MAINTENANCE AND OPERATION MANUAL

CUSTOMER: **MA'ADEN ALUMINUM COMPANY**
International Bechtel Co. Ltd

PROJECT: **Cathode Sealing Equipment**
25457-4480-PA0-MXA-0001

Quality Check by Bechtel Site DCC
11-Oct-2012
Date
J. Leons
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Signature

GNA REFERENCE: 1347
DATE: September 2011
REVISION: 1

SELLER/CONTRACTOR DOCUMENT REVIEW

Permission to proceed does not constitute acceptance or approval of design details, calculations, analysis, test methods, or materials developed or selected by SELLER/CONTRACTOR, and does not relieve SELLER/CONTRACTOR from full compliance with contractual obligations

1 ☐	Work may proceed.	4 ☒	Review not required. Work may proceed.
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Final Acceptance by Bechtel RE
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EQUIPMENT NAME:	**CATHODE SEALING EQUIPMENT**
MODEL NUMBER:	**1347**
SOHAR TAG:	**Refer to Equipment List**
PO NUMBER:	**25457-4480-PA0-MXA-0001**
DATE OF ORDER:	**June 18, 2010**

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Section 1 INTRODUCTION

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Section 2 SAFETY INFORMATION

Revision	*Date*	*Description*	*By*
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Section 6 MAINTENANCE PROCEDURE

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Section 8 TRAINING

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APPENDICES

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SECTION 1 INTRODUCTION

1.1 Equipment List

Mechanical Equipment Description	GNA Ref.	GNA Dwg No.	Project Equipment Number	Ma'aden Equipment Number
Bar Handling Beam	B1	1347-B1-1000	4481-MJJ0-0001/ 4481-MJJ0-0002	
Handling Tong Longitudinal Grip	B2	1347-B2-1000	4481-MJGB-0001	
Handling Tong Transversal	B3	1347-B3-1000	4481-MJGB-0002	
Handling Tong Tenon Grip	B4	1347-B4-1000	4481-MJGB-0003	
Chain conveyor of block oven	C1	1347-C1-1000	4481-MHCD-0001	
Chain conveyor upstream of shot blasting machine (24 bars)	C2	1347-C2-1000	4481-MHCD-0002	
Chain conveyor between shot blasting machine and oven	C3	1347-C3-1000	4481-MHCD-0003	
Chain conveyor for sealed cathode	C4	1347-C4-1000	4481-MHCD-0004	
Dust Collector for Shotblasting Machine	D1	1347-D1-1000	4481-MKBB-0001	
Fan for dust collector	D1	1347-D1-1000	4481-MAC0-0001	
Cathode block oven (capacity of 6 cathode blocks)	F1	1347-F1-1000	4481-MEEP-0001	
Cathode bar heating furnace (capacity of 16 bars)	F2	1347-F2-1000	4481-MBMB-0001	
Ladle Pre-Heating Station	F3	1347-F3-1000	4481-MBAD-0001	
Cast Iron Ingot Drying Station	F4	1347-F4-1000	4481-MEVD-0001 4481-MEVD-0002	
Positioning gantry for block and bars, including cathode bar alignment station	G1	1347-G1-1000	4481-MQLK-0001	
Hydraulic Power Unit	H1	1347-H1-1000	4481-MPF0-0001	
Cast Iron Pouring Ladle with one Tilting Mechanism	L1	1347-L1-1000	4481-MQBL-0001	
Cast Iron Pouring Ladle	L1	1347-L1-1000	4481-MQBL-0002 4481-MQBL-0003	

Mechanical Equipment Description	GNA Ref.	GNA Dwg No.	Project Equipment Number	Ma'aden Equipment Number
Roller conveyor at block oven exit	R1	1347-R1-1000	4481-MJR0-0005	
Roller conveyor for block and bar assembly	R2	1347-R2-1000	4481-MJR0-0007	
Roller conveyor after sealing station	R3	1347-R3-1000	4481-MJR0-0006	
Prestressing and sealing station c/w conveyor and platforms	R4	1347-R4-1000	4481-MZAC-0001 4481-MZAC-0002	
Roller conveyor at cooling and turning station	R5	1347-R5-1000	4481-MJR0-0008	
Roller conveyor at bar furnace exit	R6	1347-R6-1000	4481-MJR0-0004	
Roller conveyor at bar furnace entrance	R7	1347-R7-1000	4481-MJR0-0003	
Conical roller conveyor at shot blasting machine exit	R8	1347-R8-1000	4481-MJR0-0002	
Conical roller conveyor at shot blasting machine entrance	R9	1347-R9-1000	4481-MJR0-0001	
Cathode bar Shotblasting Machine	S1	1347-S1-1000	4481-MZBP-0001	
Cooling and turning station	T1	1347-T1-1000	4481-MJUT-0001	
Chiller for Hydraulic Power Unit	W1	1347-W1-1000	4481-MEHX-0001	
Cast Iron Ingot Scale	Z1	1347-Z1-1000	4481-MHMS-0001	

#	Electrical Equipment Description	GNA Ref.	GNA Dwg No.	Project Equipment Number
1	Local Disc Control	DSL	1347-52250	4481-MHCD-0002-M1-LDS
2	Local Disc Control	DSL	1347-52250	4481-MJR0-0001-M1-LDS
3	Local Control Station	SLC	1347-52250	4481-MHCD-0002-LCS-01
4	Local Control Panel	PLC	1347-52250	4481-MHCD-0002-CP-01
5	Local Control Panel	PLC	1347-52250	4481-MHCD-0002-CP-02
6	Junction Box	JB	1347-52250	4481-MHCD-0002-JB-01
7	Junction Box	JB	1347-52250	4481-MZBP-0001-JB-01
8	Local Disc Control	DSL	1347-52250	4481-MZBP-0001-M7-LDS
9	Local Disc Control	DSL	1347-52250	4481-MZBP-0001-M3-LDS
10	Local Disc Control	DSL	1347-52250	4481-MZBP-0001-M1-LDS
11	Local Control Station	SLC	1347-52250	4481-MZBP-0001-LCS-01
12	Local Disc Control	DSL	1347-52250	4481-MZBP-0001-M6-LDS
13	Local Disc Control	DSL	1347-52250	4481-MZBP-0001-M2-LDS
14	Local Disc Control	DSL	1347-52250	4481-MZBP-0001-M4-LDS
15	Local Control Station	SLC	1347-52250	4481-MZBP-0001-LCS-03
16	Local Disc Control	DSL	1347-52250	4481-MZBP-0001-M5-LDS
17	Local Control Station	SLC	1347-52250	4481-MZBP-0001-LCS-02
18	Junction Box	JB	1347-52250	4481-MKBB-0001-JB-01
19	Local Disc Control	DSL	1347-52250	4481-MACO-0001-M1-LDS
20	Local Control Station	SLC	1347-52250	4481-MACO-0001-LCS-01
21	Local Control Panel	PLC	1347-52250	4481-MHCD-0003-CP-01
22	Local Control Station	SLC	1347-52250	4481-MHCD-0003-LCS-01
23	Local Disc Control	DSL	1347-52250	4481-MHCD-0003-M1-LDS
24	Local Disc Control	DSL	1347-52250	4481-MJR0-0002-M1-LDS
25	Local Disc Control	DSL	1347-52250	4481-MJR0-0003-M1-LDS
26	Local Control Panel	PLC	1347-52250	4481-MBMB-0001-CP-01
27	Local Control Station	SLC	1347-52250	4481-MBMB-0001-LCS-01
28	Junction Box	JB	1347-52250	4481-MBMB-0001-JB-11
29	Junction Box	JB	1347-52250	4481-MBMB-0001-JB-12
30	Junction Box	JB	1347-52250	4481-MBMB-0001-JB-01
31	Junction Box	JB	1347-52250	4481-MBMB-0001-JB-02
32	Local Control Station	SLC	1347-52250	4481-MBMB-0001-LCS-03
33	Junction Box	JB	1347-52250	4481-MBMB-0001-JB-13
34	Junction Box	JB	1347-52250	4481-MBMB-0001-JB-14
35	Local Control Station	SLC	1347-52250	4481-MBMB-0001-LCS-04
36	Local control Panel	PLC	1347-52250	4481-MBMB-0001-CP-02
37	Local Disc Control	DSL	1347-52250	4481-MBMB-0001-M4-LDS

38	Local Disc Control	DSL	1347-52250	4481-MBMB-0001-M1-LDS
39	Local Control Station	SLC	1347-52250	4481-MBMB-0001-LCS-02
40	Local Disc Control	DSL	1347-52250	4481-MBMB-0001- M2-LDS
41	Local Disc Control	DSL	1347-52250	4481-MBMB-0001- M3-LDS
42	Local Disc Control	DSL	1347-52250	4481-MJR0-0005-M1-LDS
43	Local Control Station	SLC	1347-52250	4481-MJR0-0005-LCS-01
44	Local Disc Control	DSL	1347-52250	4481-MHCD-0001-M1-LDS
45	Junction Box	JB	1347-52250	4481-MJR0-0005-JB-01
46	Junction Box	JB	1347-52250	4481-MHCD-0001-JB-01
47	Local Control Panel	PLC	1347-52250	4481-MHCD-0001-CP-01
48	Junction Box	JB	1347-52250	4481-MEEP-0001-JB-01
49	Junction Box	JB	1347-52250	4481-MEEP-0001-JB-11
50	Local Control Station	SLC	1347-52250	4481-MEEP-0001-LCS-01
51	Local Disc Control	DSL	1347-52250	4481-MEEP-0001-M1-LDS
52	Local Disc Control	DSL	1347-52250	4481-MEEP-0001-M2-LDS
53	Local Control Station	SLC	1347-52250	4481-MEEP-0001-LCS-02
54	Junction Box	JB	1347-52250	4481-MEEP-0001-JB-12
55	Local Disc Control	DSL	1347-52250	4481-MEEP-0001-M3-LDS
56	Local Control Station	SLC	1347-52250	4481-MEEP-0001-LCS-03
57	Junction Box	JB	1347-52250	4481-MEEP-0001-JB-13
58	Junction Box	JB	1347-52250	4481-MEEP-0001-JB-03
59	Junction Box	JB	1347-52250	4481-MJR0-0007-JB-01
60	Junction Box	JB	1347-52250	4481-MJR0-0004-JB-01
61	Junction Box	JB	1347-52250	4481-MQLK-0001-JB-01
62	Local Control Panel	PLC	1347-52250	4481-MQLK-0001-CP-01
63	Local Disc Control	DSL	1347-52250	4481-MJR0-0004-M1-LDS
64	Local Disc Control	DSL	1347-52250	4481-MQLK-0001-M1-LDS
65	Local Control Station	SLC	1347-52250	4481-MQLK-0001-LCS-01
66	Local Disc Control	DSL	1347-52250	4481-MJR0-0007-M1-LDS
67	Junction Box	JB	1347-52250	4481-MQLK-0001-JB-03
68	Junction Box	JB	1347-52250	4481-MQLK-0001-JB-02
69	Local Control Panel	PLC	1347-52250	4481-MZAC-0001-CP-03
70	Local Control Panel	PLC	1347-52250	4481-MZAC-0002-CP-03
71	Local Control Panel	PLC	1347-52250	4481-MZAC-0002-CP-02
72	Local Disc Control	DSL	1347-52250	4481-MZAC-0002-M1-LDS
73	Local Control Station	SLC	1347-52250	4481-MZAC-0002-LCS-01
74	Local Control Panel	PLC	1347-52250	4481-MZAC-0002-CP-01
75	Central Control Panel	PLC	1347-52250	4481-CP-1001
76	Local Control Panel	PLC	1347-52250	4481-MZAC-0001-CP-02

77	Local Disc Control	DSL	1347-52250	4481-MZAC-0001-M1-LDS
78	Local Control Station	SLC	1347-52250	4481-MZAC-0001-LCS-01
79	Local Control Panel	PLC	1347-52250	4481-MZAC-0001-CP-01
80	Local Disc Control	DSL	1347-52250	4481-MJR0-0006-M1-LDS
81	Local Control Station	SLC	1347-52250	4481-MJR0-0006-LCS-01
82	Local Disc Control	DSL	1347-52250	4481-MJR0-0008-M1-LDS
83	Local Control Panel	PLC	1347-52250	4481-MJR0-0006-CP-01
84	Junction Box	JB	1347-52250	4481-MJR0-0008-JB-01
85	Junction Box	JB	1347-52250	4481-MHCD-0004-JB-03
86	Junction Box	JB	1347-52250	4481-MHCD-0004-JB-04
87	Local Disc Control	DSL	1347-52250	4481-MHCD-0004-M1-LDS
88	Local Control Station	SLC	1347-52250	4481-MHCD-0004-LCS-01
89	Local Control Panel	PLC	1347-52250	4481-MHCD-0004-CP-01
90	Junction Box	JB	1347-52250	4481-MHCD-0004-JB-01
91	Junction Box	JB	1347-52250	4481-MHCD-0004-JB-02
92	Local Control Panel	PLC	1347-52250	4481-MEHX-0001-CP-01
93	Local Control Panel	PLC	1347-52250	4481-MPF0-0001-CP-01
94	Local Disc Control	DSL	1347-52250	4481-MPF0-0001-M1-LDS
95	Local Disc Control	DSL	1347-52250	4481-MPF0-0001-M2-LDS
96	Local Control Station	SLC	1347-52250	4481-MPF0-0001-LCS-01
97	Motor Control Center	MC0	1347-52250	4480-ECM1-0001
98	Local Control Panel	PLC	1347-52250	4481-MBMB-0001-SCR
99	Local Control Panel	PLC	1347-52250	4481-MEEP-0001-SCR
100	Local Control Panel	PLC	1347-52250	4481-CP-1000
101	Local Control Panel	PLC	1347-52250	4481-MBAD-0001-CP-01
102	Local Disc Control	DSL	1347-52250	4481-MBAD-0001-M1-LDS
103	Local Control Panel	PLC	1347-52250	4481-MEVD-0001-CP-01
104	Local Disc Control	DSL	1347-52250	4481-MEVD-0001-M1-LDS
105	Local Control Panel	PLC	1347-52250	4481-MEVD-0002-CP-01
106	Local Control Disc	DSL	1347-52250	4481-MEVD-0002-M1-LDS

1.2 Equipment Description

1.2.1 BAR FEED CHAIN CONVEYOR (C2)
1.2.2 SHOTBLASTING INLET ROLLER CONVEYOR (R9)

A chain conveyor is used to support the un-cleaned steel bars in preparation for the blast cleaning operation. This conveyor will advance the bars one at a time to supply the roller conveyor that feeds the cleaning machine. As the bars advance along the chain conveyor, the roller conveyor will lower to allow the bar to be positioned overhead.

The roller conveyor then raises again to pick up the bar from the chain conveyor and transports it into the blast cleaner. The raising and lowering of the roller conveyor is done automatically. Up to 24 bars can be positioned on the bar feed chain conveyor.

Bars are loaded onto the chain conveyor using the Client's overhead crane or a forklift and the bar handling beam (B4) provided by GNA.

1.2.3 BAR HANDLING BEAM (B4)

Two (2) bars will be transported simultaneously with the bar handling beam provided by GNA. The bar handling beam will be specifically designed to be used with client overhead crane. In emergency cases, the bar handling beam can still be used, although a connection between the bar handling beam and the forklift will have to be designed and supplied by client.

1.2.4 SHOTBLASTING MACHINE (S1)
1.2.5 DUST COLLECTOR SYSTEM (D1)

The machine will be designed to process Cathode Bars. The cleaning speed will be variable, depending on initial surface condition and finished surface condition requirements.

The blast machine will be composed of a blast cabinet with inlet and exit vestibules, four Direct Drive Blast Heads drive motors, an abrasive recovery system, one baffled exhaust vent plenum, electrical control panel and a Roller Conveyor integrated into the blast machine to transport the steel bars through the equipment.

The blast heads are mounted on opposite sidewalls of the blast chamber. They are positioned along the horizontal pass line and are skewed to insure full coverage of the 4 sides of the steel bars. Ammeters are provided to monitor the cleaning capacity of the blast heads.

A screw conveyor transfers the spent abrasive to a bucket elevator. This reclaim screw is mounted along the side of the blast machine, in its own hopper external to the blast machine. The abrasive flows by gravity through a full-length baffled slot to this external screw.

The cleaned abrasive is stored in a hopper located beneath the airwash. The gravity flow of abrasive from the storage hopper to the blast heads is controlled by adjustable under cutting dipper valves. These air cylinder actuated feed valves are interlocked with the blast head motors, blast chamber inspection door and the roller conveyor drive. When in the automatic mode, they will not supply abrasive to the blast heads while the roller conveyor is stopped. A photo switch at the inlet to the machine will automatically turn the abrasive off and on as a cathode bar is sensed.

As a necessary component to the shot blast system, we require a dust collector to ventilate the blast cabinet and operate the air wash.

1.2.6 SHOT BLASTING OUTLET ROLLER CONVEYOR (R8)

A roller conveyor is located at the outlet of the blast-cleaning machine to accept the cleaned bars as they exit from the shot blasting unit. The bars are deposited onto a separate chain conveyor. Raising and lowering of this roller conveyor is also accomplished automatically.

1.2.7 TRANSFER CONVEYOR (C3)

A separate chain conveyor is supplied to accumulate cleaned bars from the blast machine exit roller conveyor and accumulate them for transport through the bar furnace. Transfer of the cleaned bars between the conveyors is accomplished by the roller conveyor raising and lowering to pick up the bars from the chain conveyor and feed the furnace.

1.2.8 BAR FURNACE INLET ROLLER CONVEYOR (R7)

The conveyor is on stand by; ready to be energised to move bars into the furnace in order to be heated. It has a capacity of 4 bars.

1.2.9 CATHODE BAR FURNACE (F2)

The cathode bar furnace is designed to contain and heat 16 bars at one time by radiation heat transfer from the resistance type elements.

The furnace has doors at each end. The doors are a guillotine design, raised and lowered by pneumatic cylinders and sealed to the furnace when in the lowered position. The door up / down movements are monitored by limit switches.The furnace doors open automatically and 4 bars are moved from the furnace to the conveyor underneath the handling gantry as replacement bars are conveyed into the furnace.

The furnace and heating system are designed to raise the temperature of the bars from ambient up to 650ºC in 94 minutes.

1.2.10 BAR FURNACE OUTLET ROLLER CONVEYOR (R6)

The heated bars exit from the furnace and are transferred to a separate roller conveyor to be transported to a position underneath the travelling gantry crane. The positioning gantry picks up the hot bars.

1.2.11 BLOCK HANDLING TONGS (B1;B2;B3)

Positioning of the blocks coming from the storage area onto the roller conveyor is accomplished by using an overhead crane and special block handling tongs designed to interface with the carbon blocks. Three handling tongs (longitudinal, transversal and tenon) will be supplied by GNA. In emergency cases, the three handling tongs can still be used, although a connection between the handling tongs and the forklift will have to be designed and supplied by client.

1.2.12 BLOCK OVEN WITH INTEGRAL CHAIN CONVEYOR (F1;C1)

The cathode block oven is a panel construction incorporating a chain conveyor for block movement through the system. It is electrically heated using Incalloy sheathed tubular elements. Heat transfer is accomplished using three (3) recirculating fans located in the roof of the oven. The air is recirculated through a plenum, over the electric elements and back through the workspace again.

The unit is designed to accommodate a total of 9 blocks at one time; 6 cathode blocks inside being heated, while 2 blocks are at the entrance and 1 is at the exit. All 6 blocks located in the oven are supported on the roller chain conveyor that rests on a structural steel pedestal incorporated into the oven hearth. The main chain conveyor also supports the 2 blocks at the oven inlet. The block at the outlet is supported on a separate roller conveyor.

Pneumatic cylinders operate the doors and limit switches control the up/down limits. The doors are clamped against the oven to seal tightly when in the closed position.

The oven is designed to heat the blocks from ambient to 300ºC in 141 minutes.

The oven is designed to accept blocks within the following dimensions:

Length: 3250mm to 3450mm
Width: 650mm
Height: 420mm to 500mm

1.2.13 BLOCK OVEN OUTLET ROLLER CONVEYOR (R1)

After the preheated block exits from the oven on the chain conveyor, a roller conveyor equipped with a hydraulic lifting mechanism transports the block directly onto the roller conveyor under the handling gantry.

A guiding system assures the alignment of the block onto the central axis of the conveyor.

1.2.14 BLOCK/BAR ASSEMBLY ROLLER CONVEYOR (R2)

The heated block exit from the oven and is transferred to a separate roller conveyor to be transported underneath the positioning gantry. This roller conveyor is equipped with length & width centering devices to properly position the block and to receive the four heated bars. The length & width centering devices are adjustable to fit different block dimensions.

1.2.15 POSITIONING GANTRY (G1)

A heavy-duty five tonne overhead crane is used to transfer the hot bars to the waiting block for assembly. The accuracy and repeatability of this action is assured by the use of a variable speed drive control and proximity control system to guide the gantry and stop it in the exact position for interface with the hot block. Hydraulically powered clamps are used to assure the stability of the bars during the transfer movement.

The carbon block is positioned under the gantry by motor driven rollers and then automatically aligned against a fixed stopper using the clamps. Those clamps are adjustable to fit different block dimensions. This action centres the block in its final position for the assembly procedure.

The handling mechanism itself is fixed to the two beams of the motorised overhead crane. The crane operates on flanged wheels and is stabilised by the use of track rollers to assure parallelism. The carriage under the crane moves vertically up and down to take the bars and clamp them by hydraulically operated

arms. Following the transfer motion, the crane is automatically positioned over the cathode block grooves. The transfer motion is a 2 speed action with slower speeds being used for start and stop actions and a faster travelling speed for cycle time conformity. Hydraulic operation of this operation assures a smooth and controlled descent of the bars into the block. Sensors and/or mechanical stops are incorporated to assure exact positioning of the gantry at all critical points of position.

The heated block is supported on a separate roller conveyor that is equipped with an automatic centering mechanism to insure exact location of the block to receive the heated bars during the mating process by the gantry. The automatic centering mechanism is adjustable to fit different block dimensions

The area for the gantry and associated equipment is a restricted access area due to the movement of the equipment. Consequently, there is a safety barrier surrounding the equipment and all moving parts.

1.2.16 PRE-STRESSING AND SEALING STATION (P1;R4)

The block and bar assembly is now moved onto the pre-stressing and pouring station by a motor driven roller conveyor which decelerates and stops automatically.

There is a platform that allows access to the bar/block assembly for the necessary continuing operations. The assembly tolerances are verified at this point and any necessary adjustments can be made by the system operating personnel.

After positioning the assembly, the conveyor is lowered to set the block / bars on two points, one fixed and the other pivoting. A pneumatic cylinder lowers the pre-stressing head onto the assembly and is automatically tensioned to the correct stress for a minimum of 25 minutes by a control incorporating a precision pressure regulator (4500 daN). The head includes the four weighted contacts (40 daN) on the bars to prevent unwanted movement during the pouring of the molten iron.

The molten iron can now be poured to seal the bars to the carbon block and the cooling period begins.

Following the initial cooling period, the pre-stressing head is raised, the hydraulic system is activated and the roller conveyor picks up the block again as the conveyor is raised. The adjustable stopper is lowered and the assembly is moved to the next station.

1.2.17 COOLING CONVEYOR (R3)

The sealed bar and block assembly is transferred by roller conveyor to the cooling conveyor for a minimum of 30 minutes.

1.2.18 COOLING AND TURNING STATION (R5;T1)

The sealed bar and block assembly is transferred by roller conveyor to the cooling and turning station, also consisting of a roller conveyor and 2-stage turning device. The assemblies are now rotated 180º in two separate 90° movements in preparation for stacking/storage. The rotating movements are precisely controlled so as not to transfer any shock to the sealed bar/block assemblies.

1.2.19 COOLING CONVEYOR (C4)

Following the 180° rotation of the bar/block units, a chain conveyor will accumulate up to 8 mated assemblies. The sealed cathodes are picked up from this conveyor and transported to a storage area.

1.2.20 CHARGING AND POURING LADLES (L1,L2,L3)

The pouring ladles will be lined with refractory suitable for the molten iron. The ladles will be equipped with a removable bail for handling and a manual hand wheel and gear system to tip the ladle for pouring.

1.2.21 LADLE PREHEATER (F3)

The gas fired ladle preheater will be used for pre-heating and dryout of green ladles. The system will be complete with its own control panel, temperature controller, high limit temperature controller and gas train.

The system will be capable of executing ramp and hold functions to automatically pre-heat the ladle. The ladle is positioned in a pre-determined position by a fork truck in front of the ladle heater. At this time, the heated cover can be manually positioned onto the ladle and the heating started. Moving the cover automatically stops the heating operation.

1.2.22 CAST IRON INGOT DRYER (F4)

We will provide a cast iron ingot dryer to remove surface moisture from the cast iron ingots The ingots will be placed manually in the drying tank. The equipment will be equipped with a tilting mechanism to empty the ingots into a loading bucket after the heating. The system will be complete with its own control panel, temperature controller, high limit temperature controller and gas train. The cast iron must reach a temperature of 100°C after 30 minutes of heating.

1.2.23 HYDRAULIC POWER UNIT (H1)

The hydraulic power pack is a self-contained unit incorporating a reservoir. There are two pumps (one on standby) and all necessary solenoid valves mounted on distribution blocks. The unit is equipped with a return/suction line filters, level indicator and a drip pan.

The hydraulic power unit will be equipped with a water:fluid heat exchanger for cooling the fluid. The hydraulic fluid is fire retardant.

1.2.24 CAST IRON SCALE (Z1)

The cast iron ingot scale is a floor scale that is fully electronic with a low profile that makes it easy to load and unload. It is rugged enough to stand up to tough industrial environment. It has a capacity of 2 500 kg.

1.2.25 CONTROL DESK

All process temperatures are regulated through PID loops in the PLC system.

A HMI in the control desk will be used to control and monitor the process. This monitor presents simple but complete graphic views of all the principal parts of the process equipment and stops the operation of the equipment.

Any deficiency or failure diagnosis in the alarm circuit will be notified to an operator by audio-visual means located in the control desk and also displayed on the level 1 HMI.

1.3 Equipment Performance

Performance Data

Production rate: approximately 2 sealed blocks every 47 minutes

Bar Furnace Performance

- Each bar must stay 94 minutes in the furnace.
- 4 Bars is raised to 650°C.
- Maximum range of 50°C in the same bar

Block Oven Performance

- Each block must stay minimum 140 minutes in the oven
- 1 Block is raised approximately to 300°C

Prestressing Performance

- Temperature before sealing

Block	Minimum 200°C
Bar	Between 530°C – 630°C

- Prestress

Block:	4500 daN ± 30%
Bar:	40 daN
Prestressing time:	25 minutes
Cooling time:	30 minutes

1.4 Warranty Policy

GNA alutech inc. guarantees the equipment manufactured and supplied by GNA to be fit for the purpose intended and to be free from defects in workmanship and material for a period of twelve (12) months from date of start-up, respectively 18 months from date of delivery. Any part found to be faulty or defective would either be repaired or replaced at our option so long as it occurs within the warranty period and is not a result of misuse or abuse by the owner. Normal wear and tear of refractory sections and other specific parts is excluded from this guarantee.

Component manufacturer's warranties will be extended in the context of their original terms to the owner.

GNA does not accept any responsibility for equipment, materials or components specified or supplied by the owner other than that of the warranty offered by the specified part, material or equipment supplier.

The limits of liability are restricted to the cost of repairing or replacing the faulty or defective equipment or workmanship so long as such faults are noted to have taken place within the prescribed warranty period and that GNA is given notification in writing as soon as any defect is observed. GNA will respond in a prompt manner to any such notification.

Component warranties are F.C.A. GNA.

1.5 Motor List

Project Equipment #	GNA Ref.	Motor Description	Project Motor Tag #	Brake	Power Kw	Drive	Thermistor	Application
4481-MHCD-0002	C2	CHAIN CONVEYOR UPSTREAM OF SHOTBLASTING MACHINE (24 BARS)	4481-MHCD-0002-M1	Brake	1,1	No	No	Conveyor
4481-MJR0-0001	R9	CONICAL ROLLER CONVEYOR AT SHOTBLASTING MACHINE ENTRANCE	4481-MJR0-0001-M1	No	0,37	Drive Fwd/Rev **	Thermistor	Conveyor
4481-MZBP-0001	S1	CATHODE BAR SHOTBLASTING MACHINE BLAST WHEEL No. 1	4481-MZBP-0001-M1	No	11	No	No	Blast Wheel
4481-MZBP-0001	S1	CATHODE BAR SHOTBLASTING MACHINE BLAST WHEEL No. 2	4481-MZBP-0001-M2	No	11	No	No	Blast Wheel
4481-MZBP-0001	S1	CATHODE BAR SHOTBLASTING MACHINE BLAST WHEEL No. 3	4481-MZBP-0001-M3	No	11	No	No	Blast Wheel
4481-MZBP-0001	S1	CATHODE BAR SHOTBLASTING MACHINE BLAST WHEEL No. 4	4481-MZBP-0001-M4	No	11	No	No	Blast Wheel
4481-MZBP-0001	S1	CATHODE BAR SHOTBLASTING MACHINE ELEVATOR	4481-MZBP-0001-M5	Brake	2,2	No	No	Elevator
4481-MZBP-0001	S1	CATHODE BAR SHOTBLASTING MACHINE WORK CONVEYOR	4481-MZBP-0001-M6	No	0,37	Drive Fwd/Rev	Thermistor	Conveyor
4481-MZBP-0001	S1	CATHODE BAR SHOTBLASTING MACHINE SCREW	4481-MZBP-0001-M7	No	2,2	No	No	Screw
4481-MAC0-0001	D1	DUST COLLECTOR FAN	4481-MAC0-0001-M1	No	7,5	No	No	Fan
4481-MJR0-0002	R8	CONICAL ROLLER CONVEYOR AT SHOTBLASTING MACHINE EXIT	4481-MJR0-0002-M1	No	0,37	Drive Fwd/Rev **	Thermistor	Conveyor
4481-MHCD-0003	C3	CHAIN CONVEYOR BETWEEN SHOTBLASTING CONVEYOR AND OVEN	4481-MHCD-0003-M1	No	0,75	Drive Fwd/Rev	Thermistor	Conveyor
4481-MJR0-0003	R7	ROLLER CONVEYOR AT BAR FURNACE ENTRANCE	4481-MJR0-0003-M1	Brake	0,75	No	No	Conveyor
4481-MBMP-0001	F2	CATHODE BAR HEATING FURNACE CONVEYOR No. 1	4481-MBMP-0001-M1	No	0,75	Drive Fwd/Rev	Thermistor	Conveyor
4481-MBMP-0001	F2	CATHODE BAR HEATING FURNACE CONVEYOR No. 2	4481-MBMP-0001-M2	No	0,75	Drive Fwd/Rev	Thermistor	Conveyor
4481-MBMP-0001	F2	CATHODE BAR HEATING FURNACE CONVEYOR No. 3	4481-MBMP-0001-M3	No	0,75	Drive Fwd/Rev	Thermistor	Conveyor
4481-MBMP-0001	F2	CATHODE BAR HEATING FURNACE CONVEYOR No. 4	4481-MBMP-0001-M4	No	0,75	Drive Fwd/Rev	Thermistor	Conveyor
4481-MJR0-0004	R6	ROLLER CONVEYOR AT BAR FURNACE EXIT	4481-MJR0-0004-M1	No	0,75	Drive Fwd/Rev	Thermistor	Conveyor
4481-MQLK-0001	G1	POSITIONNING GANTRY FOR BLOCK AND BARS No. 1	4481-MQLK-0001-M1	Brake	1,1	Drive Fwd/Rev *	Thermistor	Gantry
4481-MQLK-0001	G1	POSITIONNING GANTRY FOR BLOCK AND BARS No. 2	4481-MQLK-0001-M2	Brake	1,1	Drive Fwd/Rev *	Thermistor	Gantry
4481-MEEP-0001	F1	CATHODE BLOCK OVEN FAN A	4481-MEEP-0001-M1	No	15	No	No	Fan
4481-MEEP-	F1	CATHODE BLOCK OVEN FAN B	4481-MEEP-	No	15	No	No	Fan

Project Equipment #	GNA Ref.	Motor Description	Project Motor Tag #	Brake	Power Kw	Drive	Thermistor	Application
0001			0001-M2					
4481-MEEP-0001	F1	CATHODE BLOCK OVEN FAN C	4481-MEEP-0001-M3	No	15	No	No	Fan
4481-MHCD-0001	C1	CHAIN CONVEYOR OF BLOCK OVEN	4481-MHCD-0001-M1	Brake	3,7	No	No	Conveyor
4481-MJR0-0005	R1	ROLLER CONVEYOR AT BLOCK OVEN EXIT	4481-MJR0-0005-M1	Brake	0,75	No	No	Conveyor
4481-MJR0-0007	R2	ROLLER CONVEYOR FOR BLOCK AND BAR ASSEMBLY	4481-MJR0-0007-M1	No	1,1	Drive Fwd/Rev	Thermistor	Conveyor
4481-MZAC-0001	R4A	PRESTRESSING AND SEALING STATION CONVEYOR A	4481-MZAC-0001-M1	No	1,1	Drive Fwd/Rev	Thermistor	Conveyor
4481-MZAC-0002	R4B	PRESTRESSING AND SEALING STATION CONVEYOR B	4481-MZAC-0002-M1	No	1,1	Drive Fwd/Rev	Thermistor	Conveyor
4481-MJR0-0006	R3	ROLLER CONVEYOR AFTER SEALING STATION	4481-MJR0-0006-M1	Brake	1,1	No	No	Conveyor
4481-MJR0-0008	R5	ROLLER CONVEYOR AT COOLING & TURNING STATION	4481-MJR0-0008-M1	Brake	1,1	No	No	Conveyor
4481-MHCD-0004	C4	CHAIN CONVEYOR FOR SEALED CATHODE	4481-MHCD-0004-M1	Brake	3,7	No	No	Conveyor
4481-MEHX-0001	W1	MOTOR FOR CHILLER - PUMP	4481-MEHX-0001-M1	No	1,86	No	No	Pump
4481-MEHX-0001	W1	MOTOR FOR CHILLER- COMPRESSOR	4481-MEHX-0001-M2	No	7,5	No	No	Compressor
4481-MEHX-0001	W1	MOTOR FOR CHILLER - FAN	4481-MEHX-0001-M3	No	0,75	No	No	Fan
4481-MEHX-0001	W1	MOTOR FOR CHILLER – RECIRC. PUMP	4481-MEHX-0001-M4	No	1,86	No	No	Pump
4481-MPF0-0001	H1	HYDRAULIC POWER UNIT PUMP A	4481-MPF0-0001-M1	No	11	No	No	Pump
4481-MPF0-0001	H1	HYDRAULIC POWER UNIT PUMP B	4481-MPF0-0001-M2	No	11	No	No	Pump
4481-MBAD-0001	F3	LADLE PRE-HEATING STATION – COMBUSTION FAN	4481-MBAD-0001-M1	No	1,1	No	No	Fan
4481-MEVD-0001	F4A	CAST IRON INGOT DRYING STATION – COMBUSTION FAN	4481-MEVD-0001-M1	No	1,1	No	No	Fan
4481-MEVD-0002	F4B	CAST IRON INGOT DRYING STATION – COMBUSTION FAN	4481-MEVD-0002-M1	No	1,1	No	No	Fan

1.6 Motor Data Sheets

TECHNICAL DATA SHEET

FOR

LOW VOLTAGE INDUCTION MOTORS

AZ ZABIRAH ALUMINIUM SMELTER PROJECT

000	17-Mar-09	Issue For Project Use	AJ/AB	FB	TS	PB	JMA
00B	27-Feb-09	Issue For Client Approval	AJ/AB	FB	TS	PB	JMA
00A	18-Feb-09	Issue For Review	AJ/AB	FB	TS	PB	JMA
REV	DATE	REASON FOR REVISION	BY	CHECK	EGS	PEM	CLIENT

DATA SHEET	JOB No: 25457-4480-POA-MXA0-0001	
	DOCUMENT No.:	
	25457-4480-V1A-MXA0-XXXX	Rev 000
LOW VOLTAGE INDUCTION MOTORS		Sheet 1 of 5
CLIENT DOCUMENT No.:		

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CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No. 4481-MHCD-0002

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
1.0		**SITE CONDITION**					
1.1	B	Altitude ASL	< 100	m			
1.2	B	Maximum Ambient Temperature	55	°C	000		
1.3	B	Minimum Ambient Temperature	0	°C			
1.4	B	Design Ambient Temperature (Indoors)	40	°C			
1.5	B	Maximum Relative Humidity	71	%			
1.6	B	Wind	NA	kph			
1.7	B	Seismic Zone	ND	-			
1.8	B	Type of Protection Required	Yes	-			
1.9	B	Indoors of Outdoors	Outdoors	-			
1.10	B	Cable Size	TBD	mm^2			
1.11	B	Earth connection Size	TBD	mm^2			
1.12	B	Unclassified Area	NA	-			
1.13	B	Hazardous Area Classification	Non-Hazardous	-			
1.13.1	B	Class	NA	-			
1.13.2	B	Division	NA	-			
1.13.3	B	Group(s)	NA	-			
1.13.4	B	Gas Ignition Temperature	NA	°C			
2.0		**DESIGN AND RATING**					
2.1	B	System Voltage	460	V			
2.2	B	Voltage tolerance	±5	%			
2.3	B	Phase(s)/Frequency	3/60	-/Hz			
2.4	B	Neutral Earthing	High Resistance Grounded	-			
2.5	B	Duty type IEC 34-1	S1-Continuous	-			
2.6	S	Rated Output		kW		1.1	
2.7	S	Synchronous Speed(s)		rpm		1800	
2.8	S	Direction of rotation viewed from drive end		-		Both	
2.9	B	Insulation Class/Temperature rise limit	F/B	-			
2.10	S	Minimum Terminal voltage during starting		per unit		N.A.	
2.11	S	Maximum no load sound pressure level at one metre		dBA		N.A.	
2.12	S	External Inertia (Max)		kg m^2		0.00401	
2.13	B	Type of Starter/Short circuit protection	DOL/MCCB	-			
2.14	S	Service Factor		per unit		1.85	
2.15	S	Minimum Rated Power factor at full load		%		73	
2.16	S	Minimum Efficiency at full rated load		-		84%	
2.17	S	Mounting - Horizontal/Vertical		-		horizontal M1	
2.18	S	Minimum starting voltage - percent of rated		%		N.A.	
2.19	S	Winding - Star/Delta		-		Star Star/ Star	
3.0		**MECHANICAL AND ENCLOSURES**					
3.1	B	Enclosure Type	Cast Iron				
3.2	B	Degree of Protection - IP Code	IP 55				
3.3	S	Mounting IEC 34-7 IM Code				M1	
3.4	S	Cooling IEC 34-6 IC Code		-		IC411 (fan-cooled)	
3.5	S	Drain Holes		-		Y	
3.6	S	Shaft				Standard	
3.7	S	Drive Connection				To suit load	

NOTES:

1. (B) Indicates Buyer. (S) Indicates Seller
2. All (B) items shall be completed by Buyer. All (S) items shall be completed by Seller
3. Y = Yes; N = No; ND = Information Not Available; NA = Not Applicable.
4. TBD: To Be Determined

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CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No. 4481-MHCD-0002

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
3.8	S	Finish bore half-coupling furnished by others		-		N	
3.9	S	Install half-coupling furnished by others		-		N	
3.10	S	Vibration Grade (IEC 60034-14)	A	-		N.A.	**Grade B in Special Cases**
3.11	S	Max Motor shaft load (R-Radial, A-Axial)		N		N.A.	
3.12	S	Bearing Type D end		-		DIN625-6306-2Z-J-C3-K08	
3.13	S	Bearing Type N end		-		DIN625-6205-2RS-J-C3-K08	
3.14	B	Antifriction Bearing L_{10} Life	MIN 40,000	Hours			**80,000 for re-greasable bearings**
3.15	S	Bearing Lubrication		-		GREASE	
3.16	S	Bearing Seals		-		D(2Z) - N(2RS)	
4.0		**ACCESSORIES**					
4.1	B	Space heaters required/rated voltage	Yes/115 Vac	/V			
4.2	B	Winding Over temperature protection required - type	Yes				**As per Specification**
4.3	B	Winding temperature devices No per phase	1				
4.4	B	Bearing over temperature protection required - type	No				
4.5	S	Auxilliary terminal boxe(es) or space heaters and temp devices				Separate	
4.6	S	Tachometer				N	
4.7	S	Brake				N	
4.8	S	Slide base for belt drive				Y	
4.9	S	Soleplate				N	
4.10	B	Rating Plate					**As per Specification**
4.11	B	Identification Plate					**As per Specification**
4.12	B	Separately powered cooling fan	Yes				

NOTES:

1. (B) Indicates Buyer. (S) Indicates Seller
2. All (B) items shall be completed by Buyer. All (S) items shall be completed by Seller
3. Y = Yes; N = No; ND = Information Not Available; NA = Not Applicable.
4. TBD: To Be Determined

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CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No.: Individual Motor 4481-MHCD-0002

To Be Completed by SELLER for Each Motor

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
5.0	S	**MANUFACTURER'S DATA**					
5.1	S	Manufacturer		-		**SEW Eurodrive Canada**	
5.2	S	Frame Number		-		DRE 90M 4/BE	
5.3	S	Serial Number		-		80.1803955901.0001.10.00	
5.4	S	Model Number		-		R97 R57 DRE90M4BE2HF/DH	
5.5	S	Full Load Speed		rpm		1740	
5.6	S	Full Load Current		A		4.5/2.25	
5.7	S	Locked Rotor Current		A		34.65/17.33	
5.8	S	Locked Rotor Power Factor		pu		N.A.	
5.9	S	Temperature rise by resistance at full load		K		30	
5.10	S	Full Load Torque		nm		6.04	
5.11	S	Breakdown Torque in percent of Full Load		% IFL		380	
5.12	S	Weight		kg		23	
5.13	S	Efficiency at: 100 % Load		%		84.3	
5.14	S	75% Load		%		83.7	
5.15	S	50% Load		%		80.9	
5.16	S	Power Factor at: 100 % Load		pu		0.73	
5.17	S	75% Load		pu		0.64	
5.18	S	50% Load		pu		0.51	
5.19	S	Provide Following Data @ Rated Operating Temperature		-		-20ºC - 40ºC	
5.20	S	Locked rotor Withstand time @ nominal V		Seconds		N.A.	
5.21	S	Accelaration Time (Motor & Load) @ nominal V		Seconds		N.A.	
5.22	S	Locked rotor Withstand time @ min V		Seconds		N.A.	
5.23	S	Accelaration Time (Motor & Load) @ min V		Seconds		N.A.	
5.24	S	Rotor WK^2		kg m^2		0.00401	
5.25	S	Sub - Transient Reactance *X"*		%		N.A.	
5.26	S	Sub - Transient *X/R*		-		N.A.	
5.27	S	Provide thermal Limit curves		-			
5.28	S	Provide Current and Torque/Speed Curves		-			
5.29	S	Space Heater watts at nominal operating voltage		W		N.A.	
5.30	S	Motor RTD Alarm Temperature		deg C		N.A.	
5.31	S	Motor RTD Trip Temperature		deg C		N.A.	
6.0		**TESTS**					
6.1	B	Routine Tests					
6.2	B	Complete Test					
6.3	B	Vibration (with half coupling installed if available)					
6.4	B	Noise					

NOTES:

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CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No. 4481-MHCD-0002

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
7.0		**ADDITIONAL REQUIREMENTS FOR VFD SERVICE**					
7.1	S	Inverter Type		-		PWM	
7.2	S	Rated operation modes - VT / CT / CP		-		VT	
7.3	S	Rated power output at Base Speed		kW		1.1	
7.4	S	Base Speed		rpm		1740	
7.5	S	Constant Power speed range		rpm		1740-1740	
7.6	S	Constant Torque speed range		rpm		0-1740	
7.7	S	Continuous Constant Torque speed range		rpm		750-1740	
7.8	S	Variable Torque speed range		rpm		0-1700	
7.9	S	Variable Torque speed exponent		-		N.A.	
7.10	S	Starting (breakaway) torque		per unit		N.A.	
7.11	S	Run up torque		per unit		N.A.	

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6.10 Torque limit curves for DRS, DRE, DRP motors operated on an inverter

Thermally approved torque

Note thermally approved torque in project planning for operation of DR, asynchronous AC motors with frequency inverter. The following factors determine the thermally permitted torque:

- Duty type
- Type of cooling: Self-ventilation or forced cooling
- Base frequency f_{base} = 60 Hz (460 V ⅄) or f_{base} = 120Hz (230 ⅄⅄)

Use the torque limit curves to determine the thermally permitted torque. The projected, effective torque has to be less than the limit curve value. The following illustration shows the limit curves for 4-pole DR, asynchronous AC motors with f_{base} = 60 Hz and f_{base} = 120 Hz. The following peripheral conditions apply to the shown limit curves:

- Duty type S1
- Supply voltage of the inverter $V_{supply} = 3 \times 460\ V_{AC}$
- Motor in thermal class F

f_{base} = 60 Hz (460 V ⅄/60 Hz)

The following diagram shows the limit curves for operation at f_{base} = 60 Hz. The curves are different for those motors with self-ventilation and those with forced cooling (= optional forced cooling fan).

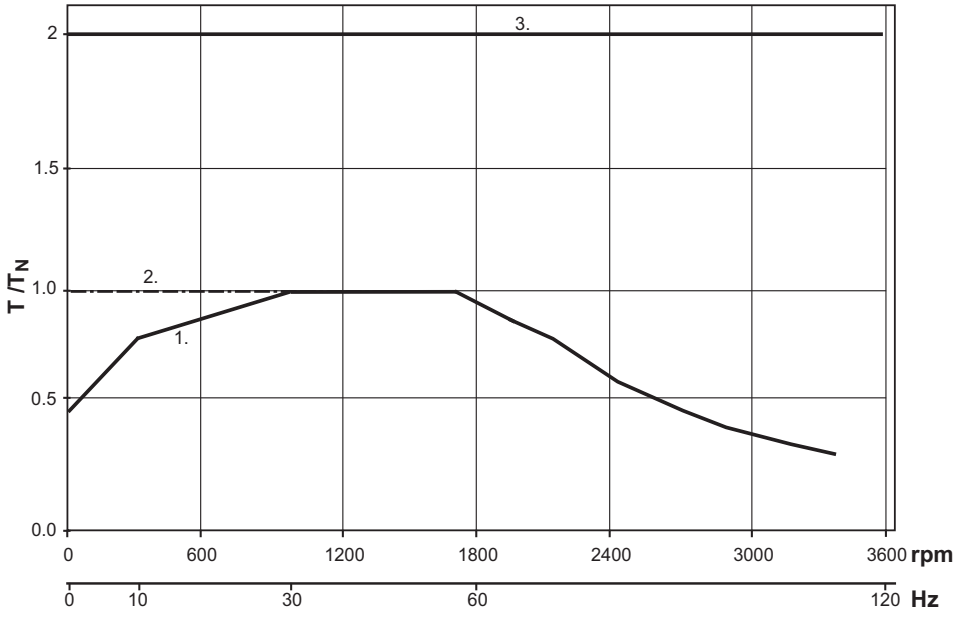

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Figure 1: Torque limit curves for f_{base} = 60 Hz

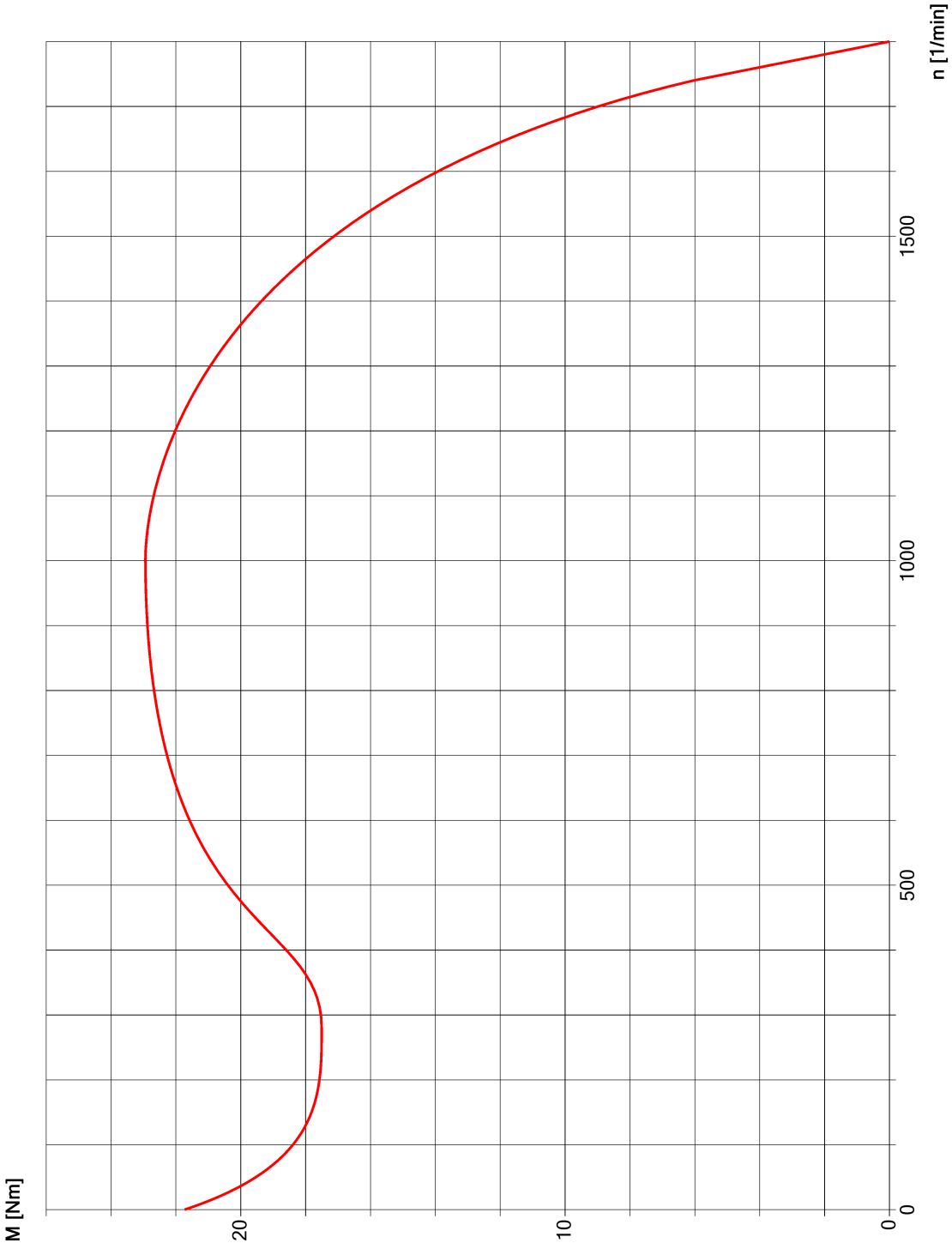
1. S1 operation with self-ventilation (= without forced cooling fan)
2. S1 operation with forced cooling (= with forced cooling fan)
3. Mechanical limitations for gearmotors

Motorkennlinie
Motor characteristic
Caractéristique du moteur

DRE 90M 4

1.1kW 4pol

Drehzahl-Drehmoment-Kennlinie 60Hz
Speed-torque characteristic
Caractéristique vitesse-couple



LOW VOLTAGE INDUCTION MOTORS
AZ ZABIRAH ALUMINIUM SMELTER

CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No. 4481-MHCD-0003

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
1.0		**SITE CONDITION**					
1.1	B	Altitude ASL	< 100	m			
1.2	B	Maximum Ambient Temperature	55	℃	000		
1.3	B	Minimum Ambient Temperature	0	℃			
1.4	B	Design Ambient Temperature (Indoors)	40	℃			
1.5	B	Maximum Relative Humidity	71	%			
1.6	B	Wind	NA	kph			
1.7	B	Seismic Zone	ND	-			
1.8	B	Type of Protection Required	Yes	-			
1.9	B	Indoors of Outdoors	Outdoors	-			
1.10	B	Cable Size	TBD	mm^2			
1.11	B	Earth connection Size	TBD	mm^2			
1.12	B	Unclassified Area	NA	-			
1.13	B	Hazardous Area Classification	Non-Hazardous	-			
1.13.1	B	Class	NA	-			
1.13.2	B	Division	NA	-			
1.13.3	B	Group(s)	NA	-			
1.13.4	B	Gas Ignition Temperature	NA	℃			
2.0		**DESIGN AND RATING**					
2.1	B	System Voltage	460	V			
2.2	B	Voltage tolerance	±5	%			
2.3	B	Phase(s)/Frequency	3/60	-/Hz			
2.4	B	Neutral Earthing	High Resistance Grounded	-			
2.5	B	Duty type IEC 34-1	S1-Continuous	-			
2.6	S	Rated Output		kW		0.75	
2.7	S	Synchronous Speed(s)		rpm		1800	
2.8	S	Direction of rotation viewed from drive end		-		Both	
2.9	B	Insulation Class/Temperature rise limit	F/B	-			
2.10	S	Minimum Terminal voltage during starting		per unit		N.A.	
2.11	S	Maximum no load sound pressure level at one metre		dBA		N.A.	
2.12	S	External Inertia (Max)		kg m^2		0.00229	
2.13	B	Type of Starter/Short circuit protection	DOL/MCCB	-			
2.14	S	Service Factor		per unit		2.5	
2.15	S	Minimum Rated Power factor at full load		%		78	
2.16	S	Minimum Efficiency at full rated load		-		82.5	
2.17	S	Mounting - Horizontal/Vertical		-		M1 horizontal	
2.18	S	Minimum starting voltage - percent of rated		%		N.A.	
2.19	S	Winding - Star/Delta		-		Star Star/Star	
3.0		**MECHANICAL AND ENCLOSURES**					
3.1	B	Enclosure Type	Cast Iron				
3.2	B	Degree of Protection - IP Code	IP 55				
3.3	S	Mounting IEC 34-7 IM Code				M1	
3.4	S	Cooling IEC 34-6 IC Code		-		IC411 (fan-cooled)	
3.5	S	Drain Holes		-		Y	
3.6	S	Shaft				Standard	
3.7	S	Drive Connection				To suit load	

NOTES:

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CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No. 4481-MHCD-0003

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
3.8	S	Finish bore half-coupling furnished by others		-		N	
3.9	S	Install half-coupling furnished by others		-		N	
3.10	S	Vibration Grade (IEC 60034-14)	A	-		N.A.	**Grade B in Special Cases**
3.11	S	Max Motor shaft load (R-Radial, A-Axial)		N		N.A.	
3.12	S	Bearing Type D end		-		DIN625 6304-2Z-J-C3-K08	
3.13	S	Bearing Type N end		-		DIN625 6304-2RS-J-C3-K08	
3.14	B	Antifriction Bearing L_{10} Life	MIN 40,000	Hours			**80,000 for re-greasable bearings**
3.15	S	Bearing Lubrication		-		GREASE	
3.16	S	Bearing Seals		-		D(2Z) - N(2RS)	
4.0		**ACCESSORIES**					
4.1	B	Space heaters required/rated voltage	Yes/115 Vac	/V			
4.2	B	Winding Over temperature protection required - type	Yes				**As per Specification**
4.3	B	Winding temperature devices No per phase	1				
4.4	B	Bearing over temperature protection required - type	No				
4.5	S	Auxilliary terminal boxe(es) or space heaters and temp devices				Separate	
4.6	S	Tachometer				N	
4.7	S	Brake				N	
4.8	S	Slide base for belt drive				Y	
4.9	S	Soleplate				N	
4.10	B	Rating Plate					**As per Specification**
4.11	B	Identification Plate					**As per Specification**
4.12	B	Separately powered cooling fan	Yes				

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CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No.: Individual Motor 4481-MHCD-0003

To Be Completed by SELLER for Each Motor

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
5.0	S	**MANUFACTURER'S DATA**					
5.1	S	Manufacturer		-		**SEW Eurodrive Canada**	
5.2	S	Frame Number		-		DRE80M4/DH	
5.3	S	Serial Number		-		80.1803912402.0001.10.00	
5.4	S	Model Number		-		R77 DRE80M4/DH	
5.5	S	Full Load Speed		rpm		1750	
5.6	S	Full Load Current		A		12.9 / 6.5	
5.7	S	Locked Rotor Current		A		98.1 / 49.4	
5.8	S	Locked Rotor Power Factor		pu		N.A.	
5.9	S	Temperature rise by resistance at full load		K		55	
5.10	S	Full Load Torque		nm		20.2	
5.11	S	Breakdown Torque in percent of Full Load		% IFL		310	
5.12	S	Weight		kg		37.1	
5.13	S	Efficiency at: 100 % Load		%		87.5	
5.14	S	75% Load		%		88.4	
5.15	S	50% Load		%		87.9	
5.16	S	Power Factor at: 100 % Load		pu		0.83	
5.17	S	75% Load		pu		0.78	
5.18	S	50% Load		pu		0.67	
5.19	S	Provide Following Data @ Rated Operating Temperature		-		-20ºC - 40ºC	
5.20	S	Locked rotor Withstand time @ nominal V		Seconds		N.A.	
5.21	S	Accelaration Time (Motor & Load) @ nominal V		Seconds		N.A.	
5.22	S	Locked rotor Withstand time @ min V		Seconds		N.A.	
5.23	S	Accelaration Time (Motor & Load) @ min V		Seconds		N.A.	
5.24	S	Rotor WK^2		kg m^2		0.0096	
5.25	S	Sub - Transient Reactance *X"*		%		N.A.	
5.26	S	Sub - Transient *X/R*		-		N.A.	
5.27	S	Provide thermal Limit curves		-			
5.28	S	Provide Current and Torque/Speed Curves		-			
5.29	S	Space Heater watts at nominal operating voltage		W		N.A.	
5.30	S	Motor RTD Alarm Temperature		deg C		N.A.	
5.31	S	Motor RTD Trip Temperature		deg C		N.A.	
6.0		**TESTS**					
6.1	B	Routine Tests					
6.2	B	Complete Test					
6.3	B	Vibration (with half coupling installed if available)					
6.4	B	Noise					

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CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No. 4481-MHCD-0003

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
7.0		**ADDITIONAL REQUIREMENTS FOR VFD SERVICE**					
7.1	S	Inverter Type		-		PWM	
7.2	S	Rated operation modes - VT / CT / CP		-		VT	
7.3	S	Rated power output at Base Speed		kW		0.75	
7.4	S	Base Speed		rpm		1740	
7.5	S	Constant Power speed range		rpm		1740-1740	
7.6	S	Constant Torque speed range		rpm		0-1740	
7.7	S	Continuous Constant Torque speed range		rpm		750-1740	
7.8	S	Variable Torque speed range		rpm		0-1700	
7.9	S	Variable Torque speed exponent		-		N.A.	
7.10	S	Starting (breakaway) torque		per unit		N.A.	
7.11	S	Run up torque		per unit		N.A.	

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6.10 Torque limit curves for DRS, DRE, DRP motors operated on an inverter

Thermally approved torque

Note thermally approved torque in project planning for operation of DR, asynchronous AC motors with frequency inverter. The following factors determine the thermally permitted torque:

- Duty type
- Type of cooling: Self-ventilation or forced cooling
- Base frequency f_{base} = 60 Hz (460 V ⅄) or f_{base} = 120Hz (230 ⅄⅄)

Use the torque limit curves to determine the thermally permitted torque. The projected, effective torque has to be less than the limit curve value. The following illustration shows the limit curves for 4-pole DR, asynchronous AC motors with f_{base} = 60 Hz and f_{base} = 120 Hz. The following peripheral conditions apply to the shown limit curves:

- Duty type S1
- Supply voltage of the inverter $V_{supply} = 3 \times 460\ V_{AC}$
- Motor in thermal class F

f_{base} = 60 Hz (460 V ⅄/60 Hz)

The following diagram shows the limit curves for operation at f_{base} = 60 Hz. The curves are different for those motors with self-ventilation and those with forced cooling (= optional forced cooling fan).

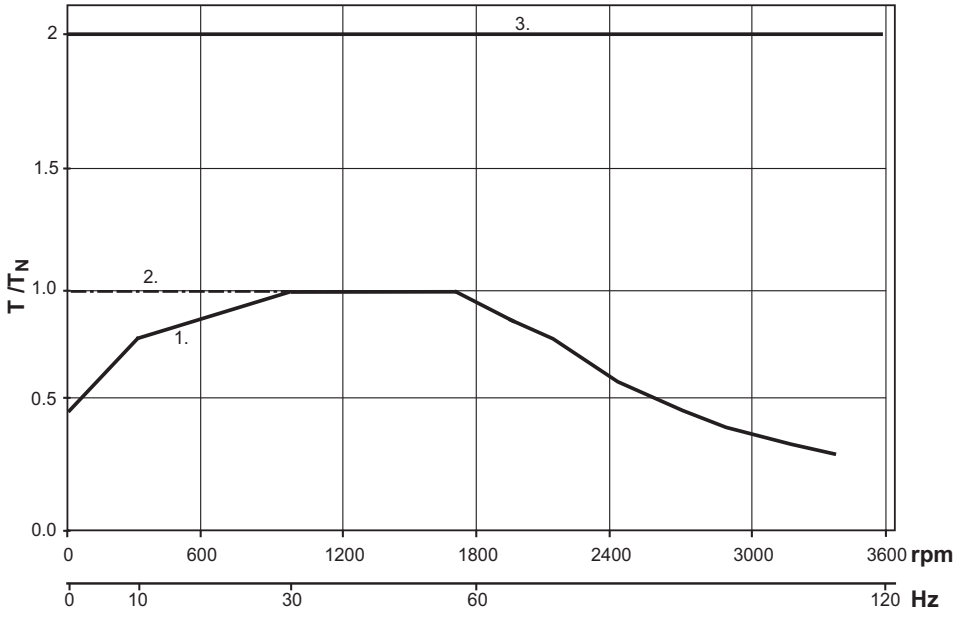

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Figure 1: Torque limit curves for f_{base} = 60 Hz

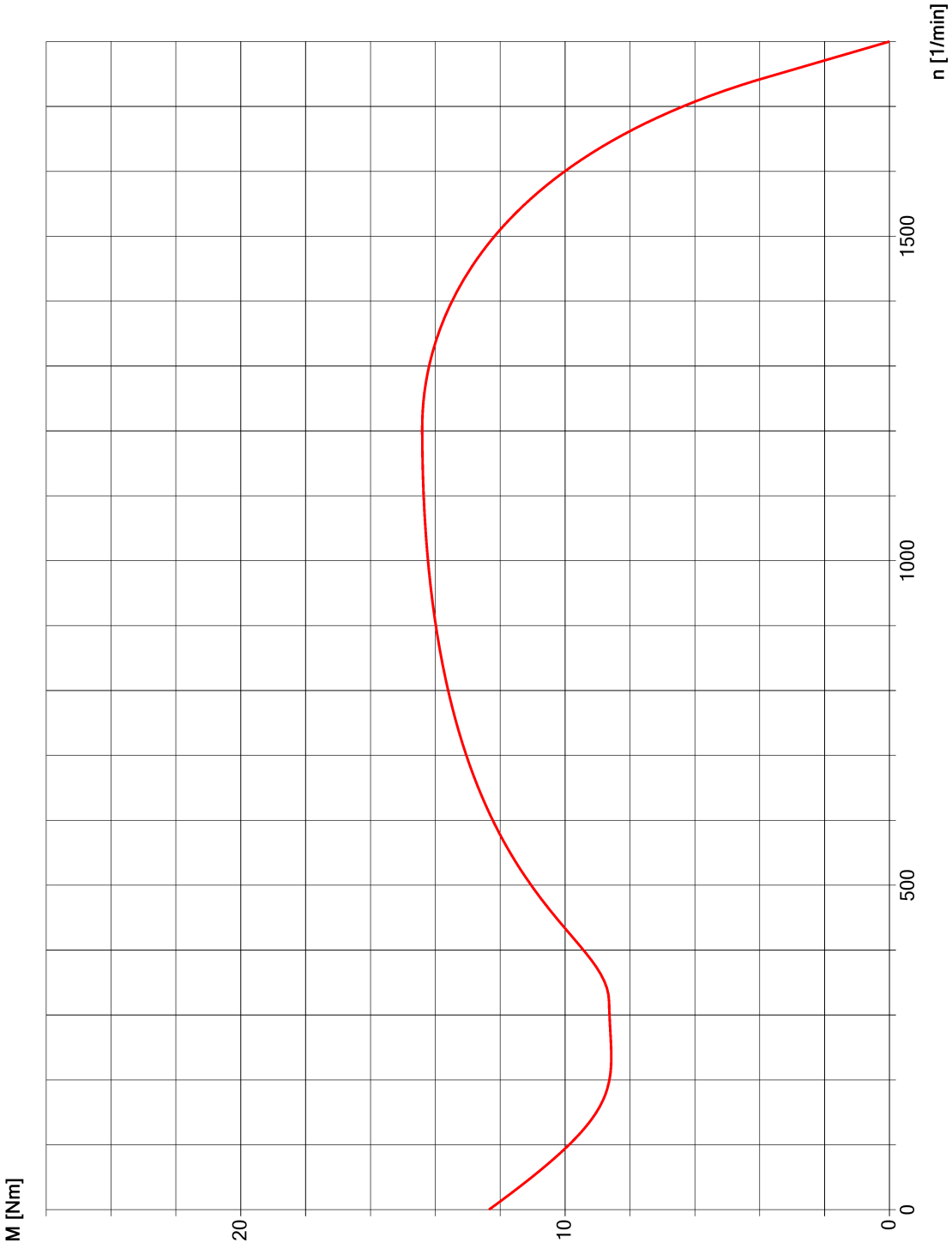
1. S1 operation with self-ventilation (= without forced cooling fan)
2. S1 operation with forced cooling (= with forced cooling fan)
3. Mechanical limitations for gearmotors

Motorkennlinie
Motor characteristic
Caractéristique du moteur

DRE 80M 4

0.75kW 4pol

Drehzahl-Drehmoment-Kennlinie 60Hz
Speed-torque characteristic
Caractéristique vitesse-couple



LOW VOLTAGE INDUCTION MOTORS
AZ ZABIRAH ALUMINIUM SMELTER

CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No. 4481-MHCD-0004

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
1.0		**SITE CONDITION**					
1.1	B	Altitude ASL	< 100	m			
1.2	B	Maximum Ambient Temperature	55	℃	000		
1.3	B	Minimum Ambient Temperature	0	℃			
1.4	B	Design Ambient Temperature (Indoors)	40	℃			
1.5	B	Maximum Relative Humidity	71	%			
1.6	B	Wind	NA	kph			
1.7	B	Seismic Zone	ND	-			
1.8	B	Type of Protection Required	Yes	-			
1.9	B	Indoors of Outdoors	Outdoors	-			
1.10	B	Cable Size	TBD	mm^2			
1.11	B	Earth connection Size	TBD	mm^2			
1.12	B	Unclassified Area	NA	-			
1.13	B	Hazardous Area Classification	Non-Hazardous	-			
1.13.1	B	Class	NA	-			
1.13.2	B	Division	NA	-			
1.13.3	B	Group(s)	NA	-			
1.13.4	B	Gas Ignition Temperature	NA	℃			
2.0		**DESIGN AND RATING**					
2.1	B	System Voltage	460	V			
2.2	B	Voltage tolerance	±5	%			
2.3	B	Phase(s)/Frequency	3/60	-/Hz			
2.4	B	Neutral Earthing	High Resistance Grounded	-			
2.5	B	Duty type IEC 34-1	S1-Continuous	-			
2.6	S	Rated Output		kW		3.7	
2.7	S	Synchronous Speed(s)		rpm		1800	
2.8	S	Direction of rotation viewed from drive end		-		Both	
2.9	B	Insulation Class/Temperature rise limit	F/B	-			
2.10	S	Minimum Terminal voltage during starting		per unit		N.A.	
2.11	S	Maximum no load sound pressure level at one metre		dBA		N.A.	
2.12	S	External Inertia (Max)		$kg\ m^2$		0.0096	
2.13	B	Type of Starter/Short circuit protection	DOL/MCCB	-			
2.14	S	Service Factor		per unit		1.7	
2.15	S	Minimum Rated Power factor at full load		%		83	
2.16	S	Minimum Efficiency at full rated load		-		87.50%	
2.17	S	Mounting - Horizontal/Vertical		-		horizontal M1	
2.18	S	Minimum starting voltage - percent of rated		%		N.A.	
2.19	S	Winding - Star/Delta		-		Star Star / Star	
3.0		**MECHANICAL AND ENCLOSURES**					
3.1	B	Enclosure Type	Cast Iron				
3.2	B	Degree of Protection - IP Code	IP 55				
3.3	S	Mounting IEC 34-7 IM Code				M1	
3.4	S	Cooling IEC 34-6 IC Code		-		IC411 (fan-cooled)	
3.5	S	Drain Holes		-		Yes	
3.6	S	Shaft				N.A.	
3.7	S	Drive Connection				N.A.	

NOTES:

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CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No. 4481-MHCD-0004

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
3.8	S	Finish bore half-coupling furnished by others		-		No	
3.9	S	Install half-coupling furnished by others		-		No	
3.10	S	Vibration Grade (IEC 60034-14)	A	-		N.A.	**Grade B in Special Cases**
3.11	S	Max Motor shaft load (R-Radial, A-Axial)		N		N.A.	
3.12	S	Bearing Type D end		-		DGB brg. 6306-2Z-C3-K08	
3.13	S	Bearing Type N end		-		DGB brg. 6205-2RS-C3-K08	
3.14	B	Antifriction Bearing L_{10} Life	MIN 40,000	Hours			**80,000 for re-greasable bearings**
3.15	S	Bearing Lubrication		-		GREASE	
3.16	S	Bearing Seals		-		D(2Z) - N(2RS)	
4.0		**ACCESSORIES**					
4.1	B	Space heaters required/rated voltage	Yes/115 Vac	/V			
4.2	B	Winding Over temperature protection required - type	Yes				**As per Specification**
4.3	B	Winding temperature devices No per phase	1				
4.4	B	Bearing over temperature protection required - type	No				
4.5	S	Auxilliary terminal boxe(es) or space heaters and temp devices				Separate	
4.6	S	Tachometer				No	
4.7	S	Brake				Yes	
4.8	S	Slide base for belt drive				No	
4.9	S	Soleplate				No	
4.10	B	Rating Plate					**As per Specification**
4.11	B	Identification Plate					**As per Specification**
4.12	B	Separately powered cooling fan	Yes				

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CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No.: Individual Motor 4481-MHCD-0004

To Be Completed by SELLER for Each Motor

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
5.0	S	**MANUFACTURER'S DATA**					
5.1	S	Manufacturer		-		**SEW Eurodrive Canada**	
5.2	S	Frame Number		-		DRE 100LC 4/BE	
5.3	S	Serial Number		-		80.1803955402.0001.10.00	
5.4	S	Model Number		-		R137 R77 DRE100LC4BE2HF/DH	
5.5	S	Full Load Speed		rpm		1750	
5.6	S	Full Load Current		A		12.9 / 6.5	
5.7	S	Locked Rotor Current		A		98.1 / 49.4	
5.8	S	Locked Rotor Power Factor		pu		N.A.	
5.9	S	Temperature rise by resistance at full load		K		55	
5.10	S	Full Load Torque		nm		20.2	
5.11	S	Breakdown Torque in percent of Full Load		% IFL		310	
5.12	S	Weight		kg		37.1	
5.13	S	Efficiency at: 100 % Load		%		87.5	
5.14	S	75% Load		%		88.4	
5.15	S	50% Load		%		87.9	
5.16	S	Power Factor at: 100 % Load		pu		0.83	
5.17	S	75% Load		pu		0.78	
5.18	S	50% Load		pu		0.67	
5.19	S	Provide Following Data @ Rated Operating Temperature		-		-20ºC - 40ºC	
5.20	S	Locked rotor Withstand time @ nominal V		Seconds		N.A.	
5.21	S	Accelaration Time (Motor & Load) @ nominal V		Seconds		N.A.	
5.22	S	Locked rotor Withstand time @ min V		Seconds		N.A.	
5.23	S	Accelaration Time (Motor & Load) @ min V		Seconds		N.A.	
5.24	S	Rotor WK^2		kg m^2		0.0096	
5.25	S	Sub - Transient Reactance *X"*		%		N.A.	
5.26	S	Sub - Transient *X/R*		-		N.A.	
5.27	S	Provide thermal Limit curves		-		See attached file	
5.28	S	Provide Current and Torque/Speed Curves		-		See attached file	
5.29	S	Space Heater watts at nominal operating voltage		W		N.A.	
5.30	S	Motor RTD Alarm Temperature		deg C		N.A.	
5.31	S	Motor RTD Trip Temperature		deg C		N.A.	
6.0		**TESTS**					
6.1	B	Routine Tests					
6.2	B	Complete Test					
6.3	B	Vibration (with half coupling installed if available)					
6.4	B	Noise					

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CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No. 4481-MHCD-0004

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
7.0		**ADDITIONAL REQUIREMENTS FOR VFD SERVICE**					
7.1	S	Inverter Type		-		PWM	
7.2	S	Rated operation modes - VT / CT / CP		-		VT	
7.3	S	Rated power output at Base Speed		kW		3.7	
7.4	S	Base Speed		rpm		1750	
7.5	S	Constant Power speed range		rpm		1750-1750	
7.6	S	Constant Torque speed range		rpm		0-1750	
7.7	S	Continuous Constant Torque speed range		rpm		750-1750	
7.8	S	Variable Torque speed range		rpm		0-1700	
7.9	S	Variable Torque speed exponent		-		N.A.	
7.10	S	Starting (breakaway) torque		per unit		N.A.	
7.11	S	Run up torque		per unit		N.A.	

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6.10 Torque limit curves for DRS, DRE, DRP motors operated on an inverter

Thermally approved torque

Note thermally approved torque in project planning for operation of DR, asynchronous AC motors with frequency inverter. The following factors determine the thermally permitted torque:

- Duty type
- Type of cooling: Self-ventilation or forced cooling
- Base frequency f_{base} = 60 Hz (460 V ⅄) or f_{base} = 120Hz (230 ⅄⅄)

Use the torque limit curves to determine the thermally permitted torque. The projected, effective torque has to be less than the limit curve value. The following illustration shows the limit curves for 4-pole DR, asynchronous AC motors with f_{base} = 60 Hz and f_{base} = 120 Hz. The following peripheral conditions apply to the shown limit curves:

- Duty type S1
- Supply voltage of the inverter $V_{supply} = 3 \times 460\ V_{AC}$
- Motor in thermal class F

f_{base} = 60 Hz (460 V ⅄/60 Hz)

The following diagram shows the limit curves for operation at f_{base} = 60 Hz. The curves are different for those motors with self-ventilation and those with forced cooling (= optional forced cooling fan).

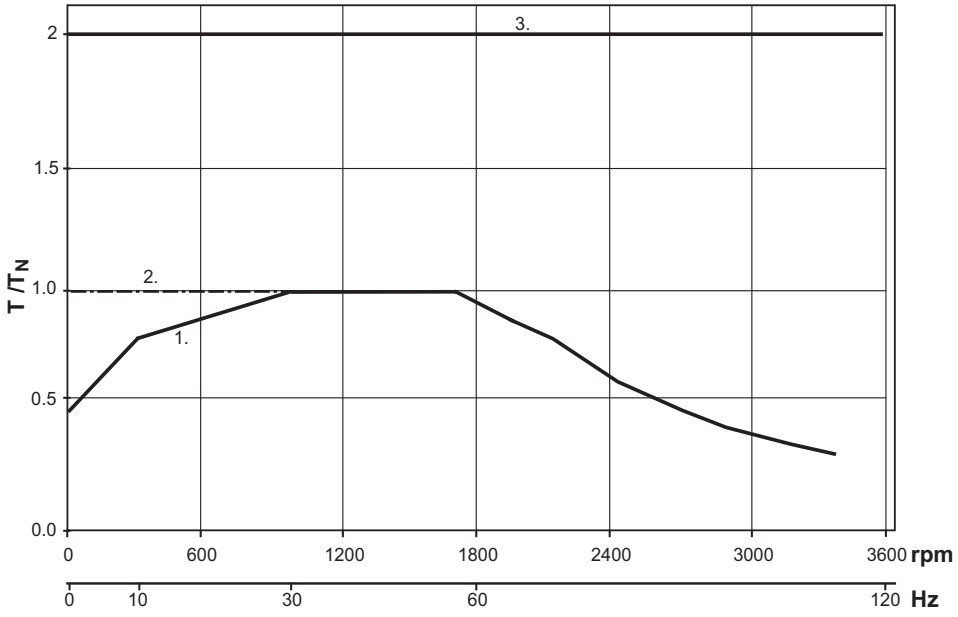

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Figure 1: Torque limit curves for f_{base} = 60 Hz

1. S1 operation with self-ventilation (= without forced cooling fan)
2. S1 operation with forced cooling (= with forced cooling fan)
3. Mechanical limitations for gearmotors

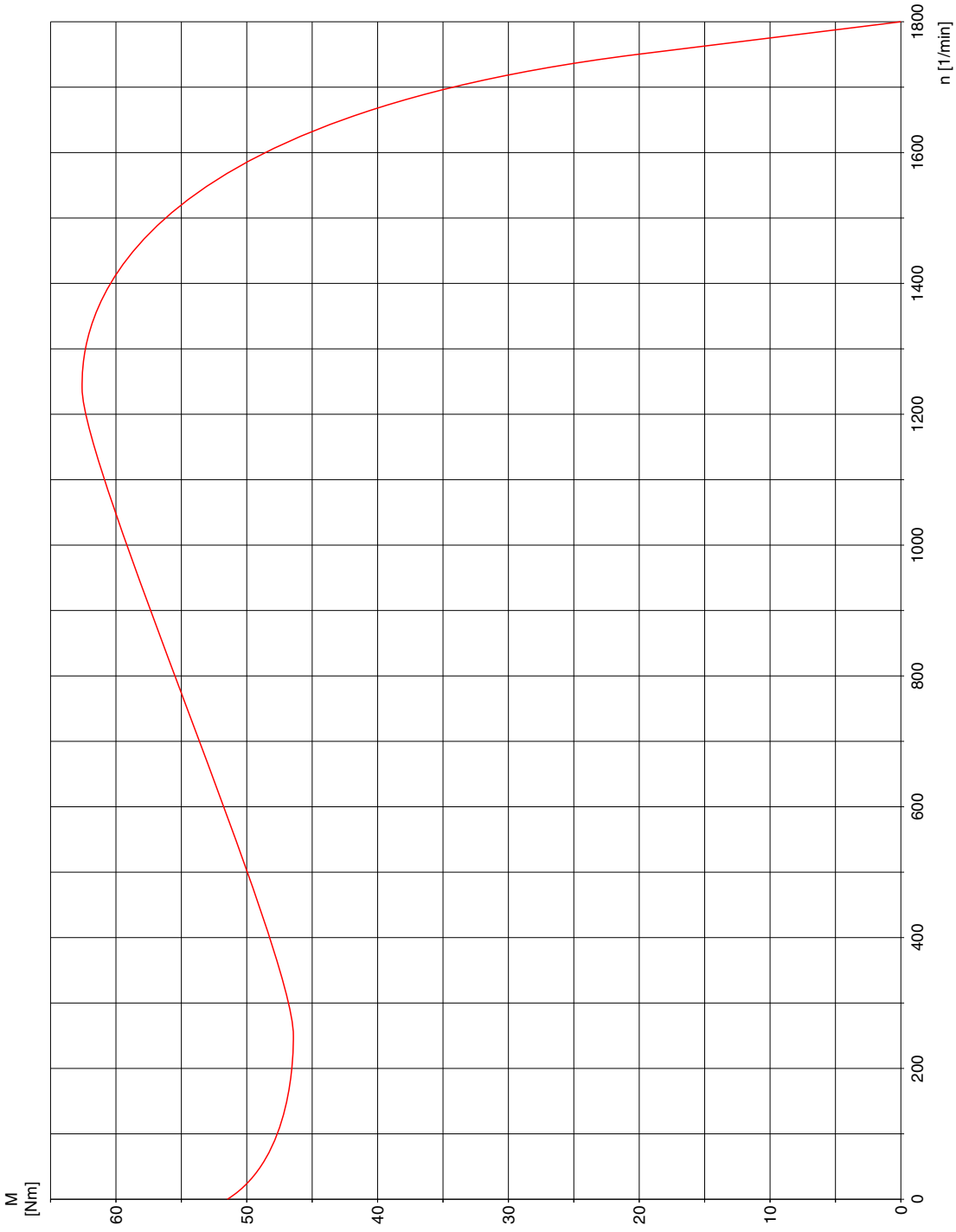
Motorkennlinie
Motor characteristic
Caractéristique du moteur

3,7kW - 4pol

Drehzahl-Drehmoment-Kennlinie
Speed-torque characteristic
Caractéristique vitesse-couple

60Hz

10.11.2010



LOW VOLTAGE INDUCTION MOTORS
AZ ZABIRAH ALUMINIUM SMELTER

CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No. 4481-MBMB-0001

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
1.0		**SITE CONDITION**					
1.1	B	Altitude ASL	< 100	m			
1.2	B	Maximum Ambient Temperature	55	℃	000		
1.3	B	Minimum Ambient Temperature	0	℃			
1.4	B	Design Ambient Temperature (Indoors)	40	℃			
1.5	B	Maximum Relative Humidity	71	%			
1.6	B	Wind	NA	kph			
1.7	B	Seismic Zone	ND	-			
1.8	B	Type of Protection Required	Yes	-			
1.9	B	Indoors of Outdoors	Outdoors	-			
1.10	B	Cable Size	TBD	mm^2			
1.11	B	Earth connection Size	TBD	mm^2			
1.12	B	Unclassified Area	NA	-			
1.13	B	Hazardous Area Classification	Non-Hazardous	-			
1.13.1	B	Class	NA	-			
1.13.2	B	Division	NA	-			
1.13.3	B	Group(s)	NA	-			
1.13.4	B	Gas Ignition Temperature	NA	℃			
2.0		**DESIGN AND RATING**					
2.1	B	System Voltage	460	V			
2.2	B	Voltage tolerance	±5	%			
2.3	B	Phase(s)/Frequency	3/60	-/Hz			
2.4	B	Neutral Earthing	High Resistance Grounded	-			
2.5	B	Duty type IEC 34-1	S1-Continuous	-			
2.6	S	Rated Output		kW		0.75	
2.7	S	Synchronous Speed(s)		rpm		1800	
2.8	S	Direction of rotation viewed from drive end		-		Both	
2.9	B	Insulation Class/Temperature rise limit	F/B	-			
2.10	S	Minimum Terminal voltage during starting		per unit		N.A.	
2.11	S	Maximum no load sound pressure level at one metre		dBA		N.A.	
2.12	S	External Inertia (Max)		$kg\ m^2$		0.00229	
2.13	B	Type of Starter/Short circuit protection	DOL/MCCB	-			
2.14	S	Service Factor		per unit		2.5	
2.15	S	Minimum Rated Power factor at full load		%		78	
2.16	S	Minimum Efficiency at full rated load		-		82.5	
2.17	S	Mounting - Horizontal/Vertical		-		M1 horizontal	
2.18	S	Minimum starting voltage - percent of rated		%		N.A.	
2.19	S	Winding - Star/Delta		-		Star Star/Star	
3.0		**MECHANICAL AND ENCLOSURES**					
3.1	B	Enclosure Type	Cast Iron				
3.2	B	Degree of Protection - IP Code	IP 55				
3.3	S	Mounting IEC 34-7 IM Code				M1	
3.4	S	Cooling IEC 34-6 IC Code		-		IC411 (fan-cooled)	
3.5	S	Drain Holes		-		Y	
3.6	S	Shaft				Standard	
3.7	S	Drive Connection				To suit load	

NOTES:

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CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No. 4481-MBMB-0001

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
3.8	S	Finish bore half-coupling furnished by others		-		N	
3.9	S	Install half-coupling furnished by others		-		N	
3.10	S	Vibration Grade (IEC 60034-14)	A	-		N.A.	**Grade B in Special Cases**
3.11	S	Max Motor shaft load (R-Radial, A-Axial)		N		N.A.	
3.12	S	Bearing Type D end		-		DIN625 6304-2Z-J-C3-K08	
3.13	S	Bearing Type N end		-		DIN625 6304-2RS-J-C3-K08	
3.14	B	Antifriction Bearing L_{10} Life	MIN 40,000	Hours			**80,000 for re-greasable bearings**
3.15	S	Bearing Lubrication		-		GREASE	
3.16	S	Bearing Seals		-		D(2Z) - N(2RS)	
4.0		**ACCESSORIES**					
4.1	B	Space heaters required/rated voltage	Yes/115 Vac	/V			
4.2	B	Winding Over temperature protection required - type	Yes				**As per Specification**
4.3	B	Winding temperature devices No per phase	1				
4.4	B	Bearing over temperature protection required - type	No				
4.5	S	Auxilliary terminal boxe(es) or space heaters and temp devices				Separate	
4.6	S	Tachometer				N	
4.7	S	Brake				N	
4.8	S	Slide base for belt drive				Y	
4.9	S	Soleplate				N	
4.10	B	Rating Plate					**As per Specification**
4.11	B	Identification Plate					**As per Specification**
4.12	B	Separately powered cooling fan	Yes				

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CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No.: Individual Motor 4481-MBMB-0001

To Be Completed by SELLER for Each Motor

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
5.0	S	**MANUFACTURER'S DATA**					
5.1	S	Manufacturer		-		**SEW Eurodrive Canada**	
5.2	S	Frame Number		-		DRE 80M 4 /BE	
5.3	S	Serial Number		-		80.1803914101.0001.10.00	
5.4	S	Model Number		-		K47 DRE80M4BE05HF/DH	
5.5	S	Full Load Speed		rpm		1740	
5.6	S	Full Load Current		A		2.90/1.44	
5.7	S	Locked Rotor Current		A		20.59/10.22	
5.8	S	Locked Rotor Power Factor		pu		N.A.	
5.9	S	Temperature rise by resistance at full load		K		30	
5.10	S	Full Load Torque		nm		4.12	
5.11	S	Breakdown Torque in percent of Full Load		% IFL		350	
5.12	S	Weight		kg		23	
5.13	S	Efficiency at: 100 % Load		%		83.5	
5.14	S	75% Load		%		83.3	
5.15	S	50% Load		%		80.8	
5.16	S	Power Factor at: 100 % Load		pu		0.78	
5.17	S	75% Load		pu		0.7	
5.18	S	50% Load		pu		0.57	
5.19	S	Provide Following Data @ Rated Operating Temperature		-		-20ºC - 40ºC	
5.20	S	Locked rotor Withstand time @ nominal V		Seconds		N.A.	
5.21	S	Accelaration Time (Motor & Load) @ nominal V		Seconds		N.A.	
5.22	S	Locked rotor Withstand time @ min V		Seconds		N.A.	
5.23	S	Accelaration Time (Motor & Load) @ min V		Seconds		N.A.	
5.24	S	Rotor WK^2		kg m^2		0.00229	
5.25	S	Sub - Transient Reactance *X"*		%		N.A.	
5.26	S	Sub - Transient *X/R*		-		N.A.	
5.27	S	Provide thermal Limit curves		-		See attached file	
5.28	S	Provide Current and Torque/Speed Curves		-		See attached file	
5.29	S	Space Heater watts at nominal operating voltage		W		N.A.	
5.30	S	Motor RTD Alarm Temperature		deg C		N.A.	
5.31	S	Motor RTD Trip Temperature		deg C		N.A.	
6.0		**TESTS**					
6.1	B	Routine Tests					
6.2	B	Complete Test					
6.3	B	Vibration (with half coupling installed if available)					
6.4	B	Noise					

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CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No. 4481-MBMB-0001

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
7.0		**ADDITIONAL REQUIREMENTS FOR VFD SERVICE**					
7.1	S	Inverter Type		-		PWM	
7.2	S	Rated operation modes - VT / CT / CP		-		VT	
7.3	S	Rated power output at Base Speed		kW		0.75	
7.4	S	Base Speed		rpm		1740	
7.5	S	Constant Power speed range		rpm		1740-1740	
7.6	S	Constant Torque speed range		rpm		0-1740	
7.7	S	Continuous Constant Torque speed range		rpm		750-1740	
7.8	S	Variable Torque speed range		rpm		0-1700	
7.9	S	Variable Torque speed exponent		-		N.A.	
7.10	S	Starting (breakaway) torque		per unit		N.A.	
7.11	S	Run up torque		per unit		N.A.	

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6.10 Torque limit curves for DRS, DRE, DRP motors operated on an inverter

Thermally approved torque

Note thermally approved torque in project planning for operation of DR, asynchronous AC motors with frequency inverter. The following factors determine the thermally permitted torque:

- Duty type
- Type of cooling: Self-ventilation or forced cooling
- Base frequency f_{base} = 60 Hz (460 V ⅄) or f_{base} = 120Hz (230 ⅄⅄)

Use the torque limit curves to determine the thermally permitted torque. The projected, effective torque has to be less than the limit curve value. The following illustration shows the limit curves for 4-pole DR, asynchronous AC motors with f_{base} = 60 Hz and f_{base} = 120 Hz. The following peripheral conditions apply to the shown limit curves:

- Duty type S1
- Supply voltage of the inverter $V_{supply} = 3 \times 460\ V_{AC}$
- Motor in thermal class F

f_{base} = 60 Hz (460 V ⅄/60 Hz)

The following diagram shows the limit curves for operation at f_{base} = 60 Hz. The curves are different for those motors with self-ventilation and those with forced cooling (= optional forced cooling fan).

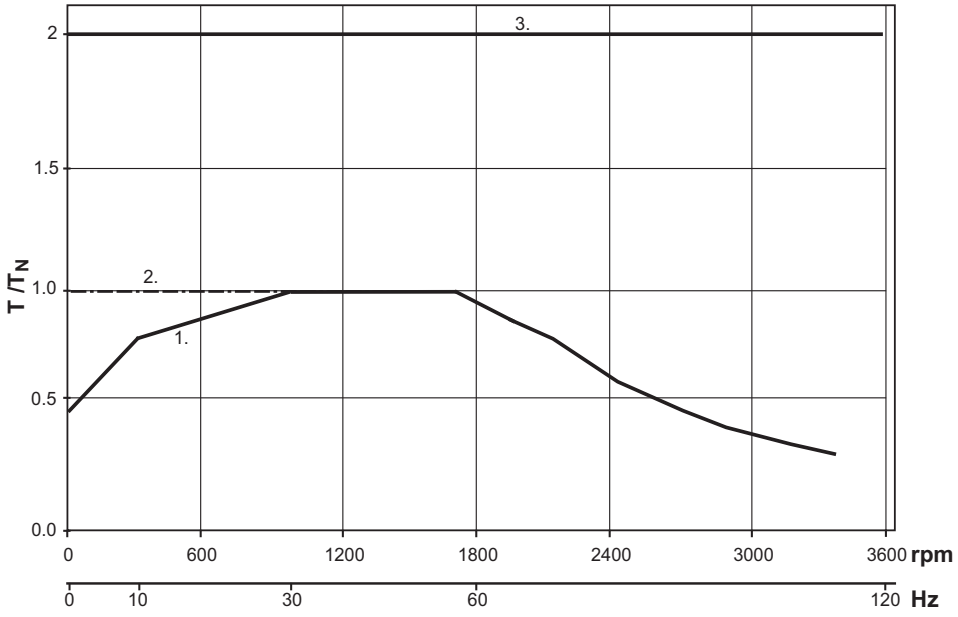

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Figure 1: Torque limit curves for f_{base} = 60 Hz

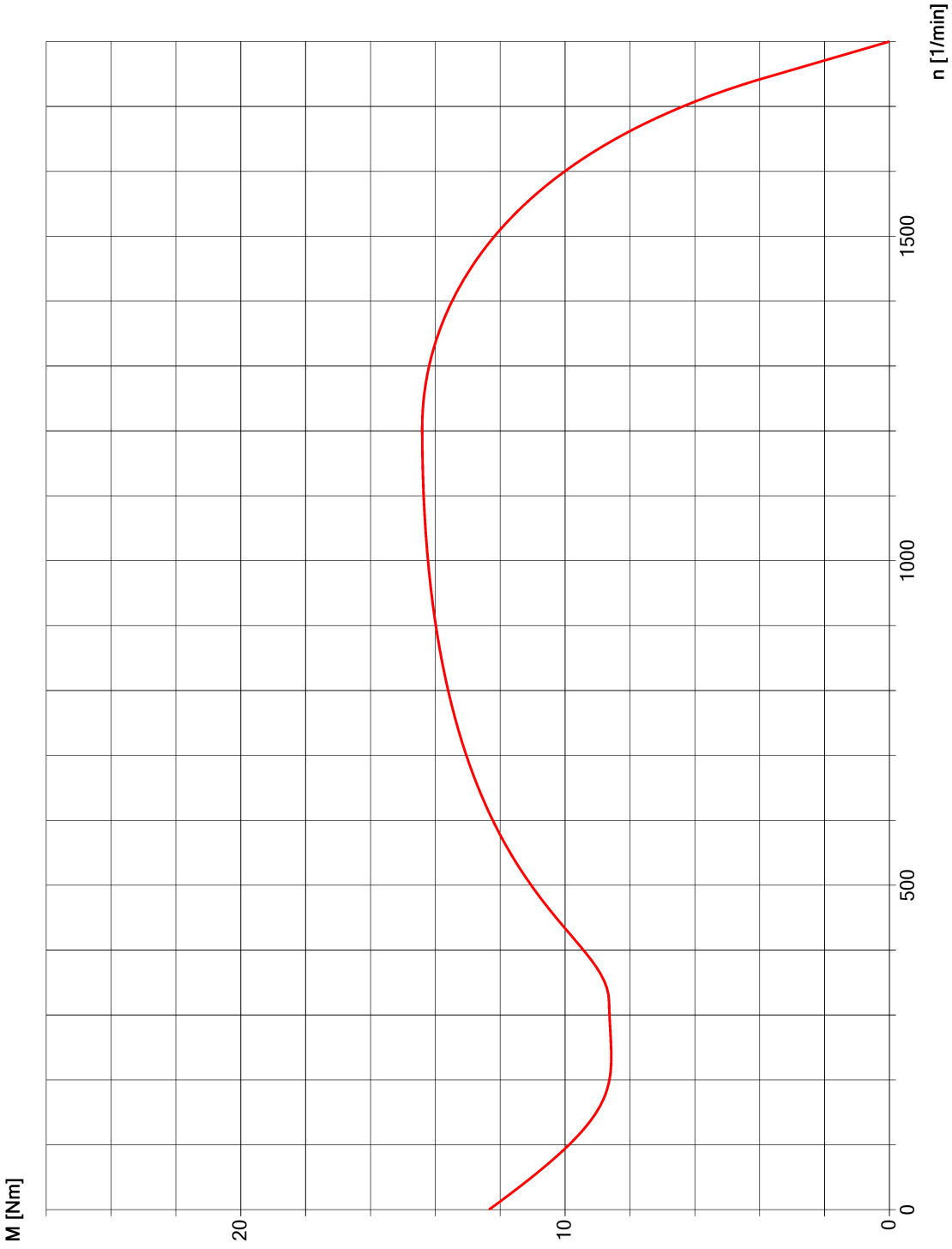
1. S1 operation with self-ventilation (= without forced cooling fan)
2. S1 operation with forced cooling (= with forced cooling fan)
3. Mechanical limitations for gearmotors

Motorkennlinie
Motor characteristic
Caractéristique du moteur

DRE 80M 4

0.75kW 4pol

Drehzahl-Drehmoment-Kennlinie 60Hz
Speed-torque characteristic
Caractéristique vitesse-couple



LOW VOLTAGE INDUCTION MOTORS
AZ ZABIRAH ALUMINIUM SMELTER

CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No. 4481-MJR0-0005

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
1.0		**SITE CONDITION**					
1.1	B	Altitude ASL	< 100	m			
1.2	B	Maximum Ambient Temperature	55	℃	000		
1.3	B	Minimum Ambient Temperature	0	℃			
1.4	B	Design Ambient Temperature (Indoors)	40	℃			
1.5	B	Maximum Relative Humidity	71	%			
1.6	B	Wind	NA	kph			
1.7	B	Seismic Zone	ND	-			
1.8	B	Type of Protection Required	Yes	-			
1.9	B	Indoors of Outdoors	Outdoors	-			
1.10	B	Cable Size	TBD	mm^2			
1.11	B	Earth connection Size	TBD	mm^2			
1.12	B	Unclassified Area	NA	-			
1.13	B	Hazardous Area Classification	Non-Hazardous	-			
1.13.1	B	Class	NA	-			
1.13.2	B	Division	NA	-			
1.13.3	B	Group(s)	NA	-			
1.13.4	B	Gas Ignition Temperature	NA	℃			
2.0		**DESIGN AND RATING**					
2.1	B	System Voltage	460	V			
2.2	B	Voltage tolerance	±5	%			
2.3	B	Phase(s)/Frequency	3/60	-/Hz			
2.4	B	Neutral Earthing	High Resistance Grounded	-			
2.5	B	Duty type IEC 34-1	S1-Continuous	-			
2.6	S	Rated Output		kW		0.75	
2.7	S	Synchronous Speed(s)		rpm		1800	
2.8	S	Direction of rotation viewed from drive end		-		Both	
2.9	B	Insulation Class/Temperature rise limit	F/B	-			
2.10	S	Minimum Terminal voltage during starting		per unit		N.A.	
2.11	S	Maximum no load sound pressure level at one metre		dBA		N.A.	
2.12	S	External Inertia (Max)		$kg\ m^2$		0.00229	
2.13	B	Type of Starter/Short circuit protection	DOL/MCCB	-			
2.14	S	Service Factor		per unit		2.5	
2.15	S	Minimum Rated Power factor at full load		%		78	
2.16	S	Minimum Efficiency at full rated load		-		82.5	
2.17	S	Mounting - Horizontal/Vertical		-		M1 horizontal	
2.18	S	Minimum starting voltage - percent of rated		%		N.A.	
2.19	S	Winding - Star/Delta		-		Star Star/Star	
3.0		**MECHANICAL AND ENCLOSURES**					
3.1	B	Enclosure Type	Cast Iron				
3.2	B	Degree of Protection - IP Code	IP 55				
3.3	S	Mounting IEC 34-7 IM Code				M1A	
3.4	S	Cooling IEC 34-6 IC Code		-		IC411 (fan-cooled)	
3.5	S	Drain Holes		-		Y	
3.6	S	Shaft				Standard	
3.7	S	Drive Connection				To suit load	

NOTES:

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CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No. 4481-MJR0-0005

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
3.8	S	Finish bore half-coupling furnished by others		-		N	
3.9	S	Install half-coupling furnished by others		-		N	
3.10	S	Vibration Grade (IEC 60034-14)	A	-		N.A.	**Grade B in Special Cases**
3.11	S	Max Motor shaft load (R-Radial, A-Axial)		N		N.A.	
3.12	S	Bearing Type D end		-		DIN625 6304-2Z-J-C3-K08	
3.13	S	Bearing Type N end		-		DIN625 6304-2RS-J-C3-K08	
3.14	B	Antifriction Bearing L_{10} Life	MIN 40,000	Hours			**80,000 for re-greasable bearings**
3.15	S	Bearing Lubrication		-		GREASE	
3.16	S	Bearing Seals		-		D(2Z) - N(2RS)	
4.0		**ACCESSORIES**					
4.1	B	Space heaters required/rated voltage	Yes/115 Vac	/V			
4.2	B	Winding Over temperature protection required - type	Yes				**As per Specification**
4.3	B	Winding temperature devices No per phase	1				
4.4	B	Bearing over temperature protection required - type	No				
4.5	S	Auxilliary terminal boxe(es) or space heaters and temp devices				separate	
4.6	S	Tachometer				N	
4.7	S	Brake				Y	
4.8	S	Slide base for belt drive				N	
4.9	S	Soleplate				N	
4.10	B	Rating Plate					**As per Specification**
4.11	B	Identification Plate					**As per Specification**
4.12	B	Separately powered cooling fan	Yes				

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CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No.: Individual Motor 4481-MJR0-0005

To Be Completed by SELLER for Each Motor

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
5.0	S	**MANUFACTURER'S DATA**					
5.1	S	Manufacturer		-		**SEW Eurodrive Canada**	
5.2	S	Frame Number		-		DRE80M4BE1HF/DH	
5.3	S	Serial Number		-		80.1803969202.0001.10.00	
5.4	S	Model Number		-		K47 DRE80M4BE1HF/DH	
5.5	S	Full Load Speed		rpm		1750	
5.6	S	Full Load Current		A		12.9 / 6.5	
5.7	S	Locked Rotor Current		A		98.1 / 49.4	
5.8	S	Locked Rotor Power Factor		pu		N.A.	
5.9	S	Temperature rise by resistance at full load		K		55	
5.10	S	Full Load Torque		nm		20.2	
5.11	S	Breakdown Torque in percent of Full Load		% IFL		310	
5.12	S	Weight		kg		37.1	
5.13	S	Efficiency at: 100 % Load		%		87.5	
5.14	S	75% Load		%		88.4	
5.15	S	50% Load		%		87.9	
5.16	S	Power Factor at: 100 % Load		pu		0.83	
5.17	S	75% Load		pu		0.78	
5.18	S	50% Load		pu		0.67	
5.19	S	Provide Following Data @ Rated Operating Temperature		-		-20ºC - 40ºC	
5.20	S	Locked rotor Withstand time @ nominal V		Seconds		N.A.	
5.21	S	Accelaration Time (Motor & Load) @ nominal V		Seconds		N.A.	
5.22	S	Locked rotor Withstand time @ min V		Seconds		N.A.	
5.23	S	Accelaration Time (Motor & Load) @ min V		Seconds		N.A.	
5.24	S	Rotor WK^2		kg m^2		0.0096	
5.25	S	Sub - Transient Reactance *X"*		%		N.A.	
5.26	S	Sub - Transient *X/R*		-		N.A.	
5.27	S	Provide thermal Limit curves		-			
5.28	S	Provide Current and Torque/Speed Curves		-			
5.29	S	Space Heater watts at nominal operating voltage		W		N.A.	
5.30	S	Motor RTD Alarm Temperature		deg C		N.A.	
5.31	S	Motor RTD Trip Temperature		deg C		N.A.	
6.0		**TESTS**					
6.1	B	Routine Tests					
6.2	B	Complete Test					
6.3	B	Vibration (with half coupling installed if available)					
6.4	B	Noise					

NOTES:

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CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No. 4481-MJR0-0005

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
7.0		**ADDITIONAL REQUIREMENTS FOR VFD SERVICE**					
7.1	S	Inverter Type		-		PWM	
7.2	S	Rated operation modes - VT / CT / CP		-		VT	
7.3	S	Rated power output at Base Speed		kW		0.75	
7.4	S	Base Speed		rpm		1740	
7.5	S	Constant Power speed range		rpm		1740-1740	
7.6	S	Constant Torque speed range		rpm		0-1740	
7.7	S	Continuous Constant Torque speed range		rpm		750-1740	
7.8	S	Variable Torque speed range		rpm		0-1700	
7.9	S	Variable Torque speed exponent		-		N.A.	
7.10	S	Starting (breakaway) torque		per unit		N.A.	
7.11	S	Run up torque		per unit		N.A.	

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6.10 Torque limit curves for DRS, DRE, DRP motors operated on an inverter

Thermally approved torque

Note thermally approved torque in project planning for operation of DR, asynchronous AC motors with frequency inverter. The following factors determine the thermally permitted torque:

- Duty type
- Type of cooling: Self-ventilation or forced cooling
- Base frequency f_{base} = 60 Hz (460 V ⅄) or f_{base} = 120Hz (230 ⅄⅄)

Use the torque limit curves to determine the thermally permitted torque. The projected, effective torque has to be less than the limit curve value. The following illustration shows the limit curves for 4-pole DR, asynchronous AC motors with f_{base} = 60 Hz and f_{base} = 120 Hz. The following peripheral conditions apply to the shown limit curves:

- Duty type S1
- Supply voltage of the inverter $V_{supply} = 3 \times 460\ V_{AC}$
- Motor in thermal class F

f_{base} = 60 Hz (460 V ⅄/60 Hz)

The following diagram shows the limit curves for operation at f_{base} = 60 Hz. The curves are different for those motors with self-ventilation and those with forced cooling (= optional forced cooling fan).

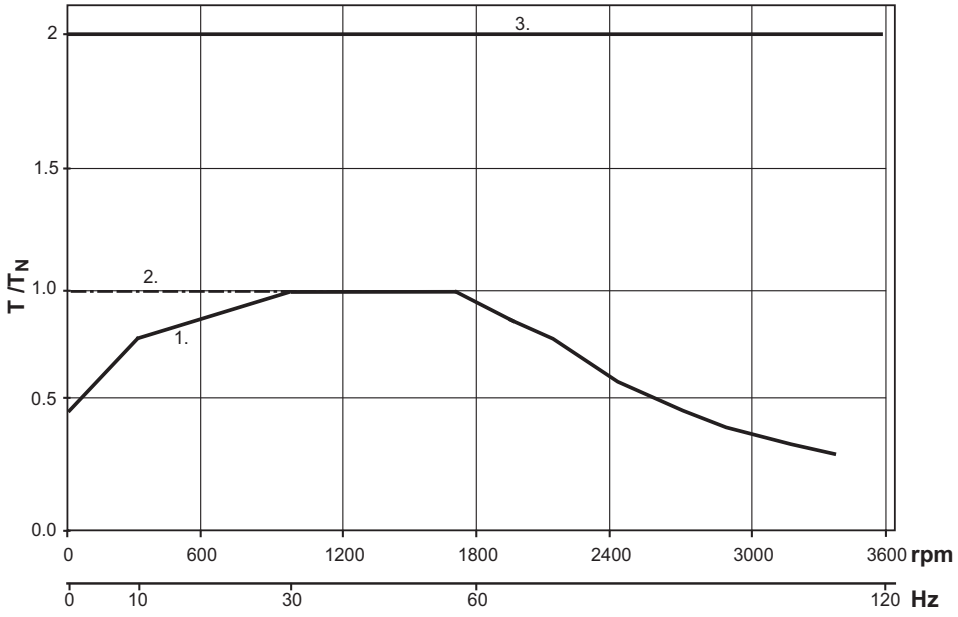

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Figure 1: Torque limit curves for f_{base} = 60 Hz

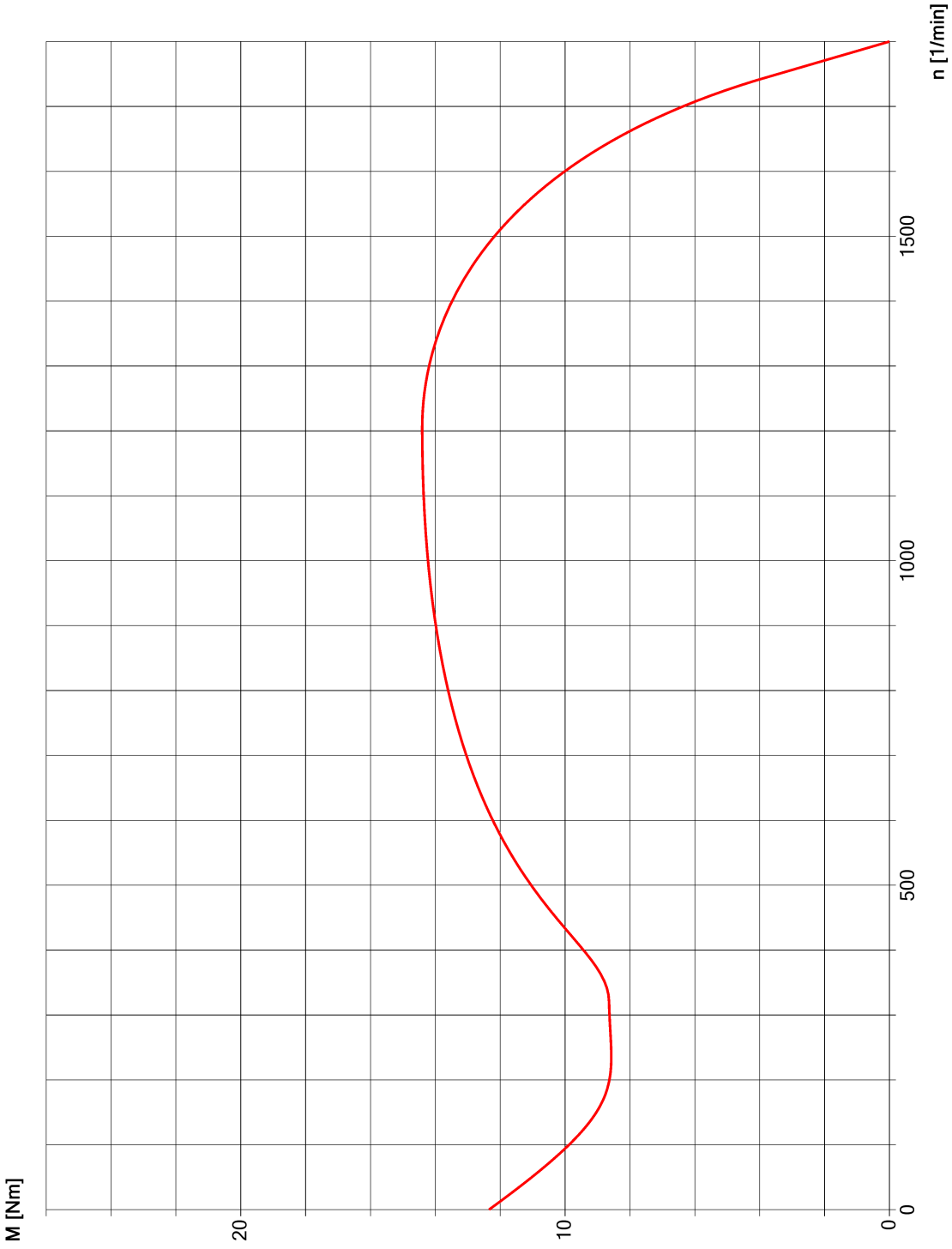
1. S1 operation with self-ventilation (= without forced cooling fan)
2. S1 operation with forced cooling (= with forced cooling fan)
3. Mechanical limitations for gearmotors

Motorkennlinie
Motor characteristic
Caractéristique du moteur

DRE 80M 4

0.75kW 4pol

Drehzahl-Drehmoment-Kennlinie 60Hz
Speed-torque characteristic
Caractéristique vitesse-couple



LOW VOLTAGE INDUCTION MOTORS
AZ ZABIRAH ALUMINIUM SMELTER

CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No. 4481-MJR0-0007

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
1.0		**SITE CONDITION**					
1.1	B	Altitude ASL	< 100	m			
1.2	B	Maximum Ambient Temperature	55	℃	000		
1.3	B	Minimum Ambient Temperature	0	℃			
1.4	B	Design Ambient Temperature (Indoors)	40	℃			
1.5	B	Maximum Relative Humidity	71	%			
1.6	B	Wind	NA	kph			
1.7	B	Seismic Zone	ND	-			
1.8	B	Type of Protection Required	Yes	-			
1.9	B	Indoors of Outdoors	Outdoors	-			
1.10	B	Cable Size	TBD	mm^2			
1.11	B	Earth connection Size	TBD	mm^2			
1.12	B	Unclassified Area	NA	-			
1.13	B	Hazardous Area Classification	Non-Hazardous	-			
1.13.1	B	Class	NA	-			
1.13.2	B	Division	NA	-			
1.13.3	B	Group(s)	NA	-			
1.13.4	B	Gas Ignition Temperature	NA	℃			
2.0		**DESIGN AND RATING**					
2.1	B	System Voltage	460	V			
2.2	B	Voltage tolerance	±5	%			
2.3	B	Phase(s)/Frequency	3/60	-/Hz			
2.4	B	Neutral Earthing	High Resistance Grounded	-			
2.5	B	Duty type IEC 34-1	S1-Continuous	-			
2.6	S	Rated Output		kW		1.1	
2.7	S	Synchronous Speed(s)		rpm		1800	
2.8	S	Direction of rotation viewed from drive end		-		Both	
2.9	B	Insulation Class/Temperature rise limit	F/B	-			
2.10	S	Minimum Terminal voltage during starting		per unit		N.A.	
2.11	S	Maximum no load sound pressure level at one metre		dBA		N.A.	
2.12	S	External Inertia (Max)		kg m^2		0.00401	
2.13	B	Type of Starter/Short circuit protection	DOL/MCCB	-			
2.14	S	Service Factor		per unit		1.85	
2.15	S	Minimum Rated Power factor at full load		%		73	
2.16	S	Minimum Efficiency at full rated load		-		84%	
2.17	S	Mounting - Horizontal/Vertical		-		horizontal M1	
2.18	S	Minimum starting voltage - percent of rated		%		N.A.	
2.19	S	Winding - Star/Delta		-		Star Star/ Star	
3.0		**MECHANICAL AND ENCLOSURES**					
3.1	B	Enclosure Type	Cast Iron				
3.2	B	Degree of Protection - IP Code	IP 55				
3.3	S	Mounting IEC 34-7 IM Code				M1A	
3.4	S	Cooling IEC 34-6 IC Code		-		IC411 (fan-cooled)	
3.5	S	Drain Holes		-		Y	
3.6	S	Shaft				Standard	
3.7	S	Drive Connection				To suit load	

NOTES:

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CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No. 4481-MJR0-0007

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
3.8	S	Finish bore half-coupling furnished by others		-		N	
3.9	S	Install half-coupling furnished by others		-		N	
3.10	S	Vibration Grade (IEC 60034-14)	A	-		N.A.	**Grade B in Special Cases**
3.11	S	Max Motor shaft load (R-Radial, A-Axial)		N		N.A.	
3.12	S	Bearing Type D end		-		DIN625-6306-2Z-J-C3-K08	
3.13	S	Bearing Type N end		-		DIN625-6205-2RS-J-C3-K08	
3.14	B	Antifriction Bearing L_{10} Life	MIN 40,000	Hours			**80,000 for re-greasable bearings**
3.15	S	Bearing Lubrication		-		GREASE	
3.16	S	Bearing Seals		-		D(2Z) - N(2RS)	
4.0		**ACCESSORIES**					
4.1	B	Space heaters required/rated voltage	Yes/115 Vac	/V			
4.2	B	Winding Over temperature protection required - type	Yes				**As per Specification**
4.3	B	Winding temperature devices No per phase	1				
4.4	B	Bearing over temperature protection required - type	No				
4.5	S	Auxilliary terminal boxe(es) or space heaters and temp devices				Separate	
4.6	S	Tachometer				N	
4.7	S	Brake				Y	
4.8	S	Slide base for belt drive				N	
4.9	S	Soleplate				N	
4.10	B	Rating Plate					**As per Specification**
4.11	B	Identification Plate					**As per Specification**
4.12	B	Separately powered cooling fan	Yes				

NOTES:

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CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No.: Individual Motor 4481-MJR0-0007

To Be Completed by SELLER for Each Motor

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
5.0	S	**MANUFACTURER'S DATA**					
5.1	S	Manufacturer		-		**SEW Eurodrive Canada**	
5.2	S	Frame Number		-		DRE90M4BE2HF/DH	
5.3	S	Serial Number		-		80.1804732901.0001.10.00	
5.4	S	Model Number		-		K57 DRE90M4BE2HF/DH	
5.5	S	Full Load Speed		rpm		1740	
5.6	S	Full Load Current		A		4.5/2.25	
5.7	S	Locked Rotor Current		A		34.65/17.33	
5.8	S	Locked Rotor Power Factor		pu		N.A.	
5.9	S	Temperature rise by resistance at full load		K		30	
5.10	S	Full Load Torque		nm		6.04	
5.11	S	Breakdown Torque in percent of Full Load		% IFL		380	
5.12	S	Weight		kg		23	
5.13	S	Efficiency at: 100 % Load		%		84.3	
5.14	S	75% Load		%		83.7	
5.15	S	50% Load		%		80.9	
5.16	S	Power Factor at: 100 % Load		pu		0.73	
5.17	S	75% Load		pu		0.64	
5.18	S	50% Load		pu		0.51	
5.19	S	Provide Following Data @ Rated Operating Temperature		-		-20ºC - 40ºC	
5.20	S	Locked rotor Withstand time @ nominal V		Seconds		N.A.	
5.21	S	Accelaration Time (Motor & Load) @ nominal V		Seconds		N.A.	
5.22	S	Locked rotor Withstand time @ min V		Seconds		N.A.	
5.23	S	Accelaration Time (Motor & Load) @ min V		Seconds		N.A.	
5.24	S	Rotor WK^2		kg m^2		0.00401	
5.25	S	Sub - Transient Reactance *X"*		%		N.A.	
5.26	S	Sub - Transient *X/R*		-		N.A.	
5.27	S	Provide thermal Limit curves		-		See file attached	
5.28	S	Provide Current and Torque/Speed Curves		-		See file attached	
5.29	S	Space Heater watts at nominal operating voltage		W		N.A.	
5.30	S	Motor RTD Alarm Temperature		deg C		N.A.	
5.31	S	Motor RTD Trip Temperature		deg C		N.A.	
6.0		**TESTS**					
6.1	B	Routine Tests					
6.2	B	Complete Test					
6.3	B	Vibration (with half coupling installed if available)					
6.4	B	Noise					

NOTES:

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CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No. 4481-MJR0-0007

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
7.0		**ADDITIONAL REQUIREMENTS FOR VFD SERVICE**					
7.1	S	Inverter Type		-		PWM	
7.2	S	Rated operation modes - VT / CT / CP		-		VT	
7.3	S	Rated power output at Base Speed		kW		1.1	
7.4	S	Base Speed		rpm		1740	
7.5	S	Constant Power speed range		rpm		1740-1740	
7.6	S	Constant Torque speed range		rpm		0-1740	
7.7	S	Continuous Constant Torque speed range		rpm		750-1740	
7.8	S	Variable Torque speed range		rpm		0-1700	
7.9	S	Variable Torque speed exponent		-		N.A.	
7.10	S	Starting (breakaway) torque		per unit		N.A.	
7.11	S	Run up torque		per unit		N.A.	

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6.10 Torque limit curves for DRS, DRE, DRP motors operated on an inverter

Thermally approved torque

Note thermally approved torque in project planning for operation of DR, asynchronous AC motors with frequency inverter. The following factors determine the thermally permitted torque:

- Duty type
- Type of cooling: Self-ventilation or forced cooling
- Base frequency f_{base} = 60 Hz (460 V ⅄) or f_{base} = 120Hz (230 ⅄⅄)

Use the torque limit curves to determine the thermally permitted torque. The projected, effective torque has to be less than the limit curve value. The following illustration shows the limit curves for 4-pole DR, asynchronous AC motors with f_{base} = 60 Hz and f_{base} = 120 Hz. The following peripheral conditions apply to the shown limit curves:

- Duty type S1
- Supply voltage of the inverter $V_{supply} = 3 \times 460\ V_{AC}$
- Motor in thermal class F

f_{base} = 60 Hz (460 V ⅄/60 Hz)

The following diagram shows the limit curves for operation at f_{base} = 60 Hz. The curves are different for those motors with self-ventilation and those with forced cooling (= optional forced cooling fan).

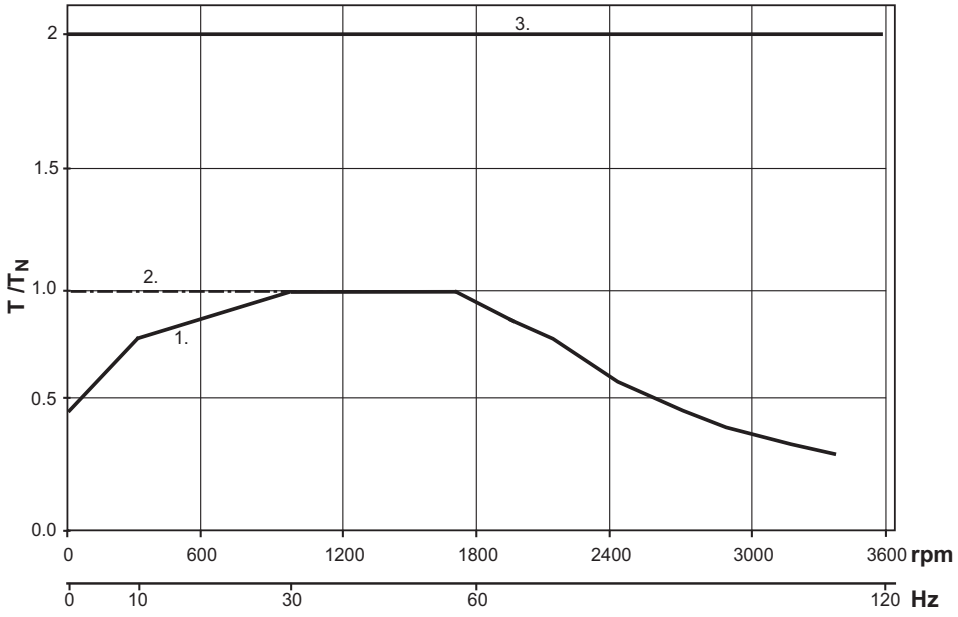

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Figure 1: Torque limit curves for f_{base} = 60 Hz

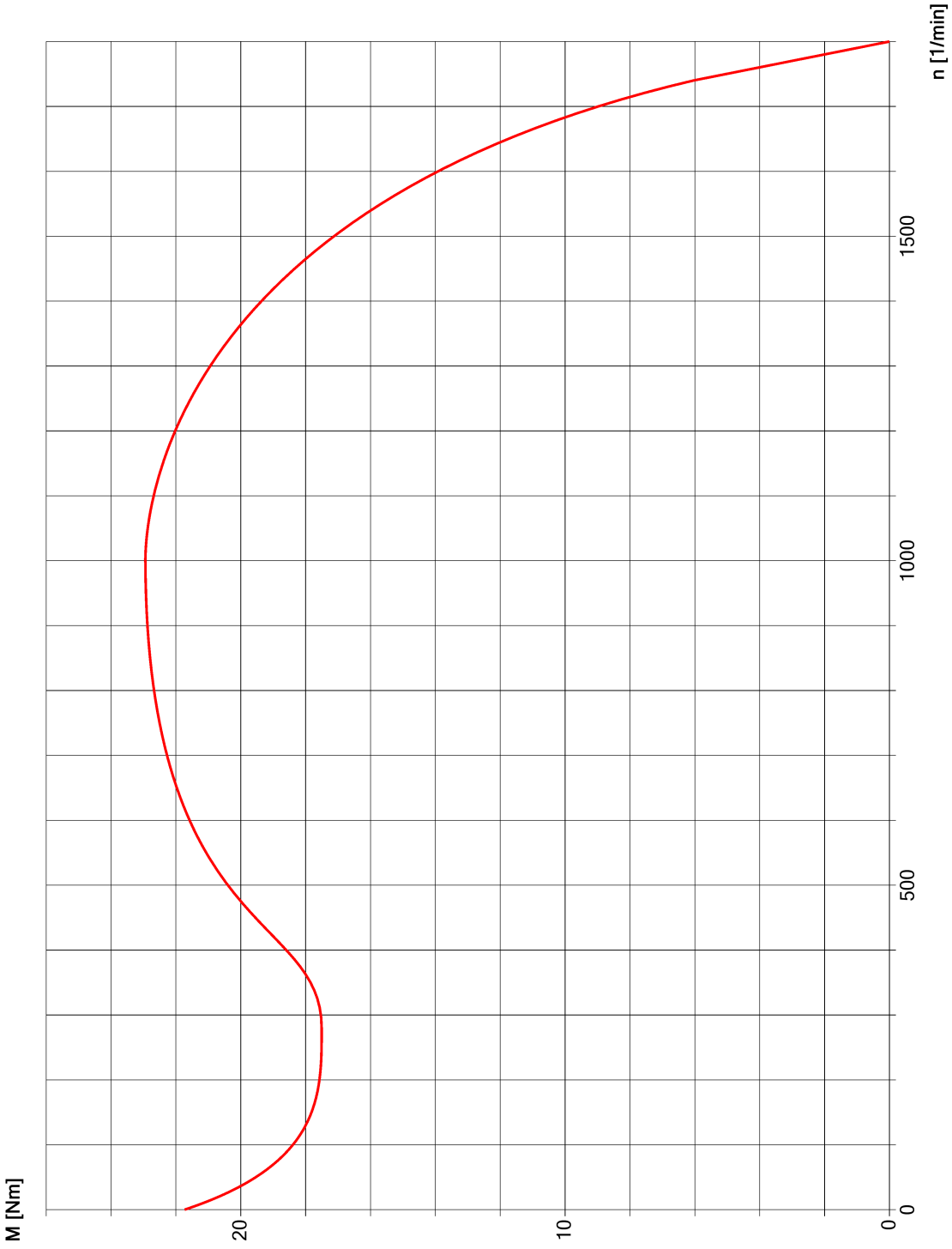
1. S1 operation with self-ventilation (= without forced cooling fan)
2. S1 operation with forced cooling (= with forced cooling fan)
3. Mechanical limitations for gearmotors

Motorkennlinie
Motor characteristic
Caractéristique du moteur

DRE 90M 4

1.1kW 4pol

Drehzahl-Drehmoment-Kennlinie 60Hz
Speed-torque characteristic
Caractéristique vitesse-couple



CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No. 4481-MJR0-0006

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
1.0		**SITE CONDITION**					
1.1	B	Altitude ASL	< 100	m			
1.2	B	Maximum Ambient Temperature	55	℃	000		
1.3	B	Minimum Ambient Temperature	0	℃			
1.4	B	Design Ambient Temperature (Indoors)	40	℃			
1.5	B	Maximum Relative Humidity	71	%			
1.6	B	Wind	NA	kph			
1.7	B	Seismic Zone	ND	-			
1.8	B	Type of Protection Required	Yes	-			
1.9	B	Indoors of Outdoors	Outdoors	-			
1.10	B	Cable Size	TBD	mm^2			
1.11	B	Earth connection Size	TBD	mm^2			
1.12	B	Unclassified Area	NA	-			
1.13	B	Hazardous Area Classification	Non-Hazardous	-			
1.13.1	B	Class	NA	-			
1.13.2	B	Division	NA	-			
1.13.3	B	Group(s)	NA	-			
1.13.4	B	Gas Ignition Temperature	NA	℃			
2.0		**DESIGN AND RATING**					
2.1	B	System Voltage	460	V			
2.2	B	Voltage tolerance	±5	%			
2.3	B	Phase(s)/Frequency	3/60	-/Hz			
2.4	B	Neutral Earthing	High Resistance Grounded	-			
2.5	B	Duty type IEC 34-1	S1-Continuous	-			
2.6	S	Rated Output		kW		1.1	
2.7	S	Synchronous Speed(s)		rpm		1800	
2.8	S	Direction of rotation viewed from drive end		-		Both	
2.9	B	Insulation Class/Temperature rise limit	F/B	-			
2.10	S	Minimum Terminal voltage during starting		per unit		N.A.	
2.11	S	Maximum no load sound pressure level at one metre		dBA		N.A.	
2.12	S	External Inertia (Max)		kg m^2		0.00401	
2.13	B	Type of Starter/Short circuit protection	DOL/MCCB	-			
2.14	S	Service Factor		per unit		1.85	
2.15	S	Minimum Rated Power factor at full load		%		73	
2.16	S	Minimum Efficiency at full rated load		-		84%	
2.17	S	Mounting - Horizontal/Vertical		-		horizontal M1	
2.18	S	Minimum starting voltage - percent of rated		%		N.A.	
2.19	S	Winding - Star/Delta		-		Star Star/ Star	
3.0		**MECHANICAL AND ENCLOSURES**					
3.1	B	Enclosure Type	Cast Iron				
3.2	B	Degree of Protection - IP Code	IP 55				
3.3	S	Mounting IEC 34-7 IM Code				M1A	
3.4	S	Cooling IEC 34-6 IC Code		-		IC411 (fan-cooled)	
3.5	S	Drain Holes		-		Y	
3.6	S	Shaft				Standard	
3.7	S	Drive Connection				To suit load	

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PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No. 4481-MJR0-0006

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
3.8	S	Finish bore half-coupling furnished by others		-		N	
3.9	S	Install half-coupling furnished by others		-		N	
3.10	S	Vibration Grade (IEC 60034-14)	A	-		N.A.	**Grade B in Special Cases**
3.11	S	Max Motor shaft load (R-Radial, A-Axial)		N		N.A.	
3.12	S	Bearing Type D end		-		DIN625-6306-2Z-J-C3-K08	
3.13	S	Bearing Type N end		-		DIN625-6205-2RS-J-C3-K08	
3.14	B	Antifriction Bearing L_{10} Life	MIN 40,000	Hours			**80,000 for re-greasable bearings**
3.15	S	Bearing Lubrication		-		GREASE	
3.16	S	Bearing Seals		-		D(2Z) - N(2RS)	
4.0		**ACCESSORIES**					
4.1	B	Space heaters required/rated voltage	Yes/115 Vac	/V			
4.2	B	Winding Over temperature protection required - type	Yes				**As per Specification**
4.3	B	Winding temperature devices No per phase	1				
4.4	B	Bearing over temperature protection required - type	No				
4.5	S	Auxilliary terminal boxe(es) or space heaters and temp devices				Separate	
4.6	S	Tachometer				N	
4.7	S	Brake				Y	
4.8	S	Slide base for belt drive				N	
4.9	S	Soleplate				N	
4.10	B	Rating Plate					**As per Specification**
4.11	B	Identification Plate					**As per Specification**
4.12	B	Separately powered cooling fan	Yes				

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CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No.: Individual Motor 4481-MJR0-0006

To Be Completed by SELLER for Each Motor

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
5.0	S	**MANUFACTURER'S DATA**					
5.1	S	Manufacturer		-		**SEW Eurodrive Canada**	
5.2	S	Frame Number		-		DRE90M4BE2HF/DH	
5.3	S	Serial Number		-		80.1804732901.0001.10.00	
5.4	S	Model Number		-		K57 DRE90M4BE2HF/DH	
5.5	S	Full Load Speed		rpm		1740	
5.6	S	Full Load Current		A		4.5/2.25	
5.7	S	Locked Rotor Current		A		34.65/17.33	
5.8	S	Locked Rotor Power Factor		pu		N.A.	
5.9	S	Temperature rise by resistance at full load		K		30	
5.10	S	Full Load Torque		nm		6.04	
5.11	S	Breakdown Torque in percent of Full Load		% IFL		380	
5.12	S	Weight		kg		23	
5.13	S	Efficiency at: 100 % Load		%		84.3	
5.14	S	75% Load		%		83.7	
5.15	S	50% Load		%		80.9	
5.16	S	Power Factor at: 100 % Load		pu		0.73	
5.17	S	75% Load		pu		0.64	
5.18	S	50% Load		pu		0.51	
5.19	S	Provide Following Data @ Rated Operating Temperature		-		-20ºC - 40ºC	
5.20	S	Locked rotor Withstand time @ nominal V		Seconds		N.A.	
5.21	S	Accelaration Time (Motor & Load) @ nominal V		Seconds		N.A.	
5.22	S	Locked rotor Withstand time @ min V		Seconds		N.A.	
5.23	S	Accelaration Time (Motor & Load) @ min V		Seconds		N.A.	
5.24	S	Rotor WK^2		kg m^2		0.00401	
5.25	S	Sub - Transient Reactance *X"*		%		N.A.	
5.26	S	Sub - Transient *X/R*		-		N.A.	
5.27	S	Provide thermal Limit curves		-		See file attached	
5.28	S	Provide Current and Torque/Speed Curves		-		See file attached	
5.29	S	Space Heater watts at nominal operating voltage		W		N.A.	
5.30	S	Motor RTD Alarm Temperature		deg C		N.A.	
5.31	S	Motor RTD Trip Temperature		deg C		N.A.	
6.0		**TESTS**					
6.1	B	Routine Tests					
6.2	B	Complete Test					
6.3	B	Vibration (with half coupling installed if available)					
6.4	B	Noise					

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PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No. 4481-MJR0-0006

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7.0		**ADDITIONAL REQUIREMENTS FOR VFD SERVICE**					
7.1	S	Inverter Type		-		PWM	
7.2	S	Rated operation modes - VT / CT / CP		-		VT	
7.3	S	Rated power output at Base Speed		kW		1.1	
7.4	S	Base Speed		rpm		1740	
7.5	S	Constant Power speed range		rpm		1740-1740	
7.6	S	Constant Torque speed range		rpm		0-1740	
7.7	S	Continuous Constant Torque speed range		rpm		750-1740	
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7.9	S	Variable Torque speed exponent		-		N.A.	
7.10	S	Starting (breakaway) torque		per unit		N.A.	
7.11	S	Run up torque		per unit		N.A.	

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6.10 Torque limit curves for DRS, DRE, DRP motors operated on an inverter

Thermally approved torque

Note thermally approved torque in project planning for operation of DR, asynchronous AC motors with frequency inverter. The following factors determine the thermally permitted torque:

- Duty type
- Type of cooling: Self-ventilation or forced cooling
- Base frequency f_{base} = 60 Hz (460 V ⅄) or f_{base} = 120Hz (230 ⅄⅄)

Use the torque limit curves to determine the thermally permitted torque. The projected, effective torque has to be less than the limit curve value. The following illustration shows the limit curves for 4-pole DR, asynchronous AC motors with f_{base} = 60 Hz and f_{base} = 120 Hz. The following peripheral conditions apply to the shown limit curves:

- Duty type S1
- Supply voltage of the inverter $V_{supply} = 3 \times 460\ V_{AC}$
- Motor in thermal class F

f_{base} = 60 Hz (460 V ⅄/60 Hz)

The following diagram shows the limit curves for operation at f_{base} = 60 Hz. The curves are different for those motors with self-ventilation and those with forced cooling (= optional forced cooling fan).

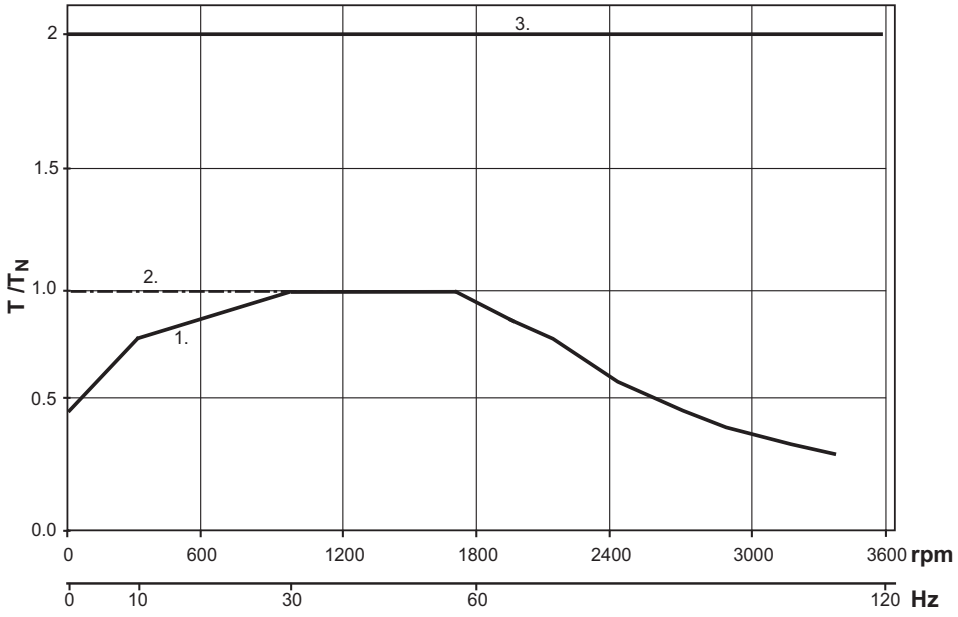

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Figure 1: Torque limit curves for f_{base} = 60 Hz

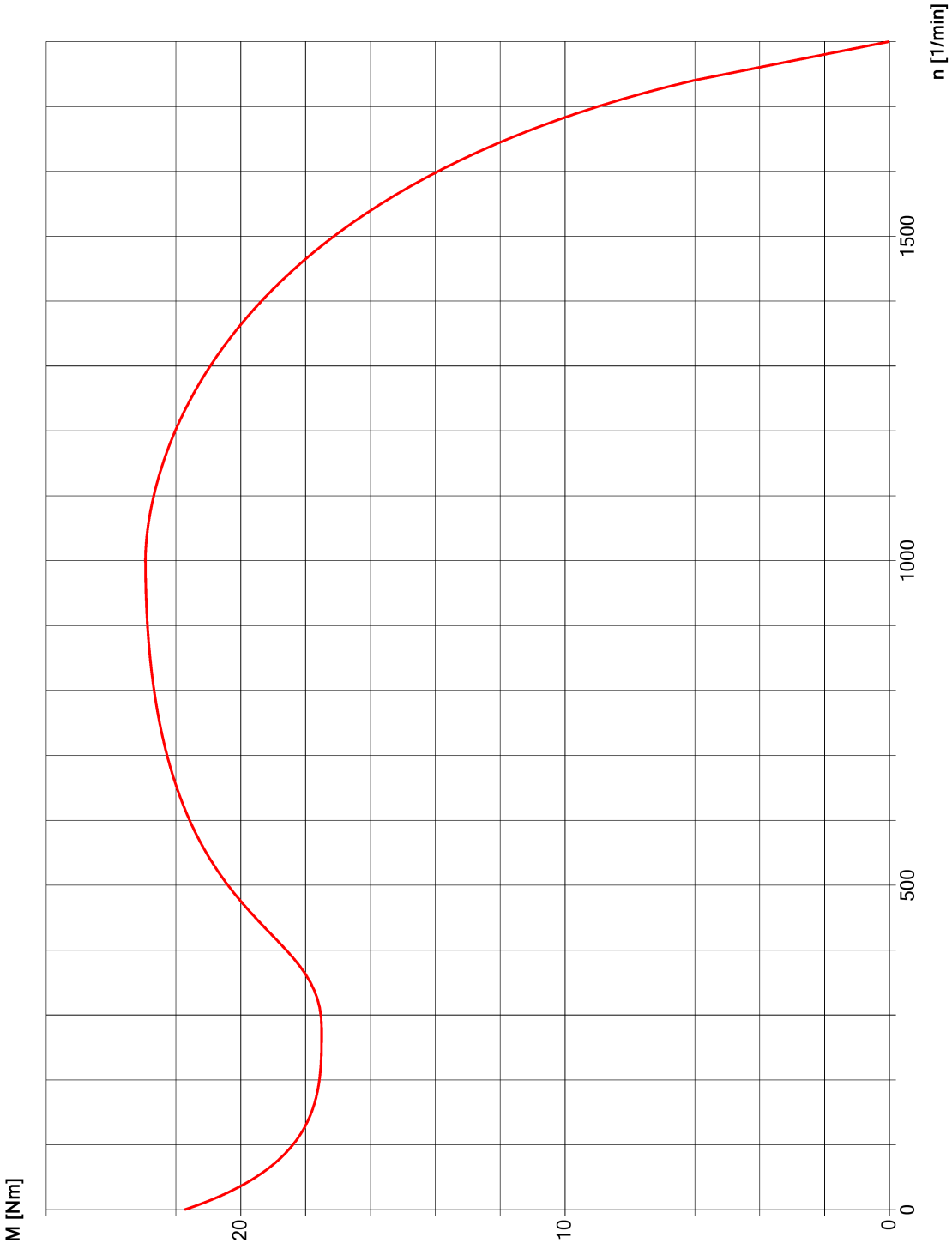
1. S1 operation with self-ventilation (= without forced cooling fan)
2. S1 operation with forced cooling (= with forced cooling fan)
3. Mechanical limitations for gearmotors

Motorkennlinie
Motor characteristic
Caractéristique du moteur

DRE 90M 4

1.1kW 4pol

Drehzahl-Drehmoment-Kennlinie 60Hz
Speed-torque characteristic
Caractéristique vitesse-couple



CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No. 4481-MZAC-0001

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
1.0		**SITE CONDITION**					
1.1	B	Altitude ASL	< 100	m			
1.2	B	Maximum Ambient Temperature	55	℃	000		
1.3	B	Minimum Ambient Temperature	0	℃			
1.4	B	Design Ambient Temperature (Indoors)	40	℃			
1.5	B	Maximum Relative Humidity	71	%			
1.6	B	Wind	NA	kph			
1.7	B	Seismic Zone	ND	-			
1.8	B	Type of Protection Required	Yes	-			
1.9	B	Indoors of Outdoors	Outdoors	-			
1.10	B	Cable Size	TBD	mm^2			
1.11	B	Earth connection Size	TBD	mm^2			
1.12	B	Unclassified Area	NA	-			
1.13	B	Hazardous Area Classification	Non-Hazardous	-			
1.13.1	B	Class	NA	-			
1.13.2	B	Division	NA	-			
1.13.3	B	Group(s)	NA	-			
1.13.4	B	Gas Ignition Temperature	NA	℃			
2.0		**DESIGN AND RATING**					
2.1	B	System Voltage	460	V			
2.2	B	Voltage tolerance	±5	%			
2.3	B	Phase(s)/Frequency	3/60	-/Hz			
2.4	B	Neutral Earthing	High Resistance Grounded	-			
2.5	B	Duty type IEC 34-1	S1-Continuous	-			
2.6	S	Rated Output		kW		1.1	
2.7	S	Synchronous Speed(s)		rpm		1800	
2.8	S	Direction of rotation viewed from drive end		-		Both	
2.9	B	Insulation Class/Temperature rise limit	F/B	-			
2.10	S	Minimum Terminal voltage during starting		per unit		N.A.	
2.11	S	Maximum no load sound pressure level at one metre		dBA		N.A.	
2.12	S	External Inertia (Max)		kg m^2		0.00401	
2.13	B	Type of Starter/Short circuit protection	DOL/MCCB	-			
2.14	S	Service Factor		per unit		1.85	
2.15	S	Minimum Rated Power factor at full load		%		73	
2.16	S	Minimum Efficiency at full rated load		-		84%	
2.17	S	Mounting - Horizontal/Vertical		-		horizontal M1	
2.18	S	Minimum starting voltage - percent of rated		%		N.A.	
2.19	S	Winding - Star/Delta		-		Star Star/ Star	
3.0		**MECHANICAL AND ENCLOSURES**					
3.1	B	Enclosure Type	Cast Iron				
3.2	B	Degree of Protection - IP Code	IP 55				
3.3	S	Mounting IEC 34-7 IM Code				M1A	
3.4	S	Cooling IEC 34-6 IC Code		-		IC411 (fan-cooled)	
3.5	S	Drain Holes		-		Y	
3.6	S	Shaft				Standard	
3.7	S	Drive Connection				To suit load	

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EQUIPMENT No. 4481-MZAC-0001

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
3.8	S	Finish bore half-coupling furnished by others		-		N	
3.9	S	Install half-coupling furnished by others		-		N	
3.10	S	Vibration Grade (IEC 60034-14)	A	-		N.A.	**Grade B in Special Cases**
3.11	S	Max Motor shaft load (R-Radial, A-Axial)		N		N.A.	
3.12	S	Bearing Type D end		-		DIN625-6306-2Z-J-C3-K08	
3.13	S	Bearing Type N end		-		DIN625-6205-2RS-J-C3-K08	
3.14	B	Antifriction Bearing L_{10} Life	MIN 40,000	Hours			**80,000 for re-greasable bearings**
3.15	S	Bearing Lubrication		-		GREASE	
3.16	S	Bearing Seals		-		D(2Z) - N(2RS)	
4.0		**ACCESSORIES**					
4.1	B	Space heaters required/rated voltage	Yes/115 Vac	/V			
4.2	B	Winding Over temperature protection required - type	Yes				**As per Specification**
4.3	B	Winding temperature devices No per phase	1				
4.4	B	Bearing over temperature protection required - type	No				
4.5	S	Auxilliary terminal boxe(es) or space heaters and temp devices				Separate	
4.6	S	Tachometer				N	
4.7	S	Brake				Y	
4.8	S	Slide base for belt drive				N	
4.9	S	Soleplate				N	
4.10	B	Rating Plate					**As per Specification**
4.11	B	Identification Plate					**As per Specification**
4.12	B	Separately powered cooling fan	Yes				

NOTES:

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CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No.: Individual Motor 4481-MZAC-0001

To Be Completed by SELLER for Each Motor

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
5.0	S	**MANUFACTURER'S DATA**					
5.1	S	Manufacturer		-		**SEW Eurodrive Canada**	
5.2	S	Frame Number		-		DRE90M4BE2HF/DH	
5.3	S	Serial Number		-		80.1804732901.0001.10.00	
5.4	S	Model Number		-		K57 DRE90M4BE2HF/DH	
5.5	S	Full Load Speed		rpm		1740	
5.6	S	Full Load Current		A		4.5/2.25	
5.7	S	Locked Rotor Current		A		34.65/17.33	
5.8	S	Locked Rotor Power Factor		pu		N.A.	
5.9	S	Temperature rise by resistance at full load		K		30	
5.10	S	Full Load Torque		nm		6.04	
5.11	S	Breakdown Torque in percent of Full Load		% IFL		380	
5.12	S	Weight		kg		23	
5.13	S	Efficiency at: 100 % Load		%		84.3	
5.14	S	75% Load		%		83.7	
5.15	S	50% Load		%		80.9	
5.16	S	Power Factor at: 100 % Load		pu		0.73	
5.17	S	75% Load		pu		0.64	
5.18	S	50% Load		pu		0.51	
5.19	S	Provide Following Data @ Rated Operating Temperature		-		-20ºC - 40ºC	
5.20	S	Locked rotor Withstand time @ nominal V		Seconds		N.A.	
5.21	S	Accelaration Time (Motor & Load) @ nominal V		Seconds		N.A.	
5.22	S	Locked rotor Withstand time @ min V		Seconds		N.A.	
5.23	S	Accelaration Time (Motor & Load) @ min V		Seconds		N.A.	
5.24	S	Rotor WK^2		kg m^2		0.00401	
5.25	S	Sub - Transient Reactance *X"*		%		N.A.	
5.26	S	Sub - Transient *X/R*		-		N.A.	
5.27	S	Provide thermal Limit curves		-		See file attached	
5.28	S	Provide Current and Torque/Speed Curves		-		See file attached	
5.29	S	Space Heater watts at nominal operating voltage		W		N.A.	
5.30	S	Motor RTD Alarm Temperature		deg C		N.A.	
5.31	S	Motor RTD Trip Temperature		deg C		N.A.	
6.0		**TESTS**					
6.1	B	Routine Tests					
6.2	B	Complete Test					
6.3	B	Vibration (with half coupling installed if available)					
6.4	B	Noise					

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CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No. 4481-MZAC-0001

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
7.0		**ADDITIONAL REQUIREMENTS FOR VFD SERVICE**					
7.1	S	Inverter Type		-		PWM	
7.2	S	Rated operation modes - VT / CT / CP		-		VT	
7.3	S	Rated power output at Base Speed		kW		1.1	
7.4	S	Base Speed		rpm		1740	
7.5	S	Constant Power speed range		rpm		1740-1740	
7.6	S	Constant Torque speed range		rpm		0-1740	
7.7	S	Continuous Constant Torque speed range		rpm		750-1740	
7.8	S	Variable Torque speed range		rpm		0-1700	
7.9	S	Variable Torque speed exponent		-		N.A.	
7.10	S	Starting (breakaway) torque		per unit		N.A.	
7.11	S	Run up torque		per unit		N.A.	

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6.10 Torque limit curves for DRS, DRE, DRP motors operated on an inverter

Thermally approved torque

Note thermally approved torque in project planning for operation of DR, asynchronous AC motors with frequency inverter. The following factors determine the thermally permitted torque:

- Duty type
- Type of cooling: Self-ventilation or forced cooling
- Base frequency f_{base} = 60 Hz (460 V ⅄) or f_{base} = 120Hz (230 ⅄⅄)

Use the torque limit curves to determine the thermally permitted torque. The projected, effective torque has to be less than the limit curve value. The following illustration shows the limit curves for 4-pole DR, asynchronous AC motors with f_{base} = 60 Hz and f_{base} = 120 Hz. The following peripheral conditions apply to the shown limit curves:

- Duty type S1
- Supply voltage of the inverter $V_{supply} = 3 \times 460\ V_{AC}$
- Motor in thermal class F

f_{base} = 60 Hz (460 V ⅄/60 Hz)

The following diagram shows the limit curves for operation at f_{base} = 60 Hz. The curves are different for those motors with self-ventilation and those with forced cooling (= optional forced cooling fan).

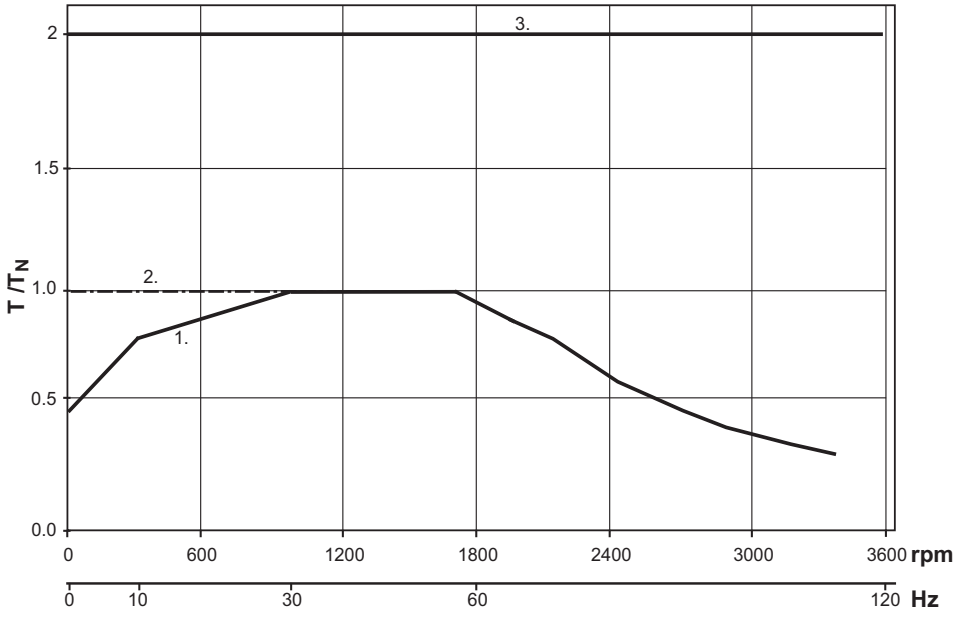

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Figure 1: Torque limit curves for f_{base} = 60 Hz

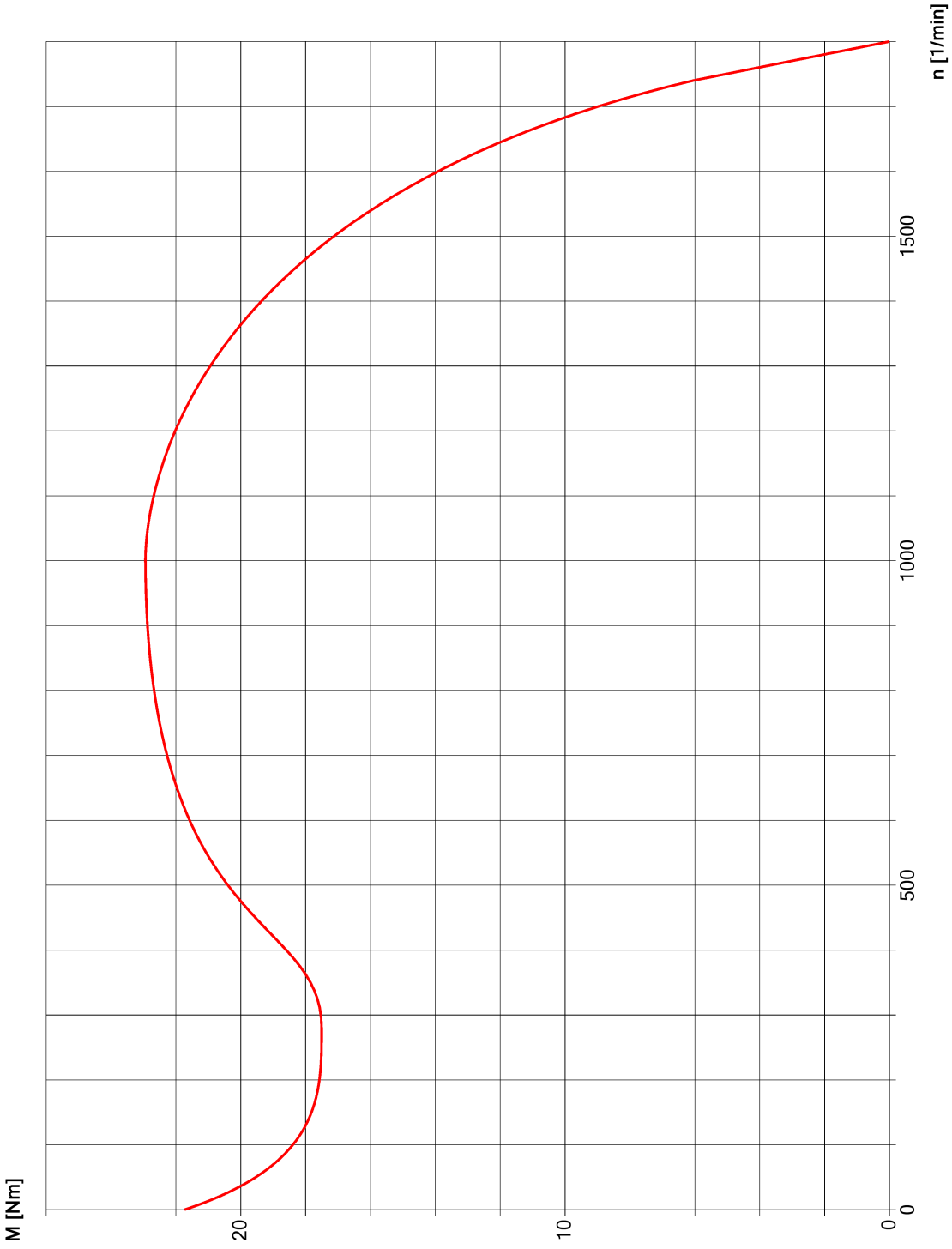
1. S1 operation with self-ventilation (= without forced cooling fan)
2. S1 operation with forced cooling (= with forced cooling fan)
3. Mechanical limitations for gearmotors

Motorkennlinie
Motor characteristic
Caractéristique du moteur

DRE 90M 4

1.1kW 4pol

Drehzahl-Drehmoment-Kennlinie 60Hz
Speed-torque characteristic
Caractéristique vitesse-couple



LOW VOLTAGE INDUCTION MOTORS
AZ ZABIRAH ALUMINIUM SMELTER

CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No. 4481-MJR0-0008

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
1.0		**SITE CONDITION**					
1.1	B	Altitude ASL	< 100	m			
1.2	B	Maximum Ambient Temperature	55	℃	000		
1.3	B	Minimum Ambient Temperature	0	℃			
1.4	B	Design Ambient Temperature (Indoors)	40	℃			
1.5	B	Maximum Relative Humidity	71	%			
1.6	B	Wind	NA	kph			
1.7	B	Seismic Zone	ND	-			
1.8	B	Type of Protection Required	Yes	-			
1.9	B	Indoors of Outdoors	Outdoors	-			
1.10	B	Cable Size	TBD	mm^2			
1.11	B	Earth connection Size	TBD	mm^2			
1.12	B	Unclassified Area	NA	-			
1.13	B	Hazardous Area Classification	Non-Hazardous	-			
1.13.1	B	Class	NA	-			
1.13.2	B	Division	NA	-			
1.13.3	B	Group(s)	NA	-			
1.13.4	B	Gas Ignition Temperature	NA	℃			
2.0		**DESIGN AND RATING**					
2.1	B	System Voltage	460	V			
2.2	B	Voltage tolerance	±5	%			
2.3	B	Phase(s)/Frequency	3/60	-/Hz			
2.4	B	Neutral Earthing	High Resistance Grounded	-			
2.5	B	Duty type IEC 34-1	S1-Continuous	-			
2.6	S	Rated Output		kW		1.1	
2.7	S	Synchronous Speed(s)		rpm		1800	
2.8	S	Direction of rotation viewed from drive end		-		Both	
2.9	B	Insulation Class/Temperature rise limit	F/B	-			
2.10	S	Minimum Terminal voltage during starting		per unit		N.A.	
2.11	S	Maximum no load sound pressure level at one metre		dBA		N.A.	
2.12	S	External Inertia (Max)		kg m^2		0.00401	
2.13	B	Type of Starter/Short circuit protection	DOL/MCCB	-			
2.14	S	Service Factor		per unit		1.85	
2.15	S	Minimum Rated Power factor at full load		%		73	
2.16	S	Minimum Efficiency at full rated load		-		84%	
2.17	S	Mounting - Horizontal/Vertical		-		horizontal M1	
2.18	S	Minimum starting voltage - percent of rated		%		N.A.	
2.19	S	Winding - Star/Delta		-		Star Star/ Star	
3.0		**MECHANICAL AND ENCLOSURES**					
3.1	B	Enclosure Type	Cast Iron				
3.2	B	Degree of Protection - IP Code	IP 55				
3.3	S	Mounting IEC 34-7 IM Code				M1	
3.4	S	Cooling IEC 34-6 IC Code		-		IC411 (fan-cooled)	
3.5	S	Drain Holes		-		Y	
3.6	S	Shaft				Standard	
3.7	S	Drive Connection				To suit load	

NOTES:

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CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No. 4481-MJR0-0008

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
3.8	S	Finish bore half-coupling furnished by others		-		N	
3.9	S	Install half-coupling furnished by others		-		N	
3.10	S	Vibration Grade (IEC 60034-14)	A	-		N.A.	**Grade B in Special Cases**
3.11	S	Max Motor shaft load (R-Radial, A-Axial)		N		N.A.	
3.12	S	Bearing Type D end		-		DIN625-6306-2Z-J-C3-K08	
3.13	S	Bearing Type N end		-		DIN625-6205-2RS-J-C3-K08	
3.14	B	Antifriction Bearing L_{10} Life	MIN 40,000	Hours			**80,000 for re-greasable bearings**
3.15	S	Bearing Lubrication		-		GREASE	
3.16	S	Bearing Seals		-		D(2Z) - N(2RS)	
4.0		**ACCESSORIES**					
4.1	B	Space heaters required/rated voltage	Yes/115 Vac	/V			
4.2	B	Winding Over temperature protection required - type	Yes				**As per Specification**
4.3	B	Winding temperature devices No per phase	1				
4.4	B	Bearing over temperature protection required - type	No				
4.5	S	Auxilliary terminal boxe(es) or space heaters and temp devices				Separate	
4.6	S	Tachometer				N	
4.7	S	Brake				Y	
4.8	S	Slide base for belt drive				N	
4.9	S	Soleplate				N	
4.10	B	Rating Plate					**As per Specification**
4.11	B	Identification Plate					**As per Specification**
4.12	B	Separately powered cooling fan	Yes				

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PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No. 4481-MJR0-0008

To Be Completed by SELLER for Each Motor

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
5.0	S	**MANUFACTURER'S DATA**					
5.1	S	Manufacturer		-		**SEW Eurodrive Canada**	
5.2	S	Frame Number		-		DRE90M4BE2HF/DH	
5.3	S	Serial Number		-		80.1804732901.0001.10.00	
5.4	S	Model Number		-		K57 DRE90M4BE2HF/DH	
5.5	S	Full Load Speed		rpm		1740	
5.6	S	Full Load Current		A		4.5/2.25	
5.7	S	Locked Rotor Current		A		34.65/17.33	
5.8	S	Locked Rotor Power Factor		pu		N.A.	
5.9	S	Temperature rise by resistance at full load		K		30	
5.10	S	Full Load Torque		nm		6.04	
5.11	S	Breakdown Torque in percent of Full Load		% IFL		380	
5.12	S	Weight		kg		23	
5.13	S	Efficiency at: 100 % Load		%		84.3	
5.14	S	75% Load		%		83.7	
5.15	S	50% Load		%		80.9	
5.16	S	Power Factor at: 100 % Load		pu		0.73	
5.17	S	75% Load		pu		0.64	
5.18	S	50% Load		pu		0.51	
5.19	S	Provide Following Data @ Rated Operating Temperature		-		-20ºC - 40ºC	
5.20	S	Locked rotor Withstand time @ nominal V		Seconds		N.A.	
5.21	S	Accelaration Time (Motor & Load) @ nominal V		Seconds		N.A.	
5.22	S	Locked rotor Withstand time @ min V		Seconds		N.A.	
5.23	S	Accelaration Time (Motor & Load) @ min V		Seconds		N.A.	
5.24	S	Rotor WK^2		kg m^2		0.00401	
5.25	S	Sub - Transient Reactance *X"*		%		N.A.	
5.26	S	Sub - Transient *X/R*		-		N.A.	
5.27	S	Provide thermal Limit curves		-		See file attached	
5.28	S	Provide Current and Torque/Speed Curves		-		See file attached	
5.29	S	Space Heater watts at nominal operating voltage		W		N.A.	
5.30	S	Motor RTD Alarm Temperature		deg C		N.A.	
5.31	S	Motor RTD Trip Temperature		deg C		N.A.	
6.0		**TESTS**					
6.1	B	Routine Tests					
6.2	B	Complete Test					
6.3	B	Vibration (with half coupling installed if available)					
6.4	B	Noise					

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CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No. 4481-MJR0-0008

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
7.0		**ADDITIONAL REQUIREMENTS FOR VFD SERVICE**					
7.1	S	Inverter Type		-		PWM	
7.2	S	Rated operation modes - VT / CT / CP		-		VT	
7.3	S	Rated power output at Base Speed		kW		1.1	
7.4	S	Base Speed		rpm		1740	
7.5	S	Constant Power speed range		rpm		1740-1740	
7.6	S	Constant Torque speed range		rpm		0-1740	
7.7	S	Continuous Constant Torque speed range		rpm		750-1740	
7.8	S	Variable Torque speed range		rpm		0-1700	
7.9	S	Variable Torque speed exponent		-		N.A.	
7.10	S	Starting (breakaway) torque		per unit		N.A.	
7.11	S	Run up torque		per unit		N.A.	

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6.10 Torque limit curves for DRS, DRE, DRP motors operated on an inverter

Thermally approved torque

Note thermally approved torque in project planning for operation of DR, asynchronous AC motors with frequency inverter. The following factors determine the thermally permitted torque:

- Duty type
- Type of cooling: Self-ventilation or forced cooling
- Base frequency f_{base} = 60 Hz (460 V ⅄) or f_{base} = 120Hz (230 ⅄⅄)

Use the torque limit curves to determine the thermally permitted torque. The projected, effective torque has to be less than the limit curve value. The following illustration shows the limit curves for 4-pole DR, asynchronous AC motors with f_{base} = 60 Hz and f_{base} = 120 Hz. The following peripheral conditions apply to the shown limit curves:

- Duty type S1
- Supply voltage of the inverter $V_{supply} = 3 \times 460\ V_{AC}$
- Motor in thermal class F

f_{base} = 60 Hz (460 V ⅄/60 Hz)

The following diagram shows the limit curves for operation at f_{base} = 60 Hz. The curves are different for those motors with self-ventilation and those with forced cooling (= optional forced cooling fan).

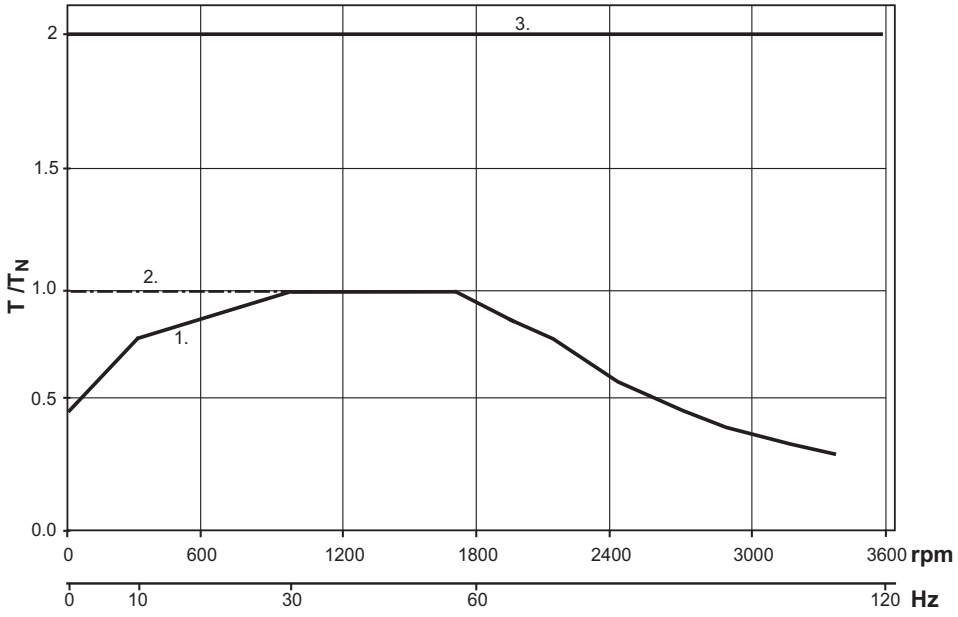

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Figure 1: Torque limit curves for f_{base} = 60 Hz

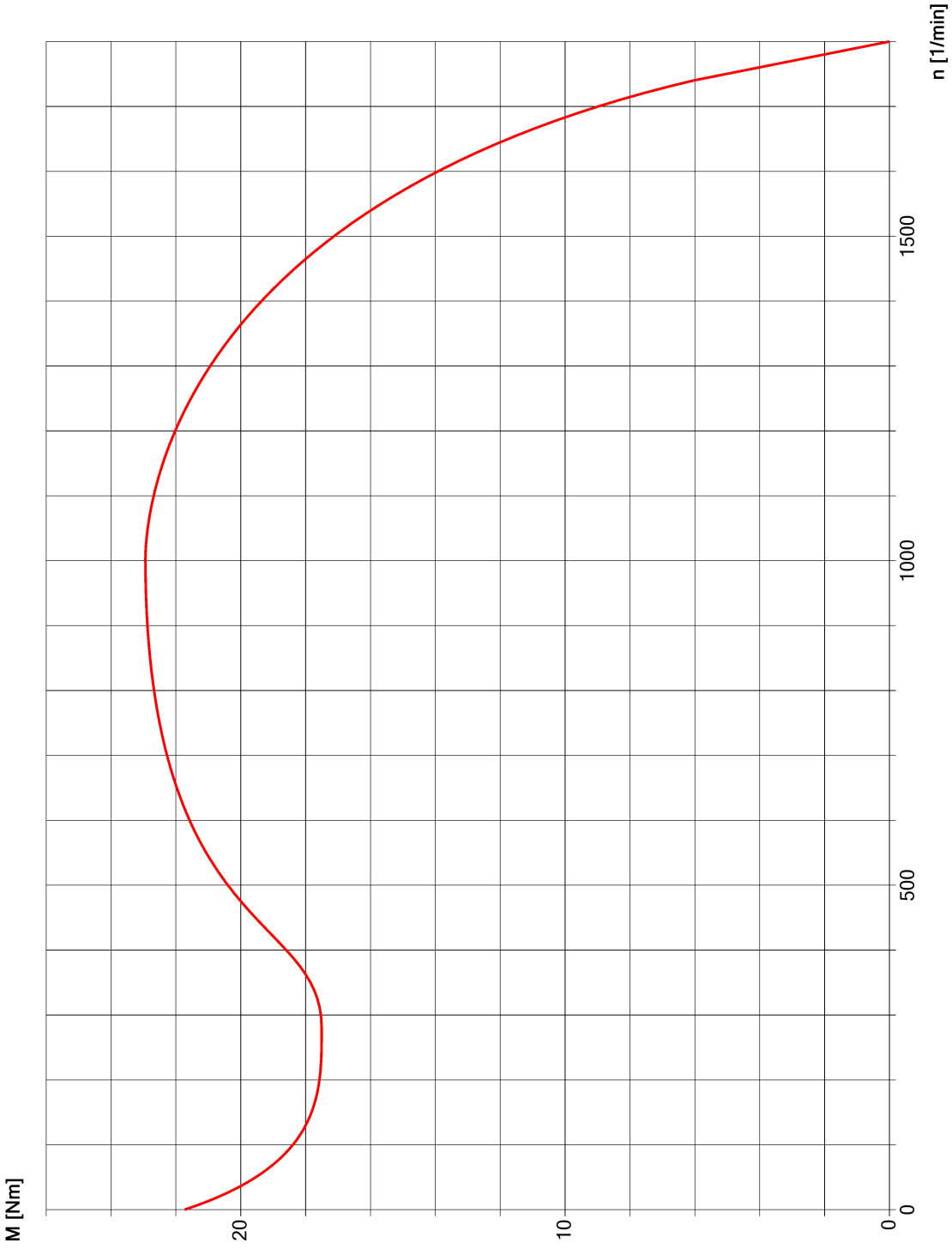
1. S1 operation with self-ventilation (= without forced cooling fan)
2. S1 operation with forced cooling (= with forced cooling fan)
3. Mechanical limitations for gearmotors

Motorkennlinie
Motor characteristic
Caractéristique du moteur

DRE 90M 4

1.1kW 4pol

Drehzahl-Drehmoment-Kennlinie 60Hz
Speed-torque characteristic
Caractéristique vitesse-couple



CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No. 4481-MJR0-0004

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
1.0		**SITE CONDITION**					
1.1	B	Altitude ASL	< 100	m			
1.2	B	Maximum Ambient Temperature	55	℃	000		
1.3	B	Minimum Ambient Temperature	0	℃			
1.4	B	Design Ambient Temperature (Indoors)	40	℃			
1.5	B	Maximum Relative Humidity	71	%			
1.6	B	Wind	NA	kph			
1.7	B	Seismic Zone	ND	-			
1.8	B	Type of Protection Required	Yes	-			
1.9	B	Indoors of Outdoors	Outdoors	-			
1.10	B	Cable Size	TBD	mm^2			
1.11	B	Earth connection Size	TBD	mm^2			
1.12	B	Unclassified Area	NA	-			
1.13	B	Hazardous Area Classification	Non-Hazardous	-			
1.13.1	B	Class	NA	-			
1.13.2	B	Division	NA	-			
1.13.3	B	Group(s)	NA	-			
1.13.4	B	Gas Ignition Temperature	NA	℃			
2.0		**DESIGN AND RATING**					
2.1	B	System Voltage	460	V			
2.2	B	Voltage tolerance	±5	%			
2.3	B	Phase(s)/Frequency	3/60	-/Hz			
2.4	B	Neutral Earthing	High Resistance Grounded	-			
2.5	B	Duty type IEC 34-1	S1-Continuous	-			
2.6	S	Rated Output		kW		0.75	
2.7	S	Synchronous Speed(s)		rpm		1800	
2.8	S	Direction of rotation viewed from drive end		-		Both	
2.9	B	Insulation Class/Temperature rise limit	F/B	-			
2.10	S	Minimum Terminal voltage during starting		per unit		N.A.	
2.11	S	Maximum no load sound pressure level at one metre		dBA		N.A.	
2.12	S	External Inertia (Max)		$kg\ m^2$		0.00229	
2.13	B	Type of Starter/Short circuit protection	DOL/MCCB	-			
2.14	S	Service Factor		per unit		2.5	
2.15	S	Minimum Rated Power factor at full load		%		78	
2.16	S	Minimum Efficiency at full rated load		-		82.5	
2.17	S	Mounting - Horizontal/Vertical		-		M1 horizontal	
2.18	S	Minimum starting voltage - percent of rated		%		N.A.	
2.19	S	Winding - Star/Delta		-		Star Star/Star	
3.0		**MECHANICAL AND ENCLOSURES**					
3.1	B	Enclosure Type	Cast Iron				
3.2	B	Degree of Protection - IP Code	IP 55				
3.3	S	Mounting IEC 34-7 IM Code				M1	
3.4	S	Cooling IEC 34-6 IC Code		-		IC411 (fan-cooled)	
3.5	S	Drain Holes		-		Y	
3.6	S	Shaft				Standard	
3.7	S	Drive Connection				To suit load	

NOTES:

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CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No. 4481-MJR0-0004

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
3.8	S	Finish bore half-coupling furnished by others		-		N	
3.9	S	Install half-coupling furnished by others		-		N	
3.10	S	Vibration Grade (IEC 60034-14)	A	-		N.A.	**Grade B in Special Cases**
3.11	S	Max Motor shaft load (R-Radial, A-Axial)		N		N.A.	
3.12	S	Bearing Type D end		-		DIN625 6304-2Z-J-C3-K08	
3.13	S	Bearing Type N end		-		DIN625 6304-2RS-J-C3-K08	
3.14	B	Antifriction Bearing L_{10} Life	MIN 40,000	Hours			**80,000 for re-greasable bearings**
3.15	S	Bearing Lubrication		-		GREASE	
3.16	S	Bearing Seals		-		D(2Z) - N(2RS)	
4.0		**ACCESSORIES**					
4.1	B	Space heaters required/rated voltage	Yes/115 Vac	/V			
4.2	B	Winding Over temperature protection required - type	Yes				**As per Specification**
4.3	B	Winding temperature devices No per phase	1				
4.4	B	Bearing over temperature protection required - type	No				
4.5	S	Auxilliary terminal boxe(es) or space heaters and temp devices				Separate	
4.6	S	Tachometer				N	
4.7	S	Brake				N	
4.8	S	Slide base for belt drive				Y	
4.9	S	Soleplate				N	
4.10	B	Rating Plate					**As per Specification**
4.11	B	Identification Plate					**As per Specification**
4.12	B	Separately powered cooling fan	Yes				

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CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No.: Individual Motor 4481-MJR0-0004

To Be Completed by SELLER for Each Motor

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
5.0	S	**MANUFACTURER'S DATA**					
5.1	S	Manufacturer		-		**SEW Eurodrive Canada**	
5.2	S	Frame Number		-		DRE80M4/DH	
5.3	S	Serial Number		-		80.1803912402.0001.10.00	
5.4	S	Model Number		-		R77 DRE80M4/DH	
5.5	S	Full Load Speed		rpm		1750	
5.6	S	Full Load Current		A		12.9 / 6.5	
5.7	S	Locked Rotor Current		A		98.1 / 49.4	
5.8	S	Locked Rotor Power Factor		pu		N.A.	
5.9	S	Temperature rise by resistance at full load		K		55	
5.10	S	Full Load Torque		nm		20.2	
5.11	S	Breakdown Torque in percent of Full Load		% IFL		310	
5.12	S	Weight		kg		37.1	
5.13	S	Efficiency at: 100 % Load		%		87.5	
5.14	S	75% Load		%		88.4	
5.15	S	50% Load		%		87.9	
5.16	S	Power Factor at: 100 % Load		pu		0.83	
5.17	S	75% Load		pu		0.78	
5.18	S	50% Load		pu		0.67	
5.19	S	Provide Following Data @ Rated Operating Temperature		-		-20ºC - 40ºC	
5.20	S	Locked rotor Withstand time @ nominal V		Seconds		N.A.	
5.21	S	Accelaration Time (Motor & Load) @ nominal V		Seconds		N.A.	
5.22	S	Locked rotor Withstand time @ min V		Seconds		N.A.	
5.23	S	Accelaration Time (Motor & Load) @ min V		Seconds		N.A.	
5.24	S	Rotor WK^2		kg m^2		0.0096	
5.25	S	Sub - Transient Reactance *X"*		%		N.A.	
5.26	S	Sub - Transient *X/R*		-		N.A.	
5.27	S	Provide thermal Limit curves		-		See file attached	
5.28	S	Provide Current and Torque/Speed Curves		-		See file attached	
5.29	S	Space Heater watts at nominal operating voltage		W		N.A.	
5.30	S	Motor RTD Alarm Temperature		deg C		N.A.	
5.31	S	Motor RTD Trip Temperature		deg C		N.A.	
6.0		**TESTS**					
6.1	B	Routine Tests					
6.2	B	Complete Test					
6.3	B	Vibration (with half coupling installed if available)					
6.4	B	Noise					

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CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No. 4481-MJR0-0004

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
7.0		**ADDITIONAL REQUIREMENTS FOR VFD SERVICE**					
7.1	S	Inverter Type		-		PWM	
7.2	S	Rated operation modes - VT / CT / CP		-		VT	
7.3	S	Rated power output at Base Speed		kW		0.75	
7.4	S	Base Speed		rpm		1740	
7.5	S	Constant Power speed range		rpm		1740-1740	
7.6	S	Constant Torque speed range		rpm		0-1740	
7.7	S	Continuous Constant Torque speed range		rpm		750-1740	
7.8	S	Variable Torque speed range		rpm		0-1700	
7.9	S	Variable Torque speed exponent		-		N.A.	
7.10	S	Starting (breakaway) torque		per unit		N.A.	
7.11	S	Run up torque		per unit		N.A.	

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6.10 Torque limit curves for DRS, DRE, DRP motors operated on an inverter

Thermally approved torque

Note thermally approved torque in project planning for operation of DR, asynchronous AC motors with frequency inverter. The following factors determine the thermally permitted torque:

- Duty type
- Type of cooling: Self-ventilation or forced cooling
- Base frequency f_{base} = 60 Hz (460 V ⅄) or f_{base} = 120Hz (230 ⅄⅄)

Use the torque limit curves to determine the thermally permitted torque. The projected, effective torque has to be less than the limit curve value. The following illustration shows the limit curves for 4-pole DR, asynchronous AC motors with f_{base} = 60 Hz and f_{base} = 120 Hz. The following peripheral conditions apply to the shown limit curves:

- Duty type S1
- Supply voltage of the inverter $V_{supply} = 3 \times 460\ V_{AC}$
- Motor in thermal class F

f_{base} = 60 Hz (460 V ⅄/60 Hz)

The following diagram shows the limit curves for operation at f_{base} = 60 Hz. The curves are different for those motors with self-ventilation and those with forced cooling (= optional forced cooling fan).

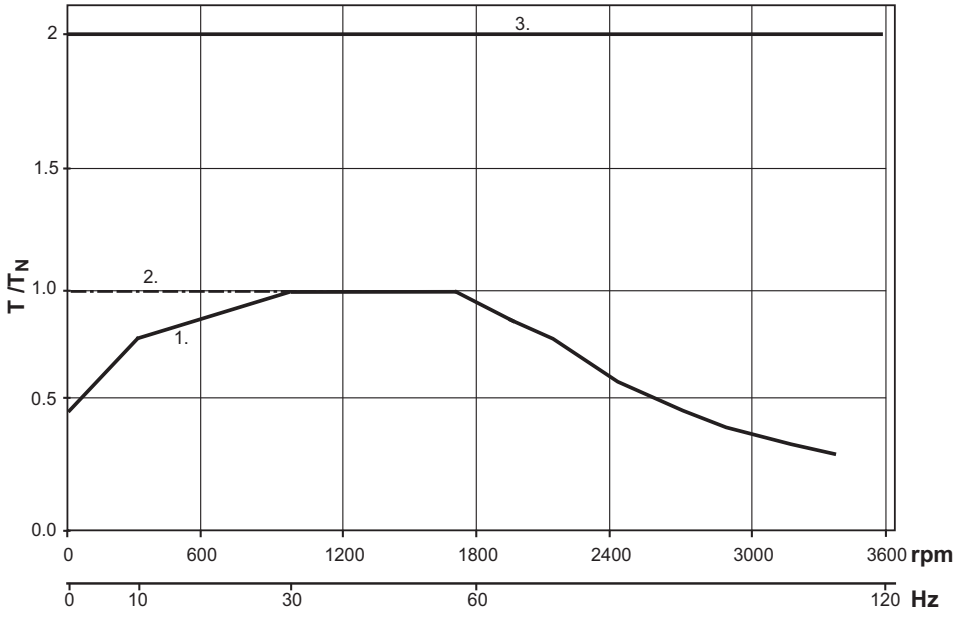

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Figure 1: Torque limit curves for f_{base} = 60 Hz

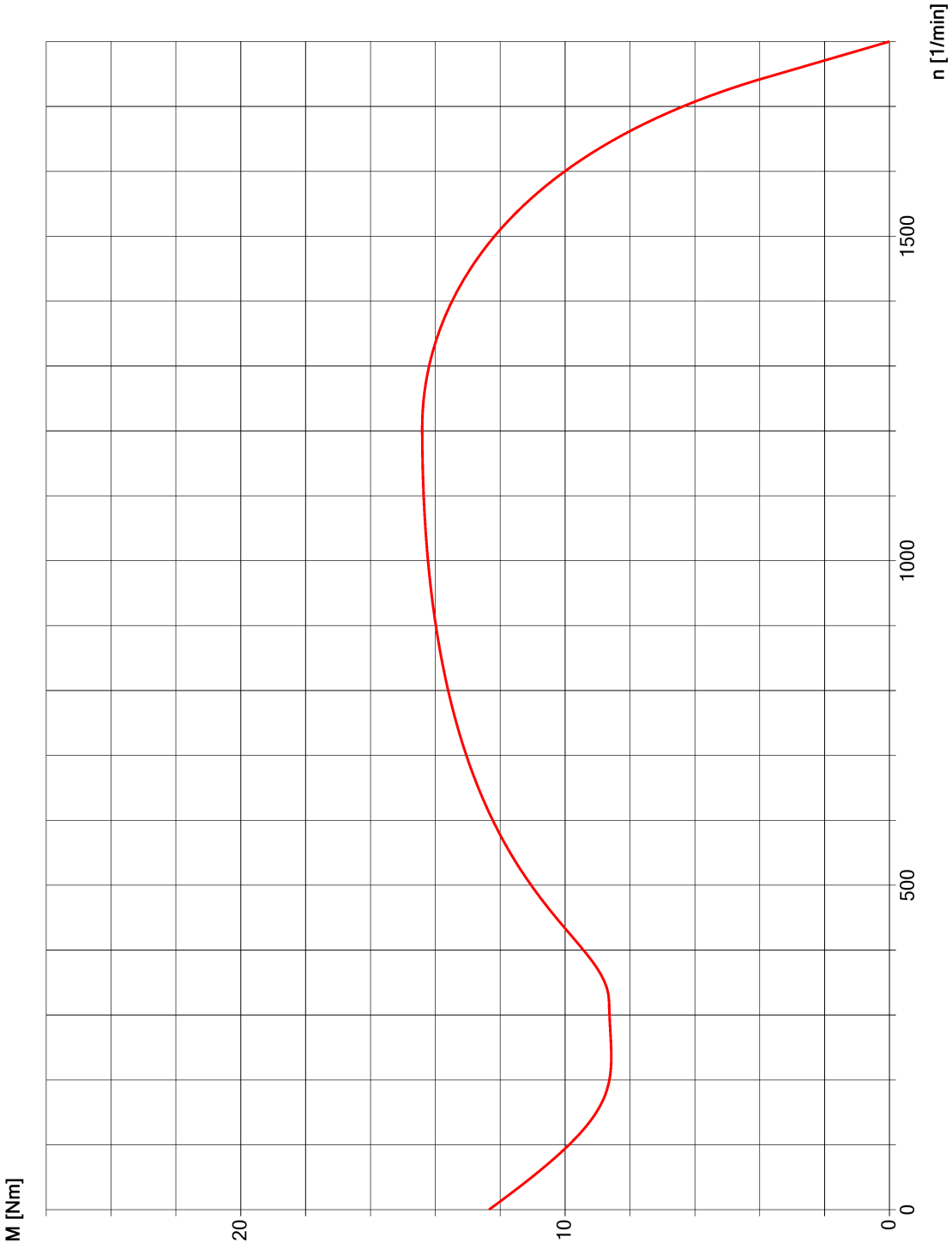
1. S1 operation with self-ventilation (= without forced cooling fan)
2. S1 operation with forced cooling (= with forced cooling fan)
3. Mechanical limitations for gearmotors

Motorkennlinie
Motor characteristic
Caractéristique du moteur

DRE 80M 4

0.75kW 4pol

Drehzahl-Drehmoment-Kennlinie 60Hz
Speed-torque characteristic
Caractéristique vitesse-couple



LOW VOLTAGE INDUCTION MOTORS
AZ ZABIRAH ALUMINIUM SMELTER

CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No. 4481-MJR0-0003

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
1.0		**SITE CONDITION**					
1.1	B	Altitude ASL	< 100	m			
1.2	B	Maximum Ambient Temperature	55	℃	000		
1.3	B	Minimum Ambient Temperature	0	℃			
1.4	B	Design Ambient Temperature (Indoors)	40	℃			
1.5	B	Maximum Relative Humidity	71	%			
1.6	B	Wind	NA	kph			
1.7	B	Seismic Zone	ND	-			
1.8	B	Type of Protection Required	Yes	-			
1.9	B	Indoors of Outdoors	Outdoors	-			
1.10	B	Cable Size	TBD	mm^2			
1.11	B	Earth connection Size	TBD	mm^2			
1.12	B	Unclassified Area	NA	-			
1.13	B	Hazardous Area Classification	Non-Hazardous	-			
1.13.1	B	Class	NA	-			
1.13.2	B	Division	NA	-			
1.13.3	B	Group(s)	NA	-			
1.13.4	B	Gas Ignition Temperature	NA	℃			
2.0		**DESIGN AND RATING**					
2.1	B	System Voltage	460	V			
2.2	B	Voltage tolerance	±5	%			
2.3	B	Phase(s)/Frequency	3/60	-/Hz			
2.4	B	Neutral Earthing	High Resistance Grounded	-			
2.5	B	Duty type IEC 34-1	S1-Continuous	-			
2.6	S	Rated Output		kW		0.75	
2.7	S	Synchronous Speed(s)		rpm		1800	
2.8	S	Direction of rotation viewed from drive end		-		Both	
2.9	B	Insulation Class/Temperature rise limit	F/B	-			
2.10	S	Minimum Terminal voltage during starting		per unit		N.A.	
2.11	S	Maximum no load sound pressure level at one metre		dBA		N.A.	
2.12	S	External Inertia (Max)		$kg\ m^2$		0.00229	
2.13	B	Type of Starter/Short circuit protection	DOL/MCCB	-			
2.14	S	Service Factor		per unit		2.5	
2.15	S	Minimum Rated Power factor at full load		%		78	
2.16	S	Minimum Efficiency at full rated load		-		82.5	
2.17	S	Mounting - Horizontal/Vertical		-		M1 horizontal	
2.18	S	Minimum starting voltage - percent of rated		%		N.A.	
2.19	S	Winding - Star/Delta		-		Star Star/Star	
3.0		**MECHANICAL AND ENCLOSURES**					
3.1	B	Enclosure Type	Cast Iron				
3.2	B	Degree of Protection - IP Code	IP 55				
3.3	S	Mounting IEC 34-7 IM Code				M1	
3.4	S	Cooling IEC 34-6 IC Code		-		IC411 (fan-cooled)	
3.5	S	Drain Holes		-		Y	
3.6	S	Shaft				Standard	
3.7	S	Drive Connection				To suit load	

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CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No. 4481-MJR0-0003

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
3.8	S	Finish bore half-coupling furnished by others		-		N	
3.9	S	Install half-coupling furnished by others		-		N	
3.10	S	Vibration Grade (IEC 60034-14)	A	-		N.A.	**Grade B in Special Cases**
3.11	S	Max Motor shaft load (R-Radial, A-Axial)		N		N.A.	
3.12	S	Bearing Type D end		-		DIN625 6304-2Z-J-C3-K08	
3.13	S	Bearing Type N end		-		DIN625 6304-2RS-J-C3-K08	
3.14	B	Antifriction Bearing L_{10} Life	MIN 40,000	Hours			**80,000 for re-greasable bearings**
3.15	S	Bearing Lubrication		-		GREASE	
3.16	S	Bearing Seals		-		D(2Z) - N(2RS)	
4.0		**ACCESSORIES**					
4.1	B	Space heaters required/rated voltage	Yes/115 Vac	/V			
4.2	B	Winding Over temperature protection required - type	Yes				**As per Specification**
4.3	B	Winding temperature devices No per phase	1				
4.4	B	Bearing over temperature protection required - type	No				
4.5	S	Auxilliary terminal boxe(es) or space heaters and temp devices				Separate	
4.6	S	Tachometer				N	
4.7	S	Brake				N	
4.8	S	Slide base for belt drive				Y	
4.9	S	Soleplate				N	
4.10	B	Rating Plate					**As per Specification**
4.11	B	Identification Plate					**As per Specification**
4.12	B	Separately powered cooling fan	Yes				

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CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No.: Individual Motor 4481-MJR0-0003

To Be Completed by SELLER for Each Motor

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
5.0	S	**MANUFACTURER'S DATA**					
5.1	S	Manufacturer		-		**SEW Eurodrive Canada**	
5.2	S	Frame Number		-		DRE 80M 4 /BE	
5.3	S	Serial Number		-		80.1803914101.0001.10.00	
5.4	S	Model Number		-		K47 DRE80M4BE05HF/DH	
5.5	S	Full Load Speed		rpm		1740	
5.6	S	Full Load Current		A		2.90/1.44	
5.7	S	Locked Rotor Current		A		20.59/10.22	
5.8	S	Locked Rotor Power Factor		pu		N.A.	
5.9	S	Temperature rise by resistance at full load		K		30	
5.10	S	Full Load Torque		nm		4.12	
5.11	S	Breakdown Torque in percent of Full Load		% IFL		350	
5.12	S	Weight		kg		23	
5.13	S	Efficiency at: 100 % Load		%		83.5	
5.14	S	75% Load		%		83.3	
5.15	S	50% Load		%		80.8	
5.16	S	Power Factor at: 100 % Load		pu		0.78	
5.17	S	75% Load		pu		0.7	
5.18	S	50% Load		pu		0.57	
5.19	S	Provide Following Data @ Rated Operating Temperature		-		-20ºC - 40ºC	
5.20	S	Locked rotor Withstand time @ nominal V		Seconds		N.A.	
5.21	S	Accelaration Time (Motor & Load) @ nominal V		Seconds		N.A.	
5.22	S	Locked rotor Withstand time @ min V		Seconds		N.A.	
5.23	S	Accelaration Time (Motor & Load) @ min V		Seconds		N.A.	
5.24	S	Rotor WK^2		kg m^2		0.00229	
5.25	S	Sub - Transient Reactance *X"*		%		N.A.	
5.26	S	Sub - Transient *X/R*		-		N.A.	
5.27	S	Provide thermal Limit curves		-		See file attached	
5.28	S	Provide Current and Torque/Speed Curves		-		See file attached	
5.29	S	Space Heater watts at nominal operating voltage		W		N.A.	
5.30	S	Motor RTD Alarm Temperature		deg C		N.A.	
5.31	S	Motor RTD Trip Temperature		deg C		N.A.	
6.0		**TESTS**					
6.1	B	Routine Tests					
6.2	B	Complete Test					
6.3	B	Vibration (with half coupling installed if available)					
6.4	B	Noise					

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CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No. 4481-MJR0-0003

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
7.0		**ADDITIONAL REQUIREMENTS FOR VFD SERVICE**					
7.1	S	Inverter Type		-		PWM	
7.2	S	Rated operation modes - VT / CT / CP		-		VT	
7.3	S	Rated power output at Base Speed		kW		0.75	
7.4	S	Base Speed		rpm		1740	
7.5	S	Constant Power speed range		rpm		1740-1740	
7.6	S	Constant Torque speed range		rpm		0-1740	
7.7	S	Continuous Constant Torque speed range		rpm		750-1740	
7.8	S	Variable Torque speed range		rpm		0-1700	
7.9	S	Variable Torque speed exponent		-		N.A.	
7.10	S	Starting (breakaway) torque		per unit		N.A.	
7.11	S	Run up torque		per unit		N.A.	

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6.10 Torque limit curves for DRS, DRE, DRP motors operated on an inverter

Thermally approved torque

Note thermally approved torque in project planning for operation of DR, asynchronous AC motors with frequency inverter. The following factors determine the thermally permitted torque:

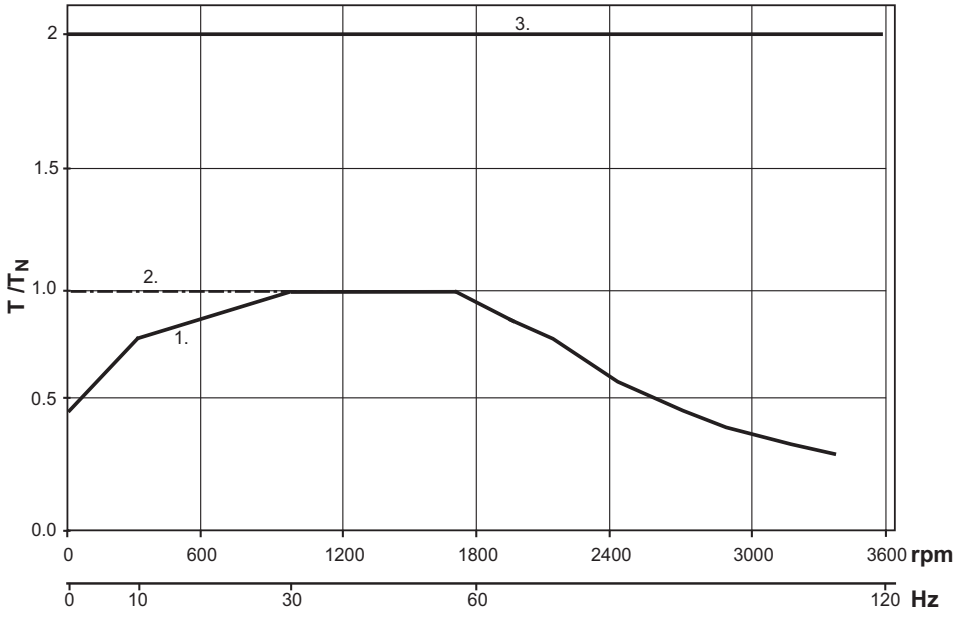
- Duty type
- Type of cooling: Self-ventilation or forced cooling
- Base frequency f_{base} = 60 Hz (460 V ⅄) or f_{base} = 120Hz (230 ⅄⅄)

Use the torque limit curves to determine the thermally permitted torque. The projected, effective torque has to be less than the limit curve value. The following illustration shows the limit curves for 4-pole DR, asynchronous AC motors with f_{base} = 60 Hz and f_{base} = 120 Hz. The following peripheral conditions apply to the shown limit curves:

- Duty type S1
- Supply voltage of the inverter $V_{supply} = 3 \times 460\ V_{AC}$
- Motor in thermal class F

f_{base} = 60 Hz (460 V ⅄/60 Hz)

The following diagram shows the limit curves for operation at f_{base} = 60 Hz. The curves are different for those motors with self-ventilation and those with forced cooling (= optional forced cooling fan).



60850AUS

Figure 1: Torque limit curves for f_{base} = 60 Hz

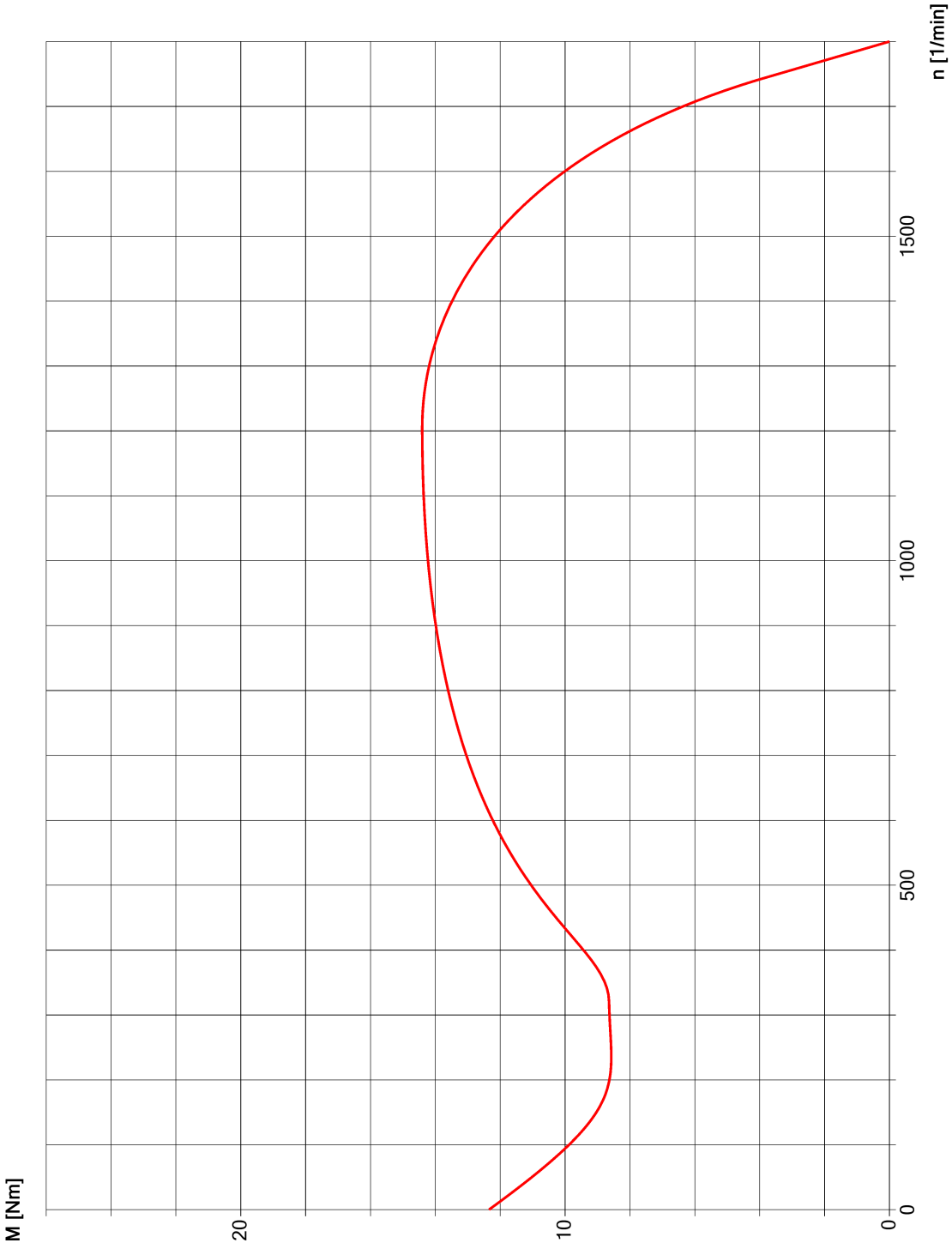
1. S1 operation with self-ventilation (= without forced cooling fan)
2. S1 operation with forced cooling (= with forced cooling fan)
3. Mechanical limitations for gearmotors

Motorkennlinie
Motor characteristic
Caractéristique du moteur

DRE 80M 4

0.75kW 4pol

Drehzahl-Drehmoment-Kennlinie 60Hz
Speed-torque characteristic
Caractéristique vitesse-couple



LOW VOLTAGE INDUCTION MOTORS
AZ ZABIRAH ALUMINIUM SMELTER

CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No. 4481-MJR0-0002

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
1.0		**SITE CONDITION**					
1.1	B	Altitude ASL	< 100	m			
1.2	B	Maximum Ambient Temperature	55	℃	000		
1.3	B	Minimum Ambient Temperature	0	℃			
1.4	B	Design Ambient Temperature (Indoors)	40	℃			
1.5	B	Maximum Relative Humidity	71	%			
1.6	B	Wind	NA	kph			
1.7	B	Seismic Zone	ND	-			
1.8	B	Type of Protection Required	Yes	-			
1.9	B	Indoors of Outdoors	Outdoors	-			
1.10	B	Cable Size	TBD	mm^2			
1.11	B	Earth connection Size	TBD	mm^2			
1.12	B	Unclassified Area	NA	-			
1.13	B	Hazardous Area Classification	Non-Hazardous	-			
1.13.1	B	Class	NA	-			
1.13.2	B	Division	NA	-			
1.13.3	B	Group(s)	NA	-			
1.13.4	B	Gas Ignition Temperature	NA	℃			
2.0		**DESIGN AND RATING**					
2.1	B	System Voltage	460	V			
2.2	B	Voltage tolerance	±5	%			
2.3	B	Phase(s)/Frequency	3/60	-/Hz			
2.4	B	Neutral Earthing	High Resistance Grounded	-			
2.5	B	Duty type IEC 34-1	S1-Continuous	-			
2.6	S	Rated Output		kW		0.37	
2.7	S	Synchronous Speed(s)		rpm		1800	
2.8	S	Direction of rotation viewed from drive end		-		Both	
2.9	B	Insulation Class/Temperature rise limit	F/B	-			
2.10	S	Minimum Terminal voltage during starting		per unit		N.A.	
2.11	S	Maximum no load sound pressure level at one metre		dBA		N.A.	
2.12	S	External Inertia (Max)		kg m^2		0.00046	
2.13	B	Type of Starter/Short circuit protection	DOL/MCCB	-			
2.14	S	Service Factor		per unit		1.0	
2.15	S	Minimum Rated Power factor at full load		%		71	
2.16	S	Minimum Efficiency at full rated load		-		65.40%	
2.17	S	Mounting - Horizontal/Vertical		-		horizontal M3	
2.18	S	Minimum starting voltage - percent of rated		%		N.A.	
2.19	S	Winding - Star/Delta		-		Star Star / Star	
3.0		**MECHANICAL AND ENCLOSURES**					
3.1	B	Enclosure Type	Cast Iron				
3.2	B	Degree of Protection - IP Code	IP 55				
3.3	S	Mounting IEC 34-7 IM Code				M3	
3.4	S	Cooling IEC 34-6 IC Code		-		IC411 (fan-cooled)	
3.5	S	Drain Holes		-		Yes	
3.6	S	Shaft				N.A.	
3.7	S	Drive Connection				N.A.	

NOTES:

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2. All (B) items shall be completed by Buyer. All (S) items shall be completed by Seller
3. Y = Yes; N = No; ND = Information Not Available; NA = Not Applicable.
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CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No. 4481-MJR0-0002

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
3.8	S	Finish bore half-coupling furnished by others		-		N	
3.9	S	Install half-coupling furnished by others		-		N	
3.10	S	Vibration Grade (IEC 60034-14)	A	-		N.A.	**Grade B in Special Cases**
3.11	S	Max Motor shaft load (R-Radial, A-Axial)		N		N.A.	
3.12	S	Bearing Type D end		-		DGB brg. 6303-2Z-C3-K08	
3.13	S	Bearing Type N end		-		DGB brg. 6203-2Z-C3-K08	
3.14	B	Antifriction Bearing L_{10} Life	MIN 40,000	Hours			**80,000 for re-greasable bearings**
3.15	S	Bearing Lubrication		-		GREASE	
3.16	S	Bearing Seals		-		D(2Z) - N(2Z)	
4.0		**ACCESSORIES**					
4.1	B	Space heaters required/rated voltage	Yes/115 Vac	/V			
4.2	B	Winding Over temperature protection required - type	Yes				**As per Specification**
4.3	B	Winding temperature devices No per phase	1				
4.4	B	Bearing over temperature protection required - type	No				
4.5	S	Auxilliary terminal boxe(es) or space heaters and temp devices				Separate	
4.6	S	Tachometer				N	
4.7	S	Brake				N	
4.8	S	Slide base for belt drive				N	
4.9	S	Soleplate				N	
4.10	B	Rating Plate					**As per Specification**
4.11	B	Identification Plate					**As per Specification**
4.12	B	Separately powered cooling fan	Yes				

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CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No.: Individual Motor 4481-MJR0-0002

To Be Completed by SELLER for Each Motor

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
5.0	S	**MANUFACTURER'S DATA**					
5.1	S	Manufacturer		-		**SEW Eurodrive Canada**	
5.2	S	Frame Number		-		DT71D4/VS	
5.3	S	Serial Number		-		80.1803914301.0001.10.00	
5.4	S	Model Number		-		K47 DT71D4/VS	
5.5	S	Full Load Speed		rpm		1700	
5.6	S	Full Load Current		A		2.0 / 1.0	
5.7	S	Locked Rotor Current		A		8.0 / 4.0	
5.8	S	Locked Rotor Power Factor		pu		N.A.	
5.9	S	Temperature rise by resistance at full load		K		N.A.	
5.10	S	Full Load Torque		nm		2.08	
5.11	S	Breakdown Torque in percent of Full Load		% IFL		225%	
5.12	S	Weight		kg		6.8	
5.13	S	Efficiency at: 100 % Load		%		N.A.	
5.14	S	75% Load		%		N.A.	
5.15	S	50% Load		%		N.A.	
5.16	S	Power Factor at: 100 % Load		pu		0.71	
5.17	S	75% Load		pu		N.A.	
5.18	S	50% Load		pu		N.A.	
5.19	S	Provide Following Data @ Rated Operating Temperature		-		-20ºC - 40ºC	
5.20	S	Locked rotor Withstand time @ nominal V		Seconds		N.A.	
5.21	S	Accelaration Time (Motor & Load) @ nominal V		Seconds		N.A.	
5.22	S	Locked rotor Withstand time @ min V		Seconds		N.A.	
5.23	S	Accelaration Time (Motor & Load) @ min V		Seconds		N.A.	
5.24	S	Rotor WK^2		kg m^2		0.00046	
5.25	S	Sub - Transient Reactance *X"*		%		N.A.	
5.26	S	Sub - Transient *X/R*		-		N.A.	
5.27	S	Provide thermal Limit curves		-			
5.28	S	Provide Current and Torque/Speed Curves		-			
5.29	S	Space Heater watts at nominal operating voltage		W		N	
5.30	S	Motor RTD Alarm Temperature		deg C		N	
5.31	S	Motor RTD Trip Temperature		deg C		N	
6.0		**TESTS**					
6.1	B	Routine Tests					
6.2	B	Complete Test					
6.3	B	Vibration (with half coupling installed if available)					
6.4	B	Noise					

NOTES:

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CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No. 4481-MJR0-0002

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
7.0		**ADDITIONAL REQUIREMENTS FOR VFD SERVICE**					
7.1	S	Inverter Type		-		PWM	
7.2	S	Rated operation modes - VT / CT / CP		-		VT	
7.3	S	Rated power output at Base Speed		kW		0.37	
7.4	S	Base Speed		rpm		1700	
7.5	S	Constant Power speed range		rpm		1700-1700	
7.6	S	Constant Torque speed range		rpm		0-1700	
7.7	S	Continuous Constant Torque speed range		rpm		750-1700	
7.8	S	Variable Torque speed range		rpm		0-1700	
7.9	S	Variable Torque speed exponent		-		N.A.	
7.10	S	Starting (breakaway) torque		per unit		N.A.	
7.11	S	Run up torque		per unit		N.A.	

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8.4 Torque limit curves with inverter operation

Thermally approved torque

Note thermally approved torque in project planning for operation of DR, DT, DV asynchronous AC motors with frequency inverter. The following factors determine the thermally permitted torque:

- Duty type
- Type of cooling: Self-ventilation or forced cooling
- Base frequency f_{base} = 60 Hz (460 V ⅄) or f_{base} = 120 Hz (230 V ⅄⅄)

Use the torque limit curves to determine the thermally permitted torque. The projected, effective torque has to be less than the limit curve value. The following illustration shows the limit curves for 4-pole DR, DT, DV asynchronous AC motors with f_{base} = 60 Hz and f_{base} = 120 Hz. The following peripheral conditions apply to the shown limit curves:

- Duty type S1
- Supply voltage of the inverter $V_{mains} = 3 \times 460\ V_{AC}$
- Motor in thermal class F

f_{base} = 60 Hz (460 V ⅄/60 Hz)

The following diagram shows the limit curves for operation at f_{base} = 60 Hz. The curves are different for those motors with self-ventilation and those with forced cooling (= optional forced cooling fan).

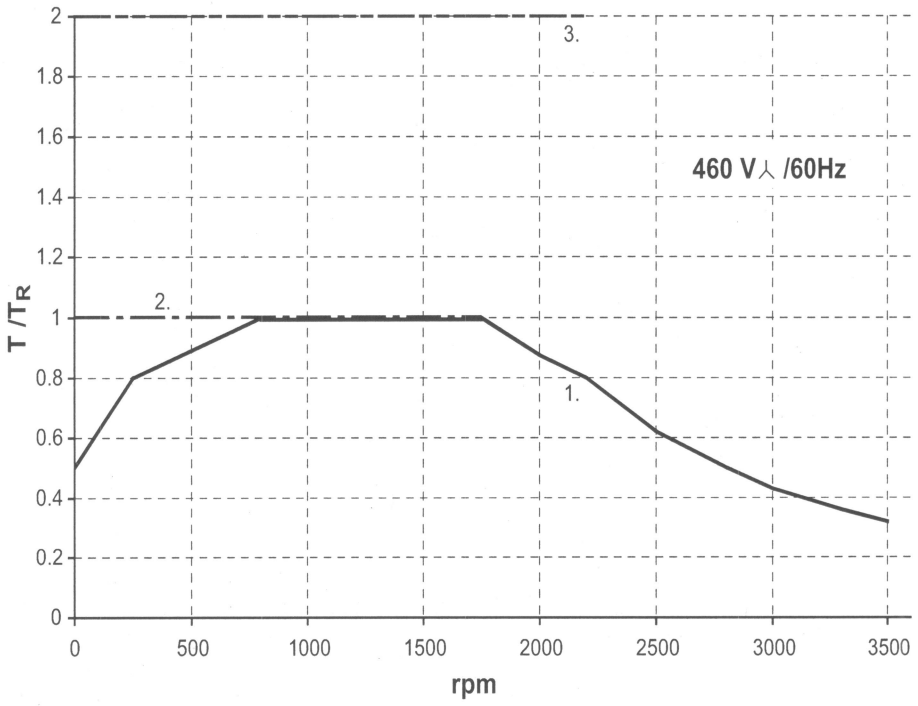


Figure 80: Torque limit curves for f_{base} = 60 Hz

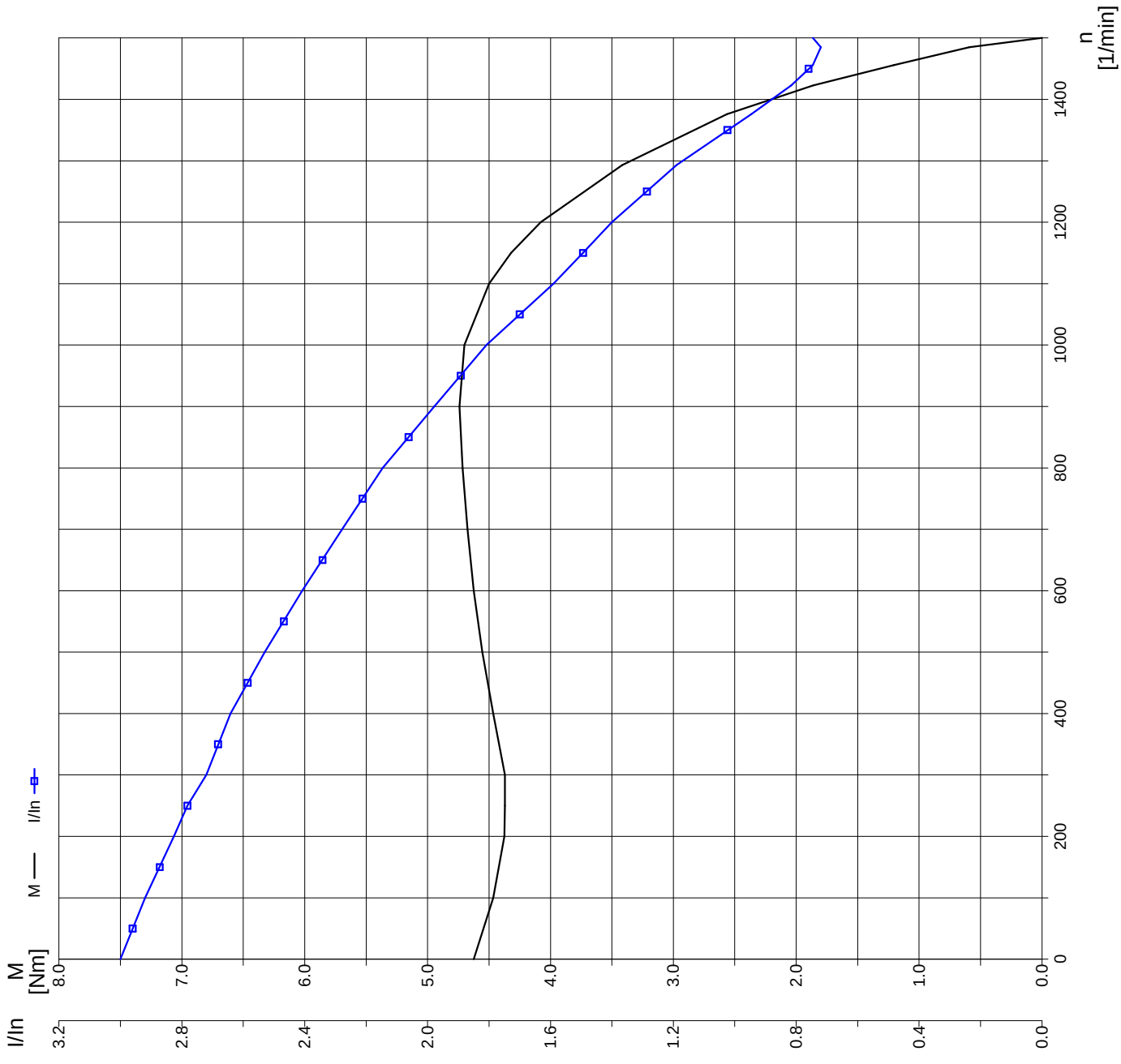
1. S1 operation with self-ventilation (= without forced cooling fan)
2. S1 operation with forced cooling (= with forced cooling fan)
3. Mechanical limitations for gearmotors

Meßprotokoll
Test record
Protocole d'essai

DT 71 D 4 **93 033 192**

0.37 kW S1 4pol

Drehzahl-Drehmoment-Messung 50Hz 2.7.96



LOW VOLTAGE INDUCTION MOTORS
AZ ZABIRAH ALUMINIUM SMELTER

CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No. 4481-MJR0-0001

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
1.0		**SITE CONDITION**					
1.1	B	Altitude ASL	< 100	m			
1.2	B	Maximum Ambient Temperature	55	℃	000		
1.3	B	Minimum Ambient Temperature	0	℃			
1.4	B	Design Ambient Temperature (Indoors)	40	℃			
1.5	B	Maximum Relative Humidity	71	%			
1.6	B	Wind	NA	kph			
1.7	B	Seismic Zone	ND	-			
1.8	B	Type of Protection Required	Yes	-			
1.9	B	Indoors of Outdoors	Outdoors	-			
1.10	B	Cable Size	TBD	mm^2			
1.11	B	Earth connection Size	TBD	mm^2			
1.12	B	Unclassified Area	NA	-			
1.13	B	Hazardous Area Classification	Non-Hazardous	-			
1.13.1	B	Class	NA	-			
1.13.2	B	Division	NA	-			
1.13.3	B	Group(s)	NA	-			
1.13.4	B	Gas Ignition Temperature	NA	℃			
2.0		**DESIGN AND RATING**					
2.1	B	System Voltage	460	V			
2.2	B	Voltage tolerance	±5	%			
2.3	B	Phase(s)/Frequency	3/60	-/Hz			
2.4	B	Neutral Earthing	High Resistance Grounded	-			
2.5	B	Duty type IEC 34-1	S1-Continuous	-			
2.6	S	Rated Output		kW		0.37	
2.7	S	Synchronous Speed(s)		rpm		1800	
2.8	S	Direction of rotation viewed from drive end		-		Both	
2.9	B	Insulation Class/Temperature rise limit	F/B	-			
2.10	S	Minimum Terminal voltage during starting		per unit		N.A.	
2.11	S	Maximum no load sound pressure level at one metre		dBA		N.A.	
2.12	S	External Inertia (Max)		kg m^2		0.00046	
2.13	B	Type of Starter/Short circuit protection	DOL/MCCB	-			
2.14	S	Service Factor		per unit		1.0	
2.15	S	Minimum Rated Power factor at full load		%		71	
2.16	S	Minimum Efficiency at full rated load		-		65.40%	
2.17	S	Mounting - Horizontal/Vertical		-		horizontal M3	
2.18	S	Minimum starting voltage - percent of rated		%		N.A.	
2.19	S	Winding - Star/Delta		-		Star Star / Star	
3.0		**MECHANICAL AND ENCLOSURES**					
3.1	B	Enclosure Type	Cast Iron				
3.2	B	Degree of Protection - IP Code	IP 55				
3.3	S	Mounting IEC 34-7 IM Code				M3	
3.4	S	Cooling IEC 34-6 IC Code		-		IC411 (fan-cooled)	
3.5	S	Drain Holes		-		Yes	
3.6	S	Shaft				N.A.	
3.7	S	Drive Connection				N.A.	

NOTES:

1. (B) Indicates Buyer. (S) Indicates Seller
2. All (B) items shall be completed by Buyer. All (S) items shall be completed by Seller
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CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No. 4481-MJR0-0001

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
3.8	S	Finish bore half-coupling furnished by others		-		N	
3.9	S	Install half-coupling furnished by others		-		N	
3.10	S	Vibration Grade (IEC 60034-14)	A	-		N.A.	**Grade B in Special Cases**
3.11	S	Max Motor shaft load (R-Radial, A-Axial)		N		N.A.	
3.12	S	Bearing Type D end		-		DGB brg. 6303-2Z-C3-K08	
3.13	S	Bearing Type N end		-		DGB brg. 6203-2Z-C3-K08	
3.14	B	Antifriction Bearing L_{10} Life	MIN 40,000	Hours			**80,000 for re-greasable bearings**
3.15	S	Bearing Lubrication		-		GREASE	
3.16	S	Bearing Seals		-		D(2Z) - N(2Z)	
4.0		**ACCESSORIES**					
4.1	B	Space heaters required/rated voltage	Yes/115 Vac	/V			
4.2	B	Winding Over temperature protection required - type	Yes				**As per Specification**
4.3	B	Winding temperature devices No per phase	1				
4.4	B	Bearing over temperature protection required - type	No				
4.5	S	Auxilliary terminal boxe(es) or space heaters and temp devices				Separate	
4.6	S	Tachometer				N	
4.7	S	Brake				N	
4.8	S	Slide base for belt drive				N	
4.9	S	Soleplate				N	
4.10	B	Rating Plate					**As per Specification**
4.11	B	Identification Plate					**As per Specification**
4.12	B	Separately powered cooling fan	Yes				

NOTES:

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CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No.: Individual Motor 4481-MJR0-0001

To Be Completed by SELLER for Each Motor

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
5.0	S	**MANUFACTURER'S DATA**					
5.1	S	Manufacturer		-		**SEW Eurodrive Canada**	
5.2	S	Frame Number		-		DT71D4/VS	
5.3	S	Serial Number		-		80.1803914301.0001.10.00	
5.4	S	Model Number		-		K47 DT71D4/VS	
5.5	S	Full Load Speed		rpm		1700	
5.6	S	Full Load Current		A		2.0 / 1.0	
5.7	S	Locked Rotor Current		A		8.0 / 4.0	
5.8	S	Locked Rotor Power Factor		pu		N.A.	
5.9	S	Temperature rise by resistance at full load		K		N.A.	
5.10	S	Full Load Torque		nm		2.08	
5.11	S	Breakdown Torque in percent of Full Load		% IFL		225%	
5.12	S	Weight		kg		6.8	
5.13	S	Efficiency at: 100 % Load		%		N.A.	
5.14	S	75% Load		%		N.A.	
5.15	S	50% Load		%		N.A.	
5.16	S	Power Factor at: 100 % Load		pu		0.71	
5.17	S	75% Load		pu		N.A.	
5.18	S	50% Load		pu		N.A.	
5.19	S	Provide Following Data @ Rated Operating Temperature		-		-20ºC - 40ºC	
5.20	S	Locked rotor Withstand time @ nominal V		Seconds		N.A.	
5.21	S	Accelaration Time (Motor & Load) @ nominal V		Seconds		N.A.	
5.22	S	Locked rotor Withstand time @ min V		Seconds		N.A.	
5.23	S	Accelaration Time (Motor & Load) @ min V		Seconds		N.A.	
5.24	S	Rotor WK^2		kg m^2		0.00046	
5.25	S	Sub - Transient Reactance *X"*		%		N.A.	
5.26	S	Sub - Transient *X/R*		-		N.A.	
5.27	S	Provide thermal Limit curves		-			
5.28	S	Provide Current and Torque/Speed Curves		-			
5.29	S	Space Heater watts at nominal operating voltage		W		N	
5.30	S	Motor RTD Alarm Temperature		deg C		N	
5.31	S	Motor RTD Trip Temperature		deg C		N	
6.0		**TESTS**					
6.1	B	Routine Tests					
6.2	B	Complete Test					
6.3	B	Vibration (with half coupling installed if available)					
6.4	B	Noise					

NOTES:

1. (B) Indicates Buyer. (S) Indicates Seller
2. All (B) items shall be completed by Buyer. All (S) items shall be completed by Seller
3. Y = Yes; N = No; ND = Information Not Available; NA = Not Applicable.
4. TBD: To Be Determined

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CLIENT: MA'ADEN
PROJECT TITLE: AZ ZABIRAH ALUMINIUM SMELTER PROJECT
PROJECT LOCATION: AZ ZAWR, KINGDOM OF SAUDI ARABIA

EQUIPMENT No. 4481-MJR0-0001

ITEMS No.	BUYER / SELLER	DESCRIPTION	SPECIFIED	UNITS	REV	SUPPLIER'S INFORMATION. CONFIRM COMPLIANCE IF ANY OR CONFIRM EXCEPTION	BUYER's COMMENTS
7.0		**ADDITIONAL REQUIREMENTS FOR VFD SERVICE**					
7.1	S	Inverter Type		-		PWM	
7.2	S	Rated operation modes - VT / CT / CP		-		VT	
7.3	S	Rated power output at Base Speed		kW		0.37	
7.4	S	Base Speed		rpm		1700	
7.5	S	Constant Power speed range		rpm		1700-1700	
7.6	S	Constant Torque speed range		rpm		0-1700	
7.7	S	Continuous Constant Torque speed range		rpm		750-1700	
7.8	S	Variable Torque speed range		rpm		0-1700	
7.9	S	Variable Torque speed exponent		-		N.A.	
7.10	S	Starting (breakaway) torque		per unit		N.A.	
7.11	S	Run up torque		per unit		N.A.	

NOTES:

1. (B) Indicates Buyer. (S) Indicates Seller
2. All (B) items shall be completed by Buyer. All (S) items shall be completed by Seller
3. Y = Yes; N = No; ND = Information Not Available; NA = Not Applicable.
4. TBD: To Be Determined

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8.4 Torque limit curves with inverter operation

Thermally approved torque

Note thermally approved torque in project planning for operation of DR, DT, DV asynchronous AC motors with frequency inverter. The following factors determine the thermally permitted torque:

- Duty type
- Type of cooling: Self-ventilation or forced cooling
- Base frequency f_{base} = 60 Hz (460 V ⅄) or f_{base} = 120 Hz (230 V ⅄⅄)

Use the torque limit curves to determine the thermally permitted torque. The projected, effective torque has to be less than the limit curve value. The following illustration shows the limit curves for 4-pole DR, DT, DV asynchronous AC motors with f_{base} = 60 Hz and f_{base} = 120 Hz. The following peripheral conditions apply to the shown limit curves:

- Duty type S1
- Supply voltage of the inverter $V_{mains} = 3 \times 460\ V_{AC}$
- Motor in thermal class F

f_{base} = 60 Hz (460 V ⅄/60 Hz)

The following diagram shows the limit curves for operation at f_{base} = 60 Hz. The curves are different for those motors with self-ventilation and those with forced cooling (= optional forced cooling fan).

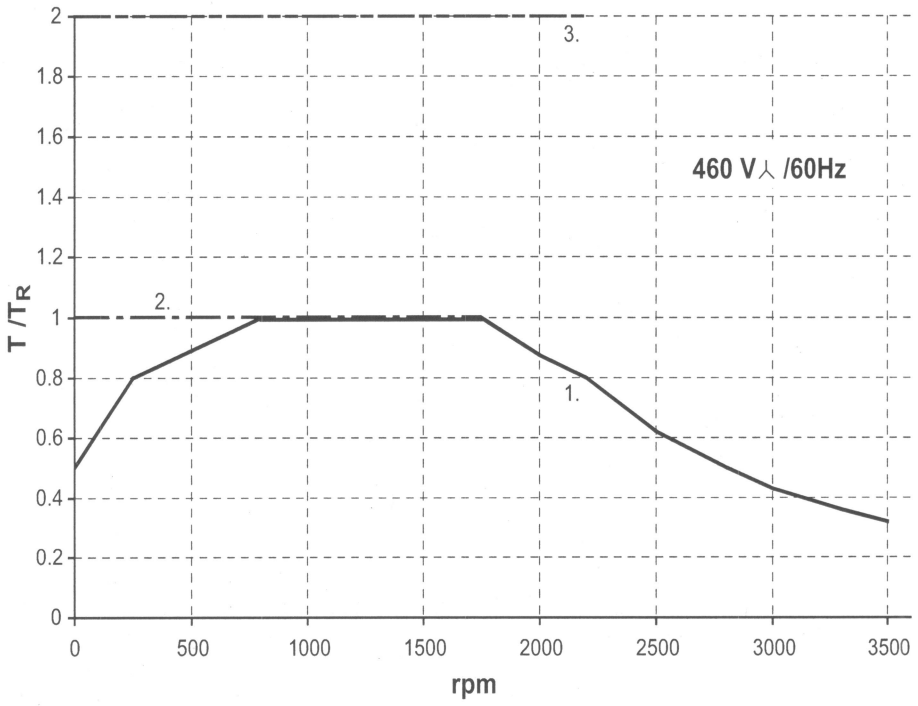


Figure 80: Torque limit curves for f_{base} = 60 Hz

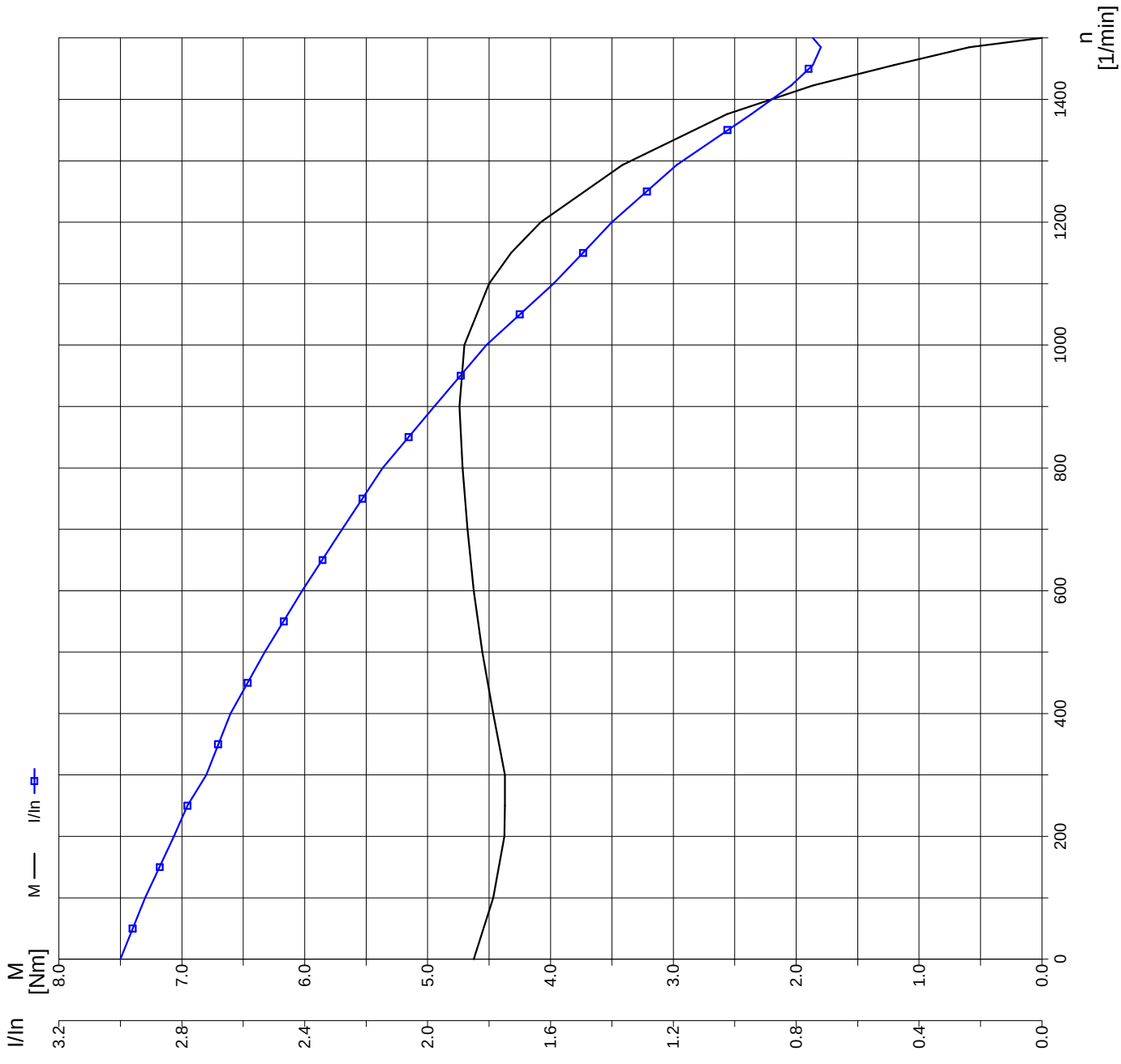
1. S1 operation with self-ventilation (= without forced cooling fan)
2. S1 operation with forced cooling (= with forced cooling fan)
3. Mechanical limitations for gearmotors

Meßprotokoll
Test record
Protocole d'essai

DT 71 D 4 **93 033 192**

0.37 kW S1 4pol

Drehzahl-Drehmoment-Messung 50Hz 2.7.96



SECTION 2 SAFETY INFORMATION

2.1 GENERAL

THE CATHODE ASSEMBLY LINE IS A COMPLEX MACHINE WITH A LOT OF MOVING PARTS AND CONVEYING HOT MATERIALS. IT IS NECESSARY TO BE FAMILIAR WITH THE OPERATION OF THIS EQUIPMENT TO AVOID INJURIES OR DAMAGE TO EQUIPMENT.

DO NOT MAINTAIN OR REPAIR THIS EQUIPMENT DURING OPERATION.

SAFETY SIGNS SHALL BE RESPECTED BY ALL THE PERSONNEL.

The furnace walls shall not be touch. **HOT ZONES** and **HOT SURFACES** are clearly identify and shall be respected by the operator.

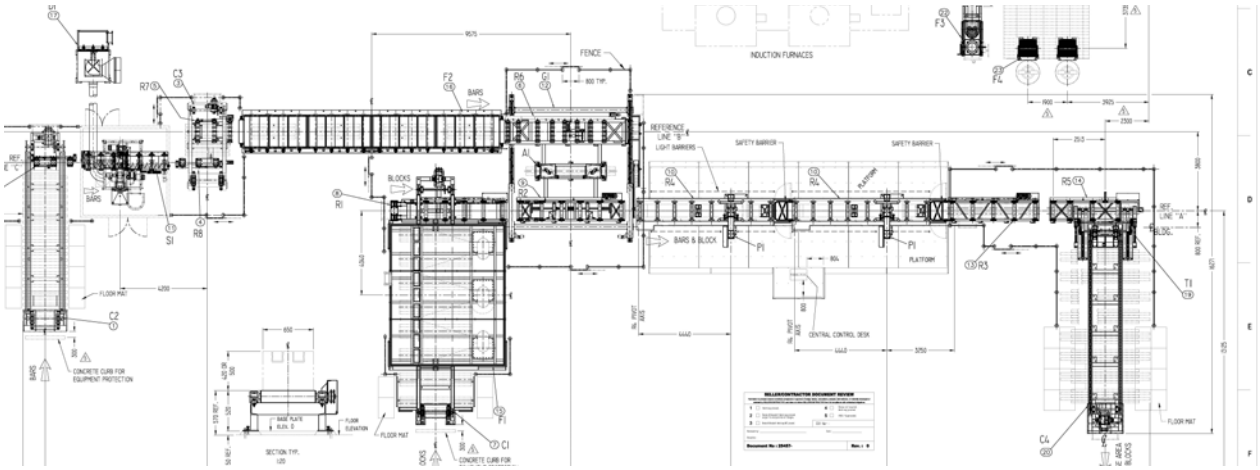
ONE OF THE MOST APPLICABLE INDUSTRIAL SAFETY PRINCIPLES IS THE LOCKOUT / TAGOUT. THE LOCKOUT/TAGOUT SHALL BE INCLUDED IN YOUR SAFETY AND OPERATOR TRAINING PROCEDURE.

2.2 FENCED AREA

CRITICAL AREAS ARE SURROUNDED BY A SAFETY FENCES TO PROTECT THE OPERATOR AND PERSONNEL FROM THE OPERATION.

NOBODY SHALL BE IN THESE AREAS DURING NORMAL OPERATION.

Refer to GNA drawing 1347-AR-0000 for Fenced area.



IMPORTANT

General Safety Clothing:

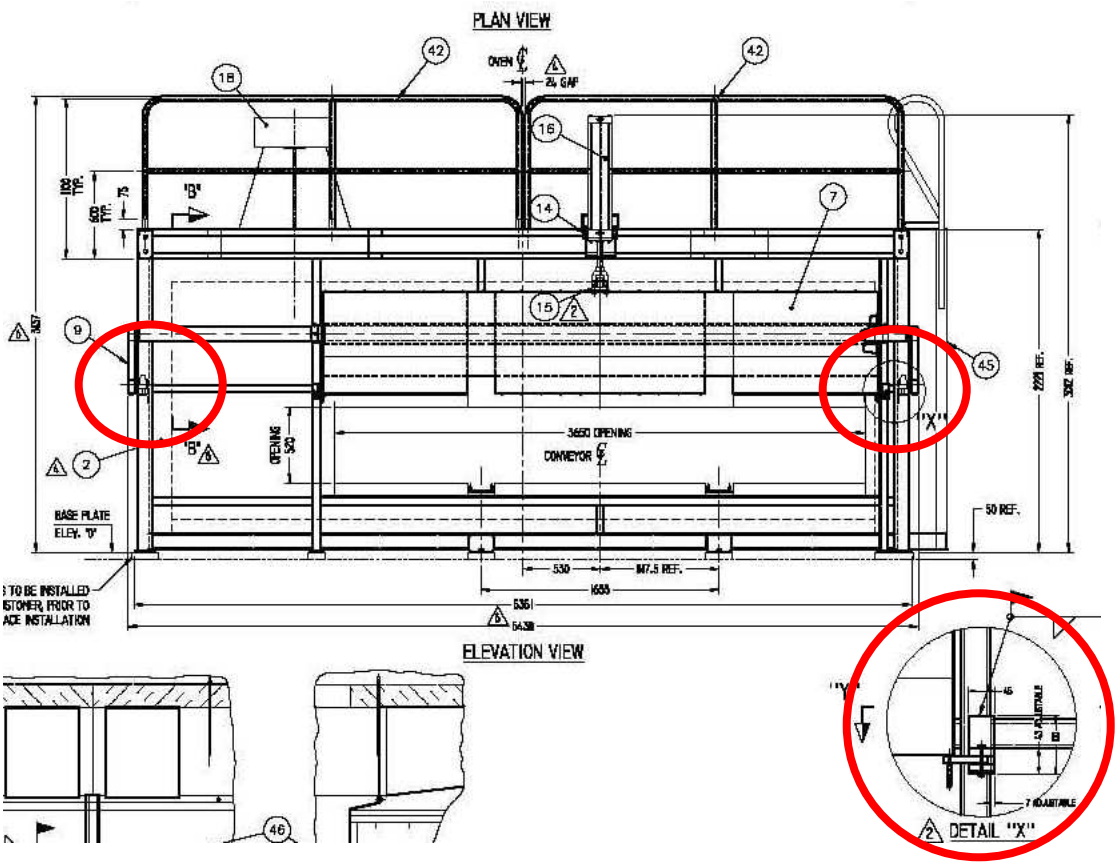
- Safety hat
- Eye protection
- Safety boots
- Suitable protective clothing when pouring of the cast iron

Clean environment:

- Maintain good housekeeping around the machine all the time
- Clean up any spilled abrasive around the shotblasting machine
- Ensure to designate the area as a NO SMOKING area

DURING MAINTENANCE INSIDE THE BLOCK OVEN, THE PERSONNEL SHALL USE THE MECHANICAL DOOR LOCK SYSTEM TO PREVENT ANY HAZARDOUS SITUATIONS AND INJURIES.

Refer to GNA drawing 1347-F1-1000 (refer to figure below).



2.3 SAFETY EQUIPMENT

BAR FEED CHAIN CONVEYOR (C2)
SHOTBLASTING INLET ROLLER CONVEYOR (R9)

GUARD

We have a guard for the motorized components (refer to pictures) at the entry and loading side of the conveyor.

THE GUARD WILL BE LOCKED IN PLACE USING SECURITY SCREWS. A SPECIAL TOOL WILL BE REQUIRED TO REMOVE THE GUARD.

During maintenance procedure, the personnel will have to disable local disconnect switches and padlock them prior to removing any guarding system.

FLOOR MAT

A SAFETY FLOOR MAT WILL BE INSTALLED EACH SIDE OF THE CONVEYOR. WHEN A PRESENCE WILL BE DETECTED ON THE FLOOR MAT THE CONVEYOR MOTOR WILL AUTOMATICALLY BE DISABLED, A RESET STATION IS PROVIDED.

FLASHING LIGHT AND AUDIBLE SIGNAL

In order to prevent delay on the production, a flashing light (RED) and a sound signal will advise the operator during 5 seconds that the conveyor needs to move and feed the shotblasting machine within the next 30 seconds (The light will remain for the duration of the movement). The operator will have to evacuate the zone (mat) to make sure it is not delaying the process.

FENCE WITH GATE

At the opposite end of this conveyor, the individual equipment guard will be removed in favour of a fence surrounding the whole conveyor. This fence will allow clear visibility for the maintenance personnel in order to facilitate troubleshooting and maintenance. The local disconnect switches for the two motors will be installed outside of the fenced zone. Also, a manual hydraulic valve that can be locked using a padlock will be accessible from outside the fenced area to isolate the zone.

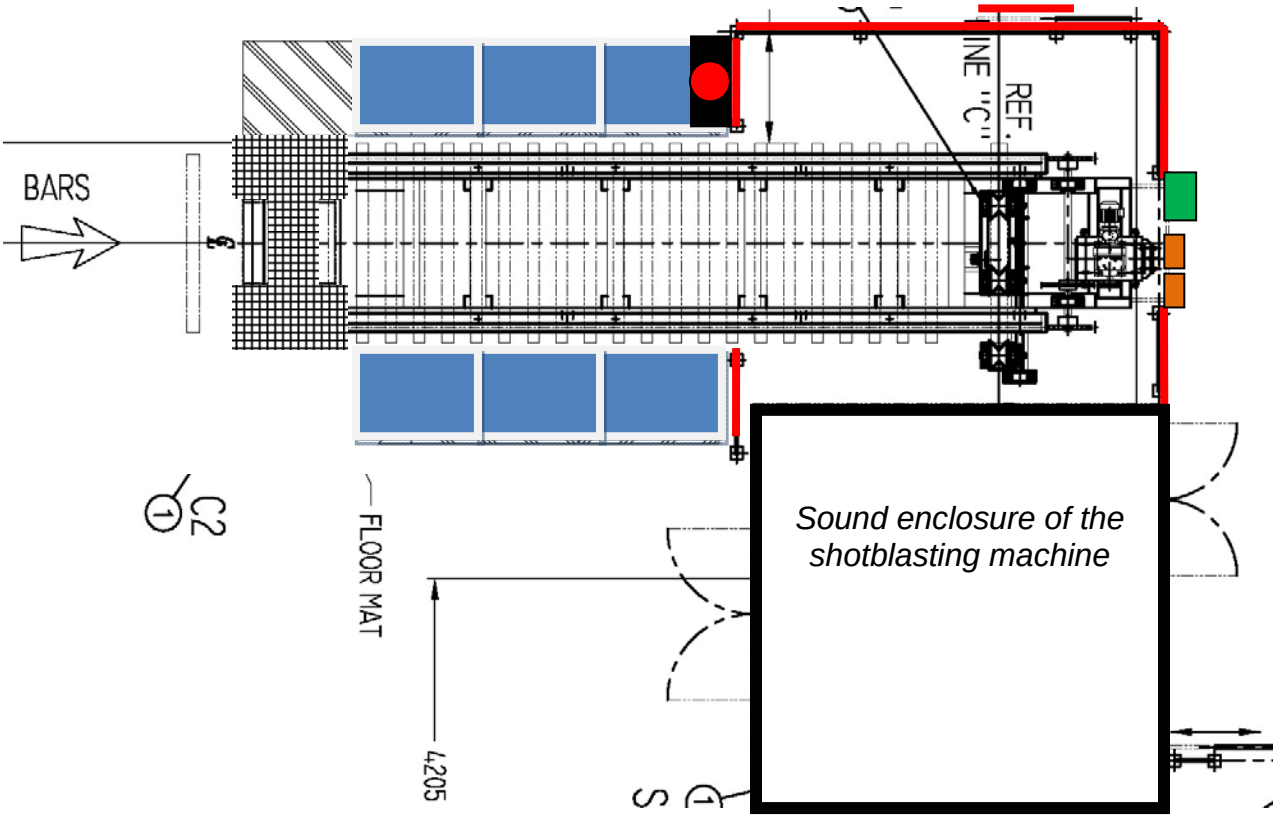
An entry request control station will be located near the zone. Refer to Control panel & junction box location drawing 1347-52250. Each entry request control station is equipped with an emergency pushbutton (mushroom type).

THE PROCEDURE IS ALWAYS THE SAME FOR ALL FENCING AREA.

THE GATE WILL BE NORMALLY LOCKED. THE PROCEDURE TO OPEN A GATE AND HAVE ACCESS TO THE HAZARDOUS AREA IS AS FOLLOWS:

1. **REQUEST ACCESS TO THE SPECIFIC ZONE BY PRESSING THE GREEN PUSHBUTTON ON THE ENTRY REQUEST CONTROL STATION. THE PLC WILL FINISH THE CYCLE (IF REQUIRED). AFTER THE CYCLE IS COMPLETED, THE GREEN LIGHT WILL FLASH.**
2. **LOCAL DISCONNECT SWITCH OF ALL MOTORS OF THE AREA SHALL BE DISABLED AND PADLOCKED (OFF).**
3. **LOCAL HYDRAULIC MANUAL VALVE SHALL BE CLOSED AND PADLOCKED.**
4. **THE PLC WILL VERIFY IF ALL THE MOTORS ARE DISABLED (OFF) AND VERIFY THE HYDRAULIC VALVE POSITION (CLOSED). WHEN VERIFICATION IS CONFIRMED, THE GREEN LIGHT WILL STOP FLASHING AND REMAIN ON TO ADVISE THE MAINTENANCE PERSONNEL THAT THE ZONE IS SECURED.**
5. **FOLLOWING THIS, MAINTENANCE PERSONNEL WILL RELEASE KEY A FROM THE SOLENOID RELEASE UNIT WHICH IS LOCATED NEAR THE ENTRY REQUEST CONTROL STATION.**
6. **WITH THE KEY A, THE MAINTENANCE PERSONNEL WILL OPEN THE INTERLOCK DEVICE OF THE GATE TO HAVE ACCESS IN THE ZONE.**
7. **AFTER MAINTENANCE PERSONNEL HAVE UNLOCKED THE GATE AND REMOVED KEY B, THIS KEY AND THE HYDRAULIC VALVE PADLOCK KEY ARE TO BE LOCKED IN THE APPROPRIATE KEY BOX. THE KEY BOX IS LOCATED INSIDE THE FENCED AREA AND SHALL BE PADLOCKED.**

WHEN/IF ADDITIONAL MAINTENANCE PERSONNEL REQUIRE ACCESS TO THE ZONE; THEY HAVE ONLY TO PADLOCK THE KEY BOX AT THE ENTRY OF THE HAZARDOUS ZONE.


BARS
REF. LINE "C"
C2
FLOOR MAT
4205
Sound enclosure of the shotblasting machine

SHOTBLASTING MACHINE (S1)
DUST COLLECTOR SYSTEM (D1)

The shotblasting machine is surrounded by a sound enclosure.

For maintenance personnel, the local safety disconnect switches will be installed inside the sound enclosure.

The top of the sound enclosure is opened.

THE DOORS WILL NOT BE LOCKED SINCE OPERATOR NEEDS ACCESS TO CHARGE SHOTS DURING OPERATION.

The sound enclosure will be equipped with double doors.

GUARD

All the rotating equipment, chains and sprockets are covered by guards inside the shotblasting machine.

During maintenance procedure, the personnel will have to disable local disconnect switches and padlock them prior to removing any guard.

HANDRAIL/LADDER

Handrail with a self closing gate is installed on top of the shotblasting machine. A ladder is provided to get access.

SHOT BLASTING OUTLET ROLLER CONVEYOR (R8)
TRANSFER CONVEYOR (C3)
BAR FURNACE INLET ROLLER CONVEYOR (R7)

FENCE WITH GATES

For the three conveyors, the individual equipment guard will be removed in favour of a fence surrounding the three conveyors. This fence will allow clear visibility for the maintenance personnel in order to facilitate troubleshooting and maintenance.

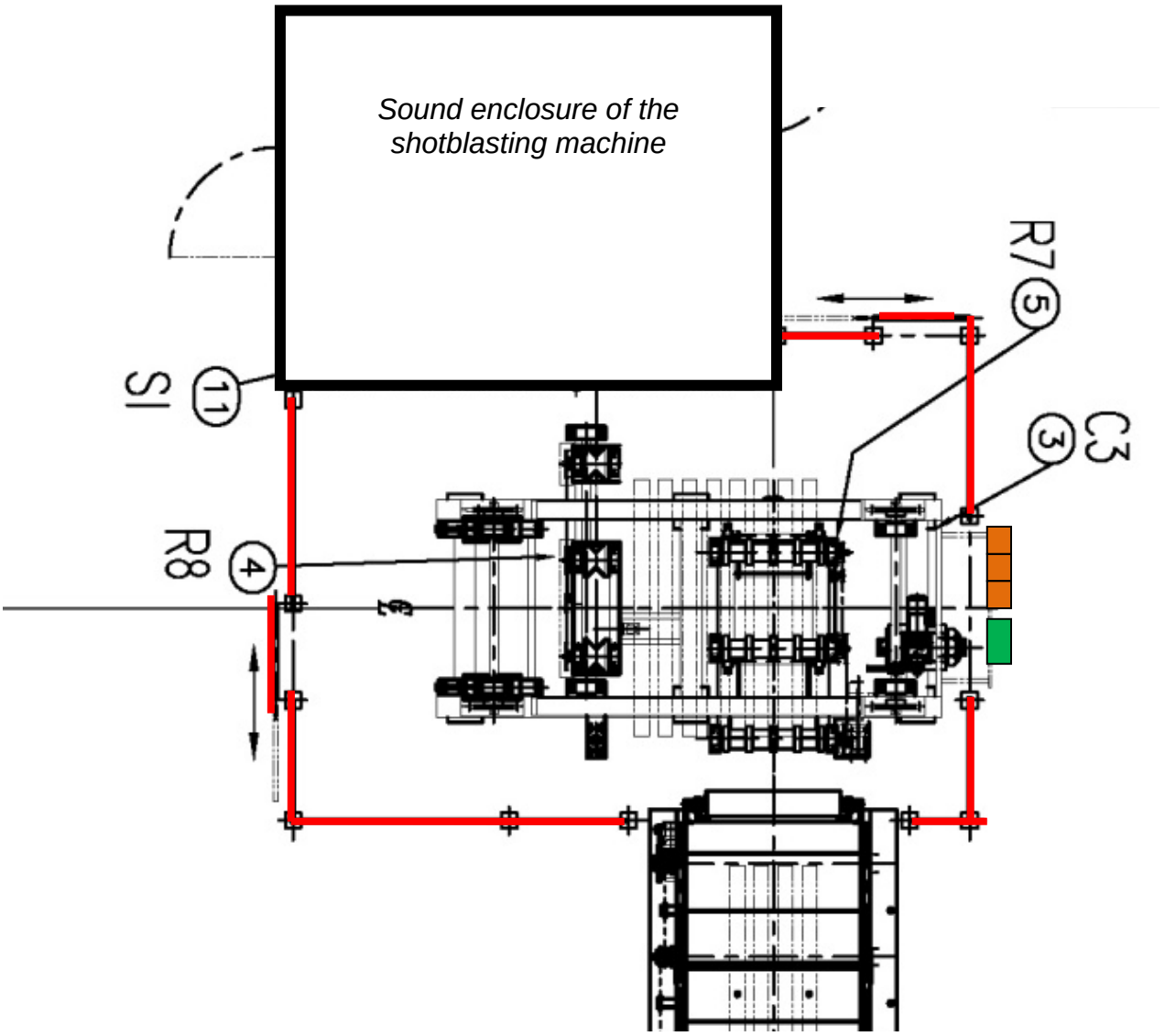
The local disconnect switches for the three motors will be installed outside of the fenced zone. A manual hydraulic valve that can be locked using a padlock will be accessible from outside the fenced area to isolate the zone.

An entry request control station will be located near the zone. Refer to Control panel & junction box location drawing 1347-52250. Each entry request control station is equipped with an emergency pushbutton (mushroom type).

The gate will be normally locked. The procedure to open a gate and have access to the hazardous area is as follows:

1. Request access to the specific zone by pressing the green pushbutton on the entry request control station. The PLC will finish the cycle (if required). After the cycle is completed, the green light will flash.
2. Local disconnect switch of ALL motors of the area shall be disabled and padlocked (off).
3. Local hydraulic manual valve shall be closed and padlocked.
4. The PLC will verify if all the motors are disabled (off) and verify the hydraulic valve position (closed). When verification is confirmed, the green light will stop flashing and remain ON to advise the maintenance personnel that the zone is secured.
5. Following this, maintenance personnel will release KEY A from the solenoid release unit which is located near the entry request control station.
6. With the KEY A, the maintenance personnel will open the interlock device of the gate to have access in the zone.
7. After maintenance personnel have unlocked the gate and removed KEY B, this key and the hydraulic valve padlock key are to be locked in the appropriate key box. The key box is located inside the fenced area and shall be padlocked.

When/if additional maintenance personnel require access to the zone; they have only to padlock the key box at the entry of the hazardous zone.


Sound enclosure of the shotblasting machine
R7
5
SI
11
C3
3
R8
4

CATHODE BAR FURNACE (F2)

GUARD

The bar furnace is provided with guards that prevent any injuries, refer to picture. We do not see any needs for fence around this equipment.

The furnace guarding system will be the same on each side. At the exit and the entry, the fence of the gantry zone and the inlet conveyor zone will prevent access to the door openings.

GUARD FOR ELEMENT

The guard will be locked in place with security screws. A special tool will be required to remove the guard.

DURING MAINTENANCE PERIOD, THE PERSONNEL WILL HAVE TO MANUALLY SET THE MAIN BREAKER TO THE OFF POSITION AND PADLOCK IT PRIOR TO REMOVING ANY GUARD ON THE FURNACE.

GUARD FOR CHAIN&SPROCKET

The guard will be locked in place with security screws. A special tool will be required to remove the guard.

DURING MAINTENANCE PROCEDURE, THE PERSONNEL WILL HAVE TO DISABLE LOCAL DISCONNECT SWITCHES AND PADLOCK THEM PRIOR TO REMOVING ANY GUARD.

POSITIONING GANTRY (G1)
ALIGNMENT STATION (A1)
BAR FURNACE OUTLET ROLLER CONVEYOR (R6)
BLOCK/BAR ASSEMBLY ROLLER CONVEYOR (R2)

These equipments shall be surrounded by fence to prevent any injuries and restrict access. Only maintenance personnel shall have access to this zone.

You have to pass under the gantry structure to get access to the center.

FENCE WITH GATES

Three gates will be provided to get access to the fenced area. This fence will allow clear visibility for the maintenance personnel in order to facilitate troubleshooting and maintenance.

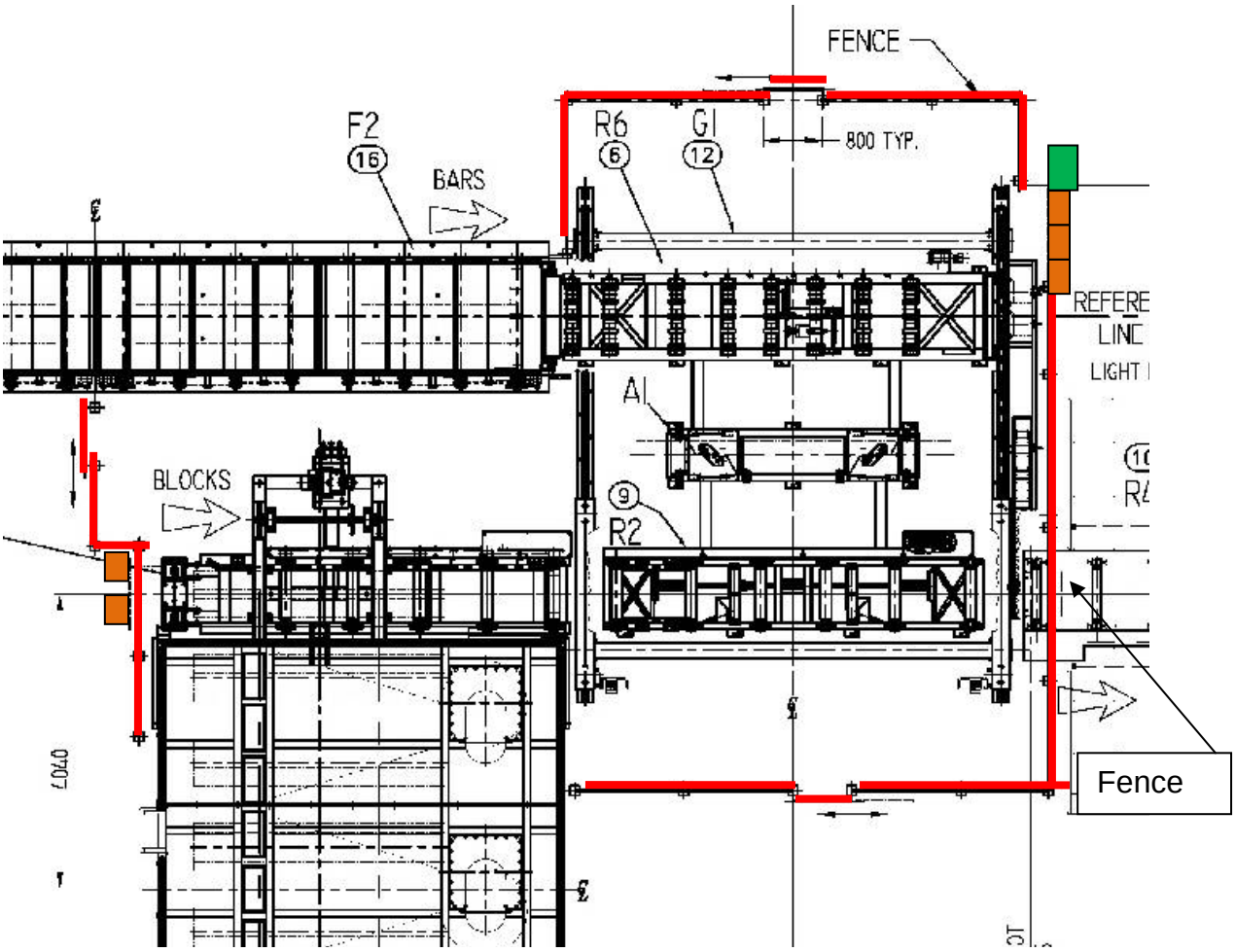
The local disconnect switches for ALL (seven) motors will be installed outside of the fenced zone. The hydraulic pump motors will have to be locked using a padlock to isolate the zone.

An entry request control station will be located near the zone. Refer to Control panel & junction box location drawing 1347-52250. Each entry request control station is equipped with an emergency pushbutton (mushroom type).

The gate will be normally locked. The procedure to open a gate and have access to the hazardous area is as follows:

1. Request access to the specific zone by pressing the green pushbutton on the entry request control station. The PLC will finish the cycle (if required). After the cycle is completed, the green light will flash.
2. Local disconnect switch of ALL motors of the area shall be disabled and padlocked (off).
3. Local hydraulic manual valve shall be closed and padlocked.
4. The PLC will verify if all the motors are disabled (off) and verify the hydraulic valve position (closed). When verification is confirmed, the green light will stop flashing and remain ON to advise the maintenance personnel that the zone is secured.
5. Following this, maintenance personnel will release KEY A from the solenoid release unit which is located near the entry request control station.
6. With the KEY A, the maintenance personnel will open the interlock device of the gate to have access in the zone.
7. After maintenance personnel have unlocked the gate and removed KEY B, this key and the hydraulic valve padlock key are to be locked in the appropriate key box. The key box is located inside the fenced area and shall be padlocked.

When/if additional maintenance personnel require access to the zone; they have only to padlock the key box at the entry of the hazardous zone.



LOCAL DISCONNECT STATIONS OF THE HYDRAULIC PUMPS ARE LOCATED IN THE HYDRAULIC ROOM.

BLOCK OVEN WITH INTEGRAL CHAIN CONVEYOR (F1;C1)

GUARD

We have a guard for the motorized components at the entry and loading side of the conveyor.

The guard will be locked in place using security screws. A special tool will be required to remove the guard.

During maintenance procedure, the personnel will have to disable local disconnect switches and padlock them prior to removing any guarding system.

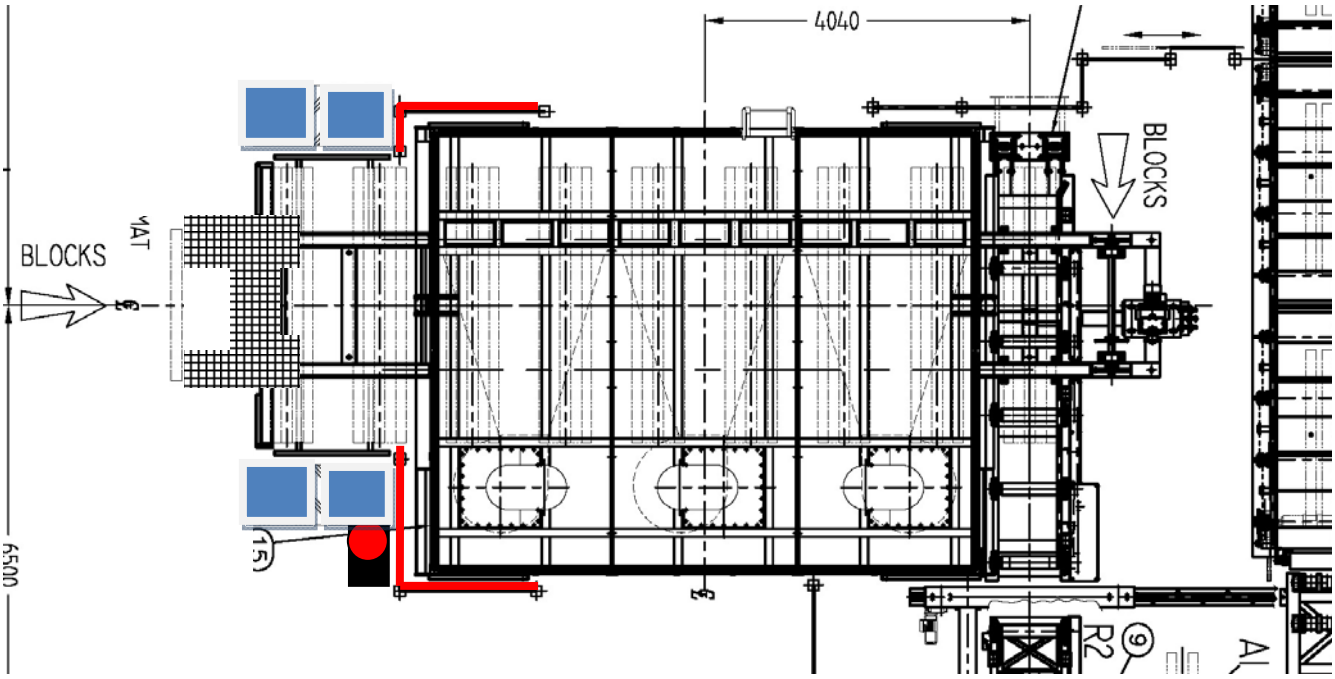
FLOOR MAT

A safety floor mat will be installed each side of the conveyor. When a presence will be detected on the floor mat the conveyor motor will automatically be disabled.

FLASHING LIGHT AND AUDIBLE SIGNAL

In order to prevent delay on the production, a flashing light (RED) and a sound signal will advise the operator during 5 seconds that the conveyor needs to move within the next 30 seconds (The light will remain for the duration of the movement). The operator will have to evacuate the zone (mat) to make sure it is not delaying the process.

Refer to drawing next page for guarding system at the block oven entry..


4040
BLOCKS
BLOCKS
4500
R2

HANDRAIL/LADDER

Only maintenance personnel should have access to the roof. Handrails are installed all around the furnace roof and grating is installed to facilitate the maintenance.

The roof will be closed by a self closing gate at the top.

Access to the roof will not stop fans or motors of the oven.

GUARD FOR ELEMENT

The guard for elements will be locked in place with security screws. A special tool will be required to remove the guard.

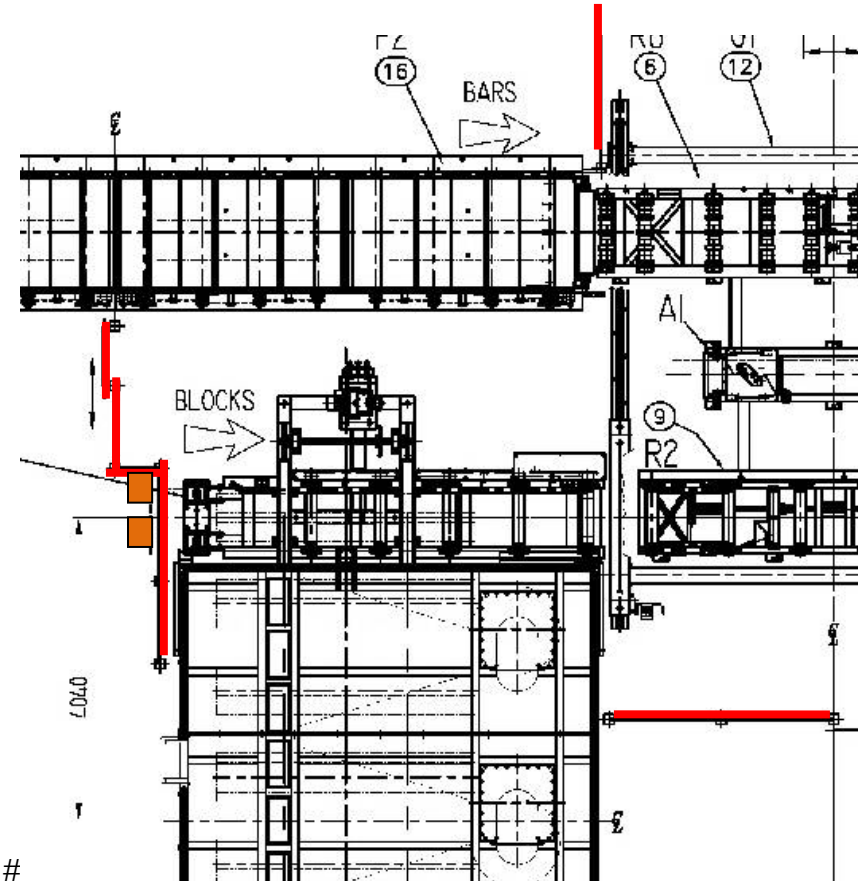
DURING MAINTENANCE PERIOD, THE PERSONNEL WILL HAVE TO MANUALLY SET THE MAIN BREAKER TO THE OFF POSITION AND PADLOCK IT PRIOR TO REMOVING ANY GUARD ON THE FURNACE.

THE LOCAL DISCONNECT SWITCHES OF FANS WILL BE LOCATED ON THE ROOF NEAR EACH MOTOR.

BLOCK OVEN OUTLET ROLLER CONVEYOR (R1)

Refer to drawing below for the fenced area at the block oven exit. The access is restricted to maintenance personnel. Refer to section of POSITIONING GANTRY (G1) for complete description.

For the conveyor, the individual equipment guard will be removed in favour of a fence surrounding the conveyor. This fence will allow clear visibility for the maintenance personnel in order to facilitate troubleshooting and maintenance.



#

PRE-STRESSING AND SEALING STATION (P1;R4)

We have two separate zones for the two prestressing stations.

GUARD

We have a guard for the motorized components at the entry and loading side of the conveyor.

The guard will be locked in place using security screws. A special tool will be required to remove the guard.

During maintenance procedure, the personnel will have to disable local disconnect switches and padlock them prior to removing any guards.

LIGHT CURTAIN

Three light curtains will be installed for each prestressing station.

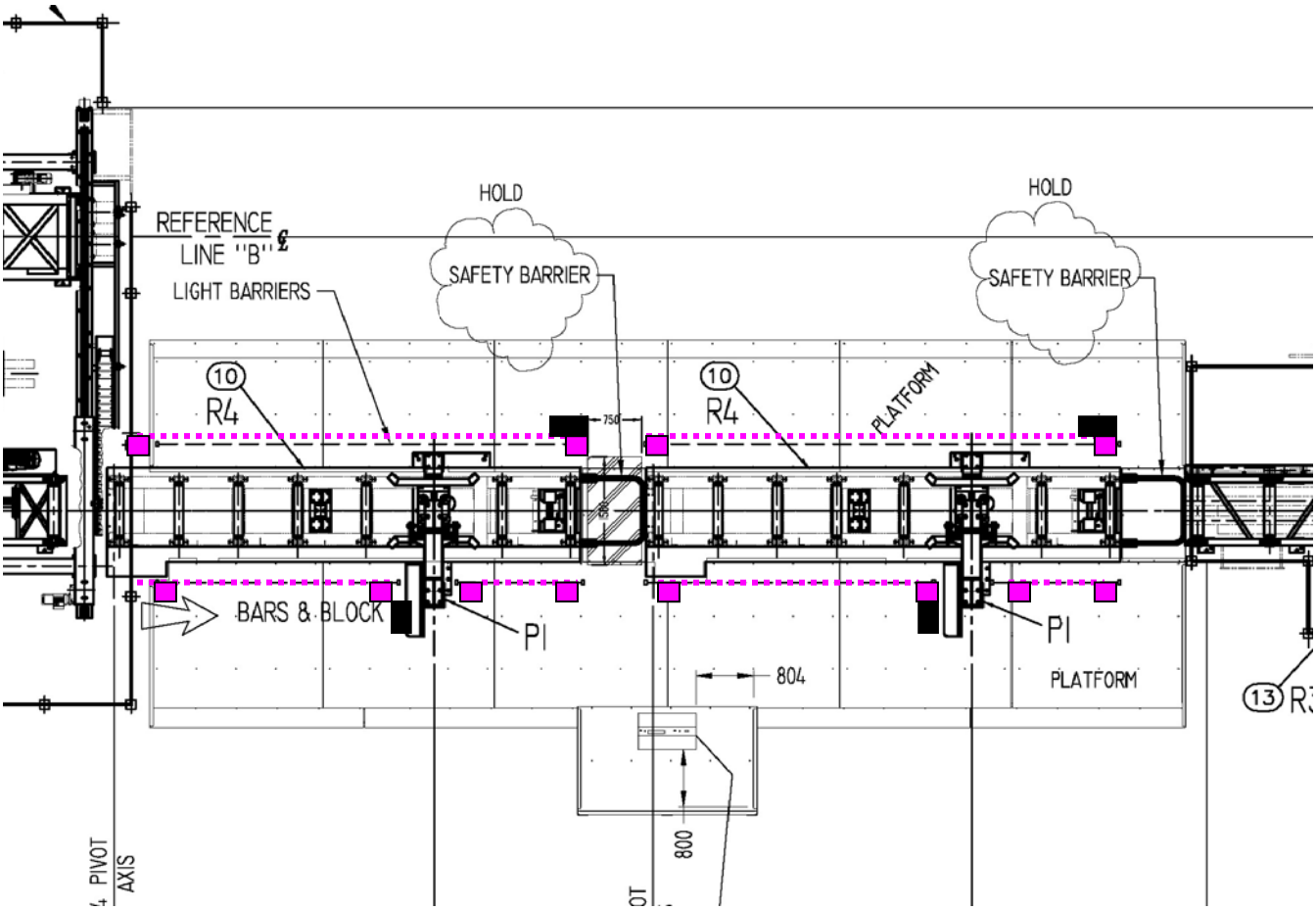
CROSSING THE LIGHT CURTAIN WILL STOP THE MOTOR OF THE CONVEYOR. THE LIGHT CURTAINS WILL HAVE TO BE RESET WHEN LEAVING THE HAZARDOUS AREA. THE LIGHT CURTAINS MUST BE ACTIVATED TO PERMIT THE MOVEMENT OF THE CONVEYOR.

A local control panel will be located outside the area with the reset pushbutton and will also be equipped with an emergency pushbutton (mushroom type).

PNEUMATIC

PNEUMATIC CYLINDER WILL NOT STOP WHEN AN OPERATOR IS CROSSING THE LIGHT CURTAINS. WE WILL INSTALL A STOP PUSHBUTTON TO ACTIVATE THE SOLENOID AND CHANGE THE DIRECTION OF THE CYLINDER.

Guard will be installed to limit access around the prestressing head.


HOLD
HOLD
REFERENCE
LINE "B"
LIGHT BARRIERS
SAFETY BARRIER
SAFETY BARRIER
10
R4
10
R4
PLATFORM
BARS & BLOCK
PI
PI
804
PLATFORM
13
800
PIVOT
AXIS

COOLING CONVEYOR (R3)
COOLING AND TURNING STATION (R5;T1)
COOLING CONVEYOR (C4)

GUARD

We have a guard for the motorized components at the entry and loading side of the conveyor. The guard will be locked in place using security screws. A special tool will be required to remove the guard.

During maintenance procedure, the personnel will have to disable local disconnect switches and padlock them prior to removing any guarding system.

FLOOR MAT

A safety floor mat will be installed each side of the conveyor. When a presence will be detected on the floor mat the conveyor motor will automatically be disabled.

FLASHING LIGHT AND AUDIBLE SIGNAL

In order to prevent delay on the production, a flashing light (RED) and a sound signal will advise the operator during 5 seconds that the conveyor needs to move within the next 30 seconds. (The light will remain for the duration of the movement). The operator will have to evacuate the zone (mat) to make sure it is not delaying the process.

FENCE WITH GATE

At the opposite end of this conveyor, the individual equipment guard will be removed in favour of a fence surrounding the whole conveyor. This fence will allow clear visibility for the maintenance personnel in order to facilitate troubleshooting and maintenance. The local disconnect switches for the two motors will be installed outside of the fenced zone. Also, a manual hydraulic valve that can be locked using a padlock will be accessible from outside the fenced area to isolate the zone.

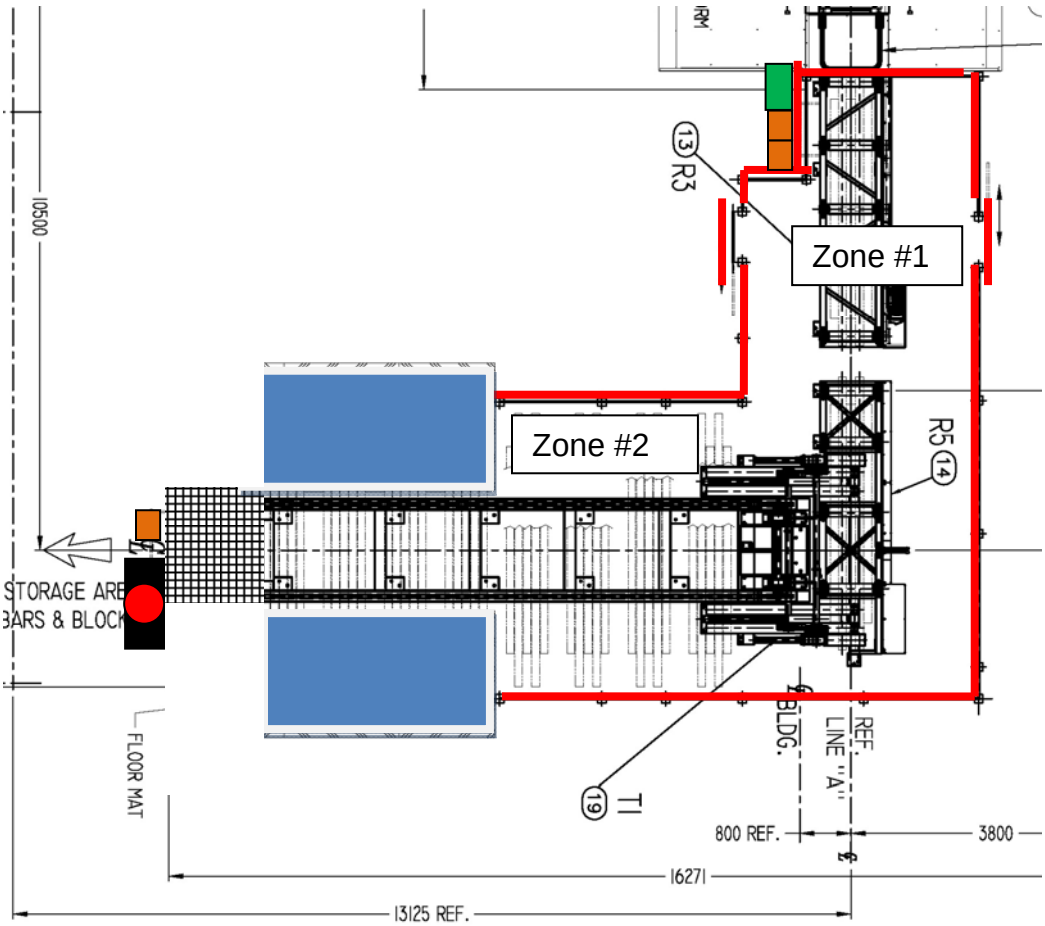
An entry request control station will be located near the zone. Refer to Control panel & junction box location drawing 1347-52250. Each entry request control station is equipped with an emergency pushbutton (mushroom type).

The gate will be normally locked. The procedure to open a gate and have access to the hazardous area is as follows:

1. Request access to the specific zone by pressing the green pushbutton on the entry request control station. The PLC will finish the cycle (if required). After the cycle is completed, the green light will flash.
2. Local disconnect switch of ALL motors of the area shall be disabled and padlocked (off).
3. Local hydraulic manual valve shall be closed and padlocked.
4. The PLC will verify if all the motors are disabled (off) and verify the hydraulic valve position (closed). When verification is confirmed, the green light will stop flashing and remain ON to advise the maintenance personnel that the zone is secured.
5. Following this, maintenance personnel will release KEY A from the solenoid release unit which is located near the entry request control station.
6. With the KEY A, the maintenance personnel will open the interlock device of the gate to have access in the zone.
7. After maintenance personnel have unlocked the gate and removed KEY B, this key and the hydraulic valve padlock key are to be locked in the appropriate key box. The key box is located inside the fenced area and shall be padlocked.

When/if additional maintenance personnel require access to the zone; they have only to padlock the key box at the entry of the hazardous zone.

The operator will have access to Zone #2 only.

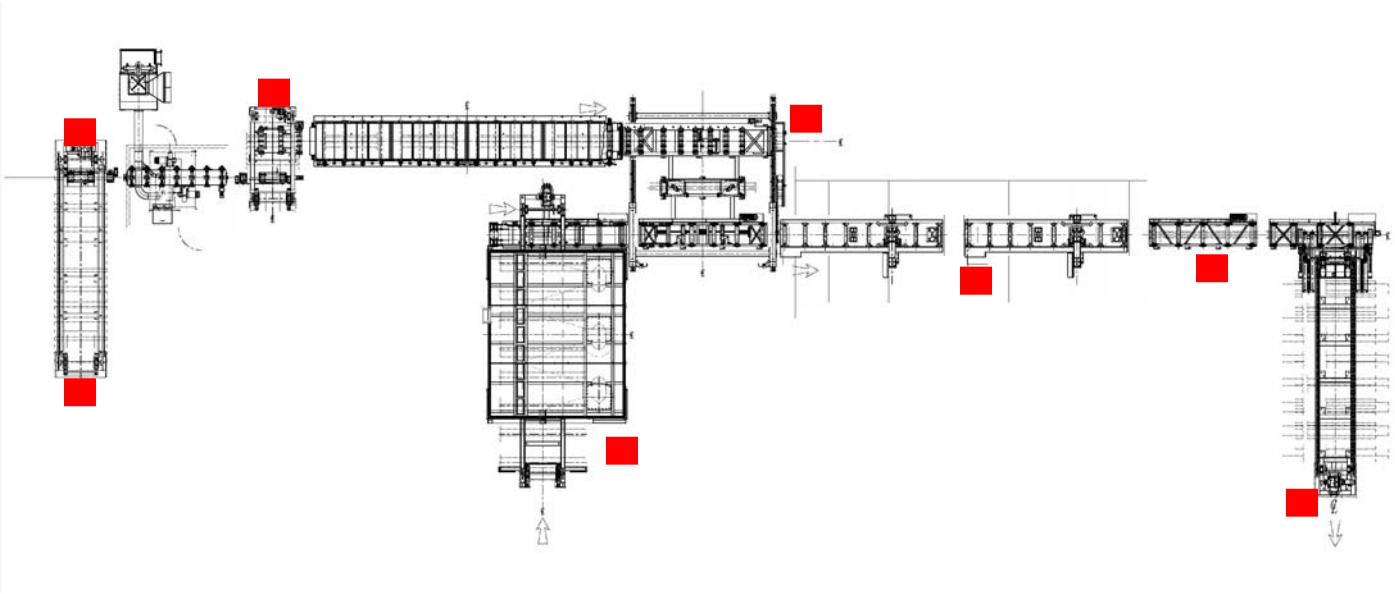


SAFETY INTERLOCK FOR MOTOR

** We have one safety interlock for each motor which are associated to safety issues of the motor as per your typical electrical motor schematic diagram, refer to the following drawings. **

DESCRIPTION	***DOCUMENT NUMBER***
Motor 4481-MHCD-0002-M1 Electrical Shematic Diagram	25457-4480-V1A-MXA0-0067
Motor 4481-MJRO-0001-M1 Electrical Shematic Diagram	25457-4480-V1A-MXA0-0068
Motor 4481-MZBP-0001-M1 Electrical Shematic Diagram	25457-4480-V1A-MXA0-0217
Motor 4481-MZBP-0001-M3 Electrical Shematic Diagram	25457-4480-V1A-MXA0-0218
Motor 4481-MZBP-0001-M7 Electrical Shematic Diagram	25457-4480-V1A-MXA0-0219
Motor 4481-MZBP-0001-M5 Electrical Shematic Diagram	25457-4480-V1A-MXA0-0220
Motor 4481-MZBP-0001-M2 Electrical Shematic Diagram	25457-4480-V1A-MXA0-0221
Motor 4481-MZBP-0001-M4 Electrical Shematic Diagram	25457-4480-V1A-MXA0-0222
Motor 4481-MZBP-0001-M6 Electrical Shematic Diagram	25457-4480-V1A-MXA0-0223
Motor 4481-MAC0-0001-M1 Electrical Shematic Diagram	25457-4480-V1A-MXA0-0224
Motor 4481-MJR0-0002-M1 Electrical Schematic Diagram	25457-4480-V1A-MXA0-0078
Motor 4481-MJR0-0002-M1-Electrical Schematic Diagram	25457-4480-V1A-MXA0-0225
Motor 4481-MHCD-0003-M1 Electrical Schematic Diagram	25457-4480-V1A-MXA0-0079
Motor 4481-MHCD-0003-M1 Electrical Shematic Diagram	25457-4480-V1A-MXA0-0226
Motor 4481-MJR0-0003-M1 Electrical Schematic Diagram	25457-4480-V1A-MXA0-0080
Motor 4481-MJR0-0003-M1 Electrical Shematic Diagram	25457-4480-V1A-MXA0-0227
Motor 4481-MBMB-0001-M1 Electrical Shematic Diagram	25457-4480-V1A-MXA0-0228
Motor 4481-MBMB-0001-M2 Electrical Shematic Diagram	25457-4480-V1A-MXA0-0229
Motor 4481-MBMB-0001-M3 Electrical Shematic Diagram	25457-4480-V1A-MXA0-0230
Motor 4481-MBMB-0001-M4 Electrical Shematic Diagram	25457-4480-V1A-MXA0-0231

EMERGENCY STOP LOCATION



WHEN ACTIVATED, THE EMERGENCY STOP PUSHBUTTONS WILL STOP ALL THE CATHODE ASSEMBLY LINE .

INSTRUMENTATION

DATA SHEET OF THIS EQUIPMENT IS IN THE SECTION 7 OF THIS MAINTENANCE AND OPERATION MANUAL. REFER TO AS BUILT ELECTRICAL DRAWING FOR THE COMPLETE MODEL NUMBER AND FINAL SELECTION.

Safety light curtain: C2 area
Allen Bradley PAC type 4
Model # 445L
Dimensions are shown in appendix A

The light curtain will be 840mm with three active zones of 120mm and two passive zones of 240mm.

Safety relay: Allen Bradley
Model number # MSR127

Flashing light with audible unit: Télémécanique
Model number # XVB

Trapped Key Switch: Allen Bradley
Model number # 440T
Refer to Appendix A

The trap key system can be removed once an external signal is given to its internal solenoid locking mechanism. An indicator light on the solenoid release unit indicates when the trapped key can be removed.

Exchange Units: Allen Bradley
Model Number #440T
1 key with 2 key out

The operating principle is such that no secondary key can be removed from the unit until all primary keys have been inserted.

Access Interlock device: Allen Bradley
Model Number #440T

See data sheet in appendix A

Single Key Access Lock:
Allen Bradley
Model number # 440T
Mainly for guard

Non-contact safety switches:
Allen Bradley
Model number # 440N

Guard Locking switch:
Allen Bradley
Model number # 440G

Floor mat:
Allen Bradley MatGuard
Model number # 440F

2.4 Material Safety Data Sheet – Refractory

- THERMAL CERAMIC - Superwool 607
- THERMAL CERAMIC – Insulating Refractory Brick
- THERMAFIBER – Insulation KFAC 19

Thermal Ceramics

MATERIAL SAFETY DATA SHEET

MSDS No: 600	Date Prepared: 03/30/2004	Current Date: 5/9/2008 Last Revised: (05/09/2008)

1. PRODUCT AND COMPANY IDENTIFICATION

Product Group: **ALKALINE EARTH SILICATE (AES) WOOL PRODUCT**

Chemical Name: Calcium-Magnesium-Silicate Wool

Synonyms: AES Wool, CMS Wool, Synthetic Vitreous Fiber (SVF), Man-made Vitreous Fiber (MMVF), Man-made Mineral Fiber (MMMF)

Trade Names: Superwool™ (*) 607HT: Bulk, Blanket, Mat, Module, Bloc, Log, Strip, Die-Cut

Manufacturer/Supplier:

Thermal Ceramics Inc.
P. O. Box 923; Dept. 300
Augusta, GA 30903-0923

For Product Stewardship and Emergency Information -
Hotline: 1-800-722-5681
Fax: 706-560-4054

For additional MSDSs and to confirm this is the most current MSDS for the product, visit our web page [*www.thermalceramics.com*]

*** Superwool™ is a trademark of The Morgan Crucible Company plc**

2. COMPOSITION/INFORMATION ON INGREDIENTS

INGREDIENT & CAS NUMBER	% BY WEIGHT	OSHA PEL	ACGIH TLV
Alkaline-Earth Silicate Wool [(1)] 436083-99-7	100	15 mg/m^3 (total dust) 5 mg/m^3 (respirable dust)	10 mg/m^3 (inhalable dust) 3 mg/m^3 (respirable dust)

[(1)] **CAS definition:** Alkaline Earth Silicate (AES) consisting of silica (50-82 wt %), calcia and magnesia (18-43 wt %), alumina, titania and zirconia (less than 6 wt %), and trace oxides. This CAS composition also covers Thermal Ceramics products Calcium-Magnesium-Silicate Wool (CAS no. 329211-92-9) and Calcium-Magnesium-Zirconium-Silicate Wool (CAS no. 308084-09-5).

(See Section 8 "Exposure Controls / Personal Protection" for exposure guidelines.)

3. HAZARDS IDENTIFICATION

- May cause temporary, mild mechanical irritation to the eyes, skin, nose and/or throat.
- Pre-existing skin and respiratory conditions may be aggravated by exposure.

4. FIRST AID MEASURES

RESPIRATORY TRACT (nose and throat) IRRITATION
If respiratory tract irritation develops, move the person to a dust free location. See Section 8 for additional measures to reduce or eliminate exposure.

EYE IRRITATION
If eyes become irritated, flush immediately with large amounts of lukewarm water for at least 15 minutes. Eyelids should be held away from the eyeball to ensure thorough rinsing. Do not rub eyes.

SKIN IRRITATION
If skin becomes irritated, remove soiled clothing. Do not rub or scratch exposed skin. Wash area of contact thoroughly with soap and water. Using a skin cream or lotion after washing may be helpful.

GASTROINTESTINAL IRRITATION
If gastrointestinal tract irritation develops, move the person to a dust free environment.

- If symptoms persist, seek medical attention. -

NOTE TO PHYSICIANS
Skin and respiratory effects are the result of temporary, mild mechanical irritation; fiber exposure does not result in allergic manifestations.

5. FIRE FIGHTING MEASURES

NFPA Codes: **Flammability: 0 , Health: 1 , Reactivity: 0 , Special: 0**

NFPA Unusual Hazards:	None
Flammable Properties:	None
Flash Point:	None
Hazardous Decomposition Products:	None
Unusual Fire and Explosion Hazard:	None
Extinguishing Media:	Use extinguishing media suitable for type of surrounding fire.

6. ACCIDENTAL RELEASE MEASURES

SPILL PROCEDURES
Avoid creating airborne dust. Dust suppressing cleaning methods such as wet sweeping or vacuuming should be used to clean the work area. If vacuuming, the vacuum should be equipped with a HEPA filter. Compressed air or dry sweeping should not be used for cleaning.

7. HANDLING AND STORAGE

STORAGE
Store in original factory container in a dry area. Keep container closed when not in use.

HANDLING
Limit use of power tools unless in conjunction with local exhaust. Use hand tools whenever possible. Frequently clean the work area with HEPA filtered vacuum or wet sweeping to minimize the accumulation of debris. Do not use compressed air for clean-up.

EMPTY CONTAINERS
Do not reuse the container.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

MANUFACTURER'S RECOMMENDATION
It is prudent to reduce exposure to respirable dusts to the lowest attainable level through the use of engineering controls such as ventilation and dust collection devices. Industrial hygiene standards and occupational exposure limits may vary between countries, state and local jurisdictions. Contact your employer to determine which exposure levels apply to your facility. If no regulatory dust or other standards apply, a qualified industrial hygienist can assist with a specific workplace evaluation including recommendations for respiratory protection. In the absence of such guidance, the manufacturer generally recommends the control of CMS wool exposures to 1 fiber/cc or less.

ENGINEERING CONTROLS

Use feasible engineering controls such as local exhaust ventilation, point of generation dust collection, down draft work stations, emission controlling tool designs, and materials handling equipment designed to minimize airborne fiber emissions.

PERSONAL PROTECTION EQUIPMENT

Skin Protection

Wear gloves, head coverings and full body clothing as necessary to prevent skin irritation. Washable or disposable clothing may be used. If possible, do not take unwashed work clothing home. If soiled work clothing must be taken home, employers should ensure employees are trained on the best practices to minimize or avoid non-work dust exposure (e.g., vacuum clothes before leaving the work area, wash work clothing separately, rinse washer before washing other household clothes, etc.).

Eye Protection

Wear safety glasses with side shields or other forms of eye protection in compliance with appropriate OSHA standards to prevent eye irritation. The use of contact lenses is not recommended, unless used in conjunction with appropriate eye protection. Do not touch eyes with soiled body parts or materials. If possible, have eye-washing facilities readily available where eye irritation can occur.

Respiratory Protection

When it is not possible or feasible to reduce respirable dust exposures through engineering controls, employees are encouraged to use good work practices together with respiratory protection. Comply with OSHA Respiratory Protection Standards, 29 CFR 1910.134 and 29 CFR 1926.103, for the particular hazard or airborne concentrations to be encountered in the work environment. For the most current information on respirator selection, contact your supplier.

9. PHYSICAL AND CHEMICAL PROPERTIES

ODOR AND APPEARANCE:	White odorless material with a wool type appearance
CHEMICAL FAMILY:	Calcium, Magnesium, Silicate Mixture
BOILING POINT:	Not Applicable
WATER SOLUBILITY (%):	Slight
MELTING POINT:	> 1400℃ (2552℉)
SPECIFIC GRAVITY RANGE:	2.5 – 3.0 (for fiber)
VAPOR PRESSURE:	Not Applicable
pH:	Not Applicable
VAPOR DENSITY (Air = 1):	Not Applicable
% VOLATILE:	Not Applicable
MOLECULAR FORMULA:	Not Applicable

10. STABILITY AND REACTIVITY

CHEMICAL STABILITY:	Stable under conditions of normal use
CHEMICAL INCOMPATIBILITIES:	Avoid contact with strong acids.
CONDITIONS TO AVOID:	None
HAZARDOUS DECOMPOSITION PRODUCTS:	Upon heating above 900℃ for sustained periods, thi s amorphous material begins to transform to mixtures of crystalline phases. For further information please refer to Section 16.
HAZARDOUS POLYMERIZATION:	Not applicable

11. TOXICOLOGICAL INFORMATION

TOXICOLOGY

CMS wools have been tested for their biopersistence using methods devised by the European Union. The results from these studies exonerate CMS wools from carcinogen classification under the criteria listed in Nota Q of European Commission Directive 97/69/EU.

In a lifetime carcinogenicity test, rats were exposed by inhalation for two years (5 days a week; 6 hours a day) to CMS fibers at 200 WHO fibers/ml. There was neither fibrosis nor carcinogenic response; only reversible cellular changes

were seen. Further, subchronic inhalation studies on rats with CMS fibers at concentrations of 150 fibers (>20 µm long) per ml for 90 days with follow up to 1 year showed neither inflammation nor cell proliferation. All parameters studied returned rapidly to baseline levels on cessation of exposure.

After-service, CMS wools may contain crystalline phases including some forms of silica. (See Section 16) However, CMS fibers heated to 1000℃ for 2 weeks were not cytot oxic to macrophage-like cells at concentrations up to 320 µg/cm^2. In the same test, samples of pure crystalline quartz were significantly active at 20 µg/cm^2.

EPIDEMIOLOGY
This material has not been the subject of an epidemiology study.

NOTE
Neither the International Agency for Research on Cancer (IARC) nor the National Toxicology Program nor any other U.S. regulatory or classification entity has evaluated CMS wool. Superwool products are members of a family of materials whose properties are distinct in several ways from other man-made mineral fibers. In October 2001 IARC re-reviewed Man-Made Vitreous Fibers and "elected not to make an overall evaluation of the newly developed fibers" [such as CMS wool] but recognized that "those that have been tested appear to have low carcinogenic potential in experimental animals."

While CMS wool is an inert material that does not react with the skin, exposures may cause temporary mild mechanical irritation to the eyes, skin, nose and/or throat (for First Aid Measurers, see Section 4). Proper handling practices and the use of protective clothing (see Section 8) can minimize irritation.

12. ECOLOGICAL INFORMATION

No adverse effects of this material on the environment are anticipated.

13. DISPOSAL INFORMATION

WASTE MANAGEMENT
To prevent waste materials becoming airborne, a covered container or plastic bagging is recommended.

RCRA
CMS wool, as manufactured, is not classified as a hazardous waste according to Federal regulations (40 CFR 261). As manufactured, CMS wool was tested using EPA's Toxicity Characteristics Leaching Procedure (TCLP). Results showed there were no detectable contaminants or detectable leachable contaminants that exceeded the regulatory levels. Any processing, use, alteration or chemical additions to the product, as purchased, may alter the disposal requirements. Under Federal regulations, it is the waste generator's responsibility to properly characterize a waste material, to determine if it is a "hazardous" waste. Check local, regional, state or provincial regulations to identify all applicable disposal requirements.

14. TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION (DOT)

Hazard Class:	Not regulated	United Nations (UN) Number:	Not applicable
Labels:	Not applicable	North America (NA) Number:	Not applicable
Placards:	Not applicable		
Bill of Lading:	Product name		

INTERNATIONAL
Not classified as dangerous goods under ADR (road), RID (train), IATA (air) or IMDG (ship).

15. REGULATORY INFORMATION

UNITED STATES REGULATIONS
SARA Title III: This product does not contain any substances reportable under Sections 302, 304, 313 (40 CFR 372). Sections 311 and 312 apply.

OSHA: Comply with Hazard Communication Standards 29 CFR 1910.1200 and 29 CFR 1926.59 and Respiratory Protection Standards 29 CFR 1910.134 and 29 CFR 1926.103.

TSCA: CMS wools have been assigned two CAS numbers; however, they are not required to be listed on the TSCA inventory.

CERCLA: CMS wool contains fibers with an average diameter greater than one micron and thus is not considered a CERCLA hazardous substance.

CAA: CMS wool contains fibers with an average diameter greater than one micron and thus is not considered a hazardous air pollutant.

States: CMS wools are not known to be regulated by any State. If in doubt, contact your local regulatory agency.

INTERNATIONAL REGULATIONS

Canada WHMIS: No Canadian Workplace Hazardous Materials Information System categories apply to this product.

Canadian EPA: All substances in this product are listed, as required, on the Domestic Substance List (DSL).

European Union: These products are exonerated from any carcinogenic classification in the countries of the European Union under the provisions of Nota Q of the European Commission Directive 97/69/EC.

16. OTHER INFORMATION

SUPERWOOL™ DEVITRIFICATION

As produced, Superwools™ are vitreous (glassy) AES Wools that do not contain crystalline silica. Continued exposure to elevated temperatures (>900^{0}C) may cause these materials to form crystalline phases, including crystalline silica. The occurrence and extent of crystalline silica formation is dependent on the duration and temperature of exposure, CMS Wool chemistry and/or the presence of fluxing agents. The presence of crystalline silica can be confirmed only through laboratory analysis of the "hot face" fiber. If crystalline silica is present, follow appropriate hygiene standards and national regulations.

Devitrified, after-service Superwool™, containing crystalline silica, has shown no adverse reactions in toxicity assays (See Section 11). These findings are consistent with IARC's evaluation, which states "Crystalline silica inhaled in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (Group 1)" and additionally notes "carcinogenicity in humans was not detected in all industrial circumstances studied. Carcinogenicity may be dependent on inherent characteristics of the crystalline silica or on external factors affecting its biological activity or distribution of its polymorphs." (IARC Monograph Vol. 68, 1997).

Respirable dust from devitrified Superwool™ products can be controlled with ventilation, dust collectors or respiratory protection as detailed in Section 8 (above). Ventilation and respiratory protection should be provided in compliance with OSHA standards. The evaluation of workplace hazards and, if necessary, the identification of appropriate respiratory protection is best performed by qualified Industrial Hygienists.

For more information, call the Thermal Ceramics Product Stewardship Hotline (800-722-5681).

PRODUCT STEWARDSHIP PROGRAM

Morgan Thermal Ceramics has established a program to provide customers with up-to-date information regarding the proper use and handling of Superwool™. If you would like more information about this program, please call your local supplier or visit one of the following web sites.

Thermal Ceramics - Global	www.thermalceramics.com
Refractory Ceramic Fibers Coalition (USA)	www.RCFC.net
ECFIA (Europe)	www.ecfia.org

LABELING

As product information labels may be required on Superwool™ packages, check local destination regulations before shipping.

HMIS HAZARD RATING

HMIS Health: 1
HMIS Flammable: 0
HMIS Reactivity: 0
HMIS Personal Protective: To be determined by user

DEFINITIONS

ACGIH:	American Conference of Governmental Industrial Hygienists
ADR:	Carriage of Dangerous Goods by Road (International Regulation)
CAA:	Clean Air Act
CAS:	Chemical Abstracts Service Registry Number
CERCLA:	Comprehensive Environmental Response, Compensation and Liability Act
EPA:	Environmental Protection Agency
EU:	European Union
f/cc:	Fibers per cubic centimeter
HEPA:	High Efficiency Particulate Air
HMIS:	Hazardous Materials Identification System
IARC:	International Agency for Research on Cancer
IATA:	International Air Transport Association
IMDG:	International Maritime Dangerous Goods Code
mg/m^3 :	Milligrams per cubic meter of air
mppcf:	Million particles per cubic meter
MSHA:	Mine Safety and Health Administration
NFPA:	National Fire Protection Association
NIOSH:	National Institute for Occupational Safety and Health
OSHA:	Occupational Safety and Health Administration
PEL:	Permissible Exposure Limit
PNOC:	Particulates Not Otherwise Classified
PNOR:	Particulates Not Otherwise Regulated
RCRA:	Resource Conservation and Recovery Act
RID:	Carriage of Dangerous Goods by Rail (International Regulation)
SARA:	Superfund Amendments and Reauthorization Act
Title III:	Emergency Planning and Community Right to Know Act
…Section 302:	Extremely Hazardous Substances
…Section 304:	Emergency Release
…Section 311:	MSDS/List of Chemicals
…Section 312:	Emergency and Hazardous Inventory
…Section 313:	Toxic Chemicals Release Reporting
STEL:	Short-Term Exposure Limit
TCLP:	Toxicity Characteristics Leaching Procedures (EPA)
TLV:	Threshold Limit Values (ACGIH)
TSCA:	Toxic Substance Control Act
WHMIS:	Workplace Hazardous Materials Information System (Canada)

29 CFR 1910.134 & 1926.103: OSHA Respiratory Protection Standards
29 CFR 1910.1200 & 1926.59: OSHA Hazard Communication Standards

Revision Summary: **Section 1: Content revised.**
Section 2: Alkaline-Earth Silicate Wool CAS number changed and content revised.

MSDS Prepared By: THERMAL CERAMICS ENVIRONMENTAL, HEALTH & SAFETY DEPARTMENT

DISCLAIMER

The information presented herein is presented in good faith and believed to be accurate as of the effective date of this Material Safety Data Sheet. Employers may use this MSDS to supplement other information gathered by them in their efforts to assure the health and safety of their employees and the proper use of the product. This summary of the relevant data reflects professional judgment; employers should note that information perceived to be less relevant has not been included in this MSDS. Therefore, given the summary nature of this document, Thermal Ceramics does not extend any warranty (expressed or implied), assume any responsibility, or make any representation regarding the completeness of this information or its suitability for the purposes envisioned by the user.

Thermal Ceramics

MATERIAL SAFETY DATA SHEET

MSDS No: 151-1	Date Prepared: 03/28/1995	Current Date: 9/20/2004 Last Revised: (09/20/2004)

1. PRODUCT AND COMPANY IDENTIFICATION

Product Group: **INSULATING REFRACTORY BRICK**
Chemical Name: Aluminosilicate Product
Intended Use: High Temperature Thermal Insulation
Trade Names: K-20, K-22 HS, K-23, JM-20, JM-23, K-24 HS, K-25, K-26, IFB Dust (Low Temp), TC-23, TC-23 HS

Manufacturer/Supplier:

Thermal Ceramics Inc.
P. O. Box 923; Dept. 300
Augusta, GA 30903-0923

For Product Stewardship and Emergency Information -
Hotline: 1-800-722-5681
Fax: 706-560-4054

For additional MSDSs and to confirm this is the most current MSDS for the product, visit our web page [*www.thermalceramics.com*]

2. COMPOSITION/INFORMATION ON INGREDIENTS

INGREDIENT & CAS NUMBER	% BY WEIGHT	OSHA PEL	ACGIH TLV
Anorthite NONE	Up to 70	15 mg/m^3 (total dust) 5 mg/m^3 (respirable dust)	10 mg/m^3 (inhalable dust) 3 mg/m^3 (respirable dust)
Glass 65997-17-3	Up to 30	15 mg/m^3 (total dust) 5 mg/m^3 (respirable dust)	10 mg/m^3 (inhalable dust) 3 mg/m^3 (respirable dust)
Mullite 1344-28-1	Up to 20	15 mg/m^3 (total dust) 5 mg/m^3 (respirable dust)	10 mg/m^3 (inhalable dust) 3 mg/m^3 (respirable dust)
Crystalline silica 14808-60-7 or 14464-46-1	Up to 5	See notes[(1)]	0.05 mg/m^3 (respirable dust)

NOTES:

(1) Depending on the percentage and type(s) of silica in the mineral, the OSHA Permissible Exposure Limit (PEL) for respirable dust containing crystalline silica (8 HR TWA) is based on the formula listed in 29 CFR 1910.1000, "Air Contaminants" under Table Z-3, "Mineral Dust". For quartz containing mineral dust, the PEL = 10 mg/m³ / (% of silica + 2); for cristobalite or tridymite, the PEL = 5 mg/m³/ (% of silica + 2); for mixtures, the PEL = 10 mg/m³ / (% of quartz + 2 (% of cristobalite) + 2 (% of tridymite) + 2).

(See Section 8 "Exposure Controls / Personal Protection" for exposure guidelines.)

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

WARNING!
Respirable dust from these products may contain crystalline silica, which is known to cause respiratory disease.
(See Section 11 for more information)

POSSIBLE HEALTH EFFECTS

Target Organs:	Eyes, skin, nose and/or throat
Primary Entry Route:	Inhalation
Acute effects:	May cause temporary, mild mechanical irritation to the eyes, skin, nose and/or throat. Pre-existing skin and respiratory conditions may be aggravated by exposure.
Chronic effects:	Prolonged/repeated inhalation of respirable crystalline silica may cause delayed lung injury (e.g.: silicosis, lung cancer).

HAZARD CLASSIFICATION

Dust samples from these products have not been tested for their specific toxicity, but may contain more than 0.1% crystalline silica, for which the following apply:

The **International Agency for Research on Cancer (IARC)** has classified crystalline silica inhaled in the form of quartz or cristobalite from occupational sources as carcinogenic to humans (Group 1).

The Ninth Annual Report on Carcinogens (2000), prepared by the **National Toxicology Program (NTP),** classified silica, crystalline (respirable size), as a substance known to be a human carcinogen.

The **American Conference of Governmental Industrial Hygienists (ACGIH)** has classified crystalline silica (quartz) as “A2-Suspected Human Carcinogen.”

The **State of California,** pursuant to Proposition 65, The Safe Drinking Water and Toxic Enforcement Act of 1986, has listed "silica, crystalline (airborne particles of respirable size)" as a chemical known to the State of California to cause cancer.

The **Canadian Workplace Hazardous Materials Information System (WHMIS) –** Crystalline silica [quartz and cristobalite] is classified as Class D2A - Materials Causing Other Toxic Effects.

The **Hazardous Materials Identification System (HMIS) –**
Health: 0* Flammability: 0 Reactivity: 0 Personal Protection Index: X (Employer determined)
(* denotes potential for chronic effects)

4. FIRST AID MEASURES

EYE IRRITATION:
Flush with large amounts of water for at least 15 minutes. Do not rub eyes.

SKIN IRRITATION:
Wash affected area gently with soap and water. Skin cream or lotion after washing may be helpful.

INGESTION:
Unlikely route of exposure.

INHALATION:
Remove affected person to dust free location. See Section 8 for additional measures to reduce or eliminate exposure.

- If symptoms persist, seek medical attention. -

5. FIRE FIGHTING MEASURES

NFPA CODES: **Flammability: 0 , Health: 1 , Reactivity: 0 , Special: 0**

NFPA Unusual Hazards: None
Flash Point: None
Extinguishing Media: Use extinguishing media suitable for type of surrounding fire.
Explosion Hazards: None
Hazardous Decomposition Products: None

6. ACCIDENTAL RELEASE MEASURES

SPILL/LEAK PROCEDURES:

Avoid creating airborne dust. Follow routine housekeeping procedures. Vacuum only with HEPA filtered equipment. If sweeping is necessary, use a dust suppressant and place material in closed containers. Do not use compressed air for clean-up. Personnel should wear gloves, goggles and approved respirator.

7. HANDLING AND STORAGE

HANDLING

Limit the use of power tools unless in conjunction with local exhaust. Use hand tools whenever possible. Frequently clean the work area with HEPA filtered vacuum or wet sweeping to minimize the accumulation of debris. Do not use compressed air for clean-up.

STORAGE

Store in original factory container in a dry area. Keep container closed when not in use.

EMPTY CONTAINERS

Product packaging may contain residue. Do not reuse.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

ENGINEERING CONTROLS

Use engineering controls, such as ventilation and dust collection devices, to reduce airborne particulate concentrations to the lowest attainable level.

RESPIRATORY PROTECTION

When it is not possible or feasible to reduce airborne crystalline silica or particulate levels below the PEL through engineering controls, or until they are installed, employees are encouraged to use good work practices together with respiratory protection. Before providing respirators to employees (especially negative pressure type), employers should **1)** monitor for airborne crystalline silica and/or dust concentrations using appropriate NIOSH analytical methods and select respiratory protection based upon the results of that monitoring , **2)** have the workers evaluated by a physician to determine the workers' ability to wear respirators, and **3)** implement respiratory protection training programs. Use NIOSH-certified particulate respirators (42 CFR 84), in compliance with OSHA Respiratory Protection Standard 29 CFR 1910.134 and 29 CFR 1926.103, for the particular hazard or airborne concentrations to be encountered in the work environment. For the most current information on respirator selection, contact your supplier.

PROTECTIVE CLOTHING

Wear full body clothing, gloves, hat, and eye protection as necessary to prevent skin irritation. Washable or disposable clothing may be used. If possible, do not take unwashed work clothing home. If soiled work clothing must be taken home, employers should ensure employees are trained on the best practices to minimize or avoid non-work dust exposure (e.g., vacuum clothes before leaving the work area, wash work clothing separately, rinse washer before washing other household clothes, etc.).

EYE PROTECTION

Wear safety glasses with side shields or other forms of eye protection in compliance with appropriate OSHA standards to prevent eye irritation. The use of contact lenses is not recommended, unless used in conjunction with appropriate eye protection. Do not touch eyes with soiled body parts or materials. If possible, have eye-washing facilities readily available where eye irritation can occur.

9. PHYSICAL AND CHEMICAL PROPERTIES

ODOR AND APPEARANCE:	Solid brick or block
CHEMICAL FAMILY:	Insulating refractory brick
BOILING POINT:	Not applicable
WATER SOLUBILITY (%):	Not soluble in water
MELTING POINT:	2750°F to 2800°F
SPECIFIC GRAVITY:	Not applicable
VAPOR PRESSURE:	Not applicable
pH:	Not applicable
VAPOR DENSITY:	Not applicable
VOLATILE BY VOLUME (%):	Not applicable
MOLECULAR FORMULA:	Not Applicable

10. STABILITY AND REACTIVITY

HAZARDOUS POLYMERIZATION:	Will not occur
CHEMICAL INCOMPATIBILITIES:	Powerful oxidizers; fluorine, manganese trioxide, oxygen disulfide
HAZARDOUS DECOMPOSITION PRODUCTS:	None

11. TOXICOLOGICAL INFORMATION

TOXICOLOGY

Dust samples from these products have not been tested. They may contain respirable crystalline silica.

Crystalline silica

Some samples of crystalline silica administered to rats by inhalation and intratracheal instillation have caused fibrosis and lung cancer. Mice and hamsters, similarly exposed, develop inflammatory disease including fibrosis but no lung cancer.

EPIDEMIOLOGY

No studies have been undertaken on humans exposed to these products in occupational environments.

Crystalline silica

Exposure to crystalline silica can cause silicosis, and exacerbate pulmonary tuberculosis and bronchitis. IARC (Monograph vol. 68, 1997) concluded that “crystalline silica from occupational sources inhaled in the form of quartz or cristobalite is carcinogenic to humans (Group 1)”, and noted that “carcinogenicity in humans was not detected in all industrial circumstances studied” and “may be dependent on inherent characteristics of the crystalline silica or on external factors affecting its biological activity”.

12. ECOLOGICAL INFORMATION

Adverse effects of this material on the environment are not anticipated.

13. DISPOSAL INFORMATION

WASTE MANAGEMENT

To prevent waste materials becoming airborne during waste storage, transportation and disposal, a covered container or plastic bagging is recommended. Comply with federal, state and local regulations.

DISPOSAL

If discarded in its purchased form, this product would not be a hazardous waste under Federal regulations (40 CFR 261) Any processing, use, alteration or chemical additions to the product, as purchased, may alter the disposal requirements. Under Federal regulations, it is the waste generator's responsibility to properly characterize a waste material, to determine if it is a hazardous waste. Check local, regional, state or provincial regulations to identify all applicable disposal requirements.

14. TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION (DOT)

Hazard Class:	Not Regulated	United Nations (UN) Number:	Not Applicable
Labels:	Not Applicable	North America (NA) Number:	Not Applicable
Placards:	Not Applicable	Bill of Lading:	Product Name

INTERNATIONAL

Canadian TDG Hazard Class & PIN: Not regulated
Not classified as dangerous goods under ADR (road), RID (train) or IMDG (ship).

15. REGULATORY INFORMATION

UNITED STATES REGULATIONS

SARA Title III: This product does not contain any substances reportable under Sections 302, 304, 313 (40 CFR 372). Sections 311 and 312 apply.

OSHA: Comply with Hazard Communication Standards 29 CFR 1910.1200 and 29 CFR 1926.59 and Respiratory Protection Standards 29 CFR 1910.134 and 29 CFR 1926.103.

TSCA: All substances contained in this product are listed in the TSCA Chemical Inventory

California: "Silica, crystalline (airborne particles of respirable size)" is listed in Proposition 65, The Safe Drinking Water and Toxic Enforcement Act of 1986 as a chemical known to the State of California to cause cancer.

Other States: Crystalline silica products are not known to be regulated by states other than California; however, state and local OSHA and EPA regulations may apply to these products. Contact your local agency if in doubt.

INTERNATIONAL REGULATIONS

Canadian WHMIS: Class D-2A Materials Causing Other Toxic Effects

Canadian EPA: All substances in this product are listed, as required, on the Domestic Substance List (DSL).

16. OTHER INFORMATION

SARA TITLE III HAZARD CATEGORIES

Acute Health:	No	**Pressure Hazard:**	No
Chronic Health:	Yes	**Reactivity Hazard:**	No
Fire Hazard:	No		

DEFINITIONS:

ACGIH:	American Conference of Governmental Industrial Hygienists
ADR:	Carriage of Dangerous Goods by Road (International Regulation)
CAA:	Clean Air Act
CAS:	Chemical Abstracts Service Registry Number
CERCLA:	Comprehensive Environmental Response, Compensation and Liability Act
EPA:	Environmental Protection Agency
EU:	European Union
f/cc:	Fibers per cubic centimeter
HEPA:	High Efficiency Particulate Air
HMIS:	Hazardous Materials Identification System
IARC:	International Agency for Research on Cancer
IATA:	International Air Transport Association
IMDG:	International Maritime Dangerous Goods Code
mg/m^3 :	Milligrams per cubic meter of air
mppcf:	Million particles per cubic meter
MSHA:	Mine Safety and Health Administration
NFPA:	National Fire Protection Association
NIOSH:	National Institute for Occupational Safety and Health
OSHA:	Occupational Safety and Health Administration
PEL:	Permissible Exposure Limit
PNOC:	Particulates Not Otherwise Classified
PNOR:	Particulates Not Otherwise Regulated
RCRA:	Resource Conservation and Recovery Act
RID:	Carriage of Dangerous Goods by Rail (International Regulation)
SARA:	Superfund Amendments and Reauthorization Act
Title III:	Emergency Planning and Community Right to Know Act
…Section 302:	Extremely Hazardous Substances
…Section 304:	Emergency Release
…Section 311:	MSDS/List of Chemicals
…Section 312:	Emergency and Hazardous Inventory
…Section 313:	Toxic Chemicals Release Reporting
STEL:	Short-Term Exposure Limit
TCLP:	Toxicity Characteristics Leaching Procedures (EPA)
TLV:	Threshold Limit Values (ACGIH)
TSCA:	Toxic Substance Control Act
WHMIS:	Workplace Hazardous Materials Information System (Canada)
29 CFR 1910.134 & 1926.103:	OSHA Respiratory Protection Standards
29 CFR 1910.1200 & 1926.59:	OSHA Hazard Communication Standards

Revision Summary: Product **TC-23 and TC-23 HS** added under Trade Names.
Faxback information removed.

MSDS Prepared By: THERMAL CERAMICS ENVIRONMENTAL, HEALTH & SAFETY DEPARTMENT

DISCLAIMER

The information presented herein is presented in good faith and believed to be accurate as of the effective date of this Material Safety Data Sheet. Employers may use this MSDS to supplement other information gathered by them in their efforts to assure the health and safety of their employees and the proper use of the product. This summary of the relevant data reflects professional judgment; employers should note that information perceived to be less relevant has not been included in this MSDS. Therefore, given the summary nature of this document, Thermal Ceramics does not extend any warranty (expressed or implied), assume any responsibility, or make any representation regarding the completeness of this information or its suitability for the purposes envisioned by the user.

MATERIAL SAFETY DATA SHEET
THERMAFIBER® KFAC-19

Thermafiber Inc.
3711 W. Mill Street Extended
Wabash, Indiana 46992
Phone (260) 563-2111
Version Date: December 4, 2003
MSDS NO. 00001, Version 4

SECTION I
PRODUCT IDENTIFICATION

PRODUCT(S): THERMAFIBER® KFAC-19
®Trademark of Thermafiber Inc.
SYNONYM: Insulation
CHEMICAL FAMILY: Man-made Vitreous Fibers.

SECTION II
INGREDIENTS

MATERIAL	WT%	ACGIH TLV	OSHA PEL	CAS NUMBER
Mineral wool fiber[1]	0-60	Respirable: 1 f/cc	Respirable: 1 f/cc	65997-17-3
Fibrous Glass	0-5	1 f/cc	1 f/cc	65997-17-3
Hydrous Aluminum Silicate	15-25	As respirable crystalline silica: 0.1 mg/m3	As respirable crystalline silica: 0.1 mg/m3	14808-60-7

If laminated, contains the following adhesive:
Vinyl alcohol polymer <1 (NE) (NE) 9002-89-5
(T) - Total (R) - Respirable (NE) - Not Established

[1]OSHA and ACGIH recommended exposure level is 1 fiber/cc and NIOSH recommended exposure level is 3 fibers/cc. This material is slag wool. Other generic terms that are used or have been used to classify this material include mineral wool, stone wool, man-made mineral fiber (MMMF), and man-made vitreous fiber (MMVF). A more recent generic term that has appeared in the literature to describe these glass-like materials is synthetic vitreous fiber (SVF).

SECTION III
HAZARD IDENTIFICATION

POTENTIAL HEALTH EFFECTS:
ACUTE: The components of panels are bound in a cementitious matrix. When panels are cut or trimmed, especially with power tools, the resulting dust may cause mechanical irritation.
EYES: Direct contact with eye can cause mechanical irritation.
SKIN: This material (in wet state or as dust) is not chemically harmful if it gets on the skin and is not immediately washed off. However direct contact of dust and especially mineral wool fibers with skin can cause skin irritation (mechanical) and itchiness.
INHALATION: Inhalation of dust can cause nose, throat, lungs and upper respiratory tract irritation. Persons exposed to dust may be forced to leave area because of nuisance conditions such as coughing, sneezing and nasal irritation.
INGESTION: No known effects.
CHRONIC: Prolonged and repeated overexposure to respirable crystalline silica may result in lung disease (i.e., silicosis) and/or lung cancer. Persons with chronic or systemic skin or eye disease should use extra ordinary precautions and wear all personal protective equipment when working with this product. *Fiber Glass and Mineral Wool:* In October 2001, the International Agency for Research on Cancer (IARC) classified fiber glass wool as Group 3 (not classifiable as to carcinogenicity to humans).

SECTION IV
FIRST AID MEASURES

EYES: In case of contact, immediately flush thoroughly with copious amounts of water occasionally lifting the lower and upper lids (to remove particulates). Get medical attention immediately. Contact lenses should not be worn when working with this product.
SKIN: Skin contact is not a chemical hazard. Mechanical action of fibers on skin can cause itchiness. Irritation of skin may occur with prolonged and repeated contact. Rinse with cool water, followed by washing with soap and warm water. A commercially available skin cream or lotion may be helpful to treat dry skin areas. Wash hands before eating or using restroom.
INHALATION: If exposed to excessive levels of dust, leave area of dust exposure and remain away until coughing and other symptoms subside. Other measures are usually not necessary, however if conditions warrant, get medical attention.
INGESTION: No harmful or chronic effects expected. No specific recommendation. If gastric disturbance occurs, call physician.
TARGET ORGANS: Eyes, skin, lungs and respiratory system.
MEDICAL CONDITIONS WHICH MAY BE AGGRAVATED: Pre-existing upper respiratory and lung disease such as, but not limited to, bronchitis, emphysema and asthma.
PRIMARY ROUTES OF ENTRY: Inhalation, eyes and skin contact. Note to physician: This product is a mechanical irritant, and is not expected to produce any chronic health effects from acute exposures. Treatment should be directed toward removing the source of irritation with symptomatic treatment as necessary.

SECTION V
FIRE FIGHTING MEASURES

The products are non-combustible and do not pose a fire hazard. However, packaging material may burn.
Extinguishing Media: Water fog, dry chemical ABC, rated not combustible.
Special Fire Fighting Procedures: No special procedures are expected to be necessary for this product. Normal fire fighting procedures should be followed to avoid inhalation of smoke and gases.
Unusual Fire and Explosion Hazards: None.
Special Fire Fighting Protective Equipment: Observe normal fire fighting procedures.
Flash Point (Method Used): Not applicable.
Upper and lower flammable limits in air: Not applicable.
Autoignition temperature: Not applicable.
Hazardous Combustion Products: Carbon dioxide, carbon monoxide and trace gases.

SECTION VI
ACCIDENTAL RELEASE MEASURES

CONTAINMENT: Not necessary. Treat as inert material.
CLEAN UP: Pick up large pieces. Use gloves to avoid skin irritation. Avoid creating dust and install in well ventilated area. Cut and trim with razor knife or hand saw to minimize dust levels. Using power tools for cutting will generate high dust levels. Power tools should be equipped with dust collection system. If sweeping is necessary, use dust suppressant such as water. Do not dry sweep dust accumulation or use compressed air for clean up. These procedures will help minimize potential exposures.
DISPOSAL: Dispose in sanitary landfill in accordance with local, state and federal requirements.

SECTION VII
HANDLING AND STORAGE

HANDLING: Use protective equipment to avoid irritation as described in Section 8.
STORAGE: Warehouse storage should be in accordance with package directions. Material should be kept dry and protected from the elements.

SECTION VIII
EXPOSURE CONTROL/PERSONAL PROTECTION

ENGINEERING CONTROLS: Provide general ventilation and local exhaust ventilation to meet TLV requirements of individual ingredients (see Section 2) and to control dusting conditions.
If cutting or trimming with power equipment, dust collectors and local ventilation should be used.
Avoid unnecessary exposure to dust and handle with care. Keep work area clean of dust and fibers by using an industrial vacuum cleaner with high efficiency filter or wetting down area with water. Never use compressed air and avoid dry sweeping.
EYE PROTECTION: Wear safety glasses with sideshields or goggles to avoid eye irritation.
RESPIRATORY PROTECTION: Wear a NIOSH/MSHA-approved dust

respirator in poorly ventilated areas, where local exhaust is not feasible, if TLV is exceeded, and/or when dusty conditions exist. Avoid prolonged and repeated breathing of dust.
PERSONAL PROTECTIVE EQUIPMENT: Wear tight fitting goggles and gloves when dusty conditions exist. Wear long-sleeved, loose fitting clothing at the neck and wrists and minimize skin contact. Wash work clothing separately from other clothing. Rinse washer thoroughly after use.

SECTION IX
PHYSICAL AND CHEMICAL PROPERTIES

- **Appearance and Odor:** Gray, pressed man-made vitreous fiber panel of various colors.
- **Physical State:** Solid
- **Boiling Point:** Not applicable
- **Freezing Point:** Not applicable
- **Melting Point:** 2100º F (1150º C)
- **Specific Gravity (H_2O=1):** Not applicable
- **Solubility in Water:** Not applicable
- **pH Range:** Not applicable
- **Vapor Pressure:** Not applicable
- **Evaporation Rate (in-Butyl Acetate=1):** Not applicable
- **Percent Volatile:** Not applicable
- **Volatile Organic Compounds:** Not applicable

SECTION X
CHEMICAL STABILITY

STABILITY: Stable
REACTIVITY: Not reactive
INCOMPATIBILITY: Not known
HAZARDOUS POLYMERIZATION: Not applicable
HAZARDOUS DECOMPOSITION: Carbon dioxide, and other trace pyrolysis products typical of decomposition of any organic compound.

SECTION XI
TOXICOLOGICAL INFORMATION

ACUTE DATA:
SLAG WOOL FIBER (65997-17-3)
Oral LD_{50}RAT: Not determined
Dermal LD_{50}RAT: Not determined
Skin Irritation: Mechanical Irritant
Eye Irritation: Mechanical Irritant
Contact with this material may cause temporary eye and skin irritation (mechanical). When products are handled continually, the skin irritation generally diminishes.
Chronic Data: Prolonged and repeated overexposure to respirable crystalline silica may result in lung disease (i.e., silicosis) and/or lung cancer. Persons with chronic or systemic skin or eye disease should use extra ordinary precautions and wear all personal protective equipment when working with this product. *Fiber Glass and Mineral Wool Fiber:.* In October 2001, the International Agency for Research on Cancer (IARC) classified fiber glass wool as Group 3 (not classifiable as to carcinogenicity to humans.

SECTION XII
ECOLOGICAL INFORMATION

This product is not expected to have an adverse effect on the environment.

SECTION XIII
DISPOSAL CONSIDERATIONS

WASTE DISPOSAL METHOD: Dispose of material in accordance with federal, state, and local regulations.
WASTE NUMBERS: No EPA Waste Numbers are applicable for this product's components.

SECTION XIV
TRANSPORT INFORMATION

U.S. DOT INFORMATION: Not a hazardous material per DOT shipping requirements. Not classified or regulated.

SECTION XV
REGULATORY INFORMATION

USA REGULATIONS:
All ingredients of this product are included in the U.S. Environmental Protection Agency's Toxic Substances Control Act Chemical Substance Inventory.

CARCINOGENICITY CLASSIFICATION OF INGREDIENTS:

Material	IARC	NTP
Mineral Wool Fiber	Group 3	None
Fibrous Glass	Group 3	None
Crystalline Silica	Group 1	Anticipated

Fiber Glass Wool: In October 2001, the International Agency for Research on Cancer (IARC) classified fiber glass wool as Group 3 (not classifiable as to carcinogenicity to humans). *Mineral Wool Fiber:* In October 2001, the International Agency for Research on Cancer (IARC) classified fiber glass wool as Group 3 (not classifiable as to carcinogenicity to humans). *Crystalline Silica:* Long term exposure to crystalline silica dust in concentrations higher than the recommended PEL or TLV may cause silicosis. NTP has classified respirable crystalline silica as a substance that may be anticipated to be a carcinogen. IARC has established a group 1 classification to crystalline silica as a known carcinogen to humans.

SECTION XVI
OTHER INFORMATION

INFORMATION FOR HANDLING AND IDENTIFICATION OF CHEMICAL HAZARDS

NFPA Ratings:	Health: 0	Fire: 0	Reactivity: 0	Other: N/A
HMIS Ratings:	Health: 1	Fire: 0	Reactivity: 0	

Personal Protection: Use eye and skin protection. Use NIOSH/MSHA - approved respiratory protection when necessary.
0 = Minimal Hazard 1 = Slight Hazard 2 = Moderate Hazard
3 = Serious Hazard 4 = Severe Hazard
△ **WARNING:**
Sustained high level exposure to crystalline silica is thought to increase the risk of lung cancer. Dust exposure can cause temporary eye, skin and respiratory tract irritation. Avoid creating dust and install in well ventilated area. Cut and trim with razor knife or hand saw to minimize dust levels. Using power tools for cutting will generate high dust levels. Power tools should be equipped with dust collection system. Use NIOSH/MSHA-approved dust respirator. Avoid dust contact with eyes and skin. Wear eye protection and long-sleeve, loose fitting clothing closed at the neck and wrists. Wash work clothing separately from other clothing. Rinse washer thoroughly.

KEEP OUT OF REACH OF CHILDREN
THIS PRODUCT CONTAINS NO ASBESTOS

FIRST AID: For skin irritation, rinse skin with cool water, followed by washing with soap and warm water. For eye irritation, flush eyes thoroughly with water for 15 minutes. If irritation continues, or product is swallowed, consult a physician. Additional product safety information is available on the Thermafiber web site, www.thermafiber.com or by calling (260) 563-2111.

Key/Legend

ACGIH	American Conference of Government Industrial Hygienists
CAS	Chemical Abstracts Service (Registry Number)
DOT	United States Department of Transportation
EPA	United States Environmental Protection Agency
HMIS	Hazardous Materials Identification System
IARC	International Agency for Research on Cancer
MSDS	Material Safety Data Sheet
MSHA	Mine Safety and Health Administration
NFPA	National Fire Protection Association
NIOSH	National Institute for Occupational Safety & Health
NTP	National Toxicology Program
OSHA	Occupational Health and Safety Administration
PEL	Permissible Exposure Limit
TLV	Threshold Limit Value

12/03 Printed in U.S.A.

2.5 Material Safety Data Sheet – Oil / Grease

- SHELL OMALA –Oil
- DOW CORNING –Molykote Bearing Grease

Material Safety Data Sheet

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND COMPANY/UNDERTAKING

Material Name	:	**Shell Omala Oil 220**
Uses	:	Gear lubricant.
Product Code	:	001A0776
Manufacturer/Supplier	:	**Shell UK Oil Products Limited** PO Box 3 Ellesmere Port CH65 4HB United Kingdom
Telephone	:	+44-(0) 151-350-4000
Fax	:	+44-(0) 151-350-4843
Emergency Telephone Number	:	+44-(0) 151-350-4595

2. COMPOSITION/INFORMATION ON INGREDIENTS

Preparation description	:	Highly refined mineral oils and additives.
Additional Information	:	The highly refined mineral oil contains <3% (w/w) DMSO-extract, according to IP346.

3. HAZARDS IDENTIFICATION

EC Classification	:	Not classified as dangerous under EC criteria.
Health Hazards	:	Not expected to be a health hazard when used under normal conditions. Prolonged or repeated skin contact without proper cleaning can clog the pores of the skin resulting in disorders such as oil acne/folliculitis. Used oil may contain harmful impurities.
Signs and Symptoms	:	Oil acne/folliculitis signs and symptoms may include formation of black pustules and spots on the skin of exposed areas. Ingestion may result in nausea, vomiting and/or diarrhoea.
Safety Hazards	:	Not classified as flammable but will burn.
Environmental Hazards	:	Not classified as dangerous for the environment.

4. FIRST AID MEASURES

General Information	:	Not expected to be a health hazard when used under normal conditions.
Inhalation	:	No treatment necessary under normal conditions of use. If symptoms persist, obtain medical advice.
Skin Contact	:	Remove contaminated clothing. Flush exposed area with water and follow by washing with soap if available. If persistent irritation occurs, obtain medical attention.
Eye Contact	:	Flush eye with copious quantities of water. If persistent

irritation occurs, obtain medical attention.

Ingestion	:	In general no treatment is necessary unless large quantities are swallowed, however, get medical advice.
Advice to Physician	:	Treat symptomatically.

5. FIRE FIGHTING MEASURES

Clear fire area of all non-emergency personnel.

Specific Hazards	:	Hazardous combustion products may include: A complex mixture of airborne solid and liquid particulates and gases (smoke). Carbon monoxide. Unidentified organic and inorganic compounds.
Extinguishing Media	:	Foam, water spray or fog. Dry chemical powder, carbon dioxide, sand or earth may be used for small fires only.
Unsuitable Extinguishing Media	:	Do not use water in a jet.
Protective Equipment for Firefighters	:	Proper protective equipment including breathing apparatus must be worn when approaching a fire in a confined space.

6. ACCIDENTAL RELEASE MEASURES

Avoid contact with spilled or released material. For guidance on selection of personal protective equipment see Chapter 8 of this Material Safety Data Sheet. See Chapter 13 for information on disposal. Observe all relevant local and international regulations.

Protective measures	:	Avoid contact with skin and eyes. Use appropriate containment to avoid environmental contamination. Prevent from spreading or entering drains, ditches or rivers by using sand, earth, or other appropriate barriers.
Clean Up Methods	:	Slippery when spilt. Avoid accidents, clean up immediately. Prevent from spreading by making a barrier with sand, earth or other containment material. Reclaim liquid directly or in an absorbent. Soak up residue with an absorbent such as clay, sand or other suitable material and dispose of properly.
Additional Advice	:	Local authorities should be advised if significant spillages cannot be contained.

7. HANDLING AND STORAGE

General Precautions	:	Use local exhaust ventilation if there is risk of inhalation of vapours, mists or aerosols. Properly dispose of any contaminated rags or cleaning materials in order to prevent fires. Use the information in this data sheet as input to a risk assessment of local circumstances to help determine appropriate controls for safe handling, storage and disposal of this material.
Handling	:	Avoid prolonged or repeated contact with skin. Avoid inhaling vapour and/or mists. When handling product in drums, safety footwear should be worn and proper handling equipment should be used.
Storage	:	Keep container tightly closed and in a cool, well-ventilated place. Use properly labelled and closeable containers. Storage

Temperature: 0 - 50°C / 32 - 122°F
The storage of this product may be subject to the Control of Pollution (Oil Storage) (England) Regulations. Further guidance maybe obtained from the local environmental agency office.

Recommended Materials : For containers or container linings, use mild steel or high density polyethylene.

Unsuitable Materials : PVC.

Additional Information : Polyethylene containers should not be exposed to high temperatures because of possible risk of distortion. Exposure to this product should be reduced as low as reasonably practicable. Reference should be made to the Health and Safety Executive's publication "COSHH Essentials".

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Occupational Exposure Limits

Exposure Controls : The level of protection and types of controls necessary will vary depending upon potential exposure conditions. Select controls based on a risk assessment of local circumstances. Appropriate measures include: Adequate ventilation to control airborne concentrations. Where material is heated, sprayed or mist formed, there is greater potential for airborne concentrations to be generated.

Personal Protective Equipment : Personal protective equipment (PPE) should meet recommended national standards. Check with PPE suppliers.

Respiratory Protection : No respiratory protection is ordinarily required under normal conditions of use. In accordance with good industrial hygiene practices, precautions should be taken to avoid breathing of material. If engineering controls do not maintain airborne concentrations to a level which is adequate to protect worker health, select respiratory protection equipment suitable for the specific conditions of use and meeting relevant legislation. Check with respiratory protective equipment suppliers. Where air-filtering respirators are suitable, select an appropriate combination of mask and filter. Select a filter suitable for combined particulate/organic gases and vapours [boiling point <65 °C (149 °F)] meeting EN371.

Hand Protection : Where hand contact with the product may occur the use of gloves approved to relevant standards (e.g. Europe: EN374, US: F739) made from the following materials may provide suitable chemical protection: PVC, neoprene or nitrile rubber gloves. Suitability and durability of a glove is dependent on usage, e.g. frequency and duration of contact, chemical resistance of glove material, glove thickness, dexterity. Always seek advice from glove suppliers. Contaminated gloves should be replaced. Personal hygiene is a key element of effective hand care. Gloves must only be worn on clean hands. After using gloves, hands should be washed and dried thoroughly. Application of a non-perfumed moisturizer is recommended.

Eye Protection : Wear safety glasses or full face shield if splashes are likely to occur. Approved to EU Standard EN166.

Protective Clothing	:	Skin protection not ordinarily required beyond standard issue work clothes.
Monitoring Methods	:	Monitoring of the concentration of substances in the breathing zone of workers or in the general workplace may be required to confirm compliance with an OEL and adequacy of exposure controls. For some substances biological monitoring may also be appropriate.
Environmental Exposure Controls	:	Minimise release to the environment. An environmental assessment must be made to ensure compliance with local environmental legislation.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	:	Brown. Liquid.
Odour	:	Slight hydrocarbon.
pH	:	Not applicable.
Boiling point	:	> 280 °C / 536 °F estimated value(s)
Pour point	:	Typical -18 °C / 0 °F
Flash point	:	Typical 200 °C / 392 °F (COC)
Explosion / Flammability limits in air	:	Typical 1 - 10 %(V) (based on mineral oil)
Auto-ignition temperature	:	> 320 °C / 608 °F
Vapour pressure	:	< 0.5 Pa at 20 °C / 68 °F (estimated value(s))
Density	:	Typical 899 kg/m3 at 15 °C / 59 °F
Water solubility	:	Negligible.
n-octanol/water partition coefficient (log Pow)	:	> 6 (based on information on similar products)
Kinematic viscosity	:	Typical 220 mm2/s at 40 °C / 104 °F
Vapour density (air=1)	:	> 1 (estimated value(s))
Evaporation rate (nBuAc=1)	:	Data not available

10. STABILITY AND REACTIVITY

Stability	:	Stable.
Conditions to Avoid	:	Extremes of temperature and direct sunlight.
Materials to Avoid	:	Strong oxidising agents.
Hazardous Decomposition Products	:	Hazardous decomposition products are not expected to form during normal storage.

11. TOXICOLOGICAL INFORMATION

Basis for Assessment	:	Information given is based on data on the components and the toxicology of similar products.
Acute Oral Toxicity	:	Expected to be of low toxicity: LD50 >2000 mg/kg , Rat
Acute Dermal Toxicity	:	Expected to be of low toxicity: LD50 >2000 mg/kg , Rabbit
Acute Inhalation Toxicity	:	This product is not expected to pose an inhalation hazard under conditions of foreseeable use.
Skin Irritation	:	Expected to be slightly irritating. Prolonged or repeated skin contact without proper cleaning can clog the pores of the skin resulting in disorders such as oil acne/folliculitis.
Eye Irritation	:	Expected to be slightly irritating.
Respiratory Irritation	:	Inhalation of vapours or mists may cause irritation.
Sensitisation	:	Not expected to be a skin sensitiser.

Repeated Dose Toxicity	:	Not expected to be a hazard.
Mutagenicity	:	Not considered a mutagenic hazard.
Carcinogenicity	:	Product contains mineral oils of types shown to be non-carcinogenic in animal skin-painting studies. Highly refined mineral oils are not classified as carcinogenic by the International Agency for Research on Cancer (IARC). Other components are not known to be associated with carcinogenic effects.
Reproductive and Developmental Toxicity	:	Not expected to be a hazard.
Additional Information	:	Used oils may contain harmful impurities that have accumulated during use. The concentration of such impurities will depend on use and they may present risks to health and the environment on disposal. ALL used oil should be handled with caution and skin contact avoided as far as possible.

12. ECOLOGICAL INFORMATION

Ecotoxicological data have not been determined specifically for this product. Information given is based on a knowledge of the components and the ecotoxicology of similar products.

Acute Toxicity	:	Poorly soluble mixture. May cause physical fouling of aquatic organisms. Expected to be practically non toxic: LL/EL/IL50 > 100 mg/l (to aquatic organisms) (LL/EL50 expressed as the nominal amount of product required to prepare aqueous test extract). Mineral oil is not expected to cause any chronic effects to aquatic organisms at concentrations less than 1 mg/l.
Mobility	:	Liquid under most environmental conditions. Floats on water. If it enters soil, it will adsorb to soil particles and will not be mobile.
Persistence/degradability	:	Expected to be not readily biodegradable. Major constituents are expected to be inherently biodegradable, but the product contains components that may persist in the environment.
Bioaccumulation	:	Contains components with the potential to bioaccumulate.
Other Adverse Effects	:	Product is a mixture of non-volatile components, which are not expected to be released to air in any significant quantities. Not expected to have ozone depletion potential, photochemical ozone creation potential or global warming potential.

13. DISPOSAL CONSIDERATIONS

Material Disposal	:	Recover or recycle if possible. It is the responsibility of the waste generator to determine the toxicity and physical properties of the material generated to determine the proper waste classification and disposal methods in compliance with applicable regulations. Do not dispose into the environment, in drains or in water courses.
Container Disposal	:	Dispose in accordance with prevailing regulations, preferably to a recognised collector or contractor. The competence of the collector or contractor should be established beforehand.
Local Legislation	:	Disposal should be in accordance with applicable regional, national, and local laws and regulations.

EU Waste Disposal Code (EWC): 13 02 05 mineral-based non-chlorinated engine, gear and lubricating oils. Classification of waste is always the responsibility of the end user.

14. TRANSPORT INFORMATION

ADR
This material is not classified as dangerous under ADR regulations.

RID
This material is not classified as dangerous under RID regulations.

ADNR
This material is not classified as dangerous under ADNR regulations.

IMDG
This material is not classified as dangerous under IMDG regulations.

IATA (Country variations may apply)
This material is not classified as dangerous under IATA regulations.

15. REGULATORY INFORMATION

The regulatory information is not intended to be comprehensive. Other regulations may apply to this material.

EC Classification	:	Not classified as dangerous under EC criteria.
EC Symbols	:	No Hazard Symbol required
EC Risk Phrases	:	Not classified.
EC Safety Phrases	:	Not classified.
EINECS	:	All components listed or polymer exempt.
TSCA	:	All components listed.
Other Information	:	Environmental Protection Act 1990 (as amended). Health and Safety at Work Act 1974. Consumers Protection Act 1987. Control of Pollution Act 1974. Environmental Act 1995. Factories Act 1961. Carriage of Dangerous Goods by Road and Rail (Classification, Packaging and Labelling) Regulations. Chemicals (Hazard Information and Packaging for Supply) Regulations 2002. Control of Substances Hazardous to Health Regulations 1994 (as amended). Road Traffic (Carriage of Dangerous Substances in Packages) Regulations. Merchant Shipping (Dangerous Goods and Marine Pollutants) Regulations. Road Traffic (Carriage of Dangerous Substances in Road Tankers in Tank Containers) Regulations. Road Traffic (Training of Drivers of Vehicles Carrying Dangerous Goods) Regulations. Reporting of Injuries, Diseases and Dangerous

Occurrences Regulations. Health and Safety (First Aid) Regulations 1981. Personal Protective Equipment (EC Directive) Regulations 1992. Personal Protective Equipment at Work Regulations 1992.

16. OTHER INFORMATION

R-phrase(s)

Not classified.

MSDS Version Number	:	1.1
MSDS Effective Date	:	05.03.2007
MSDS Revisions	:	A vertical bar (|) in the left margin indicates an amendment from the previous version.
MSDS Regulation	:	The content and format of this safety data sheet is in accordance with Commission Directive 2001/58/EC of 27 July 2001, amending for the second time Commission Directive 91/155/EEC.
MSDS Distribution	:	The information in this document should be made available to all who may handle the product.
Disclaimer	:	This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only. It should not therefore be construed as guaranteeing any specific property of the product.

DOW CORNING

DOW CORNING CORPORATION
Material Safety Data Sheet

Version: 1.3
Revision Date: 2005/09/20

MOLYKOTE(R) 41 EXTREME HIGH TEMP. BEARING GREASE

1. IDENTIFICATION OF THE SUBSTANCE AND OF THE COMPANY

Dow Corning Corporation
South Saginaw Road
Midland, Michigan 48686

24 Hour Emergency Telephone: (989) 496-5900
Customer Service: (989) 496-6000
Product Disposal Information: (989) 496-6315
CHEMTREC: (800) 424-9300

MSDS No.: 01889796
Revision Date: 2005/09/20

Generic Description: Silicone grease.
Physical Form: Grease
Color: Black
Odor: Some odor

NFPA Profile: Health 0 Flammability 1 Instability/Reactivity 0

Note: NFPA = National Fire Protection Association

2. OSHA HAZARDOUS COMPONENTS

CAS Number	Wt %	Component Name
None	1.0 - 5.0	Mixed zinc carboxylates

The above components are hazardous as defined in 29 CFR 1910.1200.

3. HAZARDS IDENTIFICATION

POTENTIAL HEALTH EFFECTS

Acute Effects

Eye: Direct contact may cause mild irritation.

Skin: No significant irritation expected from a single short-term exposure.

Inhalation: No significant effects expected from a single short-term exposure.

Oral: Low ingestion hazard in normal use.

Prolonged/Repeated Exposure Effects

Skin: No known applicable information.

Inhalation: No known applicable information.

Oral: No known applicable information.

Signs and Symptoms of Overexposure

No known applicable information.

Medical Conditions Aggravated by Exposure

No known applicable information.

The above listed potential effects of overexposure are based on actual data, results of studies performed upon similar compositions, component data and/or expert review of the product. Please refer to Section 11 for the detailed toxicology information.

4. FIRST AID MEASURES

Eye:	Immediately flush with water for 15 minutes.
Skin:	No first aid should be needed.
Inhalation:	No first aid should be needed.
Oral:	No first aid should be needed.
Comments:	Treat according to person's condition and specifics of exposure.

5. FIRE FIGHTING MEASURES

Flash Point:	Not applicable.
Autoignition Temperature:	Not determined.
Flammability Limits in Air:	Not determined.
Extinguishing Media:	On large fires use dry chemical, foam or water spray. On small fires use carbon dioxide (CO2), dry chemical or water spray. Water can be used to cool fire exposed containers.
Fire Fighting Measures:	Self-contained breathing apparatus and protective clothing should be worn in fighting large fires involving chemicals. Determine the need to evacuate or isolate the area according to your local emergency plan. Use water spray to keep fire exposed containers cool.
Unusual Fire Hazards:	None.

Hazardous Decomposition Products

Thermal breakdown of this product during fire or very high heat conditions may evolve the following hazardous decomposition products: Carbon oxides and traces of incompletely burned carbon compounds. Metal oxides. Formaldehyde. Silicon dioxide.

6. ACCIDENTAL RELEASE MEASURES

Containment/Clean up:	Observe all personal protection equipment recommendations described in Sections 5 and 8. Wipe up or scrape up and contain for salvage or disposal. Clean area as appropriate since spilled materials, even in small quantities, may present a slip hazard. Final cleaning may require use of steam, solvents or detergents. Dispose of saturated absorbant or cleaning materials appropriately, since spontaneous heating may occur. Local, state and federal laws and regulations may apply to releases and disposal of this material, as well as those materials and items employed in the cleanup of releases. You will need to determine which federal, state and local laws and regulations are applicable. Sections 13 and 15 of this MSDS provide information regarding certain federal and state requirements.

Note: See section 8 for Personal Protective Equipment for Spills. Call (989) 496-5900, if additional information is required.

7. HANDLING AND STORAGE

Use with adequate ventilation. Traces of benzene (carcinogen) may form if heated in air above 300 F (149 C). Provide ventilation to control vapor exposure within inhalation guidelines when handling at elevated temperatures. Review the OSHA benzene regulation for detailed information on safe handling requirements. Avoid eye contact.

Use reasonable care and store away from oxidizing materials.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Component Exposure Limits

CAS Number	Component Name	Exposure Limits
None	Mixed zinc carboxylates	Observe particulate limits. OSHA PEL: TWA 15 mg/m3 total dust, 5 mg/m3 respirable fraction. ACGIH TLV: TWA 10 mg/m3 inhalable particulate, 3 mg/m3 respirable particulate.

Engineering Controls

Local Ventilation:	None should be needed.
General Ventilation:	Recommended.

Personal Protective Equipment for Routine Handling

Eyes:	Use proper protection - safety glasses as a minimum.
Skin:	Washing at mealtime and end of shift is adequate.
Suitable Gloves:	No special protection needed.
Inhalation:	No respiratory protection should be needed.

Suitable Respirator:	None should be needed.

Personal Protective Equipment for Spills

Eyes:	Use proper protection - safety glasses as a minimum.
Skin:	Washing at mealtime and end of shift is adequate.
Inhalation/Suitable Respirator:	No respiratory protection should be needed.
Precautionary Measures:	Avoid eye contact. Use reasonable care.
Comments:	Traces of benzene (carcinogen) may form if heated in air above 300 F (149 C). Provide ventilation to control vapor exposure within inhalation guidelines when handling at elevated temperatures. Review the OSHA benzene regulation for detailed information on safe handling requirements.

Note: These precautions are for room temperature handling. Use at elevated temperature or aerosol/spray applications may require added precautions.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical Form:	Grease
Color:	Black
Odor:	Some odor
Specific Gravity @ 25°C:	1.05
Viscosity:	Not determined.
Freezing/Melting Point:	Not determined.
Boiling Point:	Not determined.
Vapor Pressure @ 25°C:	Not determined.
Vapor Density:	Not determined.
Solubility in Water:	Not determined.
pH:	Not determined.
Volatile Content:	Not determined.

Note: The above information is not intended for use in preparing product specifications. Contact Dow Corning before writing specifications.

10. STABILITY AND REACTIVITY

Chemical Stability:	Stable.
Hazardous Polymerization:	Hazardous polymerization will not occur.
Conditions to Avoid:	None.
Materials to Avoid:	Oxidizing material can cause a reaction.

MOLYKOTE(R) 41 EXTREME HIGH TEMP. BEARING GREASE

11. TOXICOLOGICAL INFORMATION

Special Hazard Information on Components

No known applicable information.

12. ECOLOGICAL INFORMATION

Environmental Fate and Distribution

Complete information is not yet available.

Environmental Effects

Complete information is not yet available.

Fate and Effects in Waste Water Treatment Plants

Complete information is not yet available.

Ecotoxicity Classification Criteria

Hazard Parameters (LC50 or EC50)	High	Medium	Low
Acute Aquatic Toxicity (mg/L)	<=1	>1 and <=100	>100
Acute Terrestrial Toxicity	<=100	>100 and <= 2000	>2000

This table is adapted from "Environmental Toxicology and Risk Assessment", ASTM STP 1179, p.34, 1993.

This table can be used to classify the ecotoxicity of this product when ecotoxicity data is listed above. Please read the other information presented in the section concerning the overall ecological safety of this material.

13. DISPOSAL CONSIDERATIONS

RCRA Hazard Class (40 CFR 261)

When a decision is made to discard this material, as received, is it classified as a hazardous waste? No

State or local laws may impose additional regulatory requirements regarding disposal.

Call (989) 496-6315, if additional information is required.

14. TRANSPORT INFORMATION

DOT Road Shipment Information (49 CFR 172.101)

Not subject to DOT.

Ocean Shipment (IMDG)

Not subject to IMDG code.

Air Shipment (IATA)

Not subject to IATA regulations.

Call Dow Corning Transportation, (989) 496-8577, if additional information is required.

15. REGULATORY INFORMATION

Contents of this MSDS comply with the OSHA Hazard Communication Standard 29 CFR 1910.1200.

TSCA Status: All chemical substances in this material are included on or exempted from listing on the TSCA Inventory of Chemical Substances.

EPA SARA Title III Chemical Listings

Section 302 Extremely Hazardous Substances (40 CFR 355):
None.

Section 304 CERCLA Hazardous Substances (40 CFR 302):
None.

Section 311/312 Hazard Class (40 CFR 370):

Acute:	No
Chronic:	No
Fire:	No
Pressure:	No
Reactive:	No

Section 313 Toxic Chemicals (40 CFR 372):

CAS Number	Wt %	Component Name
None	1.0	Mixed zinc carboxylates

Supplemental State Compliance Information

California

Warning: This product contains the following chemical(s) listed by the State of California under the Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65) as being known to cause cancer, birth defects or other reproductive harm.

None known.

Massachusetts

CAS Number	Wt %	Component Name

1333-86-4	15.0 - 40.0	Carbon black

New Jersey

CAS Number	Wt %	Component Name
63148-58-3	40.0 - 70.0	Phenylmethyl siloxane, trimethyl-terminated
63148-52-7	15.0 - 40.0	Dimethyl, phenylmethyl siloxane, trimethyl-terminated
1333-86-4	15.0 - 40.0	Carbon black
None	1.0 - 5.0	Mixed zinc carboxylates

Pennsylvania

CAS Number	Wt %	Component Name
63148-58-3	40.0 - 70.0	Phenylmethyl siloxane, trimethyl-terminated
63148-52-7	15.0 - 40.0	Dimethyl, phenylmethyl siloxane, trimethyl-terminated
1333-86-4	15.0 - 40.0	Carbon black

16. OTHER INFORMATION

Prepared by: Dow Corning Corporation

These data are offered in good faith as typical values and not as product specifications. No warranty, either expressed or implied, is hereby made. The recommended industrial hygiene and safe handling procedures are believed to be generally applicable. However, each user should review these recommendations in the specific context of the intended use and determine whether they are appropriate.

(R) indicates Registered Trademark

2.6 Material Safety Data Sheet – Hydraulic Fluid

- EXXON MOBIL – QUINTOLUBRIC Hydraulic Fluid

MATERIAL SAFETY DATA SHEET

SECTION 1 PRODUCT AND COMPANY IDENTIFICATION

PRODUCT

Product Name: **QUAKER QUINTOLUBRIC 888-46**
Product Description: Synthetic Base Stocks and Additives
Product Code: 605550-00, 97Z195
Intended Use: Hydraulic fluid

COMPANY IDENTIFICATION

Supplier: **EXXON MOBIL CORPORATION**
3225 GALLOWS RD.
FAIRFAX, VA. 22037 USA

24 Hour Health Emergency	609-737-4411
Transportation Emergency Phone	800-424-9300
ExxonMobil Transportation No.	281-834-3296
Product Technical Information	800-662-4525, 800-947-9147
MSDS Internet Address	http://www.exxon.com, http://www.mobil.com

SECTION 2 COMPOSITION / INFORMATION ON INGREDIENTS

No Reportable Hazardous Substance(s) or Complex Substance(s).

SECTION 3 HAZARDS IDENTIFICATION

This material is not considered to be hazardous according to regulatory guidelines (see (M)SDS Section 15).

POTENTIAL HEALTH EFFECTS

Low order of toxicity. Excessive exposure may result in eye, skin, or respiratory irritation. High-pressure injection under skin may cause serious damage.

NFPA Hazard ID:	Health:	0	Flammability:	1	Reactivity:	0
HMIS Hazard ID:	Health:	0	Flammability:	1	Reactivity:	0

NOTE: This material should not be used for any other purpose than the intended use in Section 1 without expert advice. Health studies have shown that chemical exposure may cause potential human health risks which may vary from person to person.

SECTION 4 FIRST AID MEASURES

Inhalation

Remove from further exposure. For those providing assistance, avoid exposure to yourself or others. Use adequate respiratory protection. If respiratory irritation, dizziness, nausea, or unconsciousness occurs, seek immediate medical assistance. If breathing has stopped, assist ventilation with a mechanical device or use

mouth-to-mouth resuscitation.

SKIN CONTACT

Wash contact areas with soap and water. If product is injected into or under the skin, or into any part of the body, regardless of the appearance of the wound or its size, the individual should be evaluated immediately by a physician as a surgical emergency. Even though initial symptoms from high pressure injection may be minimal or absent, early surgical treatment within the first few hours may significantly reduce the ultimate extent of injury.

EYE CONTACT

Flush thoroughly with water. If irritation occurs, get medical assistance.

Ingestion

First aid is normally not required. Seek medical attention if discomfort occurs.

SECTION 5 FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA

Appropriate Extinguishing Media: Use water fog, foam, dry chemical or carbon dioxide (CO2) to extinguish flames.

Inappropriate Extinguishing Media: Straight Streams of Water

FIRE FIGHTING

Fire Fighting Instructions: Evacuate area. Prevent runoff from fire control or dilution from entering streams, sewers, or drinking water supply. Firefighters should use standard protective equipment and in enclosed spaces, self-contained breathing apparatus (SCBA). Use water spray to cool fire exposed surfaces and to protect personnel.

Unusual Fire Hazards: Pressurized mists may form a flammable mixture.

Hazardous Combustion Products: Smoke, Fume, Incomplete combustion products, Oxides of carbon

FLAMMABILITY PROPERTIES

Flash Point [Method]: 260C (500F) [ASTM D-92]
Flammable Limits (Approximate volume % in air): LEL: 0.9 UEL: 7.0
Autoignition Temperature: N/D

SECTION 6 ACCIDENTAL RELEASE MEASURES

NOTIFICATION PROCEDURES

In the event of a spill or accidental release, notify relevant authorities in accordance with all applicable regulations. US regulations require reporting releases of this material to the environment which exceed the applicable reportable quantity or oil spills which could reach any waterway including intermittent dry creeks. The National Response Center can be reached at (800)424-8802.

SPILL MANAGEMENT

Land Spill: Stop leak if you can do it without risk. Recover by pumping or with suitable absorbent.

Water Spill: Stop leak if you can do it without risk. Confine the spill immediately with booms. Warn other shipping. Remove from the surface by skimming or with suitable absorbents. Seek the advice of a specialist before using dispersants.

Water spill and land spill recommendations are based on the most likely spill scenario for this material; however, geographic conditions, wind, temperature, (and in the case of a water spill) wave and current direction and speed may greatly influence the appropriate action to be taken. For this reason, local experts should be consulted. Note: Local regulations may prescribe or limit action to be taken.

ENVIRONMENTAL PRECAUTIONS

Large Spills: Dike far ahead of liquid spill for later recovery and disposal. Prevent entry into waterways, sewers, basements or confined areas.

SECTION 7 HANDLING AND STORAGE

HANDLING

Prevent small spills and leakage to avoid slip hazard.

Static Accumulator: This material is a static accumulator.

STORAGE

Do not store in open or unlabelled containers. Keep away from incompatible materials.

SECTION 8 EXPOSURE CONTROLS / PERSONAL PROTECTION

Exposure limits/standards for materials that can be formed when handling this product: When mists / aerosols can occur, the following are recommended: 5 mg/m³ - ACGIH TLV, 10 mg/m³ - ACGIH STEL, 5 mg/m³ - OSHA PEL.

NOTE: Limits/standards shown for guidance only. Follow applicable regulations.

ENGINEERING CONTROLS

The level of protection and types of controls necessary will vary depending upon potential exposure conditions. Control measures to consider:

No special requirements under ordinary conditions of use and with adequate ventilation.

PERSONAL PROTECTION

Personal protective equipment selections vary based on potential exposure conditions such as applications, handling practices, concentration and ventilation. Information on the selection of protective equipment for use with this material, as provided below, is based upon intended, normal usage.

Respiratory Protection: If engineering controls do not maintain airborne contaminant concentrations at a

level which is adequate to protect worker health, an approved respirator may be appropriate. Respirator selection, use, and maintenance must be in accordance with regulatory requirements, if applicable. Types of respirators to be considered for this material include:

No special requirements under ordinary conditions of use and with adequate ventilation.

For high airborne concentrations, use an approved supplied-air respirator, operated in positive pressure mode. Supplied air respirators with an escape bottle may be appropriate when oxygen levels are inadequate, gas/vapor warning properties are poor, or if air purifying filter capacity/rating may be exceeded.

Hand Protection: Any specific glove information provided is based on published literature and glove manufacturer data. Glove suitability and breakthrough time will differ depending on the specific use conditions. Contact the glove manufacturer for specific advice on glove selection and breakthrough times for your use conditions. Inspect and replace worn or damaged gloves. The types of gloves to be considered for this material include:

No protection is ordinarily required under normal conditions of use.

Eye Protection: If contact is likely, safety glasses with side shields are recommended.

Skin and Body Protection: Any specific clothing information provided is based on published literature or manufacturer data. The types of clothing to be considered for this material include:

No skin protection is ordinarily required under normal conditions of use. In accordance with good industrial hygiene practices, precautions should be taken to avoid skin contact.

Specific Hygiene Measures: Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants. Discard contaminated clothing and footwear that cannot be cleaned. Practice good housekeeping.

ENVIRONMENTAL CONTROLS

See Sections 6, 7, 12, 13.

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

Typical physical and chemical properties are given below. Consult the Supplier in Section 1 for additional data.

GENERAL INFORMATION

Physical State: Liquid
Form: Clear
Color: Amber
Odor: Characteristic
Odor Threshold: N/D

IMPORTANT HEALTH, SAFETY, AND ENVIRONMENTAL INFORMATION

Relative Density (at 15 C): 0.911
Flash Point [Method]: 260C (500F) [ASTM D-92]
Flammable Limits (Approximate volume % in air): LEL: 0.9 UEL: 7.0
Autoignition Temperature: N/D
Boiling Point / Range: > 400C (752F)
Vapor Density (Air = 1): > 2 at 101 kPa
Vapor Pressure: < 0.013 kPa (0.1 mm Hg) at 20 C

Evaporation Rate (n-butyl acetate = 1): N/D
pH: N/A
Log Pow (n-Octanol/Water Partition Coefficient): N/A
Solubility in Water: Negligible
Viscosity: 46 cSt (46 mm2/sec) at 40 C
Oxidizing Properties: See Hazards Identification Section.

OTHER INFORMATION

Freezing Point: N/D
Melting Point: N/A
DMSO Extract (mineral oil only), IP-346: < 3 %wt

SECTION 10 STABILITY AND REACTIVITY

STABILITY: Material is stable under normal conditions.

CONDITIONS TO AVOID: Excessive heat. High energy sources of ignition.

MATERIALS TO AVOID: Strong oxidizers

HAZARDOUS DECOMPOSITION PRODUCTS: Material does not decompose at ambient temperatures.

HAZARDOUS POLYMERIZATION: Will not occur.

SECTION 11 TOXICOLOGICAL INFORMATION

ACUTE TOXICITY

Route of Exposure	Conclusion / Remarks
Inhalation	
Toxicity (Rat): LC50 > 5000 mg/m3	Minimally Toxic. Based on test data for structurally similar materials.
Irritation: No end point data.	Negligible hazard at ambient/normal handling temperatures. Based on assessment of the components.
Ingestion	
Toxicity (Rat): LD50 > 5000 mg/kg	Minimally Toxic. Based on test data for structurally similar materials.
Skin	
Toxicity (Rabbit): LD50 > 5000 mg/kg	Minimally Toxic. Based on test data for structurally similar materials.
Irritation (Rabbit): Data available.	Negligible irritation to skin at ambient temperatures. Based on test data for structurally similar materials.
Eye	
Irritation (Rabbit): Data available.	May cause mild, short-lasting discomfort to eyes. Based on test data for structurally similar materials.

CHRONIC/OTHER EFFECTS

Contains:

Base oil severely refined: Not carcinogenic in animal studies. Representative material passes IP-346, Modified Ames test, and/or other screening tests. Dermal and inhalation studies showed minimal effects; lung non-specific infiltration of immune cells, oil deposition and minimal granuloma formation. Not sensitizing in test

animals.

Additional information is available by request.

The following ingredients are cited on the lists below: None.

--REGULATORY LISTS SEARCHED--

1 = NTP CARC	3 = IARC 1	5 = IARC 2B
2 = NTP SUS	4 = IARC 2A	6 = OSHA CARC

SECTION 12 ECOLOGICAL INFORMATION

The information given is based on data available for the material, the components of the material, and similar materials.

ECOTOXICITY

Material -- Not expected to be harmful to aquatic organisms.

PERSISTENCE AND DEGRADABILITY

Biodegradation:

Material -- Expected to biodegrade slowly.

SECTION 13 DISPOSAL CONSIDERATIONS

Disposal recommendations based on material as supplied. Disposal must be in accordance with current applicable laws and regulations, and material characteristics at time of disposal.

DISPOSAL RECOMMENDATIONS

Product is suitable for burning in an enclosed controlled burner for fuel value or disposal by supervised incineration at very high temperatures to prevent formation of undesirable combustion products.

REGULATORY DISPOSAL INFORMATION

RCRA Information: The unused product, in our opinion, is not specifically listed by the EPA as a hazardous waste (40 CFR, Part 261D), nor is it formulated to contain materials which are listed as hazardous wastes. It does not exhibit the hazardous characteristics of ignitability, corrositivity or reactivity and is not formulated with contaminants as determined by the Toxicity Characteristic Leaching Procedure (TCLP). However, used product may be regulated.

Empty Container Warning Empty Container Warning (where applicable): Empty containers may contain residue and can be dangerous. Do not attempt to refill or clean containers without proper instructions. Empty drums should be completely drained and safely stored until appropriately reconditioned or disposed. Empty containers should be taken for recycling, recovery, or disposal through suitably qualified or licensed contractor and in accordance with governmental regulations. DO NOT PRESSURISE, CUT, WELD, BRAZE, SOLDER, DRILL, GRIND, OR EXPOSE SUCH CONTAINERS TO HEAT, FLAME, SPARKS, STATIC ELECTRICITY, OR OTHER SOURCES OF IGNITION. THEY MAY EXPLODE AND CAUSE INJURY OR DEATH.

SECTION 14 TRANSPORT INFORMATION

LAND (DOT): Not Regulated for Land Transport

LAND (TDG): Not Regulated for Land Transport

SEA (IMDG): Not Regulated for Sea Transport according to IMDG-Code

AIR (IATA): Not Regulated for Air Transport

SECTION 15 REGULATORY INFORMATION

OSHA HAZARD COMMUNICATION STANDARD: When used for its intended purposes, this material is not classified as hazardous in accordance with OSHA 29 CFR 1910.1200.

NATIONAL CHEMICAL INVENTORY LISTING: AICS, IECSC, EINECS, ENCS, KECI, PICCS, TSCA
Special Cases:

Inventory	Status
NDSL	Restrictions Apply

EPCRA: This material contains no extremely hazardous substances.

SARA (311/312) REPORTABLE HAZARD CATEGORIES: None.

SARA (313) TOXIC RELEASE INVENTORY: This material contains no chemicals subject to the supplier notification requirements of the SARA 313 Toxic Release Program.

The following ingredients are cited on the lists below:

Chemical Name	CAS Number	List Citations
DISTILLATES (PETROLEUM), HYDROTREATED LIGHT (DEAROMATIZED HEAVY MINERAL SPIRIT 200-250)	64742-47-8	17, 18, 19
PHENOL, 4,4-METHYLENEBIS(2,6-BIS(1,1-DIMETHYLETHYL)-	118-82-1	5, 9

--REGULATORY LISTS SEARCHED--

1 = ACGIH ALL	6 = TSCA 5a2	11 = CA P65 REPRO	16 = MN RTK
2 = ACGIH A1	7 = TSCA 5e	12 = CA RTK	17 = NJ RTK
3 = ACGIH A2	8 = TSCA 6	13 = IL RTK	18 = PA RTK
4 = OSHA Z	9 = TSCA 12b	14 = LA RTK	19 = RI RTK

5 = TSCA 4 10 = CA P65 CARC 15 = MI 293

Code key: CARC=Carcinogen; REPRO=Reproductive

SECTION 16 OTHER INFORMATION

N/D = Not determined, N/A = Not applicable

THIS SAFETY DATA SHEET CONTAINS THE FOLLOWING REVISIONS:

Revision Changes:
Section 04: First Aid Inhalation - Header was modified.
Section 04: First Aid Ingestion - Header was modified.
Section 06: Notification Procedures - Header was modified.
Section 10 Stability and Reactivity - Header was modified.
Section 13: Disposal Recommendations - Note was modified.
Section 13: Empty Container Warning was modified.
Section 09: Boiling Point C(F) was modified.
Section 09: n-Octanol/Water Partition Coefficient was modified.
Section 08: Personal Protection was modified.
Section 08: Hand Protection was modified.
Section 09: Vapor Pressure was modified.
Section 07: Handling and Storage - Handling was modified.
Section 07: Handling and Storage - Storage Phrases was modified.
Hazard Identification: Health Hazards was modified.
Section 01: Product Description was modified.
Section 11: Dermal Lethality Test Data was modified.
Section 11: Oral Lethality Test Data was modified.
Section 11: Inhalation Lethality Test Data was modified.
Section 11: Inhalation Lethality Test Comment was modified.
Section 11: Dermal Irritation Test Comment was modified.
Section 11: Eye Irritation Test Comment was modified.
Section 05: Hazardous Combustion Products was modified.
Section 06: Accidental Release - Spill Management - Water was modified.
Section 09: Relative Density - Header was modified.
Section 09: Flash Point C(F) was modified.
Section 09: Viscosity was modified.
Section 14: Sea (IMDG) - Header was modified.
Section 14: Air (IATA) - Header was modified.
Section 14: LAND (TDG) - Header was modified.
Section 14: LAND (DOT) - Header was modified.
Section 15: List Citation Table - Header was modified.
Section 14: LAND (DOT) - Default was modified.
Section 14: LAND (TDG) Default was modified.
Section 14: Sea (IMDG) - Default was modified.
Section 14: Air (IATA) - Default was modified.
Section 16: Code to MHCs was modified.
Section 08: Exposure limits/standards was modified.
Hazard Identification: OSHA - May be Hazardous Statement was modified.
Section 06: Notification Procedures was modified.
Section 09: Oxidizing Properties was modified.
Section 01: Company Contact Methods Sorted by Priority was modified.
Section 15: Chemical Name - Header was added.

Section 15: CAS Number - Header was added.
Section 15: List Citations - Header was added.
Section 15: List Citations Table was added.
Section 12: Ecological Information - Biodegradation was added.
Section 12: Ecological Information - Biodegradation was added.
Section 12: Mobility - Header was deleted.
Section 12: Bioaccumulation - Header was deleted.
Section 12: Ecological Information - Mobility was deleted.
Section 12: Ecological Information - Mobility was deleted.
Section 12: Ecological Information - Biodegradation was deleted.
Section 12: Ecological Information - Biodegradation was deleted.
Section 12: Ecological Information - Bioaccumulation was deleted.
Section 12: Ecological Information - Bioaccumulation was deleted.
Section 15: TSCA Class 2 Statement was deleted.

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MHC: 0B, 0B, 0, 0, 0, 0 PPEC: A

DGN: 7001227XUS (1004881)

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SECTION 3 INSTALLATION / PRE-OP MANUAL

3.1 Installation Instructions

See document 25457-4480-V1A-MXA0-0346.

3.2 Storage Instruction

3.2.1 Storage

The cathode sealing equipment crates and packages must be stored inside.

3.2.2 Special Handling Instructions

Most of the equipment is crated. The bar heating furnace sections (F2) is not crated. To pull furnace sections F2 out of the container, you should use the lug provided at the top of the furnace sections.

All the equipment must be handled carefully using appropriate lifting device (verify weight of equipment). Use lifting lugs when available.

Note that easily damage material is marked “Fragile”.

When lifting device is directly in contact with the equipment paint, use lifting straps instead of chains protect the paint.

Refer to installation instruction.

3.3 Pre-Op manual

See document 25457-4480-V1A-MXA0-0359.

SECTION 4 COMMISSIONING

4.1 Commissioning Manual

Refer to document 25457-4480-V1A-MXA0-0349.

SECTION 5 OPERATION

5.1 Functional Description

See document 25457-4480-V1A-MXA0-0107.

5.2 P&ID's

Drawing Number	GNA Ref.	Description
25457-4480-V1A-MXA0-0029	P&ID C2	Steel Bar Conveyor (24 bars)
25457-4480-V1A-MXA0-0030	P&ID R9	Shot Blasting Machine Feed Conveyor
25457-4480-V1A-MXA0-0031	P&ID R8	Shot Blasting Machine Exit Conveyor
25457-4480-V1A-MXA0-0032	P&ID C3	Bar Transfer Conveyor
25457-4480-V1A-MXA0-0033	P&ID R7	Furnace Feed Conveyor
25457-4480-V1A-MXA0-0034	P&ID F2	Steel Bar Heating Furnace (1/3)
25457-4480-V1A-MXA0-0035	P&ID F2	Steel Bar Heating Furnace (2/3)
25457-4480-V1A-MXA0-0036	P&ID F2	Steel Bar Heating Furnace (3/3)
25457-4480-V1A-MXA0-0037	P&ID R6	Furnace Exit Conveyor
25457-4480-V1A-MXA0-0038	P&ID G1	Bar Alignment Station (1/2)
25457-4480-V1A-MXA0-0039	P&ID A1	Bar Alignment Station (2/2)
25457-4480-V1A-MXA0-0040	P&ID C1	Carbon Block Oven Conveyor
25457-4480-V1A-MXA0-0041	P&ID F1	Carbon Block Heating Oven (1/2)
25457-4480-V1A-MXA0-0042	P&ID F1	Carbon Block Heating Oven (2/2)
25457-4480-V1A-MXA0-0043	P&ID R1	Carbon Block oven Exit Conveyor
25457-4480-V1A-MXA0-0044	P&ID R2	Cathode Bar Positioning Gantry
25457-4480-V1A-MXA0-0045	P&ID R4A	Bar & Block Assembly Conveyor (1/2)
25457-4480-V1A-MXA0-0046	P&ID R4A	Bar & Block Assembly Conveyor (2/2)
25457-4480-V1A-MXA0-0047	P&ID R4B	Carbon Block Pre-stressing Unit (1/2)
25457-4480-V1A-MXA0-0048	P&ID R4A	Bar & Block Assembly Conveyor (2/2)
25457-4480-V1A-MXA0-0049	P&ID R3	Pre-Stressing Conveyor
25457-4480-V1A-MXA0-0050	P&ID R5	Block Cooling and Turning Equipment Conveyor
25457-4480-V1A-MXA0-0051	P&ID T1	Block Cooling and Turning Equipment
25457-4480-V1A-MXA0-0052	P&ID C4	Block Assembly Accumulation Conveyor
25457-4480-V1A-MXA0-0386	P&ID F3	Ladle preheating station
25457-4480-V1A-MXA0-0387	P&ID F4A	Cast iron drying station A
25457-4480-V1A-MXA0-0400	P&ID F4B	Cast iron drying station B

5.3 Screen Display

See document 25457-4480-V1A-MXA0-0394.

5.4 HAZAN REPORT

See document 25457-4480-V1A-MXA0-0126.

5.5 I/O List

See document 25457-4480-V1A-MXA0-0342.

6 MAINTENANCE PROCEDURES

6.1 General

Daily

1) Clean refractory fiber or dust on the element surfaces inside the bar furnace, before each start-up. If you remove elements, protect the electronic devices.

2) The electrical connections should be checked by a qualified electrician before each start-up.

3) Visually inspect of all the equipment.

4) Keep the area clean (shots, dust, cast iron spills…)

Weekly

1) Chiller: Check liquid line sight glasses. Flow should appear smooth with no evidence of gas bubbles. If gas bubbles appear, a refrigerant shortage is indicated. Check for refrigerant leak, repair and add refrigerant.

2) Chiller: Inspect entire system for any unusual conditions such as noisy compressor, loose access panels, pipe or joint leakage or chattering contactors.

3) Inspect strainer and filter of the hydraulic system.

4) Add grease on the block oven chain conveyor.

5) Visually inspect the inside of the bar furnace and block oven.

Monthly

1) Verify transmission chain tension and adjust if necessary.

2) Verify conveyor chain tension and use the tensioner to tend it, if necessary.

IMPORTANT:
TEND CHAIN ONLY WHEN IT IS AT COLD TEMPERATURE.

3) Verify hydraulic unit oil level.

4) Verify hydraulic service pressure and viscosity.

4) Verify cooling system on each electrical motor.

5) Change filter and clean strainer of hydraulic system.

6) Verify and tight hydraulic connection so air is excluded of the system.

6) Verify the mechanical and hydraulic system of the cathode assembly system visually.

7) Grease transmission chain of the rollers.

8) Verify the recirculating fan of the block oven.

9) Chiller: Start unit and observe operating pressures. If pressures are above or below normal, see “Trouble Analysis” section in Freeze Co. MOM.

10) Chiller: Check fan alignment and clean condenser fins from any foreign particle or dust.

3000 Hours or 6 Months

1) Check oil and oil level, and check seals visually for leakage of each gear reducer.

Yearly

Perform the weekly and monthly inspection.

1) Purge all bearing grease.

2) Grease all transmission chain.

3) General verification of the mechanical and hydraulic system of the cathode assembly system.

4) Chiller: Clean the chilled Reservoir and brazed plate heat exchanger. Inspect contacts of motors contactors and system controls. Check setting and functions of each system control. Inspect system for leaks. Also inspect all valves, pumps and related equipment for proper operation. Remove rust and corrosion from any surfaces. Inspect expansion valve sensing bulb for cleanliness, proper installation and insulation. Perform an oil analysis to determine the acidity of the compressor oil and record the results.

3 Years

1) Drain all gear reducers. Change mineral oil.
2) Refer to DEMAG manual and lubrication schedule.

10 000 Hours or 4 Years

1) Drain all DEMAG gear reducers. Refer to DEMAG manual.

IMPORTANT NOTE

- **ShotBlasting machine and Dust collector :** Refer to APPENDICE - Wheelabrator.
- **Chiller:** Refer to APPENDICE Freeze Co.
- **Hydraulic Power Unit:** Refer to APPENDICE - Pneutech.
- **Motor Reducer:** Refer to section 6.0 - SEW Eurodrive Maintenance Manual.

PLEASE FOLLOW MANUFACTURER AND VENDOR RECOMMENDATIONS FOR MAINTENANCE AND LUBRICATION

6.2 Manufacturer

6.2.1	*3R*	*Fiberglass Tubing*
6.2.2	*Allen Bradley*	*ControlLogix CPU*
6.2.3	*Allen Bradley*	*Industrial Display*
6.2.4	*Allen Bradley*	*Panelview*
6.2.5	*Allen Bradley*	*Photo Switch*
6.2.6	*Allen Bradley*	*Safety Mat*
6.2.7	*Allen Bradley*	*Safety Relay*
6.2.8	*Allen Bradley*	*Trapped Key System*
6.2.9	*ASB Heating Element*	*Tubular Elements F1*
6.2.10	*Carlo Gavazzi*	*Fiber Optic*
6.2.11	*CEFEM*	*Isolator Switch*

6.2.12	*Demag*	*Wheel*
6.2.13	*Demag*	*Geared Motor*
6.2.14	*Demag*	*Motor*
6.2.15	*Dungs*	*Valve*
6.2.16	*Dungs*	*Pressure Switch*
6.2.17	*Eclipse*	*Combustion system*
6.2.18	*Fisher*	*Pressure Regulator*
6.2.19	*Honeywell*	*Modulator Motor*
6.2.20	*I square R*	*Silicone Carbide Element F2*
6.2.21	*Mashaltown*	*Gauge*
6.2.22	*Martin*	*Sprocket*
6.2.23	*Mettler Toledo*	*Scale*
6.2.24	*New York Blower*	*block Oven Fan*
6.2.25	*Parker*	*Flexible Hose*
6.2.26	*Parker*	*Hydraulic Cylinder 2H*
6.2.27	*Parker*	*Hydraulic Tubing*
6.2.28	*Parker*	*Pneumatic Cylinder 2A*
6.2.29	*Pilz*	*Safety Relay*
6.2.30	*RDC Controle*	*Thermocouple*
6.2.31	*Renold*	*Transmission Chain*
6.2.32	*Rosemount*	*Temperature Transmitter*
6.2.33	*Sew Eurodrive Canada*	*Motor*
6.2.34	*Sew Eurodrive Canada*	*Reducer*
6.2.35	*SKF*	*Pillow Block SNL*
6.2.36	*Square D*	*Proximity Switch*
6.2.37	*Square D*	*Relay*
6.2.38	*Telemecanique*	*Beacon*
6.2.39	*Telemecanique*	*Flashing Light*
6.2.40	*Telemecanique*	*Emergency Pushbutton*

6.2.41	*Telemecanique*	*Limit Switch*
6.2.42	*Telemecanique*	*Proximity Switch*
6.2.43	*Telemecanique*	*Pushbutton*
6.2.44	*Thermafiber*	*Insulation F1*
6.2.45	*Thermal Ceramic*	*Refractory F2*
6.2.46	*Tsubaki*	*Conveyor Chain*
6.2.47	*Watlow*	*SCR Bar Furnace*
6.2.48	*Watlow*	*SCR Block Oven*
6.2.49	*Watlow*	*High Temperature Controller*

PRINT THE TECHNICAL DATA SHEET | DOWNLOAD THE MSDS SHEET

TXP **660**
FIBERGLASS TUBING

ISO 9001 : 2000 Certified

*The tubing **TXP660** is made of 100% glass yarn and designed for high temperature industrial and commercial applications. It is braided in a tubular form with the best quality of glass yarn. The construction is such that it produces a very soft and flexible tubing that can be fit over uneven surfaces and bend around sharp corners.*

Applications //

There are many insulating applications in electrical engineering for which the flexible **TXP660** glass tubing is more suitable than any other types of insulations. Typical examples of such applications are the insulation of induction coils for metal treatment and coils leads. It is commonly used over hot and cold pipes and tubing to insulate pipe support and to make static joints. It is completely incombustible and resist most acids and alkalis.

Physical properties //

Temperature	1000° F(538° C)
Tensile strength	stable upto 500°F (260°C)

Int. Diameter	Feet/roll
¼"	100
3/8"	100
½"	100
¾"	100
1"	100
1 ¼"	100
1 ½"	100
1 ¾"	100
2"	100
2 ½"	75
3"	50

® Texpro is a registered trademark of Industries 3R inc.

06-09/rev.0

N.B. The information, details, dimensions and values indicated are to our best knowledge. We recommend testing according to local conditions. The specifications are subject to change without notice.

55, Route 116 West, Danville (Quebec) J0A 1A0 Tel.: (819) 839-2793
Fax: (819) 839-2797 • www.industries3r.com

Installation Instructions

Industrial Integrated Display Computers

Catalog Numbers 6181P-2PXP, 6181P-2PXPDC, 6181P-12NPXP, 6181P-12TPXP, 6181P-12TPXPDC, 6181F-12TPXP, 6181F-12TPWE, 6181F-12TPXPDC, 6181F-12TPWEDC, 6181P-12NSXP, 6181P-12TSXP, 6181F-12TSXP, 6181F-12TSWE, 6181P-15NPXP, 6181P-15TPXP, 6181P-15TPXPDC, 6181P-15TPXPSS, 6181F-15TPXP, 6181F-15TPWE, 6181F-15TPXPDC, 6181F-15TPWEDC, 6181F-15TPXPSS, 6181F-15TPWESS, 6181P-15NSXP, 6181P-15TSXP, 6181F-15TSXP, 6181F-15TSWE, 6181P-17NPXP, 6181P-17TPXP, 6181P-17TPXPDC, 6181F-17TPXP, 6181F-17TPWE, 6181F-17TPXPDC, 6181F-17TPWEDC, 6181F-17TPXPSS, 6181F-17TPWESS, 6181P-17TPXPSS, 6181P-17NSXP, 6181P-17TSXP, 6181F-17TSXP, 6181F-17TSWE

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Allen-Bradley • Rockwell Software Rockwell Automation

Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls (Publication SGI-1.1 available from your local Rockwell Automation sales office or online at http://literature.rockwellautomation.com) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

Reproduction of the contents of this manual, in whole or in part, without written permission of Rockwell Automation, Inc., is prohibited.

Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

WARNING	Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.
ATTENTION	Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard and recognize the consequences.
SHOCK HAZARD	Labels may be on or inside the equipment (for example, drive or motor) to alert people that dangerous voltage may be present.
BURN HAZARD	Labels may be on or inside the equipment (for example, drive or motor) to alert people that surfaces may reach dangerous temperatures.

Environment and Enclosure Information

Review the information on enclosures and environments before installing the product.

ATTENTION

Environment and Enclosure

This equipment is intended for use in a Pollution Degree 2 industrial environment, in overvoltage Category II applications (as defined in IEC publication 60664-1), at altitudes up to 2000 m (6561 ft) without derating.

This equipment is considered Group 1, Class A industrial equipment according to IEC/CISPR Publication 11. Without appropriate precautions, there may be potential difficulties ensuring electromagnetic compatibility in other environments due to conducted as well as radiated disturbance.

UL listed equipment need not be mounted inside another enclosure if NEMA Type and IEC ratings are not required, but the mounting method must limit the tilt of the product to ±60° from vertical. An example is a tabletop stand. The mounting means must be firmly attached to the supporting surface using screws, bolts, or clamps so the computer cannot tip. These units ship with a gasketed bezel to meet specified NEMA and IEC ratings only when mounted in a panel or enclosure with an equivalent rating. Subsequent sections of this publication may contain additional information regarding specific enclosure type ratings that are required to comply with certain product safety certifications.

In addition to this publication, see:

- Industrial Automation Wiring and Grounding Guidelines, for additional installation requirements, publication 1770-4.1.
- NEMA Standards publication 250 and IEC publication 60529, as applicable, for explanations of the degrees of protection provided by different types of enclosure.

European Union Directive Compliance

This product meets the European Union Directive requirements when installed within the European Union or EEA regions and have the CE mark. A copy of the Declaration of Conformity is available at the Rockwell Automation website http://ab.com under Product Certification.

ATTENTION

This product is intended to operate in an industrial or control room environment, which utilizes some form of power isolation from the public low-voltage mains. Some computer configurations may not comply with the EN 61000-3-2 Harmonic Emissions standard as specified by the EMC Directive of the European Union. Obtain permission from the local power authority before connecting any computer configuration that draws more than 75 Watts of AC power directly from the public mains.

ATTENTION

To comply with EN 55024, the Ethernet port LAN cable must be less than 30 m (98.42 ft). All other I/O cables must be less than 3 m (9.84 ft) and used only indoors; these cables must not exit the building at any point.

Product Options

This table summarizes the product options available for the industrial integrated display computers.

Catalog Number	Model	Series	Display Size	Touchscreen	Package
6181P-2PXP	NDM	E	Non-display	n/a	Performance
6181P-2PXPDC[1]					
6181P-12NPXP	1200P		12.1 in.	No	Performance
6181P-12TPXP				Yes	
6181P-12TPXPDC[1]					
6181F-12TPXP[2]					
6181F-12TPWE[2]					
6181F-12TPXPDC[1][2]					
6181F-12TPWEDC[1][2]					
6181P-12NSXP				No	Standard
6181P-12TSXP				Yes	
6181F-12TSXP[2]					
6181F-12TSWE[2]					
6181P-15NPXP	1500P		15 in.	No	Performance
6181P-15TPXP				Yes	
6181P-15TPXPDC[1]					
6181P-15TPXPSS[3]					
6181F-15TPXP[2]					
6181F-15TPWE[2]					
6181F-15TPXPDC[1][2]					
6181F-15TPWEDC[1][2]					
6181F-15TPXPSS[2][3]					
6181F-15TPWESS[2][3]					
6181P-15NSXP				No	Standard
6181P-15TSXP				Yes	
6181F-15TSXP[2]					
6181F-15TSWE[2]					

(1) Models with a catalog number ending in DC operate from DC power.

(2) Models with a catalog number with a base number ending in F have solid state hard drives.

(3) Models with a catalog number with a base number ending in SS have a stainless steel bezel.

Catalog Number	Model	Series	Display Size	Touchscreen	Package
6181P-17NPXP	1700P	E	17 in.	No	Performance
6181P-17TPXP				Yes	
6181P-17TPXPDC[1]					
6181F-17TPXP[2]					
6181F-17TPWE[2]					
6181F-17TPXPDC[1][2]					
6181F-17TPWEDC[1][2]					
6181F-17TPXPSS[2]					
6181F-17TPWESS[2]					
6181P-17TPXPSS[3]					
6181P-17NSXP				No	Standard
6181P-17TSXP				Yes	
6181F-17TSXP[2]					
6181F-17TSWE[2]					

(1) Models with a catalog number ending in DC operate from DC power.

(2) Models with a catalog number with a base number ending in F have solid state hard drives.

(3) Models with a catalog number with a base number ending in SS have a stainless steel bezel.

Operating System

The computers are shipped with one of these Microsoft-licensed embedded operating systems:

- Windows XP Professional for Embedded Systems, Service Pack 2b
- Windows Embedded Standard 2009

No Windows XP operating system updates have been applied to the factory image beyond the service packs. All available Windows Embedded Standard 2009 operating system updates have been applied as of September 2009.

For computers with Windows XP, the I386 source directory for Microsoft Windows is on the system drive of your computer off the root directory, C:\I386. This allows for easy removal and addition of Windows components.

Computers with rotating hard-disk drives include a recovery partition on the system drive containing the original factory image. You can use the supplied Computer System Cloning CD to restore the operating system from the recovery partition, create a new recovery image, and create bootable external-recovery media. Refer to the Cloning Utility technical data, publication 6000-TD002, for instructions.

Computers with Windows Embedded Standard 2009 include a utility for configuring the Enhanced Write Filter (EWF) and Hibernate Once Restore Many (HORM) features. Refer to the EWF/HORM Configuration Utility technical data, publication 6000-TD003, for instructions.

To obtain the original factory image on bootable external-recovery media, contact your local technical support center.

Multilingual User Interface CD Pack

The following section only applies to systems that contain the Microsoft Multilingual user-interface (MUI) CD pack.

The Microsoft Multilingual User-interface (MUI) CD Pack contains a collection of different language sets that can be installed into the operating system. The MUI pack provides a localized start menu and system icons support.

The instructions for installing MUI languages on your computer are supplied with the MUI CD Pack.

Parts List

Your computer is shipped with the following items:

- Panel mounting clips (display models only)
- Power cord, (for AC power models)
- Ground bus strip, pre-installed (for DC power models)
- Panel cutout template
- Installation Instructions
- Production test report
- System CDs
  - Accessory CD with Cloning Utility (red)
  - System Support CD with Diagnostic Utility (green)
  - Microsoft Multilingual User Interface (MUI) CD Pack (gray, 5 cd-pack), where applicable
  - DVD burning software (performance models only)

Required Tools

These tools are required for product installation:

- Panel cutout tools (panel mount only)
- #2 Phillips screwdriver
- Antistatic wrist strap (recommended)

Installation Guidelines

Follow these guidelines to make sure your product provides safe and reliable service.

- The installation site must have sufficient power.

ATTENTION

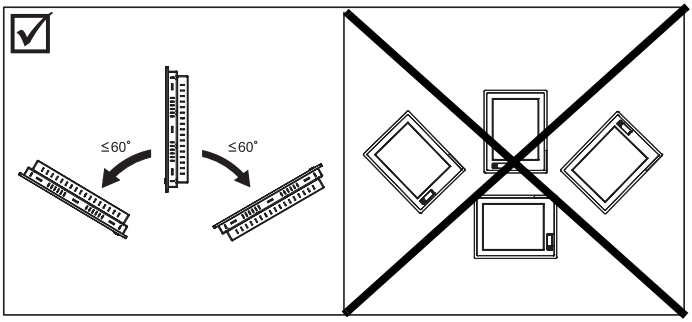
To maintain an electrically safe installation, the AC powered products must be plugged into a grounded outlet.

- The enclosure must allow sufficient space around air inlets and outlets to provide the circulation necessary for cooling. Never allow air passages to become obstructed.
- The ambient air temperature must not exceed the maximum operating temperature. Consider heat produced by other devices in the enclosure. You may need a user-supplied fan, heat exchanger, or air conditioner to meet this condition.

TIP Hot air rises. The temperature at the top of the enclosure is often higher than the temperature in other parts of the enclosure, especially if air is not circulating.

IMPORTANT The product can operate at a range of extremes. However, the life span of any electronic device is shortened if you continuously operate the product at its highest rated temperature.

- The humidity of the ambient air must not exceed specified limits. In very dry environments, static charges build up readily. Proper grounding of the equipment helps to reduce static discharges, which may cause shocks and damage electronic components.
- The enclosure or cover must remain in place at all times during operation. The cover provides protection against high voltages inside the product and inhibits radio-frequency emissions that might interfere with other equipment.
- When mounted, the product cannot be tilted more than ±60° from vertical.



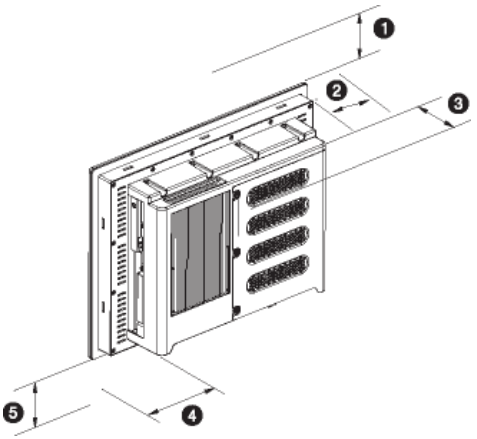
Mounting Clearances

When selecting an installation site for the computers, be sure to allow adequate clearance on the sides and rear of the computer for proper ventilation, cable connection, and hardware access. Sufficient airflow throughout the system unit is required to maintain proper cooling. Clearance should be enough to allow convenient installation or removal of peripheral components, such as the CompactFlash card.

IMPORTANT

Use adequate ventilation or other cooling methods to maintain the product temperature at its specified rating.

Because of self-heating, do not operate the computer in an enclosure using the minimum clearances unless adequate ventilation or other cooling methods are used to lower the temperature within the enclosure.

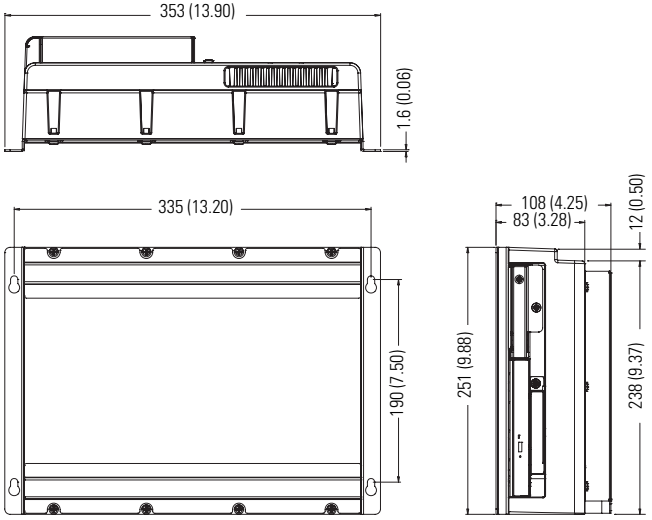


Item	Description	Value
1	Top	50 mm (2 in.)
2	Back	50 mm (2 in.)
3	Left (for airflow)	50 mm (2 in.)
4	Right (for airflow and drive access)	127 mm (5 in.)
5	Bottom (for I/O port access and ventilation)	102 mm (4 in.)

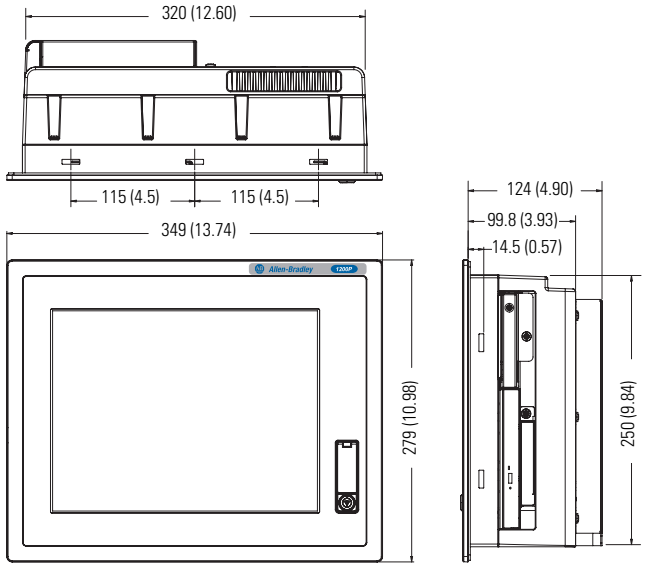
Product Dimensions

Product dimensions for the computers are given in mm (in).

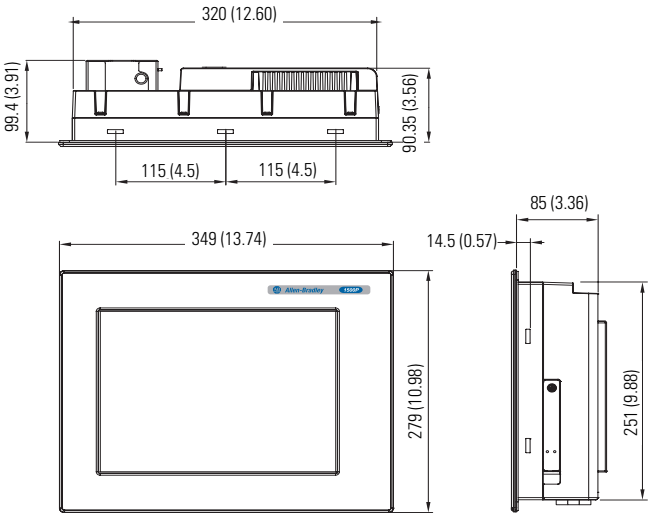
1200P Non-display Computers



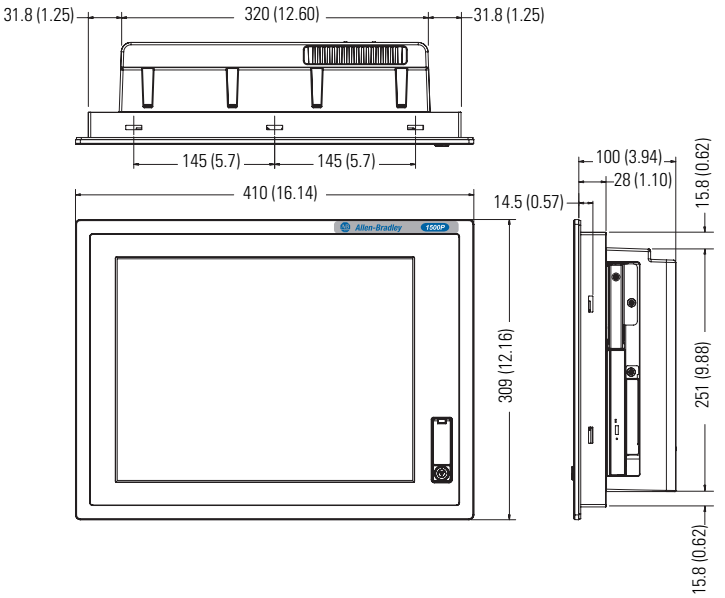
1200P Integrated Display Computer - Performance



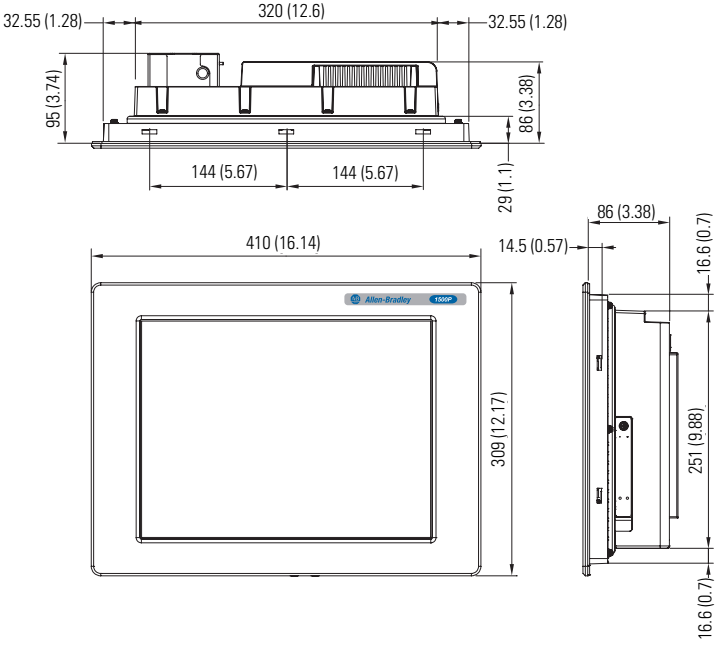
1200P Integrated Display Computer - Standard



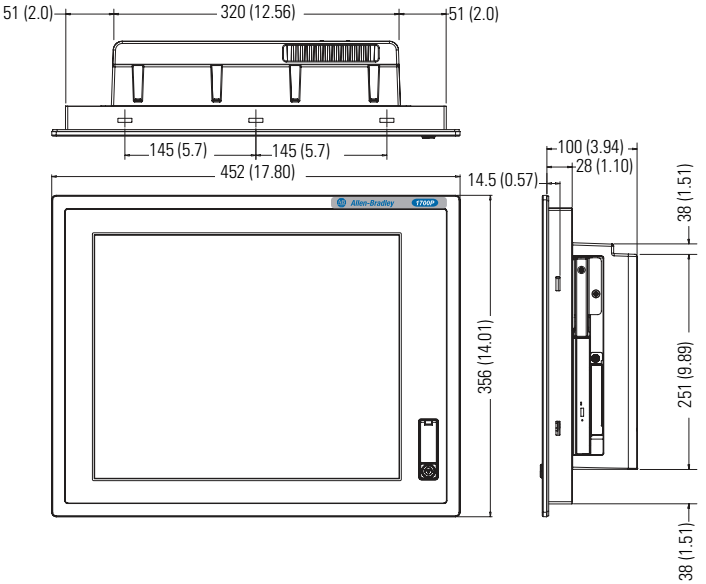
1500P Integrated Display Computer - Performance



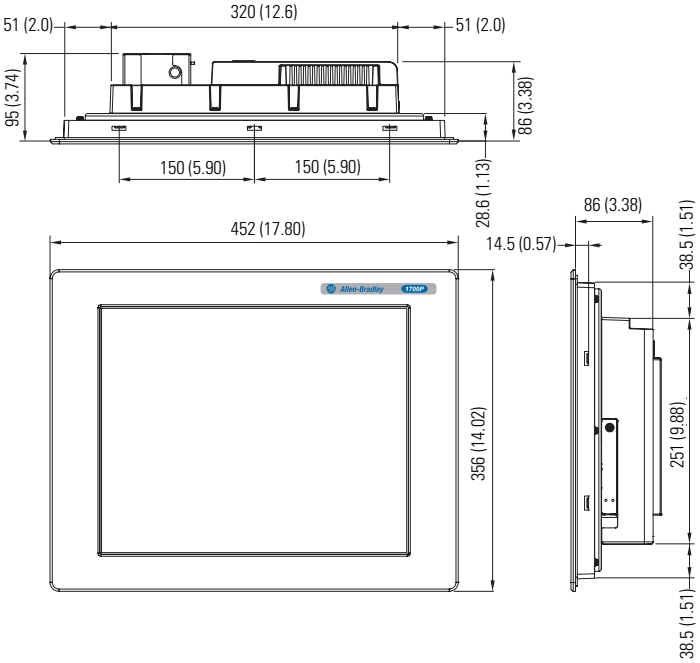
1500P Integrated Display Computer - Standard



1700P Integrated Display Computers - Performance



1700P Integrated Display Computer - Standard



Install the Computer

The computers support the following mounting options:

- Panel mount
- Wall mount (for non-display computers)

Panel Mounting Guidelines

Observe these guidelines when installing the unit in a panel.

- Remove all electrical power from the panel before making the cutout.
- Confirm that there is adequate space behind the panel. For specific information refer to Mounting Clearances on page 9.
- Cut supporting panels to specifications before installation. Take precautions so metal cuttings do not enter components already installed in panel.

  Supporting panels must be at least 14 gauge to ensure proper sealing against water and dust and to provide proper support. The mounting hardware supplied accommodates panel thickness between 1.5 to 5.5. mm (0.06…0.25 in.).

- Make sure the area around the panel cutout is clear.

ATTENTION

Failure to follow these guidelines may result in personal injury or damage to the panel components.

Panel Cutout Dimensions

The products must be appropriately mounted in the panel cutout specified below.

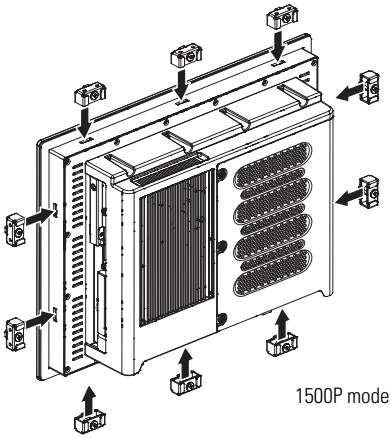
Computer Model	Cutout Dimensions (HxW), approx.
1200P	254.0 x 324.0 mm (10.0 x 12.76 in.)
1500P	285.0 x 386.6 mm (11.24 x 15.22 in.)
1700P	329.5 x 424.0 mm (12.97 x 16.69 in.)

Mount the Display Computer in a Panel

Mounting clips secure the display computer to the panel. The number of clips varies by model.

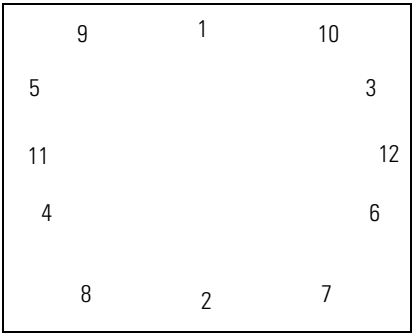
Follow these steps to mount the computer in a panel.

1. Remove power from the panel.
2. Cut an opening in the panel using the appropriate panel cutout dimensions.
3. Place the computer in the panel cutout.
4. Slide the mounting clips into the holes on the top, bottom, and sides of the computer.



1500P model shown

5. Gradually tighten the clips, one at a time, around the bezel using the specified sequence starting with the center clips and continuing to the corner clips.



6. Tighten the mounting clips to a torque of 1.4 N•m (12 lb•in) by using the sequence in step 5, being sure not to overtighten.

   Repeat this process at least three times until the clips are properly torqued, making sure the gasket is compressed uniformly against the panel.

ATTENTION

Tighten the mounting clips to the specified torque to provide a proper seal and prevent damage to the product. Rockwell Automation assumes no responsibility for water or chemical damage to the product or other equipment within the enclosure because of improper installation.

Mount the Non-display Computer on a Wall

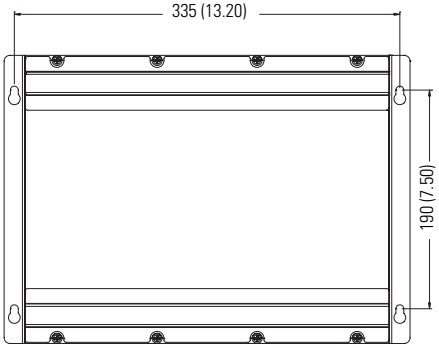
Four mounting screws secure the non-display computers to a wall.

Follow these steps to mount a non-display computer:

1. Make sure the power is disconnected.

2. Mount the computer to a wall by using four M5 panhead screws and tighten to a torque that is appropriate for the screw and wall material.

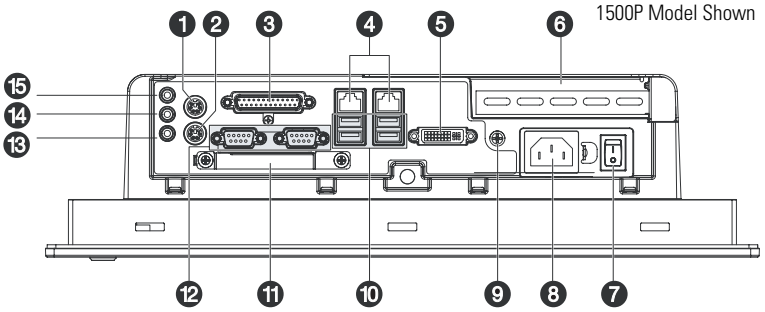
3. The illustration shows the location of the holes with the dimensions in mm (inches).



Connect Peripherals

Connect the required necessary peripherals such as keyboard and mouse.

Performance and Non-display Models



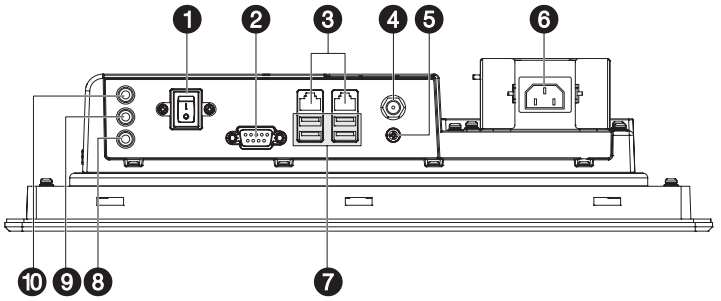
Item	Component
1	PS/2 mouse port
2	PS/2 keyboard port
3	Parallel port
4	Ethernet ports (RJ-45), 2
5	DVI-I port
6	PCI riser slot cover(1)
7	Power switch
8	Power input, AC or DC(2)
9	Functional ground screw
10	USB ports, 4
11	CompactFlash Type II card slot
12	Serial COM ports, 2
13	Microphone-in jack
14	Audio line-out jack
15	Audio line-in jack

(1) 1500P and 1700P have one PCI riser slot; 1200P and non-display computers have two PCI riser slots.

(2) Model dependent.

Standard Model

1500P Model Shown



Item	Component
1	Power switch
2	Serial COM port
3	Ethernet ports (RJ–45), 2
4	Power input, DC
5	Functional ground screw
6	Power input, AC
7	USB ports, 4
8	Microphone-in jack
9	Audio line-out jack
10	Audio line-in jack

Apply Power

The computer connects to either a 100…240V AC or 18…32V DC power source, depending on the model.

ATTENTION

- Connect the AC power cord or the DC ground connection to a power source with an earth ground to prevent electrical shock. Failure to follow this warning could result in electrical shock.
- The computer circuit should have its own disconnect. Use an uninterruptible power source (UPS) to protect against unexpected power failure or power surges.
- Always shut down the operating system before removing power to minimize performance degradation and operating system failures.
- You may need to remove the AC retainer clip before installing the computers in a panel cutout. Reattach the clip after installing the unit.

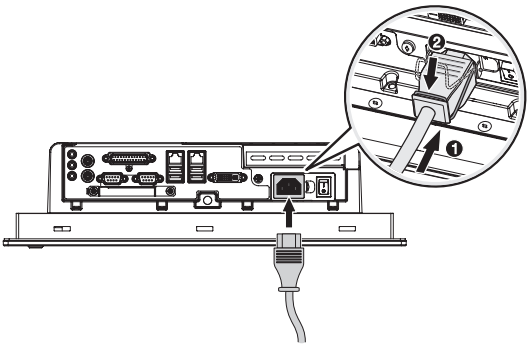
Connect AC Power to Performance and Non-display Computers

A grounded 3-prong IEC320 power cord provides power to a computer with an AC power input. The power supply input accepts 100…240V AC and is autoranging.

TIP If using an alternate IEC320 cord, make sure the female end of the cord is sized appropriately for the retention clip.

Follow these steps to connect AC power to performance and non-display computers.

1. Connect the power cord to the AC power input.
2. Secure the power cord in place with the retention clip.

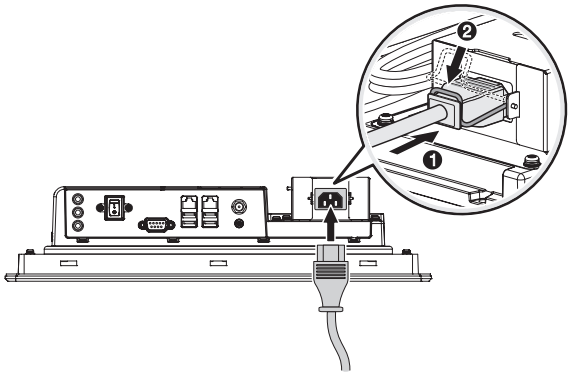


3. Apply 100…240V AC power to the computer.

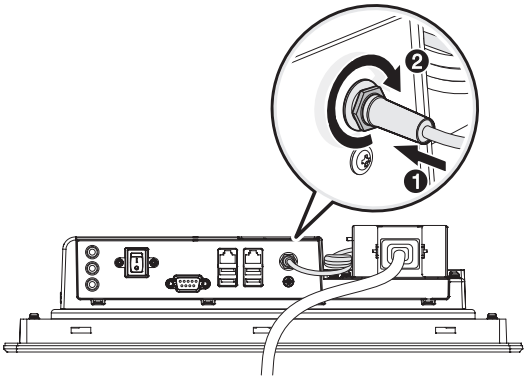
Connect AC Power to Standard Computers

Follow these steps to connect AC power to the standard computers.

1. Connect the power cord to the AC power input **(1)**, and secure it in place with the retention clip **(2)**.



2. Connect the DC barrel connector to the power input jack **(1)** and twist the locking ring clockwise to secure it in place **(2)**.



3. Apply 100…240V AC power to the computer.

Connect DC Power

Performance and non-display computers with a catalog numbers ending in DC have a DC input terminal block for connecting to a 18…32V DC power source.

The DC power option supports operation from either Safety Extra-low Voltage (SELV) or Protected Extra-low Voltage (PELV) power source. A ground bus strip is provided to allow a user to connect the DC common and functional ground terminals together. This is to support some cases of SELV where grounding at the product may be required by the end user.

The power supply is internally protected against reverse polarity.

ATTENTION

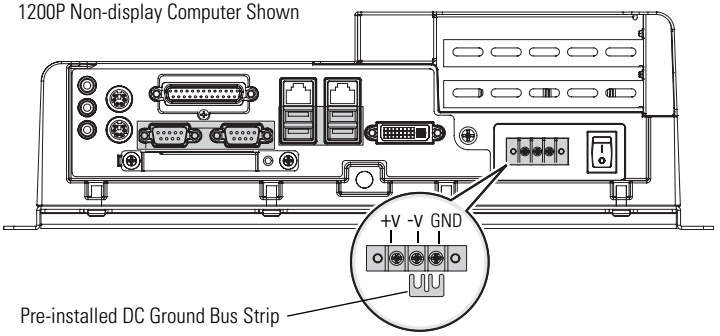
Use an SELV isolated and ungrounded power supply as input power to the computer. This power source provides protection so that under normal and single fault conditions, the voltage between the conductors and Functional Earth/Protective Earth does not exceed a safe value.

Follow these steps to connect the computer to a DC power source.

1. Verify the main power switch or breaker is off.
2. Verify that the DC power wires meet these requirements:
   - Material: Stranded copper
   - Wire gauge: #22…#18 AWG
3. Secure the DC power wires to the terminal block screws, and the ground wire to the GND terminal screw.

   Tighten the terminal to a torque of 0.687 N•m (6.1 lb•in.).
4. Apply 18…32V DC power to the computer.

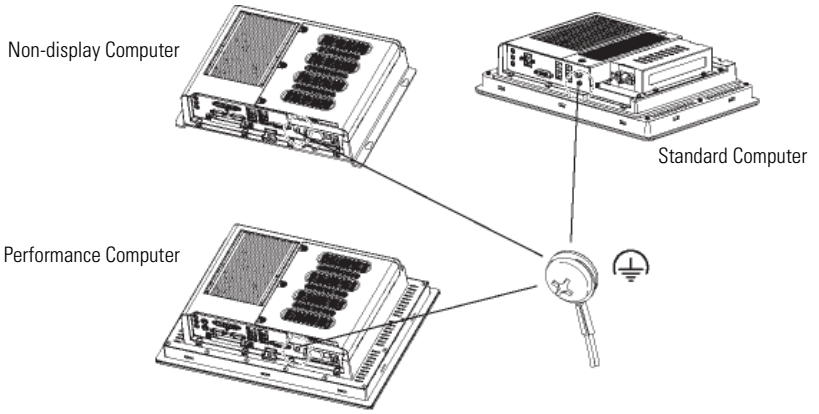
1200P Non-display Computer Shown



Functional Ground Screw

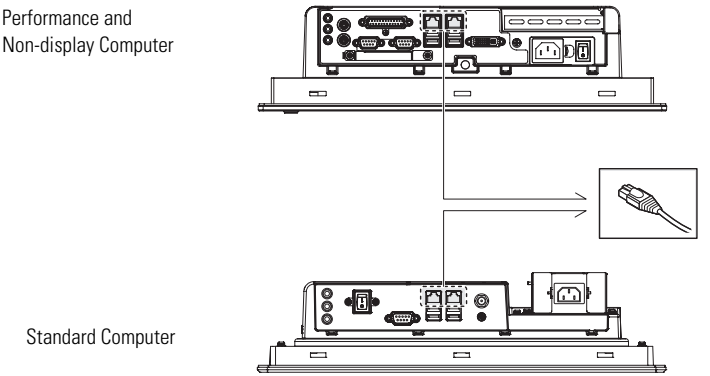
The pre-installed functional ground screw is not required for safety or regulatory compliance. However, if a supplemental ground is desired, use the functional ground screw in the I/O port panel of the computer.

If using the functional ground screw, connect the product to earth ground by using a 1.5 mm^2 (16 AWG) or larger external wire. Use a ground wire with green insulation and a yellow stripe for easy identification.



Connect to a Network

The computers have two Gigabit LAN ports. The computers connect to an Ethernet network using CAT5 or CAT5E twisted-pair Ethernet cabling with RJ-45 connectors.



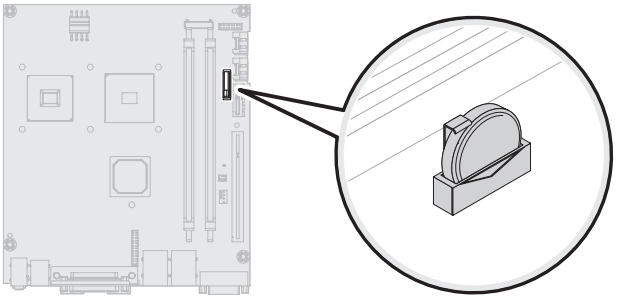
IMPORTANT To prevent performance degradation of Ethernet communication, do not subject the computer or cables to extreme radiation or conducted high-frequency noise.

Proper cable routing and power conditioning is required to be sure of reliable Ethernet communication in an industrial environment. Rockwell Automation recommends that you route all Ethernet cabling through dedicated metal conduits. Installing ferrite bead filters at the cable ends may also improve reliability.

RTC Battery

This product contains a lithium battery which is intended to be replaced during the life of the product.

The computers use nonvolatile memory that require a battery to retain system information when power is removed. The battery is located beside the DIMM1 slot.



The battery life depends on the amount of time the computer is powered on.

Battery Life

On Time	Expected Battery Life
0 hours/week	4 years
40 hours/week	5.5 years
80 hours/week	7 years

If your computer does not display the correct time and date, replace the battery.

ATTENTION Replace the battery with a specially-packaged replacement part from Allen-Bradley. Use of another battery may present a risk of fire or explosion.

At the end of its life, the used battery should be collected separately from any unsorted municipal waste and recycled.

WARNING

A risk of fire and chemical burn exists if the battery is not handled properly. Do not disassemble, crush, puncture, or short external contacts, or expose the battery to temperatures higher than 85 °C (185 °F).

Do not dispose of a used battery in water or fire. Dispose of used batteries according to the manufacturer's instructions.

IMPORTANT

Loss of BIOS settings occurs when the battery is removed. BIOS settings must be reconfigured whenever the battery is replaced.

Ship or Transport the Product

If you need to ship the product via common carrier or otherwise transport it to another location, you must first uninstall the product and place it in its original packing material.

ATTENTION

Do not ship or transport the product when it is installed in a machine, panel, or rack. Doing so may cause damage to the product. You must uninstall the product and place it in its original packing material before shipping. Rockwell Automation is not responsible for damage incurred to a product that is shipped or transported while installed in a machine, panel, or rack.

Specifications

Industrial Integrated Display Computers

Attribute	Value
Electrical	
Performance and non-display, AC	
Input voltage, AC	100…240V AC, autoranging
Line frequency	47…63 Hz
Power consumption, AC	110 VA (0.95 A @ 100V rms, 0.46A @ 240V rms)
Performance and non-display, DC	
Input voltage, DC	18…32V DC
Power consumption, DC	95 W (5.28 A @ 18V 2.97 A @ 32V)
Standard models	
Input voltage, AC	100…240 V AC, autoranging
Line frequency	47…63 Hz
Input voltage, DC[1]	20V DC (3.25 A)
Power consumption, AC	100 VA (1 A @ 100V rms, 0.42 A @ 240V rms)
Heat dissapation[2]	65W (222 BTU/h)
Mechanical	
Weight, approx	
Non-display	7.7 kg (16.98 lb)
1200P, Performance	9.5 kg (20.94 lb)
1200P, Standard	7.85 kg (17.31 lb)
1500P, Performance	10.7 kg (23.59 lb)
1500P, Standard	9.0 kg (19.84 lb)
1500P, Performance, SS	11.9 kg (26.24 lb)
1700P, Performance	12.6 kg (27.78 lb)
1700P, Standard	11.0 kg (24.25 lb)
1700P, Performance, SS	14.5 kg (31.97 lb)
Dimensions, overall (HxWxD)	
Non-display	251 x 353 x 108 mm (7.5 x 13.20 x 4.25 in.)
1200P	
Performance	279 x 349 x 124 mm (10.98 x 13.74 x 4.90 in.)
Standard	279 x 349 x 99 mm (10.98 x 13.74 x 3.91 in.)
1500P	
Performance	309 x 410 x 100 mm (12.16 x 16.14 x 3.94 in.)
Standard	309 x 410 x 95 mm (12.16 x 16.14 x 3.74 in.)
1700P	
Performance	356 x 452 x 100 mm (14.01 x 17.80 x 3.94 in.)
Standard	356 x 452 x 95 mm (14.01 x 17.80 x 3.74 in.)
Enclosure ratings (for display models only)[3]	
Performance	NEMA Type 1, 12, 4, and IEC IP66
Standard	NEMA Type 1, 12, 4, and IEC IP66
Stainless steel models	NEMA Type 1, 12, 4, 4X, and IEC IP66

(1) Power adapter required.

(2) Add-in cards and peripherals are not included in the heat dissipation value. Calculate heat dissipation separately for installed add-in cards and peripherals

(3) Type ratings only apply when unit is properly mounted on a flat surface of an equivalent type enclosure.

Environmental	
Temperature, operating Standard Performance 1700P Performance 1200P, 1500P, Non-display	 0…50 °C (32…122 °F) 0…50 °C (32…122 °F) 0…55 °C (32…131°F)
Temperature, nonoperating	-20…60 °C (-4…140 °F)
Relative humidity	10…90% noncondensing
Shock, operating[1][2]	15 g (1/2 sine, 11 ms)
Shock, nonoperating[1]	30 g (1/2 sine, 11 ms)
Vibration, operating 6181P[1][2] 6181F[1]	 0.006 in. p-p, (10…57 Hz); 1 g peak, (57…640 Hz) 0.012 in. p-p, (10…57 Hz); 2 g peak, (57…640 Hz)
Vibration, nonoperating	0.012 in. p-p, (10…57 Hz); 2 g peak, (57…640 Hz)

(1) Applies to panel mounted computers only.

(2) The optical disc drive is considered a maintenance device. Do not operate computers with this drive in environments with the shock and vibration levels listed. Do not operate the drive in temperatures above 45 °C (113 °F).

Certification [1]	
c-UL-us	UL/c-UL Listed per UL 60950-1 and CSA C22.2 No. 60950-1-03
CE	Marked for all applicable directives EMC 2004/108/EC LVD 2006/95/EC
RoHS	China RoHS
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions

(1) See http://ab.com for declarations of conformity, certificates, and other certification details.

Additional Resources

For additional information on the Non-display Computers, refer to the following publications.

Resource	Description
Industrial Integrated Display Computer User Manual, publication 6181P-UM002	Gives an overview of the system and provides procedures to install the computer, set up computer connections, operate the computer, and troubleshoot the computer.
Cloning Utility Technical Data, publication 6000-TD002	Provides information on how to create and restore a backup image of your computer's hard drive.
Diagnostic Utility for Industrial Computers, publication 6000-TG001	Provides information on how to diagnose hardware issues with industrial computers.
EWF and HORM Configuration Utility Technical Data, publication 6000-TD003	Provides information on how to configure Enhanced Write Filter (EFW) and Hiberate Once Restore Many (HORM) features for computers with the Windows Embedded Standard 2009 operating system.

You can view or download publications at http://literature.rockwellautomation.com. To order paper copies of technical documentation, contact your local Rockwell Automation distributor or sales representative.

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Solenoid Release Units

Description

The solenoid release unit is used for electrical isolation of machinery to improve safe access. It consists of a rotary power switch and a solenoid. The trapped key can be removed once an external signal is given to its internal solenoid locking mechanism. An indicator light on the solenoid release unit indicates when the trapped key can be removed; that is, when power is applied to the solenoid. The solenoid signal only needs to be present when key removal is necessary. The solenoid is rated for 100% duty cycle. Power to the solenoid can be removed after the trapped key is removed.

Rotating the trapped key causes the isolating power switch to change state; the normally open contacts open and the normally closed contacts (if applicable) will close.

The trapped key can then be used in the next sequence of the operation.

Features

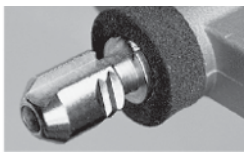
- Direct drive operation—positively opens contacts
- Integral solenoid monitoring
- Key trapped until release signal is applied
- LED or NEON "key free" indication
- 316L stainless steel construction
- 24V DC, 110V AC or 230V AC solenoid options
- Weatherproof stainless steel dust cap as standard
- UL and CSA Approval on switches
- Single or multiple key units available (contact factory)
- Replaceable code barrel assembly

Specifications

Safety Ratings

Standards	EN1954-1, IEC/EN60204-1,EN1088, IEC/EN60947-5-1, ISO13849-1, ISO12100-1&2, ISO14119, GS-ET-19, AS4024.1
Certifications	CE Marked for all applicable directives and BG
Operating Characteristics	
Solenoid Voltage	24V DC, 110V AC, 230V AC
Solenoid Power	DC Types: 6.5 W continuous AC Types: 6V A continuous
Electrical Life	100,000 operations
Mechanical Life	100,000 operations
Utilization Category	
Electrical Characteristics	See rotary power switches.
Environmental & Physical Characteristics	
Shear Force to Key	15.1 k•N (3398 lbs), max.
Torque to Key	14 N•m (124 lb•in), max.
Material	Trapped Key Components: 316L stainless steel Steel Face Plate: 316L stainless steel Optional Box: ABS plastic
Operating Temperature [C (F)]	0…40 ° (32…104 °)
Relative Humidity	95%

The Prosafe Advantage



Stainless steel construction.

Product Selection

Type	Solenoid Voltage	Contacts	Current, Nom	Cat. No.
Single key out	24V DC	2 N.O. & 2 N.C.	20 A	440T-MSRUE11✶
		4 N.O.		440T-MSRUE10✶
			32 A	440T-MSRUE12✶
		3 N.O. & 3 N.C.	20 A	440T-MSRUE13✶
	110V AC	2 N.O. & 2 N.C.	20 A	440T-MSRUE22✶
		4 N.O.		440T-MSRUE20✶
			32 A	440T-MSRUE23✶
		3 N.O. & 3 N.C.	20 A	440T-MSRUE14✶
		4 N.O.	63 A	440T-MSRUE24✶
	230V AC	2 N.O. & 2 N.C.	20 A	440T-MSRUE33✶
		4 N.O.		440T-MSRUE30✶
			32 A	440T-MSRUE34✶
			63 A	440T-MSRUE35✶
	110V DC	2 N.O. & 2 N.C.	20 A	440T-MSRUE44✶
		4 N.O.		440T-MSRUE40✶
		3 N.O. & 3 N.C.		440T-MSRUE46✶
Dual key out	24V DC	4 N.O.	20 A	440T-MS2097D✶✶
		2 N.O. & 2 N.C.		440T-MS2097A✶✶
		4 N.O.	32 A	440T-MS2097G✶✶
			63 A	440T-MS2097J✶✶
Triple key out	24V DC	4 N.O.	20 A	440T-MS3417D✶✶✶
		2 N.O. & 2 N.C.		440T-MS3417A✶✶✶
		4 N.O.	32 A	440T-MS3417G✶✶✶
			63 A	440T-MS3417J✶✶✶
Quad key out	24V DC	4 N.O.	20 A	440T-MS3418D✶✶✶✶
		2 N.O. & 2 N.C.		440T-MS3418A✶✶✶✶
		4 N.O.	32 A	440T-MS3418G✶✶✶✶
			63 A	440T-MS3418J✶✶✶✶

✶ Substitute the desired primary code for this symbol (key not included). See 3-107.

Accessories

Description	Additional Information	Cat. No.
Stainless steel key	3-140	440T-AKEYE10✶
Stainless steel replacement code barrel with dust cap		440T-ASCBE14✶
Stainless steel weatherproof replacement dust cap		440T-ASFC10✶
Optional plastic enclosure	For use with single key out 20 A units	440T-AIPB10
	For use with single key out 32 A units	440T-AIPB22
Optional ABS plastic enclosure	For use with triple/quad key out units	440T-AIPB50
Optional stainless steel enclosure	For use with triple/quad key out units	440T-AIPB55

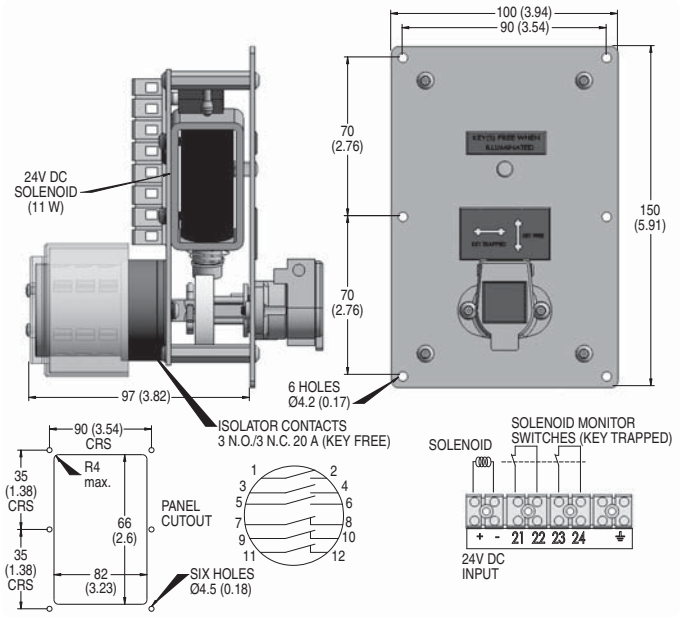
✶ Substitute the desired primary code for this symbol (key not included). See 3-107.

Solenoid Release Units

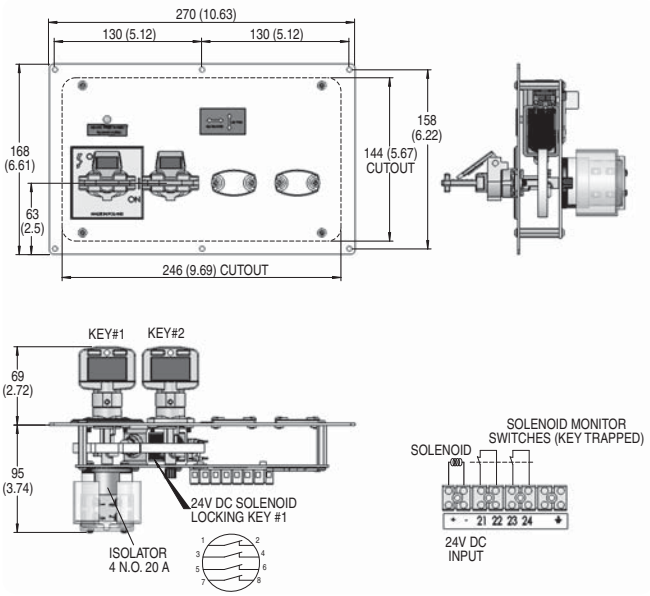
Approximate Dimensions [mm (in.)]

Dimensions are not intended to be used for installation purposes.

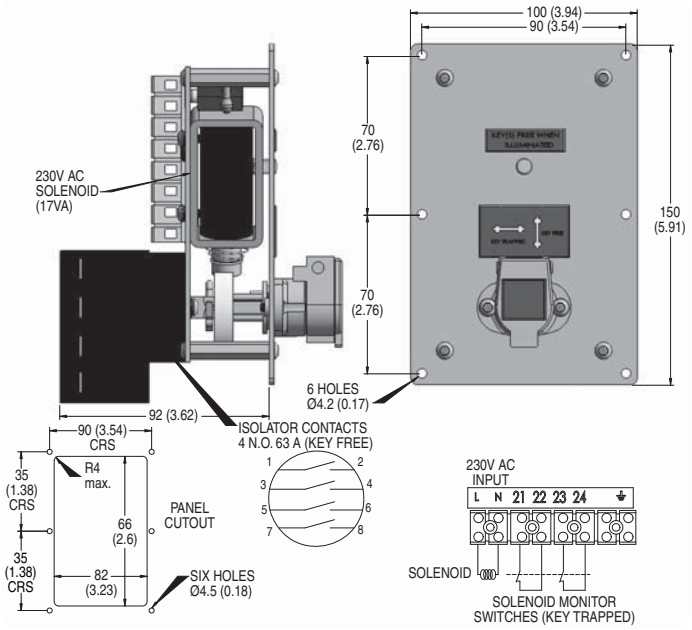
MSRUE13



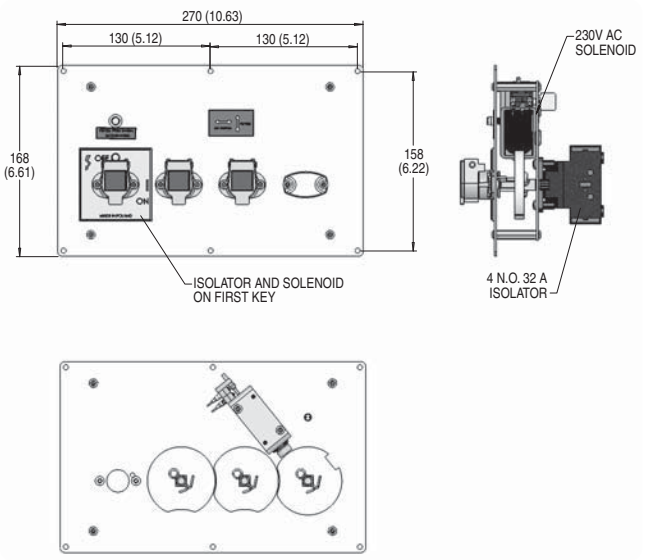
MS2097



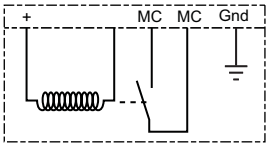
MSRUE35



MS3417



Typical Wiring



1756 ControlLogix Controllers Specifications

ControlLogix Controller Catalog Numbers

1756-L61, 1756-L62, 1756-L63, 1756-L64, 1756-L65, 1756-L72, 1756-L73, 1756-L74, 1756-L75

GuardLogix Controller Catalog Numbers

1756-L61S, 1756-L62S, 1756-L63S, 1756-LSP

ControlLogix-XT Controller Catalog Number

1756-L63XT

ControlLogix Redundancy Catalog Numbers

1756-RM, 1756-RMXT

Memory Card Catalog Numbers

1784-CF64, 1784-CF128, 1784-SD1, 1784-SD2

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Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls (publication SGI-1.1 available from your local Rockwell Automation sales office or online at http://www.rockwellautomation.com/literature/) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

	WARNING: Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
	ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence
	SHOCK HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.
	BURN HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.

Rockwell Automation, Rockwell Software, Allen-Bradley, ArmorBlock, ArmorBlock Guard I/O, ArmorBlock MaXum, ArmorPoint, Compact I/O, CompactBlock I/O, CompactBlock Guard I/O, CompactLogix, ControlLogix, ControlLogix-XT, Data Highway Plus, DH+, DriveLogix, FactoryTalk, FLEX Ex, FLEX I/O, FLEX I/O-XT, FlexLogix, Guard I/O, GuardLogix, InView, MicroLogix, On-Machine, PanelView, PanelView e, PanelView Plus, PLC-2, PLC-3, PLC-5, POINT I/O, POINT Guard I/O, PowerFlex, RSLinx, RSLinx Enterprise, RSLogix 5000, SCANport, SLC, SoftLogix, SynchLink, TechConnect are trademarks of Rockwell Automation, Inc.

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1756 ControlLogix Controllers

The ControlLogix controller provides a scalable controller solution that is capable of addressing a large amount of I/O points. The ControlLogix controller can be placed into any slot of a ControlLogix I/O chassis and multiple controllers can be installed in the same chassis.

ControlLogix controllers can monitor and control I/O across the ControlLogix backplane, as well as over network links. To provide communication for a ControlLogix controller, install the appropriate communication interface module into the chassis.

Features - Standard ControlLogix Controllers

Feature	1756-L61, 1756-L62, 1756-L63, 1756-L64, 1756-L65	1756-L72, 1756-L73, 1756-L74, 1756-L75
Controller tasks	• 32 tasks • 100 programs/task • Event tasks: all event triggers	
Built-in communication ports	1 port RS-232 serial	1 port USB
Communication options	• EtherNet/IP • ControlNet • DeviceNet • Data Highway Plus • Remote I/O • SynchLink • Third-party process and device networks	
Serial port communication	• ASCII • DF1 full/half-duplex • DF1 radio modem • DH-485 • Modbus via logic	—
Controller connections supported, max	250	500
Network connections, per network module	• 100 ControlNet (1756-CN2/A) • 40 ControlNet (1756-CNB) • 256 EtherNet/IP; 128 TCP (1756-EN2*x*) • 128 EtherNet/IP; 64 TCP (1756-ENBT)	
Controller redundancy	Full support	
Integrated motion	• SERCOS interface • Analog options (encoder input, LDT input, SSI input)	
Programming languages	• Relay ladder • Structured text • Function block • SFC	

IMPORTANT Scan time for a project loaded in a 1756-L64 or 1756-L65 controller may be slower than for the same project loaded in one of the other 1756-L6*x* controllers. See the Logix5000 Controllers Instruction Execution Time and Memory Use Reference Manual, publication 1756-RM087, for instruction execution times.

Technical Specifications - 1756-L6*x* ControlLogix Controllers

Attribute	1756-L61	1756-L62	1756-L63	1756-L64	1756-L65
User memory	2 MB	4 MB	8 MB	16 MB	32 MB
I/O memory	478 KB				
Optional nonvolatile memory storage	64 MB (cat. no. 1784-CF64) 128 MB (cat. no. 1784-CF128)				
Digital I/O, max	128,000				
Analog I/O, max	4000				
Total I/O, max	128,000				
Replacement battery[1]	Series A: 1756-BA1, 1756-BATM, 1756-BATA Series B: 1756-BA2	Series A: 1756-BA1, 1756-BATM, 1756-BATA Series B: 1756-BA2	Series A: 1756-BA1, 1756-BATM, 1756-BATA Series B: 1756-BA2	1756-BA2	
Current draw @ 5.1V DC	1200 mA				
Current draw @ 24V DC	14 mA				
Power dissipation	3.5 W				
Thermal dissipation	11.9 BTU/hr				
Isolation voltage	30V (continuous), basic insulation type, RS-232 to system Controllers tested to withstand 720V DC for 60 s				
Serial cables	1756-CP3 or 1747-CP3, right angle connector to controller, straight to serial port, 3 m (9.84 ft)				
Weight, approx.	Series A: 0.32 kg Series B: 0.35 kg (Series A: 0.71 lb Series B: 0.78 lb)	Series A: 0.32 kg Series B: 0.35 kg (Series A: 0.71 lb Series B: 0.78 lb)	Series A: 0.32 kg Series B: 0.35 kg (Series A: 0.71 lb Series B: 0.78 lb)	Series A: 0.32 kg Series B: 0.35 kg (Series A: 0.71 lb Series B: 0.78 lb)	Series A: 0.32 kg Series B: 0.35 kg (Series A: 0.71 lb Series B: 0.78 lb)
Slot width	1				
Module location	Chassis-based, any slot				
Chassis	1756-A4, 1756-A7, 1756-A10, 1756-A13, 1756-A17				
Power supply, standard	1756-PA72/C, 1756-PA75/B, 1756-PB72/C, 1756-PB75/B, 1756-PC75/B, 1756-PH75/B				
Power supply, redundant	1756-PA75R, 1756-PB75R, 1756-PSCA2				
Wire category	2 - on communication ports[2]				
North American temperature code	T4A				
IEC temperature code	T4				
Enclosure type rating	None (open-style)				

(1) For Australian Mining certification applications, only Series A and a 1756-BA1 battery can be used. For more information, contact your local distributor or sales office.

(2) Use this conductor category information for planning conductor routing as described in the system level installation manual. See the Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

Environmental Specifications - 1756-L6*x* ControlLogix Controllers

Attribute	1756-L61, 1756-L62, 1756-L63, 1756-L64, 1756-L65
Temperature, operating IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock)	0…60 °C (32…140 °F)
Temperature, storage IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock)	-40…85 °C (-40…185 °F)
Relative humidity IEC 60068-2-30 (Test Db, Unpackaged Damp Heat)	5…95% noncondensing
Vibration IEC 60068-2-6 (Test Fc, Operating)	2 g @ 10…500 Hz
Shock, operating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	30 g
Shock, nonoperating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	50 g
Emissions CISPR 11	Group 1, Class A
ESD immunity IEC 61000-4-2	6 kV contact discharges 8 kV air discharges
Radiated RF immunity IEC 61000-4-3	10V/m with 1 kHz sine-wave 80% AM from 80…2000 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 900 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 1890 MHz 3V/m with 1 kHz sine-wave 80% AM from 2000…2700 MHz
EFT/B immunity IEC 61000-4-4	±4 kV at 5 kHz on communication ports
Surge transient immunity IEC 61000-4-5	±2 kV line-earth (CM) on communication ports
Conducted RF immunity IEC 61000-4-6	10Vrms with 1 kHz sine-wave 80% AM from 150 kHz…80 MHz

Certifications - 1756-L6*x* ControlLogix Controllers

Certification[1]	1756-L61, 1756-L62, 1756-L63, 1756-L64, 1756-L65
c-UL-us	UL Listed Industrial Control Equipment, certified for US and Canada. See UL File E65584. UL Listed for Class I, Division 2 Group A,B,C,D Hazardous Locations, certified for U.S. and Canada. See UL File E194810.
CSA	CSA Certified Process Control Equipment. See CSA File LR54689C. CSA Certified Process Control Equipment for Class I, Division 2 Group A,B,C,D Hazardous Locations. See CSA File LR69960C.
CE	European Union 2004/108/EC EMC Directive, compliant with: • EN 61326-1; Meas./Control/Lab., Industrial Requirements • EN 61000-6-2; Industrial Immunity • EN 61000-6-4; Industrial Emissions • EN 61131-2; Programmable Controllers (Clause 8, Zone A & B)
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
Ex	European Union 94/9/EC ATEX Directive, compliant with: • EN 60079-15; Potentially Explosive Atmospheres, Protection “n” (Zone 2) • EN60079-0; General Requirements • II 3 G Ex nA IIC T4 X **Important:** The 1756-L64 and 1756-L65 controllers do not have this certification.
FM	FM Approved Equipment for use in Class I Division 2 Group A,B,C,D Hazardous Locations
Functional safety[2]	Certified by TÜV: Capable of SIL2 **Important:** This certification applies only to the 1756-L61, 1756-L62, and 1756-L63 controllers.

(1) When marked. See the Product Certification link at http://www.ab.com for Declarations of Conformity, Certificates, and other certification details.

(2) When used with specified firmware revisions.

Technical Specifications - 1756-L7*x* ControlLogix Controllers

Attribute	1756-L72	1756-L73	1756-L74	1756-L75
User memory	4 MB	8 MB	16 MB	32 MB
I/O memory	0.98 MB			
Optional nonvolatile memory storage	1 GB (cat. no. 1784-SD1) 2 GB (cat. no. 1784-SD2)			
Digital I/O, max	128,000			
Analog I/O, max	4000			
Total I/O, max	128,000			
Energy storage module	1756-ESMCAP capacitor-based energy-storage module 1756-ESMNSE energy-storage module without stored energy 1756-ESMNRM energy-storage module that secures the controller by preventing the USB connection and Secure Digital card use			
Current draw @ 1.2V DC	5 mA			
Current draw @ 5.1V DC	800 mA			
Power dissipation	2.5 W			
Thermal dissipation	8.5 BTU/hr			
Isolation voltage	30V (continuous), basic insulation type, USB port-to-system Type tested at 500V AC for 60 s			
USB port	USB 2.0, full speed (12 Mbps)			
USB cable	Samtec cable, P/N RSP-199350			
Weight, approx.	0.25 kg (0.55 lb)			
Slot width	1			
Module location	Chassis-based, any slot			
Chassis	1756-A4, 1756-A7, 1756-A10, 1756-A13, 1756-A17			
Power supply, standard	1756-PA72/C, 1756-PA75/B, 1756-PB72/C, 1756-PB75/B, 1756-PC75/B, 1756-PH75/B			
Power supply, redundant	1756-PA75R, 1756-PB75R, 1756-PSCA2			
Wire category	3 - on USB port[1]			
North American temperature code	T5			
IEC temperature code	T5			
Enclosure type rating	None (open-style)			

(1) Use this conductor category information for planning conductor routing as described in the system level installation manual. See the Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

Environmental Specifications - 1756-L7*x* ControlLogix Controllers

Attribute	1756-L72, 1756-L73, 1756-L74, 1756-L75
Temperature, operating IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock)	0…60 °C (32…140 °F)
Temperature, storage IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock)	-40…85 °C (-40…185 °F)
Relative humidity IEC 60068-2-30 (Test Db, Unpackaged Damp Heat)	5…95% noncondensing
Vibration IEC 60068-2-6 (Test Fc, Operating)	2 g @ 10…500 Hz
Shock, operating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	30 g
Shock, nonoperating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	50 g (45 g with SD card installed)
Emissions CISPR 11	Group 1, Class A
ESD immunity IEC 61000-4-2	6 kV contact discharges 8 kV air discharges
Radiated RF immunity IEC 61000-4-3	10V/m with 1 kHz sine-wave 80% AM from 80…2000 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 900 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 1890 MHz 3V/m with 1 kHz sine-wave 80% AM from 2000…2700 MHz

Certifications - 1756-L7*x* ControlLogix Controllers

Certification[1]	1756-L72, 1756-L73, 1756-L74, 1756-L75
c-UL-us	UL Listed Industrial Control Equipment, certified for US and Canada. See UL File E65584. UL Listed for Class I, Division 2 Group A,B,C,D Hazardous Locations, certified for U.S. and Canada. See UL File E194810.
CE	European Union 2004/108/EC EMC Directive, compliant with: • EN 61326-1; Meas./Control/Lab., Industrial Requirements • EN 61000-6-2; Industrial Immunity • EN 61000-6-4; Industrial Emissions • EN 61131-2; Programmable Controllers (Clause 8, Zone A & B)
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
Ex	European Union 94/9/EC ATEX Directive, compliant with: • EN 60079-15; Potentially Explosive Atmospheres, Protection 'n' • EN 60079-0; General Requirements • II 3 G Ex nA IIC T5X

(1) When marked. See the Product Certification link at http://www.ab.com for Declarations of Conformity, Certificates, and other certification details.

1756 GuardLogix Controllers

A GuardLogix controller is a ControlLogix controller that also provides safety control. The GuardLogix system is a dual controller solution—you must use a 1756-L6*x*S primary controller and a 1756-LSP safety partner to achieve SIL 3/CAT. 4. A major benefit of this system is that it's still a single project, safety and standard together. The safety partner controller is a part of the system, is automatically configured, and requires no user setup.

During development, safety and standard have the same rules, multiple programmers, online editing, and forcing are all allowed. Once the project is tested and ready for final validation, you set the Safety Task to a SIL 3 integrity level, which is then enforced by the GuardLogix controller. When safety memory is locked and protected, the safety logic can't be modified and all safety functions operate with SIL 3 integrity. On the standard side of the GuardLogix controller, all functions operate like a regular Logix controller. Thus online editing, forcing, and other activities are all allowed.

With this level of integration, safety memory can be read by standard logic and external devices, like HMIs or other controllers, eliminating the need to condition safety memory for use elsewhere. The result is easy system-wide integration and the ability to display safety status on displays or marquees. Use Guard I/O modules for field device connectivity on Ethernet or DeviceNet networks, and for safety interlocking between GuardLogix controllers use Ethernet or ControlNet networks. Multiple GuardLogix controllers can share safety data for zone to zone interlocking, or a single GuardLogix controller can use remote distributed safety I/O between different cells/areas.

In addition to the standard features of a ControlLogix controller, the GuardLogix controller has these safety-related features.

Features - GuardLogix Controllers

Feature	1756-L61S, 1756-L62S, 1756-L63S, 1756-LSP
Safety communication options	Standard and safety • EtherNet/IP • ControlNet • DeviceNet
Network connections, per network module	• 100 ControlNet (1756-CN2/A) • 40 ControlNet (1756-CNB) • 256 EtherNet/IP; 128 TCP (1756-EN2*x*) • 128 EtherNet/IP; 64 TCP (1756-ENBT)
Controller redundancy	Not supported
Programming languages	Relay ladder

Technical Specifications - 1756 GuardLogix Controllers

Attribute	1756-L61S	1756-L62S	1756-L63S	1756-LSP
User memory	2 MB	4 MB	8 MB	—
Safety memory	1 MB	1 MB	3.75 MB	—
I/O memory	478 KB			—
Optional flash memory[1]	64 MB (cat. no. 1784-CF64) 128 MB (cat. no. 1784-CF128)			—
Digital I/O, max	128,000			—
Analog I/O, max	4000			—
Total I/O, max	128,000			—
Replacement battery	1756-BA2			
Current draw @ 5.1V DC	1200 mA			
Current draw @ 24V DC	14 mA			
Power dissipation	3.5 W			
Thermal dissipation	11.9 BTU/hr			
Isolation voltage	30V (continuous), Basic Insulation Type, RS-232 to system Type tested at 720V DC for 60 s			
Serial cables	1756-CP3 or 1747-CP3, right angle connector to controller, straight to serial port, 3 m (9.84 ft)			
Weight, approx.	0.32 kg (0.70 lb)			
Slot width	1			
Module location	Chassis-based, any slot			
Chassis	1756-A4, 1756-A7, 1756-A10, 1756-A13, 1756-A17			
Power supply, standard	1756-PA72/C, 1756-PA75/B, 1756-PB72/C, 1756-PB75/B, 1756-PC75/B, 1756-PH75/B			
Power supply, redundant	1756-PA75R, 1756-PB75R, 1756-PSCA2			
Wire category	2 - on communication ports[2]			
North American temperature code	T4A			
Enclosure type rating	None (open-style)			

(1) The GuardLogix controller does not support user program storage or retrieval by using a CompactFlash card.

(2) Use this conductor category information for planning conductor routing as described in the system level installation manual. See the Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

Environmental Specifications - 1756 GuardLogix Controllers

Attribute	1756-L61S, 1756-L62S, 1756-L63S, 1756-LSP
Temperature, operating IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock)	0…60 °C (32…140 °F)
Temperature, storage IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock)	-40…85 °C (-40…185 °F)
Relative humidity IEC 60068-2-30 (Test Db, Unpackaged Damp Heat)	5…95% noncondensing
Vibration IEC 60068-2-6 (Test Fc, Operating)	2 g @ 10…500 Hz
Shock, operating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	30 g
Shock, nonoperating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	50 g
Emissions CISPR 11	Group 1, Class A
ESD immunity IEC 61000-4-2	6kV contact discharges 8kV air discharges
Radiated RF immunity IEC 61000-4-3	10V/m with 1 kHz sine-wave 80% AM from 80…2000 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 900 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 1890 MHz 3V/m with 1 kHz sine-wave 80% AM from 2000…2700 MHz
EFT/B immunity IEC 61000-4-4	±4 kV at 5 kHz on communication ports
Surge transient immunity IEC 61000-4-5	±2 kV line-earth (CM) on communication ports
Conducted RF immunity IEC 61000-4-6	10Vrms with 1 kHz sine-wave 80% AM from 150 kHz…80 MHz

Certifications - 1756 GuardLogix Controllers

Certification[1]	1756-L61S, 1756-L62S, 1756-L63S, 1756-LSP
c-UL-us	UL Listed Industrial Control Equipment, certified for US and Canada. See UL File E65584. UL Listed for Class I, Division 2 Group A,B,C,D Hazardous Locations, certified for U.S. and Canada. See UL File E194810.
CSA	CSA Certified Process Control Equipment. See CSA File LR54689C. CSA Certified Process Control Equipment for Class I, Division 2 Group A,B,C,D Hazardous Locations. See CSA File LR69960C.
CE	European Union 2004/108/EC EMC Directive, compliant with: • EN 61000-6-4; Industrial Emissions • EN 61326-1; Meas./Control/Lab., Industrial Requirements • EN 61000-6-2; Industrial Immunity • EN 61131-2; Programmable Controllers (Clause 8, Zone A & B)
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
FM	FM Approved Equipment for use in Class I, Division 2 Group A, B, C, D Hazardous Locations
Functional Safety[2]	Certified by TÜV: capable of SIL 3, according to IEC 61508; and PLe/Cat. 4 according to ISO 13849-1:2006. Certified by UL: capable of SIL 3, see UL File E256621.

(1) When marked. See the Product Certification link at http://www.ab.com for Declarations of Conformity, Certificates, and other certification details.

(2) When used with specified firmware revision.

1756 ControlLogix-XT Controllers

The ControlLogix-XT controllers function in the same way as the traditional ControlLogix controllers. The ControlLogix-XT products include control and communication system components that are conformally coated to extend product life in harsh, corrosive environments.

- When used with FLEX I/O-XT products, the ControlLogix-XT system can withstand temperatures range from -20...70 °C (-4...158 °F).
- When used independently, the ControlLogix-XT system can withstand temperature ranges from -25...70 °C (-13...158 °F).

Technical Specifications - 1756-L63XT Controller

Attribute	1756-L63XT
User memory	8 MB
I/O memory	478 KB
Optional flash memory	64 MB (cat. no. 1784-CF64) 128 MB (cat. no. 1784-CF128)
Digital I/O, max	128,000
Analog I/O, max	4000
Total I/O, max	128,000
Replacement battery	1756-BA2
Current draw @ 5.1V DC	1200 mA
Current draw @ 24V DC	14 mA
Power dissipation	3.5 W
Thermal dissipation	11.9 BTU/hr
Isolation voltage	30V (continuous), basic insulation type, RS-232 to system Type tested at 720V DC for 60 s
Serial cables	1756-CP3 or 1747-CP3, right angle connector to controller, straight to serial port, 3 m (9.84 ft)
Weight, approx.	0.35 kg (0.78 lb)
Slot width	1
Module location	Chassis-based, any slot
Chassis	1756-A5XT, 1756-A7LXT
Power supply, standard	1756-PBXT
Power supply, redundant	None
Wire category	2 - on communication ports[1]
North American temperature code	T4A
IEC temperature code	T4
Enclosure type rating	None (open-style)

[1] Use this conductor category information for planning conductor routing as described in the system level installation manual. See the Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

Environmental Specifications - 1756-L63XT and 1756-L73XT Controller

Attribute	1756-L63XT
Temperature, operating IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock)	-25…70 °C (-13…158 °F)
Temperature, storage IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock)	-40…85 °C (-40…185 °F)
Relative humidity IEC 60068-2-30 (Test Db, Unpackaged Damp Heat)	5…95% noncondensing
Vibration IEC 60068-2-6 (Test Fc, Operating)	2 g @ 10…500 Hz
Shock, operating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	30 g
Shock, nonoperating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	50 g
Emissions CISPR 11	Group 1, Class A
ESD immunity IEC 61000-4-2	6 kV contact discharges 8 kV air discharges
Radiated RF immunity IEC 61000-4-3	10V/m with 1 kHz sine-wave 80% AM from 80…2000 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 900 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 1890 MHz 3V/m with 1 kHz sine-wave 80% AM from 2000…2700 MHz
EFT/B immunity IEC 61000-4-4	±4 kV at 5 kHz on communication ports
Surge transient immunity IEC 61000-4-5	±2 kV line-earth (CM) on communication ports
Conducted RF immunity IEC 61000-4-6	10Vrms with 1 kHz sine-wave 80% AM from 150 kHz…80 MHz

Certifications - 1756-L63XT Controller

Certification[1]	1756-L63XT
c-UL-us	UL Listed Industrial Control Equipment, certified for US and Canada. See UL File E65584. UL Listed for Class I, Division 2 Group A,B,C,D Hazardous Locations, certified for U.S. and Canada. See UL File E194810.
CE	European Union 2004/108/EC EMC Directive, compliant with: • EN 61000-6-4; Industrial Emissions • EN 61326-1; Meas./Control/Lab., Industrial Requirements • EN 61000-6-2; Industrial Immunity • EN 61131-2; Programmable Controllers (Clause 8, Zone A & B)
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
Ex	European Union 94/9/EC ATEX Directive, compliant with: • EN 60079-15; Potentially Explosive Atmospheres, Protection 'n' • EN 60079-0; General Requirements • II 3 G Ex nA IIC T4 X
Functional safety[2]	Certified by TÜV: Capable of SIL 2

(1) When marked. See the Product Certification link at http://www.ab.com for Declarations of Conformity, Certificates, and other certification details.

(2) When used with specified firmware revisions.

Controller Memory Use

The following equations provide a rough memory estimate.

Controller tasks	_____ x 4000	=	_____ bytes (minimum 1 task)
Digital I/O points	_____ x 400	=	_____ bytes
Analog I/O points	_____ x 2600	=	_____ bytes
DeviceNet modules[1]	_____ x 7400	=	_____ bytes
Other communication modules[2]	_____ x 2000	=	_____ bytes
Motion axis	_____ x 8000	=	_____ bytes
FactoryTalk alarm instruction	_____ x 1000	=	_____ bytes (per alarm)
FactoryTalk subscriber	_____ x 10000	=	_____ bytes

(1) The first DeviceNet module is 7400 bytes. Additional DeviceNet modules are 5800 bytes each.

(2) Count all the communication modules in the system, not just those in the local chassis. This includes device connection modules, adapter modules, and ports on PanelView terminals.

For redundant controller systems, double the memory estimate you calculate. For example, if you estimate you need 2 MB of memory, select a controller with 4 MB of memory.

Reserve 20…30% of the controller memory to accommodate growth.

Controller Compatibility

Control Distributed I/O Modules

The controller can control these distributed I/O modules via the I/O Configuration tree in RSLogix 5000 programming software.

I/O Modules	EtherNet/IP	ControlNet	DeviceNet	Remote I/O
Chassis-based I/O				
1746 SLC I/O	No	No	No	Yes
1756 ControlLogix I/O	Yes	Yes	No	No
1769 Compact I/O	No	No	Yes	No
1771 Universal I/O	No	Yes	No	Yes
In-cabinet I/O				
1734 POINT I/O	Yes	Yes	Yes	No
1734D POINTBlock I/O	No	No	Yes	No
1790, 1790D, 1790P CompactBlock LDX I/O	No	No	Yes	No
1791D, 1791P, 1791R CompactBlock I/O	No	No	Yes	No
1794 FLEX I/O	Yes	Yes	Yes	Yes
1797 FLEX Ex I/O	No	Yes	No	No
On-machine I/O				
1732 ArmorBlock I/O	Yes	No	Yes	No
1738 ArmorPoint I/O	Yes	Yes	Yes	No
1792D ArmorBlock MaXum I/O	No	No	Yes	No
1799 Embedded I/O	No	No	Yes	No

Control Safety I/O Modules

The GuardLogix controller can control these safety I/O modules in a safety system.

I/O Modules	EtherNet/IP	ControlNet	DeviceNet
In-cabinet I/O			
1791DS CompactBlock Guard I/O	No	No	Yes
1791ES CompactBlock Guard I/O	Yes	No	No
1734 POINT Guard I/O	Yes	No	No
On-machine I/O			
1732DS ArmorBlock Guard I/O	No	No	Yes

Communicate with Display Devices

The controller can communicate with these display devices.

Display Devices	EtherNet/IP	ControlNet	DeviceNet	DH+	Remote I/O	RS-232 (DF1)	DH-485
Industrial Computers							
Rockwell Automation industrial computers (all)[1]	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Graphic Terminals							
PanelView Plus and PanelView CE terminals	Yes	Yes	Yes	Yes	Yes	Yes	Yes
PanelView Standard terminals	Yes	Yes	Yes	Yes	Yes	Yes	Yes
PanelView 'e' terminals	No	Yes	No	Yes	Yes	No	No
Message Displays							
InView message displays	Yes	Yes	Yes	Yes	Yes	Yes	Yes

(1) Includes Rockwell Automation integrated display rotating media (HDD) and solid state (SSD) computers, Rockwell Automation non-display computers, and Rockwell Automation integrated display computers with keypad.

Communicate with Other Controllers

The controller can communicate with these programmable controllers.

Controller	EtherNet/IP	ControlNet	DeviceNet	DH+	RS-232 (DF1)	DH-485[1]
1756 ControlLogix 1756 GuardLogix	Yes	Yes	Yes	Yes	Yes	Yes
1768, 1769 CompactLogix 1768 Compact GuardLogix	Yes	Yes	Yes	No	Yes	Yes
1789 SoftLogix5800	Yes	Yes	Yes	No	Yes	No
1794 FlexLogix	Yes	Yes	Yes	No	Yes	Yes
PowerFlex with DriveLogix	Yes	Yes	Yes	No	Yes	Yes
1785 PLC-5	Yes[2] [3]	Yes	Yes[4]	Yes	Yes	—
1747 SLC	Yes[5]	Yes	Yes[4]	Yes	Yes	Yes
1761 MicroLogix	Yes	No	Yes[4]	No	Yes	Yes
1762 MicroLogix	Yes	No	Yes[4]	No	Yes	Yes
1763 MicroLogix	Yes	No	Yes[4]	No	Yes	Yes
1764 MicroLogix	Yes	No	Yes[4]	No	Yes	Yes
1772 PLC-2	—	—	—	Yes	Yes	—
1775 PLC-3	—	—	—	Yes	Yes	—
5250 PLC-5/250	—	—	No	Yes	Yes	—

(1) The 1756-DH485 module supports full DH-485 functionality.

(2) The Ethernet PLC-5 controller must be series C, firmware revision N.1 or later; series D, firmware revision E.1 or later; or series E, firmware revision D.1 or later.

(3) The 1785-ENET Ethernet communication interface module must be series A, firmware revision D or later.

(4) The PLC-5, SLC, and MicroLogix processors appear as I/O points to the Logix controller. Use the appropriate DeviceNet interface for the controller.

(5) Use a 1747-L55*x* controller with OS501 or later.

Communicate with Other Communication Devices

The controller can communicate with these communication devices.

Communication Device	EtherNet/IP	ControlNet	DeviceNet	DH+
Linking device (ControlLogix controllers only)	1788-EN2DN	1788-CN2DN 1788-CN2FF	1788-EN2DN 1788-CN2DN	—
PCMCIA card	—	1784-PCC	1784-PCD	1784-PCMK
PCI card	—	1784-PCIC 1784-PCICS	1784-PCID 1784-PCIDS 1784-CPCIDS	—
Drives SCANport module	—	1203-FM1 1203-FB1[1]	—	—
Communication module	—	1203-CN[2] 1770-KFC15 1770-KFCD15 1747-KFC15	1770-KFD 1770-KFG	—
Communication card	—	1784-PKTCS 1784-KTCS 1784-KTCX15	1784-PKTX 1784-PKTXD	—
USB communication device	—	1784-U2CN	1784-U2DN	1784-U2DHP

(1) Use a CIP generic MSG instruction to communicate with the 1203-FM1 SCANport module on a DIN rail that is remote to the controller. The remote DIN rail also requires a 1794-ACN15 or 1794-ACNR15 ControlNet adapter module.

(2) Use the generic module configuration to configure the 1203-CN1 module and a CIP generic MSG instruction to communicate with the module.

ControlLogix Redundancy

The ControlLogix controller supports controller redundancy. In a redundant controller system, you need these components:

- Two 1756 chassis, each with the same of the following:
  - Number of slots
  - Modules in the same slots
  - Redundancy firmware revisions in each module
  - Two additional ControlNet nodes outside the redundant chassis pair if the application uses ControlNet networks
- One 1756-RM or 1756-RMXT module per chassis that is connected by a 1756-RMC*x* cable
- One or two 1756-L6x or 1756-L7x controllers in each chassis
- Up to seven **enhanced** ControlNet communication modules, that is, 1756-CN2/B, 1756-CN2R/B, 1756-CN2RXT modules
- Up to seven **enhanced** EtherNet/IP communication modules, that is, 1756-EN2T, 1756-EN2TR, or 1756-EN2TXT modules

Technical Specifications - 1756 Redundancy Modules

Attribute	1756-RM	1756-RMXT
Current draw @ 1.2V DC	4 mA	
Current draw @ 5.1V DC	1.2 A	
Current draw @ 24V DC	120 mA	
Power dissipation	9.0 W	
Thermal dissipation	31 BTU/hr	
Connector cables	1756-RMC1, 1 m (3.28 ft) 1756-RMC3, 3 m (9.84 ft) 1756-RMC10, 10 m (32.81 ft)	
Slot width	1 slot	
Module location	Chassis-based, any slot	
Chassis	1756-A4, 1756-A7, 1756-A10, 1756-A13, 1756-A17	1756-A4LXT, 1756-A5LXT, 1756-A7LXT
Power supply, standard	1756-PA72/C, 1756-PA75/B, 1756-PB72/C, 1756-PB75/B, 1756-PC75/B, 1756-PH75/B	1756-PBXT
Power supply, redundant	1756-PA75R, 1756-PB75R, 1756-PSCA2	None
North American temperature code	T4	
IEC temperature code	T4	
Enclosure type	None (open-style)	
Weight	0.293 kg (0.64 lb)	
Mounting	ControlLogix-XT chassis, single-slot module	

Environmental Specifications - 1756 Redundancy Module

Attribute	1756-RM	1756-RMXT
Temperature, operating IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock)	0…60 °C (32…140 °F)	-25…70 °C (-13…158 °F)
Temperature, storage IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock)	-40…85 °C (-40…185 °F)	
Relative humidity IEC 60068-2-30 (Test Db, Unpackaged Damp Heat)	5…95% noncondensing	
Vibration IEC 60068-2-6 (Test Fc, Operating)	2 g @ 10…500 Hz	
Shock, operating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	30 g	
Shock, nonoperating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	50 g	
Emissions CISPR 11	Group 1, Class A	
ESD immunity IEC 61000-4-2	6 kV contact discharges 8 kV air discharges	
Radiated RF immunity IEC 61000-4-3	10V/m with 1 kHz sine-wave 80% AM from 80…2000 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 900 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 1890 MHz 3V/m with 1 kHz sine-wave 80% AM from 2000…2700 MHz	

Certifications - 1756 Redundancy Module

Certification[1]	1756-RM	1756-RMXT
CSA	CSA Certified Process Control Equipment. See CSA File LR54689C. CSA Certified Process Control Equipment for Class I, Division 2 Group A,B,C,D Hazardous Locations. See CSA File LR69960C.	—
CE	European Union 2004/108/IEC EMC Directive, compliant with: • EN 61326-1; Meas./Control/Lab., Industrial Requirements • EN 61000-6-2; Industrial Immunity • EN 61000-6-4; Industrial Emissions • EN 61131-2; Programmable Controllers (Clause 8, Zone A & B)	
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions	
c-UL-us	UL Listed Industrial Control Equipment, certified for U.S. and Canada. See UL file E65584. UL Listed for Class I, Division 2 Group A,B,C,D Hazardous Locations, certified for U.S. and Canada. See UL File E194810.	
Ex	European Union 94/9/EC ATEX Directive, compliant with: • EN 60079-15; Potentially Explosive Atmospheres, Protection “n” • EN 60079-0; General Requirements • II 3 G Ex nA IIC T4 X	
FM	FM Approved Equipment for use in Class I Division 2 Group A,B,C,D Hazardous Locations	—
Functional safety[2]	Certified by TÜV: Capable of SIL 2	

(1) When marked. See the Product Certification link at http://www.ab.com for Declarations of Conformity, Certificates, and other certification details.

(2) When used with specified firmware revisions.

ControlLogix Connections

A ControlLogix system uses connections to establish communication links between devices. The types of connections include the following:

- Controller-to-local I/O modules or local communication modules
- Controller-to-remote I/O or remote communication modules
- Controller-to-remote I/O (rack-optimized) modules
- Produced and consumed tags
- Messages
- Controller access by RSLogix 5000 programming software
- Controller access by RSLinx software for HMI or other applications

You indirectly determine the number of connections the controller uses by configuring the controller to communicate with other devices in the system. The limit of connections may ultimately reside in the communication module you use for the connection. If a message path routes through a communication module, the connection related to the message also counts towards the connection limit of that communication module.

The 1756-L6*x* controller supports 250 connections; the 1756-L7*x* controller supports 500. To calculate the total connections for a controller, consider the connections to local I/O modules and the connections to remote modules. Use this table to tally **local** connections.

Connection Type	Device Quantity	Connections per Device	Total Connections
Local I/O module (always a direct connection)		1	
1756-M16SE, 1756-M08SE, 1756-M03SE SERCOS motion module 1756-M02AE, 1756-M02AS, 1756-HYD02 analog motion module		3	
1756-CN2, 1756-CN2R communication module 1756-CNB, 1756-CNBR communication module 1756-CN2RXT communication module		0	
1756-EN2F, 1756-EN2T communication module 1756-ENBT, 1756-EWEB communication module 1756-EN2TXT communication module		0	
1756-DNB communication module		2	
1756-DHRIO communication module 1756-RIO communication module 1756-DHRIOXT communication module		1	
1756-DH485 communication module		1	
Total			

Regardless of how you configure local I/O modules (rack-optimized or direct connect), the controller establishes a direct connection for each local I/O module.

Remote connections depend on the communication module. The number of connections the module supports determines how many connections the controller can access through that module. Use this table to tally **remote** connections for the controller.

Connection Type	Device Quantity	Connections per Device	Total Connections
Remote ControlNet communication module Configured as a direct (none) connection Configured as a rack-optimized connection		0 **or** 1	
Remote I/O module over a ControlNet network (direct connection)		1	
Remote Ethernet communication module Configured as a direct (none) connection Configured as a rack-optimized connection		0 **or** 1	
Remote I/O module over an EtherNet/IP network (direct connection)		1	
Remote device over a DeviceNet network (accounted for in rack-optimized connection for local 1756-DNB module)		0	
Other remote communication adapter		1	
Safety input module		1	
Safety output module		2	
Produced tag		1	
Each consumer		1	
Consumed tag		1	
Cached message		1	
Block-transfer message		1	
Total			

ControlLogix Controller Accessories

Memory Cards

Memory cards offer nonvolatile memory to permanently store a user program and tag data on a controller. The 1756-L7*x* ControlLogix controller comes with 1784-SD1 Secure Digital card already installed. The 1756-L6*x* controllers support optional CompactFlash cards that you purchase separately. The memory cards install in a socket on the controller. Through RSLogix 5000 software, you can manually trigger the controller to save to or load from nonvolatile memory or configure the controller to load from nonvolatile memory on powerup.

The GuardLogix controller does not support user program storage or retrieval by using a CompactFlash card.

Technical Specifications - 1784 Memory Cards

Attribute	1784-CF64	1784-CF128	1784-SD1	1784-SD2
Memory	64 MB	128 MB	1 GB	2 GB
Supported controllers	1756-L6*x*		1756-L7*x*	
Weight, approx.	14.2 g (0.5 oz)		1.76 g (0.062 oz)	

Environmental Specifications - 1784 Memory Cards

Attribute	1784-CF64	1784-CF128	1784-SD1, 1784-SD2
Temperature, operating IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock)	-25…70 °C (-13…158 °F)		
Temperature, storage IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock)	-40…85 °C (-40…185 °F)		
Relative humidity IEC 60068-2-30 (Test Db, Unpackaged Damp Heat)	5…95% noncondensing		
Vibration IEC 60068-2-6 (Test Fc, Operating)	2 g @ 10…500 Hz		
Shock, operating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	30 g		
Shock, nonoperating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	50 g		
Emissions CISPR 11	Group 1, Class A		
ESD immunity IEC 61000-4-2	6 kV contact discharges 8 kV air discharges		
Radiated RF immunity IEC 61000-4-3	10V/m with 1 kHz sine-wave 80% AM from 80…2000 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 900 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 1890 MHz 3V/m with 1 kHz sine-wave 80% AM from 2000…2700 MHz		

Certifications - 1784 Memory Cards

Certification[1]	1784-CF64, 1784-CF128, 1784-SD1, 1784-SD2
CE	European Union 2004/108/EC EMC Directive, compliant with: • EN 61000-6-4; Industrial Emissions • EN 61326-1; Meas./Control/Lab., Industrial Requirements • EN 61000-6-2; Industrial Immunity • EN 61131-2; Programmable Controllers (Clause 8, Zone A & B)
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions

(1) When marked. See the Product Certification link at http://www.ab.com for Declarations of Conformity, Certificates, and other certification details.

1756 Energy Storage Modules

Instead of a battery, the 1756-L7*x* controller ships with a 1756-ESMCAP energy storage module (ESM) already installed.

Technical Specifications - 1756 Energy Storage Modules

Attribute	1756-ESMCAP	1756-ESMNSE	1756-ESMNRM
Description	Capacitor-based energy-storage module Comes with the controller	ESM without WallClockTime back-up power Use this ESM if your application requires that the installed ESM deplete its residual energy to 40 µJoule or less before transporting it into or out of your application. In this case, complete these steps before you remove the ESM. 1. Turn off power to the chassis. After you turn off power to the chassis, the controller's OK status indicator transitions from Green to Solid Red to OFF. 2. Wait **at least 20 minutes** for the residual stored energy to decrease to 40 µJoule or less before you remove the ESM. There is no visual indication of when the 20 minutes has expired. **You must track that time period**. Additionally, you can use this ESM with a 1756-L73 (8 MB) or smaller memory-sized controller only.	Energy-storage module that secures the controller by preventing the USB connection and access to SD card removal. If the SD card is installed prior to insertion of the 1756 ESMNRM module, the SD card remains functional, but not removable. This ESM provides your application an enhanced degree of security.
Current draw @ 5.1V DC	330 mA	300 mA	330 mA
North American temperature code	T5		
IEC temperature code	T5		

Certifications - 1756 Energy Storage Modules

Certification[1]	1784-CF64, 1784-CF128
c-UL-us	UL Listed Industrial Control Equipment, certified for US and Canada. See UL File E65584. UL Listed for Class I, Division 2 Group A,B,C,D Hazardous Locations, certified for US and Canada. See UL File E194810.
CE	European Union 2004/108/EC EMC Directive, compliant with: • EN 61326-1; Meas./Control/Lab., Industrial Requirements • EN 61000-6-2; Industrial Immunity • EN 61000-6-4; Industrial Emissions • EN 61131-2; Programmable Controllers (Clause 8, Zone A & B)
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
Ex	European Union 94/9/EC ATEX Directive, compliant with: • EN 60079-15; Potentially Explosive Atmospheres, Protection 'n' • EN 60079-0; General Requirements • II 3 G Ex nA IIC T5 X

(1) When marked. See the Product Certification link at http://www.ab.com for Declarations of Conformity, Certificates, and other certification details.

1756 ControlLogix Batteries

Each ControlLogix controller ships with a battery. The 1756-L6*x* controllers have nonvolatile memory if you install a 1784-CF64 or 1784-CF128 industrial CompactFlash card. With nonvolatile memory, the controller can be used without a battery. If you do not use a battery, current tag data will remain in the state it was when the nonvolatile memory was saved.

These tables summarize battery life, replacement battery compatibility, and recommendations for use of an externally-mounted battery assembly.

Technical Specifications - 1756 ControlLogix Batteries

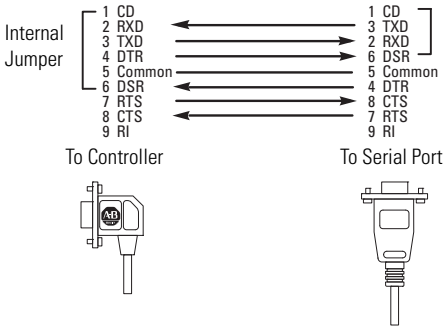
Attribute	1756-BA1	1756-BA2	1756-BATM[1]	1756-BATA
Description	Lithium battery (0.59 g)	Lithium battery (0.59 g)	Externally-mounted battery assembly	Replacement lithium battery for 1756-BATM (5 g max lithium per each D cell; contains 2 D cells)
ControlLogix controllers	1756-L61, 1756-L62, 1756-L63 controllers, series A	1756-L61, 1756-L62, 1756-L63 controllers, series B 1756-L64, 1756-L65 controllers	1756-L61, 1756-L62, 1756-L63 controllers, series A	1756-BATM battery module
GuardLogix controllers	—	1756-L61S, 1756-L62S, 1756-L63S	—	—
Supported legacy controllers	1756-L55M*x* controllers[2] 1756-L60M03SE controller	—	1756-L55M*x* controllers[3] 1756-L60M03SE controller	1756-BATM battery module

(1) The 1756-BATM externally-mounted battery assembly is recommended for use with all 1756-L55*x*, and is highly recommended for use with all series A 1756-L6*x* controllers, and provides longer battery life than the 1756-BA1 battery. The 1756-BATM assembly includes one 1756-BATA lithium battery assembly and a 1 m (3.28 ft) cable to connect housing to controller.

(2) The 1756-L55M22, 1756-L55M23, and 1756-L55M24 controllers have nonvolatile memory and can be used without a battery.

Serial Communication Cables

The 1756-L6*x* controllers have a built-in serial port.



Technical Specifications - 1756 Serial Cables

Attribute	1756-CP3	1747-CP3
Connector type	Female 9-pin D-shell	
Connector angle	Right angle connector to controller, straight to serial port	
Length	3 m (9.84 ft)	

Rockwell Automation Support

Rockwell Automation provides technical information on the Web to assist you in using its products. At http://www.rockwellautomation.com/support/, you can find technical manuals, a knowledge base of FAQs, technical and application notes, sample code and links to software service packs, and a MySupport feature that you can customize to make the best use of these tools.

For an additional level of technical phone support for installation, configuration, and troubleshooting, we offer TechConnect support programs. For more information, contact your local distributor or Rockwell Automation representative, or visit http://www.rockwellautomation.com/support/.

Installation Assistance

If you experience an anomaly within the first 24 hours of installation, review the information that is contained in this manual.
You can contact Customer Support for initial help in getting your product up and running.

United States or Canada	1.440.646.3434
Outside United States or Canada	Use the Worldwide Locator at http://www.rockwellautomation.com/support/americas/phone_en.html, or contact your local Rockwell Automation representative.

New Product Satisfaction Return

Rockwell Automation tests all of its products to ensure that they are fully operational when shipped from the manufacturing facility. However, if your product is not functioning and needs to be returned, follow these procedures.

United States	Contact your distributor. You must provide a Customer Support case number (call the phone number above to obtain one) to your distributor to complete the return process.
Outside United States	Please contact your local Rockwell Automation representative for the return procedure.

Documentation Feedback

Your comments will help us serve your documentation needs better. If you have any suggestions on how to improve this document, complete this form, publication RA-DU002, available at http://www.rockwellautomation.com/literature/.

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Allen-Bradley

PanelView Plus Terminals

400, 600, 700, 1000, 1250 1500

User Manual

Rockwell Automation

Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls (publication SGI-1.1 available from your local Rockwell Automation sales office or online at http://literature.rockwellautomation.com) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

WARNING	Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.
ATTENTION	Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.
SHOCK HAZARD	Labels may be located on or inside the equipment (for example, drive or motor) to alert people that dangerous voltage may be present.
BURN HAZARD	Labels may be located on or inside the equipment (for example, drive or motor) to alert people that surfaces may be at dangerous temperatures.

Allen-Bradley, ControlLogix, DH+, PLC-2, PLC-3, PLC-5, RSView, SLC, VersaView, CompactLogix, FlexLogix, InView, Logix, MicroLogix, PanelView, PanelView Plus, RSLogix, RSView32 and SoftLogix are trademarks of Rockwell Automation.

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The information below summarizes the changes to this manual since the last revision.

Revision bars, as shown in the margin identify updated information. Changes for this version of the document include:

For	See Page
New conformally-coated display modules for the 700 and 1250 touch screen displays	22
New logic modules with ac power input	25
Updated bezel replacement catalog numbers	26
New 2-position and 3-position input power terminal blocks for logic modules supporting ac and dc power	28, 49
Updated wire type information for input power terminal blocks	50, 51, 53, 54
New ac power connections for the 700 to 1500 terminal	53
Updated compatibility information for terminal components	104
Updated logic controller, cable charts that include DeviceNet	128
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Objectives

This preface provides information on these topics.

- Intended audience
- Parts List
- Additional resources
- Software and firmware upgrades
- European Communities (EC) Directive Compliance

Parts List

The PanelView Plus terminals ship with these items.

- Power terminal block
- RSView Machine Edition runtime software (preloaded)
- Mounting levers for 400 and 600 terminals (quantity eight)
- Mounting clips for 700 to 1500 terminals (quantity four to eight)
- Installation instructions
- Panel cutout template

Intended Audience

Use this manual if you are responsible for installing, operating, or troubleshooting the PanelView Plus terminals.

No special knowledge is required to understand this manual or operate the terminal. However, you must understand the functions and operations of RSView Machine Edition applications that will run on the terminal. Consult the application designer for this information.

Equipment installers must be familiar with standard panel installation techniques.

Additional Resources

For additional information, refer to these publications, that you can download from:

http://literature.rockwellautomation.com

Related Publications

Publication	Pub. No.
ControlNet Communications for PanelView Plus and VersaView CE Terminals	2711P-UM003
Creating Modbus Applications for PanelView Plus and VersaView CE Terminals	2711P-UM002
Wiring and Grounding Applications for PanelView Plus and VersaView CE terminals	2711P-TD001

You may also want to refer to:

- online help for RSView Studio or RSLinx software.
- documentation for your logic controller or processor.

Software and Firmware Upgrades

To receive software updates (software serial number required) and firmware upgrades for your terminal:

- call your local Rockwell Automation sales office or distributor.
- call Rockwell Software at 1-440-646-7800 or fax 1-440-646-7801.
- access www.software.rockwell.com.

European Communities (EC) Directive Compliance

If this product has the CE mark, it is approved for installation within the European Union and EEA regions. It has been designed and tested to meet the following directives.

EMC Directive

This product is tested to meet the Council Directive 89/336/EC Electromagnetic Compatibility (EMC) by applying the following standards, in whole or in part, documented in a technical construction file:

- EN 50081-2 EMC - Generic Emission Standard, Part 2 - Industrial Environment
- EN 61000-6-2 EMC - Generic Immunity Standard, Part 2 - Industrial Environment

This product is intended for use in an industrial environment.

Low Voltage Directive

This product is tested to meet Council Directive 73/23/EEC Low Voltage, by applying the safety requirements of EN 61131-2 Programmable Controllers, Part 2 - Equipment Requirements and Tests. For specific information required by EN 61131-2, see the appropriate sections in this publication, as well as Industrial Automation Wiring and Grounding Guidelines For Noise Immunity, Allen-Bradley publication 1770-4.1.

Open-style devices must be provided with environmental and safety protection by proper mounting in enclosures designed for specific application conditions. See NEMA Standards publication 250 and IEC publication 529, as applicable, for explanations of the degrees of protection provided by different types of enclosure.

Overview

Chapter Objectives

This chapter gives an overview of the PanelView Plus terminals.

- Software support
- PanelView Plus 400 and 600 features
- PanelView Plus 700 to 1500 features
- Catalog number configuration
- Product components

Software Support

RSView Machine Edition runtime software is included with all PanelView Plus terminals. RSView Machine Edition software provides runtime and terminal configuration software for the PanelView Plus terminals and does not require activation.

RSView Studio software is used on a personal computer to create applications that run in the PanelView Plus terminals. This software is purchased separately.

PanelView Plus 400 and 600 Features

This section gives an overview of the PanelView Plus 400 and 600 terminals.

- Hardware features
- Base-configured units
- Communication modules
- Power supply, ac or dc
- Displays

Hardware Features

PanelView Plus Terminals

The PanelView Plus 400 and 600 terminals are operator interface devices with these features.

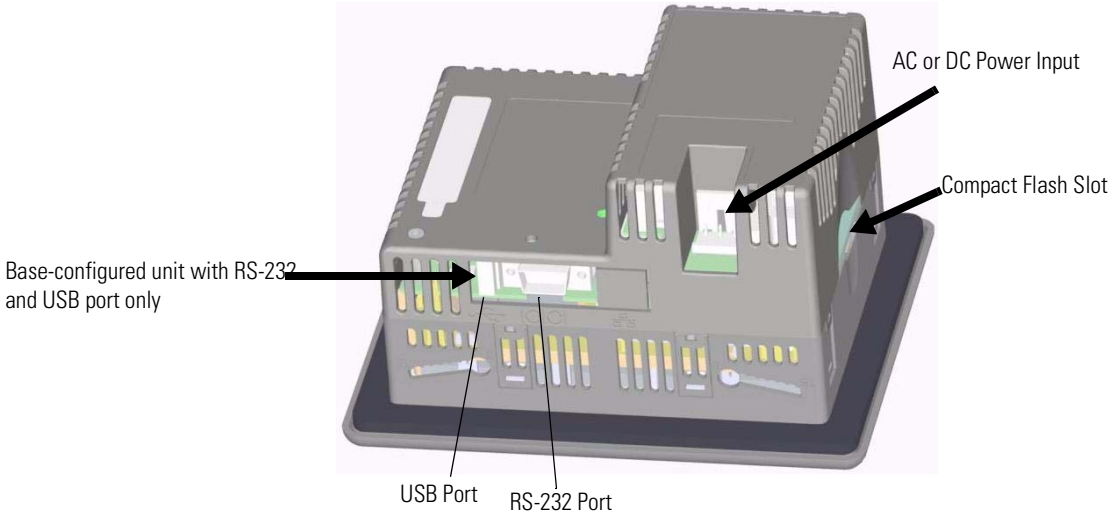
- PanelView Plus 400 terminals with:
  - grayscale graphic displays
  - keypad input support
- PanelView Plus 600 terminals with:
  - color or grayscale graphic displays
  - keypad, touch screen, or keypad and touch screen input
- Base-configured unit with:
  - RS-232 only **or**
  - RS-232, Ethernet and modular communications interface
- Communication modules provide add-on capability to base-configured units with modular communications interface
- Ac (85 through 264V ac) or dc (18 through 30V dc) power input
- Compact flash card slot supports Type I compact flash cards
- USB port for attaching mouse, keyboard, printer, bar code scanner, and other devices
- Same panel cutouts as the PanelView Standard 550 terminals

Base-configured Units

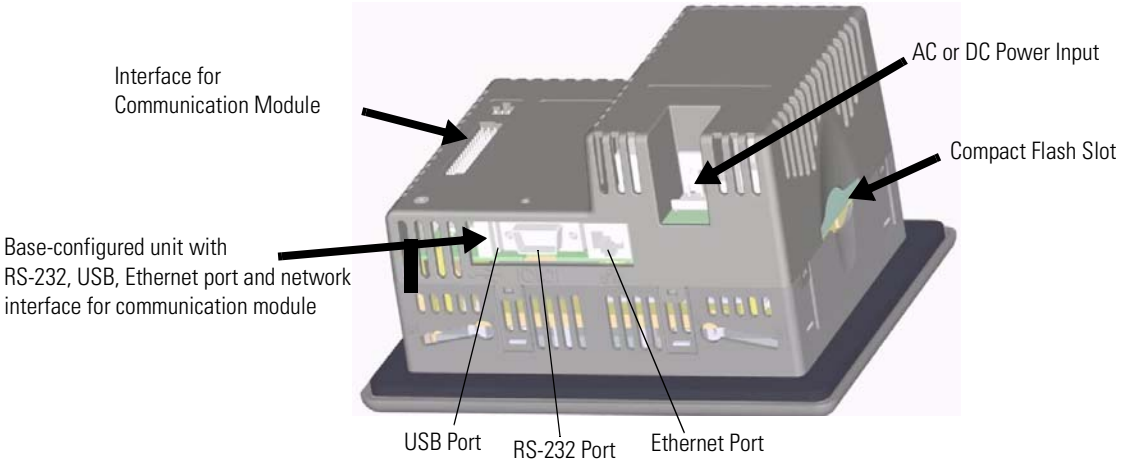
The base-configured unit of the 400 and 600 terminals is available in two versions.

- Base unit with RS-232 only and one USB port
- Base unit with RS-232, 10/100BaseT Ethernet with one USB port and a network interface for a communication module

Base Unit with RS-232 Only



Base Unit with RS-232, Ethernet, and Modular Communications Interface



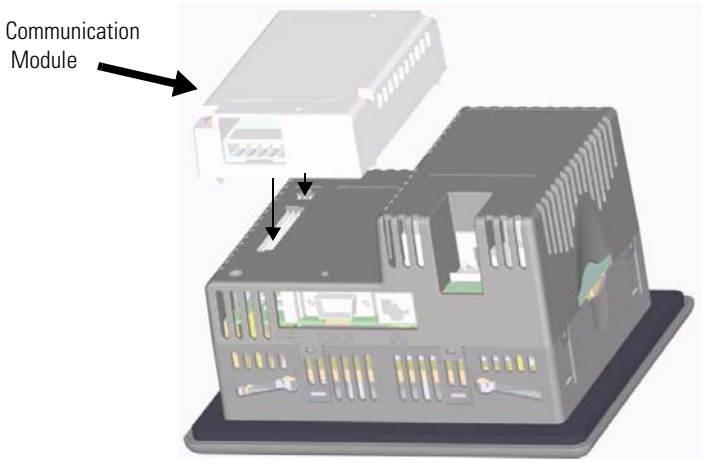
Communication Modules

You can attach a communication module with a network interface to the base-configured unit of the PanelView Plus terminal to increase your communication capability with these networks.

- DH-485
- DH+
- Remote I/O (single rack)
- Isolated RS-232
- DeviceNet
- ControlNet

The communication module installs easily on the back of the unit.

Communication Module



Power Options

The base-configured unit of the PanelView Plus 400 and 600 terminals is available with either ac (85 through 264V ac) or dc (18 through 30V dc) power input providing application flexibility.

Displays and Input Options

PanelView Plus 400 and 600 terminals are available with these display and operator input options.

- 400 terminals: 3.8 in. grayscale (320 x 240) graphics display with keypad
- 600 terminals: 5.5 in. color or grayscale (320 x 240) graphics display with keypad, touch screen, or keypad & touch support

Touch Screen

The PanelView Plus 600 terminals offer an analog resistive touch screen allowing for flexible touch area configuration.

600 Color or Grayscale Terminals with Touch Screen

IMPORTANT Use a plastic stylus device with a minimum tip radius of 1 mm (0.040 in.) to prevent damage to the touch screen.

Keypad or Keypad and Touch

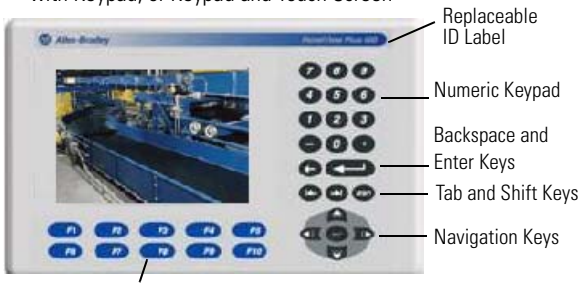
The keypad versions of the PanelView Plus 400 and 600 terminals are available with these options.

- 400 terminals: grayscale display with keypad input only
- 600 terminals: color or grayscale displays with either keypad, or keypad and touch input

Keypad or Keypad and Touch Display

400 Grayscale Terminal
with Keypad

600 Grayscale or Color Terminal
with Keypad, or Keypad and Touch Screen



Keys	Description
400 F1…F8 600 F1…F10	Programmable keys that initiate functions on terminal display. Replaceable legends are available for the 600 terminals allowing for custom function key labels.
ID Label	Allen-Bradley ID label. The ID label is replaceable allowing for custom product identification.
Numeric Keypad	0…9, ., -, Backspace, Enter, Left and Right Tab keys, Shift keys
Navigation Keys	Use the arrow keys for navigation. Use the Alt+arrow keys to activate home, end, page up, and page down functions.

PanelView Plus 700 to 1500 Features

This section gives an overview of the PanelView Plus 700, 1000, 1250, 1500 terminals.

- Hardware features
- Modular components
- Base-configured unit
- Communication modules
- Power supply, ac or dc
- Display modules

Hardware Features

PanelView Plus Terminals

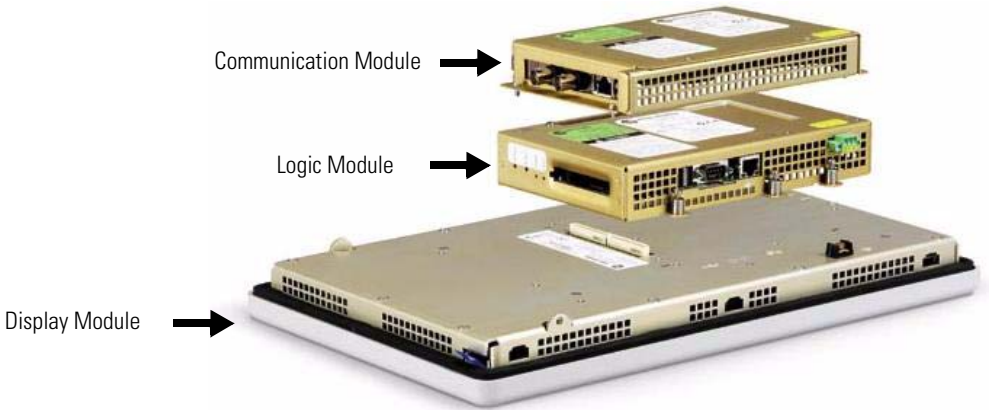
The PanelView Plus 700 to 1500 terminals are operator interface devices with these features.

- Graphic color display modules with keypad, touch screen, or keypad & touch screen support
- Analog resistive touch screen
- Field replaceable bezels
- Modular communications for easy add-on capability
- Memory expansion modules for field upgrades to 256 MB RAM and 512 MB Compact Flash
- Compact flash card slot supports Type I compact flash cards
- USB ports provide connections for keyboard/mouse/printer
- Ethernet and serial communications
- Same panel cutouts as the PanelView Standard and PanelView Enhanced terminals
- 24V dc (18 through 32V dc) or ac (85 through 264V ac) power input

Modular Components

The terminals use modular components allowing for flexible configuration, installation, and upgrades. You can order items as separate components or factory assembled per your configuration.

Modular Components



Base-configured Unit

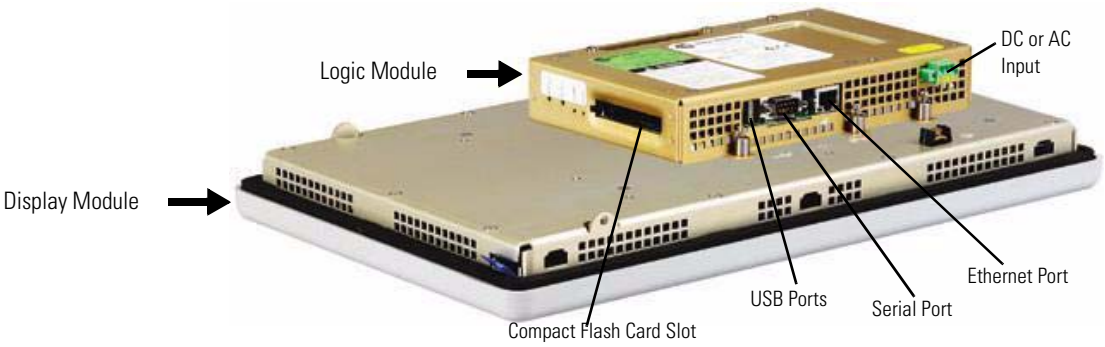
The base-configured unit of the terminal consists of:

- Display module (700, 1000, 1250, 1500) with keypad, touch, or keypad and touch input
- Logic module

The logic module contains:

- 24V dc input (18 through 32V dc) or ac input (85 through 264V ac)
- SDRAM and flash memory (various sizes)
- 10/100 BaseT Ethernet port
- Serial RS-232 port for file transfers, printing, and logic controller communications
- Two USB ports for attaching mouse, keyboard, or printer
- Compact flash card slot for Type I compact flash cards
- Battery-backed real-time clock

Base-configured Unit



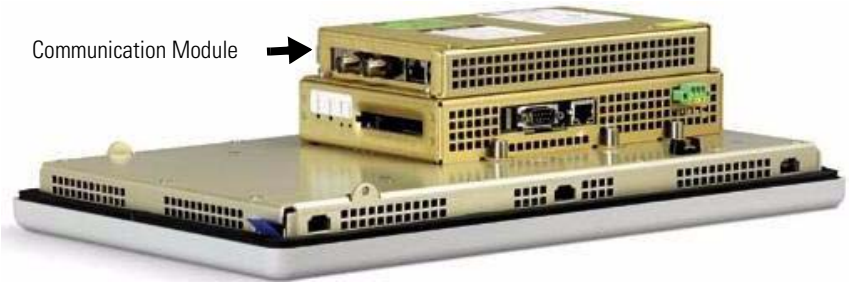
Communication Modules

You can attach a communication module with a network interface to the base-configured unit of the terminal to increase your communication capability with these networks.

- DH+/DH-485/Remote I/O
- DeviceNet
- ControlNet

The communication module installs easily on top of the logic module on the back of the unit.

Communication Module



Power Options

The base-configured units of the PanelView Plus terminals are available with either ac (85 through 264V ac) or dc (18 through 32V dc) power input providing applications flexibility.

Remote AC Power Supply

For dc applications using ac power, a remote ac-to-dc power supply, cat. no. 2711P-RSACDIN, is available for DIN-rail mounting.

Display Modules

The terminals offer a range of TFT color graphic displays with either keypad, touch screen, or keypad and touch support.

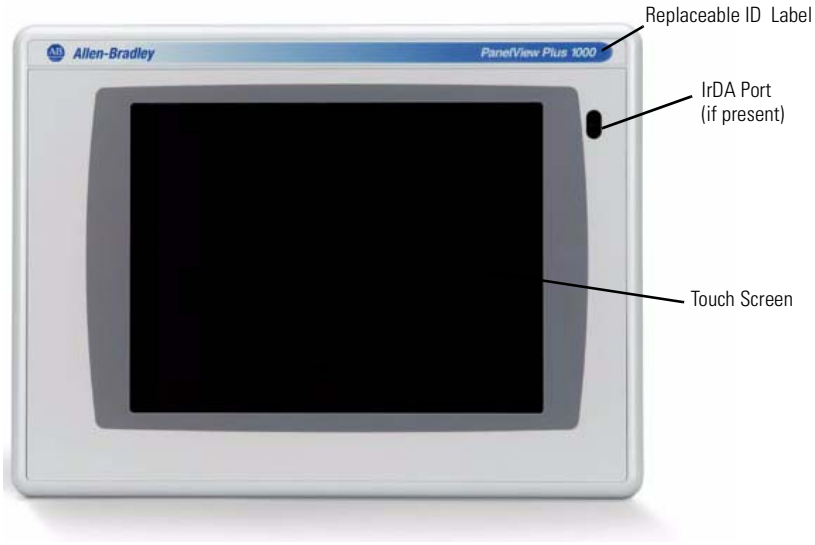
- 700 (6.5 in.)
- 1000 (10.4 in.)
- 1250 (12.1 in.)
- 1250 High-bright Touch (12.1 in.)
- 1500 (15 in.)

All displays have common features and firmware providing for easy migration to a larger display. Field-replaceable bezels are also available.

Touch Screen

All touch-screen displays are analog resistive and similar except for size.

1000 Touch Screen Display

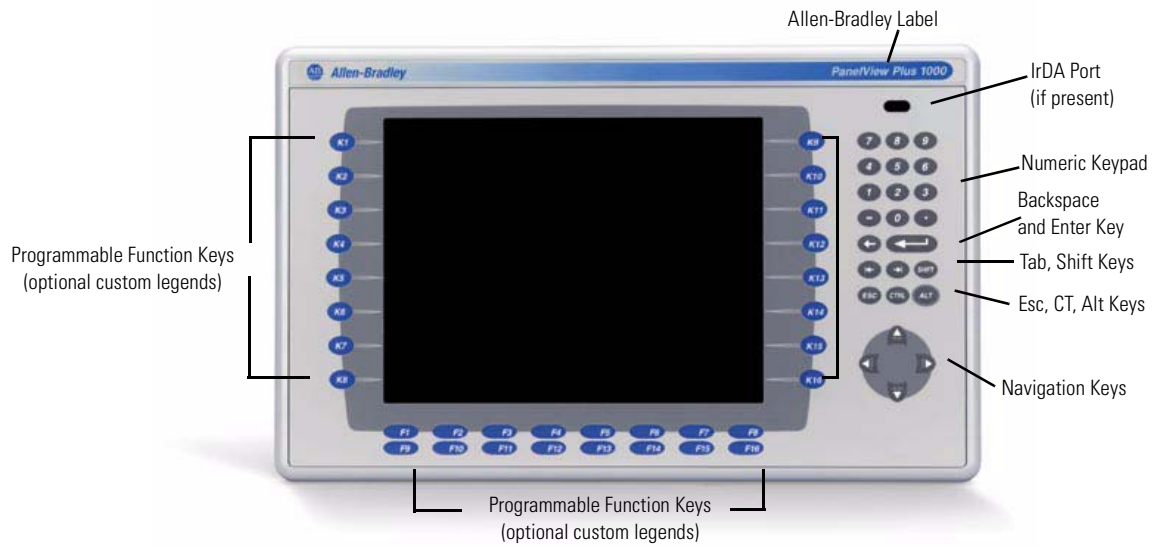


IMPORTANT Use a plastic stylus device with a minimum tip radius of 1 mm (0.040 in.) to prevent damage to the touch screen.

Keypad, or Keypad and Touch

All displays are similar except for size and the number of function keys available.

1000 Keypad or Keypad and Touch Display



The K*xx* and F*xx* function keys on the keypad terminals are programmable.

Function Keys

Feature	Description
Function Keys 700 (F1…F10, K1…K12) 1000 (F1…F16, K1…K16) 1250 (F1…F20, K1…K20) 1500 (F1…F20, K1…K20)	Programmable keys that initiate functions on terminal display. Replaceable legends are available for the terminals allowing for custom function key labels.
Label	Allen-Bradley or customer applied label.
Numeric Keypad	0…9, ., -, Backspace, Enter, Left and Right tab, Shift, Esc, Ctrl, Alt keys.
Navigation Keys	Use the arrow keys to move cursor in lists and select objects. Alt+arrow key activates home, end, page up, page down functions.

Catalog Number Configuration

The graphic shows the catalog number configuration for the terminals.

	Input Type	Display Size	Display Type	Communications[1]	Power	Memory Flash/RAM[2]
2711P-	**K** = Keypad	**4** = 3.8 in.	**C** = Color	**PanelView Plus 400 and 600 Terminals**	**A** = ac	**1**= 64 MB/64 MB
	T = Touch	**6** = 5.5 in.	**M**=Grayscale	**1** = Remote I/O (single rack), ENet, RS-232 & USB	**D** = dc	**2** = 128 MB/128 MB
	B = Key &Touch	**7** = 6.5 in.		**3** = DH-485, ENet, RS-232 & USB		
		10 = 10.4 in.		**5** = RS-232 & USB		
		12 = 12.1 in.		**8** = DH+, ENet, RS-232 & USB		
		15 = 15 in.		**10** = DNet, ENet, RS-232 & USB		
				15 = CNet, ENet, RS-232 & USB		
				20 = ENet, RS-232 & USB plus Communication Module Interface		
				PanelView Plus 700 to 1500 Terminals		
				4 = ENet, RS-232 & (2) USB		
				6 = DH+, DH-485, RIO, ENet, RS-232 & (2) USB		
				10 = DNet, ENet, RS-232 & (2) USB		
				15 = CNet, ENet, RS-232 & (2) USB		

(1) Not all combinations are available. For more information, refer to the Visualization Selection Guide, VIEW-SG001.

(2) Applies to PanelView Plus 700 to 1500 terminals only.

PanelView Plus Product Components

Components are available as separate catalog numbers for field installation or replacement.

Display Modules (700 to 1500 only)

Cat. No.	Description
2711P-RDK7C	700 Keypad Color Display
2711P-RDT7C	700 Touch Color Display
2711P-RDB7C	700 Keypad and Touch Color Display
2711P-RDT7CK	Conformally-coated 700 Touch Color Display
2711P-RDK10C	1000 Keypad Color Display
2711P-RDT10C	1000 Touch Color Display
2711P-RDB10C	1000 Keypad and Touch Color Display
2711P-RDK12C	1250 Keypad Color Display
2711P-RDT12C	1250 Touch Color Display
2711P-RDT12CK	Conformally-coated 1250 Touch Color Display
2711P-RDT12H	1250 Touch High-bright Color Display
2711P-RDB12C	1250 Keypad and Touch Color Display
2711P-RDK15C	1500 Keypad Color Display
2711P-RDT15C	1500 Touch Color Display
2711P-RDB15C	1500 Keypad and Touch Color Display

Logic Modules (700 to 1500 only)

Cat. No.	Description
2711P-RP	Logic Module without Flash/RAM memory, dc Input
2711P-RPA	Logic Module without Flash/RAM memory, ac Input
2711P-RP1	Logic Module with 64 MB Flash/64 MB RAM, dc Input
2711P-RP1A	Logic Module with 64 MB Flash/64 MB RAM, ac Input
2711P-RP2	Logic Module with 128 MB Flash/128 MB RAM, dc Input
2711P-RP2A	Logic Module with 128 MB Flash/128 MB RAM, ac Input
2711P-RP2K	Conformally-coated Logic Module with 128 MB Flash/128 MB RAM, dc Input
2711P-RP3	Logic Module with 256 MB Flash/256 MB RAM, dc Input
2711P-RP3A	Logic Module with 256 MB Flash/256 MB RAM, ac Input

Communication Modules

Terminal Type	Cat. No.	Description
400 and 600	2711P-RN1	Single-rack Remote I/O Communication Module
	2711P-RN3	DH-485 Communication Module
	2711P-RN8	DH+ Communication Module
	2711P-RN10C	DeviceNet Communication Module
	2711P-RN15C	ControlNet Communication Module
	2711P-RN22C	RS-232 Isolated Communication Module
700 to 1500	2711P-RN6	DH+/DH-485/Remote I/O Communication Module
	2711P-RN10H	DeviceNet Communication Module
	2711P-RN15S	ControlNet Communication Module

Internal Compact Flash Cards (700 to 1500 only)

Cat. No.	Description
2711P-RW1	64 MB Compact Flash with RSView Machine Edition
2711P-RW2	128 MB Compact Flash with RSView Machine Edition
2711P-RW3	256 MB Compact Flash with RSView Machine Edition

RAM Memory (700 to 1500 only)

Cat. No.	Description
2711P-RR64	64 MB SODIMM Memory
2711P-RR128	128 MB SODIMM Memory
2711P-RR256	256 MB SODIMM Memory

Compact Flash Cards (Blank)

Cat. No.	Description
2711P-RC2	128 MB Blank Compact Flash Card
2711P-RC3	256 MB Blank Compact Flash Card
2711P-RC4	512 MB Blank Compact Flash Card
2711P-RCH	Compact Flash to PCMCIA Adapter

Legend Kits

Cat. No.	Description
2711P-RFK6	Replacement Legend Strips for 600 Keypad Terminal
2711P-RFK7	Replacement Legend Strips for 700 Keypad Terminal
2711P-RFK10	Replacement Legend Strips for 1000 Keypad Terminal
2711P-RFK12	Replacement Legend Strips for 1250 Keypad Terminal
2711P-RFK15	Replacement Legend Strips for 1500 Keypad Terminal

Backlights (700 to 1500 only)

Cat. No.	Description
2711P-RL7C	Replacement Color Backlight for 700 Displays
2711P-RL10C	Replacement Color Backlight for 1000 Displays
2711P-RL12C	Replacement Color Backlight for 1250 Series A and B Displays
2711P-RL12C2	Replacement Color Backlight for 1250 Series C Displays
2711P-RL15C	Replacement Color Backlight for 1500 Series B Displays

Replacement Bezels

Cat. No.	Description
2711P-RBK7	Replacement Bezel for 700 Keypad Terminal
2711P-RBT7	Replacement Bezel for 700 Touch Terminal
2711P-RBB7	Replacement Bezel for 700 Keypad or Keypad/Touch Terminal
2711P-RBK10	Replacement Bezel for 1000 Keypad Terminal
2711P-RBT10	Replacement Bezel for 1000 Touch Terminal
2711P-RBB10	Replacement Bezel for 1000 Keypad or Keypad/Touch Terminal
2711P-RBK12	Replacement Bezel for 1250 Keypad Terminal
2711P-RBT12	Replacement Bezel for 1250 Touch Terminal
2711P-RBT12	Replacement Bezel for 1250 Touch High-bright Terminal
2711P-RBB12	Replacement Bezel for 1250 Keypad or Keypad/Touch Terminal
2711P-RBK15	Replacement Bezel for 1500 Keypad Terminal
2711P-RBT15	Replacement Bezel for 1500 Touch Terminal
2711P-RBB15	Replacement Bezel for 1500 Keypad or Keypad/Touch Terminal

Protective Antiglare Overlays

Cat. No.[1]	Description
2711P-RGK4	Antiglare Overlay for PanelView Plus 400 Keypad Terminal
2711P-RGK6	Antiglare Overlay for PanelView Plus 600 Keypad or Keypad/Touch Terminal
2711P-RGT6	Antiglare Overlay for PanelView Plus 600 Touch Terminal
2711P-RGK7	Antiglare Overlay for PanelView Plus 700 Keypad or Keypad/Touch Terminal
2711P-RGT7	Antiglare Overlay for PanelView Plus 700 Touch Terminal
2711P-RGK10	Antiglare Overlay for PanelView Plus 1000 Keypad or Keypad/Touch Terminal
2711P-RGT10	Antiglare Overlay for PanelView Plus 1000 Touch Terminal
2711-RGK12	Antiglare Overlay for PanelView Plus 1250 Keypad or Keypad/Touch Terminal
2711P-RGT12	Antiglare Overlay for PanelView Plus 1250 Touch and High-bright Touch Terminal
2711P-RGK15	Antiglare Overlay for PanelView Plus 1500 Keypad or Keypad/Touch Terminal
2711P-RGT15	Antiglare Overlay for PanelView Plus 1500 Touch Terminal

(1) All catalog numbers ship with a quantity of three overlays.

Adapter Plates

Cat. No.	Description
2711P-RAK4	Adapts a PanelView Plus 400 Keypad Terminal to a PanelView Standard 550 Keypad Cutout
2711P-RAK6	Adapts a PanelView Plus 600 Keypad Terminal to a PanelView Standard 600 Keypad Cutout
2711P-RAK7	Adapts a PanelView Plus 700 Keypad Terminal to a PanelView Standard 900 Keypad Cutout
2711P-RAT7	Adapts a PanelView Plus 700 Touch Terminal to a PanelView Standard 900 Touch Cutout
2711P-RAK10	Adapts a PanelView Plus 1000 Keypad Terminal to a PanelView 1000/1000E Keypad Cutout
2711P-RAT10	Adapts a PanelView Plus 1000 Touch Terminal to a PanelView 1000/1000E Touch Cutout
2711P-RAK12E	Adapts a PanelView Plus 1250 (or PV1000/1000E) Keypad Terminal to a PanelView 1200/1400E Keypad Cutout
2711P-RAT12E2	Adapts a PanelView Plus 1250 (or PV1000/1000E) Touch Terminal to a PanelView 1200E Touch Cutout
2711P-RAT12E	Adapts a PanelView Plus 1250 (or PV1000/1000E) Touch Terminal to a PanelView 1400E Touch Cutout
2711P-RAK12S	Adapts a PanelView Plus 1250 (or PV1000/1000E) Keypad Terminal to a PanelView Standard 1400 Keypad Cutout
2711P-RAT12S	Adapts a PanelView Plus 1250 (or PV1000/1000E) Touch Terminal to a PanelView Standard 1400 Touch Cutout
2711P-RAK15	Adapts a PanelView Plus 1500 Keypad or Keypad & Touch Terminal to a PanelView 1200E/1400E Keypad Terminal
2711P-RAT15	Adapts a PanelView Plus 1500 Touch Terminal to a PanelView 1400E Touch Cutout

Cables

Cat. No.	Description
2711-NC13	RS-232 Operating/Programming Cable (9-pin D-shell to 9-pin D-shell), 5 m (16.4 ft)
2711-NC14	RS-232 Operating/Programming Cable (9-pin D-shell to 9-pin D-shell), 10 m (32.7 ft)
2711-NC17	Remote RS-232 Serial Cable (9-pin D-shell to 9-pin D-shell)
2711-NC21	RS-232 Operating Cable (9-pin D-shell to 8-pin Mini DIN), 5 m (16.4 ft)
2711-NC22	RS-232 Operating Cable (9-pin D-shell to 8-pin Mini DIN), 10 m (32.7 ft)
1761-CBL-AS03	DH-485 Operating Cable (6-pin Phoenix to RJ45), 3 m (10 ft)
1761-CBL-AS09	DH-485 Operating Cable (6-pin Phoenix to RJ45), 9 m (30 ft)
1746-C10	DH-485 Network Interface Cable (SDL AMP to RJ45), 1.83 m (6 ft)
1746-C11	DH-485 Network Interface Cable (SDL AMP to RJ45), .3 m (1 ft.)
1784-CP14	DH-485 Network Interface Cable (5-pin Phoenix to RJ45)
2711P-CBL-EX04	Ethernet CAT5 Crossover Cable, Industrial Grade, 4.3 m (14 ft)
2711P-CBL-US02	USB to Serial Network Interface Cable
2711P-CBL-UU02	USB Host-to-Host Data Transfer Cable

Communication Adapters

Cat. No.	Description
2711P-CBL-UP02	USB to PS/2 Adapter
1761-NET-AIC	AIC+ Advanced Interface Converter
1747-AIC	DH-485 Isolated Link Coupler for use with DH-485 Communication Modules (2711P-RN3, 2711P-RN6)

Remote AC Power Supply (700 to 1500 only)

Cat. No.	Description
2711P-RSACDIN	DIN-rail Power Supply, ac-to-dc, 85…265V ac, 47…63 Hz

Miscellaneous

Cat. No.	Description
2711P-RVT12	Solar Visor for Outdoor High-bright 1250 Touch Screen Display Modules
2711P-RY2032	Replacement Battery for 700 to 1500 terminals
2711P-RTMC	Replacement Mounting Clips for 700 to 1500 terminals (Quantity of 8)
2711P-RTFC	Replacement Mounting Levers for 400 and 600 terminals (Quantity of 8)
2711P-RVAC	Replacement AC Power Terminal Block for 400 and 600 terminals
2711-TBDC	Replacement DC Power Terminal Block for 400 and 600 terminals
2711P-RTBDC3 (1)	3-position Terminal Block for dc Logic Modules (Series A to D)
2711P-RTBDC2 (1)	2-position Terminal Block for dc Logic Modules (Series E or later)
2711P-RTBAC3(1)	3-position Terminal Block for all ac Logic Modules

(1) Catalog numbers ship with a quantity of ten.

Firmware Upgrade Kits

Cat. No.	Description
2711P-RU310	PanelView Plus Media Kit includes Firmware Upgrade Wizard, 1 Firmware License, Certificate of Authenticity, End User License Agreement.
2711P-RUA310	PanelView Plus Advanced Media Kit includes the 2711P-RU310 Media Kit, PCMCIA to Compact Flash Adapter, and 32 MB Compact Flash Card.
2711P-RUL01	Firmware Upgrade License Kit with 1 PanelView Plus Firmware License. (1)
2711P-RUL05	Firmware Upgrade License Kit with 5 PanelView Plus Firmware Licenses. (1)
2711P-RUL10	Firmware Upgrade License Kit with 10 PanelView Plus Firmware Licenses.(1)
2711P-RUL25	Firmware Upgrade License Kit with 25 PanelView Plus Firmware Licenses. (1)
2711P-RUL50	Firmware Upgrade License Kit with 50 PanelView Plus Firmware Licenses. (1)

(1) Also includes Certificate of Authenticity, End User License Agreement, Installation Instructions.

Installation

Chapter Objectives

This chapter provides pre-installation information and procedures on how to install the terminals.

- Hazardous locations
- Environment
- Enclosures
- Outdoor installation (1250 high-bright display only, cat. no. 2711P-RDT12H)
- Required tools
- Clearances
- Panel cutout dimensions
- Mount the 400 or 600 terminal in a panel
- Mount the 700 to 1500 terminal in a panel
- Product dimensions

Hazardous Locations

This equipment is suitable for:

- Class I, Division 2, Groups A, B, C, D
- Class I, Zone 2, Group IIC
- Class II, Division 2, Groups F, G
- Class III
- (ordinary) nonhazardous locations

The following statement applies to use in hazardous locations.

WARNING

Explosion Hazard

Substitution of components may impair suitability for hazardous locations.

Do not disconnect equipment unless power has been switched off and area is known to be nonhazardous.

Do not connect or disconnect components unless power has been switched off.

All wiring must comply with N.E.C. articles 501, 502, 503, and/or C.E.C. section 18-1J2 as appropriate.

Peripheral equipment must be suitable for the location in which it is used.

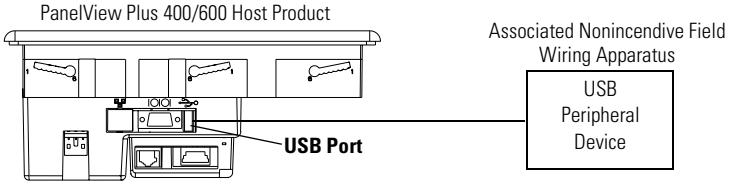
The dc powered terminals have a temperature code of T4 when operating in a 55 °C (131 °F) maximum ambient temperature. Do not install the terminals in environments where atmospheric gases have ignition temperatures **less** than 135 °C (275 °F).

The ac-powered terminals have a temperature code of T3 when operating in a 55 °C (131 °F) maximum ambient temperature. Do not install the terminals in environments when atmospheric gases have ignition temperatures **less** than 200 °C (392 °F).

USB Ports

The terminals contain universal serial bus (USB) ports that comply with hazardous location environments. The 400 and 600 terminals have one USB port; the 700 to 1500 terminals have two USB ports. This section details the field-wiring compliance requirements and is provided in accordance with the National Electrical Code, article 500.

USB Port Connection to USB Peripheral Device



The USB peripheral device must be rated for use in the hazardous location environment in which it is used and also comply with the circuit parameters in Table 2.2.

The circuit parameters in Table 2.1 define the maximum voltage and current of the USB ports on the terminal.

PanelView Plus USB Port Circuit Parameters

Parameter	Value	Parameter Definition
V_{oc}	5.25V dc	Open circuit voltage of the host USB port.
I_{sc}	1.68 A	Maximum output current of the host USB port.

The circuit parameters in Table 2.2 define the maximum voltage, current, capacitance, and inductance values for any peripheral device connected to a PanelView Plus USB port in a hazardous location environment.

Required Circuit Parameters for the USB Peripheral Device

Parameter	Value	Parameter Definition and Application Requirement
V_{max}	5.25V dc	Maximum applied voltage rating of the USB peripheral device. V_{max} shall be greater than or equal to V_{oc} in Table 2.1 ($V_{max} \geq V_{oc}$).
I_{max}	1.68 A	Maximum current to which the USB peripheral device can be subjected. I_{max} shall be greater than or equal to I_{sc} in Table 2.1 ($I_{max} \geq I_{sc}$).
C_a	10 µF	Maximum allowed capacitance of the USB peripheral device and its associated cable. The sum of C_{int} of the USB peripheral device and C_{cable} of the associated cable shall be less than or equal to C_a ($C_{int} + C_{cable} \leq C_a$).
L_a	15 µH	Maximum allowed inductance of the USB peripheral device and its associated cable. The sum of L_{int} of the USB peripheral device and L_{cable} of the associated cable shall be less than or equal to L_a ($L_{int} + L_{cable} \leq L_a$).

Application Information

Per the National Electrical Code, the circuit parameters of associated field-wired apparatus for use in hazardous locations shall be coordinated with the host product such that their combination remains nonincendive. The PanelView Plus terminal and the USB peripheral device shall be treated in this manner.

The circuit parameters of the PanelView Plus USB ports are given in Table 2.1. The USB peripheral device and its associated cabling shall have circuit parameters with the limits given in Table 2.2 for them to remain nonincendive when used with the PanelView Plus USB port. If cable compliance and inductance are not known, use the following values from UL 913:

C_{cable} = 60 pF/ft
L_{cable} = 0.20 µH/ft

Environmental Considerations

The terminals are suitable for use in an industrial environment when installed in accordance with these instructions. Specifically, this equipment is intended for use in clean, dry environments (Pollution Degree 2)(1) and with circuits not exceeding Over Voltage Category II(2) (IEC 60664-1).(3)

The terminals are intended for use with programmable logic controllers. Terminals that are ac powered must also be connected to the secondary of an isolating transformer.

(1) Pollution Degree 2 is an environment where normally only nonconductive pollution occurs except that occasionally a temporary conductivity caused by condensation shall be expected.

(2) Over Voltage Category II is the load-level, section of the electrical distribution system. At this level, transient voltages are controlled and do not exceed the impulse voltage capability of the product's insulation.

(3) Pollution Degree 2 and Over Voltage Category II are International Electrotechnical Commissions (IEC) designations.

Enclosures

The terminals must be mounted in a panel or enclosure to protect the internal circuitry. The terminals meet IP54, IP65, and NEMA Type 12/13 and 4X (indoor) ratings only when mounted in a panel or enclosure with the equivalent rating. When the terminal is not mounted in a panel, it is not secure or safe for operation. You must comply with NEMA Type 4X (indoor) requirements for environmental specifications.

For more enclosure and certification information on the Outdoor high-bright display module, refer to publication 2711P-IN026.

Outdoor Installation (cat. no. 2711P-RDT12H only)

When using the high-bright display module outdoors, important considerations in maximizing the field life of the front bezel and display are:

- selecting the proper enclosure.
- orientation of the terminal.

Both ultraviolet and infrared radiation can reduce the field life of any electronic device. While the materials used in the terminal bezels provide long field life, that life can be extended by proper installation.

Ultraviolet radiation from the sun causes all plastics to fade or yellow and become brittle over time. Using an antiglare overlay, cat. no. 2711P-RGT12, will protect the front of the terminal from direct exposure to UV radiation and greatly increase its field life.

When installing the high-bright display module in an environment where the front of the terminal will be in direct sunlight during the hottest part of the day and the external ambient temperature can exceed 40 °C (104 °F), use the visor kit, cat. no. 2711P-RVT12. The visor reduces the solar load on the front of the display and helps to maintain internal temperatures within specification.

The high-bright display module has a built in temperature sensor that automatically reduces the backlight intensity if the temperature inside the cabinet exceeds 55 °C (131 °F). This reduces the risk of damage to the display.

The paint color, size, and power dissipated by the internal components of an enclosure affect the temperature rise inside the cabinet. Hoffman, a Rockwell Automation Encompass Partner, has information to assist you with enclosure selection and heating/cooling accessories to meet the temperature requirements of the installed equipment. See website http://www.hoffmanonline.com.

Stirring fans or active cooling may be required in high altitude and high ambient temperature locations to keep the internal enclosure temperature below 55 °C (131 °F). Use a heater in installations where the ambient temperature is below 0 °C (32 °F).

The backlight of the high-bright display generates a significant amount of heat when set to full intensity. To minimize the amount of heat generated and extend the life of the backlight, decrease the display intensity by using the screen saver with a 5 to 10 minute delay.

Avoid placing the terminal on the south (north in the southern hemisphere) or west side of the cabinet, if possible. This will reduce the heat rise due to solar loading during the hottest part of the day.

Mount the terminal vertically to minimize solar loading on the display. Do not mount the terminal in a sloped enclosure if it will be exposed to direct sunlight.

Required Tools

These tools are required for panel installation.

- Panel cutout tools
- Small, slotted screwdriver for securing power and RS-232 connections
- Torque wrench (lb-in) for tightening the mounting clips on the PanelView Plus 700 to 1500 terminals

Clearances

Allow adequate clearance around the terminal, inside the enclosure, for adequate ventilation. Consider heat produced by other devices in the enclosure. The ambient temperature around the terminals must be between 0 to 55 °C (32 to 131 °F).

Clearances

Clearance Area	400 and 600 Terminals	700 to 1500 Terminals
Top	51 mm (2 in.)	51 mm (2 in.)
Bottom	102 mm (4 in.)	51 mm (2 in.)
Side[1]	25 mm (1 in.)	25 mm (1 in.)
Back	None	25 mm (1 in.)

(1) Minimum side clearance for insertion of memory card and cable wiring is 102 mm (4 in.).

Cutout Dimensions

The table lists the panel cutout dimensions for each terminal. Use the full size template shipped with your terminal to mark the cutout dimensions.

Cutout Dimensions

PanelView Plus Terminals	Height mm (in.)	Width mm (in.)
400 Keypad	123 (4.86)	156 (6.15)
600 Keypad or Keypad and Touch	142 (5.61)	241 (9.50)
600 Touch	123 (4.86)	156 (6.15)
PanelView Plus 700 Keypad or Keypad and Touch	167 (6.57)	264 (10.39)
PanelView Plus 700 Touch	154 (6.08)	220 (8.67)
PanelView Plus 1000 Keypad or Keypad and Touch	224 (8.8)	375 (14.75)
PanelView Plus 1000 Touch	224 (8.8)	305 (12.00)
PanelView Plus 1250 Keypad or Keypad and Touch	257 (10.11)	390 (15.35)
PanelView Plus 1250 Touch / 1250 High-bright Touch	257 (10.11)	338 (13.29)
PanelView Plus 1500 Keypad or Keypad and Touch	305 (12.00)	419 (16.50)
PanelView Plus 1500 Touch	305 (12.00)	391 (15.40)

Mount the 400 or 600 Terminal in a Panel

Mounting levers secure the terminal to the panel. The number of levers you use (4 or 6) varies by terminal type.

ATTENTION

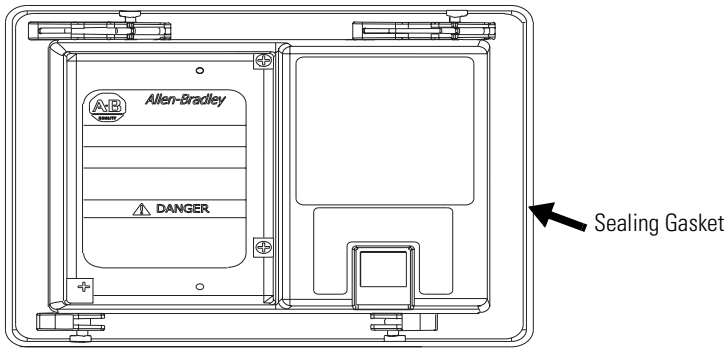
- Disconnect all electrical power from the panel before making the panel cutout.
- Make sure the area around the panel cutout is clear.
- Take precautions so metal cuttings do not enter any components already installed in the panel.
- Failure to follow these warnings may result in personal injury or damage to panel components.

To mount the terminal in a panel:

1. Cut an opening in the panel using the panel cutout shipped with the terminal.
2. If a Communication Module is ordered separately, attach the module to the base unit before panel installation.

   Refer to the instructions shipped with module.
3. Make sure the terminal sealing gasket is properly positioned on the terminal.

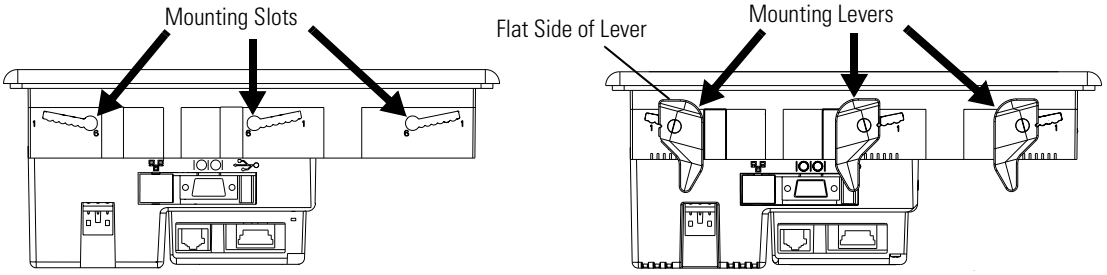
This gasket forms a compression-type seal. Do not use sealing compounds.



4. Install legend strips before installing the terminal if you are using keypad legend strips on a 600 keypad terminal.
   Be careful not to pinch legend strip during installation.

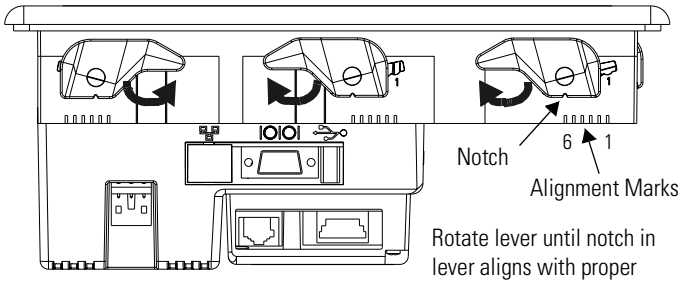
5. Place the terminal in the panel cutout.
   If installing terminal in existing 550 panel cutout, align terminal with center of cutout for best gasket sealing.

6. Insert all mounting levers into the mounting slots on the terminal.
   Slide each lever until flat side of lever touches the surface of the panel.

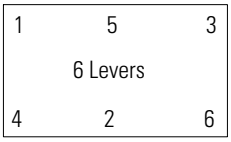


7. When all levers are in place, slide each lever an additional notch or two until you hear a click.
8. Rotate each lever in direction indicated until it is in the final latch position.

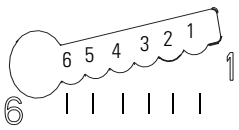
Follow the latching sequence for the optimum terminal fit.



Rotate lever until notch in lever aligns with proper alignment mark on terminal.



Use this table as a guide to provide an adequate gasket seal between the terminal and the panel.

	Lever Position	Panel Thickness Range	Typical Gauge
 Terminal Markings or Alignment	1	0.15…2.01 mm (0.060…0.079 in.)	16
	2	2.03…2.64 mm (0.08…0.104 in.)	14
	3	2.67…3.15 mm (0.105…0.124 in.)	12
	4	3.17…3.66 mm (0.125…0.144 in.)	10
	5	3.68…4.16 mm (0.145…0.164 in.)	8/9
	6	4.19…4.75 mm (0.165…0.187 in.)	7

ATTENTION

Follow instructions above to provide a proper seal and to prevent potential damage to the product. Allen-Bradley assumes no responsibility for water or chemical damage to the terminal or other equipment within the enclosure because of improper installation.

Mount the 700 to 1500 Terminal in a Panel

Mounting clips secure the terminal to the panel. The number of clips you use (4, 6, or 8) varies by terminal type.

ATTENTION

Disconnect all electrical power from the panel before making the panel cutout.

Make sure the area around the panel cutout is clear.

Take precautions so metal cuttings do not enter any components already installed in the panel.

Failure to follow these warnings may result in personal injury or damage to panel components.

To mount the terminal in a panel:

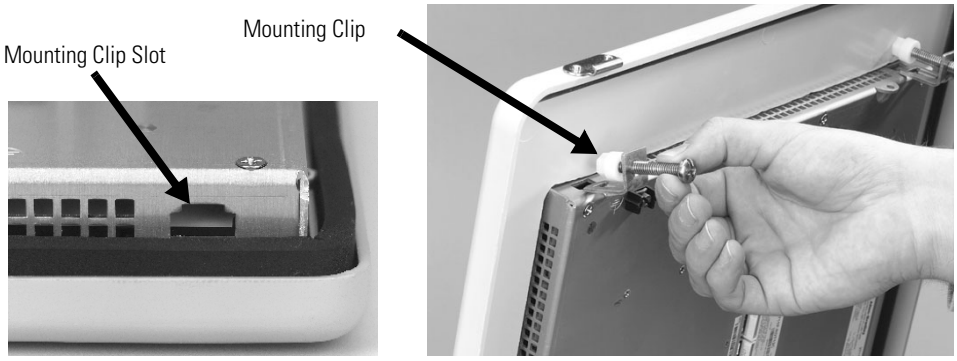
1. Cut an opening in the panel using the panel cutout shipped with the terminal.

2. Make sure the terminal sealing gasket is properly positioned on the terminal.
   This gasket forms a compression-type seal. Do not use sealing compounds.

3. Install the legend strips before installing the terminal if you are using keypad legend strips on keypad terminals.
   Be careful not to pinch the legend strip during installation.

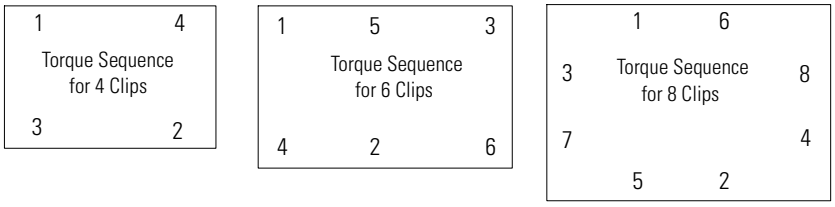
4. Place the terminal in the panel cutout.

5. Slide the ends of the mounting clips into the slots on the terminal.



6. Tighten the mounting clip screws by hand until the gasket seal contacts the mounting surface uniformly.

7. Tighten the mounting clips screws to a torque of 0.90 to 1.1 Nm (8 to 10 lb-in) using the specified sequence, making sure not to over-tighten.



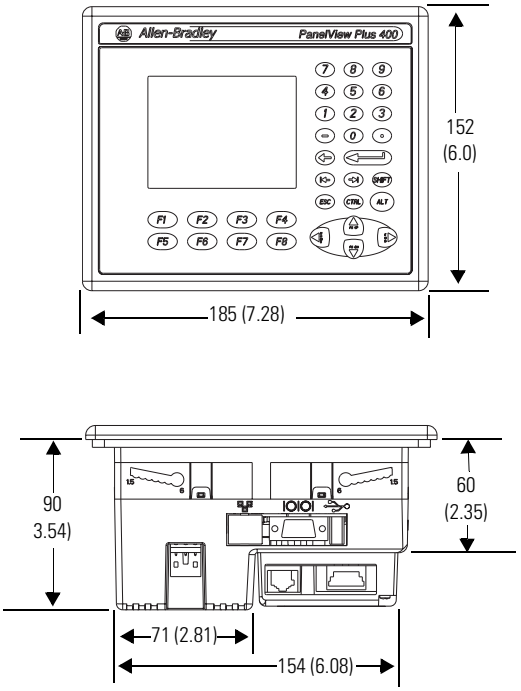
ATTENTION

Tighten the mounting clips to the specified torque to provide a proper seal and to prevent damage to the product. Allen-Bradley assumes no responsibility for water or chemical damage to the product or other equipment within the enclosure because of improper installation.

Product Dimensions

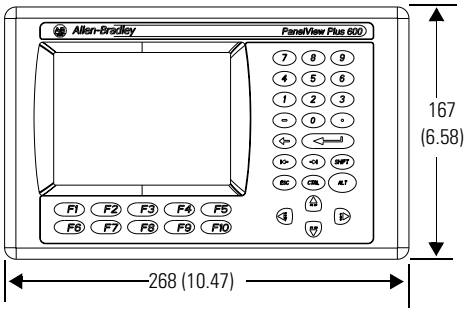
Product dimensions for each terminal are in mm (in.).

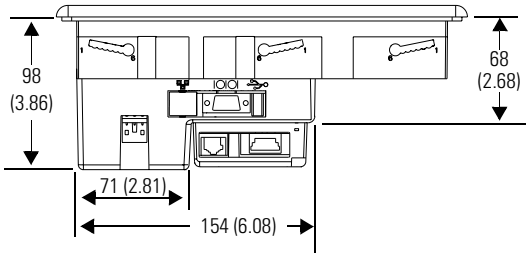
PanelView Plus 400 Dimensions



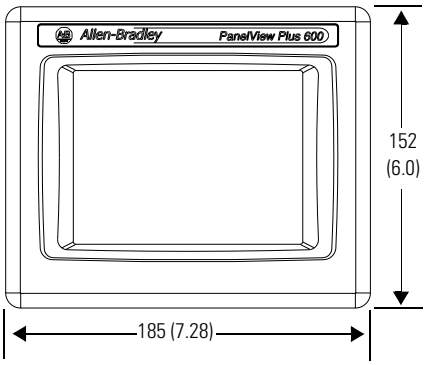
PanelView Plus 600 Dimensions

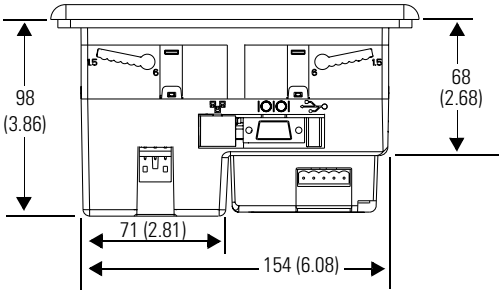
600 Keypad or Keypad and Touch Terminal





600 Touch Terminal



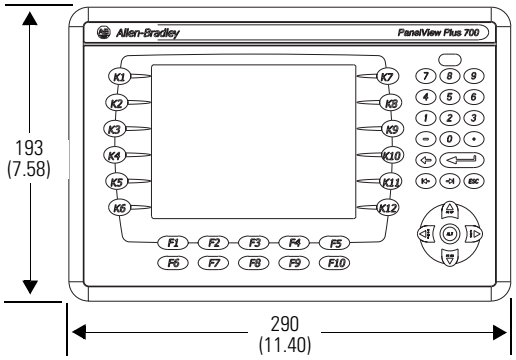


The depth dimensions are shown for:

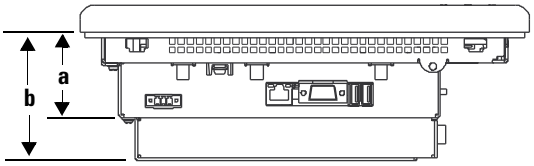
- Base-configured unit (display module and logic module)
- Base-configured unit with communication module

PanelView Plus 700 Dimensions

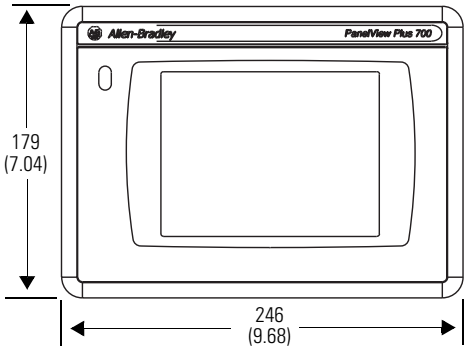
700 Keypad or Keypad and Touch Terminal



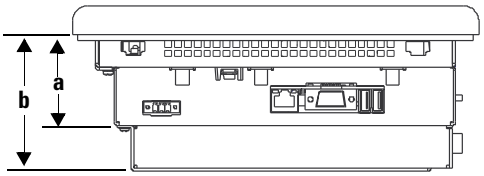
a 55 (2.18) Display to Logic Module
b 83 (3.27) Display to Communication Module



700 Touch Screen Terminal



a 55 (2.18) Display to Logic Module
b 83 (3.27) Display to Communication Module

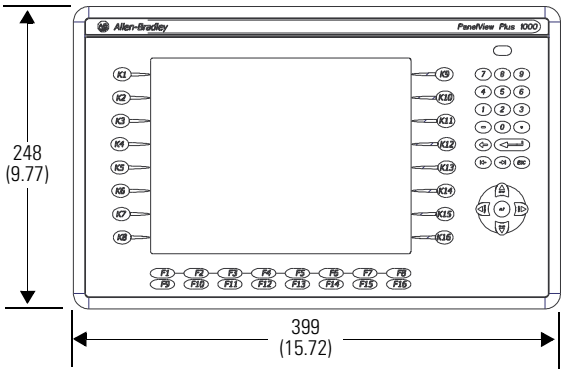


The depth dimensions are shown for:

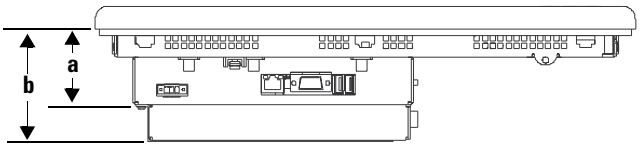
- Base-configured unit (display module and logic module)
- Base-configured unit with communication module

PanelView Plus 1000 Dimensions

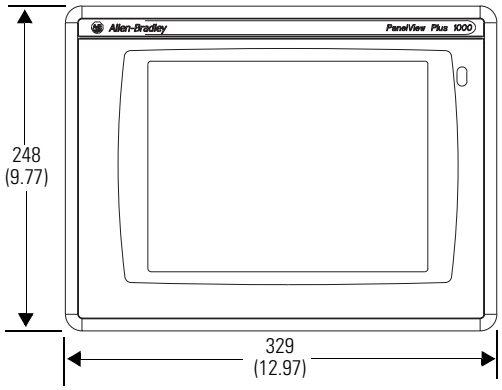
1000 Keypad or Keypad and Touch Terminal



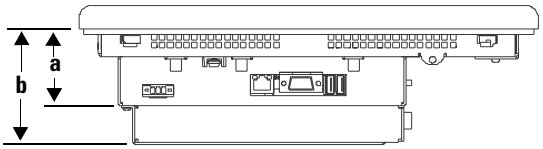
a 55 (2.18) Display to Logic Module
b 83 (3.27) Display to Communication Module



1000 Touch Screen Terminal



a 55 (2.18) Display to Logic Module
b 83 (3.27) Display to Communication Module

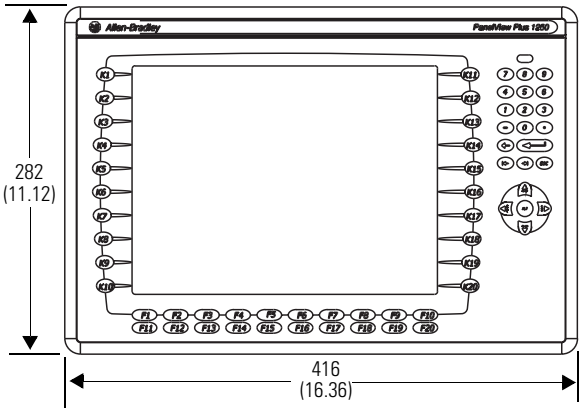


The depth dimensions are shown for:

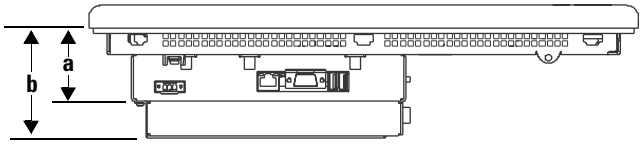
- Base-configured unit (display module and logic module)
- Base-configured unit with communication module

PanelView Plus 1250 Dimensions

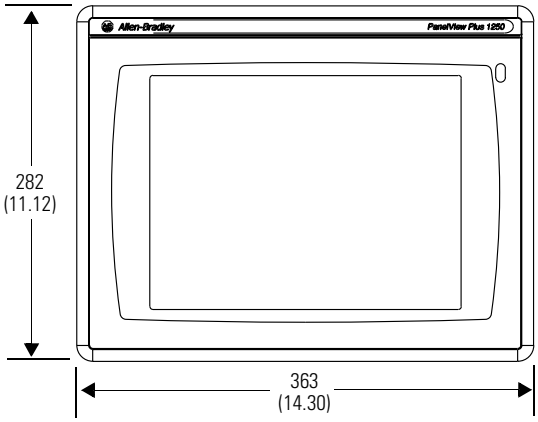
1250 Keypad or Keypad and Touch Terminal



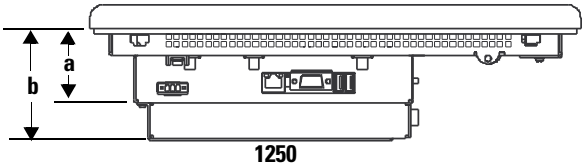
a 55 (2.18) Display to Logic Module
b 83 (3.27) Display to Communication Module



1250 Touch Screen Terminal

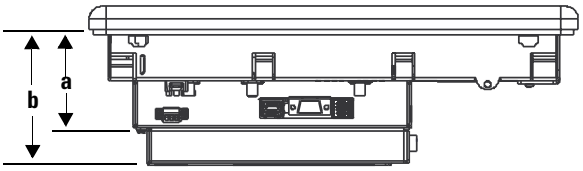


a 55 (2.18) Display to Logic Module
b 83 (3.27) Display to Communication Module



1250

a 74 (2.90) Display to Logic Module
b 101 (3.99) Display to Communication Module



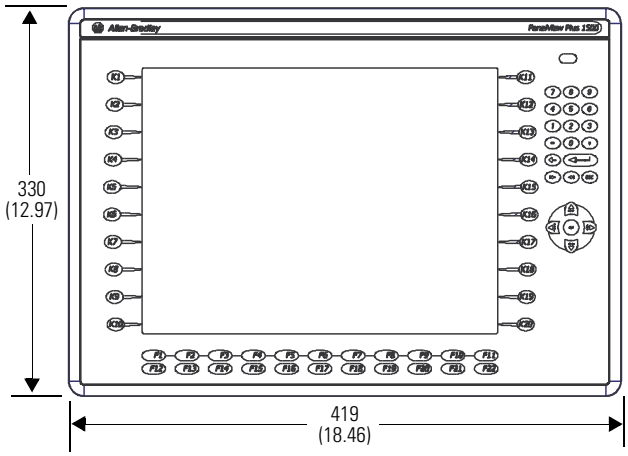
1250 High-bright

The depth dimensions are shown for:

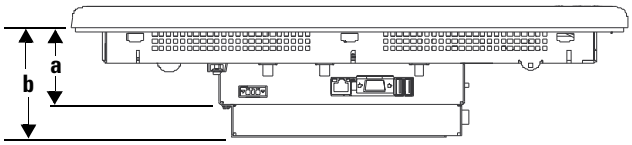
- Base-configured unit (display module and logic module)
- Base-configured unit with communication module

PanelView Plus 1500 Dimensions

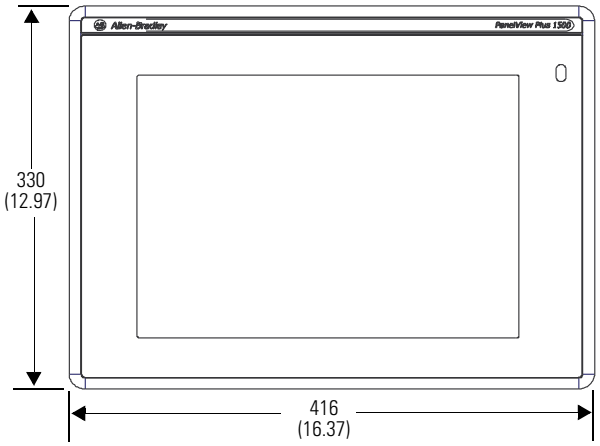
1500 Keypad or Keypad and Touch Terminal



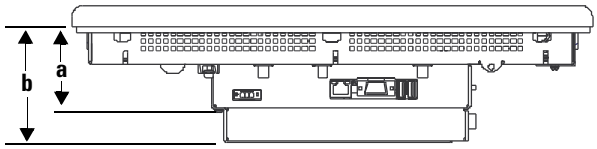
a 65 (2.55) Display to Logic Module
b 93 (3.65) Display to Communication Module



1500 Touch Screen Terminal



a 65 (2.55) Display to Logic Module
b 93 (3.65) Display to Communication Module



Connect Power

Chapter Objectives

This chapter covers wiring and safety guidelines, and provides procedures to:

- remove and install the power terminal block.
- connect dc power.
- connect ac power.
- reset the terminal.

Wiring and Safety Guidelines

Use publication NFPA 70E, Electrical Safety Requirements for Employee Workplaces, IEC 60364 Electrical Installations in Buildings or other applicable wiring safety requirements for the country of installation when wiring the devices. In addition to the NFPA guidelines:

- connect the device and other similar electronic equipment to its own branch circuit.
- protect the input power by a fuse or circuit breaker rated at no more than 15 A.
- route incoming power to the device by a separate path from the communication lines.
- cross power and communication lines at right angles if they must cross.

  Communication lines can be installed in the same conduit as low-level dc I/O lines (less than 10V).

- shield and ground cables appropriately to avoid electromagnetic interference (EMI).

  Grounding minimizes noise from EMI and is a safety measure in electrical installations.

For more information on grounding recommendations, refer to the National Electrical Code published by the National Fire Protection Association.

For additional information on terminal wiring and grounding applications, refer to publication 2711P-TD001. You can locate this publication in the literature library at this website

http://literature.rockwellautomation.com

Remove and Install the Power Terminal Block

You can remove and reinstall the power terminal block for ease of installation, wiring, and maintenance. The terminals ship with the power block installed.

WARNING

Explosion Hazard

Substitution of components may impair suitability for hazardous locations.

Do not disconnect equipment unless power has been switched off and area is known to be nonhazardous.

Do not connect or disconnect components unless power has been switched off.

All wiring must comply with N.E.C. articles 501, 502, 503, and/or C.E.C. section 18-1J2 as appropriate.

Peripheral equipment must be suitable for the location in which it is used.

ATTENTION

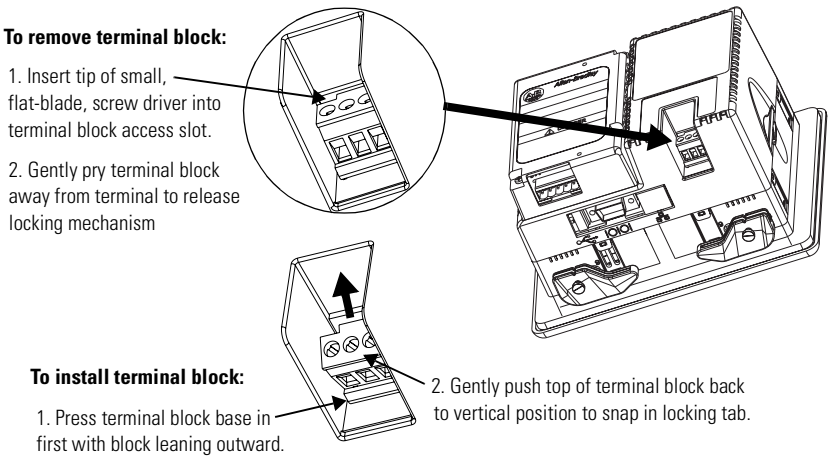
Disconnect all power before installing or replacing components. Failure to disconnect power may result in electrical shock and/or damage to the terminal.

Remove and Install the Terminal Block for 400 and 600 Terminals

ATTENTION

The ac and dc terminal blocks are keyed and marked differently so be sure to follow markings. Do not force terminal blocks into connectors to prevent potential damage to terminal.

Remove and Install the Terminal Block for 400 and 600 Terminals

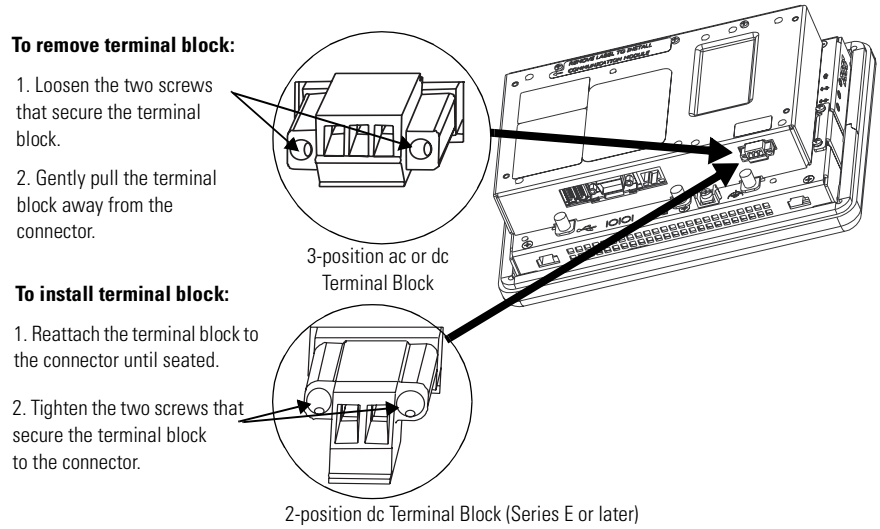


Remove and Install the Terminal Block for 700 to 1500 Terminals

PanelView Plus 700 to 1500 terminals operate on dc or ac power.

- Series A through D dc logic modules use a 3-position terminal block.
- Series E or later dc logic modules use a 2-position terminal block.
- All ac logic modules use a 3-position terminal block.

Remove and Install the Terminal Block for 700 to 1500 Terminals



DC Power Connections

PanelView Plus terminals with an integrated dc power supply have these power ratings

Power Ratings, dc

Power Type	Terminal	Input Range
dc	400 and 600	24V dc nom (18…30 V dc) 25 W max (1.0 A at 24V dc)
	700 to 1500	24V dc nom (18…32 V dc) 70 W max (2.9 A at 24V dc)

PanelView Plus terminals have an integrated, nonisolated, 24V dc power supply. The power supply is internally protected against reverse polarity of the dc+ and dc- connections. Connecting dc+ or dc- to the functional-earth terminal may damage the device.

The input power terminal block on the integrated power supply is removable and supports these wire sizes.

Wire Specifications for dc Input Terminal Block

Terminal	Wire Type		Dual-wire Gauge[1]	Single-wire Gauge	Terminal Screw Torque
400 and 600	Stranded or solid	Cu 90 °C (194 °F)	22…16 AWG	22…14 AWG	0.45…0.56 Nm (4…5 lb-in)
700 to 1500 logic module Series A to D					0.23…0.34 Nm (2…3 lb-in)
700 to 1500 logic module Series E and later					0.56 Nm (5 lb-in)

(1) Two-wire max. per terminal.

External Power Supply

Use a single, 24V dc power supply to power each PanelView Plus terminal, such as cat. no. 2711P-RSACDIN. Using a separate, isolated and ungrounded source to power each terminal prevents ground loop currents from damaging the terminals.

The output on the power supply must be isolated from the input and not connected to earth ground.

ATTENTION

Use a Class 2 or SELV supply as required by local wiring codes for your installation. The Class 2 and SELV power sources provide protection so that under normal and single-fault conditions, the voltage between conductors and between conductors and functional-earth or protective-earth does not exceed a safe value.

Functional-earth Connection

PanelView Plus dc terminals have a functional-earth terminal that you must connect to a low-impedance earth ground.

IMPORTANT The functional-earth connection to ground is mandatory. This connection is required for noise immunity, reliability, and Electromagnetic Compliance (EMC) with the European Union (EU) EMC directive for CE-mark conformance.

- The 700 to 1500 dc terminals have the functional-earth ground connection on the rear of the display module.
- The 400 and 600 dc terminals have the functional-earth ground connection on the power input terminal block.

The functional-earth terminal wiring requires a minimum wire gauge.

Functional-earth wire specifications for dc Power

Terminal	Wire Type		Wire Gauge	Terminal Screw Torque
400 and 600	Stranded or solid	Cu 90 °C (194 °F)	14…12 AWG	0.45…0.56 Nm (4…5 lb-in)
700 to1500			14…10 AWG	1.13…1.36 Nm (10…12 lb-in)

On most PanelView Plus dc terminals, the functional-earth terminal is internally connected to the dc- terminal within the product.

ATTENTION Damage or malfunction can occur when a voltage potential exists between two separate ground points. Make sure the terminal does not serve as a conductive path between ground points at different potentials.

The PanelView terminals contain isolated and nonisolated communication ports.

Refer to Chapter 6 for information on Communication Port Isolation.

IMPORTANT For more information on wiring and grounding the terminals, refer to publication 2711P-TD001.

Connect dc Power

WARNING

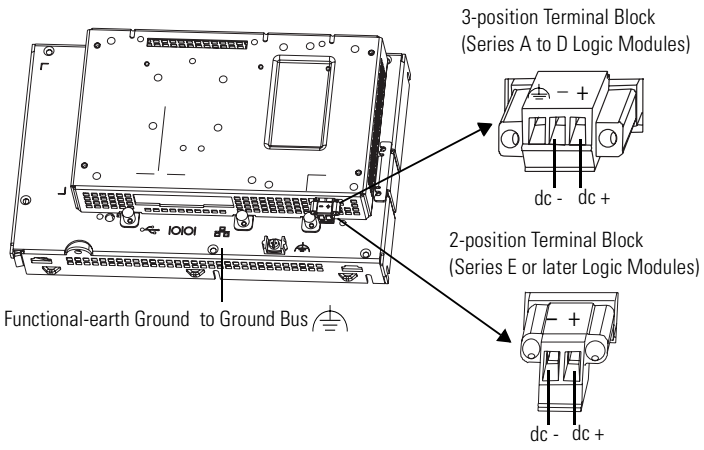
Explosion Hazard - Do not disconnect equipment unless power has been switched off and area is known to be nonhazardous.

Disconnect all power before installing or replacing components. Failure to disconnect power may result in electrical shock and/or damage to the terminal.

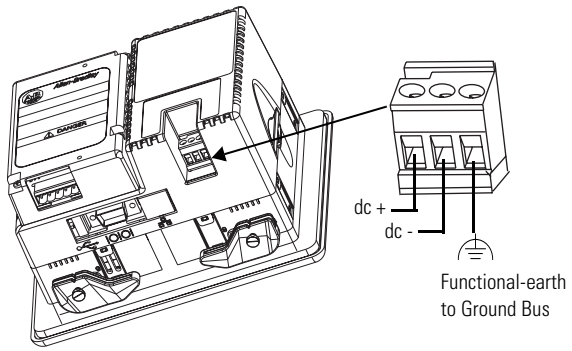
To connect the terminal to dc power:

1. Disconnect power to the terminal.
2. Secure the dc power wires to the terminal block screws.
   Follow the markings on terminal blocks and terminal for proper connections.
3. Secure the functional-earth ground wire to the appropriate terminal screw.
   - On the 400 and 600 terminals, secure the functional-earth ground wire to the functional-earth ground terminal screw on the input power terminal block.
   - On the 700 to 1500 terminals, secure the functional-earth ground wire to the functional-earth ground terminal screw at the bottom of the display.

700 to 1500 dc Terminals



400 and 600 dc Terminals



4. Apply 24V dc power to the terminal.

AC Power Connections

PanelView Plus terminals with an integrated ac power supply have these power ratings.

Power Rating, ac

Terminal	Voltage Range	Frequency	V A
400 and 600	85…264V ac	47…63 Hz	60V A max.
700 to 1500	85…264V ac	47…63 Hz	160V A max.

The input power terminal block on the integrated power supply is removable and supports these wire sizes.

Wire Specifications for ac Input Power Terminal Block

Terminal	Wire Type		Dual-wire Gauge(1)	Single-wire Gauge	Terminal Screw Torque
400 and 600	Stranded or solid	Cu 90 °C (194 °F)	22…16 AWG	22…14 AWG	0.45…0.56 Nm (4…5 lb-in)
700 to 1500			22…16 AWG	22…14 AWG	0.56 Nm (5 lb-in)

(1) Two-wire max. per terminal

Protective-earth Connection

PanelView Plus ac terminals have a protective-earth ground terminal that you must connect to a low-impedance earth ground.

ATTENTION

The protective-earth connection is required for both electrical safety and Electromagnetic Compliance (EMC) with the European Union (EU) EMC directive for CE-mark conformance.

The protective-earth ground connection is on the power input terminal block. The protective-earth terminal wiring requires a minimum wire gauge.

Protective-earth Wire Specifications for ac Power

Terminal	Wire Type		Wire Gauge	Terminal Screw Torque
400 and 600	Stranded or solid	Cu 90 °C (194 °F)	14…12 AWG	0.45…0.56 Nm (4…5 lb-in)
700 to 1500			14…12 AWG	0.56 Nm (5 lb-in)

Functional-earth Connection

The PanelView Plus 700 to 1500 ac terminals also have a functional-earth connection on the back of the display.

IMPORTANT On 700 to 1500 terminals, you must connect both protective-earth and functional-earth to ground.

The functional-earth terminal wiring requires a minimum wire gauge.

Functional-earth Wire Specifications for ac Power

Terminal	Wire Type		Wire Gauge	Terminal Screw Torque
700 to 1500	Stranded or solid	Cu 90 °C (194 °F)	14…10 AWG	1.13…1.36 Nm (10…12 lb-in)

ATTENTION

The functional-earth and protective-earth connections to ground are mandatory. The functional-earth is required for electrical safety and Electromagnetic Compliance (EMC) with the European Union (EU) EMC directive for CE-mark conformance. The protective-earth ground connection is required for safety and regulatory compliance.

Connect ac Power

WARNING

Explosion Hazard - Do not disconnect equipment unless power has been switched off and area is known to be nonhazardous.

Disconnect all power before installing or replacing components. Failure to disconnect power may result in electrical shock and/or damage to the terminal.

ATTENTION

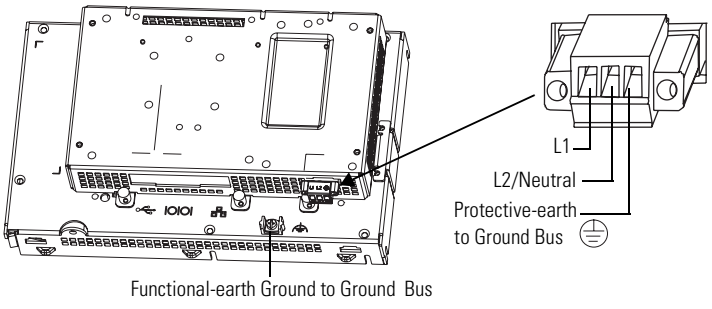
Improper wiring of the power terminals may result in voltage at the communication connector shells.

Do not apply power to the terminal until all wiring connections have been made. Failure to do so may result in electrical shock.

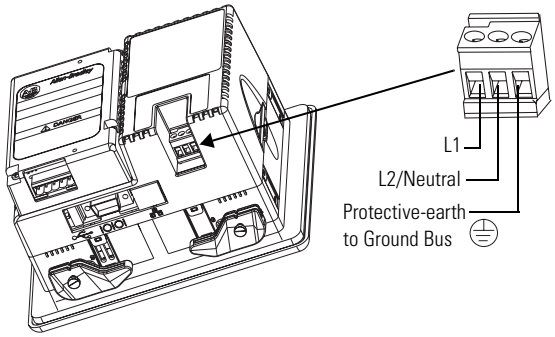
To connect the terminal to ac power:

1. Disconnect power to the terminal.
2. Secure the ac power wires to the terminal block screws.
   Follow the markings on terminal blocks and terminal for proper connections.
3. Secure the protective-earth ground wire to the protective-earth ground screw on the input terminal block.
4. On the 700 to 1500 terminals, also secure the functional-earth ground wire on the back of the display to ground bus.

700 to 1500 ac Terminals



400 and 600 ac Terminals

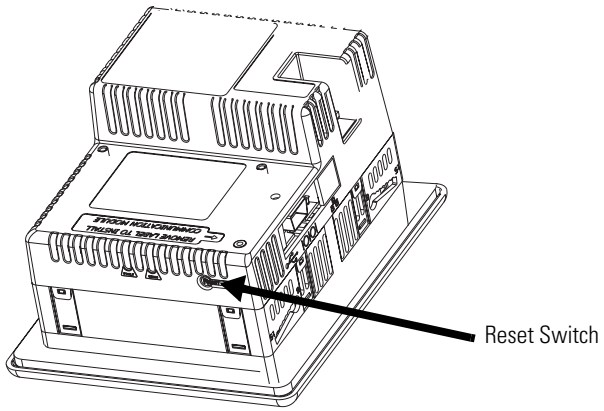


5. Apply ac power to the terminal.

Reset the Terminal

Reset the 400 and 600 Terminals

The 400 and 600 terminals have a Reset switch on the side of the terminal. Use the Reset switch to restart the terminal without having to disconnect and reapply power. When reset, the terminal performs a series of startup tests and runs RSView ME software. The loaded .MER application may also run depending on how the terminal is configured.



Press Reset with your finger or a nonconductive object.

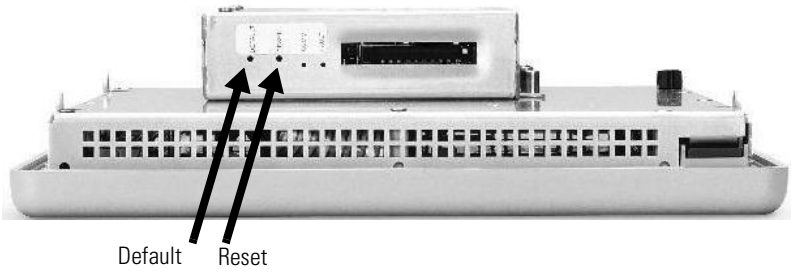
ATTENTION

Use a nonconductive object to press the RESET switch. Do not use a conducting object such as a paper clip or you may damage the terminal. Do not use the tip of a pencil; graphite may damage the terminal.

Reset the 700 to 1500 Terminals

The 700 to 1500 terminals have a Reset switch and a Default switch on the side of the logic module.

Default and Reset Switch



Reset

Use the Reset switch to restart the terminal without having to disconnect and reapply power. Insert a thin, nonconductive probe into the hole marked Reset and press the switch. The terminal performs a series of startup tests and runs RSView ME software. The loaded .MER application may also run depending on how the terminal is configured.

Default

Use the Default switch with the Reset switch to start the terminal in Safe mode. Safe mode is targeted for VersaView CE terminals that may run other programs in addition to RSView Machine Edition software. This is a diagnostics mode where the system is reduced to a known state that allows recovery from a software problem. Safe mode ignores all user changes to the system and avoids any problem that is due to interactions with end-user software or changes.

For more details on Safe mode, refer to Chapter 8.

1. Insert a thin, nonconductive probe into the hole marked Default and press the switch.

2. Insert the probe into the hole marked Reset and press the switch. The system will restart immediately into the Safe mode.

ATTENTION

Use a nonconductive object to press the Reset and Default switch. **Do not** use a conducting object such as a paper clip or you may damage the terminal. **Do not** use the tip of a pencil; graphite may damage the terminal.

Startup Sequence

After a reset, the terminal performs a series of startup tests and then either:

- runs the .MER application currently loaded in the terminal
- enters configuration mode

The action that occurs depends on what startup options are configured for your terminal.

Refer to Chapter 8 on Troubleshooting for a list of startup, status and error codes.

Configuration Mode

Chapter Objectives

This chapter shows how to use the configuration screens of your PanelView Plus terminal to:

- perform data entry and navigation.
- load an application.
- run an application.
- modify application settings.
- modify terminal settings.

Start Configuration Mode

When you reset or start up the terminal, you should automatically enter configuration mode. Your application will automatically run on startup if you configured this option under Terminal Settings>Startup Options.

If you are unable to enter configuration mode, refer to Chapter 8 on Troubleshooting.

To access configuration mode from a running application:

- Press the Goto Configuration Mode button.

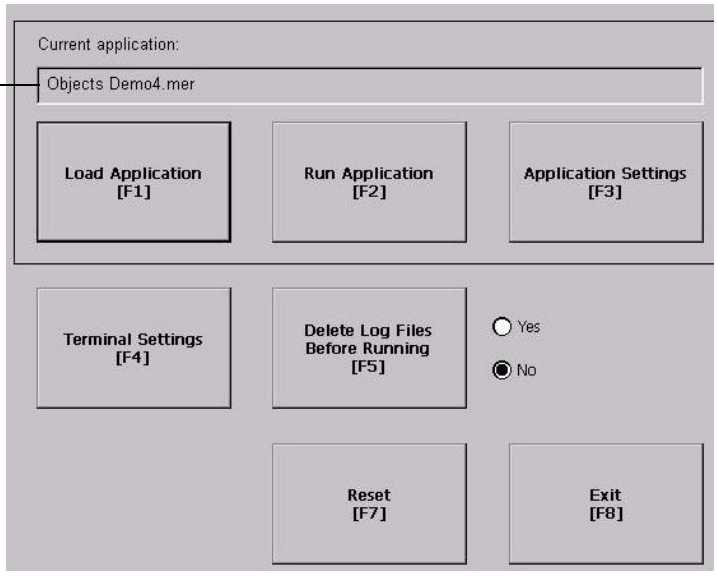
  This button is added to application screen in RSView Studio.

  The application stops running but is still loaded.

Name of application that is currently loaded. Only appears if application is loaded.

To activate buttons:

- on keypad terminals, select the corresponding function key [Fx]
- on touch screen terminals, tap the button with your finger or stylus.
- if a mouse is attached, make selections with the mouse.



RSView ME Station Main Screen Buttons

Main Screen Button	Description
Load Application (F1)	Opens another screen where you can select an application to load. Once loaded, the application name will appear under Current Application.
Run Application (F2)	Runs the .MER application displayed under Current Application. An application must be loaded before you can run it.
Application Settings (F3)	Opens a menu of application-specific configuration settings.
Terminal Settings (F4)	Opens a menu of options to configure non-application, specific terminal settings for the terminal.
Delete Log Files Before Running (F5)	Toggles between Yes and No. If you select Yes, all data log files, alarm history and alarm status file will be deleted before the application is run. If you select No, log files are not deleted first.
Reset (F7)	Resets the terminal. The action that occurs on startup depends on whether you defined shortcut paths in the Windows Startup folder.
Exit (F8)	Exits Configuration Mode.

Data Entry and Navigation

Configuration Mode uses screen buttons for data entry and navigation.

- On terminals with a touch screen, tap the button with your finger or stylus.
- On terminals with a keypad, select the function key listed on the button, or in some cases, the corresponding key on the keypad.

Besides operation specific buttons that are used to modify configuration data, most screens have a combination of these buttons.

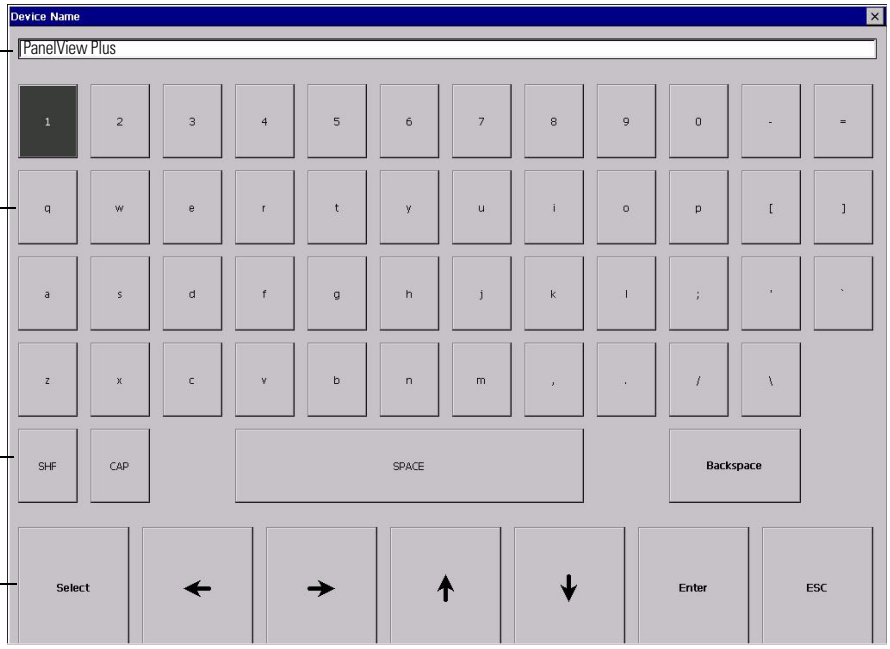
Screen Buttons

Screen Buttons	Description
Close [F8]	Returns to the previous screen.
OK [F7]	Accepts modified values and returns to previous screen.
Cancel [F8]	Cancels the current operation without saving any changes.
▲ ▼	Moves highlight up or down a list.
↵	Selects a highlighted screen or item from a list.

Input Panel

Many screens have buttons that access fields where you must enter/edit data. When you press the button or function key, the Input Panel opens ready for you to input data.

If the field is restricted to a numeric value, only the 0…9 keys will be enabled. If the value is an IP address, the 0…9 and decimal point keys will be enabled. All other buttons will be disabled.



- on a touch terminal, tap the keys.
- on a keypad terminal, use the arrow keys on the keypad to select keys.
- If a mouse is attached, use the mouse to select keys.

Input Panel Control Functions

Controls	Function
SHF	Switches keys between their shifted and unshifted state. The initial default is shifted.
CAPS	Switches keys between lowercase and uppercase characters. The initial default is lowercase.
SPACE	Enters a space between characters in the Display Area.
Backspace	Deletes the previous character (to the left of the cursor) in the Display Area.
Select	Selects a character and enters it in the Display Area.
Right, Left, Up, Down Arrow Keys	Selects the character to the right, left, above or below the currently selected character.
Enter	Accepts the entered characters and returns to the previous screen
ESC	Cancels the current operation and returns to the previous screen.

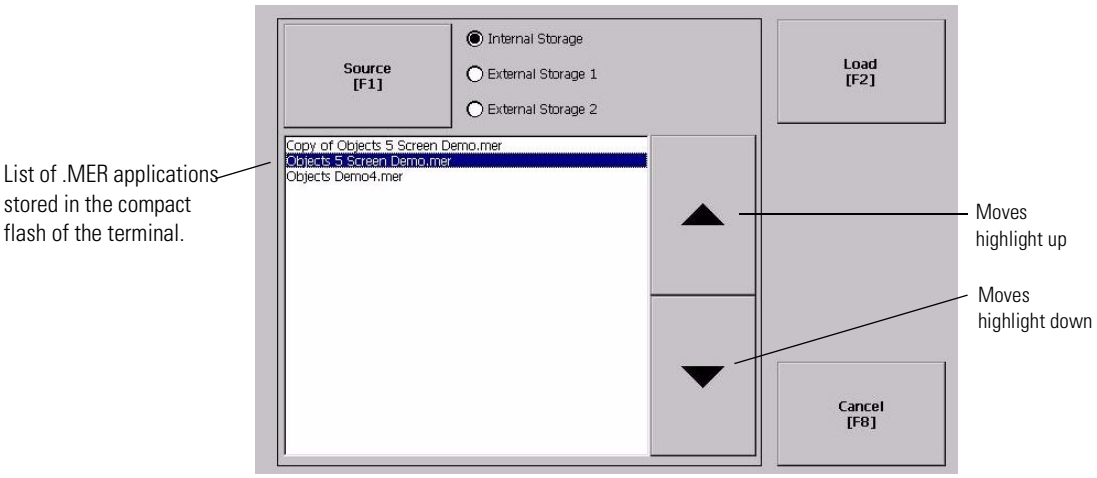
To enter characters in the Display Area:

1. Select a character on the Character Keyboard.
2. Press the Select button to copy the character to the Display Area.
3. When done entering all characters, press Enter.

You will return to the previous screen with the newly data entered.

Load an Application

To load an RSView ME .MER application, select the Load Application button on the main screen.



1. Select the Source button to select the storage location of the application file you want to load.
   - Internal Storage - the internal compact flash in the terminal.
   - External Storage 1 - the external compact flash card loaded in the card slot of the terminal.
   - External Storage 2 - for future use.

   TIP RSView ME software only recognizes files in the \RockwellSoftware\RSViewME\Runtime\ folder.

2. Select an .MER file from the list. Use the up and down cursor keys to select a file.

3. Select the Load button to load the application.

   You will be asked if you want to replace the terminals' current communication configuration with the application's communication configuration.

4. Select Yes or No.

   If you select Yes, any changes made to the device addresses or driver properties in the RSLinx Communications screen will be lost.

The name of the currently loaded application will appear at the top of the main configuration mode screen.

Run an Application

To run the currently loaded application, select the Run Application button on the main Configuration Mode screen. You must load an application before it can run. Log files generated by the application may be deleted if this option was selected on the main screen or enabled as a Startup Option under Terminal Settings.

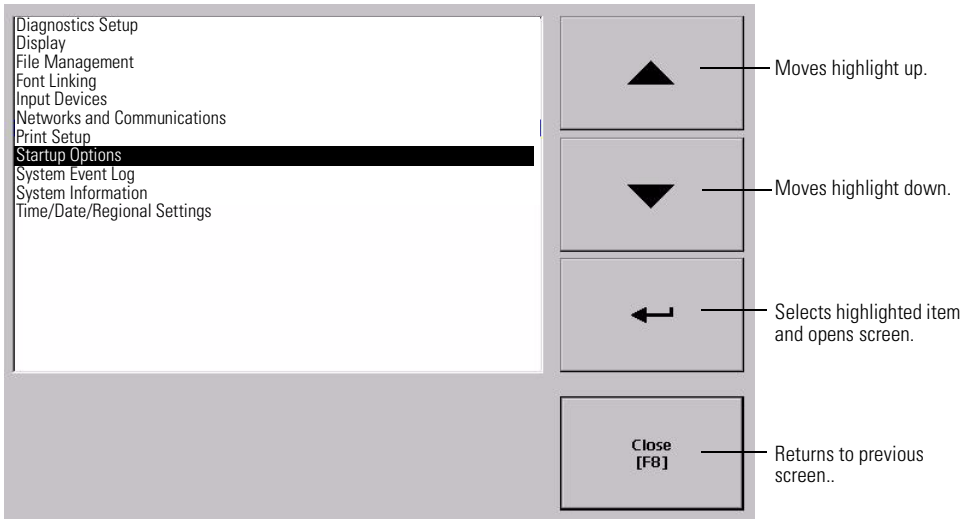
Application Settings

From the Application Settings screen, you can show device shortcuts defined for the loaded .MER application. For example, your .MER application might have SLC defined as a device shortcut name for the SLC 5/05 controller. Device shortcuts are read-only and cannot be edited.

Terminal Settings

From Terminal Settings, you can open screens to configure and modify non-application settings for the terminal.

- On a touch terminal, tap the button.
- On a keypad terminal, press the corresponding key on the keypad.



Terminal Setting Descriptions

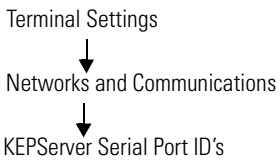
Terminal Setting	Description
Diagnostic	Forwards diagnostic messages form a remote log destination to a computer running diagnostics.
Display	Shows the temperature of the display, sets the intensity of the backlight, contrast of grayscale displays, and enables/disables the screen saver.
File Management	Copies or deletes application files or font files from a storage location.
Font Linking	Links a font file to a base font loaded on the terminal.
Input Devices	Configures settings for the keypad, touch screen, or attached keyboard and mouse.
Networks and Communications	Configures network connections and communication settings specific to the application (DHPlus, DH485, Remote I/O, ControlNet, DeviceNet, Serial).
Print Setup	Configures settings for printing displays, alarm messages, and diagnostics messages generated by the application.

Terminal Setting	Description
Startup Options	Specifies whether the terminal starts up in configure or run mode. Also lets you enable/disable tests to run on the terminal at startup.
System Event Log	Displays a list of system events currently logged by the terminal.
System Information	Displays power, temperature, battery and memory details for the terminal. Also shows the firmware number for RSView ME and technical support information.
Time/Date/Regional Settings	Sets the date, time, language, and numeric format used by the terminal and applications.

Networks and Communications

From the Networks and Communications screen, you can access settings for:

- KEPServer Serial Port ID's
- Network Connections
- RSLinx Enterprise Communications



KEPServer Serial Port ID's

To access the KEPServer Serial Port ID's screen, you must have KEPServer Enterprise installed on your terminal. Otherwise, you will get an error message when accessing this screen. If you plan on using KEPServer Enterprise and serial communications, you must specify which COM port to use.

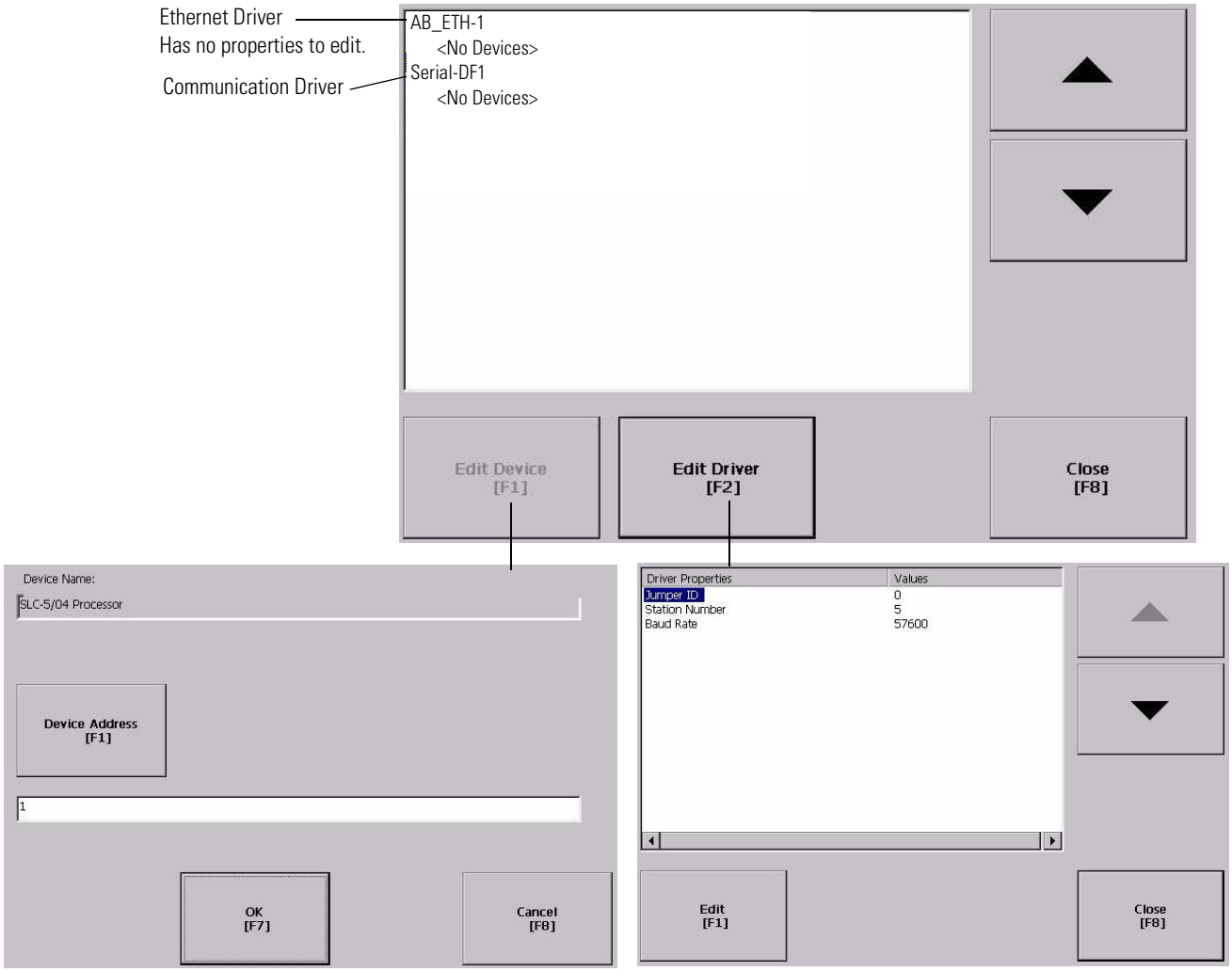
Terminal Settings
↓
Networks and Communications
↓
RSLinx Enterprise Communications

RSLinx Enterprise Communications

The RSLinx Enterprise Communications screen shows a tree view of installed communication cards and network configurations. You can:

- edit or view the driver settings for the communication protocol used by your .MER application.
- edit the device address of the controller on the network.

The procedure for editing these settings is the same regardless of the communication protocol. The only differences are the properties for each communication protocol and the device address of the logic controller. The properties for each communication protocol are defined immediately after this section.



To edit communication settings:

1. From the RSLinx Configuration Screen, select the communication card installed on your terminal.

2. Select the Driver Settings button.

   A properties screen opens showing the current communication settings for the driver.

3. To modify a setting, select the setting and then the Edit button. The Input Panel opens showing the current setting.

4. Using the Input Panel, modify the setting and then select the Enter button.

You return to the previous screen with the newly entered data.

To edit the device address of the logic controller:

1. From the RSLinx Configuration screen, select a device node.

2. Select the Edit Device button.

   A screen opens showing the name of the device and its current node address.

3. To modify the device address, press the Device Address button. The Input Panel opens showing the current address.

4. Using the Input Panel, modify the address and then select the Enter button.

You return to the previous screen with the new address.

IMPORTANT Modified settings do not take effect until the terminal is rebooted.

DHPlus Properties

The DHPlus Properties screen lets you view or modify settings for a terminal connected to a DHPlus network.

DHPlus Communication Settings

Field	Description	Valid Values
Jumper ID[1]	Identifies the communication card if multiple cards are installed on terminal.	0…3
Station Number	The unique address of the terminal on the DHPlus network.	0…77 (octal)
Baud Rate	The communication rate of the DHPlus network.	57,600 (default) 115,200 230,400

(1) For use with PanelView Plus 700 to 1500 terminals only.

DH485 Properties

The DH485 Properties screen lets you view or modify settings for a terminal connected to a DH-485 network.

DH485 Communication Settings

Field	Description	Valid Values
Jumper ID[1]	Identifies the communication card if multiple cards are installed on terminal.	0…3
Station Number	The unique station number of the terminal on the DH-485 network.	0…31 (decimal)
Baud Rate	The communication rate of the DH-485 network.	9,600 19,200
MaxStationNumber	The maximum station number on the DH-485 network. The value must be greater than or equal to the Station Number.	0…31 (decimal)

(1) For use with PanelView Plus 700 to 1500 terminals only.

Remote I/O Properties

The RIO Properties screen configures communication settings for the terminal on a Remote I/O link.

Remote I/O Communication Settings

Field	Description	Valid Values
Jumper ID[1]	Identifies the communication card if multiple cards are installed on terminal.	0…3
Baud Rate	The communication rate of the Remote I/O network.	57,600 (default) 115,200 230,400

(1) For use with PanelView Plus 700 to 1500 terminals only.

ControlNet Properties

The ControlNet Properties screen configures communication settings for the terminal on a ControlNet network.

ControlNet Communication Settings

Field	Description	Valid Values
Device ID	Unique address of the terminal on the ControlNet network.	1…99

DeviceNet Properties

The DeviceNet Properties screen configures communication settings for the terminal on a ControlNet network.

DeviceNet Communication Settings

Field	Description	Valid Values
MacID	Unique address of the terminal on the DeviceNet network.	0…63
Baud Rate	The communication rate at which the DeviceNet driver communicates.	125K (default) 250K 500K

Serial Properties

The Serial Properties screen configures settings for serial communications (using the RS-232 serial port) on the terminal.

Serial Communication Settings

Field	Description	Valid Values
Device	The serial device your terminal is connected to.	PLC_CH0 KF2 SLC_CH0 KF3 KFC KFC15 AC_CH0
Error Check	Type of error checking used. Error checking is automatically configured if Use Auto Config is set to Yes.	BCC, CRC
Parity	Type of parity used. The parity is automatically configured if Use Auto Config is set to Yes.	None, Odd, Even
Stop Bits	Number of stop bits used.	1 or 2
Ack Timeout	Ack/Poll timeout value in milliseconds.	20…60,000 ms
Max Retries	Maximum number of retries before the serial driver fails.	0…255

Field	Description	Valid Values
Station	Station number based on a specific device.	PLC_CH0 0…77 (octal) KF2 0…77 (octal) SLC_CH0 0…31 KF3 0…31 KFC 1…99 KFC15 1…99 AC_CH0 0…255
Baud Rate	Data rate at which serial driver communicates. The communication rate is automatically configured if Use Auto Config is set to Yes.	110 300 600 1200 4800 9600 19,200 38,400 115,200
Use Auto Config	Automatically or manually configures the baud rate, parity, and error checking parameters.	Yes (auto configure) No (manual configure)
Com Port	Communication port used on the terminal.	1 (COM1) 2 (COM2)

Terminal Settings
↓
Networks and Communications
↓
Network Connections

Network Connections

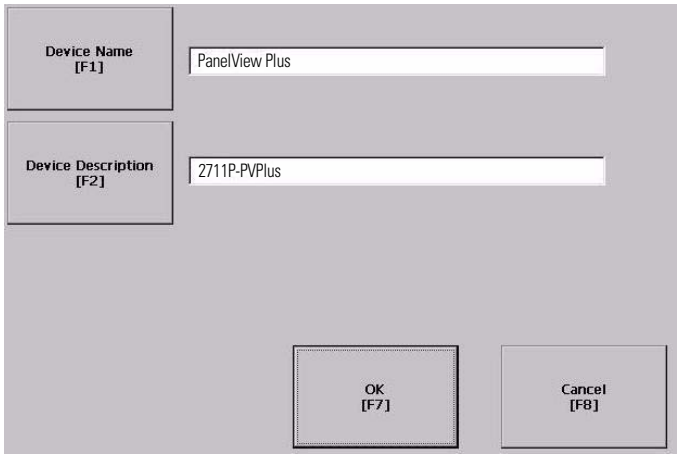
The Network Connections screen lets you configure these items for the terminal.

- Device Name
- Network Adapters
- Network Identification

Terminal Settings
↓
Networks and Communications
↓
Network Connections
↓
Device Name

Device Name

The Device Name screen identifies the terminal to other computers on the network.



Device Name Properties

Field	Description	Valid Values
Device Name[1]	Name that identifies the terminal to other computers on the network.	1 to 15 characters A leading character in the range a…z or A…Z. Remaining characters in the range a…z, A…Z, 0…9, or - (hyphen).
Device Description	Provides a description of the terminal.	50 characters max.

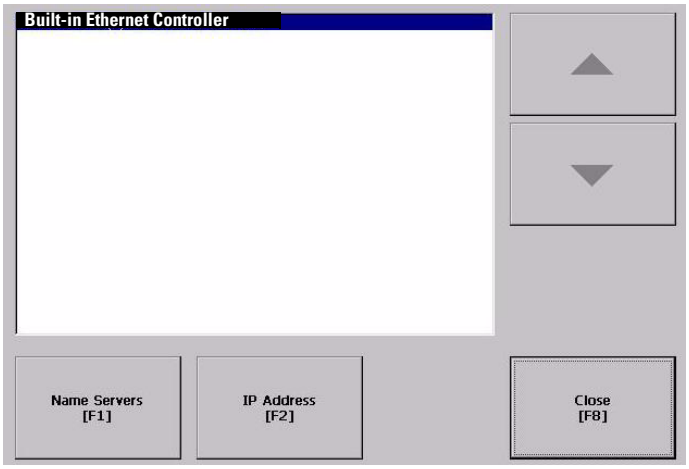
(1) Check with your network administrator to determine a valid device name.

Terminal Settings
↓
Networks and Communications
↓
Network Connections
↓
Network Adapters

Network Adapters

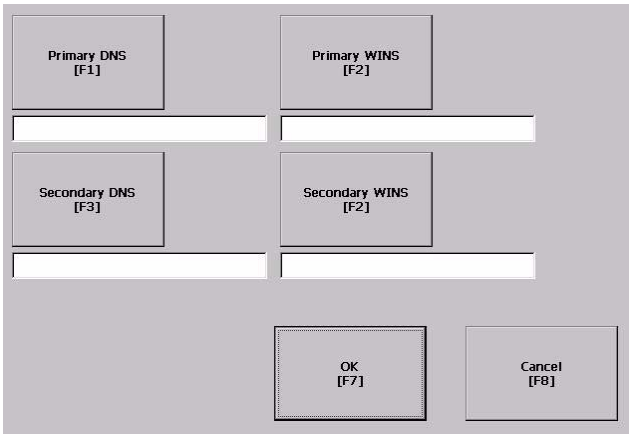
The Network Adapters screen configures driver settings for all network adapters installed on the terminal. The only network adapter on the terminal is the (IntelR) Fast Ethernet Controller.

Press the Name Servers button or IP Address button to access driver settings.



Name Servers

Defines Name Server addresses for the Network Adapter. These addresses are automatically assigned if DHCP is enabled for the network adapter.

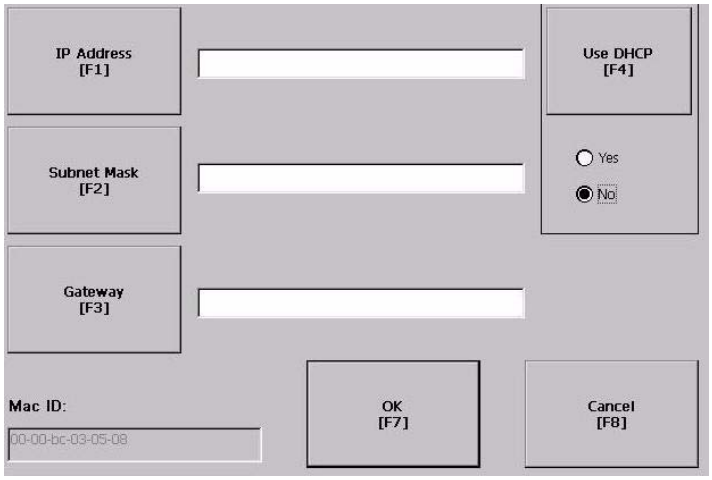


Name Server Addresses

Field	Description	Valid Values
Primary DNS	The address of the primary DNS resolver.	xxx.xxx.xxx.xxx
Secondary DNS	The address of the secondary DNS resolver.	xxx.xxx.xxx.xxx
Primary WINS	The address of the primary WINS resolver.	xxx.xxx.xxx.xxx
Secondary WINS	The address of the secondary WINS resolver.	xxx.xxx.xxx.xxx

IP Address

The IP Address screen identifies the IP address of the selected network adapter. If the network the terminal is connected to does not automatically assign an IP address, you can assign the address in this screen.



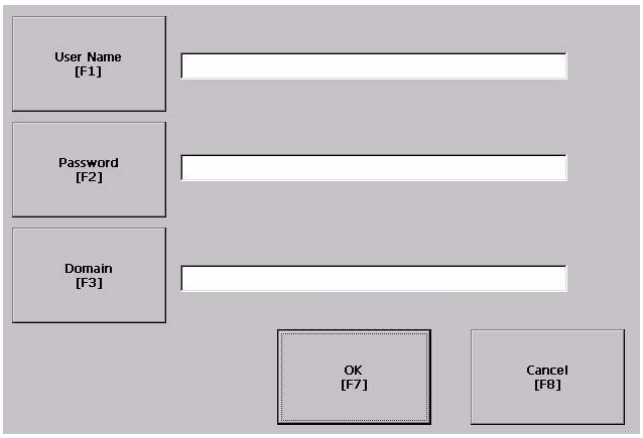
IP Address Properties

Field	Description	Valid Values
Use DHCP	Enables or disables Dynamic Host Configuration Protocol (DHCP) settings. DHCP automatically allocates network devices and configurations to newly attached devices on the network. If DHCP is set to Yes, the terminal is automatically assigned an IP address, Subnet Mask, and Gateway. The fields are disabled. If DHCP is set to No, you can enter the IP address, Subnet Mask, and Gateway address.	Yes (default) No
IP Address	A unique address identifying the terminal on the Ethernet network.	xxx.xxx.xxx.xxx 000.000.000.000 (default) Range of values for the first set of decimal numbers is 1…255 unless all fields are set to 000. The range of values for the last three sets of decimal numbers is 0…255.
Subnet Mask	Address must be identical to the server subnet mask.	xxx.xxx.xxx.xxx
Gateway	Optional Gateway address.	xxx.xxx.xxx.xxx
Mac ID	Read-only field.	

Terminal Settings
↓
Networks and Communications
↓
Network Connections
↓
Network Identification

Network Identification

The Network Identification screen configures settings that enable the terminal to gain access to network resources. You can enter a user name, password, and domain provided by your network administrator.



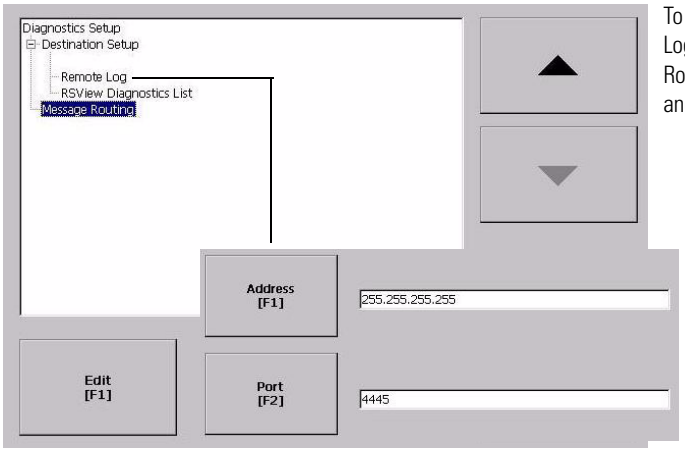
Network Identification

Field	Description	Valid Values
User Name	Identifies the user to the network.	70 characters max.
Password	Characters that gain access to network along with the user name.	No character limitation
Domain Name	Provided by network administrator.	15 characters max.

Diagnostic Setup

Terminal Settings
↓
Diagnostic Setup

The Diagnostic Setup screen configures diagnostics for the current computer. The screen shows a tree view of possible diagnostic nodes.



To access the Remote Log Setup or Message Routing, select the node and then the Edit button.

The Remote Log Destination forwards messages that it receives to a Windows 2000/XP computer running diagnostics. The location is determined by the IP address and port number.

Remote Log Destination

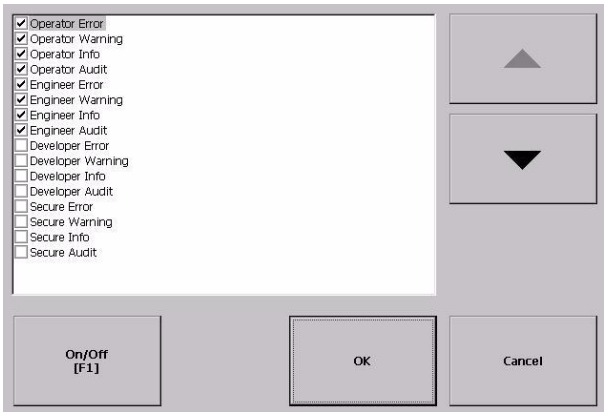
Field	Description	Valid Values
Address	Address of the remote Windows 2000/XP computer.	xxx.xxx.xxx.xxx
Port	The port used to communicate with the remote Windows 2000/XP computer.	4445 (default)

Message Routing

The Message Routing screen lets you access these screens.

- Remote Log
- RSView Diagnostics List

Each one of the above screens shows a list of messages that can be sent to that destination. The list shows the On/Off status of each message type. Use the On/Off button to turn a message type on or off. A message type is enabled if it has a checked box.



File Management

The File Management screen lets you access screens to:

- delete files.
- copy files.

Terminal Settings
↓
File Management
↓
Delete Files

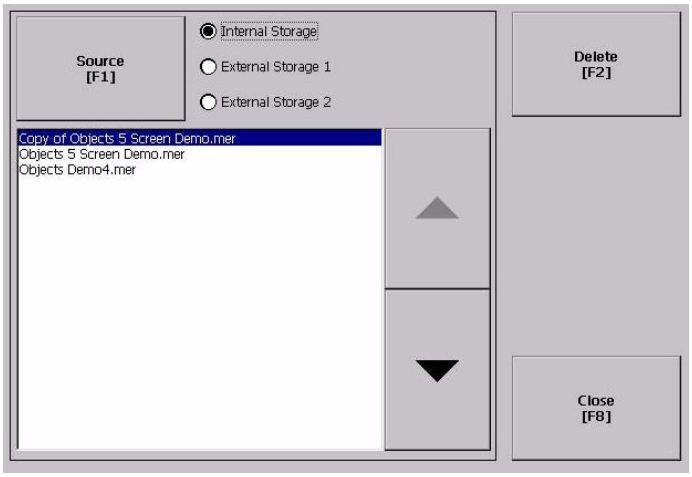
Delete Files

From the Delete Files screen you can select these options.

- Delete Applications - deletes an .MER application file from a storage location.
- Delete Fonts - deletes a font file from a storage location.
- Delete Log Files - deletes any data log files, alarm history files and alarm status files in the System Default location on the terminal.

Delete Application or Font Files

The process for deleting an application file or a font file is the same.



1. Select the Source button to select the storage location of the application or font file that you want to delete.
   - Internal Storage - the internal compact flash in the terminal.
   - External Storage 1 - the external compact flash card loaded in the card slot of the terminal.
   - External Storage 2 - for future use.
2. Select a file from the list.
3. Select the Delete button.
4. When asked if you want to delete the selected application or font file from the storage location, select Yes or No.

Delete Log Files

Select this option to delete any data log files, alarm history files, and alarm status files in the System Default location on the terminal. You will be asked to confirm the operation.

Do you want to delete all of the RSView ME Station Log Files?

Select Yes or No. Any log files not located in the System Default location will not be deleted.

Terminal Settings
↓
File Management
↓
Copy Files

Copy Files

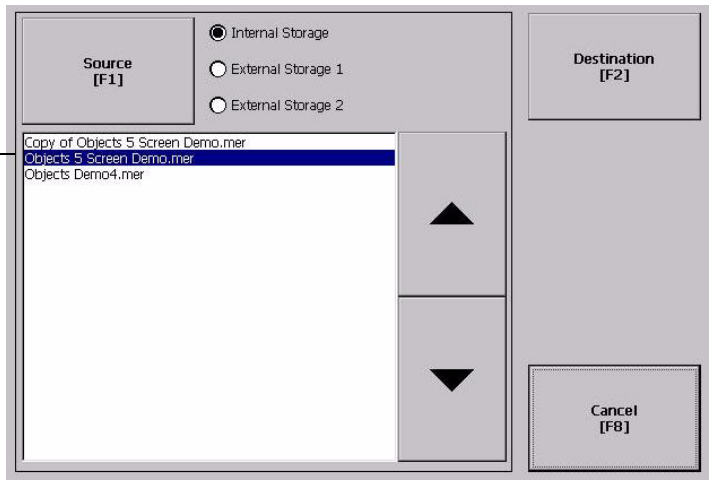
From the Copy Files screen, you can select these options.

- Copy Applications - copies an .MER application file from one storage location to another.
- Copy Fonts - copies a font file from one storage location to another.

Copy Applications or Fonts

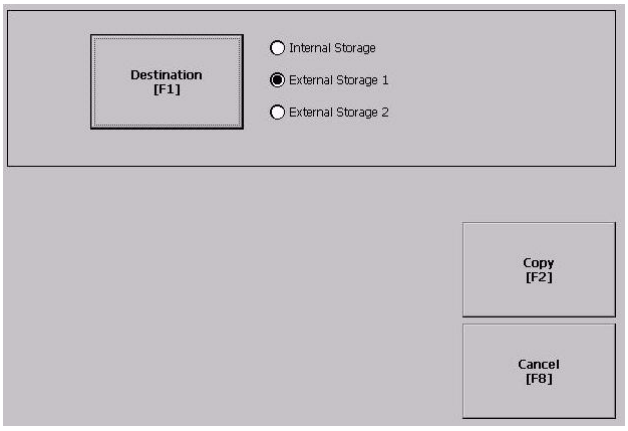
The process for copying an application file or a font file is the same.

List of files stored in compact flash of terminal.



1. Select the Source button to select the location of the application or font file that you want to copy.
   - Internal Storage - the internal compact flash in the terminal.
   - External Storage 1 - the external compact flash card loaded in the card slot of the terminal.
   - External Storage 2 - for future use.

2. Select the Destination button on the same screen to open the this screen.



3. Select the Destination button to select the storage location where you want to copy the application or font file to.
   - Internal Storage - the internal compact flash in the terminal.
   - External Storage 1 - the external compact flash card loaded in the card slot of the terminal.
   - External Storage 2 - for future use.
4. Select the Copy button to copy the selected application or font file to the selected destination.

   If the file exists, you will receive a warning and will be asked if you want to overwrite the existing application.
5. Select Yes or No.

TIP RSView ME software looks for .MER files in the \RockwellSoftware\RSViewME\Runtime folder and font files in the \RockwellSoftware\RSViewME\Fonts\ folder.

Display

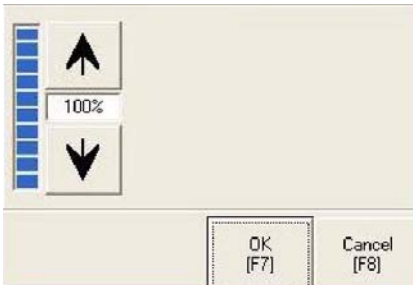
The Display screen lets you open these screens.

- Display Contrast
- Display Intensity
- Display Temperature
- Screen Saver
- Cursor

Terminal Settings
↓
Display
↓
Display Contrast

Display Contrast

The Display Contrast screen lets you view and modify the current contrast setting of the PanelView Plus 400 and 600 grayscale displays. The numeric display shows the current contrast level as a percentage. The change is not permanent until you select OK.

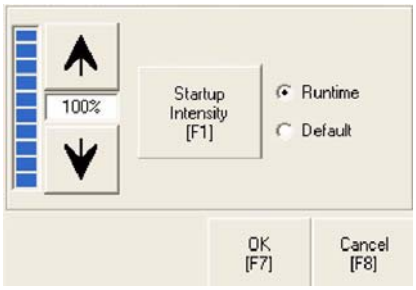


TIP Displays are shipped with the contrast level set at 50%, which is the optimum setting.

Terminal Settings
↓
Display
↓
Display Intensity

Display Intensity

The Display Intensity screen lets you view or modify the current intensity of the backlight. The default intensity is 100%. When you change the intensity, the terminal temporarily changes to that intensity. The change is not permanent until you select OK.



The Startup Intensity button toggles between Runtime and Default. If Runtime is selected, the terminal startup screens will use the runtime intensity setting selected on the above screen. If Default is selected, the terminal startup screens will use the terminal default setting, which is near 100%.

Terminal Settings
↓
Display
↓
Display Temperature

Display Temperature

The Display Temperature screen shows the current temperature of the display.

The 600 -1500 terminals have a cold-cathode fluorescent lamp (CCFL) backlight. This backlight requires temperature control when the internal temperature of the product is below 10 °C or above 60 °C. For proper backlight operation, the terminal monitors low and high temperature conditions.

- If the internal temperature of the product is below 10 °C, the backlight is set to overdrive or the full-rated current setting for at least five minutes.
- If the internal temperature is at or above 60 °C, the backlight is set to underdrive; 40% or less of full brightness. This reduces heat generation from the backlight.

Temperature monitoring begins when the terminal powers on, or when the backlight turns on, for example, exiting screen saver mode. The temperature control only affects display intensity; it does not restrict the use or operation of the terminal.

When a low or high temperature condition is detected, an error is sent to the system event log. If the temperature control is not functioning, a noncritical error is sent to the system event log but the terminal continues to operate normally.

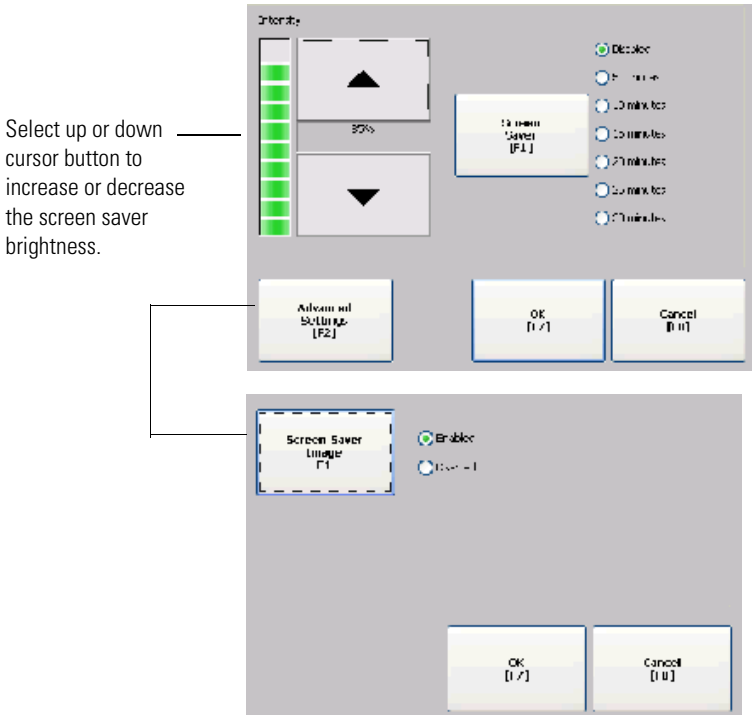
TIP The CCFL backlight temperature control takes precedence over the application Backlight Settings.

Terminal Settings
↓
Display
↓
Screen Saver

Screen Saver

The Screen Saver screen lets you:

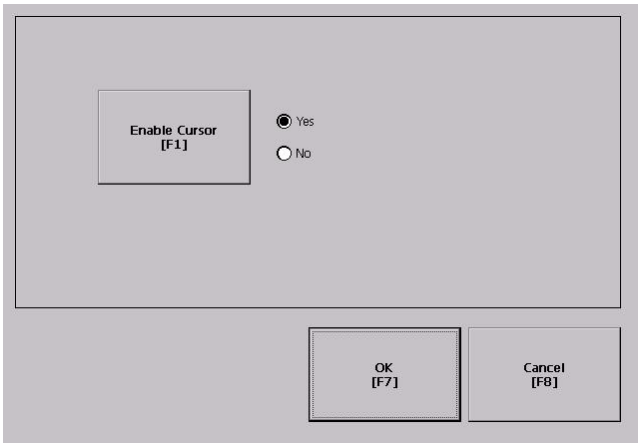
- disable the screen saver.
- enable the screen saver after the selected idle time.
- adjust the brightness intensity of the screen saver.
- enable/disable the screen saver bitmap.



Terminal Settings
↓
Display
↓
Cursor

Cursor

The Cursor screen enables/disables the on-screen cursor.

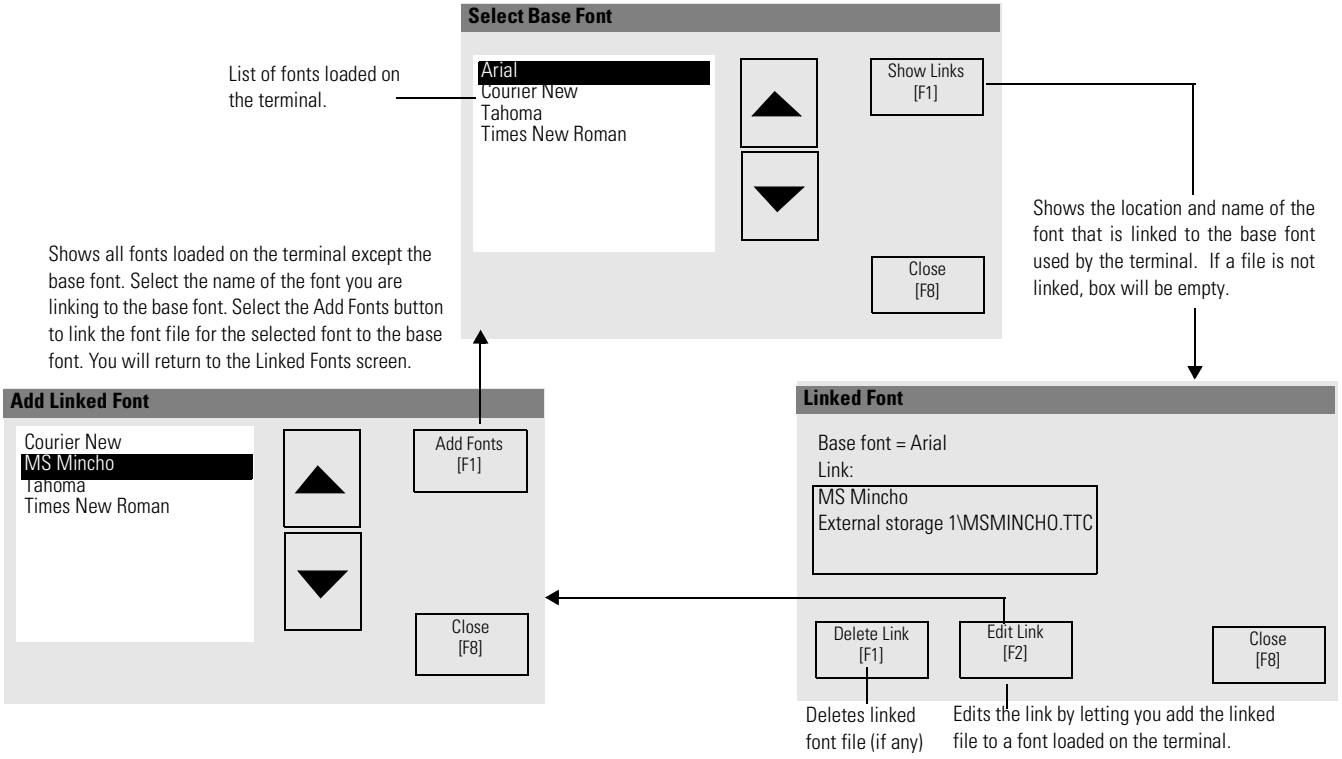


Font Linking

Terminal Settings
↓
Font Linking

Font linking lets you run a translated application on the terminal by linking a font file to the base font (for example, linking a Chinese font file to the base font Arial).

For more details on preinstalled terminal fonts and additional fonts available for downloading, see Appendix C.



Input Devices

The Input Devices screen lets you access screens to view and modify settings for these input devices.

- Keyboard
- Keypad
- Mouse
- Touch Screen

Keyboard and Keypad Setup

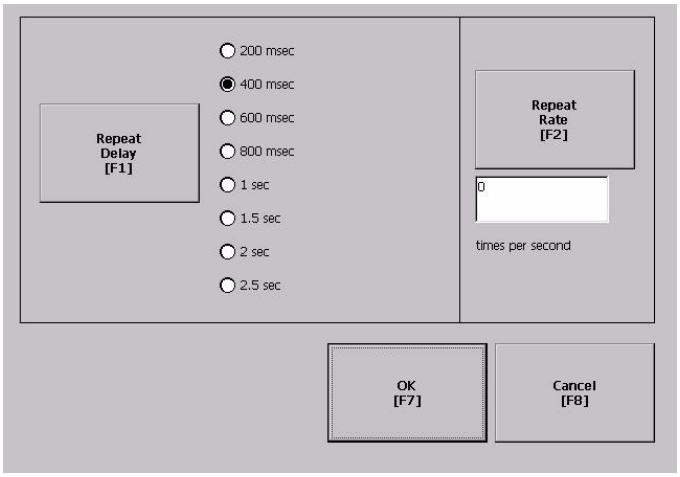
Terminal Settings
↓
Input Devices
↓
Keyboard or Keypad

The Keyboard and Keypad screen opens these screens.

- Key Repeat Settings
- Keypad Settings

Key Repeat Settings for Attached Keyboard or Terminal Keypad

The Key Repeat Settings configures settings for keys on the terminal **or** keys an attached keyboard.

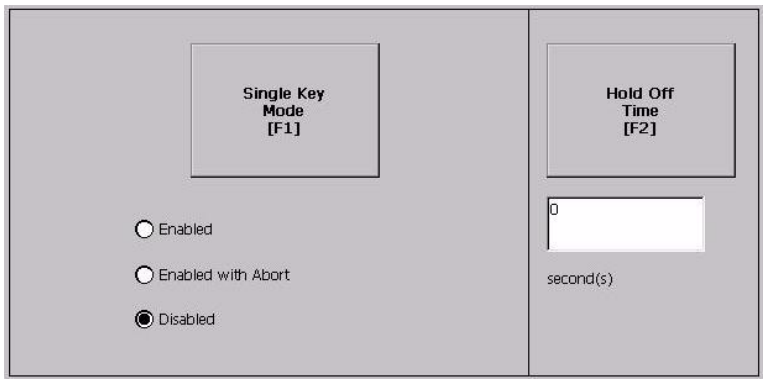


Key Repeat Rate and Delay Settings

Field	Description	Valid Values
Repeat Rate	The number of times a key is repeated per second when you hold down a key.	Keypad: 0, 2…30 Keyboard: Device dependent 0, 2…30 is typical
Repeat Delay	The amount of time that elapses before a key is repeated.	200 ms 400 ms 600 ms 1 s 1.5 s 2 s 2.5 s Values are device dependent. An unsupported value appears dimmed.

Key Settings for Terminal Keypad

The Keypad Settings screen enables/disables Single Key Mode option, that is used to restrict multiple or simultaneous key presses.



Keypad Settings

Field	Description	Valid Values
Single Key Mode	Enables or disables Single Key mode. If enabled, any programmable key that is pressed inhibits all keys until the programmable key is pressed again. This includes the Alt, Ctrl, Shift keys. If enabled with abort, any secondary key press will terminate the initial key press immediately. If disabled, there are no restrictions on key presses.	Enabled Enabled with Abort Disabled (default)
Hold Off Time	The length of time to ignore multiple presses of the same key.	400 ms (default)

IMPORTANT The keypad cannot produce Home, End, Page Up or Page Down when Single Key mode is enabled.

Terminal Settings
↓
Input Devices
↓
Touch Screen

Touch Screen

The Touch Screen lets you access these screens.

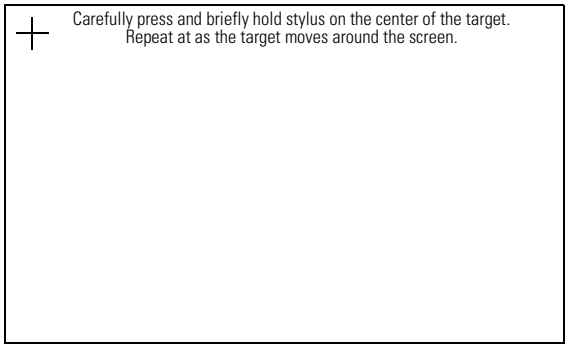
- Calibration
- Cursor
- Double-tap Sensitivity

Touch-screen Calibration

IMPORTANT Use a plastic stylus device with a minimum tip radius of 1 mm (0.040 in) to prevent damage to the touch screen.

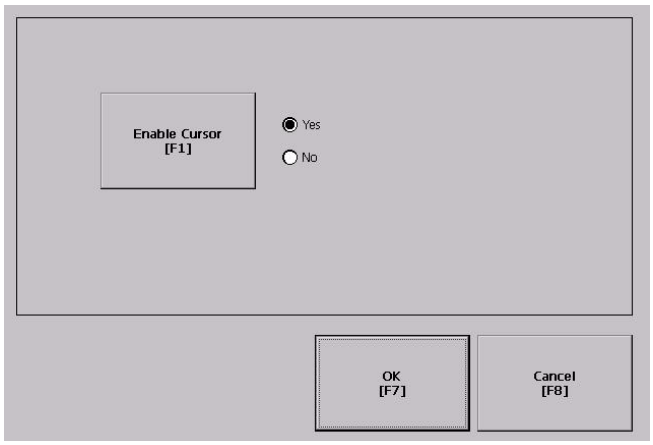
This screen calibrates the touch screen of the terminal. Touch the center of the target (+) each of the 4 times it appears. When the calibration is complete, you will see the message:

Tap the screen to register saved data. Wait for 30 seconds to cancel saved data and keep the current settings.



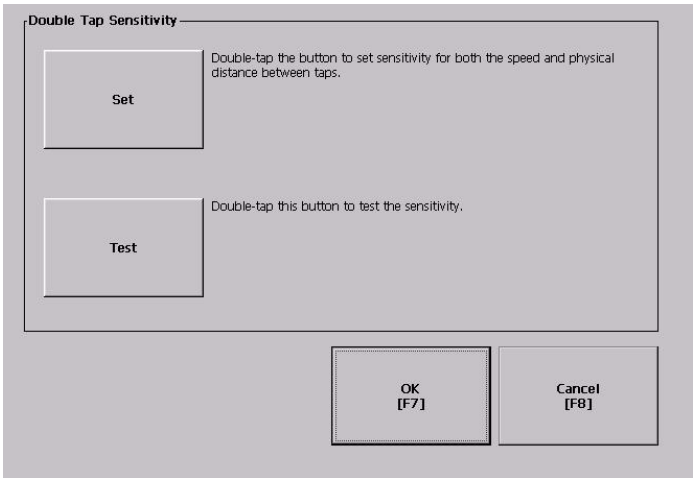
Cursor

This screen enables or disables the cursor on touch-screen terminals. Disabling the touch-screen cursor will not disable the mouse.



Double-tap Sensitivity

This screen lets you set and test the sensitivity for both speed and physical distance between touch-screen presses.



- The Set button sets the sensitivity of touch-screen presses.
- The Test button tests the sensitivity of touch-screen presses. If you double-tap the test button with the time set using the Set button, the Test button will reverse its foreground and background colors.

Terminal Settings
↓
Input Devices
↓
Mouse

Mouse

The Mouse screen sets and tests the sensitivity for both speed and physical distance between mouse clicks. This process is identical to that for setting Double-tap sensitivity for the touch screen.

Print Setup

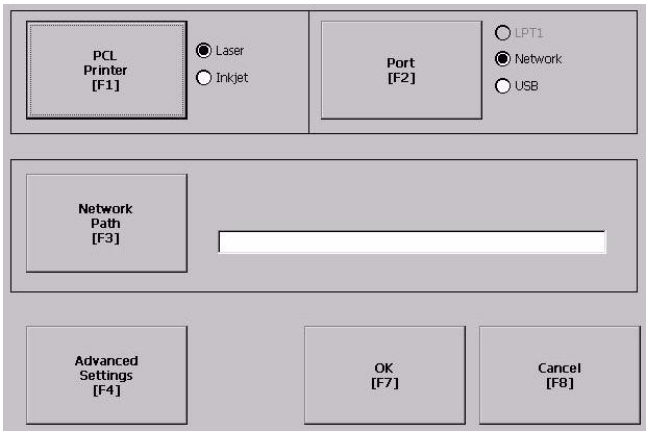
The Print Setup screen lets you access screens to configure print options for:

- displays.
- alarms.
- diagnostic messages.

Terminal Settings
↓
Print Setup

Display, Alarm, and Diagnostic Print Setup

The general setup for printing displays, alarm messages, and diagnostics messages from an RSView .MER application is the same. The Advanced Settings for each function are different.



Print Setup Properties

Field	Description	Valid Values
PCL Printer	Type of printer to use.	Laser (default) Inkjet
Port	Port to use for printing displays, alarm messages, and diagnostic messages.	Network (default) USB
Network Path	Network path of printer to use if the Port selection is Network.	519 characters max.
Advanced Settings	Press this button to open additional settings.	

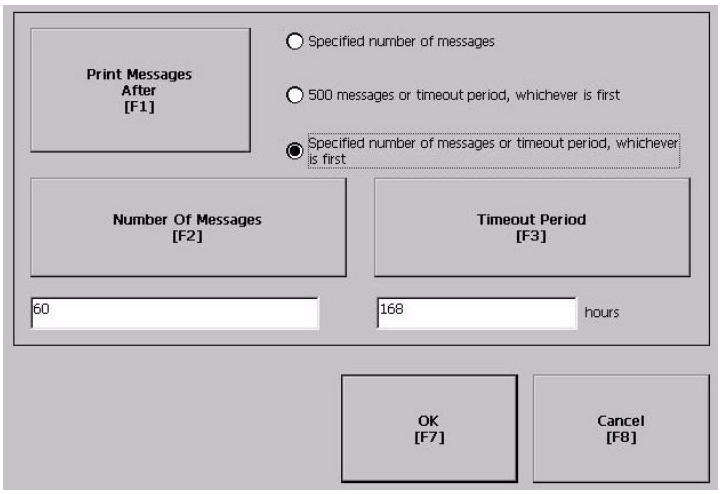
Advanced Settings for Display Print Setup

Select the Advanced Settings button to:

- change the print orientation (portrait or landscape).
- enable or disable Draft mode.

Advanced Settings for Diagnostic Messages and Alarm Messages

This screen configures when to print diagnostic or alarm messages that are sent to the Network or USB port.



To configure how messages are queued for printing, select the Print Messages After button and set one of these options.

- Specified number of messages

  Prints messages after 60 are queued or another specified value. The default is 60 (about one full page of messages.)

- 500 messages or timeout period, whichever is first

  Prints after 500 messages are queued or a specific time period has elapsed, whichever comes first. The default time period is 168 hours (7 days). You can specify another value. For example, if 350 messages are in the queue and 7 days have elapsed, the 350 messages will print.

- Specified number of messages or timeout period, whichever is first

  Prints after a specified number of messages are queued or a specific time period has elapsed, whichever comes first.

  The default number of messages to queue is 60. The default timeout period is 168 hours (7 days). You can change both values. For example, the number of messages is set to 75 and the timeout period is set to 48 hours (2 days). If the queue has 75 messages after only 24 hours, these messages will print. If there are only 15 messages in the queue at 48 hours, the 15 messages will not print until the time period has elapsed.

Startup Options

The Startup Options screen accesses these screens.

- RSView ME Station Startup
- Startup Tests

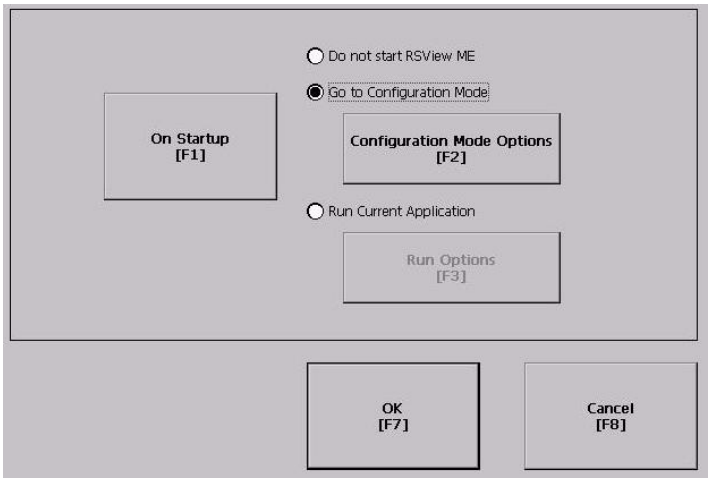
Terminal Settings
↓
Startup Options
↓
RSView ME Station Startup

RSView ME Station Startup

The RSView Machine Station Startup screen specifies what action the terminal takes on startup.

- Do not start RSView ME Station.
- Go to Configuration Mode.
- Run the Current Application.

  This option is available only if an application is loaded.



RSView ME Station will start up based on shortcuts in the Windows Startup folder and whether an application is loaded.

Select the On Startup button to switch between Do not start RSView ME, Go to Configuration Mode, or Run the Current Application. Select the button under the last two options to configure specific settings for each mode.

Configuration Mode

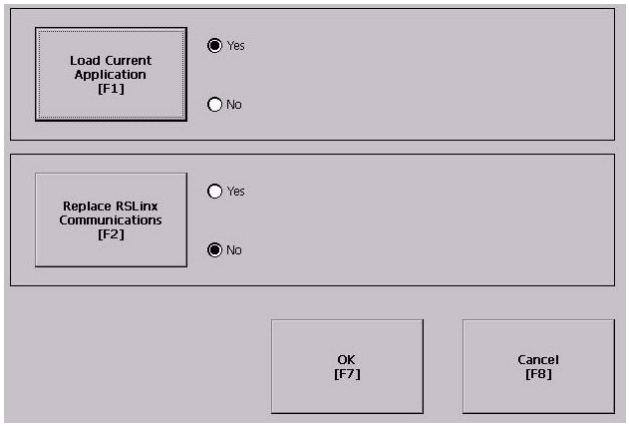
The Configuration Mode Options screen specifies whether the terminal will start in configuration mode:

- with the current application loaded.
- with the communication configuration of the current application or the terminal's RSLinx communication configuration.

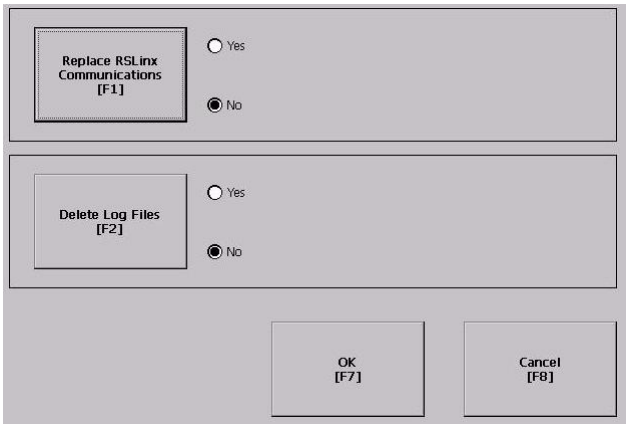
  If you select Yes to replace the terminal's communication configuration with that of the application, any changes made to the device addresses or driver properties in the RSLinx Communications screen will be lost.

These options are available only if an application is loaded in the terminal. If an application is not loaded, both options are disabled and set to No.

Configuration Mode



Run Options



Run Options

The Run Options screen specifies whether to:

- replace the terminal's communication (RSLinx) settings with application settings when the application is run.

  If you select Yes, any changes to the device addresses or driver properties in the RSLinx Communications screen will be lost when the terminal boots up.
- delete the log files (data, alarm history, alarm status) generated by the terminal from the System Default location before running the application.

Terminal Settings
↓
Startup Options
↓
Startup Tests

Startup Tests

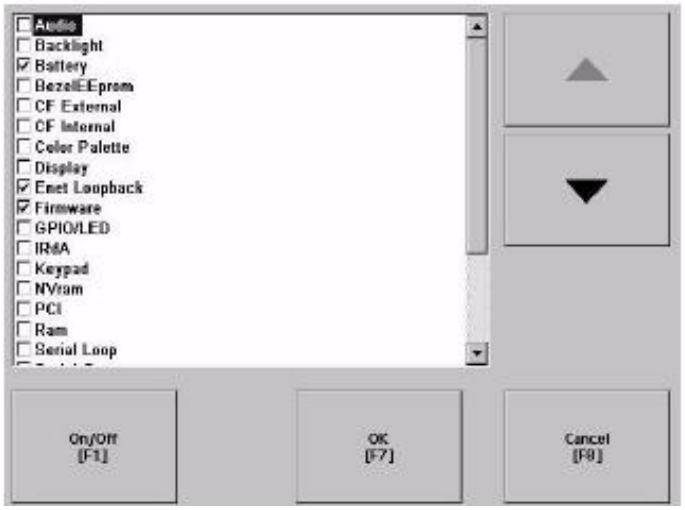
The terminal can run extended tests on startup. The Startup Tests screen provides access to these screens.

- Startup Tests Settings
- Repeat Count

IMPORTANT Startup Tests apply only to PanelView Plus 700 to 1500 terminals.

Select Tests

The Select Tests screen shows a list of each test that can be performed on the terminal at startup and its current On/Off status. You can turn any test in the list on or off by selecting the On/Off button. The terminal will only run tests with a checked box.

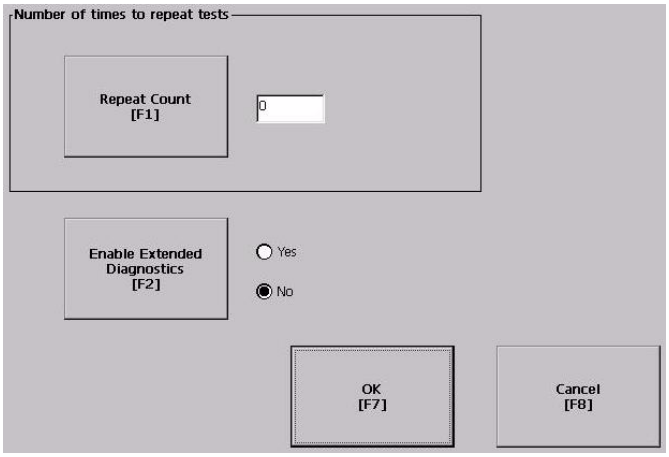


Startup Tests Settings

From the Startup Tests Settings screen, you can:

- enable extended diagnostics to run on the terminal at startup.
- disable extended diagnostics at startup.
- specify how many times to repeat the selected tests that are run on the terminal during startup.

The Repeat Count field shows the current value. You can enter a value in the range of 0…128.



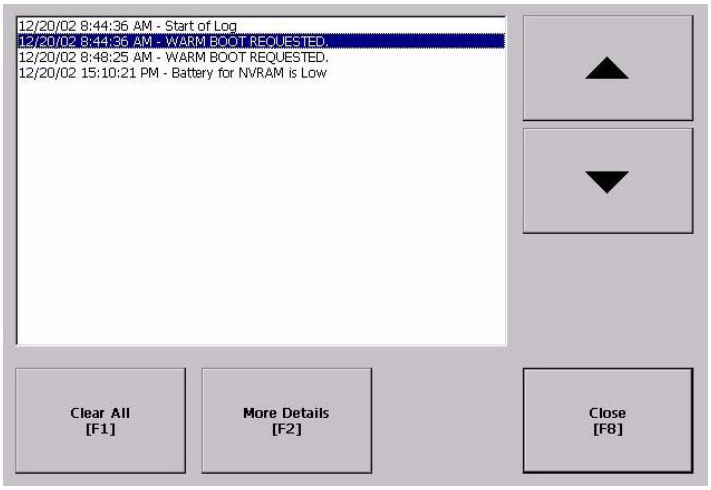
IMPORTANT Enabling Extended Diagnostics and setting a high Repeat Count will increase the time it takes the terminal to reboot.

The tests will run each time you reset or cycle power to the terminal until you disable Extended Diagnostics. Setting a low repeat count will also decrease the startup time.

System Event Log

The System Event Log screen displays a list of system events currently logged by the terminal.

Terminal Settings
↓
System Event Log



- To display System Event Log Details for a specific event, select an event and then select the More Details button.
- To clear all System Event Logs, press the Clear All button.

System Information

The System Information screen lets you access these screens.

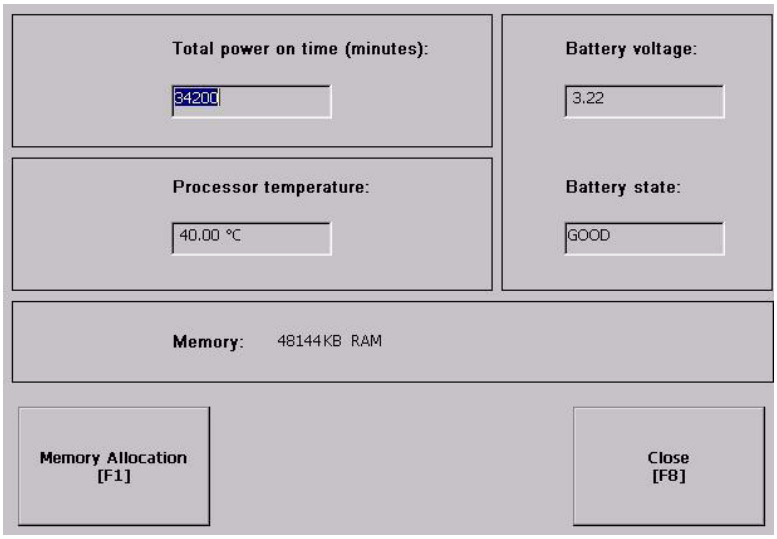
- RSView ME Station information
- Terminal Information

Terminal Settings
↓
System Information
↓
Terminal Information

Terminal Information

The Terminal Information screen displays these details for the terminal.

- Total power on time
- Processor temperature
- Battery voltage and battery state
- Amount of memory on terminal



All fields are read only except for memory allocation. To access details on Memory Allocation, select the Memory Allocation button.

Battery State

Battery State	400 and 600	700 to 1500
Good	Good battery condition	Good battery condition
Failing	Does not have a replaceable battery. Replace terminal.	Low battery. Replace battery.
Bad	N/A	Battery is missing or bad. Replace battery.

Battery Voltage

For PanelView Plus 400 and 600 terminals, the Battery Voltage field indicates the battery state only.

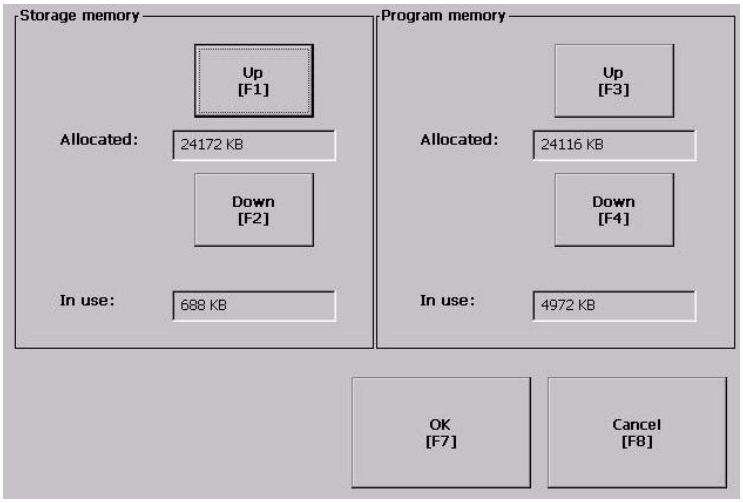
Processor Temperature

For the 400 and 600 terminals, the Processor Temperature shows the temperature of the display.

Memory Allocation

The Memory Allocation screen displays the:

- amount of allocated storage or program memory.
- amount of storage or program memory currently in use.



You can modify the allocation of storage or program memory. Press the Up or Down button to increase/decrease the memory allocation. Each button press changes the allocation by a value of four. If you change the allocation for one type of memory, the other is automatically updated accordingly.

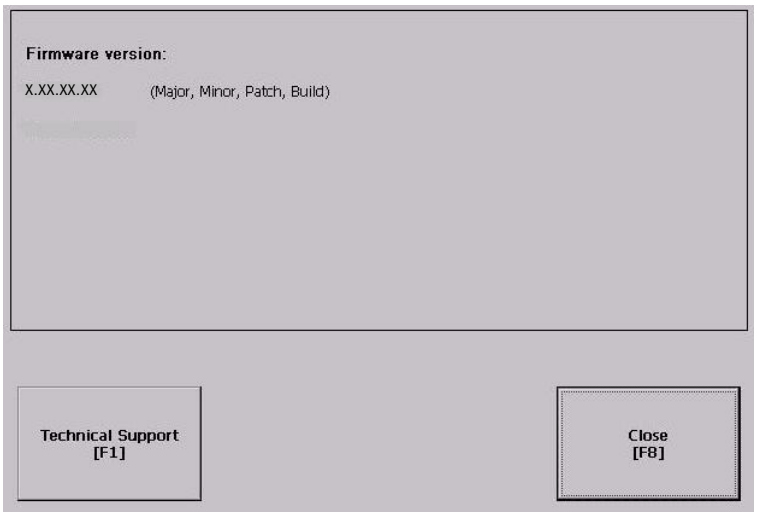
TIP These settings are not retained after a power cycle. Values return to the default settings.

Terminal Settings
↓
System Information
↓
About RSView ME Station

RSView ME Station Information

The About RSView ME Station screen provides access to:

- RSView ME Station firmware number.
- Rockwell Technical Support information.



Time/Date/Regional Settings

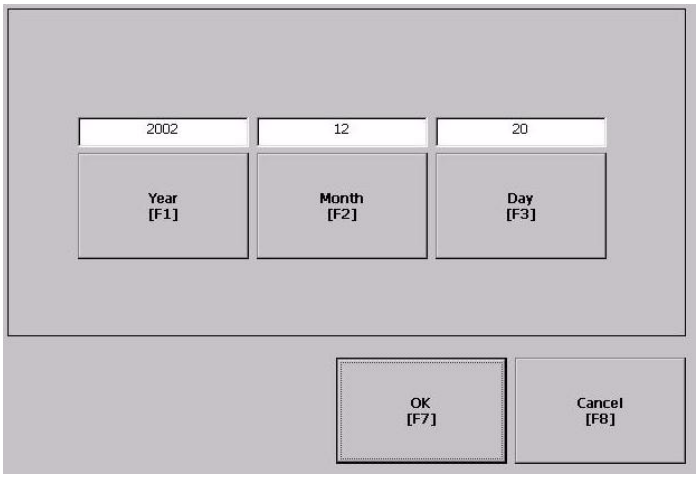
The Time/Date/Regional Settings screen lets you access these screens.

- Date
- Regional settings
- Time
- Time zone

Terminal Settings
↓
Time/Date/Regional Settings
↓
Date

Date

The Date screen shows and configures the current date in separate Year, Month, and Day fields.



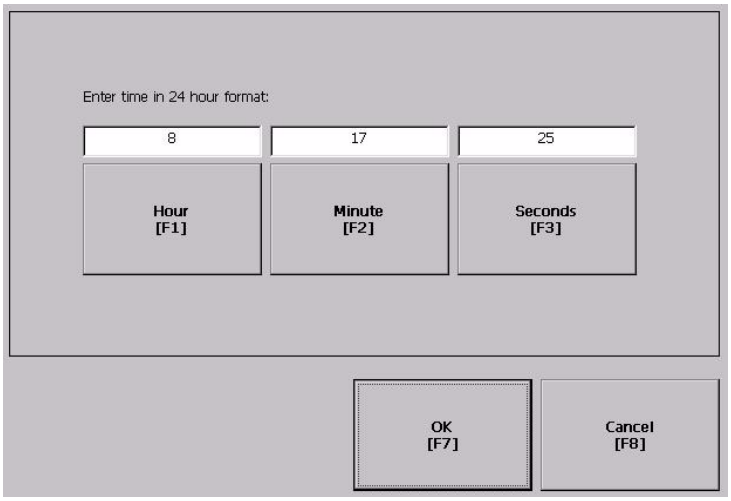
Date Settings

Field	Description	Valid Values
Year	The current year in a four-digit format.	1980…2099
Month	The current month.	1…12
Day	The current day. The day of the month is validated based on the month.	0…31

Terminal Settings
↓
Time/Date/Regional Settings
↓
Time

Time

The Time screen shows and configures the current time in 24-hour format in separate Hour, Minute, and Second fields.



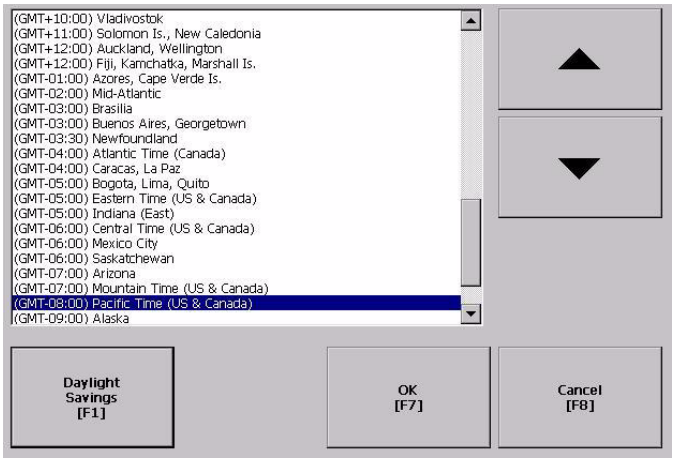
Time Settings

Field	Description	Valid Values
Hour	The current hour in 24-hour format.	0…23
Minute	The current minute in 24-hour format.	0…59
Seconds	The current second in 24-hour format.	0…59

Terminal Settings
↓
Time/Date/Regional Settings
↓
Time Zone

Time Zone

The Time Zone screen shows the current time zone that is installed on the terminal. Time zones are installed as a part of the operating system. Changing the time zone adjusts the current time and date to match the new time zone.



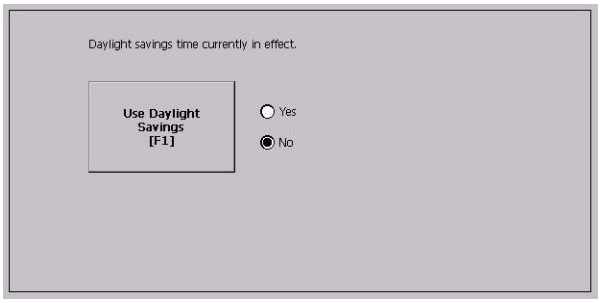
Time Zones

Language	Default Time Zone
English	(GMT -05:00) Eastern Time (US and Canada)
French	(GMT +01:00) Brussels, Copenhagen, Madrid, Paris
German	(GMT +01:00) Amsterdam, Berlin, Bern, Rome, Stockholm, Vienna
Japanese	(GMT +09:00) Osaka, Sapporo, Tokyo

If the selected time zone supports Daylight Savings, you can select the Daylight Savings button.

Daylight Savings

The Daylight Savings screen configures whether daylight savings time is in effect for the current time zone. Daylight Savings is set to Yes for all time zones except for Japanese, which does support daylight savings. Daylight savings changes are not permanently applied until you close the Time Zone screen.



Terminal Settings
↓
Time/Date/Regional Settings
↓
Regional Settings

Regional Settings

The Regional Settings screen lets you access these screens.

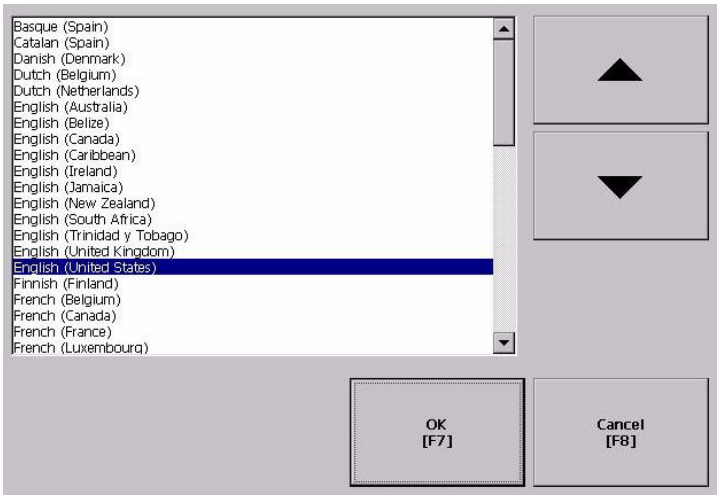
- Language
- Numeric Format
- Long Date Format
- Short Date Format
- Time Format

The current language is shown at the bottom of the Regional Settings screen.

Terminal Settings
↓
Time/Date/Regional Settings
↓
Regional Settings
↓
Language

Language

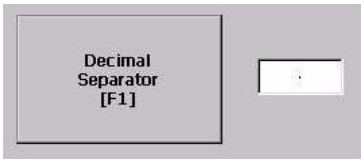
The Language screen lets you select a language that is installed on the terminal. Languages are installed as a part of the operating system.



Terminal Settings
↓
Time/Date/Regional Settings
↓
Regional Settings
↓
Numeric Format

Numeric Format screen

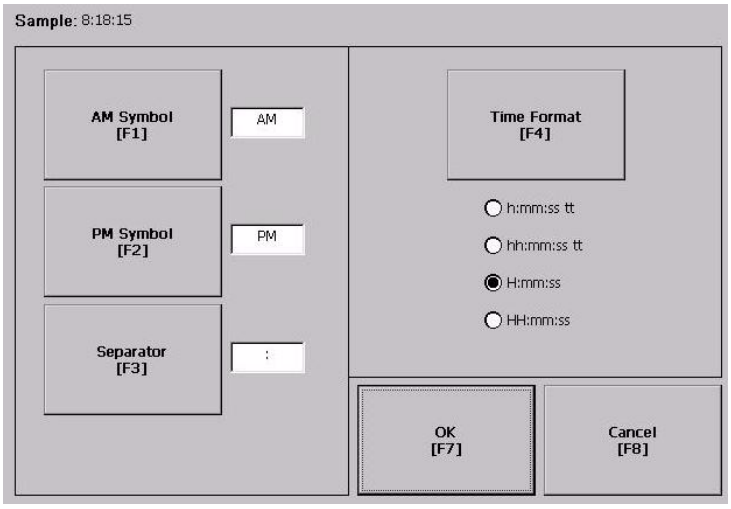
The Numeric Format screen lets you modify the decimal separator used by the current language. The default decimal separator is a period. The field will accept a separator up to three characters.



Terminal Settings
↓
Time/Date/Regional Settings
↓
Regional Settings
↓
Time Format

Time Format

The Time Format screen configures the time format for the current language. A sample of the current time is shown using the currently selected format.



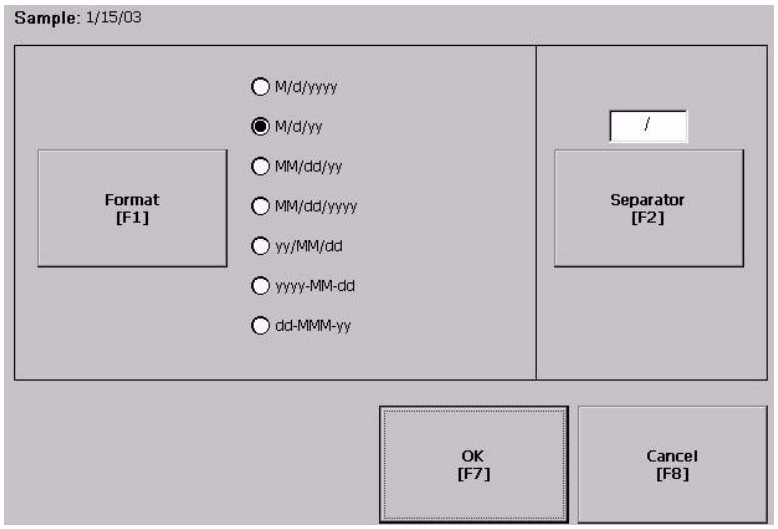
Time Format

Field	Description	Example
Time Format	h:mm:ss tt (default) h = hour, no leading zero tt = AM or PM symbol	7:23:02 AM or 1:13:31 PM 11:43:59 AM
	hh:mm:ss tt hh = hour with leading zero tt = AM or PM symbol	07:23:02 AM or 01:13:31 PM 11:43:59 PM
	H:mm:ss H = hour in 24-hour format, no leading zero	7:03:42 or 1:13:32 23:43:59
	HH:mm:ss HH = hour in 24-hour format with leading zero	07:03:42 or 01:13:22 23:43:59
AM Symbol	Characters to indicate AM. If the time format is set to h:mm:ss tt or hh:mm:ss tt, you can modify the AM symbol.	AM (default) 12 character max.
PM Symbol	Characters to indicate PM. If the time format is set to h:mm:ss tt or hh:mm:ss tt, you can modify the PM symbol.	PM (default) 12 character max.
Separator	Characters that separate fields in time format.	: (default) 3 character max.

Terminal Settings
↓
Time/Date/Regional Settings
↓
Regional Settings
↓
Short Date Format

Short Date Format

The Short Date Format screen configures the short date format used by the current language. A sample of the current date is shown using the currently selected short date format.



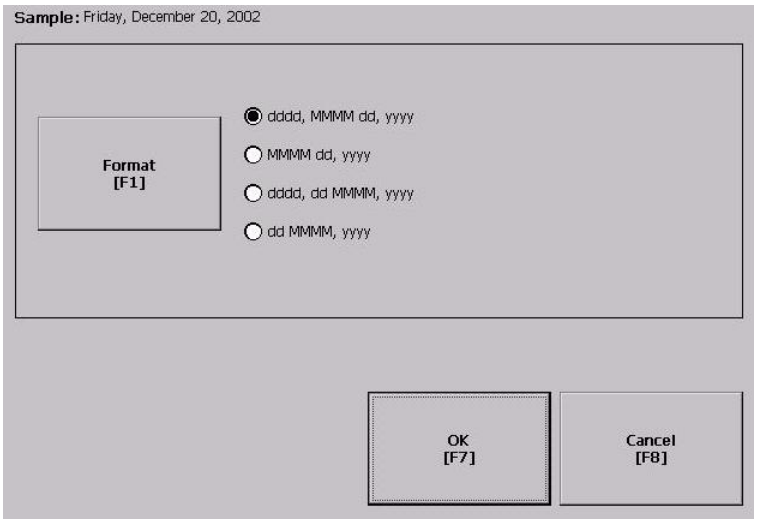
Short Date Format

Field	Short Date Formats	Example
Format	M/d/yyyy (default) M/d/yy MM/dd/yy MM/dd/yyyy yy/MM/dd yyyy-MM-dd dd-MMM-yy	1/2/2003 1/2/03 01/02/03 01/02/2003 03/01/02 2003-01-02 02-Jan-03
Separator	Characters separator for fields in time format. The default separator is either - or / depending on short date format.	- or / (default) 3 character max.

Terminal Settings
↓
Time/Date/Regional Settings
↓
Regional Settings
↓
Long Date Format

Long Date Format

The Long Date Format screen configures the long date format used by the current language. A sample of the current date is shown using the currently selected long date format.



Long Date Format

Field	Short Date Formats	Example
Format	dddd, MMMM, dd, yyyy (default) dddd is name of week day MMMM is name of month dd is two-digit day of month with leading zero yyyy is four-digit year	Monday, January 01, 2003
	MMMM dd, yyyy MMMM is name of month dd is two-digit day of month with leading zero yyyy is four-digit year	January 01, 2003
	dddd, dd MMMM, yyyy dddd is name of week day dd is two-digit day of month with leading zero MMMM is name of month yyyy is four-digit year	Monday, 01 January, 2003
	dd MMMM, yyyy dd is two-digit day of month with leading zero MMMM is name of month yyyy is four-digit year	01 January, 2003

Install and Replace Components

Chapter Objectives

This chapter shows how to install, replace, or upgrade various components of the PanelView Plus terminals.

- Logic module
- RAM and internal compact flash
- Communication module
- Display module
- Battery
- Display module bezel
- Backlight
- Product ID label
- Keypad legend inserts
- External compact flash card

Required Tools

The following tools are required to install and replace components.

- #00, #1, and #2 Phillips screwdriver
- Electrostatic Discharge (ESD) wristband

Precautions

Before installing or replacing any components, disconnect power from the terminal. During installation, take care not to touch any of the exposed electronic components.

WARNING

Disconnect all power from the terminal before installing or replacing any components. Failure to disconnect power may result in electrical shock and/or damage to the terminal.

ATTENTION

Be careful when touching any of the exposed electronic components to prevent damage from electrostatic discharge (ESD).

Work in a static free environment and wear a properly grounded ESD wristband.

Compatibility of Terminal Components

700 to 1500 Terminals Only

When assembling components of a terminal or replacing the internal compact flash in a logic module, the components must be compatible.

To verify compatibility of the internal compact flash with the logic module, you must know what version of RSView ME is running on the terminal.

1. Locate the green label on the back of the logic module to determine the revision level of your terminal.
   - Rev B: Contains RSView ME software, version 3.0
   - Rev C: Contains RSView ME software, version 3.10
   - Rev D, E: Contains RSView ME software, version 3.20
   - Rev F: Contains RSView ME software, version 4.0
2. Determine the series of the internal compact flash and logic module.

The table matches the correct series of the internal compact flash card with the correct series of the logic module for the terminals. The logic module is available with or without memory installed.

Component Compatibility for PanelView Plus Terminals

Terminal Revision	Logic Module 2711P-RPx Compatibility	Internal Compact Flash 2711P-RW1, 2, 3	RSView ME Software Version
Rev B [1]	**Series A**: 2711P-RPx/A	**Series B**: 2711P-RWx/B	3.0
Rev C	**Series B**: 2711P-RPx/B	**Series C**: 2711P-RWx/C	3.10
		Series D: 2711P-RWx/D **Series E:** 2711P-RWx/E	3.20
		Series F: 2711P-RWx/F	4.0
Rev D	**Series C**: 2711P-RPx/C **Series D**: 2711P-RPx/D	**Series D**: 2711P-RWx/D **Series E**: 2711P-RWx/E	3.20
		Series F: 2711P-RWx/F	4.0
Rev E	**Series D**: 2711P-RPx/D **Series E**: 2711P-RPx/E	**Series D**: 2711P-RWx/D **Series E**: 2711P-RWx/E	3.20
		Series F: 2711P-RWx/F	4.0
Rev F	**Series D**: 2711P-RPxH/D **Series E**: 2711P-RPxH/E	**Series D**: 2711P-RWx/D **Series E**: 2711P-RWx/E	3.20
		Series F: 2711P-RWx/F	4.0

[1] When upgrading RSView ME software, version 3.0 to 3.10 or later, the Firmware Upgrade Kit is required.

RSView ME terminals are compatible with .MER applications that are the same version or a previous version. For example, RSView ME 3.20 terminals can run .MER applications for RSView ME software, versions 3.0, 3.10, and 3.20.

Install RAM or Internal Compact Flash

700 to 1500 Terminals Only

The logic module is available with or without RAM/internal compact flash installed. If RAM and internal compact flash are ordered as separate components, you must install the memory before attaching the logic module to the display module.

To install/replace RAM or internal compact flash:

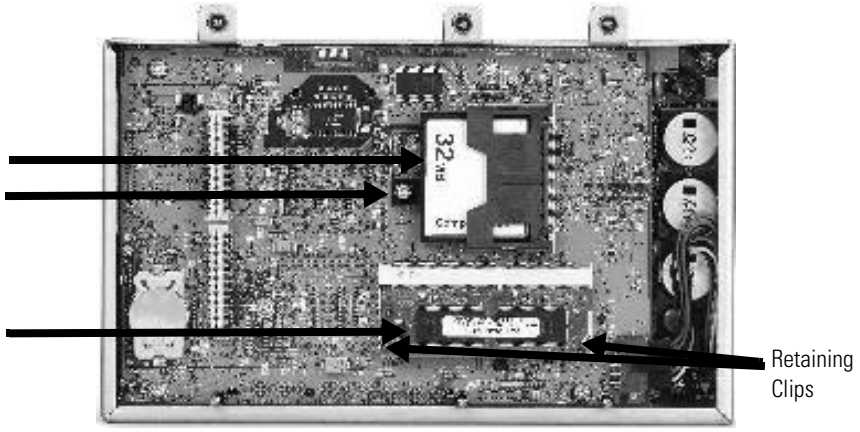
1. Remove power from the terminal.
2. Place the terminal, display side down, on a flat stable surface.
3. Loosen the six captive screws that secure the logic module.
4. Carefully lift the logic module away from the terminal and turn over to expose the circuit board.

ATTENTION

Wear a properly grounded ESD wristband before touching any of the electronic components in the logic module.

Skip Steps 5 to 6 if not replacing RAM.

5. Locate the RAM module on the circuit board, pull the metal retaining clips away from the module, and slide out the RAM module.



6. Insert the new RAM module at a 45° angle and snap down.

Skip Steps 7 to 11 if not replacing internal compact flash.

7. Unscrew and remove the retaining clip that secures the internal compact flash card.
8. Pull out the internal compact flash card.
9. Insert the new internal compact flash card.
10. Reattach the retaining clip.
11. Attach the logic module by aligning the two connectors on the bottom of module with the connectors on the display module.
12. Push down on the logic module until firmly seated.
13. Tighten the six captive screws that secure the logic module to a torque of 0.68 Nm (6 to 8 lb-in).

Install or Replace the Logic Module

700 to 1500 Terminals Only

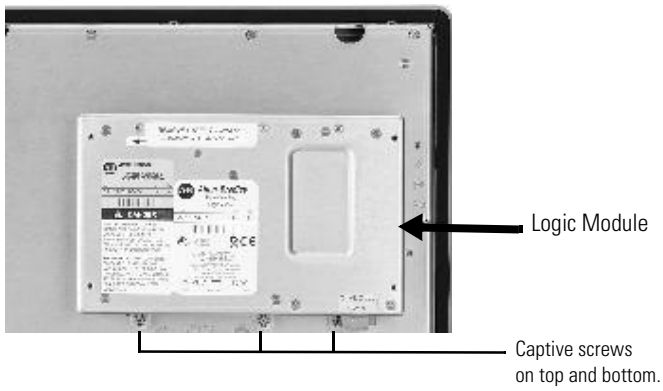
This section shows how to install and replace the logic module. If the display module and logic module are ordered as separate components, attach the logic module to the display module before panel installation.

The logic module is available with or without RAM and internal compact flash installed. If ordered as separate components, you must install the memory before attaching the logic module to the display module.

To install a logic module:

1. Disconnect power from the terminal.
2. Set the terminal, display side down, on a clean, flat, stable surface to prevent scratches, if the terminal is removed from panel.
3. Position the logic module over the back of the display module until the two connectors on the bottom of the logic module align with the connectors on the display module.

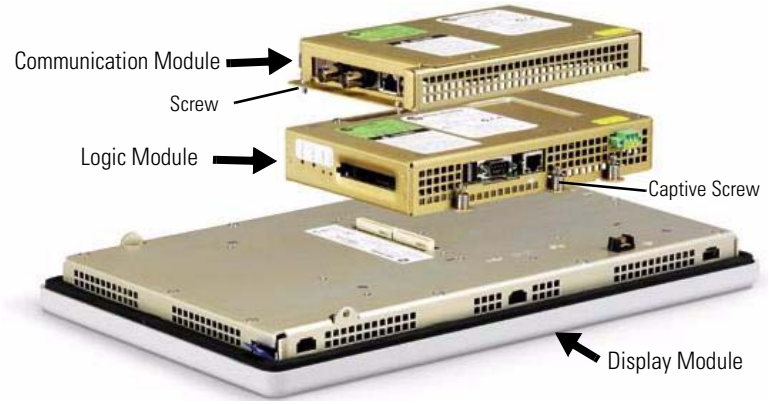
4. Push down on the logic module until firmly seated.
5. Tighten the six captive screws that secure the logic module to the display module to a torque of 0.68 Nm (6 to 8 lb-in).



Before replacing the logic module, you must remove the communication module, if attached. You will also need to remove the Internal RAM and compact flash from the logic module to reuse in the new logic module.

To replace the logic module:

1. Disconnect power from the terminal.
2. Disconnect all power and communication cables.
3. Set the terminal, display side down, on a clean, flat, stable surface to prevent scratches, if the terminal is removed from panel.
4. Remove the four screws that attach the communication module (if attached) to the logic module and arefully lift the communication module away from the logic module.



5. Loosen the six captive screws that secure the logic module to the display module.
6. Carefully lift the logic module away from the back of the display module.

ATTENTION

Wear a properly grounded ESD wristband before touching any of the electronic components in the logic module.

7. If reusing the memory in the new logic module:
   - Remove the RAM and internal compact flash from the logic module.
   - Insert the RAM and internal compact flash in the new logic module.
8. Install the new logic module.
9. Attach the communication module, if necessary.

Install or Replace a Communication Module

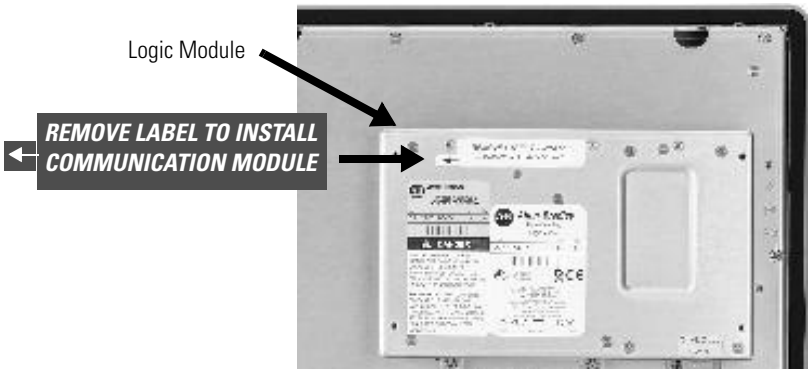
This section shows how to install and replace a communication module. The communication module installs over the logic module. The communication modules are available as separate catalog numbers for specific communication protocols. The installation is the same for all modules regardless of the communication type.

Install/Replace Communication Module on 700 to 1500 Terminals

TIP The logic module must be attached to the display module before you attach the communication module.

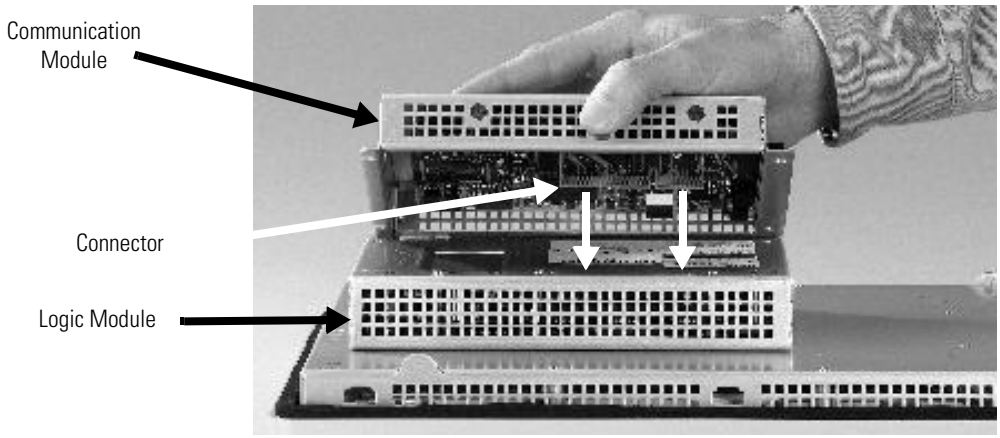
To install a communication module:

1. Disconnect power from the terminal.
2. Set the terminal, display side down, on a clean, flat, stable surface to prevent scratches if the terminal is removed from panel.
3. Remove the label covering the communication module connector on the logic module.

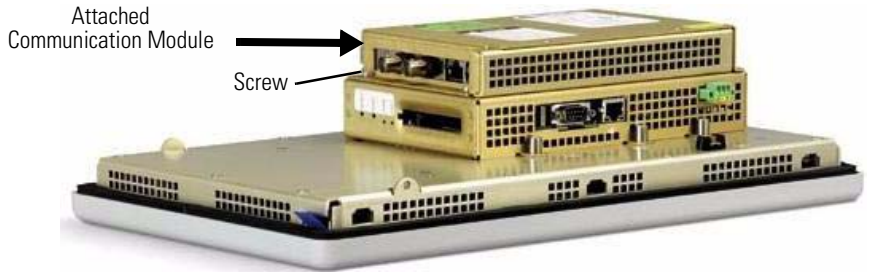


4. Position the communication module over the logic module so that the connectors on bottom of module align with connectors on the logic module.

To prevent ESD between the modules, allow the communication module to touch the logic module before making connection.



5. Push down on the communication module until the connectors are firmly seated.
6. Tighten the four screws that secure the communication module to the logic module to a torque of 0.68 Nm (6 to 8 lb-in).



To replace a communication module:

1. Disconnect power from the terminal.
2. Disconnect the communication cables from the module.

WARNING

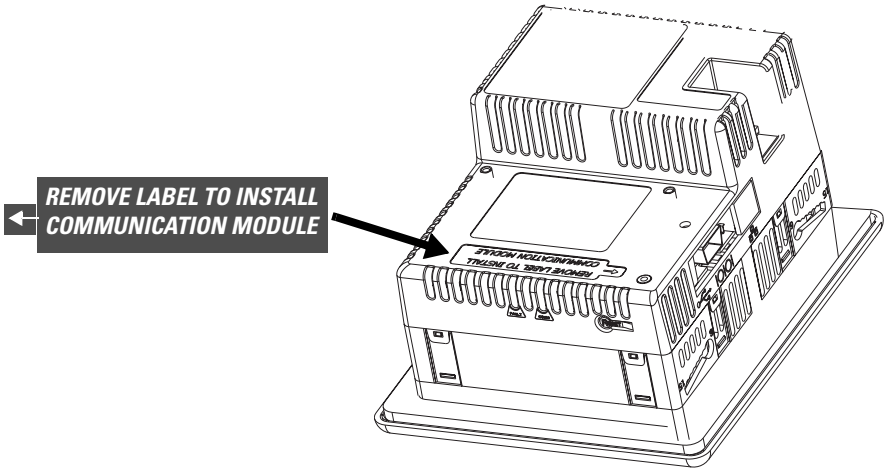
Do not connect or disconnect any communication cable with power applied to this device or any device on the network. An electrical arc could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.

3. Remove the four screws that secure the communication module to the logic module.
4. Carefully lift the communication module away from the logic module and set aside.
5. Install the new communication module.

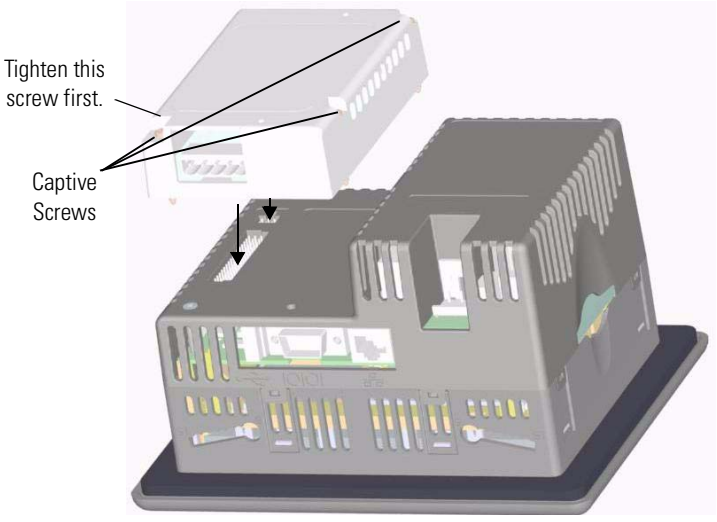
Install or Replace Communication Module on 400/600 Terminals

To install a communication module:

1. Disconnect power from the terminal.
2. Set the terminal, display side down, on a clean, flat, stable surface.
3. Remove the label covering the connectors on the base unit of the terminal.



4. Position the communication module over back of the terminal so that the connector on bottom of communication module align with the connector on the base unit.



5. Push down on the communication module until the connector is firmly seated.
6. Tighten the three captive screws that secure the module to the terminal, starting with the bottom, left screw on the module. Tighten screws to a torque of 0.34 to 0.45 Nm (3 to 4 lb-in).

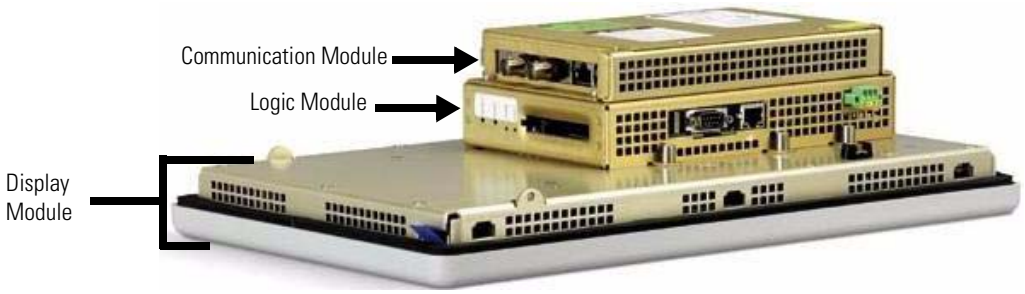
To replace a Communication module:

1. Disconnect power from the terminal.
2. Disconnect the communication cables from the module.
3. Loosen the three screws that secure the communication module to the terminal.
4. Carefully lift the communication module away from the terminal and set aside.
5. Install the new communication module.

Replace the Display Module

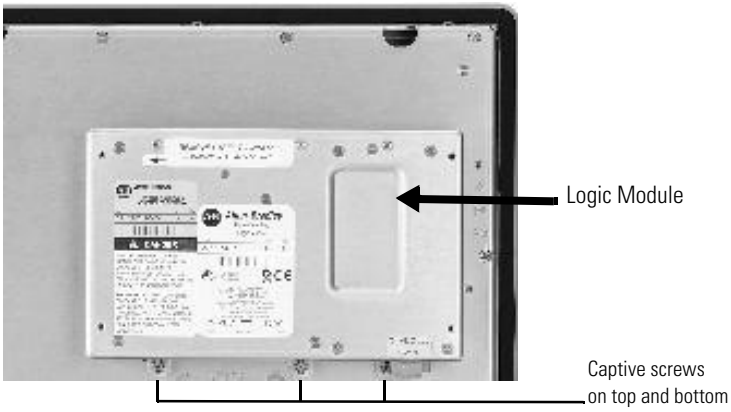
700 to 1500 Terminals Only

This section shows how to replace the display module. It is necessary to remove the communication module from the logic module to perform this operation.



To replace the display module:

1. Disconnect power from the terminal.
2. Remove the terminal from the panel.
3. Detach the communication module (if attached) from the logic module by removing the four screws.
4. Loosen the six captive screws that attach the logic module to the display module.



5. Carefully lift the logic module from the terminal.
6. Set the display module aside.

7. Position the new logic module over the new display module so that the connectors align.

8. Push down on the logic module until firmly seated.

9. Tighten the six captive screws that secure the logic module to the display module to a torque of 0.68 Nm (6 to 8 lb-in).

10. Attach the communication module (if necessary) and tighten the four screws to a torque of 0.68 Nm (6 to 8 lb-in).

Replace the Battery
700 to 1500 Terminals Only

A lithium battery is used by the real-time clock and static RAM; it is not used for application backup or retention. The clock module has a life expectancy of two years without power.

WARNING

When you connect or disconnect the battery an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that power is removed and the area is nonhazardous before proceeding. Replace the battery only with the indicated catalog number.

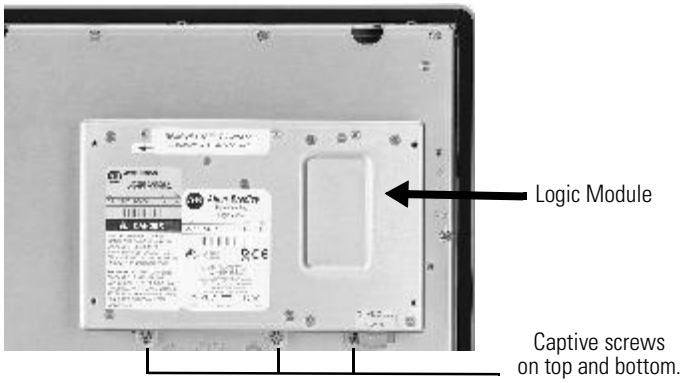
For Safety information on the handling of lithium batteries, including handling and disposal of leaking batteries, see Guidelines for Handling Lithium Batteries, publication AG 5-4.

Do not dispose of battery in a fire or incinerator. Dispose of used batteries in accordance with local regulations.

Store batteries in a cool, dry environment. We recommend 25 °C with 40…60% relative humidity. You may store batteries for up to 30 days between -45 to 85 °C (-49…185 °F), such as during transportation. To avoid possible leakage, do not store batteries above 60 °C (140 °F)for more than 30 days.

To replace the battery:

1. Disconnect power from the terminal.
2. Place the terminal, display side down, on a flat stable surface.
3. Detach the communication module (if attached) from the logic module by removing the four screws.
4. Loosen the six captive screws that attach the logic module to the display module.

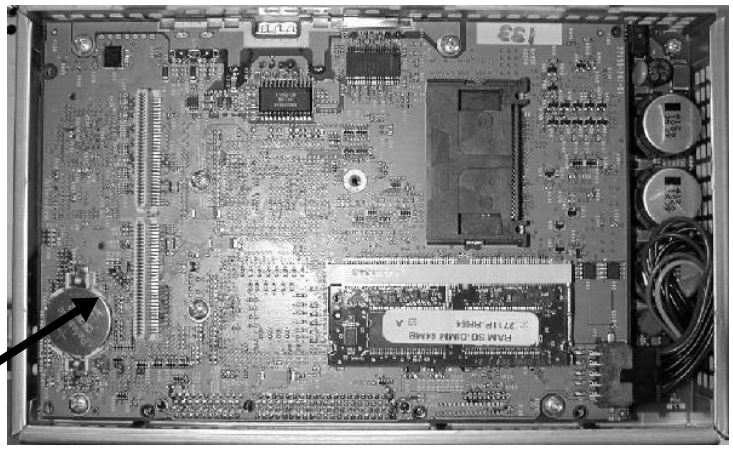


5. Carefully lift the logic module away from the terminal and flip over to expose the circuit board.

ATTENTION

Wear a properly grounded ESD wristband before touching any of the electronic components in the logic module.

6. Locate the battery on the circuit board.



7. Remove the battery by lifting up the side of the battery.
8. Insert the new battery.
9. Attach the logic module by aligning the two connectors on the bottom of the module with the connectors on the terminal.

10. Push down on the logic module until firmly seated.
11. Tighten the six captive screws that secure the logic module to a torque of 0.68 Nm (6 to 8 lb-in).
12. Attach the communication module (if necessary) and tighten the four screws to a torque of 0.68 Nm (6 to 8 lb-in).

Replace the Bezel

700 to 1500 Terminals Only

Remove the Display Module Bezel

It is not necessary to remove the logic module or communication module before removing the bezel, except for the PanelView Plus 700.

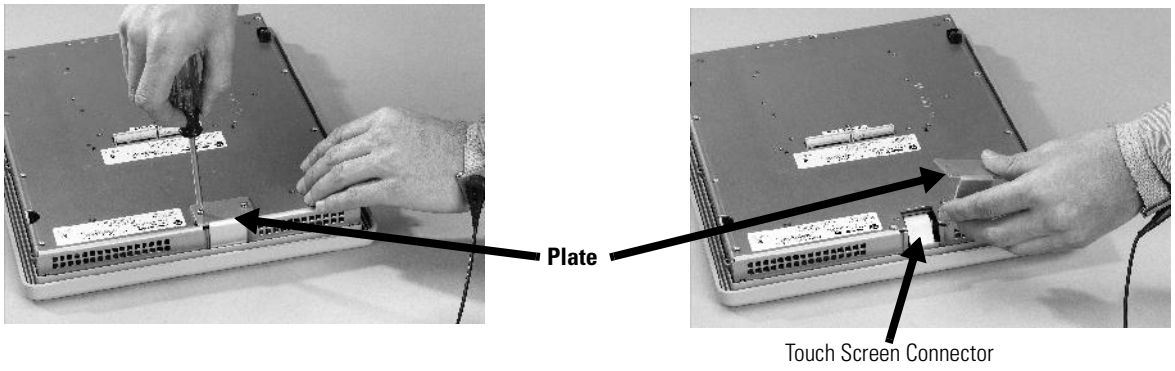
To replace the display module bezel:

1. Disconnect power from the terminal.
2. Set the terminal, display side down, on a flat stable surface.

ATTENTION

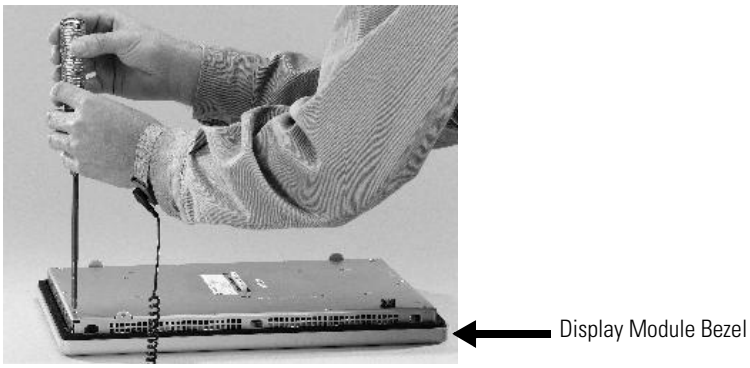
Wear a properly grounded ESD wristband before touching any of the electronic components in the logic module.

3. On touch screen only terminals, remove the two screws that secure the small metal plate to the back of the display module.
4. Disconnect the (touch screen) connector.

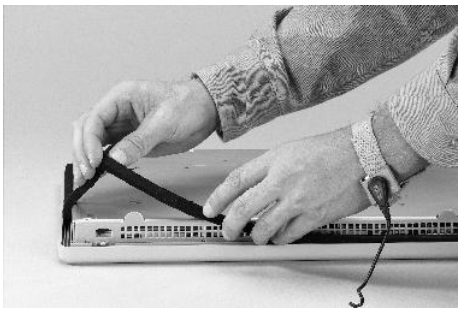


5. Remove the screws from the back of the display module.

   The number of screws varies for each terminal type.

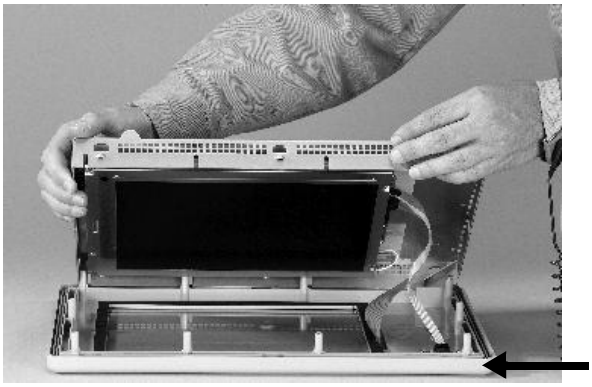


6. Remove the sealing gasket.



7. Lift the back of the display module away from the bezel.

   Work on a clean, flat, stable surface to protect the display from debris, scratches and damage.



8. Detach all connectors (maximum of three).

   The number of connectors varies by model.
   - IrDa connector (if present)
   - Function key connector
   - Touch screen connector

9. Set the bezel aside.

Replace the Display Module Bezel

To replace the display module bezel:

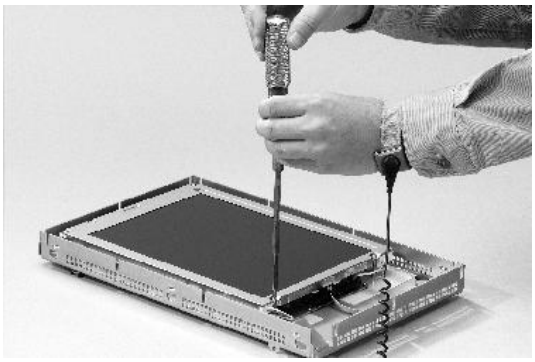
1. Make sure the bezel is free of lint and marks before attaching.
2. Attach the connectors.
   The number of connectors varies by model.
   - IrDa connector (if present)
   - Function key connector
   - Touch screen connector
3. Place the back of the display module over the bezel.
   Be careful not to pinch any of the cables. Allow the touch screen connector to extend out of the access opening.
4. Attach the touch screen connector.
5. Replace the sealing gasket.
6. Attach the screws that secure the display module to the bezel and tighten to a torque of 1.35 to 1.58 Nm (12 to 14 lb-in).
7. On touch screen terminals, reattach the small metal plate to the back of the display module using two screws and torque to 0.68 Nm (6 to 8 lb-in).

Replace the Backlight
700 to 1500 Terminals Only

This section shows how to replace the backlight for the 700, 1000, 1250, and 1500 terminals. The 1250 high-bright terminals do not have a replaceable backlight.

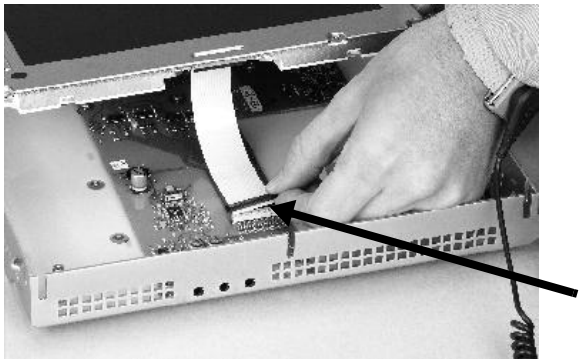
To replace the backlight:

1. Disconnect power from the terminal.
2. Remove the display module bezel.
3. Remove the four screws that secure the LCD Display.



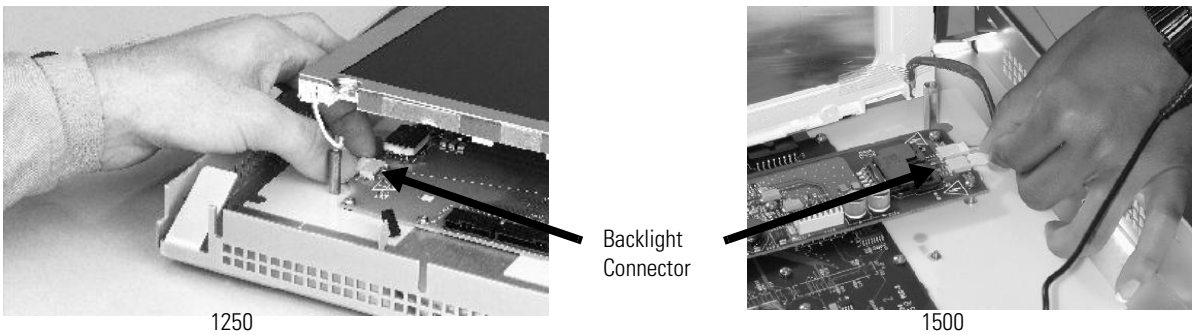
4. Lift the LCD display and detach the display connector from the circuit board.

   The location of the connector varies by model.



5. Detach the backlight connectors from the circuit board.

   The 1250 has one or two backlight connectors depending on the series of the display. The 1500 has four backlight connectors.

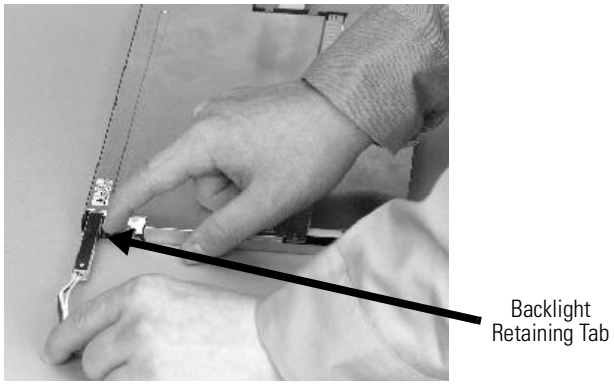


1250 1500

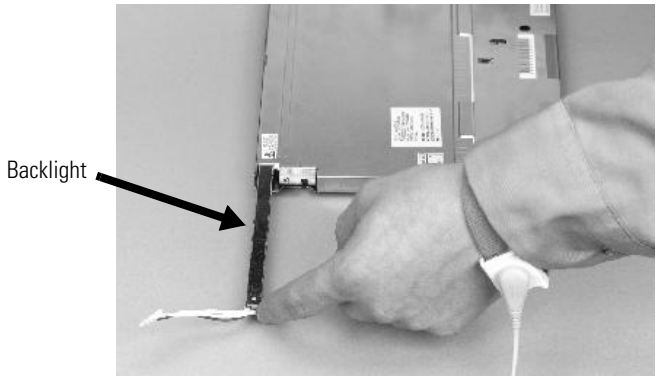
For PanelView Plus 700 and 1000

Work on a clean, flat, stable surface to protect the display from debris, scratches, and damage.

6. Press the retaining tab that secures the backlight and then pull out the backlight.



7. Insert the new backlight.



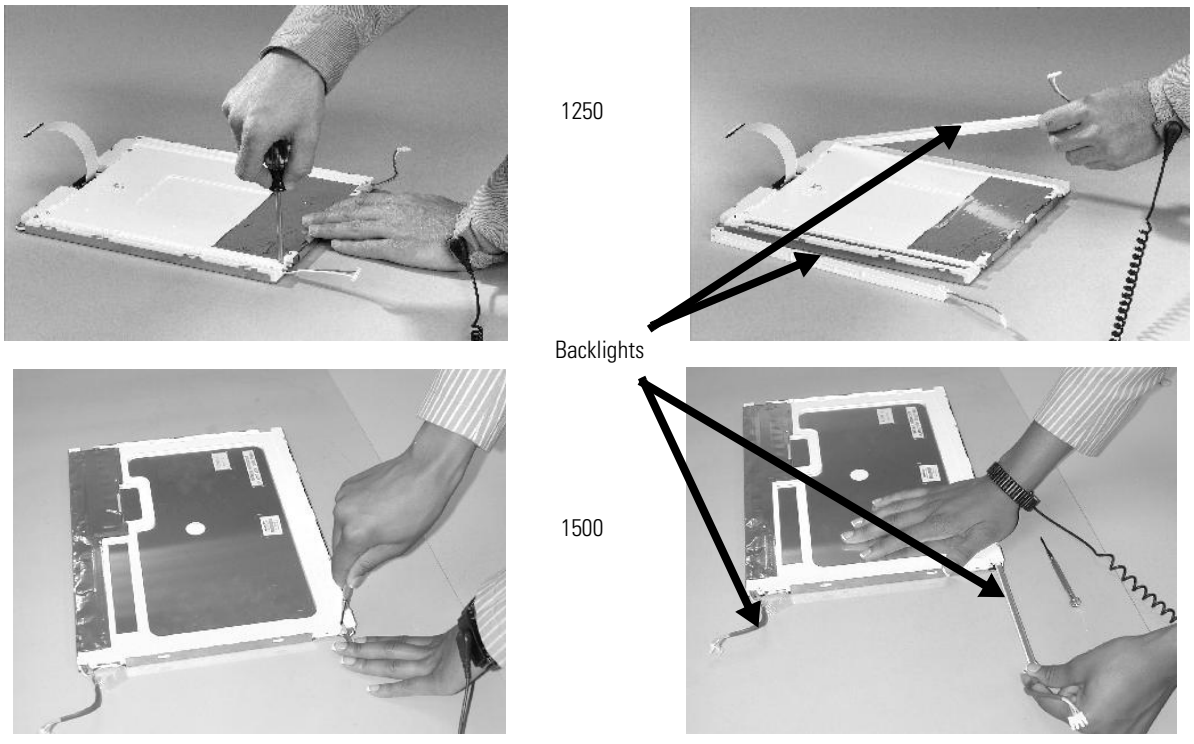
For PanelView Plus 1250 and 1500

- The 1250 Series A and B displays have two backlights and use cat. no. 2711P-RL12C backlight replacement.
- The 1250 Series C displays have only one backlight and use cat. no. 2711P-RL12C2 backlight replacement.
- The 1500 Series B displays have four backlights and use cat. no. 2711P-RL15C backlight replacement.

  Work on a clean, flat, stable surface to protect the display from debris, scratches and damage.

8. Remove the screws that secure the backlights and remove the backlights.

- The two backlights for the 1250 Series A and B displays are each secured with two screws.
- The single backlight for the 1250 Series C displays is secured with one screw.
- For the 1500 Series B displays, remove the tape and then remove the backlights.



9. Insert the new backlights and secure with the same screws.

Torque the screws to 0.117 Nm (1.04 lb-in).

10. Reattach the LCD display connector to the circuit board.

11. Reattach the backlight connector to the circuit board.

12. Secure the LCD display by attaching the four screws and tighten to the specified torque.

Screw Size	Torque
#4	0.68 Nm (6 to 8 lb-in)

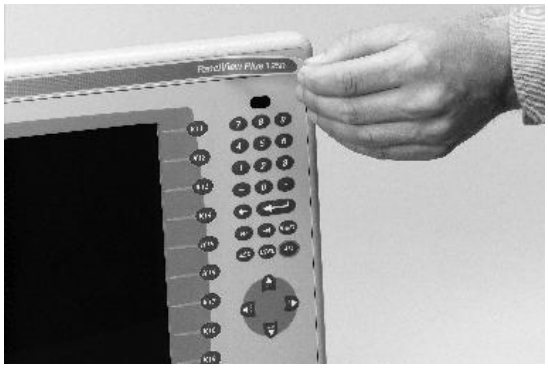
13. Replace the display module bezel.

Remove the Product ID Label

If you ordered a terminal with a label, you can remove the label and attach your own label.

To remove the product ID label:

1. Remove the Allen-Bradley label using your fingers or a tweezers.



2. Clean area with damp cloth and isopropyl alcohol.

3. Remove adhesive backing of OEM label and affix over area where Allen-Bradley label was located.

Replace the Keypad Legend Inserts

This section shows how to replace the legend inserts in the keypad terminals. The legend strips are available as separate catalog numbers for each keypad terminal, except for the PanelView Plus 400 terminal, which does not support replaceable legend strips. One side of the legend strips have the default key legends and the other side is blank for creating custom legends.

Replace the Keypad Legend Inserts on the 600 Terminal

The legend inserts for function keys F1…F10 are accessible from the back on the unit and can be replaced with the terminal mounted in the enclosure.

To replace the F1…F10 function key legends:

1. From the rear of the unit, pull the legend strips out from the slots on the lower side of the terminal.
2. Slide the new insert into the same slot until only the end tab is visible.

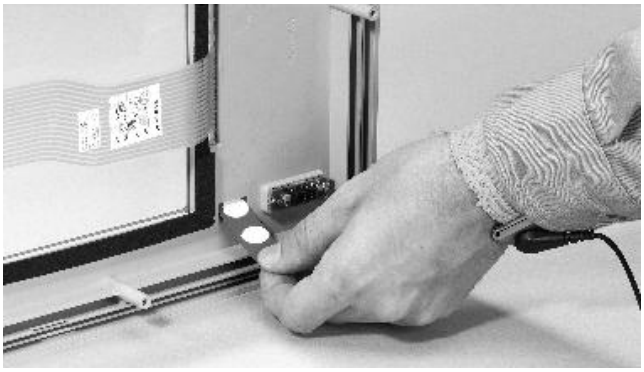
600 Terminal

Replace the Keypad Legend Inserts on the 700 to 1500 Terminals

The F1-F*xx* and K1-K*xx* legend inserts on the PanelView Plus 700 to 1500 terminals are accessible when the display module bezel is removed.

To replace the F1-F*xx* or K1-K*xx* function key legends:

1. Remove power from the terminal.
2. Remove the display module bezel.
3. Pull the legend inserts out from the slots on the bezel.



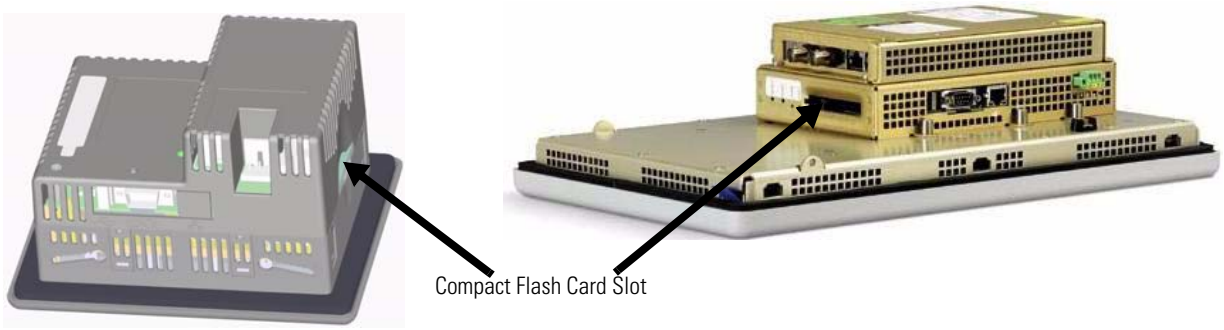
4. Slide the new legend strips into the same slots until only the end tab is visible.
5. Replace the display module bezel.

Use an External Compact Flash Card

All of the terminals have a compact flash card slot that supports Type I compact flash cards. These cards are available in different memory sizes.

The orientation of the card slot on the 700 to 1500 terminals varies depending on the series of the logic module.

Compact Flash Card Slot

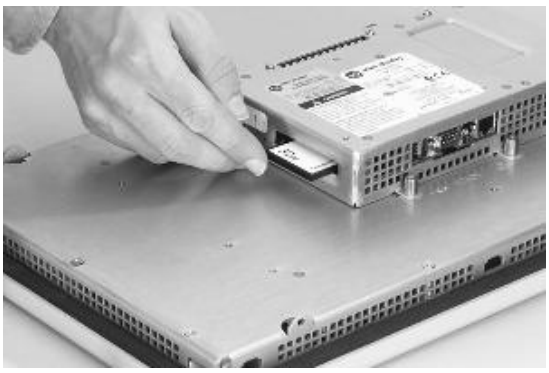


Insert a Compact Flash Card

Insert the card in the compact flash card slot of the terminal until firmly seated.

400 and 600 Terminals

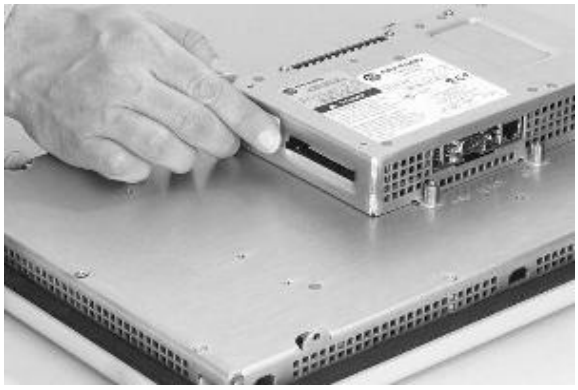
700 to 1500 Terminals



Remove a Compact Flash Card

Press the Eject button on the logic module. When the button pops out, press it again to release the card. The location of the button varies depending on the series of the logic module.

The PanelView Plus 400 and 600 terminals do not have an eject button. Simply secure edge of card with fingers and pull card away from slot.



Terminal Connections

Chapter Objectives

This chapter provides network and device connections for the terminals.

- Wiring and safety guidelines
- Logic controller cable charts
- Communication port isolation
- USB ports
- Serial connections on base unit
- Ethernet (onboard communications)
- DH485/DH+/RIO communications module
- ControlNet communications module
- DeviceNet communications module

Wiring and Safety Guidelines

Use publication NFPA 70E, Electrical Safety Requirements for Employee Workplaces, IEC 60364 Electrical Installations in Buildings or other applicable wiring safety requirements for the country of installation when wiring the devices. In addition to the NFPA guidelines.

- Route communication cables to terminal by a separate path from incoming power.

IMPORTANT Do not run signal wiring and power wiring in the same conduit.

- Cross power and communication lines at right angles if they must cross.

  Communication lines can be installed in the same conduit as low-level dc I/O lines (less than 10V).

- Shield and ground cables appropriately to avoid electromagnetic interference (EMI).

  Grounding minimizes noise from EMI and is a safety measure in electrical installations.

For more information on grounding recommendations, refer to the National Electrical Code published by the National Fire Protection.

Logic Controller Cable Charts

The charts provide a summary of terminal connections to controllers and network interface modules.

Runtime Communication Cables - To Controller

PanelView Plus Terminals to SLC Controllers

		Cables: PanelView Plus to SLC Controllers				
Protocol	**PanelView Plus Comm Port**	**SLC-500, 5/01, 5/02 CH1 RJ45 (DH-485)**	**SLC-5/03, 5/04, 5/05 CH0 (9-pin RS-232) (DF1 or DH-485)**	**SLC 5/03 CH1 (RJ45) (DH-485)**	**SLC 5/04 CH1 (DH+)**	**SLC 5/05 CH1 (ENET)**
DF1 (any)	RS-232 (DF1) Comm Port (9-pin) PanelView Plus 400 to 1500 2711P-RN22C	N/A	2711-NC13 (16ft/5m) 2711-NC14 (32ft/10m) 2706-NC13 (10ft/3m)	N/A	N/A	N/A
DH-485 (any)	RS-232 (DH-485) Comm Port (9-pin) PanelView Plus 400 to 1500 2711P-RN22C	Use AIC+ Module (1761-NET-AIC) Connect to Port 1 or 2	2711-NC13 (16ft/5m) 2711-NC14 (32ft/10m) 2706-NC13 (10ft/3m)	Use AIC+ Module (1761-NET-AIC) Connect to Port 1 or 2	N/A	N/A
	DH-485 Communication Port PanelView Plus 400 and 600 2711P-xxx3xx, 2711P-RN3	1747-C10 (6ft/2m) 1747-C11 (0.3m/1ft) 1747-C20 (20ft/6m)	Use AIC+ Module (1761-NET-AIC) Connect to Port 3	1747-C10 (6ft/2m) 1747-C11 (0.3m/1ft) 1747-C20 (20ft/6m)	N/A	N/A
	DH-485 Communication Port PanelView Plus 700 to 1500 2711P-xxx6xx, 2711P-RN6	1761-CBL-AS03 (10ft/3m) 1761-CBL-AS09 (30ft/9m)	Use AIC+ Module (1761-NET-AIC) Connect to Port 3	1761-CBL-AS03 (10ft/3m) 1761-CBL-AS09 (30ft/9m)	N/A	N/A
ControlNet xxx15xx	ControlNet Communication Port PanelView Plus 400 and 600 2711P-RN15C PanelView Plus 700 to 1500 2711P-xxx15xx, 2711P-RN15S	N/A	1747-KFC15A or 1747-SCRNR/A Module with ControlNet cable			
DeviceNet xxx10xx	DeviceNet Communication Port PanelView Plus 400 and 600 2711P-RN10C PanelView Plus 700 to 1500 2711P-RN10H	N/A	Use 1747-SDN Module with DeviceNet Cable			
EtherNet/IP (any except xxx5xx)	EtherNet/IP Comm Port PanelView Plus 400 to 1500 (except 2711P-xxx5xx)	N/A	Use 1761-NET-ENI Module with Ethernet Cable	N/A	N/A	2711P-CBL-EX04 Ethernet Crossover Cable [1]
Remote I/O xxx1xx xxx6xx	Remote I/O Communication Port PanelView Plus 400 to 1500 2711P-xxx1xx, -xxx6xx, 2711P-RN1, 2711P-RN6	SLC 5/02 only use 1747-SN with shielded twinaxial cable (1770-CD)	Use 1747-SN Module with shielded twinaxial cable (1770-CD)			
DH+ xxx6xx xxx8xx	DH+ Communication Port PanelView Plus 400 to 1500 2711P-xxx6xx, -xxx8xx, 2711P-RN6, 2711P-RN8	N/A	N/A	N/A	Shielded twin axial cable (1770-CD)	N/A

(1) PanelView Plus EtherNet/IP direction connection to SLC 5/05 requires hub or crossover cable listed.

PanelView Plus Terminals to PLC-5 and MicroLogix Controllers

		Cables: PanelView Plus to PLC-5 and MicroLogix Controllers		
Protocol	**PanelView Plus Comm Port**	**PLC-5, PLC-5C, PLC-5E CH0 (25-pin RS-232) (DF1)**	**MicroLogix 1500LRP CH1 (9-pin RS-232) (DF1 or DH-485)**	**MicroLogix 1000, 1200, 1500LSP CH0 (8-pin Mini DIN) (DF1 or DH-485)**
DF1 (any)	RS-232 (DF1) Comm Port (9-pin) PanelView Plus 400 to 1500 2711P-RN22C	2711-NC13 (16ft/5m) 2711-NC14 (32ft/10m) 2706-NC13 (10ft/3m) (9-to-25 pin adapter required)	2711-NC13 (16ft/5m) 2711-NC14 (32ft/10m) 2706-NC13 (10ft/3m)	2711-NC21 (16ft/5m) 2711-NC22 (49ft/15m) (null modem not required) (1)
DH-485 (any)	RS-232 (DH-485) Comm Port (9-pin) PanelView Plus 400 to 1500 2711P-RN22C	N/A	2711-NC13 (16ft/5m) 2711-NC14 (32ft/10m) 2706-NC13 (10ft/3m)	2711-NC21 (16ft/5m) 2711-NC22 (49ft/15m) (null modem not required) (1)
	DH-485 Communication Port PanelView Plus 400 to 1500 2711P-xxx3xx, -xxx6xx, 2711P-RN3, 2711P-RN6	N/A	N/A	Use AIC+ Module (1761-NET-AIC) Connect to Port 3
ControlNet xxx15xx	ControlNet Communication Port PanelView Plus 400 and 600 2711P-RN15C PanelView Plus 400 to 1500 2711P-xxx15xx, 2711P-RN15S	To PLC-5C with ControlNet cable	N/A	N/A
DeviceNet	DeviceNet Communication Port PanelView Plus 400 and 600 2711P-RN10C PanelView Plus 700 to 1500 2711P-RN10H	Use 1771-SDN Module with DeviceNet Cable	N/A	N/A
EtherNet/IP (any except xx5xx)	EtherNet/IP Comm Port PanelView Plus 400 to 1500 (except 2711P-xxx5xx)	To PLC-5E with Ethernet cable	Use 1761-NET-ENI Module with Ethernet cable	
Remote I/O xxx1xx xxx6xx	Remote I/O Communication Port PanelView Plus 400 to 1500 2711P-xxx1xx, -xxx6xx, 2711P-RN1, 2711P-RN6	Shielded twinaxial cable (1770-CD)	N/A	N/A
DH+ xxx6xx xxx8xx	DH+ Communication Port PanelView Plus 400 to 1500 2711P-xxx6xx, -xxx8xx, 2711P-RN6, 2711P-RN8	Shielded twinaxial cable (1770-CD)	N/A	N/A

(1) AIC+ Module recommended for isolation purposes when PanelView and controller are not on same power supply.

PanelView Plus Terminals to Logix Controllers

		Cables: PanelView Plus to Logix Controllers		
Protocol	**PanelView Plus Comm Port**	**ControlLogix CH0 (9-pin RS-232) (DF1)**	**CompactLogix CH0 (9-pin RS-232) (DF1 or DH-485)**	**FlexLogix CH0 (9-pin RS-232) (DF1)**
DF1 (any)	RS-232 (DF1) Comm Port (9-pin) PanelView Plus 400 to 1500 2711P-RN22C	2711-NC13 (16ft/5m) 2711-NC14 (32ft/10m) 2706-NC13 (10ft/3m)		
DH-485 (any)	RS-232 (DH-485) Comm Port (9-pin) PanelView Plus 400 to 1500 2711P-RN22C	N/A	2711-NC13 (16ft/5m) 2711-NC14 (32ft/10m) 2706-NC13 (10ft/3m)	
	DH-485 Communication Port PanelView Plus 400 -1500 2711P-xxx3xx, -xxx6xx, 2711P-RN3, 2711P-RN6	N/A	Use AIC+ Module (1761-NET-AIC) Connect to Port 3	N/A
ControlNet xxx15xx	ControlNet Communication Port PanelView Plus 400 and 600 2711P-RN15C PanelView Plus 700 to 1500 2711P-xxx15xx, 2711P-RN15S	Use 1756-CNB Module with ControlNet cable	1769-L35C with ControlNet cable	Use 1788-CNC or 1788-CNF Card with ControlNet cable
DeviceNet	DeviceNet Communication Port PanelView Plus 400 and 600 2711P-RN10C PanelView Plus 700 to 1500 2711P-RN10H	Use 1756-DNB Module with DeviceNet Cable	Use 1769-SDN Module with DeviceNet Cable	Use 1788-DNBO Module with DeviceNet Cable
EtherNet/IP (any except xx5xx)	EtherNet/IP Comm Port PanelView Plus 400 to 1500 (except 2711P-xxx5xx)	Use 1756-ENET or 1756-ENBT Module with Ethernet cable	To 1769-L35E with Ethernet cable	Use 1788-ENBT Module with EtherNet cable
Remote I/O xxx1xx xxx6xx	Remote I/O Communication Port PanelView Plus 400 to 1500 2711P-xxx1xx, -xxx6xx, 2711P-RN1, 2711P-RN6	Use 1756-DHRIO Module with shielded twinaxial cable (1770-CD)	N/A	N/A
DH+ xxx6xx xxx8xx	DH+ Communication Port PanelView Plus 400 to 1500 2711P-xxx6xx, -xxx8xx, 2711P-RN6, 2711P-RN8	Use 1756-DHRIO Module with shielded twinaxial cable (1770-CD)	N/A	N/A

PanelView Plus Terminals to Communication Adapters

		Cables: PanelView Plus to Communication Adapters				
			1761-NET-AIC			
Protocol	**PanelView Plus Comm Port**	**1747-AIC**	**Port 1 (9-pin)**	**Port 2 8-pin Mini DIN()**	**Port 3 (DH485)**	**1761-NETDNI or 1771-NET-ENI**
DF1 (any)	RS-232 Comm Port (9-pin) PanelView Plus 400 to 1500 2711P-RN22C	N/A	2711-NC13 (16ft/5m) 2711-NC14 (32ft/10m) 2706-NC13 (10ft/3m)	2711-NC21 (16ft/5m) 2711-NC22 (49ft/15m)	N/A	1761-CBL-AP00 (5m) 1761-CBL-PM02 (2m) 2711-CBL-PM05 (5m) 2711-CBL-PM10 (10m)
DH-485 (any)	RS-232 Comm Port (9-pin) PanelView Plus 400 to 1500 2711P-RN22C	N/A	2711-NC13 (16ft/5m) 2711-NC14 (32ft/10m) 2706-NC13 (10ft/3m)	2711-NC21 (16ft/5m) 2711-NC22 (49ft/15m)	N/A	
	DH-485 Communication Port PanelView Plus 400 and 600 2711P-xxx3xx, 2711P-RN3	1747-C10 (6ft/2m) 1747-C11 (0.3m/1ft) 1747-C20 (20ft/6m)	N/A		1761-CBL-AS03 (10ft/3m) 1761-CBL-AS09 (30ft/9m) to single AIC+	N/A
	DH-485 Communication Port PanelView Plus 700 to 1500 2711P-xxx6xx, 2711P-RN6	Direct connection to single AIC with Belden 9842 cable(1)	N/A		Direct connection to single AIC+ with Belden 9842 cable(1)	N/A

(1) Use serial port on terminal with an AIC+ module for a DH-485 network solution.

Communication Port Isolation

The PanelView Plus and VersaView CE terminals contain integral and modular (externally attached) communication ports. Some of these ports contain electrical isolation depending on the catalog number of the terminal or communication module.

Integral Communication Port Isolation

Communication Port	400 and 600 Terminal	700 to 1500 Terminal
RS-232	Non-isolated	Isolated
USB	Non-isolated	Non-isolated
Ethernet	Isolated	Isolated

400 and 600 Modular Communication Port Isolation

Communication Port	Module	Isolation
RS-232	2711P-RN22C	Isolated
DH-485	2711P-RN3	Non-isolated
DH+	2711P-RN8	Isolated
Remote I/O	2711P-RN1	Isolated
DeviceNet	2711P-RN10C	Isolated
ControlNet	2711P-RN15C	Isolated (1)

(1) NAP port is nonisolated.

700 to 1500 Modular Communication Port Isolation

Communication Port	Module	Isolation
DH-485	2711P-RN6	Isolated
DH+	2711P-RN6	Isolated
Remote I/O	2711P-RN6	Isolated
DeviceNet	2711P-RN10H	Isolated
ControlNet	2711P-RN15S	Isolated

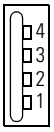
USB Ports

The 700 to 1500 terminals have two USB ports. The 400 and 600 terminals have one USB port. The terminals support standard USB keyboard and mouse devices (HID devices) with native device drivers. They also support some USB printers that have Printer Control Language (PCL) capabilities. A vendor specific Windows CE driver is required for all other USB devices.

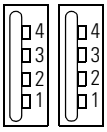
See Appendix B for a list of compatible USB devices.

Plug the USB device into either one of the two USB ports on the 700 to 1500 terminals.

400 and 600 USB Port



700 to 1500 USB Ports



USB Connector Pinout

Pin	Signal
1	USBVCC
2	USBD-
3	USBD+
4	USB-GND

WARNING

Do not connect or disconnect the communication cable with power applied to the terminal, or the serial device on the other end of the cable. An electrical arc could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.

WARNING

USB devices not powered by the USB port must be within the same enclosure and connected to a ground system common with the terminal, or the USB devices must be used with a USB hub that provides galvanic isolation.

If a USB hub is connected to the terminal, an externally powered USB hub is recommended. Before attaching devices to a USB hub, check that the power adapter is connected and powered on.

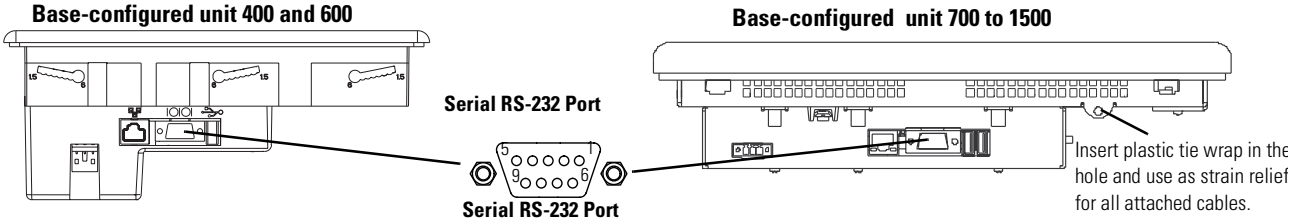
Serial Connections

The base-configured unit of all terminals has a multi-purpose serial RS-232 port that supports:

- DH-485 communications through a serial connection.
- DF1 full duplex communications with controllers using direct connections or modem connections.
- third-party point-to-point communications.
- application uploads/downloads.
- printing.

The serial port on the base-configured unit of the terminal is a 9-pin, male, RS-232 connector. The table shows the pinout descriptions for this port and how these pins map to the serial ports on the controllers.

Serial Port



Serial Port Connector Pinout

PanelView Plus RS-232 Port 9-pin DCE		SLC 9-pin	PLC 25-pin	MicroLogix/ DNI 8-pin DIN
1				
2	RXD →	2	3	4
3	← TXD	3	2	7
4	← DTR	4	20	
5	↔ COM	5	7	2
6	DSR →	6	6	
7	← RTS	7	4	
8	CTS →	8	5	
9				
Connector Shell	Chassis Gnd			

The maximum cable length for serial communications is:

- 15.24 m (50 ft) at 19,200 baud
- 152 m (500 ft) at 9,600 baud

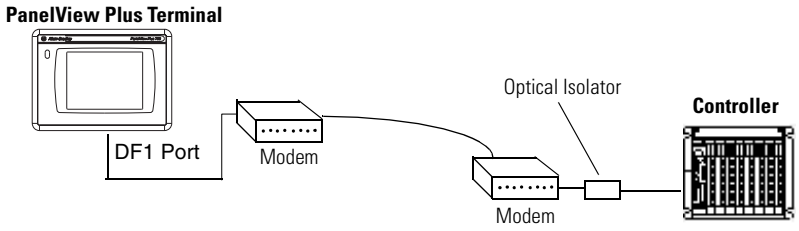
WARNING

Do not connect or disconnect the communication cable with power applied to the terminal, or the serial device on the other end of the cable. An electrical arc could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.

Modem Connection

Wire or radio modem communications is possible between the terminal and controller. Each modem must support full duplex communications. Refer to your modem user manual for details on settings and configuration.

Modem Connection



Construct a Null Modem Cable

To construct a null modem cable, refer to this pinout.

Null Modem Pinout

	PanelView Plus 9-pin	9-pin
FG (Frame Ground)	-	-
TD (Transmit Data)	3	2
RD (Receive Data)	2	3
RTS (Request to Send)	7	8
CTS (Clear to Send)	8	7
SG (Signal Ground)	5	5
DSR (Data Set Ready)	6	4
DTR (Data Terminal Ready)	4	6

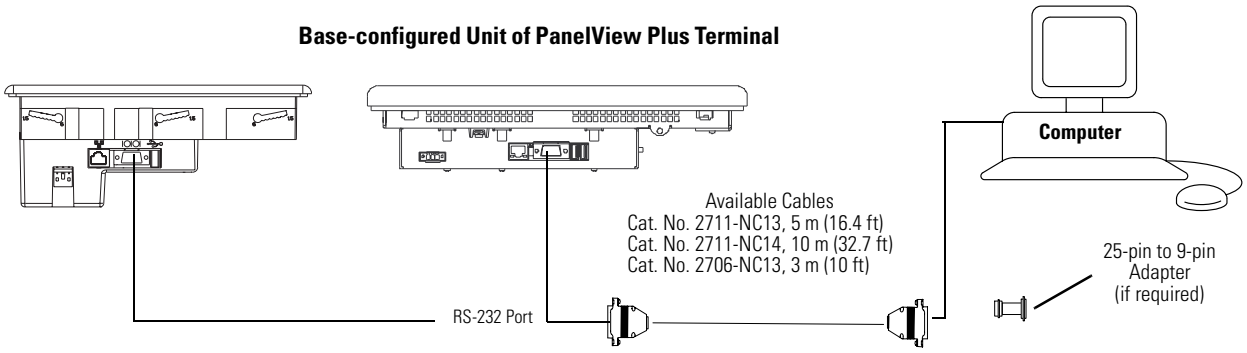
PanelView Plus 9-pin	25-pin	
-	1	FG
3	3	RD
2	2	TD
7	5	CTS
8	4	RTS
5	7	SG
6	20	DTR
4	6	DSR

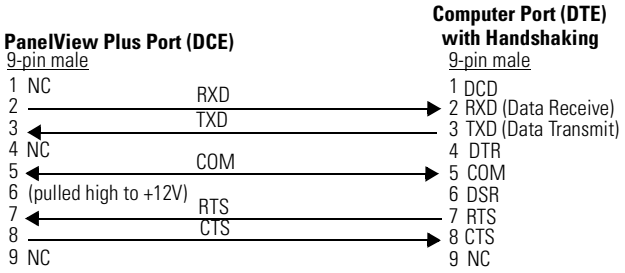
Computer Connections

The RS-232 serial port on the base-configured unit of the terminals supports:

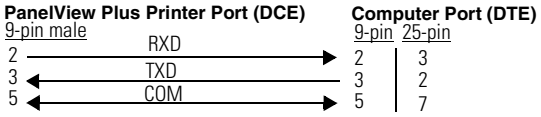
- application uploads/downloads using a direct connection.
- printing.

Computer or Printer Connection





Upload/Download Cable without Hardware Handshaking



Ethernet Connections

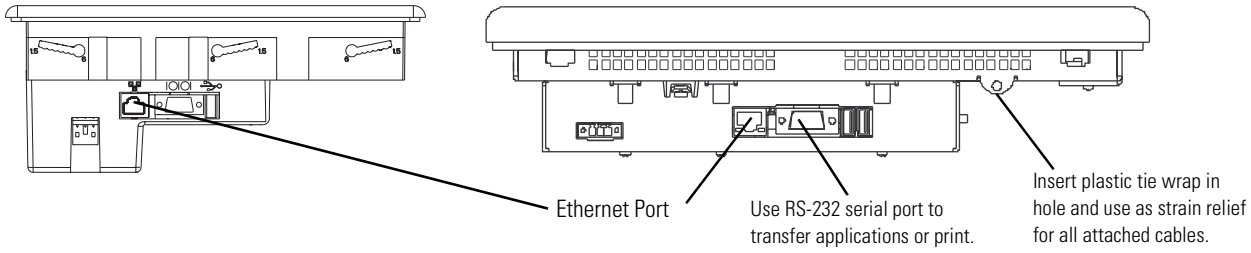
The base-configured unit of the 700 to 1500 terminals and the network based unit of the 400 and 600 terminals have an Ethernet port that supports:

- EtherNet/IP communications.
- third-party Ethernet communications.
- network connections.
- application uploads/downloads.
- printing.

Ethernet Connector

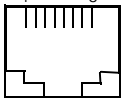
The base-configured unit of the terminals has an RJ45, 10/100 Base-T connector for EtherNet/IP or Ethernet TCP/IP network communications.

Ethernet Port



The table shows the connector pinouts.

Ethernet Connector Pinout

Pin	Pin	Pin Name
Looking into RJ45 Connector 	1	TD+
	2	TD-
	3	RD+
	4	NC
	5	NC
	6	RD-
	7	NC
	8	NC
	Shield Connection	Chassis Gnd

Use point-to-point, 10/100 Base-T cables with cross over pin-outs (such as 2711P-CBL-EX04) when connecting the Ethernet port on the terminal directly to a logic controller's Ethernet port or a computer 10/100 Base-T port. Use standard Ethernet cables when connecting to a switch or hub.

Cables

The PanelView Plus terminals require category 5 shielded twisted-pair cables with RJ45 connectors. The shielded cable helps to maintain industrial noise immunity levels. The maximum cable length between the terminal's Ethernet port and a 10/100 Base-T port on an Ethernet hub (without repeaters or fiber) is 100 m (328 ft). In industrial applications, keep the cable length to a minimum.

WARNING

Do not connect or disconnect any communication cable with power applied to this device or any device on the network. An electrical arc could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.

Security Considerations

IGMP (Internet Group Management Protocol) is used for IPv4 multicast. A multicast is communication between a single sender and multiple receivers on a network. IGMP is used to exchange membership status data between IPv4 routers that support multicasting and members of multicast groups. A router is an intermediary device on a communication network that expedites message delivery by finding the most efficient route for a message packet within a network, or by routing packets from one subnetwork to another. A sub-network is a separate part of an organization's network identified through IP addressing.

PanelView Plus terminals provide level 2 (full) support for IPv4 multicasting (IGMP version 2) as described in RFC 1112 and RFC 2236.

Note: SNMP (Simple Network Management Protocol) is used for internal network management and is not supported.

Ports 137 and 138 are normally open to support the NetBIOS protocol used by Windows CE.NET similar to other Microsoft and IBM network operating systems.

DH-485/DH+/Remote I/O Module

Terminals with a DH-485/DH+/Remote I/O communication module support communication with these networks.

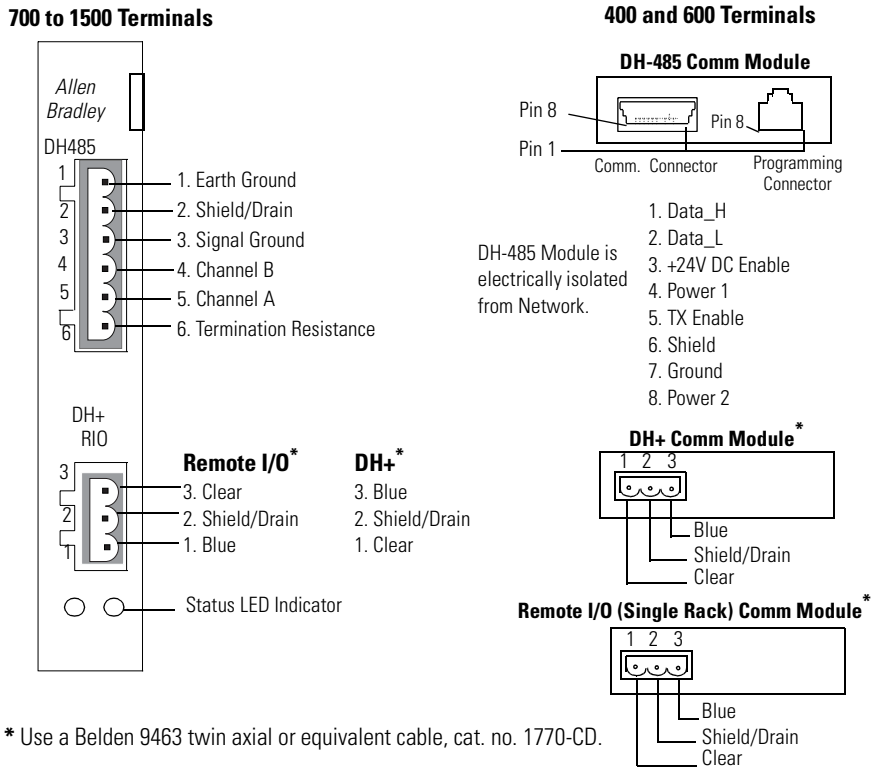
- DH+ networks
- DH-485 networks
- Remote I/O networks

You can communicate with only one network at one time.

The 700 to 1500 terminals support all protocols on one module. The 400 and 600 terminals require a separate module for each protocol. The DH+, DH-485 and Remote I/O connections are different between the modules for the 400 and 600 and 700 to 1500 terminals.

Module Connections

IMPORTANT See your controller documentation for appropriate controller connections.



***** Use a Belden 9463 twin axial or equivalent cable, cat. no. 1770-CD.

DH+ Status Indicator

Condition	Indication
Off	Channel is not online.
Blinking green	Device is only node on the network.
Solid green	Device is online and receiving token.
Blinking red	Duplicate node.
Solid red	Failed selftest.

DH-485 Status Indicator

Condition	Indication
Off	Channel is not online.
Blinking green	Device is only node on the network.
Solid green	Device is online and receiving token.
Blinking red	Parity error.
Solid red	Failed selftest.

Remote I/O Scanner Mode Status Indicator

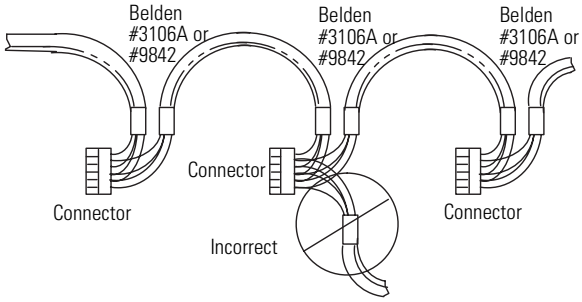
Condition	Indication
Off	Channel is not online.
Blinking green	At least one but not all adapters in the scanlist are not responding.
Solid green	All adapters in the scanlist are responding.
Blinking red	None of the adapters in the scanlist are responding.
Solid red	Failed selftest.

DH-485 Network Port Wiring (700 to 1500 only)

Use these instructions for wiring Belden cable. If you are using standard Allen-Bradley cables, see the Logic Controller Cable Charts.

IMPORTANT A daisy-chained network is recommended. We do not recommend hybrid star/daisy chain networks as shown.

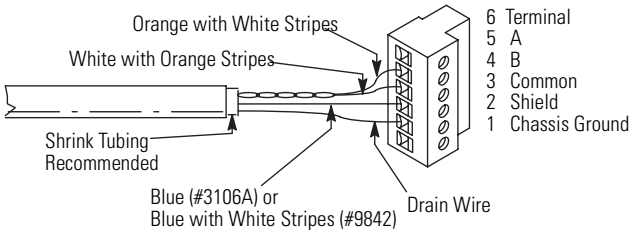
RS-485 Connector to the Communication Cable



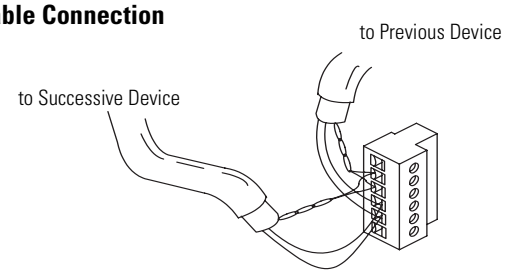
Attach the connector to the Belden #3106A or #9842 Cable as shown.

Single and Multiple Cable Connections

Single Cable Connection



Multiple Cable Connection



The table shows connections for Belden #3106A.

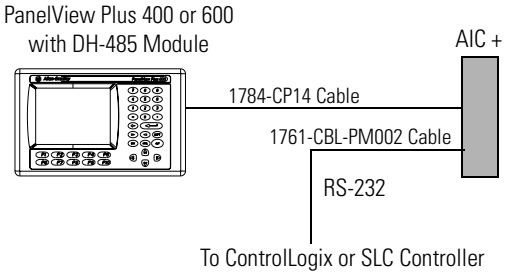
Belden 3106A Wire Connections

For this Wire/Pair	Connect this Wire	To this Terminal
Shield/Drain	Non-jacketed	Terminal 2 - Shield
Blue	Blue	Terminal 3 - (Common)
White/Orange	White with Orange Stripe	Terminal 4 - (Data B)
	Orange with White Stripe	Terminal 5 - (Data A)

DH-485 Connections (400 and 600 only)

This section shows connections between a 400 and 600 terminal with a DH-485 communication module and an SLC or ControlLogix controller through the AIC+ module.

DH-485 Connections



DH+ Network Connections

Use the Belden 9463 twin axial or equivalent cable (cat. no. 1770-CD), to connect a terminal to a DH+ link.

You can connect a DH+ link in two ways:

- trunk line/drop line - from the drop line to the connector screw terminals on the DH+ connectors of the processor
- daisy chain - to the connector screw terminals on the DH+ connectors on the processor

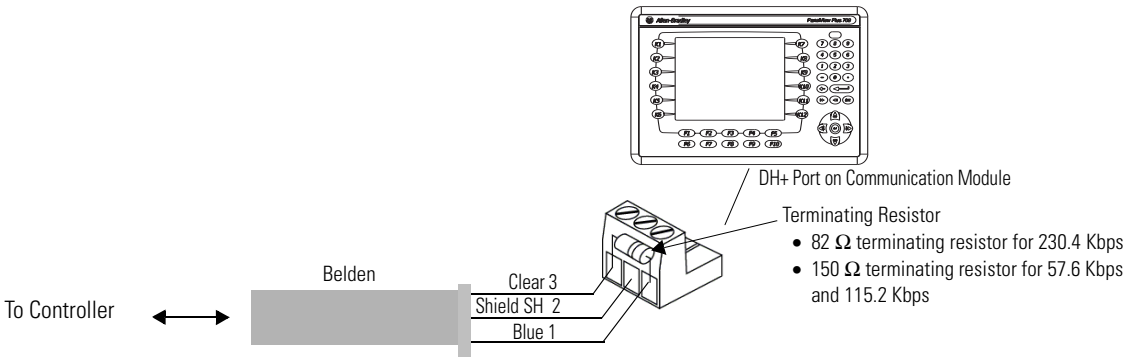
Follow these guidelines when installing DH+ communication links:

- do not exceed these cable lengths:
  - trunk line-cable length: 3,048 m (10,000 ft).
  - drop-cable length: 30.4 m (100 ft).

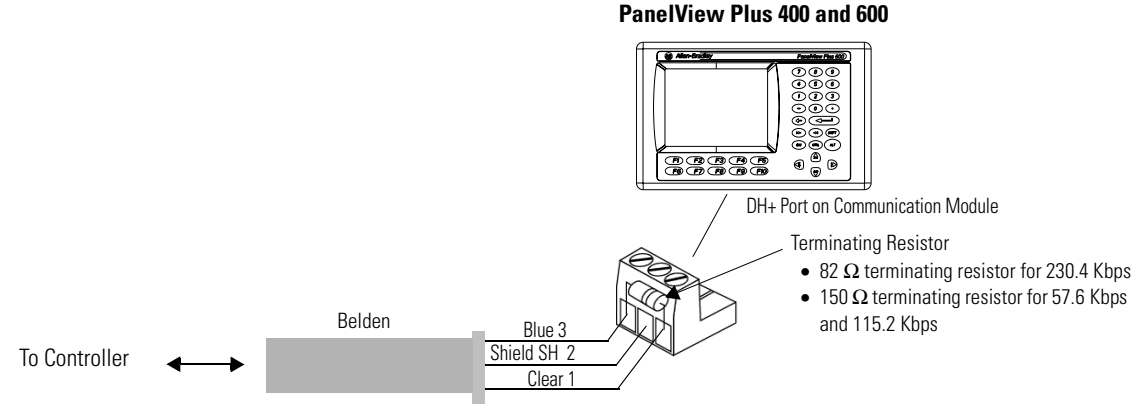
  The maximum cable length is determined by baud rate.
- do not connect more than 64 stations on a single DH+ link

DH+ Network Connections

PanelView Plus 700 to 1500



PanelView Plus 400 and 600



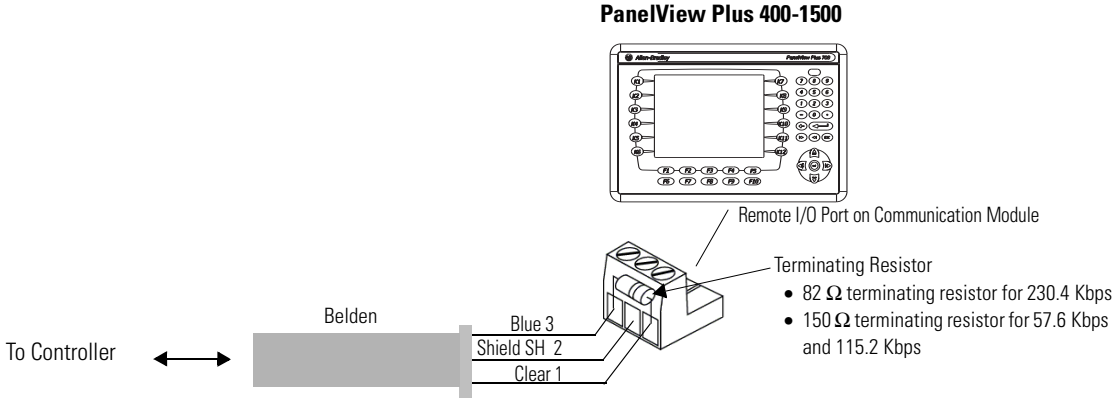
Remote I/O Connections

Use the Belden 9463 twin axial or equivalent cable (cat. no. 1770-CD), to connect a terminal to a Remote I/O scanner. The maximum cable length (link distance) is determined by the baud rate.

- 2,800 m (10,000 ft) for 57.6 Kbps
- 1,400 m (5,000 ft) for 115.2 Kbps
- 700 m (2,500 ft) for 230.4 Kbps

See Programmable Controller Wiring and Grounding Guidelines, publication 1770-4.1. The user manual for the I/O scanner module also provides cabling information.

Remote I/O Connections



ControlNet Module

Terminals with a ControlNet communication module support communications and the transfer of applications between devices on a ControlNet network.

Related Information

For more information on ControlNet products, refer to these publications.

- ControlNet System Overview, publication 1786-2.9
- ControlNet System Planning and Installation Manual, publication 1786-6.2.1
- ControlNet Cable System Component List, publication AG-2.2
- ControlNet Communications for PanelView Plus and VersaView CE Terminals, publication 2711P-UM003

The Rockwell Automation website http:\\rockwellautomation.com provides information and product descriptions of ControlNet products. Under the Products and Services heading, select Communications.

ControlNet Protocol

The terminals support Unscheduled and Scheduled messaging, Scheduled I/O, and redundant cabling with PLC-5C and ControlLogix controllers.

The ControlNet architecture supports multiple processors and up to 99 nodes (via taps) anywhere along the trunk cable of the network. There is no minimum tap separation and you can access the ControlNet network from every node (including adapters).

Compatible ControlNet Controllers

A terminal with a ControlNet Module communicates with a PLC-5C (PCCC commands) or a ControlLogix processor (CIP protocol) using Unscheduled messaging. The following controllers are supported:

- ControlLogix using 1756-CNB module
- PLC-5/20C, -5/40C, -5/60C, -5/80C

Minimum Requirements

The following software and firmware must be installed on the development computer and the PanelView Plus terminal to configure and communicate with an Allen-Bradley controller on a ControlNet network.

ControlNet Unscheduled Communications

Software/Firmware	PanelView Plus 700 to 1500	PanelView Plus 400 or 600
RSView Studio	Version 3.10 or later	Version 4.0 or later
RSView Machine Edition Runtime	Version 3.10 or later	Version 4.0 or later
ControlNet Module Firmware	2711P-RN15S, Series A, Rev A (firmware version 2.07 or later) (1)	2711P-RN15C, Series B, Rev A or later

(1) This applies to terminals that are ordered as pre-configured units with the ControlNet module.

ControlNet Scheduled Communications

Requirements	PanelView Plus 700 to 1500	PanelView Plus 400 or 600
RSView Studio	Version 3.20 or later	Version 4.0 or later
RSView Machine Edition Runtime	Version 3.20.04 or later	Version 4.0 or later
RSNetWorx for ControlNet	Version 5.11 or later	Version 6.0 or later
RSLogix 5000	v13.0 or later	Version 15.0 or later
ControlNet Module Firmware	2711P-RN15S, Series A, Rev C (firmware version 3.08 or later) (1)	2711P-RN15C, Series B, Rev A or later

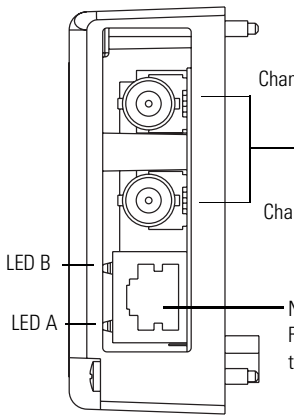
(1) This applies to terminals that are ordered as preconfigured units with the ControlNet module.

WARNING

The ControlNet Communications Module (2711P-RN15S) will not run with RSView ME firmware version 3.20.04 or earlier. All ControlNet Modules with version 3.07 firmware must be upgraded to version 3.08 or later; otherwise, outputs may turn on an indeterminate state.

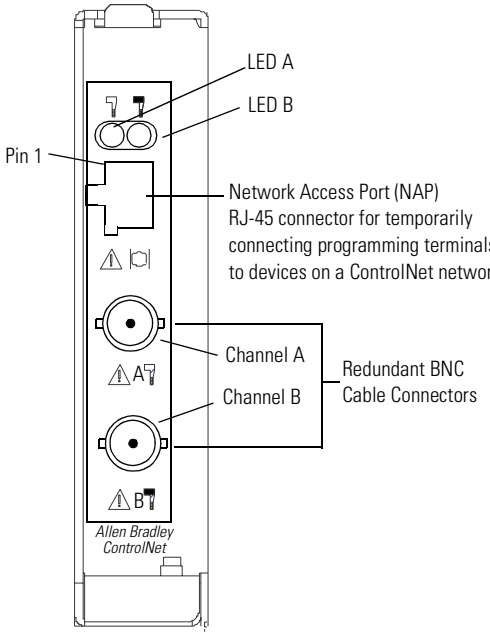
ControlNet Connections

2711P-RN15C ControlNet Module for 400 and 600 Terminals



Pin	NAP Signal
1	Signal Common
2	No Connection
3	TX_H
4	TX_L
5	RX_L
6	RX_H
7	No Connection
8	Signal Common
Shell	Earth Ground

2711P-RN15S ControlNet Module for 700 to 1500 Terminals



Pin	NAP Signal
1	Signal Common
2	No Connection
3	TX_H
4	TX_L
5	RX_L
6	RX_H
7	No Connection
8	Signal Common
Shell	Earth Ground

ATTENTION

Do not connect more than one ControlNet network to the Communications Module. If you attempt to connect a second network to the module, your communication system will operate erratically.

NAP and Redundant Cables

Refer to the ControlNet Cable System Planning and Installation manual, publication 1786-6.2.1 for descriptions of ControlNet components. For information on purchasing these items, refer to the Allen-Bradley ControlNet Cable System Component List, publication AG-2.2.

ControlNet NAP and Redundant Cables

Item	Cat. No.
RG-6 quad-shield	1786-RG6
Coax repeater	1786-RPT, -RPTD
Coax taps	1786-TPR, -TPS, -TPYR, -TPYS
Network access cable	1786-CP
Coax tool kit	1786-CTK
Segment terminators	1786-XT
BNC connectors	1786-BNC, -BNCJ, -BNCP, -BNCJ1

IMPORTANT Do not connect to a network using both the redundant cable BNC connector and the Network Access Port (NAP).

Connect the Module to the Network

You can connect the ControlNet Module:

- directly to a ControlNet network, which requires a tap.
- to a device already connected to the ControlNet network.

WARNING

When used in a Class I, Division 2, hazardous location, this equipment must be mounted in a suitable enclosure with proper wiring that complies with the governing electrical codes.

Do not connect or disconnect any communication cable with power applied to this device or any device on the network. An electrical arc could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.

DeviceNet Module

Terminals with a DeviceNet communication module support communication and the transfer of applications between devices on a DeviceNet network.

Related Information

For more information on DeviceNet products, refer to these publications.

- DeviceNet Selection Guide, publication DNET-SG001
- DeviceNet Media Design Installation Guide, publication DNET-UM072
- DeviceNet Tips & Tricks, publication DNET-BR003

The Rockwell Automation website http:\\rockwellautomation.com provides information and product descriptions of DeviceNet products. Under the Products and Services heading, select Communications.

DeviceNet Protocol

The terminals support DeviceNet Scheduled I/O only. This protocol allows direct connection of field devices such as lights, drives, and valves. It also provides a control architecture that supports multiple processors. The DeviceNet network is a trunk/drop or bus-based network that supports up to 64 nodes and operates at 125, 250, or 500 Kbps.

Compatible DeviceNet Controllers

A terminal with a DeviceNet module communicates with an SLC-500 and PLC-5 (PCCC commands), or a ControlLogix processor (CIP protocol) using Unscheduled messaging. Supported controllers include:

- ControlLogix using 1756-DNB module
- PLC-5 with a 1771-SDN module
- SLC 5/03 - SLC/505 with a 1747-SDN module

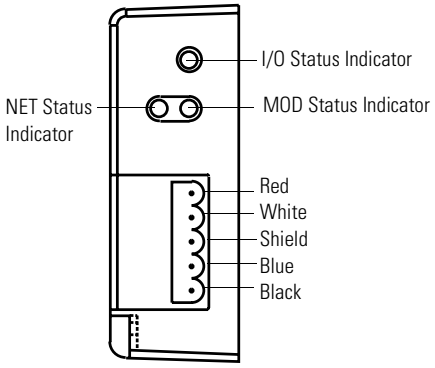
Minimum Requirements

Software and Firmware Requirements for DeviceNet Communications

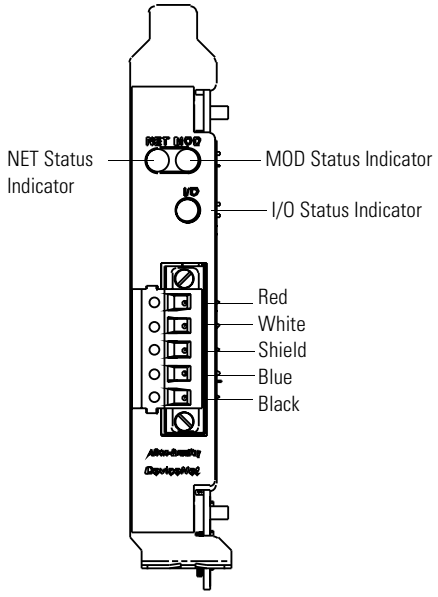
Software/Firmware	PanelView Plus 700 to 1500	PanelView Plus 400 and 600
RSView Studio	Version 4.0 or later	Version 4.0 or later
RSView Machine Edition Runtime	Version 4.0 or later	Version 4.0 or later
DeviceNet Module	2711P-RN10H	2711P-RN10C

DeviceNet Connections

2711P-RN10C DeviceNet Module for 400 and 600 Terminals



2711P-RN10H DeviceNet Module for 700 to 1500 Terminals



WARNING

Do not connect or disconnect any communication cable with power applied to this device or any device on the network. An electrical arc could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.

DeviceNet I/O Status Indicator

This bicolor (green/red) LED provides information on the states of inputs and/or outputs.

DeviceNet I/O Status Indicator

Condition	Status	Indication
Off	Outputs active	All outputs are active.
	Inputs active	All inputs are active.
Green	Outputs active	One or more outputs are active and under control, and no outputs are faulted.
	Inputs active	One or more inputs are active and producing data, and no inputs are faulted.
Flashing green(1)	Outputs idle	One or more outputs are idle, and no outputs are active or faulted.
Flashing red (1)	Outputs faulted	One or more outputs are faulted, and may be in the fault state.
	Inputs faulted	One or more inputs are faulted, and may be in the fault state.
Red	Outputs forced off	One or more outputs are forced off (may be an unrecoverable fault).
	Input unrecoverable fault	One or more inputs has an unrecoverable fault.

(1) The flash rate of the LED is approximately 1 flash per second. The LED should be on for approximately 0.5 seconds and off for approximately 0.5 seconds.

DeviceNet Module (MOD) Status Indicator

This bicolor (green/red) LED provides device status. It indicates whether or not the device has power and is operating properly.

DeviceNet I/O Status Indicator

Condition	Status	Indication
Off	No power	No power applied to device.
Green	Device operational	Device is operating in a normal condition.
Flashing green[1]	Device in standby (device needs commissioning)	Device needs commissioning due to configuration missing, incomplete, or incorrect.
Flashing red [1]	Recoverable fault	For example, the device's scan list configuration does match the actual network configuration.
Red	Unrecoverable fault	Device has an unrecoverable fault. Cycle power to your computer. If the problem persists, the device may need to be replaced.
	Device self testing	Device is in self test. Refer to the DeviceNet Specification, Volume II, Identity Object.

[1] The flash rate of the LED is approximately 1 flash per second. The LED should be on for approximately 0.5 seconds and off for approximately 0.5 seconds.

DeviceNet Network (NET) Status Indicator

This bicolor (green/red) LED indicates the status of the communication link.

DeviceNet Network (NET) Status Indicator

Condition	Status	Indication
Off	Not powered	Device is not online.
	Not online	The device has not completed the Dup_MAC_ID test yet.
		The device may not be powered; look at the Module Status LED.
Flashing green[1]	Online	Device is online, but has no connections in the established state.
	Not connected	The device has passed the Dup_MAC_ID test, is online, but has no established connections to other nodes.
Green	Link okay, online, connected	The device is online and has connections in the established state.
Flashing red [1]	Connection timeout	One or more I/O connections are in the timed-out state.
Red	Critical link failure	Failed communication device. The device has detected an error that has rendered it incapable of communicating on the network (Duplicate MAC ID or Bus-off). Check network integrity and baud rate of all devices. Then cycle power to the card by shutting down and cycling power to your computer.

[1] The flash rate of the LED is approximately 1 flash per second. The LED should be on for approximately 0.5 seconds and off for approximately 0.5 seconds.

ATTENTION

Extensive use of Change-of-State connections, particularly with rapidly changing data, can adversely impact the available DeviceNet network bandwidth. If the network bandwith becomes consumed, some devices may only be able to communicate intermittently. This can result in timeout errors and possible loss of data. If timeouts occur, consider changing the connection type for some of the Change-of-State connections to Cyclic or Polled.

Transfer Files

Chapter Objectives

This chapter covers information on how to:

- transfer applications using a compact flash card or from a computer.
- upgrade terminal firmware.

Transfer Files with a Compact Flash Card

The PanelView Plus terminal lets you copy or load files using a compact flash card from RSView ME.

To copy files in RSView ME using a compact flash card, see page 76.

Transfer Files from a Computer

For details on transferring .MER applications from a computer to the PanelView Plus terminal, refer to RSView Studio help or documentation.

Upgrade Firmware

The Firmware Upgrade Wizard (FUW) lets you upgrade firmware in the PanelView Plus terminal. Using the FUW, you can:

- create a firmware upgrade card (compact flash card) that you then load in the card slot of the terminal to upgrade firmware.
- upgrade firmware in a terminal that is connected to your desktop computer using a Serial, Ethernet, or Network connection via RSLinx Enterprise software (for supported protocols).

The FUW is available in RSView Studio software or with the Firmware Upgrade Kit.

Prepare Terminal for Firmware Upgrade

Before starting the Firmware Upgrade Wizard (FUW), follow these steps to prepare the terminal for a successful upgrade.

1. Backup all .MER files on the terminal to an external storage card or network.
2. Delete all applications on the terminal.
3. Record any Ethernet communication settings, such as IP address, subnet masks, and gateways by selecting Terminal Settings>Network and Communications>Network Connections>Network Adapters>IP Address.
4. Disable the Auto-start feature on the terminal by selecting Startup Options>RSView ME Station Startup and select Go to Configuration Mode.
5. Reset the terminal.

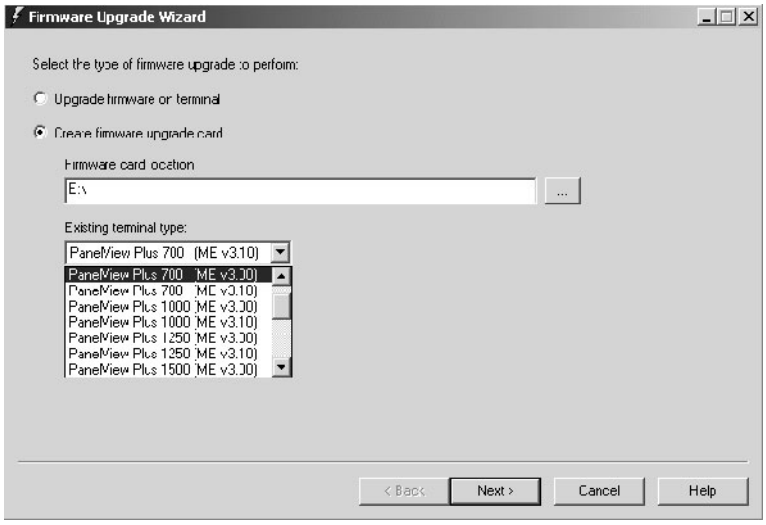
Upgrade Firmware with a Compact Flash Card

This section shows how to upgrade the firmware in the terminal using a compact flash card. This is a two step-process. First, you create a firmware upgrade card with the necessary firmware files. Second, you load this card in the target terminal to upgrade the firmware.

Create Firmware Upgrade Card

1. Start the Firmware Upgrade Wizard by selecting Start>Rockwell Software>RSView Enterprise>Firmware Upgrade Wizard.

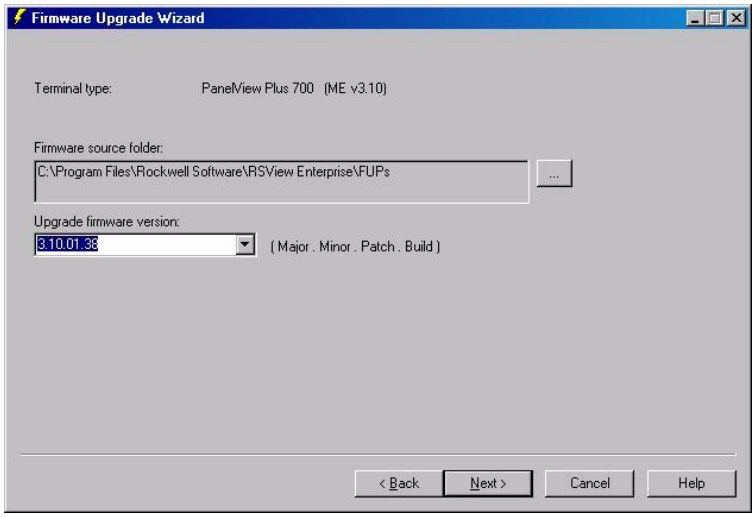
2. Select Create firmware upgrade card.
   - In the Firmware card location text box, select the destination for the compact flash files (folder on the hard drive or physical location of the compact flash card, for example, E:\).
   - From the Existing terminal list, select the type of terminal you are upgrading, then press Next.



3. From the Firmware source folder list, select the location of the firmware files.

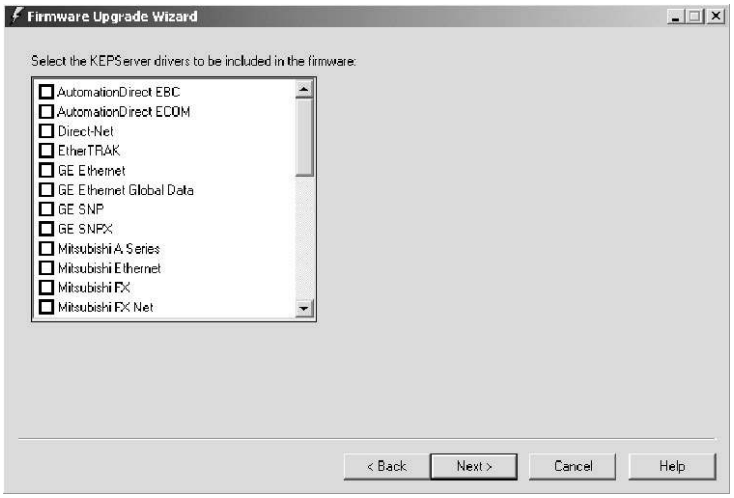
   The default location is C:\Program Files\Rockwell Software\RSView Enterprise\FUPs.

4. From the Upgrade firmware version list, select the version of the firmware you want to upgrade to, then press Next.



5. Select the appropriate KEPServer drivers and press Next.

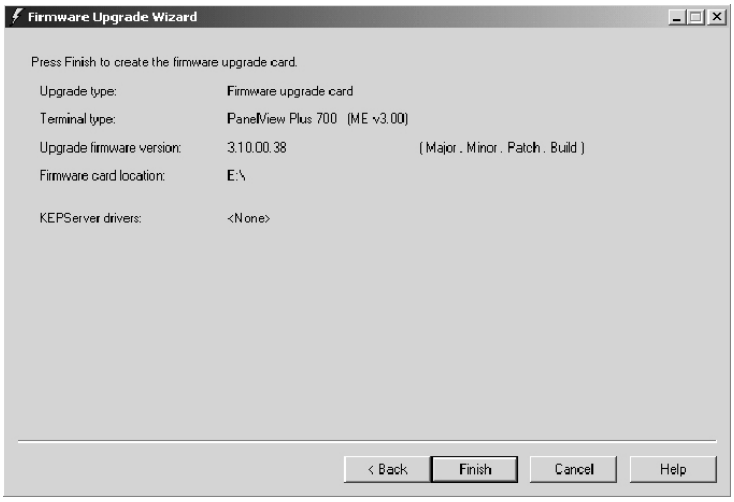
   If no KEPServer drivers are needed, just press Next.



TIP If the selected FUP file does not support the KEPServer drivers, this dialog will not appear.

6. Select Finish to copy the firmware source files to the location specified in step 2.

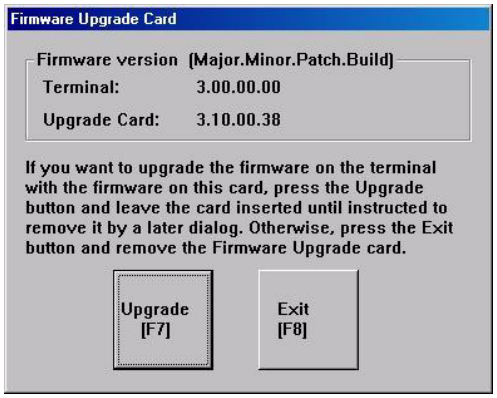
TIP If the files were created in a separate folder on a local hard drive, copy the files to the root directory of the compact flash card.



Upgrade Firmware in Terminal with Firmware Upgrade Card

1. Insert the compact flash card into the card slot of a powered terminal.

   A dialog appears indicating the firmware upgrade is about to occur.



2. Press Upgrade to begin the firmware upgrade.

IMPORTANT Do not remove the compact flash card while the upgrade is in process.

If other terminals exist on the same Ethernet network, the following error may display:

'Error registering name on network (may be duplicate). Change in system Control Panel and try again.'

Ignore this error. It will be corrected during the upgrade. Press **OK** to acknowledge error and wait for terminal to reset.

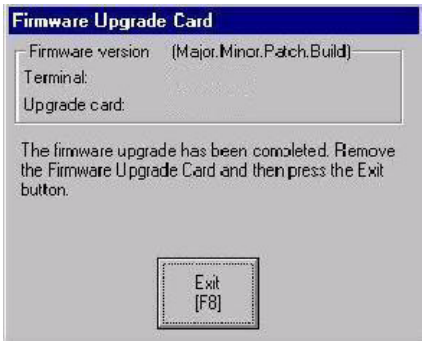
TIP If a USB mouse is available, you can acknowledge this error by selecting OK.

3. On touch or touch/screen terminals, you must calibrate the touch screen by selecting pointers in all four corners of the screen and pressing the middle of the screen when prompted.

   Ignore the following message if it appears. It means RSView ME is being installed. Do not touch the two buttons that appear with this message.
   'Machine edition may be corrupted. Do you want to download firmware?'

4. Remove the card and press F8 or Exit to reset the terminal.

   When the upgrade is complete, a dialog appears requesting you to remove the compact flash card from the card slot.



   Communication settings are cleared when the terminal is upgraded. If Ethernet communications is used, reconfigure the Ethernet communication settings using the values recorded when preparing the terminal.

5. Replace the .MER files that you backed up before starting the upgrade or download a new .MER file to the terminal.

6. Load the .MER file and run the project.

TIP You can configure your application to start automatically on power cycle under Startup Options.

Upgrade Firmware with a Network (Ethernet) Connection

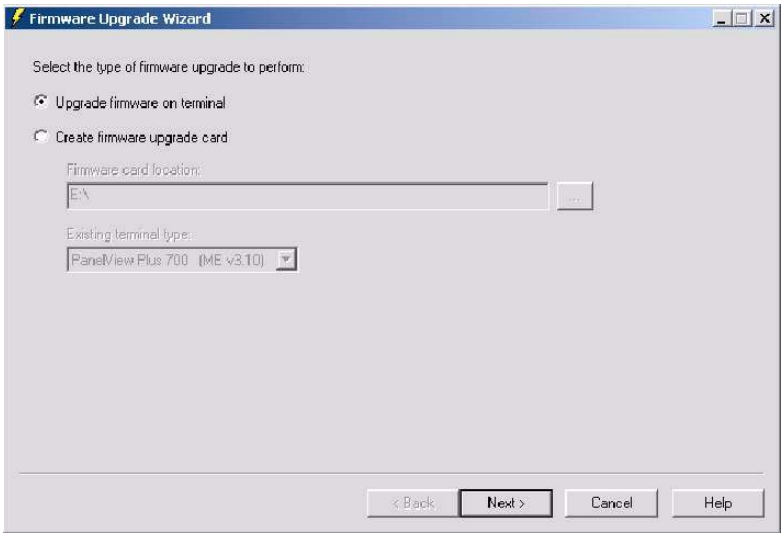
You can upgrade the firmware in a terminal that is connected to a desktop computer using a Serial, Ethernet or Network with RSLinx Enterprise software connection.

- **Serial connection** requires a RAS connection to be set up on computer. During the RAS setup, you select the COM port.
- **Ethernet connection** requires that you enter the terminal's IP Address.
- **Network connection** requires RSLinx Enterprise software where you select the terminal on an existing network.

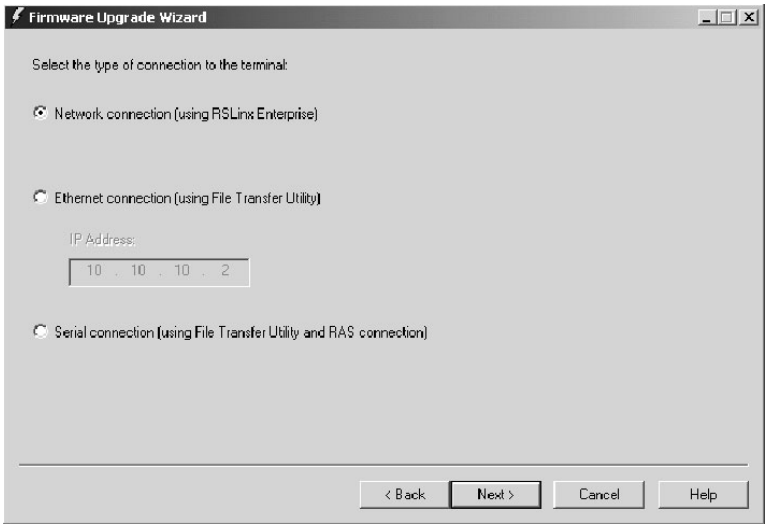
Both the Serial and Ethernet connection requires the File Transfer Utility running on the terminal.

This section shows how to upgrade firmware in a terminal using a Network connection via Ethernet communications.

1. Start the Firmware Upgrade Wizard by selecting Start>Rockwell Software>RSView Enterprise>Firmware Upgrade Wizard.



2. Select Upgrade firmware on terminal and press OK.

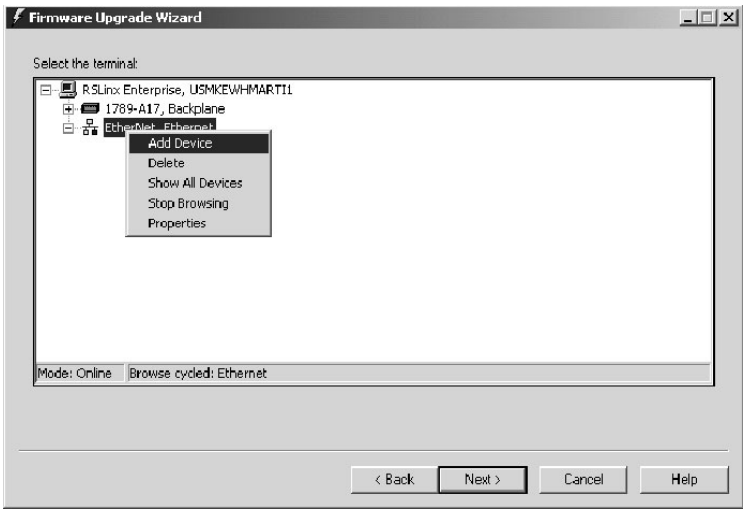


3. Select Network connection and press Next.

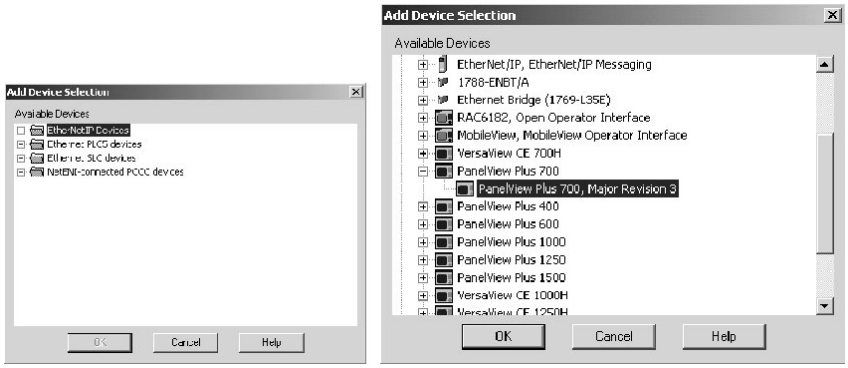
   Use the Ethernet and Serial connections only if the firmware upgrade is unsuccessful.

4. Locate the terminal on your Ethernet network via its IP address.

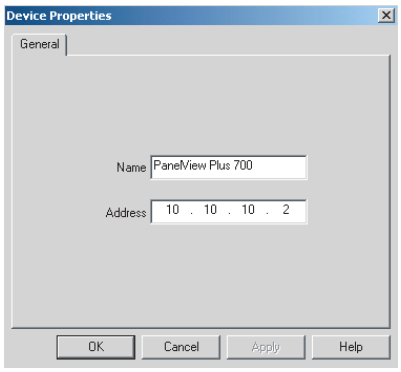
   Skip to Step 6 if you found the terminal. If you do not see the terminal, right click on the Ethernet driver and add the device to the browse tree.



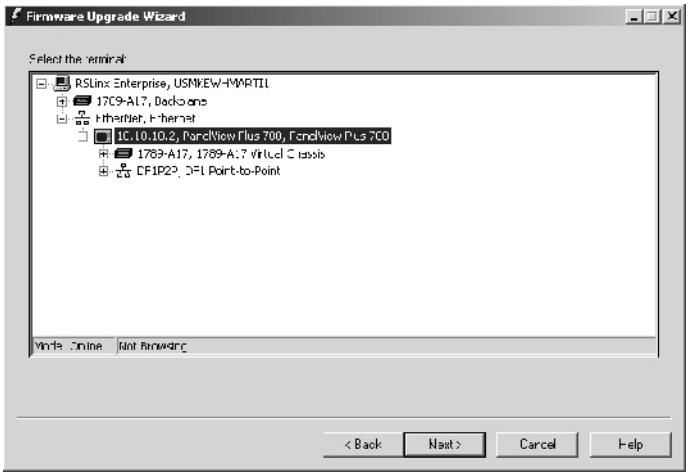
5. Double-click EthernetIP Devices and select the appropriate terminal and press OK.



6. Enter the IP address for the terminal and press OK.



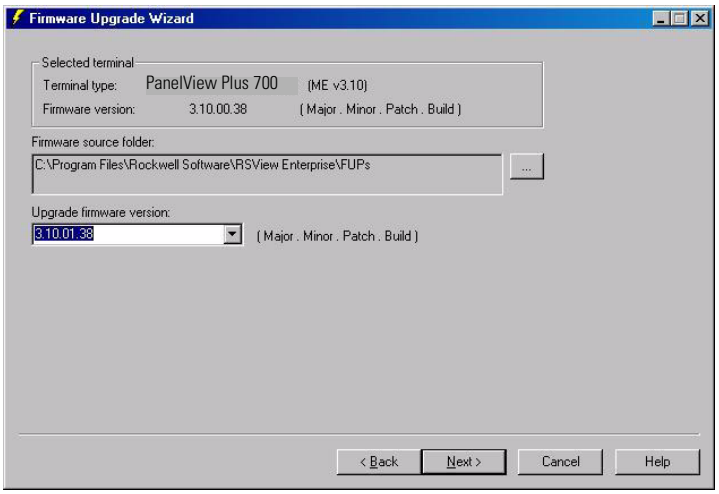
7. Select the terminal to be upgraded and press OK.



8. From the Firmware source folder text box, select the location of the firmware files.

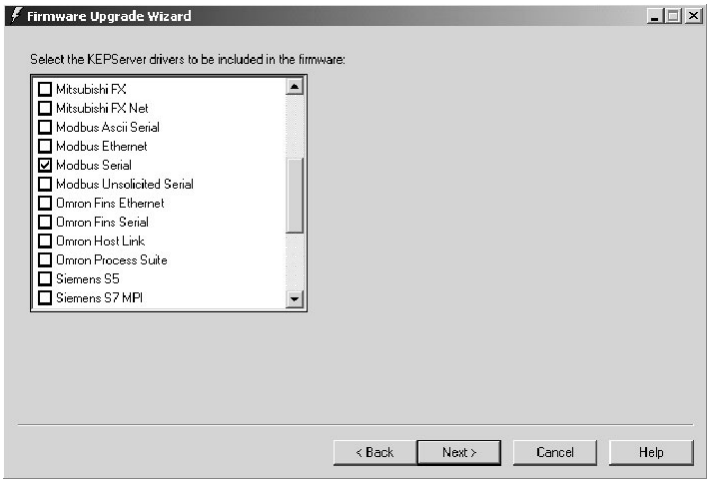
   The default location is C:\Program Files\Rockwell Software\RSView Enterprise\FUPs.

9. From the Upgrade firmware version list, select the version of the firmware you want to upgrade to, then select Next.



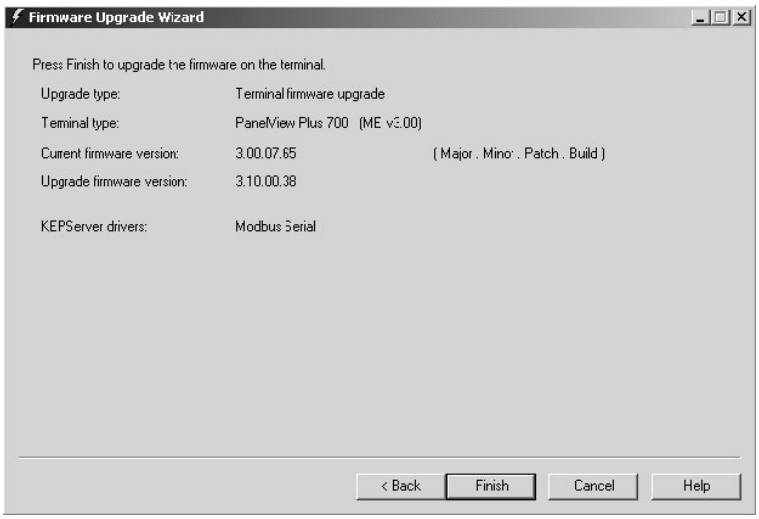
10. Select the appropriate KEPServer drivers and select Next.

    If no KEPServer drivers are needed, just select Next.



TIP If the selected FUP file does not support the KEPServer drivers, this dialog will not appear.

11. Press Finish to start the upgrade.

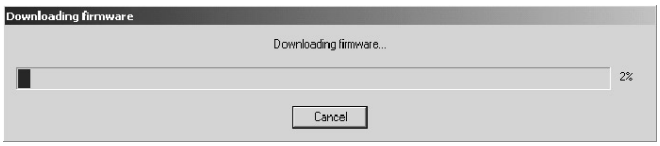


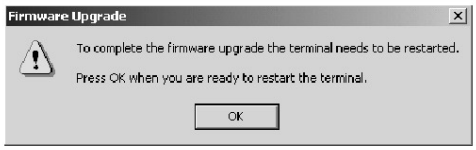
12. Press Yes to continue the upgrade process.

If the terminal was properly prepared for the upgrade, no applications should be running.

Firmware files are downloaded to the terminal. This may take several minutes to 15 minutes.

13. When the download is complete, press OK to reset the terminal.





If other terminals exist on the same Ethernet network, the following error may display:

'Error registering name on network (may be duplicate). Change in system Control Panel and try again.'

Ignore this error. It will be corrected during the upgrade. Press OK to acknowledge error and wait for terminal to reset.

TIP If a USB mouse is available, you can acknowledge the error by selecting OK.

14. On touch or touch/screen terminals, you must calibrate the touch screen by selecting pointers in all four corners of the screen and pressing the middle of the screen when prompted.

Ignore the following message if it appears. It means RSView ME is being installed. Do not touch the two buttons that appear with the message.

'Machine edition may be corrupted. Do you want to download firmware?'

Communication settings are cleared when the terminal is upgraded. If Ethernet communications is used, reconfigure the Ethernet communication settings using the values recorded when preparing the terminal.

15. Replace the .MER files that you backed up before starting the upgrade or download the new .MER files to the terminal.

16. Load the .MER file and run the project.

TIP You can configure your application to start automatically on power cycle under Startup Options.

Troubleshoot the System

Chapter Objectives

This chapter provides information on how to isolate and correct common operating problems with system components.

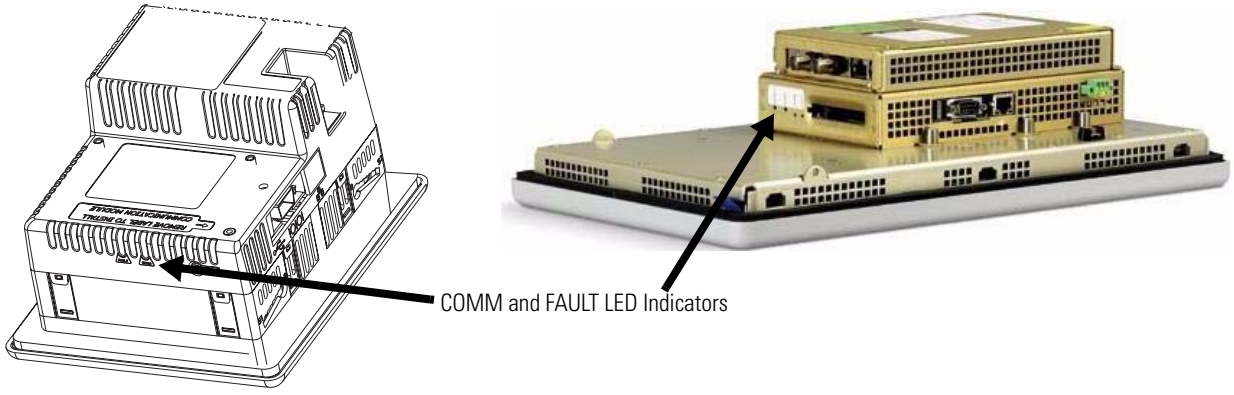
- LED indicators
- Isolate the problem
- Check components (display, touch screen, keypad, attached keyboard or mouse)
- Ethernet connection
- Advanced diagnostics
- Startup error messages
- Startup information messages
- Startup sequence
- System identification errors
- Startup
- Enter configuration mode
- Restart in safe mode
- Clean the display window

LED Indicators

The terminals have two LED indicators to isolate operating problems:

- COMM indicator (green) for communications
- FAULT indicator (red) for hardware faults

LED Indicators



Isolate the Problem

This section provides a list of general troubleshooting steps to follow when trying to isolate problems.

- **Check for adequate power**. An under-powered unit could result in unpredictable behavior.
  - The 400/600 dc powered terminals require 24V dc at 1.0 A.
  - The 400/600 ac powered terminals require 85 to 264V ac.
  - The 700 to 1500 dc powered terminals require 24V dc at 2.9 A.
  - The ac Power Supply (2711P-RSACDIN) for 700 to 1500 terminals meets Class 2/SELV requirements.
- **Check LED indicators on the terminal at startup**. Is power on? Is the unit attempting to start? The red LED indicator should be Off, except for a few brief flashes, and the green LED indicator should be On. If the LED indicators remain Off on the 700 to 1500 terminals, the power supply or logic module has failed. Check the power cable. Replace the logic module if the power is within range; if not, replace the power supply. If the LED indicators remain off on the 400/600 terminals, check the power cable.

  If the terminal cycles power and stops during startup, the state of the LED indicators will indicate an error.

After a successful startup, both LED indicators are off and controlled by the application running on the terminal.

Blinking Red LED Indicates a Recoverable Error

Red LED	Green LED	Indication
Blinking	Off	Last firmware download failed. Reload firmware using Firmware Upgrade Wizard (FUW) utility.
Blinking	Blinking	EBC boot loader firmware failed or is missing. Reload firmware using Firmware Upgrade Wizard (FUW) utility.
Blinking	On	Windows CE OS firmware failed or is missing. Reload firmware using Firmware Upgrade Wizard (FUW) utility.

Solid Red LED Indicates a Nonrecoverable, Fatal Error

Red LED	Green LED	Indication
On	Off	Fatal hardware error occurred. Replace logic module (700 to 1500) or the terminal (400 and 600).
On	Blinking	Fatal hardware error occurred in Display. Replace the display module (700 to 1500) or the terminal (400 and 600).

- **Check the messages at startup for errors**. Record any error message and refer to the Startup Error Message table.
- **Check the voltages and temperatures (700 to 1500 only)**. From Configuration Mode, open Terminal Settings>System Information>Terminal Information.
  - Battery Voltage for 700 to 1500 terminals should be at least 2.75V dc. Replace the battery if less than 2.75V dc.
  - Display Temperatures should be less than 55 °C (131 °F). The CPU temperature should be less than 95 °C.

    If the temperatures are higher, check for obstructed airflow through the chassis and attempt to moderate the ambient temperatures within the enclosure and surroundings.

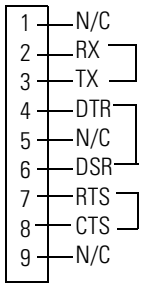
- **Check the System Event Log for errors or unexpected reboots.** From Configuration Mode, open Terminal Settings>System Event Log.
- **Use Extended Diagnostics on 700 to 1500 terminals only to perform more extensive hardware testing at startup**. From Configuration Mode, open Terminal Settings>Startup Tests>Select Tests.

  Select one or more of the tests you want to run. Enable extended diagnostics and set the iteration or repeat count.

  Restart the terminal. The Serial Port test requires a loopback connector with these connections.

Loopback Connector

DB9 Connector (female)



Extended Diagnostics are performed at every startup until disabled. A failure will momentarily halt startup and display an error message.

Check Components

This section provides tips on how to isolate problems with individual components of the terminal, including the display, touch screen, keypad, attached keyboard or mouse.

Display

This section provides tips on how to isolate problems with the display.

- **Check the brightness setting of the Display**. Is the display brightness dim or unreadable?

  From Configuration Mode, open Terminal Settings>Display Intensity.

- **Check the contrast setting of Display for 400 and 600 grayscale displays.** From Configuration Mode, open Terminal Settings>Display Contrast.
- **Check the Screen Saver settings**. Is the backlight turning off or dimming the display unexpectedly.

  From Configuration Mode, open Terminal Settings>Display>Screen Saver.

- **Check the LED indicators**. Do they flash during startup? Is power on and is the unit attempting to start?
- **Check the Display temperature (700 to 1500 only).** The display intensity will decrease to 40% if its temperature (or the temperature within the enclosure) is too high to reduce damage to the display. This can be checked using the RSView ME Events log.
- **Check the startup messages**. Is the Display operating at all and do the startup messages appear? Record any error message and refer to the Startup Error Messages table.
- **Replace the display module if all other attempts do not resolve problem (700 to 1500 only)**. If replacing the display module corrects the problem, then the Display was not functioning properly.

Touch Screen

This section provides tips on how to isolate problems with the Touch Screen.

- **Check the catalog number of the unit**. Verify that your terminal has a touch screen by looking at the label on the terminal.
- **Perform a calibration of the touch screen**. From Configuration Mode, open Terminal Settings>Input Devices>Touch Screen>Calibration. Follow the directions.

  The calibration requires four user screen touches. When the touches do not converge to a satisfactory calibration, you are asked repeatedly for additional screen touches and the calibration process never terminates. A touch screen that does not calibrate is not present or not functioning properly. Replace the display module (700 to 1500) or the terminal (400 and 600).
- **Check the Cursor Enable setting for the touch screen**. Is the cursor visible? From Configuration Mode, open Terminal Settings>Input Devices>Touch Screen>Cursor.
- **Check the pointer input by attaching a USB mouse**. If the mouse works, but the touch screen does not, then the touch driver or touch screen is not functioning properly. If both the mouse and the touch screen are not working, then it is an application problem.
- **Does touching or dragging on the screen appear to work?** If yes, even if incorrectly, the touch screen is present and working but requires calibration.
- **Replace the bezel or display module if all other attempts do not resolve the problem (700 to 1500 only)**. If replacing the display module or bezel corrects the problem, then the touch screen was not functioning properly.

Keypad

This section provides tips on how to isolate problems with the keypad:

- **Check the Multi-Key/Hold-Off settings**. From Configuration Mode, open Terminal Settings>Keypad>Keypad Settings.

  Is the Hold-Off Delay longer than expected, or are multiple key presses inhibited by Multi-Key Lockout? Check all configurable settings.
  Home, End, Page Up or Page Down are not supported when Multi-Key Lockout is enabled.
- **Check key input by attaching a USB keyboard**. If the keyboard works, but the keypad does not, then the keypad driver or keypad is not working. If both the keypad and keyboard are not working, then the problem may be the application.
- **Replace the display module if all other attempts do not resolve problem**. If replacing the display module corrects the problem, then the keypad was not functioning properly.

Mouse

This section provides tips on how to isolate problems with an attached mouse.

- **Check the Cursor Enable setting**. Is the cursor visible? From Configuration mode, open Terminal Settings>Input Devices>Touch Screen>Cursor. Also check mouse settings.
- **Check the USB cable and connection**. Detach and then reattach the mouse. Cycle power to the terminal.
- **Is the mouse a USB composite device?** If the mouse is a keyboard/mouse composite device, then try a standalone USB mouse.
- **Replace the USB mouse**. Try a different model or manufacturer.

  See Appendix B for a list of compatible mouse devices.

  You can also check the Knowledgebase at the http://support.rockwellautomation.com site for a list of USB devices that are compatible with the terminal.

  If attaching a new mouse resolves the problem, then the old mouse was not working or noncompliant.

Keyboard

This section provides tips on how to isolate problems with the keyboard.

- **Check for enabled Alt-Ctrl keys.** From Configuration Mode, open Terminal Settings>Input Devices>Keyboard>Keyboard Settings.

  Are the keys enabled as expected? Check all configurable settings in Keyboard Properties.
- **If the keypad is present, check input using the keypad**. If the keypad works, but the keyboard does not, then the keyboard driver or keyboard is probably not working. If both the keypad and the keyboard are not working, then it is probably an application problem.
- **Check the USB cable and connector**. Detach and re-attach the keyboard. Verify a good connection. Cycle power to the terminal.
- **Is the keyboard a USB composite device?** If the keyboard is a keyboard/mouse composite device, then try a stand-alone USB keyboard.
- **Replace the USB keyboard**. Try a different model or manufacturer

  See Appendix B for a list of compatible keyboards.

  You can also check the Knowledgebase at the http://support.rockwellautomation.com site for a list of USB devices that are compatible with the terminal.

  If a new keyboard resolves the problem, then the old keyboard was probably non-compliant.

Ethernet Connnection

This section provides tips on how to isolate Ethernet problems.

- **Check the LED indicators at the Ethernet connector**. The green LED indicates a communications link and should be ON. The amber LED indicates data activity and should be flashing. Verify that there is a connection to the hub?
- **Check the cable connections and quality of cable.** Check for good connections and things such as quality, crimping, hub connection, and uplink ports.
- **Check the IP Address of the Built-in Ethernet Controller**. From Configuration Mode, select Terminal Settings>Networks and Communications>Network Connections>Network Adapters.

  If DHCP is enabled, the device expects a valid IP address to be acquired within a several seconds after startup. The TCP/IP protocol automatically assigns 169.254.nnn.nnn when it fails to acquire an IP address from the server. In general, an IP address that begins with 169 will not support a network connection.

  A bad Ethernet connection and the absence of a valid IP address are typically reported in a Communications error message box with the Winsock critical error 10065 - No route to host.

- **Check for conflicting IP addresses**. If DHCP is not enabled, make sure the IP address you specify is not in conflict with the address of another device on the network.
- **Check the Device Name of the terminal**. Do not allow devices on the network with same (host) name. From Configuration Mode, open Terminal Settings>Communications and Networks>Network Connections>Device Name.
- **Contact your Network Administrator to check peer or server settings**. The other side of the Ethernet connection may also be a problem.

Advanced Diagnostics

- Take advantage of alternate connectivity - mouse versus touch screen, keyboard versus keypad, serial communications, and alternate Ethernet connections.
- Know useful keyboard shortcuts so that you can navigate around the system without a mouse or touch screen.
- From Configuration mode, select Terminal Settings>System Event Log to check the event log. Look for error conditions or reasons for unexpected reboots.
- Check the configuration settings in Configuration mode for incorrect settings.
- Most importantly, general troubleshooting thoroughness means getting answers to questions such as:
  - Does the failure always happen? Is it repeatable?
  - Does the failure happen at bootup or some other time? Is there a set of actions that reveal the problem?
  - Does the failure occur on just one terminal or on multiple machines? If more than one machine, what do they have in common? If not all machines, then what is different between machines that fail and those that don't?
  - What appears on the screen, the LED indicators?
  - Lastly, and most importantly; did everything work until recently? If so, what changed?

Startup Error Messages

When an error occurs, the terminal displays the error number with a text message. The word ERROR! appears under this line in different languages.

Displayed Message
ERROR! FEHLER! ERREUR! ERRORE!

Startup Error Messages

Error #	Displayed Message	Description	Recommended Corrective Action
1	RAM Test	RAM Test failure	Reset the terminal. 400 and 600: If error persists, replace the terminal. 700 to 1500: If error persists, reseat the SO-DIMM RAM module. If error still persists, replace the logic module.
14 (1)	RAM Header Check	OS firmware that is downloading is not compatible with hardware.	Check that you are using the correct version and type of firmware upgrade. Reset the terminal and upgrade with the correct firmware version.
20 (1)	Transfer Image	Programming the downloaded OS firmware into flash failed.	Reset the terminal and attempt the firmware upgrade again. If error persists, replace the terminal.
23	Download Task (1)	OS firmware that is downloading to the terminal is too large.	Check that you are using the correct version and type of firmware upgrade. Reset the terminal and upgrade with the correct firmware version.
	Internal CF (2)	Error programming the new OS firmware to internal compact flash.	Reload the firmware. If error persists, replace the internal compact flash. If error still persists, replace the logic module.
24	CRC Check	Checksum of the OS firmware failed.	Reload the firmware. 400 and 600: If error persists, replace the terminal. 700 to 1500: If error persists, replace the internal compact flash card. If error still persists, replace the logic module.
25 (1)	Invalid Prod Family	OS firmware that is downloading is not compatible with terminal.	Check that you are using the correct version and type of firmware upgrade. Reset the terminal and upgrade with the correct firmware version.
27 (1)	Decompress System	Error decompressing the OS firmware from flash to RAM.	Reload the firmware. If error persists, replace the terminal.
30	Watchdog Test	Watchdog test failure	Reload the firmware. 400 and 600: If error persists, replace the terminal. 700 to 1500: If error persists, replace the logic module.
31	Stuck Key	Function key failure	Check that nothing is pressed against a key. Reset the terminal without key presses. If error persists, replace display module.
31.5 (2)	Stuck Touch	Touch screen failure	Check that nothing is pressed against the touch screen. Reset the terminal without touch screen presses. If error persists, replace the display module.
32 (2)	Battery Test	Battery failure	Replace the battery. If error persists, replace the logic module.
33.5 (2)	NVRAM Access	Nonvolatile memory failure	Upgrade the system firmware to revision 3.10.03 or later.
3a (1)	Stuck Touch	Touch screen failure	Check that nothing is pressed against the touch screen. Reset the terminal without touch screen presses. If error persists, replace the terminal.
40	EXE Check	System OS firmware is missing or corrupt.	Reload the firmware. 400 and 600: If error persists, replace the terminal. 700 to 1500: If error persists, replace the internal compact flash card. If error still persists, replace the logic module.
50 (2)	External CF	Error loading the OS firmware from the external compact flash card.	Reload the firmware. If error persists, replace the external compact flash card and attempt the firmware upgrade again.

(1) The error number and message displays only on the 400 and 600 terminals.

(2) The error number and message displays only on the 700 to 1500 terminals.

Startup Information Messages

Startup messages display in a specific sequence on the terminal screen during startup and typically display for a few seconds. These messages indicate the startup sequence of the terminal but do not require that you perform any action.

Startup Information Messages

Message #	Displayed Message	Description
37 (1)	Video Initialized	Configures and initializes the graphics video system.
30	Watchdog Test	Tests the watchdog circuitry to verify system integrity.
1	RAM Test	Tests the RAM memory.
31 (1)	Stuck Key	Checks the integrity of the function key hardware.
31.5 (1)	Stuck Touch	Checks the integrity of the touch screen hardware.
32 (1)	Battery Test	Checks the integrity of the battery hardware.
2.5 (1)	Registry Search	Locates and loads the most recent, valid registry. Multiple copies of the registry are maintained. If power is lost during a registry update, a valid registry is available the next time power is applied to the terminal.
2	Image Search	Checks for new OS firmware upgrade on the external compact flash card and the serial port.
11 (2)	Downloading Image	Downloads a new OS firmware upgrade to internal RAM. Message may remain on screen for several minutes.
50 (1)	External CF	Transfers a new OS firmware upgrade from the external compact flash card to the terminal. Message may display for several minutes.
20 (2)	Transfer Image	Programs the OS firmware just downloaded into RAM. Message may remain on screen for several minutes.
23 (1)	Internal CF	Programs the OS firmware just downloaded into the internal flash memory. Message may display for several minutes.
24	CRC Check	Checks the integrity of the OS firmware.
27 (2)	Decompress System	Decompresses the compressed OS firmware into RAM.
28	Starting System	Launches the operating system (OS).
29	System Check ###	Checks internal file system integrity (### is percent progress indicator).
29.1	System Check	Disables internal file system integrity check. Contact technical support.

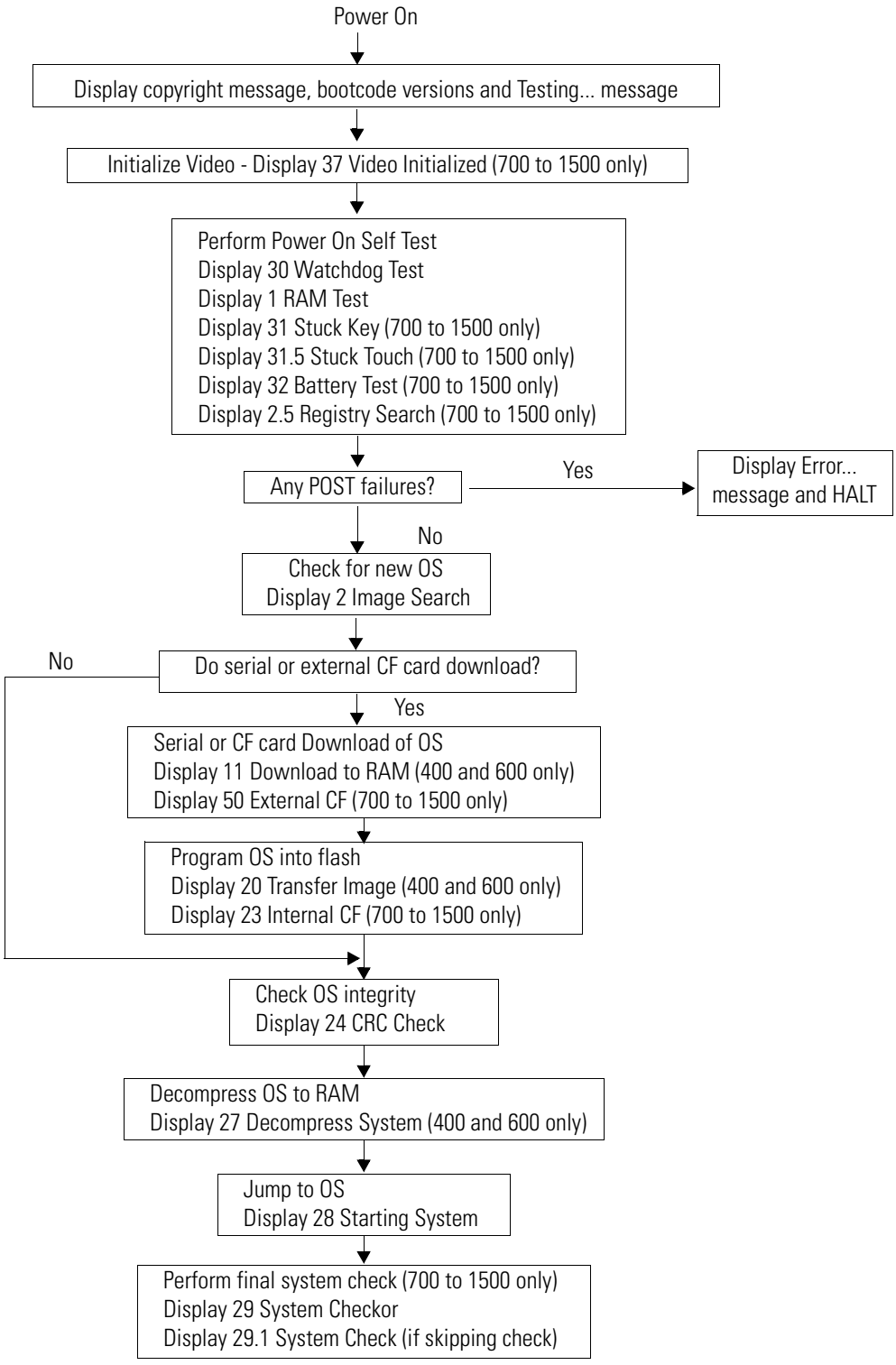
(1) The status number and message displays only on the 700 to 1500 terminals.

(2) The status number and message displays only on the 400 and 600 terminals.

Startup Sequence

This flow chart provides a sequence of startup operations for the terminal and shows system information messages that are displayed on the terminal.

Flowchart of Startup Sequence

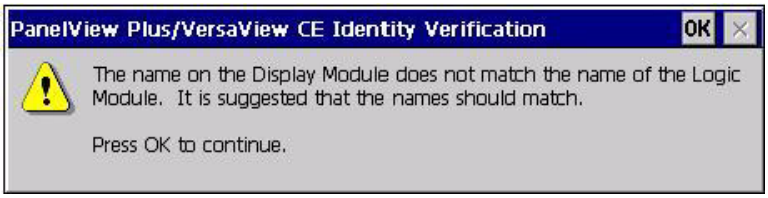


System Identification Errors

700 to 1500 only

The error messages in this section appear on startup if incorrect or invalid components are used with the 700 to 1500 terminals.

- This dialog appears if a VersaView CE logic module is attached to a PanelView display module or a PanelView Plus logic module is attached to a VersaView CE display module. We recommend that you use a VersaView CE display module with a VersaView CE logic module and a PanelView Plus display module with a PanelView Plus logic module. This is a warning letting you continue to operate.



- This dialog appears if the PanelView Plus logic module contains a 6189-RW*x* internal compact flash card for the VersaView CE terminal.

After pressing OK, you will be asked to power off the terminal and insert a valid 2711P-RW*x* internal compact flash card for the PanelView Plus terminal.

- This dialog appears if the VersaView CE logic module contains a 2711P-RW*x* internal compact flash card for the PanelView Plus terminal.

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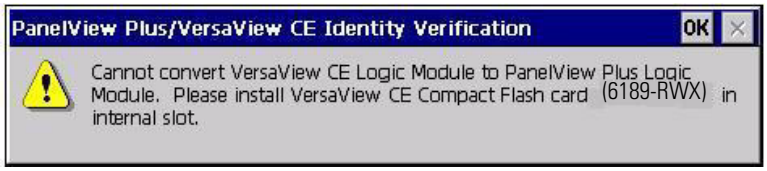
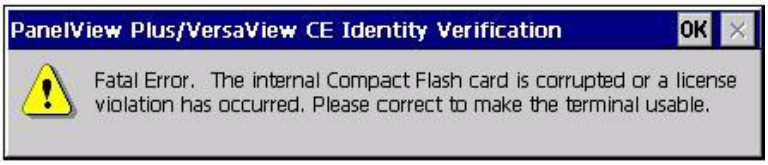


After pressing OK, you will be asked to power off the terminal and insert a valid 6189-RW*x* internal compact flash card for the VersaView CE terminal.

- This dialog appears if the internal compact flash in the PanelView Plus logic module is corrupt. This is a fatal error.



After pressing OK, you will be asked to power off the terminal and insert a valid 2711P-RW*x* internal compact flash card.

Startup

If the terminal is configured to enter configuration mode at startup and does not, then reload the firmware. See Chapter 7.

If the application does not start, there may be a problem with the .MER RSView Machine Edition file. Check for a startup screen and compatible version.

Enter Configuration Mode

To access configuration mode, your RSView .MER application must contain a screen with a Goto Configure mode button. When the terminal is running the application, you can press this button to access configuration mode.

Restart in Safe Mode

700 to 1500 only

The Safe mode restart option is targeted for VersaView CE terminals that may have additional software application programs loaded.

When you restart the PanelView Plus terminal in Safe mode:

1. The default operating system registry is loaded.
2. The operating system boots but RSView Machine Edition software is not started.
3. The operating system displays the 'ME may be corrupt' diagnostic screen.

   Disregard this message. RSView Machine Edition software is not corrupt; it has not been loaded on this boot cycle.
4. The next time you reset or power up the terminal, the system will start normally and run RSView Machine Edition software.

TIP Safe mode indicates that the terminal passes all startup self tests and can successfully launch the operating system. Safe mode is not a diagnostic function for the RSView Machine Edition application.

Clean the Display Window

ATTENTION

Use of abrasive cleaners or solvents may damage the display. Do not scrub or use brushes.

To clean the display window:

1. Disconnect power from the terminal at the power source.
2. Use a clean sponge or soft cloth with a mild soap or detergent to clean the display.
3. Dry the display with a chamois or moist cellulose sponge to avoid water spots.

Remove Paint and Grease

Remove fresh paint splashes and grease before drying by rubbing lightly with isopropyl alcohol (70% concentration). Afterward, wash using a mild soap or detergent. Rinse with clean water.

Use a protective antiglare overlay for easier cleaning of display window.

Specifications

Electrical

Attribute	Value
400 and 600 Input Voltage, dc Power Consumption, dc 700 to 1500 Input Voltage, dc Power Consumption, dc	 24V dc nom (18…30V dc) 25 W max. (1.0 A at 24V dc) 24V dc nom (18…32V dc) 70 W max. (2.9 A at 24V dc)
400 and 600 Input Voltage, ac Line Frequency Power Consumption, ac 700 to 1500 Input Voltage, ac Line Frequency Power Consumption, ac Remote Power 700 to 1500 (2711P-RSAC) Input Voltage, ac Line Frequency Power Consumption, ac	 85…264V ac 47…63 Hz 60V A max. 85…264V ac 47…63 Hz 160V A max. 85…264V ac 47…63 Hz 120V A max.
PCI Slot Max. Available Power dc Supply ac Supply	 11 W 5 W

Environmental

Attribute	Value
Operating Temperature	0…55 °C (32…131 °F)
Storage Temperature	-25…70 °C (-13…158 °F)
Heat Dissipation 400 and 600 700 to 1500	 85 BTU/hr 240 BTU/hr
Relative Humidity	5…95% without condensation
Altitude, Operating	2000 m (6561 ft)
Shock, Operating	15 g at 11 ms
Shock, Nonoperating	30 g at 11 ms
Vibration	10…57 Hz, 0.012 pk-pk displacement 57…500 Hz, 2 g pk acceleration
Enclosure Ratings	NEMA Type 12, 13, 4X (Indoor use only), IP54, IP65

Display

Attribute	Value
Display Type 400 and 600 Monochrome 600 to 1500 Color	 Monochrome Passive Matrix, Film Compensated Super-twist Nematic (FSTN) Color Active Matrix TFT Thin-film Transistor with LCD Liquid Crystal Display
Display Size, Diagonal 400 600 700 1000 1250 and 1250 High-bright 1500	 3.8 in. 5.5 in. 6.5 in. 10.4 in. 12.1 in. 15.0 in.
Display Area (WxH) 400 600 700 1000 1250 and 1250 High-bright 1500	 78 x 59 mm (3.07 x 2.32 in.) 111 x 84 mm (4.37 x 3.30 in.) 132 x 99 mm (5.20 x 3.90 in.) 211 x 158 mm (8.31 x 6.22 in.) 246 x 184 mm (9.69 x 7.25 in.) 304 x 228 mm (11.98 x 8.98 in.)
Resolution 400 600 700 1000 1250 and 1250 High-bright 1500	 320 x 240 320 x 240 640 x 480 640 x 480 800 x 600 1024 x 768
Luminance 700 to 1500 1250 High-bright	 300 cd/m^2 (Nits) 1000 cd/m^2 (Nits)
Backlight 400 600 to 1500 1250 High-bright	 LED CCFL 50,000 hours life, min. Backlight not replaceable
Touch Screen Touch Technology Actuation Rating Operating Force	 Analog resistive 1 million presses 10…110 g
Keypad Function Keys(1) Actuation Rating Operating Force	 Function keys, numeric and navigation 1 million presses 340 g

(1) number of function keys varies by terminal size.

Mechanical

Attribute	Value
Weight , Approx., HxWxD (for base unit without modules)	
400 Keypad[1]	562 g (1.24 lb)
600 Keypad or Keypad and Touch[1]	930 g (2.05 lb)
600 Touch[1]	789 g (1.74 lb)
700 Keypad or Keypad and Touch	1.9 kg (4.2 lb)
700 Touch	1.7 kg (3.8 lb)
1000 Keypad or Keypad and Touch	2.9 kg (6.3 lb)
1000 Touch	2.6 kg (5.7 lb)
1250 Keypad or Keypad and Touch	3.4 kg (7.6 lb)
1250 Touch and 1250 High-bright Touch	3.2 kg (7.1 lb)
1500 Keypad or Keypad and Touch	4.6 kg (10.0 lb)
1500 Touch	4.2 kg (9.3 lb)
Dimensions, Approx. HxWxD (for base unit without communication module)	
400 Keypad	152 x 185 x 90 mm (6.0 x 7.28 x 3.54 in.)
600 Keypad or Keypad and Touch	167 x 266 x 98 mm (6.58 x 10.47 x 3.86 in.)
600 Touch	152 x 185 x 98 mm (6.0 x 7.28 x 3.86 in.)
700 Keypad or Keypad and Touch	193 x 290 x 55 mm (7.58 x 11.40 x 2.18 in.)
700 Touch	179 x 246 x 55 mm (7.04 x 9.68 x 2.18 in.)
1000 Keypad or Keypad and Touch	248 x 399 x 55 mm (9.77 x 15.72 x 2.18 in.)
1000 Touch	248 x 329 x 55 mm (9.77 x 12.97 x 2.18 in.)
1250 Keypad or Keypad and Touch	282 x 416 x 55 mm (11.12 x 16.36 x 2.18 in.)
1250 Touch	282 x 363 x 55 mm (11.12 x 14.30 x 2.18 in.)
1250 Touch High-bright	282 x 363 x 74 mm (11.12 x 14.30 x 2.90 in.)
1500 Keypad or Keypad and Touch	330 x 469 x 65 mm (12.97 x 18.46 x 2.55 in)
1500 Touch	330 x 416 x 65 mm (12.97 x 16.37 x 2.55 in)

(1) Add approximately 95 g (0.21 lb) for communication module.

General

Attribute	Value
Battery Life 400 and 600 700 to 1500	 5 years min. at 25 °C (77 °F) 4 years min. at 25 °C (77 °F)
Clock	Battery-backed, +/-2 minutes per month
LED Indicators	COMM (Green), Fault (Red)
Application Flash Memory 400 and 600, Series A 400 and 600, Series B or later 700 to 1500 Logic Modules, Series A to D 700 to 1500 Logic Modules, Series E or later 2711P-RW1 2711P-RW2 2711P-RW3	 5 MB 10 MB 12 MB 26 MB 72 MB 195 MB
External Compact Flash Storage	512 MB max.

Agency Certifications

UL Listed Industrial Control Equipment UL Listed Industrial Control Equipment for use in Canada UL Listed Industrial Control Equipment for use in: • Class I, Div 2, Group A, B, C, D • Class I, Zone 2, Group IIC (1) • Class II, Div 2 Groups F, G • Class III Hazardous Locations
CE marked for all applicable directives
C-Tick

(1) Applies only to the 1250 high-bright display module.

Compatible USB Devices

The following table provides a list of compatible USB devices that can be used on the USB ports of the terminals.

Compatible USB Devices

Device	Vendor	Model	PanelView Plus 700 to 1500	PanelView Plus 400 and 600
USB Keyboard	Rockwell Automation	Cat. No. 6189-KBDEPU1U	Yes	Yes
	Ortek	MCK-600USB	Yes	Yes
	Dell	RT7D10	Yes	Yes
USB Keyboard/Mouse	Rockwell Automation	Cat. No. 6189-KBDEPC1U	Yes	No
USB Mouse	Logitec	Optical Mouse - M-BJ58	Yes	Yes
	Microsoft	Intellimouse D58-00026	Yes	Yes
	Atek	USB Mouse	Yes	No
	VersaView (Rockwell Automation)	USB Mouse	Yes	Yes
USB Hub	Belkin	USB 4-Port Hub - ESU021	Yes	Yes

Available Fonts for Terminal Applications

The following fonts are pre-installed on PanelViewPlus/VersaView CE terminals:

- True Type fonts (scalable)
  - Tahoma.ttf (proportional)
  - Courier.ttf (fixed width)
  - Arial.ttf (proportional)
- 23 fonts of various sizes migrated from PanelView Standard and PanelView e terminals (various sizes)

To simplify the creation and downloading of .mer application files on these devices, use the above list of fonts when developing screens in RSView Studio software.

Additional fonts are available in RSView Studio software when developing application screens.

- If the font used to develop screens is not available on the target device, the closest font is selected.
- If bold or italics is used, and a separate bold or italics font is unavailable, then the target operating system will use an algorithm to produce these affects.

In either case, the device screens will look different than they do in RSView Studio software.

Download Fonts to Terminal

To use additional fonts on a PanelView Plus/VersaView CE device, copy any of the font files on the VersaView CE Accessories CD or the RSView Machine Edition Fonts CD to the following directory on the computer where RSView Studio software is installed:

c:\Documents and Settings\All Users\Documents\RSView Enterprise\ME\Runtime

You can now use the File Transfer Utility in RSView Studio software to download the font files to the target device:

1. Select Tools>Transfer Utility.
2. Select Source File>True Type Fonts.
3. Select a font file to download to the device and press the Download button.

VersaView CE Accessories CD

The following True Type fonts are included on the VersaView CE Accessories CD:

- Times New Roman.ttf
- Symbol.ttf
- Wingdings.ttf

This CD is not supplied with PanelView Plus terminals.

RSView Machine Edition Fonts CD

Additional fonts are available on a CD, titled RSView Machine Edition Fonts. This CD is available from your local distributor.

For additional information, refer to the Rockwell Automation Knowledgebase at http://support.rockwellautomation.com. Select Knowledgebase under Online Tools and then enter Tech Note ID A66647102.

Available Fonts

Fonts	File Name	Size (Bytes)
Arial		
Arial (Subset 1_30)	arial_1_30.ttf	153,720
Arial Black	arialk.ttf	117,028
Arial Bold	arialbd.ttf	288,496
Arial Bold Italic	arialbi.ttf	226,748
Arial Italic	ariali.ttf	207,808
Comic Sans MS		
Comic Sans MS	comic.ttf	126,364
Comic Sans MS Bold	comicbd.ttf	111,476
Courier New		
Courier New (Subset 1_30)	cour_1_30.ttf	162,460
Courier New Bold	courbd.ttf	312,920
Courier New Bold Italic	courbi.ttf	236,148
Courier New Italic	couri.ttf	245,032
Georgia		
Georgia	georgia.ttf	149,628
Georgia Bold	georgiab.ttf	141,032
Georgia Bold Italic	georgiaz.ttf	159,736
Georgia Italic	georgiai.ttf	157,388
Impact	impact.ttf	136,076
Kino	kino.ttf	28,872
MSLogo	mslogo.ttf	2,500
Symbol	symbol.ttf	69,464
Tahoma		
Tahoma (Subset 1_07)	tahoma_1_07.ttf	123,980
Tahoma Bold	tahomabd.ttf	295,432
Times New Roman		
Times New Roman (Subset 1_30)	times_1_30.ttf	184,976
Times New Roman Bold	timesbd.ttf	334,944
Times New Roman Bold Italic	timesbi.ttf	239,692
Times New Roman Italic	timesi.ttf	248,368

Fonts	File Name	Size (Bytes)
Trebuchet MS		
Trebuchet MS	trebuc.ttf	69,688
Trebuchet MS Bold	trebucbd.ttf	66,444
Trebuchet MS Bold Italic	trebucbi.ttf	66,348
Trebuchet MS Italic	trebucit.ttf	72,560
Verdana		
Verdana	verdana.ttf	149,752
Verdana Bold	verdanab.ttf	137,616
Verdana Bold Italic	verdanaz.ttf	154,800
Verdana Italic	verdanai.ttf	155,076
Webdings	webdings.ttf	118,752
Wingding	wingding.ttf	81,000
Chinese (Simplified) Locale Specific Support		
Simsun & NSimSun		
Simsun & NSimSun	simsun.ttc	10,500,400
Simsun & NSimSun (Subset 2_50)	simsun_2_50.ttc	3,051,024
Simsun & NSimSun (Subset 2_60)	simsun_2_60.ttc	3,578,692
Simsun & NSimSun (Subset 2_70)	simsun_2_70.ttc	6,975,948
Simsun & NSimSun (Subset 2_80)	simsun_2_80.ttc	8,116,188
Simsun & NSimSun (Subset 2_90)	simsun_2_90.ttc	9,066,640
SC_Song	sunfon.ttf	4,686,044
Chinese (Traditional) Locale Specific Support		
MingLiU & PMingLiU (Choose 1)		
MingLiU & PMingLiU	mingliu.ttc	8,822,400
MingLiU & PMingLiU (Subset 2_70)	mingliu_2_70.ttc	4,786,488
MingLiU & PMingLiU (Subset 2_80)	mingliu_2_80.ttc	5,772,700
MingLiU & PMingLiU (Subset 2_90)	mingliu_2_90.ttc	7,354,808
MSMing	msming.ttf	3,172,552
Japanese Locale Specific Support		
MS Gothic		
MS Gothic & P Gothic & UI Gothic	msgothic.ttc	8,272,028
MS Gothic & P Gothic & UI Gothic (Subset 1_50)	msgothic_1_50.ttc	4,456,536
MS Gothic & P Gothic & UI Gothic (Subset 1_60)	msgothic_1_60.ttc	6,057,400
MS Gothic & P Gothic & UI Gothic (Subset 1_70)	msgothic_1_70.ttc	3,795,500
MS Gothic & P Gothic & UI Gothic (Subset 1_80)	msgothic_1_80.ttc	5,438,776
MS Gothic & P Gothic & UI Gothic (Subset 1_90)	msgothic_1_90.ttc	6,408,352
MS Gothic & P Gothic (Subset 30)	msgothic30.ttc	4,197,524
MS Gothic & P Gothic (Subset 30_1_19)	msgothic30_1_19.ttc	3,304,056

Fonts	File Name	Size (Bytes)
Korean Locale Specific Support		
GL_CE	gl_ce.ttf	4,130,084
Gulim & GulimChe (Choose 1)		
Gulim & GulimChe (Subset 1_30)	gulim_1_30.ttc	3,010,268
Gulim & GulimChe (Subset 1_40)	gulim_1_40.ttc	4,683,896
Gulim & GulimChe (Subset 1_50)	gulim_1_50.ttc	7,128,756
Gulim & GulimChe (Subset 1_60)	gulim_1_60.ttc	9,360,100

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Rockwell Automation Support

Rockwell Automation provides technical information on the Web to assist you in using its products. At http://support.rockwellautomation.com, you can find technical manuals, a knowledge base of FAQs, technical and application notes, sample code and links to software service packs, and a MySupport feature that you can customize to make the best use of these tools.

For an additional level of technical phone support for installation, configuration, and troubleshooting, we offer TechConnect Support programs. For more information, contact your local distributor or Rockwell Automation representative, or visit http://support.rockwellautomation.com.

Installation Assistance

If you experience a problem with a hardware module within the first 24 hours of installation, please review the information that's contained in this manual. You can also contact a special Customer Support number for initial help in getting your module up and running.

United States	1.440.646.3223 Monday – Friday, 8am – 5pm EST
Outside United States	Please contact your local Rockwell Automation representative for any technical support issues.

New Product Satisfaction Return

Rockwell tests all of its products to ensure that they are fully operational when shipped from the manufacturing facility. However, if your product is not functioning, it may need to be returned.

United States	Contact your distributor. You must provide a Customer Support case number (see phone number above to obtain one) to your distributor in order to complete the return process.
Outside United States	Please contact your local Rockwell Automation representative for return procedure.

www.rockwellautomation.com

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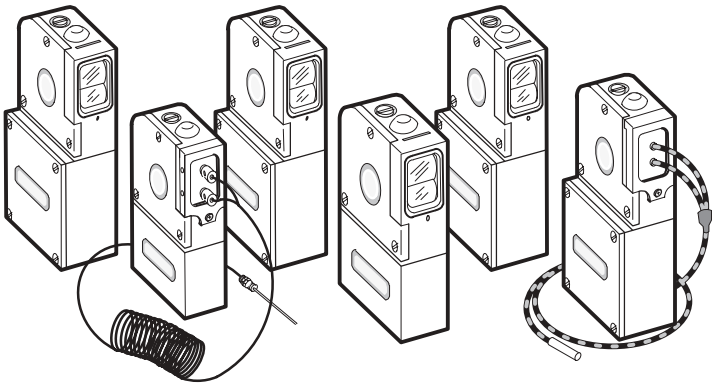


Description

The Green Line of the Series 5000 photoelectric sensor family is a full featured, multi-voltage solution for use in general purpose applications. Like all other Series 5000 sensors, the sensor consists of a power/terminal base and a separate photohead that houses the electronics. In the event that the head needs to be replaced, it can be done so without disturbing any wiring or realignment.

Along with the modular power/terminal base and photohead, the Green Line sensor also has provisions for plug-in output modules and optional logic modules. Application flexibility is now increased because the user may select from a wide variety of output types, operating voltages, and logic, i.e. timing, functions, etc.

A single red LED indicator located on the top of the photohead provides a visual indication of the sensor output state. This output can be set to activate in either a light or dark operate mode. A single-turn sensitivity adjustment is provided on the top cover for use in the installation phase.

Features

- Modular package for increased flexibility
- Economical DC-powered sensor
- Wide variety of sensing modes
- Selectable light/dark operation
- Both NPN and PNP outputs
- Screw terminal or cable connections

General Specifications

Light Source	See Product Selection table
Unit Protection	False pulse
Supply Voltage	24V DC, 24V AC, 120V AC, 220V AC
Current Consumption	4VA maximum
Output Type	Determined by plug-in module—see page 1–255
Output Mode	Light/dark operate selectable
Output Rating	Determined by plug-in module—see page 1–255
Response Time	Determined by plug-in module—see page 1–255
Housing Material	Valox®
Lens Material	Acrylic (glass on polarized models)
LED Indicators	See User Interface on page 1–270
Connection Types	4-pin DC mini QD, 5-pin DC mini QD, screw terminal
Supplied Accessories	None
Optional Accessories	Mounting brackets, reflectors, cordsets
Operating Environment	NEMA 3, 4, 12, 13 (IP66)
Vibration	10–55Hz, 1mm amplitude, Meets or exceeds IEC 60947–5–2
Shock	30g with 1ms pulse duration, Meets or exceeds IEC 60947–5–2
Operating Temperature	–40°C to +65°C (–40°F to +150°F) for EM relay –40°C to +52°C (–40°F to +125°F) for solid state
Relative Humidity	90% maximum
Approvals	UL listed, CSA certified, and CE marked for all applicable directives

General Information

Wiring Diagrams . . . . . page 1–270
Dimensions . . . . . page 1–256

Sensing Modes

Retroreflective . . . . . page 1–271
Polarized Retroflective . . . page 1–272
Standard Diffuse . . . . . page 1–273
Wide Angle Diffuse page 1–275, 1–276
Fixed Focus Diffuse page 1–275, 1–276
Transmitted Beam . . . . . page 1–274
Infrared Glass Fiber Optic/Fixed Focus/Wide Angle Diffuse page 1–275
Visible Red Plastic Fiber Optic/ Fixed Focus/
Wide Angle Diffuse . . . . . page 1–276
Background Suppression . page 1–277

Accessories

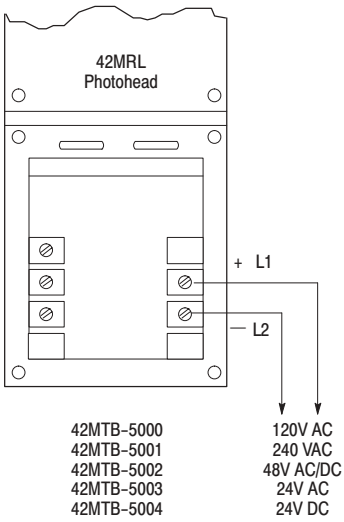
Mounting Assemblies . . . . page 1–375
Right Angle Mirror Adaptor page 1–380
Counter and Totalizer . . . . page 1–380
Protective Photoguard . . . . page 1–380
NEMA 7 and 9 Enclosure . page 1–380
Reflectors, Reflective Tape page 1–386

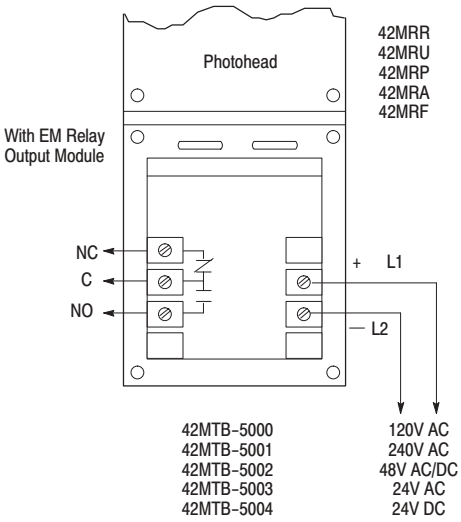
User Interface Panel

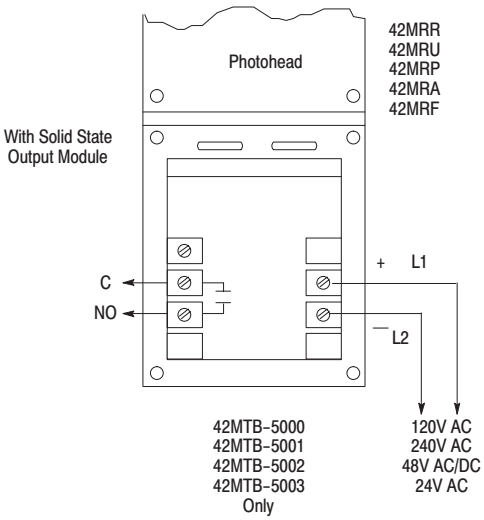
Label	Color	State	Status
Output	Red	OFF	Sensor output de-activated
		ON	Sensor output activated

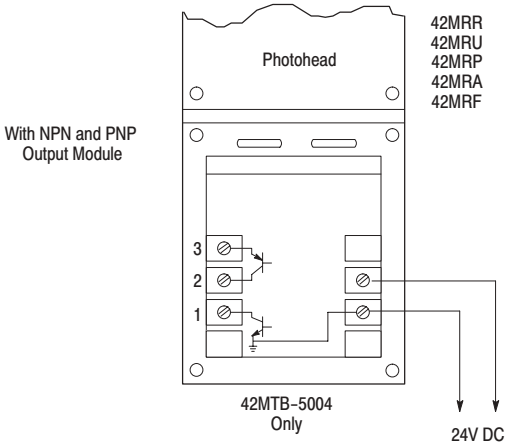
Wiring Diagrams

With Terminal Style Power Base



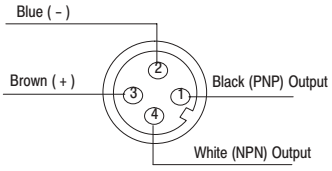




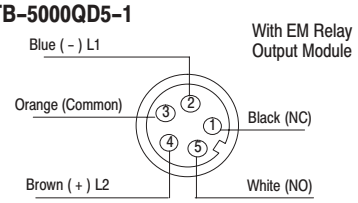


With Mini Quick-Disconnector Style Power Base

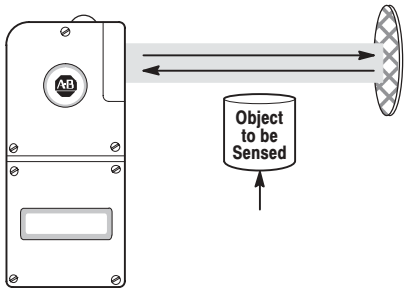
42MTB-5004QD4-1



42MTB-5000QD5-1



Note: Details of connection of Allen-Bradley Series 5000 photoelectric sensors to Allen-Bradley Programmable Controllers can be found in publication 42-2.0.
Wire colors shown refer to Allen-Bradley quick-disconnect cables.



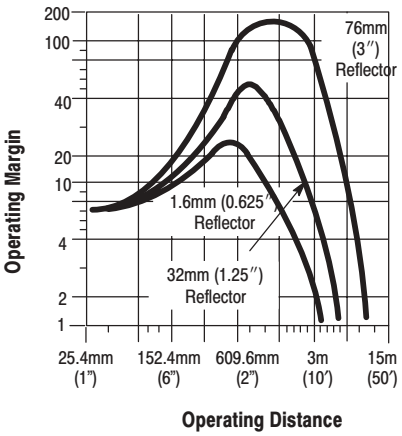
Specifications

Field of View	2.5°
Emitter LED	Infrared red 880nm

QD Cordsets and Accessories

Description	Catalog/Page Number
Terminal Chambers	7–20
Screw Terminal	**42MTB–5000**
5-pin DC Mini QD	**42MTB–5000–QD5–1**
Right Angle Bracket	**60–1785**
Conduit Adaptor 1/2in NPT	**60–2213**
Armoured Cable Adaptor	**60–1577**
76mm (3in) Diameter Reflector	**92–39**
32mm (1.25in) Diameter Reflector	**92–47**

Typical Response Curve



Product Selection

1. Select Photohead.

Sensing Distance	Output Energized	Sensor Response Time❶	Catalog Number
50.8mm (2in) to 10m (33ft) with 76mm (3″) Reflector	Light/Dark Selectable	1ms	**42MRU–5000**

2. Select Power Base (required).

Operating Voltage	Supply Current	Catalog Number	
		Terminal Style	Mini Quick-Disconnect Style
102–132V AC, 50–60Hz	2VA	**42MTB–5000**	**42MTB–5000QD5–1**
204–254V AC, 50–60Hz	4VA	**42MTB–5001**	—
40–54V AC/DC, 50–60Hz	1VA	**42MTB–5002**	—
20–30V AC, 50–60Hz		**42MTB–5003**	—
20–30V DC		**42MTB–5004**	**42MTB–5004QD4–1** ❶

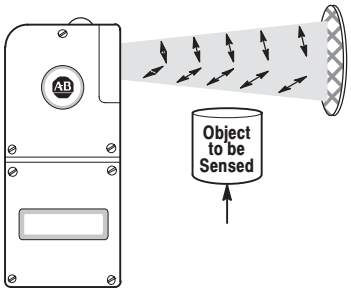
❶ Prewired for use with output 8–593 only.

3. Select output module on page 1–255.

4. Select optional logic module on page 1–255.

Series 5000 Polarized Retroreflective

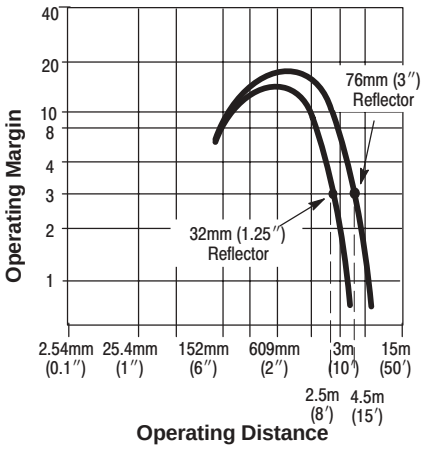
Green Line



QD Cordsets and Accessories

Description	Catalog/Page Number
Terminal Chambers	7–20
Screw Terminal	**42MTB–5000**
5-pin DC mini QD	**42MTB–5000–QD5–1**
Right Angle Bracket	**60–1785**
Conduit Adaptor 1/2in NPT	**60–2213**
Armoured Cable Adaptor	**60–1577**
76mm (3in) Diameter Reflector	**92–39**
32mm (1.25in) Diameter Reflector	**92–47**

Typical Response Curve



Specifications

Field of View	2.5°
Emitter LED	Visible Red 660nm

Product Selection

1. Select Photohead.

Sensing Distance	Output Energized	Sensor Response Time❶	Catalog Number
50.8mm (2in) to 6m (20ft) with 76mm (3″) Reflector	Light/Dark Selectable	2.5ms	**42MRU–5200**

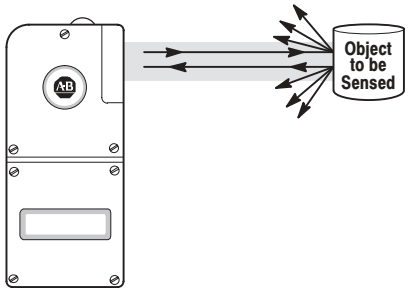
2. Select Power Base.

Operating Voltage	Supply Current	Catalog Number	
		Terminal Style	Mini Quick-Disconnect Style
102–132V AC, 50–60Hz	2VA	**42MTB–5000**	**42MTB–5000QD5–1**
204–254V AC, 50–60Hz	4VA	**42MTB–5001**	—
40–54V AC/DC, 50–60Hz	1VA	**42MTB–5002**	—
20–30V AC, 50–60Hz		**42MTB–5003**	—
20–30V DC		**42MTB–5004**	**42MTB–5004QD4–1** ❶

❶ Prewired for use with output 8–593 only.

3. Select output module on page 1–255.

4. Select optional logic module on page 1–255.



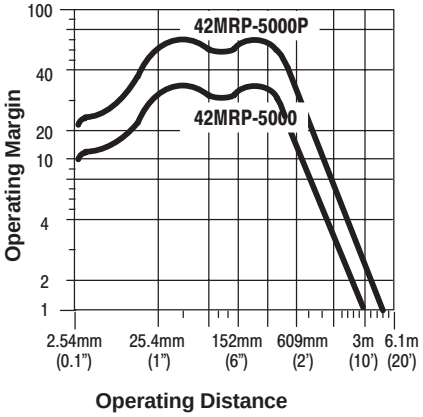
Specifications

Field of View	3°
Emitter LED	Infrared 880nm

QD Cordsets and Accessories

Description	Catalog/Page Number
Terminal Chambers	7–20
Screw Terminal	**42MTB–5000**
5-pin DC mini QD	**42MTB–5000–QD5–1**
Right Angle Bracket	**60–1785**
Conduit Adaptor 1/2in NPT	**60–2213**
Armoured Cable Adaptor	**60–1577**

Typical Response Curve



Product Selection

1. Select Photohead.

Sensing Mode	Sensing Distance	Output Energized	Sensor Response Time❶	Catalog Number
Standard Diffuse	Short Range: 50.8mm (2in) to 3m (10ft) with White Paper	Light/Dark Selectable	2.5ms	**42MRP–5000**
Long Range Diffuse	Long Range: 50.8mm (2in) to 4.8m (16ft) with White Paper			**42MRP–5000P**

2. Select Power Base.

Operating Voltage	Supply Current	Catalog Number	
		Terminal Style	Mini Quick-Disconnect Style
102–132V AC, 50–60Hz	2VA	**42MTB–5000**	**42MTB–5000QD5–1**
204–254V AC, 50–60Hz	4VA	**42MTB–5001**	—
40–54V AC/DC, 50–60Hz	1VA	**42MTB–5002**	—
20–30V AC, 50–60Hz		**42MTB–5003**	—
20–30V DC		**42MTB–5004**	**42MTB–5004QD4–1** ❶

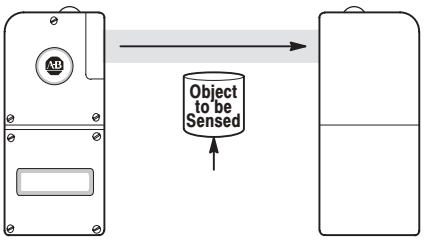
❶ Prewired for use with output 8–593 only.

3. Select output module on page 1–255.

4. Select optional logic module on page 1–255.

Series 5000 Transmitted Beam

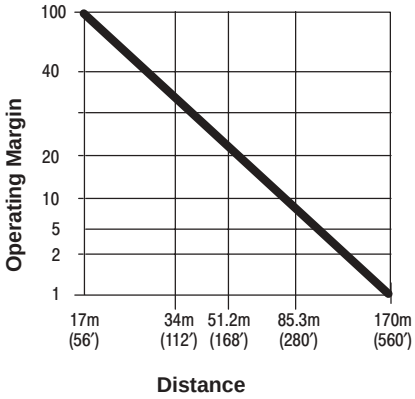
Green Line



QD Cordsets and Accessories

Description	Catalog/Page Number
Terminal Chambers	7–20
Screw Terminal	**42MTB–5000**
5-pin DC mini QD	**42MTB–5000–QD5–1**
Right Angle Bracket	**60–1785**
Conduit Adaptor 1/2in NPT	**60–2213**
Armoured Cable Adaptor	**60–1577**

Typical Response Curve



Specifications

Field of View	3°
Emitter LED	Infrared 880nm

Product Selection

1. Order one of each Photohead.

Sensing Mode	Sensing Distance	Output Energized	Sensor Response Time❶	Catalog Number
Transmitted Beam Receiver	25.4mm (1in) to 171m (560ft)	Light/Dark Selectable	5ms	**42MRR–5000**
Transmitted Beam Lightsource		—	N/A	**42MRL–5000**

2. Select Power Bases (two required).

Operating Voltage	Supply Current	Catalog Number	
		Terminal Style	Mini Quick-Disconnect Style
102–132V AC, 50–60Hz	2VA	**42MTB–5000**	**42MTB–5000QD5–1**
204–254V AC, 50–60Hz	4VA	**42MTB–5001**	—
40–54V AC/DC, 50–60Hz	1VA	**42MTB–5002**	—
20–30V AC, 50–60Hz		**42MTB–5003**	—
20–30V DC		**42MTB–5004**	**42MTB–5004QD4–1** ❶

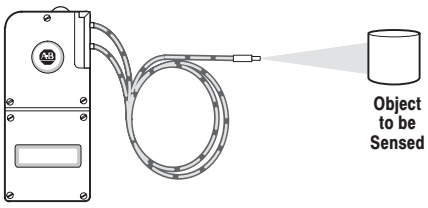
❶ Prewired for use with output 8–593 only.

3. Select output module on page 1–255.

4. Select optional logic module on page 1–255.

Series 5000 Infrared Glass Fiber Optic/Fixed Focus/Wide Angle Diffuse

Green Line



Specifications

Field of View	Determined by fiber optics or lens type
Emitter LED	Infrared 880nm

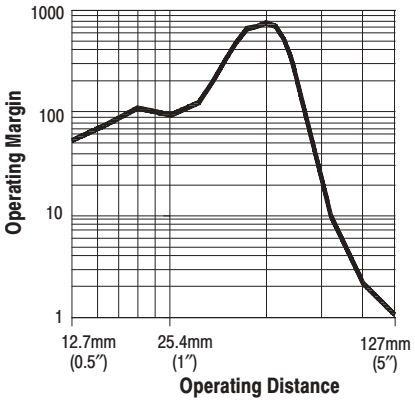
QD Cordsets and Accessories

Description	Catalog/Page Number
Terminal Chambers	7–20
Screw Terminal	**42MTB–5000**
5-pin DC mini QD	**42MTB–5000–QD5–1**
Right Angle Bracket	**60–1785**
Conduit Adaptor 1/2in NPT	**60–2213**
Armoured Cable Adaptor	**60–1577**

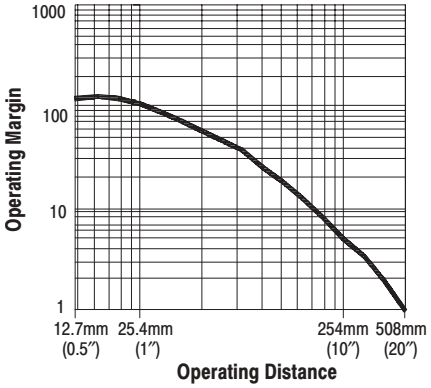
Typical Response Curve

Depends on Fiber Optics and lens type selected. See Fiber Optic sections page 1–292, and curves below for lens types.

Fixed Focus Lens



Wide Angle Lens



Product Selection

1. Select Photohead.

Sensing Mode	Sensing Distance	Output Energized	Sensor Response Time❶	Catalog Number
Fiber Optic	Depends on Fiber Optic selected.	Light/Dark Selectable	2.5ms	**42MRA–5000FO**
Fixed Focus	5.08mm (0.2in) to 172mm (5in)			**42MRA–5000FF**
Wide Angle Diffuse	5.08mm (0.2in) to 508mm (20in)			**42MRA–5000WA**

2. Select Power Base.

Operating Voltage	Supply Current	Catalog Number	
		Terminal Style	Mini Quick-Disconnect Style
102–132V AC, 50–60Hz	2VA	**42MTB–5000**	**42MTB–5000QD5–1**
204–254V AC, 50–60Hz	4VA	**42MTB–5001**	—
40–54V AC/DC, 50–60Hz	1VA	**42MTB–5002**	—
20–30V AC, 50–60Hz		**42MTB–5003**	—
20–30V DC		**42MTB–5004**	**42MTB–5004QD4–1** ❶

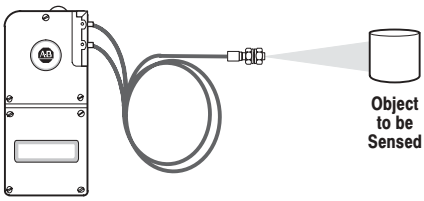
❶ Prewired for use with output 8–593 only.

3. Select output module on page 1–255.

4. Select optional logic module on page 1–255.

Series 5000 Visible Red Fiber Optic/Fixed Focus/Wide Angle Diffuse

Green Line



Specifications

Field of View	Determined by fiber optics or lens type
Emitter LED	Visible red 660nm

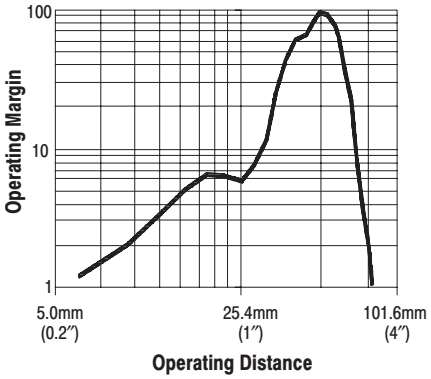
QD Cordsets and Accessories

Description	Catalog/Page Number
Terminal Chambers	7–20
Screw Terminal	**42MTB–5000**
5-pin DC mini QD	**42MTB–5000–QD5–1**
Right Angle Bracket	**60–1785**
Conduit Adaptor 1/2in NPT	**60–2213**
Armoured Cable Adaptor	**60–1577**

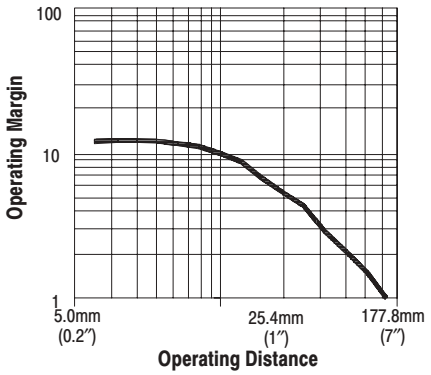
Typical Response Curve

Depends on Fiber Optics and lens type selected. See Fiber Optic sections, pages 1–292, and curves below for lens types.

Fixed Focus Lens



Wide Angle Lens



Product Selection

1. Select Photohead.

Sensing Mode	Sensing Distance	Output Energized	Sensor Response Time❶	Catalog Number
Fiber Optic	Depends on Fiber Optic selected.	Light/Dark Selectable	2.5ms	**42MRF–5000FO**
Fixed Focus	5.08mm (0.2in) to 76mm (3in)			**42MRF–5000FF**
Wide Angle Diffuse	5.08mm (0.2in) to 170mm (6.7in)			**42MRF–5000WA**

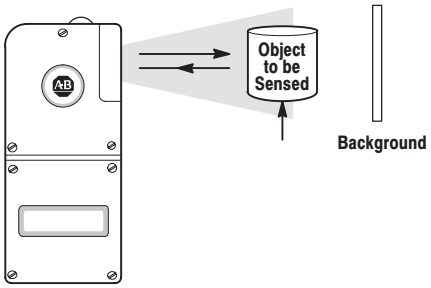
2. Select Power Base.

Operating Voltage	Supply Current	Catalog Number	
		Terminal Style	Mini Quick-Disconnect Style
102–132V AC, 50–60Hz	2VA	**42MTB–5000**	**42MTB–5000QD5–1**
204–254V AC, 50–60Hz	4VA	**42MTB–5001**	—
40–54V AC/DC, 50–60Hz	1VA	**42MTB–5002**	—
20–30V AC, 50–60Hz		**42MTB–5003**	—
20–30V DC		**42MTB–5004**	**42MTB–5004QD4–1** ❶

❶ Prewired for use with output 8–593 only.

3. Select output module on page 1–255.

4. Select optional logic module on page 1–255.

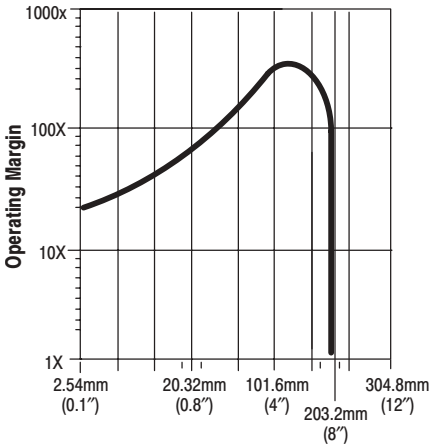


QD Cordsets and Accessories

Description	Catalog/Page Number
Terminal Chambers	7–20
Screw Terminal	**42MTB–5000**
5-pin DC mini QD	**42MTB–5000–QD5–1**
Right Angle Bracket	**60–1785**
Conduit Adaptor 1/2in NPT	**60–2213**
Armoured Cable Adaptor	**60–1577**

Typical Response Curve

Example: Operating distance set at 8in.



Specifications

Field of View	3°
Emitter LED	Infrared 880nm

Product Selection

1. Select Photohead

Sensing Mode	Sensing Distance	Output Energized	Timing		Sensor Response Time❶	Catalog Number
			Function	Range		
Background Suppression Without Timing	Suppression Point Adjustment Range 50.8mm (2in) to 63.5mm – 304.8mm (2.5in – 12in)	Light/Dark Selectable	—	—	5ms	**42MBS–5000**
Background Suppression With Timing			Selectable On Delay Off Delay On & Off Delay One-shot Delayed One-shot	0–1.5 Sec 0–15 Sec Selectable		**42MBS–5100**

2. Select Power Base.

Operating Voltage	Supply Current	Catalog Number	
		Terminal	Mini Quick-Disconnect
102–132V AC, 50–60Hz	2V A	**42MTB–5000**	**42MTB–5000QD5–1**
204–264V AC, 50–60Hz	4V A	**42MTB–5001**	—
40–54V AC/DC, 50–60Hz	1V A	**42MTB–5002**	—
20–30V AC, 50–60Hz		**42MTB–5003**	—
20–30V DC		**42MTB–5004**	**42MTB–5004QD4–1** ❶

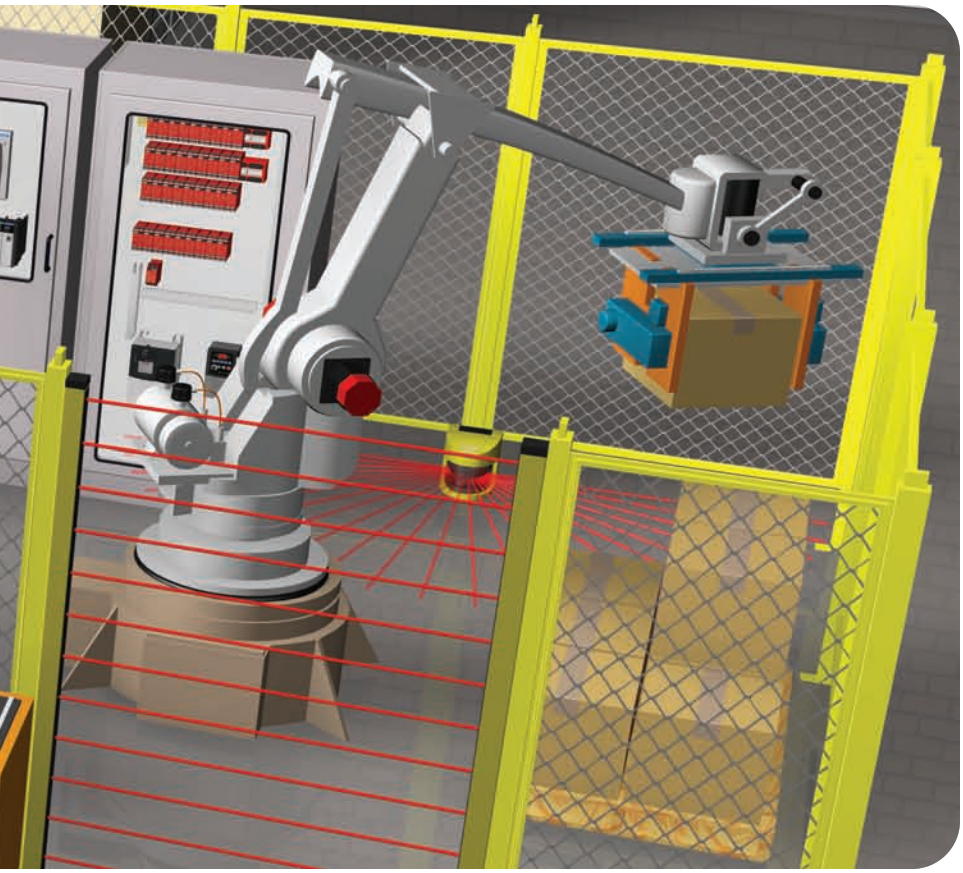
❶ Prewired for use with output 8–593 only.

3. Select output module on page 1–255.

Allen-Bradley

Guardmaster®

Safety Products



- Principles, Standards, & Implementation
- Presence Sensing Safety Devices
- Safety Switches
- Operator Interface
- Logic
- Power
- Connection Systems
- Applied Safety Solutions
- Safety Applications

LISTEN. THINK. SOLVE.®

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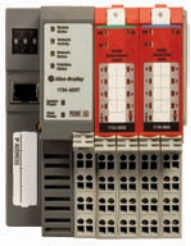

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What Is Preferred Availability?

Products with Preferred Availability are our most commonly ordered items and are typically in factory stock. In this catalog, Preferred Availability products are indicated by ***bold*** *catalog numbers for your convenience.*

The latest Functional Safety Data and SISTEMA library for Rockwell Automation safeguarding products can be found at:
http://discover.rockwellautomation.com/Functional_Safety_DS

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Important User Information

Because of the variety of uses for the products described in this publication, those responsible for the application and use of this control equipment must satisfy themselves that all necessary steps have been taken to assure that each application and use meets all performance and safety requirements, including any applicable laws, regulations, codes and standards.

The Illustrations, charts, sample programs and layout examples shown in this catalog are intended solely for purposes of example. Since there are many variables and requirements associated with any particular installation, Rockwell Automation does not assume responsibility or liability including intellectual property liability, for actual use based upon the examples shown in this publication.

Related Safety Information

The installer is responsible for the safety of the entire installed control system and for meeting all applicable laws, codes, and safety requirements.

ATTENTION: As the installer of this control system, you must be knowledgeable of other applicable standards pertaining to safety recommendations related to:
- Machine Construction
- General Electrical
- Machine Guarding
- Point of Operation guards, safety light curtains, mechanical guards, and two-hand controls, and safety monitoring relays

In addition to local laws and codes, you are responsible for the safety recommendations detailed in all applicable national and international codes and standards including:
- National Electric Code
- National Regulations Implementing European Directives
- OSHA Regulations
- ANSI Standards
- ISO and IEC Standards
- NFPA
- CSA

Terms and Conditions

For applicable "Terms and Conditions of Sale" please see page G-4.

IMPORTANT

Rockwell Automation reserves the right to make revisions to the material contained in this catalog and specifically disclaims all liability for any incidental or consequential damages resulting from the furnishing, performance or use of this material.

Application Considerations

Selection of Equipment—Because of the variety of uses for the products described in this catalog, those responsible for the application and use of this control equipment must satisfy themselves that all necessary steps have been taken to assure each application and use meets all performance and safety requirements, including any applicable laws, regulations, codes and standards.

The illustrations, charts and layout examples shown in this catalog are intended solely for purposes of example. Because there are many variables and requirements associated with any particular installation, Rockwell Automation does not assume responsibility or liability (to include intellectual property liability) for actual use based upon the examples shown in this publication.

Rockwell Automation Publication SGI-1.1, "Safety Guidelines for the Application, Installation and Maintenance of Solid-state Control" (available from your local Rockwell Automation Sales Office) describes some important differences between solid-state equipment and electromechanical devices which should be taken into consideration when applying products such as those described in this catalog.

Service and Installation Conditions—Unless otherwise noted, the products described in this catalog are designed to meet "usual service and installation conditions" as defined in NEMA (National Electrical Manufacturers Association) Standards Publication–Part ICS 1-108. Open style devices must be provided with environmental protection by proper mounting in enclosures designed for specific application conditions.

See page G-7 and page G-11 of this section for information on enclosures and an explanation of the degrees of protection provided by the different types, based on NEMA Standards Publication 250 and IEC Publication 529, as applicable.

Performance Data—Performance data given in this catalog is provided as a guide for the user in determining suitability and does not constitute a warranty. It may represent the result of accelerated testing at elevated stress levels, and the user should correlate it to actual application requirements. Actual performance is subject to Rockwell Automation WARRANTY and LIMIT OF LIABILITY (see page G-4).

Metric Conversion Factors

From	To	Multiply by
Length		
Inches (in.)	Millimeters (mm)	25.4
Inches (in.)	Centimeters (cm)	25.4
Feet (ft)	Meters (m)	0.305
Yards (yd)	Meters (m)	0.914
Millimeters (mm)	Inches (in.)	0.0394
Centimeters (cm)	Inches (in.)	0.394
Meters (m)	Feet (ft)	3.28
Meters (m)	Yards (yd)	1.09
Area		
Square inches ($in.^2$)	Square millimeters (mm^2)	645.0
Square inches ($in.^2$)	Square centimeters (cm^2)	6.45
Square feet (ft^2)	Square meters (m^2)	0.0929
Square yards (yd^2)	Square meters (m^2)	0.836
Square millimeters (mm^2)	Square inches ($in.^2$)	0.00155
Square centimeters (cm^2)	Square inches ($in.^2$)	0.155
Square meters (m^2)	Square feet (ft^2)	10.8
Square meters (m^2)	Square yards (yd^2)	1.20
Weight		
Ounces (oz)	Grams (g)	28.3
Pounds (lb)	Kilograms (kg)	0.454
Grams (g)	Ounces (oz)	0.0353
Kilograms (kg)	Pounds (lb)	2.20
Volume		
Cubic inches ($in.^3$)	Cubic centimeters (cm^3)	16.4
Cubic feet (ft^3)	Cubic meters (m^3)	0.0283
Cubic inches ($in.^3$)	Litres (L)	0.0164
Cubic feet (ft^3)	Litres (L)	28.3
Gallons (Imp)	Litres (L)	4.55
Gallons (US)	Litres (L)	3.79
Cubic centimeters (cm^3)	Cubic inches ($in.^3$)	0.061
Cubic meters (m^3)	Cubic feet (ft^3)	35.3
Liters (L)	Cubic inches ($in.^3$)	61.0
Liters (L)	Cubic feet (ft^3)	0.0353
Liters (L)	Gallons (Imp)	0.220
Liters (L)	Gallons (US)	0.264
Pressure		
Pounds/square inch (psi)	Kilopascals (kPa)	6.89
Pounds/square inch (psi)	Bars (Bar)	0.0689
Kilopascals (kPa)	Pounds/square inch (psi)	0.145
Bars (Bar)	Pounds/square inch (psi)	14.5
Torque		
Pound inch (lb•in)	Newton meters (N•m)	0.113
Newton meters (N•m)	Pound inch (lb•in)	8.85
Temperature		
Degrees Fahrenheit (°F)	Degrees Celsius (°C)	Conversion Formula: 5/9 (°F – 32°F) = °C
Degrees Celsius (°C)	Degrees Fahrenheit (°F)	Conversion Formula: 9/5 (°C) + 32°F = °F

Terms and Conditions of Sale

These general terms and conditions of sale only apply to direct sales by the manufacturer or its affiliates. Sales by appointed distributors and other independent authorized resellers will be subject to terms and conditions of sale and may be separately established by each such distributor or reseller. Sales outside of North America, as well as sales of other Rockwell Automation products and services, also may be subject to separate or supplemental terms and conditions of sale. For further information, please consult a Rockwell Automation sales office or an Allen-Bradley distributor.

General—These general terms and conditions of sale (along with any directly associated written Seller specification or quotation) exclusively will govern the sale or licensing by Seller of all goods and services (including without limitation, hardware, firmware and software products, training, programming, maintenance, engineering, parts and repair services—collectively, the "Products") furnished hereunder. No addition or modification to these terms and conditions will be binding on Seller unless agreed to in writing signed by an authorized representative at Seller's headquarters. Seller objects to other terms and conditions that may be proposed by the customer not otherwise consistent with these or other terms and conditions set forth in Seller's written specification, quotation or order acknowledgment.

Payment Terms—Net thirty (30) days from date of invoice with ongoing approved credit as determined by Seller. Seller reserves the right to suspend any further performance under this agreement or otherwise in the event payment is not made when due. No payment by offset is permitted unless approved by Seller.

Delivery Terms—Delivery terms are Ex Works with respect to shipping costs, risk of loss and title transfer, except that title to all intellectual property rights associated with the Products (e.g., software and firmware) remains with Seller (or its suppliers and licensors), and such Products are made available or licensed only for use by the customer pursuant to this agreement or other Seller license agreement. Acknowledged shipping dates are approximate only and based on prompt receipt of all necessary information from the customer.

Warranty—

A. **Hardware:** Seller warrants for a period of one (1) year from the date of invoice from Seller or its appointed distributor, as the case may be, that hardware Products furnished hereunder will be of merchantable quality, free from defects in material, workmanship and design. Repaired or replacement Products provided under warranty are similarly warranted for a period of six (6) months from the date of shipment to Customer or the remainder of the original warranty term, whichever is longer.

B. **Software and Firmware:** Unless otherwise provided in a Seller or third party license agreement, Seller warrants for a period of one (1) year from the date of invoice from Seller or its appointed distributor, as the case may be, that standard software or firmware Products furnished hereunder, when used with Seller-specified hardware, will perform in accordance with published specifications prepared, approved, and issued by Seller's headquarters. Seller makes no representation or warranty, express or implied, that the operation of the software or firmware Products will be uninterrupted or error free, or that the functions contained therein will meet or satisfy the Customer's intended use or requirements. Software and firmware corrections are warranted for a period of three (3) months from the date of shipment to Customer or the remainder of the original warranty term, whichever is longer.

C. **Factory Repair and Field Exchange:** Seller warrants for a period of six (6) months from the date of invoice from Seller or its appointed distributor, as the case may be, that billable or non-warranty factory-repaired or field-exchanged hardware Products furnished hereunder will be free from defects in material and workmanship. Products furnished on an exchange basis may be new or reconditioned.

D. **Service:** Seller warrants that Products comprised of services, including engineering and custom application programming services, whether provided on a fixed cost or time and material basis, will be performed in accordance with generally accepted industry practices to the extent such services are subject to written acceptance criteria agreed to in advance by Seller. All other warranties relative to provided services are disclaimed.

E. **Customer Specifications:** Seller does not warrant and will not be liable for any design, materials or construction criteria furnished or specified by Customer and incorporated into the Products or for Products made by or source from other manufacturers or vendors specified by Customer. Any warranty applicable to such Customer-specified Products will be limited solely to the warranty, if any, extended by the original manufacturer or vendor other than Seller to the extent permissible thereunder.

F. **Remedies:** Satisfaction of the above warranties will be limited, at Seller's option, to the replacement, repair, re-performance or modification of, or issuance of a credit for the purchase price of the Products involved, and where applicable, only after the return of such Products with Seller's consent. Replacement Products may be new or reconditioned. Any warranty service (consisting of time, travel and expenses related to such services) performed other than at Seller's factory, will be at Customer's expense.

G. **General:** Warranty satisfaction is available only if (a) Seller is promptly notified in writing and (b) Seller's examination discloses, to its satisfaction, that any alleged defect has not been caused by misuse; neglect; improper installation, operation, maintenance, repair, alteration or modification; accident; or unusual deterioration or degradation of the Products or parts thereof due to physical environment or electrical or electromagnetic noise environment.

H. THE ABOVE WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES WHETHER EXPRESSED, IMPLIED OR STATUTORY, INCLUDING IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE, OR PERFORMANCE OR APPLICATION WARRANTIES, AND EXTEND ONLY TO CUSTOMERS PURCHASING FROM SELLER OR ITS APPOINTED DISTRIBUTOR.

Limit of Liability—IN NO EVENT WILL SELLER BE LIABLE FOR INCIDENTAL, INDIRECT OR CONSEQUENTIAL DAMAGES OF ANY KIND. SELLER'S MAXIMUM CUMULATIVE LIABILITY RELATIVE TO ALL OTHER CLAIMS AND LIABILITIES, INCLUDING THAT WITH RESPECT TO DIRECT DAMAGES AND OBLIGATIONS UNDER ANY INDEMNITY, WHETHER OR NOT INSURED, WILL NOT EXCEED THE COST OF THE PRODUCTS GIVING RISE TO THE CLAIM OR LIABILITY. ANY ACTION AGAINST SELLER MUST BE BROUGHT WITHIN EIGHTEEN (18) MONTHS AFTER THE CAUSE OF ACTION ACCRUES. THESE DISCLAIMERS AND LIMITATIONS OF LIABILITY WILL APPLY REGARDLESS OF ANY OTHER CONTRARY PROVISION OF THE AGREEMENT AND REGARDLESS OF THE FORM OF ACTION, WHETHER IN CONTRACT, TORT OR

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Intellectual Property—Seller will defend any suit or proceeding brought against the customer based on a claim that the design or construction of the Products sold or licensed hereunder by Seller infringe any United States or Canadian Patent, Copyright or Mask Work Registration, provided that the customer promptly notifies Seller of any such claim and resulting suit or proceeding in writing and further provided that, at Seller's expense, (a) the customer gives Seller the sole right to defend or control the defence of the suit or proceeding, including settlement, and (b) the customer provides all necessary information and assistance for that defence. Except for any consequential damages, Seller will pay all costs and damages finally awarded or agreed upon by Seller that are directly related to any such claim. In the event of a charge of infringement Seller's obligation under the Agreement will be fulfilled if Seller, at its option and expense, either (i) procures for the customer the right to continue using such Products; (ii) replaces the same with non-infringing Products; (iii) modifies the same so as to make them non-infringing; or (iv) accepts the return of any infringing Products and refunds their purchase price. Notwithstanding the foregoing, Seller will have no liability with respect to any claim of infringement to the extent based on a configuration or modification incorporated in the Products at the request of the customer, on any process application into which the Products are integrated by the customer, or on use of the Products in combination with other equipment or products not supplied by Seller. THIS PARAGRAPH SETS FORTH SELLER'S ENTIRE LIABILITY WITH RESPECT TO INTELLECTUAL PROPERTY AND INFRINGEMENT OF PATENTS BY ANY PRODUCTS (INCLUDING SOFTWARE PROGRAMS, EQUIPMENT OR PRODUCTS THEREOF) OR BY THEIR OPERATION, AND IS IN LIEU OF ALL WARRANTIES OR CONDITIONS RELATING TO INFRINGEMENT OR INTELLECTUAL PROPERTY, EITHER EXPRESS OR IMPLIED.

Licensed Software and Firmware—Products comprised of software or firmware may be subject to additional terms and conditions set forth in separate Seller's license agreements that will control to the extent necessary to resolve any conflict with the terms and conditions stated herein. Such Products will not be delivered or made available until the customer also agrees to the terms and conditions of such separate license agreements.

Packing and Marking—Customer-specified packing or marking may be subject to additional charges not otherwise included in the price of the Products.

Weights and Dimensions—Published weights and dimensions are estimates or approximate only and are not warranted.

Quotations—Written quotations are valid for 30 days from issue unless otherwise stated. Verbal quotations expire the same day they are made. All typographical and clerical errors are subject to correction.

Prices—Prices and other information shown in any Seller publication (including product catalogs and brochures) are subject to change without notice and confirmation by specific quotation. Such publications are not offers to sell and are maintained only as a source of general information. The customer will pay or reimburse Seller for all sales, use, excise or similar taxes. Products comprised of time and material services will be provided in accordance with Seller's published service rates (including applicable overtime and travel expenses) in effect as of the date such services are provided, unless otherwise confirmed by Seller's written quotation or order acknowledgment. Billable service time includes travel time to and from the job site and all time Seller's representatives are available for work and waiting (whether on or off the job site) to perform the services.

Changes—Customer-requested order changes, including those affecting the identity, scope and delivery of the Products, must be documented in writing and are subject to Seller's prior approval and adjustments in price, scheduling and other affected terms and conditions. In any event, Seller reserves the right to reject any change that it deems unsafe, technically inadvisable or inconsistent with established engineering or quality guidelines and standards, or incompatible with Seller's design or manufacturing capabilities.

Returns—All returns of Products will be subject to prior Seller approval. Non-warranty returns of unused and salable Products for credit will be subject to Seller's return policies in effect at the time, including applicable restocking charges and other conditions of return. Products returned under warranty must be properly packed and shipped to Seller-specified locations. Shipping containers must be clearly marked per Seller's instruction and shipped freight prepaid by the customer.

Order Cancellation—An order may be cancelled by the customer prior to shipment only by written notice and upon payment to Seller of reasonable cancellation and restocking charges, including reimbursement for direct costs, plus allowances for disruption. Cancellation charges associated with orders for custom Products or Products specifically manufactured to the customer's specification may equal the actual selling price of the Products. Seller has the right to cancel an order for cause at any time by written notice, and Seller will be entitled to cancellation and restocking charges as identified above. No termination by the customer for cause will be effective unless and until Seller has failed to correct such alleged cause within forty-five (45) days after receipt of the customer's written notice specifying such cause.

Force Majeure—Seller will not be liable for any loss, damage or delay arising out of its failure to perform hereunder due to causes beyond its reasonable control, including without limitation, acts of God or the customer, acts of civil or military authority, fires, strikes, floods, epidemics, quarantine restrictions, war, riots, delays in transportation, or transportation embargoes. In the event of any such delay, Seller's performance date(s) will be extended for that length of time as may be reasonably necessary to compensate for the delay.

Government Clauses and Contracts—No government contract regulations or clauses will apply to the Products or this agreement or act to bind Seller unless specifically agreed to by Seller in writing at Seller's headquarters. Products sold or licensed hereunder are not intended to be used, nor should they be used, in any nuclear-related application either as a "Basic Component" under 10 CFR 21 (United States NRC) or otherwise under similar nuclear laws and regulations of this or any other country.

Terms and Conditions of Sale

Export Control—Products and associated materials supplied or licensed under this agreement may be subject to various export laws and regulations. It is the responsibility of the exporter to comply with all such laws and regulations.

Disputes—The parties will attempt in good faith promptly to resolve any dispute arising out of this agreement by negotiations between representatives who have authority to settle the controversy. If unsuccessful, the parties further will attempt in good faith to settle the dispute by non-binding third-party mediation, with fees and expenses of such mediation apportioned equally to each side. Any dispute not so resolved by negotiation or mediation may then be submitted to a court of competent jurisdiction in accordance with the terms of this agreement. These procedures are the exclusive procedures for the resolution of all such disputes between the parties.

Governing Law—This agreement and all disputes arising thereunder will be governed by and interpreted in accordance with the internal laws of the state, province or other governmental jurisdiction in which Seller's principal place of business resides, but specifically excluding the provisions of the 1980 UN Convention on Contracts for the International Sales of Goods.

Assignment—This agreement may not be assigned by either party without the written consent of the other, however, consent will not be required for internal transfers and assignments as between Seller and its parent corporations, subsidiaries or affiliates as part of a consolidation, merger or other form of corporate reorganization.

Language—The parties acknowledge that they have required that this agreement be drawn up in English. Les parties reconnaissent avoir exigé la rédaction en anglais du Contrat. In the event of a conflict between the English and other language versions of this agreement, the English version will prevail.

ATTENTION: Servicing energized Industrial Control Equipment can be hazardous. Severe injury or death can result from electrical shock, burn, or unintended actuation of controlled equipment. Recommended practice is to disconnect and lockout control equipment from power sources, and release stored energy, if present. Refer to **National Fire Protection Association Standard No. NFPA70E, Part II and (as applicable) OSHA rules for Control of Hazardous Energy Sources (Lockout/Tagout) and OSHA Electrical Safety Related Work Practices** for safety related work practices, including procedural requirements for lockout/tagout, and appropriate work practices, personnel qualifications and training requirements where it is not feasible to de-energize and lockout or tagout electric circuits and equipment before working on or near exposed circuit parts.

Periodic Inspection—Industrial control equipment should be inspected periodically. Inspection intervals should be based on environmental and operating conditions and adjusted as indicated by experience. An initial inspection within three to four months after installation is suggested. See National Electrical Manufacturers Association (NEMA) Standard No. ICS 1.3, Preventive Maintenance of Industrial Control and Systems Equipment, for general guidelines for setting-up a periodic maintenance program. We suggest that a periodic maintenance program is set up. Some specific guidelines for Allen-Bradley products are listed below.

Contamination—If inspection reveals that dust, dirt, moisture or other contamination has reached the control equipment, the cause must be eliminated. This could indicate an incorrectly selected or ineffective enclosure, unsealed enclosure openings (conduit or other) or incorrect operating procedures. Replace any improperly selected enclosure with one that is suitable for the environmental conditions—refer to NEMA Standard No. 250, Enclosures for Electrical Equipment for enclosure type descriptions and test criteria. Replace any damaged or embrittled elastomer seals and repair or replace any other damaged or malfunctioning parts (e.g., hinges, fasteners, etc.). Dirty, wet or contaminated control devices must be replaced unless they can be cleaned effectively by vacuuming or wiping. Compressed air is not recommended for cleaning because it may displace dirt, dust, or debris into other parts or equipment, or damage delicate parts.

Cooling Devices—Inspect blowers and fans used for forced air cooling. Replace any that have bent, chipped, or missing blades, or if the shaft does not turn freely. Apply power momentarily to check operation. If unit does not operate, check and replace wiring, fuse, or blower or fan motor as appropriate. Clean or change air filters as recommended in the product manual. Also, clean fins of heat exchangers so convection cooling is not impaired.

Hazardous Location Enclosures—

ATTENTION: Explosion hazard. Always disconnect power before opening enclosures in hazardous locations. Close and secure such enclosures before re-applying power.

Location Enclosures—NEMA Types 7 & 9 enclosures require careful handling so machined flanges do not get damaged. For removable covers, remove the cover and set aside with machined surface up. For hinged covers, open the cover fully and restrain in the full open position if necessary. Clean and examine the flanges on both the body and cover before re-assemble. If there are scratches, nicks, grooves or rust on the mating surfaces, replace the body or cover as necessary. Examine all bolts and replace any that have damaged threads. Also check mating threads for damage and replace enclosure if necessary. Covers and bodies of some enclosures are manufactured as matched sets (not interchangeable). The manufacturer should be consulted before replacing a cover or body unless it is specified by the manufacturer as interchangeable.

Operating Mechanisms—Check for proper functioning and freedom from sticking or binding. Replace any broken, deformed or badly worn parts or assemblies according to individual product renewal parts lists. Check for, and re-tighten securely, any loose fasteners. Lubricate if specified in individual product instructions.

Note: Allen-Bradley magnetic starters, contactors and relays are designed to operate without lubrication—**do not** lubricate these devices because oil or grease on the pole faces (mating surfaces) of the operating magnet may cause the device to stick in the "ON" mode. Some parts of other devices are factory-lubricated—if lubrication during use or maintenance of these devices is needed, it will be specified in their individual instructions. If in doubt, consult your local Allen-Bradley Sales Office for information.

Contacts—Check contacts for excessive wear and dirt accumulations. Vacuum or wipe contacts with a soft cloth if necessary to remove dirt. Contacts are not harmed by discoloration and slight pitting. Contacts should never be filed, as dressing only shortens contact life. Contact spray cleaners **should not be** used as their residue on magnet pole faces or in operating mechanisms may cause sticking, and on contacts can interfere with electrical continuity. Contacts should only be replaced after silver has become badly worn. Always replace contacts in complete sets to avoid misalignment and uneven contact pressure.

Vacuum Contactors—Contacts of vacuum contactors are not visible, so contact wear must be checked indirectly. Vacuum bottles should be replaced when:

The estimated number of operations equals one million, or

The contact life line indicator shows need for replacement, or

The vacuum bottle integrity tests show need for replacement.

Replace all vacuum bottles in the contactor at the same time to avoid misalignment and uneven contact wear. If the vacuum bottles do not require replacement, check and adjust overtravel to the value listed on the maintenance instructions.

Terminals—Loose connections in power circuits can cause overheating that can lead to equipment malfunction or failure. Loose connections in control circuits can cause control malfunctions. Loose bonding or grounding connections can increase hazards of electrical shock and contribute to electromagnetic interference (EMI). Check the tightness of all terminals and bus bar connections and tighten **securely** any loose connections. Replace any parts or wiring damaged by overheating, and any broken wires or bonding straps.

Arc Hoods—Check for cracks, breaks, or deep erosion. Arc hoods and arc chutes should be replaced if damaged or deeply eroded.

Coils—If a coil exhibits evidence of overheating (cracked, melted or burned insulation), it must be replaced. In that event, check for and correct overvoltage or undervoltage conditions, which can cause coil failure. Be sure to clean any residue of melted coil insulation from other parts of the device or replace such parts.

Batteries—Replace batteries periodically as specified in product manual or if a battery shows signs of electrolyte leakage. Use tools to handle batteries that have leaked electrolyte; most electrolytes are corrosive and can cause burns. Dispose of the old battery in accordance with instructions supplied with the new battery or as specified in the manual for the product.

Pilot Lights—Replace any burned out lamps or damaged lenses.

Photoelectric Switches—The lenses of photoelectric switches require periodic cleaning with a soft dry cloth. Reflective devices used in conjunction with photoelectric switches also require periodic cleaning. Do not use solvents or cleaning agents on the lenses or reflectors. Replace any damaged lenses and reflectors.

Solid-State Devices

ATTENTION: Use of other than factory-recommended test equipment for solid-state controls may result in damage to the control or test equipment or unintended actuation of the controlled equipment. Refer to paragraph titled HIGH-VOLTAGE TESTING.

Solid-state devices require little more than a periodic visual inspection. Discolored, charred or burned components may indicate the need to replace the component or circuit board. Necessary replacements should be made only at the PC board or plug-in component level. Printed circuit boards should be inspected to determine whether they are properly seated in the edge board connectors. Board locking tabs should also be in place. Solid-state devices must also be protected from contamination, and cooling provisions must be maintained—refer to paragraphs titled CONTAMINATION and COOLING DEVICES on previous page. Solvents should not be used on printed circuit boards.

High-Voltage Testing—High-voltage insulation resistance (IR) and dielectric-withstanding voltage (DWV) tests should not be used to check solid-state control equipment. When measuring IR or DWV of electrical equipment such as transformers or motors, a solid-state device used for control or monitoring must be disconnected before performing the test. Even though no damage is readily apparent after an IR or DWV test, the solid-state devices are degraded and repeated application of high voltage can lead to failure.

Locking and Interlocking Devices—Check these devices for proper working condition and capability of performing their intended functions. Make any necessary replacements only with Allen-Bradley renewal parts or kits. Adjust or repair only in accordance with Allen-Bradley instructions.

Maintenance After a Fault Condition—Opening of the short circuit protective device (such as fuses or circuit breakers) in a properly coordinated motor branch circuit is an indication of a fault condition in excess of operating overload. Such conditions can cause damage to control equipment. **Before restoring power**, the fault condition must be corrected and any necessary repairs or replacements must be made to restore the control equipment to good working order. Refer to NEMA Standards Publication No. ICS 2, Part ICS2 302 for procedures.

Replacements—Use only replacement parts and devices recommended by Allen-Bradley to maintain the integrity of the equipment. Make sure the parts are properly matched to the model, series and revision level of the equipment.

Final Check Out—After maintenance or repair of industrial controls, always test the control system for proper functioning under controlled conditions that avoid hazards in the event of a control malfunction.

For additional information, refer to NEMA ICS 1.3, PREVENTIVE MAINTENANCE OF INDUSTRIAL CONTROL AND SYSTEMS EQUIPMENT, published by the National Electrical Manufacturers Association, and NFPA70B, ELECTRICAL EQUIPMENT MAINTENANCE, published by the National Fire Protection Association.

Degree of Protection

IEC Publication 60259 describes standard Degrees of Protection that enclosures of a product are designed to provide when properly installed.

Summary

The publication defines degrees of protection with respect to:

- Persons
- Equipment within the enclosure
- Ingress of water

It does **not** define:

- Protection against risk of explosion
- Environmental protection (e.g. against humidity, corrosive atmospheres or fluids, fungus or the ingress of vermin)

Note: The IEC test requirements for Degrees of Protection against liquid ingress refer only to water. Those products in this catalog, which have a high degree of protection against ingress of liquid, in most cases include Nitrile seals. These have good resistance to a wide range of oils, coolants and cutting fluids. However, some of the available lubricants, hydraulic fluids and solvents can cause severe deterioration of Nitrile and other polymers. Some of the products listed are available with seals of Viton® or other materials for improved resistance to such liquids. For specific advice on this subject refer to your local Rockwell Automation sales office.

IEC Enclosure Classification

The degree of protection is indicated by two letters (IP) and two numerals. International Standard IEC 529 contains descriptions and associated test requirements that define the degree of protection each numeral specifies. The table on this page indicates the general degree of protection—refer to the **Abridged Descriptions of IEC Enclosure Test Requirements** starting below. **For complete test requirements refer to IEC 60259.**

Abridged Descriptions of IEC Enclosure Test Requirements

(Refer to IEC 60259 for complete test specifications—e.g., test apparatus configuration; tolerances; etc. For Metric Conversion factors—see page G-3.)

Tests for Protection Against Access to Hazardous Parts (first characteristic numeral)

The first characteristic numeral of the IP number indicates compliance with the following tests for the degree of protection against access to hazardous parts. It also indicates compliance with tests as shown in the next section for the degree of protection against solid foreign objects.

The protection against access to hazardous parts is satisfactory if adequate clearance is kept between the specified access probe and hazardous parts. For voltage less than 1000V AC and 1500V DC, the access probe must not touch the hazardous live parts. For voltage exceeding 1000V AC and 1500V DC, the equipment must be capable of withstanding specified dielectric tests with the access probe in the most unfavorable position.

First Numeral*	Second Numeral*
Protection of persons against access to hazardous parts and protection against penetration of solid foreign objects.	Protection against ingress of water under test conditions specified in IEC 60259.
0 Non-protected	0 Non-protected
1 Back of hand; objects greater than 50 mm in diameter	2 Vertically falling drops of water
3 Finger; objects greater than 12.5 mm in diameter	4 Vertically falling drops of water with enclosure tilted 15°
5 Tools or objects greater than 2.5 mm in diameter	6 Spraying water
7 Tools or objects greater than 1.0 mm in diameter	8 Splashing water
9 Dust-protected (dust may enter during specified test but must not interfere with operation of the equipment or impair safety)	10 Water jets
11 Dusttight (no dust observable inside enclosure at end of test)	12 Powerful water jets
	13 Temporary submersion
	14 Continuous submersion
Example: IP41 describes an enclosure that is designed to protect against the entry of tools or objects greater than 1 mm in diameter and to protect against vertically dripping water under specified test conditions.	
Note: All first numerals and second numerals up to and including characteristic numeral 6, imply compliance also with the requirements for all lower characteristic numerals in their respective series (first or second). Second numerals 7 and 8 do not imply suitability for exposure to water jets (second characteristic numeral 5 or 6) unless dual coded; e.g., **IP_5/ IP_7**.	

* The IEC standard permits use of certain supplementary letters with the characteristic numerals. If such letters are used, refer to IEC 60259 for the explanation.

IP0_ —No test required.

IP1_—A rigid sphere 50 mm in diameter shall not completely pass through any opening. Force = 50 N.

IP2_—A jointed test finger 80 mm long and 12 mm in diameter may penetrate to its 80 mm length, but shall have adequate clearance as specified above, from hazardous live parts, in every possible position of the test finger as both joints are bent through an angle up to 90°. Force = 10 N.

IP3_—A test rod 2.5 mm in diameter shall not penetrate and adequate clearance shall be kept from hazardous live parts (as specified in table above). Force = 3 N.

IP4_—A test wire 1 mm in diameter shall not penetrate and adequate clearance shall be kept from hazardous live parts (as specified in table above). Force = 1 N.

IP5_ —A test wire 1 mm in diameter shall not penetrate and adequate clearance shall be kept from hazardous live parts (as specified in table above). Force = 1 N.

IP6_—A test wire 1 mm in diameter shall not penetrate and adequate clearance shall be kept from hazardous live parts (as specified in the table above). Force = 1 N.

Tests for Protection Against Solid Foreign Objects (first characteristic numeral)

For first numerals **1, 2, 3,** and **4** the protection against solid foreign objects is satisfactory if the full diameter of the specified probe does not pass through any opening. Note that for first numerals **3** and **4** the probes are intended to simulate foreign objects which may be spherical. Where shape of the entry path leaves any doubt about ingress or a spherical object capable of motion, it may be necessary to examine drawings or to provide special access for the object probe. For first numerals **5** and **6** see test descriptions below for acceptance criteria.

IP0_—No test required.

IP1_—The full diameter of a rigid sphere 50 mm in diameter must not pass through any opening at a test force of 50 N.

IP2_—The full diameter of a rigid sphere 12.5 mm in diameter must not pass through any opening at a test force of 30 N.

IP3_—A rigid steel rod 2.5 mm in diameter must not pass through any opening at a test force of 3 N.

IP4_—A rigid steel wire 1 mm in diameter must not pass through any opening at a test force of 1 N.

IP5_—The test specimen is supported inside a specified dust chamber where talcum powder, able to pass through a square-meshed sieve with wire diameter 50 mm and width between wires 75 mm, is kept in suspension.

Enclosures for equipment subject to thermal cycling effects (category 1) are vacuum pumped to a reduced internal pressure relative to the surrounding atmosphere: maximum depression = 2 kPa; maximum extraction rate = 60 volumes per hour. If extraction rate of 40 to 60 volumes/hr. is obtained, test is continued until 80 volumes have been drawn through or 8 hr. has elapsed. If extraction rate is less than 40 volumes/hr. at 20 kPa depression, test time = 8 hr.

Enclosures for equipment not subject to thermal cycling effects **and** designated category 2 in the relevant product standard are tested for 8 hr. without vacuum pumping.

Protection is satisfactory if talcum powder has not accumulated in a quantity or location such that, as with any other kind of dust, it could interfere with the correct operation of the equipment or impair safety; and no dust has been deposited where it could lead to tracking along creepage distances.

IP6_—All enclosures are tested as category 1, as specified above for **IP5**_. The protection is satisfactory if no deposit of dust is observable inside the enclosure at the end of the test.

Tests for Protection Against Water (second characteristic numeral)

The second characteristic numeral of the IP number indicates compliance with the following tests for the degree of protection against water. For numerals **1** through **7**, the protection is satisfactory if any water that has entered does not interfere with satisfactory operation, does not reach live parts not designed to operate when wet, and does not accumulate near a cable entry or enter the cable. For second numeral **8** the protection is satisfactory if no water has entered the enclosure.

IP_0—No test required.

IP_1—Water is dripped onto the enclosure from a "drip box" having spouts spaced on a 20 mm square pattern, at a "rainfall" rate of 1 mm/min. The enclosure is placed in its normal operating position under the drip box. Test time = 10 min.

IP_2—Water is dripped onto the enclosure from a "drip box" having spouts spaced on a 20 mm square pattern, at a "rainfall" rate of 3 mm/min. The enclosure is placed in 4 fixed positions tilted 15° from its normal operating position, under the drip box. Test time = 2.5 min. for each position of tilt.

IP_3—Water is sprayed onto all sides of the enclosure over an arc of 60° from vertical, using an oscillating tube device with spray holes 50 mm apart (or a hand-held nozzle for larger enclosures). Flow rate, oscillating tube device = 0.07 l/min. per hole x number of holes; for hand-held nozzle = 10 l/min. Test time, oscillating tube = 10 min.; for hand-held nozzle = 1 min./m2 of enclosure surface area, 5 min. minimum.

IP_4—Same as test for **IP_3** except spray covers an arc of 180° from vertical.

IP_5—Enclosure is sprayed from all practicable directions with a stream of water at 12.5 l/min. from a 6.3 mm nozzle from a distance of 2.5 to 3 m. Test time = 1 min./m^2 of enclosure surface area to be sprayed, 3 min. minimum.

IP_6—Enclosure is sprayed from all practicable directions with a stream of water at 100 l/min. from a 12.5 mm nozzle from a distance of 2.5 to 3 m. Test time = 1 min./m^2 of enclosure surface area to be sprayed, 3 min. minimum.

IP_7—Enclosure is immersed in water in its service position for 30 min. Lowest point of enclosures less than 850 mm tall = 1000 mm below surface of water. Highest point of enclosures more than 850 mm tall = 150 mm below surface of water.

IP_8—Test conditions are subject to agreement between manufacturer and user, but shall be at least as severe as those for **IP_7**.

Specify the Correct Enclosure for Your Motor Controls

Type 1
General Purpose Surface Mounting

Type 1 enclosures are intended for indoor use primarily to provide a degree of protection against contact with the enclosed equipment in locations where unusual service conditions do not exist. The enclosures are designed to meet the rod entry and rust-resistance design tests. Enclosure is sheet steel, treated to resist corrosion.

Type 1
Flush Mounting

Type 1 Flush mounting enclosures for installation in machine frames and plaster wall. These enclosures are for similar applications and are designed to meet the same tests as Type 1 surface mounting.

Type 3
Rainproof Dusttight

Type 3 enclosures are intended for outdoor use primarily to provide a degree of protection against windblown dust, rain and sleet; and to be undamaged by the formation of ice on the enclosure. They are designed to meet rain ✶, external icing ❄, dust, and rust-resistance design tests. They are not intended to provide protection against conditions such as internal condensation or internal icing.

Type 3R
Rainproof

Type 3R enclosures are intended for outdoor use primarily to provide a degree of protection against falling rain, and to be undamaged by the formation of ice on the enclosure. They are designed to meet rod entry, rain ‡ external icing ❄, and rust-resistance design tests. They are not intended to provide protection against conditions such as dust, internal condensation, or internal icing.

Type 4
Watertight

Type 4 enclosures are intended for indoor or outdoor use primarily to provide a degree of protection against windblown dust and rain, splashing water, and hose-directed water; and to be undamaged by the formation of ice on the enclosure. They are designed to meet hosedown, dust, and external icing tests ❄. They are not intended to provide protection against conditions such as internal condensation or internal icing.

Type 4X
Non-Metallic, Corrosion-Resistant

Type 4X enclosures are intended for indoor or outdoor use primarily to provide a degree of protection against corrosion, windblown dust and rain, splashing water, and hose-directed water; and to be undamaged by the formation of ice on the enclosure. They are designed to meet the hosedown, dust, external icing ❄, and corrosion-resistance design tests. They are not intended to provide protection against conditions such as internal condensation or internal icing.

Type 6P
For Prolonged Submersion at a Limited Depth

Type 6P enclosures are intended for indoor or outdoor use primarily to provide a degree of protection against the entry of water during prolonged submersion at a limited depth; and to be undamaged by the formation of ice on the enclosure. They are designed to meet air pressure, external icing ✶, hosedown and corrosion-resistance design tests. They are not intended to provide protection against conditions such as internal condensation or internal icing.

Type 7
For Hazardous Gas Locations

Type 7 enclosures are for indoor use in locations classified as Class I, Groups C or D, as defined in the U.S. National Electrical Code. Type 7 enclosures are designed to be capable of withstanding the pressures resulting from an internal explosion of specified gases, and contain such an explosion sufficiently that an explosive gas-air mixture existing in the atmosphere surrounding the enclosure will not be ignited. Enclosed heat generating devices are designed not to cause external surfaces to reach temperatures capable of igniting explosive gas-air mixtures in the surrounding atmosphere. Enclosures are designed to meet explosion, hydrostatic, and temperature design tests. Finish is a special corrosion-resistant, gray enamel.

Type 9
For Hazardous Dust Locations

Type 9 enclosures are intended for indoor use in locations classified as Class II, Groups E, F, or G, as defined in the U.S. National Electrical Code. Type 9 enclosures are designed to be capable of preventing the entrance of dust. Enclosed heat generating devices are designed not to cause external surfaces to reach temperatures capable of igniting or discolouring dust on the enclosure or igniting dust-air mixtures in the surrounding atmosphere. Enclosures are designed to meet dust penetration and temperature design tests, and aging of gaskets. The outside finish is a special corrosion-resistant gray enamel.

Type 12
Dusttight Industrial Use

Type 12 enclosures are intended for indoor use primarily to provide a degree of protection against dust, falling dirt, and dripping non-corrosive liquids. They are designed to meet drip ❄, dust, and rust-resistance tests. They are not intended to provide protection against conditions such as internal condensation.

Type 13
Oiltight

Type 13 enclosures are intended for indoor use primarily to provide a degree of protection against dust, spraying of water, oil, and noncorrosive coolant. They are designed to meet oil exclusion and rust-resistance design tests. They are not intended to provide protection against conditions such as internal condensation.

✶ Evaluation criteria: No water has entered enclosure during specified test.
❄ Evaluation criteria: Undamaged after ice buildup during specified test has melted. (**Note:** Not required to be operable while ice-laden.)
‡ Evaluation criteria: No water shall have reached live parts, insulation or mechanisms.

NEMA Enclosures

ENCLOSURES:
Refer to the brief descriptions below for the various types of enclosures offered by Rockwell Automation. For definitions, descriptions and test criteria, see National Electrical Manufactures Association (NEMA) Standards Publication No. 250. Also see individual product listings within this Rockwell Automation catalog for available enclosure types and for any additional information relating to these descriptions.

NOTE: Enclosures do not normally protect devices against conditions such as condensation, icing, corrosion or contamination that may occur within the enclosure or enter via the conduit or unsealed openings. Users must make adequate provisions to safeguard against such conditions and satisfy themselves that the equipment is properly protected.

Selection Criteria

Enclosures for Non-Hazardous Locations

For a Degree of Protection Against:	Designed to Meet Tests No. ✶	Type							
		For Indoor Use			For Outdoor Use		Indoor or Outdoor		
		1	12	13	3R	3	4	4X	6P
Incidental contact with enclosed equipment	6.2	✓	✓	✓	✓	✓	✓	✓	✓
Falling dirt	6.2	✓	✓	✓	✓	✓	✓	✓	✓
Rust	6.8	✓	✓	✓	✓	✓	✓	✓	✓
Circulating dust, lint, fibres and flyings❄	6.5.1.2 (2)		✓	✓		✓	✓	✓	✓
Windblown dust	6.5.1.1 (2)					✓	✓	✓	✓
Falling liquids and light splashing	6.3.2.2		✓	✓		✓	✓	✓	✓
Rain (Test evaluated per 6.4.2.1)	6.4.2.1				✓	✓	✓	✓	✓
Rain (Test evaluated per 6.4.2.2)	6.4.2.2					✓	✓	✓	✓
Snow and sleet	6.6.2.2				✓	✓	✓	✓	✓
Hosedown and splashing water	6.7						✓	✓	✓
Occasional prolonged submersion	6.11 (2)								✓
Oil and coolant seepage	6.3.2.2		✓	✓					
Oil or coolant spraying and splashing	6.12			✓					
Corrosive agents	6.9				✓	✓	✓	✓	✓

✶ See page G-13 for abridged description of NEMA enclosure test requirements. Refer to NEMA Standards Publication No. 250 for complete test specifications.
❄ Non-hazardous materials, not Class III ignitable or combustible.

Enclosures for Hazardous Locations (Division 1 or 2)♣

For a Degree of Protection Against Atmospheres Typically Containing:➢	Designed to Meet Tests‡	Class (National Electrical Code)	7, Class I Group				9, Class II Group		
			A	B	C	D	E	F	G
Acetylene	Explosion Test Hydrostatic Test Temperature Test	I	✓						
Hydrogen, Manufactured Gas			✓	✓					
Diethyl Ether, Ethylene, Hydrogen Sulfide					✓				
Acetone, Butane, Gasoline, Propane, Toluene					✓	✓			
Metal dusts and other combustible dusts with resistivity of less than 10^5 Ω-cm	Dust Penetration Test Temperature Test with Dust Blanket	II					✓		
Carbon black, charcoal, coal or coke dusts with resistivity between 10^2…10^8 Ω-cm								✓	
Combustible dusts with resistivity of 10^5 Ω-cm or greater									✓
Fibers, flyings	§	III							✓

♣ For indoor locations only, unless cataloged with additional NEMA Type enclosure number(s) suitable for outdoor use as shown in the table on this page. Some control devices (if so listed in the catalog) are suitable for Division 2 hazardous location use in enclosures for nonhazardous locations. For explanation of CLASSES, DIVISIONS and GROUPS, refer to the National Electrical Code.
➢ For listing of additional materials and information noting the properties of liquids, gases and solids, refer to NFPA 497M-1991, Classification of Gases, Vapors, and Dusts for Electrical Equipment in Hazardous (Classified) Locations.
‡ See abridged description of test requirements on page G-13. For complete requirements, refer to UL Standard 698, compliance with which is required by NEMA enclosure standards.
§ UL 698 does not include test requirements for Class III. Products that meet Class II, Group G requirements are acceptable for Class III.

Abridged Description of NEMA Enclosure Test Requirements

6.2 **Rod Entry Test**—A 3.18 mm (0.125 in.) diameter rod must not be able to enter enclosure except at locations where nearest live part is more than 102 mm (4 in.) from an opening — such opening shall not permit a 13 mm (0.5 in.) diameter rod to enter.

6.3 **Drip Test**—Water is dripped onto enclosure for 30 minutes from an overhead pan having uniformly spaced spouts, one every 12,900 mm^2 (20 $in.^2$) of pan area, each spout having a drip rate of 20 drops per minute.

Evaluation 6.3.2.2: No water shall have entered enclosure.

6.4 **Rain Test**—Entire top and all exposed sides are sprayed with water at a pressure of 0.35 kg/cm^2 (5 psi) from nozzles for one hour at a rate to cause water to rise 457 mm (18 in.) in a straight-sided pan beneath the enclosure.

Evaluation 6.4.2.1: No water shall have reached live parts, insulation or mechanisms.

Evaluation 6.4.2.2: No water shall have entered enclosure.

6.5.1.1 (2) **Outdoor Dust Test (Alternate Method)**—Enclosure and external mechanisms are subjected to a stream of water at 170.5 liters (45 gallons) per minute from a 25.4 mm (1 in.) diameter nozzle, directed at all joints from all angles from a distance of 3…3.7 m (10…12 ft). Test time is 48 seconds times the test length (height + width + depth of enclosure in feet), or a minimum of 5 minutes. No water shall enter enclosure.

6.5.1.2 (2) **Indoor Dust Test (Alternate Method)**—Atomized water at a pressure of 2.11 kg/cm^2 (30 psi) is sprayed on all seams, joints and external operating mechanisms from a distance of 305…381 mm (12…15 in.) at a rate of 11 liters (3 gallons) per hour. No less than 142 gms (5 oz) of water per linear foot of test length (height + length + depth of enclosure) is applied. No water shall enter enclosure.

6.6 **External Icing Test**—Water is sprayed on enclosure for one hour in a cold room +2°C (36°F); then room temperature is lowered to approximately –5°C (–23°F) and water spray is controlled so as to cause ice to build up at a rate of 6.4 mm (0.25 in.) per hour until 19 mm (0.75 in.) thick ice has formed on top surface of a 25.4 mm (1 in.) diameter metal test bar, then temperature is maintained at –5°C (–23°F) for 3 hours.

Evaluation 6.6.2.2: Equipment shall be undamaged after ice has melted (external mechanisms not required to be operable while ice-laden).

6.7 **Hosedown Test**—Enclosure and external mechanisms are subjected to a stream of water at 246 liters (65 gallons) per minute from a 25.4 mm (1 in.) diameter nozzle, directed at all joints from all angles from a distance of 3…3.7 m (10 to 12 ft). Test time is 48 seconds times the test length [height + width + depth] of enclosure in meters (feet), or a minimum of 5 seconds. No water shall enter enclosure.

6.8 **Rust Resistance Test (Applicable Only to Enclosures Incorporating External Ferrous Parts)**—Enclosure is subjected to a salt spray (fog) for 24 hours, using water with five parts by weight of salt (NaCl), at 35°C (95°F), then rinsed and dried. There shall be no rust except where protection is impractical (e.g., machined mating surfaces, sliding surfaces of hinges, shafts, etc.).

6.9 **Corrosion Protection**—Sheet steel enclosures are evaluated per Underwriter's Laboratories (UL) 50, Part 13 (test for equivalent protection as G-90 commercial zinc coated sheet steel). Other materials per Underwriter's Laboratories (UL) 508, 6.9 or 6.10.

6.11 (2) **Air Pressure Test (Alternate Method)**—Enclosure is submerged in water at a pressure equal to water depth of 2 m (6 ft), for 24 hours. No water shall enter enclosure.

6.12 **Oil Exclusion Test**—Enclosure is subjected to a stream of test liquid for 30 minutes from a 9.5 mm (0.375 in.) diameter nozzle at 7.57 liters (2 gallons) a minute. Water with 0.1% wetting agent is directed from all angles from a distance of 305…457 mm (12…18 in.), while any externally operated device is operated at 30 operations per minute. No test liquid shall enter the enclosure.

Abridged Description of UL Standard 698 Test Requirements

Explosion Test—During a series of tests in which gas-air mixtures of the specific gas, over its range of explosive concentrations, are ignited inside the enclosure, the enclosure shall prevent the passage of flame and sparks capable of igniting a similar gas-air mixture surrounding the enclosure. In addition, there shall be no mechanical damage to enclosed electrical mechanisms or the enclosure.

Hydrostatic Test—The enclosure shall withstand for one minute a hydrostatic test based on the maximum internal explosion pressure developed during the explosion tests, as follows: cast metal, four times the explosion pressure without rupture or permanent deformation; fabricated steel, twice the explosion pressure without permanent deformation and three times the explosion pressure without rupture. Exception: Hydrostatic tests may be omitted if calculations show safety factor of 5:1 for cast metal and 4:1 for fabricated steel.

Temperature Test—The enclosed device is subjected to a temperature test to determine maximum temperature at any point on the external surface. The device must be marked with a temperature code based on the result only if the temperature exceeds +100°C (+212°F).

Dust Penetration Test—The device is operated at full rated load until equilibrium temperatures are attained, then allowed to cool to ambient (room) temperature, through six heating and cooling cycles covering at least 30 hours, while continuously exposed to circulating dust of specified properties in a test chamber. No dust shall enter the enclosure.

Temperature Test with Dust Blanket—This test is conducted as described for the Dust Penetration test except that the re-circulating dust nozzles are positioned so that the dust is not blown directly on the device under test. The device is operated at full rated load (and under abnormal conditions for equipment subject to overloading) until equilibrium temperatures are attained. Dust in contact with the enclosure shall not ignite or discolour from heat, and the exterior temperatures based on +40°C (+104°F) ambient shall not exceed:

Group	Normal Operation	Abnormal Operation
E	+200°C (+392°F)	+200°C (+392°F)
F	+150°C (+302°F)	+200°C (+392°F)
G	+120°C (+248°F)	+165°C (+329°F)

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Regulations

EU Directives and Legislation

The purpose of this section is to act as a guide for anyone concerned with machine safety especially guarding and protective systems in the European Union. It is intended for designers and users of industrial equipment.

In order to promote the concept of an open market within the European Economic Area (EEA) (which comprises all EU Member States plus three other countries) all member states are obliged to enact legislation that defines essential safety requirements for machinery and its use.

Machinery that does not meet these requirements cannot be supplied into or within EEA countries.

There are several European Directives that can apply to the safety of industrial machinery and equipment but the two that are of the most direct relevance are:

1. The Machinery Directive
2. The Use of Work Equipment by Workers at Work Directive

These two Directives are directly related as the Essential Health and Safety Requirements (EHSRs) from the Machinery Directive can be used to confirm the safety of equipment in the Use of Work Equipment Directive.

This section deals with aspects of both directives and it is strongly recommended that anyone concerned with the design, supply, purchase or use of industrial equipment within or into the EEA and also certain other European countries should familiarize themselves with their requirements. Most suppliers and users of machinery will simply not be allowed to supply or operate machinery in these countries unless they conform to these directives.

There are other European Directives that may have relevance to machinery. Most of them are fairly specialized in their application and are therefore left outside the scope of this section but it is important to note that, where relevant, their requirements must also be met. Examples are: The EMC Directive 2004/108/EC and the ATEX Directive 94/9/EC.

The EU Machinery Directive

The Machinery Directive covers the supply of new machinery and other equipment including safety components. It is an offense to supply machinery within the EU unless the provisions and requirements of the Directive are met.

The broadest definition of “machinery” given within the Directive is a follows: an assembly, fitted with or intended to be fitted with a drive system other than directly applied human or animal effort, consisting of linked parts or components, at least one of which moves, and which are joined together for a specific application.

Detailed information and guidance on the definition and all other aspects of the Machinery Directive can be found at the official EU website:

http://ec.europa.eu/enterprise/sectors/mechanical/machinery/index_en.htm

The current Machinery Directive (2006/42/EC) replaced the former version (98/37/EC) at the end of 2009. It clarifies and amends but does not introduce any radical changes to its Essential Health and Safety Requirements (EHSRs). It does introduce some changes to take account of changes in technology and methods. It extends its scope to cover some extra types of equipment (e.g. construction site hoists). There is now an explicit requirement for a risk assessment for the determination of which EHSRs are applicable and there are changes made to the conformity assessment procedures for Annex IV equipment.

The key provisions of the original Directive (98/37/EC) came into force for machinery on January 1, 1995 and for Safety Components on January 1, 1997.

The provisions of the current Directive (2006/42/EC) became applicable on December 29, 2009. It is the responsibility of the manufacturer or his authorized representative to ensure that equipment supplied is in conformity with the Directive. This includes:

Figure 1: CE Marking Affixed to Machine

- Ensuring that the applicable EHSRs contained in Annex I of the Directive are fulfilled
- A technical file is prepared
- Appropriate conformity assessment is carried out
- An “EC Declaration of Conformity” is given
- CE Marking is affixed where applicable
- Instructions for safe use are provided

Essential Health and Safety Requirements

Annex 1 of the Directive gives a list of Essential Health and Safety Requirements (referred to as EHSRs) to which machinery must comply where relevant. The purpose of this list is to ensure that the machinery is safe and is designed and constructed so that it can be used, adjusted and maintained throughout all phases of its life without putting persons at risk. The following text provides a quick overview of some typical requirements but it is important to consider all of the EHSRs given in Annex 1.

A risk assessment must be carried out to determine which EHSRs are applicable to the equipment under consideration.

The EHSRs in Annex 1 provides a hierarchy of measures for eliminating the risk:

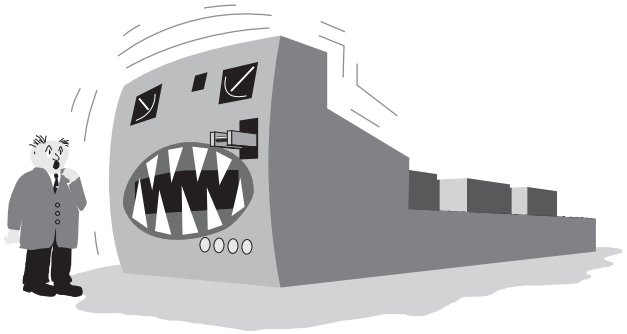

Figure 2: Machine Must Meet EHSRs

(1) Inherently Safe Design—Where possible the design itself will prevent any hazards.

Where this is not possible **(2) Additional Protective Measures**, e.g., Guards with interlocked access points, non-material barriers such as light curtains, sensing mats etc., should be used.

Any residual risk which cannot be dealt with by the above methods must be contained by **(3) Personal Protective Equipment and/or Training**. The machine supplier must specify what is appropriate.

Suitable materials should be used for construction and operation. Adequate lighting and handling facilities should be provided. Controls and control systems must be safe and reliable. Machines must not be capable of starting up unexpectedly and should usually have one or more emergency stop devices fitted. Consideration

must be given to complex installations where processes upstream or downstream can affect the safety of a machine. Failure of a power supply or control circuit must not lead to a dangerous situation. Machines must be stable and capable of withstanding foreseeable stresses. They must have no exposed edges or surfaces likely to cause injury.

Guards or protection devices must be used to protect risks such as moving parts. These must be of robust construction and difficult to bypass. Fixed guards must be mounted by methods that can only be removed with tools. Movable guards should be interlocked. Adjustable guards should be readily adjustable without the use of tools.

Electrical and other energy supply hazards must be prevented. There must be minimal risk of injury from temperature, explosion, noise, vibration, dust, gases or radiation. There must be proper provisions for maintenance and servicing. Sufficient indication and warning devices must be provided. Machinery shall be provided with instructions for safe installation, use, adjustment etc.

The Machinery Directive—Conformity Assessment and Standards

A harmonized European (EN) Standard that is listed in the Official Journal of the European Union (OJ) under the Machinery Directive, and whose date of cessation of presumption of conformity has not expired, confers a presumption of conformity with certain of the EHSRs. (Many recent standards listed in the OJ include a cross-reference identifying the EHSRs that is covered by the standard).

Therefore, where equipment complies with such current harmonized European standards, the task of demonstrating conformity with the EHSRs is greatly simplified, and the manufacturer also benefits from the increased legal certainty. These standards are not legally required, however, their use is strongly recommended since proving conformity by alternative methods can be an extremely complex issue. These standards support the Machinery Directive and are produced by CEN (the European Committee for Standardization) in cooperation with ISO, and CENELEC (the European Committee for Electrotechnical Standardization) in cooperation with IEC.

A thorough, documented risk assessment must be conducted to ensure that all potential machine hazards are addressed. It is the responsibility of the machine manufacturer to ensure that all EHSRs are satisfied, even those that are not addressed by harmonized EN Standards.

Technical File

The manufacturer or his authorized representative must prepare a Technical File to provide evidence of conformity with the EHSRs. This file should include all relevant information such as test results, drawings, specifications, etc.

It is not essential that all the information is permanently available as hard copy but it must be possible to make the entire Technical File available for inspection on request from a competent authority (a body appointed by an EU country to monitor the conformity of machinery).

At the minimum, the following documentation must be included in a Technical File:

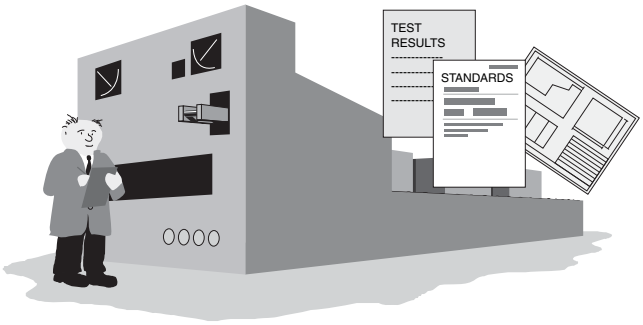

Figure 3: Document Assessment Results

1. Overall drawings of the equipment including control circuit drawings.
2. Detailed drawings, calculation notes, test results, etc. required for checking the conformity of the machinery with the EHSRs.
3. Risk assessment documentation, including a list of the essential health and safety requirements which apply to the machinery and a description of the protective measures implemented.
4. A list of the standards and other technical specifications used, indicating the essential health and safety requirements covered.
5. A description of methods adopted to eliminate hazards presented by the machinery.
6. If relevant, any technical reports or certificates obtained from a test facility or other body.
7. If conformity is declared with a Harmonized European Standard, any technical report giving test results for it.
8. A copy of the instructions for the machinery.
9. Where appropriate, the declaration of incorporation for included partly completed machinery and the relevant assembly instructions for such machinery.
10. Where appropriate, copies of the EC declaration of conformity of machinery or other products incorporated into the machinery.
11. A copy of the EC declaration of conformity.

For series manufacture, details of internal measures (quality systems, for example) to ensure all machinery produced remains in conformity:

- The manufacturer must carry out necessary research or tests on components, fittings or the completed machinery to determine whether by its design and construction it is capable of being erected and put into service safely.
- The technical file need not exist as a permanent single file, but it must be possible to assemble it to make it available in a reasonable time. It must be available for ten years following production of the last unit.

The technical file does not need to include detailed plans or any other specific information regarding sub-assemblies used for the manufacture of the machinery, unless they are essential to verify conformity with the EHSRs.

Conformity Assessment

Certain types of equipment are subject to special measures. This equipment is listed in Annex IV of the Directive and includes dangerous machines such as some woodworking machines, presses, injection molding machines, underground equipment, vehicle servicing lifts, etc.

Annex IV also includes certain safety components such as Protective devices designed to detect the presence of persons (e.g. light curtains) and logic units for ensuring safety functions.

Figure 4: Conformity Assessments

For Annex IV machines that are not in full conformity with the relevant Harmonized European Standards the manufacturer or his authorized representative must apply one of the following procedures:

1. **EC Type Examination**. A Technical File must be prepared and an example of the machine must submitted to a notified body (test house) for EC type examination. If it passes, the machine will be given an EC type examination certificate. The validity of the certificate must be reviewed every five years with the Notified Body.
2. **Full Quality Assurance**. A Technical File must be prepared and the manufacturer must operate an approved quality system for design, manufacture, final inspection and testing. The quality system must ensure conformity of the machinery with the provisions of this Directive. The quality system must be periodically audited by a Notified Body.

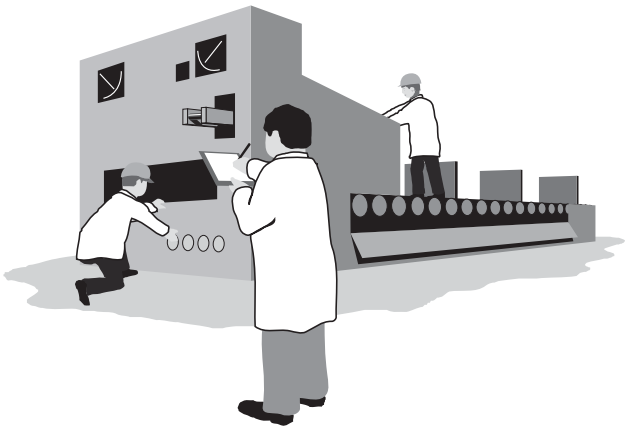

Figure 5: Notified Body Examinations

For machines that are not included in Annex IV or machines that are included in Annex IV but are in full conformity with the relevant Harmonized European Standards, the manufacturer or his authorized representative also has the option prepare the Technical and self assess and declare the conformity of the equipment. There must be internal checks to ensure that the manufactured equipment remains in conformity.

Notified Bodies

A network of notified bodies that communicate with each other and work to common criteria exists throughout the EU. Notified Bodies are appointed by governments (not by industry) and details of organizations with notified body status can be obtained from: *http://ec.europa.eu/enterprise/sectors/mechanical/machinery/index_en.htm*

EC Declaration of Conformity Procedure

The CE Marking must be applied to all machines supplied. The machines should also be supplied with an EC Declaration of Conformity.

CE

Figure 6: CE Mark

The CE Mark indicates that the machine conforms to all applicable European Directives and that the appropriate conformity assessment procedures have been completed. It is an offense to apply the CE Mark for the Machinery Directive unless the machine satisfies the relevant EHSRs.

The EC Declaration of Conformity must contain the following information:

- Business name and full address of the manufacturer and, where appropriate, the authorized representative;
- Name and address of the person authorized to compile the technical file, who must be established in the Community (in the case of a manufacturer outside the EU this may be the "Authorized Representative") ;
- Description and identification of the machinery, including generic denomination, function, model, type, serial number and commercial name;
- A sentence expressly declaring that the machinery fulfills all the relevant provisions of this Directive and where appropriate, a similar sentence declaring the conformity with other Directives and/or relevant provisions with which the machinery complies;
- Where appropriate, a reference to the harmonized standards used;
- Where appropriate, the reference to other technical standards and specifications used;
- (For an Annex IV machines) where appropriate, the name, address and identification number of the notified body which carried out the EC type-examination referred to in Annex IX and the number of the EC type-examination certificate;
- (For an Annex IV machines) where appropriate, the name, address and identification number of the notified body which approved the full quality assurance system referred to in Annex X;
- The place and date of the declaration;
- The identity and signature of the person empowered to draw up the declaration on behalf of the manufacturer or the authorized representative.

EC Declaration of Incorporation for Partly Completed Machinery

Where the equipment is supplied for assembly with other items to form a complete machine at a later date, a DECLARATION OF INCORPORATION should be issued with it. The CE mark should not be applied. The declaration should state that the equipment must not be put into service until the machine into which it has been incorporated has been declared in conformity. A Technical File must be prepared and the partly completed machinery must be supplied with information containing a description of the conditions which must be met with a view to correct incorporation in the final machinery, so as not to compromise safety.

This option is not available for equipment which can function independently or which modifies the function of a machine.

The Declaration of Incorporation must contain the following information:

- Business name and full address of the manufacturer of the partly completed machinery and, where appropriate, the authorized representative;
- Name and address of the person authorized to compile the relevant technical documentation, who must be established in the Community (in the case of a manufacturer outside the EU this may be the "Authorized Representative");
- Description and identification of the partly completed machinery including generic denomination, function, model, type, serial number and commercial name;
- A sentence declaring which essential requirements of this Directive are applied and fulfilled and that the relevant technical documentation is compiled in accordance with part B of Annex VII, and, where appropriate, a sentence declaring the conformity of the partly completed machinery with other relevant Directives;
- An undertaking to transmit, in response to a reasoned request by the national authorities, relevant information on the partly completed machinery. This shall include the method of transmission and shall be without prejudice to the intellectual property rights of the manufacturer of the partly completed machinery;
- A statement that the partly completed machinery must not be put into service until the final machinery into which it is to be incorporated has been declared in conformity with the provisions of this Directive, where appropriate;
- The place and date of the declaration;
- The identity and signature of the person empowered to draw up the declaration on behalf of the manufacturer or the authorized representative.

Machinery Supplied from Outside the EU—Authorized Representatives

If a manufacturer based outside the EU (or EEA) exports machinery into the EU they will need to appoint an Authorized Representative.

An Authorized Representative means any natural or legal person established in the European Community who has received a written mandate from the manufacturer to perform on his behalf all or part of the obligations and formalities connected with the Machinery Directive.

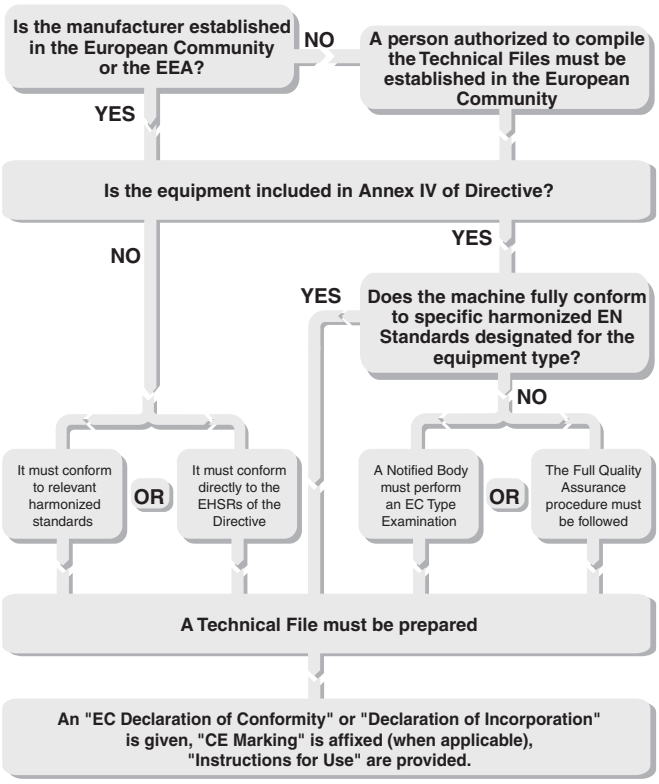

Figure 7: Overview of Procedures for the Machinery Directive

It is important to study the Directive (2006/42/EC) for full details.

The EU Use of Work Equipment Directive (U.W.E. Directive)

Whereas the Machinery Directive is aimed at suppliers, this Directive (89/655/EEC as amended by 95/63/EC, 2001/45/EC and 2007/30/EC) is aimed at users of machinery. It covers all industrial sectors and it places general duties on employers together with minimum requirements for the safety of work equipment. All EU countries are enacting their own forms of legislation to implement this Directive.

For example it is implementation in the UK under the name of The Provision and Use of Work Equipment Regulations (often abbreviated to P.U.W.E.R.). The form of implementation may vary between countries but the effect of the Directive is retained.

The articles of the Directive give details of which types of equipment and workplaces are covered by the Directive.

They also place general duties on employers such as instituting safe systems of working and providing suitable and safe equipment that must be properly maintained. Machine operators must be given proper information and training for the safe use of the machine.

New machinery (and second hand machinery from outside the EU) provided after January 1, 1993 should satisfy any relevant product directives, e.g., The Machinery Directive (subject to transitional arrangements). Second hand equipment from within the EU provided for the first time in the workplace must immediately provide minimum requirements given in an annex of the U.W.E. Directive.

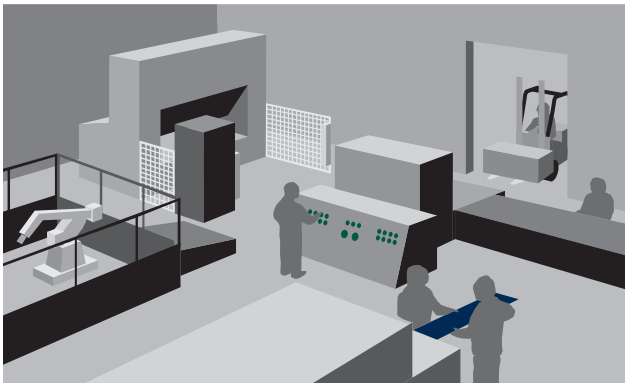

Figure 8: Directive Covers Use of Equipment

Note: Existing or second-hand machinery which is significantly overhauled or modified will be classified as new equipment, so the work carried out on it must ensure compliance with the Machinery Directive (even if it is for a company's own use).

Suitability of work equipment is an important requirement of the directive and it highlights the employer's responsibility to carry out a proper process of risk assessment.

It is a requirement that machinery must be properly maintained. This will normally mean that there must be a routine and planned preventive maintenance schedule. It is recommended that a log is compiled and kept up to date. This is especially important in cases where the maintenance and inspection of equipment contributes to the continuing safety integrity of a protective device or system.

The Annex of the U.W.E. Directive gives general minimum requirements applicable to work equipment.

If the equipment conforms to relevant product directives, e.g., The Machinery Directive, they will automatically comply with the corresponding machine design requirements given in the minimum requirements of the Annex.

Member states are allowed to issue legislation regarding the use of work equipment that goes beyond the minimum requirements of the U.W.E. Directive.

Detailed information on the Use of Work Equipment Directive can be found at the official EU website:
http://europa.eu/legislation_summaries/employment_and_social_policy/health_hygiene_safety_at_work/c11116_en.htm

U.S. Regulations

This section introduces some of the industrial machine guarding safety regulations in the U.S. This is only a starting point; readers must further investigate the requirements for their specific applications and take measures to ensure that their designs, uses and maintenance procedures and practices meet their own needs as well as national and local codes and regulations.

There are many organizations that promote industrial safety in the United States. These include:

1. Corporations, which use established requirements as well as establish their own internal requirements;
2. The Occupational Safety and Health Administration (OSHA);
3. Industrial organizations like the National Fire Protection Association (NFPA), the Robotics Industries Association (RIA), the Association of Manufacturing Technology (AMT) and the suppliers of safety products and solutions such as Rockwell Automation.

Occupational Safety and Health Administration

In the United States, one of the main drivers of industrial safety is the Occupational Safety and Health Administration (OSHA). OSHA was established in 1970 by an Act of the U.S. Congress. The purpose of this act is to provide safe and healthful working conditions and to preserve human resources. The act authorizes the Secretary of Labor to set mandatory occupational safety and health standards applicable to businesses affecting interstate commerce. This Act shall apply with respect to employment performed in a workplace in a State, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, American Samoa, Guam, the Trust Territory of the Pacific Islands, Wake Island, Outer Continental Shelf Lands defined in the Outer Continental Shelf Lands Act, Johnston Island, and the Canal Zone.

Article 5 of the Act sets the basic requirements. Each employer shall furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees; and shall comply with occupational safety and health standards promulgated under this Act.

Article 5 also states that each employee shall comply with occupational safety and health standards and all rules, regulations, and orders issued pursuant to this Act which are applicable to his own actions and conduct.

The OSHA Act places the responsibility on both the employer and the employee. This is quite divergent from Machinery Directive, which requires suppliers to place machines on the market that are free from hazards. In the U.S., a supplier can sell a machine without any safeguarding. The user must add the safeguarding to make the machine safe. Although this was a common practice when the Act was approved, the trend is for suppliers to provide machines with the safeguarding, as designing safety into a machine is far more cost effective than adding the safeguarding after the machine is designed and built. Standards are now attempting to get the supplier and user to communicate requirements for safeguarding so that machines are made not only safe but more productive.

The Secretary of Labor has the authority to promulgate as an occupational safety or health standard any national consensus standard, and any established Federal standard, unless the promulgation of such a standard would not result in improved safety or health for specifically designated employees.

OSHA accomplishes this task by publishing regulations in Title 29 of the Code of Federal Regulation (29 CFR). Standards pertaining to industrial machinery are published by OSHA in Part 1910 of 29 CFR. They are freely available on the OSAH website at www.osha.gov. Unlike most standards, which are voluntary, the OSHA standards are laws.

Some of the important parts as they pertain to machine safety are as follows:

A General
B Adoption and Extension of Established Federal Standards
C General Safety and Health Provisions
H Hazardous Materials
I Personal Protective Equipment
J General Environmental Controls—includes Lockout/Tagout
O Machinery and Machine Guarding
R Special Industries
S Electrical

Some OSHA standards reference voluntary standards. The legal effect of incorporation by reference is that the material is treated as if it were published in full in the Federal Register. When a national consensus standard is incorporated by reference in one of the subparts, that standard is considered the law. For example, NFPA 70, a voluntary standard known as the US National Electric Code, is referenced in Subpart S. This makes the requirements in the NFPA70 standard mandatory.

The 29 CFR 1910.147, in Subpart J, covers the control of hazardous energy. This is commonly known as the Lockout/Tagout standard. The equivalent voluntary standard is ANSI Z244.1. Essentially, this standard requires power to the machine to be locked out when undergoing service or maintenance. The purpose is to prevent the unexpected energization or startup of the machine which would result in injury to employees.

Employers must establish a program and utilize procedures for affixing appropriate lockout devices or tagout devices to energy isolating devices, and to otherwise disable machines or equipment to prevent unexpected energization, start up or release of stored energy in order to prevent injury to employees.

Minor tool changes and adjustments, and other minor servicing activities, which take place during normal production operations, are not covered by this standard if they are routine, repetitive, and integral to the use of the equipment for production, provided that the work is performed using alternative measures which provide effective protection. Alternative measures are safeguarding devices like light curtains, safety mats, gate interlocks and other similar devices connected to a safety system. The challenge to the machine designer and user is to determine what is “minor” and what is “routine, repetitive and integral.”

Subpart O covers “Machinery and Machine Guarding.” This subpart lists the general requirements for all machines as well as requirements for some specific machines. When OSHA was formed in 1970, it adopted many existing ANSI standards. For example B11.1 for mechanical power presses was adopted as 1910.217.

The 1910.212 is the general OSHA standard for machines. It states that one or more methods of machine guarding shall be provided to protect the operator and other employees in the machine area from hazards such as those created by the point of operation, ingoing nip points, rotating parts, flying chips and sparks. Guards shall be affixed to the machine where possible and secured elsewhere if for any reason attachment to the machine is not possible. The guard shall be such that it does not offer an accident hazard in itself.

The “point of operation” is the area on a machine where work is actually performed upon the material being processed. The point of operation of a machine, whose operation exposes an employee to injury, shall be guarded. The guarding device shall be in conformity with any appropriate standards or, in the absence of applicable specific standards, shall be so designed and constructed as to prevent the operator from having any part of his body in the danger zone during the operating cycle.

Subpart S (1910.399) states the OSHA electrical requirements. An installation or equipment is acceptable to the Assistant Secretary of Labor, and approved within the meaning of this Subpart S if it is accepted, certified, listed, labeled, or otherwise determined to be safe by a nationally recognized testing laboratory (NRTL).

What is Equipment? A general term including material, fittings, devices, appliances, fixtures, apparatus, and the like, used as a part of, or in connection with, an electrical installation.

What is “Listed”? Equipment is “listed” if it is of a kind mentioned in a list which, (a) is published by a nationally recognized laboratory which makes periodic inspection of the production of such equipment, and (b) states such equipment meets nationally recognized standards or has been tested and found safe for use in a specified manner.

As of August 2009, the following companies are recognized by OSHA as NRTLs:
Canadian Standards Association (CSA)
Communication Certification Laboratory, Inc. (CCL)
Curtis-Straus LLC (CSL)
FM Approvals LLC (FM)
Intertek Testing Services NA, Inc. (ITSNA)
MET Laboratories, Inc. (MET)
NSF International (NSF)
National Technical Systems, Inc. (NTS)
SGS U.S. Testing Company, Inc. (SGSUS)
Southwest Research Institute (SWRI)
TÜV America, Inc. (TÜVAM)
TÜV Product Services GmbH (TÜVPSG)
TÜV Rheinland of North America, Inc. (TÜV)
Underwriters Laboratories Inc. (UL)
Wyle Laboratories, Inc. (WL)

Some states have adopted their own local OSHAs. Twenty-four states, Puerto Rico and the Virgin Islands have OSHA-approved State Plans and have adopted their own standards and enforcement policies. For the most part, these States adopt standards that are identical to Federal OSHA. However, some States have adopted different standards applicable to this topic or may have different enforcement policies.

Employers must report incident history to OSHA. OSHA compiles incident rates and transmits the information to local offices, and uses this information to prioritize inspections. The key inspection drivers are:

- Imminent Danger
- Catastrophes and Fatalities
- Employee Complaints
- High Hazardous Industries
- Local Planned Inspections
- Follow-up Inspections
- National and Local Focus Programs

Violations of OSHA standards can result in fines. The schedule of fines is:

- Serious: up to $7000 per violation
- Other than Serious: discretionary but not more than $7000
- Repeat: up to $70,000 per violation
- Willful: up to $70,000 per violation
- Violations resulting in death: further penalties
- Failure to abate: $7000/day

The table below shows the top 14 OSHA citations from October 2004 to September 2005.

Standard	Description
1910.147	The control of hazardous energy (lockout/tagout)
1910.1200	Hazard communication
1910.212	General requirements for all machines
1910.134	Respiratory protection
1910.305	Wiring methods, components, and equipment for general use
1910.178	Powered industrial trucks
1910.219	Mechanical power transmission
1910.303	General requirements
1910.213	Woodworking machinery
19102.215	Abrasive wheel machinery
19102.132	General requirements
1910.217	Mechanical power presses
1910.095	Occupational noise exposure
1910.023	Guarding floor and wall openings and holes

Table 1

Canada Regulations

In Canada, Industrial Safety is governed at the Provincial level. Each province has its own regulations that are maintained and enforced. For example, Ontario established the Occupational Health and Safety Act, which sets out the rights and duties of all parties in the workplace. Its main purpose is to protect workers against health and safety hazards on the job. The Act establishes procedures for dealing with workplace hazards, and it provides for enforcement of the law where compliance has not been achieved voluntarily.

Within the Act there is regulation 851, Section 7 that defines the Pre-Start Health and Safety review. This review is a requirement within Ontario for any new, rebuilt or modified piece of machinery and a report needs to be generated by a professional engineer.

Standards

This section provides a list of some of the typical international and national standards that are relevant to machinery safety. It is not intended to form an exhaustive list but rather to give an insight on what machinery safety issues are the subject of standardization.

This section should be read in conjunction with the Regulation section.

The countries of the world are working towards global harmonization of standards. This is especially evident in the area of machine safety. Global safety standards for machinery are governed by two organizations: ISO and IEC. Regional and country standards are still in existence and continue to support local requirements but in many countries there has been a move toward using the international standards produced by ISO and IEC.

For example, the EN (European Norm) standards are used throughout the EEA countries. All new EN standards are aligned with, and in most cases have identical text with ISO and IEC standards.

IEC covers electrotechnical issues and ISO covers all other issues. Most industrialized countries are members of IEC and ISO. Machinery safety standards are written by working groups comprised of experts from many of the world's industrialized counties.

In most countries standards can be regarded as voluntary whereas regulations are legally mandatory. However standards are usually used as the practical interpretation of the regulations. Therefore the worlds of standards and regulations are closely interlinked.

ISO (International Organization for Standardization)

ISO is a non-governmental organization comprised of the national standards bodies of most of the countries of the world (157 countries at the time of this printing). A Central Secretariat, located in Geneva, Switzerland, coordinates the system. ISO generates standards for designing, manufacturing and using machinery more efficiently, safer and cleaner. The standards also make trade between countries easier and fairer.

ISO standards can be identified by the three letters ISO.

The ISO machine standards are organized in the same fashion as the EN standards, three levels: Type A, B and C (see the later section on EN Harmonized European Standards).

For more information, visit the ISO website: *www.iso.org*

IEC (International Electrotechnical Commission)

The IEC prepares and publishes international standards for electrical, electronic and related technologies. Through its members, the IEC promotes international cooperation on all questions of electrotechnical standardization and related matters, such as the assessment of conformity to electrotechnical standards.

For more information, visit the IEC website: *www.iec/ch*.

EN Harmonized European Standards

These standards are common to all EEA countries and are produced by the European Standardization Organizations CEN and CENELEC. Their use is voluntary but designing and manufacturing equipment to them is the most direct way of demonstrating compliance with the EHSRs of the Machinery Directive.

They are divided into 3 types: A, B and C standards.

Type A. STANDARDS: Cover aspects applicable to all types of machines.

Type B. STANDARDS: Subdivided into 2 groups.

Type B1 STANDARDS: Cover particular safety and ergonomic aspects of machinery.

Type B2 STANDARDS: Cover safety components and protective devices.

Type C. STANDARDS: Cover specific types or groups of machines.

It is important to note that complying with a C Standard gives automatic presumption of conformity with the EHSRs. In the absence of a suitable C Standard, A and B Standards can be used as part or full proof of EHSR conformity by pointing to compliance with relevant sections.

Agreements have been reached for cooperation between CEN/CENELEC and bodies such as ISO and IEC. This should ultimately result in common worldwide standards. In most cases an EN Standard has a counterpart in IEC or ISO. In general the two texts will be the same and any regional differences will be given in the forward of the standard.

This section lists some of the EN, ISO, IEC and other national and regional Standards relevant to machinery safety. Where an EN standard is shown in brackets it is identical or very closely aligned with the ISO or IEC standard. For a complete list of EN Machinery Safety standards go to:
http://ec.europa.eu/enterprise/sectors/mechanical/machinery/index_en.htm

ISO and EN Standards (Type A)

EN ISO 12100

Safety of machinery. Basic concepts, general principles for design. Pts 1 & 2

This is an A standard which outlines all the basic principles including risk assessment, guarding, interlocking, emergency stops, trip devices, safety distances, etc. It references to other standards that provide greater levels of detail.

In the near future it is likely that EN ISO 12100 and EN ISO 14121 will be combined into one standard.

EN ISO 14121

Principles for risk assessment.

This principle outlines the fundamentals of assessing the risks during the life of the machinery. It summarizes methods for hazard analysis and risk estimation.

An ISO Technical Report: ISO/TR 14121-2 is also available. It gives practical guidance and examples of methods for risk assessment.

ISO and EN Standards (Type B)

EN ISO 11161

Safety of Integrated Manufacturing Systems—Basic Requirements.

This standard was published in its revised form in 2007. It was significantly updated making it very useful for contemporary integrated machinery.

EN ISO 13849-1:2008 Safety related parts of control systems—Pt 1: General principles for design

This standard is the result of the significant revision of the old EN 954-1 (which is due for withdrawal at the end of 2011). It introduced many new aspects for Functional Safety of control systems. The term “PL” (Performance Level) is used to describe the level of integrity of a system or a subsystem.

It is available as an alternative to IEC/EN 62061 (see later). Note that EN ISO 13849-1 covers all technologies of control system whereas IEC/EN 62061 only covers electrical technology.

EN ISO 13849-1 is intended to provide a direct transition path from the categories of the previous EN 954-1. It has a relatively simple methodology compared to IEC/EN 62061 but this is at the expense of some constraints and restrictions. Either the revised ISO/EN 13849-1 or IEC/EN 62061 can be applied to machinery electrical safety related systems and the user should choose whichever one is best suited to their needs but EN ISO 13849-1 is often preferred when transitioning from Categories.

Note: Recent to the time of publication of this text, CEN (European Committee for Standardisation) announced that the final date for presumption of conformity of EN 954-1 will be extended to the end of 2011 to facilitate transition to the later standards. This replaces the original date of December 29, 2009.

For the latest information on the use and status of EN 954-1 visit: *http://discover.rockwellautomation.com/EN_Safety_Solutions.aspx*. In the meantime it is advised that the extension of the transition period is used to move over to the use of the later standards (EN ISO 13849-1 or IEC/EN 62061) in a timely manner.

EN ISO 13849-2

Safety related parts of control systems—Pt 2: Validation

This standard provides details for validation of safety related parts of control systems. It has annexes that give details safety components, principles and fault exclusion.

EN ISO 13850

Emergency Stop devices, functional aspects—Principles for design.

Provides design principles and requirements.

ISO 13851 (EN 574)

Two-hand control devices—Functional aspects—Principles for design.

Provides requirements and guidance on the design and selection of two-hand control devices, including the prevention of defeat and the avoidance of faults.

EN ISO 13857

Safety distances to prevent danger zones being reached by the upper and lower limbs.

Provides data for calculation of safe aperture sizes and positioning for guards, etc.

ISO 13854 (EN 349)

Minimum distances to avoid crushing parts of the human body.

Provides data for calculation of safe gaps between moving parts, etc.

ISO 13855 (EN 999)

The positioning of protective equipment in respect to approach speeds of parts of the human body.

Provides methods for designers to calculate the minimum safety distances from a hazard for specific safety devices, in particular for electrosensitive devices (e.g., light curtains), pressure sensitive mats/floors and two-hand controls. It contains a principle for the positioning of safety devices based on approach speed and machine stopping time that can reasonably be extrapolated to cover interlocked guard doors without guard locking.

ISO 13856-1 (EN 1760-1)

Pressure Sensitive Safety Devices—Pt 1: Mats & Floors.

Provides requirements and test procedures.

ISO 13856-2 (EN 1760-2)

Pressure Sensitive Safety Devices—Pt 2: Edges & Bars.

Provides requirements and test procedures

ISO 14118 (EN 1037)

Prevention of unexpected start-up—Isolation and energy dissipation

Defines measures aimed at isolating machines from power supplies and dissipating stored energy to prevent unexpected machine startup and allow safe intervention with machinery.

ISO 14119 (EN 1088)

Interlocking devices associated with guards—Principles for design and selection.

Provides principles for the design and selection of interlocking devices associated with guards.

In order to verify mechanical switches it refers to IEC 60947-5-1—Low voltage switch gear—Pt 5: Control circuit devices and switching elements—Section 1: Electromechanical control circuit devices.

In order to verify non-mechanical switches it refers to IEC 60947-5-3—Particular requirements for proximity devices with defined behavior under fault conditions.

ISO 14120 (EN 953)

General Requirements for the Design and Construction of Guards.

Provides definitions, descriptions and design requirements for fixed and movable guards.

ISO and EN Standards (Type C)

There is a large range of Type C Standards that cover specific types of machinery. For example:

EN ISO 10218-1

Industrial robots

EN 415-4

Safety of packaging machines. Palletizers and depalletizers.

IEC and EN Standards

IEC/EN 60204-1

Electrical equipment of machines—Pt 1 General requirements.

This is a very important standard that outlines recommendations for safety related aspects of wiring and electrical equipment on machines. A significantly revised version was published in 2006. This revision removed the former preference for electromechanical safety circuits.

IEC/EN 61508

Functional safety of electrical, electronic and programmable electronic safety-related systems.

This standard is important because it contains the requirements and provisions that are necessary for the design of complex electronic and programmable systems and subsystems. The standard is generic so it is not restricted to the machinery sector. It is a lengthy and complex document comprising seven parts. Within the machinery sector, its use is mostly for the design of complex devices such as safety PLCs. For system level design and integration aspects for machinery the sector specific standards such as IEC/EN 62061 or EN ISO 13849-1 are probably the most suitable. IEC 61508 has mapped out the approach for a new generation of sector and product specific standards that is now emerging. It introduced the term SIL (safety integrity level) and gives a hierarchy of 4 SILs which are applied to a safety function. SIL 1 is the lowest and SIL 4 is the highest. SIL 4 is not usually applicable to the machinery sector because it is intended to be related to very high risk levels more associated with sectors such as petrochemical or nuclear.

IEC 62061 (EN 62061)

Functional safety of safety related electrical, electronic and programmable electronic control systems.

This standard is one of the new generations of standards that use the term SIL (safety integrity level). It is the machinery specific implementation of IEC/EN 61508. It specifies requirements and makes recommendations for the design, integration and validation of electrical safety related control systems for machines. This standard provides an alternative approach to EN ISO 13849-1 and is intended to be useful for the increasingly complex safety functionality required for today's current and future machinery For less complex safety functionality EN ISO 13849-1 may be easier to implement. The use of these standards requires the availability of data such as PFH_D (probability of dangerous failure per hour) or MTTFd (mean time to dangerous failure).

IEC 61496 (EN 61496)

Electro-sensitive protective equipment Pt 1: General requirements and tests.

General requirements and tests.

Pt 2: Particular requirements for equipment using active optoelectronic protective devices.

Part 1 gives requirements and test procedures for the control and monitoring aspects for electrosensitive protective equipment. Subsequent parts deal with aspects particular to the sensing side of the system. Part 2 gives particular requirements for safety light curtains.

IEC 61800-5-2 (EN 61800-5-2)

Functional safety of power drive systems.

This standard deals with drives that have safety functionality.

US Standards

OSHA Standards

Where possible, OSHA promulgates national consensus standards or established Federal standards as safety standards. The mandatory provisions (e.g., the word shall implies mandatory) of the standards, incorporated by reference, have the same force and effects as the standards listed in Part 1910. For example, the national consensus standard NFPA 70 is listed as a reference document in Appendix A of Subpart S-Electrical of Part 1910 of 29 CFR. NFPA 70 is a voluntary standard, which was developed by the National Fire Protection Association (NFPA). NFPA 70 is also known as the National Electric Code (NEC). By incorporation, all the mandatory requirements in the NEC are mandatory by OSHA.

The following is a list of some of the OSHA standards relevant to machinery safety,

1910 Subpart O - Machinery and Machine Guarding

1910.211 - Definitions.

1910.212 - General requirements for all machines.

1910.213 - Woodworking machinery requirements.

1910.214 - Cooperage machinery. [Reserved]

1910.215 - Abrasive wheel machinery.

1910.216 - Mills and calendars in the rubber and plastics industries.

1910.217 - Mechanical power presses.

1910.217 App A - Mandatory requirements for certification/ validation of safety systems for presence sensing device initiation of mechanical power presses

1910.217 App B - Nonmandatory guidelines for certification/ validation of safety systems for presence sensing device initiation of mechanical power presses

1910.217 App C - Mandatory requirements for OSHA recognition of third-party validation organizations for the PSDI standard

1910.217 App D - Nonmandatory supplementary information

1910.218 - Forging machines.

1910.219 - Mechanical power

1910.255 - Resistance welding.

1910 Subpart R - Special Industries

1910.261 - Pulp, paper, and paperboard mills.

1910.262 - Textiles.

1910.263 - Bakery equipment.

1910.264 - Laundry machinery and operations.

1910.265 - Sawmills.

1910.266 - Logging operations.

ANSI Standards

The American National Standards Institute (ANSI) serves as the administrator and coordinator of the United States private sector voluntary standardization system. It is a private, nonprofit, membership organization supported by a diverse constituency of private and public sector organizations.

ANSI, itself, does not develop standards; it facilitates the development of standards by establishing consensus among qualified groups. ANSI also ensures that the guiding principles of consensus, due process and openness are followed by the qualified groups. Below is a partial list of industrial safety standards that can be obtained by contacting ANSI.

These standards are categorized as either application standards or construction standards. Application standards define how to apply a safeguarding to machinery. Examples include ANSI B11.1, which provides information on the use of machine guarding on power presses, and ANSI/RIA R15.06, which outlines safeguarding use for robot guarding.

National Fire Protection Association

The National Fire Protection Association (NFPA) was organized in 1896. Its mission is to reduce the burden of fire on the quality of life by advocating scientifically based consensus codes and standards, research and education for fire and related safety issues. The NFPA sponsors many standards to help accomplish its mission. Two very important standards related to industrial safety and safe-guarding are the National Electric Code (NEC) and Electrical Standard for Industrial Machinery.

The National Fire Protection Association has acted as sponsor of the NEC since 1911. The original code document was developed in 1897 as a result of the united efforts of various insurance, electrical, architectural, and allied interests. The NEC has since been updated numerous times; it is revised about every three years. Article 670 of the NEC covers some details on industrial machinery and refers the reader to the Electrical Standard for Industrial Machinery, NFPA 79.

NFPA 79 applies to electrical/electronic equipment, apparatus, or systems of industrial machines operating from a nominal voltage of 600 volts or less. The purpose of NFPA 79 is to provide detailed information for the application of electrical/electronic equipment, apparatus, or systems supplied as part of industrial machines that will promote safety to life and property. NFPA 79, which was officially adopted by ANSI in 1962, is very similar in content to the standard IEC 60204-1.

Machines, which are not covered by specific OSHA standards, are required to be free of recognized hazards which may cause death or serious injuries. These machines must be designed and maintained to meet or exceed the requirements of applicable industry standards. NFPA 79 is a standard that would apply to machines not specifically covered by OSHA standards.

ANSI/NFPA 70

US National Electrical Code

ANSI/NFPA 70E

Electrical Safety Requirements for Employee Workplaces

ANSI/NFPA 79

Electrical Standard for Industrial Machinery

Association for Manufacturing Technology

ANSI B11.1

Machine Tools - Mechanical Power Presses - Safety Requirements for Construction, Care, and Use

ANSI B11.2

Machine Tools - Hydraulic Power Presses, Safety Requirements for Construction, Care, and Use

ANSI B11.3

Power Press Brakes, Safety Requirements for the Construction, Care, and Use

ANSI B11.4

Machine Tools - Shears - Safety Requirements for Construction, Care, and Use

ANSI B11.5

Machine Tools - Iron Workers - Safety Requirements for Construction, Care, and Use

ANSI B11.6

Lathes, Safety Requirements for the Construction, Care, and Use

ANSI B11.7

Machine Tools - Cold Headers and Cold Formers, Safety Requirements for Construction, Care, and Use

ANSI B11.8

Drilling, Milling, and Boring Machines, Safety Requirements for the Construction, Care, and Use

ANSI B11.9

Grinding Machines, Safety Requirements for the Construction, Care, and Use

ANSI B11.10

Metal Sawing Machines, Safety Requirements for Construction, Care, and Use

ANSI B11.11

Gear Cutting Machines, Safety Requirements for the Construction, Care, and Use

ANSI B11.12

Machine Tools - Roll-Forming and Roll-Bending Machines - Safety Requirements for the Construction, Care, and Use

ANSI B11.13

Machine Tools - Single- and Multiple-Spindle Automatic Bar and Chucking Machines - Safety Requirements for Construction, Care and Use

ANSI B11.14

Machine Tools - Coil-Slitting Machines Safety Requirements for Construction, Care, and Use – Withdrawn and rolled into B11.18

ANSI B11.15

Pipe, Tube, and Shape Bending Machines, Safety Requirements for Construction, Care, and Use

ANSI B11.16

Metal Powder Compacting Presses, Safety Requirements for Construction, Care, and Use

ANSI B11.17

Machine Tools - Horizontal Hydraulic Extrusion Presses - Safety Requirements for Construction, Care, and Use

ANSI B11.18

Machine Tools - Machines and Machinery Systems for Processing Strip, Sheet, or Plate from Coiled Configuration - Safety Requirements for Construction, Care, and Use

ANSI B11.19

Machine Tools - Safeguarding When Referenced by Other B11 Machine Tool Safety Standards-Performance Criteria for the Design, Construction, Care and Operation

ANSI B11.20

Machine Tools - Manufacturing Systems/Cells – Safety Requirements for Construction, Care, and Use

ANSI B11.21

Machine Tools - Machine Tools Using Lasers for Processing Materials - Safety Requirements for Design, Construction, Care, and Use

ANSI B11.TR3

Risk assessment and risk reduction – A guide to estimate, evaluate and reduce risks associated with machine tools

ANSI B11.TR4

This technical report covers the application of programmable controllers to safety applications.

ANSI B11.TR6

This technical report, currently in development, will provide circuit examples of safety functions to accommodate various levels of risk Reduction.

ANSI ISO 12100

Safety of machinery. Basic concepts, general principles for design. Pts -1 and -2

The standard ISO 12100 has been adopted in the US by AMT as an identical ANSI standard. ISO 12100 is a globally applicable top level basic principles standard that forms the framework for most of the ISO, IEC and EN machinery safety standards. It provides a risk assessment approach as opposed to a prescriptive and restrictive approach. The aim is to avoid cost and trade barrier problems caused by a multiplicity of different national standards covering the same subject in different ways.

Robot Industries Association

ANSI RIA R15.06

Safety Requirements for Industrial Robots and Robot Systems

ANSI RIA R15.06

Safety Requirements for Industrial Robots and Robot Systems

Packaging Machinery Manufacturer's Institute

ANSI PMMI B155.1

Safety Requirements for Packaging Machinery and Packaging-Related Converting Machinery

The packaging standard was recently revised to incorporate risk assessment and risk reduction.

American Society of Safety Engineers

Z224.1

Control of Hazardous Energy, Lockout/Tag out and Alternative Methods

This standard is similar to OSHA 1910.147. It provides a method (risk assessment) to determine the appropriate alternative method when energy cannot be locked out.

Society of Plastics Industry

ANSI B151.1

Horizontal Injection Molding Machines – Safety Requirements for Manufacture, Care and Use

ANSI B151.15

Extrusion Blow Molding Machines – Safety Requirements

ANSI B151.21

Injection Blow Molding Machines - Safety Requirements

ANSI B151.26

Plastics Machinery - Dynamic Reaction - Injection Molding Machines - Safety Requirements for the Manufacture, Care and Use

ANSI B151.27

Plastics Machinery - Robots used with Horizontal Injection Molding Machines - Safety Requirements for the Integration, Care and Use

ANSI B151.28

Plastics Machinery - Machines to Cut, Slit, of Buff Plastic Foams - Safety Requirements for the Manufacture, Care and Use

Canada Standards

CSA Standards reflect a national consensus of producers and users – including manufactures, consumers, retailers, unions and professional organizations, and government agencies. The standards are used widely by industry and commerce and often adopted by municipal, provincial, and federal governments in their regulations, particularly in the fields of health, safety, building and construction, and the environment.

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The Standards Council of Canada is the coordinating body of the National Standards system, a federation of independent, autonomous organizations working towards the further development and improvement of voluntary standardization in the national interest.

CSA Z432-04

Safeguarding of Machinery

CSA Z434-03

Industrial Robots and Robot Systems - General Safety Requirements

CSA Z460-05

Control of hazardous energy – Lockout and other methods

CSA Z142-02

Code for Power Press Operation: Health, Safety, and Guarding Requirements

Australia Standards

Most of these standards are closely aligned with the equivalent ISO/IEC/EN standards

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AS 4024.1-2006

Safeguarding of machinery. Part 1: General principles

AS 4024.1101-2006 Terminology – General

AS 4024.1201-2006 Basic terminology and methodology

AS 4024.1202-2006 Technical principles

AS 4024.1301-2006 Principles of risk assessment

AS 4024.1302-2006 Reduction of risks to health and safety from hazardous substances emitted by machinery

AS 4024.1401-2006 Design principles – Terminology and general principles

AS 4024.1501-2006 Design of safety related parts of control systems – General principles

AS 4024.1502-2006 Design of safety related parts of control systems – Validation

AS 4024.1601-2006 General requirements for the design and construction of fixed and movable guards

AS 4024.1602-2006 Principles for the design and selection of interlocks

AS 4024.1603-2006 Prevention of unexpected start-up

AS 4024.1604-2006 Emergency stop – Principles for design

AS 4024.1701-2006 Basic human body measurements for technological design

AS 4024.1702-2006 Principles for determining the dimensions required for openings for whole body access to machinery

AS 4024.1703-2006 Principles for determining the dimensions required for access openings

AS 4024.1704-2006 Anthropometric data

AS 4024.1801-2006 Safety distances – Upper limbs

AS 4024.1802-2006 Safety distances – Lower limbs

AS 4024.1803-2006 Minimum gaps to prevent crushing of parts of the human body

AS 4024.1901-2006 General principles for human interaction with displays and control actuators

AS 4024.1902-2006 Displays

AS 4024.1903-2006 Control actuators

AS 4024.1904-2006 Requirements for visual, auditory and tactile signs

AS 4024.1905-2006 Requirements for marking

AS 4024.1906-2006 Requirements for the location and operation of actuators

AS 4024.1907-2006 System of auditory and visual danger and information signals

AS4024.2-1998

Safeguarding of machinery. Part 2: Installation and commissioning requirements for electro-sensitive systems—Optoelectronic devices

The basis of this standard is IEC 61496-1 and -2. Part 2 covers the installation and commissioning of light curtains specifically related to machinery safety.

AS 4024.3-1998

Safeguarding of machinery. Part 3: Manufacturing and testing requirements for electro-sensitive systems— Optoelectronic devices

The basis of this standard is IEC 61496-1 and -2. Part 3 covers the manufacturing and testing of light curtains specifically related to machinery safety.

AS4024.4-1998

Safeguarding of machinery. Part 4: Installation and commissioning requirements for electro-sensitive systems—Pressure-sensitive devices

The basis of this standard is EN 1760-1 and EN 1760-2. Part 4 covers the installation and commissioning of mats, floors, edges and bars that are used with machinery, regardless of the energy used.

AS 4024.5-1998

Safeguarding of machinery. Part 5: Manufacturing and testing requirements for electro-sensitive systems— Pressure-sensitive devices

The basis of this standard is EN1760-1 and EN1760-2. Part 5 covers the manufacturing and testing mats, floors, edges and bars that are used with machinery, regardless of the energy used.

Safety Strategy

From a purely functional point of view the more efficiently a machine performs its task of processing material then the better it is. But, in order for a machine to be viable it must also be safe. Indeed safety must be regarded as a prime consideration.

In order to devise a proper safety strategy there must be two key steps, which work together as shown in Figure 9.

Risk Assessment based on a clear understanding of the machine limits and functions and the tasks that may be required to be performed at the machine throughout its life.

Risk Reduction is then performed if necessary and safety measures are selected based on the information derived from the risk assessment stage.

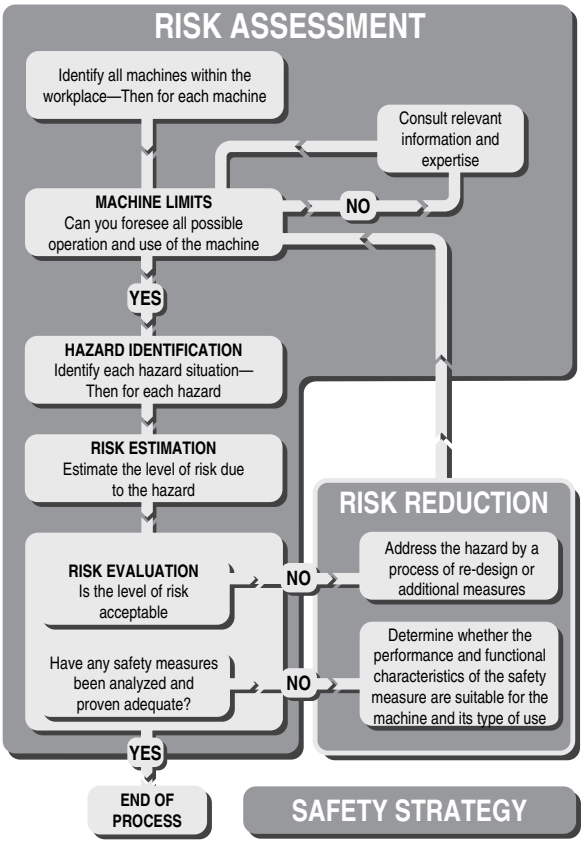


Figure 9: Safety Strategy

The manner in which this is done is the basis of the Safety Strategy for the machine.

We need a checklist to follow and ensure that all aspects are considered, and that the overriding principle does not become lost in the detail. The whole process should be documented. Not only will this ensure a more thorough job, but it will also make the results available for checking by other parties.

This section applies both to machine manufacturers and to machine users. The manufacturer needs to ensure that his machine is capable of being used safely. The risk assessment should be started at the machine design phase and it should take account of all the foreseeable tasks that will need to be performed on the machine. This task based approach at the early iterations of the risk assessment is very important. For example, there may be a regular need for adjustment of moving parts at the machine. At the design phase it should be possible to design in measures that will allow this process to be carried out safely. If it is missed at the early stage it may be difficult or impossible to implement at later stage. The result could be that the adjustment of moving parts still has to be performed but must be done in a manner that is either unsafe or inefficient (or both). A machine on which all tasks have been taken account of during the risk assessment will be a safer machine and a more efficient machine.

The user (or employer) needs to ensure that the machines in their working environment are safe. Even if a machine has been declared safe by the manufacturer, the machine user should still perform a risk assessment to determine whether the equipment is safe in their environment. Machines are often used in circumstances unforeseen by the manufacturer. For example, a milling machine used in a school workshop will need additional considerations to one that is used in an industrial tool room.

It should also be remembered that if a user company acquires two or more independent machines and integrates them into one process they are the manufacturer of the resulting combined machine.

So now let us consider the essential steps on the route to a proper safety strategy. The following can be applied to an existing factory installation or a single new machine.

Risk Assessment

It is wrong to regard risk assessment as a burden. It is a helpful process that provides vital information and empowers the user or designer to take logical decisions about ways of achieving safety.

There are various standards that cover this subject. ISO 14121: “Principles for risk assessment” and ISO 12100: “Safety of machinery—Basic principles” contain the most globally applied guidance.

Which ever technique is used to carry out a risk assessment, a cross functional team of people will usually produce a result with wider coverage and better balance than one individual.

Risk assessment is an iterative process; it will be performed at different stages of the machine life cycle. The information available will vary according to the stage of the life cycle. For example, a risk assessment conducted by a machine builder will have access to every detail of the machine mechanisms and construction materials but probably only an approximate assumption of the machine’s ultimate working environment. A risk assessment conducted by the machine user would not necessarily have access to the in-depth technical details but will have access to every detail of the machines working environment. Ideally the output of one iteration will be the input for the next iteration.

Machine Limit Determination

This involves collecting and analyzing information regarding the parts, mechanisms and functions of a machine. It will also be necessary to consider all the types of human task interaction with the machine and the environment in which the machine will operate. The objective is to get a clear understanding of the machine and its usage.

Where separate machines are linked together, either mechanically or by control systems, they should be considered as a single machine, unless they are “zoned” by appropriate protective measures.

It is important to consider all limits and stages of the life of a machine including installation, commissioning, maintenance, decommissioning, correct use and operation as well as the consequences of reasonably foreseeable misuse or malfunction.

Task and Hazard Identification

All the hazards at the machine must be identified and listed in terms of their nature and location. Types of hazard include crushing, shearing, entanglement, part ejection, fumes, radiation, toxic substances, heat, noise, etc.

The results of the task analysis should be compared with the results of the hazard identification. This will show where there is a possibility for the convergence of a hazard and a person i.e. a hazardous situation. All the hazardous situations should be listed. It may be possible that the same hazard could produce different type of hazardous situation depending on the nature of the person or the task. For example, the presence of a highly skilled and trained maintenance technician may have different implications than the presence of an unskilled cleaner who has no knowledge of the machine. In this situation if each case is listed and addressed separately it may be possible to justify different protective measures for the maintenance technician than the ones for the cleaner. If the cases are not listed and addressed separately then the worst case should be used and the maintenance and the cleaner will both be covered by the same protective measure.

Sometimes it will be necessary to carry out a general risk assessment on an existing machine that already has protective measures fitted (e.g., a machine with dangerous moving parts protected by an interlocked guard door). The dangerous moving parts are a potential hazard that may become an actual hazard in the event of failure of the interlocking system. Unless that interlock system has already been validated (e.g., by risk assessment or design to an appropriate standard), its presence should not be taken into account.

Risk Estimation

This is one of the most fundamental aspects of risk assessment. There are many ways of tackling this subject and the following pages illustrate the basic principles.

Any machinery that has potential for hazardous situations presents a risk of a hazardous event (i.e. of harm). The greater the amount of risk, the more important it becomes to do something about it. At one hazard the risk could be so small that we can tolerate and accept it but at another hazard the risk could be so large that we need to go to extreme measures to protect against it. Therefore in order to make a decision on "if and what to do about the risk," we need to be able to quantify it.

Risk is often thought of solely in terms of the severity of injury at an accident. Both the severity of potential harm AND the probability of its occurrence have to be taken into account in order to estimate the amount of risk present.

The suggestion for risk estimation given on the following pages is not advocated as the definitive method as individual circumstances may dictate a different approach. IT IS INTENDED ONLY AS A GENERAL GUIDELINE TO ENCOURAGE A METHODICAL AND DOCUMENTED STRUCTURE.

The point system used has not been calibrated for any particular type of application therefore is not necessarily suitable for any specific application. ISO TR (Technical Report) 14121-2 "Risk assessment – Practical guidance and examples of methods" provides practical guidance and some shows different methods for quantification of risk.

The following factors are taken into account:

- THE SEVERITY OF POTENTIAL INJURY.
- THE PROBABILITY OF ITS OCCURRENCE.

The probability of occurrence includes two factors:

- FREQUENCY OF EXPOSURE.
- PROBABILITY OF INJURY.

Dealing with each factor independently we will assign values to each of these factors.

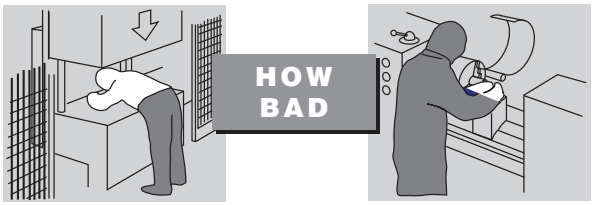
Make use of any data and expertise available to you. You are dealing with all stages of machine life, so to avoid too much complexity base your decisions on the worst case for each factor.

It is also important to retain common sense. Decisions need to take account of what is feasible, realistic and plausible. This is where a cross functional team approach is valuable.

Remember, for the purposes of this exercise you should usually not take account of any existing protective system. If this risk estimation shows that a protective system is required there are some methodologies as shown later in this chapter that can be used to determine the characteristics required.

1. Severity of potential injury

For this consideration we are presuming that the accident or incident has occurred, perhaps as a result of the hazards shown in Figure 10. Careful study of the hazard will reveal what is the most severe injury possible.



In this example most severe injury would be "fatal."

In this example the probable most severe injury would be "serious," with the possibility of bruising, breakage, finger amputation or injury from ejected chuck key, etc.

Figure 10: Potential Injury

Remember: For this consideration we are presuming that an injury is inevitable and we are only concerned with its severity. You should assume that the operator is exposed to the hazardous motion or process.

The severity of injury should be assessed as:

- **FATAL:** Death
- **MAJOR**: (Normally irreversible) Permanent disability, loss of sight, limb amputation, respiratory damage, etc.
- **SERIOUS**: (Normally reversible) Loss of consciousness, burns, breakages, etc.
- **MINOR**: Bruising, cuts, light abrasions, etc.

Each description could be assigned a points value (shown in Figure 11).

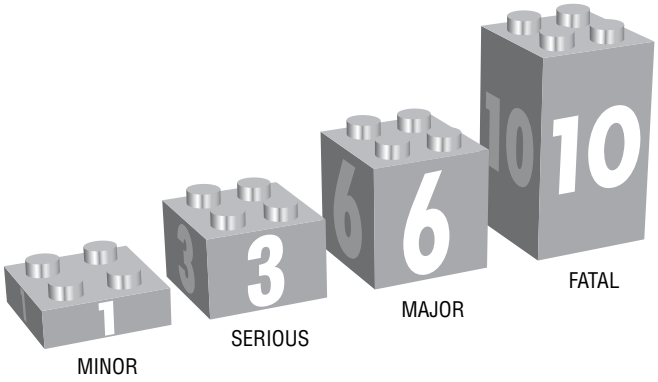


Figure 11: Points Assigned to Severity

2. Frequency of exposure

Frequency of exposure answers the question of how often is the operator or the maintenance person exposed to the hazard (Figure 12).

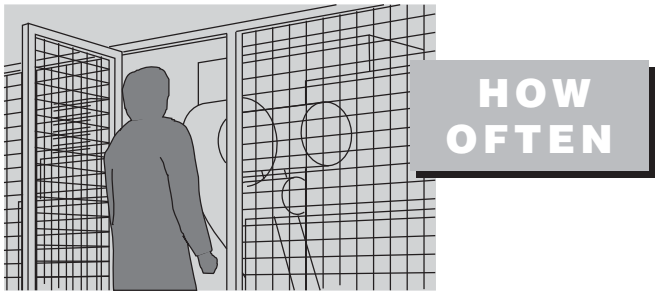


Figure 12: Frequency of Exposure

The frequency of exposure to hazard can be classified as:

- **FREQUENT**: Several times per day
- **OCCASIONAL**: Daily
- **SELDOM**: Weekly or less

Each description could be assigned a points value (shown in Figure 13).

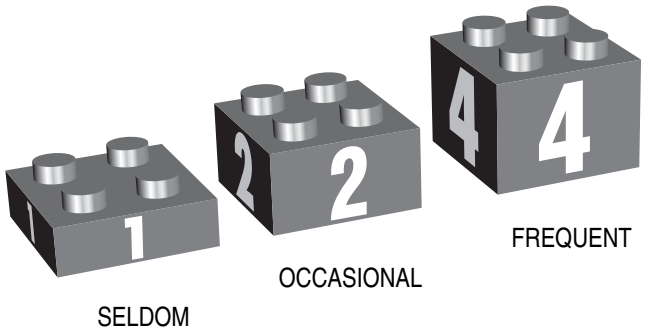
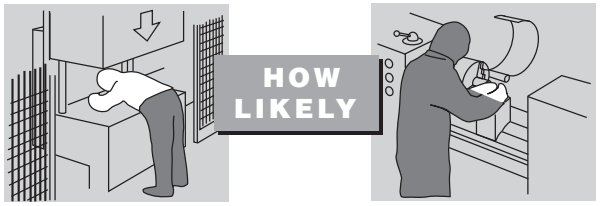


Figure 13: Points Assigned to Frequency of Exposure

3. Probability of injury

You should assume that the operator is exposed to the hazardous motion or process (Figure 14).



In this example the probability of injury could be rated as "certain" because of the amount of body in the hazard area and the speed of machine operation.

In this example the probability of injury may be rated as "possible" as there is minimal contact between the hazard and the operator. There may be time to withdraw from the danger.

Figure 14: How Likely

By considering the manner in which the operator is involved with the machine and other factors (speed of start up, for example) the probability of injury can be classified as:

- Unlikely
- Probable
- Possible
- Certain

Each description could be assigned a points value shown in Figure 15.

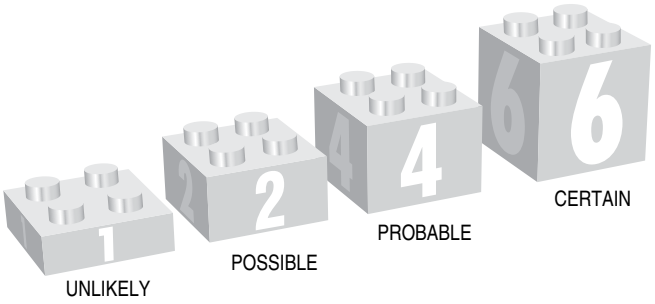


Figure 15: Points Assigned to Probability of Injury

All headings are assigned a value and they are now added together to give an initial estimate. Figure 16 shows the sum of the three components adds up to a value of 13. But we must consider a few more factors.

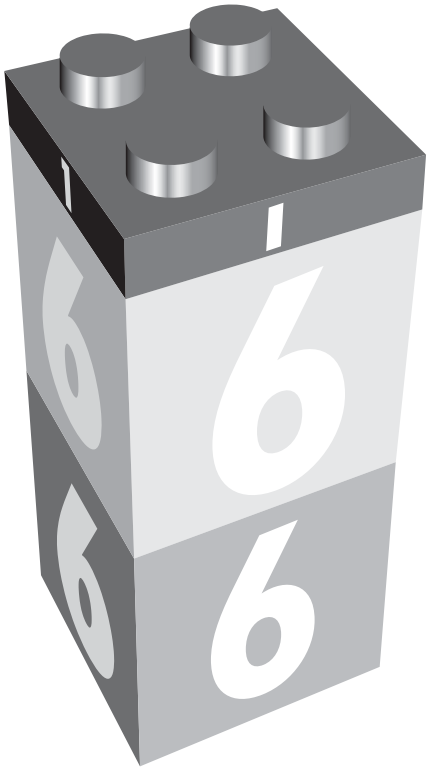


Figure 16: Initial Estimate

(**Note**: This is not based necessarily on the previous example pictures.)

The next step is to adjust the initial estimate by considering additional factors such as those shown in Table 2. Often they can only be properly considered when the machine is installed in its permanent location.

Typical Factor	Suggested Action
More than one person exposed to the hazard	Multiply the severity by the number of people
Protracted time in the danger zone without complete power isolation	If time spent per access is more than 15 minutes, add 1 point to the frequency factor.
Operator is unskilled or untrained	Add 2 points to the total.
Very long intervals (e.g., one year) between accesses. (There may be progressive and undetected failures particularly in monitoring systems.)	Add points equivalent to the maximum frequency factor.

Table 2: Additional Considerations for Risk Estimate

The results of any additional factors are then added to the previous total as shown in Figure 17.

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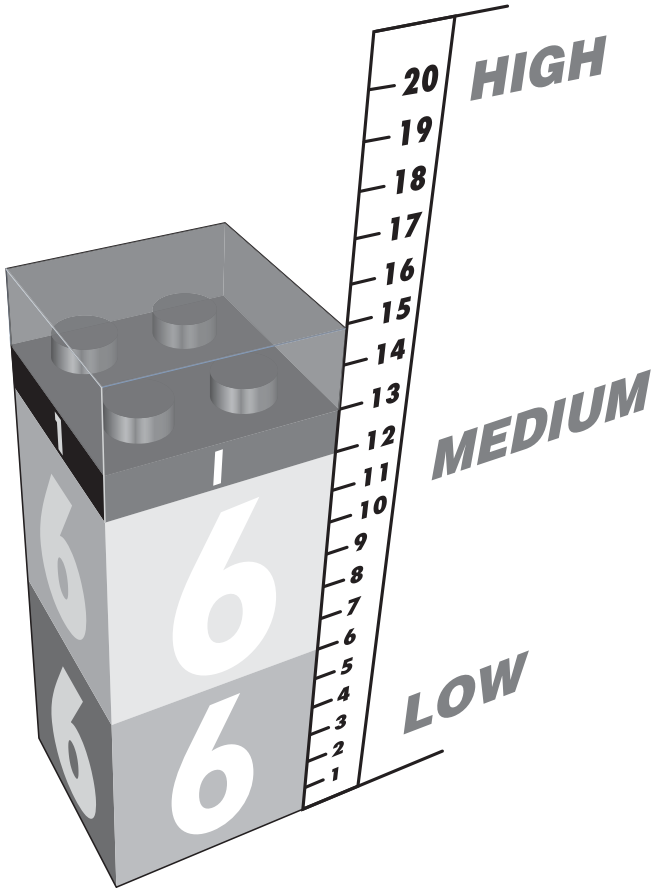

Figure 17: Final Value with Adjustments

Risk Reduction

Now we must consider each machine and its respective risks in turn and take measures to address all of its hazards.

The chart shown in Figure 18 is a suggestion for part of a documented process of accounting for all safety aspects of the machinery being used. It acts as a guide for machinery users, but machine manufacturers or suppliers can also use the same principle to confirm that all equipment has been evaluated. It will also act as an index to more detailed reports on risk assessment.

It shows that where a machine carries the CE Mark it simplifies the process as the machine hazards have already been evaluated by the manufacturer and that all the necessary measures have been taken. Even with CE Marked equipment there may still be hazards due to the nature of its application or material being processed which the manufacturer did not foresee.

Hierarchy of Measures for Risk Reduction

There are three basic methods to be considered and used in the following order:

1. Eliminate or reduce risks as far as possible (inherently safe machinery design and construction).
2. Install the necessary protective systems and measures (e.g. interlocked guards, light curtains etc) in relation to risks that cannot be eliminated by design.
3. Inform users of the residual risks due to any shortcomings of the protection measures adopted, indicate whether any particular training is required and specify any need to provide personal protection equipment.

Each measure from the hierarchy should be considered starting from the top and used where possible. This will usually result in the use of a combination of measures.

Company - MAYKIT WRIGHT LTD
Facility - Tool room - East Factory.
Date - 8/29/95
Operator profile - skilled.

Equipment Identity & Date	Directive Conformity	Risk Assessment Report Number	Accident History	Notes	Hazard Identity	Hazard Type	Action Required	Implemented and Inspected - Reference
Bloggs center lathe. Serial no. 8390726 Installed 1978	None claimed	RA302	None	Electrical equipment complies with BS EN 60204 E-Stops fitted (replaced 1989)	Chuck rotation with guard open	Mechanical Entanglement Cutting	Fit guard interlock switch	11/25/94 J Kershaw Report no 9567
					Cutting fluid	Toxic	Change to non toxic type	11/30/94 J Kershaw Report no 9714
					Swarf cleaning	Cutting	Supply gloves	11/30/94 J Kershaw Report no 9715
Bloggs turret head milling m/c Serial no 17304294 Manuf 1995 Installed May 95	M/c Dir. EMC Dir	RA416	None		Movement of bed (towards wall)	Crushing	Move machine to give enough clearance	4/13/95 J Kershaw Report no 10064

Figure 18: Risk Assessment Matrix

Inherently Safe Design

At the machine design phase it will be possible to avoid many of the possible hazards simply by careful consideration of factors such as materials, access requirements, hot surfaces, transmission methods, trap points, voltage levels, etc.

For example, if access is not required to a dangerous area, the solution is to safeguard it within the body of the machine or by some type of fixed enclosing guard.

Protective Systems and Measures

If access is required, then life becomes a little more difficult. It will be necessary to ensure that access can only be gained while the machine is safe. Protective measures such as interlocked guard doors and/or trip systems will be required. The choice of protective device or system should be heavily influenced by the operating characteristics of the machine. This is extremely important as a system that impairs machine efficiency will render itself liable to unauthorized removal or bypassing.

The safety of the machine in this case will depend on the proper application and correct operation of the protective system even under fault conditions.

The correct operation of the system must now be considered. Within each type there is likely to be a choice of technologies with varying degrees of performance of fault monitoring, detection or prevention.

In an ideal world every protective system would be perfect with absolutely no possibility of failing to a dangerous condition. In the real world, however, we are constrained by the current limits of knowledge and materials. Another very real constraint is cost. Based on these factors it becomes obvious that a sense of proportion is required. Common sense tells us that it would be ridiculous to insist that the integrity of a safety system on a machine that may, at the worst case, cause mild bruising to be the same as that required to keep a jumbo jet in the air. The consequences of failure are drastically different and therefore we need to have some way of relating the extent of the protective measures to the level of risk obtained at the risk estimation stage.

Whichever type of protective device is chosen it must be remembered that a “safety related system” may contain many elements including the protective device, wiring, power switching device and sometimes parts of the machine’s operational control system. All these elements of the system (including guards, mounting, wiring etc.) should have suitable performance characteristics relevant to their design principle and technology. IEC/EN 62061 and EN ISO 13849-1 classify hierarchical levels of performance for safety related parts of control systems and they provide risk assessment methods in their annexes to determine the integrity requirements for a protective system.

ISO 13849-1:2006 provides an enhanced risk graph in its Annex A. This graph is shown in Figure 19.

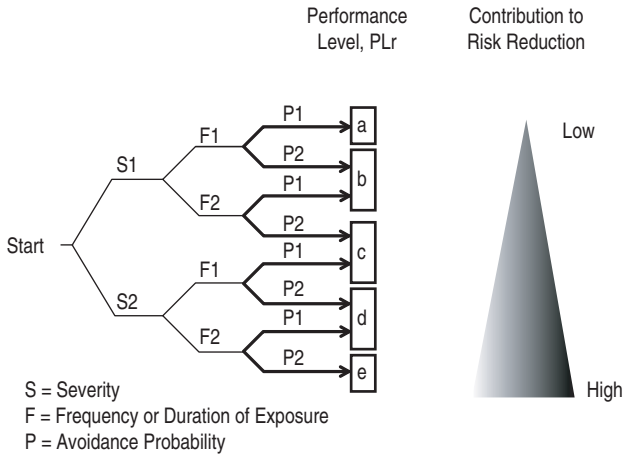

Figure 19: Risk Graph for Determining the Required Performance Level for a Safety Function—from ISO 13849-1:2006

IEC 62061 also provides a method in its Annex A, it takes the form shown in Figure 20.

The use of either of the above methods should provide equivalent results. Each method is intended to take account of the detailed content of the standard to which it belongs.

In both cases it is extremely important that the guidance provided in the text of the standard is used. The Risk Graph or Table must not be used in isolation or in an overly simplistic manner.

Evaluation

After the protective measure has been chosen and before it is implemented it is important to repeat the risk estimation. This is a procedure that is often missed. It may be that if we install a protective measure, the machine operator may feel that they are totally and completely protected against the original envisaged risk. Because they no longer have the original awareness of danger, they may intervene with the machine in a different way. They may be exposed to the hazard more often, or they may enter further into the machine for example. This means that if the protective measure fails they will be at a greater risk than envisaged before. This is the actual risk that we need to estimate. Therefore the risk estimation needs to be repeated taking into account any foreseeable changes in the way that people may intervene with the machine. The result of this activity is used to check whether the proposed protective measures are, in fact, suitable. For further information Annex A of IEC/EN 62061 is recommended.

Training, Personal Protective Equipment, etc.

It is important that operators have the necessary training in the safe working methods for a machine. This does not mean that the other measures can be omitted. It is not acceptable to merely tell an operator that they must not go near dangerous areas (as an alternative to guarding them).

It may also be necessary for the operator to use equipment such as special gloves, goggles, respirators, etc. The machinery designer should specify what sort of equipment is required. The use of personal protective equipment will not usually form the primary safeguarding method but will complement the measures shown above.

Risk assessment and safety measures

Document No.:
Part of:

Product:
Issued by:
Date:

☐ Pre risk assessment
☐ Intermediate risk assessment
☐ Follow up risk assessment

Black area = Safety measures required
Grey area = Safety measures recommended

Consequences	Severity Se	Class Cl 3 - 4	5 - 7	8 - 10	11 - 13	14 - 15	Frequency and duration, Fr		Probability of hzd. event, Pr		Avoidance Av	
Death, losing an eye or arm	4	SIL 2	SIL 2	SIL 2	SIL 3	SIL 3	<= 1 hour	5	Common	5		
Permanent, losing fingers	3		OM	SIL 1	SIL 2	SIL 3	> 1 h - <=day	5	Likely	4		
Reversible, medical attention	2			OM	SIL 1	SIL 2	>1day - <= 2wks	4	Possible	3	Impossible	5
Reversible, first aid	1				OM	SIL 1	> 2wks - <= 1 yr	3	Rarely	2	Possible	3
							> 1 yr	2	Negligible	1	Likely	1

Ser. No.	Hzd. No.	Hazard	Se	Fr	Pr	Av	Cl	Safety measure	Safe

Comments

Figure 20: Table for Determining the Required Safety Integrity Level for a Safety Function—from IEC 62061

Standards

Many standards and technical reports provide guidance on risk assessment. Some are written for wide applicability, and some are written for specific applications. The following is a list of standards that include information on risk assessment.

ANSI B11.TR3: Risk assessment and risk reduction—A guide to estimate, evaluate and reduce risks associated with machine tools

ANSI PMMI B155.1: Safety Requirements for Packaging Machinery and Packaging-Related Converting Machinery

ANSI RIA R15.06: Safety Requirements for Industrial Robots and Robot Systems

AS 4024.1301-2006: Principles of risk assessment

CSA Z432-04: Safeguarding of Machinery

CSA Z434-03: Industrial Robots and Robot Systems—General Safety Requirements

IEC/EN 61508: Functional safety of electrical, electronic and programmable electronic safety-related systems.

IEC/EN 62061: Safety of machinery—Functional safety of safety related electrical, electronic and programmable electronic control systems.

EN ISO 13849-1: Safety of machinery—Safety related parts of control systems

EN ISO 14121-1: Principles for risk assessment

ISO TR 14121-2: Risk assessment—Practical guidance and examples of methods

Protective Measures and Complementary Equipment

When the risk assessment shows that a machine or process carries a risk of injury, the hazard must be eliminated or contained. The manner in which this is achieved will depend on the nature of the machine and the hazard. Protective measures in conjunction with guarding either prevent access to a hazard or prevent dangerous motion at a hazard when access is available. Typical examples of protective measures are interlocked guards, light curtains, safety mats, two-hand controls and enabling switches.

Emergency stop devices and systems are associated with safety related control systems but they are not direct protective systems, they should only be regarded as complementary protective measures.

Preventing Access

Fixed Enclosing Guards

If the hazard is on a part of the machinery which does not require access, a guard should be permanently fixed to the machinery as shown in Figure 21. These types of guards must require tools for removal. The fixed guards must be able to 1) withstand their operating environment, 2) contain projectiles where necessary, and 3) not create hazards by having, for example, sharp edges. Fixed guards may have openings where the guard meets the machinery or openings due to the use of a wire mesh type enclosure.

Windows provide convenient ways to monitor machine performance, when access to that portion of the machine. Care must be taken in the selection of the material used, as chemical interactions with cutting fluids, ultra-violet rays and simple aging cause the window materials to degrade over time.

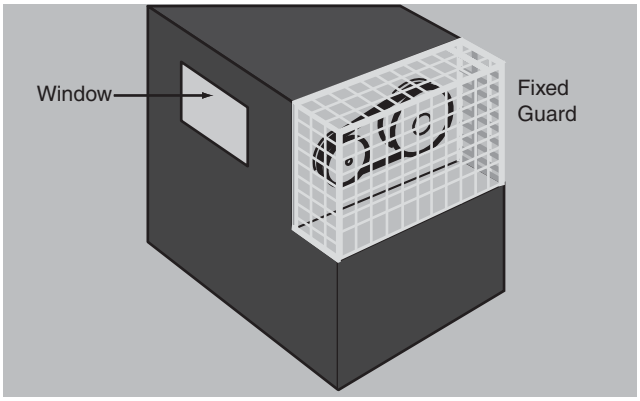

Figure 21: Fixed Guards

The size of the openings must prevent the operator from reaching the hazard. Table O-10 in U.S. OHSA 1910.217 (f) (4), ISO 13854, Table D-1 of ANSI B11.19, Table 3 in CSA Z432, and AS4024.1 provide guidance on the appropriate distance a specific opening must be from the hazard.

Detecting Access

Protective measures can be used to detect access to a hazard. When detection is selected as the method of risk reduction, the designer must understand that a complete safety system must be used; the safeguarding device, by itself, does not provide necessary risk reduction.

This safety system generally consists of three blocks: 1) an input device that senses the access to the hazard, 2) a logic device that process the signals from the sensing device, checks the status of the safety system and turns on or off output devices, and 3) an output device that controls the actuator (for example, a motor). Figure 22 shows the block diagram of a simple safety system.

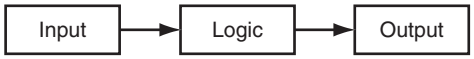

Figure 22: Simple Safety System Block Diagram

Detection Devices

Many alternative devices are available to detect the presence of a person entering or inside a hazard area. The best choice for a particular application is dependent on a number of factors.

- Frequency of access,
- Stopping time of hazard,
- Importance of completing the machine cycle, and
- Containment of projectiles, fluids, mists, vapors, etc.

Appropriately selected movable guards can be interlocked to provide protection against projectiles, fluids, mists and other types of hazards, and are often used when access to the hazard is infrequent. Interlocked guards can also be locked to prevent access while the machine is in the middle of the cycle and when the machine takes a long time to come to a stop.

Presence sensing devices, like light curtains, mats and scanners, provide quick and easy access to the hazard area and are often selected when operators must frequently access the hazard area. These types of devices do not provide protection against projectiles, mists, fluids, or other types of hazards.

The best choice of protective measure is a device or system that provides the maximum protection with the minimum hindrance to normal machine operation. All aspects of machine use must be considered, as experience shows that a system that is difficult to use is more liable to be removed or by-passed.

Presence Sensing Devices

When deciding how to protect a zone or area it is important to have a clear understanding of exactly what safety functions are required.

In general there will be at least two functions.

1. Switch off or disable power when a person enters the hazard area.
2. Prevent switching on or enabling of power when a person is in the hazard area.

At first thought these may seem to be one and the same thing but although they are obviously linked, and are often achieved by the same equipment, they are actually two separate functions. To achieve the first point we need to use some form of trip device. In other words a device which detects that a part of a person has gone beyond a certain point and gives a signal to trip off the power. If the person is then able to continue past this tripping point and their presence is no longer detected then the second point (preventing switching on) may not be achieved.

Figure 23 shows a full body access example with a vertically mounted light curtain as the trip device. Interlocked guard doors may also be regarded as a trip only device when there is nothing to prevent the door being closed after entry.

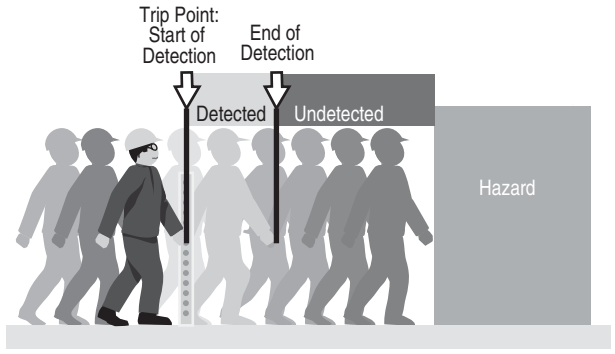

Figure 23: Full Body Access

If whole body access is not possible, so a person is not able to continue past the tripping point, their presence is always detected and the second point (preventing switching on) is achieved.

For partial body applications, as shown in Figure 24, the same types of devices perform tripping and presence sensing. The only difference being the type of application.

Presence sensing devices are used to detect the presence of people. The family of devices includes safety light curtains, single beam safety barriers, safety area scanners, safety mats and safety edges.

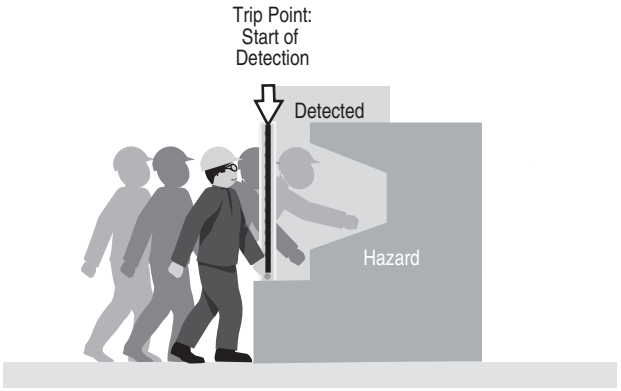

Figure 24: Partial Body Access

Safety Light Curtains

Safety light curtains are most simply described as photoelectric presence sensors specifically designed to protect personnel from injuries related to hazardous machine motion. Also known as AOPDs (Active Opto-electronic Protective Devices) or ESPE (Electro Sensitive Protective Equipment), light curtains offer optimal safety, yet they allow for greater productivity and are the more ergonomically sound solution when compared to mechanical guards. They are ideally suited for applications where personnel need frequent and easy access to a point of operation hazard.

Light curtains are designed and tested to meet IEC 61496-1 and -2. There is no harmonized EN version of part 2 so Annex IV of the European Machinery Directive requires third party certification of light curtains prior to placing them on the market in the European Community. Third parties test the light curtains to meet this international standard. Underwriter's Laboratory has adopted IEC 61496-1 as a U.S. national standard.

Operation

Safety light curtains consist of an emitter and receiver pair that creates a multi-beam barrier of infrared light in front of, or around, a hazardous area. The emitter is synchronized with the receiver by the photoelectric beam nearest one end of the housing. To eliminate susceptibility to false tripping attributed to ambient light and interference (crosstalk) from other opto-electronic devices, the LEDs in the emitter are pulsed at a specific rate (frequency modulated), with each LED pulsed sequentially so that an emitter can only affect the specific receiver associated with it. When all the beams have been checked, the scan starts over again. An example of a basic light curtain system is shown in Figure 25.

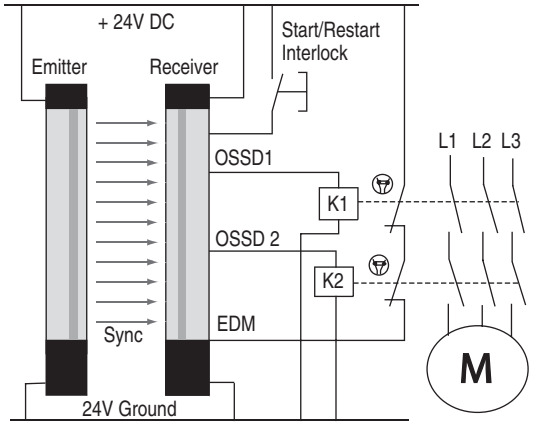

Figure 25: Basic Light Curtain Safety System

When any of the beams are blocked by intrusion into the sensing field, the light curtain control circuit turns its output signals off. The output signal must be used to turn the hazard off. Most light curtains have OSSD (Output Signal Switching Devices) outputs. The OSSDs are PNP type transistors with short circuit protection, overload protection and cross fault (channel to channel) detection. They can switch DC powered devices, like safety contactors and safety control relays, usually up to 500 mA.

Start/Restart Interlock: Light curtains are designed to interface directly with either low power machine actuators or logic devices like monitoring safety relays or programmable safety controllers. When switching machine actuators directly, the Start/Restart interlocking input of the light curtain must be used. This prevents the light curtain from re-initiating the hazard when the light curtain is initially powered or when the light curtain is cleared.

EDM: Light curtains also have an input that allows them to monitor the machine actuators. This is known as EDM (external device monitoring). After the light curtain is cleared, the light curtain determines if the external actuator is off before enabling any restart.

The emitter and receiver can also be interfaced to a control unit that provides the necessary logic, outputs, system diagnostics and additional functions (muting, blanking, PSDI) to suit the application.

The light curtain system must be able to send a stop signal to the machine even in the event of a component failure(s). Light curtains have two cross monitored outputs that are designed to change state when the safety light curtain sensing field is broken. If one of the outputs fails, the other output responds and sends a stop signal to the controlled machine and as part of the cross monitored system detects that the other output did not change state or respond. The light curtain would then go to a lock out condition, which prevents the machine from being operated until the safety light curtain is repaired. Resetting the safety light curtains or cycling power will not clear the lock out condition.

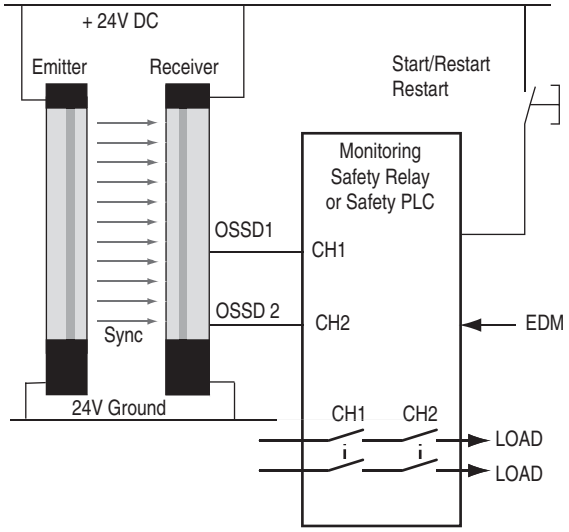

Figure 26: Light Curtain Interfacing with MSR or Safety PLC

Light curtains are often integrated into the safety system by connecting them to a monitoring safety relay (MSR) or safety PLC, as shown in Figure 26. In this case, the MSR or safety PLC handles the switching of the loads, the start/restart interlock and the external device monitoring. This approach is used for complex safety functions, and large load switching requirements. This also minimizes the wiring to the light curtain.

Resolution:

One of the important selection criteria for light curtain is its resolution. Resolution is the theoretical maximum size that an object must be to always trip the light curtain. Frequently used resolutions are 14 mm, which is commonly used for finger detection; 30 mm, which is commonly used for hand detection; and 50 mm, which is commonly used for ankle detection. Larger values are used for full body detection.

The resolution is one of the factors that determine how close the light curtain can be placed to the hazard. See the section on "Safety Distance Calculation" for more information.

Vertical Applications:

Light curtains are most often used in vertically mounted applications. The light curtains must be placed at such distance as to prevent the user from reaching the hazard before the hazard stops.

In reach-through applications, the breaking of the light curtain initiates a stop command to the hazard. While continuing to reach through, to load or unload parts for example, the operator is protected because some part of their body is blocking the light curtain and preventing a restart of the machine.

Fixed guards or additional safeguarding must prevent the operator from reaching over, under or around the light curtain. Figure 27 shows an example of a vertical application.

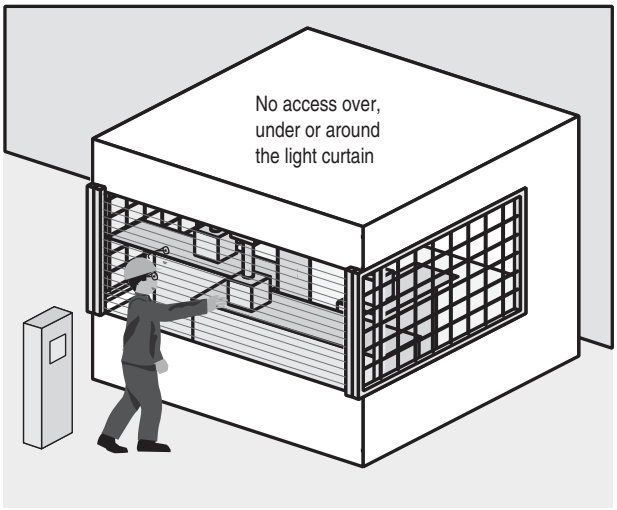

Figure 27: Vertical Application

Cascading

Cascading is a technique of connecting one set of light curtains directly to another set of light curtains like that shown in Figure 28. One set acts as the host, and the other set acts as a guest. A third light curtain can be added as the second guest. This approach saves cabling costs and input terminals at the logic device. The tradeoff is that the response time of the cascaded light curtains is increased as more beams have to be checked during each scan of the cascaded light curtain.

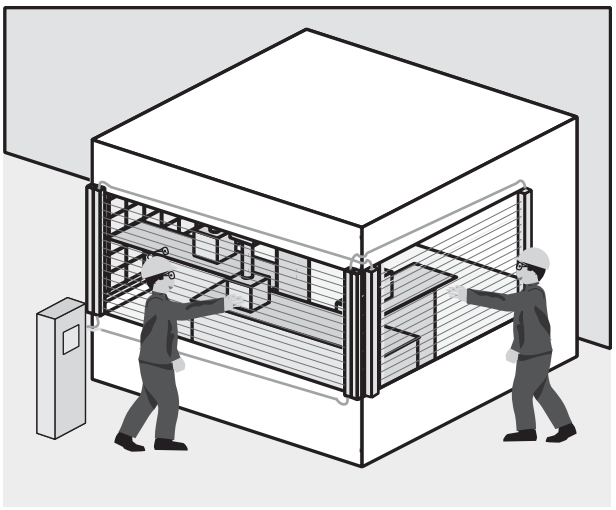

Figure 28: Cascaded Light Curtains

Fixed Blanking

Blanking allows portions of a light curtain's sensing field to be disabled to accommodate objects typically associated with the process. These objects must be ignored by the light curtain, while the light curtain still provides detection of the operator.

Figure 29 shows an example where the object is stationary. Mounting hardware, machine fixture, tooling, or conveyor are in the blanked portion of the light curtain. Known as monitored fixed blanking, this function requires that the object be in the specified area at all times. If any of the beams programmed as “blanked” are not blocked by the fixture or work piece, a stop signal is sent to the machine.

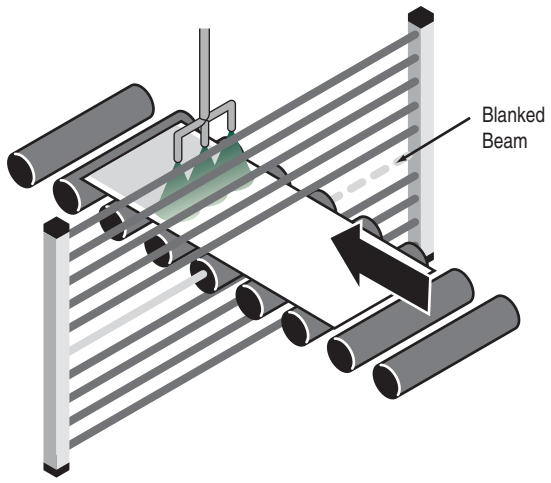

Figure 29: LIght Curtain Is Blanked Where Conveyor Is Fixed

Floating Blanking

Floating blanking allows an object such as feed stock to penetrate the sensing field at any point without stopping the machine. This is accomplished by disabling up to two light beams anywhere within the sensing field. Instead of creating a fixed window, the blanked beams move up and down, or “float,” as needed.

The number of beams that can be blanked depends on the resolution. Two beams can be blanked with a resolution of 14 mm, whereas only one beam can be blanked when a resolution of 30 mm is used. This restriction maintains a smaller opening to help prevent the operator from reaching through the blanked beams.

The beam(s) can be blocked anywhere in the sensing field except the sync beam without the system sending a stop signal to the protected machinery. A press brake, shown in Figure 30, provides a good example. As the ram moves down, the sheet metal bends and moves through the light curtain, breaking only one or two contiguous beams at a time.

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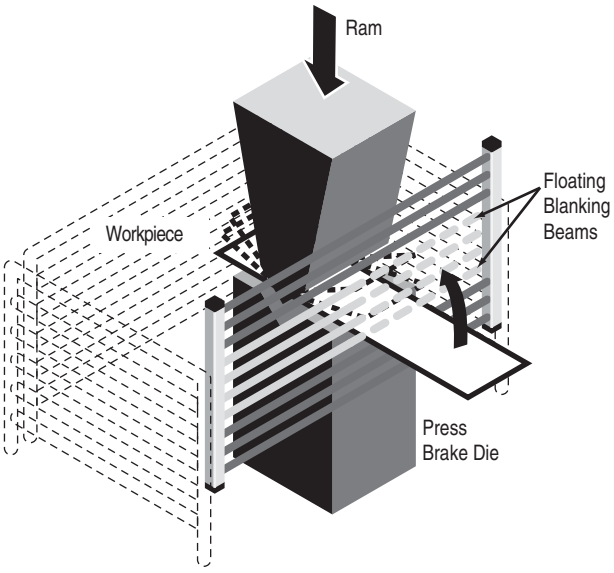

Figure 30: Floating Blanking

When using blanking, fixed or floating, the Safety Distance (the minimum distance the light curtain can be from the hazard such that an operator cannot reach the hazard before the machine stops) is affected. Since blanking increases the minimum object size that can be detected, the minimum safety distance must also increase based on the formula for calculating the minimum safety distance (see the Safety Distance Calculation section).

Horizontal Applications

After calculating the safety distance, the designer might find that the machine operator can fit in the space between the light curtain and the hazard. If this space exceeds 300 mm (12 in.), additional precautions must be considered. One solution is to mount a second light curtain in a horizontal position. These can be two independent sets of light curtains or a cascaded pair of light curtains. Another alternative is to mount a longer light curtain on an angle to the machine. These alternatives are shown in Figure 31. In either alternative, the light curtains must be located a safe distance away from the hazard.

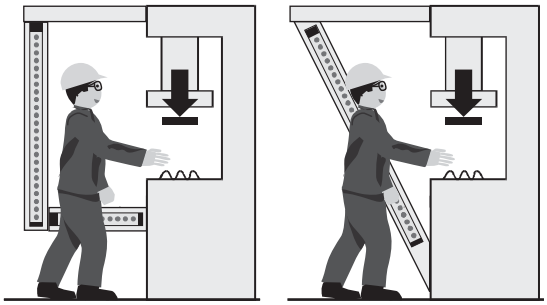

Figure 31: Alternative Solutions for Space between Light Curtain and Hazard

For longer safety distances or for area detection, light curtains can be mounted horizontally, as shown in Figure 32. The light curtains must not be mounted too close to the floor to prevent them from getting dirty, nor too high so as to allow someone to crawl under the light curtain. A distance of 300 mm (12 in.) off the floor is often used. Additionally, the light curtains must not be used as foot steps to gain access. The resolution of the light curtain must be selected to at least detect a person's ankle. No larger than 50 mm resolution is used for ankle detection. If the light curtain does not protect the whole cell, then a manual rest function must be used. The reset button must be located outside the cell with full view of the cell.

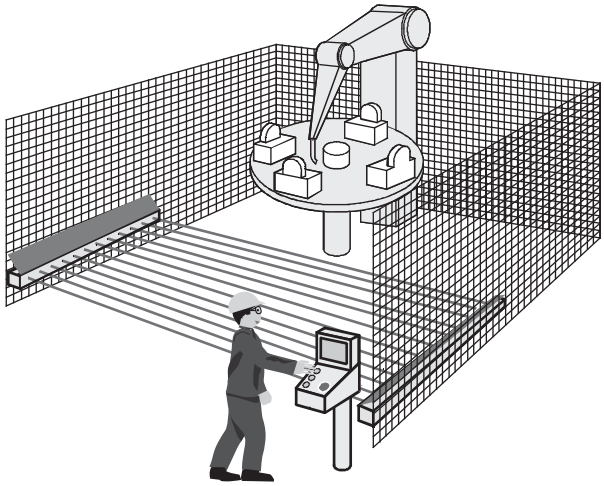

Figure 32: Horizontal Application of a Light Curtain

Perimeter or Area Access Control

Perimeter access control is often used to detect access along the outside edge of a hazard area. Light curtains used to detect perimeter access have resolutions that detect full bodies, as shown in Figure 33. This can be accomplished by a couple different ways. Multi-beam light curtains consisting of two or three beams or a single beam device that is reflected off mirrors to create a dual beam pattern are regularly used. In either case, the lowest beam should be 300 mm (12 in.) off the ground, and the highest beam should prevent a person from simply climbing over the light curtain.

Mirrors can be used to deflect the light beam around a cell. The distance the light curtain can cover is reduced due to the losses in the mirror reflections. Alignment of the light curtain is more difficult and a visible laser alignment tool is often needed during installation.

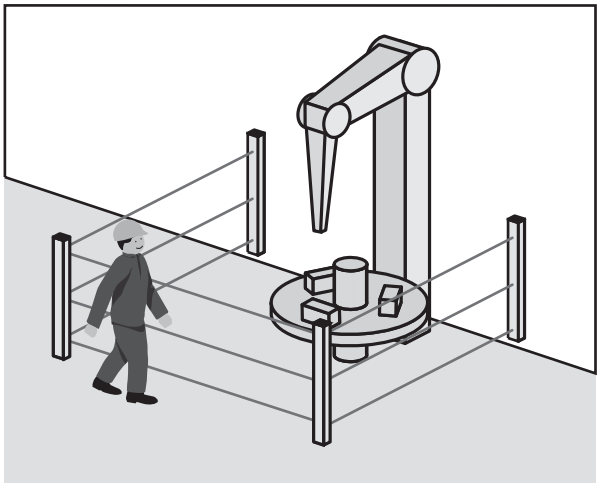

Figure 33: Mirrors Create Perimeter

Mirrors can be used to deflect the light beam around a cell. The distance the light curtain can cover is reduced due to the losses in the mirror reflections. Alignment of the light curtain is more difficult and a visible laser alignment tool is often needed during installation.

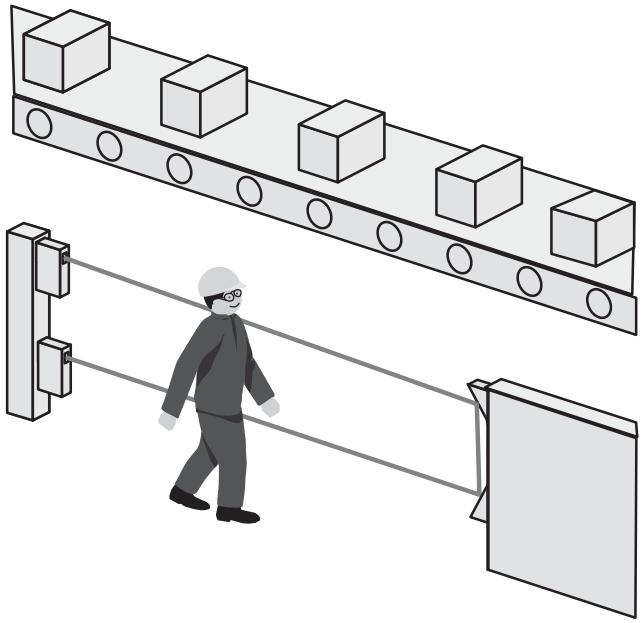

Figure 34: Single Beam Devices for Low Risk Applications

Some single beam devices have extensive (up to 275 feet) sensing distances. This allows a single beam device to create a protective barrier around hazardous machines. Since only a single or dual beam arrangement can be made, this approach is limited to low risk applications. The “Safety Distance Calculation” section (page) discussed beam placement and spacing to achieve adequate protective fields. Figure 34 shows an example of a single beam application. This approach is generally used in low risk applications, due to the larger beam spacing. Breakage of the beam is used to stop the hazardous machine motion.

Safety Laser Scanners

Safety laser scanners use a rotating mirror that deflects light pulses over an arc, creating a plane of detection. The location of the object is determined by the angle of rotation of the mirror. Using a “time-of-flight” technique of a reflected beam of invisible light, the scanner can also detect the distance the object is from the scanner. By taking the measured distance and the location of the object, the laser scanner determines the exact position of the object.

Laser scanners create two zones: 1) a warning zone and 2) a safety zone. The warning zone provides a signal that does not shut down the hazard and informs people that they are approaching the safety zone as shown in Figure 35. Objects entering or inside the safety zone cause the laser scanner to issue a stop command; the OSSD outputs turn off.

The shape and size of the protected area is configured by an accompanied software program and downloaded to the scanner. The safety distance calculation must be used to determine the appropriate size of the safety zone.

One advantage of the laser scanner over a horizontal light curtains or mats is the ability to reconfigure the area. Figure 35 shows an example of the warning field configured to ignore structural objects.

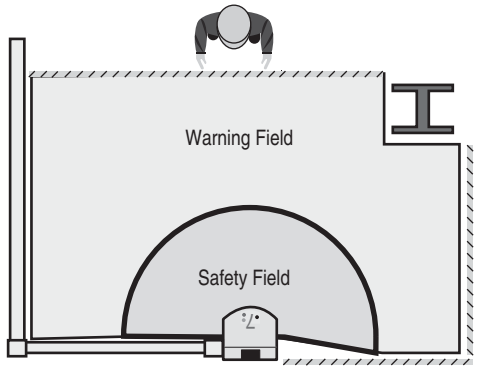

Figure 35: Warning Field Configured Around Structural Objects

Developments in laser scanner technology allow a single scanner to cover multiple zones. In Figure 36, the laser scanner allows operator access to one side (shown as Case 1) while the robot is busy on the other side (Case 2).

Older scanners have electro-mechanical outputs. Newer scanners adopt the same principles as light curtains and provide OSSD outputs with cross checking, external device monitoring and restart interlock for standalone use. The OSSD outputs can also be connected to logic devices when needed as part of a larger system.

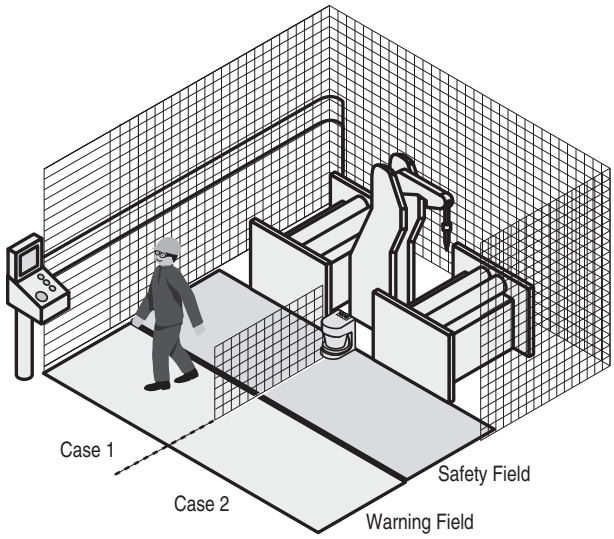

Figure 36: Multizone Application of Laser Scanner

Muting

Muting is characterized as the automatic, temporary suspension of a safety function. Sometimes the process requires that the machine stop when personnel enters the area, yet remain running when automatically-fed material enters. In such a case, a muting function is necessary. Muting is permitted during the non-hazardous portion of the machine cycle or must not expose people to a hazard.

Sensors are used to initiate the muting function. The sensors may be safety rated or non-safety rated. The types, number and location of muting sensors must be selected to meet the safety requirements determined by the risk assessment.

Figure 37 shows a typical conveyor material handling muting arrangement using two sensors. The sensors are arranged in an X pattern. Some logic units require a specific order in which the sensors are blocked. When order is important, the X pattern must be asymmetrical. For those logic units that use the sensor inputs as pairs, the X pattern can be symmetrical. Polarized, retroreflective photosensors are often used to prevent spurious reflections from falsely initiating the muting function, or causing nuisance trips. Other sensing technologies, such as inductive sensors and limit switches may also be use.

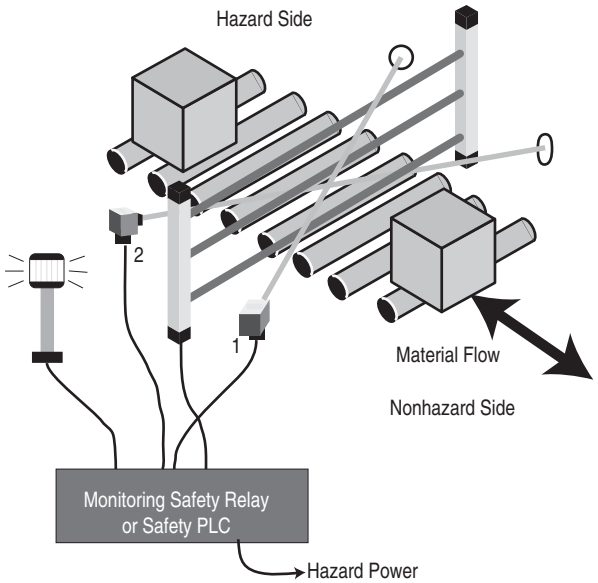

Figure 37: Conveyor 2 Sensor Muting

Another commonly applied approach is to use four sensors, as shown in Figure 38. Two sensors are mounted on the hazard side and two on the non hazard side. The sensors look directly across the conveyor. The shape and position of the object is less important in this approach. The length of the object is important as the object must block all four sensors.

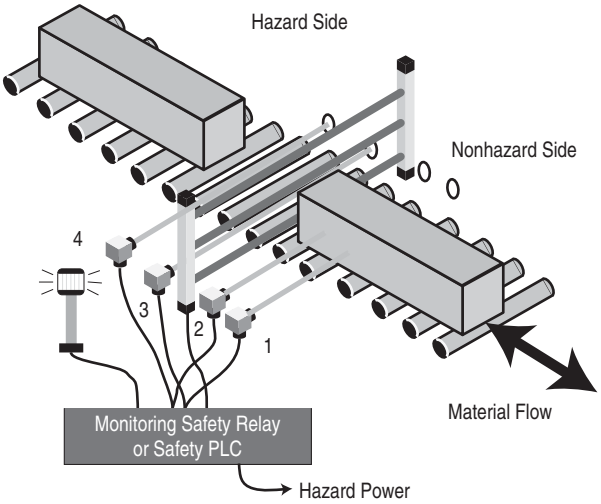

Figure 38: Conveyor 4 Sensor Muting

A common application is for a fork truck to access a conveyor. In order to mute the light curtain, the fork truck must be detected by sensors. The challenge is to locate the sensors so they detect the fork truck and not a person. Figure 39 shows an example of this application.

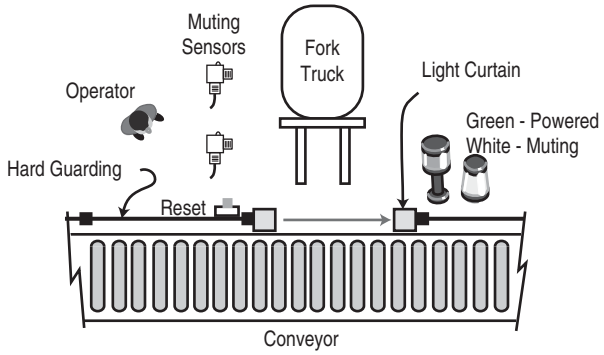

Figure 39: Fork Truck 2 Sensor Muting

Access to robot cells is also accomplished by muting. As shown in Figure 40, limit switches, located on the base of the robot, indicate the position of the robot. The safeguarding devices (the light curtains and safety mats) are muted when the robot is not in a hazardous position.

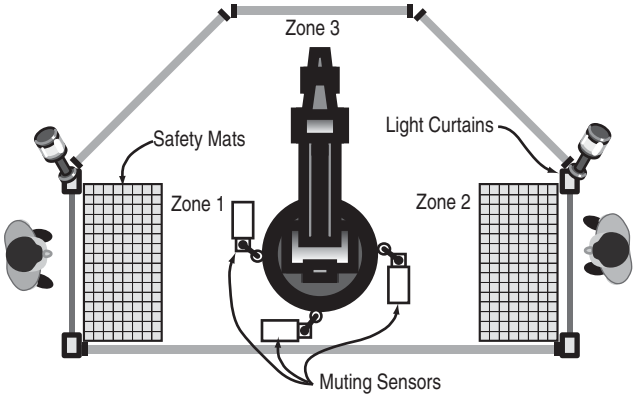

Figure 40: Muting of a Robot Cell

Presence Sensing Device Initiation (PSDI)

Also known as single break, double break, or stepping operating mode, PSDI involves the use of a light curtain not only as a safety device, but as the control for machine operation. PSDI initiates a machine cycle based on the number of times the sensing field is broken. For example, as an operator reaches toward the hazard to insert a work piece, breakage of the beams immediately stops the machine or prevents restart of the machine until the operator removes his hand from the area, at which time the machine automatically initiates its next cycle. This process can be accomplished by safety programmable logic devices or by monitoring relays specifically designed for this function.

Auto initiation allows the machine to start and stop based on the number of times the light curtain beams are broken and cleared. Illustrated in Figures 41 to 43 is an auto initiation double break mode (after initial start-up sequence).

In Step 1, the operator breaks the light curtain. The machine is stopped and the operator removes the processed material. The operator clears the light curtain, making the first break.

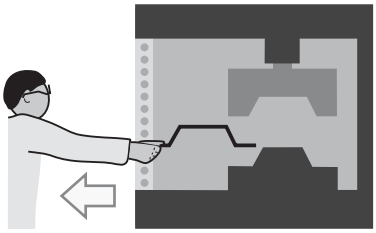

Figure 41: Step 1 of Double Break PSDI

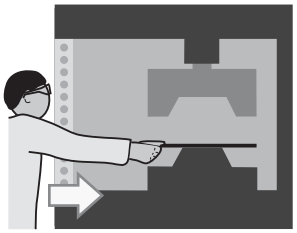

Figure 42: Step 2 of Double Break PSDI

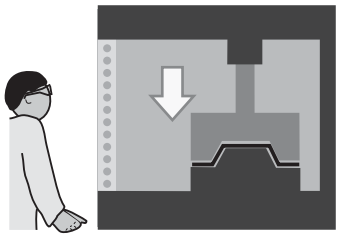

Figure 43: Step 3 of Double Break PSDI

In Step 2, the operator breaks the light curtain a second time and loads new material. The machine remains in stop mode.

In Step 3, the machine starts automatically after the second clearing of the light curtain.

Pressure Sensitive Safety Mats

These devices are used to provide guarding of a floor area around a machine, as shown in Figure 44. A matrix of interconnected mats is laid around the hazard area and pressure applied to the mat (e.g., an operator's footstep) will cause the mat controller unit to switch off power to the hazard.

There are a number of technologies used to create safety mats. One of the more popular technologies is using two parallel metal plates, as shown in Figure 45. The plates are separated by spacers. The metal plates and spacers are encapsulated in a nonconductive material with its surface designed to prevent slipping.

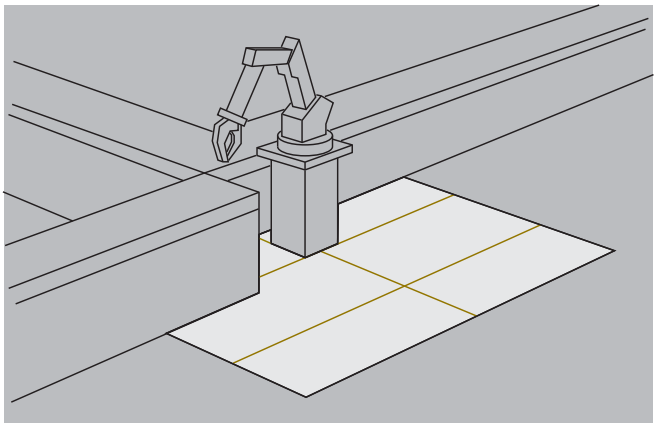

Figure 44: Safety Mats Surrounding a Robot

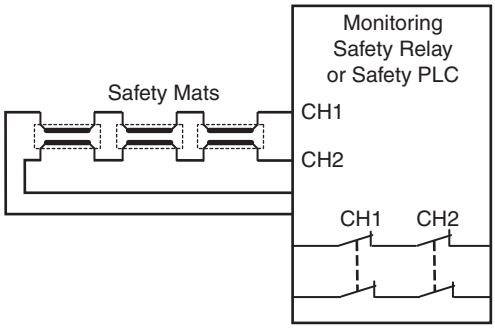

Figure 45: Safety Mat Interfacing

To ensure that the safety mat is available for use, an electrical current is passed through both plates. If an open-circuit wiring fault occurs, the safety system shuts down. To accommodate the parallel plates into a safety system, either two or four conductors are used. If two conductors are used, then a terminating resistor is used to differentiate the two plates. The more popular approach is to use four conductors. Two conductors, connected to the top plate are assigned one channel. Two conductors connected to the bottom plate are assigned to a second channel. When a person steps on the mat, the two plates create a short circuit from Channel 1 to Channel 2. The safety logic device must be designed to accommodate this short circuit. Figure 46 shows an example of how multiple 4-wire mats are connected in series to ensure the safety mats are available for use.

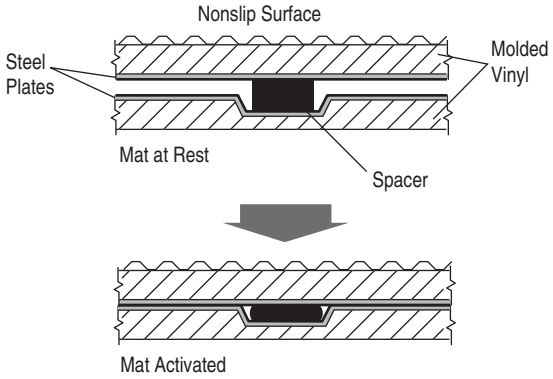

Figure 46: Typical Safety Mat Construction

Pressure sensitive mats are often used within an enclosed area containing several machines—flexible manufacturing or robotics cells, for example. When cell access is required (for setting or robot “teaching,” for example), they prevent dangerous motion if the operator strays from the safe area, or must get behind a piece of equipment, as shown in Figure 47.

The size and positioning of the mat must take the safety distance into account (see Safety Distance Calculation).

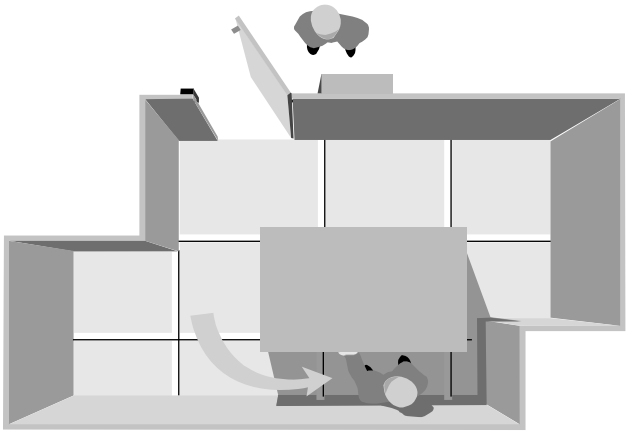

Figure 47: Safety Mat Detects Operator Behind Equipment

Pressure Sensitive Edges

These devices are flexible edging strips that can be mounted to the edge of a moving part, such as a machine table or powered door that poses a risk of a crushing or shearing, as shown in Figure 48.

If the moving part strikes the operator (or vice versa), the flexible sensitive edge is depressed and will initiate a command to switch off the hazard power source. Sensitive edges can also be used to guard machinery where there is a risk of operator entanglement. If an operator becomes caught in the machine, contact with the sensitive edge will shut down machine power.

There are a number of technologies used to create safety edges. One popular technology is to insert essentially what is a long switch inside the edge. This approach provides straight edges and generally uses the four-wire connection technique.

Figure 48: Edge on Machine Table and Powered Door

The Allen-Bradley Guardmaster Safedge uses conductive rubber, with two wires running the length of edge (Figure 49). At the end of the edge, a terminating resistor is used to complete the circuit. Depressing the rubber reduces the circuit resistance.

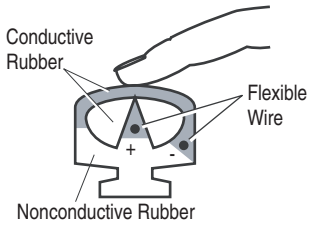

Figure 49: Conductive Rubber Safety Edge

Since a change in resistance must be detected, the monitoring safety relay must be designed to detect this change. An example wiring of this two-wire design with a terminating resistor is shown in Figure 50. One advantage of the conductive rubber technology is that it provides active corners.

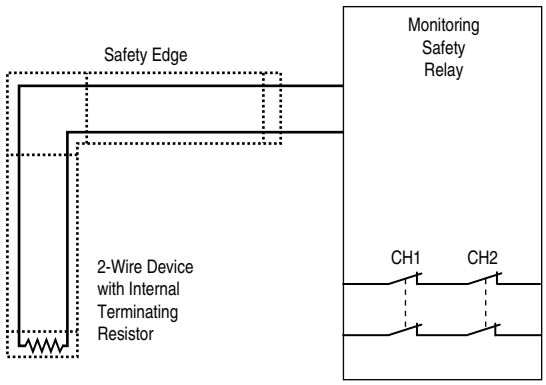

Figure 50: Conductive Rubber Safety Edge Circuit

Light curtains, scanners, floor mats and sensitive edges are classified as “trip devices.” They do not actually restrict access but only “sense” it. They rely entirely on their ability to both sense and switch for the provision of safety. In general they are only suitable on machinery which stops reasonably quickly after switching off the power source. Because an operator can walk or reach directly into the hazard area it is obviously necessary that the time taken for the motion to stop is less than that required for the operator to reach the hazard after tripping the device.

Safety Switches

When access to the machine is infrequent, movable (operable) guards are preferred. The guard is interlocked with the power source of the hazard in a manner which ensures that whenever the guard door is not closed the hazard power will be switched off. This approach involves the use of an interlocking switch fitted to the guard door. The control of the power source of the hazard is routed through the switch section of the unit. The power source is usually electrical but it could also be pneumatic or hydraulic. When guard door movement (opening) is detected the interlocking switch will initiate a command to isolate the hazard power supply either directly or via a power contactor (or valve).

Some interlocking switches also incorporate a locking device that locks the guard door closed and will not release it until the machine is in a safe condition. For the majority of applications the combination of a movable guard and an interlock switch with or without guard locking is the most reliable and cost effective solution.

Tongue Interlock Switches

Tongue operated interlocks require a tongue-shaped actuator to be inserted and removed from the switch. When the tongue is inserted, the internal safety contacts close and allow the machine to run. When the tongue is removed, the internal safety contacts open and send a stop command to the safety related parts of the control system. Tongue operated interlocks are versatile as they can be used on sliding, hinged or removable guards as shown in Figure 51.

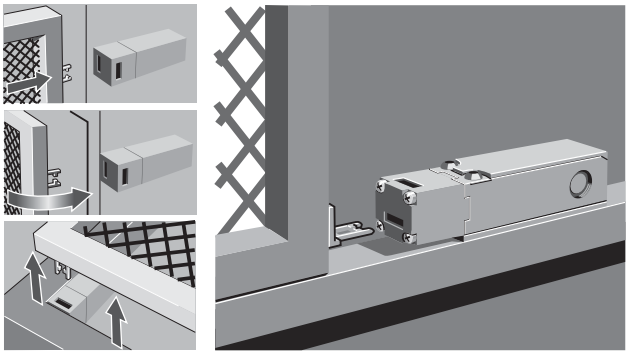

Figure 51: Tongues Interlocks on Sliding, Hinge or Removable Guards

Some of the latest functional safety standards focus on the need for complete fault tolerance as part of the requirements for device that is being used for high risk levels (e.g. SIL 3 or PLe). Because, in theory, mechanical tongue operated switches have single points of failure (e.g. the tongue actuator) even though they have two electrical switching channels. This means that non-contact switches may be preferred in these cases because they do not generally have the single mechanical failure points.

Tongue interlocks have three basic features that allow them to have a safety rating: defeatability, galvanic isolation, and direct opening action.

Defeatability

The security of an interlock switch is dependent on its ability to withstand attempts to "cheat" or defeat the mechanism. An interlock switch should be designed so that it cannot be defeated by simple tools or materials which may be readily available (like screwdrivers, coins, tape, or wire).

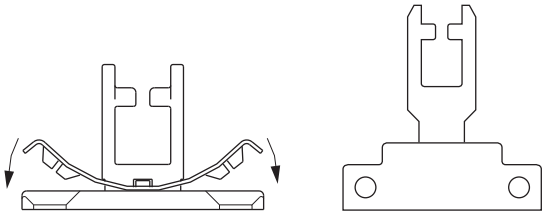

Figure 52: Tongue Shaped Actuators with Dimensional Features to Help Prevent Defeatability

This is accomplished by making the actuator a special shape, as shown in Figure 52. When maintenance is required on the machine, the interlocks may have to be bypassed. If this is done, other safeguarding methods for protection must be provided. Access to spare actuators must be controlled by management operating procedures. Some actuators, like the one on the left in Figure 52, have a spring that prevents the tongue from fully entering and operating the interlock switch unless it is correctly fixed to the guard.

In some circumstances personnel may be tempted to override the switch in some way. Information concerning the use of the machine, gathered at the risk assessment stage, will help to decide whether this is more likely or less likely to happen. The more likely it is to happen then the more difficult it should be to override the switch or system. The level of estimated risk should also be a factor at this stage. Switches are available with various levels of security ranging from resistance to impulsive tampering, to being virtually impossible to defeat.

It should be noted at this stage that if a high degree of security is required it is sometimes more practical to achieve this by the way in which it is mounted.

For example, if the switch is mounted as in Figure 53 with a covering track, there is no access to the switch with the guard door open. The nature of any "cheating" prevention measures taken at the installation will depend on the operating principle of the switch.

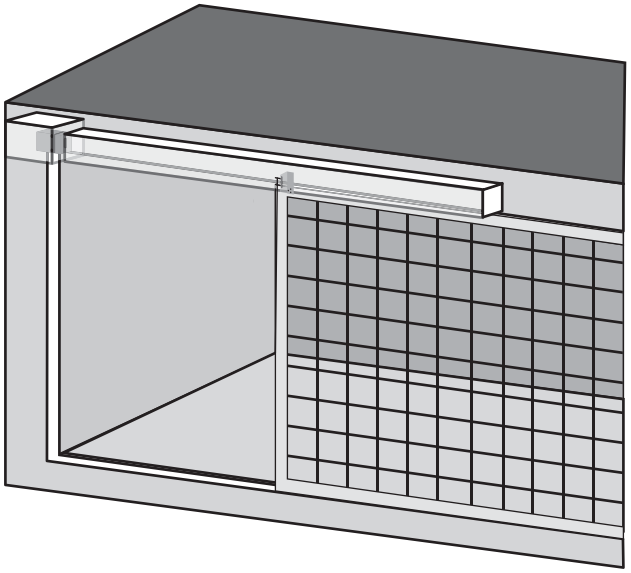

Figure 53: Switch and Actuator Hidden

Direct Opening Action

ISO 12100-2 explains that if a moving mechanical component inevitably moves another component along with it, either by direct contact or via rigid elements, these components are said to be connected in the positive mode. IEC 60947-5-1 uses the term Direct Opening Action and defines it as achievement of contact separation as the direct result of a specified movement of the switch actuator through non-resilient members (for example not dependent upon springs). This standard provides a set of test that can be used to verify Direct Opening Action. Products that meet the requirements of Direct Opening Action display the symbol shown in Figure 54 on their enclosure.

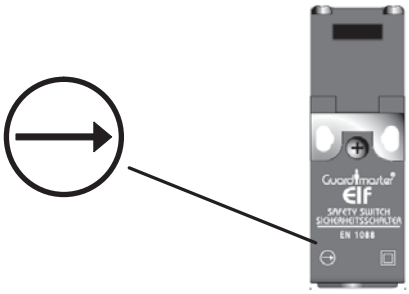

Figure 54: Symbol of Direct Opening Action

Figure 55 shows an example of positive mode operation giving forced disconnection of the contacts. The contacts are considered normally-closed (N.C.) when the actuator is inserted into the switch (i.e., guard closed). This closes an electrical circuit and allows current to flow through the circuit when the machine is allowed to run. The closed circuit approach allows for the detection of a broken wire which will initiate a stop function. These switches are typically designed with double break contacts. When the guard is opened, the tongue is removed from the operating head and rotates an internal cam. The cam drives the plunger which forces the spanner to open both contacts, breaking potentially welded contacts.

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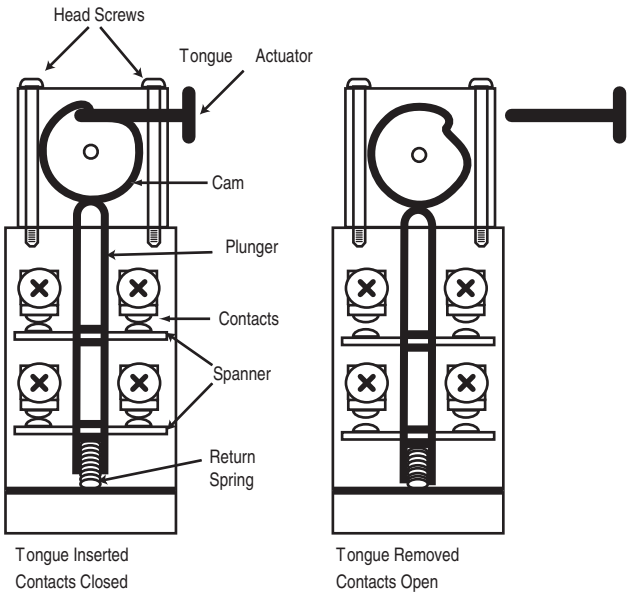

Figure 55: Double-Break with Direct Opening Action

Most tongue interlocks also have a set of normally-open (N.O.) contacts. These contacts typically close by the force of the return spring. If the spring breaks, proper contact operation cannot be performed with a high enough degree of reliability. Therefore, they are typically used to signal the machine control system that the guard is open.

Normally-open spring-return contacts can be used as a secondary channel in a safety system. This approach provides diversity to the safety system to help prevent common cause failures. The monitoring safety relay or safety PLC must be designed to accommodate this diverse N.O. + N.C. approach.

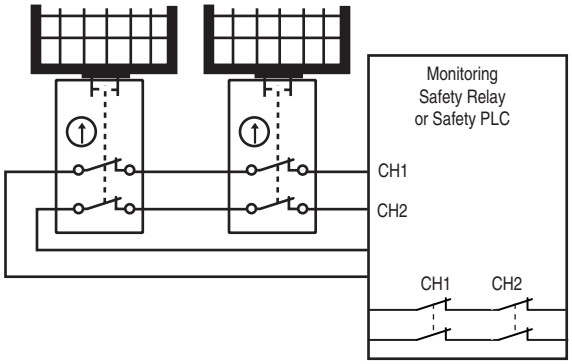

Figure 56: Daisy Chain of Multiple Two N.C. Interlocks

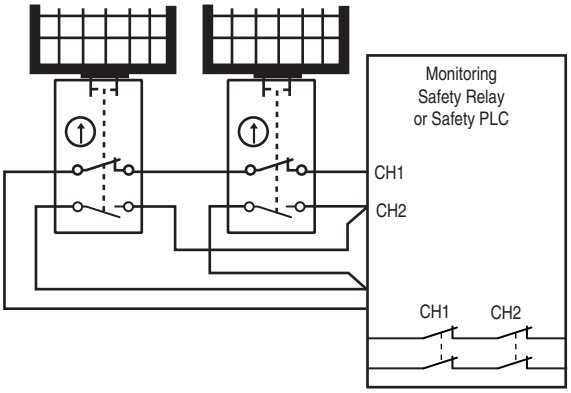

Figure 57: Multiple Interlocks with N.C. and N.O. Contacts

One advantage of using two normally closed contacts with interlocks is reduction in the wiring when multiple gates must be monitored. Figure 56 shows how multiple gates can be daisy chained. This may be practical for a small number of gates, but becomes more challenging to troubleshoot when too many gates are connected in series.

Where the risk assessment deems the use of diverse contacts, the N.C. contacts are connected in series and the N.O. contacts are connected in parallel. Figure 57 shows a basic schematic of this approach when multiple interlocks are monitored by a monitoring safety relay. The N.O. contacts in the Channel 2 circuit are connected in parallel.

Duplication (also referred to as Redundancy)

If components which are not inherently safe are used in the design, and they are critical to the safety function, then an acceptable level of safety may be provided by duplication of those components or systems. In case of failure of one component, the other one can still perform the function. It is usually necessary to provide monitoring to detect the first failure so that, for example, a dual channel system does not become degraded to a single channel without anybody being aware of it. Attention also must be given to the issue of common cause failures.

Protection must be provided against failure, which will cause all duplicated components (or channels) to fail at the same time Suitable measures may include using diverse technologies for each channel or ensuring an oriented failure mode.

Galvanic Isolation

Figure 58 shows contact blocks with two sets of contacts. A galvanic isolation barrier is required if it is possible for the contacts to touch each other back to back in the event of contact weld or sticking.

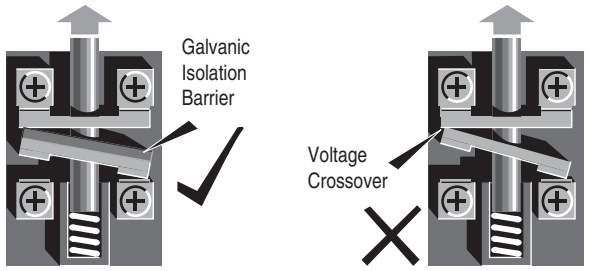

Figure 58: Galvanic Isolation of Contacts

Mechanical Stops

Interlock switches are not designed to withstand the stopping of a gate. The machine designer must provide an adequate stop while also providing enough travel for the actuator to fully insert into the switch (Figure 59).

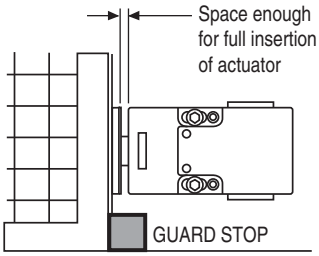

Figure 59: Mechanical Stops

The guard-mounted tongue needs to remain reasonably well aligned with the entry hole in the switch body. Over time, hinges may wear and guards may bend or twist. This adversely affects the alignment of the actuator to the head. The machine designer should consider metal bodied interfaces and flexible actuators, as shown in Figure 60.

Figure 60: Metal Interface with Flexible Actuator

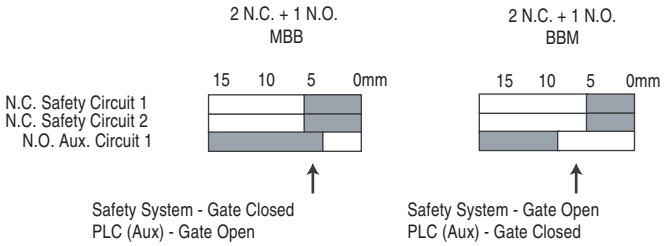

Figure 61: MBB and BBM Contacts—Conflicting Messages

Due to wear, damaged, or other changes to the guarding over time, pressure may be applied to the door forcing it open slightly. If the door moves between to the point where the change-over occurs, the safety system and machine control system will get conflicting messages, as shown in Figure 61.

Fixes for this include latching the door closed or using snap acting contacts. Selection of the appropriate tongue interlock involves many considerations: plastic or metal body, number of contacts, contact operation, size of guard, alignment of guard, movement of the guard, space available and washdown. Tongue operated switches can be difficult to clean thoroughly. Thus, food/beverage and pharmaceutical industries generally prefer non contact interlocks.

Guard Locking Switches

In some applications, locking the guard closed or delaying the opening of the guard is required. Devices suitable for this requirement are called guard locking interlock switches. They are suited to machines with run down characteristics but they can also provide a significant increase of protection level for most types of machines.

For most types of guard locking interlock switches, the unlocking action is conditional on the receipt of some form of electrical signal, for example an electrical voltage to energize a lock release solenoid. This principle of conditional release makes the solenoid controlled guard locking switch a very useful and adaptable device. Whereas with most devices the safety function is achieved by stopping the machine, guard locking switches also prevent access to the machine and prevent restart of the machine whenever the lock is released. Therefore these devices can perform two separate but inter-related safety functions: prevention of access and prevention of dangerous movement. This means that these switches are fundamentally important in the field of machinery safety. The following text describes some typical application based reasons why guard locking interlock switches are commonly used:

Protection of machine and people: In many situations tool or work piece damage can be caused or significant process disruption incurred if a machine is stopped suddenly at the wrong point in its operating sequence. A typical example of this would be the opening of an interlocked guard door of an automated machine tool in mid cycle. This situation can be avoided by using a solenoid controlled guard locking switch. If access through the guard door is required a lock release request signal is sent to the machine controller which will then wait for a properly sequenced stop before sending the release signal to the guard locking switch.

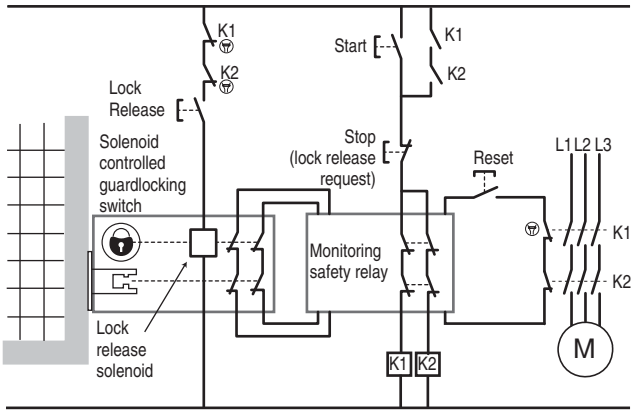

Figure 62: Simplified Basic Solenoid Guard Locking Switch Scheme

Figure 62 shows a very simplified schematic view of the principle. In practice, the start, stop and lock release functions of the push switches shown would typically be achieved by inputs and outputs of the machine's PLC. The PLC would accept a lock release request input at any point in the machine cycle but would only action a release command at the end of that cycle. The release command would be the equivalent of pressing the stop and lock release push switches.

When the lock is released and the guard door is opened, the switch contacts open causing the isolation of power to the hazard.

This type of approach can be further developed by using a key operated switch or button as the lock release request. In this way it can be possible to control not only when the guard can be opened but also who can open it.

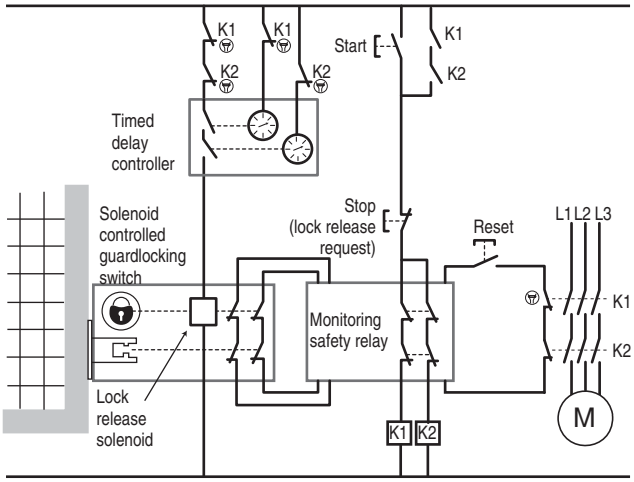

Figure 63: Timed Delay Controlled Solenoid Guard Locking Switch Scheme

Protection against machine run down: On many machines, removal of power to the motor or actuator will not necessarily cause a reliable and immediate stopping of the dangerous motion. This situation can be addressed by using a solenoid controlled guard locking switch with its release conditional on implementation of some form of delay that ensures that all dangerous motion has stopped before the lock is released.

Timed delay: The simplest method is to use a timed delay function configured so that the switch will not release the guard until the contactor is OFF and a preset time interval has elapsed. This is shown in Figure 63. The timed delay function can be provided by a Safety PLC or a dedicated controller. It is important that it is safety rated because failure that causes a shorter time delay than specified could result in exposure to dangerous moving parts.

The timed delay interval should be set at least to the worst case stopping time of the machine. This stopping time must be predictable, reliable and not dependant on braking methods that may degrade with use.

Stopped motion confirmation: It is also possible to make the lock release conditional on the confirmation that motion has stopped. The advantages with this approach are that even if the machine takes longer than expected to stop the lock will never be released too early. It also provides better efficiency than a timed delay because the lock is released as soon as the motion has stopped without having to always wait for the worst case stopping time. An example of this approach is shown in Figure 64.

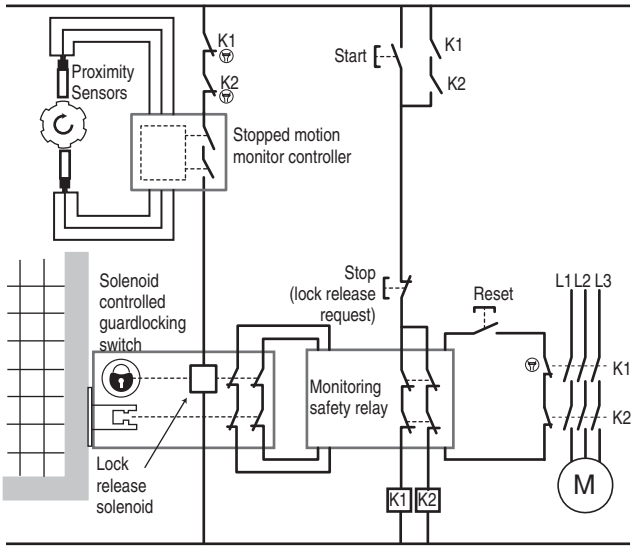

Figure 64: Simplified Stopped Motion Controlled Solenoid Guard Locking Switch Scheme

This stopped motion monitoring function must be safety rated and is usually achieved by one of the following methods:

Proximity sensors or shaft encoders combined with a dedicated controller or safety PLC.

Back EMF detection using a dedicated control unit.

Future generations of variable speed drives and motion control systems will also provide this functionality as safety rated.

Slow speed safety: For some types of machinery it may be necessary to have access to some moving parts in order to perform certain tasks such as maintenance, setting, feeding or threading. This type of activity is only considered if adequate safety can be provided by other measures. Typically these other measures will take the form of at least both of the following:

a) Access is only allowed under conditions of a safe slow speed

b) Any person with access to the moving parts must have personal local control for stopping, or prevention of starting, of the motion. The local control must override any other control signals.

This should be taken as a minimum. Whether this is acceptable or not will depend on risk assessment and relevant safety standards and regulations. However where it is found to be acceptable this type of safety functionality is often implemented using a solenoid controlled guard locking interlock switch in combination with a slow speed monitoring unit and a three position enabling device.

The safe slow speed monitoring unit constantly checks the speed of the moving parts via its input sensors and will only allow the sending of the lock release signal when the speed is not greater than its preset threshold value. After the lock has been released the slow speed unit continues to monitor the speed. If its preset threshold is exceeded while access is allowed, power to the motor will be switched off immediately. Also the safe slow speed can only continue while the enabling switch is held in the middle position (see Figure 70 for more information). It is clear that the guard locking switch, the safe slow speed unit and the enabling device must be connected to some form of safety rated logic solver in order implement the required functionality for both safety and production. In its most simple form this can simply be the way that the units are hardwired together, typically switchable via a manual mode selector switch. This switch is often key operated to restrict the safe slow speed access mode to authorized people. Greater operating efficiency and flexibility can be gained by using a configurable or programmable device for the logic solving function. This could be anything from modular configurable relay through to a Safety PLC.

This type of safe slow speed functionality is often required on complex integrated machinery systems where the equipment is divided into different operating zones each with different and interdependent operating modes. In these types of applications a Safety PLC or a dedicated configurable control unit such as the MSR57 is often a more suitable solution than individual relays and control units.

Most guard locking switches are adaptations of tongue interlocks. A solenoid is added to the interlock. The solenoid locks the actuator in place. There are two types of solenoid locking:

1. Power-to-unlock
2. Power-to-lock

Power-to-unlock devices require power to the solenoid to unlock the actuator. As long as power is applied to the solenoid, the door can be opened. With power removed from the actuator, the guard locks as soon as it is closed.

During a power loss, the gate remains closed and locked. If the guard locking device is used in full body access applications, a method of escape must be provided in case someone becomes locked in the hazard area. This is accomplished by providing a rotating lever, a pushbutton, or mechanical methods, as shown in Figure 65.

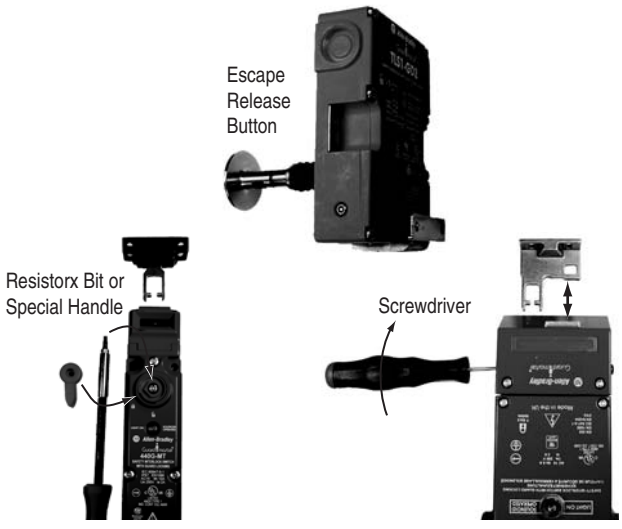

Figure 65: Escape Methods for Guard Locking

The power-to-lock requires power to the solenoid to lock the guard. A risk assessment must consider the potential hazardous situations that may arise if power is lost and the gate becomes unlocked while the machine is running down.

An important criterion when selecting guard locking interlocks is the holding force. How much force is required to hold the guard locked? When the door is manually operated, holding force can be minimal. Depending on where the guard locking switch is installed, operating leverage may suggest higher holding forces. Motorized doors may require higher holding forces.

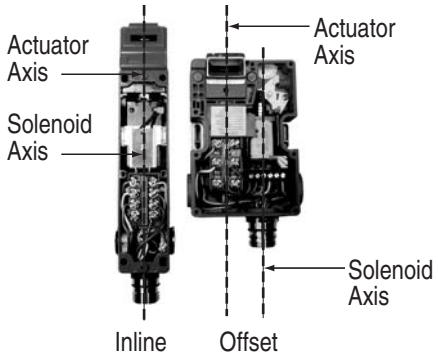

Figure 66: Inline and Offset Solenoid

Another important criterion for the selection process involves the relationship of the solenoid and the actuator. Two relationships exist: inline and offset, as shown in Figure 66. The solenoid is in the same axis as the actuator contacts or the solenoid is offset from the actuator contacts. The offset arrangement provides separate contacts that provide status of the solenoid.

The inline arrangement does not provide separate contacts for the solenoid. The inline arrangement is a little easier to apply. The offset arrangement provides more information on the operation of the switch. With the offset arrangement, the machine designer must ensure the solenoid status is monitored by the safety system. Selection of either arrangement is based on user preference.

A second type of guard locking device is manually operated and the guard can be opened at any time. A handle or knob that releases the guard lock also opens the control circuit contacts.

On a device such as the bolt switch, a time delay is imposed. The bolt which locks the guard in place operates the contacts and is withdrawn by turning the operating knob. The first few turns open the contacts but the locking bolt is not fully retracted until the knob is turned many more times (taking up to 20 seconds). These devices are simple to apply and they are extremely rugged and reliable. The time delay bolt switch is suitable mainly for sliding guards.

The stopping time of the hazard must be predictable and it must not be possible for the bolt to be withdrawn before the hazard has ceased. It must only be possible to extend the bolt into its locked position when the guard is fully closed. This means that it will be necessary to add stops to restrict the travel of the guard door, as shown in Figure 67.

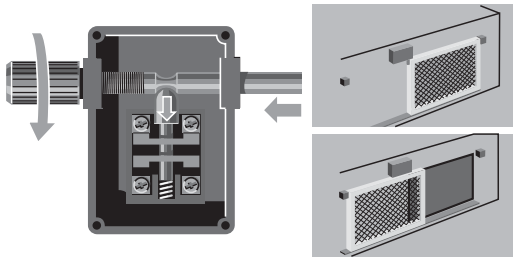

Figure 67: Sliding Bolt Interlock

Non-Contact Interlock Switches

Some of the latest functional safety standards focus on the need for complete fault tolerance as part of the requirements for device that is being used for high risk levels (e.g. SIL 3 or PLe). Because, in theory, mechanically actuated switches have single points of failure (e.g. the tongue actuator) even though they have two electrical switching channels. This means that dual channel non-contact switches may be preferred in these cases because they do not generally have the single mechanical failure points.

For non-contact interlocks, no physical contact (under normal conditions) takes place between the switch and actuator. Therefore positive mode operation cannot be used as the way of ensuring the switching action, and we need to use other methods to achieve equivalent performance.

Redundancy

Just as described in the section on tongue interlock switches, a high level of safety can be provided by non-contact devices designed with component duplication (or redundancy). In case of a failure of one component there is another one ready to perform the safety function and also a monitoring function to detect that first failure. In some cases it can be an advantage to design devices with components that have the same function but different failure mechanisms. This is referred to as diverse redundancy. A typical example is the use of one normally open contact and one normally closed contact.

Oriented Failure Mode

With simple devices we can use components with an oriented failure mode as explained in ISO 12100-2. This means using components in which the predominant failure mode is known in advance and always the same. The device is designed so that anything likely to cause a failure will also cause the device to switch off.

An example of a device using this technique is a magnetically actuated non-contact interlock switch. The contacts are connected with an internal non-reset overcurrent protection device. Any overcurrent situation in the circuit being switched will result in an open circuit at the protection device that is designed to operate at a current well below that which could endanger the safety-related contacts.

Due to the use of special components, the safety-critical fault likely to occur would be a welding of the reed contacts due to excessive current being applied to the switch as illustrated in Figure 68. This is prevented by the non-reset overcurrent protection device. There is a large margin of safety between the rating of this device and the reed contacts. Because it is non-reset, the switch should be protected by a suitably rated external fuse. The Allen-Bradley Guardmaster Ferrogard interlocks use this technique.

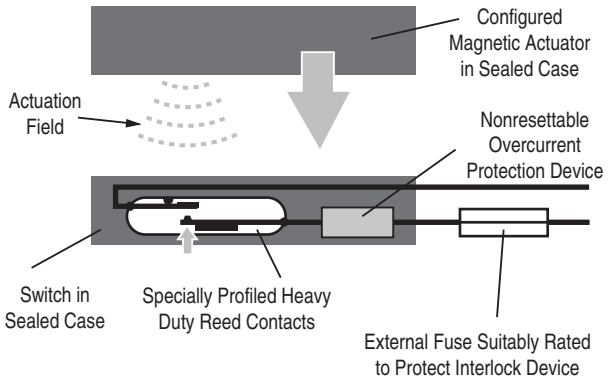

Figure 68: Simple Magnetic Operated Noncontact Interlock

Non-contact devices are designed with smooth enclosures and are fully sealed, making them ideal for food and beverage applications as they have no dirt traps and can be pressure cleaned. They are extremely easy to apply and have a considerable operating tolerance so they can accept some guard wear or distortion and still function properly.

One important consideration when applying non-contact switches is their sensing range and tolerance to misalignment. Each product family has an operating curve showing sensing range and tolerance to misalignment, as shown in Figure 69.

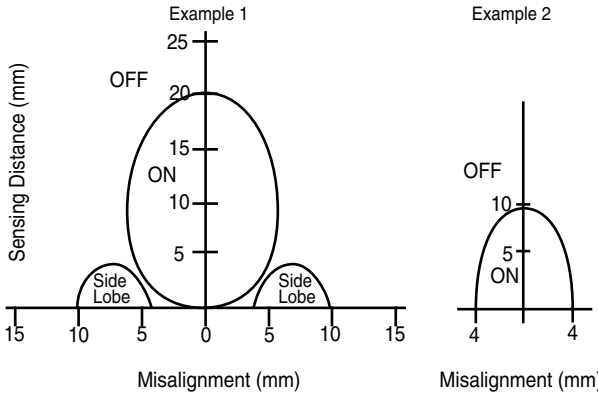

Figure 69: Non-Contact Operating Curve

Another important consideration for applying non-contact switches is the direction of approach of the actuator, as shown in Figure 70. The coding techniques determine which approaches are acceptable.

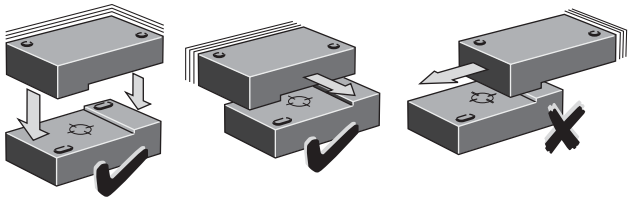

Figure 70: Approach of Actuator Affects Performance

Defeatability—Non-Contact Interlock Switches

It is important that the switch is only operated by its intended actuator. This means that ordinary proximity devices which sense ferrous metal are not appropriate. The switch should be operated by an "active" actuator.

When protection against defeatability by simple tools (a screwdriver, pliers, wire, coin, or a single magnet) is deemed necessary by the risk assessment, the noncoded actuation types must be installed so that they cannot be accessed while the guard is open. An example of this is shown in Figure 71. They should also be installed where they are not subjected to extraneous interference by magnetic/electric fields.

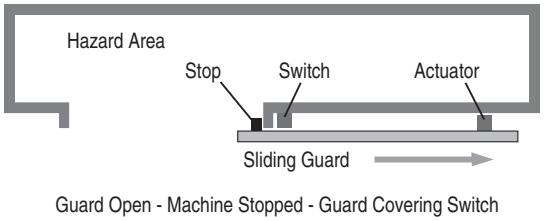

Figure 71: Sliding Guard Protects Access to Sensor

A high security against defeat can be achieved by using a coded actuator and sensor. For magnetically actuated and coded devices the actuator incorporates multiple magnets arranged to create multiple specific magnetic fields. The sensor has multiple reed switches specifically arranged to operate only with the specific magnetic fields of the actuator. Unique coding is generally not feasible using magnetic coding techniques. Unique coding, where an individual actuator is “tuned” to an individual sensor.

The reed switches used with magnetically coded switches are often small. To avoid the risk of welded contacts some switches use one normally open contact and one normally closed contact as outputs. This is based on the premise that you cannot weld an open contact. The logic device or control unit must be compatible with the N.C. + N.O. circuit arrangement and must also provide overcurrent protection. The Allen-Bradley Guardmaster Sipha interlocks use the coded magnetic technique.

RFID Non-Contact Interlock Switches

Non-contact interlock switches based on RFID (Radio Frequency Identification) technology can provide a very high level of security against defeat by “simple” tools. This technology can also be used to provide devices with unique coding for applications where security is paramount.

The use of RFID technique has many other important advantages. It is suitable for use with high integrity circuit architectures such as Category 4 or SIL 3.

It can be incorporated into devices with fully sealed IP69K enclosures manufactured from plastic or stainless steel.

When RFID technology is used for coding, and inductive technology for sensing, a large sensing range and tolerance to misalignment can be achieved, typically 15…25 mm. This means that these devices can provide very stable and reliable service combined with high levels of integrity and security over a wide range of industrial safety applications.

The Allen-Bradley Guardmaster SensaGuard interlocks use the RFID technique.

Hinge Switches

The device is mounted over the hinge-pin of a hinged guard as shown in Figure 72. The opening of the guard is transmitted via a positive mode operating mechanism to the control circuit contacts.

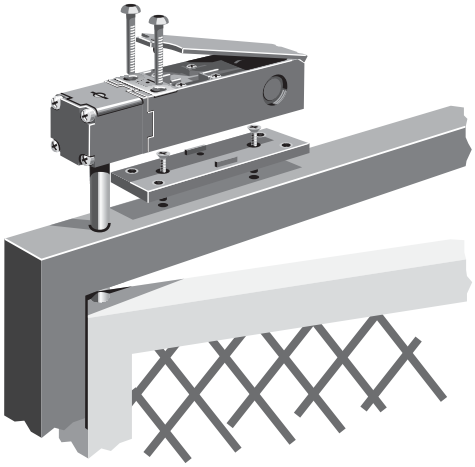

Figure 72: Hinge Switch Installation

When properly installed these types of switches are ideal for most hinged guard doors where there is access to the hinge center line. They can isolate the control circuit within 3° of guard movement and they are virtually impossible to defeat without dismantling the guard.

Care must be taken since an opening movement of only 3° can still result in a significant gap at the opening edge on very wide guard doors. It is also important to ensure that a heavy guard does not put excessive stress on the switch actuator shaft.

Position (Limit Switch) Interlocks

Cam operated actuation usually takes the form of a positive mode limit (or position) switch and a linear or rotary cam (as shown in Figure 73). It is generally used on sliding guards. When the guard is opened, the cam forces the plunger down to open the control circuit contacts. The simplicity of the system allows the switch to be both small and reliable.

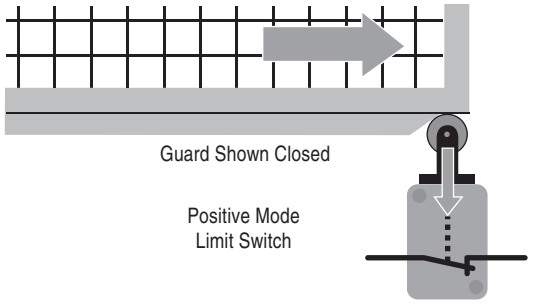

Figure 73: Positive Mode Limit Switch

Position (limit) interlocks must not be used on lift-off or hinged guards.

It is extremely important that the switch plunger can only extend when the guard is fully closed. This means that it may be necessary to install additional stops to limit the guard movement in both directions.

It is necessary to fabricate a suitably profiled cam that will operate within defined tolerances. The guard-mounted cam must never become separated from the switch as this will cause the switch contacts to close. Such a system can be prone to failures due to wear, especially when badly profiled cams or the presence of abrasive materials is a factor.

It is often advisable to use two switches as shown in Figure 74. One operates in positive mode (direct action to open contact), and one operates in negative mode (spring return).

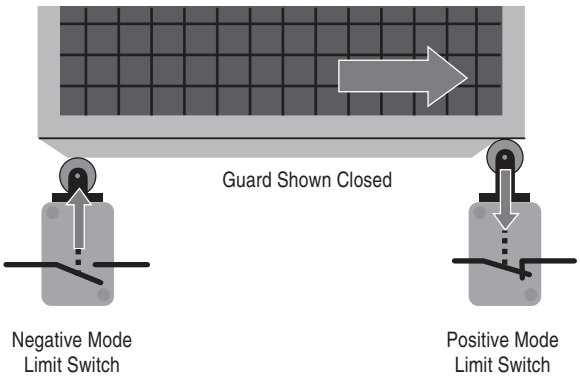

Figure 74: Diverse Redundant Position Switches

Trapped Key Interlocks

Trapped keys can perform control interlocking as well as power interlocking. With “control interlocking,” an interlock device initiates a stop command to an intermediate device, which turns off a subsequent device to disconnect the energy from the actuator. With “power interlocking,” the stop command directly interrupts the energy supply to the machine actuators.

The most practical method of power interlocking is a trapped key system (see Figure 75). The power isolation switch is operated by a key that is trapped in position while the switch is in the ON position. When the key is turned, the isolation switch contacts are locked open (isolating the power supply) and the key can be withdrawn.

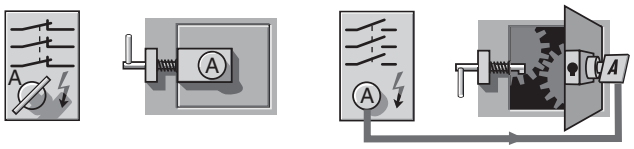

Figure 75: Power Interlocking with Trapped Key System

The guard door is locked closed and the only way to unlock it is by using the key from the isolator. When turned to release the guard locking unit, the key is trapped in position and cannot be removed until the guard is closed and locked again.

Therefore it is impossible to open the guard without first isolating the power source and it is also impossible to switch on the power without closing and locking the guard.

This type of system is extremely reliable and has the advantage of not requiring electrical wiring to the guard. The main disadvantage is that because it requires the transfer of the key every time, it is not suitable if guard access is required frequently.

Whenever whole body access is required, the use of a personnel key is recommended. As shown in Figure 76, the “B” key is the personnel key. The “B” key is taken by the operator into the hazard area. The trapped key range is available in double, triple, and quad key versions for multiple access points. The use of a personnel key ensures that the operator cannot be locked in the guarded area. The key can also be taken into the cell and inserted into another switch to enable functions like robot teach and machine jog modes.

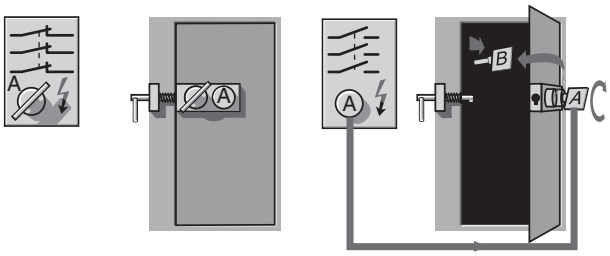

Figure 76: Full Body Access—Operator Takes "B" Key

In another example shown in Figure 77, rotate and remove Key “A” from the power isolator. Power is then OFF. To gain access through guard doors Key “A” is inserted and rotated in the Key Exchange Unit. Both “B” Keys are then released for guard locks. Key “A” is trapped preventing power from being switched on. Two “C” Keys are released from the guard door locks for use in the next sequence step or as personnel keys.

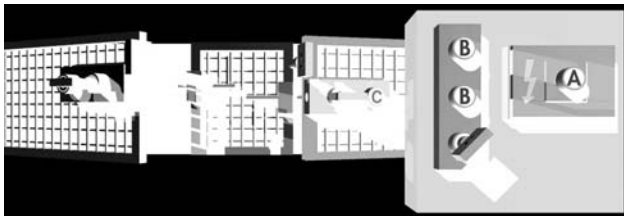

Figure 77: Multiple Doors Are Accessible

Figures 78 shows another example of trapped key interlock applications by using both single and double key locking units and keys with different codes together with a key exchange unit, complex systems can be formed. Besides ensuring that the power is isolated before access can be gained it is also possible to use the system to enforce a pre-defined sequence of operation.

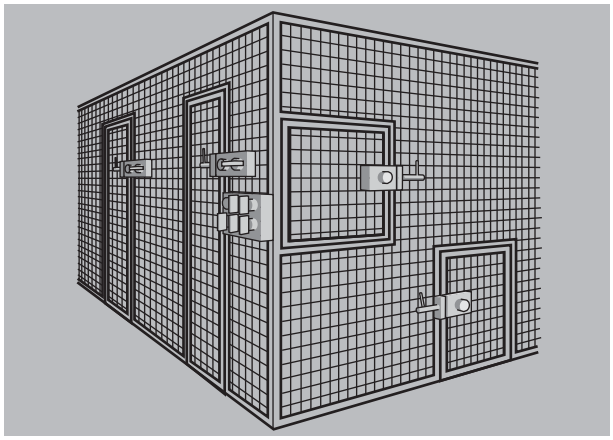

Figure 78: Defined Sequence of Events

Because the entire safety of this type of system depends on its mechanical operation it is critical that the principles and materials used are suitable for the expected demand made on them.

If an isolation switch is part of the system it should have positive mode operation and it should satisfy the requirements of the relevant parts of IEC 60947.

The integrity and security of the system revolves around the fact that under certain conditions the keys are trapped in place, therefore two basic features need to be ensured:

1. THE LOCK CAN ONLY BE OPERATED BY THE DEDICATED KEY.

This means that it should not be possible to “cheat” the lock by using screwdrivers, etc., or defeat the mechanism by mistreating it in any straightforward manner. Where there is more than one lock on the same site it also means that the specifying of key codes must in itself prevent any possibility of spurious operation.

2. IT IS NOT POSSIBLE TO OBTAIN THE KEY IN ANY WAY OTHER THAN THE INTENDED MANNER.

This means that, for example, once the key is trapped, any excessive force applied to it will result in a broken key as opposed to a broken lock.

Operator Interface Devices

Stop Function

In the U.S., Canada, Europe, and at the international level, harmonization of standards exist with regard to the descriptions of stop categories for machines or manufacturing systems.

NOTE: these categories are different to the categories from EN 954-1 (ISO 13849-1). See standards NFPA79 and IEC/EN60204-1 for further details. Stops fall into three categories:

- Category 0 is stopping by immediate removal of power to the machine actuators. This is considered an uncontrolled stop. With power removed, braking action requiring power will not be effective. This will allow motors to free spin and coast to a stop over an extended period of time. In other cases, material may be dropped by machine holding fixtures, which require power to hold the material. Mechanical stopping means, not requiring power, may also be a used with a category 0 stop. The category 0 stop takes priority over category 1 or category 2 stops.
- Category 1 is a controlled stop with power available to the machine actuators to achieve the stop. Power is then removed from the actuators when the stop is achieved. This category of stop allows powered braking to quickly stop hazardous motion, and then power can be removed from the actuators.
- Category 2 is a controlled stop with power left available to the machine actuators. A normal production stop is considered a category 2 stop.

These stop categories must be applied to each stop function, where the stop function is the action taken by the safety related parts of the control system in response to an input, category 0 or 1 should be used. Stop functions must override related start functions. The selection of the stop category for each stop function must be determined by a risk assessment.

Emergency Stop Function

The emergency stop function must operate as either a category 0 or category 1 stop, as determined by a risk assessment. It must be initiated by a single human action. When executed, it must override all other functions and machine operating modes. The objective is to remove power as quickly as possible without creating additional hazards.

Until recently, hardwired electro-mechanical components were required for e-stop circuits. Recent changes to standards such as IEC 60204-1 and NFPA 79 mean that safety PLCs and other forms of electronic logic meeting the requirements of standards like IEC61508, can be used in the e-stop circuit.

Emergency Stop Devices

Wherever there is a danger of an operator getting into trouble on a machine there must be a facility for fast access to an emergency stop device. The e-stop device must be continuously operable and readily available. Operator panels should contain at least one e-stop device. Additional e-stop devices may be used at other locations as needed. E-Stop devices come in various forms. Pushbutton switches and cable pull switches are examples of the more popular type devices. When the e-stop device is actuated, it must latch in and it must not be possible to generate the stop command without latching in. The resetting of the emergency stop device must not cause a hazardous situation. A separate and deliberate action must be used to re-start the machine.

For further information on e-stop devices, read ISO/EN13850, IEC 60947-5-5, NFPA79 and IEC60204-1, AS4024.1, Z432-94.

Emergency Stop Buttons

Emergency stop devices are considered complimentary safeguarding equipment. They are not considered primary safeguarding devices because they do not prevent access to a hazard nor do they detect access to a hazard.

The usual way of providing this is in the form of a red-colored mushroom-headed push button on a yellow background which the operator strikes in the event of an emergency (see Figure 79). They must be strategically placed in sufficient quantity around the machine to ensure that there is always one in reach at a hazard point.

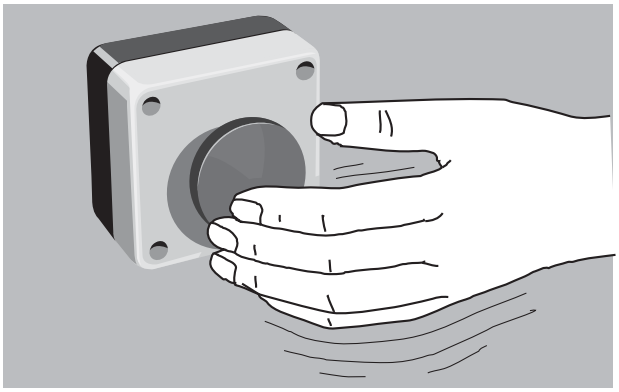

Figure 79: E-Stop Push Button—Red Colored Mushroom Head on a Yellow Background

E-Stop buttons must be readily accessible and must be available in all modes of machine operation. When a pushbutton is used as an e-stop device, it must be a mushroom (or palm operated) shaped, red colored, with a yellow background. When the button is pressed, the contacts must change state at the same time the button latches in the depressed position.

One of the latest technologies to be applied to e-stops is a self-monitoring technique. An additional contact is added to the back e-stop that monitors whether the back of the panel components are still present. This is known as a self-monitoring contact block. It consists of a spring actuated contact that closes when the contact block is snapped into place onto the panel. Figure 80 shows the self-monitoring contact connected in series with one of the direct opening safety contacts.

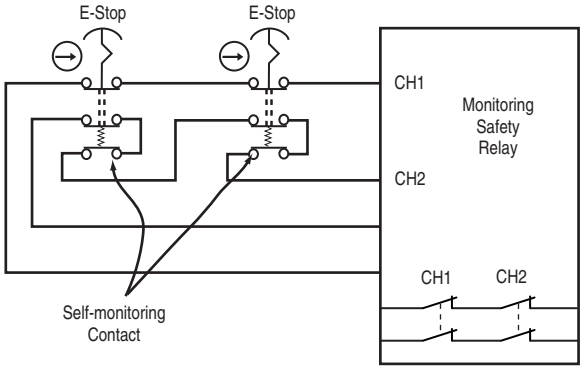

Figure 80: Self-Monitoring Contacts on E-Stop

Cable Pull Switches

For machinery such as conveyors, it is often more convenient and effective to use a cable pull device along the hazard area (as shown in Figure 81) as the emergency stop device. These devices use a steel wire rope connected to latching pull switches so that pulling on the rope in any direction at any point along its length will trip the switch and cut off the machine power.

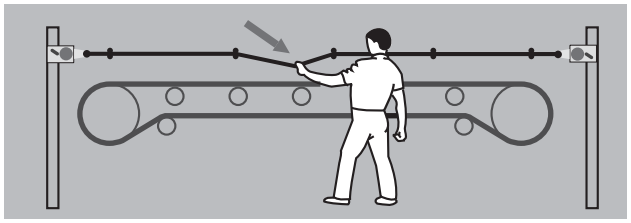

Figure 81: Cable Pull Switches

The cable pull switches must detect both a pull on the cable as well as when the cable goes slack. Slack detection ensures that the cable is not cut and is ready for use.

Cable distance affects performance of the switch. For short distances, the safety switch is mounted on one end and a tension spring mounted at the other. For longer distances, a safety switch must be mounted at both ends of the cable to ensure that a single action by the operator initiates a stop command.

The required cable pull force should not exceed 200 N (45 lb) or a distance of 400 mm (15.75 in.) at a position centered between two cable supports.

Two-Hand Controls

The use of two-hand controls (also referred to as bi-manual controls) is a common method of preventing access while a machine is in a dangerous condition. Two controls must be operated concurrently (within 0.5 s of each other) to start the machine. This ensures that both hands of the operator are occupied in a safe position (i.e., at the controls) and therefore cannot be in the hazard area. The controls must be operated continuously during the hazardous conditions. Machine operation must cease when either of the controls are released, if one control is released, the other control must also be released before the machine can be restarted.

A two-hand control system depends heavily on the integrity of its control and monitoring system to detect any faults, so it is important that this aspect is designed to the correct specification. Performance of the two-hand safety system is characterized into Types by ISO 13851 (EN 574) as shown and they are related to the Categories from ISO 13849-1. The types most commonly used for machinery safety are IIIB and IIIC. Table 4.1 shows the relationship of the types to the categories of safety performance.

	Types				
			III		
Requirements	I	II	A	B	C
Synchronous actuation			X	X	X
Use of Category 1 (from ISO 13849-1)	X		X		
Use of Category 3 (from ISO 13849-1)		X		X	
Use of Category 4 (from ISO 13849-1)					X

Table 3: Two-Hand Control Types and Categories

The physical design spacing should prevent improper operation (e.g., by hand and elbow). This can be accomplished by distance or shields as the examples shown in Figure 82.

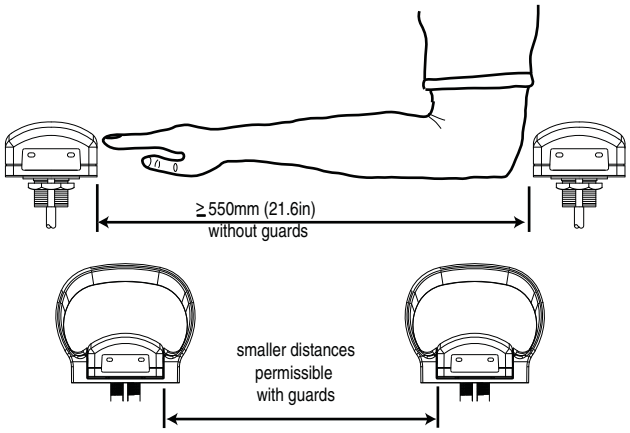

Figure 82: Separation of Two hand Controls

The machine should not go from one cycle to another without the releasing and pressing of both buttons. This prevents the possibility of both buttons being blocked, leaving the machine running continuously. Releasing of either button must cause the machine to stop.

The use of two-hand control should be considered with caution as it usually leaves some form of risk exposed. The two-hand control only protects the person using them. The protected operator must be able to observe all access to the hazard, as other personnel may not be protected.

ISO 13851 (EN574) provides additional guidance on two-hand control.

Enabling Devices

Enabling devices are controls that allow an operator to enter a hazard area with the hazard running only while the operator is holding the enabling device in the actuated position. Enabling devices use either two-position or three position types of switches. Two position types are off when the actuator is not operated, and are on when the actuator is operated. Three position switches are off when not actuated (position 1), on when held in the center position (position 2) and off when the actuator is operated past the mid position (position 3). In addition, when returning from position 3 to 1, the output circuit must not close when passing through position 2. This concept is shown in Figure 83.

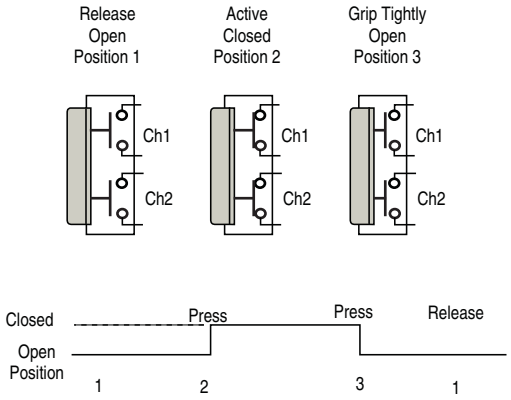

Figure 83: Three-Position Enabling Switch Operation

Enabling devices must be used in conjunction with other safety related function. A typical example is placing the motion is a controlled slow mode. Once in slow mode, an operator can enter the hazard area holding the enabling device.

When using an enabling device, a signal must indicate that the enabling device is active.

Logic Devices

Logic devices play the central role of the safety related part of the control system. Logic devices perform the checking and monitoring of the safety system and either allow the machine to start or execute commands to stop the machine.

A range of logic devices are available to create a safety architecture that meets the complexity and the functionality required for the machine. Small hardwired monitoring safety relays are most economical for smaller machines where a dedicated logic device is needed to complete the safety function. Modular and configurable monitoring safety relays are preferred where a large and diverse number of safeguarding devices and minimal zone control are required. The medium to large and more complex machine will find programmable systems with distributed I/O to be preferable.

Monitoring Safety Relays

Monitoring safety relay (MSR) modules play a key role in many safety systems. These modules are usually comprised of two or more positively guided relays with additional circuitry to ensure the performance of the safety function.

Positive guided relays are specialized “ice-cube” relays. Positively guided relays must meet the performance requirements of EN50025. Essentially, they are designed to prevent the normally closed and normally open contacts from being closed simultaneously. Newer designs replace the electromechanical outputs with safety rated solid state outputs.

Monitoring safety relays perform many checks on the safety system. Upon power-up, they perform self-checks on their internal components. When the input devices are activated, the MSR compares the results of redundant inputs. If acceptable, the MSR checks external actuators. If okay, the MSR awaits a reset signal to energize its outputs.

The selection of the appropriate safety relay is dependent on a number of factors: type of device it monitors, the type of reset, the number and type of outputs.

Inputs Types

Safeguarding devices have different types of methods of indicating something has happened:

- Contact Interlocks and E-stops:
  Mechanical contacts, single channel with one normally closed contact or dual channel, both normally closed. The MSR must be able to accept single or dual channel and provide cross fault detection for the dual channel arrangement.
- Non-Contacts Interlocks and E-stops
  Mechanical contacts, dual channel, one normally open and one normally closed contact. The MSR must be able to process diverse inputs.
- Output Solid State Switching Devices
  Light curtains, laser scanners, solid-state non-contacts have two sourcing outputs and perform their own cross fault detection. The MSR must be able to ignore the devices cross fault detection method.
- Mats:
  Mats create a short circuit between two channels. The MSR must be able to withstand the repeated short circuits.
- Edges:
  Some edges are designed like 4-wire mats. Some are two wire devices that create a change in resistance. The MSR must be able to detect a short circuit or the change resistance.
- Voltage
  Measures the Back EMF of a motor during rundown. The MSR must be able to tolerate high voltages as well as detect low voltages as the motor spins down.
- Stopped Motion
  The MSR must detect pulse streams from diverse, redundant sensors.
- Two-hand Control
  The MSR must detect normally open and normally closed diverse inputs as well as provide 0.5s timing and sequencing logic.

Input Impedance

The input impedance of the monitoring safety relays determines how many input devices can be connected to the relay and how far away the input devices can be mounted. For example, a safety relay may have a maximum allowable input impedance of 500 ohms (Ω). When the input impedance is greater than 500Ω, it will not switch on its outputs. Care must be taken by the user to ensure that the input impedance remains below the maximum specification. The length, size and type of wire used affects input impedance. Table 4 shows typical resistance of annealed copper wire at 25°C.

ISO Cross Section mm²	AWG Size	Ω per 1000 m	Ω per 1000 ft
0.5	20	33.30	10.15
0.75	18	20.95	6.385
1.5	16	13.18	4.016
2.5	14	8.28	2.525
4	12	5.21	1.588

Table 4: Wire Resistance Values

Number of Input Devices

The risk assessment process should be used to help determine how many inputs devices should be connected to a monitoring safety relay unit MSR and how often the input devices should be checked. To assure that E-Stops and gate interlocks are in an operational state, they should be checked for operation at regular intervals, as determined by the risk assessment. For example, a dual channel input MSR connected to an interlocked gate that must be opened every machine cycle (e.g., several times per day) may not have to be checked. This is because opening the guard causes the MSR to check itself, its inputs and its outputs (depending on configuration) for single faults. The more frequent the guard opening the greater the integrity of the checking process.

Another example might be E-Stops. Since E-Stops are typically used only for emergencies, they are likely to be rarely used. Therefore a program should be established to exercise the E Stops and confirm their effectiveness on a scheduled basis. Exercising the safety system in this way is called performing a Proof Test, and the time in between Proof Tests is called the Proof Test Interval. A third example might be access doors for machine adjustments, which like E-Stops might be rarely used Here again a program should be established to exercise the checking function on a scheduled basis.

The risk assessment will help determine whether the input devices need to be checked and how often they should be checked. The higher the level of risk, the greater integrity required of the checking process. And the less frequent the "automatic" checking, the more frequent should be the imposed "manual" check.

Input Crossfault Detection

In dual channel systems, channel-to-channel short circuit faults of the input devices, also known as cross faults, must be detected by the safety system. This is accomplished by the sensing device or the monitoring safety relay.

Microprocessor based monitoring safety relays, like light curtains, laser scanners and the advanced non-contact sensors detect these shorts in a variety of ways. One common way of detecting cross faults is by using diverse pulse testing shown in Figure 84. The output signals are pulsed very quickly. The channel 1 pulse is offset from the channel 2 pulse. If a short occurs, the pulses occur concurrently and are detected by the device.

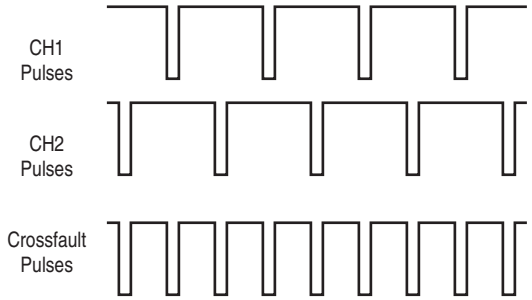

Figure 84: Pulse Testing to Detect Crossfaults

Electro-mechanical based monitoring safety relays employ a different diversity technique: one pull-up input and one pull-down input. This is shown in Figure 85. A short from Channel 1 to Channel 2 will make the overcurrent protection device active and the safety system will shut down.

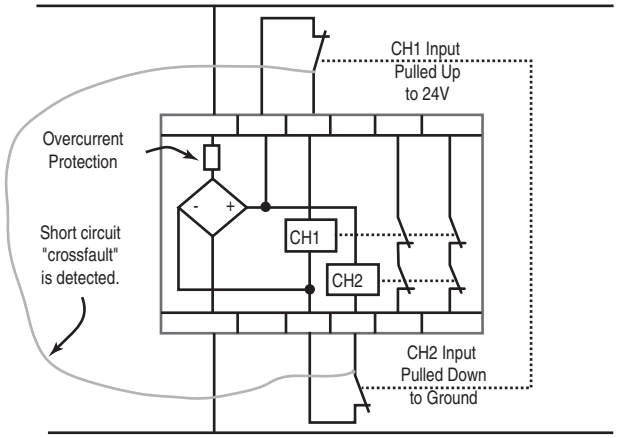

Figure 85: Diverse Inputs Detect Crossfaults

Outputs

MSRs come with various numbers of outputs. The types of outputs help determine which MSR must be used in specific applications.

Most MSRs have at least 2 immediately operating safety outputs. MSR safety outputs are characterized as normally-open. These are safety rated due to the redundancy and internal checking.

A second type of output is delayed outputs. Delayed outputs are typically used in Category 1 stops, where the machine requires time to execute the stopping function before allowing access to the hazard area. Figure 86 shows the symbols used for immediate and delayed contacts.

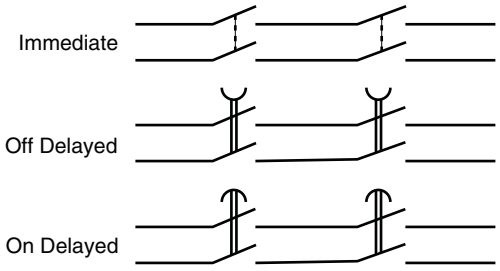

Figure 86: Symbols for Contact Types

MSRs also have auxiliary outputs. Generally these are considered normally closed. Figure 87 shows three arrangements of normally closed contacts. The circuit on the left only allows the normally closed contacts to be used as auxiliary circuits as a single fault in CH1 or CH2 will close the circuit. The middle arrangement can be auxiliary usage as shown or safety usage if connected in series. The circuit on the right shows the normally closed contacts in a redundant arrangement, so they can be used in safety related circuits.

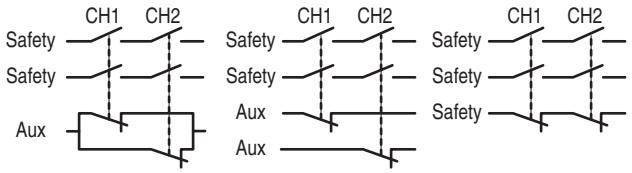

Figure 87: NC Contact Usage

Output Ratings

Output ratings describe the ability of the safeguarding device to switch loads. Typically, the ratings for industrial devices are described as resistive or electromagnetic. A resistive load may be a heater type element. Electromagnetic loads are typically relays, contactors, or solenoids; where there is a large inductive characteristic of the load. Annex A of standard IEC 60947-5-1, shown in Table 5 describes the ratings for loads.

Designation Letter: The designation is a letter followed by a number, for example A300.

The letter relates to the conventional enclosed thermal current and whether that current is direct or alternating. For example A represents 10 amps alternating current. The number stands for the rated insulation voltage. For example, 300 represents 300V.

Designation	Utilization	Enclosed Thermal Current	Rated Operational Current Ie at the Rated Operational Voltage Ue						VA	
			120V	240V	380V	480V	500V	600V	Make	Break
A150	AC-15	10	6	—	—	—	—	—	7200	720
A300	AC-15	10	6	3	—	—	—	—	7200	720
A600	AC-15	10	6	3	1.9	1.5	1.4	1.2	7200	720
B150	AC-15	5	3	—	—	—	—	—	3600	360
B300	AC-15	5	3	1.5	—	—	—	—	3600	360
B600	AC-15	5	3	1.5	0.95	0.92	0.75	0.6	3600	360
C150	AC-15	2.5	1.5	—	—	—	—	—	1800	180
C300	AC-15	2.5	1.5	0.75	—				1800	180
C600	AC-15	2.5	1.5	0.75	0.47	0.375	0.35	0.3	1800	180
D150	AC-14	1.0	0.6	—	—	—	—	—	432	72
D300	AC-14	1.0	0.6	0.3	—	—	—	—	432	72
E150	AC-14	0.5	0.3	—	—	—	—	—	216	36
Direct Current			125V	250V		400V	500V	600V		
N150	DC-13	10	2.2	—		—	—	—	275	275
N300	DC-13	10	2.2	1.1		—	—	—	275	275
N600	DC-13	10	2.2	1.1		0.63	0.55	0.4	275	275
P150	DC-13	5	1.1	—		—	—	—	138	138
P300	DC-13	5	1.1	0.55		—	—	—	138	138
P600	DC-13	5	1.1	0.55		0.31	0.27	0.2	138	138
Q150	DC-13	2.5	0.55	—		—	—	—	69	69
Q300	DC-13	2.5	0.55	0.27		—	—	—	69	69
Q600	DC-13	2.5	0.55	0.27		0.15	0.13	0.1	69	69
R150	DC-13	1.0	0.22	—		—	—	—	28	28
R300	DC-13	1.0	0.22	0.1		—	—	—	28	28

Table 5: Contact Ratings for Inductive Load Switching

Utilization: The Utilization describes the types of loads the device is designed to switch. The utilizations relevant to IEC 60947-5 are shown in Table 6.

Utilization	Description of Load
AC-12	Control of resistive loads and solid-state loads with isolation by opto-couplers
AC-13	Control of solid-state loads with transformer isolation
AC-14	Control of small electromagnetic loads (less than 72 VA)
AC-15	Electromagnetic loads greater than 72 VA
DC-12	Control of resistive loads and solid-state loads with isolation by opto-couplers
DC-13	Control of electromagnets
DC-14	Control of electromagnetic loads having economy resistors in circuit

Table 6: Utilization Categories

Thermal Current, Ith: The conventional enclosed thermal current is the value of current used for the temperature-rise tests of the equipment when mounted in a specified enclosure.

Rated Operational Voltage Ue and Current Ie; The rated operational current and voltage specify the making and breaking capacities of the switching elements under normal operating conditions. The Allen-Bradley Guardmaster products are specifically rated at 125V AC, 250V AC and 24V DC. Consult the factory for usage at voltages other than these specified ratings.

VA: The VA (Voltage x Amperage) ratings indicate the ratings of the switching elements when making the circuit as well as breaking the circuit.

Example 1: An A150, AC-15 rating indicates that the contacts can make a 7200V A circuit. At 120V AC, the contacts can make a 60 amp inrush circuit. Since the AC-15 is an electromagnetic load, the 60 amp is only for a short duration; the inrush current of the electromagnetic load. The breaking of the circuit is only 720V A because the steady state current of the electromagnetic load is 6 A, which is the rated operational current.

Example 2: An N150, DC-13 rating indicates that the contacts can make a 275V A circuit. At 125V AC, the contacts can make a 2.2 amp circuit. DC electromagnetic loads do not have an inrush current like AC electromagnetic loads. The breaking of the circuit is also 275V A because the steady state current of the electromagnetic load is 2.2, which is the rated operational current.

Machine Restart

If, for example, an interlocked guard is opened on an operating machine, the safety interlock switch will stop that machine. In most circumstances it is imperative that the machine does not restart immediately when the guard is closed. A common way of achieving this is to rely on a latching contactor start arrangement as shown in Figure 88. An interlocked guard door is used as an example here but the requirements apply to other protection devices and emergency stop systems.

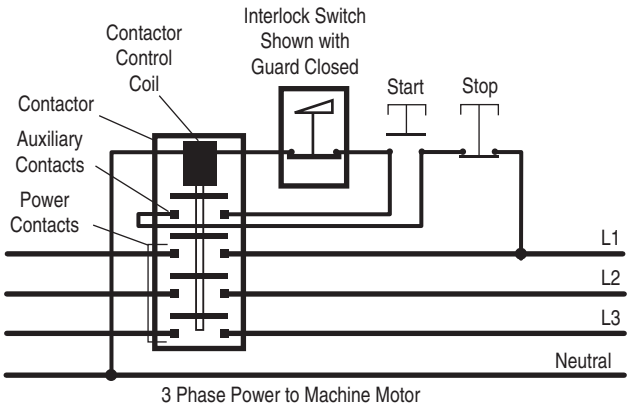

Figure 88: Simple Machine Start Stop Interlock Circuit

Pressing and releasing the start button momentarily energizes the contactor control coil which closes the power contacts. As long as power is flowing through the power contacts the control coil is kept energized (electrically latched) via the contactor's auxiliary contacts which are mechanically linked to the power contacts. Any interruption to the main power or control supply results in the de-energizing of the coil and opening of the main power and auxiliary contacts. The guard interlock is wired into the contactor control circuit. This means that restart can only be achieved by closing the guard and then switching “ON” at the normal start button which resets the contactor and starts the machine.

The requirement for normal interlocking situations is made clear in ISO 12100-1 Paragraph 3.22.4 (extract).

When the guard is closed, the hazardous machine functions covered by the guard can operate, but the closure of the guard does not by itself initiate their operation.

Many machines already have either single or double contactors which operate as described above (or have a system which achieves the same result). When fitting an interlock to existing machinery it is necessary to determine whether the power control arrangement meets this requirement and take additional measures if necessary.

Reset Functions

Allen-Bradley Guardmaster monitoring safety relays are designed with either monitored manual reset or automatic/manual reset.

Monitored Manual Reset

A monitored manual reset requires a change of state of the reset circuit after the gate is closed or the E-Stop is reset. Figure 89 shows a typical configuration of a reset switch connected in the output monitoring circuit of a safety relay with a monitored manual reset function. The mechanically linked normally closed auxiliary contacts of the power switching contactors are connected in series with a momentary push button. After the guard has been opened and closed again, the safety relay will not allow the machine to be restarted until there is a change of state at the reset button. This is in compliance with the intent of the requirements for additional manual reset as given in EN ISO 13849-1. i.e., the reset function ensures that both contactors are OFF and that both interlock circuits (and therefore the guards) are closed and also (because a change of state is required) that the reset actuator has not been bypassed or blocked in any way. If these checks are successful the machine can then be restarted from the normal controls. EN ISO 13849-1 cites the change of state from energized to de-energized but the same protective principle can also be achieved by the opposite effect.

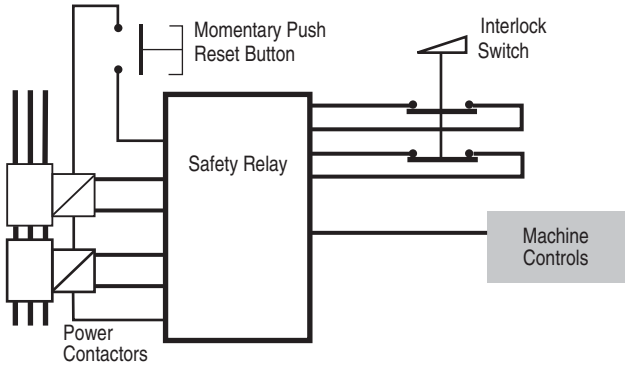

Figure 89: Monitored Manual Reset

The reset switch should be located in a place that provides a good view of the hazard so that the operator can check that the area is clear before operation.

Auto/Manual Reset

Some safety relays have automatic/manual reset. The manual reset mode is not monitored and reset occurs when the button is pressed. A short circuited or jammed in reset switch will not be detected. With this approach it may not be possible to achieve the requirements for additional manual reset as given in EN ISO 13849-1 unless additional means are used.

Alternatively the reset line can be jumpered allowing an automatic reset. The user must then provide another mechanism for preventing machine start-up when the gate closes.

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Alternatively the reset line can be jumpered allowing an automatic reset. The user must then provide another mechanism for preventing machine start-up when the gate closes.

An auto-reset device does not require a manual switching action but after de-actuation it will always conduct a system integrity check before resetting the system. An auto-reset system should not be confused with a device without reset facilities. In the latter the safety system will be enabled immediately after de-actuation but there will be no system integrity check.

Control Guards

A control guard stops a machine when the guard is opened and directly starts it again when the guard is closed. The use of control guards is only allowed under certain stringent conditions because any unexpected start-up or failure to stop would be extremely dangerous. The interlocking system must have the highest possible reliability (it is often advisable to use guard locking). The use of control guards can ONLY be considered on machinery where there is NO POSSIBILITY of an operator or part of his body staying in or reaching into the danger zone while the guard is closed. The control guard must be the only access to the hazard area.

Safety Programmable Logic Controls

The need for flexible and scaleable safety applications drove the development of safety PLCs/controllers. Programmable safety controllers provide users the same level of control flexibility in a safety application that they are accustomed to with standard programmable controllers. However there are extensive differences between standard and safety PLCs. Safety PLCs, shown in Figure 90 come in various platforms to accommodate the scalability, functional and integration requirements of the more complex safety systems.

Figure 90: Safety PLC Platforms

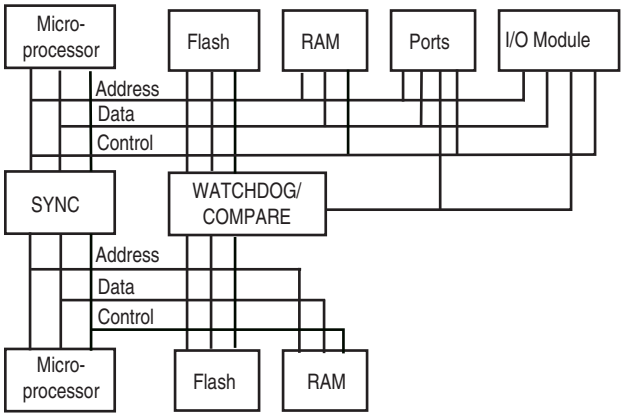

Figure 91: 1oo2D Architecture

Multiple microprocessors are used to process the I/O, memory, and safe communications. Watchdog circuits perform diagnostic analysis. This type of construction is known as 1oo2D, because either one of the two microprocessors can perform the safety function, and extensive diagnostics are performed to ensure that both microprocessors are operating in sync.

Also, each input circuit is internally tested many times each second to make sure that it is operating correctly. Figure 92 shows a block diagram of an input. You may only hit the E-Stop once a month; but when you do, the circuit has been continuously tested so that the E-Stop will be sensed correctly internal to the safety PLC.

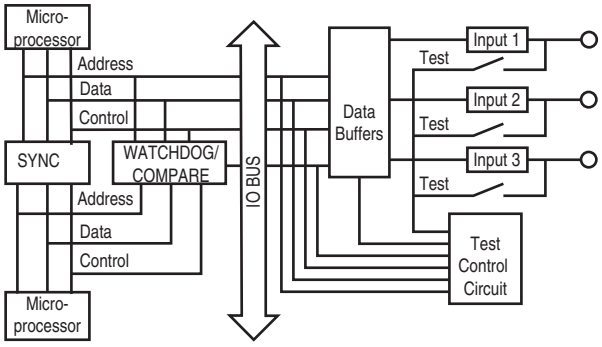

Figure 92: Block Diagram of a Safety Input Module

Safety PLC outputs are electromechanical or safety rated solid state. Figure 93 shows multiple switches in every output circuit of a safety PLC. Like the input circuits, the output circuits are tested multiple times every second to make sure that they can turn the output off. If one of the three fails, the output is turned off by the other two, and the fault is reported by the internal monitoring circuit.

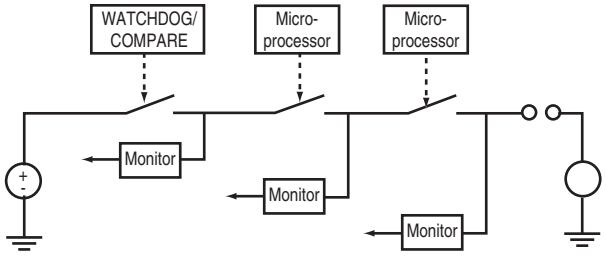

Figure 93: Safety Output Module Block Diagram

When using safety devices with mechanical contacts (E-stops, gate switches, etc), the user can apply pulse test signals to detect cross faults. To not use up expensive safety outputs, many safety PLCs provides specific pulsing outputs that can be connected to mechanical contact devices. A wiring example is shown in Figure 94. In this example, outputs O1, O2, O3, and O4 are all pulsing at different rates. The safety PLC expects to see these different pulse rates reflected in the inputs. If identical pulse rates are detected, a cross fault has occurred and appropriate action is taken in the safety PLC.

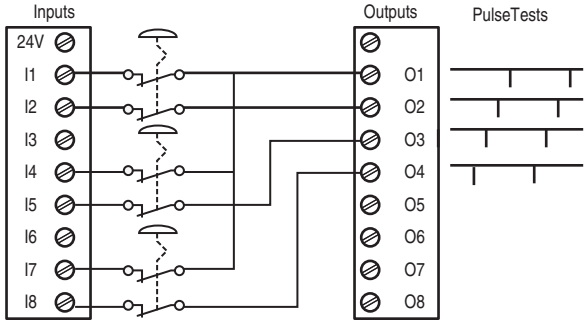

Figure 94: Pulse Testing of 2 N.C. Mechanical Inputs

Software

Safety PLCs program very much like standard PLCs do. All of the additional diagnostics and error checking mentioned earlier is done by the operating system, so the programmer is not even aware that it is happening. Most safety PLCs will have special instructions used to write the program for the safety system, and these instructions tend to mimic the function of their safety relay counterparts. For example, the Emergency Stop instruction in Figure 95 operates very much like an MSR127. Though the logic behind each of these instructions is complex, the safety programs look relatively simple because the programmer simply connects these blocks together. These instructions, along with other logical, math, data manipulation, etc. instructions are certified by a third party to ensure their operation is consistent with the applicable standards.

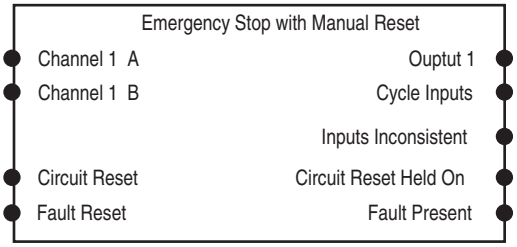

Figure 95: E-Stop Function Block

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Function blocks are the predominant methods for programming safety functions. In addition to Function Blocks and Ladder Logic, safety PLCs also provide certified safety application instructions. Certified safety instructions provide application specific behavior. This example shows an emergency stop instruction. To accomplish the same function in ladder logic would require approximately 16 rungs of ladder logic. Since the logic behavior is embedded in the E-Stop instruction, the embedded logic does not have to be tested.

Certified function blocks are available to interface with almost all safety devices. One exception to this list is the safety edge that uses resistive technology. Here is a list of certified application instructions available in the GuardPLC.

1. Diverse (1 N.O. + 1 N.C.) Input with Auto Reset
2. Diverse (1 N.O. + 1 N.C.) Input with Manual Reset
3. Emergency Stop with Auto Reset
4. Emergency Stop with Manual Reset
5. Redundant (2 N.C.) Input with Auto Reset
6. Redundant (2 N.C.) Input with Manual Reset
7. Redundant Output with Positive Feedback
8. Redundant Output with Negative Feedback
9. Enable Pendant with Auto Reset
10. Enable Pendant with Manual Reset
11. Two Hand Run Station with Active Pin
12. Two Hand Run Station without Active Pin
13. Light Curtain with Auto Reset
14. Light Curtain with Manual Reset
15. Five Position Mode Selector
16. Single Pulse Test Output
17. Redundant Pulse Test Output

Safety PLCs generate a “signature” that provides the ability to track whether changes were made. This signature is usually a combination of the program, input/output configuration, and a time stamp. When the program is finalized and validated, the user should record this signature as part of the validation results for future reference. If the program needs modification, revalidation is required and a new signature must be recorded. The program can also be locked with a password to prevent unauthorized changes.

Wiring is simplified with programmable logic systems as compared to monitoring safety relays. Unlike wiring to specific terminals on monitoring safety relays, input devices are connected to any input terminals and output devices are connected to any output terminals. The terminals are then assigned through software.

Integrated Safety Controllers

Safety control solutions now provide complete integration within a single control architecture where safety and standard control functions reside and work together. The ability to perform motion, drive, process, batch, high speed sequential, and SIL 3 safety in one controller provides significant benefits. The integration of safety and standard control provides the opportunity to utilize common tools and technologies which reduce costs associated with design, installation, commissioning and maintenance. The ability to utilize common control hardware, distributed safety I/O or devices on safety networks and common HMI devices reduce purchase and maintenance costs, and also reduce development time. All of these features improve productivity, the speed associated with troubleshooting and the lowering of training costs due to commonality.

Figure 96 shows an example of the integration of control and safety. The standard non-safety related control functions reside in the Main Task. The safety related functions reside in the Safety Task.

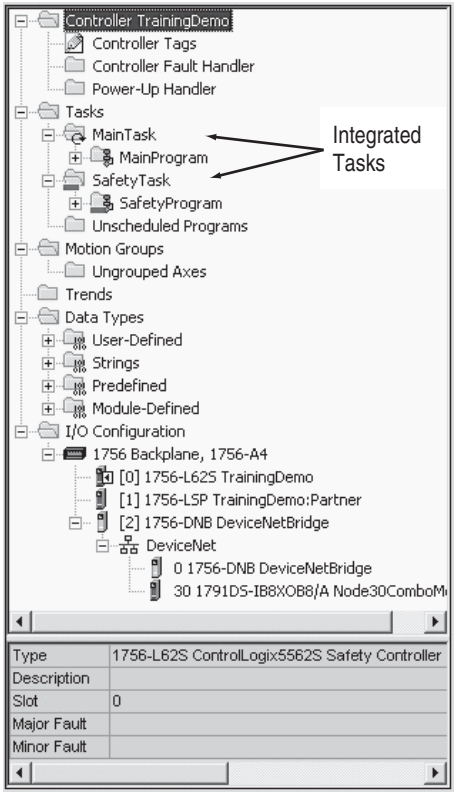


Figure 96: Integrated Safety and Nonsafety Tasks

All standard and safety related functions are isolated from each other. Figure 97 shows a block diagram of allowed interaction between the standard and safety portions of the application. For example, safety tags can be directly read by the standard logic. Safety tags can be exchanged between GuardLogix controllers over EtherNet, ControlNet or DeviceNet. Safety tag data can be directly read by external devices, Human Machine Interfaces (HMI), personal computers (PC) or other controllers.

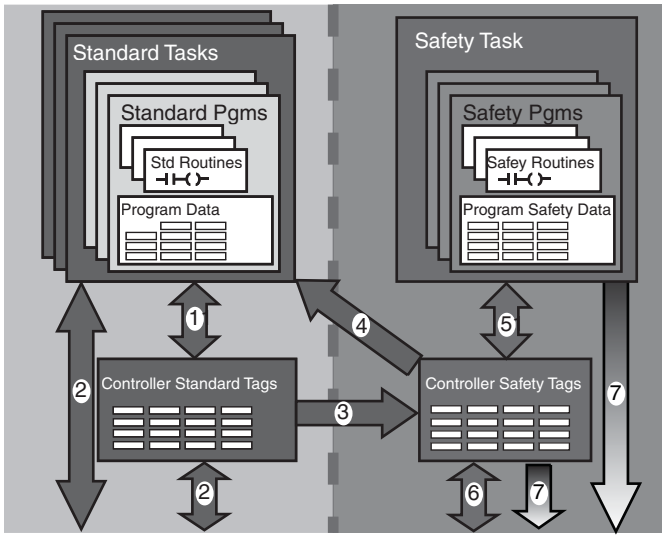


Figure 97: Standard and Safety Task Interaction

1. Standard tags and logic behave the same as ControlLogix.
2. Standard tag data, program or controller scoped and external devices, HMI, PC's, other controllers, etc.
3. As an integrated controller, GuardLogix provides the ability to move (map) standard tag data into safety tags for use within the safety task. This is to provide users the ability read status information from the standard side of GuardLogix. This data must not be used to directly control a safety output.
4. Safety tags can be directly read by standard logic.
5. Safety tags can be read or written by safety logic.
6. Safety tags can be exchanged between GuardLogix controllers over EtherNet.
7. Safety tag data, program or controller scoped can be read by external devices, HMIs, PCs, other controllers, etc. Note, once this data is read, it is considered standard data, not safety data.

Safety Networks

Plant floor communication networks have traditionally provided manufacturers the capability to improve flexibility, increase diagnostics, increase distance, reduce installation and wiring cost, ease maintainability and generally improve the productivity of their manufacturing operations. These same motivations are also driving the implementation of industrial safety networks. These safety networks allow manufacturers to distribute safety I/O and safety devices around their machinery using a single network cable, reducing installation costs while improving diagnostics and enabling safety systems of increased complexity. They also enable safe communications between safety PLCs/controllers, allowing users to distribute their safety control among several intelligent systems.

Safety networks do not prevent communication errors from occurring. Safety networks are more capable of detecting transmission errors and then allow safety devices to take the appropriate actions. Communication errors that are detected include: message insertion, message loss, message corruption, message delay, message repeat, and incorrect message sequence.

For most applications, when an error is detected the device will go to a known de-energized state, typically called a "safety state." The safety input or output device is responsible for detecting these communication errors and then going to the safe state if appropriate.

Early safety networks were tied to a particular media type or media access scheme, so manufacturers were required to use specific cables, network interface cards, routers, bridges, etc. that also became part of the safety function. These networks were limited in that they only supported communication between safety devices. This meant that manufacturers were required to use two or more networks for their machine control strategy (one network for standard control and another for safety related control) increasing installation, training and spare parts costs.

Modern safety networks allow a single network cable to communicate with safety and standard control devices. CIP (Common Industrial Protocol) Safety is an open standard protocol published by ODVA (Open DeviceNet Vendors Association) that allows for safety communications between safety devices on DeviceNet, ControlNet and EtherNet/IP networks. Because CIP Safety is an extension to the standard CIP protocol, safety devices and standard devices can all reside on the same network. Users can also bridge between networks containing safety devices, allowing them to subdivide safety devices to fine-tune safety response times, or to simply make distribution of safety devices easier. Because the safety protocol is solely the responsibility of the end devices (safety PLC/controller, safety I/O module, safety component), standard cables, network interface cards, bridges, and routers are used, eliminating any special networking hardware and removing these devices from the safety function.

Figure 98 shows a simplified example of a distributed I/O system. The operator opens the gate. The interlock switch, connected to the local Safety I/O block, sends its safety data over the DeviceNet network to the Safety PLC. The Safety PLC sends a signal back to the Safety I/O block to shut down the equipment inside of the gate and sends a standard output to a stack light to annunciate the gate is open. The HMI and the standard PLC monitors the safety data for display and additional control measures, like performing a cycle stop of adjacent equipment.

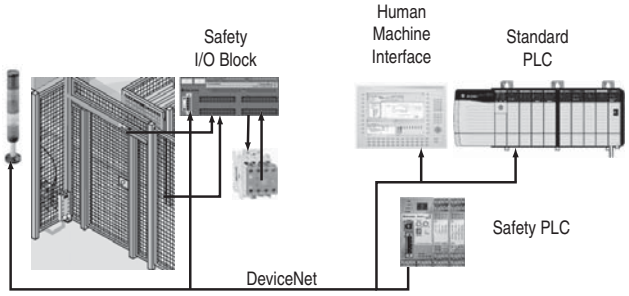


Figure 98: Example of a Simple Distributed Safety Network

For larger manufacturing systems, where safety information and control must be shared, Ethernet/IP can also be used. Figure 99 shows an example of communications between two safety controllers while DeviceNet is used for local distribution of I/O within a smaller subsystem.

Output Devices

Safety Control Relays and Safety Contactors

Control Relays and Contactors are used to remove power from the actuator. Special features are added to control relays and contactors to provide the safety rating.

Mechanically linked normally closed contacts are used to feed back the status of the control relays and contactors to the logic device. The use of mechanically linked contacts helps ensure the safety function. To meet the requirements of mechanically linked contacts, the normally closed and the normally open contacts cannot be in the closed state at the same time. IEC 60947-5-1 defines the requirements for mechanically linked contacts. If the normally open contacts were to weld, the normally closed contacts remain open by at least 0.5 mm. Conversely, if the normally closed contacts were to weld, then the normally open contacts remain open. If the product meets this requirement, the symbol shown in Figure 100 is applied to the product.

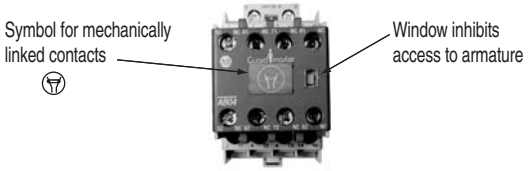


Figure 100: Mechanically Linked Contact Symbol

Safety systems must only be started at specific locations. Standard rated control relays and contactors allow the armature to be depressed to close the normally open contacts. On safety rated devices, the armature is protected from manual override to mitigate unexpected startup.

On safety control relays, the normally closed contact is driven by the main spanner. Safety contactors use an adder deck to locate the mechanically linked contacts. If the contact block were to fall off the base, the mechanically linked contacts remain closed. The mechanically linked contacts are permanently affixed to the safety control relay or safety contactor.

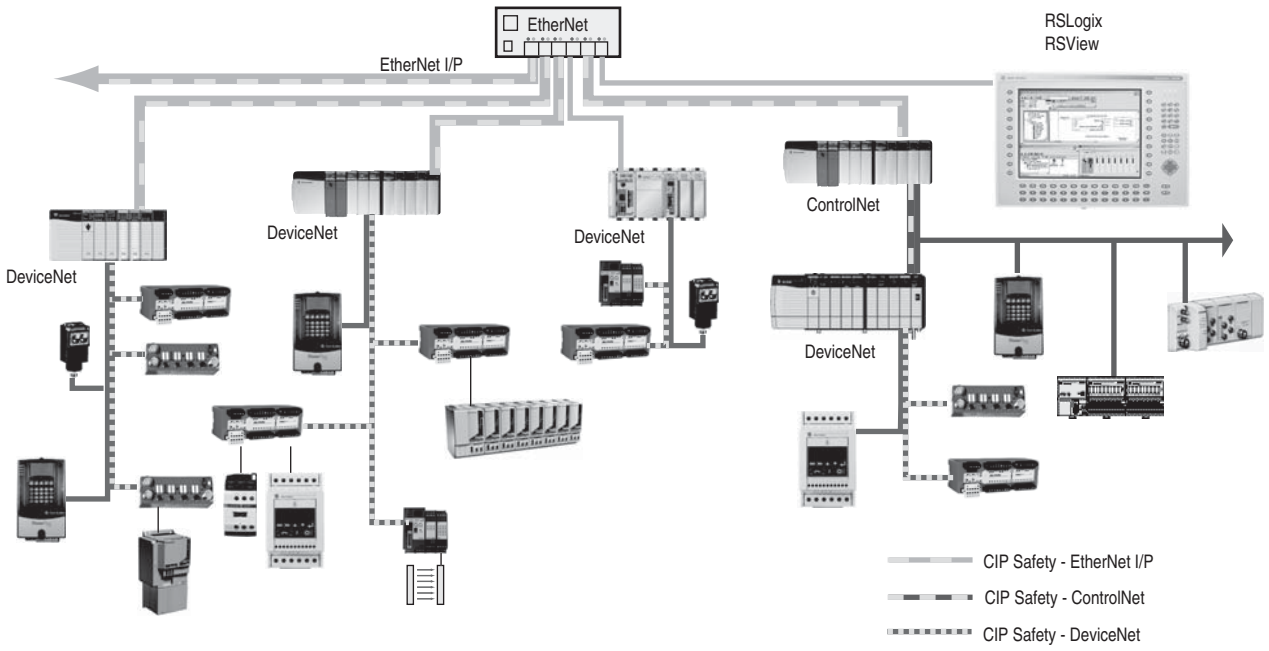


Figure 99: Example of a Complex Distributed Safety Network

On the larger contactors, an adder deck is insufficient to accurately reflect the status of the wider spanner. Mirrored contacts, shown in Figure 101 are located on either side of the contactor are used.

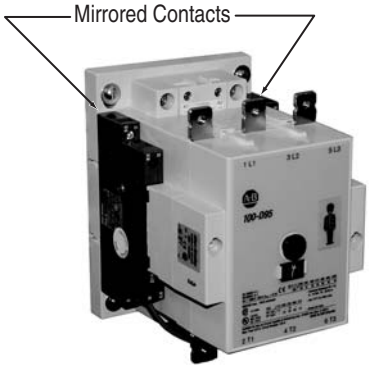


Figure 101: Mirrored Normally Closed Contacts

Dropout time of control relays or contactors play a role in the safety distance calculation. Often, a surge suppressor is placed across the coil to improve the life of the contacts driving the coil. For AC powered coils, the drop out time is not affected. For DC powered coils, the drop out time is increased. The increase is dependent on the type of suppression selected.

Control relays and contactors are designed to switch large loads, anywhere from 0.5 A to over 100 A. The safety system operates on low currents. The feedback signal generated by the safety system logic device can be on the order of a few milliamps to tens of milliamps, usually at 24V DC. The safety control relays and safety contactors use gold plated bifurcated contacts to reliably switch this small current.

Overload Protection

Overload protection for motors is required by electrical standards. Diagnostics provided by the overload protection device enhances not only equipment safety but operator safety as well. Technologies available today can detect fault conditions like an overload, phase loss, ground fault, stall, jam, under-load, current imbalance and over-temperature. Detecting and communicating abnormal conditions prior to tripping help to improve production up time and help prevent operators and maintenance people from unforeseen hazardous conditions

Figure 102 shows examples of overload protection devices. When dual contactors are used to ensure the switching off of a motor in Category 3, 4 or Control reliable solution, only one overload protection device is needed for each motor.

Figure 102: Contactor Overload Protection

Drives and Servos

Safety rated drives and servos can be used to prevent rotational energy from being delivered to achieve a safety stop as well as an emergency stop.

AC drives achieve the safety rating with redundant channels to remove power to the gate control circuitry. One channel is the Enable signal, a hardware signal that removes the input signal to the gate control circuitry. The second channel is positive guided relay that remove the power supply from the Gate control circuitry. The positive guided relay also provides a status signal back to the logic system. A block diagram of the implementation of safe off feature in the PowerFlex drive is shown in Figure 103.

This redundant approach allows the safety rated drive to be applied in emergency stop circuits without the need for a contactor.

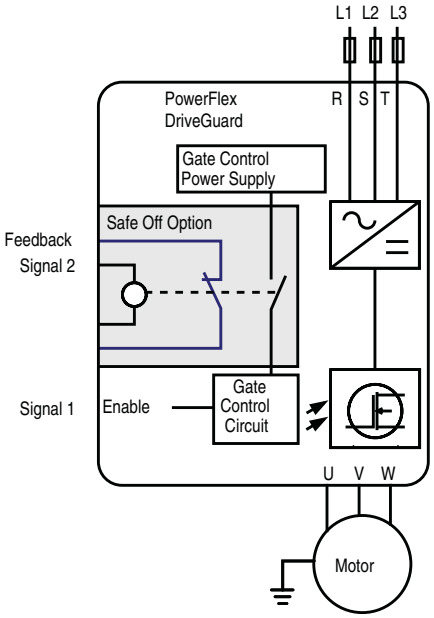


Figure 103: Drive Safety Signals

The Servo achieves a result in a manner similar to the AC drives. Figure 104 shows that redundant safety signals are used to achieve the safety function. One signal interrupts the drive to the Gate Control Circuitry. A second signal interrupts power to the power supply of the Gate control circuitry. Two positive guided relays are used to remove the signals and provide feedback to the safety logic device as well.

Connection Systems

Connection systems add value by reducing the installation and maintenance costs of safety systems. Designs must take into account consideration of single channel, dual channel, dual channel with indication and multiple types of devices.

When a series connection of dual channel interlocks is needed, a distribution block can simplify installation. Figure 105 shows a simple example of a series of interlocks connected to one port. With an IP67 rating, these types of boxes can be mounted on the machine at remote locations.

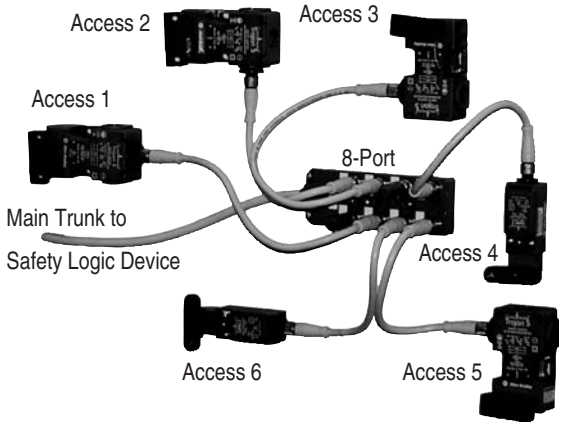


Figure 105: Safety Distribution Block

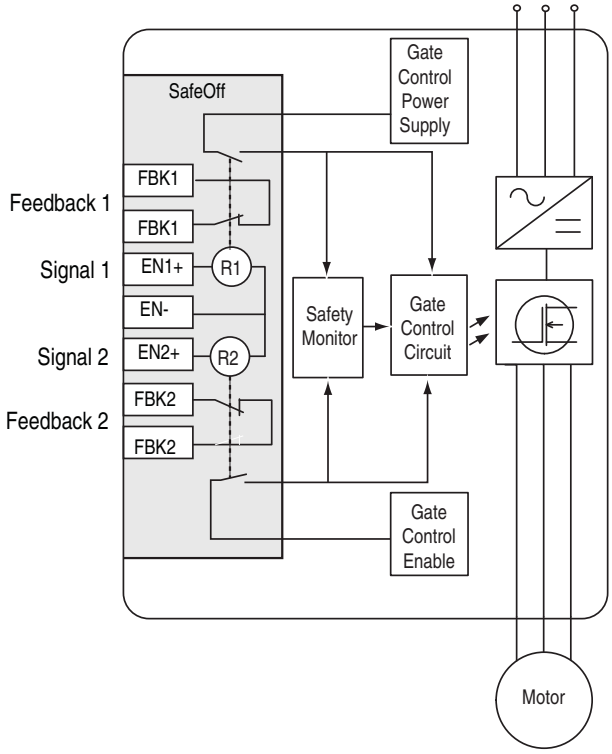


Figure 104: Kinetix Drive Safety Signals

When a diverse set of devices is required, an ArmorBlock Guard I/O box can be used. Figure 106 shows an eight port and four port block with an IP67 rating, which can be mounted directly on the machine without an enclosure. The inputs can be configured by software to accommodate various types of devices.

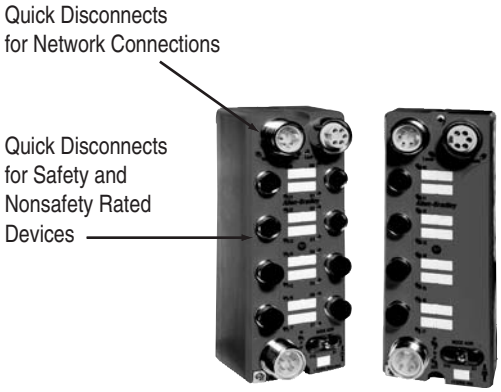


Figure 106: ArmorBlock Guard I/O

Safety Distance Calculation

Hazards must come to a safe state prior to an operator reaching the hazard. For the safety distance calculation, there are two groups of standards that have proliferated. In this chapter, these standards are grouped as follows:

ISO EN: (ISO 13855 and EN 999)

US CAN (ANSI B11.19, ANSI RIA R15.06 and CAN/CSA Z434-03)

Formula

The minimum safety distance is dependent on the time required to process the Stop command and how far the operator can penetrate the detection zone before detection. The formula used throughout the world has the same form and requirements. The differences are the symbols used to represent the variables and the units of measure.

The formulas are:

ISO EN:S =K x T+ C

US CAN: Ds =K x(Ts + Tc + Tr + Tbm) + Dpf

Where:

Ds and S are the minimum safe distance from the danger zone to the closest detection point.

Directions of Approach

When considering the safety distance calculation where a light curtains or area scanner is used, the approach to the detection device must be taken into consideration. Three types of approaches are considered:

Normal: an approach perpendicular to the detection plane

Horizontal: an approach parallel to the detection plan

Angled: an angled approach to the detection zone.

Speed Constant

K is a speed constant. The value of the speed constant is dependent on movements of the operator (i.e. hand speeds, walking speeds, and stride lengths). This parameter is based on research data showing that it is reasonable to assume a 1600 mm/sec (63 in./s) hand speed of an operator while the body is stationary. The circumstances of the actual application must be taken into account. As a general guideline, the approach speed will vary from 1600 mm/s (63 in./s) to 2500 mm/sec (100 in./s). The appropriate speed constant must be determined by the risk assessment.

Stopping Time

T is the overall stopping time of the system. The total time, in seconds, starts from the initiation of the stop signal to the cessation of the hazard. This time can be broken down to its incremental parts (Ts, Tc, Tr and Tbm) for easier analysis. Ts is the worst stopping time of the machine/equipment. Tc is the worst stopping time of the control system. Tr is the response time of the safeguarding device, including its interface. Tbm is additional stopping time allowed by the brake monitor before it detects stop-time deterioration beyond the end users' predetermined limits. Tbm is used with part revolution mechanical presses. Ts + Tc + Tr are usually measured by a stop-time measuring device if the values are unknown.

Depth Penetration Factor

The Depth Penetration Factors is represented by the symbols C and Dpf. It is the maximum travel towards the hazard before detection by the safeguarding device. Depth penetration factors will change depending on the type of device and application. Appropriate standard must be checked to determine the best depth penetration factor. For a normal approach to a light curtain or area scanner, whose object sensitivity is less than 64 mm (2.5 in.), the ANSI and Canadian standards use:

Dpf = 3.4 x (Object Sensitivity – 6.875 mm), but not less than zero.

For a normal approach to a light curtain or area scanner, whose object sensitivity is less than 40 mm (1.57 in.), the ISO and EN standards use:

C = 8 x (Object Sensitivity – 14 mm), but not less than 0

Figure 107 shows a comparison of these two factors. These two formulas have a cross over point at 19.3 mm. For object sensitivity less than 19 mm, the US CAN approach is more restrictive, as the light curtain or area scanner must be set back further from the hazard. For object sensitivities greater than 19.3 mm, the ISO EN standard is more restrictive. Machine builders, who want to build one machine for use throughout the world, must take the worst case conditions from both equations.

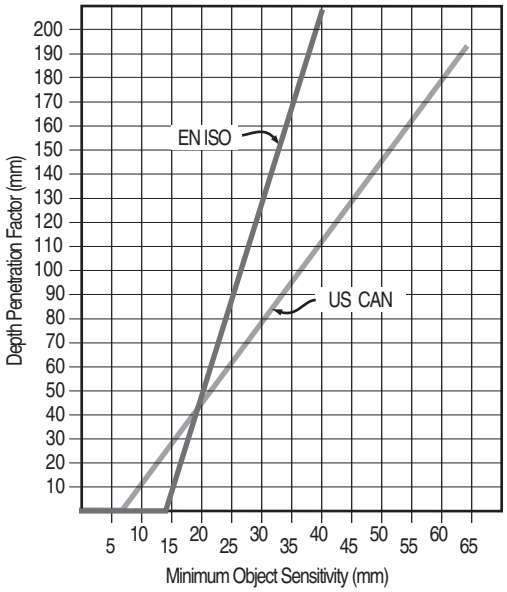


Figure 107: Depth Penetration vs. Object Sensitivity

Reach Through Applications

When larger object sensitivities are used, the US CAN and ISO EN standards differ slightly on the depth penetration factor and the object sensitivity. Figure 108 summarizes the differences. The ISO EN value is 850mm where the US CAN value is 900 mm. The standards also differ in the object sensitivity. Where the ISO EN standard allows for 40 to 70 mm, the US CAN standard allows up to 600 mm.

Safety Distance Calculation

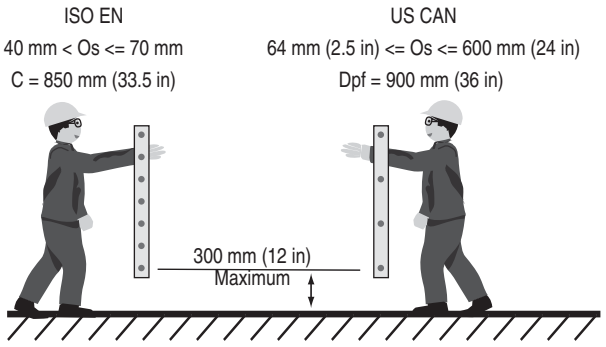


Figure 108: Depth Penetration Factors for Reach-Through Applications

Reach-Over Applications

Both standards agree that the minimum height of the lowest beam should be 300 mm, but differ with respect to the minimum height of the highest beam. The ISO EN states 900 mm, whereas the US CAN states 1200 mm. Figure 109 summarizes the differences.

The value for the highest beam seems to be moot. When considering this to be a reach-through application, the height of the highest beam will have to be much higher to accommodate an operator in a standing position. If the operator can reach over the detection plane, then the reach over criteria applies.

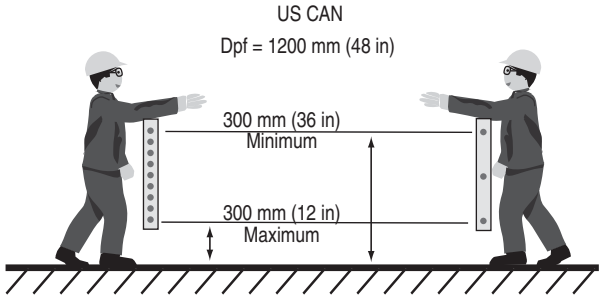


Figure 109: Depth Penetration Factors for Reach-Over Applications

Single or Multiple Beams

Single or multiple separate beams are further defined by the ISO EN standards. Table 5.1 shows the “practical” heights of multiple beams above the floor. The depth penetration is 850 mm for most cases and 1200 mm for the single beam usage. In comparison, the US CAN approach takes this into account by the Reach-Through requirements. Getting over, under or around the single and multiple beams must always be taken into consideration.

No. of Beams	Height Above the Floor [mm (in.)]	C [mm (in.)]
1	750 (29.5)	1200 (47.2)
2	400 (15.7), 900 (35.4)	850 (33.4)
3	300 (11.8), 700 (27.5), 1100 (43.3)	850 (33.4)
4	300 (11.8), 600 (23.6), 900 (35.4), 1200 (47.2)	850 (33.4)

Table 7: Single and Multiple Beam Heights and Depth Penetration Factor

Distance Calculations

For the normal approach to light curtains, the safety distance calculation for the ISO EN and U.S. CAN are close, but differences do exist. For the normal approach to vertical light curtains where the object sensitivity is a maximum of 40 m, the ISO EN approach requires two steps. First, calculate S using 2000 for the speed constant.

S = 2000 x T + 8 x (d -1 4)

The minimum distance that S can be is 100 mm.

A second step can be used when the distance is greater than 500 mm. Then the value of K can be reduced to 1600. When using K=1600, the minimum value of S is 500 mm.

The U.S. CAN approach uses a one step approach:

Ds = 1600 x T * Dpf

This leads to differences greater than 5% between the standards, when the response time is less than 560 ms. Figure 110 shows the minimum safety distance as a function of the total stopping time for 14 and 30 mm object sensitivity. A combination of both approaches needs to be examined to achieve the worst case scenario for globally designed machines.

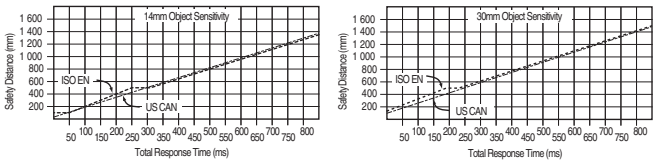


Figure 110: Safety Distance Comparisons

Angled Approaches

Most applications of light curtains and scanners are mounted in vertical (normal approach) or horizontal (parallel approach). These mountings are not considered angled if they are within ±5° of the intended design. When the angle exceeds ±5°, the potential risks (e.g. shortest distance) of foreseeable approaches must be taken into consideration. In general, angles greater than 30° from the reference plane (e.g. floor) should be consider normal and those less than 30 considered parallel. This is depicted in Figure 111.

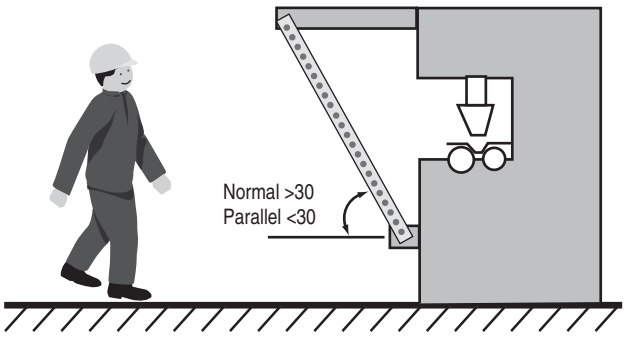


Figure 111: Angle Approach to the Detection Field

Safety Mats

With safety mats, the safety distance must take into account the operators pace and stride. Assuming the operator is walking and the safety mats are mounted on the floor. The operator's first step onto the mat is a depth penetration factor of 1200 mm or 48 in. An example arrangement is shown in Figure 112.

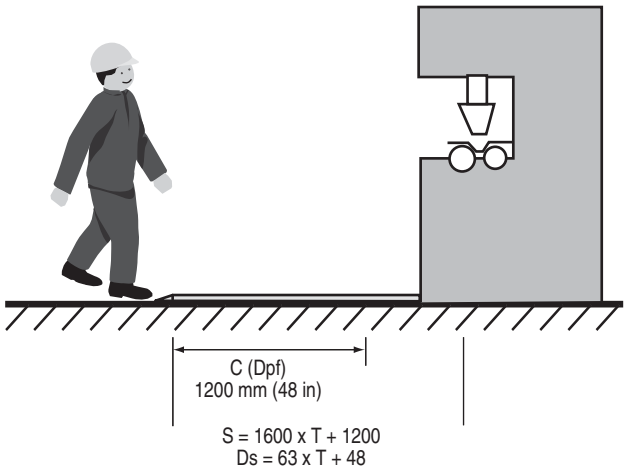


Figure 112: Safety Mat Mounted on Floor

If the operator must step up onto a platform, then the depth penetration factor can be reduced by a factor of 40% of the height of the step (see Figure 113).

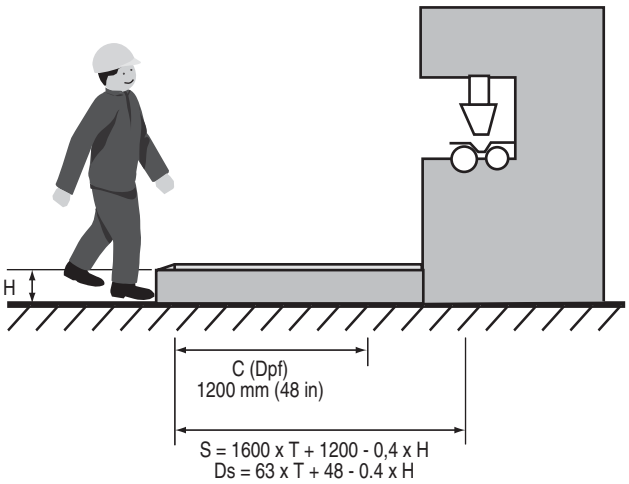


Figure 113: Step Up to Safety Mat Mounted on a Platform

Examples

Example: An operator uses a normal approach to a 14 mm light curtain, which is connected to a monitoring safety relay which is connected to a DC powered contactor with a diode suppressor. The safety system response time, Tr, is 20 + 15 + 95 = 130 ms. The machine stopping time, Ts+Tc, is 170 ms. A brake monitor is not used. The Dpf value is 1 inch, and the C value is zero. The calculation would be as follows:

Dpf = 3.4 (14 - 6.875) = 24.2 mm (1 in) C = 8 (14-14) = 0
Ds = K x (Ts + Tc + Tr + Tbm) + Dpf S = K x T + C
Ds = 63 x (0.17 + 0.13 + 0) + 1 S = 1600 x (0,3) + 0
Ds = 63 x (0.3) + 1 S = 480 mm (18.9 in)
Ds = 18.9 + 1
Ds = 19.9 in (505 mm)

Therefore, the minimum safe distance the safety light curtain must be mounted from the hazard is 508 mm (20 in.) for a machine to be used anywhere in the world.

Prevention of Unexpected Power Up

Prevention of unexpected power up is covered by many standards. Examples include ISO 14118, EN 1037, ISO 12100, OSHA 1910.147, ANSI Z244-1, CSA Z460-05, and AS 4024.1603. These standards have a common theme: the primary method of preventing unexpected power up is to remove the energy from the system and to lock the system in the off state. The purpose is to safely allow people to enter a machine's danger zones.

Lockout/Tagout

New machines must be built with lockable energy isolating devices. The devices apply to all types of energy, including electrical, hydraulic, pneumatic, gravity, and lasers. Lockout refers to applying a lock to an energy isolating device. The lock must only be removed by its owner or by a supervisor under controlled conditions. When multiple individuals must work on the machine, each individual must apply their locks to the energy isolating devices. Each lock must be identifiable to its owner.

In the U.S., tagout is an alternative to lockout for older machines where a lockable device has never been installed. In this case, the machine is turned off and a tag is applied to warn all personnel to not start the machine while the tag holder is working on the machine. Beginning in 1990, machines that are modified must be upgraded to include a lockable energy isolating device.

An energy isolating device is a mechanical device that physically prevents the transmission or release of energy. These devices can take the form of a circuit breaker, a disconnect switch, a manually operated switch, a plug/socket combination or a manually operated valve. Electrical isolating devices must switch all ungrounded supply conductors and no pole can operate independently.

The purpose of lockout and tagout is to prevent the unexpected startup of the machine. Unexpected startup may be the result of various causes: a failure of the control system; an inappropriate action on a start control, sensor, contactor, or valve; a restoration of power after an interruption; or some other internal or external influences. After completion of the lockout or tagout process, the dissipation of the energy must be verified.

Safety Isolation Systems

Safety isolation systems execute an orderly shutdown of a machine and also provide an easy method of locking off the power to a machine. This approach works well for larger machines and manufacturing systems, especially when multiple energy sources are located on a mezzanine level or at distant locations.

Figure 114 shows an overview of the system layout. Lockable stations are remotely located at convenient access points throughout the machine. When necessary, an operator uses the remote station to turn off the machine and lock the machine in the off state. The control box disconnects electrical and pneumatic power and provides a signal back to the operator that the energy has been disconnected.

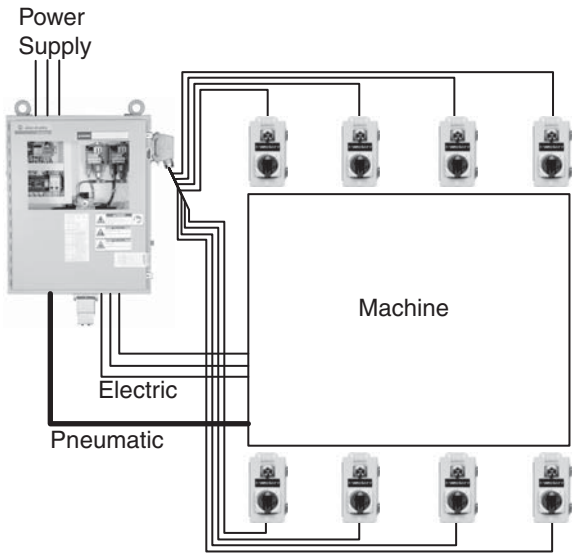


Figure 114: Layout of Safety Isolation System

Figure 115 shows that the safety isolation system not only removes power from the machine but also grounds the load side. The operator gets a monitored, visible signal at the remote station that the machine is in a safe state, and the energy is dissipated.

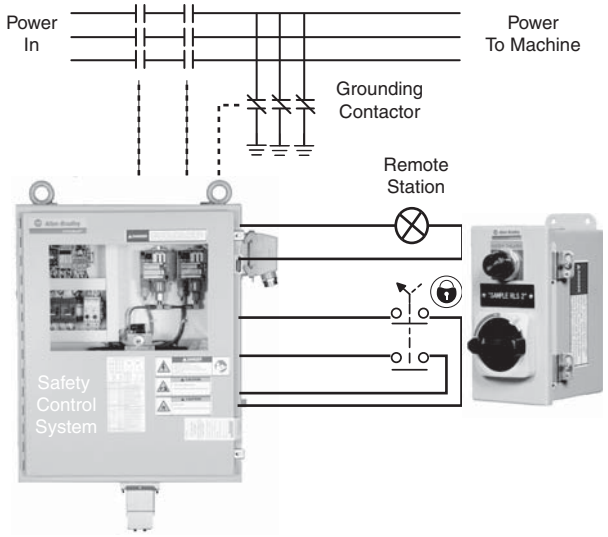


Figure 115: Machine side is grounded with signal to operator.

Load Disconnects

For local isolation of electrical devices, switches can be placed just prior to the device that needs to be isolated and locked out. The Bulletin 194E Load Switches are an example of a product that are capable of both isolation and lockout. Figure 116 shows an example of the Bulletin 194E.

Figure 116: Load switch with isolation and locking capability

Trapped Key Systems

Trapped key systems are another method for implementing a lockout system. Many trapped key systems start with an energy isolating device. When the switch is turned off by the “primary” key, the electrical energy to the machine is removed from all the ungrounded supply conductors simultaneously. The primary key can then be removed and taken to a location where machine access is needed. Figure 117 shows an example of the most basic system, an isolating switch and a gate access lock. Various components can be added to accommodate more complex lockout arrangements.

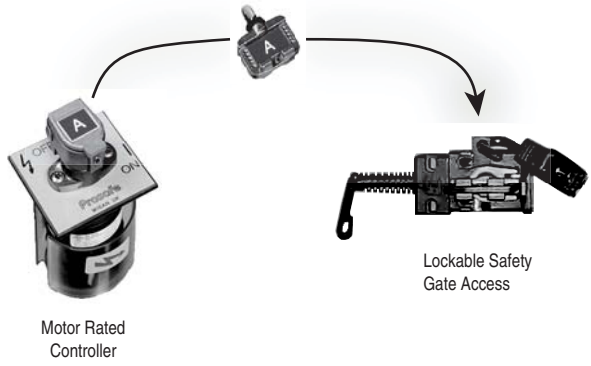


Figure 117: Trapped key isolation and lockable devices

Alternative Measures to Lockout

Lockout and tagout must be used during servicing or maintenance of the machines. Machine interventions during normal production operations are covered by safeguarding. The difference between servicing/maintenance and normal production operations is not always clear.

Some minor adjustments and servicing tasks, which take place during normal production operations, do not necessarily require the machine to be locked out. Examples include loading and unloading materials, minor tool changes and adjustments, servicing lubrication levels, and removing waste material. These tasks must be routine, repetitive, and integral to the use of the equipment for production, and the work is performed using alternative measures, like safeguarding, which provide effective protection. Safeguarding includes devices like interlocked guards, light curtains, and safety mats. Used with appropriate safety rated logic and output devices, operators can safety access the machine danger zones during normal production tasks and minor servicing.

Introduction to Safety-Related Control Systems

What is a safety-related control system (SRCS)? It is that part of the control system of a machine that prevents a hazardous condition from occurring. It can be a separate dedicated system or it may be integrated with the normal machine control system.

Its complexity will vary from a simple system, such as a guard door interlock switch and emergency stop switch connected in series to the control coil of power contactor, to a compound system comprising both simple and complex devices communicating through software and hardware.

Safety-related control systems are designed to perform safety functions. The SRCS must continue to operate correctly under all foreseeable conditions. So what is a safety function; how do we design a system to achieve this; and when we have done that, how do we show it?

Safety Function

A safety function is implemented by the safety-related parts of the machine control system to achieve or maintain the equipment under control in a safe state with respect to a specific hazard. A failure of the safety function can result in an immediate increase of the risks of using the equipment; that is, a hazardous condition.

A machine must have at least one “hazard,” otherwise, it is not a machine. A “hazardous condition” is when a person is exposed to a hazard. A hazardous condition does not imply that the person is harmed. The exposed person may be able to acknowledge the hazard and avoid injury. The exposed person may not be able to recognize the hazard, or the hazard may be initiated by unexpected startup. The main task of the safety system designer is to prevent hazardous conditions and to prevent unexpected startup.

The safety function can often be described with multi-part requirements. For example, the safety function initiated by an interlocking guard has three parts:

1. The hazard protected by the guard cannot operate until the guard is closed;
2. Opening the guard will cause the hazard to stop if operational at the time of the opening; and
3. The closure of the guard does not restart the hazard protected by the guard.

When stating the safety function for a specific application, the word “hazard” must be changed to the specific hazard. The hazard must not be confused with the results of the hazard. Crushing, cutting, and burning are results of a hazard. An example of a hazard is a motor, ram, knife, torch, pump, laser, robot, end-effector, solenoid, valve, other type of actuator, or a mechanical hazard involving gravity.

In discussing safety systems, the phrase “at or before a demand is placed on the safety function” is used. What is a demand on the safety function? Examples of demands placed on the safety function are the opening of an interlocked guard, the breaking of a light curtain, the stepping onto a safety mat, or the pressing of an e-stop. An operator is demanding that the hazard either stop or remain de-energized if it is already stopped.

The safety-related parts of the machine control system execute the safety function. The safety function is not executed by a single device, for example, just by the guard. The interlock on the guard sends a command to a logic device, which in turn, disables an actuator. The safety function starts with the command and ends with the implementation.

The safety system must be designed with a level of integrity that is commensurate with the risks of the machine. Higher risks require higher integrity levels to ensure the performance of the safety function. Machine safety systems can be classified into levels of performance of their ability to ensure the performance of their safety function or, in other words, their functional safety integrity level.

Introduction to Functional Safety of Control Systems

IMPORTANT The standards and requirements considered in this section are relatively new. Work is still being conducted by the drafting groups on some aspects especially with regard to clarification and combining some of these standards. Therefore it is possible that there will be some changes to some of the detail given in these pages. For the latest information please refer to the Rockwell Automation safety systems and components website at http://www.ab.com/safety and the Rockwell Automation Safety Solutions website at http://discover.rockwellautomation.com/EN_Safety_Solutions.aspx.

What is Functional Safety?

Functional safety is the part of the overall safety that depends on the correct functioning of the process or equipment in response to its inputs. IEC TR 61508-0 provides the following example to help clarify the meaning of functional safety. “For example, an over-temperature protection device, using a thermal sensor in the windings of an electric motor to de-energize the motor before they can overheat, is an instance of functional safety. But providing specialized insulation to withstand high temperatures is not an instance of functional safety (although it is still an instance of safety and could protect against exactly the same hazard).” As another example, compare hard guarding to an interlocked guard. The hard guarding is not considered “functional safety” although it may protect against access to the same hazard as an interlocked door. The interlocked door is an instance of functional safety. When the guard is opened, the interlock serves as an “input” to a system that achieves a safe state. Similarly, personal protective equipment (PPE) is used as a protective measure to help increase safety of personnel. PPE is not considered functional safety.

Functional safety was a term introduced in IEC 61508:1998. Since then, the term has sometimes been associated with only programmable safety systems. This is a misconception. Functional safety covers a broad range of devices that are used to create safety systems. Devices like interlocks, light curtains, safety relays, safety PLCs, safety contactors, and safety drives are interconnected to form a safety system, which performs a specific safety-related function. This is functional safety. Therefore the functional safety of an electrical control system is highly relevant to the control of hazards arising from moving parts of machinery.

Two types of requirements are necessary to achieve functional safety:

- The safety function
- The safety integrity

Risk assessment plays a key role in developing the functional safety requirements. Task and hazard analysis leads to the function requirements for safety (i.e. the safety function). The risk quantification yields the safety integrity requirements (i.e. the safety integrity or performance level).

Four of the most significant control system functional safety standards for machinery are:

1. IEC/EN 61508 “Functional safety of electrical, electronic and programmable electronic control systems”

   This standard contains the requirements and provisions that are applicable to the design of complex electronic and programmable systems and subsystems. The standard is generic so it can be applicable to all industrial sectors.
2. IEC/EN 62061 “Safety of machinery — Functional safety of safety-related electrical, electronic and programmable electronic control systems”

   This standard is the machinery specific implementation of IEC/EN 61508. It provides requirements that are applicable to the system level design of all types of machinery safety-related electrical control systems and also for the design of non-complex subsystems or devices. It requires that complex or programmable subsystems should satisfy IEC/EN 61508.
3. EN ISO 13849-1 “Safety of machinery — Safety-related parts of control systems”

   This standard is intended to provide a direct transition path from the categories of the previous EN 954-1.
4. IEC 61511 “Functional safety — Safety instrumented systems for the process industry sector”

   This standard is the process sector specific implementation of IEC/EN 61508.

The functional safety standards represent a significant step beyond the familiar existing requirements such as Control Reliable and the Categories system of the previous ISO 13849-1:1999 (EN 954-1:1996).

Note: Recent to the time of publication of this text, CEN (European Committee for Standardization) announced that the final date for presumption of conformity of EN 954-1 will be extended to the end of 2011 to facilitate transition to the later standards. This replaces the original date of December 29, 2009.

For the latest information on the use and status of EN 954-1 visit: http://discover.rockwellautomation.com/EN_Safety_Solutions.aspx. In the meantime, it is advised that the extension of the transition period is used to move over to the use of the later standards (EN ISO 13849-1 or IEC/EN 62061) in a timely manner.

Categories will not disappear completely; they are also used in current EN ISO 13849-1 which uses the functional safety concept and has introduced new terminology and requirements. It has significant additions and differences to the old EN 954-1 (ISO 13849-1:1999). In this section we will refer to the current version as EN ISO 13849-1. (EN ISO 13849-1:2008 has the same text as ISO 13849-1:2006).

IEC/EN 62061 and EN ISO 13849-1:2008

IEC/EN 62061 and EN ISO 13849-1 both cover safety-related electrical control systems. It is intended that they will eventually be combined into one standard with common terminology. Both standards produce the same results but use different methods. They are intended to provide users with an option to choose the one most suitable for their situation. A user can choose to use either standard and they are both harmonized under the European Machinery Directive.

The outputs of both standards are comparable levels of safety performance or integrity. The methodologies of each standard have differences that are appropriate for their intended users.

The methodology in IEC/EN 62061 is intended to allow for complex safety functionality which may be implemented by previously unconventional system architectures. The methodology of EN ISO 13849-1 is intended to provide a more direct and less complicated route for more conventional safety functionality implemented by conventional system architectures.

An important distinction between these two standards is the applicability to various technologies. IEC/EN 62061 is limited to electrical systems. EN ISO 13849-1 can be applied to pneumatic, hydraulic, mechanical as well as electrical systems.

Figure 118 provides a simplified flow chart to help the safety system designer determine which of these two standards to use.

Joint Technical Report on IEC/EN 62061 and EN ISO 13849-1

A joint report has been prepared within IEC and ISO to help users of both standards.

It explains the relationship between the two standards and explains how the equivalence can be drawn between PL (Performance level) of EN ISO 13849-1 and SIL (Safety Integrity Level) of IEC.EN 62061 both at system and subsystem level.

In order to show that both standards give equivalent results the report shows an example safety system calculated according to the methodologies of both standards.

The report also clarifies a number of issues that have been subject to different interpretations. Perhaps one of the most significant issues is the aspect of fault exclusion.

In general, where PLe is required for a safety function to be implemented by a safety-related control system it is not normal to rely upon fault exclusions alone to achieve this level of performance. This is dependent upon the technology used and the intended operating environment. Therefore it is essential that the designer takes additional care on the use of fault exclusions as the PL requirement increases.

In general the use of fault exclusions is not applicable to the mechanical aspects of electromechanical position switches and manually operated switches (e.g. an emergency stop device) in order to achieve PLe in the design of a safety-related control system. Those fault exclusions that can be applied to specific mechanical fault conditions (e.g. wear/corrosion, fracture) are described in Table A.4 of ISO 13849-2.

For example, a door interlocking system that has to achieve PLe will need to incorporate a minimum fault tolerance of 1 (e.g. two conventional mechanical position switches) in order to achieve this level of performance since it is not normally justifiable to exclude faults, such as, broken switch actuators. However, it may be acceptable to exclude faults, such as short circuit of wiring within a control panel designed in accordance with relevant standards.

SIL and IEC/EN 62061

IEC/EN 62061 describes both the amount of risk to be reduced and the ability of a control system to reduce that risk in terms of SIL (Safety Integrity Level). There are three SILs used in the machinery sector, SIL 1 is the lowest and SIL 3 is the highest.

Because the term SIL is applied in the same manner in other industrial sectors such as petro-chemicals, power generation and railways, IEC/EN 62061 is very useful when machinery is used within those sectors.

Risks of greater magnitude can occur in other sectors such as the process industry and for that reason IEC 61508 and the process sector specific standard IEC 61511 include SIL 4.

A SIL applies to a safety function. The subsystems that make up the system that implements the safety function must have an appropriate SIL capability. This is sometimes referred to as the SIL Claim Limit (SIL CL).

A full and detailed study of IEC/EN 62061 is required before it can be correctly applied. Some of the most commonly applicable requirements of the standard are summarized later in this text.

System Level Design
Conduct a task analysis and risk assessment to identify any hazards.
Decide which hazards will be addressed by a safety related control system.

Decide on which of the two alternative standards to use.

Are there complex safety functions or will the system require complex programmable electronics to a high level of intergrity?

If the answer to either question is yes, use

IEC62061:2005

Can the system be designed simply using the designated architectures of Categoies B, 1, 2, 3 or 4, or will the system include technologies other than electrical?
If the answer to either question is yes, use

EN/ISO13849-1:2006

Determine the functionality required for the safety function, for example:

Position Sensing → Logic Solving → Output Actuation

Note: This should take account of all tasks required at the machine and it is very important to also give full consideration to production and maintenance requirements when deciding on the safety function concept.

Use the risk assessment process to determine the required safety integrity level, SIL, for each safety function, for example SIL2

Use the risk assessment process to determine the required performance level, PL_r, for each safety function, for example, PL_d

Using the requirements for system design determine what subsystem components are required to implement the Function Blocks. Each subsystem must be suitable for the required SIL. For each subsystem, choose a combination of Safe Failure Fraction (SFF), fault tolerance, PFHd to achieve the required SIL Claim Limit.

For example for SIL2, the following is possible:

Sensing subsystem → Logic subsystem → Output subsytem

where each subsystem has
Fault Tolerance: 1, SFF: 80%, PFH_D: 1×10^{-7}

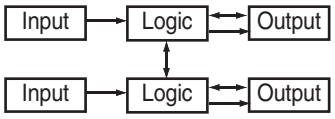
The combined PFH_D of all three subsystems is 3×10^{-7} and therefore meets the target PFH_D of 1×10^{-6} for the safety function.

The following information is required for each subsystem: PFH_D, fault tolerance, SFF.

The following is required for each system: measures against systematic failure.

Using the risk assessment charts or tables, determine which combination of architecture, diagnostic coverage and mean time to failure will achieved the required performance level.

For example, for PLd the following is possible



Designated architecture: Category 3
Diagnostic Coverage: Medium (95%)
$MTTF_d$ for each channel: 15yrs

The following information is required for each component:
$MTTF_d$

The following information is required for each system: designated architecture, diagnostic coverage, and measures against common cause and systematic failures.

Figure 118: System Design Flow Diagram

PL and EN ISO 13849-1

EN ISO 13849-1 does not use the term SIL; instead it uses the term PL (Performance Level). In many respects PL can be related to SIL. There are five performance levels, PLa is the lowest and PLe is the highest.

Comparison of PL and SIL

Table 8 shows the relationship (in terms of probability of dangerous failure between PL and SIL when applied to typical circuit structures.

PL (Performance Level)	PFH_D (Probability of Dangerous Failure per Hour)	SIL
a	$\geq 10^{-5}$ to $<10^{-4}$	None
b	$\geq 3 \times 10^{-6}$ to $<10^{-5}$	1
c	$\geq 10^{-6}$ to $<3 \times 10^{-6}$	1
d	$\geq 10^{-7}$ to $<10^{-6}$	2
e	$\geq 10^{-8}$ to $<10^{-7}$	3

Table 8: Approximate correspondence between PL and SIL

IMPORTANT Table 8 is for general guidance and must NOT be used for conversion purposes. The full requirements of the standards must be taken into account.

System Design According to EN ISO 13849 and SISTEMA

A full and detailed study of EN ISO 13849-1 is required before it can be correctly applied. The following is a brief overview:

This standard provides requirements for the design and integration of safety-related parts of control systems, including some software aspects. The standard applies to a safety-related system but can also be applied to the component parts of the system.

SISTEMA Software PL Calculation Tool

SISTEMA is a software tool for the implementation of EN ISO 13849-1. Its use will greatly simplify the implementation of the standard.

SISTEMA stands for "Safety Integrity Software Tool for the Evaluation of Machine Applications" It was developed by the BGIA in Germany and is free for use. It requires the input of various types of functional safety data as described later in this section.

The Data can be input manually or automatically by using a Manufacturer's SISTEMA Data Library.

The Rockwell Automation SISTEMA Data Library is available for download, together with a link to the SISTEMA download site, at: http://discover.rockwellautomation.com/EN_Safety_Solutions.aspx.

Overview of EN ISO 13849-1

This standard has wide applicability, as it applies to all technologies, including electrical, hydraulic, pneumatic and mechanical. Although ISO 13849-1 is applicable to complex systems, it also refers the reader to IEC 62061 and IEC 61508 for complex software embedded systems.

Let's have look at what are the basic differences between the old EN 954-1 and the new EN ISO 13849-1. The outputs of the old standard were Categories [B, 1, 2, 3 or 4]. The outputs of the new standard are Performance Levels [PL a, b, c, d or e]. The Category concept is retained but there are additional requirements to be satisfied before a PL can be claimed for a system.

The requirements can be listed in basic form as follows:

- The architecture of the system. Essentially this captures what we have become used to as the Categories
- Reliability data is required for the constituent parts of the system
- The Diagnostic Coverage [DC] of the system is required. This effectively represents the amount of fault monitoring in the system
- Protection against common cause failure
- Protection against systematic faults
- Where relevant, specific requirements for software

Later we will take a closer look at these factors but before we do it will be useful to consider the basic intent and principle of the whole standard. It is clear at this stage that there are new things to learn but the detail will make more sense once we have understood what it is trying to achieve and why.

First of all why do we need the new standard? It is obvious that the technology used in machine safety systems has progressed and changed considerably over the last ten years. Until relatively recently safety systems have depended on "simple" equipment with very foreseeable and predictable failure modes. More recently we have seen an increasing use of more complex electronic and programmable devices in safety systems. This has given us advantages in terms of cost, flexibility and compatibility but it has also meant that the pre-existing standards are no longer adequate. In order to know whether a safety system is good enough we need to know more about it. This is why the new standard asks for more information. As safety systems start to use a more "black box" approach we start to rely more heavily on their conformity to standards. Therefore those standards need to be capable of properly interrogating the technology. In order to fulfill this they must speak to the basic factors of reliability, fault detection, architectural and systematic integrity. This is the intent of EN ISO 13849-1.

In order to plot a logical course through the standard, two fundamentally different user types must be considered: the designer of safety-related subsystems and the designers of safety-related systems. In general the subsystem designer [typically a safety component manufacturer] will be subjected to a higher level of complexity. They will need to provide the required data in order that the system designer can ensure that the subsystem is of adequate integrity for the system. This will usually require some testing, analysis and calculation. The results will be expressed in the form of the data required by the standard.

The system designer [typically a machine designer or integrator] will use the subsystem data to perform some relatively straightforward calculations to determine the overall Performance Level [PL] of the system.

PLr is used to denote what performance level is required by the safety function. In order to determine the PLr the standard provides a risk graph into which the application factors of severity of injury, frequency of exposure and possibility of avoidance are input.

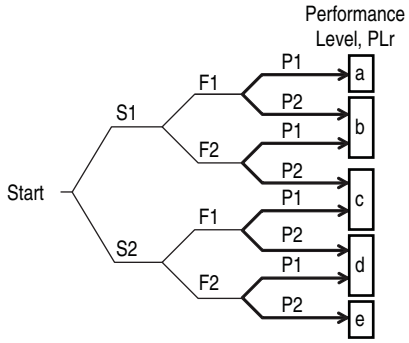


Figure 119: Risk Graph from Annex A of EN ISO 13849-1

The output is the PLr. Users of the old EN 954-1 will be familiar with this approach but take note that the S1 line now subdivides whereas the old risk graph did not. Note that this means a possible reconsideration of the integrity of safety measures required at lower risk levels.

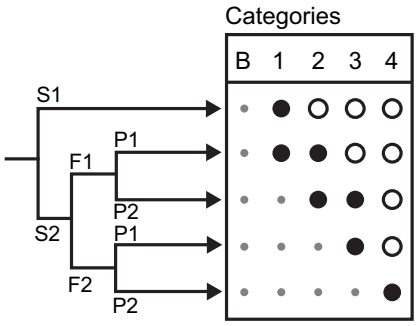


Figure 120: Risk Graph from Annex B of EN 945-1

There is one very important part yet to be covered however. We now know from the standard how good the system needs to be and also how to determine how good it is but we don't know what it needs to do. We need to decide what the safety function is. Clearly the safety function must be appropriate to the task so how do we ensure this? How does the standard help us?

It is important to realize that the functionality required can only be determined by considering the characteristics prevailing at the actual application. This can be regarded as the safety concept design stage. It cannot be completely covered by the standard because the standard does not know about all the characteristics of a specific application. This also often applies to the machine builder who produces the machine but does not necessarily know the exact conditions under which it will be used.

The standard does provide some help by listing out many of the commonly used safety functions (e.g. safety-related stop function initiated by safeguard, muting function, start/restart function) and giving some normally associated requirements. Other standards such as EN ISO 12100: Basic design principles and EN ISO 14121: Risk assessment, are highly recommended for use at this stage. Also there is a large range of machine specific standards that will provide solutions for specific machines. Within the European EN standards they are termed C type standards, some of them have exact equivalents in ISO standards.

So we can now see that the safety concept design stage is dependant on the type of machine and also on the characteristics of the application and environment in which it is used. The machine builder must anticipate these factors in order to be able to design the safety concept. The intended [i.e. anticipated] conditions of use should be given in the user manual. The user of the machine needs to check that they match the actual usage conditions.

So now we have a description of the safety functionality. From annex A of the standard we also have the required performance level [PLr] for the safety-related parts of the control system [SRP/CS] that will be used to implement this functionality. We now need to design the system and make sure that it complies with the PLr.

One of the significant factors in the decision on which standard to use [EN ISO 13849-1 or EN/IEC 62061] is the complexity of the safety function. In most cases, for machinery, the safety function will be relatively simple and EN ISO 13849-1 will be the most suitable route. Reliability data, diagnostic coverage [DC], the system architecture [Category], common cause failure and, where relevant, requirements for software are used to assess the PL.

This is a simplified description meant only to give an overview. It is important to understand that all the provisions given in the body of the standard must be applied. However, help is at hand. The SISTEMA software tool is available to help with the documentation and calculation aspects. It also produces a technical file.

At time of going to print of this publication SISTEMA is available in German and English. Other languages will be released in the near future. BGIA, the developer of SISTEMA, is a well-respected research and testing institution based in Germany. It is particularly involved in solving scientific and technical problems relating to safety in the context of statutory accident insurance and prevention in Germany. It works in cooperation with occupational health and safety agencies from over 20 countries. Experts from the BGIA, along with their BG colleagues had significant participation in the drafting of both EN ISO 13849-1 and IEC/EN 62061.

The “library” of Rockwell Automation safety component data for SISTEMA is available at:
http://discover.rockwellautomation.com/EN_Safety_Solutions.aspx.

Whichever way the calculation of the PL is done it is important to start of from the right foundation. We need to view our system in the same way as the standard so let's start with that.

System Structure

Any system can be split into basic system components or “subsystems.” Each subsystem has its own discrete function. Most systems can be split into three basic functions; input, logic solving and actuation [some simple systems may not have logic solving]. The component groups that implement these functions are the subsystems.

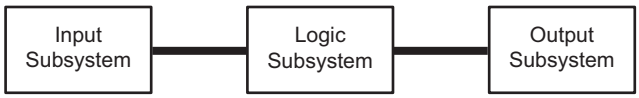


Figure 121

A simple single channel electrical system example is given in Figure 122. It comprises only input and output subsystems.

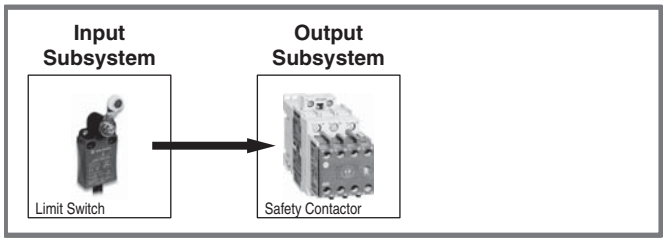


Figure 122: Interlock Switch and Contactor

In Figure 123 the system is a little more complex because some logic is also required. The safety controller itself will be fault tolerant (e.g. dual channel) internally but the overall system is still limited to single channel status because of the single limit switch and single contactor.

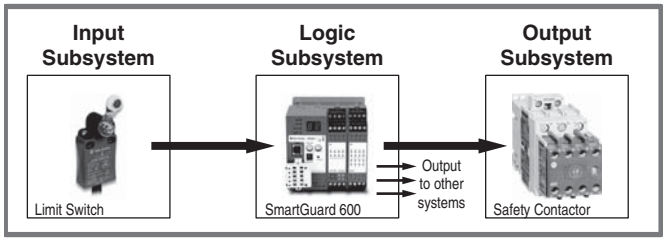


Figure 123: Interlock Switch, Safety Controller and Safety Contactor

If we take the basic architecture of Figure 123, there are also some other things to consider. First how many “channels” does the system have? A single channel system will fail if one of its subsystems fails. A two channel [also called redundant] system would need to have two failures, one in each channel before the system fails. Because it has two channels it can tolerate a single fault and still keep working. Figure 124 shows a two channel system.

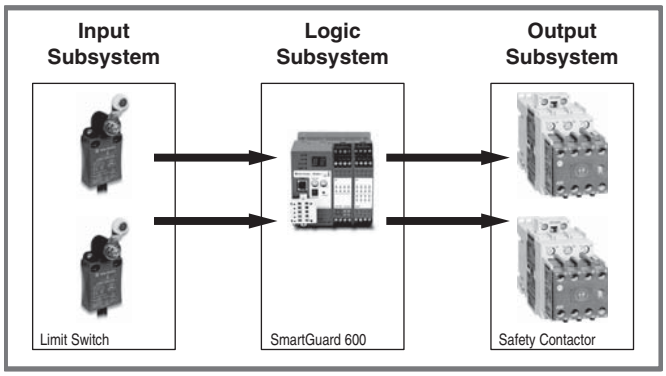


Figure 124: Dual Channel with Interlock Switch, Safety Controller and Safety Contactors

Clearly the system shown in Figure 124 is less likely to fail than the one shown in Figure 123 but we can make it even more reliable [in terms of its safety function] if we include diagnostic measures for fault detection. Of course, having detected the fault we also need to react to it and put the system into a safe state. Figure 125 shows the inclusion of diagnostic measures achieved through monitoring techniques.

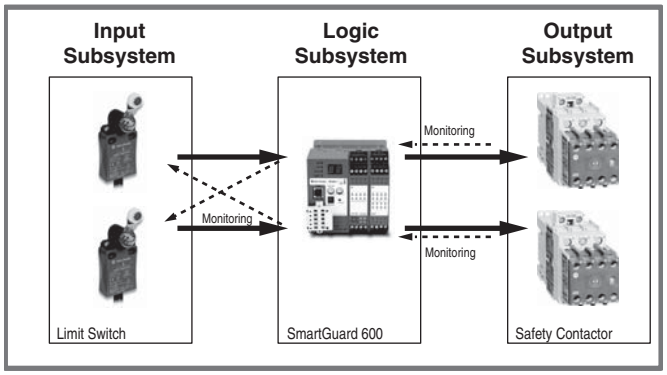


Figure 125: Dual Channel System with Interlock Switch, Safety Controller and Safety Contactors—Diagnostics Shown by Dashed Arrows

It is usually [but not always] the case that the system comprises two channels in all its subsystems as shown in Figure 125. Therefore we can see that, in this case each subsystem has two "sub channels." The standard describes these as “blocks.” A two channel subsystem will have two blocks and a single channel subsystem will have one block. It is possible that some systems will comprise a combination of dual channel and single channel blocks.

If we want to investigate the system in more depth we need to look at the components parts of the blocks. The SISTEMA tool uses the term “elements” for these component parts. Figure 126 shows our system using the SISTEMA terminology.

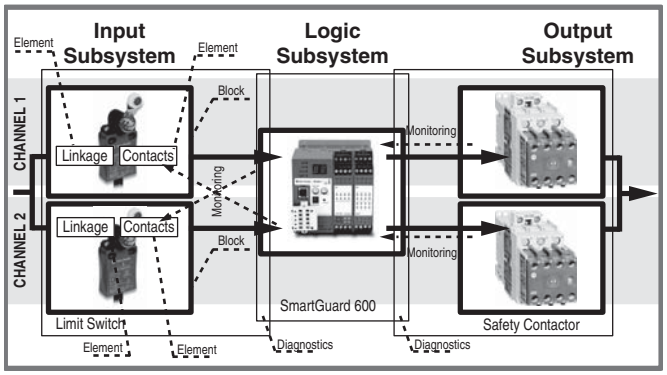


Figure 126: Dual Channel System Shown Subdivided into Subsystems, Blocks and Elements

The limit switches subsystem is shown subdivided down to its element level. The output contactor subsystem is subdivided down to its block level and the logic subsystem is not subdivided at all. The monitoring function for both the limit switches and the contactors is performed at the logic controller. Therefore the boxes representing the limit switch and contactor subsystems have a small overlap with the logic subsystem box.

This principle of system subdivision can be recognized in the methodology given in EN ISO 13849-1 and in the basic system structure principle for the SISTEMA tool. However, it is important to note that there are some subtle differences. The standard is not restrictive in its methodology but for the simplified method for estimating the PL the usual first step is to break the system structure into channels and the blocks within each channel. With SISTEMA the system is first divided into subsystems. The standard does not explicitly describe a subsystem concept but its use as given in SISTEMA provides a more understandable and intuitive approach. Of course there is no effect on the final calculation. SISTEMA and the standard both use the same principles and formulae. It is interesting to note that the subsystem approach is also used in EN/IEC 62061.

The system we have been using as an example is just one of the five basic types of system architectures that the standard designates. Anyone familiar with the Categories system will recognize our example as representative of either Category 3 or 4.

The standard uses the original EN 954-1 Categories as its five basic types of designated system architectures. It calls them Designated Architecture Categories. The requirements for the Categories are almost [but not quite] identical to those given in EN 954-1. The Designated Architecture Categories are represented by the following figures. It is important to note that they can be applied either to a complete system or a subsystem. The diagrams should not be taken purely as a physical structure. They are intended more as a graphical representation of conceptual requirements.

A more detailed look at the practical implementation of categories is dealt with in a later chapter.

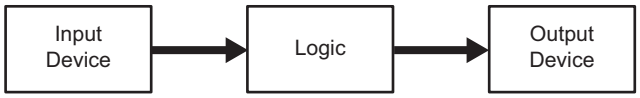


Figure 127: Designated Architecture Category B

Designated Architecture Category B must use basic safety principles [see annex of EN ISO 13849-2]. The system or subsystem can fail in the event of a single fault. See EN ISO 13849-1 for full requirements.

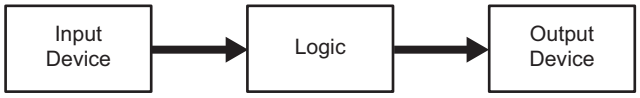


Figure 128: Designated Architecture Category 1

Designated Architecture Category 1 has the same structure as Category B and can still fail in the event of a single fault. But because it must also use well tried safety principles [see annex of EN ISO 13849-2] this is less likely than for Category B. See EN ISO 13849-1 for full requirements.

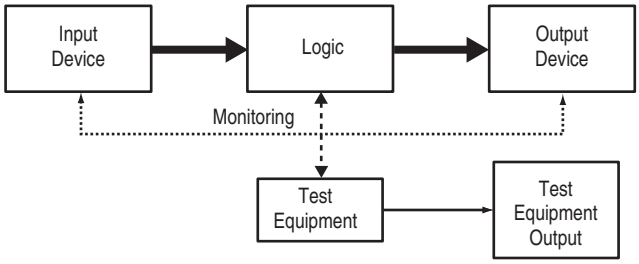


Figure 129: Designated Architecture Category 2

Designated Architecture Category 2 must use basic safety principles [see annex of EN ISO 13849-2]. There must also be diagnostic monitoring via a functional test of the system or subsystem. The test must occur at start up and then periodically with a frequency that equates to at least one hundred tests to every demand on the safety function. Note that this test rate is an additional requirement to that given in the old EN 954-1. The system or subsystem can still fail if a single fault occurs between the functional tests but this is usually less likely than for Category 1. See EN ISO 13849-1 for full requirements.

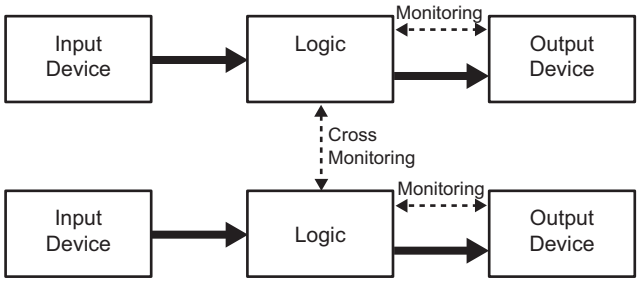


Figure 130: Designated Architecture Category 3

Designated Architecture Category 3 must use basic safety principles [see annex of EN ISO 13849-2]. There is also a requirement that the system/subsystem must not fail in the event of a single fault. This means that the system needs to have single fault tolerance with regard to its safety function. The most common way of achieving this requirement is to employ a dual channel architecture as shown in Figure 130. In addition a single fault shall be detected, wherever practicable. This requirement is the same as the original requirement for Category 3 from EN 954-1. In that context the meaning of the phrase “wherever practicable” proved somewhat problematic. It meant that Category 3 could cover everything from a system with redundancy but no fault detection [often descriptively and appropriately termed “stupid redundancy”] to a redundant system where all single faults are detected. This issue is addressed in EN ISO 13849-1 by the requirement to estimate the quality of the Diagnostic Coverage [DC]. By reference to Annex K or Table 9. We can see that the greater the reliability [MTTFd] of the system, the less the DC we need. However, DC needs to be at least 60% for Category 3 Architecture.

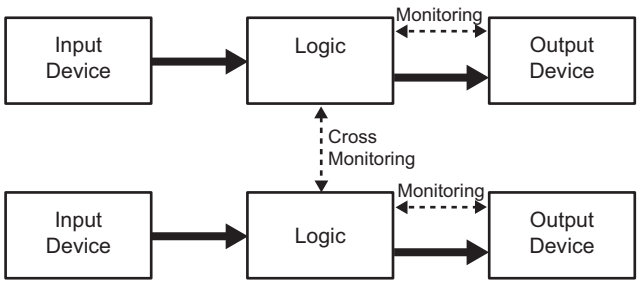


Figure 131: Designated Architecture Category 4

Designated Architecture Category 4 must use basic safety principles [see annex of EN ISO 13849-2]. It has a similar requirements diagram to Category 3 but it demands greater monitoring i.e. higher Diagnostic Coverage. This is shown by the heavier dotted lines representing the monitoring functions. In essence the difference between Categories 3 and 4 is that for Category 3 most faults must be detected but for Category 4 all faults must be detected. The DC needs to be at least 99%. Even an accumulation of faults must not cause a dangerous failure.

Reliability Data

EN ISO 13849-1 uses quantitative reliability data as part of the calculation of the PL achieved by the safety-related parts of a control system. This is a significant departure from EN 954-1. The first question this raises is "where do we get this data from?" It is possible to use data from recognized reliability handbooks but the standard makes it clear that the preferred source is the manufacturer. To this end, Rockwell Automation is making the relevant information available in the form of a data library for SISTEMA. In due course it will also publish the data in other forms. Before we go any further we should consider what types of data are required and also gain an understanding of how it is produced.

The ultimate type of data required as part of the PL determination in the standard [and SISTEMA] is the PFH [the probability of dangerous failure per hour]. This is the same data as represented by the PFHd abbreviation used in IEC/EN 62061.

PL	Average Probability of Dangerous Failure per Hour (1/h)	SIL
a	$\geq 10^{-5}$ to $<10^{-4}$	No correspondence
b	$\geq 3 \times 10^{-6}$ to $<10^{-5}$	1
c	$\geq 10^{-6}$ to $<3 \times 10^{-6}$	1
d	$\geq 10^{-7}$ to $<10^{-6}$	2
e	$\geq 10^{-8}$ to $<10^{-7}$	3

Table 9

Table 9 shows the relationship between PFH and PL and SIL. For some subsystems the PFH may be available from the manufacturer. This makes life easier for the calculation. The manufacturer will usually have to perform some relatively complex calculation and/or testing on their subsystem in order to provide it. In the event that it is not available, EN ISO13849-1 gives us an alternative simplified approach based on the average MTTFd [mean time to a dangerous failure] of a single channel. The PL [and therefore the PFH] of a system or subsystem can then be calculated using the methodology and formulae in the standard. It can be done even more conveniently using SISTEMA.

NOTE: It is important to understand that, for a dual channel system (with or without diagnostics), it is not correct to use $1/PFH_D$ to determine the MTTFd that is required by EN ISO 13849-1. The standard calls for the MTTFd of a single channel. This is a very different value to the MTTFd of the combination of both channels of a two channel subsystem. If the PFH_D of a two channel subsystem is known, it can simply be entered directly in to SISTEMA.

MTTFd of a Single Channel

This represents the average mean time before the occurrence of a failure that could lead to the failure of the safety function. It is expressed in years. It is an average value of the MTTFd's of the "blocks" of a single channel and can be applied to either a system or a subsystem. The standard gives the following formula which is used to calculate the average of all the MTTFd's of each element used in a single channel or subsystem.

At this stage the value of SISTEMA becomes apparent. Users are spared time consuming consultation of tables and calculation of formulae since these tasks are performed by the software. The final results can be printed out in the form of a multiple page report.

$$\frac{1}{MTTF_d} = \sum_{i=1}^{\tilde{N}} \frac{1}{MTTF_{di}} = \sum_{j=1}^{\tilde{N}} \frac{nj}{MTTF_{dj}}$$

Formula D1 from EN ISO 13849-1

In most dual channel systems both channel are identical therefore the result of the formula represents either channel.

If the system/subsystem channels are different the standard provides a formula to cater for this.

$$MTTF_d = \frac{2}{3}\left[MTTF_{dC1} + MTTF_{dC2} - \frac{1}{\frac{1}{MTTF_{dC1}} + \frac{1}{MTTF_{dC2}}}\right]$$

Formula 1 from EN ISO 13849-1

This, in effect, averages the two averages. In the cause of simplification it is also allowable to just use the worst case channel value.

The standard groups the MTTFd into three ranges as follows:

Denotation of MTTFd of each channel	Range of MTTFd of each channel
Low	3 years <= $MTTF_d$ < 10 years
Medium	10 years <= $MTTF_d$ < 30 years
High	30 years <= $MTTF_d$ < 100 years

Table 10: Levels of $MTTF_d$

Note that EN ISO 13849-1 limits the usable $MTTF_d$ of a single channel of a subsystem to a maximum of 100 years even though the actual values derived may be much higher.

As we will see later, the achieved range of MTTFd average is then combined with the designated architecture Category and the diagnostic coverage [DC] to provide a preliminary PL rating. The term preliminary is used here because other requirements including systematic integrity and measures against common cause failure still have to be met where relevant.

Methods of Data Determination

We now need to delve one stage deeper into how a manufacturer determines the data either in the form of PFH_D or $MTTF_d$. An understanding of this is essential when dealing with manufacturers data.

Data can be grouped into two basic types: 1) mechanistic (electro-mechanical, mechanical, pneumatic and hydraulic) and 2) electronic (solid state).

There is a fundamental difference between the common failure mechanisms of these three technology types. In basic form it can be summarized as follows:

Mechanistic Technology: Failure is proportional to both the inherent reliability and the usage rate. The greater the usage rate, the more likely that one of the component parts may be degraded and fail. Note that this is not the only failure cause, but unless we limit the operation time/cycles it will be the predominant one. It is self evident that a contactor that has switching cycle of once per ten seconds will operate reliably for a far shorter time than an identical contactor that operates one per day. Physical technology devices generally comprise components that are individually designed for their specific use. The components are shaped, molded, cast, machined etc. They are combined with linkages, springs, magnets, electrical windings etc to form a mechanism. Because the component parts do not, in general, have any history of use in other applications, we cannot find any pre-existing reliability data for them. The estimation of the PFH_D or $MTTF_d$ for the mechanism is normally based on testing. Both EN/IEC 62061 and EN ISO 13849-1 advocate a test process known as B10d Testing.

In the B10d test a number of device samples [usually at least ten] are tested under suitably representative conditions. The mean number of operating cycles achieved before 10% of the samples fail to the dangerous condition is known as the B10d value.

In practice it is often the case that all of the samples will fail to a safe state but in that case the standard states that the B10d[dangerous] value can be taken as twice the B10[safe] value.

Electronic Technology: There are no physical wear related moving parts. Given an operating environment commensurate with the specified electrical and temperature [etc] characteristics, the predominant failure of an electronic circuit is proportional to the inherent reliability of its constituent components [or lack off it]. There are many reasons for individual component failure; imperfection introduced during manufacture, excessive power surges, mechanical connection problems etc. In general, faults in electronic components are difficult to predict by analysis and they appear to be random in nature. Therefore testing of an electronic device in test laboratory conditions will not necessarily reveal typical long term failure patterns.

In order to determine the reliability of electronic devices it is usual to use analysis and calculation. We can find good data for the individual components in reliability data handbooks. We can use analysis to determine which component failure modes are dangerous. It is acceptable and usual to average out the component failure modes as 50% safe and 50% dangerous. This normally results in relatively conservative data.

IEC 61508 provides formulae that can be used to calculate the overall probability of dangerous failure [PFH or PFD] of the device i.e. the subsystem. The formulae are quite complex and take into account [where applicable] component reliability, potential for common cause failure [beta factor], diagnostic coverage [DC], functional test interval and proof test interval. The good news is that this complex calculation will normally be done by the device manufacturer. Both EN/IEC 62061 and EN ISO 13849-1 accept a subsystem calculated in this way to IEC 61508. The resulting PFH_D can be used directly into either Annex K of EN ISO 13849-1 or the SISTEMA calculation tool.

Software: Failures of software are inherently systematic in nature. Any failures are caused by the way it is conceived, written or compiled. Therefore all failures are caused by the system under which it is produced, not by its use. Therefore in order to control the failures we must control that system. Both IEC 61508 and EN ISO 13849-1 provide requirements and methodologies for this. We do not need to go into detail here other than to say they use the classic V model.

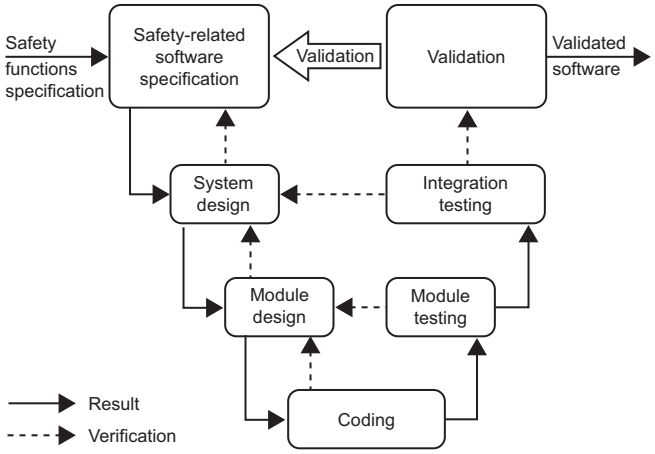


Figure 132: V Model for Software Development

Embedded software is an issue for the designer of the device. The usual approach is to develop embedded software in accordance with the formal methods explained in IEC 61508 part 3. When it comes to application code, the software that a user interfaces with, most programmable safety devices are provided with "certified" function blocks or routines. This simplifies the validation task for application code but it must be remembered that the completed application program still needs to be validated. The way the blocks are linked and parameterized must be proved correct and valid for the intended task. EN ISO 13849-1 and IEC/EN 62061 Both provide guidelines for this process.

Diagnostic Coverage

We have already touched on this subject when we considered the Designated Architecture Categories 2, 3 and 4. Those Categories require some form of diagnostic testing to check whether the safety function is still working. The term "diagnostic coverage" [usually abbreviated to DC] is used to characterise the effectiveness of this testing. It is important to realize that DC is not based just on the number of components that can fail dangerously. It takes account of the total dangerous failure rate. The symbol λ (lambda) is used for "failure rate." DC expresses the relationship of the rates of occurrence of the two following types of dangerous failure:

- Dangerous detected failure [λdd] i.e. Those failures would cause, or could lead to, a loss of the safety function, but which are detected. After detection, a fault reaction function causes the device or system to go to a safe state.
- Dangerous failure [λd] i.e. All those failures that could potentially cause, or lead to, a loss of the safety function. This includes both the failures that are detected and those that are not. Of course the failures that are that are truly dangerous are the dangerous undetected ones [termed λdu].

DC is expressed by the formula;

DC = λdd/λd expressed as a percentage.

This meaning of the term DC is common to EN ISO 13849-1 and EN/IEC 62061. However the way that it is derived differs. The latter standard proposes the use of calculation based on failure mode analysis but EN ISO 13849-1 provides a simplified method in the form of look-up tables. Various typical diagnostic techniques are listed together with the DC percentage that their use is deemed to achieve. In some cases rational judgment is still required, for example in some techniques the achieved DC is proportional to how often the test is performed. It is sometimes argued that this approach is too vague. However the estimation of DC can depend on many different variables and whichever technique is used the result can usually only truly be described as approximate. It is also important to understand that the tables in EN ISO 13849-1 are based on extensive research conducted by the BGIA into the results achieved by known actual diagnostic techniques used in real applications. In the interest of simplification the standard divides DC into four basic ranges :

<60% = none

60% to <90% = low

90% to <99% = medium

99%+ = high

This approach of dealing with ranges instead of individual percentage values can also be considered to be more realistic in terms of achievable accuracy. The SISTEMA tool uses the same look-up tables as the standard. As the use of complex electronics increases in safety-related devices DC becomes a more important factor. It is likely that future work on the standards will look further into clarification of this issue. In the meantime the use of engineering judgment and common sense should be sufficient to lead to the correct choice of DC range.

Common-Cause Failure

In most dual channel [i.e. single fault tolerant] systems or subsystems the diagnostic principle is based on the premise that there will not be dangerous failures of both channels at the same time. The term “at the same time” is more accurately expressed as “within the diagnostic test interval.” If the diagnostic test interval is reasonably short [e.g. less than eight hours] it is a reasonable assumption that two separate and unrelated faults are highly unlikely to occur within that time. However the standard makes it clear that we need to think carefully about whether the fault possibilities really are separate and unrelated. For example, if a fault in one component can foreseeably lead to failures of other components then the resulting totality of faults are deemed to be a single failure.

It is also possible that an event that causes one component to fail may also cause the failure of other components. This is termed “common cause failure” (CCF). The degree of propensity for CCF is normally described as the beta [ß] factor. It is very important that subsystem and system designers are aware of the possibilities of CCF. There are many different types of CCF and, correspondingly, many different ways of avoiding it. EN ISO 13849-1 plots a rational course between the extremes of complexity and over simplification. In common with EN/IEC 62061 it adopts an approach that is essentially qualitative. It provides a list of measures known to be effective in avoiding CCF.

Table 11 shows a summary of the scoring process.

No.	Measure Against CCF	Score
1	Separation/Segregation	15
2	Diversity	20
3	Design/Application/ Experience	20
4	Assessment/Analysis	5
5	Competence/Training	5
6	Environmental	35

Table 11: Scoring for Common-Cause Failure

A sufficient number of these measures must be implemented in the design of a system or subsystem. It could be claimed, with some justification, that the use of this list alone may not be adequate to prevent all possibility of CCF. However, if the intent of the list is properly considered it becomes clear that the spirit of its requirement is to make the designer analyse the possibilities for CCF and to implement appropriate avoidance measures based on the type of technology and the characteristics of the intended application. Use of the list enforces consideration of some of the most fundamental and effective techniques such as diversity of failure modes and design competencies. The BGIA SISTEMA tool also requires the implementation of the standard's CCF look up tables and makes them available in a convenient form.

Mission Time

Mission time represents the maximum period of time for which a subsystem (or system) can be used. After this time, it must be replaced. Mission time must be declared by the manufacturer of the components. Mission time will usually be the same as the “proof test interval” or “lifetime” (whichever is the smaller) as used in IEC/EN62061. The safety system designer must then consider the mission time of the components to determine the mission time of each safety function. For mechanistic components the T10d value gives this usable lifetime value in terms of the number of operations. The T10d value is derived as part of the B10d calculation.

Systematic Faults

We have already discussed quantified safety reliability data in the form of MTTFd and the probability of dangerous failure. However, this is not the whole story. When we referred to those terms we were really thinking about failures that appear to be random in nature. Indeed IEC/EN 62061 specifically refers to the abbreviation of PFH_D as the probability of random hardware failure. But there are some types of failures collectively known as “systematic failure” that can be attributed to errors committed in the design or manufacturing process. The classic example of this is an error in software code. The standard provides measures in Annex G to avoid these errors [and therefore the failures]. These measures include provisions such as the use of suitable materials and manufacturing techniques, reviews, analysis and computer simulation. There are also foreseeable events and characteristics that can occur in the operating environment that could cause failure unless their effect is controlled. Annex G also provides measures for this. For example it is easily foreseeable that there may be occasional losses of power. Therefore the de-energization of components must result in a safe state for the system. These measures may seem to be just common sense, and indeed they are, but they are nevertheless essential. All the rest of the requirements of the standard will be meaningless unless due consideration is given to the control and avoidance of systematic failure. This will also sometimes require the same types of measures used for the control of random hardware failure [in order to achieve the required PFH_D] such as automatic diagnostic test and redundant hardware.

Fault Exclusion

One of the primary analysis tools for safety systems is failure analysis. The designer and user must understand how the safety system performs in the presence of faults. Many techniques are available to perform the analysis. Examples include Fault Tree Analysis; Failure Modes, Effects and Criticality Analysis; Event Tree Analysis; and Load-Strength reviews.

During the analysis, certain faults may be uncovered that cannot be detected with automatic diagnostic testing without undue economic costs. Further, the probability that these faults might occur may be made extremely small, by using mitigating design, construction and test methods. Under these conditions, the faults may be excluded from further consideration. Fault exclusion is the ruling out of the occurrence of a failure because the probability of that specific failure of the SRCS is negligible.

ISO13849-1:2006 allows fault exclusion based on the technical improbability of occurrence, generally accepted technical experience and the technical requirements related to the application. ISO13849-2:2003 provides examples and justifications for excluding certain faults for electrical, pneumatic, hydraulic and mechanical systems. Fault exclusions must be declared with detailed justifications provided in the technical documentation.

It is not always possible to evaluate Safety-related Control System without assuming that certain faults can be excluded. For detailed information on fault exclusions, see ISO 13849-2.

As the level of risk gets higher, the justification for fault exclusion gets more stringent. In general, where PLe is required for a safety function to be implemented by a safety-related control system it is not normal to rely upon fault exclusions alone to achieve this level of performance. This is dependent upon the technology used and the intended operating environment. Therefore it is essential the designer takes additional care on the use of fault exclusions as that PL requirement increases.

For example, a door interlocking system that has to achieve PLe will need to incorporate a minimum fault tolerance of 1 (e.g. two conventional mechanical position switches) in order to achieve this level of performance since it is not normally justifiable to exclude faults, such as, broken switch actuators. However, it may be acceptable to exclude faults, such as short circuits in wiring within a control panel designed in accordance with relevant standards.

Performance Level (PL)

The performance level is a discrete level that specifies the ability of the safety-related parts of the control system to perform a safety function.

In order to assess the PL achieved by an implementation of any of the five designated architectures, the following data is required for the system (or subsystem):

- $MTTF_d$ (mean-time-to-dangerous failure of each channel)
- DC (diagnostic coverage)
- Architecture (the category)

Table 12 shows the PL achieved by various combinations. Refer to Annex K of the standard for more precise determination.

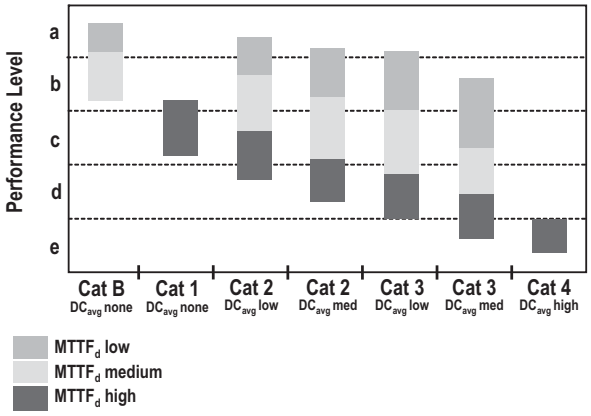


Figure 133: Graphical Determination of PL

Table 12 shows the PL achieved by various combinations. Refer to Annex K of the standard for more precise determination. For example, an application uses the Category 3 designated architecture. If the DC is between 60% and 90%, and if the MTTFd of each channel is between 10 and 30 years, then according to Figure 133, PL_d is achieved.

Other factors must also be realized to satisfy the required PL. These requirements include the provisions already discussed such as for common cause failures, systematic failure, and mission time.

If the PFH_D of the system or subsystem is known, Table 12 (Annex K of the standard) can be used to derive the PL.

System Design According to EN ISO 13849 and SISTEMA

$MTTF_d$ for each channel	Average probability of a dangerous failure per hour (1/h) and corresponding performance level (PL)															
	Cat. B	PL	Cat. 1	PL	Cat. 2	PL	Cat. 2	PL	Cat. 3	PL	Cat. 3	PL	Cat. 4	PL		
Years	DC_{avg} = none		DC_{avg} = none		DC_{avg} = low		DC_{avg} = medium		DC_{avg} = low		DC_{avg} = medium		DC_{avg} = high			
3	$3,80 \times 10^{-5}$	a			$2,58 \times 10^{-5}$	a	$1,99 \times 10^{-5}$	A	$1,26 \times 10^{-5}$	a	$6,09 \times 10^{-6}$	b				
3,3	$3,46 \times 10^{-5}$	a			$2,33 \times 10^{-5}$	a	$1,79 \times 10^{-5}$	A	$1,13 \times 10^{-5}$	a	$5,41 \times 10^{-6}$	b				
3,6	$3,17 \times 10^{-5}$	a			$2,13 \times 10^{-5}$	a	$1,62 \times 10^{-5}$	a	$1,03 \times 10^{-5}$	a	$4,86 \times 10^{-6}$	b				
3,9	$2,93 \times 10^{-5}$	a			$1,95 \times 10^{-5}$	a	$1,48 \times 10^{-5}$	a	$9,37 \times 10^{-6}$	b	$4,40 \times 10^{-6}$	b				
4,3	$2,65 \times 10^{-5}$	a			$1,76 \times 10^{-5}$	a	$1,33 \times 10^{-5}$	a	$8,39 \times 10^{-6}$	b	$3,89 \times 10^{-6}$	b				
4,7	$2,43 \times 10^{-5}$	a			$1,60 \times 10^{-5}$	a	$1,20 \times 10^{-5}$	a	$7,58 \times 10^{-6}$	b	$3,48 \times 10^{-6}$	b				
5,1	$2,24 \times 10^{-5}$	a			$1,47 \times 10^{-5}$	a	$1,10 \times 10^{-5}$	a	$6,91 \times 10^{-6}$	b	$3,15 \times 10^{-6}$	b				
5,6	$2,04 \times 10^{-5}$	a			$1,33 \times 10^{-5}$	a	$9,87 \times 10^{-6}$	b	$6,21 \times 10^{-6}$	b	$2,80 \times 10^{-6}$	c				
6,2	$1,84 \times 10^{-5}$	a			$1,19 \times 10^{-5}$	a	$8,80 \times 10^{-6}$	b	$5,53 \times 10^{-6}$	b	$2,47 \times 10^{-6}$	c				
6,8	$1,68 \times 10^{-5}$	a			$1,08 \times 10^{-5}$	a	$7,93 \times 10^{-6}$	b	$4,98 \times 10^{-6}$	b	$2,20 \times 10^{-6}$	c				
7,5	$1,52 \times 10^{-5}$	a			$9,75 \times 10^{-6}$	b	$7,10 \times 10^{-6}$	b	$4,45 \times 10^{-6}$	b	$1,95 \times 10^{-6}$	c				
8,2	$1,39 \times 10^{-5}$	a			$8,87 \times 10^{-6}$	b	$6,43 \times 10^{-6}$	b	$4,02 \times 10^{-6}$	b	$1,74 \times 10^{-6}$	c				
9,1	$1,25 \times 10^{-5}$	a			$7,94 \times 10^{-6}$	b	$5,71 \times 10^{-6}$	b	$3,57 \times 10^{-6}$	b	$1,53 \times 10^{-6}$	c				
10	$1,14 \times 10^{-5}$	a			$7,18 \times 10^{-6}$	b	$5,14 \times 10^{-6}$	b	$3,21 \times 10^{-6}$	b	$1,36 \times 10^{-6}$	c				
11	$1,04 \times 10^{-5}$	a			$6,44 \times 10^{-6}$	b	$4,53 \times 10^{-6}$	b	$2,81 \times 10^{-6}$	c	$1,18 \times 10^{-6}$	c				
12	$9,51 \times 10^{-6}$	b			$5,84 \times 10^{-6}$	b	$4,04 \times 10^{-6}$	b	$2,49 \times 10^{-6}$	c	$1,04 \times 10^{-6}$	c				
13	$8,78 \times 10^{-6}$	b			$5,33 \times 10^{-6}$	b	$3,64 \times 10^{-6}$	b	$2,23 \times 10^{-6}$	c	$9,21 \times 10^{-7}$	d				
15	$7,61 \times 10^{-6}$	b			$4,53 \times 10^{-6}$	b	$3,01 \times 10^{-6}$	b	$1,82 \times 10^{-6}$	c	$7,44 \times 10^{-7}$	d				
16	$7,31 \times 10^{-6}$	b			$4,21 \times 10^{-6}$	b	$2,77 \times 10^{-6}$	c	$1,67 \times 10^{-6}$	c	$6,76 \times 10^{-7}$	d				
18	$6,34 \times 10^{-6}$	b			$3,68 \times 10^{-6}$	b	$2,37 \times 10^{-6}$	c	$1,41 \times 10^{-6}$	c	$5,67 \times 10^{-7}$	d				
20	$5,71 \times 10^{-6}$	b			$3,26 \times 10^{-6}$	b	$2,06 \times 10^{-6}$	c	$1,22 \times 10^{-6}$	c	$4,85 \times 10^{-7}$	d				
22	$5,19 \times 10^{-6}$	b			$2,93 \times 10^{-6}$	c	$1,82 \times 10^{-6}$	c	$1,07 \times 10^{-6}$	c	$4,21 \times 10^{-7}$	d				
24	$4,76 \times 10^{-6}$	b			$2,65 \times 10^{-6}$	c	$1,62 \times 10^{-6}$	c	$9,47 \times 10^{-7}$	d	$3,70 \times 10^{-7}$	d				
27	$4,23 \times 10^{-6}$	b			$2,32 \times 10^{-6}$	c	$1,39 \times 10^{-6}$	c	$8,04 \times 10^{-7}$	d	$3,10 \times 10^{-7}$	d				
30			$3,80 \times 10^{-6}$	b	$2,06 \times 10^{-6}$	c	$1,21 \times 10^{-6}$	c	$6,94 \times 10^{-7}$	d	$2,65 \times 10^{-7}$	d	$9,54 \times 10^{-8}$	e		
33			$3,46 \times 10^{-6}$	b	$1,85 \times 10^{-6}$	c	$1,06 \times 10^{-6}$	c	$5,94 \times 10^{-7}$	d	$2,30 \times 10^{-7}$	d	$8,57 \times 10^{-8}$	e		
36			$3,17 \times 10^{-6}$	b	$1,67 \times 10^{-6}$	c	$9,39 \times 10^{-7}$	d	$5,16 \times 10^{-7}$	d	$2,01 \times 10^{-7}$	d	$7,77 \times 10^{-8}$	e		
39			$2,93 \times 10^{-6}$	c	$1,53 \times 10^{-6}$	c	$8,40 \times 10^{-7}$	d	$4,53 \times 10^{-7}$	d	$1,78 \times 10^{-7}$	d	$7,11 \times 10^{-8}$	e		
43			$2,65 \times 10^{-6}$	c	$1,37 \times 10^{-6}$	c	$7,34 \times 10^{-7}$	d	$3,87 \times 10^{-7}$	d	$1,54 \times 10^{-7}$	d	$6,37 \times 10^{-8}$	e		
47			$2,43 \times 10^{-6}$	c	$1,24 \times 10^{-6}$	c	$6,49 \times 10^{-7}$	d	$3,35 \times 10^{-7}$	d	$1,34 \times 10^{-7}$	d	$5,76 \times 10^{-8}$	e		
51			$2,24 \times 10^{-6}$	c	$1,13 \times 10^{-6}$	c	$5,80 \times 10^{-7}$	d	$2,93 \times 10^{-7}$	d	$1,19 \times 10^{-7}$	d	$5,26 \times 10^{-8}$	e		
56			$2,04 \times 10^{-6}$	c	$1,02 \times 10^{-6}$	c	$5,10 \times 10^{-7}$	d	$2,52 \times 10^{-7}$	d	$1,03 \times 10^{-7}$	d	$4,73 \times 10^{-8}$	e		
62			$1,84 \times 10^{-6}$	c	$9,06 \times 10^{-7}$	d	$4,43 \times 10^{-7}$	d	$2,13 \times 10^{-7}$	d	$8,84 \times 10^{-8}$	e	$4,22 \times 10^{-8}$	e		
68			$1,68 \times 10^{-6}$	c	$8,17 \times 10^{-7}$	d	$3,90 \times 10^{-7}$	d	$1,84 \times 10^{-7}$	d	$7,68 \times 10^{-8}$	e	$3,80 \times 10^{-8}$	e		
75			$1,52 \times 10^{-6}$	c	$7,31 \times 10^{-7}$	d	$3,40 \times 10^{-7}$	d	$1,57 \times 10^{-7}$	d	$6,62 \times 10^{-8}$	e	$3,41 \times 10^{-8}$	e		
82			$1,39 \times 10^{-6}$	c	$6,61 \times 10^{-7}$	d	$3,01 \times 10^{-7}$	d	$1,35 \times 10^{-7}$	d	$5,79 \times 10^{-8}$	e	$3,08 \times 10^{-8}$	e		
91			$1,25 \times 10^{-6}$	c	$5,88 \times 10^{-7}$	d	$2,61 \times 10^{-7}$	d	$1,14 \times 10^{-7}$	d	$4,94 \times 10^{-8}$	e	$2,74 \times 10^{-8}$	e		
100			$1,14 \times 10^{-6}$	c	$5,28 \times 10^{-7}$	d	$2,29 \times 10^{-7}$	d	$1,01 \times 10^{-7}$	d	$4,29 \times 10^{-8}$	e	$2,47 \times 10^{-8}$	e		

Table 12: Precise $MTTF_d$ to Determine PL

Source of Table 12 is Table K.1 of ISO/EN 13849-1:2006

Subsystem Design and Combinations

If the PLs of all the subsystem are known, they can be combined simply into a system using Table 13. The rational behind this table is clear. First, that the system can only be as good as its weakest link (subsystem). Second, the more subsystems there are, the greater the possibility for failure.

PL_{low}	N_{low}	PL
a	>3	Not allowed
	=<3	a
b	>2	a
	=<2	b
c	>2	b
	=<2	c
d	>3	c
	=<3	d
e	>3	d
	·3	e

Table 13: PL calculation for series combined subsystems

In the system shown in Figure 135, the lowest Performance Levels are at Subsystems 1 and 2. Both are PLb. Therefore, using Table 13, we can read across b (in the PLlow column), through 2 (in the Nlow column) and find the achieved system PL as b (in the PL column). If all three subsystems were PLb the achieved PL would be PLa.

Note: The application of this table is not mandatory. The use of Annex K of the standard (or SISTEMA) is the preferred method. This table is only intended to provide a very simple approach for small systems.

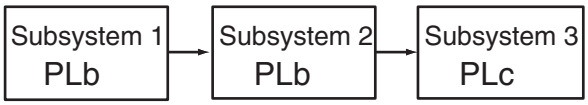


Figure 134: Combination of series subsystems as a PLb system

Validation

Validation plays an important role throughout the safety system development and commissioning process. ISO/EN 13849-2:2003 sets the requirements for validation. It calls for a validation plan and discusses validation by testing and analysis techniques such as Fault Tree Analysis and Failure Modes, Effects and Criticality Analysis. Most of these requirements will apply to the manufacturer of the subsystem rather than the subsystem user.

Machine Commissioning

At the system or machine commissioning stage, validation of the safety functions must be carried out in all operating modes and should cover all normal and foreseeable abnormal conditions. Combinations of inputs and sequences of operation must also be taken into consideration. This procedure is important because it is always necessary to check that the system is suitable for actual operational and environmental characteristics. Some of those characteristics may be different from the ones anticipated at the design stage.

System Design According to IEC/EN 62061

IEC/EN 62061, "Safety of machinery: Functional safety of electrical, electronic and programmable electronic control systems," is the machinery specific implementation of IEC/EN 61508. It provides requirements that are applicable to the system level design of all types of machinery safety-related electrical control systems and also for the design of non-complex subsystems or devices.

The risk assessment results in a risk reduction strategy which in turn, identifies the need for safety-related control functions. These functions must be documented and must include:

- Functional requirements specification
- Safety integrity requirements specification

The functional requirements include details like frequency of operation, required response time, operating modes, duty cycles, operating environment, and fault reaction functions. The safety integrity requirements are expressed in levels called safety integrity levels (SIL). Depending on the complexity of the system, some or all of the elements in Table 14 must be considered to determine whether the system design meets the required SIL.

Element for SIL Consideration	Symbol
Probability of Dangerous Failure per Hour	PFH_D
Hardware Fault Tolerance	No Symbol
Safe Failure Fraction	SFF
Proof Test Interval	T_1
Diagnostic Test Interval	T_2
Susceptibility to Common Cause Failures	ß
Diagnostic Coverage	DC

Table 14: Elements for SIL Consideration

Subsystems

The term "subsystem" has a special meaning in IEC/EN 62061. It is the first level subdivision of a system into parts which, if they fail, would cause a failure of the safety function. Therefore if two redundant switches are used in a system neither individual switch is a subsystem. The subsystem would comprise both switches and any associated fault diagnostic function.

Probability of Dangerous Failure per Hour (PFH_D)

IEC/EN 62061 uses the same basic methods as discussed in the section on EN ISO 13849-1 to determine failure rates at the component level. The same provisions and methods apply for "mechanistic" and electronic components. In IEC/EN 62061 there is no consideration of MTTFd in years. The failure rate per hour (λ) is either calculated directly or obtained or derived from the B10 value by the following formula:

$\lambda = 0.1 \times C/B10$ (where C = the number of operating cycles per hour)

There is a significant difference between the standards in the methodology for determining the total PFH_D for a subsystem or system. An analysis of the components must be undertaken to determine the probability of failure of the subsystems. Simplified formulae are provided for the calculation of common subsystem architectures (described later in text). Where these formulae are not appropriate it will be necessary to use more complex calculation methods such as Markov models. The Probability of Dangerous Failure (PFH_D) of each subsystem are then added together to determine the total PFH_D for the system. Table 15 (Table 3 of the standard) can then be used to determine which Safety Integrity Level (SIL) is appropriate to that range of PFH_D.

$\lambda_{DssB} = (1\text{-}ß)2 \times \lambda_{De1} \times \lambda_{De2} \times T_1 + ß \times (\lambda_{De1} + \lambda_{De2}) / 2$

The formulae for this architecture take into account the parallel arrangement of the subsystem elements and add the following two elements from Table 14:

ß (Beta) is the susceptibility to common cause failures.

SIL (Safety Integrity Level)	PFH_D (Probability of Dangerous Failure per Hour)
3	$\geq 10^{-8} \ldots < 10^{-7}$
2	$\geq 10^{-7} \ldots < 10^{-6}$
1	$\geq 10^{-6} \ldots < 10^{-5}$

Table 15: Probabilities of Dangerous Failure for SILs

The PFH_D data for a subsystem will usually be provided by the manufacturer. Data for Rockwell Automation safety components and systems is available in a number of forms including: http://discover.rockwellautomation.com/EN_Safety_Solutions.aspx

This website will be periodically updated as more data for other Rockwell Automation components and systems will become available over time.

IEC/EN 62061 also makes it clear that reliability data handbooks can be used if and where applicable.

For low complexity electromechanical devices, the failure mechanism is usually linked to the number and frequency of operations rather than just time. Therefore for these components the data will derived from some form of testing (e.g. B10 testing as described in the chapter on EN ISO 13849-1). Application based information such as the anticipated number of operations per year is then required in order to convert the B10d or similar data to PFH_D.

NOTE: In general the following is true (taking into account a factor to change years to hours):

$PFH_D = 1/MTTFd$

However, it is important to understand that, for a dual channel system (with or without diagnostics), it is not correct to use 1/ PFH_D to determine the MTTFd that is required by EN ISO 13849-1. That standard calls for the MTTFd of a single channel. This is a very different value to the MTTFd of the combination of both channels of a two channel subsystem.

Architectural Constraints

The essential characteristic of IEC/EN 62061 is that the safety system is divided into subsystems. The hardware safety integrity level that can be claimed for a subsystem is limited not only by the PFH_D but also by the hardware fault tolerance and the safe failure fraction of the subsystems. Hardware fault tolerance is ability of the system to execute its function in the presence of faults. A fault tolerance of zero means that the function is not performed when a single fault occurs. A fault tolerance of one allows the subsystem to perform its function in the presence of a single fault. Safe Failure Fraction is the portion of the overall failure rate that does not result in a dangerous failure. The combination of these two elements is known as the architectural constraint and its output is the SIL Claim Limit (SIL CL) Table 16 shows the relationship of the architectural constraints to the SILCL. A subsystem (and therefore its system) must satisfy both the PFH_D requirements and the Architectural Constraints together with the other relevant provisions of the standard.

Safe Failure Fraction (SFF)	Hardware Fault Tolerance		
	0	1	2
<60%	Not allowed unless specific exceptions apply	SIL1	SIL2
60%…<90%	SIL1	SIL2	SIL3
90%…<99%	SIL2	SIL3	SIL3
≥99%	SIL3	SIL3	SIL3

Table 16: Architectural Constraints on SIL

For example, a subsystem architecture that possesses single fault tolerance and has a safe failure fraction of 75% is limited to no higher than a SIL2 rating, regardless of the probability of dangerous failure.

When combining subsystems, the SIL achieved by the SRCS is constrained to be less than or equal to the lowest SIL CL of any of the subsystems involved in the safety-related control function.

System Realization

To compute the probability of dangerous failure, each safety function must be broken down into function blocks, which are then realized as subsystems. A system design implementation of a typical safety function would include a sensing device connected to a logic device connected to an actuator. This creates a series arrangement of subsystems. As we have already seen, if we can determine the probability of dangerous failure for each subsystem and know its SIL CL, then the system probability of failure is easily calculated by adding the probability of failures of the subsystems. This concept is shown in Figure 136.

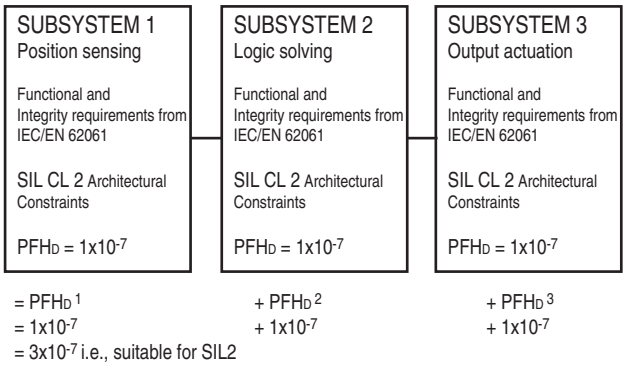


Figure 135: Example combination of subsystems

If, for example, we want to achieve SIL 2, each subsystem must have a SIL CL of at least SIL 2, and the sum of the PFH_D for the system must not exceed the limit allowed in Table 15.

Subsystem Design: IEC/EN 62061

If a system designer uses components ready “packaged” into subsystems according to IEC/EN 62061 life becomes much easier because the specific requirements for the design of subsystems do not apply. These requirements will, in general, be covered by the device (subsystem) manufacturer and are much more complex than those required for system level design.

IEC/EN 62061 requires that complex subsystems such as safety PLCs comply with IEC 61508 or other appropriate standards. This means that, for devices using complex electronic or programmable components, the full rigor of IEC 61508 applies. This can be a very rigorous and involved process. For example, the evaluation of the PFH_D achieved by a complex subsystem can be a very complicated process using techniques such as Markov modeling, reliability block diagrams or fault tree analysis.

IEC/EN 62061 does give requirements for the design of lower complexity subsystems. Typically this would include relatively simple electrical components such as interlock switches and electromechanical safety monitoring relays. The requirements are not as involved as those in IEC 61508 but can still be quite complicated.

IEC/EN 62061 supplies four subsystem logical architectures with accompanying formulae that can be used to evaluate the PFH_D achieved by a low complexity subsystem. These architectures are purely logical representations and should not be thought of as physical architectures. The four subsystem logical architectures with accompanying formulae are shown in Figures 136 through 139.

For a basic subsystem architecture shown in Figure 136, the probabilities of dangerous failures are simply added together.

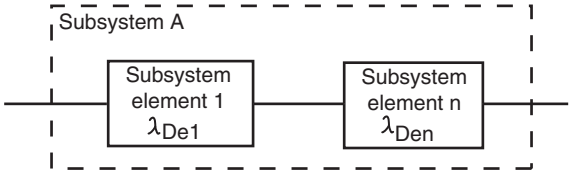


Figure 136: Subsystem logical architecture A

$\lambda_{DssA} = \lambda_{De1} + \ldots + \lambda_{Den}$

$PFH_{DssA} = \lambda_{DssA} \times 1h$

λ, (Lambda) is used to designate the failure rate. The units of the failure rate are failures per hour. λD is the dangerous failure rate. λDssA, is the dangerous failure rate of subsystem A. It is the sum of the failure rates of the individual elements, e1, e2, e3, up to and including en. The probability of dangerous failure is multiplied by 1 hour to create the probability of failure within one hour.

Figure 137 shows a single fault tolerant system without a diagnostic function. When the architecture includes single fault tolerance, the potential for common cause failure exists and must be considered. The derivation of the common cause failure is briefly described later in this section.

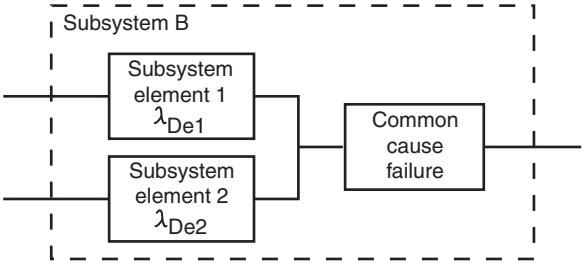


Figure 137: Subsystem logical architecture B

$\lambda_{DssB} = (1-ß)2 \times \lambda_{De1} \times \lambda_{De2} \times T_1 + ß \times (\lambda_{De1} + \lambda_{De2}) / 2$

$PFH_{DssB} = \lambda_{DssB} \times 1h$

The formulae for this architecture take into account the parallel arrangement of the subsystem elements and add the following two elements from Table 14:

ß (Beta) is the susceptibility to common cause failures.

T1 is the proof test interval or lifetime, whichever is smaller. The proof test is designed to detect faults and degradation of the safety subsystem so that the subsystem can be restored to a perfect operating condition. In practical terms this usually means replacement (like the equivalent term “mission time” in EN ISO 13849-1).

Figure 139 shows the functional representation of a zero fault tolerant system with a diagnostic function. Diagnostic coverage is used to decrease the probability of dangerous hardware failures. The diagnostic tests are performed automatically. The definition of diagnostic coverage is the same as given in EN ISO 13849-1 i.e. the ratio of the rate of detected dangerous failures compared to the rate of all dangerous failures.

These formulae include the diagnostic coverage, DC, for each of the subsystem elements. The failure rates of each of the subsystems are reduced by the diagnostic coverage of each subsystem.

The fourth example of a subsystem architecture is shown in Figure 139. This subsystem is single fault tolerant and includes a diagnostic function. The potential for common cause failure must also be considered with single fault tolerant systems.

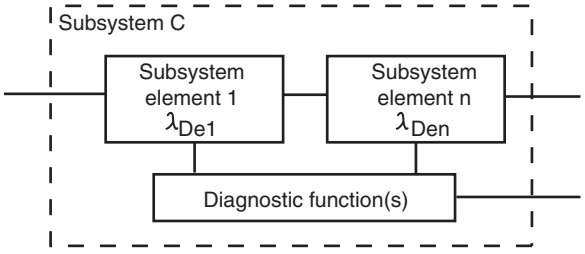


Figure 138: Subsystem logical architecture C

Figure 138 shows the functional representation of a zero fault tolerant system with a diagnostic function. Diagnostic coverage is used to decrease the probability of dangerous hardware failures. The diagnostic tests are performed automatically. The definition of diagnostic coverage is the same as given in EN ISO 13849-1 i.e. the ratio of the rate of detected dangerous failures compared to the rate of all dangerous failures.

These formulae include the diagnostic coverage, DC, for each of the subsystem elements. The failure rates of each of the subsystems are reduced by the diagnostic coverage of each subsystem.

$\lambda_{DssC} = \lambda_{De1} (1-DC_1) + \ldots + \lambda_{Den} (1-DC_n)$

$PFH_{DssC} = \lambda_{DssC} \times 1h$

The fourth example of a subsystem architecture is shown in Figure 139 This subsystem is single fault tolerant and includes a diagnostic function. The potential for common cause failure must also be considered with single fault tolerant systems.

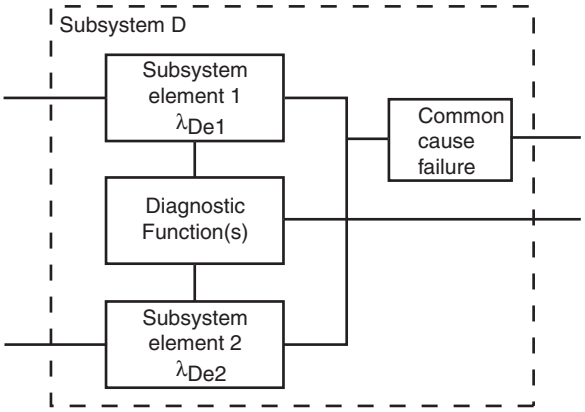


Figure 139: Subsystem logical architecture D

If the subsystem elements are different in each channel, the following formula is used:

$\lambda_{DssD} = (1 - \beta)^2 \{ \lambda_{De1} \times \lambda_{De2} \times (DC_1 + DC_2) \times T_2 / 2 + \lambda_{De1} \times \lambda_{De2} \times (2 - DC_1 - DC_2) \times T_1 / 2 \} + \beta \times (\lambda_{De1} + \lambda_{De2}) / 2$

$PFH_{DssD} = \lambda_{DssD} \times 1h$

If the subsystem elements are the same in each channel the following formula is used:

$\lambda_{DssD} = (1 - \beta)^2 \{ [\lambda_{De2} \times 2 \times DC] \times T_2 / 2 + [\lambda_{De2} \times \lambda_{De2} \times (1-DC)] \times T_1 \} + \beta \times (\lambda_{De}$

$PFH_{DssD} = \lambda_{DssD} \times 1h$

Notice that both formulae use one additional parameter, **T2** the diagnostic test interval. This is just a periodic check of the function. It is a less comprehensive test than the Proof Test.

As an example, assume the following values for the example where the subsystem elements are different:

β = 0.05
$\lambda_{De} = 1 \times 10^{-6}$ failures/hour
T1 = 87600 hours (10 years)
T2 = 2 hours
DC = 90%

PFH_{DssD} = 5.791E-08 dangerous failures per hour. This would be within the range required for SIL 3.

Affect of the Proof Test Interval

IEC/EN 62061 states that a Proof Test Interval (PTI) of 20 years is preferred (but not mandatory) Let us look at the affect the proof test interval has on the system. If we re-calculate the formula with T1 at 20 years it gives the result PFH_{DssD} = 6.581E-08. It is still within the range required for SIL 3. The designer must keep in mind that this subsystem must be combined with other subsystems to calculate the overall dangerous failure rate.

Affect of Common Cause Failure Analysis

Let's look at the affect the common cause failures have on the system. Suppose we take additional measures and our β (Beta) value improves to 1% (0,01), while the proof test interval remains at 20 years. The dangerous failure rate improves to 2.71E-08 which means that the subsystem is now more suitable for use in a SIL 3 system.

Common Cause Failure (CCF)

Common cause failure is when multiple faults resulting from a single cause produce a dangerous failure. Information on CCF will generally only be required by the subsystem designer, usually the manufacturer. It is used as part of the formulae given for estimation of the PFH_D of a subsystem. It will not usually be required at the system design level.

Annex F of IEC/EN62061 provides a simple approach for the estimation of CCF. Table 17 shows a summary of the scoring process.

No.	Measure Against CCF	Score
1	Separation/Segregation	25
2	Diversity	38
3	Design/Application/Experience	2
4	Assessment/Analysis	18
5	Competence/Training	4
6	Environmental	18

Table 17: Scoring for Measures Against Common Cause Failure

Points are awarded for employing specific measures against CCF. The score is added up to determine the common cause failure factor, which is shown in Table 18. The beta factor is used in the subsystem simplified architecture formulae to influence the failure rate as has already been shown.

Overall Score	Common Cause failure factor (ß)
<35	10% (0,1)
35…65	5% (0,05)
65…85	2% (0,02)
85…100	1% (0.01)

Table 18: Beta Factor for Common Cause Failure

Diagnostic Coverage (DC)

Automatic diagnostic tests are employed to decrease the probability of dangerous hardware failures. Being able to detect all dangerous hardware failures would be ideal, but in practice the maximum value is set at 99% (this can also be expressed as 0.99)

Diagnostic coverage is the ratio of the probability of detected dangerous failures to the probability all the dangerous failures.

Probability of Detected dangerous failures, λ_{DD}

$$DC = \frac{\text{Probability of Detected dangerous failures, } \lambda_{DD}}{\text{Probability of Total dangerous failures, } \lambda_{Dtotal}}$$

Hardware Fault Tolerance

Hardware fault tolerance represents the number of faults that can be sustained by a subsystem before it causes a dangerous failure. For example, a hardware fault tolerance of one means that two faults could cause a loss of the safety-related control function but one fault would not.

Management of Functional Safety

The standard gives requirements for the proper control of planning, project management and technical activities that are necessary for the achievement of a safety-related electrical control system.

Proof Test Interval

The proof test interval represents the time after which a subsystem must be either totally checked or replaced to ensure that it is in an "as new" condition. In practice, in the machinery sector, this is achieved by replacement. So the proof test interval is usually the same as lifetime. EN ISO 13849-1 refers to this as Mission Time.

A proof test is a check that can detect faults and degradation in a SRCS so that the SRCS can be restored as close as practical to an "as new" condition. The proof test must detect 100% of all dangerous failures. Separate channels must be tested separately.

In contrast to diagnostic functional tests, which are automatic, proof tests are usually performed manually and off line. Diagnostic functional testing is usually performed often (typically over a few hours) as compared to proof testing which is done infrequently (typically over many years). For example, the circuits going to an interlock switch on a guard can be functionally tested automatically for short and open circuit conditions with diagnostic (e.g., pulse) testing.

The proof test interval must be declared by the manufacturer. Sometimes the manufacturer will provide a range of different proof test intervals.

Safe Failure Fraction (SFF)

The safe failure fraction is similar to diagnostic coverage (DC) but also takes account of any inherent tendency to fail towards a safe state. For example, when a fuse blows, there is a failure but it is highly probable that the failure will be to an open circuit which, in most cases, would be a "safe" failure. SFF is (the sum of the rate of "safe" failures plus the rate of detected dangerous failures) divided by (the sum of the rate of "safe" failures plus the rate of detected and undetected dangerous failures). It is important to realize that the only types of failures to be considered are those which could have some affect on the safety function.

Most low complexity mechanical devices such as E-stop buttons and interlock switches will (on their own) have a relatively low SFF. Most electronic devices for safety have designed in redundancy and monitoring therefore an SFF of greater than 90% is common although this is usually completely due to the Diagnostic Coverage capability.

The SFF value will normally be supplied by the manufacturer.

The Safe Failure Fraction (SFF) can be calculated using the following equation:

$$SFF = (\Sigma\lambda_S + \Sigma\lambda_{DD}) / (\Sigma\lambda_S + \Sigma\lambda_D)$$

where

λ_S = the rate of safe failure,
$\Sigma\lambda_S + \Sigma\lambda_D$ = the overall failure rate,
λ_{DD} = the rate of detected dangerous failure
λ_D = the rate of dangerous failure.

Systematic Failure

The standard has requirements for the control and avoidance of systematic failure. Systematic failures differ from random hardware failures which are failures occurring at a random time, typically resulting from degradation of parts of hardware. Typical types of possible systematic failure are software design errors, hardware design errors, requirement specification errors and other operational procedures. Examples of steps necessary to avoid systematic failure include:

- Proper selection, combination, arrangements, assembly, and installation of components,
- Use of good engineering practice,
- Follow manufacturer's specifications and installation instructions,
- Ensuring compatibility between components,
- Withstanding environmental conditions,
- Use of suitable materials.

Safety-Related Control System Structure Considerations

Overview

This chapter looks at general structural considerations and principles that should be taken into account when designing a safety related control system to any standard. It uses much of language of the Categories from the outgoing EN 954-1 because the Categories primarily address the structure of control systems.

Note: Recent to the time of publication of this text, CEN (European Committee for Standardisation) announced that the final date for presumption of conformity of EN 954-1 will be extended to the end of 2011 to facilitate transition to the later standards. This replaces the original date of December 29, 2009.

For the latest information on the use and status of EN 954-1 visit: *http://discover.rockwellautomation.com/EN_Safety_Solutions.aspx*. In the meantime it is advised that the extension of the transition period is used to move over to the use of the later standards (EN ISO 13849-1 or IEC/EN 62061) in a timely manner.

Categories of Control Systems

The "Categories" of control systems originated in the outgoing EN 954-1:1996 (ISO13849-1:1999). However they are still often used to describe safety control systems and they remain an integral part of EN ISO13849-1 as discussed in "Introduction to Functional Safety of Control Systems" section.

There are five categories describing the fault reaction performance of a safety related control system. See Table 19 for a summary of these categories. The following notes apply to the table.

Note 1: Category B in itself has no special measures for safety but it forms the base for the other categories.

Note 2: Multiple faults caused by a common cause or as inevitable consequences of the first fault shall be counted as a single fault.

Note 3: The fault review may be limited to two faults in combination if it can be justified but complex circuits (e.g. microprocessor circuits) may require more faults in combination to be considered.

Category 1 is aimed at the prevention of faults. It is achieved through the use of suitable design principles, components and materials. Simplicity of principle and design together with stable and predictable material characteristics are the keys to this category.

Categories 2, 3 and 4 require that if faults cannot be prevented they must be detected and appropriate action taken.

Redundancy, diversity and monitoring are the keys to these categories. Redundancy is the duplication of the same technique. Diversity is using two different techniques. Monitoring is the checking the status of devices and then taking appropriate action based on results of the status. The usual, but not only, method of monitoring is to duplicate the safety critical functions and compare operation.

Summary of Requirements	System Behavior
Category B (see Note 1) Safety related parts of machine control systems and/or their protective equipment, as well as their components, shall be designed, constructed, selected, assembled and combined in accordance with relevant standards so that they can withstand the expected influence. Basic safety principles shall be applied.	When a fault occurs, it can lead to a loss of the safety function.
CATEGORY 1 The requirements of category B apply together with the use of well tried safety components and safety principles.	As described for category B but with higher safety related reliability of the safety related function. (The higher the reliability, the less the likelihood of a fault).
CATEGORY 2 The requirements of category B and the use of well tried safety principles apply. The safety function(s) shall be checked at machine start-up and periodically by the machine control system. If a fault is detected a safe state shall be initiated or if this is not possible a warning shall be given. EN ISO 13849-1 assumes that the test rate is at least 100 times more frequent that the demand rate. EN ISO 13849-1 assumes that the MTTFd of the external test equipment is larger than half of the MTTFd of the functional equipment being tested.	The loss of safety function is detected by the check. The occurrence of a fault can lead to the loss of safety function between the checking intervals.
CATEGORY 3 (see Notes 2 & 3) The requirements of category B and the use of well tried safety principles apply. The system shall be designed so that a single fault in any of its parts does not lead to the loss of safety function. Where practicable, a single fault shall be detected.	When the single fault occurs the safety function is always performed. Some but not all faults will be detected. An accumulation of undetected faults can lead to the loss of safety function.
Category 4 (see Notes 2 & 3) The requirements of category B and the use of well tried safety principles apply. The system shall be designed so that a single fault in any of its parts does not lead to the loss of safety function. The single fault is detected at or before the next demand on the safety function. If this detection is not possible then an accumulation of faults shall not lead to a loss of safety function.	When the faults occur, the safety function is always performed. The faults will be detected in time to prevent the loss of safety functions.

Table 19: Categories of Safety Performance

Category B

Category B provides the basic requirements of any control system; whether it is a safety related control system or non-safety related. A control system must work in its expected environment. The concept of reliability provides a foundation for control systems, as reliability is defined as the probability that a device will perform its intended function for a specified interval under expected conditions.

Category B requires the application of basic safety principles. ISO 13849-2 tells us the basic safety principles for electrical, pneumatic, hydraulic and mechanical systems. The electrical principles are summarized as follows:

- Proper selection, combination, arrangements, assembly and installation (i.e., per manufacturer's instructions)
- Compatibility of components with voltages and currents
- Withstand environmental conditions
- Use of de-energization principle
- Transient suppression
- Reduction of response time
- Protection against unexpected start-up
- Secure fixing of input devices (e.g. mounting of interlocks)
- Protection of control circuit (per NFPA79 & IEC60204-1)
- Correct protective bonding

The designer must select, install, and assemble according to the manufacturer's instructions. These devices must work within the expected voltage and current ratings. The expected environmental conditions, like electromagnetic compatibility, vibration, shock, contamination, washdown, must also be considered. The de-energization principle is used. Transient protection is installed across the contactor coils. The motor is protected against overloads. The wiring and grounding meets the appropriate electrical standards.

Category 1

Category 1 requires the system to meet the terms of Category B and, in addition, to use well-tried components. EN ISO 13849-2 gives information about well tried components for mechanical, hydraulic, pneumatic and electrical systems. Annex D addresses electrical components.

Components are considered to be well-tried if they have been successfully used in many similar applications. Newly designed safety components are considered to be well-tried if they are designed and verified in compliance to appropriate standards. Table 20 lists some electrical components and their respective standards.

Well-Tried Component	Standard
Switch with positive mode actuation (direct opening action)	IEC 60947-5-1
Emergency stop device	ISO 13850, IEC60947-5-5
Fuse	IEC 60269-1
Circuit Breaker	IEC 60947-2
Contactors	IIEC 60947-4-1, IEC 60947-5-1
Mechanically linked contacts	IEC 60947-5-1
Auxiliary contactor (e. g. contactor, control relay, positive guided relays)	EN 50205 IEC 60204–1, IEC 60947–5–1
Transformer	IEC 60742
Cable	IEC 60204-1
Interlocks	ISO 14119
Temperature Switch	IEC 60947-5-1
Pressure Switch	IEC 60947-5-1 + pneumatic or hydraulic requirements
Control and protective switching device or equipment (CPS)	IEC 60947-6-2
Programmable Logic Controller	IEC 61508

Table 20: Standards for Well-Tried Components

Applying well-tried components to our Category B system, the limit switch would be replaced by a direct opening action tongue switch and the contactor would be over-dimensioned to further protect against welded contacts.

Figure 140 shows the changes to the simple Category B system to achieve Category 1. The interlock and the contactor play the key roles in removing energy from the actuator, when access to the hazard is needed. The tongue interlock meets the requirements of IEC 60947-5-1 for direct opening action contacts, which is shown by the symbol of the arrow within the circle. With the well-tried components, the probability of energy being removed is higher for Category 1 than it is for Category B. The use of well-tried components is intended to prevent a loss of the safety function. Even with these improvements, a single fault can still lead to the loss of the safety function.

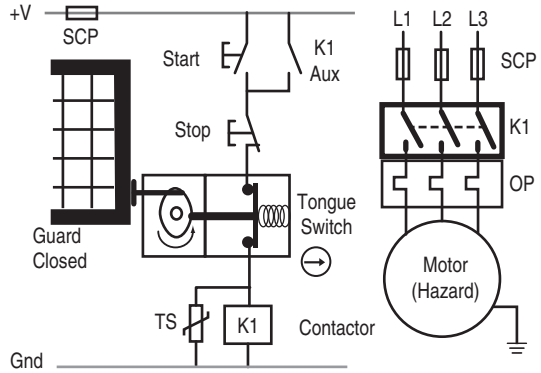


Figure 140: Category 1 of Simple Safety System

Categories B and 1 are prevention based. The design is intended to prevent a hazardous situation. When prevention by itself does not provide enough reduction in the risk, fault detection must be used. Categories 2, 3 and 4 are fault detection based, with increasingly stringent requirements to achieve higher levels of risk reduction.

Category 2

In addition to meeting the requirements of Category B and using well tried safety principles, the safety system must undergo testing to meet Category 2. The tests must be designed to detect faults within the safety related parts of the control system. If faults are not detected, the machine is allowed to run. If faults are detected, the test must initiate a command to bring the machine to a safe state.

Figure 141 shows a block diagram of a Category 2 system. The equipment performing the test can be an integral part of the safety system or a separate piece of equipment.

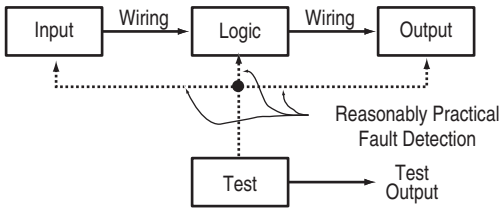


Figure 141: Category 2 Block Diagram

The testing must be performed:

- When the machine is initially powered,
- Prior to the initiation of a hazard, and
- Periodically if deemed necessary by the risk assessment.

Note: EN ISO 138491-1 assumes a test to safety function demand ration of 100:1. The example given here would not meet that requirement.

The words “whenever possible” and “reasonably practicable” indicate that not all faults are detectable. Since this is a single channel system (i.e., one wire connects input to logic to output), a single fault may lead to the loss of the safety function. In some cases, Category 2 cannot be fully applied to a safety system, because not all of the components can be checked.

Figure 140 shows the simple Category 1 system enhanced to meet Category 2. A monitoring safety relay (MSR) performs the testing. Upon power-up, the MSR checks its internal components. If no faults are detected, the MSR checks the tongue switch by monitoring the cycling of its contacts. If no faults are detected and the guard is closed, the MSR then checks the output device: the mechanically linked contacts of the contactor. If no faults are detected and the contactor is off, the MSR will energize its internal output and connect the coil of K1 to the Stop button. At this point, the non safety rated parts of the machine control system, the Start/Stop/Interlock circuit, can turn the machine on and off.

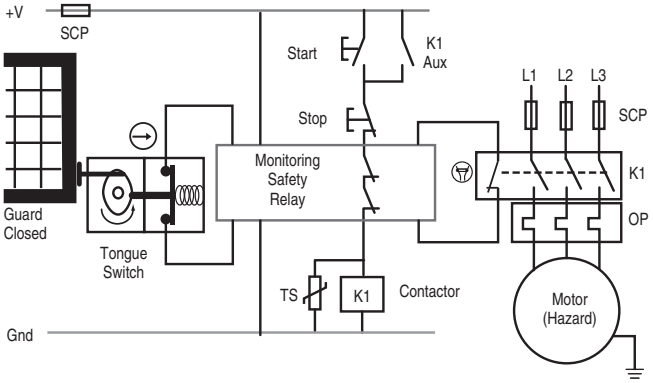


Figure 142: Category 2 Safety System

Opening the guard turns the outputs of the MSR off. When the guard is re-closed, the MSR repeats the safety system checks. If no faults are discovered, the MSR turn on is internal output. The MSR allows this circuit to meet Category 2 by performing tests on the input device, the logic device (itself) and the output device. The test is performed on initial power-up and before initiation of the hazard.

With its inherent logic capabilities, a Safety PLC (PLC safety-rated to IEC 61508) based safety system can be designed to meet category 2.

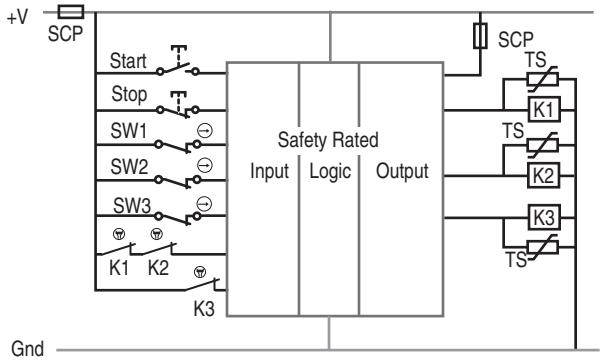


Figure 143: Complex Category 2 Safety System

Safety-Related Control System Structure Considerations

Figure 143 shows an example of a complex system using a safety rated PLC. A safety rated PLC meets the requirements of well-tried as it is designed to an appropriate standard. The mechanically linked contacts of the contactors are fed into the Input of the PLC for testing purposes. These contacts may be connected in series to one input terminal or to individual input terminals, depending on the program logic.

Although well-tried safety components are used, a single fault occurring between the checks can lead to the loss of the safety function. Therefore, Category 2 systems are used in lower risk applications. When higher levels of fault tolerance are needed, the safety system must meet Categories 3 or 4.

Category 3

In addition to meeting the requirements of Category B and well-tried safety principles, Category 3 requires successful performance of the safety function in the presence of a single fault. The fault must be detected at or before the next demand on the safety function, whenever reasonably practicable.

Here again we have the phrase “whenever reasonably practicable.” This covers those faults that may not be detected. As long as the undetectable fault does not lead to the loss of the safety function, the safety function can meet category 3. Consequently, an accumulation of undetected faults can lead to the loss of the safety function.

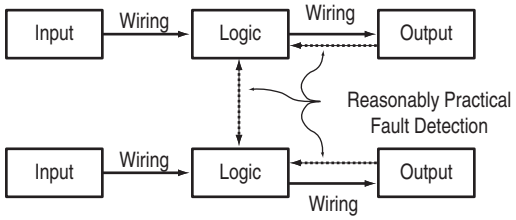


Figure 144: Category 3 Block Diagram

Figure 144 shows a block diagram to explain the principles of a Category 3 system. Redundancy combined with reasonably practicable cross monitoring and output monitoring are used to ensure the performance of the safety function

Figure 145 shows an example of a Category 3 system. A redundant set of contacts are added to the tongue interlock switch. Internally, the monitoring safety relay (MSR) contains redundant circuits that cross monitor each other. A redundant set of contactors remove power from the motor. The contactors are monitored by the MSR through the “reasonably practicable” mechanically linked contacts.

Fault detection must be considered for each part of the safety system, as well as the connections (i.e., the system). What are the failure modes of a dual channel tongue switch? What are the failure modes of the MSR? What are the failure modes of the contactors K1 and K2? What are the failure modes of the wiring?

The tongue interlock switch is designed with direct opening contacts. Therefore we know that opening the guard is designed to open a welded contact. This resolves one failure mode. Do other failure modes exist?

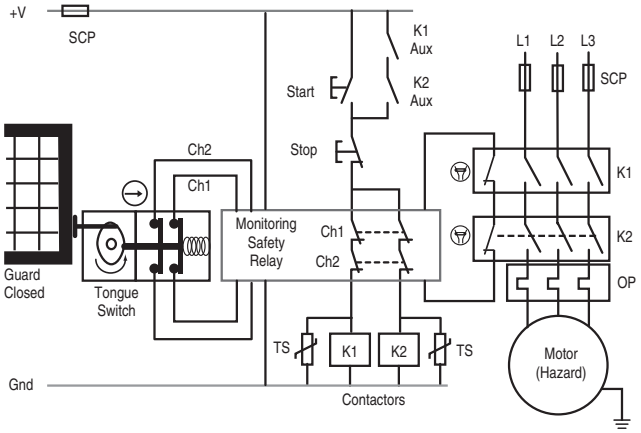


Figure 145: Category 3 System

The direct opening action switch is usually designed with a spring operate return. If the head is removed or broken off, the safety contacts spring back to the closed (safe) state. Many interlock switches are designed with removable heads to accommodate installation requirements of various applications. The head can be removed and rotated between two to four positions.

A failure could occur where the head mounting screws are not torqued properly. With this condition, the expected vibration of the machine may cause the head mounting screws to back out. The operating head, under spring pressure, removes the pressure from the safety contacts, and the safety contacts close. Subsequently, opening the guard does not open the safety contacts, and a failure to danger occurs.

Similarly, the operating mechanism within the switch must be reviewed. What is the probability that a failure of a single component will lead to the loss of the safety function? A common practice is to use tongue interlocks with dual contacts in Category 3 circuits. This usage must be based on excluding the single failure of the switch to open the safety contacts. This is considered “fault exclusion” and is discussed later in this chapter.

A monitoring safety relay (MSR) is often evaluated by a third party and assigned a category level (and/or a PL and SIL CL). The MSR often includes dual channel capability, cross channel monitoring, external device monitoring and short circuit protection. No specific standards are written to provide guidance on the design or usage of monitoring safety relays. MSRs are evaluated for their ability to perform the safety function per EN ISO 13849-1 or the outgoing EN 954-1. The rating of the MSR must be the same or higher than the required rating of the system in which it is used.

Two contactors help to ensure that the safety function is fulfilled by the output devices. With overload and short-circuit protection, the probability of the contactor failing with welded contacts is small but not impossible. A contactor can also fail due with its power switching contacts staying closed due to a stuck armature. If one contactor fails to a dangerous state, the second contactor will remove power from the hazard. The MSR will detect the faulted contactor upon the next machine cycle. When the gate is closed and the start button pressed, the mechanically linked contacts of the faulted contactor will remain open and the MSR will not be able to close its safety contacts, thereby, revealing the fault.

Undetected Faults

With a Category 3 system structure there may be some faults that cannot be detected but they must not, by themselves, lead to the loss of the safety function.

Where faults can be detected we need to know if, under some circumstances, they could be either masked or unintentionally cleared by the operation other devices within the system structure.

Figure 146 shows a widely used approach for connecting multiple devices to a monitoring safety relay. Each device contains two normally closed direct opening action contacts. These devices can be a mix of interlocks or e-stop buttons. This approach saves wiring costs as the input devices are daisy-chained. Assume a short circuit fault occurs across one of the contacts at Sw2 as shown. Can this fault be detected?

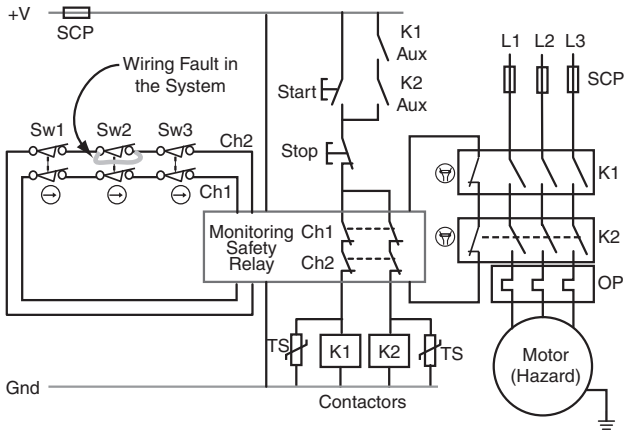


Figure 146: Series Connection of Inputs Devices

If switch Sw1 (or Sw3) is opened, both Ch1 and Ch2 are open circuit and the MSR removes power from the hazard. If Sw3 is then opened and then closed again the fault across its contacts will not be detected because there is no change of status at the MSR: both Ch1 and Ch2 remain open. If Sw1 (or Sw3) is then closed, the hazard can be restarted by pressing the start button. Under these circumstances the fault did not cause a loss of the safety function but it was not detected, it remains in the system and a subsequent fault (a short circuit across the second contact of Sw2) could lead to the loss of the safety function.

If Sw2 alone was opened and closed, with no operation of the other switches, Ch1 opens and Ch2 remains closed. The MSR de-energizes the hazard because Ch1 opened. When Sw2 closes, the motor cannot be started when the Start button is pressed, because Ch2 did not open. The fault is detected. However if for any reason, Sw1 (or Sw3) is then opened and closed, both Ch1 and Ch2 will be open then closed circuit. This sequence simulates the clearing of the fault and will result in unintentional reset at the MSR.

This raises the question of what DC could be claimed for the individual switches within this structure when using EN ISO 13849-1 or IEC 62061. At the time of publication of this text there is no specific definitive guidance on this but it is usual and reasonable to assume a DC of 60% under the condition that the switches are individually tested at suitable periods to reveal faults. If it is foreseeable that one (or more) of the switches will never be individually tested then it can be argued that its DC should be described as zero. At the time of publication of this text EN ISO 13849-2 is undergoing revision. When it is published it may provide more guidance on this issue.

The series connection of mechanical contacts is limited to Category 3 as it may lead to the loss of the safety function due to an accumulation of faults. In practical terms, the reduction of the DC (and therefore SFF) would limit the maximum achievable PL and SIL to PLd and SIL2.

It is interesting to note that these characteristics of a Category 3 structure have always required consideration but they are brought into sharp focus by the newer functional safety standards.

Figure 147 shows a category 3 circuit using a safety rated variable frequency drive. Recent developments in drive technology coupled with the updating of EN/IEC 60204-1 and NFPA79 standards allow safety rated drives to be used in e-stop circuits without the need for an electro-mechanical disconnect of the actuator (e.g., the motor).

Pressing the E-Stop opens the outputs of the MSR. This sends a stop signal to the drive, removes the enable signal and opens the gate control power. The drive executes a Category 0 Stop—immediate removal of power to the motor. This function is termed “Safe Torque Off.” The drive achieves category 3 because it has redundant signals to remove power to the motor: the enable and a positive guided relay. The positive guided relay provides reasonably practicable feedback to the actuator. The drive itself is analyzed to determine that a single fault does not lead to the loss of the safety function.

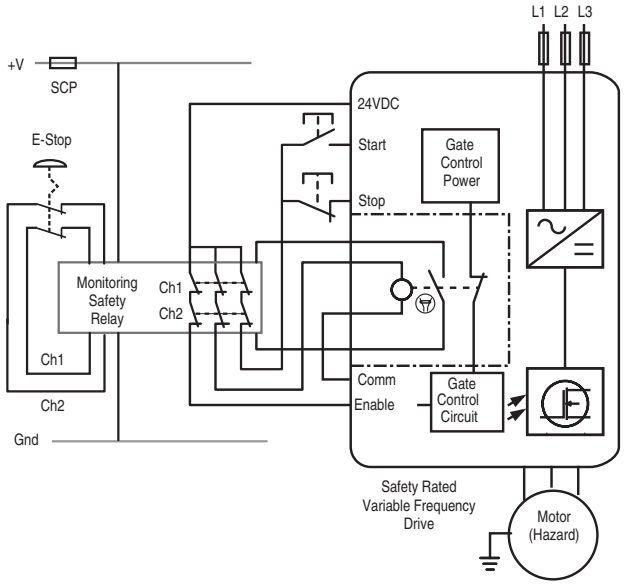


Figure 147: Safety Rated Drives with E-stop Rated to Category 3

Figure 148 shows an example of a wiring fault, a short circuit, from the MSR Channel 2 safety output to the coil of Contactor K1. All components are operating properly. This wiring fault can occur prior to machine commissioning or at some later date during maintenance or enhancements. Can this fault be detected?

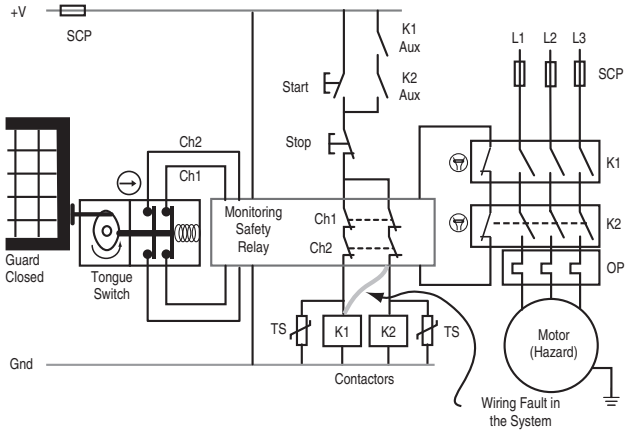


Figure 148: Example 1 of Wiring Fault

This fault cannot be detected by the safety system as shown. Fortunately it does not, on its own, lead to the loss of the safety function. This fault, as well as the fault from Ch1 to K2, must be detected during commissioning or checks following maintenance work. The list of possible fault exclusions given in EN ISO 13849-2 Annex D Table D4 clarifies that these types of faults can be excluded if the equipment is contained within an electrical enclosure and both the enclosure and wiring comply with the requirements of IEC/EN 60204-1. The Joint Technical report on EN ISO 13849-1 and IEC 62061 also clarifies that this fault exclusion can be considered up to and including PLe and SIL3. It can also be used at Category 4.

Figure 149 shows another wiring fault example. This fault occurs from the mechanically linked contact of K2 to the monitoring input of the MSR. Can this fault be detected?

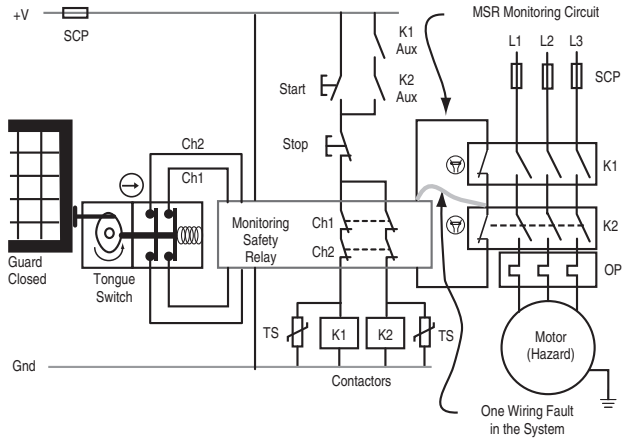


Figure 149 Monitored Manual Reset to Detect Fault

This fault cannot be detected by the safety system, as shown. The MSR monitoring circuit is a series circuit that must be closed prior to startup. As long as the circuit is closed, the MSR believes all monitored devices are in the off state and ready to go. In this example, a welded or stuck K1 contactor will not be detected; it will be masked by the short circuit fault. With two contactors, the safety function is performed by K2, if K1 is indeed faulted. An MSR with monitored manual reset could be substituted for the MSR with automatic reset to detect this type of fault. This type of MSR requires a change of state in terms of a rising or falling signal edge as discussed in the next example and also in the "Protective Measures and Complimentary Equipment" section.

Figure 150 shows the same situation as 149, except the monitoring circuit of the MSR has changed function from automatic to monitored manual. This is accomplished in the MSR by wiring changes or model changes. The monitored manual reset can detect this type of fault because the monitoring circuit must be open at the time that the guard is closed. After closing the guard, the reset button must be pressed. In many (but not all) relays, the MSR outputs energize when the reset button is released. This requirement for a change of state means that the relay cannot be "fooled" into reset by a permanent blocking down of the reset button or unintentionally reset by a short circuit fault.

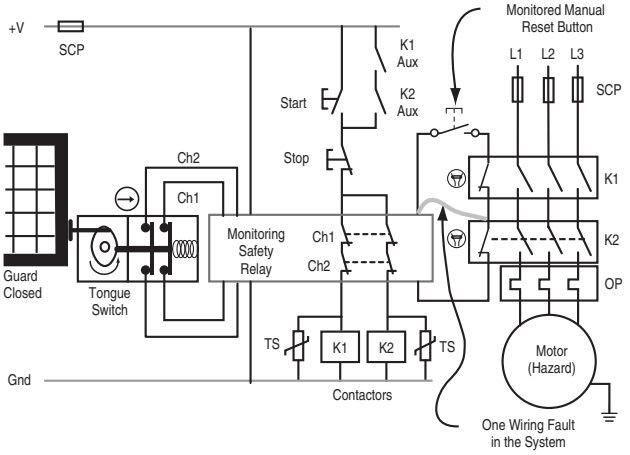


Figure 150: Monitored Manual Reset to Detect Fault

Figure 151 shows a cross channel input fault. A fault occurs from Channel 1 to Channel 2 at the input of the MSR. With eight connections for the two channels, there are numerous potential ways to create the cross channel fault. Can this fault be detected?

Detection of this fault is dependent upon the type of MSR. Microprocessor based MSRs use pulse testing fault detection techniques (see later explanation) and some MSRs utilize diverse inputs. One input is pulled up to +V, and the second input is pulled down to ground. In either case this wiring short will be detected immediately, and the safety input of the MSR will turn off, removing energy from the hazard.

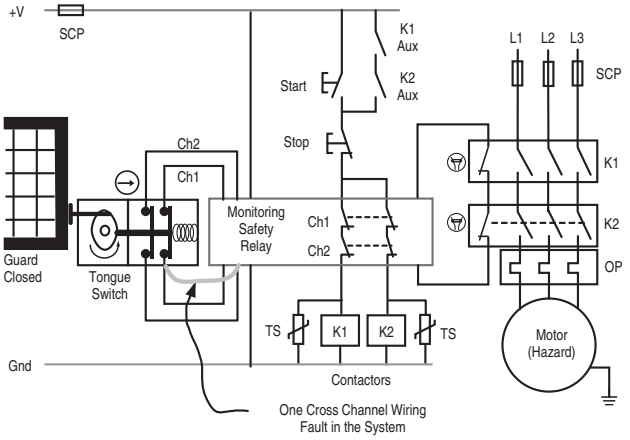


Figure 151: Cross Channel Input Fault

Pulse Testing Fault Detection

Safety circuits are designed to be carrying current when the safety system is active and the hazard is protected. Pulse testing is a technique where the circuit current drops to zero for a very short duration. The duration is too short for the safety circuit to respond and turn the hazard off, but is long enough for a microprocessor based system to detect. The pulses on the channels are offset from each other. If a cross fault short circuit occurs, the microprocessor detects the pulses on both channels and initiates a command to turn the hazard off.

Figure 152 illustrates this principle. This technique also detects shorts to the +V supply. Microprocessor based safety monitoring relays and safety PLC based systems use the pulse testing technique.

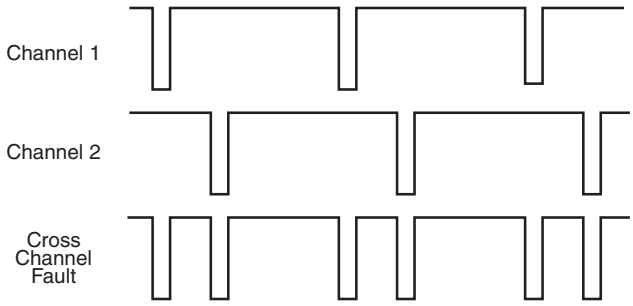


Figure 152: Cross Channel Fault with Pulse Testing

Figure 153 shows an arrangement where two outputs of the PLC are configured for pulse testing. Alternating pulses are connected to each channel operated by mechanical switches. This approach detects cross channel faults as well as faults to power and ground. This pulse testing is required by Category 3 because it is reasonably practicable to detect cross channel faults in this manner.

The faults described above are only a subset of all the faults that must be considered. Short circuits to +V, to Ground, shorts to other circuits, and open circuit conditions must be evaluated. In addition, the component ratings and performance must be considered.

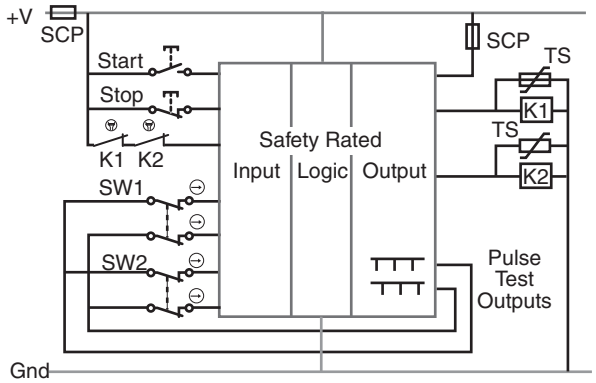


Figure 153: Safety PLC using Pulse Testing for Fault Detection

Figure 154 shows a variation of a Safety PLC arrangement. In some cases, connecting a non-safety rated device to a safety system is needed and beneficial. If the outputs are sourcing type, they can be connected directly to the input of the safety PLC. If they are dual channel, they can be considered to meet Category 3 reasonable requirements.

Another consideration for Safety PLC modules is the number of inputs. Occasionally, one or two additional inputs may be needed, but panel space does not allow for an additional block. In this case, input devices may be connected in series (e.g., SW1 and SW2) and still meet the requirements of Category 3. The tradeoff is the loss of information as to which switch is actuated, unless an additional contact is used and connected to the machine control system.

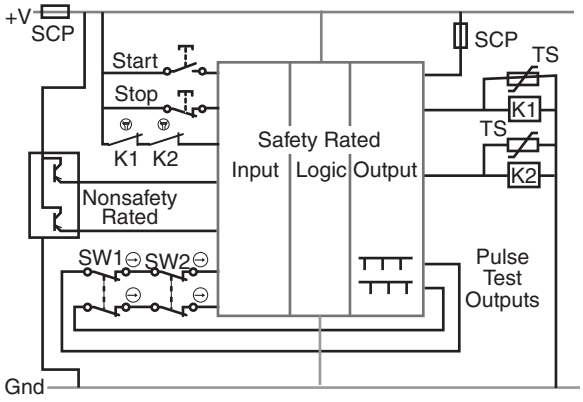


Figure 154: Complex Inputs Meeting Category 3 with a Safety PLC

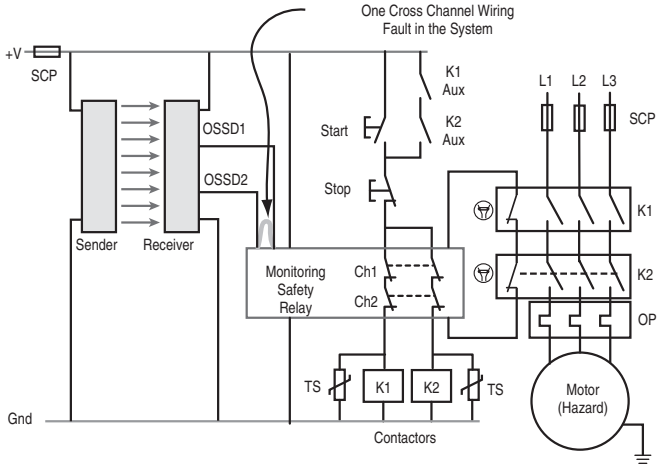


Figure 155: Cross Channel Wiring Fault with Light Curtains

Figure 155 shows an example safety system with light curtains (solid state OSSD outputs).

In this example, the wiring fault is detected by the pulse testing at the light curtain. The detection of the fault is immediate, and the light curtain turns off its output.

Category 4

Like Category 3, Category 4 requires the safety system to meet Category B, use safety principles and perform the safety function in the presence of a single fault. Unlike Category 3 where an accumulation of faults can lead to the loss of the safety function, Category 4 requires performance of the safety function in the presence of an accumulation of faults. In practice the consideration of two accumulated faults may be sufficient, although 3 faults may be necessary for some designs due to complexity.

Figure 156 shows the block diagram for Category 4. Monitoring of both output devices and cross monitoring is essentially required, not just when reasonably practicable. This helps differentiate Category 4 from Category 3.

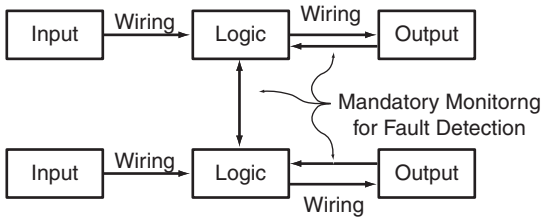


Figure 156: Category 4 Block Diagram

Figure 157 shows an example Category 4 circuit using a two channel non-contact interlock switch.

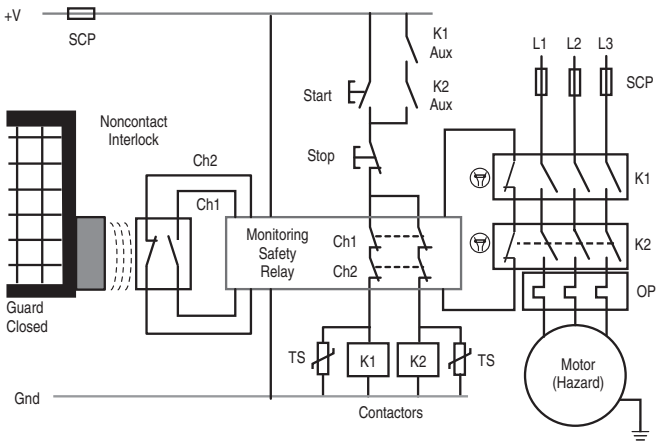


Figure 157: Non-contact Interlock Category 4 System

Up until relatively recently, tongue actuated interlock switches have sometimes been used for Category 4 circuits. In order to use a tongue interlock in a dual channel circuit it is necessary to exclude the possible single fault failure points on the mechanical actuation tongue and switch linkage. However, the Joint Technical Report on EN ISO 13849-1 and IEC 62061 has clarified that this type of fault exclusion should not be used in PLe or SIL 3 systems.

If the safety system designer prefers using tongue style interlocks, then two switches can be used to meet Category 4. Figure 158 shows an example with two tongue interlock switches with direct opening action contacts.

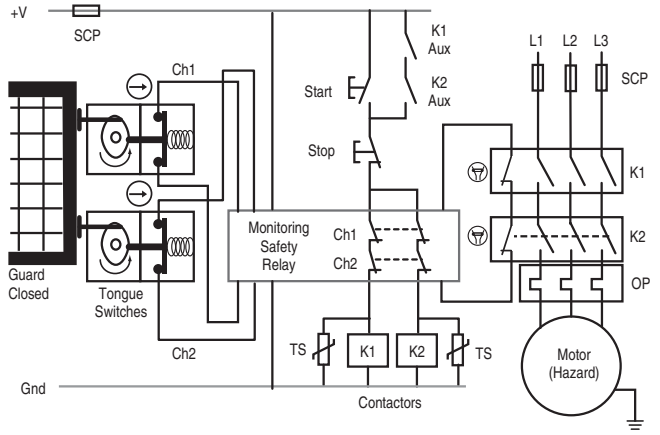


Figure 158: Category 4 with Redundant Tongue Interlocks

The Monitoring safety relay itself must be rated to meet Category 4, and both output contactors, using mechanically linked contacts, must be monitored.

Figure 159 shows a modular monitoring safety relay with one non-contact switch device connected to each input module. If the safety relay is rated for category 4, this arrangement of input devices meets Category 4. Notice that with the modular approach, the safety relay is microprocessor based and utilizes pulse checking to detect cross faults.

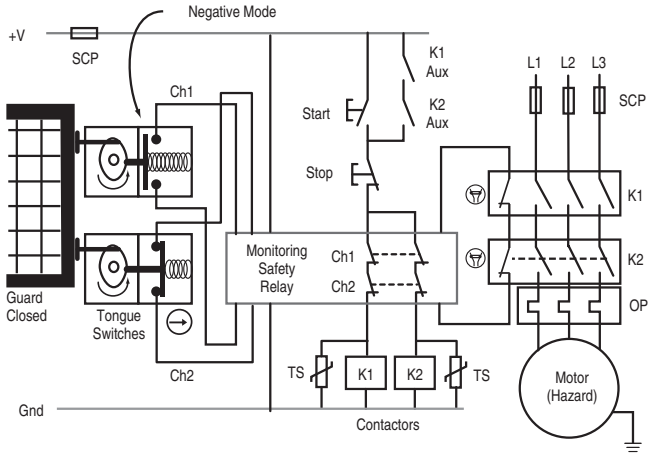


Figure 159: Modular Safety Relay Category 4 System

Component and System Ratings

Categories can be used as part of safety component (device) ratings as well as system ratings. This generates some confusion that can be clarified by understanding the components and their capabilities. By studying the preceding examples we find that a component such as an interlock switch rated to Category 1 can be used on its own in a Category 1 system, and it can be used in a Category 2 system if additional function monitoring is provided. It can also form part of a Category 3 or 4 system if two of the components are used together with a diagnostic function provided by a monitoring safety relay

Some components such as monitoring safety relays and programmable safety controllers have their own internal diagnostics and they check themselves to ensure proper performance. Therefore they can be rated as safety components to meet Categories 2, 3 or 4 without any additional measures.

Fault Considerations

Safety analysis requires extensive analysis of faults, and a thorough understanding of the performance of the safety system in the presence of faults is needed. ISO 13849-1 and ISO 13849-2 provide details on fault considerations and fault exclusions.

If a fault results in a failure of a subsequent component, the first fault and all the subsequent faults shall be considered one fault.

If two or more faults occur as a result of a single cause, the faults shall be considered a single fault. This is known as a common cause fault.

The occurrence of two or more faults at the same time is considered to be highly unlikely and is not considered in this analysis. There is a basic assumption is that only one fault will occur between demands placed on the safety function providing that the periods between the use of the function are not excessively long

Fault Exclusions

The outgoing EN 954-1, and the more recent EN ISO 13849-1 and IEC 62061 all permit the use of fault exclusions when determining a safety system classification if it can be shown that the occurrence of the fault is extremely unlikely. It is important that where fault exclusions are used that they are properly justified and are valid for the intended lifetime of the safety system. The greater the level of risk protected by the safety system then the more stringent becomes the justification required for the fault exclusion. This has always caused some confusion about when certain types of fault exclusion can or cannot be used. As we have seen already in this chapter, recent standards and guidance documents have clarified some aspects of this issue.

In general, where PLe or SIL3 is specified for a safety function to be implemented by a safety system it is not normal to rely upon fault exclusions alone to achieve this level of performance. This is dependent upon the technology used and the intended operating environment. Therefore it is essential that designer takes additional care on the use of fault exclusions as that PL or SIL increases. For example fault exclusion is not applicable to the mechanical aspects of electromechanical position switches and manually operated switches (e.g. an emergency stop device) in order to achieve a PLe or SIL3 system. Those fault exclusions that can be applied to specific mechanical fault conditions (e.g. wear/corrosion, fracture) are described in Table A.4 of ISO 13849-2. Therefore a guard interlocking system that has to achieve PLe or SIL3 will need to incorporate a minimum fault tolerance of 1 (e.g. two conventional mechanical position switches) in order to achieve this level of performance since it is not normally justifiable to exclude faults, such as, broken switch actuators. However, it may be acceptable to exclude faults, such as short circuit of wiring within a control panel designed in accordance with relevant standards.

Further information on the use of fault exclusions will be provided in the forthcoming revision of EN ISO 13849-2.

Stop Categories according to IEC/EN 60204-1 and NFPA 79

It is both unfortunate and confusing that the term “Category” in relation to safety related control systems has two different meanings. So far we have discussed the categories that originated in EN 954-1. They are a classification of the performance of a safety system under fault conditions.

There is also a classification known as “Stop Categories” that originated in IEC/EN 60204-1 and NFPA 79 There are three Stop Categories.

Stop Category 0 requires immediate removal of power to the actuators. This is sometimes considered as an uncontrolled stop because, in some circumstances, motion can take some time to cease because the motor may be free to coast to a stop.

Stop Category 1 requires that power is retained to apply braking until the stop is achieved and then remove power to the actuator.

Stop Category 2 allows that power need not be removed from the actuator.

Note that only Stop Categories 0 or 1 can be used as emergency stops. The choice of which of the two Categories to use should be dictated by a risk assessment.

All the circuit examples shown so far in this chapter have used a Stop Category 0. A Stop Category 1 is achieved with a time-delayed output for the final removal of power. An interlocked guard with guardlocking often accompanies a Category 1 stop system. This keeps the guard locked in a closed position until the machine has reached a safe (i.e., stopped) state.

Stopping a machine without taking proper account of the programmable controller may affect restarting and could result in severe tool and machine damage. A standard (non safety) PLC alone cannot be relied on for a safety related stopping task; therefore, other approaches need to be considered.

Two possible solutions are given below:

1. Safety Relay with Time Delayed Override Command

Figure 160 shows a hard wired system that has allows a correctly sequenced shut-down which protects the machine and program.

A safety relay with both immediate acting and delayed action outputs is used (e.g. MSR138DP). The immediate acting outputs are connected to inputs at the programmable device (e.g., PLC.) and the delayed acting outputs are connected to the contactor. When the guard interlock switch is actuated, the immediate outputs on the safety relay switch. This signals the programmable system to carry out a correctly sequenced stop. After short but sufficient time has elapsed to allow this process, the delayed output on the safety relay switches and isolates the main contactor.

Note: Any calculations to determine the overall stopping time must take the safety relay output delay period into account. This is particularly important when using this factor to determine the positioning of devices in accordance with the safety distance calculation.

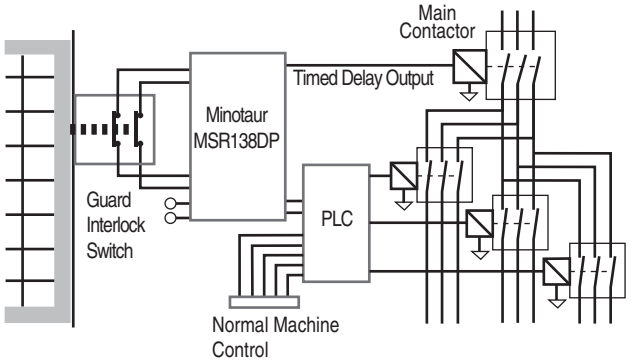


Figure 160: Delayed Outputs for Orderly Shutdown

2. Safety PLCs

The logic and timing functions required can be conveniently implemented by using a (safety) PLC with an appropriate safety integrity level. In practice this would be achieved by using a Safety PLC such as the SmartGuard or GuardLogix.

Safety-Related Control System Structure Considerations

U.S. Safety Control System Requirements

In the U.S., safety related control system requirements can be found in a number of different standards but two documents stand out: ANSI B11.TR3 and ANSI R15.06.

The technical report ANSI B11.TR3 sets out four levels characterized by the expected amount of risk reduction that each can provide: The requirements for each level follows.

Lowest

In ANSI B11.TR3, safeguards providing the lowest degree of risk reduction include electrical, electronic, hydraulic or pneumatic devices and associated control systems using a single-channel configuration. Implicit in the requirements is the requirement to use safety rated devices. This is closely aligned with Category 1 of ISO13849-1.

Low/Intermediate Risk Reduction

Safeguards, in ANSI B11.TR3 providing low/intermediate risk reduction include control systems having redundancy that may be manually checked to verify the performance of the safety system. Looking at the pure requirements, the system employs simple redundancy. Use of a checking function is not required. Without checking, one of the redundant safety components can fail, and the safety system would not realize it. This would result in a single channel system. This level of risk reduction aligns best with Category 2 when checking is used.

High/Intermediate Risk Reduction

Safeguards providing high/intermediate risk reduction in ANSI B11.TR3 include control systems having redundancy with self-checking upon startup to confirm the performance of the safety system. For machines that are started every day, the self-checking provides a significant improvement in the safety integrity over the purely redundant system. For machines running 24/7, the self-checking is a marginal improvement, at best. Employing periodic monitoring of the safety system aligns the requirements with Category 3.

Highest Degree of Risk Reduction

ANSI B11.TR3 provides a highest risk reduction by control systems having redundancy with continuous self-checking. The self checking must verify the performance of the safety system. The challenge to the safety system designer is to determine what is continuous. Many safety systems perform their checks at startup and when a demand is placed on the safety system.

Some components, on the other hand, perform continuous self-checking. Light curtains, for example, sequentially turn on and off their LEDs. If a fault occurs, the light curtain turns off its outputs, before a demand is place on the safety system, as it continuously checks itself. Microprocessor based relays and safety PLCs are other components that perform continuous self-checking.

The control system requirement for “continuous” self checking is not intended to limit the selection of components to light curtains and microprocessor based logic units. The checking should be performed at startup and after every demand on the safety system. This level of risk reduction is intended to align with Category 4 of ISO13849-1.

Robot Standards: U.S. and Canada

The robot standards in the U.S. (ANSI RIA R15.06) and Canada (CSA Z434-03) are quite similar. Both have four levels, which are similar to the categories of EN954-1:1996 and which are described below.

Simple

At this lowest level, simple safety control systems must be designed and constructed with accepted single channel circuitry, and these systems may be programmable.

In Canada, this level is further restricted for signaling and annunciation purposes only.

The challenge for the safety system designer is to determine what is “accepted”. What is an accepted single channel circuit? To whom is the system acceptable?

The simple category is most closely aligned with Category B of EN954-1:1996.

Single Channel

The next level is a single channel safety control system that:

- Is hardware based or is a safety rated software/firmware device
- Includes components that are safety rated; and
- Is used in accordance with manufacturers’ recommendations and
- Uses proven circuit designs.

An example of a proven circuit design is a single channel electromechanical positive break device that signals a stop in a de-energized state.

Being a single channel system, a single component failure can lead to the loss of the safety function.

The simple category most closely aligns with Category 1 of EN954-1:1996.

Safety Rated Software/Firmware Device

Although hardware based systems have been the preferred method providing safeguarding of robots, software/firmware devices are becoming a popular choice due to their ability to handle complex systems. Software/firmware devices (safety PLCs or safety controllers) are allowed provided these devices are safety rated. This rating requires that a single safety-related component or firmware failure does not lead to the loss of the safety function. When the fault is detected, subsequent automatic operation of the robot is prevented until the fault is cleared.

To achieve a safety rating, the software/firmware device must be tested to an approved standard by an approved lab. In the U.S., OSHA maintains a list of nationally recognized testing laboratories (NRTL). In Canada, the Standards Council of Canada (SCC) maintains a similar list.

Single Channel with Monitoring

Single channel safety control systems with monitoring must fulfill the requirements for single channel; be safety rated and utilize checking. The check of the safety function(s) must be performed at machine start-up, and periodically during operation. Automatic checking is preferred over manual checking.

The checking operation allows operation if no faults have been detected or generates a stop signal if a fault is detected. A warning must be provided if a hazard remains after cessation of motion. Of course, the check itself must not cause a hazardous situation. After detecting the fault, the robot must remain in a safe state until the fault is corrected.

Single Channel with Monitoring most closely aligns with Category 2 of EN954-1:1996.

Control Reliable

The highest level of risk reduction in the U.S. and Canadian robot standards is achieved by safety related control systems meeting the requirements of Control Reliable. Control reliable safety related control systems are dual channel architectures with monitoring. The stopping function of the robot must not be prevented by any single component failure, including the monitoring function.

The monitoring shall generate a stop command upon detection of a fault. If a hazard remains after motion stops, a warning signal must be provided. The safety system must remain in a safe state until the fault is corrected.

Preferably, the fault is detected at the time of the failure. If this cannot be achieved, then the failure must be detected at the next demand on the safety system.

Common mode failures must be taken into consideration if a significant probability of such a failure can occur.

The Canadian requirements differ from the U.S. requirement by adding two additional requirements. First, the safety related control systems shall be independent of the normal program control systems. Second, the safety system must not be easily defeated or bypassed without detection.

Control reliable systems align with Category 3 and 4 of EN 954-1:1996.

Comments on Control Reliable

The most fundamental aspect of Control Reliable is single fault tolerance. The requirements state how the safety system must respond in the presence of “a single fault,” “any single fault,” or “any single component failure.”

Three very important concepts must considered regarding faults: (1) not all faults are detected, (2) adding the word “component” raises questions about wiring, and (3) wiring is an integral part of the safety system. Wiring faults can result in the loss of a safety function.

The intent of Control Reliability is clearly the performance of the safety function in the presence of a fault. If the fault is detected, then the safety system must execute a safe action, provide notification of the fault, and prevent further operation of the machine until the fault is corrected. If the fault is not detected, then the safety function must still be performed upon demand.

Notes

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Presence Sensing Safety Devices

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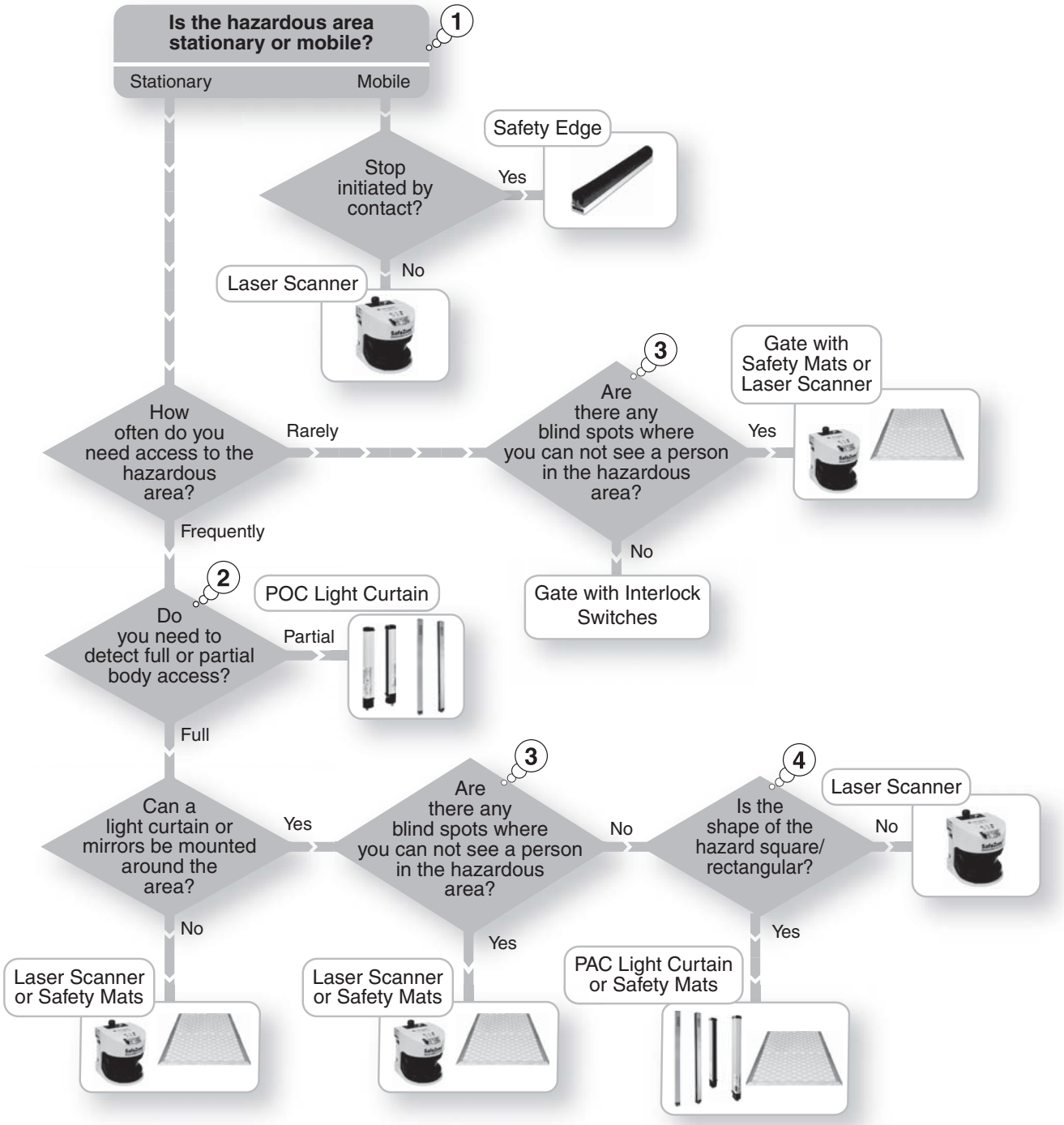
Selection Flowchart



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Allen-Bradley
Guardmaster®

Selection Tips

1 Is the hazardous area stationary or mobile?

A stationary hazard refers to a fixed machine or work cell where one or more mechanical hazards exist. A mobile hazard is generally a fixed-rail linear transfer mechanism (e.g., a transfer cart or conveyor) or an Automatic Guided Vehicle (AGV). Use of a safety device on a mobile hazard generally relates to collision avoidance with personnel or surrounding machinery.

In the instance that the hazard moves toward the operator (such as with powered doors) as opposed to the operator moving toward the hazard, a pressure-sensitive safety edge can be mounted to the leading edge of the door. Any contact between the door and personnel will stop the machine before injury can occur.

2 What do we mean by full- versus partial-body access?

Full-body access generally refers to the requirement for a person to be standing or walking in (or have access to) the hazardous area around a machine that does not require frequent interaction between personnel and the hazard during regular operation; generally this is for maintenance and troubleshooting. Full-body perimeter or area access control (PAC or AAC, respectively) is achieved through the use of a vertical or horizontal safety field, either opto-electronic (i.e., a light curtain or scanner) or by contact (safety edges and mats).

Partial-body access, on the other hand, is required for applications where an operator must regularly reach into a machine hazard as part of the process at the point of operation (known as POC or Point of Operation Control). In the case of opto-electronic safety devices such as light curtains and area scanners, full- or partial-body detection is directly related to the resolution of the safety device. Below is the relationship of sensing field resolution to the type of detection:

Object to be Detected/Protected	Resolution
Finger (vertical field)	14 mm
Hand (vertical field)	30 mm
Limb (horizontal field for leg detection)	50 mm, 70 mm
Full Body (horizontal fields)	150 mm

3 Blind Spots

In some cases it may be possible for a person to enter the guarded area and be lost from view, potentially allowing the guard door to be shut and the machine started by another person. Often used in conjunction with hard guarding and a gate outfitted with an interlock switch, presence sensing safety devices such as pressure-sensitive safety mats, and laser scanners can be used to check for the presence of a person anywhere within the enclosed safety area.

4 Is the shape of the hazardous area rectangular?

When the hazardous area to be monitored is a rectangle (or a shape consisting of contiguous rectangles), access to the area can be easily—and cost-effectively—controlled with a standard safety mat. When the hazardous area is irregularly shaped, a custom mat is a viable option, but not necessarily the most cost-effective or readily available. In such a case, a safety scanner is the best option because its scanning field can be easily programmed to scan irregular areas and ignore obstacles (walls, columns) while detecting moving objects (people, AGVs, etc.) as required.

Other Application Considerations

		Safety Mats	Safety Scanner	Point of Operation Control	Perimeter Access Control
Partial Body Detection	Finger Detection			14 mm	
	Hand Detection		30 mm	30 mm	
	Limb Detection		50/70 mm		
Full Body Detection		✓	✓		✓
Uneven Floor			✓	Horizontally Mounted	
Corrosive Chemicals			✓	✓	✓
High-Pressure Washdowns		✓		IP67/IP69K Enclosure	IP67 Enclosure
Steam, Dust Environment		✓			
Reflections, Bright Ambient Light		✓			

Safety Light Curtains

Selection Navigator

GuardShield Light Curtain	Profile Size [mm]	Type According to IEC 61496	Finger (14 mm)	Hand (30 mm)	Full Body	Protective Height [mm]	Range	Response Time	IP Rating	Integrated Laser Alignment
Standard	40 x 50	Type 4	Yes	Yes	NA	160…1760	14 mm…7 m 30 mm…16 m	20…30 ms	IP65 (IP67)	Optional/Yes
Safe 4	30 x 40					120…1920	14 mm…9 m 30 mm…18 m	14 mm: 11…90 ms 30 mm: 8…48 ms	IP65	Yes
Micro 400	15 x 20					150…1200	5 m	14 mm: 15…42 ms 30 mm: 13…24 ms	Micro 400 IP54 (IP69K) MSR4x IP20	NA
PAC	40 x 50		NA	NA	2 and 3 beams	2 beams: 520 3 beams: 820	16 m	20 ms	IP65	Optional/Yes
Safe 4 PAC	30 x 40					2 beams: 600 3 beams: 840	5…30 m	2 beams: 11 ms 3 beams: 14 ms		Yes
Type 2	40 x 50	Type 2		Yes	NA	160…1760	16 m	20 ms		NA
Safe 2	30 x 40					120…1920	18 m	14 mm: 11…90 ms 30 mm: 8…48 ms		Yes

Integrated Controller	Operating Temperature [C (F)]	Beam Coding	Blanking	EDM	Aux. Output	Cascadable	Muting	Configuration	PL/SIL CL	GuardShield Light Curtain
Yes	-10…55° (14…131°)	Yes	Yes	Yes	1 PNP 0.5 A max.	Yes	Yes with MSR42 or MSR22LM	DIP Switch	PLe/SIL CL3	Standard
	0…55° (32…131°)	NA	NA	NA	NA	NA		NA		Safe 4
Requires MSR41 or MSR42			Yes with MSR42	Yes with MSR42	MSR41: 2 PNP 0.1 A max. MSR42: 2 PNP config.	Yes	Yes with MSR42	MSR42 Wiring or Software		Micro 400
Yes	-10…55° (14…131°)	Yes	NA	Yes	1 PNP 0.5 A max.	NA	Yes with MSR42 or MSR22LM	DIP Switch		PAC
	0…55° (32…131°)	NA		NA	NA			NA		Safe 4 PAC
	-10…55° (14…131°)			Factory Option	1 PNP 0.5 A max.			Factory	Pld/SIL CL2	Type 2
	0…55° (32…131°)			NA	NA			NA		Safe 2

Safedge™ Pressure-Sensitive Safety Edges

Features/Benefits

Pressure-sensitive safety edges are flexible strips that can be mounted to the edge of a moving part—such as a machine table or powered door—that poses a crushing or shearing risk. Contact of the edge with an object or personnel switches off the machine hazard. Safety edges are a cost-effective solution for constant safety monitoring in smaller areas, especially those applications requiring physical flexibility and a tight turn radius. Rated to Category 3, safety edges do not develop 'dead spots' like some other pressure-sensitive safety offerings. They are also easy to install and maintain, and can withstand high-pressure washdowns, making them suitable for a wide range of applications and environments. Multiple profile sizes and the availability of custom edge systems also lend to a high degree of application flexibility. It is important to note that Safedge requires a dedicated safety relay for monitoring and control, which can be connected to other safety systems.

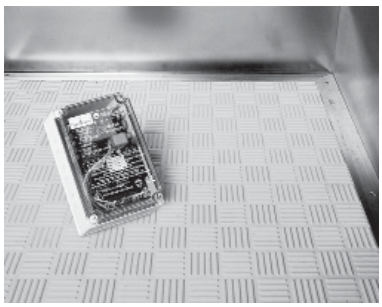
Applications

- Sliding doors
- Garage doors
- Pinch points

Common Misapplications

- Submersible applications
- Exposure to volatile chemicals (that can damage the rubber profile)
- Applications where physical contact can injure personnel

MatGuard™ Pressure-Sensitive Safety Mats



Features/Benefits

Pressure-sensitive safety mats provide constant guarding and monitoring of a floor area around a machine; 66 lbs. or more of pressure on the mat (e.g., an operator's footstep) causes the mat controller unit to switch off power to the hazard. Like safety edges, MatGuard safety mats are easy to apply and maintain, can withstand high pressure washdowns and are not susceptible to dead spots. An ideal solution for relatively small areas, MatGuard products also offer a high degree of application flexibility, offering reversible mats, direct micro quick connectivity to controllers, simple connection to standard and DeviceNet Safety I/O blocks, custom system configurations, and quick-delivery standard sizes. However, mats can be damaged by dropped objects, such as tool dies, and pose a potential trip hazard if trim is not used.

Applications

- Work cells
- Area detection

Common Misapplications

- Uneven floors
- Lack or improper use of uniting trim
- Presence of volatile chemicals

SafeZone™ Safety Laser Scanners

Features/Benefits

The SafeZone safety laser scanners are opto-electronic devices that create a user-configurable scanning field with one or more safety zones. If a person or object enters the warning field, the SafeZone scanner switches a single output that can be used to initiate a warning signal, such as an optical or acoustic alarm. If the inner safety field is breached, the scanner switches two independent safety outputs initiating a machine stop signal to halt dangerous machine motion. Offering warning fields up to 49 meters, the SafeZone is easy to install—either horizontally or vertically—and requires no dedicated controller for operation. Suited for Category 3, SIL2 PLd applications, the scanner is easily interfaced with other safety systems and the easy-to-use configuration software allows customization of the field shape.

Applications

- Work Cells
- Robot Cells
- Stationary or mobile application
- Rotary and index tables
- Moving automated vehicles (AGVs)
- Infeed machinery
- Overhead cranes

Common Misapplications

- Oil, mist, dust, or steam environments
- Outdoor applications
- Extreme temperatures

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Point of Operation Control (POC) Light Curtains

GuardShield

GuardShield Safe 4

GuardShield Micro 400

Features/Benefits

POC light curtains are placed close to the hazard, at the point of operation where personnel may frequently interact with the machine as part of a process. POC light curtains are designed for partial-body detection—finger, hand, and arm detection—and are offered in multiple resolutions and protective heights. An easy-to-install Category 4 SIL 3, PLe solution, these light curtains are easily connected to other safety systems, but usually do not require a separate controller and can therefore be operated as standalone units (i.e., without a safety relay). Since they are located at the machine's point of operation, POC light curtains eliminate the need for gates, allowing frequent and easy access to the hazardous area, and can be used as an ergonomic workstation control that increases safety while enhancing productivity. These light curtains can be mounted vertically or horizontally. However, it is important to note that these light curtains do not detect people or objects once they have passed through the light curtain.

POC light curtains are also suitable for use in washdown applications when used in conjunction with the IP67 or IP69K light curtain enclosures.

Applications

- Conveyors
- Electronic fences
- Forming operations
- Robot Cells
- Presses
- Workstations
- Washdown applications (use IP 67 tube accessory)

Common Misapplications

- Used on full revolution machinery
- Mounted too close to hazard

Perimeter Access Control (PAC) Light Curtains

GuardShield PAC

GuardShield Safe 4 PAC

Features/Benefits

PAC light curtains are an easy-to-install, Category 4 solution for full-body access detection. Designed to create a safety perimeter around a machine that does not require frequent interaction between personnel and the hazard during regular operation, PAC light curtains provide large object pass-through sensing with detection ranges up to 30 meters. PAC light curtains can be easily interfaced with other safety systems or used as standalone units without a dedicated control unit/safety relay. However, it is important to note that these light curtains do not detect people or objects once they have passed through the light curtain.

Applications

- Conveyor Systems with muting
- Robot cells
- Opto-electronic fence
- Washdown with IP 67 tube

Common Misapplications

- Used as POC device
- Used on machine that does not stop until completing a full revolution
- Horizontal installation

GuardShield™

Introduction

The Allen-Bradley Guardmaster GuardShield is offered as a Type 2 and a Type 4 POC safety light curtain as well as a Type 4 PAC safety light curtain. The Type 4 POC GuardShield is offered in both 14 mm and 30 mm resolutions while the Type 2 is offered in 30 mm resolution only. The GuardShield PAC is offered with multiple beam configurations with varying beam spacings. All GuardShield family safety light curtains meet the requirements of IEC/EN 61496.

POC safety light curtains are designed to detect the presence of an opaque object of a minimum resolution. These devices are usually positioned in front of the point of operation hazard, however, they may also be used for perimeter guarding applications.

PAC safety light curtains are typically used as opto-electronic fences or as whole body detection devices to detect personnel or large objects when they pass through the sensing field. These PAC safety light curtains are typically positioned around an area or in front of a process entry or exit area.

The Allen-Bradley Guardmaster GuardShield is a two-box safety light curtain, consisting of a nonmatched transmitter and receiver pair. Any GuardShield transmitter of the same family (POC, PAC) and same resolution will work with any receiver of the same family and resolution. The synchronization between transmitter and receiver is achieved optically. The first beam adjacent to the receiver LEDs is the synchronization channel. This synchronization beam cannot be blocked in a fixed or floating blanking application.

The GuardShield safety light curtain has two transistor type PNP safety outputs, referred to as OSSDs (Output signal switching devices). These outputs may be connected to a safety relay module or directly to the primary control element of a machine if the EDM connection within the GuardShield receiver is also connected and configured.

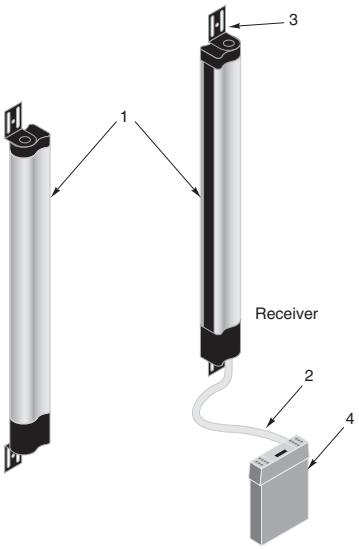
The standard GuardShield receiver also has an auxiliary nonsafety output which can be connected to a PLC for status of the OSSDs, to a stack light for signaling or to control an in-feed motor, etc.

The standard GuardShield requires separate transmitter and receiver cables. The transmitter cable utilizes a 4-pin micro quick-disconnect (M12) connector and is offered in lengths from 2 meters to 30 meters. The receiver cable has an 8-pin micro quick-disconnect (M12) connector and is also offered in lengths from 2 meters to 30 meters.

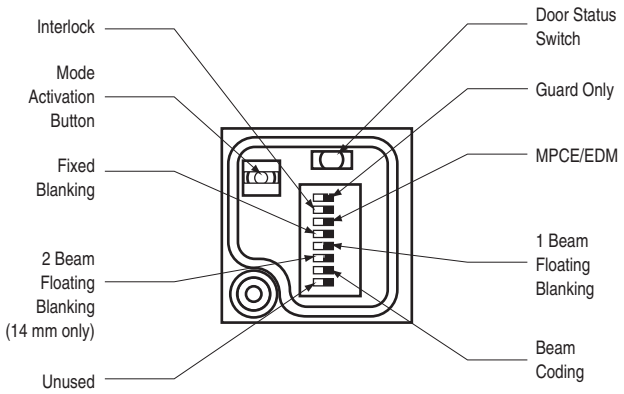
Typical System Configuration

Components required for a "Guard only" system:

1. Optic heads (operate on 24V DC—ordered as a pair (transmitter/receiver)
2. Cable—two required per pair—specify transmitter cable and receiver cable
3. Mounting brackets—included
4. Safety Relay Module—optional (**Note:** A Category 3 system may be possible by connecting the GuardShield OSSDs directly to two safety contactors and connecting and configuring the EDM mode of operation in the GuardShield receiver.)



The Allen-Bradley Guardmaster GuardShield Type 4 is a two-box light curtain with DIP switch selectable operating modes.



Receiver DIP Switch Functions or GuardShield Type 4 POC

The standard GuardShield safety light curtain has DIP-switches located in both the transmitter and receiver endcaps. The DIP-switches are accessible through a hinged door that is secured to the endcap with a security screw.

The transmitter DIP-switches provide for the configuration and activation of Beam Coding and Machine Test Signal.

The receiver DIP-switches provide for configuration of all of the GuardShield safety light curtain's modes of operation.

GuardShield Safe 4

The GuardShield Safe 4 is a Type 4 safety light curtain offered in POC and PAC versions with basic ON/OFF functionality. The Safe 4 POC is offered in both 14 mm and 30 mm resolutions in protective heights ranging from 120 mm up to 1920 mm in increments of 120 mm.

The GuardShield Safe 4 PAC (Perimeter Access) is offered with two 120 mm modules providing 500 mm spacing and with three 120 mm modules providing 400 mm spacing. Both the two- and three-beam Safe 4 PAC versions have an operating range from 5 meters up to 30 meters.

The GuardShield Safe 4 POC and Safe 4 PAC are economical Type 4 safety light curtains with ON/OFF functionality and an integrated laser alignment system. The integrated laser alignment system consists of a constantly powered Class 2 visible laser located on the top of the transmitter and on the bottom of the receiver. The constantly powered integrated laser alignment systems allows a low level of laser light to be emitted. Simply touching a finger to the laser beneath the finger symbol reflects the low level of laser light back to a photo sensor which causes the laser light intensity to increase for five minutes or until a finger covers the laser reflecting the laser back to the photo sensor which signals a reduction of the intensity of the emitted laser light. This system assures that both the top and bottom of the Safe 4 pair are quickly and easily aligned or realigned if a light curtain or corner mirror is inadvertently moved during operation.

GuardShield Safe 4

GuardShield Safe 2

The GuardShield Safe 2 is a Type 2, SIL 2, PLd, safety light curtain offered with a 30 mm resolution in protected heights ranging from 120 to 1920 mm in 120 mm increments. The GuardShield Safe 2 is an economical, two-box safety light curtain with ON/OFF functionality and an integrated laser alignment system. The integrated laser alignment system consists of a Class 2 visible laser located at the top of the transmitter and the bottom of the receiver. Each laser has a target located opposite the laser on the transmitter and receiver. This integrated laser alignment system facilitates alignment at installation and during the course of usage if the Safe 2 pair is knocked out of alignment.

GuardShield Micro 400

The GuardShield Micro 400 is an economical three-box (transmitter, receiver and controller) Type 4 safety light curtain offered in a small profile (15 mm X 20 mm) housing. Designed for use in benign industrial environments (IP54), this medium/light duty safety light curtain system is targeted to the semi-conductor, microelectronic and small assembly machine markets.

The compact housing size allows the GuardShield Micro 400 to be mounted in areas where standard safety light curtains may not be able to be mounted due to space constraints.

The GuardShield Micro 400 requires a dedicated controller, either an MSR42 or MSR41. The MSR41 is a basic controller for simple ON/OFF functionality and the MSR42, in addition to providing operating functionality for the Micro 400, can be used as a multi-function safety module. This multi-functional safety module allows the connection of additional safety light curtains, safety laser scanner or a safety device with PNP type outputs as well as E-stops or override switches. The MSR42 can have limited functionality activated by wiring but requires configuration software for any advanced functionality.

The Micro 400 transmitter and receiver are offered with eight-pin M12 connectors at the end of 500 mm (19.8 in.) integrated cables. The patchcords to connect the transmitter and receiver to the controller are the same cat. no. and are offered in various lengths. These patchcords are configured on one end with M12 connectors that mate to the integrated pigtail connectors and RJ45 connectors on the opposite end, that plug into the MSR41 or MSR42 controller.

The Micro 400 is also offered in cascadable configurations. GuardShield Cascadable Micro 400 safety light curtains allow the interconnection of multiple segments of the Micro 400 safety light curtain with a common pair of safety outputs. This cascadable configurability of the GuardShield Micro 400 reduces overall system wiring and allows the GuardShield Micro 400 to be fitted into a variety of applications where the safety distances for mounting the light curtain may allow personnel to stand between the light curtain's sensing field and the hazard or where multiple-sided guarding is required and the use of corner mirrors is not possible.

GuardShield Micro 400

Micro 400 Cascading

Micro 400 Cascaded

Typical System Configurations

The Allen-Bradley Guardmaster GuardShield and GuardShield Safe 4 safety light curtains are two-box designs. This means the safety light curtain does not need a separate controller to operate. Therefore, the safety outputs of the light curtain (OSSDs) can be connected directly to any safety relay that will accept two PNP inputs.

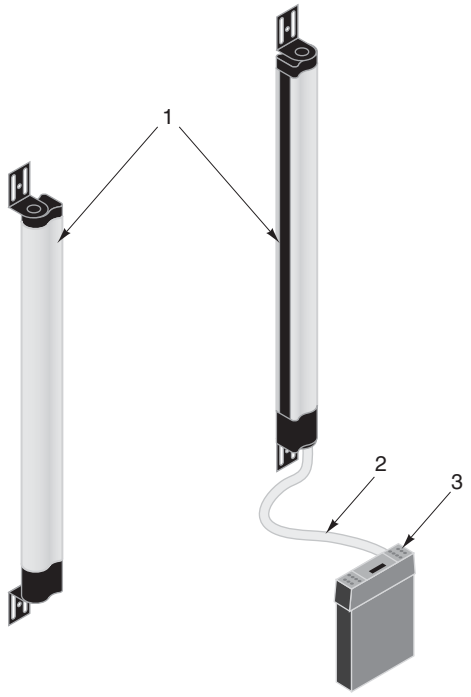
The following are some common configurations of light curtain systems. The numbers on the drawing indicate the ordering steps to follow to ensure that a complete system is specified.

Components required for a "Guard only" system:

1. Optic heads (operate on 24V DC)—ordered as a pair (transmitter/receiver)
2. Cables—two required per pair—specify length

Optional components (customer or Allen-Bradley Guardmaster supplied):

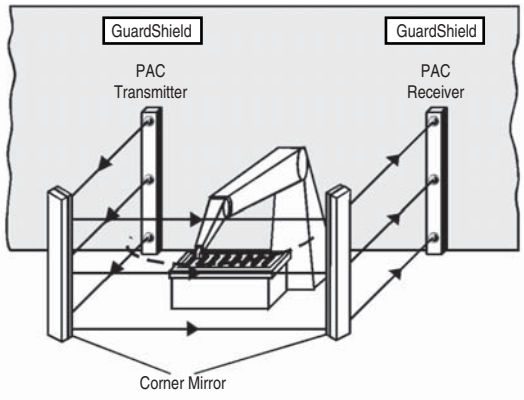
3. Safety Relays



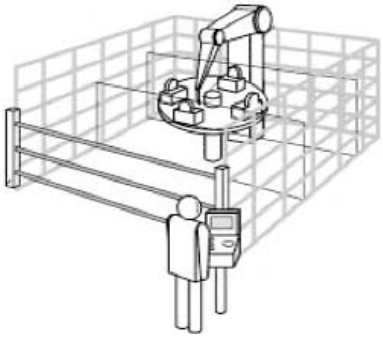
Perimeter Access Control (PAC)

Allen-Bradley Guardmaster PAC safety light curtains consist of two families, the GuardShield PAC family and the Safe 4 PAC family. The GuardShield PAC family is offered with multiple beams with various beam spacings for short range applications (16 meters or less). The Safe 4 PAC family is offered with multiple beams (2 or 3) with various beam spacings for long range (5…30 meters).

PAC safety light curtains are opto-electronic through-beam devices typically used to detect personnel around hazardous equipment or machinery. PAC safety light curtains are usually used as an opto-electronic fence and when used with corner mirrors, can provide two- or three-sided detection around the perimeter of hazardous machinery.



PAC safety light curtains are generally of resolutions that provide detection of limbs and bodies of personnel, i.e., 50 mm, 70 mm, 90 mm and up. It is also common for PAC safety light curtains to be offered with a limited number of infrared beams spaced at consistent distances from one another, such as 3 beams with 400 mm spacing between beams, or 2 beams with 500 mm beam spacing.

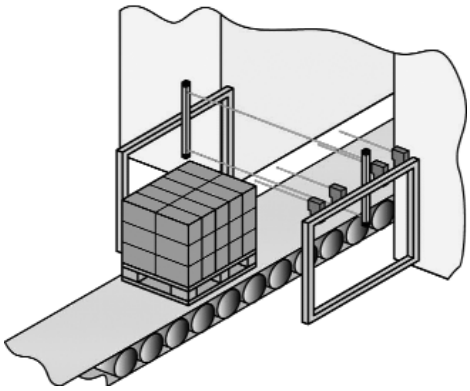


Muting

PAC safety light curtains are also used in conveyorized processes and very often are used in conjunction with a muting module. Muting is the temporary automatic suspension of the protective function of the safety light curtain.

Muting modules can be integrated into the light curtain's receiver or external to the light curtains. Rockwell currently offers external muting modules.

This muting function allows material to move through the safety light curtain's sensing field without stopping the machine, however, if a person attempts to pass through the safety light curtain, they will be detected and the machine will stop. The differentiation between material and personnel is determined by the use of muting sensors. These muting sensors create a particular switching sequence together with the safety light curtain as the material passes through the process.



Conveyorized muting

Muting sensors are typically used in pairs and depending upon the sensor configuration and muting module, allow either uni-directional or bi-directional travel of material through the safety light curtain.

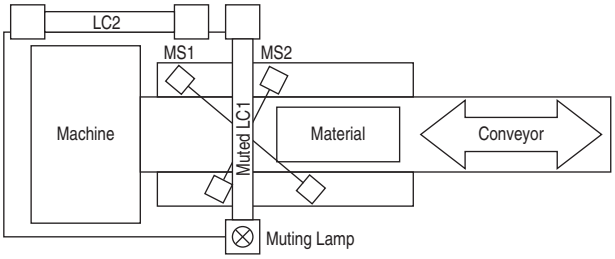


Figure 1: Two-sensor bi-directional muting

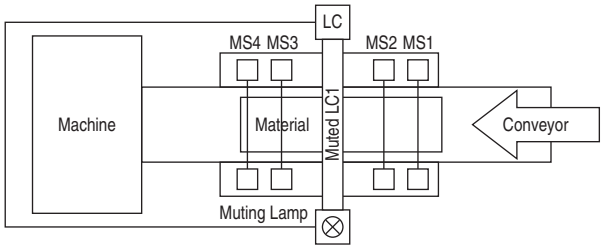


Figure 2: Four-sensor uni-directional muting

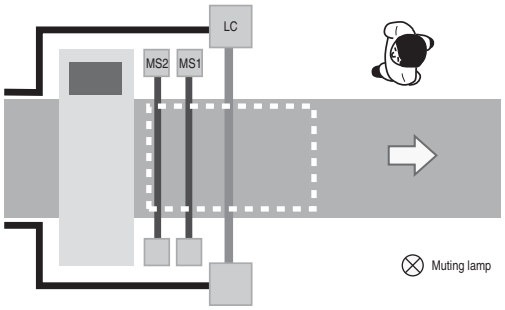


Figure 3: Two-sensor L-type with MSR42

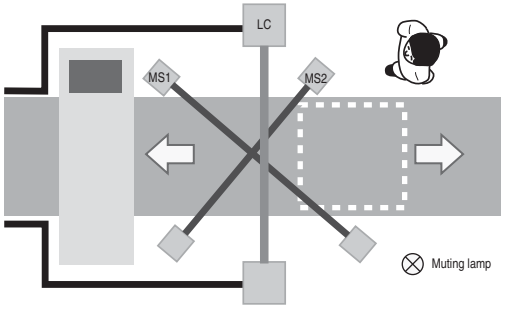


Figure 4: Two-sensor T-type with MSR42

Four-sensor muting for this particular muting module in Figure 2 allows a single direction of travel. A particular sequence is also required in this configuration; muting sensor 1 must be interrupted first followed by muting sensor 2 and then the safety light curtain, then muting sensor 3 and finally muting sensor 4. It is necessary with this particular muting module to have the light curtain's sensing field interrupted within 3 seconds of muting sensor two being interrupted. Also, the material must block muting sensor 3 and muting sensor 4 before clearing muting sensors 1 and 2 or the muting function is overridden and the safety light curtain would become active causing a nuisance shutdown of the machine if the material is within the light curtain sensing field.

An interruption of the safety light curtain sensing field would cause the machine or the hazardous motion to be turned off. The muting cycle is completed when the material clears muting sensor 4.

The muting sensors must be spaced appropriately from the safety light curtain and each other in order to ensure that the sensors cannot be interrupted by personnel, causing the activation of the muting function.

A requirement of muting in machine applications is for indication that the muting function is activated. This is typically accomplished by the use of a muting lamp. The various muting modules offered by Rockwell Automation have an output for the connection of a muting lamp.

GuardShield Perimeter Access Control (PAC)

The Allen-Bradley Guardmaster GuardShield PAC safety light curtain system is a two-box design. This means the safety light curtain does not need a separate controller to operate in a guard-only mode with manual reset. Therefore, the safety outputs of the light curtain (OSSDs) can be connected directly to any safety relay that will accept PNP inputs.

The following are some common configurations of light curtain systems. The numbers on the drawing indicate the ordering steps to follow to ensure that a complete system is specified.

Components required for a multiple-beam PAC system, see Figure 3:

- Optic heads (operate on 24V DC)—ordered as a pair (transmitter/receiver) mounting brackets included
- Cables—separate 4-pin transmitter and 8-pin receiver
- Safety relay if EDM is not used
- Corner mirrors (for multiple side protection)

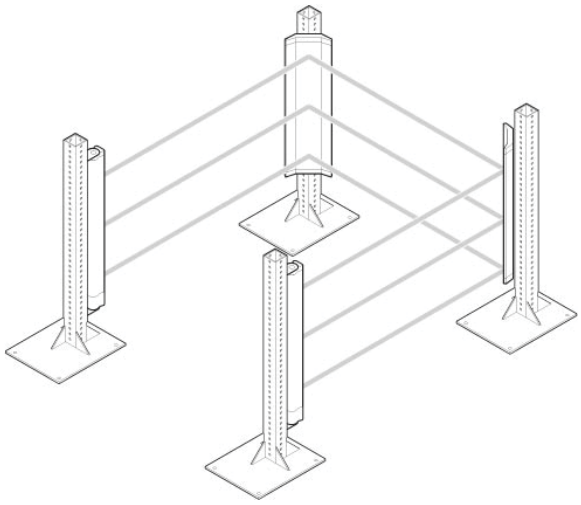
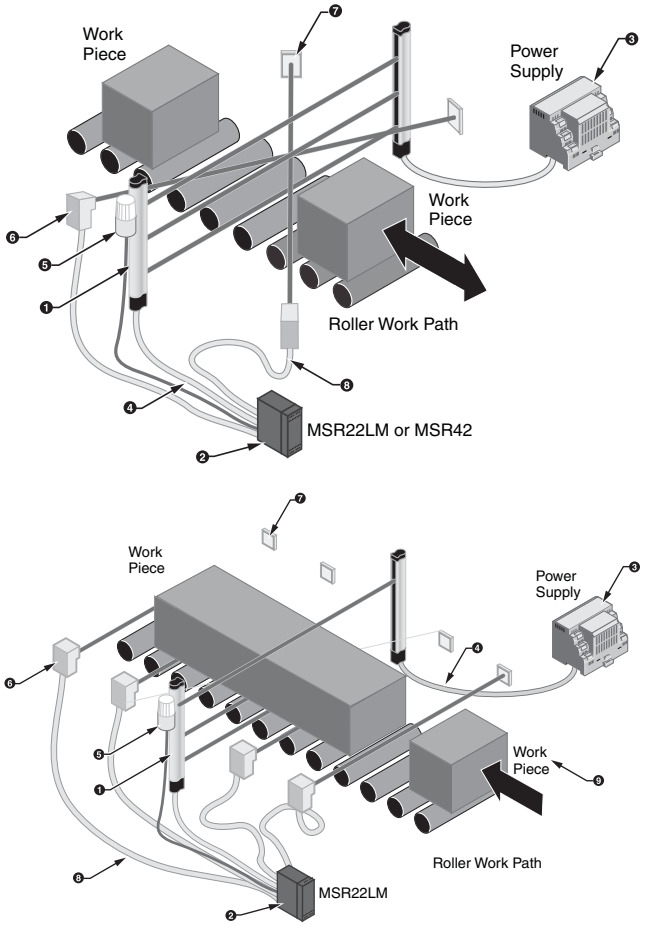


Figure 4

Components Required for PAC with Muting, see Figure 4:

1. Optic heads (operate on 24V DC) with muting module—ordered as a pair (transmitter/receiver)
2. It is also possible to use other Allen-Bradley Guardmaster muting modules such as the MSR42 or the MSR22LM muting module
3. Power supply
4. Cables for light curtains
5. Muting indication
6. Sensors for muting
7. Sensor accessories
8. Sensor cordsets



Perimeter Access Control Overview

Typical System Configurations

The Allen-Bradley Guardmaster Safe 4 PAC safety light curtain system is a two box design. This means the safety light curtain does not need a separate controller to operate in a guard-only mode. Therefore, the safety outputs of the light curtain (OSSDs) can be connected directly to any safety relay that will accept PNP inputs.

The following are some common configurations of light curtain systems. The numbers on the drawing indicate the ordering steps to follow to ensure that a complete system is specified.

Components required for a multiple-beam Safe 4 PAC, see Figure 5:

1. Optic heads (operate on 24V DC)—ordered as a pair (transmitter/receiver)
2. Cables—5-pin cables for transmitter and receiver
3. Safety relay
4. Power supply—120V AC to 24V DC
5. Mounting brackets—minimum of 4 per optic head pair
6. Corner mirror columns (for multiple side protection)
7. Mounting stand if required

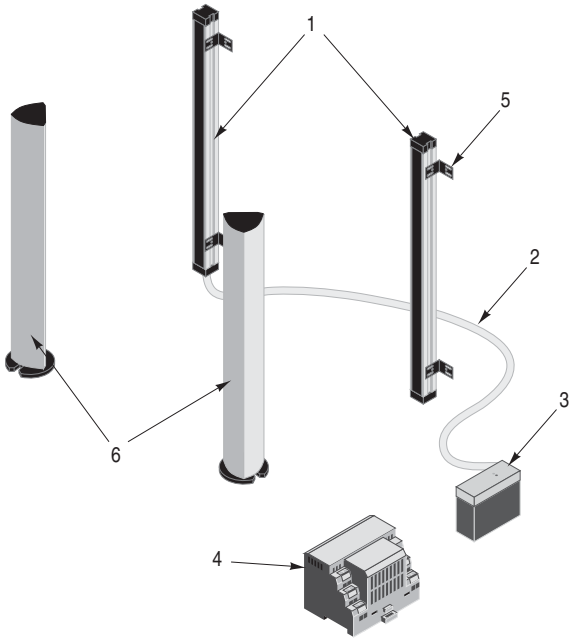


Figure 5

Description

Standard GuardShield

The Allen-Bradley Guardmaster GuardShield safety light curtain is an economical, fully featured, Type 4 safety light curtain in a uniquely styled housing. GuardShield safety light curtains are general-purpose presence sensing devices designed for use on hazardous machinery providing point of operation, as well as perimeter and access guarding. This self-contained, two-box, safety light curtain has DIP-switch selectable operating modes and is available in both 14 mm and 30 mm resolutions.

Modes of operation such as fixed and floating blanking, beam coding, start/restart interlock, external device monitoring (EDM), and machine test signal, are selected by DIP-switch settings. These DIP-switches are located beneath a security door, which are conveniently located on both the transmitter and receiver end caps.

The GuardShield's torsionally rigid, extruded aluminium, polyurethane powder-coated housing, combined with an environmental rating of IP65, allows the GuardShield to be used in guarding applications across a broad range of industries.

Remote Teach GuardShield

The GuardShield Remote Teach system provides a remote means of changing a fixed blanking configuration within the GuardShield safety light curtain. This keyswitch box eliminates the need to open the GuardShield receiver door and perform the Teach function.

The three-position key switch simulates the opening of the GuardShield receiver door, teaching the GuardShield light curtain the new fixed blanking area, closing the door and returning to the run mode of operation.

The IP65 rated key switch box is provided with a steel mounting back plate to facilitate mounting of the box in proximity to the GuardShield receiver. It is necessary to see the receiver LEDs when performing the teach function.

Cascadable GuardShield System

A cascadable GuardShield safety light curtain is a standard GuardShield safety light curtain in 14 and 30 mm resolutions with additional M12 connectors located on top of each safety light curtain. The connector on the top of the safety light curtains allow the interconnection of up to a total of three pair of GuardShield safety light curtains with a common pair of OSSDs. The ability to interconnect GuardShield pairs reduces overall system wiring and simplifies the safety circuit resulting in a lower overall cost of a multiple safety light curtain system. This product configurability also allows a GuardShield safety light curtain system to protect multiple sides of a machine or simply adds flexibility when positioning GuardShield in various applications.

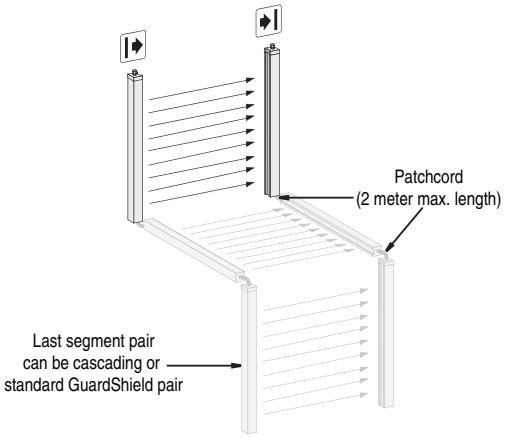
The complete cascading GuardShield system has the full functionality of a standard GuardShield (beam coding, EDM, start/restart interlock, fixed and floating blanking). There are a couple of operating modes which can not be configured in the middle and end segments (EDM and Start/Restart Interlock) and must only be configured in the host (first) pair. The system will still have these operating modes active if configured in the host or first GuardShield pair. This host or first pair is the pair of cascading GuardShield light curtains, which have the output cordsets connected and wired to the safety relay, safety PLC or FSDs. Configuring of the EDM operating mode in the end and middle segments will cause the system to go to a lock-out condition after the first interruption of the sensing field. Configuration of the start/restart interlock operating mode in the end and middle segments will cause the system to stay in a red condition awaiting reset after the interruption of the sensing field.

The cascading GuardShield safety light curtains are ordered as pairs (transmitter and receiver) and are shipped under one cat. no. After selecting the appropriate pair of cat. nos. for a cascading GuardShield system, select the interconnecting transmitter and receiver patchcord cat. nos. to connect the GuardShield pairs. The transmitter patchcord is a 4-pin M12 patchcord offered in lengths of 1/3 meter, 1 meter and 2 meters. The receiver patchcord is an 8-pin M12 patchcord offered in lengths of 1/3 meter, 1 meter, and 2 meters.

If the end pair of a cascading system is a cascading pair of GuardShield light curtains, it is necessary to attach a termination adaptor to the top M12 connector located on the receiver. Be sure to order all other required interfaces and accessories.

POC Type 4 Safety Light Curtains

GuardShield



Up to three GuardShield POC segments can be interconnected.

The upper and lower limit of the protective field is shown by markings on the housings.

The width of the protective field is derived from the length of the light path between transmitter and receiver and must not exceed the maximum rated width of the protective field: 7 m for 14 mm (22.9 ft for 0.55 in.), 18 m for 30 mm (59.0 ft for 1.18 in.).

Cascading segments are offered in protective heights from 320…1760 mm in both 14 mm and 30 mm resolutions. Cascading segments of 160 mm are not offered, however; a 160 mm GuardShield can be used as the last segment in a cascading system.

A maximum of three GuardShield light curtains can be interconnected with a common pair of OSSDs. The maximum number of beams allowed in a cascading system is 528 beams, which equates to three 1760 mm cascading GuardShields in 14 mm resolution. The individual segments can have mixed resolutions, e.g., 14 mm and 30 mm as long as the pairs have the same protective heights and resolutions.

The response time of a cascading GuardShield system is the longest response time of any pair in the cascading system. For example, if the response time of each pair in the cascading system is 20 ms, then the cascading system's response time is 20 ms.

Cascading segments can be used as standalone light curtain pairs or can have up to three segments interconnected. These cascading segments all function as independent light curtains.

IMPORTANT	When cascading segments are used as standalone pairs or as the last segment in a cascading system, it is necessary to use a termination plug on the top connector of the GuardShield cascading receiver. It is also possible to use a standard GuardShield Type 4 POC pair as the last segment in a cascading system.

GuardShield with Integrated Laser Alignment System

The GuardShield POC and GuardShield POC cascadable light curtains are offered with an integrated laser alignment system consisting of a Class 1, eye safe, constantly powered laser located in the top of the GuardShield transmitter and at the bottom of the GuardShield receiver. There are targets located across from each laser that help facilitate alignment of the light curtain when the laser is emitting visible light.

Each laser emits a low level of visible light. Simply placing a finger or opaque object in front of the laser reflects the laser light back to a photo sensor. This photo sensor causes the laser to switch state from a barely visible low level of emission to a higher level of emission of visible light. Interrupting the visible light below the finger symbol will cause the laser to change state back to a low level of light emission. The visible light will also change to a low level after five minutes.

The Integrated Laser Alignment system also quickly helps with the re-alignment of pairs when units are knocked out of alignment during the course of the work process or when corner mirrors are used.

The GuardShield and Cascadable GuardShield are offered in 14 and 30 mm resolutions in protective heights from 320 to 1600 mm. The 160 and 1760 mm protective heights are not offered with the integrated laser alignment systems.

ArmorBlock Guard I/O Connectivity

The GuardShield POC and GuardShield Cascadable light curtains are also offered with the Class 1, eye safe, integrated laser alignment system and connectivity to ArmorBlock Guard I/O. The receiver of these light curtains has a five-pin M12 quick-disconnect connector wired to connect to the 1732DS ArmorBlock I/O module, allowing the GuardShield's OSSDs to operate over a DeviceNet Safe network.

This version of the GuardShield has limited configurability, i.e., only beam coding, fixed and floating blanking can be configured by setting the appropriate DIP switches and performing the teach function. EDM, Start/Restart interlock, and the auxiliary output are not available in these models.

You can use the ArmorBlock Guard I/O with any safety controller that communicates on DeviceNet using CIP Safety for the control and monitoring of safety circuits. ArmorBlock Guard I/O detects circuit failures at each I/O point while providing detailed diagnostics directly to the controller. With CIP Safety, you can easily integrate safety and standard control systems by using safety and standard messages on the same wire.

The 1732DS ArmorBlock Guard I/O family consists of 24V DC digital I/O modules that communicate on DeviceNet networks.

Features

Standard GuardShield

- Fixed blanking—teachable
- Floating blanking
  - – One-beam floating blanking on 30 mm resolution
  - – Two-beam floating blanking on 14 mm resolution
- Beam coding
- External Device Monitoring (EDM)
- Start/restart interlock
- M12 quick-disconnect connectors
- 160 to 1760 mm in 160 mm increments
- Standard GuardShield can be used as last segment pair in a cascading system

Standard GuardShield with Integrated Laser Alignment

- Fixed blanking—teachable
- Floating blanking
- Beam coding
- M12 quick-disconnect connectors
- Ease of alignment at installation with visible laser alignment
- 320…1600 mm in 160 mm increments
- 14 and 30 mm resolutions

Remote Teach GuardShield

- Three-position momentary key switch
- IP65 rated key switch box
- Y connector for quick-disconnect connections
- Standard GuardShield cables
- Allows quick and efficient reteaching of fixed blanked areas
- 160 to 1760 mm in 160 mm increments

Cascadable GuardShield System

- Easy to interconnect light curtains up to three 1760 mm segment pairs
- No increase in system response time

ArmorBlock Guard I/O GuardShield

- Fixed blanking—teachable
- Floating blanking
- Up to three cascading pairs can connect to ArmorBlock Guard I/O
- Beam coding
- M12 quick-disconnect connectors
- DeviceNet safe network connectivity
- 320…1600 mm in 160 mm increments

Specifications

Safety Ratings	
Standards	IEC/EN 61496 Parts 1 & 2, UL 61496 Parts 1 & 2, UL 1998
Safety Classification	Type 4 per IEC/EN61496. Category 4 device per EN 954-1, SIL 3 per IEC 61508, PLe per EN/ISO 13849
Certifications	cULus, UL 61496, UL 1998, TÜV, and CE Marked for all applicable directives
Power Supply	
Input Power, Max.	24V DC ±20%
Maximum Residual Ripple	0.05 Vss
Power Consumption	0.4 A max (no load)
Outputs	
Safety Outputs	2 OSSD, 0.5 A, short-circuit protected
Non-Safety Outputs	Auxiliary output, 0.5 A max.
Output Voltage, Min.	(Uv) - 2V
Switching Current @ Voltage, Min.	500 mA @ 24V DC
Operating Characteristics	
Response Time	14 mm; 160 mm…1440 mm 20 ms, 1600 mm and 1760 mm, 25 ms. 30 mm; 20 ms. Add 10 ms when beam coding activated.
Status Indicators	ON State, OFF State, Blanking, Alignment, Interlock
Protected Height [mm (in.)]	See Product Selection tables.
Resolution [mm (in.)]	14 (0.55) or 30 (1.18)
Scanning Range/Resolution	0.3…7 m / 14 mm (0.98…22.9 ft / 0.55 in.) 0.3…16 m / 30 mm (0.98…52 ft / 1.18 in.)
Synchronization	Optical, first beam adjacent to LEDs.
Wavelength	870 nm
Environmental	
Enclosure Type Rating	IP65
Relative Humidity	15…95% (noncondensing)
Operating Temperature [C (F)]	-10…55° (14…131°)
Vibration	IEC60068-2-6: Frequency 10…55 Hz; Amplitude: 0.35 mm (0.01 in.)
Shock	IEC60068-2-29: Acceleration 10 g, pulse duration 16 ms 10…55 Hz
Physical Characteristics	
Mounting	End-cap brackets supplied
Weight	Varies by protective height
Housing Cross Section	40 mm x 50 mm (1.57 in. x 1.96 in.)
Connection Type	Transmitter: 4-pin M12 micro QD; Receiver: 8-pin M12 micro QD
Cable Length	30 m (100 ft) max.

POC Type 4 Safety Light Curtains

GuardShield

Product Selection

Standard System

The Allen-Bradley Guardmaster GuardShield safety light curtains are ordered as pairs—transmitter and receiver—and shipped under one cat. no. After selecting the appropriate light curtain pair, ensure that required interfaces and accessories are ordered.

Protected Height [mm (in.)]	Resolution [mm (in.)]	Number of Beams	Cat. No.	Protected Height [mm (in.)]	Resolution [mm (in.)]	Number of Beams	Cat. No.
160 (6.3)	14 (0.55)	16	440L-P4J0160YD	160 (6.3)	30 (1.18)	8	440L-P4K0160YD
320 (12.6)	14 (0.55)	32	**440L-P4J0320YD**	320 (12.6)	30 (1.18)	16	**440L-P4K0320YD**
480 (18.9)	14 (0.55)	48	440L-P4J0480YD	480 (18.9)	30 (1.18)	24	**440L-P4K0480YD**
640 (25.2)	14 (0.55)	64	**440L-P4J0640YD**	640 (25.2)	30 (1.18)	32	**440L-P4K0640YD**
800 (31.5)	14 (0.55)	80	**440L-P4J0800YD**	800 (31.5)	30 (1.18)	40	**440L-P4K0800YD**
960 (37.8)	14 (0.55)	96	440L-P4J0960YD	960 (37.8)	30 (1.18)	48	**440L-P4K0960YD**
1120 (44.1)	14 (0.55)	112	440L-P4J1120YD	1120 (44.1)	30 (1.18)	56	**440L-P4K1120YD**
1280 (50.4)	14 (0.55)	128	440L-P4J1280YD	1280 (50.4)	30 (1.18)	64	**440L-P4K1280YD**
1440 (56.7)	14 (0.55)	144	440L-P4J1440YD	1440 (56.7)	30 (1.18)	72	440L-P4K1440YD
1600 (63.0)	14 (0.55)	160	440L-P4J1600YD	1600 (63.0)	30 (1.18)	80	440L-P4K1600YD
1760 (69.1)	14 (0.55)	176	440L-P4J1760YD	1760 (69.1)	30 (1.18)	88	440L-P4K1760YD

Note: The GuardShield transmitter requires a 4-pin cable and the receiver requires an 8-pin cable.
Note: To select just a transmitter or receiver, replace the "P" in the above cat. nos. with a "T" for transmitter and an "R" for receiver.

Remote Teach System

The Allen-Bradley Guardmaster GuardShield remote teach system is ordered as a system. The system consists of a standard GuardShield transmitter in either 14 mm or 30 mm resolutions with mounting hardware, a GuardShield receiver with a 10 inch Y-connector cable, a metal key switch box, and a 4-pin 2 meter patchcord which connects between the key switch box and the Y-connector.

Protected Height [mm (in.)]	Resolution [mm (in.)]	Number of Beams	Cat. No.	Protected Height [mm (in.)]	Resolution [mm (in.)]	Number of Beams	Cat. No.
160 (6.3)	14 (0.55)	16	440L-S4J0160YR	160 (6.3)	30 (1.18)	8	440L-S4K0160YR
320 (12.6)	14 (0.55)	32	440L-S4J0320YR	320 (12.6)	30 (1.18)	16	440L-S4K0320YR
480 (18.9)	14 (0.55)	48	440L-S4J0480YR	480 (18.9)	30 (1.18)	24	440L-S4K0480YR
640 (25.2)	14 (0.55)	64	440L-S4J0640YR	640 (25.2)	30 (1.18)	32	440L-S4K0640YR
800 (31.5)	14 (0.55)	80	440L-S4J0800YR	800 (31.5)	30 (1.18)	40	440L-S4K0800YR
960 (37.8)	14 (0.55)	96	440L-S4J0960YR	960 (37.8)	30 (1.18)	48	440L-S4K0960YR
1120 (44.1)	14 (0.55)	112	440L-S4J1120YR	1120 (44.1)	30 (1.18)	56	440L-S4K1120YR
1280 (50.4)	14 (0.55)	128	440L-S4J1280YR	1280 (50.4)	30 (1.18)	64	440L-S4K1280YR
1440 (56.7)	14 (0.55)	144	440L-S4J1440YR	1440 (56.7)	30 (1.18)	72	440L-S4K1440YR
1600 (63.0)	14 (0.55)	160	440L-S4J1600YR	1600 (63.0)	30 (1.18)	80	440L-S4K1600YR
1760 (69.1)	14 (0.55)	176	440L-S4J1760YR	1760 (69.1)	30 (1.18)	88	440L-S4K1760YR
Remote Teach Keyswitch Box Assembly∗			440L-M8600	DC Micro Style Quick-Disconnect Patchcord, 4-Pin∗			889D-F4ACDM-2

Note: The GuardShield transmitter requires a 4-pin cable and the receiver requires an 8-pin cable.
Note: The GuardShield remote teach system light curtains can be ordered as pairs by replacing the "S" in the cat. no. a with "P."
∗ Included with each system cat. no.; can be ordered as a replacement part.

Cascadable Standard System

Protected Height [mm (in.)]	Resolution [mm (in.)]	Number of Beams	Cat. No.	Protected Height [mm (in.)]	Resolution [mm (in.)]	Number of Beams	Cat. No.
320 (12.6)	14 (0.55)	32	440L-C4J0320YD	320 (12.6)	30 (1.18)	16	440L-C4K0320YD
480 (18.9)	14 (0.55)	48	440L-C4J0480YD	480 (18.9)	30 (1.18)	24	440L-C4K0480YD
640 (25.2)	14 (0.55)	64	440L-C4J0640YD	640 (25.2)	30 (1.18)	32	440L-C4K0640YD
800 (31.5)	14 (0.55)	80	440L-C4J0800YD	800 (31.5)	30 (1.18)	40	440L-C4K0800YD
960 (37.8)	14 (0.55)	96	440L-C4J0960YD	960 (37.8)	30 (1.18)	48	440L-C4K0960YD
1120 (44.1)	14 (0.55)	112	440L-C4J1120YD	1120 (44.1)	30 (1.18)	56	440L-C4K1120YD
1280 (50.4)	14 (0.55)	128	440L-C4J1280YD	1280 (50.4)	30 (1.18)	64	440L-C4K1280YD
1440 (56.7)	14 (0.55)	144	440L-C4J1440YD	1440 (56.7)	30 (1.18)	72	440L-C4K1440YD
1660 (63.0)	14 (0.55)	160	440L-C4J1600YD	1600 (63.0)	30 (1.18)	80	440L-C4K1600YD
1760 (69.3)	14 (0.55)	176	440L-C4J1760YD	1760 (69.3)	30 (1.18)	88	440L-C4K1760YD

Note: Cascadable systems are sold in pairs represented by the "C" in the cat. no. To order the cascadable transmitter or receiver, replace the "C" with a "G" for the transmitter or "F" for the receiver.

GuardShield with Integrated Laser Alignment

Protected Height [mm (in.)]	Resolution [mm (in.)]	Number of Beams	Cat. No.	Protected Height [mm (in.)]	Resolution [mm (in.)]	Number of Beams	Cat. No.
320 (12.6)	14 (0.55)	32	440L-P4JL0320YD	320 (12.6)	30 (1.18)	16	440L-P4KL0320YD
480 (18.9)	14 (0.55)	48	440L-P4JL0480YD	480 (18.9)	30 (1.18)	24	440L-P4KL0480YD
640 (25.2)	14 (0.55)	64	440L-P4JL0640YD	640 (25.2)	30 (1.18)	32	440L-P4KL0640YD
800 (31.5)	14 (0.55)	80	440L-P4JL0800YD	800 (31.5)	30 (1.18)	40	440L-P4KL0800YD
960 (37.8)	14 (0.55)	96	440L-P4JL0960YD	960 (37.8)	30 (1.18)	48	440L-P4KL0960YD
1120 (44.1)	14 (0.55)	112	440L-P4JL1120YD	1120 (44.1)	30 (1.18)	56	440L-P4KL1120YD
1280 (50.4)	14 (0.55)	128	440L-P4JL1280YD	1280 (50.4)	30 (1.18)	64	440L-P4KL1280YD
1440 (56.7)	14 (0.55)	144	440L-P4JL1440YD	1440 (56.7)	30 (1.18)	72	440L-P4KL1440YD
1600 (63.0)	14 (0.55)	160	440L-P4JL1600YD	1600 (63.0)	30 (1.18)	80	440L-P4KL1600YD

Note: GuardShields are sold in pairs. To select a transmitter or receiver, replace the "P" in the cat. no. with a "T" for transmitter and an "R" for receiver.

Cascadable GuardShield with Integrated Laser Alignment

Protected Height [mm (in.)]	Resolution [mm (in.)]	Number of Beams	Cat. No.	Protected Height [mm (in.)]	Resolution [mm (in.)]	Number of Beams	Cat. No.
320 (12.6)	14 (0.55)	32	440L-C4JL0320YD	320 (12.6)	30 (1.18)	16	440L-C4KL0320YD
480 (18.9)	14 (0.55)	48	440L-C4JL0480YD	480 (18.9)	30 (1.18)	24	440L-C4KL0480YD
640 (25.2)	14 (0.55)	64	440L-C4JL0640YD	640 (25.2)	30 (1.18)	32	440L-C4KL0640YD
800 (31.5)	14 (0.55)	80	440L-C4JL0800YD	800 (31.5)	30 (1.18)	40	440L-C4KL0800YD
960 (37.8)	14 (0.55)	96	440L-C4JL0960YD	960 (37.8)	30 (1.18)	48	440L-C4KL0960YD
1120 (44.1)	14 (0.55)	112	440L-C4JL1120YD	1120 (44.1)	30 (1.18)	56	440L-C4KL1120YD
1280 (50.4)	14 (0.55)	128	440L-C4JL1280YD	1280 (50.4)	30 (1.18)	64	440L-C4KL1280YD
1440 (56.7)	14 (0.55)	144	440L-C4JL1440YD	1440 (56.7)	30 (1.18)	72	440L-C4KL1440YD
1600 (63.0)	14 (0.55)	160	440L-C4JL1600YD	1600 (63.0)	30 (1.18)	80	440L-C4KL1600YD

Note: Cascadable GuardShields are sold in pairs. To select a transmitter or receiver, replace the "C" with a "G" for cascadable transmitter and an "F" for a cascadable receiver.

POC Type 4 Safety Light Curtains

GuardShield

GuardShield with Integrated Laser Alignment and ArmorBlock Guard I/O Connectivity

Protected Height [mm (in.)]	Resolution [mm (in.)]	Number of Beams	Cat. No.	Protected Height [mm (in.)]	Resolution [mm (in.)]	Number of Beams	Cat. No.
320 (12.6)	14 (0.55)	32	440L-P4JL0320YA	320 (12.6)	30 (1.18)	16	440L-P4KL0320YA
480 (18.9)	14 (0.55)	48	440L-P4JL0480YA	480 (18.9)	30 (1.18)	24	440L-P4KL0480YA
640 (25.2)	14 (0.55)	64	440L-P4JL0640YA	640 (25.2)	30 (1.18)	32	440L-P4KL0640YA
800 (31.5)	14 (0.55)	80	440L-P4JL0800YA	800 (31.5)	30 (1.18)	40	440L-P4KL0800YA
960 (37.8)	14 (0.55)	96	440L-P4JL0960YA	960 (37.8)	30 (1.18)	48	440L-P4KL0960YA
1120 (44.1)	14 (0.55)	112	440L-P4JL1120YA	1120 (44.1)	30 (1.18)	56	440L-P4KL1120YA
1280 (50.4)	14 (0.55)	128	440L-P4JL1280YA	1280 (50.4)	30 (1.18)	64	440L-P4KL1280YA
1440 (56.7)	14 (0.55)	144	440L-P4JL1440YA	1440 (56.7)	30 (1.18)	72	440L-P4KL1440YA
1600 (63.0)	14 (0.55)	160	440L-P4JL1600YA	1600 (63.0)	30 (1.18)	80	440L-P4KL1600YA

Note: GuardShields are sold in pairs. To select a transmitter or receiver, replace the "P" in the cat. no. with an "R" for a receiver. The GuardShield standard transmitter is used in the pair. To order a transmitter, replace the "P" with a "T" and the "A" with a "D."

Cascadable GuardShield with Integrated Laser Alignment and ArmorBlock Guard I/O Connectivity

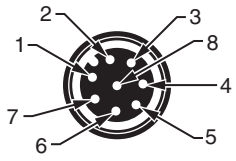
Protected Height [mm (in.)]	Resolution [mm (in.)]	Number of Beams	Cat. No.	Protected Height [mm (in.)]	Resolution [mm (in.)]	Number of Beams	Cat. No.
320 (12.6)	14 (0.55)	32	440L-C4JL0320YA	320 (12.6)	30 (1.18)	16	440L-C4KL0320YA
480 (18.9)	14 (0.55)	48	440L-C4JL0480YA	480 (18.9)	30 (1.18)	24	440L-P4KL0480YA
640 (25.2)	14 (0.55)	64	440L-C4JL0640YA	640 (25.2)	30 (1.18)	32	440L-C4KL0640YA
800 (31.5)	14 (0.55)	80	440L-C4JL0800YA	800 (31.5)	30 (1.18)	40	440L-C4KL0800YA
960 (37.8)	14 (0.55)	96	440L-C4JL0960YA	960 (37.8)	30 (1.18)	48	440L-C4KL0960YA
1120 (44.1)	14 (0.55)	112	440L-C4JL1120YA	1120 (44.1)	30 (1.18)	56	440L-C4KL1120YA
1280 (50.4)	14 (0.55)	128	440L-C4JL1280YA	1280 (50.4)	30 (1.18)	64	440L-C4KL1280YA
1440 (56.7)	14 (0.55)	144	440L-C4JL1440YA	1440 (56.7)	30 (1.18)	72	440L-C4KL1440YA
1600 (63.0)	14 (0.55)	160	440L-C4JL1600YA	1600 (63.0)	30 (1.18)	80	440L-C4KL1600YA

Note: Cascadable GuardShields are sold in pairs. To select a transmitter or receiver replace the "C" with an "F" for a cascadable receiver. The cascadable GuardShield standard transmitter is used in these pairs. To order a cascadable transmitter, replace the "C" with a "G" and the "A" with a "D" to specify the appropriate transmitter cat. no.

Recommended Logic Interfaces

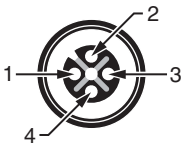
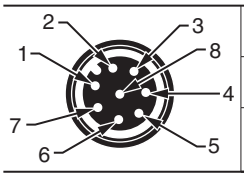
Description	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. Page No.	Cat. No.
Single-Function Safety Relays for 2 N.C. Contact Switch							
MSR127RP	3 N.O.	1 N.C.	Removable (Screw)	Monitored Manual	24V AC/DC	5-26	**440R-N23135**
MSR127TP	3 N.O.	1 N.C.	Removable (Screw)	Auto./Manual	24V AC/DC	5-26	**440R-N23132**
MSR126	2 N.O.	None	Fixed	Auto./Manual	24V AC/DC	5-24	**440R-N23117**
Modular Safety Relays							
MSR210P Base 2 N.C. only	2 N.O.	1 N.C. and 2 PNP Solid State	Removable	Auto./Manual or Monitored Manual	24V DC from the base unit	5-82	440R-H23176
MSR211	2 N.O.	1 N.C.	Removable	Auto./Manual or Monitored Manual	24V DC from the base unit	5-84	440R-H23177
MSR310P Base	MSR300 Series Output Modules	3 PNP Solid State	Removable	Auto./Manual Monitored Manual	24V DC	5-102	440R-W23219
MSR320P Input Module	—	2 PNP Solid State	Removable	—	24V DC from the base unit	5-106	440R-W23218
Muting Modules							
MSR22LM	2 N.O.	1 N.C.	Removable	Auto./Manual	24V DC	5-48	**440R-P23071**
MSR42 (requires optical interface to configure 445L-AF6150	2 PNP	2 PNP, configurable	Removable	Auto./manual or manual monitored	24V DC	5-52	**440R-P226AGS-NNR**

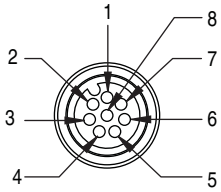
Standard and Remote Teach Cordsets—Two Required (one for transmitter and one for receiver)

Female Connector (Sensor End)		Cable			
Face View of Female	Connector Style	Pin/Wire Color	Wire Rating	Length [m (ft)]	Cat. No.
Transmitter					
	Straight Female	1 Brown 2 White 3 Blue 4 Black	22 AWG 300V 4 A	2 (6.56)	889D-F4AC-2
				5 (16.4)	889D-F4AC-5
				10 (32.8)	889D-F4AC-10
				15 (49.2)	889D-F4AC-15
				20 (65.6)	889D-F4AC-20
				30 (98.4)	889D-F4AC-30
Receiver					
	Straight Female	1 White 2 Brown 3 Green 4 Yellow 5 Grey 6 Pink 7 Blue 8 Red	24 AWG 30V AC/36V DC 1.5 A	2 (6.56)	889D-F8AB-2
				5 (16.4)	889D-F8AB-5
				10 (32.8)	889D-F8AB-10
				15 (49.2)	889D-F8AB-15
				20 (65.6)	889D-F8AB-20
				30 (98.4)	889D-F8AB-30

Cascadable System Patchcords—to connect cascadable GuardShield system

The GuardShield transmitter host patchcord has 4-pin DC micro over-molded quick-disconnect connectors offered in lengths of 1/3 m, 1 m, and 2 m. The GuardShield receiver host patchcord has 8-pin DC micro over-molded quick-disconnect connectors offered in lengths of 1/3 m, 1 m, and 2 m.

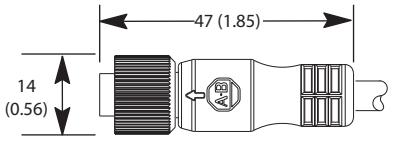
Face View of Female	Description	Cat. No.
Transmitter Patchcord		
	4-pin M12 patchcord, 0.3 m (12 in.)	889D-F4ACDM-0M3
	4-pin M12 patchcord, 1 m (39.37 in.)	889D-F4ACDM-1
	4-pin M12 patchcord, 2 m (78.74 in.)	889D-F4ACDM-2
Receiver Patchcord		
	8-pin M12 patchcord, 0.3 m (12 in.)	889D-F8ABDM-0M3
	8-pin M12 patchcord, 1 m (39.37 in.)	889D-F8ABDM-1
	8-pin M12 patchcord, 2 m (78.74 in.)	889D-F8ABDM-2

Face View of Female	Description	Cat. No.
Receiver Termination Plug		898D-81CU-DM
	Termination plug 8-pin M12 quick disconnect Required for connection to top connector of cascadable receiver if cascade light curtain is used as a standalone system or as the last segment pair in a cascaded system.	

Note: A termination plug is not necessary for the cascadable transmitter.

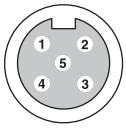
Cordsets Approximate Dimensions [mm (in.)]

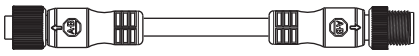
Dimensions are not intended to be used for installation purposes.



Straight Female M12 Quick Disconnect

ArmorBlock Guard I/O

Top View	Color	No. of Pins	Signal Receiver
	Brown	1	+24V
	White	2	OSSD 2
	Blue	3	0V
	Black	4	OSSD 1
	Grey	5	NC

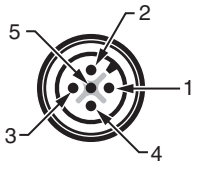


Interconnecting Patchcords—ArmorBlock I/O Connection

Cat. No.	Description
889D-F5ACDM-0M3	Five-pin M12 patchcord, 0.3 m (12 in.)
889D-F5ACDM-1	Five-pin M12 patchcord, 1 m (39.37 in.)
889D-F5ACDM-2	Five-pin M12 patchcord, 2 m (78.74 in.)
889D-F5ACDM-5	Five-pin M12 patchcord, 5 m (196.85 in.)
889D-F5ACDM-10	Five-pin M12 patchcord, 10 m (393.7 in.)

Note: The GuardShield pairs with ArmorBlock Guard I/O Connectivity have a 5-pin M12 quick-disconnect connector on the receiver wired to allow connection to the ArmorBlock 5-pin connector. The transmitter in that GuardShield pair is a standard GuardShield transmitter with integrated laser alignment system offered with a 4-pin M12 quick-disconnect connector. It is possible to connect either a standard 4-pin M12 cordset or the 5-pin M12 quick-disconnect connector cordset or patchcord to this transmitter.

Termination Connector for Cascadable GuardShield Receiver (if it's a standalone pair) with ArmorBlock Guard I/O Connectivity

Face View of Female	Description	Cat. No.
	5-pin M12 Termination Adaptor	898D-418U-DM

Note: The cascadable GuardShield with ArmorBlock Guard I/O connectivity can be used as a standalone pair if the top connector on the receiver has a termination adaptor connected. The cascadable transmitter does not require a termination adaptor.

Optional Accessories

Description		Cat. No.
	Steel L-shaped end cap mounting bracket (4 per package) **Note:** 4 brackets supplied with each GuardShield pair.	440L-AF6101
	Aluminum middle mounting bracket for vibratory applications	**440L-AF6108**
	Power supply: Output—24V DC, 3 Amps, 72 W	1606-XLP72E
	Laser alignment tool	**440L-ALAT**
	GuardShield laser alignment tool bracket	**440L-AF6109**
	Mounting stand	**440L-AMSTD**
	Vertical shock mount kit	**440L-AF6120**
	Horizontal shock mount kit	440L-AF6121
	Middle vertical mount kit	440L-AF6122
	Middle horizontal mount kit	440L-AF6123
	GuardShield weld shield (cat. no. is for a pair of light curtains)	440L-AGWS0160
		440L-AGWS0320
		440L-AGWS0480
		440L-AGWS0640
		440L-AGWS0800
		440L-AGWS0960
		440L-AGWS1120
		440L-AGWS1280
		440L-AGWS1440
		440L-AGWS1600
		440L-AGWS1760
	GuardShield Washdown Enclosure Kit **Note**: Only for use with standard GuardShield light curtain.	440L-AGST320
		440L-AGST480
		440L-AGST640
		440L-AGST800
		440L-AGST960
	8-pin M12 Receiver Termination Plug (Required for top receiver connector if a cascaded pair is used as a standalone or if it is the last pair in a cascaded system.)	898D-81CU-DM

Corner Mirror for Multi-Sided Guarding

Specially constructed glass mirrors for 2- and 3-sided safeguarding applications.

Note: Each mirror reduces maximum scan range by up to 15% per mirror. Each corner mirror suppled with two endcap mounting brackets.

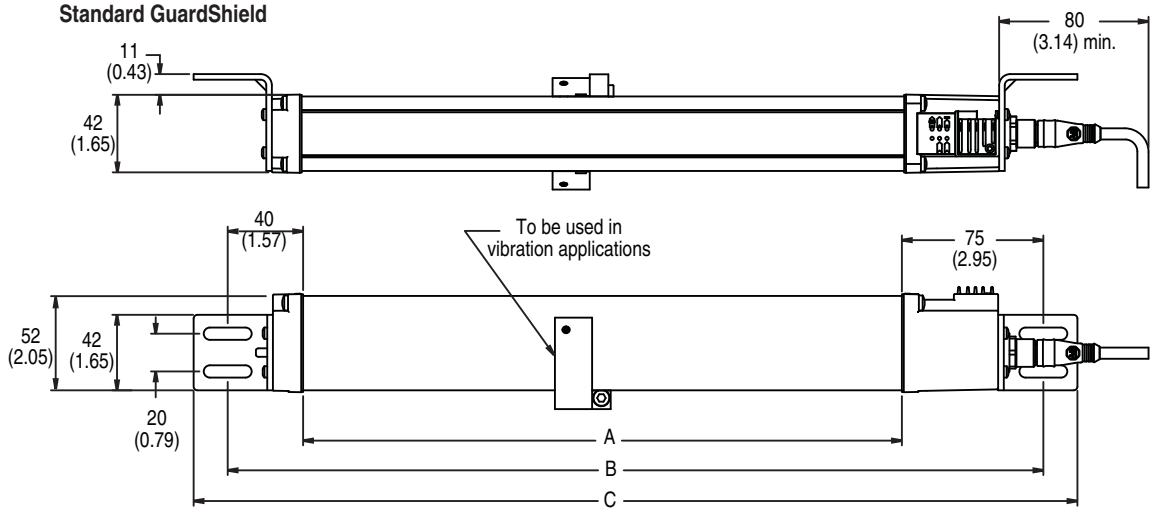
GuardShield Light Curtain Cat. No.	Narrow Mirror Short-Range 0…4 m	Cat. No.	Wide Mirror Long-Range 4…15 m	Cat. No.
440L-P4∗0160Y❄ 440L-P2K‡0160YD		440L-AM0750300		440L-AM1250300
440L-P4∗0320Y❄ 440L-P2K‡0320YD		440L-AM0750450		440L-AM1250450
440L-P4∗0480Y❄ 440L-P2K‡0480YD 440L-P4A2500YD		440L-AM0750600		440L-AM1250600
440L-P4∗0640Y❄ 440L-P2K‡0640YD		440L-AM0750750		440L-AM1250750
440L-P4∗0800Y❄ 440L-P2K‡0800YD		440L-AM0750900		440L-AM1250900
440L-P4∗0960Y❄ 440L-P2K‡0960YD 440L-P4A3400YD		440L-AM0751050		440L-AM1251050
440L-P4∗1120Y❄ 440L-P2K‡1120YD		440L-AM0751200		**440L-AM1251200**
440L-P4∗1280Y❄ 440L-P2K‡1280YD		440L-AM0751350		440L-AM1251350
440L-P4∗1440Y❄ 440L-P2K‡1440YD		440L-AM0751500		440L-AM1251500
440L-P4∗1600Y❄ 440L-P2K‡1600YD		440L-AM0751650		440L-AM1251650
440L-P4∗1760Y❄ 440L-P2K‡1760YD		440L-AM0751800		440L-AM1251800

∗ = J or K;
❄ = D or R;
‡ = A or D

Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.

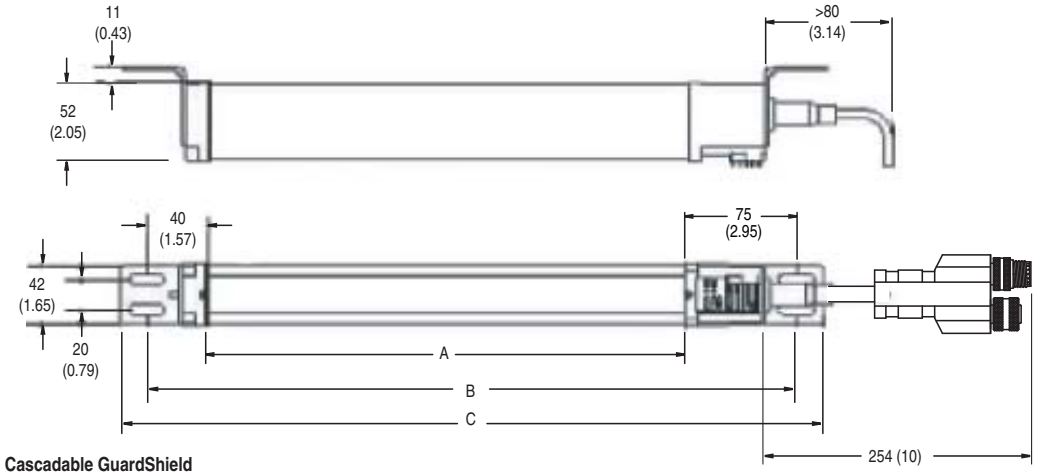
Standard GuardShield



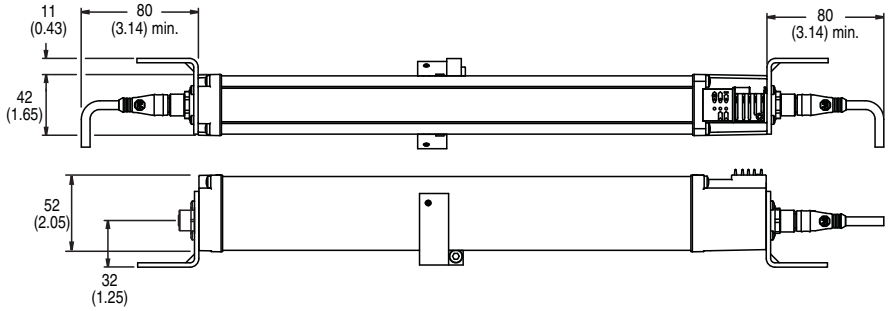
POC Type 4 Safety Light Curtains

GuardShield

Remote Teach GuardShield



Cascadable GuardShield

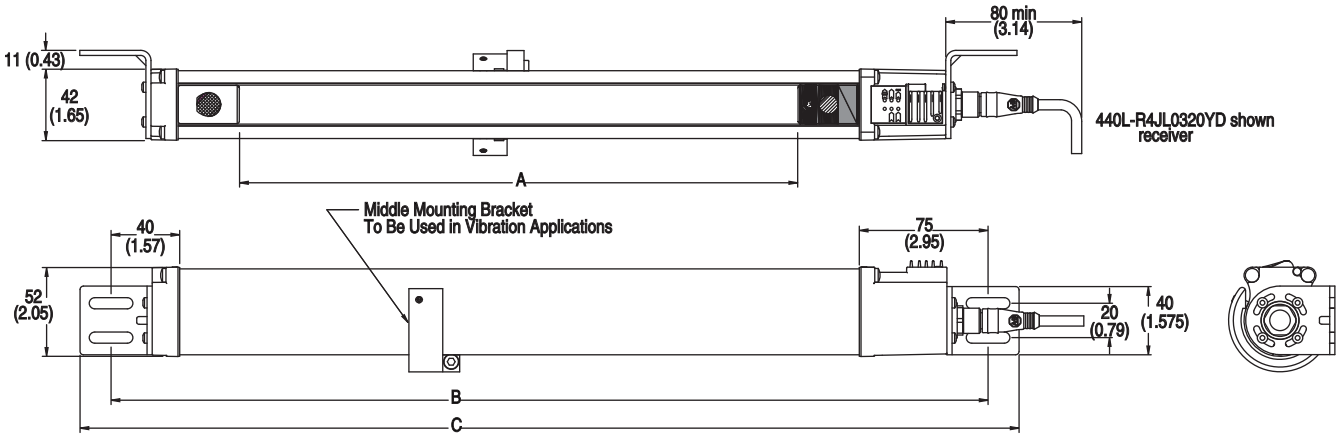


Note: Middle mounting bracket should be used in vibration applications on GuardShield light curtain protective heights of 1120 mm and larger.

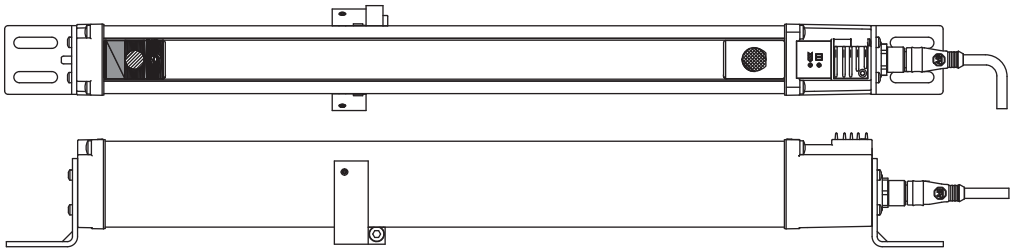
Type	A Protective Height [mm]	B Mounting Value [mm]	C Total Length [mm]
440L-✶4‡0160YD	160 ±0.5§	276	312 ±1.5
440L-❄4‡0320YD	320 ±0.5	436	472 ±1.5
440L-❄4‡0480YD	480 ±0.5	596	632 ±1.5
440L-❄4‡0640YD	640 ±0.5	756	792 ±1.5
440L-❄4‡0800YD	800 ±0.6	916	952 ±1.5
440L-❄4‡0960YD	960 ±0.6	1076	1112 ±1.5
440L-❄4‡1120YD	1120 ±0.6	1236	1272 ±1.8
440L-❄4‡1280YD	1280 ±0.7	1396	1432 ±1.8
440L-❄4‡1440YD	1440 ±0.7	1556	1592 ±1.8
440L-❄4‡1600YD	1600 ±0.8	1716	1752 ±2.0
440L-❄4‡1760YD	1760 ±0.8	1876	1912 ±2.0

✶ P = Pair, T = Transmitter, R = Receiver
❄ P = Pair, T = Transmitter, R = Receiver, C = Host Pair, G = Host Transmitter, F = Host Receiver
‡ J = 14 mm resolution or K = 30 mm resolution
§ 160 mm is not available for cascading GuardShield light curtains.

Standard GuardShield Receiver with Integrated Laser Alignment



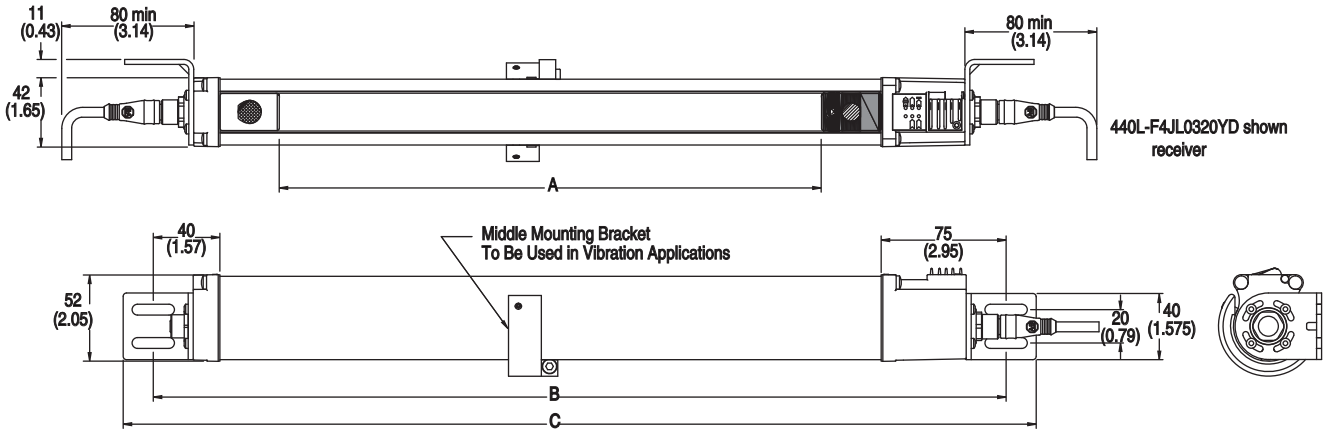
Standard GuardShield Transmitter with Integrated Laser Alignment



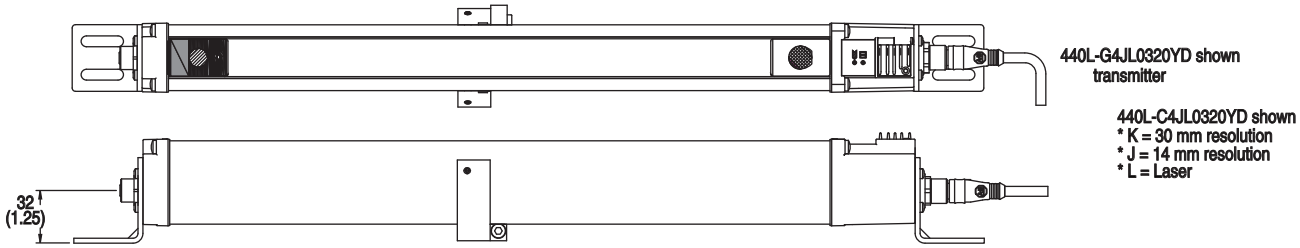
Type	A Protective Height	B Mounting	C Total Length	D Mounting
440L-P4*L0320YD	320±0.5	516	552±1.5	426
440L-P4*L0480YD	480±0.5	676	712±1.5	586
440L-P4*L0640YD	640±0.5	836	872±1.5	746
440L-P4*L0800YD	800±0.5	996	1032±1.5	906
440L-P4*L0960YD	960±0.5	1156	1192±1.5	1066
440L-P4*L1120YD	1120±0.5	1316	1352±1.5	1226
440L-P4*L1280YD	1280±0.5	1476	1512±1.5	1386
440L-P4*L1440YD	1440±0.5	1636	1672±1.5	1546
440L-P4*L1600YD	1600±0.5	1796	1832±1.5	1706

J = 14 mm resolution, K = 30 mm resolution

Cascadable GuardShield Receiver with Integrated Laser Alignment



Cascadable GuardShield Transmitter with Integrated Laser Alignment

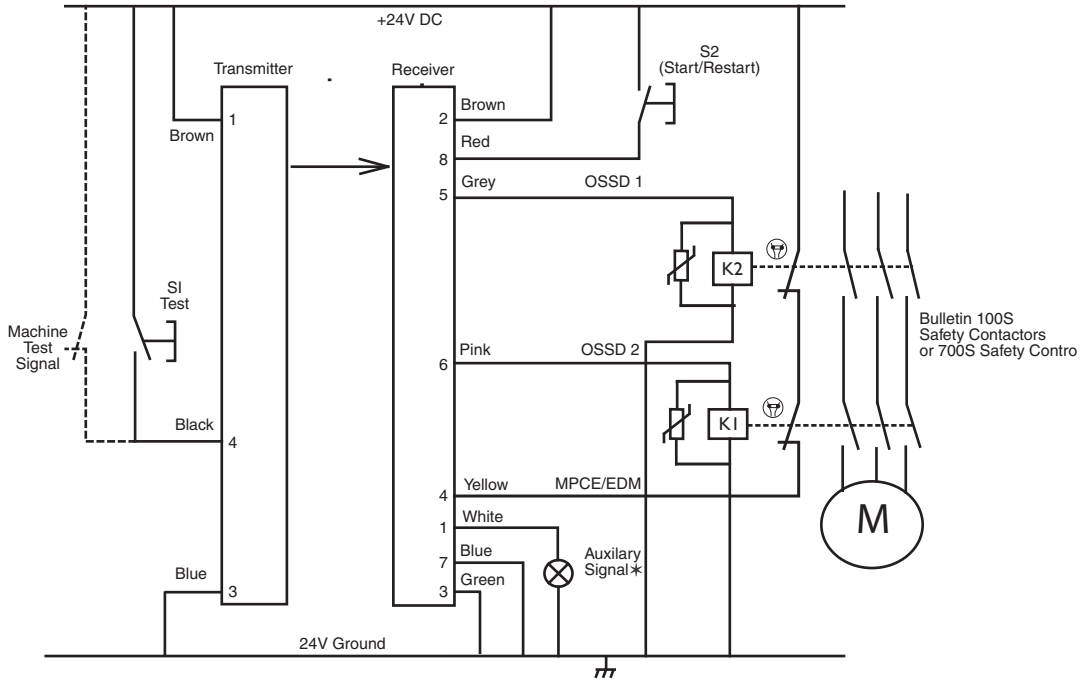


Type	A Protective Height	B Mounting	C Total Length	D Mounting
440L-C4*L0320YD	320±0.5	516	552±1.5	426
440L-C4*L0480YD	480±0.5	676	712±1.5	586
440L-C4*L0640YD	640±0.5	836	872±1.5	746
440L-C4*L0800YD	800±0.5	996	1032±1.5	906
440L-C4*L0960YD	960±0.5	1156	1192±1.5	1066
440L-C4*L1120YD	1120±0.5	1316	1352±1.5	1226
440L-C4*L1280YD	1280±0.5	1476	1512±1.5	1386
440L-C4*L1440YD	1440±0.5	1636	1672±1.5	1546
440L-C4*L1600YD	1600±0.5	1796	1832±1.5	1706

J = 14 mm resolution, K = 30 mm resolution

Wiring Diagram for Connection of OSSDs Directly to Contactors (FSDs) with Restart Interlock

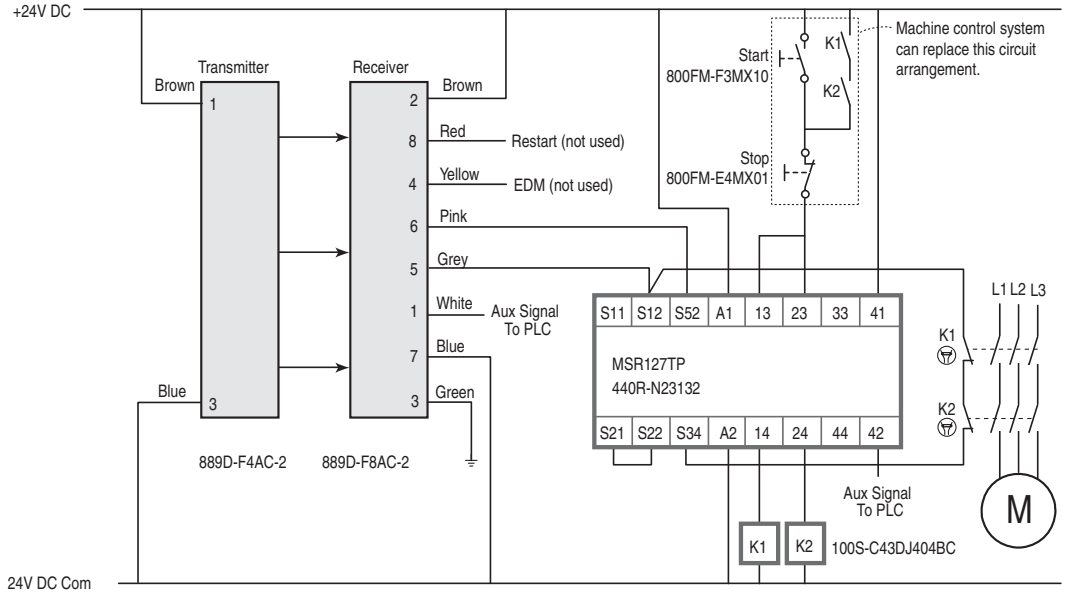
Wiring diagram is not intended to be used for installation purposes.



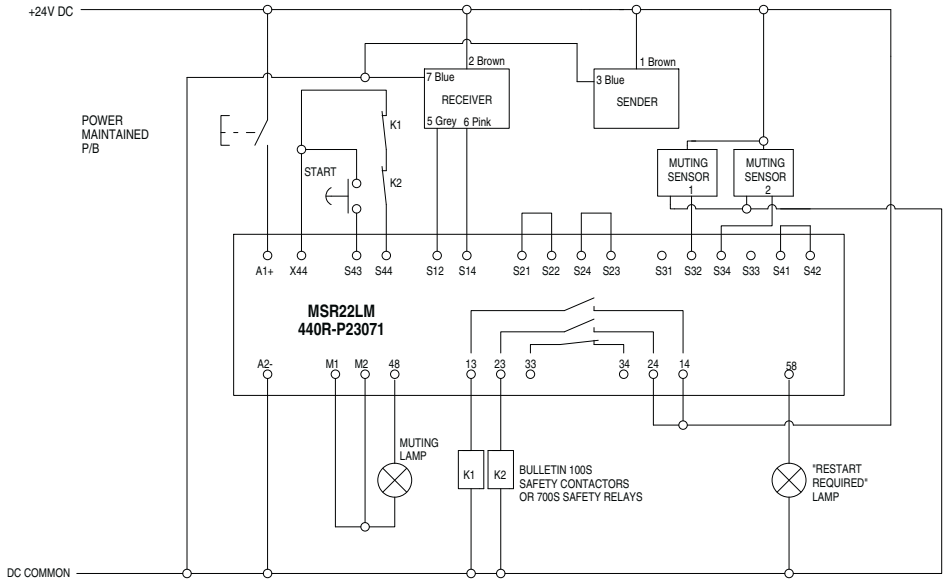
* Auxiliary output is nonsafety. Can be connected to a lamp, motor or status to a PLC.

K1, K2	Safety relay or safety contactor for OSSD 1 and OSSD 2 connection
S1	Switch for external system test (optional)
S2	Switch for reset of light curtain from start/restart interlock

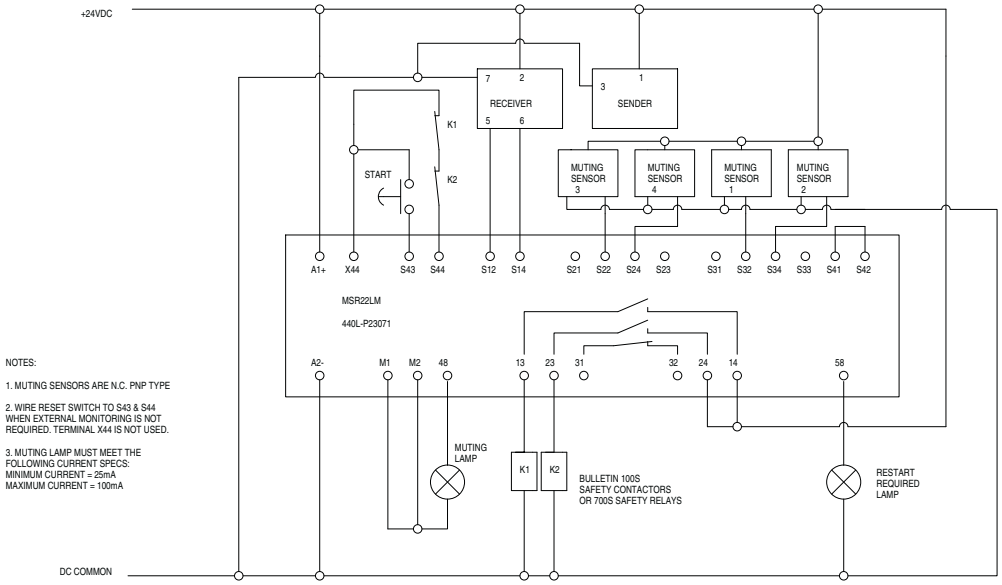
Wiring Diagram for Connection of OSSDs Directly to a Safety Relay Module



GuardShield Light Curtain Connected to MSR22LM with Two Sensor Muting



GuardShield Light Curtain Connected to MSR22LM with Four Sensor Muting



Description

The Allen Bradley Guardmaster GuardShield Safe 4 is an economical two box, Type 4 safety light curtain with ON/OFF functionality. This basic, guard-only operating mode, safety light curtain has an Integrated Laser Alignment system that simplifies the alignment of each pair of light curtains. Visible laser beams are activated by touching the laser at the finger symbol on front face of the light curtains. Positioning of the transmitter and receiver laser beams to their respective targets facilitates optimal alignment of each Safe 4 pair. The Integrated Laser Alignment system also quickly helps with the re-alignment of pairs when units are knocked out of alignment during the course of the work process or when corner mirrors are used.

The GuardShield Safe 4 is designed to be used in a variety of applications across a broad range of industries in medium to heavy industrial environments. Offered with shock isolator kits for shock and vibration applications and protective heights from 120…1920 mm in 120 mm increments assures that the correct size of safety light curtain is available to suit the application requirement.

The GuardShield Safe 4, with an environmental rating of IP65, meets all applicable global standards and can be used on or around industrial machinery and equipment anywhere in the world.

Features

- M12 connectors
- Optically synchronized
- Integrated laser alignment system
- IP65 enclosure rating
- Simple installation
- cULus Listed and CE Marked for all applicable directives

Applications

- Metal working
- Shears
- Punch presses
- Robot cells
- Automated processes

Specifications

Safety Ratings	
Standards	EN/IEC 61496 Parts 1 and 2, UL 61496 Parts 1 and 2, UL1998
Safety Classification	Type 4 per IEC/EN61496. Category 4 device per EN 954-1, SIL 3 per IEC 61508, PLe per EN/ISO 13849
Certifications	cULus Listed and CE Marked for all applicable directives
Power Supply	
Input Power, Max.	24V DC ± 20%
Maximum Residual Ripple	< 10% of U_{sp}
Power Consumption	<500 mA (no load)
Outputs	
Safety Outputs	2 PNP OSSD. 0.3 A, short-circuit protected
Output Voltage	>U_{sp} (at load = 0.1 A)
Switching Current @ Voltage, Min.	300 mA @ 24V DC
Operating Characteristics	
Response Time	Varies by protective height, see Installation Manual
Indicator LEDs	ON -State, OFF-State, internal error
Protected Height [mm (in.)]	3 beam = 840 mm (33.0 in.) 2 beam = 600 mm (23.6 in,)
Resolution [mm (in.)]	14 mm (0.55 in.) 30 mm (1.18 in.)
Scanning Range	5…30 m (16.4…98.4 ft)
Synchronization	Optical, first beam adjacent to LEDs
Wavelength	950 nm
Environmental	
Enclosure Type Rating	IP65
Relative Humidity	15…95% (noncondensing)
Operating Temperature [C (F)]	0…55 ° (0…131 °)
Vibration	IEC 60068-2-6 frequency 10…55 Hz; amplitude 0.35 mm (0.01 in.)
Shock	IEC 60068-2-29; acceleration 10 g, pulse duration 16 ms 10…55 Hz; amplitude 0.35 mm (0.01 in.)
Physical Characteristics	
Mounting	Rear mounting, standard and adjustable (180°)
Weight	Varies by by cat. no., see Installation Manual
Housing Cross Section	30 x 40 mm (1.18 x 1.57 in.)
Connection Type	Transmitter: 5-pin M12 micro QD Receiver: 5-pin M12 micro QD
Cable Length	30 m (98.4 ft) max.
ILAS Laser Class	Class 2, IEC 60825-1

POC Type 4 Safety Light Curtains

GuardShield Safe 4

Product Selection

Standard System

The Allen-Bradley Guardmaster GuardShield Safe 4 safety light curtains are offered in 14 mm and 30 mm resolutions, are ordered as pairs—transmitter and receiver—and are shipped under one cat. no. Each GuardShield Safe 4 pair is shipped with standard mounting brackets. After selecting the appropriate Safe 4 protected height and resolution, ensure that the appropriate cordsets, interfaces, and accessories are ordered.

Protected Height [mm (in.)]	14 mm (0.55 in.) Number of Beams	30 mm (1.18 in.) Number of Beams	Pair Weight [kg (lbs)]	Cat. No.	
				14 mm (0.55 in.)	30 mm (1.18 in.)
120 (4.7)	16	8	1.0 (2.2)	445L-P4L0120YD	445L-P4S0120YD
240 (9.4)	32	16	1.4 (3.1)	**445L-P4L0240YD**	445L-P4S0240YD
360 (14.2)	48	94	1.8 (4.0)	445L-P4L0360YD	445L-P4S0360YD
480 (19.9)	64	94	2.2 (4.9)	445L-P4L0480YD	445L-P4S0480YD
600 (23.6)	80	94	2.6 (5.7)	445L-P4L0600YD	**445L-P4S0600YD**
720 (28.3)	96	94	3.0 (6.6)	445L-P4L0720YD	445L-P4S0720YD
840 (33.1)	112	94	3.5 (7.7)	445L-P4L0840YD	445L-P4S0840YD
960 (37.8)	128	94	4.0 (8.8)	445L-P4L0960YD	**445L-P4S0960YD**
1080 (42.5)	144	94	4.0 (8.8)	445L-P4L1080YD	445L-P4S1080YD
1200 (47.2)	160	94	4.5 (9.9)	445L-P4L1200YD	**445L-P4S1200YD**
1320 (52.0)	176	94	5.0 (11.0)	445L-P4L1320YD	445L-P4S1320YD
1440 (56.7)	172	94	5.5 (12.1)	445L-P4L1440YD	445L-P4S1440YD
1560 (61.4)	188	102	6.0 (13.2)	445L-P4L1560YD	445L-P4S1560YD
1680 (66.1)	204	102	6.5 (14.3)	445L-P4L1680YD	445L-P4S1680YD
1800(70.9)	220	110	7.0 (15.4)	445L-P4L1800YD	445L-P4S1800YD
1920 (75.6)	236	118	7.5 (16.5)	445L-P4L1920YD	445L-P4S1920YD

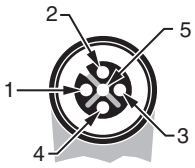
Note: The cat. nos. listed above are pair cat. nos., to specify a transmitter or receiver only, replace the "P" in the cat. no. with a "T" for transmitter or an "R" for receiver.

Required Logic Interfaces

Description	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. Page No.	Cat. No.
Single-Function Safety Relays for 2 N.C. Contact Switch							
MSR127RP	3 N.O.	1 N.C.	Removable (Screw)	Monitored Manual	24V AC/DC	5-26	**440R-N23135**
MSR127TP	3 N.O.	1 N.C.	Removable (Screw)	Auto./Manual	24V AC/DC	5-26	**440R-N23132**
MSR126	2 N.O.	None	Fixed	Auto./Manual	24V AC/DC	5-24	**440R-N23117**
Modular Safety Relays							
MSR210P Base 2 N.C. only	2 N.O.	1 N.C. and 2 PNP Solid State	Removable	Auto./Manual or Monitored Manual	24V DC from the base unit	5-82	440R-H23176
MSR220P Input Module	—	—	Removable	—	24V DC	5-86	440R-H23178
MSR310P Base	MSR300 Series Output Modules	3 PNP Solid State	Removable	Auto./Manual Monitored Manual	24V DC	5-102	440R-W23219
MSR320P Input Module	—	2 PNP Solid State	Removable	—	24V DC from the base unit	5-106	440R-W23218
Muting Modules							
MSR22LM	2 N.O.	1 N.C.	Removable	Auto./Manual	24V DC	5-48	**440R-P23071**
MSR42 (requires optical interface to configure 445L-AF6150	2 PNP	2 PNP, configurable	Removable	Auto./manual or manual monitored	24V DC	5-52	**440R-P226AGS-NNR**

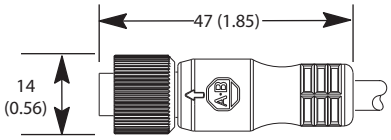
Cordsets—Transmitters and receivers both use 5-pin M12 cordsets

Note: Unshielded cordsets are most commonly used for safety light curtains, however, shielded cordsets are also offered to increase immunity to electrical interference.

Female Connector (Sensor End)		Cable			
Face View of Female	Connector Style	Pin/Wire Color	Wire Rating	Length [m (ft)]	Cat. No.
	Straight Female Nonshielded	1 Brown 2 White 3 Blue 4 Black 5 Grey	22 AWG 250V 4 A	2 (6.56)	889D-F5AC-2
				5 (16.4)	889D-F5AC-5
				10 (32.8)	889D-F5AC-10
				15 (49.2)	889D-F5AC-15
				20 (65.6)	889D-F5AC-20
				30 (98.4)	889D-F5AC-30
	Straight Female Shielded	1 Brown 2 White 3 Blue 4 Black 5 Grey	22 AWG 22 AWG 300V 4 A	2 (6.56)	889D-F5EC-2
				5 (16.4)	889D-F5EC-5
				10 (32.8)	889D-F5EC-10
				15 (49.2)	889D-F5EC-15
				20 (65.6)	889D-F5EC-20
				30 (98.4)	889D-F5EC-30

Cordsets Approximate Dimensions [mm (in.)]

Dimensions are not intended to be used for installation purposes.



Straight Female

Optional Accessories

	Description	Cat. No.
	Standard kit (4 pieces — supplied with each pair)	445L-AF6140
	180° Adjustable kit (two kits required per pair)	**445L-AF6141**
	Shock Mount Kit (2 kits required per pair of light curtains)	445L-AF6142
	Vertical mounting kit (two kits required per pair)	445L-AF6144
	MSR42 Multifunction Module (requires Cat. No. 440L-AF6150 to program)	**440R-P226AGS-NNR**
	MSR45E — Safety relay expansion module for MSR42	**440R-P4NANS**
	USB optical interface software configuration tool used to configure the MSR42 (Used to configure the MSR42 module or get diagnostic information from the Safe 4.)	**445L-AF6150**
	Ribbon cable — to connect one MSR45E to an MSR42	**440R-ACABL1**
	Ribbon cable — to connect two MSR45Es to an MSR42	440R-ACABL2
	Ribbon cable — to connect three MSR45Es to an MSR42	440R-ACABL3
	Mounting stand (Comes with hardware to level base and two GuardShield mounting brackets.)	**440L-AMSTD**

Corner Mirror for Multi-Sided Guarding

Specially constructed glass mirrors for 2- and 3-sided safeguarding applications.

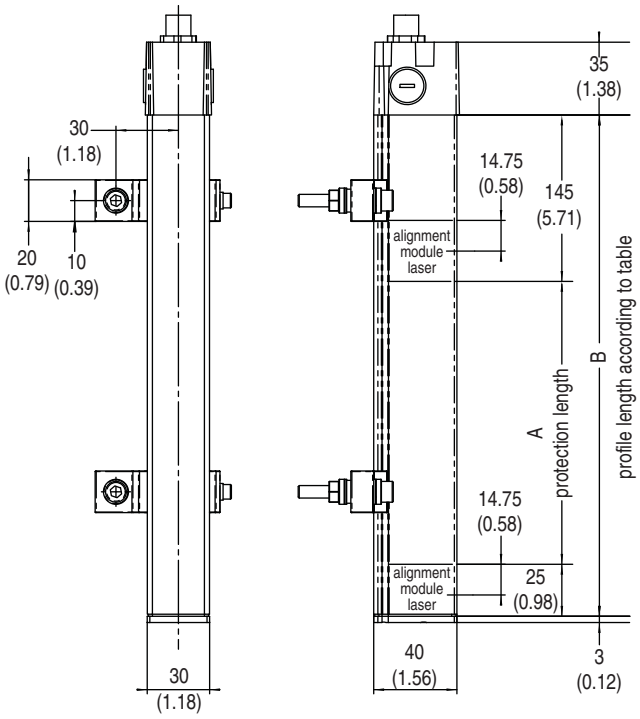
Note: Each mirror reduces maximum scan range by approximately 15% per mirror.

GuardShield Safe 2/Safe 4 Protected Height [mm (in.)]	Narrow Mirror Short-Range 0…4 m	Cat. No.	Wide Mirror Long-Range 4…15 m	Cat. No.
120/240 (4.7/9.4)		440L-AM0750300		440L-AM1250300
360 (14.2)		440L-AM0750450		440L-AM1250450
480 (19)		440L-AM0750600		440L-AM1250600
600 (24)		440L-AM0750750		440L-AM1250750
720/840 (28/33)		440L-AM0750900		440L-AM1250900
960 (38)		440L-AM0751050		440L-AM1251050
1080 (43)		440L-AM0751200		**440L-AM1251200**
1200 (47)		440L-AM0751350		440L-AM1251350
1320/1440 (52/57)		440L-AM0751500		440L-AM1251500
1560 (61)		440L-AM0751650		440L-AM1251650
1680 (66)		440L-AM0751800		440L-AM1251800
1800/1920 (70.9/75.6)		Not available		Not available

Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.

Safe 4

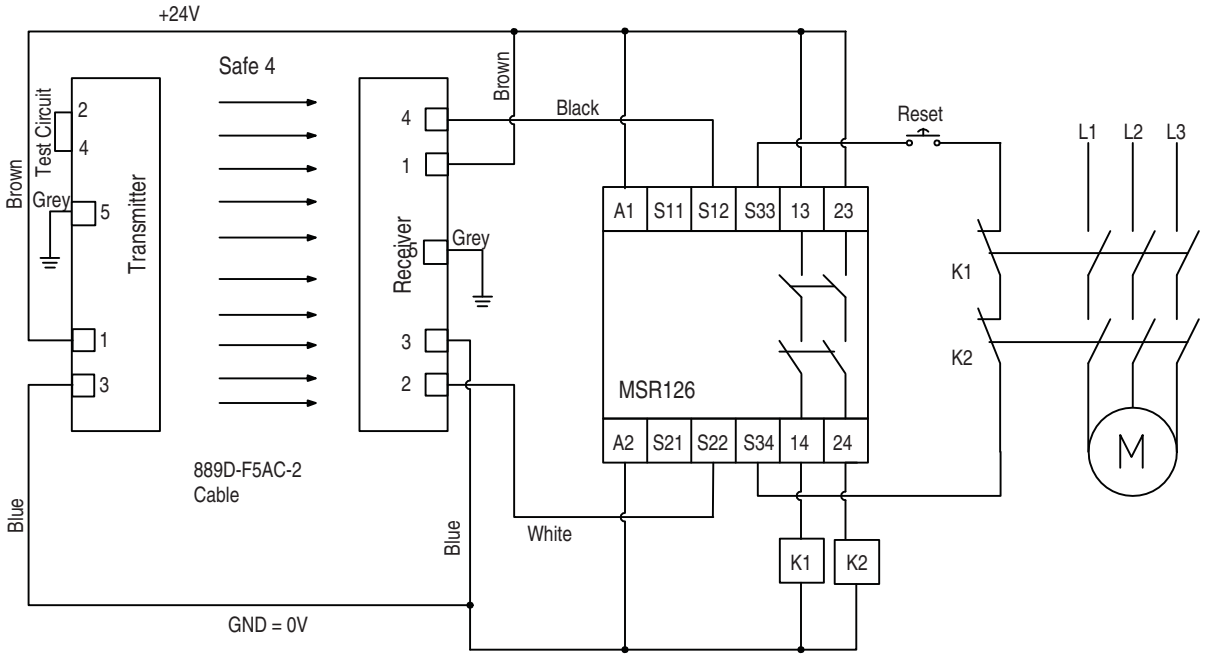


Type	A Protective Height [mm (in.)]	B Profile Length [mm (in.)]
445L-P4∗0120YD	120 (4.7)	290 (11.4)
445L-P4∗0240YD	240 (9.4)	410 (16.1)
445L-P4∗0360YD	360 (14.2)	530 (20.9)
445L-P4∗0480YD	480 (18.9)	650 (25.6)
445L-P4∗0600YD	600 (23.6)	771 (30.4)
445L-P4∗0720YD	720 (28.3)	891 (35.1)
445L-P4∗0840YD	840 (33.1)	1011 (39.8)
445L-P4∗0960YD	960 (37.8)	1131 (44.5)
445L-P4∗1080YD	1080 (42.5)	1252 (49.3)
445L-P4∗1200YD	1200 (47.2)	1372 (54.0)
445L-P4∗1320YD	1320 (51.9)	1492 (58.7)
445L-P4∗1440YD	1440 (56.7)	1612 (63.5)
445L-P4∗1560YD	1560 (61.4)	1733 (68.2)
445L-P4∗1680YD	1680 (66.1)	1853 (72.9)
445L-P4∗1800YD	1800 (70.8)	1973 (77.7)
445L-P4∗1920YD	1920 (75.6)	2093 (82.4)

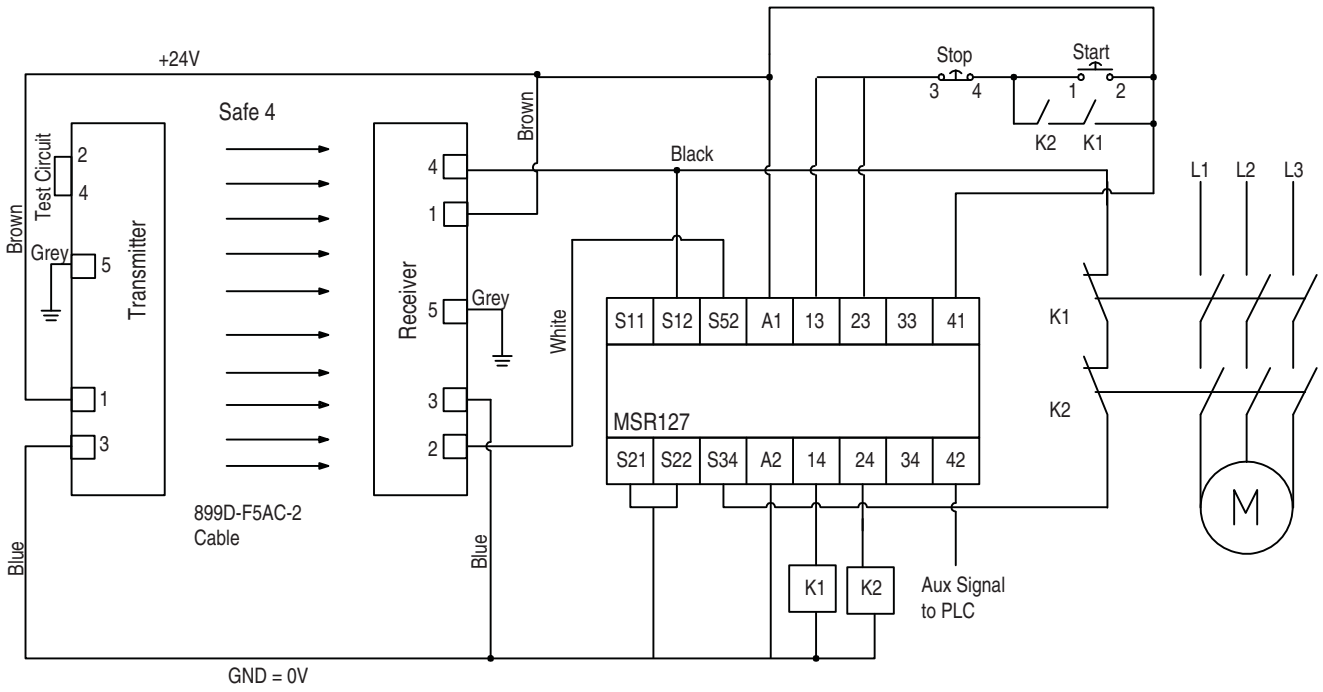
∗ For 14 mm resolution replace with an "L." For 30 mm resolution replace with an "S." Example: **Cat. No. 445L-P4S0480YD** (for 30 mm resolution).

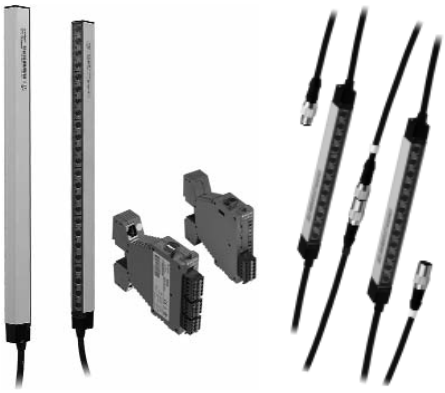
Wiring Diagram for Connection to MSR126

Wiring diagram is not intended to be used for installation purposes.



Wiring Diagram for Connection to MSR127





Description

The GuardShield Micro 400 is an economical three-box (transmitter, receiver and controller) Type 4 safety light curtain offered in a small profile (15 x 20 mm (0.59 x 0.79 in.)) housing. Designed for use in benign industrial environments (IP54), this light-duty safety light curtain system is targeted to the semi-conductor, micro electronic and small assembly machine markets.

Protective heights are offered from 150…1200 mm (5.91…47.2 in.) in 150 mm (5.91 in.) increments. The compact housing size allows the GuardShield Micro 400 to be mounted in areas where standard safety light curtains may not be able to be mounted due to space constraints. It is also possible to recess the GuardShield Micro 400 transmitter and receiver into machine frames.

The Micro 400 requires a dedicated controller. The MSR41 controller is used for on/off application and the MSR42 can also be used as a multi-function safety module, allowing the connection of additional safety light curtains, safety laser scanner, or any safety device with two Output Signal Switch Devices (OSSD) outputs, or two contacts, such as E-stops and enabling switches.

There are a number of operating modes that can be configured with the MSR42 controller. EDM, START/Restart interlock, fixed and floating blanking and muting are possible.

The Micro 400 transmitter and receiver are offered with 8-pin M12 connectors at the end of 500 mm (19.8 in.) integrated cables. The patchcords to connect the transmitter and receiver to the controller are the same and are offered in 3, 5, and 8 m (9.8, 16.4, and 26.2 ft) lengths. These patchcords are configured on one end with M12 connectors (which mate to the integrated pigtail connectors) and RJ45 connectors on the opposite end (which plug into the MSR42 controller).

Cascadable System

The GuardShield Micro 400 is also offered in a cascadable configuration. GuardShield Cascadable Micro 400 safety light curtains allow the interconnection of multiple segments of the Micro 400 safety light curtain with a common pair of safety outputs. This cascadable configurability of the GuardShield Micro 400 reduces overall system wiring and allows the GuardShield Micro 400 to be fitted into a variety of applications where the safety distances for mounting the light curtain may allow personnel to stand between the sensing field of the light curtain and the hazard or where multiple sided guarding is required and the use of corner mirrors is not possible.

A GuardShield Cascadable Micro 400 safety light curtain system is comprised of one or two pair of Cascadable Micro 400 light curtains as well as a standard Micro 400 pair as the last segment pair in the cascaded system.

GuardShield Micro 400 cascaded pairs are offered in both 14 mm and 30 mm resolutions in limited protected heights which are listed in the table below. It is possible to mix 14 mm and 30 mm resolution pairs in a cascaded Micro 400 system.

IMPORTANT	The standard GuardShield Micro 400 must always be the last segment in a cascaded Micro 400 system.

The cascadable Micro 400 safety light curtains are ordered as pairs (transmitter and receiver) and are shipped under one cat. no. After selecting the appropriate light curtain cat. nos. for a cascaded Micro 400 system, select the standard Micro 400 pair as the last segment in the cascaded system and also select interconnecting patchcords.

A cascadable pair of GuardShield Micro 400 light curtains has a 500 mm (19.8 in.) pigtail with a female M12 QD on the bottom of the Micro 400 light curtain and a 500 mm (19.8 in.) pigtail with a male M12 QD attached to the top of the Micro 400 transmitter and receiver.

The GuardShield Cascadable Micro 400 system operates as a single light curtain pair with a common set of OSSDs. Each segment pair is connected in series making the response time of the complete system the sum of each segment pair, plus the response time of the MSR41 or MSR42 and other safety devices in the stop circuit.

When connecting two cascadable segments together, the resultant cable length between segments is 1000 mm (39.6 in.).

If an additional length between segment pairs is required, Rockwell Automation offers an M12-to-M12 patchcord in 1 m (39.37 in.) and 3 m (118.1 in.) lengths (Cat. Nos. 445L-AC8PC1 or 445L-AC8PC3).

IMPORTANT	The maximum cascaded Micro 400 system length can not exceed 10 m as measured between the RJ45 connection at the MSR42 controller to the last beam in the standard Micro 400, including all cable lengths. The maximum number of beams in a cascaded Micro 400 system can not exceed 255 beams.

Features

- Very small profile 15 x 20 mm (0.59 x 0.79 in.)
- M12 connector on 20 inch pigtails
- Minimal dead space of optic heads

Applications

- Light assembly machines/equipment
- Semi-conductor
- Micro-electronics
- Pharmaceutical

Specifications

Safety Ratings	
Standards	IEC/EN61496 Parts 1 and 2. UL61496 Parts 1 and 2, UL1998
Safety Classification	Type 4 per IEC/EN61496. Category 4 device per EN 954-1, SIL 3 per IEC 61508, PLe per EN/ISO 13849
Certifications	cULus Listed, TÜV, CE Marked for all applicable directives
Power Supply	Input power from MSR41 or MSR42 controller
Input Power, Max.	24V DC ±15%
Maximum Residual Ripple	5% of Vss
Power Consumption	0.07 A max. (no load)
Outputs	
Micro 400 Outputs	Data output to controller (MSR41 or MSR42)
MSR41/MSR42 Outputs	Two 400 mA OSSD
Non-Safety Outputs	Auxiliary outputs from MSR41 or MSR42 controller—2 configurable 100 mA, outputs
Switching Current @ Voltage, Max.	400 mA @ 24V DC
Operating Characteristics	
Response Time	14 mm: 14…42 ms; 30 mm; 12…23 ms, varies by protective height and resolution
Indicator LEDs—light curtains	ON -State, OFF-State, Intensity
Protected Height [mm (in.)]	150…1200 mm (5.91…47.24 in.) in 150 mm increments
Resolution [mm (in.)]	14 (0.55), 30 (1.18)
Scanning Range/Resolution	14 mm (0.55 in.) resolution: 0…5 m (16.4 ft) 30 mm (1.18 in.) resolution: 0…5 m (16.4 ft)
Synchronization	Electrical through MSR41 or MSR42
Wavelength	940 nm
Environmental	
Enclosure Type Rating	Micro 400 is IP54; MSR41 and MSR42 are IP20
Relative Humidity	15…95% (noncondensing)
Operating Temperature [C (F)]	0…55 ° (14…131 °)
Vibration	IEC 60068-2-6; Frequency 10…55 Hz; Amplitude 0.35 mm (0.01 in.)
Shock	IEC 60068-2-29; Acceleration 10 g, pulse duration 16 ms 10…55 Hz; Amplitude 0.35 mm (0.01 in.)
Physical Characteristics	
Mounting	180° adjustable mounting brackets supplied
Weight	Varies by protective height
Housing Cross Section	15 mm x 20 mm (0.59…0.79 in.)
Connection Type	Transmitter/receiver: 8-pin M12 micro QD
Cable Length	For MSR41 and MSR42: 3, 5, and 8 m (9.8, 16.4, and 26.2 ft), max. Total system length can not exceed 10 m (32.8 ft).
Cascadable Patchcords	1 and 3 m (39.37 and 118.1 in.) M12 to M12 patchcords. Total system length cannot exceed 10 m (32.8 ft) including protective height of Micro 400 (500 mm (19.8 in.)), integrated cables and patchcords from M12 connector to MSR41 or MSR42.

Product Selection

IMPORTANT The maximum length of a GuardShield Micro 400 system is limited to 10 m. This total length includes the length from the last beam in the light curtain housing plus the length of the pigtail cable and the patchcord length.

Standard System

The Allen-Bradley Guardmaster GuardShield Micro 400 safety light curtains are offered in 14 and 30 mm resolution, are ordered as pairs (transmitter and receiver) and are shipped under one cat. no. Each GuardShield Micro 400 pair is shipped with 180° adjustable mounting brackets. After selecting the appropriate pair by cat. no., ensure that the dedicated safety controller (MSR42), required cables, interfaces and accessories are ordered as needed.

Protected Height [mm (in.)]	Resolution [mm (in.)]	Number of Beams	Cat. No.	Protected Height [mm (in.)]	Resolution [mm (in.)]	Number of Beams	Cat. No.
150 (5.9)	14 (0.55)	15	445L-P4C0150FP	150 (5.9)	30 (1.18)	6	445L-P4E0150FP
300 (11.8)	14 (0.55)	30	445L-P4C0300FP	300 (11.8)	30 (1.18)	12	445L-P4E0300FP
450 (17.7)	14 (0.55)	45	445L-P4C0450FP	450 (17.7)	30 (1.18)	18	445L-P4E0450FP
600 (23.6)	14 (0.55)	60	445L-P4C0600FP	600 (23.6)	30 (1.18)	24	445L-P4E0600FP
750 (29.5)	14 (0.55)	75	445L-P4C0750FP	750 (29.5)	30 (1.18)	30	445L-P4E0750FP
900 (35.4)	14 (0.55)	90	445L-P4C0900FP	900 (35.4)	30 (1.18)	36	445L-P4E0900FP
1050 (41.3)	14 (0.55)	105	445L-P4C1050FP	1050 (41.3)	30 (1.18)	42	445L-P4E1050FP
1200 (47.2)	14 (0.55)	120	445L-P4C1200FP	1200 (47.2)	30 (1.18)	48	445L-P4E1200FP

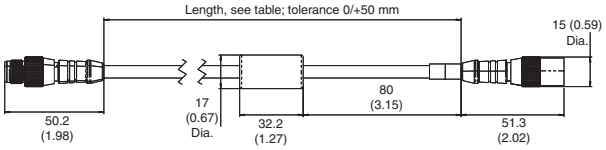
IMPORTANT The GuardShield Micro 400 requires a dedicated controller (MSR41 or MSR42) as well as transmitter and receiver patchcords.

Cascadable System

The Allen Bradley Guardmaster GuardShield Cascadable Micro 400 safety light curtains are offered in limited protective heights in 14 mm and 30 mm resolutions.They are most commonly ordered as pairs (cascadable transmitter and cascadable receiver) and are shipped under one part number. Each GuardShield Cascadable Micro 400 pair is shipped with mounting brackets. After selecting the appropiate cascadable pair cat. no., ensure that the dedicated safety controller (MSR41 or MSR42), appropiate cables, interfaces and accessories are ordered as well.

Protected Height [mm (in.)]	Resolution [mm (in.)]	Number of Beams	Cat. No.	Protected Height [mm (in.)]	Resolution [mm (in.)]	Number of Beams	Cat. No.
150 (5.9)	14 (0.55)	15	445L-C4C0150FP	150 (5.9)	30 (1.18)	6	445L-C4E0150FP
300 (11.8)	14 (0.55)	30	445L-C4C0300FP	300 (11.8)	30 (1.18)	12	445L-C4E0300FP
450 (17.7)	14 (0.55)	45	445L-C4C0450FP	600 (23.6)	30 (1.18)	24	445L-C4E0600FP
600 (23.6)	14 (0.55)	60	445L-C4C0600FP	900 (35.4)	30 (1.18)	36	445L-C4E0900FP
900 (35.4)	14 (0.55)	90	445L-C4C0900FP	1200 (47.2)	30 (1.18)	48	445L-C4E1200FP
1200 (47.2)	14 (0.55)	120	445L-C4C1200FP	—			

Micro 400 Patchcord for Interconnecting Cascaded Segments (if required)



Cascadable Patchcords

Description	Cat. No.
1 m (39.37 in.) patchcord	445L-AC8PC1
3 m (118.11 in.) patchcord	445L-AC8PC3
5 m (196.85 in.) patchcord	445L-AC8PC5

POC Type 4 Safety Light Curtains

GuardShield Micro 400

Micro 400 IP69K Light Curtains

The GuardShield Micro 400 is offered with the transmitter and receiver sealed in clear acrylic tubes with an environmental rating of IP69K. These IP69K Micro 400 light curtains are factory sealed and are ordered as pairs. They are offered in a 14 mm resolution in protected heights of 300 mm (11.8 in.), 600 mm (23.6 in.), 900 mm (35.4 in.) and 1200 mm (47.2 in.) with an operating range of five meters.

The required MSR 41 or MSR42 controllers maintain the IP20 rating and must be mounted in a suitable enclosure.

The Micro 400 IP69K transmitter and receiver are both offered with eight pin M12 connectors at the end of 500 mm (19.8 in.) integrated cables. The patchcords to connect the transmitter and receiver to the controller are the same cat. no. and are offered in 3 m (9.8 ft), 5 m (16.4 ft), and 8 m (26.2 ft) lengths.

These patchcords are configured on one end with M12 connectors, which mate to the integrated pigtail connectors and RJ45 connectors on the opposite end. These connectors plug into the MSR41 or MSR42 controller.

Areas of Use

- Light assembly machines/equipment
- Semi-conductor
- Micro-electronics
- Pharmaceutical
- Filling systems
- Clean rooms
- Food processing

Protected Height [mm (in.)]	Resolution [mm (in.)]	Number of Beams	Cat. No.
300 (11.8)	14 (0.55)	30	445L-P4C0300KD
600 (23.6)	14 (0.55)	60	445L-P4C0600KD
900 (35.4)	14 (0.55)	90	445L-P4C0900KD
1200 (47.2)	14 (0.55)	120	445L-P4C1200KD

Required Micro 400 Controller—Select One

	Mounting	Size	Cat. No.
MSR41—ON/OFF	35 mm DIN Rail	22.5 mm	**440R-P221AGS**
MSR42—Multi-functional module	35 mm DIN Rail	22.5 mm	**440R-P226AGS-NNR**

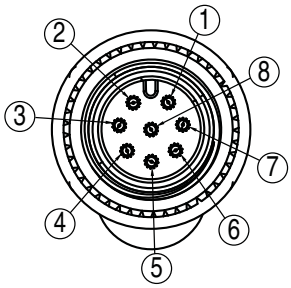
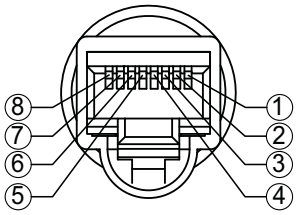
Optional Safety Relay Interfaces

Relay	Input Voltage	Reset	Outputs	Cat. No.
MSR45E Safety Relay Expansion Model	Supplied by MSR41 or MSR42	Determined by MSR41 or MSR42	2 N.O.	**440R-P4NANS**

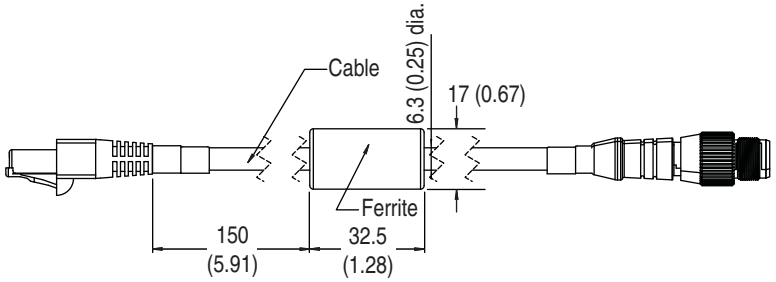
Possible Logic Interfaces

Description	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. Page No.	Cat. No.
Single-Function Safety Relays for 2 N.C. Contact Switch							
MSR127RP	3 N.O.	1 N.C.	Removable (Screw)	Monitored Manual	24V AC/DC	5-26	**440R-N23135**
MSR127TP	3 N.O.	1 N.C.	Removable (Screw)	Auto./Manual	24V AC/DC	5-26	**440R-N23132**
MSR126	2 N.O.	None	Fixed	Auto./Manual	24V AC/DC	5-24	**440R-N23117**

Standard Micro 400 Patchcords—Required (Transmitters and receivers both use 8-pin M12 to RJ45 patchcords)

Face View M12 Connector	Face View RJ45 Connector	Description	Cat. No.
 Pinning table: 1: blue 2: grey 3: green 4: white 5: black 6: pink 7: brown 8: yellow Shield: Braid wires	Pinning table: 1: blue 2: grey 3: green 4: white 5: black 6: pink 7: brown 8: yellow Shield: Braid wires 	1 m patchcord, PVC jacket	445L-AC8RJ1
		2 m patchcord, PVC jacket	445L-AC8RJ2
		3 m patchcord, PVC jacket	445L-AC8RJ3
		5 m patchcord, PVC jacket	445L-AC8RJ5
		8 m patchcord, PVC jacket	445L-AC8RJ8

Patchcord [mm (in.)]



Optional Safety Relay Interface (accessories for MSR41 or MSR42 Controllers)

The MSR41 or MSR42 can have up to three MSR45E safety relays inter-connected. Each module requires a ribbon cable connector to make the interconnection. The table shows the cat. no. for each ribbon cable connector as well as the optical interface for the programming of the MSR42. Programming of the MSR42 is only necessary for advanced operating modes or connection of additional devices.

Description		Cat. No.
	Ribbon cable—for one MSR45E	**440R-ACABL1**
	Ribbon cable—for two MSR45Es	440R-ACABL2
	Ribbon cable—for three MSR45Es	440R-ACABL3
	USB optical interface software configuration tool used to configure the MSR42	**445L-AF6150**

Note: The configuration software can be downloaded at *www.ab.com/safety*.

Optional Accessories

Description		Cat. No.
	Adjustable 180° bracket kit (two per kit) supplied with each pair Two kits required per pair	445L-AF6143
	Flat bracket kit (two per kit) Two kits per pair	445L-AF6145
	Adjustable flat bracket (two per kit) Two kits required per pair	445L-AF6149
	IP69K mounting bracket kit (two kits per pair supplied with each pair)	445L-AF6160

Corner Mirror for Multi-Sided Guarding

Specially constructed glass mirrors for 2- and 3-sided safeguarding applications.

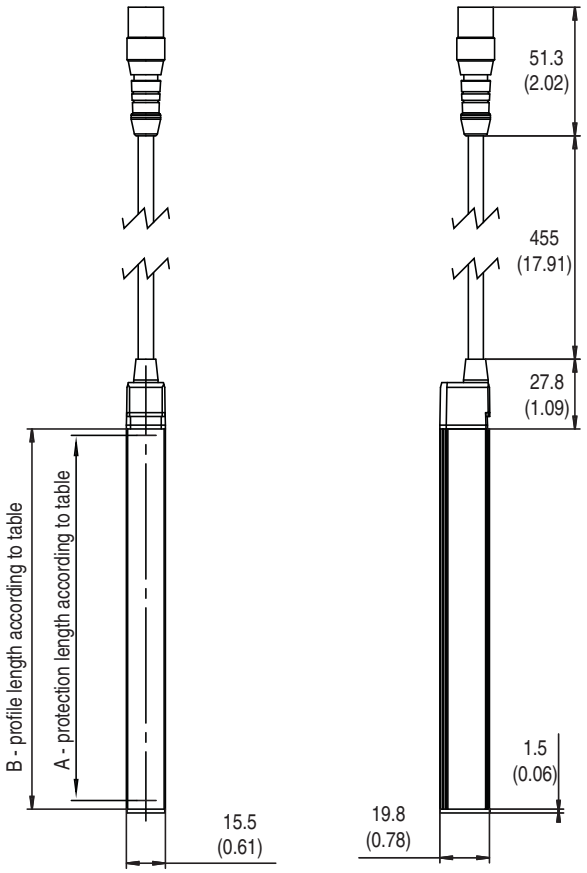
IMPORTANT Each mirror reduces maximum scan range by 10% per mirror.

GuardShield Micro 400 Protected Height [mm (in.)]	Narrow Mirror Short-Range 0…4 m	Cat. No.
150 (5.9)/300 (11.8)		440L-AM0750300
450 (17.7)		440L-AM0750450
600 (23.6)		440L-AM0750600
750 (29.5)		440L-AM0750750
900 (35.4)		440L-AM0750900
1050 (41.3)		440L-AM0751050
1200 (47.2)		440L-AM0751200

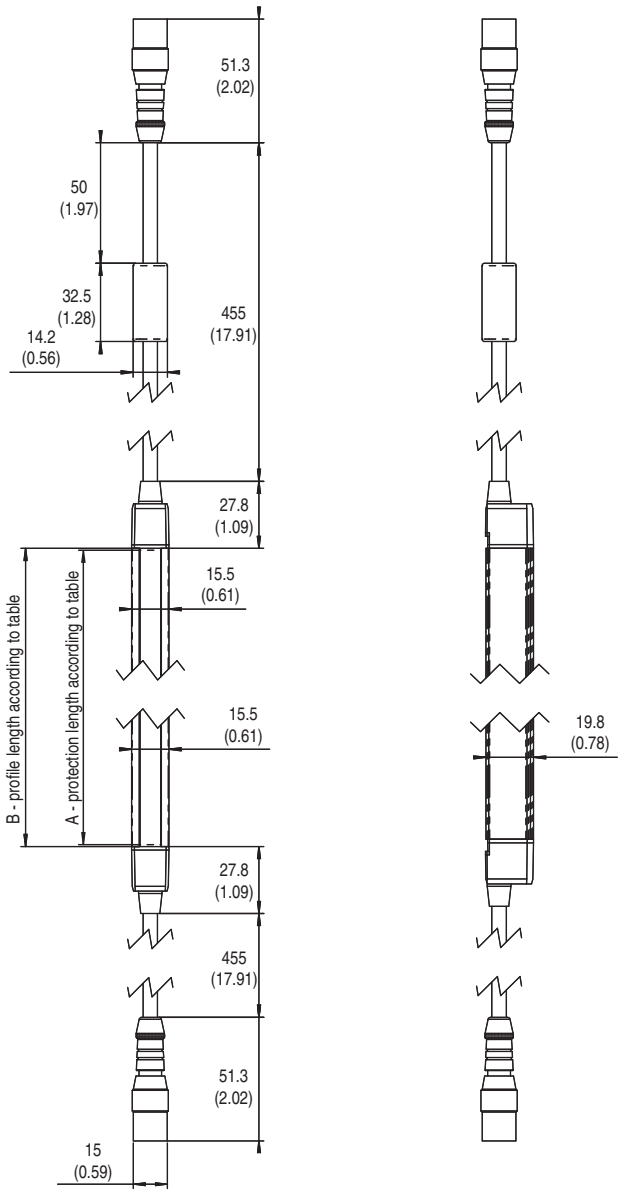
Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.

Safety Light Curtains—Standard



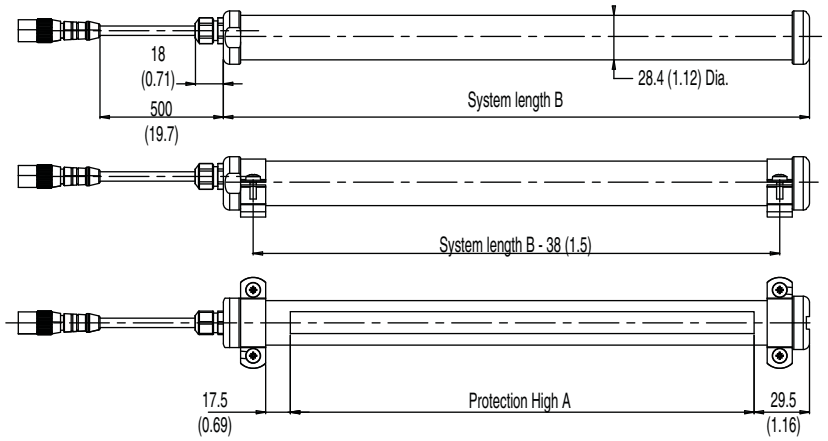
Safety Light Curtains—Cascadable



Type	A Protective Height [mm]	B Profile Length [mm]
445L-❄4‡0150FB	150	151.5 ±0.3
445L-❄4‡0300FB	300	301 ±0.3
445L-❄4‡0450FB	450	451 ±0.3
445L-❄4‡0600FB	600	601 ±0.3
445L-❄4‡0750FB	750	751 ±0.3
445L-❄4‡0900FB	900	901 ±0.3
445L-❄4‡1050FB	1050	1051 ±0.3
445L-❄4‡1200FB	1200	1201 ±0.3

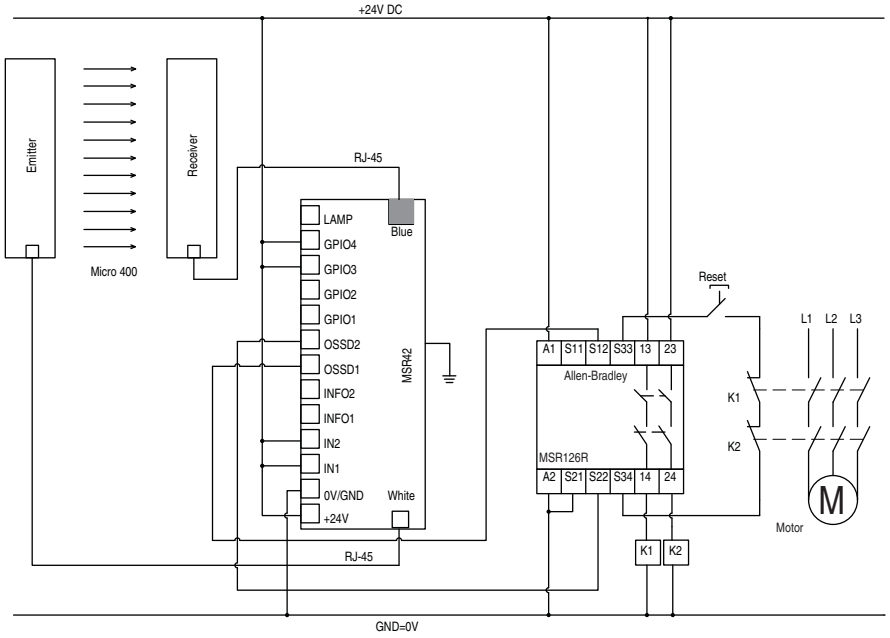
❄ P = Standard pair, C = Cascadable pair
‡ C = 14 mm, E = 30 mm

IP69K Micro 400



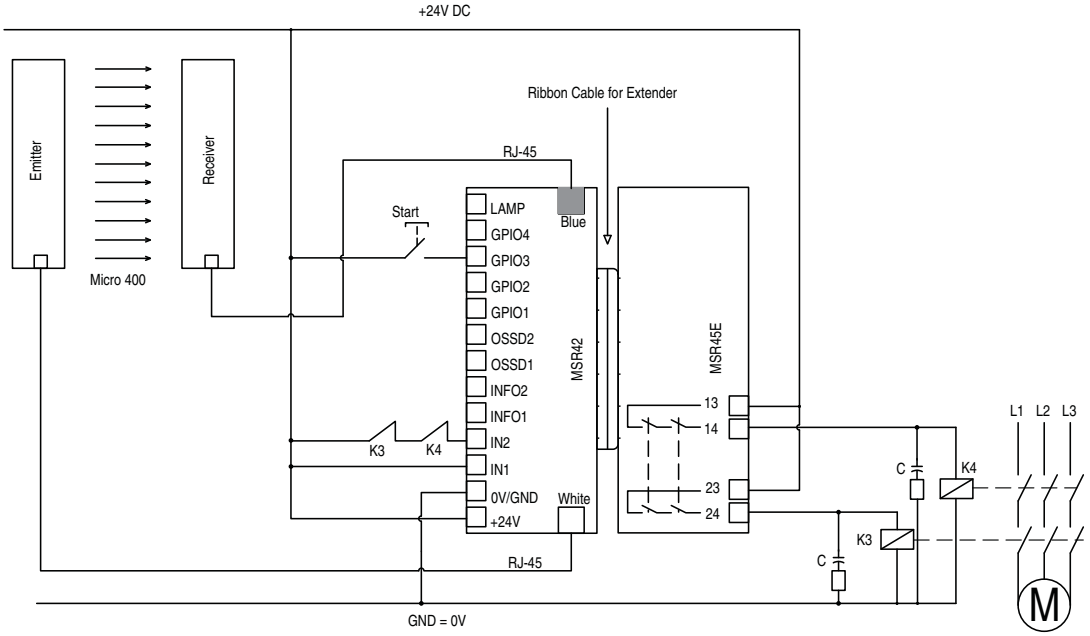
Wiring Diagram for Connection to MSR126 Relay

Wiring diagram is not intended to be used for installation purposes.



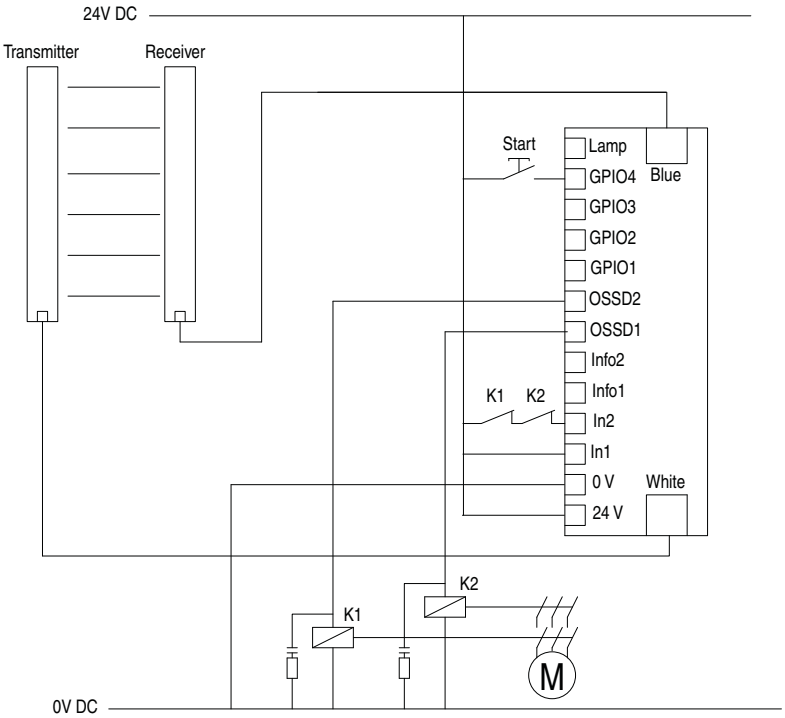
Micro 400 with MSR42 and MSR126R for Monitored Manual Reset with Monitored Output

Wiring Diagram for Connection to MSR45E Expansion Module



Micro 400 with MSR42 Add-on MSR45E for Manual Reset with Start Release

Wiring Diagram for Connection of MSR42 to Contactor if EDM Is Activated



POC Type 2 Safety Light Curtains

GuardShield Type 2

Overview

The Allen-Bradley Guardmaster GuardShield Type 2 safety light curtain is a new addition to the ABGM portfolio of Opto-Electronic safety devices. The “Type 2” designation means that this particular safety light curtain meets a lesser requirement for performance under fault conditions than the GuardShield Type 4. As a result, the GuardShield Type 2 safety light curtain can only be applied in applications where a formal risk assessment has determined that a Type 2 device is sufficient to meet the level of risk posed by the hazard.

There are a number of regulations that discuss risk assessment. The US based methods of conducting risk assessments which provide guidance for the determination of the level of risk to personnel can be found as follows:

- ANSI TR3—for machinery
- ANSI/RIA 15.05—for the Robotics industry
- ANSI/ISO 12100-1 Safety of Machinery

Typically in North America the use of Type 2 light curtains is not allowed for machinery or equipment covered by ANSI/OSHA regulations and standards whose requirement for performance under fault conditions is "control reliability." Type 2 light curtains do not meet the requirements of "control reliability."

The European Union requires the Risk Assessment be performed per EN ISO 14121 "Principles for Risk Assessment."

Safeguarding of the machine must be appropriate to the foreseeable risks and identified hazards. The level(s) of risk determined from the completion of a formal risk assessment indicate the level of the safety device required. In many instances it is necessary to use a combination of safety devices for adequate protection of personnel from hazards based on the risk assessment.

What Is "Type 2" and "Type 4"

Three types of safety ESPEs (Electro-Sensitive Protective Equipment) are defined within International and European standard IEC/EN 61496 Parts 1 and 2. This standard specifies the requirements for the design, construction, testing and performance of ESPEs—designed specifically to detect persons as part of a safety related system. The three types differ in their performance in the presence of faults and under influences from environmental conditions.

A Type 2 safety light curtain requires:

- A single fault resulting in the loss of detection capability,
- Failure of the OSSDs to go to the OFF state,
- Shall cause the light curtain to lock out as a result of the cycling of power, the next periodic test, or the interruption of the sensing function.

A Type 2 device requires the need for a periodic test of the system prior to a demand on the system, i.e., interruption of the light curtain's sensing field. This periodic test may be initiated by a simple manually operated switch (e.g., pushbutton) or by a more complex automatically controlled PLC.

Ideally the periodic test will be twice the operator interface frequency of exposure to the hazard.

The Type 4 device is required to detect a fault in its safety circuitry and immediately switch to a lock-out condition when the fault occurs. The fault detection is assured through diverse redundancy and cross monitoring of the internal circuit. A Type 4 device will fail to a safe state in the presence of an accumulation of undetected faults.

IMPORTANT	Type 2 safety light curtains do not meet OSHA regulations nor ANSI published standards, which define the requirements of “Control Reliability,” therefore it is not allowable to use a Type 2 safety light curtain device on equipment or machinery that requires “Control Reliability.”

Description

The Allen-Bradley Guardmaster GuardShield Type 2 safety light curtain is a self contained “two box,” Type 2 safety light curtain. Designed for use on or around machinery in which a formal risk assessment has determined that a Type 2 safety device is of a sufficient level of safety to meet the guarding application, the GuardShield Type 2 is the ideal solution. GuardShield Type 2 is offered in either a “Guard Only” operating mode or in a factory configured operating mode of restart interlock with external device monitoring. In either operating mode, the GuardShield Type 2 safety light curtain will provide the appropriate level of protection to personnel.

The GuardShield Type 2 is designed to protect personnel from equipment or machinery hazards where the risk of injury are low. A formal risk assessment should be performed prior to selecting the proper safeguarding device. In many instances it is necessary to use a combination of safety devices to assure complete protection of personnel from hazards.

ATTENTION	Safety light curtains of a Type 2 level of safety typically do not meet OSHA or ANSI requirements of “Control Reliability,” therefore it is not allowable to use a safety device of a Type 2 level on or around equipment or machinery that requires “Control Reliability.”

Applications

- Conveyors
- Packaging machinery (excluding palletizers)
- Textile machinery
- Automated assembly lines
- Automatic storage and retrieval machinery

Specifications

Safety Ratings	
Standards	IEC/EN 61496 Parts 1 & 2, UL 61496 Parts 1 & 2, UL 1998
Safety Classification	Type 2 per IEC/EN61496. Category 2 device per EN 954-1, SIL 2 per IEC 61508, PLd per EN/ISO 13849
Certifications	CE Marked for all applicable directives, UL 1998 Listed, cULus Listed, and TÜV
Power Supply	
Input Power, Max.	24V DC ±20%
Maximum Residual Ripple	0.05 Vss
Power Consumption	400 mA max (no load)
Outputs	
Safety Outputs	2 OSSDs, 0.5 A, short-circuit protected
Non-Safety Outputs	1 auxiliary output, 0.5 A max.
Output Voltage, Min.	U_v - 2V
Switching Current @ Voltage, Min.	500 mA @ 24V DC
Operating Characteristics	
Response Time	20 ms
Status Indicators	On state, off state, alignment, interlock
Protected Height—mm (in)	160…1760 (6.3…69.36) in 160 (6.3) increments
Resolution [mm (in.)]	30 (1.18)
Scanning Range	16 m (52.5 ft)
Synchronization	Optical, without separate synchronization channel
Wavelength	870 nm
Environmental	
Enclosure Type Rating	IP65
Relative Humidity	15…95% (noncondensing)
Operating Temperature [C (F)]	-10…55° (14…131°)
Vibration	IEC 60068-2-6, frequency, 10…55 Hz Amplitude: 0.35 mm (0.01 in.)
Shock	IEC 60068-2-29 acceleration 10 g, pulse duration 16 ms
Physical Characteristics	
Mounting	End-cap mounting brackets
Weight	Varies by protective height
Housing Cross Section	40 x 50 mm (1.57 x 1.96 in.)
Connection Type	Transmitter: 4-pin micro QD Receiver: 8-pin micro QD
Cable Length	30 m (100 ft) max.

POC Type 2 Safety Light Curtains

GuardShield Type 2

Product Selection

Standard System

The Allen-Bradley Guardmaster GuardShield safety light curtains are ordered as pairs—transmitter and receiver—and are shipped under one part number. Each GuardShield Type 2 transmitter and receiver is packaged with two right angle mounting brackets. After selecting the appropriate light curtain pair, ensure that required interfaces and accessories are ordered.

Resolution [mm (in.)]	Number of Beams	Protective Height—mm (in)	Pair Weight [kg (lb)]	Cat. No.	
				Guard Only	Restart Interlock with EDM
30 (1.18)	8	160 (6.3)	0.9 (1.9)	440L-P2KA0160YD	440L-P2KD0160YD
30 (1.18)	16	320 (12.6)	1.1 (2.4)	440L-P2KA0320YD	440L-P2KD0320YD
30 (1.18)	24	480 (18.9)	1.6 (3.5)	**440L-P2KA0480YD**	440L-P2KD0480YD
30 (1.18)	32	640 (25.2)	2.0 (4.4)	**440L-P2KA0640YD**	440L-P2KD0640YD
30 (1.18)	40	800 (31.5)	2.5 (5.5)	440L-P2KA0800YD	440L-P2KD0800YD
30 (1.18)	48	960 (37.8)	2.9 (6.4)	440L-P2KA0960YD	440L-P2KD0960YD
30 (1.18)	56	1120 (44.1)	3.4 (7.5)	440L-P2KA1120YD	440L-P2KD1120YD
30 (1.18)	64	1280 (50.4)	3.8 (8.4)	440L-P2KA1280YD	440L-P2KD1280YD
30 (1.18)	72	1440 (56.7)	4.3 (9.5)	440L-P2KA1440YD	440L-P2KD1440YD
30 (1.18)	80	1600 (63.0)	4.7 (10.4)	440L-P2KA1600YD	440L-P2KD1600YD
30 (1.18)	88	1760 (69.1)	5.2 (11.5)	440L-P2KA1760YD	440L-P2KD1760YD

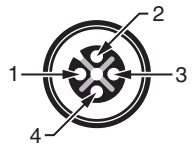
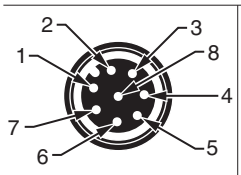
Note: The GuardShield transmitter requires a 4-pin cable and the receiver requires an 8-pin cable.

Recommended Logic Interfaces

Description	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. Page No.	Cat. No.
Single-Function Safety Relays for 2 N.C. Contact Switch							
MSR127RP	3 N.O.	1 N.C.	Removable (Screw)	Monitored Manual	24V AC/DC	5-26	**440R-N23135**
MSR127TP	3 N.O.	1 N.C.	Removable (Screw)	Auto./Manual	24V AC/DC	5-26	**440R-N23132**
MSR126	2 N.O.	None	Fixed	Auto./Manual	24V AC/DC	5-24	**440R-N23117**
Modular Safety Relays							
MSR210P Base 2 N.C. only	2 N.O.	1 N.C. and 2 PNP Solid State	Removable	Auto./Manual or Monitored Manual	24V DC from the base unit	5-82	440R-H23176
MSR220P Input Module	—	—	Removable	—	24V DC	5-86	440R-H23178
MSR310P Base	MSR300 Series Output Modules	3 PNP Solid State	Removable	Auto./Manual Monitored Manual	24V DC	5-102	440R-W23219
MSR320P Input Module	—	2 PNP Solid State	Removable	—	24V DC from the base unit	5-106	440R-W23218
Muting Modules							
MSR22LM	2 N.O.	1 N.C.	Removable	Auto./Manual	24V DC	5-48	**440R-P23071**
MSR42 (requires optical interface to configure 445L-AF6150	2 PNP	2 PNP, configurable	Removable	Auto./manual or manual monitored	24V DC	5-52	**440R-P226AGS-NNR**

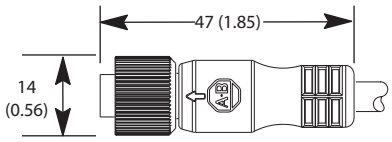
Note: The use of a category 4 safety relay module does not improve the category rating of the safety system beyond the category 2 rating of the Type 2 GuardShield light curtain.

Cordsets—Two Required (one for transmitter and one for receiver)

Female Connector (Sensor End)		Cable			
Face View of Female	Connector Style	Pin/Wire Color	Wire Rating	Length [m (ft)]	Cat. No.
Transmitter					
	Straight Female	1 Brown 2 White 3 Blue 4 Black	22 AWG 300V 4 A	2 (6.56)	889D-F4AC-2
				5 (16.4)	889D-F4AC-5
				10 (32.8)	889D-F4AC-10
				15 (49.2)	889D-F4AC-15
				20 (65.6)	889D-F4AC-20
				30 (98.4)	889D-F4AC-30
Receiver					
	Straight Female	1 White 2 Brown 3 Green 4 Yellow 5 Grey 6 Pink 7 Blue 8 Red	24 AWG 30V AC/36V DC 1.5 A	2 (6.56)	889D-F8AB-2
				5 (16.4)	889D-F8AB-5
				10 (32.8)	889D-F8AB-10
				15 (49.2)	889D-F8AB-15
				20 (65.6)	889D-F8AB-20
				30 (98.4)	889D-F8AB-30

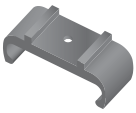
Cordsets Approximate Dimensions [mm (in.)]

Dimensions are not intended to be used for installation purposes.



Straight Female

Optional Accessories

Description		Cat. No.
	Steel L-shaped end cap mounting bracket (4 per package) **Note:** 4 brackets supplied with each GuardShield pair.	440L-AF6101 (1 package per system)
	Aluminum middle mounting bracket for vibratory applications	**440L-AF6108** (1 package per system)
	Power Supply: Output 24V DC, 3 Amps, 72 W	1606-XLP72E
	Laser alignment tool	**440L-ALAT**
	GuardShield laser alignment tool bracket	**440L-AF6109**
	Mounting stand	**440L-AMSTD**
	GuardShield weld shield (cat. no. is for a pair of light curtains)	440L-AGWS0160
		440L-AGWS0320
		440L-AGWS0480
		440L-AGWS0640
		440L-AGWS0800
		440L-AGWS0960
		440L-AGWS1120
		440L-AGWS1280
		440L-AGWS1440
		440L-AGWS1600
		440L-AGWS1760
	Vertical shock mount kit	**440L-AF6120**
	Horizontal shock mount kit	440L-AF6121
	Middle vertical mount kit	440L-AF6122
	Middle horizontal mount kit	440L-AF6123

Corner Mirror for Multi-Sided Guarding

Specially constructed glass mirrors for 2- and 3-sided safeguarding applications.

Note: Each mirror reduces maximum scan range by approximately 15% per mirror.

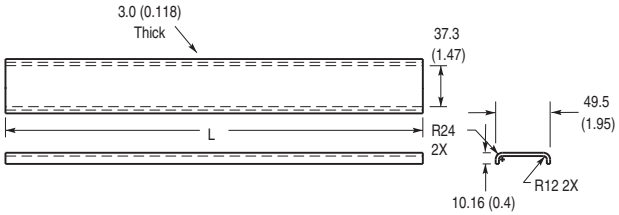
GuardShield Light Curtain Cat. No.	Narrow Mirror Short-Range 0…4 m	Cat. No.	Wide Mirror Long-Range 4…15 m	Cat. No.
440L-P2K‡0160YD		440L-AM0750300		440L-AM1250300
440L-P2K‡0320YD		440L-AM0750450		440L-AM1250450
440L-P2K‡0480YD		440L-AM0750600		440L-AM1250600
440L-P2K‡0640YD		440L-AM0750750		440L-AM1250750
440L-P2K‡0800YD		440L-AM0750900		440L-AM1250900
440L-P2K‡0960YD		440L-AM0751050		440L-AM1251050
440L-P2K‡1120YD		440L-AM0751200		**440L-AM1251200**
440L-P2K‡1280YD		440L-AM0751350		440L-AM1251350
440L-P2K‡1440YD		440L-AM0751500		440L-AM1251500
440L-P2K‡1600YD		440L-AM0751650		440L-AM1251650
440L-P2K‡1760YD		440L-AM0751800		440L-AM1251800

‡ = A or D

Weld Shields

The GuardShield weld shields are sold as pairs in the same lengths as the protective heights of the GuardShield safety light curtain.

These polycarbonate weld shields are designed as disposable devices whose purpose is to protect the front window of the GuardShield from damage.

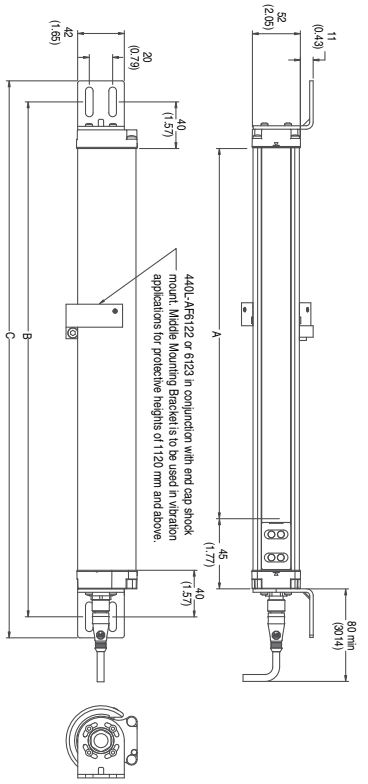


Dimensions "L"—mm (in)	Cat. No.
175.3 (6.9)	440L-AGWS0160
335.3 (13.2)	440L-AGWS0320
495.3 (19.5)	440L-AGWS0480
655.3 (25.8)	440L-AGWS0640
815.3 (32.1)	440L-AGWS0800
975.4 (38.4)	440L-AGWS0960
1135.4 (44.7)	440L-AGWS1120
1295.4 (51.0)	440L-AGWS1280
1455.4 (57.3)	440L-AGWS1440
1615.4 (63.6)	440L-AGWS1600
1778 (70.0)	440L-AGWS1760

Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.

Safety Light Curtain

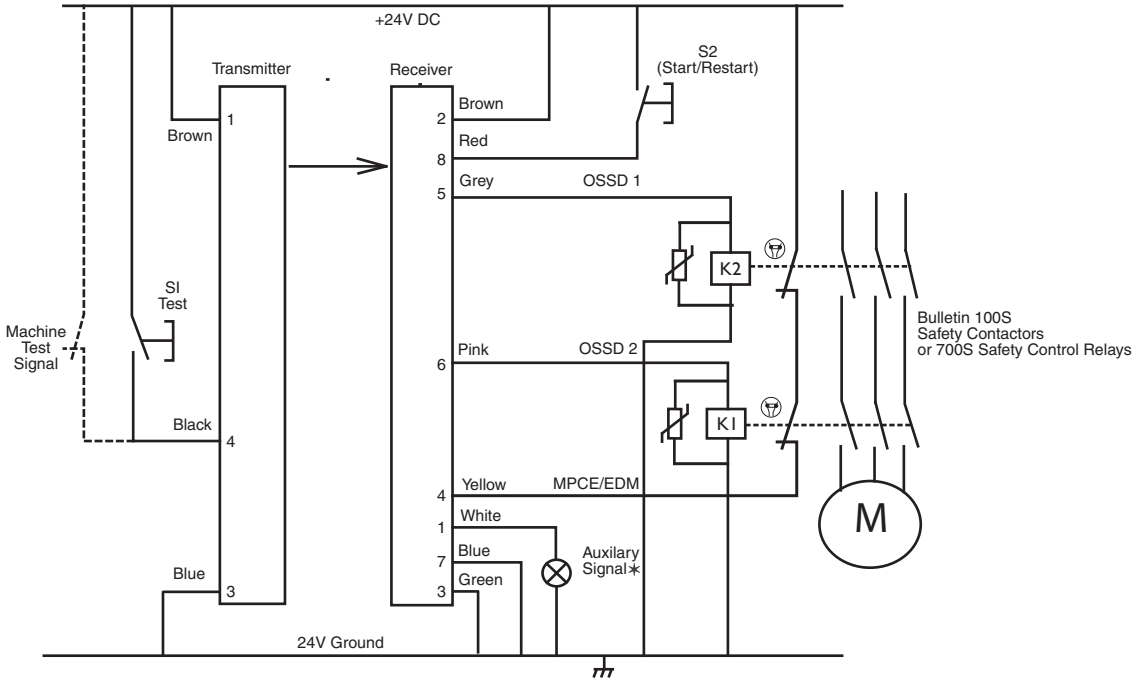


Type	A Protective Height [mm]	B Mounting Value [mm]	C Total Length [mm]
440L-P2K∗0160YD	160 ±0.5	285	321 ±1.5
440L-P2K∗0320YD	320 ±0.5	445	481 ±1.5
440L-P2K∗0480YD	480 ±0.5	605	641 ±1.5
440L-P2K∗0640YD	640 ±0.5	765	801 ±1.5
440L-P2K∗0800YD	800 ±0.5	925	961 ±1.5
440L-P2K∗0960YD	960 ±0.5	1085	1121 ±1.5
440L-P2K∗1120YD	1120 ±0.5	1245	1281 ±1.8
440L-P2K∗1280YD	1280 ±0.5	1405	1441 ±1.8
440L-P2K∗1440YD	1440 ±0.5	1565	1601 ±1.8
440L-P2K∗1600YD	1600 ±0.5	1725	1636 ±2.0
440L-P2K∗1760YD	1760 ±0.5	1885	1112 ±1.5

∗ A for Guard Only or D for Restart Interlock with EDM.

Wiring Diagram for Connection of OSSDs Directly to Contactors (FSDs) fpr GuardShield Type with EDM and Restart Interlock

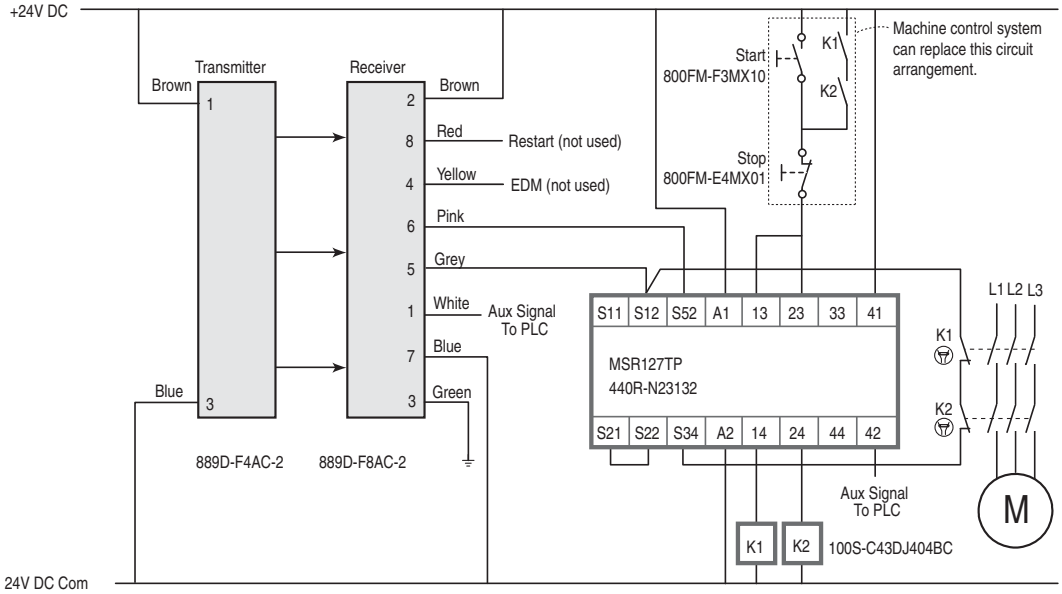
Wiring diagram is not intended to be used for installation purposes.



* Auxiliary output is nonsafety. Can be connected to a lamp, motor or status to a PLC.

K1, K2	Safety relay or safety contactor for OSSD 1 and OSSD 2 connection
S1	Switch for external system test (optional)
S2	Switch for reset of light curtain from start/restart interlock

Wiring Diagram for Connection of OSSDs Directly to a Safety Relay Module



POC Type 2 Safety Light Curtains

GuardShield Safe 2

Description

The Allen-Bradley Guardmaster GuardShield Safe 2 safety light curtain is a new addition to the Allen-Bradley Guardmaster portfolio of opto-electronic safety devices. The “Type 2” designation means that this particular safety light curtain meets a lesser requirement for performance under fault conditions than the GuardShield Type 4 safety light curtains. As a result, the GuardShield Type 2 safety light curtain can only be applied in applications where a formal risk assessment has determined that a Type 2 device is sufficient to meet the level of risk posed by the hazard.

The GuardShield Safe 2 safety light curtain is a self-contained two-box, safety light curtain in a robust housing with an integrated laser alignment system. The integrated laser alignment system generates two visible beams of light which simplifies alignment of the light curtain pair.

This economical opto-electronic Type 2 safety light curtain is offered in a guard-only mode of operation and is designed for use on or around machinery or equipment where a formal risk assessment has determined that a Type 2 safety device is of a sufficient level of safety to meet the guarding application.

ATTENTION	Safety light curtains of a Type 2 level of safety typically do not meet OSHA or ANSI requirements of “Control Reliability,” therefore it is not allowable to use a safety device of a Type 2 level on or around equipment or machinery that requires “Control Reliability.”

Features

- M12 connectors
- Optically synchronized
- Integrated laser alignment system
- IP65 enclosure rating
- Simple Installation
- cULus Listed and CE Marked for all applicable directives

Applications

- Conveyors
- Textile machinery
- Automatic storage and retrieval machinery
- Automated assembly lines

Specifications

Safety Ratings	
Standards	IEC/EN61496 Parts 1 and 2, UL61496 Parts 1 and 2, UL1998
Safety Classification	Type 2 per IEC/EN61496. Category 2 device per EN 954-1, SIL 2 per IEC 61508, PLd per EN/ISO 13849
Certifications	cULus Listed, TÜV, and CE Marked for all applicable directives
Power Supply	
Input Power, Max.	24V DC ± 20% (U_{sp})
Maximum Residual Ripple	< 10% of U_{sp}
Power Consumption	<500 mA (no load)
Outputs	
Safety Outputs	2 PNP OSSD. 0.3 A, short-circuit protected
Output Voltage, Min.	U_{sp} -1
Switching Current @ Voltage, Min.	300 mA @ 24V DC
Operating Characteristics	
Response Time	Varies by protective height
Indicator LEDs	ON -State, OFF-State, internal error
Protected Height [mm (in.)]	120…1920 mm (4.7…75.6 in.) in 120 mm (4.7 in.) increments
Resolution [mm (in.)]	30 mm (1.18 in.)
Scanning Range	0…18 m (0…59 ft)
Synchronization	Optical, first beam adjacent to LEDs
Wavelength	950 nm
Environmental	
Enclosure Type Rating	IP65
Relative Humidity	15…95% (noncondensing)
Operating Temperature [C (F)]	0…55 ° (0…131 °)
Vibration	IEC 60068-2-6 frequency 10…55 Hz; amplitude 0.35 mm (0.01 in.)
Shock	IEC 60068-2-29; acceleration 10 g, pulse duration 16 ms 10…55 Hz; amplitude 0.35 mm (0.01 in.)
Physical Characteristics	
Mounting	Rear mounting, standard and adjustable (180°)
Weight	Varies by protective height
Housing Cross Section	30 x 40 mm (1.18 x 1.57 in.)
Connection Type	Transmitter: 5-pin M12 micro QD Receiver: 5-pin M12 micro QD
Cable Length	30 m (98.4 ft) max.
ILAS Laser Class	Class 2, IEC 60825-1

Product Selection

Standard System Safety Light Curtain

The Allen-Bradley Guardmaster GuardShield Safe 2 safety light curtains are offered in 30 mm resolution, are ordered as pairs—transmitter and receiver—and are shipped under one cat. no. Each GuardShield Safe 2 pair are shipped with 180° mounting brackets. After selecting the appropriate light curtain pair, ensure that the appropriate cables, interfaces, and accessories are ordered.

Protected Height [mm (in.)]	Resolution [mm (in.)]	Number of Beams	Pair Weight [kg (lbs)]	Cat. No.
120 (4.7)	30 (1.18)	8	1.0 (2.2)	445L-P2S0120YD
240 (9.4)	30 (1.18)	16	1.4 (3.09)	445L-P2S0240YD
360 (14.2)	30 (1.18)	24	1.8 (3.97)	445L-P2S0360YD
480 (19.9)	30 (1.18)	32	2.2 (4.85)	445L-P2S0480YD
600 (23.6)	30 (1.18)	40	2.6 (5.73)	445L-P2S0600YD
720 (28.3)	30 (1.18)	48	3.0 (6.61)	445L-P2S0720YD
840 (33.1)	30 (1.18)	56	3.5 (7.72)	445L-P2S0840YD
960 (37.8)	30 (1.18)	64	4.0 (8.82)	445L-P2S0960YD
1080 (42.5)	30 (1.18)	72	4.0 (8.82)	445L-P2S1080YD
1200 (47.2)	30 (1.18)	80	4.5 (9.92)	445L-P2S1200YD
1320 (52.0)	30 (1.18)	88	5.0 (11.02)	445L-P2S1320YD
1440 (56.7)	30 (1.18)	86	5.5 (12.13)	445L-P2S1440YD
1560 (61.4)	30 (1.18)	94	6.0 (13.23)	445L-P2S1560YD
1680 (66.1)	30 (1.18)	102	6.5 (14.33)	445L-P2S1680YD
1800 (70.9)	30 (1.18)	110	7.0 (15.43)	445L-P2S1800YD
1920 (75.6)	30 (1.18)	118	7.5 (16.53)	445L-P2S1920YD

Note: The cat. nos. listed above are pair cat. nos., to specify a transmitter or receiver only, replace the "P" in the cat. no. with a "T" for transmitter or an "R" for receiver.

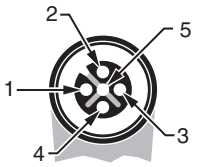
Recommended Logic Interfaces

Description	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. Page No.	Cat. No.
Single-Function Safety Relays for 2 N.C. Contact Switch							
MSR127RP	3 N.O.	1 N.C.	Removable (Screw)	Monitored Manual	24V AC/DC	5-26	**440R-N23135**
MSR127TP	3 N.O.	1 N.C.	Removable (Screw)	Auto./Manual	24V AC/DC	5-26	**440R-N23132**
MSR126	2 N.O.	None	Fixed	Auto./Manual	24V AC/DC	5-24	**440R-N23117**
Modular Safety Relays							
MSR210P Base 2 N.C. only	2 N.O.	1 N.C. and 2 PNP Solid State	Removable	Auto./Manual or Monitored Manual	24V DC from the base unit	5-82	440R-H23176
MSR220P Input Module	—	—	Removable	—	24V DC	5-86	440R-H23178
MSR310P Base	MSR300 Series Output Modules	3 PNP Solid State	Removable	Auto./Manual Monitored Manual	24V DC	5-102	440R-W23219
MSR320P Input Module	—	2 PNP Solid State	Removable	—	24V DC from the base unit	5-106	440R-W23218
Muting Modules							
MSR22LM	2 N.O.	1 N.C.	Removable	Auto./Manual	24V DC	5-48	**440R-P23071**
MSR42 (requires optical interface to configure 445L-AF6150	2 PNP	2 PNP, configurable	Removable	Auto./manual or manual monitored	24V DC	5-52	**440R-P226AGS-NNR**

Note: The use of a category 4 safety relay module does not improve the category rating of the safety system beyond the Category 2 rating of the Type 2 light curtain in use.

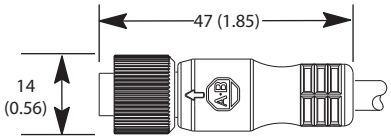
Cordsets—Transmitters and receivers both use 5-pin M12 cordsets

Note: Unshielded cordsets are most commonly used for safety light curtains, however, shielded cordsets are also offered to increase immunity to electrical interference.

Female Connector (Sensor End)		Cable			
Face View of Female	Connector Style	Pin/Wire Color	Wire Rating	Length [m (ft)]	Cat. No.
	Straight Female Nonshielded	1 Brown 2 White 3 Blue 4 Black 5 Grey	22 AWG 250V 4 A	2 (6.56)	889D-F5AC-2
				5 (16.4)	889D-F5AC-5
				10 (32.8)	889D-F5AC-10
				15 (49.2)	889D-F5AC-15
				20 (65.6)	889D-F5AC-20
				30 (98.4)	889D-F5AC-30
	Straight Female Shielded	1 Brown 2 White 3 Blue 4 Black 5 Grey	22 AWG 22 AWG 300V 4 A	2 (6.56)	889D-F5EC-2
				5 (16.4)	889D-F5EC-5
				10 (32.8)	889D-F5EC-10
				15 (49.2)	889D-F5EC-15
				20 (65.6)	889D-F5EC-20
				30 (98.4)	889D-F5EC-30

Cordsets Approximate Dimensions [mm (in.)]

Dimensions are not intended to be used for installation purposes.



Straight Female

Corner Mirror for Multi-Sided Guarding

Specially constructed glass mirrors for 2- and 3-sided safeguarding applications.

Note: Each mirror reduces maximum scan range by approximately 15% per mirror.

GuardShield Safe 2/Safe 4 Protected Height [mm (in.)]	Narrow Mirror Short-Range 0…4 m	Cat. No.	Wide Mirror Long-Range 4…15 m	Cat. No.
120/140 (4.7/9.4)		440L-AM0750300		440L-AM1250300
360 (14.2)		440L-AM0750450		440L-AM1250450
480 (19)		440L-AM0750600		440L-AM1250600
600 (24)		440L-AM0750750		440L-AM1250750
720/840 (28/33)		440L-AM0750900		440L-AM1250900
960 (38)		440L-AM0751050		440L-AM1251050
1080 (43)		440L-AM0751200		**440L-AM1251200**
1200 (47)		440L-AM0751350		440L-AM1251350
1320/1440 (52/57)		440L-AM0751500		440L-AM1251500
1560 (61)		440L-AM0751650		440L-AM1251650
1680 (66)		440L-AM0751800		440L-AM1251800
1800/1920 (70.9/75.6)		Not available		Not available

Optional Accessories

Description		Cat. No.
	Standard kit (4 pieces — supplied with each pair)	445L-AF6140
	180° Adjustable kit (two kits required per pair)	**445L-AF6141**
	Shock Mount Kit (2 kits required per pair of light curtains)	445L-AF6142
	Vertical mounting kit (two kits required per pair)	445L-AF6144
	MSR42 Multifunction Module (requires Cat. No. 440L-AF6150 to program)	**440R-P226AGS-NNR**
	MSR45E—Safety Relay for MSR41 or MSR42 (requires ribbon cable connection)	**440R-P4NANS**
	USB optical interface software configuration tool used to configure the MSR42	**445L-AF6150**
	Ribbon cable—for one MSR45E	**440R-ACABL1**
	Ribbon cable—for two MSR45Es	440R-ACABL2
	Ribbon cable—for three MSR45Es	440R-ACABL3
	Mounting stand	**440L-AMSTD**

Note: MSR42 operating software may be downloaded at *www.ab.com/safety*.

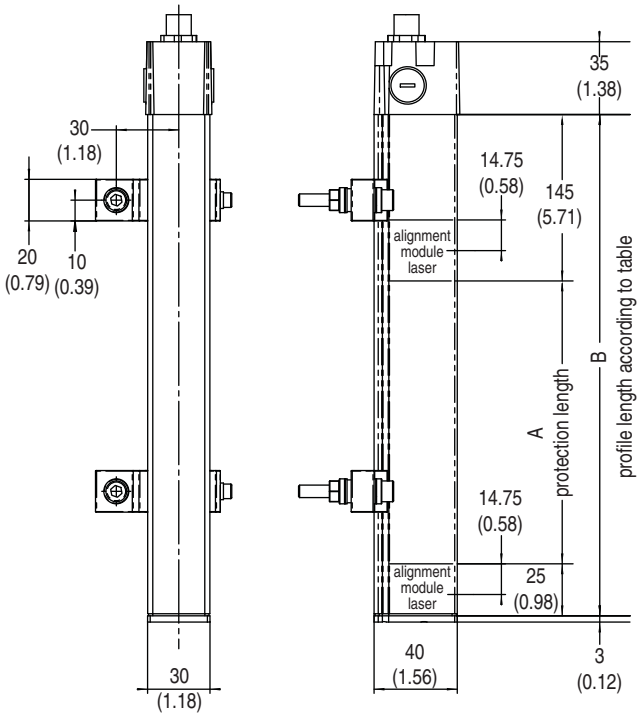
POC Type 2 Safety Light Curtains

GuardShield Safe 2

Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.

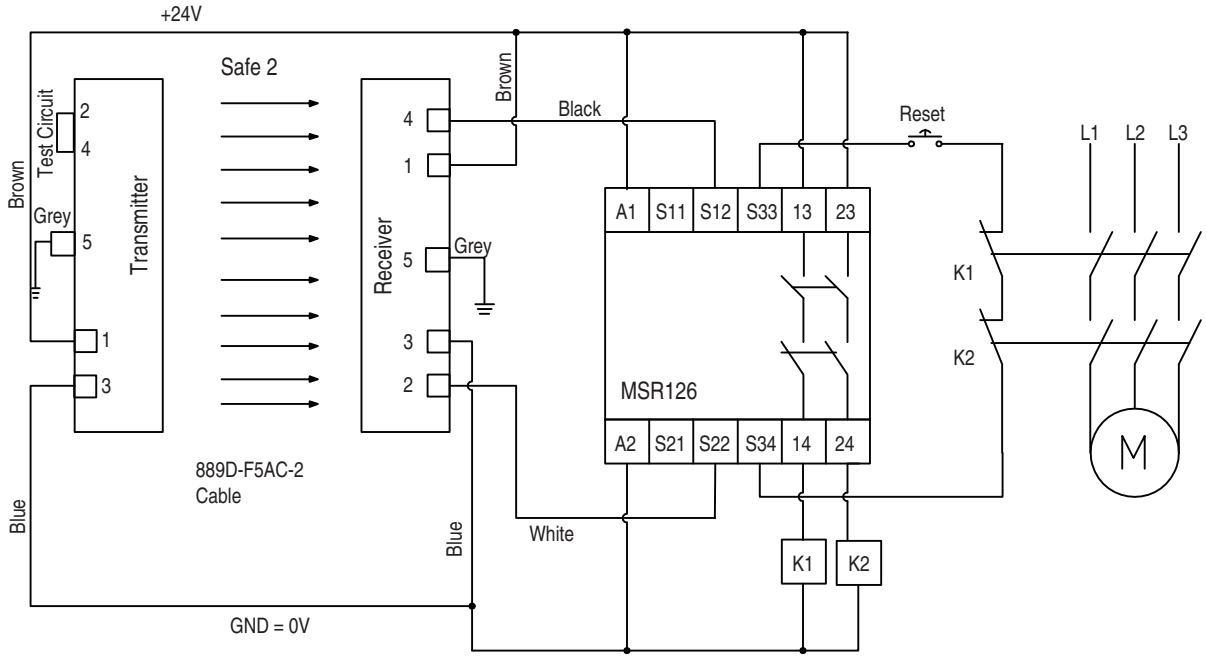
Safety Light Curtain



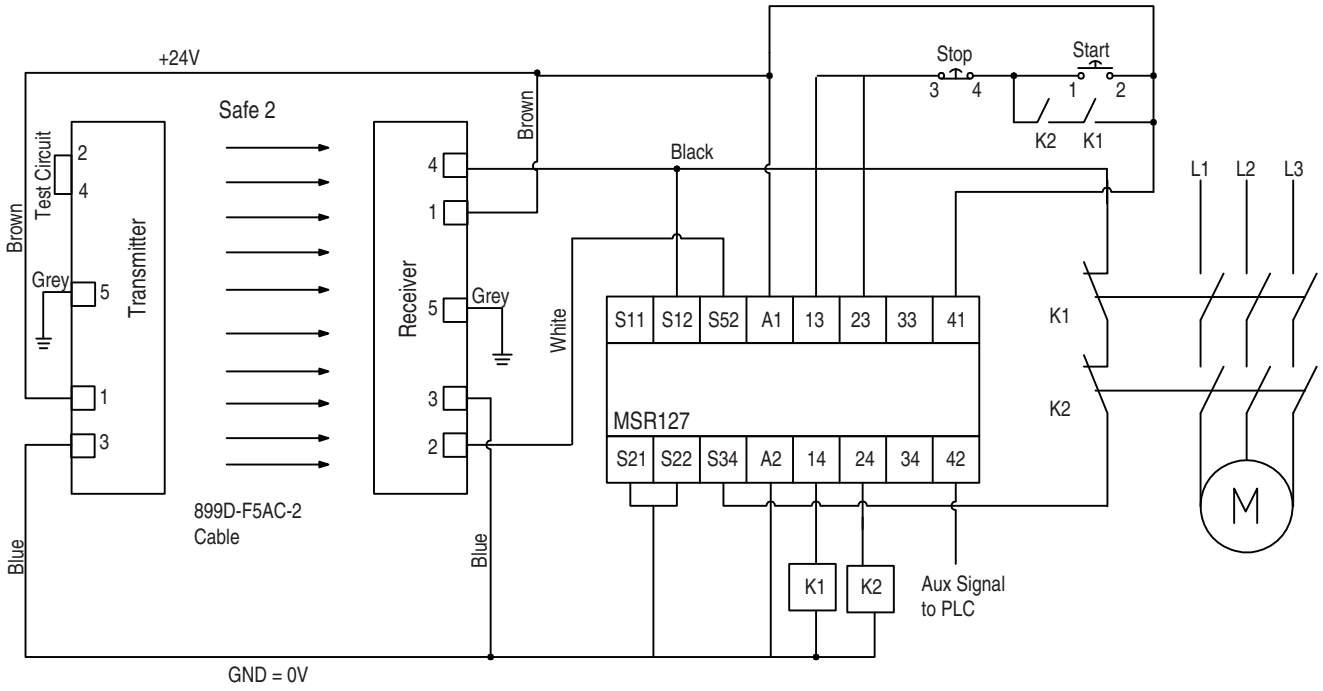
Type	A Protective Height [mm (in.)]	B Profile Length [mm (in.)]
445L-P2S0120YD	120 (4.7)	290 (11.4)
445L-P2S0240YD	240 (9.4)	410 (16.1)
445L-P2S0360YD	360 (14.2)	530 (20.9)
445L-P2S0480YD	480 (18.9)	650 (25.6)
445L-P2S0600YD	600 (23.6)	771 (30.4)
445L-P2S0720YD	720 (28.3)	891 (35.1)
445L-P2S0840YD	840 (33.1)	1011 (39.8)
445L-P2S0960YD	960 (37.8)	1131 (44.5)
445L-P2S1080YD	1080 (42.5)	1252 (49.3)
445L-P2S1200YD	1200 (47.2)	1372 (54.0)
445L-P2S1320YD	1320 (51.9)	1492 (58.7)
445L-P2S1440YD	1440 (56.7)	1612 (63.5)
445L-P2S1560YD	1560 (61.4)	1733 (68.2)
445L-P2S1680YD	1680 (66.1)	1853 (72.9)
445L-P2S1800YD	1800 (70.8)	1973 (77.7)
445L-P2S1920YD	1920 (75.6)	2093 (82.4)

Wiring Diagram for Connection to MSR126

Wiring diagram is not intended to be used for installation purposes.

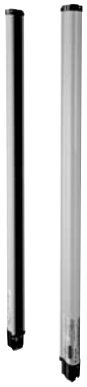


Wiring Diagram for Connection to MSR127



PAC Type 4 Safety Light Curtains

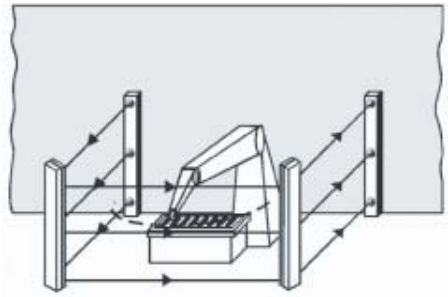
GuardShield PAC



Description

Standard GuardShield PAC

The Allen-Bradley Guardmaster GuardShield Perimeter Access Control (PAC) safety light curtain is a multiple beam, short range (0.3…16 m), Type 4 safety light curtain typically used to provide access detection at machine entry points. It is also possible to use the GuardShield PAC in perimeter guarding applications as an optoelectronic fence as long as the perimeter distance does not exceed the maximum range of 16 meters. Note that when using the GuardShield PAC with corner mirrors for multiple sided guarding, each mirror reduces the maximum scan range of 16 meters by approximately 15%.



The GuardShield PAC safety light curtain is designed for whole body detection and is currently offered in two configurations: two beams at 500 mm spacing and three beams at 400 mm spacing.

GuardShield PAC with Integrated Laser Alignment System

The GuardShield PAC light curtains are offered with an integrated laser alignment system consisting of a Class 1, eye safe, constantly powered laser located in the top of the GuardShield PAC transmitter and at the bottom of the GuardShield PAC receiver. There are targets located across from each laser which help facilitate alignment of the light curtain when the laser is emitting visible light.

Each laser emits a low level of visible light. Simply placing a finger or opaque object in front of the laser reflects the laser light back to a photo sensor. This photo sensor causes the laser to switch state from a barely visible low level of emission to a higher level of emission of visible light. Interrupting the visible light below the finger symbol will cause the laser to change state back to a low level of light emission. The visible light will also change to a low level after five minutes.

The Integrated Laser Alignment system also quickly helps with the re-alignment of pairs when units are knocked out of alignment during the course of the work process or when corner mirrors are used.

ArmorBlock Guard I/O Connectivity

The GuardShield PAC light curtains are also offered with the integrated laser alignment system and connectivity to ArmorBlock Guard I/O. The receiver of these light curtains has a five-pin M12 quick disconnect connector wired to allow connection to the 1732DS ArmorBlock I/O module. This connectivity of the GuardShield PAC receiver allows the GuardShield's OSSDs to operate over a DeviceNet Safe network.

This version of the GuardShield has limited configurability, i.e., only beam coding can be configured by setting the appropriate DIP switches and performing the teach function. EDM, Start/Restart interlock as well as the auxiliary output are not available in these GuardShield PAC models.

The ArmorBlock Guard I/O can be used with any safety controller that communicates on DeviceNet using CIP Safety for the control and monitoring of safety circuits. ArmorBlock Guard I/O detects circuit failures at each I/O point while providing detailed diagnostics directly to the controller. With CIP Safety, you can easily integrate safety and standard control systems by using safety and standard messages on the same wire.

The 1732DS ArmorBlock Guard I/O family consists of 24V DC digital I/O modules that communicate on DeviceNet networks.

Features

- Beam coding
- External device monitoring (EDM)
- Machine test signal
- Start/restart interlock

Industries

- Material handling
- Packaging equipment
- Automotive
- Robot cells

Specifications

Safety Ratings	
Standards	IEC/EN 61496 Parts 1 & 2, UL 61496 Parts 1 & 2, UL 1998
Safety Classification	Type 4 per IEC/EN61496. Category 4 device per EN 954-1, SIL 3 per IEC 61508, PLe per EN/ISO 13849
Certifications	UL 61496, UL 1998, cULus Listed, TÜV and CE marked for all applicable directives
Power Supply	
Input Power, Max.	24V DC ±20%
Maximum Residual Ripple	0.05 Vss
Power Consumption	400 mA (no load)
Outputs	
Safety Outputs	2 x PNP, 0.5 A, short circuit protected
Non-Safety Outputs	1 x PNP 0.5 A max.
Output Voltage, Min.	U_v - 2V
Switching Current @ Voltage, Min.	500 mA @ 24V DC
Operating Characteristics	
Response Time	20 ms, 30 ms with beam coding activated
Status Indicators	On-state, off-state, alignment, interlock
Protected Height—mm (in)	3 beam = 820 (32.3); 2 beam = 520 (20.4)
Scanning Range	16 m (52.5 ft)
Synchronization	Optical, without separate synchronization channel. First beam adjacent to LEDs.
Wavelength	870 nm
Environmental	
Enclosure Type Rating	IP65
Relative Humidity	15%...95% (noncondensing)
Operating Temperature [C (F)]	-10…55° (14…131°)
Vibration	IEC60068-2-6, frequency 10…55 Hz Amplitude: 0.35 mm (0.01 in)
Shock	IEC60068-2-29 acceleration 10 g, pulse duration 16 ms
Physical Characteristics	
Mounting	End-cap mounting brackets
Weight	Varies by Cat. No.
Housing Cross Section	40 mm x 50 mm (1.57 in x 1.96 in)
Connection Type	Transmitter: 4-pin micro QD (M12) Receiver: 8-pin micro QD (M12)
Cable Length	30 m (100 ft) max.

PAC Type 4 Safety Light Curtains

GuardShield PAC

Product Selection

PAC Safety Light Curtains—Standard

The Allen-Bradley Guardmaster GuardShield PAC safety light curtains are ordered as a pair—transmitter and receiver—and are shipped under one Cat. No. After selecting the appropriate Cat. No. ensure that the required interfaces and accessories are ordered as well.

Protected Height [mm (in.)]	Beam Spacing	Number of Beams	Cat. No.
520 (20.4)	500 mm (19.7 in.)	2	440L-P4A2500YD
820 (32.3)	400 mm (15.7 in.)	3	**440L-P4A3400YD**

Note: The GuardShield transmitter requires a 4-pin cable and the receiver requires an 8-pin cable.
Note: To select a transmitter or receiver substitute the "P" in the above cat. nos. with a "T" for a transmitter or an "R" for a receiver.

GuardShield PAC with Integrated Laser Alignment

Protected Height [mm (in.)]	Beam Spacing	Number of Beams	Cat. No.
520 (20.4)	500 mm (19.7 in.)	2	440L-P4AL2500YD
820 (32.3)	400 mm (15.7 in.)	3	440L-P4AL3400YD

Note: The GuardShield transmitter requires a 4-pin cable and the receiver requires an 8-pin cable.
Note: GuardShields are sold in pairs. To select a transmitter or receiver, replace the "P" in the cat. no. with a "T" for a transmitter or an "R" for a receiver.

GuardShield PAC with Integrated Laser Alignment and I/O Connectivity

Protected Height [mm (in.)]	Beam Spacing	Number of Beams	Cat. No.
520 (20.4)	500 mm (19.7 in.)	2	440L-P4AL2500YA
820 (32.3)	400 mm (15.7 in.)	3	440L-P4AL3400YA

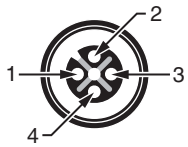
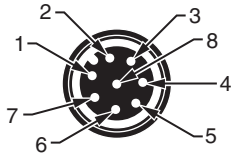
Note: GuardShields are sold in pairs. To select a transmitter or receiver, replace the "P" in the cat. no. with an "R" for a receiver. PAC with integrated laser alignment and I/O connectivity uses a standard transmitter. To order a transmitter, replace the "P" with a "T" and the last "A" with a "D" (example: 440L-T2500YD).

Recommended Logic Interfaces

Description	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. Page No.	Cat. No.
Single-Function Safety Relays for 2 N.C. Contact Switch							
MSR127RP	3 N.O.	1 N.C.	Removable (Screw)	Monitored Manual	24V AC/DC	5-26	**440R-N23135**
MSR127TP	3 N.O.	1 N.C.	Removable (Screw)	Auto./Manual	24V AC/DC	5-26	**440R-N23132**
MSR126	2 N.O.	None	Fixed	Auto./Manual	24V AC/DC	5-24	**440R-N23117**
Modular Safety Relays							
MSR210P Base 2 N.C. only	2 N.O.	1 N.C. and 2 PNP Solid State	Removable	Auto./Manual or Monitored Manual	24V DC from the base unit	5-82	440R-H23176
MSR220P Input Module	—	—	Removable	—	24V DC	5-86	440R-H23178
MSR310P Base	MSR300 Series Output Modules	3 PNP Solid State	Removable	Auto./Manual Monitored Manual	24V DC	5-102	440R-W23219
MSR320P Input Module	—	2 PNP Solid State	Removable	—	24V DC from the base unit	5-106	440R-W23218
Muting Modules							
MSR22LM	2 N.O.	1 N.C.	Removable	Auto./Manual	24V DC	5-48	**440R-P23071**
MSR42 (requires optical interface to configure 445L-AF6150	2 PNP	2 PNP, configurable	Removable	Auto./manual or manual monitored	24V DC	5-52	**440R-P226AGS-NNR**

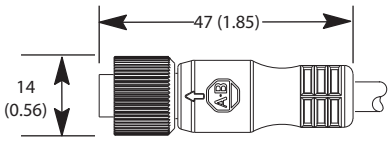
Note: The use of a category 4 safety relay module does not improve the category rating of the safety system beyond the Category 2 rating of the Type 2 light curtain in use.

Cordsets—Two Required (one for transmitter and one for receiver)

Female Connector (Sensor End)		Cable			
Face View of Female	Connector Style	Pin/Wire Color	Wire Rating	Length [m (ft)]	Cat. No.
Transmitter					
	Straight Female	1 Brown 2 White 3 Blue 4 Black	22 AWG 300V 4 A	2 (6.56)	889D-F4AC-2
				5 (16.4)	889D-F4AC-5
				10 (32.8)	889D-F4AC-10
				15 (49.2)	889D-F4AC-15
				20 (65.6)	889D-F4AC-20
				30 (98.4)	889D-F4AC-30
Receiver					
	Straight Female	1 White 2 Brown 3 Green 4 Yellow 5 Grey 6 Pink 7 Blue 8 Red	24 AWG 30V AC/36V DC 1.5 A	2 (6.56)	889D-F8AB-2
				5 (16.4)	889D-F8AB-5
				10 (32.8)	889D-F8AB-10
				15 (49.2)	889D-F8AB-15
				20 (65.6)	889D-F8AB-20
				30 (98.4)	889D-F8AB-30

Cordsets Approximate Dimensions [mm (in.)]

Dimensions are not intended to be used for installation purposes.



Straight Female

Accessories

Muting Sensors

Sensor Type	Connection Location	Type	Cat. No.
Retroreflective	Connected directly to muting module	Dark Switching	42GRU-9000-QD
Transmitted Beam	Receiver (connected directly to the muting module)		42GRR-9000-QD∗
Retroreflective	Connected directly to muting module		42GRU-9000-QD∗
Polarized Retroreflective	Three inch standard reflector		92-39
Polarized Retroreflective	Connected directly to muting module		42GRU-9200-QD∗
Polarized Retroreflective	Three inch standard reflector		92-39
Mechanical Limit Switch	Connected directly to muting module (operating lever must be selected separately)		802M-NX10∗
Muting lamp		Two cat. nos. make this assembly.	855E-24TL7
			855E-BVMC
∗Use with 4-pin, DC Micro cordset when connecting to muting module (5 m length shown). 1 m, 2 m, 3 m, and 5 m lengths available.			889D-F4AC-5

Accessories—Optional

Description		Cat. No.
	Steel L-shaped end cap mounting bracket (4 per package) **Note:** 4 brackets supplied with each GuardShield pair.	440L-AF6101 (1 package per system)
	Power Supply: Output 24V DC, 3 A, 72 W	1606-XLP72E
	Laser alignment tool	**440L-ALAT**
	GuardShield laser alignment tool bracket	**440L-AF6109**
	Mounting stand	**440L-AMSTD**
	GuardShield weld shield pair—3 beam	440L-AGWS0960
	GuardShield weld shield pair—2 beam	440L-AGWS0640
	Vertical shock mount kit	**440L-AF6120**
	GuardShield washdown enclosure kit—2 beam PAC	440L-AGST640
	GuardShield washdown enclosure kit—3 beam PAC	440L-AGST960

Note: The GuardShield washdown enclosure kits will not accommodate the GuardShield with Integrated Laser and with Inegrated Laser and ArmorBlock Guard I/O connectivity.

Corner Mirror for Multi-Sided Guarding

Specially constructed glass mirrors for 2- and 3-sided safeguarding applications.

Note: Each mirror reduces maximum scan range by 10% per mirror.

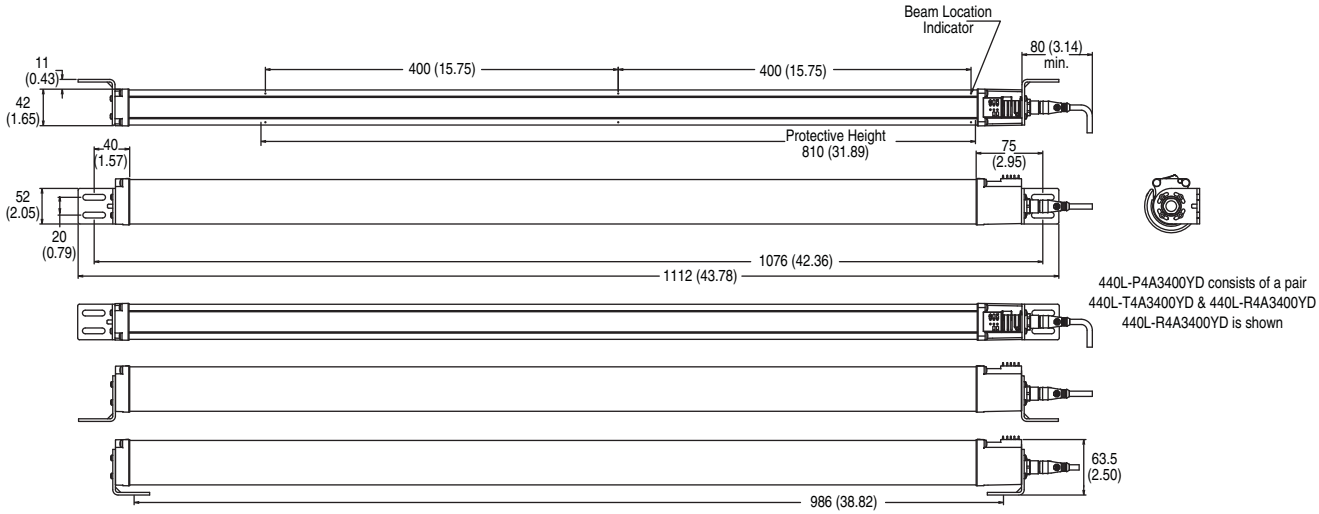
GuardShield Light Curtain Cat. No.	Narrow Mirror Short-Range 0…4 m	Cat. No.	Wide Mirror Long-Range 4…15 m	Cat. No.
440L-P4A2500YD		440L-AM0750750		440L-AM1250750
440L-P4A3400YD		440L-AM0751050		440L-AM1251050

Approximate Dimensions

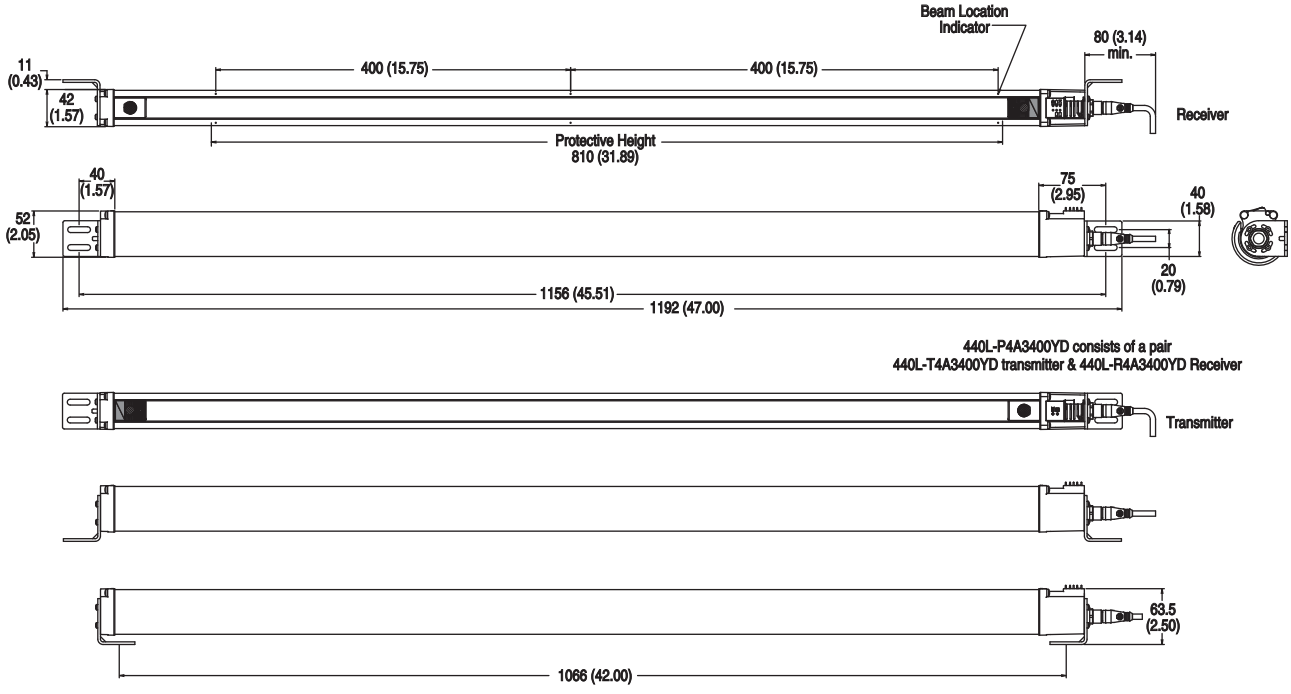
Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.

Safety Light Curtain

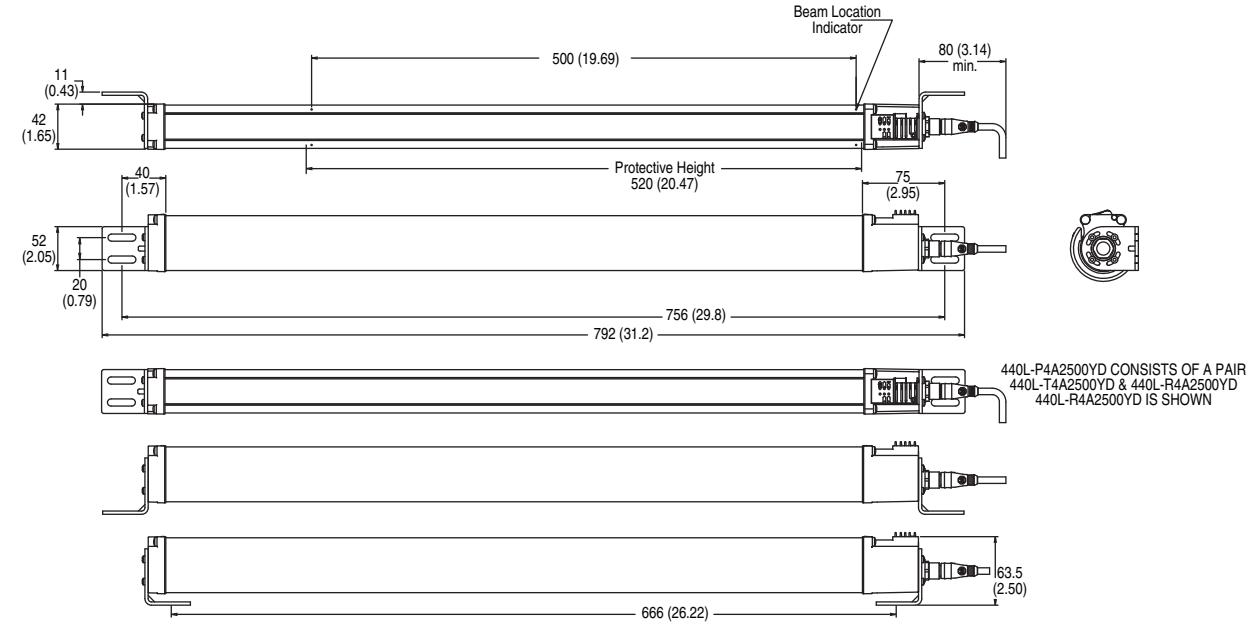
440L-P4A3400YD



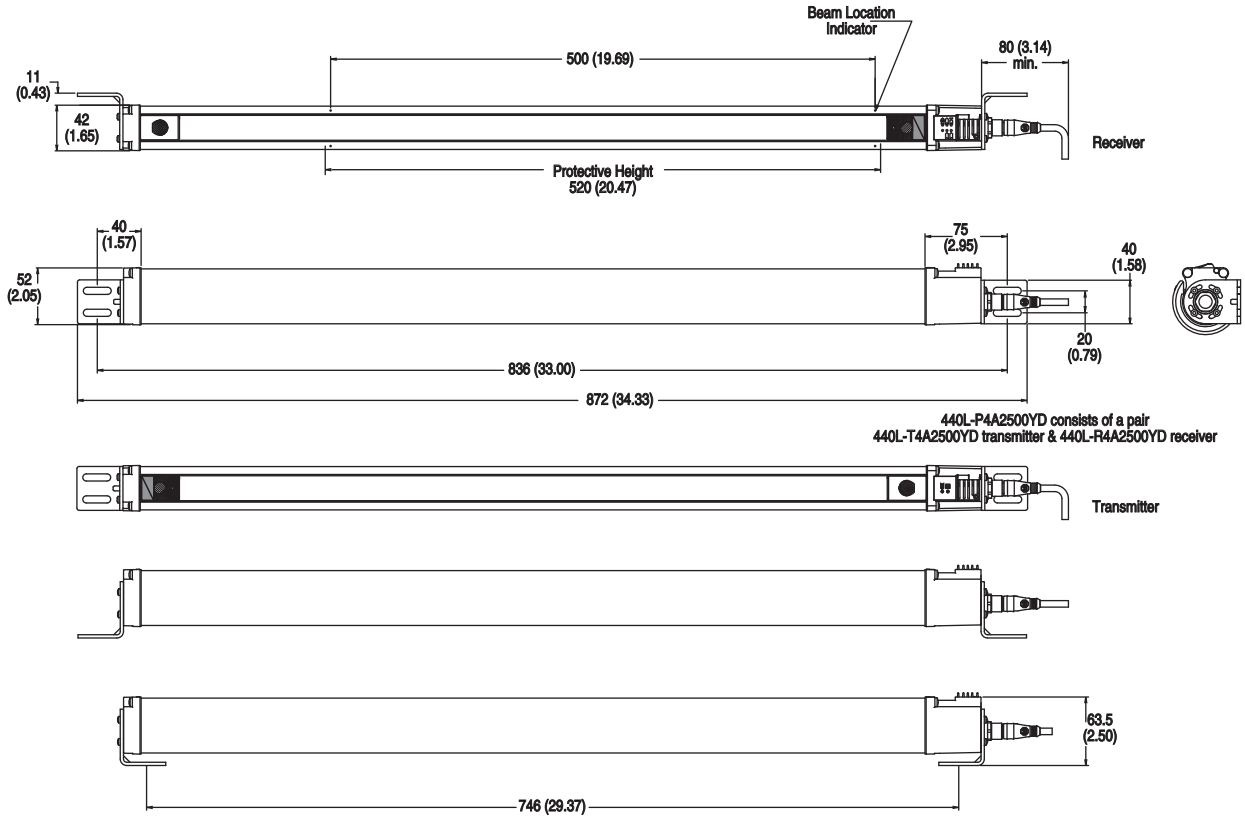
440L-P4AL3400YD



440L-P4A2500YD



440L-P4AL2500YD

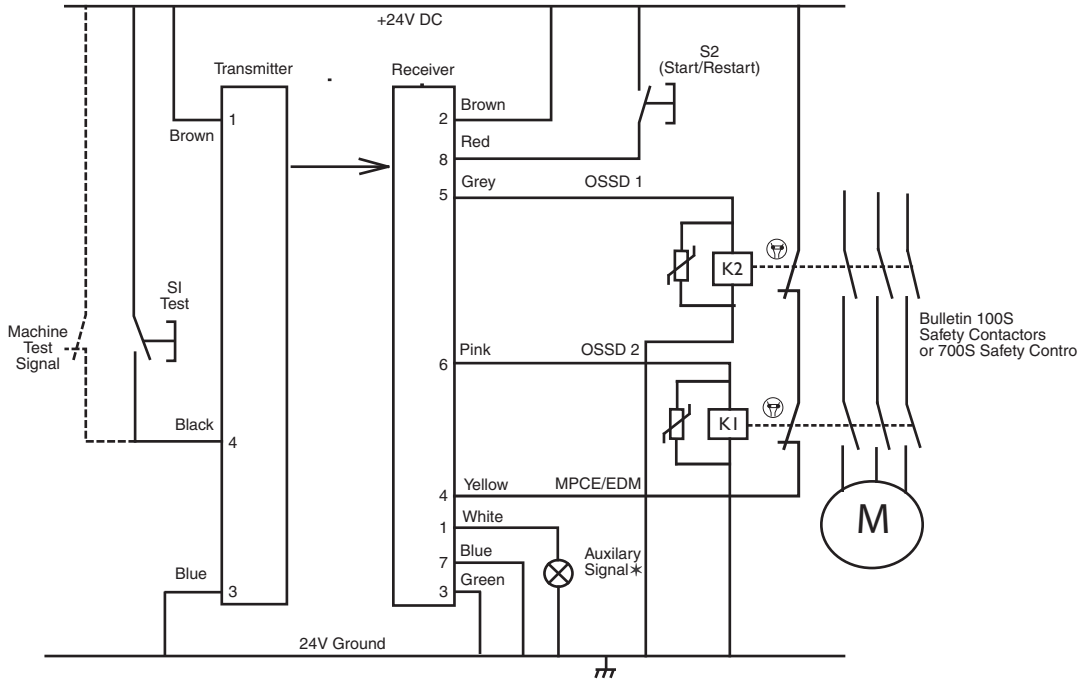


Cat. No.	A Protective Height [mm]	B Mounting Value [mm]	C Total Length [mm]
440L-P4A3400YD	820 ±0.5	1076	1112 ±1.5
440L-P4A2500YD	520 ±0.5	756	792 ±1.5
440L-P4AL3400Y∗	820 ±0.5	—	—
440L-P4AL2500Y∗	520 ±0.5	—	—

∗ Replace with "D" for standard 8-pin M12 or "A" for 5-pin M12 for ArmorBlock Guard I/O connectivity.

Wiring Diagram for Connection of OSSDs Directly to Contactors (FSDs)

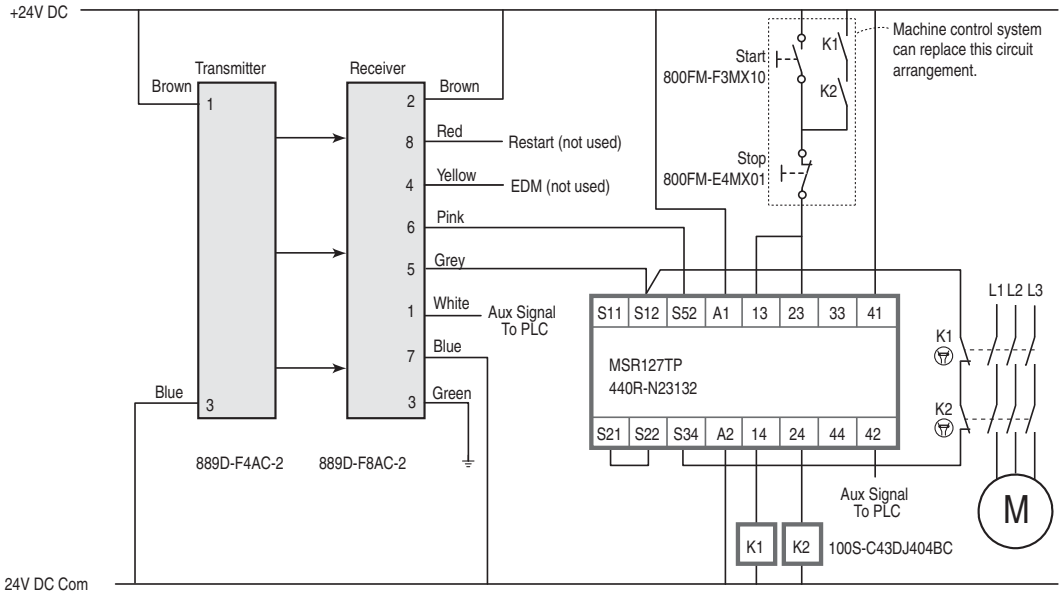
Wiring diagram is not intended to be used for installation purposes.



* Auxiliary output is nonsafety. Can be connected to a lamp, motor or status to a PLC.

K1, K2	Safety relay or safety contactor for OSSD 1 and OSSD 2 connection
S1	Switch for external system test (optional)
S2	Switch for reset of light curtain from start/restart interlock

Wiring Diagram for Connection of OSSDs Directly to a Safety Relay Module



PAC Type 4 Safety Light Curtains

GuardShield Safe 4 PAC

Description

The Allen Bradley Guardmaster GuardShield Safe 4 PAC is an economical two box, Type 4 safety light curtain with ON/OFF functionality. This basic, guard-only operating mode, perimeter access safety light curtain has an integrated laser alignment system that simplifies the alignment of each pair of light curtains. Visible laser beams are activated by touching the finger symbol on front face of the light curtains. Positioning of the transmitter and receiver laser beams to their respective targets facilitates optimal alignment of each Safe 4 PAC pair. The integrated laser alignment system also helps with the re-alignment of pairs if units are knocked out of alignment during the course of the work process or when corner mirrors are used.

The GuardShield Safe 4 PAC is offered with two 120 mm long, 30 mm resolution optic modules spaced at 500 mm and three 120 mm long, 30 mm resolution optic modules spaced at 400 mm providing whole body detection. Designed for perimeter guarding applications, both configurations of the Safe 4 PAC have operating ranges from 5 to 30 meters which allows them to be used as opto-electronic fences. The use of corner mirrors with the Safe 4 PAC allows multiple-sided guarding in large perimeter applications. The GuardShield Safe 4 PAC is also a low cost solution for entry or exit guarding of a machine process when paired with the MSR42 muting module. The MSR42 can be configured for two-sensor muting with the Safe 4 PAC. The muting function allows material to pass through the sensing field of the Safe 4 PAC when the muting sensors are properly activated by the flow of material.

The GuardShield Safe 4 PAC, with an environmental rating of IP65, is designed to be used in a variety of applications across a broad range of industries in medium to heavy industrial environments. Offered with shock isolator kits for shock and vibration applications, the Safe 4 PAC is suited to medium- and heavy-duty applications.

Features

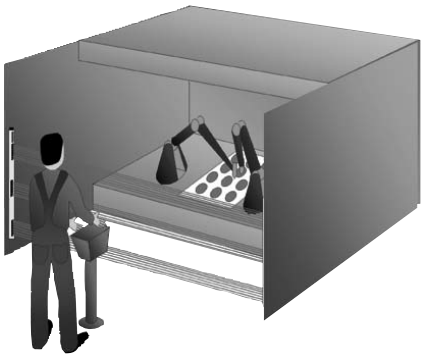
- M12 connectors
- Optically synchronized
- Integrated laser alignment system
- IP65 enclosure rating
- Simple installation
- cULus Listed and CE Marked for all applicable directives

Applications

- Palletizers
- Material handling systems
- Packaging equipment
- Robot cells
- Automated processes

Specifications

Safety Ratings	
Standards	EN/IEC 61496 Parts 1 and 2, UL 61496 Parts 1 and 2, UL1998
Safety Classification	Type 4 per IEC/EN61496. Category 4 device per EN 954-1, SIL 3 per IEC 61508, PLe per EN/ISO 13849
Certifications	cULus Listed and CE Marked for all applicable directives
Power Supply	
Input Power, Max.	24V DC ± 20%
Maximum Residual Ripple	< 10% of U_{sp}
Power Consumption	<500 mA (no load)
Outputs	
Safety Outputs	2 PNP OSSD. 0.3 A, short-circuit protected
Output Voltage, Min.	U_{sp} -1
Switching Current @ Voltage, Min.	300 mA @ 24V DC
Operating Characteristics	
Indicator LEDs	ON -State, OFF-State, internal error
Protected Height [mm (in.)]	3 beam = 840 mm (33.0 in.) 2 beam = 600 mm (23.6 in,)
Scanning Range	5…30 m (16.4…98.4 ft)
Synchronization	Optical, first beam adjacent to LEDs
Wavelength	950 nm
Environmental	
Enclosure Type Rating	IP65
Relative Humidity	15…95% (noncondensing)
Operating Temperature [C (F)]	0…55° (0…131°)
Vibration	IEC 60068-2-6 frequency 10…55 Hz; amplitude 0.35 mm (0.01 in.)
Shock	IEC 60068-2-29; acceleration 10 g, pulse duration 16 ms 10…55 Hz; amplitude 0.35 mm (0.01 in.)
Physical Characteristics	
Mounting	Rear mounting, standard and adjustable (180°)
Weight	Varies by by cat. no., see Installation Manual
Housing Cross Section	30 x 40 mm (1.18 x 1.57 in.)
Connection Type	Transmitter: 5-pin M12 micro QD Receiver: 5-pin M12 micro QD
Cable Length	30 m (98.4 ft) max.
ILAS Laser Class	Class 2, IEC 60825-1



Product Selection

Safety Light Curtain—Standard PAC System

The Allen-Bradley Guardmaster GuardShield Safe 4 PAC safety light curtains are offered with two or three modules with various spacing for whole body detection. These are ordered as pairs (transmitter and receiver) and are shipped under one catalog number. Each GuardShield Safe 4 PAC pair is shipped with mounting brackets. After selecting the appropriate Safe 4 PAC, ensure that the appropriate cordsets, interfaces and accessories are ordered.

Protected Height [mm (in.)]	Number of Beams	Beam Spacing	Pair Weight [kg (lbs)]	Cat. No.
600 (23.6)	2	500 mm	4.0 (8.8)	445L-P4S2500YD
840 (33.0)	3	400 mm	4.5 (9.9)	445L-P4S3400YD

Note: The cat. nos. listed above are pair cat. nos. designated by the "P" in the cat. no. To specify a transmitter or receiver, replace the "P" with a "T" for transmitter and "R" for a receiver. The GuardShield Safe 4 PAC requires a 5-pin M12 cordset for the transmitter and the receiver.

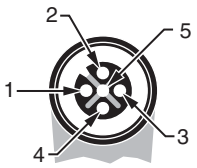
Required Logic Interfaces

Description	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. Page No.	Cat. No.
Single-Function Safety Relays for 2 N.C. Contact Switch							
MSR127RP	3 N.O.	1 N.C.	Removable (Screw)	Monitored Manual	24V AC/DC	5-26	**440R-N23135**
MSR127TP	3 N.O.	1 N.C.	Removable (Screw)	Auto./Manual	24V AC/DC	5-26	**440R-N23132**
MSR126	2 N.O.	None	Fixed	Auto./Manual	24V AC/DC	5-24	**440R-N23117**
Modular Safety Relays							
MSR210P Base 2 N.C. only	2 N.O.	1 N.C. and 2 PNP Solid State	Removable	Auto./Manual or Monitored Manual	24V DC from the base unit	5-82	440R-H23176
MSR220P Input Module	—	—	Removable	—	24V DC	5-86	440R-H23178
MSR310P Base	MSR300 Series Output Modules	3 PNP Solid State	Removable	Auto./Manual Monitored Manual	24V DC	5-102	440R-W23219
MSR320P Input Module	—	2 PNP Solid State	Removable	—	24V DC from the base unit	5-106	440R-W23218
Muting Modules							
MSR22LM	2 N.O.	1 N.C.	Removable	Auto./Manual	24V DC	5-48	**440R-P23071**
MSR42 (requires optical interface to configure 445L-AF6150	2 PNP	2 PNP, configurable	Removable	Auto./manual or manual monitored	24V DC	5-52	**440R-P226AGS-NNR**

Note: The use of a category 4 safety relay module does not improve the category rating of the safety system beyond the Category 2 rating of the Type 2 light curtain in use.

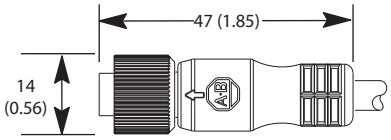
Cordsets—Transmitters and receivers both use 5-pin M12 cordsets

Note: Unshielded cordsets are most commonly used for safety light curtains, however, shielded cordsets are also offered to increase immunity to electrical interference.

Female Connector (Sensor End)		Cable			
Face View of Female	Connector Style	Pin/Wire Color	Wire Rating	Length [m (ft)]	Cat. No.
	Straight Female	1 Brown 2 White 3 Blue 4 Black 5 Grey	22 AWG 250V 4 A	2 (6.56)	889D-F5AC-2
				5 (16.4)	889D-F5AC-5
				10 (32.8)	889D-F5AC-10
				15 (49.2)	889D-F5AC-15
				20 (65.6)	889D-F5AC-20
				30 (98.4)	889D-F5AC-30
	Shielded Straight Female	1 Brown 2 White 3 Blue 4 Black 5 Grey	22 AWG 22 AWG 300V 4 A	2 (6.56)	889D-F5EC-2
				5 (16.4)	889D-F5EC-5
				10 (32.8)	889D-F5EC-10
				15 (49.2)	889D-F5EC-15
				20 (65.6)	889D-F5EC-20
				30 (98.4)	889D-F5EC-30

Cordsets Approximate Dimensions [mm (in.)]

Dimensions are not intended to be used for installation purposes.



Straight Female

Accessories

Muting Sensors

Sensor Type	Connection Location	Type	Cat. No.
Retroreflective	Connected directly to muting module	Dark Switching	42GRU-9000-QD
Transmitted Beam	Receiver (connected directly to the muting module)		42GRR-9000-QD*
Retroreflective	Connected directly to muting module		42GRU-9000-QD*
Polarized Retroreflective	Three inch standard reflector		92-39
Polarized Retroreflective	Connected directly to muting module		42GRU-9200-QD*
Polarized Retroreflective	Three inch standard reflector		92-39
Mechanical Limit Switch	Connected directly to muting module (operating lever must be selected separately)		802M-NX10*
Muting lamp		Two cat. nos. make this assembly.	855E-24TL7 **855E-BVMC**
*Use with 4-pin, DC Micro patchcord when connecting to muting module (5 m length shown). 1 m, 2 m, 3 m, and 5 m lengths available.			889D-F4AC-5

Optional Accessories

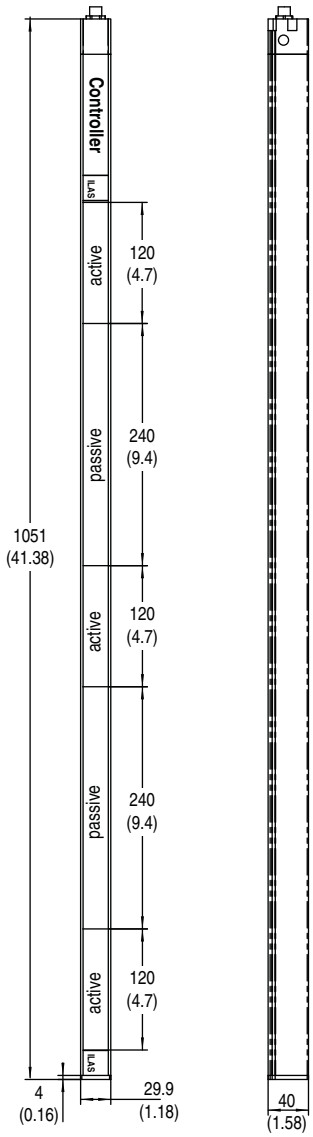
Description		Cat. No.
	Standard kit (4 pieces — supplied with each pair)	445L-AF6140
	180° Adjustable kit (two kits required per pair)	**445L-AF6141**
	Shock Mount Kit (2 kits required per pair of light curtains)	445L-AF6142
	Vertical mounting kit (two kits required per pair)	445L-AF6144
	MSR42 Multifunction Module (requires 440L-AF6150 to program)	**440R-P226AGS-NNR**
	MSR45E — Safety relay expansion module for MSR42	**440R-P4NANS**
	USB optical interface software configuration tool used to configure the MSR42 (Used to configure the MSR42 module or get diagnostic information from the Safe 4.)	**445L-AF6150**
	Ribbon cable — to connect one MSR45E to an MSR42	**440R-ACABL1**
	Ribbon cable — to connect two MSR45Es to an MSR42	440R-ACABL2
	Ribbon cable — to connect three MSR45Es to an MSR42	440R-ACABL3
	Mounting stand (Comes with hardware to level base and two GuardShield mounting brackets.)	**440L-AMSTD**

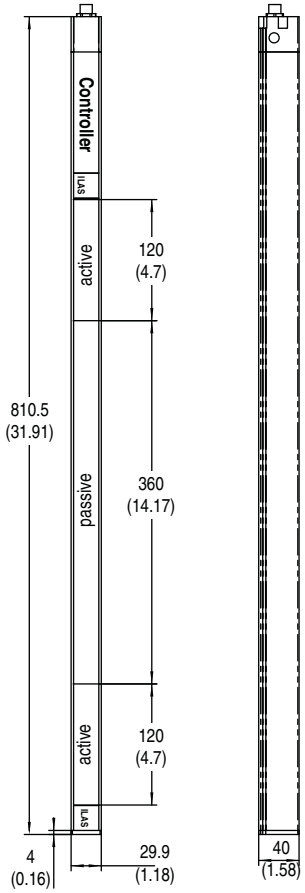
Corner Mirror for Multi-Sided Guarding

GuardShield Safe 4	Narrow Mirror Short-Range 0…4 m	Cat. No.	Wide Mirror Long-Range 4…15 m	Cat. No.
445L-P4S2500YD		440L-AM0750900		440L-AM1250900
445L-P4S3400YD		440L-AM0751200		**440L-AM1251200**

Approximate Dimensions

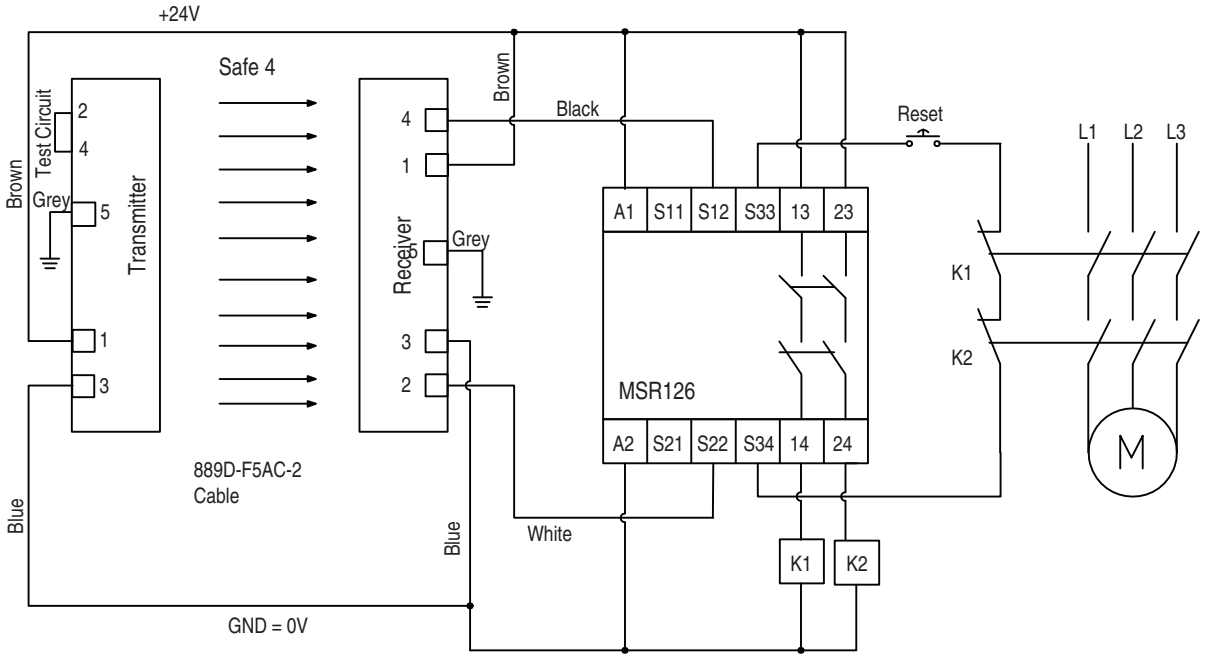
Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



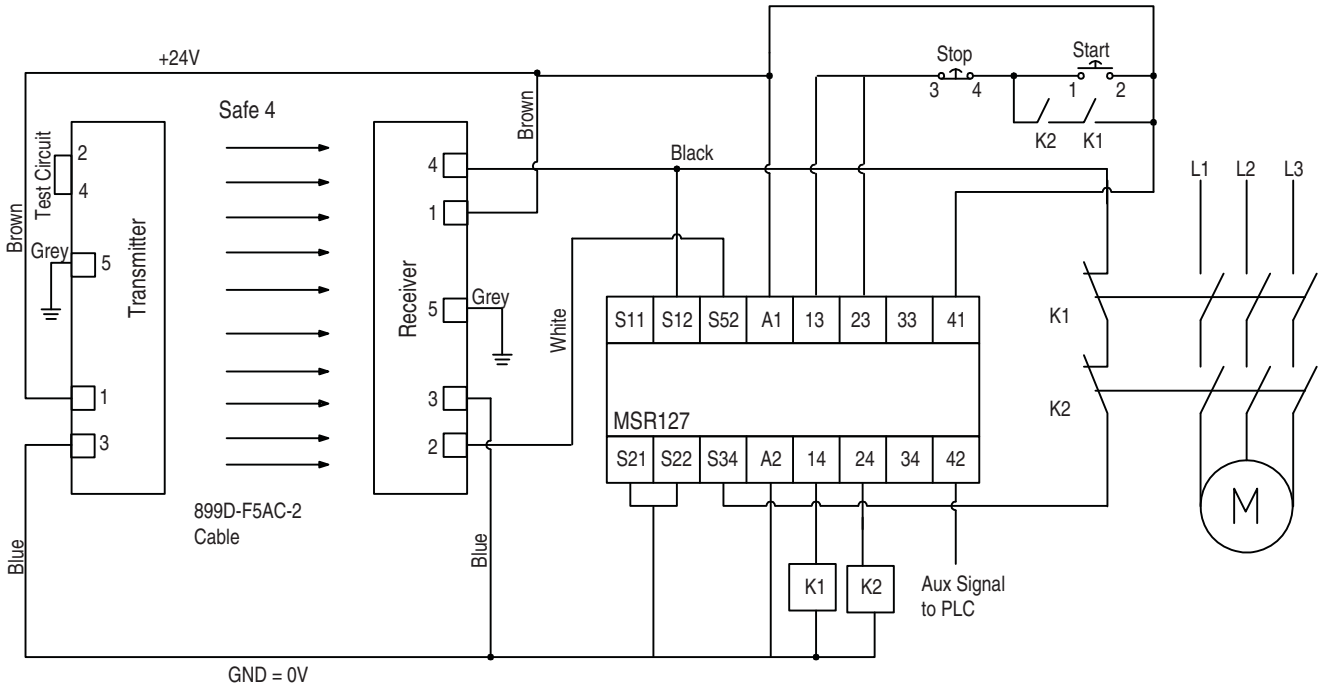


Wiring Diagram for Connection to MSR126

Wiring diagram is not intended to be used for installation purposes.



Wiring Diagram for Connection to MSR127



Safety Single Beam

Area Access Control

Description

The Area Access Control (AAC) safety single-beam is a 24V DC through-beam opto-electronic safety switch offered with two operating ranges (a short range (0.5…20 m (1.64…65.5 ft) or a long range (15…70 m (49.2…300 ft)) system. The AAC system uses the same transmitter for both ranges and one of two receivers for a short-range or long-range system. This unique system configuration minimizes the number of cat. nos. necessary for specifying the AAC single-beam system.

The AAC safety single-beam is used as a whole-body detection device. The light beam produced between the AAC transmitter and receiver provides whole-body access detection for hazardous areas such as:

- Robotic work cells
- Processing machines
- Machining centers
- Palletizers
- Transfer lines
- High bay warehouses

Features

- Long scan range (up to 70 m (300 ft))
- Easy installation
- Die cast aluminium housing
- Heated front lens, allowing use even in outdoor applications
- Relay outputs

Specifications

Safety Ratings	
Standards	IEC 61496, Parts 1 & 2
Safety Classification	Type 4, IEC 61496; SIL 3 (IEC 61508); SIL CL3 (IEC 62061); Category 4 (EN ISO 13849); PLe (EN ISO 13849); B_{10d} parameter: 1 x 10^6 switching cycles (@ DC-13, 24V, 0.6 A); 2 x 10^5 switching cycles (@ DC-13, 24V, 1.5 A) PFH_d: 4.0 x 10^{-9}; Mission time: 20 years
Certifications	CE Marked for all applicable directives and BG
Power Supply	
Input Power, Max.	24V DC ±20%
Maximum Residual Ripple	5% of U_v, max.
Power Consumption	24V DC 8 W max.
Outputs	
Safety Outputs	2 N.O. Relays
Switching Current @ Voltage, Min.	0.02 A to 2 A
Operating Characteristics	
Response Time	< 22 ms
Status Indicators	On state, Off state, alignment
Beam Diameter	23 mm (0.91 in.)
Scanning Range	0.5…20 m (1.64…65.5) or 15…70 m (49.2…300 ft)
Synchronization	Optical
Wavelength	950 nm
Environmental	
Enclosure Type Rating	IP67 (EN 60529)
Relative Humidity	15…95%, noncondensing
Operating Temperature [C (F)]	-25…55° (-13…131°)
Vibration	5 g, 10…55 Hz per IEC 60068-2.6
Shock	10 g, 16 ms per IEC 60068-2.29
Physical Characteristics	
Front Window	Heated
Weight	Transmitter unit: approx. 0.9…1.3 kg Receiver unit: approx. 1…1.4
Housing Cross Section	50 x 156 x 116 mm (1.96 x 6.14 x 4.56 in.)
Connection Type	Terminal chamber with cable gland (PG13.5 thread)
Cable Length	50 m (164 ft) max.

Note: The external power supply must be capable of buffering brief power failures of 20 ms as specified in IEC 60204-1.

Product Selection

Selection Guide for Receiver

Operating Range	Connection Type	Cat. No.
0.5…20 m (1.64…65.5)	Terminal chamber with cable gland (PG13.5 thread)	**440L-R4F0020Q**
15…70 m (49.2…300 ft)		**440L-R4F1570Q**

Selection Guide for Transmitter

Operating Range	Connection Type	Cat. No.
0…70 m (0…300 ft)	Terminal chamber with cable gland (PG13.5 thread)	**440L-T4F2070Q**

Recommended Logic Interfaces

Description	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. Page No.	Cat. No.
Single-Function Safety Relays for 2 N.C. Contact Switch							
MSR127RP	3 N.O.	1 N.C.	Removable (Screw)	Monitored Manual	24V AC/DC	5-26	**440R-N23135**
MSR127TP	3 N.O.	1 N.C.	Removable (Screw)	Auto./Manual	24V AC/DC	5-26	**440R-N23132**
MSR126	2 N.O.	None	Fixed	Auto./Manual	24V AC/DC	5-24	**440R-N23117**
Modular Safety Relays							
MSR210P Base 2 N.C. only	2 N.O.	1 N.C. and 2 PNP Solid State	Removable	Auto./Manual or Monitored Manual	24V DC from the base unit	5-82	440R-H23176
MSR220P Input Module	—	—	Removable	—	24V DC	5-86	440R-H23178
MSR310P Base	MSR300 Series Output Modules	3 PNP Solid State	Removable	Auto./Manual Monitored Manual	24V DC	5-102	440R-W23219
MSR320P Input Module	—	2 PNP Solid State	Removable	—	24V DC from the base unit	5-106	440R-W23218
Muting Modules							
MSR22LM	2 N.O.	1 N.C.	Removable	Auto./Manual	24V DC	5-48	**440R-P23071**
MSR42 (requires optical interface to configure 445L-AF6150	2 PNP	2 PNP, configurable	Removable	Auto./manual or manual monitored	24V DC	5-52	**440R-P226AGS-NNR**

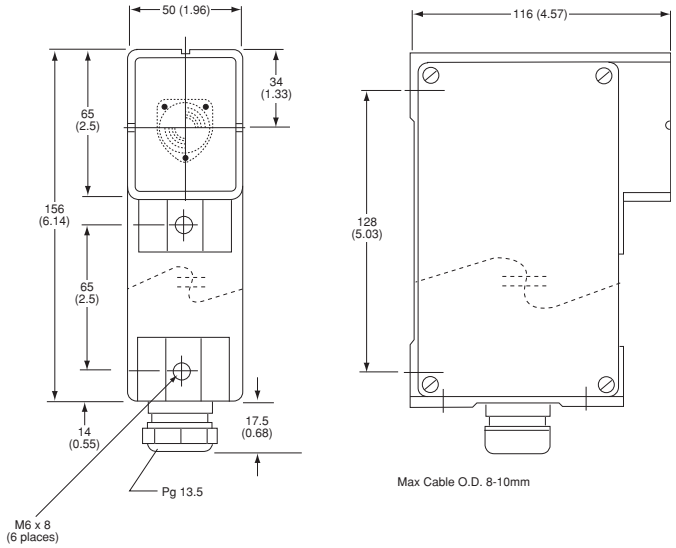
Note: The use of a category 4 safety relay module does not improve the category rating of the safety system beyond the Category 2 rating of the Type 2 light curtain in use.

Accessories

	Description	Cat. No.
	Laser alignment tool	**440L-ALAT**
	Adaptor for alignment aid on AAC	440L-ALBRK1
	Mounting bracket for AAC	**440L-AMBRK4**
	Corner mirror for scanning range 0…30 m	440L-AMIRR1
	Mounting kit for 440L-AMIRR1	440L-AMKIT
	Mounting bracket for mirror 440L-AMIRR1	440L-AMBRK1
	Glass corner mirror, 45° angle 0…30 m	**440L-AMIRR2**

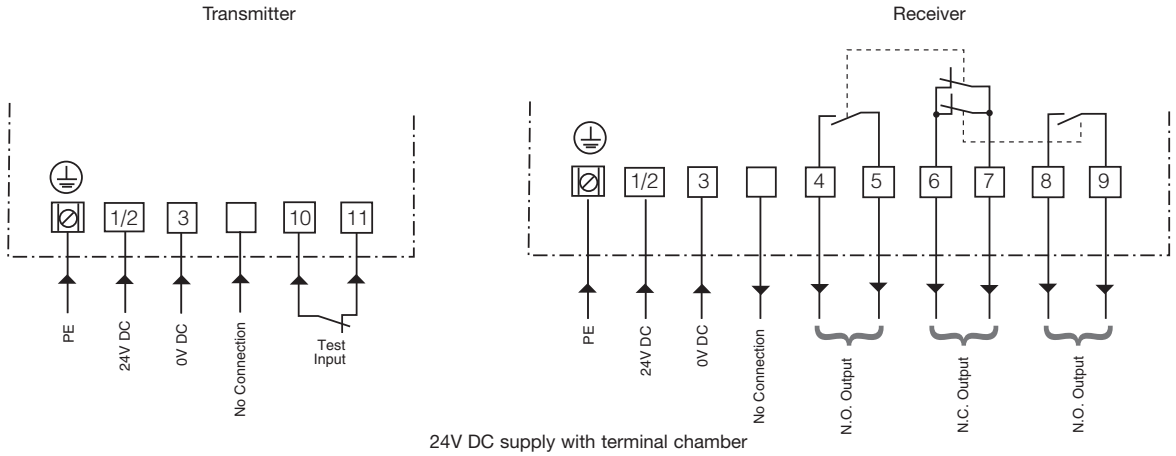
Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



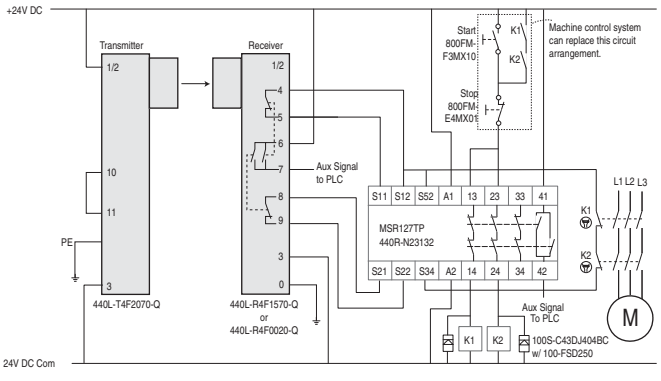
Typical Wiring Diagrams

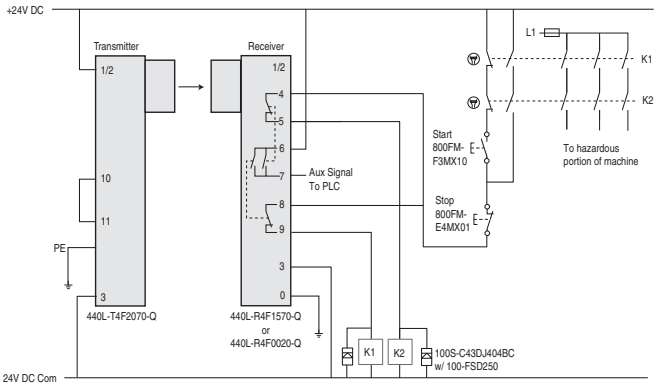
Wiring diagram is not intended to be used for installation purposes.



24V DC supply with terminal chamber

Transmitter

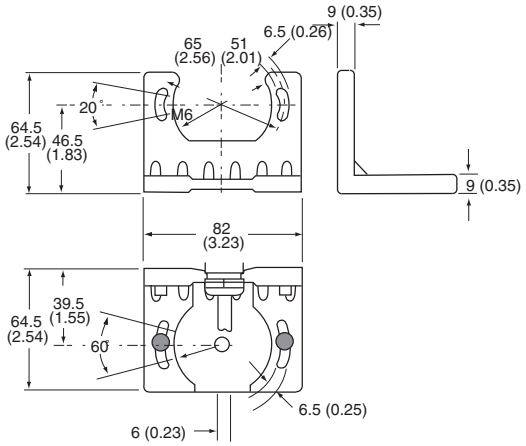




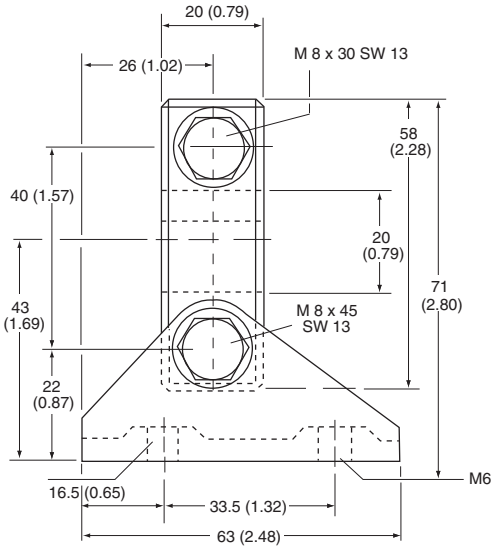
Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.

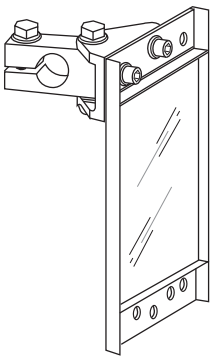
AAC Mounting Bracket 440L-AMBRK4



Mounting Bracket 440L-AMBRK1

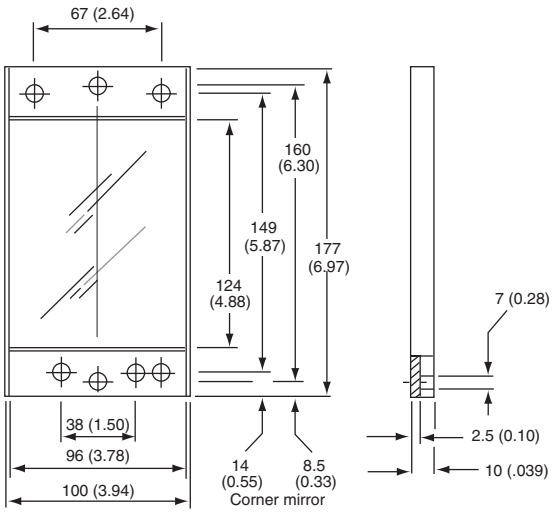


Mounting Bracket 440L-AMBRK1 Mounted to Mirror 440L-AMIRR1



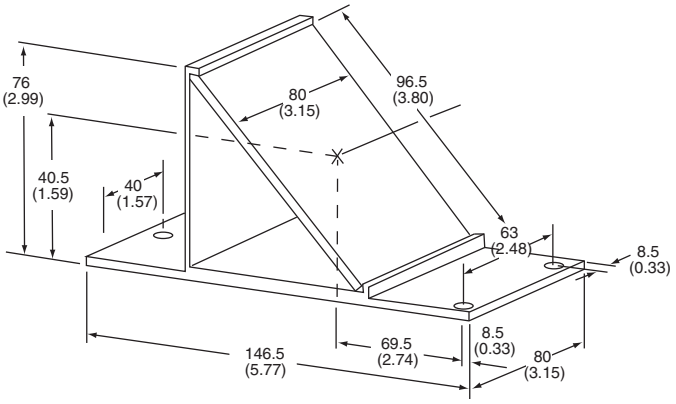
Shown with bracket 440L-AMBRK1
Mounted to mirror 440L-AMIRR1

Mirror 440L-AMIRR1

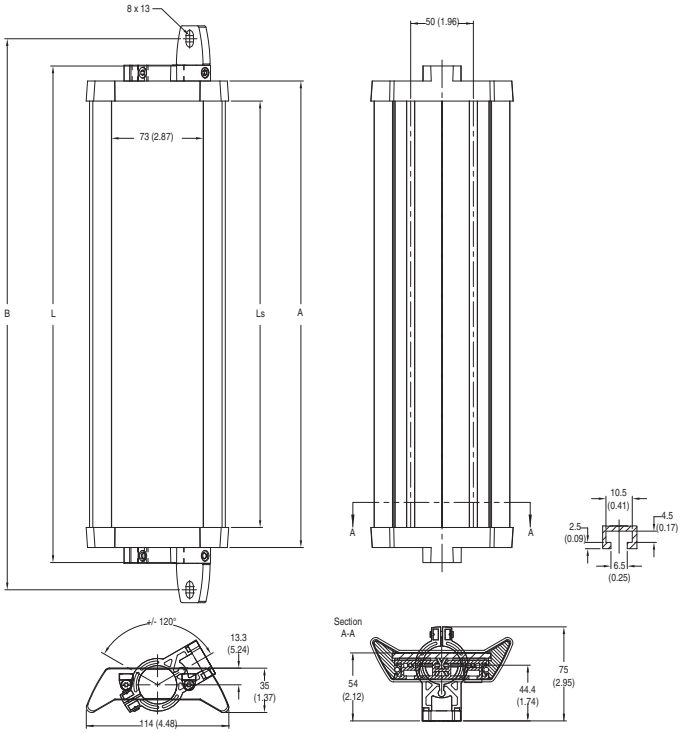


Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.

Mirror 440L-AMIRR2



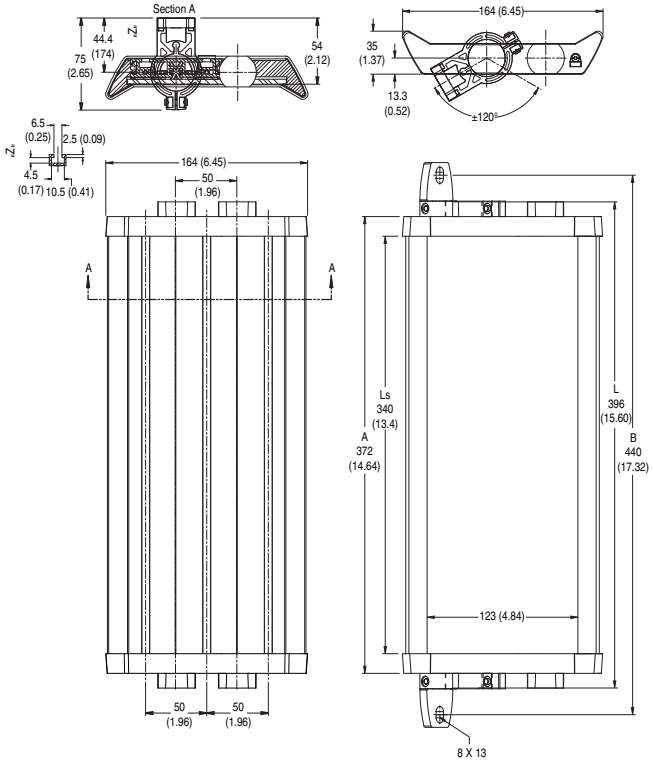
Mirror 440L-AM075



MODEL NO.	SERIES	DESCRIPTION	L	L_S	A	B
440L-AM0750300	A	Mirror, 300 mm, 4 m	396	340	372	440
440L-AM0750450	A	Mirror, 450 mm, 4 m	546	490	522	590
440L-AM0750600	A	Mirror, 600 mm, 4 m	696	640	672	740
440L-AM0750750	A	Mirror, 750 mm, 4 m	846	790	822	890
440L-AM0750900	A	Mirror, 900 mm, 4 m	996	940	972	1040
440L-AM0751050	A	Mirror, 1050 mm, 4 m	1146	1090	1122	1190
440L-AM0751200	A	Mirror, 1200 mm, 4 m	1296	1240	1272	1340
440L-AM0751350	A	Mirror, 1350 mm, 4 m	1446	1390	1422	1490
440L-AM0751500	A	Mirror, 1500 mm, 4 m	1596	1540	1572	1640
440L-AM0751650	A	Mirror, 1650 mm, 4 m	1746	1690	1722	1790
440L-AM0751800	A	Mirror, 1800 mm, 4 m	1896	1840	1872	1940

Note: The 1800 mm corner mirror can not be mounted to the floor stand (440L-AMSTD) with end cap brackets. This requires the t-nut kit (440L-AF6115) for rear mounting.

Mirror 440L-AM125

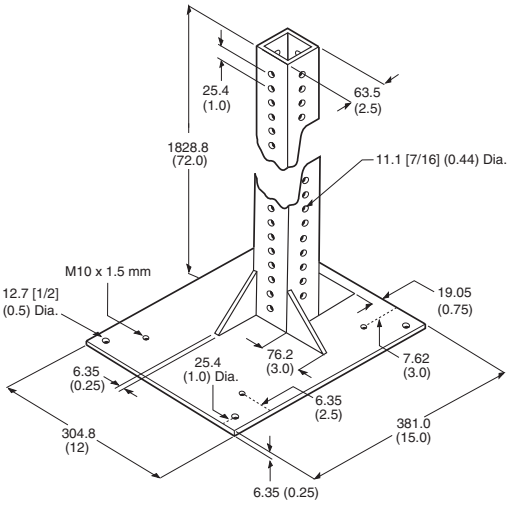


MODEL NO.	SERIES	DESCRIPTION	L	L_S	A	B
440L-AM1250300	A	Mirror, 300 mm, 15 m	396	340	372	440
440L-AM1250450	A	Mirror, 450 mm, 15 m	546	490	522	590
440L-AM1250600	A	Mirror, 600 mm, 15 m	696	640	672	740
440L-AM1250750	A	Mirror, 750 mm, 15 m	846	790	822	890
440L-AM1250900	A	Mirror, 900 mm, 15 m	996	940	972	1040
440L-AM1251050	A	Mirror, 1050 mm, 15 m	1146	1090	1122	1190
440L-AM1251200	A	Mirror, 1200 mm, 15 m	1296	1240	1272	1340
440L-AM1251350	A	Mirror, 1350 mm, 15 m	1446	1390	1422	1490
440L-AM1251500	A	Mirror, 1500 mm, 15 m	1596	1540	1572	1640
440L-AM1251650	A	Mirror, 1650 mm, 15 m	1746	1690	1722	1790
440L-AM1251800	A	Mirror, 1800 mm, 15 m	1896	1840	1872	1940

Note: The 1800 mm corner mirror can not be mounted to the floor stand (440L-AMSTD) with end cap brackets. This requires the t-nut kit (440L-AF6115) for rear mounting.

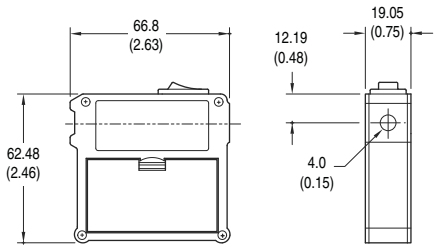
Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.

Mounting Stand—440L-AMSTD

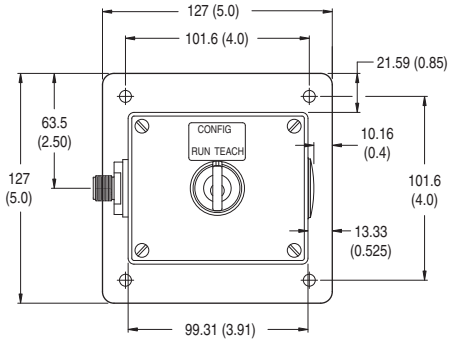


Two of each bracket included with **440L-AMSTD** to mount GuardShield light curtains to mounting stand.

Laser Alignment Tool—440L-ALAT

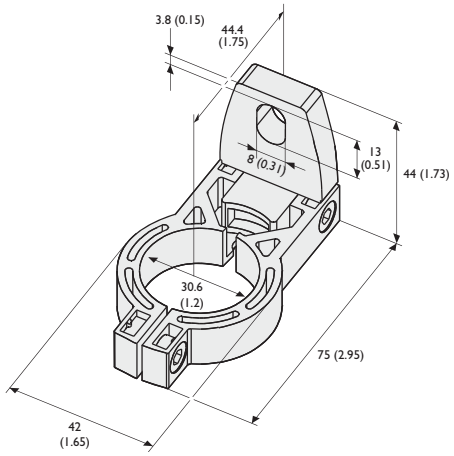


440L-M8600—GuardShield Remote Teach Box

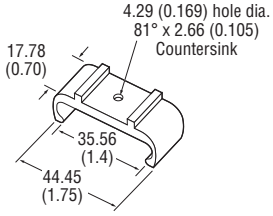


Swivel Mounting Bracket 442L-AF6106

Used for end mounting of corner mirrors. Two supplied with each corner mirror.



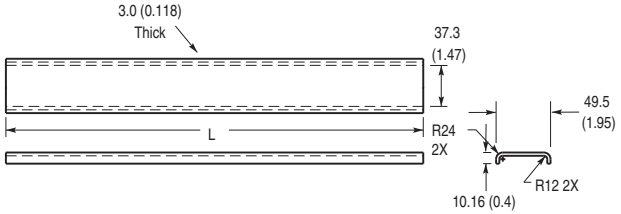
440L-AF6109—used to mount the 440L-ALAT laser alignment tool to Guard Shield light curtains



Weld Shields

The GuardShield weld shields are sold as pairs in the same lengths as the protective heights of the GuardShield safety light curtain.

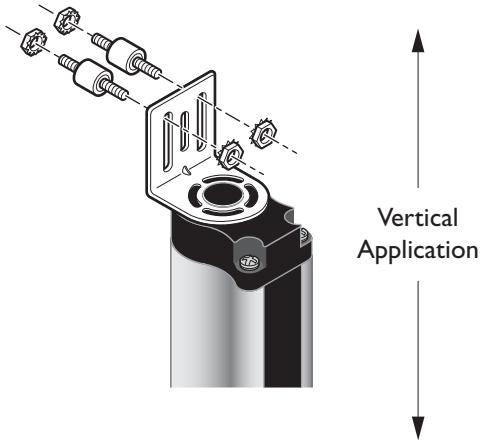
These polycarbonate weld shields are designed as disposable devices whose purpose is to protect the front window of the GuardShield safety light curtain from damage.



Dimension "L" [mm (in.)]	Cat. No.	Dimension "L" [mm (in.)]	Cat. No.
175.3 (6.9)	440L-AGWS0160	1135.4 (44.70)	440L-AGWS1120
335.3 (13.20)	440L-AGWS0320	1295.4 (51.00)	440L-AGWS1280
495.3 (19.50)	440L-AGWS0480	1455.4 (57.30)	440L-AGWS1440
655.3 (25.80)	440L-AGWS0640	1615.4 (63.60)	440L-AGWS1600
815.3 (32.10)	440L-AGWS0800	1778 (70.00)	440L-AGWS1760
975.4 (38.40)	440L-AGWS0960		

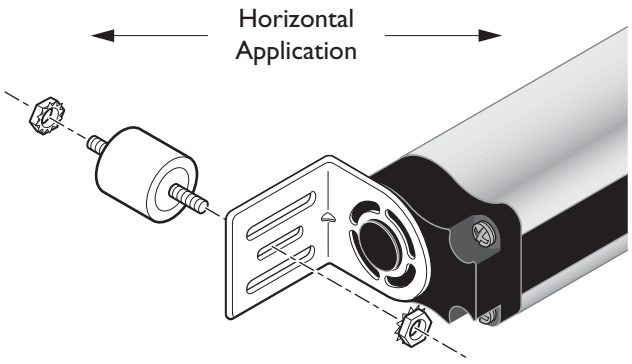
Torque Requirements by Mounting Kit

Cat. No.	Description	Max. Load per Isolator (shear)	Tightening Torque	Spring Rate (shear)
440L-AF6120	Vertical shock mount kit	5 lbs	40 inch lbs	55 lbs/inch
440L-AF6121	Horizontal shock mount kit	22 lbs	40 inch lbs	200 lbs/inch
440L-AF6122	Middle vertical mount kit	5 lbs	40 inch lbs	55 lbs/inch
440L-AF6123	Middle horizontal mount kit	22 lbs	40 inch lbs	200 lbs/inch



Shock Mounts

Shock mount kits are used for attenuating excessive shock and vibration for both vertical and horizontal applications of the GuardShield family of safety light curtains. These kits are designed to protect the internal optical and electronic components of the GuardShield light curtains and are used mostly in press applications.

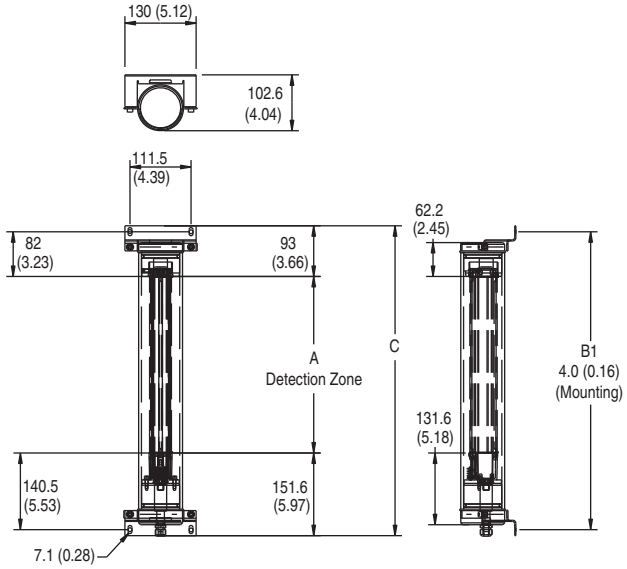


GuardShield Washdown Enclosures

The GuardShield washdown enclosure is designed to provide an environmentally protective enclosure for the GuardShield Type 4 and GuardShield PAC safety light curtains when they are applied in washdown applications. There is a range loss of approximately 10% when GuardShield light curtains are mounted inside of the IP67 washdown enclosures.

Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



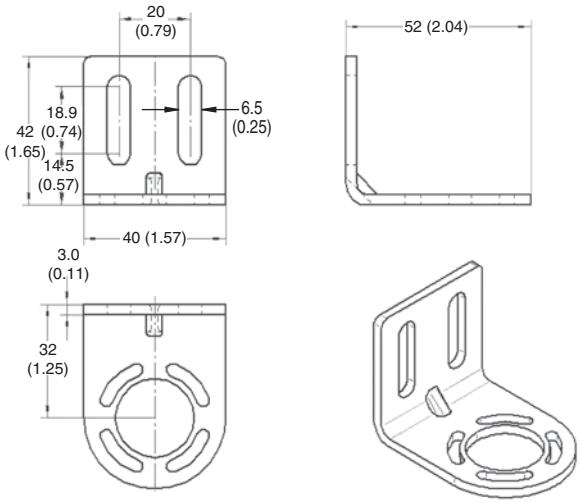
Cat. No.	Use with Light Curtain Cat. No.	A Protective Height [mm (in.)]	B1 Mounting Value [mm (in.)]	C Total Length [mm (in.)]
440L-AGST320	440L-P4➢0320YD	320 ±0.5 (12.6 ±0.02)	542.58 (21.36)	564.58 (22.23)
440L-AGST480	440L-P4➢0480YD	480 ±0.5 (18.9 ±0.02)	702.58 (27.66)	724.58 (27.66)
440L-AGST640	440L-P4➢0640YD	640 ±0.5 (25.2 ±0.02)	862.58 (33.96)	884.58 (34.83)
440L-AGST800	440L-P4➢0800YD	800 ±0.5 (31.5 ±0.02)	1022.58 (40.26)	1044.58 (41.13)
440L-AGST960	440L-P4➢0960YD	960 ±0.5 (37.8 ±0.02)	1182.58 (46.56)	1204.58 (47.42)

➢ Replace with J for 14 mm or K for 30 mm.

GuardShield PAC

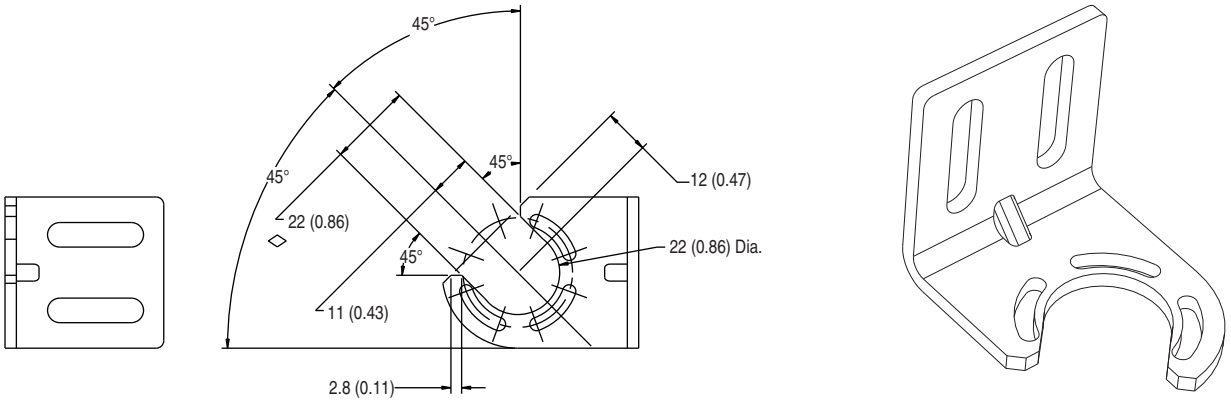
Cat. No.	Use with Light Curtain Cat. No.	A Protective Height [mm (in.)]	B1 Mounting Value [mm (in.)]	C Total Length [mm (in).]
440L-AGST960	**440L-P4A3400YD**	810 ±0.5 (31.8 ±0.02)	1182.58 (46.56)	1204.58 (47.42)
440L-AGST640	440L-P4A2500YD	810 ±0.5 (31.8 ±0.02)	1182.58 (46.56)	884.58 (34.83)

GuardShield Mounting Brackets:



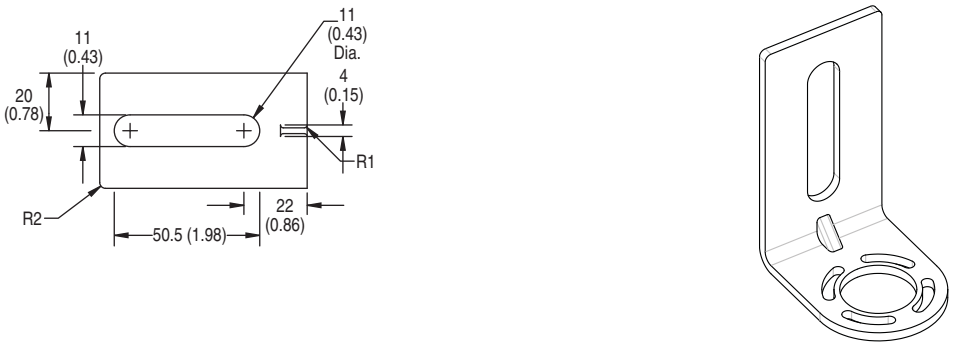
Supplied with each GuardShield safety light curtains.

GuardShield Remote Teach Receiver Bracket



One supplied with each Remote Teach receiver.

GuardShield 440L-AMSTD mounting column brackets



Two supplied with each stand.

Safety Light Curtain Interfaces

120V AC Power Supply and Safety Relay

Description

The Allen-Bradley Guardmaster 120V AC interface box consists of a NEMA 4 rated lockable metal enclosure, a DIN mount 3 A, 24V DC power supply and either a single or dual 22.5 mm safety relay(s).

The single safety relay module provides three N.O. safety and one N.C. auxiliary (nonsafety) “potential free” relay outputs. The dual safety relay configuration allows two pairs of safety light curtains to independently control one or two machines.

The safety relay(s) can be configured for manual reset or automatic reset. The resetting function can be through the key switch mounted on the front cover of the interface box.

Pre-punched holes located on the bottom of the enclosure allow for easy wiring of the system.

Product Selection

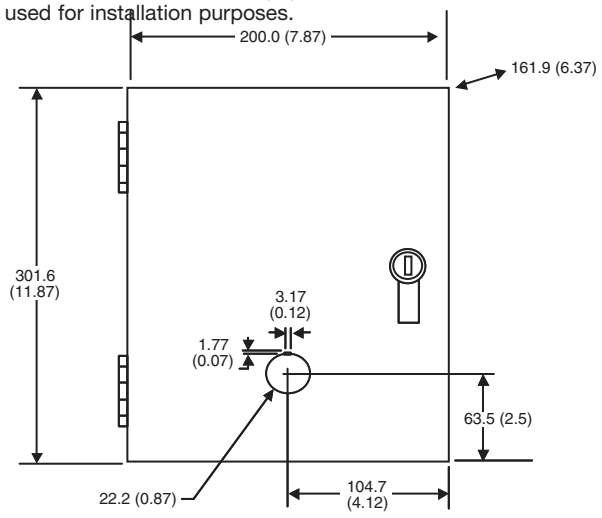
Safety Outputs	Auxiliary Outputs	Power Supply Output	Cat. No.
2 N.O.	1 N.C. nonsafety	120V AC/230V DC	440L-M8400
4 N.O.	2 N.C. nonsafety	120V AC/230V DC	440L-M8500

Specifications

Safety Ratings	
Safety Classification	Nonsafety Rated
Power Supply	
Input Power, Max.	120/230V AC
Power Consumption	2 W/4 W
Outputs	
Safety Outputs	2 N.O. or 4 N.O.
Auxiliary Outputs	1 N.C. or 2 N.C. Nonsafety
Switching Current @ Voltage, Min.	10 mA @ 10V
Operating Characteristics	
Response Time	15 ms
Status Indicators	Power = Green K1 = Green if Closed. K2 = Green if Closed.
Recovery Time	100 ms
Electrical Life	222V AC/4 A/880V A cosϕ = 0.35 - 100,000 operations
Mechanical Life	2,000,000 operations
Operating Frequency	1200 cycles/hour, max.
Environmental	
Enclosure Type Rating	IP65 (NEMA 4)
Relative Humidity	90%
Operating Temperature [C (F)]	-5…55° (23…131°)
Vibration	0.35 mm, 10…55 Hz
Shock	10 g, 16 ms, 100 shocks
Physical Characteristics	
Weight [kg (lb)]	440L-M8400: 4.87 (10.75) 440L-M8500: /5.1 (11.25)

Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



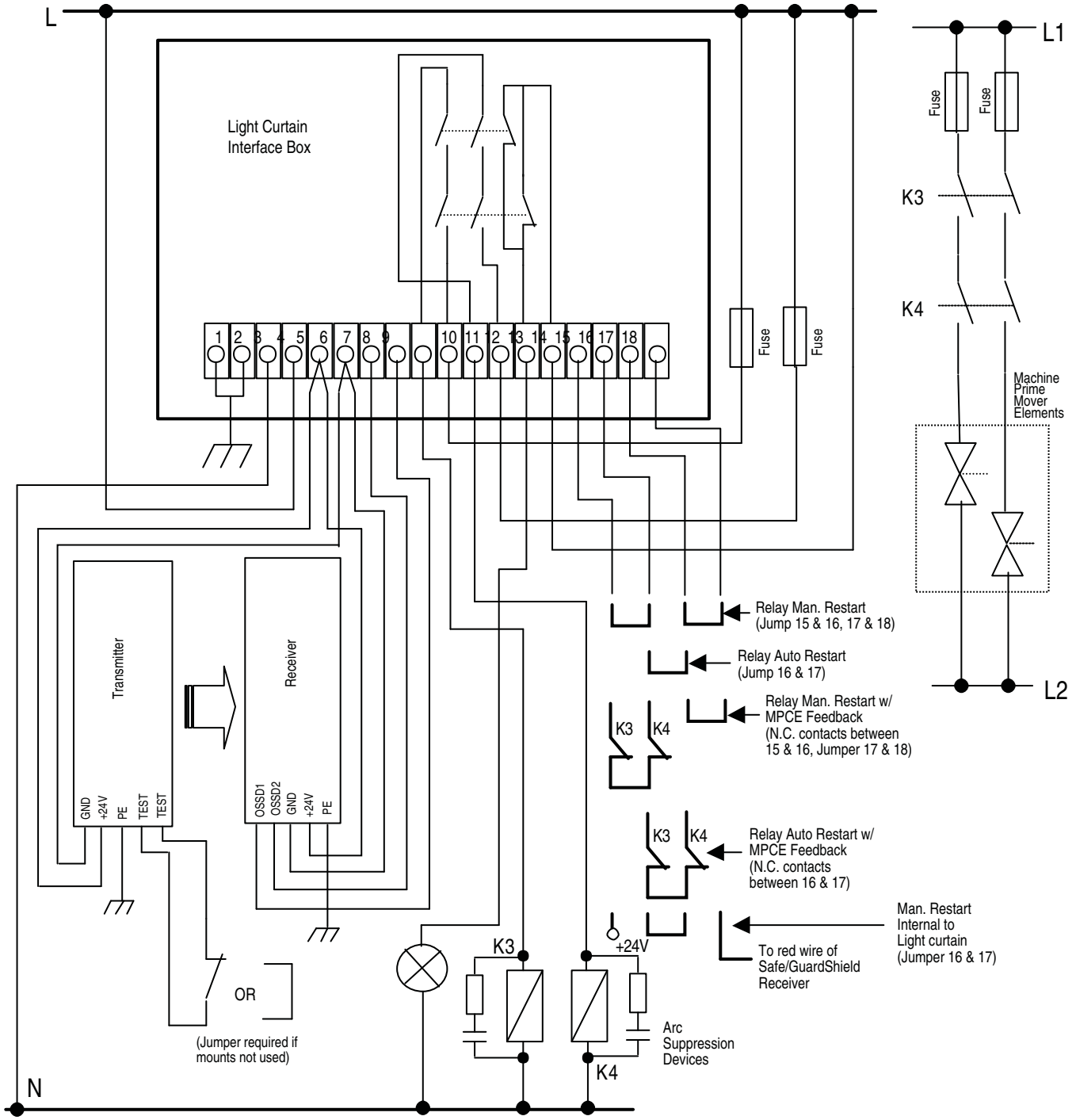
Safety Light Curtain Interfaces

120V AC Power Supply and Safety Relay

Typical Wiring Diagram

M8400 Single Relay

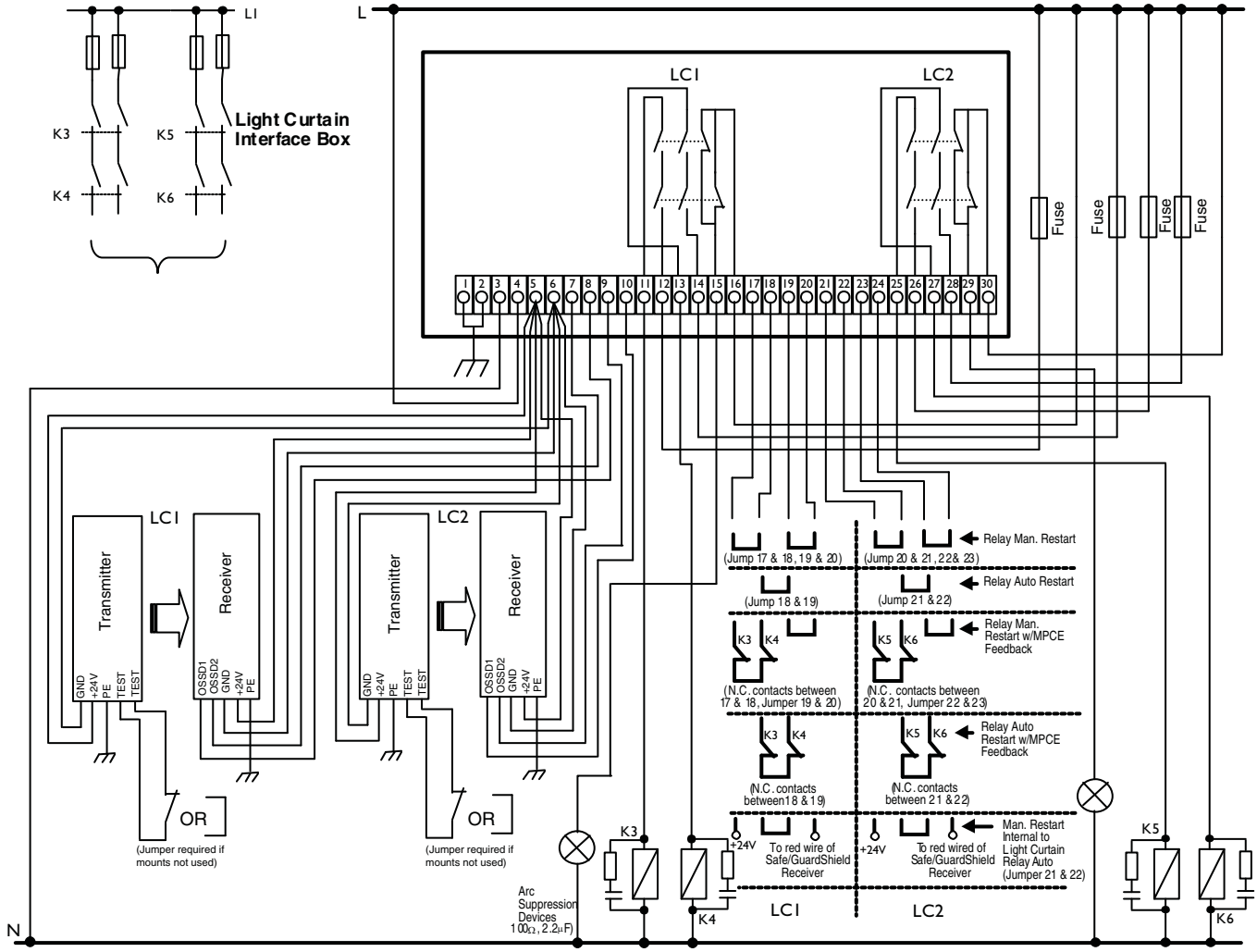
Wiring diagram is not intended to be used for installation purposes.



Typical Wiring Diagram

M8500 Dual Relay

Wiring diagram is not intended to be used for installation purposes.

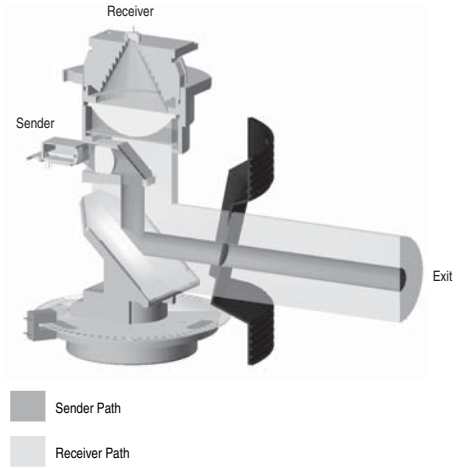


Safety Laser Scanner

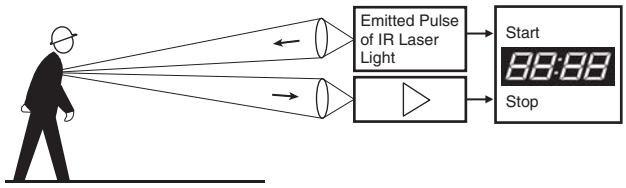
Overview

Principles of Operation

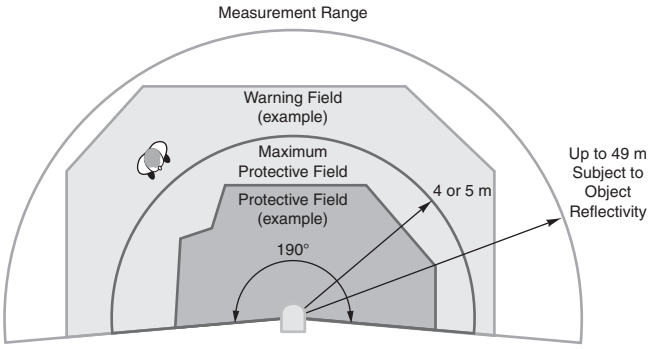
The SafeZone™ safety laser scanner operates on the principle of diffuse reflection and the time flight of light. Pulses of Infrared light are reflected off of a rotating mirror and are emitted over a 190° arc. The diffuse reflection of light is received from an intrusion in the preconfigured sensing field and processed to determine the location and distance of the object from the SafeZone scanner.



At the time of the emission of Infrared light, an electronic stop watch begins. The reflected light is then seen by the SafeZone scanner and processed to determine the distance of the object from the scanner.



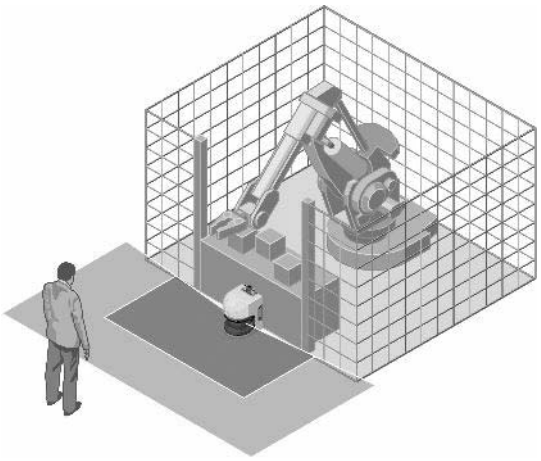
Configuration of the SafeZone's warning and safety fields are accomplished using the Safety Configuration and Diagnostic (SCD) software supplied with each scanner. This Windows®-based software allows easy configuration of irregularly shaped fields by simply clicking and dragging points along the perimeter of the particular zone to shape the contour of the perimeter of the warning or safety field.



The SafeZone safety laser scanner is well suited to industrial applications and can be used in either vertical or horizontal applications to detect the intrusion of personnel or objects into the configured sensing field(s). This detection can result in an audible alarm or warning light being activated to warn of the intrusion or if the intrusion is in the safety field, the hazardous motion of machinery can be stopped.

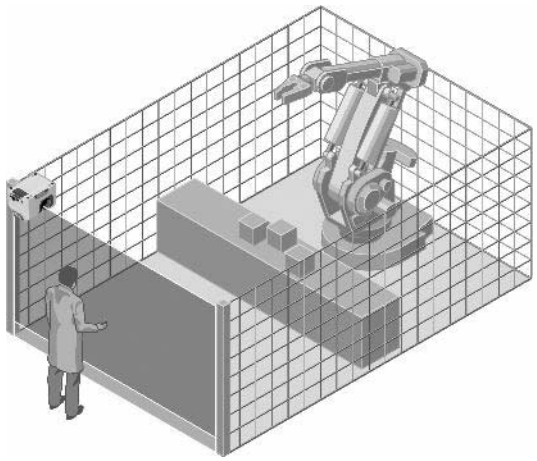
Stationary Horizontal Guarding—Single Field Set

It is possible to configure a warning field and a safety field in front of machinery or equipment to protect personnel from accessing the area where hazardous motion takes place. The SafeZone safety laser scanner is required to be mounted at a particular height from the floor. Irregular shapes are easily configured using the Windows-based SCD software.



Stationary Vertical Guarding

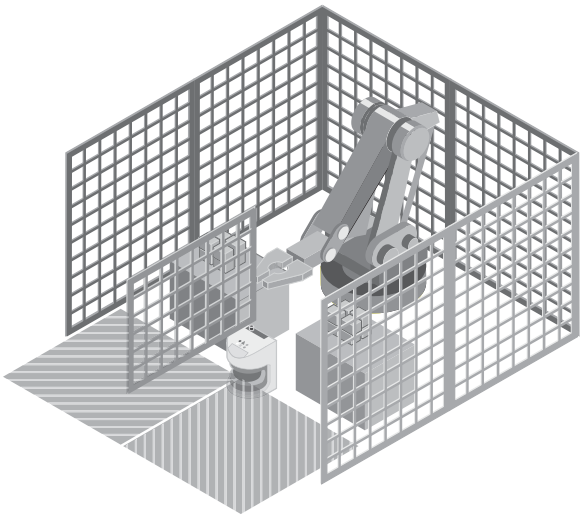
It is possible to mount the SafeZone safety laser scanner to create a vertical safety field that provides access detection to a hazardous area. It is necessary to configure "contour as a reference," which monitors specific areas at the perimeter of the safety field. Contour as a reference must be configured for vertical applications as this configured feature prevents the manipulation of the scanner.



Note: Both the SafeZone singlezone and multizone can be used in stationary horizontal or vertical guarding applications. The SafeZone multizone has a safety field range of 5 m (16.4 ft) and up to four configurable and switchable field sets. The SafeZone singlezone has a safety field range of 4 m (13 ft) and a single configurable field set.

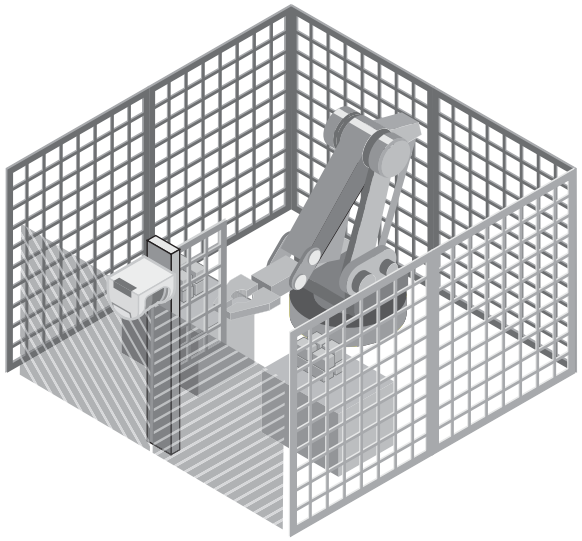
Stationary Horizontal Guarding—Up to Four Safety Zones

The SafeZone multizone safety laser scanner can be configured with up to four field sets; each set may consist of a warning zone and a safety zone. If the application warrants, it may only be necessary to configure the safety zone(s).



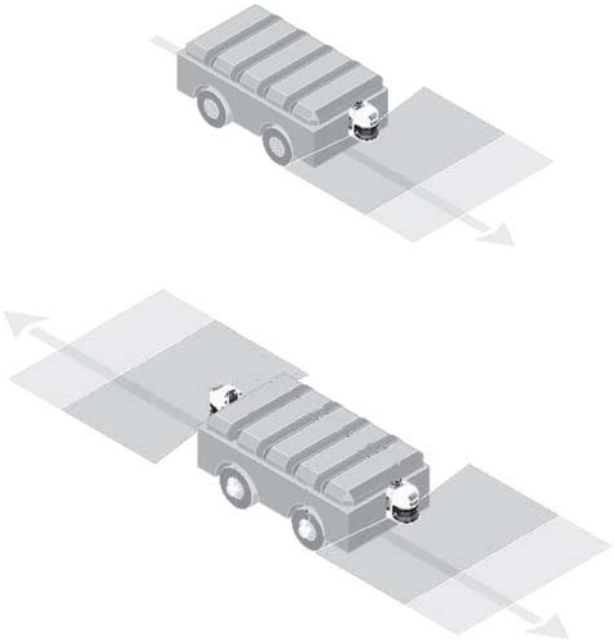
Stationary Vertical Guarding—Two or More Safety Zones

The SafeZone multizone safety laser scanner can be mounted to create up to four vertical detection areas in the same plane. Contour as a reference should be configured to prevent manipulation of the scanner. A static control input switches between the configured fields.



Automatic Guided Vehicles (AGVs)

The SafeZone safety laser scanner is designed to detect fixed objects (walls, columns), as well as moving objects (people, AGVs). The SafeZone safety laser scanner is typically mounted on the front of a mobile vehicle or for AGVs capable of bi-directional travel, in each direction of travel. Any object in the path of the moving vehicle, of sufficient resolution, is detected. When an object or person is detected in the configured warning field, a signal can be used to decrease the speed of the AGV. Intrusion into the safety field will send a signal to the AGV to stop. It is also possible to configure a predetermined time delay where the SafeZone safety laser scanner will monitor the safety field. If the safety field becomes clear, the SafeZone's Output Signal Switching Device (OSSD) will change to a green state and allow the AGV to continue traveling.



Note: Both the SafeZone singlezone and multizone can be used in mobile applications, depending upon safety field range requirements and the required number of switchable pre-configured field sets.

Safety Laser Scanner

SafeZone™ Singlezone/Multizone

Description

The Allen-Bradley Guardmaster SafeZone safety laser scanners are Type 3 opto-electronic devices, which use the diffuse reflection of emitted infrared laser light to determine the intrusion of a person or object within a defined area. A rotating deflection mirror periodically emits Class 1 (eye safe) infrared laser pulses over a 190° angular area to create a two dimensional detection field.

The reflected light is processed by the SafeZone, which sends a stop signal by switching the state of its OSSD, if it is determined that an object is within the preconfigured sensing field(s).

The SafeZone laser scanners are versatile, rugged, opto-electronic devices in an IP65 housing and are ideally suited for a wide range of industrial applications.

Singlezone

The single field set (warning and safety) can be configured within the maximum scanning range of the device. The Safety Configuration and Diagnostic (SCD) Windows-based software, supplied with each scanner, makes programming the SafeZone singlezone simple. A configuration wizard is available to guide the programmer through simple or complex system configurations.

Multizone

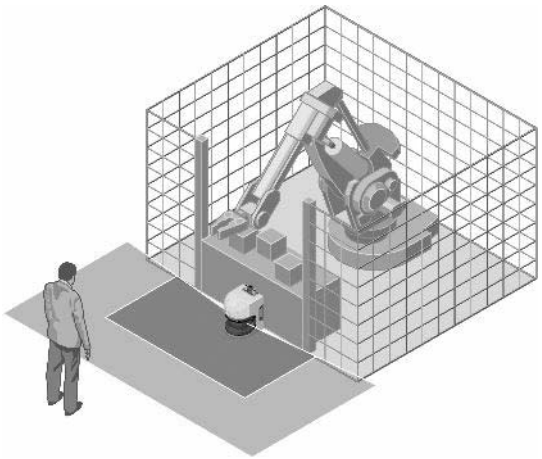
Four switchable zone sets (warning and safety) can be configured within the maximum scanning range of the device. The SCD Windows-based software, supplied with each scanner, simplifies the programming of the SafeZone multizone scanners. A configuration wizard is available to guide the programmer through simple or complex system configurations.

Features

- 190° scanning angle
- Seven-segment diagnostic display
- Configurable resolutions 30, 40, 50, 70, and 150 mm
- Integrated EDM
- Horizontal or vertical mounting
- Four or five meter safety field range

Specifications

Safety Ratings	
Standards	IEC 61496-3, UL 61496, IEC 61508
Safety Classification	Type 3, IEC 61496; SIL CL 2, IEC 61508, IEC 62061; Category 3, PLd EN ISO 13849:2009
Certifications	CE Marked for all applicable directives, TÜV, cULus, Type 3 AOPDDR per IEC 61496, SIL 2 per IEC 61508
Power Supply	
Input Power, Max.	24V DC +20%/-30%
Maximum Residual Ripple	5%
Power Consumption	55 W with max. output load, 19 W without output load
Outputs	
Safety Outputs	2 PNP OSSDs 500 mA short-circuit protection
Auxiliary Outputs	1 PNP OSSD, 500 mA nonsafety
Switching Current @ Voltage, Min.	2 A
Operating Characteristics	
Response Time	60 ms or 120 ms
Status Indicators	OSSDs on, reset required, warning field interruption, front screen contaminated, OSSDs off
Scanning Angle	190° max.
Safety Field Range	4 m (13 ft) for Singlezone 5 m (16.4 ft) for Multizone
Resolution [mm (in.)]	30 (1.18), 40 (1.57), 50 (1.96), 70 (2.75), 150 (5.90)
Angular Resolution	0.25…0.50°
Wavelength	905 nm
Power-Up Delay	9…20 s
Environmental	
Enclosure Type Rating	IP65
Operating Temperature [C (F)]	-5…55° (23…131°)
Storage Temperature [C (F)]	-25…70° (-13…+158°)
Vibration	10…150 Hz, 0.35 mm or 5 g per IEC 61496
Shock	Single: 15 g, 11 ms per EN 60068-2-27 Continuous: 10 g, 16 ms per IEC 61496
Physical Characteristics	
Weight [kg (lb)]	3.3 (7.28)
Material	Die-cast aluminum
Display Window	Polycarbonate
Cable Length	10 m or 20 m (32.8 ft or 65.6 ft)



Product Selection

Singlezone Safety Laser Scanner System Components

Item	Description		Cat. No.
1		Scan head and I/O module assembly	**442L-SFZNSZ**
2		Prewired 13 conductor cable with memory module (10 or 20 m (32.8 or 65.6 ft) required)	**442L-CSFZNMZ-10** 442L-CSFZNMZ-20
3	2 m (6.56 ft) RS232 program cable (required) or		**442L-ACRS232**
	10 m (32.8 ft) RS232 program cable		442L-ACRS232-8

Multizone Safety Laser Scanner System Components

Item	Description		Cat. No.
1		Scan head and I/O Module (required)	**442L-SFZNMZ**
2		Prewired 13 conductor cable with memory module (10 or 20 m (32.8 or 65.6 ft) required)	**442L-CSFZNMZ-10** 442L-CSFZNMZ-20
3	2 m (6.56 ft) RS232 program cable (required)		**442L-ACRS232**
	10 m (32.8 ft) RS232 program cable		442L-ACRS232-8

Note: A SafeZone safety laser scanner system requires the scan head and I/O module assembly (1) with either a 10 or 20 meter prewired memory module (2) and a programming cable (3).

Recommended Logic Interfaces

Description	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. Page No.	Cat. No.
Single-Function Safety Relays for 2 N.C. Contact Switch							
MSR127RP	3 N.O.	1 N.C.	Removable (Screw)	Monitored Manual	24V AC/DC	5-26	**440R-N23135**
MSR127TP	3 N.O.	1 N.C.	Removable (Screw)	Auto./Manual	24V AC/DC	5-26	**440R-N23132**
MSR126	2 N.O.	None	Fixed	Auto./Manual	24V AC/DC	5-24	**440R-N23117**
Modular Safety Relays							
MSR211P Base 2 N.C. only	2 N.O.	1 N.C.	Removable	Auto./Manual or Monitored Manual	24V DC from the base unit	5-84	440R-H23177
MSR221P Input Module	—	—	Removable	—	24V DC from the base unit	5-88	440R-H23179
MSR310P Base	MSR300 Series Output Modules	3 PNP Solid State	Removable	Auto./Manual Monitored Manual	24V DC	5-102	440R-W23219
MSR320P Input Module	—	2 PNP Solid State	Removable	—	24V DC from the base unit	5-106	440R-W23218
Muting Modules							
MSR22LM	2 N.O.	1 N.C.	Removable	Auto./Manual	24V DC	5-48	**440R-P23071**
MSR42 (requires optical interface to configure 445L-AF6150	2 PNP	2 PNP, configurable	Removable	Auto./manual or manual monitored	24V DC	5-52	**440R-P226AGS-NNR**

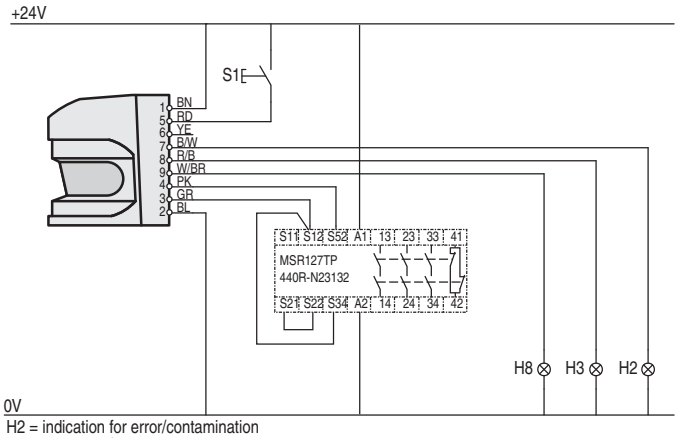
Accessories—Optional

Description		Cat. No.
	Mounting Kit 1: Mounting bracket for direct mounting at the rear on wall or machine. No adjustment facility.	**442L-AMBSFZNMZ1**
	Mounting Kit 2: Bracket only in conjunction with mounting kit 1. Mounting at the rear on wall or machine. Longitudinal and cross-wise adjustment possible.	442L-AMBSFZNMZ2
	Mounting Kit 3: Bracket only in conjunction with mounting kit 1 and 2. Mounting at the rear or below on wall, floor or machine. Longitudinal and cross-wise adjustment possible.	442L-AMBSFZNMZ3
	3.0 A power supply	1606-XLP72E
	USB to serial port adaptor cable	9300USBS
	100 m cable spool 13 conductor	442L-C13GD-S100
	Replacement window kit	442L-SFZNMZW
	Replacement part—Singlezone scan head, 4 m	442L-SFZNSZ-SM
	Replacement part—Multizone scan head, 5 m	442L-SFZNMZ-SM
	Replacement part—Singlezone I/O module, 1 field set	442L-SFZNSZ-FM
	Replacement part—Multizone I/O module, 4 field sets	442L-SFZNMZ-FM
	Replacement part—unwired memory module	442L-SFZNMZ-MEM

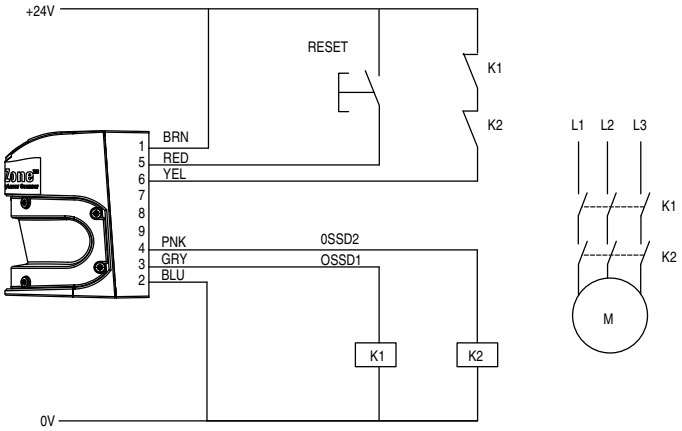
Note: All SafeZone accessories work with either the multizone or singlezone.

Typical Wiring Diagram

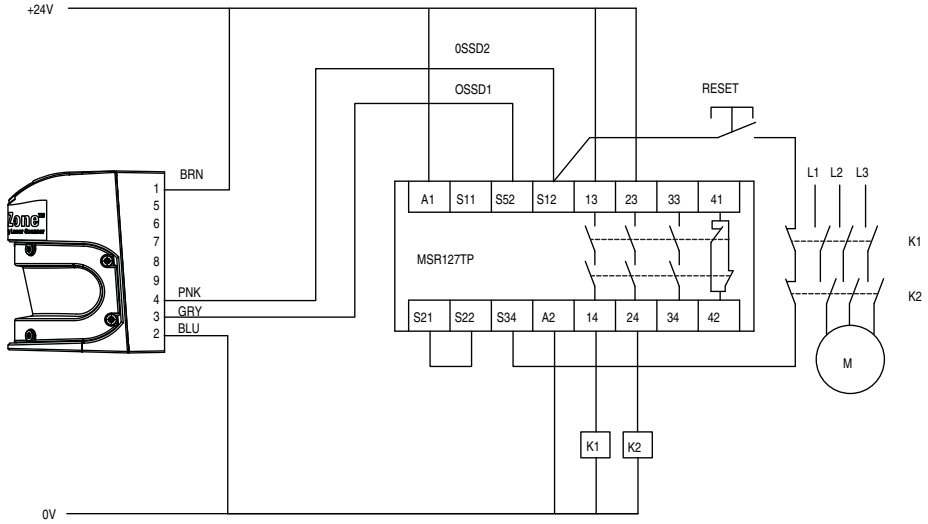
Wiring diagram is not intended to be used for installation purposes.



SafeZone with Restart Interlock to MSR127

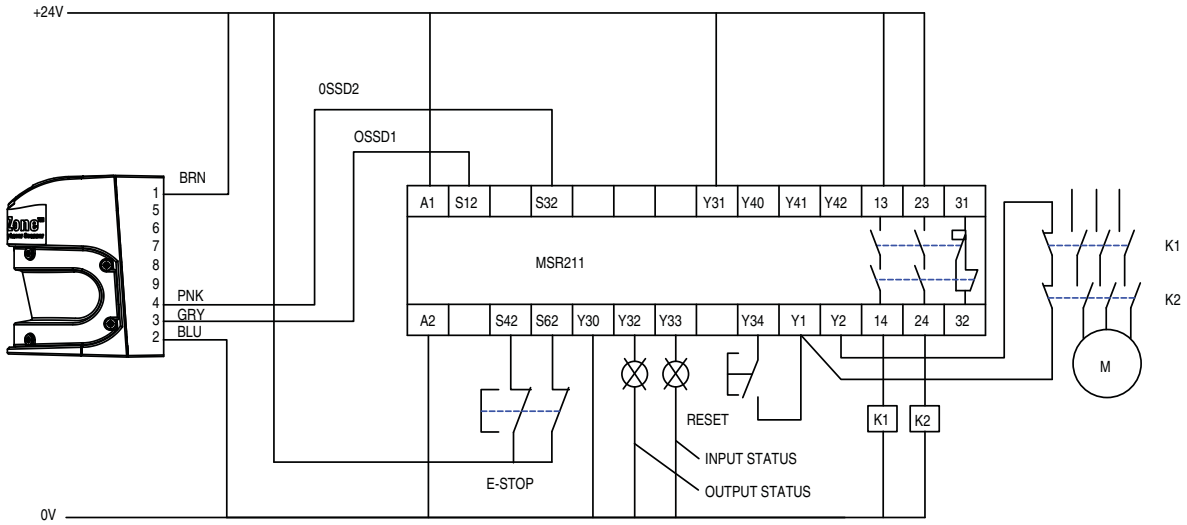


SafeZone with EDM and Restart Interlock

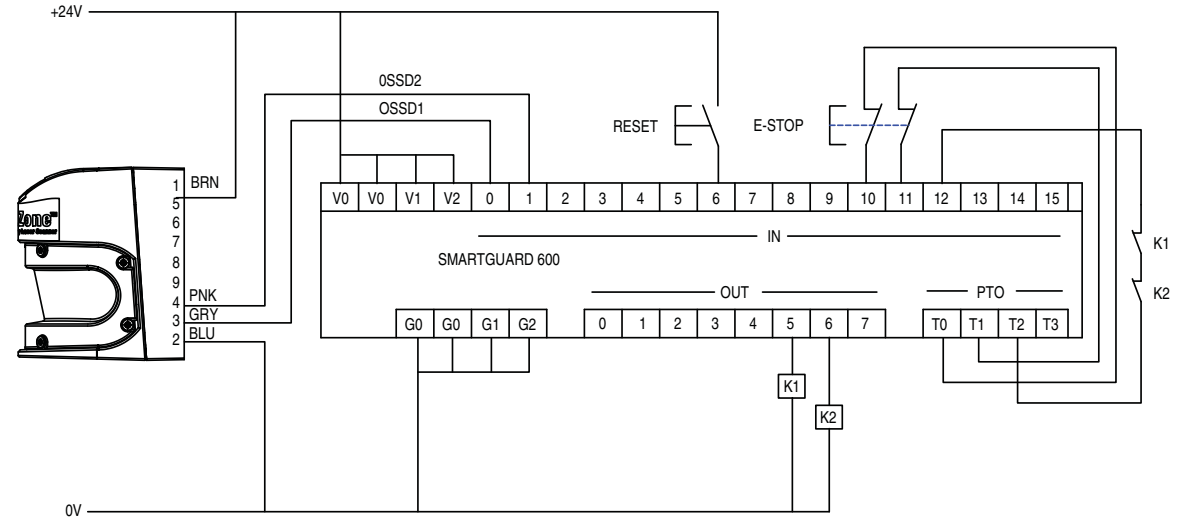


SafeZone to MSR127

Wiring diagram is not intended to be used for installation purposes.



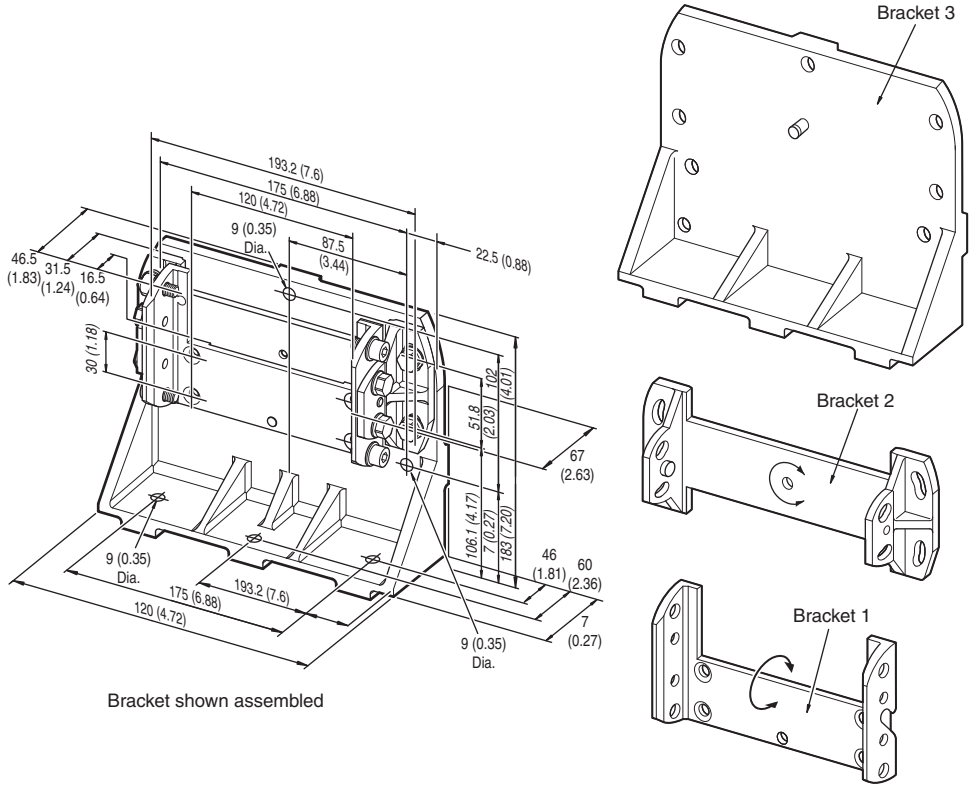
SafeZone to MSR211



SafeZone to SmartGuard 600

Bracket Assembly

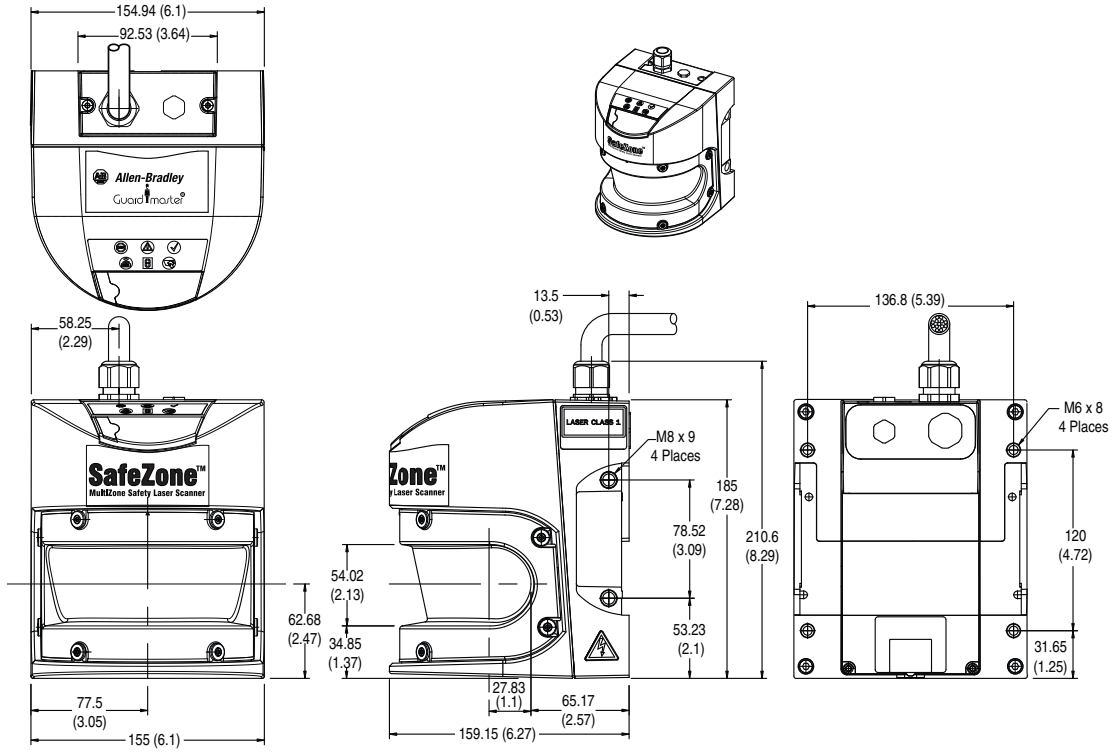
Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



Bracket shown assembled

Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



MatGuard™ Mats

Overview

Description

MatGuard consists of a number of interconnecting pressure-sensitive safety mats and a monitoring control unit that provide a system for area detection. The mat has been designed from the "ground up" to meet the arduous conditions found on the factory floor, and uses well-tried components and techniques to be consistent with Category B and Category 1 requirements.

The mats are available in a wide range of standard sizes to meet most requirements. Special sizes and shapes are available. Each mat has two conductive plates that are held apart by non-conductive compressible separators. Each four-wire mat, operating on only 24V DC, is pre-wired and connected in series with other mats, forming a complete floor-level guarding system for hazardous areas. The circuit through the mat must be monitored by a safety-rated control unit, which may be a Minotaur™ Safety Relay, MatGuard control unit, or MatGuard Mat Manager. When the mat is clear, the control unit provides a signal to the machine control circuit.

When a mat is stepped on, the conductive plates touch and the resistance in the circuit falls to zero. This is monitored by the control unit, which sends a stop command to the machine control system.

The unique molding process allows for the long life and reliability of the mat. Being completely sealed (IP67), water, liquids and coolants present no problem. In addition the tough vinyl will resist bleaches, acids, salts, and all but the most aggressive of industrial chemicals.

A range of control units is available including the Mat Manager, which monitors the status of each mat or area of mats individually. This enables quick fault detection/repair and identification of actuated area.

Features

- EC type certification
- Third party certification to EN 1760-1
- Also meets EN954-1 (ISO 13849-1) category 3 system and IEC/EN 60204-1, AS 4024.5, ANSI B11.19, ANSI RIA R15.06
- Overall sensitivity including uniting strip
- Mat manager monitors the status of each mat individually
- Rugged construction will take the pressure of 4500 psi (does not include the active uniting trim)
- Vinyl construction resistant to most oils
- Sealed to IP67
- 5-year warranty on mats

Chemical Resistance of Sensor Mat Vinyl Covering

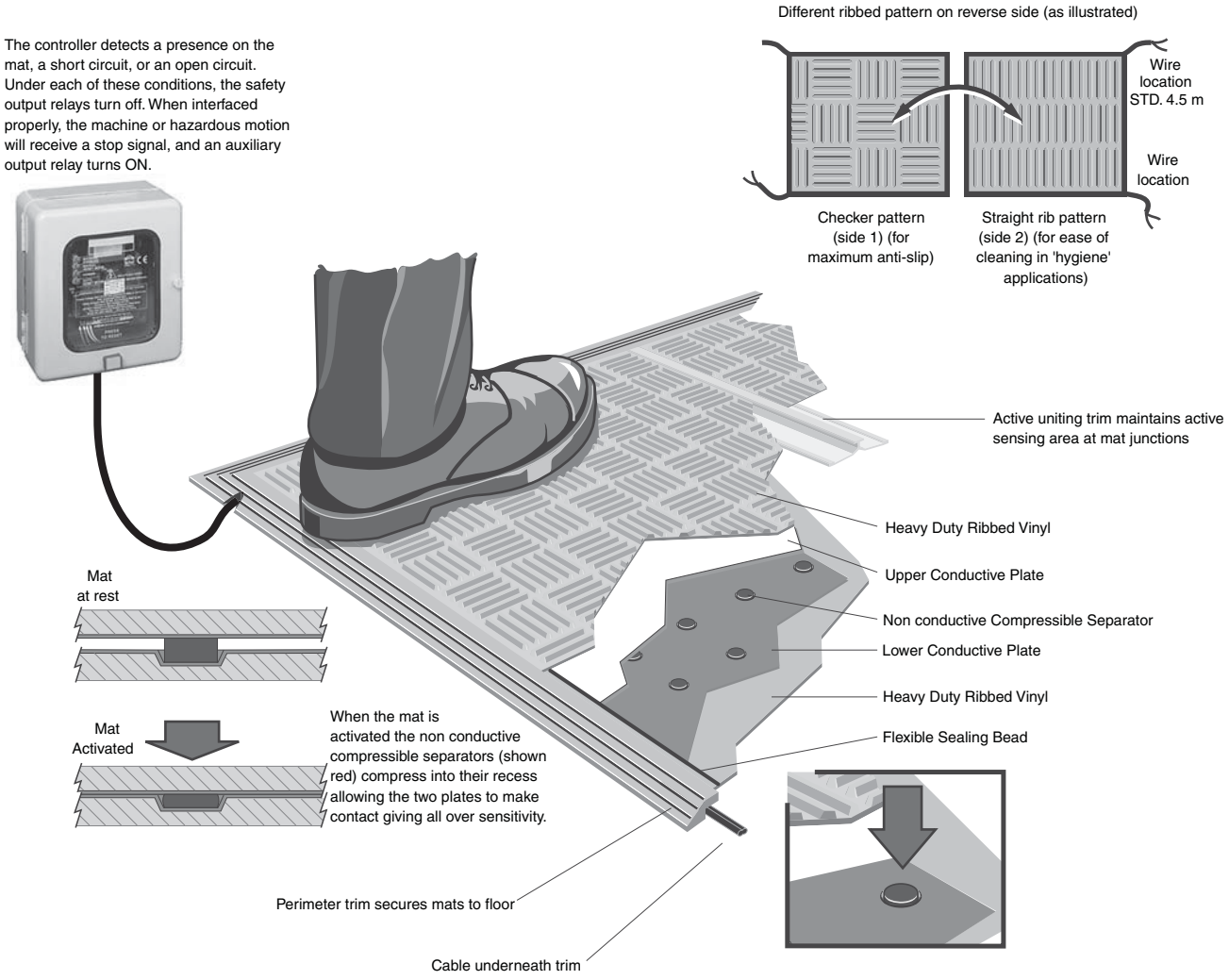
Substance	Resistance of Mat Covering
Water	Excellent
Ethyl Alcohol	Excellent
Sodium Chloride	Excellent
Bleach	Excellent
Hydrochloric Acid	Fair to Excellent
Sulphuric Acid	Fair to Excellent
Nitric Acid	Fair to Excellent
Acetic Acid	Fair
Petrol (Gasoline)	Fair
Trichlorethylene	Poor to Fair
Benzene	Poor
Acetone	Poor
Water (Sea)	Excellent
Lubricating Oil	Fair to Excellent
Cutting Fluids	Fair to Excellent
Oil (Auto)	Fair to Excellent
Brake Fluids	Poor to Fair

In general, the covering has excellent resistance to acids, alkalis and salts. Hot acids and alkalis, as well as concentrated and organic acids, have a deleterious effect on prolonged exposure. The covering has fair resistance to aliphatic solvents, fair to poor resistance to aromatic and chlorinated solvents, and poor resistance to ketones and most esters.

Note: Combinations of chemicals can have unpredictable effects. Testing is recommended in such cases. Small pieces of the vinyl material are available if testing is required.

Application Types

Anatomy of a Mat System



Standards

The MatGuard mat system has been designed to conform with the latest European Standard EN 1760-1 “Safety of machinery—Pressure sensitive devices; mats and floors.”

This standard contains requirements for all aspects of design. Some of the most important points are as follows: **(From 4.2.2)** Where an effective sensing area is built up from more than one sensor (mat) it shall have no dead zone.

The standard gives details of the size, force and positioning of test pieces for testing the mat sensitivity.

(From 4.5.1) A single sensor (mat) shall still perform its function after one million actuations by a mass of 75 kg.

(From 4.7) When the actuating force is applied the output signal switching device(s) shall change from an ON state to an OFF state. It shall remain in the OFF state for at least as long as the actuating force is applied.

(From 4.7.1) Device with reset – b) After the actuating force has been removed, the output signal switching device(s) shall only change to the ON state after the application of a reset signal.

(From 4.7.2) Device without reset—For a pressure sensitive mat without reset the output signal switching device(s) shall change to an ON state at power ON and after the actuating force has been removed.

(From 4.15) The pressure sensitive mats shall meet the requirements of the category for which they are specified...

Note: The MatGuard mat system features an “active” mat and a dual channel monitoring control unit. This means that a single electrical fault in the mat, wiring or control unit will be detected and the control unit will go to a safe (OFF) condition.

(From informative annex B.1.1) The top (mat) surface should be of a material which will withstand the operating duty.....The top surface should not present a risk through becoming slippery due to wear or the effects of liquids....

(From informative annex B.1.7) In some situations, heavy loads (such as fork lift trucks) can be applied to the sensor (mat)..... If this is required the user should identify the need to the mat manufacturer.

Note: The standard MatGuard mat can be successfully used with fork lift trucks. The MatGuard Mat System should be installed in accordance with the requirements of EN 999, "The positioning of protective equipment in respect of approach speeds of parts of the human body."

The MatGuard Safety Mat system is also designed to meet the U.S. standards ANSI/RIA R15.06-1999 Safety Requirements for Industrial Robots and Robot Systems and ANSI B11.19 Performance Criteria for Safeguarding.

These two U.S. standards have many similar requirements and provide performance criteria for design, installation and use. Excerpts from these standards include:

From RIA R15.06

(From 11.7) Safety mat systems shall be designed, constructed, and applied such that any single component failure shall not prevent the stopping action of the robot.

(From 5.3.4) Safety mats shall have a minimum object sensitivity which detects 30 kg (66 lb,) weight of an 80 mm (3.125 in.) diameter circular disk anywhere on the mat sensing surface; provide a means to retain minimum object sensitivity at the area where mats joined together.

From ANSI B11.19

(From 11.1.1.4) The safety mat device shall have a maximum response time that is not affected by object sensitivity adjustments or environmental changes.

(From 11.1.1.5) When a component, module, device or system failure occurs, the safety related function shall prevent initiation of the hazardous machine motion, initiate an immediate stop command and prevent re-initiation of the hazardous machine motion.

From AS 4024.5

The MatGuard Safety Mat system is designed to meet the Australian Standard AS 4024.5, which has many similarities to the European Standard EN1760-1. Excerpts from this standard include:

(From 3.2.2) Where an effective sensing area is built up of more than one sensor, it shall have no dead zone.

(From 3.7) When the actuating force is applied the output signal switching device (s) shall change from an 'on' state to an 'off' state. It shall remain in the 'off' state for at least as long as the actuating force is applied.

(From 3.8) The sensor shall be provided with a means for fixed permanent location.

(From 3.10) Provisions shall be made on the top surface of the sensor to minimize slipping under the expected operating conditions.

Application Details

Safety Distance Calculations ANSI/RIA R15.06

The minimum distance calculated is the minimum horizontal distance from the outer edge of the MatGuard sensor mat detection zone to the nearest part of the hazard. The formula for floor mounted safety mats is:

Ds = [K x (Ts + Tc + Tr)] + Dpf

- **Ds** is the minimum safety distance.
- **K** is a minimum speed constant based on the movement of the hand/arm only and the body being stationary.
  K=1600 mm/s (63 in./s)
- **Ts** is the worst stopping time of the machine/equipment.
- **Tc** is the worst stopping time of the control system.
- **Tr** is the response time of the safeguarding device.
- **Dpf** is the depth penetration factor which is the maximum travel towards the hazard within the safety mat area that may occur before a stop is signalled.
  Dpf=1200 mm (48 in.)

The response time of the machine and control system used in the calculation must be the worst case. Some machines have inconsistent response times that are dependent upon mode of operation, nature of the work piece and point in the operating cycle at which stopping is initiated. An allowance should be made for wear in brakes, temperature, aging of components, etc., if this can affect the response time. An allowance for further delays in the machine control system may be required in some circumstances.

Calculation Example

In this example, the MatGuard system is being used with a machine and control system with a worst-case response time measured at 0.485 seconds. The system is on a flat surface, it is not on a raised platform. Using the formula above.

$$T = Ts + Tc + Tr$$
$$0.035 + 0.485$$
$$0.520 \text{ s}$$

$$S = (63 \times 0.520) + 48$$
$$80.76 \text{ in.}$$

Sensor mats will be required from 2032 mm right up to the edge of the machine base plate.

Safety Distance Calculations EN999

The minimum distance calculated is the minimum horizontal distance from the outer edge of the MatGuard sensor mat detection zone to the nearest part of the hazard. The formula for floor mounted safety mats is:

S = [1600 x (t1 + t2)] + (1200 – 0,4H)

- **S** is the minimum safety distance in mm in a horizontal plane from the danger zone to the detecting edge of the device furthest from the danger zone.
- **1600** is a minimum speed constant based on the movement of the hand/arm only and the body being stationary.
  1600 mm/s = 63 in./s
- $\mathbf{t_1}$ is the maximum time between the actuation of the sensing function and the output signal switching devices being in the off state.
- $\mathbf{t_2}$ is the maximum response time of the machine, i.e., the time required to stop the machine or remove the risks after receiving the output signal from the protective equipment.
- **1200** is the depth penetration factor which is the maximum travel towards the hazard within the safety mat area that may occur before a stop is signalled.
  1200 mm = 48 in.
- **H** is the distance above the reference plane, e.g., floor, in millimeters.

The response time of the machine and control system used in the calculation must be the worst case time. Some machines have inconsistent response times that are dependent upon mode of operation, nature of the work piece and point in the operating cycle at which stopping is initiated. An allowance should be made for wear in brakes, temperature, aging of components, etc., if this can affect the response time. An allowance for further delays in the machine control system may be required in some circumstances.

Calculation Example

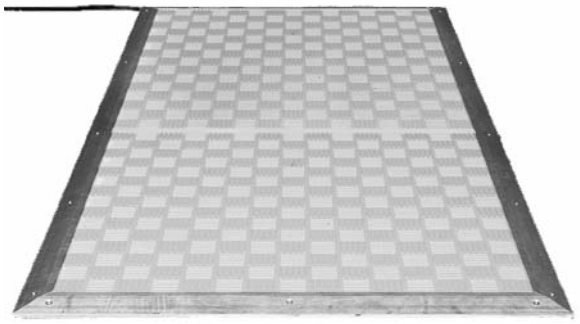
In this example, the MatGuard system is being used with a machine and control system whose worst case response time has been measured as 0.485 seconds. The system is on a flat surface, it is not on a raised platform. Using the formula above,

$$T = t_1 + t_2$$
$$0.035 + 0.485$$
$$0.520 \text{ s}$$

$$S = (1600 \times 0.520) + 1200$$
$$832 + 1200$$
$$2032 \text{ mm}$$

Sensor mats will be required from 2032 mm right up to the edge of the machine base plate.

MatGuard™ Mats



Description

The MatGuard safety mat is a pressure-sensitive safeguarding product that is designed to detect the presence of people on its sensing surface.

The MatGuard safety mat has two conductive hardened steel plates that are held apart by non-conductive compressible separators. Each four-wire mat, operating on only 24V DC, is pre-wired and connected in series with other mats to form a floor level guarding system for hazardous areas. The circuit through the mat must be monitored by a safety-rated control unit, which may be a Minotaur Safety Relay, MatGuard control unit, or MatGuard Mat Manager. When the mat is clear, the control unit provides a signal to the machine control circuit.

When a mat is stepped on, the conductive plates touch and the resistance in the circuit falls to zero. This is monitored by the control unit, which sends a shutdown signal to the machine.

Since the MatGuard safety mat is completely sealed (IP67), water, liquids and coolants present no problem. In addition, the tough vinyl will resist bleaches, acids, salts and many industrial chemicals.

The unique molding process allows the long life and reliability of the mat.

Features

- Hardened steel plate construction
- No dead spots
- 4-wire system to detect opens and shorts
- Can withstand a static pressure of 4500 psi
- IP67 rated

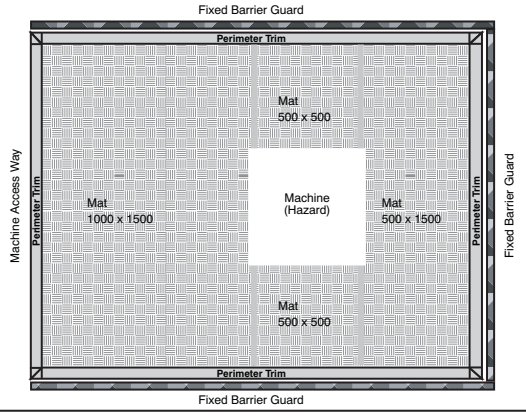
Specifications

Standards	EN1760-1, EN954-1, ISO 13849-1, IEC/EN60204-1, ANSI RIA R15.06, ANSI/B11.19, AS4024.5
Category	Cat. 1 device per EN954-1, suitable for Cat. 3 systems
Certifications	CE Marked for all applicable directives, cULus Listed, CSA Z432-04, and TÜV
Power Supply	24V DC, -20% +10%, provided by the control unit
Connection Wire Length, Max.	200 m (656 ft)
Cable Length	4.5 m (15 ft) standard (see Product Selection)
Detection Weight	30 kg (66 lbs) minimum on an 80 mm (3.125 in.) diameter circular disk
Maximum Pressure Applied to Mat	31,034 kPa (4500 psi)
Zone Size	100 m^2 (1076 ft^2), maximum
Mechanical Life	10,000,000 operations
Operating Temperature [C (F)]	-25…55° (-14…131°)
Relative Humidity	100%
Enclosure Type Rating	IP67 (NEMA 6P)
Vibration	5 g, 10…200 Hz
Shock	11 ms 10 g/16 ms 10 g
Terminal Protection	IP 20 DIN 0470
Wire Size	0.75 mm^2 (18 AWG), 2 wire; 3.8 mm x 7.4 mm (0.15 in. x 0.29 in.) jacket OD
Weight	10.9 kg/m^2 (2.2lbs/ft^2)
Material	Plastisol Vinyl
Color	Yellow or Black
Trim Material	6063 Aluminum
Mounting	Flat surface
Thickness	16 mm (0.63 in.)

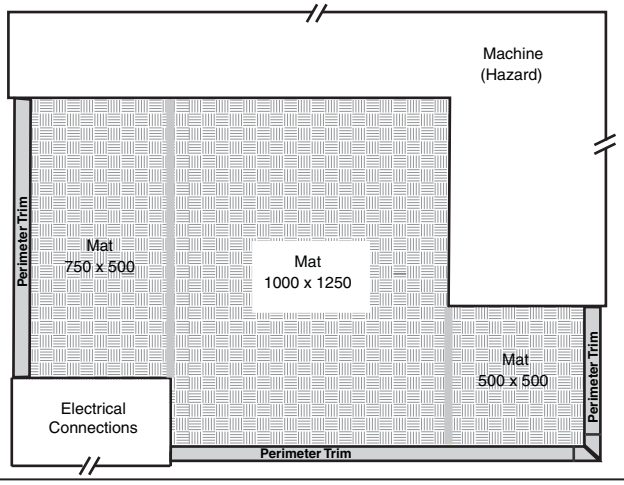
Product Selection—Standard Mats

Mat Size [mm (in.)]	Cat. No.	
	Standard Perimeter Trim Kit	Safety Mat
500 x 500 (19.7 x 19.7)	440F-T1010	**440F-M1010BYNN**
500 x 1500 (19.7 x 59.1)	440F-T1030	**440F-M1030BYNN**
500 x 750 (19.7 x 29.5)	440F-T1015	440F-M1015BYNN
750 x 750 (29.5 x 29.5)	440F-T1515	440F-M1515BYNN
750 x 1500 (29.5 x 59.1)	440F-T1530	**440F-M1530BYNN**
500 X 1000 (19.7 X 39.4)	440F-T1020	**440F-M1020BYNN**
750 X 1000 (29.5 X 39.4)	440F-T1520	440F-M1520BYNN
1000 x 1000 (39.4 x 39.4)	440F-T2020	**440F-M2020BYNN**
1000 x 1250 (39.4 x 49.2)	440F-T2025	**440F-M2025BYNN**
1000 x 1500 (39.4 x 59.1)	440F-T2030	**440F-M2030BYNN**
1000 x 1800 (39.4 x 70.9)	440F-T2036	440F-M2036BYNN
Recommended control unit. For other control units, see page 5-69.		**440R-C23139**

Examples of Standard System Configurations



Bill of Materials		
Description	Quantity	Cat. No.
Mat	1	**440F-M2030BYNN**
	2	**440F-M1010BYNN**
Mat	1	**440F-M1030BYNN**
Perimeter Trim*	2	440F-T3210
Perimeter Trim*	1	440F-T3310
Active Uniting Trim Used to join two mats to ensure no dead spots	1	440F-T3220
MatGuard Controllers	1	440F-C4000S
Corner Trim	4	440F-T3012

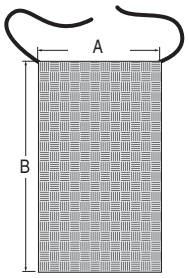


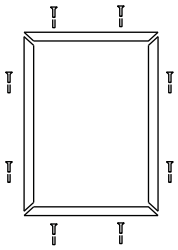
Bill of Materials		
Description	Quantity	Cat. No.
MatGuard Safety Mats	1	**440F-M2025BYNN**
	1	**440F-M1010BYNN**
	1	440F-M1015BYNN
Perimeter Trim*	1	440F-T3310
Corner Trim	1	440F-T3012
Uniting Trim	2	440F-T3020
MatGuard Controllers	1	440F-C4000P

* Customer must cut trim to proper length.

Product Selection—Configurable Mats

MatGuard safety mat and trim kit cat. nos. can be configured by selecting the appropriate codes from the tables below.





Mats:	440F	M	13	23	A	Y	NN
			a	*b*	*c*	*d*	
Trim Kit:	440F	T	13	23			
		e	*a*	*b*			

a

"A" Dimension [mm (in.)]	
Code	Description
2 digit number	Length of the mat in millimetres/50 Must be in 50 (1.97) increments Min. allowed 150 (03); Max. allowed 1000 (20) The length of A must be equal to or shorter than B.

b

"B" Dimensions [mm (in.)]	
Code	Description
2 digit number	Length of the mat in millimetres/50 Must be in 50 (1.97) increments Min. allowed 200 (04); Max. allowed 1800 (36) The length of A must be equal to or shorter than B.

c

Cable Exit	
Code	Description
A	Two 4.5 m (15 ft) 2-wire cables—exit out the A corners
B	Two 4.5 m (15 ft) 2-wire cables—exit out the B corners
C	One 9.1 m (30 ft) 4-wire cable with M12 male connector exits out of upper left corner
D	One 9.1 m (30 ft) 4-wire cable without connector exits out of upper left corner
F	One 0.76 m (2.5 ft) 4-wire cable with M12 male connector exits out of upper right corner
G	One 9.1 m (30 ft) 4-wire cable with M12 male connector exits out of upper left corner for use with 898D Distribution Box
H	One 9.1 m (30 ft) 5-wire cable with M12 male connector exits out of upper left corner for use with ArmorBlock Guard I/O

d

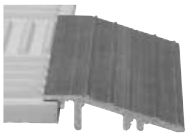
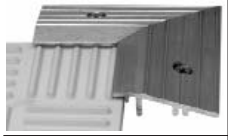
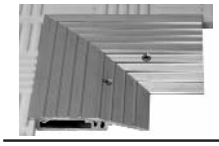
Color	
Code	Description
B	Black
Y	Yellow

e

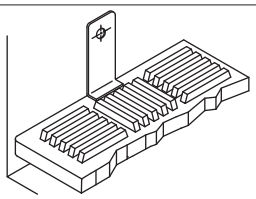
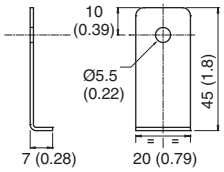
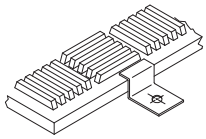
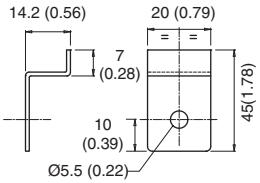
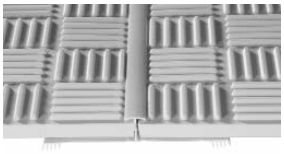
Trim Options	
Code	Description
K	Cable Channel Trim
T	Standard Trim

Note: Order controller separately, see page 5-68 for selection details.

Product Selection, Trim Options

Type	Description	Length	Cat. No.
	Standard perimeter trim (aluminum) for use with up to 3 cables running through channel.	2 m, square ends	440F-T3210
	Aluminum standard perimeter trim. For use with up to 3 cables running through channel.	3 m, square ends	440F-T3310
	Aluminum external corner standard perimeter trim	See page 2-99	440F-T3012
	Aluminum internal corner standard perimeter trim		440F-T3013
	Aluminum perimeter trim with cable channel. Used when up to 8 cables need to be fed through channel.	2 m, square ends	440F-T3211
		3 m, square ends	440F-T3311
		4 m, square ends	440F-T3411
	Aluminium external corner perimeter trim with cable channel	See page 2-99	440F-T3014
	Internal corner perimeter trim with cable channel		440F-T3015

Accessories

Type	Description	Dimensions—mm (in)	Cat. No.
	Aluminum right angle perimeter trim	13 x 25 mm, 2 m length (½ x 1 in., 6.6 ft length)	440F-T3216
		13 x 25 mm, 3 m length (½ x 1 in., 9.8 ft length)	440F-T3316
	Stainless steel angle clip perimeter trim (5 per package)		440F-T102933
	Stainless steel z-clip perimeter trim (5 per package)		440F-T102935
	Active uniting trim (used to join two mats to ensure no dead spots)	1 m (3.28 ft) length, square ends	440F-T3120
		1.5 m (4.9 ft) length, square ends	440F-T3020
		2 m (6.5 ft) length, square ends	440F-T3220
		3 m (9.8 ft) length, square ends	440F-T3320
	Vinyl wire guide	63.5 mm (2.5 in.) width, 2 m (6.6 ft) length	440F-T3230
	Accessories kit for 440F-C4000S and 440F-C4000P. 4 butt splices, 2 500 mA fuses, 4 wire terminations	N/A	440F-A108433
	12 Philips flat head, stainless steel screws for 440FA-3211 and 440FT3411 channel trim. Secures top to the bottom.	#6 x 9.5 (3/8)	440F-A17143
	12 Philips flat head, stainless steel screws with anchors for 440F-T3210, 440F-T3310, and 440F-T3510 trim	#10 x 38 (1.5)	440F-A17141
	12 flat head, stainless steel screws with anchors for 440F-T3211 and 440F-T3411 channel trim	#10 x 32 (1.25)	440F-A17142
	DC Micro QD Cordset, 4-pin 1 Brown 2 White 3 Blue 4 Black	2 m (6.5 ft)	889D-F4AC-2
		5 m (16.4 ft)	889D-F4AC-5
		10 m (32.8 ft)	889D-F4AC-10
		15 m (49.2 ft)	889D-F4AC-15
		20 m (65.6 ft)	889D-F4AC-20
		30 m (98.4 ft)	889D-F4AC-30
Reset push button for Mat Manager controllers			800FP-FOPN3YX11

Approximate Dimensions

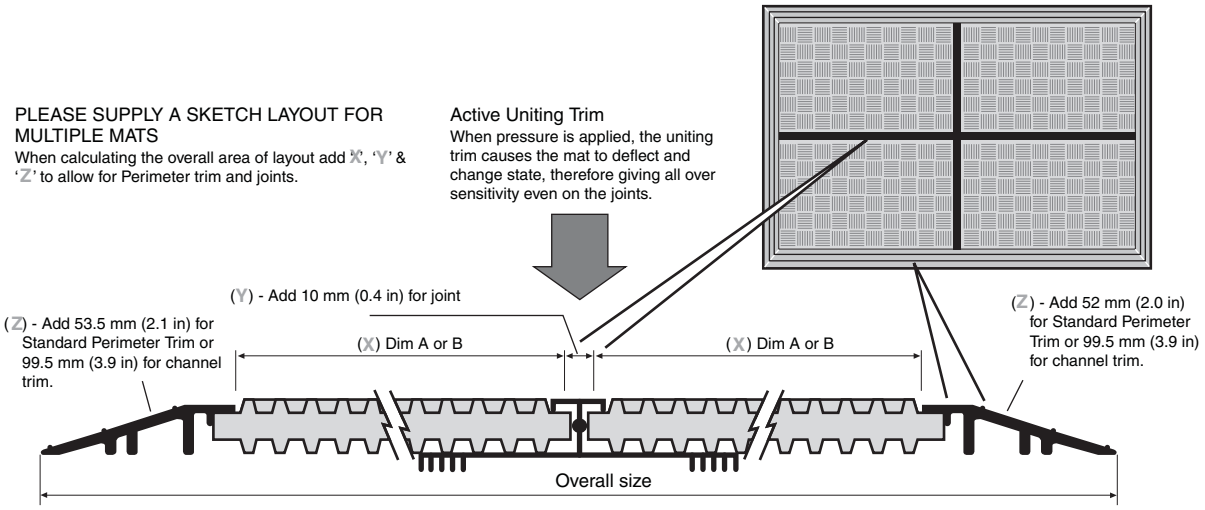
Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.

Mat System

When more than one mat is needed to protect an area, use the dimensions below to determine how large of an area is covered.

PLEASE SUPPLY A SKETCH LAYOUT FOR MULTIPLE MATS
When calculating the overall area of layout add 'X', 'Y' & 'Z' to allow for Perimeter trim and joints.

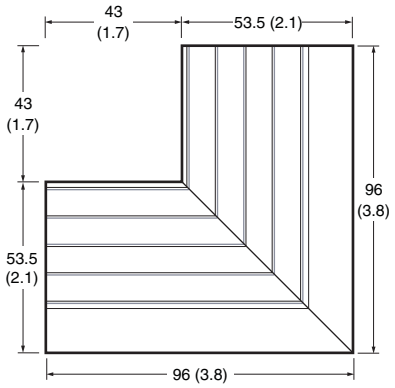
Active Uniting Trim
When pressure is applied, the uniting trim causes the mat to deflect and change state, therefore giving all over sensitivity even on the joints.



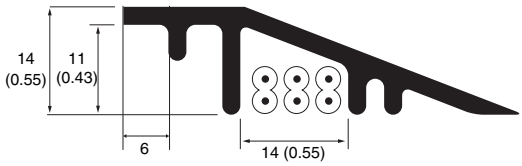
IMPORTANT Use the Distance Calculation on page 2-92 to ensure adequate coverage around the hazard.

Standard Perimeter Trim

Internal and External Corners



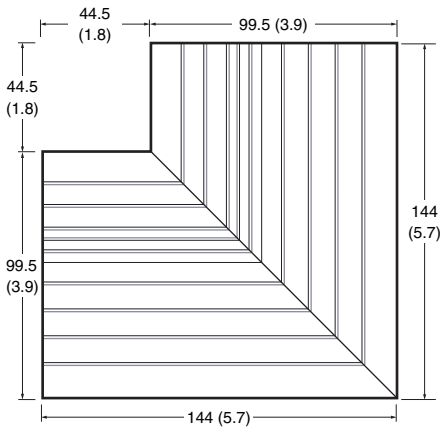
Channel Dimensions



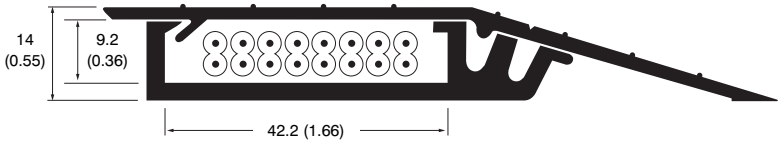
Standard perimeter trim holds three standard 2-wire mat cables or 2 4-wire cables. The equivalent of two cables are needed when connecting two mats in series.

Perimeter Trim with Cable Channel

Internal and External Corners



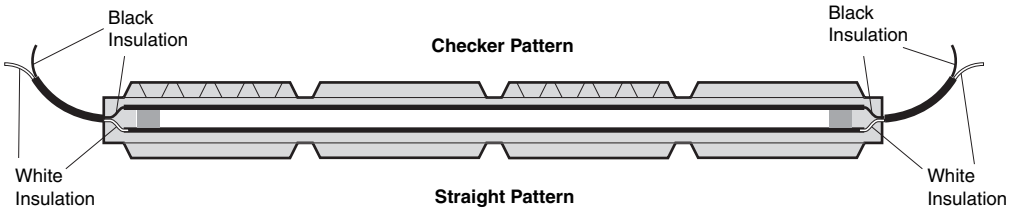
Channel Dimensions



Cable channel trim holds up to 8 standard 2-wire mats cables or 7 4-wire cables even when going around corners.

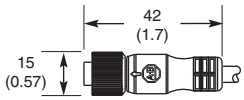
Connectivity

Two-Wire Cable Option



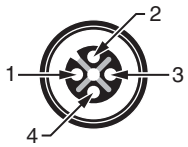
Note: Flat cable O.D. 6.5 mm x 3.5 mm

4-Pin Micro M12 Connector Option [mm (in.)]



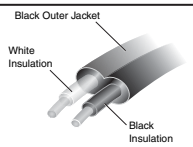
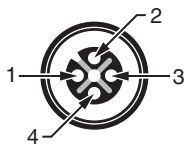
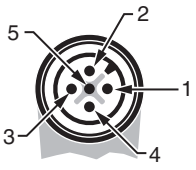
Straight Male

Checkered Rib Side of Mat



Straight Rib Side of Mat

Connection Cables

Cable Exit Configuration Code	Description	Compatibility	Connector	Wire Color	Circuit
A	Two 4.5 m (15 ft) 2-wire cables—exit out the A corners	Safety Relays		Black Black	N.C.
B	Two 4.5 m (15 ft) 2-wire cables—exit out the B corners	Safety Relays		White White	N.C.
C	One 9.1 m (30 ft) 4-wire cable with M12 male connector exits out of upper left corner	Mat Managers		1 Brown 2 White	N.C.
				3 Blue 4 Black	N.C.
D	One 9.1 m (30 ft) 4-wire cable without connector exits out of upper left corner	Safety Relays		1 Brown 2 White	N.C.
				3 Blue 4 Black	N.C.
F	One 0.76 m (2.5 ft) 4-wire cable with M12 male connector exits out of upper left corner	Mat Managers		1 Brown 2 White	N.C.
				3 Blue 4 Black	N.C.
G	One 9.1 m (30 ft) 4-wire cable with M12 male connector exits out of upper left corner	Distribution Block (2 N.C.) 898D-4*LT-DM4		1 Brown 3 Blue	N.C.
				2 White 4 Black	N.C.
H	One 9.1 m (30 ft) 5-wire cable with M12 male connector exits out of upper left corner	ArmorBlock Guard I/O		1 Brown 2 White	N.C.
				4 Black 5 Grey	N.C.

Connection to Logic Interfaces

Description	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. Page No.	Cat. No.
Single-Function Safety Relays							
MSR131RTP	3 N.O.	2 N.C., 2 PNP Solid State	Removable (Screw)	Auto./Manual or Monitored Manual	24V AC/DC	5-28	440R-C23139
MSR30RT	2 N.O. Solid State	1 N.O. Solid State	Removable	Auto./Manual or Monitored Manual	24V DC	5-16	440R-N23198
Specialty Safety Relays							
MSR23M	2 N.O.	1 N.C.	Fixed	Automatic/Manual Monitored Manual	24V AC/DC	5-66	**440R-P23073**
Mat Controller	2 N.O.	1 N.C.	Fixed	Automatic/Manual Monitored Manual	24V AC/DC or 115/230V AC	5-68	**440F-C4000S**
Mat Manager	2 N.O.	1 N.C.	Fixed	Auto./Manual Monitored Manual	24V DC	5-70	**440F-C28011**
Modular Safety Relays							
MSR210P Base (2 N.C.)	2 N.O.	1 N.C. and 2 PNP Solid State and 2 PNP Solid State	Removable	Auto./Manual or Monitored Manual	24V DC from the base unit	5-82	440R-H23176
MSR220P Input Module (all)	—	—	Removable	—	24V DC	5-86	440R-H23178
MSR320P Input Module (all)	—	2 PNP Solid State	Removable	—	24V DC from the base unit	5-106	440R-W23218

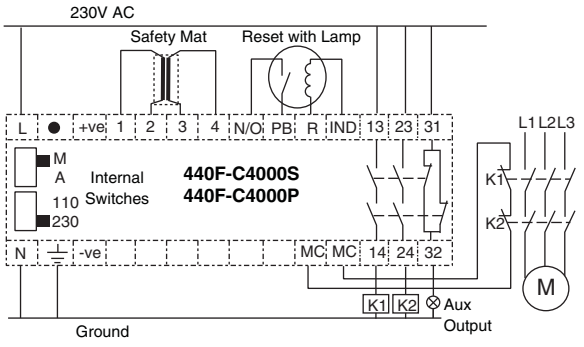
Note: For additional Safety Relays connectivity, see the Logic section of this catalog.
For additional Safety I/O connectivity, see the Safety I/O section of this catalog.
For Application and wiring diagrams, see the Applications section of this catalog.

Connection Systems

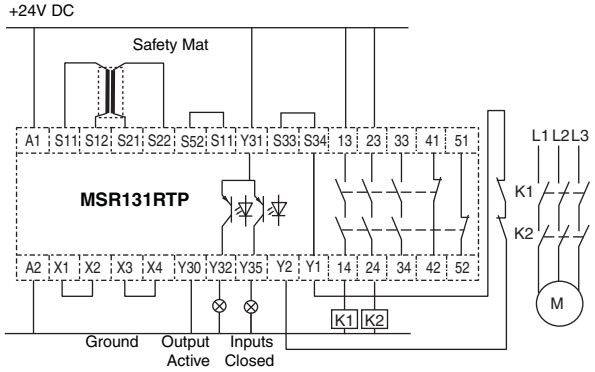
Connection	4-Pin	5-Pin
Cordset	889D-F4AC-✶	889D-F5AC-✶
Patchcord	889D-F4ACDM-❄	889D-F5ACDM-❄
Distribution Box	898D-4‡LT-DM4	NA
Shorting Plug	898D-41LU-DM	NA
T-Port	898D-43LY-D4	NA

✶ Replace symbol with 2 (2 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
❄ Replace symbol with 1 (1 m), 2 (2 m), 3 (3 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
‡ Replace symbol with 4 or 8 for number of ports.

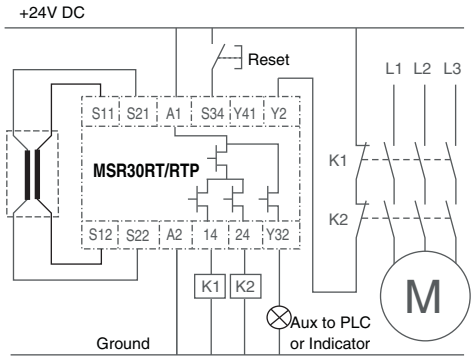
Typical Wiring Diagrams



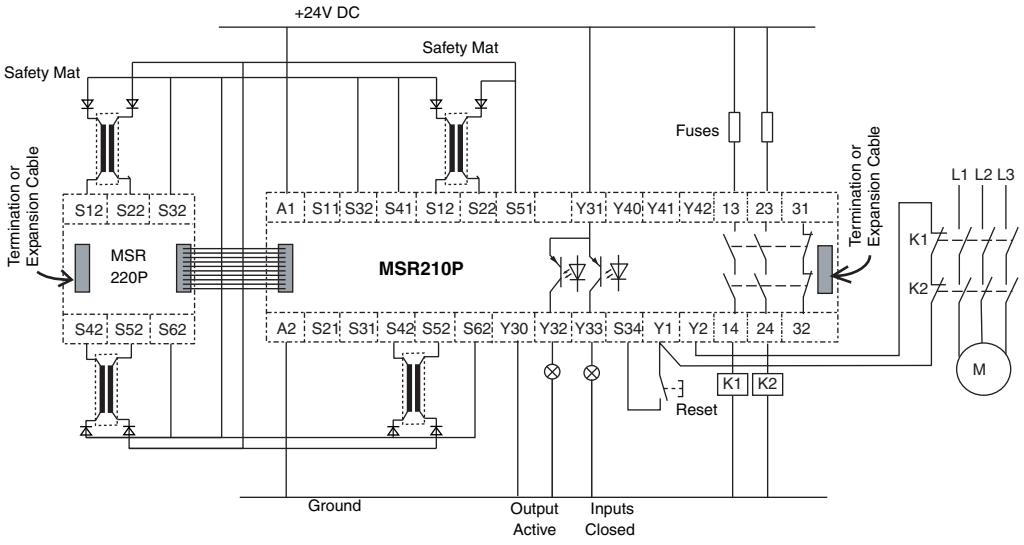
Safety Mat, Monitored Manual Reset, Dual Channel Output, Monitored Output



Safety Mat, Automatic Reset, No Output Monitoring

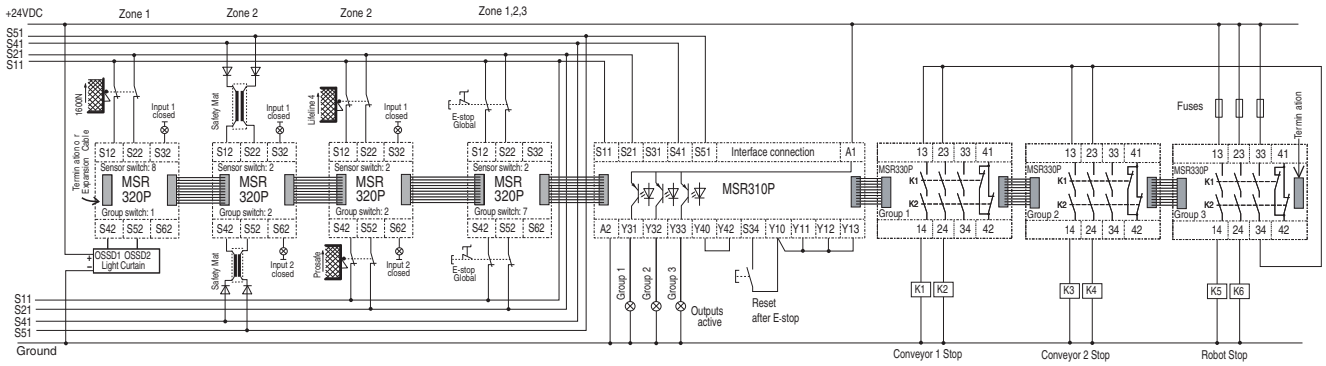


Safety Mat, Dual Channel Output Monitored, Manual Reset, Output Monitoring

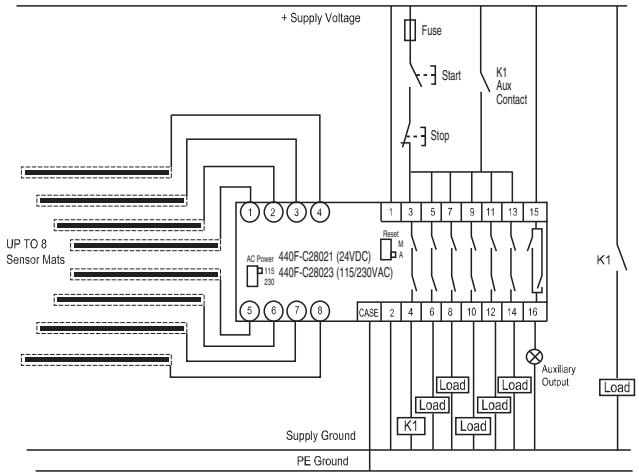


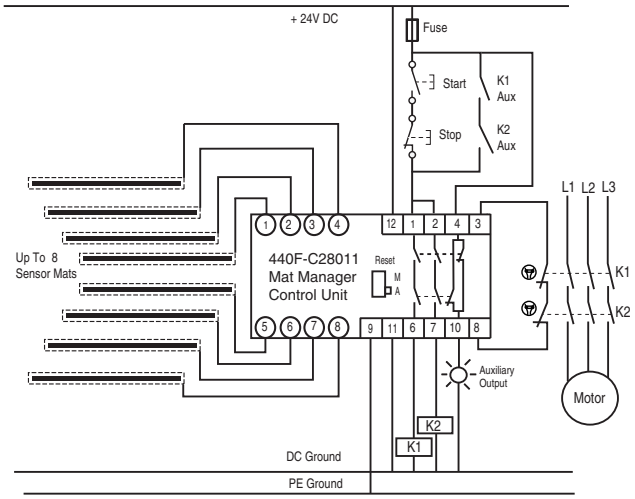
Four Individually Monitored Safety Mats, Monitored Manual Reset, Dual Output, Output Monitoring

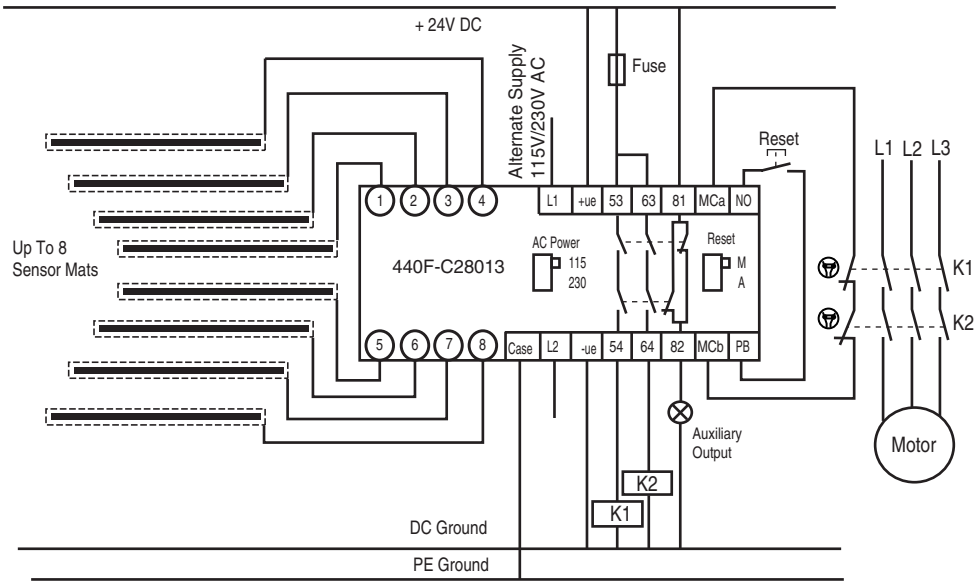
Note: The diodes shown can be terminal blocks with built-in diodes (1492-JD3DF or 1492-JD3DR).



Note: The diodes shown can be terminal blocks with built-in diodes (1492-JD3DF or 1492-JD3DR).





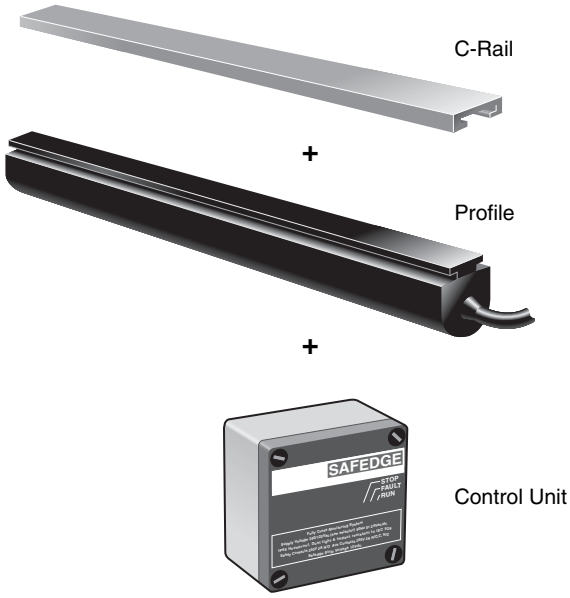


Safedge™ Profiles

Overview

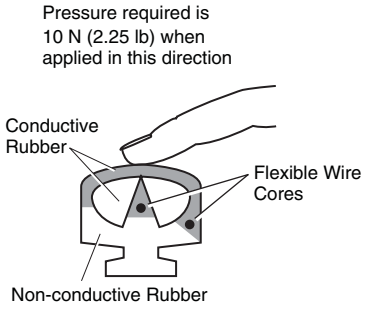
System Components

The Safedge sensitive edge systems are used in a variety of applications where the edge of an object must be detected by contact. The Safedge system consists of three parts: 1) a C-rail, which is used to mount the profile; 2) a profile, which contains the sensing surface; and 3) a control unit, which checks the operation of the profile and interfaces with the control system. A typical system is shown below.



Operating Principle

The profile works on the principle of a two-wire design with conductive rubber. Two wires run the length of the profile. The wires are terminated with a known resistor. When the profile is deformed, the conductive rubber comes in contact with each other and causes the overall resistance to drop.

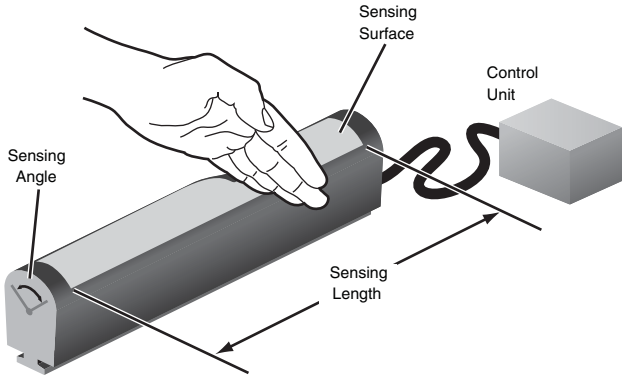


The control unit provides a voltage source to the wires in the profile. It continuously checks the continuity of the wires for shorts, opens and changes in resistance. If the circuit opens, becomes shorted, or the resistance changes, the output of the control unit turns off.

The control unit can also be used to monitor the performance of the output switching devices.

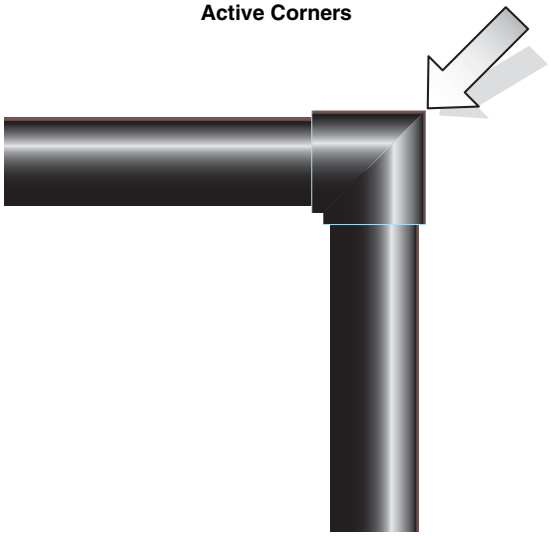
Sensing Surface

The profile is best actuated along its sensing surface. The sensing surface of the Safedge system is active along almost the full length of the edge. The 10 mm at the beginning and end are not active.



One distinct advantage of the Safedge system is the active corners. Pressure applied to the corners is detected by the control unit.

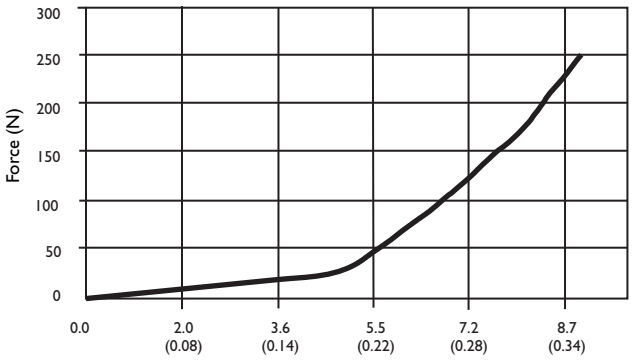
Active Corners



Force Travel Relationship

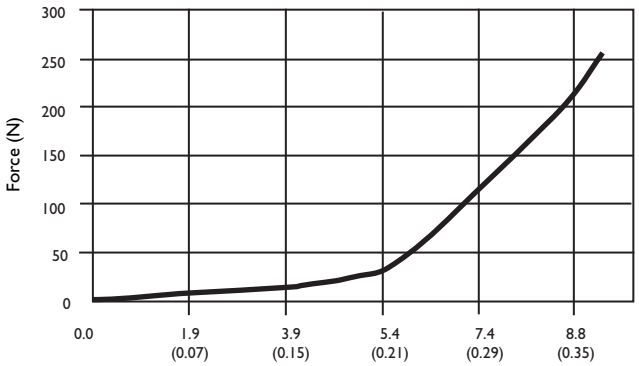
Since the Safedge system is a contact device, a force is required to operate the device. This force is dependent on the shape of the object applying the force, the speed of the object and deformation distance on the profile. To help understand the force requirements, the European standard EN1760-2 2001 provides three test objects travelling at two speeds. Shown in the graph below is the force that is applied over the deformation distance on the surface of the profile. Note that the force required to operate the corners is greater than the force required along the straight section of the profile. This force must be used as a guideline, as the inanimate object can not be harmed.

Force vs. Distance



Vp = 10 mm/s

Force vs. Distance



Vp = 100 mm/s

Risk Assessment

A risk assessment must be performed to determine the proper use of the edge system. Additional protective measures must be used when an individual can reach around or over the edge system and gain access to a hazard. The edge system is designed to be a contact type of system. Therefore “cushion factor” is an important consideration.

Selecting the Cushion Factor

One of the important characteristics of edge systems is called cushion factor. The cushion factor is the distance the profile can be depressed after the signal is generated. This is important when the profile is mounted on automated doors.

Automated doors will continue to close for some finite time after the profile sends the initial stop signal. This is known as the system response time. The system response time is the sum of the Safedge control unit response time, the control system response time, and the mechanical stopping time. Systems with longer response time should utilize larger cushion factors. Users must validate that injury does not occur if parts of the body get jammed, for example between the sensing edge and the fixed part of a machine.

Users might also consider a reversing option. When the profile is depressed, the Safedge control unit sends a signal to a reversing relay. Since the reversing relay is not a safety rated device, the user must still confirm that injury does not occur if parts of the body get jammed.

Typical Applications

Typical applications for sensitive edge systems are:

- Sliding doors
- Sliding gates
- Automated guided vehicles
- X-Y tables
- Fence tops
- Scissor jacks
- Loading platforms

The profile is mounted on the leading edge of the moving object. As the profile comes in contact with an object, the sensing surface of the profile deforms. The deformation causes the conductive rubber parts to make contact and reduce the circuit resistance. The control makes contact.

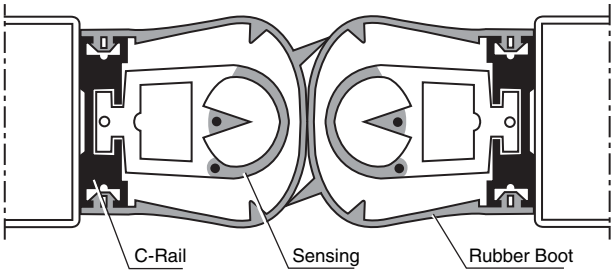
Typically, the edge of the object is leading edge and is moving, like a sliding door or gate. Edge systems have also been used on the leading edges of X-Y tables and automated guided vehicles.

In some applications, a drip edge or seal is needed to reduce wind and rain leaking into a door. The Safedge system accommodates both types of applications. Safedge has three profiles that include a sealing lip.

Safedge™ Profiles

Overview

Safedge can also be ordered with a rubber cover as shown below. This allows compression of the rubber boot without deforming the profile.

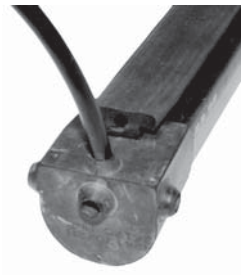


Cable Termination

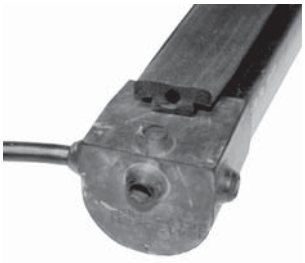
The cable can be terminated in one of four ways providing flexibility in design and installation of cable routing. Specify the LHT or RHT from the point of view of looking directly at the end of the profiles as shown below.

SET—Straight

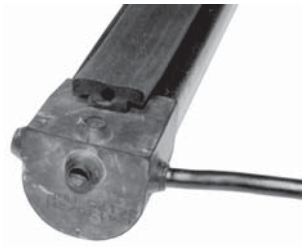
UNDER—Under



LHT—Left-hand



RHT—Right-hand

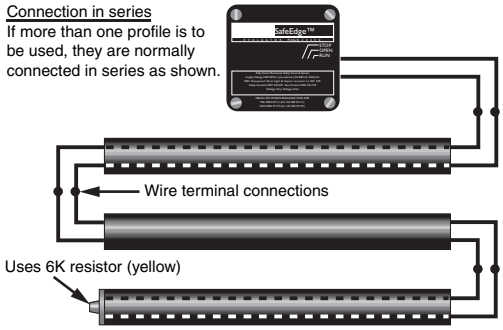


Connection Methods

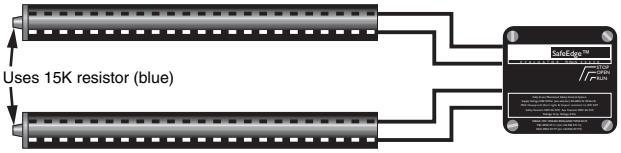
The profiles can be connected in one of two ways: series or parallel. Either method provides the same performance. Selection of the method is determined by ease of installation. The more popular method is series.

Series Connection

Connection in series
If more than one profile is to be used, they are normally connected in series as shown.



Parallel Connection



A maximum of two profiles can be connected in parallel.

Safedge™ Profiles

Description

The ability of the Safedge profile to out perform competition lies in its innovative design. It uses a combination of non-conductive rubber and flexible wire-cored conductive rubber bonded together so it keeps bouncing back into shape even after repeated compressions.

The Safedge profiles come in three different cushions factors: 5 mm (0.2 in.), 19 mm (0.75 in.), and 41 mm (1.6 in.). Cushion factor is the distance the profile can be depressed after a signal has been generated. The profiles are also offered with a sealing lip which is designed to reduce drafts between the profile and opposing surface.

The profiles come in two different materials. Use the EPDM material in the presence of conductive fluids. The NBR/CR material performs better in the presence of oils. Review the chemical resistance chart to help make the best choice of material. If in doubt, a small sample of the profile should be tested for chemical resistance before a final selection is made.

The Safedge profile has no rigid internal parts which can “break through” or cause fatigue failures after prolonged use. The multi-stranded copper wire core throughout the length of the strip reduces the risk of resistance build up on long lengths.

Features

- Various profiles
- Conductive rubber technology
- Up to 50 m lengths
- Aluminum, plastic or zinc-coated steel mounting rails
- Rubber boot optional
- Active corners
- Sealing lip available

Specifications

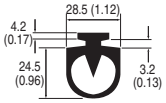
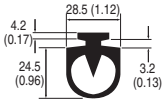
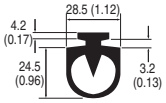
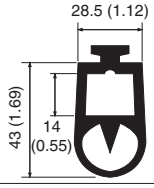
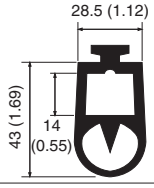
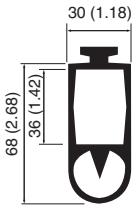
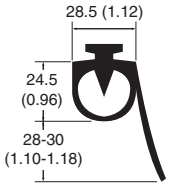
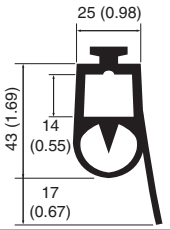
Standards	EN1760-2, EN 954-1, ISO13849-1, IEC/EN60204-1, ANSI B11.19, AS 4024.5
Certifications	CE Marked for all applicable directives and TÜV. C-Tick not required.
Power Supply	Operates on 4V DC supplied from control unit.
Operating Temperature [C (F)]	EPDM material: -5…55° (23…131°) NBR/CR material: 0…55° (32…131°)
Relative Humidity	90%
Enclosure Type Rating	IP65 (NEMA 6P)
Wire Size	18 AWG
Material	EPDM: Ethylene Propylene Diene Modified Rubber NBR/CR: Acrylonitrile (34% nitrile) Butadiene Rubber/Chloropriene Rubber
Bend Radius, Min.	500 mm (19.6 in.)

Chemical Resistance of Safedge Profile

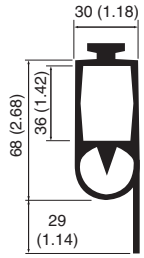
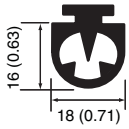
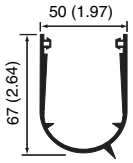
Substance	Resistance—"S" Profile EPDM	Resistance—"N" Profile NBR/CR
Acetic Acid (10%)	Good	Good
Acetone	Good	Fair
Ammonium Hydroxide (35%)	Good	Good
Benzene	Poor	Poor
Diesel Oil	Poor	Good
Ethyl Alcohol (Ethanol)	Good	Good
Hydrochloric Acid (10%)	Good	Good
Lubricating Oil	Poor	Good
Nitric Acid (10%)	Good	Fair
Petrol (Gasoline)	Poor	Fair
Silicone Fluids	Good	Good
Sodium Chloride (25%)	Good	Good
Trichlorethylene	Good	Poor
Vegetable Oils (general)	Good	Good
Water (distilled)	Good	Good
Water (sea)	Good	Good
Latex Paint	Good	Good
Oil Base Paint	Good (easy to clean)	

Safedge™ Profiles

Product Selection—Profiles

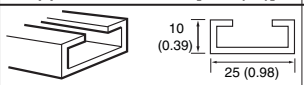
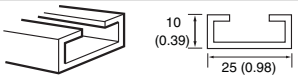
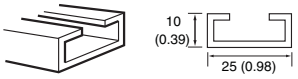
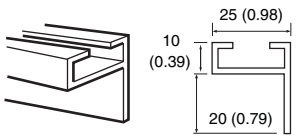
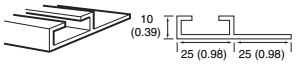
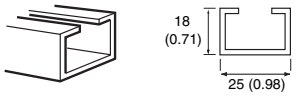
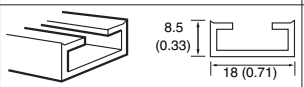
Code (See page 2-112)	Approx. Dimensions [mm (in.)]	Safedge Profile	Description	Cushion Factor	Length [m (ft)]	Cat. No.
A		0110S	Black, EPDM, Weight: 463 g/m (0.33 lbs/ft)	5 mm (0.20 in.)	5 (16.4)	440F-E0110S05
					10 (32.8)	440F-E0110S10
					20 (65.6)	440F-E0110S20
C		0110N	Black, NBR/CR, Weight: 460 g/m (0.31 lbs/ft)	5 mm (0.20 in.)	5 (16.4)	440F-E0110N05
					10 (32.8)	440F-E0110N10
					20 (65.6)	440F-E0110N20
B		0110R	Red, EPDM, Weight: 502 g/m (0.34 lbs/ft)	5 mm (0.20 in.)	5 (16.4)	440F-E0110R05
					10 (32.8)	440F-E0110R10
					20 (65.6)	440F-E0110R20
E		1610S	Black, EPDM, Weight: 843 g/m (0.57 lbs/ft)	19 mm (0.75 in.)	5 (16.4)	440F-E1610S05
					10 (32.8)	440F-E1610S10
					20 (65.6)	440F-E1610S20
F		1610N	Black, NBR/CR, Weight: 837 g/m (0.56 lbs/ft)	19 mm (0.75 in.)	5 (16.4)	440F-E1610N05
					10 (32.8)	440F-E1610N10
					20 (65.6)	440F-E1610N20
H		0310S	Black, EPDM, Weight: 1209 g/m (0.81 lbs/ft)	41 mm (1.61 in.)	5 (16.4)	440F-E0310S05
					10 (32.8)	440F-E0310S10
					20 (65.6)	440F-E0310S20
D, J		0510S	Black, EPDM, with Sealing Lip, Weight: 545 g/m (0.37 lbs/ft)	5 mm (0.20 in.)	5 (16.4)	440F-E0510S05
					10 (32.8)	440F-E0510S10
					20 (65.6)	440F-E0510S20
G, K		0804S	Black, EPDM, with Sealing Lip, Weight: 1013 g/m (0.68 lbs/ft)	19 mm (0.75 in.)	5 (16.4)	440F-E0804S05
					10 (32.8)	440F-E0804S10
					20 (65.6)	440F-E0804S20

Note: Maximum roll size before axial connector needed is 20 m (65.6 ft).

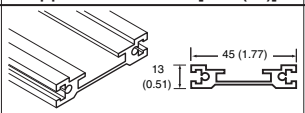
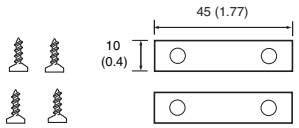
Code (See page 2-112)	Approx. Dimensions [mm (in.)]	Safedge Profile	Description	Cushion Factor	Length [m (ft)]	Cat. No.
I, L		0210S	Black, EPDM, with Sealing Lip, Weight: 1291 g/m (0.87 lbs/ft)	41 mm (1.61 in.)	5 (16.4)	440F-E0210S05
					10 (32.8)	440F-E0210S10
					20 (65.6)	440F-E0210S20
M		0118S	Black, EPDM, Weight: 242 g/m (0.163 lbs/ft) (mini profile)	3.75 mm (0.15 in.)	5 (16.4)	440F-E0118S05
					10 (32.8)	440F-E0118S10
					20 (65.6)	440F-E0118S20
N, O		1111S	Black, EPDM, Weight: 680 g/m (0.457 lbs/ft)	NA	5 (16.4)	440F-E1111S05
					10 (32.8)	440F-E1111S10
					20 (65.6)	440F-E1111S20

Note: Maximum roll size before axial connector needed is 20 m (65.6 ft).

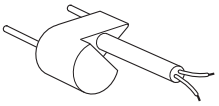
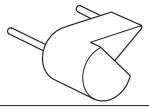
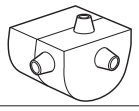
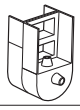
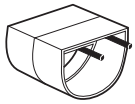
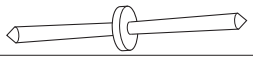
Product Selection—C-Rails

Code	Approx. Dimension [mm (in.)]	Description	Cat. No.
A		Aluminium type, Type C112/A. Suitable for all profiles. Length: 3 m (9.8 ft) Weight: 258 g/m (0.17 lbs/ft)	440F-R1212
B		Zinc-Coated Steel; Type C112/S. Suitable for all profiles. Length: 2 m (6.5 ft) Weight: 663 g/m (0.45 lbs/ft)	440F-R1112
C		PVC Black; Type C112/PB. Suitable for all profiles. Length: 3 m (9.8 ft) Weight: 111 g/m (0.07 lbs/ft)	440F-R1212PB
D		PVC Red; Type C112/PR. Suitable for all profiles. Length: 3 m (9.8 ft) Weight: 111 g/m (0.07 lbs/ft)	440F-R1212PR
E		PVC Yellow; Type C112/PY. Suitable for all profiles. Length: 3 m (9.8 ft) Weight: 111 g/m (0.07 lbs/ft)	440F-R1212PY
F		Aluminium Vertical Lip; Type C112/A2. Suitable for all profiles. Length: 2 m (6.5 ft) Weight: 368 g/m (0.25 lbs/ft)	440F-R1214
G		Aluminium Horizontal Lip; Type C112/A3. Suitable for all profiles. Length: 2 m (6.5 ft) Weight: 388 g/m (0.26 lbs/ft)	440F-R1215
H		Aluminium Deep Channel; Type C112/A4. Suitable for all profiles. Length: 2 m (6.5 ft) Weight: 345 g/m (0.23 lbs/ft)	440F-R1216
I		Aluminium; Suitable for Mini Profile Only. Length: 2 m (6.5 ft) Weight: 150 g/m (0.10 lbs/ft)	440F-R1219

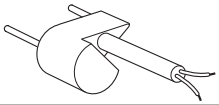
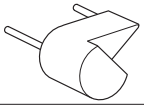
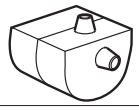
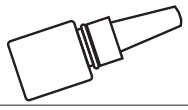
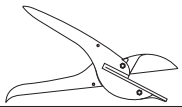
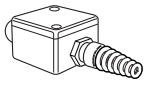
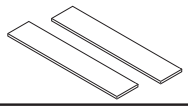
Safedge™ Profiles

Code	Approx. Dimension [mm (in.)]	Description	Cat. No.
J		Aluminium; Suitable for Rubber Boot Only. Length: 2 m (6.5 ft) Weight: 667 g/m (0.448 lbs/ft)	440F-R2151
NA		Aluminium End Plate for C-Rail Option J; 2 Plates; 4 Screws, flat head Philips, 10mm, #6 Weight: 7g (0.01 lbs)	440F-R2152

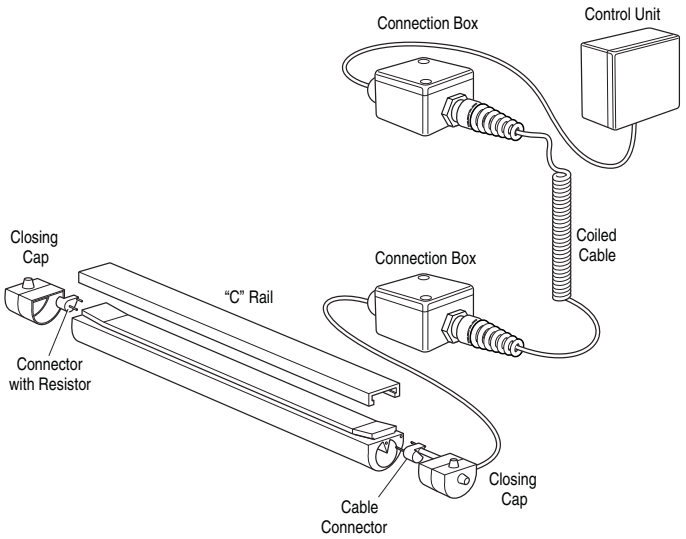
Product Selection—Component Parts

Description		Product Selection Criteria	Cat. No.
	Connector and Cable (diameter = 5 mm (0.20 in.)	1 m (3.2 ft)	440F-A1301
		2 m (6.56 ft)	440F-A1302
		5 m (16.4 ft)	440F-A1305
		10 m (32.8 ft)	440F-A1306
		15 m (49.2 ft)	440F-A1307
	Terminator	6 kΩ (yellow) resistor for series termination	440F-A1308
		15 kΩ (blue) for parallel termination	440F-A1309
	Closing Cap for profile codes (A, B, C, D, J)	Closing Cap material: EPDM	440F-A1302S
		Closing Cap material: NRB	440F-A1302N
	Closing Cap for profile codes (E, F, G, H, K)	Used to close profiles 440F-E0310S and 440F-E1610S.	440F-A1303S
		Used to close profile 440F-E1610N.	440F-A1303N
	Axial Connector	With this connector you can directly connect two profiles. Suitable for 440F-E0110S profiles.	440F-A0061S
		With this connector you can directly connect two profiles. Suitable for 440F-E0110R profiles.	440F-A0061N
	Straight Pin Connector	Kit contains one pair of pins suitable for one joint.	440F-A0004
	90° Corner Connector	For use with profile 440F-E0110S	440F-A0071S
		For use with profile 440F-E0110R	440F-A007IS
		For use with profile 440F-E0110N	440F-A007IN
		For use with profile 440F-E0310S	440F-A0073S
		For use with profile 440F-E1610S	440F-A0074S
		For use with profile 440F-E1610N	440F-A0074N
	90° Corner Connector (vertical)	For use with profile 440F-E0110N	440F-A0072N
		For use with profile 440F-E0110S or 440F-E0110R	440F-A0072S
		For use with profile 440F-E1610N	440F-A0075N
		For use with profile 440F-E1610S	440F-A0075S
		For use with profile 440F-E0310S	440F-A0076S
	45° Corner Connector	For use with profile 440F-E0110N	440F-A0071N45 *

* Includes two rubber strips (440F-A0005) when using profile 440F-E0110N.

Description		Product Selection Criteria	Cat. No.
	60° Corner Connector	When using profile 440F-E0110N	440F-A0071N60 ✶
	30° Corner Connector	When using profile 440F-E0110N	440F-A24007130 ✶
	Connector and Cable	Use only on Mini Profile—1 m (3.3 ft)	440F-A1181
		Use only on Mini Profile—3 m (9.8 ft)	440F-A1183
		Use only on Mini Profile—5 m (16 ft)	440F-A1185
	Terminator	Use only on Mini Profile—8 kΩ (yellow) resistor for series termination	440F-A1186
	Closing Cap	Use only on Mini Profile—Closing Cap material: EPDM	440F-A1318
	Cyanocrylate Adhesive	Use Loctite 401 for dry applications. Use Loctite 380E for wet applications.	NA
	Shears	Use to cut profiles.	440F-A3084
	Connection Box	Polycarbonate housing 53 x 53 x 35 mm (2.09 x 2.09 x 1.38 in.) complete with two pole terminal and trumpet type screw on connector with strain and relief clamp. For use with coiled cable.	440F-A0116
	Coiled Connection Cable	2.5 m (8.2 ft) (extended) of flexible coiled cable. Shelf length is 889 mm (35 in.) long. OD of coil is 22 mm (0.86 in.) and OD of cable is 5 mm (0.20 in.).	440F-A2450
		3.5 m (11.5 ft) (extended) of flexible coiled cable. Shelf length is 1270 mm (50 in.) long. OD of coil is 22 mm (0.86 in.) and OD of cable is 5 mm (0.20 in.).	440F-A2700
	Two rubber strips	When using profile 440F-E0110N shelf length is 175 x 10 x 0.7 mm (6.89 x 0.39 x 0.03 in.).	440F-A0005

✶ Includes two rubber strips (440F-A0005) when using profile 440F-E0110N.



Example application of profile using coiled cable. The coiled cable can not be directly connected to the profile due to the weight of the cable. The proper use of the coiled cable is to connect the coiled cable to the profile through the connection box. The coiled cable should be secured to both the moving and stationary objects so as to prevent straining of the terminal connections.

Safedge™ Profiles

Factory Assembled Product Selection (standard profile)

440F -	E*	C	A	M	V	01270
	a	*b*	*c*	*d*		*e*

a

Profile	
Code	Description
A	0110S
B	0110R
C	0110N
D	0510S with Sealing Lip on Right Side
E	1610S
F	1610N
G	0804S with Sealing Lip on Right Side
H	0310S
I	0210S with Sealing Lip on Right Side
J	0510S with Sealing Lip on Left Side
K	0804S with Sealing Lip on Left Side
L	0210S with Sealing Lip on Left Side
N	Rubber Boot over 0110S
O	Rubber Boot over 1610S
P	No Profile

b

C-Rail	
Code	Description
A	1212 aluminium for profile codes A-L
B	1112 zinc coated steel for profile codes A-L
C	1212PB PVC black for profile codes A-L
D	1212PR PVC red for profile codes A-L
E	1212PY PVC yellow for profile codes A-L
F	1214 aluminium with vertical lip for profile codes A-L
G	1215 aluminium with horizontal lip for profile codes A-L
H	1216 aluminium deep rail for profile codes A-L
J	2151 aluminium for profile codes N and O
N	No C-Rail (not needed)

e

Length of Edge	
Code	Description
5 digit number	Enter length of edge in mm; for example: 50 m = 50000, 500 mm = 00500; 300 mm minimum; ± 2.5 mm tolerance

* Order Controller separately. Refer to SafeEdge Controllers product selection on page 2-115.

c

Cable Entrance	
Code	Description
A	LHT left entrance with 1 m cable
B	LHT left entrance with 2 m cable
C	LHT left entrance with 3 m cable
D	LHT left entrance with 5 m cable
E	LHT left entrance with 10 m cable
F	RHT right entrance with 1 m cable
G	RHT right entrance with 2 m cable
H	RHT right entrance with 3 m cable
I	RHT right entrance with 5 m cable
J	RHT right entrance with 10 m cable
K	SET straight entrance with 1 m cable
L	SET straight entrance with 2 m cable
M	SET straight entrance with 3 m cable
N	SET straight entrance with 5 m cable
O	SET straight entrance with 10 m cable
P	UNDER entrance with 1 m cable
Q	UNDER entrance with 2 m cable
R	UNDER entrance with 3 m cable
S	UNDER entrance with 5 m cable
T	UNDER entrance with 10 m cable
U	No entrance components

d

Termination	
Code	Description
A	LHT left exit with 1 m cable
B	LHT left exit with 2 m cable
C	LHT left exit with 3 m cable
D	LHT left exit with 5 m cable
E	LHT left exit with 10 m cable
F	RHT right exit with 1 m cable
G	RHT right exit with 2 m cable
H	RHT right exit with 3 m cable
I	RHT right exit with 5 m cable
J	RHT right exit with 10 m cable
K	SET straight exit with 1 m cable
L	SET straight exit with 2 m cable
M	SET straight exit with 3 m cable
N	SET straight exit with 5 m cable
O	SET straight exit with 10 m cable
P	UNDER exit with 1 m cable
Q	UNDER exit with 2 m cable
R	UNDER exit with 3 m cable
S	UNDER exit with 5 m cable
T	UNDER exit with 10 m cable
U	Parallel Termination—15 kΩ
V	Series Termination—6 kΩ
W	No exit components

Factory Assembled Product Selection (mini-profile)

440F	-	E*	M	I	M	V	01270
		a	*b*	*c*	*d*		*e*

a

Profile	
Code	Description
M	0118S 3.75 mm (0.15 in.) Cushion Factor Black, Mini Profile
P	No Profile

b

C-Rail	
Code	Description
I	1219 aluminium for “Profile” code M
N	No C-Rail (not needed)

c

Cable Entrance	
Code	Description
K	SET straight entrance 1 m cable
M	SET straight entrance 3 m cable
N	SET straight entrance 5 m cable
P	UNDER entrance 1 m cable
R	UNDER entrance 3 m cable
S	UNDER entrance 5 m cable
U	No entrance components

d

Termination	
Code	Description
K	SET straight entrance 1 m cable
M	SET straight entrance 3 m cable
N	SET straight entrance 5 m cable
P	UNDER entrance 1 m cable
R	UNDER entrance 3 m cable
S	UNDER entrance 5 m cable
V	Series Termination—8 kΩ
W	No Termination

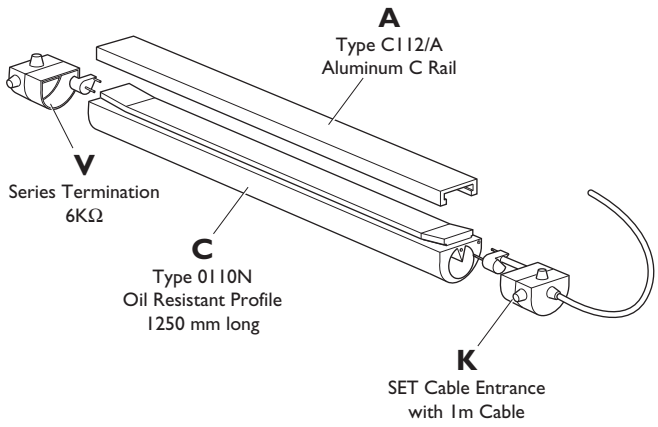
e

Length of Edge	
Code	Description
5 digit number	Enter length of edge in mm; for example: 50 m = 50000, 500 mm = 00500; 300 mm minimum; ± 2.58 mm tolerance

* Order Controller separately. Refer to SafeEdge Controllers product selection.

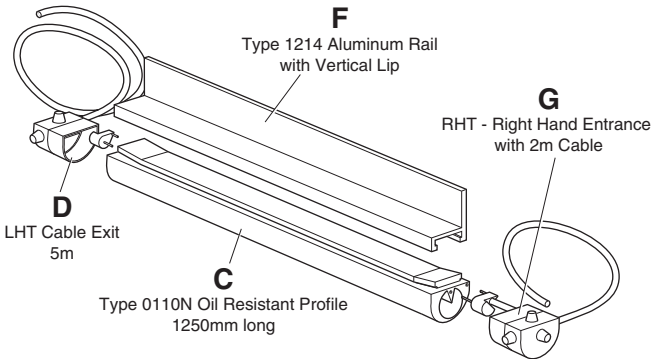
Factory Assembled Examples

440F-ECAKV01250



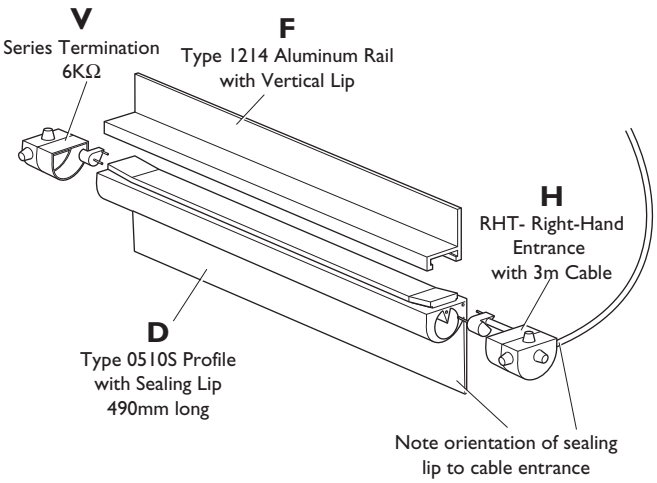
This is a single oil resistant profile which is 1250 mm (49.2 in.) long. The edge is terminated with a Series Termination. A 1 m (3.2 ft) cable enters straight into the closing cap. The profile is mounted on a standard aluminum C-rail.

440F-ECFGD01250



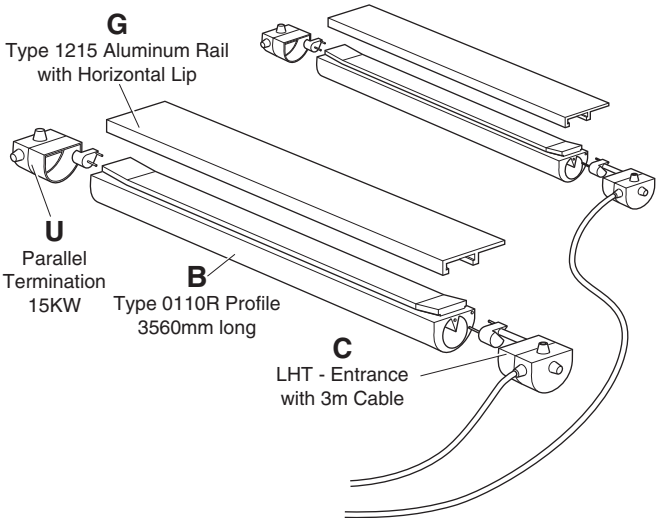
This is a single oil resistant profile which is 1250 mm (49.2 in.) long. The edge is terminated with a 1 m (3.2 ft) cable. A 1 m cable enters straight into the closing cap. The profile is mounted on an aluminum C-rail with a vertical mounting lip. A control unit is not included. This edge is intended to be used in series with another length of edge which has a terminating resistor.

440F-EDFHV00490



This single profile has a sealing lip and is 490 mm (19.2 in.) long. The profile is terminated with a Series Termination. A 3 m (9.8 ft) cable enters into the right hand side of the closing cap from a plastic surface mounted controller. The profile is mounted on an aluminum rail with a vertical lip for ease of mounting. The orientation of the sealing lip to the vertical lip can be reversed by the user by sliding the profile out of the C-rail, rotating the C-rail 180° and then re-inserting the profile back into the C-rail.

440F-EBGCU03560

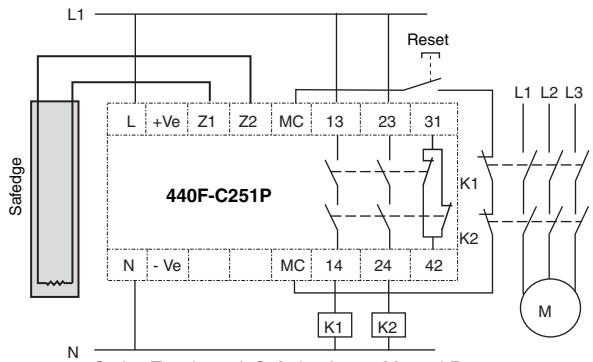


This is a red-colored single profile which is 3560 mm (140.15 in.) long. This profile is part of a parallel profile system, for ease of mounting, as it is terminated with a Parallel Termination. A 3 m (9.8 ft) cable enters into the left side of the closing cap. The profile is mounted on an aluminum C-rail with a horizontal lip for ease of mounting. The horizontal lip can be reversed by the user by sliding the profile out of the C-rail, rotating the C-rail and then re-inserting the profile back into the C-rail. A separate Cat. No. must be entered for the other profile.

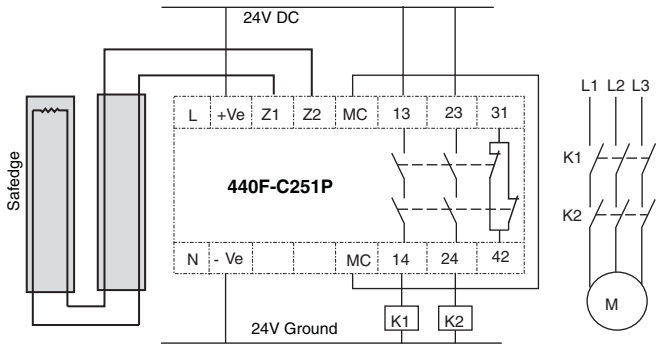
Product Selection—Relays

Single Function Safety Relays	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. Page No.	Cat. No.
	2 N.O.	1 N.C.	Fixed	Automatic/Manual	24V AC/DC or 115/230V AC	5-72	440F-C251D
	1 N.O.		Removable		24V AC/DC		440F-C252D
	2 N.O.		Fixed		24V AC/DC or 115/230V AC		440F-C251P

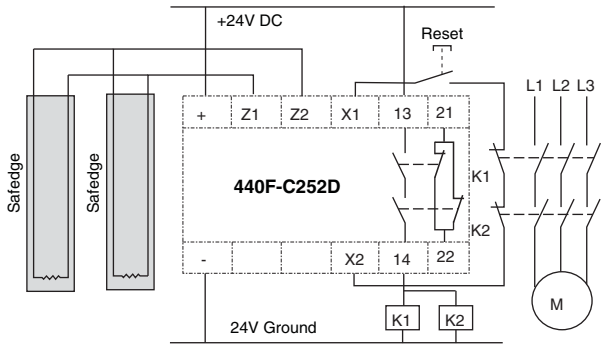
Typical Wiring Diagrams



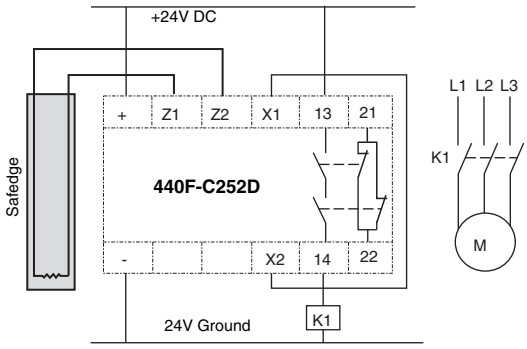
Series Terminated, Safedge Input, Manual Reset, Dual Channel Output, Monitored Output



Series Terminated, Cascaded, Safedge Input, Automatic Reset, Dual Channel Output, No Output Monitored



Parallel Terminated, Safedge Input, Manual Reset, Dual Channel Output, Monitored Output



Series Terminated, Safedge Input, Automatic Reset, Single Channel Output, No Output Monitored

Notes

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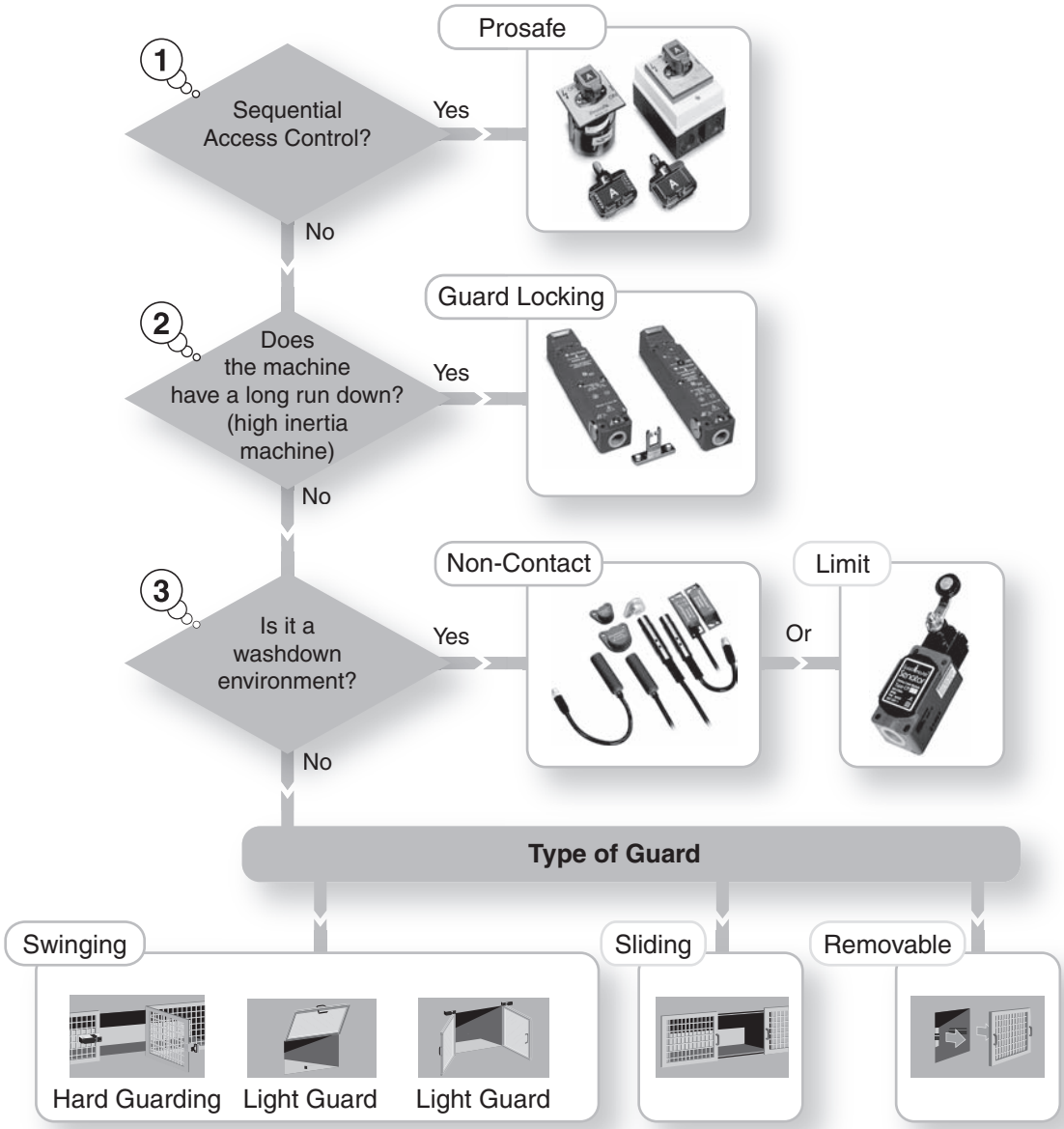
Selection Flowchart



Recommended Product Type					
Tongue	✓	✓		✓	
Guard Locking	✓			✓	
Non-Contact	✓	✓	✓	✓	✓
Hinge	✓		✓		

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1 Sequential Access Control

A Sequential Access Control system requires that a predetermined sequence of events takes place or that hazards have been reduced before operators can become exposed to them. Prosafe trapped key interlocks are a mechanical system based on coded keys that achieves this via the premise that no single key can be used in two places at once. And because of their mechanical operation, Prosafe trapped key interlocks are widely used in applications where the location of plant, environment or explosive atmospheres make the use of electrical interlock systems unsuitable or expensive to install.

2 High Inertia Machine (Long Run Down Time)

A High Inertia Machine is one on which hazardous motion does not cease immediately when the safety measures are engaged. As a result, there is a possibility that an operator can reach the hazard while it is "running down" and is still dangerous. *Interlock switches with guard locking reduce the risk that the guard opens during hazardous machine motion.*

Alternative measures:

- Install a braking device which stops the machine motion in a shorter time span.
- Increase the distance between the guard door and the hazard such that the operator cannot physically reach the hazard before it has stopped.

3 Washdown Environments

In many applications, primarily those in the pharmaceutical and food/beverage industries, frequent washdown of the machinery with water and/or cleaning fluids is common. Therefore, it is important to select a safety switch with the appropriate environmental protection as indicated by the product's enclosure (Ingress Protection or IP) rating. Non-contact switches have no "traps" where debris can accumulate and are available in fully sealed versions (IP67/IP68/IP69K), making them ideal for washdown applications.

For details on enclosure ratings, refer to the General section of this catalog (page G-9) and IEC 529.

Other Application Considerations

	Non-Contact Switches	Hinge Switches	Tongue Switches	Limit Switches
Large Door	✓		✓	✓
Vibration	✓		✓	
Misalignment	✓	✓		
Debris	✓	✓		
Washdown	✓			✓

Tongue Interlock Switches

Features/Benefits

Tongue interlock switches are the most commonly used technology for door interlocking. They detect the movement of a guard using a key fitted to an opening in the switch body. Available in a variety of packages, contact configurations and degrees of holding force, these switches are generally the lowest-cost solution. The use of flexible keys also enhances tolerance to misalignment to address an even broader range of applications.

Applications

- Wide range of doors

Common Misapplications

- Washdown
- Heavy debris
- Cutting fluids
- Removable guards

Guard Locking Interlock Switches

Features/Benefits

Guard locking switches employ the same principle of operation as tongue interlocks, but feature an internal solenoid that locks the key—and therefore the guard—in place until the machine's power is isolated. Ideal for applications requiring controlled access to hazardous areas, guard locking switches are available in a variety of holding forces and with flexible actuators for optimal performance.

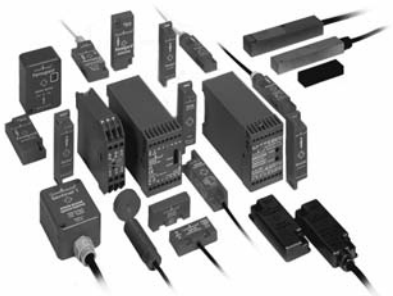
Applications

- Printing presses
- Large access doors
- Saws/cutting blades
- High inertia machinery
- Web machines

Common Misapplications

- Wet environments
- Improper holding force selected

Non-Contact Interlock Switches



Features/Benefits

Since there is no contact between actuator and switch, non-contact switches offer simple setup and alignment, less wear, and superior tamper-resistance as well as reduced installation cost. In addition, the IP67- and IP69K-sealed plastic or stainless steel housings make them ideal for food processing applications and other harsh environments.

Applications

- Hinged doors
- A wide range of doors

Common Misapplications

- Mounted at the door hinge
- Mounted to mild steel
- Exposed to rapid temperature changes

Hinge Interlock Switches

Features/Benefits

Hinge switches are designed to fit at the hinge point of swinging guards. Because they do not use keys which must slide into a slot in the switch body, hinge switches are ideal for machines with misaligned doors or applications with contaminants that could be caught in a key slot. Offering a higher integrity level than standard tongue interlocks, hinge switches are difficult to defeat and can be adjusted for the opening angle of the door.

Applications

- Hinged doors

Common Misapplications

- Large doors
- Doors with poor hinge alignment

Limit Switches

Features/Benefits

Available in a variety of actuators and contact configurations, safety position (limit) switches satisfy Machinery Directive requirements. 802T limit switches with direct opening action offer positive opening safety contacts in a rugged NEMA-style housing for use in control reliable and other safety applications, while 440P IEC limit switches provide safety function in a compact, economical package.

Applications

- Conveyors
- Slide doors
- Muting sensors
- Robot positioning

Common Misapplications

- Mounting a single limit switch on a guard door

Trapped Key Switches

Features/Benefits

Prosafe™ trapped-key interlock switches are designed to provide power isolation, key exchange and interlocking for safety applications requiring a pre-defined sequence of operations. Most of these rugged products do not require power to operate, making them ideal for applications in remote or intrinsically safe locations. Stainless steel construction also allows their use in harsh environments for process/valve control.

Applications

- Sequencing/process control
- Intrinsic safety
- 1/4 turn valves

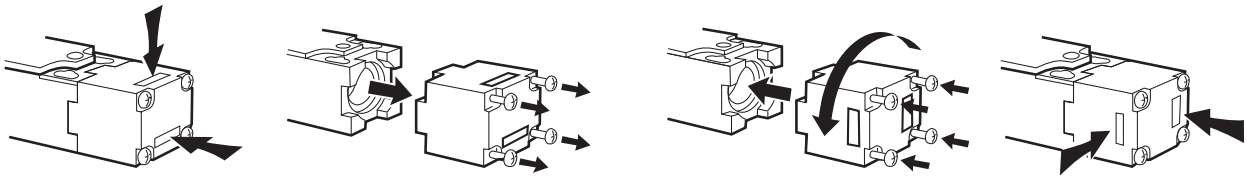
Common Misapplications

- Duplicate coded keys on the plant floor

Versatility

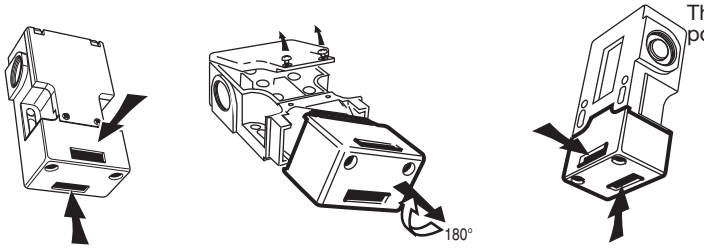
Many safety switches allow the head of the switch to rotate, offering different options on how the switch can be operated and mounted on the guard. This offers flexibility to best fit typical applications.

Elf, Cadet3, MT-GD2, 440G-MT



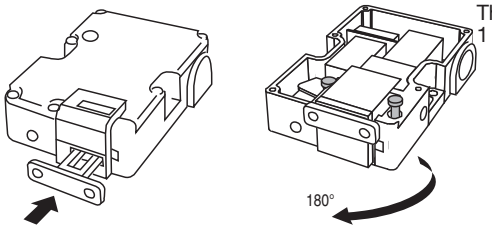
The head can be rotated 4 times at 90º allowing the key to fit the switch in 8 different positions.

Trojan T15, Trojan 5, Trojan 6 (Not GD2 Models)



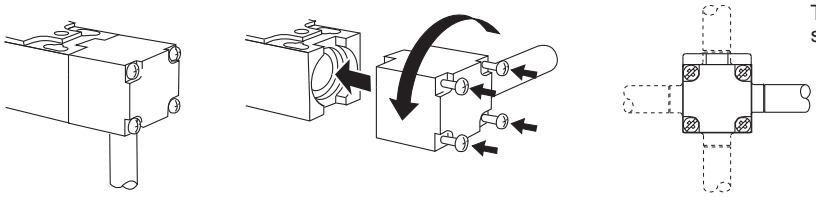
The head rotates 180º allowing the key to fit the switch in 4 different positions: 2 in the front, 1 in the top and 1 in the back.

TLS-GD2



The head rotates 180º allowing the key to fit the switch in 4 different positions: 2 in the front, 1 in the top and 1 in the back.

Sprite, Ensign



The head can be rotated 4 times at 90º allowing the switch to be mounted in 4 different positions.

Accessories for Tongue and Guard Locking Switches

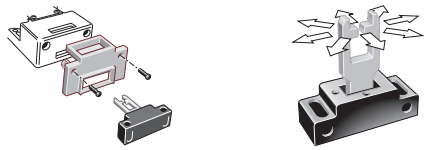
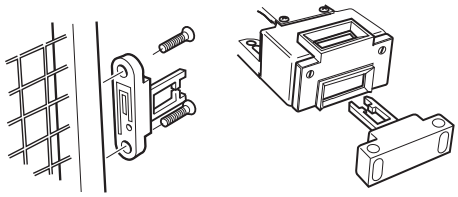
The correct actuator for your application

A large variety of tongue actuators are available:

Standard: 90°, Flat, Standard

Flexible: Semi and Fully

Specialty: Extended Flat and GD2 models

	Standard type actuators accommodate most of the applications. Their design allows for the actuator and the switch to be mounted in different position and the guard to work properly. The flat actuator is mounted on small rubber blocks allowing for some play when the guard closes. The 90° is typically used on sliding doors.
	*Flexible type* actuators are used when doors are sagging or are not sturdy enough to guarantee insertion of the actuator always in-line with the opening of the switch. The flexible actuator allows for some motion of the actuator to "self" align with the opening of the switch. Fully flexible actuators allow the actuator to move within a 15° angle in any direction. Semi-flexible actuators can be used for tight angles where the actuator enters the switch at an angle. This angle is adjustable on the actuator. The semi-flexible actuator moves only in a single plan direction.
	*GD2* actuators are dedicated actuators for GD2 models and are not suitable for use with standard models.
	Extended flat type actuator is used mostly when the actuator is mounted on a chain and inserted in the switch. The guard is latched and the key is just inserted in the switch attached to a chain. When the door opens, the chain pulls the actuator activating the safety contacts.

Product Selection

Description		Elf	Cadet 3	T15	T15 GD2	T5-T6	T5 GD2-T6 GD2	MT-GD2	TLS GD2	Atlas 5	440G-MT	Cat. No.
Standard actuator						✓						**440K-A11095**
Standard actuator				✓								440K-A11238
Standard actuator										✓		440G-A07136
GD2 standard actuator					✓		✓	✓	✓		✓	**440G-A27011**
Flat actuator, not to be used with metal alignment guide		✓	✓									**440K-A21014**
GD2 flat actuator					✓		✓	✓	✓		✓	**440K-A11112**
90° actuator, not to be used with metal alignment guide		✓	✓									**440K-A21006**
Fully flex actuator					✓		✓	✓	✓		✓	**440G-A27143**
Fully flex actuator										✓		440G-A07269
Extended flat actuator					✓		✓	✓	✓		✓	**440K-A17116**
Metal alignment guide with semi-flexible actuator		✓	✓									440K-A21030
Alignment guide with semi-flexible actuator				✓	✓	✓	✓	✓				440K-A11144
Alignment guide with fully-flexible actuator				✓		✓						440K-A27010
Catch and Retainer Kit						✓						440K-A11094
Replacement Alignment Guide						✓						440K-A11115

Safety Switches and Connectors

Many interlock switches are offered with connectors allowing easy installation and replacement on-site, reducing downtime. Standard cordsets and connectors can be used to connect these products directly to:

- Terminal Blocks
- Safety Distribution Boxes
- ArmorBlock™ Guard I/O (IP 67 Safety I/O Blocks on DeviceNet™ Safety)

Type of Connectors	Cordset Terminal Block	Patchcord Safety Distribution Box	ArmorBlock Guard I/O
4-Pin Micro (M12)	✓	✓	
5-Pin Micro (M12)	✓		✓
6-Pin Micro (M12)	✓	✓	
8-Pin Micro (M12)	✓		
12-Pin M23	✓		

Type of Connector by Product Family

Description	Interlock						Guard Locking		
	Elf	Cadet	Trojan T15	T5	T6	MT-GD2	TLS	Atlas 5	440G-MT
Connection to Distribution Box									
4-Pin Micro (M12)	✓		✓						
6-Pin MIcro (M12)		✓		✓					
Connection to ArmorBlock Guard I/O									
5-Pin Micro (M12)	✓	✓	✓	✓		✓			
Other Connectors									
8-Pin Micro (M12)					✓	✓	✓	✓	✓
12-Pin M23						✓	✓	✓	✓

Type of Connector by Product Family (continued)

Description	Non-Contact						Hinge			Cable Pull		
	Sensa-Guard	Ferrogard 2, 20	Ferrogard 21	Ferrogard 6, 9, SS	Sipha S3	Sipha SS S4	Sprite	Ensign	Rotacam	Lifeline 3	Lifeline 4	Lifeline SS 4
Connection to Distribution Box												
4-Pin Micro (M12)		✓		✓	✓		✓					
6-Pin MIcro (M12)			✓					✓				
Connection to ArmorBlock Guard I/O												
5-Pin Micro (M12)	✓						✓	✓		✓	✓	
Other Connectors												
8-Pin Micro (M12)	✓					✓			✓	✓	✓	
12-Pin M23										✓	✓	✓

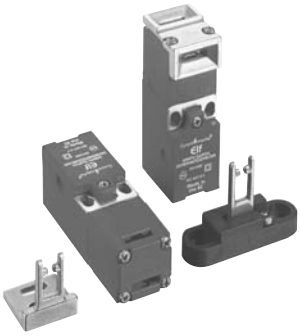
Note: All connectors on Safety Switches are male.

Connectors Ratings

	Max. Ratings		Applicable Standards
	AC	DC	
4-Pin Micro (M12)	250V, 4 A	250V, 4 A	IEC 61076-2-101:2003
5-Pin Micro (M12)	60V, 4 A	60V, 4 A	IEC 61076-2-101:2003
6-Pin Micro (M12)	30V, 2 A	30V, 2 A	IEC 61076-2-101:2003
8-Pin Micro (M12)	30V, 2 A	30V, 2 A	IEC 61076-2-101:2003
12-Pin M23	63V, 6 A	63V, 6 A	IEC 61984:2001

Tongue Switches

Elf™



Description

The Elf is a tongue-operated (or key-operated) safety interlock switch designed to fit at the leading edge of sliding, hinged or lift-off guards. The Elf's unique miniature housing (only 75 x 25 x 29 mm (2.95 x 0.98 x 1.14 in.)) makes it the smallest interlock currently available. It is designed for smaller machines such as printers, copiers and domestic machinery which, until now, have been unable to use safety interlocks due to space restrictions. With its dual entry slots and rotatable head, the versatile Elf can offer up to eight different actuator entry options.

Operation of the switch is achieved through the insertion of a specially-profiled stainless-steel key that is permanently mounted to the guard door. The semi-flexible key allows the Elf to be used on small-radii doors (60 mm or 2.36 in.).

The Elf is available with a variety of contact configurations, conduit entry types and connectors. It is sealed to IP67 (watertight and dustproof). A blanking plug is supplied for the unused key entry.

Features

- Ideal for small, lightweight guards
- The smallest interlock switch available
- Contacts, 2 N.C. or 1 N.O. and 1 N.C.
- Eight possible actuator entry points, easy to install
- Environmental protection: IP67
- GD2 style available for demanding applications

Specifications

Safety Ratings					
Standards		EN954-1, ISO13849-1, IEC/EN60204-1, NFPA79, EN1088, ISO14119, IEC/EN60947-5-1, ANSI B11.19, AS4024.1			
Safety Classification		Cat. 1 Device per EN954-1 Dual channel interlocks suitable for Cat. 3 or 4 systems			
Certifications		CE Marked for all applicable directives, cULus, TÜV, and CCC			
Outputs					
Safety Contacts ❄ Direct Opening Action		1 N.C.		2 N.C.	
Auxiliary Contacts		1 N.O.		None	
Thermal Current I_{th}		5 A (10 A if A600)			
Rated Insulation Voltage		2500V			
Switching Current @ Voltage, Min.		5 mA @ 5V DC			
Utilization Category					
A600/AC-15	(Ue)	600V	500V	240V	120V
	(Ie)	1.2 A	1.4 A	3.0 A	6.0 A
DC-13	(Ue)	24V			
	(Ie)	2 A			
Operating Characteristics					
Break Contact Force, Min.		6 N (1.35 lbf)			
Actuation Speed, Max.		160 mm (6.29 in.)/s			
Actuation Frequency, Max.		2 cycles/s			
Operating Radius, Min		150 mm (5.90 in.) [60 mm (2.36 in.) with GD2 kit, min.]			
Operating Life @ 100 mA load		1 x 10^6 operations			
Environmental					
Enclosure Type Rating		IP67			
Operating Temperature [C (F)]		-20…+80° (-4…+176°)			
Physical Characteristics					
Housing Material		UL Approved glass-filled PBT			
Actuator Material		Stainless Steel			
Weight [g (oz)]		60 (2.11)			
Color		Red			

∗ Usable for ISO 13849-1:2006 and IEC 62061. Data other than B10d is based on:
- Usage rate of 1op/10 mins., 24 hrs/day, 360 days/year, representing 51840 operations per year
- Mission time/Proof test interval of 38 years

❄ The safety contacts are described as normally closed (N.C.) i.e., with the guard closed, actuator in place (where relevant) and the machine able to be started.

Product Selection

Contact			Actuator Type	Cat. No.			
				M16 Conduit		Connector§	
Safety	Auxiliary	Action		M16	1/2 inch NPT Adaptor	Connect to Distribution Box 4-Pin Micro (M12)	Connect to ArmorBlock Guard I/O 5-Pin Micro (M12) ♣
1 N.C.	1 N.O.	BBM	Flat	440K-E33036	440K-E33029	440K-E33074	—
			90°	**440K-E33040**	440K-E33030	440K-E33025	—
			GD2 Metal alignment guide w/semi-flex actuator	440K-E33034	440K-E33031	440K-E33075	—
			—	440K-E33014	440K-E33053	440K-E33076	—
2 N.C.	—	—	Flat	440K-E33080	440K-E33037	440K-E33077	440K-E2NNFPS
			90°	**440K-E33041**	440K-E33045	440K-E33024	—
			GD2 Metal alignment guide w/semi-flex actuator	—	440K-E33046	440K-E33078	440K-E2NNAPS
			—	**440K-E33047**	—	440K-E33079	—

§ For connector ratings see page 3-9.
§ With a 5-pin micro (M12) connector, not all contacts are connected. See *Typical Wiring Diagram* on page 3-13 for wiring details.

Recommended Logic Interfaces

Description	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. Page No.	Cat. No.
Single-Function Safety Relays for 2 N.C. Contact Switch							
MSR127RP	3 N.O.	1 N.C.	Removable (Screw)	Monitored Manual	24V AC/DC	5-24	440R-N23135
MSR127TP	3 N.O.	1 N.C.	Removable (Screw)	Auto./Manual	24V AC/DC	5-24	440R-N23132
MSR30RT	2 N.O. Solid State	1 N.O. Solid State	Removable	Auto./Manual or Monitored Manual	24V DC	5-16	440R-N23198
Single-Function Safety Relays for 1 N.C. & 1 N.O. Contact Switch							
MSR9T	2 N.O.	1 N.C.	Fixed	Auto./Manual	24V AC/DC	5-14	440R-F23027
MSR33RT	2 N.O. Solid State	1 N.O.	Removable	Auto. or Monitored Manual	24V DC SELV	5-18	440R-F23200
Modular Safety Relays							
MSR210P Base 2 N.C. only	2 N.O.	1 N.C. and 2 PNP Solid State	Removable	Auto./Manual or Monitored Manual	24V DC from the base unit	5-74	440R-H23176
MSR220P Input Module	—	—	Removable	—	24V DC	5-78	440R-H23178
MSR310P Base	MSR300 Series Output Modules	3 PNP Solid State	Removable	Auto./Manual Monitored Manual	24V DC	5-94	440R-W23219
MSR320P Input Module	—	2 PNP Solid State	Removable	—	24V DC from the base unit	5-98	440R-W23218

Note: For additional Safety Relays connectivity, see the Safety Relays section (page 5-8) of this catalog.
For additional Safety I/O and Safety PLC connectivity, see the Programmable Safety System section (page 5-107) of this catalog.
For application and wiring diagrams, see the Safety Applications section (page 10-1) of this catalog.

Connection Systems

Description	Connection to Distribution Box 4-Pin Micro (M12)		Connection to ArmorBlock Guard I/O 5-Pin Micro (M12)
	1 N.C. & 1 N.O.	2 N.C.	2 N.C.
Cordset	889D-F4AC-∗	889D-F4AC-∗	—
Patchcord	889D-F4ACDM-❄	889D-F4ACDM-❄	889R-F5ECRM-∗
Distribution Box	898D-P4‡KT-DM4	898D-4‡LT-DM4	—
Shorting Plug	898D-41KU-DM	898D-41LU-DM	—
T-Port	898D-43KY-D4	898D-43LY-D4	—

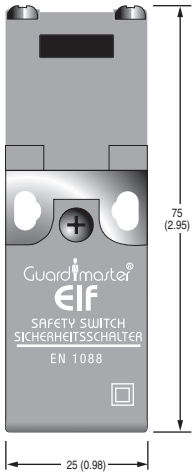
∗ Replace symbol with 2 (2 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
❄ Replace symbol with 1 (1 m), 2 (2 m), 3 (3 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
‡ Replace symbol with 4 or 8 for number of ports.
Note: For additional information, see the Safety Connection System section (page 7-1) of this catalog.

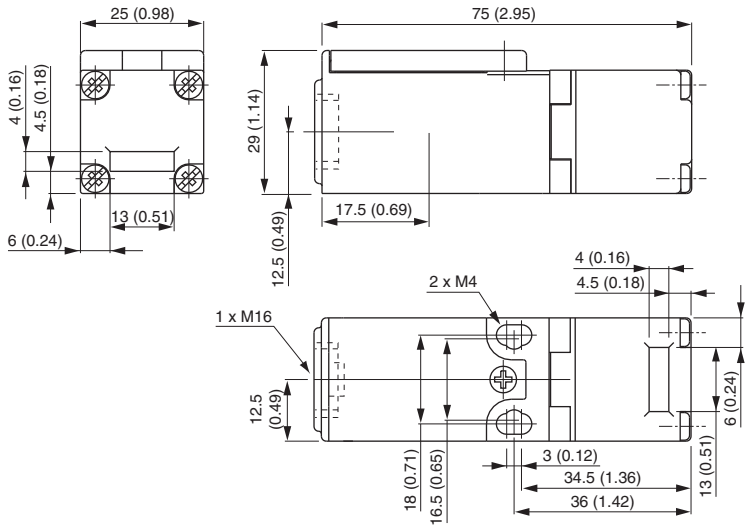
Accessories

Description		Dimensions	Cat. No.
	Flat actuator, not to be used with metal alignment guide	3-52	**440K-A21014**
	90° actuator, not to be used with metal alignment guide	3-52	**440K-A21006**
	Metal alignment guide with semi-flexible actuator	3-52	440K-A21030
	Metal Alignment Guide	3-52	440K-A21069
	Replacement Cover	—	440A-A33085
	Dust Cover	—	440K-A17182

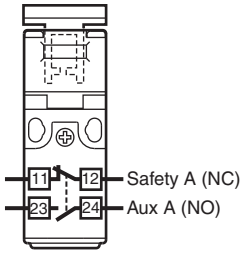
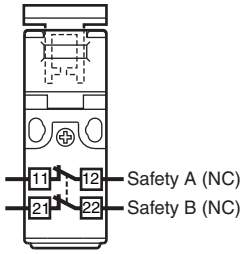
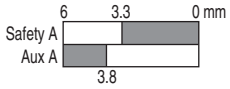
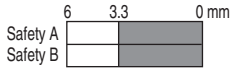
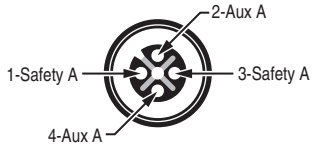
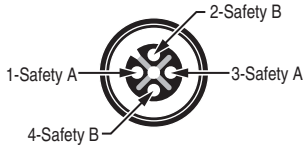
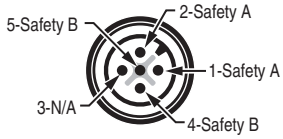
Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.





Typical Wiring Diagrams

Description		1 N.C. & 1 N.O.	2 N.C.
Contact Configuration			
Contact Action □Open ■Closed		 BBM	
4-Pin Micro (M12)			
5-Pin Micro (M12) For ArmorBlock Guard I/O		—	
Cordset 889D-F4AC-∗	Brown	Safety A	Safety A
	Blue		
	White	Aux A	Safety B
	Black		

∗ Replace symbol with 2 (2 m), 5 (5 m) or 10 (10 m) for standard cable lengths.

Tongue Switches

Cadet™ 3

Description

The Cadet 3 is a tongue-operated (or key-operated) safety interlock switch designed to fit at the leading edge of sliding, hinged or lift-off guards. With its dual entry slots and rotatable head, the versatile Cadet 3 can offer up to eight different actuator entry options. The unique compact housing (90.5 x 31 x 30.4 mm (3.56 x 1.22 x 1.19 in.)) has industry standard DIN 50047 fixing centers for ease of mounting.

Operation of the switch is achieved through the insertion of a specially-profiled stainless-steel key that is permanently mounted to the guard door. A semi-flexible key allows the Cadet 3 to be used on small-radii doors (60 mm or 2.36 in.).

Available with a variety of contact configurations, the Cadet 3 is sealed to IP67. A blanking plug is supplied for the unused key entry.

Features

- Compact size
- Ideal for small, lightweight guards
- Contacts, 2 N.C. and 1 N.O. or 3 N.C.
- Sealed to IP67
- Eight possible actuator entry points, easy to install
- Industry standard fixing centres to DIN 50047
- GD2 style available for demanding applications

Specifications

Safety Ratings					
Standards		EN954-1, ISO13849-1, IEC/EN60204-1, NFPA79, EN1088, ISO14119, IEC/EN60947-5-1, ANSI B11.19, AS4024.1			
Safety Classification		Cat. 1 device per EN 954-1 dual channel interlocks suitable for Cat. 3 or 4 systems			
Certifications		CE Marked for all applicable directives, cULus, TÜV, and CCC			
Outputs					
Safety Contacts ❄ Direct Opening Action		2 N.C.		3 N.C.	
Auxiliary Contacts		1 N.O.		None	
Thermal Current I_{th}		10 A			
Rated Insulation Voltage		(Ui) 500V			
Switching Current @ Voltage, Min.		5 mA @ 5V DC			
Utilization Category					
A600/AC-15	(Ue)	600V	500V	240V	120V
	(Ie)	1.2 A	1.4 A	3.0 A	6.0 A
DC-13	(Ue)	24V			
	(Ie)	2 A			
Operating Characteristics					
Break Contact Force, Min.		15 N (3.37 lbf)			
Actuation Speed, Max.		160 mm (6.29 in.)/s			
Actuation Frequency, Max.		2 cycles/s			
Operating Radius, Min		150 mm (5.90 in.) [60 mm (2.36 in.) with GD2 kit]			
Operating Life @ 100 mA load		1 x 10^6 operations			
Environmental					
Enclosure Type Rating		IP67			
Operating Temperature [C (F)]		-20…+ 80° (-4…+176°)			
Physical Characteristics					
Housing Material		UL Approved glass-filled PBT			
Actuator Material		Stainless Steel			
Weight [g (lb)]		80 (0.176)			
Color		Red			

∗ Usable for ISO 13849-1:2006 and IEC 62061. Data other than B10d is based on:
- Usage rate of 1op/10 mins., 24 hrs/day, 360 days/year, representing 51840 operations per year
- Mission time/Proof test interval of 38 years

❄ The safety contacts are described as normally closed (N.C.) i.e., with the guard closed, actuator in place (where relevant) and the machine able to be started.

Product Selection

Contact			Actuator Type	Cat. No.			
				M16 Conduit		Connector§	
Safety	Auxiliary	Action		M16	1/2 inch NPT Adaptor	Connect to Distribution Box 6-Pin Micro (M12)	Connect to ArmorBlock Guard I/O 5-Pin Micro (M12)♣
3 N.C.	—	—	Flat	440K-C21096	440K-C21048	440K-C21090	440K-C2NNFPS
			90°	440K-C21097	440K-C21057	440K-C21091	—
			GD2 Metal alignment guide w/semi-flex actuator	—	440K-C21062	440K-C21092	440K-C2NNAPS
			—	440K-C21070	—	—	—
2 N.C.	1 N.O.	BBM	Flat	440K-C21098	440K-C21050	440K-C21054	—
			90°	**440K-C21061**	440K-C21058	440K-C21067	—
			GD2 Metal alignment guide w/semi-flex actuator	—	**440K-C21074**	**440K-C21088**	—
			—	440K-C21055	—	—	—
		MBB	Flat	440K-C21052	440K-C21093	440K-C21060	—
			90°	440K-C21065	440K-C21094	440K-C21068	—
			GD2 Metal alignment guide w/semi-flex actuator	—	440K-C21095	440K-C21089	—
			—	440K-C21080	—	—	—

§ For connector ratings see page 3-9.
§ With a 5-pin micro (M12) connector, not all contacts are connected. See *Typical Wiring Diagram* on page 3-17 for wiring details.

Recommended Logic Interfaces

Description	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. Page No.	Cat. No.
Single-Function Safety Relays							
MSR127RP	3 N.O.	1 N.C.	Removable (Screw)	Monitored Manual	24V AC/DC	5-24	440R-N23135
MSR127TP	3 N.O.	1 N.C.	Removable (Screw)	Auto./Manual	24V AC/DC	5-24	440R-N23132
MSR126T	2 N.O.	None	Fixed	Auto./Manual	24V AC/DC	5-22	440R-N23117
MSR30RT	2 N.O. Solid State	1 N.O. Solid State	Removable	Auto./Manual or Monitored Manual	24V DC	5-16	440R-N23198
Modular Safety Relays							
MSR210P Base 2 N.C. only	2 N.O.	1 N.C. and 2 PNP Solid State	Removable	Auto./Manual or Monitored Manual	24V DC from the base unit	5-74	440R-H23176
MSR220P Input Module	—	—	Removable	—	24V DC	5-78	440R-H23178
MSR310P Base	MSR300 Series Output Modules	3 PNP Solid State	Removable	Auto./Manual Monitored Manual	24V DC	5-94	440R-W23219
MSR320P Input Module	—	2 PNP Solid State	Removable	—	24V DC from the base unit	5-98	440R-W23218

Note: For additional Safety Relays connectivity, see the Safety Relays section (page 5-8) of this catalog.
For additional Safety I/O and Safety PLC connectivity, see the Programmable Safety System section (page 5-107) of this catalog.
For application and wiring diagrams, see the Safety Applications section (page 10-1) of this catalog.

Connection Systems

Description	6-Pin Micro (M12)	5-Pin Micro (M12)
Cordset	889R-F6ECA-✶	—
Patchcord	889R-F6ECRM-❄	889R-F5ECRM-✶
Distribution Box	898R-P68MT-A5	—
Shorting Plug	898R-P61MU-RM	—
T-Port	NA	—

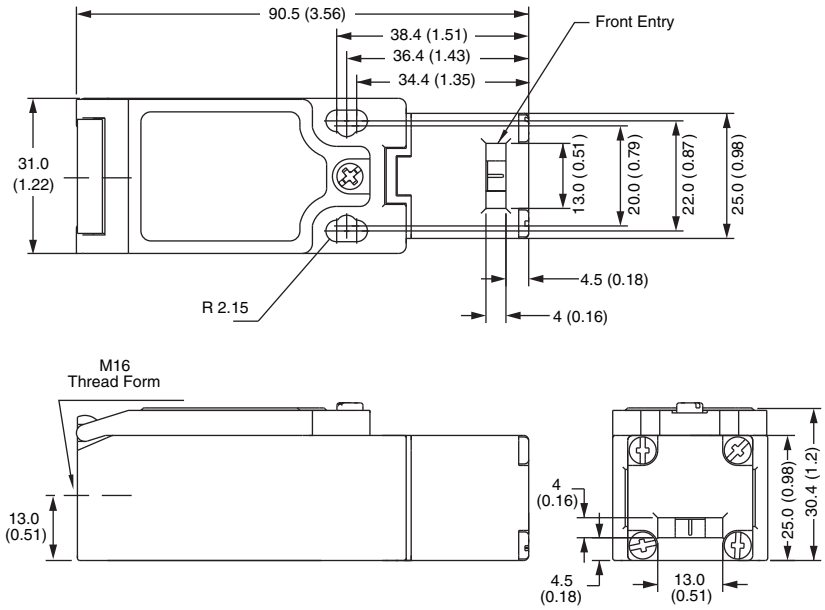
✶ Replace symbol with 2 (2 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
❄ Replace symbol with 1 (1 m), 2 (2 m), 3 (3 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
Note: For additional information, see the Safety Connection System section (page 7-1) of this catalog.

Accessories

Description		Dimensions	Cat. No.
	Flat actuator, not to be used with metal alignment guide	3-52	**440K-A21014**
	90° actuator, not to be used with metal alignment guide		**440K-A21006**
	Metal alignment guide with semi-flexible actuator		440K-A21030
	Replacement Cover	—	440A-A21115
	Dust Cover	—	440K-A17182

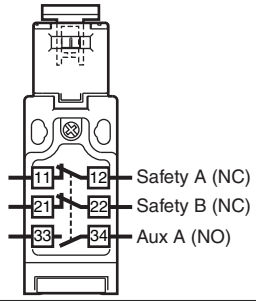
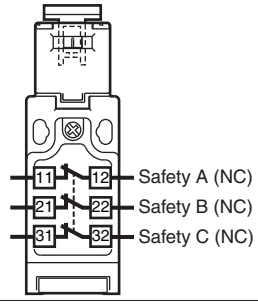
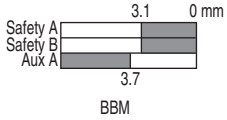
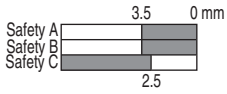
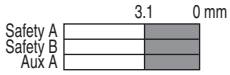
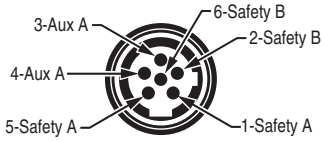
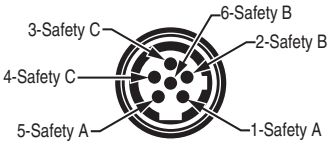
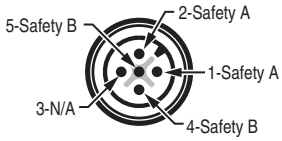
Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



***Note**: 2D, 3D and electrical drawings are available on www.ab.com.*

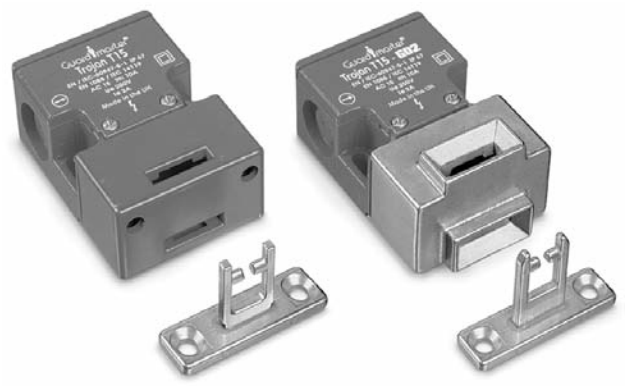
Typical Wiring Diagrams

Description		2 N.C. & 1 N.O.	3 N.C.
Contact Configuration			
Contact Action □Open ■Closed		 BBM  MBB	
6-Pin Micro (M12)			
5-Pin Micro (M12)		—	
Cordset 889R-F6ECA-∗	Red/White	Safety A	Safety A
	Red/Black		
	Red	Safety B	Safety B
	Red/Blue		
	Green	Aux A	Safety C
	Red/Yellow		

∗ Replace symbol with 2 (2 m), 5 (5 m) or 10 (10 m) for standard cable lengths.

Tongue Switches

Trojan™ T15



Description

The Trojan T15 is a compact universal tongue-operated (or key-operated) safety interlock switch designed to fit at the leading edge of sliding, hinged or lift-off guards. With its dual entry slots and rotatable head, movable only by releasing the cover screws, the Trojan T15 can offer four different options for actuator entry.

The Trojan T15 features a compact housing, only 75 x 52 x 32 mm (2.95 x 2.04 x 1.25 in.) and includes direct opening action contacts and a tamper-resistant mechanism. The Trojan T15 has 2 N.C. safety contacts or 1 N.C. safety contact and 1 N.O. auxiliary contact. The unit is sealed to IP67 and has three M20 conduit entries.

Operation of the switch is achieved by the insertion of the specially-profiled stainless-steel actuator which should be permanently fixed to the leading edge of the guard door. The standard T15 incorporates actuator retention force of 30N. An optional catch mechanism helps keep doors shut on vibrating machinery.

Features

- Compact size, 75 x 52 x 32 mm (2.95 x 2.05 x 1.26 in.) case
- 30 N actuator retention force
- Strong and versatile, can be used in most applications
- Contacts: 2 N.C. safety or 1 N.C. safety & 1 N.O. auxillary
- GD2 style available for demanding applications

Specifications

Safety Ratings				
Standards		EN954-1, ISO13849-1, IEC/EN60204-1, NFPA79, EN1088, ISO14119, IEC/EN60947-5-1, ANSI B11.19, AS4024.1		
Safety Classification		Cat. 1 device per EN 954-1 dual channel interlocks suitable for Cat. 3 or 4 systems		
Certifications		CE Marked for all applicable directives, cULus, TÜV, and CCC		
Outputs				
Safety Contacts ❄ Direct Opening Action		2 N.C.		1 N.C.
Auxiliary Contacts		None		1 N.O.
Thermal Current I_{th}		10 A		
Rated Insulation Voltage		(Ui) 500V		
Switching Current @ Voltage, Min.		5 mA @ 5V DC		
Utilization Category				
A600/AC-15 (Ue)	(Ue)	600V	500V	240V	120V
(Ie)	(Ie)	1.2 A	1.4 A	3.0 A	6.0 A
DC-13 (Ue)	(Ue)	24V			
(Ie)	(Ie)	2 A			
Operating Characteristics				
Break Contact Force, Min.		30 N (6.70 lbf)		
Actuation Speed, Max.		160 mm (6.29 in.)/s		
Actuation Frequency, Max.		2 cycles/s		
Operating Radius, Min		175 mm (6.89 in.) [60 mm (2.36 in.) with flexible actuator]		
Operating Life @ 100 mA load		1 x 10^6 operations		
Environmental				
Enclosure Type Rating		IP67		
Operating Temperature [C (F)]		-20…+80° (-4…+176°)		
Physical Characteristics				
Housing Material		UL Approved glass-filled PBT		
Actuator Material		Stainless Steel		
Weight [g (lb)]		120 (0.265)		
Color		Red		

∗ Usable for ISO 13849-1:2006 and IEC 62061. Data other than B10d is based on:
- Usage rate of 1op/10 mins., 24 hrs/day, 360 days/year, representing 51840 operations per year
- Mission time/Proof test interval of 38 years

❄ The safety contacts are described as normally closed (N.C.) i.e., with the guard closed, actuator in place (where relevant) and the machine able to be started.

Product Selection

Type	Contact		Contact Action	Actuator Type	Cat. No.			
					M20 Conduit		Connector§	
	Safety	Auxiliary			M20	1/2 inch NPT Adaptor	Connect to Distribution Box 4-Pin Micro (M12)	Connect to ArmorBlock Guard I/O 5-Pin Micro (M12)
Trojan T15 Standard	2 N.C.	—	—	Standard	440K-T11303	440K-T11267	440K-T11307	440K-V2NNSPS
				Fully-Flex	440K-T11395	440K-T11273	440K-T11384	440K-V2NNBPS
				—	**440K-T11269**	—	440K-T11385	—
	1 N.C.	1 N.O.	BBM	Standard	440K-T11305	440K-T11268	440K-T11386	—
				Fully-Flex	440K-T11396	440K-T11276	440K-T11387	—
				—	440K-T11270	—	440K-T11388	—
Trojan T15 GD2	2 N.C.	—	—	GD2 Standard	440K-T11463	440K-T11288	440K-T11389	440K-V2NNGPS-NG
				Fully-Flex	440K-T11397	440K-T11287	440K-T11390	—
				—	440K-T11280	—	440K-T11391	—
	1 N.C.	1 N.O.	BBM	GD2 Standard	440K-T11398	440K-T11284	440K-T11392	—
				Fully-Flex	440K-T11399	440K-T11283	440K-T11393	—
				—	440K-T11279	—	440K-T11394	—

§ For connector ratings see page 3-9.

Recommended Logic Interfaces

Description	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. Page No.	Cat. No.
Single-Function Safety Relays for 2 N.C. Contact Switch							
MSR127RP	3 N.O.	1 N.C.	Removable (Screw)	Monitored Manual	24V AC/DC	5-24	440R-N23135
MSR127TP	3 N.O.	1 N.C.	Removable (Screw)	Auto./Manual	24V AC/DC	5-24	440R-N23132
MSR30RT	2 N.O. Solid State	1 N.O. Solid State	Removable	Auto./Manual or Monitored Manual	24V DC	5-16	440R-N23198
Single-Function Safety Relays for 1 N.C. & 1 N.O. Contact Switch							
MSR9T	2 N.O.	1 N.C.	Fixed	Auto./Manual	24V AC/DC	5-14	440R-F23027
MSR33RT	2 N.O. Solid State	1 N.O.	Removable	Auto. or Monitored Manual	24V DC SELV	5-18	440R-F23200
Modular Safety Relays							
MSR210P Base 2 N.C. only	2 N.O.	1 N.C. and 2 PNP Solid State	Removable	Auto./Manual or Monitored Manual	24V DC from the base unit	5-74	440R-H23176
MSR220P Input Module	—	—	Removable	—	24V DC	5-78	440R-H23178
MSR310P Base	MSR300 Series Output Modules	3 PNP Solid State	Removable	Auto./Manual Monitored Manual	24V DC	5-94	440R-W23219
MSR320P Input Module	—	2 PNP Solid State	Removable	—	24V DC from the base unit	5-98	440R-W23218

Note: For additional Safety Relays connectivity, see the Safety Relays section (page 5-8) of this catalog.
For additional Safety I/O and Safety PLC connectivity, see the Programmable Safety System section (page 5-107) of this catalog.
For application and wiring diagrams, see the Safety Applications section (page 10-1) of this catalog.

Connection Systems

Description	Connection to Distribution Box 4-Pin Micro (M12)		Connection to ArmorBlock Guard I/O 5-Pin Micro (M12)
	2 N.C.	1 N.C. & 1 N.O.	2 N.C.
Cordset	889D-F4AC-∗	889D-F4AC-∗	—
Patchcord	889D-F4ACDM-❄	889D-F4ACDM-❄	889D-F5ACDM-∗
Distribution Box	898D-4‡LT-DM4	898D-P4‡KT-DM4	—
Shorting Plug	898D-41LU-DM	898D-41KU-DM	—
T-Port	898D-43LY-D4	898D-43KY-D4	—

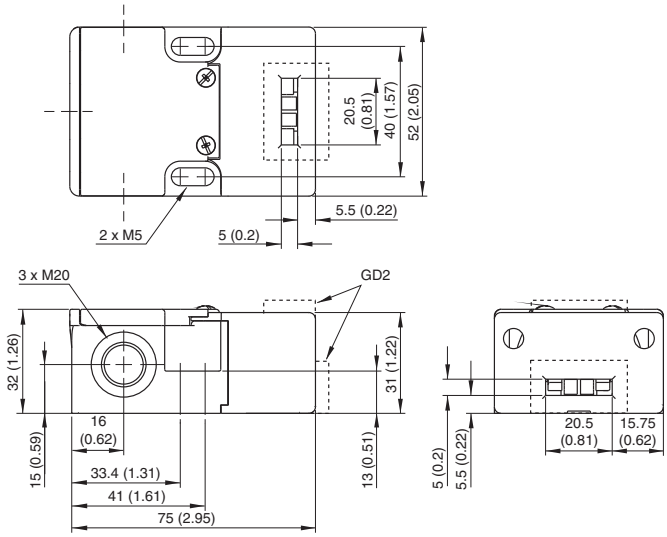
∗ Replace symbol with 2 (2 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
❄ Replace symbol with 1 (1 m), 2 (2 m), 3 (3 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
‡ Replace symbol with 4 or 8 for number of ports.
Note: For additional information, see the Safety Connection System section (page 7-1) of this catalog.

Accessories

Description		To Be Used With:	Dimensions	Cat. No.
	Standard actuator	Trojan T15 Standard Models Only	3-51	440K-A11238
	GD2 standard actuator	Trojan GD2 Models Only	3-50	**440G-A27011**
	GD2 flat actuator	Trojan GD2 Models Only	3-51	**440K-A11112**
	Alignment guide with semi-flexible actuator	Discard Alignment Guide for GD2 Models		440K-A11144
	Alignment guide with fully-flexible actuator	Discard Alignment Guide for GD2 Models	3-52	440K-A27010
	Sliding bolt actuator	Trojan GD2 Models Only	3-55	440G-A27163
	Catch and Retainer Kit	Trojan T15 Standard Models Only	3-50	440K-A11094
	Replacement Cover	All Models	—	440A-A11499
	Dust Cover	All Models	—	440K-A17180

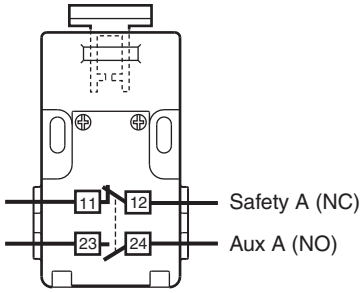
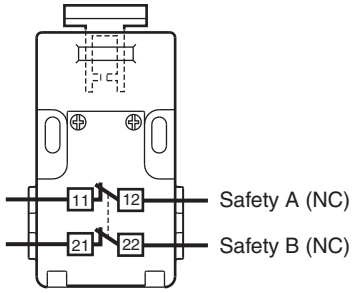
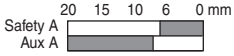
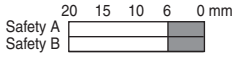
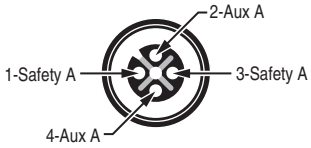
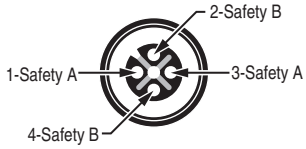
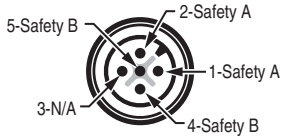
Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



***Note**: 2D, 3D and electrical drawings are available on www.ab.com.*

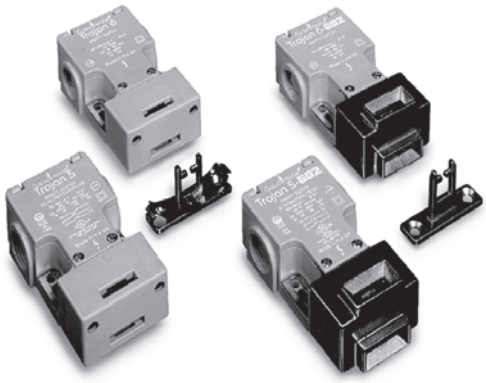
Typical Wiring Diagrams

Description		1 N.C. & 1 N.O.	2 N.C.
Contact Configuration			
Contact Action □Open ■Closed		 BBM	
4-Pin Micro (M12)			
5-Pin Micro (M12) For ArmorBlock Guard I/O		—	
Cordset 889D-F4AC-∗	Brown	Safety A	Safety A
	Blue		
	White	Aux A	Safety B
	Black		

∗ Replace symbol with 2 (2 m), 5 (5 m) or 10 (10 m) for standard cable lengths.

Tongue Switches

Trojan™ 5 & 6



Description

The Trojan family is a universal tongue-operated (or key-operated) safety-interlock switch designed to fit at the leading edge of sliding, hinged or lift-off guards. The dual key entry slots and rotatable head, movable only by releasing the cover screws, allow four actuator entry options. The Trojan contains all of the safety related functions—i.e., forced guided contacts, tamper resistant mechanism—allowing the machine to be safeguarded in compliance with the machine directive.

Operation of the switch is achieved through the insertion of a specially-profiled stainless-steel key that is permanently mounted to the leading edge of the guard door. The standard (not GD2) Trojan actuator includes a self-ejecting mechanism that prevents operation of the switch if the actuator is not mounted to the guard door (e.g., if the operator uses a spare key).

Features

- Strong and versatile, can be used in most applications
- Self-ejecting tamper resistant actuator, only operates when mounted to the guard (not with GD2 models)
- Four possible actuator entry points, easy to install
- GD2 style available for demanding applications

Specifications

Safety Ratings				
Standards	EN 954-1, ISO 13849-1, IEC/EN 60204-1, NFPA 79, EN 1088, ISO 14119, IEC/EN 60947-5-1, ANSI B11.19, AS 4024.1			
Safety Classification	Cat. 1 device per EN 954-1 dual channel interlocks suitable for Cat. 3 or 4 systems			
Functional Safety Data ✶ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	B10d: > 2 x 10^6 operations at min. load PFH_D: > 3 x10^{-7} MTTFd: > 385 years Dual channel interlock may be suitable for performance levels Ple or Pld (according to ISO 13849-1:2006) and for use in SIL2 or SIL3 systems (according to IEC 62061) depending on application characteristics			
Certifications	CE Marked for all applicable directives, cULus, TÜV, and CCC			
Outputs				
Safety Contacts ❄ Direct Opening Action	3 N.C.	2 N.C.	2 N.C.	
Auxiliary Contacts	1 N.O.	2 N.O.	1 N.O.	
Thermal Current I_{lth}	10 A			
Rated Insulation Voltage	(Ui) 500V			
Switching Current @ Voltage, Min.	5 mA @ 5V DC			
Utilization Category				
Trojan 5 A300/AC-15 (Ue)	240V	120V		
(Ie)	3 A	6 A		
DC-13 (Ue)	24V	24V		
(Ie)	2 A			
Trojan 6 A600/AC-15 (Ue)	600V	500V	240V	120V
(Ie)	1.2 A	1.4 A	3 A	6 A
DC-13 (Ue)	24V			
(Ie)	2 A			
Operating Characteristics				
Break Contact Force, Min.	Trojan 5: 12 N (2.7 lbf) & 30 N (6.75 lbf)			
	Trojan 6: 20 N (4.5 lbf)			
Actuation Speed, Max.	160 mm (6.29 in.)/s			
Actuation Frequency, Max.	2 cycles/s			
Operating Radius, Min	175 mm (6.89 in.) [60 mm (2.36 in.) with flexible actuator]			
Operating Life @ 100 mA load	1 x 10^6 operations			
Environmental				
Enclosure Type Rating	IP67			
Operating Temperature [C (F)]	-20…+80° (-4…+176°)			
Physical Characteristics				
Housing Material	UL Approved glass-filled PBT			
Actuator Material	Stainless Steel			
Weight [g (lb)]	160 (0.35)			
Color	Red			

✶ Usable for ISO 13849-1:2006 and IEC 62061. Data other than B10d is based on:
- Usage rate of 1op/10 mins., 24 hrs/day, 360 days/year, representing 51840 operations per year
- Mission time/Proof test interval of 38 years

❄ The safety contacts are described as normally closed (N.C.) i.e., with the guard closed, actuator in place (where relevant) and the machine able to be started.

Product Selection

Type	Contact			Actuator Type	Cat. No.			
					M20 Conduit		Connector§	
	Safety	Auxiliary	Action		M20	1/2 inch NPT Adaptor	Connect to Distribution Box 6-Pin Micro (M12)	Connect to ArmorBlock Guard I/O 5-Pin Micro (M12)♣
Trojan 5 Standard	2 N.C.	1 N.O.	BBM	Standard	**440K-T11090**	**440K-T11202**	440K-T11205	—
				Guide/Semi-Flex	440K-T11110	440K-T11203	440K-T11206	—
				Guide/Fully-Flex	**440K-T11467**	440K-T11204	440K-T11207	440K-T2NNBPS
				—	**440K-T11089**	—	440K-T11129	—
			BBM Gold Contacts	Standard	440K-T11085	—	—	—
			MBB	Standard	**440K-T11118**	440K-T11208	440K-T11224	—
				Guide/Semi-Flex	440K-T11123	440K-T11209	440K-T11363	—
				Guide/Fully-Flex	440K-T11468	440K-T11210	440K-T11364	—
				—	440K-T11146	440K-T11469	440K-T11365	—
Trojan 5 GD2			BBM	GD2 Standard	440K-T11336	440K-T11211	440K-T11366	440K-T2NNGPS-NG
				Guide/Semi-Flex	440K-T11337	440K-T11212	440K-T11367	—
				Guide/Fully-Flex	440K-T11338	440K-T11213	440K-T11368	—
				—	**440K-T11147**	—	440K-T11226	—
			MBB	GD2 Standard	440K-T11339	440K-T11470	440K-T11369	—
				Guide/Semi-Flex	440K-T11340	440K-T11471	440K-T11370	—
				Guide/Fully-Flex	440K-T11341	440K-T11472	440K-T11371	—
				—	440K-T11167	—	440K-T11372	—
Trojan 5 30 N			BBM	Standard	440K-T11333	440K-T91024	440K-T11492	—

§ For connector ratings see page 3-9.
§ With a 5-pin micro (M12) connector, not all contacts are connected. See *Typical Wiring Diagram* on page 3-27 for wiring details.

Type	Contact			Actuator Type	Cat. No.		
					M20 Conduit		Connector§
	Safety	Auxiliary	Action		M20	1/2 inch NPT Adaptor	8-Pin Micro (M12)♣
Trojan 6	3 N.C.	1 N.O.	BBM	Standard	440K-T11171	440K-T11435	—
				—	440K-T11449	440K-T11408	—
	2 N.C.	2 N.O.	BBM	Standard	440K-T11174	440K-T11438	—
				—	440K-T11452	440K-T11416	440K-W21BNPH
			MBB	—	440K-T11453	440K-T11454	440K-W21MNPH
Trojan 6 GD2	3 N.C.	1 N.O.	BBM	GD2 Standard	440K-T11418	440K-T11466	—
				—	440K-T11188	440K-T11444	—
			MBB	—	440K-T11456	440K-T11457	—
	2 N.C.	2 N.O.	BBM	GD2 Standard	440K-T11445	440K-T11425	—
				—	440K-T11459	440K-T11433	440K-W21BNPH-NG
			MBB	—	440K-T11460	440K-T11461	440K-W21MNPH-NG

§ For connector ratings see page 3-9.
§ With an 8-pin micro (M12) connector, not all contacts are connected. See *Typical Wiring Diagram* on page 3-27 for wiring details.

Tongue Switches

Trojan™ 5 & 6

Recommended Logic Interfaces

Description	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. Page No.	Cat. No.
Single-Function Safety Relays							
MSR127RP	3 N.O.	1 N.C.	Removable (Screw)	Monitored Manual	24V AC/DC	5-24	440R-N23135
MSR127TP	3 N.O.	1 N.C.	Removable (Screw)	Auto./Manual	24V AC/DC	5-24	440R-N23132
MSR126T	2 N.O.	None	Fixed	Auto./Manual	24V AC/DC	5-22	440R-N23117
MSR30RT	2 N.O. Solid State	1 N.O. Solid State	Removable	Auto./Manual or Monitored Manual	24V DC	5-16	440R-N23198
Modular Safety Relays							
MSR210P Base 2 N.C. only	2 N.O.	1 N.C. and 2 PNP Solid State	Removable	Auto./Manual or Monitored Manual	24V DC from the base unit	5-74	440R-H23176
MSR220P Input Module	—	—	Removable	—	24V DC	5-78	440R-H23178
MSR310P Base	MSR300 Series Output Modules	3 PNP Solid State	Removable	Auto./Manual Monitored Manual	24V DC	5-94	440R-W23219
MSR320P Input Module	—	2 PNP Solid State	Removable	—	24V DC from the base unit	5-98	440R-W23218

Note: For additional Safety Relays connectivity, see the Safety Relays section (page 5-8) of this catalog.
For additional Safety I/O and Safety PLC connectivity, see the Programmable Safety System section (page 5-107) of this catalog.
For application and wiring diagrams, see the Safety Applications section (page 10-1) of this catalog.

Connection Systems

Description	Trojan 5		Trojan 6
	5-Pin Micro (M12)	6-Pin Micro (M12)	8-Pin Micro (M12)
Cordset	—	889R-F6ECA-✶	889D-F8AB-✶
Patchcord	889R-F5ECRM-✶	889R-F6ECRM-❄	889D-F8ABDM-❄
Distribution Box	—	898R-F68MT-A5	—
Shorting Plug	—	898R-P61MU-RM	—
T-Port	—	—	—

✶ Replace symbol with 2 (2 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
❄ Replace symbol with 1 (1 m), 2 (2 m), 3 (3 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
‡ Replace symbol with 4 or 8 for number of ports.
Note: For additional information, see the Safety Connection System section (page 7-1) of this catalog.

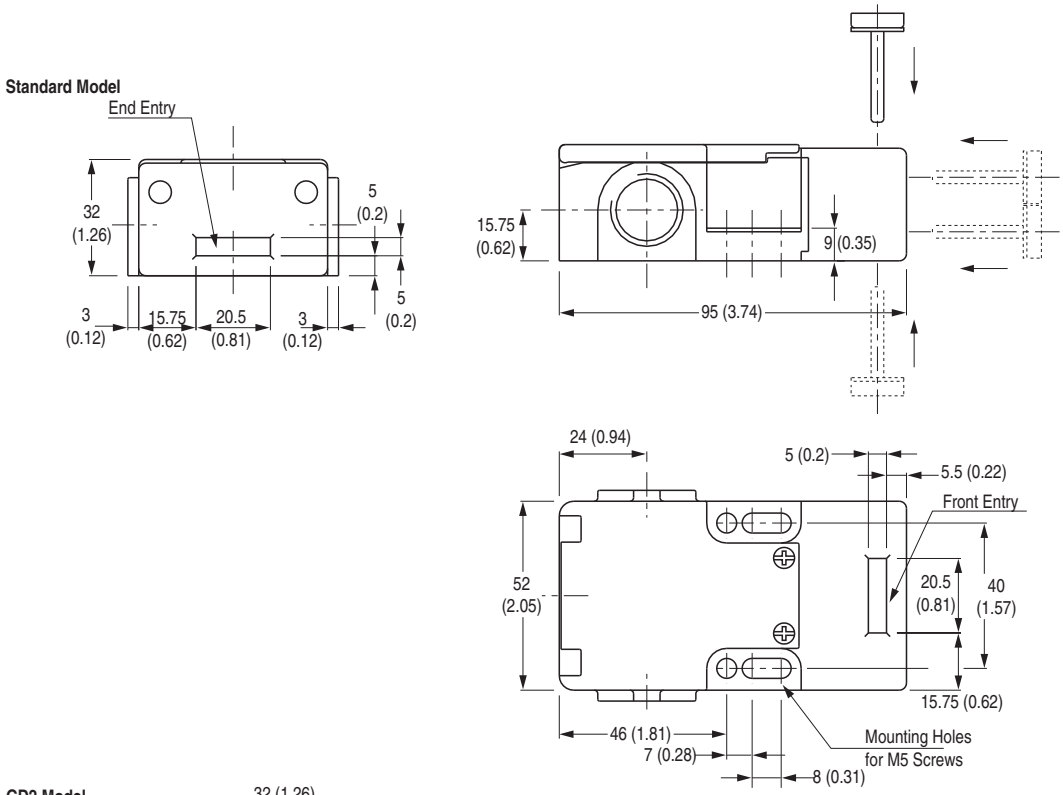
Accessories

Description		To Be Used With:	Dimensions	Cat. No.
	Standard actuator	Trojan T5 and T6 Standard Models Only	3-51	**440K-A11095**
	GD2 standard actuator	GD2 Models Only	3-50	**440G-A27011**
	GD2 flat actuator	GD2 Models Only	3-51	**440K-A11112**
	Alignment guide with semi-flexible actuator	Discard Alignment Guide for GD2 Models	3-51	440K-A11144
	Alignment guide with fully-flexible actuator	Discard Alignment Guide for GD2 Models	3-52	440K-A27010
	Sliding bolt actuator	GD2 Models Only	3-55	440G-A27163
	Catch and Retainer Kit	Trojan T5 and T6 Standard Models Only	3-50	440K-A11094
	Replacement Cover	Trojan T5 Standard Models Only	—	440A-A11495
		Trojan T5 GD2		440A-A11496
		Trojan T6 Standard Models Only		440A-A11497
		Trojan T6 GD2		440A-A11498
	Dust Cover	All Models	—	440K-A17180

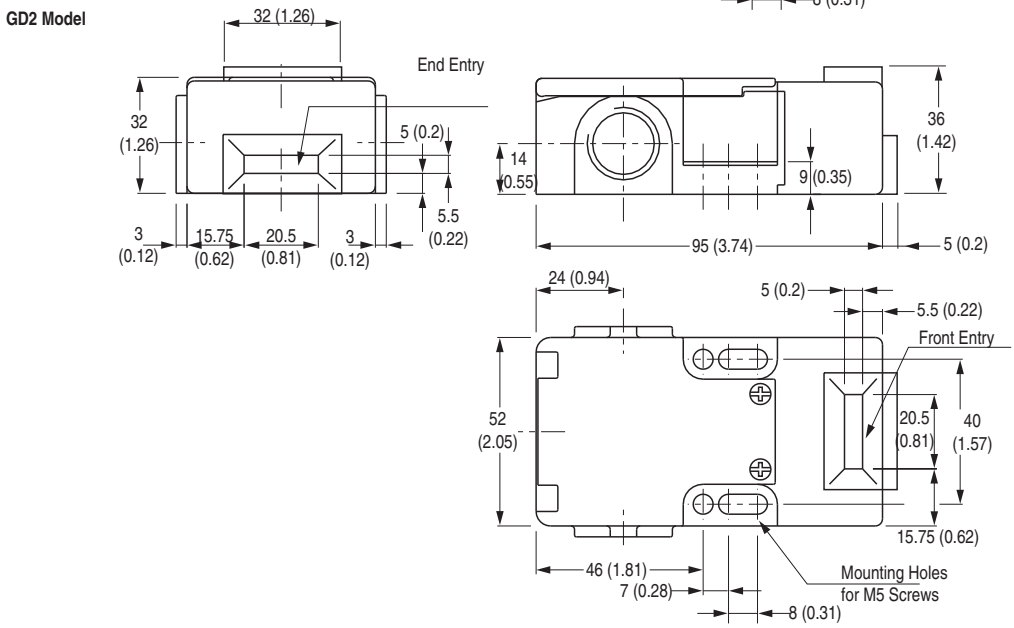
Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.

Standard Model

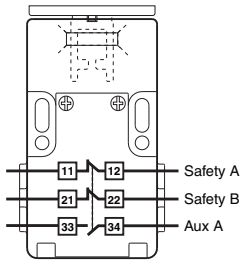
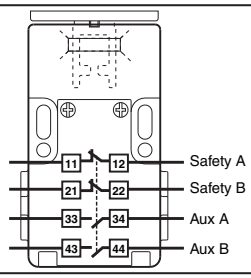
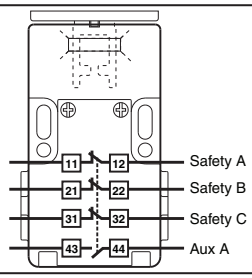
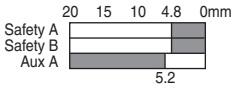
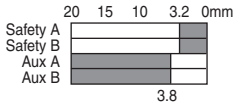
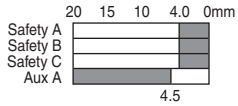
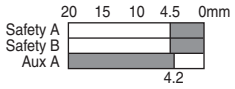
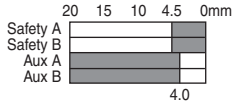
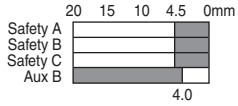
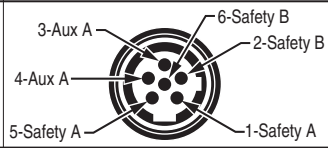
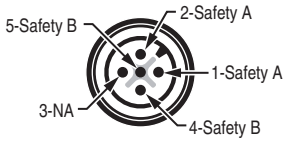
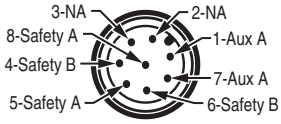


GD2 Model



***Note**: 2D, 3D and electrical drawings are available on www.ab.com.*

Typical Wiring Diagrams

Description		Trojan 5	Trojan 6	
		2 N.C. & 1 N.O.	2 N.C. & 2 N.O.	3 N.C. & 1 N.O.
Contact Configuration				
Contact Action ☐Open ■Closed	BBM			
	MBB			
6-Pin Micro (M12)			—	—
5-Pin Micro (M12) for ArmorBlock Guard I/O			—	—
8-Pin Micro (M12)		—		—
6-Pin Cordset 889R-F6ECA-∗	Red/White	Safety A	—	—
	Red/Black			
	Red	Safety B	—	—
	Red/Blue			
	Green	Aux	—	—
	Red/Yellow			
8-Pin Cordset 889D-F8AB-∗	Grey Red	—	Safety A	—
	Yellow Pink	—	Safety B	—
	White Blue	—	Aux A	—
	Green Brown	—	NA	—

∗ Replace symbol with 2 (2 m), 5 (5 m) or 10 (10 m) for standard cable lengths.

Tongue Switches

MT-GD2

Description

The MT-GD2 family is a robust, tongue-operated (or key-operated) safety-interlock switch designed to fit at the leading edge of sliding, hinged or lift-off guards. With its dual entry slots and rotatable head, the MT-GD2 can offer eight different options for actuator entry.

The MT-GD2 features a compact housing of only 117 x 40 x 43 mm (4.60 x 1.57 x 1.69 in.) with DIN 50041 standard fixing centres and includes forced guided contacts and a tamper-resistant mechanism.

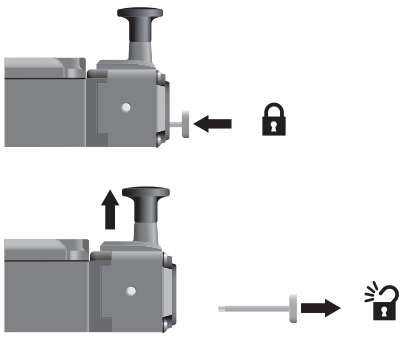
The MT-GD2 is available with a variety of contact configurations enabling it to be used as part of a system for higher-risk applications. Operation of the switch is achieved by the insertion of the specially-profiled stainless-steel actuator which should be permanently fixed to the leading edge of the guard door. An optional flexible actuator allows the MT-GD2 to operate on smaller-radii doors (≥60 mm) and a flat actuator gives additional mounting options, for example, on a chain.

A style incorporating a latch release mechanism allows manual retention of the actuator in the switch until the release mechanism is manually activated.

Features

- Strong and versatile, can be used in most applications
- Eight possible actuator entry points, easy to install
- Variety of contact configurations
- Snap acting MT-GD2 gives a min. break contact force of 40 N
- Optional latch release styles
- Industry standard fixing centers to DIN/EN50041

MT-GD2 Latch Release Style



Specifications

Safety Ratings					
Standards		EN954-1, ISO13849-1, IEC/EN60204-1, NFPA79, EN1088, ISO14119, IEC/EN60947-5-1, ANSI B11.19, AS4024.1			
Safety Classification		Cat. 1 device per EN 954-1 dual channel interlocks suitable for Cat. 3 or 4 systems			
Functional Safety Data ✶ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*		B10d: > 2 x 10^6 operations at min. load PFH_D: > 3 x10^{-7} MTTFd: > 385 years Dual channel interlock may be suitable for performance levels Ple or Pld (according to ISO 13849-1:2006) and for use in SIL2 or SIL3 systems (according to IEC 62061) depending on application characteristics			
Certifications		CE Marked for all applicable directives, cULus, TÜV, and CCC			
Outputs					
Safety Contacts ❄		Standard: 3 N.C. or 2 N.C. direct opening action Snap acting: 2 N.C. direct opening forced disconnection			
Auxiliary Contacts		Standard: 1 N.O. or 2 N.O. Snap Acting: 2 N.O.			
Thermal Current I_{th}		10 A			
Rated Insulation Voltage		(Ui) 500V			
Switching Current @ Voltage, Min.		5 mA @ 5V DC			
Utilization Category					
A600/AC-15	(Ue)	600V	500V	240V	120V
	(Ie)	1.2 A	1.4 A	3 A	6 A
Standard—DC-13	(Ue)	24V			
	(Ie)	2 A			
Snap-Acting—A300/AC-15	(Ue)	240V	120V		
	(Ie)	3 A	6 A		
Snap-Acting—DC-13	(Ue)	24V			
	(Ie)	2 A			
Operating Characteristics					
Break Contact Force, Min.		BBM & MBB: 12 N (2.7 lbf) BBM & Extended Flat Actuator: 32 N (7.2 lbf) Snap acting: 40 N (9.0 lbf)			
Actuation Speed, Max.		160 mm (6.29 in.)/s			
Actuation Frequency, Max.		2 cycles/s			
Operating Life @ 100 mA load		1 x 10^6 operations			
Environmental					
Enclosure Type Rating		IP67			
Operating Temperature [C (F)]		-20…+80° (-4…+176°)			
Physical Characteristics					
Housing Material		Painted zinc			
Actuator Material		Stainless Steel			
Weight [g (lb)]		520 (1.15)			
Color		Yellow or Red			

✶ Usable for ISO 13849-1:2006 and IEC 62061. Data other than B10d is based on:
- Usage rate of 1op/10 mins., 24 hrs/day, 360 days/year, representing 51840 operations per year
- Mission time/Proof test interval of 38 years

❄ The safety contacts are described as normally closed (N.C.) i.e., with the guard closed, actuator in place (where relevant) and the machine able to be started.

Product Selection

Red Body Switches

Type	Contact			Actuator Type	Cat. No.				
					Conduit		Connector§		
	Safety	Auxiliary	Action		M20	1/2 in NPT	12-Pin M23	8-Pin Micro (M12)❄	Connect to ArmorBlock Guard I/O 5-Pin Micro (M12)∗
MT-GD2	3 N.C.	1 N.O.	BBM	—	**440K-MT55002**	440K-MT55085	440K-MT55094	—	—
				GD2 Standard	440K-MT55074	**440K-MT55022**	**440K-MT55095**	—	—
				Fully Flexible	440K-MT55075	**440K-MT55029**	**440K-MT55096**	—	—
			MBB	—	440K-MT55004	**440K-MT55088**	440K-MT55100	—	—
	2 N.C.	2 N.O.	BBM	—	**440K-MT55005**	440K-MT55086	440K-MT55097	440K-M21BNDH	—
				GD2 Standard	**440K-MT55076**	**440K-MT55026**	440K-MT55098	—	—
				Fully Flexible	440K-MT55077	**440K-MT55087**	440K-MT55099	—	—
			MBB	—	440K-MT55006	440K-MT55089	440K-MT55101	—	—
			Snap Acting	—	—	440K-M22ANDT	440K-M22ANDL	440K-M21ANDH	440K-M2NNNDS
				Extended Flat	440K-M22AEDM	**440K-M22AEDT**	—	—	—
				GD2 Standard	440K-M22ASDM	440K-M22ASDT	—	—	—
				Fully Flexible	440K-M22ABDM	440K-M22ABDT	—	—	—
MT-GD2 Latch Release	3 N.C.	1 N.O.	BBM	—	**440K-MT55039**	440K-MT55062	440K-MT55042	—	—
				GD2 Standard	**440K-MT55078**	440K-MT55041	440K-MT55070	—	—
				Fully Flexible	440K-MT55079	440K-MT55045	440K-MT55103	—	—
			MBB	—	440K-MT55082	440K-MT55091	440K-MT55106	—	—
	2 N.C.	2 N.O.	BBM	—	440K-MT55063	440K-MT55065	440K-MT55066	440K-M21BNDH-N5	440K-M2NNNDS-N5
				GD2 Standard	440K-MT55080	**440K-MT55050**	440K-MT55104	—	—
				Fully Flexible	440K-MT55081	440K-MT55051	440K-MT55052	—	—
			MBB	—	440K-MT55083	440K-MT55092	440K-MT55105	440K-M21MNDH-N5	—

§ For connector ratings see page 3-9.
∗ With a 5-pin micro (M12) connector, not all contacts are connected. See *Typical Wiring Diagram* on page 3-32 for wiring details.
❄ With an 8-pin micro (M12) connector, not all contacts are connected. See *Typical Wiring Diagram* on page 3-32 for wiring details.

Yellow Body Switches

Type	Contact			Actuator Type	Cat. No.		
					Conduit	Connector§	
	Safety	Auxiliary	Action		1/2 in NPT	12-Pin M23	5-Pin Micro (M12)∗
MT-GD2	2 N.C.	2 N.O.	Snap Acting	—	**440K-M22ANYT**	—	—
				Extended Flat	**440K-M22AEYT**	440K-M22AEYL	440K-M2NAEYS
—	2 N.C.	2 N.O.	MBB	—	440K-M22MNYT-N5	—	440K-M2NNNYS-N5

§ For connector ratings see page 3-9.
∗ With a 5-pin micro (M12) connector, not all contacts are connected. See *Typical Wiring Diagram* on page 3-32 for wiring details.
❄ With an 8-pin micro (M12) connector, not all contacts are connected. See *Typical Wiring Diagram* on page 3-32 for wiring details.

Recommended Logic Interfaces

Description	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. Page No.	Cat. No.
Single-Function Safety Relays							
MSR127RP	3 N.O.	1 N.C.	Removable (Screw)	Monitored Manual	24V AC/DC	5-24	440R-N23135
MSR127TP	3 N.O.	1 N.C.	Removable (Screw)	Auto./Manual	24V AC/DC	5-24	440R-N23132
MSR126T	2 N.O.	None	Fixed	Auto./Manual	24V AC/DC	5-22	440R-N23117
MSR30RT	2 N.O. Solid State	1 N.O. Solid State	Removable	Auto./Manual or Monitored Manual	24V DC	5-16	440R-N23198
Modular Safety Relays							
MSR210P Base 2 N.C. only	2 N.O.	1 N.C. and 2 PNP Solid State	Removable	Auto./Manual or Monitored Manual	24V DC from the base unit	5-74	440R-H23176
MSR220P Input Module	—	—	Removable	—	24V DC	5-78	440R-H23178
MSR310P Base	MSR300 Series Output Modules	3 PNP Solid State	Removable	Auto./Manual Monitored Manual	24V DC	5-94	440R-W23219
MSR320P Input Module	—	2 PNP Solid State	Removable	—	24V DC from the base unit	5-98	440R-W23218

Note: For additional Safety Relays connectivity, see the Safety Relays section (page 5-8) of this catalog.
For additional Safety I/O and Safety PLC connectivity, see the Programmable Safety System section (page 5-107) of this catalog.
For application and wiring diagrams, see the Safety Applications section (page 10-1) of this catalog.

Connection Systems

Description	4-Pin Micro (M12)	5-Pin Micro (M12)	8-Pin Micro (M12)	12-Pin M23
Cordset	889D-F4AC-✶	—	889D-F8AB-✶	889M-FX9AE-✶
Patchcord	889D-F4ACDM-❄	889D-F5ACDM-✶	889D-F8ABDM-❄	—
Distribution Box	898D-P4‡LT-DM4	—	—	—
Shorting Plug	898D-41LU-DM	—	—	—
T-Port	898D-43LY-D4	—	—	—

✶ Replace symbol with 2 (2 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
❄ Replace symbol with 1 (1 m), 2 (2 m), 3 (3 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
‡ Replace symbol with 4 or 8 for number of ports.
Note: For additional information, see the Safety Connection System section (page 7-1) of this catalog.

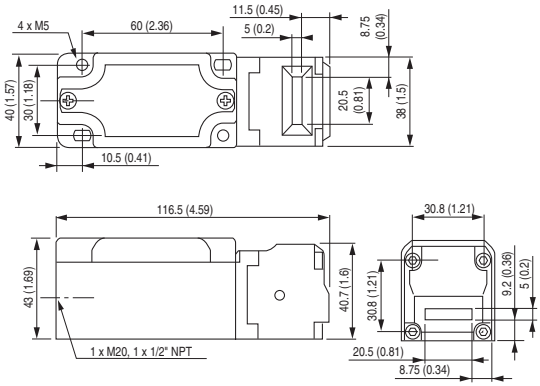
Accessories

Description		Dimensions	Cat. No.
	GD2 standard actuator	3-50	**440G-A27011**
	GD2 flat actuator	3-51	**440K-A11112**
	Fully flex actuator	3-50	**440G-A27143**
	Sliding bolt actuator	3-55	440G-A27163
	Extended flat actuator	3-51	**440K-A17116**
	Dust Cover	—	440K-A17180

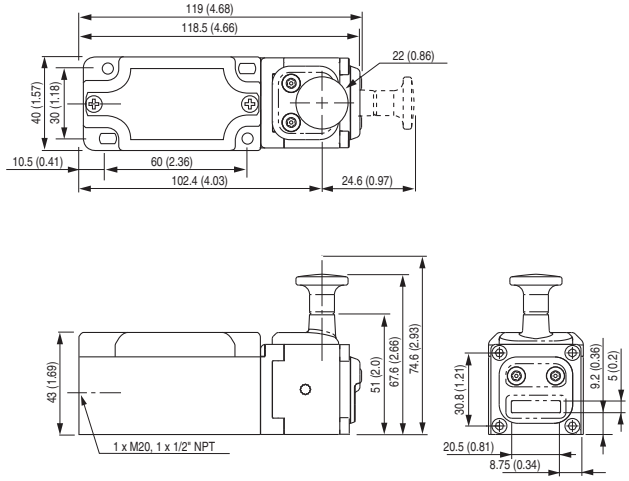
Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.

MT-GD2

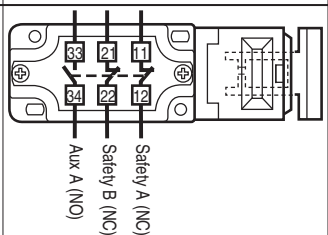
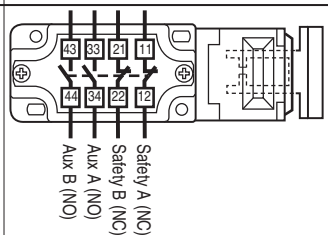
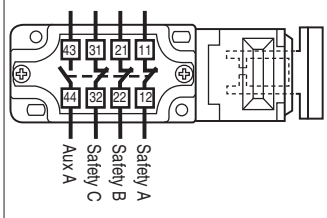
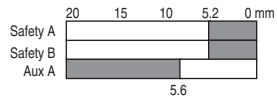
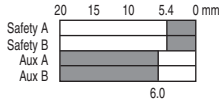
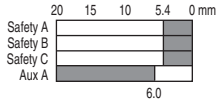
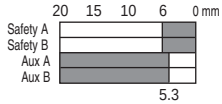
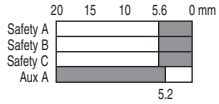
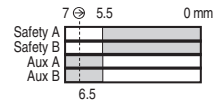
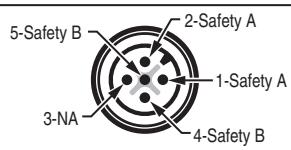
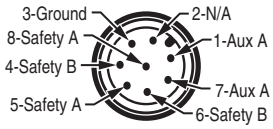
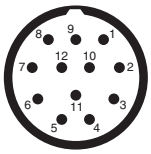


MT-GD2 Latch Release



***Note**: 2D, 3D and electrical drawings are available on www.ab.com.*

Typical Wiring Diagrams

Description		2 N.C. & 1 N.O.	2 N.C. & 2 N.O.	3 N.C. & 1 N.O.
Contact Configuration				
Contact Action □Open ■Closed		 BBM	 BBM	 BBM
		—	 MBB	 MBB
		—	 Snap Acting	—
5-Pin Micro (M12) for Connection to ArmorBlock Guard I/O		—		—
8-Pin Micro (M12)		—		—
12-Pin Cordset  Pins 2, 5 and 11 are not connected.	1 and 3	Safety A	Safety A	Safety A
	4 and 6	Safety B	Safety B	Safety B
	7 and 8	NC	Aux A	Safety C
	9 and 10	Aux A	Aux B	Aux A
	12	Ground	Ground	Ground
8-Pin Cordset 889D-F8AB-∗	Grey Red	—	Safety A	—
	Yellow Pink	—	Safety B	—
	White Blue	—	Aux A	—
	Green	—	Ground	—
	Brown	—	Not Used	—
12-Pin Cordset 889M-FX9AE-∗	Brown Blue	Safety A	Safety A	Safety A
	White Green	Safety B	Safety B	Safety B
	Yellow Grey	Not Used	Aux A	Safety C
	Pink Red	Aux A	Aux B	Aux A
	Green/Yellow	Ground	Ground	Ground

∗ Replace symbol with 2 (2 m), 5 (5 m) or 10 (10 m) for standard cable lengths.

Visit our website: www.ab.com/catalog
Publication S117-CA001A-EN-P

Allen-Bradley
GuardMaster®

Overview

Guard locking switches are used to protect hazardous areas where a danger is not immediately removed after a stop request. On many machines removal of power of the motor or actuator will not necessarily cause a reliable and immediate stopping of the dangerous motion. Typical applications are: high inertia rotating machines, fast rotating machines, and machines where high pressure needs to be released from pneumatic valves.

Gates protected with guard locking switches are usually opened on exception basis. For example: to clear a jam or to regularly maintain the machine. This type of switch should not be used for frequent access during normal operation of the machine.

Guard locking switches use a solenoid to activate a lock which blocks or releases the tongue from the switch.

Rockwell Automation offers two different types of guard locking switches:

Power to Lock

When power is applied to the solenoid, the tongue is locked in the switch. When power is removed, the lock is released allowing the tongue to be extracted from the switch.

Power to Release

When power is applied to the solenoid the lock is released allowing the tongue to be extracted from the switch. When power is removed, the tongue is locked in the switch.

Why Use Power to Lock or Power to Release?

	Power to Lock	Power to Release
Advantage	When the power is removed from the cell after a "controlled stop," the doors unlock allowing maintenance personnel to go in easily.	Power is not applied to the switch all the time, only when the door needs to be opened. Sudden lose of power does not compromise safety of personnel, as the doors stay closed.
Disadvantage	Sudden lose of power will unlock the door allowing personnel to go in the hazardous area and the machine may not be stopped.	Loss of power will not unlock the door and maintenance personnel will not be able to go inside the cell.

Different methodologies can help decrease the risk that the danger is removed before the operator has access to the hazardous area:

Time based

The risk assessment process and stop time measurement will determine the maximum time for the machine to stop from its normal speed of operation. This time defines the delay between the request to open the gate and the authorization to access the zone by unlocking the gate by energizing (Power to Release) or de-energizing (Power to Lock) the solenoid.

This time delay can be implemented by using any of our time delay units such as the MSR178 or MSR138 safety relay or by software in one of our Safety PLC.

Stop motion

Another methodology is to measure when the motion is stopped. When the no-motion is detected, the lock is released to allow personnel to enter the hazardous zone.

The CU2, CU3, or MSR57 safety relay will be used to detect the motion is stopped.

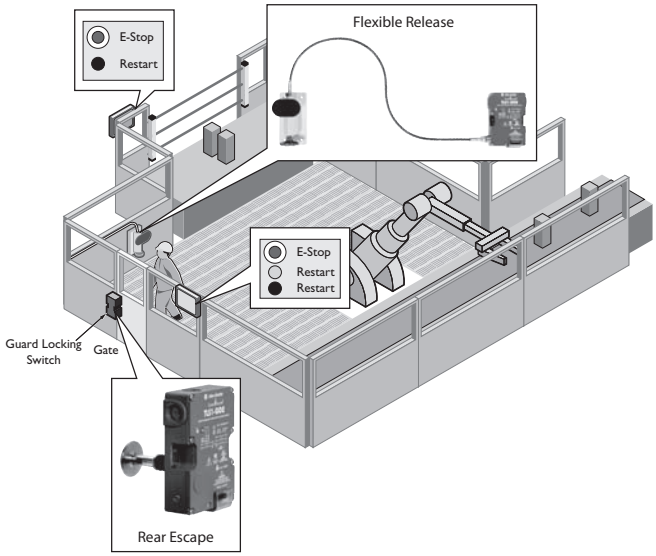
Safe speed conditions

In some applications, the user may need access while the machine is running at a safe speed. The MSR57P used with encoder technology can handle this application. It will verify the speed of the motion and allow access only if the speed does not exceed a preconfigured limit or otherwise the machine will enter a stop condition.

Typical Sequence of Actions

1. The operator requests to enter the hazardous area
2. A controlled or immediate stop of the machine is initiated
3. The machine is stopped: time delay expired or stop motion detected
4. The gate is unlocked by either energizing (Power to Release) or de-energizing (Power to Lock) the solenoid
5. The operator opens the gate and works in the hazardous area
6. The operator exits the hazardous area and closes the gate
7. The operator restarts the machine
8. The gate is locked by either de-energizing (Power to Release) or energizing (Power to Lock) the solenoid
9. The machine returns to its normal speed

Manual Override



In the situation where a person is still in the hazardous area, the door is locked and the machine restarts, the TLS guard locking switch product family provides two options for the person to escape the hazard (in addition of an Emergency Stop located outside of the hazardous area):

Option 1: Rear Escape (Not Latched)

A 40 mm push button is mounted on the back of the TLS and is accessible from the inside of the cell. Pushing the rear escape push button releases the lock mechanism inside the TLS guard locking switch allowing the door to be opened, the machine to stop and the person to escape the hazardous area.

Option 2: Flexible Release (Latched)

The flexible release push button accessory is designed to be installed inside the hazardous area to provide a means of escape for personnel who become trapped there. It provides remote access to the manual release mechanism within the TLS-GD2 switch in the event of an emergency situation. The flexible release can be retro-fitted to existing TLS1-GD2 and TLS3-GD2 switches or installed along with a new switch.

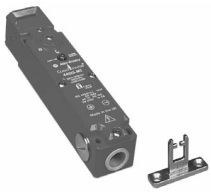
The unit is installed at an accessible height next to the guard door, inside the guarded area, while the TLS-GD2 can be mounted outside the guarded area. The flexible release is available with either a 1 m (3.28 ft) or a 3 m (9.84 ft) cable.

Pushing the black button on the flexible release, the movement of the cable activates the release mechanism within the switch, allowing the door to be opened, the machine to stop and the person to escape the hazardous area. The flexible release is then reset using the blue reset handle.

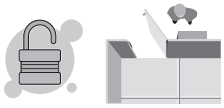
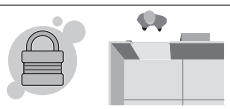
Guard Locking Switches

Overview

Selection Guide

Product	440G-MT		TLS1-GD2	TLS2-GD2	TLS3-GD2	Atlas 5
						
Holding Force	1600 N (360 lb)		2000 N (450 lb)			5000 N (1124 lb)
Housing Material	Metal		Plastic			Metal
Locking Mechanism	Power to Release		Power to Release	Power to Lock	Power to Release	Power to Release
Escape Release	None		Rear Escape and Flexible Release	None	Rear Escape and Flexible Release	None
Safety Contacts	2 N.C.	3 N.C.	2 N.C.			2 N.C.
Aux Contacts	2 N.O.	1 N.O.	1 N.O.			1 N.O.
Solenoid Monitoring	Direct Drive		1 N.O. & 1 N.C.		2 N.C.	2 N.C.

Typical Sequence of Actions and Contact Status

Step		440G-MT	TLS1	TLS2	TLS3	Atlas 5
Step 1—Hazardous Area Protected	**Solenoid Power**	**De-energized**	**De-energized**	**Energized**	**De-energized**	**De-energized**
	Solenoid Feedback A/B	Not Available	Closed/Open	Open/Closed	Closed/Closed	Closed/Closed
	Safety A/B	Closed	Closed	Closed	Closed	Closed
	Aux A (/B✶)	Open	Open	Open	Open	Open/Open
Step 2—Access to Hazardous Area Authorized	**Solenoid Power**	**Energized**	**Energized**	**De-energized**	**Energized**	**Energized**
	Solenoid Feedback A/B	Not Available	Open/Closed	Closed/Open	Open/Open	Open/Open
	Safety A/B	Open ✶	Closed	Closed	Closed	Closed
	Aux A (/B ❄)	Closed	Open	Open	Open	Open/Closed
Step 3—Access Authorized AND Door Open	**Solenoid Power**	**Energized**	**Energized**	**De-energized**	**Energized**	**Energized**
	Solenoid Feedback A/B	Not Available	Open/Closed	Closed/Open	Open/Open	Open/Open
	Safety A/B	Open	Open	Open	Open	Open
	Aux A (/B✶)	Closed	Closed	Closed	Closed	Open/Closed
Step 4—Gate Ready to Be Locked	**Solenoid Power**	**De-energized**	**De-energized**	**Energized**	**De-energized**	**De-energized**
	Solenoid Feedback A/B	Not Available	Closed/Open	Open/Closed	Closed/Closed	Closed/Closed
	Safety A/B	Open	Open	Open	Open	Open
	Aux A (/B✶)	Closed	Closed	Closed	Closed	Closed/Open
Step 5—Door Locked and Hazardous Area Protected	**Solenoid Power**	**De-energized**	**De-energized**	**Energized**	**De-energized**	**De-energized**
	Solenoid Feedback A/B	Not Available	Closed/Open	Open/Closed	Closed/Closed	Closed/Closed
	Safety A/B	Closed	Closed	Closed	Closed	Closed
	Aux A (/B✶)	Open	Open	Open	Open	Open/Open

✶ Direct drive of the contacts from the solenoid forces the safety contact to open even if the door is closed.
❄ Aux B solenoid auxiliary contact is available only on the Atlas 5 safety switch.

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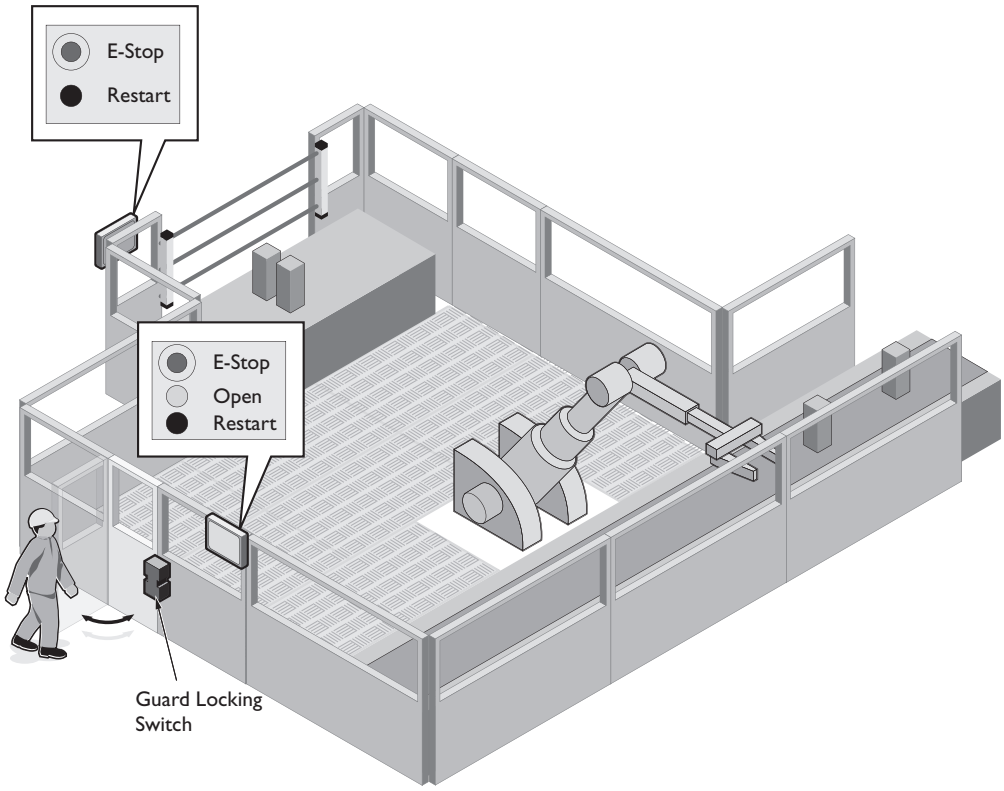
Application Example



Operating Conditions

- The door is closed and locked with a 440G-MT safety switch.
- The robot is running.
- The GuardShield light curtain is muted when the robot is away from the assembly table.

Maintenance Conditions

- In order to clear the jam safely, the operator requests to unlock the door by activating the Open push button.
- The control system (MSR safety relay or SmartGuard 600) shuts down the robot and conveyor when the process conditions allow the robot and conveyor to be stopped without damaging the machine or the products (Controlled stop).
- When the robot and conveyor are stopped the control system allows the door to unlock by applying power to the solenoid in the 440G-MT safety switch.
- The maintenance person opens the door and clears the jam.
- When the task is done, the maintenance person exits the area, closes the door and activates the Restart push button.
- The control system restarts the robot and conveyor.

Remarks

- The safety mats are in place to avoid the machine restarting when the door is closed and the maintenance person is still in the hazardous area. Without the safety mats a Flexible Release can be mounted inside the hazardous area to unlock the door if this situation was to happen.
- The push of any E-Stop push buttons will stop the robot and the conveyor immediately (Immediate stop).

Guard Locking Switches

440G-MT

Description

The 440G-MT solenoid switch is a positive mode, tongue operated guard locking interlock switch that locks a machine guard closed until power is isolated while the guard is open. The guard may only be opened when a signal is applied to the internal solenoid which releases the lock mechanism. The 440G-MT locking mechanism is designed to withstand forces up to 1600 N (360 lb) and the die-cast alloy housing is ideal for use in harsh environments.

The 440G-MT solenoid switch is designed for machines that do not stop immediately or where premature interruption of the machine could cause damage to tooling and components or cause an additional hazard.

A 24V DC enhanced version is available with diagnostic output, which may be used by a control system to indicate whether a guard door is open or shut independently of the lock mechanism status. A built in LED further visually indicates the status of the switch as “door open,” “door shut and unlocked,” and “door shut and locked.”

This enhanced version is supplied with a metal manual override key to more easily enable manual unlocking in conditions when power is not available to electrically unlock the switch.

Features

- Mechanical lock
- High locking force—1600 N (360 lb)
- Heavy-duty die-cast alloy housing, ideal for harsh environments
- Diagnostic version available

Specifications

Safety Ratings						
Standards		EN954-1, ISO13849-1, IEC/EN60204-1, NFPA79, EN1088, ISO14119, IEC/EN60947-5-1, ANSI B11.19, AS4024.1				
Safety Classification		Cat. 1 Device per EN954-1 May be suitable for use in Cat 3 or Cat 4 systems depending on the architecture and application characteristics				
Functional Safety Data (related to Safety Contacts) ✶ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*		B10d: > 2 x 10^6 operations at min. load PFH_D: < 3 x10^{-7} MTTFd: > 385 years May be suitable for use in performance levels Ple or Pld systems (according to ISO 13849-1:2006) and for use in SIL2 or SIL3 systems (according to IEC 62061) depending on the architecture and application characteristics				
Certifications		CE Marked for all applicable directives, cULus, TÜV, and CCC				
Outputs						
Safety Contacts ❄		3 N.C. or 2 N.C. direct opening action				
Auxiliary Contacts		1 N.O. or 2 N.O.				
Thermal Current I_{th}		10 A				
Rated Insulation Voltage		(Ui) 500V				
Switching Current @ Voltage, Min.		5 mA @ 5V DC				
Utilization Category						
A600/AC-15	(Ue)	600V	500V	240V	120V	
	(Ie)	1.2 A	1.4 A	3 A	6 A	
DC-13	(Ue)	24V				
	(Ie)	2 A				
Solenoid Characteristics						
Locking Type		Power to Release				
Holding Force, Max.		1600 N (360 lb)				
Power Supply		24V AC/DC or 110V AC or 230V AC				
Solenoid Power		13 W typical 100% ED				
Operating Characteristics						
Break Contact Force, Min.		6 N (1.35 lbf)				
Actuation Speed, Max.		160 mm (6.29 in.)/s				
Actuation Frequency, Max.		2 cycles/s				
Operating Radius, Min		60 mm (2.36 in.)				
Operating Life @ 100 mA load		1,000,000 operations				
Environmental						
Enclosure Type Rating		IP67				
Operating Temperature [C (F)]		-25…+60° (13…+140°)				
Physical Characteristics						
Housing Material		Painted zinc alloy				
Actuator Material		Stainless Steel				
Weight [g (lb)]		1400 (3.08)				
Color		Red				

✶ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the B10d value given and:
- Usage rate of 1op/10 mins., 24 hrs/day, 360 days/year, representing 51840 operations per year
- Mission time/Proof test interval of 38 years

❄ The safety contacts are described as normally closed (N.C.) i.e., with the guard closed, actuator in place (where relevant) and the machine able to be started.

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Publication S117-CA001A-EN-P

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Product Selection

Solenoid Voltage	Contact			Actuator Type	Cat. No.			
					M20 Conduit		Connector§	
	Safety	Auxiliary	Action		M20	1/2 inch NPT	12-Pin M23	8-Pin Micro (M12)♣
24V AC/DC	3 N.C.	1 N.O.	BBM	GD2 standard	**440G-MT47037**	440G-MT47039	440G-MT47041	440G-M3NBGDH-AC
				Fully-flexible	440G-MT47038	440G-MT47040	440G-MT47042	440G-M3NBBDH-AC
				—	440G-MT47007	440G-MT47008	**440G-MT47043**	—
	2 N.C.	2 N.O.	BBM	GD2 standard	440G-MT47044	440G-MT47046	440G-MT47048	—
				Fully-flexible	440G-MT47045	440G-MT47047	440G-MT47049	—
				—	440G-MT47010	440G-MT47011	440G-MT47050	—
24V DC with diagnostic function and metal override key	3 N.C.	1 N.O.	BBM	GD2 standard	440G-MT47149	440G-MT47150	440G-MT47151	—
				Fully flexible	440G-MT47152	440G-MT47153	440G-MT47154	—
				No actuator	440G-MT47155	440G-MT47156	440G-MT47157	—
	2 N.C.	2 N.O.	BBM	GD2 standard	440G-MT47158	440G-MT47159	440G-MT47160	—
				Fully flexible	440G-MT47161	440G-MT47162	440G-MT47163	—
				No actuator	440G-MT47164	440G-MT47165	440G-MT47166	—
110V AC/DC	3 N.C.	1 N.O.	BBM	GD2 standard	440G-MT47070	440G-MT47073	—	—
				Fully-flexible	440G-MT47071	440G-MT47074	—	—
				—	440G-MT47013	440G-MT47009	—	—
	2 N.C.	2 N.O.	BBM	GD2 standard	440G-MT47077	440G-MT47079	—	—
				Fully-flexible	440G-MT47078	440G-MT47080	—	—
				—	440G-MT47012	440G-MT47014	—	—
230V AC/DC	3 N.C.	1 N.O.	BBM	—	440G-MT47016	440G-MT47017	—	—
	2 N.C.	2 N.O.		—	440G-MT47015	440G-MT47024	—	—

§ For connector ratings see page 3-9.
♣ With an 8-pin micro (M12) connector, not all contacts are connected. See page 3-39 for wiring details.

Recommended Logic Interfaces

Description	Safety Outputs	Auxiliary Outputs	Time Delay	Terminals	Reset Type	Power Supply	Cat. Page No.	Cat. No.
Single-Function Safety Relays								
MSR127RP	3 N.O.	1 N.C.	—	Removable (Screw)	Monitored Manual	24V AC/DC	5-26	**440R-N23135**
MSR127TP	3 N.O.	1 N.C.	—	Removable (Screw)	Auto./Manual	24V AC/DC	5-26	**440R-N23132**
MSR126T	2 N.O.	None	—	Fixed	Auto./Manual	24V AC/DC	5-24	**440R-N23117**
MSR30RT	2 N.O. Solid State	1 N.O. Solid State	—	Removable	Auto./Manual or Monitored Manual	24V DC	5-16	440R-N23198
Specialty Safety Relays								
MSR178	3 N.O.	2 N.C.	0.5 s…30 min	Removable	Automatic	24V AC/DC, 115V AC or 230V AC	5-40	440R-M23227
CU2	2 N.O.	1 N.C.	0.1 s…40 min	Fixed	—	24V AC/DC	5-56	440R-S07281
CU3	2 N.O.	1 N.C.	—	Fixed	Automatic/Manual	110V AC	5-64	440R-S35002
Modular Safety Relays								
MSR210P Base 2 N.C. only	2 N.O.	1 N.C. and 2 PNP Solid State	—	Removable	Auto./Manual or Monitored Manual	24V DC from the base unit	5-82	440R-H23176
MSR220P Input Module	—	—	—	Removable	—	24V DC	5-86	440R-H23178
MSR310P Base	MSR300 Series Output Modules	3 PNP Solid State	—	Removable	Auto./Manual Monitored Manual	24V DC	5-102	440R-W23219
MSR320P Input Module	—	2 PNP Solid State	—	Removable	—	24V DC from the base unit	5-106	440R-W23218

Note: For additional Safety Relays connectivity, see page 5-12.
For additional Safety I/O and Safety PLC connectivity, see page 5-116.
For application and wiring diagrams, see page 10-1.

Guard Locking Switches

440G-MT

Connection Systems

Description	8-Pin Micro	12-Pin M23
Cordset	889D-F8AB-✶	889M-F12AH-✶
Patchcord	889D-F8ABDM-❄	889M-F12AHMU-‡

✶ Replace symbol with 2 (2 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
❄ Replace symbol with 1 (1 m), 2 (2 m), 3 (3 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
‡ Replace symbol with 0M3, (0.3 m), 0M6 (0.6 m), 1 (1 m), 2 (2 m) or 3 (3 m) for standard lengths.
Note: For additional information, see page 7-1.

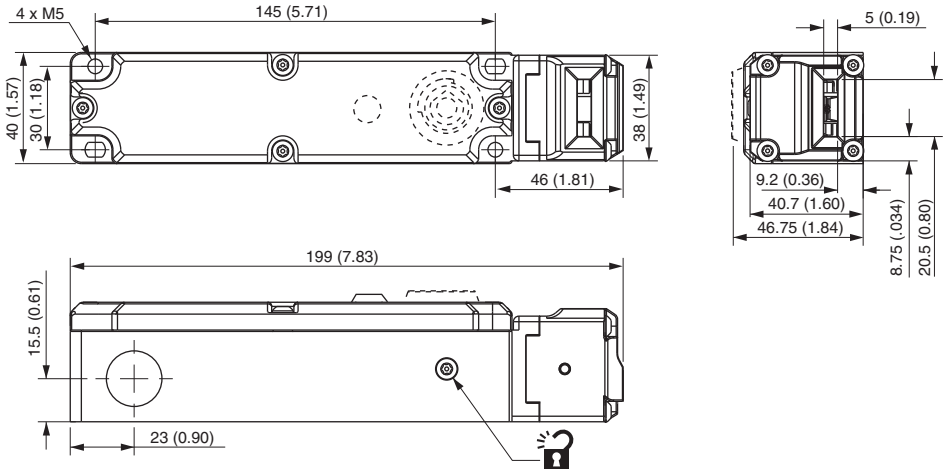
Accessories

Description		Dimensions	Cat. No.
	GD2 standard actuator	3-50	**440G-A27011**
	GD2 flat actuator		**440K-A11112**
	Fully flex actuator		**440G-A27143**
	Sliding bolt actuator		440G-A27163
	Extended flat actuator		**440K-A17116**
	Replacement Cover, No LED, No Override Key	—	440G-MT47120
	Replacement Cover, LED, Override Key		440G-MT47123
	Emergency Override Key (See Warning below.)	—	440G-A36026
	Dust Cover	—	440K-A17180

WARNING: Do not attach the Emergency Override Key to the 440G-MT switch.

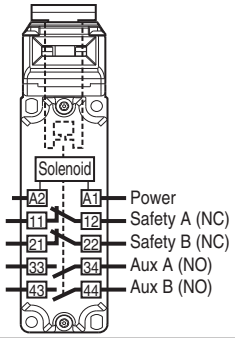
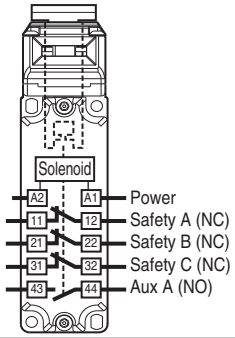
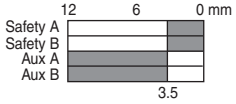
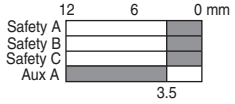
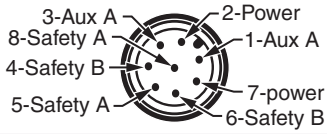
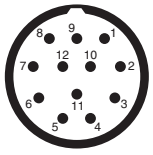
Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



***Note**: 2D, 3D and electrical drawings are available on www.ab.com.*

Typical Wiring Diagrams

		2 N.C. & 2 N.O.	3 N.C. & 1 N.O.
Contact Configuration			
Contact Action □Open ■Closed		 BBM	 BBM
8-Pin Micro (M12)		—	
12-Pin M23 QD  Pin 11 not connected.	1 and 3	Solenoid Power	Solenoid Power
	4 and 6	Safety A	Safety A
	7 and 8	Safety B	Safety B
	2 and 5	Aux A	Safety C
	9 and 10	Aux B	Aux A
	12	Ground	Ground
8-Pin Cordset 889D-F8AB-∗	Brown Blue	—	Solenoid Power
	Grey Red	—	Safety A
	Yellow Pink	—	Safety B
	White Green	—	Aux A
12-Pin Cordset 889M-F12AH-∗	Brown Grey	Solenoid Power	Solenoid Power
	Pink Yellow	Safety A	Safety A
	White Red/Blue	Safety B	Safety B
	Blue Red	Aux A	Safety C
	Black Violet	Aux B	Aux A
Grey/Pink not connected.	Green	Ground	Ground

∗ Replace symbol with 2 (2 m), 5 (5 m) or 10 (10 m) for standard cable lengths.

Diagnostic Version

Actuator	LED Output Matrix	
	Solenoid Off	Solenoid On
In	Green	Amber
Out	Flashing Red	Red

Diagnostic Electrical Output

Actuator	Voltage
In	0V DC
Out	+24V DC

Electrical output independent of solenoid status. Maximum output is 100 mA.

Guard Locking Switches

TLS-GD2

Description

The TLS-GD2 is a positive mode, tongue operated guard locking interlock switch that locks a machine guard closed until power is isolated and ensures that it remains isolated while the guard is open. It has three safety (N.C.) contacts and two auxiliary (N.O.) contacts. The TLS-GD2 head has two entry slots and it can be rotated to provide four actuator entry points. A blanking plug is provided to seat the unused slot.

The guard may only be opened when a signal is applied to the TLS-GD2's internal solenoid which releases the lock mechanism. This signal can be via CU1 electronic timer relays or CU2 stopped motion detectors. Therefore the TLS-GD2 is ideal for machines which do not stop immediately or where premature interruption of the machine could cause damage to tooling and components or cause an additional hazard.

The TLS-GD2 is available in three types. The TLS-1 GD2 and TLS-3 GD2 incorporate a power-to-release function. Two manual release points with security screws allow the locked TLS-GD2 to be released in emergencies. An optional lid-mounted key-release style can also be supplied. The TLS-2 GD2 has a power-to-lock function. Each type of switch has five sets of contacts of various forms and are suitable for use with PLCs.

The TLS-1 GD2 and TLS-3 GD2 are both available with escape release options. They are intended for machine guarding with full body access. The switch is installed so that the escape release push button on the rear side is accessible from inside the hazardous area. This allows the intentional unlocking of the TLS-GD2 from inside a hazardous area, providing a means of escape for a person who may become trapped.

A stainless-steel actuator guide is fitted to protect the unit from actuator damage due to poor guard alignment or guard wear.

TLS-GD2 has an ingress protection rating of IP69K making it suitable for harsh washdown applications as found in the food and beverage, pharmaceutical, solar and semiconductor industries.

IMPORTANT: With the TLS-2 GD2 "power to lock" style, provisions may be required to ensure that a dangerous situation can not result from open circuit faults or power cuts.

Features

- Power to release or power to lock
- High locking force ≤2000 N (450 lb)
- Five contacts: 2 N.C. & 1 N.O. for door position monitoring 1 N.C. & 1 N.O. or 2 N.C. for lock monitoring
- Rotatable head: 4 possible key entry slots
- Conforms to EN 1088 & EN 60947-5-1
- Escape Release version available
- IP69K, suitable for high pressure, high temperature washdown

Specifications

Safety Ratings					
Standards		EN954-1, ISO13849-1, IEC/EN60204-1, NFPA79, EN1088, ISO14119, IEC/EN60947-5-1, ANSI B11.19, AS4024.1			
Safety Classification		Cat. 1 device per EN 954-1 dual channel interlocks suitable for Cat. 3 or 4 systems			
Functional Safety Data (related to Safety Contacts) ✶ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*		B10d: > 2 x 10^6 operations at min. load PFH_D: < 3 x10^{-7} MTTFd: > 385 years May be suitable for use in performance levels Ple or Pld systems (according to ISO 13849-1:2006) and for use in SIL2 or SIL3 systems (according to IEC 62061) depending on the architecture and application characteristics			
Certifications		CE Marked for all applicable directives, cULus, TÜV, and CCC			
Outputs					
Safety Contacts ❄		(TLS-1 & -2) 3 N.C. direct opening action (TLS-3) 4 N.C. direct opening action			
Auxiliary Contacts		(TLS-1 & -2) 2 N.O. (1 solenoid monitoring) (TLS-3 1 N.O.)			
Thermal Current I_{th}		10 A			
Rated Insulation Voltage		(Ui) 500V			
Switching Current @ Voltage, Min.		5 mA @ 5V DC			
Utilization Category					
A600/AC-15	(Ue)	600V	500V	240V	120V
	(Ie)	1.2 A	1.4 A	3.0 A	6.0 A
DC-13	(Ue)	24V			
	(Ie)	2 A			
Solenoid Characteristics					
Locking Type		TLS-1 & -3 Power-to-Release TLS-2 Power-to-Lock			
Holding Force, Max.		2000 N (450 lbf)			
Releasable Load, Max.		100 N (22.5 lbf)			
Power Supply		24V AC/DC or 110V AC or 230V AC (solenoid)			
Solenoid Power		Typically 7 W 100% ED			
Escape Release Button		Force max.: 50 N (11.25 lbs)			
Operating Characteristics					
Break Contact Force, Min.		20 N (4.5 lbf)			
Actuation Speed, Max.		160 mm (6.29 in.)/s			
Actuation Frequency, Max.		1 cycle/s			
Operating Radius, Min		160 mm (6.3 in.) [80 mm (3.15 in.) with flexible actuator]			
Operating Life @ 100 mA load		1,000,000 operations			
Environmental					
Enclosure Type Rating		IP66, IP67 and IP69K			
Operating Temperature [C (F)]		-20…+60° (-4…+140°)			
Physical Characteristics					
Housing Material		UL Approved glass-filled PBT			
Actuator Material		Stainless Steel			
Weight [g (lb)]		400 (0.88)			
Color		Red			

✶ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the B10d value given and:
- Usage rate of 1op/10mins., 24hrs/day, 360 days/year, representing 51840 operations per year
- Mission time/Proof test interval of 38 years

❄ The safety contacts are described as normally closed (N.C.) i.e., with the guard closed, actuator in place (where relevant) and the machine able to be started.

Product Selection

Type	Contacts		Solenoid		Actuator Type	Cat. No.			
						Conduit		Connector§	
	Safety	Auxiliary	Contacts	Voltage		M20	1/2 inch NPT Adaptor	12-Pin M23	8-Pin Micro (M12)♣
TLS-1 GD2 Power to Release	2 N.C.	1 N.O.	1 N.C. & 1 N.O.	24V AC/DC	—	**440G-T27121**	—	440G-T27233	440G-T2NBBPH-1R
					GD2 Standard	440G-T27251	440G-T27169	440G-T27234	—
					Fully Flex	440G-T27252	**440G-T27171**	440G-T27235	—
				110V AC/DC	—	440G-T27124	—	—	—
					GD2 Standard	440G-T27253	440G-T27172	—	—
					Fully Flex	440G-T27254	440G-T27174	—	—
				230V AC/DC	—	440G-T27123	—	—	—
TLS-2 GD2 Power to Lock	2 N.C.	1 N.O.	1 N.C. & 1 N.O.	24V AC/DC	—	**440G-T27127**	—	440G-T27239	440G-T2NBBPH-1L
					GD2 Standard	440G-T27255	440G-T27175	440G-T27240	—
					Fully Flex	440G-T27256	**440G-T27177**	440G-T27241	—
				110V AC/DC	—	440G-T27132	—	—	—
					GD2 Standard	440G-T27257	440G-T27178	—	—
					Fully Flex	440G-T27258	440G-T27180	—	—
				230V AC/DC	—	440G-T27129	—	—	—
TLS-3 GD2 Power to Release	2 N.C.	1 N.O.	2 N.C.	24V AC/DC	—	**440G-T27134**	—	440G-T27245	440G-T2NBBPH-2R
					GD2 Standard	440G-T27259	440G-T27181	440G-T27246	—
					Fully Flex	440G-T27260	440G-T27183	440G-T27247	—
				110V AC/DC	—	440G-T27138	—	—	—
					GD2 Standard	440G-T27261	440G-T27184	—	—
					Fully Flex	440G-T27262	440G-T27186	—	—
				230V AC/DC	—	440G-T27136	—	—	—
TLS-1 GD2 Power to Release with Escape Release	2 N.C.	1 N.O.	1 N.C. & 1 N.O.	24V AC/DC	—	440G-T21BNPM-1B	440G-T21BNPT-1B	440G-T21BNPL-1B	440G-T2NBNPH-1B
					GD2 Standard	440G-T21BGPM-1B	440G-T21BGPT-1B	440G-T21BGPL-1B	—
				110V AC/DC	—	440G-T21BNPM-4B	440G-T21BNPT-4B	—	—
					GD2 Standard	440G-T21BGPM-4B	440G-T21BGPT-4B	—	—
TLS-3 GD2 Power to Release with Escape Release	2 N.C.	1 N.O.	2 N.C.	24V AC/DC	—	440G-T21BNPM-2B	440G-T21BNPT-2B	440G-T21BNPL-2B	440G-T2NBNPH-2B
					GD2 Standard	440G-T21BGPM-2B	440G-T21BGPT-2B	440G-T21BGPL-2B	—
				110V AC/DC	—	440G-T21BNPM-5B	440G-T21BNPT-5B	—	—
					GD2 Standard	440G-T21BGPM-5B	440G-T21BGPT-5B	—	—

§ For connector ratings, see page 3-9.
♣ With an 8-pin micro connector, not all contacts are connected. See page 3-45 for wiring details.

WARNING:

To monitor **independently** the safety contact(s) and the solenoid feedback (TLS 1, 2 and 3):

- The 12-wire cordset 889M-F12AH-∗ must be used

AND

- For the TLS1 and TLS2: the jumper between 12 and 41 must be removed
- For the TLS3: the jumpers between 12 and 41 and 22 and 51 must be removed

WARNING:

Monitoring of safety contact(s) and the solenoid feedback (in series) is available, when jumpers are in place:

AND

- For the TLS1 and TLS2: by using pins 4 and 6 on the 12-pin, M23 receptacle or Pink and Yellow wires on the 12-wire cordset (889M-F12AH-∗)
- For the TLS3: by using pins 4 and 6 and pins 7 and 8 on the 12-pin, M23 receptacle or Pink and Yellow and White and Red/Blue wires on the 12-wire cordset (889M-F12AH-∗)

∗ Replace symbol with 2 (2 m), 5 (5 m), or 10 (10 m) for standard cable lengths.

Guard Locking Switches

TLS-GD2

Recommended Logic Interfaces

Description	Safety Outputs	Auxiliary Outputs	Time Delay	Terminals	Reset Type	Power Supply	Cat. Page No.	Cat. No.
Single-Function Safety Relays								
MSR127RP	3 N.O.	1 N.C.	—	Removable (Screw)	Monitored Manual	24V AC/DC	5-26	**440R-N23135**
MSR127TP	3 N.O.	1 N.C.	—	Removable (Screw)	Auto./Manual	24V AC/DC	5-26	**440R-N23132**
MSR126T	2 N.O.	None	—	Fixed	Auto./Manual	24V AC/DC	5-24	**440R-N23117**
MSR30RT	2 N.O. Solid State	1 N.O. Solid State	—	Removable	Auto./Manual or Monitored Manual	24V DC	5-16	440R-N23198
Specialty Safety Relays								
MSR178	3 N.O.	2 N.C.	0.5 s…30 min	Removable	Automatic	24V AC/DC, 115V AC or 230V AC	5-40	440R-M23227
CU2	2 N.O.	1 N.C.	0.1 s…40 min	Fixed	—	24V AC/DC	5-56	440R-S07281
CU3	2 N.O.	1 N.C.	—	Fixed	Automatic/Manual	110V AC	5-64	440R-S35002
Modular Safety Relays								
MSR210P Base 2 N.C. only	2 N.O.	1 N.C. and 2 PNP Solid State	—	Removable	Auto./Manual or Monitored Manual	24V DC from the base unit	5-82	440R-H23176
MSR220P Input Module	—	—	—	Removable	—	24V DC	5-86	440R-H23178
MSR310P Base	MSR300 Series Output Modules	3 PNP Solid State	—	Removable	Auto./Manual Monitored Manual	24V DC	5-102	440R-W23219
MSR320P Input Module	—	2 PNP Solid State	—	Removable	—	24V DC from the base unit	5-106	440R-W23218

Note: For additional Safety Relays connectivity, see page 5-12.
For additional Safety I/O and Safety PLC connectivity, see page 5-116.
For application and wiring diagrams, see page 10-1.

Connection Systems

Description	8-Pin Micro (M12)	12-Wire, 12-Pin M23	9-Wire, 12-Pin M23§
Cordset	889D-F8AB-✶	889M-F12AH-✶	889M-FX9AE-✶
Patchcord	889D-F8ABDM-❄	889M-F12AHMU-‡	—

✶ Replace symbol with 2 (2 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
❄ Replace symbol with 1 (1 m), 2 (2 m), 3 (3 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
‡ Replace symbol with 0M3, (0.3 m), 0M6 (0.6 m), 1 (1 m), 2 (2 m) or 3 (3 m) for standard lengths.
§ The 9-wire cordset can be used only with the TLS3 versions.
Note: For additional information, see page 7-1.

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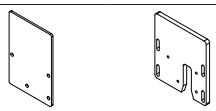
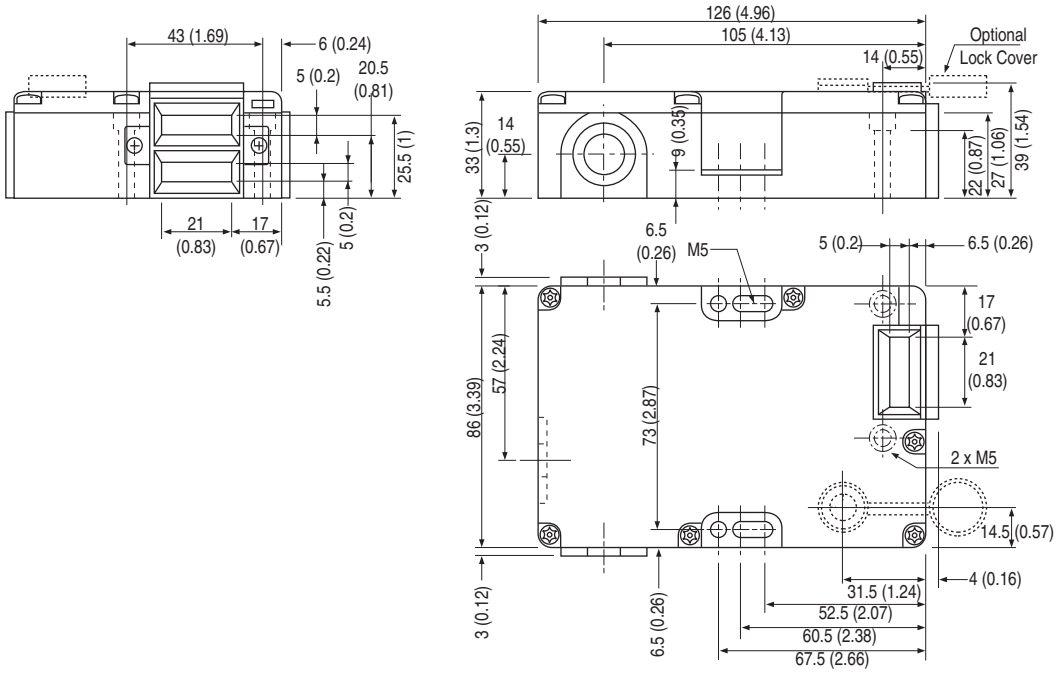
Accessories

Description		Dimensions	Cat. No.
	GD2 standard actuator	3-50	**440G-A27011**
	GD2 flat actuator	3-51	**440K-A11112**
	Extended flat actuator	3-51	**440K-A17116**
	Fully flex actuator	3-50	**440G-A27143**
	Sliding bolt actuator not to be used with the Escape Release	3-55	440G-A27163
	Cover for TLS-1 with external override key for series D and earlier	—	440G-A27140
	Cover for TLS-3 with external override key for series D and earlier		440G-A27142
	Cover for TLS-1 with override key attached for series D and earlier		440G-A27207
	Cover for TLS-3 with override key attached for series D and earlier		440G-A27208
	Cover for TLS-1 with external override key for series E and later		440G-A27371
	Cover for TLS-3 with external override key for series E and later		440G-A27372
	Cover for TLS-1 with override key attached for series E and later		440G-A27373
	Cover for TLS-3 with override key attached for series E and later		440G-A27374
	Emergency Override Key (See Warning below.)	—	440G-A36026
	Flexible Release—1 m (3.28 ft) Cable	3-54	440G-A27356
	Flexible Release—3 m (9.84 ft) Cable		440G-A27357
	Dust Cover	—	440K-A17183
	Sliding Bolt	3-55	440K-AMDS
	Mounting Plate	3-55	440K-AMDSSMPB

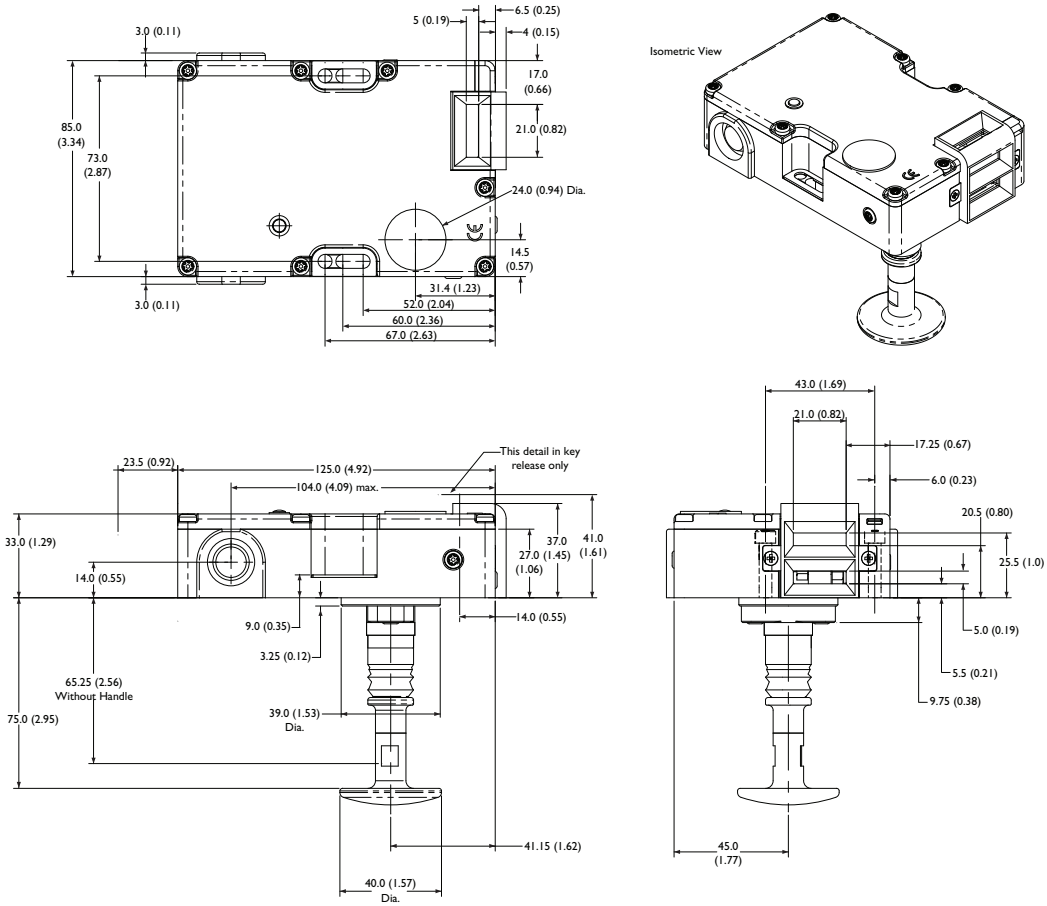
WARNING: Do not attach the Emergency Override Key to the TLS-GD2 switch.

Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.

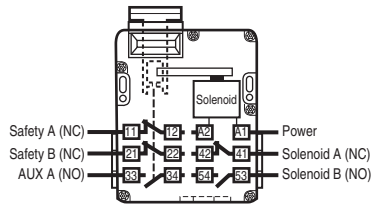
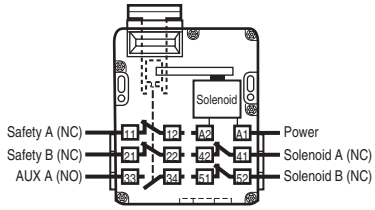
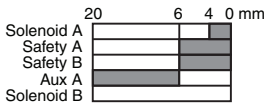
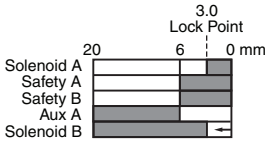
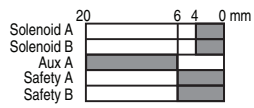
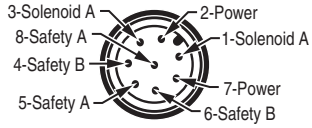
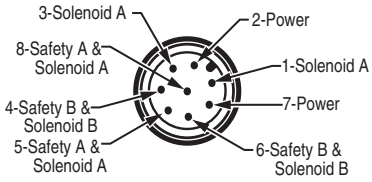


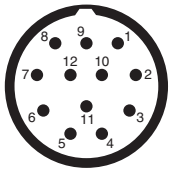
TLS-GD2 Escape Release



***Note**: 2D, 3D and electrical drawings are available on www.ab.com.*

Typical Wiring Diagrams

Red Switches	TLS1	TLS2	TLS3
Contact Configuration	 Jumper between 12 & 41		 Jumper between 12 & 41 and 22 & 51
Contact Action □Open ■Closed	 BBM	 BBM	 BBM
8-Pin Micro (M12)	 No jumper on 12-41.		 Jumper on 12-41 and 22-51.

12-Pin M23 	1 and 3	Solenoid Power	1 and 3	Solenoid Power
	4 and 12	Safety A ❖	4 and 12	Safety A ❖
	7 and 8	Safety B	7 and 5	Safety B ❖
	9 and 10	Aux A	9 and 10	Aux A
	6 and 11	Solenoid A ❖	6 and 11	Solenoid A ❖
	2 and 5	Solenoid B	2 and 8	Solenoid B ❖
8-Pin Cordset 889D-F8AB-∗	Brown Blue	Solenoid Power	Solenoid Power	
	Grey Red	Safety A	Safety A & Solenoid A	
	Yellow Pink	Safety B	Safety B & Solenoid B	
	White Green	Solenoid A	Solenoid A	
12-Pin, 9-Wire Cordset 889M-FX9AE-∗ Pink/Yellow: Not connected	Can not be used.		Brown Blue	Solenoid Power
			White Green	Safety A & Solenoid A
			Yellow Grey	Safety B & Solenoid B
			Pink Red	Aux A
12-Pin, 12-Wire Cordset 889M-F12AH-∗	Brown Grey	Solenoid Power	Brown Grey	Solenoid Power
	Pink Green	Safety A ❖	Pink Green	Safety A ❖
	White Red/Blue	Safety B	White Red	Safety B ❖
	Black Violet	Aux A	Black Violet	Aux A
	Grey/Pink Yellow	Solenoid A ❖	Grey/Pink Yellow	Solenoid A ❖
	Blue Red	Solenoid B	Blue Red/Blue	Solenoid B ❖

∗ Replace symbol with 2 (2 m), 5 (5 m) or 10 (10 m) for standard cable lengths.
❖ See **WARNING** notes on page 3-41.

Guard Locking Switches

Atlas™ 5

Description

The Atlas 5 is a positive-mode, tongue-operated guard-locking interlock switch that locks a machine guard closed until power is isolated to ensure that it remains isolated while the guard is open. A heavy-duty switch, the Atlas 5 locking mechanism is designed to withstand forces up to 5000 N (1124 lb) and the die-cast alloy housing is ideal for use in harsh environments. A unique feature of the Atlas 5 is a patented self-aligning head that tolerates actuator or guard misalignment, making it particularly useful for heavy machine guards.

The Atlas 5 is designed for machines that do not stop immediately or where premature interruption of the machine could cause damage to tooling and components or cause an additional hazard. With 2 safety (N.C.) contacts and 2 auxiliary (N.O.) contact, Atlas 5 is ideal for PLC controlled machines.

Features

- Mechanical lock
- High locking force—5000 N (1124 lb)
- Heavy duty die-cast alloy housing ideal for harsh environments
- Patented self-aligning head tolerates actuator misalignment

Specifications

Safety Ratings			
Standards		EN954-1, ISO13849-1, IEC/EN60204-1, NFPA79, EN1088, ISO14119, IEC/EN60947-5-1, ANSI B11.19, AS4024.1	
Safety Classification		Cat. 1 Device per EN954-1 Dual channel interlocks suitable for Cat. 3 or 4 systems	
Functional Safety Data (related to Safety Contacts) ∗ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*		B10d: > 2 x 10^6 operations at min. load PFH_D: < 3 x10^{-7} MTTFd: > 385 years May be suitable for use in performance levels Ple or Pld systems (according to ISO 13849-1:2006) and for use in SIL2 or SIL3 systems (according to IEC 62061) depending on the architecture and application characteristics	
Certifications		CE Marked for all applicable directives, cULus, CSA, and TÜV	
Outputs			
Safety Contacts ❄		Atlas 5: 2 N.C. direct opening action; 1 N.O. direct opening action Atlas 5 trapped key (left hand): 2 N.C. direct opening action; 1 N.O. direct opening action	
Auxiliary Contacts		1 N.O.	
Thermal Current I_{lth}		10 A	
Rated Insulation Voltage		(Ui) 500V	
Switching Current @ Voltage, Min.		5 mA @ 5V DC	
Utilization Category			
AC-15	(Ue)	240V	120V
	(Ie)	1.5 A	3 A
DC-13	(Ue)	24V	
	(Ie)	2 A	
Solenoid Characteristics			
Locking Type		Power to Release	
Holding Force, Max.		5000 N (1124 lbf)	
Power Supply		24V AC/DC or 110V AC or 230V AC (solenoid)	
Solenoid Power		13 W typical 100% ED	
Operating Characteristics			
Break Contact Force, Min.		12 N (2.7 lbf)	
Actuation Speed, Max.∗		160 mm (6.29 in.)/s	
Actuation Frequency, Max.		2 cycles/s	
Operating Radius, Min		300 mm end entry, 800 mm entry front	
Operating Life @ 100 mA load		1,000,000 operations	
Environmental			
Enclosure Type Rating		IP65	
Operating Temperature [C (F)]		-10…+60° (+14…+140°)	
Physical Characteristics			
Housing Material		Die-cast alloy	
Actuator Material		Stainless Steel	
Weight [g (lb)]		1200 (2.65)	
Color		Red	

∗ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the B10d value given and:
- Usage rate of 1op/10mins., 24hrs/day, 360 days/year, representing 51840 operations per year
- Mission time/Proof test interval of 38 years

❄ The safety contacts are described as normally closed (N.C.) i.e., with the guard closed, actuator in place (where relevant) and the machine able to be started.

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Product Selection

Module Type	Actuator Type	Contact		Solenoid Contacts	Solenoid Voltage	Cat. No.			
						M20 Conduit		Connector§	
		Safety	Auxiliary			M20	1/2 inch NPT Adaptor	12-Pin M23	8-Pin Micro (M12)♣
Standard	Standard	2 N.C.	1 N.O.	2 N.C. & 1 N.O.	24V AC/DC	440G-L07264	440G-L07258	440G-L07298	440G-L2NNSDH-3N
					110V AC/DC	440G-L07263	440G-L07257	—	—
					230V AC/DC	440G-L07262	440G-L07256	—	—
LH Key Lock					24V AC/DC	440G-L07255	440G-L07249	440G-L07301	440G-L2NNSDH-38
					110V AC/DC	440G-L07254	440G-L07248	—	—
					230V AC/DC	440G-L07253	440G-L07247	—	—

§ For connector ratings, see 3-9.
♣ With an 8-pin micro connector, not all contacts are connected. See page 3-49 for wiring details.

Recommended Logic Interfaces

Description	Safety Outputs	Auxiliary Outputs	Time Delay	Terminals	Reset Type	Power Supply	Cat. Page No.	Cat. No.
Single-Function Safety Relays								
MSR127RP	3 N.O.	1 N.C.	—	Removable (Screw)	Monitored Manual	24V AC/DC	5-26	**440R-N23135**
MSR127TP	3 N.O.	1 N.C.	—	Removable (Screw)	Auto./Manual	24V AC/DC	5-26	**440R-N23132**
MSR126T	2 N.O.	None	—	Fixed	Auto./Manual	24V AC/DC	5-24	**440R-N23117**
MSR30RT	2 N.O. Solid State	1 N.O. Solid State	—	Removable	Auto./Manual or Monitored Manual	24V DC	5-16	440R-N23198
Specialty Safety Relays								
MSR178	3 N.O.	2 N.C.	0.5 s…30 min	Removable	Automatic	24V AC/DC, 115V AC or 230V AC	5-40	440R-M23227
CU2	2 N.O.	1 N.C.	0.1 s…40 min	Fixed	—	24V AC/DC	5-56	440R-S07281
CU3	2 N.O.	1 N.C.	—	Fixed	Automatic/Manual	110V AC	5-64	440R-S35002
Modular Safety Relays								
MSR210P Base 2 N.C. only	2 N.O.	1 N.C. and 2 PNP Solid State	—	Removable	Auto./Manual or Monitored Manual	24V DC from the base unit	5-82	440R-H23176
MSR220P Input Module	—	—	—	Removable	—	24V DC	5-86	440R-H23178
MSR310P Base	MSR300 Series Output Modules	3 PNP Solid State	—	Removable	Auto./Manual Monitored Manual	24V DC	5-102	440R-W23219
MSR320P Input Module	—	2 PNP Solid State	—	Removable	—	24V DC from the base unit	5-106	440R-W23218

Note: For additional Safety Relays connectivity, see page 5-12.
For additional Safety I/O and Safety PLC connectivity, see page 5-116.
For application and wiring diagrams, see page 10-1.

Connection Systems

Description	8-Pin Micro (M12)	12-Pin M23
Cordset	889D-F8AB-✶	889M-F12AH-✶
Patchcord	889D-F8ABDM-❄	889M-F12AHMU-‡

✶ Replace symbol with 2 (2 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
❄ Replace symbol with 1 (1 m), 2 (2 m), 3 (3 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
‡ Replace symbol with 0M3, (0.3 m), 0M6 (0.6 m), 1 (1 m), 2 (2 m) or 3 (3 m) for standard lengths.
Note: For additional information, see page 7-1.

Guard Locking Switches

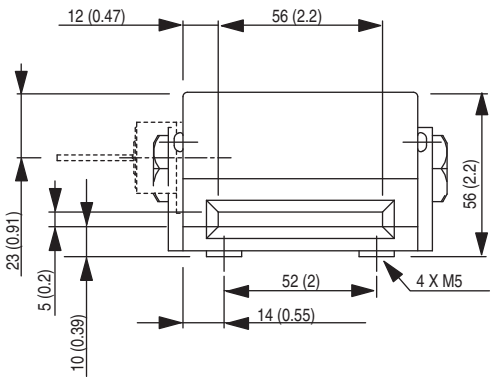
Atlas™ 5

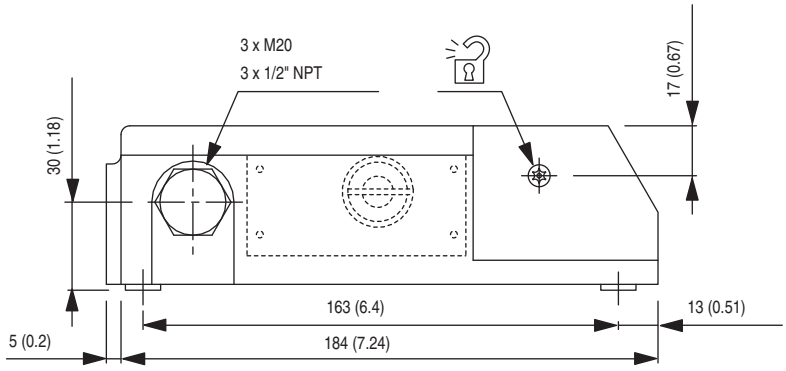
Accessories

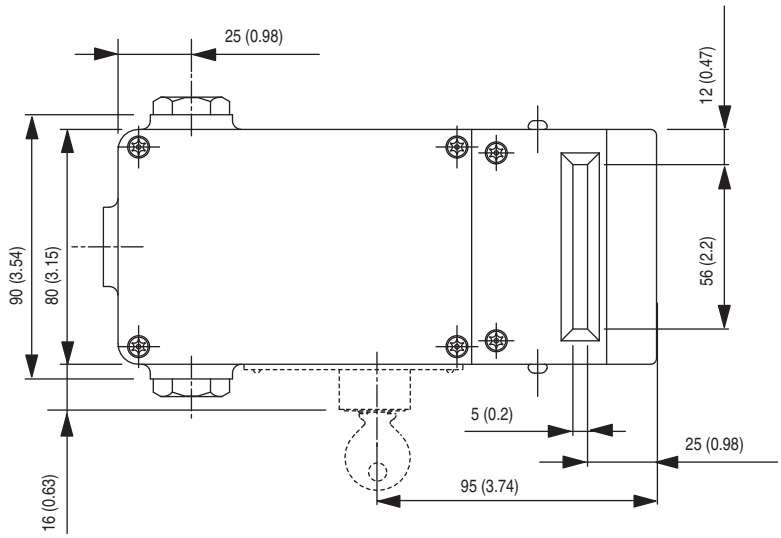
Description		Dimensions	Cat. No.
	Standard actuator	3-50	440G-A07136
	Atlas Replacement End Cap	—	440G-A07180
	Fully flex actuator	3-50	440G-A07269
	Dust Cover	—	440K-A17181

Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.

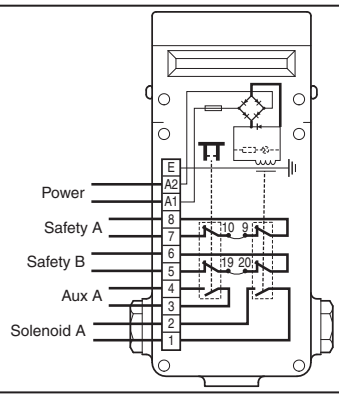
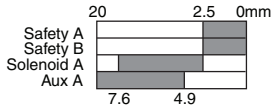
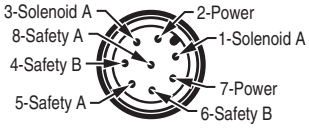
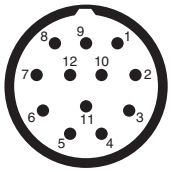






***Note**: 2D, 3D and electrical drawings are available on www.ab.com.*

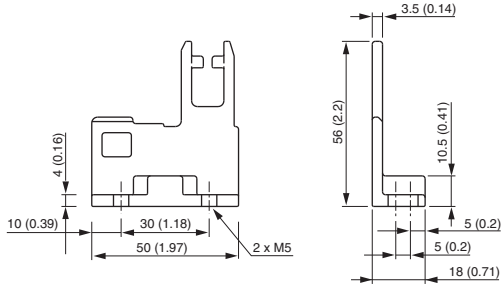
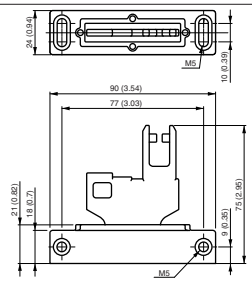
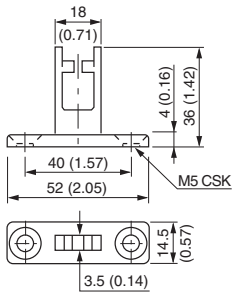
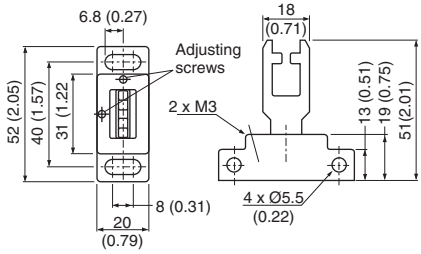
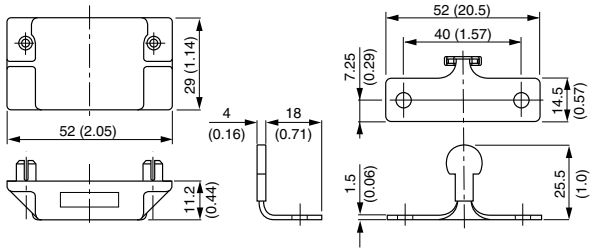
Typical Wiring Diagrams

		Atlas 5
Contact Configuration		
Contact Action □Open ■Closed		 BBM
8-Pin Micro (M12)		 Jumpers on 9-10 and 19-20.
12-Pin M23  Pin 11 not connected.	1 and 3	Solenoid Power
	4 and 6	Safety A
	7 and 8	Safety B
	2 and 5	Aux A
	9 and 10	Solenoid A
	12	Ground
8-Pin Cordset 889D-F8AB-∗	Brown Blue	Solenoid Power
	Grey Red	Safety A
	Yellow Pink	Safety B
	White Green	Solenoid A
12-Pin Cordset 889M-F12AH-∗	Brown Grey	Solenoid Power
	Pink Yellow	Safety A
	White Red/Blue	Safety B
	Blue Red	Aux A
	Black Violet	Solenoid A
	Green	Ground

∗ Replace symbol with 2 (2 m), 5 (5 m) or 10 (10 m) for standard cable lengths.

Accessories for Interlock and Guard Locking Switches

Actuators*

Item	Description	Approximate Dimensions [mm (in.)]	Cat. No.
	Standard actuator		440G-A07136
	Fully flex actuator		440G-A07269
	GD2 standard actuator		**440G-A27011**
	Fully flex actuator		**440G-A27143**
	Catch and Retainer Kit		440K-A11094

* See page 3-8 for Switch Compatibility table.

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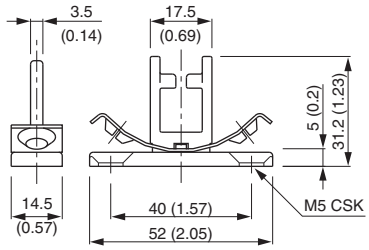
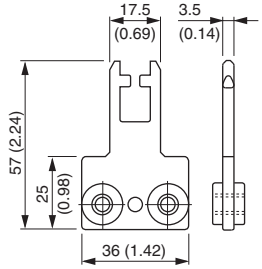
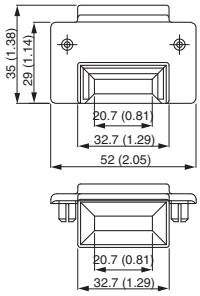
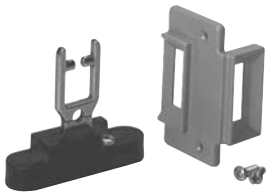
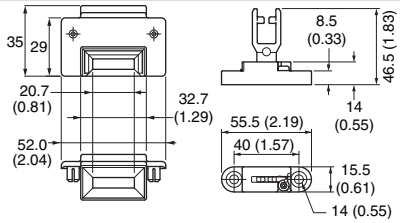
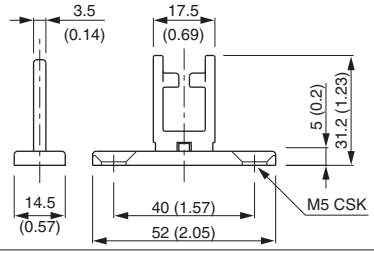
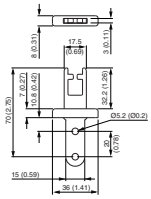
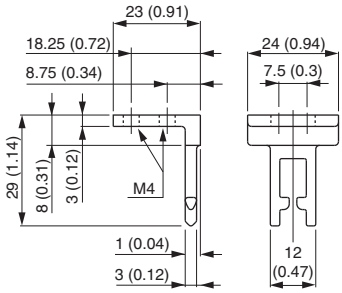
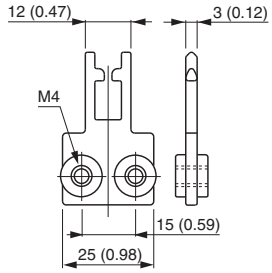
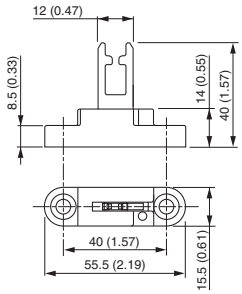
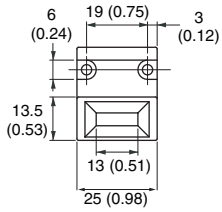
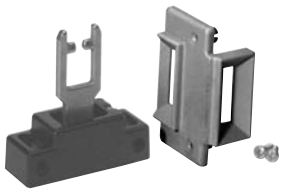
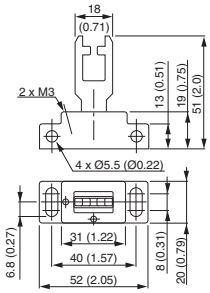
Actuators* (continued)

Item	Description	Approximate Dimensions [mm (in.)]	Cat. No.
	Standard actuator		**440K-A11095**
	GD2 flat actuator		**440K-A11112**
	Replacement Alignment Guide		440K-A11115
	Alignment guide with semi-flexible actuator		440K-A11144
	Standard actuator		440K-A11238
	Extended flat actuator		**440K-A17116**

* See page 3-8 for Switch Compatibility table.

Actuators* (continued)

Item	Description	Approximate Dimensions [mm (in.)]	Cat. No.
	90° actuator, not to be used with metal alignment guide		**440K-A21006**
	Flat actuator, not to be used with metal alignment guide		**440K-A21014**
	Metal alignment guide with semi-flexible actuator		440K-A21030
	Metal Alignment Guide		440K-A21069
	Alignment guide with fully-flexible actuator		440K-A27010

* See page 3-8 for Switch Compatibility table.

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Beacons and Bulbs

Item	Description	Cat. No.
	Indicator, M20 Conduit Pilot Light—Amber Lens T-3 1/4 Insert Use T-3 1/4 Bulb (Sold Separately)	440A-A19001
	Indicator, M20 Conduit Pilot Light—Red Lens T-3 1/4 Insert Use T-3 1/4 Bulb (Sold Separately)	440A-A19002
	Indicator, 1/2 inch NPT Conduit Pilot Light—Amber Lens T-3 1/4 Insert Use T-3 1/4 Bulb (Sold Separately)	440A-A19005
	Indicator, 1/2 inch NPT Conduit Pilot Light—Red Lens T-3 1/4 Insert Use T-3 1/4 Bulb (Sold Separately)	440A-A19007
	Bulb, 24V for Conduit Pilot Light 2.8W T-3 1/4 Bulb, Miniature Screw Base	440A-A09056
	Bulb, 110V for Conduit Pilot Light 2.6W T-3 1/4 Bulb, Miniature Screw Base	440A-A09055
	Bulb, 240V for Conduit Pilot Light 0.75W T-3 1/4 Bulb, Miniature Screw Base	440A-A09054
	Red LED Bulb, 24V AC/DC for Conduit Pilot Light Bayonet Style Insert	800T-N319R
	Amber LED Bulb, 24V AC/DC for Conduit Pilot Light Bayonet Style Insert	800T-N319A
	Red LED Bulb, 120V AC for Conduit Pilot Light Bayonet Style Insert	800T-N320R
	Amber LED Bulb, 120V AC for Conduit Pilot Light Bayonet Style Insert	800T-N320A

Conduit Accessories

Item	Description	Cat. No.
	Blanking plug, M20 conduit	440A-A07265
	Cable Grip, M16 Conduit, Accommodates Cable Diameter 4…7 mm (0.27…0.16 in.)	440A-A09004
	Cable grip, M20 conduit, accommodates cable diameter 7…10.5 mm (0.27…0.41 in.)	440A-A09028
	Adaptor, conduit, M20 to 1/2 inch NPT, plastic	440A-A09042
	Adaptor, Conduit, 1/2 inch NPT to M16, Brass	440A-A09093
	Adaptor, Conduit, M16 to 1/2 inch NPT, Brass	440A-A09094

Accessories

Replacement and Dust Covers, Emergency Override, and Flex Release

Replacement Covers

Item	Description	Cat. No.
	Elf™	440A-A33085
	Cadet™	440A-A21115
	Trojan T15	440A-A11499
	Trojan 5 Standard Models Only	440A-A11495
	Trojan T5 GD2	440A-A11496
	Trojan T6 Standard Models Only	440A-A11497
	Trojan T6 GD2	440A-A11498
	440G-MT No LED, No Override	440G-MT47120
	440G-MT LED and Override	440G-MT47123
	Cover for TLS-1 with external override key for series D and earlier	440G-A27140
	Cover for TLS-3 with external override key for series D and earlier	440G-A27142
	Cover for TLS-1 with override key attached for series D and earlier	440G-A27207
	Cover for TLS-3 with override key attached for series D and earlier	440G-A27208
	Atlas Replacement End Cap	440G-A07180

Dust Covers

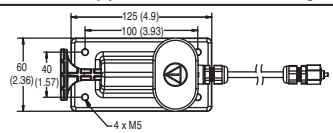
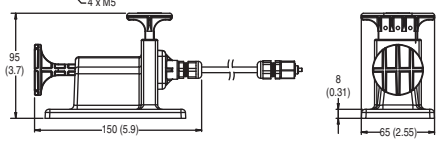
Item	Applicable Switch	Cat. No.
	Elf Cadet	440K-A17182
	Trojan T15, T5, and T6 All Models MT G2 440G-MT	440K-A17180
	TLS-GD2	440K-A17183
	Atlas 5	440K-A17181

Emergency Override

Item	Description	Cat. No.
	TLS-GD2/440G-MT Solenoid Emergency Override (See Warning below.)	440G-A36026

WARNING: Do not attach the Emergency Override Key to the TLS-GD2/440G-MT switch.

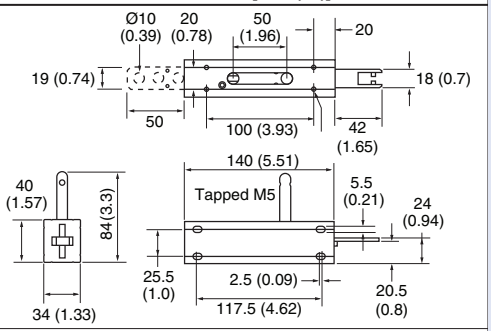
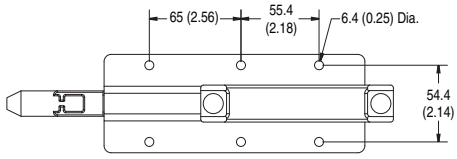
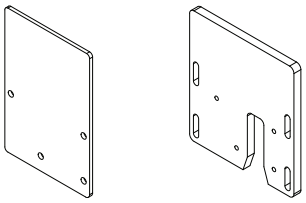
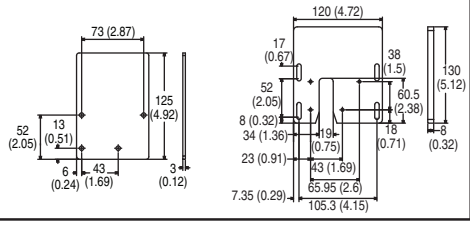
Flex Release

Item	Description	Approximate Dimensions [mm (in.)]	Cat. No.
	Flexible Release—1 m (3.28 ft) Cable		440G-A27356
	Flexible Release—3 m (9.84 ft) Cable		440G-A27357

Tools

Item	Description	Cat. No.
	Security Bit	440A-A09015
	Screwdriver Including Security Bit	440A-A09018

Door Handles

Item	Description	Dimensions [mm (in.)]	Cat. No.
	Sliding bolt actuator		440G-A27163
	Sliding Bolt		440K-AMDS
	Sliding Bolt Mounting Plate for TLS-GD2		440K-AMDSSMPB

Non-Contact Switches

SensaGuard™

Description

When it comes to machine safety, Rockwell Automation knows that protection of personnel and equipment is your main concern. At the same time, flexibility and productivity are points that must also be considered as you design your safety system. Optimize all of these with the new Allen-Bradley SensaGuard family of non-contact switches.

Featuring the latest generation of RFID technology for coding and inductive technology for sensing, SensaGuard's large sensing range and tolerance to misalignment is a cost-effective solution that is ideally suited for a wide range of industrial safety applications.

The SensaGuard product line is a Category 4/SIL 3 rated switch per EN954-1, TÜV functional safety approved to IEC 61508.

Features

- Switches can be connect to a standard safety relay, for example, the MSR126, MSR127, MSR200/300 Family, SmartGuard™ and Safety I/O Blocks
- Multiple actuator sizes for large sensing distance
- IP69K environmental rating
- Short-circuit and over-voltage protection
- LED located on the switch for door status and troubleshooting
- Unique coded version
  - Automatic learn process at unit power up
  - During commissioning you have the option to select if the sensor can learn a new actuator up to eight times or lock the unit so it can not learn another actuator
- Integrated latch version
  - Adjustable magnetic latch force 20…60N
  - Designed for easy mounting on aluminum profile

Benefits

- No dedicated controller required
- Cat 4/SIL 3 rating maintained even with multiple units connected in series
- Switches can be connected in series with other devices (light curtain, E-stops, key interlock switches)
- Extended diagnostics for easy troubleshooting
- Large sensing distances
- Tolerance to misalignment
- Multiple sensing directions
- Stainless steel version suitable for use in harsh environments
- Use standard proximity brackets

Specifications

Safety Ratings		
Standards	IEC 60947-5-3, IEC 61508, EN 954	
Safety Classification	Cat. 4/SIL3	
Functional Safety Data ∗ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	PFH_D: > 1.12 x 10^{-9} MTTFd: > 385 years Dual channel interlock may be suitable for performance levels PLe or PLd (according to ISO 13849-1:2006) and for use in SIL2 or SIL3 systems (according to IEC 62061) depending on application characteristics	
Certifications	CE Marked for all applicable directives, cULus (UL 508), and TÜV	
Outputs (Guard Door Closed, Actuator in Place)		
Safety Outputs	2 x PNP, 0.2 A, max.; Status: ON (+24V DC)	
Auxiliary Outputs	1 x PNP, 0.2 A max.; Status: OFF (0V DC)	
Operating Characteristics		
Sensing Distance (Assure)	18 mm Plastic Barrel/18 mm Target	15 mm (0.59 in.)
	18 mm Plastic Barrel/30 mm Target	25 mm (0.98 in.)
	18 mm Stainless Steel Barrel/Standard Target	10 mm (0.39 in.)
	Large Rectangular Flat Pack with Standard Target	15 mm (0.59 in.)
Misalignment Tolerance, Min	See misalignment curve	
Repeat Accuracy	10% of Sensing Range	
Output Current, Max.	200 mA (all outputs)	
Operating Voltage	24V DC, +10%/-15% Class 2	
Current Consumption	50 mA	
Frequency of Operating Cycle	1 Hz	
Response Time (Off)	54 ms	
Environmental		
Enclosure Type Rating	NEMA 3, 4X, 12, 13, IP69K	
Operating Temperature [C (F)]	-10…+55° (+14…+131°)	
Relative Humidity	5…95%	
Shock	IEC 68-2-27, 30 g, 11 ms	
Vibration	IEC 68-2-6 10…55 Hz	
Radio Frequency	IEC 61000-4-3, IEC 61000-4-6	
Physical Characteristics		
Housing Material	VALOX® DR 48	
Actuator Material	VALOX® DR 48	
Color	Red	

∗ Usable for ISO 13849-1:2006 and IEC 62061. Data other than B10d is based on:
- Usage rate of 1op/10 mins., 24 hrs/day, 360 days/year, representing 51840 operations per year
- Mission time/Proof test interval of 30 years

Product Selection

Type	Assured Sensing Distance	LED Door Indication/ Diagnostic	Margin Indication	Magnetic Hold	Actuator Code Type	Cat. No.		
						Cable		Connector
						3 m	10 m	6 inch Pigtail, 8-pin Micro (M12)
18 mm plastic barrel/18 mm actuator	15 mm (0.59 in.)	Yes	—	—	Standard	440N-Z21S16A	440N-Z21S16B	**440N-Z21S16H**
					Unique	440N-Z21U16A	440N-Z21U16B	440N-Z21U16H
18 mm plastic barrel/30 mm actuator	25 mm (0.98 in.)	Yes	—	—	Standard	440N-Z21S26A	440N-Z21S26B	**440N-Z21S26H**
					Unique	440N-Z21U26A	440N-Z21U26B	440N-Z21U26H
18 mm stainless steel barrel/18 mm actuator	10 mm (0.39 in.)	Yes	—	—	Standard	440N-Z21S17A	440N-Z21S17B	**440N-Z21S17H**
					Unique	440N-Z21U17A	440N-Z21U17B	440N-Z21U17H
Plastic rectangular/ rectangular actuator	18 mm (0.71 in.)	Yes	—	—	Standard	440N-Z21SS2A	440N-Z21SS2B	**440N-Z21SS2H**
					Unique	440N-Z21US2A	440N-Z21US2B	440N-Z21US2H
			Yes	—	Standard	440N-Z21SS2AN	440N-Z21SS2BN	**440N-Z21SS2HN**
					Unique	440N-Z21US2AN	440N-Z21US2BN	440N-Z21US2HN
			Yes	Yes (9 N)	Standard	440N-Z21SS2AN9	440N-Z21SS2BN9	440N-Z21SS2HN9
					Unique	440N-Z21US2AN9	440N-Z21US2BN9	440N-Z21US2HN9
Plastic housing with integrated latch	Contact/ latched	Yes	—	Adjustable 20…60 N	Standard	440N-Z21SS3PA	440N-Z21SS3PB	440N-Z21SS3PH
					Unique	440N-Z21US3PA	440N-Z21US3PB	440N-Z21US3PH

Recommended Logic Interfaces

Description	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. Page No.	Cat. No.
Single-Function Safety Relays							
MSR127RP	3 N.O.	1 N.C.	Removable (Screw)	Monitored Manual	24V AC/DC	5-26	**440R-N23135**
MSR127TP				Auto./Manual		5-26	**440R-N23132**
Modular Safety Relays							
MSR211P Base 2 N.C. only	2 N.O.	1 N.C.	Removable	Auto./Manual or Monitored Manual	24V DC from the base unit	5-84	440R-H23177
MSR220P Input Module	—	—	Removable	—	24V DC	5-86	440R-H23178
MSR310P Base	MSR300 Series Output Modules	3 PNP Solid State	Removable	Auto./Manual Monitored Manual	24V DC	5-102	440R-W23219
MSR320P Input Module	—	2 PNP Solid State	Removable	—	24V DC from the base unit	5-106	440R-W23218

Note: For additional Safety Relays connectivity, see page 5-12.
For additional Safety I/O and Safety PLC connectivity, see page 5-116.
For application and wiring diagrams, see page 10-1.

Connection Systems

Description	Cat. No.
Cordset	889D-F8AB-✶
Patchcord	889D-F8ABDM-❄
Safety Wired T-Port	898D-438Y-D8
Safety Wired Shorting Plug	898D-418U-DM

✶ Replace symbol with 2 (2 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
❄ Replace symbol with 1 (1 m), 2 (2 m), 3 (3 m), 5 (5 m), or 10 (10 m) for standard lengths.
Note: For additional information, see page 7-1.

Non-Contact Switches

SensaGuard™

Accessories

	Description	To Be Used With	Cat. No.
	18 mm plastic actuator	Standard coded models only	440N-Z18PT
		Unique coded models only	440N-Z18UPT
	30 mm plastic actuator	Standard coded models only	440N-Z30PT
		Unique coded models only	440N-Z30UPT
	18 mm stainless steel actuator	Standard coded models only	440N-Z18SST
		Unique coded models only	440N-Z18USST
	Rectangular plastic actuator	Standard coded models only	440N-ZPREC
		Unique coded models only	440N-ZUPREC
		Standard coded margin/magnetic hold models only	440N-ZPRECM
		Unique coded margin/magnetic hold models only	440N-ZUPRECM
	Integrated latch actuator	Standard coded models only	440N-ZLPREC
		Unique coded models only	440N-ZULPREC
	Mountingbracket for tubular proximity sensors—right angle style	18 mm barrel models	871A-BRS18
	Mounting bracket for tubular sensors—clamp style		871A-BP18
	Snap clamp mounting bracket		871A-SCBP18
	Swivel/tilt bracket allows ±10° vertical and 360° rotation adjustment		60-2649
	Mounting plate for vertically hinged doors	Integrated latch version only	440N-AHDB
	Mounting plate for slide and gull wing doors		440N-ASDB

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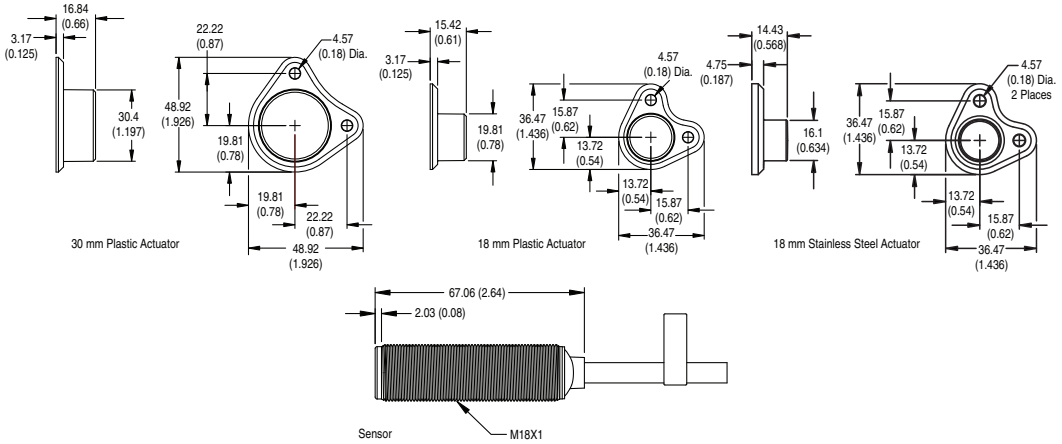
Publication S117-CA001A-EN-P

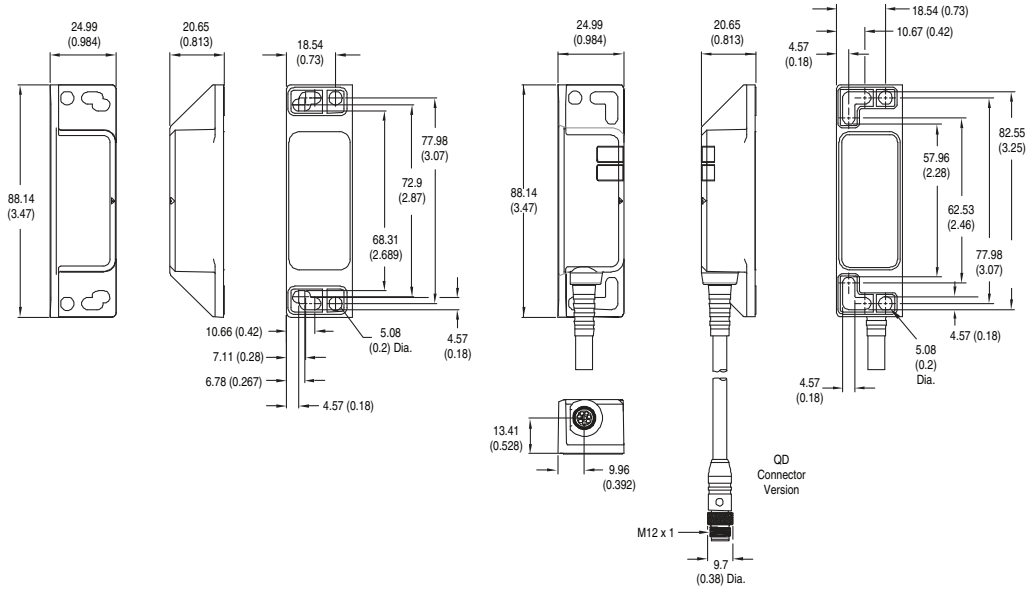
Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.

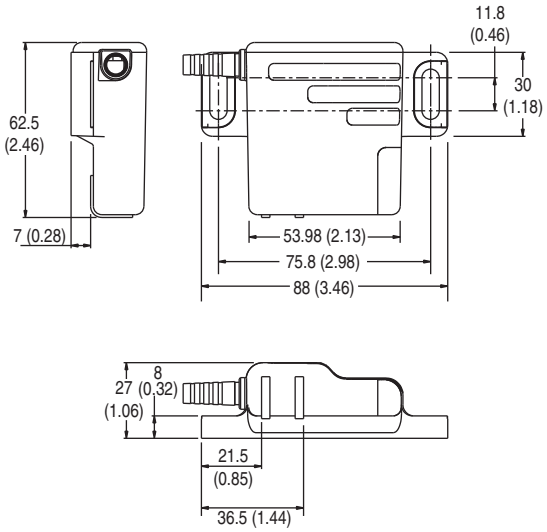
18 mm Barrel



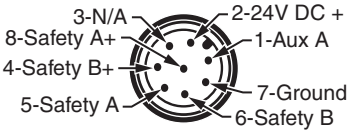
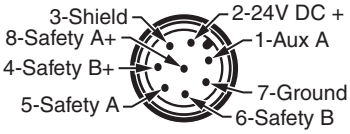
Large Rectangular Flat Pack



Integrated Latch



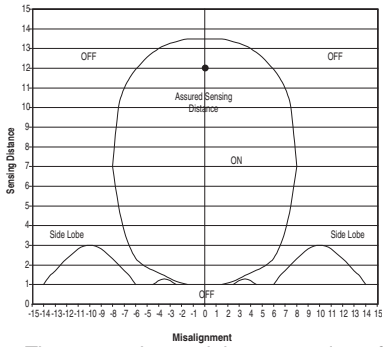
Typical Wiring Diagrams

Description		Plastic	Stainless Steel
8-Pin Micro (M12)			
8-Pin Cordset 889D-F8AB-∗ or cable version	Grey	Safety A	Safety A
	Red	Safety A+	Safety A+
	Pink	Safety B	Safety B
	Yellow	Safety B+	Safety B+
	White	Aux A	Aux A
	Brown	24V DC +	24V DC +
	Blue	Gnd	Gnd
	Green	NA	Shield

∗ Replace symbol with 2 (2 m), 5 (5 m) or 10 (10 m) for standard cable lengths.

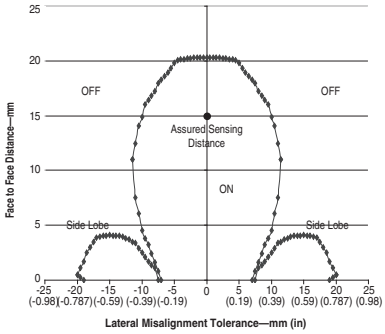
Misalignment Curves

18 mm Stainless Steel Barrel



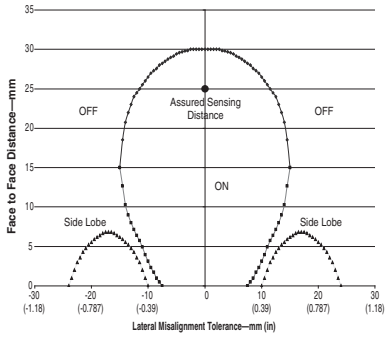
Note: There must be a minimum spacing of 4 mm (0.157 in.) if actuator and sensor face approaches laterally. This will prevent false triggering due to the side lobe areas.

18 mm Plastic Barrel



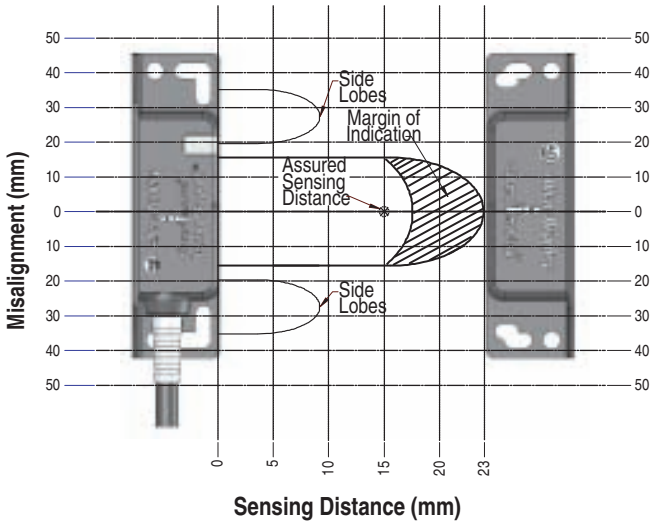
Note: There must be a minimum spacing of 4 mm (0.157 in.) if actuator and sensor face approaches laterally. This will prevent false triggering due to the side lobe areas.

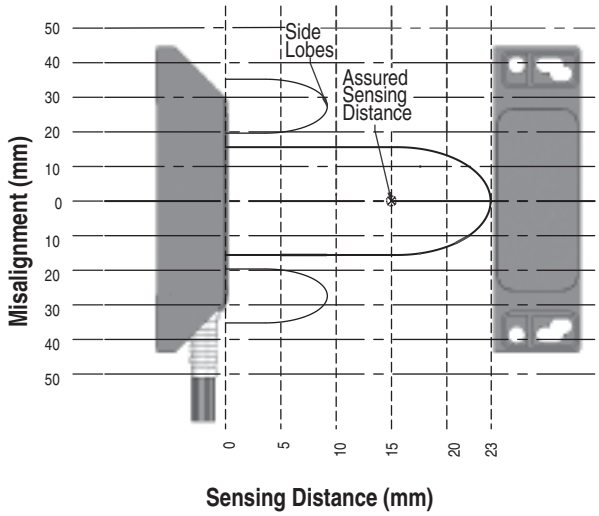
30 mm Plastic Barrel



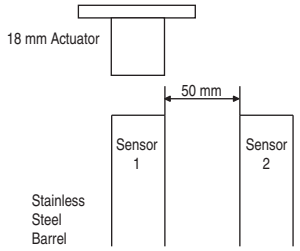
Note: There must be a minimum spacing of 7 mm (0.275 in.) if actuator and sensor face approaches laterally. This will prevent false triggering due to the side lobe areas.

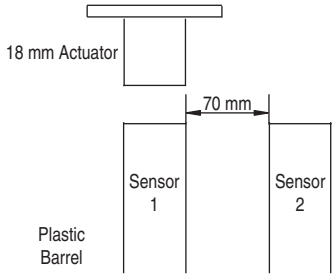
Large Rectangular Flat Pack

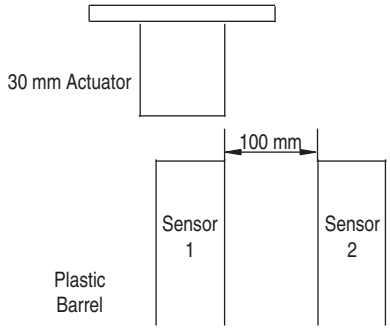


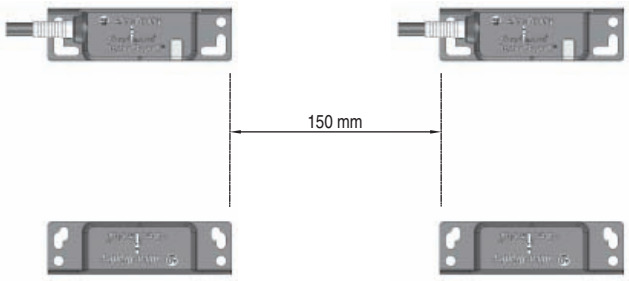


Minimum Distance Between Sensors

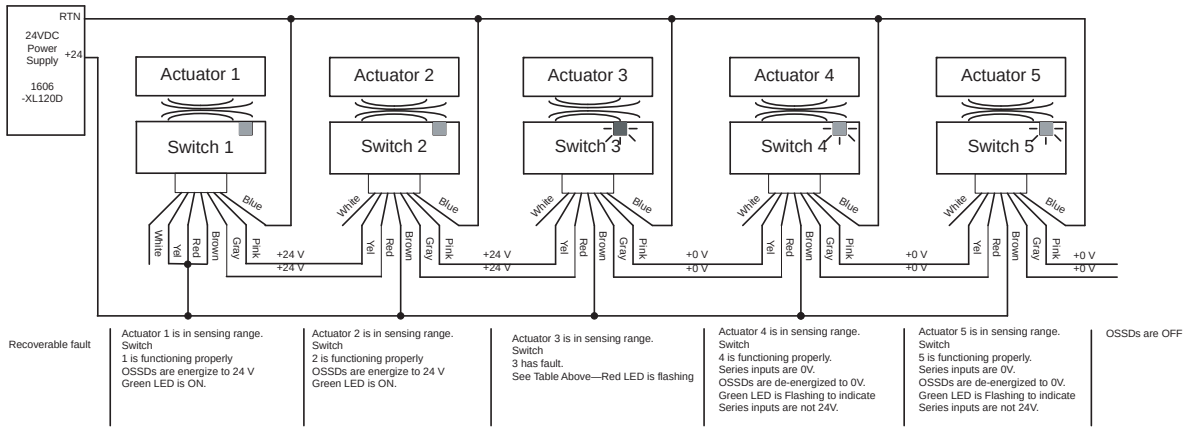








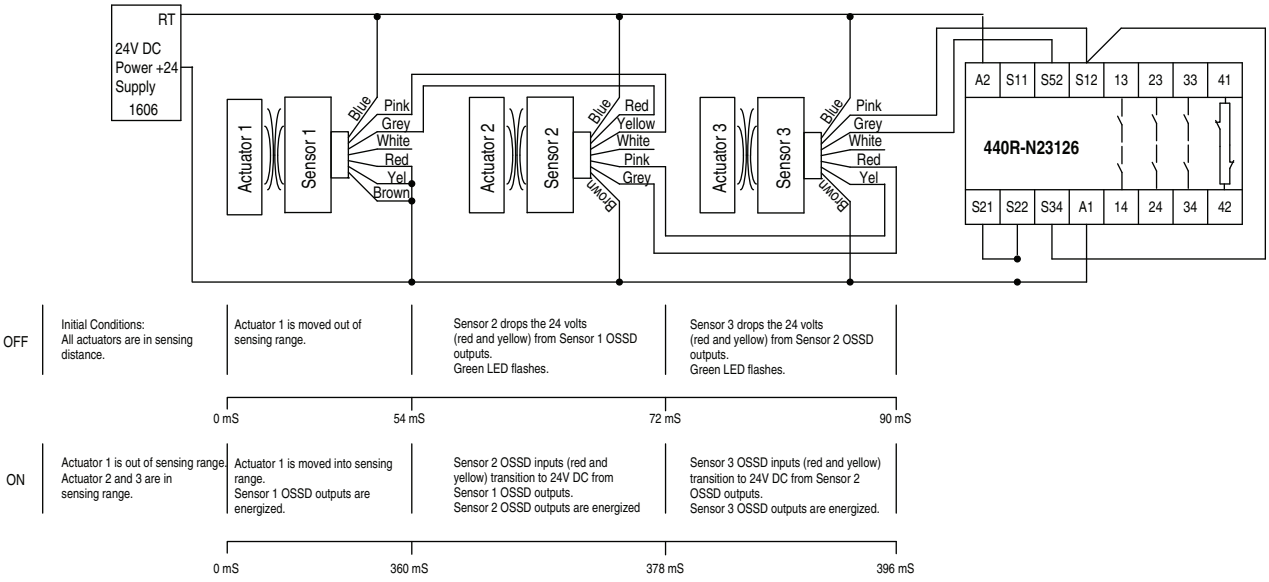
Diagnostic



Unit Indicators (per IEC 60073)

	State	Status	Troubleshooting
Device Output LED	Off	Not Powered	NA
	Red	Not Safe, Output Off	NA
	Green	Safe, Output On	NA
	Green Flash	Power Up Test	Check 24V DC on Safety + Outputs (yellow and red wire)
	Red Flash	1 Hz Flash Recoverable Fault 4 Hz Flash Nonrecoverable Fault	Recoverable Fault: Check Safety Outputs Are Not Shorted to GND, 24V DC or Each Other. Cycle Power.
	Amber Flash	Safe, Output On, Sensor Is Reaching Max. Sensing Distance	Re-adjust Distance Between Actuator and Sensor until Output LED Is Green

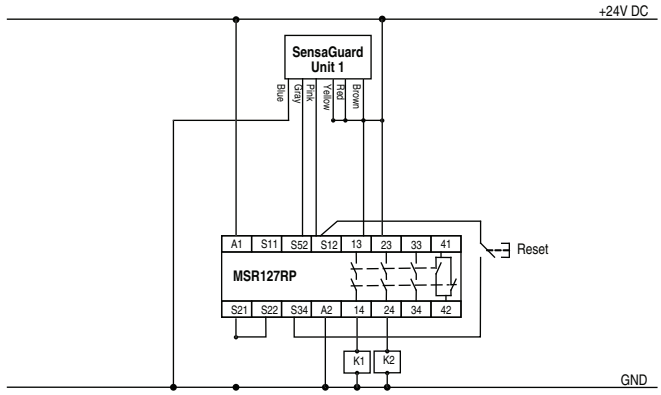
Unit Response Time



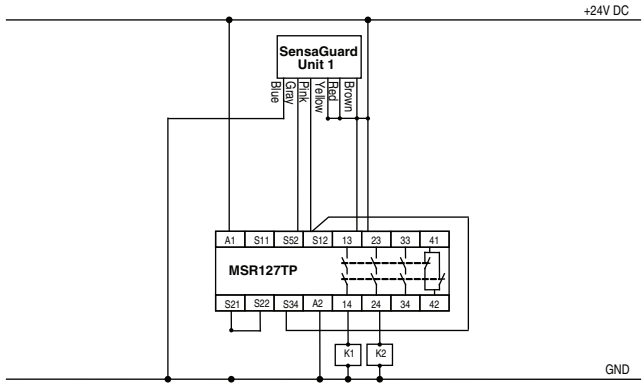
Application Wiring Examples

MSR127RP with One Sensor

Monitored Reset

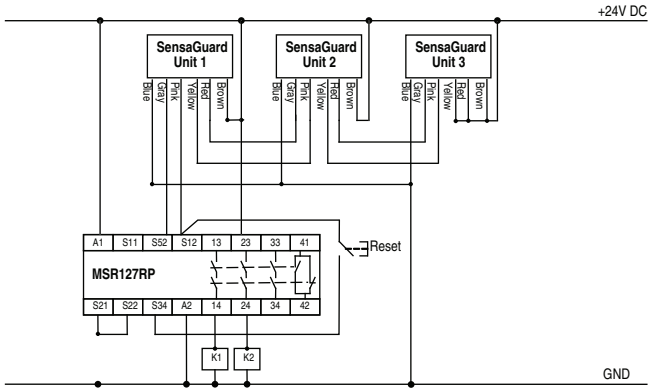


Automatic Reset

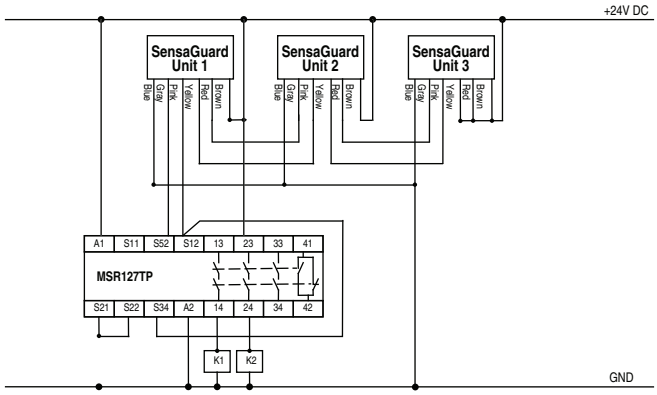


MSR127RP with Three Sensors

Monitored Reset

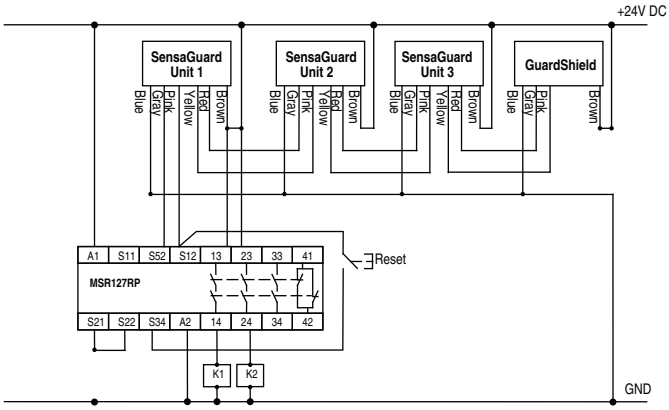


Automatic Reset



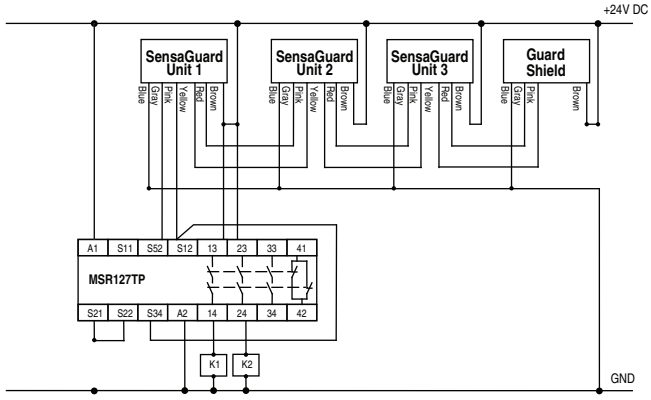
MSR127RP with Two Sensors and One Light Curtain

Monitored Reset



Note: Light curtain must be last (farthest from MSR127).

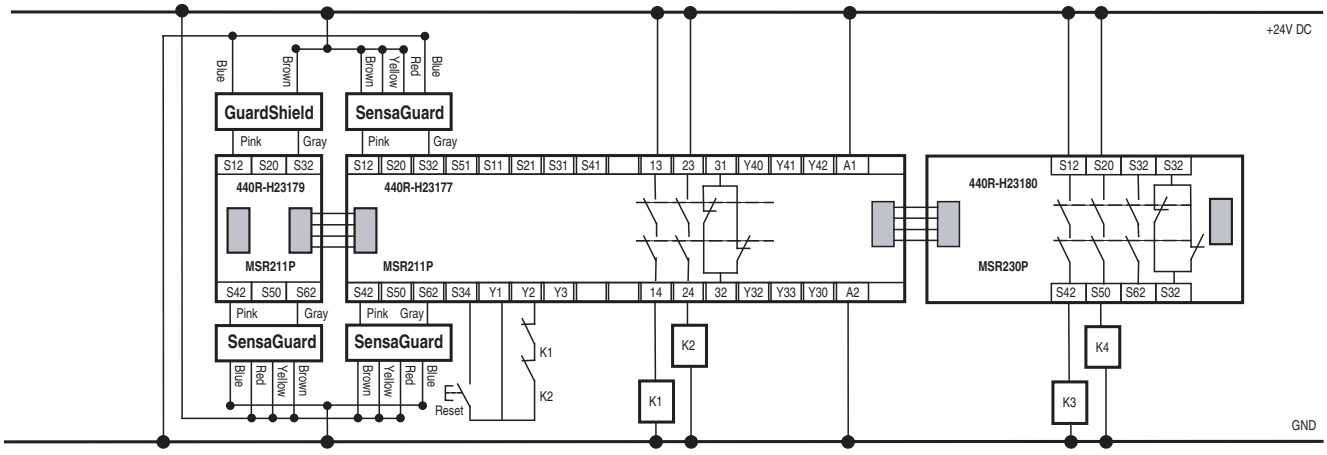
Automatic Reset



Note: Light curtain must be last (farthest from MSR127).

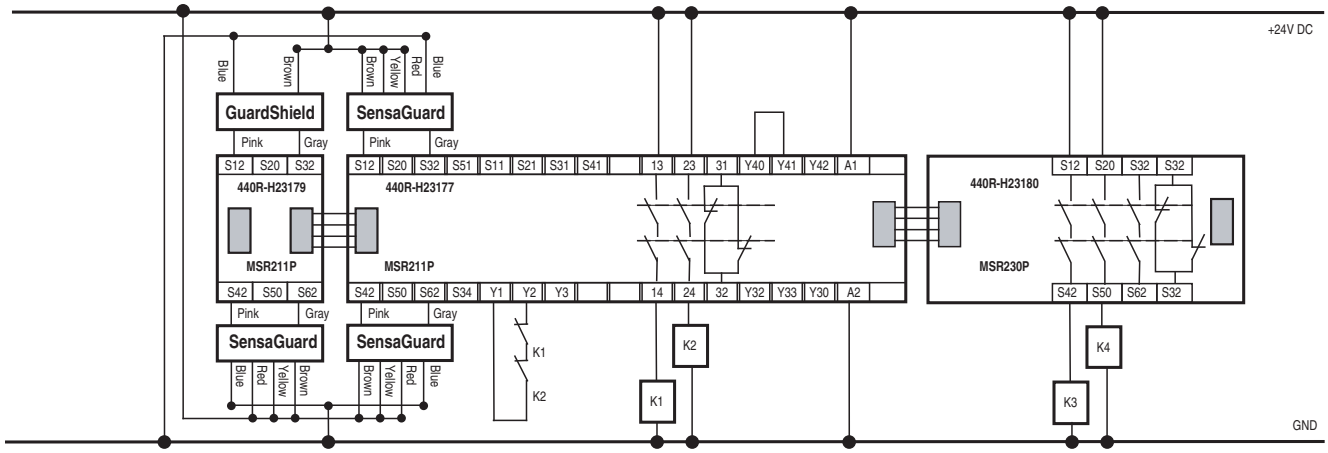
MSR200 Series with Three Sensors and One Light Curtain

Manual Reset



Note: Light curtain can be attached to any input.

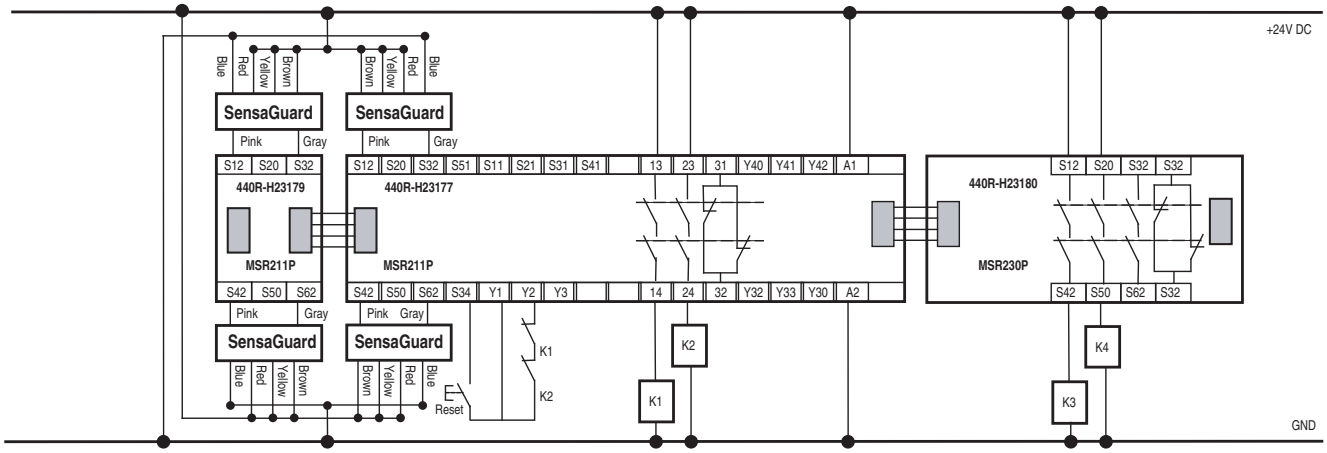
Automatic Reset



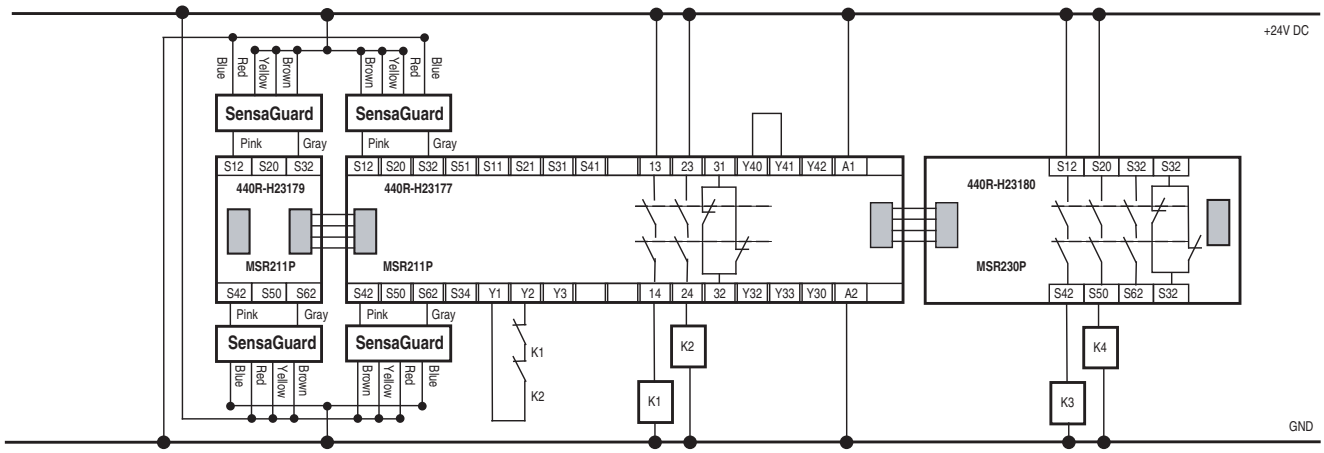
Note: Light curtain can be attached to any input

MSR200 Series with Four Sensors

Manual Reset



Automatic Reset



Non-Contact Switches

Magnetically Coded

Description

With the increasing speed and complexity of applications a simple magnetic switch may be insufficient to meet the increased risks, therefore the design incorporates several magnetically sensitive elements which must be triggered in a particular sequence to operate correctly.

The sensor with its molded-in brackets and diminutive size, is extremely versatile and simple to install. For high-risk applications the control unit is used with a single sensor to give a high-integrity system. For other applications, multiple sensors (including mechanical switches) can be connected.

Features

- Non-contact actuation
- Magnetic coded sensing
- High tolerance to misalignment
- Designed for use with specified controllers

Specifications

	MC1	MC2
Safety Ratings		
Standards	EN954-1, ISO13849-1, IEC/EN60204-1, NFPA79, EN1088, ISO14119, IEC60947-5-1, IEC/EN60947-5-3, ANSI B11.19, AS4024.1	
Safety Classification	Cat. 1 Device per EN 954-1; Dual channel interlocks suitable for Cat. 3 or 4 systems	
Functional Safety Data ✶ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	B10d: > 2 x 10^6 operations at min. PFH_D: > 3 x 10^{-7} MTTFd: > 385 years Dual channel interlock may be suitable for performance levels PLe or PLd (according to ISO 13849-1:2006) and for use in SIL2 or SIL3 systems (according to IEC 62061) depending on application characteristics	
Certifications	CE Marked for all applicable directives, cULus, and TÜV	
Outputs (Guard Door Closed, Actuator in Place)		
Safety Outputs	2 N.C. REEDS	2 N.C. Solid-State Relays
Auxiliary Outputs	—	1 x PNP, 0.2 A max.; Status: OFF (0V DC)
Operating Characteristics		
Operating Distance, Make [mm (in.)]	8 (0.3)	10 (0.39)
Operating Distance, Break [mm (in.)]	15 (0.59)	25 (0.98)
Misalignment Tolerance, Min	See Misalignment Wire	
Repeat Accuracy	10% of Sensing Range	
Output Current, Max.	200 mA	200 mA
Switching Current @ Voltage, Max.	24V DC @ 200 mA	24V DC @ 200 mA +10%/-15%
Operating Voltage/Power Supply	—	24V DC, +10%/-15%/50 mA max./Class 2 SELV
Frequency of Operating Cycle	1 Hz	1 Hz
Environmental		
Enclosure Type Rating	IP67 (NEMA 6P)	IP 69K
Operating Temperature [C (F)]	-10…+55° (+14…+131°)	
Relative Humidity	5…95%	
Shock	IEC 68-2, 27, 30 g, 11 ms	
Vibration	IEC 68-2-6, 10…55 Hz	
Radio Frequency	IEC 61000-4-3, IEC 61000-4-6	
Physical Characteristics		
Housing Material	Molded ABS	Ultrador
Actuator Material	Molded ABS	Ultrador
Color	Red	

✶ Usable for ISO 13849-1:2006 and IEC 62061. Data other than B10d is based on:
- Usage rate of 1op/10 mins., 24 hrs/day, 360 days/year, representing 51840 operations per year
- Mission time/Proof test interval of 38 years

Product Selection

Type	Operating Voltage/Input Current	Safety Outputs	Auxiliary Outputs	Status Indicator	Connection	Cat. No.
MC1	—	2 N.C. REEDS	—	No	—	**440N-Z2NRS1C**
					—	**440N-Z2NRS1A**
					10 m Cable	440N-Z2NRS1B
MC2	24V DC, +10%/-15%/50 mA max.	2 N.C. Solid-State Relays	1 x PNP, 0.2 A max.; Status: OFF (0V DC)	Yes	8-Pin Micro (M12)	440N-Z21W1PH
					—	440N-Z21W1PA
					—	440N-Z21W1PB

Recommended Logic Interfaces

Description	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. Page No.	Cat. No.
Single-Function Safety Relays for 2 N.C. Contact Switch							
MSR127RP	3 N.O.	1 N.C.	Removable (Screw)	Monitored Manual	24V AC/DC	5-26	**440R-N23135**
MSR127TP	3 N.O.	1 N.C.	Removable (Screw)	Auto./Manual	24V AC/DC	5-26	**440R-N23132**
Modular Safety Relays							
MSR210P Base 2 N.C. only	2 N.O.	1 N.C. and 2 PNP Solid State	Removable	Auto./Manual or Monitored Manual	24V DC from the base unit	5-82	440R-H23176
MSR220P Input Module	—	—	Removable	—	24V DC	5-86	440R-H23178
MSR310P Base	MSR300 Series Output Modules	3 PNP Solid State	Removable	Auto./Manual Monitored Manual	24V DC	5-102	440R-W23219
MSR320P Input Module	—	2 PNP Solid State	Removable	—	24V DC from the base unit	5-106	440R-W23218

Note: For additional Safety Relays connectivity, see page 5-12.
For additional Safety I/O and Safety PLC connectivity, see page 5-116.
For application and wiring diagrams, see page 10-1.

Connection Systems

Description	Connection to Distribution Box 4-Pin Micro (M12)	8-Pin Micro (M12)
	2 N.C.	2 N.C. & 1 N.O.
Cordset	889D-F4AC-✶	889D-F8AB-✶
Patchcord	889D-F4ACDM-❄	889D-F8ABDM-❄
Distribution Box	898D-4‡LT-DM4	—
Shorting Plug	898D-41LU-DM	—
T-Port	898D-43LY-D4	—

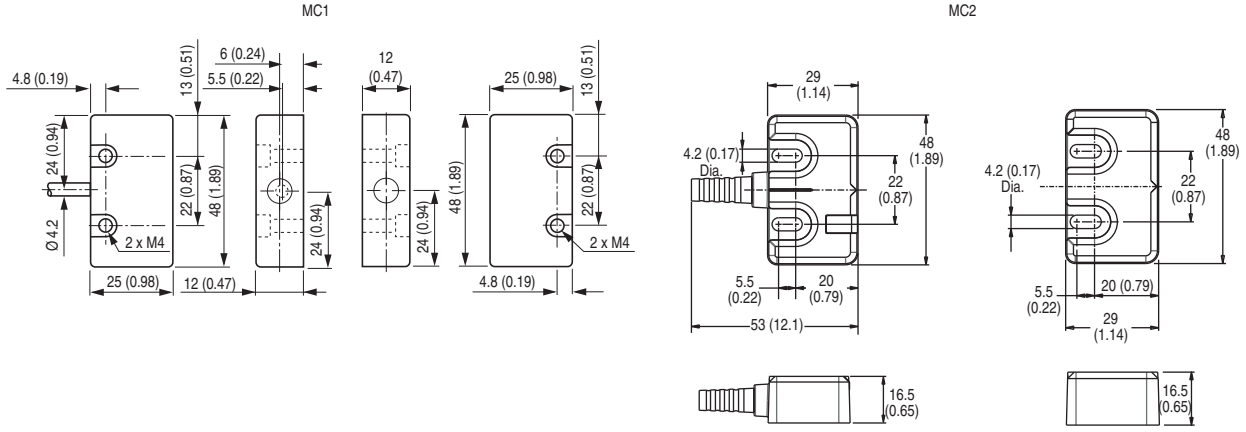
✶ Replace symbol with 2 (2 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
❄ Replace symbol with 1 (1 m), 2 (2 m), 3 (3 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
‡ Replace symbol with 4 or 8 for number of ports.
Note: For additional information, see the page 7-1.

Accessories

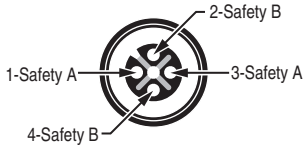
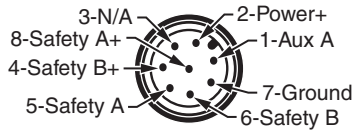
Description	Cat. No.
MC1 Spare Actuator	440N-A17233
MC2 Spare Actuator	440N-A32114

Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



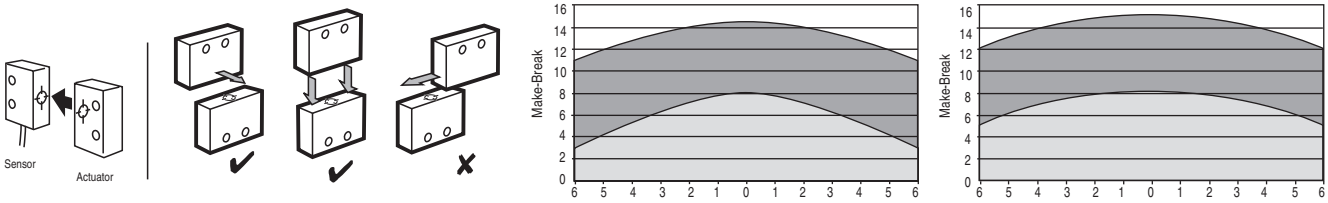
Typical Wiring Diagrams

Description		MC1 2 N.C.	MC2 2 N.C. + 1 N.O.
4-Pin Micro (M12)			—
8-Pin Micro (M12)		—	
Cordset 889D-F4AC-∗ or Cable Version	Brown	Safety A	—
	Blue		
	White	Safety B	—
	Black		
8-Pin Cordset 889D-F8AB-∗ or Cable Version	Grey	—	Safety A
	Red		Safety A
	Pink		Safety B
	Yellow		Safety B
	White		Aux
	Brown		24V DC +
	Blue		Gnd
	Green		NA

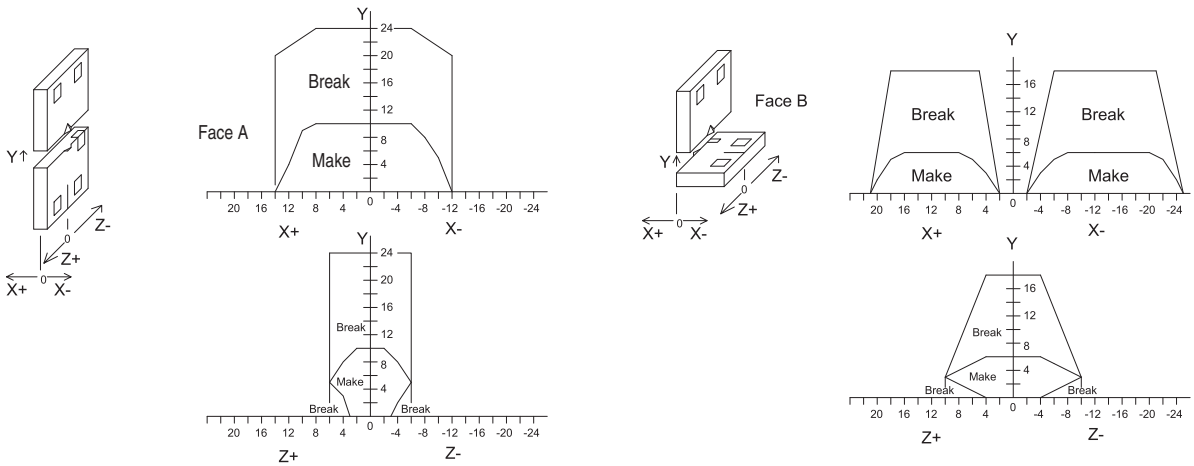
∗ Replace symbol with 2 (2 m), 5 (5 m) or 10 (10 m) for standard cable lengths.

Sensing & Misalignment Curve

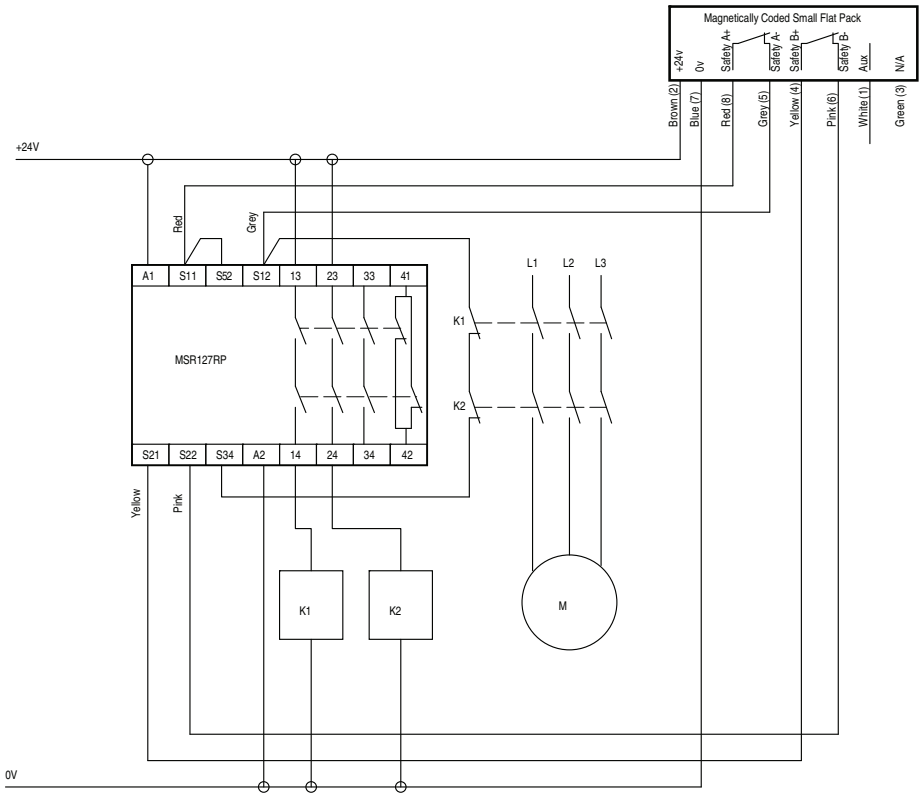
MC1



MC2



MC2 Application Wiring Example



Non-Contact Switches

Ferrogard™ 1, 2, 20 & 21

Description

The Ferrogard range of magnetically actuated safety switches offers non-contact reliability together with tolerance to misalignment. They are designed to be installed so that when a guard door is opened, the action of the magnetic actuator being removed from the switch opens the N.C. safety contacts which are intended for the isolation of control power to a machine primary control element.

The FRS1, FRS2, FRS20, FRS21 are rectangular housings. Sealed to IP67 (NEMA 6P), these Ferrogards are ideal for wet environments.

Unlike some magnetic switches the Ferrogards have protected safety contacts to help ensure that they do not fail to danger. In addition, some versions have independent auxiliary signal contacts to indicate the guard condition.

All Ferrogards have internal non-resettable overload protection on the safety contact. They should be protected by an external fuse rated as shown in the Specifications table.

Features

- Non-contact actuation
- High tolerance to misalignment
- High switching current (up to 2 A AC, 1 A DC)
- Plastic rectangular housing (IP67)
- Cable or quick-disconnect (QD) connections

Specifications

Safety Ratings	
Standards	EN954-1, ISO13849-1, IEC/EN60204-1, NFPA79, EN1088, ISO14119, ANSI B11.19, AS4024.1
Safety Classification	Cat. 1 Device per EN954-1 Dual channel interlocks suitable for Cat. 3 or 4 systems
Functional Safety Data **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	B10d: > 2 x 10^6 operations at min. PFH_D: > 3 x 10^{-7} MTTFd: > 385 years Dual channel interlock may be suitable for performance levels PLe or PLd (according to ISO 13849-1:2006) and for use in SIL2 or SIL3 systems (according to IEC 62061) depending on application characteristics
Certifications	CE Marked for all applicable directives and cULus
Outputs (Guard Door Closed, Actuator in Place)	
Safety Outputs	FRS1: 1 N.C., FRS2: 1 N.C., FRS20: 2 N.C., FRS21: 2 N.C.
Auxiliary Outputs	FRS1: None, FRS2: 1 N.O., FRS20: None, FRS21: 1 N.O.
Operating Characteristics	
Operating Distance, Make [mm (in.)]	Safety: 12 (0.47); Auxiliary: 15 (0.59)
Operating Distance, Break [mm (in.)]	Safety: 23 (0.91); Auxiliary: 26 (1.02)
Fuses, External	FRS1, 2 & 21: 1.6 A (Bussmann BK/60 A-1.6 A) max. FRS20: 0.4 A (Bussmann BK/60 A-400 mA) max.
Environmental	
Enclosure Type Rating	IP67 (NEMA 6P)
Operating Temperature [C (F)]	-10…+55° (+14…+131°)
Relative Humidity	5…95%
Shock	50 g
Vibration	7 g; 50…200 Hz
Radio Frequency	IEC 61000-4-3, IEC 61000-4-6
Physical Characteristics	
Actuator/Housing Material	Molded ABS plastic
Weight [g (lbs)]	FRS 1—Sensor: 35 (0.08)/Actuator: 85 (0.19) FRS 2—Sensor: 40 (0.09)/Actuator: 85 (0.19) FRS 20—Sensor: 43 (0.09)/Actuator: 85 (0.19) FRS 21—Sensor: 43 (0.09)/Actuator: 85 (0.19)
Color	Red

∗ Usable for ISO 13849-1:2006 and IEC 62061. Data other than B10d is based on:
- Usage rate of 1op/10 mins., 24 hrs/day, 360 days/year, representing 51840 operations per year
- Mission time/Proof test interval of 38 years

Product Selection

Safety Contact Switching Capability	Safety Contacts	Auxiliary Contacts	Connection	Type	Cat. No.
250V AC, 2 A max	1 N.C.	—	2 m Cable	FRS 1	440N-G02001
			4 m Cable		440N-G02004
			6 m Cable		440N-G02022
			8 m Cable		440N-G02041
			10 m Cable		440N-G02015
		1 N.O.	2 m Cable	FRS 2	440N-G02002
			4 m Cable		440N-G02014
			6 m Cable		440N-G02038
			8 m Cable		440N-G02033
			10 m Cable		440N-G02019
			15 m Cable		440N-G02043
			20 m Cable		440N-G02040
			4-Pin Micro QD		440N-G02093
	2 N.C.	—	4-Pin Micro QD	FRS 20	440N-G02097
	2 N.C.	1 N.O.	2 m Cable	FRS 21	440N-G02055
			4 m Cable		440N-G02061
			6 m Cable		440N-G02060
			10 m Cable		440N-G02059
			6-Pin AC Micro QD§		440N-G02098
24V DC, 1 A	1 N.C.	1 N.O.	2 m Cable	FRS 2	440N-G02092
			4-Pin Micro QD		**440N-G02094**
	2 N.C.	—	4 m Cable	FRS 20	440N-G02085
			4-Pin Micro QD		**440N-G02090**
		1 N.O.	2 m Cable	FRS 21	440N-G02058
			4 m Cable		440N-G02077
			6 m Cable		440N-G02083
			6-Pin Micro QD		**440N-G02099**

Note: Contacts are described with the guard door closed, that is, actuator in place. Switch is shipped complete with actuator.
§ For connector ratings see 3-9.

Non-Contact Switches

Ferrogard™ 1, 2, 20 & 21

Recommended Logic Interfaces

Description	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. Page No.	Cat. No.
Single-Function Safety Relays for 2 N.C. Contact Switch							
MSR127RP	3 N.O.	1 N.C.	Removable (Screw)	Monitored Manual	24V AC/DC	5-26	**440R-N23135**
MSR127TP	3 N.O.	1 N.C.	Removable (Screw)	Auto./Manual	24V AC/DC	5-26	**440R-N23132**
MSR30T	2 N.O. Solid State	1 N.O. Solid State	Removable	Auto./Manual or Monitored Manual	24V DC	5-16	440R-N23198
Single-Function Safety Relays for 1 N.C. & 1 N.O. Contact Switch							
MSR9T	2 N.O.	1 N.C.	Fixed	Auto./Manual	24V AC/DC	5-14	440R-F23027
MSR33RT	2 N.O. Solid State	1 N.O.	Removable	Auto. or Monitored Manual	24V DC SELV	5-18	440R-F23200
Modular Safety Relays							
MSR211P Base 2 N.C. only	2 N.O.	1 N.C. and 2 PNP Solid State	Removable	Auto./Manual or Monitored Manual	24V DC from the base unit	5-84	440R-H23176
MSR220P Input Module	—	—	Removable	—	24V DC	5-86	440R-H23178
MSR310P Base	MSR300 Series Output Modules	3 PNP Solid State	Removable	Auto./Manual Monitored Manual	24V DC	5-102	440R-W23219
MSR320P Input Module	—	2 PNP Solid State	Removable	—	24V DC from the base unit	5-106	440R-W23218

Note: For additional Safety Relays connectivity, see page 5-12.
For additional Safety I/O and Safety PLC connectivity, see page 5-116.
For application and wiring diagrams, see page 10-1.

Connection Systems

Description	Connection to Distribution Box 4-Pin Micro (M12) 1 N.C. & 1 N. O.	6-Pin Micro (M12) 2 N.C. & 1 N.O.
Cordset	889D-F4AC-∗	889R-F6ECA-∗
Patchcord	889D-F4ACDM-❄	889R-F6ECRM-❄
Distribution Box	898D-P4‡KT-DM4	898R-F68MT-A5
Shorting Plug	898D-41KU-DM	898R-P61MU-RM
T-Port	898D-43KY-D4	—

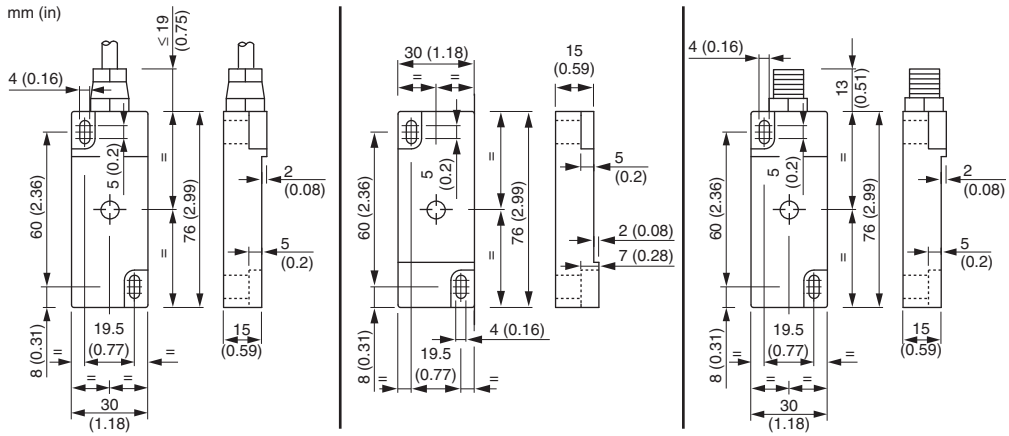
∗ Replace symbol with 2 (2 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
❄ Replace symbol with 1 (1 m), 2 (2 m), 3 (3 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
‡ Replace symbol with 4 or 8 for number of ports.
Note: For additional information, see the Safety Connection System section (page 7-1) of this catalog.

Accessories

Description	Cat. No.
Replacement Actuator	440N-A02005

Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



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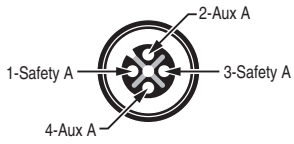
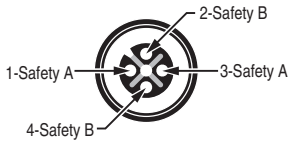
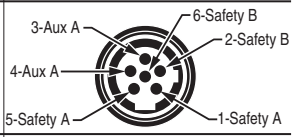
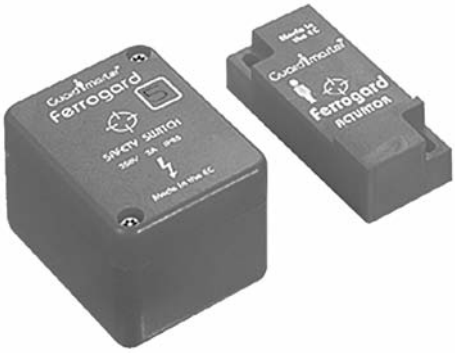
Typical Wiring Diagrams

		FRS1	FRS2	FRS20	FRS21
		1 N.C.	1 N.C. + 1 N.O.	2 N.C.	2 N.C. + 1 N.O.
4-Pin Micro (M12)		—			—
6-Pin Micro (M12)		—	—	—	
Cordset 889D-F4AC-∗ or Cable Versions	Brown	—	Safety A	Safety A	—
	Blue				
	Black	—	Aux A	Safety B	—
	White				
Cordset 889R-F6ECA-∗	Red/White	—	—	—	Safety A
	Red/Black				
	Red				Safety B
	Red/Blue				
	Green				Aux A
	Red/Yellow				
Cable Versions	Safety A	Brown	Blue	Brown	Black
		Blue	White	Blue	White
	Safety B	—	Yellow	Black	Red
			Green	White	Blue
	Aux A	—	—	—	Yellow
					Green

∗ Replace symbol with 2 (2 m), 5 (5 m) or 10 (10 m) for standard cable lengths.

Non-Contact Switches

Ferrogard™ 3, 4 & 5



Description

The Ferrogard range of magnetically actuated switches offers non-contact reliability together with tolerance to misalignment. They are designed to be installed so that when a guard door is opened, the action of the magnetic actuator being removed from the switches opens the N.C. safety contacts which are intended for the isolation of control power to a machine primary control element.

The FRS 3, 4 and 5 have terminal connections. The user must drill a hole in the housing at a convenient location to allow the wiring to enter the housing. The cover is secured with anti-tamper security screws.

Unlike some magnetic switches the Ferrogards have protected safety contacts to help ensure that they do not fail to danger. In addition, some versions have independent auxiliary signal contacts to indicate the guard condition.

All Ferrogards have internal non-resettable overload protection on the safety contact. They should be protected by an external fuse rated as shown in the Specifications table.

Features

- Non-contact actuation
- High tolerance to misalignment
- High switching current (up to 2 A)
- Various contact arrangements
- Terminal connections

Specifications

Safety Ratings	
Standards	EN954-1, ISO13849-1, IEC/EN60204-1, NFPA79, EN1088, ISO14119, ANSI B11.19, AS4024.1
Safety Classification	Cat. 1 Device per EN954-1 Dual channel interlocks suitable for Cat. 3 or 4 systems
Functional Safety Data ∗ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	B10d: > 2 x 10^6 operations at min. PFH_D: > 3 x 10^{-7} MTTFd: > 385 years Dual channel interlock may be suitable for performance levels PLe or PLd (according to ISO 13849-1:2006) and for use in SIL2 or SIL3 systems (according to IEC 62061) depending on application characteristics
Certifications	CE Marked for all applicable directives and cULus
Outputs (Guard Door Closed, Actuator in Place)	
Safety Outputs	FRS3: 1 N.C., FRS4: 1 N.C., FRS5: 1 N.C.
Auxiliary Outputs	FRS3: 1 N.C., FRS4: 1 N.O., FRS5: None
Operating Characteristics	
Operating Distance, Make [mm (in.)]	Safety/Auxiliary: FRS 3—12 (0.47); FRS 4—12 (0.47); FRS 5—12 (0.47)
Operating Distance, Break [mm (in.)]	Safety/Auxiliary: FRS 3—24 (0.94); FRS 4—10 (0.39); FRS 5—12 (0.47)
Auxiliary Contact Switching Capability, Min	300V DC, 250V AC 0.5 A including inrush
Safety Contact External Fusing	≤1.6 A quick blow
Environmental	
Enclosure Type Rating	IP65 (NEMA 13)
Operating Temperature [C (F)]	-10…+65° (+14…+149°)
Relative Humidity	5…95%
Shock	IEC 68-2-27, 30 g, 11 ms
Vibration	IEC 68-2-6, 10…200 Hz
Radio Frequency	IEC 61000-4-3, IEC 61000-4-6
Physical Characteristics	
Housing Material	Molded ABS plastic
Actuator Material	Molded ABS plastic
Color	Red

∗ Usable for ISO 13849-1:2006 and IEC 62061. Data other than B10d is based on:
- Usage rate of 1op/10 mins., 24 hrs/day, 360 days/year, representing 51840 operations per year
- Mission time/Proof test interval of 38 years

Product Selection

Safety Contact Switching Capability	Connection Type	Housing Material	Safety Contacts	Auxiliary Contacts	Type	Cat. No.
250V AC 2 A max	Terminals	Red Molded ABS Plastic	1 N.C.	1 N.C.	FRS 3	440N-G02003
				1 N.O.	FRS 4	440N-G02008
				—	FRS 5	440N-G02009

Note: Contacts are described with the guard door closed, that is, actuator in place.

Recommended Logic Interfaces

Description	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. Page No.	Cat. No.
Single-Function Safety Relays							
MSR127RP	3 N.O.	1 N.C.	Removable (Screw)	Monitored Manual	24V AC/DC	5-26	**440R-N23135**
MSR127TP	3 N.O.	1 N.C.	Removable (Screw)	Auto./Manual	24V AC/DC	5-26	**440R-N23132**
MSR126T	2 N.O.	None	Fixed	Auto./Manual	24V AC/DC	5-24	**440R-N23117**
MSR30T	2 N.O. Solid State	1 N.O. Solid State	Removable	Auto./Manual or Monitored Manual	24V DC	5-16	440R-N23198
Modular Safety Relays							
MSR210P Base 2 N.C. only	2 N.O.	1 N.C. and 2 PNP Solid State	Removable	Auto./Manual or Monitored Manual	24V DC from the base unit	5-82	440R-H23176
MSR220P Input Module	—	—	Removable	—	24V DC	5-86	440R-H23178
MSR310P Base	MSR300 Series Output Modules	3 PNP Solid State	Removable	Auto./Manual Monitored Manual	24V DC	5-102	440R-W23219
MSR320P Input Module	—	2 PNP Solid State	Removable	—	24V DC from the base unit	5-106	440R-W23218

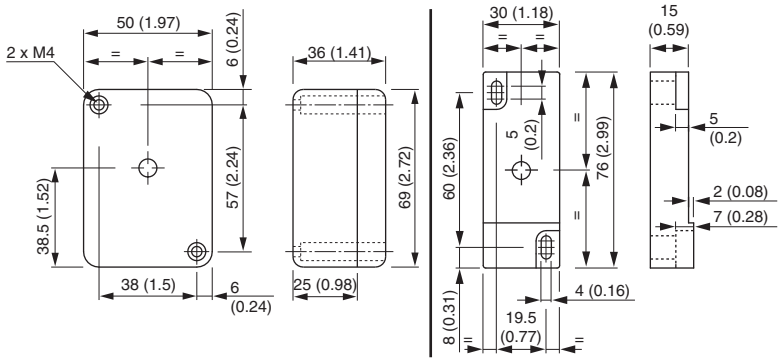
Note: For additional Safety Relays connectivity, see page 5-12.
For additional Safety I/O and Safety PLC connectivity, see page 5-116.
For application and wiring diagrams, see page 10-1.

Accessories

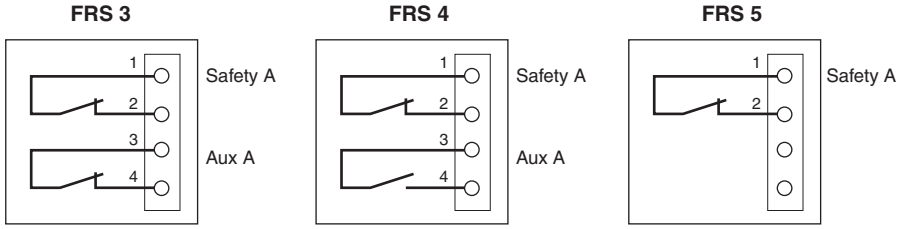
Description	Cat. No.
Replacement Actuator	440N-A02005

Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.

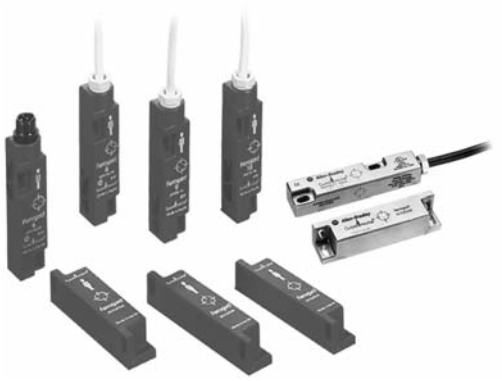


Typical Wiring Diagrams



Non-Contact Switches

Ferrogard™ 6, 9,10, 13 & 14



Description

The Ferrogard range of magnetically actuated safety switches offers non-contact reliability together with tolerance to misalignment. They are designed to be installed so that when a guard door is opened, the action of the magnetic actuator being removed from the switch opens the N.C. safety contact which is intended for the isolation of control power to a machine primary control element.

The FRS 6, 9, 10, 13, and 14 sensors and actuators incorporate slim housings to accommodate narrow mounting areas. They are environmentally sealed to IP67 (NEMA 6P), which makes them ideal for wet environments. These Ferrogard switches have two active sensing faces allowing more flexible mounting options.

Unlike some magnetic switches the Ferrogards have protected safety contacts to help ensure that they do not fail to danger.

All Ferrogards have internal non-resettable overload protection on the safety contact. They should be protected by an external fuse rated as shown in the Specifications table.

Features

- Non-contact actuation
- High tolerance to misalignment
- High switching current (up to 3 A)
- Two sensing faces
- IP67 (NEMA 6P) Rating
- Slim housings
- Stainless steel models available

Specifications

Safety Ratings		
Standards	EN954-1, ISO13849-1, IEC/EN60204-1, NFPA79, EN1088, ISO14119, ANSI B11.19, AS4024.1	
Safety Classification	Cat. 1 Device per EN954-1 Dual channel interlocks suitable for Cat. 3 or 4 systems	
Functional Safety Data ∗ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	B10d: > 2 x 10^6 operations at min. PFH_D: > 3 x 10^{-7} MTTFd: > 385 years Dual channel interlock may be suitable for performance levels PLe or PLd (according to ISO 13849-1:2006) and for use in SIL2 or SIL3 systems (according to IEC 62061) depending on application characteristics	
Certifications	CE Marked for all applicable directives and cULus	
Outputs (Guard Door Closed, Actuator in Place)		
Safety Outputs	1 N.C.	1 N.C.
Auxiliary Outputs	—	1 N.C.
Operating Characteristics		
Operating Distance, Make [mm (in.)]	12 (0.47)	
Operating Distance, Break [mm (in.)]	23 (0.91)	
Environmental		
Enclosure Type Rating	IP67 (NEMA 6P)	
Operating Temperature [C (F)]	-10…+65° (+14…+149°)	
Relative Humidity	5…95%	
Shock	IEC 68-2-27, 30 g, 11 ms	
Vibration	IEC 68-2-6, 10…55 Hz	
Radio Frequency	IEC 61000-4-3, IEC 61000-4-6	
Physical Characteristics		
Actuator/Housing Material	Molded ABS plastic	
Weight [g (lb)]	Sensor/Actuator FRS 6—28 (0.06)/70 (0.15) FRS 9—28 (0.06)/70 (0.15) FRS 10—28 (0.06)/70 (0.15)	
Color	Red	

∗ Usable for ISO 13849-1:2006 and IEC 62061. Data other than B10d is based on:
- Usage rate of 1op/10 mins., 24 hrs/day, 360 days/year, representing 51840 operations per year
- Mission time/Proof test interval of 38 years

Product Selection

Safety Contact Switching Capability	Safety Contacts	Auxiliary Contacts	Housing Material	Type	Connection	Cat. No.
250V AC, 2 A	1 N.C.	—	Red Molded ABS Plastic	FRS 6	2 m Cable	**440N-G02023**
					4 m Cable	440N-G02028
					6 m Cable	440N-G02032
					10 m Cable	440N-G02013
					4-Pin Micro QD	440N-G02095
24V DC, 1 A				FRS 9	2 m Cable	**440N-G02044**
					4 m Cable	440N-G02075
					6 m Cable	440N-G02082
					10 m Cable	440N-G02089
					4-Pin Micro QD	440N-G02096
110V AC, 3 A				FRS 10	2 m Cable	440N-G02045
					4 m Cable	440N-G02088
250V AC, 2 A		1 N.C.	Stainless Steel	FRS 13	2 m Cable	440N-G02154
					4 m Cable	440N-G02155
					4-Pin Micro QD	440N-G02160
24V DC, 1 A				FRS 14	2 m Cable	440N-G02156
					4 m Cable	440N-G02157
					4-Pin Micro QD	440N-G02161

Note: Contacts are described with the guard door closed, that is, actuator in place.

Recommended Logic Interfaces

Description	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. Page No.	Cat. No.
Single-Function Safety Relays							
MSR127RP	3 N.O.	1 N.C.	Removable (Screw)	Monitored Manual	24V AC/DC	5-26	**440R-N23135**
MSR127TP	3 N.O.	1 N.C.	Removable (Screw)	Auto./Manual	24V AC/DC	5-26	**440R-N23132**
MSR126T	2 N.O.	None	Fixed	Auto./Manual	24V AC/DC	5-24	**440R-N23117**
MSR30T	2 N.O. Solid State	1 N.O. Solid State	Removable	Auto./Manual or Monitored Manual	24V DC	5-16	440R-N23198
Modular Safety Relays							
MSR210P Base 2 N.C. only	2 N.O.	1 N.C. and 2 PNP Solid State	Removable	Auto./Manual or Monitored Manual	24V DC from the base unit	5-82	440R-H23176
MSR220P Input Module	—	—	Removable	—	24V DC	5-86	440R-H23178
MSR310P Base	MSR300 Series Output Modules	3 PNP Solid State	Removable	Auto./Manual Monitored Manual	24V DC	5-102	440R-W23219
MSR320P Input Module	—	2 PNP Solid State	Removable	—	24V DC from the base unit	5-106	440R-W23218

Note: For additional Safety Relays connectivity, see page 5-12.
For additional Safety I/O and Safety PLC connectivity, see page 5-116.
For application and wiring diagrams, see page 10-1.

Connection Systems

Description	4-Pin Micro (M12)
Cordset	889D-F4AC-∗
Patchcord	889D-F4ACDM-❄

∗ Replace symbol with 2 (2 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
❄ Replace symbol with 1 (1 m), 2 (2 m), 3 (3 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
Note: For additional information, see page 7-1.

Accessories

Description	Cat. No.
FRS 6, 9, 10 Plastic Replacement Actuator	440N-A02025
FRS 13, 14 Stainless Steel Replacement Actuator	440N-A02165

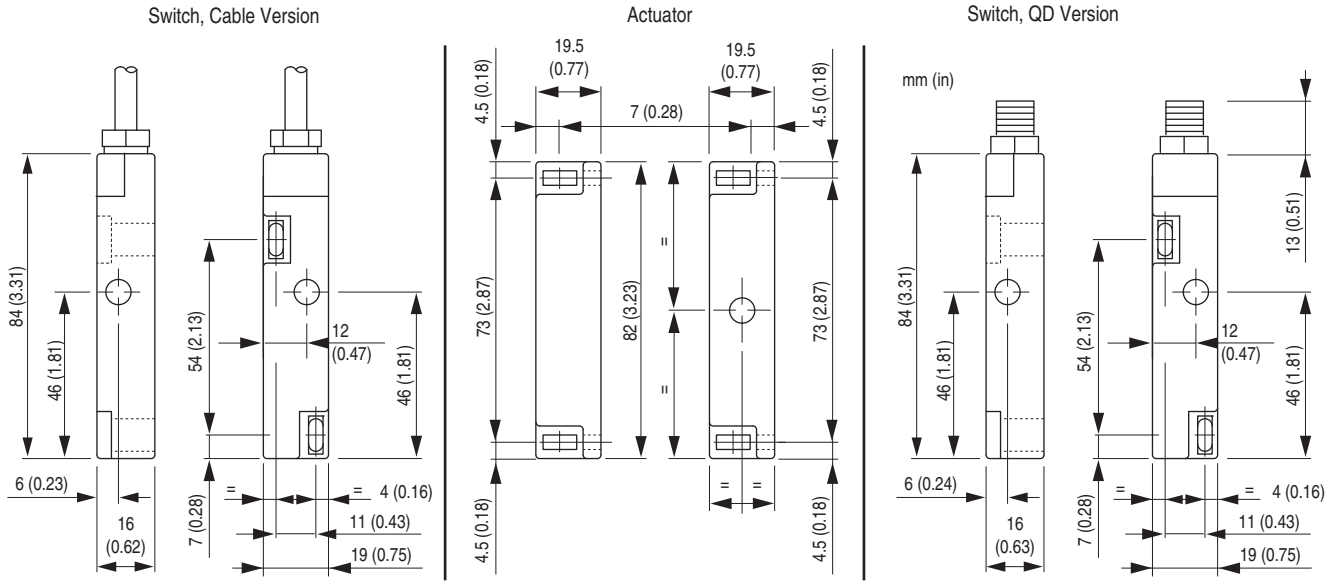
Non-Contact Switches

Ferrogard™ 6, 9,10, 13 & 14

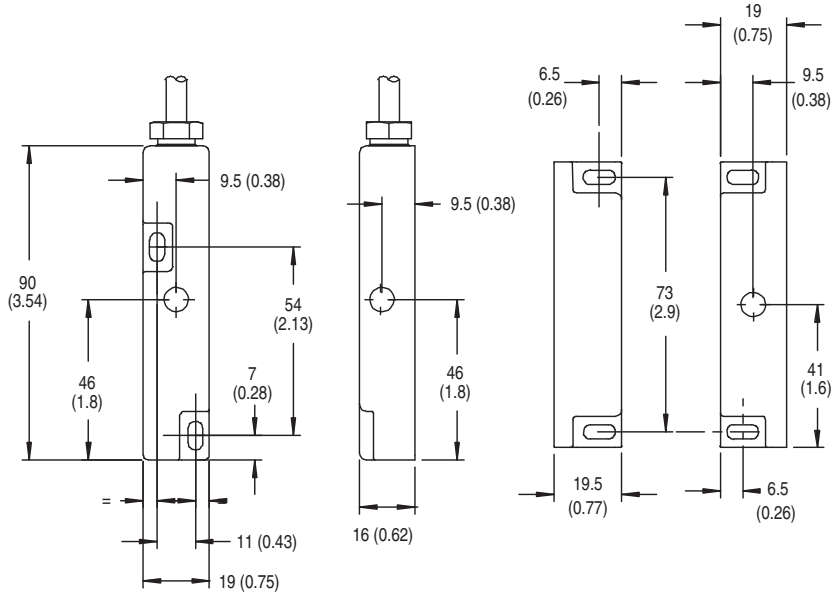
Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.

FRS 6, 9, 10



FRS 13, 14



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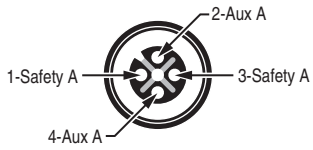
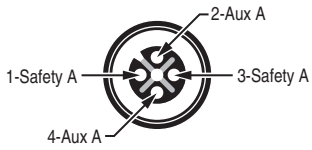
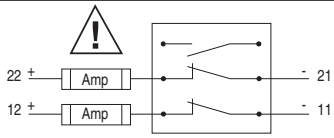
Typical Wiring Diagrams

		FRS 6, 9, 10	FRS 13, 14
		1 N.C.	1 N.C. + 1 N.O.
4-Pin Micro (M12)			
Cordset 889D-F4AC-∗	Brown	Safety A	Safety A
	Blue		
	White	—	Aux A
	Black		
Cable Version	Safety A	Brown	Brown
		Blue	Blue
	Aux A	—	Black
			Grey

∗ Replace symbol with 2 (2 m), 5 (5 m) or 10 (10 m) for standard cable lengths.

External Fuse Safety Contacts

WARNING: All safety contacts fitted with internal non-resettable fuse and must be fused externally as detailed.



	Recommended: *Bussman BK/GDA-1.6 A ** Bussman BK/GDA-400 mA ***Bussman BK/GDA-2.5 A
FRS 1, 2, 3, 4, 5, 6, 13, 21 AC	AC ≤ 1.6 A* (F) IEC 60127-2
FRS 9, 14, 2 DC, 20 DC, 21 DC	DC ≤ 0.4 A** (F) IEC 60127-2
FRS 10	AC ≤ 2.5 A*** (F) IEC 60127-2

Non-Contact Switches

Ferrogard™ GD2

Description

The Ferrogard range of magnetically actuated safety switches offers non-contact reliability together with tolerance to misalignment. They are designed to be installed so that when a guard door is opened, the action of the magnetic actuator being removed from the switch opens the N.C. safety contacts which are intended for the isolation of control power to a machine primary control element.

The GD2 version has a stainless steel housing for added protection against inadvertent impacts to the housing. The contacts are completely sealed to meet IP68 (NEMA 6P) requirements, making them ideal for wet environments. The GD2 also has a wider temperature range than the plastic Ferrogard switches, making them useful in a wider range of applications.

Unlike some magnetic switches, the Ferrogards have protected safety contacts to help ensure that they do not fail to danger. In addition, some versions have independent auxiliary signal contacts to indicate the machine and guard condition.

All Ferrogards have internal non-resettable overload protection on the safety contact. They should be protected by an external fuse rated as shown in the Specifications table.

Features

- Non-contact actuation
- High tolerance to misalignment
- High switching current (up to 2 A AC, 1 A DC)
- Wide temperature range (-25…+125°C (-13…+257°F))
- Stainless steel housing
- Various contact arrangements

Specifications

Safety Ratings			
Standards	EN954-1, ISO13849-1, IEC/EN60204-1, NFPA79, EN1088, ISO14119, ANSI B11.19, AS4024.1		
Safety Classification	Cat. 1 Device per EN954-1 Dual channel interlocks suitable for Cat. 3 or 4 systems		
Functional Safety Data ∗ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	B10d: > 2 x 10^6 operations at min. PFH_D: > 3 x 10^{-7} MTTFd: > 385 years Dual channel interlock may be suitable for performance levels PLe or PLd (according to ISO 13849-1:2006) and for use in SIL2 or SIL3 systems (according to IEC 62061) depending on application characteristics		
Certifications	CE Marked for all applicable directives and cULus		
Outputs (Guard Door Closed, Actuator in Place)			
Safety Outputs	1 N.C.	2 N.C.	2 N.C.
Auxiliary Outputs	1 N.O.	—	1 N.O.
Operating Characteristics			
Operating Distance, Make [mm (in.)]	Safety: 12 (0.47); Auxiliary: 15 (0.59)		
Operating Distance, Break [mm (in.)]	Safety: 23 (0.91); Auxiliary: 26 (1.02)		
Environmental			
Enclosure Type Rating	IP68 (NEMA 6P)		
Operating Temperature [C (F)]	-25…+125° (-13…+257°)		
Relative Humidity	5…95%		
Shock	IEC 68-2-27, 30 g, 11 ms		
Vibration	IEC 68-2-6, 10…200 Hz		
Radio Frequency	IEC 61000-4-3, IEC 61000-4-6		
Physical Characteristics			
Housing Material	Stainless Steel; BS3146 ANC4B (316L)		
Actuator Material	Stainless Steel; BS3146 ANC4B (316L)		
Weight [g (lbs)]	Sensor: 156 (0.34); Actuator: 168 (0.37)		

∗ Usable for ISO 13849-1:2006 and IEC 62061. Data other than B10d is based on:
- Usage rate of 1op/10 mins., 24 hrs/day, 360 days/year, representing 51840 operations per year
- Mission time/Proof test interval of 38 years

Product Selection

Safety Contact Switching Capability	Safety Contacts	Auxiliary Contacts	Connection	Type	Cat. No.
250V AC, 2 A max.	2 N.C.	—	3 m Cable	FRS 20 GD2	440N-G02113
	1 N.C.	1 N.O.	3 m Cable	FRS 2 GD2	440N-G02112
	2 N.C.		3 m Cable	FRS 21 GD2	440N-G02117
24V DC, 1 A max.	1 N.C.	1 N.O.	3 m Cable	FRS 2 GD2	440N-G02118
			10 m Cable	FRS 2 GD2	440N-G02147
	2 N.C.	—	3 m Cable	FRS 20 GD2	440N-G02119
	2 N.C.	1 N.O.	3 m Cable	FRS 21 GD2	**440N-G02123**
			6 m Cable	FRS 21 GD2	440N-G02143
			10 m Cable	FRS 21 GD2	440N-G02137
			8-Pin Micro (M12)	FRS 21 GD2	**440N-G02149**

Note: Contacts are described with the guard door closed, that is, actuator in place. Switch is shipped with complete actuator.

Recommended Logic Interfaces

Description	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. Page No.	Cat. No.
Single-Function Safety Relays							
MSR127RP	3 N.O.	1 N.C.	Removable (Screw)	Monitored Manual	24V AC/DC	5-26	**440R-N23135**
MSR127TP	3 N.O.	1 N.C.	Removable (Screw)	Auto./Manual	24V AC/DC	5-26	**440R-N23132**
MSR126T	2 N.O.	None	Fixed	Auto./Manual	24V AC/DC	5-24	**440R-N23117**
MSR30T	2 N.O. Solid State	1 N.O. Solid State	Removable	Auto./Manual or Monitored Manual	24V DC	5-16	440R-N23198
Modular Safety Relays							
MSR210P Base 2 N.C. only	2 N.O.	1 N.C. and 2 PNP Solid State	Removable	Auto./Manual or Monitored Manual	24V DC from the base unit	5-82	440R-H23176
MSR220P Input Module	—	—	Removable	—	24V DC	5-86	440R-H23178
MSR310P Base	MSR300 Series Output Modules	3 PNP Solid State	Removable	Auto./Manual Monitored Manual	24V DC	5-102	440R-W23219
MSR320P Input Module	—	2 PNP Solid State	Removable	—	24V DC from the base unit	5-106	440R-W23218

Note: For additional Safety Relays connectivity, see page 5-12.
For additional Safety I/O and Safety PLC connectivity, see page 5-116.
For application and wiring diagrams, see page 10-1.

Connection Systems

Description	8-Pin Micro (M12)
Cordset	889D-F8AB-✶
Patchcord	889D-F8ABDM-❄

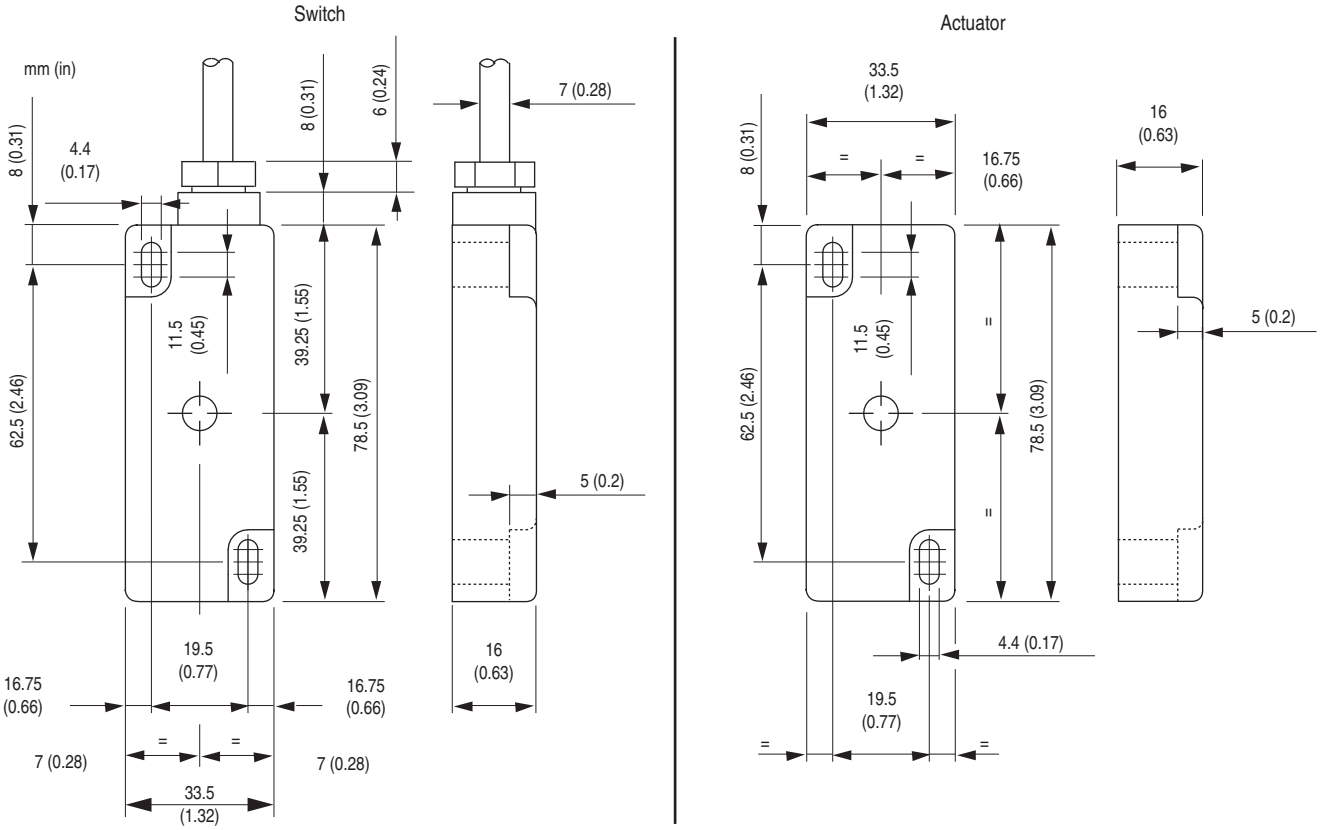
Accessories

Description	Cat. No.
Actuator	440N-A02128

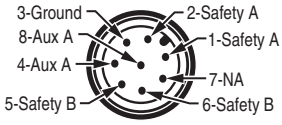
✶ Replace symbol with 2 (2 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
❄ Replace symbol with 1 (1 m), 2 (2 m), 3 (3 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
Note: For additional information, see page 7-1.

Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



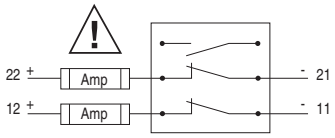
Typical Wiring Diagrams

Description		FRS21 2 N.C. + 1 N.O.	FRS2 1 N.C. + 1 N.O.	FRS20 2 N.C.
Cable Versions	Safety A	Black	Blue	Brown
		White	Red	Blue
	Safety B	Red	—	Black
		Blue		White
	Aux A	Yellow	Yellow	—
		Green	Green	
	Shield Gnd	—	Green/Yellow	Green/Yellow
8-Pin Micro (M12)			—	—
Cordset 889D-F8AB-∗	Brown White	Safety A	—	—
	Grey Pink	Safety B	—	—
	Yellow Red	Safety B	—	—
	Green Blue	NA	—	—

∗ Replace symbol with 2 (2 m), 5 (5 m) or 10 (10 m) for standard cable lengths.

External Fuse Safety Contacts

WARNING: All safety contacts fitted with internal non-resettable fuse and must be fused externally as detailed.

	FRS 2 GD2 FRS20 GD2 FRS21 GD2	AC ≤ 1.6 A* (F) IEC 60127-2
	FRS 2 GD2 FRS 20 GD2 FRS21 GD2	DC ≤ 0.4 A** (F) IEC 60127-2

Recommended:
*Bussman BK/GDA-1.6 A
** Bussman BK/GDA-400 mA

Non-Contact Switches

Ferrogard™ GS1 & GS2

Description

The Ferrogard range of magnetically actuated safety switches offers non-contact reliability together with tolerance to misalignment. They are designed to be installed so that when a guard door is opened, the action of the magnetic actuator being removed from the switch opens the N.C. safety contacts which are intended for the isolation of control power to a machine primary control element.

The GS1 and GS2 are designed for heavy duty applications. The GS1 is housed in a stainless steel or brass housing. The GS2 offers the same characteristic as the GS1, but in an Ex Range housing for hazardous locations.

Unlike some magnetic switches the Ferrogards have protected safety contacts to help ensure that they do not fail to danger.

All Ferrogards have internal non-resettable overload protection on the safety contact. They should be protected by an external fuse rated as shown in the Specifications table.

See **Other Safety Products** section on page **9-1** for more information on the Ex Range version of the Ferrogard GS2.

Features

- Non-contact actuation
- High tolerance to misalignment
- High switching current (2 A AC)
- Metal housings (IP68)
- Ex Range version available

Specifications

Safety Ratings	
Standards	EN954-1, ISO13849-1, IEC/EN60204-1, NFPA79, EN1088, ISO14119, ANSI B11.19, AS4024.1
Safety Classification	Cat. 1 Device per EN954-1 Dual channel interlocks suitable for Cat. 3 or 4 systems
Functional Safety Data ∗ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	B10d: > 2 x 10^6 operations at min. PFH_D: > 3 x 10^{-7} MTTFd: > 385 years Dual channel interlock may be suitable for performance levels PLe or PLd (according to ISO 13849-1:2006) and for use in SIL2 or SIL3 systems (according to IEC 62061) depending on application characteristics
Certifications	GS1 & GS2 - CE Marked for all applicable directives and cULus GS2 Ex - EExd IIC T6 Baseefa
Outputs (Guard Door Closed, Actuator in Place)	
Safety Outputs	1 N.C.
Auxiliary Outputs	—
Operating Characteristics	
Operating Distance, Make [mm (in.)]	GS1: 12 (0.47); GS2: 15 (0.59)
Operating Distance, Break [mm (in.)]	GS1: 23 (0.91); GS2: 26 (1.02)
Environmental	
Enclosure Type Rating	IP68 (NEMA 6P)
Operating Temperature [C (F)]	GS1: -25…+125° (-13…+257°) GS2: -40…+60° (-40…146°)
Relative Humidity	5…95%
Shock	IEC 68-2-27, 30 g, 11 ms
Vibration	IEC 68-2-6, 10…55 Hz
Radio Frequency	IEC 61000-4-3, IEC 61000-4-6
Physical Characteristics	
Housing Material	Stainless Steel or Brass
Weight [g (lbs)]	GS1 Brass: 381 (0.84) GS1 Steel: 388 (0.86) Actuator: 116 (0.26)

∗ Usable for ISO 13849-1:2006 and IEC 62061. Data other than B10d is based on:
- Usage rate of 1op/10 mins., 24 hrs/day, 360 days/year, representing 51840 operations per year
- Mission time/Proof test interval of 38 years

Product Selection

Safety Contact Switching Capability	Safety Contacts	Auxiliary Contacts	Connection	Housing Material	Type	Cat. No.
250V AC, 2 A	1 N.C.	None	2 m Cable	Brass	GS 1	440N-G02048
				Stainless Steel		440N-G02049
			3 m Cable	Brass	GS2-Ex (brass)	440N-H02046
				Stainless Steel	GS2-Ex (stainless steel)	440N-H02047

Note: Contacts are described with the guard door closed, that is, actuator in place. Switch is shipped with complete actuator.

Recommended Logic Interfaces

Description	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. Page No.	Cat. No.
Single-Function Safety Relays							
MSR127RP	3 N.O.	1 N.C.	Removable (Screw)	Monitored Manual	24V AC/DC	5-26	**440R-N23135**
MSR127TP	3 N.O.	1 N.C.	Removable (Screw)	Auto./Manual	24V AC/DC	5-26	**440R-N23132**
MSR126T	2 N.O.	None	Fixed	Auto./Manual	24V AC/DC	5-24	**440R-N23117**
MSR30T	2 N.O. Solid State	1 N.O. Solid State	Removable	Auto./Manual or Monitored Manual	24V DC	5-16	440R-N23198
Modular Safety Relays							
MSR210P Base 2 N.C. only	2 N.O.	1 N.C. and 2 PNP Solid State	Removable	Auto./Manual or Monitored Manual	24V DC from the base unit	5-82	440R-H23176
MSR220P Input Module	—	—	Removable	—	24V DC	5-86	440R-H23178
MSR310P Base	MSR300 Series Output Modules	3 PNP Solid State	Removable	Auto./Manual Monitored Manual	24V DC	5-102	440R-W23219
MSR320P Input Module	—	2 PNP Solid State	Removable	—	24V DC from the base unit	5-106	440R-W23218

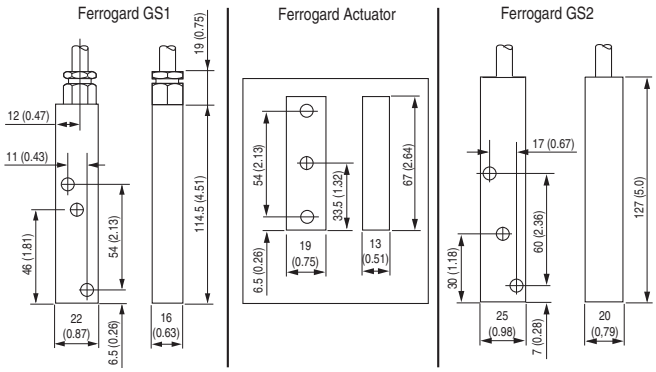
Note: For additional Safety Relays connectivity, see page 5-12.
For additional Safety I/O and Safety PLC connectivity, see page 5-116.
For application and wiring diagrams, see page 10-1.

Accessories

Description	Used with	Cat. No.
Actuator, Alnico	Brass Switch	440N-A02056
Actuator, Epoxy-painted	Stainless Steel	440N-A02057

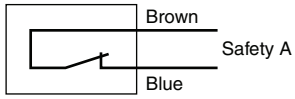
Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



Typical Wiring Diagrams

Cable



External Fuse Safety Contacts

WARNING: All safety contacts fitted with internal non-resettable fuse and must be fused externally as detailed.

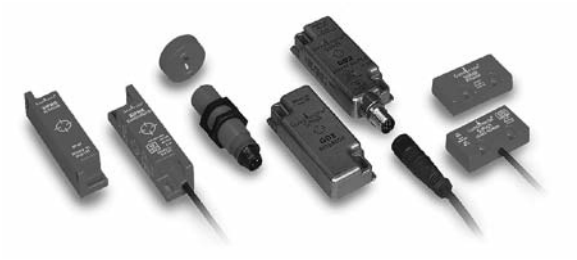
GS1 GS2	AC ≤ 1.6 A* (F) IEC 60127-2

Recommended:
*Bussman BK/GDA-1.6 A

3-Interlock Switches

Non-Contact Switches

Sipha™ Sensors



Description

With the increasing speed and complexity of applications a simple magnetic switch may be insufficient to meet the increased risks, therefore Sipha's design incorporates several magnetically sensitive elements which must be triggered in a particular sequence to operate correctly. The Sipha sensor, designed to operate with its own actuator, helps prevent defeatability by a simple magnet.

The Sipha with its molded-in brackets and diminutive size, is extremely versatile and simple to install. The Sipha sensor must be connected to the Sipha control unit giving a monitored circuit. For high-risk applications the control unit is used with a single sensor to give a high-integrity system. For other applications, multiple sensors (including mechanical switches) can be connected to one Sipha control unit. Sipha has facilities for connecting a manual reset button and for monitoring external devices such as contactors.

Four types of sensors and actuators are available incorporating different operating distances and physical sizes.

Features

- Non-contact actuation
- Magnetic coded sensing
- Four housing styles
- Must be operated with its own safety control unit

Specifications

Safety Ratings	
Standards	EN954-1, ISO13849-1, IEC/EN60204-1, NFPA79, EN1088, ISO14119, IEC60947-5-1, IEC/EN60947-5-3, ANSI B11.19, AS4024.1
Safety Classification	Rating dependent on control unit and application.
Functional Safety Data **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	B10d: > 2 x 10^6 operations at min. PFH_D: > 3 x 10^{-7} MTTFd: > 385 years Dual channel interlock may be suitable for performance levels PLe or PLd (according to ISO 13849-1:2006) and for use in SIL2 or SIL3 systems (according to IEC 62061) depending on application characteristics
Certifications	CE Marked for all applicable directives, cULus, and TÜV
Outputs (Guard Door Closed, Actuator in Place)	
Auxiliary Output Switching	300V DC, 250V AC, 0.5 A including inrush. 15V A/10 W suitable for AC/DC circuits
Operating Characteristics	
Sensing Distance, Make [mm (in.)]	Style S1: 5 (0.20) Style S2: 9 (0.35) Style S3: 5 (0.20) Style S4: 10 (0.39)
Sensing Distance, Break [mm (in.)]	Style S1: 11 (0.43) Style S2: 12 (0.47) Style S3: 12 (0.47) Style S4: 13 (0.51)
Environmental	
Enclosure Type Rating	IP67 (NEMA 6P)
Operating Temperature [C (F)]	S1, S2, S3: -10…+55° (+14…+131°) S4 (GD2): -25…+125° (-13…+257°)
Vibration	1 mm, 10…55 Hz
Shock	30 g, 11 ms half-sine
Physical Characteristics	
Cable Size	0.54 mm^2 (20 AWG) 4-wire PVC Jacket OD—4 mm (0.16 in.)
Material	S1, S2: Molded ABS S30 (Actuator): Polyester S31 (Sensor): Nylon (Trogamid) S4 (GD2): Stainless Steel
Mounting	Any position
Weight [g (lbs)]	S1: Sensor: 18 (0.04); Actuator: 15 (0.03) S2: Sensor: 20 (0.04); Actuator: 30 (0.07) S3: Sensor: 18 (0.04) Actuator: 6 (0.01) S4: Sensor: 150 (0.33); Actuator: 170 (0.37)

Product Selection

Housing Style	Housing Material	Safety Contacts	Auxiliary Contacts	Type	Connection	Cat. No.
S1	ABS plastic	1 N.C. & 1 N.O.	None	S11	3 m Cable	**440N-S32014**
					10 m Cable	440N-S32016
			1 N.C.	S12	3 m Cable	440N-S32022
					10 m Cable	440N-S32032
			1 N.O.	S13	3 m Cable	440N-S32037
					10 m Cable	440N-S32036
S2			None	S21	3 m Cable	440N-S32015
					10 m Cable	440N-S32017
			1 N.C.	S22	3 m Cable	440N-S32023
					10 m Cable	440N-S32033
			1 N.O.	S23	3 m Cable	440N-S32038
					10 m Cable	440N-S32039
S3	Actuator: Polyester Sensor: Nylon [Trogamid]		None	S31	3 m Cable	440N-S32101
					4-Pin Micro (M12)	440N-S32024
S4	Stainless Steel		1 N.C.	S42	8-Pin Micro (M12)	**440N-S32047**
					3 m Cable	440N-S32055
					10 m Cable	440N-S32056
			1 N.O.	S43	8-Pin Micro (M12)	440N-S32046
					3 m Cable	440N-S32053
					10 m Cable	440N-S32054

Recommended Logic Interfaces

Housing	Supply Voltage	Safety Contacts	Auxiliary Contacts	Housing Width	Type	Cat. Page No.	Cat. No.
	24V AC/DC	1 N.O.	1 N.C. Solid State	22.5 mm	Control Unit 1	5-74	440N-S32013
	24V AC/DC; 115/230V AC	2 N.O.	1 N.C.	45 mm	Control Unit 2		440N-S32021
	24V AC/DC; 115/230V AC	2 N.O. + 1 N.O. delayed	1 N.C.	90 mm	Sipha 6		440N-S32052

Connection Systems

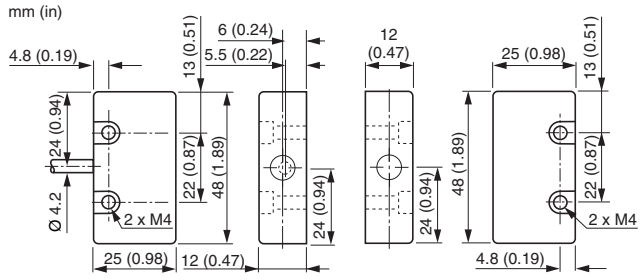
Description	4-Pin Micro (M12)	8-Pin Micro (M12)
Cordset	889D-F4ECA-✶	889D-F8AB-✶
Patchcord	889D-F4ECRM-❄	889D-F8ABDM-❄

✶ Replace symbol with 2 (2 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
❄ Replace symbol with 1 (1 m), 2 (2 m), 3 (3 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
Note: For additional information, see page 7-1.

Approximate Dimensions

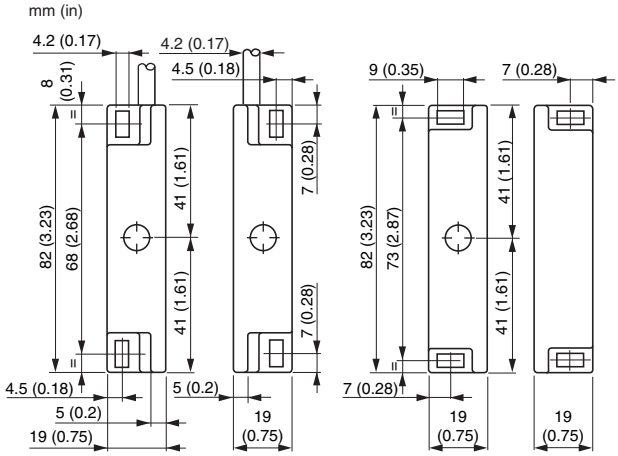
Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.

Sipha S1



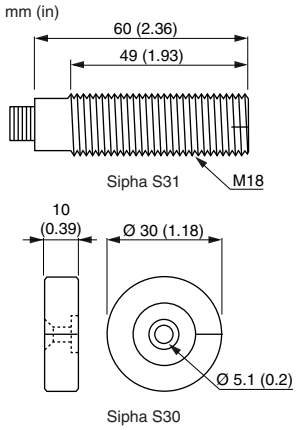
Sipha S11, S12, S13 Sipha S10

Sipha S2



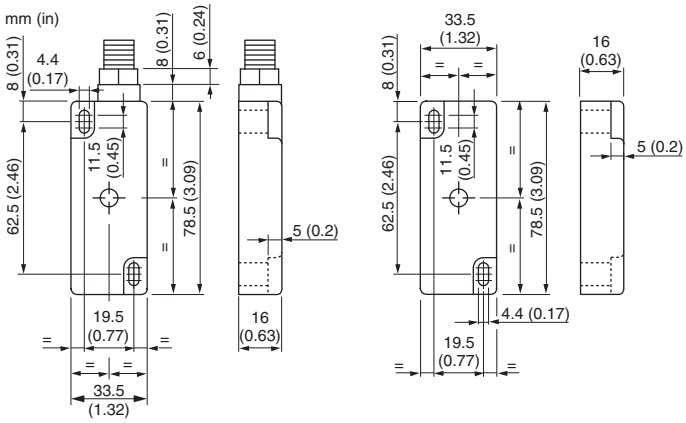
Sipha S21, S22, S23 Sipha S20

Sipha S3



Sipha S31 Sipha S30

Sipha S4



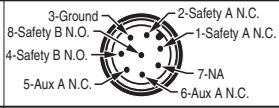
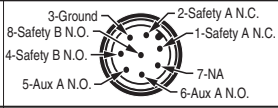
Sipha S42, S43 Sipha S40

Accessories

Description	Cat. No.
Actuator S10	440N-A32019
Actuator S20	440N-A32020
Actuator S30	440N-A32025
Actuator S40 (GD2)	440N-A32041
Bag of 40 washers for S2 models	440N-A17127

Typical Wiring Diagrams

Description		S11, S21 1 N.O. + 1 N.C.	S42, S12, S22 2 N.C. + 1 N.O.	S43, S13, S23 1 N.C. + 2 N.O.
Cable Versions	Red	Safety A_N.C.	Safety A_N.C.	Safety A_N.C.
	Blue			
	Yellow	Safety B_N.O.	Safety B_N.O.	Safety B_N.O.
	Green			
	Black	—	Aux A_N.C.	Aux A_N.O.
	White			
	Green/Yellow	—	External Ground	External Ground

Description		S31	S42	S43
4-Pin Micro (M12)			—	—
8-Pin Micro (M12)		—		
4-Pin Cordset 889D-F4AC-∗	Brown	Safety A_N.C.	—	—
	Blue			
	White	Safety B_N.O.	—	—
	Black			
8-Pin Cordset 889D-F8AB-∗	White Brown	Safety A	Safety A_N.C.	Safety A_N.C.
	Red Yellow	Safety B	Safety B_N.O.	Safety B_N.O.
	Grey Pink	Aux A	Aux A_N.C.	Aux A_N.O.
	Green Blue	NA	Gnd	Gnd

∗ Replace symbol with 2 (2 m), 5 (5 m) or 10 (10 m) for standard cable lengths.

Hinge Switches

Sprite™

Description

The Sprite is a hinge-actuated safety interlock switch in a compact housing—only 75 x 25 x 29 mm (2.95 x 0.98 x 1.14 in.)—making it the smallest interlock currently available. The Sprite has been designed for smaller machines such as printing machines, copiers and domestic machinery, which until now, have been able to use standard safety interlocks due to space restrictions. Despite its small size, the Sprite includes the necessary safety-related functions, such as forced-guided contacts and a tamper-resistant mechanism allowing machinery to be safeguarded in compliance with the machinery directive.

The shaft of the Sprite is connected to the existing hinge pin and the degree of operation can be adjusted to suit the application via the adjustable cam in the switch head.

IMPORTANT: After adjustment, the cam must be secured in position with the supplied cam locking pin to ensure optimal performance.

Features

- Ideal for small, light-weight guards
- The smallest hinge interlock switch available, 75 x 25 mm case
- Degree of operation can customized with adjustable cam
- Contacts, 2 N.C. or 1 N.C. & 1 N.O.
- Four possible shaft positions, easy to install

Specifications

Safety Ratings					
Standards		EN954-1, ISO13849-1, IEC/EN60204-1, NFPA79, EN1088, ISO14119, IEC/EN60947-5-1, ANSI B11.19, AS4024.1			
Safety Classification		Cat. 1 device per EN 954-1 May be suitable for use in Cat 3 or Cat 4 systems depending on the architecture and application characteristics			
Functional Safety Data ∗ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*		B10d: > 2 x 10^6 operations at min. load PFH_D: < 3 x10^{-7} MTTFd: > 385 years May be suitable for use in performance levels Ple or Pld systems (according to ISO 13849-1:2006) and for use in SIL2 or SIL3 systems (according to IEC 62061) depending on the architecture and application characteristics			
Certifications		CE Marked for all applicable directives, cULus NRTL/C and TÜV			
Outputs					
Safety Contacts ❄		2 N.C. direct-opening action		1 N.C. direct-opening action	
Auxiliary Contacts		—		1 N.O.	
Shaft Rotation for Contact Operation		Maximum 11°; Minimum 3° (adjustable)			
Thermal Current I_{lth}		10 A			
Rated Insulation Voltage		(Ui) 500V			
Switching Current @ Voltage, Min.		5 mA @ 5V DC			
Utilization Category					
A600/AC-15	(Ue)	600V	500V	240V	120V
	(Ie)	1.2 A	1.4 A	3 A	6 A
DC-13	(Ue)	24V			
	(Ie)	2 A			
Operating Characteristics					
Break Contact Force, Min.		8 cNm (torque on shaft)			
Actuation Speed, Max.		160 mm (6.29 in.)/s			
Actuation Frequency, Max.		1 cycle/s			
Operating Life @ 100 mA load		1,000,000 operations			
Environmental					
Enclosure Type Rating		IP67			
Operating Temperature [C (F)]		-20…+80° (-4…176°)			
Physical Characteristics					
Housing Material		UL Approved glass-filled PBT			
Shaft Material		Stainless Steel			
Weight [g (lb)]		80 (0.176)			
Color		Red			

∗ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the B10d value given and:
- Usage rate of 1op/10 mins., 24 hrs/day, 360 days/year, representing 51840 operations per year
- Mission time/Proof test interval of 38 years

❄ The safety contacts are described as normally closed (N.C.) i.e., with the guard closed, actuator in place (where relevant) and the machine able to be started.

Product Selection

Contact			Shaft Type	Actuator Shaft Dimensions—mm (in)	Cat. No.			
					M16 Conduit		Connector§	
Safety	Auxiliary	Action			M16	1/2 inch NPT Adaptor	4-Pin Micro (M12)	Connect to ArmorBlock Guard I/O 5-Pin Micro (M12)
2 N.C.	—	—	Solid	80 x Ø10 (3.14 x 0.39)	440H-S34019	440H-S34023	440H-S34027	—
				60 x Ø8 (2.36 x 0.31)	440H-S34020	440H-S34024	440H-S34028	—
				50 x Ø10(1.96 x 0.39)	440H-S34010	440H-S34017	440H-S34014	440H-S2NNPPS
			Pre-Bored	30 x Ø16 (1.18 x 0.63) bore Ø9.5 (0.37)	440H-S34033	440H-S34034	440H-S34035	440H-S2NNHPS
1 N.C.	1 N.O.	BBM	Solid	80 x Ø10 (3.14 x 0.39)	440H-S34021	440H-S34025	440H-S34029	—
				60 x Ø8 (2.36 x 0.31)	440H-S34022	440H-S34026	440H-S34030	—
				50 x Ø10(1.96 x 0.39)	440H-S34012	440H-S34018	440H-S34015	—
			Pre-Bored	30 x Ø16 (1.18 x 0.63) bore Ø9.5 (0.37)	440H-S34036	—	—	—

§ For connector ratings, see page 3-9.

Recommended Logic Interfaces

Description	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. Page No.	Cat. No.
Single-Function Safety Relays							
MSR127RP	3 N.O.	1 N.C.	Removable (Screw)	Monitored Manual	24V AC/DC	5-26	**440R-N23135**
MSR127TP	3 N.O.	1 N.C.	Removable (Screw)	Auto./Manual	24V AC/DC	5-26	**440R-N23132**
MSR9T	2 N.O.	1 N.C.	Fixed	Auto./Manual	24V AC/DC	5-14	440R-F23027
MSR30RT	2 N.O. Solid State	1 N.O. Solid State	Removable	Auto./Manual or Monitored Manual	24V DC	5-16	440R-N23198
MSR33RT	2 N.O. Solid State	1 N.O.	Removable	Auto. or Monitored Manual	24V DC SELV	5-18	440R-F23200
Modular Safety Relays							
MSR210P Base 2 N.C. only	2 N.O.	1 N.C. and 2 PNP Solid State	Removable	Auto./Manual or Monitored Manual	24V DC from the base unit	5-82	440R-H23176
MSR220P Input Module	—	—	Removable	—	24V DC	5-86	440R-H23178
MSR310P Base	MSR300 Series Output Modules	3 PNP Solid State	Removable	Auto./Manual Monitored Manual	24V DC	5-102	440R-W23219
MSR320P Input Module	—	2 PNP Solid State	Removable	—	24V DC from the base unit	5-106	440R-W23218

Note: For additional Safety Relays connectivity, see page 5-12.
For additional Safety I/O and Safety PLC connectivity, see page 5-116.
For application and wiring diagrams, see page 10-1.

Connection Systems

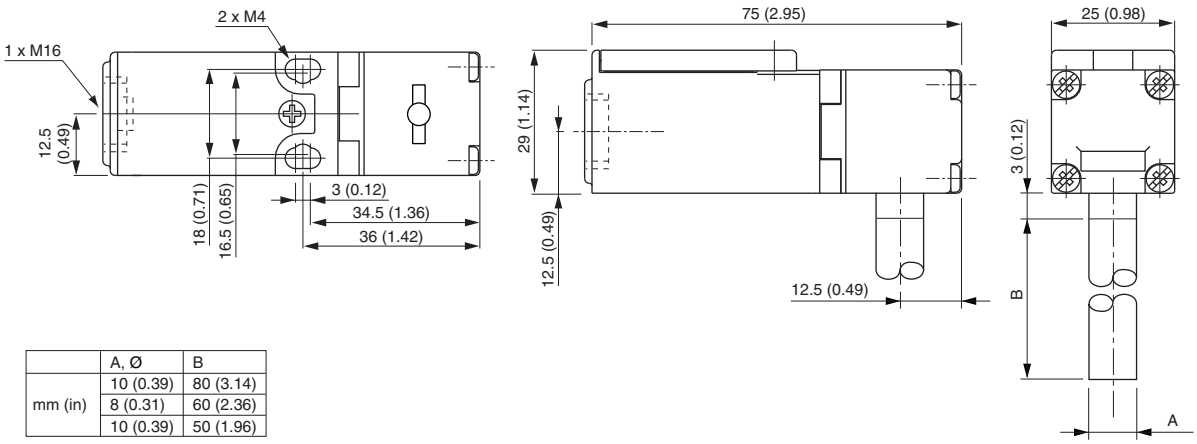
Description	4-Pin Micro (M12)		5-Pin Micro (M12) for ArmorBlock Guard I/O
	2 N.C.	1 N.C. & 1 N.O.	2 N.C.
Cordset	889D-F4AC-✶	889D-F4AC-✶	—
Patchcord	889D-F4ACDM-❄	889D-F4ACDM-❄	889D-F5ACDM-✶
Distribution Box	889D-4‡LT-DM4	898D-F4‡KT-DM4	—
Shorting Plug	889D-41LU-DM	898D-41KU-DM	—
T-Port	889D-43LY-D4	898D-43KY-D4	—

✶ Replace symbol with 2 (2 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
❄ Replace symbol with 1 (1 m), 2 (2 m), 3 (3 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
‡ Replace symbol with 4 or 8 for number of ports.
Note: For additional information, see the Safety Connection System section (page 7-1) of this catalog.

Approximate Dimensions

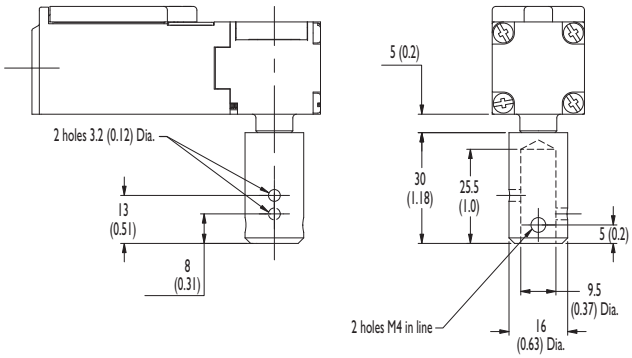
Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.

= mm (in)



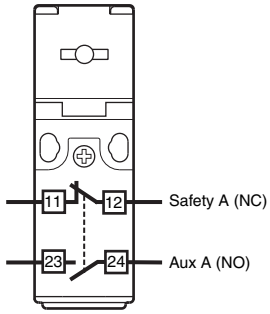
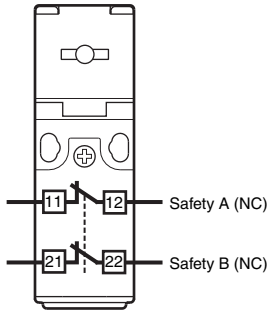
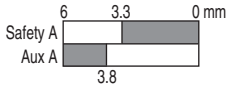
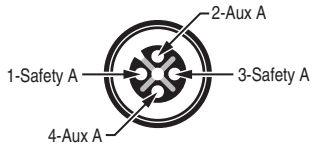
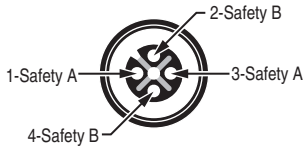
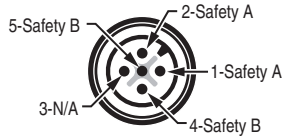
	A, Ø	B
mm (in)	10 (0.39)	80 (3.14)
	8 (0.31)	60 (2.36)
	10 (0.39)	50 (1.96)

Hollow Shaft



Note: *2D, 3D and electrical drawings are available on www.ab.com.*

Typical Wiring Diagrams

Description		1 N.C. & 1 N.O.	2 N.C.
Contact Configuration			
Contact Action □Open ■Closed			
4-Pin Micro (M12)			
5-Pin Micro (M12) For ArmorBlock Guard I/O		—	
Cordset 889D-F4AC-∗	Brown	Safety A	Safety A
	Blue		
	White	Aux A	Safety B
	Black		

∗ Replace symbol with 2 (2 m), 5 (5 m) or 10 (10 m) for standard cable lengths.

Hinge Switches

Ensign™ 3

Description

The Ensign 3 is a hinge-actuated safety-interlock switch designed to fit at the hinge point of guards. With its rotatable head, the versatile Ensign 3 offers up to four different mounting options.

Operation of the unit is achieved by the hinging action of the guard. The actuation shaft is connected to the existing hinge pin and the degree of operation can be adjusted to suit the application via the adjustable cam in the switch head.

IMPORTANT: After adjustment, the cam must be secured in position with the supplied cam locking pin to ensure safety function performance.

The switch includes the necessary safety-related functions, such as forced-guided contacts and a tamper-resistant mechanism, allowing machinery to be safeguarded in compliance with the machinery directive. It is sealed to IP67 and has one conduit entry, M16 or connector style.

Features

- Compact size—90.5 x 31 x 30.4 mm (3.56 x 1.22 x 1.2 in) housing
- Ideal for small, lightweight guards
- Degree of operation can be customized with adjustable cam
- Contacts, 2 N.C. & 1 N.O. or 3 N.C. (sealed to IP67)
- Four possible shaft positions, easy to install
- Solid and hollow shafts available

Specifications

Safety Ratings					
Standards		EN954-1, ISO13849-1, IEC/EN60204-1, NFPA79, EN1088, ISO14119, IEC/EN60947-5-1, ANSI B11.19, AS4024.1			
Safety Classification		Cat. 1 device per EN 954-1 dual channel interlocks suitable for Cat. 3 or 4 systems			
Functional Safety Data ✶ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*		B10d: > 2 x 10^6 operations at min. load PFH_D: < 3 x10^{-7} MTTFd: > 385 years May be suitable for use in performance levels Ple or Pld systems (according to ISO 13849-1:2006) and for use in SIL2 or SIL3 systems (according to IEC 62061) depending on the architecture and application characteristics			
Certifications		CE Marked for all applicable directives, cULus, and TÜV			
Outputs					
Safety Contacts ❄		3 N.C. direct-opening action		2 N.C. direct-opening action	
Auxiliary Contacts		—		1 N.O.	
Shaft Rotation for Contact Operation		3 N.C. Adjustable 12° max.: 3° min. 2 N.C. 1 N.O. (BBM) Adjustable 14° max.: 5° min. 2 N.C. 1 N.O. (MBB) Adjustable 12° max.: 3° min.			
Thermal Current I_{th}		10 A			
Rated Insulation Voltage		(Ui) 500V			
Switching Current @ Voltage, Min.		5 mA @ 5V DC			
Utilization Category					
A600/AC-15	(Ue)	600V	500V	240V	120V
	(Ie)	1.2 A	1.4 A	3 A	6 A
DC-13	(Ue)	24V			
	(Ie)	2 A			
Operating Characteristics					
Break Contact Force, Min.		8 cNm (torque on shaft)			
Actuation Speed, Max.		160 mm (6.29 in.)/s			
Actuation Frequency, Max.		1 cycle/s			
Operating Life @ 100 mA load		1,000,000 operations			
Environmental					
Enclosure Type Rating		IP67			
Operating Temperature [C (F)]		-20…+80° (-4…176°)			
Physical Characteristics					
Housing Material		UL Approved glass-filled PBT			
Shaft Material		Stainless Steel			
Weight [g (lb)]		100 (0.22)			
Color		Red			

✶ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the B10d value given and:
- Usage rate of 1op/10 mins., 24 hrs/day, 360 days/year, representing 51840 operations per year
- Mission time/Proof test interval of 38 years

❄ The safety contacts are described as normally closed (N.C.) i.e., with the guard closed, actuator in place (where relevant) and the machine able to be started.

Product Selection

Contact			Actuator Shaft Dimensions— mm (in)	Shaft Type	Cat. No.			
					M16 Conduit		Connector❄	
Safety	Auxiliary	Action			M16	1/2 inch NPT Adaptor	6-Pin Micro (M12)	Connect to ArmorBlock Guard I/O 5-Pin Micro (M12) ✶
3 N.C.	—	—	80 x Ø10 (3.14 x 0.39)	Solid	440H-E22025	440H-E22050	440H-E22059	—
			60 x Ø8 (2.36 x 0.31)		440H-E22031	440H-E22051	440H-E22060	—
			50 x Ø10 (1.96 x 0.39)		440H-E22047	440H-E22052	440H-E22061	440H-E2NNPPS
			30 x Ø16 (1.18 x 0.63) bore Ø9.5 (0.37)	Pre-bored	440H-E22067	440H-E22068	440H-E22069	440H-E2NNHPS
2 N.C.	1 N.O.	BBM	80 x Ø10 (3.14 x 0.39)	Solid	440H-E22027	440H-E22053	440H-E22037	—
			60 x Ø8 (2.36 x 0.31)		440H-E22033	440H-E22054	440H-E22039	—
			50 x Ø10 (1.96 x 0.39)		440H-E22048	440H-E22055	440H-E22062	—
			30 x Ø16 (1.18 x 0.63) bore Ø9.5 (0.37)	Pre-bored	440H-E22064	440H-E22065	440H-E22066	—
		MBB	80 x Ø10 (3.14 x 0.39)	Solid	440H-E22029	440H-E22056	440H-E22038	—
			60 x Ø8 (2.36 x 0.31)		440H-E22035	440H-E22057	440H-E22040	—
			50 x Ø10 (1.96 x 0.39)		440H-E22049	440H-E22058	440H-E22063	—
			30 x Ø16 (1.18 x 0.63) bore Ø9.5 (0.37)	Pre-bored	440H-E22070	440H-E22071	440H-E22072	—

✶ With a 5-pin micro (M12) connector, not all contacts are connected. See page 3-97 for wiring details.
❄ For connector ratings, see 3-9.

Recommended Logic Interfaces

Description	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. Page No.	Cat. No.
Single-Function Safety Relays							
MSR127RP	3 N.O.	1 N.C.	Removable (Screw)	Monitored Manual	24V AC/DC	5-26	**440R-N23135**
MSR127TP	3 N.O.	1 N.C.	Removable (Screw)	Auto./Manual	24V AC/DC	5-26	**440R-N23132**
MSR126T	2 N.O.	None	Fixed	Auto./Manual	24V AC/DC	5-24	**440R-N23117**
MSR30RT	2 N.O. Solid State	1 N.O. Solid State	Removable	Auto./Manual or Monitored Manual	24V DC	5-16	440R-N23198
Modular Safety Relays							
MSR210P Base 2 N.C. only	2 N.O.	1 N.C. and 2 PNP Solid State	Removable	Auto./Manual or Monitored Manual	24V DC from the base unit	5-82	440R-H23176
MSR220P Input Module	—	—	Removable	—	24V DC	5-86	440R-H23178
MSR310P Base	MSR300 Series Output Modules	3 PNP Solid State	Removable	Auto./Manual Monitored Manual	24V DC	5-102	440R-W23219
MSR320P Input Module	—	2 PNP Solid State	Removable	—	24V DC from the base unit	5-106	440R-W23218

Note: For additional Safety Relays connectivity, see page 5-12.
For additional Safety I/O and Safety PLC connectivity, see page 5-116.
For application and wiring diagrams, see page 10-1.

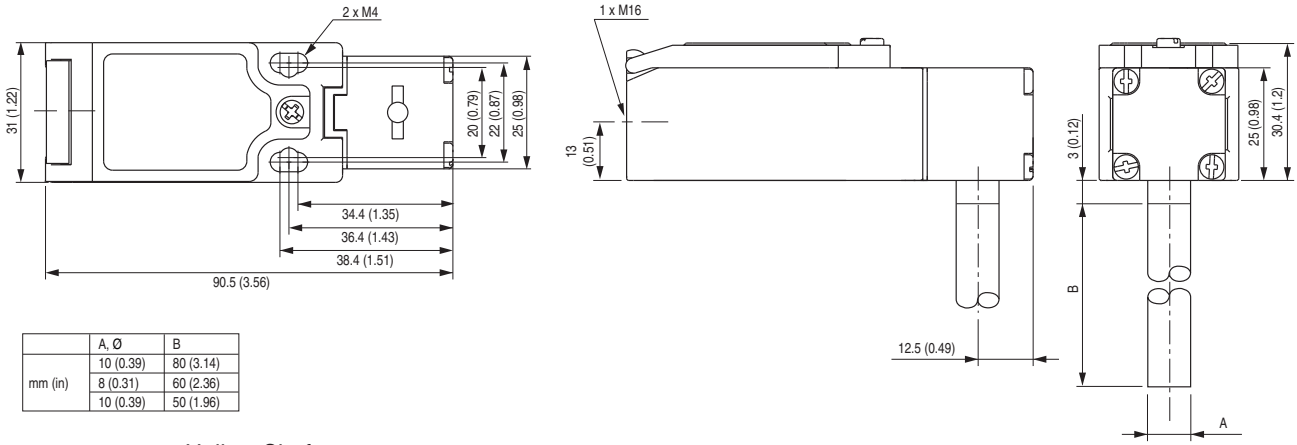
Connection Systems

Description	6-Pin Micro 3 N.C.-2 N.C. & 1 N.O.	Connections to ArmorBlock Guard I/O 5-Pin Micro (M12) 3 N.C.
Cordset	889R-F6ECA-‡	—
Patchcord	889R-F6ECRM-§	889D-F5ACDM-‡
Distribution Box	898R-P68MT-A5	—
Shorting Plug	898R-P61MU-RM	—

‡ Replace symbol with 2 (2 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
§ Replace symbol with 1 (1 m), 2 (2 m), 3 (3 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
Note: For additional information, see page 7-1.

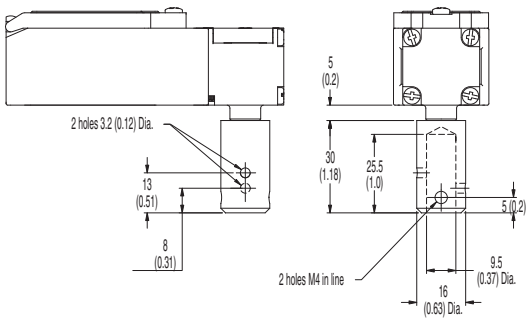
Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



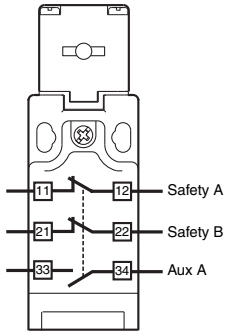
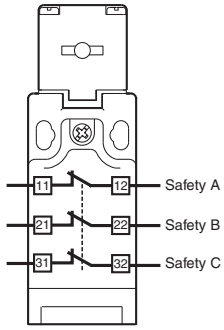
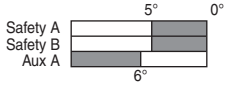
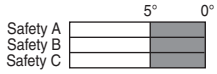
	A, Ø	B
mm (in)	10 (0.39)	80 (3.14)
	8 (0.31)	60 (2.36)
	10 (0.39)	50 (1.96)

Hollow Shaft



***Note**: 2D, 3D and electrical drawings are available on www.ab.com.*

Typical Wiring Diagrams

Description		2 N.C. & 1 N.O.	3 N.C.
Contact Configuration			
Contact Action □Open ■Closed			
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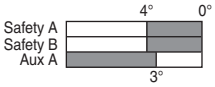
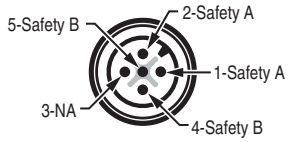
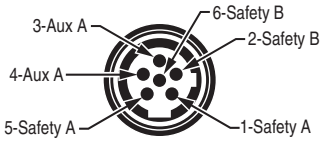
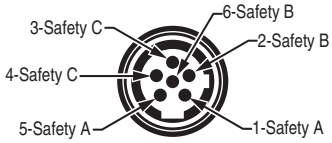
			
		MBB	
5-Pin Micro (M12) For ArmorBlock Guard I/O		—	
6-Pin Micro (M12)			
Cordset 889R-F6ECA-∗	1 Red/White	Safety A	Safety A
	5 Red/Black		
	2 Red	Safety B	Safety B
	6 Red/Blue		
	3 Green	Aux A	Safety C
	4 Red/Yellow		

∗ Replace symbol with 2 (2 m), 5 (5 m) or 10 (10 m) for standard cable lengths.

Hinge Switches

Rotacam™

Description

The Rotacam is heavy-duty, hinge-actuated safety-interlock switch. It can be used as, or connected to, the existing hinge pin for direct operation of the switch. Machine power is isolated when the guard has been opened just 5°. For applications requiring a larger degree of operation, the internal cam can be adjusted from 5…11°.

IMPORTANT: After adjustment, the cam must be secured in position with the supplied cam locking pin to ensure optimal performance.

The Rotacam is available with two N.C. safety contacts and one N.O. auxiliary contact. The switch includes the necessary safety-related functions, such as forced-guided contacts and a tamper-resistant mechanism, allowing machinery to be safeguarded in compliance with the machinery directive.

The die-cast housing is sealed to IP66 and features one M20 conduit entry (1/2 inch NPT and connector style also available). Two different shaft lengths of 30 mm and 85 mm can also be specified.

EX and Pneumatic styles of Rotacam are also available; see page 9-10 for more information.

Features

- Can be used as a hinge pin on light- and medium-weight guard doors
- Isolates power within 5° of door movement
- Degree of operation can be customized with adjustable cam
- Robust die-cast case, ideal for heavy-duty applications
- Contacts, 2 N.C. & 1 N.O.

Specifications

Safety Ratings					
Standards		EN954-1, ISO13849-1, IEC/EN60204-1, NFPA79, EN1088, ISO14119, IEC/EN60947-5-1, ANSI B11.19, AS4024.1			
Safety Classification		Cat. 1 Device per EN954-1 Dual channel interlocks suitable for Cat. 3 or 4 systems			
Functional Safety Data ∗ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*		B10d: > 2 x 10^6 operations at min. load PFH_D: < 3 x10^{-7} MTTFd: > 385 years May be suitable for use in performance levels Ple or Pld systems (according to ISO 13849-1:2006) and for use in SIL2 or SIL3 systems (according to IEC 62061) depending on the architecture and application characteristics			
Certifications		CE Marked for all applicable directives, cULus, SUVA, and TÜV			
Outputs					
Safety Contacts ❄		2 N.C. direct opening action			
Auxiliary Contacts		1 N.O.			
Shaft Rotation for Contact Operation		11° maximum; 5° minimum, (adjustable)			
Thermal Current I_{th}		10 A			
Rated Insulation Voltage		(Ui) 500V			
Switching Current @ Voltage, Min.		5 mA @ 5V DC			
Utilization Category					
A600/AC-15	(Ue)	600V	500V	240V	120V
	(Ie)	1.2 A	1.4 A	3 A	6 A
DC-13	(Ue)	24V			
	(Ie)	2 A			
Operating Characteristics					
Break Contact Force, Min.		12 cNm (torque on shaft)			
Actuation Speed, Max.		160 mm (6.29 in.)/s			
Actuation Frequency, Max.		1 cycle/s			
Operating Life @ 100 mA load		>1,000,000 operations			
Environmental					
Enclosure Type Rating		IP66			
Operating Temperature [C (F)]		-20…+80° (-4…176°)			
Physical Characteristics					
Housing Material		Heavy-duty die-cast alloy			
Shaft Material		Stainless Steel			
Weight [g (lb)]		420 (0.926)			
Color		Red			

∗ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the B10d value given and:
- Usage rate of 1op/10 mins., 24 hrs/day, 360 days/year, representing 51840 operations per year
- Mission time/Proof test interval of 38 years

❄ The safety contacts are described as normally closed (N.C.) i.e., with the guard closed, actuator in place (where relevant) and the machine able to be started.

Visit our website: www.ab.com/catalogs
Publication S117-CA001A-EN-P

Allen-Bradley
Guardmaster®

Product Selection

Safety Contacts	Auxiliary Contacts	Contact Action	Shaft Dimensions	Operating Shaft Type	Cat. No.		
					M20 Conduit		Connector§
					M20	1/2 inch NPT Adaptor	8-Pin Micro (M12)
2 N.C.	1 N.O.	BBM	L = 30 (1.18) D = 16 (0.63)	Pre-Bored	440H-R03074	440H-R03078	440H-R03111
			L = 85 (3.35) D = 12.7 (0.5)	Solid	440H-R03079	440H-R03088	440H-R03112

§ For connector ratings, see 3-9.

Recommended Logic Interfaces

Description	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. Page No.	Cat. No.
Single-Function Safety Relays							
MSR127RP	3 N.O.	1 N.C.	Removable (Screw)	Monitored Manual	24V AC/DC	5-26	**440R-N23135**
MSR127TP	3 N.O.	1 N.C.	Removable (Screw)	Auto./Manual	24V AC/DC	5-26	**440R-N23132**
MSR126T	2 N.O.	None	Fixed	Auto./Manual	24V AC/DC	5-24	**440R-N23117**
MSR30RT	2 N.O. Solid State	1 N.O. Solid State	Removable	Auto./Manual or Monitored Manual	24V DC	5-16	440R-N23198
Modular Safety Relays							
MSR210P Base 2 N.C. only	2 N.O.	1 N.C. and 2 PNP Solid State	Removable	Auto./Manual or Monitored Manual	24V DC from the base unit	5-82	440R-H23176
MSR220P Input Module	—	—	Removable	—	24V DC	5-86	440R-H23178
MSR310P Base	MSR300 Series Output Modules	3 PNP Solid State	Removable	Auto./Manual Monitored Manual	24V DC	5-102	440R-W23219
MSR320P Input Module	—	2 PNP Solid State	Removable	—	24V DC from the base unit	5-106	440R-W23218

Note: For additional Safety Relays connectivity, see page 5-12.
For additional Safety I/O and Safety PLC connectivity, see page 5-116.
For application and wiring diagrams, see page 10-1.

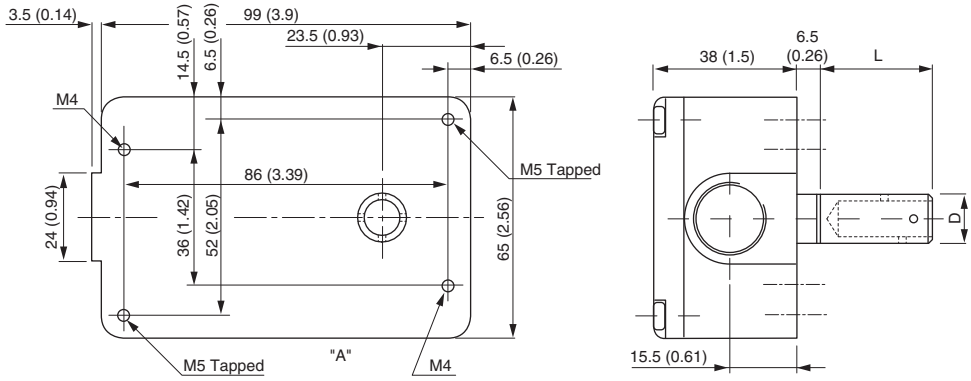
Connection Systems

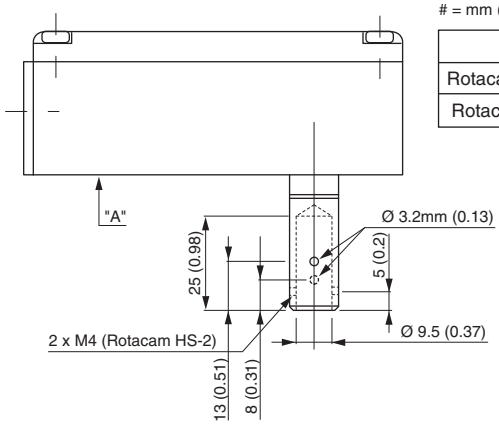
Description	8-Pin Micro (M12)
	2 N.C. & 1 N.O.
Cordset	889D-F8AB-∗
Patchcord	889D-F8ABDM-❄
Distribution Box	—
Shorting Plug	—
T-Port	—

∗ Replace symbol with 2 (2 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
❄ Replace symbol with 1 (1 m), 2 (2 m), 3 (3 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
Note: For additional information, see page 7-1.

Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



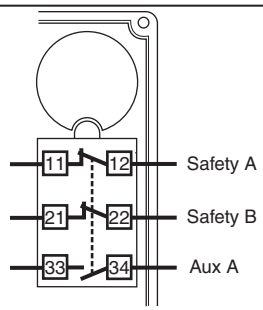
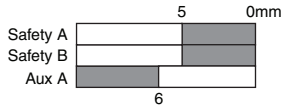
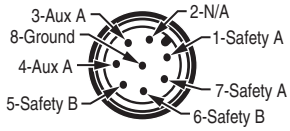


= mm (in)

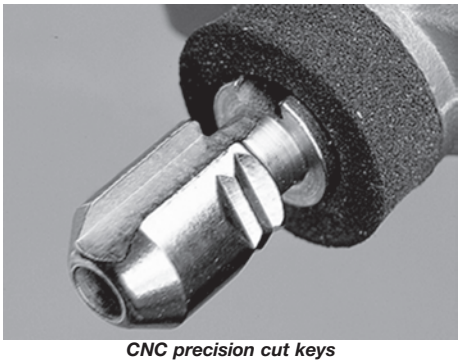
	L	D
Rotacam HS-2	30mm (1.18)	16mm (0.63)
Rotacam P85	85mm (3.35)	12.7mm (0.5)

Note: Holes only on pre-bored models.
Note: 2D, 3D and electrical drawings are available on www.ab.com.

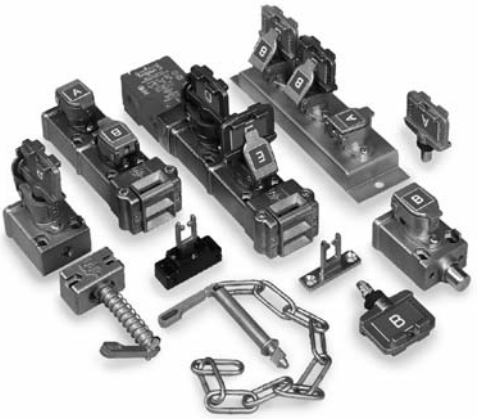
Typical Wiring Diagrams

Description		2 N.C. & 1 N.O.
Contact Configuration		
Contact Action □Open ■Closed		
8-Pin Micro (M12) Pin 2 Not Connected		
8-Pin Cordset 889D-F8AB-∗	White Blue	Safety A
	Grey Pink	Safety B
	Green Yellow	Aux A
	Red	Ground
	Brown	Not Connected

∗ Replace symbol with 2 (2 m), 5 (5 m) or 10 (10 m) for standard cable lengths.



CNC precision cut keys



Interlocking and Control Solutions

Trapped Key Interlocks—Why Use Them?

Based upon the premise that no one key can be in two places at once, key interlock systems can be configured to provide that a predetermined sequence of events takes place or that hazards have been reduced before operators can become exposed to them.

It is a mechanical system and is therefore widely used in applications including those where the location of plant, environment or explosive atmospheres make the use of electrical interlock systems unsuitable or expensive to install. In addition, unique coding can be provided, leading to a greater degree of security and tamper-resistance.

Why Prosafe?

In order to derive the full benefits from a trapped key interlocking system its components must be totally practical, easily maintainable and readily available. Prosafe's unique key and code barrel gives the ability for even complicated interlocking systems and spare parts to be ordered from our worldwide network of distributors—fast! A first for trapped key interlocks.

Five Unique Prosafe Benefits

Compare the following to other trapped key manufacturers:

1. All stainless interlocking and coded parts—including the code barrel and internal components at no extra cost.
2. Weather cap as standard—no extra charge for dust caps and seals.
3. Standard red color-coded key and ID tags—at no extra charge.
4. Custom color/text keys and ID tags—nominal extra charge.
5. A complete range of isolators, key exchange, miniature valve interlocks and gate interlocks—all using the same key principle.

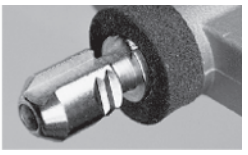
CE Marking—Tested and Approved

Only Prosafe products carry the prestigious BG mark. A sign of safety, independently tested by the German Berufsgenossen-schaftliches Institut für Arbeitssicherheit, "BIA." Additional tests for valve interlocks include Lloyds Certificate for fire test and salt-mist resistance.

Over 100,000 Operations

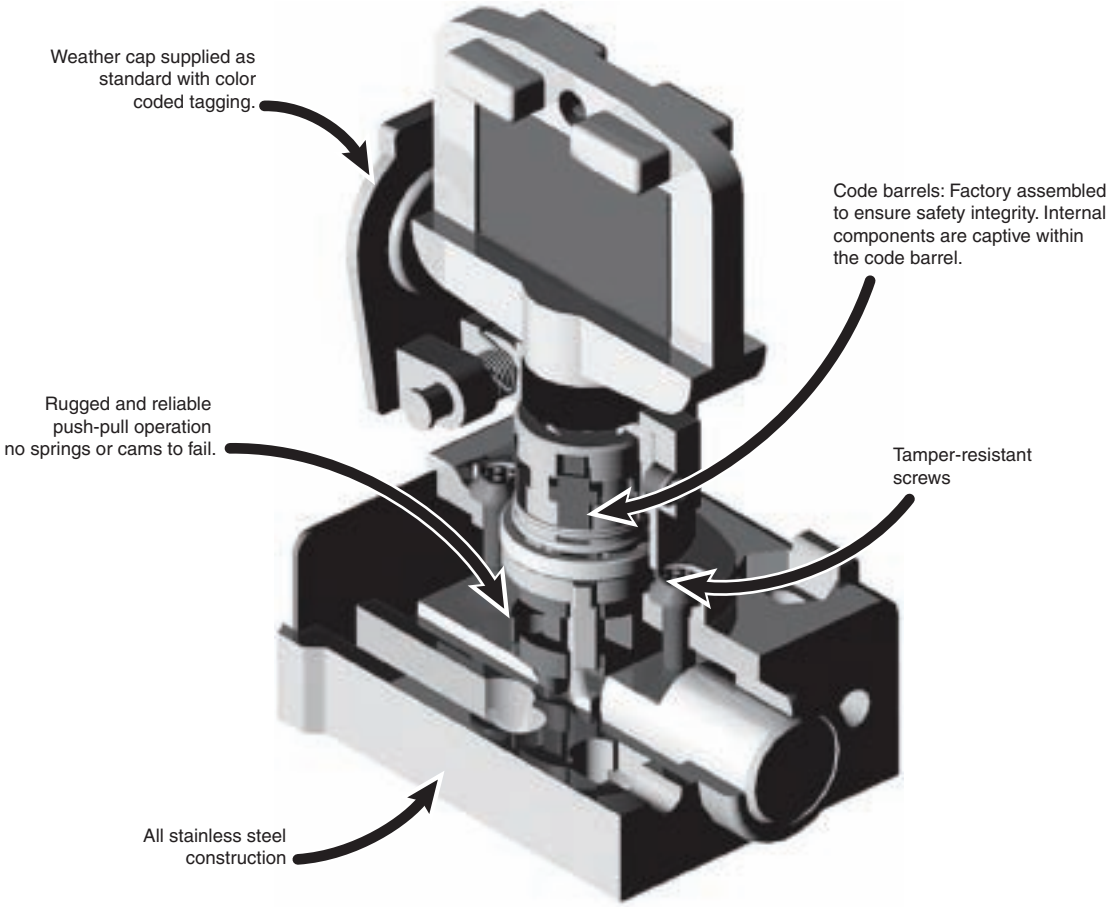
Prosafe products have been subjected to independent, exhaustive testing. With only a small amount of lubricant added infrequently, keys were inserted, rotated and removed at a rate of 12 times per minute. After 100,000 operations (at 10 operations a day this is equivalent to 27 years) the unit was functioning satisfactorily and most importantly would "pass" only the original or equivalent new key. No incorrect keys could operate the lock, underlining the unit's integrity as well as longevity.

The Prosafe Advantage



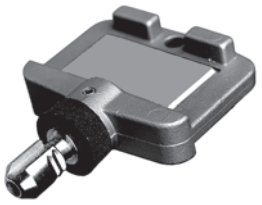
Stainless steel construction.

The Advantage



Prosafe Keys

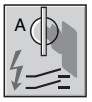
Compact, solid and sturdy keys supplied with dust seals and coded tagging. Optional colors/text are available.



Design Suggestions for an Interlocking System

Plant and Machinery Interlocking

Primary hazards
(Power isolation)



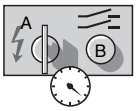
Rotary key switch

3 Port spool valve

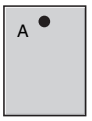
Consider removal of all power providing kinetic energy to the system i.e., electrical motors, pressurized air, etc.

Comments
Consider factors such as run down and environmental factors such as hazardous (explosive) atmospheres. Use EEX isolator and timed delay units where necessary.

Auxiliary hazards



Timed delay unit

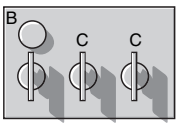


Solenoid key release unit coupled to temperature or pressure switch sensors

Bolt lock off device for grounding and capacitive discharge

Consider if the hazard is removed immediately i.e.,
a) Machine run on due to momentum.
b) Pressurization of hydraulic or pneumatic systems.
c) Stored energy such as capacitance or static electricity.
d) Temperature, either hot or cold, creating a hazard.

Key control element

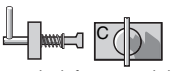


Required when more than one hazard element needs isolation or more than one exposure/access point interlocking.

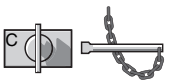
Comments
Consider sequentially interlocking all primary sources of hazard so all are eliminated. In turn, releasing a single key to input in key control element. Additional monitoring, isolation or control functions such as switches or solenoid locks may be incorporated at this stage to eliminate other elements.

Guarded area access

Bolt lock for sliding guards

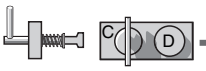


Access lock for general duty sliding, hinge and lift off guards



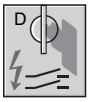
Chain interlock for large or poorly aligned sliding, hinge and lift off guards

To gain access to the danger zone.



Comments
Consider 2 key versions to provide
a) Personnel key exchange types to prevent operator lock-in (whole body access applications only).
b) Lock out devices requiring 2 keys in from different sources to enable controlled access.

Ancillary functions



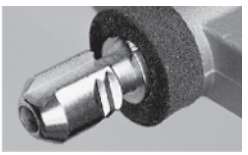
Rotary key switch

3 Port spool valve

Required when additional functions such as programming/machine resetting are necessary.

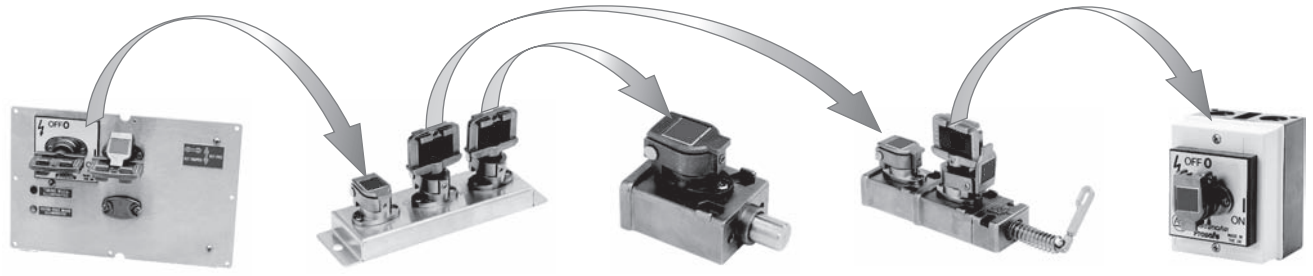
Comments
Two key versions required at access points to facilitate this feature.

The Prosafe Advantage



Stainless steel construction.

Illustrated Principles of Trapped Key Interlocking



AA
ETU
Isolator with timed delay key release

AA AB AB
KEX
Trapped key 'AA' Locking off ETU, Release access door lock, key 'AB'.

AB
SBL
'AB' key in to retract bolt from guard door.

AB AC
DAL
'AB' key in then 'AC' key out to open guard door.

AC
RKS
To energize robot teach mode.

Sequence of Operation

1. The ETU isolator has two keys. One is a nonremovable key. The other key (a "AA" coded key) can be removed after a timed duration, which is set by a potentiometer inside the ETU isolator. Turn the nonremovable key to turn the hazardous machine motion off and start the timer. When the time expires, the Key Free LED turns ON. Remove the "AA" key.
2. Insert the "AA" key into the Key Exchange Unit (KEX) and turn it 90°.
3. Turn one of the "AB" keys 90° and remove it from the KEX. This traps the "AA" key in the KEX and prevents the restarting of the machine.
4. Insert the "AB" key into the Single-key Bolt Lock (SBL) and turn it 90° to gain partial body access to the machine.
5. Turn the second "AB" key 90° and remove it from the KEX. Removal of this key also traps the "A" key in the KEX and prevents the restarting of the machine.
6. Insert the "AB" key into the Dual-key Access Lock (DAL) and turn it 90°.
7. Turn the "AC" key 90° and remove the "C" key. Rotate the access handle to allow full body entry into the hazard zone.
8. Take the "AC" key into the hazard zone, insert it into the rotary key switch (RKSE) and turn it 90° to send a signal to the machine control system, to allow the machine to operate in a slow or teach mode.
9. Reverse the process to return the machine to full operational mode.

Bill of Materials

Item	Quantity	Description	Cat. No.
1	1	Single Key Time Delayed with an AA Primary Key	**440T-MSTUE11AA**
2	1	Key Exchange Unit, AB Primary Key, Two B Secondary Keys Trapped (included)	**440T-MKEXE11AAABAB**
3	1	Single Bolt Lock, AB Primary Key	**440T-MSBLE10AB**
4	1	Dual Access Lock, AB Primary Key, C Secondary Key Trapped (included)	**440T-MDALE10ABAC**
5	1	Rotary Key Switch, AC Primary Code Barrel	**440T-MRKSE10AC**
6	1	AA Key	**440T-AKEYE10AA**

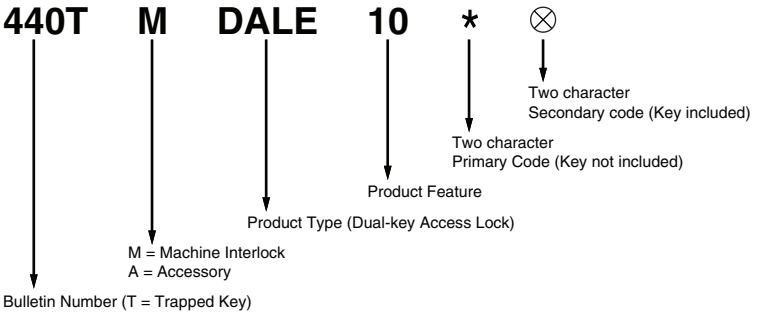
Note: Primary keys must be ordered separately, when not provided for by a previous sequential trapped key. In the example above, only one primary key must be ordered separately. The remaining primary keys are provided by a previous sequential secondary (trapped) key.

Code Selection

Ordering Prosafe trapped key products requires codes to be included in the cat. no.

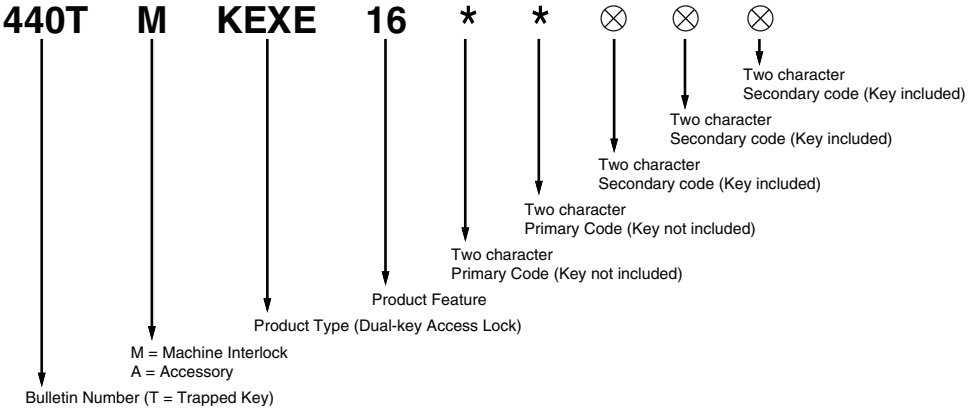
- The codes are added to the end of the cat. no.
- Each code must be two characters in length.
- The first code(s) is the primary code and the last code(s), if necessary, are the secondary code(s).
- Primary codes do not include the key. The key must be ordered separately or must come from a previous operation.
- Secondary codes come complete with a key, as the key is trapped in the code barrel.
- Use the tables on page 3-107 to select and track codes.

Ordering Example 1



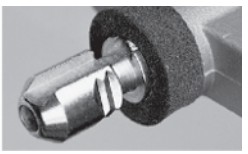
Order Cat. No. 440TMDALE100AAAB to get a Dual key Access Lock with an "AA" primary code and a "AB" secondary code, with a "AB" key included.

Ordering Example 2



Order Cat. No. 440TMKEXE16AAABACACAC to get a key exchange unit with "AA" and "AB" primary codes and three "AC" secondary codes. The "AA" and "AB" keys are not included. The three "AC" keys, which are trapped in the secondary code barrels, are included.

The Prosafe Advantage



Stainless steel construction.

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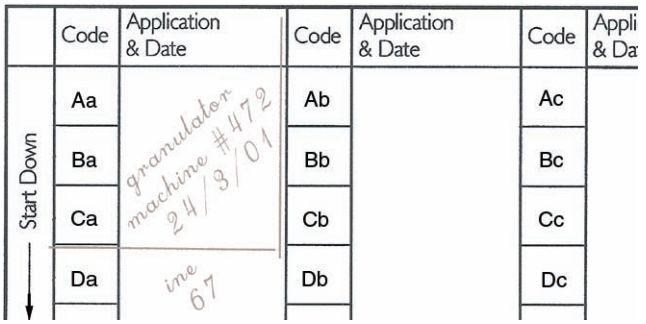
Allen-Bradley
Guardmaster®

Key Coding

Below is an example reference guide that is useful in selecting and tracking codes. Start down the Aa column as the lower codes (typically Aa to Za) are stocked. The chart continues on to Zz. Note that there are only 24 letters used—O & Q are not used.

Codes are ordered with upper case letters. Labels with two letter codes will show the first letter in the upper case and the second letter in lower case.



Code	Application & Date	Code	Application & Date	Code	Application & Date	Code	Application & Date	Code	Application & Date	Code	Application & Date
Aa		Ab		Ac		Ad		Ae		Af	
Ba		Bb		Bc		Bd		Be		Bf	
Ca		Cb		Cc		Cd		Ce		Cf	
Da		Db		Dc		Dd		De		Df	
Ea		Eb		Ec		Ed		Ee		Ef	
Fa		Fb		Fc		Fd		Fe		Ff	
Ga		Gb		Gc		Gd		Ge		Gf	
Ha		Hb		Hc		Hd		He		Hf	
Ia		Ib		Ic		Id		Ie		If	
Ja		Jb		Jc		Jd		Je		Jf	
Ka		Kb		Kc		Kd		Ke		Kf	
La		Lb		Lc		Ld		Le		Lf	
Ma		Mb		Mc		Md		Me		Mf	
Na		Nb		Nc		Nd		Ne		Nf	
Pa		Pb		Pc		Pd		Pe		Pf	
Ra		Rb		Rc		Rd		Re		Rf	
Sa		Sb		Sc		Sd		Se		Sf	
Ta		Tb		Tc		Td		Te		Tf	
Ua		Ub		Uc		Ud		Ue		Uf	
Va		Vb		Vc		Vd		Ve		Vf	
Wa		Wb		Wc		Wd		We		Wf	
Xa		Xb		Xc		Xd		Xe		Xf	
Ya		Yb		Yc		Yd		Ye		Yf	
Za		Zb		Zc		Zd		Ze		Zf	

Rotary Switches

Description

The rotary switches are used for electrical isolation of machinery to improve safe access and also as teach boxes in robot cells. Once the power has been turned off, the key can then be withdrawn and used in the next sequence of operation such as unlocking an access hatch or allowing valves to be operated.

The rotary switch can either be mounted in a panel or purchased in an enclosure. The rotary switch is available with 4 poles, either 4 N.O. or 2 N.C. and 2 N.O. The 100 A 4 N.O. switch has 3 contacts rated at 100 A and 1 contact rated at 20 A.

Features

- 316L stainless steel keys
- Direct drive operation—positively opens contacts
- Stainless steel dust cap included
- Up to 400 A isolation
- 4 N.O., 2 N.O. and 2 N.C., 3 N.O./1 N.C., 3 N.O., or 3 N.C. and neutral contacts
- Replaceable code barrel assembly

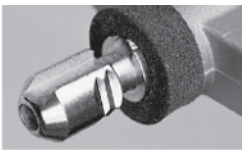
Specifications

Safety Ratings	
Standards	EN1088, IEC/EN60204-1, IEC/EN60947-5-1, ISO12100-1&2, ISO14119, GS-ET-19, AS4024.1, UL508, CSA 22.2
Category	Cat. 1 per EN 954-1 (ISO 13849-1) Suitable for Cat. 2, 3, and 4 systems
Certifications	CE Marked for all applicable directives, BG, cULus on contact block; C-Tick not required
Operating Characteristics	
Conduit Entry	4 x M20 (RKS only)
Mechanical Life	100,000 operations
Finger Protection	DIN 57106/VDE 0106 T.100
Environmental Characteristics	
Operating Temperature [C (F)]	-10…+40 ° (14…104 °)
Relative Humidity	95%
Physical Characteristics	
Shear Force to Key	15.1 k•N (3398 lbs), max.
Torque to Key	14 N•m (124 lb•in), max.

Specifications (continued)

Weight [g (lbs)]	RPSE	10, 11, 12, 13, 20:	500 (1.1)	14, 16:	1000 (2.2)
	RKSE	10, 11, 12, 13:	850 (1.9)	14, 16:	1250 (2.8)
Electrical Life		100,000 operations			
Climatic Test		Constant to DIN IEC 68 Part 2-3 Variable to DIN IEC 68 Part 2-30			
Ambient Temperature, Operation		Encased -25…40 °C (10…104 °F)			
(Ui) Rated Insulation Voltage		690V			
(Uimp) Rated Impulse withstand Voltage		6 kV			
S3 Intermittent Rating Duty Factor (VDE 0530, Part 1)		60/40/25% = 1, 3/1, 6/2 xlu			
Last two digits of Cat. No. (See Product Selection table)		10 11 16	12	13	14
Rated Uninterrupted Current (Iu)	IEC/EN/VDE	20A	32A	63A	100A
	UL/CSA	16A	30A	60A	100A
Rated Operational Voltage (Ue)	IEC/EN/VDE	690V	690V	690V	1000V
	UL/CSA	600V	600V	600V	600V
	Main Switch Isolation Voltage, Max.	750V	750V	750V	1000V
Rated Operational Current (Ie)	AC-21A IEC/EN/VDE	20A	32A	63A	100A
	AC-1 SEV	20A	32A	63A	100A
Rated Operational Power at 50/60 Hz (AC-23A IEC/EN/VDE)	3-phase 220…240V	4 kW	5.5 kW	15 kW	22 kW
	3-pole 380…440V	7.5 kW	11 kW	22 kW	37 kW
	500…690V	7.5 kW	11 kW	22 kW	37 kW
Rated Operational Power at 50/60 Hz (AC-3A IEC/EN/VDE)	3-phase 220…240V	3 kW	4 kW	11 kW	22 kW
	3-pole 380…440V	5.5 kW	7.5 kW	18.5 kW	30 kW
	500…690V	5.5 kW	7.5 kW	18.5 kW	30 kW
DOL Rating (UL/CSA)	3-phase 140V	1 HP	2 HP	5 HP	10 HP
	3-pole 240V	2 HP	5 HP	15 HP	25 HP
	480V	5 HP	10 HP	30 HP	30 HP
	600V	5 HP	10 HP	40 HP	30 HP
Rated Breaking Capacity	AC-23/AC-3 220…240V	250A	330A	500A	600A
	Motor Switch 380…440V	250A	330A	500A	600A
	500…690V	150A	220A	270A	300A
Fuse Rating (GI)		25 A, max.	35 A, max.	63/50 A, max.	100 A, max.
Rated Fuse Short Circuit Current		15 kA	15 kA	15/20 kA	25 kA
Terminal Cross Section		1…10		4…16	2.5…3.5
		mm^2 single/multiple wire			
Conductor Size, mm^2 min…max		0.75 …6		2.5…10	1.5…2.5
		(stranded) with sleeve			
		8 AWG		6 AWG	2 AWG

The Prosafe Advantage



Stainless steel construction.

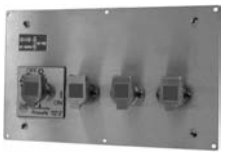
Visit our website: www.ab.com/catalogs
Publication S117-CA001A-EN-P

Allen-Bradley
GuardMaster®

Product Selection

Type	Contact Type	Current Accuracy	Cat. No.
Enclosure Mounted (RKS only)	4 N.O.	20 A	440T-MRKSE10✶
	2 N.O. & 2 N.C.	20 A	440T-MRKSE11✶
	4 N.O.	32 A	440T-MRKSE12✶
	4 N.O.	63 A	440T-MRKSE13✶
	3 N.O. & 1 N.O.	3 N.O. 100 A and 1 N.O. 20 A	440T-MRKSE14✶
	8 N.O.	20 A	440T-MRKSE16✶
Mild Steel Enclosure Mounted (RKS only)	3 N.O. + Neutral	200 A	440T-MRKSE21✶
	3 N.O.	400 A	440T-MRKSE22✶
Panel Mounted	4 N.O.	20 A	440T-MRPSE10✶
	2 N.O. & 2 N.C.	20 A	440T-MRPSE11✶
	4 N.O.	32 A	440T-MRPSE12✶
	4 N.O.	63 A	440T-MRPSE13✶
	3 N.O. & 1 N.O.	3 N.O. 100 A and 1 N.O. 20 A	440T-MRPSE14✶
	8 N.O.	20 A	440T-MRPSE16✶
	3 N.O. & 3 N.C.	20 A	440T-MRPSE18✶
	4 N.O.	40 A	440T-MRPSE20✶

✶ Substitute the desired primary code for this symbol (key not included). See page 3-107.

	Type	Number of Keys	Contact Type	Current Accuracy	Cat. No.
Isolator on First Key Out					
	Dual key isolator	2 keys out	4 N.O.	20 A	440T-MMRSE10✶✶
			2 N.O. & 2 N.C.	20 A	440T-MMRSE11✶✶
			4 N.O.	32 A	440T-MMRSE12✶✶
			4 N.O.	63 A	440T-MMRSE13✶✶
	Triple key isolator	3 keys out	4 N.O.	20 A	440T-MMRSE20✶✶✶
			2 N.O. & 2 N.C.	20 A	440T-MMRSE21✶✶✶
			4 N.O.	32 A	440T-MMRSE22✶✶✶
			4 N.O.	63 A	440T-MMRSE23✶✶✶
	Quad key isolator	4 keys out	4 N.O.	20 A	440T-MMRSE30✶✶✶✶
			2 N.O. & 2 N.C.	20 A	440T-MMRSE31✶✶✶✶
			4 N.O.	32 A	440T-MMRSE32✶✶✶✶
			4 N.O.	63 A	440T-MMRSE33✶✶✶✶
	Dual key exchange isolator	1 key in/ 1 key out	4 N.O.	20 A	440T-MMRXE10✶⊗
			2 N.O. & 2 N.C.	20 A	440T-MMRXE11✶⊗
			4 N.O.	32 A	440T-MMRXE12✶⊗
			4 N.O.	63 A	440T-MMRXE13✶⊗
	Triple key exchange isolator	1 key in/ 2 key out	4 N.O.	20 A	440T-MMRXE20✶⊗⊗
			2 N.O. & 2 N.C.	20 A	440T-MMRXE21✶⊗⊗
			4 N.O.	32 A	440T-MMRXE22✶⊗⊗
			4 N.O.	63 A	440T-MMRXE23✶⊗⊗
	Quad key exchange isolator	1 key in/ 3 key out	4 N.O.	20 A	440T-MMRXE30✶⊗⊗⊗
			2 N.O. & 2 N.C.	20 A	440T-MMRXE31✶⊗⊗⊗
			4 N.O.	32 A	440T-MMRXE32✶⊗⊗⊗
			4 N.O.	63 A	440T-MMRXE33✶⊗⊗⊗

✶ Substitute the desired primary code for this symbol (key not included). See page 3-107.
⊗ Substitute the desired secondary code for this symbol (key included). See page 3-107.

Accessories

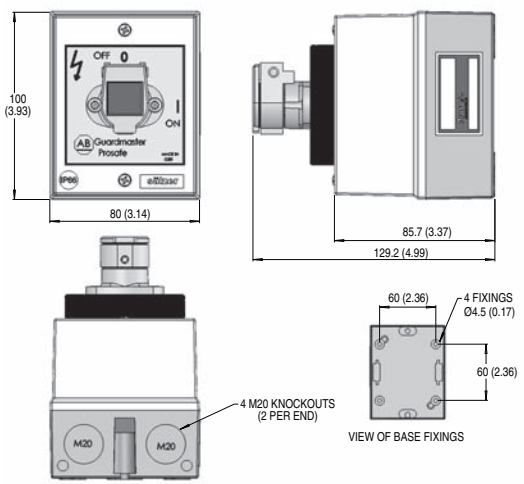
Description	Additional Information	Cat. No.
Stainless steel key	3-140	440T-AKEYE10∗
Stainless steel replacement code barrel for products other than 100 A RPS/RKS units with dust cap		440T-ASCBE14∗
Stainless steel replacement code barrel for 100 A unit rotary switch		440T-ASCBE11∗
Stainless steel weatherproof replacement dust cap		440T-ASFC10∗
Cable grip, M20 conduit, accommodates cable diameter 7…10.5 mm (0.27…0.41 in.)	3-53	440A-A09028
Adaptor, conduit, M20 to 1/2 inch NPT, plastic		440A-A09042
Supplemental Contact Block, 20 A, 1 N.O. Late Make, Early Break 1 N.C. Auxiliary	For use with RPSE12, RPSE20 (maximum 1 per switch)	440T-AACA10
Supplemental Contact Block, 20 A, 2 N.O. Late Make, Early Break	For use with RPSE12, RPSE20 (maximum 1 per switch)	440T-AACA11
Supplemental Contact Block, 20 A, 1 N.O., 1 N.C.	For use with RPSE13 & 14	440T-AACA20
Supplemental Contact Block, 20 A, 2 N.O.	For use with RPSE13 & 14	440T-AACA21
ABS plastic enclosure	For use with dual key, and dual key exchange, isolators	440T-AIPB10
Stainless steel enclosure (240x180x150 mm)	For use with >20 A RPSE units (not including RPSE21 or 22)	440T-AIPB25
Stainless steel enclosure (150x150x80 mm)	For use with RPSE10 & 11	440T-AIPB26
ABS plastic enclosure	For use with triple/quad key, and triple/quad key exchange, isolators	440T-AIPB50
Stainless steel enclosure	For use with triple/quad key, and triple/quad key exchange, isolators	440T-AIPB55

∗ Substitute the desired primary code for this symbol (key not included). See page 3-107.

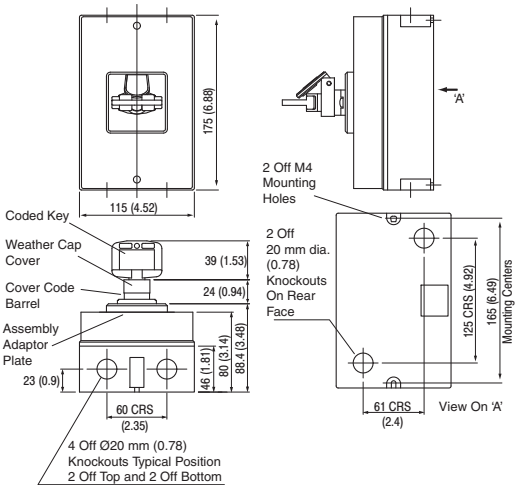
Approximate Dimensions [mm (in.)]

Dimensions are not intended to be used for installation purposes.

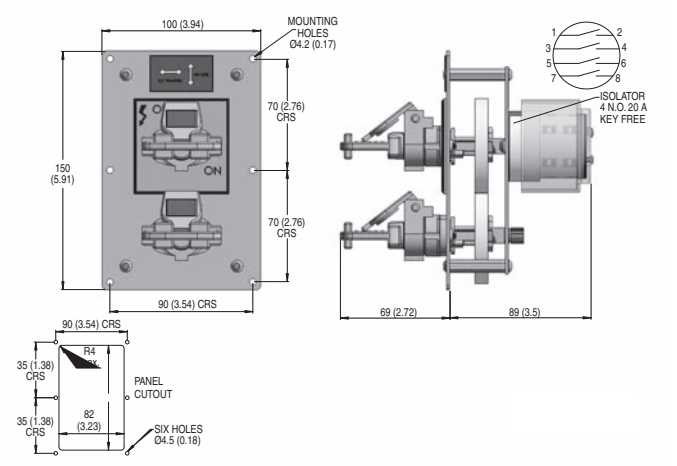
MRKSE10 and MRKSE11



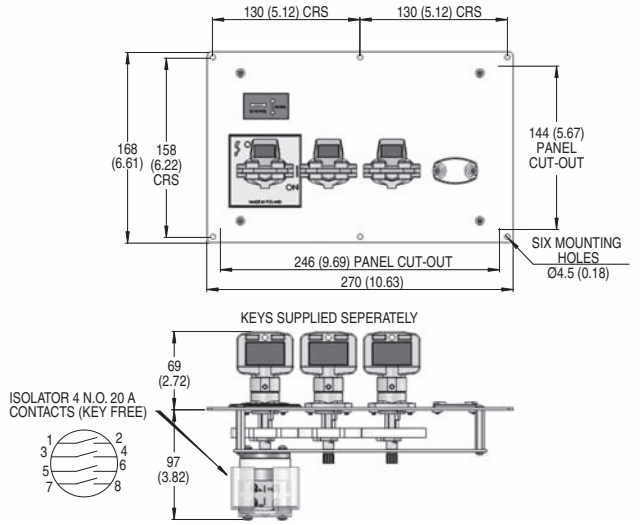
MRKSE12 and MRKSE13



MMRSE10



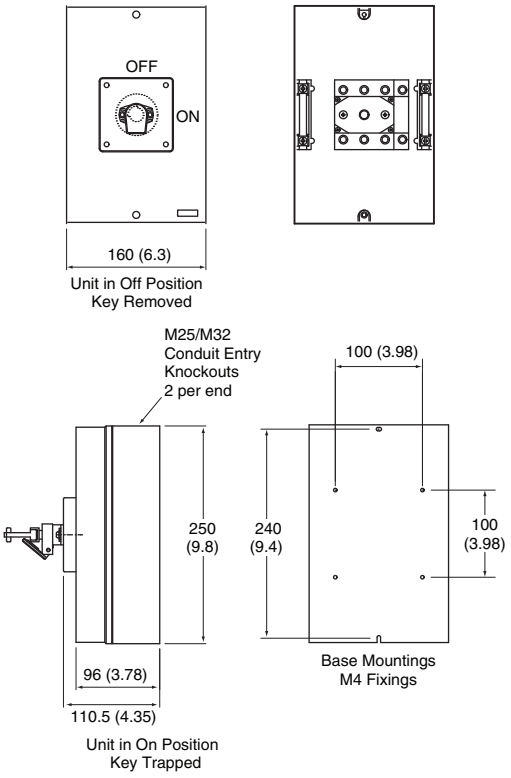
MMRSE20



Approximate Dimensions [mm (in.)] (continued)

Dimensions are not intended to be used for installation purposes.

MRKSE14



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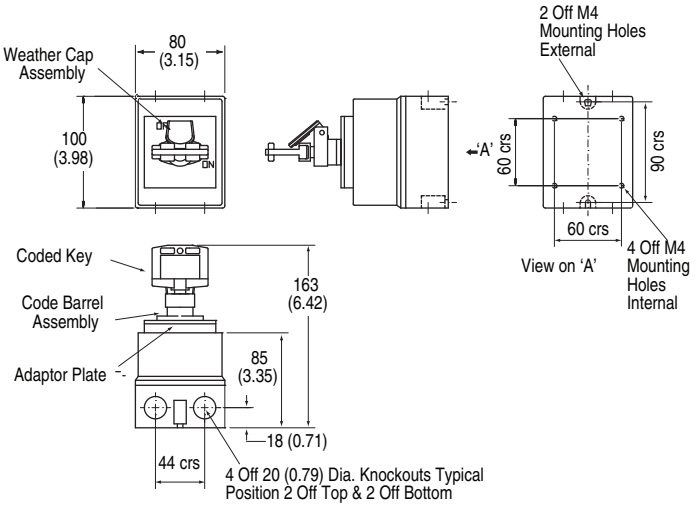
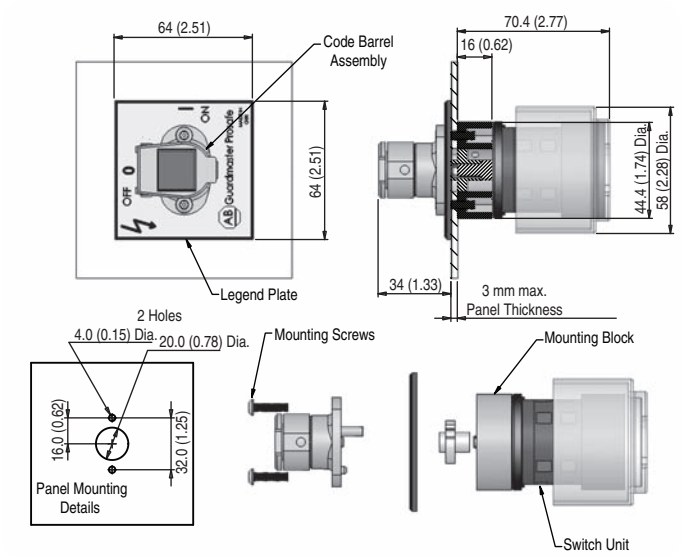
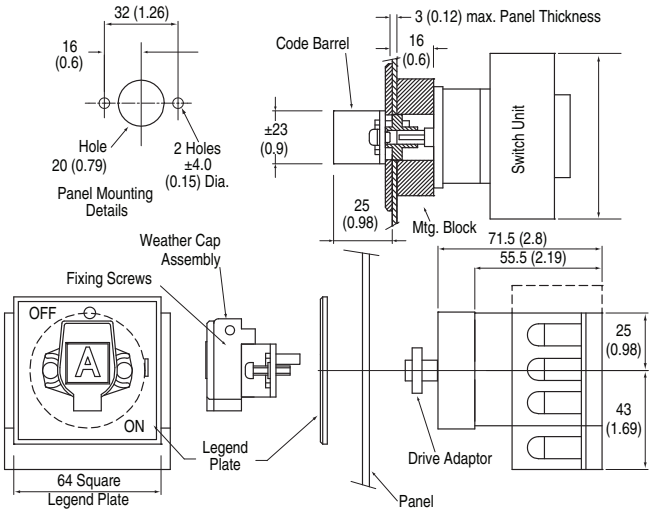


MRPSE10 and 11

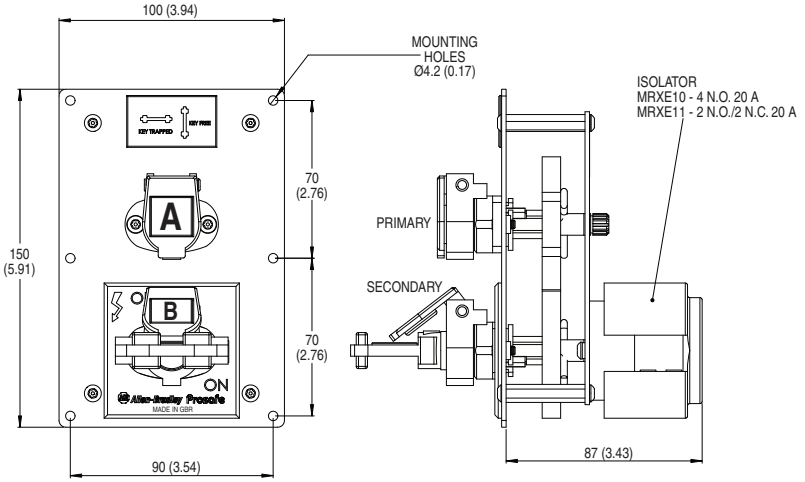


MRPSE 12, 13, 14 and 20

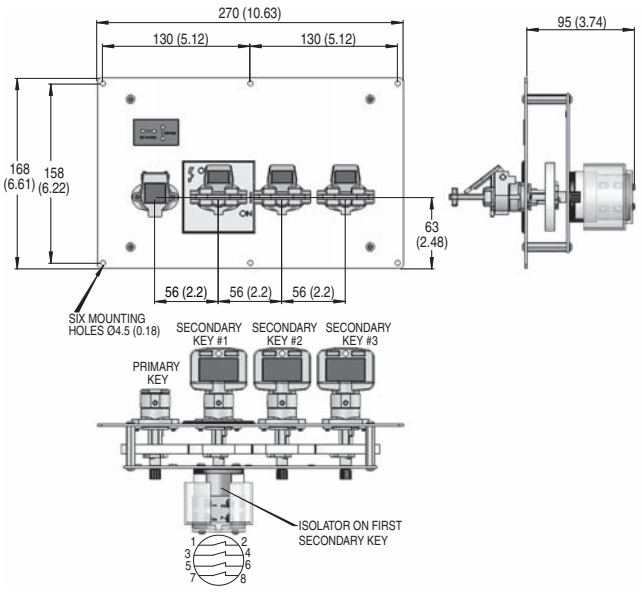


Approximate Dimensions [mm (in.)] (continued)

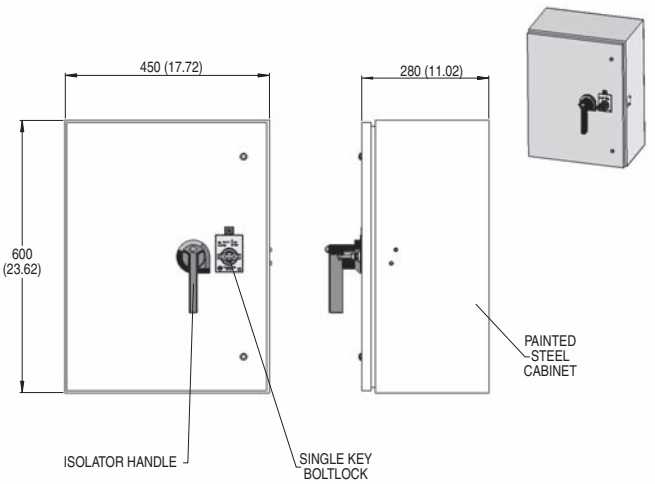
MMRXE10 and MMRXE11



MMRXE30

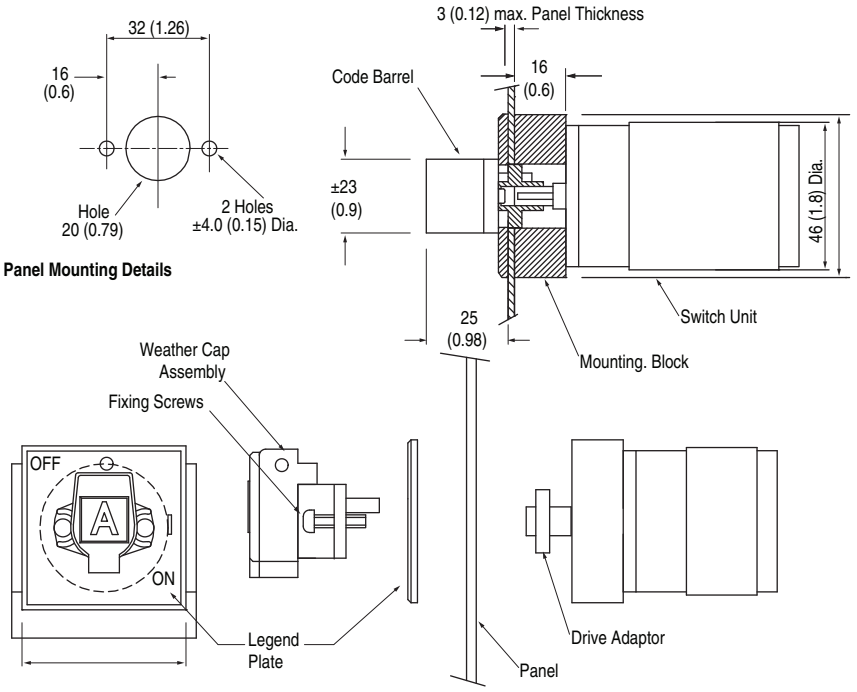


MRKSE22



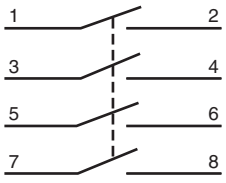
Approximate Dimensions [mm (in.)] (continued)

MRPSE16

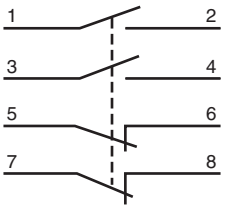


Typical Wiring

Diagrams Shown with Key Free



MRKSE10 and MRPSE10
MRKSE12 and MRPSE12
MRKSE13 and MRPSE13
---------- and MRPSE20
MMRSE10 and MMRXE10
MMRSE12 and MMRXE12
MMRSE13 and MMRXE13
MMRSE20 and MMRXE20
MMRSE22 and MMRXE22
MMRSE23 and MMRXE23
MMRSE30 and MMRXE30
MMRSE32 and MMRXE32
MMRSE33 and MMRXE33



MRKSE11 and MRPSE11
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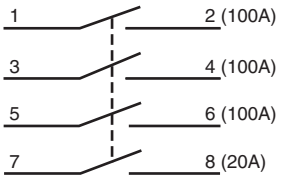
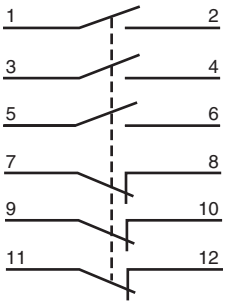
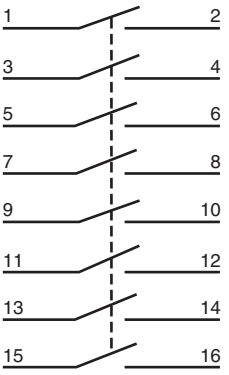
MMRSE21 and MMRXE21
MMRSE31 and MMRXE31



MRKSE14 and MRPSE14



MRKSE18 and MRPSE18



MRKSE16 and MRPSE16

Solenoid Release Units

Description

The solenoid release unit is used for electrical isolation of machinery to improve safe access. It consists of a rotary power switch and a solenoid. The trapped key can be removed once an external signal is given to its internal solenoid locking mechanism. An indicator light on the solenoid release unit indicates when the trapped key can be removed; that is, when power is applied to the solenoid. The solenoid signal only needs to be present when key removal is necessary. The solenoid is rated for 100% duty cycle. Power to the solenoid can be removed after the trapped key is removed.

Rotating the trapped key causes the isolating power switch to change state; the normally open contacts open and the normally closed contacts (if applicable) will close.

The trapped key can then be used in the next sequence of the operation.

Features

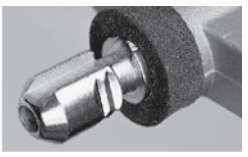
- Direct drive operation—positively opens contacts
- Integral solenoid monitoring
- Key trapped until release signal is applied
- LED or NEON "key free" indication
- 316L stainless steel construction
- 24V DC, 110V AC or 230V AC solenoid options
- Weatherproof stainless steel dust cap as standard
- UL and CSA Approval on switches
- Single or multiple key units available (contact factory)
- Replaceable code barrel assembly

Specifications

Safety Ratings

Standards	EN1954-1, IEC/EN60204-1,EN1088, IEC/EN60947-5-1, ISO13849-1, ISO12100-1&2, ISO14119, GS-ET-19, AS4024.1
Certifications	CE Marked for all applicable directives and BG
Operating Characteristics	
Solenoid Voltage	24V DC, 110V AC, 230V AC
Solenoid Power	DC Types: 6.5 W continuous AC Types: 6V A continuous
Electrical Life	100,000 operations
Mechanical Life	100,000 operations
Utilization Category	
Electrical Characteristics	See rotary power switches.
Environmental & Physical Characteristics	
Shear Force to Key	15.1 k•N (3398 lbs), max.
Torque to Key	14 N•m (124 lb•in), max.
Material	Trapped Key Components: 316L stainless steel Steel Face Plate: 316L stainless steel Optional Box: ABS plastic
Operating Temperature [C (F)]	0…40 ° (32…104 °)
Relative Humidity	95%

The Prosafe Advantage



Stainless steel construction.

Product Selection

Type	Solenoid Voltage	Contacts	Current, Nom	Cat. No.
Single key out	24V DC	2 N.O. & 2 N.C.	20 A	440T-MSRUE11✶
		4 N.O.		440T-MSRUE10✶
			32 A	440T-MSRUE12✶
		3 N.O. & 3 N.C.	20 A	440T-MSRUE13✶
	110V AC	2 N.O. & 2 N.C.	20 A	440T-MSRUE22✶
		4 N.O.		440T-MSRUE20✶
			32 A	440T-MSRUE23✶
		3 N.O. & 3 N.C.	20 A	440T-MSRUE14✶
		4 N.O.	63 A	440T-MSRUE24✶
	230V AC	2 N.O. & 2 N.C.	20 A	440T-MSRUE33✶
		4 N.O.		440T-MSRUE30✶
			32 A	440T-MSRUE34✶
			63 A	440T-MSRUE35✶
	110V DC	2 N.O. & 2 N.C.	20 A	440T-MSRUE44✶
		4 N.O.		440T-MSRUE40✶
		3 N.O. & 3 N.C.		440T-MSRUE46✶
Dual key out	24V DC	4 N.O.	20 A	440T-MS2097D✶✶
		2 N.O. & 2 N.C.		440T-MS2097A✶✶
		4 N.O.	32 A	440T-MS2097G✶✶
			63 A	440T-MS2097J✶✶
Triple key out	24V DC	4 N.O.	20 A	440T-MS3417D✶✶✶
		2 N.O. & 2 N.C.		440T-MS3417A✶✶✶
		4 N.O.	32 A	440T-MS3417G✶✶✶
			63 A	440T-MS3417J✶✶✶
Quad key out	24V DC	4 N.O.	20 A	440T-MS3418D✶✶✶✶
		2 N.O. & 2 N.C.		440T-MS3418A✶✶✶✶
		4 N.O.	32 A	440T-MS3418G✶✶✶✶
			63 A	440T-MS3418J✶✶✶✶

✶ Substitute the desired primary code for this symbol (key not included). See 3-107.

Accessories

Description	Additional Information	Cat. No.
Stainless steel key	3-140	440T-AKEYE10✶
Stainless steel replacement code barrel with dust cap		440T-ASCBE14✶
Stainless steel weatherproof replacement dust cap		440T-ASFC10✶
Optional plastic enclosure	For use with single key out 20 A units	440T-AIPB10
	For use with single key out 32 A units	440T-AIPB22
Optional ABS plastic enclosure	For use with triple/quad key out units	440T-AIPB50
Optional stainless steel enclosure	For use with triple/quad key out units	440T-AIPB55

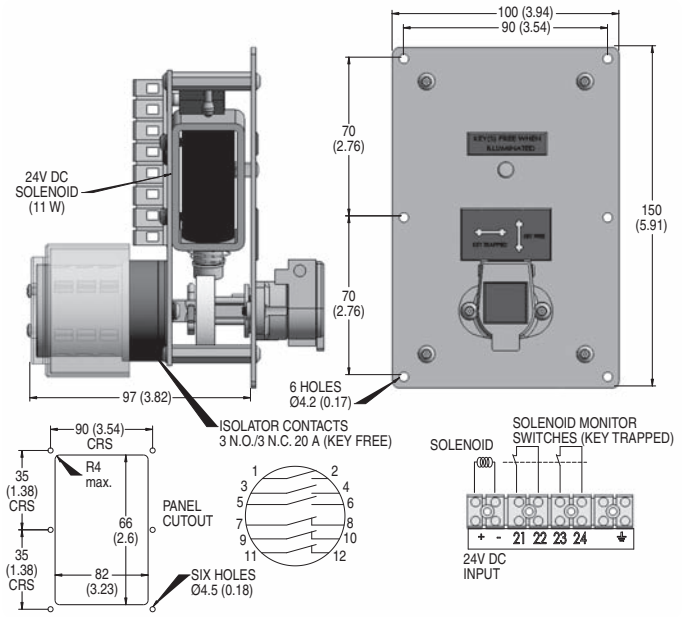
✶ Substitute the desired primary code for this symbol (key not included). See 3-107.

Solenoid Release Units

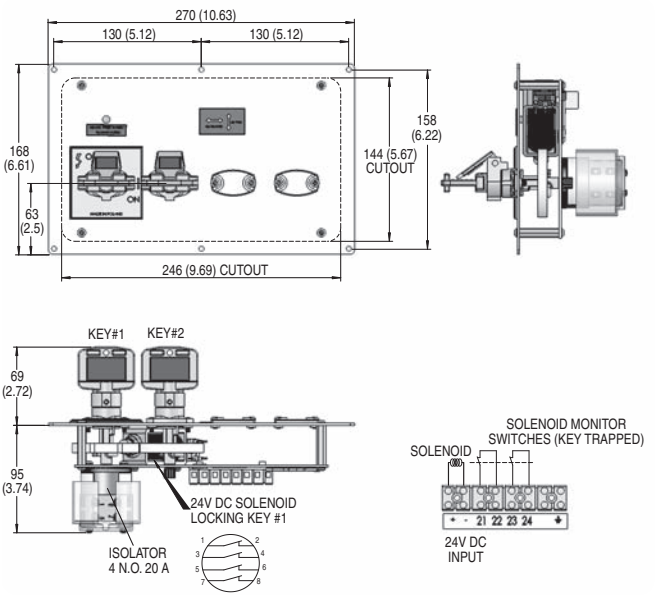
Approximate Dimensions [mm (in.)]

Dimensions are not intended to be used for installation purposes.

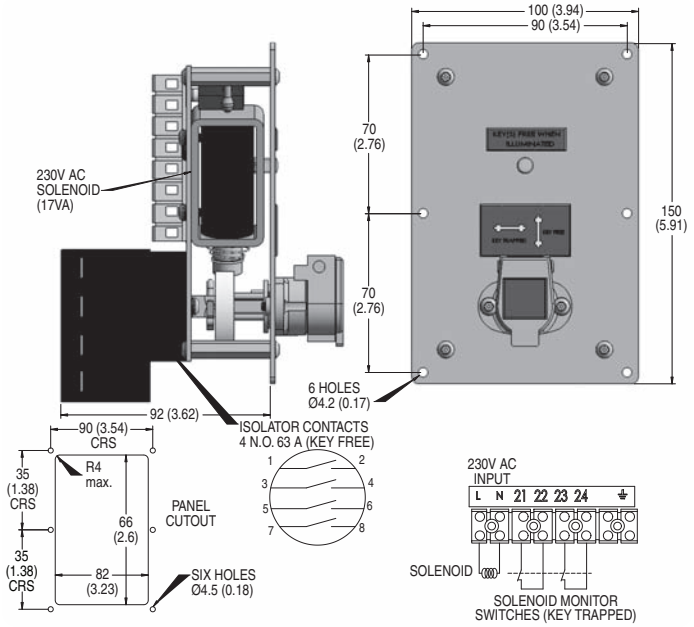
MSRUE13



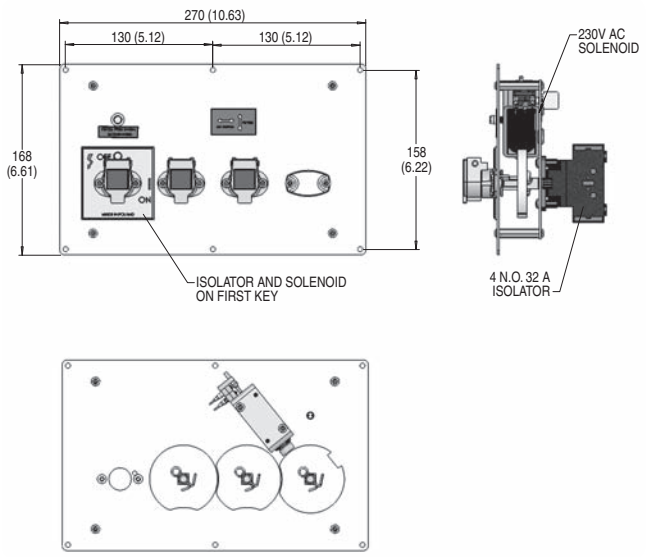
MS2097



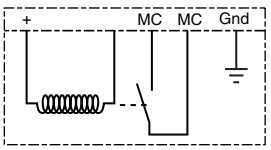
MSRUE35



MS3417



Typical Wiring



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Description

The Electronic Timed-delay Unit (ETU) is used in applications that require an elapsed time to occur before allowing access to a hazardous area. The ETU uses an CU1 control unit timer to execute the timing sequence. Turning a nonremovable key initiates the timer. When the CU1 times out, its output energizes an internal solenoid, which then allows the removal of either one or two trapped keys.

The Single-key Timed delay Unit (STU) has one trapped key. After the CU1 preset time has expired, the single trapped key can be removed and used to continue the next sequence in allowing access to the hazard. The single key must be returned to the STU and trapped to allow the nonremovable key to re-initiate the hazard.

The Dual-key Timed delay Unit (DTU) has two trapped keys. After the CU1 preset time has expired, both keys can be removed and used to continue the next sequences in allowing access to the hazard. Both keys must be returned to the DTU and trapped to allow the nonremovable key re-initiate the hazard.

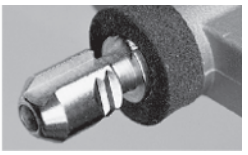
Features

- Timed-delay output up to 40 minutes
- Single key or dual key
- 316L stainless steel keys
- Category 1 Stop
- Replaceable code barrel assembly

Specifications

Safety Ratings	
Standards	IEC/EN60204-1,EN1088, IEC/EN60947-5-1, ISO13849-1, ISO12100-1&2, ISO14119, GS-ET-19, AS4024.1
Category	Cat. 1 per EN 954-1 (ISO 13849-1)
Certifications	CE Marked for all applicable directives and BG
Operating Characteristics	
Electrical Life	100,000 operations
Mechanical Life	100,000 operations
Solenoid Voltage	24V DC, 110V AC, and 230V AC
Time Delay	0.1 s…30 min
Environmental & Physical Characteristics	
Operating Temperature [C (F)]	0…40 ° (32…104 °)
Relative Humidity	95%
Shear Force to Key	15.1 k•N (3398 lbs), max.
Torque to Key	14 N•m (124 lb•in), max.
Material	Trapped key components: 316L stainless steel Face plate: 316L stainless steel Optional box: ABS plastic or stainless steel

The Prosafe Advantage



Stainless steel construction.

Electronic Timed-Delay Units

Product Selection

Type	Solenoid Voltage	Contact Set 1	Contact Set 2	Cat. No.
Single key out Panel mounted	24V DC	3 N.O. 40 A	1 N.O. 20 A	440T-MSTUE10∗
		2 N.O. 20 A	1 N.C. 20 A	440T-MSTUE11∗
	110V AC	3 N.O. 40 A	1 N.O. 20 A	440T-MSTUE20∗
		2 N.O. 20 A	1 N.C. 20 A	440T-MSTUE22∗
	230V AC	3 N.O. 40 A	1 N.O. 20 A	440T-MSTUE30∗
		2 N.O. 20 A	1 N.C. 20 A	440T-MSTUE33∗
Dual key out Panel mounted	24V DC	3 N.O. 40 A	1 N.O. 20 A	440T-MDTUE10∗∗
		2 N.O. 20 A	1 N.C. 20 A	440T-MDTUE11∗∗
	110V AC	3 N.O. 40 A	1 N.O. 20 A	440T-MDTUE20∗∗
		2 N.O. 20 A	1 N.C. 20 A	440T-MDTUE22∗∗
	230V AC	3 N.O. 40 A	1 N.O. 20 A	440T-MDTUE30∗∗
		2 N.O. 20 A	1 N.C. 20 A	440T-MDTUE33∗∗

∗ Substitute the desired primary code for this symbol (key not included). See 3-107 for code selection.

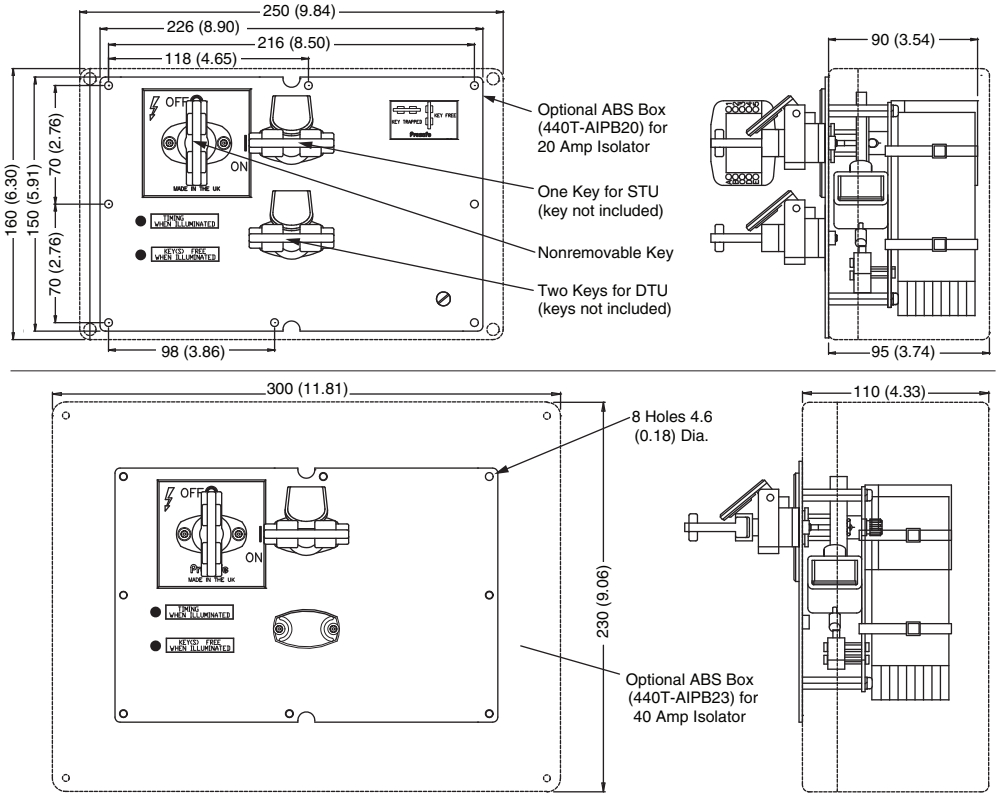
Accessories

Description	Additional Information	Cat. No.
Stainless steel key	3-140	440T-AKEYE10∗
Stainless steel replacement code barrel with dust cap		440T-ASCBE14∗
Stainless steel weatherproof replacement dust cap		440T-ASFC10∗
Optional plastic enclosure	For use with 20 A units	440T-AIPB20
	For use with 40 A units	440T-AIPB23
Optional stainless steel enclosure	For use with all units	440T-AIPB46

∗ Substitute the desired primary code for this symbol (key not included). See 3-107 for code selection.

Approximate Dimensions [mm (in.)]

Dimensions are not intended to be used for installation purposes.



Description

The Stopped Motion Unit (SMU) is used in applications that require the detection of stopped motion of mechanical parts of a machine. The SMU uses inductive proximity sensors to detect motion and the CU2 control unit to monitor the sensors.

The CU2 requires a PNP and an NPN output type proximity sensors. When the proximity sensors stop detecting movement, the CU2 activates its output, powering an internal solenoid. With the solenoid energized, one or two trapped keys can be removed from the SMU.

The removable trapped keys (one or two) can be used to continue the next sequence in allowing access to the hazardous area.

See the CU2 control unit for details on setting the delay time.

Additional proximity sensors can be found in the Sensors catalog.

Features

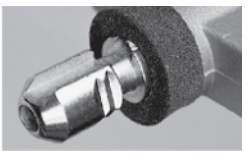
- Stopped motion detection
- NPN and PNP proximity sensors
- Timed-delay output up to 40 minutes
- Category 1 Stop
- Replaceable code barrel assembly

Specifications

Safety Ratings

Standards	EN1954-1, IEC/EN60204-1, EN1088, IEC/EN60947-5-1, ISO13849-1, ISO12100-1&2, ISO14119, GS-ET-19, AS4024.1
Category	Cat. 3 per EN 954-1 (ISO 13849-1)
Certifications	CE Marked for all applicable directives and BG
Operating Characteristics	
Electrical Life	100,000 operations
Mechanical Life	100,000 operations
Solenoid Voltage	24V DC, 110V AC, and 230V AC
Time Delay	0.1 s…40 min
Zero Speed Sensors	2x inductive sensors
Environmental & Physical Characteristics	
Operating Temperature [C (F)]	0…40° (32…104°)
Relative Humidity	95%
Shear Force to Key	15.1 k•N (3398 lbs)
Torque to Key	14 N•m (124 lb•in)
Material	Trapped key components: 316L stainless steel Face plate: 316L stainless steel Optional box: ABS plastic or stainless steel Inductive sensors: stainless steel barrel, plastic face
Mounting	Tamper resistant screws
Weight	2.0 kg (4.4 lbs)

The Prosafe Advantage



Stainless steel construction.

Stopped Motion Units

Product Selection

Type	Solenoid Voltage	Contact Set 1	Contact Set 2	Cat. No.
Single key out Panel mounted	24V DC	3 N.O. 40 A	1 N.O. 20 A	440T-MSMSE10∗
		2 N.O. 20 A	1 N.C. 20 A	440T-MSMSE11∗
	110V AC	3 N.O. 40 A	1 N.O. 20 A	440T-MSMSE20∗
		2 N.O. 20 A	1 N.C. 20 A	440T-MSMSE22∗
	230V AC	3 N.O. 40 A	1 N.O. 20 A	440T-MSMSE30∗
		2 N.O. 20 A	1 N.C. 20 A	440T-MSMSE33∗
Dual key out Panel mounted	24V DC	3 N.O. 40 A	1 N.O. 20 A	440T-MDMSE10∗∗
		2 N.O. 20 A	1 N.C. 20 A	440T-MDMSE11∗∗
	110V AC	3 N.O. 40 A	1 N.O. 20 A	440T-MDMSE20∗∗
		2 N.O. 20 A	1 N.C. 20 A	440T-MDMSE22∗∗
	230V AC	3 N.O. 40 A	1 N.O. 20 A	440T-MDMSE30∗∗
		2 N.O. 20 A	1 N.C. 20 A	440T-MDMSE33∗∗

∗ Substitute the desired primary code for this symbol (key not included). See 3-107 for code selection.

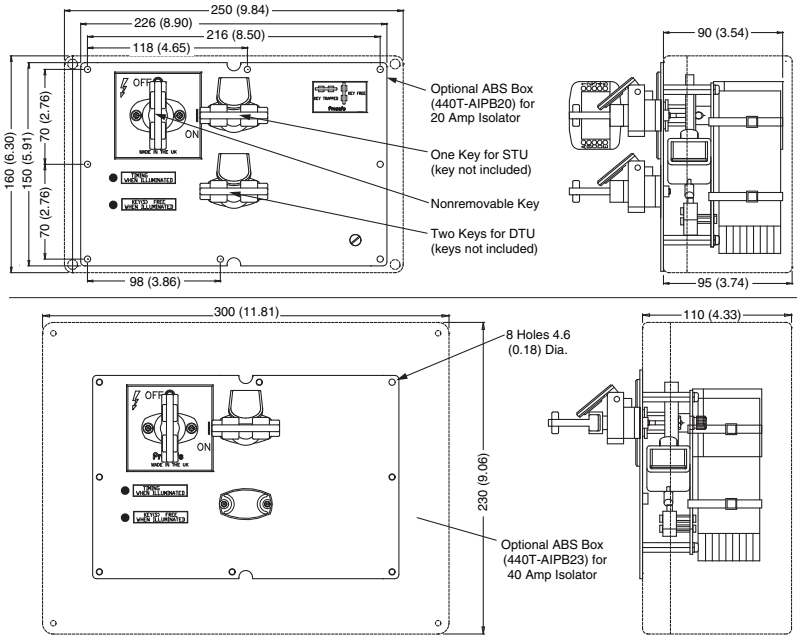
Accessories

Description	Size [mm]	Type	Additional Information	Cat. No.
Stainless steel key	—	—	3-140	440T-AKEYE10∗
Stainless steel replacement code barrel with dust cap				440T-ASCBE14∗
Stainless steel weatherproof replacement dust cap				440T-ASFC10∗
500 mA fuse—Bussmann Cat. No. ETF-500 mA		500 mA @ 250V	NA	440R-A31562
Optional plastic enclosure		—	For use with 20 A units	440T-AIPB20
			For use with 40 A units	440T-AIPB23
Optional stainless steel enclosure			For use with all units	440T-AIPB46
Inductive Proximity Sensor, Three-wire, DC	12	NPN	page 5-57	872C-D3NN12-E2
		PNP		872C-D3NP12-E2
	18	NPN		872C-D5NN18-E2
		PNP		872C-D5NP18-E2
	30	NPN		872C-D10NN30-E2
		PNP		**872C-D10NP30-E2**

∗ Substitute the desired primary code for this symbol (key not included). See 3-107 for code selection.

Approximate Dimensions [mm (in.)]

Dimensions are not intended to be used for installation purposes.



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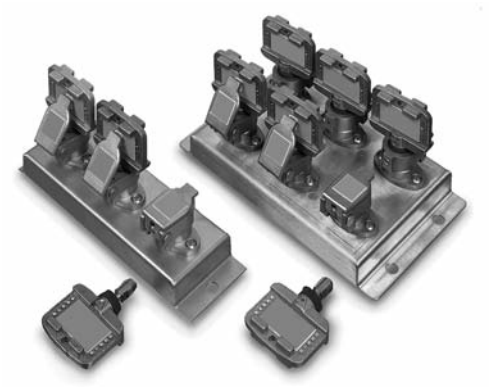


Description

The key exchange unit (KEX) is used in an interlocking sequence to link together other devices in the Prosafe range and caters to more complex operating sequences.

The operating principle is such that no secondary keys can be removed from the unit until all primary keys have been inserted, rotated, and trapped. The primary keys remain trapped until all secondary keys have been re-inserted, rotated, and trapped.

It is typically used in applications where there is more than one access way to the hazardous area, and each access way must be open at the same time. The key exchange unit accomplishes this by allowing one or more keys to be inserted which then releases multiple keys out.

A typical process may require a rotary key switch to turn a motor off. The key from the rotary switch is removed and inserted into a KEX. The KEX then releases three keys which would allow simultaneous access to the hazard area through three different gates. This KEX is described as 1 key in 3 keys out. The keys in are considered primary codes, so the keys are not included in the KEX. The keys out are considered secondary codes, so the keys are included.

Features

- A range of off-the-shelf units in various combinations
- 316L stainless steel construction
- Primary key(s) in release secondary keys simultaneously on units up to six ways
- Weatherproof stainless steel dust cap as standard
- Replaceable code barrel assembly

Specifications

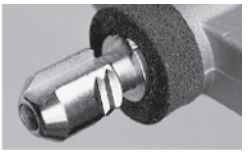
Safety Ratings

Standards	EN1088, ISO12100-1&2, ISO14119, AS4024.1
Category	Cat. 3 per EN 954-1 (ISO 13849-1) cULus and TÜV
Certifications	CE Marked for all applicable directives and BG; C-Tick not required
Operating Characteristics	
Operating Temperature [C (F)]	-40…+200 ° (-40…+392 °)
Mechanical Life	100,000 operations
Environmental & Physical Characteristics	
Shear Force to Key	15.1 k•N (3398 lbs), max.
Torque to Key	14 N•m (124 lb•in), max.
Relative Humidity	95%
Material	316L stainless steel

Optional Key Exchange Cabinets

Number of Keys	Length [mm (in.)]	Width [mm (in.)]	Depth [mm (in.)]	Cat. No.
Painted Mild Steel				
7…11 way (max)	400 (15.7)	300 (11.8)	200 (7.87)	440T-AIPB30
12…15 way (max)	400 (15.7)	400 (15.7)	210 (8.26)	440T-AIPB33
16…25 way (max)	600 (23.6)	600 (23.6)	210 (8.26)	440T-AIPB34
Stainless Steel				
12…15 way (max)	400 (15.7)	400 (15.7)	210 (8.26)	440T-AIPB40
16…25 way (max)	600 (23.6)	600 (23.6)	210 (8.26)	440T-AIPB44

The Prosafe Advantage



Stainless steel construction.

Exchange Units

Product Selection

Key Exchange Units		
Number of Keys	Keys In and Out	Cat. No.
2 way	1 key in 1 key out	440T-MKEXE10‡
3 way	1 key in 2 keys out	440T-MKEXE11‡
4 way	1 key in 3 keys out	440T-MKEXE12‡
5 way	1 key in 4 keys out	440T-MKEXE13‡
6 way	1 key in 5 keys out	440T-MKEXE14‡
4 way	2 key in 2 keys out	440T-MKEXE15‡
5 way	2 key in 3 keys out	440T-MKEXE16‡
6 way	2 key in 4 keys out	440T-MKEXE17‡
6 way	3 key in 3 keys out	440T-MKEXE18‡
7 way	1 key in 6 keys out	440T-MKEXE19‡
8 way	1 key in 7 keys out	440T-MKEXE20‡
9 way	1 key in 8 keys out	440T-MKEXE22‡
10 way	1 key in 9 keys out	440T-MKEXE23‡
11 way	1 key in 10 keys out	440T-MKEXE24‡
12 way	1 key in 11 keys out	440T-MKEXE25‡
13 way	1 key in 12 keys out	440T-MKEXE26‡
14 way	1 key in 13 keys out	440T-MKEXE27‡
15 way	1 key in 14 keys out	440T-MKEXE28‡
16 way	1 key in 15 keys out	440T-MKEXE29‡
17 way	1 key in 16 keys out	440T-MKEXE30‡
18 way	1 key in 17 keys out	440T-MKEXE33‡
19 way	1 key in 18 keys out	440T-MKEXE34‡
20 way	1 key in 19 keys out	440T-MKEXE35‡
21 way	1 key in 20 keys out	440T-MKEXE36‡
22 way	1 key in 21 keys out	440T-MKEXE37‡
23 way	1 key in 22 keys out	440T-MKEXE38‡
24 way	1 key in 23 keys out	440T-MKEXE39‡
25 way	1 key in 24 keys out	440T-MKEXE40‡

‡ Specify the codes individually for each primary key in (key not included) and for each secondary key (key included). See 3-107 for code selection.
Consult factory for other configurations of keys in and keys out.

Accessories

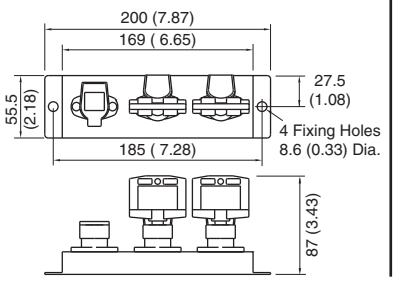
Description	Additional Information	Cat. No.
Stainless steel key	3-140	440T-AKEYE10✶
Stainless steel replacement code barrel with dust cap		440T-ASCBE14✶
Stainless steel weatherproof replacement dust cap		440T-ASFC10✶
Optional Key Exchange Cabinet	Mild steel cabinet for 7-…11-way units	440T-AIPB30
	Mild steel cabinet for 12-…15-way units	440T-AIPB33
	Mild steel cabinet for 16-…25-way units	440T-AIPB34
	Stainless steel cabinet for 12-…15-way units	440T-AIPB40
	Stainless steel cabinet for 16-…25-way units	440T-AIPB44

✶ Substitute the desired primary code for this symbol (key not included). See 3-107 for code selection.

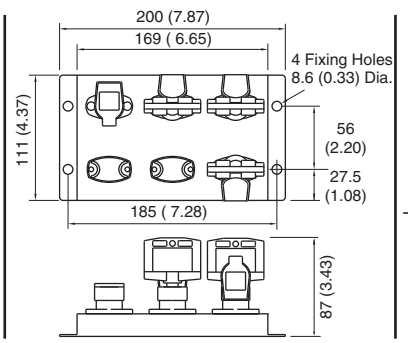
Approximate Dimensions [mm (in.)]

Dimensions are not intended to be used for installation purposes.

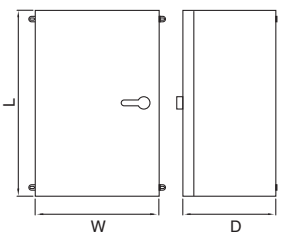
(2) 3 Way Key Exchange Unit

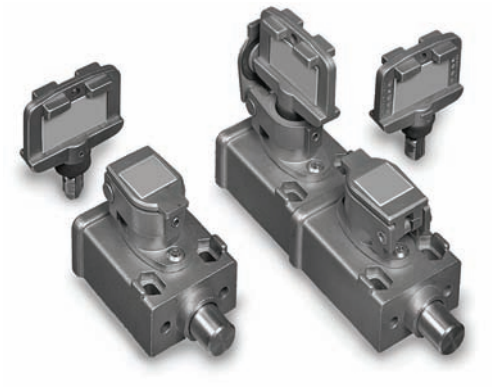


(4, 5 or) 6 Way Key Exchange Unit



Key Exchange Cabinets
(painted mild steel or stainless steel)





Description

The bolt interlocks are designed to allow access to hazardous areas when an appropriate key is inserted into the interlock. These bolt interlocks are manufactured in 316L stainless steel to provide a rugged, industrial grade method of helping prevent access through gates.

One advantage of the bolt interlocks is that there is no need to run power wires to the gate. Power is disconnected by a trapped key rotary switch on a control panel and the key is then hand-carried to the gate by the operator.

The Single Bolt interlock (SBL) is designed to be used to access hazardous areas where partial body exposure is required. The SBL is not shipped with a key. If two keys are needed for partial body access, select the Dual Bolt interlock (DBL) that requires both keys to be trapped to operate. This version of the DBL does not include the keys.

When whole body access is needed, the DBL, with one primary key and one secondary trapped key (included) should be used. The secondary key serves the function of a personnel key. This DBL allows the operator to carry the personnel key into the hazardous area. When the operator returns from the hazardous area and returns the personnel key to the DBL, the locking sequence can be reversed and the process re-started.

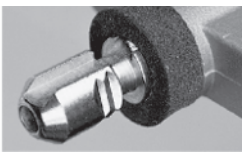
Features

- 316L stainless steel construction
- Various extensions of bolt
- Direct drive push/pull operation
- Replaceable code barrel assembly
- Fitted with tamper resistant screws
- Weatherproof stainless steel dust cap as standard
- Solenoid and electric versions
- Multiple key options

Specifications

Safety Ratings	
Standards	EN1088, ISO12100-1&2, ISO14119, AS4024.1
Category	Cat. 1 per EN 954-1 (ISO 13849-1) Suitable for Cat. 2, 3, or 4 systems
Certifications	CE Marked for all applicable directives and BG; C-Tick not required
Operating Characteristics	
Operating Temperature [C (F)]	Mechanical: -40…+200 ° (-40…+392°) Electrical: -20…+80 ° (-4…+176 °) Solenoid: -20…+60 ° (-4…+140°)
Mechanical Life	100,000 operations
Environmental & Physical Characteristics	
Shear Force to Key	15.1 k•N (3398 lbs), max.
Torque to Key	14 N•m (124 lb•in), max.
Relative Humidity	95%
Weight [kg (lbs)]	SBL: 0.60 (1.32) DBL: 1.10 (2.43)
Material	316L stainless steel
Mounting	SBL: 2 x M5 counterbored from top or 2 x M5 from underside with M5 nuts DBL: 4 x M5 counterbored from top or 4 x M5 from underside with M5 nuts
Bolt Diameter	15 mm (0.59 in.)

The Prosafe Advantage



Stainless steel construction.

Bolt Interlocks

Product Selection - Mechanical

Type	Trapped Key Condition	Bolt Retracted [mm (in.)]	Bolt Extended [mm (in.)]	Cat. No.
Single key	Key trapped to retract bolt	0	14 (0.55)	440T-MSBLE10∗
		3 (0.11)	17 (0.66)	440T-MSBLE11∗
		6 (0.23)	20 (0.78)	440T-MSBLE12∗
		13 (0.51)	27 (1.06)	440T-MSBLE13∗
Dual key	Both keys trapped to retract bolt	0	14 (0.55)	440T-MDBLE10∗∗
		3 (0.11)	17 (0.66)	440T-MDBLE11∗∗
		6 (0.23)	20 (0.78)	440T-MDBLE12∗∗
		13 (0.51)	27 (1.06)	440T-MDBLE13∗∗
	Primary key trapped, secondary key free to retract bolt	0	14 (0.55)	440T-MDBLE14∗⊗
		3 (0.11)	17 (0.66)	440T-MDBLE15∗⊗
		6 (0.23)	20 (0.78)	440T-MDBLE16∗⊗
		13 (0.51)	27 (1.06)	440T-MDBLE17∗⊗
Dual Key with Secondary Ejector Key		0	14 (0.55)	440T-MDBLJ14∗⊗
		3 (0.11)	17 (0.66)	440T-MDBLJ15∗⊗
		6 (0.23)	20 (0.78)	440T-MDBLJ16∗⊗
		13 (0.51)	20 (0.78)	440T-MDBLJ17∗⊗
Triple key	Three keys trapped to retract bolt	0	14 (0.55)	440T-MTBLE10∗∗∗
		3 (0.11)	17 (0.66)	440T-MDBLE11∗∗∗
		6 (0.23)	20 (0.78)	440T-MTBLE12∗∗∗
		13 (0.51)	27 (1.06)	440T-MTBLE13∗∗∗
	Two primary trapped, one secondary key free to retract bolt	0	14 (0.55)	440T-MTBLE14∗∗⊗
		3 (0.11)	17 (0.66)	440T-MTBLE15∗∗⊗
		6 (0.23)	20 (0.78)	440T-MTBLE16∗∗⊗
		13 (0.51)	27 (1.06)	440T-MTBLE17∗∗⊗
	One primary trapped, two secondary keys free to retract bolt	0	14 (0.55)	440T-MTBLE18∗⊗⊗
		3 (0.11)	17 (0.66)	440T-MTBLE19∗⊗⊗
		6 (0.23)	20 (0.78)	440T-MTBLE20∗⊗⊗
		13 (0.51)	27 (1.06)	440T-MTBLE21∗⊗⊗
Quad key	Four keys trapped to retract bolt	0	14 (0.55)	440T-MQBLE10∗∗∗∗
		3 (0.11)	17 (0.66)	440T-MQBLE11∗∗∗∗
		6 (0.23)	20 (0.78)	440T-MQBLE12∗∗∗∗
		13 (0.51)	27 (1.06)	440T-MQBLE13∗∗∗∗
	Three primary trapped, one secondary key free to retract bolt	0	14 (0.55)	440T-MQBLE14∗∗∗⊗
		3 (0.11)	17 (0.66)	440T-MQBLE15∗∗∗⊗
		6 (0.23)	20 (0.78)	440T-MQBLE16∗∗∗⊗
		13 (0.51)	27 (1.06)	440T-MQBLE17∗∗∗⊗

∗ Substitute the desired primary code for this symbol (key not included). See 3-107 for code selection.
⊗ Substitute the desired secondary code for this symbol (key included). See 3-107 for code selection.

Product Selection - Electrical

Contact Type	Type	Trapped Key Condition	Bolt Retracted [mm (in.)]	Bolt Extended [mm (in.)]	Cat. No.
2 N.C. & 1 N.O. break before make	Single key	Free key to retract bolt	0	14 (0.55)	440T-MSBSE10∗
			3 (0.11)	17 (0.66)	440T-MSBSE11∗
			6 (0.23)	20 (0.78)	440T-MSBSE12∗
			13 (0.51)	27 (1.06)	440T-MSBSE13∗
		Key trapped to retract bolt	0	14 (0.55)	440T-MSBSE33∗
			3 (0.11)	17 (0.66)	440T-MSBSE34∗
			6 (0.23)	20 (0.78)	440T-MSBSE35∗
			13 (0.51)	27 (1.06)	440T-MSBSE36∗
	Dual key	Both keys trapped to retract bolt	0	14 (0.55)	440T-MDBSE10∗∗
			3 (0.11)	17 (0.66)	440T-MDBSE11∗∗
			6 (0.23)	20 (0.78)	440T-MDBSE12∗∗
			13 (0.51)	27 (1.06)	440T-MDBSE13∗∗
		Primary key trapped, secondary key free to retract bolt	0	14 (0.55)	440T-MDBSE14∗⊗
			3 (0.11)	17 (0.66)	440T-MDBSE15∗⊗
			6 (0.23)	20 (0.78)	440T-MDBSE16∗⊗
			13 (0.51)	27 (1.06)	440T-MDBSE17∗⊗

∗ Substitute the desired primary code for this symbol (key not included). See 3-107 for code selection.
⊗ Substitute the desired secondary code for this symbol (key included). See 3-107 for code selection.

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Product Selection - Solenoid

Solenoid Voltage	Contact Type	Type	Trapped Key Condition	Bolt Retracted [mm (in.)]	Bolt Extended [mm (in.)]	Cat. No.
24V DC	2 N.C. & 1 N.O. break before make	Single key	Free key to retract bolt	0	14 (0.55)	440T-MSBUE10∗
				3 (0.11)	17 (0.66)	440T-MSBUE11∗
				6 (0.23)	20 (0.78)	440T-MSBUE12∗
				13 (0.51)	27 (1.06)	440T-MSBUE13∗
			Key trapped to retract bolt	0	14 (0.55)	440T-MSBUE33∗
				3 (0.11)	17 (0.66)	440T-MSBUE34∗
				6 (0.23)	20 (0.78)	440T-MSBUE35∗
				13 (0.51)	27 (1.06)	440T-MSBUE36∗
		Dual key	Both keys trapped to retract bolt	0	14 (0.55)	440T-MDBUE10∗∗
				3 (0.11)	17 (0.66)	440T-MDBUE11∗∗
				6 (0.23)	20 (0.78)	440T-MDBUE12∗∗
				13 (0.51)	27 (1.06)	440T-MDBUE13∗∗
			Primary key trapped, secondary key free to retract bolt	0	14 (0.55)	440T-MDBUE14∗⊗
				3 (0.11)	17 (0.66)	440T-MDBUE15∗⊗
				6 (0.23)	20 (0.78)	440T-MDBUE16∗⊗
				13 (0.51)	27 (1.06)	440T-MDBUE17∗⊗

∗ Substitute the desired primary code for this symbol (key not included). See 3-107 for code selection.
⊗ Substitute the desired secondary code for this symbol (key included). See 3-107 for code selection.

Accessories

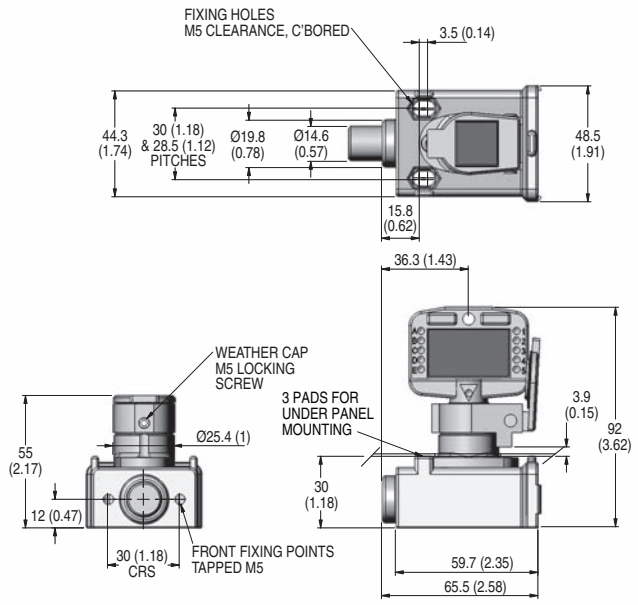
Description	Additional Information	Cat. No.
Stainless steel key	3-140	440T-AKEYE10∗
Stainless steel replacement code barrel with dust cap		440T-ASCBE14∗
Stainless steel weatherproof replacement dust cap		440T-ASFC10∗
Stainless steel ejector key		440T-AKEYE13∗

∗ Substitute the desired primary code for this symbol (key not included). See 3-107 for code selection.

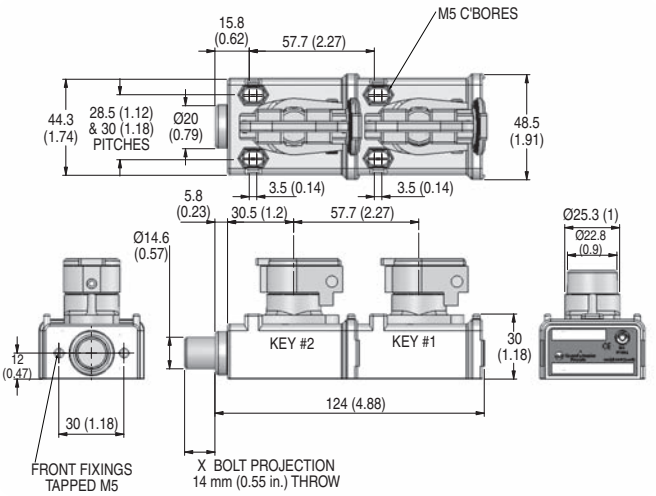
Approximate Dimensions [mm (in.)]

Dimensions are not intended to be used for installation purposes.

MSBLE10, 11, 12, and 13



MDBLE10, 11, 12, and 13

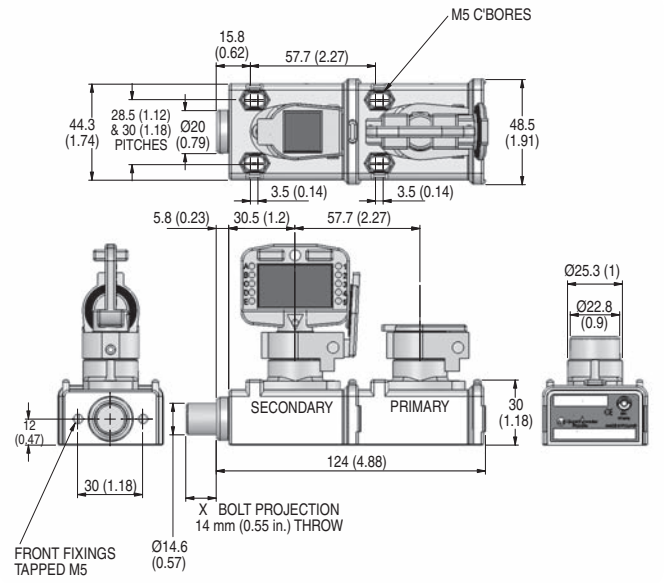


Type	X [mm (in.)]
440T-MDBLE10	0 (0)
440T-MDBLE11	3 (0.12)
440T-MDBLE12	6 (0.24)
440T-MDBLE13	13 (0.51)

Approximate Dimensions [mm (in.)] (continued)

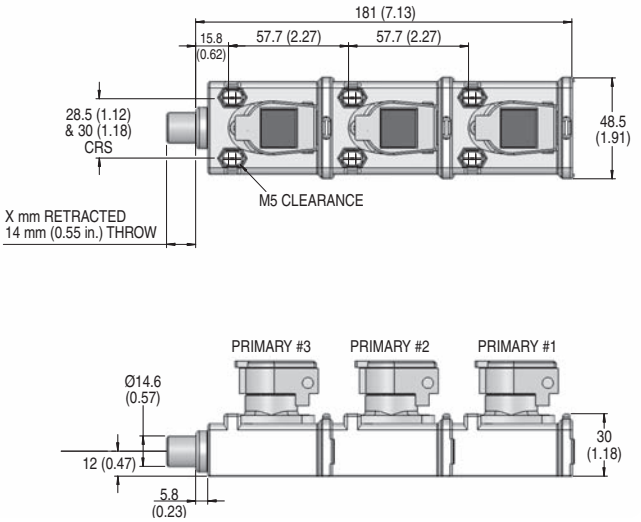
Dimensions are not intended to be used for installation purposes.

MDBLE14, 15, 16, and 17



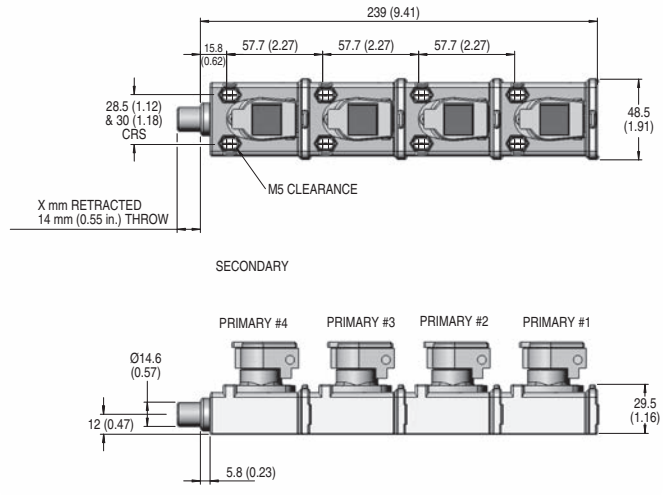
Type	X [mm (in.)]
440T-MDBLE14	0 (0)
440T-MDBLE15	3 (0.12)
440T-MDBLE16	6 (0.24)
440T-MDBLE17	13 (0.51)

MTBLE10, 11, 12, and 13



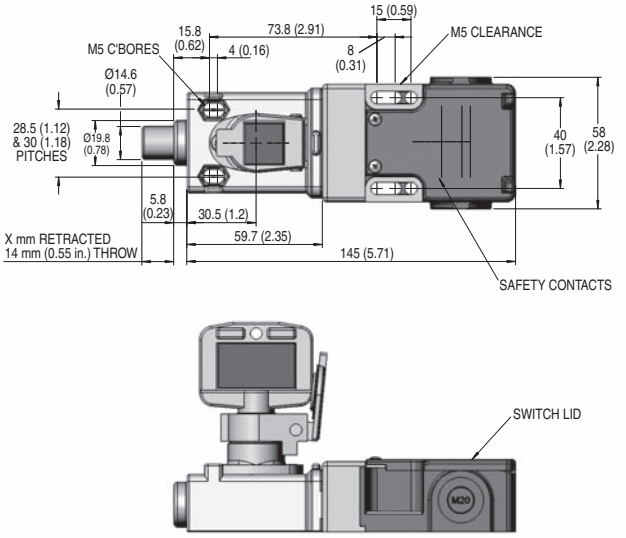
Type	X [mm (in.)]
440T-MTBLE10	0 (0)
440T-MTBLE11	3 (0.12)
440T-MTBLE12	6 (0.24)
440T-MTBLE13	13 (0.51)

MQBLE10, 11, 12, and 13



Type	X [mm (in.)]
440T-MQBLE10	0 (0)
440T-MQBLE11	3 (0.12)
440T-MQBLE12	6 (0.24)
440T-MQBLE13	13 (0.51)

MSBSE10, 11, 12, and 13

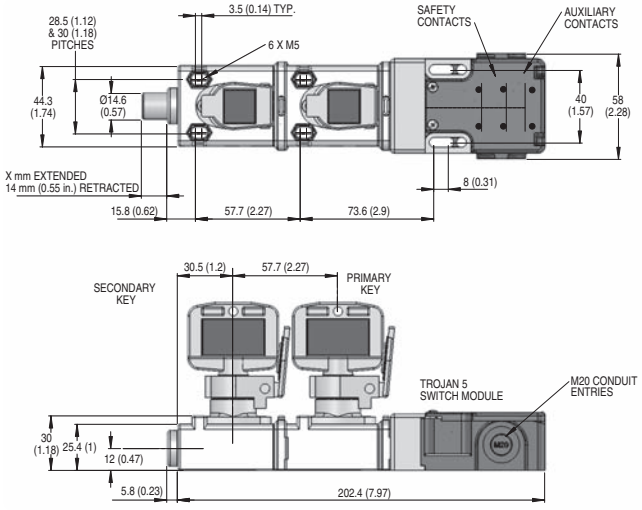


Type	X [mm (in.)]
440T-MSBSE10	0 (0)
440T-MSBSE11	3 (0.12)
440T-MSBSE12	6 (0.24)
440T-MSBSE13	13 (0.51)

Approximate Dimensions [mm (in.)] (continued)

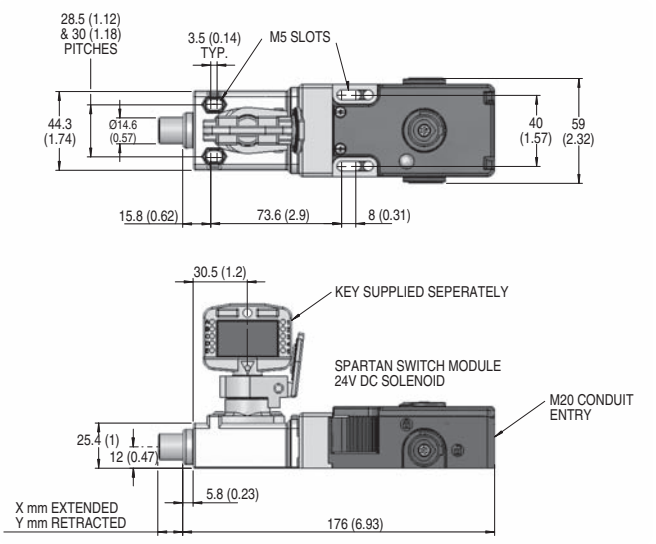
Dimensions are not intended to be used for installation purposes.

MDBSE10, 11, 12, and 13



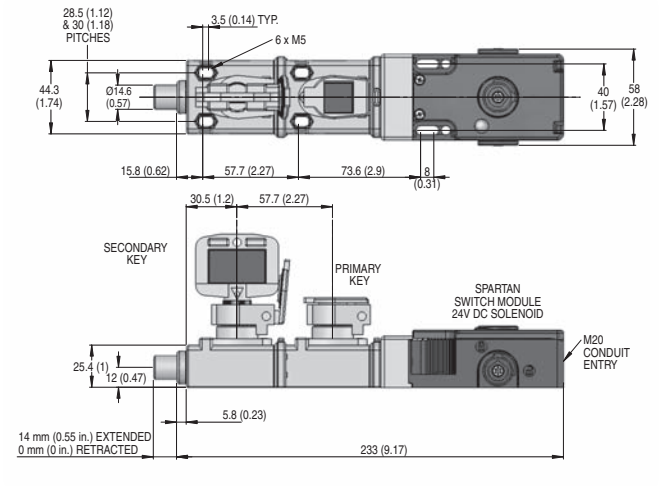
Type	X [mm (in.)]
440T-MDBSE10	0 (0)
440T-MDBSE11	3 (0.12)
440T-MDBSE12	6 (0.24)
440T-MDBSE13	13 (0.51)

MSBUE33, 34, 35, and 36

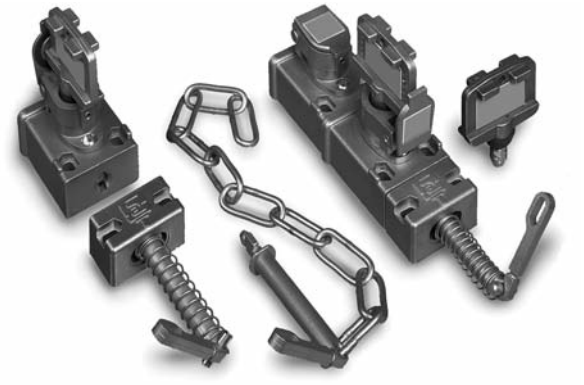


Type	X [mm (in.)]	Y [mm (in.)]
440T-MSBUE33	14 (0.55)	0 (0)
440T-MSBUE34	17 (0.67)	3 (0.12)
440T-MSBUE35	20 (0.79)	6 (0.24)
440T-MSBUE36	27 (1.06)	13 (0.51)

MDBUE14, 15, 16, and 17



Access/Chain Interlocks



Description

The access interlocks are designed to allow access to hazardous areas when an appropriate key is inserted into the interlock. These access interlocks are manufactured in 316L stainless steel to provide rugged, industrial grade method of helping prevent access through gates. They are actuated by either a lever or a rod which is connected to chain.

One advantage of the access interlocks is that there is no need to run power wires to the gate. Power is disconnected by a trapped key rotary switch on a control panel and the key is then hand-carried to the gate by the operator.

The Single-key Access Lock (SAL) and Single-key Chain Lock (SCL) are designed to be used to access hazardous areas where partial body exposure is required. If two keys are needed for partial body access, select the Dual-key Access Lock (DAL) or Dual-key Chain Lock (DCL) with both keys trapped.

When whole body access is needed, the DAL or DCL, with one key trapped and one key free should be used. The secondary key serves the function of a personnel key. The DAL and DCL allow the operator to carry the personnel key into the hazardous area. When the operator returns from the hazardous area and returns the personnel key to the DAL or DCL, the locking sequence can be reversed and the process restarted.

Features

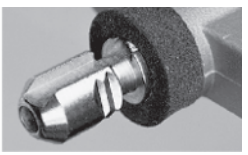
- 316L stainless steel construction
- Direct drive operation
- Fitted with tamper resistant screws
- Stainless steel dust cap as standard
- Replaceable code barrel assembly
- Solenoid and electric versions
- Multiple key options

Specifications

Safety Ratings

Standards	EN1088, ISO12100-1&2, ISO14119, AS4024.1
Category	Cat. 1 per EN 954-1 (ISO 13849-1) Suitable for Cat. 2, 3, or 4 systems
Certifications	CE Marked for all applicable directives and BG; C-Tick not required
Operating Characteristics	
Operating Temperature [C (F)]	Mechanical: -40…+200 ° (-40…+392 °) Electrical: -20…+80 ° (-4…+176 °) Solenoid: -20…+60 ° (-4…+140°)
Relative Humidity	95%
Mechanical Life	100,000 operations
Physical Characteristics	
Misalignment Tolerance	±10 mm (0.39 in.)
Shear Force to Key	15.1 k•N (3398 lbs), max.
Torque to Key	14 N•m (124 lb•in), max.
Material	316L stainless steel
Mounting	SAL and SCL: 2 or 4 x M5 counterbored from top or 2 or 4 x M5 from underside with nuts DAL and DCL: 4 or 6 x M5 counterbored from top or 4 or 6 x M5 from underside with nuts
Weight [kg (lbs)]	SAL and SCL: 0.8 (1.8) DAL and DCL: 1.35 (3)

The Prosafe Advantage



Stainless steel construction.

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Product Selection - Mechanical

Type	Actuator Type	Trapped Key Condition	Cat. No.
Single key	Lever	Key trapped to release lever	440T-MSALE10∗
	Chain	Key trapped to release chain	440T-MSCLE10∗
	Extended Lever	Key trapped to release lever	440T-MSALE20∗
Single key with padlock hasp	Lever	Key trapped to release lever	440T-MSALE11∗
	Chain	Key trapped to release chain	440T-MSCLE11∗
Dual key	Lever	Primary key trapped, secondary key free to release lever	440T-MDALE10∗⊗
		Both keys trapped to release lever	440T-MDALE11∗∗
	Chain	Primary key trapped, secondary key free to release chain	440T-MDCLE10∗⊗
		Both keys trapped to release chain	440T-MDCLE11∗∗
Dual key with padlock hasp	Lever	Primary key trapped, secondary key free to release lever	440T-MDALE45∗⊗
Dual key with eject key	Lever	Primary key trapped, secondary spring eject key	440T-MDALJ10∗⊗
	Chain		440T-MDCLJ10∗⊗
Triple key	Lever	One primary trapped, two secondary keys free to release lever	440T-MTALE11∗⊗⊗
	Chain	One primary trapped, two secondary keys free to release chain	440T-MTCLE11∗⊗⊗

∗ Substitute the desired primary code for this symbol (key not included). See 3-107 for code selection.
⊗ Substitute the desired secondary code for this symbol (key included). See 3-107 for code selection.

Product Selection - Electrical

Contact Type	Type	Actuator Type	Trapped Key Condition	Cat. No.
2 N.C. & 1 N.O. break before make	Dual Key	Lever	Both keys trapped to release lever	440T-MDASE21∗∗
			Primary key trapped, secondary key free to release lever	440T-MDASE20∗⊗
		Chain	Both keys trapped to release chain	440T-MDCSE21∗∗
			Primary key trapped, secondary key free to release chain	440T-MDCSE20∗⊗

∗ Substitute the desired primary code for this symbol (key not included). See 3-107 for code selection.
⊗ Substitute the desired secondary code for this symbol (key included). See 3-107 for code selection.

Accessories

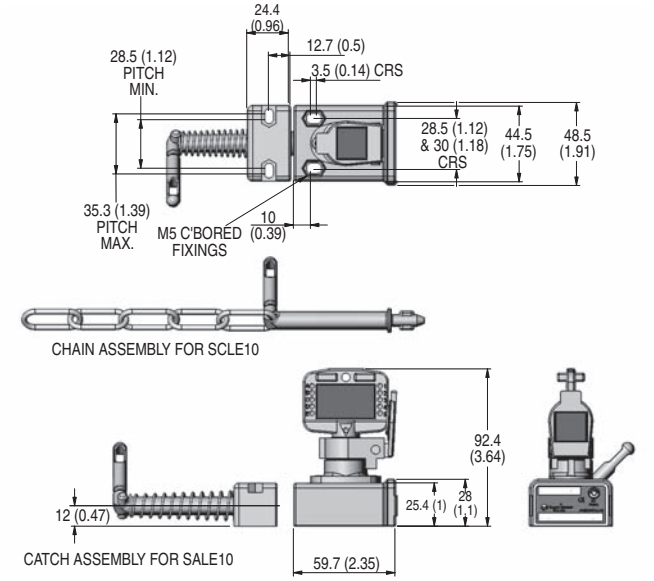
Description	Additional Information	Cat. No.
Stainless steel key	3-140	440T-AKEYE10∗
Stainless steel replacement code barrel with dust cap		440T-ASCBE14∗
Stainless steel weatherproof replacement dust cap		440T-ASFC10∗
Replacement actuator type lever	—	440T-ACAD10
Replacement actuator type chain	—	440T-ACHA10
Stainless steel ejector key	—	440T-AKEYE13∗

∗ Substitute the desired primary code for this symbol (key not included). See 3-107 for code selection.

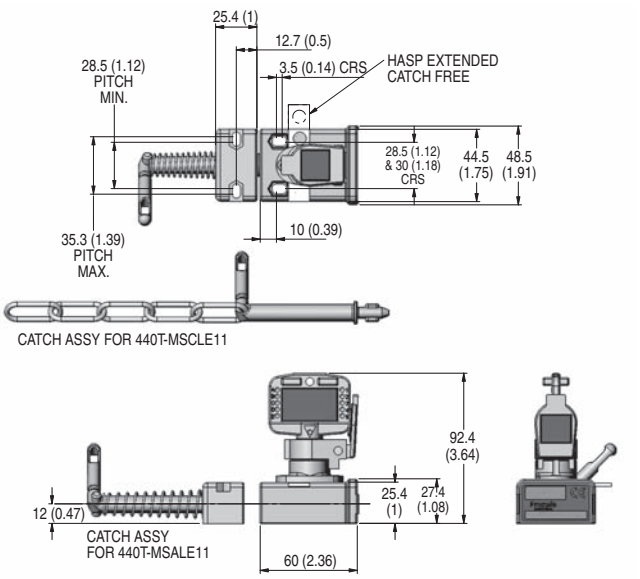
Approximate Dimensions [mm (in.)]

Dimensions not intended to be used for installation purposes.

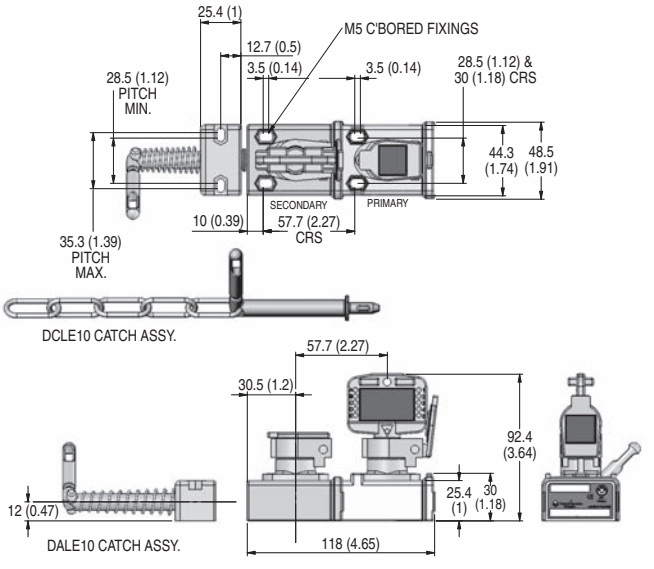
MSALE10



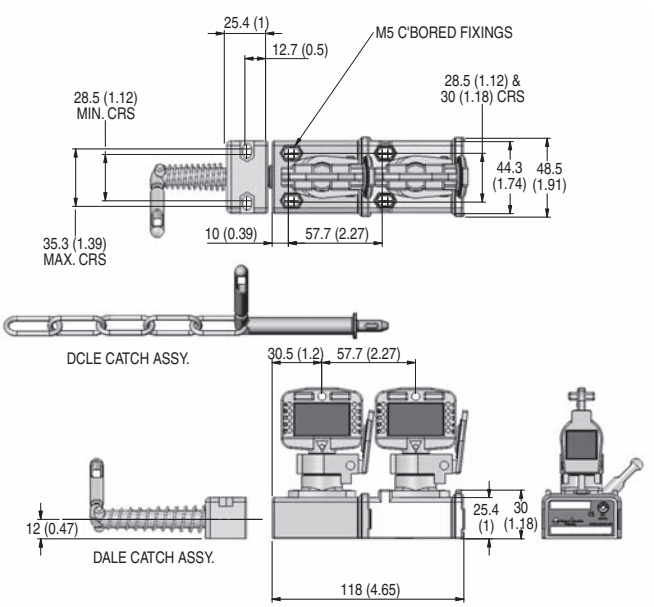
MSALE11



MDALE10 and MDCLE10



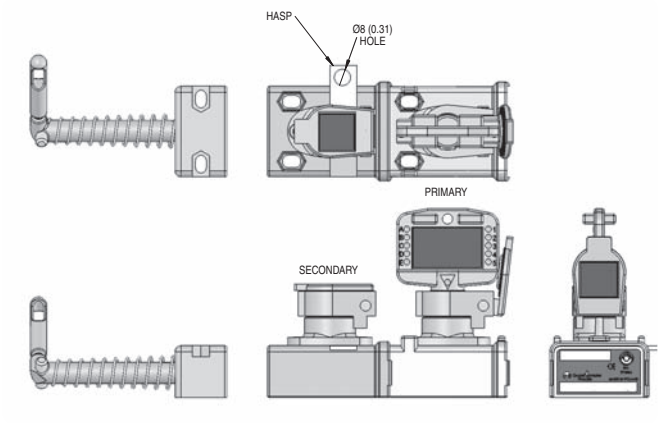
MDALE11



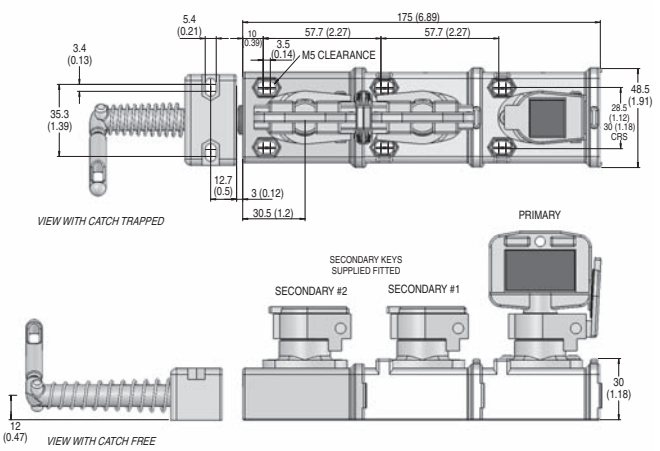
Approximate Dimensions [mm (in.)] (continued)

Dimensions not intended to be used for installation purposes.

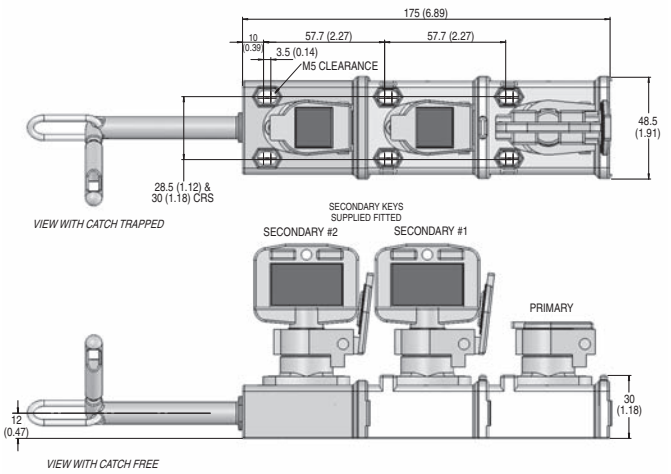
MDALE45



MTALE11

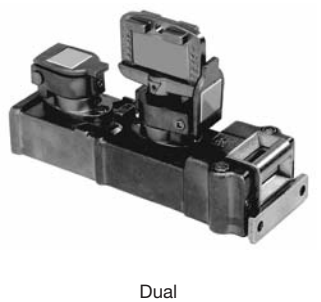


MTCLE11



Slamlock Mechanical

Single



Dual

Description

The Prosafe Slamlock combines the features of trapped keys with tongue actuated interlocks. When the actuator is inserted into the interlock (guard closed), the trapped key can be rotated and removed. With the key free, the actuator can not be removed thus locking closed the guard door. The trapped key must be re-inserted and rotated 90° to unlock the guard.

Slamlocks are manufactured in 316L stainless steel to provide a rugged, industrial grade method of interlocking guard doors.

One advantage of the slamlock is that there is no need to run power wires to the gate. Power is disconnected by a trapped key on a control panel or by a Prosafe RKS type unit and the key is then hand-carried to the gate by the operator.

The Single-key Slamlock (SSL) is used to interlock hatches, guards and doors where full body access is not required.

Dual-key Slamlock (DSL) is similar to the single key version but has a secondary key to allow "two key in" or "key exchange" conditions. The key exchange version may be used where whole body access is required, as the secondary key can be used as a personnel key.

Features

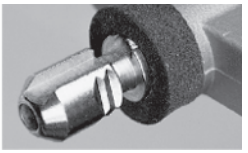
- 316L stainless steel construction
- Selection of actuator types available
- Direct drive operation
- Replaceable code barrel assembly
- Fitted with tamper resistant screws
- Weatherproof stainless steel dust cap as standard
- Multiple key options

Specifications

Safety Ratings

Standards	EN1088, IEC/EN60947-5-1, GS-ET-19, ISO12100-1&2, ISO14119, AS4024.1
Category	Cat. 1 per EN 954-1 (ISO 13849-1) Suitable for Cat. 2, 3, or 4 systems
Certifications	CE Marked for all applicable directives and BG; C-Tick not required
Operating Characteristics	
Operating Temperature [C (F)]	-40…+200 ° (-40…+392 °)
Mechanical Life	In excess of 100,000 operations under normal working conditions
Code Barrel Life	Tested to 100,000 operations
Environmental & Physical Characteristics	
Shear Force to Key	15.1 k•N (3398 lbs), max.
Torque to Key	14 N•m (124 lb•in), max.
Relative Humidity	95%
Weight [kg (lbs)]	Single Key: 0.76 (1.68) Dual Key: 1.33 (2.93)
Ambient Temperature [C (F)]	-10…+50 ° (14…122 °)
Material	316L stainless steel
Mounting	SSL: 2 x M5 counterbored from top or 2 x M5 from underside with nuts DSS: 4 x M5 counterbored from top or 4 x M5 from underside with nuts
Holding Force, Max.	2000 N (450 lbs)

The Prosafe Advantage



Stainless steel construction.

Product Selection

Type	Actuator Type	Trapped Key Condition	Cat. No.
Single key	Standard	Key trapped to release actuator	440T-MSSLE10∗
	Flexible		440T-MSSLE11∗
	Flat		440T-MSSLE12∗
Dual key	Standard	Primary key trapped, secondary key free to release actuator	440T-MDSLE10∗⊗
	Flexible		440T-MDSLE11∗⊗
	Flat		440T-MDSLE12∗⊗
	Standard	Both keys trapped to release actuator	440T-MDSLE20∗∗
	Flexible		440T-MDSLE22∗∗
	Flat		440T-MDSLE23∗∗
Dual with secondary ejector key	Standard	Primary key trapped, secondary key free to release actuator	440T-MDSLJ10∗⊗
	Flexible		440T-MDSLJ11∗⊗
	Flat		440T-MDSLJ12∗⊗

∗ Substitute the desired primary code for this symbol (key not included). See 3-107 for code selection.
⊗ Substitute the desired secondary code for this symbol (key included). See 3-107 for code selection.

Accessories

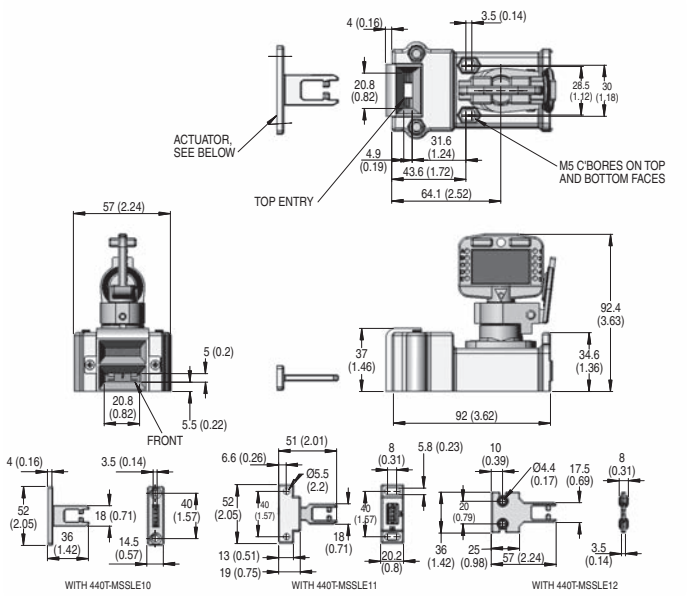
Description	Additional Information	Cat. No.
Stainless steel key	3-140	440T-AKEYE10⊗
Stainless steel ejector key		440T-AKEYE13⊗
Stainless steel replacement code barrel with dust cap		440T-ASCBE14∗
Stainless steel weatherproof replacement dust cap		440T-ASFC10⊗
GD2 standard actuator	—	**440G-A27011**
GD2 flat actuator	—	**440K-A11112**
Fully flex actuator	—	**440G-A27143**

∗ Substitute the desired primary code for this symbol (key not included). See 3-107 for code selection.
⊗ Substitute the desired code for this symbol. See 3-107 for code selection.

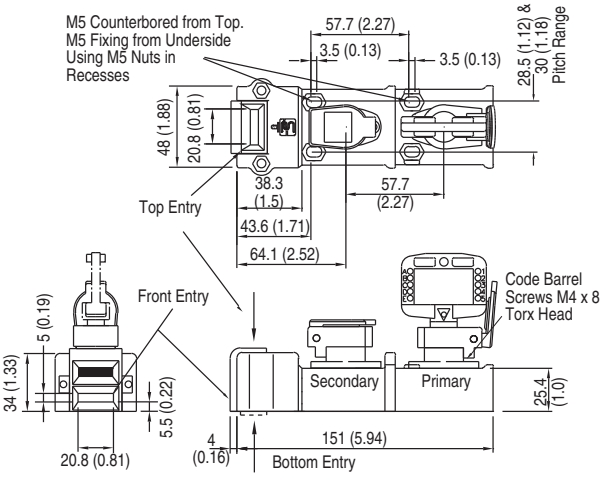
Approximate Dimensions [mm (in.)]

Dimensions are not intended to be used for installation purposes.

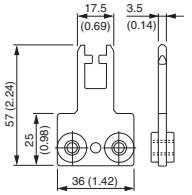
Single Key Slamlock



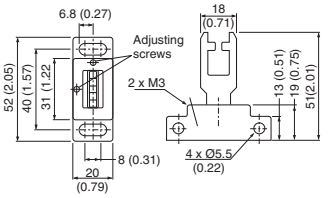
Dual Key Slamlock



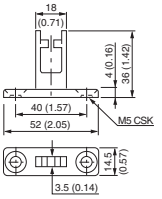
Flat Actuator



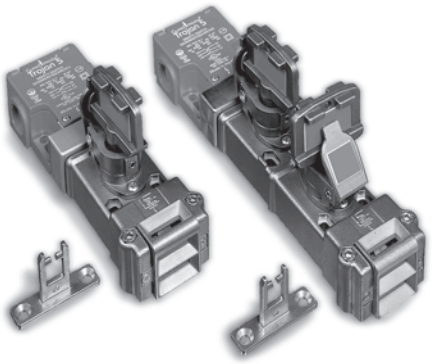
Flexible/Adjustable Actuator



Standard Actuator



Slamlock Electrical



Single Dual

Description

The Prosafe Slamlock with electrical isolation combines the features of trapped key tongue actuated interlocks while also providing sets of electrical safety and auxiliary contacts. When the actuator is inserted into the lock and the key is removed the actuator is trapped in the unit thus locking closed the guard door. In this state the safety contacts are closed and the auxiliary contacts are open. To open the guard door the key must be inserted and rotated 90°, opening the safety contacts, closing the auxiliary contacts and enabling the actuator to be released thus unlocking the guard door. While the guard door is open the key is trapped in the unit.

Slamlocks with electrical isolation offer the features of electrical safety interlock switches with the benefits of a trapped key/enforced sequence systems. They allow a combination of both approaches for safeguarding machinery and processes to be used.

The Single-key Slamlock (SSS) is used to interlock hatches, guards and doors where full body access is not required. The single key locks the actuator and operates the switch in the same action.

Dual-key Slamlock (DSS) is similar to the single key version but has a secondary key to allow "two key in" or "key exchange" conditions. The key exchange version may be used where whole body access is required, as the secondary key can be used as a personnel key.

Features

- Electrical safety contacts combined with trapped key/enforced sequence feature
- Most of unit constructed from 316L stainless steel
- Selection of actuator types available
- Single or dual key versions available
- Direct drive operation
- Replaceable code barrel assembly
- Weatherproof stainless steel dust cap as standard
- Solenoid versions

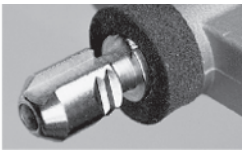
Specifications

Safety Ratings

Standards		EN1088, IEC/EN60947-5-1, GS-ET-19, ISO12100-1&2, ISO14119, AS4024.1		
Category		Cat. 1 per EN 954-1 (ISO 13849-1) Suitable for Cat. 2, 3, or 4 systems		
Certifications		CE Marked for all applicable directives and BG; C-Tick not required		
Outputs				
Safety Contacts		2 N.C. positive break		
Switching Current @ Voltage, Max.		500V/500V A		
Thermal Current (Ith)		10 A		
Current, Min.		5 mA @ 5V DC		
Safety Contact Gap		>2 x 2 mm (0.07 in.)		
Rated Insulation Voltage		(Ui) 500V		
Rated Impulse withstand Voltage		(Uimp) 2500V		
Auxiliary Contacts		1 N.O.		
Operating Characteristics				
Break Contact Force, Min.		12 N (2.7 lbs)		
Actuation Speed, Max.		1 ms		
Actuation Frequency, Max.		2 cycle/s		
Utilization Category				
AC 15	(Ue)	500V	250V	100V
	(Ie)	1 A	2 A	5 A
DC		250V	0.5 A, 24V	2 A
Environmental Characteristics				
Enclosure Type Rating		IP67		
Operating Temperature [C (F)]		Electrical: -20…+80 ° (-4…+176°) Solenoid: -20…+60 ° (-4…+140 °)		
Relative Humidity		95%		
Physical Characteristics				
Actuator Travel for Positive Opening		5 mm (0.19 in.)		
Operating Radius, Min.		175 mm (6.88 in.) [60 mm (2.36 in.) with flexible actuator]		
Actuator Holding Force, Max.		2000 N (450 lbs)		
Releasable Load, Max.		100 N (22.5 lbs)		
Case Material		UL Approved glass-filled polyester & 316L stainless steel		
Actuator Material		Stainless steel		
Conduit Entry		3 x M20		
Mounting		SSS: 4 x M5 counterbored from top or 4 x M5 from underside with nuts DSS: 6 x M5 counterbored from top or 6 x M5 from underside with nuts		
Mechanical Life		100,000 operations		
Electrical Life		1,000,000 operations		
Weight [g (lbs)]		SSE: 1160 (2.6) DSSE: 1700 (3.7)		
Color		Red/Stainless		
Shear Force to Key		15.1 k•N (3398 lbs), max.		
Pollution Degree		3		
Torque to Key		14 N•m (124 lb•in), max.		

Note: The safety contacts of the Guardmaster switches are described as normally closed (N.C.), i.e. with the guard closed, actuator in place (where relevant) and the machine able to be started.

The Prosafe Advantage



Stainless steel construction.

Product Selection - Electrical

Contact Type	Type	Trapped Key Condition	Actuator Type	Cat. No.
2 N.C. + 1 N.O. Break before make	Single key	Key trapped to release actuator	Standard	440T-MSSSE10∗
			Flexible	440T-MSSSE11∗
			Flat	440T-MSSSE12∗
		Key free to release actuator	Standard	440T-MSSSE20∗
			Flexible	440T-MSSSE22∗
			Flat	440T-MSSSE23∗
	Dual key	Primary key trapped, secondary key free to release actuator	Standard	440T-MDSSE10∗⊗
		Primary key trapped, secondary key eject to release actuator		440T-MDSSJ10∗⊗
		Primary key trapped, secondary key free to release actuator	Flexible	440T-MDSSE11∗⊗
		Primary key trapped, secondary key eject to release actuator		440T-MDSSJ11∗⊗
		Primary key trapped, secondary key free to release actuator	Flat	440T-MDSSE12∗⊗
		Primary key trapped, secondary key eject to release actuator		440T-MDSSJ12∗⊗
		Both keys free to release actuator	Standard	440T-MDSSE20∗∗
			Flexible	440T-MDSSE22∗∗
			Flat	440T-MDSSE23∗∗
2 N.C. + 2 N.O. Break before make	Single key	Key free to release actuator	Standard	440T-MSSSE26∗
			Flexible	440T-MSSSE27∗
			Flat	440T-MSSSE25∗

∗ Substitute the desired primary code for this symbol (key not included). See 3-107 for code selection.
⊗ Substitute the desired secondary code for this symbol (key included). See 3-107 for code selection.

Product Selection - Solenoid

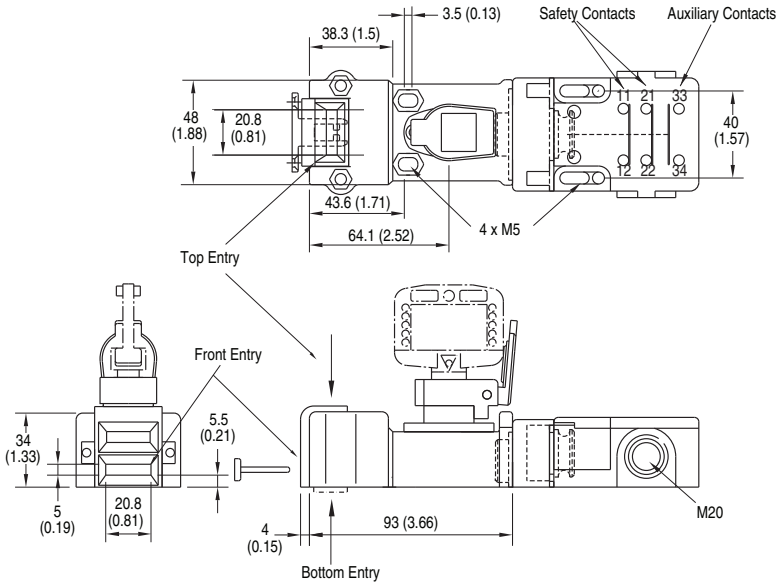
Contact Type	Type	Trapped Key Condition	Solenoid Voltage	Actuator Type	Cat. No.
2 N.C. & 1 N.O. Break before make	Single key	Key free to release actuator	24V DC	Standard	440T-MSSUE20∗
				Flexible	440T-MSSUE22∗
				Flat	440T-MSSUE23∗
	Dual key	Primary key trapped, secondary key free to release actuator	24V DC	Standard	440T-MDSUE10∗
				Flexible	440T-MDSUE11∗
				Flat	440T-MSSUE12∗
	Single key	Key free to release actuator	110V AC	Standard	440T-MSSUE50∗

∗ Substitute the desired primary code for this symbol (key not included). See 3-107 for code selection.

Approximate Dimensions [mm (in.)]

Dimensions are not intended to be used for installation purposes.

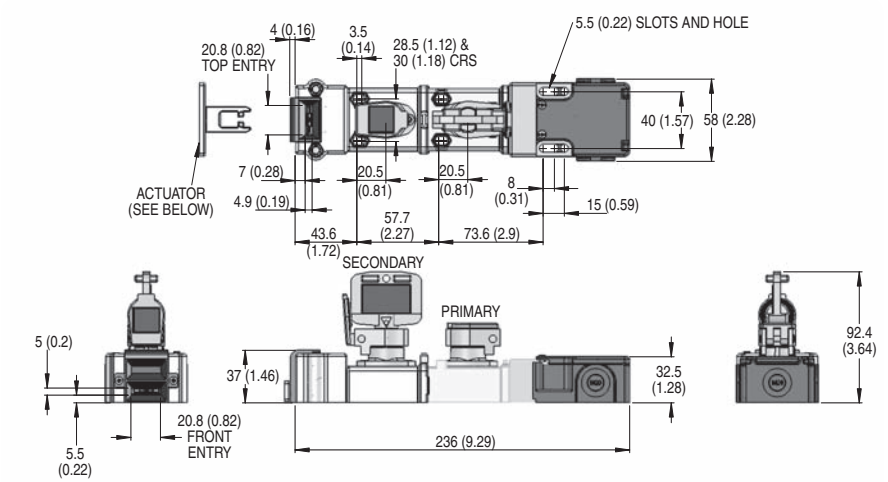
Single Key Slamlock

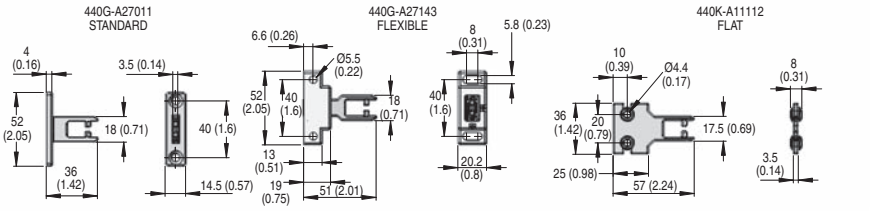


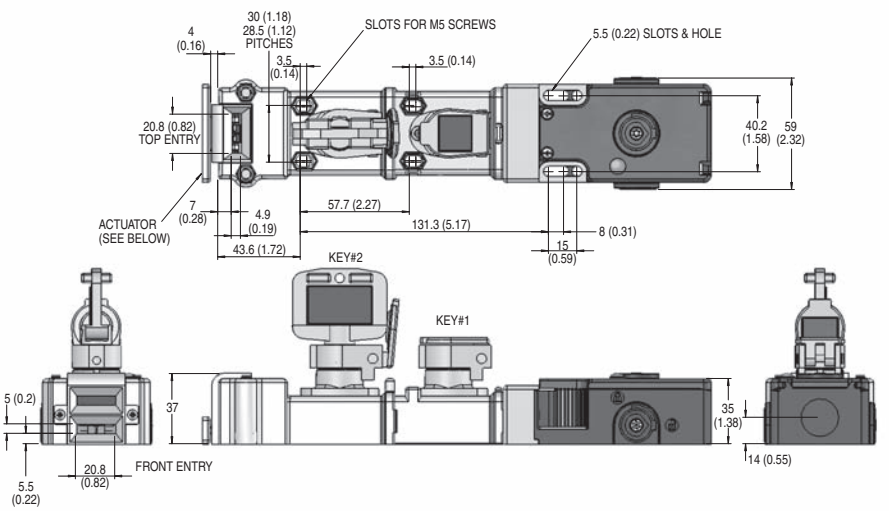
Approximate Dimensions [mm (in.)] (continued)

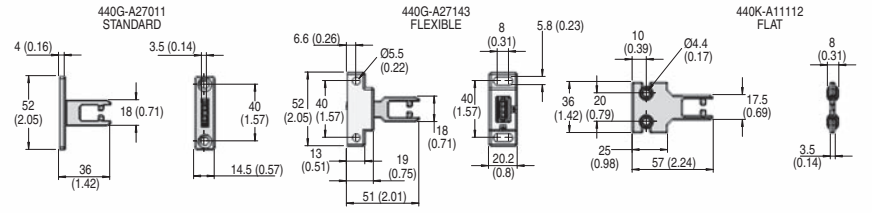
Dimensions are not intended to be used for installation purposes.

Dual Key Slamlock









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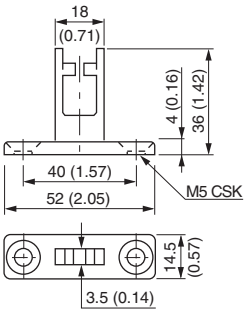
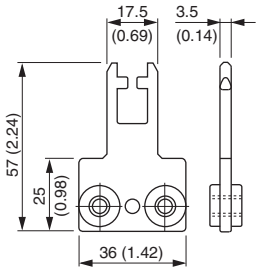
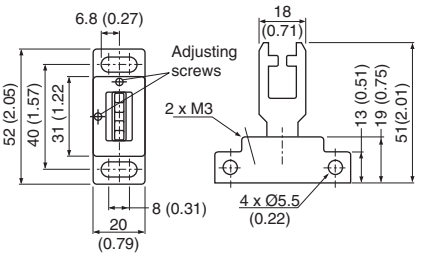
Publication S117-CA001A-EN-P

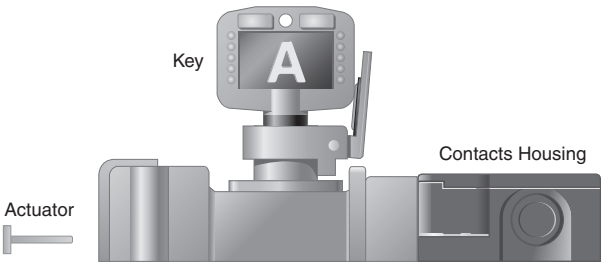
Accessories

Description		Approximate Dimensions [mm (in.)]	Cat. No.
	GD2 standard actuator		**440G-A27011**
	GD2 flat actuator		**440K-A11112**
	Fully flex actuator		**440G-A27143**
	Stainless steel key	page 3-140	440T-AKEYE10⊗
	Stainless steel replacement code barrel with dust cap		440T-ASCBE14✶
	Stainless steel weatherproof replacement dust cap		440T-ASFC10⊗

✶ Substitute the desired primary code for this symbol (key not included). See 3-107 for code selection.
⊗ Substitute the desired code for this symbol. See 3-107 for code selection.

Typical Applications

Actuator out, key trapped, safety contacts open, auxiliary contact closed.



Locking force = 2000 N (450 lb)

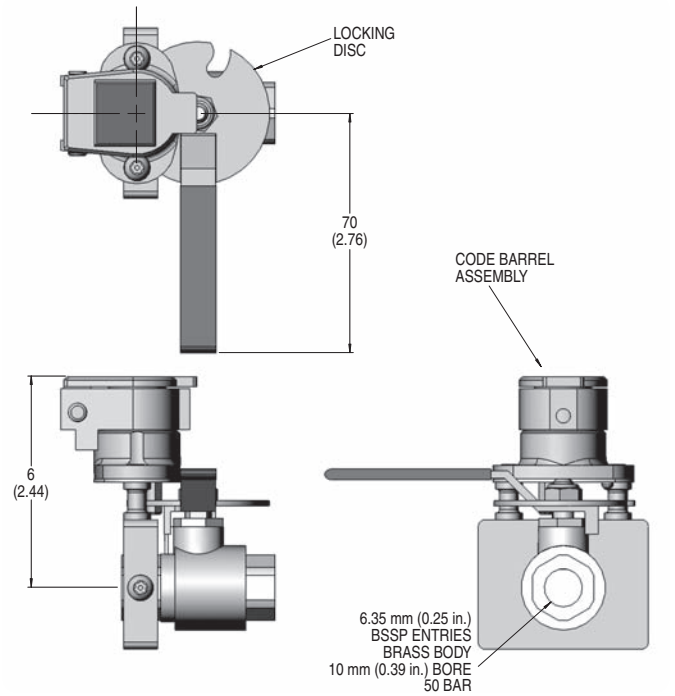
Miniature Valve Interlocks

Features

- Direct drive operation
- Supplied with valves 0.25…1 in.
- Direct body mounting with security screws
- Locked open or locked closed options
- Virtually maintenance free
- Weatherproof stainless steel dust cap as standard
- Replaceable code barrel assembly
- Valve is chrome-plated brass

Approximate Dimensions [mm (in.)]

Dimensions are not intended to be used for installation purposes.



Approximate Dimensions [mm (in.)]			
Model	A	B	C
440T-VMVLE10	104 (4.1)	68 (2.7)	38 (1.5)
440T-VMVLE11	104 (4.1)	68 (2.7)	38 (1.5)
440T-VMVLE12	112 (4.4)	80 (3.2)	48 (1.9)
440T-VMVLE13	104 (4.1)	68 (2.7)	38 (1.5)
440T-VMVLE14	104 (4.1)	68 (2.7)	38 (1.5)
440T-VMVLE15	112 (4.4)	80 (3.2)	48 (1.9)
440T-VMVLE16	108 (4.3)	110 (4.3)	53 (2.1)
440T-VMVLE17	108 (4.3)	110 (4.3)	53 (2.1)
440T-VMVLE18	115 (4.5)	110 (4.3)	61 (2.4)
440T-VMVLE19	115 (4.5)	110 (4.3)	61 (2.4)

Specifications

Standards	EN1088, ISO12100-1&2, ISO14119, AS4024.1
Certifications	CE Marked for all applicable directives and BG
Operating Temperature [C (F)]	-10…+40 ° (14…104 °)
Mechanical Life	100,000 operations
Shear Force to Key	15.1 k•N (3398 lbs)
Torque to Key	14 N•m (124 lb•in)
Relative Humidity	25…95%
Material	316L stainless steel

Product Selection

Valve Size	Valve Status	Cat. No.
0.25 in. BSP❄	Key Free/Valve Locked Closed	440T-VMVLE10✶
0.375 in. BSP❄		440T-VMVLE11✶
0.5 in. BSP❄		440T-VMVLE12✶
0.25 in. BSP❄	Key Free/Valve Locked Open	440T-VMVLE13✶
0.375 in. BSP❄		440T-VMVLE14✶
0.5 in. BSP❄		440T-VMVLE15✶
1.0 in. BSP❄	Key Free/Valve Locked Closed	440T-VMVLE18✶
	Key Free/Valve Locked Open	440T-VMVLE19✶
2.0 in. BSP❄	Key Free/Valve Locked Closed	440T-VMVLE20✶
	Key Free/Valve Locked Open	440T-VMVLE21✶

✶ Substitute the desired primary code for this symbol (key not included). See 3-107 for code selection.

❄ BSP = British standard pipe threads.

Accessories

Description	Additional Information	Cat. No.
Stainless steel key	3-140	440T-AKEYE10✶
Stainless steel replacement code barrel with dust cap		440T-ASCBE14✶
Stainless steel weatherproof replacement dust cap		440T-ASFC10✶

✶ Substitute the desired primary code for this symbol (key not included). See 3-107 for code selection.

Description

The switch gear adaptor is used to interlock preparatory switch gear applications or other host equipment such as spool valves. Power is isolated and locked off when the key is rotated and removed. The key can then be used in the next sequence of operation.

Features

• Virtually maintenance free

Specifications

Standards	EN1088, ISO12100-1&2, ISO14119, AS4024.1
Category	Cat. 1 per EN 954-1
Certifications	CE Marked for all applicable directives and BG
Operating Temperature [C (F)]	-10…+50 ° (14…122 °)
Mechanical Life	>100,000 operations
Shear Force to Key	15.1 k•N (3398 lbs), max.
Torque to Key	14 N•m (124 lb•in), max.
Relative Humidity	95%
Weight [kg (lbs)]	0.30 (0.66)
Material	316L stainless steel
Mounting	2 x M4
Shaft Dimensions	3/8 in² x 7/8 in long (standard) 9/16 in dia. x 7/8 in long (optional: contact factory)

Product Selection (3/8 square shaft)

Mounting	Trap Direction	Cat. No.
2 x M4	65° CW to trap	440T-MSGAU10∗
	65° CCW to trap	440T-MSGAU11∗
	90° CW to trap	440T-MSGAU12∗
	90° CCW to trap	440T-MSGAU13∗
	±90° to trap	440T-MSGAU14∗
	45° CW to trap	440T-MSGAU17∗
	45° CCW to trap	440T-MSGAU18∗

∗ Substitute the desired primary code for this symbol (key not included). See 3-107 for code selection.

Accessories

Description	Additional Information	Cat. No.
Stainless steel key	3-140	440T-AKEYE10∗
Stainless steel ejector key		440T-AKEYE13∗
Stainless steel weatherproof replacement dust cap		440T-ASFC10∗

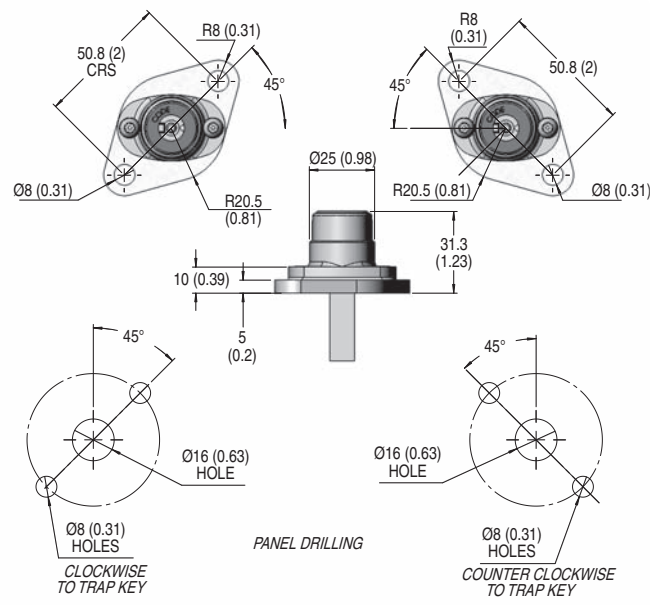
∗ Substitute the desired primary code for this symbol (key not included). See 3-107 for code selection.

Approximate Dimensions [mm (in.)]

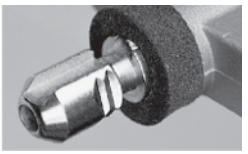
Dimensions are not intended to be used for installation purposes.

45° Mounting Type

Panel Drilling Detail

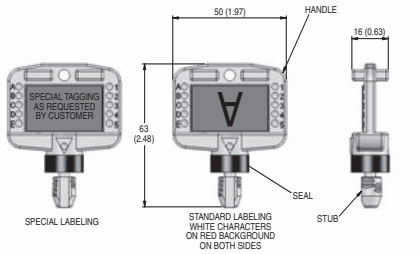
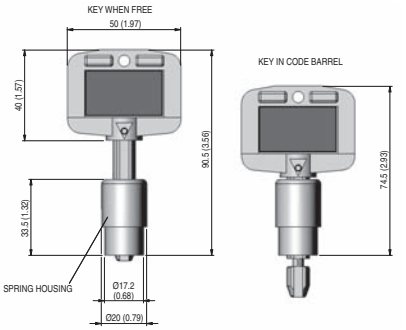
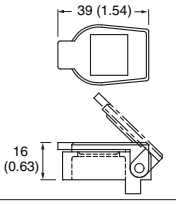
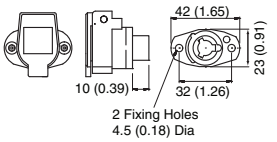
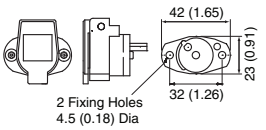


The Prosafe Advantage



Stainless steel construction.

Accessories

Description		Approximate Dimensions [mm (in.)]	Cat. No.
	Stainless steel key		440T-AKEYE10✶
	Stainless steel ejector key		440T-AKEYE13✶
	Stainless steel weatherproof replacement dust cap		440T-ASFC10✶
	Stainless steel replacement code barrel for 100 A unit rotary switch		440T-ASCBE11✶
	Stainless steel replacement code barrel with dust cap❄		440T-ASCBE14✶

Description	Material	Cat. No.
Emergency break glass key box	Plastic case	440T-AIPB11
	Metal case with hammer	440T-AIPB12

Description	Code	Cat. No.
Emergency repair kit for code barrels❄ 2 offset pin code barrels with key	ER1	440T-AKITE45ER1
	ER2	440T-AKITE45ER2
	ER3	440T-AKITE45ER3
	ER4	440T-AKITE45ER4
	ER5	440T-AKITE45ER5
	ER6	440T-AKITE45ER6
	ER7	440T-AKITE45ER7
	ER8	440T-AKITE45ER8
	ER9	440T-AKITE45ER9

✶ Substitute the desired primary code for this symbol (key not included). See 3-107 for code selection.
❄ Not suitable for 440T-MRKSE14/440T-MRPSE14 OR 440T-MSGAU units.

WARNING: The presence of spare keys, override keys, or spare actuators can compromise the integrity of safety interlocking systems. Personal injury or death, property damage or economic loss can result from the introduction of spare keys, override keys or spare actuators into interlocking systems without appropriate management controls, working procedures and alternative protective measures to control their use and availability.

22 mm Small Plastic

22 mm Compact Metal

30 mm Large Metal

15 mm Plastic

General Description

The 440P limit switch family offers a full range of international-style solutions for both safety and standard sensing applications. Available in four different body styles—30 mm metal, 22 mm metal and plastic, and 15 mm plastic—with a broad selection of operator types, circuit arrangements and connection options, the 440P is ideal for a wide variety of applications. These include material handling, packaging, elevators, escalators, scissor lifts, industrial trucks and tractors, cranes and hoists, overhead door as well as general safety guarding applications.

Mechanical Enclosure

The large metal-body (440P-M) models feature die-cast alloy construction and conform to EN 50041 (30 x 60 mm), while the small plastic (440P-C) models are constructed of a glass-filled polymer and conform to EN 50047 (22 mm). Both body types are IP66 rated and available with M20 or 1/2 in. NPT conduit opening or in a micro quick-disconnect version. The 15 mm plastic models (440P-M18001 and 440P-M18002) are constructed of glass-filled polyester and are IP30 rated. The 22 mm metal models (440P-A) have a painted body and are IP66/IP67 rated.

Actuator Type

The 440P international-style limit switches are available with a wide variety of actuators to solve a broad range of applications. All lever-type switches include their respective actuator arm. The large, metal-body style is available in the following operator types:

- Metal roller plunger
- Metal dome plunger
- Metal short lever

The compact metal body style is available in the following operator types:

- Roller plunger
- Dome plunger
- Short lever
- Cross roller plunger

All, except the short lever, are available with panel mount threading.

The small, plastic-body style isavailable in the following operator types:

- Short lever
- Hinge lever
- Roller plunger
- Dome plunger
- Offset hinge lever

The 15 mm plastic switch is available with top push roller and top push cross roller actuators.

Contact Arrangements

All 440P international-style limit switches contain positive opening-action contacts, making them ideal for safety-related applications. The small, plastic models include a choice of snap-acting, slow-break/make with 2- or 3-contact configurations, while the large-metal switches contain snap-acting, slow-break contacts in 2-, 3-, or 4-contact configurations. The 15 mm plastic versions are slow-break, 2-circuit models. The small metal models are all snap-acting, 2-circuit.

IEC Style Switches

22 mm Compact Metal Position Switches

Description

The 22 mm IEC style metal safety limit switches have been developed to provide a small metal case with a choice of actuator heads. All units are supplied with an integral 2 m cable. For safety applications it is important that upon actuation, the guard or other moving objects should not pass completely over the switch and allow the plunger or lever to return to its original position.

Features

- Rugged die cast enclosure
- Positive operation, forced disconnection of contacts (direct opening action)
- Snap-acting contact actuation
- Contacts 1 N.C. + 1 N.O.
- Pre-wired 2 m cable, bottom or side exit

Specifications

Safety Ratings	
Standards	EN 954-1, ISO 13849-1, IEC/EN 60204-1, NFPA 79, EN 1088, ISO 14119, IEC/EN 60947-5-1, ANSI B11.19, AS 4024.1
Safety Classification	Cat. 1 Device per EN 954-1 Dual channel limit switch suitable for Cat. 3 or 4 systems when ganged together
Certifications	UL Recognized, TÜV and CE Marked for all applicable directives
Outputs	
Safety Contacts ❄	1 N.C. snap acting
Auxiliary Contacts	1 N.O. snap acting
Thermal Current	10 A
Rated Insulation Voltage	300V AC
Contact Rating	

Maximum AC Contact Rating Per Pole

NEMA Rating	Max. Voltage	Amperes		Continuous Carrying Current (Amp.)	Volt Amperes	
		Make	Break		Make	Break
AC15/B300	120	30	3.0	5	3600	360
AC15/B300	240	15	1.5			

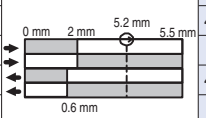
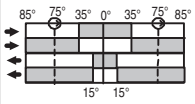
Maximum DC Contact Rating Per Pole

DC13/Q300	240	0.27	0.27	2.5	69	69

Operating Characteristics	
Actuation Speed, Max.	250 mm/s
Actuation Speed, Min.	100 mm/min
Actuation Frequency, Max.	6000 operations per hr
Mechanical Life	1 x 10^7
Environmental	
Enclosure Type Rating	NEMA 1, IP66/67
Operating Temperature [C (F)]	2…70 ° (35.6…158 °)
Pollution Degree	3
Physical Characteristics	
Housing Material	Die-cast alloy
Actuator Material	Various polymers and metals
Mounting	2 x M14, any position
Vibration	IEC 68-2-6 (10…55 Hz, 0.35 mm amplitude)
Shock	IEC 68-2-7 (30 Gn 3 pulses per axis)
Connection Type	2 m (6.5 ft) cable
Color	Red body/black head

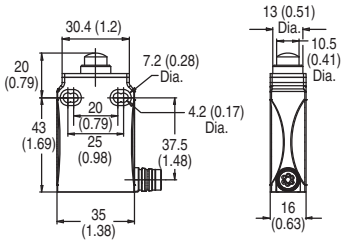
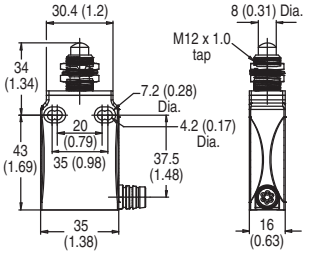
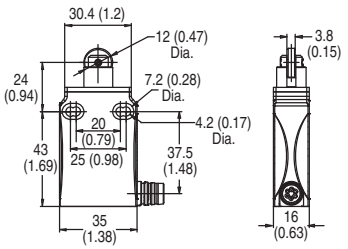
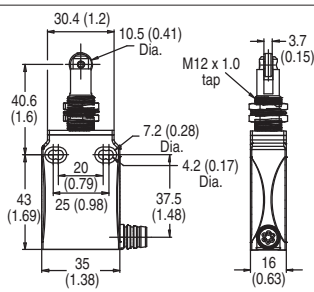
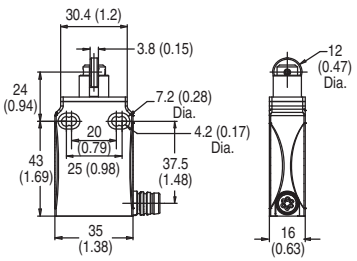
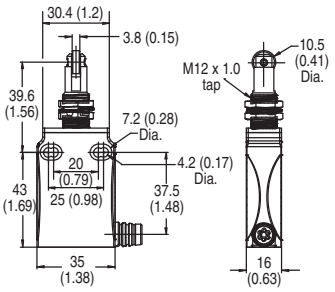
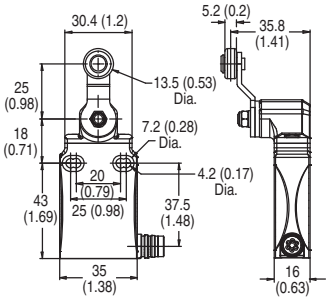
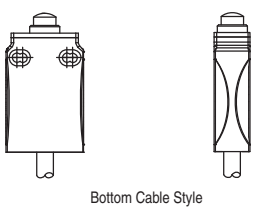
❄ The safety contacts are described as normally closed (N.C.) i.e., with the guard closed, actuator in place (where relevant) and the machine able to be started.

Product Selection

Operator Type	Contact			Typical Force/Torque to Operate	Panel Mount	Contact Opening Characteristics	Cat. No.	
	Safety	Auxiliary	Type			□Open ■Closed ⊖ Positive Opening Point	Bottom Cable Style	Side Cable Style
Roller Plunger	1 N.C.	1 N.O.	Snap Acting	10 (2.25)	No		**440P-ARPS11C**	**440P-ARPS11CS**
					Yes		440P-ARP1S11C	440P-ARP1S11CS
Dome Plunger	1 N.C.	1 N.O.	Snap Acting	10 (2.25)	No		440P-ADPS11C	440P-ADPS11CS
					Yes		440P-ADP1S11C	440P-ADP1S11CS
Cross Roller Plunger	1 N.C.	1 N.O.	Snap Acting	10 (2.25)	No		440P-ACRS11C	440P-ACRS11CS
					Yes		440P-ACR1S11C	440P-ACR1S11CS
Lever	1 N.C.	1 N.O.	Snap Acting	0.7 N•m (0.62 lb•in)	—		**440P-ASLS11C**	**440P-ASLS11CS**

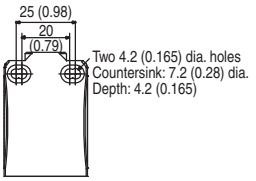
Approximate Dimensions [mm (in.)]

Dimensions are not intended to be used for installation purposes.

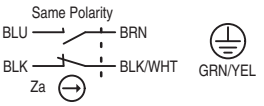
	Nonpanel Mount	Panel Mount
Dome Plunger		
Roller Plunger		
Cross Roller Plunger		
Lever Type		 Bottom Cable Style

- Side cable style shows strain relief only. Units include a 2 m integral cable.
- Bottom cable style units have same dimensions as side cable style.
- Panel mount clearance hole = 13 mm (0.51 in.)

Countersink Hole



Typical Wiring Diagrams



IEC Style Switches

22 mm Plastic Body

Description

These 22 mm plastic-body safety limit switches conform to EN 50047 standards and are available with snap-acting or slow-break/make 2- or 3-contact configurations as well as a variety of actuator heads.

These switches also feature an optional rotating head that can be adjusted in 90° increments before installation to allow for ease of mounting.

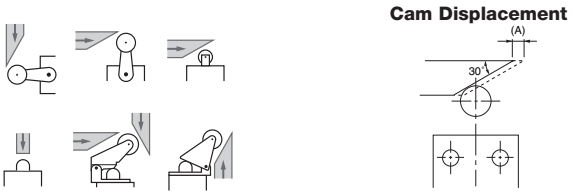
Allen-Bradley Guardmaster limit switches can be used in guard door applications as well as on moving machine beds, crane arms, lifts, elevators, etc.

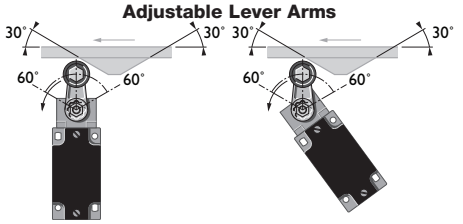
Operation of these limit switches is achieved by the sliding action of a guard, or other moving object, deflecting the plunger or lever. For safety applications, it is important that upon actuation, the guard or moving object should not pass completely beyond the switch to allow the plunger or lever to return to its original position—the plunger or lever must remain engaged by the guard or object.

Features

- Large selection of actuator heads
- Positive operation, forced disconnection of contacts
- Snap-acting, slow make before break or slow break before make contact blocks
- Contacts 1 N.C. + 1 N.O., 2 N.C. + 1 N.O. 3 N.C.
- Conforms to EN 50047, EN 1088, EN 60947-5-1, EN 292 and EN 60204-1

Operating Examples





The actuating cam should be profiled at 30° for optimum operation.

Note: Plunger-type switches operate from a flat profile.

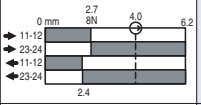
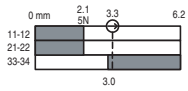
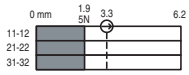
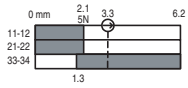
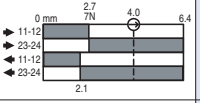
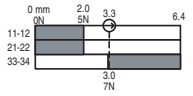
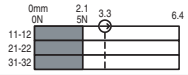
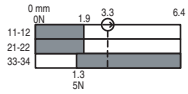
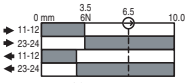
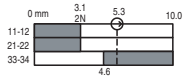
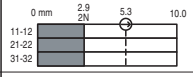
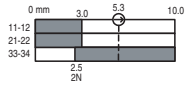
Specifications

Safety Ratings					
Standards		EN 954-1, ISO 13849-1, IEC/EN 60204-1, NFPA 79, EN 1088, ISO 14119, IEC/EN 60947-5-1, ANSI B11.19, AS 4024.1			
Safety Classification		Cat. 1 Device per EN 954-1 Dual channel limit switch suitable for Cat. 3 or 4 systems and used with a safety monitoring device			
Functional Safety Data ✶ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*		B10d: > 2 x 10^6 operations at min. load PFH_D: > 3 x10^{-7} MTTFd: > 385 years Dual channel limit switch may be suitable for performance levels Ple or Pld (according to ISO 13849-1:2006) and for use in SIL2 or SIL3 systems (according to IEC 62061) depending on application characteristics			
Certifications		CE Marked for all applicable directives, cULus, and TÜV			
Outputs					
Safety Contacts ❄		1 N.C. snap acting, 2 N.C. or 3 N.C. slow acting			
Auxiliary Contacts		1 N.O. (except 3 N.C. versions)			
Thermal Current I_{th}		10 A			
Rated Insulation Voltage		600V AC			
Switching Current @ Voltage, Min.		25 mA @ 5V DC			
Utilization Category					
A600/AC-15	(Ue)	600V	500V	240V	120V
	(Ie)	1.2 A	1.4 A	3.0 A	6.0 A
N600/DC-13	(Ue)	600V	500V	250V	125V
	(Ie)	0.4 A	0.55 A	1.1 A	2.2 A
Operating Characteristics					
Actuation Speed, Max.		250 mm/s			
Actuation Speed, Min.		100 mm/min			
Actuation Frequency, Max.		6000 operation per hour			
Mechanical Life		1 x 10^7			
Environmental					
Enclosure Type Rating		IP66			
Operating Temperature [C (F)]		-25…80° (-18…+176°)			
Pollution Degree		3			
Physical Characteristics					
Housing Material		UL Approved glass-filled polybutylene terephthalate			
Actuator Material		Various polymers and metals			
Mounting		2 x M4, Any position			
Vibration		IEC 68-2-6 (10…55 Hz, 0.35 mm amplitude)			
Shock		IEC 68-2-7 (30 Gn 3 pulses per axis)			
Conduit Entry		M20 or 1/2 inch NPT			
Color		Red			

✶ Usable for ISO 13849-1:2006 and IEC 62061. Data other than B10d is based on:
- Usage rate of 1op/10 mins., 24 hrs/day, 360 days/year, representing 51840 operations per year
- Mission time/Proof test interval of 38 years

❄ The safety contacts are described as normally closed (N.C.) i.e., with the guard closed, actuator in place (where relevant) and the machine able to be started.

Product Selection

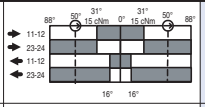
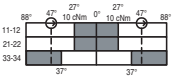
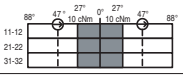
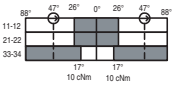
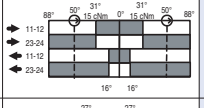
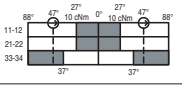
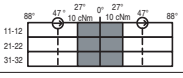
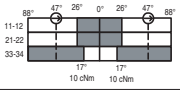
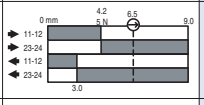
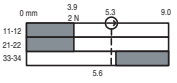
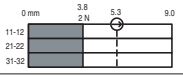
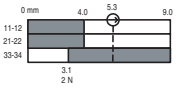
Description	Contact			Typical Force/Torque to Operate	Contact Opening Characteristics □Open ■Closed ⊖ Positive Opening Point	Cat. No.		
	Safety	Auxiliary	Type			1/2 inch NPT Conduit	M20 Conduit	Connector Style✶
	1 N.C.	1 N.O.	Snap acting	5 N		**440P-CRPS11E**	440P-CRPS11B	440P-CRPS11D4
	2 N.C.	1 N.O.	BBM	6 N		440P-CRPB12E	440P-CRPB12B	440P-CRPB12R6
	3 N.C.	—	—	5 N		440P-CRPB03E	440P-CRPB03B	440P-CRPB03R6
Roller Plunger	2 N.C.	1 N.O.	MBB	6 N		440P-CRPM12E	440P-CRPM12B	440P-CRPM12R6
	1 N.C.	1 N.O.	Snap acting	5N		**440P-CDPS11E**	440P-CDPS11B	440P-CDPS11D4
	2 N.C.	1 N.O.	BBM	6N		440P-CDPB12E	440P-CDPB12B	440P-CDPB12R6
	3 N.C.	—	—	5N		440P-CDPB03E	440P-CDPB03B	440P-CDPB03R6
Dome Plunger	2 N.C.	1 N.O.	MBB	6N		440P-CDPM12E	440P-CDPM12B	440P-CDPM12R6
	1 N.C.	1 N.O.	Snap Acting	5N		**440P-CHLS11E**	440P-CHLS11B	440P-CHLS11D4
	2 N.C.	1 N.O.	BBM	6N		**440P-CHLB12E**	440P-CHLB12B	440P-CHLB12R6
	3 N.C.	—	—	5N		440P-CHLB03E	440P-CHLB03B	440P-CHLB03R6
Hinge Lever	2 N.C.	1 N.O.	MBB	6N		440P-CHLM12E	440P-CHLM12B	440P-CHLM12R6
Recommended standard cordset, 2 m, 4-pin, DC Micro (M12) connector.								889D-F4AC-2
Recommended standard cordset, 2 m, 6-pin, AC Micro (M12) connector.								889R-F6ECA-2

✶ D4 suffix uses a 4-pin DC Micro (M12) connector and R6 suffix uses a 6-pin AC Micro (dual keyway) consumer.

IEC Style Switches

22 mm Plastic Body

Product Selection (continued)

Description	Contact			Typical Force/Torque to Operate	Contact Opening Characteristics □Open ■Closed ⊖ Positive Opening Point	Cat. No.		
	Safety	Auxiliary	Type			1/2 inch NPT Conduit	M20 Conduit	Connector Style*
Short Lever Plastic Roller	1 N.C.	1 N.O.	Snap acting	0.15 N•m		**440P-CSLS11E**	440P-CSLS11B	440P-CSLS11D4
	2 N.C.	1 N.O.	BBM	0.14 N•m		**440P-CSLB12E**	440P-CSLB12B	440P-CSLB12R6
	3 N.C.	—	—	0.14 N•m		440P-CSLB03E	440P-CSLB03B	440P-CSLB03R6
	2 N.C.	1 N.O.	MBB	0.14 N•m		440P-CSLM12E	440P-CSLM12B	440P-CSLM12R6
Short Lever Metal Roller	1 N.C.	1 N.O.	Snap acting	0.15 N•m		440P-CMHS11E	440P-CMHS11B	440P-CMHS11D4
	2 N.C.	1 N.O.	BBM	0.14 N•m		440P-CMHB12E	440P-CMHB12B	440P-CMHB12R6
	3 N.C.	—	—	0.14 N•m		440P-CMHB03E	440P-CMHB03B	440P-CMHB03R6
	2 N.C.	1 N.O.	MBB	0.14 N•m		440P-CMHM12E	440P-CMHM12B	440P-CMHM12R6
Offset Hinge	1 N.C.	1 N.O.	Snap acting	5 N		**440P-COHS11E**	440P-COHS11B	440P-COHS11D4
	2 N.C.	1 N.O.	BBM	6 N		**440P-COHB12E**	440P-COHB12B	440P-COHB12R6
	3 N.C.	—	—	5 N		440P-COHB03E	440P-COHB03B	440P-COHB03R6
	2 N.C.	1 N.O.	MBB	6 N		440P-COHM12E	440P-COHM12B	440P-COHM12R6
Recommended standard cordset, 2 m, 4-pin, DC Micro (M12) connector.								889D-F4AC-2
Recommended standard cordset, 2 m, 6-pin, AC Micro (M12) connector.								889R-F6ACA-2

* D4 suffix uses a 4-pin DC Micro (M12) connector and R6 suffix uses a 6-pin AC Micro (dual keyway) consumer.

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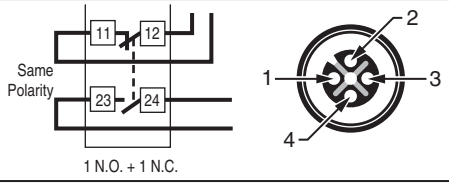
Publication S117-CA001A-EN-P

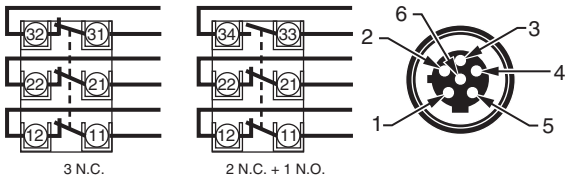
Allen-Bradley
Guardmaster®

Typical Wiring Diagrams ∗

Two-Circuit Type D4 4-Pin Micro Connector

Connector Pinout		1 N.C. + 1 N.O.	
		Terminal	Contact
	1	11	N.C.
	3	12	
	2	23	N.O.
	4	24	

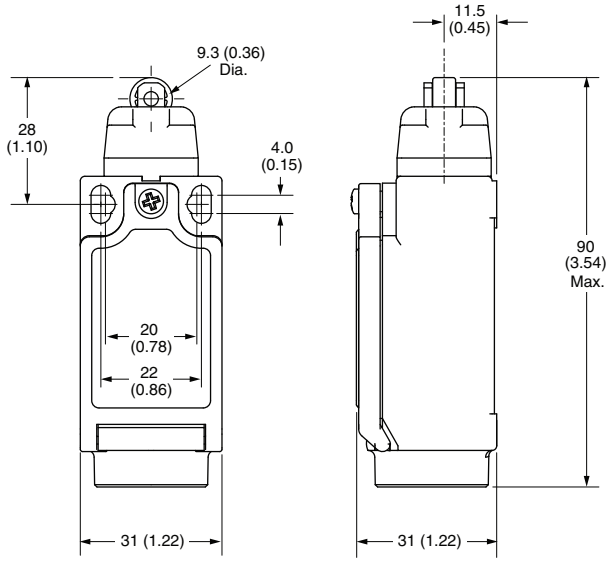
Three-Circuit Type R6 6-Pin Micro Connector

Connector Pinout		3 N.C.		2 N.C. + 1 N.O.	
		Terminal	Contact	Terminal	Contact
	1	11	N.C.	11	N.C.
	5	12		12	
	2	21	N.C.	21	N.C.
	6	22		22	
	3	33	N.O.	31	N.C.
	4	34		32	

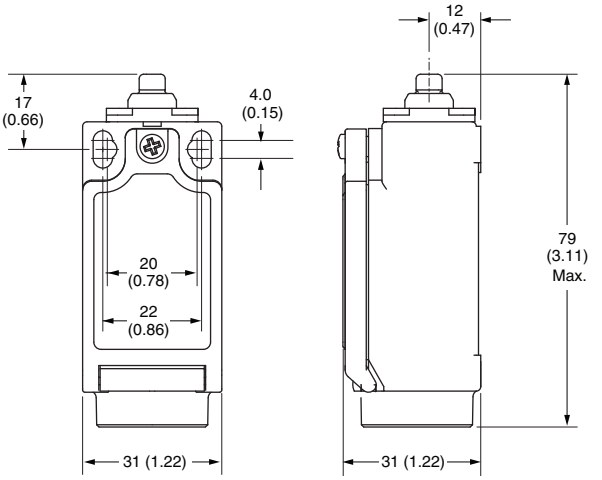
∗ See page 3-145 for positive opening circuits.

Approximate Dimensions [mm (in.)]

Dimensions are not intended to be used for installation purposes.



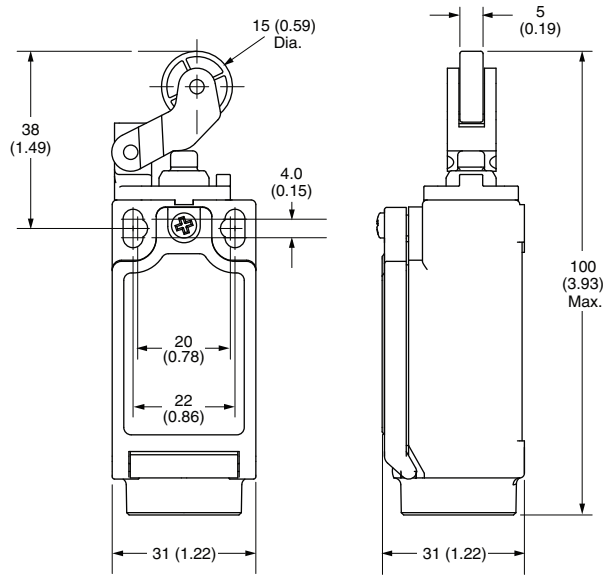
Roller Plunger



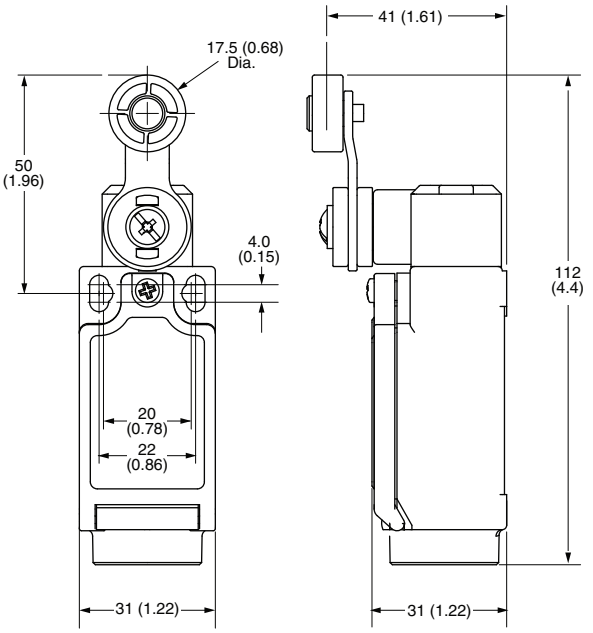
Dome Plunger

Approximate Dimensions [mm (in.)] (continued)

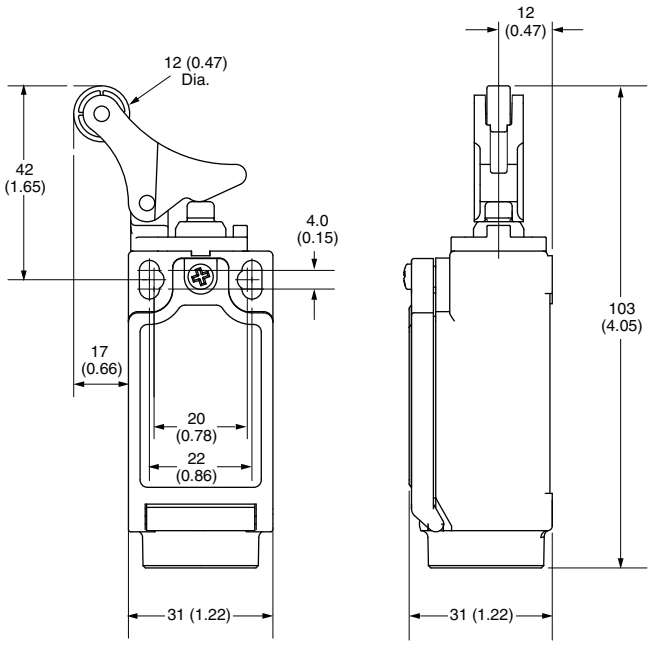
Dimensions are not intended to be used for installation purposes.



Hinge Lever



Short Lever,
Metal and Plastic Roller



Offset Hinge

Description

These 30 mm metal-body safety limit switches conform to EN 50041 standards and are available in snap acting or slow break/make with 2-, 3- or 4-contact configurations.

These switches feature a rotating head that can be adjusted in 90° increments before installation to allow for ease of mounting.

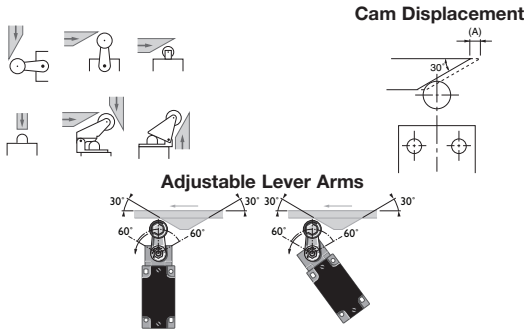
Allen-Bradley Guardmaster can be used in guard door applications as well as on moving machine beds, crane arms, lifts, elevators, etc.

Operation of these limit switches is achieved by the sliding action of a guard, or other moving object, deflecting the plunger or lever. For safety applications, it is important that upon actuation, the guard or moving object should not pass completely beyond the switch to allow the plunger or lever to return to its original position—the plunger or lever must remain engaged by the guard or object.

Features

- Large selection of actuator heads
- Positive operation, forced disconnection of contacts
- Snap-acting, slow make before break or slow break before make contact blocks
- Contacts 1 N.C. + 1 N.O., 2 N.C. + 2 N.O., 3 N.C. + 1 N.O., or 4 N.C.
- Conforms to EN 50041, EN 1088, EN 60947-5-1, EN 292 and EN 60204-1

Operating Examples



For optimum cam operation, the actuating arm should be adjusted with a 30° offset profile.

Note: Plunger-type switches operate from a flat profile.

Specifications

Safety Ratings					
Standards		EN 954-1, ISO 13849-1, IEC/EN 60204-1, NFPA 79, EN 1088, ISO 14119, IEC/EN 60947-5-1, ANSI B11.19, AS 4024.1			
Safety Classification		Cat. 1 Device per EN954-1 Dual-channel limit switch suitable for Cat. 3 or 4 systems and used with a safety monitoring device			
Functional Safety Data ✶ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*		B10d: > 2 x 10^6 operations at min. load PFH_D: > 3 x10^{-7} MTTFd: > 385 years Dual channel limit switch may be suitable for performance levels Ple or Pld (according to ISO 13849-1:2006) and for use in SIL2 or SIL3 systems (according to IEC 62061) depending on application characteristics			
Certifications		CE Marked for all applicable directives, cULus, and TÜV			
Outputs					
Safety Contacts ❄		1 N.C. snap acting, 2 N.C., 3 N.C. or 4 N.C. slow acting			
Auxiliary Contacts		1 N.O., 2 N.O., or zero			
Thermal Current I_{th}		10 A			
Rated Insulation Voltage		600V AC			
Switching Current @ Voltage, Min.		25 mA @ 5V DC			
Utilization Category					
A600/AC-15	(Ue)	600V	500V	240V	120V
	(Ie)	1.2 A	1.4 A	3.0 A	6.0 A
N600/DC-13	(Ue)	600V	500V	250V	125V
	(Ie)	0.4 A	0.55 A	1.1 A	2.2 A
Operating Characteristics					
Actuation Speed, Max.		250 mm/s			
Actuation Speed, Min.		100 mm/min			
Actuation Frequency, Max.		6000 operation per hour			
Mechanical Life		1 x 10^7			
Environmental					
Enclosure Type Rating		IP66			
Operating Temperature [C (F)]		-25…80° (-18…+176°)			
Pollution Degree		3			
Physical Characteristics					
Housing Material		Die-cast alloy			
Actuator Material		Various polymers and metals			
Mounting		2 x M5, Any position			
Vibration		IEC 68-2-6 (10…55 Hz, 0.35 amplitude)			
Shock		IEC 68-2-7 (30 Gn 3 pulses per axis)			
Conduit Entry		M20 or 1/2 inch NPT			
Color		Red			

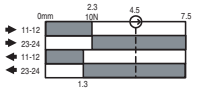
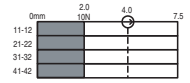
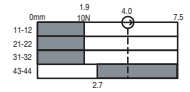
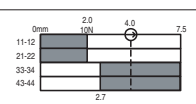
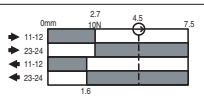
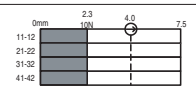
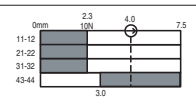
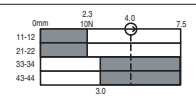
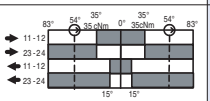
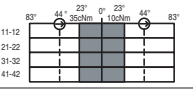
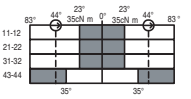
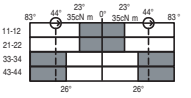
✶ Usable for ISO 13849-1:2006 and IEC 62061. Data other than B10d is based on:
- Usage rate of 1op/10 mins., 24 hrs/day, 360 days/year, representing 51840 operations per year
- Mission time/Proof test interval of 38 years

❄ The safety contacts are described as normally closed (N.C.) i.e., with the guard closed, actuator in place (where relevant) and the machine able to be started.

IEC Style Switches

30 mm Metal Body

Product Selection

Description	Contact			Typical Force/Torque to Operate	Contact Opening Characteristics □Open ■Closed ⊖ Positive Opening Point	Cat. No.		
	Safety	Auxiliary	Type			1/2 inch NPT Conduit	M20 Conduit	Connector ✶
Metal Roller Plunger	1 N.C.	1 N.O.	Snap Acting	13 N		440P-MRPS11E	440P-MRPS11B	440P-MRPS11N5
	4 N.C.	—	—	11 N		440P-MRPB04E	440P-MRPB04B	440P-MRPB04M9
	3 N.C.	1 N.O.	BBM	11 N		440P-MRPB13E	440P-MRPB13B	440P-MRPB13M9
	2 N.C.	2 N.O.	BBM	11 N		**440P-MRPB22E**	440P-MRPB22B	440P-MRPB22M9
Metal Dome Plunger	1 N.C.	1 N.O.	Snap Acting	13 N		**440P-MDPS11E**	440P-MDPS11B	440P-MDPS11N5
	4 N.C.	—	—	11 N		440P-MDPB04E	440P-MDPB04B	440P-MDPB04M9
	3 N.C.	1 N.O.	BBM	11 N		440P-MDPB13E	440P-MDPB13B	440P-MDPB13M9
	2 N.C.	2 N.O.	BBM	11 N		440P-MDPB22E	440P-MDPB22B	440P-MDPB22M9
Metal Short Lever	1 N.C.	1 N.O.	Snap Acting	0.34 N•m		**440P-MSLS11E**	440P-MSLS11B	440P-MSLS11N5
	4 N.C.	—	—	0.20 N•m		440P-MSLB04E	440P-MSLB04B	440P-MSLB04M9
	3 N.C.	1 N.O.	BBM	0.34 N•m		440P-MSLB13E	440P-MSLB13B	440P-MSLB13M9
	2 N.C.	2 N.O.	BBM	0.34 N•m		440P-MSLB22E	440P-MSLB22B	440P-MSLB22M9
Recommended standard cordset, 2 m, 5-pin mini connector.								889N-F5AE-6F
Recommended standard cordset, 2 m, 12-pin 9-wire.								889M-FX9AE-2

✶ N5 = 5-pin mini connector.
M9 = 12-pin M23 connector (use 9 wire).

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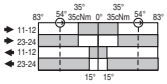
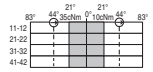
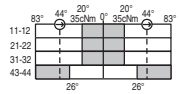
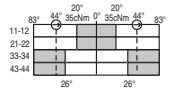
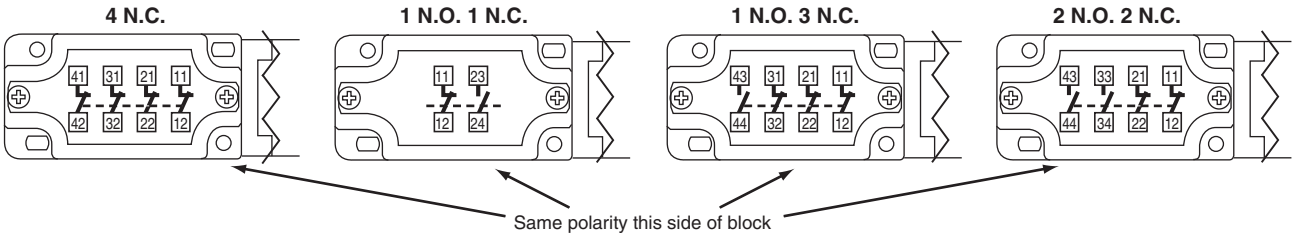
Product Selection (continued)

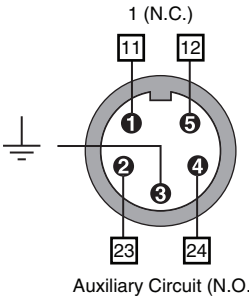
Description	Safety Contacts	Auxiliary Contacts	Contact Type	Typical Force/Torque to Operate	Contact Opening Characteristics □Open ■Closed ⊖ Positive Opening Point	Cat. No. 1/2 inch NPT Conduit	Cat. No. M20 Conduit	Cat. No. Connector ∗
Metal Short Lever, Metal Roller	1 N.C.	1 N.O.	Snap Acting	0.34 N•m		440P-MMHS11E	440P-MMHS11B	440P-MMHS11N5
	4 N.C.	—	—	0.20 N•m		440P-MMHB04E	440P-MMHB04B	440P-MMHB04M9
	3 N.C.	1 N.O.	BBM	0.34 N•m		440P-MMHB13E	440P-MMHB13B	440P-MMHB13M9
	2 N.C.	2 N.O.	BBM	0.34 N•m		440P-MMHB22E	440P-MMHB22B	440P-MMHB22M9
Recommended standard cordset, 2 m, 5-pin mini connector.								889N-F5AE-6F
Recommended standard cordset, 2 m, 12-pin 9-wire.								889M-FX9AE-2

∗ N5 = 5-pin mini connector.
M9 = 12-pin M23 connector (use 9 wire).

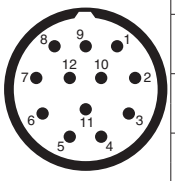
Typical Wiring Diagrams



N5 Connector 2 Circuit 5-Pin Mini Connector

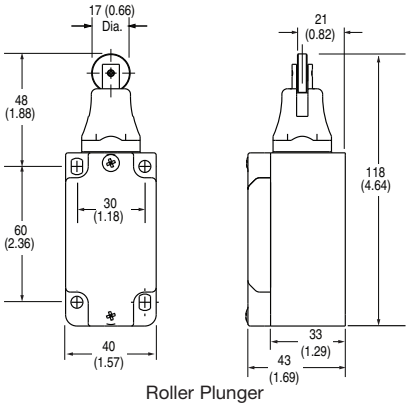


M9 12-Pin M23 Connector

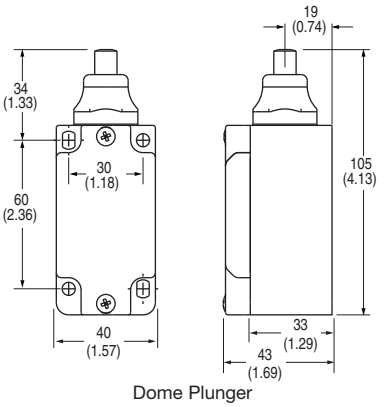
Connector Pinout		4 N.C. Terminal	4 N.C. Contact	3 N.C. 1 N.O. Terminal	3 N.C. 1 N.O. Contact	3 N.C. Terminal	3 N.C. Contact
	1	11	N.C.	11	N.C.	11	N.C.
	3	12		12		12	
	4	21	N.C.	21	N.C.	21	N.C.
	6	22		22		22	
	7	31	N.C.	31	N.C.	33	N.O.
	8	32		32		34	
	9	41	N.C.	43	N.O.	43	N.O.
	10	42		44		44	
	12	Ground					

Approximate Dimensions [mm (in.)]

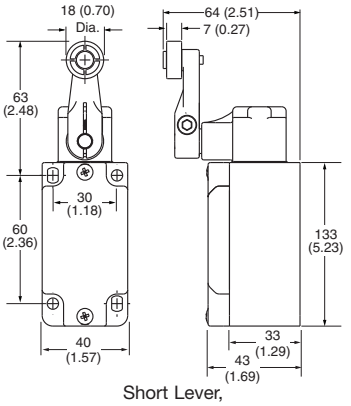
Dimensions are not intended to be used for installation purposes.



Roller Plunger



Dome Plunger



Short Lever,
(Metal & Plastic Roller)

Imp 1

Imp 2

Description

The Imp offers safety switch performance of bigger units in the most compact case available. Designed with two mounting hole options and a choice of actuator positions, the Imp will fit in most confined spaces.

Features

- Positive operation, forced disconnection of contacts
- Contacts 1 N.C. + 1 N.O.

Specifications

Safety Ratings				
Standards		EN 954-1, ISO 13849-1, IEC/EN 60204-1, NFPA 79, EN 1088, ISO 14119, IEC/ EN 60947-5-1, ANSI B11.19, AS 4024.1		
Safety Classification		Cat. 1 Device per EN954-1 Dual channel limit switch suitable for Cat. 3 or 4 systems		
Functional Safety Data ✶ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*		B10d: > 2 x 10^6 operations at min. load PFH_D: > 3 x10^{-7} MTTFd: > 385 years Dual channel limit switch may be suitable for performance levels Ple or Pld (according to ISO 13849-1:2006) and for use in SIL2 or SIL3 systems (according to IEC 62061) depending on application characteristics		
Certifications		CE Marked for all applicable directives and CSA NRTL/C		
Outputs				
Safety Contacts ❄		1 N.C. positive break		
Auxiliary Contacts		1 N.O.		
Thermal Current I_{lth}		10 A (Ith)		
Rated Insulation Voltage		(Ui) 500V		
Switching Current @ Voltage, Min.		25 mA @ 5V DC		
Utilization Category				
AC-15	(Ue)	500V	250V	100V
	(Ie)	1 A	2 A	5 A
DC	(Ue)	250V	24V	
	(Ie)	0.5 A	2 A	
Operating Characteristics				
Actuation Speed, Max.		160 mm (6.29 in.)/s		
Actuation Speed, Min.		100 mm (3.93 in.)/min		
Actuator Travel, Max.		5 mm (0.20 in.)		
Actuation Frequency, Max.		2 cycles/s		
Mechanical Life		10,000,000 operations		
Electrical Life		1,000,000 operations		
Mechanical Life		10,000,000 operations		
Environmental				
Enclosure Type Rating		IP30		
Operating Temperature [C (F)]		-25…80° (-13…176°)		
Pollution Degree		3		
Physical Characteristics				
Housing Material		UL Approved glass-filled PBT		
Actuator Material		Stainless steel		
Mounting		2 x M4 front or 2 x M3 top		
Vibration		10…55 Hz		
Shock		11 ms @ 30 g		
Conduit Entry		3x break-outs		
Color		Red		

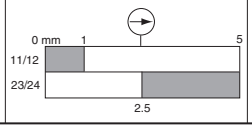
✶ Usable for ISO 13849-1:2006 and IEC 62061. Data other than B10d is based on:
- Usage rate of 1op/10 mins., 24 hrs/day, 360 days/year, representing 51840 operations per year
- Mission time/Proof test interval of 38 years

❄ The safety contacts are described as normally closed (N.C.) i.e., with the guard closed, actuator in place (where relevant) and the machine able to be started.

IEC Style Switches

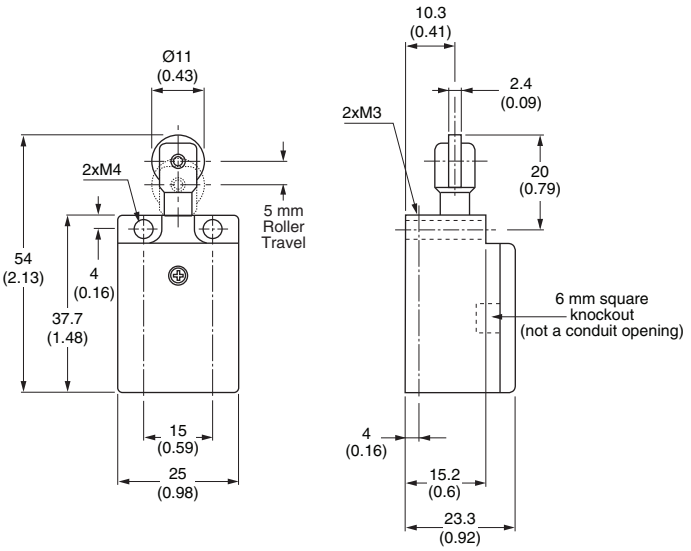
15 mm Plastic Body

Product Selection

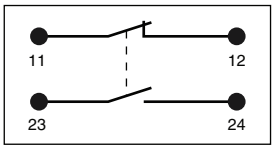
Actuator Type	Contact		Contact Action □Open ■Closed ⊖ Positive Opening Point	Conduit	Type	Cat. No.
Top push roller	Slow break before make	1 N.C. & 1 N.O.		3 x breakouts	Imp 1 (roller parallel to switch front)	**440P-M18001**
Top push cross roller					Imp 2 (roller perpendicular to switch front)	**440P-M18002**

Approximate Dimensions [mm (in.)]

Dimensions are not intended to be used for installation purposes.



Wiring Diagrams



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Publication S117-CA001A-EN-P

Allen-Bradley
Guardmaster®

Description

The 802T Direct Opening Action limit switches have been designed for use in control reliable applications and safety applications per ISO 14119. These limit switches utilize the same mounting dimensions as other NEMA style limit switches. The rugged metal construction and plug-in body are designed for use in harsh industrial environments.

Direct Opening Action allows the normally closed contacts to open when the limit switch is actuated. This opening will occur even in the event of a contact weld condition, up to 10 Newtons.

ATTENTION: To ensure that the normally closed (safety) contacts open, the limit switch actuator must be displaced beyond the point of Direct Opening Action (see specifications).

Features

- Direct opening action
- Snap acting contacts
- Rugged metal construction
- Long life and reliability
- Plug-in design
- NEMA 12, 13, 4, 6P/IP67 sealing

Typical Applications

- Machine guards
- Access gates and doors
- Cranes or hoists
- Transfer stations
- Indexing tables
- Robotic cells

Specifications

Safety Ratings					
Standards		EN 954-1, ISO 13849-1, IEC/EN 60204-1, NFPA 79, EN 1088, ISO 14119, IEC/EN 60947-5-1, ANSI B11.19, AS 4024.1			
Safety Classification		Cat. 1 Device per EN 954-1 Dual channel limit switch suitable for Cat. 3 or 4 systems			
Functional Safety Data ✶ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*		B10d = > 2 x 10^6 operations at min. load PFH_D = > 3 x10^{-7} MTTFd = > 385 years Dual channel limit switch may be suitable for Performace levels Ple or Pld (according to ISO 13849-1:2006) and for use in SIL2 or SIL3 systems (according to IEC 62061) depending on application characteristics			
Certifications		CE Marked for all applicable directives, cULus Listed, and TÜV for 2- and 4-circuit models			
Outputs					
Safety Contacts ❄		1 N.C. snap acting or 2 N.C. snap acting			
Auxiliary Contacts		1 N.O. snap acting or 2 N.O. snap acting			
Thermal Current I_{th}		10 A			
Rated Insulation Voltage		300V AC or 600V AC			
Switching Current @ Voltage, Min.		—			
Utilization Category					
A600/AC-15	(Ue)	600V	500V	240V	120V
	(Ie)	1.2 A	1.4 A	3.0 A	6.0 A
N600/DC-13	(Ue)	600V	500V	250V	125V
	(Ie)	0.4 A	0.55 A	1.1 A	2.2 A
Operating Characteristics					
Actuation Speed, Max.		200 ft/min varies with applied loading and actuation method✶			
Actuation Speed, Min.		200 ft/min varies with applied loading and actuation method✶			
Actuation Frequency, Max.		8000 operations per hour			
Mechanical Life		20 million cycles			
Environmental					
Enclosure Type Rating		NEMA 4, 6P, 12, 13 and IP65/67			
Operating Temperature [C (F)]		-18…+110° (0…+230°)			
Pollution Degree		3			
Physical Characteristics					
Housing Material		Die-cast alloy			
Actuator Material		Various metals or plastics			
Mounting		2 #10 equal length fasteners			
Vibration		Contact fragility (10…2000 Hz @ 0.06 inch peak-to-peak)			
Shock		Contact fragility (25 Gn 3 pulses per axis)			
Conduit Entry		1/2 inch NPT or M20			
Color		Grey			

✶ Usable for ISO 13849-1:2006 and IEC 62061. Data other than B10d is based on:
- Usage rate of 1op/10 mins., 24 hrs/day, 360 days/year, representing 51840 operations per year
- Mission time/Proof test interval of 38 years

❄ The safety contacts are described as normally closed (N.C.) i.e., with the guard closed, actuator in place (where relevant) and the machine able to be started.

AC Contact Rating (Maximum per Pole, 50 or 60Hz, 2 Circuits)

NEMA Rating Designation	Max Voltage	A		Continuous Carrying Current	VA	
		Make	Break		Make	Break
A600	120	60	6.00	10	7200	720
	240	30	3.00	10	7200	720
AC-15	480	15	1.50	10	7200	720
	600	12	1.20	10	7200	720

AC Contact Rating (Maximum per Pole, 50 or 60Hz, 4 Circuits)

NEMA Rating Designation	Max Voltage	A		Continuous Carrying Current	VA	
		Make	Break		Make	Break
A300	120	60	6.00	10	7200	720
	240	30	3.00	10	7200	720

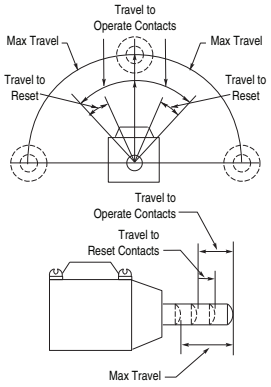
DC Contact Rating (Maximum per Pole)

NEMA Rating Designation	Max Voltage	A		Continuous Carrying Current	VA	
		Make	Break		Make	Break
Q300	250	0.27	0.27	2.5	69	69
	125	0.55	0.55	2.5	69	69
DC 13						

Low Voltage DC

24V DC @ 1.1 Amps resistive load

Range of Operation



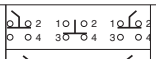
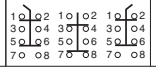
Lever Type Spring Return

Top Push Roller Spring Return

Side Push Vertical Roller Spring Return

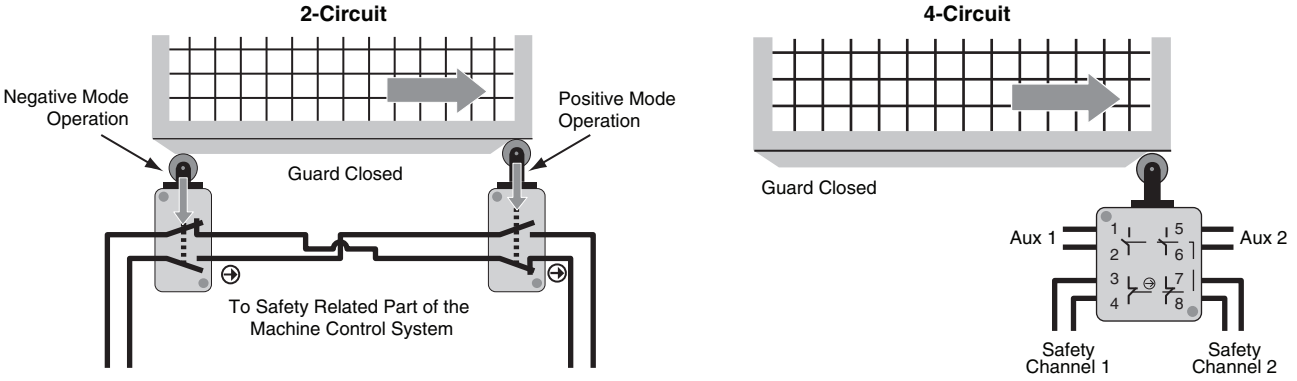
Side Push Horizontal Roller Spring Return

Product Selection

Number of Circuits	Lever Movement	Description	Typical Force/Torque to Operate	Travel to Operate Contacts [mm (in.)]	Torque/Force to Operate Direct Opening Action	Travel to Operate Direct Opening Action [mm (in.)]	Maximum Travel [mm (in.)]	Travel to Reset Contacts [mm (in.)]	Cat. No.
Lever Type • Spring Return									
2	Clockwise or Counter Clockwise		0.45 N•m (4.0 lb•in), max.	13°, max.	0.90 N•m (8 lb•in), min.	25°, min.	90°	7°, max.	Switch w/o Lever 802T-APD
4									802T-ATPD
Top Push Roller • Spring Return									
2	Normal	Operated	28.47 N•m (6.4 lb•in), max.	1.17 (0.046), max.	66.72 N (15.0 lb), min.	2.29 (0.090), min.	5.99 (0.236)	0.64 (0.025), max.	Complete Switch 802T-DPD
4									802T-DTPD
Side Push Vertical Roller • Spring Return									
2	Normal	Operated	24.5 N•m (5.5 lb•in), max.	2.08 (0.082), max.	53.4 N (12.0 lb), min.	4.19 (0.165), min.	5.74 (0.226)	1.14 (0.045), max.	Complete Switch 802T-KPD
4									802T-KTPD
Side Push Horizontal Roller • Spring Return									
2	Normal	Operated	24.5 N•m (5.5 lb•in), max.	2.08 (0.082), max.	53.4 N (12.0 lb), min.	4.19 (0.165), min.	5.74 (0.226)	1.14 (0.045), max.	Complete Switch 802T-K1PD
4									802T-K1TPD

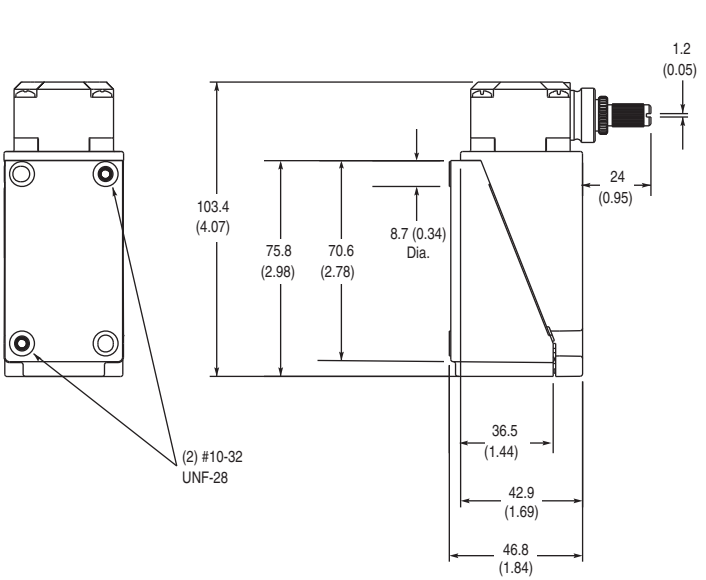
Modifications and Typical Levers—page 3-159.

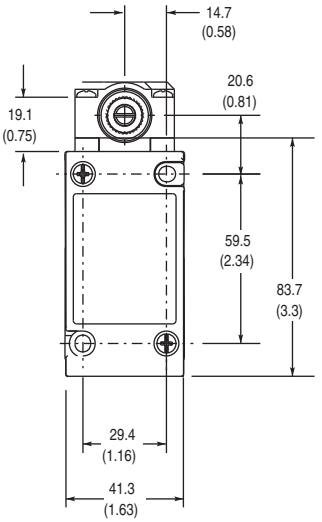
Typical Example of a Dual Channel Safety Application



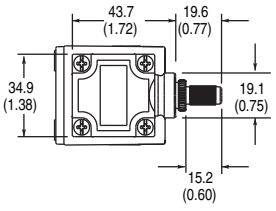
Approximate Dimensions [mm (in.)]

Dimensions are not intended to be used for installation purposes.

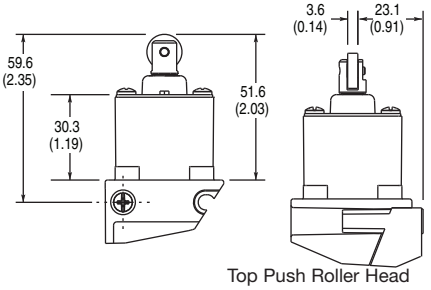




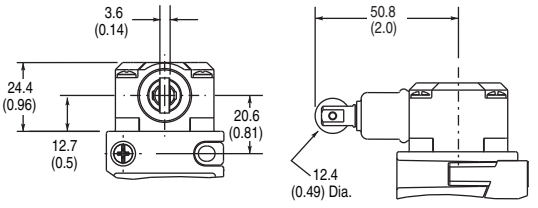
Plug-In Switch



Lever Type Head



Top Push Roller Head



Side Push Roller Head

Modifications

Metric Conduit Entry

To order a limit switch with a 20 mm conduit entry, add the suffix **S6** to the cat. no. **Example: 802T-APDS6.**

Pre-wired Cable

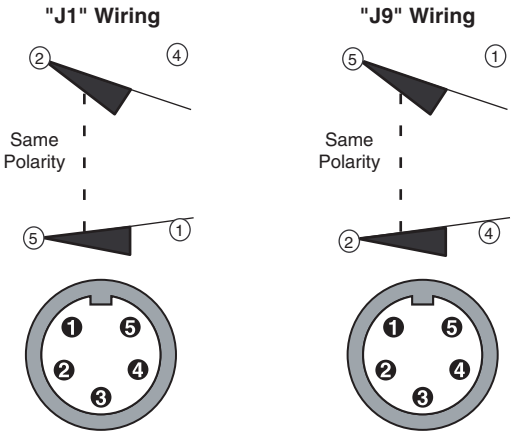
To order a factory-installed pre-wired type STOOW-A cable (5-conductor), add the suffix **Y** plus the number of feet required. The standard cable length is 1.52 m (5 ft). Extended cable lengths are available in multiples of 1.22 m (4 ft) only.

Example: To order a limit switch with a factory-installed 1.52 m (5 ft) cable, the cat. no. would become **802T-APDY5**. To order a limit switch with a factory-installed 2.44 m (8 ft) cable, the cat. no. would become **802T-APDY8**.

Mini-Style Quick-Disconnect

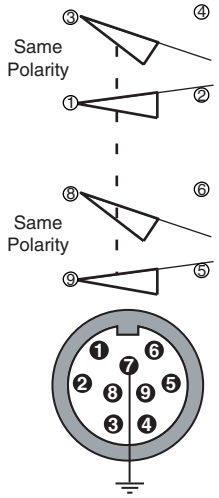
To order an 802T pre-wired limit switch with a 5-pin (2 circuit) or 9-pin (4 circuit) mini connector, add the suffix **J1** or **J9** depending on desired wiring (J9 wiring not available for 4-circuit models) to the cat. no. **Example: 802TAPDJ1**.

5-Pin Mini-Type Receptacle (2 circuit)



9-Pin Mini-Type Receptacle (4 circuit)

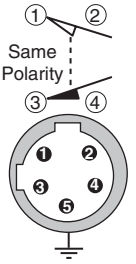
"J1" Wiring ("J9" wiring not available for 4 circuit)



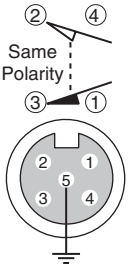
Micro-Style Quick-Disconnect

Micro quick-disconnects are available with a 5-pin 2-keyway AC or 5-pin single keyway DC. To order a limit switch with a AC micro quick-disconnect, add the suffix **R5** to the cat. no. To order a limit switch with a DC micro quick-disconnect, add the suffix **D5** to the cat. no. **Example: 802TAPDR5** and **802TAPDD5**.

AC Micro QD



DC Micro QD



Levers

Type	Roller [mm (in.)]			Cat. No.
	Material	Diameter	Width	
	Nylon	19.05 (0.75)	7.11 (0.28)	802T-W1
	Nylon	19.05 (0.75)	25.4 (1.0)	802T-W1H
	Steel	19.05 (0.75)	6.35 (0.25)	802T-W1A
Non-Adj. Cast Lever 38.1 mm (1.5 in.) Radius Roller on Front	Ball Bearing	19.05 (0.75)	5.84 (0.23)	802T-W1B

Note: Additional lever options are available in the Limit Switch section of the *Sensors* catalog.

Notes

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Publication S117-CA001A-EN-P

Operator Interface

Emergency Stop Devices

Cable Pull Switches

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Lifeline™ 4 Stainless Steel 4-16

Enabling Switches

GripSwitch 4-24

Push Button Switches

22.5 mm 4-29
30 mm 4-41

Two-Hand Control Devices

Touch Buttons

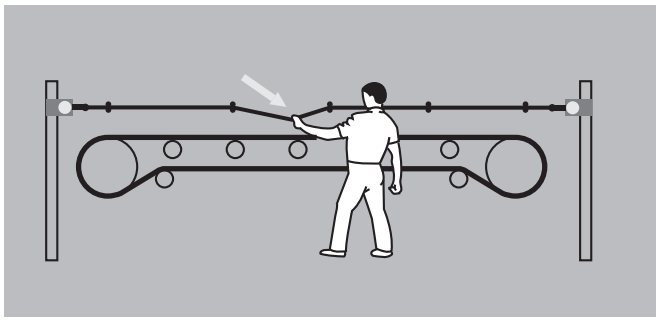
800Z Zero-Force Touch Buttons 4-48

Cable Pull Switches

Overview

Cable Pull Switches Overview

For machinery such as conveyors, it is often more convenient and effective to use a cable pull device along the hazard area (as shown in the figure below) as the emergency stop device. These devices use a steel wire rope connected to latching pull switches so that pulling on the rope in any direction at any point along its length will trip the switch to cut off the machine power.



The cable pull switches must detect both a pull on the cable as well as when the cable goes slack. Slack detection ensures that the cable is not cut and is ready for use.

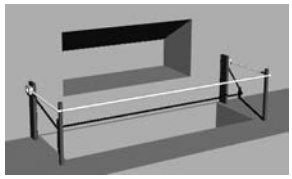
Rockwell Automation developed a unique Lifeline Rope Tensioner System (LRTS) which helps enable quicker installations.

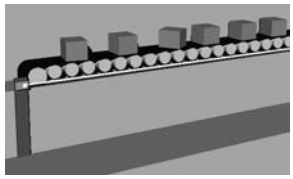
A dedicated stainless steel installation kit must be used with the stainless steel Lifeline 4 instead of the LRTS.

Selection Guide

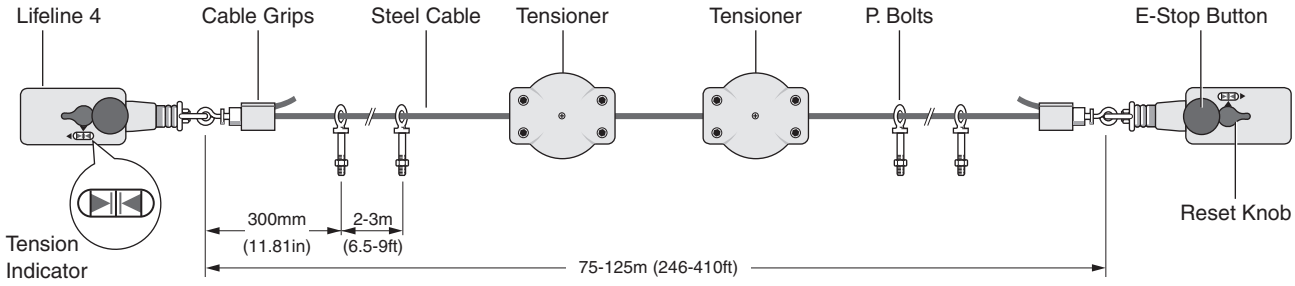
Description	Lifeline 3	Lifeline 4	Stainless Steel Lifeline 4
Material	Painted Zinc Alloy	Painted Aluminum Alloy	Stainless Steel 316
Reset	Yes	Yes	Yes
E-Stop	No	Yes	Yes
Cable Span	30 m (98.42 ft)	75 m (246 ft) 125 m (410 ft) extended model	75 m (246 ft)

Typical Applications





Mounting Specifications for Extended Length Models



Notes:

1. The first and last **P. bolt/eye bolt** must be located as close as possible to the switch eyelet while maintaining adequate clearance (125 mm/5 in) from the cable grips to allow free movement. This provides for a straight and efficient pulling action on the switches.
2. Additional **P. bolts/eye bolts**, spaced 2-3 m (6-9 ft) apart, help keep the perpendicular pull force, F, and distance, d, within IEC60947-5-5 specifications of 200 N (45 lbs) and 400 mm (15.75 in).
3. We recommend using a switch at both cable ends, especially in applications with long cable runs or cable runs going around bends. This helps ensure that the safety function is fulfilled upon actuation of the cable in any direction.
4. ISO 13850 requires that the full length of cable to be within view when the reset is turned to the run position or the machine must be inspected over the whole length of the cable, both before and after resetting.
5. On shorter cable runs (max 10 m), a Lifeline tensioner spring may be used at one end of the span. The installation must be such that the above requirements can be met. When a spring is used, the last **P. Bolt/eye bolt** must be located as close as possible to the spring while maintaining adequate clearance (125 mm/5 in) from the cable grips to allow free movement. This is intended to help to ensure that a pull near the end of the cable will be between **P. Bolts/eye bolts**. This should result in operation of the switch contacts instead of only the spring moving.
6. Careful attention is required for the design of the installation to ensure that the cable is not likely to become trapped or snagged. This is especially important when using a tensioner spring because a cable snag between the location of the pull and the switch could prevent the actuation of the safety function.
7. It is essential that when the installation is complete, a thorough functional test is made. This should include checking all types and directions of pull over the length of the cable as well as checking for slack-cable tripping.

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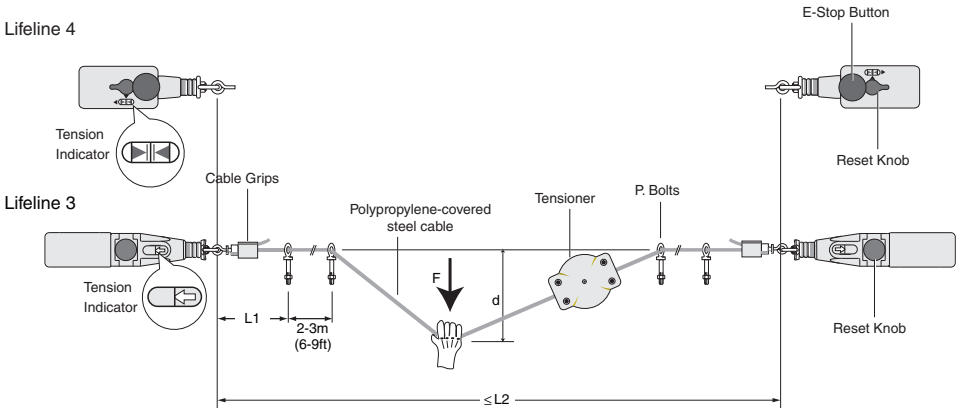
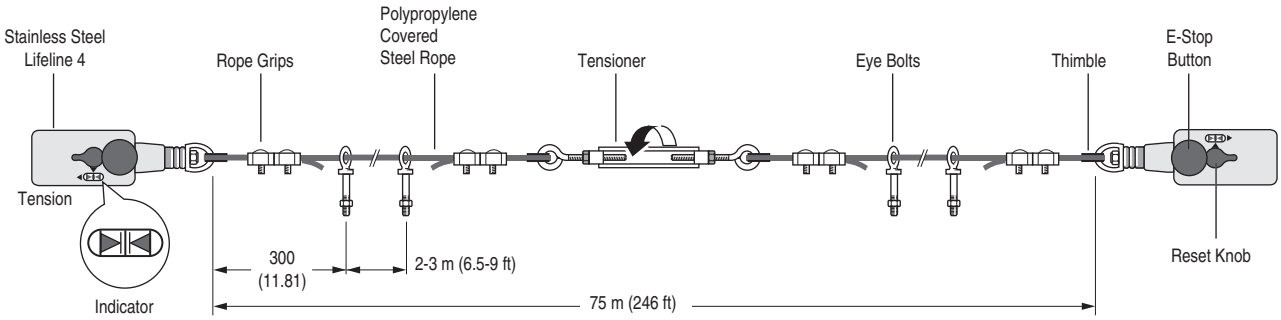
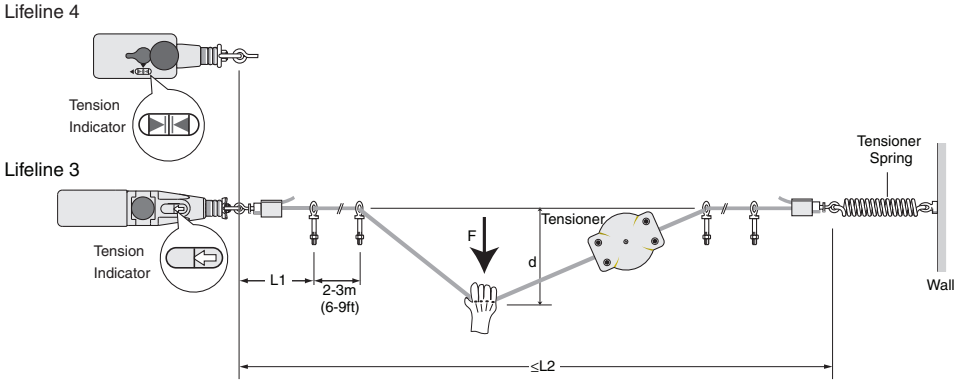
Mounting Specifications for Standard Rope Length Models



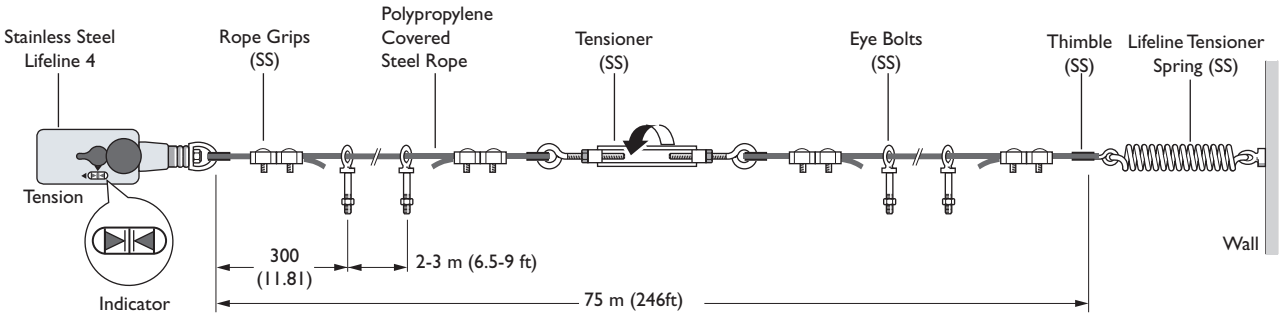
	L1	L2
Lifeline 4	300 mm (11.81 in)	75 m (246 ft)
Lifeline 3	125 mm (5 in)	30 m (98 ft)



Mounting Specifications with Spring Tensioner



	L1	L2
Lifeline 4	300 mm (11.81 in)	75 m (246 ft)
Lifeline 3	125 mm (5 in)	30 m (98 ft)



The choice between using two switches or one switch and a spring is a matter of a risk assessment taking into consideration the probability of a trapped rope along the span. See also notes 3 and 6 on the previous page.

Cable Pull Switches

Lifeline™ Rope Tensioner System (LRTS)

Description

The LRTS is a unique cable (rope) tensioning system which enables quicker installation of cable actuated systems. Other methods are traditionally time consuming and sometimes awkward to fit. Features of the system include:

1. Cable adjustment up to 300 mm (11.8 in) (150 mm (5.9 in) either side of tensioner)
2. Quick thread and grip of cable with cable grip
3. Cable tidy incorporated into the cable grips
4. Simple tensioning via the tensioner with allen key.

Due to the appeal of quick installation and universal use, the LRTS can also be used for applications other than cable actuated emergency stop systems.

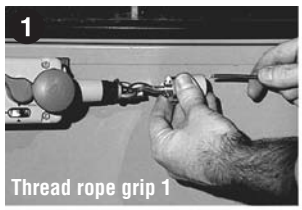
Features

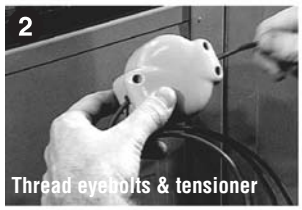
- Unique cable grip system
- Can be installed and commissioned in approximately 3 minutes
- Ease of installation, no specialty tools required
- Up to 300 mm (11.8 in) of cable adjustment
- Cable tidy incorporated into cable grips

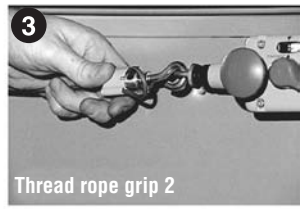
Specifications

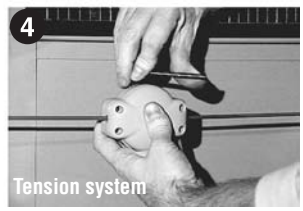
Material	Tensioner: Glass-filled nylon Cable gripper: Acetal, zinc alloy, stainless steel Cable gripper gears: Stainless steel Cable: Cable to BS 302:1987, wire Ø4.0 Steel Core with polypropylene sheath P. Bolt: Stainless steel
Color	Tensioner: Yellow Cable gripper: Yellow/natural Cable: Red P. Bolt: Natural
Weight [g (lb)]	Tensioner: 140 (0.31) Cable gripper: 80 (0.17)
Operating Temperature [C (F)]	-25…80° (-13…176°)
Cable O.D.	4 mm (0.15 in.)
Cable Adjustment Range, Max.	300 mm (11.8 in.)
Tensioner Holding Force, Max.	500 N (112.5 lbf)
Gripper Holding Force, Max.	280 N (63.0 lbf)
Enclosure Type Rating	IP30
Tensioner Adjustment Tool	5 mm A/F Allen key

Four Steps to Install









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Product Selection

Description		No. of P-Bolts	Cat. No.
	Installation Kit—5 m (16.4 ft)	3	**440E-A13079**
	Installation Kit—10 m (32.8 ft)	6	440E-A13080
	Installation Kit—15 m (49.2 ft)	8	**440E-A13081**
	Installation Kit—20 m (65.6 ft)	10	440E-A13082
	Installation Kit—30 m (98.4 ft)	14	440E-A13083
	Installation Kit—50 m (164 ft)	22	440E-A13084
	Installation Kit—75 m (246 ft)	32	440E-A13085

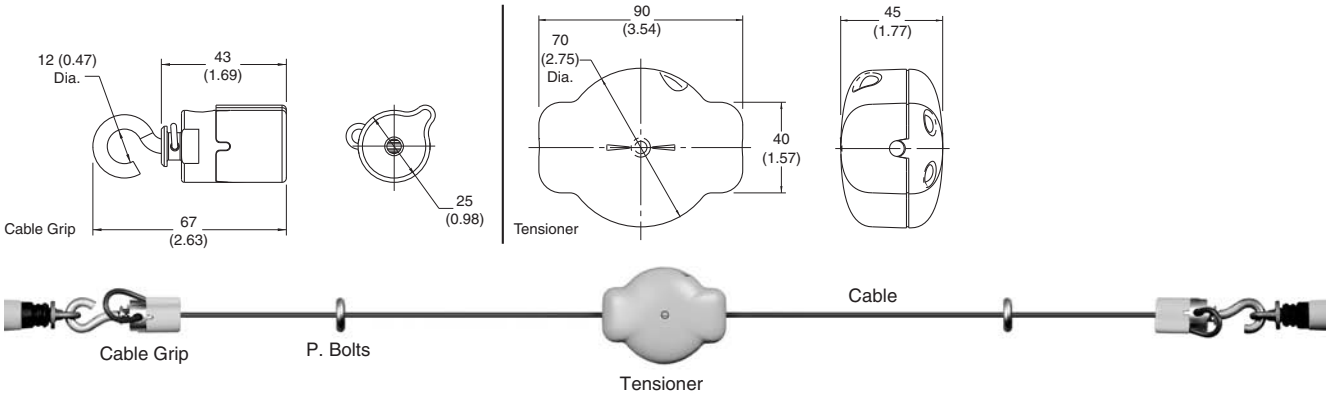
A stainless steel tensioner kit is available for use with the Lifeline 4 Stainless Steel, see page 4-18.

Accessories

Description			Cat. No.
	Lifeline tensioner and Allen key only		**440E-A17105**
	Lifeline gripper two pack		440E-A17107
	Lifeline gripper 20 pack		440E-A17106
	Lifeline tensioner, two grippers and Allen wrench		**440E-A17112**
	Two Lifeline tensioners, two grippers and Allen wrench		440E-A17140
Red Cable	Polypropylene covered steel cable	15 m (49.2 ft)	440E-A17026
		30 m (98.4 ft)	440E-A17027
		100 m (328 ft)	440E-A17028
		125 m (410 ft)	440E-A17129
		300 m (984 ft)	440E-A17095
		500 m (1640 ft)	440E-A17032
	UV resistant polypropylene covered steel cable	100 m (328 ft)	440E-A14739
		300 m (984 ft)	440E-A14740

Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



***Note**: 2D, 3D and electrical drawings are available on www.ab.com.*

Cable Pull Switches

Lifeline™ 3

Description

The Lifeline 3 is a cable (rope) operated emergency stop device designed to meet the stringent requirements of ISO 13850 (Safety of Machinery—Emergency Stop Equipment). The Lifeline 3 system can be installed along or around awkward machinery such as conveyors and provides a constant-access emergency-stop facility.

1. The positive-mode mechanism helps ensure that the contacts are immediately latched open on actuation and can only be reset by the intentional action of turning the blue reset knob. The design also protects against nuisance tripping and the effects of thermal expansion.
2. The cable-status indicator makes the system easy to set up and maintain for spans up to 30 m (98 ft).
3. Four sets of contacts are provided: 2 N.C. + 2 N.O., or 3 N.C. + 1 N.O. contacts.
4. Sealed to IP 67 with rugged construction using die-cast alloy and stainless steel to withstand harsh conditions.

Features

- Switches up to 30 m (98 ft) span
- Universal mounting and operation
- Switch lockout on cable pulled and cable slack
- Cable-status indicator on switch lid
- Industry standard fixing centers to DIN/EN 50041
- Quick disconnect styles available

Specifications

Safety Ratings					
Standards		ISO 13850, EN ISO 12100, IEC 60947-5-1, IEC 60947-5-5			
Safety Classification		Cat. 1 device per EN 954-1 May be suitable for use in Cat 3 or Cat 4 systems depending on the architecture and application characteristics			
Functional Safety Data ✶ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*		B10d: > 2 x 10^6 operations at min. load PFH_D: < 3 x10^{-7} MTTFd: > 385 years May be suitable for use in performance levels Ple or Pld systems (according to ISO 13849-1:2006) and for use in SIL2 or SIL3 systems (according to IEC 62061) depending on the architecture and application characteristics			
Certifications		CE Marked for all applicable directives, cULus, TÜV, and CCC			
Outputs					
Safety Contacts ❄		2 N.C. direct-opening action		3 N.C. direct-opening action	
Auxiliary Contacts		2 N.O. direct-opening action		1 N.O. direct-opening action	
Thermal Current I_{th}		10 A			
Rated Insulation Voltage		(Ui) 500V			
Switching Current @ Voltage, Min.		5 mA @ 5V DC			
Utilization Category					
A600/AC-15	(Ue)	600V	500V	240V	120V
	(Ie)	1.2 A	1.4 A	3 A	6 A
DC-13	(Ue)	24V			
	(Ie)	2 A			
Operating Characteristics					
Cable Span Between Switches, Max.		30 m (98 ft)			
Tensioning Force to Run Position		103 N (23.17 lbf) typical			
Tensioning Force to Lockout		188 N (42.3 lbf) typical			
Operating Force, Min.		<125 N (28.1 lb) at 300 mm deflection			
Actuation Frequency, Max.		1 cycle/s			
Operating Life @ 100 mA load		1 x 10^6			
Environmental					
Enclosure Type Rating		IP67			
Operating Temperature [C (F)]		-25…80° (-13…176°)			
Physical Characteristics					
Housing Material		Heavy-duty painted zinc-based die-cast alloy			
Indicator Material		Glass-filled nylon			
Eye Nut Material		Stainless steel			
Weight [g (lb)]		610 (1.34)			
Color		Yellow body, blue reset button			

✶ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the B10d value given and:
- Usage rate of 1op/10 mins., 24 hrs/day, 360 days/year, representing 51840 operations per year
- Mission time/Proof test interval of 38 years

❄ The safety contacts are described as normally closed (N.C.) i.e., with the guard closed, actuator in place (where relevant) and the machine able to be started.

Note: It is recommended that the LRTS (Lifeline Rope Tensioning System) should be used with the Lifeline 3 cable rope switch.

Product Selection

Contacts		Cat. No.				
		Conduits		Connectors✶		
Safety	Auxiliary	M20	1/2 inch NPT	12-Pin M23	8-Pin Micro (M12)❄	Connect to ArmorBlock Guard I/O 5-Pin Micro (M12)‡
2 N.C.	2 N.O.	**440E-D13118**	**440E-D13120**	440E-D13132	440E-D21BNYH	440E-D2NNNYS
3 N.C.	1 N.O.	**440E-D13112**	440E-D13114	440E-D13124	—	—

✶ For connector ratings, see page 3-9.
❄ With an 8-pin micro (M12) connector, not all contacts are connected. See *Typical Wiring Diagram* on page 4-9 for wiring details.
‡ For connection to ArmorBlock Guard I/O. With a 5-pin micro (M12) connector, not all contacts are connected. See *Typical Wiring Diagram* on page 4-9 for wiring details.

Recommended Logic Interfaces

Description	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. Page No.	Cat. No.
Single-Function Safety Relays for 2 N.C. Contact Switch							
MSR127RP	3 N.O.	1 N.C.	Removable (Screw)	Monitored Manual	24V AC/DC	5-26	**440R-N23135**
MSR127TP	3 N.O.	1 N.C.	Removable (Screw)	Auto./Manual	24V AC/DC	5-26	**440R-N23132**
MSR126T	2 N.O.	None	Fixed	Auto./Manual	24V AC/DC	5-24	**440R-N23117**
MSR30RT	2 N.O. Solid State	1 N.O. Solid State	Removable	Auto./Manual or Monitored Manual	24V DC	5-16	440R-N23198
Modular Safety Relays							
MSR210P Base 2 N.C. only	2 N.O.	1 N.C. and 2 PNP Solid State	Removable	Auto./Manual or Monitored Manual	24V DC from the base unit	5-82	440R-H23176
MSR220P Input Module	—	—	Removable	—	24V DC	5-86	440R-H23178
MSR310P Base	MSR300 Series Output Modules	3 PNP Solid State	Removable	Auto./Manual Monitored Manual	24V DC	5-102	440R-W23219
MSR320P Input Module	—	2 PNP Solid State	Removable	—	24V DC from the base unit	5-106	440R-W23218

Note: For additional Safety Relays connectivity, see the Safety Relays section (page 5-8) of this catalog.
For additional Safety I/O and Safety PLC connectivity, see the Programmable Safety System section (page 5-115) of this catalog.
For application and wiring diagrams, see the Safety Applications section (page 10-1) of this catalog.

Connection Systems

Description	5-Pin Micro (M12)⌘	8-Pin Micro (M12)	12-Pin M23
Cordset	—	889D-F8AB-§	889M-FX9AE-§
Patchcord	889D-F5ACDM-♣	889D-F8ABDM-♣	889M-F12AHMU-➢

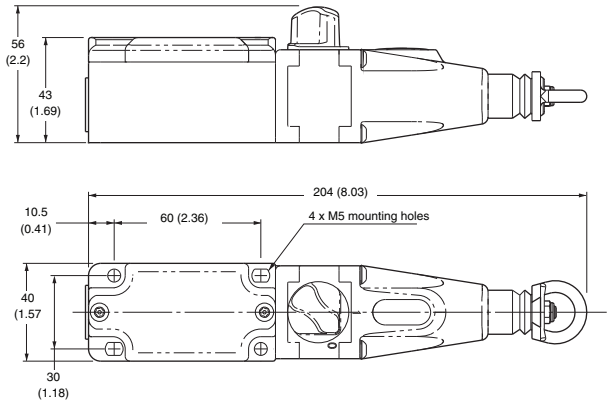
§ Replace symbol with 2 (2 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
♣ Replace symbol with 1 (1 m), 2 (2 m), 3 (3 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
➢ Replace symbol with 0M3 (0.3 m), 0M6 (0.6 m), 1 (1 m), 2 (2 m) or 3 (3 m) for standard lengths.
⌘ To connect to ArmorBlock Guard I/O.

Accessories

Description		Cat. No.
	Lifeline P. bolt M8 x 1.25 thread size, 58 mm (2.28 in.) threaded length, 12 mm (0.47 in.) dia. eye, 95 mm (3.74 in.) overall length	**440E-A17003**
	Lifeline tensioner spring 19 mm (0.75 in.) diameter, 210 mm (8.27 in.) overall length, 50 N force	**440E-A13078**
	Lifeline inside corner pulley Internal diameter 16 mm (0.64 in.) zinc-plated mild steel	**440A-A17101**
	Lifeline outside corner pulley Outside diameter 38 mm (1.5 in.) zinc-plated mild steel	440A-A17102
	Blanking plug, M20 conduit	440A-A07265
	Cable grip, M20 conduit, accommodates cable diameter 7…10.5 mm (0.27…0.41 in.)	440A-A09028
	Adaptor, conduit, M20 to 1/2 inch NPT, plastic	440A-A09042
	Screwdriver including security bit	440A-A09018

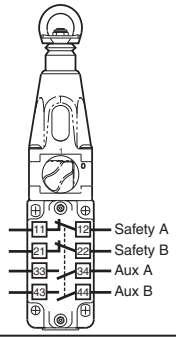
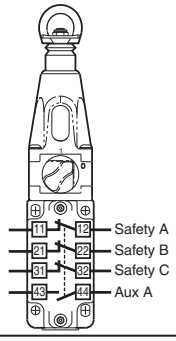
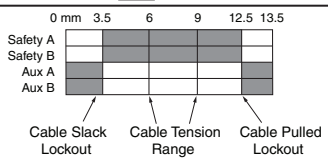
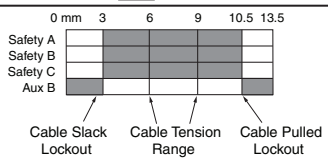
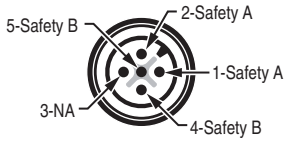
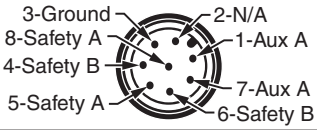
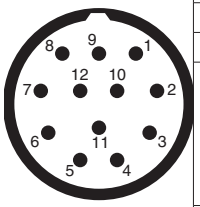
Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



***Note**: 2D, 3D and electrical drawings are available on www.ab.com.*

Typical Wiring Diagrams

Description		2 N.C. & 2 N.O.	3 N.C. & 1 N.O.
Contact Configuration			
Contact Action □Open ■Closed			
5-Pin Micro (M12) for ArmorBlock Guard I/O			—
8-Pin Micro (M12)			—
12-Pin M23  Pins 2, 5, 11 not connected	1-3	Safety A	Safety A
	4-6	Safety B	Safety B
	7-8	Aux A	Safety C
	9-10	Aux B	Aux A
	12	Ground	Ground
8-Pin Cordset 889D-F8AB-∗	Grey Red	Safety A	
	Yellow Pink	Safety B	
	White Blue	Aux A	
	Green	Ground	
	Brown	Not Used	
12-Pin Cordset 889M-FX9AE-❄	Brown Blue	Safety A	Safety A
	White Green	Safety B	Safety B
	Yellow Grey	Aux A	Safety C
	Pink Red	Aux B	Aux A
	Green Yellow	Ground	Ground

∗ Replace symbol with 2 (2 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
❄ Replace symbol with 0F5 (0.5 ft) or 1F (1 ft) for standard cable lengths.

Cable Pull Switches

Lifeline™ 4

Description

The Lifeline 4 cable/push button operated system can be installed along or around awkward machinery such as conveyors and provide a constant emergency stop access.

The Lifeline 4 is the only device of its kind to incorporate the following features in one unit making it the most versatile cable switch on the market.

1. The positive mode mechanism helps ensure that the contacts are immediately latched open on actuation and can only be reset by the intentional action of turning the blue reset knob. The design also protects against nuisance tripping and the effects of thermal expansion.
2. A mushroom head emergency stop button is included on the unit to provide E-Stop access even at the extreme ends of the span.
3. The cable status indicator makes the system easy to set up and maintain for spans up to 125 meters.
4. Four sets of contacts are provided: 2 N.C. + 2 N.O. or 3 N.O. + 1 N.O. contacts
5. Sealed to IP66 with rugged construction using die-cast alloy and stainless steel to withstand harsh conditions.

Features

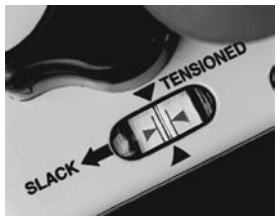
- Switches up to 125 meter span
- Universal mounting and operation
- Lid mounted emergency stop button, designed to conform to ISO 850
- Switch lockout on cable pulled and cable slack
- Cable status indicator on switch lid

Lid mounted E-Stop button

A mushroom head emergency stop button is included on the unit to provide total E-Stop access even at the extreme ends of the span.

Cable status indicator on lid

The cable status indicator makes the system easy to setup and maintain for spans up to 125 meters.



Specifications

Safety Ratings					
Standards		ISO 13850, EN ISO 12100, IEC 60947-5-1, IEC 60947-5-5			
Safety Classification		Cat. 1 device per EN 954-1 May be suitable for use in Cat 3 or Cat 4 systems depending on the architecture and application characteristics			
Functional Safety Data ✶ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*		B10d: > 2 x 10^6 operations at min. load PFH_D: < 3 x10^{-7} MTTFd: > 385 years May be suitable for use in performance levels Ple or Pld systems (according to ISO 13849-1:2006) and for use in SIL2 or SIL3 systems (according to IEC 62061) depending on the architecture and application characteristics			
Certifications		CE Marked for all applicable directives, cULus, TÜV, and CCC			
Outputs					
Safety Contacts ❄		2 N.C. direct-opening action		3 N.C. direct-opening action	
Auxiliary Contacts		2 N.O. direct-opening action		1 N.O. direct-opening action	
Thermal Current I_{th}		10 A			
Rated Insulation Voltage		(Ui) 500V			
Switching Current @ Voltage, Min.		5 mA @ 5V DC			
Utilization Category					
A600/AC-15	(Ue)	600V	500V	240V	120V
	(Ie)	1.2 A	1.4 A	3 A	6 A
DC-13	(Ue)	24V			
	(Ie)	2 A			
Operating Characteristics					
Cable Span Between Switches, Max.		75 m (246 ft) standard model and 75…125 m (146…410 ft) extended length model			
Tensioning Force to Run Position		103 N (23.16 lbf) typical			
Tensioning Force to Lockout		188 N (42.3 lbf) typical			
Operating Force, Min.		<125 N (28.1 lbf) at 300 mm deflection			
Actuation Frequency, Max.		1 cycle/s			
Operating Life @ 100 mA load		1 x 10^6			
Environmental					
Enclosure Type Rating		IP66			
Operating Temperature [C (F)]		-25…80° (-13…176°)			
Physical Characteristics					
Housing Material		Heavy-duty painted zinc-based die-cast alloy (LM24)			
Indicator Material		Glass-filled nylon			
Eye Nut Material		Stainless steel			
Weight [g (lb)]		630 (1.38)			
Color		Yellow body, blue reset button			

✶ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the B10d value given and:
- Usage rate of 1op/10 mins., 24 hrs/day, 360 days/year, representing 51840 operations per year
- Mission time/Proof test interval of 38 years

❄ The safety contacts are described as normally closed (N.C.) i.e., with the guard closed, actuator in place (where relevant) and the machine able to be started.

Note: It is recommended that the LRTS (Lifeline Rope Tensioning System) should be used with the Lifeline 4 cable rope switch.

Product Selection

Cable Span	Safety Contacts	Auxiliary Contacts	Cat. No.				
			Conduits		Connectors✶		
			M20	1/2 inch NPT	12-Pin M23	8-Pin Micro❄	Connect to ArmorBlock Guard I/O 5-Pin Micro (M12)‡
75 m (246 ft)	2 N.C.	2 N.O.	**440E-L13137**	**440E-L13133**	440E-L13140	440E-L21BNYH	440E-L2NNNYS
	3 N.C.	1 N.O.	**440E-L13042**	**440E-L13043**	440E-L13141	—	—
75…125 m (146…410 ft)	2 N.C.	2 N.O.	440E-L13153	440E-L13155	440E-L13163	440E-L21BTYH	—
	3 N.C.	1 N.O.	440E-L13150	440E-L13152	440E-L13164	—	—

✶ For connector ratings, see page 3-9.
❄ For connection to ArmorBlock Guard I/O. With a 5-pin micro (M12) connector, not all contacts are connected. See page 4-15 for wiring details.
‡ With an 8-pin micro (M12) connector, not all contacts are connected. See page 4-15 for wiring details.

Recommended Logic Interfaces

Description	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. Page No.	Cat. No.
Single-Function Safety Relays for 2 N.C. Contact Switch							
MSR127RP	3 N.O.	1 N.C.	Removable (Screw)	Monitored Manual	24V AC/DC	5-26	**440R-N23135**
MSR127TP	3 N.O.	1 N.C.	Removable (Screw)	Auto./Manual	24V AC/DC	5-26	**440R-N23132**
MSR126T	2 N.O.	None	Fixed	Auto./Manual	24V AC/DC	5-24	**440R-N23117**
MSR30RT	2 N.O. Solid State	1 N.O. Solid State	Removable	Auto./Manual or Monitored Manual	24V DC	5-16	440R-N23198
Modular Safety Relays							
MSR210P Base 2 N.C. only	2 N.O.	1 N.C. and 2 PNP Solid State	Removable	Auto./Manual or Monitored Manual	24V DC from the base unit	5-82	440R-H23176
MSR220P Input Module	—	—	Removable	—	24V DC	5-86	440R-H23178
MSR310P Base	MSR300 Series Output Modules	3 PNP Solid State	Removable	Auto./Manual Monitored Manual	24V DC	5-102	440R-W23219
MSR320P Input Module	—	2 PNP Solid State	Removable	—	24V DC from the base unit	5-106	440R-W23218

Note: For additional Safety Relays connectivity, see page 5-4.
For additional Safety I/O and Safety PLC connectivity, see page 5-116.
For application and wiring diagrams, see page 10-1.

Connection Systems

Description	5-Pin Micro (M12)	8-Pin Micro (M12)	12-Pin M23
Cordset	—	889D-F8AB-§	889M-FX9AE-§
Patchcord	889D-F5ACDM-✶	889D-F8ABDM-♣	889M-F12AHMU-➢

✶ Replace symbol with 0M3 (0.3 m), 1 (1 m), 2 (2 m), 3 (3 m), 5 (5 m), or 10 (10 m) for standard lengths.
§ Replace symbol with 2 (2 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
♣ Replace symbol with 1 (1 m), 2 (2 m), 3 (3 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
➢ Replace symbol with 0M3 (0.3 m), 0M6 (0.6 m), 1 (1 m), 2 (2 m) or 3 (3 m) for standard length.

Accessories

Description		Cat. No.
	Lifeline P. bolt	**440E-A17003**
	Lifeline tensioner spring	**440E-A13078**
	Replacement cover for Lifeline 4 cable/push button	440E-A13054
	Replacement cover for Lifeline 4 cable/push button, no E-Stop	440E-A17115
	Lifeline inside corner pulley	**440A-A17101**
	Lifeline outside corner pulley	440A-A17102
	Mounting bracket for Lifeline 4 cable/push button	440E-A17130
	Blanking plug, M20 conduit	440A-A07265
	Cable grip, M20 conduit, accommodates cable diameter 7…10.5 mm (0.27…0.41 in.)	440A-A09028
	Adaptor, conduit, M20 to 1/2 inch NPT, plastic	440A-A09042
	Screwdriver including security bit	440A-A09018

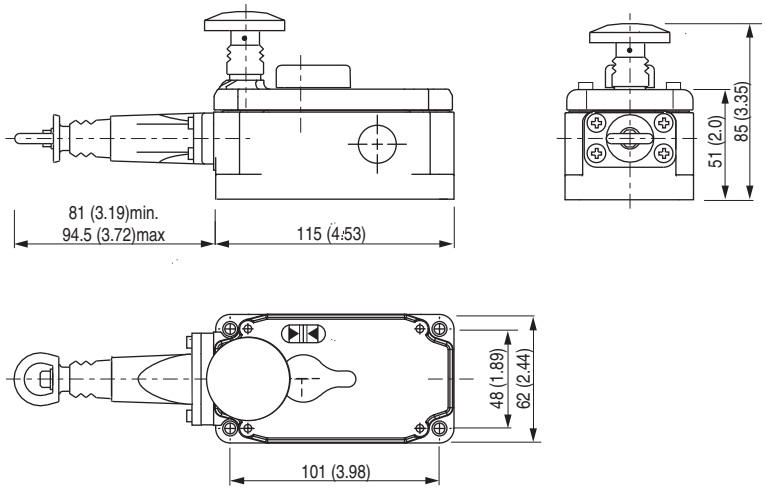
Accessories (continued)

	Description	Cat. No.
	Indicator, M20 Conduit Pilot Light—Amber Lens T-3 1/4 Insert Use T-3 1/4 Bulb (Sold Separately)	440A-A19001
	Indicator, 1/2in NPT Conduit Pilot Light—Amber Lens T-3 1/4 Insert Use T-3 1/4 Bulb (Sold Separately)	440A-A19005
	Indicator, M20 Conduit Pilot Light—Amber Lens Bayonet Style Insert Use LED Bulb (Sold Separately)	440A-A17124
	Indicator, 1/2in NPT Conduit Pilot Light—Amber Lens Bayonet Style Insert Use LED Bulb (Sold Separately)	440A-A17122
	Indicator, M20 Conduit Pilot Light—Red Lens T-3 1/4 Insert Use T-3 1/4 Bulb (Sold Separately)	440A-A19002
	Indicator, 1/2in NPT Conduit Pilot Light—Red Lens T-3 1/4 Insert Use T-3 1/4 Bulb (Sold Separately)	440A-A19007
	Indicator, M20 Conduit Pilot Light—Red Lens Bayonet Style Insert Use LED Bulb (Sold Separately)	440A-A17125
	Indicator, 1/2in NPT Conduit Pilot Light—Red Lens Bayonet Style Insert Use LED Bulb (Sold Separately)	440A-A17123
	Bulb, 24V for Conduit Pilot Light 2.8W T-3 1/4 Bulb, Miniature Screw Base	440A-A09056
	Bulb, 110V for Conduit Pilot Light 2.6W T-3 1/4 Bulb, Miniature Screw Base	440A-A09055
	Bulb, 240V for Conduit Pilot Light 0.75W T-3 1/4 Bulb, Miniature Screw Base	440A-A09054
	Red LED Bulb, 24V AC/DC for Conduit Pilot Light Bayonet Style Insert	800T-N319R
	Amber LED Bulb, 24V AC/DC for Conduit Pilot Light Bayonet Style Insert	800T-N319A
	Red LED Bulb, 120V AC for Conduit Pilot Light Bayonet Style Insert	800T-N320R
	Amber LED Bulb, 120V AC for Conduit Pilot Light Bayonet Style Insert	800T-N320A

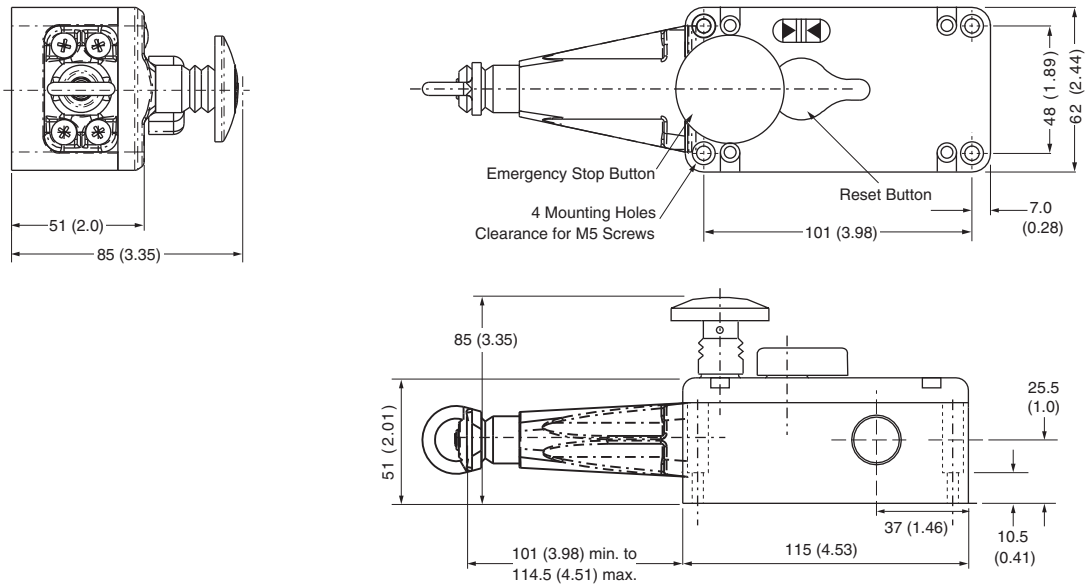
Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.

Standard Model

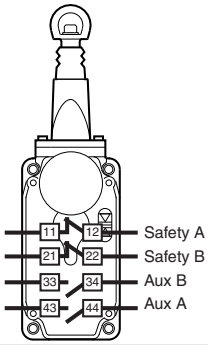
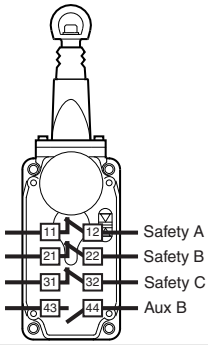
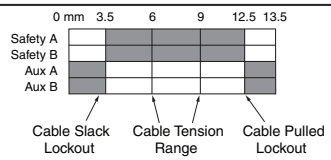
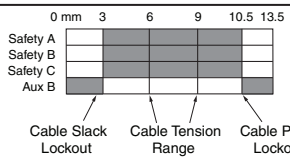
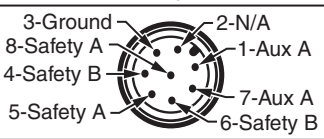
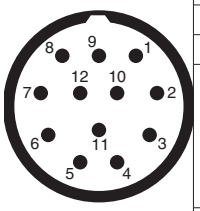
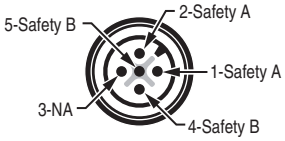


Extended Length Models (75…125 m cable span)



Note: 2D, 3D and electrical drawings are available on www.ab.com.

Typical Wiring Diagrams

Description		2 N.C. & 2 N.O.	3 N.C. & 1 N.O.
Contact Configuration			
Contact Action □Open ■Closed			
8-Pin Micro (M12)			—
12-Pin M23  Pins 2, 5, 11 not connected	1-3	Safety A	Safety A
	4-6	Safety B	Safety B
	7-8	Aux A	Safety C
	9-10	Aux B	Aux A
	12	Ground	Ground
5-Pin Micro for ArmorBlock Guard I/O			—
8-Pin Cordset 889D-F8AB-∗	Grey Red	Safety A	—
	Yellow Pink	Safety B	—
	White Blue	Aux A	—
	Green	Ground	—
	Brown	Not Used	
12-Pin Cordset 889M-FX9AE-∗	Brown Blue	Safety A	Safety A
	White Green	Safety B	Safety B
	Yellow Grey	Aux A	Safety C
	Pink Red	Aux B	Aux A
	Green Yellow	Ground	Ground

∗ Replace symbol with 2 (2 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
❄ Replace symbol with 0F5 (0.5 ft) or 1F (1 ft) for standard cable lengths.

Cable Pull Switches

Lifeline™ 4 Stainless Steel

Description

The stainless steel Lifeline 4 cable/push button operated system can be installed along or around awkward machinery such as conveyors and provide a constant emergency stop access. This switch is made from stainless steel 316 and is suitable for external use, applications where there are hygiene requirements and other situations where a level of corrosion resistance is required.

The Lifeline 4 is the only device of its kind to incorporate the following features in one unit making it the most versatile cable switch on the market.

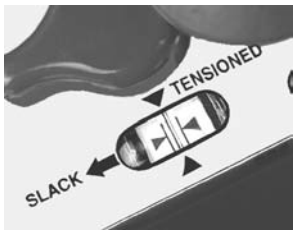
1. The positive mode mechanism helps ensure that the contacts are immediately latched open on actuation and can only be reset by the intentional action of turning the blue reset knob. The design also protects against nuisance tripping and the effects of thermal expansion.
2. A mushroom head emergency stop button is included on the unit to provide E-Stop access even at the extreme ends of the span.
3. The cable status indicator makes the system easy to set up and maintain for spans up to 75 meters.
4. Four sets of contacts are provided: 2 N.C. + 2 N.O.
5. Sealed to IP66 and IP69K with rugged construction using stainless steel 316 to withstand harsh conditions.

Features

- Switches up to 75 m (246 ft) span
- Universal mounting and operation
- Lid mounted emergency stop button, designed to conform to ISO 850
- Switch lockout on cable pulled and cable slack
- Cable status indicator on switch lid
- Made from stainless steel 316

Lid mounted E-Stop button
A mushroom head emergency stop button is included on the unit to provide total E-Stop access even at the extreme ends of the span.

Cable status indicator on lid
The cable status indicator makes the system easy to setup and maintain for spans up to 75 m (246 ft).



Specifications

Safety Ratings					
Standards		EN 60947-5-5, ISO 13850, EN ISO 12100, IEC 60947-5-1			
Safety Classification		Cat. 1 device per EN 954-1 May be suitable for use in Cat 3 or Cat 4 systems depending on the architecture and application characteristics			
Functional Safety Data ✶ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*		B10d: > 2 x 10^6 operations at min. load PFH_D: < 3 x10^{-7} MTTFd: > 385 years May be suitable for use in performance levels Ple or Pld systems (according to ISO 13849-1:2006) and for use in SIL2 or SIL3 systems (according to IEC 62061) depending on the architecture and application characteristics			
Certifications		CE Marked for all applicable directives, cULus Certified and TÜV			
Outputs					
Safety Contacts ❄		2 N.C. direct opening action			
Auxiliary Contacts		2 N.O.			
Thermal Current I_{th}		10 A			
Rated Insulation Voltage		(Ui) 500V			
Switching Current @ Voltage, Min.		5 mA @ 5V DC			
Utilization Category					
A600/AC-15	(Ue)	600V	500V	240V	120V
	(Ie)	1.2 A	1.4 A	3 A	6 A
DC-13	(Ue)	24V			
	(Ie)	2 A			
Operating Characteristics					
Cable Span Between Switches, Max.		75 m (246 ft)			
Tensioning Force to Run Position		103 N (23.17 lbf) typical			
Tensioning Force to Lockout		188 N (42.3 lbf) typical			
Operating Force, Min.		<125 N (28.1 lbf) at 300 mm deflection			
Actuation Frequency, Max.		1 cycle/s			
Operating Life @ 100 mA load		1 x 10^6			
Environmental					
Enclosure Type Rating		IP66, IP67, IP69K			
Operating Temperature [C (F)]		-25…80° (-13…176°)			
Physical Characteristics					
Housing Material		Stainless steel 316			
Indicator Material		Acetal			
Eye Nut Material		Stainless steel			
Weight [g (lb)]		1442 (3.17)			
Color		Unpainted metal			

✶ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the B10d value given and:
- Usage rate of 1op/10 mins., 24 hrs/day, 360 days/year, representing 51840 operations per year
- Mission time/Proof test interval of 38 years

❄ The safety contacts are described as normally closed (N.C.) i.e., with the guard closed, actuator in place (where relevant) and the machine able to be started.

Note: It is recommended that the stainless steel installation kit should be used with the stainless steel Lifeline 4 as it is made of suitable materials for harsh conditions.

Product Selection

Cable Span	Safety Contacts	Auxiliary Contacts	Cat. No.		
			Conduits		Connectors§
			M20	1/2 inch NPT	12-Pin M23
Up to 75 m (246 ft)	2 N.C.	2 N.O.	**440E-L22BNSM**	**440E-L22BNST**	440E-L22BNSL

§ For connector ratings, see 3-9.

Recommended Logic Interfaces

Description	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. Page No.	Cat. No.
Single-Function Safety Relays for 2 N.C. Contact Switch							
MSR127RP	3 N.O.	1 N.C.	Removable (Screw)	Monitored Manual	24V AC/DC	5-26	**440R-N23135**
MSR127TP	3 N.O.	1 N.C.	Removable (Screw)	Auto./Manual	24V AC/DC	5-26	**440R-N23132**
MSR126T	2 N.O.	None	Fixed	Auto./Manual	24V AC/DC	5-24	**440R-N23117**
MSR30RT	2 N.O. Solid State	1 N.O. Solid State	Removable	Auto./Manual or Monitored Manual	24V DC	5-16	440R-N23198
Modular Safety Relays							
MSR210P Base 2 N.C. only	2 N.O.	1 N.C. and 2 PNP Solid State	Removable	Auto./Manual or Monitored Manual	24V DC from the base unit	5-82	440R-H23176
MSR220P Input Module	—	—	Removable	—	24V DC	5-86	440R-H23178
MSR310P Base	MSR300 Series Output Modules	3 PNP Solid State	Removable	Auto./Manual Monitored Manual	24V DC	5-102	440R-W23219
MSR320P Input Module	—	2 PNP Solid State	Removable	—	24V DC from the base unit	5-106	440R-W23218

Note: For additional Safety Relays connectivity, see page 5-4.
For additional Safety I/O and Safety PLC connectivity, see page 5-116.
For application and wiring diagrams, see page 10-1.

Connection Systems

Description	12-Pin M23
Cordset	889M-FX9AE-✶
Patchcord	889M-F12AHMU-❄

✶ Replace symbol with 2 (2 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
❄ Replace symbol with 0M3 (0.3 m), 0M6 (0.6 m), 1 (1 m), 2 (2 m) or 3 (3 m) for standard length.

Cable Pull Switches

Lifeline™ 4 Stainless Steel

Accessories

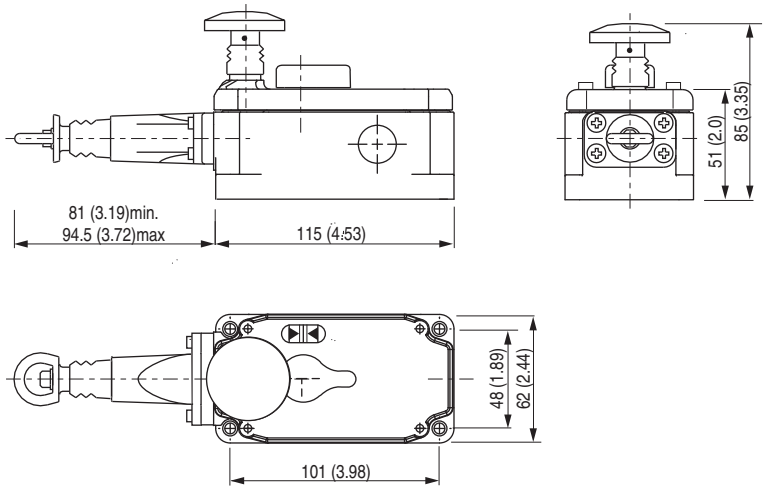
	Description	Eye Bolts	Cat. No.
	Stainless steel installation kit—5 m (16.4 ft)—polypropylene	4	440E-A13194
	Stainless steel installation kit—10 m (32.8 ft)—polypropylene	4	440E-A13195
	Stainless steel installation kit—15 m (49.2 ft)—polypropylene	7	440E-A13196
	Stainless steel installation kit—20 m (65.6 ft)—polypropylene	8	440E-A13197
	Stainless steel installation kit—30 m (98.4 ft)—polypropylene	12	440E-A13198
	Stainless steel installation kit—50 m (164 ft)—polypropylene	20	440E-A13199
Polypropylene Covered Steel Cable	Stainless steel installation kit—75 m (246 ft)—polypropylene	30	440E-A13200
	Stainless steel installation kit—5 m (16.4 ft)—UV resistant	4	440E-A13220
	Stainless steel installation kit—10 m (32.8 ft)—UV resistant	4	440E-A13221
	Stainless steel installation kit—15 m (49.2 ft)—UV resistant	7	440E-A13222
	Stainless steel installation kit—20 m (65.6 ft)—UV resistant	8	440E-A13223
	Stainless steel installation kit—30 m (98.4 ft)—UV resistant	12	440E-A13224
	Stainless steel installation kit—50 m (164 ft)—UV resistant	20	440E-A13225
UV Resistant Polypropylene-Covered Steel Cable	Stainless steel installation kit—75 m (246 ft)—UV resistant	30	440E-A13226
	Stainless steel turn buckle kit (no cable)		440E-A13227
	Stainless steel 304 eyebolt complete M8 x 1.25 thread size, 58 mm (2.28 in) threaded length, 12 mm (0.47 in) dia. eye 95 mm (3.74 in) overall length		**440E-A13201**
	Stainless steel 316 tensioner spring, 19 mm (0.75 in) dia. 210 mm (8.27 in) overall length		**440E-A13202**
	Replacement Cover		440E-A13203
	Replacement cover no E-Stop		440E-A13204
	Stainless steel 316 inside corner pulley		440E-A13205
	Stainless steel outside corner pulley		440E-A13206

Note: Installation Kits include the following parts: one rope, one turnbuckle tensioner, four thimbles, eight rope grips and eyebolts, nuts and washers depending on the length of the rope.

Approximate Dimensions

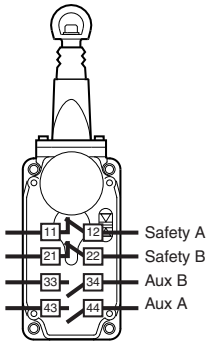
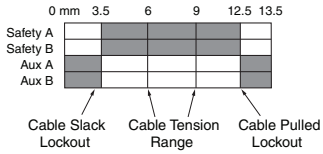
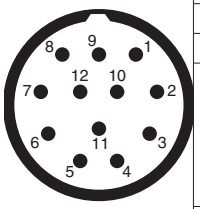
Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.

Standard Model



Note: 2D, 3D and electrical drawings are available on www.ab.com.

Typical Wiring Diagrams

Description		2 N.C. & 2 N.O.
Contact Configuration		
Contact Action □Open ■Closed		
12-Pin M23  Pins 2, 5, 11 not connected	1-3	Safety A
	4-6	Safety B
	7-8	Aux A
	9-10	Aux B
	12	Ground
12-Pin Cordset 889M-FX9AE-∗	Brown Blue	Safety A
	White Green	Safety B
	Yellow Grey	Aux A
	Pink Red	Aux B
	Green Yellow	Ground

∗ Replace symbol with 0F5 (0.5 ft) or 1F (1 ft) for standard cable lengths.

Enabling Switches

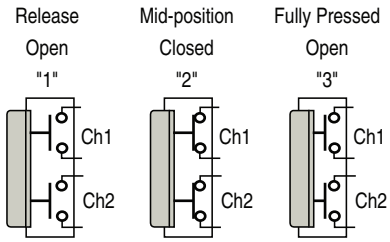
Overview

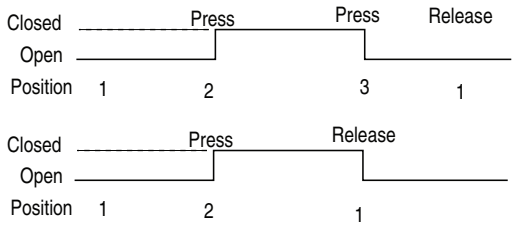
Overview

An enabling device is a manually operated control device used in conjunction with a start control. The safety function of the enabling switch has two parts: 1) when continuously actuated, the enabling device allows machine operation, and 2) when not actuated, the enabling device initiates a stop command to prevent machine operation.

Historically, many enabling devices used a two-position switch. In the event of an unexpected incident, the two-position switch is designed to open when the muscles relax. The three-position switch provides enhanced performance as it is designed to open when the muscles either relax or contract. The trend in machine safeguarding is towards the use of three-position switches. Various types of devices use the three-position switch as enabling devices. These are typically push buttons, grip switches and foot switches.

The Allen-Bradley Guardmaster 440J is a hand-operated grip style enabling device. Underneath the rubber boot, called the trigger switch, the 440J enabling device has two three-position switches. The contacts are closed when the actuator is in the mid-position (partly depressed). The contacts are open when the actuator is in the rest (released) position and in the fully pressed position. When transitioning from fully pressed to released, the contacts remain open. The 440J meets the requirements of IEC 60947-5-8:2006, which was written to describe the performance and design requirements of three-position enabling devices.





Enabling devices are typically used when access to the hazardous portion of the machine is needed while the machine is running. Visual observations, minor adjustments, troubleshooting, calibration, tool changes, and lubrication are examples of tasks that may utilize an enabling device. Before accessing the machine, the operator must usually place the machine in a reduced performance role. A risk assessment must be performed to determine the level of reduced performance. The concept is that in the event of an unexpected event, the operator will either release or squeeze the actuator of the enabling device and disable the machine, prior to getting injured.

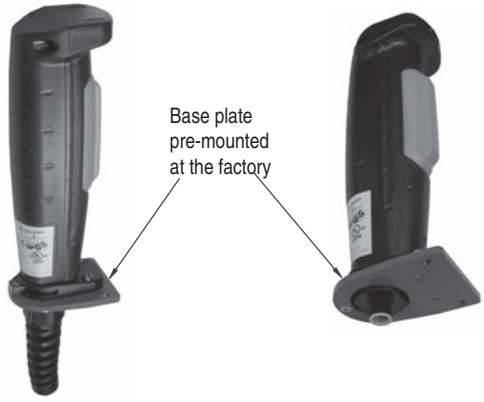
The 440J enabling switches come in three models: 1) standard switch with no additional buttons, 2) switch with an additional single normally open contact, and 3) switch with an additional dual channel e-stop button.

The model with the normally open contact is typically used as a jog or reset function. The safety system design must only allow the use of the jog or reset function when the trigger switch is in the mid-position.

The e-stop button has two normally closed contacts with direct opening action. The e-stop button latches when the contacts open per IEC 60947-5-5 and ISO 13850. When this model is selected with the quick disconnect option, the user must store the enabling switch in an out-of-sight location if it is disconnected.

Mounting Considerations

All three 440J enabling switches come with a base plate. All three models are offered with either a cable strain-relief or an M12 micro quick-disconnect connector.



Cable Strain Relief M12 Micro Quick Disconnect

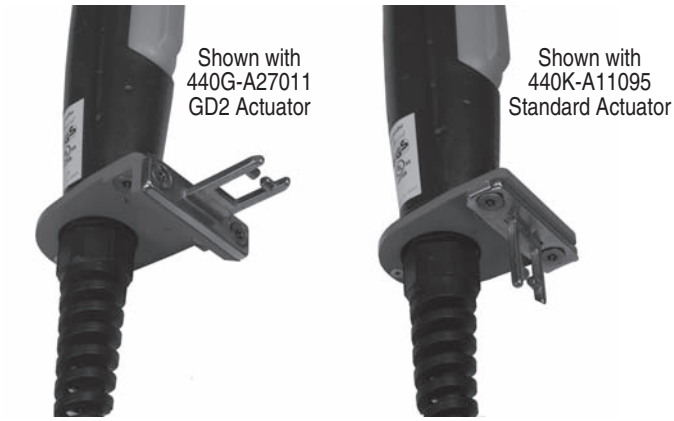
In some applications, the operation of the switch contacts is all that is needed. In this case, the holding bracket 440J-A00N is used.

440J-A00N

Additional accessory brackets can be added to achieve various arrangements. Cat. No. 440J-A01N right angle bracket is designed to accommodate Cat. No. 440K-A11238 (standard actuator) which is used with the standard Trojan 6 or Trojan T15 and Cat. No. 440G-A27011 (GD2 actuator) which is used with the GD2 interlocks.

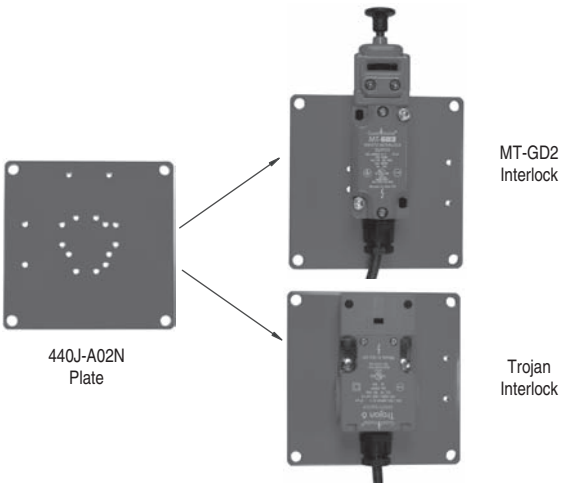
440J-A01N
Bracket
Shown with
GD2 Actuator

With two additional screws, the right angle bracket can be mounted to the 440J enabling switch for horizontal mounting. An actuator can also be mounted for vertical use without the 440J-A01N bracket.



Horizontal Mounting Vertical Mounting

The mounting plate (Cat. No. 440J-A02N) has multiple pre-drilled and tapped holes to facilitate mounting of a single 440K-MT (MT-GD2) or 440K-T (Trojan) interlock. Four additional through-holes at the corners allow mounting of the plate to a flat surface.



The MT-GD2 with the manual latch release should be used for horizontal actuator mounting. The Trojan should only be used with vertical mounting. To use the 440K-T (Trojan 6 or T15), the head must be rotated 180°. The Trojan GD2 models cannot be used with the 440J-A02N as its head cannot be rotated.

The recommended method for single-switch mounting is to use the 440K-MT (MT-GD2) with the latch release. The latch holds the contacts closed when the enabling switch is bumped or rattled. An alternative is to use the 440K-T (Trojan 6 or T15) with a vertical mounting. The holding force of these interlocks is enough to keep the contacts closed under minor bumps and rattles.

Horizontal Mount
with MT-GD2

Vertical Mount
with Trojan

In some applications, additional contacts are needed when the enabling switch is used. Two additional accessories are used to allow the enabling switch to interact with two interlocks.

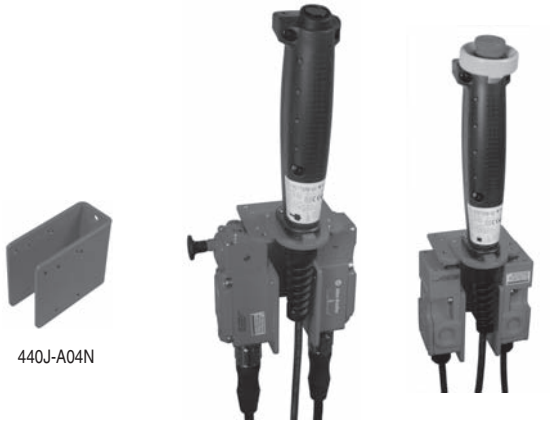
Cat. No. 440J-A03N accessory mounts to the enabling switch base plate. This accessory has two sets of holes to accommodate either two standard or two GD2 actuators. This arrangement is used in conjunction with Cat. No. 440K-A04N accessory.

440J-A03N

Enabling Switch mounted on
440J-A03N, shown with
two standard actuators

The U-shaped 440J-A04N can accommodate two interlocks: either 440K-MT or 440K-T. Using the 440J-A03N plate with dual actuators, a total of eight contacts, four in each switch, can be made available for the safety and control system.

Application Considerations



Dual Interlock Switches
Provide Eight Contacts

Safety system designers will quickly realize that the enabling device by itself is easy to understand; it is simply a set of contacts. The application of the enabling device into a machine safeguarding system is the challenge.

Consideration must be given to the following:

1. Setting the machine in reduced performance mode.

In some cases, the speed or other characteristic of the machine must be reduced to allow the operator to avoid the hazard by releasing or squeezing the trigger switch. The control system must be designed so that the machine is not changed back to normal performance during the enabling task. A key-operated mode selector switch is one method of setting the machine in a reduced performance mode. The operator selects reduced mode and then removes the key from the switch, taking the key with him or her. Holding the trigger switch then allows the hazard to operate in a reduced mode.

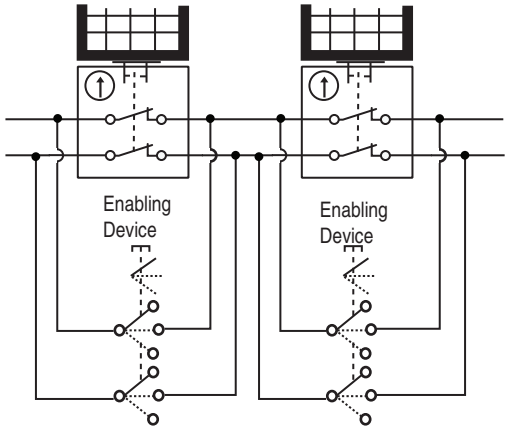
2. Knowing the machine is in reduced performance mode

Sensors can be used to determine that reduced performance of the machine is maintained. Position sensors, encoders or other devices, monitored by an appropriated logic device, provide feedback to the control system. If the performance (e.g., operating speed) were to increase beyond a predetermined limit, the control system would execute a stop command. Releasing the enabling device could also be used to execute a stop command.

3. Type of access

The safety system architecture will differ depending on whether partial body or full body access is required.

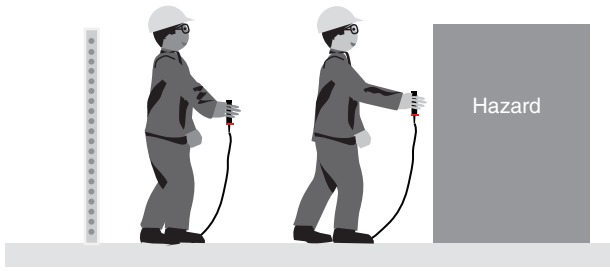
When partial body access is required, the enabling device must continuously bypass the primary safeguard (e.g. gate interlock, light curtain, safety mat, or safety scanner). Enabling devices must only bypass one primary safeguard—bypassing multiple safeguards with one enabling device must be avoided as access to the hazard may not be detected by the other bypassed safeguards.



If full body access is required, consideration must be given to whether the primary safeguard can or must be active during the operation of the enabling device. With the primary safeguard active, additional entries into the hazard area will be detected. If the primary safeguard must remain inactive, administrative procedures must ensure that additional personnel do not enter the hazard area.

4. Multiple Personnel Access

When more than one person must access the hazard, all persons must utilize their own enabling device. All enabling devices must be active to energize the hazard.



The table below summarizes when additional interlocking devices must be used in conjunction with the enabling device. For partial body access, three cases exist, depending on the type of device being bypassed and the logic unit used by the safety system.

1. The enabling switch can be connected directly across the safeguarding device that has dry contacts.
2. Devices with OSSD outputs, like the GuardShield Light curtain will need a single interlock with four contacts to avoid nuisance faults when a monitoring safety relay is used as the safety system logic device.
3. When a safety PLC is used as the logic device, the enabling device can be connected to separate inputs and internal programming logic can be used to bypass the light curtain when the enabling switch is needed.

For full body access, there are two cases, which depend on the logic device used by the safety system.

1. When a safety PLC is used, a single interlock with four contacts is needed. These four contacts are used to interlock the safety system reset function and the machine start function.
2. When a monitoring safety relay is used, two interlocks with four contacts each are needed. Four contacts are used to bypass the primary safeguarding device. Two contacts are used to reset the safety system. Two contacts are used to interlock the machine start control to prevent starting of the machine from the control panel.

Access Type	Safeguard Type	Logic Device	Interlocks Required
Partial Body	Dry Contact Interlocks (e.g., Elf, Cadet, Trojan, MT-GD2, Sipha, Ferrogard, 440G-MT, TLS-GD2, Atlas)	Monitoring Safety Relay or Safety PLC	None
	Devices with OSSD Outputs (e.g., GuardShield Light Curtain, SensaGuard, SafeZone Multizone)	Safety PLC	
		Monitoring Safety Relay	Single Interlock with Four Contacts
Full Body	All Types	Safety PLC	Single Interlock with Four Contacts
		Monitoring Safety Relay	Dual Interlocks, each with Four Contacts

Enabling Switches

GripSwitch

Description

The three position enabling switch can be used as part of the conditions required to allow safe working inside a machine guard, e.g., set-up, maintenance, or troubleshooting. It is lightweight and ergonomically designed for easy use. The standard model includes two independent three-position switches which are actuated by squeezing the trigger. Additional models are available with an optional jog button or dual channel e-stop button.

The trigger switch has three positions. The mid-position is the "enabled" position.

Position 1—there is no pressure on the trigger switch, and the safety contacts are open.

Position 2—the trigger switch is squeezed to the mid-position, and the safety contacts are closed. This mid-position is the "enabled" position.

Position 3—the trigger switch is fully pressed and the safety contacts are open.

When the trigger switch is released from position three back to position one, the safety contacts remain open, as it passes through position two.

Features

- Dual three position enabling switches
- Lightweight and ergonomic
- Optional jog and e-stop functions

Specifications

Safety Ratings				
Standards		IEC/EN60947-5-8, IEC/EN 60947-5-1, IEC/EN 60204-1, NFPA 79, ANSI B11.19, ANSIR15.06, ISO 10218, ISO 11161		
Safety Classification		Cat. 1 Device per EN954-1; Dual channel suitable for Cat. 3 or 4 systems		
Certifications		CE Marked for all applicable directives, cULus Listed, BG		
Outputs				
Safety Contacts ❄		2 N.C. direct opening action		
Auxiliary Contacts		1 N.C.		
Jog Contact		1 N.O.		
E-Stop		2 N.C. Direct-Opening Action		
Thermal Current I_{th}		3 A		
Rated Insulation Voltage		(Ui) 250V (jog button 125V)		
Switching Current @ Voltage, Min.		5 mA @ 3V AC/DC		
Utilization Category		30V DC	125V AC	250V AC
3-Position Switch Terminals 1-2 and 3-4	DC-12 or AC-12 Resistive	2 A	3 A	0.5 A
	DC-13 or AC-15 Inductive	1 A	1.5 A	0.5 A
Monitor Switch Terminals 5-6	DC-12 or AC-12 Resistive	2 A	2 A	1 A
	DC-13 or AC-15 Inductive	1 A	1 A	0.5 A
E-Stop Switch Terminals 5-6 and 7-8	DC-12 or AC-12 Resistive			
	DC-13 or AC-15 Inductive			0.5 A
Operating Characteristics				
Operating Force, Min.		Position 2: 15 N (3.37 lbf) approx. Position 3: 50 N (11.2 lbf) max.		
Direct Opening Force		90 N (20 lbf)		
Actuation Frequency, Max.		1200 operations per hour		
Environmental				
Enclosure Type Rating		IP66 Standard Switch (NEMA 6) IP65 Jog Button and E-Stop Switches		
Relative Humidity		45…85%		
Operating Temperature [C (F)]		-10…+60° (14…140°)		
Vibration		5…55 Hz, 0.5 mm		
Shock		10 g		
Physical Characteristics				
Wire Size		0.14…1.5 mm^2 (24…14 AWG)		
Cable Size		7…13 mm (0.27… 0.51 in.)		
Terminal Screw Torque		0.5…0.6 N•m (4.4…5.3 ibf•in)		
Conduit Type		M20		
Material		Polyamide (Nylon) PA66		
Boot Material		NBR/PVC Nitrile Blended with PVC		
Weight [g (lb)]		250 (0.55) with E-stop 210 (0.46) standard and jog		
Color		Black/grey		

❄ The safety contacts are described as normally closed (N.C.) i.e., with the guard closed, actuator in place (where relevant) and the machine able to be started.

Product Selection

Description	Cat. No. M20 Conduit with Cable Strain Relief
Standard Switch (No additional buttons)	440J-N21TNPM
Switch with Jog Button	440J-N21TNPM-NP
Switch with Emergency Stop Button	440J-N2NTNPM-NE

Note: Base plate included with all switches.

Recommended Logic Interfaces

Description	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. Page No.	Cat. No.
Single-Function Safety Relays for 2 N.C. Contact Switch							
MSR127RP	3 N.O.	1 N.C.	Removable (Screw)	Monitored Manual	24V AC/DC	5-26	**440R-N23135**
MSR127TP	3 N.O.	1 N.C.	Removable (Screw)	Auto./Manual	24V AC/DC	5-26	**440R-N23132**
Modular Safety Relays							
MSR210P Base 2 N.C. only	2 N.O.	1 N.C. and 2 PNP Solid State	Removable	Auto./Manual or Monitored Manual	24V DC from the base unit	5-82	440R-H23176
MSR220P Input Module	—	—	Removable	—	24V DC	5-86	440R-H23178
MSR310P Base	MSR300 Series Output Modules	3 PNP Solid State	Removable	Auto./Manual Monitored Manual	24V DC	5-102	440R-W23219
MSR320P Input Module	—	2 PNP Solid State	Removable	—	24V DC from the base unit	5-106	440R-W23218

Note: For additional Safety Relays connectivity, see page 5-4.
For additional Safety I/O and Safety PLC connectivity, see page 5-116.
For application and wiring diagrams, see page 10-1.

Connection Systems

Description	Cat. No. 4-Pin Micro (M12) Quick Disconnect	5-Pin Micro (M12) Quick Disconnect‡	8-Pin Micro (M12) Quick Disconnect
Cordset	889D-F4AC-♣	889D-F5AC-♣	889D-F8AB-♣
Patchcord	889D-F4ACDM-§	889D-F5ACDM-§	889D-F8ABDM-§

♣ Replace symbol with 2 (2 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
§ Replace symbol with 1 (1 m), 2 (2 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
‡ To connect to ArmorBlock Guard I/O.

Accessories

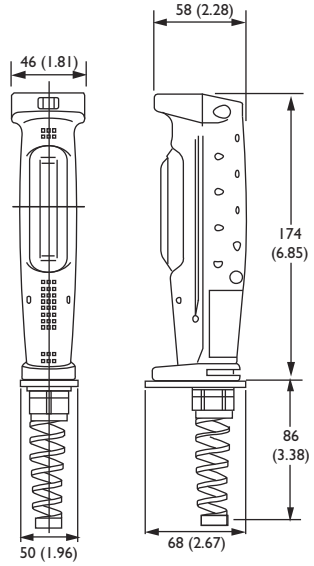
	Description	Cat. No.
	Mounting bracket suitable for single enabling switch∗	440J-A00N
	Mounting bracket suitable for one actuator mounted onto switch∗ Includes four flat head screws and one resistorx bit.	440J-A01N
	Mounting bracket suitable for single enabling switch and single safety switch∗	440J-A02N
	Mounting bracket suitable for two actuators mounted onto switch∗ Includes six flat head screws and one resistorx bit.	440J-A03N
	Mounting bracket suitable for single enabling switch and two safety switches∗	440J-A04N
	NBR/PVC (silicone free) rubber boot kit	440J-A10N

∗ The bracket has predrilled holes suitable for mounting either the MT-GD2, Trojan 5, or Trojan 6. Please note that the enabling switch, safety switch, and actuator are not supplied with the mounting bracket and are available separately.

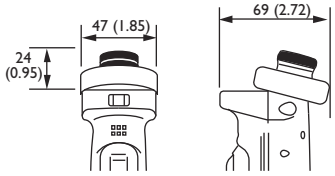
Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.

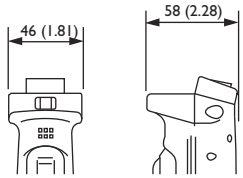
Standard Switch

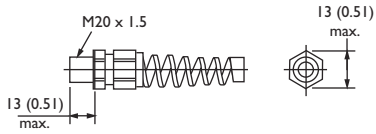


Emergency Stop Button

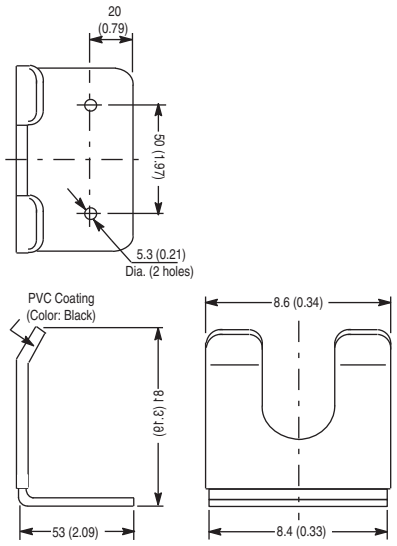


Jog Button

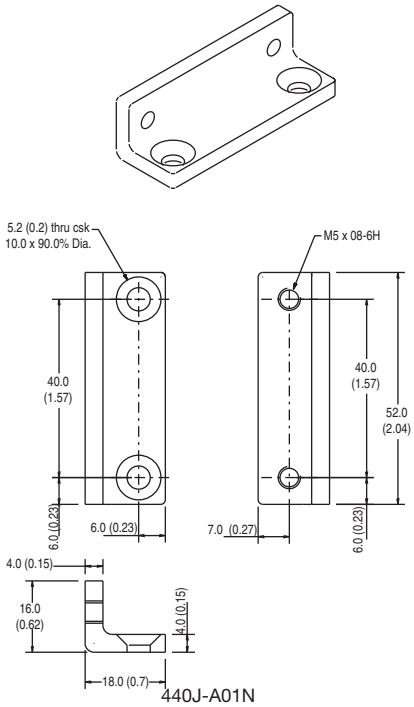




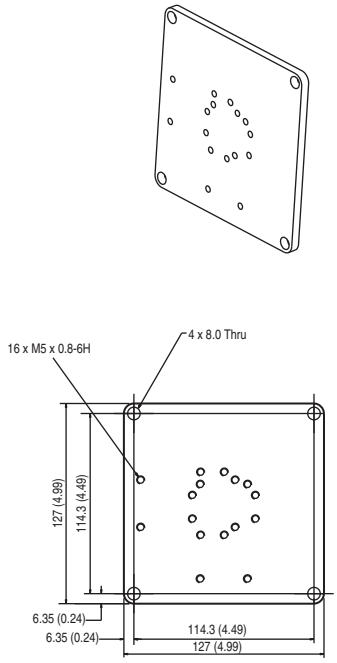
A range of brackets are available to allow the enabling switch to be mounted alone, or with one or two safety switches. A small bracket has already been fitted to the enabling switch onto which the actuator bracket is mounted. An Application Note on the use of the enabling switch in conjunction with a safety switch is available.



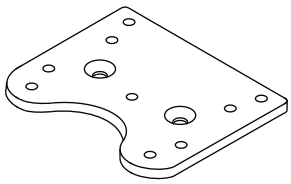
440J-A00N
Enabling Switch Mounting Bracket

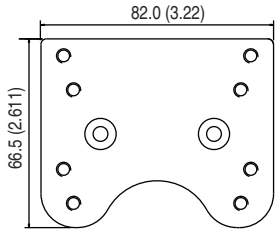


440J-A01N
Single Actuator Bracket

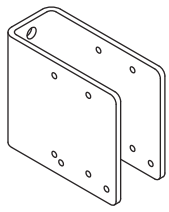


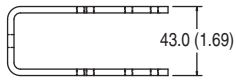
440J-A02N
Single Safety Switch Plate

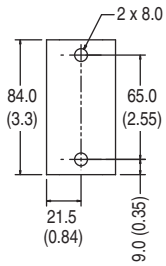


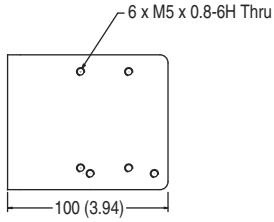


440J-A03N
Double Actuator Plate



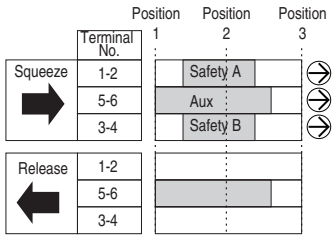
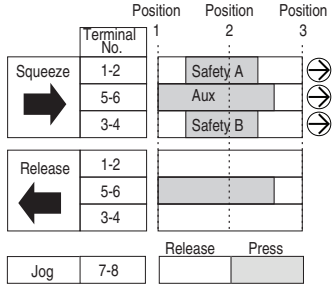
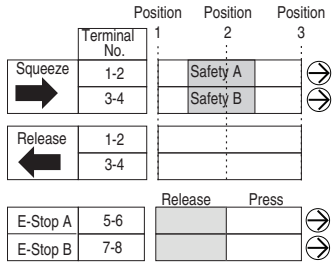
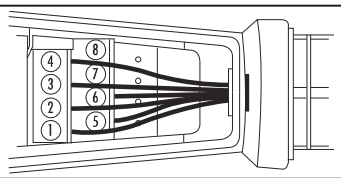
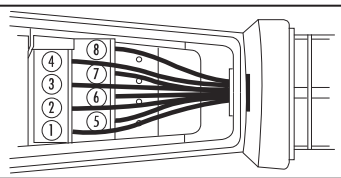
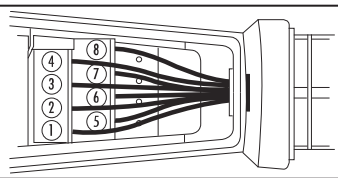
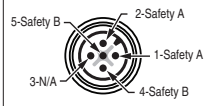
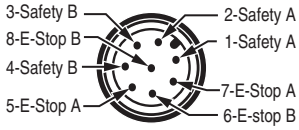






440J-A04N
Double Safety Switch Bracket

Typical Wiring Diagram

	Standard		With Jog Button		With E-Stop Button	
Contact Operation						
Cable Termination						
Quick Disconnect Termination						
Mating Cordsets	889D-F4AC-*		889D-F5AC-*		889D-F8AB-*	
	1 Brown 2 White	Safety A	1 Brown 2 White	Safety A	1 White 2 Brown	Safety A
	—		3 Blue	NA	3 Green 4 Yellow	Safety B
	3 Blue 4 Black	Safety B	4 Black 5 Grey	Safety B	5 Grey 6 Pink	Aux
					7 Blue 8 Red	Jog

889D-F8AB-*	
1 White 2 Brown	Safety A
3 Green 4 Yellow	Safety B
5 Grey 6 Pink	E-Stop A
7 Blue 8 Red	E-Stop B

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Allen-Bradley
Guardmaster®

Specifications — 22.5 mm*

Front-of-Panel (Operators)

Description		Plastic (Bulletin 800FP)	Metal (Bulletin 800FM)
Mechanical Ratings			
Vibration (assembled to panel)		Tested at 10…2000 Hz, 1.52 mm displacement (peak-to-peak) max./10 G max. for 3 hr duration, no damage	
Shock		Tested at 1/2 cycle sine wave for 11 ms; no damage at 100 G	
Degree of protection❄		IP65/66 (Type 3/3R/4/4X/12/13)	IP65/66 (Type 3/3R/4/12/13)
Mechanical durability per EN 60947-5-1 (Annex C)	10 000 000 Cycles	Momentary push buttons, momentary mushroom	
	1 000 000 Cycles	Multi-function, selector switch, key selector switch, selector jog, SensEject™ key selector switch	
	500 000 Cycles	Non-illuminated push-pull E-stop	
	300 000 Cycles	Twist-to-release E-stop, illuminated push-pull E-stop, alternate action push buttons	
	100 000 Cycles	Potentiometer, toggle switch	
Operating forces (typical with one contact block)		Flush/extended = 5 N, E-stop = 36 N Mushroom = 9 N	
Operating torque (typical application with one contact block)		Selector switch = 0.25 N•m (2.2 lb•in)	
Mounting torque	Plastic	1.7 N•m (15 lb•in)	
	Metal	4.4 N•m (40 lb•in)	
Environmental			
Temperature range (operating)		–25…+70 °C (-13…158 °F)‡	
Temperature range (short term storage)		–40…+85 °C (-40…185 °F)	
Humidity		50…95% RH from 25…60 °C (77…140 °F)	

* Performance Data — see page Important-3 of the Industrial Controls catalog.
❄ Momentary mushroom operators are IP65. Plastic keyed operators are IP66, Type 4/13; not Type 4X.
‡ Operating temperatures below 0 °C (32 °F) are based on the absence of freezing moisture and liquids, UL Recognized to 55 °C (131 °F) - Incandescent module Max 40 °C (104 °F).

Product Certifications

Certifications	UR/UL, CSA, CCC, CE
Standards Compliance — CE Marked	NEMA ICS-5; UL 508, EN ISO 13850, EN 60947-1, EN 60947-5-1, EN 60947-5-5
Terminal Identification	EN/IEC 60947-1
Shipping Approvals	ABS
RoHS	✓

Back-of-Panel Components

Electrical Ratings				
Standard contact block ratings		A600, Q600 600V AC AC 15, DC 13 to IEC/EN 60947-5-1 and UL 508, 17V, 5 mA min.		
Low voltage contact block ratings❄		5V, 1 mA DC min. C300, R150, AC 15, DC 13 to EN 60947-5-1 and UL 508		
	Nominal Voltage	**Range**	**Current Draw**	**Frequency**
LED Module Ratings	24V AC 24V DC 120V AC 240V AC	10…29V AC 10…30V DC 70…132V AC 180…264V AC	31 mA 24 mA 25 mA 22 mA	50/60 Hz DC 50/60 Hz 50/60 Hz
Thermal current		10 A max. enclosed (40 °C ambient) to UL508, EN 60947-5-1		
Insulation voltage (Ui)		Screw terminal = 690V, spring-clamp = 300V		
Wire capacity (screw terminal)‡		#18…12 AWG (0.75…2.5 mm²) Max. (2) #14 AWG or (1) #12 AWG		
Wire capacity (spring-clamp terminal)		#18…14 AWG (0.75…1.5 mm²) One per spring clamp, two spring clamps per terminal		
Recommended tightening torque on screw terminals		0.7…0.9 N•m (6…8 lb•in)		
Dielectric strength (minimum)		2500V for one minute		
External short circuit protection	Standard blocks	10 A type gL/gG cartridge fuse to EN 60269-2-1 or gN (Class J to UL 248-8 or Class C to UL 248-4)		
	Low voltage contact blocks	6 A type gL/gG cartridge fuse to EN 60269-2-1 or gN (Class J to UL 248-8 or Class C to UL 248-4)		
Electrical shock protection		Finger-safe conforming to IP2X		
Mechanical Ratings				
Vibration (assembled to panel)		Tested at 10…2000 Hz, 1.52 mm displacement (peak-to-peak) max./10 G max. 6 hr		
Shock		Tested at 1/2 cycle sine wave for 11 ms and no damage at 100 G max.		
Contact durability per EN 60947-5-1 (Annex C)		10 000 000 cycles		
Contact operation	N.O.	Slow double make and break		
	N.C.	Slow double make and break — positive opening		
	N.O.E.M.	Double break / double make, early make		
	N.C.L.B.	Double break / double make, late break — positive opening		
	N.C.E.B.	Double break / double make, early break — positive opening		
Push button travel to change electrical state		N.C. and N.O.E.M.	1.5 mm (0.060 in.)	
		N.O. and N.C.L.B.	2.5 mm (0.1 in.)	
Operating forces (typical)	Single circuit contact block	3.4 N		
	Dual circuit contact block	5…6.5 N		
Illumination				
LED Dominant Wavelength	Green Red Yellow Blue White	525 nm 629 nm 590 nm 470 nm —		
LED Luminous Intensity	Green Red Yellow Blue White	780 mcd 780 mcd 600 mcd 168 mcd 360 mcd		
Incandescent maximum wattage		2.6 W		
Materials				
Springs		Stainless steel and zinc coated music wire		
Electrical contacts	Standard	Silver-nickel		
	Low voltage	Gold-plated over silver		
Terminals	Screw	Brass		
	Spring-clamp	Silver-plated brass		

✶ Performance Data — see page Important-3 of the Industrial Controls catalog.
❄ Low voltage contacts are recommended for applications below 17V, 5 mA.
‡ Wires less than #18 AWG (0.75 mm²) may not hold in terminal securely.

Material Listing

Component	For Use with	Material Used
Panel gasket	All operators	Nitrile, TPE
Diaphragm seal	Illuminated push button, non-illuminated push button	Automotive industry acceptable silicone
K-seal	Selector switch, key selector switch, push/twist-to-release E-stop, key E-stop, push/pull mushroom	Nitrile
Diaphragm retainer, return spring I	Illuminated push button, non-illuminated push button, momentary mushroom	Stainless steel
Return spring II	Reset, selector switch, key selector switch, alternate action, push/twist-to-release E-stop, key E-stop, push/pull mushroom	Zinc-coated music wire
Button cap/mushroom head	Non-illuminated push button, momentary mushroom, reset, push/twist-to-release E-stop, key E-stop, push/pull mushroom, multi-function	PBT/polycarbonate blend
2-color molded button cap	Non-illuminated push button	PBT/polycarbonate blend
Lens	Multi-function	Acetal
Lens, knob	Illuminated push button, illuminated momentary mushroom, illuminated selector switch	Polyamide
Knob	Non-illuminated selector switch	Glass-filled polyamide
Plastic bezel/bushing I	Non-illuminated push button, illuminated push button, momentary mushroom, selector switch, key selector switch, push/twist-to-release E-stop, key E-stop, push/pull mushroom, multi-function, reset	Glass-filled polyamide
Plastic bezel/bushing II, jam nut	Pilot light, reset jam nut, reset pushers	Glass-filled PBT
Metal bezel/bushing	All metal operators	Zinc
Diffuser	Illuminated push button, pilot light	Polycarbonate
Legend frames	—	Glass-filled polyamide
Plastic mounting ring	All plastic operators	Glass-filled polyamide
Metal mounting ring	All metal operators	Chromated zinc
Plastic latch	—	Glass-filled polyamide
Metal latch	—	Chromated zinc + stainless steel
Plastic enclosure	—	PBT/polycarbonate blend
Metal enclosure	—	Aluminum
Terminal screws	LED module, incandescent module, contact blocks	Zinc-plated steel with chromate
Terminals	LED module, incandescent module, contact blocks	Brass with silver-nickel contacts
Spring clamps	LED module, incandescent module, contact blocks	Stainless steel
Lamp socket	Incandescent module	Brass
Housing	Incandescent module, LED module	Glass-filled polyamide
Low-voltage terminals	Contact blocks	Gold-plated silver-nickel contacts
Low-voltage spanner	Contact blocks	Gold-plated silver-nickel contacts
Spanner	Contact blocks	Brass with silver-nickel contacts
Boot	Toggle Switch, illuminated push button, non-illuminated push button, multi-function illuminated and non-illuminated	Automotive industry acceptable silicone

Emergency Stop Operators*

Non-Illuminated Twist-to-Release, Push-Pull

60 mm Non-Illuminated Twist-to-Release
Cat. No. 800FP-MT64

40 mm Non-Illuminated Push-Pull
Cat. No. 800FP-MP44

Color	Size	Pkg. Quantity	Twist-to-Release (Trigger Action)		Push-Pull (Trigger Action)	
			Plastic	Metal	Plastic	Metal
			Cat. No.	Cat. No.	Cat. No.	Cat. No.
Red	30	1	800FP-MT34	800FM-MT34	–	–
	40		800FP-MT44	800FM-MT44	800FP-MP44	800FM-MP44
	60		800FP-MT64	800FM-MT64	–	–

Illuminated — Twist-to-Release, Push-Pull‡

40 mm Illuminated Twist-to-Release
Cat. No. 800FP-LMT44

40 mm Mushroom Push/Pull
Cat. No. 800FM-LMP44

Color	Size	Pkg. Quantity	Twist-to-Release (Trigger Action)		Push-Pull (Trigger Action)	
			Plastic	Metal	Plastic	Metal
			Cat. No.	Cat. No.	Cat. No.	Cat. No.
Red	30	1	–	–	800FP-LMP34	800FM-LMP34
	40		800FP-LMT44	800FM-LMT44	800FP-LMP44	800FM-LMP44
	60		800FP-LMT64	800FM-LMT64	800FP-LMP64	800FM-LMP64

‡ LED module required for illumination, can not use incandescent module.

Key Release Mushroom Operator

40 mm Non-Illuminated Key Release
Cat. No. 800FP-MK44

Color	Size	Pkg. Quantity	Ronis Key Lock (Trigger Action)❄	
			Plastic	Metal
			Cat. No.	Cat. No.
Red	40 mm	1	800FP-MK44	800FM-MK44

* All emergency stop operators are EN ISO 13850 compliant with standard NC, NCLB, or self-monitoring contact blocks.
❄ For key options, see the Industrial Controls catalog.

2-Position Push-Pull Operators, Non-Illuminated — Twist-to-Release (Trigger Action), Push-Pull (Trigger Action)∗

40 mm Trigger Action Twist-to-Release Mushroom
Cat. No. 800FP-MT44

40 mm Trigger Action Push-Pull Mushroom
Cat. No. 800FP-MP44

90 mm Half-Dome
Cat. No. 800FP-MP94

Color	Pkg. Quantity	40 mm Mushroom (Trigger Action) Twist-to-Release		40 mm Mushroom (Trigger Action) Push-Pull	
		Plastic	Metal	Plastic	Metal
		Cat. No.	Cat. No.	Cat. No.	Cat. No.
Red	1	800FP-MT44	800FM-MT44	800FP-MP44	800FM-MP44

800F P – MT4 4
a b c d

a

Operator Construction	
Code	Description
P	Round plastic operator (IP66, Type 4/4X/13)
M	Round metal operator (IP66, Type 4/13)

b

Operator Type	
Push, Twist-to-Release➢	
Code	Type
MT3	30 mm color cap
MT4	40 mm color cap
MT6	60 mm color cap
Push-Pull	
Code	Type
MP4	40 mm color cap
Half-Dome Push-Pull	
Code	Type
MP9	90 mm color cap❄

c

Color Cap	
Code	Color
2	Black
3	Green
4	Red
5	Yellow
6	Blue

d‡§♣

Engraving	
Code	Description
Blank	No engraving on cap
LE	EMO laser engraved
E	EMO printed

∗ All emergency stop operators are EN ISO 13850 compliant with standard NC, NCLB, or self-monitoring contact blocks.
➢ Only available with red color cap.
‡ For EMO guards, see page 4-45.
§ Only available on 40 mm color cap.
♣ Only available on red, 40 mm push, twist-to-release operator type (MT44).
❄ Half-dome operators only available with black, red, and yellow color caps.

2-Position Push-Pull Operators, Illuminated — Twist-to-Release (Trigger Action), Push-Pull (Trigger Action)∗❄

40 mm Mushroom Trigger Action Twist-to-Release
Cat. No. 800FP-LMT44

40 mm Mushroom Push/Pull
Cat. No. 800FM-LMP44

90 mm Half-Dome
Cat. No. 800FP-LMP94

Color	Pkg. Quantity	40 mm Mushroom (Trigger Action) Twist-to-Release		40 mm Mushroom (Trigger Action) Push-Pull	
		Plastic	Metal	Plastic	Metal
		Cat. No.	Cat. No.	Cat. No.	Cat. No.
Red	1	800FP-LMT44	800FM-LMT44	800FP-LMP44	800FM-LMP44

800F **P** **–** **LMP4** **3**
a ***b*** ***c***

a

Operator Construction	
Code	Description
P	Round plastic operator (IP66, Type 4/4X/13)
M	Round metal operator (IP66, Type 4/13)

b

Operator Type	
Push, Twist-to-Release‡§	
Code	Type
LMT4	40 mm color cap
LMT6	60 mm color cap
Push-Pull	
Code	Type
LMP3	30 mm color cap
LMP4	40 mm color cap
LMP6	60 mm color cap
Half-Dome Push-Pull	
Code	Type
LMP9	90 mm color cap⌘

c

Lens Cap Color	
Code	Color
3	Green
4	Red
5	Yellow➢
6	Blue♣

∗ LED module required for illumination, can not use incandescent module.
❄ All emergency stop operators are EN ISO 13850 compliant with standard NC, NCLB, or self-monitoring contact blocks.
‡ Only available with red color cap.
§ 60 mm version has black arrows; 30 and 40 mm versions have white arrows.
➢ When using LED for illumination, a white LED is recommended.
♣ Only available with 40 mm Push-Pull color cap (**LMP4** from Table b).
⌘ Half-dome operators only available with red and yellow lens cap colors.

2-Position Non-Illuminated Operators — Mushroom, Key Release (Trigger Action)∗

40 mm Key Release Mushroom
Cat. No. 800FP-MK44

Color	Pkg. Quantity	2-Position (Trigger Action) 40 mm Mushroom Key Release	
		Plastic	Metal
		Cat. No.	Cat. No.
Red	1	800FP-MK44	800FM-MK44

Note: For Ronis replacement keys, see the Industrial Controls catalog. Key release mushroom operators use key no. 3825.

800F **P** – **MK4** **4** ____
a *b* *c* *d*

a

Operator Construction	
Code	Description
P	Round plastic operator (IP66, Type 4/13)
M	Round metal operator (IP66, Type 4/13)

b

Operator Type	
Key Release Mushroom	
Code	Type
MK4	40 mm

c

Lens Cap Color	
Code	Color
4	Red

d

Ronis Key Lock❄‡§	
Code	Key No.
Blank	3825 (Standard)
R	455
01R	3801
02R	3802
03R	3803
04R	3804
05R	3805
06R	3806
27R	4001
28R	4002
29R	4003
30R	4004
31R	4005
32R	4006
33R	4007

∗ All emergency stop operators are EN ISO 13850 compliant with standard NC, NCLB, or self-monitoring contact blocks.
❄ Keyed operators are IP66, Type 4/13.
‡ Not intended for high security applications. Interoperability is possible with certain key/cylinder lock combinations. Consult your local Rockwell Automation sales office or Allen-Bradley distributor for interoperability information.
§ For Ronis replacement keys, see the Industrial Controls catalog.

3-Position Push-Pull Operators, Illuminated & Non-Illuminated — Mushroom♣

Illuminated 3-Position Push-Pull
Cat. No. 800FM-LMP44E3

Target Table and Operator Position✶			
Contact Type✦	Out	Center	In
N.O.	O	O	X
N.C.E.B.	X	O	O
N.C.L.B.	X	X	O

Note: X = Closed/O = Open

✦ Contact selection is limited to the following options, consult your local Rockwell Automation sales office or Allen-Bradley distributor for other options.

Operator Function	Operator Type	Color	Pkg. Quantity	Cat. No.
Momentary Out, Maintained Center, Momentary In	Non-Illuminated	Black§	1	800FM-MM42E3
		Green		800FM-MM43E3
		Red		800FM-MM44E3
	Illuminated❄	Amber‡		800FM-LMM40E3
		Green		800FM-LMM43E3
		Red		800FM-LMM44E3
		Blue‡		800FM-LMM46E3
		Clear‡		800FM-LMM47E3
Momentary Out, Maintained Center, Maintained In	Non-Illuminated	Black§	1	800FM-MP42E3
		Green		800FM-MP43E3
		Red		800FM-MP44E3
	Illuminated❄	Amber‡		800FM-LMP40E3
		Green		800FM-LMP43E3
		Red		800FM-LMP44E3
		Blue‡		800FM-LMP46E3
		Clear‡		800FM-LMP47E3

800F M – L MM 4 4 E3
a b c d e f

a

Operator Construction	
Code	Description
M	Round metal operator (IP66, Type 4/13)

b

Operator Type	
Code	Description
Blank	Non-Illuminated
L	Illuminated❄

c

Operator Function	
Code	Description
MM	Momentary Out, Maintained Center, Momentary In
MP	Momentary Out, Maintained Center, Maintained In

d

Cap Size	
Code	Description
4	40 mm Plastic

e

Cap Color	
Code	Description
0	Amber‡
2	Black§
3	Green
4	Red
6	Blue‡
7	Clear‡

f

Positions	
Code	Description
E3	3-Position

♣ Sold as stand-alone operator only. Not available as a composite catalog number.
✶ Cannot use N.C. or N.O.E.M. contact blocks with 3-position push-pull operators. Must use N.O., N.C.E.B., or N.C.L.B. contact blocks.
❄ Available in integrated LED version only.
‡ Available in illuminated only.
§ Available in non-illuminated only.

Momentary Push Button Operators, Non-Illuminated — Mushroom∗

40 mm Mushroom
Cat. No. 800FP-MM42

60 mm Mushroom
Cat. No. 800FP-MM63

90 mm Mushroom
Cat. No. 800FP-MM94

Color	Pkg. Quantity	40 mm Mushroom		60 mm Mushroom	
		Plastic	Metal	Plastic	Metal
		Cat. No.	Cat. No.	Cat. No.	Cat. No.
Black	1	800FP-MM42	800FM-MM42	**800FP-MM62**	800FM-MM62
Green		800FP-MM43	800FM-MM43	**800FP-MM63**	800FM-MM63
Red		800FP-MM44	800FM-MM44	**800FP-MM64**	800FM-MM64
Yellow		800FP-MM45	800FM-MM45	**800FP-MM65**	800FM-MM65
Blue		**800FP-MM46**	**800FM-MM46**	**800FP-MM66**	800FM-MM66

800F **P** **–** **MM4** **3**
a *b* *c*

a

Operator Construction	
Code	Description
P	Round plastic operator (IP65, Type 4/4X/13)
M	Round metal operator (IP65, Type 4/13)

b

Size and Operator Type	
Mushroom	
Code	Type
MM4	40 mm momentary
MM6	60 mm momentary
MM9	90 mm momentary❄

c

Color Cap	
Code	Color
2	Black
3	Green
4	Red
5	Yellow
6	Blue

∗ Momentary mushroom operators are IP65 rated.
❄ Only available with black, red, and yellow cap colors.

Momentary Push Button Operators, Illuminated — Mushroom∗

40 mm Mushroom
Cat. No. 800FP-LMM43

Color	Pkg. Quantity	40 mm Mushroom	
		Plastic	Metal
		Cat. No.	Cat. No.
Green	1	800FP-LMM43	800FM-LMM43
Red		800FP-LMM44	800FM-LMM44
Yellow		800FP-LMM45	800FM-LMM45
Blue		**800FP-LMM46**	**800FM-LMM46**
Clear		**800FP-LMM47**	**800FM-LMM47**

800F [P] – [LMM4] [3]
a b c

a

Operator Construction	
Code	Description
P	Round plastic operator (IP65, Type 4/4X/13)
M	Round metal operator (IP65, Type 4/13)

b

Size and Operator Type	
Mushroom	
Code	Type
LMM4	40 mm momentary

c

Lens Cap Color	
Code	Color
3	Green
4	Red
5	Yellow❄
6	Blue
7	Clear

∗ Momentary mushroom operators are IP65 rated.
❄ When using LED for illumination, a white LED is recommended.

Back-of-Panel Components

Contact Blocks with Latch — Composite

800F – P X 0 1 E
a b c d e

a

Style	
Code	Description
P	Plastic latch
M	Metal latch

b

Contact Block(s) Termination Style∗	
Code	Description
X	Screw termination
Q	Spring-clamp termination

∗ Six circuits maximum allowable.

c

N.O. (Normally Open) Circuits	
Code	Description
0	No contact
1	1 N.O.
2	2 N.O.
3	3 N.O.
4	4 N.O.
5	5 N.O.
6	6 N.O.

d

N.C. (Normally Closed) Circuits	
Code	Description
0	No contact
1	1 N.C.
2	2 N.C.
3	3 N.C.
4	4 N.C.
5	5 N.C.
6	6 N.C.

e

Specialty Contact Block(s)	
Code	Description
Blank	Standard blocks
V	Low voltage — QuadCONNECT™
E	N.O. early make
L	N.C. late break
B	N.C. early break
S	N.C. self-monitoring

Power Modules

Power Modules with Latch — Composite

800F – M N 3 G
a b c d

a

Style	
Code	Description
P	Plastic latch
M	Metal latch

b

Power Module Type‡§	
Code	Description
D	Incandescent module, screw termination
N	Integrated LED module, screw termination
Q	Integrated LED module, spring-clamp termination

c

Voltage	
Code	Description
0	No bulb♣
1	6V AC/DC♣
2	12V AC/DC♣
3	24V AC/DC
4	48V AC/DC♣
5	120V AC
7	240V AC➢

d

Lamp Color⌘	
Code	Description
C	Incandescent
R	Red LED
G	Green LED
Y	Amber LED
W	White LED
B	Blue LED

‡ LED modules for use with all illuminated operators. Incandescent module for use with pilot lights, momentary push buttons, and momentary mushroom operators only.
§ Four circuits maximum allowable when power module is used. Do not stack contact block on power module.
♣ Only available for incandescent module.
➢ Only available for integrated LED module.
⌘ For best illumination results, LED color should match lens color. For yellow operator, select a white LED.

Back-of-Panel Components, Continued

Power Modules with Contact Blocks and Latch — Composite

800F –	P	N	5	R	X	1	0	E
	a	*b*	*c*	*d*	*e*	*f*	*g*	*h*

a

Style	
Code	Description
P	Plastic latch
M	Metal latch

b

Power Module Type✶❄	
Code	Description
D	Incandescent module, screw termination
N	Integrated LED module, screw termination
Q	Integrated LED module, spring-clamp termination

c

Voltage	
Code	Description
0	No bulb‡
1	6V AC/DC‡
2	12V AC/DC‡
3	24V AC/DC
4	48V AC/DC‡
5	120V AC
7	240V AC§

d

Lamp Color♣	
Code	Description
C	Incandescent
R	Red LED
G	Green LED
Y	Amber LED
W	White LED
B	Blue LED

e

Contact Block(s) Termination Style	
Code	Description
X	Screw termination
Q	Spring-clamp termination

f

N.O. (Normally Open) Circuits	
Code	Description
0	No contact
1	1 N.O.
2	2 N.O.
3	3 N.O.
4	4 N.O.

g

N.C. (Normally Closed) Circuits	
Code	Description
0	No contact
1	1 N.C.
2	2 N.C.
3	3 N.C.
4	4 N.C.

h

Specialty Contact Block(s)	
Code	Description
Blank	Standard blocks
V	Low voltage — QuadCONNECT™
E	N.O. early make
L	N.C. late break
S	N.C. self-monitoring

✶ Four circuits maximum allowable when power module is used. Do not stack contact block on power module.
❄ LED modules for use with all illuminated operators. Incandescent module for use with pilot lights, push buttons, and momentary mushroom operators only.
‡ Only available for incandescent module.
§ Only available for integrated LED module.
♣ For best illuminated results, LED should match lens color. For yellow operator, select a white LED.

Back-of-Panel Components, Continued

Other

	Description	Pkg. Quantity	Cat. No.
Cat. No. 800F-ALM	**Metal Mounting Latch** These are zinc-plated, metal die cast mounting latches. **Note:** Sold only in multiples of 10. Order (quantity of) 10 to receive one package of 10 pieces.	10	800F-ALM
	Note: Sold only in multiples of 100. Order (quantity of) 100 to receive one package of 100 pieces.	100	800F-ALM-BP
Cat. No. 800F-ALP	**Plastic Mounting Latch** **Note:** Sold only in multiples of 10. Order (quantity of) 10 to receive one package of 10 pieces.	10	800F-ALP
	Note: Sold only in multiples of 100. Order (quantity of) 100 to receive one package of 100 pieces.	100	800F-ALP-BP

	Description	Contact Type	Pkg. Quantity	Cat. No.
	Contact Block **Note:** Sold only in multiples of 10. Order (quantity of) 10 to receive one package of 10 pieces. Latch not included.	N.O.	10	800F-X10
		N.C.		800F-X01
		N.O. low voltage — QuadCONNECT™		800F-X10V
		N.C. low voltage — QuadCONNECT™		800F-X01V
		N.O.L.M.		♣ 800F-X10N
		N.O.E.M.		800F-X10E
		N.O.E.E.M.		➢ 800F-X10M
		N.C.L.B.		800F-X01L
		N.C.E.B.		✶ 800F-X01B
		Self-Monitoring		❄ 800F-X01S
		Dual circuit of 2 N.O.		❄ 800F-X20D
		Dual circuit of 2 N.C.		❄ 800F-X02D
		Dual circuit of 1 N.O.-1 N.C.		❄ 800F-X11D
		N.O. with stab terminals		800F-X10T
		N.C. with stab terminals		800F-X01T
		N.O. spring-clamp		800F-Q10
		N.C. spring-clamp		800F-Q01
		N.O. spring-clamp low-voltage — QuadConnect™		800F-Q10V
		N.C. spring-clamp low-voltage — QuadConnect™		800F-Q01V
		N.O.E.M. spring-clamp		800F-Q10E
		N.C.L.B. spring clamp		**800F-Q01L**
		N.C.E.B. spring-clamp		✶ 800F-Q01B
		Ring lug N.O.		‡§ 800F-R10
		Ring lug N.C.		‡§ 800F-R01
Cat. No. 800F-X10	**Note:** Sold only in multiples of 100. Order (quantity of) 100 to receive one package of 100 pieces. Latch not included.	N.O.	100	800F-X10-BP
		N.C.		800F-X01-BP

♣ For use with **Cat. No. 800FP-CB_** and **Cat. No. 800FP-CC_** operators.
➢ For use with **Cat. No. 800FP-CC_** operators.
✶ Only for use with 4-position selector switch, 4-position toggle switch, or 3-position push-pull operator.
❄ Cannot stack.
‡ Cannot be used in a composite catalog number.
§ Replacement screws are available (**Cat. No. 800F-ARS1**)

Back of Panel Components, Continued

Other

	Description	Volts	Pkg. Quantity	Cat. No.
Cat. No. 800F-D3C	**Incandescent Module** For use with pilot lights, push buttons, and momentary mushroom operators. **Note:** Sold in multiples of 10. Order (quantity of) 10 to receive one package of 10 pieces. Latch not included.	No bulb	10	800F-D0C
		6V AC/DC		800F-D1C
		12V AC/DC		800F-D2C
		24V AC/DC		800F-D3C
		48V AC/DC		800F-D4C
		120V AC/DC		800F-D5C
Cat. No. 800F-N3G	**Integrated LED Module** For use with all illuminated devices. For best results, LED should match lens color. For amber operators, use yellow LED. **Note:** Sold in multiples of 10. Order (quantity of) 10 to receive one package of 10 pieces. Latch not included.	24V AC/DC	10	✶ 800F-N3x
		120V AC		✶ 800F-N5x
		240V AC		✶ 800F-N7x
		24V AC/DC spring-clamp		✶ 800F-Q3x
		120V AC spring-clamp		✶ 800F-Q5x
		240V AC spring-clamp		✶ 800F-Q7x
		24V AC/DC ring lug		❄‡ 800F-R3x

	Description	Contact Material	Pkg. Quantity	Cat. No.
Cat. No. 800F-BX01	**Base Mounted Contact Block** Base mounted contact blocks can be used in plastic or metal enclosures. **Note:** Sold only in multiples of 10. Order (quantity of) 10 to receive one package of 10 pieces. Latch not included.	N.O.	10	800F-BX10
		N.C.		800F-BX01
		N.O. low voltage — QuadCONNECT™		800F-BX10V
		N.C. low voltage — QuadCONNECT™		800F-BX01V
		N.O.E.M.		800F-BX10E
		N.C.L.B.		800F-BX01L
		N.O. spring-clamp		800F-BQ10
		N.C. spring-clamp		800F-BQ01

	Description	Volts	Pkg. Quantity	Cat. No.
Cat. No. 800F-BN3R	**Base Mounted Integrated LED Module** Base mounted modules can be used in plastic or metal enclosures. For best illumination results, LED should match lens color. **Note:** Sold in multiples of 10. Order (quantity of) 10 to receive one package of 10 pieces. Latch not included.	24V AC/DC	10	✶ 800F-BN3x
		120V AC		✶ 800F-BN5x
		240V AC		✶ 800F-BN7x
		24V AC/DC spring-clamp		✶ 800F-BQ3x
		120V AC spring-clamp		✶ 800F-BQ5x
		240V AC spring-clamp		✶ 800F-BQ7x

✶ To complete the cat. no., replace the **x** with one of the following letters for the desired color: **Y** = Amber, **R** = Red, **G** = Green, **B** = Blue, **W** = White.
❄ Cannot be used in a composite catalog number.
‡ Replacement screws are available (Cat. No. 800F-ARS1)

Assembled Stations

Cat. No. 800F-1YP4

1-Hole Yellow Enclosure E-Stop Station

Enclosure Material	Quick Connect		Operator Type	Illumination Voltage	Contact Configuration	Cat. No.	
						PG Knockouts	Metric Knockouts
Plastic	N/A		Twist-to-Release 40 mm	Non-Illuminated	1 N.C.	800F-1YP1	800F-1YM1
					1 N.O. / 1 N.C.	800F-1YP2	800F-1YM2
					2 N.C.	800F-1YP3	800F-1YM3
			Key Release 40 mm		1 N.C.	800F-1YP4	800F-1YM4
					1 N.O. / 1 N.C.	800F-1YP5	800F-1YM5
					2 N.C.	800F-1YP6	800F-1YM6
			Twist-to-Release 60 mm		2 N.C.	800F-1YP7	—
					1 N.O. / 2 N.C.	800F-1YP8	—
			Twist-to-Release 40 mm	24V AC/DC	1 N.C.	—	800F-1YML1
				120V AC		—	800F-1YML2
				240V AC		—	800F-1YML3
	AC Micro∗	5-pin		Non-Illuminated	2 N.C. — Low voltage	—	**800F-1YMQ53V**
		6-pin			1 N.O. / 2 N.C.	—	**800F-1YMQA**
	DC Micro∗	4-pin		Non-Illuminated/EMO/Guard	1 N.C.	—	**800F-NX1**
				Non-Illuminated	1 N.C.	—	**800F-1YMQ1**
					1 N.O. / 1 N.C.	—	**800F-1YMQ2**
					2 N.C.	—	**800F-1YMQ3**
				Non-Illuminated/EMO/Guard		—	**800F-1YMQ3VEG**
		5-pin		Non-Illuminated		—	**800F-1YMQ3V**
	Mini Receptacle∗	4-pin		Non-Illuminated	1 N.C.	—	800F-1YMQ41
				24V AC/DC	1 N.O. / 1 N.C.	—	800F-1YMQ44
		6-pin		24V AC/DC	1 N.O. / 1 N.C.	—	800F-1YMQ4
				120V AC	1 N.O. / 1 N.C.	—	800F-1YMQ5
				240V AC	1 N.O. / 1 N.C.	—	800F-1YMQ6
Metal				24V AC/DC	1 N.O./1 N.C.	—	800F-1MYMQ4
				120V AC	1 N.O./1 N.C.	—	800F-1MYMQ5
				240V AC	1 N.O./1 N.C.	—	800F-1MYMQ6

∗ Please reference Assembled Station Pin Out Chart on page 4-44

1-Hole Grey Enclosure E-Stop Station

Enclosure Material	Quick Connect	Operator Type	Illumination Voltage	Contact Configuration	Cat. No.	
					PG Knockouts	Metric Knockouts
Metal	N/A	Twist-to-Release 40 mm	Non-Illuminated	1 N.C.	—	800F-1MM1
				1 N.O. / 1 N.C.	—	800F-1MM2
				2 N.C.	—	800F-1MM3
		Key Release 40 mm		1 N.C.	—	800F-1MM4
				1 N.O. / 1 N.C.	—	800F-1MM5
				2 N.C.	—	800F-1MM6

Grey Enclosure Assembled Stations

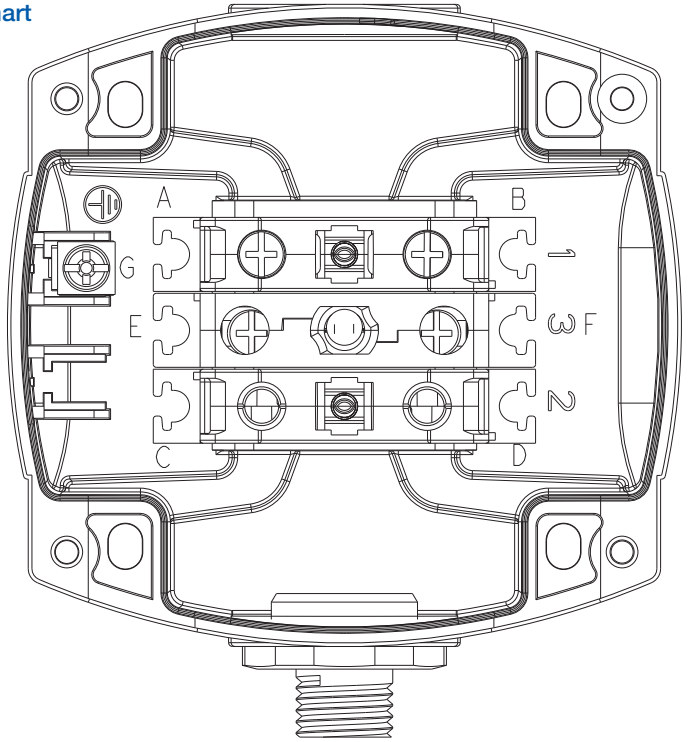
Enclosure Material	Quick Connect	Operator Type	Illumination Voltage	Contact Configuration	Cat. No.	
					PG Knockouts	Metric Knockouts
1-Hole Plastic	N/A	Black Push Button	Non-Illuminated	1 N.O.	800F-1PP1	800F-1PM1
		"0-1" 2-Position Selector Switch		1 N.O.	800F-1PP2	800F-1PM2
		"OFF-ON" 2-Position Selector Switch		1 N.O. / 1 N.C.	800F-1PP3	800F-1PM3
		↔ (Flush Black)		1 N.O.	800F-1PP4	—
2-Hole Plastic		Start and Stop Push Buttons		1 N.O./1 N.C.	800F-2PP1	—
3-Hole Plastic		↑ (Flush Black) O (Extended Red) ↓ (Flush Black)		4 N.O./1 N.C.	800F-3PP1	—

Assembled Stations, Continued

90 mm Enclosed Stations

Enclosure Material	Quick Connect	Operator Type	Illumination Voltage	Contact Configuration	Cat. No.	
					PG Knockouts	Metric Knockouts
1-Hole, Yellow Plastic	N/A	Red half dome	Non-illuminated	1 N.C.	800F-1YP1HD	800F-1YM1HD
				1 N.O./1 N.C.	800F-1YP2HD	800F-1YM2HD
				2 N.C.	800F-1YP3HD	800F-1YM3HD
			24V AC/DC	1 N.C.	—	800F-1YML1HD
			120V AC		—	800F-1YML2HD
			240V AC		—	800F-1YML3HD
		Red 90 mm momentary	Non-illuminated	1 N.C.	800F-1YP1M94	800F-1YM1M94
				1 N.O./1 N.C.	800F-1YP2M94	800F-1YM2M94
				2 N.C.	800F-1YP3M94	800F-1YM3M94
1-Hole, Grey Plastic		Black 90 mm momentary		1 N.O./1 N.C.	800F-1PP2M92	800F-1PM2M92

Assembled Station Pin Out Chart



Cat. No.	Connector Style / No. of Pins	Location 1	A to Pin #	B to Pin #	Location 2	C to Pin #	D to Pin #	Location 3	E to Pin #	F to Pin #	G to Pin #
800F-1YMQ53V	AC Micro / 5-pin	BX01V	1	2	BX01V	4	5	—	—	—	3
800F-1YMQA	AC Micro / 6-pin	BX01	1	5	BX01	2	6	BX10	3	4	—
800F-NX1	DC Micro / 4-pin	BX01	1/4	2/3	—	—	—	—	—	—	—
800F-1YMQ1		BX01	1/4	2/3	—	—	—	—	—	—	—
800F-1YMQ2		BX10V	2	4	BX01V	1	3	—	—	—	—
800F-1YMQ3		BX01V	1	3	BX01V	2	4	—	—	—	—
800F-1YMQ3VEG		BX01V	1	3	BX01V	2	4	—	—	—	—
800F-1YMQ3V	DC Micro / 5-pin	BX01V	1	2	BX01V	4	5	—	—	—	3
800F-1YMQ41	Mini Receptacle / 4-pin	BX01	2	4	—	—	—	—	—	—	—
800F-1YMQ44		BX10	1	J	BX01	2	4	BN3R	3	J	J
800F-1YMQ4	Mini Receptacle / 6-pin	BX10	1	J	BX01	6	5	BN3R	2	J	J
800F-1YMQ5		BX10	1	J	BX01	6	5	BN5R	2	J	J
800F-1YMQ6		BX10	1	J	BX01	6	5	BN7R	2	J	J
800F-1MYMQ4		BX10	1	J	BX01	6	5	BN3R	2	J	J
800F-1MYMQ5		BX10	1	J	BX01	6	5	BN5R	2	J	J
800F-1MYMQ6		BX10	1	J	BX01	6	5	BN7R	2	J	J

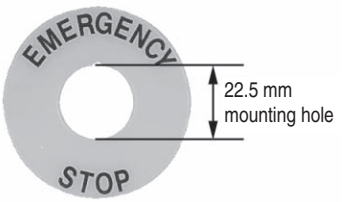
J = Jumper

Guards

	Description	Type	Cat. No.	Pkg. Quantity
Cat. No. 800F-AMRG	**Protective Ring** for use with non-illuminated 2-position momentary and illuminated/non-illuminated 3-position mushroom operators (40 mm only)	Shiny metal	800F-AMRG	1
		Black	800F-AMRGB	
		Yellow Metal	800F-AMRGY	
Cat. No. 800F-A6PR5	**Plastic Guard** for use with the following operators: • 40 mm E-stop (SEMI Standards Compliant) • 40 mm illuminated/non-illuminated alternate action and momentary operators • 60 mm illuminated/non-illuminated momentary operators • Selector switches (standard knob and key operated) • Potentiometers	Yellow, round	800F-A6PR5	
Cat. No. 800F-AMEGY	**Narrow Plastic Guard** for use with the following operators: • Illuminated and non-illuminated momentary mushroom operators (40 mm) only • Bul. 800FD monolithic E-stops (SEMI standards compliant) • Flush/extended/guarded push buttons • Alternate action operators • Selector switches (standard knob and key operated) • Potentiometers	Yellow	800F-AMEGY	
Cat. No. 800F-AMMG	**40 mm Protective Guard** used with illuminated and non-illuminated momentary mushroom operators (40 mm) only.	Shiny Metal	800F-AMMG	

Emergency Stop Legend Plates§

800F –15YS
a *b*



Cat. No. 800F-15YSE112

a

Size/Color (Yellow)	
Code	Description
15Y	60 mm round (30.5 mm mounting hole)
15YS	60 mm round (22.5 mm mounting hole)➢
16Y	90 mm round (22.5 mm mounting hole)➢

b

Text	
Code	Description
Blank	No text
E112	EMERGENCY STOP
F112	ARRÊT D'URGENCE⌘
G112	NOT AUS
T112	ARRESTO EMERGENZA
S112	PARADA DE EMERGENCIA
B112	EMERGENCY STOP, ARRÊT D'URGENCE, PARADA DE EMERGENCIA⌘

b (cont'd)

Text	
Code	Description
M112	NOT AUS, ARRESTO EMERGENZA, ARRÊT D'URGENCE✦
	EMERGENCY STOP, ARRÊT D'URGENCE, NOT AUS❖
D112	NOODSTOP⌘
N112	NÖDSTOPP, EMERGENCY STOP⌘
W112	NØDSTOPP, EMERGENCY STOP⌘
A112	NØDSTOP
L112	NEYÐARSTOPP, NEYÐARSTOPP⌘
H112	NÖD-STOP, HÄTÄ-SEIS, NÖD-STOP⌘

§ Sold only multiples of 10. Order (quantity of) 10 to receive one package of 10 pieces.
➢ Not for use with base mounted contact blocks.
⌘ Not available on 15YS version.
✦ Text printed on the 15Y version only.
❖ Text printed on the 15YS & 16Y versions only.

Non-Illuminated

2-Pos. Push-Pull
Cat. No. 800T-FX6D4

2-Pos. Push-Pull / Twist
Cat. No. 800H-FRXT6D4

2-Pos. Push-Pull / Twist
Cat. No. 800T-FXT6D4

Illuminated

2-Pos. Push-Pull
Cat. No. 800T-FXP16RA1

2-Pos. Push-Pull/Twist
Cat. No. 800H-FRXTP16RA1

2-Pos. Push-Pull/Twist
Cat. No. 800T-FXTP16RA1

Description

The Bulletin 800T and 800H 30.5 mm Emergency Stop devices provide increased reliability. E-stops with normally closed late break contacts comply with EN418 and IEC 947-5-5 standards. This means the operator will latch when actuated before the contacts will change state.

Application flexibility is offered with 2-position push-pull or 2-position push-pull/twist release configurations. Non-illuminated and illuminated operator options are available. Contact block versions are also available that provide IP2X finger-safe protection.

Rockwell Automation also offers Self-Monitoring™ contact blocks (SMCB) which feature enhanced E-stop safety for critical process control applications. The SMCB monitors whether or not it is properly installed on the operator so that the normally closed contacts will open when the E-stop is actuated. If the SMCB is separated from the operator for any reason, the controlled circuit will automatically open.

Features

- 30.5 mm mounting hole
- Type 4/13 watertight/oiltight (Bul. 800T)
- Type 4/4X/13 corrosion-resistant/watertight/oiltight (Bul. 800H)
- Heavy industrial stations and operators

Specifications

Electrical Ratings		
Contact ratings		Refer to the contact ratings tables below.
Dielectric strength		2200V for one minute, 1300V for one minute (Logic Reed)
Electrical design life cycles		1 000 000 at max. rated load, 200 000 at max. rated load (Logic Reed)
Mechanical Ratings		
Vibration		10…2000 Hz 1.52 mm displacement (peak-to-peak) max./10 G max. (except Logic Reed)
Shock		1/2 cycle sine wave for 11 ms ≥ 25 G (contact fragility) and no damage at 100 G
Degree of protection		Type 1/4/12/13 (Bul. 800T); Type 1/4/4X/12/13 (Bul. 800H); EN/IEC 60529 IP66/65
Mechanical design life cycles (Push-pull/twist-to-release)		250 000 min.
Contact operation		Shallow, mini, and low voltage contact blocks: Slow, double make and break Logic Reed and sealed switch contact blocks: Single break magnetic
Wire gauge/Terminal screw torque		#18…12 AWG / 6…8 lb•in
Typical operating forces 2-position push-pull		7.5 lbs max. push or pull
Twist-to-release or push-pull		9 lbs max. push or pull 30 in oz. max. twist, 6 in oz. minimum return
Contact blocks	Standard	1 lb
	Logic Reed	1 lb max.
	Sealed switch	3 lbs max. at 0.205 in plunger travel
	Stackable sealed switch	1 lb max.
Environment		
Temperature range	Operating	–40…+131 °F (–40…+55 °C)
	Storage	–40…+185 °F (–40…+85 °C)
Note: Operating temperatures below freezing are based on the absence of moisture and liquids. Contact your local Rockwell Automation sales office or Allen-Bradley distributor for use in lower temperature applications.		
Humidity		50…95% RH from 77…140 °F (25…60 °C) per Procedure IV of MIL-STD-BIOC, Method 507.1 cycling test

Standard Contact Ratings

Minimum: 24V 24 mA

Maximum thermal continuous current I^{th} 10 A AC/2.5 A DC. Bulletin 800T and 800H units with Cat. No. 800T-XA contacts have ratings as follows:

Max. Opertnl. Volts Ue	Utilization Category		Rated Operational Currents		
	IEC	NEMA	Volts Ue	Make	Break
AC 600	AC-15	A600	120…600 72…120 24…72	7200VA 60 A 60 A	720VA 720VA 10 A
DC 600	DC-13	Q600	28…600 24…28❄	69VA 2.5 A	

❄ For applications below 24V/24 mA, Pen*TUFF*™ or Logic Reed contacts are recommended.

Self-Monitoring is a trademark of Rockwell Automation, Inc.

2-Position Push-Pull and Push-Pull/Twist Release, Non-Illuminated

Note: A jumbo or large legend plate is recommended, if space allows.

Contact Type	Operator Position: Out	Operator Position: In	Button Color	Type 4/13: Push-Pull Cat. No.	Type 4/13: Push-Pull/Twist Release Cat. No.	Type 4/4X/13: Push-Pull/Twist Release Cat. No.
N.C.L.B.∗	X	O	Red	**800T-FX6D4**	**800T-FXT6D4**	**800H-FRXT6D4**
N.O. - N.C.L.B.∗	O X	X O	Red	**800T-FX6A1**	**800T-FXT6A1**	**800H-FRXT6A1**
N.C.L.B. - N.C.L.B.∗	X X	O O	Red	**800T-FX6A5**	**800T-FXT6A5**	**800H-FRXT6A5**
S.M.C.B.∗❄	X	O	Red	**800TC-FX6D4S**	800TC-FXT6D4S	800HC-FRXT6D4S
N.O. - S.M.C.B.∗❄	O X	X O	Red	800TC-FX6A1S	800TC-FXT6A1S	800HC-FRXT6A1S
S.M.C.B. - S.M.C.B∗❄	X X	O O	Red	**800TC-FX6A5S**	800TC-FXT6A5S	800HC-FRXT6A5S

Note: X = Closed/O = Open
Note: Emergency stop push buttons are compliant with EN 418 and EN/IEC 60947-5-5 Standards when using N.C.L.B. contact blocks.
Note: These caps are only available in plastic.

2-Position Push-Pull and Push-Pull/Twist Release Units, Illuminated

Note: A jumbo or large legend plate is recommended, if space allows.

Type	Lamp Type	Volts	Color	Contacts	Operator Position: Maintained Out	Operator Position: Maintained In	Type 4/13: Push-Pull Release Cat. No.	Type 4/13: Push-Pull/Twist Release Cat. No.	Type 4/4X/13: Push-Pull/Twist Release Cat. No.
Full Voltage	Incandescent	24V AC/DC	Red	N.O. - N.C.L.B. ∗‡	O X	X O	**800T-FXQ24RA1**	**800T-FXTQ24RA1**	**800H-FRXTQ24RA1**
	LED	120V AC					**800T-FXQH10RA1**	**800T-FXTQH10RA1**	800H-FRXTQH10RA1
		24V AC/DC					**800T-FXQH24RA1**	800T-FXTQH24RA1	800H-FRXTQH24RA1
Transformer	Incandescent	120V AC	Red	N.O. - N.C.L.B. ∗‡	O X	X O	**800T-FXP16RA1**	**800T-FXTP16RA1**	**800H-FRXTP16RA1**
		240V AC					**800T-FXP26RA1**	800T-FXTP26RA1	800H-FRXTP26RA1
	LED	120V AC					**800T-FXPH16RA1**	**800T-FXTPH16RA1**	**800H-FRXTPH16RA1**
		240V AC					800T-FXPH26RA1	800T-FXTPH26RA1	800H-FRXTPH26RA1

Note: X = Closed/O = Open
Note: Emergency stop push buttons are compliant with EN 418 and EN/IEC 60947-5-5 Standards when using N.C.L.B. contact blocks.

∗ Normally closed late break contact. When button is pushed from the OUT to IN position, the mechanical detent action of the operator occurs before electrical contacts change state. When the button is pulled from the IN to the OUT position, the electrical contacts change state before the mechanical detent occurs.
❄ The Self Monitoring Contact Block (S.M.C.B.) is composed of a N.C.L.B. contact wired in series with a N.O. monitoring contact. The N.O. monitoring contact automatically closes when the S.M.C.B. is properly installed onto the E-stop operator. If the S.M.C.B. is separated from the E-stop operator, the N.O. monitoring contact will automatically open.
‡ Contact your local Rockwell Automation sales office or Allen-Bradley distributor for availability of illuminated E-stops with Self Monitoring Contact Blocks (S.M.C.B.s).

Accessories

	Type	Style	Color	Cat. No.
	Emergency Stop Legend Plates	For 800T Buttons	Yellow, Blank	**800T-X646**
			Yellow, Emergency Stop	**800T-X646EM**
		For 800H Buttons	Yellow, Emergency Stop	**800H-W690**

General Purpose
Cat. No. 800Z-GF2Q5

General Purpose
Cat. No. 800Z-GL3Q5B

Heavy Industrial
Cat. No. 800Z-HF1

Heavy Industrial
Cat. No. 800Z-HL1Y

Description

Bulletin 800Z Zero-Force Touch Buttons are designed for use by machine control systems requiring the use of two hands. An interlinked sensor surface weaves two capacitive sensors in offset planes for superior product sensitivity.

Bulletin 800Z touch buttons are ergonomically designed for ease of operation. Simply touching the surface of the switch will initiate an output. The Bulletin 800Z line can detect the hand through most industrial gloves.

The contour of Bulletin 800Z touch buttons serves two purposes; it easily conforms to the shape of the hand while helping prevent defeatability when two-hand control is needed.

Two bi-colored diagnostic LEDs provide guidance during operation. The power/fault LED blinks at different rates to provide diagnostic information to the user. The Bulletin 800Z line detects the presence of a hand during power-up, noise, and conductive film build-up over time.

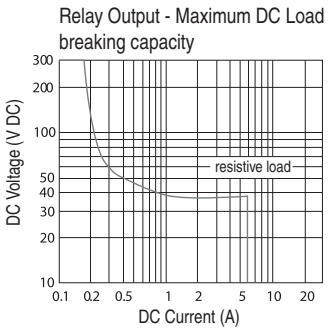
Features

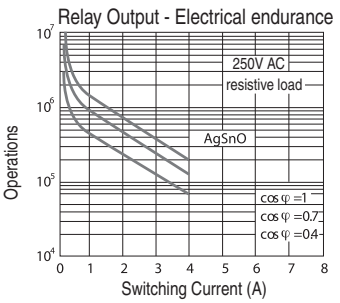
- Internationally rated ergonomic touch buttons
- Zero force to operate
- EMC protection
- Diagnostic LEDs
- Replaceable relays (heavy industrial design)

Specifications

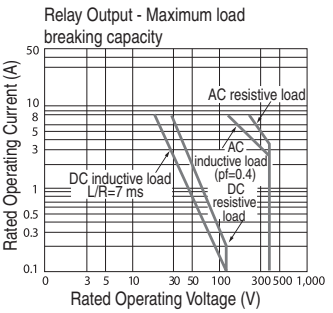
Description	General Purpose Line (Cat. No. 800Z-G)	Heavy Industrial Line (Cat. No. 800Z-H)
Mechanical Ratings		
Vibration Endurance	Tested @ 10 G, 1.52 mm displacement	
Mechanical Shock	Tested @ 100 G (mechanical durability)	
Degree of Protection	Type 4/4X/13 IP66 1200 psi Washdown	Type 4/13 IP66
Operating Force	Zero	
Electrical Ratings		
Input Voltage (Relay type)	Low Voltage: 10…40V DC, 20…30V AC Full Voltage (800Z-GF): 85…264V AC	
Input Voltage (Solid-State type)	Low Voltage (800Z-GN/GP): 10…30V DC	
Electrical Design Life (Relay type)	Relay Output 200,000 Operations @ 2A inductive 4A resistive	Relay Output 150,000 Operations @ 5A inductive 2.5 A resistive
On-delay/Off-delay	Off 60 ms max. On 76 ms max.	
Current Draw (Solid-State type)	100 mA at 24V DC = 2.23 W (no external load)	
Terminal Block Ratings		
Degree of Protection	—	IP2X
Wire Range		#22…12 AWG (0.5…4 mm²)
Tightening Torque		9 lb-in. (1N•m)
Environmental		
Temperature Range (Operating)	–25...+55°C	
Temperature Range (Storage)	–40...+85°C	
Humidity	95% RH from 25...50°C (full operation)	
Materials		
Housing/Guard	Valox 357	
Gasket	BUNA-N	1/16 in. Cork-BUNA-N
Connector	Insulator material (micro connector) = nylon Insulator material (mini connector) = PVC	
Standards and Certifications		
Certifications	$_{c}UL_{us}$, CE, C-TICK, CSA	
Standards Conformity	UL508, CSA 22.2 No. 14, UL50, EN/IEC 60947-5-1, EN50081-2, EN61000-6-2, EN954-1	

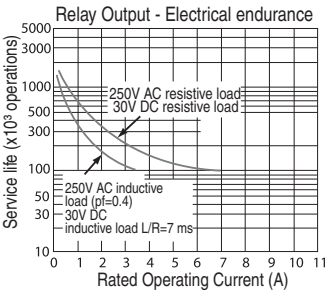
Load Life Curves for General Purpose Product Line





Load Life Curves for Heavy Industrial Line





General Purpose Line — Momentary Touch Buttons

Mounting Hole Size	Input Voltage	Output Type	Electrical Connection	No Guard Cat. No.	Black Guard Cat. No.
30.5 mm	85...264V AC	Relay Output	5-Pin QD	**800Z-GF3Q5**	**800Z-GF3Q5B**
			6 ft Cabled — 5-Wire	**800Z-GF3065**	**800Z-GF3065B**
	10...40V DC and 20...30V AC	Relay Output	5-Pin QD	**800Z-GL3Q5**	**800Z-GL3Q5B**
			6 ft Cabled — 5-Wire	**800Z-GL3065**	800Z-GL3065B
22.5 mm	85...264V AC	Relay Output	5-Pin QD	**800Z-GF2Q5**	**800Z-GF2Q5B**
			6 ft Cabled — 5-Wire	**800Z-GF2065**	**800Z-GF2065B**
	10...40V DC and 20...30V AC	Relay Output	5-Pin QD	**800Z-GL2Q5**	**800Z-GL2Q5B**
			6 ft Cabled — 5-Wire	**800Z-GL2065**	**800Z-GL2065B**
Recommended standard cordset, 2 m (6.5 ft). See *Safety Catalog* for additional lengths.			Mini-Plus Style QD Cordset, 5-Pin	889N-F5AE-6F	889D-F5AC-2

Use the configurator below to build a Bulletin 800Z touch button to suit your application.

800Z – G [L] [3] [065] [B] – [ ]
a *b* *c* *d* *e*

a

Input Voltage and Output Type ‡	
Code	Description
Relay Output	
L	Input: 10…40V DC and 20…30V AC Output: Relay
F	Input: 85…264V AC Output: Relay
Transistor Output	
P	10…30V DC PNP (Sourcing) Output

b

Mounting Hole Size §	
Code	Description
2	22.5 mm
3	30.5 mm

c

Electrical Connection	
Code	Description
Sinking/Sourcing Output ∗	
Q4	4-Pin QD
064	6 ft (1.8 m) Cabled
244	24 ft (7.2 m) Cabled
Relay Output ❄	
Q5	5-Pin QD
065	6 ft (1.8 m) Cabled
245	24 ft (7.2 m) Cabled

d

Guard Option	
Code	Description
Blank	No Guard
B	Black Guard
Y	Yellow Guard

∗ These devices are transistor outputs.
❄ These devices have separate N.O. and N.C. output relays with a shared common.
‡ Safety relays should be used in conjunction with two relay output type Zero-Force Touch Buttons™ in 2-hand control applications. Order separately, safety relay 440R-D23171 for 24V, 440R-D23169 for 120V, 440R-D23168 for 240V.
§ 22.5 mm touch buttons use micro connector, 30.5 mm touch buttons use mini connector.

Heavy Industrial Line — Momentary Touch Buttons

Button Type	Input Voltage	Output Type	Electrical Connection	No Guard Cat. No.	Yellow Guard Cat. No.
Flush Mount	10...40V DC and 20...30V AC	Relay Output	Terminal Block	**800Z-HL1**	**800Z-HL1Y**
	85...264V AC	Relay Output	Terminal Block	**800Z-HF1**	**800Z-HF1Y**

Use the configurator below to build a Bulletin 800Z touch button to suit your application.

800Z – H [L] [1] [Y] - [ ]
a *b* *c* *d*

a

Voltage ❄	
Code	Description
L	Input: 10…40V DC and 20…30V AC Output: Relay
F	Input: 85…264V AC Output: Relay

b

Mounting Type ∗	
Code	Description
1	Flush Mounting

c

Guard Option	
Code	Description
Blank	No Guard
Y	Yellow Guard

∗ Heavy industrial devices have an 8-position terminal block connection. See wiring diagrams on page 4-53 for details.
❄ Safety relays should be used in conjunction with two relay output type Zero-Force Touch Buttons in 2-hand control applications. Order separately, safety relay 440R-D23171 for 24V, 440R-D23169 for 120V, 440R-D23168 for 240V.

Accessories — General Purpose

Heavy Industrial with Guard

	Description		Cat. No.
Cat. No. 800Z-G3AG1 ***Cat. No. 800Z-G3AG2***	**Guards** These guards help protect against accidental activation of the touch button surface and protect it from damage. Can be used for both the 22.5 mm and 30.5 mm mounted products.	Yellow Plastic	**800Z-G3AG1**
		Black Plastic	**800Z-G3AG2**
Plastic Mounting Kit ***Cat. No. 800Z-G2AH1***	**Mounting Ring Nut for 22.5 mm Holes** Used on 22.5 mm devices.		800Z-G2AH1
Plastic Mounting Kit ***Cat. No. 800Z-G3AH1***	**Mounting Ring Nut for 30.5 mm Hole** Used on 30.5 mm devices.		800Z-G3AH1
Swivel Assembly ***Cat. No. 60-2439***	**30.5 mm Swivel/Tilt Mounting Assembly** This bracket allows you to orient the touch button in any position. It can be mounted on any vertical or horizontal surface. Compatible with 30.5 mm mounting only.	2.25 in. (57 mm)	60-2681
		1.15 in. (29 mm)	60-2439
Cat. No. 800E-AHA1	**30.5 mm to 22.5 mm Hole Size Adapter** This adapter allows a 22.5 mm push button operator to be installed in a panel with existing 30.5 mm mounting holes.	Metal	800F-AHA1
		Black Metal	800E-AHA2

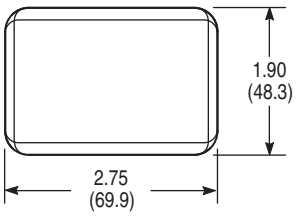
Accessories — Heavy Industrial

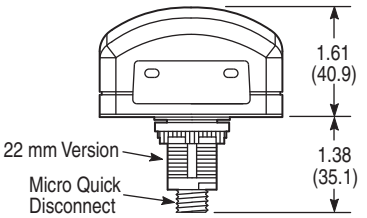
	Description		Cat. No.
Cat. No. 800Z-HAG1	**Guard** This guard helps protects against accidental activation of the touch surface and protects it from damage. Mounting screws are included.	Yellow Plastic	**800Z-HAG1**
Single Hub Base **Cat. No. 800P-B1** *Double Hub Base* **Cat. No. 800P-B2**	**Mounting Bases** The heavy industrial line products mount directly on these bases. The conduit hub(s) come with a 3/4 inch opening.	1	**800P-B1**
		2	**800P-B2**
Cat. No. 800P-N150	**Adapter** This adapter is used if mounting touch button onto a 4-1/2 in. x 2-3/8 in. (114.3 x 60.3 mm) enclosure pattern.		**800P-N150**
Cat. No. 800Z-N12	**Replacement Relay** **Note:** Package quantity of 2.	10...264V	800Z-N12
Cat. No. 800Z-HAH1	**Replacement Screws**	Guard-to-Base Mounting **Note:** package quantity of 4	800Z-HAH1
		Base Mounting **Note:** package quantity of 4	800Z-HAH2

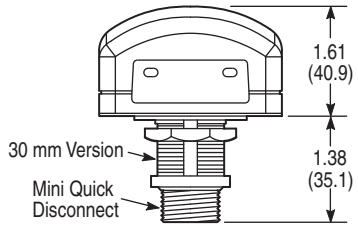
Approximate Dimensions

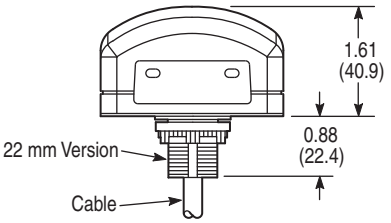
Dimensions in in. (mm). Dimensions are not intended to be used for manufacturing purposes.

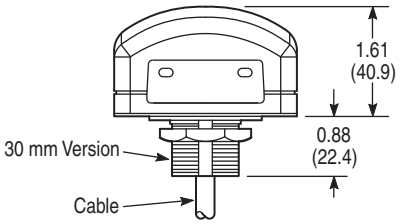
General Purpose



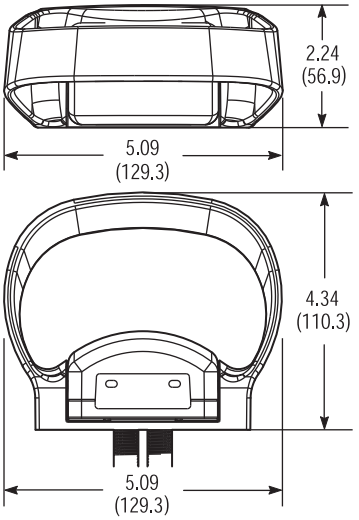




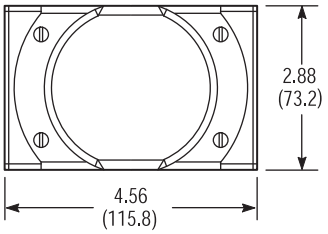


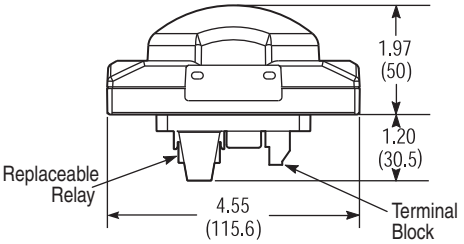


General Purpose With Guard

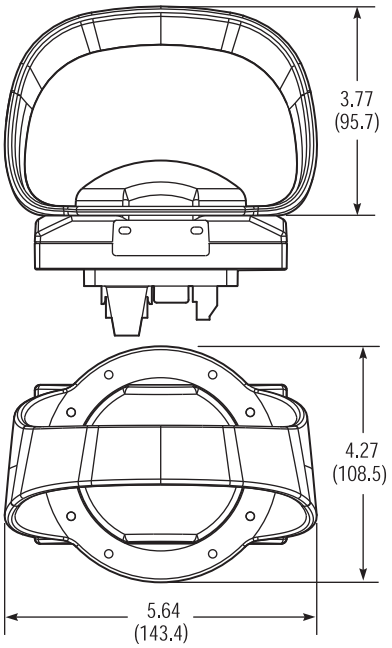


Heavy Industrial

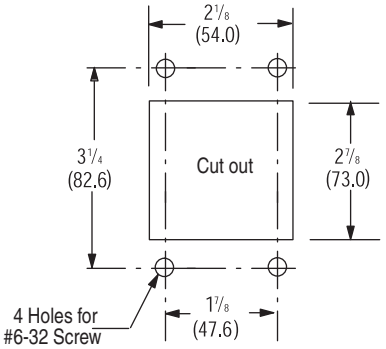




Heavy Industrial With Guard



Cutout and Mounting Screw Locations for a Flush Mounted Cover



Wiring Diagrams — Touch Button Terminations

General Purpose Line

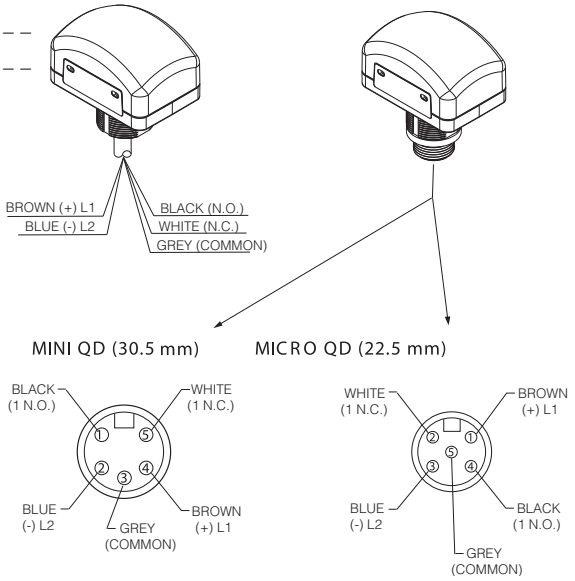
Electrical Connections: 10...40V DC and 20...30V AC Input Voltage (Relay Output); 85...264V AC Input Voltage (Relay Output)

Note: Separate N.O. and N.C. output relays with shared common.

5-Conductor Cabled (Relay Output)

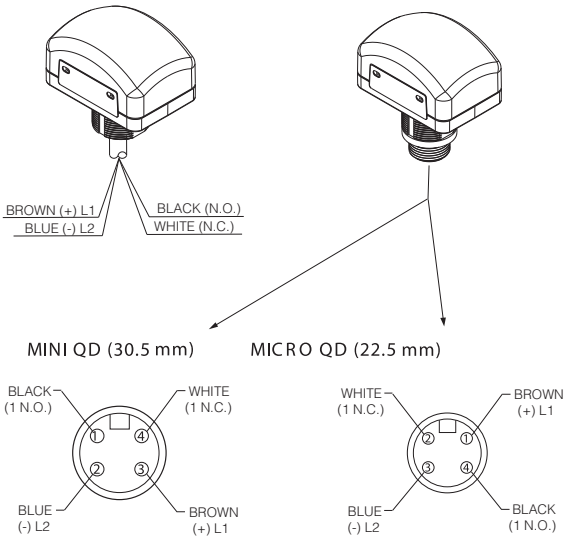
For 800Z-GL_ _ _

For 800Z-GF_ _ _

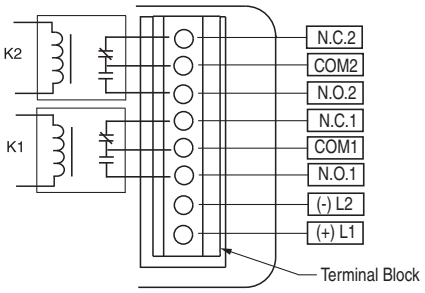


Electrical Connections: 10...30V DC Input Voltage (Transistor Output); 150 mA Max. per Circuit Output

4-Conductor Cabled



Heavy Industrial Line



Applications Detail

LED Blink Rate	Diagnostic	Description
** ** **	Power Up	Device touched during power up. Device will resume 10 seconds after removal of hand.
*** *** ***	Noise Detection	Device detected an unacceptable level of noise (>20 V/m). Device will resume once noise subsides.
**** **** ****	Margin Detection	A conductive film is building up on the sensing surface. Device will resume once cleared.

Notes

Logic

Selection Criteria

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Safety Relays

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Single-Function Safety Relays

MSR9T 5-14
MSR30RT/RTP 5-16
MSR33RT/RTP 5-18
MSR41 5-20
MSR117T 5-22
MSR126R/T 5-24
MSR127RP/TP 5-26
MSR131RTP 5-28
MSR142RTP 5-30
MSR144RTP 5-32
With Delayed Outputs
CU4 5-34
MSR38D/DP 5-36
MSR138DP 5-38
MSR178DP 5-40

Specialty Safety Relays

Two-Hand
MSR35H/HP 5-44
MSR125H/HP 5-46
Muting Light Curtain
MSR22LM 5-48
MSR42 5-52
Stop Motion Monitors
CU2 5-56
CU2 Sensor Details 5-58
Speed Monitors
MSR57P 5-60
Back EMF Monitors
CU3 5-64
Mat Controllers
MSR23M 5-66
MatGuard™ Controllers 5-68
MatGuard™ Mat Manager 5-70
Safedge™ Controllers 5-72
Sipha Control Units 5-74

Expansion Relays

MSR45E 5-76
With Delayed Outputs
MSR132E 5-78

Modular Safety Relays (200 Series)

Input and Output Module Selection 5-80
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MSR220P 5-86
MSR221P 5-88
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MSR238P 5-92
MSR240P 5-94
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Configurable Safety Relays (300 Series)

Input and Output Module Selection 5-100
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MSR312P 5-104
MSR320P 5-106
MSR329P 5-108
MSR330P 5-110
MSR338DP 5-112

Accessories

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Note:

E =	Expander	T =	Automatic Reset
D =	Delayed	R =	Manual Reset
H =	Two-Hand Control	M =	Safety Mat
P =	Removable Terminals		

‡ Information for this product line is available on the Safety Products Catalog website: www.ab.com/catalogs.

Programmable Safety Solutions

Overview

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Safety Logic Selection Flowchart 5-117

SmartGuard™ 600 Controller

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RSNetWorx™ for DeviceNet™ Software 5-121
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GuardPLC™ Safety Control Systems

GuardPLC Safety Control Systems 5-123
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GuardPLC 1800 Controller 5-127
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GuardPLC 2000 Safety System ....Web‡
Distributed Safety I/O for GuardPLC Ethernet 5-129
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GuardLogix® Integrated Safety System

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Guard I/O™ Modules

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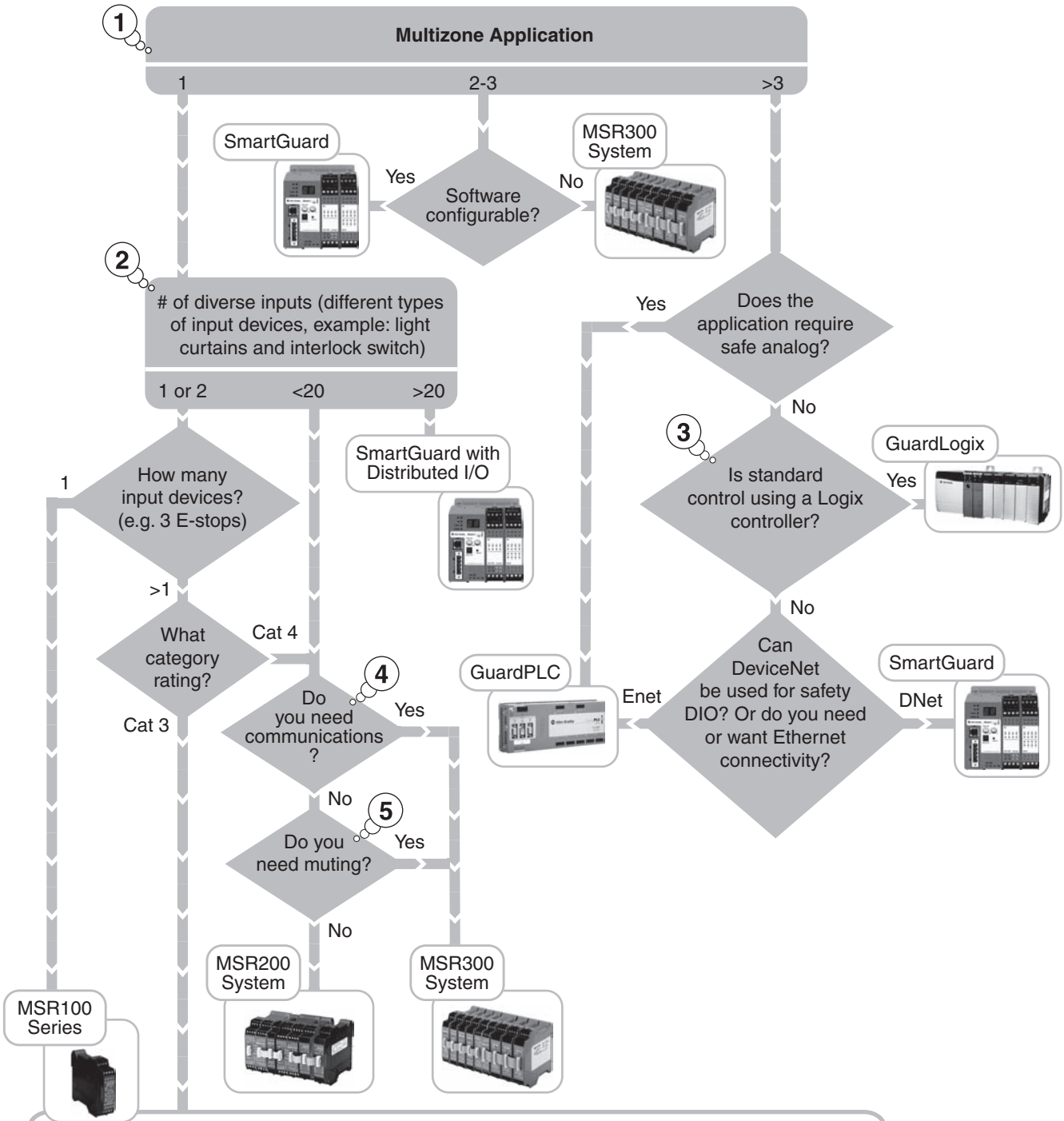
ArmorBlock® Guard I/O™ 5-141

Selection Flowchart



RECOMMENDED PRODUCTS

E-stop/Safety Switch	Light Curtain	Muting & Blanking	Time Delay	Two-Hand Control	Safety Mat
MSR126 **MSR127**	**MSR127** **MSR131**	**MSR42**	**MSR138**	**MSR125**	**MSR131**

Visit our website: www.ab.com/catalogs
Publication S117-CA001A-EN-P

1 Is This a Multizone Application?

In order to comply with safety standards and remain productive, machine builders have begun building functional safety features into machines using what has been termed the “Zone Concept.” The Zone Concept increases both safety and productivity by allowing a portion of the production line to slow or stop while the rest of the line remains active. The safety hazard, whether a minor malfunction of line equipment or an obstruction, can be removed or corrected without taking the entire line down, eliminating lengthy production shut downs and worker downtime. When the hazard is cleared, the line can quickly return to normal operation. Single function and/or expandable relays systems are suited only for single-zone control, while multizone control for 2…3 zones is best served through a configurable system such as MSR300 relays or a SmartGuard packaged controller. Any applications involving control of more than three zones (and therefore more complex logic) is better suited for a programmable safety controller—SmartGuard, GuardPLC or GuardLogix.

2 Diverse Inputs—Number and Type

For single- and multizone applications (≤ 3 zones), the number and type of inputs (e.g. interlock switches, safety mats, light curtains) will dictate the use of either safety relays (MSR100, MSR200 and MSR300) or a small packaged safety controller such as SmartGuard. For 1…2 inputs, dedicated standalone relays (MSR100) are a simple and cost effective solution, but for applications involving a high number of input devices, the hard wiring associated with individual relays can be restrictive. Therefore, in applications requiring a moderate input device count (20 or less), an expandable relay system with modular design and plug-in connections (MSR200, MSR300) is an ideal solution. In any case with safety relays, the types of input devices used will dictate the relay modules that must be selected; thus relay selection for a wide range of input devices can be complex. Applications requiring greater than 20 diverse inputs and a degree of complex logic lend themselves to the SmartGuard Controller in combination with Distributed I/O. Larger installations—those with a high number and wide variety of input device types—are best served with a safety PLC system as their programmable nature allows safety applications to be solved in software rather than hard-wiring large, cascaded relay systems.

3 Is Standard Control Using a Logix Controller?

A safety control system can be a dedicated (safety only) system or integrated, where standard and safety control are combined to maximize the re-use of components and tools.

GuardLogix brings together the benefits of a Logix platform—common programming environment, common networks, and common control engine—with integrated safety control in an easy-to-use environment while providing Safety Integrity Level (SIL) 3 control. By partnering with the Logix5000™ processor, GuardLogix users can benefit from common programming software, controller and I/O to help reduce development time and application cost.

GuardPLC and SmartGuard are the recommended platforms for applications requiring safety to be physically separated from standard control.

4 Do You Need Communications?

On-board communications allow the relay to deliver output and error status over an RS232/RS485 or fieldbus network (such as DeviceNet) to an HMI or other device. While the MSR200 series of modular safety relays does offer communications compatibility, it is not the most economical solution—MSR300 configurable safety relays are the best choice for applications requiring communications. Programmable safety controllers offer network connectivity and a high level of diagnostics, with SmartGuard and GuardPLC having DeviceNet and Ethernet capabilities, respectively.

5 Do You Need Muting?

Sometimes the process requires that the machine stop when personnel enters the area, yet remains running when automatically-fed material enters or exits—this is a situation where a muting function is necessary. Muting requires the combination of a light curtain, two or four muting sensors and a control unit to process the signals and determine if and when to activate the muting function. Muting sensors are mounted in front of and behind the light curtain and only a specific sequence of sensor outputs will initiate the muting function. For example, when the two sensors in front of the light curtain change state within a predetermined timeframe, the light curtain is “muted” and will not send a stop signal to the machine as the material enters. The MSR300 modular safety monitoring relay offering includes a module specifically designed to control the muting function in applications that do not require a specific sequence or timing requirement. Muting of the MSR42 can be conveniently set up using configuration software. If sequence and timing is required, then the MSR22LM may be better suited for your application.

Safety Relay Overview

Safety Relay Selection Navigator

Relay Model	Cat. per EN 954-1	1 NC	2 NC	1 NC & 1 NO	THC	SM	LC/ SG	SE	Immediate Outputs					Delayed Outputs					
									Safety		Auxiliary			Safety			Auxiliary		
									EM NO	SS NO	EM NC	SS NC	SS NO	EM NO	EM NC	SS NO	EM NC	SS NC	SS NO
Single Function Safety Relays																			
MSR9T	3	—	—	1	—	—	—	—	2	—	1	—	—	—	—	—	—	—	—
MSR30RT/RTP	4	1	1	—	—	—	—	—	—	2	—	—	1	—	—	—	—	—	—
MSR33RT/RTP	4	—	—	1	—	—	—	—	—	2	—	—	1	—	—	—	—	—	—
MSR41	4	—	—	—	—	—	1	—	—	2	—	2	—	—	—	—	—	—	—
MSR117	4	1	—	—	—	—	—	—	3	—	1	—	—	—	—	—	—	—	—
MSR126R/T	4	1	1	—	—	—	1	—	2	—	—	—	—	—	—	—	—	—	—
MSR127RP/TP	4	1	1	—	—	—	1	—	3	—	1	—	—	—	—	—	—	—	—
MSR131RP/TP	4	1	1	—	—	1	1	—	3	—	2	2	—	—	—	—	—	—	—
MSR142RTP	4	1	1	—	—	1	1	—	7	—	4	2	—	—	—	—	—	—	—
MSR144RTP	4	1	1	—	—	1	1	—	2	—	2	2	—	—	—	—	—		—
Delayed Outputs																			
CU4	3	—	—	—	—	—	—	—	—	—	—	—	—	2	1	—	—	—	—
MSR38D/DP	4	1	1	—	—	1	—	—	—	—	—	—	1	—	—	2	—	—	—
MSR138DP	4/3	1	1	—	—	—	1	—	2	—	—	—	—	3	—	—	—	—	—
MSR138.1DP	4/3	1	1	—	—	—	1	—	2	—	—	—	—	2	1	—	—	—	—
MSR178DP	4	1	1	—	1	—	1	—	—	—	—	—	—	3	—	—	2	—	—
Specialty Safety Relays																			
Two-Hand Control																			
MSR35H/HP	4	—	—	2	1	—	—	—	—	2	—	—	1	—	—	—	—	—	—
MSR125H/HP	4	—	—	2	1	—	—	—	2	—	—	—	—	—	—	—	—	—	—
Muting LIght Curtain																			
MSR22LM	4	—	—	—	—	—	3	—	2	—	1	2	—	—	—	—	—	—	—
MSR42	4	—	1	—	—	—	3	—	—	2	—	2	—	—	—	—	—	—	—
Stop Motion Monitors																			
CU2	1	—	—	1	—	—	—	—	—	—	—	—	—	2	—	1	—	—	—
Speed Monitors																			
MSR57P	4	1	1	1	—	1	1	—	—	6	—	—	—	—	—	—	—	—	—
Back EMF Monitors																			
CU3	1	—	—	—	—	—	—	—	2	—	1	—	—	—	—	—	—	—	—
Mat Controllers																			
MSR23	3	—	—	—	—	1	—	—	2	—	1	—	—	—	—	—	—	—	—
440F-C4000P	3	—	—	—	—	1	—	—	2	—	1	—	—	—	—	—	—	—	—
440F-C4000S	3	—	—	—	—	1	—	—	2	—	1	—	—	—	—	—	—	—	—
Mat Manager																			
C280**	3	—	—	—	—	8✶	—	—	6❄	—	1	—	—	—	—	—	—	—	—
Safedge™ Controllers																			
251D	3	—	—	—	—	—	—	1‡	2	—	1	—	—	—	—	—	—	—	—
252D	3	—	—	—	—	—	—	1‡	1	—	1	—	—	—	—	—	—	—	—
C251P	3	—	—	—	—	—	—	1‡	2	—	1	—	—	—	—	—	—	—	—
Sipha Controllers																			
Sipha 1	3	—	—	1	—	—	—	—	1	—	—	1	—	—	—	—	—	—	—
Sipha 2	3	—	—	6	—	—	—	—	2	—	1	—	—	—	—	—	—	—	—
Sipha 6	4	—	—	6	—	—	—	—	2	—	1	—	—	1	—	—	—	—	—

Note: THC= Two-hand Control, SM = Safety Mat, LC = Light Curtain, SG = SensaGuard, SE = Safedge, EM = Electromechanical, SS = Solid State, and • = included

✶ Up to eight mats can be monitored.

❄ Up to six mats can be monitored.

‡ Can support more than one edge in series or parallel.

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Publication S117-CA001A-EN-P

Allen-Bradley
GuardMaster®

Operating Voltage				Reset❄		Output Switching Current, A		Housing Width (mm)	Removable Terminals	Additional Information	Relay Model
24 DC	24 AC	115 AC	230 AC	Auto./ Man.	Mon. Man.	250V AC	24V DC				
•	•	•	•	•	—	4	3	45.5	—	5-14	MSR9T
•	—	—	—	•	•	—	2	22.5	•	5-16	MSR30RT/RTP
•	—	—	—	•	•	—	2	22.5	•	5-18	MSR33RT/RTP
•	—	—	—	•	—	—	4	22.5	•	5-22	MSR41
•	•	—	—	•	—	5	3	22.5	—	5-22	MSR117
•	•	•	•	•	•	6	3	22.5	—	5-24	MSR126R/T
•	•	•	•	•	•	5	3	22.5	•	5-26	MSR127RP/TP
•	•	•	•	•	•	6	3	45.0	•	5-28	MSR131RP/TP
—	•	•	•	•	•	6	3	67.5	•	5-30	MSR142RTP
•	—	—	—	•	•	5	3	45.0	•	5-32	MSR144RTP
•	•	—	—	•	—	5	3	22.5	—	5-34	CU4
•	—	—	—	•	•	—	2	22.5	•	5-36	MSR38D/DP
•	•	•	•	•	•	6	3	45.0	•	5-38	MSR138DP
•	•	•	•	•	•	6	3	45.0	•	5-38	MSR138.1DP
•	•	•	•	•	—	4	2	35.0	•	5-40	MSR178DP
•	—	—	—	—	—	—	2	22.5	•	5-44	MSR35H/HP
•	—	•	•	—	—	6	3	22.5	•	5-46	MSR125H/HP
•	—	—	—	—	•	3	3	45.0	•	5-48	MSR22LM
•	—	—	—	•	•	—	4	22.5	•	5-48	MSR42
•	•	•	•	•	—	4	3	45	—	5-56	CU2
•	—	—	—	•	•	—	2	67.5	•	5-60	MSR57P
•	•	•	•	•	—	4	3	45	—	5-64	CU3
•	•	•	—	•	•	3	3	22.5 & 45.0	•	5-66	MSR23M
•	•	•	•	•	•	4	2	210	—	5-66	440F-C4000P
•	•	•	•	•	•	4	2	210	—	5-66	440F-C4000S
•	•	•	•	•	•	4	2	210	—	5-70	C280
•	•	•	•	•	—	2	1	45	—	5-72	251D
•	•	—	—	•	—	2	1	22.5	—	5-72	252D
•	•	•	•	•	—	2	1	130	—	5-72	C251P
•	•	—	—	•	—	4	2	22.5	—	5-74	Sipha 1
•	•	•	•	•	—	4	2	45	—	5-74	Sipha 2
•	•	•	•	•	—	4	2	90	—	5-74	Sipha 6

Note: Auto./Man. = Automatic/Manual and Mon. Man. = Monitored Manual, and • = included

Safety Relay Overview

Relay Model	Cat. per EN 954-1	1 NC	2 NC	1 NC & 1 NO	THC	SM	LC/ SG	SE	Immediate Outputs					Delayed Outputs					
									Safety		Auxiliary			Safety			Auxiliary		
									EM NO	SS NO	EM NC	SS NC	SS NO	EM NO	EM NC	SS NO	EM NC	SS NC	SS NO
Expansion Relays																			
MSR45E	4	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—
MSR132E/EP	4	1	1	—	—	—	—	—	4	—	2	—	—	—	—	—	—	—	—
Delayed Outputs																			
MSR132ED/EDP	3	1	1	—	—	—	—	—	—	—	—	—	—	4	—	—	2	—	—
Modular Safety Relays (Series 200)																			
MSR210P	4	2	2	2	—	2	—	—	2	—	1	—	2	—	—	—	—	—	—
MSR211P	4	2	2	—	—	—	2	—	2	—	1	—	2	—	—	—	—	—	—
MSR220P	4	2	2	2	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—
MSR221P	4	2	2	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—
MSR230P	4	—	—	—	—	—	—	—	4	—	—	—	—	—	—	—	—	—	—
MSR238P	3	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	1	—	—
MSR240P	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
MSR241P	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—
MSR245P	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Configurable Safety Relays (Series 300)																			
MSR310P	4	—	—	—	—	—	—	—	—	—	—	—	3	—	—	—	—	—	—
MSR312P	4	—	—	—	—	—	—	—	—	—	—	—	4	—	—	—	—	—	—
MSR320P	4	2	2	2	1	2	2	—	—	—	—	—	2	—	—	—	—	—	—
MSR329P	4	—	—	—	—	—	—	—	—	—	—	—	4	—	—	—	—	—	—
MSR330P	4	—	—	—	—	—	—	—	3	—	1	—	—	—	—	—	—	—	—
MSR338DP	3	—	—	—	—	—	—	—	—	—	—	—	—	3	—	—	1	—	—

Note: THC= Two-hand Control, SM = Safety Mat, LC = Light Curtain, SG = SensaGuard, SE = Safedge, EM = Electromechanical, and SS = Solid State

Operating Voltage				Reset❄		Output Switching Current, A		Housing Width (mm)	Removable Terminals	Additional Information	Relay Model
24 DC	24 AC	115 AC	230 AC	Auto./Man.	Mon. Man.	250V AC	24V DC				
—	—	—	—	—	—	3	6	22.5	•	5-78	MSR45E
•	•	—	—	—	—	6	3	22.5	•	5-78	MSR132E/EP
•	—	—	—	—	—	6	3	22.5	•	5-78	MSR132ED/EDP
•	—	—	—	•	•	3	2.5	45.0	•	5-82	MSR210P
•	—	—	—	•	•	3	2.5	45.0	•	5-84	MSR211P
•	—	—	—	—	—	—	—	17.5	•	5-86	MSR220P
•	—	—	—	—	—	—	—	17.5	•	5-88	MSR221P
•	—	—	—	—	—	3	2.5	22.5	•	5-90	MSR230P
•	—	—	—	—	—	5	3	22.5	•	5-92	MSR238P
•	—	—	—	—	—	—	—	17.5	•	5-94	MSR240P
•	—	—	—	—	—	—	2	45	•	5-96	MSR241P
•	—	—	—	—	—	—	—	144	•	5-98	MSR245P
•	—	—	—	•	•	—	—	35	•	5-102	MSR310P
•	—	—	—	•	•	—	—	35	•	5-104	MSR312P
•	—	—	—	—	—	—	50 mA	17.5	•	5-106	MSR320P
•	—	—	—	—	—	—	30…200 mA	17.5	•	5-108	MSR329P
•	—	—	—	—	—	6	3	22.5	•	5-110	MSR330P
•	—	—	—	—	—	5	3	22.5	•	5-112	MSR338DP

Note: Auto./Man. = Automatic/Manual and Mon. Man. = Monitored Manual, and • = included

MSR100 Single Function Safety Relays

Features/Benefits

A simple and cost-effective solution for a wide variety of applications, MSR100 single function safety relays support a wide variety of input devices and output configurations. Ideal for relatively small safety applications and single zone control, MSR100 relays are designed in a compact package with removable terminal for ease of installation and maintenance. These relays are also available in electromechanical versions, or solid-state models for applications involving high cycle rates.

Applications

- Wide range of general purpose applications
- Automotive
- Packaging
- Food and beverage
- Semiconductor
- Material handling
- OEM machines

Common Misapplications

- Complex safety solutions
- Applications requiring a high level of diagnostics
- Driving high current loads
- Electromechanical relays used for high cycle rates

MSR200 Modular Safety Relays

Features/Benefits

Using plug-and-play digital I/O expansion modules, the MSR200 expandable modular relay system supports up to 22 diverse inputs (mats, light curtains, switches, etc.) to allow safety control of larger, more complex manufacturing equipment with a single relay system. The MSR200 family's microprocessor-based design offers enhanced diagnostic and communication functionality over multiple protocols. It also allows the relay to deliver output and error status over a fieldbus network to an HMI. Simple plug-in connectivity between modules provides simple system expansion with reduced wiring. Offering SIL3, delayed output support and an optional dedicated display module, the MSR200 system provides substantial cabinet space savings over dedicated single-function relays.

Applications

- Wide range of general purpose applications
- Automotive
- Packaging
- Food and beverage
- Semiconductor
- Material handling
- PLC controlled applications
- Medium size machines

Common Misapplications

- Dedicated input connections for input devices
- Not economical when communication is needed (MSR300 recommended)

MSR300 Configurable Safety Relays

Features/Benefits

The MSR300 family of expandable modular safety relays handles larger, more complicated safety systems by allowing connection of multiple input modules to a single base unit. It offers a logic configuration with multiple inputs and the control of multiple independent outputs. The system supports up to 20 diverse inputs and can control up to 3 zones, performing simple function block logic configurations through rotary switch settings as opposed to software configuration. Modules can be mixed and matched to work with various input device types, reducing the need for multiple single-purpose relays, simplifying setup, wiring, maintenance and saving valuable panel space. The MSR300's diagnostic capabilities over multiple protocols provide input, output and error status. Offering SIL3, two-hand control support and monitoring through HMI, the MSR300 is easily customized and expanded thanks to plug-in connections that reduce wiring for the addition of inputs and outputs.

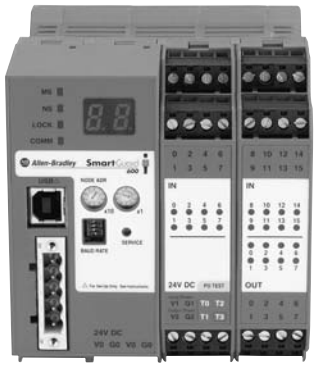
Applications

- Wide range of general purpose applications
- Automotive
- Packaging
- Food and beverage
- Semiconductor
- Material handling
- Wide variety of input types
- Reduced inventory

Common Misapplications

- Single zone applications with no communications requirements

SmartGuard™ 600



Features/Benefits

The SmartGuard 600 controller is designed for SIL3 applications that require some complex logic. It is a “packaged safety controller” that includes the CPU, 16 Safety Inputs and 8 Safety Outputs and an embedded DeviceNet communications port. Using the DeviceNet communications port, the SmartGuard 600 controller can control additional safety I/O modules including the 1791DS CompactBlock Guard I/O and 1732DS ArmorBlock Guard I/O, as well as 1734 POINT Guard I/O modules via a 1734-PDN module. In addition, the SmartGuard controller can also communicate with standard PLCs and HMIs on DeviceNet or EtherNet/IP networks. SmartGuard 600 systems are programmed using RSNetworx software.

Applications

- Wide range of general purpose applications
- Automotive
- Packaging
- Food and beverage
- Semiconductor
- Material handling

Common Misapplications

- Simple applications (MSR300 recommended)

Guard I/O™

Features/Benefits

Guard I/O is the name for the Rockwell Automation family of Safety I/O modules that communicate via CIP Safety on EtherNet/IP and DeviceNet networks. CompactBlock Guard I/O modules on EtherNet/IP and DeviceNet networks are available in IP20 (in-cabinet) form-factor ArmorBlock Guard I/O modules on DeviceNet networks are available in IP67 (on-machine) form-factors. POINT Guard I/O modules provide EtherNet/IP and Devicenet connectivity in a maximum density in-cabinet I/O solution.

Applications

- Wide range of general purpose applications
- Automotive
- Packaging
- Food and beverage
- Semiconductor
- Material handling

Common Misapplications

- Simple applications (MSR300 recommended)

GuardPLC™

Features/Benefits

GuardPLC refers to a family of SIL3 safety controllers that are programmed with the RSLogix Guard software package. Like the SmartGuard 600, the GuardPLC 1600 and GuardPLC 1800 Safety PLCs are “packaged safety controllers” with a CPU, safety I/O and embedded communication networks. In the case of the GuardPLC 1600 and 1800 the embedded communication network is Ethernet for communication to GuardPLC Safety I/O modules as well as EtherNet/IP for communications to standard controllers and HMIs. The GuardPLC 1600 includes 20 safety inputs and 8 safety outputs. The GuardPLC 1800 includes 24 safety inputs, 8 safety outputs, 8 analog safety inputs and 2 safety rated high speed counters.

Applications

- Wide range of general purpose applications
- Automotive
- Packaging
- Food and beverage
- Semiconductor
- Material handling

Common Misapplications

- Simple applications with low I/O counts

GuardLogix®

Features/Benefits

The GuardLogix system is a SIL3 Logix5000™ controller that in addition to running all standard control functions like sequential, motion, etc., also has the ability to run a Safety Task and control safety DIO. This enables both safety and standard applications to run simultaneously in a single application project. This significantly reduces integration, spares and training and improves the flow of data to HMI and information systems. A GuardLogix controller communicates to Safety I/O via a standard communication modules. It is programmed with RSLogix 5000, just like a Logix5000 processor.

Applications

- Wide range of general purpose applications
- Automotive
- Packaging
- Food and beverage
- Semiconductor
- Material handling

Common Misapplications

- Simple applications with low I/O counts

Safety Relay Overview

Why Use a Minotaur?

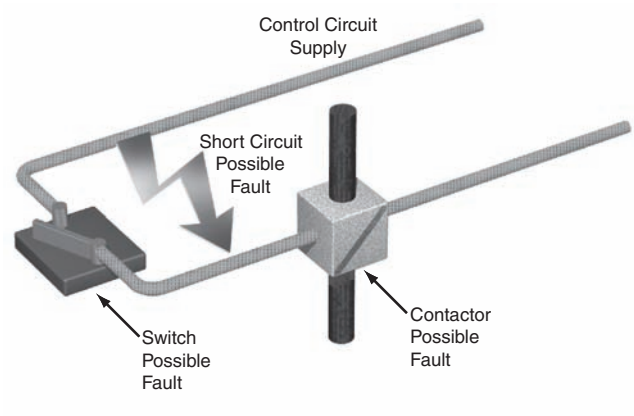
Control units provide functions such as time delays, motion sensing and two hand control supervision.

The functional requirements for monitoring safety relay units, such as the Guardmaster Minotaur range, will depend on their use in the system.

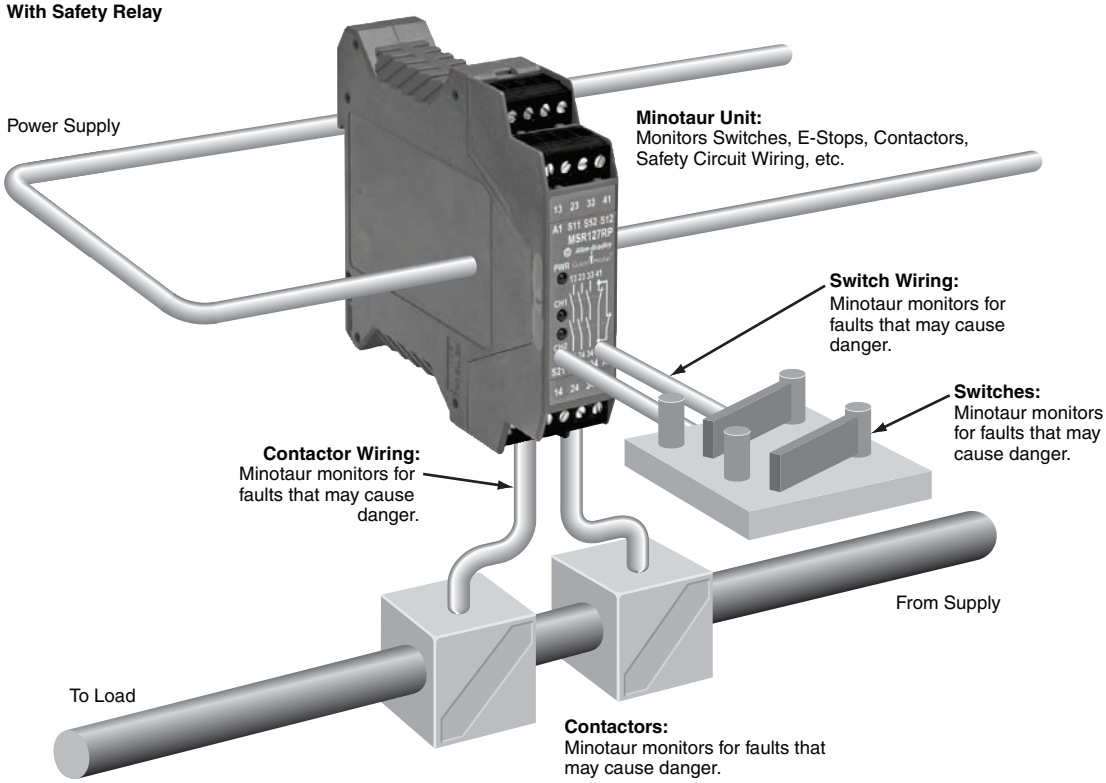
Their basic tasks are:

1. To detect faults on safety-related electrical control circuits, e.g. faults in sensors, wiring, contactors, etc.
2. To provide an ensured switching action, e.g. to act as an intermediate relay to amplify a signal or distribute it to multiple devices.
3. To provide a manual reset facility. They achieve their function by using internal redundancy (e.g. duplication) and monitoring.

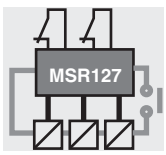
With Safety Relay



With Safety Relay



Applications



- Contactor monitoring circuit
- Contactor switching circuit
- Supply inclusive of switching circuit
- Contactor
- Monitored by Minotaur

Selection Guidelines

There are four safety system architectures available from Rockwell Automation. They are as follows:

1. Component systems: At the lowest level, a safety function can be accomplished with an actuating device and a control device. For example, an e-stop button that opens up the coil of a safety control relay performs a simple safety function. Component system architectures are typically used in low risk applications.

2. Dedicated safety monitoring relay systems: Dedicated safety relays are used for specific applications. These systems utilize packaged control modules that are designed to interface to common safety devices such as e-stops, safety gates, light curtains, and safety mats. Some dedicated relays provide special functions like timing, two-hand control, muting, and presence sensing device initiation. Since there are many different types of input devices and functions, there are many different types of dedicated safety monitoring relays. Dedicated safety monitoring relays have the ability to provide basic diagnostics in the form of LEDs on their front panels and auxiliary contacts that may be connected to a PLC or indicator lamp. Dedicated safety relays system architectures are typically used in medium to high-risk applications.

3. Expandable safety monitoring relay systems (MSR200): It provides the unique ability to easily add input and output modules to a "basic" safety relay module. Since the modular system is microprocessor based, it also has the ability to provide enhanced diagnostics over a communication connection. For instance, the I/O and error status can be communicated over a field bus network. Being a relatively new architecture, it currently accepts inputs from common types of safety devices: e-stops, safety gates, light curtains and safety mats. Modular safety relay system architectures are typically used in medium- to high-risk applications.

4. Configurable safety monitoring relay systems (MSR300): The MSR300 family of expandable modular safety relays handles larger, more complicated safety systems by allowing connection of multiple input modules to a single base unit. It offers the ability for a logic configuration with multiple inputs and the control of multiple independent outputs. The system can control up to three independent groups of outputs and perform simple function block logic configurations through rotary switch settings—no software needed. Mix and match modules to work with various input device types, reduces the need for multiple single-purpose relays, simplifies setup, wiring, maintenance and saves valuable panel space. The MSR300s diagnostic capabilities and communication functionality also reduces maintenance time by providing input, output and error status.

5. Safety PLC systems: Safety PLCs bring programmability, high I/O counts, distributed control and a high level of communications to safety architectures. They also bring some special functions not previously available in dedicated systems: high speed counters and analog signals. Safety PLC architectures are often applied in a variety of complex, high-risk applications.

Making the Right Choice

Begin the selection process by evaluating the needs of your application. The *Quick Guide* below can be used to direct you towards the best solution. Some of the guidelines will clearly point you to one type of architecture or another. Some will require further analysis before making a final decision. Due to the diverse nature of machine guarding, it is possible to create a hybrid system or a combination of architectures to provide adequate safeguarding of a particular machine or manufacturing system.

Quick Guide

Characteristics	Architecture
Application Complexity	
Low	Dedicated Relays
Medium	Dedicated or Expandable Relays
High	Safety PLCs
Communication	
Status	Expandable Relays
Control	Safety PLCs
Diagnostics	
Low	Dedicated Relays
Medium	Expandable Relays
High	Safety PLCs
Expandability	
Low	Dedicated Relays
Medium	Expandable Relays
High	Safety PLCs
Input Types	
Special	Dedicated Relays or Safety PLCs
Common	Dedicated or Expandable Relays
I/O Count	
Low	Dedicated Relays
Medium	Expandable Relays
High	Safety PLCs
I/O Location	
Contained	Dedicated or Expandable Relays
Spread Out	Safety PLCs
Sequential Shutdown	
None	Dedicated or Expandable Relays
Yes	Safety PLCs
Zone Control	
Few	Dedicated or Expandable Relays
Many	Safety PLCs

Single-Function Safety Relays

MSR9T

Description

The MSR9T has one normally closed and one normally open dual-channel input for use with gate interlocks and emergency stop buttons in higher risk applications. The MSR9T is typically used for gate interlocks incorporating the diversity of one positive opening and one non-positive opening interlock.

The MSR9T has output monitoring that can accommodate an automatic/manual reset. Automatic/manual reset can use a jumper or can be used to check operation of the contacts.

The MSR9T has two normally open safety outputs and one normally closed auxiliary output. The safety outputs have independent and redundant internal contacts to support the safety function. The auxiliary contact is a nonsafety output intended to provide an external signal about the status of the safety outputs.

Features

- Category 3 per EN 954-1
- Stop category 0
- One N.C. and one N.O. dual channel input
- Two N.O. safety outputs
- One N.C. auxiliary output
- Automatic reset
- 45 mm wide housing

LED Indicators

Green	Power On
Green	Output On

Specifications

Safety Ratings			
Standards		EN 954-1, ISO13849-1, IEC/EN 60204-1, IEC 60947-5-1, ANSI B11.19, AS4024.1	
Safety Classification		Cat. 3 per EN 954-1 (ISO 13849-1)	
Certifications		CE Marked for all applicable directives, cULus, and c-Tick	
Power Supply			
Input Power Entry		24V AC/DC, 115/230V AC, 50/60 Hz	
Power Consumption		<4V A	
Inputs			
Safety Inputs		1 N.C. & 1 N.O.	
Input Simultaneity		0.5 seconds	
Input Resistance, Max.		500 Ω	
Reset		Auto./Manual	
Response Time		50 ms	
Outputs			
Safety Contacts		2 N.O.	
Auxiliary Contacts		1 N.C.	
Thermal Current I_{th}		4 A (nonswitching)	
Rated Impulse withstand Voltage		2500V	
Switching Current @ Voltage, Min.		10 mA @ 10V	
Fuses, Output		5 A quick acting (external)	
Electrical Life		220V AC/4A/880VA cosϕ = 0.35…0.1 M 220V AC/1.7A/375VA cosϕ = 0.6…0.5 M 30V DC/2A/60W = 1 M 10V DC/0.01A/0.1W = 2 M	
Mechanical Life		2,000,000 operations	
Utilization Category			
A300/AC-15	(Ue)	240V	120V
	(Ie)	3 A	6 A
A300/DC-13	(Ue)	24V	
	(Ie)	3 A	
Environmental and Physical Characteristics			
Enclosure Type Rating/ Terminal Protection		IP40 (NEMA 1), DIN 0470/ IP20, DIN 0470	
Operating Temperature [C (F)]		-10…+55 ° (14…131 °)	
Vibration		0.75 mm (0.30 in.) peak, 10…55 Hz	
Shock		30 g, 11 ms half-sine	
Mounting		35 mm DIN Rail	
Weight [g (lbs)]		210 (0.46)	
Conductor Size, Max.		1 x 2.5 mm² (14 AWG) stranded, 1 x 4 mm² (12 AWG) solid	

∗ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the following assumptions:
- Mission time/Proof test interval of 20 years
- Functional test at least once within six-month period

Product Selection

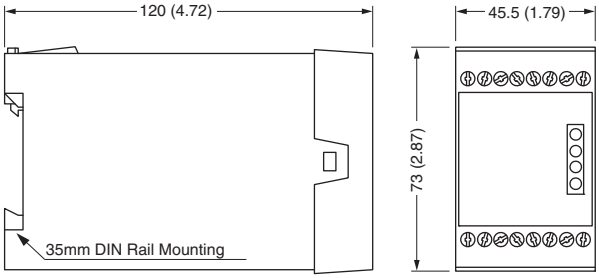
Inputs	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. No.
1 N.C. & 1 N.O.	2 N.O.	1 N.C.	Fixed	Auto./Manual	24V AC/DC	440R-F23027
					110/230V AC	440R-F23028

Accessories

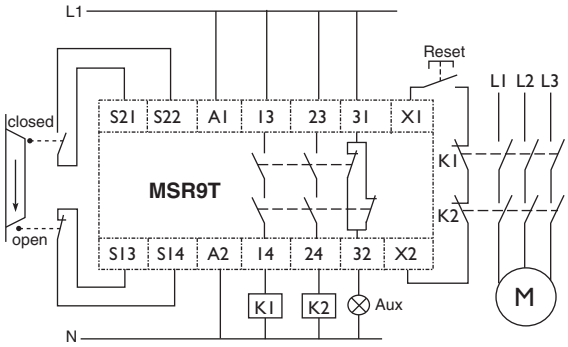
Description	Cat. No.
500 mA Fuse—Bussmann Cat. No. ETF-500 mA	440R-A31562

Approximate Dimensions

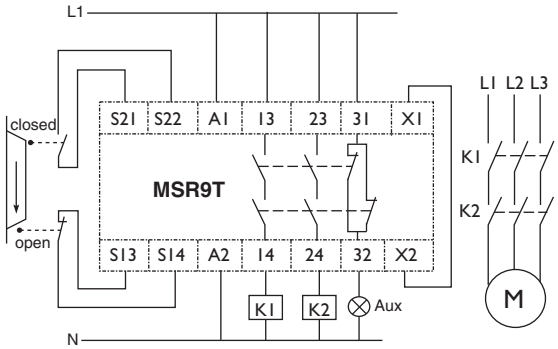
Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



Typical Wiring Diagrams

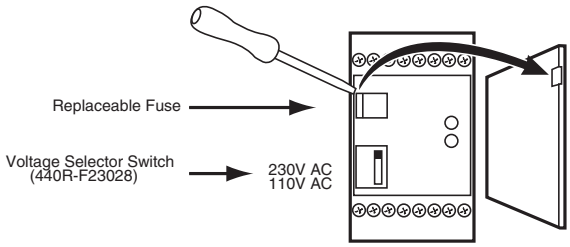


Dual-Channel Safety Gate, Manual Reset, Dual-Channel Output, Monitored Output



Dual-Channel Safety Gate, Automatic Reset, Dual-Channel Output, No Monitored Output

Application Details



Single-Function Safety Relays

MSR30RT/RTP

Housing with removable terminals shown.

Description

The Minotaur MSR30RT/RTP is a microprocessor based, monitoring safety relay, with safety-rated, solid-state outputs.

The versatility of the MSR30RT/RTP inputs allows it to be connected to gate interlocks, e-stop devices and four-wire safety mats. The gate interlocks and e-stops can be either single channel or dual channel normally-closed circuits.

The reset capability of the MSR30RT/RTP allows it to set up for manual or automatic start and restart.

The outputs include two normally-open safety-rated outputs that can be connected to loads up to 2 A at 24V DC. These outputs can be used to send a safety stop signal to a machine or manufacturing system.

The MSR30RT/RTP also has one solid-state normally-closed auxiliary output, which must only be used to indicate the status of the MSR30RT/ RTP.

Features

- Category 4 per EN954-1
- Stop Category 0
- Two solid-state safety outputs
- One solid-state auxiliary output
- One N.C., two N.C or safety mat input
- Monitored manual or automatic/manual reset

LED Indicators

Green	Power (Pwr)
Green	K1 Closed
Green	K2 Closed

Wiring Terminations

S11 & S21	Pulse train output
S12 & S22	Input contacts
A1 – S34	Reset switch
S11 – S34	Automatic reset, start-up test disabled
S21 – S34	Automatic reset, start-up test enabled
A1 – Y2	Monitoring circuit
A1 – Y41	Cross-fault monitoring disabled

Specifications

Safety Ratings	
Standards	EN 954-1, ISO 13849-1, IEC EN 60204-1, ANSI B11.19, AS 4024.5
Safety Classification	Cat. 4 per EN 954-1 (ISO 13849-1), SIL CL3 per EN IEC 62061, PLe per ISO 13849-1
Functional Safety Data ✶ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	PFH_D: < 9.2 x 10^{-10} MTTFd: > 631 years Suitable for performance levels Ple (according to ISO 13849-1:2006) and for use in SIL CL3 systems (according to IEC 62061) depending on the architecture and application characteristics
Certifications	CE Marked for all applicable directives, cULus, c-Tick, and TÜV
Power Supply	
Input Power Entry	24V DC SELV
Power Consumption	3 W
Inputs	
Safety Inputs	1 N.C., 2 N.C.
Input Simultaneity	Infinite
Input Resistance, Max.	200 Ω
Reset	Auto./Manual or Monitored Manual
Power On Delay/ Recovery Time	3 seconds/20 ms
Response Time	15 ms
Outputs	
Safety Contacts	2 N.O. Solid State
Auxiliary Contacts	1 N.O. Solid State
Fuses, Output	External 6 A slow blow or 10 A fast acting
Power LED Diagnostics	3 s Blink: Initialization Constant: Normal Operation 2 Blinks: Configuration change during operation 3 Blinks: Cross-fault after reset 4 Blinks: Solid-state output switch fault Continuous blinking: Internal fault 5 Blinks: Reset switch closed after reset
Utilization Category	
DC-13	2 A @ 24V DC
Environmental and Physical Characteristics	
Enclosure Type Rating/ Terminal Protection	IP40 (NEMA 1) DIN 0470/ IP20, DIN 0470
Operating Temperature [C (F)]	-5…+55 ° (23…131 °)
Vibration	10…55 Hz, 0.35 mm
Shock	10 g, 16 ms, 100 shocks
Mounting	35 mm DIN Rail
Weight [g (lbs)]	130 (0.287)
Conductor Size, Max.	0.2…2.5 mm^2 (24…14 AWG)

✶ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the following assumptions:
- Mission time/Proof test interval of 20 years

Product Selection

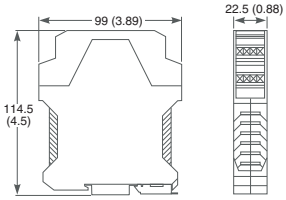
Inputs	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. No.
1 N.C., 2 N.C.	2 N.O. Solid State	1 N.O. Solid State	Fixed	Auto./Manual or Monitored Manual	24V DC SELV	440R-N23197
			Removable		24V DC	440R-N23198

Accessories

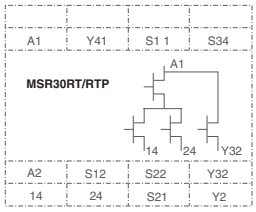
Description	Cat. No.
Bag of 4, 4-Pin Screw Terminal Blocks	440R-A23209
Bag of 4, 4-Pin Spring Clamp Terminal Blocks	440R-A23228

Approximate Dimensions

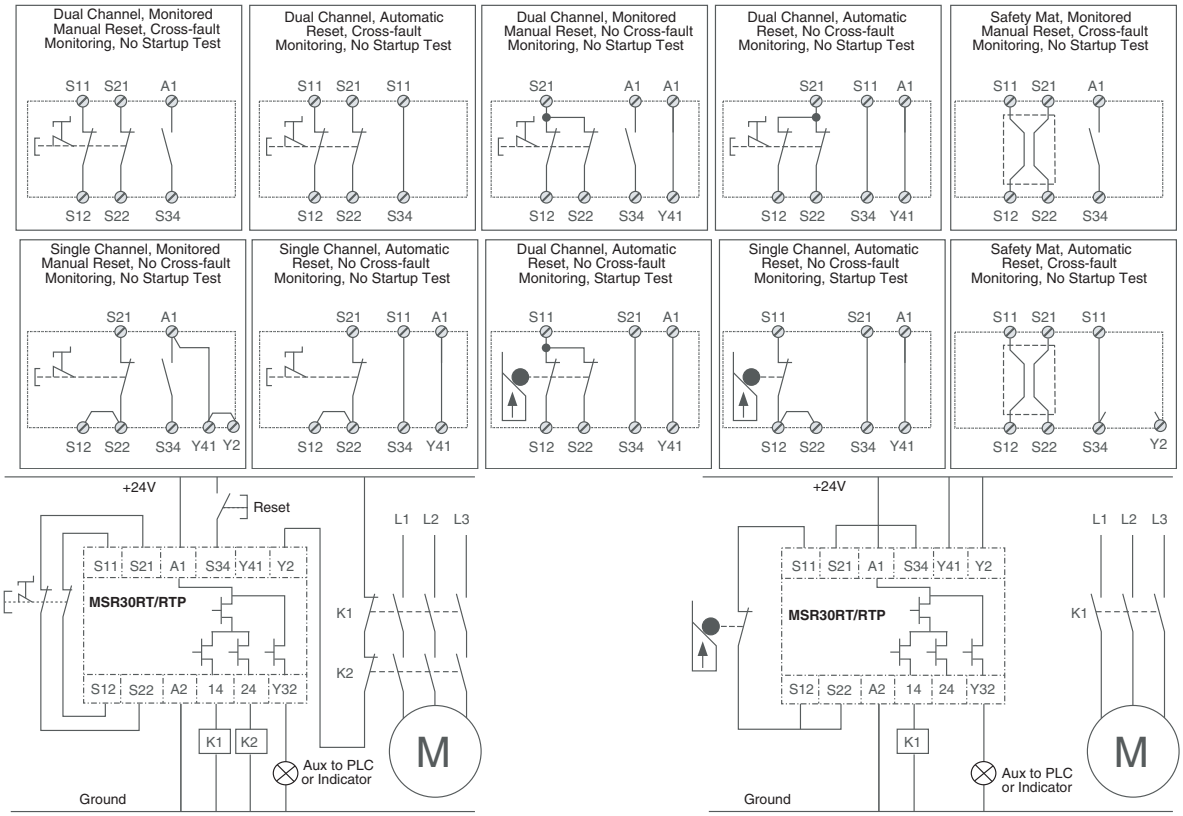
Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



Block Diagram



Typical Wiring Diagrams



Dual Channel E-Stop, Dual Channel Outputs, Monitored Manual Reset, Output Monitoring

Single Channel Gate Interlock, Single Channel Output, Automatic Reset, No Output Monitoring

Single-Function Safety Relays

MSR33RT/RTP

Housing with removable terminals shown.

Description

The Minotaur MSR33RT/RTP is a microprocessor-based, monitoring safety relay, with safety-rated, solid-state outputs.

The MSR33RT/RTP is designed to operate with dual channel inputs where one channel is normally closed and the other is normally open. The Sipha sensors can be connected to the MSR33RT/RTP inputs.

Test pulses are used to dynamically check the input circuits. All inputs and outputs are short-circuit protected.

The reset capability of the MSR33RT/RTP allows it to set up for monitored manual or automatic reset. A start-up test can be enabled if automatic reset is used. The start-up test requires the inputs to be cycled before energizing the outputs. The reset and start-up test is determined by the connection wiring.

The outputs include two normally-open safety-rated outputs that can be connected to loads up to 2 A at 24V DC. These outputs can be used to send a safety stop signal to a machine or manufacturing system.

The MSR33 also has one solid-state, normally-open auxiliary output, which must only be used to indicate status of the MSR33RT/RTP.

Features

- Category 4 per EN954-1
- Stop Category 0
- Two solid-state N.O. safety outputs
- One solid-state N.O. auxiliary output
- One N.O. and one N.C. input

LED Indicators

Green	Power (Pwr)
Green	CH1 Energized
Green	CH2 Energized

Wiring Terminations

S11 & S21	Pulse checking dynamic output
S12 & S22	Input contacts
A1 – S34	Reset switch
S11 – S34	Automatic reset, start-up test disabled
S21 – S34	Automatic reset, start-up test enabled
A1 – Y2	Monitoring circuit

Specifications

Safety Ratings	
Standards	EN 954-1, ISO 13849-1, IEC/EN 60204-1, ANSI B11.19, AS 4024.5
Safety Classification	Cat. 4 per EN 954-1 (ISO 13849-1), SIL CL3 per EN IEC 62061, PLe per ISO 13849-1
Functional Safety Data ∗ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	PFH_D: < 9.2 x 10^{-10} MTTFd: > 631 years Suitable for performance levels Ple (according to ISO 13849-1:2006) and for use in SIL CL3 systems (according to IEC 62061) depending on the architecture and application characteristics
Certifications	CE Marked for all applicable directives, cULus, c-Tick, and TÜV
Power Supply	
Input Power Entry	24V DC SELV
Power Consumption	3 W
Inputs	
Safety Inputs	1 N.C. + 1 N.O.
Input Simultaneity	Infinite
Input Resistance, Max.	200 Ω
Reset	Auto. or Monitored Manual
Power On Delay/ Recovery Time	3 seconds/20 ms
Response Time	15 ms
Outputs	
Safety Contacts	2 N.O. Solid State
Auxiliary Contacts	1 N.O. Solid State
Power LED Diagnostics	3 s Blink: Initialization Constant: Normal Operation 2 Blinks: Configuration change during operation 4 Blinks: Solid state output switch fault Continuous blinking: Internal fault
Environmental and Physical Characteristics	
Enclosure Type Rating/ Terminal Protection	IP40 (NEMA 1), DIN VDE 0470-1/ IP20
Operating Temperature [C (F)]	-5…+55 ° (23…131 °)
Vibration	10…55 Hz, 0.35 mm
Shock	10 g, 16 ms, 100 shocks
Mounting	In panel enclosure (IP54); 35 mm DIN Rail
Weight [g (lbs)]	130 (0.287)
Conductor Size, Max.	0.2…2.5 mm^2 (24…14 AWG)

∗ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the following assumptions:
- Mission time/Proof test interval of 20 years

Product Selection

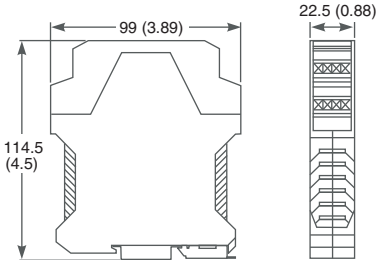
Inputs	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. No.
1 N.C. & 1 N.O.	2 N.O. Solid State	1 N.O. Solid State	Fixed	Auto. or Monitored Manual	24V DC SELV	440R-F23199
			Removable			440R-F23200

Accessories

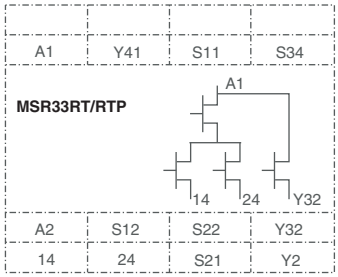
Description	Cat. No.
Bag of 4, 4-Pin Screw Terminal Blocks	440R-A23209
Bag of 4, 4-Pin Spring Clamp Terminal Blocks	440R-A23228

Approximate Dimensions

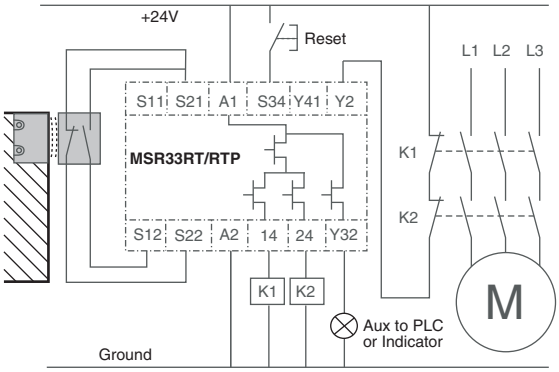
Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



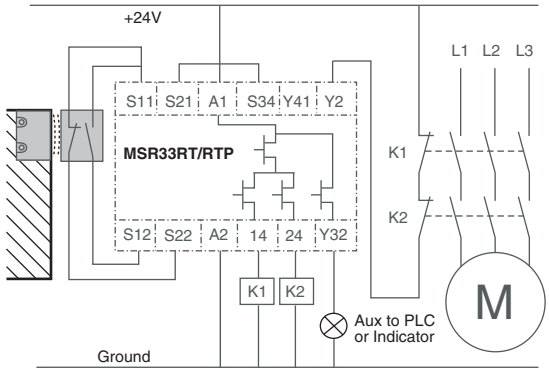
Block Diagram



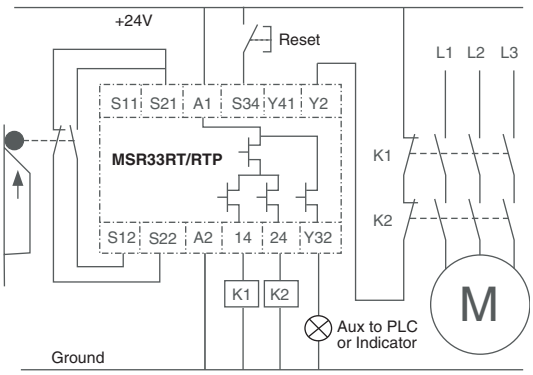
Typical Wiring Diagrams



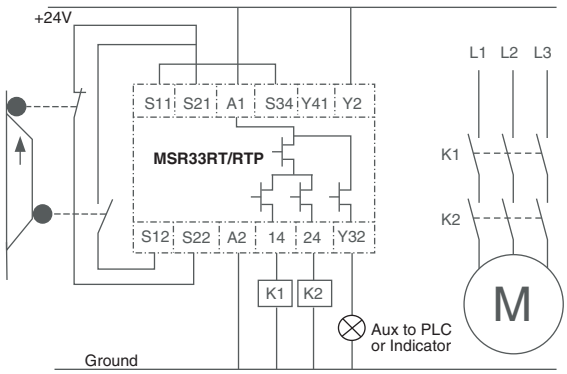
Sipha Sensor Inputs, Dual Channel Outputs, Monitored Manual Reset, Output Monitoring Start-up Test Disabled



Sipha Sensor Inputs, Dual Channel Outputs, Automatic Reset, No Output Monitoring Start-up Test Enabled



Dual Channel Inputs, Dual Channel Outputs, Monitored Manual Reset, Output Monitoring Start-up Test Disabled



Dual Independent Inputs, Dual Channel Outputs, Automatic Reset, No Output Monitoring Start-up Test Disabled

Single-Function Safety Relays

MSR41

Description

The MSR41 safety relay is a simple on/off control module for the GuardShield Micro 400 safety light curtain. This Category 4, SIL CL3 safety device has a pair of PNP solid state, 400 mA OSSDs for direct connection to the final switching device. When safety relay outputs are required, the MSR41 easily accommodates the interconnection of up to three MSR45E safety relay expansion modules, each providing a pair of safety relay outputs. Simply connect ribbon cable connectors from the back of the MSR41 to each of the MSR45E modules for a series of interconnections for two PNP OSSDs, and six N.O. relay outputs.

This 22.5 mm DIN mount safety relay can only be configured through hard-wired configurations. This relay module does not support configuration through the software but can be used for diagnostics only. The removable spring terminal connectors on the MSR41 allow for ease of wiring of the device as well as hard-wired operating mode configuration.

Manual/automatic reset and start/restart can be configured by simply changing the wiring (see examples).

Features

- Category 4 per EN 954-1
- SIL CL3 IEC 61508, IEC 62061
- 22.5 mm housing
- Stop category 0
- 24V DC supply voltage
- Manual or automatic reset
- Eight diagnostic LEDs
- Unique design allows for easy addition of relay expansion modules
- Removable terminal blocks
- Two auxiliary and standard outputs
- RJ45 connections for Micro 400 safety light curtain
- Supports up to three MSR45E expander units

LED Indicators (Default Configuration)

LED	Green	Red
OSSD2	Output active	Output inactive
OSSD1	Output active	Output inactive
Info2 (LED)	System OK	Lockout
Info1 (LED)	Safety Outputs ON	Safety Outputs OFF
IN2	Reset OK	Waiting for reset signal
IN1	—	—
0V	—	—
+24V	Power connected	No power connected

Specifications

Safety Ratings	
Standards	EN 954-1, IEC/EN 60204-1, IEC 61496-1
Safety Classification	Cat. 4 per EN 954-1 (ISO 13849-1), SIL CL3 per EN IEC 61508, PLe per ISO 13849-1
Functional Safety Data ∗ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	PFD: 2.92E-09 (w LC) SFF: 96.40% (w LC) For use in SIL3 systems (according to IEC 61508) depending on the architecture and application characteristics
Certifications	CE Marked for all applicable directives, cULus, and TÜV
Power Supply	
Input Power Entry	24V DC
Power Consumption	2.4 W (semi-conductor outputs unloaded)
Inputs	
Safety Inputs	GuardShield Micro 400 Light Curtain
Input Resistance, Max.	—
Reset	Auto./manual
Power On Delay Time	Determined by configuration
Response Time	Determined by configuration
Outputs	
Safety Contacts	2 PNP, 400 mA each
Auxiliary Contacts	2 PNP
Environmental and Physical Characteristics	
Enclosure Type Rating/ Terminal Protection	IP20/ IP20
Operating Temperature [C (F)]	0…55 ° (32…131 °)
Vibration	0.35 mm 10…55 Hz
Mounting	35 mm DIN Rail
Weight [g (lbs)]	130 (0.287)
Conductor Size, Max.	1 x 2.5 mm2 (14 AWG) stranded

∗ Usable for IEC 62061. Data is based on the following assumptions:
- Mission time/Proof test interval of 20 years

Product Selection

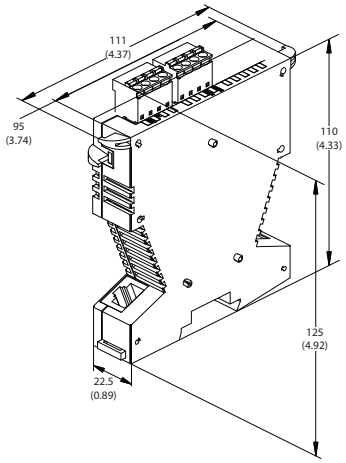
Inputs	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. No.
GuardShield Micro 400	2 PNP	2 PNP	Removable	Auto./manual	24V DC	**440R-P221AGS**

Accessories

Description	Cat. No.
MSR45E—expander for MSR41 and MSR42	440R-P4NANS
Ribbon cable—for one MSR45E	**440R-ACABL1**
Ribbon cable—for two MSR45Es	440R-ACABL2
Ribbon cable—for three MSR45Es	440R-ACABL3
Replacement terminal block kit—MSR41	440R-ATERM1P
Replacement terminal block kit—MSR45E	440R-ATERM2C

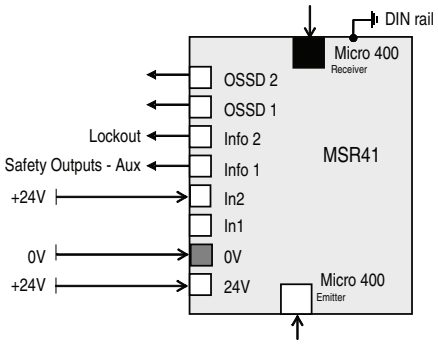
Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.

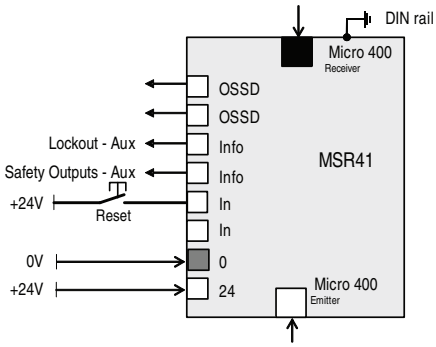


Typical Wiring Diagrams

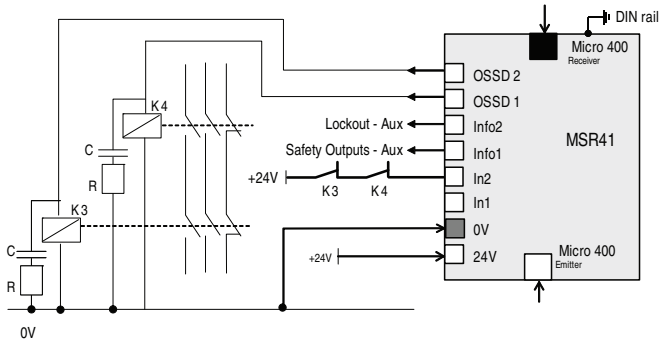
Default Configurations (No Software)



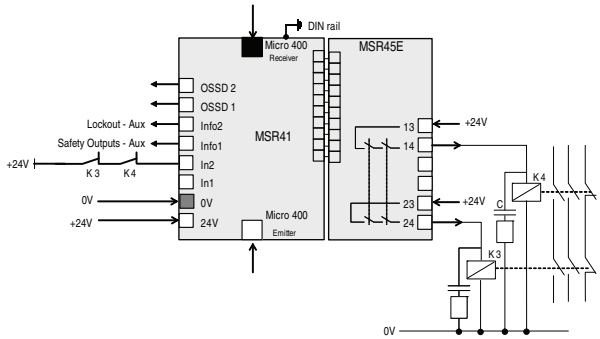
Micro 400 Light Curtain, Automatic Reset, No Output Monitoring



Micro 400 Light Curtain, Manual Reset, No Output Monitoring



Micro 400 Light Curtain, Manual Reset, Output Monitoring



Micro 400 Light Curtain, Automatic Reset, Output Monitoring

Single-Function Safety Relays

MSR117T

Description

The MSR117T has one normally closed single-channel input for use with gate interlocks and emergency stop buttons in lower risk applications. The MSR117T has output monitoring that can accommodate an automatic/manual reset function. Automatic/manual reset can use a jumper or can be used to check operation of the contacts.

The MSR117T has three normally open safety outputs and one normally closed auxiliary output. The safety outputs have independent and redundant internal contacts to help ensure the safety function. The auxiliary contact is a nonsafety output intended to provide an external signal about the status of the safety outputs.

The MSR117T can be activated via the terminals A1-A2 and the feedback/reset loop X1-X2. Then the safety outputs 13-14, 23-24 and 33-34 close and enable operation.

Features

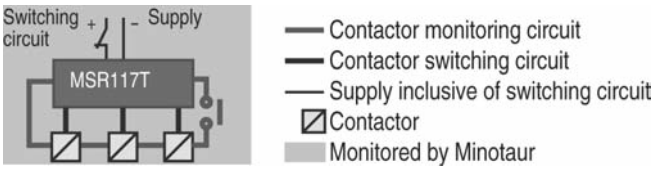
- Category 4 per EN 954-1
- Stop category 0
- Single channel input
- Three N.O. safety outputs
- One N.C. auxiliary output
- 22.5 mm wide housing

Specifications

Safety Ratings	
Standards	IEC/EN 60204-1, ISO 12100, ISO 13849-1 (EN 954-1)
Safety Classification	Cat. 4 per EN 954-1 (ISO 13849-1), SIL CL3 per EN IEC 62061, PLe per ISO 13849-1
Functional Safety Data ∗ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	PFH_D: < 2.53 x 10^{-9} MTTFd: > 425 years Suitable for performance levels Ple (according to ISO 13849-1:2006) and for use in SIL3 systems (according to IEC 62061) depending on the architecture and application characteristics
Certifications	CE Marked for all applicable directives, cULus, and TÜV
Power Supply	
Input Power Entry	24V AC/DC
Power Consumption	2 W
Inputs	
Safety Inputs	1 N.C.
Input Resistance, Max.	25 ohms
Reset	Auto./Manual or Monitored Manual
Power On Delay/ Recovery Time	1 sec/110 ms
Response Time	30 ms
Outputs	
Safety Contacts	3 N.O.
Auxiliary Contacts	1 N.C.
Thermal Current/$_{Ith}$	2 x 5 A or 3 x 4 A
Rated Impulse withstand Voltage	2500V
Switching Current @ Voltage, Min.	10 mA @ 10V
Fuses, Output	6 A slow blow or 10 A quick blow (external)
Electrical Life	230V AC/4 A/880V A cosϕ=0.35…0.1 M 230V AC/1.7 A/375V A cosϕ=0.6…0.5 M 30V DC/2 A/60 = 1 M 10V DC/0.01 A/0.1 W = 2 M
Mechanical Life	2,000,000 cycles
Environmental and Physical Characteristics	
Enclosure Type Rating/ Terminal Protection	IP40 (NEMA 1), DIN 0470/ IP20, DIN 0470
Operating Temperature [C (F)]	-5…+55 ° (23…131 °)
Vibration	10…55 Hz, 0.35 mm
Shock	10 g, 16 ms 100 shocks
Mounting	35 mm DIN Rail
Weight [g (lbs)]	180 (0.37)
Conductor Size, Max.	0.2…4 mm² (24…12 AWG) wire size only

∗ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the following assumptions:
- Mission time/Proof test interval of 20 years
- Functional test at least once within six-month period

Applications



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Publication S117-CA001A-EN-P

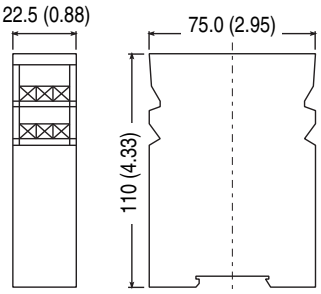
Allen-Bradley
GuardMaster®

Product Selection

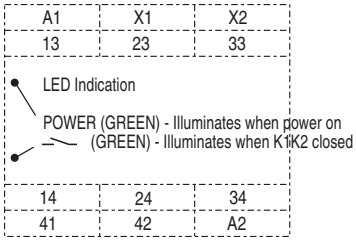
Inputs	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. No.
1 N.C.	3 N.O.	1 N.C.	Fixed	Auto./Manual or Monitored Manual	24V AC/DC	440R-B23211

Approximate Dimensions

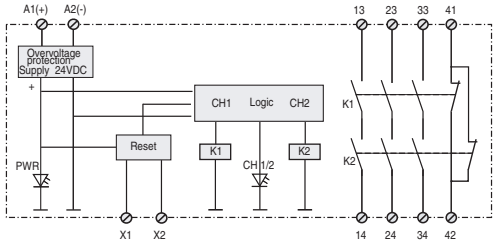
Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



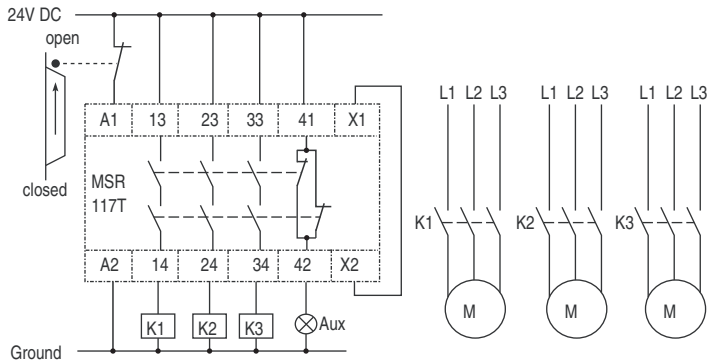
Connections



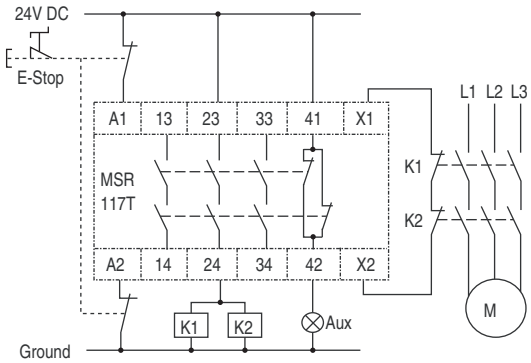
Block Diagram



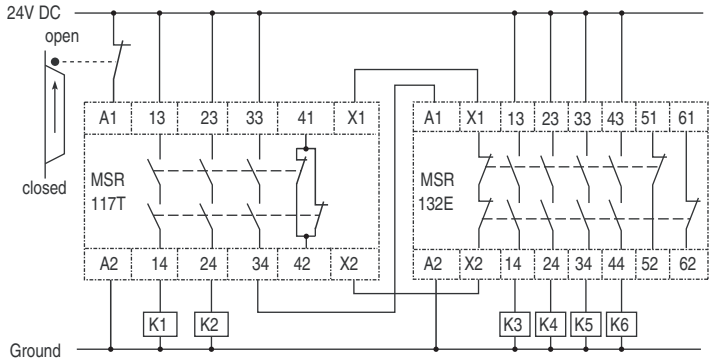
Typical Wiring Diagrams



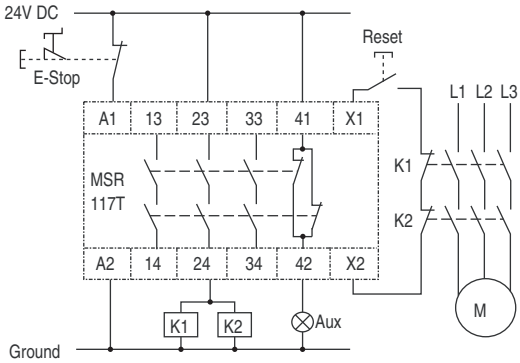
Single Channel Gate Interlock, Automatic Reset, Single Channel Output, No Monitored Output



Dual Channel E-Stop, Automatic Reset, Single Channel Output, Monitored Output



Single Channel Gate Interlock, Automatic Reset, Single Channel Output Expansion



Single Channel E-Stop, Manual Reset, Single Channel Output, Monitored Output

Single-Function Safety Relays

MSR126RT

Description

The Allen-Bradley Guardmaster Minotaur MSR126R/T is a safety monitoring relay that provides the very basics for safety control systems in a 22.5 mm package.

The MSR126R/T is designed for connection to a single channel safety gate, a single channel e-stop or a light curtain that provides cross fault detection. The MSR126.1R/T is designed for connection to a dual channel safety gate or e-stop, as it performs cross fault detection across the inputs.

The MSR126R and MSR126.1R are designed for applications where a monitored manual reset is required. Monitored manual reset requires the use of a momentary normally open switch to activate the outputs.

The MSR126T and MSR126.1T are designed for applications where automatic/manual reset is required.

The outputs are only two normally open safety-rated outputs. The safety outputs have independent and redundant internal contacts to support the safety function.

Features

- Category 4 per EN 954-1
- Stop category 0
- Two safety contacts N.O.
- Single/dual channel operation
- Cross fault monitoring
- Monitored or automatic reset
- E-stop, safety gate or light curtain applications

LED Indicators

Green	Power On
Green	K1 Closed
Green	K2 Closed

Specifications

Safety Ratings		
Standards	EN 954-1, ISO 13849-1, IEC/EN 60204-1, IEC 60947-4-1, IEC 60947-5-1, ANSI B11.19, AS 4024.1	
Safety Classification	Cat. 4 per EN 954-1 (ISO 13849-1), SIL CL3 per EN IEC 62061, PLe per ISO 13849-1	
Functional Safety Data ✶ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	PFH_D: < 1.45 x 10^{-9} MTTFd: > 398 years Suitable for performance levels Ple (according to ISO 13849-1:2006) and for use in SIL3 systems (according to IEC 62061) depending on the architecture and application characteristics	
Certifications	CE Marked for all applicable directives, cULus, c-Tick, and BG	
Power Supply		
Input Power Entry	24V AC/DC, 115/230V AC	
Power Consumption	4 W	
Inputs		
Safety Inputs	1 N.C., 2 N.C., or LC	
Input Simultaneity	Infinite	
Input Resistance, Max.	90 Ω	
Reset	Auto./Manual or Monitored Manual	
Power On Delay/ Recovery Time	300 ms/100 ms	
Response Time	15 ms	
Outputs		
Safety Contacts	2 N.O.	
Thermal Current I_{th}	Max 6 A in one current path (nonswitching)	
Rated Impulse withstand Voltage	2500V	
Switching Current @ Voltage, Min.	10 mA @ 10V	
Fuses, Output	External 6 A slow blow or 10 A fast acting	
Electrical Life (Operations)	(With surge suppression) 250V AC/6 A/1500VA cosϕ = 1…0.1 M 250V AC/2.5 A/625VA cosϕ = 1…0.5 M 250V AC/1.5 A/375VA cosϕ = 0.35…0.3 M 250V AC/5 A/1250VA cosϕ = 0.6…0.1 M 24V DC/2 A/48 W = 1 M 10V DC/0.01 A/0.1 W = 2 M	
Mechanical Life	2,000,000 operations	
Utilization Category	UL: B300, 5 A/250V AC, 24V AC, 6 A/24V DC	
Resistive: AC-1	6 A/250V AC	
Resistive: DC-1	6 A/24V DC	
Inductive: AC-15	6 A/250V AC	6 A/125V AC
Inductive: DC-13	3 A/24V DC	6 A/24V DC @ 6 ops/min
Environmental and Physical Characteristics		
Enclosure Type Rating/ Terminal Protection	IP40 (NEMA 1), DIN 0470/ IP20, DIN 0470	
Operating Temperature [C (F)]	-5…+55 ° (23…131 °)	
Vibration	10…55 Hz, 0.35 mm	
Shock	10 g, 16 ms 100 shocks	
Mounting	35 mm DIN Rail	
Weight [g (lbs)]	24V DC: 160 (0.35); 115/230V AC: 215 (0.47)	
Conductor Size, Max.	0.2…4 mm^2 (24…12 AWG)	

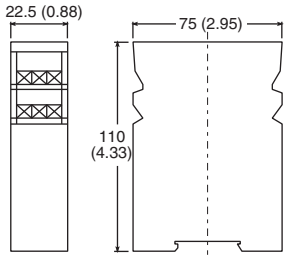
✶ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the following assumptions:
- Mission time/Proof test interval of 20 years
- Functional test at least once within six-month period

Product Selection

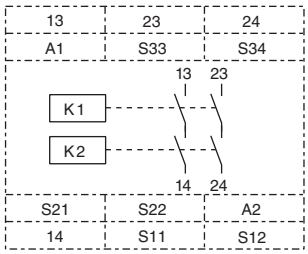
Inputs	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. No.
Light Curtain or Single Channel (MSR126T)	2 N.O.	None	Fixed	Auto./Manual	24V AC/DC	**440R-N23117**
					115V AC	440R-N23116
					230V AC	440R-N23115
Dual Channel 2 N.C. (MSR126.1T)					24V AC/DC	**440R-N23114**
					115V AC	440R-N23113
					230V AC	440R-N23112
Light Curtain or Single Channel (MSR126R)				Monitored Manual	24V AC/DC	440R-N23123
					115V AC	440R-N23122
					230V AC	440R-N23121
Dual Channel 2 N.C. (MSR126.1R)					24V AC/DC	440R-N23120
					115V AC	440R-N23119
					230V AC	440R-N23118

Approximate Dimensions

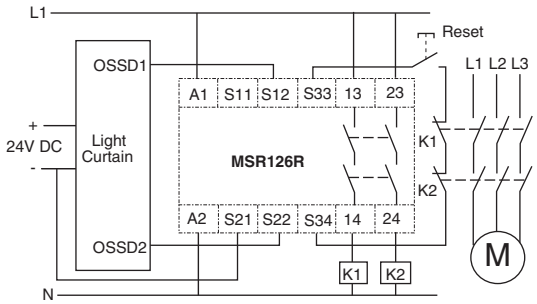
Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



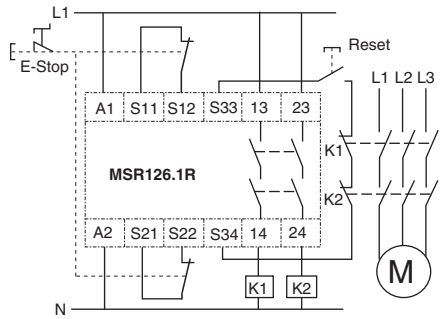
Block Diagram



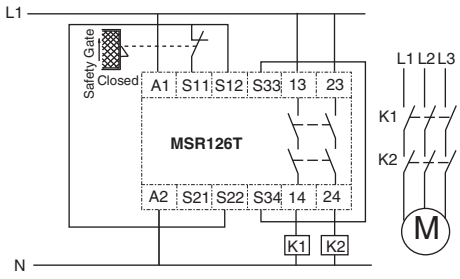
Typical Wiring Diagrams



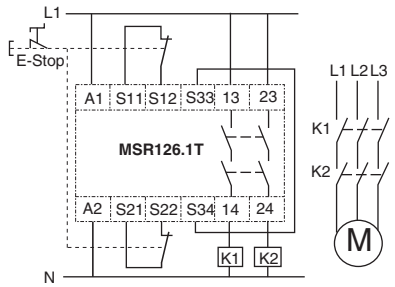
115/230V Supply, 24V DC Light Curtain, Monitored Manual Reset, Monitored Output



Dual Channel E-Stop Input, Monitored Manual Reset, Monitored Output



Single Channel Safety Gate, Automatic Reset, No Output Monitoring



Dual Channel E-Stop, Automatic Reset, No Output Monitoring

Single-Function Safety Relays

MSR127RTP

Description

The MSR127RTP can be connected in three different input wiring configurations: one normally closed, two normally closed, or with two PNP connections from a light curtain. When connected in the two normally closed fashion, the MSR127RTP checks for cross faults across the two inputs. When connected to light curtains, the light curtain must perform the cross fault detection.

The MSR127RP has a monitored manual reset. The MSR127TP has an automatic/manual reset. Models with automatic/manual reset can have the reset jumpered or can be converted to an unmonitored manual reset by adding a normally open switch in the monitoring loop. Models with monitored manual reset provide checking of the output monitoring circuit.

The outputs include three normally open safety-rated outputs as well as one normally closed auxiliary output. The safety outputs have independent and redundant internal contacts to support the safety function. The auxiliary output is a nonsafety output intended to provide an external signal about the status of the safety outputs.

Features

- Category 4 per EN 954-1
- Stop category 0
- Three safety contacts
- One auxiliary contact
- Cross fault monitoring
- Monitored or automatic reset
- Removable terminals
- Light curtain, E-stop or safety gate applications

LED Indicators

Green	Power On
Green	CH1 Closed
Green	CH2 Closed

Specifications

Safety Ratings		
Standards	EN 954-1, ISO 13849-1, IEC/EN 60204-1, IEC 60947-4-1, IEC 60947-5-1, ANSI B11.19, AS4024.1	
Safety Classification	Cat. 4 per EN 954-1 (ISO 13849-1), SIL CL3 per EN IEC 62061, PLe per ISO 13849-1	
Functional Safety Data ✶ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	PFH_D: < 1.45 x 10^{-9} MTTFd: > 398 years Suitable for performance levels Ple (according to ISO 13849-1:2006) and for use in SIL3 systems (according to IEC 62061) depending on the architecture and application characteristics	
Certifications	CE Marked for all applicable directives, cULus and BG	
Power Supply		
Input Power Entry	24V AC/DC, 115V AC or 230V AC 50/60 Hz	
Power Consumption	2 W	
Inputs		
Safety Inputs	1 N.C. or 2 N.C. or LC	
Input Simultaneity	Infinite (ch2 before ch1) with Auto Reset	
Input Resistance, Max.	110 Ω	
Reset	Auto./Manual or Monitored Manual	
Power On Delay/ Recovery Time	1 second/100 ms	
Response Time	15 ms	
Outputs		
Safety Contacts	3 N.O.	
Auxiliary Contacts	1 N.C.	
Thermal Current/$_{Ith}$	Units with 24V AC/DC supply: 3 x 4 A or 2 x 5 A nonswitching Units with 115/230V AC supplies: 3 x 3 A or 2 x 4 A or 1 x 5 A nonswitching	
Rated Impulse withstand Voltage	2500V	
Switching Current @ Voltage, Min.	10 mA/10V	
Fuses, Output	External 6 A slow blow or 10 A fast acting	
Electrical Life (Operations)	(With surge suppression) 250V AC/6 A/1500VA cosϕ = 1…0.1 M 250V AC/2.5 A/625VA cosϕ = 1…0.5 M 250V AC/1.5 A/375VA cosϕ = 0.35…0.3 M 250V AC/5 A/1250VA cosϕ = 0.6…0.1 M 24V DC/2 A/48 W = 1 M 10V DC/0.01 A/0.1 W = 2 M	
Mechanical Life	2,000,000 operations	
Utilization Category	UL: B300, R300 5 A/250V AC, 24V DC	
Resistive: AC-1	5 A/250V AC	
Resistive: DC-1	5 A/24V DC	
Inductive: AC-15	5 A/250V AC	
Inductive: DC-13	3 A/24V DC	5 A/24V DC @ 6 ops/min
Environmental and Physical Characteristics		
Enclosure Type Rating/ Terminal Protection	IP40 (NEMA 1)/ IP20	
Operating Temperature [C (F)]	-5…+55 ° (23…131 °)	
Vibration	10…55 Hz, 0.35 mm	
Shock	10 g, 16 ms 100 shocks	
Mounting	35 mm DIN Rail	
Weight [g (lbs)]	24V DC: 210 (0.46), 115/230V AC: 260 (0.57)	
Conductor Size, Max.	0.2…4 mm^2 (24…12 AWG)	

✶ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the following assumptions:
- Mission time/Proof test interval of 20 years
- Functional test at least once within six-month period

Product Selection

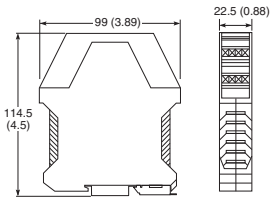
Inputs	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. No.
1 N.C., 2 N.C., Light Curtain	3 N.O.	1 N.C.	Fixed	Auto./Manual	24V AC/DC	**440R-N23126**
				Monitored Manual		440R-N23129
				Auto./Manual	115V AC	440R-N23125
				Monitored Manual		440R-N23128
				Auto./Manual	230V AC	440R-N23124
				Monitored Manual		440R-N23127
			Removable (Screw)	Auto./Manual	24V AC/DC	**440R-N23132**
				Monitored Manual		**440R-N23135**
			Removable (Spring Clamp)	Auto./Manual	24V AC/DC	440R-N23132S
				Monitored Manual		440R-N23135S
			Removable (Screw)	Auto./Manual	115V AC	**440R-N23131**
				Monitored Manual		440R-N23134
				Auto./Manual	230V AC	440R-N23130
				Monitored Manual		440R-N23133

Accessories

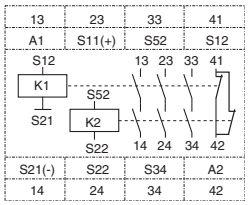
Description	Cat. No.
4 Replacement 4-pin Terminals (screw)	440R-A23209
4 Replacement 4-pin Terminals (spring clamp)	440R-A23228

Approximate Dimensions

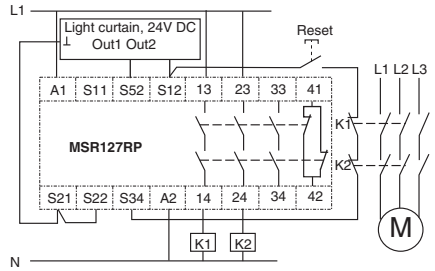
Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



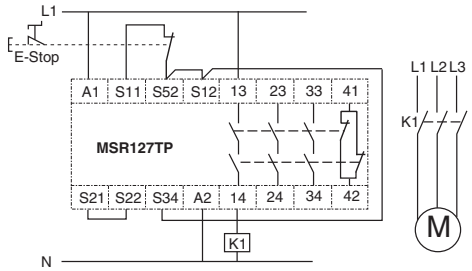
Block Diagram



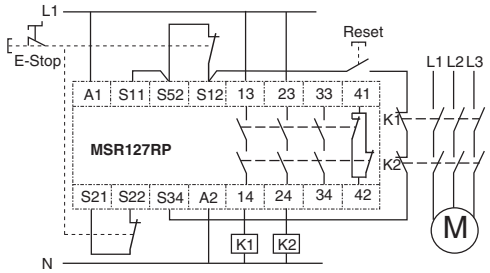
Typical Wiring Diagrams



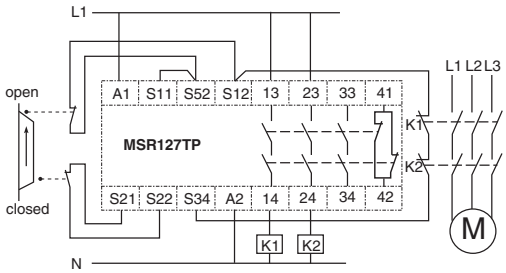
Light Curtain, Monitored Manual Reset, Monitored Output



Single Channel E-Stop, Automatic Reset, No Output Monitoring



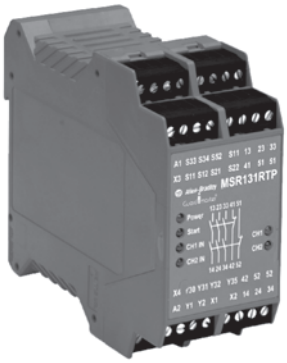
Dual Channel E-Stop, Monitored Manual Reset, Monitored Output



Dual Channel Safety Gates, Automatic Reset, Monitored Output

Single-Function Safety Relays

MSR131RTP



Description

The MSR131RTP is a versatile monitoring safety relay. It can be connected in four different input wiring configurations: one normally closed, 2 normally closed, 2 PNP connections from a light curtain, or a four-wire safety mat. When connected in the two normally closed fashion, the MSR131RTP checks for cross faults across the two inputs. When connected to light curtains, the light curtain must perform the cross-fault detection.

The MSR131RTP has output monitoring that can accommodate either automatic/manual reset or a monitored manual reset. When configured with automatic/manual reset (jumpers on X1-X2 and X3-X4), the MSR131RTP can have the reset terminals S33-S34 jumpered or can be converted to an unmonitored manual reset by adding a normally open switch in the monitoring loop (S33-S34). When configured to monitored manual reset, the MSR131RTP checks the output monitoring circuit through the manual application of the reset switch.

The outputs include three normally open safety rated outputs, two normally closed auxiliary outputs, and two solid-state outputs. One solid-state output indicates that the inputs are closed. The second solid-state output indicates that the safety outputs are active.

The safety outputs have independent and redundant internal contacts to help ensure the safety function. The auxiliary output is a nonsafety output intended to provide an external signal about the status of the safety outputs.

Features

- Category 4 per EN 954-1
- Stop category 0
- Light curtain, safety mat, E-stop inputs
- Three safety contacts
- Two auxiliary contact
- Two solid-state outputs
- Cross fault monitoring
- Monitored or automatic reset
- Removable terminals

LED Indicators

Green	Power
Green	Start
Green	CH1 Input Closed
Green	CH2 Input Closed
Green	CH1 Output Active
Green	CH2 Output Active

Specifications

Safety Ratings		
Standards	EN 954-1, ISO 13849-1, IEC/EN 60204-1, IEC 60947-4-1, IEC 60947-5-1, ANSI B11.19, AS4024.1	
Safety Classification	Cat. 4 per EN 954-1 (ISO 13849-1), SIL CL3 per EN IEC 62061, PLe per ISO 13849-1	
Functional Safety Data ✶ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	PFH_D: < 1.67 x 10^{-9} MTTFd: > 389 years Suitable for performance levels Ple (according to ISO 13849-1:2006) and for use in SIL3 systems (according to IEC 62061) depending on the architecture and application characteristics	
Certifications	CE Marked for all applicable directives, cULus, BG, and c-Tick	
Power Supply		
Input Power Entry	24V AC/DC, 115V AC or 230V AC	
Power Consumption	4 W	
Inputs		
Safety Inputs	1 N.C., 2 N.C., LC or SM	
Input Simultaneity	Infinite	
Input Resistance, Max.	45 Ω	
Reset	Auto./Manual or Monitored Manual	
Power On Delay/ Recovery Time	1 second/100 ms	
Response Time	15 ms	
Outputs		
Safety Contacts	3 N.O.	
Auxiliary Contacts	2 N.C.; 1 SS PNP inputs closed; 1 SS PNP outputs active; 30V DC/20 mA solid state	
Thermal Current/I_{th}	1 x 6 A or 3 x 5 A nonswitching	
Rated Impulse withstand Voltage	2500V	
Switching Current @ Voltage, Min.	10 mA @ 10V	
Fuses, Output	External 6 A slow blow or 10 A fast acting	
Electrical Life (Operations)	(With surge suppression) 250V AC/6 A/1500VA cosϕ = 1…0.1 M 250V AC/2.5 A/625VA cosϕ = 1…0.5 M 250V AC/1.5 A/375VA cosϕ = 0.35…0.3 M 250V AC/5 A/1250VA cosϕ = 0.6…0.1 M 24V DC/2 A/48 W = 1 M 10V DC/0.01 A/0.1 W = 2 M	
Mechanical Life	2,000,000 operations	
Utilization Category		
Resistive: AC-1	6 A/250V AC	
Resistive: DC-1	6 A/24V DC	
Inductive: AC-15	6 A/250V AC	6 A/125V AC
Inductive: DC-13	3 A/24V DC	6 A/24V DC @ 6 ops/min
UL	B300, R300, 1 x 6 A or 2 x 5 A resistive/250V AC, 24V DC	
Environmental and Physical Characteristics		
Enclosure Type Rating/ Terminal Protection	IP40 (NEMA 1)/ IP20	
Operating Temperature [C (F)]	-5…+55 ° (23…131 °)	
Vibration	10…55 Hz, 0.35 mm	
Shock	10 g, 16 ms 100 shocks	
Mounting	45 mm housing, 35 mm DIN Rail	
Weight [g (lbs)]	24V DC: 320 (0.71) 115/230V AC: 450 (0.99)	
Conductor Size, Max.	0.2…4 mm^2 (24…12 AWG)	

✶ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the following assumptions:
- Mission time/Proof test interval of 20 years
- Functional test at least once within six-month period

Product Selection

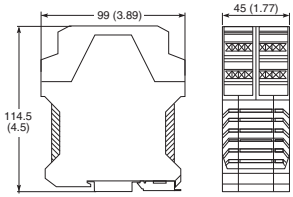
Inputs	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. No.
1 N.C., 2 N.C., Light Curtain, Safety Mat	3 N.O.	2 N.C., 2 PNP Solid State	Removable (Screw)	Auto./Manual or Monitored Manual	24V AC/DC	**440R-C23139**
			Removable (Spring Clamp)			440R-C23139S
			Removable (Screw)		115V AC	440R-C23137
					230V AC	440R-C23136

Accessories

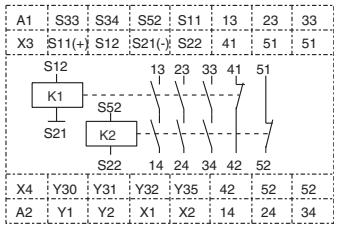
Description	Cat. No.
Bag of 4, 4-Pin Screw Terminal Blocks	440R-A23209
Bag of 4, 4-Pin Spring Clamp Terminal Blocks	440R-A23228

Approximate Dimensions

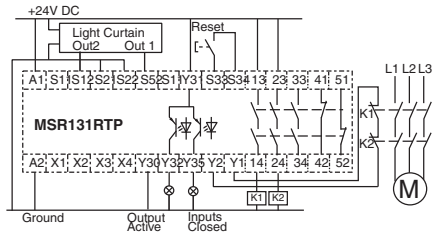
Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



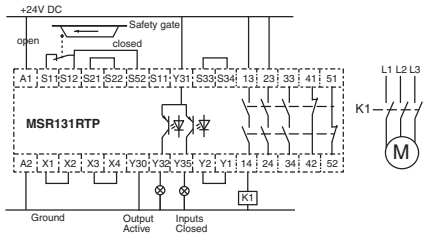
Block Diagram



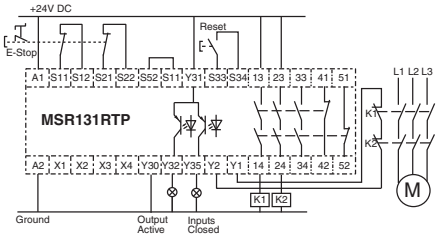
Typical Wiring Diagrams



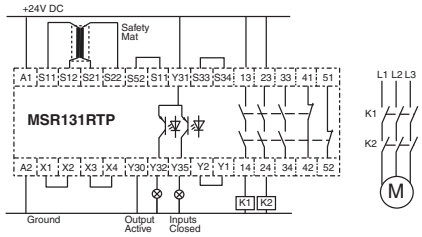
Light Curtain, Monitored Manual Reset, Monitored Output



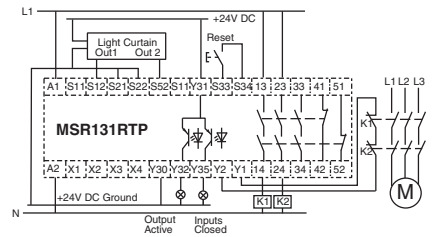
Single Channel Safety Gate, Automatic Reset, No Output Monitoring



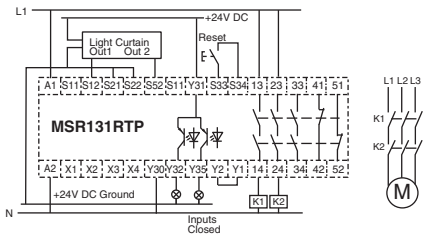
Dual Channel E-Stop, Monitored Manual Reset, Monitored Output



Safety Mat, Automatic Reset, No Output Monitoring



115/230V AC Supply, 24V DC, Light Curtain, Monitored Manual Reset, Monitored Output



115/230V AC Supply, 24V DC, Light Curtain, Monitored Manual Reset, No Output Monitoring

Single-Function Safety Relays

MSR142RTP

Description

The MSR142RTP is a versatile monitoring safety relay. It can be connected in four different input wiring configurations: one normally closed, two normally closed, two PNP connections from a light curtain, or a four-wire safety mat. When connected in the two normally closed fashion, the MSR142RTP checks for cross faults across the two inputs. When connected to light curtains, the light curtain must perform the cross-fault detection.

The MSR142RTP has output monitoring that can accommodate either automatic/manual reset or a monitored manual reset. When configured with automatic/manual reset (jumpers on X1-X2 and X3-X4), the MSR142RTP can have the reset terminals S33-S34 jumpered or can be converted to an unmonitored manual reset by adding a normally open switch in the monitoring loop (S33-S34). When configured to monitored manual reset, the MSR142RTP checks the output monitoring circuit through the manual application of the reset switch.

The outputs include seven normally open safety-rated outputs, four normally closed auxiliary outputs, and two solid-state outputs. One solid-state output indicates that the inputs are closed. The second solid-state output indicates that the safety outputs are active. The safety outputs have independent and redundant internal contacts to support the safety function. The auxiliary outputs are nonsafety outputs intended to provide an external signal about the status of the safety outputs.

Features

- Category 4 per EN 954-1
- Stop category 0
- Light curtain, safety mat, E-stop inputs
- Seven electromechanical N.O. state safety outputs
- Four electromechanical N.C. auxiliary outputs
- Two solid-state auxiliary outputs
- Cross-fault monitoring
- Monitored or automatic reset
- Removable terminals

LED Indicators

Green	Power
Green	Start
Green	CH1 IN
Green	CH2 IN
Green	CH1 output energized
Green	CH2 output energized

Specifications

Safety Ratings	
Standards	EN 954-1, ISO 13849-1, IEC/EN 60204-1, IEC 60947-5-1, AS 4042.1, ISOTR 12100, B11.19
Safety Classification	Cat. 4 per EN 954-1 (ISO 13849-1), SIL CL3 per EN IEC 62061, PLe per ISO 13849-1
Functional Safety Data ∗ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	PFH_D: < 1.92 x 10^{-9} MTTFd: > 210 years Suitable for performance levels Ple (according to ISO 13849-1:2006) and for use in SIL3 systems (according to IEC 62061) depending on the architecture and application characteristics
Certifications	CE Marked for all applicable directives, cULus, TÜV, and c-Tick
Power Supply	
Input Power Entry	24V AC/DC, 115V AC or 230V AC 50/60 Hz
Power Consumption	5 W
Inputs	
Safety Inputs	1 N.C., 2 N.C., Light Curtain or 4-Wire Safety Mat
Input Simultaneity	Infinite
Input Resistance, Max.	45 ohms
Reset	Auto./Manual or Monitored Manual
Power On Delay/ Recovery Time	1 s/100 ms
Response Time	15 ms
Outputs	
Safety Contacts	7 N.O.
Auxiliary Contacts	4 N.C., 2 PNP
Rated Impulse withstand Voltage	2500V
Switching Current @ Voltage, Min.	10 mA @ 10V DC
Fuses, Output	6 A slow blow or 10 A quick blow (external)
Electrical Life (Operations)	220V AC/4 A/880VA cosϕ = 0.35…0.1 M 220V AC/1.7 A/375VA cosϕ = 0.6…0.5 M 30V DC/2 A/60 W = 1 M 10V DC/0.01 A/0.1 W = 2 M
Mechanical Life	2,000,000 operations
Utilization Category	
Inductive: Safety & Aux.: AC-15	6 A/250V AC
Inductive: AC-13	3 A/24V DC
Resistive: DC-13	20 mA/30V DC short-circuit protected
UL	4 x B300 or 7 x 4 A Resistive
Environmental and Physical Characteristics	
Enclosure Type Rating/ Terminal Protection	IP40 (NEMA 1), DIN VDE 0470-1/ IP20
Operating Temperature [C (F)]	-5…+55 ° (14…131 °)
Vibration	10…55 Hz, 0.35 mm
Shock	10 g, 16 ms, 100 shocks
Mounting	35 mm DIN Rail
Weight [g (lbs)]	24V: 470 (1.04); 115/230V AC: 607 (1.34)
Conductor Size, Max.	0.2…4 mm^2 (24…12 AWG)

∗ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the following assumptions:
- Mission time/Proof test interval of 20 years
- Functional test at least once within six-month period

Product Selection

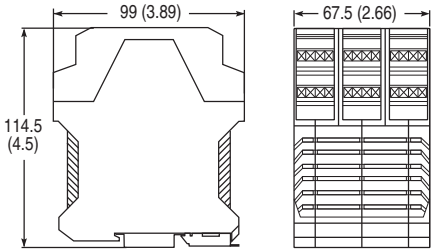
Inputs	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. No.
1 N.C., 2 N.C., Light Curtain, Safety Mat	7 N.O.	4 N.C., 2 PNP, Solid-state	Removable	Monitored Manual or Auto/Manual	24V AC/DC	**440R-G23216**
					115V AC	440R-G23215
					230V AC	440R-G23214

Accessories

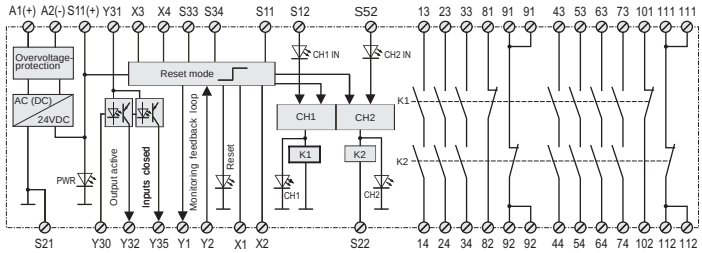
Description	Cat. No.
Bag of 4, 4-Pin Screw Terminal Blocks	440R-A23209
Bag of 4, 4-Pin Spring Clamp Terminal Blocks	440R-A23228

Approximate Dimensions

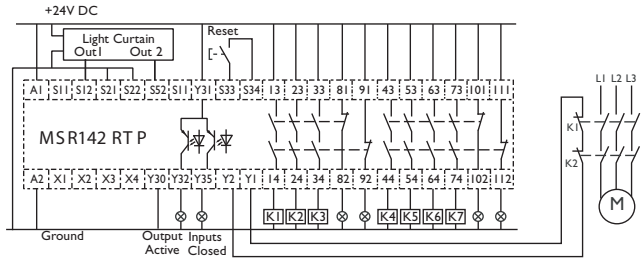
Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



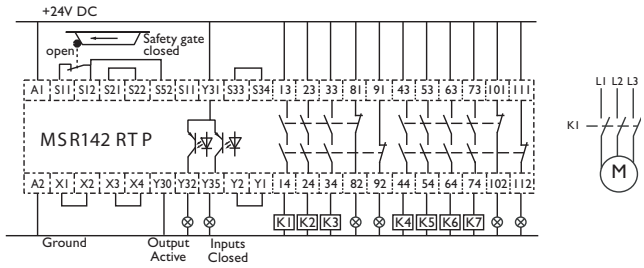
Block Diagram



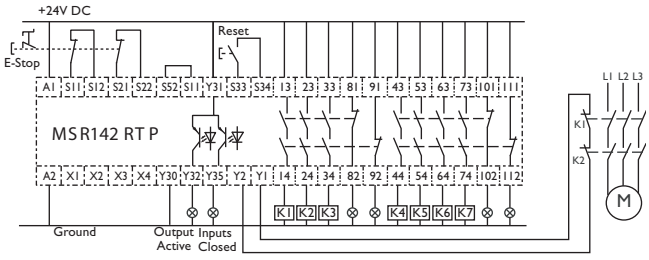
Typical Wiring Diagrams



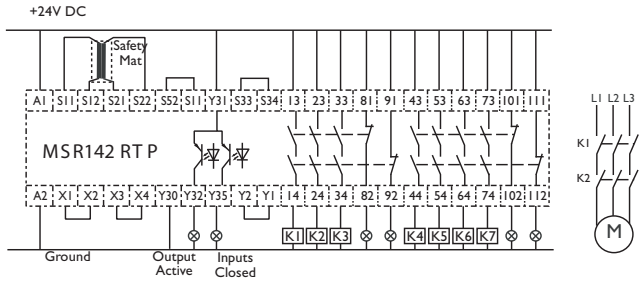
LIght Curtain, Monitored Manual Reset, Monitored Output



Single Channel Safety Gate, Auto Reset, No Output Monitoring



Dual Channel E-Stop, Monitored Manual Reset, Monitored Output



Safety Mat, Automatic Reset, No Output Monitoring

Single-Function Safety Relays

MSR144RTP

Description

The MSR144RTP is a versatile monitoring safety relay. It can be connected in four different input wiring configurations: one normally closed, two normally closed, two PNP connections from a light curtain, or a four-wire safety mat. When connected in the two normally closed fashion, the MSR144RTP checks for cross faults across the two inputs. When connected to light curtains, the light curtain must perform the cross-fault detection.

Any combination of up to five MSR230 and MSR238 output modules can be easily connected to the MSR144RTP by removing the terminator, inserting a ribbon cable from the expander and then placing the terminator into the last expansion module.

The MSR144RTP has output monitoring that can accommodate either automatic/manual reset or a monitored manual reset. When configured with automatic/manual reset (jumpers on X1-X2 and X3-X4), the MSR144RTP can have the reset terminals S33-S34 jumpered or can be converted to an unmonitored manual reset by adding a normally open switch in the monitoring loop (S33-S34). When configured to monitored manual reset, the MSR144RTP checks the output monitoring circuit through the manual application of the reset switch.

The outputs include two normally open safety rated outputs, two normally closed auxiliary outputs, and two solid-state auxiliary outputs. One solid-state output indicates the inputs are closed. The second solid-state output indicates the safety outputs are active.

The safety outputs have independent and redundant internal contacts to help ensure the safety function. The auxiliary outputs are nonsafety outputs intended to provide an external signal about the status of the safety outputs.

Features

- Category 4 per EN 954-1
- Stop category 0 or 1 (with MSR238)
- Light curtain, safety mat, E-stop inputs
- Two N.O. safety outputs
- Two N.C. auxiliary outputs
- Two solid-state auxiliary outputs
- Cross-fault monitoring
- Monitored manual or automatic/manual
- Removable terminals
- Expansion for up to five modules

LED Indicators

Green	Power
Green	Start
Green	CH1 IN
Green	CH2 IN
Green	CH1 output energized
Green	CH2 output energized

Specifications

Safety Ratings	
Standards	EN 954-1, ISO 13849-1, IEC/EN 60204-1, AS 4024.1, ISOTR 12100
Safety Classification	Cat. 4 per EN 954-1 (ISO 13849-1), SIL CL3 per EN IEC 62061, PLe per ISO 13849-1
Functional Safety Data ∗ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	PFH_D: < 1.67 x 10^{-9} MTTFd: > 389 years Suitable for performance levels Ple (according to ISO 13849-1:2006) and for use in SIL3 systems (according to IEC 62061) depending on the architecture and application characteristics
Certifications	CE Marked for all applicable directives, cULus, TÜV, and c-Tick
Power Supply	
Input Power Entry	24V DC
Power Consumption	4 W + expanders
Inputs	
Safety Inputs	1 N.C., 2 N.C., LC or 4-wire safety mat
Input Simultaneity	Infinite
Input Resistance, Max.	45 ohms
Reset	Auto./Manual or Monitored Manual
Power On Delay/ Recovery Time	1 s/100 ms
Response Time	15 ms
Outputs	
Safety Contacts	2 N.O.
Auxiliary Contacts	2 N.C., 2 PNP
Rated Impulse withstand Voltage	2500V
Switching Current @ Voltage, Min.	10 mA @ 10V DC
Fuses, Output	6 A slow blow or 10 A quick blow (external)
Electrical Life (Operations)	220V AC/4 A/880VA cosϕ = 0.35…0.1 M 220V AC/1.7 A/375VA cosϕ = 0.6…0.5 M 30V DC/2 A/60 W = 1 M 10V DC/0.01 A/0.1 W = 2 M
Mechanical Life	2,000,000 operations
Utilization Category	
Inductive: Safety & Aux.: AC-15	5 A/250V AC
Inductive: Safety & Aux.: DC-13	3 A/24V DC
UL	B300, R300, 1 x 6 A or 2 x 5 A resistive/250V AC, 24V DC
Solid State:	20 mA/30V DC short circuit protection
Environmental and Physical Characteristics	
Enclosure Type Rating/ Terminal Protection	IP40 (NEMA 1), DIN VDE 0470-1/ IP20
Operating Temperature [C (F)]	-5…+55 ° (23…131 °)
Vibration	10…55 Hz, 0.35 mm
Shock	10 g, 16 ms, 100 shocks
Mounting	35 mm DIN Rail
Weight [g (lbs)]	315 (0.71)
Conductor Size, Max.	0.2…4 mm² (24…12 AWG)

∗ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the following assumptions:
- Mission time/Proof test interval of 20 years
- Functional test at least once within six-month period

Product Selection

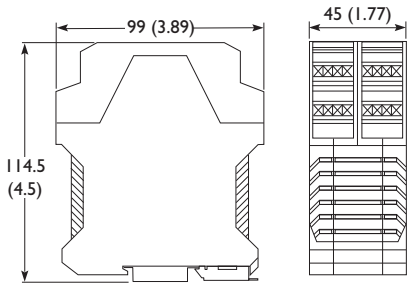
Inputs	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. No.
1 N.C., 2 N.C., Light Curtain, Safety Mat	2 N.O.	2 N.C. 2 PNP solid-state	Removable	Monitored Manual or Auto/Manual	24V DC	440R-C23205

Accessories

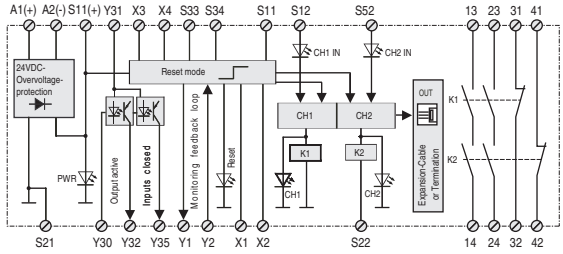
Description	Cat. No.
Bag of 4, 4-Pin Screw Terminal Blocks	440R-A23209
Bag of 4, 4-Pin Spring Clamp Terminal Blocks	440R-A23228

Approximate Dimensions

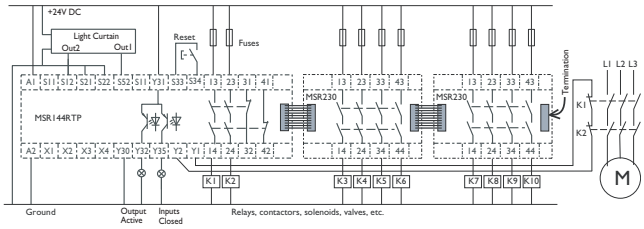
Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



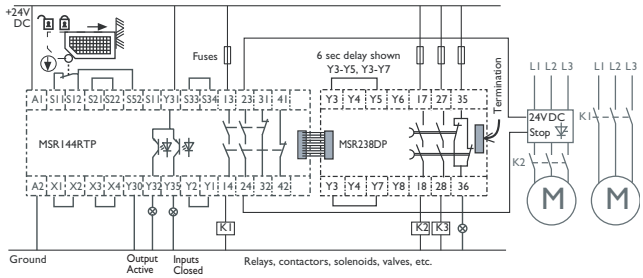
Block Diagram



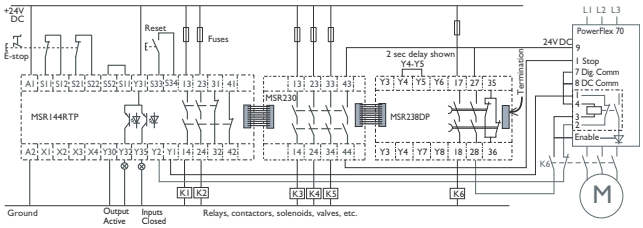
Typical Wiring Diagrams



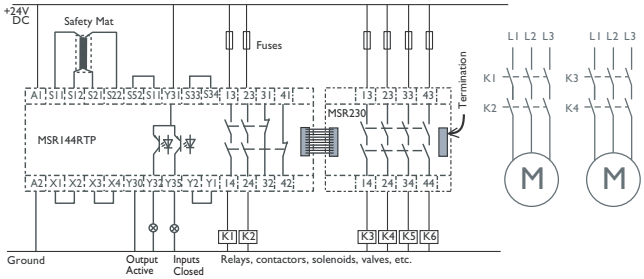
Light Curtain, Manual Reset with Manual Reset



115V/230V AC Supply, 24V DC, Dual Channel, Automatic Reset, Monitored Output



Dual Channel E-Stop, Monitored Manual Reset, Monitored Output



Safety Mat, Automatic Reset, No Output Monitoring

Single-Function Safety Relays with Delayed Outputs

CU4

Description

The CU4 is an off-delay timing unit which can be operated standalone or as an extension of a host relay. The timed outputs are used in applications where power must be maintained for a fixed duration after an input signal is received. For example, driving a power to lock TLS2-GD2 to maintain a guard door in the locked position for a fixed duration after a stop button is pressed. Another example would be maintaining the connection of a drive to a motor until the braking function is achieved, and then dropping out a contactor to remove power to the motor.

The inputs can be connected in either a single channel or dual channel configuration. The inputs must remain open during the complete timing cycle. Closing the contacts before the timing cycle completes causes the timer to be reset to zero.

The CU4 has a redundant structure with two independent safe timer circuits. The outputs include two normally open safety delayed outputs as well as one normally closed auxiliary output. The safety outputs have independent and redundant internal contacts to support the safety function. When used as an extension of a host relay, the normally closed contacts should be used in the feedback loop of the host relay. If used in standalone application, the normally closed contacts can be used to signal an auxiliary device or PLC.

A typical operation starts with power applied to A1/A2 and the input circuits open.

1. Close the B11/B12 and B21/B22 circuits.
   a. The safety outputs (17/18 & 27/28) close immediately.
2. Open the B11/B12 or B21/B22 circuits.
   a. The timing process starts.
   b. The safety outputs (17/18 & 27/28) open after the time expires.
3. Go to Step 1.

Features

- Category 3 per EN 954-1
- Stop category 1
- Timed off-delay 0.15…30 s
- Two safety contacts
- One auxiliary contact

LED Indicators

Green	Power
Green	CH1 t1 Active
Green	CH2 t2 Active

Specifications

Safety Ratings		
Standards	EN 954-1, ISO 13849-1, IEC/EN 60204-1, IEC 60947-5-1, ANSI B11.19, AS4024.1	
Safety Classification	Cat. 3 per EN 954-1 (ISO 13849-1), SIL CL2 per EN IEC 62061, PLe per ISO 13849-1	
Functional Safety Data ✶ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	PFH_D: < 2.16 x 10^{-9} MTTFd: > 345 years Suitable for performance levels Ple (according to ISO 13849-1:2006) and for use in SIL3 systems (according to IEC 62061) depending on the architecture and application characteristics	
Certifications	CE Marked for all applicable directives, cULus, c-Tick, and BG	
Power Supply		
Input Power Entry	24V AC/DC, 50/60 Hz; 0.85…1.1 x rated voltage	
Power Consumption	2.5 W	
Inputs		
Safety Inputs	1 N.C. or 2 N.C.	
Input Simultaneity	Infinite	
Reset	Automatic	
Response Time	30 ms	
Outputs		
Safety Contacts	2 N.O.	
Auxiliary Contacts	1 N.C.	
Rated Impulse withstand Voltage	2500V	
Switching Current @ Voltage, Min.	10 mA/10V	
Fuses, Output	External 6 A slow blow or 10 A fast acting	
Electrical Life (Operations)	220V AC/4 A/880VA cosϕ = 0.35…0.1 M 220V AC/1.7 A/375VA cosϕ = 0.6…0.5 M 30V DC/2 A/60 W = 1 M 10V DC/0.01 A/0.1 W = 2 M	
Mechanical Life	2,000,000 operations	
Utilization Category		
AC-15	5 A @ 250V AC	5 A @ 125V AC
DC-13	3 A/24V DC	
UL:	B300, 5 A/250V AC, 24V DC	
Environmental and Physical Characteristics		
Enclosure Type Rating/ Terminal Protection	IP40, DIN 0470/ IP20	
Operating Temperature [C (F)]	-5…+55 ° (23…131 °)	
Vibration	10…55 Hz, 0.35 mm	
Shock	10 g, 16 ms, 100 shocks	
Mounting	35 mm DIN Rail	
Weight [g (lbs)]	165 (0.36)	
Conductor Size, Max.	0.2…4 mm² (24…12 AWG)	

✶ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the following assumptions:
- Mission time/Proof test interval of 20 years
- Functional test at least once within six-month period

Single-Function Safety Relays with Delayed Outputs

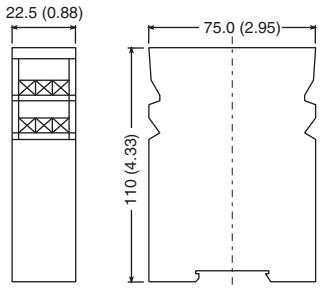
CU4

Product Selection

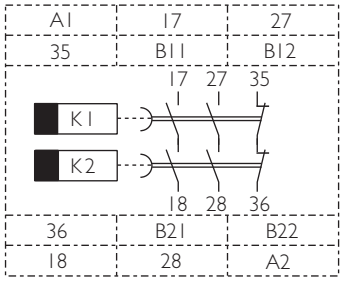
Inputs	Safety Outputs	Auxiliary Outputs	Time Range	Reset Type	Power Supply	Cat. No.
1 N.C. or 2 N.C.	2 N.O.	1 N.C.	0.15…3s	Automatic	24V AC/DC, 50/60 Hz 0.85…1.1 x rated voltage	440R-S23173
			0.5…10s			440R-S23174
			1.5…30s			440R-S23175

Approximate Dimensions

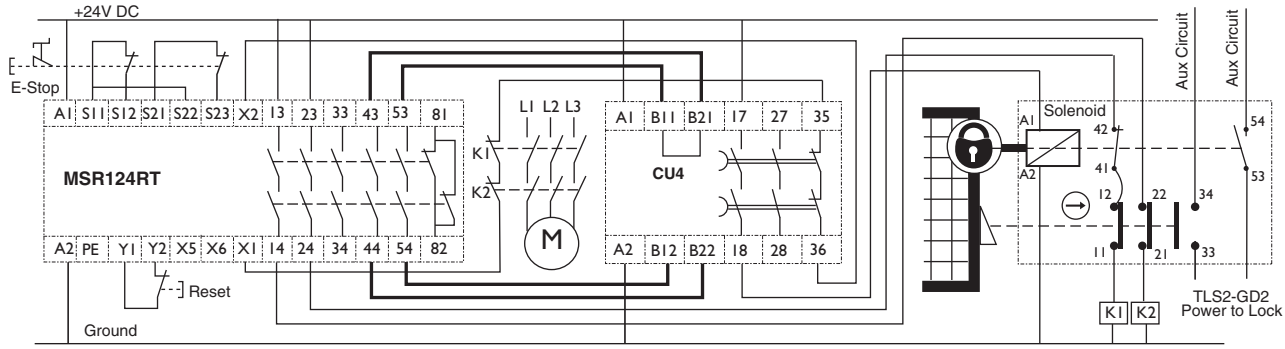
Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



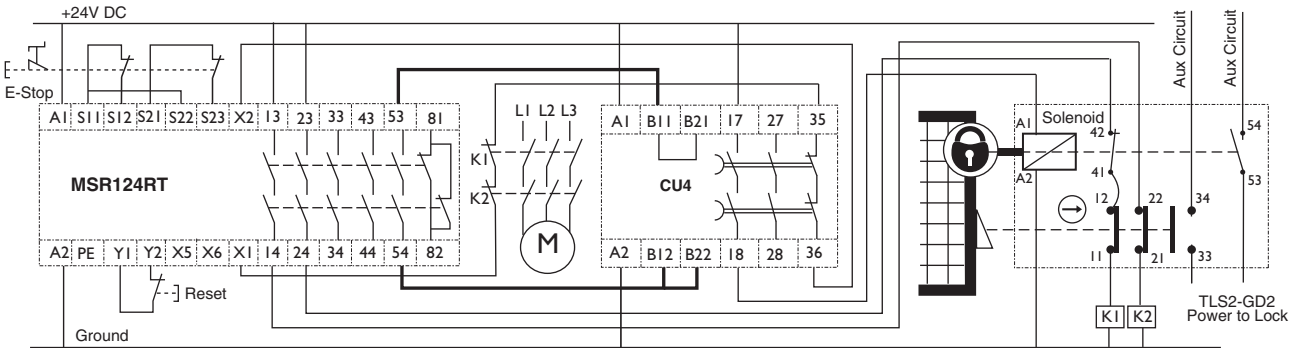
Block Diagram



Typical Wiring Diagrams



Dual Channel Wiring to CU4 Inputs



Single Channel Wiring to CU4 Inputs

Single-Function Safety Relays with Delayed Outputs

MSR38D/DP

Housing with removable terminals shown.

Description

The Minotaur MSR38D/DP is a microprocessor-based, monitoring safety relay, with delayed, safety-rated, solid-state outputs.

The inputs of the MSR38D/DP are the same as the MSR30. They can be connected to gate interlocks, e-stop devices or four-wire safety mats. The gate interlocks and e-stops can be either single channel or dual channel normally-closed circuits.

The reset capability of the MSR38D/DP allows it to set up for monitored manual or automatic/manual reset.

The outputs include two delayed normally-open safety rated outputs that can be connected to loads up to 2 A at 24V DC. These outputs can be used to send a safety stop signal to a machine or manufacturing system. The delay is accomplished by the configuration of jumpers on the terminals. The delay can be easily adjusted by reconfiguring the jumpers.

The MSR38D/DP also has one solid-state normally-closed auxiliary output, which must only be used to indicate the status of the MSR38D/DP. The auxiliary output responds immediately to the change in input status; it is not delayed.

Features

- Category 4 per EN 954-1
- Stop Category 0 or 1
- Two delayed solid-state safety outputs
- One solid-state auxiliary output
- One N.C., two N.C. or safety mat input
- Monitored manual or automatic/manual reset

LED Indicators

Green	Power (Pwr)
Green	K1 Closed
Green	K2 Closed

Wiring Terminations

S11 & S21	Pulse train output
S12 & S22	Input contacts
A1 – S34	Reset switch
S11 – S34	Automatic reset, start-up test disabled
S21 – S34	Automatic reset, start-up test enabled
A1 – Y2	Monitoring circuit
A1 – Y41	Cross-fault monitoring disabled

Specifications

Safety Ratings	
Standards	EN 954-1, ISO 13849-1, IEC/EN 60204-1, ANSI B11.19, AS4024.1
Safety Classification	Cat. 4 per EN 954-1 (ISO 13849-1), SIL CL3 per EN IEC 62061, PLe per ISO 13849-1
Functional Safety Data ✶ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	PFH_D: < 9.2 x 10^{-10} MTTFd: > 631 years Suitable for performance levels Ple (according to ISO 13849-1:2006) and for use in SIL3 systems (according to IEC 62061) depending on the architecture and application characteristics
Certifications	CE Marked for all applicable directives, cULus, c-Tick, and TÜV
Power Supply	
Input Power Entry	24V DC SELV
Power Consumption	3 W
Inputs	
Safety Inputs	1 N.C. or 2 N.C. or SM
Input Resistance, Max.	200 Ω
Reset	Auto./Manual or Monitored Manual
Power On Delay/ Recovery Time	3 seconds/20 ms
Response Time	15 ms
Outputs	
Safety Contacts	2 N.O. SS, 2 A @ 24V DC
Auxiliary Contacts	1 N.O. SS, 50 mA @ 24V DC
Fuses, Output	External 6 A slow blow or 10 A fast acting
Power LED Diagnostics	3 s Blink: Initialization Constant: Normal Operation 2 Blinks: Configuration change during operation 4 Blinks: Solid state output switch fault 5 Blinks: Reset switch closed after reset Continuous blinking: Internal fault
Environmental and Physical Characteristics	
Enclosure Type Rating/ Terminal Protection	IP40 (NEMA 1), DIN 0470/ IP20, DIN 0470
Operating Temperature [C (F)]	-5…+55 ° (23…131 °)
Vibration	10…55 Hz, 0.35 mm
Shock	10 g, 16 ms, 100 shocks
Mounting	35 mm DIN Rail
Weight [g (lbs)]	130 (0.287)
Conductor Size, Max.	0.2…2.5 mm^2 (24…14 AWG)

✶ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the following assumptions:
- Mission time/Proof test interval of 20 years

Product Selection

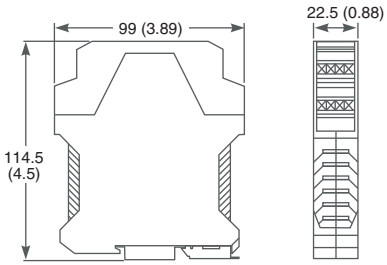
Inputs	Delayed Safety Outputs	Instantaneous Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. No.
1 N.C., 2 N.C., Safety Mat	2 N.O. Solid State	1 N.O. Solid State	Fixed	Auto./Manual or Monitored Manual	24V DC SELV	440R-M23203
			Removable			440R-M23204

Accessories

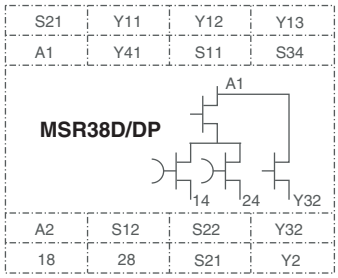
Description	Cat. No.
Bag of 4, 4-Pin Screw Terminal Blocks	440R-A23209
Bag of 4, 4-Pin Spring Clamp Terminal Blocks	440R-A23228

Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.

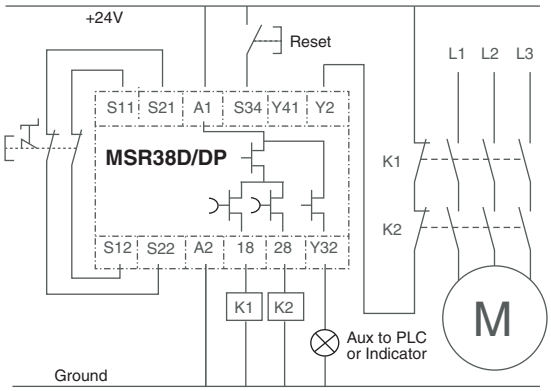


Block Diagram

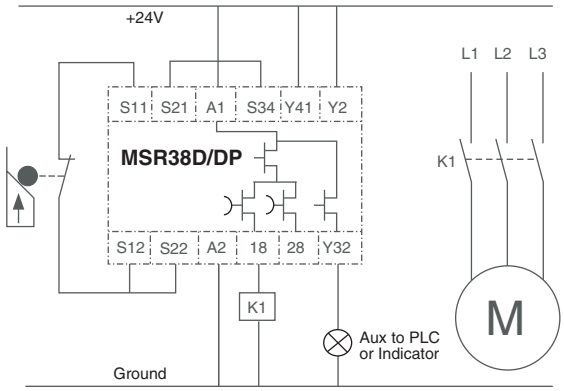


Typical Wiring Diagrams

See MSR30 on 5-16 for additional input wiring configurations.



Dual Channel E-Stop, Dual Channel Delayed Outputs, Monitored Manual Reset, Output Monitoring



Single Channel Gate Interlock, Single Channel Delayed Output, Automatic Reset, No Output Monitoring

Apply jumpers (links) on the terminals identified to achieve the desired off delay.

Delay(s)	Y11	Y12	Y13	Delay(s)	Y11	Y12	Y13	Delay(s)	Y11	Y12	Y13
0	—	—	—	8	S21	S11	—	50	—	S21	S21
0.5	S11	—	—	10	—	S11	S21	60	S11	S11	S11
1	—	S11	—	12	S21	—	S11	80	S11	S11	S21
1.5	—	—	S11	15	—	S21	S11	100	S11	S21	S11
2	S21	—	—	18	S11	S11	—	120	S11	S21	S21
3	—	S21	—	21	S11	—	S11	160	S21	S11	S11
4	—	—	S21	26	—	S11	S11	200	S21	S11	S21
5	S11	S21	—	30	S21	S21	—	250	S21	S21	S11
6	S11	—	S21	40	S21	—	S21	300	S21	S21	S21

Single-Function Safety Relays with Delayed Outputs

MSR138DP

Description

The MSR138DP can be connected in 3 different input wiring configurations: 1 normally closed, 2 normally closed, or 2 OSSD. When connected in the two normally closed fashion, the MSR138DP checks for cross faults across the two inputs. When connected to light curtains, the light curtain must perform the cross-fault detection.

The MSR138DP has output monitoring that can accommodate either automatic/manual reset or a monitored manual reset. When configured with automatic/manual reset (jumpers on X1-X2 and X3-X4), the MSR138DP can have the reset terminals S33-S34 jumpered or can be converted to an unmonitored manual reset by adding a normally open switch in the monitoring loop (S33-S34). When configured to monitored manual reset, the MSR138DP checks the output monitoring circuit through the manual application of the reset switch. The unit cannot be reset until the timing function has completed.

The outputs of the MSR138DP include two normally open immediate safety outputs and three normally open delayed safety outputs. The outputs of the MSR138.1DP include two normally open immediate safety rated outputs, two normally open delayed safety outputs and one normally closed delayed safety output. The safety outputs have independent and redundant internal contacts to support the safety function. If a reset request is made during the time cycle, it will cause a lockout condition. Cycle inputs after timing has completed and reset after the delay time has expired to clear lockout. Connecting contacts 55-56 of the MSR138.1DP in series to Y1-Y2 can avoid this lockout.

A normally closed timer reset switch can be added to force the delayed contacts open prior to the completion of the timing cycle.

Features

- Category 4/3 per EN 954-1
- Stop category 0 and 1
- Light curtain, E-stop, safety gate inputs
- Two immediate safety outputs
- Delayed outputs: 3 N.O. safety or 2 N.C. safety and 1 N.C. aux.
- Cross fault monitoring
- Monitored or automatic reset
- Removable terminals

LED Indicators

Green	Power—Illuminates when power on
Green	Start—Illuminates when S33-S34 is closed
Green	CH1 IN—Illuminates when channel 1 input is closed
Green	CH2 IN—Illuminates when channel 2 input is closed
Green	CH1—Illuminates when K1 is closed
Green	CH2—Illuminates when K2 is closed
Green	CHT1—Illuminates during timing period
Green	CHT2—Illuminates during timing period

Specifications

Safety Ratings		
Standards	EN 954-1, ISO 13849-1, IEC/EN 60204-1, IEC 60947-4-1, IEC 60947-5-1, ANSI B11.19, AS4024.1	
Safety Classification	Cat. 4 per EN 954-1 (ISO 13849-1), SIL CL3 per EN IEC 62061, PLe per ISO 13849-1	
Functional Safety Data ✶ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	PFH_D: < 2.38 x 10^{-9} MTTFd: > 195 years Suitable for performance levels Ple (according to ISO 13849-1:2006) and for use in SIL3 systems (according to IEC 62061) depending on the architecture and application characteristics	
Certifications	CE Marked for all applicable directives, cULus, c-Tick, and TÜV	
Power Supply		
Input Power Entry	24V AC/DC, 115V AC or 230V AC	
Power Consumption	4 W	
Inputs		
Safety Inputs	1 N.C., 2 N.C. or LC	
Input Simultaneity	Infinite	
Input Resistance, Max.	135 Ω	
Reset	Auto./Manual or Monitored Manual	
Power On Delay/ Recovery Time	1 second/100 ms	
Response Time	15 ms	
Outputs		
Safety Contacts	2 N.O.	
Auxiliary Contacts	Delayed 3/2 N.O.	
Thermal Current/$_{Ith}$	5 x 2.5 A or 3 x 3.5 A nonswitching	
Rated Impulse withstand Voltage	2500V	
Switching Current @ Voltage, Min.	10 mA @ 10V	
Fuses, Output	External 6 A slow blow or 10 A fast acting	
Electrical Life (Operations)	(With surge suppression) 250V AC/6 A/1500VA cosϕ = 1…0.1 M 250V AC/2.5 A/625VA cosϕ = 1…0.5 M 250V AC/1.5 A/375VA cosϕ = 0.35…0.3 M 250V AC/5 A/1250VA cosϕ = 0.6…0.1 M 24V DC/2 A/48 W = 1 M 10V DC/0.01 A/0.1 W = 2 M	
Mechanical Life	2,000,000 cycles	
Utilization Category		
Resistive: AC-1	7 A@ 250V AC	
Resistive: DC-1	7 A/24V DC	
Inductive: AC-15	6 A@ 250V AC	6 A @ 125V AC
Inductive: DC-13	3 A/24V DC	6 A/24V DC @ 6 ops/min
UL	B300, 5 A/250V AC, 24V DC	
Environmental and Physical Characteristics		
Enclosure Type Rating/ Terminal Protection	IP40 (NEMA 1)/ IP20	
Operating Temperature [C (F)]	-5…+55 ° (23…131 °)	
Vibration	10…55 Hz, 0.35 mm	
Shock	10 g, 16 ms, 100 shocks	
Mounting	35 mm DIN Rail	
Weight [g (lbs)]	24V DC: 350 (0.77); 115/230V AC: 490 (1.08)	
Conductor Size, Max.	0.2…4 mm² (24…12 AWG)	

✶ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the following assumptions:
- Mission time/Proof test interval of 20 years
- Functional test at least once within six-month period

Single-Function Safety Relays with Delayed Outputs

MSR138DP

Product Selection

Inputs	Safety Outputs	Delayed Safety Outputs	Delayed Auxiliary Outputs	Time Delay	Terminals	Reset Type	Power Supply	Cat. No.
1 N.C., 2 N.C., Light Curtain	2 N.O.✶	3 N.O.❄ (MSR138DP)	—	1.0 seconds, fixed	Removable	Auto./Manual or Monitored Manual	115V AC	440R-M23080
				0.15…3 s			24V AC/DC	**440R-M23143**
					Spring Clamp			440R-M23143S
				0.15…3 seconds	Removable		115V AC	440R-M23141
							230V AC	440R-M23140
				0.5…10 s			24V AC/DC	**440R-M23147**
					Spring Clamp			440R-M23147S
				0.5…10 seconds	Removable		115V AC	440R-M23145
							230V AC	440R-M23144
				1.5…30 seconds			24V AC/DC	440R-M23151
							115V AC	440R-M23149
							230V AC	440R-M23148
		2 N.O.❄ (MSR138.1DP)	1 N.C.	0.15…3 seconds			24V AC/DC	**440R-M23084**
							115V AC	440R-M23082
							230V AC	440R-M23081
				0.5…10 seconds			24V AC/DC	**440R-M23088**
							115V AC	440R-M23086
							230V AC	440R-M23085
				1.5…30 seconds			24V AC/DC	440R-M23092
							115V AC	440R-M23090
							230V AC	440R-M23089

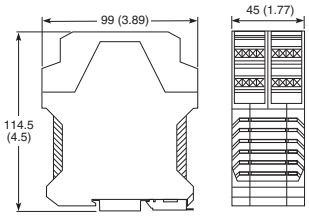
✶ Instantaneous safety outputs Cat. 4
❄ Delayed safety outputs are Cat. 3

Accessories

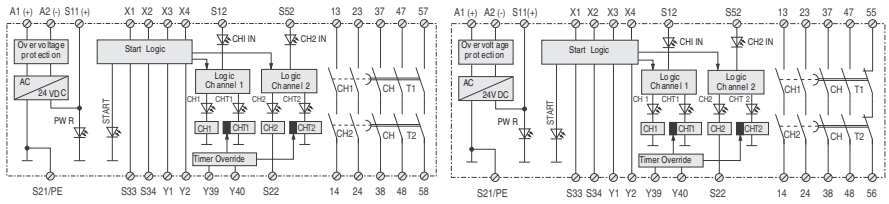
Description	Cat. No.
Bag of 4, 4-Pin Screw Terminal Blocks	440R-A23209
Bag of 4, 4-Pin Spring Clamp Terminal Blocks	440R-A23228

Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



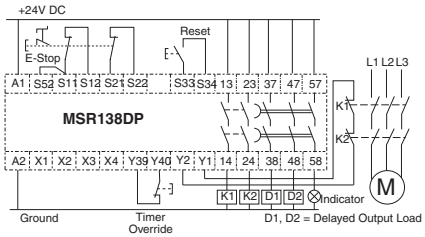
Block Diagram



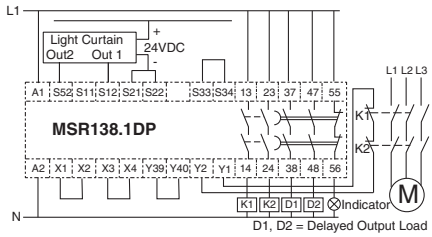
MSR138DP **MSR138.1DP**

In applications with 24V AC supply: terminal S21 must not be connected to PE.

Typical Wiring Diagrams



24V DC Supply Dual Channel E-Stop, Monitored Manual Reset, Monitored Output



115/230V AC Supply, 24V DC Light Curtain, Automatic Reset, Monitored Output

5-Safety Relays

Single-Function Safety Relays with Delayed Outputs

MSR178DP

Description

The MSR178DP is a multi-function time-delay relay for use in safety circuits. It can be configured by the user to perform on-delay, off-delay or single-pulse modes. It is used for applications such as delayed unlocking of safety gates, delayed de-energizing of variable speed controlled motors, or jogging (single pulse) in teaching or setup mode.

The MSR178DP can be used e.g. in conjunction with a power to release or power to lock guard locking switch to time out high inertia machines with significant run down in potentially dangerous equipment. The single-pulse mode enables implementation of two-hand control by use of two normally open contacts. It also can be used as a preset time limited mute dependent bypass in order to clear a blockage in the muting sensor area.

The operating function is selected by external jumpers to Y21 and Y22. The delay time is selected by a combination of external jumpers to Y31 and Y32 and the potentiometer located on the front face.

The input to the MSR178DP can be connected in five different configurations: one normally closed, two normally closed, one normally open, two normally open, or two PNP connections from a light curtain. The normally closed connections are used for off-delay timing. The normally open inputs are used for on-delay timing and the single-pulse function. To generate the single pulse both inputs must be closed within 0.5 seconds. Thus a two-hand control arrangement in accordance with EN 574 Cat. IIIA can be used to trigger the single pulse.

The MSR178DP has three normally open redundant safety outputs. The two normally closed outputs can be connected in series to achieve redundant safety or connected in parallel for auxiliary signaling. External devices can be monitored by the Y11 terminal. Power to the MSR178DP can be either 24V AC/DC (24V/GND terminals) or 115V AC (A3/A2 terminals), or 230V AC (A1/A2 terminals).

The MSR178DP can be used as a standalone control module or in combination with an MSR safety relay to combine instant and delayed safety outputs, as needed.

Features

- Category 4 per EN 954-1
- SIL3 per IEC 61508
- Stop category 1
- On-/off-delayed, or single-pulse (one shot) operation
- Four time ranges up to 30 mins.
- Pulsed or static input monitoring
- Three N.O. safety outputs
- One N.C. safety or two N.C. auxiliary outputs
- Eight diagnostic LEDs
- Automatic reset
- Removable terminals

Specifications

Safety Ratings	
Standards	EN 954-1, IEC 61508, EN IEC 62061, ISO 13849-1, IEC/EN 60204-1, IEC 60947-5-1, EN 61812-1, AS 4024.1, ISOTR 12100, B11.19
Safety Classification	Cat. 4 per EN 954-1 (ISO 13849-1), SIL CL3 per EN IEC 62061, PLe per ISO 13849-1
Functional Safety Data ✶ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	PFH_D: < 2.74 x 10^{-9} MTTFd: > 285 years Suitable for performance levels Ple (according to ISO 13849-1:2006) and for use in SIL3 systems (according to IEC 62061) depending on the architecture and application characteristics
Certifications	CE Marked for all applicable directives, cULus, c-Tick, and TÜV
Power Supply	
Input Power Entry	24V AC/DC, 115/230V AC 50/60 Hz
Power Consumption	4 W
Inputs	
Safety Inputs	1 or 2 N.O., 1 or 2 N.C., Light Curtain
Input Simultaneity	Infinite for On-/Off-delay, 0.5 s for single pulse function
Input Resistance, Max.	900 Ω
Reset	Automatic
Power On Delay/ Recovery Time	500 ms/300 ms single pulse only
Response Time	<±0.5% (at constant temp)
Outputs	
Safety Contacts	3 N.O.
Auxiliary Contacts	2 N.C.
Thermal Current/I_{th}	6 A
Rated Impulse withstand Voltage	2500V
Switching Current @ Voltage, Min.	10 mA @ 10V DC
Fuses, Output	External 6 A slow blow or 10 A quick blow
Electrical Life (Operations)	230V AC/4 A/880VA cosϕ = 0.35…0.1 M 230V AC/1.7 A375VA cosϕ = 0.6…0.5 M 30V DC/2 A/60 W = 1 M 10V DC/0.01 A/0.1 W = 2 M
Mechanical Life	2,000,000 operations
Utilization Category	
Inductive: AC-15	6 A/250V AC
Inductive: DC-13	3 A/24V DC
UL:	B300, 6 A/250V AC, 3 A/24V DC
Environmental and Physical Characteristics	
Enclosure Type Rating/ Terminal Protection	IP40 (NEMA 1), DIN VDE 0470-1/ IP20
Operating Temperature [C (F)]	-5…+55 ° (14…131 °)
Vibration	10…55 Hz, 0.35 mm
Shock	10 g, 16 ms, 100 shocks
Mounting	35 mm DIN Rail
Weight [g (lbs)]	325 (0.72)
Conductor Size, Max.	0.2…4 mm^2 (24… 12 AWG)

✶ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the following assumptions:
- Mission time/Proof test interval of 20 years
- Functional test at least once within six-month period

Single-Function Safety Relays with Delayed Outputs

MSR178DP

Product Selection

Inputs	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. No.
1 or 2 N.O., 1 or 2 N.C., Light Curtain, Two-Hand Control, Enabling Switch	3 N.O.	2 N.C.	Removable	Automatic	24V AC/DC, 115V AC or 230V AC	440R-M23227

Accessories

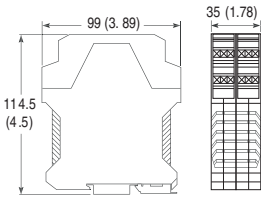
Description	Cat. No.
Bag of 4, 3-Pin Screw Terminal Blocks	440R-A23210
Bag of 4, 3-Pin Spring Clamp Terminal Blocks	440R-A23229

LED Indicators

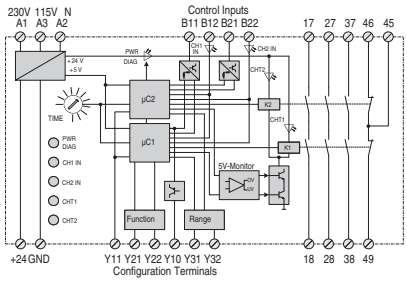
PWR: Green	Power on
Flashing Green/Red	Faillure
CH1/2 IN: Static Green	Input closed
Flashing Green	Time lapse
CHT1: Green	Output CH1 Active
CHT2: Green	Output CH2 Active

Approximate Dimensions

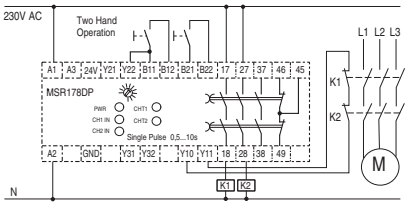
Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.

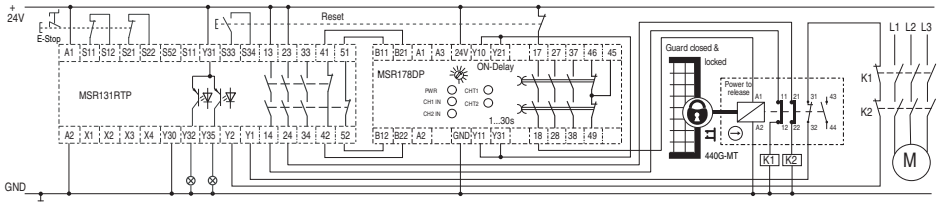


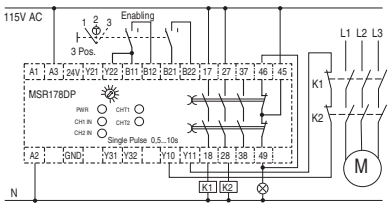
Block Diagram

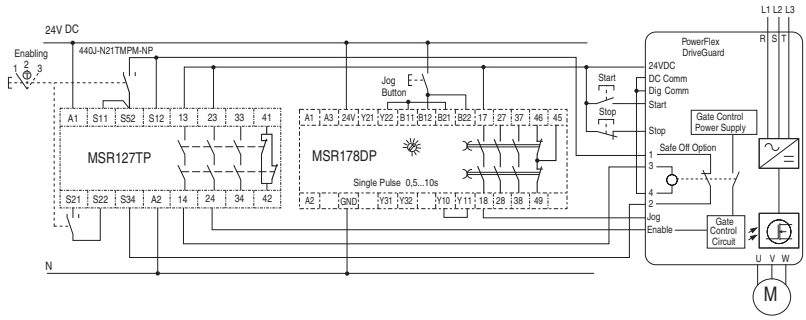


Typical Wiring Diagrams





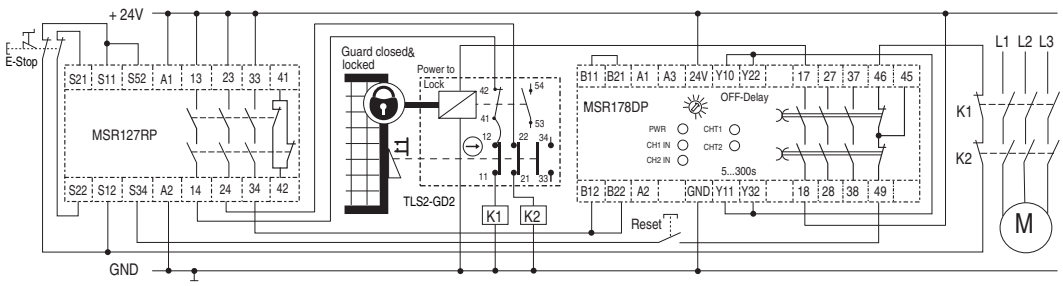




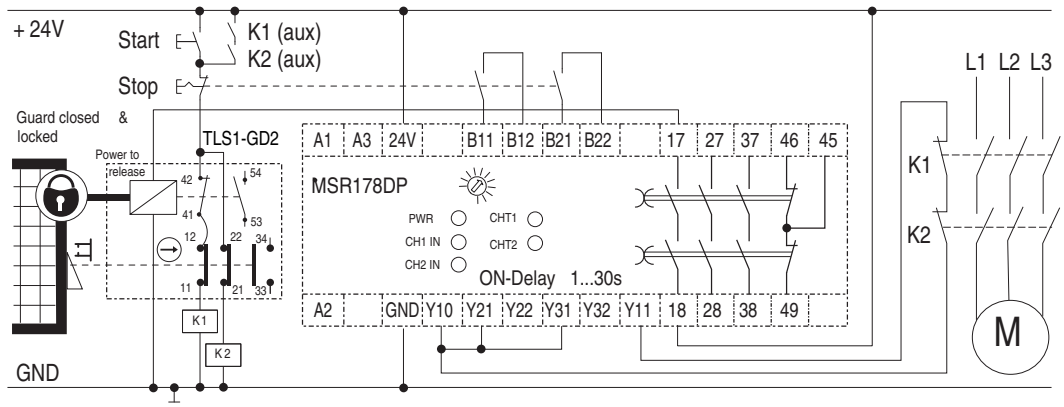
Single-Function Safety Relays with Delayed Outputs

MSR178DP

Typical Wiring Diagrams (continued)



MSR178DP generates OFF-delayed solenoid release after E-Stop on MSR127

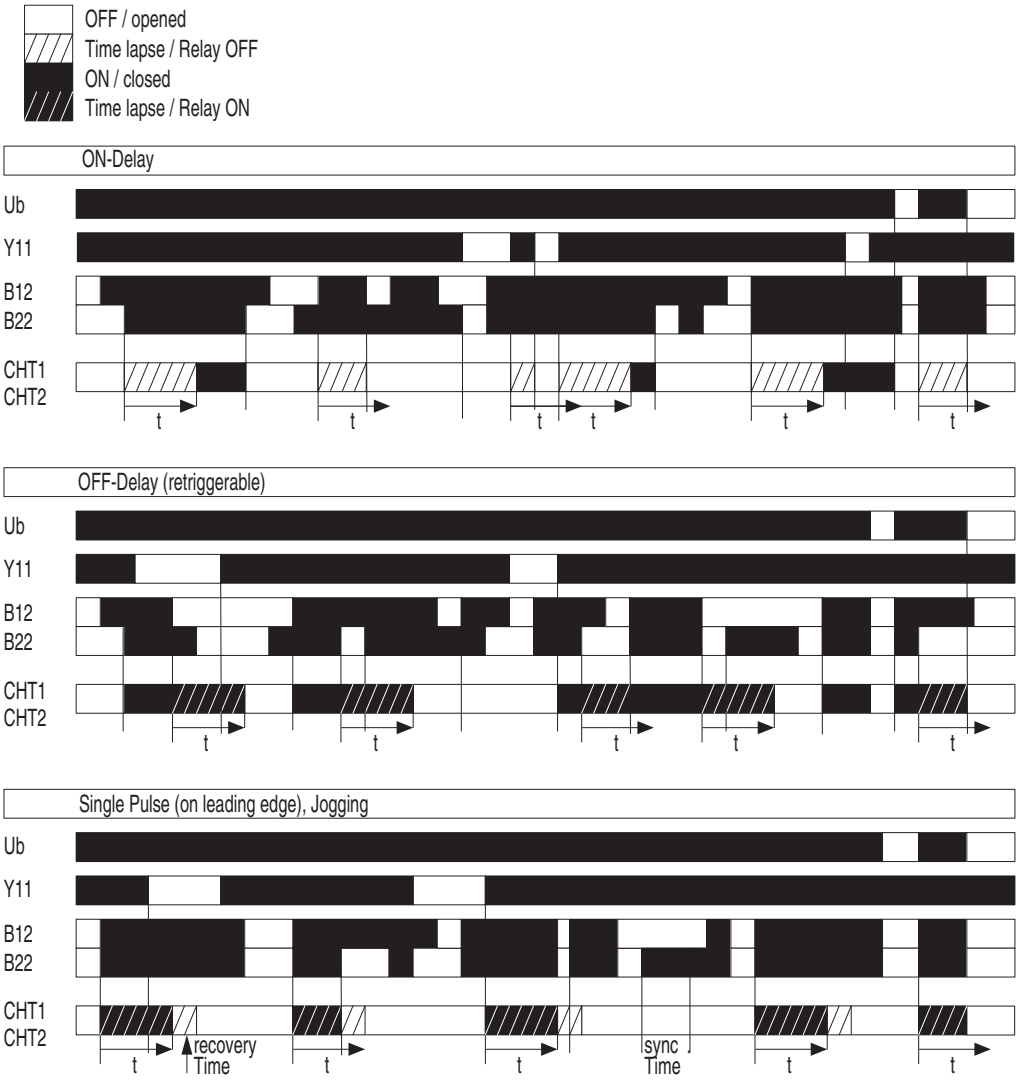


MSR178DP ON-delayed unlocking the Gate after maintained stop switch pressed

Jumper Configuration

Operating Function	
Y10…Y21	ON Delay
Y10…Y22	OFF Delay
B11…Y22	Single Pulse
Time Range	
—	0.5…10 s
Y10…Y31	1…30 s
Y10…Y32	5…300 s
Y10…Y31…Y32	1…30 min
Cross Fault Detection on Inputs	
—	Enabled
B11…B21	Disabled
Feedback Loop	
Y10…Y11	Close before reset

Time Function Diagrams



Specialty Safety Relays

MSR35H/HP Two-Hand Control

Housing with removable terminals shown.

Description

The Minotaur MSR35H/HP is a microprocessor-based, two-hand control monitoring safety relay, with safety-rated, solid-state outputs.

The input of the MSR35H/HP accepts two switches, each containing one normally open and one normally closed. Both switches must be actuated within 0.5 seconds of each other.

The MSR35 can alternatively be wired with two switches with normally open contacts to a Category IIIA application per EN 574.

The reset capability of the MSR35H/HP allows it to be set up for manual or automatic reset.

The outputs include two normally-open safety-rated outputs that can be connected to loads up to 2 A at 24V DC. These outputs can be used to send a safety stop signal to a machine or manufacturing system.

The MSR35H/HP also has one solid-state normally-closed auxiliary output, which must only be used to indicate the status of the MSR35H/HP.

Features

- Category 4 per EN 954-1
- Category IIIC or IIIA per EN 574
- Two solid-state safety outputs
- One solid-state auxiliary output
- Two-hand control input

LED Indicators

Green	Power (Pwr)
Green	K1 Energized
Green	K2 Energized

Specifications

Safety Ratings	
Standards	EN 954-1, ISO 13849-1, EN 574, IEC/EN 60204-1, ANSI B11.19, AS4024.1
Safety Classification	Cat. 4 per EN 954-1 (ISO 13849-1), SIL CL3 per EN IEC 62061, PLe per ISO 13849-1
Functional Safety Data ∗ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	PFH_D: < 9.2 x 10^{-10} MTTFd: > 631 years Suitable for performance levels Ple (according to ISO 13849-1:2006) and for use in SIL3 systems (according to IEC 62061) depending on the architecture and application characteristics
Certifications	CE Marked for all applicable directives, cULus, c-Tick, and TÜV
Power Supply	
Input Power Entry	24V DC SELV
Power Consumption	3 W
Inputs	
Safety Inputs	1 N.C. & 1 N.O. or 2 N.O.
Input Simultaneity	0.5 s
Input Resistance, Max.	200 Ω
Reset	Automatic
Power On Delay/ Recovery Time	3 seconds/20 ms
Response Time	15 ms
Outputs	
Safety Contacts	2 N.O., 2 A @ 24V DC
Auxiliary Contacts	1 N.O., 50 mA @ 24V DC
Fuses, Output	External 6 A slow blow or 10 A fast acting
Power LED Diagnostics	3 s Blink: Initialization Constant: Normal Operation 2 Blinks: Configuration change during operation 4 Blinks: Solid state output switch fault Continuous blinking: Internal fault
Environmental and Physical Characteristics	
Enclosure Type Rating/ Terminal Protection	IP40 (NEMA 1), DIN 0470/ IP20, DIN 0470
Operating Temperature [C (F)]	-5…+55 ° (23…131 °)
Vibration	10…55 Hz, 0.35 mm
Shock	10 g, 16 ms, 100 shocks
Mounting	35 mm DIN Rail
Weight [g (lbs)]	130 (0.287)
Conductor Size, Max.	0.2…2.5 mm^2 (24…14 AWG)

∗ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the following assumptions:
- Mission time/Proof test interval of 20 years

Product Selection

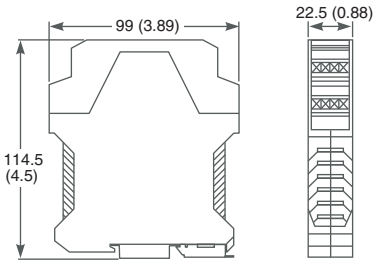
Inputs	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. No.
2 x 1 N.C. + 1 N.O. (Two-Hand Control) or 2 x N.O.	2 N.O. Solid State Safety; 1 N.O. Solid State Auxiliary	1 N.O. Solid State	Fixed	Automatic	24V DC SELV	440R-D23201
			Removable			440R-D23202

Accessories

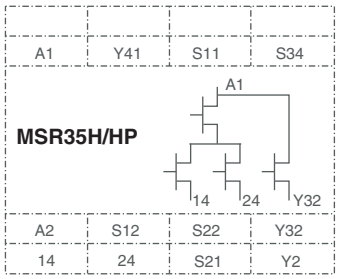
Description	Cat. No.
Bag of 4, 4-Pin Screw Terminal Blocks	440R-A23209
Bag of 4, 4-Pin Spring Clamp Terminal Blocks	440R-A23228

Approximate Dimensions

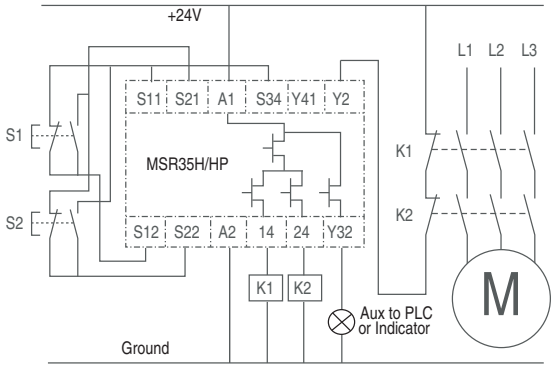
Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



Block Diagram



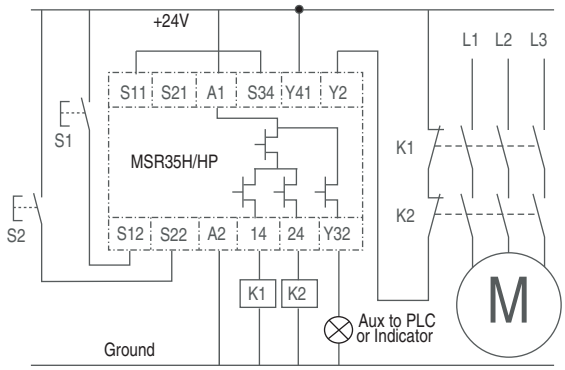
Typical Wiring Diagrams



Switch connection to pulsed signals from S11 and S21, connection between S11 and S34.

Two-Hand Control, Dual Channel Outputs, Output Monitoring

Note: EN 574 IIIC when wired with two sets of N.O./N.C., EN 574 IIIA when wired with two sets of N.O. contacts.



Switch connection direct to 24V DC supply, Y41 to +24V DC, connection between S11 and S34.

Two-Hand Control, Dual Channel Outputs, Output Monitoring

Note: Connect Y41 to +24V to disable pulse testing.

Specialty Safety Relays

MSR125H/HP Two-Hand Control

Description

The Allen-Bradley Guardmaster Minotaur MSR125H/HP is a logic unit for monitoring and interfacing two-hand control devices with a safety-related circuit. The MSR125H/HP is for use with mechanical switches and the Rockwell Automation Bulletin 800Z Zero-Force Touch Buttons.

The MSR125H/HP has two normally open safety outputs. The safety outputs have independent and redundant internal contacts to support the safety function.

The MSR125H/HP requires the two switches to be operated within 0.5 seconds of each other and will only authorize the ON state while both switches are held down. If one of the switches is released, the output goes to the OFF state and the machine cannot be restarted until both buttons are released and then operated simultaneously.

The MSR125H/HP conforms to EN 574 Category IIIC, which gives specific requirements for two-hand control units and logic devices.

The MSR125H has fixed terminals and the MSR125HP has removable terminals.

Features

- Category 4 per EN 954-1
- Safety category IIIC per EN 574
- Two-hand control unit
- Two N.O. safety outputs
- Fixed or removable terminals
- 22.5 mm wide housing

LED Indicators

Green	Power on
Green	CH1 Output Active
Green	CH2 Output Active

Specifications

Safety Ratings		
Standards	EN 574, EN 954-1, ISO 13849-1, IEC/EN 60204-1, IEC 60947-4-1, IEC 60947-5-1, ANSI B11.19, AS 4024.1	
Safety Classification	Cat. 4 per EN 954-1 (ISO 13849-1), SIL CL3 per EN IEC 62061, PLe per ISO 13849-1	
Functional Safety Data ✶ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	PFH_D: < 1.44 x 10^{-9} MTTFd: > 385 years Suitable for performance levels Ple (according to ISO 13849-1:2006) and for use in SIL3 systems (according to IEC 62061) depending on the architecture and application characteristics	
Certifications	CE Marked for all applicable directives, cULus, c-Tick, and BG	
Power Supply		
Input Power Entry	24V DC, 24V AC, 115V AC, 230V AC	
Power Consumption	2 W	
Inputs		
Safety Inputs	1 N.C. + 1 N.O.	
Input Simultaneity	<0.5 sec	
Input Resistance, Max.	40 Ω	
Reset	Automatic	
Power On Delay/ Recovery Time	1 second/500 ms	
Response Time	20 ms	
Outputs		
Safety Contacts	2 N.O.	
Thermal Current/$_{Ith}$	1 x 6 A or 2 x 4 A nonswitching	
Rated Impulse withstand Voltage	2500V	
Switching Current @ Voltage, Min.	10 mA/10V	
Fuses, Output	External 6 A slow blow or 10 A fast acting	
Electrical Life (Operations)	(With surge suppression) 250V AC/6 A/1500VA cosϕ = 0.35…0.1 M 250V AC/2.5 A/625VA cosϕ = 0.6…0.5 M 250V AC/1.5 A/375VA cosϕ = 0.35…0.3 M 250V AC/5 A/1250VA cosϕ = 0.6…0.1 M 24V DC/2 A/48 W = 1 M 10V DC/0.01 A/0.1 W = 2 M	
Mechanical Life	2,000,000 operations	
Utilization Category		
Resistive: AC-1	8 A @ 250V AC	
Resistive: DC-1	6 A/24V DC	
Inductive: AC-15	6 A @ 250V AC	6 A @ 125V AC
Inductive: DC-13	3 A/24V DC	6 A/24V DC @ 6 ops/min
Resistive UL:	B300, R300, 8 A/250V AC, 6 A/24V DC, 30V DC Resistive	
Environmental and Physical Characteristics		
Enclosure Type Rating/ Terminal Protection	IP40 (NEMA 1), DIN 0470/ IP20, DIN 0470	
Operating Temperature [C (F)]	-5…+55 ° (23…131 °)	
Vibration	10…55 Hz, 0.35 mm	
Shock	10 g, 16 ms, 100 shocks	
Mounting	35 mm DIN Rail	
Weight [g (lbs)]	24V DC: 210 (0.46); 115/230V AC: 260 (0.57)	
Conductor Size, Max.	0.2…4 mm^2 (24…12 AWG)	

✶ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the following assumptions:
- Mission time/Proof test interval of 20 years

Product Selection

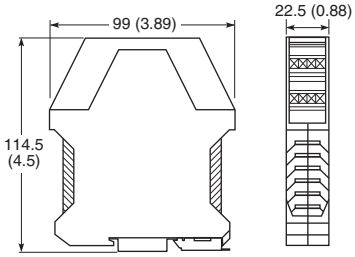
Inputs	Button Type	Safety Outputs	Terminals	Reset Type	Power Supply	Cat. No.
1 N.C. + 1 N.O. (Two-Hand Control)	Mechanical or Bulletin 800Z	2 N.O.	Removable (MSR125HP)	Automatic	24V DC	**440R-D23171**
					24V AC	440R-D23170
					115V AC	440R-D23169
					230V AC	440R-D23168
			Fixed (MSR125H)		24V DC	440R-D23166
					115V AC	440R-D23164
					230V AC	440R-D23163

Accessories

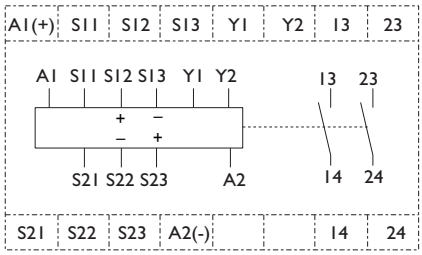
Description	Cat. No.
Bag of 4, 4-Pin Screw Terminal Blocks	440R-A23209
Bag of 4, 4-Pin Spring Clamp Terminal Blocks	440R-A23228

Approximate Dimensions

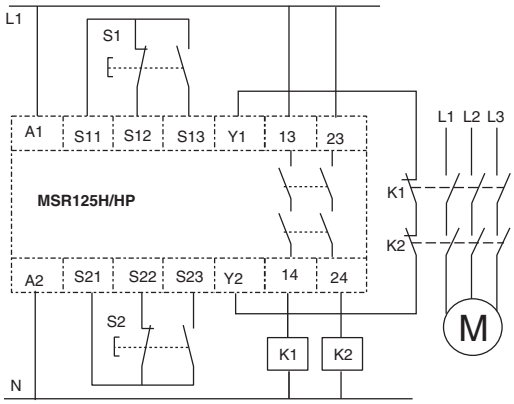
Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



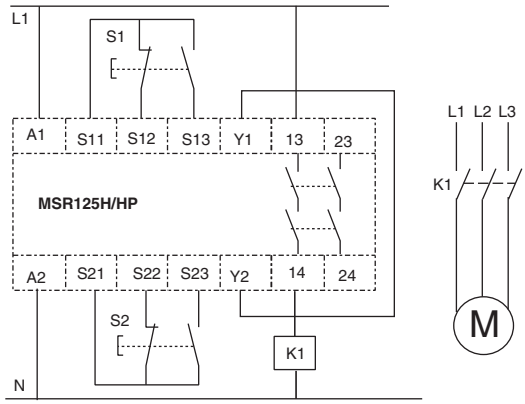
Block Diagram



Typical Wiring Diagrams



Two-Hand Control, Dual Channel, Auto Reset, Output Monitoring



Two-Hand Control, Dual Channel, Auto Reset, No Output Monitoring

Specialty Safety Relays

MSR22LM Muting Light Curtain

Description

The MSR22LM safety monitoring relay is designed to monitor light curtains with the added features of muting and presence sensing device initiation (PSDI). It provides an output to a machine control system when the light curtain is clear. When the inputs to the MSR22LM are closed (conducting), the output relays are closed if the monitoring circuit is satisfied.

The MSR22LM has three sets of dual channel inputs. This allows it to operate in four different configurations:

1. Monitors up to three light curtains in guard only mode.
2. Monitors up to two light curtains with two muting sensors (only one curtain muted).
3. Monitor one light curtain with four muting sensors.
4. Monitors up to three light curtains with PSDI (only one curtain initiated).

The MSR22LM uses microprocessor based technology to offer a wide variety of advanced safety solutions in a small 45 mm DIN rail mounted housing. Internal selector switches provide for easy selection of up to ten different applications. Four LEDs give operational status as well as diagnostic information. Removable terminals reduce wiring and installation costs when replacement is necessary.

Features

- Category 4 per EN 954-1
- Stop category 0
- Light curtain muting—two or four sensors
- Presence sensing device initiation—up to three breaks
- 45 mm housing
- Removable terminals
- 24V DC supply voltage
- Start/restart interlock

LED Indicators

Power: Green	Ready
K1: Green	K1 Closed
If K1 alone is lit, check for short across reset button	
K2: Green	K2 Closed

Specifications

Safety Ratings		
Standards	EN 954-1, ISO13849-1, IEC/EN 60204-1, IEC 60947-5-1, IEC 61496-1, ANSI B11.19, AS4024.3	
Safety Classification	Cat. 4 per EN 954-1 (ISO 13849-1), SIL CL3 per EN IEC 62061, PLe per ISO 13849-1	
Functional Safety Data ✶ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	PFH_D: < See website MTTFd: > See website Suitable for performance levels Ple (according to ISO 13849-1:2006) and for use in SIL3 systems (according to IEC 62061) depending on the architecture and application characteristics	
Certifications	CE Marked for all applicable directives and BG	
Power Supply		
Input Power Entry	24V DC	
Power Consumption	4 W	
Inputs		
Safety Inputs	2 N.C. Symmetric or Asymmetric, Switch Selectable	
Input Simultaneity	0.5 seconds	
Input Resistance, Max.	S12-S14: 300 Ω S21-S22: 200 Ω S33-S34: 250 Ω	
Reset	Auto./Manual	
Power On Delay Time	40 ms (Manual Reset); 200 ms (Auto Reset)	
Response Time	15 ms	
Outputs		
Safety Contacts	2 N.O.	
Auxiliary Contacts	1 N.C.	
Thermal Current/I_{th}	5 A nonswitching	
Switching Current @ Voltage, Min.	1 mA @ 10V	
Fuses, Output	6 A fast acting (external)	
Electrical Life (Operations)	220V AC/4 A/880VA cosϕ = 0.35…0.1 M 220V AC/1.7 A375VA cosϕ = 0.6…0.5 M 30V DC/2 A/60 W = 1 M 10V DC/0.01 A/0.1 W = 2 M	
Mechanical Life	10,000,000 operations	
Utilization Category (Inductive)		
B500: AC-15	3 A @ 250V AC	3 A @ 120V AC
P300 DC-13	3 A/24V DC	
B300 AC-15	2 A @ 250V AC	2 A @ 120V AC
DC-13	2 A/24V DC	
Environmental and Physical Characteristics		
Enclosure Type Rating/ Terminal Protection	IP40 (NEMA 1), DIN 0470/ IP20, DIN 0470	
Operating Temperature [C (F)]	-15…+55 ° (5…131 °)	
Vibration	0.35 mm 10…55 Hz	
Mounting	35 mm DIN Rail	
Weight [g (lbs)]	220 (0.485)	
Conductor Size, Max.	1 x 2.5 mm² (14 AWG) stranded, 1 x 4 mm² (12 AWG) solid	

✶ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the following assumptions:
- Mission time/Proof test interval of 20 years
- Functional test at least once within six-month period

Product Selection

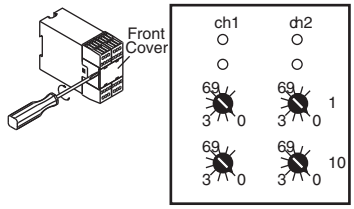
Inputs	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. No.
3 x 2 N.C.	2 N.O.	1 N.C.	Removable	Auto./Manual	24V DC	**440R-P23071**

Accessories

Description	Cat. No.
70 mm Tower Light Clear LED Module—Black Enclosure	855T-B24YL7
70 mm Tower Light Clear LED Module—Grey Enclosure	855T-G24YL7

Application Details

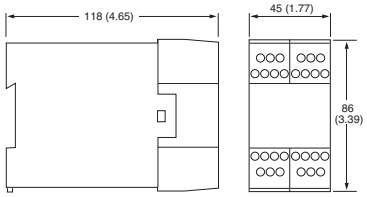
Disconnect power. Use a screwdriver to pop open cover to reveal internal switches.



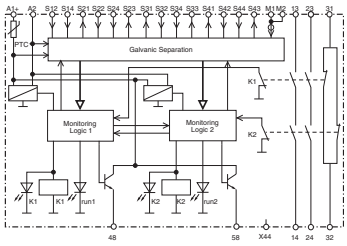
Inside View

Approximate Dimensions

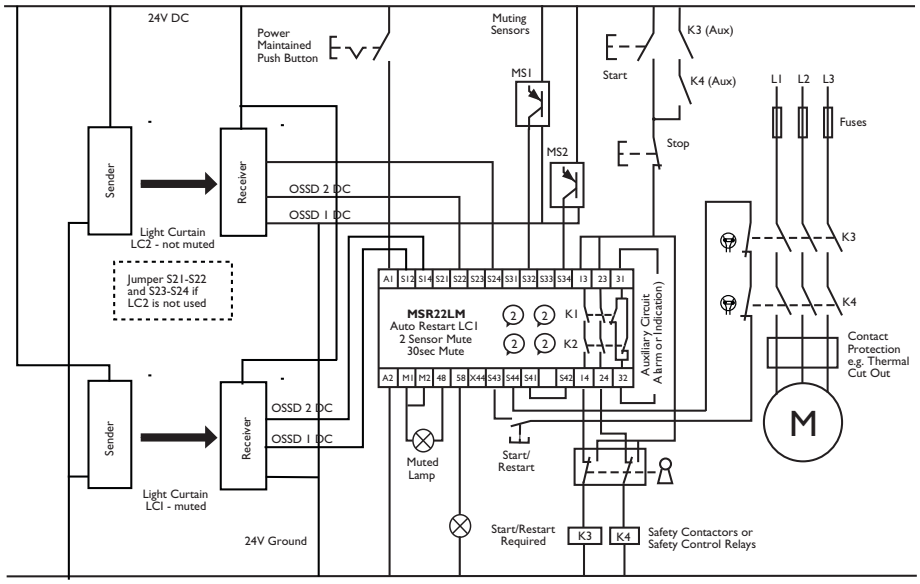
Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



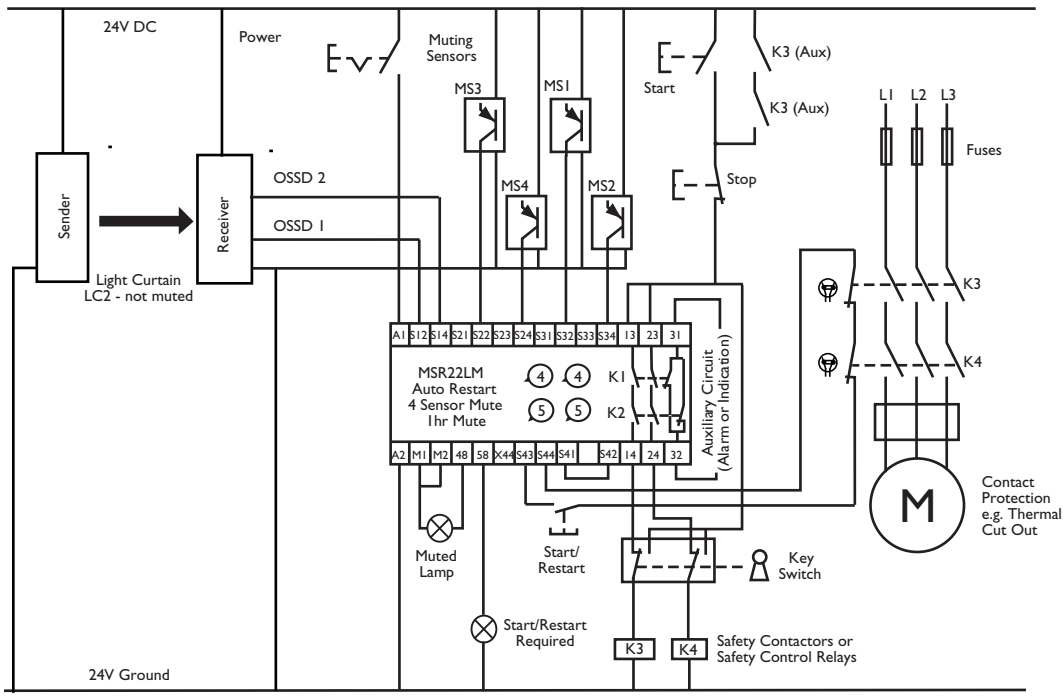
Block Diagram



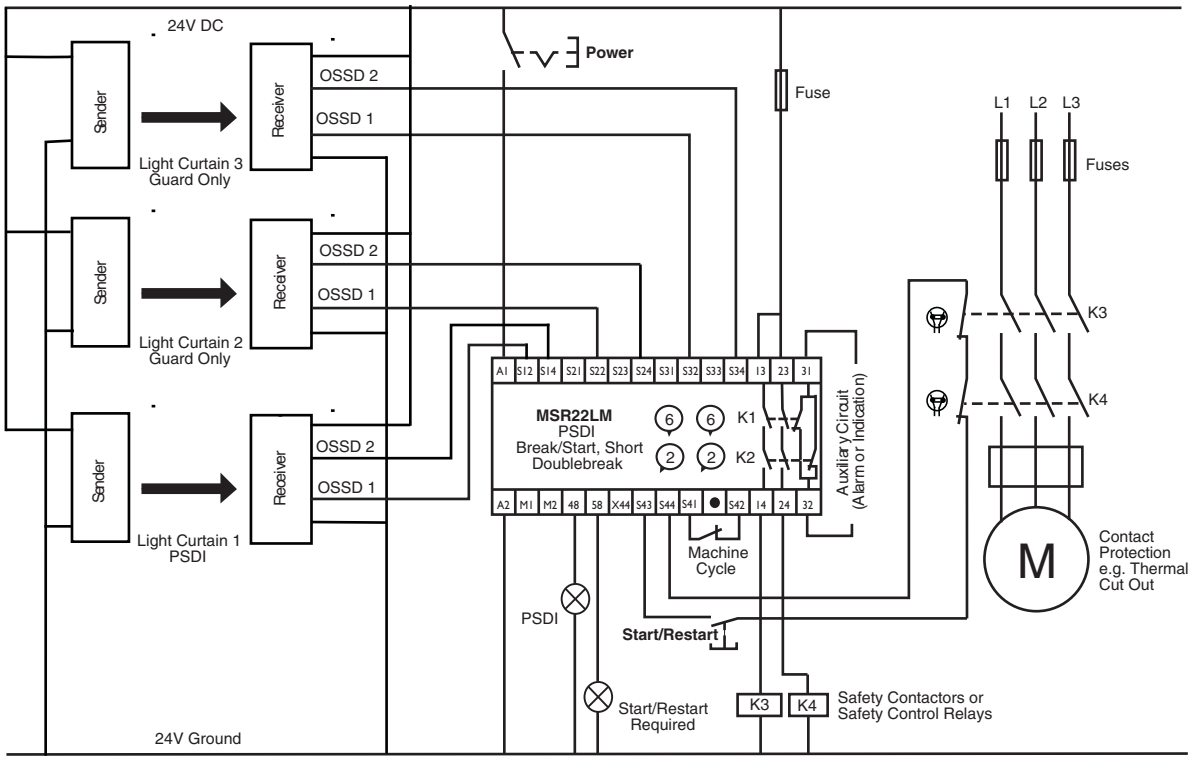
Typical Wiring Diagrams



Note: Two light curtains with two-sensor muting and Auto Restart LC1.



Note: Typical one light curtain with four-sensor muting and Auto Restart LC1.



Note: Light curtain inputs, Presence Sensing Device Initiation (on LC1) Start/Restart Interlock, Dual Channel Output, Output Monitoring.

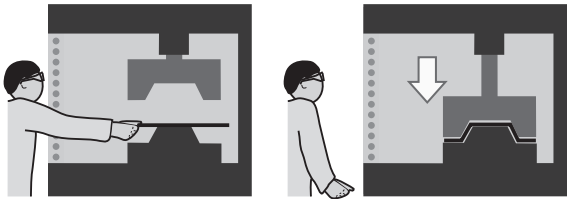
Application Details

MSR22LM—Shown connected to a safety light curtain.

Multiple settings are available offering a variety of advantages. Below are the three most common settings.

Protective Mode

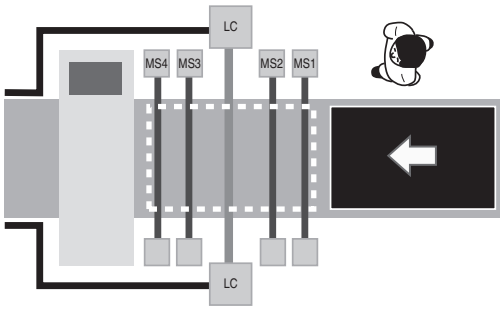
Example shows a press protected by a safety light curtain connected to the MSR22LM.



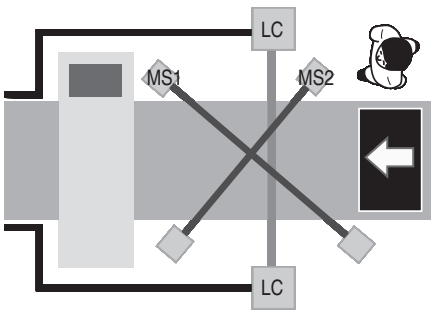
In machine operation, whenever the light curtain beams are broken the press immediately stops to help avoid danger to the operator. Once the beams are cleared the machine can then be started.

Muting Mode

Two examples are shown, both conveyor applications with a safety light curtain protecting the dangerous area. In-line and cross beam muting is used to allow the material to pass through the light curtain without stopping the machine. Any other object or person will be detected by the light curtain which will initiate machine stop.



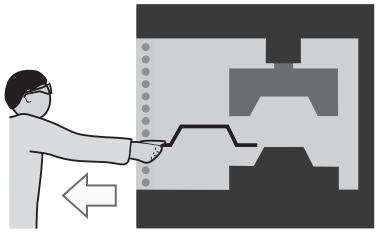
In-line muting requires the material to break the beams in a sequence, as shown. Only if all four MS beams are broken in turn and then clear in turn will the light curtain allow material through without initiating machine stop.



Cross-beam muting requires the material to break the beams in a sequence. MS1 first and then MS2. Only if the beams are broken in turn and then clear in turn will the light curtain allow material through without initiating machine stop.

Auto Initiation Sequence (Stepping)—Double Break Shown

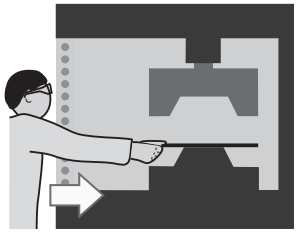
Auto initiation allows the machine to start and stop according to the number of times the light curtain beams are broken and cleared. Illustrated below is the MSR22LM set to auto initiation double break mode (after initial start-up sequence). Single- or three-break modes can also be selected.



First break—processed material removed

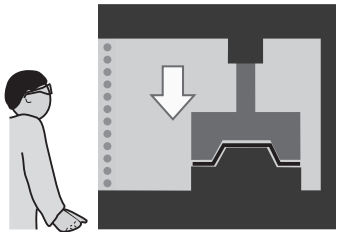
First clear—light curtain clear

Machine remains in stop mode



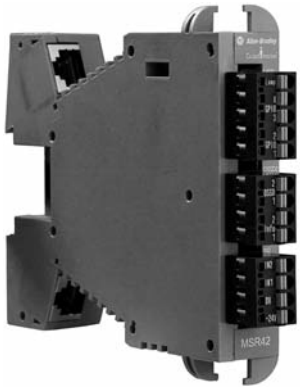
Second break—new material inserted

Machine remains in stop mode



Second clear—light curtain clear

Machine starts. Upon completion of cycle first break will start sequence again.



Description

The MSR42 multi-function safety relay is the control module for the GuardShield Micro 400 safety light curtain, but can also be used with any light curtain. This versatile Category 4 safety device has a pair of PNP solid state, 400 mA OSSDs for direct connection to the final switching device. When safety relay outputs are required, the MSR42 easily accommodates the interconnection of up to three MSR45E safety relay expansion modules, each providing a pair of safety relay outputs. Simply connect ribbon cable connectors from the back of the MSR42 to each of the MSR45E modules for a series of interconnections for two PNP OSSDs, and six N.O. relay outputs.

The MSR42 has four software configurable inputs. These configurable safety inputs allow the connection of a multitude of safety devices such as safety light curtains, safety laser scanners, e-stops, safety switches, etc.

This 22.5 mm DIN mount multi-function safety module has both hard wired and software configurable operating modes. The removable spring terminal connectors on the MSR42 allow for ease of wiring of the device as well as hard-wired operating mode configuration.

Manual/automatic reset and start/restart can be configured by simply changing the wiring (see basic configuration examples).

Features such as two or four sensor muting, connecting up to two additional safety light curtains or other safety devices and configuring one or two auxiliary outputs are easily configured using the optical interface with the supplied software.

The MSR42 and Micro 400 light curtains support fixed blanking which is only available in the basic configuration mode and configured through a "teach-in" selector switch via the GPIO pins.

Features

- Category 4 per EN 954-1
- SIL CL3 IEC 61508, IEC 62061
- 22.5 mm housing
- Stop category 0, 1
- 24V DC supply voltage
- Manual, monitored or automatic reset
- Thirteen diagnostic LEDs
- Unique design allows for easy addition of relay expansion modules
- Removable terminal blocks
- One or two configurable auxiliary, standard outputs
- Connection of one or two additional safety devices
- RJ45 connections for Micro 400 safety light curtain
- Two or four sensor muting (Micro 400 only)
- Fixed blanking (Micro 400 only)
- Two sensor muting all GuardShield light curtains
- Supports up to three MSR45E expander units
- Free configuration software can be downloaded at www.ab.com/safety

Specifications

Safety Ratings	
Standards	EN 954-1, IEC/EN 60204-1, IEC 61496-1
Safety Classification	Cat. 4 per EN 954-1 (ISO 13849-1), SIL CL3 per EN IEC 61508, PLe per ISO 13849-1
Functional Safety Data ✶ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	PFH_D: < 9.00E-10 MTTFd: > 331 years For use in SIL3 systems (according to IEC 61508) depending on the architecture and application characteristics
Certifications	CE Marked for all applicable directives, cULus, and TÜV
Power Supply	
Input Power Entry	24V DC
Power Consumption	2.4 W (semi-conductor outputs unloaded)
Inputs	
Safety Inputs	2 N.C. or 2 OSSD, Micro 400 software selectable
Input Resistance, Max.	—
Reset	Auto./manual or manual monitored
Power On Delay Time	Determined by configuration
Response Time	Determined by configuration
Outputs	
Safety Contacts	2 PNP, 400 mA each
Auxiliary Contacts	2 PNP, configurable
Environmental and Physical Characteristics	
Enclosure Type Rating/ Terminal Protection	IP20/ IP20
Operating Temperature [C (F)]	0…55 ° (32…131 °)
Vibration	0.35 mm 10…55 Hz
Mounting	35 mm DIN Rail
Weight [g (lbs)]	130 (0.287)
Conductor Size, Max.	1 x 2.5 mm^2 (14 AWG) stranded

✶ Usable for IEC 62061. Data is based on the following assumptions:
- Mission time/Proof test interval of 20 years

LED Indicators (Basic Configuration) ✶❄

LED	Green	Red
Lamp	—	—
GPI04	Automatic start	Manual start (off)
GPI03	Manual or automatic start	Manual start (off)
GPI02	Configurable	Configurable
GPI01	Configurable	Configurable
OSSD2	Output active	Output inactive
OSSD1	Output active	Output inactive
Info2 (LED)	Configurable	Configurable
Info1 (LED)	Configurable	Configurable
IN2	Start release	No start release signal
IN1	No test input	Test input
0V	—	—
+24V	Power connected	No power connected

✶ All I/O is configurable except OSSD1 and OSSD2.
❄ LED behavior depends on configuration (see instruction sheet for details).

Product Selection

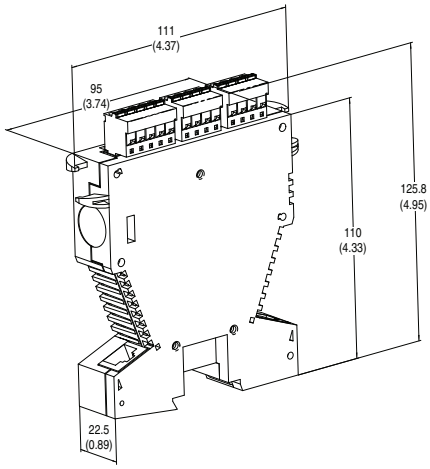
Inputs	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. No.
GuardShield Micro 400 and 4 x GPI0	2 PNP	2 PNP, configurable	Removable	Auto./manual or manual monitored	24V DC	**440R-P226AGS-NNR**

Accessories

Description	Cat. No.
MSR45E—Safety Relay for MSR41 or MSR42 (requires ribbon cable connection)	440R-P4NANS
Ribbon cable—for one MSR45E	**440R-ACABL1**
Ribbon cable—for two MSR45Es	440R-ACABL2
Ribbon cable—for three MSR45Es	440R-ACABL3
Replacement terminal block kit—MSR42	440R-ATERM2P
Replacement terminal block kit—MSR45E	440R-ATERM2C
USB optical interface software configuration tool used to configure the MSR42	445L-AF6150
Replacement suction cup	445L-AF6151
Optical interface fastener	445L-AF6152

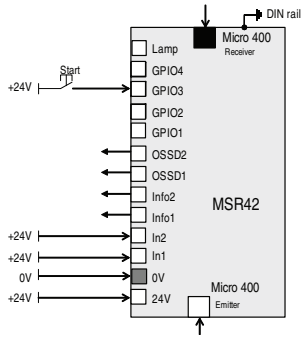
Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.

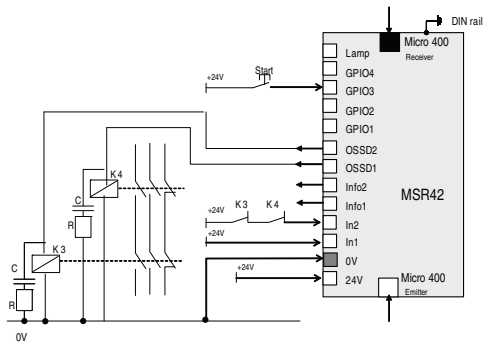


Typical Wiring Diagrams

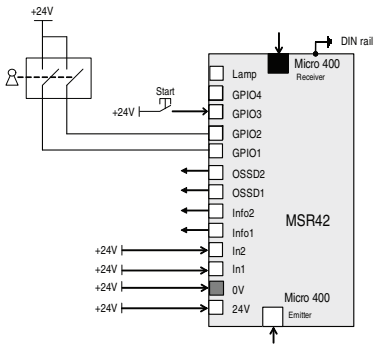
Basic Configurations (No Software)



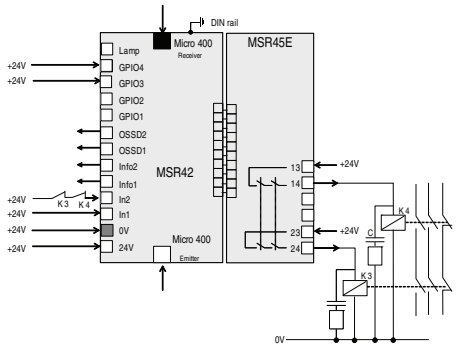
Micro 400 Light Curtain, Manual Reset, No Output Monitoring



Micro 400 Light Curtain, Manual Reset, Start/Restart Monitored Output

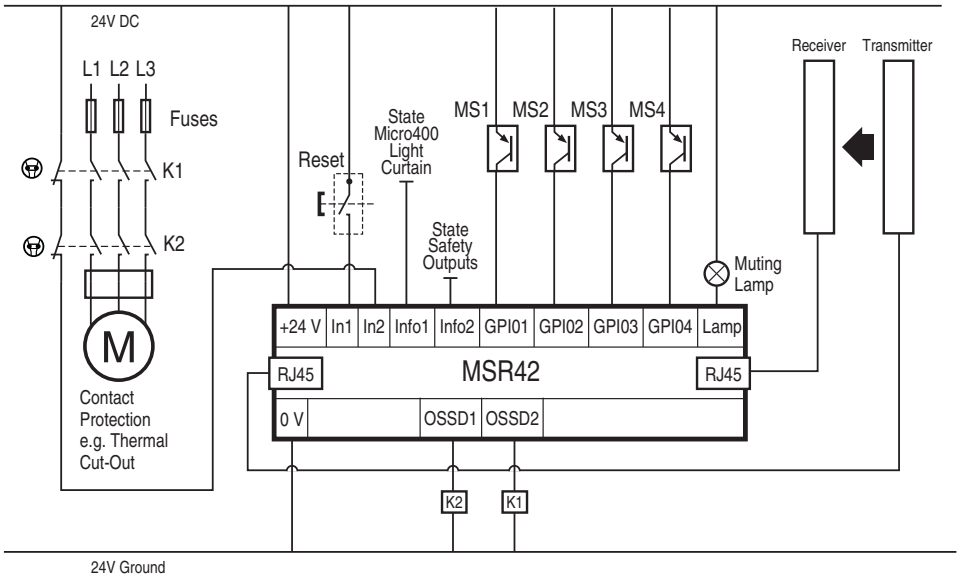


Fixed Blanking, Micro 400 Light Curtain, Manual Reset, No Output Monitoring

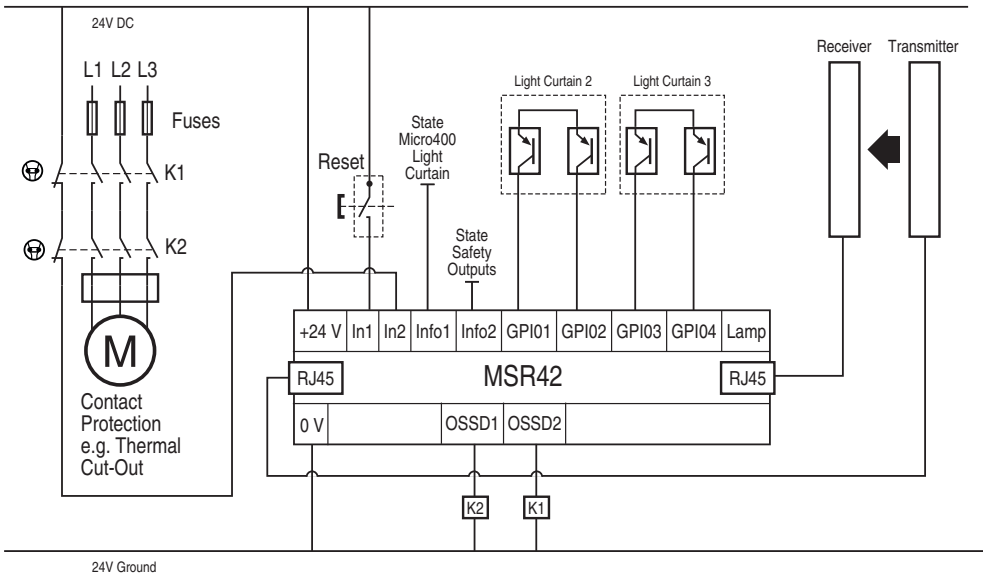


Micro 400 Light Curtain, Automatic Reset, Start/Restart Monitored Output and MSR45E Expansion Module

Software Configurations



Note: Four Sensor T-type muting: GuardShield Micro 400, four muting PNP sensors, manual reset, output monitoring



Note: Three-light curtain application: GuardShield Micro 400 light curtain, two GuardShield light curtains, manual reset, output monitoring

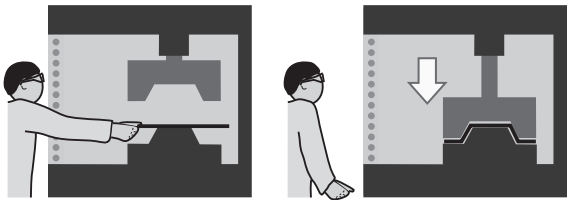
Application Details

MSR42—Shown connected to safety light curtains.

Multiple settings are available offering a variety of advantages.

Protective Mode

Example shows a press protected by a safety light curtain connected to the MSR42.

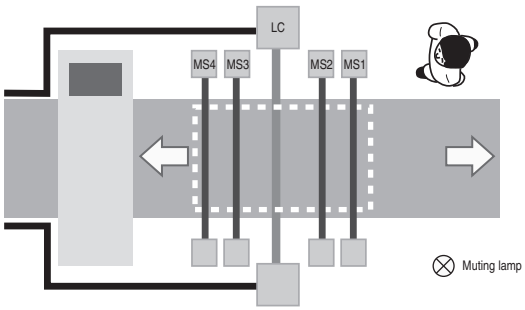


In machine operation, whenever the light curtain beams are broken the press immediately stops to help avoid danger to the operator. Once the beams are cleared the machine can then be started.

Muting Modes

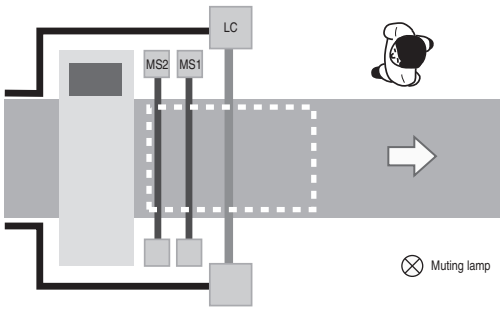
Four conveyor examples: All conveyor applications shown with a safety light curtain helping protect the dangerous area. In-line and cross beam muting is used to allow the material to pass through the light curtain without stopping the machine. Any other object or person will be detected by the light curtain which will initiate machine stop.

Four Sensor T-type



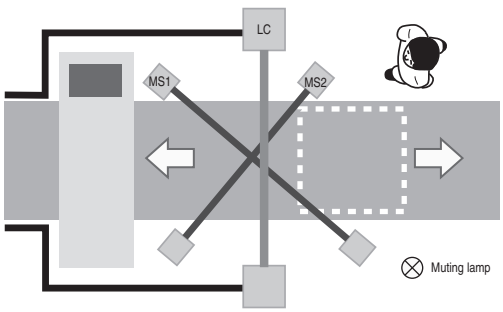
Bi-directional muting: In-line muting requires the material to break the beams in a sequence, as shown. Only if all four muting sensor (MS) beams are broken in turn and then clear in turn will the light curtain allow material through without initiating machine stop.

Two Sensor L-type



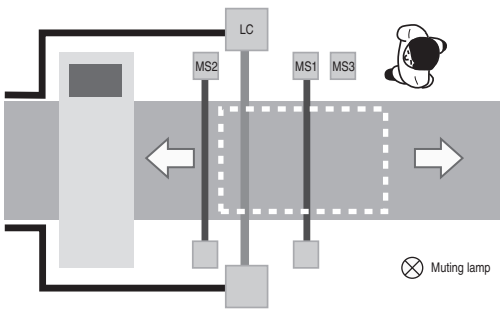
Uni-directional muting: This will allow material to exit the machine but not allow material or personnel to enter the machine without a fault condition. Only if both MS beams are broken in-turn and then cleared in-turn, will the light curtain allow material through without initiating a machine stop.

Two Sensor T-type



Bi-directional muting: Cross-beam muting requires the material to break the beams in a sequence. MS1 first and then MS2. Only if the beams are broken in turn and then clear in turn will the light curtain allow material through without initiating machine stop.

Two Sensor T-type with Enable



Bi-directional muting: The MS3 is an input to the MSR42 from a PLC output card. The MS3 enables the muting function to be performed. If a high signal is not detected on MS3, the muting function will not operate even if the MS1 and MS2 beams are broken. Only if MS3 is high and both MS beams are broken in-turn and then cleared in-turn, will the light curtain allow material through without initiating a machine stop.

Description

The CU2 control unit is a compact timing and stop motion detector interface module. By utilizing two independent inductive proximity inputs, which monitor the movement of two metal parts of the machine (e.g., sprockets, cams or linkages). The control unit detects when hazardous motion has ceased. When the hazardous motion has stopped the unit will send a signal to unlock guard locking devices. It has been developed to integrate guard locking interlock switches on machines which have variable or unpredictable run down cycles.

A removable cover allows access to the DIP switches and potentiometer which control the timing. The on-delay may be adjusted between 0.1 seconds to 40 minutes, through a series of 4 broad time ranges. The final adjustment is made by a potentiometer.

The Y1/Y2 terminals provide a check of contactors at machine power up. This is only relevant to certain special applications. For normal use these terminals should be linked. After all motion has ceased, the normally open safety on contacts close, which may be used to energize electrically operated solenoid locking guard switches. In addition the normally closed contacts open to indicate the unit's status.

LED indication in the unit displays power, timer on, and outputs.

Features

- Category 1 per EN 954-1
- Stop category 1
- NPN and PNP inputs
- Timed off-delay 0.1 s…40 min
- Two N.O. safety outputs
- One N.C. auxiliary output

LED Indicators

Red	Power on
Red/Green	Timing/Output On

Specifications

Safety Ratings		
Standards	EN 954-1, ISO 13849-1, IEC/EN 60204-1, IEC 60947-5-1, ANSI B11.19, AS4024.1	
Safety Classification	Cat. 1 per EN 954-1 (ISO 13849-1), SIL CL1 per EN IEC 62061, PL c per ISO 13849-1	
Certifications	CE Marked for all applicable directives, cULus, c-Tick, and TÜV	
Power Supply		
Input Power Entry	24V AC/DC or 110/230V AC	
Power Consumption	<4 VA	
Inputs		
Safety Inputs	1 NPN and 1 PNP, Normally Open	
Input Resistance, Max.	500 Ω	
Reset	Automatic/Manual	
Outputs		
Safety Contacts	2 N.O.	
Auxiliary Contacts	1 N.C.	
Rated Impulse withstand Voltage	2500V	
Switching Current @ Voltage, Min.	10 mA @ 10V	
Fuses, Output	5 A quick acting (external)	
Electrical Life (Operations)	220V AC/4 A/880VA cosϕ = 0.35…0.1 M 220V AC/1.7 A375VA cosϕ = 0.6…0.5 M 30V DC/2 A/60 W = 1 M 10V DC/0.01 A/0.1 W = 2 M	
Mechanical Life	2,000,000 operations	
Utilization Category		
Inductive: B300: AC-15	5 A @ 250V AC	5 A @ 120V AC
Inductive: DC-13	3 A/24V DC	
Environmental and Physical Characteristics		
Enclosure Type Rating/ Terminal Protection	IP40 (NEMA 1), DIN 0470/ IP20, DIN 0470	
Operating Temperature [C (F)]	-10…+55 ° (14…131 °)	
Vibration	0.75 mm (0.30 in) peak, 10…55 Hz	
Shock	30 g, 11 ms half-sine	
Mounting	35 mm DIN Rail	
Weight [g (lbs)]	360 (0.79)	
Conductor Size, Max.	1 x 2.5 mm^2 (14 AWG) stranded, 1 x 4 mm^2 (12 AWG) solid	

∗ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the following assumptions:
- Mission time/Proof test interval of 20 years
- Functional test at least once within six-month period

Product Selection

Description	Sensor Voltage	Sensor Size (mm)	Sensing Distance (mm)	Terminals	Reset Type	Control Unit Voltage	Cat. No.
Controller and Sensors	24V DC supplied by Control Unit	12	3	Fixed	Automatic/Manual	24V AC/DC	440R-S07279
						110/230V AC	440R-S07280
		18	5			24V AC/DC	440R-S07281
						110/230V AC	440R-S07282
		30	10			24V AC/DC	440R-S07283
						110/230V AC	440R-S07284

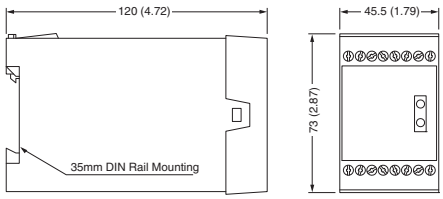
When you order a combination Cat. No.	You will receive a control unit, an NPN sensor and a PNP sensor.
440R-S07279	440R-S07139, 872C-D3NN12-E2, and 872C-D3NP12-E2
440R-S07280	440R-S07140, 872C-D3NN12-E2, and 872C-D3NP12-E2
440R-S07281	440R-S07139, 872C-D5NN18-E2, and 872C-D5NP18-E2
440R-S07282	440R-S07140, 872C-D5NN18-E2, and 872C-D5NP18-E2
440R-S07283	440R-S07139, 872C-D10NN30-E2, and 872C-D10NP30-E2
440R-S07284	440R-S07140, 872C-D10NN30-E2, and 872C-D10NP30-E2

Accessories

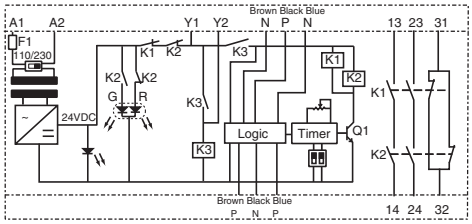
Description	Power Supply	Size (mm)	Output Type	Cat. No.
Control Unit Only	24V AC/DC	45	2 N.O. & 1 N.C.	440R-S07139
	110/230V AC		2 N.O. & 1 N.C.	440R-S07140
Sensor Only	24V DC supplied by Control Unit	12	NPN	872C-D3NN12-E2
			PNP	872C-D3NP12-E2
		18	NPN	872C-D5NN18-E2
			PNP	872C-D5NP18-E2
		30	NPN	872C-D10NN30-E2
			PNP	872C-D10NP30-E2
500 mA fuse—Bussmann Cat. No. ETF-500 mA				440R-A31562

Approximate Dimensions

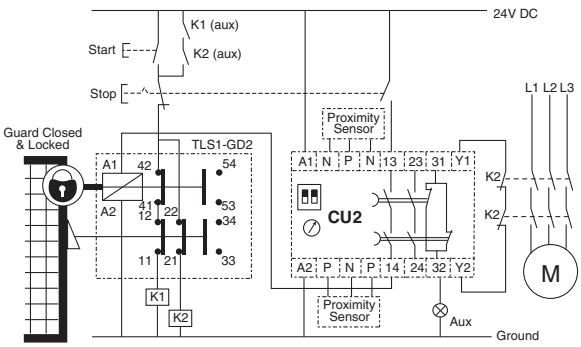
Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



Block Diagram



Typical Wiring Diagrams



Guard Locking Safety Gates, Motion Sensors, Delayed Gate Release, Automatic Reset, Monitored Output

5-Safety Relays

Description

Bulletin 872C WorldProx inductive proximity sensors are self-contained, general purpose, solid-state devices designed to sense the presence of ferrous and nonferrous metal objects without touching them.

The switch body consists of a plastic face and a nickel-plated brass barrel. It meets NEMA 1, 2, 3, 4, 6P, 12, 13 and IP67 (IEC 529) enclosure standards. The electronic circuitry is fully potted for protection against shock, vibration, and contamination.

The CU2 is designed to operate with one normally-open NPN and one normally-open PNP inductive proximity sensor.

The sensors translucent end caps glow when the LED indicator is on, and are visible from almost every angle.

The sensors contained in this section are some of the more popular size inductive proximity sensors. See the Rockwell Automation/ Allen-Bradley Sensors catalog for an extensive range of proximity sensors.

LED Indicators

Amber	Output energized, 360° visibility

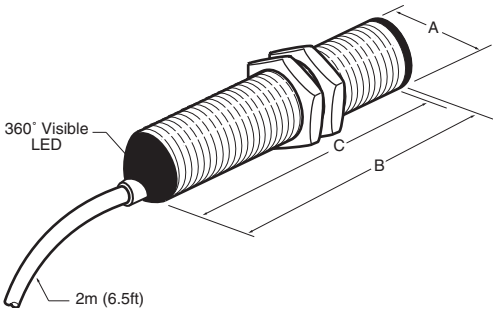
Specifications

Standards	EN 954-1, ISO 13849-1, IEC/EN 60204-1, IEC 60947-5-1, ANSI B11.19, AS4024.1
Safety Classification	Cat. 1 per EN 954-1 (ISO 13849-1)
Certifications	CE Marked for all applicable directives, cULus, c-Tick, and TÜV
Operating Voltage	10…30V DC
Sensing Distance	2, 5 or 10 mm
Correction Factors	Mild Steel = 1.0 Stainless Steel = 0.7…0.8 Brass = 0.4…0.5 Aluminum = 0.3…0.4 Copper = 0…0.3
Load Current, Max.	200 mA
Outputs	NPN or PNP normally open
Leakage Current	≤10 mA
Sensor Voltage Drop	≤1.64V
Repeatability	≤2%
Hysteresis	≤10% typical
Status Indicators	Red = Output energized
Operating Temperature [C (F)]	-25…+70 ° (-13…+158 °)
Relative Humidity	95%
Enclosure Type Rating	NEMA 1, 2, 3, 4, 6P, 12, 13, IP67
Protection	False pulse on power, transient noise, reverse polarity, short circuit, overload
Cable Size	3 x 1 mm² (26 AWG) stranded
Cable Length	2 m (6.5 ft)
Material	Plastic-faced, nickel-plated brass barrel
Mounting	M12, M18 or M30 Flush Fitting (Shielded Sensing)/IP20, DIN 0470
Shock	30 g, 11 ms half-sine
Vibration	1 mm peak, 10…55 Hz

Note: See Output Ratings on page 1-39 for details. Consult factory for ratings not shown.

Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.

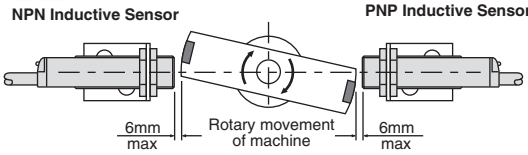


Thread Size	Shielded	mm (inches)		
		A	B (max)	C (min)
M12 x 1	Yes	12 (0.47)	50.8 (2.00)	46.7 (1.84)
M18 x 1		18 (0.71)		
M30 x 1		30 (1.18)		

Application Details

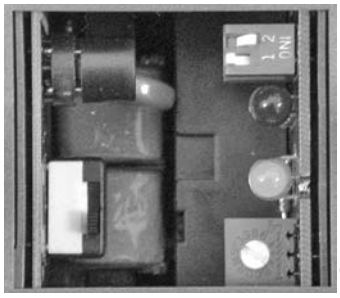
Application Accessories

PNP and NPN Inductive Sensors for use with CU2
Sensors detect when motion has ceased by monitoring two targets on moving metal parts. When motion has ceased the CU2 begins timing down. Once preset time limit has been passed the CU2 sends a single allowing locked guard to be opened.

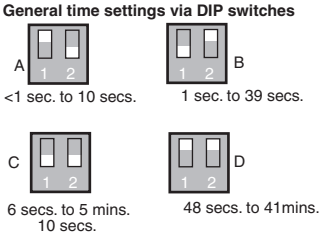


CU1 remote indication unit:
A remote indication unit to indicate the status of the circuit can be connected to the CU 1s, R1, R2 and R3 connections.

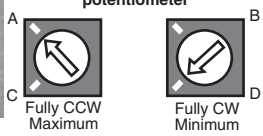
Adjustable Time Delay
DIP switches general time setting and the potentiometer fine tunes the time settings. Easy access 500 mAT replaceable fuse.



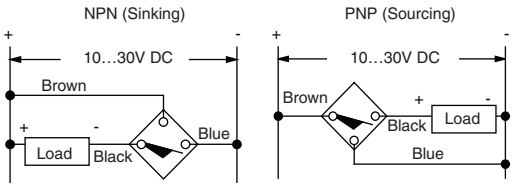
General time settings via DIP switches



Fine adjustment time setting via potentiometer



Typical Wiring Diagrams



Specialty Safety Relays

MSR57P Safe Speed and Standstill Monitor

Description

The MSR57P speed monitoring safety relay is designed to solve motion applications which require interaction by personnel during operation. It connects to any drive and monitors the speed using currently installed encoders. The MSR57P can be configured to unlock the access door only when the machine is either stopped or at a safe speed defined by the user. If required, the speed monitoring relay can monitor an enabling switch to constantly monitor personnel while in the hazardous area. Other supported functions are safe maximum speed and zero speed detection.

The MSR57P can be configured and monitored via two methods: drive explorer using a PC and the standard HIM device. During configuration, the user can set a variety of parameters to the specific requirements of their application including type of input devices, quantity, door locking and monitoring, enabling switches and a maintenance (safe speed) mode.

The MSR57P can easily be adapted to current installations with standard drives or drives with the safe-off feature. The safety relay uses standard outputs to control the drives speed but uses safety outputs to control the outputs of the drive. The speed is determined by using an encoder(s). This device can monitor the encoder data which is already transmitting to the drive, assuming an encoder is already installed, or a new encoder can be installed and only connected to the MSR57P. Two encoders are needed for Category 4, SIL 3 applications which cannot exclude shaft slippage and breakage.

This device also supports multiple axis applications. During configuration, it can be setup to be the first, middle or last axis in the chain. This is important since the input devices will all be installed on the first unit only while the output devices are connected to the last MSR57P in the chain.

Features

- SIL 3 IEC 61508
- Category 4 per EN 954-1
- Stop category 0, 1, 2
- Six N.O. solid-state safety outputs
- Four solid-state auxiliary outputs
- One or two encoders (sin/cos and TTL)
- Eight diagnostic LEDs
- DPI configuration port
- 67.5 mm DIN Rail housing
- Removable terminals

Specifications

Safety Ratings	
Standards	EN 954-1, ISO 13849-1, ISOTR 12100, IEC/EN 60204-1, ANSI B11.19, AS4024.1
Safety Classification	Cat. 4 per EN 954-1 (ISO 13849-1), SIL CL3 per EN IEC 62061, PLe per ISO 13849-1
Functional Safety Data ∗ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	PFH_D: See website MTTFd: See website Suitable for performance levels Ple (according to ISO 13849-1:2006) and for use in SIL3 systems (according to IEC 62061) depending on the architecture and application characteristics
Certifications	cULus, c-Tick, and TÜV
Power Supply	
Input Power Entry	24V DC, 0.8…1.1 x rated voltage PELV/SELV
Power Consumption	5 W
Inputs	
Safety Inputs	1 N.C. & 1 N.O., 2 N.C., 1 N.C., 2 OSSD
Input Simultaneity	Infinite or 3 sec (configurable)
Input Resistance, Max.	4 K Ω
Reset	Auto./Manual or Manual Monitored
Response Time	Configurable
Outputs	
Safety Contacts	6 N.O. Solid State
Auxiliary Contacts	4 N.O. Solid State
Current, Max	Outputs 14, 24, 68, 78 24V DC, 2 A, short-circuit protected Outputs 34, 44 24V DC, 100 mA, short-circuit protected Outputs Y35, Y37 24V DC, 50 mA, short-circuit protected Door switches 51, 52 24V DC, 750 mA, short-circuit protected Outputs Y1, Y32, Y33 24V DC, 100 mA, short-circuit protected Pulse Outputs S11, S21 24V DC, 100 mA, short-circuit protected Pulse Inputs S12, S22, S32, S42, S52, S62, S72, S82, X32, X42, S34, Y2 8.5 mA per input
Environmental and Physical Characteristics	
Enclosure Type Rating/ Terminal Protection	IP40 (NEMA 1)/ IP20, DIN 0470
Operating Temperature [C (F)]	-5…+55 ° (23…131 °)
Vibration	10…55 Hz, 0.35 mm
Shock	10 g, 16 ms, 100 shocks
Mounting	35 mm DIN Rail
Weight [g (lbs)]	335 (0.74)
Conductor Size, Max.	0.2…2.5 mm^2 (24…12 AWG)

∗ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the following assumptions:
- Mission time/Proof test interval of 20 years
- Functional test at least once within six-month period

Product Selection

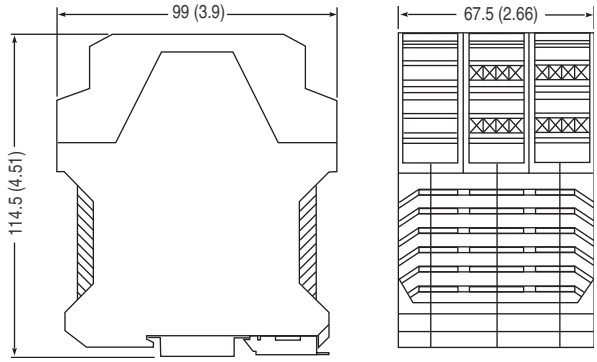
Inputs	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. No.
5 x 1 N.C., 2 N.C., LC, 1 N.O. + 1 N.C.	6 N.O. Solid State	4 N.O. Solid State	Removable	Auto./Manual or Manual Monitored	24V DC	440R-S845AER-NNL

Accessories

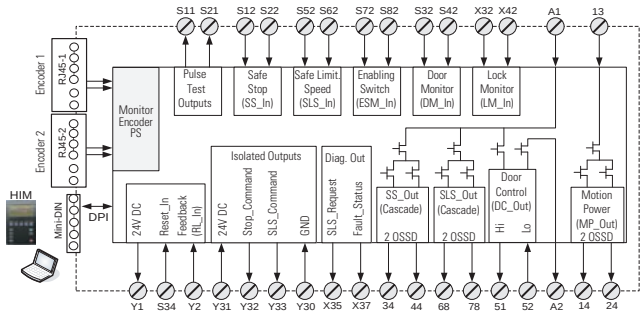
Description	Cat. No.
MSR57 Encoder cable with flying leads (2.5 meters)	1585J-M8RB-2M5
3 meter cable HIM	1202-C30
1 meter cable HIM	1202-C10
AnaCANda serial converter (RS232)	1203-SSS
AnaCANda USB converter	1203-USB
HIM full numeric LCD IP20 (NEMA 1)	20-HIM-A3
Kinetix 6000/7000 low profile connector kit	2090-K6CK-Dxxx
Kinetix 2000 low profile connector kit	2090-K2CK-D15M
HIM to MSR 57 cable (1 meter)	20-HIM-H10
Sin/Cos encoder (1024 PPR)	842HR-xJxxx15FWY2
TTL encoder (size 20)	845T-xxxxxxx
TTL encoder (size 25)	845H-SJxxx4xxYxx

Approximate Dimensions

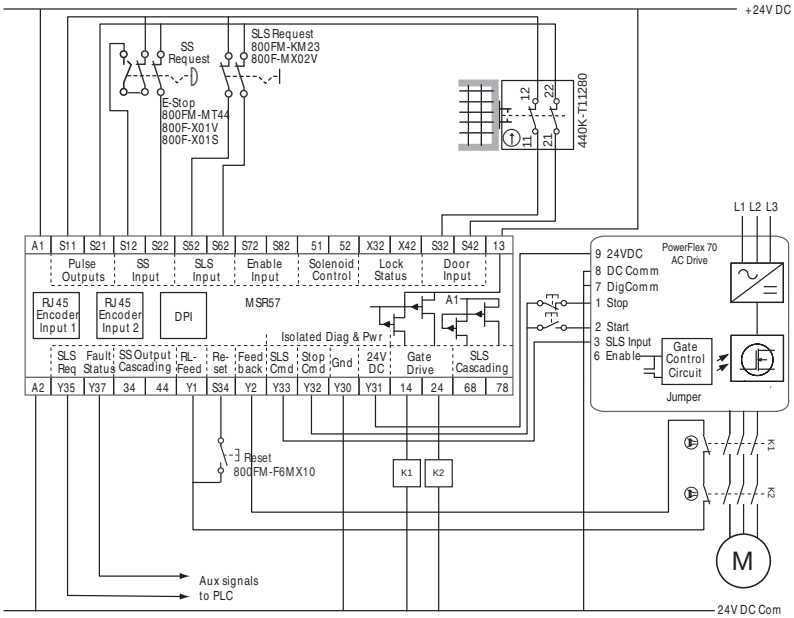
Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



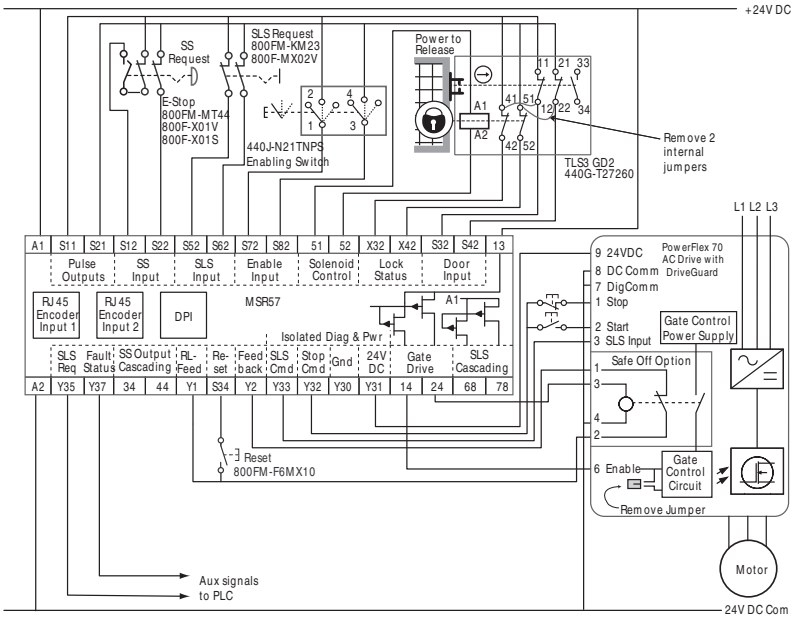
Block Diagram



Typical Wiring Diagrams

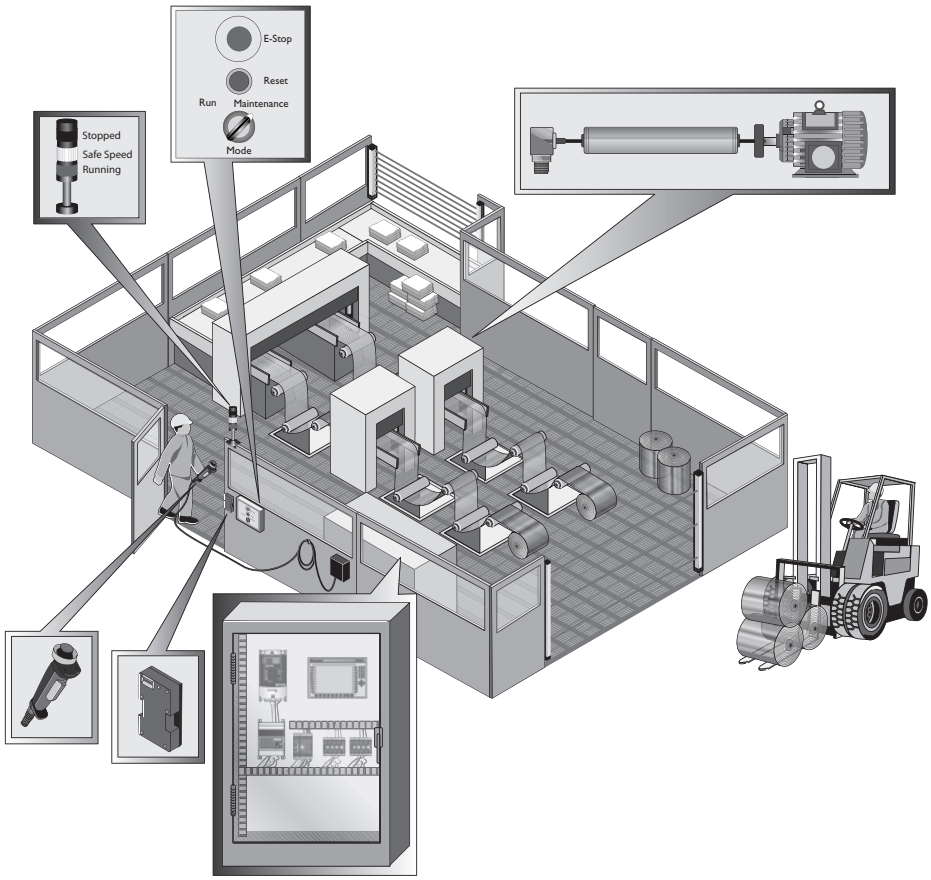


Note: Cat. 1 stop, 1 encoder, door monitoring, safe limited speed, PowerFlex 70 without safe off.



Note: Cat. 1 stop, 1 encoder, door monitoring, enabling switch, safe limited speed, PowerFlex 70 with safe off.

Application Details



Operating Conditions

- The door is closed and locked with a TLS3 safety switch
- The machine is running at normal speed

Maintenance Conditions

- In order to remove a jam condition or during start-up personnel must enter the hazardous area.
- The operator moves Limited Speed Selector switch to “enable.”
- The MSR57 monitors speed profile and verifies drive is reducing speed per the preconfigured profile.
- Once the speed is equal to or below limited speed value, the door is unlocked.
- If configured, user must hold enabling switch in the middle position before opening door. Otherwise the machine will shutdown.
- The operator performs maintenance on the machine.
- Once maintenance is complete, the operator exits machine, closes door and moves the safe limited speed switch to "maintenance" mode BEFORE releasing the enabling switch.
- The machine will resume normal speed according to the drive profile.

Remarks

- The MSR57 can also monitor if the speed has exceeded a preconfigured value and shutdown the process.
- The MSR57 is compatible with all drives and uses standard inputs on the drive to perform controlled start and stop sequences.
- Pressing the E-stop at any time, will cause the machine to stop according to the preconfigured stop mode.
- The MSR57 can also be used in cascading applications with multiple MSR57s and drives.

Description

The CU3 is a control unit which detects stopped motion and is ideal for use with guard locking interlock switches. It is designed to interface with single or three-phase induction motors by measuring the drive voltage and the back electro-magnetic field (emf) of the motor.

The front window of the CU3 can be popped off to reveal a replaceable fuse and a potentiometer. The potentiometer sets the threshold voltage measured at terminals Z1/Z2. The maximum threshold voltage is approximately 2.5V peak (potentiometer turned fully CCW). When the voltage at Z1/Z2 exceeds the threshold voltage, the safety outputs de-energize, and the safety contacts at terminals 13/14 and 23/24 open.

When the supply to a motor is disconnected, motor speed will reduce to zero. During the run down period the back emf generated by the motor is monitored by the CU3. When the level of the back emf dips below the threshold voltage, the safety outputs close. This enables the output device (e.g., solenoid locking or unlocking switch) to be activated.

If the Z1/Z2 circuit opens, the CU3 goes into a fault state, indicated by the fault led. The fault must be corrected and the power to the CU3 cycled to clear the fault state.

The 24V DC version must be operated with an isolated supply. The CU3 is not intended for use with variable frequency drives.

Features

- Category 1 per EN 954-1
- Stop category 1
- Two N.O. safety outputs
- One N.C. auxiliary output
- Automatic/manual, monitored reset supported
- Motor voltage up to 500V max.

LED Indicators

Red	Power on
Red/Green	Timing/Output On
Yellow	Fault
Red	Motor Running

Specifications

Safety Ratings		
Standards	EN 954-1, ISO 13849-1, IEC/EN 60204-1, IEC 60947-5-1, ANSI B11.19, AS4024.1	
Safety Classification	Cat. 1 per EN 954-1 (ISO 13849-1), SIL CL1 per EN IEC 62061, PL c per ISO 13849-1	
Functional Safety Data ∗ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	PFH_D: See website MTTFd: See website Suitable for performance levels Ple (according to ISO 13849-1:2006) and for use in SIL3 systems (according to IEC 62061) depending on the architecture and application characteristics	
Certifications	CE marked for all applicable directives, cULus, c-Tick, and TÜV	
Power Supply		
Input Power Entry	24V AC/DC, 115/230V AC	
Power Consumption	<4 VA	
Motor Voltage	500V max.	
Inputs		
Safety Inputs	Z1/Z2 Motor Voltage	
Reset	Automatic/Manual	
Outputs		
Safety Contacts	2 N.O.	
Auxiliary Contacts	1 N.C.	
Rated Impulse withstand Voltage	2500V	
Switching Current @ Voltage, Min.	10 mA/10V	
Fuses, Output	5 A quick acting (external)	
Electrical Life (Operations)	220V AC/4 A/880VA $\cos\phi$ = 0.35…0.1 M 220V AC/1.7 A375VA $\cos\phi$ = 0.6…0.5 M 30V DC/2 A/60 W = 1 M 10V DC/0.01 A/0.1 W = 2 M	
Mechanical Life	2,000,000 operations	
Utilization Category		
Inductive: B300: AC-15	5 A @ 250V AC	5 A @ 120V AC
Inductive: DC-13	3 A/24V DC	
Environmental and Physical Characteristics		
Enclosure Type Rating/ Terminal Protection	IP40, DIN 0470/ IP20 DIN 0470	
Operating Temperature [C (F)]	-10…+55 ° (14…131 °)	
Vibration	0.75 mm (0.30 in) peak, 10…55 Hz	
Shock	30 g, 11 ms half-sine	
Mounting	35 mm DIN Rail	
Weight [g (lbs)]	510 (1.12)	
Conductor Size, Max.	1 x 2.5 mm^2 (14 AWG) stranded, 1 x 4 mm^2 (12 AWG) solid	

∗ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the following assumptions:
- Mission time/Proof test interval of 20 years
- Functional test at least once within six-month period

Product Selection

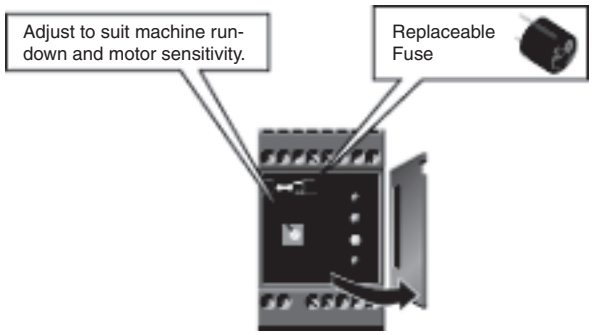
Safety Outputs	Auxiliary Outputs	Power Supply	Terminals	Reset Type	Cat. No.
2 N.O.	1 N.C.	24V AC/DC∗	Fixed	Monitored Manual, Automatic/Manual	440R-S35001
2 N.O.	1 N.C.	110V AC			440R-S35002
2 N.O.	1 N.C.	230V AC			440R-S35003

∗ The 440R-S35001 requires an isolated supply when operating on 24V DC.

Accessories

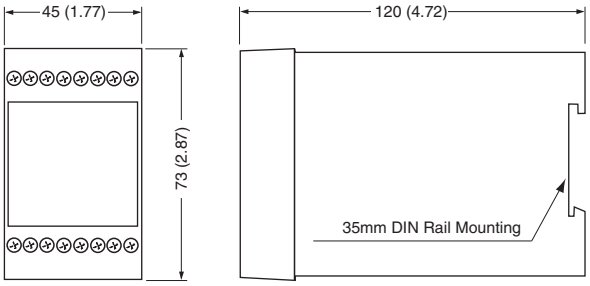
Description	Cat. No.
500 mA Fuse—Bussmann Cat. No. ETF-500 mA	440R-A31562

Application Details

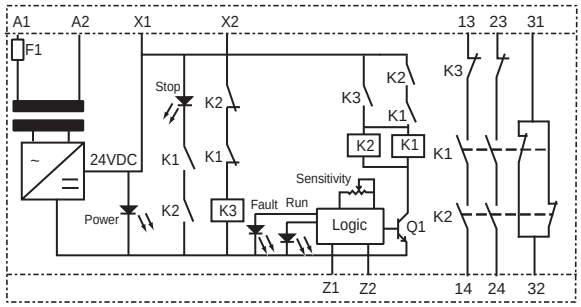


Approximate Dimensions

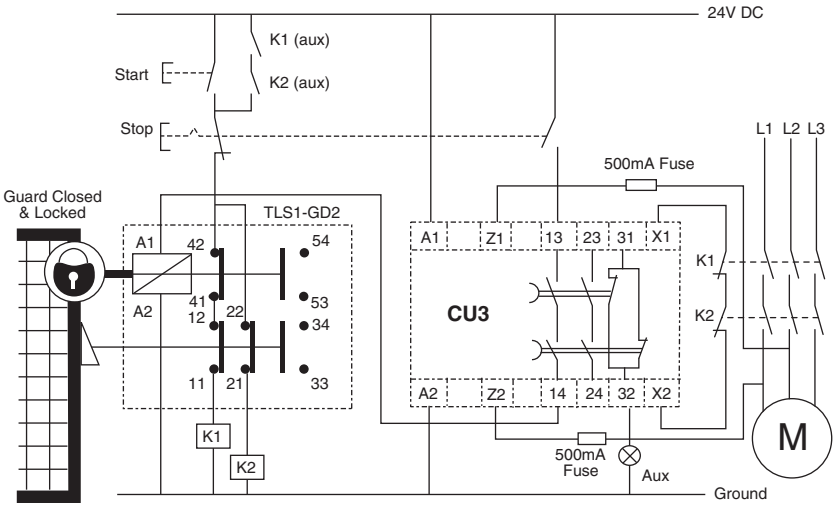
Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



Block Diagram



Typical Wiring Diagrams



Guard Locking Safety Gate, Back EMF Detection, Automatic Reset, Monitored Output

5-Safety Relays

Specialty Safety Relays

MSR23M Mat Controllers

Description

The MSR23M control unit is designed to monitor four-wire safety mats that are connected together to form a safeguarded zone. The size of the safeguarded zone is limited by the total input impedance (100 ohms maximum) created by the wiring and connections. The controller is designed to interface with the control circuit of the machine and includes two safety relays to help provide control redundancy.

The controller detects a presence on the mat, a short circuit, or an open circuit. Under each of these conditions, the safety output relays turn off. When interfaced properly, the machine or hazardous motion receives a stop signal, and an auxiliary output turns ON.

Features

- Category 4
- Stop category 0
- Removable terminals
- Monitored or automatic/manual reset
- Four-wire safety mats sensing

LED Indicators

Power: Green	Ready, Red = Mat Activated
K1: Green	K1 Closed. If K1 alone is lit, check for short across reset button.
K2: Green	K2 Closed

Specifications

Safety Ratings		
Standards	EN 954-1, ISO 13849-1, IEC/EN 60204-1, IEC 60947-5-1, ANSI B11.19, AS 4024.5	
Safety Classification	Cat. 3 per EN 954-1 (ISO 13849-1), SIL CL2 per EN IEC 62061, PLe per ISO 13849-1	
Functional Safety Data ✶ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	PFH_D: See website MTTFd: See website Suitable for performance levels Ple (according to ISO 13849-1:2006) and for use in SIL3 systems (according to IEC 62061) depending on the architecture and application characteristics	
Certifications	CE Marked for all applicable directives, BG, and CSA (24V only)	
Power Supply		
Input Power Entry	24V AC/DC or 115V AC	
Power Consumption	2 W	
Inputs		
Safety Inputs	2 N.C., 4-Wire SM	
Input Resistance, Max.	100 Ω	
Reset	Auto./Manual or Monitored Manual	
Power On Delay Time	40 ms (Manual Reset); 200 ms (Auto Reset)	
Response Time	15 ms	
Outputs		
Safety Contacts	2 N.O.	
Auxiliary Contacts	1 N.C.	
Thermal Current I_{th}	1 x 8 A or 2 x 7 A nonswitching	
Switching Current @ Voltage, Min.	1 mA/10V	
Fuses, Output	6 A fast acting (external)	
Electrical Life (Operations)	220V AC/4 A/880VA cosϕ = 0.35…0.1 M 220V AC/1.7 A375VA cosϕ = 0.6…0.5 M 30V DC/2 A/60 W = 1 M 10V DC/0.01 A/0.1 W = 2 M	
Mechanical Life	10,000,000 operations	
Utilization Category (Inductive)		
N.O.—B300 AC-15	3 A @ 250V AC	3 A @ 120V AC
P300 DC-13	3 A @ 24V DC	
N.C.—B300 AC-15	2 A @ 250V AC	2 A @ 120V AC
DC-13	2 A @ 24V DC	
Environmental and Physical Characteristics		
Enclosure Type Rating/ Terminal Protection	IP40 (NEMA 1) DIN 0470/ IP20, DIN 0470	
Operating Temperature [C (F)]	-15…+55 ° (5…131 °)	
Vibration	10 g 10…55 Hz	
Shock	30 g, 11 ms half-sine	
Mounting	22.5 mm housing, 35 mm DIN Rail	
Weight [g (lbs)]	220 (0.485)	
Conductor Size, Max.	1 x 2.5 mm^2 (14 AWG) stranded, 1 x 4 mm^2 (12 AWG) solid	

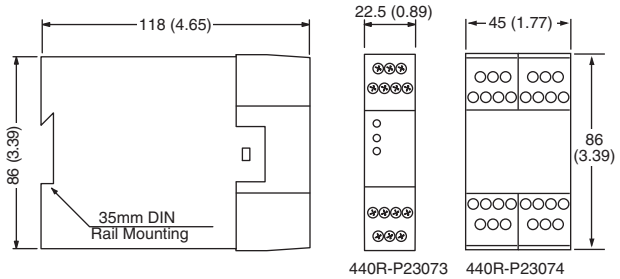
✶ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the following assumptions:
- Mission time/Proof test interval of 20 years
- Functional test at least once within six-month period

Product Selection

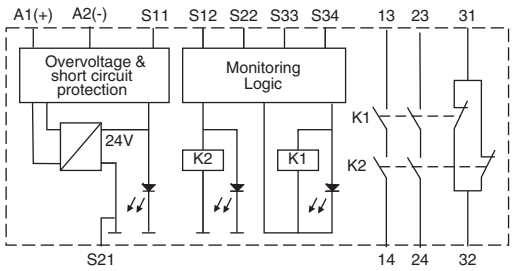
Inputs	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. No.
4-Wire Safety Mat	2 N.O.	1 N.C.	Fixed	Automatic/Manual Monitored Manual	24V AC/DC	440R-P23073
					115V AC	440R-P23074

Approximate Dimensions

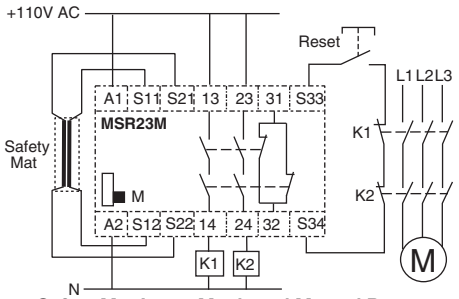
Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



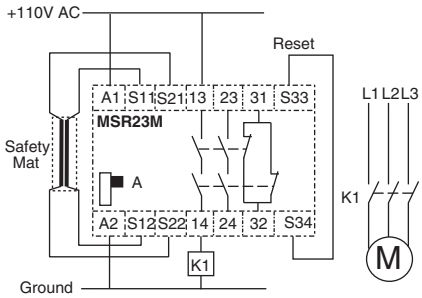
Block Diagram



Typical Wiring Diagrams

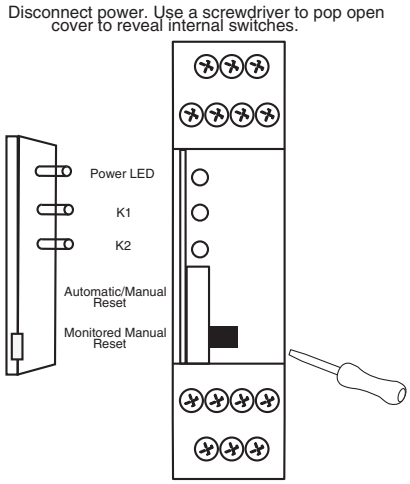


Safety Mat Input, Monitored Manual Reset, Dual Channel Output, Monitored Output



Safety Mat Input, Automatic Reset, Single Channel Output, No Monitored Output

Application Details



MatGuard™ Controllers Safety Relays

Description

The MatGuard Control Unit monitors all of the mats which are connected together to form a safeguarded zone. The safeguarded zone can be up to a total of 100 m^2 and made from any number of mats. The controller is designed to interface with the control circuit of the machine and includes two safety relays to help provide control redundancy.

The controller detects a presence on the mat, a short circuit, or an open circuit. Under each of these conditions, the safety output relays turn off. When interfaced properly, the machine or hazardous motion will receive a stop signal, and an auxiliary output relay turns ON.

The controller comes in two different package styles, a plastic case for surface or wall mounting, and a steel case for surface or wall mounting. Each style offers many of the same basic features. Each controller accepts power supplies of 24V AC/DC, and 110/230V AC. The plastic and steel-cased styles include reset buttons. The steel-cased controller offers extra protection against inadvertent impacts.

Alternatively, see the Product Selection table for safety relays that can also control and monitor safety mats.

Features

- Selectable voltage supply
- Auto/manual reset
- Four-wire system to detect opens and shorts
- Third party approval—AMTRI, TÜV

LED Indicators

Green	Power
Green	Auto Reset Mode
Green	Manual Reset Mode
Green	Machine Enabled

Specifications

Safety Ratings	
Standards	EN1760-1, EN 954-1, ISO13849-1, IEC/EN 60204-1, ANSI RIA R15.06, ANSI B11.19, AS 4024.5
Safety Classification	Cat. 3 per EN 954-1 (ISO 13849-1), SIL CL2 per EN IEC 62061, PLe per ISO 13849-1
Functional Safety Data ✶ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	PFH_D: See website MTTFd: See website Suitable for performance levels Ple (according to ISO 13849-1:2006) and for use in SIL3 systems (according to IEC 62061) depending on the architecture and application characteristics
Certifications	CE Marked for all applicable directives, cULus, and TÜV
Power Supply	
Input Power Entry	24V AC/DC or 115/230V AC
Power Consumption	6 W, 9V A
Inputs	
Safety Inputs	Safety Mats
Reset	Monitored Manual or Automatic/Manual
Response Time	35 ms, Mat pressed to output open
Outputs	
Safety Contacts	2 N.O.
Auxiliary Contacts	1 N.C.
Switching Current @ Voltage, Min.	10 mA @ 10V
Fuses, Output	5 A fast acting (external)
Electrical Life (Operations)	220V AC/4 A/880VA cosϕ = 0.35…0.1 M 220V AC/1.7 A375VA cosϕ = 0.6…0.5 M 30V DC/2 A/60 W = 1 M 10V DC/0.01 A/0.1 W = 2 M
Mechanical Life	10,000,000 operations
Environmental and Physical Characteristics	
Enclosure Type Rating/ Terminal Protection	4000P: IP65 (NEMA 13); 4000S: IP62 (NEMA 12)/ IP20, DIN 0470
Operating Temperature [C (F)]	-10…+45 ° (14…113 °)
Vibration	0.15 mm, 10…55 Hz
Mounting	Surface (Wall) Mount
Weight [g (lbs)]	4000P: 880 (1.94); 4000S: 3200 (7.05)
Conductor Size, Max.	4000P, 4000S: 1 x 1.5 mm^2 (16 AWG), max.

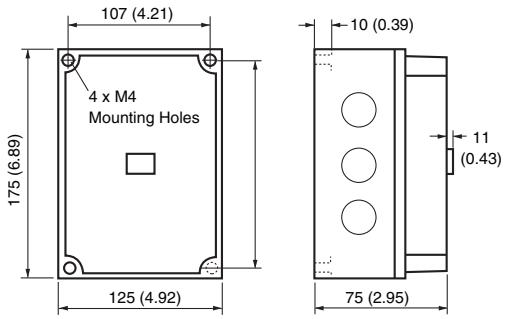
✶ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the following assumptions:
- Mission time/Proof test interval of 20 years
- Functional test at least once within six-month period

Product Selection

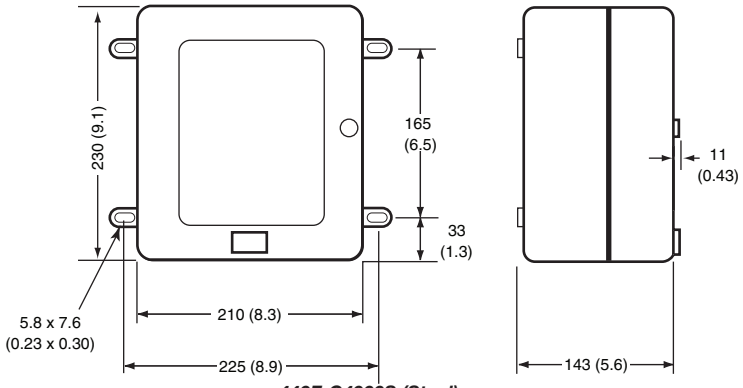
Inputs	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. No.
SM	2 N.O.	1 N.C.	NA	Monitored Manual or Automatic/Manual	24V AC/DC or 115/230V AC	440F-C4000P
						440F-C4000S

Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.

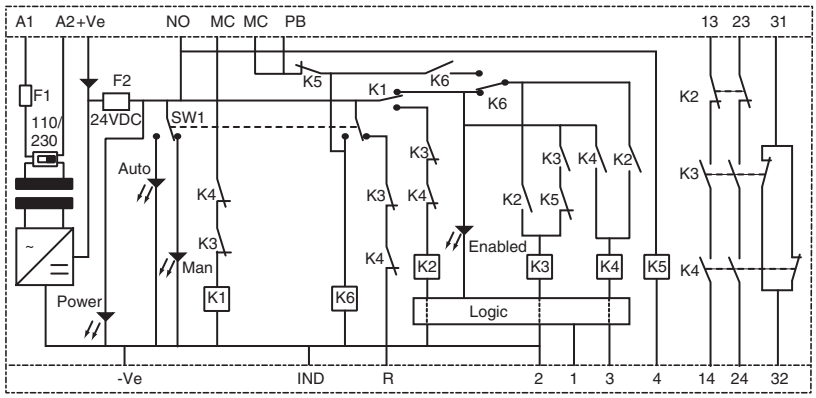


440F-C4000P (Polycarbonate)

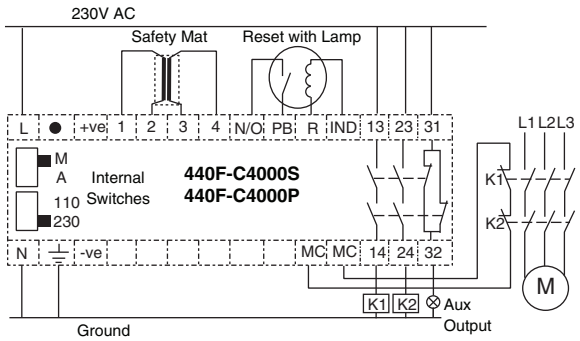


440F-C4000S (Steel)

Block Diagram



Typical Wiring Diagrams



MatGuard™ Mat Manager

Description

The Safety Mat Manager is designed to monitor multiple safety mats, each with its own connection. The Safety Mat Manager accepts up to eight individual mats with four-pin micro quick disconnect connectors.

The Safety Mat Manager provides an LED status indication for each of the mat connections. Since the LEDs indicate whether the mat is shorted or open, troubleshooting and replacement of a damaged mat within a mat system, is much quicker when compared to a traditional mat system where multiple mats are wired in series.

An internal switch allows for the setting of the reset to automatic/manual or monitored manual. When set to automatic/manual, the reset circuit can be jumpered, connected auxiliary contacts, or connected to an unmonitored manual reset by adding a momentary normally open switch in the monitoring loop. When set to monitored manual, the monitoring circuit must be closed and then opened to activate the outputs.

Stepping on any one of the mats deactivates the safety outputs. The outputs include two or six normally open safety rated outputs used to shut down the machine and one normally closed or normally open auxiliary output to indicate the status of the Mat Manager. The safety outputs have independent and redundant internal contacts to support the safety function.

Features

- Accepts up to eight individual mats
- Two or six safety output contacts
- One auxiliary output contact
- Automatic/manual or monitored manual reset

LED Indicators

Green	Power
Green	Machine Enabled
Green	Auto Reset Mode
Green	Manual Reset Mode
Mat Status:	
Green	Run Condition
Red	Stop Condition, Mat Pressed
Off	Not Used/Mat Disabled

Specifications

Safety Ratings	
Standards	EN 1760-1, EN 954-1, ISO 13849-1, IEC/EN 60204-1, ANSI RIA R15.06, ANSI B11.19, AS 4024.5, E 1760-1
Safety Classification	Cat. 3 per EN 954-1 (ISO 13849-1), SIL CL3 per EN IEC 62061, PLe per ISO 13849-1
Functional Safety Data ✶ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	PFH_D: < 2.59 x 10^{-9} MTTFd: > 290 years Suitable for performance levels Ple (according to ISO 13849-1:2006) and for use in SIL3 systems (according to IEC 62061) depending on the architecture and application characteristics
Certifications	CE Marked for all applicable directives, cULus, c-Tick, and TÜV
Power Supply	
Input Power Entry	24V AC/DC, 115/230V AC 50/60 Hz
Power Consumption	12 W or 9 VA
Inputs	
Safety Inputs	8, 4-Pin Micro-QD M12 Inputs (4 wire mats)
Input Resistance, Max.	500 Ω
Mat Size [mm (in.)]	100 m^2 (1076 ft^2) max.
Reset	Auto./Manual Monitored Manual
Power On Delay/ Recovery Time	3 s/48 ms
Response Time	35 ms
Outputs	
Safety Contacts	2 N.O. or 6 N.O.
Auxiliary Contacts	1 N.C. or 1 N.O.
Output Rating❄	B300, AC15, 4 A/250V AC; R300, DC13, 2 A/30V DC
Rated Impulse withstand Voltage	2500V
Switching Current @ Voltage, Min.	10 mA @ 10V
Fuses, Output	External 6 A slow blow or 10 A fast acting
Electrical Life (Operations)	220V AC/4 A/880VA cosϕ = 0.35…0.1 M 220V AC/1.7 A375VA cosϕ = 0.6…0.5 M 30V DC/2 A/60 W = 1 M 10V DC/0.01 A/0.1 W = 2 M
Mechanical Life	10,000,000 operations
Environmental and Physical Characteristics	
Enclosure Type Rating/ Terminal Protection	IP65 (NEMA 13) steel with polycarbonate face plate/ —
Operating Temperature [C (F)]	-25…45° (-13…113°)
Vibration	0.15 mm, 10…55 Hz
Shock	10 g, 11 ms, half-sine
Mounting	Surface (Wall) Mount
Weight [g (lbs)]	3200 (7)
Conductor Size, Max.	0.2…2.5 mm^2 (24…14 AWG), max.

✶ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the following assumptions:
- Mission time/Proof test interval of 20 years
- Functional test at least once within six-month period

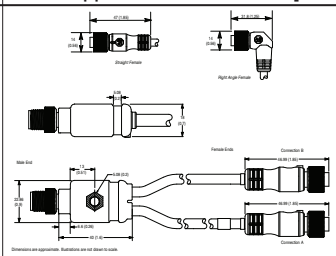
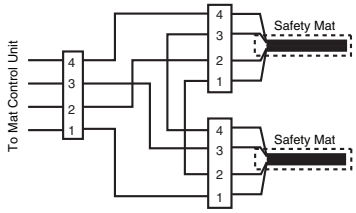
❄ Ratings vary due to output connectors. See installation instructions for details.

Product Selection

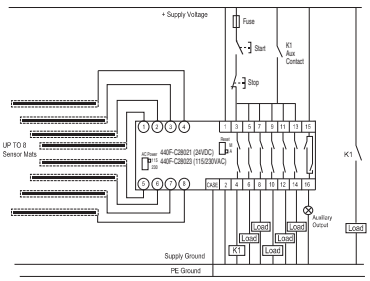
Safety Inputs	Safety Outputs	Aux. Outputs	Reset	Output Current	Connection Type	Power Supply	Cat. No.
8, 4-pin micro-QD M12 Inputs (4-wire mats)	2 N.O.	1 N.C.	Auto./Manual Monitored Manual	4 A	12-pin Brad Harrison	24V DC	440F-C28011
						115V or 230V AC	440F-C28012
					Terminal Strip	24V DC, 115V AC, or 230V AC	✶ 440F-C28013
	6 N.O.	1 N.O.		4 A	24-pin Harting	24V DC	440F-C28021
						115V or 230V AC	440F-C28023
8 Cable Grips	2 N.O.	1 N.C.		2 A	8-pin Lumberg M12 Micro	24V DC	✶ 440F-C28024
							440F-C28025
8, 4-pin micro-QD M12 Inputs (4-wire mats)	2 N.O.	1 N.C.		4 A	12-pin M23	24V DC	440F-C28026

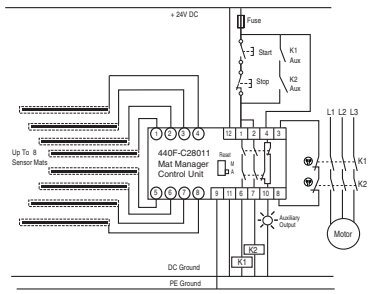
✶ Manual reset button located on front of unit.

Accessories

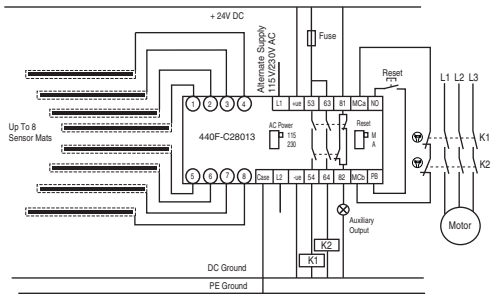
Description	Approximate Dimensions [mm (in.)]	Wiring	Cat. No.
Y-Cable			879D-F4ACDM-B0M3
Shorting Plug			440F-A28639
500 mA Fuse			440R-A31562
Fuse, 1 A—Bussman Cat. No. ETF-1			440R-A70972

Typical Wiring Diagram





Safety Mat System, Automatic Reset, Dual Channel Output, Output Monitoring



Safety Mat System, Monitored Manual Reset, Dual Channel Output, Output Monitoring

Safedge™ Controllers

Description

The Safedge controllers are designed to operate with the Safedge profiles. The controller continuously monitors the profile for actuation and generates an output signal when the profile is depressed.

The Safedge controller provides a low voltage to the profile. When the profile is pressed, the controller detects a change in resistance and turns off its output relays. When pressure is released from the profile, the output relays of the controller return to an on state. The controller has redundant voltage free positively-guided output relays, which can be used to interface with a machine control system.

The 251 controller comes capable of operating at 24V AC/DC, or 120/230V AC from separate terminals. An internal switch changes the operating voltage from 120V AC to 230V AC. The 252 controller operates at 24V AC/DC.

An auxiliary output relay is available to provide a signal about the controller's status. Three LEDs indicate whether the controller is in RUN, STOP or OPEN condition. The controller operates in manual or automatic reset mode.

Features

- One N.O. or two N.O. safety outputs
- One N.C. auxiliary output
- 24V AC/DC or 120/240V AC
- Output monitoring
- LED indicators for RUN, STOP, and OPEN
- Automatic/manual reset

LED Indicators

Green	Run
Yellow	Open Circuit
Red	Stop

Specifications

Safety Ratings	
Standards	EN1760-2, EN954-1, ISO 13849-1, AS 4024.5, EN 954-1, ANSI B11.19
Safety Classification	Cat. 3 per EN 954-1
Certifications	CE Marked for all applicable directives, cULus, and TÜV
Power Supply	
Input Power Entry	251: 24V AC/DC or 115/230V AC 50/60 Hz; 252: 24V AC/DC 50/60 Hz
Power Consumption	251: < 6 VA 252: < 4 VA
Inputs	
Safety Inputs	Profile: 6 kΩ, 12V DC open circuit, 4V DC run condition Monitoring: 1 N.O.
Response Time	13 ms, max.
Outputs	
Safety Contacts	251: 2 N.O.; 252: 1 N.O.
Auxiliary Contacts	1 N.C.
Rated Impulse withstand Voltage	2500V
Switching Current @ Voltage, Min.	10 mA @ 10V
Fuses, Output	4 A on AC, 2 A on DC (external)
Electrical Life (Operations)	220V AC/4 A/880VA cosϕ = 0.3… 0.1 M 220V AC/1.7 A375VA cosϕ = 0.6…0.5 M 30V DC/2 A/60 W = 1 M 10V DC/0.01 A/0.1 W = 2 M
Environmental and Physical Characteristics	
Enclosure Type Rating/ Terminal Protection	251D, 252D: IP40 (NEMA 1); 251P: IP65 (NEMA 13)/ IP20 DIN 0470
Operating Temperature [C (F)]	-10…55° (-14…131°)
Vibration	0.15 mm, 10…55 Hz
Shock	10 g, 11 ms, half-sine
Mounting	Surface mount 35 mm or DIN Rail
Weight [g (lbs)]	251D: 450 (1.0) 252D: 181 (0.4) 251P: 650 (1.4)
Conductor Size, Max.	251D, 252D: 1 x 4 mm^2 (10 AWG) stranded, 1 x 4 mm^2 (10 AWG) solid 251P: 1 x 1.1 mm^2 (18 AWG) stranded, 1 x 1.5 mm^2 (16 AWG) solid

✶ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the following assumptions:
- Mission time/Proof test interval of 20 years
- Functional test at least once within six-month period

Visit our website: www.ab.com/catalogs
Publication S117-CA001A-EN-P

Allen-Bradley
Guardmaster®

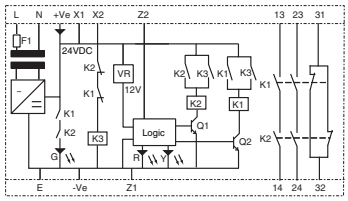
Product Selection

Inputs	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. No.
Safedge	2 N.O.	1 N.C.	Fixed	Automatic/Manual	24V AC/DC or 115/230V AC	440F-C251D
	1 N.O.				24V AC/DC	440F-C252D
	2 N.O.				24V AC/DC or 115/230V AC	440F-C251P

Accessories

Description	Cat. No.
500 mA Fuse—Bussmann Cat. No. ETF-500 mA	440R-A31562
Fuse, 2 A—Bussmann Cat. No. ETF-2	440A-A09197

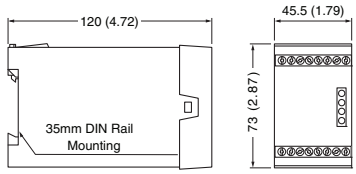
Block Diagram



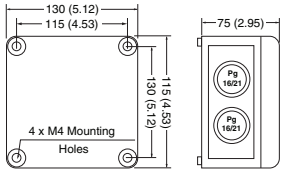
Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.

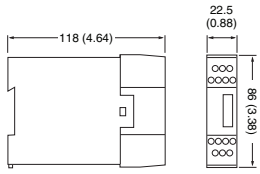
440F-C251D



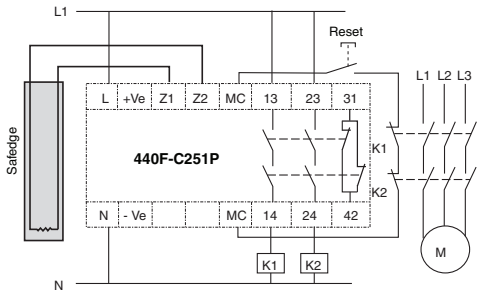
440F-C251P



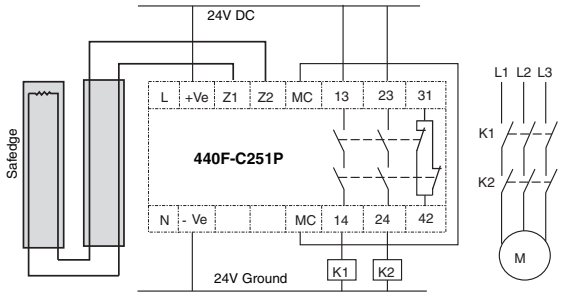
440F-C252D



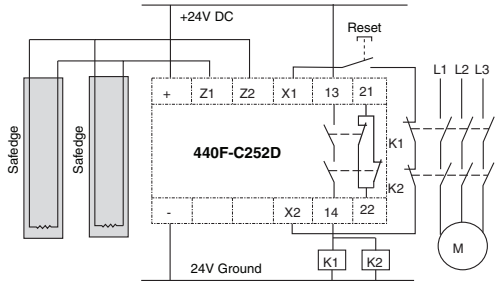
Typical Wiring Diagrams



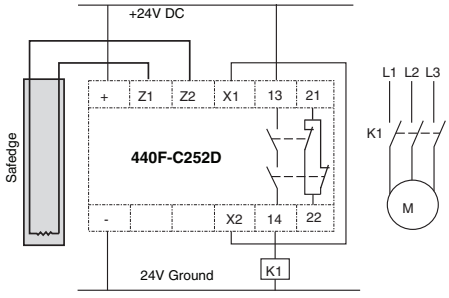
Series Terminated, Safedge Input, Manual Reset, Dual Channel Output, Monitored Output



Series Terminated, Cascaded, Safedge Input, Automatic Reset, Dual Channel Output, No Output Monitored



Parallel Terminated, Safedge Input, Manual Reset, Dual Channel Output, Monitored Output



Series Terminated, Safedge Input, Automatic Reset, Single Channel Output, No Output Monitored

Sipha Control Units

Description

With the increasing speed and complexity of applications a simple magnetic switch may be insufficient to meet the increased risks, therefore Sipha's design incorporates several magnetically sensitive elements which must be triggered in a particular sequence to operate correctly. The Sipha sensor, designed to operate with its own actuator, helps prevent defeatability by a simple magnet.

The control unit is available in three types. The Sipha 1 control unit operates on 24V AC/DC and offers one normally open safety output and one normally closed solid-state auxiliary output. The Sipha 2 control unit operates on either 24V AC/DC, 110V AC or 230V AC and offers two normally open safety outputs and one normally closed auxiliary output. The Sipha 6 has wiring terminals for up to six sensors, a delayed output for Category 1 stops and offers the same wide range of power supply capability as the Sipha 2 control unit. Between two and six Sipha sensors can be directly connected to the Sipha 6 control unit. An internal DIP switch mutes the unused connections to sensors 1, 2, 3 and 4. This allows for individual monitoring to each interlock and provides enhanced safety integrity when compared to six interlocks running off a single Sipha 2 control unit.

The Sipha control units are designed to operate with the Sipha sensors and actuators. The controllers have automatic reset.

Features

- Noncontact actuation
- Magnetic coded sensing
- Control unit acts as safety relay
- Four types of switches

LED Indicators

Green LED	Power on
Green LED	Output Closed

Application Details

See Sipha Sensors for details.

Specifications

Safety Ratings	
Standards	EN954-1, ISO13849-1, IEC/EN60204-1, NFPA79, EN1088, ISO14119, IEC/EN60947-5-1, ANSI B11.19, AS4024.1
Safety Classification	Sipha 1 & 2: Cat. 3 per EN954-1 Sipha 6: Cat. 4 per EN954-1
Certifications	CE Marked for all applicable directives, cULus, and TÜV
Power Supply	
Input Power Entry	Sipha 1: 24V AC/DC; Sipha 2 & 6: 24V AC/DC and 115/230V AC
Power Consumption	Sipha 1: <2VA Sipha 2 & 6: <4VA
Inputs	
Safety Inputs	Sipha 1: 1 N.C. & 1 N.O. Sipha 2 & 6: 6 x (1 N.C. & 1 N.O.)
Input Resistance, Max.	Terminals 1…4: 200 Ω Terminals 2…3: 150 Ω
Outputs	
Safety Contacts	Sipha 1: 1 N.O. Sipha 2: 2 N.O. Sipha 6: 2 N.O. + 1 N.O. Delayed (0.6…30 sec.)
Auxiliary Contacts	1 N.C.
Rated Impulse withstand Voltage	2500V
Switching Current @ Voltage, Min.	10 mA @ 10V
Fuses, Output	External 5 A quick blow AC, 3 A quick blow DC
Electrical Life (Operations)	220V AC/4 A/880VA cosϕ = 0.35…0.1 M 220V AC/1.7 A375VA cosϕ = 0.6…0.5 M 30V DC/2 A/60 W = 1 M 10V DC/0.01 A/0.1 W = 2 M
Mechanical Life	2,000,000 operations
Environmental and Physical Characteristics	
Operating Temperature [C (F)]	-10…+55° (+14…+131°)
Vibration	1 mm, 10…55 Hz
Shock	30 g, 11 ms half-sine
Mounting	35 mm DIN Rail
Weight [g (lbs)]	Sipha 1: 140 (0.31) Sipha 2: 410 (0.90) Sipha 6: 675 (1.49)
Conductor Size, Max.	0.2…2.5 mm² (24…14 AWG)

✶ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the following assumptions:
- Mission time/Proof test interval of 20 years
- Functional test at least once within six-month period

Product Selection

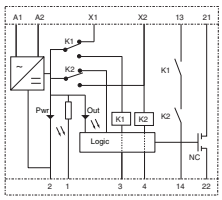
Housing	Supply Voltage	Safety Contacts	Auxiliary Contacts	Housing	Type	Cat. No.
	24V AC/DC	1 N.O.	1 N.C. Solid State	22.5 mm	Control Unit 1	440N-S32013
	24V AC/DC; 115/230V AC	2 N.O.	1 N.C.	45 mm	Control Unit 2	440N-S32021
	24V AC/DC; 115/230V AC	3 N.O. 1 N.O. Delayed	1 N.C.	90 mm	Sipha 6	440N-S32052

Accessories

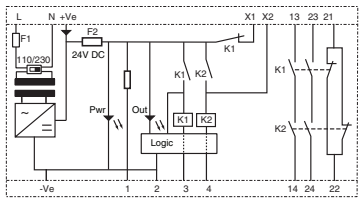
Description	Cat. No.
Replacement Fuse, 500 mA	440R-A31562

Block Diagrams

Sipha 1



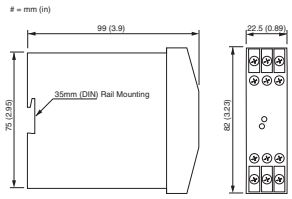
Sipha 2



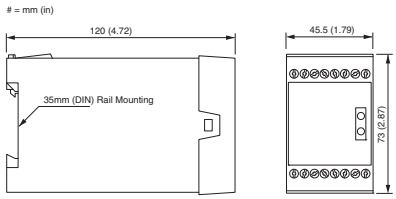
Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.

Sipha Control Unit Type 1

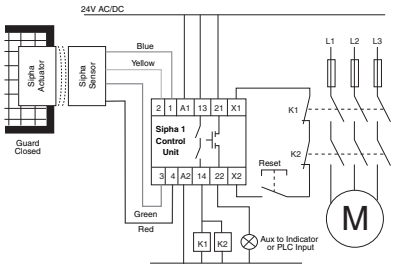


Sipha Control Unit Type 2

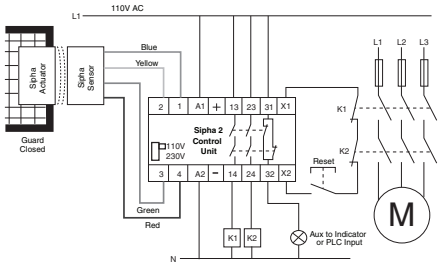


Sipha 6 Control Unit

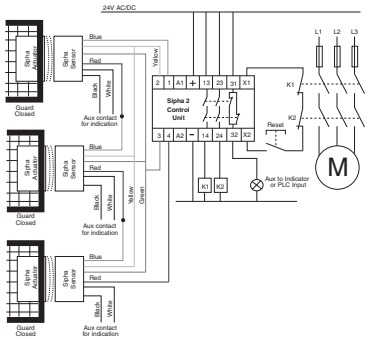
Typical Wiring Diagrams



Single Sipha Sensor, 24V Supply, Dual Channel Output, Manual Reset, Monitored Output



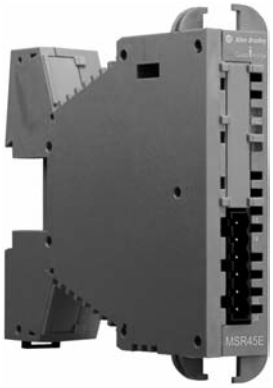
Single Sipha Sensor, 110V Supply, Dual Channel Output, Manual Reset, Monitored Output



Multiple Sipha Sensor, Manual Reset, Dual Channel Output, Monitored Output

Expansion Safety Relays

MSR45E



Description

The MSR45E is a safety relay expansion module for the MSR41/MSR42 (MSR4x) multi-function safety controller. The MSR45E comes in 22.5 mm DIN housing and is designed to easily connect to the MSR4x. The MSR45E safety relay expansion module is a Category 4 module with externally monitored contactors via the MSR4x. Interconnecting these devices is as simple as plugging ribbon-cable connectors to the back of each module. Up to three MSR45E safety relay expansion modules may be interconnected to an MSR4x. The ribbon-cable connectors must be ordered separately based on the number of MSR45E units that are attached to the MSR4x.

Features

- Category 4 per EN 954-1
- SIL CL3 per IEC 61508
- Stop category 0 or 1
- Two safety contacts N.O.

LED Indicators

Green	K1 Closed
Green	K2 Closed

Specifications

Safety Ratings	
Standards	EN 954-1, IEC/EN 60204-1, IEC 61496-1
Safety Classification	Cat. 4 per EN 954-1, SIL CL3 per EN IEC 61508
Functional Safety Data ✶ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	PFH_D: < 3.0E-10 MTTFd: > 206 years For use in SIL3 systems (according to IEC 62061) depending on the architecture and application characteristics
Certifications	CE Marked for all applicable directives, cULus, and TÜV
Power Supply	
Input Power Entry	24V DC from MSR41 or MSR42
Power Consumption	1.5 W
Inputs	
Reset	Determined by MSR41 or MSR42
Power On Delay/ Recovery Time	<35 ms/ Determined by configuration
Response Time	Determined by configuration
Outputs	
Safety Contacts	2 N.O.
Auxiliary Contacts	—
Thermal Current/I_{th}	1 x 8 A or 2 x 6 A nonswitching
Rated Impulse withstand Voltage/I_{th}	—
Switching Current @ Voltage, Min.	10 mA @ 10V
Fuses, Output	External 6 A slow blow or 10 A fast acting
Mechanical Life	10,000,000 operations
Utilization Category	
Inductive: AC-15	3 A @ 250V AC
Inductive: DC-13	6 A @ 24V DC
Environmental and Physical Characteristics	
Enclosure Type Rating/ Terminal Protection	IP20/ IP20
Operating Temperature [C (F)]	0…55° (32…131°)
Vibration	10…55 Hz, 0.35 mm
Shock	10 g, 16 ms, 100 shocks
Mounting	35 mm DIN Rail
Weight [g (lbs)]	150 (0.33)
Conductor Size, Max.	1 x 2.5 mm^2 (14 AWG) stranded

✶ Usable for IEC 62061. Data is based on the following assumptions:
- Mission time/Proof test interval of 20 years
- Functional test at least once within six-month period

Product Selection

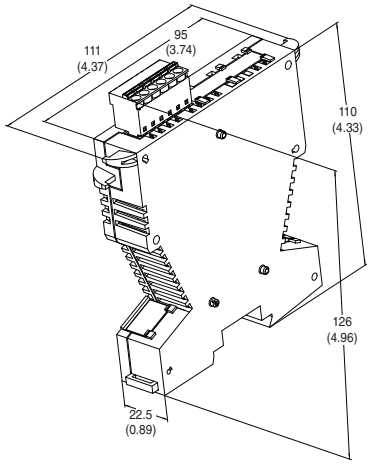
Inputs	Safety Outputs	Auxiliary Outputs	Time Delay	Terminals	Reset Type	Power Supply	Cat. No.
MSR4x base module	2	—	Software configurable thorugh MSR4x	Removable	MSR4x base module defines reset type	24V DC from the base unit	**440R-P4NANS**

Accessories

Description	Cat. No.
Ribbon cable—for one MSR45E	**440R-ACABL1**
Ribbon cable—for two MSR45Es	440R-ACABL2
Ribbon cable—for three MSR45Es	440R-ACABL3
Replacement terminal block kit—MSR45E	440R-ATERM2C

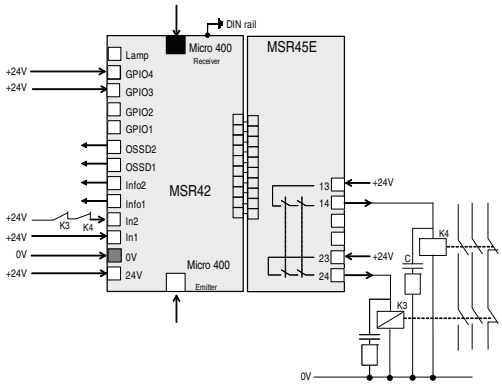
Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



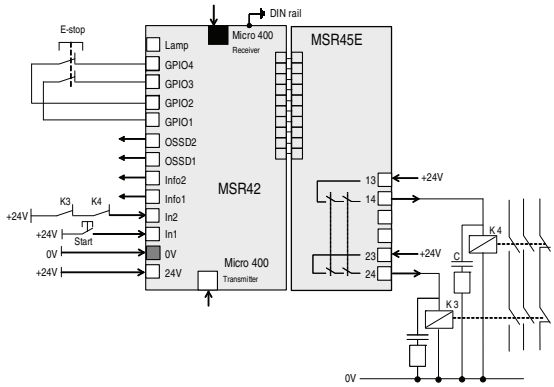
Typical Wiring Diagrams

Hardware Configuration



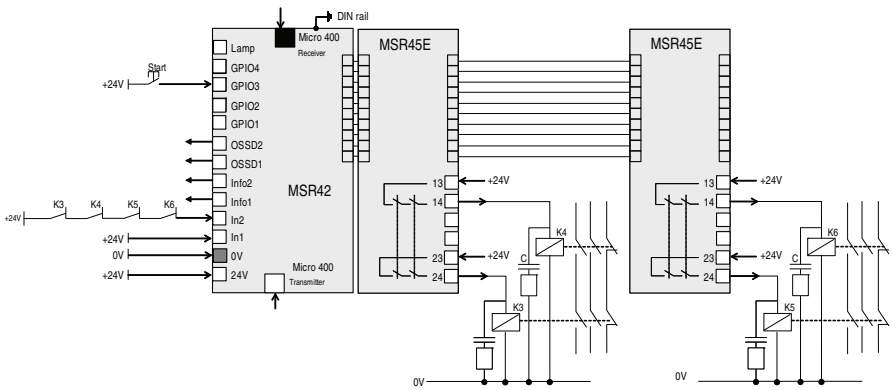
Micro 400, Automatic Reset, Start/Restart Monitored Output

Software Configuration



Micro 400 Light Curtain, E-Stop, Manual Reset, Start/Restart Monitored Output

Hardware Configuration



Micro 400 Light Curtain, Manual Reset, Start/Restart Monitored Output

Expansion Safety Relays with Delayed Outputs

MSR132E

Description

The Minotaur MSR132E is a monitoring safety expansion relay unit with single or dual channel input and either immediate or timed off-delay outputs. It is designed to be operated as an “extension” of a “master” safety relay. When wired properly, the outputs of the MSR132E will mimic the outputs of the master relay.

The outputs include four normally open safety rated outputs used to shut down the manufacturing system and two normally closed auxiliary outputs to indicate status of the MSR132E. One additional normally closed output is available to allow the host relay to monitor the status of the MSR132E. The safety, auxiliary and monitoring outputs have independent and redundant internal contacts to support the safety function.

A delayed output version is also available (MSR132ED) that have off-delayed outputs with a fixed time without the need for an auxiliary supply during the off-delay time.

Features

- Category 4/3 per EN 954-1
- Stop Category 0 or 1
- Four safety contacts N.O.
- Two auxiliary contacts N.C.
- One monitoring contact N.C.
- Single channel input

LED Indicators

Green	K1 Closed
Green	K2 Closed

Specifications

Safety Ratings		
Standards	EN 954-1, ISO 13849-1, IEC/EN 60204-1, IEC 60947-5-1, ANSI B11.19, AS 4024.1	
Safety Classification	Cat. 4 per EN 954-1 (ISO 13849-1), SIL CL3 per EN IEC 62061, PLe per ISO 13849-1	
Functional Safety Data ✶ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	PFH_D: < 0.46 x 10^{-9} MTTFd: > 417 years Suitable for performance levels Ple (according to ISO 13849-1:2006) and for use in SIL3 systems (according to IEC 62061) depending on the architecture and application characteristics	
Certifications	CE Marked for all applicable directives, cULus, c-Tick, and BG	
Power Supply		
Input Power Entry	24V AC/DC 50/60 Hz or 24V DC 0.8…1.1	
Power Consumption	1.5 W	
Inputs		
Safety Inputs	1 N.C. or 2 N.C.	
Reset	Automatic	
Power On Delay/ Recovery Time	100 ms/100 ms	
Response Time	50 ms	
Outputs		
Safety Contacts	4 N.O.	
Auxiliary Contacts	2 N.C.	
Thermal Current/I_{th}	2 x 6 A or 3 x 5 A or 4 x 4 A nonswitching	
Rated Impulse withstand Voltage/I_{th}	2500V	
Switching Current @ Voltage, Min.	10 mA @ 10V	
Fuses, Output	External 6 A slow blow or 10 A fast acting	
Electrical Life (Operations)	(With surge suppression) 250V AC/6 A/1500VA cosϕ = 1…0.1 M 250V AC/2 A/500VA cosϕ = 1…0.5 M 250V AC/4 A/1000VA cosϕ = 0.35…0.3 M 250V AC/1.5 A/1000VA cosϕ = 0.6…0.1 M 24V DC/2 A/48 W = 1 M 10V DC/0.01 A/0.1 W = 2 M	
Mechanical Life	2,000,000 operations	
Utilization Category		
Resistive: AC-1	6 A @ 250V AC	
Resistive: DC-1	3 A @ 24V DC	
Inductive: AC-15	6 A @ 250V AC	6 A @ 125V AC
Inductive: DC-13	3 A @ 24V DC	
UL:	B300, R300, 6 A/250V AC, 3 A/24V DC	
Environmental and Physical Characteristics		
Enclosure Type Rating/ Terminal Protection	IP40 (NEMA 1), DIN 0470/ IP20, DIN 0470	
Operating Temperature [C (F)]	-5…55° (23…131°)	
Vibration	10…55 Hz, 0.35 mm	
Shock	10 g, 16 ms, 100 shocks	
Mounting	35 mm DIN Rail	
Weight [g (lbs)]	215 (0.474)	
Conductor Size, Max.	0.2…4 mm^2 (24…12 AWG)	

✶ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the following assumptions:
- Mission time/Proof test interval of 20 years
- Functional test at least once within six-month period

Expansion Safety Relays with Delayed Outputs

MSR132E

Product Selection

Inputs	Safety Outputs	Auxiliary Outputs	Time Delay	Terminals	Reset Type	Power Supply	Cat. No.
1 N.C. or 2 N.C.	4 N.O.	2 N.C.	0 s	Fixed	Automatic	24V AC/DC	440R-E23191✶
			0.5 s			24V DC	440R-E23192
			1 s				440R-E23193
			2 s				440R-E23194
			3 s				440R-E23195
			0 s	Removable		24V AC/DC	440R-E23097✶
			0.5 s			24V DC	440R-E23159
			1 s				440R-E23160
			2 s				440R-E23098
			3 s				440R-E23161
			4 s				440R-E23162❄

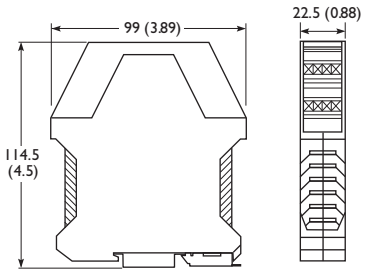
✶ Cat. 4 rated.
❄ 45 mm wide housing.

Accessories

Description	Cat. No.
Bag of 4, 4-Pin Screw Terminal Blocks	440R-A23209
Bag of 4, 4-Pin Spring Clamp Terminal Blocks	440R-A23228

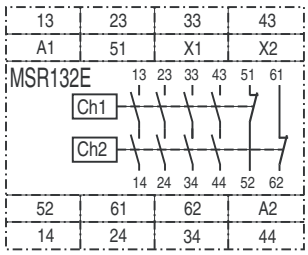
Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.

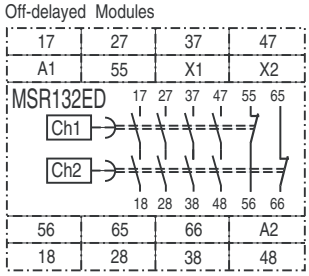


Block Diagram

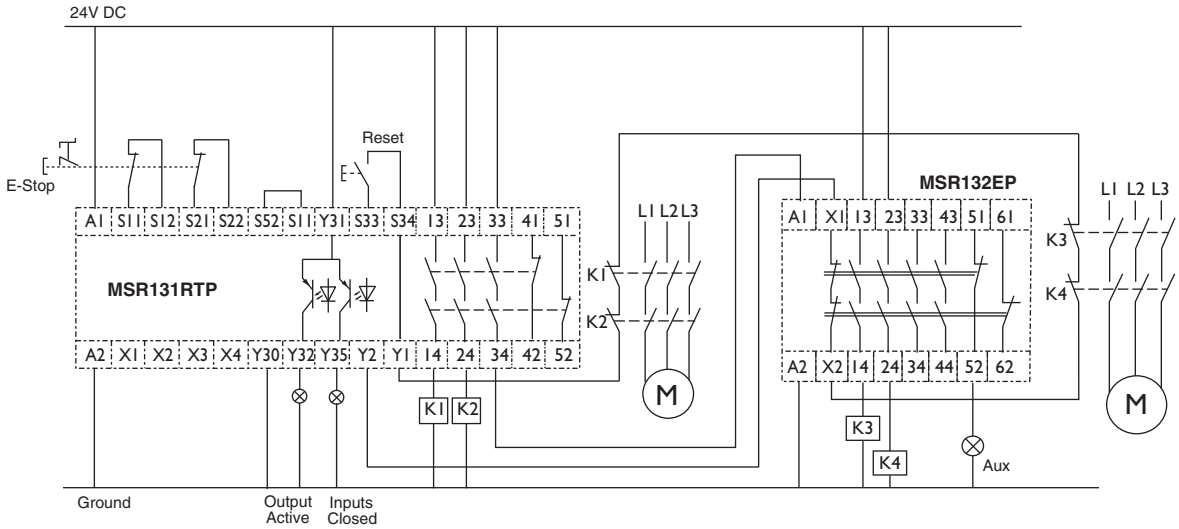
Standard Module



Off-delayed Modules



Typical Wiring Diagrams



Dual Channel E-Stop, Monitored Manual Reset, Dual Channel Output, Single Channel Delayed Expansion, Monitored Output

Input Module Selection

To determine the base module and input modules needed, start on the left side and count down the number of OSSD input devices you have to connect to the system. Then move to the right according to the number of non-OSSD input devices you need, such as 1 N.C. or 2 N.C. input devices. Count the modules and this will be your total required for the system.

# of OSSD Inputs \ # of non-OSSD Devices	0	1 2	3 4	5 6	7 8	9 10	11 12	13 14	15 16	17 18	19 20	21 22
0		**MSR210**	MSR220	MSR220	MSR220	MSR220	MSR220	MSR220	MSR220	MSR220	MSR220	MSR220
1 2	**MSR211**	MSR220	MSR220	MSR220	MSR220	MSR220	MSR220	MSR220	MSR220	MSR220	MSR220	
3 4	MSR221	MSR220	MSR220	MSR220	MSR220	MSR220	MSR220	MSR220	MSR220	MSR220		
5 6	MSR221	MSR220	MSR220	MSR220	MSR220	MSR220	MSR220	MSR220	MSR220			
7 8	MSR221	MSR220	MSR220	MSR220	MSR220	MSR220	MSR220	MSR220				
9 10	MSR221	MSR220	MSR220	MSR220	MSR220	MSR220	MSR220					
11 12	MSR221	MSR220	MSR220	MSR220	MSR220	MSR220						
13 14	MSR221	MSR220	MSR220	MSR220	MSR220							
15 16	MSR221	MSR220	MSR220	MSR220								
17 18	MSR221	MSR220	MSR220									
19 20	MSR221	MSR220										
21 22	MSR221											

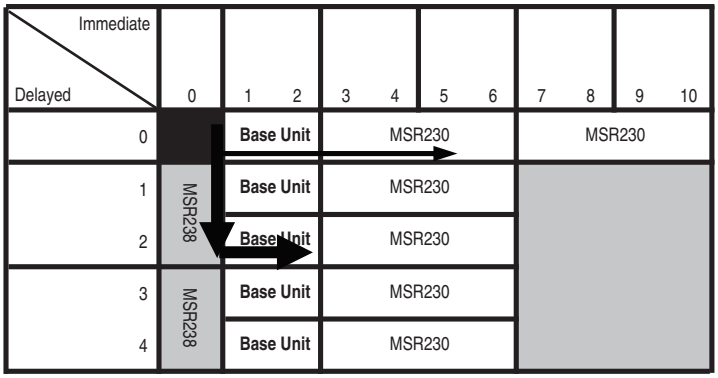
Example 1: 7 OSSD inputs and 5 non-OSSD inputs required.
Solution: MSR211, 3 MSR221, and 3 MSR220.

Example 2: 9 non-OSSD inputs required.
Solution: 1 MSR210 Base, 4 MSR220.

Note: This selection chart assumes that **if** you have OSSD input devices, they will be connected to the base module. If you do **not** want this, then change the MSR211 to the MSR210 and change one MSR220 to an MSR221. This will provide you the same system, but now the OSSD input device will not be on the base module.

Output Module Selection

Start at the top left and count the number of delayed outputs required. Then count across the number of immediate outputs required. Ensure you only have a total of two output modules total.



Example 1: 2 Delayed outputs and 2 Immediate outputs

Solution: (black lines) One MSR238, 2 Immediate outputs built in the base module

Example 2: 5 Immediate outputs required

Solution: (red line) 1 MSR230 Output module and 2 immediate outputs built into base module

Note: The base module has two N.O. safety outputs built in.

Modular Safety Relays

MSR210P

Description

The MSR210P forms one of the base units for the modular Minotaur MSR200 family of monitoring safety relays. It can be combined with other modules of the MSR200 Series to configure a safety control system with numbers of inputs and outputs matching users' specific application requirements, as well as diagnostic and networking capabilities. Up to ten input modules and two output modules can be connected to one base unit by simply removing the terminator, included with each base unit, and connecting the ribbon cables of the neighboring module. The terminators must be inserted into the final input and output modules.

The MSR210P has two inputs. Each input can be wired in one of four ways: one normally closed, two normally closed, three normally closed, safety mat connections. The MSR210P uses pulsed input monitoring to check for faults to power, ground or between inputs before a demand is placed on the safety system. Connecting a single device (must be at least dual channel) to each input meets the requirements of Category 4 per EN 954-1.

The MSR210P has the capability to perform external device monitoring (EDM). The EDM capability works in conjunction with the reset option. The user selects EDM and the reset function by jumpers across terminals Y40, Y41 and Y42.

The MSR210P has two semiconductor outputs designed to send status information to a PLC. Terminal Y33 indicates the inputs are closed (the ready LED is on). Terminal Y32 indicates the outputs are active.

The outputs include two normally open safety rated outputs and one normally closed auxiliary output.

Features

- Category 4 per EN 954-1
- Stop category 0
- Pulsed input monitoring
- Two input circuits: safety gate, E-stop or safety mat
- Up to 22 diverse input devices
- Two safety outputs, three auxiliary outputs
- Ten diagnostic LEDs
- Removable terminals

LED Indicators

Green	Input 1 Closed
Red	Input 1 Open
Green	Input 2 Closed
Red	Input 2 Open
Green	CH1 Output Active
Green	CH2 Output Active
Green	Power
Green	Run (Outputs Active)
Red	Stop (Outputs Off) + Diagnostics
Amber	Ready (Inputs Closed)

Specifications

Safety Ratings		
Standards	EN 954-1, ISO 13849-1, IEC/EN 60204-1, IEC 60947-4-1, IEC 60947-5-1, ANSI 11.19, AS 4024.1	
Safety Classification	Cat. 4 per EN 954-1 (ISO 13849-1), SIL CL3 per EN IEC 62061, PLe per ISO 13849-1	
Functional Safety Data ✶ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	PFH_D: < 3.44 x 10^{-9} MTTFd: > 203 years Suitable for performance levels Ple (according to ISO 13849-1:2006) and for use in SIL3 systems (according to IEC 62061) depending on the architecture and application characteristics	
Certifications	CE Marked for all applicable directives, cULus, c-Tick, and TÜV	
Power Supply		
Input Power Entry	24V DC 0.8…1.1 x rated voltage	
Power Consumption	8 W	
Inputs		
Safety Inputs	1 N.C., 2 N.C., 3 N.C., or SM	
Input Simultaneity	Infinite	
Input Resistance, Max.	Inputs: 900 Ω Reset: 3200 Ω	
Reset	Auto./Manual or Monitored Manual	
Power On Delay/ Recovery Time	3 seconds/ 40…145 ms, depending on expansion modules used	
Response Time	MSR210: 29 ms MSR210 + Input Exp. Mod.: 34 ms + 6 ms/module	
Outputs		
Safety Contacts	2 N.O.	
Auxiliary Contacts	1 N.C., 2 PNP	
Thermal Current I_{th}	1 x 6 A or 2 x 4 A (nonswitching)	
Rated Impulse withstand Voltage	2500V	
Switching Current @ Voltage, Min.	10 mA @ 10V DC	
Fuses, Output	External 6 A slow blow or 10 A fast acting	
Solid State Output Rating	20 mA @ 30V DC short-circuit protection	
Electrical Life (Operations)	(With surge suppression) 250V AC/6 A/1500VA cosϕ = 1…0.1 M 250V AC/2 A/500VA cosϕ = 1…0.5 M 250V AC/4 A/1000VA cosϕ = 0.35…0.3 M 250V AC/1.5 A/1000VA cosϕ = 0.6…0.1 M 24V DC/2 A/48 W = 1 M 10V DC/0.01 A/0.1 W = 2 M	
Mechanical Life	2,000,000 cycles	
Utilization Category		
Inductive: AC-15	3 A @ 250V AC	3 A @ 125V AC
Inductive: DC-13	2.5 A @ 24V DC	
UL	1 x B300, R300, or 2 x C300 1 x 6 A or 2 x 4 A Resistive	
Environmental and Physical Characteristics		
Enclosure Type Rating/ Terminal Protection	IP40 (NEMA 1)/ IP20	
Operating Temperature [C (F)]	-5…+55 ° (23…131 °)	
Vibration	10…55 Hz, 0.35 mm	
Shock	10 g, 16 ms, 100 shocks	
Mounting	45 mm housing, 35 mm DIN Rail	
Weight [g (lb)]	280 (0.62)	
Conductor Size, Max.	0.2…4 mm^2 (24…12 AWG)	

✶ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the following assumptions:
- Mission time/Proof test interval of 20 years
- Functional test at least once within six-month period

Product Selection

Inputs	Safety Outputs	Auxiliary Outputs	Solid State Outputs	Terminals	Reset Type	Power Supply	Cat. No.
Two independent inputs; 2 x 1 N.C., 2 N.C., 3 N.C., or Safety Mat	2 N.O.	1 N.C. and 2 PNP Solid State	2 PNP	Removable	Auto./Manual or Monitored Manual	24V DC from the base unit	440R-H23176

Accessories

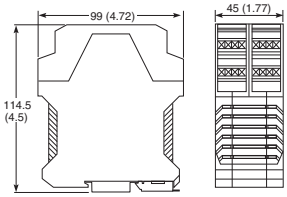
Description	Cat. No.
MSR200, Two Terminators	440R-A17138
Bag of 4, 4-Pin Screw Terminal Blocks	440R-A23209
Bag of 4, 4-Pin Spring Clamp Terminal Blocks	440R-A23228

Diagnostics—Red Stop LED Blinks

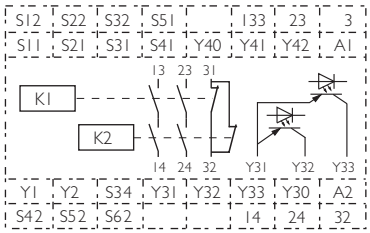
Blink Rate	Description
2	Change in Y40/Y41/Y42 circuit during operation.
3	Fault in external feedback circuit Y1-Y2. Clear fault and cycle power to reset the module.
Continuous	Internal fault in base or expansion module.

Approximate Dimensions

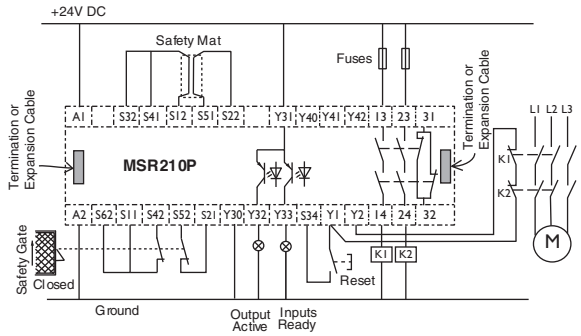
Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



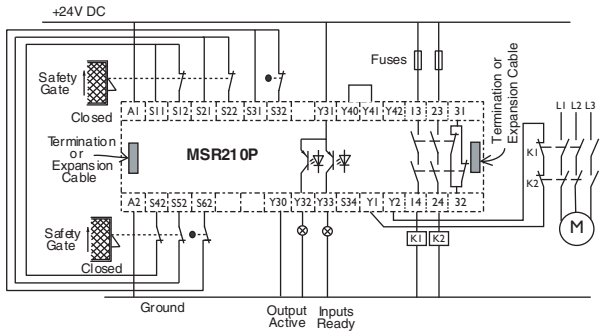
Block Diagram



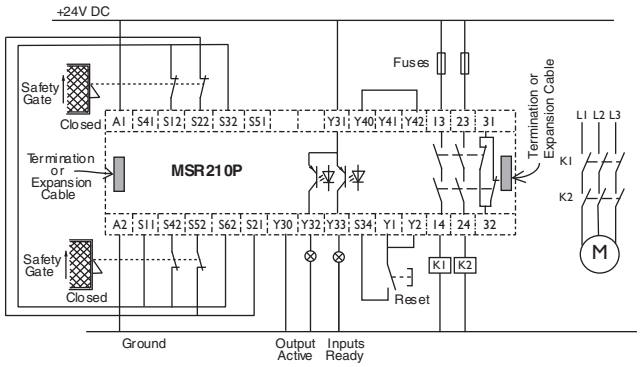
Typical Wiring Diagrams



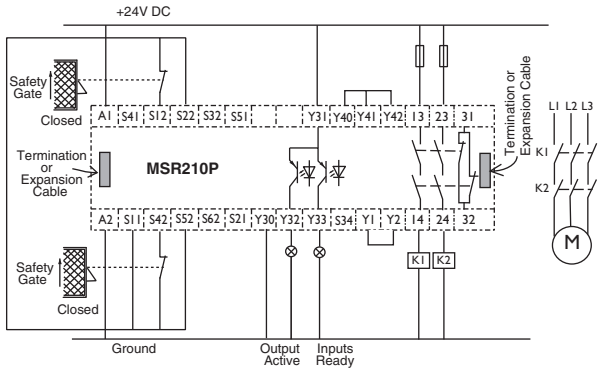
Safety Mat and Dual Channel Safety Gate, Monitored Manual Reset, Monitored Output



Two Triple Channel Inputs, Automatic Reset, Monitored Output



Two Dual Channel Safety Gates, Monitored Manual Reset, No Monitored Output



Two Single Channel Safety Gates, Automatic Reset, No Monitored Output

Modular Safety Relays

MSR211P

Description

The MSR211P forms one of the base units for the modular Minotaur MSR200 family of monitoring safety relays. It can be combined with other modules of the MSR200 Series to configure a safety control system with numbers of inputs and outputs matching users' specific application requirements, as well as diagnostic and networking capabilities. Up to ten input modules and two output modules can be connected to one base unit by simply removing the terminator, included with each base unit, and connecting the ribbon cables of the neighboring module. The terminators must be inserted into the final input and output modules.

The MSR211P has two inputs. Each input can be wired in one of three ways: one normally closed, two normally closed, or two OSSD connections from a light curtain. The MSR211P does not perform cross fault monitoring, and would not detect a short across the inputs of a two normally closed input. When connected to light curtains, the light curtain must perform the cross fault detection.

The MSR211P has the capability to perform external device monitoring (EDM). The EDM capability works in conjunction with the reset option. The user selects EDM and the reset function by jumpers across terminals Y40, Y41 and Y42.

The MSR211P has two semiconductor outputs designed to send status information to a PLC. Terminal Y33 indicates the inputs are closed (the ready LED is on). Terminal Y32 indicates the outputs are active.

The outputs include two normally open safety rated outputs and one normally closed auxiliary output.

Features

- Category 4 per EN 954-1
- Stop category 0
- Two input circuits: light curtain, safety gate, or E-stop inputs
- Two safety outputs, three auxiliary outputs
- Ten diagnostic LEDs
- Monitored or automatic reset
- Removable terminals

LED Indicators

Green	Input 1 Closed
Red	Input 1 Open
Green	Input 2 Closed
Red	Input 2 Open
Green	CH1 Output Active
Green	CH2 Output Active
Green	Power
Green	Run (Outputs Active)
Red	Stop (Outputs Off) + Diagnostics
Amber	Ready (Inputs Closed)

Specifications

Safety Ratings		
Standards	EN 954-1, ISO 13849-1, IEC/EN 60204-1, IEC 60947-4-1, IEC 60947-5-1, ANSI 11.19, AS 4024.1	
Safety Classification	Cat. 4 per EN 954-1 (ISO 13849-1), SIL CL3 per EN IEC 62061, PLe per ISO 13849-1	
Functional Safety Data ✶ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	PFH_D: < 3.49 x 10^{-9} MTTFd: > 188 years Suitable for performance levels Ple (according to ISO 13849-1:2006) and for use in SIL3 systems (according to IEC 62061) depending on the architecture and application characteristics	
Certifications	CE Marked for all applicable directives, cULus, c-Tick, and TÜV	
Power Supply		
Input Power Entry	24V DC 0.8…1.1 x rated voltage	
Power Consumption	8 W	
Inputs		
Safety Inputs	Two Inputs 1 N.C. or 2 N.C. or LC	
Input Simultaneity	Infinite	
Input Resistance, Max.	Inputs: 900 Ω Reset: 3200 Ω	
Reset	Auto./Manual or Monitored Manual	
Power On Delay/ Recovery Time	3 seconds/40…145 ms, depending on expansion modules used	
Response Time	MSR211: 25 ms MSR211+ MSR221.: 30 ms+2.4 ms per MSR221	
Outputs		
Safety Contacts	2 N.O.	
Auxiliary Contacts	1 N.C., 2 PNP	
Thermal Current/$_{Ith}$	1 x 6 A or 2 x 4 A (nonswitching)	
Rated Impulse withstand Voltage/$_{Ith}$	2500V	
Switching Current @ Voltage, Min.	10 mA @ 10V DC	
Fuses, Output	External 6 A slow blow or 10 A quick blow	
Solid State Output Rating	20 mA @ 30V DC short-circuit protection	
Electrical Life (Operations)	220V AC/4 A/880VA cosϕ = 0.35…0.1 M 220V AC/1.7 A375VA cosϕ = 0.6…0.5 M 30V DC/2 A/60 W = 1 M 10V DC/0.01 A/0.1 W = 2 M	
Mechanical Life	2,000,000 cycles	
Utilization Category		
Resistive: AC-1	6 A @ 250V AC	
Resistive: DC-1	6 A @ 24V DC	
Inductive: AC-15	3 A @ 250V AC B300	3 A @ 125V AC
Inductive: DC-13	2.5 A @ 24V DC	
UL	1 x B300, R300 or 2 x C300 1 x 6 A or 2 x 4 A Resistive	
Environmental and Physical Characteristics		
Enclosure Type Rating/ Terminal Protection	IP40 (NEMA 1)/ IP20	
Operating Temperature [C (F)]	-5…+55 ° (23…131 °)	
Vibration	10…55 Hz, 0.35 mm	
Shock	10 g, 16 ms, 100 shocks	
Mounting	35 mm DIN Rail	
Weight [g (lbs)]	280 (0.62)	
Conductor Size, Max.	0.2…4 mm² (24…12 AWG)	

✶ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the following assumptions:
- Mission time/Proof test interval of 20 years
- Functional test at least once within six-month period

Product Selection

Inputs	Safety Outputs	Auxiliary Outputs	Solid State Outputs	Terminals	Reset Type	Power Supply	Cat. No.
Two independent inputs; 2 x 1 N.C., 2 N.C., or Light Curtain	2 N.O.	1 N.C.	2 PNP	Removable	Auto./Manual or Monitored Manual	24V DC from the base unit	440R-H23177

Accessories

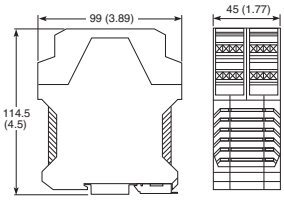
Description	Cat. No.
MSR200, Two Terminators	440R-A17138
Bag of 4, 4-Pin Screw Terminal Blocks	440R-A23209
Bag of 4, 4-Pin Spring Clamp Terminal Blocks	440R-A23228

Diagnostics—Red Stop LED Blinks

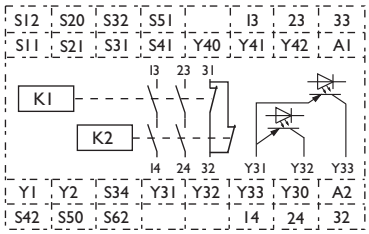
Blink Rate	Description
2	Change in Y40/Y41/Y42 circuit during operation.
3	Fault in external feedback circuit Y1-Y2. Clear fault and cycle power to reset the module.
Continuous	Internal fault in base or expansion module.

Approximate Dimensions

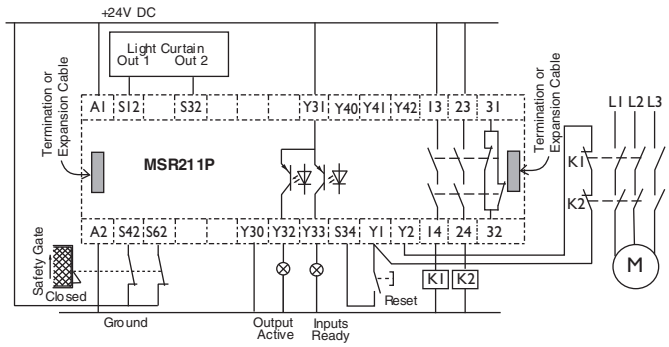
Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



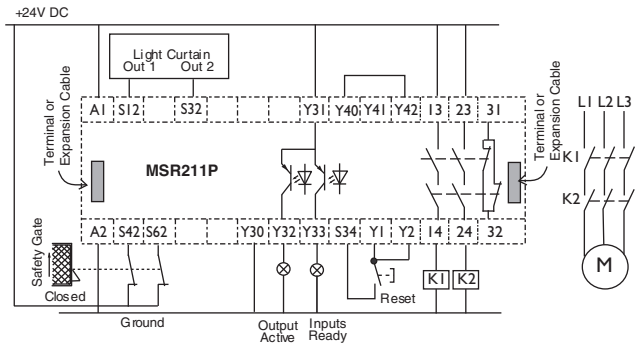
Block Diagram



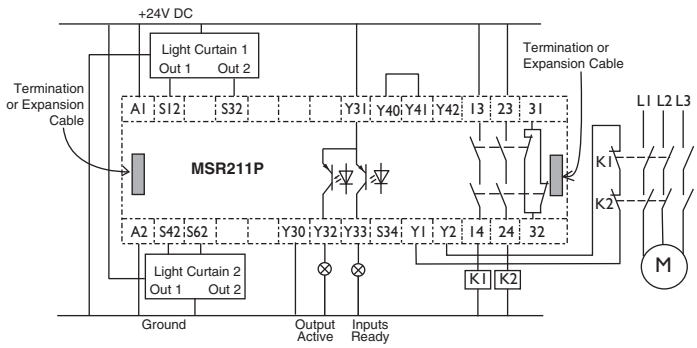
Typical Wiring Diagrams



Light Curtain and Dual Channel Safety Gate, Monitored Manual Reset, Monitored Output



Light Curtain and Dual Channel Safety Gate, Monitored Manual Reset, No Monitored Output



Two Light Curtains, Automatic Reset, Monitored Output

Modular Safety Relays

MSR220P

Description

The MSR220P is an input expansion module for the modular Minotaur MSR200 family of monitoring safety relays. It can be connected to either the MSR210P or MSR211P to provide additional inputs.

Up to ten input modules can be connected to a base unit by simply removing the terminator, included with each base unit, and connecting the ribbon cables of the neighboring module. The connecting ribbon cable provides power to the MSR220P as well as a check on its status. The terminators must be inserted into the final output module. The input modules to a base unit can be either MSR220P or MSR221P in any combination or order.

The MSR220P has two independent inputs, which can be wired in one of five ways: one normally closed, two normally closed, three normally closed, one normally closed and one normally open or a safety mat. When used with the MSR210 base unit, the inputs to the MSR220 are continuously pulse-checked for shorts to power, ground and across inputs. Connecting a single device (must be at least dual channel) to each input meets the requirements of Category 4 per EN 594-1.

Four LEDs provide status information on the inputs. Green indicates the input is closed and red indicates the input is open.

Features

- Category 4 per EN 954-1
- Stop category 0
- 17.5 mm DIN Rail housing
- Two input circuits: safety gate, E-stop or safety mat
- Four diagnostic LEDs
- Removable terminals

LED Indicators

Green	Input 1 Closed
Red	Input 1 Open
Green	Input 2 Closed
Red	Input 2 Open

Specifications

Safety Ratings	
Standards	EN 954-1, ISO 13849-1, IEC/EN 60204-1, IEC 60947-4-1, IEC 60947-5-1, ANSI 11.19, AS4024.1
Safety Classification	Cat. 4 per EN 954-1 (ISO 13849-1), SIL CL3 per EN IEC 62061, PLe per ISO 13849-1
Functional Safety Data ∗ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	PFH_D: < 3.7 x 10^{-10} MTTFd: > 825 years Suitable for performance levels Ple (according to ISO 13849-1:2006) and for use in SIL3 systems (according to IEC 62061) depending on the architecture and application characteristics
Certifications	CE Marked for all applicable directives, cULus, c-Tick, and BG
Power Supply	
Input Power Entry	24V DC from the base unit
Power Consumption	2 W
Inputs	
Safety Inputs	1 N.C. or 2 N.C. or 3 N.C. or 1 N.C. + 1 N.O. or SM
Input Simultaneity	Infinite
Input Resistance, Max.	900 Ω
Reset	See base unit
Power On Delay/ Recovery Time	See base unit
Response Time	See base unit
Environmental and Physical Characteristics	
Enclosure Type Rating/ Terminal Protection	IP40 (NEMA 1)/ IP20
Operating Temperature [C (F)]	-5…+55 ° (23…131 °)
Vibration	10…55 Hz, 0.35 mm
Shock	10 g, 16 ms, 100 shocks
Mounting	17.5 mm housing, 35 mm DIN Rail
Weight [g (lbs)]	90 (0.20)
Conductor Size, Max.	0.2…4 mm^2 (24…12 AWG)

∗ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the following assumptions:
- Mission time/Proof test interval of 20 years
- Functional test at least once within six-month period

Product Selection

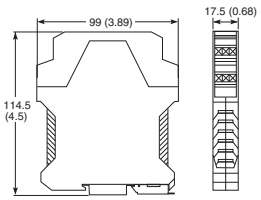
Inputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. No.
Two Independent Inputs: 1 N.C., 2 N.C., 3 N.C., 1 N.C. + 1 N.O., or SM	—	Removable	—	24V DC	440R-H23178

Accessories

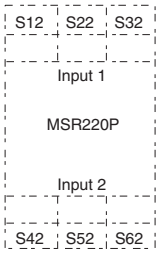
Description	Cat. No.
Bag of 4, 3-Pin Screw Terminal Blocks	440R-A23210
Bag of 4, 3-Pin Spring Clamp Terminal Blocks	440R-A23229

Approximate Dimensions

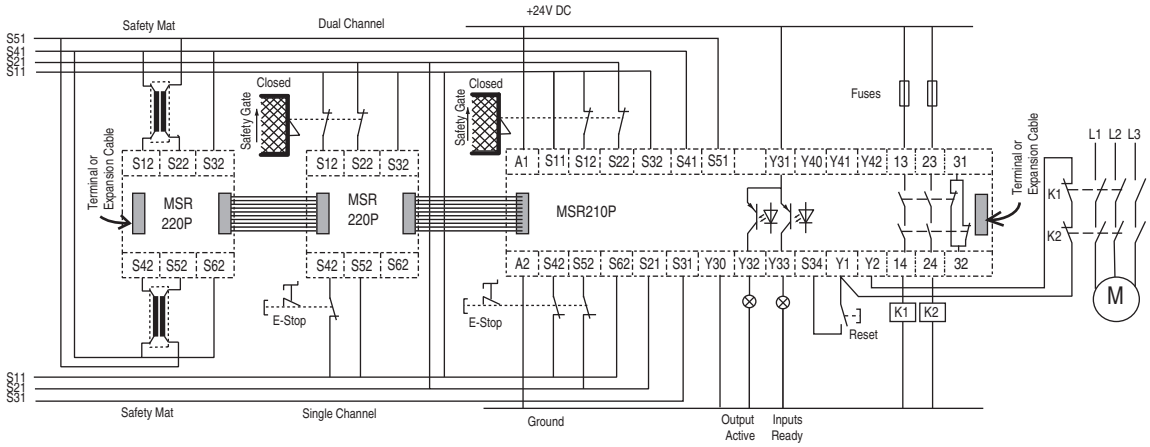
Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



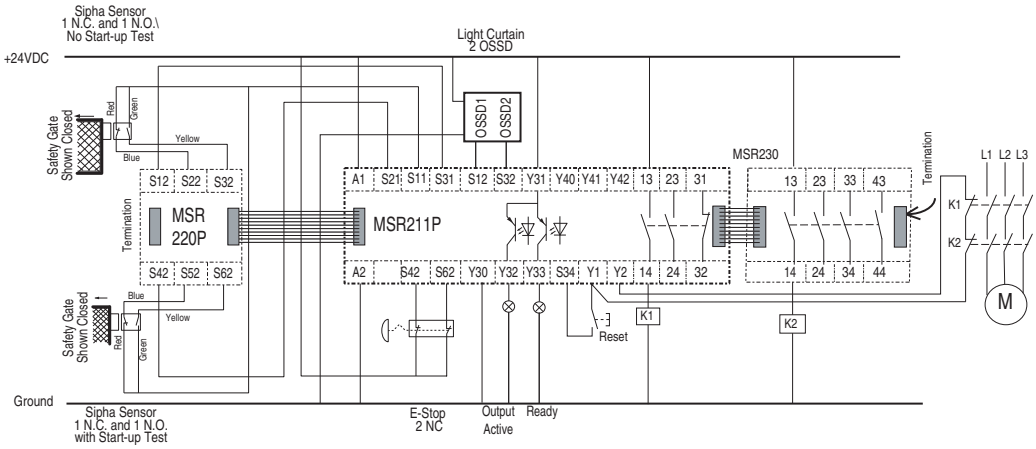
Block Diagram



Typical Wiring Diagrams



MSR220P Expanding an MSR210P



MSR220P Expanding an MSR211P

Modular Safety Relays

MSR221P

Description

The MSR221P is an input expansion module for the modular Minotaur MSR200 family of monitoring safety relays. It can be connected to either the MSR210P or MSR211P to provide additional inputs.

Up to ten input modules can be connected to a base unit by simply removing the terminator, included with each base unit, and connecting the ribbon cables of the neighboring module. The connecting ribbon cable provides power to the MSR220P as well as a check on its status. The terminators must be inserted into the final output module. The input modules to a base unit can be either MSR220P or MSR221P in any combination or order.

The MSR221P has two independent inputs, which can be wired in one of three ways: one normally closed, two normally closed, or a light curtain. When connected in the two normally closed configuration, the MSR221P does not perform cross fault monitoring (i.e., checks for shorts between the two inputs).

Four LEDs provide status information on the inputs. Green indicates the input is closed and red indicates the input is open.

Features

- 17.5 mm DIN Rail housing
- Two input circuits: gate, E-stop or light curtains
- Four diagnostic LEDs
- Removable terminals

LED Indicators

Green	Input 1 Closed
Red	Input 1 Open
Green	Input 2 Closed
Red	Input 2 Open

Specifications

Safety Ratings	
Standards	IEC/EN 60204-1, ISOTR 121100, ISO 13849-1 (EN 954-1), B11.19, AS 4024.1
Safety Classification	Cat. 4 per EN 954-1 (ISO 13849-1), SIL CL3 per EN IEC 62061, PLe per ISO 13849-1
Functional Safety Data ✶ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	PFH_D: < 3.7 x 10^{-10} MTTFd: > 825 years Suitable for performance levels Ple (according to ISO 13849-1:2006) and for use in SIL3 systems (according to IEC 62061) depending on the architecture and application characteristics
Certifications	CE Marked for all applicable directives, cULus, c-Tick, and TÜV
Power Supply	
Input Power Entry	24V DC from the base unit
Power Consumption	2 W
Inputs	
Safety Inputs	1 N.C. or 2 N.C. or LC
Input Simultaneity	Infinite
Input Resistance, Max.	1300 Ω
Reset	See base unit
Power On Delay/ Recovery Time	See base unit
Response Time	See base unit
Environmental and Physical Characteristics	
Enclosure Type Rating/ Terminal Protection	IP40 (NEMA 1)/ IP20
Operating Temperature [C (F)]	-5…+55 ° (23…131 °)
Vibration	10…55 Hz, 0.35 mm
Shock	10 g, 16 ms, 100 shocks
Mounting	35 mm DIN Rail
Weight [g (lbs)]	90 (0.20)
Conductor Size, Max.	0.2…4 mm^2 (24…12 AWG)

✶ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the following assumptions:
- Mission time/Proof test interval of 20 years
- Functional test at least once within six-month period

Product Selection

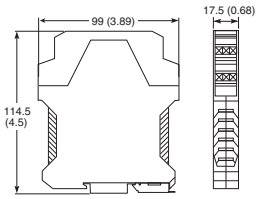
Inputs	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. No.
Two Independent Inputs: 1 N.C., 2 N.C., or LC	—	—	Removable	—	24V DC from the base unit	440R-H23179

Accessories

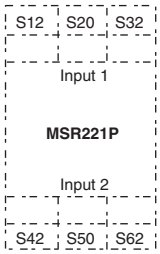
Description	Cat. No.
Bag of 4, 3-Pin Screw Terminal Blocks	440R-A23210
Bag of 4, 3-Pin Spring Clamp Terminal Blocks	440R-A23229

Approximate Dimensions

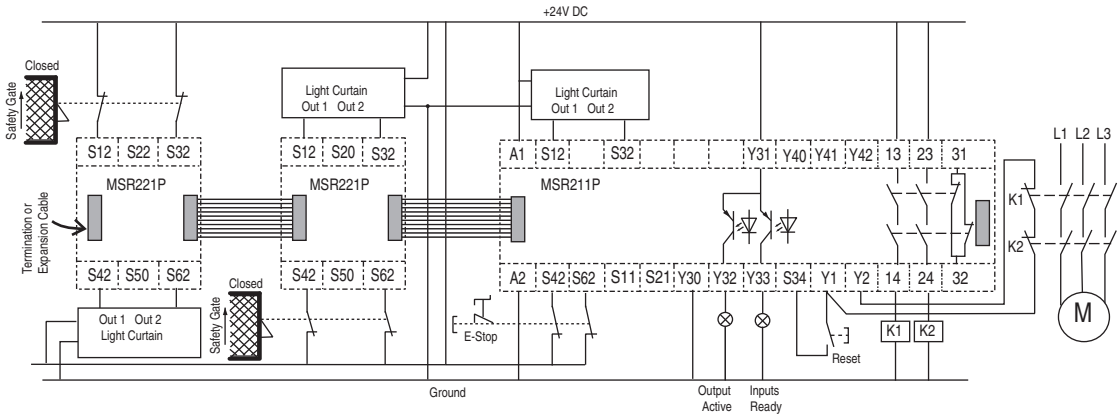
Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



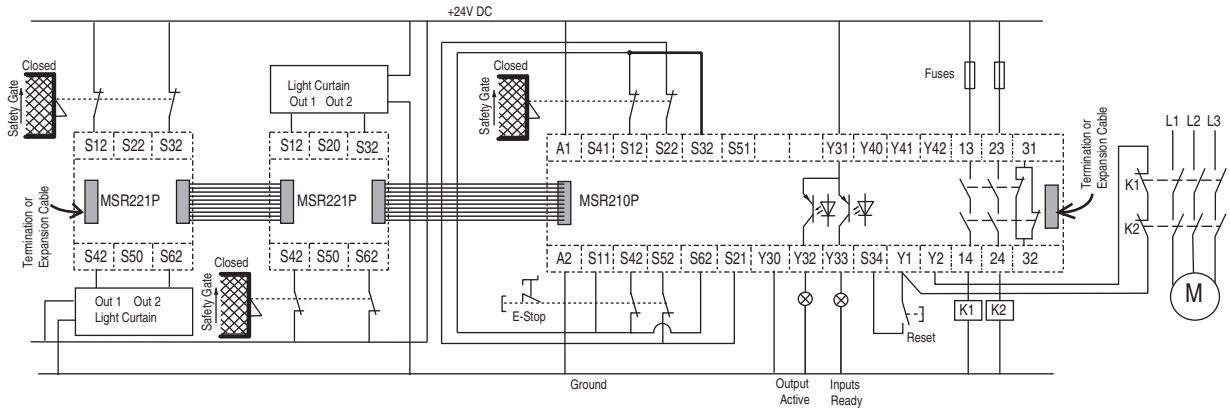
Block Diagram



Typical Wiring Diagrams



Light Curtain, Safety Gate, E-Stop, Monitored Manual Reset, Monitored Output



Light Curtain, Dual Channel Safety Gates and E-Stop, Monitored Manual Reset, Monitored Output

Modular Safety Relays

MSR230P

Description

The MSR230P is an output expansion module for the modular Minotaur MSR200 family of monitoring safety relays. It can be connected to either the MSR210P or MSR211P base unit to provide additional outputs.

Up to two MSR230P output modules can be connected to one base unit by simply removing the terminator, included with each base unit, and connecting the ribbon cables of the neighboring module. The connecting ribbon cable provides power to the MSR230P as well as a check on its status. The terminators must be inserted into the final output module.

The MSR230P has four safety rated outputs that work in parallel with the safety outputs of the base unit. When the output of the base unit is activated, the outputs of the MSR230P are also activated.

The outputs are four normally open safety rated outputs. The safety outputs have independent and redundant internal contacts to help support the safety function.

Features

- Four N.O. safety outputs
- Two diagnostic LEDs
- Removable terminals

LED Indicators

Green	Channel 1 Output ON
Red	Channel 1 Output OFF
Green	Channel 2 Output ON
Red	Channel 2 Output OFF

Specifications

Safety Ratings		
Standards	EN 954-1, ISO 13849-1, IEC/EN 60204-1, IEC 60947-4-1, IEC 60947-5-1, ANSI 11.19, AS 4024.1	
Safety Classification	Cat. 4 per EN 954-1 (ISO 13849-1), SIL CL3 per EN IEC 62061, PLe per ISO 13849-1	
Functional Safety Data ✶ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	PFH_D: < 2.3 x 10^{-10} MTTFd: > 454 years Suitable for performance levels Ple (according to ISO 13849-1:2006) and for use in SIL3 systems (according to IEC 62061) depending on the architecture and application characteristics	
Certifications	CE Marked for all applicable directives, cULus, c-Tick, and TÜV	
Power Supply		
Input Power Entry	24V DC from the base unit	
Power Consumption	1.5 W	
Inputs		
Response Time	Does not add additional response time to base module	
Outputs		
Safety Contacts	4 N.O.	
Thermal Current I_{th}	2 x 6 A or 3 x 5 A or 4 x 4 A (nonswitching)	
Rated Impulse withstand Voltage	2500V	
Switching Current @ Voltage, Min.	10 mA @ 10V DC	
Fuses, Output	External 6 A slow blow or 10 A fast acting	
Electrical Life (Operations)	220V AC/4 A/880VA cosϕ = 0.35…0.1 M 220V AC/1.7 A375VA cosϕ = 0.6…0.5 M 30V DC/2 A/60 W = 1 M 10V DC/0.01 A/0.1 W = 2 M	
Mechanical Life	2,000,000 cycles	
Utilization Category		
Resistive: AC-1	6 A @ 250V AC	
Resistive: DC-1	6 A @ 24V DC	
Inductive: AC-15	3 A @ 250V AC	3 A @ 125V AC
Inductive: DC-13	2.5 A @ 24V DC	
UL	3 x B300, P300 or 4 x C300 2 x 6 A or 3 x 5 A or 4 x 4 A Resistive	
Environmental and Physical Characteristics		
Enclosure Type Rating/ Terminal Protection	IP40 (NEMA 1)/ IP20	
Operating Temperature [C (F)]	-5…+55 ° (23…131 °)	
Vibration	10…55 Hz, 0.35 mm	
Shock	10 g, 16 ms, 100 shocks	
Mounting	35 mm DIN Rail	
Weight [g (lbs)]	215 (0.47)	
Conductor Size, Max.	0.2…4 mm^2 (24…12 AWG)	

✶ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the following assumptions:
- Mission time/Proof test interval of 20 years
- Functional test at least once within six-month period

Product Selection

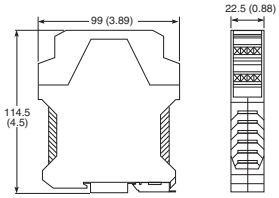
Inputs	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. No.
NA	4 N.O.	—	Removable	—	24V DC from the base unit (terminals only)	440R-H23180

Accessories

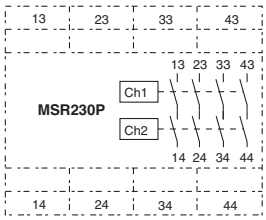
Description	Cat. No.
Bag of 4, 4-Pin Screw Terminal Blocks	440R-A23209
Bag of 4, 4-Pin Spring Clamp Terminal Blocks	440R-A23228

Approximate Dimensions

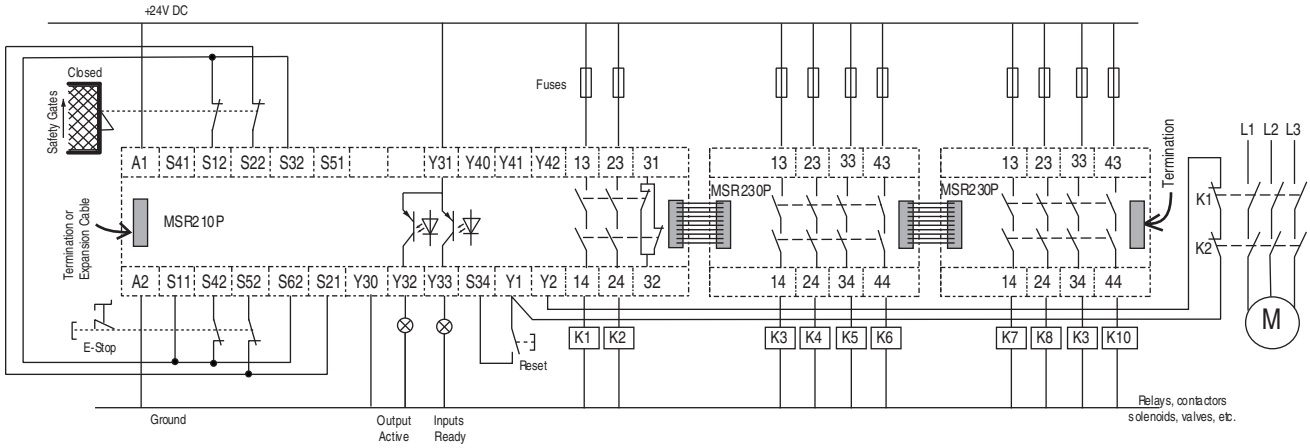
Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



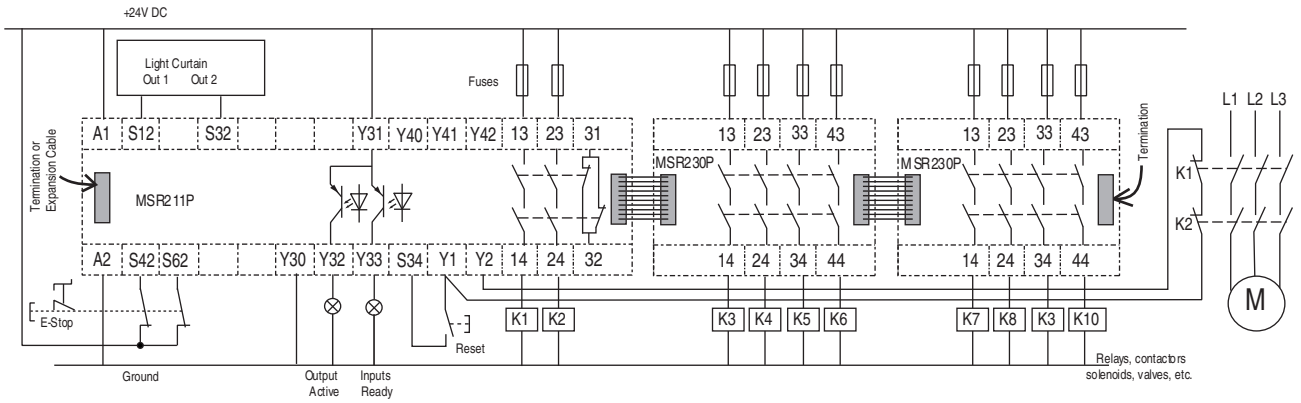
Block Diagram



Typical Wiring Diagrams



Dual Channel Safety Gate and E-Stop, Monitored Manual Reset, Monitored Output



Light Curtain and Dual Channel E-Stop, Monitored Manual Reset, Monitored Output

Modular Safety Relays

MSR238DP

Description

The MSR238 is an time-delayed output expansion module for the modular Minotaur MSR200 family of monitoring safety relays. It can be connected to either the MSR210 or MSR211 base unit or to the MSR230 output module to provide time-delayed outputs.

Up to two output modules can be connected to one base unit by simply removing the terminator, included with each base unit, and connecting the ribbon cables of the neighboring module. The connecting ribbon cable provides power to the MSR238 as well as a check on its status. The terminators must be inserted into the final output module.

The MSR238 has two safety rated outputs that work in parallel with the safety outputs of the base unit. When the output of the base unit is de-activated, the outputs of the MSR238 are de-activated after the time delay expires. The time delay is set by connecting jumpers to the wiring terminals.

The outputs are two normally open safety rated outputs. The safety outputs have independent and redundant internal contacts to help support the safety function. The delayed normally closed output is an auxiliary signal that must only be used to indicate the status of the MSR238.

Features

- Category 3 per EN 954-1
- Stop category 1
- Two diagnostic LEDs
- Removable terminals
- Two N.O. delayed safety outputs
- One N.C. delayed auxiliary output

LED Indicators

Green	CH1 Output Active
Green	CH2 Output Active

Specifications

Safety Ratings	
Standards	EN 954-1, ISO 13849-1, IEC/EN 60204-1, IEC 60947-4-1, IEC 60947-5-1, ANSI 11.19, AS4024.1
Safety Classification	Cat. 3 per EN 954-1 (ISO 13849-1), SIL CL2 per EN IEC 62061, PLe per ISO 13849-1
Functional Safety Data ✶ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	PFH_D: < 7.7 x 10^{-9} MTTFd: > 373 years Suitable for performance levels Ple (according to ISO 13849-1:2006) and for use in SIL3 systems (according to IEC 62061) depending on the architecture and application characteristics
Certifications	CE Marked for all applicable directives, cULus, c-Tick, and TÜV
Power Supply	
Input Power Entry	24V DC from the base unit
Power Consumption	2.5 W
Outputs	
Safety Contacts	2 N.O.
Auxiliary Contacts	1 N.C.
Thermal Current I_{th}	1 x 6 A or 2 x 4 A (nonswitching)
Rated Impulse withstand Voltage	2500V
Switching Current @ Voltage, Min.	10 mA @ 10V DC
Fuses, Output	Recommended External 6 A slow blow or 10 A fast acting
Electrical Life (Operations)	220V AC/4 A/880VA cosϕ = 0.35…0.1 M 220V AC/1.7 A375VA cosϕ = 0.6…0.5 M 30V DC/2 A/60 W = 1 M 10V DC/0.01 A/0.1 W = 2 M
Mechanical Life	10,000,000 cycles
Utilization Category	
Resistive: AC-1	6 A @ 250V AC
Resistive: DC-1	6 A @ 24V DC
Inductive: AC-15	5 A @ 250V AC
Inductive: DC-13	3 A @ 24V DC
UL:	1 x B300, P300 or 2 x C300, 1 x 6 A or 2 x 4 A Resistive
Environmental and Physical Characteristics	
Enclosure Type Rating/ Terminal Protection	IP40 (NEMA 1)/ IP20
Operating Temperature [C (F)]	-5…+55 ° (23…131 °)
Vibration	10…55 Hz, 0.35 mm
Shock	10 g, 16 ms, 100 shocks
Mounting	35 mm DIN Rail
Weight [g (lbs)]	215 (0.47)
Conductor Size, Max.	0.2…2.5 mm^2 (24…14 AWG)

✶ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the following assumptions:
- Mission time/Proof test interval of 20 years
- Functional test at least once within six-month period

Product Selection

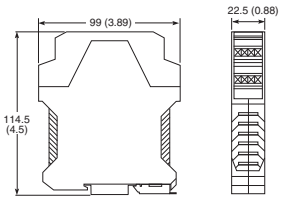
Delayed Safety Outputs	Delayed Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. No.
2 N.O.	1 N.C.	Removable	—	24V DC from the base unit	440R-H23196

Accessories

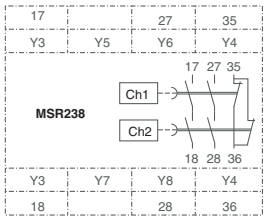
Description	Cat. No.
Bag of 4, 4-Pin Screw Terminal Blocks	440R-A23209
Bag of 4, 4-Pin Spring Clamp Terminal Blocks	440R-A23228

Approximate Dimensions

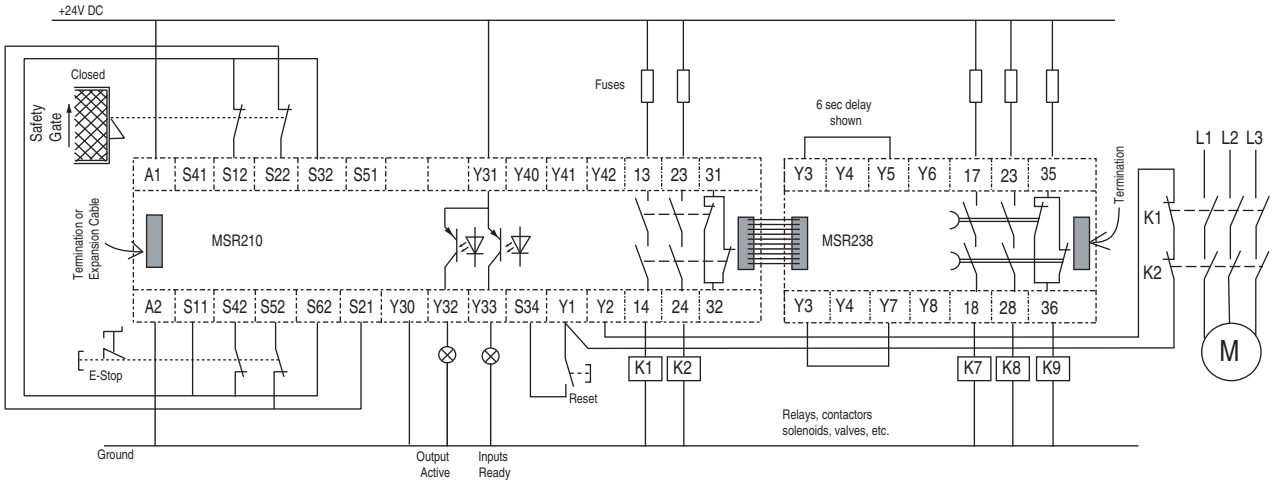
Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



Block Diagram



Typical Wiring Diagrams



Application Details (Typical)

Apply jumpers (links) on the terminals identified to achieve the desired off delay.

Delay (s)	Jumper	Jumper	Delay (s)	Jumper	Jumper	Delay (s)	Jumper	Jumper
0	None	None	8	Y3-Y6	Y3-Y7	50	Y3-Y6	Y3-Y8
0.5	Y3-Y5	None	9	Y4-Y5	Y3-Y7	60	Y4-Y5	Y3-Y8
1	Y4-Y6	None	10	None	Y4-Y8	80	None	Y4-Y7
1.5	Y3-Y6	None	12	Y3-Y5	Y4-Y8	100	Y3-Y5	Y4-Y7
2	Y4-Y5	None	15	Y4-Y6	Y4-Y8	120	Y4-Y6	Y4-Y7
3	Y3-Y5	Y4-Y6	18	Y3-Y6	Y4-Y8	160	Y3-Y6	Y4-Y7
4	Y3-Y6	Y4-Y5	21	Y4-Y5	Y4-Y8	200	Y4-Y5	Y4-Y7
5	None	Y3-Y7	26	None	Y3-Y8	250	Y3-Y5, Y4-Y6	Y3-Y7
6	Y3-Y5	Y3-Y7	30	Y3-Y5	Y3-Y8	300	Y3-Y5, Y4-Y5	Y3-Y7
7	Y4-Y6	Y3-Y7	40	Y4-Y6	Y3-Y8			

Modular Safety Relays

MSR240P

Description

The MSR240P is a communications module for the modular Minotaur MSR200 family of monitoring safety relays. It can be connected to either the MSR210P or MSR211P base unit to provide diagnostic and status information to remote devices like the MSR245P display.

The MSR240P is connected in place of the terminator plug to the free bus connector of the Basic Module or the last connected Expansion Module, depending on the system configuration. Data transfer and power supply are routed through the same bus cable and connectors.

A green LED in the front of the MSR240P indicates the presence of supply voltage. A blinking yellow LED signals data exchange activity through the RS232/RS485 interface.

The transmission rate for the RS485 can be set with the help of two DIP switch segments at 2400, 4800, 9600, or 19200 baud.

The station address can be set by five additional DIP switch segments. Up to 32 stations can be connected onto a single RS485 network.

The connected supervisory monitoring or data acquisition system can process and store the data, display it, and record the reason causing a shutdown, along with the time and date of each such occurrence. This makes fault diagnosis much easier.

Features

- Data transmission
- RS232 or RS485
- Supported baud rates: 2400, 4800, 9600, or 19200
- Galvanically isolated interfaces
- 17.5 mm DIN Rail housing
- Two diagnostic LEDs
- Removable terminals

Specifications

Safety Ratings	
Standards	IEC/EN 60204-1, ISOTR 12100
Certifications	CE Marked for all applicable directives
Power Supply	
Input Power Entry	24V DC from the base unit
Power Consumption	2 W
Environmental and Physical Characteristics	
Enclosure Type Rating/ Terminal Protection	IP40 (NEMA 1)/ IP20
Operating Temperature [C (F)]	-5…+55 ° (23…131 °)
Vibration	10…55 Hz, 0.35 mm
Shock	10 g, 16 ms, 100 shocks
Mounting	35 mm DIN Rail
Weight [g (lbs)]	90 (0.20)
Conductor Size, Max.	0.2…4 mm² (24…12 AWG)

Product Selection

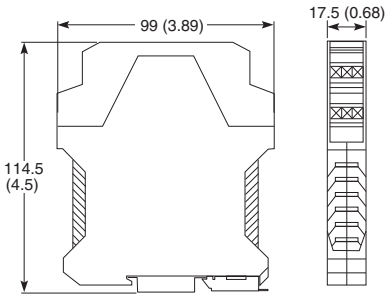
Communication Interface	Cat. No.
RS232	440R-H23181
RS232 + RS485	440R-H23183

Accessories

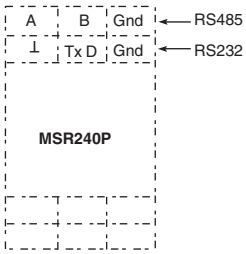
Description	Cat. No.
Bag of 4, 3-Pin Screw Terminal Blocks	440R-A23210
Bag of 4, 3-Pin Spring Clamp Terminal Blocks	440R-A23229

Approximate Dimensions

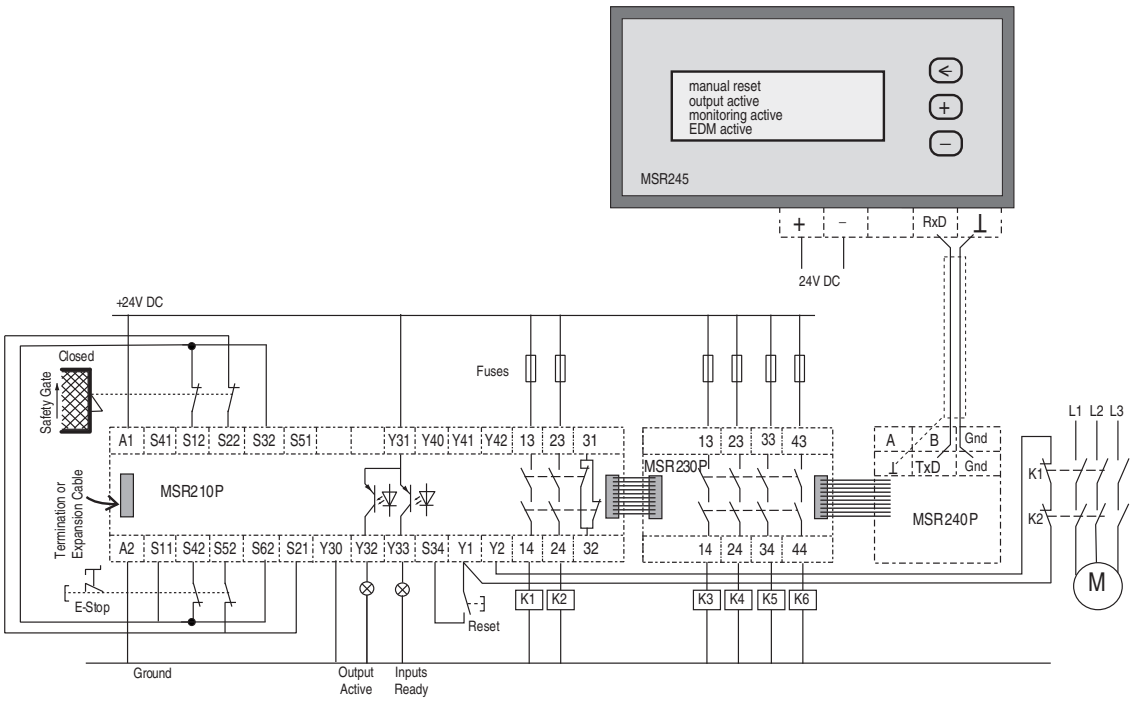
Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



Block Diagram



Typical Wiring Diagrams



Safety Gate, E-Stop, Manual Reset, Monitored Output

Modular Safety Relays

MSR241P

Description

The MSR241P is a DeviceNet™ communications module for the modular Minotaur MSR200 family of monitoring safety relays. It can be connected to either the MSR210P, MSR211P, or MSR230P modules to provide diagnostic and I/O status information to remote locations.

The MSR241P is connected via the flat ribbon cable to the base module or the last connected expansion module, depending on the system configuration. Data transfer and power supply are routed through the same bus cable and connectors.

The MSR241P has two nonsafety rated relay outputs that are activated with the last two bits of the one input byte.

The baud rate and address is set by means of the dipswitch on the front panel.

The connected supervisory monitoring or data acquisition system can process and store the data, display it, and record the reason causing a shutdown, along with the time and date of each such occurrence. This makes fault diagnosis much easier.

Features

- DeviceNet™ data transmission
- Switch selectable baud rates: 125 K, 250 K, 500 K
- Switch selectable address
- 45 mm DIN Rail housing
- Four diagnostic LEDs
- Removable terminals
- Group two only slave

LED Indicators

Green	K1 Active
Green	K2 Active
Green	Module Status Operative Network Status
Green	Online
Red	Critical Connection Error
Blinking Green	Connection Interrupted
Blinking Red	Connection Timed Out

Specifications

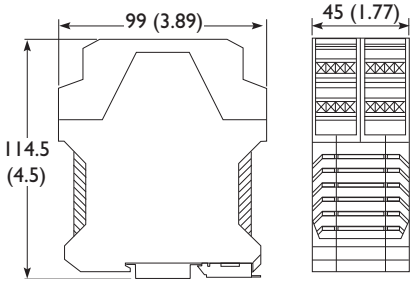
Safety Ratings	
Standards	IEC/EN 60204-1, ISOTR 12100, ISO 13849-0
Certifications	CE Marked for all applicable directives
Power Supply	
Input Power Entry	24V DC from the base unit
Power Consumption	2 W
Outputs	
Auxiliary Contacts	2 N.O.
Thermal Current/$_{Ith}$	2 A @ 30V DC, 300 mA @ 110V DC, 500 mA @ 125V DC
Rated Impulse withstand Voltage	60 W max. switching voltage
Switching Current @ Voltage, Min.	10 mA @ 10V DC
Environmental and Physical Characteristics	
Enclosure Type Rating/ Terminal Protection	IP40 (NEMA 1)/ IP20
Operating Temperature [C (F)]	-5…+50 ° (23…122 °)
Vibration	10…55 Hz, 0.35 mm
Shock	10 g, 16 ms, 100 shocks
Mounting	35 mm DIN Rail
Weight [g (lbs)]	180 (0.396)
Conductor Size, Max.	0.2…2.5 mm (24…12 AWG)

Product Selection

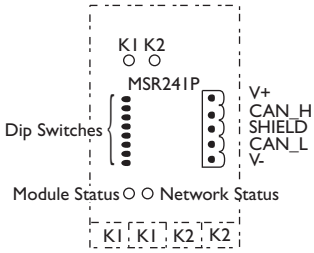
Interface Type	Cat. No.
DeviceNet™	440R-H23187

Approximate Dimensions

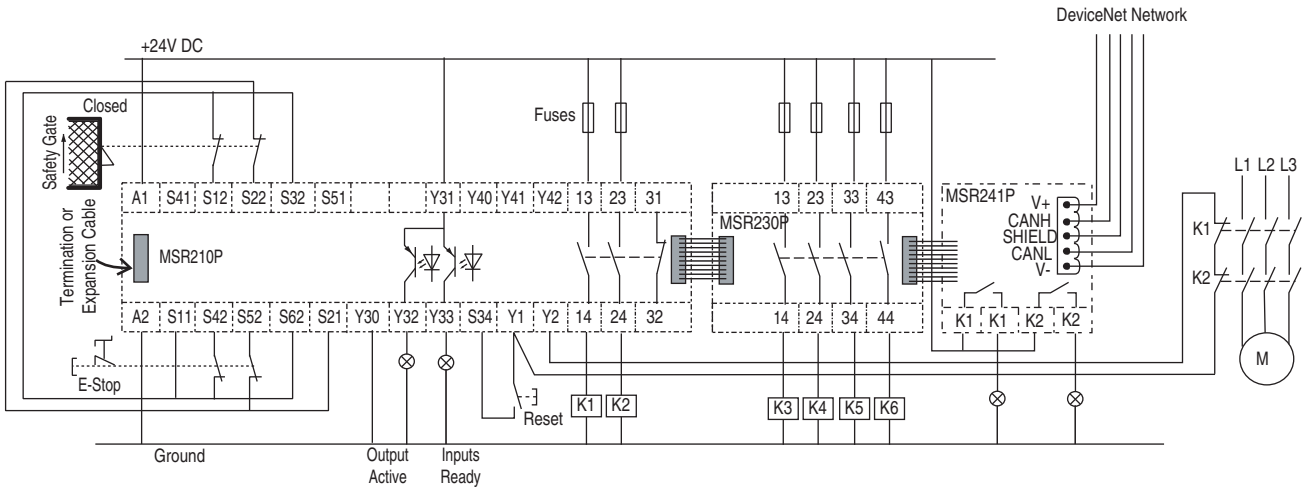
Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



Block Diagram



Typical Wiring Diagrams



Switch Settings

Switch	125K	250K	500K
1	0	0	1
2	0	1	0
3	Bit 5	Switches 3-8 set the node address	
4	Bit 4		
5	Bit 3		
6	Bit 2		
7	Bit 1		
8	Bit 0		

Modular Safety Relays

MSR245P

Description

The MSR245P is a display module for the modular Minotaur MSR200 family of monitoring safety relays. The MSR245P Display Module is interfaced to an MSR200 system through an MSR240P Communication Module, using the RS232 interface, with a two-core shielded cable. The display is refreshed approximately every six seconds.

Using the four-line LCD display and the three function key-switches, the configuration of external circuits, and the on-off status of all inputs of the system can be checked and interrogated.

The microprocessor, in the base module, scans all the inputs starting with the base module and working its way to the left. The first scanned input is “base module input 1.” The last scanned input would be input two of the module furthest from the base module.

The display shows the lowest scanned input that de-energized the safety outputs (safety outputs open). After the lowest scanned input is cleared, the display will refresh and show the next input which is open. In this way, each open input circuit can be troubleshot and closed. When all inputs are closed, the user can scroll through the display.

The MSR245P requires 24V DC supply voltage. The power supply input as well as the RS232 are galvanically isolated from the MSR200 system, but can be connected non-isolated if required.

The messages in the MSR245 are capable of being customized with application specific text. The first three lines of the display can be changed to describe each of the inputs (3 x 20 characters). The text language can be selected and written in either English or German.

For programming, a PC running under Windows™ must be connected to the nine-pole sub-miniature D connector on the back of the MSR245 using a standard serial data interface cable.

The program allows the user to generate and transfer the text blocks into the nonvolatile memory of the MSR245.

The software for text programming and the manual is available for download on the Rockwell Automation safety website at *www.ab.com/safety*.

Features

- Recalls and displays system information
- Simple menu selection
- Stores details of last registered stop occurrence
- Clearly readable backlit display
- Back-lit four-line alphanumeric display
- RS232 interface

Specifications

Safety Ratings	
Standards	IEC/EN 60204-1, ISOTR 12100
Certifications	CE Marked for all applicable directives
Power Supply	
Input Power Entry	24V DC
Power Consumption	0.5 W
Environmental and Physical Characteristics	
Enclosure Type Rating/ Terminal Protection	IP40 (NEMA 1)/ IP20
Operating Temperature [C (F)]	-5…+55 ° (23…131 °)
Vibration	10…55 Hz, 0.35 mm
Shock	10 g, 16 ms, 100 shocks
Mounting	Panel or 35 mm DIN Rail (option)
Weight [g (lbs)]	210 (0.46)
Conductor Size, Max.	0.2…2.5 mm² (24…14 AWG)

Example Messages

Bold = standard text

Not Bold = text depending on function

System menu:

Manual/auto **reset**

Output active/deactivated

Monitoring active/device ready

EDM active/deactivated (feedback circuit)

Input configuration:

Input Module 4

MSR220 emergency off

Input 1: 2-channel

Input 2: 1-channel

Functions/Interruption messages:

Input Module 4

Input 2 causes interrupt

safety mats or cross-fault causes interrupt

transmission fault

fault EDM loop

fault Y40 loop

malfunction

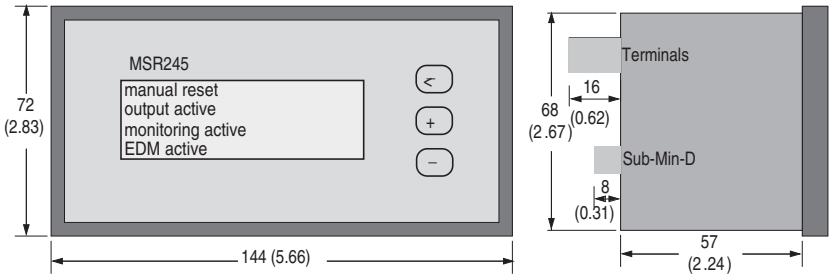
Output active/inactive

Product Selection

Description	Cat. No.
Display module	440R-H23184
DIN Rail Base Adapter Kit	440R-H23185

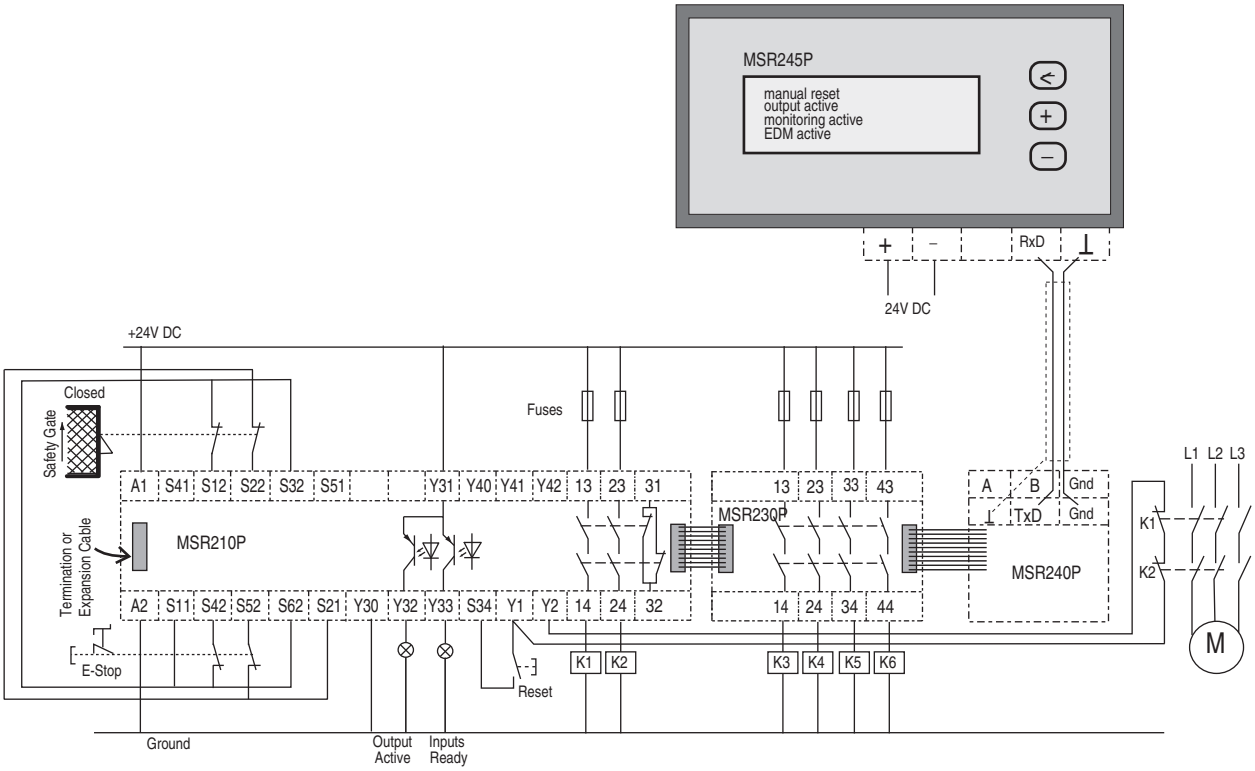
Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



Front cut out: 68 x 138
Optional DIN rail mounting base EN 50022-35 x 7.5

Typical Wiring Diagrams



Input Module Selection

Groups / # of inputs	Group 1	Group 2	Group 3
1 2	MSR320	MSR320	MSR320
3 4	MSR320	MSR320	MSR320
5 6	MSR320	MSR320	MSR320
7 8	MSR320	MSR320	MSR320
9 10	MSR320	MSR320	MSR320
11 12	MSR320	MSR320	MSR320
13 14	MSR320	MSR320	MSR320
15 16	MSR320	MSR320	MSR320
17 18	MSR320	MSR320	MSR320
19 20	MSR320	MSR320	MSR320

				<=10 modules
Example 1: Total System: MSR310/MSR312 +	1	2	3	<=10 modules
Example 2: Total System: MSR310/MSR312 +	2	1	4	<=10 modules

Note: If a muting module is required in the application, it counts as one of the ten input modules.

Output Module Selection

Groups / # of outputs	Immediate Group 1	Immediate Group 2	Immediate Group 3	Delayed Group 1	Delayed Group 2	Delayed Group 3
1 2 3	W23221	W23222	W23223	W23224	W23225	W23226
4 5 6	W23221	W23222	W23223	W23224	W23225	W23226
7 8 9	W23221	W23222	W23223	W23224	W23225	W23226
10 11 12	W23221	W23222	W23223	W23224	W23225	W23226
13 14 15	W23221	W23222	W23223	W23224	W23225	W23226
16 17 18	W23221	W23222	W23223	W23224	W23225	W23226

	+	+	+	+	+	<=6 modules

Example 1: 2 Group 1 Immediate Outputs, 1 Group 2 Immediate Outputs, 2 Group 3 Immediate Outputs:	2	1	2	0	0	0	5
Example 2: 1 Group 1 Immediate Outputs, 2 Group 3 Immediate Outputs, 1 Group 1 Delayed Outputs:	1	0	2	1	0	0	4
Example 3: 1 Group 2 Immediate Outputs, 2 Group 3 Immediate Outputs, 3 Group 3 Delayed Outputs:	0	1	2	0	0	3	6
							Total Modules

Configurable Safety Relays

MSR310P RS232

Description

The MSR310P is one of the base units available for the MSR300 system. It can be combined with other modules of the MSR300 Series to configure a safety control system with numbers of inputs and outputs matching users' specific application requirements, as well as diagnostic and networking capabilities. Up to ten input modules and six output modules can be connected to one base unit by simply removing the terminator, included with each base unit, and connecting the ribbon cables of the neighboring module. The terminators must be inserted into the final input and output modules. A fully utilized system can support up to 20 inputs devices (e-stops/gates) and 18 normally open outputs.

The MSR300 System supports up to three group outputs. The input modules can be configured to control one or more of the output groups. This creates flexibility for the customer to solve applications requiring simple logic functions (simple AND and OR function). No software is needed for configuration, only rotary switches on the Input Modules are required. Please see the Input Modules for more information.

The base module supports multiple reset configurations for each group output. The user can select from the following choices: manual, manual monitored and automatic reset. The reset configuration is set up by jumpers on the base module terminals. If manual monitored and automatic reset is mixed, the preferred combination of Output Group Modules should be considered.

The MSR310P base module does not have any inputs or safety outputs within the device. A minimum of one input module and one output module are required to make a functional system. The base module does have three solid-state auxiliary outputs to signify the status of the output groups—one output for each Group (1, 2, or 3).

The MSR310P has the capability to monitor external devices individually for each group with a separate feedback loop control.

Features

- Category 4 per EN 954-1
- SIL3 per IEC 61508
- EN 574 Type IIIC
- Stop category 0
- Pulsed input monitoring
- Three auxiliary group outputs
- Six diagnostic LEDs
- Manual, monitored or automatic reset
- Zone control—up to three
- RS232 Diagnostic Comms
- Unidirectional RS232, 4800 baud
- Bidirectional RS232, 2400, 4800, 9600, 19200 baud
- Removable terminals

Specifications

Safety Ratings	
Standards	IEC/EN 60204-1, ISOTR 12100, EN 61508, ISO 13849-1
Safety Classification	Cat. 4 per EN 954-1 (ISO 13849-1), SIL CL3 per EN IEC 62061, PLe per ISO 13849-1
Functional Safety Data ∗ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	PFH_D: < 3.15 x 10^{-9} MTTFd: > 396 years Suitable for performance levels Ple (according to ISO 13849-1:2006) and for use in SIL3 systems (according to IEC 62061) depending on the architecture and application characteristics
Certifications	CE Marked for all applicable directives, cULus, C-Tick, and TÜV
Power Supply	
Input Power Entry	24V DC 0.8…1.1 x rated voltage PELV/SELV
Power Consumption	5 W
Inputs	
Safety Inputs	MSR300 Series Input Modules
Input Simultaneity	Infinite or 3 seconds
Reset	Auto./Manual or Monitored Manual
Power On Delay/Recovery Time	3 seconds/26 ms + 6 ms per connected input
Response Time	26 ms + 6 ms per connected input
Outputs	
Auxiliary Contacts	3 PNP, 24V DC @ 50 mA
Environmental and Physical Characteristics	
Enclosure Type Rating/ Terminal Protection	IP40 (NEMA 1)/ IP20, DIN 0470
Operating Temperature [C (F)]	-5…+55 ° (23…131 °)
Vibration	10…55 Hz, 0.35 mm
Shock	10 g, 16 ms, 100 shocks
Mounting	35 mm DIN Rail
Weight [g (lbs)]	210 (0.46)
Conductor Size, Max.	0.2…2.5 mm^2 (#24…12 AWG)

∗ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the following assumptions:
- Mission time/Proof test interval of 20 years
- Functional test at least once within six-month period

System-Supported Inputs

- 1 N.C., 2 N.C., or 3 N.C. inputs—E-stops/Gates
- 1 N.C. and 1 N.O inputs—Gates
- Two-Hand Control
- Two OSSD—Light Curtains
- Safety Mats

Product Selection

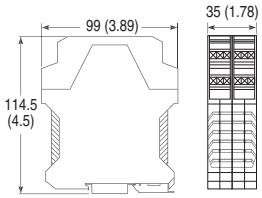
Safety Inputs	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. No.
MSR300 Series Input Modules	MSR300 Series Output Modules	3 PNP Solid State	Removable	Auto./Manual Monitored Manual	24V DC	440R-W23219

Accessories

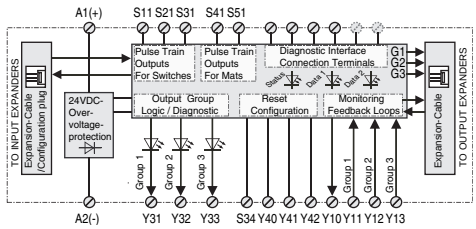
Description	Cat. No.
MSR300 Two Terminators	440R-A17234
Bag of 4, 3-Pin Screw Terminal Blocks	440R-A23210
Bag of 4, 3-Pin Spring Clamp Terminal Blocks	440R-A23229

Approximate Dimensions

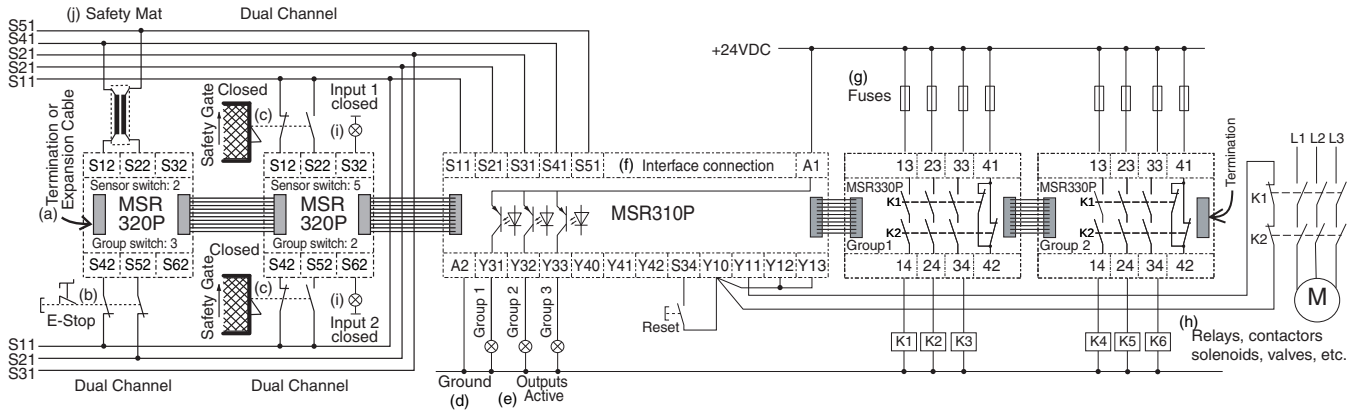
Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



Block Diagram

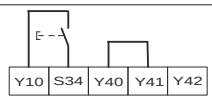
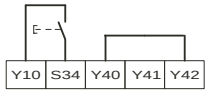
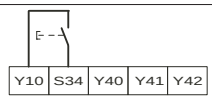
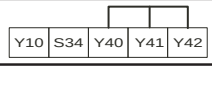


Typical Wiring Diagrams



(k) MSR 300 system with various Inputs, Two Output Groups with common monitored reset, Group 1 with monitored contactors Safety Mat or E-Stop shut down both Output modules, Safety Gates only shut down the Group 2 module

Reset Behavior

Reset Behavior	Circuit
Groups 1 and 2: manual, monitored reset Group3: automatic reset	
Groups 1 and 2: automatic reset Group3: manual, monitored reset	
Groups 1, 2, and 3: manual, monitored reset	
Groups 1, 2, and 3: automatic reset	

Configurable Safety Relays

MSR312P DeviceNet™

Description

The MSR312P is one of the base units available for the MSR300 system. It can be combined with other modules of the MSR300 Series to configure a safety control system with numbers of inputs and outputs matching users' specific application requirements, as well as diagnostic and networking capabilities. Up to ten input modules and six output modules can be connected to one base unit by simply removing the terminator, included with each base unit, and connecting the ribbon cables of the neighboring module. The terminators must be inserted into the final input and output modules. A fully utilized system can support up to 20 inputs devices (e-stops/gates) and 18 normally open outputs.

The MSR300 System supports up to three group outputs. The input modules can be configured to control one or more of the output groups. This creates flexibility for the customer to solve applications requiring simple logic functions (simple AND and OR function). No software is needed for configuration, only rotary switches on the Input Modules are required. Please see the Input Modules for more information.

The base module supports multiple reset configurations for each group output. The user can select from the following choices: manual, manual monitored and automatic reset. The reset configuration is set up by jumpers on the base module terminals. If manual monitored and automatic reset is mixed, the preferred combination of Output Group Modules should be considered.

The MSR312P base module does not have any inputs or safety outputs within the device. A minimum of one input module and one output module are required to make a functional system. The base module does have three solid-state auxiliary outputs to signify the status of the output groups—one output for each group (1, 2, or 3).

The MSR312P has the capability to monitor external devices individually for each group with a separate feedback loop control.

Features

- Category 4 per EN 954-1
- SIL3 per IEC 61508
- EN 574 Type IIIC
- Stop category 0
- Pulsed input monitoring
- Three auxiliary group outputs
- One PNP solid state output controlled via DeviceNet™ connection
- Six diagnostic LEDs
- Manual, monitored or automatic reset
- Zone control—up to three
- DeviceNet™ Comms including UCMM
- Support baud rates: 125 k, 250 k, 500 k
- Removable terminals

Specifications

Safety Ratings	
Standards	IEC/EN 60204-1, ISOTR 12100, EN 61508, ISO 13849-1
Safety Classification	Cat. 4 per EN 954-1 (ISO 13849-1), SIL CL3 per EN IEC 62061, PLe per ISO 13849-1
Functional Safety Data ∗ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	PFH_D: < 3.15 x 10^{-9} MTTFd: > 396 years Suitable for performance levels Ple (according to ISO 13849-1:2006) and for use in SIL3 systems (according to IEC 62061) depending on the architecture and application characteristics
Certifications	CE Marked for all applicable directives, cULus, c-Tick, and TÜV
Power Supply	
Input Power Entry	24V DC 0.8…1.1 x rated voltage PELV/SELV
Power Consumption	3 W
Inputs	
Safety Inputs	MSR300 Series Input Modules
Input Simultaneity	Infinite or 3 seconds
Reset	Auto./Manual or Monitored Manual
Power On Delay/ Recovery Time	3 seconds/26 ms + 6 ms per connected input
Response Time	26 ms + 6 ms per connected input
Outputs	
Auxiliary Contacts	3 PNP, Diagnostic, 1 PNP Output, 24V DC @ 50 mA
Switching Current @ Voltage, Min.	24V DC @ 50 mA
Environmental and Physical Characteristics	
Enclosure Type Rating/ Terminal Protection	IP40 (NEMA 1)/ IP20, DIN 0470
Operating Temperature [C (F)]	-5…+55 ° (23…131 °)
Vibration	10…55 Hz, 0.35 mm
Shock	10 g, 16 ms, 100 shocks
Mounting	35 mm DIN Rail
Weight [g (lbs)]	210 (0.46)
Conductor Size, Max.	0.2…2.5 mm^2 (24… AWG)

∗ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the following assumptions:
- Mission time/Proof test interval of 20 years
- Functional test at least once within six-month period

System-Supported Inputs

- 1 N.C., 2 N.C., or 3 N.C. inputs—E-stops/Gates
- 1 N.C. and 1 N.O inputs—Gates
- Two-Hand Control
- Two OSSD—Light Curtains
- Safety Mats

Product Selection

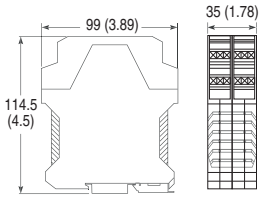
Safety Inputs	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. No.
MSR300 Series Input Modules	MSR300 Series Output Modules	3 PNP, DeviceNet	Removable	Auto./Manual or Monitored Manual	24V DC	440R-W23220

Accessories

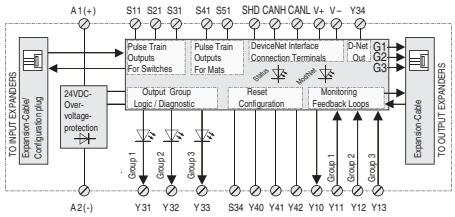
Description	Cat. No.
MSR300 Two Terminators	440R-A17234
Bag of 4, 3-Pin Screw Terminal Blocks	440R-A23210
Bag of 4, 3-Pin Spring Clamp Terminal Blocks	440R-A23229

Approximate Dimensions

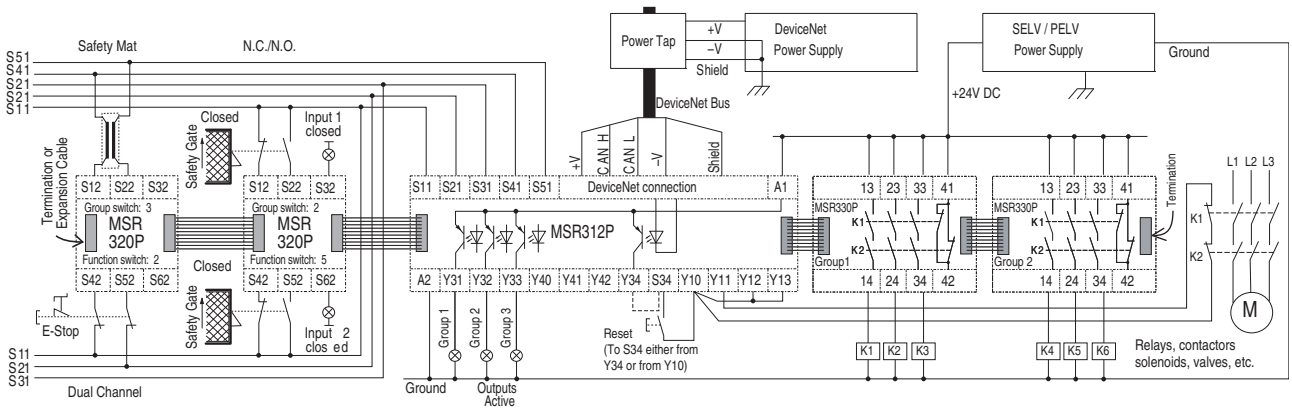
Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



Block Diagram

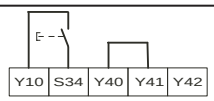
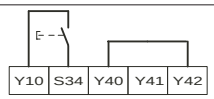
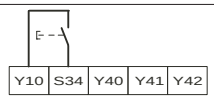
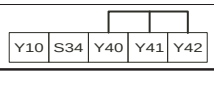


Typical Wiring Diagrams



MSR300 system with various Inputs, Two Output Groups with common monitored reset (reset alternative via DeviceNet with S34 linked to Y34), Group 1 with monitored contactors Safety Mat or E-Stop shut down both Output modules, Safety Gates only shut down the Group 2 module.

Reset Behavior

Reset Behavior	Circuit
Groups 1 and 2: manual, monitored reset Group3: automatic reset	
Groups 1 and 2: automatic reset Group3: manual, monitored reset	
Groups 1, 2, and 3: manual, monitored reset	
Groups 1, 2, and 3: automatic reset	

Configurable Safety Relays

MSR320P Input Module

Description

The MSR320P is an input expansion module for the modular MSR300 family of monitoring safety relays. Up to ten input modules can be connected to a base unit by simply removing the terminator, included with each base unit, and connecting the ribbon cables of the neighboring module. The connecting ribbon cable provides power to the MSR320P as well as a check on its status. The terminator removed from the base module must be inserted into the input module furthest to the left.

Although the base module of the MSR300 system holds all of the configuration information, the input modules are the devices that actually configure the base module. The input modules select both the type of inputs connected and the outputs or groups those inputs will control.

The MSR320P has two independent inputs, which are configured by the rotary switches on the side of the module. There are two switches, for redundancy, so both must be set to the same value. An example of the switch settings is to the right. The selection of the switch setting signifies to the base module what inputs to expect and what to test for. Connecting a single device (must be at least dual channel) to each input meets the requirements of Category 4 per EN594-1. Below is a list of supported inputs.

The MSR320P Input module supports up to three group outputs. Two rotary switches, for redundancy, on the side of the module select the output group or groups the connected inputs will control. Below is an example of the possible group settings.

When three channel N.C. inputs are not chosen, functions switch setting three, one solid-state output is available for each input to provide annunciation for that input.

Two LEDs provide the status information on the inputs. Green indicates the input is closed and red indicates the input is open. Three LEDs provide information regarding which output groups are controlled by this input module.

Features

- Category 4 per EN 954-1
- SIL3 IEC 61508
- EN 574 Type IIIC
- Stop category 0
- 17.5 mm DIN Rail housing
- Five diagnostic LEDs
- Configurable inputs
- Output group configurable
- Removable terminals

LED Indicators

2x input status	Input Closed
Green	Input Open; 3x output switch group assignment

Specifications

Safety Ratings	
Standards	IEC/EN 60204-1, ISO TR 12100, EN 61508, ISO 13849-1, EN 574 Cat IIIC
Safety Classification	Cat. 4 per EN 954-1 (ISO 13849-1), SIL CL3 per EN IEC 62061, PLe per ISO 13849-1
Functional Safety Data ✶ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	PFH_D: < 3.1 x 10^{-10} MTTFd: > 835 years Suitable for performance levels Ple (according to ISO 13849-1:2006) and for use in SIL3 systems (according to IEC 62061) depending on the architecture and application characteristics
Certifications	CE Marked for all applicable directives, cULus, c-Tick, and TÜV
Power Supply	
Input Power Entry	24V DC from the base unit
Power Consumption	3 W
Inputs	
Safety Inputs	1 N.C., 2 N.C., or 3 N.C., 1 N.C and 1 N.O., LC, SM, or two-hand control
Input Simultaneity	3 seconds or infinite
Input Resistance, Max.	900 Ω
Reset	Selected on base module
Outputs	
Auxiliary Contacts	2 PNP, 24V DC @ 50 mA
Environmental and Physical Characteristics	
Enclosure Type Rating/ Terminal Protection	IP40 (NEMA 1)/ IP20, DIN 0470
Operating Temperature [C (F)]	-5…+55 ° (23…131 °)
Vibration	10…55 Hz, 0.35 mm
Shock	10 g, 16 ms, 100 shocks
Mounting	17.5 mm housing, 35 mm DIN Rail
Weight [g (lbs)]	110 (0.24)
Conductor Size, Max.	0.2…2.5 mm^2 (24…12 AWG)

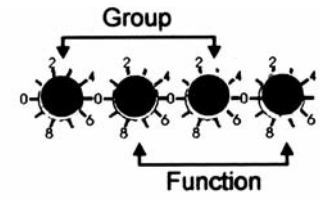
✶ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the following assumptions:
- Mission time/Proof test interval of 20 years
- Functional test at least once within six-month period

System-Supported Inputs

- E-stops
- Safety Gates
- Safety Mats
- Light Curtains
- Two-Hand Control

Input Configurations

- 1 N.C., 2 N.C., 3 N.C.
- 1 N.C. and 1 N.O.
- 2 OSSD
- 3-second or infinite simultaniety



Group
0 Logic function
1 Group 1
2 Group 2
3 Group 1+2
4 Group 3
5 Group 1+3
6 Group 2+3
7 Group 1+2+3
8 Muting - Robotcell
9 Add Safe Area

Function
1 1-channel 1N/C
2 2-channel 2N/C, Safety Mat
3 3-channel 3N/C
4 Safety gate with startup-test 1N/C 1N/O
5 Safety gate 1N/C 1N/O
6 Light curtain 2OSSD
7 Two-hand control 2 sets of 1N/C+1N/O
8 Input1: 2-channel Input2: Light curtain
9 Input1: Safety gate Input2: Light curtain

Allen-Bradley
GuardMaster®

Product Selection

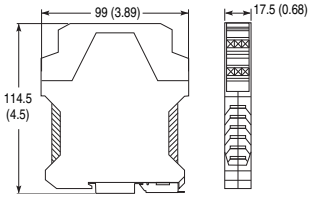
Safety Inputs	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. No.
1 N.C., 2 N.C., or 3 N.C., 1 N.C and 1 N.O., LC, SM, or two-hand control	—	2 PNP Solid State	Removable	—	24V DC from the base unit	440R-W23218

Accessories

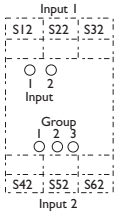
Description	Cat. No.
Bag of 4, 3-Pin Screw Terminal Blocks	440R-A23210
Bag of 4, 3-Pin Spring Clamp Terminal Blocks	440R-A23229

Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



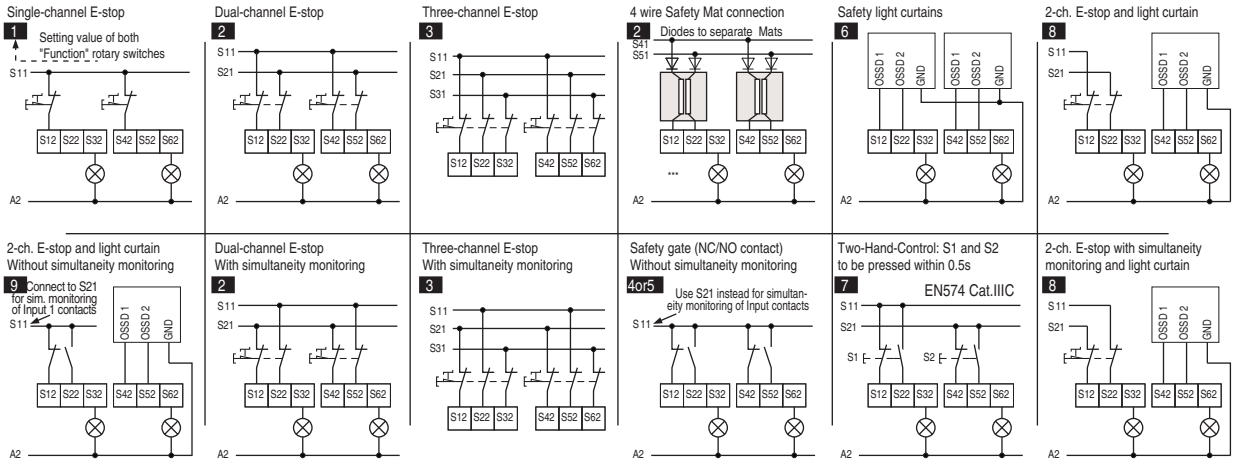
Block Diagram



Typical Wiring Diagrams

Wiring of input according to switch-selected function

Applications in the first row have infinite time to reset the contacts per input. Second row options require the connection per input to be simultaneous reset (within three second time frame). ✶



✶ "Infinite Reset" and "Simultaneous Reset" time refers to the amount of time the user has to close all the contacts of one input without causing a fault condition. Infinite configuration indicates to the base unit NOT to check when the contacts close. Simultaneous reset time requires that all the contacts on each input MUST reset within 3 seconds or a fault/lockout condition will occur.

❄ When applying safety mats to the MSR300, it is recommended to use diodes, as shown, to indicate which mat has been pressed. If only one safety mat is connected to the system, no diodes are needed.

MSR329 Muting Lamp Module

Description

The MSR329P is an input expansion module for the modular MSR300 family to monitor the function of connected muting lamps if the system is setup for a robot cell application. One muting lamp module can be used in each MSR300 system. To use the muting module there must be at least two MSR320P input modules. The muting lamp module can be connected anywhere in the string of input modules but the terminator must be located in the left most module. The connecting ribbon cable provides power to the MSR329P as well as a check on its status. The muting lamp module is used to drive and to monitor the muting lamps only. The MSR320 input module can operate a muted cell operation without the muting lamp module present.

The MSR329P can be used for robot cell applications when the application requires a portion(s) of the inputs devices to the cell to be temporarily disabled. If for example, parts needed to be added or removed from the machine. The light curtain may need to be muted during this time to prevent the machine from stopping during this condition. Interlock switches can be used to determine the position of the robot within the cell to initiate the muting function.

When using the muting module, group three MSR330P output modules are required for the robot control or power. Group outputs 1 and 2 will still change state normally when an input changes state such as a light curtain. Output groups 1 and 2 are not required for robot cell applications but can be used to remove hazardous local voltages such as an arc welder during a muting condition.

The muting module has two main lamp modules and two spare lamp modules. If the main lamp module fails, the spare lamp module will be used. The MSR329P muting module requires an incandescent bulb operating between 30…200 mA to accurately determine the bulb status. LEDs cannot be used. Two LEDs provide the status information on all four lamps. They indicate if the bulbs are okay or if any have failed.

Lamp Outputs

- Two Main Lamps
- Two Auxiliary Lamps

Features

- Category 4 per EN 954-1
- SIL3 IEC 61508
- 17.5 mm DIN Rail housing
- Two Diagnostic LEDs
- Removable terminals

Specifications

Safety Ratings	
Standards	IEC/EN 60204-1, ISO TR 12100, EN 61508, ISO 13849-1 (EN 954-1)
Safety Classification	Cat. 4 per EN 954-1 (ISO 13849-1), SIL CL3 per EN IEC 62061, PLe per ISO 13849-1
Functional Safety Data ∗ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	PFH_D: < 3.8 x 10^{-10} MTTFd: > 662 years Suitable for performance levels Ple (according to ISO 13849-1:2006) and for use in SIL3 systems (according to IEC 62061) depending on the architecture and application characteristics
Certifications	CE Marked for all applicable directives, cULus, c-Tick, and TÜV
Power Supply	
Input Power Entry	24V DC from the base unit
Power Consumption	1 W
Inputs	
Safety Inputs	Monitoring of 2 muting lamps 24V DC current between 30.....200 mA
Reset	Selected on base module
Outputs	
Safety Contacts	2 x muting lamps, 2 x reserve lamps
Status Indicator	Status of lamps
Environmental and Physical Characteristics	
Enclosure Type Rating/ Terminal Protection	IP40 (NEMA 1)/ IP20, DIN 0470
Operating Temperature [C (F)]	-5…+55 ° (23…131 °)
Vibration	10…55 Hz, 0.35 mm
Shock	10 g, 16 ms, 100 shocks
Mounting	35 mm DIN Rail
Weight [g (lbs)]	110 (0.24)
Conductor Size, Max.	0.2…2.5 mm^2 (24…12 AWG)

∗ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the following assumptions:
- Mission time/Proof test interval of 20 years
- Functional test at least once within six-month period

Product Selection

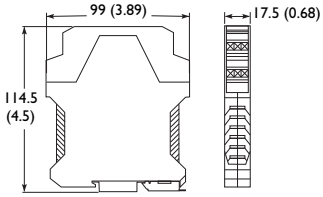
No. of Main Lamps	No. of Auxiliary Lamps	Current Range	Terminals	Reset Type	Power Supply	Cat. No.
2	2	30…200 mA	Removable	—	24V DC from the base unit	440R-W23217

Accessories

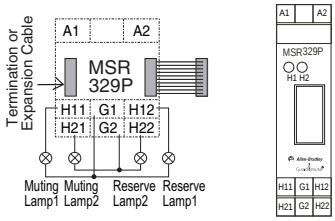
Description	Cat. No.
Bag of 4, 3-Pin Screw Terminal Blocks	440R-A23210
Bag of 4, 3-Pin Spring Clamp Terminal Blocks	440R-A23229

Approximate Dimensions

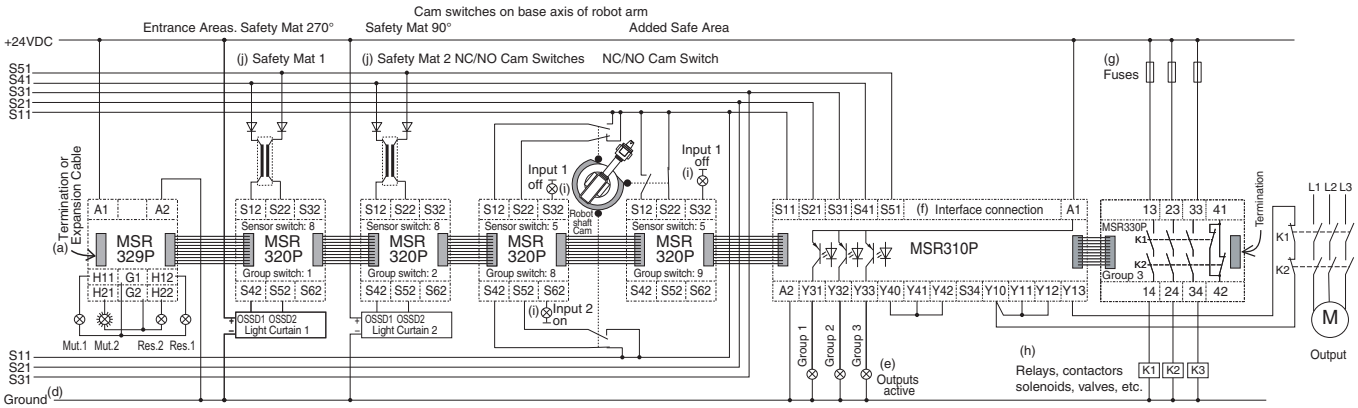
Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



Block Diagram



Typical Wiring Diagrams



MSR300 three-zone Robot Cell application allowing safe material flow in and out of the cell without process interruption as long as the robot arm is working in monitored safe zones.

Configurable Safety Relays

MSR330P Output Module

Description

The MSR330P is an output expansion module for the modular Minotaur MSR300 family of monitoring safety relays. Up to six MSR330P output modules and 18 N.O. safety outputs, can be connected to one base unit by simply removing the terminator, included with each base unit, and connecting the ribbon cables of the neighboring module. The six MSR330P output modules can be used in any combination and order when connected to the MSR300 system. The connecting ribbon cable provides power to the MSR330P as well as a check on its status. The terminator must be inserted into the final output module.

The MSR330P has three safety-rated outputs and one auxilary output controlled by the base unit. There are three different MSR330P modules, one for each group. In most instances, the output group module is not specific to each application. The exceptions are robot cell applications and logic or functions which correspond with group three outputs. The safety outputs have independent and redundant internal contacts to help support the safety function.

Features

- Category 4 per EN 954-1
- SIL3 IEC 61508
- Stop category 0
- Three N.O. safety outputs
- One N.C. auxiliary output
- Three group modules available
- Two Diagnostic LEDs
- 22.5 mm DIN Rail housing
- Removable terminals

Specifications

Safety Ratings	
Standards	IEC/EN 60204-1, ISO TR 12100, EN 61508, ISO 13849-1 (EN 954-1)
Safety Classification	Cat. 4 per EN 954-1 (ISO 13849-1), SIL CL3 per EN IEC 62061, PLe per ISO 13849-1
Functional Safety Data ∗ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	PFH_D: < 2.3 x 10^{-10} MTTFd: > 454 years Suitable for performance levels Ple (according to ISO 13849-1:2006) and for use in SIL3 systems (according to IEC 62061) depending on the architecture and application characteristics
Certifications	CE Marked for all applicable directives, cULus, c-Tick, and TÜV
Power Supply	
Input Power Entry	24V DC from the base unit
Power Consumption	1.5 W
Inputs	
Reset	Selected on base module
Response Time	Does not add additional response time to base module
Outputs	
Safety Contacts	3 N.O.
Auxiliary Contacts	1 N.C.
Thermal Current I_{th}	2 x 6 A or 3 x 5 A
Rated Impulse withstand Voltage	2500V
Switching Current @ Voltage, Min.	10 mA @ 10V
Fuses, Output	External 6 A slow blow or 10 A quick blow
Mechanical Life	2,000,000 cycles
Utilization Category	
UL	B300, P300, 2 x 6 A or 3 x 5 A/250V AC, 24V DC
Environmental and Physical Characteristics	
Enclosure Type Rating/ Terminal Protection	IP40 (NEMA 1)/ IP20, DIN 0470
Operating Temperature [C (F)]	-5…+55 ° (23…131 °)
Vibration	10…55 Hz, 0.35 mm
Shock	10 g, 16 ms, 100 shocks
Mounting	35 mm DIN Rail
Weight [g (lbs)]	190 (0.42)
Conductor Size, Max.	0.2…2.5 mm^2 (24…12 AWG)

∗ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the following assumptions:
- Mission time/Proof test interval of 20 years
- Functional test at least once within six-month period

Product Selection

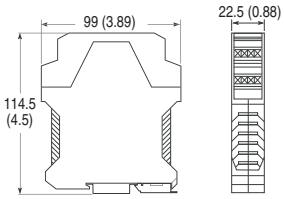
Group No.	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. No.
1	3 N.O.	1 N.C.	Removable	Selected on base module	24V DC	440R-W23221
2						440R-W23222
3						440R-W23223

Accessories

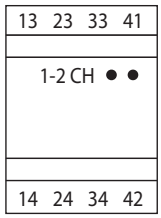
Description	Cat. No.
Bag of 4, 4-Pin Screw Terminal Blocks	440R-A23209
Bag of 4, 4-Pin Spring Clamp Terminal Blocks	440R-A23228

Approximate Dimensions

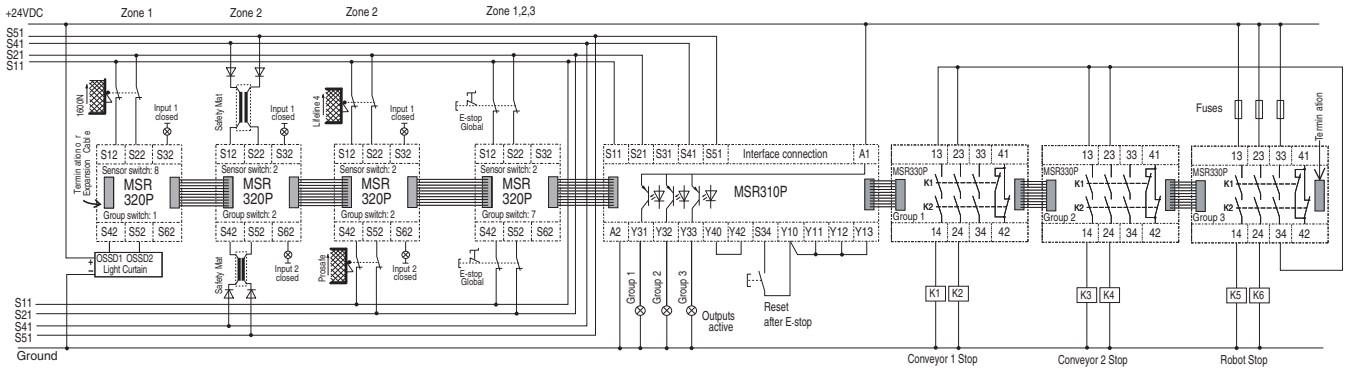
Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



Block Diagram



Typical Wiring Diagrams



Zone 1 inputs shut down conveyor 1 and zone 2 inputs shut down conveyor 2, global e-stops shut down the complete line and require a reset.

Configurable Safety Relays

MSR338DP

Description

The MSR338 is an time-delayed output expansion module for the configurable Minotaur MSR300 family of monitoring safety relays. Up to six output modules, can be connected to one base unit by simply removing the terminator, included with each base unit, and connecting the ribbon cables of the neighboring module. The MSR338DP output modules can be used in any combination and order also together with the instant modules MSR330P when connected to the MSR300 system. The connecting ribbon cable provides power to the MSR338DP as well as a check on its status. The terminator must be inserted into the final output module.

There are three different MSR338P modules, one for each group. In most instances, the output group module is not specific to each application. The exceptions are robot cell applications and logic OR functions which correspond with group three outputs.

The MSR338 has three safety rated outputs that work in parallel with the immediate safety outputs of the MSR330P outputs modules. When the output signal from the base unit is de-activated, the outputs of the MSR338 are de-activated after the time delay expires. The time delay is set by connecting jumpers to the wiring terminals. The outputs are three normally open and one normally closed safety rated outputs. The safety outputs have independent and redundant internal contacts to help support the safety function.

Features

- Category 3 per EN 954-1 performance
- Level D per ISO 13849-1 Stop category 1
- Three N.O. safety outputs
- One N.C. safety output
- Three group modules available
- Diagnostic LED
- 22.5 mm DIN Rail housing
- Removable terminals

LED Indicators

Off	Output Inactive
Green	Output Active

Specifications

Safety Ratings	
Standards	EN 954-1, EN IEC 62061, ISO 13849-1, IEC/EN 60204-1, ISO 12100, IEC 60947-4-1, IEC 60947-5-1, ANSI B11.19, AS 4024.1
Safety Classification	Cat. 3 per EN 954-1 (ISO 13849-1), SIL CL2 per EN IEC 62061, PLe per ISO 13849-1
Functional Safety Data ∗ **Note**: For up-to-date information, visit *http://www.ab.com/Safety/*	PFH_D: < 7.7 x 10^{-10} MTTFd: > 373 years Suitable for performance levels Ple (according to ISO 13849-1:2006) and for use in SIL3 systems (according to IEC 62061) depending on the architecture and application characteristics
Certifications	CE Marked for all applicable directives, cULus, c-Tick, and TÜV
Power Supply	
Input Power Entry	24V DC from base unit
Power Consumption	2.5 W
Inputs	
Safety Inputs	Configured on base unit
Reset	Configured on base unit
Outputs	
Safety Contacts	3 N.O.
Auxiliary Contacts	1 N.C.
Thermal Current I_{th}	2 x 5 A, 3 x 4 A (nonswitching)
Rated Impulse withstand Voltage	2500V
Switching Current @ Voltage, Min.	10 mA @ 10V DC
Fuses, Output	6 A slow blow or 10 A quick blow (external recommended)
Electrical Life (Operations)	220V AC/4 A/880V A cosϕ = 0.35…0.1 M 220V AC/1.7 A/375V A cosϕ = 0.6…0.5 M 30V DC/2 A/60 W = 1 M 10V DC/0.01 A/0.1 W = 2 M
Mechanical Life	10,000,000 cycles
Status Indicators	Output: Green = Output active
Output Utilization	
Resistive:	AC-1: 6 A/250V AC; DC-1: 6 A/24V DC
Inductive:	AC-15: 5 A/250V AC; DC-13: 3 A/30V DC
UL	B300, P300, 2 x 5 A or 3 x 4 A res 250V
Environmental and Physical Characteristics	
Enclosure Type Rating/ Terminal Protection	IP40 (NEMA 1)/ IP20
Operating Temperature [C (F)]	-5…+55 ° (23…131 °)
Vibration	10…55 Hz, 0.35 mm
Shock	10 g, 16 ms, 100 shocks
Mounting	35 mm DIN Rail
Weight [g (lbs)]	205 (0.45)
Conductor Size, Max.	0.2…2.5 mm^2 (24…12 AWG)

∗ Usable for ISO 13849-1:2006 and IEC 62061. Data is based on the following assumptions:
- Mission time/Proof test interval of 20 years
- Functional test at least once within six-month period

Product Selection

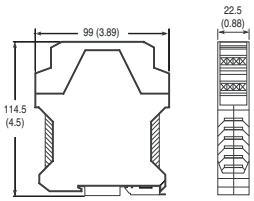
Group No.	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. No.
1	3 N.O.	1 N.C.	Removable	—	24V DC from the base unit	440R-W23224
2						440R-W23225
3						440R-W23226

Accessories

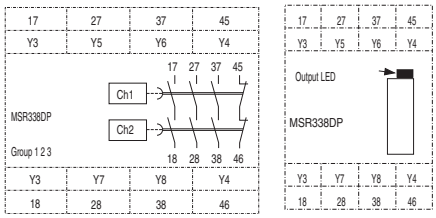
Description	Cat. No.
Bag of 4, 4-Pin Screw Terminal Blocks	440R-A23209
Bag of 4, 4-Pin Spring Clamp Terminal Blocks	440R-A23228

Approximate Dimensions

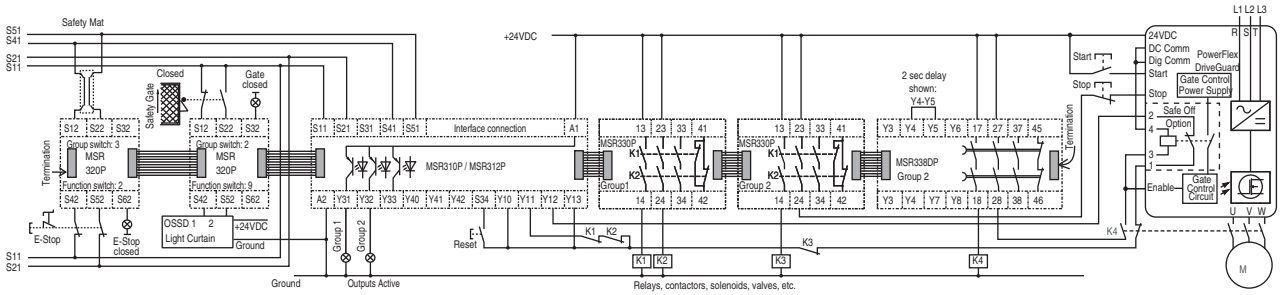
Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



Block Diagram



Typical Wiring Diagrams



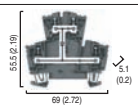
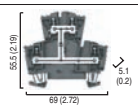
MSR 300 system with various Inputs. Two Output Groups with common monitored reset, each Group with monitored contactors Safety Mat or E-Stop shut down both Groups, Safety Gate and Light Curtain only shut down the Group 2 modules: Controlled Stop via instant contacts, delayed Safe Off and Power removal via MSR338DP

Off-Delay Time Table

			All jumpers (links) on the terminals identified to achieve the desired off delay.					
Delay(s)	Jumper	Jumper	Delay(s)	Jumper	Jumper	Delay(s)	Jumper	Jumper
0	None	None	8	Y3-Y6	Y3-Y7	50	Y3-Y6	Y3-Y8
0.5	Y3-Y5	None	9	Y4-Y5	Y3-Y7	60	Y4-Y5	Y3-Y8
1	Y4-Y6	None	10	None	Y4-Y8	80	None	Y4-Y7
1.5	Y3-Y6	None	12	Y3-Y5	Y4-Y8	100	Y3-Y5	Y4-Y7
2	Y4-Y5	None	15	Y4-Y6	Y4-Y8	120	Y4-Y6	Y4-Y7
3	Y3-Y5	Y4-Y6	18	Y3-Y6	Y4-Y8	160	Y3-Y6	Y4-Y7
4	Y3-Y6	Y4-Y5	21	Y4-Y5	Y4-Y8	200	Y4-Y5	Y4-Y7
5	None	Y3-Y7	26	None	Y3-Y8	250	Y3-Y5, Y4-Y6	Y4-Y7
6	Y3-Y5	Y3-Y7	30	Y3-Y5	Y3-Y8	300	Y3-Y6, Y4-Y5	Y4-Y7
7	Y4-Y6	Y3-Y7	40	Y4-Y6	Y3-Y8			

Accessories

Description		Cat. No.
	Fuse, 250 mA—Bussmann Cat. No. ETF-250mA	440A-A09196
	500 mA fuse—Bussmann Cat. No. ETF-500 mA	440R-A31562
	Fuse, 1 A—Bussman Cat. No. ETF-1	440R-A70972
	Fuse, 2 A—Bussmann Cat. No. ETF-2	440A-A09197
	MSR200, Two Terminators	440R-A17138
	MSR300 Two Terminators	440R-A17234
	Bag of 4, 4-Pin Screw Terminal Blocks	440R-A23209
	Bag of 4, 3-Pin Screw Terminal Blocks	440R-A23210
	Bag of 4, 4-Pin Spring Clamp Terminal Blocks	440R-A23228
	Bag of 4, 3-Pin Spring Clamp Terminal Blocks	440R-A23229
	Ribbon cable—for one MSR45E	**440R-ACABL1**
	Ribbon cable—for two MSR45Es	440R-ACABL2
	Ribbon cable—for three MSR45Es	440R-ACABL3
	Replacement terminal block kit—MSR41	440R-ATERM1P
	Replacement terminal block kit—MSR42	440R-ATERM2P
	Replacement terminal block kit—MSR45E	440R-ATERM2C
	USB optical interface software configuration tool used to configure the MSR42	445L-AF6150
	Replacement suction cup	445L-AF6151
	Optical interface fastener	445L-AF6152

Description		Cat. No.
	24V DC power supply 2.1 A	1606-XLP50E
	24V DC power supply 3.0 A	1606-XLP72E
	24V DC power supply 5 A	1606-XL120D
	Non-illuminated, 40 mm Twist-to-release maintained mushroom (plastic)	800FP-MT44
	Non-illuminated, 40 mm Twist-to-release maintained mushroom (metal)	800FM-MT44
	Terminal Block with Diode (Forward)	**1492-JD3DF**
	Terminal Block with Diode (Reverse)	**1492-JD3DR**
	70 mm Tower Light Clear Module—Black Base (no bulb)	855T-B00XN7
	70 mm Tower Light Clear Module—Grey Base (no bulb)	855T-G00XN7
	70 mm Tower Light Clear Module—Black Base (LED)	855T-B24YL7
	70 mm Tower Light Clear Module—Grey Base (LED)	855T-G24YL7

Programmable Safety Solutions Overview

Safety PLC systems bring the programmability and flexibility of traditional PLC systems to complex safety applications. Their programmable nature means that safety applications can now be solved in software rather than hard-wiring large, cascaded relay systems. This makes activities such as zone control and simplified machine access procedures much easier to achieve. Safety I/O modules are connected to Safety PLCs via safety certified networks, reducing wiring costs and allowing for advanced diagnostic information to be monitored by the safety PLC and shared with HMI systems. This results in reduced costs associated with wiring, troubleshooting and managing production equipment.

Benefits of safety PLCs include:

- **Flexibility.** Safety PLCs are programmable systems. This allows control engineers to easily design applications in which the behavior of the safety system can be flexible and based on the mode that the machine is currently operating in, the zone of the machine being accessed or the task that an operator or maintenance person is performing. This means that Safety PLCs can be used to help solve applications that are difficult if not impossible to solve with traditional safety relay systems.
- **Productivity.** The flexible programming of Safety PLCs permits control engineers to create maintenance modes of operation with "limited shutdown" capability, allowing for quicker access to production equipment and faster restart times, which help to reduce downtime. The extensive diagnostics also aid in the troubleshooting and repair of the system, improving MTTR (Mean Time to Repair) and further reducing downtime and improving productivity.
- **Wiring Simplification.** Safety input and output devices are wired directly to Safety I/O modules. These modules communicate to Safety PLCs via a single network cable. In applications that require logic or have safety devices distributed around equipment, Safety PLC systems can reduce the amount of wiring and commissioning effort required to install and start up production equipment.
- **Diagnostics.** Safety PLC systems perform internal and external diagnostics checks many times per second. Safety I/O modules also perform checks on their connected input and output devices. This information can be made easily available to operators and service personnel meaning that the exact source of a safety event can often be quickly identified and appropriate action taken, reducing MTTR, getting a machine back into production sooner.
- **Integration.** Safety PLCs enable machine makers to think of safety as part of the normal control of the machine, not just a piece that is added on at the end. Because safety PLCs communicate on standard automation networks, they allow for easy interlocking between the standard control system and the safety system. Some safety systems are so integrated, they can perform all of the standard machine control (sequential, motion, …) plus safety control, all from one unit.
- **Reliability.** Safety PLC systems are designed specifically for very high MTBF (Mean Time Between Failure) and very low PFD (Probability of Failure on Demand).
- **Expandability.** Safety PLC systems are easily expanded. Additional I/O modules can be added to the system and application code can be easily modified and expanded by control engineers.
- **Security.** All safety PLCs have a "Safety Signature" associated with them, a unique identifier that changes whenever any part of the safety configuration or program is changed. This allows for quick spot checks to determine that the safety system is still the way it was when commissioned. Also, some safety PLCs have multiple layers of password protection to allow only authorized personnel to make changes.
- Safety Certification. Safety PLCs are designed to meet stringent standards for programmable safety systems. To demonstrate their compliance, they are certified by professional testing agencies that they meet the appropriate standard. All Rockwell Automation safety systems are certified by the TÜV Rheinland Group for use in applications up to SIL 3 per IEC 61508, and PLe/Category 4 per ISO 13849-1.

Typical applications for safety PLCs include (i) perimeter access control of production cells, robotic systems and complex manufacturing processes and lines, (ii) point of operation control for press and manual loading applications, and (iii) maintenance simplification, alternative methods for lockout/tagout and other applications where users want to streamline the service procedures for production equipment. Safety PLC systems typically consist of (i) a safety PLC where the user-designed application code is executed, (ii) safety I/O which is where safety input and output devices are wired, and (iii) a safety network that allows the safety PLC to communicate with the safety I/O and with each other. The safety PLC system provides you with an environment to write and execute application code with a very high safety integrity. You generate the application code that is executed in the safety PLC system and then, as part of the commissioning process, validate (test) that the safety PLC system mitigates the safety hazards that it was designed to monitor and control.

Rockwell Automation Safety PLCs

Rockwell Automation manufactures three distinct families of safety PLCs and a variety of safety I/O modules.

SmartGuard™ 600 Controllers

The SmartGuard 600 controller is designed for applications that require some complex logic. It is a "packaged safety controller" that includes the CPU, 16 Safety Inputs and 8 Safety Outputs and an embedded DeviceNet communications port all in one unit. Using the DeviceNet communications port, the SmartGuard 600 controller can control additional safety I/O modules including the 1791DS CompactBlock Guard I/O and 1732DS ArmorBlock Guard I/O, as well as 1734 POINT Guard I/O modules via a 1734-PDN module. In addition, the SmartGuard controller can also communicate with standard PLCs and HMIs on DeviceNet or EtherNet/IP networks. SmartGuard 600 systems are programmed using RSNetWorx for DeviceNet software. For more information on SmartGuard 600 controllers, see page 5-119.

GuardPLC™ Controllers

GuardPLC refers to a family of safety controllers that are programmed with the RSLogix Guard PLUS software package. Like the SmartGuard 600, the GuardPLC 1600 and GuardPLC 1800 Safety PLCs are "packaged safety controllers" with a CPU, safety I/O and embedded communication networks. In the case of the GuardPLC 1600 and 1800 the embedded communication network is Ethernet for communication to GuardPLC Safety I/O modules as well as EtherNet/IP for communications to standard controllers and HMIs. The GuardPLC 1600 includes 20 safety inputs and 8 safety outputs. The GuardPLC 1800 includes 24 safety inputs, 8 safety outputs, 8 safety analog inputs and 2 safety rated high speed counters. For more information on GuardPLC controllers, see page 5-123.

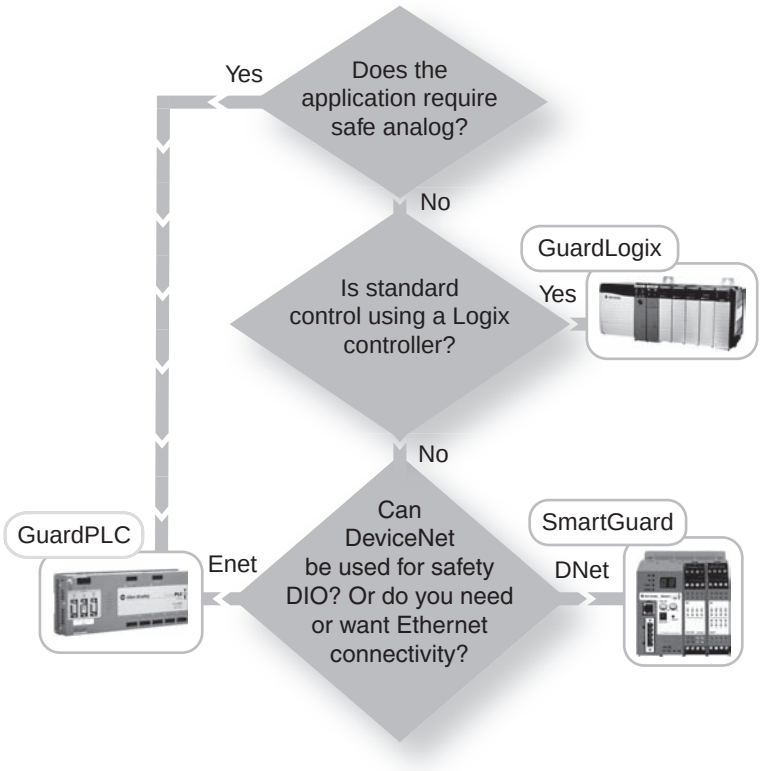
GuardLogix® Controllers

The GuardLogix system is a Logix5000™ controller that in addition to running all standard control functions like sequential, motion, etc., also has the ability to run a Safety Task and control safety I/O. This enables both safety and standard applications to run simultaneously in a single application project. This reduces integration, spare parts, training and improves the flow of data to HMI and information systems. A GuardLogix controller communicates to Guard I/O modules via standard control networks (EtherNet/IP or DeviceNet™) using the CIP Safety protocol. It is programmed with RSLogix™ 5000 software, just like a Logix5000™ processor. For more information on GuardLogix controllers, see page 5-133.

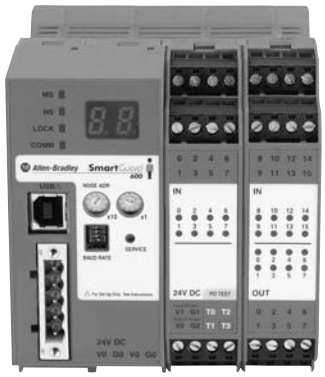
Guard I/O™ Modules

Guard I/O is the name for the Rockwell Automation family of Safety I/O modules that communicate via CIP Safety on EtherNet/IP and DeviceNet networks. CompactBlock Guard I/O modules on EtherNet/IP and DeviceNet networks are available in IP20 (in-cabinet) form-factor ArmorBlock Guard I/O modules on DeviceNet networks are available in IP67 (on-machine) form-factors. POINT Guard I/O modules provide EtherNet/IP connectivity in a maximum density in-cabinet I/O solution. For more information on Guard I/O modules, see page 5-137.

Safety Logic Selection Flowchart



Product	 SmartGuard™ 600 (Bulletin 1752) page 5-119	 GuardPLC™ Controllers (Bulletin 1753) page 5-123	 GuardLogix® Controllers (Bulletin 1756) page 5-133
Form Factor	• Standalone	• Standalone	• ControlLogix® Chassis (1756 GuardLogix controller) • 1768 CompactLogix (1768 Compact GuardLogix controller)
Safety Communication Network	• DeviceNet™ (on-board)	• GuardPLC Ethernet (on-board)	• DeviceNet and EtherNet/IP via 1756-based communication bridges
Standard Communication Network	• DeviceNet (on-board) • EtherNet/IP (on-board 1752-L24BBBE)	• EtherNet/IP (on-board) • Profibus or Modbus (on-board)	• Many via 1756-based or 1768-based communication bridges
Programming Network	• DeviceNet (on-board) • USB (on-board) • EtherNet/IP (on-board 1752-L24BBBE)	• GuardPLC Ethernet (on-board)	• EtherNet/IP, ControlNet, DeviceNet via 1756-based or 1768-based communication bridges
Programming Editor	• RSNetWorx™ for DeviceNet™ Software	• RSLogix Guard PLUS! Software	• RSLogix™ 5000 Software
Discrete Safety I/O	• 16 safety inputs/8 safety outputs (on-board) • Guard I/O (remote via DeviceNet network)	• 20 or 24 safety inputs/8 safety outputs • GuardPLC I/O (remote via GuardPLC Ethernet)	• Guard I/O™ (remote via DeviceNet or EtherNet/IP networks)
Safety Analog Input	N/A	• 8 safety analog inputs (on-board GuardPLC 1800) • 8 safety analog inputs (remote via GuardPLC I/O Module)	N/A
High Speed Counter	N/A	• 2 high speed counter inputs (on-board GuardPLC 1800)	N/A



Description

The SmartGuard 600 safety controller is a programmable safety controller designed for safety applications that require some complex logic allowing for more advanced safety functionality. It features 16 safety-rated inputs, 8 safety-rated outputs, 4 pulse test sources and an optional EtherNet/IP™ port. To support both standard CIP and CIP safety, a DeviceNet™ connection is also included. Configuration and programming is accomplished on EtherNet/IP, DeviceNet, or through the built-in USB port.

Since the SmartGuard 600 safety controller is a safety master on the DeviceNet network, you can use Rockwell Automation Guard I/O™ modules to expand the number of safety devices the SmartGuard 600 controller can control. It can also perform safety interlocking between a GuardLogix or other SmartGuard 600 controllers. With your choice of EtherNet/IP™ or DeviceNet™ communication, other devices such as standard PLCs and HMIs can read data out of the SmartGuard 600 controller for system-level diagnostics and troubleshooting.

Use RSNetWorx™ for DeviceNet™ software to configure the network and program the controller. From within RSNetWorx for DeviceNet software, you can launch an editor that lets you write function block programs for the SmartGuard 600 controller. No additional programming software is required. With ten safety application instructions, plus another dozen logic and timing instructions, you can write powerful, yet simple safety control programs.

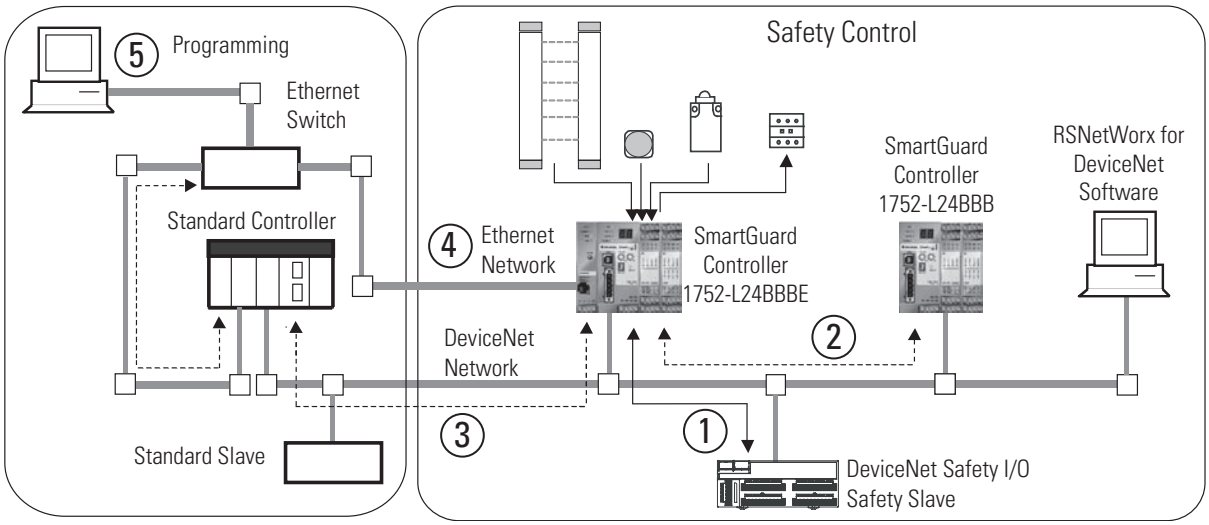
Benefits

- Small, cost-effective, intelligent safety controller
- Ideal mid-level safety controller when the application is too complex for a safety relay, yet too simple for a full-sized safety PLC
- Use the DeviceNet network to distribute safety I/O and integrate into a standard control system
- Use RSNetWorx for DeviceNet software for configuration and programming — no special programming software required

Networking with SmartGuard 600 Controllers

The SmartGuard 600 controller can function simultaneously as a DeviceNet safety master, DeviceNet safety slave, and DeviceNet standard slave as well as an EtherNet/IP target (see network illustration).

- As a DeviceNet safety master (1), the SmartGuard 600 controller can control up to 32 Guard I/O modules. These 1791DS and 1732DS modules are the same distributed safety I/O modules used with GuardLogix controllers.
- As a DeviceNet safety slave (2), the SmartGuard 600 controller looks like distributed safety I/O to a safety master. A GuardLogix or another SmartGuard safety master can read and write safety data to the SmartGuard slave controller. This lets you perform distributed safety control through the interlocking of multiple controllers via CIP Safety on DeviceNet networks.
- As a DeviceNet standard slave (3), the SmartGuard 600 controller can look like a standard distributed I/O module and respond to explicit messages so that standard DeviceNet masters like ControlLogix, SLC 500, or PLC-5 controllers or an HMI can read and write information to and from the SmartGuard 600 controller. This facilitates coordination with your standard PLC application, including displaying safety system information on an HMI.
- As an EtherNet/IP standard target (4), the SmartGuard 600 controller communicates with an Ethernet/IP standard originator, such as a CompactLogix or MicroLogix controller or an HMI device.
- As a limited EtherNet/IP bridge device (5), the SmartGuard 600 controller lets programming tools bridge to DeviceNet to view and program the SmartGuard 600 controller and configure other DeviceNet devices.



Configuration and Programming

You can program and configure the SmartGuard 600 controller through its USB port, through a DeviceNet connection or through an Ethernet connection. The SmartGuard's USB port has limited pass-through capabilities, letting you configure other devices on DeviceNet networks. You can use any type of A-to-B connection USB cable that supports USB 1.x or 2.0. Alternatively, you can connect to the SmartGuard controller through its DeviceNet port via a PCD card or a PC connected to an EtherNet/IP-to-DeviceNet linking device or gateway. You can also connect the 1752-L24BBBE SmartGuard controller to a PC's Ethernet port using a Category 5 Ethernet cable.

Safety System Management

Multiple system management tools are built into the SmartGuard 600 controller and RSNetWorx for DeviceNet software.

- You can password-protect the entire SmartGuard 600 controller so you cannot download any changes without the password. You can also password-protect the program with a separate password, to help prevent unauthorized edits to the program.
- Each safety device contains a configuration signature that changes any time the DeviceNet configuration or SmartGuard program changes, even if it is changed back to its original state. The configuration signature can be read by external devices, such as standard PLCs, HMI, or asset management software, to determine whether the configuration or program has been changed.
- Lastly, you can use the Safety Device Verification Wizard in RSNetWorx for DeviceNet software to safety-lock the SmartGuard 600 controller. Safety-locking via the Safety Device Verification Wizard verifies that the offline and online configuration and program are identical and provides documentation that you can keep in your files to show that the controller has not been tampered with.

Typical Applications

The SmartGuard 600 controller is positioned between a safety relay system and a safety PLC. It is ideally sized for applications that cannot be solved with safety relays, or are very cumbersome to solve with relays, but are not complex enough for a traditional safety PLC like a GuardLogix® or GuardPLC™ controller.

- Applications where a safety relay solution (or configurable safety relay solution) is just too complex
- Applications that require distributed safety I/O and/or network integration with a standard PLC
- Applications where GuardLogix or GuardPLC controllers seem too big (or are not cost-effective)
- Applications that require multi-zone control
- Complex light curtain applications; for example, implementing light curtain muting when a robot is not in the operator load zone and monitoring an enable pendant that lets the operator enter the zone with the robot present.

Catalog Numbers and Related Products

Cat. No.	Product Description
1752-L24BBB	SmartGuard 600 Safety Controller
1752-L24BBBE	SmartGuard 600 Controller with EtherNet/IP
9357-DNETL3	RSNetWorx for DeviceNet✶
9355-WAB100ENE	RSLinx Classic (Lite)❄

✶ 1752-L24BBB requires version 8 (minimum) or version 9.1 (recommended); 1752-L24BBBE requires version 9.1 or later
❄ 1752-L24BBB requires version 2.51 or later; 1752-L24BBBE requires version 2.55 or later

Specifications

Environmental Specifications and Certifications

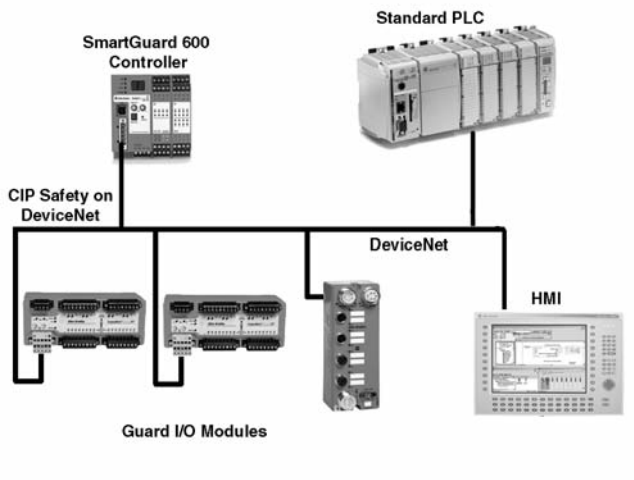
Cat. No.	1752-L24BBB	1752-L24BBBE
Operating Temperature	-10…55 °C (14…131 °F)	
Non-Operating Temperature	-40…70 °C (-40…158 °F)	
Relative Humidity	10…95% noncondensing	
Vibration	0.35 mm @ 10…57 Hz 5 g @ 57…500 Hz	5 g @ 10…500 Hz
Shock, Operating	15 g	
Certifications✶	UL, CE, C-Tick, cULus Class I Div 2 Hazardous, UL NRGF, NFPA 79, certified by TÜV for Functional Safety up to SIL 3, and PLe/Cat. 4	

✶ When product is marked. See the Product Certification link at http://www.ab.com/certification for Declarations of Conformity, Certificates, and other certification details.

Controller Specifications

Cat. No.	1752-L24BBB	1752-L24BBBE
Supply Voltage	20.4…26.4V DC (24V DC, -15…10%)	20.4…26.4V DC (24V DC, -15…10%)
Input Voltage Range	11…25V DC DeviceNet Specification	11…25V DC DeviceNet Specification
DeviceNet Current (mA)	15 mA	15 mA
Current Consumption	230 mA @ 24V DC	280 mA @ 24V DC
Digital Inputs		
Number of Digital Inputs	16	16
Voltage, On-State Input, Min.	11V DC	11V DC
Voltage, Off-State Input, Max.	5V DC	5V DC
Current, Off-State Input, Max.	1 mA	1 mA
Current, On-State Input, Nom.	4.5 mA	4.5 mA
Digital Outputs		
Number of Digital Outputs	8	8
Output Current Rating	0.5 A	0.5 A
Voltage, Off-State Output, Max.	1.2V	1.2V
Leakage Current, Off-State Output, Max	0.1 mA	0.1 mA
Pulse Test Sources		
Number of Pulse Test Sources	4	4
Pulse Test Output Current	0.7 A	0.7 A
Pulse Test Voltage, Off-State Output, Max.	1.2V	1.2V
Pulse Test Output Leakage Current, Max.	0.1 mA	0.1 mA
General		
Dimensions (HxWxD), Metric	99.0 x 90.4 x 131.4 mm	99.0 x 113.0 x 131.4 mm
Dimensions (HxWxD), Imperial	3.90 x 3.56 x 5.18 in.	3.90 x 4.48 x 5.18 in.
Weight, Metric	470 g	575 g
Weight, Imperial	1.03 lb	1.27 lb

Typical SmartGuard 600 System Architectures



SmartGuard 600 controller (1752-L24BBB) on a DeviceNet network.

RSNetWorx™ for DeviceNet™ Software Description

RSNetWorx™ for DeviceNet™ software is the premier configuration software for your Open DeviceNet Vendor Association DeviceNet network; it provides configuration management and diagnostic features, and it is one of the most advanced DeviceNet network management software packages available today. RSNetWorx Software for DeviceNet Network helps you achieve maximum productivity with your DeviceNet installations.

You can quickly define the devices on your DeviceNet network and the input/output exchanges that take place through this simple software interface.

RSNetWorx for DeviceNet software supports configuration of DeviceNet Safety devices. A Safety Device Verification Wizard guides you through the verification and configuration locking process and provides a report listing the configuration information for all of the safety devices on the network.

RSNetWorx Software for DeviceNet contains the editor used to program the SmartGuard 600 controller. Once you have configured your network containing a SmartGuard 600 controller, you launch the editor, which lets you write function block programs. No additional programming software is needed!

Cat. No.	Description
9357-DNETL3	RSNetWorx for DeviceNet

Benefits

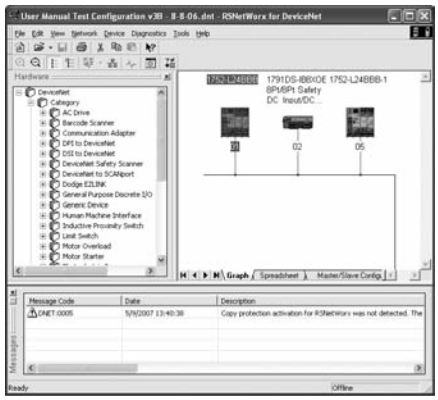
- Define the devices that are present on your network. You can either manually drag/drop devices/modules or go online to a DeviceNet network and let the software determine the devices/modules that are present.
- Define configuration settings for devices on the DeviceNet network through a convenient property page interface.
- Define the input/output information exchanges that you want to take place on the DeviceNet network.
- Access a comprehensive product tutorial to help you get the most value from the software as quickly as possible.
- Receive troubleshooting hints whenever error messages are presented, making you more productive.
- Configure and exchange data with DeviceNet Safety Scanner and DeviceNet Safety I/O nodes.
- Verify and lock safety devices for use in high-integrity safety systems.

System Requirements

RSNetWorx software can be used with these operating systems:

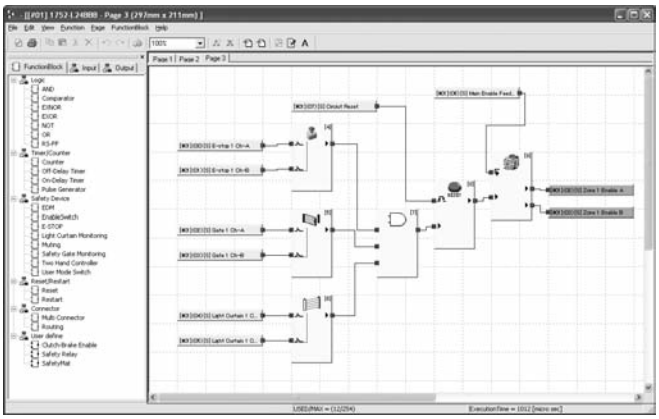
- Microsoft Windows Vista
- Microsoft Windows XP
- Microsoft Windows 2000

RSNetWorx for DeviceNet Software Examples



Use RSNetWorx for DeviceNet software to configure all of your DeviceNet devices, including SmartGuard 600 controllers and Guard I/O modules.

The Properties page for the SmartGuard 600 controller allows you to configure all of its parameters including I/O tags, I/O discrepancy times, connections to Guard I/O modules, and data that can be read by standard controllers or HMIs.



By clicking on the 'Logic' tab on the Properties dialog, RSNetWorx for DeviceNet software launches the editor for the SmartGuard 600 controller where you create your program using safety instructions, basic logic, timers, and counters. You also have the ability to create your own instructions.

Guard I/O™ Modules

When the SmartGuard 600 controller needs additional safety I/O points, you can control and monitor your safety device with Guard I/O. When used with SmartGuard controllers, Guard I/O communicates on DeviceNet using CIP Safety protocol. As a proven technology, Guard I/O detects failures at the I/O and field device level, while enhancing operator protection.

CompactBlock Guard I/O modules are available in IP20 (in-cabinet) form factor. ArmorBlock Guard I/O modules are IP67 (on-machine) form factor. POINT Guard I/O provides maximum I/O density in minimal panel space (used in conjunction with a 1734-PDN adapter on a DeviceNet network).

For more information on Guard I/O see page 5-137.

System Overview

The GuardPLC system is a state-of-the-art safety system offering fast safety PLCs, optimum controller throughput, and a reliable safety network.

The GuardPLC system meets the worldwide standard for programmable controls, complying with many of the latest global safety standards and the worldwide standard for functional safety in programmable electronic systems. The GuardPLC system can be used without restriction in applications up to Safety Integrity Level 3 (SIL 3) according to IEC 61508 and PLe/Category 4, according to ISO 13849-1.

The GuardPLC system consists of four main components:

- Packaged controller and associated integrated I/O
- Safety Communication via GuardPLC Ethernet networks
- Distributed I/O modules for GuardPLC Ethernet networks
- Programming and configuration software

Benefits

Benefits resulting from the use of safety PLCs and safety networks include:

- Greater integration and flexibility of machine controls.
- Capability for better and easier diagnostics when intelligence is provided to the standard control level
- Faster and easier maintenance
- Reduction in the cost of installation, commissioning, and reconfiguring
- Reduction in design and hardware costs, compared to using safety relays alone for logic
- Potential for throughput performance improvement in more complex systems

GuardPLC Safety Control Systems

	 GuardPLC 1600 5-125	 GuardPLC 1800 5-127	 GuardPLC Distributed I/O 5-129
Description	A cost-effective safety PLC offering a built-in 4-port Ethernet switch, digital I/O, and flexible communication options for connecting devices.	Analog inputs and high-speed counters allow the GuardPLC 1800 to sense temperature, pressure, speed, and motion.	Distributed safety I/O blocks provide exceptional flexibility in configuring the right mix of I/O in the right place.
Memory	• 250kB user program • 250kB application data	• 250kB user program • 250kB application data	—
Digital I/O	• 20 inputs • 8 outputs	• 24 inputs • 8 outputs	• 16 inputs only • 16 outputs only • 8 inputs and 8 outputs • 16 inputs and 8 outputs • 20 inputs and 8 outputs
Other I/O	—	• 8 analog inputs • 2 high-speed counters	• 8 analog inputs • 8 relay outputs
Embedded Ethernet	4-port switch	4-port switch	2-port switch
Other Communications	• EtherNet/IP • GuardPLC Ethernet • Modbus RTU Slave or PROFIBUS DP Slave • ASCII (RS-485)	• EtherNet/IP • GuardPLC Ethernet • Modbus RTU Slave or PROFIBUS DP Slave • ASCII (RS-485)	• GuardPLC Ethernet
Programming Software	All GuardPLC controllers are programmed with RSLogix Guard PLUS! programming software.		

GuardPLC™ Safety Control Systems

Overview

Communication

GuardPLC safety controllers communicate on a Safe Ethernet communications network called GuardPLC Ethernet. The network is certified by TÜV for use in safety applications up to SIL 3 and PLe/Category 4, and can be used for distributed safety I/O and peer-to-peer communications between GuardPLC controllers, as well as programming using RSLogix Guard PLUS! software. And because it's Ethernet, you use standard category 5 cables, switches and routers.

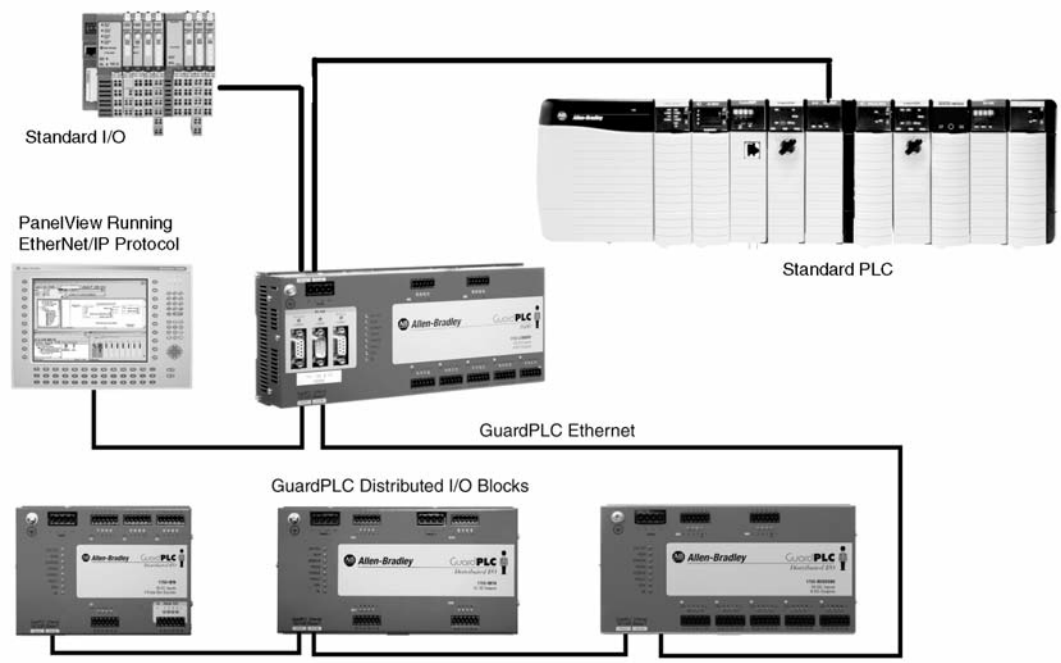
Using GuardPLC distributed I/O, you can place your safety I/O where your safety field devices are located, reducing wiring costs. Peer-to-peer communications allow GuardPLC controllers running their own programs to interlock with each other for applications that need to link one manufacturing cell to others.

NetLinx Integration

The ever-increasing demand for both enhanced plant productivity and improved workplace safety has fueled a trend toward integrated safety control and standard control systems. Control system users now expect their safety systems to possess all of the efficiencies and conveniences of their standard controls. Today's modern manufacturing plants will not accept safety systems that compromise productivity. Both machine builders and end users expect that the cost of implementing and maintaining a safety system will continue to drop without reducing the level of protection to the user.

The first level of integrating your GuardPLC controller into your standard control system is at the information network level. The GuardPLC 1600 and 1800 controllers let you to accomplish this easily with embedded EtherNet/IP protocol. Able to run EtherNet/IP protocol at the same time as safety-rated GuardPLC Ethernet protocol, the GuardPLC controller uses EtherNet/IP protocol to communicate status about the safety control system to other standard devices such as PLCs (ControlLogix®, FlexLogix™, CompactLogix™, SLC™ 500 or PLC-5®), HMIs (PanelView™, PanelView Plus, VersaView®) and others. The GuardPLC controller can even control standard I/O, like Flex I/O and Point I/O, on an EtherNet/IP network. This capability lets you integrate your GuardPLC on the EtherNet/IP network already running in your plant.

GuardPLC Typical Configuration



GuardPLC 1600 Controller

The GuardPLC 1600 controller is a mainstream, cost-effective safety PLC that provides onboard digital I/O, a built-in 4-port Ethernet switch, and flexible communication options for connection to HMIs and to standard PLCs.

Benefits

- 28 safety digital I/O points – designed specifically for interfacing with safety components such as e-stops, light curtains, etc.
- Embedded 4-port Ethernet switch – eliminates the need for external networking hardware, reducing system cost.
- EtherNet/IP for easy integration with standard PLCs and HMIs.
- Modbus RTU slave and PROFIBUS DP slave communication options – allow the controller to connect to standard PLCs and HMI devices, and an RS-485 port is available for ASCII communication (read only).
- Expandability – use GuardPLC Distributed I/O to cost-effectively expand your safety system.
- Removable terminal blocks – make swapping controllers an efficient task so operations can be up and running again quickly in the event of a failure.

Typical Applications

- Perimeter guarding for robot / weld cells
- Perimeter guarding for packaging machines
- Press controls
- Semiconductor tools
- Material handling systems

Product Design

The GuardPLC 1600 controller features a built-in four-port Ethernet switch and digital I/O (20 safety rated inputs and eight safety rated outputs). 100M GuardPLC Ethernet comes standard, plus for flexibility in connecting to HMI devices and standard PLCs, the controller includes EtherNet/IP, Modbus RTU Slave or PROFIBUS DP Slave, an RS-485 port for ASCII communications.

At 10 ms throughput, this controller is one of the fastest safety PLCs in the industry. Its exceptionally high mean time between failures helps increase the safety and reliability of your system. Removable terminal blocks make swapping controllers a quick task so operations can be up and running again quickly in the event of failure.

Features

- 28 digital I/O points: 20 inputs, 8 outputs
- Use GuardPLC Distributed I/O to expand safety system
- EtherNet/IP, RS-485 port for ASCII communication (read only)
- Embedded 4-port Ethernet switch eliminates the need for external networking hardware
- Modbus RTU slave and PROFIBUS DP slave communication options to connect to standard PLCs and HMI devices
- Certified by TÜV for use in applications to SIL 3 according to IEC 61508 and PLe/Category 4, according to ISO 13849-1
- Programmed with RSLogix Guard PLUS! Software
- DIN rail mounting
- Cost-effective safety control system

Specifications

General Specifications

The following specifications are common to all GuardPLC products unless indicated.

Temperature, operating	0…60 °C (32…140 °F)
Temperature, nonoperating	-40…85 °C (-40…185 °F) without backup battery
Relative Humidity	95%
Vibration	1 g @ 10…150 Hz
Shock, operating	15 g

Certifications

(When product is marked.)

Certifications	GuardPLC 1600, GuardPLC 1800, and 1753 I/O
c-UL-us	c-UL Listed Industrial Control Equipment.
CE	Compliant for all applicable directives.
C-Tick	C-Tick compliant with all applicable acts
Functional Safety	certified by TÜV up to SIL 3, and PLe/Cat. 4

GuardPLC 1600 Controller Specifications

Cat. No.	1753-L28BBBM	1753-L28BBBP
Application Memory	250 KB	
User Program Memory	250 Kbytes	
Available User Memory	500	
Current Consumption	8 A with maximum load 0.5 A idle current (controller only)	
Operating Voltage Range	24V DC, -15% to +20%, $w_{ss} \leq 15\%$∗	
Communication Ports	4 Ethernet 10/100BaseT ports 1 9-pin D-shell RS-485 port (Modbus Slave) 1 9-pin D-shell RS-485 port (GuardPLC ASCII) 1 9-pin D-shell Comm port (unused)	4 Ethernet 10/100BaseT ports 1 9-pin D-shell RS-485 port (PROFIBUS DP Slave) 1 9-pin D-shell RS-485 port (GuardPLC ASCII) 1 9-pin D-shell Comm port (unused)
Ethernet Port	4 x RJ-45, 10/100BaseT (with 100 Mbit/s) with integrated switch	
EtherNet/IP Communication Rate	10/100 Mbps	
Enclosure Protection	IP20	
Digital Inputs		
Number of Digital Inputs	20 safety❄	
Voltage, On-State Input, Max.	30V DC	
Voltage, On-State Input, Nom.	24V DC	
Digital Outputs		
Number of Digital Outputs	8 safety❄	
Current, On-State Output, per Channel	Channels 1…3; 5…7: 0.5 A @ 60 °C (140 °F) Channels 4 and 8: 1 A @ 60 °C (140 °F); 2 A @ 50 °C (122 °C)	
Voltage, On-State Output, Max.	26.8V DC	
Voltage, On-State Output, Min.	18.4V DC	
Voltage, On-State Output, Nom.	24V DC	
General		
Dimensions (HxWxD), Metric	114 x 257 x 78 mm‡	
Dimensions (HxWxD), Imperial	4.49 x 10.1 x 3.07 in‡	

∗ Requires a power supply with protective separation conforming to IEC 61131-2 requirements.
❄ Not electrically isolated.
‡ Height includes latch; width includes housing screws; depth includes grounding bolt and connectors.

GuardPLC 1800 Controller

The GuardPLC 1800 controller takes all the features of the GuardPLC 1600 controller, then adds analog inputs and high-speed counters for specialized applications such as emergency shut down, flame control, and amusement park ride control.

Benefits

- 32 safety digital I/O points – designed specifically for interfacing with safety components such as e-stops and light curtains.
- 8 safety-rated analog inputs – for sensing temperature, pressure, etc.
- 2 safety-rated high-speed counters – for sensing speed, flow, and motion.
- Embedded 4-port Ethernet switch – eliminates the need for external networking hardware.
- Supports EtherNet/IP protocol for easy integration with standard PLCs and HMIs.
- Modbus RTU slave and PROFIBUS DP slave communication options – lets the controller connect to standard PLCs and HMI devices, and an RS-485 port is available for ASCII communication (read only).
- Expandability – Use GuardPLC Distributed I/O to expand your safety system.
- Removable terminal blocks – make swapping controllers an efficient task so operations can be up and running again quickly in the event of a failure.

Typical Applications

- Emergency shutdown
- Burner management systems
- Perimeter guarding for robot / weld cells
- Perimeter guarding for packaging machines

Product Design

The GuardPLC 1800 controller has the same features as the GuardPLC 1600 controller with additional I/O, including analog I/O and high-speed counters for specialty applications. Built-in I/O includes 24 digital inputs, 8 digital outputs, 8 analog inputs, plus 2 high-speed counters. With GuardPLC distributed I/O you can place additional safety I/O where your safety field devices are located, reducing wiring costs.

The GuardPLC 1800 offers a built-in four-port Ethernet switch and 100M GuardPLC Ethernet comes standard. For flexibility in connecting to HMI devices and standard PLCs, the controller includes EtherNet/IP, Modbus RTU Slave or PROFIBUS DP Slave, an RS-485 port for ASCII communications.

At 10 ms throughput, this controller is one of the fastest safety PLCs in the industry. Its exceptionally high mean time between failures helps increase the safety and reliability of your system. Removable terminal blocks make swapping controllers a quick task so operations can be up and running again quickly in the event of failure.

Features

- 32 digital I/O points: 24 inputs, 8 outputs
- 8 analog inputs
- 2 high-speed counters
- EtherNet/IP for easy integration with standard PLCs and HMIs.
- Modbus RTU slave and PROFIBUS DP slave communication options – allow the controller to connect to standard PLCs and HMI devices, and an RS-485 port is available for ASCII communication (read only).
- Programmed with RSLogix Guard PLUS! software
- Certified by TÜV for use in applications to SIL 3 according to IEC 61508 and PLe/Category 4, according to ISO 13849-1
- DIN rail mounting

Specifications

General Specifications

The following specifications are common to all GuardPLC products unless indicated.

Temperature, operating	0…60 °C (32…140 °F)
Temperature, nonoperating	-40…85 °C (-40…185 °F) without backup battery
Relative Humidity	95%
Vibration	1 g @ 10…150 Hz
Shock, operating	15 g

Certifications

(When product is marked.)

Certifications	GuardPLC 1600, GuardPLC 1800, and 1753 I/O
c-UL-us	c-UL Listed Industrial Control Equipment.
CE	Compliant for all applicable directives.
C-Tick	C-Tick compliant with all applicable acts
Functional Safety	certified by TÜV up to SIL 3, and PLe/Cat. 4

GuardPLC 1800 Controller Specifications

Cat. No.	1753-L32BBBM8A	1753-L32BBBP8A
Application Memory	250 KB	
User Program Memory	250 Kbytes	
Available User Memory	500	
Current Consumption	9 A with maximum load 0.75 A idle current (controller only)	
Operating Voltage Range	24V DC, -15% to +20%, $w_{ss} \leq 15\%$∗	
Communication Ports	4 Ethernet 10/100BaseT ports 1 9-pin D-shell RS-485 port (Modbus Slave) 1 9-pin D-shell RS-485 port (GuardPLC ASCII) 1 9-pin D-shell Comm port (unused)	4 Ethernet 10/100BaseT ports 1 9-pin D-shell RS-485 port (PROFIBUS DP Slave) 1 9-pin D-shell RS-485 port (GuardPLC ASCII) 1 9-pin D-shell Comm port (unused)
Ethernet Port	4 RJ-45	
EtherNet/IP Communication Rate	10/100 Mbps	
Enclosure Protection	IP20	
Digital Inputs		
Number of Digital Inputs	24 safety❄	
Voltage, On-State Input, Max.	30V DC	
Voltage, On-State Input, Nom.	24V DC	
Digital Outputs		
Number of Digital Outputs	8 safety❄	
Current, On-State Output, per Channel	Channels 1…3; 5…7: 0.5 A @ 60 °C (140 °F) Channels 4 and 8: 1 A @ 60 °C (140 °F); 2 A @ 50 °C (122 °C)	
Voltage, On-State Output, Max.	Supply Voltage (L+)	
Voltage, On-State Output, Min.	Supply Voltage (L+) minus 2V	
Voltage, On-State Output, Nom.	24V DC	
Counters		
Number of Counters	2 safety❄	
Counter Resolution, Bits	24 bits	
Counting Frequency (kHz), Max.	100	
Inputs per Counter	3 (A, B, Z)	
Analog Inputs		
Number of Analog Inputs	8 safety‡	
Input Resolution	12-bit	
Input Signal Range	0…10V DC (nominal); -0.1…11.5V DC (service value) 0…20 mA (nominal); 0.4…23 mA (service value)§	
Accuracy	0.1% @ 25 °C (77 °F) 0.5% @ 60 °C (140 °F)	
Safety Accuracy	± 2%	
General		
Dimensions (HxWxD), Metric	114 x 257 x 81 mm♣	
Dimensions (HxWxD), Imperial	4.49 x 10.1 x 3.19 in♣	

∗ From a power supply with protective separation conforming to IEC 61131-2 requirements.
❄ Not electrically isolated.
‡ Unipolar, not electrically isolated.
§ With 500 Ω shunt.
♣ Height including latch; width including housing screws; depth including grounding bolt and shield plate.

Distributed Safety I/O for GuardPLC Ethernet

Take advantage of all the benefits of traditional distributed I/O with GuardPLC distributed safety I/O, available for all GuardPLC systems.

GuardPLC distributed I/O modules provide considerable flexibility in configuring the right mix of I/O in the right place. The 16 digital input module offers 4 pulse test source terminals, allowing users to pulse test all 16 digital inputs from the I/O module and providing PLe/Category 4 capable safety circuitry while retaining all the advantages of distributed I/O. The 16 digital output module is rated for 2A on every other output point, limiting the need for additional interposing safety relays for additional current and therefore saving on machine costs.

The safety relay output module can provide dry contact enable signals as well as high current AC or DC outputs. The 8 input/8 output and 16 input/8 output digital combination modules feature both positive and negative switching outputs, for applications that use diverse outputs. The analog input module lets you distribute analog inputs for more process-oriented safety applications.

All I/O modules include GuardPLC 100 Mbps Ethernet, which provides one of the fastest safety networks and machine stop times in the industry. The built-in two-port Ethernet switches make connecting I/O modules to the GuardPLC controller as easy as daisy-chaining Ethernet cable from I/O module to controller.

Benefits

- Place the I/O where the devices reside.
- Reduce wiring costs and the time necessary to wire the machine or cell.
- Reduce machine or cell start up time.
- Increase machine and cell reliability.

Digital Safety I/O Module Specifications

Cat. No.	1753-IB16	1753-IB8XOB8	1753-IB16XOB8	1753-IB20XOB8	1753-OB16
Description	GuardPLC Digital Input Module	GuardPLC Digital Combination Module	GuardPLC Digital Combination Module	GuardPLC Digital Combination Module	GuardPLC Digital Output Module
Operating Voltage Range	24V DC, -15%…+20%, w_{ss} 15%✶	24V DC, -15%…+20%, w_{ss} 15%✶	24V DC, -15%…+20%, w_{ss} 15%✶	24V DC, -15%…+20%, w_{ss} 15%✶	24V DC, -15%…+20% w_{ss} 15%✶
Digital Inputs					
Number of Digital Inputs	16 safety❄	8 safety❄	16 safety❄	20 safety❄	—
Voltage, On-State Input, Nom.	24V DC	24V DC	24V DC	24V DC	—
Digital Outputs					
Number of Digital Outputs	—	8 positive-switching and 2 negative-switching safety ❄	8 positive-switching and 8 negative-switching safety ❄	8 safety❄	16 safety❄
Current, On-State Output, per Channel	—	L+ Channels 1…3, 5…7: 0.5 A @ 60 °C (140 °F) L+ Channels 4 and 8: 1 A @ 60 °C (140 °F), 2 A @ 40 °C (104 °F) L- Channels 1 and 2: 1 A @ 60 °C (140 °F), 2 A @ 40 °C (104 °F)	Channels 2, 4, 5 and 7: 0.5 A @ 60 °C (140 °F) Channels 1 and 8: 1 A @ 60 °C (140 °F), 2 A @ 40 °C (104 °F) Channels 3 and 6: 1 A @ 60 °C (140 °F)	Channels 1…3, 5…7: 0.5 A @ 60 °C (140 °F) Channels 4 and 8: 1 A @ 60 °C (140 °F), 2 A @ 50 °C (122 °F)	1 A @ 60 °C (140 °F) 2 A @ 40 °C (104 °F)
Voltage, On-State Output, Max.	—	Supply Voltage (L+)	Supply Voltage (L+)	Supply Voltage (L+)	Supply Voltage (L+)
Pulse Test Sources					
Number of Pulse Test Sources	4❄	2❄	2❄	—	—
General					
Temperature, operating	0…60° C (32…140° F)	0…60°C (32…140°F)	0…60°C (32…140°F)	0…60°C (32…140°F)	0…60 °C (32…140 °F)
Temperature, nonoperating	-40…85 °C (-40…185 °F)	-40…85 °C (-40…185 °F)	-40…85 °C (-40…185 °F)	-40…85 °C (-40…185 °F)	-40…85 °C (-40…185 °F)
Dimensions (HxWxD), Metric	114 x 152 x 78 mm‡	114 x 152 x 78 mm‡	114 x 205 x 100 mm‡	114 x 207 x 78 mm‡	114 x 207 x 78 mm‡
Dimensions (HxWxD), Imperial	4.49 x 5 99 x 3.07 in‡	4.49 x 6.00 x 3.07 in‡	4.49 x 8.08 x 3.94 in‡	4.49 x 8.16 x 3.07 in‡	4.49 x 8.16 x 3.07 in‡

✶ Requires a power supply with protective separation, conforming to IEC 61131-2 requirements.
❄ Not electrically isolated.
‡ Height including latch; width including housing screws; depth including grounding bolt and connectors.

Digital Relay Safety Output Module Specifications

Cat. No.	1753-OW8
Description	GuardPLC Digital Relay Output Module
Number of Outputs	8 safety relay
Operating Voltage Range	24V DC, -15%…+20% w_{ss} 15%✶
Switching Voltage	5…250 V AC/ DC
Switching Current	• UL: 24V DC @ 1A resistive load, 250V AC @ 6 A general purpose • TUV: up to 240VA (for V AC), up to 30V DC @ 90 W, up to 70V DC @ 35 W, up to 127V DC @ 30 W
Service Life, Mechanical	≥10^6 switching cycles
Temperature, operating	0…60 °C (32…140 °F)
Temperature, nonoperating	-40…+85 °C (-40…+185 °F)
Dimensions (HxWxD), Metric	114 x 207 x 98 mm❄
Dimensions (HxWxD), Imperial	4.49 x 8.16 x 3.86 in❄

‡ External fusing adapted.
✶ Requires a power supply with protective separation, conforming to IEC 61131-2 requirements.
❄ Height including latch; width including housing screws; depth including grounding bolt and connectors.

Analog Safety I/O Module Specifications

Cat. No.	1753-IF8XOF4
Description	GuardPLC Analog Combination Module
Operating Voltage Range	24V DC, -15%…+20%, w_{ss} 15%✶
Number of Safety Analog Inputs	8
Input Signal Range	Nominal: 0…+10V DC or 0…20 mA (with shunt) Service: -0.1…+11.5V DC or -0.4…23 mA (with shunt)
Input Impedance	Analog Input: >2 MΩ
Input Resolution	12 bit
Accuracy	0.5%
Number of Analog Outputs (Standard)	4‡
Output Signal Range	4…20 mA 0…20 mA
Output Impedance	Current Output: 600 Ω max.
Temperature, operating	0…60°C (32…140°F)
Temperature, nonoperating	-40…85 °C (-40…185 °F)
Dimensions (HxWxD), Metric	114 x 207 x 111 mm❄
Dimensions (HxWxD), Imperial	4.49 x 8.16 x 4.37 in❄

‡ Non-safety-related with common safety switch-off.
✶ Requires a power supply with protective separation, conforming to IEC 61131-2 requirements.
❄ Height including latch; width including housing screws; depth including grounding bolt, connectors, and shield plate.

RSLogix Guard PLUS! Programming Software

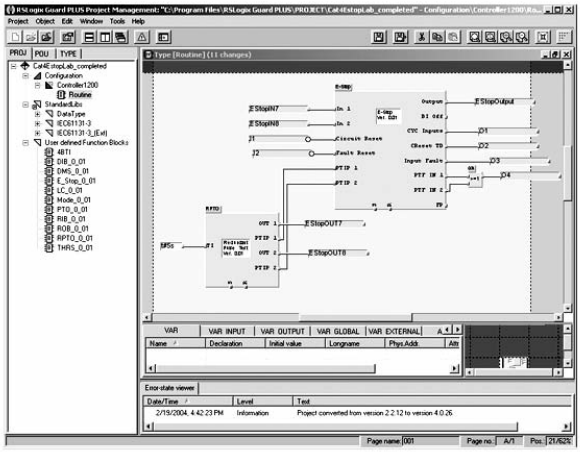
Development and testing of programs for all GuardPLC systems is done with RSLogix Guard PLUS! programming software, an easy to use yet highly powerful programming software. RSLogix Guard PLUS! software is project-based, meaning you can store programs for multiple controllers in one project.

RSLogix Guard PLUS! is based on graphical function blocks. Simply design your logic using pre-defined elements such as AND-gates, OR-gates, numerical functions, etc., then connect inputs and outputs using the mouse.
RSLogix Guard PLUS! software offers unlimited data tags, program pages, and function blocks for maximum flexibility.

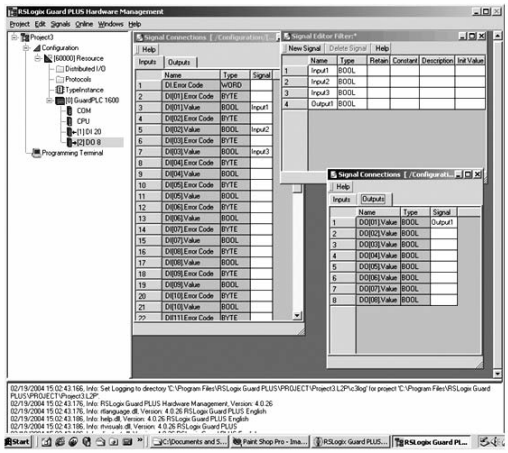
Once RSLogix Guard PLUS! software has been configured for the chosen controller, input and output variables are defined in a tag list to establish the link between hardware and software in a manner similar to that used by ControlLogix controllers and RSLogix 5000 programming software.

To save time and decrease development effort, the offline program simulation allows you to test your program without downloading it to a GuardPLC controller. Online program monitoring allows you to view your logic inside the controller to see which parts are logically true and false and to troubleshoot as necessary.

RSLogix Guard PLUS! Programming Software Examples



Use the project management screen to write a program, perform offline program simulation, and view the program running online.



The hardware management screen within RSLogix Guard PLUS! lets you configure the hardware of your GuardPLC system, create tags, and then drag them into your program.

Benefits

- Ease of use – program your safety control system using pre-defined graphical elements and a "drag and drop" palette.
- Tag-based system – define program variables to suit specific application and use variable names.
- Offline program simulation – test your program without using the controller.
- Online program monitoring – eases troubleshooting by viewing logic inside of GuardPLC controllers.
- Unlimited program pages and unlimited variables – configure program to suit specific needs.
- User-defined function blocks with library function – create your own specific instructions.
- Project-based controller linkage – store programs from multiple controllers in one project; ideal for cells that contain multiple GuardPLC controllers.
- Safety certified function blocks – save programming and configuration time by using function blocks that are already certified for use in safety applications.

System Requirements

Requirements to install RSLogix Guard PLUS! programming software on a personal computer.

Requirements	Minimum	Recommended
Personal Computer	Pentium III, 500 MHz	Pentium IV, 1.2 GHz
Operating System	Windows NT/2000	Windows NT/2000/XP
RAM	256 MB	512 MB
Free Hard Disk Space	at least 200 MB plus space for user programs	at least 200 MB plus space for user programs
Resolution	1024 x 768/256 colors	1280 x 1024/true color

GuardPLC™ Safety Control Systems

RXLogix Guard PLUS! Programming Software/GuardPLC Hand-held Terminal

RSLogix Guard PLUS! Programming Software

You can install RSLogix Guard PLUS! programming software on a local drive only (not a network).

Cat. No.	Description
1753-PCS-USB	RSLogix Guard PLUS! for all GuardPLC controllers. USB hardlock.
1753-PCS-PAR	RSLogix Guard PLUS! for all GuardPLC controllers. Parallel port hardlock.

Certified Function Blocks for RSLogix Guard PLUS!

GuardPLC Certified Function Blocks are additional, application-specific instructions that can be used in your GuardPLC controller's application program. Certified by TÜV, these function blocks make application development, debugging, and troubleshooting quicker and easier. Certified Function Blocks are sold in suites or libraries that contain several blocks for specific applications.

Cat. No.	Description
1753-CFBBASIC	Basic Suite of Certified Function Blocks. Includes: E-stop. Diverse Input, Light Curtain, Two-hand Run Station, Enable Pendant, Redundant Output, and Pulse Test Output.

GuardPLC OPC Server Software

GuardPLC OPC Server software allows a Windows-based PC to read data from and write data to the GuardPLC controller across the GuardPLC Ethernet network. For example, a VersaView computer could be running the GuardPLC OPC server and RSView software, then could display status information from the GuardPLC controller, such as which e-stop has been pressed, which gate is open, or which light curtain has been interrupted.

Cat. No.	Description
1753-OPC	GuardPLC OPC Server software

GuardPLC Hand-held Terminal

The GuardPLC Hand-held Terminal is a maintenance tool that lets you commission new GuardPLC controllers and Distributed I/O modules by downloading configuration data and the application program. Store all of the programs for a project on a multimedia memory card, and connect to any GuardPLC device on the Ethernet network. The hand-held terminal is ideal for a downtime event that requires quick replacement of a GuardPLC controller or DIO block, helping to get production up and running again.

1753-HHT Specifications

Operating Voltage Range	2.4…3.0V DC
Current Consumption	Approximately 360 mA (display illumination off) Approximately 560 mA (display illumination max)
Batteries	2 AA rechargeable batteries NiMH 2000 mAh or standard batteries
Operating Time, Min. with NiMH 2000 mAh batteries	Approximately 3 hours
Battery Charger, Supply Voltage	12V
Battery Charger, Current Input	≤ 0.83 A
Battery Charger, Charging Current	Approximately 1 A
Battery Charger, Trickle Charge	25 mA
Temperature, operating	5…55 °C (41…131 °F)
Temperature, nonoperating	-40…70 °C (-40…158 °F)
Relative Humidity	5…90% noncondensing
Vibration	5 g @ 10…500 Hz
Shock, operating	15 g
Dimensions (HxWxD), Metric	16.5 x 9 x 3 cm
Dimensions (HxWxD), Imperial	6.5 x 3.4 x 1.2 in
Weight, Metric	300 g
Weight, Imperial	0.66 lb

GuardLogix Integrated Safety System Overview

A GuardLogix® controller is a full-function Logix processor that also provides safety control. The GuardLogix system is a dual processor solution that uses a primary controller and a safety partner to achieve SIL 3, PLe. A major benefit of this system is that it is a single project, with safety and standard control together. The GuardLogix system is a 1oo2 safety architecture that provides unmatched safety and ease of use.

Just like other Logix processors during development, safety and standard have the same rules. Online editing, forcing, even multiple users are all allowed. Once the project is tested and ready for final validation, you set the Safety Task to a SIL 3 integrity level, which is then enforced by the GuardLogix controller. When safety memory is locked and protected, the safety logic cannot be modified. On the standard side of the GuardLogix controller, all functions operate like a regular Logix controller, motion, drive, sequential, even process. Thus, online editing, forcing, and other activities are all allowed, while safety is securely isolated.

With this level of integration, safety memory can be read by standard logic and external devices, such as HMIs or other controllers, eliminating the need to condition safety memory for use elsewhere. The result is easy, system-wide integration and the ability to display safety status on displays or marquees. Use Guard I/O modules for field device connectivity on Ethernet or DeviceNet networks. For safety interlocking between GuardLogix controllers, use Ethernet or ControlNet networks. Multiple GuardLogix controllers can share safety data for zone-to-zone interlocking, or a single GuardLogix controller can use remote distributed safety I/O between different cells/areas.

Environmentals and Certifications

GuardLogix Controllers Environmental Specifications

	1756 GuardLogix Controllers	1768 Compact GuardLogix Controllers∗
Operating temperature	0…60 °C (32…140 °F)	0…60 °C (32…140 °F)
Storage temperature	-40…85 °C (-40…185 °F)	-40…85 °C (-40…185 °F)
Relative humidity	5…95% noncondensing	5…95% noncondensing
Vibration	2 g at 10…500 Hz	5 g at 10…500 Hz
Operating shock	30 g	30 g
Nonoperating shock	50 g	50 g

∗ 1768 Compact GuardLogix controller specification and certification listings are preliminary.

GuardLogix Controllers Certifications

Certifications: UL, c-UL-us, CE, CSA, C-Tick, FM, ATEX, certified by TÜV for Functional Safety.

When product is marked. See the Product Certification link at www.ab.com/certification/ce to Declarations of Conformity, Certificates, and other certification details. For safety and SIL certification details, see www.rockwellautomation.com/products/certification/safety/index.html.

GuardLogix Controllers

Cat. No.	Description	User Memory		Module Expansion Capacity‡
		Standard Tasks and Components	Safety Task and Components	
1756-L61S	GuardLogix safety controller	2 MB	1 MB	Not applicable
1756-L62S		4 MB	1 MB	
1756-L63S		8 MB	3.75 MB	
1756-LSP	GuardLogix safety partner∗	—	—	
1768-L43S	Compact GuardLogix safety controller	2 MB	0.5 MB	1768 Modules: 2 1769 Modules: 16
1768-L45S		3 MB	1 MB	1768 Modules: 4 1769 Modules: 30

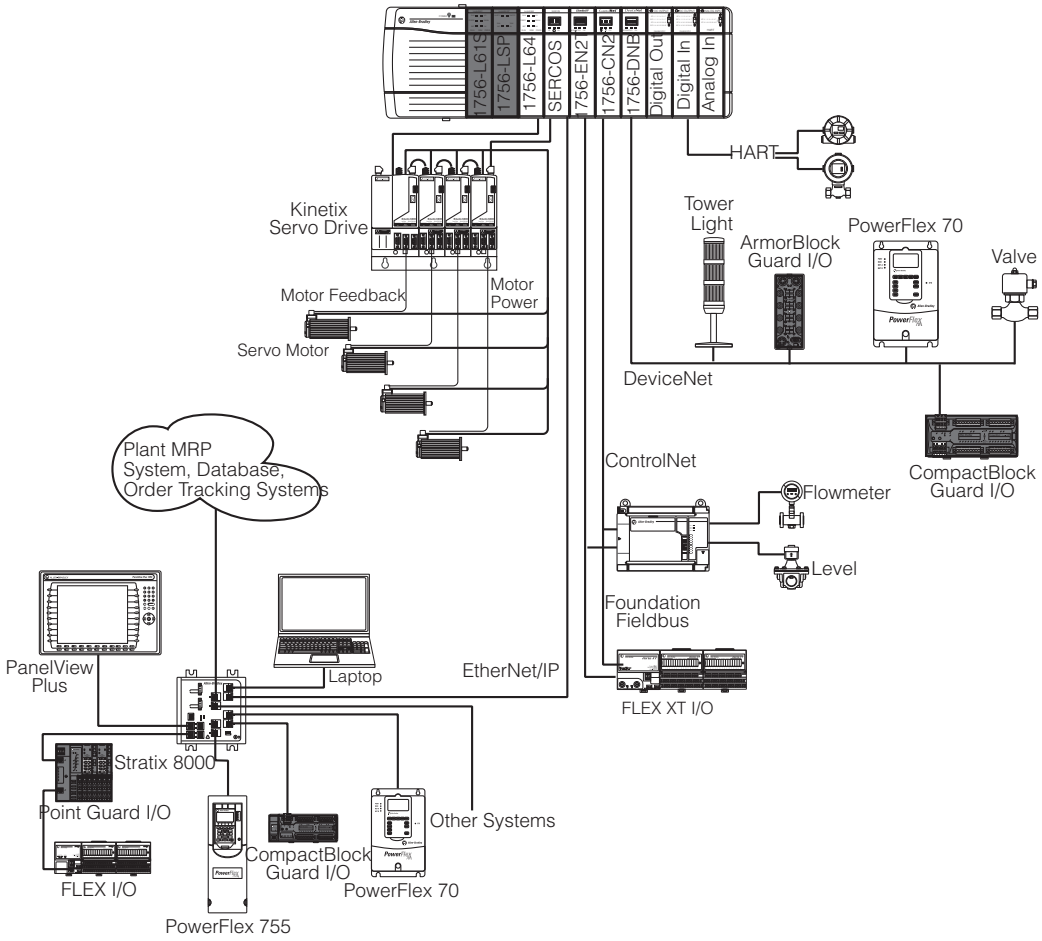
∗ A safety partner is required for each 1756 GuardLogix controller.
‡ You can install any combination of motion and network modules in a 1768 system. A maximum of two network modules may be installed in a 1768 system.

Features

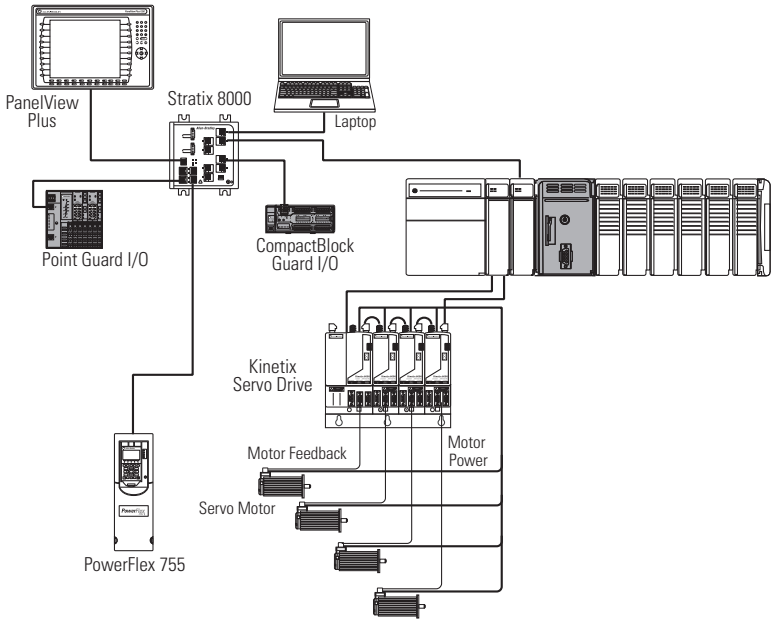
In addition to the standard features of a Logix controller, GuardLogix controllers have these safety-related features.

Feature	1756-L61S, 1756-L62S, 1756-L63S, 1756-LSP	1768-L43S, 1768-L45S	
Communication options	Standard and safety • EtherNet/IP • ControlNet • DeviceNet	Standard • EtherNet/IP • ControlNet • DeviceNet	Safety • EtherNet/IP • ControlNet
Network connections, per network module	• 256 EtherNet/IP; 128 TCP (1756-EN2x) • 128 EtherNet/IP; 64 TCP (1756-ENBT) • 100 ControlNet (1756-CN2/A) • 40 ControlNet (1756-CNB)	• 128 EtherNet/IP; 64 TCP (1768-ENBT) • 48 ControlNet (1768-CNB)	
Controller redundancy	Not supported		
Programming languages	Standard control—all languages Safety control—relay ladder		

Example Configuration—1756 GuardLogix System



Example Configuration—1768 Compact GuardLogix System



Standard Components in a GuardLogix System

Virtually all standard components are approved for use in GuardLogix safety systems. For specific series or version supported, see www.rockwellautomation.com/products/certification/safety/index.html.

For control that is not SIL 3 related, other 1756 series I/O modules can be used with 1756 GuardLogix controllers and 1768 or 1769 I/O modules can be used with 1768 Compact GuardLogix controllers. These modules must be certified to the Low Voltage and EMC Directives. Refer to www.ab.com/certification/ce to find the certificate for the Programmable Control – ControlLogix or CompactLogix Product Families.

Accessories

Replacement Batteries

	1756-BA2
Description	Lithium battery (0.59 g)
GuardLogix controllers	1756-L61S, 1756-L62S, 1756-L63S

Industrial CompactFlash Cards

CompactFlash cards offer nonvolatile memory (flash) to permanently store a user program and tag data on a controller. You install the 1784 CompactFlash card in a socket on the controller. You can manually trigger the controller to save to or load from nonvolatile memory or configure the controller to load from nonvolatile memory on power up.

1756 and 1768 GuardLogix controllers support user program storage or retrieval by using a CompactFlash card with version 18 or later of RSLogix 5000 software.

	1784-CF64	1784-CF128
Memory	64 MB	128 MB
Weight, approx.	14.2 g (0.5 oz)	

Software

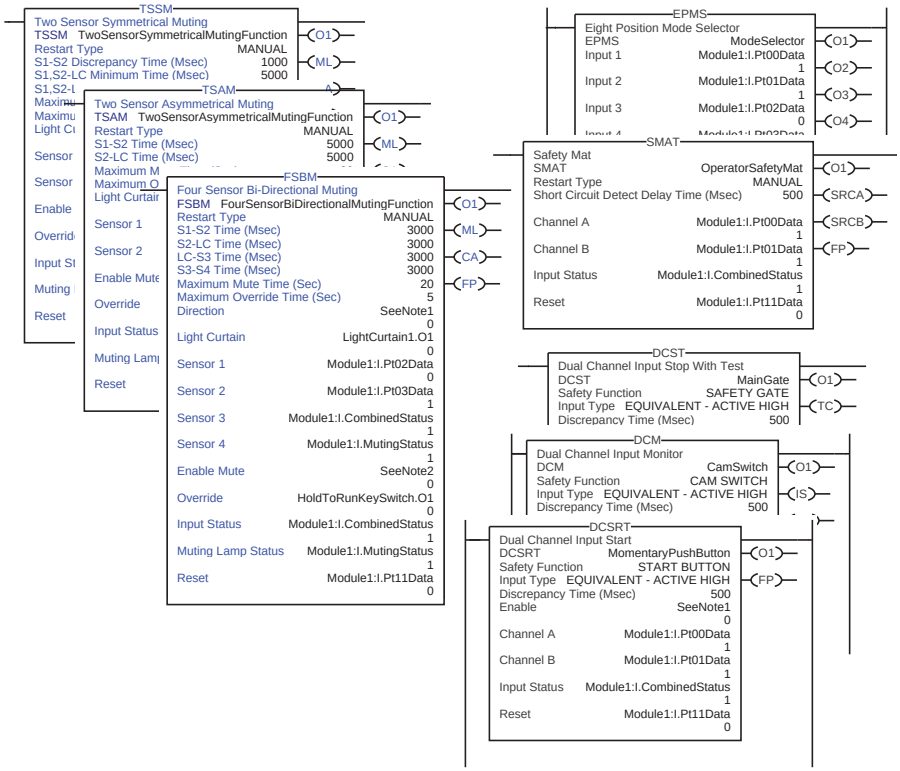
GuardLogix controllers use RSLogix™ 5000 programming software, the standard development environment for all Allen-Bradley Logix controllers. RSLogix 5000 software manages safety, so you don't have to manually manage the separation of standard and safety memory, or worry about partitioning logic to isolate safety.

FactoryTalk Suite from Rockwell Software extends the Rockwell Automation Integrated Architecture™ by providing an information tier of software applications and services for production and performance management. Tight integration with the Rockwell Automation Logix control platform, as well as connectivity to third-party and legacy systems can help deliver a seamless flow of high-fidelity data across your enterprise.

Safety-certified Instructions in RSLogix 5000 Software

All instructions available for use within the safety task are certified safety instructions. Choose from standard relay ladder safety instructions and safety application instructions, including:

- 49 safety-certified instructions
  - Subset of standard ladder logic instruction set
- Safety-certified application instructions
  - Dual channel suite - 6 instructions
  - Metalforming suite - 10 instructions
  - Muting suite - 3 instructions
  - Safety mat



Safety application instructions provide unmatched ease of use for complex safety functions like muting, safety gate control, metalforming, and more.

Guard I/O™ Modules

Overview

Guard I/O™ Modules Overview

Control and monitor your safety devices with Guard I/O. When used with Rockwell Automation safety controllers, Guard I/O communicates on EtherNet/IP or DeviceNet using CIP Safety protocol. As an effective technology, Guard I/O detects failures at the I/O and field device level, while helping enhance operator protection.

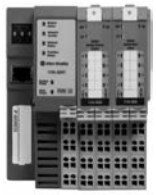
CompactBlock Guard I/O modules are available in IP20 (in-cabinet) form factor. ArmorBlock Guard I/O modules are IP64, IP65, or IP67 (on-machine) form factor (as marked on the product label) . POINT Guard I/O provides maximum I/O density in minimal panel space.

Guard I/O modules offer the following advantages when implementing a safety control system:

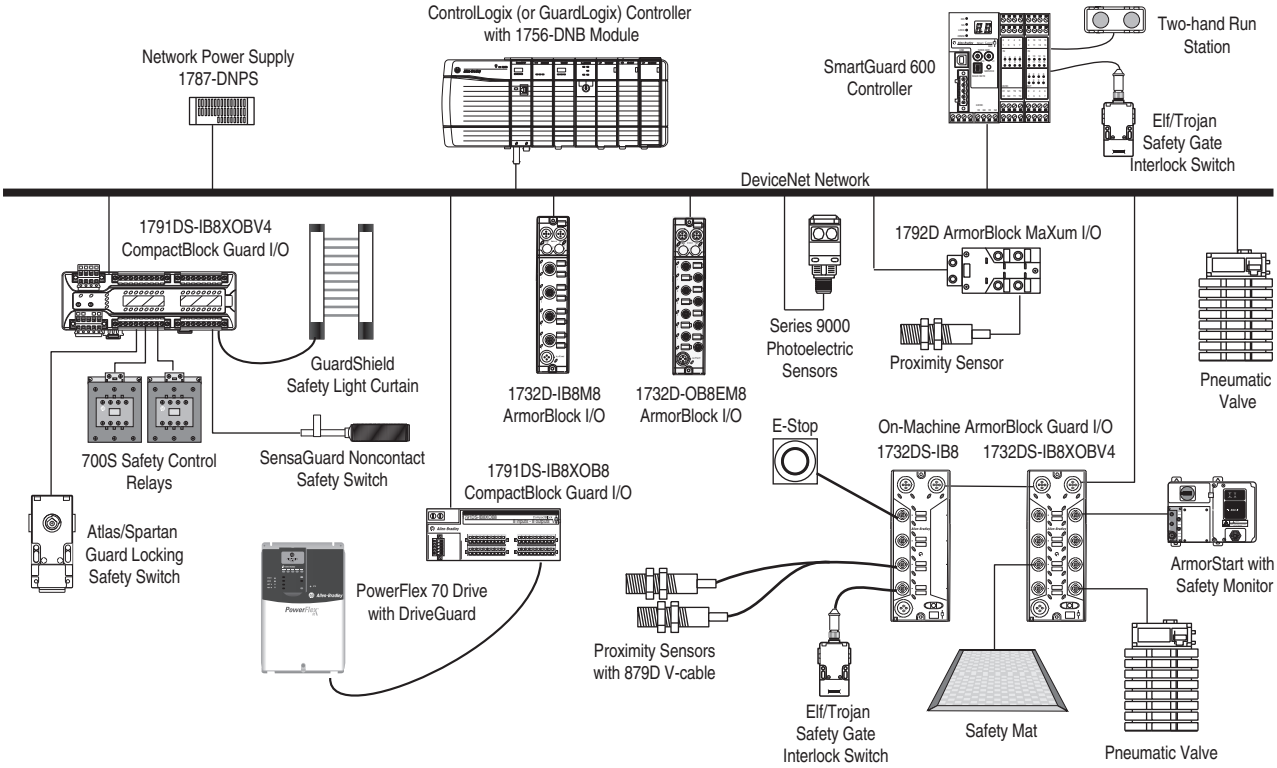
- **Reduced engineering** — Onboard, Guard I/O has self-diagnostics, hardware testing, and field circuit testing (short-circuit, wire break, discrepancy) with no additional programming required.
- **Cost-reduced hardware options** — Helps increase ability to safely shutdown an application without additional safety relays.
- **Space-savings** — Monitor and control more safety devices using less panel space.
- **Use of existing network infrastructures** — Connect to standard and safety I/O over one DeviceNet or EtherNet/IP network.
- **Flexibility and easy migration to EtherNet/IP** — The same Guard I/O modules for both DeviceNet and EtherNet/IP networks lets you re-use engineering designs.
- **High safety level** — certified by TÜV for Functional Safety up to SIL 3 and PLe/Category 4.

Common Guard I/O Module features:

- Integrated pulse test outputs for testing safety circuitry like e-stops and gate switches, for use in applications up to Performance Level e/Category 4. These outputs can also be used independently for standard output control or voltage source to sensors.
- Safety outputs, with integrated pulse testing for use in applications up to PLe, Cat.4.
- Ability to detect at each I/O point:
  - short-circuit to 24V DC or 0V
  - wire breakage
  - discrepancy of dual channel circuitry, due to mechanical alignment or a failure
- All Guard I/O modules have common circuit functionality, operation, programming, troubleshooting, and diagnostics.
- Built in diagnostic LEDs for I/O circuitry and power status.
- I/O point status available to any controller.
- EDS file or Logix 5000 profile compatible.
- Removable and keyed terminal blocks.
- Common power and I/O wiring across Guard I/O modules on DeviceNet and EtherNet/IP networks (1791DS-IB16/1791ES-IB16 and 1791DS-IB8XOBV4/1791ES-IB8XOBV4).
- Safety input power source separate from safety output power source.
- Removable and insertable under power, when following appropriate safety practices.
- Electronic overcurrent protection of all outputs.

	CompactBlock Guard I/O Modules	ArmorBlock Guard I/O Modules	 POINT Guard I/O Modules
Description	Cost-effective block I/O for use in an enclosure.	Cost-effective block I/O with IP64, IP65, or IP67 protection (as indicated on the product label) for use on the machine.	Cost-effective I/O modules provide maximum I/O density in minimum panel space.
Digital Safety Inputs	Up to 16 channels	Up to 8 channels	Up to 8 channels
Digital Safety Outputs	Up to 8 channels	Up to 4 channels	Up to 8 channels
Safety Relays	Up to 4 channels (1791DS)	No	No
High Current Capacity Outputs	Up to 2 amps per channel	Up to 2 amps per channel	Up to 1 amp per channel
Use in Hazardous Areas	UL Listed for Class I, Division 2 Group A,B,C,D	No	UL Listed for Class I, Division 2 Group A,B,C,D; ATEX
DeviceNet			
Interface Module	1756-DNB, 1753-DNSI, 1752	1756-DNB, 1753-DNSI, 1752	1734-PDN
Bulletin Number	1791DS	1732DS	1734
EtherNet/IP			
Interface Module	1756-ENBT, 1756-EN2T, 1756-EN2F	Not available	1734-AENT, 1734-AENTR
Bulletin Number	1791ES	Not available	1734

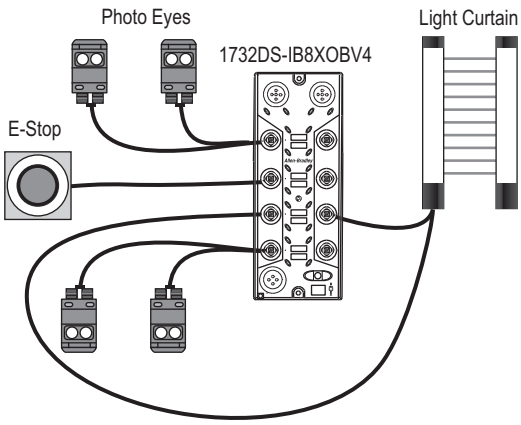
Typical Configurations

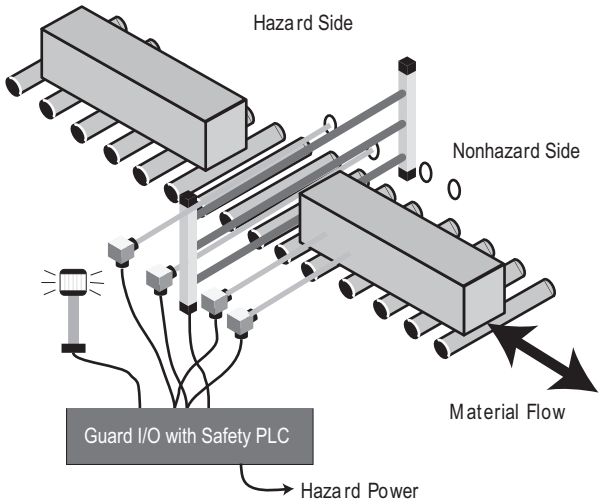


The above example network shows how almost any 24V DC safety-rated or standard sensor can be wired to any Guard I/O module to monitor the machine's status.

Choosing Your I/O Hardware

Guard I/O module options are available to minimize associated safety hardware. Additionally, installation costs, wiring time, and commissioning time can be further reduced when using ArmorBlock Guard I/O, as shown in the example below with a light curtain muting application.





A variety of CompactBlock Guard I/O is available to suit most every need.

- **1791DS-IB8XOB8 Module.** This module has up to 8 single channel safety inputs and 8 single channel safety outputs. It is often the universally chosen Guard I/O hardware for almost every application. Whether you need single or dual channel safety input or safety output circuits, the 1791DS–IB8XOB8 module is a good choice.
- **1791DS-IB4XOW4 Module.** This module has up to 4 single channel safety inputs and 4 single channel (replaceable) safety relay outputs. This module is often chosen for AC actuators or specialty safety interface applications. Whether you need single or dual-channel safety input or safety output circuits, the 1791DS-IB4XOW4 module is a good choice.
- **1791DS-IB8XOBV4 or 1791ES-IB8XOBV4 Modules.** These modules have up to 8 single channel safety inputs and 4 dual channel sink/source safety outputs, also know as bipolar or two-pole switching. They are often chosen for safety actuators that require more than 0.5 amps. For example, the control of press safety valves or control of the solenoid on a guard-locking switch like the Atlas or Trojan safety products. Whether you need single or dual channel safety input circuits and dual channel safety outputs, the 1791DS-IB8XOBV4 or 1791ES-IB8XOBV4 module will suit most any application.
- **1791DS-IB16 or 1791ES-IB16 Modules.** These modules have up to 16 single channel safety inputs. They are the universal choice of Guard I/O hardware when an application calls for the monitoring of many safety devices in one central location. When your safety application requires 2 safety mats, 2 run stations with 2 e-stops, or any similar configuration, these modules are an excellent and economical choice for every programmable safety system.

CompactBlock™ Guard I/O™

Description

CompactBlock Guard I/O provides all the advantages of traditional distributed I/O for safety systems. Distributed safety I/O reduces wiring costs and startup time for machines and cells, as compared to in-chassis I/O. You can use Guard I/O with any safety controller that communicates on DeviceNet or EtherNet/IP networks using CIP Safety, for the control and monitoring of safety circuits. Guard I/O detects circuit failures at each I/O point while providing detailed diagnostics directly to the controller. With CIP Safety you can easily integrate safety and standard control systems by using safety and standard messages on the same wire.

Several Guard I/O blocks are available with a variety of features:

- The 1791DS CompactBlock Guard I/O family consists of 24V DC digital I/O modules that communicate on DeviceNet networks.
- The 1791ES CompactBlock Guard I/O family consists of 24V DC digital I/O modules that communicate on EtherNet/IP networks.

Benefits

- TÜV Certified as a system with GuardLogix, GuardPLC 1600 and 1800, and SmartGuard 600 controllers
- Supports both standard and safety control
- I/O point-level and other detailed fault diagnostics are available to the PLC or HMI, with the self testing inputs and outputs
- EDS (RSNetWorx for DeviceNet) or RSLogix 5000 profile configuration
- Certified by TÜV for Functional Safety up to SIL 3 according to IEC 61508, and Category 4, PLe according to ISO 13849-1
- Supports single and dual channel devices on inputs and outputs
- Additional standard solid-state outputs that can be configured as pulse test sources, outputs for standard PLC control, 24V DC sources, or for muting lamp control and monitoring
- DIN Rail mounting for easy installation
- Compatible with Guardmaster and similar safety devices

CompactBlock Guard I/O DeviceNet Safety Module Specifications

Cat. No.	1791DS-IB12	1791DS-IB16	1791DS-IB8XOB8	1791DS-IB8XOBV4	1791DS-IB4XOW4
Description	24V DC Input Module on DeviceNet Networks	24V DC Input Module on DeviceNet Networks	24V DC Input/Solid-State Output Module on DeviceNet Networks	24V DC Input/Output Module on DeviceNet Networks	24V DC Input / Relay Output Module for DeviceNet Networks
Current Consumption	110 mA @ 24V DC	85 mA @ 24V DC	110 mA @ 24V DC	85 mA @ 24V DC	110 mA @ 24V DC
Operating Voltage Range	20.4…26.4V DC (24V DC, -15…+10%)	19.2…28.8V DC (24V DC, -20…+20%)	20.4…26.4V DC (24V DC, -15…+10%)	19.2…28.8V DC (24V DC, -20…+20%)	20.4…26.4V DC (24V DC, -15…+10%)
Digital Inputs					
Number of Inputs (single-channel)	12 safety	16 safety	8 safety	8 safety	4 safety
Input Type	current sinking	current sinking	current sinking	current sinking	current sinking
Voltage, On-State Input, Min.	11 V DC	11 V DC	11 V DC	11V DC	11V DC
Voltage, Off-State Input, Max.	5V DC	5V DC	5V DC	5V DC	5V DC
Current, On-State Input, Min.	6 mA	3.3 mA	6 mA	3.3 mA	6 mA
Digital Outputs					
Number of Outputs	—	—	8 single-channel, safety solid-state	4 dual channel, safety solid-state	4 single-channel, safety relay
Output Type	—	—	current sourcing	current sourcing/current sinking	relay
Output Current Rating	—	—	0.5 A per point	2.0 A continuous	2 A max. per contact
Output Leakage Current, Max.	—	—	0.1 mA	± 1.0 mA	—
Service Life, Electrical	—	—	—	—	100 000 operations, min.
Short Circuit Protection	—	—	Yes	Yes	No
Standard Pulse Test Outputs					
Number of Pulse Test Sources	4	16	4	8	4
Pulse Test Output Current	0.7 A per point	0.7 A per point	0.7 A per point	0.7 A per point	0.7 A per point
Short Circuit Protection	Yes	Yes	Yes	Yes	Yes
General					
Temperature, operating	-10…55° C (14…131 °F)	-20°C…+60°C (-4°F…+140°F)	-10…55° C (14…131 °F)	-20°C…+60°C (-4°F…+140°F)	-10…55° C (14…131 °F)
Relative Humidity	5…95% noncondensing	5…95% noncondensing	10…95% noncondensing	5…95% noncondensing	10…85% noncondensing
Vibration	5 g @ 57…150 Hz	5 g @ 10…500 Hz	5 g @ 57…150 Hz	5 g @ 10…500 Hz	5 g @ 57…150 Hz
Shock, operating	15 g	30 g	15 g	30 g	10 g
Enclosure Protection	IP20	IP20	IP20	IP20	IP20
Dimensions (HxWxD), Metric	68 x 170 x 72 mm∗	81 x 170 x 76 mm∗	68 x 170 x 72 mm∗	81 x 170 x 76 mm∗	95 x 170 x 83 mm∗
Certifications‡	UL, CE, C-Tick, CSA, UL Class I Div 2 Hazardous, UL NRGF, ODVA Conformance, certified by TÜV for Functional Safety up to SIL 3 and Cat. 4, PLe	UL, CE, C-Tick, CSA, UL Class I Div 2 Hazardous, ODVA Conformance, certified by TÜV for Functional Safety up to SIL 3 and Cat. 4, PLe	UL, CE, C-Tick, CSA, UL Class I Div 2 Hazardous, UL NRGF, ODVA Conformance, certified by TÜV for Functional Safety up to SIL 3 and Cat. 4, PLe	UL, CE, C-Tick, CSA, UL Class I Div 2 Hazardous, ODVA Conformance, certified by TÜV for Functional Safety up to SIL 3 and Cat. 4, PLe	UL, CE, C-Tick, CSA, UL NRGF, ODVA Conformance, TÜV certified for functional safety up to SIL 3 and Cat. 4, PLe

∗ Includes DIN latch and connectors.
‡ When product is marked. See the Product Certification link at http://www.ab.com/certification for Declarations of Conformity, Certificates, and other certification details.
All specifications are subject to change. Refer to product installations instructions.

CompactBlock Guard I/O EtherNet/IP Safety Module Specifications

Cat. No.	1791ES-IB16	1791ES-IB8XOBV4
Description	24V DC Input Module on EtherNet/IP	24V DC Input/Output Module on EtherNet/IP
Current Consumption	250 mA @ 24V DC	250 mA @ 24V DC
Operating Voltage Range	19.2…28.8V DC (24V DC, -20…+20%)	19.2…28.8V DC (24V DC, -20…+20%)
Digital Inputs		
Number of Inputs	16 single channel; 8 dual channel	8 single channel; 4 dual channel
Input Type	current sinking	current sinking
Voltage, On-State Input, Min.	11 V DC	11 V DC
Voltage, Off-State Input, Max.	5V DC	5V DC
Current, On-State Input, Min.	3.3 mA	3.3 mA
Digital Outputs		
Number of Outputs	0	4 dual channel
Output Type	—	Current sourcing/current sinking - bipolar pair
Output Current Rating	—	2.0 A continuous
Short Circuit Protection	Yes	Yes
Standard Pulse Test Outputs		
Number of Pulse Test Sources	16 current sourcing	8 current sourcing
Pulse Test Output Current	0.7 A per point	0.7 A per point
Short Circuit Protection	Yes	Yes
General		
Temperature, operating	-20…60° C (-4…140° F)	-20…60° C (-4…140° F)
Relative Humidity	5…95% noncondensing	5…95% noncondensing
Vibration	5 g at 10…500 Hz	5 g at 10…500 Hz
Shock, operating	30 g	30 g
Enclosure Protection	IP20	IP20
Dimensions (HxWxD), Metric	80 x 196 x 77 mm∗	80 x 196 x 77 mm∗
Certifications‡	cULus, CE, C-Tick, CSA, UL Class I Div 2 Hazardous, UL NRGF, ODVA Conformance, certified by TÜV and UL for Functional Safety up to SIL 3 and Cat. 4, PLe	cULus, CE, C-Tick, CSA, UL Class I Div 2 Hazardous, UL NRGF, ODVA Conformance, certified by TÜV and UL for Functional Safety up to SIL 3 and Cat. 4, PLe

∗ Includes terminal block.
‡ When product is marked. See the Product Certification link at http://www.ab.com/certification for Declarations of Conformity, Certificates, and other certification details.

All specifications are subject to change. Refer to product installations instructions.

ArmorBlock® Guard I/O™

Description

ArmorBlock® Guard I/O™ provides all the advantages of traditional distributed I/O for safety systems, but has an IP64, IP65, or IP67 package (as marked on the product label) that can be mounted directly on your machine. On-machine safety I/O reduces wiring time and startup costs for safety controller applications by eliminating electrical boxes and simplifying cable installation. The ArmorBlock family provides industrially hardened I/O blocks that you can mount directly on equipment near sensors or actuators. Wiring the I/O to the sensors and actuators is easy using pre-wired quick disconnect cables.

You can use Guard I/O with any safety controller that communicates on DeviceNet using CIP Safety for the control and monitoring of safety circuits. Guard I/O detects circuit failures at each I/O point while providing detailed diagnostics directly to the controller. With CIP Safety, you can easily integrate safety and standard control systems by using safety and standard messages on the same wire.

The 1732DS ArmorBlock Guard I/O family consists of 24V dc digital I/O modules that communicate on DeviceNet networks. The I/O connectors are sealed M12 micro style while the network and auxiliary power connectors are sealed mini style. Plus, the ArmorBlock Guard I/O uses the same input and output M12 pin configuration as standard ArmorBlock and Maxum.

Benefits

- IP64, IP65, or IP67 rated for direct mounting on machine without an enclosure (rating is marked on the product label)
- Compact footprint
- Quick disconnect dual-channel M12 I/O connectors allow a single cable connected between ArmorBlock Guard I/O and a dual-channel safety device (See the following table of Allen-Bradley Guardmaster safety devices)
- TÜV certified as a system with GuardLogix, GuardPLC1600/1800, SmartGuard 600 controllers
- Supports both standard and safety control
- Supports single and dual-channel devices on inputs and outputs
- I/O point-level and other detailed fault diagnostics are available to the PLC or HMI with self-testing inputs and outputs
- EDS (RSNetWorx for DeviceNet) or RSLogix 5000 profile configuration
- Certified by TÜV and UL for Functional Safety up to SIL 3 according to IEC 61508, and PLe/Category 4, according to ISO 13849-1
- Additional standard solid-state outputs can be configured as pulse test sources, outputs for standard PLC control, 24V dc sources, or muting lamp control and monitoring

Specifications

Cat. No.	1732DS-IB8	1732DS-IB8XOBV4
Description	24V DC Input Module for DeviceNet Networks	24V DC Input/Output Module on DeviceNet Networks
Current Consumption	85 mA @ 24V DC	
I/O Operating Voltage Range	19.2V…28.8 V DC (24V DC, -20…+20%)	
Digital Inputs		
Number of Inputs	8 safety single-channel or 4 safety dual-channel	
Input Type	current sinking	
Voltage, On-State Input, Min.	11V DC	
Voltage, Off-State Input, Max.	5V DC	
Current, On-State Input, Min.	3.3 mA	
Digital Outputs		
Number of Outputs	—	4 safety solid-state
Output Type	—	dual channel, current sourcing/current sinking pair
Output Current Rating	—	2.0 A max per point
Short Circuit Protection	—	Yes
Standard Pulse Test Outputs		
Number of Pulse Test Sources	8	
Pulse Test Output Current	0.7 A per point	
Short Circuit Protection	Yes	
General		
Temperature, operating	-20°…+60°C (-4°C…+140°F)	
Relative Humidity	10…95% non-condensing	
Vibration	0.76 mm @ 10…500 Hz	
Shock, operating	30 g	
Enclosure Protection	IP64, IP65, or IP67 as marked on the product label	
Dimensions (HxWxD), Metric	179 x 70 x 68.7 mm∗	
Dimensions (HxWxD), Imperial	7.05 x 2.76 x 2.71 in∗	
Weight, Metric	600 g	
Weight, Imperial	1.2 lb	
Certifications❄	UL, CE, C-Tick, CSA, UL NRGF, ODVA Conformance, certified by TÜV for Functional Safety up to SIL 3 and PLe/Cat. 4	

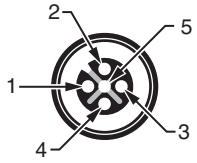
∗ Includes terminal block.
❄ When product is marked. See the Product Certification link at http://www.ab.com/certification for Declarations of Conformity, Certificates, and other certification details.
All specifications are subject to change. Refer to product installations instructions.

Safety Products that Connect Directly to ArmorBlock Guard I/O with a Single 5-Pin Micro (M12) Patchcord*

Product Family	Actuator Type	Cat. No. (with M12)	Catalog Page
Elf	Flat	440K-E2NNFPS	3-11
	Semi-flexible	440K-E2NNAPS	3-11
Cadet	Flat	440K-C2NNFPS	3-15
	Semi-flexible	440K-C2NNAPS	3-15
Trojan T15	Standard	440K-V2NNSPS	3-19
	Fully-flexible	440K-V2NNBPS	3-19
Trojan T15-GD2	GD2 Standard	440K-V2NNGPS	3-19
Trojan T5	Standard	440K-T2NBSPS	3-23
	Fully-flexible	440K-T2NBBPS	3-23
Trojan T5-GD2	GD2 Standard	440K-T2NBGPS	3-23
MT-GD2, Case Color Red with Snap-acting Contacts	None	440K-M2NBNDS	3-29
	None	440K-M2NANDS	3-29
MT-GD2, Case Color Yellow, Snap-acting Contacts	None	440K-M2NANYS	3-29
Sprite	Solid - 50xØ10 mm	440H-S2NNPPS	3-91
	Pre-bored - 30xØ16 mm	440H-S2NNHPS	3-91
Ensign	Solid - 50xØ10 mm	440H-E2NNPPS	3-95
	Pre-bored - 30xØ16 mm	440H-E2NNHPS	3-95
Lifeline3	N/A	440E-D2NNNYS	[S-3503977]
Lifeline4	N/A	440E-L2NNNYS	4-11
Emergency Stop	N/A	800F-1YMQ53V	4-43
Safety Mats	N/A	440F-MxxxHxNN	2-94

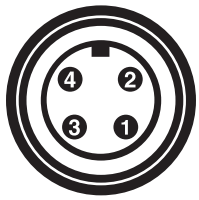
* Only the 2 N.C. safety contacts of the safety switches are connected to the 5-pin micro (M12) connector.

1732DS ArmorBlock Guard I/O Micro Connector Pin Assignments

Input Configuration			Output Configuration	
Pin	Signal	Female	Pin	Signal
1	Test Output n+1		1	Output +24V dc Power
2	Safe Input n+1		2	Output n+1 (Sinking)
3	Input Common		3	Output Power Common
4	Safe Input n		4	Output n (Sourcing)
5	Test Output n		5	Output Power Common

1732DS ArmorBlock Guard I/O Mini Connector Pin Assignments

ArmorBlock Guard I/O DeviceNet Configuration			
Pin	Signal	Male	Female
1	Drain		
2	V+ (Red)		
3	V- (Black)		
4	CAN_H (White)		
5	CAN_L (Blue)		

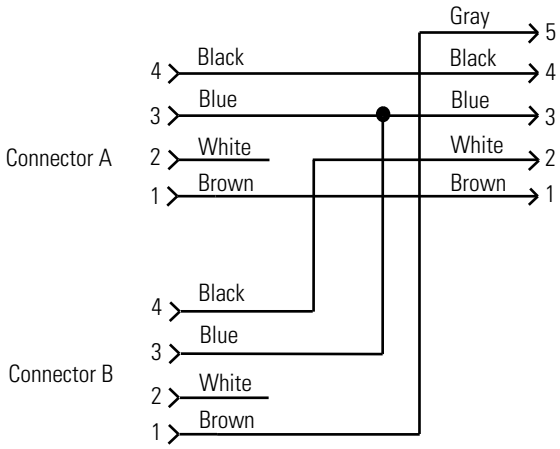
ArmorBlock Guard I/O Power Configuration		
Pin	Signal	Male
1	Output +24V dc Power (Red)	
2	Input +24V dc Power (Green)	
3	Input Power Common (White)	
4	Output Power Common (Black)	

ArmorBlock Guard I/O Recommended Compatible Cables and Connectors*

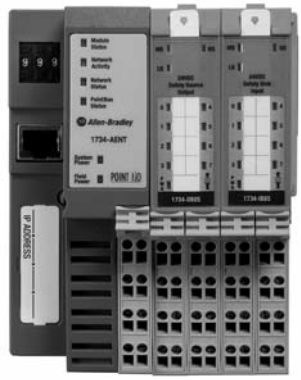
Description		Cat. No.
	DC Micro (M12) Male Cordset	889D-M5AC-❄
	DC Micro Style Patchcord	889D-F5ACDM-‡
	DC Micro V-Cable for Single-Channel Sensors	879D-F4ACD5M-§
	M12 Single-Channel Splitter	879D-F4D5M
	M12 Terminal Chamber—Straight Male	871A-TS5-DM
	M12 Terminal Chamber—Right Angle Male	871A-TR5-DM

* All cables must use 5-pin connections for ArmorBlock Guard I/O M12 input compatibility.
❄ Replace symbol with 0M3 (0.3 m), 2 (2 m), or 5 (5 m) for standard cable length.
‡ Replace symbol with 1 (1 m), 2 (2 m), 5 (5 m), or 10 (10 m) for standard cable length.
§ Replace symbol with 0M3 (0.3 m), 1 (1 m), 2 (2 m), or 5 (5 m) for standard cable length.

Single Channel Wiring (879D-F4ACD5M and 1485P-PID5-RR4)



POINT Guard I/O™



Description

POINT Guard I/O™ modules are safety-rated I/O modules designed to fit into the standard POINT I/O system, offering automation and safety functionality in a maximum density I/O solution. They are ideal for use is applications requiring safety and automation control. They communicate by using CIP Safety protocol over EtherNet/IP for GuardLogix controllers or DeviceNet for SmartGuard safety controllers. The application of CIP Safety protocol allows simultaneous transmission of safety and automation control and diagnostic data over one CIP network.

POINT Guard I/O and POINT I/O can be controlled by one GuardLogix controller for both safety and automation control through one node. If separate safety control is required, a GuardLogix controller can be used with POINT Guard I/O for safety control and a ControlLogix controller can be used with POINT I/O for automation control. No changes are required to the POINT I/O system.

This solution is ideal for applications requiring maximum I/O density in minimum panel space. The advanced solid-state design allows for module replacement in minutes and helps reduce the need for special maintenance or training.

POINT Guard I/O is designed for use with industrial equipment and is especially suited for robotic, point-of-operation, guard-monitoring, and distributed control applications.

Benefits

- Mix safety inputs and outputs with standard POINT I/O, all with one node
- Maximum I/O density in minimum panel space
- Simple to add to existing panels using POINT I/O
- I/O point-level diagnostics quickly identify problems and reduce downtime
- Easy configuration by using RSLogix 5000 with full support of IP addressing
- Optimize installations by assigning individual test output for safety input device
- Connect single and dual-channel safety devices on inputs and outputs
- Certified by TÜV for Functional Safety up to SIL 3 according to IEC 61508, and PLe/Category 4, according to ISO 13849-1
- Muting lamp control and monitoring on selected test pulse outputs

Networking with POINT Guard I/O™

POINT Guard I/O™ modules are used in the POINT I/O platform and can communicate safety messages via network adapters to connect to EtherNet/IP or DeviceNet networks. Use these adapters for network communication.

Network	System	Adapter✶
EtherNet/IP	GuardLogix	1734-AENT
		1734-AENTR
DeviceNet	SmartGuard 600	1734-PDN

✶ Not compatible with 1734-ADN, 1734-ADNX, 1734-AP, or 1734-ACNR adapters.

Specifications

Cat. No.	1734-IB8S	1734-OB8S
Description	Point I/O 24V DC 8 Input Safety Module	Point I/O 24V DC 8 Output Safety Module
PointBus Current (mA), Max.	175	190
Operating Voltage Range	19.2…28.8V DC	19.2…28.8V DC
Digital Inputs		
Number of Inputs	8	—
Input Type	Current Sinking	—
Voltage, On-State Input, Min.	11V DC	—
Voltage, Off-State Input, Max.	5V DC	—
Current, On-State Input, Min.	3.3 mA	—
Input Delay Time, Off to On	16.2 ms max	—
Input Delay Time, On to Off	—	—
Digital Outputs		
Number of Outputs	—	8
Output Type	—	Current Sourcing
Output Current Rating, Max.	—	1 A max per point
Leakage Current, Off-State Output, Max	—	0.1 mA
Output Delay Time, Off to On, Max.	—	6.2 ms‡
Output Delay Time, On to Off, Max.	—	6.2 ms§
Short Circuit Protection	—	Yes, Electronic
Overcurrent Detection	—	Yes
Standard Pulse Test Outputs		
Number of Pulse Test Sources	4	—
Pulse Test Output Current	0.7A per point	—
Pulse Test Output Leakage Current, Max.	0.1 mA	—
Short Circuit Protection	Yes	—
General		
Temperature, operating	-20…55 °C (-4…131 °F)	
Temperature, nonoperating	-40…85 °C (-40…185 °F)	
Relative Humidity	5…95% noncondensing	
Vibration	5 g at 10…500 Hz	
Shock, operating	30 g	
Enclosure Protection	IP20	
Dimensions (HxWxD), Metric	77.0 x 25.0 x 55.0 mm✶	
Dimensions (HxWxD), Imperial	3.03 x 0.98 x 2.17 in✶	
Weight, Metric	62.4 g	
Weight, Imperial	2.2 oz	
Certifications❄	CE, C-Tick, CSA, ODVA Conformance, certified by TÜV for Functional Safety up to SIL 3 and PLe/Cat. 4	

Note: All specifications are subject to change. Refer to product installations instructions.
✶ Includes terminal block.
❄ When product is marked. See the Product Certification link at http://www.ab.com/certification for Declarations of Conformity, Certificates, and other certification details.
‡ Off/on delay is time from a valid ouput "on" signal to output energization.
§ On/off delay is time from a valid output "off" signal to output deenergization.

Notes

Visit our website: www.ab.com/catalogs
Publication S117-CA001A-EN-P

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Safety ArmorStart® Distributed Motor Controllers

Bulletin 280D/281D

280D/281D ArmorStart Distributed Motor Controller — Safety Version

Description

The Bulletin 280/281 ArmorStart Distributed Motor Controller is an integrated, pre-engineered, starter for full-voltage and reversing applications. The ArmorStart offers a robust IP67/NEMA Type 4 enclosure design, which is suitable for water wash-down environments. The modular plug-and-play design offers simplicity in wiring the installation. The quick disconnects for the I/O, communications, and motor connection reduce the wiring time and eliminate wiring errors. The ArmorStart offers as standard, four DC inputs and two relay outputs to be used with sensors and actuators respectively, for monitoring and controlling the application process. The ArmorStart's LED status indication and built-in diagnostics capabilities allows ease of maintenance and troubleshooting. The optional Hand/Off/Auto (HOA) keypad allows for local start/stop control at the ArmorStart Distributed Motor Controller.

The Bulletin 280/281 ArmorStart Distributed Motor Controller offers short-circuit protection per UL 508 and IEC 60947. The ArmorStart is rated for local-disconnect service by incorporating the Bulletin 140 Motor Protector as the local-disconnect, eliminating the need for additional components. The ArmorStart Distributed Motor Controllers are suitable for group motor installations.

Safety ArmorStart

The safety version of the ArmorStart provides a safety solution integrated into DeviceNet Safety installations. The Bulletin 280/281 Safety ArmorStart achieves Category 4 functionality by using redundant contactors. The Safety ArmorStart offers a quick connects via the gland plate to the 1732DS-IB8XOBV4 safety I/O module. The Bulletin 1732DS Safety I/O inputs will monitor the status of the safety rated contactors inside the ArmorStart. The Bulletin 1732DS Safety I/O outputs to provide 24V DC power for control power to the ArmorStart.

Note: The Bulletin 280/281 Safety ArmorStart is suitable for safety applications up to Safety Category 4 PLe (TÜV assessment per ISO 13849-1:2008). TÜV compliance letter is available upon request.

Note: For additional information regarding the 1732DS-IB8XOBV4 safety I/O module, see publication 1791DS-UM001*-EN-P.

Features

- On-Machine™ starting solution
- Full-voltage and reversing
- Horsepower range 0.5…10 Hp (0.37…7.5 kW)
- Robust IP67/NEMA Type 4 enclosure rating
- Modular plug and play design
- Quick disconnect connections for I/O, communications, motor, and three-phase power
- Gland plate entry: conduit entrance or ArmorConnect® power media
- Four inputs and two outputs (expandable with ArmorPoint)
- LED status indication
- DeviceNet™ communications
- DeviceLogix™ component technology
- Peer-to-peer communication (ZIP)
- Factory installed option:
  – Hand/Off/Auto (HOA) keypad configuration

Certifications

cULus (File No. E3125, Guides NLDX, NLDX7)

Standards Compliance

UL 508	CSA C22.2, No. 14
EN/IEC 60947-1	CCC

CE Marked per Low Voltage Directive 73/23/EEC and EMC Directive 89/336/EEC

Mode of Operation

Full-Voltage Start

This method is used in applications requiring across-the-line starting. Full in-rush current and locked-rotor torque are realized. The ArmorStart Bulletin 280 offers full-voltage starting, and the Bulletin 281 offers full-voltage starting for reversing applications.

Description of Features

Inputs

The inputs are single keyed (two inputs per connector), which are sourced from DeviceNet power (24V DC), with LED status indication.

Outputs

Two dual-key relay output connectors are supplied as standard. The outputs are sourced from the control voltage power, which is 24V DC with LED status indication.

Overload Protection

The Bulletin 280/281 ArmorStart Distributed Motor Controller incorporates, as standard, electronic motor overload protection. This overload protection is accomplished electronically with an I^2t algorithm. The ArmorStart's overload protection is programmable via the communication network providing the user with flexibility. The overload trip class can be selected for class 10, 15, or 20 protection. Ambient insensitivity is inherent in the electronic design of the overload.

Gland Plate Entrance

The ArmorStart product offers two different methods for connecting incoming three-phase power to the device. One method offered is the traditional conduit entrance which provides a 1 in. conduit hole opening for wiring three-phase power. The second method offers connectivity to the ArmorConnect power media. A factory-installed receptacle is provided for connectivity to both three-phase power media.

Motor Cable

With every Bulletin 280/281 ArmorStart Distributed Motor Controller, a 3-meter unshielded 4-conductor cordset is provided with each unit as standard.

LED Status Indication

The LED Status Indication provides four status LEDs and a Reset button. The LEDs provide status indication for the following:

- **POWER LED**
  The LED is illuminated solid green when control power is present and with the proper polarity
- **RUN LED**
  This LED is illuminated solid green when a start command and control power are present
- **NETWORK LED**
  This bicolor (red/green) LEDs indicates the status of the communication link
- **FAULT LED**
  Indicates Controller Fault (trip) condition
- The "Reset Button" as a local trip reset.

Fault Diagnostics

Fault diagnostics capabilities built in the ArmorStart Distributed Motor Controller help you pinpoint a problem for easy troubleshooting and quick re-starting.

- Short Circuit
- Overload
- Phase Loss
- Control Power Loss
- Control Power Fuse Detection
- I/O Fault
- Output Power Fuse Detection
- Overtemperature
- Phase Imbalance
- DeviceNet Power Loss
- EEPROM Fault
- Hardware Fault

Cat. No. Explanation

Examples given in this section are for reference purposes. This basic explanation should not be used for product selection; not all combinations will produce a valid catalog number.

280	D	–	F	12S	–	10	C	–	CR	–	Option 1
a	*b*		*c*	*d*		*e*	*f*		*g*		*h*

a

Bulletin Number	
Code	Description
280	Full Voltage Starter
281	Reversing Starter

b

Communications	
Code	Description
D	DeviceNet™

c

Enclosure Type	
Code	Description
F	Type 4 (IP67)

d

Contactor Size/Control Voltage	
Code	Description
12S	24V DC
23S	

∗ See Accessories on page 6-4 for extended motor cable lengths.

e

Short Circuit Protection (Motor Circuit Protector)	
Code	Description
10	10 A Rated Device
25	25 A Rated Device

f

Overload Selection Current Range	
Code	Description
B	0.5…2.5 A
C	1.1…5.5 A
D	3.2…16 A

g

Control and 3-Phase Power Connections/Motor Cable Connection (CR: Conduit/Round Media) or (RR: Round/Round Media)				
Code		Description		
		Control Power	3-Phase Power	Motor Cable
CR	blank	Conduit Entrance	Conduit Entrance	3 m, unshielded cordset male 90°
CR	W ∗	Conduit Entrance	Conduit Entrance	No cable
RR	blank	Round Media (Male Receptacle)	Round Media (Male Receptacle)	3 m, unshielded cordset male 90°
RR	W ∗	Round Media (Male Receptacle)	Round Media (Male Receptacle)	No cable

h

Option 1	
Code	Description
3	Hand/Off/Auto Selector Keypad
3FR	Hand/Off/Auto Selector Keypad with Forward/Reverse

Product Selection

Full-voltage starters — IP67/NEMA Type 4 with conduit entrance and DeviceNet communications, Up to 460V AC

	kW		Hp			24V DC Control Voltage
Current Rating [A]	230V AC, 50 Hz	400V AC, 50 Hz	200V AC, 60 Hz	230V AC, 60 Hz	460V AC, 60 Hz	Cat. No.
0.5…2.5	0.37	0.75	0.5	0.5	1	280D-F12S-10B-CR
1.1…5.5	1.1	2.2	1	1	3	280D-F12S-10C-CR
3.2…16	4	7.5	3	5	10	280D-F23S-25D-CR

Full-voltage starters — IP67/NEMA Type 4 with quick disconnects for ArmorConnect power media and DeviceNet communications, Up to 460V AC

	kW		Hp			24V DC Control Voltage
Current Rating [A]	230V AC, 50 Hz	400V AC, 50 Hz	200V AC, 60 Hz	230V AC, 60 Hz	460V AC, 60 Hz	Cat. No.
0.5…2.5	0.37	0.75	0.5	0.5	1	280D-F12S-10B-RR
1.1…5.5	1.1	2.2	1	1	3	280D-F12S-10C-RR
3.2…16	4	7.5	3	5	10	280D-F23S-25D-RR

Reversing starters — IP67/NEMA Type 4 with conduit entrance and DeviceNet communications, Up to 460V AC

	kW		Hp			24V DC Control Voltage
Current Rating [A]	230V AC, 50 Hz	400V AC, 50 Hz	200V AC, 60 Hz	230V AC, 60 Hz	460V AC, 60 Hz	Cat. No.
0.5…2.5	0.37	0.75	0.5	0.5	1	281D-F12S-10B-CR
1.1…5.5	1.1	2.2	1	1	3	281D-F12S-10C-CR
3.2…16	4	7.5	3	5	10	281D-F23S-25D-CR

Reversing starters — IP67/NEMA Type 4 with quick disconnects for ArmorConnect power media and DeviceNet communications, Up to 460V AC

	kW		Hp			24V DC Control Voltage
Current Rating [A]	230V AC, 50 Hz	400V AC, 50 Hz	200V AC, 60 Hz	230V AC, 60 Hz	460V AC, 60 Hz	Cat. No.
0.5…2.5	0.37	0.75	0.5	0.5	1	281D-F12S-10B-RR
1.1…5.5	1.1	2.2	1	1	3	281D-F12S-10C-RR
3.2…16	4	7.5	3	5	10	281D-F23S-25D-RR

Options – Factory Installed

Description				Cat. No. Modification
	Hand/Off/Auto Selector Keypad			-3
	Hand/Off/Auto Selector Keypad with Forward/Reverse Function			-3FR
	Supplied without motor cable		**Enclosure Rating** IP67	-CRW
	Connectivity to ArmorConnect Power Media supplied without motor cable	**Short Circuit Protection Rating** 10 A 25 A	**Enclosure Rating** IP67	-RRW

Accessories

Sealing Caps

Description	For Use With	Cat. No.
Plastic Sealing Cap (M12)∗	Input I/O Connection	1485A-M12
AC Micro Aluminum Sealing Cap - External∗	Output I/O Connection	889A-RMCAP

∗ To achieve IP67 rating, sealing caps must be installed on all unused I/O connections.

Cables

Description	Cable Rating	Length [m (ft)]	Cat. No.
Extended Motor Cable Cordsets			
90° M22 Motor Cordset	IP67/NEMA Type 4	6 (19.6)	280-MTR22-M6
		14 (45.9)	280-MTR22-M14
90° M35 Motor Cordset	IP67/NEMA Type 4	6 (19.6)	280-MTR35-M6
		14 (45.9)	280-MTR35-M14

DeviceNet Media ♣

Description		Length [m (ft)]	Cat. No.
			Sealed
	KwikLink pigtail drops are Insulation Displacement Connector (IDC) with integral Class 1 round cables for interfacing devices or power supplies to flat cable.	1 (3.3)	1485P-P1E4-B1-N5
		2 (6.5)	1485P-P1E4-B2-N5
		3 (9.8)	1485P-P1E4-B3-N5
		6 (19.8)	1485P-P1E4-B6-N5
	DeviceNet Mini- T-Port Tap	Left Keyway	**1485P-P1N5-MN5KM**
		Right Keyway	1485P-P1N5-MN5NF

Description		Connector	Cat. No.
	Grey PVC Thin Cable	Mini Straight Female Mini Straight Male	1485G-P❄N5-M5
		Mini Straight Female Mini Right Angle Male	1485G-P❄W5-N5
		Mini Right Angle Female Mini Straight Male	1485G-P❄M5-Z5
		Mini Right Angle Female Mini Straight Male	1485G-P❄W5-Z5
	Thick Cable	Mini Straight Female Mini Straight Male	1485C-P‡N5-M5
		Mini Straight Female Mini Right Angle Male	1485C-P‡W5-N5
		Mini Right Angle Female Mini Straight Male	1485C-P‡M5-Z5
		Mini Right Angle Female Mini Straight Male	1485C-P‡W5-Z5

Description		Length [m (ft)]	Cat. No.
	DeviceNet Configuration Terminal Used to interface with objects on a DeviceNet network, includes 1 m communications cable	1 (3.3)	193-DNCT
	Communication cable, color-coded bare leads	1 (3.3)	193-CB1
	Communication cable, microconnector (male)	1 (3.3)	193-CM1
	Panel Mount Adapter/Door Mount Bezel Kit	—	193-DNCT-BZ1

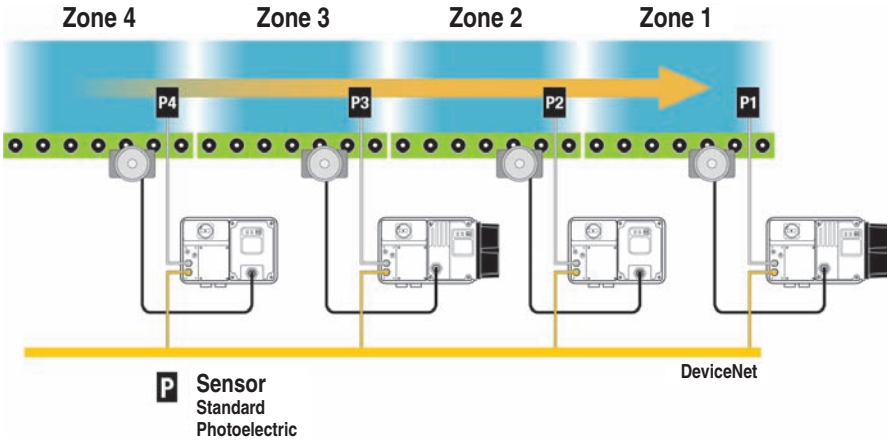
♣ See publication M116-CA001_-EN-P for complete cable selection information.
❄ Replace symbol with desired length in meters (Example: **1485G-P1N5-M5** for a 1 m cable). Standard cable lengths: 1, 2, 3, 4, 5, and 6 m.
‡ Replace symbol with desired length in meters (Example: **1485C-P1N5-M5** for a 1 m cable). Standard cable lengths: 1, 2, 3, 4, 5, 6, 8, 10, 12, 18, 24, and 30 m.

Sensor Media ⌘

Description		ArmorStart I/O Connection	Pin Count	Connector	Cat. No.
	DC Micro Patchcord	Input	5-pin	Straight Female Straight Male	889D-F4ACDM-➢
				Straight Female Right Angle Male	889D-F4ACDE-➢
	DC Micro V-Cable	Input	5-pin	Straight Female	879D-F4ACDM-➢
				Right Angle Male	879D-R4ACM-➢
	AC Micro Patchcord	Output	3-pin	Straight Female Straight Male	889R-F3AERM-➢
				Straight Female Right Angle Male	889R-F3AERE-➢

⌘ See the On-Machine Connectivity catalog for complete cable selection information.
➢ Replace symbol with desired length in meters (Example: **889D-F4ACDM-1** for a 1 m cable). Standard cable lengths: 1, 2, 5, and 10 m.
NOTE: Stainless steel versions may be ordered by adding an **S** to the cat. no. (Example: **889DS-F4ACDM-1**)

Peer-to-Peer Communications



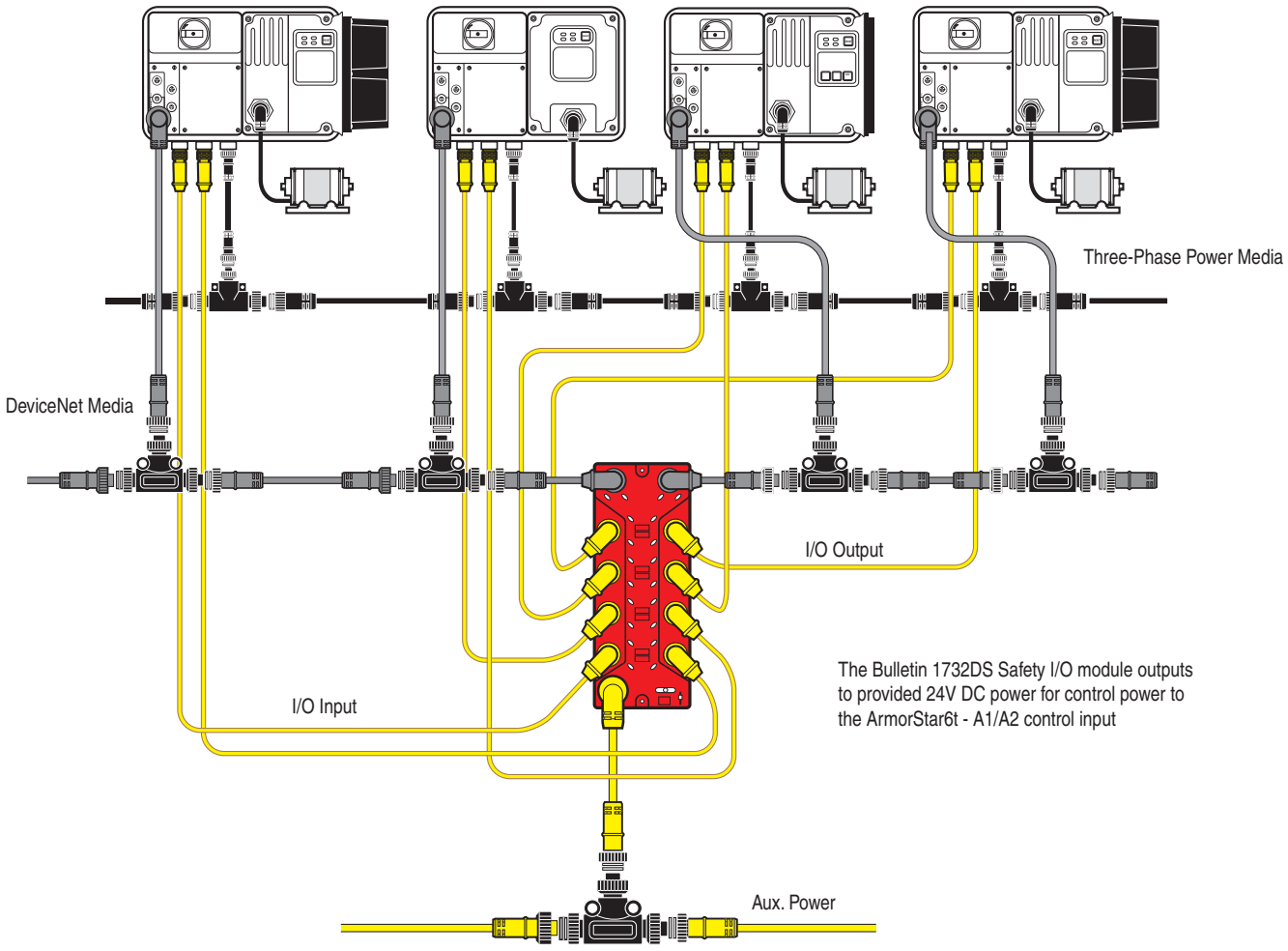
The Zone Control capabilities of ArmorStart Distributed Motor Controller is ideal for large horsepower (0.5…10 Hp) motored conveyors. The ArmorStart Distributed Motor Controllers have built-in DeviceNet Communications, DeviceLogix technology, and the added Zone Interlocking Parameters (ZIP) which allows one ArmorStart to consume data directly from up to four other DeviceNet nodes without going through the network scanner. These direct communications between conveyor zones are beneficial in a merge, diverter, and accumulation conveyor applications.

Safety I/O Module and TÜV Requirements

ArmorStart Safety-Related Parts

Each ArmorStart Safety Distributed motor controller is intended to be combined with the 1732DS-IB8XOBV4 safety I/O module to form a subsystem that is part of the overall machine stop function. The motor controllers are connected to the safety I/O module through specified cable assemblies. The combination of one of these controllers, the safety module, and the specified interconnecting cables are referred to as the ArmorStart Safety-Related Parts. The part numbers for each of these components is specified below. The combination of these components is shown in Figure E.1. The safety I/O module and PLC program must be configured as outlined. See configuration of Safety I/O Module and PLC program.

Catalog Number	Description
280…S* * - denotes safety version of Bulletin 280	Bulletin 280 Distributed Motor Controller – controller is full-voltage, non-reversing
281…S* * - denotes safety version of Bulletin 281	Bulletin 281 Distributed Motor Controller – controller is full-voltage, reversing
284…S* * - denotes safety version of Bulletin 284	Bulletin 284 Distributed Motor Controller – controller is variable-frequency AC drive
1732DS-IB8XOBV4	Guard I/O DeviceNet Safety Module
889D-F4HJDM-*, 889D-F4AEDM-* or equivalent * - denotes length	• SM cable assembly - Interconnecting cable assembly between safety module input and ArmorStart controller connector labeled “SM”. Assembly provides contactor position feedback. • A1/A2 cable assembly - Interconnecting cable assembly between safety module output and ArmorStart controller connector labeled “A1/A2”. Assembly provides output contactor coil power and controller power supply.



The Bulletin 1732DS Safety I/O module inputs will monitor the status of the safety-related contactors inside the ArmorStart - SM safety monitor input

ArmorBlock® Guard I/O™ Modules

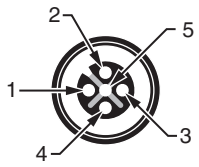
	Description	Cat. No.
	ArmorBlock Guard I/O provides all the advantages of traditional distributed I/O for safety systems, but has an IP67 package that can be mounted directly on your machine. On-machine safety I/O reduces wiring time and startup costs for safety controller applications by eliminating electrical boxes and simplifying cable installation. The ArmorBlock family provides industrially hardened I/O blocks that you can mount directly on equipment near sensors or actuators. Wiring the I/O to the sensors and actuators is easy using pre-wired quick disconnect cables. You can use Guard I/O with any safety controller that communicates on DeviceNet using CIP Safety for the control and monitoring of safety circuits. Guard I/O detects circuit failures at each I/O point while providing detailed diagnostics directly to the controller. With CIP Safety, you can easily integrate safety and standard control systems by using safety and standard messages on the same wire. The 1732DS ArmorBlock Guard I/O family consists of 24V DC digital I/O modules that communicate on DeviceNet networks. The I/O connectors are sealed M12 micro style while the network and auxiliary power connectors are sealed mini style. Plus, the ArmorBlock Guard I/O uses the same input and output M12 pin configuration as standard ArmorBlock and Maxum®.	1732DS-IB8XOBV4

Specifications

Description	24V DC Input/Output Module on DeviceNet Networks
Current Consumption	85 mA @ 24V DC
I/O Operating Voltage Range	19.2V…28.8 V DC (24V DC, -20…+20%)
Digital Inputs	
Number of Inputs	8 safety single-channel or 4 safety dual-channel
Input Type	current sinking
Voltage, On-State Input, Min.	11V DC
Voltage, Off-State Input, Max.	5V DC
Current, On-State Input, Min.	3.3 mA
Digital Outputs	
Number of Outputs	4 safety solid-state
Output Type	dual channel, current sourcing/current sinking pair
Output Current Rating	2.0 A max per point
Short Circuit Protection	Yes
Standard Pulse Test Outputs	
Number of Pulse Test Sources	8
Pulse Test Output Current	0.7 A per point
Short Circuit Protection	Yes
General	
Temperature, operating	-20…+60 °C (-4…+140 °F)
Relative Humidity	10…95% non-condensing
Vibration	0.76 mm @ 10…500 Hz
Shock, operating	30 g
Enclosure Protection	IP67
Dimensions (HxWxD), Metric	179 x 70 x 68.7 mm∗
Dimensions (HxWxD), Imperial	7.05 x 2.76 x 2.71 in.∗
Weight, Metric	600 g
Weight, Imperial	1.2 lb
Certifications❄	UL, CE, C-Tick, CSA, UL NRGF, ODVA Conformance, TÜV certified for functional safety up to SIL 3 and Cat. 4, PLe

∗ Includes terminal block.
❄ When product is marked. See the Product Certification link at http://www.ab.com/certification for Declarations of Conformity, Certificates, and other certification details.
All specifications are subject to change. Refer to product installations instructions.

1732DS ArmorBlock Guard I/O Micro Connector Pin Assignments

Input Configuration		Female	Output Configuration	
Pin	Signal		Pin	Signal
1	Test Output n+1		1	Output +24V DC Power
2	Safe Input n+1		2	Output n+1 (Sinking)
3	Input Common		3	Output Power Common
4	Safe Input n		4	Output n (Sourcing)
5	Test Output n		5	Output Power Common

1732DS ArmorBlock Guard I/O Mini Connector Pin Assignments

ArmorBlock Guard I/O DeviceNet Configuration			
Pin	Signal	Male	Female
1	Drain		
2	V+ (Red)		
3	V- (Black)		
4	CAN_H (White)		
5	CAN_L (Blue)		

ArmorBlock Guard I/O Power Configuration		
Pin	Signal	Male
1	Output +24V DC Power (Red)	
2	Input +24V DC Power (Green)	
3	Input Power Common (White)	
4	Output Power Common (Black)	

ArmorBlock Guard I/O Recommended Compatible Cables and Connectors*

Description		Cat. No.
	DC Micro (M12) Male Cordset	889D-F4HJ-❄
	DC Micro Style Patchcord	889D-F4HJDM-‡
	M12 Terminal Chamber—Straight Male	871A-TS4-DM
	M12 Terminal Chamber—Right Angle Male	871A-TR4-DM

* All cables must use 5-pin connections for ArmorBlock Guard I/O M12 input compatibility.
❄ Replace symbol with 0M3 (0.3 m), 2 (2 m), or 5 (5 m) for standard cable length.
‡ Replace symbol with 1 (1 m), 2 (2 m), 5 (5 m), or 10 (10 m) for standard cable length.

Specifications

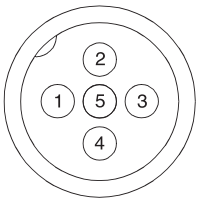
Electrical Ratings			UL/NEMA	IEC
Power Circuit	Rated Operation Voltage		380Y/220…480Y/277V AC	380Y/220…480Y/277V AC
	Rate Insulation Voltage		600V	
	Rated Impulsed Voltage		4 kV	
	Dielectric Withstand		2200V AC	2500V AC
	Operating Frequency		50/60 Hz	
	Utilization Category		—	AC-3
	Protection Against Shock		—	IP2X
	Rated Operating Current Max.		2.5 A	
			5.5 A	
			16 A	
Control Circuit	Rated Operation Voltage		24V DC (+10%, -15%) A2 (should be grounded at voltage source)	
	Rate Insulation Voltage		250V	
	Rated Impulsed Voltage		—	4 kV
	Dielectric Withstand		1500V AC	2000V AC
	Overvoltage Category		—	III
	Operating Frequency		50/60 Hz	
Short Circuit Protection	SCPD Performance Type 1 Sym. Amps RMS @ 480Y/277V	**Current Rating**		
		0.5…2.5 A	65 kA	
		1.1…5.5 A		
		3.2…16 A	30 kA	
	SCPD List		Size per NEC Group Motor	—

Power Requirements			
	Units	**Without HOA**	**With HOA**
Control Voltage	Volts	24V DC	
Contactor (Pick Up)	Amps	1.09	
Contactor (Hold In)	Amps	0.30	
Total Control Power (Pick Up)	VA (W)	(26 W)	
Total Control Power (Hold In)	VA (W)	(7.2 W)	
External Devices powered by Control Voltage			
Outputs (2) (1 A max. each)	Amps	2	2
Total Control (Pick Up) with max outputs	VA (W)	(65 W)	(73 W)
Total Control (Hold In) with max outputs	VA (W)	(50 W)	(58 W)

Input Ratings	Rated Operation Voltage	24V DC	
	Input On-State Voltage Range	10…26V DC	
	Input On-State Current	3.0 mA @ 10V DC	
		7.2 mA @ 24V DC	
	Input Off-State Voltage Range	0…5V DC	
	Input Off-State Current	<1.5 mA	
	Input Filter — Software Selectable		
	Off to On	Settable from 0…64 ms in 1 ms increments	
	On to Off	Settable from 0…64 ms in 1 ms increments	
	Input Compatibility	N/A	IEC 1+
	Number of Inputs	4	
	Sensor Source		
	Voltage Status Only	11…25V DC from DeviceNet	
	Current Available	50 mA max. per input, 200 mA total	
Output Ratings (Sourced from Control Circuit)	Rated Operation Voltage	240V AC/30V DC	240V AC/30V DC
	Rate Insulation Voltage	250V	250V
	Dielectric Withstand	1500V AC	2000V AC
	Operating Frequency	50/60 Hz	50/60 Hz
	Type of Control Circuit	Electromechanical relay	
	Type of Current	AC/DC	
	Conventional Thermal Current Ith	Total of both outputs ≤ 2 A	
	Type of Contacts	Normally open (N.O.)	
	Number of Contacts	2	
ArmorPoint Ratings	Backplane Current Load	400 mA	

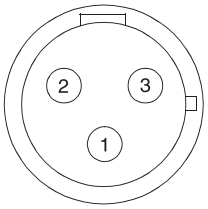
		UL/NEMA	IEC
Environmental	Operating Temperature Range	-20…+40 °C (-4…+104 °F)	
	Storage and Transportation Temperature Range	–25….+85 °C (–13…+185 °F)	
	Altitude	2000 m	
	Humidity	5…95% (non-condensing)	
	Pollution Degree	3	
	Enclosure Ratings	NEMA 4/12/13	IP67
	Approximate Shipping Weight	6.8 kg (15 lb)	
Mechanical	**Resistance to Shock**		
	Operational	15 G	
	Non-Operational	30 G	
	Resistance to Vibration		
	Operational	1 G, 0.15 mm (0.006 in.) displacement	
	Non-Operational	2.5 G, 0.38 mm (0.015 in.) displacement	
	Power and Ground Terminals		
	Wire Size	Primary terminal: (#16 …#10 AWG) Secondary terminal: (#18 …#10 AWG)	Primary terminal: 1.5…5.3 mm^2 Secondary terminal: 0.8…5.3 mm^2
	Tightening Torque	Primary terminal: 10.8 lb•in Secondary terminal: 4.5 lb•in	Primary Terminal: 1.2 N•m Secondary terminal: 0.5 N•m
	Wire Strip Length	9 mm (0.35 in.)	
Other Rating	**EMC Emission Levels**		
	Conducted Radio Frequency Emissions	Class A	
	Radiated Emissions	Class A	
	EMC Immunity Levels		
	Electrostatic Discharge	4 kV contact and 8 kV Air	
	Radio Frequency Electromagnetic Field	10V/m	
	Fast Transient	2 kV	
	Surge Transient	1 kV $_{L-L}$, 2 kV $_{L-N}$ (earth)	
	Overload Characteristics		
	Overload Current Range	0.5…2.5 A	
		1.1…5.5 A	
		3.2…16 A	
	Trip Classes	10, 15, 20	
	Trip Rating	120% of FLC setting	
	Number of poles	3	
	DeviceNet Specifications		
	DeviceNet Supply Voltage Rating	Range 11…25V DC, 24V DC nominal	
	DeviceNet Input Current	167 mA @ 24V DC - 4.0 W	
		364 mA @ 11V DC - 4.0 W	
	External Devices powered by DeviceNet	Sensors inputs 4 x 50 mA - total 200 mA	
	Total w/max Sensor Inputs (4)	367 mA @ 24V DC - 8.8 W	
	DeviceNet Input Current Surge	15 A for 250 µs	
	DeviceNet Communications		
	Baud Rates	125, 250, 500 kbps	
	Distance Maximum	500 m (1630 ft) @ 125 kbps	
		200 m (656 ft) @ 250 kbps	
		100 m (328 ft) @ 500 kbps	
	Certifications	cULus (File No. E3125) UL 508 EN/IEC 60947-4-1 CE Marked per Low Voltage Directive 73/23/EEC and EMC Directive 89/336/EEC	

External Connections for Input Connector



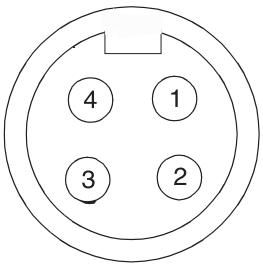
Pin 1: +V Out
Pin 2: Input
Pin 3: Comm
Pin 4: Input
Pin 5: NC (No Connection)

External Connections for Output Connector



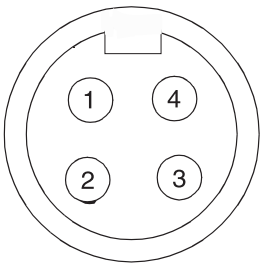
Pin 1: PE
Pin 2: Return
Pin 3: Relay Out

External Connections for Motor Connector (≤ 3 Hp @ 460V AC)



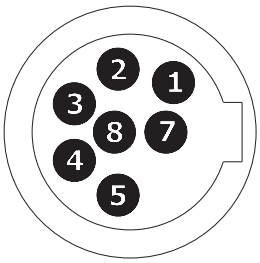
Pin 1: T1 - Black
Pin 2: T2 - White
Pin 3: T3 - Red
Pin 4: Ground - Green/Yellow

External Connections for Motor Connector (> 3 Hp @ 460V AC)



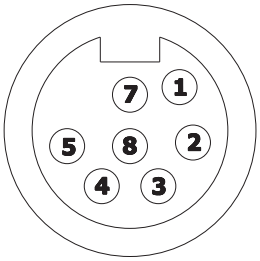
Pin 1: T1 - Black
Pin 2: Ground - Green/Yellow
Pin 3: T3 - Red
Pin 4: T2 - White

External Connections for ArmorPoint Interface (IN)



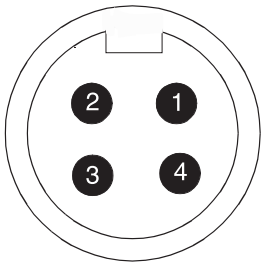
Pin 1: CAN High
Pin 2: Common
Pin 3: +5V
Pin 4: CAN Low
Pin 5: Enable In
Pin 7: Common
Pin 8: PE

External Connections for ArmorPoint Interface (OUT)



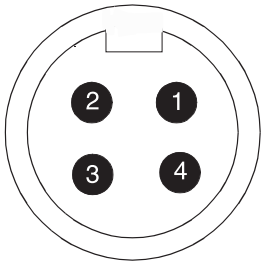
Pin 1: CAN High
Pin 2: Common
Pin 3: +5V
Pin 4: CAN Low
Pin 5: Enable Out
Pin 7: Common
Pin 8: NC (No Connection)

Safety Monitor Input (SM1/SM2)



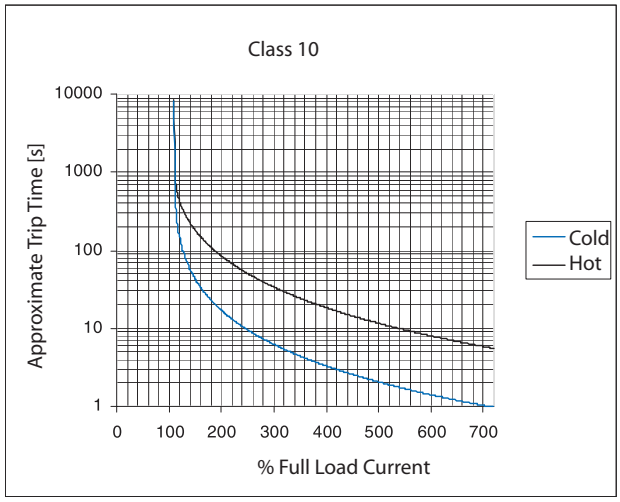
Pin 1: SM2 - White
Pin 2: SM1 - Brown
Pin 3: NC (No Connection)
Pin 4: NC (No Connection)

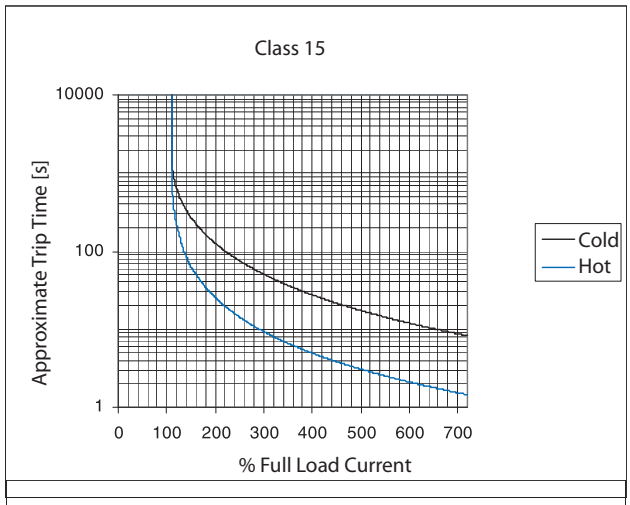
External Connections for Safety Input Power (A1/A2)

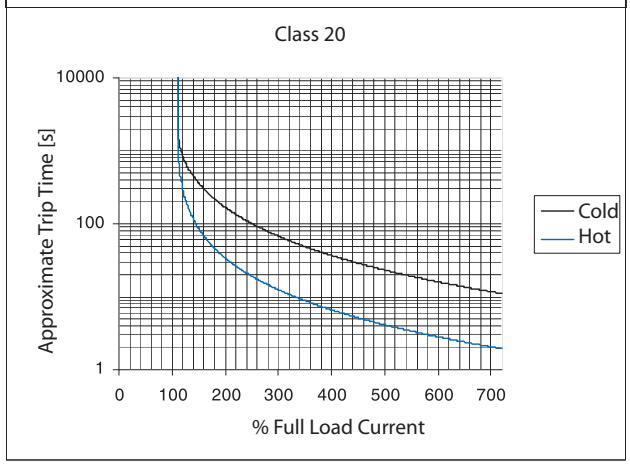


Pin 1: M - White
Pin 2: A1 - Brown
Pin 3: P - Black
Pin 4: A2 - Blue

Overload Curves



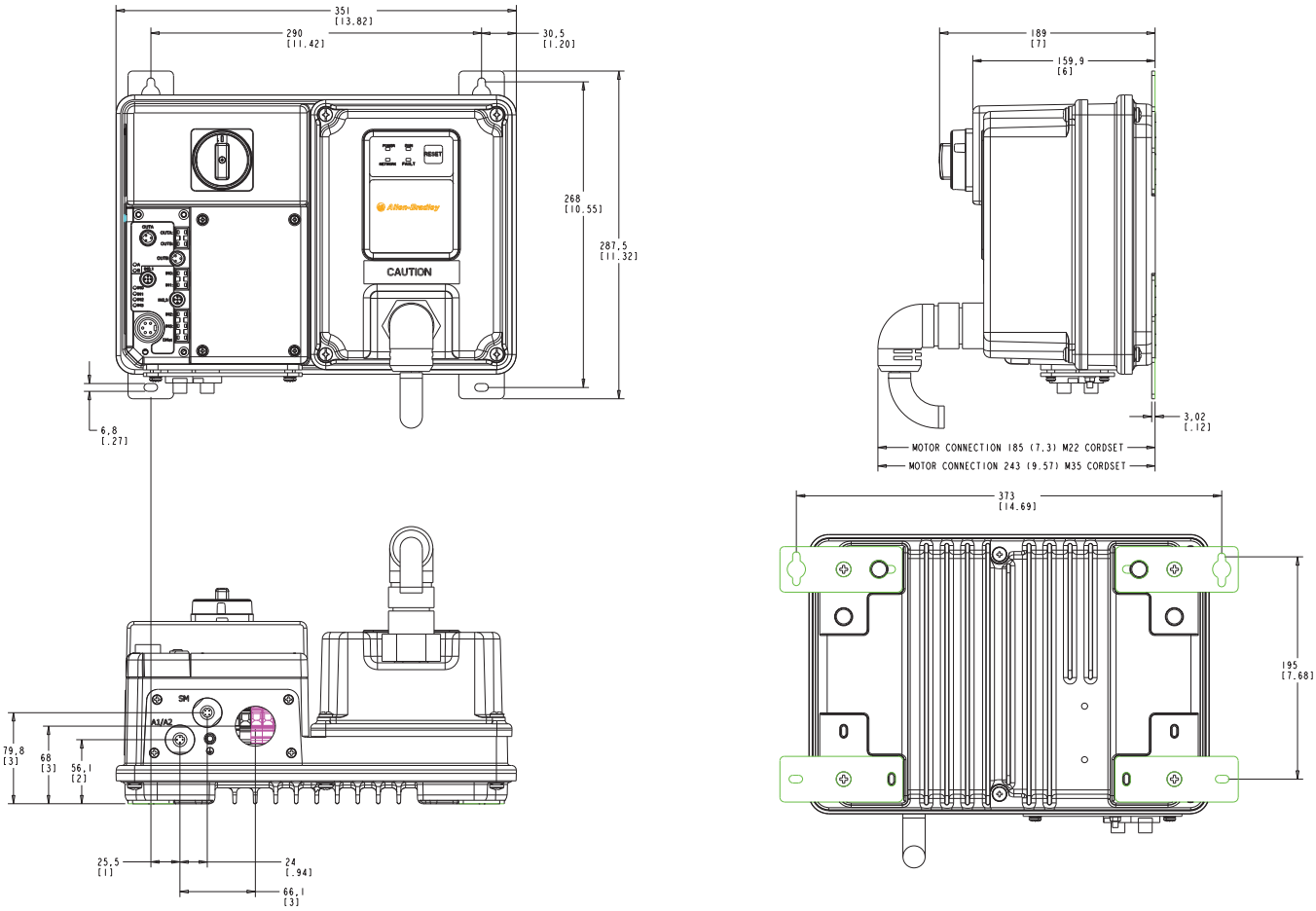




Approximate Dimensions

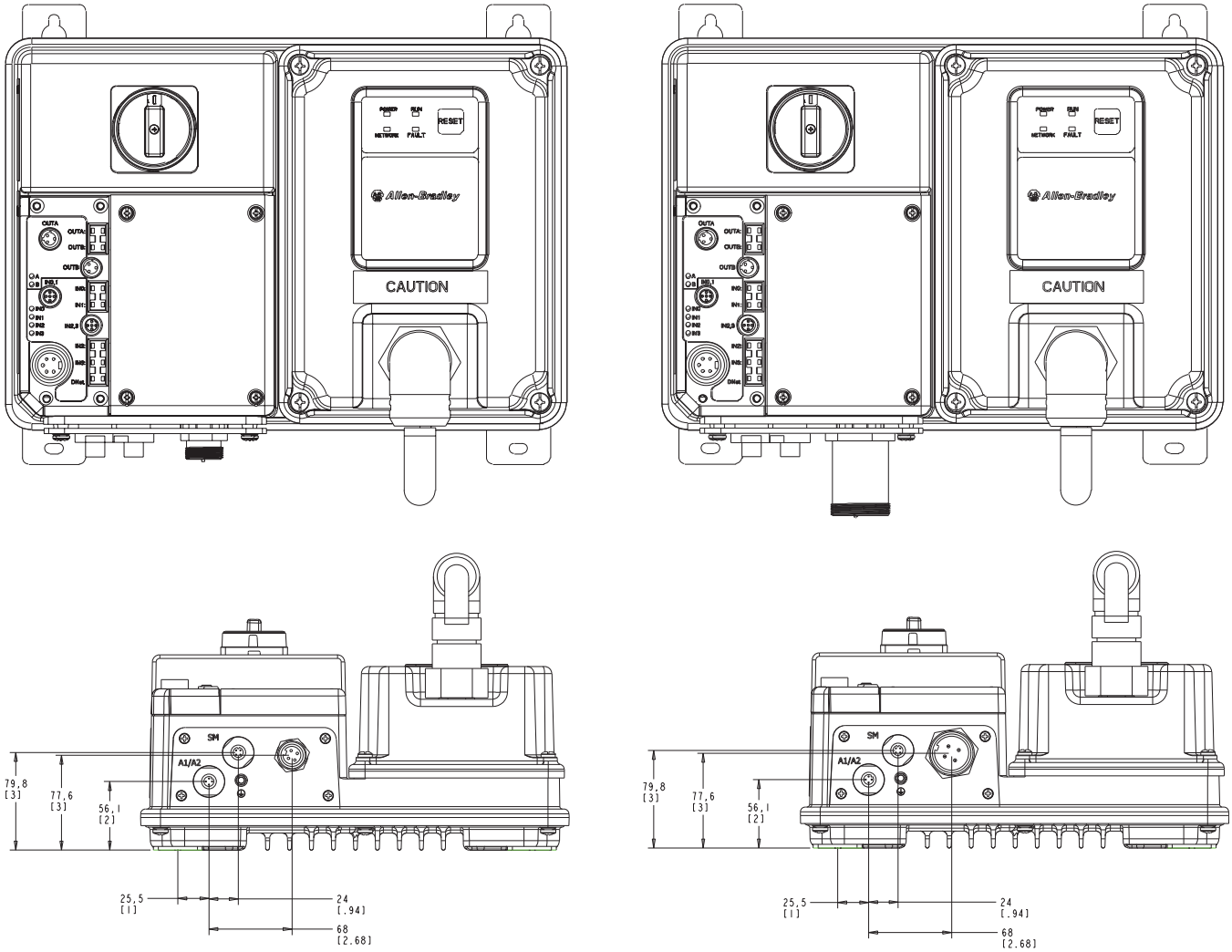
Dimensions for IP67/NEMA Type 4 with Conduit Entrance

Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes. All dimensions are subject to change.



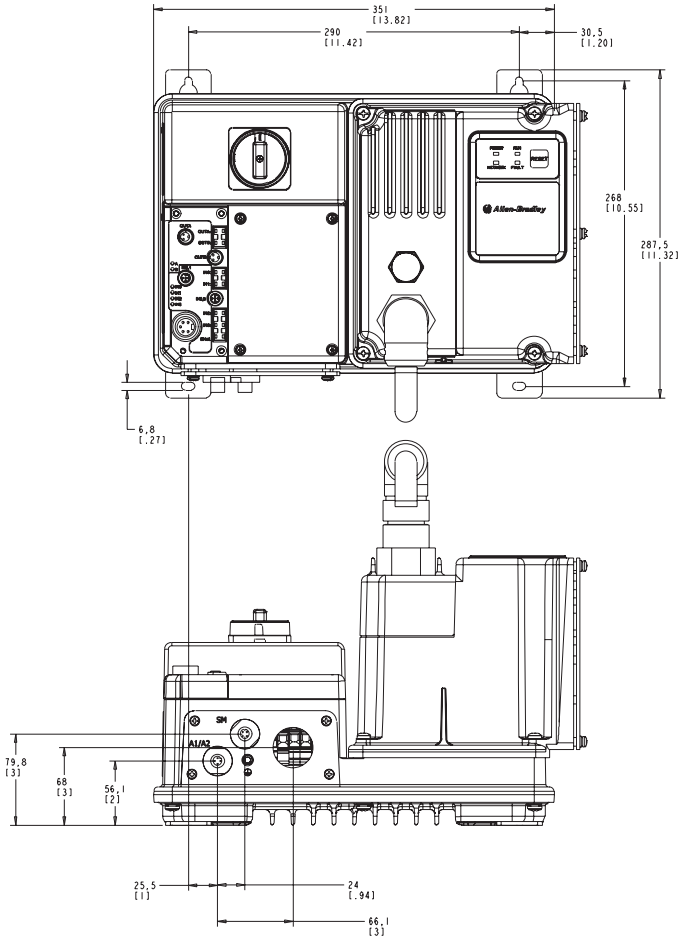
Dimensions for IP67/NEMA Type 4 with ArmorConnect Connectivity

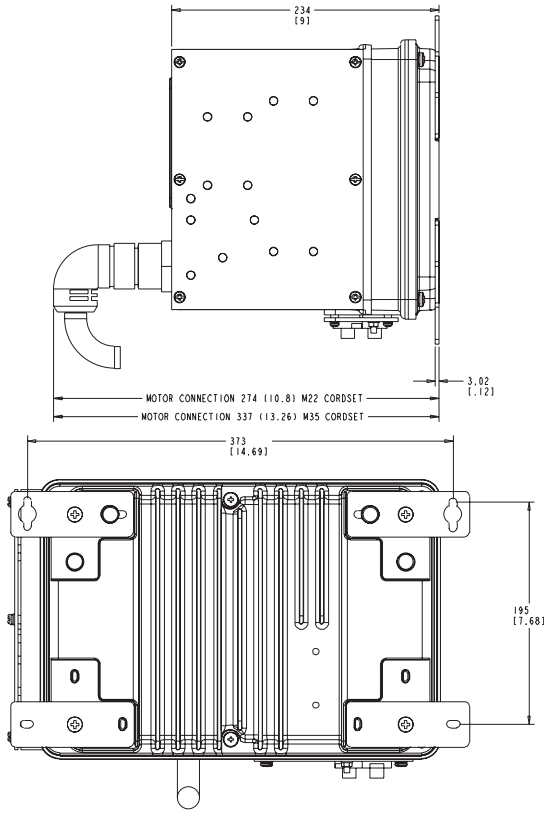
Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes. All dimensions are subject to change.



Dimensions for Reversing, IP67/NEMA Type 4 with Conduit Entrance

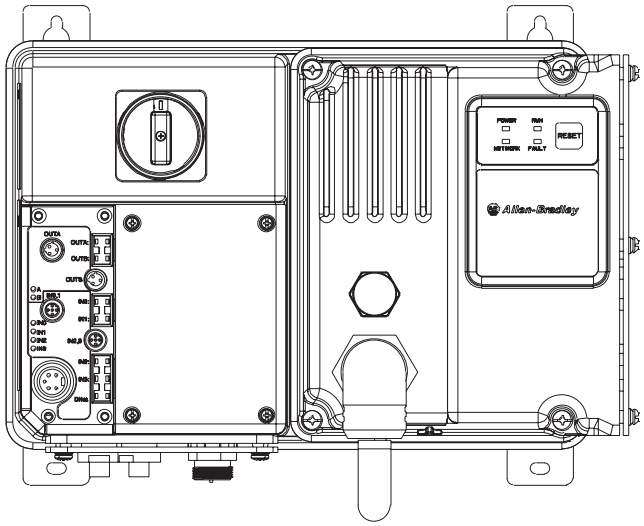
Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes. All dimensions are subject to change.

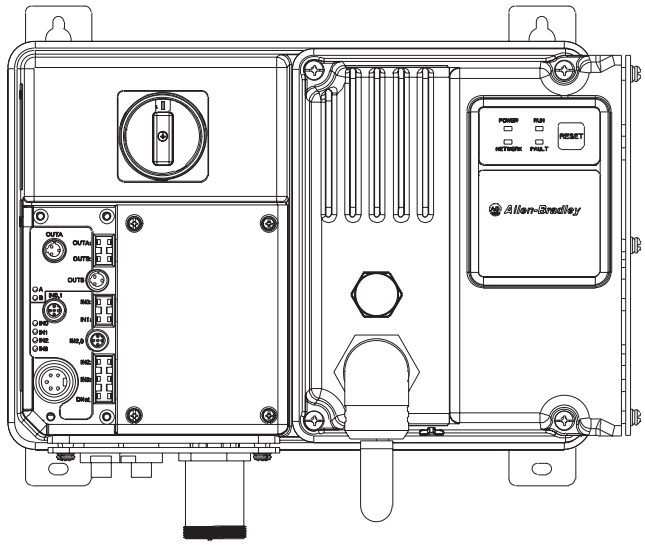


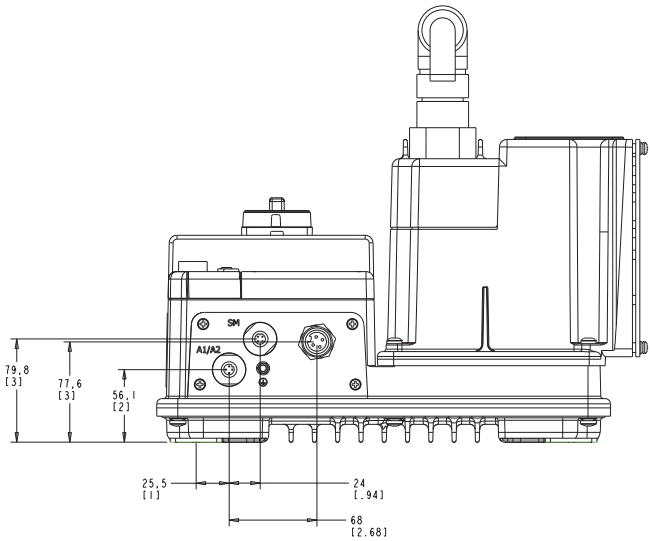


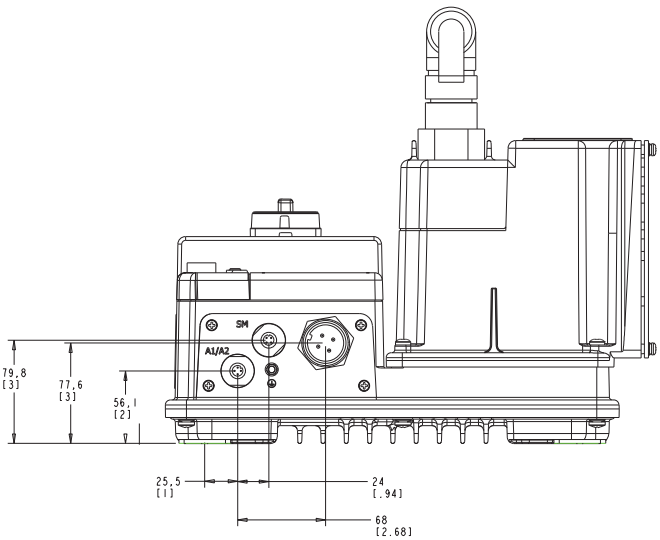
Dimensions for Reversing, IP67/NEMA Type 4 with ArmorConnect Connectivity

Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes. All dimensions are subject to change.









Safety ArmorStart® Distributed Motor Controllers

Bulletin 284D

Bulletin 284D ArmorStart Distributed Motor Controller - Safety Version

Description

The Bulletin 284 ArmorStart Distributed Motor Controller is an integrated, pre-engineered starter for variable frequency AC drive applications. The ArmorStart offers a robust IP67/NEMA Type 4 enclosure design, which is suitable for water wash-down environments. The modular plug-and-play design offers simplicity in wiring the installation. The quick disconnects for the I/O, communication, and motor connection reduce the wiring time and eliminate wiring errors. The ArmorStart offers, as standard, four DC inputs and two relay outputs to be used with sensors and actuators respectively, for monitoring and controlling the application process. The ArmorStart's LED status indication and built-in diagnostics capabilities allows ease of maintenance and troubleshooting. The optional Hand/Off/Auto (HOA) keypad allows for local start/stop control at the ArmorStart Distributed Motor Controller.

The Bulletin 284 ArmorStart Distributed Motor Controller offers short circuit protection per UL 508C and IEC 60947-1. The ArmorStart is rated for local-disconnect service by incorporating the Bulletin 140 Motor Protector as the local-disconnect, eliminating the need for additional components. The ArmorStart Distributed Motor Controllers are suitable for group motor installations.

Safety ArmorStart

The safety version of the ArmorStart provides a safety solution integrated into DeviceNet Safety installations. The Bulletin 284 Safety ArmorStart achieves Category 4 functionality by using redundant contactors. The Safety ArmorStart offers a quick connects via the gland plate to the 1732DS-IB8XOBV4 safety I/O module. The Bulletin 1732DS Safety I/O inputs will monitor the status of the safety rated contactors inside the ArmorStart. The Bulletin 1732DS Safety I/O outputs to provide 24V DC power for control power to the ArmorStart.

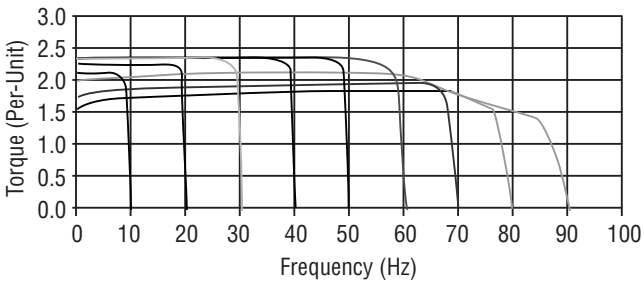
Note: The Bulletin 284 Safety ArmorStart is suitable for safety applications up to Safety Category 4 PLe (TÜV assessment per ISO 13849-1:2008). TÜV compliance letter is available upon request.

Note: For additional information regarding the 1732DS-IB8XOBV4 safety I/O module, see publication 1791DS-UM001*-EN-P.

Mode of Operation

Sensorless Vector Control (SVC)

Sensorless vector control provides exceptional speed regulation and very high levels of torque across the entire speed range of the drive.



ArmorStart with Sensorless Vector Control — 3 Hp, High Speed

Additional Features

- Eight Preset Speeds
- Skip Frequency
- Flying Start
- Auto Restart
- Process Control Loop (PID)
- Step Logic Functionality
- Timer/Counter Functions

Features

- On-Machine starting solution
- Variable frequency AC drive using PowerFlex® technology
- Horsepower range 0.5…5 Hp (0.4…3.3 kW)
- Robust IP67/NEMA Type 4 enclosure rating
- Modular plug and play design
- Quick disconnect connections for I/O, communications, motor, and three-phase power
- Four inputs and two outputs (expandable with ArmorPoint)
- LED status indication
- DeviceNet communications
- DeviceLogix component technology
- Peer-to-peer communications (ZIP)
- Factory installed options:
  - EMI filter
  - Dynamic brake connector
  - Hand/Off/Auto (HOA) keypad configuration
  - Source brake contactor
  - Shielded motor cable
  - Output contactor
  - Hand/Off/Auto (HOA) Keypad Configuration
  - EMI Filter
  - Dynamic Brake Connector
  - Output Contactor
  - Control Brake Contactor
  - Source Brake Contactor
  - Shielded Motor Cable
  - Safety Monitor
  - 0…10V Analog Input

Standards Compliance

UL 508C
CSA C22.2, No. 14
EN/IEC 60947-1, EN 50178, EN 61800-3
CE Marked per Low Voltage Directive 73/23/EEC and EMC Directive 89/336/EEC

Certifications

cULus (File No. E207834, Guide NMMS, NMMS7)

Description of Features

Overload Protection

The Bulletin 284 ArmorStart Distributed Motor Controller incorporates, as standard, electronic motor overload protection. This overload protection is accomplished electronically with an I^2t algorithm. The ArmorStart's overload protection is programmable via the communication network providing the user with flexibility. The overload trip class allows for class 10 overload protection. Ambient insensitivity is inherent in the electronic design of the overload.

Gland Plate Entrance

The ArmorStart product offers two different methods for connecting incoming three-phase power to the device. One method offered is the traditional conduit entrance which provides a 1 in. conduit hole opening for wiring three-phase power. The second method offers connectivity to the ArmorConnect power media. A factory installed receptacle is provided for connectivity to three-phase power media.

Motor Cable

With every Bulletin 284 ArmorStart Distributed Motor Controller, a 3 m unshielded 4-conductor cordset is provided with each unit as standard. If the optional EMI filter is selected, a 3 m shielded 4-conductor cordset is provided with each unit as standard.

LED Status Indication

The LED Status Indication provides four status LEDs and a Reset button. The LEDs provide status indication for the following:

- **POWER LED**
  The LED is illuminated solid green when control power is present and with the proper polarity
- **RUN LED**
  This LED is illuminated solid green when a start command and control power are present
- **NETWORK LED**
  This bicolor (red/green) LEDs indicates the status of the communication link
- **FAULT LED**
  Indicates Controller Fault (trip) condition
- The "Reset Button" as a local trip reset.

Inputs

The inputs are single keyed (two inputs per connector), which are sourced from DeviceNet power (24V DC), with LED status indication.

Outputs

Two dual-key relay output connectors are supplied as standard. The outputs are sourced from the control voltage power, which is 24V DC with LED status indication.

Fault Diagnostics

Fault diagnostics capabilities built into the Bulletin 284 ArmorStart Distributed Motor Controller help you pinpoint a problem for easy troubleshooting and quick re-starting.

- Short Circuit
- Overload
- Phase Short
- Ground Fault
- Stall
- Control Power Loss
- Control Power Fuse Protection
- I/O Fault
- Overcurrent
- Brake Fuse Protection
- Overtemperature
- Output Fuse Protection
- DeviceNet Power Loss
- Internal Communication Fault
- DC Bus Fault
- EEPROM Fault
- Hardware Fault
- Restart Retries
- Miscellaneous Fault

Factory Installed Options

HOA Selector Keypad with Jog Function

The HOA Selector Keypad with Jog Function allows for local start/stop control with capabilities to JOG and to Forward/Reverse motor direction.

EMI Filter

The EMI Filter option is required if the Bulletin 284 ArmorStart Distributed Motor requires to be CE compliant. If the EMI Filter is selected, a 3–meter shielded 4–conductor cordset is provided as standard. This option is only available with sensorless vector control.

Dynamic Brake Connector

A 3 m, 3-pin cable for connection to a dynamic brake module is provided as standard when this option is selected. See Accessories on page 6-22 for available dynamic brake modules.

Source Brake Contactor

An internal contactor is used to switch the electromechanical motor brake on/off. The motor brake is powered from the main power circuit. A customer accessible 3.0 A fuse is provided to protect the brake cable. A 3-meter, 3-pin cable for connection to the motor, is provided as standard when this option is selected.

Shielded Motor Cable

A 3-meter shielded 4-conductor cordset is provided instead of the 3-meter unshielded 4-conductor cordset. If the EMI Filter is selected, a 3-meter shielded 4-conductor cordset is provided as standard.

Cat. No. Explanation

Examples given in this section are for reference purposes. This basic explanation should not be used for product selection; not all combinations will produce a valid catalog number.

284	D	–	F	V	D2P3	S	–	10	–	CR	–	Option 1	–	Option 2	–	Option 3
a	*b*		*c*	*d*	*e*	*f*		*g*		*h*		*i*		*j*		*k*

a

Bulletin Number	
Code	Description
284	VFD Starter

b

Communications	
Code	Description
D	DeviceNet™

c

Enclosure Type	
Code	Description
F	Type 4 (IP67)

d

Torque Performance Mode	
Code	Description
V	Sensorless Vector Control and Volts per Hertz

e

Output Current	
Code	Description
D1P4	1.4 A, 0.4 kW, 0.5 Hp
D2P3	2.3 A, 0.75 kW, 1.0 Hp
D4P0	4.0 A, 1.5 kW, 2.0 Hp
D6P0	6.0 A, 2.2 kW, 3.0 Hp
D7P6	7.6 A, 3.3 kW, 5.0 Hp

f

Control Voltage	
Code	Description
S	24V DC

g

Short Circuit Protection (Motor Circuit Protector)	
Code	Description
10	10 A Rated Device
25	25 A Rated Device

h

Control and 3-Phase Power Connections / Motor Cable Connection (CR: Conduit/Round Media) or (RR: Round/Round Media)				
Code		Description		
		Control Power	3-Phase Power	Motor Cable
CR	blank	Conduit Entrance	Conduit Entrance	3 m, unshielded cordset male 90°
CR	N	Conduit Entrance	Conduit Entrance	3 m, shielded cordset male 90°
CR	W ∗	Conduit Entrance	Conduit Entrance	No cable
RR	blank	Round Media (Male Receptacle)	Round Media (Male Receptacle)	3 m, unshielded cordset male 90°
RR	N	Round Media (Male Receptacle)	Round Media (Male Receptacle)	3 m, shielded cordset male 90°
RR	W ∗	Round Media (Male Receptacle)	Round Media (Male Receptacle)	No cable

∗ See Accessories on page 6-21 for extended motor and brake cable lengths.

i

Option 1	
Code	Description
3	Hand/Off/Auto Selector Keypad with Jog Function

j

Option 2		
Code		Description
DB1	blank	Connectivity to IP67 DB Resistor
SB	blank	Source Brake Contactor
SB	W ∗	No cable

k

Option 3	
Code	Description
EMI	EMI Filter

Product Selection

IP67/NEMA Type 4 with conduit entrance, DeviceNet communications, Sensorless Vector Control, and Volts per Hertz torque performance, Up to 480V AC

Input Voltage	3-Phase kW Rating	3-Phase Hp Rating	Output Current	24V DC Control Voltage Cat. No.
380…480V, 50/60 Hz 3-Phase	0.4	0.5	1.4	284D-FVD1P4S-10-CR
	0.75	1	2.3	284D-FVD2P3S-10-CR
	1.5	2	4	284D-FVD4P0S-10-CR
	2.2	3	6	284D-FVD6P0S-25-CR
	3	5	7.6	284D-FVD7P6S-25-CR

IP67/NEMA Type 4 with quick disconnects for ArmorConnect power media, DeviceNet communications, Sensorless Vector Control, and Volts per Hertz torque performance, Up to 480V AC

Input Voltage	3-Phase kW Rating	3-Phase Hp Rating	Output Current	24V DC Control Voltage Cat. No.
380…480V, 50/60 Hz 3-Phase	0.4	0.5	1.4	284D-FVD1P4S-10-RR
	0.75	1	2.3	284D-FVD2P3S-10-RR
	1.5	2	4	284D-FVD4P0S-10-RR
	2.2	3	6	284D-FVD6P0S-25-RR
	3	5	7.6	284D-FVD7P6S-25-RR

Options – Factory Installed

Description				Cat. No. Modification
	Hand/Off/Auto Selector Keypad			-3
	EMI Filter			-EMI
	Shielded motor cable		**Enclosure Rating**	-CRN
	Supplied without motor cable		IP67	-CRW
	Supplied with source brake cable			-SB
	Supplied without source brake cable			-SBW
	Dynamic Brake Connector			-DB1
	Connectivity to ArmorConnect Power Media supplied with shielded motor cable	**Short Circuit Protection Rating**	**Enclosure Rating**	-RRN
		10 A	IP67	
		25 A		
	Connectivity to ArmorConnect Power Media supplied without motor cable	10 A		-RRW
		25 A		

Accessories

Sealing Caps

Description	For Use With	Cat. No.
Plastic Sealing Cap (M12)✶	Input I/O Connection	1485A-M12
AC Micro Aluminum Sealing Cap - External✶	Output I/O Connection	889A-RMCAP

✶ To achieve IP67 rating, sealing caps must be installed on all unused I/O connections.

Cables

Description	Cable Rating	Length [m (ft)]	Cat. No.
Extended Motor Cable Cordsets			
90° M22 Motor Cordset	IP67/NEMA Type 4	6 (19.6)	280-MTR22-M6
		14 (45.9)	280-MTR22-M14
Shielded Motor Cable Cordsets			
90° M22 Motor Cordset	IP67/NEMA Type 4	6 (19.6)	**284-MTRS22-M6**
90° M22 Motor Cordset	IP67/NEMA Type 4	14 (45.9)	284-MTRS22-M14
Extended Brake Cable Cordsets			
90° M25 Source Brake Cable	IP67/NEMA Type 4	6 (19.6)	285-BRC25-M6
90° M25 Source Brake Cable	IP67/NEMA Type 4	14 (45.9)	285-BRC25-M14

Sensor Media ⌘

Description		ArmorStart I/O Connection	Pin Count	Connector	Cat. No.
	DC Micro Patchcord	Input	5-pin	Straight Female Straight Male	889D-F4ACDM-➤
				Straight Female Right Angle Male	889D-F4ACDE-➤
	DC Micro V-Cable	Input	5-pin	Straight Female	879D-F4ACDM-➤
				Right Angle Male	879D-R4ACM-➤
	AC Micro Patchcord	Output	3-pin	Straight Female Straight Male	889R-F3AERM-➤
				Straight Female Right Angle Male	889R-F3AERE-➤

⌘ See the On-Machine Connectivity catalog for complete cable selection information.
➤ Replace symbol with desired length in meters (Example: 889D-F4ACDM-1 for a 1 m cable). Standard cable lengths: 1, 2, 5, and 10 m.
Note: Stainless steel versions may be ordered by adding an "S" to the cat. no. (Example: 889DS-F4ACDM-1).

DeviceNet Media ♣

Description		Length [m (ft)]	Cat. No.
			Sealed
	KwikLink pigtail drops are Insulation Displacement Connector (IDC) with integral Class 1 round cables for interfacing devices or power supplies to flat cable	1 (3.3)	1485P-P1E4-B1-N5
		2 (6.5)	1485P-P1E4-B2-N5
		3 (9.8)	1485P-P1E4-B3-N5
		6 (19.8)	1485P-P1E4-B6-N5
	DeviceNet Mini- T-Port Tap	Left Keyway	**1485P-P1N5-MN5KM**
		Right Keyway	1485P-P1N5-MN5NF

Description		Connector	Cat. No.
	Gray PVC Thin Cable	Mini Straight Female Mini Straight Male	1485G-P❄N5-M5
		Mini Straight Female Mini Right Angle Male	1485G-P❄W5-N5
		Mini Right Angle Female Mini Straight Male	1485G-P❄M5-Z5
		Mini Right Angle Female Mini Straight Male	1485G-P❄W5-Z5
	Thick Cable	Mini Straight Female Mini Straight Male	1485C-P‡N5-M5
		Mini Straight Female Mini Right Angle Male	1485C-P‡W5-N5
		Mini Right Angle Female Mini Straight Male	1485C-P‡M5-Z5
		Mini Right Angle Female Mini Straight Male	1485C-P‡W5-Z5

Description		Length [m (ft)]	Cat. No.
	DeviceNet Configuration Terminal Used to interface with objects on a DeviceNet network. Includes 1 m communications cable.	1 (3.3)	193-DNCT
	Communication cable, color-coded bare leads	1 (3.3)	193-CB1
	Communication cable, microconnector (male)	1 (3.3)	193-CM1
	Panel Mount Adapter/Door Mount Bezel Kit	—	193-DNCT-BZ1

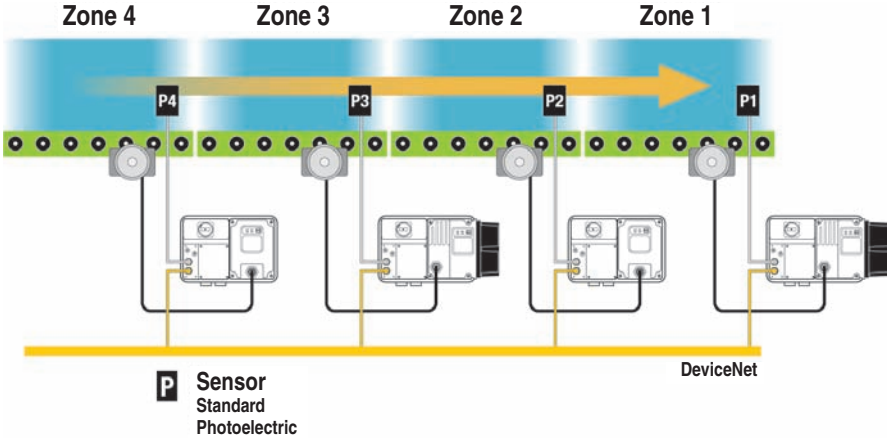
♣ See publication M116-CA001_-EN-P for complete cable selection information.
❄ Replace symbol with desired length in meters (Example: **1485G-P1N5-M5** for a 1 m cable). Standard cable lengths: 1, 2, 3, 4, 5, and 6 m.
‡ Replace symbol with desired length in meters (Example: **1485C-P1N5-M5** for a 1 m cable). Standard cable lengths: 1, 2, 3, 4, 5, 6, 8, 10, 12, 18, 24, and 30 m.

IP67 Dynamic Brake Resistors – 400…480V AC Input Drives

Drive and Motor Size kW (Hp)	Cat. No.	Resistance⌘ [Ω ± 5%]	Continuous Power kW	Max. Energy kJ	Max. Braking Torque % of Motor	Application Type 1		Application Type 2	
						Braking Torque % of Motor	Duty Cycle§ %	Braking Torque % of Motor	Duty Cycle§ %
0.37 (0.5)	284R-360P500-M∗	360	0.086	17	305%	100%	47%	150%	31%
0.75 (1)	284R-360P500-M∗	360	0.086	17	220%	100%	23%	150%	15%
1.5 (2)	284R-360P500-M∗	360	0.086	17	110%	100%	12%	110%	11%
2.2 (3)	284R-120P1K2-M∗	120	0.26	52	197%	100%	24%	150%	16%
4 (5)	284R-120P1K2-M∗	120	0.26	52	124%	100%	13%	124%	10%

∗ Indicates cable length (0.5 m or 1.0 m).
⌘ Always check the resistor ohms against the minimum resistance for the drive being used.
§ The duty cycle listed is based on full speed to zero speed deceleration. For constance regen at full speed, the duty cycle capability is half of the listed value. Application Type 1 represents maximum capability up to 100% braking torque where possible. Application Type 2 represents more than 100% braking torque where possible, up to a mximum of 150%.

Peer-to-Peer Communications



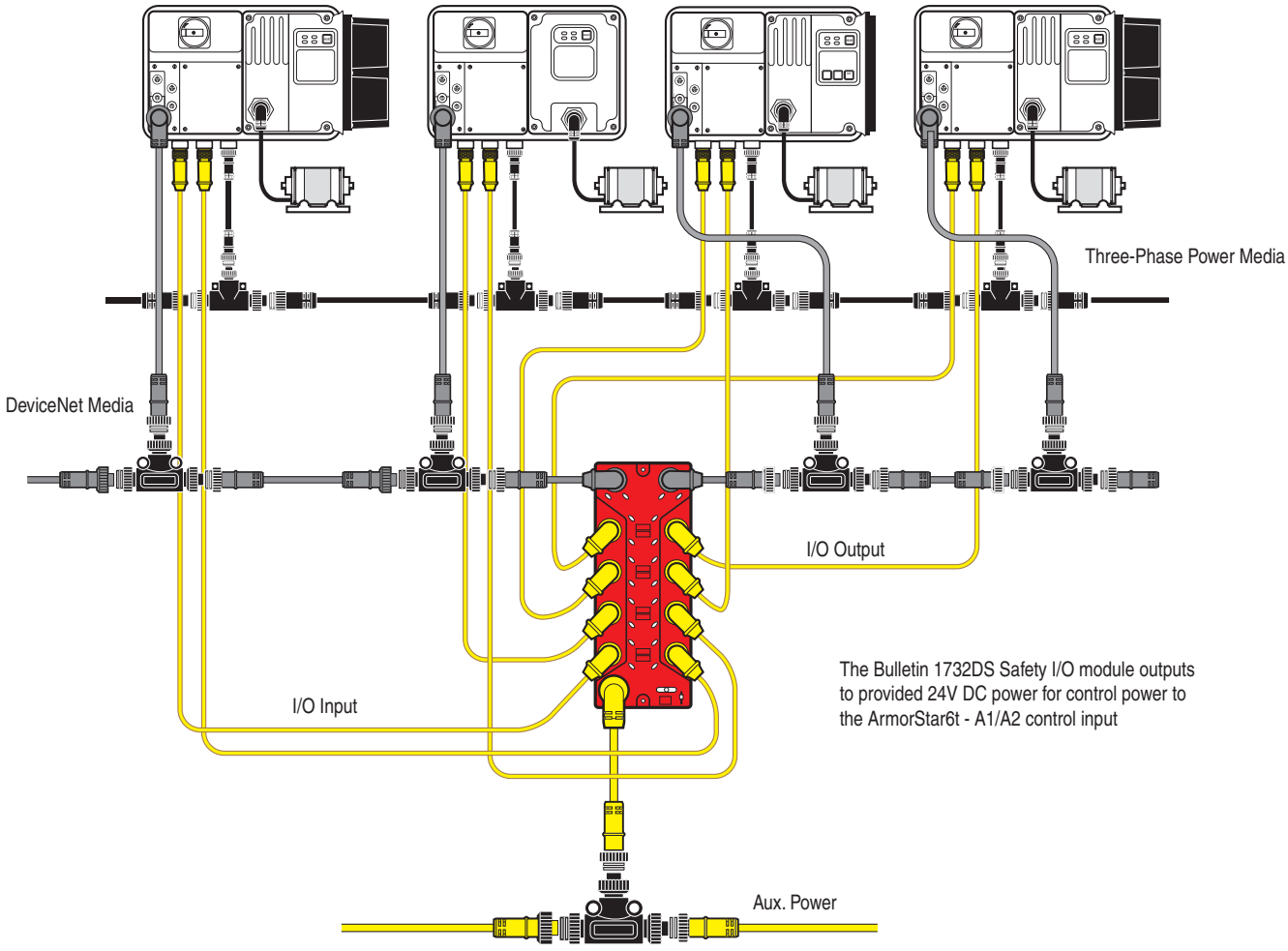
The Zone Control capabilities of ArmorStart Distributed Motor Controller is ideal for large horsepower (0.5…10 Hp) motored conveyors. The ArmorStart Distributed Motor Controllers have built-in DeviceNet Communications, DeviceLogix technology, and the added Zone Interlocking Parameters (ZIP) which allows one ArmorStart to consume data directly from up to four other DeviceNet nodes without going through the network scanner. These direct communications between conveyor zones are beneficial in a merge, diverter, and accumulation conveyor applications.

Safety I/O Module and TÜV Requirements

ArmorStart Safety-Related Parts

Each ArmorStart Safety Distributed motor controller is intended to be combined with the 1732DS-IB8XOBV4 safety I/O module to form a subsystem that is part of the overall machine stop function. The motor controllers are connected to the safety I/O module through specified cable assemblies. The combination of one of these controllers, the safety module, and the specified interconnecting cables are referred to as the ArmorStart Safety-Related Parts. The part numbers for each of these components is specified below. The combination of these components is shown in Figure E.1. The safety I/O module and PLC program must be configured as outlined. See configuration of Safety I/O Module and PLC program.

Catalog Number	Description
280…S* * - denotes safety version of Bulletin 280	Bulletin 280 Distributed Motor Controller – controller is full-voltage, non-reversing
281…S* * - denotes safety version of Bulletin 281	Bulletin 281 Distributed Motor Controller – controller is full-voltage, reversing
284…S* * - denotes safety version of Bulletin 284	Bulletin 284 Distributed Motor Controller – controller is variable-frequency AC drive
1732DS-IB8XOBV4	Guard I/O DeviceNet Safety Module
889D-F4HJDM-*, 889D-F4AEDM-* or equivalent * - denotes length	• SM cable assembly - Interconnecting cable assembly between safety module input and ArmorStart controller connector labeled “SM”. Assembly provides contactor position feedback. • A1/A2 cable assembly - Interconnecting cable assembly between safety module output and ArmorStart controller connector labeled “A1/A2”. Assembly provides output contactor coil power and controller power supply.



The Bulletin 1732DS Safety I/O module inputs will monitor the status of the safety-related contactors inside the ArmorStart - SM safety monitor input

ArmorBlock® Guard I/O™ Modules

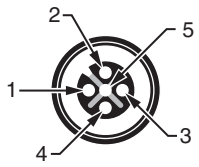
	Description	Cat. No.
	ArmorBlock Guard I/O provides all the advantages of traditional distributed I/O for safety systems, but has an IP67 package that can be mounted directly on your machine. On-machine safety I/O reduces wiring time and startup costs for safety controller applications by eliminating electrical boxes and simplifying cable installation. The ArmorBlock family provides industrially hardened I/O blocks that you can mount directly on equipment near sensors or actuators. Wiring the I/O to the sensors and actuators is easy using pre-wired quick disconnect cables. You can use Guard I/O with any safety controller that communicates on DeviceNet using CIP Safety for the control and monitoring of safety circuits. Guard I/O detects circuit failures at each I/O point while providing detailed diagnostics directly to the controller. With CIP Safety, you can easily integrate safety and standard control systems by using safety and standard messages on the same wire. The 1732DS ArmorBlock Guard I/O family consists of 24V DC digital I/O modules that communicate on DeviceNet networks. The I/O connectors are sealed M12 micro style while the network and auxiliary power connectors are sealed mini style. Plus, the ArmorBlock Guard I/O uses the same input and output M12 pin configuration as standard ArmorBlock and Maxum.	1732DS-IB8XOBV4

Specifications

Description	24V DC Input/Output Module on DeviceNet Networks
Current Consumption	85 mA @ 24V DC
I/O Operating Voltage Range	19.2V…28.8 V DC (24V DC, -20…+20%)
Digital Inputs	
Number of Inputs	8 safety single-channel or 4 safety dual-channel
Input Type	current sinking
Voltage, On-State Input, Min.	11V DC
Voltage, Off-State Input, Max.	5V DC
Current, On-State Input, Min.	3.3 mA
Digital Outputs	
Number of Outputs	4 safety solid-state
Output Type	dual channel, current sourcing/current sinking pair
Output Current Rating	2.0 A max per point
Short Circuit Protection	Yes
Standard Pulse Test Outputs	
Number of Pulse Test Sources	8
Pulse Test Output Current	0.7 A per point
Short Circuit Protection	Yes
General	
Temperature, operating	-20…+60 °C (-4…+140 °F)
Relative Humidity	10…95% non-condensing
Vibration	0.76 mm @ 10…500 Hz
Shock, operating	30 g
Enclosure Protection	IP67
Dimensions (HxWxD), Metric	179 x 70 x 68.7 mm✶
Dimensions (HxWxD), Imperial	7.05 x 2.76 x 2.71 in.✶
Weight, Metric	600 g
Weight, Imperial	1.2 lb
Certifications❄	UL, CE, C-Tick, CSA, UL NRGF, ODVA Conformance, TÜV certified for functional safety up to SIL 3 and Cat. 4, PLe

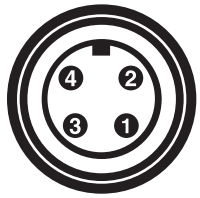
✶ Includes terminal block.
❄ When product is marked. See the Product Certification link at http://www.ab.com/certification for Declarations of Conformity, Certificates, and other certification details.
All specifications are subject to change. Refer to product installations instructions.

1732DS ArmorBlock Guard I/O Micro Connector Pin Assignments

Input Configuration		Female	Output Configuration	
Pin	Signal		Pin	Signal
1	Test Output n+1		1	Output +24V DC Power
2	Safe Input n+1		2	Output n+1 (Sinking)
3	Input Common		3	Output Power Common
4	Safe Input n		4	Output n (Sourcing)
5	Test Output n		5	Output Power Common

1732DS ArmorBlock Guard I/O Mini Connector Pin Assignments

ArmorBlock Guard I/O DeviceNet Configuration			
Pin	Signal	Male	Female
1	Drain		
2	V+ (Red)		
3	V- (Black)		
4	CAN_H (White)		
5	CAN_L (Blue)		

ArmorBlock Guard I/O Power Configuration		
Pin	Signal	Male
1	Output +24V DC Power (Red)	
2	Input +24V DC Power (Green)	
3	Input Power Common (White)	
4	Output Power Common (Black)	

ArmorBlock Guard I/O Recommended Compatible Cables and Connectors✶

Description		Cat. No.
	DC Micro (M12) Male Cordset	889D-F4HJ-❄
	DC Micro Style Patchcord	889D-F4HJDM-‡
	M12 Terminal Chamber—Straight Male	871A-TS4-DM
	M12 Terminal Chamber—Right Angle Male	871A-TR4-DM

✶ All cables must use 5-pin connections for ArmorBlock Guard I/O M12 input compatibility.
❄ Replace symbol with 0M3 (0.3 m), 2 (2 m), or 5 (5 m) for standard cable length.
‡ Replace symbol with 1 (1 m), 2 (2 m), 5 (5 m), or 10 (10 m) for standard cable length.

Specifications

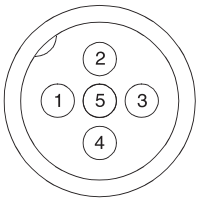
Electrical Ratings		UL/NEMA			IEC		
Power Circuit	Rated Operation Voltage	200…575V			200…500V		
	Rate Insulation Voltage	600V			600V		
	Rated Impulsed Voltage	6 kV			6 kV		
	Dielectric Withstand	2200V AC			2500V AC		
	Operating Frequency	50/60 Hz			50/60 Hz		
	Utilization Category	N/A			AC-3		
	Protection Against Shock	N/A			IP2X		
Control Circuit	Rated Operation Voltage	24V DC (+10%, -15%) A2 (should be grounded at voltage source)					
		120V AC (+10%, -15%) A2 (should be grounded at voltage source)					
		240V AC (+10%, -15%) A2 (should be grounded at voltage source)					
	Rate Insulation Voltage	250V			250V		
	Rated Impulsed Voltage	—			4 kV		
	Dielectric Withstand	1500V AC			2000V AC		
	Overvoltage Category	—			III		
	Operating Frequency	50/60 Hz					
Short Circuit Protection	SCPD performance Type 1	**Current Rating**	**Voltage**	480Y/277V	480/480V	600Y/347V	600V
		10 A	Sym. Amps RMS	65 kA	65 kA	30 kA	30 kA
		25 A		30 kA	30 kA	30 kA	30 kA
	SCPD List	Size per NEC Group Motor			—		

Power Requirements			
	Units	**No Options**	**w/ Brake Contactor**
Control Voltage	Volts	24V DC	
Total Control VA (Pick Up)	VA (W)	(11 W)	(16 W)
Total Control VA (Hold In)	VA (W)	(11 W)	(16 W)
External Devices powered by Control Voltage			
Outputs (2) (1 A max. each)	Amps	2	
Total Control VA (Pick Up) with max outputs	VA (W)	(59 W)	(64 W)
Total Control VA (Hold In) with max outputs	VA (W)	(59 W)	(64 W)

Input Ratings	Rated Operation Voltage	24V DC	
	Input On-State Voltage Range	10…26V DC	
	Input On-State Current	3.0 mA @ 10V DC	
		7.2 mA @ 24V DC	
	Input Off-State Voltage Range	0…5V DC	
	Input Off-State Current	<1.5 mA	
	Input Filter — Software Selectable		
	Off to On	Settable from 0…64 ms in 1 ms increments	
	On to Off	Settable from 0…64 ms in 1 ms increments	
	Input Compatibility	N/A	IEC 1+
	Number of Inputs	4	
	Sensor Source		
	Voltage Status Only	11…25V DC from DeviceNet	
	Current Available	50 mA max. per input, 200 mA total	
Output Ratings (Sourced from Control Circuit)	Rated Operation Voltage	240V AC/30V DC	240V AC/30V DC
	Rate Insulation Voltage	250V	250V
	Dielectric Withstand	1500V AC	2000V AC
	Operating Frequency	50/60 Hz	50/60 Hz
	Type of Control Circuit	Electromechanical relay	
	Type of Current	AC/DC	
	Conventional Thermal Current Ith	Total of both outputs ≤ 2 A	
	Type of Contacts	Normally open (N.O.)	
	Number of Contacts	2	
ArmorPoint Ratings	Backplane Current Load	400 mA	

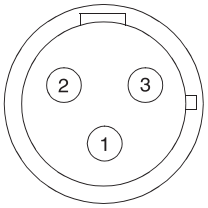
		UL/NEMA	IEC
Environmental	Operating Temperature Range	-20…+40 °C (-4…+104 °F)	
	Storage and Transportation Temperature Range	–25….+85 °C (–13…+185 °F)	
	Altitude	1000 m	
	Humidity	5…95% (non-condensing)	
	Pollution Degree	3	
	Enclosure Ratings	NEMA 4/12/13	IP67
		NEMA 4X	IP69K
	Approximate Shipping Weight	13.6 kg (30 lb)	
Mechanical	**Resistance to Shock**		
	Operational	15 G	
	Non-Operational	30 G	
	Resistance to Vibration		
	Operational	1 G, 0.15 mm (0.006 in.) displacement	
	Non-Operational	2.5 G, 0.38 mm (0.015 in.) displacement	
	Wire Size	Primary terminal: (16 …10 AWG) Secondary terminal: (18 …10 AWG)	Primary terminal: 1.3…5.3 mm^2 Secondary terminal: 0.8…5.3 mm^2
	Tightening Torque	Primary terminal: 10.8 lb•in Secondary terminal: 4.5 lb•in	Primary terminal: (1.2 N•m) Secondary terminal: (0.5 N•m)
	Wire Strip Length	0.35 in. (9 mm)	
	Control and Safety Monitor Inputs		
	Wire Size	(18…10 AWG)	1.0…4.0 mm^2
	Tightening Torque	6.2 lb•in	0.7 N•m
	Wire Strip Length	0.35 in. (9 mm)	
Other Rating	**EMC Emission Levels**		
	Conducted Radio Frequency Emissions	Class A	
	Radiated Emissions	Class A	
	EMC Immunity Levels		
	Electrostatic Discharge	4 kV contact and 8 kV Air	
	Radio Frequency Electromagnetic Field	10V/m	
	Fast Transient	2 kV	
	Surge Transient	1 kV (12) $_{L-L}$, 2 kV (2) $_{L-N}$ (earth)	
	Overload Characteristics		
	Trip Class	10	
	Overload Protection	I^2t overload protection - 150% for 60 s, 200% for 30 s	
	Number of Poles	3	
	DeviceNet Specifications		
	DeviceNet Supply Voltage Rating	Range 11…25V DC, 24V DC nominal	
	DeviceNet Input Current	167 mA @ 24V DC - 4.0 W	
		364 mA @ 11V DC - 4.0 W	
	External Devices powered by DeviceNet	Sensors inputs 4 x 50 mA - total 200 mA	
	Total w/max Sensor Inputs (4)	367 mA @ 24V DC - 8.8 W	
	DeviceNet Input Current Surge	15 A for 250 µs	
	DeviceNet Communications		
	Baud Rates	125, 250, 500 kbps	
	Distance Maximum	500 m (1630 ft) @ 125 kbps	
		200 m (656 ft) @ 250 kbps	
		100 m (328 ft) @ 500 kbps	
	Certifications	cULus (File No. E207834) UL 508C EN/IEC 60947-1, EN 50178, EN 61800-3 CE Marked per Low Voltage Directive 73/23/EEC and EMC Directive 89/336/EEC	

External Connections for Input Connector



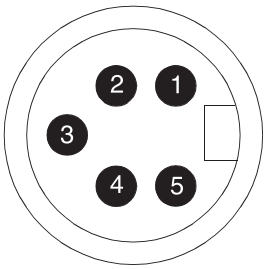
Pin 1: +V Out
Pin 2: Input
Pin 3: Comm
Pin 4: Input
Pin 5: NC (No Connection)

External Connections for Output Connector



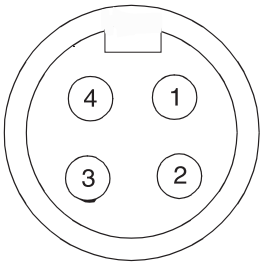
Pin 1: PE
Pin 2: Return
Pin 3: Relay Out

External Connections for DeviceNet Connector



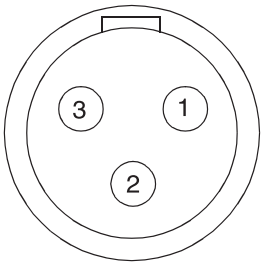
Pin 1: Drain (Not Connected)
Pin 2: +VDNET
Pin 3: -VDNET
Pin 4: CAN_H
Pin 5: CAN_L

External Connections for Motor Connector



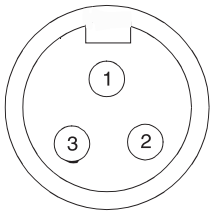
Pin 1: T1 - Black
Pin 2: T2 - White
Pin 3: T3 - Red
Pin 4: Ground - Green/Yellow

External Connections for Brake Contactor Connector



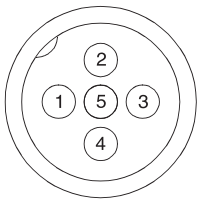
Pin 1: L1 - Black
Pin 2: GND - Green/Yellow
Pin 3: L2 - White

External Connections for Dynamic Brake Connection



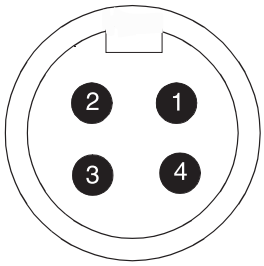
Pin 1: GND - Green/Yellow
Pin 2: BR+ - Black
Pin 3: BR- - White

External Connections for 0...10V Analog Input



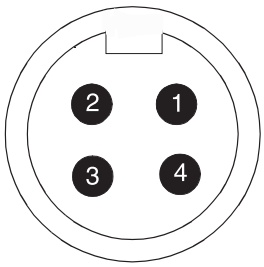
Pin 1: 10VDC
Pin 2: 0...10V Input
Pin 3: Analog Common
Pin 4: Analog Output
Pin 5: NC (No Connection)

Safety Monitor Input (SM1/SM2)



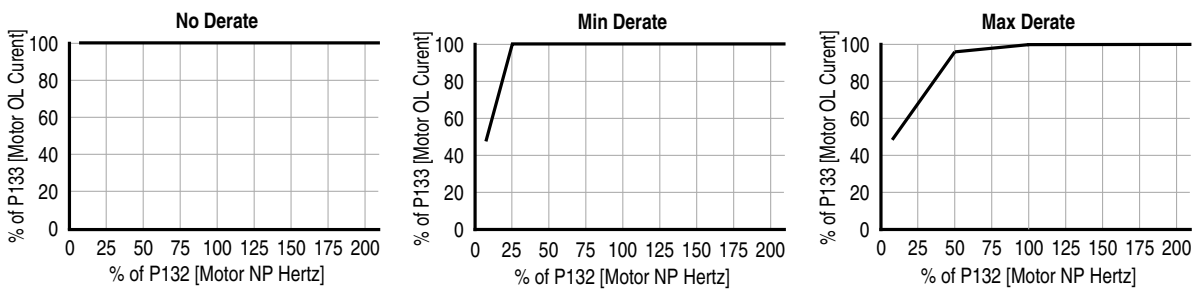
Pin 1: SM2 - White
Pin 2: SM1 - Brown
Pin 3: NC (No Connection)
Pin 4: NC (No Connection)

External Connections for Safety Input Power (A1/A2)



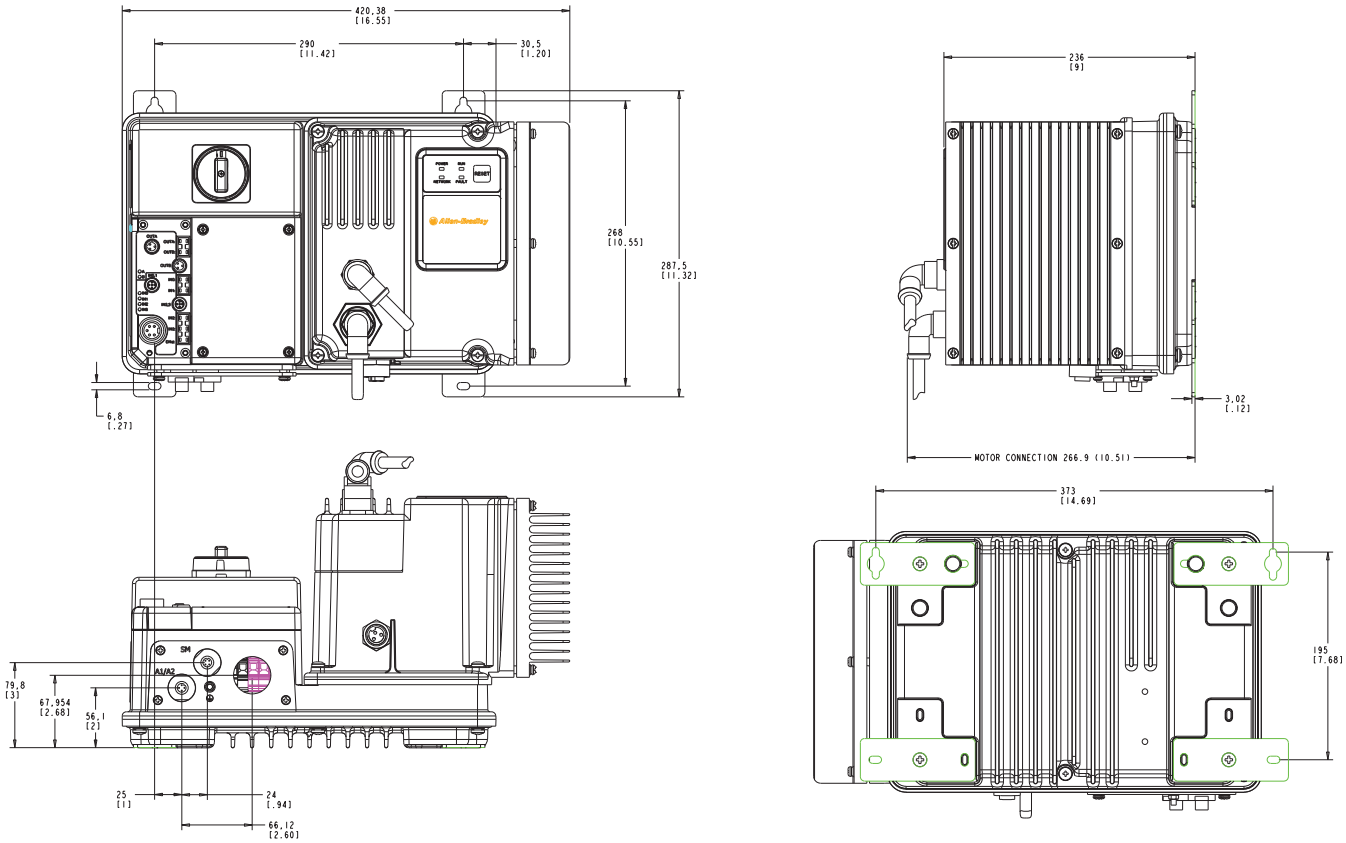
Pin 1: M - White
Pin 2: A1 - Brown
Pin 3: P - Black
Pin 4: A2 - Blue

Overload Curves



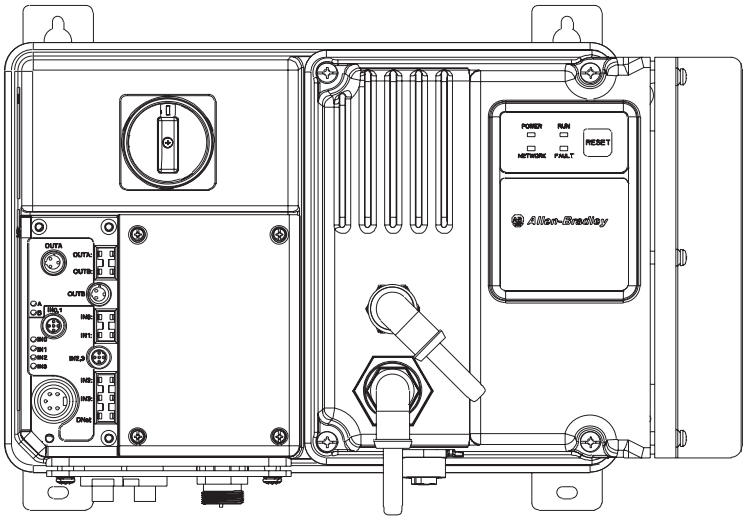
Dimensions for Safety Product, 2 Hp and below @ 460V AC, IP67/NEMA Type 4 with Conduit Entrance

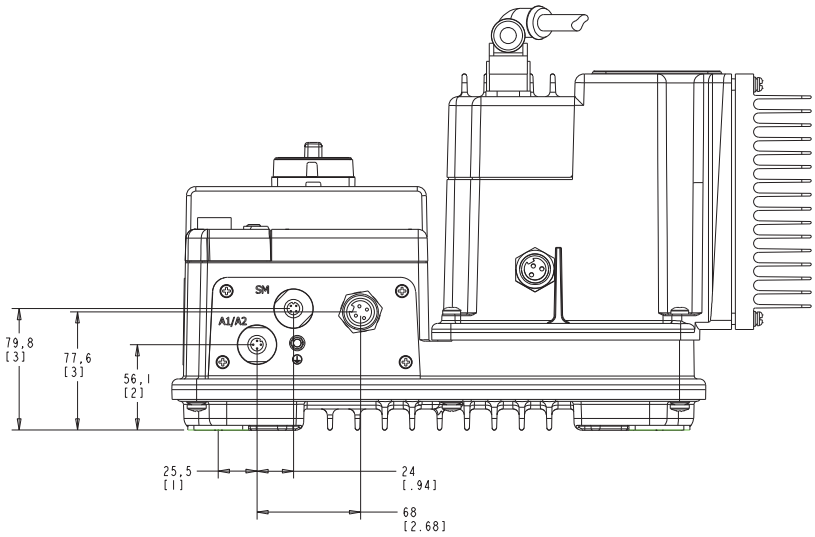
Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes. All dimensions are subject to change.



Dimensions for Safety Product, 2 Hp and below @ 460V AC, NEMA Type 4 with ArmorConnect™ Connectivity

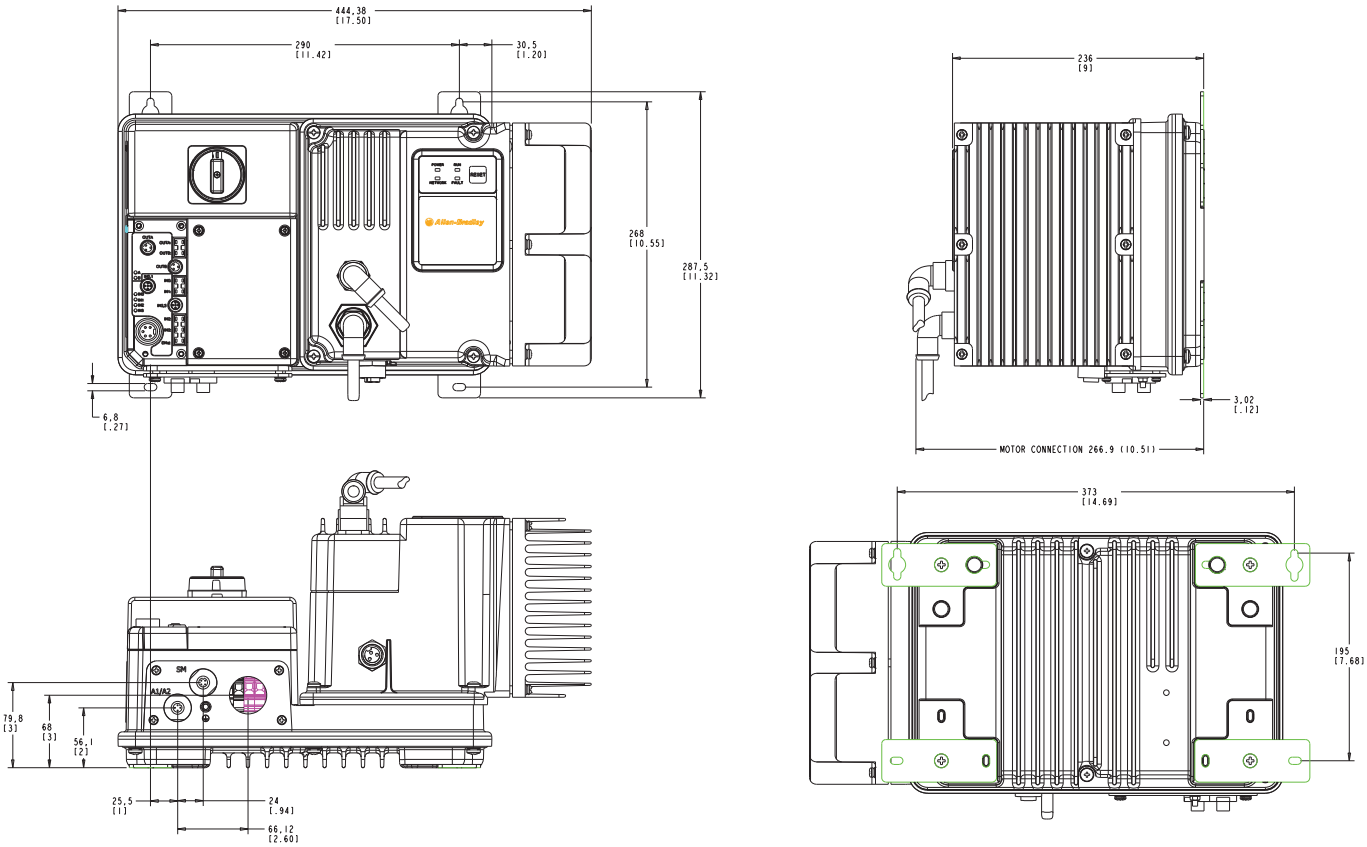
Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes. All dimensions are subject to change.





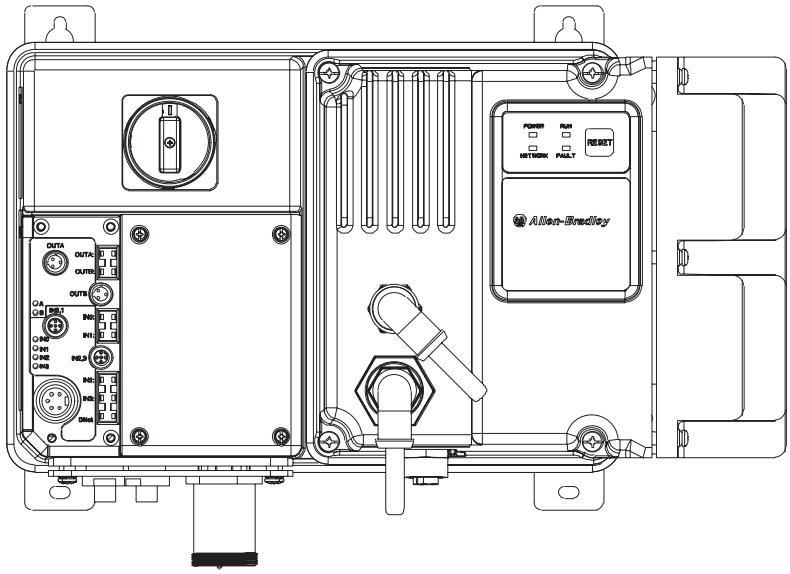
Dimensions for Safety Product, 3 Hp and above @ 460V AC, IP67/NEMA Type 4 with Conduit Entrance

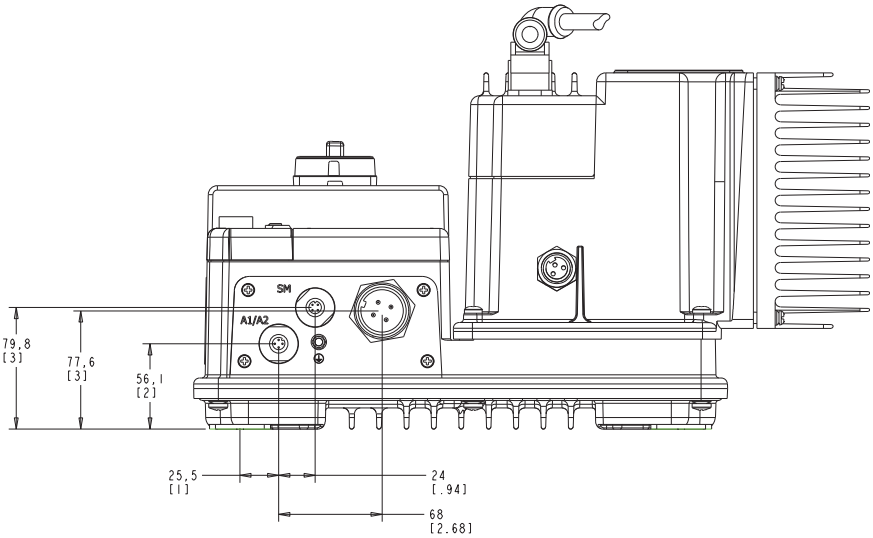
Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes. All dimensions are subject to change.



Dimensions for Safety Product, 3 Hp and above @ 460V AC, IP67/NEMA Type 4 with ArmorConnect Connectivity

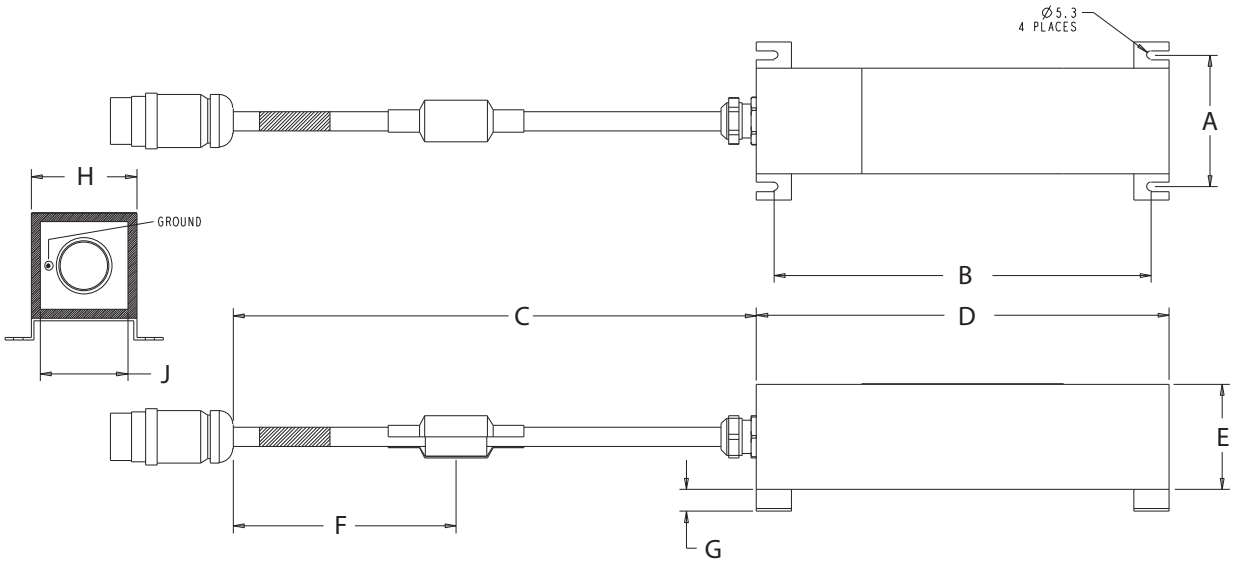
Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes. All dimensions are subject to change.





Dynamic Brake Resistors

Dimensions are in millimeters. Dimensions are not intended to be used for manufacturing purposes.



Cat. No.	A	B	C	D	E	F	G	H	J
284R-091P500	75±3	215±5	*	235±5	60±2	127	12.54	60±2	50±1.5
284R-360P500		215±5		235±5					
284R-120P1K2		420±5		440±5					

* Length is user-selectable based on a suffix added to the catalog number. For a length of 500±10 mm, add **-M05** to the end of the catalog number. For a length of 1000±10 mm, add **-M1** to the end of the catalog number.

Help improve machine uptime and reduce wear and tear with safety-rated PowerFlex and Kinetix drives

The requirement for a machine to be placed in a safe state often needs to be done with a high level of confidence. Many times this is necessary to perform routine maintenance, correct a mechanical problem, or in some cases it may happen very frequently as part of the normal machine process cycle (e.g. punch press). Finding a way to do this without removing power from the system and performing a lockout / tagout procedure can improve process up-time, and reduce wear and stress on mechanical and electrical components. Also, providing an efficient way to exercise functional safety can reduce the chances of safety system tampering.

Safe Torque-Off

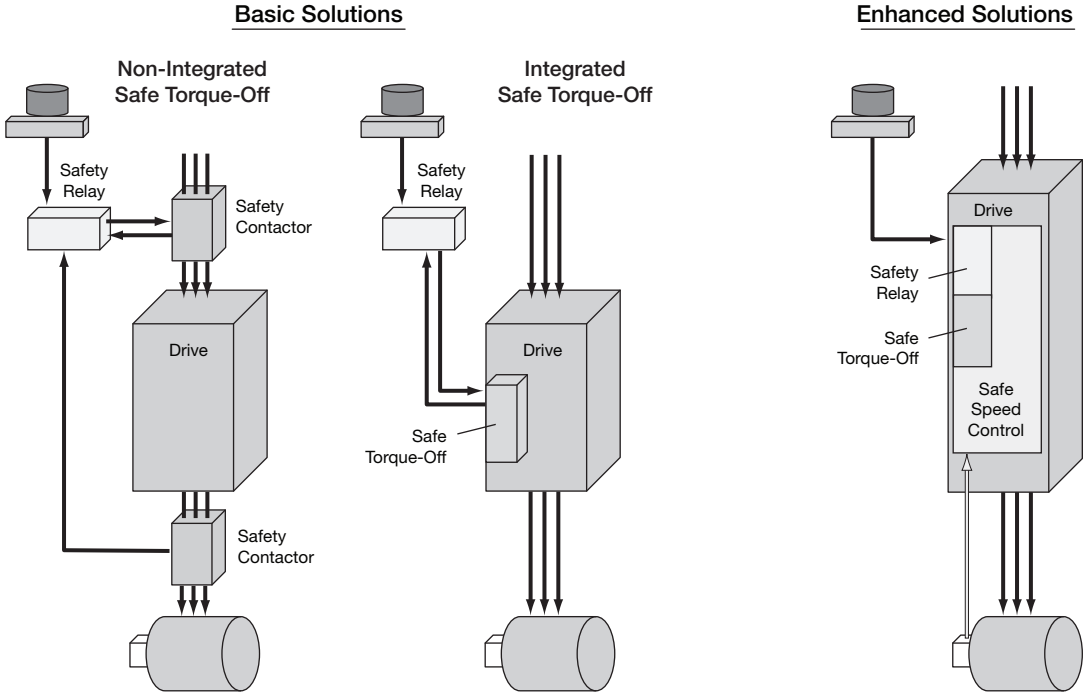
For many drive applications, simple removal of torque is all that is necessary to perform the desired task (e.g. maintenance). This function is referred to as Safe Torque-Off (also known as DriveGuard or GuardMotion), and can be accomplished with the use of a standard drive, along with external safety components (e.g. safety contactors) to place the system in a safe state. Some of the PowerFlex and Kinetix drive products reduce the amount of external safety components by integrating safe torque-off functionality inside the drive. Using the integrated solution simplifies the safety circuit design, and reduces panel space and cost. In either case, whether the function is implemented inside or outside the drive, it can be designed to meet the requirements of relevant safety standards.

Safe Speed Monitor

For applications able to benefit from more advanced safety features, Allen-Bradley offers a Safe Speed Monitor option that uses machine or motor velocity feedback for even greater flexibility in how safety can be deployed. This new offering helps provide safety zone access while there is limited motion. By reducing and monitoring the speed of an application, an operator may safely inspect and perform a process operation or maintenance work without stopping the machine, resulting in reduced downtime and reduced production waste. The Safe Speed Monitor is configurable for following functions:

- Safe Torque-Off
- Stop Categories 0, 1 and 2
- Safe Stop
- Safe Limited Speed
- Safe Maximum Speed
- Safe Maximum Acceleration
- Safe Direction
- Zero Speed Monitoring
- Door Control and Monitoring
- Enabling Switch Input

In addition to the safe monitoring of speed dependent functions, the Safe Speed Monitor integrates the functionality of a safety monitoring relay, providing direct inputs for interfacing door locks, light curtains, E-Stop pushbuttons, enabling switches, and key switches. While this can be accomplished with a standard drive and a separate speed monitoring relay (Allen-Bradley MSR57), select PowerFlex and Kinetix drives are capable of integrating this functionality internally, again simplifying the safety system, and reducing panel space and cost.



Safety Solutions for PowerFlex® Drives

Overview

The Allen-Bradley PowerFlex 40P, 70, 700H, 700L, 700S, 753 and 755 offer certified safety options to help provide integral, cost-effective, and certified protection for AC drive control.

All safety options are available as a kit for user installation.

	PowerFlex 40P	PowerFlex 70	PowerFlex 700H
Safe Torque-Off	✓	✓	✓
Safe Speed Functions (speed, accel, direction, etc.)			
Safety Category 3	✓	✓	✓
Safety Category 4			
Performance Level d	✓	✓	✓
Performance Level e			
SIL Claim Level 3			
Stop Categories 0 and/or 1	✓	✓	✓
Stop Category 2			
200…240V Ratings	0.37…7.5 kW (0.5…10 Hp)	0.37…18.5 kW (0.5…25 Hp)	–
380…480V Ratings	0.37…11 kW (0.5…15 Hp)	0.37…37 kW (0.5…50 Hp)	132…1200 kW (200…1900 Hp)
500…600V Ratings	0.75…11 kW (1…15 Hp)	0.37…37 kW (0.5…50 Hp)	160…2000 kW (250…900 Hp)
690V Ratings	–	–	160…2000 kW (150…2400 Hp)
Safe Torque-Off Board *(User Installed)*	20A-DG01	20A-DG02	NA
Safety Category	ISO/EN13849-1 (EN954-1), Category 3	ISO/EN13849-1 (EN954-1), Category 3	NA
Safe Speed Monitor *(User Installed)*	NA	NA	NA
Safety Category	NA	NA	NA
ATEX Safe-Off *(User Installed)*	NA	NA	20C-DG1
Safety Category	NA	NA	EN954-1, Category 5
Motor Control	• Volts per Hertz • Sensorless Vector Control	• Vector Control w/FORCE™ Technology • Volts per Hertz • Sensorless Vector Control	• Volts per Hertz • Sensorless Vector Control

❄ Also available with embedded logix controller - DriveLogix 5730.
‡ Frames 9…13 are functionally approved by TUV, but not certified.

PowerFlex 700S ❄	PowerFlex 700L w/700S Control	PowerFlex 753	PowerFlex 755
✓	✓	✓	✓
		✓	✓
✓	✓	✓	✓
		✓	✓
✓	✓	✓	✓
		✓	✓
		✓	✓
✓	✓	✓	✓
		✓	✓
0.75…66 kW (1…100 Hp)	–	–	–
0.75…800 kW (1…1250 Hp) ‡	200…860 kW (300…1150 Hp)	0.75…250 kW (1…350 Hp)	0.75…250 kW (1…350 Hp)
0.75…1500 kW (1…1600 Hp) ‡	345…650 kW (465…870 Hp)	NA	NA
45…1500 kW (50…1600 Hp) ‡	355…657 kW (475…881 Hp)	NA	NA
20D-P2-DG01	20D-P2-DG01	20-750-S	20-750-S
ISO/EN13849-1 (EN954-1), Category 3	ISO/EN13849-1 (EN954-1), Cat. 3	ISO/EN13849-1 (EN954-1), Category 3	ISO/EN13849-1 (EN954-1), Category 3
NA	NA	20-750-S1	20-750-S1
NA	NA	ISO/EN 13849-1 PLe/SIL3 Cat. 4	ISO/EN 13849-1 PLe/SIL3 Cat. 4
NA	NA	NA	NA
NA	NA	NA	NA
• Vector Control w/FORCE™ Technology • Volts per Hertz • Permanent Magnet Motor Control	• Available with PowerFlex 700 Vector Control or PowerFlex 700S Phase II Control Boards	• Vector Control w/FORCE™ Technology • Volts per Hertz • Sensorless Vector Control • Adjustable Voltage Control	• Vector Control w/FORCE™ Technology • Volts per Hertz • Sensorless Vector Control • Permanent Magnet Motor Control

Safety Solutions for PowerFlex® Drives

PowerFlex 40P AC Drive

The PowerFlex 40P AC drive addresses user needs for closed loop control with an option for Category 3 Safe Torque-off in a compact and cost effective design. Based on the popular PowerFlex 40 this drive is designed to meet global OEM and end-user demands for flexibility, space savings and ease of use. This drive is a cost-effective alternative for speed or basic position control of applications such as diverters, smart conveyors, packaging machines, palletizers, drafting machines, ring spinning machines and synthetic fiber spinning machines and shares common options and accessories with the PowerFlex 40.

Ratings	200…240V:	0.37…7.5 kW / 0.5…10 Hp / 2.3…33 A
	380…480V:	0.37…11 kW / 0.5…15 Hp / 1.4…24 A
	500…600V:	0.75…11 kW / 1…15 Hp / 1.7…19 A
Motor Control	• V/Hz control • Sensorless Vector Control	
Communications	Integral RS 485, Common Industrial Protocol	
User Interface	4 digit display, 3 additional LED indicators and scroll/reset button, optional Remote Human Interface Modules (HIM) or PC interface for programming	
Enclosures	IP20, IP30, Flange Mount	
Safety	DriveGuard Safe Torque-Off / EN 954-1 Cat. 3	
Additional Features	• Speed control with and without encoder feedback • Fiber application specific features • StepLogic allows operation as an independent position controller	
Certifications	• UL • CE (240 and 480V Ratings) • cUL • C-Tick • TÜV FS ISO/EN13849-1 (EN954-1) with Safe Torque-Off option	
Options	See page 6-39	

200…240V AC, Three-Phase Drives (50/60 Hz, No Filter)

Drive Ratings				IP20/NEMA Type Open	IP20 Plate Drive	IP20 Flange Mount ∗
kW	Hp	Output Current A	Frame Size	Cat. No.	Cat. No.	Cat. No.
0.4	0.5	2.3	B	22D-B2P3N104	22D-B2P3H204	22D-B2P3F104
0.75	1	5	B	22D-B5P0N104	22D-B5P0H204	22D-B5P0F104
1.5	2	8	B	22D-B8P0N104	22D-B8P0H204	22D-B8P0F104
2.2	3	12	B	22D-B012N104	22D-B012H204	22D-B012F104
3.7	5	17.5	B	22D-B017N104	22D-B017H204	22D-B017F104
5.5	7.5	24	C	22D-B024N104	22D-B024H204	22D-B024F104
7.5	10	33	C	22D-B033N104	22D-B033H204	22D-B033F104

∗ Meets IP40/54/65 (NEMA 1/12/4/4X) when installed in an enclosure of like rating.

380…480V AC, Three-Phase Drives (50/60 Hz, No Filter)

Drive Ratings				IP20/NEMA Type Open	IP20 Plate Drive	IP20 Flange Mount ∗
kW	Hp	Output Current A	Frame Size	Cat. No.	Cat. No.	Cat. No.
0.4	0.5	1.4	B	22D-D1P4N104	22D-D1P4H204	22D-D1P4F104
0.75	1	2.3	B	22D-D2P3N104	22D-D2P3H204	22D-D2P3F104
1.5	2	4	B	22D-D4P0N104	22D-D4P0H204	22D-D4P0F104
2.2	3	6	B	22D-D6P0N104	22D-D6P0H204	22D-D6P0F104
4	5	10.5	B	22D-D010N104	22D-D010H204	22D-D010F104
5.5	7.5	12	C	22D-D012N104	22D-D012H204	22D-D012F104
7.5	10	17	C	22D-D017N104	22D-D017H204	22D-D017F104
11	15	24	C	22D-D024N104	22D-D024H204	22D-D024F104

∗ Meets IP40/54/65 (NEMA 1/12/4/4X) when installed in an enclosure of like rating.

500…600V AC, Three-Phase Drives (50/60 Hz, No Filter)

Drive Ratings				IP20/NEMA Type Open	IP20 Plate Drive	IP20 Flange Mount ✶
kW	Hp	Output Current A	Frame Size	Cat. No.	Cat. No.	Cat. No.
0.75	1	1.7	B	22D-E1P7N104	22D-E1P7H204	22D-E1P7F104
1.5	2	3	B	22D-E3P0N104	22D-E3P0H204	22D-E3P0F104
2.2	3	4.2	B	22D-E4P2N104	22D-E4P2H204	22D-E4P2F104
4	5	6.6	B	22D-E6P6N004	22D-E6P6H204	22D-E6P6F104
5.5	7.5	9.9	C	22D-E9P9N104	22D-E9P9H204	22D-E9P9F104
7.5	10	12	C	22D-E012N104	22D-E012H204	22D-E012F104
11	15	19	C	22D-E019N104	22D-E019H204	22D-E019F104

✶ Meets IP40/54/65 (NEMA 1/12/4/4X) when installed in an enclosure of like rating.

Options

Human Interface Modules and Accessories

Description	Cat. No.
Remote (Panel Mount) LCD Display, Digital Speed Control, CopyCat Capable. Includes 2.0 meter cable. IP66, NEMA Type 4X/12 - Indoor Use Only.	22-HIM-C2S §
Remote Handheld, LCD Display, Full Numeric Keypad, Digital Speed Control, CopyCat Capable. Includes 1.0 meter cable. IP30, NEMA Type 1. Panel mount with optional Bezel Kit.	22-HIM-A3
Remote Handheld, Wireless Interface Module with Bluetooth® Technology. IP30, NEMA Type 1. Panel Mount with optional Bezel Kit.	22-WIM-N1
Remote (Panel Mount), Wireless Interface Module with Bluetooth Technology. IP66, NEMA Type 4X/12 - Indoor Use Only.	22-WIM-N4S
Bezel Kit. Panel Mount for LCD Display, Remote Handheld Unit. IP30, NEMA Type 1. Includes a 22-RJ45CBL-C20 cable.	22-HIM-B1
DSI HIM Cable (DSI HIM to RJ45 cable)	
1.0 Meter (3.3 Feet) DSI HIM Cable (DSI HIM to RJ45 cable)	22-HIM-H10
2.9 Meter (9.51 Feet) DSI HIM Cable (DSI HIM to RJ45 cable)	22-HIM-H30

§ The 22-HIM-C2S is smaller than the 22-HIM-C2 and cannot be used as a direct replacement.

Communication Option Kits

Description	Cat. No.
ControlNet™ Communication Adapter	22-COMM-C ♣
DeviceNet™ Communication Adapter	22-COMM-D ♣
EtherNet/IP™ Communication Adapter	22-COMM-E ♣
LonWorks® Communication Adapter	22-COMM-L ♣
PROFIBUS™ DP Communication Adapter	22-COMM-P ♣
Serial Converter Module (RS485 to RS232). Provides serial communication via DF1 protocol for use with DriveExplorer and DriveExecutive™ software. Includes DSI to RS232 serial converter, 1203-SFC serial cable, 22-RJ45CBL-C20 cable, and DriveExplorer Lite CD.	22-SCM-232
Serial Cable. 2.0 meter with a locking low profile connector. Connects the serial converter to a 9-pin sub-miniature D female computer connector.	1203-SFC
Serial Null Modem Adapter. Use when connecting the serial converter to DriveExplorer on a handheld PC.	1203-SNM
Universal Serial Bus™ (USB) Converter includes 2m USB, 20-HIM-H10 & 22-HIM-H10 Cables	1203-USB
DSI Cable. 2.0 meter RJ45 to RJ45 cable, male to male connectors.	22-RJ45CBL-C20
Splitter Cable. RJ45 one to two port splitter cable.	AK-U0-RJ45-SC1
Terminal Block. RJ45 two position terminal block (6 pieces) with two 120 Ohm terminating resistors (loose).	AK-U0-RJ45-TB2P
Terminating Resistors. 120 Ohm resistor embedded in an RJ45 connector (2 pieces).	AK-U0-RJ45-TR1
DSI External Communications Kit. External mounting kit for 22-COMM Communication Adapters.	22-XCOMM-DC-BASE
External Communications Kit Power Supply Optional 100…240V AC Power Supply for External DSI Communications Kit.	20-XCOMM-AC-PS1
Compact I/O Module (3 Channel)	1769-SM2
Communication Adapter Cover Houses the Communication Adapter for B & C Frame drives. Note: Cover adds 25 mm (0.98 in.) to the overall depth of the drive.	
Frame B Drive	22D-CCB ➢
Frame C Drive	22D-CCC ➢

♣ Requires a Communication Adapter Cover when used with Frame B & C PowerFlex 40/40P drives or Frame C PowerFlex 400 drives.
➢ If IP30, NEMA/UL Type 1 is required, a 22-JBCB (Frame B drives) or 22-JBCC (Frame C drives) must also be ordered.

Safety Options

Description	Cat. No.
DriveGuard Safe Torque-Off	20A-DG01

Terminators

Description ✶	Cat. No.
for use with 3.7 kW (5 Hp) & below drives	1204-TFA1
for use with 1.5 kW (2 Hp) & up drives	1204-TFB2

✶ Refer to Appendix A of publication *DRIVES-IN001* for selection information.

Reflected Wave Reduction Modules w/Common Mode Choke

Description ✶	Cat. No.
17A with Common Mode Choke	1204-RWC-17-A

✶ Refer to Appendix A of publication *DRIVES-IN001* for selection information.

Reflected Wave Reduction Modules

Voltage	ND kW	ND Hp	Cat. No.
380… 480V AC	2.2…4	3…5	1321-RWR8-DP
	4	5	1321-RWR12-DP
	5.5	7.5	1321-RWR18-DP
	7.5	10	1321-RWR25-DP
	11	15	1321-RWR25-DP
500… 600V AC	4	5	1321-RWR8-EP
	5.5	7.5	1321-RWR12-EP
	7.5	10	1321-RWR18-EP
	11	15	1321-RWR25-EP

Dynamic Brake Resistors

Drive Rating			Minimum Resistance ⌘	Resistance ⌘	
Voltage	kW	Hp	Ohms ±10%	Ohms ±5%	Cat. No. ✦
200…240V, 50/60 Hz, Three-Phase	0.4	0.5	48	91	AK-R2-091P500
	0.75	1	48	91	AK-R2-091P500
	1.5	2	48	91	AK-R2-091P500
	2.2	3	32	47	AK-R2-047P500
	3.7	5	19	47	AK-R2-047P500
	5.5	7.5	13	30	AK-R2-030P1K2
	7.5	10	10	30	AK-R2-030P1K2
380…480V, 50/60 Hz, Three-Phase	0.4	0.5	97	360	AK-R2-360P500
	0.75	1	97	360	AK-R2-360P500
	1.5	2	97	360	AK-R2-360P500
	2.2	3	97	120	AK-R2-120P1K2
	4.0	5	77	120	AK-R2-120P1K2
	5.5	7.5	55	120	AK-R2-120P1K2
	7.5	10	39	120	AK-R2-120P1K2
	11	15	24	120	❖AK-R2-120P1K2
500…600V, 50/60 Hz, Three-Phase	0.75	1	120	360	AK-R2-360P500
	1.5	2	120	360	AK-R2-360P500
	2.2	3	82	120	AK-R2-120P1K2
	4.0	5	82	120	AK-R2-120P1K2
	5.5	7.5	51	120	AK-R2-120P1K2
	7.5	10	51	120	AK-R2-120P1K2
	11	15	51	120	❖AK-R2-120P1K2

⌘ Verify resistor Ohms against minimum resistance for drive being used.
✦ Resistors listed are rated 5% duty cycle.
❖ Requires two resistors wired in parallel.

IP30, NEMA/UL Type 1 Conversion Kit

Description	Frame	Cat. No.
Converts IP20 drive to IP30, NEMA/UL Type 1 enclosure. Includes conduit box, mounting screws and plastic top panel.	B	22-JBAB
	C	22-JBAC
Converts IP20 drive to IP30, NEMA/UL Type 1 enclosure. Includes communication option conduit box, mounting screws and plastic top panel.	B	22-JBCB
	C	22-JBCC

Spare Parts

Description		Cat. No.
Fan Replacement Kits	Fan Replacement Kit - Frame B, 1 Fan	SK-U1-FAN1-B1
	Fan Replacement Kit - Frame B, 2 Fans	SK-U1-FAN2-B1
	Fan Replacement Kit - Frame C, 1 Fan	SK-U1-FAN1-C1
	Fan Replacement Kit - Frame C, 1 Fan, 15 Hp	SK-U1-FAN1-C2
Covers	Encoder Terminal Cover (All Frames)	SK-U1-DCVR4-EN
	Frame B Cover with Power Terminal Guard	SK-U1-DCVR3-B1
	Frame C Cover with Power Terminal Guard	SK-U1-DCVR3-C1

EMC Filters (Required to Meet CE Certification)

Drive Ratings			S Type Filter	L Type Filter
Input Voltage	kW	Hp	Cat. No. ✶	Cat. No. ‡
200…240V, 50/60 Hz, Single-Phase	0.4	0.5	❄	–
	0.75	1	❄	–
	1.5	2	❄	–
	2.2	3	❄	–
200…240V, 50/60 Hz, Three-Phase	0.4	0.5	➢22-RF021-BS	22-RF021-BL
	0.75	1	➢22-RF021-BS	22-RF021-BL
	1.5	2	➢22-RF021-BS	22-RF021-BL
	2.2	3	➢22-RF021-BS	22-RF021-BL
	3.7	5	➢22-RF021-BS	22-RF021-BL
	5.5	7.5	22-RF034-CS	22-RF034-CL
	7.5	10	22-RF034-CS	22-RF034-CL
380…480V, 50/60 Hz, Three-Phase	0.4	0.5	22-RF012-BS	22-RF012-BL
	0.75	1	22-RF012-BS	22-RF012-BL
	1.5	2	22-RF012-BS	22-RF012-BL
	2.2	3	22-RF012-BS	22-RF012-BL
	3.7	5	22-RF012-BS	22-RF012-BL
	5.5	7.5	22-RF018-CS	22-RF018-CL
	7.5	10	22-RF018-CS	22-RF018-CL
	11	15	22-RF026-CS	22-RF026-CL
500…600V, 50/60 Hz, Three-Phase	0.75	1	–	22-RF8P0-BL
	1.5	2	–	22-RF8P0-BL
	2.2	3	–	22-RF8P0-BL
	4.0	5	–	22-RF8P0-BL
	5.5	7.5	–	22-RF015-CL
	7.5	10	–	22-RF015-CL
	11	15	–	22-RF024-CL

✶ This filter is suitable for use with a cable length of up to 10 meters for Class A and 1 meter for Class B environments.
❄ Drives are available in these ratings with internal "S Type" filters.
‡ This filter is suitable for use with a cable length of up to 100 meters for Class A and 5 meters for Class B environments.
➢ Filter must be Series B or later.

The PowerFlex 70 offers a compact package of power, control and operator interface, designed to meet the demands for space, simplicity and reliability. This drive provides a broad spectrum of features, allowing you to easily integrate it into your architecture and configure it for most application needs.

Ratings	200…240V:	0.37…18.5 kW / 0.5…25 Hp / 2.2…70 A
	380…480V:	0.37…37 kW / 0.5…50 Hp / 1.1…72 A
	500…600V:	0.37…37 kW / 0.5…50 Hp / 0.9…52 A
Motor Control	• V/Hz control • Sensorless Vector Control • Flux Vector Control	
Communications	Common Industrial Protocol	
User Interface	HIM (option)	
Enclosures	IP20, Flange Mount, IP66 / NEMA 4X	
Safety	DriveGuard Safe Torque-Off / EN 954-1 Cat. 3	
Additional Features	• Speed and torque control with and without encoder feedback • Pjump and Traverse for Fibers application	
Certifications	• UL • cUL • IEC (Designed to Meet) • CE (excluding 600V) • C-Tick (excluding 600V) • NSF Certified (IP66, NEMA/UL Type 4X/12 only) • TÜV FS ISO/EN13849-1 (EN954-1) with Safe Torque-Off option • RINA Certified • ABS • Lloyd's Register • SEMI F47	
Options	See pages 6-65…6-74	

Panel Mount - IP 20, NEMA/UL Type 1, No HIM

200...240V AC, Three-Phase Drives

240V AC Input						208V AC Input ❄							
Output Amps			Normal Duty Hp	Heavy Duty Hp	Cat. No.	Output Amps			Normal Duty kW	Heavy Duty kW	Cat. No.	with Filter	Frame Size
Cont.	1 Min.	3 Sec.				Cont.	1 Min.	3 Sec.					
2.2	2.4	3.3	0.5	0.33	20AB2P2A0AYNNNC0	2.5	2.7	3.7	0.37	0.25	20AB2P2A0AYNNNC0	N	A
2.2	2.4	3.3	0.5	0.33	20AB2P2A0AYNANC0	2.5	2.7	3.7	0.37	0.25	20AB2P2A0AYNANC0	Y	B
4.2	4.8	6.4	1	0.75	20AB4P2A0AYNNNC0	4.8	5.5	7.4	0.75	0.55	20AB4P2A0AYNNNC0	N	A
4.2	4.8	6.4	1	0.75	20AB4P2A0AYNANC0	4.8	5.5	7.4	0.75	0.55	20AB4P2A0AYNANC0	Y	B
6.8	9	12	2	1.5	20AB6P8A0AYNNNC0	7.8	10.3	13.8	1.5	1.1	20AB6P8A0AYNNNC0	N	B
6.8	9	12	2	1.5	20AB6P8A0AYNANC0	7.8	10.3	13.8	1.5	1.1	20AB6P8A0AYNANC0	Y	B
9.6	10.6	14.4	3	2	20AB9P6A0AYNNNC0	11	12.1	16.5	2.2	1.5	20AB9P6A0AYNNNC0	N	B
9.6	10.6	14.4	3	2	20AB9P6A0AYNANC0	11	12.1	16.5	2.2	1.5	20AB9P6A0AYNANC0	Y	B
15.3	17.4	23.2	5	3	20AB015A0AYNANC0	17.5	19.2	26.2	4	3	20AB015A0AYNANC0	Y	C
22	24.2	33	7.5	5	20AB022A0AYNANC0	25.3	27.8	37.9	5.5	4	20AB022A0AYNANC0	Y	D
28	33	44	10	7.5	20AB028A0AYNANC0	32.2	37.9	50.6	7.5	5.5	20AB028A0AYNANC0	Y	D
42	46.2	63	15	10	20AB042A0AYNANC0	43	55.5	74	11	7.5	20AB042A0AYNANC0	Y	D
54	63	84	20	15	20AB054A0AYNANC0	62.1	72.4	96.6	15	11	20AB054A0AYNANC0	Y	E
70	81	108	25	20	20AB070A0AYNANC0	78.2	93.1	124	18.5	15	20AB070A0AYNANC0	Y	E

❄ Drive must be programmed to lower voltage to obtain the currents shown.

Panel Mount - IP 20, NEMA/UL Type 1, No HIM (continued)

380...480V AC, Three-Phase Drives

480V AC Input						400V AC Input							
Output Amps			Normal Duty Hp	Heavy Duty Hp	Cat. No.	Output Amps			Normal Duty kW	Heavy Duty kW	Cat. No.	with Filter	Frame Size
Cont.	1 Min.	3 Sec.				Cont.	1 Min.	3 Sec.					
1.1	1.2	1.6	0.5	0.33	20AD1P1A0AYNNNC0	1.3	1.4	1.9	0.37	0.25	20AC1P3A0AYNNNC0	N	A
1.1	1.2	1.6	0.5	0.33	20AD1P1A0AYNANC0	1.3	1.4	1.9	0.37	0.25	20AC1P3A0AYNANC0	Y	B
2.1	2.4	3.2	1	0.75	20AD2P1A0AYNNNC0	2.1	2.4	3.2	0.75	0.55	20AC2P1A0AYNNNC0	N	A
2.1	2.4	3.2	1	0.75	20AD2P1A0AYNANC0	2.1	2.4	3.2	0.75	0.55	20AC2P1A0AYNANC0	Y	B
3.4	4.5	6	2	1.5	20AD3P4A0AYNNNC0	3.5	4.5	6	1.5	1.1	20AC3P5A0AYNNNC0	N	A
3.4	4.5	6	2	1.5	20AD3P4A0AYNANC0	3.5	4.5	6	1.5	1.1	20AC3P5A0AYNANC0	Y	B
5	5.5	7.5	3	2	20AD5P0A0AYNNNC0	5	5.5	7.5	2.2	1.5	20AC5P0A0AYNNNC0	N	B
5	5.5	7.5	3	2	20AD5P0A0AYNANC0	5	5.5	7.5	2.2	1.5	20AC5P0A0AYNANC0	Y	B
8	8.8	12	5	3	20AD8P0A0AYNNNC0	8.7	9.9	13.2	4	3	20AC8P7A0AYNNNC0	N	B
8	8.8	12	5	3	20AD8P0A0AYNANC0	8.7	9.9	13.2	4	3	20AC8P7A0AYNANC0	Y	B
11	12.1	16.5	7.5	5	20AD011A0AYNANC0	11.5	13	17.4	5.5	4	20AC011A0AYNANC0	Y	C
14	16.5	22	10	7.5	20AD014A0AYNANC0	15.4	17.2	23.1	7.5	5.5	20AC015A0AYNANC0	Y	C
22	24.2	33	15	10	20AD022A0AYNANC0	22	24.2	33	11	7.5	20AC022A0AYNANC0	Y	D
27	33	44	20	15	20AD027A0AYNANC0	30	33	45	15	11	20AC030A0AYNANC0	Y	D
34	40.5	54	25	20	20AD034A0AYNANC0	37	45	60	18.5	15	20AC037A0AYNANC0	Y	D
40	51	68	30	25	20AD040A0AYNANC0	43	56	74	22	18.5	20AC043A0AYNANC0	Y	D
52	60	80	40	30	20AD052A0AYNANC0	60	66	90	30	22	20AC060A0AYNANC0	Y	E
65	78	104	50	40	20AD065A0AYNANC0	72	90	120	37	30	20AC072A0AYNANC0	Y	E

500...600V AC, Three-Phase Drives

600V AC Input							
Output Amps			Normal Duty Hp	Heavy Duty Hp	Cat. No.	with Filter	Frame Size
Cont.	1 Min.	3 Sec.					
0.9	1	1.4	0.5	0.33	20AE0P9A0AYNNNC0	N	A
1.7	1.9	2.6	1	0.75	20AE1P7A0AYNNNC0	N	A
2.7	3.6	4.8	2	1	20AE2P7A0AYNNNC0	N	A
3.9	4.3	5.8	3	1.5	20AE3P9A0AYNNNC0	N	B
6.1	6.7	9.1	5	3	20AE6P1A0AYNNNC0	N	B
9	9.9	13.5	7.5	5	20AE9P0A0AYNNNC0	N	C
11	13.5	18	10	7.5	20AE011A0AYNNNC0	N	C
17	18.7	25.5	15	10	20AE017A0AYNNNC0	N	D
22	25.5	34	20	15	20AE022A0AYNNNC0	N	D
27	33	44	25	20	20AE027A0AYNNNC0	N	D
32	40.5	54	30	25	20AE032A0AYNNNC0	N	D
41	48	64	40	30	20AE041A0AYNANC0	N	E
52	61.5	82	50	40	20AE052A0AYNANC0	N	E

Wall / Machine Mount - IP66, NEMA/UL Type 4X/12, with HIM, For Indoor Use

200...240V AC, Three-Phase Drives

240V AC Input						208V AC Input ❄							
Output Amps			Normal Duty Hp	Heavy Duty Hp	Cat. No.	Output Amps			Normal Duty kW	Heavy Duty kW	Cat. No.	with Filter	Frame Size
Cont.	1 Min.	3 Sec.				Cont.	1 Min.	3 Sec.					
2.2	2.4	3.3	0.5	0.33	20AB2P2C3AYNNNC0	2.5	2.7	3.7	0.37	0.25	20AB2P2C3AYNNNC0	N	B
2.2	2.4	3.3	0.5	0.33	20AB2P2C3AYNANC0	2.5	2.7	3.7	0.37	0.25	20AB2P2C3AYNANC0	Y	B
4.2	4.8	6.4	1	0.75	20AB4P2C3AYNNNC0	4.8	5.5	7.4	0.75	0.55	20AB4P2C3AYNNNC0	N	B
4.2	4.8	6.4	1	0.75	20AB4P2C3AYNANC0	4.8	5.5	7.4	0.75	0.55	20AB4P2C3AYNANC0	Y	B
6.8	9	12	2	1.5	20AB6P8C3AYNNNC0	7.8	10.3	13.8	1.5	1.1	20AB6P8C3AYNNNC0	N	B
6.8	9	12	2	1.5	20AB6P8C3AYNANC0	7.8	10.3	13.8	1.5	1.1	20AB6P8C3AYNANC0	Y	B
9.6	10.6	14.4	3	2	20AB9P6C3AYNNNC0	11	12.1	16.5	2.2	1.5	20AB9P6C3AYNNNC0	N	B
9.6	10.6	14.4	3	2	20AB9P6C3AYNANC0	11	12.1	16.5	2.2	1.5	20AB9P6C3AYNANC0	Y	B
15.3	17.4	23.2	5	3	20AB015C3AYNANC0	17.5	19.2	26.2	4	3	20AB015C3AYNANC0	Y	D
22	24.2	33	7.5	5	20AB022C3AYNANC0	25.3	27.8	37.9	5.5	4	20AB022C3AYNANC0	Y	D
28	33	44	10	7.5	20AB028C3AYNANC0	32.2	37.9	50.6	7.5	5.5	20AB028C3AYNANC0	Y	D
42	46.2	63	15	10	20AB042C3AYNANC0	43	55.5	74	11	7.5	20AB042C3AYNANC0	Y	D
54	63	84	20	15	20AB054C3AYNANC0	62.1	72.4	96.6	15	11	20AB054C3AYNANC0	Y	E
70	81	108	25	20	20AB070C3AYNANC0	78.2	93.1	124	18.5	15	20AB070C3AYNANC0	Y	E

❄ Drive must be programmed to lower voltage to obtain the currents shown.

380...480V AC, Three-Phase Drives

480V AC Input						400V AC Input							
Output Amps			Normal Duty Hp	Heavy Duty Hp	Cat. No.	Output Amps			Normal Duty kW	Heavy Duty kW	Cat. No.	with Filter	Frame Size
Cont.	1 Min.	3 Sec.				Cont.	1 Min.	3 Sec.					
1.1	1.2	1.6	0.5	0.33	20AD1P1C3AYNNNC0	1.3	1.4	1.9	0.37	0.25	20AC1P3C3AYNNNC0	N	B
1.1	1.2	1.6	0.5	0.33	20AD1P1C3AYNANC0	1.3	1.4	1.9	0.37	0.25	20AC1P3C3AYNANC0	Y	B
2.1	2.4	3.2	1	0.75	20AD2P1C3AYNNNC0	2.1	2.4	3.2	0.75	0.55	20AC2P1C3AYNNNC0	N	B
2.1	2.4	3.2	1	0.75	20AD2P1C3AYNANC0	2.1	2.4	3.2	0.75	0.55	20AC2P1C3AYNANC0	Y	B
3.4	4.5	6	2	1.5	20AD3P4C3AYNNNC0	3.5	4.5	6	1.5	1.1	20AC3P5C3AYNNNC0	N	B
3.4	4.5	6	2	1.5	20AD3P4C3AYNANC0	3.5	4.5	6	1.5	1.1	20AC3P5C3AYNANC0	Y	B
5	5.5	7.5	3	2	20AD5P0C3AYNNNC0	5	5.5	7.5	2.2	1.5	20AC5P0C3AYNNNC0	N	B
5	5.5	7.5	3	2	20AD5P0C3AYNANC0	5	5.5	7.5	2.2	1.5	20AC5P0C3AYNANC0	Y	B
8	8.8	12	5	3	20AD8P0C3AYNNNC0	8.7	9.9	13.2	4	3	20AC8P7C3AYNNNC0	N	B
8	8.8	12	5	3	20AD8P0C3AYNANC0	8.7	9.9	13.2	4	3	20AC8P7C3AYNANC0	Y	B
11	12.1	16.5	7.5	5	20AD011C3AYNANC0	11.5	13	17.4	5.5	4	20AC011C3AYNANC0	Y	D
14	16.5	22	10	7.5	20AD014C3AYNANC0	15.4	17.2	23.1	7.5	5.5	20AC015C3AYNANC0	Y	D
22	24.2	33	15	10	20AD022C3AYNANC0	22	24.2	33	11	7.5	20AC022C3AYNANC0	Y	D
27	33	44	20	15	20AD027C3AYNANC0	30	33	45	15	11	20AC030C3AYNANC0	Y	D
34	40.5	54	25	20	20AD034C3AYNANC0	37	45	60	18.5	15	20AC037C3AYNANC0	Y	D
40	51	68	30	25	20AD040C3AYNANC0	43	56	74	22	18.5	20AC043C3AYNANC0	Y	D
52	60	80	40	30	20AD052C3AYNANC0	60	66	90	30	22	20AC060C3AYNANC0	Y	E
65	78	104	50	40	20AD065C3AYNANC0	72	90	120	37	30	20AC072C3AYNANC0	Y	E

Wall / Machine Mount - IP66, NEMA/UL Type 4X/12, with HIM, For Indoor Use (continued)

500...600V AC, Three-Phase Drives

600V AC Input							
Output Amps							
Cont.	1 Min.	3 Sec.	Normal Duty Hp	Heavy Duty Hp	Cat. No.	with Filter	Frame Size
0.9	1	1.4	0.5	0.33	20AE0P9C3AYNNNC0	N	B
1.7	1.9	2.6	1	0.75	20AE1P7C3AYNNNC0	N	B
2.7	3.6	4.8	2	1	20AE2P7C3AYNNNC0	N	B
3.9	4.3	5.8	3	1.5	20AE3P9C3AYNNNC0	N	B
6.1	6.7	9.1	5	3	20AE6P1C3AYNNNC0	N	B
9	9.9	13.5	7.5	5	20AE9P0C3AYNNNC0	N	D
11	13.5	18	10	7.5	20AE011C3AYNNNC0	N	D
17	18.7	25.5	15	10	20AE017C3AYNNNC0	N	D
22	25.5	34	20	15	20AE022C3AYNNNC0	N	D
27	33	44	25	20	20AE027C3AYNNNC0	N	D
32	40.5	54	30	25	20AE032C3AYNNNC0	N	D
41	48	64	40	30	20AE041C3AYNANC0	N	E
52	61.5	82	50	40	20AE052C3AYNANC0	N	E

Wall / Machine Mount - IP54, NEMA/UL Type 12, with HIM

200...240V AC, Three-Phase Drives

240V AC Input					208V AC Input ❄							
Output Amps			Normal Duty Hp	Heavy Duty Hp	Output Amps			Normal Duty kW	Heavy Duty kW	Cat. No.	with Filter	Frame Size
Cont.	1 Min.	3 Sec.			Cont.	1 Min.	3 Sec.					
54	63	84	20	15	62.1	72.4	96.6	15	11	20AB054G3AYNANC0	Y	E
70	81	108	25	20	78.2	93.1	124	18.5	15	20AB070G3AYNANC0	Y	E

❄ Drive must be programmed to lower voltage to obtain the currents shown.

380...480V AC, Three-Phase Drives

480V AC Input						400V AC Input							
Output Amps			Normal Duty Hp	Heavy Duty Hp	Cat. No.	Output Amps			Normal Duty kW	Heavy Duty kW	Cat. No.	with Filter	Frame Size
Cont.	1 Min.	3 Sec.				Cont.	1 Min.	3 Sec.					
52	60	80	40	30	20AD052G3AYNANC0	60	66	90	30	22	20AC060G3AYNANC0	Y	E
65	78	104	50	40	20AD065G3AYNANC0	72	90	120	37	30	20AC072G3AYNANC0	Y	E

500...600V AC, Three-Phase Drives

600V AC Input							
Output Amps							
Cont.	1 Min.	3 Sec.	Normal Duty Hp	Heavy Duty Hp	Cat. No.	with Filter	Frame Size
41	48	64	40	30	20AE041G3AYNANC0	Y	E
52	61.5	82	50	40	20AE052G3AYNANC0	Y	E

Flange Mount - Front Chassis = IP20, NEMA/UL Type 1, Heatsink = IP66, NEMA/UL Type 4X/12, No HIM

200...240V AC, Three-Phase Drives

240V AC Input						208V AC Input ❄							
Output Amps			Normal Duty Hp	Heavy Duty Hp	Cat. No.	Output Amps			Normal Duty kW	Heavy Duty kW	Cat. No.	with Filter	Frame Size
Cont.	1 Min.	3 Sec.				Cont.	1 Min.	3 Sec.					
2.2	2.4	3.3	0.5	0.33	20AB2P2F0AYNNNC0	2.5	2.7	3.7	0.37	0.25	20AB2P2F0AYNNNC0	N	A
2.2	2.4	3.3	0.5	0.33	20AB2P2F0AYNANC0	2.5	2.7	3.7	0.37	0.25	20AB2P2F0AYNANC0	Y	B
4.2	4.8	6.4	1	0.75	20AB4P2F0AYNNNC0	4.8	5.5	7.4	0.75	0.55	20AB4P2F0AYNNNC0	N	A
4.2	4.8	6.4	1	0.75	20AB4P2F0AYNANC0	4.8	5.5	7.4	0.75	0.55	20AB4P2F0AYNANC0	Y	B
6.8	9	12	2	1.5	20AB6P8F0AYNNNC0	7.8	10.3	13.8	1.5	1.1	20AB6P8F0AYNNNC0	N	B
6.8	9	12	2	1.5	20AB6P8F0AYNANC0	7.8	10.3	13.8	1.5	1.1	20AB6P8F0AYNANC0	Y	B
9.6	10.6	14.4	3	2	20AB9P6F0AYNNNC0	11	12.1	16.5	2.2	1.5	20AB9P6F0AYNNNC0	N	B
9.6	10.6	14.4	3	2	20AB9P6F0AYNANC0	11	12.1	16.5	2.2	1.5	20AB9P6F0AYNANC0	Y	B
15.3	17.4	23.2	5	3	20AB015F0AYNANC0	17.5	19.2	26.2	4	3	20AB015F0AYNANC0	Y	C
22	24.2	33	7.5	5	20AB022F0AYNANC0	25.3	27.8	37.9	5.5	4	20AB022F0AYNANC0	Y	D
28	33	44	10	7.5	20AB028F0AYNANC0	32.2	37.9	50.6	7.5	5.5	20AB028F0AYNANC0	Y	D
42	46.2	63	15	10	20AB042F0AYNANC0	43	55.5	74	11	7.5	20AB042F0AYNANC0	Y	D
54	63	84	20	15	20AB054F0AYNANC0	62.1	72.4	96.6	15	11	20AB054F0AYNANC0	Y	E
70	81	108	25	20	20AB070F0AYNANC0	78.2	93.1	124	18.5	15	20AB070F0AYNANC0	Y	E

❄ Drive must be programmed to lower voltage to obtain the currents shown.

380...480V AC, Three-Phase Drives

480V AC Input						400V AC Input							
Output Amps			Normal Duty Hp	Heavy Duty Hp	Cat. No.	Output Amps			Normal Duty kW	Heavy Duty kW	Cat. No.	with Filter	Frame Size
Cont.	1 Min.	3 Sec.				Cont.	1 Min.	3 Sec.					
1.1	1.2	1.6	0.5	0.33	20AD1P1F0AYNNNC0	1.3	1.4	1.9	0.37	0.25	20AC1P3F0AYNNNC0	N	A
1.1	1.2	1.6	0.5	0.33	20AD1P1F0AYNANC0	1.3	1.4	1.9	0.37	0.25	20AC1P3F0AYNANC0	Y	B
2.1	2.4	3.2	1	0.75	20AD2P1F0AYNNNC0	2.1	2.4	3.2	0.75	0.55	20AC2P1F0AYNNNC0	N	A
2.1	2.4	3.2	1	0.75	20AD2P1F0AYNANC0	2.1	2.4	3.2	0.75	0.55	20AC2P1F0AYNANC0	Y	B
3.4	4.5	6	2	1.5	20AD3P4F0AYNNNC0	3.5	4.5	6	1.5	1.1	20AC3P5F0AYNNNC0	N	A
3.4	4.5	6	2	1.5	20AD3P4F0AYNANC0	3.5	4.5	6	1.5	1.1	20AC3P5F0AYNANC0	Y	B
5	5.5	7.5	3	2	20AD5P0F0AYNNNC0	5	5.5	7.5	2.2	1.5	20AC5P0F0AYNNNC0	N	B
5	5.5	7.5	3	2	20AD5P0F0AYNANC0	5	5.5	7.5	2.2	1.5	20AC5P0F0AYNANC0	Y	B
8	8.8	12	5	3	20AD8P0F0AYNNNC0	8.7	9.9	13.2	4	3	20AC8P7F0AYNNNC0	N	B
8	8.8	12	5	3	20AD8P0F0AYNANC0	8.7	9.9	13.2	4	3	20AC8P7F0AYNANC0	Y	B
11	12.1	16.5	7.5	5	20AD011F0AYNANC0	11.5	13	17.4	5.5	4	20AC011F0AYNANC0	Y	C
14	16.5	22	10	7.5	20AD014F0AYNANC0	15.4	17.2	23.1	7.5	5.5	20AC015F0AYNANC0	Y	C
22	24.2	33	15	10	20AD022F0AYNANC0	22	24.2	33	11	7.5	20AC022F0AYNANC0	Y	D
27	33	44	20	15	20AD027F0AYNANC0	30	33	45	15	11	20AC030F0AYNANC0	Y	D
34	40.5	54	25	20	20AD034F0AYNANC0	37	45	60	18.5	15	20AC037F0AYNANC0	Y	D
40	51	68	30	25	20AD040F0AYNANC0	43	56	74	22	18.5	20AC043F0AYNANC0	Y	D
52	60	80	40	30	20AD052F0AYNANC0	60	66	90	30	22	20AC060F0AYNANC0	Y	E
65	78	104	50	40	20AD065F0AYNANC0	72	90	120	37	30	20AC072F0AYNANC0	Y	E

❄ Drive must be programmed to lower voltage to obtain the currents shown.

Flange Mount - Front Chassis = IP20, NEMA/UL Type 1, Heatsink = IP66, NEMA/UL Type 4X/12, No HIM (continued)

500...600V AC, Three-Phase Drives

600V AC Input							
Output Amps							
Cont.	1 Min.	3 Sec.	Normal Duty Hp	Heavy Duty Hp	Cat. No.	with Filter	Frame Size
0.9	1	1.4	0.5	0.33	20AE0P9F0AYNNNC0	N	A
1.7	1.9	2.6	1	0.75	20AE1P7F0AYNNNC0	N	A
2.7	3.6	4.8	2	1	20AE2P7F0AYNNNC0	N	A
3.9	4.3	5.8	3	1.5	20AE3P9F0AYNNNC0	N	B
6.1	6.7	9.1	5	3	20AE6P1F0AYNNNC0	N	B
9	9.9	13.5	7.5	5	20AE9P0F0AYNNNC0	N	C
11	13.5	18	10	7.5	20AE011F0AYNNNC0	N	C
17	18.7	25.5	15	10	20AE017F0AYNNNC0	N	D
22	25.5	34	20	15	20AE022F0AYNNNC0	N	D
27	33	44	25	20	20AE027F0AYNNNC0	N	D
32	40.5	54	30	25	20AE032F0AYNNNC0	N	D
41	48	64	40	30	20AE041F0AYNANC0	N	E
52	61.5	82	50	40	20AE052F0AYNANC0	N	E

Ratings	380…480V:	132…1200 kW / 200…1900 Hp / 261…2150 A
	500…600V:	160…2000 kW / 250…900 Hp / 261…820 A
	690V:	160…2300 kW / 150…2400 Hp / 170…2250 A
Motor Control	• V/Hz control • Sensorless Vector Control	
Communications	Common Industrial Protocol	
User Interface	HIM (option)	
Enclosures	IP21	
Safety	DriveGuard Safe Torque-Off / EN954-1 Cat. 3	
Certifications	• UL • cUL • ATEX Certified with Safe Torque-Off • IEC (Designed to Meet) - with Rittal Enclosure • CE - with Rittal Enclosure • C-Tick • TÜV FS ISO/EN13849-1 (EN954-1) with Safe Torque-Off option	
Options	See pages 6-65…6-74	

The PowerFlex 700H drive is ideal for high power applications requiring speed control performance. This drive provides excellent torque at low speeds for demanding speed control applications and has configurable control modes for a wide variety of applications. The PowerFlex 700H also has an ATEX certified option for drives that operate in potentially explosive environments.

IP21, NEMA Type 1

380…480V AC, Three-Phase Drives with 24V DC I/O

480V AC Input						400V AC Input						Frame Size
Output Amps ✶			Normal Duty Hp	Heavy Duty Hp	Cat. No. §➢	Output Amps ✶			Normal Duty kW	Heavy Duty kW	Cat. No. §➢	
Cont.	1 Min.	2 Sec. ❄				Cont.	1 Min.	2 Sec. ❄				
261 (205)	287 (308)	410 (410)	200	150	20CD261A0ANNBNA0	261 (205)	287 (308)	410 (410)	132	110	20CC261A0ANNBNA0	9
300 (245)	330 (368)	450 (490)	250	200	20CD300A0ANNBNA0	300 (245)	330 (368)	450 (490)	160	132	20CC300A0ANNBNA0	9
385 (300)	424 (450)	600 (600)	300	250	20CD385A0ANNBNA0	385 (300)	424 (450)	600 (600)	200	160	20CC385A0ANNBNA0	10
460 (385)	506 (578)	770 (770)	350	300	20CD460A0ANNBNA0	460 (385)	506 (578)	770 (770)	250	200	20CC460A0ANNBNA0	10
500 (420)	550 (630)	750 (840)	450	350	20CD500A0ANNBNA0	500 (420)	550 (630)	750 (840)	250	250	20CC500A0ANNBNA0	10
590 (520)	649 (780)	956 (956)	500	450	20CD590A0ANNBNA0	590 (520)	649 (780)	956 (956)	315	250	20CC590A0ANNBNA0	11
650 (590)	715 (885)	1062 (1062)	500	500	20CD650A0ANNBNA0	650 (590)	715 (885)	1062 (1062)	355	315	20CC650A0ANNBNA0	11
730 (650)	803 (975)	1095 (1170)	600	500	20CD730A0ANNBNA0	730 (650)	803 (975)	1095 (1170)	400	355	20CC730A0ANNBNA0	11
820 (730)	902 (1095)	1230 (1314)	700	600	20CD820A0ANNBNA0	820 (730)	902 (1095)	1230 (1314)	450	400	20CC820A0ANNBNA0	12
920 (820)	1012 (1230)	1380 (1476)	800	700	20CD920A0ANNBNA0	920 (820)	1012 (1230)	1380 (1476)	500	450	20CC920A0ANNBNA0	12
1030 (920)	1133 (1370)	1555 (1600)	900	800	20CD1K0A0ANNBNA0	1030 (920)	1133 (1370)	1555 (1600)	560	500	20CC1K0A0ANNBNA0	12
1150 (1030)	1265 (1545)	1620 (1620)	1000	900	20CD1K1A0ANNBNA0	1150 (1030)	1265 (1545)	1620 (1620)	630	560	20CC1K1A0ANNBNA0	13
1300 (1150)	1430 (1725)	2079 (2079)	1200	1000	20CD1K3A0ANNBNA0	1300 (1150)	1430 (1725)	2079 (2079)	710	630	20CC1K3A0ANNBNA0	13
1450 (1200)	1595 (1800)	2175 (2400)	1250	1000	20CD1K4A0ANNBNA0	1450 (1200)	1595 (1800)	2175 (2400)	800	710	20CC1K4A0ANNBNA0	13
1770 (1600)	1947 (2400)	2655 (2880)	1500	1400	20CD1K7A0ANNENA0	1770 (1600)	1947 (2400)	2655 (2880)	1000	900	20CC1K7A0ANNENA0	14
2150 (1940)	2365 (2910)	3225 (3492)	1900	1700	20CD2K1A0ANNENA0	2150 (1940)	2365 (2910)	3225 (3492)	1200	1100	20CC2K1A0ANNENA0	14

✶ These drives have dual current ratings; normal duty applications and heavy duty applications (in parenthesis). The drive may be operated at either rating.
❄ The 2 sec. output current is only available at initial start or drive operating at light load.
§ Frames 10 & up include a Rittal enclosure.
➢ Drives listed do not include a Control and I/O option.

IP21, NEMA Type 1 (continued)

600…690V AC, Three-Phase Drives with 24V DC I/O

600V AC Input						690V AC Input						Frame Size
Output Amps ✶			Normal Duty Hp	Heavy Duty Hp	Cat. No. §➢	Output Amps ✶			Normal Duty kW	Heavy Duty kW	Cat. No. §➢	
Cont.	1 Min.	2 Sec. ❄				Cont.	1 Min.	2 Sec. ❄				
170 (144)	187 (216)	245 (245)	150	150	20CE170A0ANNBNA0	170 (144)	187 (216)	245 (245)	160	132	20CF170A0ANNBNA0	9
208 (170)	230 (250)	289 (289)	200	150	20CE208A0ANNBNA0	208 (170)	230 (250)	289 (289)	200	160	20CF208A0ANNBNA0	9
261 (208)	287 (312)	375 (375)	250	200	20CE261A0ANNBNA0	261 (208)	287 (312)	375 (375)	250	200	20CF261A0ANNBNA0	10
325 (261)	358 (392)	470 (470)	350	250	20CE325A0ANNBNA0	325 (261)	358 (392)	470 (470)	315	250	20CF325A0ANNBNA0	10
385 (325)	424 (488)	585 (585)	400	350	20CE385A0ANNBNA0	385 (325)	424 (488)	585 (585)	355	315	20CF385A0ANNBNA0	10
416 (325)	458 (488)	585 (585)	450	350	20CE416A0ANNBNA0	416 (325)	458 (488)	585 (585)	400	315	20CF416A0ANNBNA0	10
460 (385)	506 (578)	693 (693)	500	400	20CE460A0ANNBNA0	460 (385)	506 (578)	693 (693)	450	355	20CF460A0ANNBNA0	11
502 (460)	552 (690)	828 (828)	500	500	20CE502A0ANNBNA0	502 (460)	552 (690)	828 (828)	500	450	20CF502A0ANNBNA0	11
590 (502)	649 (753)	885 (904)	600	500	20CE590A0ANNBNA0	590 (502)	649 (753)	885 (904)	560	500	20CF590A0ANNBNA0	11
650 (590)	715 (885)	1062 (1062)	700	650	20CE650A0ANNBNA0	650 (590)	715 (885)	1062 (1062)	630	560	20CF650A0ANNBNA0	12
750 (650)	825 (975)	1170 (1170)	800	700	20CE750A0ANNBNA0	750 (650)	825 (975)	1170 (1170)	710	630	20CF750A0ANNBNA0	12
820 (750)	902 (975)	1170 (1170)	900	700	20CE820A0ANNBNA0	820 (750)	902 (975)	1170 (1170)	800	630	20CF820A0ANNBNA0	12
920 (820)	1012 (1230)	1380 (1410)	1000	900	20CE920A0ANNBNA0	920 (820)	1012 (1230)	1380 (1410)	900	800	20CF920A0ANNBNA0	13
1030 (920)	1133 (1380)	1545 (1755)	1100	1000	20CE1K0A0ANNBNA0	1030 (920)	1133 (1380)	1545 (1755)	1000	900	20CF1K0A0ANNBNA0	13
1180 (1030)	1298 (1463)	1755 (1755)	1300	1100	20CE1K1A0ANNBNA0	1180 (1030)	1298 (1463)	1755 (1755)	1100	1000	20CF1K1A0ANNBNA0	13
1500 (1300)	1650 (1950)	2250 (2340)	1600	1400	20CE1K5A0ANNENA0	1500 (1300)	1650 (1950)	2250 (2340)	1500	1300	20CF1K5A0ANNENA0	14
1900 (1500)	2090 (2250)	2700 (2700)	2000	1600	20CE1K9A0ANNENA0	1900 (1500)	2090 (2250)	2700 (2700)	1900	1500	20CF1K9A0ANNENA0	14
2250 (1900)	2475 (2782)	3335 (3335)	2400	2000	20CE2K2A0ANNENA0	2250 (1900)	2475 (2782)	3335 (3335)	2300	1900	20CF2K2A0ANNENA0	14

✶ These drives have dual current ratings; normal duty applications and heavy duty applications (in parenthesis). The drive may be operated at either rating.
❄ The 2 sec. output current is only available at initial start or drive operating at light load.
§ Frames 10 & up include a Rittal enclosure.
➢ Drives listed do not include a Control and I/O option.

IP20, NEMA Type 1, MCC

380…480V AC, Three-Phase Drives with 24V DC I/O

480V AC Input						400V AC Input						Frame Size
Output Amps ✶			Normal Duty Hp	Heavy Duty Hp	Cat. No. ➢	Output Amps ✶			Normal Duty kW	Heavy Duty kW	Cat. No. ➢	
Cont.	1 Min.	2 Sec. ❄				Cont.	1 Min.	2 Sec. ❄				
385 (300)	424 (450)	600 (600)	300	250	20CD385B0ANNBNA0	385 (300)	424 (450)	600 (600)	200	160	20CD385B0ANNBNA0	10
460 (385)	506 (578)	770 (770)	350	300	20CD460B0ANNBNA0	460 (385)	506 (578)	770 (770)	250	200	20CD460B0ANNBNA0	10
500 (420)	550 (630)	750 (840)	450	350	20CD500B0ANNBNA0	500 (420)	550 (630)	750 (840)	250	250	20CD500B0ANNBNA0	10
590 (520)	649 (780)	956 (956)	500	450	20CD590B0ANNBNA0	590 (520)	649 (780)	956 (956)	315	250	20CD590B0ANNBNA0	11
650 (590)	715 (885)	1062 (1062)	500	500	20CD650B0ANNBNA0	650 (590)	715 (885)	1062 (1062)	355	315	20CD650B0ANNBNA0	11
730 (650)	803 (975)	1095 (1170)	600	500	20CD730B0ANNBNA0	730 (650)	803 (975)	1095 (1170)	400	355	20CD730B0ANNBNA0	11
820 (730)	902 (1095)	1230 (1314)	700	600	20CD820B0ANNBNA0	820 (730)	902 (1095)	1230 (1314)	450	400	20CD820B0ANNBNA0	12
920 (820)	1012 (1230)	1380 (1476)	800	700	20CD920B0ANNBNA0	920 (820)	1012 (1230)	1380 (1476)	500	450	20CD920B0ANNBNA0	12
1030 (920)	1133 (1370)	1555 (1600)	900	800	20CD1K0B0ANNBNA0	1030 (920)	1133 (1370)	1555 (1600)	560	500	20CD1K0B0ANNBNA0	12

✶ These drives have dual current ratings; normal duty applications and heavy duty applications (in parenthesis). The drive may be operated at either rating.
❄ The 2 sec. output current is only available at initial start or drive operating at light load.
➢ Drives listed do not include a Control and I/O option.

600V AC, Three-Phase Drives with 24V DC I/O

600V AC Input						
Output Amps ✶						Frame Size
Cont.	1 Min.	2 Sec. ❄	Normal Duty Hp	Heavy Duty Hp	Cat. No. ➢	
261 (208)	287 (312)	375 (375)	250	200	20CE261B0ANNBNA0	10
325 (261)	358 (392)	470 (470)	350	250	20CE325B0ANNBNA0	10
385 (325)	424 (488)	585 (585)	400	350	20CE385B0ANNBNA0	10
416 (325)	458 (488)	585 (585)	450	350	20CE416B0ANNBNA0	10
460 (385)	506 (578)	693 (693)	500	400	20CE460B0ANNBNA0	11
502 (460)	552 (690)	828 (828)	500	500	20CE502B0ANNBNA0	11
590 (502)	649 (753)	885 (904)	600	500	20CE590B0ANNBNA0	11
650 (590)	715 (885)	1062 (1062)	700	650	20CE650B0ANNBNA0	12
750 (650)	825 (975)	1170 (1170)	800	700	20CE750B0ANNBNA0	12
820 (750)	902 (975)	1170 (1170)	900	700	20CE820B0ANNBNA0	12

✶ These drives have dual current ratings; normal duty applications and heavy duty applications (in parenthesis). The drive may be operated at either rating.
❄ The 2 sec. output current is only available at initial start or drive operating at light load.
➢ Drives listed do not include a Control and I/O option.

IP54, NEMA Type 12, Rittal

380…480V AC, Three-Phase Drives with 24V DC I/O

480V AC Input						400V AC Input						Frame Size
Output Amps ✶			Normal Duty Hp	Heavy Duty Hp	Cat. No. ➢	Output Amps ✶			Normal Duty kW	Heavy Duty kW	Cat. No. ➢	
Cont.	1 Min.	2 Sec. ❄				Cont.	1 Min.	2 Sec. ❄				
385 (300)	424 (450)	600 (600)	300	250	20CD385H0ANNBNA0	385 (300)	424 (450)	600 (600)	200	160	20CC385H0ANNBNA0	10
460 (385)	506 (578)	770 (770)	350	300	20CD460H0ANNBNA0	460 (385)	506 (578)	770 (770)	250	200	20CC460H0ANNBNA0	10
500 (420)	550 (630)	750 (840)	450	350	20CD500H0ANNBNA0	500 (420)	550 (630)	750 (840)	250	250	20CC500H0ANNBNA0	10
590 (520)	649 (780)	956 (956)	500	450	20CD590H0ANNBNA0	590 (520)	649 (780)	956 (956)	315	250	20CC590H0ANNBNA0	11
650 (590)	715 (885)	1062 (1062)	500	500	20CD650H0ANNBNA0	650 (590)	715 (885)	1062 (1062)	355	315	20CC650H0ANNBNA0	11
730 (650)	803 (975)	1095 (1170)	600	500	20CD730H0ANNBNA0	730 (650)	803 (975)	1095 (1170)	400	355	20CC730H0ANNBNA0	11
820 (730)	902 (1095)	1230 (1314)	700	600	20CD820H0ANNBNA0	820 (730)	902 (1095)	1230 (1314)	450	400	20CC820H0ANNBNA0	12
920 (820)	1012 (1230)	1380 (1476)	800	700	20CD920H0ANNBNA0	920 (820)	1012 (1230)	1380 (1476)	500	450	20CC920H0ANNBNA0	12
1030 (920)	1133 (1370)	1555 (1600)	900	800	20CD1K0H0ANNBNA0	1030 (920)	1133 (1370)	1555 (1600)	560	500	20CC1K0H0ANNBNA0	12
1150 (1030)	1265 (1545)	1620 (1620)	1000	900	20CD1K1H0ANNBNA0	1150 (1030)	1265 (1545)	1620 (1620)	630	560	20CC1K1H0ANNBNA0	13
1300 (1150)	1430 (1725)	2079 (2079)	1200	1000	20CD1K3H0ANNBNA0	1300 (1150)	1430 (1725)	2079 (2079)	710	630	20CC1K3H0ANNBNA0	13
1450 (1200)	1595 (1800)	2175 (2400)	1250	1000	20CD1K4H0ANNBNA0	1450 (1200)	1595 (1800)	2175 (2400)	800	710	20CC1K4H0ANNBNA0	13
1770 (1600)	1947 (2400)	2655 (2880)	1500	1400	20CD1K7H0ANNENA0	1770 (1600)	1947 (2400)	2655 (2880)	1000	900	20CC1K7H0ANNENA0	14
2150 (1940)	2365 (2910)	3225 (3492)	1900	1700	20CD2K1H0ANNENA0	2150 (1940)	2365 (2910)	3225 (3492)	1200	1100	20CC2K1H0ANNENA0	14

✶ These drives have dual current ratings; normal duty applications and heavy duty applications (in parenthesis). The drive may be operated at either rating.
❄ The 2 sec. output current is only available at initial start or drive operating at light load.
➢ Drives listed do not include a Control and I/O option.

600…690V AC, Three-Phase Drives with 24V DC I/O

600V AC Input						690V AC Input						Frame Size
Output Amps ✶			Normal Duty Hp	Heavy Duty Hp	Cat. No. ➢	Output Amps ✶			Normal Duty kW	Heavy Duty kW	Cat. No. ➢	
Cont.	1 Min.	2 Sec. ❄				Cont.	1 Min.	2 Sec. ❄				
261 (208)	287 (312)	375 (375)	250	200	20CE261H0ANNBNA0	261 (208)	287 (312)	375 (375)	250	200	20CF261H0ANNBNA0	10
325 (261)	358 (392)	470 (470)	350	250	20CE325H0ANNBNA0	325 (261)	358 (392)	470 (470)	315	250	20CF325H0ANNBNA0	10
385 (325)	424 (488)	585 (585)	400	350	20CE385H0ANNBNA0	385 (325)	424 (488)	585 (585)	355	315	20CF385H0ANNBNA0	10
416 (325)	458 (488)	585 (585)	450	350	20CE416H0ANNBNA0	416 (325)	458 (488)	585 (585)	400	315	20CF416H0ANNBNA0	10
460 (385)	506 (578)	693 (693)	500	400	20CE460H0ANNBNA0	460 (385)	506 (578)	693 (693)	450	355	20CF460H0ANNBNA0	11
502 (460)	552 (690)	828 (828)	500	500	20CE502H0ANNBNA0	502 (460)	552 (690)	828 (828)	500	450	20CF502H0ANNBNA0	11
590 (502)	649 (753)	885 (904)	600	500	20CE590H0ANNBNA0	590 (502)	649 (753)	885 (904)	560	500	20CF590H0ANNBNA0	11
650 (590)	715 (885)	1062 (1062)	700	650	20CE650H0ANNBNA0	650 (590)	715 (885)	1062 (1062)	630	560	20CF650H0ANNBNA0	12
750 (650)	825 (975)	1170 (1170)	800	700	20CE750H0ANNBNA0	750 (650)	825 (975)	1170 (1170)	710	630	20CF750H0ANNBNA0	12
820 (750)	902 (975)	1170 (1170)	900	700	20CE820H0ANNBNA0	820 (750)	902 (975)	1170 (1170)	800	630	20CF820H0ANNBNA0	12
920 (820)	1012 (1230)	1380 (1410)	1000	900	20CE920H0ANNBNA0	920 (820)	1012 (1230)	1380 (1410)	900	800	20CF920H0ANNBNA0	13
1030 (920)	1133 (1380)	1545 (1755)	1100	1000	20CE1K0H0ANNBNA0	1030 (920)	1133 (1380)	1545 (1755)	1000	900	20CF1K0H0ANNBNA0	13
1180 (1030)	1298 (1463)	1755 (1755)	1300	1100	20CE1K1H0ANNBNA0	1180 (1030)	1298 (1463)	1755 (1755)	1100	1000	20CF1K1H0ANNBNA0	13
1500 (1300)	1650 (1950)	2250 (2340)	1600	1400	20CE1K5H0ANNENA0	1500 (1300)	1650 (1950)	2250 (2340)	1500	1300	20CF1K5H0ANNENA0	14
1900 (1500)	2090 (2250)	2700 (2700)	2000	1600	20CE1K9H0ANNENA0	1900 (1500)	2090 (2250)	2700 (2700)	1900	1500	20CF1K9H0ANNENA0	14
2250 (1900)	2475 (2782)	3335 (3335)	2400	2000	20CE2K2H0ANNENA0	2250 (1900)	2475 (2782)	3335 (3335)	2300	1900	20CF2K2H0ANNENA0	14

✶ These drives have dual current ratings; normal duty applications and heavy duty applications (in parenthesis). The drive may be operated at either rating.
❄ The 2 sec. output current is only available at initial start or drive operating at light load.
➢ Drives listed do not include a Control and I/O option.

The PowerFlex 700S offers optimized integration for the most demanding stand-alone and coordinated drive control and drive system applications. The PowerFlex 700S offers a DriveLogix option which combines the powerful performance and flexible control of PowerFlex AC drives with a high-performance Logix engine to produce a highly functional, cost-effective drive and control solution.

Ratings	200…240V:	0.75…66 kW / 1…100 Hp / 4.2…260 A
	380…480V:	0.75…800 kW / 1…1250 Hp / 2.1…1450 A
	500…600V:	0.75…1500 kW / 1…1600 Hp / 1.7…1500 A
	690V:	45…1500 kW / 50…1600 Hp / 77…1500 A
Motor Control	• V/Hz control • Vector Control with FORCE Technology (with and without encoder) • Permanent Magnet Motor Control	
Communications	Common Industrial Protocol	
User Interface	HIM (option)	
Enclosures	IP20, IP21	
Safety	DriveGuard Safe Torque-Off / EN 954-1 Cat. 3	
Additional Features	• Integrated position loop for simple indexing to electronic line shaft applications • SynchLink for high speed data transfer and synchronization • Multiple motor feedback options • DriveLogix	
Certifications	• UL • cUL • CE • C-Tick • IEC (Designed to Meet) • TÜV FS ISO/EN13849-1 (EN954-1) with Safe Torque-Off option • RINA, Frames 1…10	
Options	See pages 6-65…6-74	

IP20, NEMA/UL Type 1

200…240V AC, Three-Phase Drives

240V AC Input						208V AC Input ✶						Frame Size
Output Amps			Normal Duty Hp	Heavy Duty Hp	Cat. No.	Output Amps			Normal Duty kW	Heavy Duty kW	Cat. No.	
Cont.	1 Min.	3 Sec.				Cont.	1 Min.	3 Sec.				
4.2	4.8	6.4	1	0.75	20DB4P2A0EYNANANE	4.8	5.6	7	0.75	0.37	20DB4P2A0EYNANANE	1
6.8	9	12	2	1.5	20DB6P8A0EYNANANE	7.8	10.4	13.8	1.5	0.75	20DB6P8A0EYNANANE	1
9.6	10.6	14.4	3	2	20DB9P6A0EYNANANE	11	12.1	17	2.2	1.5	20DB9P6A0EYNANANE	1
15.3	16.8	23	5	3	20DB015A0EYNANANE	17.5	19.3	26.3	4	2.2	20DB015A0EYNANANE	1
22	24.2	33	7.5	5	20DB022A0EYNANANE	25.3	27.8	38	5.5	4	20DB022A0EYNANANE	1
28	33	44	10	7.5	20DB028A0EYNANANE	32.2	38	50.6	7.5	5.5	20DB028A0EYNANANE	2
42	46.2	63	15	10	20DB042A0EYNANANE	48.3	53.1	72.5	11	7.5	20DB042A0EYNANANE	3
52	63	80	20	15	20DB052A0EYNANANE	56	64	86	15	11	20DB052A0EYNANANE	3
70	78	105	25	20	20DB070A0ENNANANE	78.2	86	117.3	18.5	15	20DB070A0ENNANANE	4 §
80	105	136	30	25	20DB080A0ENNANANE	92	117.3	156.4	22	18.5	20DB080A0ENNANANE	4 §
104 (80) ❄	115 (120)	175 (160)	40	30	20DB104A0ENNANANE	120 (92)	132 (138)	175 (175)	30	22	20DB104A0ENNANANE	5 §
130 (104) ❄	143 (156)	175 (175)	50	40	20DB130A0ENNANANE	130 (104)	143 (156)	175 (175)	30	30	20DB130A0ENNANANE	5 §
154 (130) ❄	169 (195)	231 (260)	60	50	20DB154A0ENNANANE	177 (150)	195 (225)	266 (300)	45	37	20DB154A0ENNANANE	6 §
192 (154) ❄	211 (231)	288 (308)	75	60	20DB192A0ENNANANE	221 (177)	243 (266)	308 (308)	55	45	20DB192A0ENNANANE	6 §
260 (205) ❄	286 (305)	390 (410)	100	75	20DB260A0ENNANANE	260 (205)	286 (305)	390 (410)	66	55	20DB260A0ENNANANE	6 §

✶ Drive must be programmed to lower voltage to obtain higher currents shown.

❄ These drives have dual current ratings; one for normal duty applications, and one for heavy duty applications (in parenthesis). The drive may be operated at either rating.

§ Also available with internal Brake IGBT (20DxxxxA0E **Y** NANANE).

380…480V AC, Three-Phase Drives

480V AC Input						400V AC Input						Frame Size
Output Amps			Normal Duty Hp	Heavy Duty Hp	Cat. No.	Output Amps			Normal Duty kW	Heavy Duty kW	Cat. No.	
Cont.	1 Min.	3 Sec.				Cont.	1 Min.	3 Sec.				
2.1	2.4	3.2	1	0.75	20DD2P1A0EYNANANE	2.1	2.4	3.2	0.75	0.55	20DC2P1A0EYNANANE	1
3.4	4.5	6	2	1.5	20DD3P4A0EYNANANE	3.5	4.5	6	1.5	0.75	20DC3P5A0EYNANANE	1
5	5.5	7.5	3	2	20DD5P0A0EYNANANE	5	5.5	7.5	2.2	1.5	20DC5P0A0EYNANANE	1
8	8.8	12	5	3	20DD8P0A0EYNANANE	8.7	9.9	13.2	4	2.2	20DC8P7A0EYNANANE	1
11	12.1	16.5	7.5	5	20DD011A0EYNANANE	11.5	13	17.4	5.5	4	20DC011A0EYNANANE	1
14	16.5	22	10	7.5	20DD014A0EYNANANE	15.4	17.2	23.1	7.5	5.5	20DC015A0EYNANANE	1
22	24.2	33	15	10	20DD022A0EYNANANE	22	24.2	33	11	7.5	20DC022A0EYNANANE	1
27	33	44	20	15	20DD027A0EYNANANE	30	33	45	15	11	20DC030A0EYNANANE	2
34	40.5	54	25	20	20DD034A0EYNANANE	37	45	60	18.5	15	20DC037A0EYNANANE	2
40	51	68	30	25	20DD040A0EYNANANE	43	56	74	22	18.5	20DC043A0EYNANANE	3
52	60	80	40	30	20DD052A0EYNANANE	56	64	86	30	22	20DC056A0EYNANANE	3
65	78	104	50	40	20DD065A0EYNANANE	72	84	112	37	30	20DC072A0EYNANANE	3
77 (65) ❄	85 (98)	116 (130)	60	50	20DD077A0ENNANANE	85 (72)	94 (108)	128 (144)	45	37	20DC085A0ENNANANE	4 §
96 (77) ❄	106 (116)	144 (154)	75	60	20DD096A0ENNANANE	105 (85)	116 (128)	158 (170)	55	45	20DC105A0ENNANANE	5 §
125 (96) ❄	138 (144)	163 (168)	100	75	20DD125A0ENNANANE	125 (96)	138 (144)	163 (168)	55	45	20DC125A0ENNANANE	5 §
–	–	–	–	–	–	140 (105)	154 (158)	210 (210)	75	55	20DC140A0ENNANANE	5 §
156 (125) ❄	172 (188)	233 (250)	125	100	20DD156A0ENNANANE	170 (140)	187 (210)	255 (280)	90	75	20DC170A0ENNANANE	6 §
180 (156) ❄	198 (234)	270 (312)	150	125	20DD180A0ENNANANE	205 (170)	220 (255)	289 (313)	110	90	20DC205A0ENNANANE	6 §
248 (180) ❄	273 (270)	372 (360)	200	150	20DD248A0ENNANANE	260 (205)	286 (308)	390 (410)	132	110	20DC260A0ENNANANE	6 §
261 (205) ❄	287 (308)	410 (410)	200	150	20DD261A0ENNBNANE	261 (205)	287 (308)	410 (410)	132	110	20DC261A0ENNBNANE	9
300 (245) ❄	330 (368)	450 (490)	250	200	20DD300A0ENNBNANE	300 (245)	330 (368)	450 (490)	160	130	20DC300A0ENNBNANE	9
385 (300) ❄	424 (450)	600 (600)	300	250	20DD385A0ENNBNANE	385 (300)	424 (450)	600 (600)	200	160	20DC385A0ENNBNANE	10
460 (385) ❄	506 (578)	770 (770)	350	300	20DD460A0ENNBNANE	460 (385)	506 (578)	770 (770)	250	200	20DC460A0ENNBNANE	10
500 (420) ❄	550 (630)	750 (840)	450	350	20DD500A0ENNBNANE	500 (420)	550 (630)	750 (840)	250	250	20DC500A0ENNBNANE	10
590 (520) ❄	649 (780)	956 (956)	500	450	20DD590A0ENNBNANE	590 (520)	649 (780)	956 (956)	315	250	20DC590A0ENNBNANE	11
650 (590) ❄	715 (885)	1062 (1062)	500	500	20DD650A0ENNBNANE	650 (590)	715 (885)	1062 (1062)	355	315	20DC650A0ENNBNANE	11
730 (650) ❄	803 (975)	1095 (1170)	600	500	20DD730A0ENNBNANE	730 (650)	803 (975)	1095 (1170)	400	355	20DC730A0ENNBNANE	11
820 (730) ❄	902 (1095)	1230 (1314)	700	600	20DD820A0ENNBNANE	820 (730)	902 (1095)	1230 (1314)	450	400	20DC820A0ENNBNANE	12
920 (820) ❄	1012 (1230)	1380 (1476)	800	700	20DD920A0ENNBNANE	920 (820)	1012 (1230)	1380 (1476)	500	450	20DC920A0ENNBNANE	12
1030 (920) ❄	1133 (1370)	1555 (1600)	900	800	20DD1K0A0ENNBNANE	1030 (920)	1133 (1370)	1555 (1600)	560	500	20DC1K0A0ENNBNANE	12
1150 (1030) ❄	1265 (1545)	1620 (1620)	1000	900	20DD1K1A0ENNBNANE	1150 (1030)	1265 (1545)	1620 (1620)	630	560	20DC1K1A0ENNBNANE	13
1300 (1150) ❄	1430 (1725)	2079 (2079)	1200	1000	20DD1K3A0ENNBNANE	1300 (1150)	1430 (1725)	2079 (2079)	710	630	20DC1K3A0ENNBNANE	13
1450 (1200) ❄	1595 (1800)	2175 (2400)	1250	1000	20DD1K4A0ENNBNANE	1450 (1200)	1595 (1800)	2175 (2400)	800	710	20DC1K4A0ENNBNANE	13

❄ These drives have dual current ratings; one for normal duty applications, and one for heavy duty (in parenthesis). The drive may be operated at either rating.
§ Also available with internal Brake IGBT (20DxxxxA0E **Y** NANANE).

500…690V AC, Three-Phase Drives

500…600V AC Input ♣						690V AC Input ♣						
Output Amps			Normal Duty Hp	Heavy Duty Hp	Cat. No.	Output Amps			Normal Duty kW	Heavy Duty kW	Cat. No.	Frame Size
Cont.	1 Min.	3 Sec.				Cont.	1 Min.	3 Sec.				
1.7	2	2.6	1	0.5	20DE1P7A0EYNANANE	–	–	–	–	–	–	1
2.7	3.6	4.8	2	1	20DE2P7A0EYNANANE	–	–	–	–	–	–	1
3.9	4.3	5.9	3	2	20DE3P9A0EYNANANE	–	–	–	–	–	–	1
6.1	6.7	9.2	5	3	20DE6P1A0EYNANANE	–	–	–	–	–	–	1
9	9.9	13.5	7.5	5	20DE9P0A0EYNANANE	–	–	–	–	–	–	1
11	13.5	18	10	7.5	20DE011A0EYNANANE	–	–	–	–	–	–	1
17	18.7	25.5	15	10	20DE017A0EYNANANE	–	–	–	–	–	–	1
22	25.5	34	20	15	20DE022A0EYNANANE	–	–	–	–	–	–	2
27	33	44	25	20	20DE027A0EYNANANE	–	–	–	–	–	–	2
32	40.5	54	30	25	20DE032A0EYNANANE	–	–	–	–	–	–	3
41	48	64	40	30	20DE041A0EYNANANE	–	–	–	–	–	–	3
52	61.5	82	50	40	20DE052A0EYNANANE	52	57	78	50	40	20DF052A0ENNANANE	3 ➢
62	78	104	60	50	20DE062A0EYNANANE	60	66	90	55	45	20DF062A0ENNANANE	4 ➢§
77 (63) ❄	85 (94)	116 (126)	75	60	20DE077A0ENNANANE	82 (60)	90 (90)	120 (123)	75	55	20DF082A0ENNANANE	5 §
99 (77) ❄	109 (116)	126 (138)	100	75	20DE099A0ENNANANE	98 (82)	108 (123)	127 (140)	90	75	20DF098A0ENNANANE	5 §
125 (99) ❄	138 (149)	188 (198)	125	100	20DE125A0ENNANANE	119 (98)	131 (147)	179 (196)	110	90	20DF119A0ENNANANE	6 §
144 (125) ❄	158 (188)	216 (250)	150	125	20DE144A0ENNANANE	142 (119)	156 (179)	213 (238)	132	110	20DF142A0ENNANANE	6 §
170 (144) ❄	187 (216)	245 (245)	150	150	20DE170A0ENNBNANE	170 (144)	187 (216)	245 (245)	160	132	20DF170A0ENNBNANE	9
208 (170) ❄	230 (250)	289 (289)	200	150	20DE208A0ENNBNANE	208 (170)	230 (250)	289 (289)	200	160	20DF208A0ENNBNANE	9
261 (208) ❄	287 (312)	375 (375)	250	200	20DE261A0ENNBNANE	261 (208)	287 (312)	375 (375)	250	200	20DF261A0ENNBNANE	10
325 (261) ❄	358 (392)	470 (470)	350	250	20DE325A0ENNBNANE	325 (261)	358 (392)	470 (470)	315	250	20DF325A0ENNBNANE	10
385 (325) ❄	424 (488)	585 (585)	400	350	20DE385A0ENNBNANE	385 (325)	424 (488)	585 (585)	355	315	20DF385A0ENNBNANE	10
416 (325) ❄	458 (488)	585 (585)	450	350	20DE416A0ENNBNANE	416 (325)	458 (488)	585 (585)	400	315	20DF416A0ENNBNANE	10
460 (385) ❄	506 (578)	693 (693)	450	400	20DE460A0ENNBNANE	460 (385)	506 (578)	693 (693)	450	355	20DF460A0ENNBNANE	11
502 (460) ❄	552 (690)	828 (828)	500	450	20DE502A0ENNBNANE	502 (460)	552 (690)	828 (828)	500	450	20DF502A0ENNBNANE	11
590 (502) ❄	649 (753)	904 (904)	600	500	20DE590A0ENNBNANE	590 (502)	649 (753)	904 (904)	560	500	20DF590A0ENNBNANE	11
650 (590) ❄	715 (885)	1062 (1062)	700	650	20DE650A0ENNBNANE	650 (590)	715 (885)	1062 (1062)	630	560	20DF650A0ENNBNANE	12
750 (650) ❄	825 (975)	1170 (1170)	800	700	20DE750A0ENNBNANE	750 (650)	825 (975)	1170 (1170)	710	630	20DF750A0ENNBNANE	12
820 (750) ❄‡	902 (975)	1170 (1170)	900	700	20DE820A0ENNBNANE	820 (750)	902 (975)	1170 (1170)	800	630	20DF820A0ENNBNANE	12
920 (820) ❄	1012 (1230)	1380 (1410)	1000	900	20DE920A0ENNBNANE	920 (820)	1012 (1230)	1380 (1410)	900	800	20DF920A0ENNBNANE	13
1030 (920) ❄	1133 (1380)	1545 (1755)	1100	1000	20DE1K0A0ENNBNANE	1030 (920)	1133 (1380)	1545 (1755)	1000	900	20DF1K0A0ENNBNANE	13
1180 (1030) ❄	1298 (1463)	1755 (1755)	1300	1100	20DE1K1A0ENNBNANE	1180 (1030)	1298 (1463)	1755 (1755)	1100	1000	20DF1K1A0ENNBNANE	13
1500 (1300) ❄	1650 (1950)	2250 (2340)	1600	1400	20DE1K5A0ENNBNANE	1500 (1300)	1650 (1950)	2250 (2340)	1500	1300	20DF1K5A0ENNBNANE	14

❄ These drives have dual current ratings; one for normal duty applications, and one for heavy duty applications (in parenthesis). The drive may be operated at either rating.
‡ 600V class drives at 820 amps (ND) such as 20DF820 & 20DE820 are only capable of producing 95% of starting torque under 10 Hz.
§ Also available with internal Brake IGBT (20DxxxxA0E **Y** NANANE).
♣ CE Certification testing has not been performed on 600V class drives Frames 1…4.
➢ 690V drives are Frame 5.

IP21, NEMA/UL Type 1, MCC

380…480V AC, Three-Phase Drives

480V AC Input						400V AC Input						Frame Size
Output Amps ❄			Normal Duty Hp	Heavy Duty Hp	Cat. No.	Output Amps ❄			Normal Duty kW	Heavy Duty kW	Cat. No.	
Cont.	1 Min.	3 Sec.				Cont.	1 Min.	3 Sec.				
385 (300)	424 (450)	600 (600)	300	250	20DD385B0ENNBNANE	385 (300)	424 (450)	600 (600)	200	160	20DC385B0ENNBNANE	10
460 (385)	506 (578)	770 (770)	350	300	20DD460B0ENNBNANE	460 (385)	506 (578)	770 (770)	250	200	20DC460B0ENNBNANE	10
500 (420)	550 (630)	750 (840)	450	350	20DD500B0ENNBNANE	500 (420)	550 (630)	750 (840)	250	250	20DC500B0ENNBNANE	10
590 (520)	649 (780)	956 (956)	500	450	20DD590B0ENNBNANE	590 (520)	649 (780)	956 (956)	315	250	20DC590B0ENNBNANE	11
650 (590)	715 (885)	1062 (1062)	500	500	20DD650B0ENNBNANE	650 (590)	715 (885)	1062 (1062)	355	315	20DC650B0ENNBNANE	11
730 (650)	803 (975)	1095 (1170)	600	500	20DD730B0ENNBNANE	730 (650)	803 (975)	1095 (1170)	400	355	20DC730B0ENNBNANE	11
820 (730)	902 (1095)	1230 (1314)	700	600	20DD820B0ENNBNANE	820 (730)	902 (1095)	1230 (1314)	450	400	20DC820B0ENNBNANE	12
920 (820)	1012 (1230)	1380 (1476)	800	700	20DD920B0ENNBNANE	920 (820)	1012 (1230)	1380 (1476)	500	450	20DC920B0ENNBNANE	12
1030 (920)	1133 (1370)	1555 (1600)	900	800	20DD1K0B0ENNBNANE	1030 (920)	1133 (1370)	1555 (1600)	560	500	20DC1K0B0ENNBNANE	12

❄ These drives have dual current ratings; one for normal duty applications, and one for heavy duty (in parenthesis). The drive may be operated at either rating.

500…690V AC, Three-Phase Drives

600V AC Input						
Output Amps ❄						
Cont.	1 Min.	3 Sec.	Normal Duty Hp	Heavy Duty Hp	Cat. No.	Frame Size
261 (208)	287 (312)	375 (375)	250	200	20DE261B0ENNBNANE	10
325 (261)	358 (392)	470 (470)	350	250	20DE325B0ENNBNANE	10
385 (325)	424 (488)	585 (585)	400	350	20DE385B0ENNBNANE	10
416 (325)	458 (488)	585 (585)	450	350	20DE416B0ENNBNANE	10
460 (385)	506 (578)	693 (693)	450	400	20DE460B0ENNBNANE	11
502 (460)	552 (690)	828 (828)	500	450	20DE502B0ENNBNANE	11
590 (502)	649 (753)	904 (904)	600	500	20DE590B0ENNBNANE	11
650 (590)	715 (885)	1062 (1062)	700	650	20DE650B0ENNBNANE	12
750 (650)	825 (975)	1170 (1170)	800	700	20DE750B0ENNBNANE	12
820 (750) ‡	902 (975)	1170 (1170)	900	700	20DE820B0ENNBNANE	12

❄ These drives have dual current ratings; one for normal duty applications, and one for heavy duty applications (in parenthesis). The drive may be operated at either rating.

‡ 600V class drives at 820 amps (ND) such as 20DF820 & 20DE820 are only capable of producing 95% of starting torque under 10 Hz.

Ratings	380…480V:	200…860 kW / 300…1150 Hp / 360...1250 A
	500…600V:	345…650 kW / 465…870 Hp / 425…800 A
	690V:	355…657 kW / 475…881 Hp / 380…705 A
Motor Control	Select PowerFlex 700 or PowerFlex 700S Control	
Communications	Common Industrial Protocol	
User Interface	HIM (option)	
Enclosures	IP00, IP20	
Safety	DriveGuard Safe Torque-Off / EN 954-1 Cat. 3 with PowerFlex 700S control	
Additional Features	SynchLink and DriveLogix functionality with PowerFlex 700S control	
Certifications	• UL • cUL • IEC (Designed to Meet) • CE • TÜV FS ISO/EN13849-1 (EN954-1) with PowerFlex 700S control	
Options	See pages 6-65…6-74	

The PowerFlex 700L is available with the PowerFlex 700 or PowerFlex 700S control in a fully regenerative, liquid-cooled power structure. This powerful combination offers great performance and high power capabilities in a small package along with low harmonics.

Available as a panel mount unit or in a cabinet, this liquid cooled drive features regenerative braking which is ideal for precise, high-response speed and position control, continuous holdback, rapid deceleration and stopping of high inertia loads. Instead of wasting energy with resistor braking technology, regenerative braking actually puts the energy back into the system to be used by other equipment.

400V AC, Three-Phase Drives

Output Amps			Nominal Power Ratings				IP20, NEMA/UL Type 1 ∗	
400V AC Input			Normal Duty		Heavy Duty			
Cont.	1 Min.	3 Sec.	kW	Hp	kW	Hp	Cat. No.	Frame Size
360	396	540	200	268	150	200	20LC360N0ENNAN10WA	2
650	715	975	370	500	270	365	20LC650A0ENNAN10WA	3A
1250	1375	1875	715	960	525	700	20LC1K2A0ENNAN10WA	3B

∗ Frames 3A and 3B Only. Frame 2 drives are IP00, NEMA/UL Type Open.

480V AC, Three-Phase Drives

Output Amps			Nominal Power Ratings				IP20, NEMA/UL Type 1 ∗	
480V AC Input			Normal Duty		Heavy Duty			
Cont.	1 Min.	3 Sec.	kW	Hp	kW	Hp	Cat. No.	Frame Size
360	396	540	224	300	175	235	20LD360N0ENNAN10WA	2
650	715	975	445	600	325	440	20LD650A0ENNAN10WA	3A
1250	1375	1875	860	1150	630	845	20LD1K2A0ENNAN10WA	3B

∗ Frames 3A and 3B Only. Frame 2 drives are IP00, NEMA/UL Type Open.

600V AC, Three-Phase Drives

Output Amps			Nominal Power Ratings				IP20, NEMA/UL Type 1	
600V AC Input			Normal Duty		Heavy Duty			Frame Size
Cont.	1 Min.	3 Sec.	kW	Hp	kW	Hp	Cat. No.	
425	470	640	345	465	255	345	20LE425A0ENNAN10WA	3A
800	885	1200	650	870	480	640	20LE800A0ENNAN10WA	3B

690V AC, Three-Phase Drives

Output Amps			Nominal Power Ratings				IP20, NEMA/UL Type 1	
690V AC Input			Normal Duty		Heavy Duty			Frame Size
Cont.	1 Min.	3 Sec.	kW	Hp	kW	Hp	Cat. No.	
380	420	570	355	475	260	350	20LF380A0ENNAN10WA	3A
705	780	1060	657	881	485	650	20LF705A0ENNAN10WA	3B

Cooling Loops

Drive Requirements		Supply Loop Requirements			Liquid to Liquid Heat Exchanger ❄
Frame Size	Heat Dissipation into Liquid	Minimum Flow @ Pressure ✶	Maximum Pressure	Temperature Range	Cat. No.
2	7,900 W	15.1 LPM @ 0.83 bar (4 GPM @ 12 PSI)	8.62 bar (125 PSI)	0…40 °C (32…104 °F)	20L-LL13K-P75A
3A	12,000 W	22.7 LPM @ 0.83 bar (6 GPM @ 12 PSI)	8.62 bar (125 PSI)	0…35 °C (32…95 °F)	20L-LL13K-P75A
3B	24,000 W	56.8 LPM @ 0.83 bar (15 GPM @ 12 PSI)	8.62 bar (125 PSI)	0…35 °C (32…95 °F)	20L-LL24K-1P0A

✶ The minimum pressure applies to the pressure drop across the drive and does not take into account additional pressure drop in the system such as piping or hosing.

❄ Recommended cooling loops shown are based on a single drive per cooling loop. Consult your local Rockwell Automation sales office or Allen-Bradley distributor for use of multiple drives on one cooling loop.

Hose Kits

Hose Length [m (ft.)]	Hoses per Kit	Drive Side Coupling Size	Heat Exchanger Side Coupling Size	Used with …	Hose Kit Cat. No. ‡
3 (10)	2	0.75 in.	0.75 in.	Frame 2 and 13 kW HEX	20L-GH10-B1
9.1 (30)	2	0.75 in.	0.75 in.	Frame 2 and 13 kW HEX	20L-GH30-B1
3 (10)	2	1 in.	1 in. with 90° Elbow	Frame 3A and 13 kW HEX	20L-GH10-A2
9.1 (30)	2	1 in.	1 in. with 90° Elbow	Frame 3A and 13 kW HEX	20L-GH30-A2
3 (10)	2	1 in.	1 in.	Frame 3B and 24 kW HEX	20L-GH10-A1
9.1 (30)	2	1 in.	1 in.	Frame 3B and 24 kW HEX	20L-GH30-A1

‡ Each hose kit contains (2) hoses and the appropriate connectors.

Designed for general purpose applications, the PowerFlex 753 AC drive offers multiple options and features along with the added benefit of simple integration. The PowerFlex 753 comes standard with built-in I/O making it a cost effective solution ideal for OEMs and system integrators looking to reduce engineering costs, deliver machines to market faster and meet end-user demand for more productive and safer machines.

Ratings	380…480V: 0.75…250 kW / 1…350 Hp / 2.1…456 A
Motor Control	• V/Hz Control • Adjustable Voltage Control • Vector Control with FORCE Technology • Sensorless Vector Control
Communications	Common Industrial Protocol
User Interface	HIM (option)
Enclosures	IP00/IP20, Flange Mount, IP54/NEMA/UL Type 12
Safety	• Safe Torque-Off / EN 954-1 Cat. 3 • Safe Speed Monitor PLe/SIL3 Cat. 4
Additional Features	• DeviceLogix • Preventative Diagnostics • Standard I/O with 3 Digital In, 1 Analog In, 1 Analog Out, 1 Relay & 1 Transistor Out • Three option slots for I/O, feedback, safety, auxiliary control power, communications • Indexing • Pump Jack and Pump Off for oil well applications • Pjump and Traverse for Fibers application • Conformal Coating
Certifications	• UL • cUL • CE • C-Tick • SEMI F47 • GOST-R • TÜV FS ISO/EN13849-1 (EN954-1) with Safe Torque-Off option • Meets material restrictions specified in the RoHS directive
Options	See pages 6-65…6-74

IP00/IP20, NEMA/UL Type Open ❄

380…480V AC, Three-Phase Drives

480V AC Input						400V AC Input						Frame Size
Output Amps ‡			Normal Duty Hp	Heavy Duty Hp	Cat. No.	Output Amps ‡			Normal Duty kW	Heavy Duty kW	Cat. No. ✶	
Cont.	1 Min.	3 Sec.				Cont.	1 Min.	3 Sec.				
2.1	3.1	3.7	1	1	20F11ND2P1AA0NNNNN	2.1	3.1	3.7	0.75	0.75	20F11NC2P1JA0NNNNN	2
3.4	5.1	6.1	2	2	20F11ND3P4AA0NNNNN	3.5	5.2	6.3	1.5	1.5	20F11NC3P5JA0NNNNN	2
5	7.5	9	3	3	20F11ND5P0AA0NNNNN	5	7.5	9.0	2.2	2.2	20F11NC5P0JA0NNNNN	2
8	12	14.4	5	5	20F11ND8P0AA0NNNNN	8.7	13	15.6	4	4	20F11NC8P7JA0NNNNN	2
11	16.5	19.8	7.5	7.5	20F11ND011AA0NNNNN	11.5	17.2	20.7	5.5	5.5	20F11NC011JA0NNNNN	2
14 (11)	15.4 (16.5)	21 (21)	10	7.5	20F11ND014AA0NNNNN	15.4 (11.5)	16.9 (17.3)	23.1 (23.1)	7.5	5.5	20F11NC015JA0NNNNN	2
22 (14)	24.2 (21)	33 (33)	15	10	20F11ND022AA0NNNNN	22 (15.4)	24.2 (23.1)	33 (33)	11	7.5	20F11NC022JA0NNNNN	2
27 (22)	29.7 (33)	40.5 (40.5)	20	15	20F11ND027AA0NNNNN	30 (22)	33 (33)	45 (45)	15	11	20F11NC030JA0NNNNN	3
34 (27)	37.4 (40.5)	51 (51)	25	20	20F11ND034AA0NNNNN	37 (30)	40.7 (45)	55.5 (55.5)	18.5	15	20F11NC037JA0NNNNN	3
40 (34)	44 (51)	60 (61.2)	30	25	20F11ND040AA0NNNNN	43 (37)	47.3 (55.5)	64.5 (66.6)	22	18.5	20F11NC043JA0NNNNN	3
52 (40)	57.2 (60)	78 (78)	40	30	20F11ND052AA0NNNNN	60 (43)	66 (66)	90 (90)	30	22	20F11NC060JA0NNNNN	4
65 (52)	71.5 (78)	97.5 (97.5)	50	40	20F11ND065AA0NNNNN	72 (60)	79.2 (90)	108 (108)	37	30	20F11NC072JA0NNNNN	4
77 (65)	84.7 (97.5)	115.5 (117)	60	50	20F11ND077AA0NNNNN	85 (72)	93.5 (108)	127.5 (129.6)	45	37	20F11NC085JA0NNNNN	5
96 (77)	105.6 (115.5)	144 (144)	75	60	20F11ND096AA0NNNNN	104 (85)	114.4 (127.5)	156 (156)	55	45	20F11NC104JA0NNNNN	5
125 (96)	137.5 (144)	187.5 (187.5)	100	75	20F1AND125AN0NNNNN	140 (104)	154 (156)	210 (210)	75	55	20F1ANC140JN0NNNNN	6
156 (125)	171.6 (187.5)	234 (234)	125	100	20F1AND156AN0NNNNN	170 (140)	187 (210)	255 (255)	90	75	20F1ANC170JN0NNNNN	6
186 (156)	204.6 (234)	279 (280.8)	150	125	20F1AND186AN0NNNNN	205 (170)	225.5 (255)	307.5 (307.5)	110	90	20F1ANC205JN0NNNNN	6
248 (186)	272.8 (279)	372 (372)	200	150	20F1AND248AN0NNNNN	260 (205)	286 (307.5)	390 (390)	132	110	20F1ANC260JN0NNNNN	6
302 (248)	332.2 (372)	453 (453)	250	200	20F1AND302AN0NNNNN	302 (260)	332.2 (390)	453 (468)	160	132	20F1ANC302JN0NNNNN	7
361 (302)	397.1 (453)	541.5 (543.6)	300	250	20F1AND361AN0NNNNN	367 (302)	403.7 (453)	550.5 (550.5)	200	160	20F1ANC367JN0NNNNN	7
415 (361)	456.5 (541.5)	622.5 (649.8)	350	300	20F1AND415AN0NNNNN	456 (367)	501.6 (550.5)	684 (684)	250	200	20F1ANC456JN0NNNNN	7

✶ The 11th character determines default Filtering and Common Mode Cap jumper configuration. "J" = Installed, "A" = Removed.

❄ Frames 2…5 are IP20, Frames 6…7 are IP00.

‡ Some drives have dual current ratings; one for normal duty applications, and one for heavy duty applications (in parenthesis). The drive may be operated at either rating.

IP54, NEMA/UL Type 12

380…480V AC, Three-Phase Drives

480V AC Input						400V AC Input						Frame Size
Output Amps ‡			Normal Duty Hp	Heavy Duty Hp	Cat. No.	Output Amps ‡			Normal Duty kW	Heavy Duty kW	Cat. No.	
Cont.	1 Min.	3 Sec.				Cont.	1 Min.	3 Sec.				
2.1	3.1	3.7	1	1	20F11GD2P1AA0NNNNN	2.1	3.1	3.7	0.75	0.75	20F11GC2P1∗A0NNNNN	2
3.4	5.1	6.1	2	2	20F11GD3P4AA0NNNNN	3.5	5.2	6.3	1.5	1.5	20F11GC3P5∗A0NNNNN	2
5	7.5	9	3	3	20F11GD5P0AA0NNNNN	5	7.5	9.0	2.2	2.2	20F11GC5P0∗A0NNNNN	2
8	12	14.4	5	5	20F11GD8P0AA0NNNNN	8.7	13	15.6	4	4	20F11GC8P7∗A0NNNNN	2
11	16.5	19.8	7.5	7.5	20F11GD011AA0NNNNN	11.5	17.2	20.7	5.5	5.5	20F11GC011∗A0NNNNN	2
14 (11)	15.4 (16.5)	21 (21)	10	7.5	20F11GD014AA0NNNNN	15.4 (11.5)	16.9 (17.3)	23.1 (23.1)	7.5	5.5	20F11GC015∗A0NNNNN	2
22 (14)	24.2 (21)	33 (33)	15	10	20F11GD022AA0NNNNN	22 (15.4)	24.2 (23.1)	33 (33)	11	7.5	20F11GC022∗A0NNNNN	2
27 (22)	29.7 (33)	40.5 (40.5)	20	15	20F11GD027AA0NNNNN	30 (22)	33 (33)	45 (45)	15	11	20F11GC030∗A0NNNNN	3
34 (27)	37.4 (40.5)	51 (51)	25	20	20F11GD034AA0NNNNN	37 (30)	40.7 (45)	55.5 (55.5)	18.5	15	20F11GC037∗A0NNNNN	3
40 (34)	44 (51)	60 (61.2)	30	25	20F11GD040AA0NNNNN	43 (37)	47.3 (55.5)	64.5 (66.6)	22	18.5	20F11GC043∗A0NNNNN	3
52 (40)	57.2 (60)	78 (78)	40	30	20F11GD052AA0NNNNN	60 (43)	66 (66)	90 (90)	30	22	20F11GC060∗A0NNNNN	4
65 (52)	71.5 (78)	97.5 (97.5)	50	40	20F11GD065AA0NNNNN	72 (60)	79.2 (90)	108 (108)	37	30	20F11GC072∗A0NNNNN	5
77 (65)	84.7 (97.5)	115.5 (117)	60	50	20F11GD077AA0NNNNN	85 (72)	93.5 (108)	127.5 (129.6)	45	37	20F11GC085∗A0NNNNN	5
96 (77)	105.6 (115.5)	144 (144)	75	60	20F1AGD096AN0NNNNN	104 (85)	114.4 (127.5)	156 (156)	55	45	20F1AGC104∗N0NNNNN	6
125 (96)	137.5 (144)	187.5 (187.5)	100	75	20F1AGD125AN0NNNNN	140 (104)	154 (156)	210 (210)	75	55	20F1AGC140∗N0NNNNN	6
156 (125)	171.6 (187.5)	234 (234)	125	100	20F1AGD156AN0NNNNN	170 (140)	187 (210)	255 (255)	90	75	20F1AGC170∗N0NNNNN	6
186 (156)	204.6 (234)	279 (280.8)	150	125	20F1AGD186AN0NNNNN	205 (170)	225.5 (255)	307.5 (307.5)	110	90	20F1AGC205∗N0NNNNN	6
248 (186)	272.8 (279)	372 (372)	200	150	20F1AGD248AN0NNNNN	260 (205)	286 (307.5)	390 (390)	132	110	20F1AGC260∗N0NNNNN	7
302 (248)	332.2 (372)	453 (453)	250	200	20F1AGD302AN0NNNNN	302 (260)	332.2 (390)	453 (468)	160	132	20F1AGC302∗N0NNNNN	7
361 (302)	397.1 (453)	541.5 (543.6)	300	250	20F1AGD361AN0NNNNN	367 (302)	403.7 (453)	550.5 (550.5)	200	160	20F1AGC367∗N0NNNNN	7
415 (361)	456.5 (541.5)	622.5 (649.8)	350	300	20F1AGD415AN0NNNNN	456 (367)	501.6 (550.5)	684 (684)	250	200	20F1AGC456∗N0NNNNN	7

∗ The 11th character determines default Filtering and Common Mode Cap jumper configuration. "J" = Installed, "A" = Removed.

‡ Some drives have dual current ratings; one for normal duty applications, and one for heavy duty applications (in parenthesis). The drive may be operated at either rating.

Flange Mount
Front = IP20, NEMA/UL Type Open, Back/Heatsink = IP66, NEMA/UL Type 4X

380…480V AC, Three-Phase Drives

480V AC Input						400V AC Input						
Output Amps ‡			Normal Duty Hp	Heavy Duty Hp	Cat. No.	Output Amps ‡			Normal Duty kW	Heavy Duty kW	Cat. No.	Frame Size
Cont.	1 Min.	3 Sec.				Cont.	1 Min.	3 Sec.				
2.1	3.1	3.7	1	1	20F11FD2P1AA0NNNNN	2.1	3.1	3.7	0.75	0.75	20F11FC2P1∗A0NNNNN	2
3.4	5.1	6.1	2	2	20F11FD3P4AA0NNNNN	3.5	5.2	6.3	1.5	1.5	20F11FC3P5∗A0NNNNN	2
5	7.5	9	3	3	20F11FD5P0AA0NNNNN	5	7.5	9.0	2.2	2.2	20F11FC5P0∗A0NNNNN	2
8	12	14.4	5	5	20F11FD8P0AA0NNNNN	8.7	13	15.6	4	4	20F11FC8P7∗A0NNNNN	2
11	16.5	19.8	7.5	7.5	20F11FD011AA0NNNNN	11.5	17.2	20.7	5.5	5.5	20F11FC011∗A0NNNNN	2
14 (11)	15.4 (16.5)	21 (21)	10	7.5	20F11FD014AA0NNNNN	15.4 (11.5)	16.9 (17.3)	23.1 (23.1)	7.5	5.5	20F11FC015∗A0NNNNN	2
22 (14)	24.2 (21)	33 (33)	15	10	20F11FD022AA0NNNNN	22 (15.4)	24.2 (23.1)	33 (33)	11	7.5	20F11FC022∗A0NNNNN	2
27 (22)	29.7 (33)	40.5 (40.5)	20	15	20F11FD027AA0NNNNN	30 (22)	33 (33)	45 (45)	15	11	20F11FC030∗A0NNNNN	3
34 (27)	37.4 (40.5)	51 (51)	25	20	20F11FD034AA0NNNNN	37 (30)	40.7 (45)	55.5 (55.5)	18.5	15	20F11FC037∗A0NNNNN	3
40 (34)	44 (51)	60 (61.2)	30	25	20F11FD040AA0NNNNN	43 (37)	47.3 (55.5)	64.5 (66.6)	22	18.5	20F11FC043∗A0NNNNN	3
52 (40)	57.2 (60)	78 (78)	40	30	20F11FD052AA0NNNNN	60 (43)	66 (66)	90 (90)	30	22	20F11FC060∗A0NNNNN	4
65 (52)	71.5 (78)	97.5 (97.5)	50	40	20F11FD065AA0NNNNN	72 (60)	79.2 (90)	108 (108)	37	30	20F11FC072∗A0NNNNN	4
77 (65)	84.7 (97.5)	115.5 (117)	60	50	20F11FD077AA0NNNNN	85 (72)	93.5 (108)	127.5 (129.6)	45	37	20F11FC085∗A0NNNNN	5
96 (77)	105.6 (115.5)	144 (144)	75	60	20F11FD096AA0NNNNN	104 (85)	114.4 (127.5)	156 (156)	55	45	20F11FC104∗A0NNNNN	5

∗ The 11th character determines default Filtering and Common Mode Cap jumper configuration. "J" = Installed, "A" = Removed.

‡ Some drives have dual current ratings; one for normal duty applications, and one for heavy duty applications (in parenthesis). The drive may be operated at either rating.

Note: Frames 6…7 require a user installed flange kit with an IP00, NEMA/UL Type Open drive.

Designed for ease of integration, application flexibility and performance the PowerFlex 755 AC drive provides improved functionality across many manufacturing systems. The PowerFlex 755 AC drive is designed to maximize user's investment and help improve productivity. Ideal for applications that require safety, high motor control performance, and application flexibility, the PowerFlex 755 is highly functional and cost effective solution.

Ratings	380…480V: 0.75…250 kW / 1…350 Hp / 2.1…456 A
Motor Control	• V/Hz Control • Vector Control with FORCE Technology • Sensorless Vector Control • Permanent Magnet Motor Control
Communications	Embedded EtherNet/IP port standard, Common Industrial Protocol
User Interface	HIM (option)
Enclosures	IP00/IP20, Flange Mount, IP54/NEMA/UL Type 12
Safety	• Safe Torque-Off PLe/SIL3 Cat. 3 • Safe Speed Monitor PLe/SIL3 Cat. 4
Additional Features	• DeviceLogix • Preventative Diagnostics • Five option slots for I/O, feedback, safety, auxiliary control power, communications • Accurate positioning with PCAM, Indexer, Electronic Gearing, and speed/position profiling • Incremental and Absolute feedback supported • TorqProve for lifting applications • Conformal Coating
Certifications	• UL • cUL • CE • C-Tick • SEMI F47 • GOST-R • TÜV FS ISO/EN13849-1 (EN954-1) with Safe Torque-Off option • Meets material restrictions specified in the RoHS directive
Options	See pages 6-65…6-74

IP00/IP20, NEMA/UL Type Open ❄

380…480V AC, Three-Phase Drives

480V AC Input						400V AC Input						Frame Size
Output Amps ‡			Normal Duty Hp	Heavy Duty Hp	Cat. No.	Output Amps ‡			Normal Duty kW	Heavy Duty kW	Cat. No. ✶	
Cont.	1 Min.	3 Sec.				Cont.	1 Min.	3 Sec.				
2.1	3.1	3.7	1	1	20G11ND2P1AA0NNNNN	2.1	3.1	3.7	0.75	0.75	20G11NC2P1✶A0NNNNN	2 §
3.4	5.1	6.1	2	2	20G11ND3P4AA0NNNNN	3.5	5.2	6.3	1.5	1.5	20G11NC3P5✶A0NNNNN	2 §
5	7.5	9	3	3	20G11ND5P0AA0NNNNN	5	7.5	9.0	2.2	2.2	20G11NC5P0✶A0NNNNN	2 §
8	12	14.4	5	5	20G11ND8P0AA0NNNNN	8.7	13	15.6	4	4	20G11NC8P7✶A0NNNNN	2 §
11	16.5	19.8	7.5	7.5	20G11ND011AA0NNNNN	11.5	17.2	20.7	5.5	5.5	20G11NC011✶A0NNNNN	2 §
14 (11)	15.4 (16.5)	21 (21)	10	7.5	20G11ND014AA0NNNNN	15.4 (11.5)	16.9 (17.3)	23.1 (23.1)	7.5	5.5	20G11NC015✶A0NNNNN	2
22 (14)	24.2 (21)	33 (33)	15	10	20G11ND022AA0NNNNN	22 (15.4)	24.2 (23.1)	33 (33)	11	7.5	20G11NC022✶A0NNNNN	2
27 (22)	29.7 (33)	40.5 (40.5)	20	15	20G11ND027AA0NNNNN	30 (22)	33 (33)	45 (45)	15	11	20G11NC030✶A0NNNNN	3
34 (27)	37.4 (40.5)	51 (51)	25	20	20G11ND034AA0NNNNN	37 (30)	40.7 (45)	55.5 (55.5)	18.5	15	20G11NC037✶A0NNNNN	3
40 (34)	44 (51)	60 (61.2)	30	25	20G11ND040AA0NNNNN	43 (37)	47.3 (55.5)	64.5 (66.6)	22	18.5	20G11NC043✶A0NNNNN	3
52 (40)	57.2 (60)	78 (78)	40	30	20G11ND052AA0NNNNN	60 (43)	66 (66)	90 (90)	30	22	20G11NC060✶A0NNNNN	4
65 (52)	71.5 (78)	97.5 (97.5)	50	40	20G11ND065AA0NNNNN	72 (60)	79.2 (90)	108 (108)	37	30	20G11NC072✶A0NNNNN	4
77 (65)	84.7 (97.5)	115.5 (117)	60	50	20G11ND077AA0NNNNN	85 (72)	93.5 (108)	127.5 (129.6)	45	37	20G11NC085✶A0NNNNN	5
96 (77)	105.6 (115.5)	144 (144)	75	60	20G11ND096AA0NNNNN	104 (85)	114.4 (127.5)	156 (156)	55	45	20G11NC104✶A0NNNNN	5
125 (96)	137.5 (144)	187.5 (187.5)	100	75	20G1AND125AN0NNNNN	140 (104)	154 (156)	210 (210)	75	55	20G1ANC140✶N0NNNNN	6
156 (125)	171.6 (187.5)	234 (234)	125	100	20G1AND156AN0NNNNN	170 (140)	187 (210)	255 (255)	90	75	20G1ANC170✶N0NNNNN	6
186 (156)	204.6 (234)	279 (280.8)	150	125	20G1AND186AN0NNNNN	205 (170)	225.5 (255)	307.5 (307.5)	110	90	20G1ANC205✶N0NNNNN	6
248 (186)	272.8 (279)	372 (372)	200	150	20G1AND248AN0NNNNN	260 (205)	286 (307.5)	390 (390)	132	110	20G1ANC260✶N0NNNNN	6
302 (248)	332.2 (372)	453 (453)	250	200	20G1AND302AN0NNNNN	302 (260)	332.2 (390)	453 (468)	160	132	20G1ANC302✶N0NNNNN	7
361 (302)	397.1 (453)	541.5 (543.6)	300	250	20G1AND361AN0NNNNN	367 (302)	403.7 (453)	550.5 (550.5)	200	160	20G1ANC367✶N0NNNNN	7
415 (361)	456.5 (541.5)	622.5 (649.8)	350	300	20G1AND415AN0NNNNN	456 (367)	501.6 (550.5)	684 (684)	250	200	20G1ANC456✶N0NNNNN	7

✶ The 11th character determines default Filtering and Common Mode Cap jumper configuration. "J" = Installed, "A" = Removed.

❄ Frames 2…5 are IP20, Frames 6…7 are IP00.

‡ These drives have dual current ratings; one for normal duty applications, and one for heavy duty applications (in parenthesis). The drive may be operated at either rating.

§ Contact your local Rockwell Automation sales office or Allen-Bradley distributor for availability.

IP54, NEMA/UL Type 12

380…480V AC, Three-Phase Drives

480V AC Input						400V AC Input						Frame Size
Output Amps ‡			Normal Duty Hp	Heavy Duty Hp	Cat. No.	Output Amps ‡			Normal Duty kW	Heavy Duty kW	Cat. No. ∗	
Cont.	1 Min.	3 Sec.				Cont.	1 Min.	3 Sec.				
2.1	3.1	3.7	1	1	20G11GD2P1AA0NNNNN	2.1	3.1	3.7	0.75	0.75	20G11GC2P1∗A0NNNNN	2 §
3.4	5.1	6.1	2	2	20G11GD3P4AA0NNNNN	3.5	5.2	6.3	1.5	1.5	20G11GC3P5∗A0NNNNN	2 §
5	7.5	9	3	3	20G11GD5P0AA0NNNNN	5	7.5	9.0	2.2	2.2	20G11GC5P0∗A0NNNNN	2 §
8	12	14.4	5	5	20G11GD8P0AA0NNNNN	8.7	13	15.6	4	4	20G11GC8P7∗A0NNNNN	2 §
11	16.5	19.8	7.5	7.5	20G11GD011AA0NNNNN	11.5	17.2	20.7	5.5	5.5	20G11GC011∗A0NNNNN	2 §
14 (11)	15.4 (16.5)	21 (21)	10	7.5	20G11GD014AA0NNNNN	15.4 (11.5)	16.9 (17.3)	23.1 (23.1)	7.5	5.5	20G11GC015∗A0NNNNN	2
22 (14)	24.2 (21)	33 (33)	15	10	20G11GD022AA0NNNNN	22 (15.4)	24.2 (23.1)	33 (33)	11	7.5	20G11GC022∗A0NNNNN	2
27 (22)	29.7 (33)	40.5 (40.5)	20	15	20G11GD027AA0NNNNN	30 (22)	33 (33)	45 (45)	15	11	20G11GC030∗A0NNNNN	3
34 (27)	37.4 (40.5)	51 (51)	25	20	20G11GD034AA0NNNNN	37 (30)	40.7 (45)	55.5 (55.5)	18.5	15	20G11GC037∗A0NNNNN	3
40 (34)	44 (51)	60 (61.2)	30	25	20G11GD040AA0NNNNN	43 (37)	47.3 (55.5)	64.5 (66.6)	22	18.5	20G11GC043∗A0NNNNN	3
52 (40)	57.2 (60)	78 (78)	40	30	20G11GD052AA0NNNNN	60 (43)	66 (66)	90 (90)	30	22	20G11GC060∗A0NNNNN	4
65 (52)	71.5 (78)	97.5 (97.5)	50	40	20G11GD065AA0NNNNN	72 (60)	79.2 (90)	108 (108)	37	30	20G11GC072∗A0NNNNN	5
77 (65)	84.7 (97.5)	115.5 (117)	60	50	20G11GD077AA0NNNNN	85 (72)	93.5 (108)	127.5 (129.6)	45	37	20G11GC085∗A0NNNNN	5
96 (77)	105.6 (115.5)	144 (144)	75	60	20G1AGD096AN0NNNNN	104 (85)	114.4 (127.5)	156 (156)	55	45	20G1AGC104∗N0NNNNN	6
125 (96)	137.5 (144)	187.5 (187.5)	100	75	20G1AGD125AN0NNNNN	140 (104)	154 (156)	210 (210)	75	55	20G1AGC140∗N0NNNNN	6
156 (125)	171.6 (187.5)	234 (234)	125	100	20G1AGD156AN0NNNNN	170 (140)	187 (210)	255 (255)	90	75	20G1AGC170∗N0NNNNN	6
186 (156)	204.6 (234)	279 (280.8)	150	125	20G1AGD186AN0NNNNN	205 (170)	225.5 (255)	307.5 (307.5)	110	90	20G1AGC205∗N0NNNNN	6
248 (186)	272.8 (279)	372 (372)	200	150	20G1AGD248AN0NNNNN	260 (205)	286 (307.5)	390 (390)	132	110	20G1AGC260∗N0NNNNN	7
302 (248)	332.2 (372)	453 (453)	250	200	20G1AGD302AN0NNNNN	302 (260)	332.2 (390)	453 (468)	160	132	20G1AGC302∗N0NNNNN	7
361 (302)	397.1 (453)	541.5 (543.6)	300	250	20G1AGD361AN0NNNNN	367 (302)	403.7 (453)	550.5 (550.5)	200	160	20G1AGC367∗N0NNNNN	7
415 (361)	456.5 (541.5)	622.5 (649.8)	350	300	20G1AGD415AN0NNNNN	456 (367)	501.6 (550.5)	684 (684)	250	200	20G1AGC456∗N0NNNNN	7

∗ The 11th character determines default Filtering and Common Mode Cap jumper configuration. "J" = Installed, "A" = Removed.

‡ Some drives have dual current ratings; one for normal duty applications, and one for heavy duty applications (in parenthesis). The drive may be operated at either rating.

§ Contact your local Rockwell Automation sales office or Allen-Bradley distributor for availability.

Flange Mount
Front = IP20, NEMA/UL Type Open, Back/Heatsink = IP66, NEMA/UL Type 4X

380…480V AC, Three-Phase Drives

480V AC Input						400V AC Input						Frame Size
Output Amps ‡			Normal Duty Hp	Heavy Duty Hp	Cat. No.	Output Amps ‡			Normal Duty kW	Heavy Duty kW	Cat. No. ∗	
Cont.	1 Min.	3 Sec.				Cont.	1 Min.	3 Sec.				
2.1	3.1	3.7	1	1	20G11FD2P1AA0NNNNN	2.1	3.1	3.7	0.75	0.75	20G11FC2P1∗A0NNNNN	2 §
3.4	5.1	6.1	2	2	20G11FD3P4AA0NNNNN	3.5	5.2	6.3	1.5	1.5	20G11FC3P5∗A0NNNNN	2 §
5	7.5	9	3	3	20G11FD5P0AA0NNNNN	5	7.5	9.0	2.2	2.2	20G11FC5P0∗A0NNNNN	2 §
8	12	14.4	5	5	20G11FD8P0AA0NNNNN	8.7	13	15.6	4	4	20G11FC8P0∗A0NNNNN	2 §
11	16.5	19.8	7.5	7.5	20G11FD011AA0NNNNN	11.5	17.2	20.7	5.5	5.5	20G11FC011∗A0NNNNN	2 §
14 (11)	15.4 (16.5)	21 (21)	10	7.5	20G11FD014AA0NNNNN	15.4 (11.5)	16.9 (17.3)	23.1 (23.1)	7.5	5.5	20G11FC015∗A0NNNNN	2
22 (14)	24.2 (21)	33 (33)	15	10	20G11FD022AA0NNNNN	22 (15.4)	24.2 (23.1)	33 (33)	11	7.5	20G11FC022∗A0NNNNN	2
27 (22)	29.7 (33)	40.5 (40.5)	20	15	20G11FD027AA0NNNNN	30 (22)	33 (33)	45 (45)	15	11	20G11FC030∗A0NNNNN	3
34 (27)	37.4 (40.5)	51 (51)	25	20	20G11FD034AA0NNNNN	37 (30)	40.7 (45)	55.5 (55.5)	18.5	15	20G11FC037∗A0NNNNN	3
40 (34)	44 (51)	60 (61.2)	30	25	20G11FD040AA0NNNNN	43 (37)	47.3 (55.5)	64.5 (66.6)	22	18.5	20G11FC043∗A0NNNNN	3
52 (40)	57.2 (60)	78 (78)	40	30	20G11FD052AA0NNNNN	60 (43)	66 (66)	90 (90)	30	22	20G11FC060∗A0NNNNN	4
65 (52)	71.5 (78)	97.5 (97.5)	50	40	20G11FD065AA0NNNNN	72 (60)	79.2 (90)	108 (108)	37	30	20G11FC072∗A0NNNNN	4
77 (65)	84.7 (97.5)	115.5 (117)	60	50	20G11FD077AA0NNNNN	85 (72)	93.5 (108)	127.5 (129.6)	45	37	20G11FC085∗A0NNNNN	5
96 (77)	105.6 (115.5)	144 (144)	75	60	20G11FD096AA0NNNNN	104 (85)	114.4 (127.5)	156 (156)	55	45	20G11FC104∗A0NNNNN	5

∗ The 11th character determines default Filtering and Common Mode Cap jumper configuration. "J" = Installed, "A" = Removed.

‡ Some drives have dual current ratings; one for normal duty applications, and one for heavy duty applications (in parenthesis). The drive may be operated at either rating.

Note: Frames 6…7 require a user installed flange kit with an IP00, NEMA/UL Type Open drive.

§ Contact your local Rockwell Automation sales office or Allen-Bradley distributor for availability.

Human Interface and Wireless Interface Modules

Blank Plate

20-HIM-A3

20-HIM-A5

20-HIM-A6

20-HIM-C3S

20-HIM-C5S

20-HIM-C6S

20-WIM-N1

20-WIM-N4S

Human Interface and Wireless Interface Modules

Description	Cat. No.	Used with PowerFlex Drive				
		70	700H	700S	700L	753/755
No HIM (Blank Plate), Handheld/Local (Drive Mount)	20-HIM-A0	✓	✓	✓	✓	✓
LCD Display, Full Numeric Keypad, Handheld/Local (Drive Mount)	20-HIM-A3	✓	✓	✓	✓	
LCD Display, Programmer Only, Handheld/Local (Drive Mount)	20-HIM-A5	✓	✓	✓	✓	
Enhanced, LCD, Full Numeric, Handheld/Local (Drive Mount)	20-HIM-A6	✓	✓	✓	✓	✓
Remote (Panel Mount) LCD Display, Full Numeric Keypad ✶❄	20-HIM-C3S	✓	✓	✓	✓	
Remote (Panel Mount) LCD Display, Programmer Only ✶❄	20-HIM-C5S	✓	✓	✓	✓	
Enhanced, LCD, Full Numeric ✶❄	20-HIM-C6S	✓	✓	✓	✓	✓
Wireless Interface Module, Handheld/Local (Drive Mount)	20-WIM-N1	✓	✓	✓	✓	✓
Wireless Interface Module, Remote (Panel Mount) ✶❄	20-WIM-N4S	✓	✓	✓	✓	✓

✶ IP66, NEMA Type 4X/12 - For indoor use only.
❄ Includes a 1202-C30 interface cable (3 meters) for connection to drive.

Human Interface Module Accessories

Description	Cat. No.	Used with PowerFlex Drive				
		70	700H	700S	700L	753/755
Bezel Kit for LCD HIMs, NEMA Type 1 ❄	20-HIM-B1	✓	✓	✓	✓	✓
PowerFlex HIM Interface Cable, 1 m (39 in) §	20-HIM-H10	✓	✓	✓	✓	✓
Comm Option Cable Kit (Male-Male)						
0.33 m (1.1 ft)	1202-C03	✓	✓	✓	✓	✓
1 m (3.3 ft)	1202-C10	✓	✓	✓	✓	✓
3 m (9.8 ft)	1202-C30	✓	✓	✓	✓	✓
9 m (29.5 ft)	1202-C90	✓	✓	✓	✓	✓
Cable Kit (Male-Female) ♣						
0.33 m (1.1 ft)	1202-H03	✓	✓	✓	✓	✓
1 m (3.3 ft)	1202-H10	✓	✓	✓	✓	✓
3 m (9.8 ft)	1202-H30	✓	✓	✓	✓	✓
9 m (29.5 ft)	1202-H90	✓	✓	✓	✓	✓
DPI™ Cable Kit with Connectors, Tools and 100 m (328 ft) Cable	1202-CBL-KIT-100M	✓	✓	✓	✓	✓
DPI Cable Connector Kit	1202-TB-KIT-SET	✓	✓	✓	✓	✓
DPI/SCANport™ One to Two Port Splitter Cable	1203-S03	✓	✓	✓	✓	✓

❄ Includes a 1202-C30 interface cable (3 meters) for connection to drive.
§ Required only when HIM is used as handheld or remote.
♣ Required in addition to 20-HIM-H10 for distances up to a total maximum of 10 m (32.8 ft).

Communication Accessories

Description	Cat. No.	Used with PowerFlex Drive				
		70	700H	700S	700L	753/755
Serial Null Modem Adapter	1203-SNM	✓	✓	✓	✓	✓
Smart Self-powered Serial Converter (RS232) includes 1203-SFC and 1202-C10 Cables	1203-SSS	✓	✓	✓	✓	✓
Universal Serial Bus™ (USB) Converter includes 2 m USB, 20-HIM-H10 & 22-HIM-H10 Cables	1203-USB	✓	✓	✓	✓	✓
ControlNet Ex Right-Angle T-Tap	1786-TPR			✓	✓	✓
Communication Carrier Card	20-750-20COMM					✓

Communication Option Kits

Description	Cat. No.	Used with PowerFlex Drive				
		70	700H	700S	700L	753/755
BACnet® MS/TP RS485 Communication Adapter	20-COMM-B	✓	✓			
ControlNet™ Communication Adapter (Coax)	20-COMM-C	✓	✓	✓	✓	✓ ‡
ControlNet™ Communication Adapter (Coax) Conformal Coat	20-COMM-C-MX3	✓	✓	✓	✓	✓ ‡
DeviceNet Option Module	20-750-DNET					✓
DeviceNet™ Communication Adapter	20-COMM-D	✓	✓	✓	✓	✓ ‡
DeviceNet™ Communication Adapter Conformal Coat	20-COMM-D-MX3	✓	✓	✓	✓	✓ ‡
EtherNet/IP™ Communication Adapter	20-COMM-E	✓	✓	✓	✓	✓ ‡
EtherNet/IP™ Communication Adapter Conformal Coat	20-COMM-E-MX3	✓	✓	✓	✓	✓ ‡
HVAC Communication Adapter	20-COMM-H	✓	✓	✓ ⌘		✓ ⌘‡
Interbus™ Communication Adapter	20-COMM-I	✓	✓	✓	✓	✓ ‡
CANopen® Communication Adapter	20-COMM-K	✓	✓	✓	✓	✓ ‡
LonWorks® Communication Adapter	20-COMM-L	✓	✓			
Modbus/TCP Communication Adapter	20-COMM-M	✓	✓	✓	✓	✓ ‡
PROFIBUS™ DP Communication Adapter	20-COMM-P	✓	✓	✓	✓	✓ ‡
ControlNet™ Communication Adapter (Fiber)	20-COMM-Q	✓	✓	✓	✓	✓ ‡
Remote I/O Communication Adapter	20-COMM-R	✓	✓	✓	✓	✓ ‡
Remote I/O Communication Adapter Conformal Coat	20-COMM-R-MX3	✓	✓	✓	✓	✓ ‡
RS485 DF1 Communication Adapter	20-COMM-S	✓	✓	✓	✓	✓ ‡
RS485 DF1 Communication Adapter Conformal Coat	20-COMM-S-MX3	✓	✓	✓	✓	✓ ‡
External Communications Kit Power Supply	20-XCOMM-AC-PS1	✓	✓	✓	✓	✓
DPI External Communications Kit	20-XCOMM-DC-BASE	✓	✓	✓	✓	✓
External DPI I/O Option Board ➢	20-XCOMM-IO-OPT1	✓	✓	✓	✓	✓
Compact I/O Module (3 Channel)	1769-SM1	✓	✓	✓	✓	✓
DriveLogix ControlNet Communication Adapter (Coax) ❄	1788-CNC			✓	✓ ✦	
DriveLogix Comm Option, ControlNet Redundant (Coax) ❄	1788-CNCR			✓	✓ ✦	
DriveLogix Comm Option, ControlNet (Fiber) ❄	1788-CNF			✓	✓ ✦	
DriveLogix Comm Option, ControlNet Redundant (Fiber) ❄	1788-CNFR			✓	✓ ✦	
DriveLogix Comm Option, DeviceNet (Open Conn.) ❄	1788-DNBO			✓	✓ ✦	
DriveLogix Comm Option, EtherNet/IP (Twisted Pair) ❄	1788-ENBT			✓	✓ ✦	
DriveLogix5730 Comm Option, Embedded EtherNet/IP	20D-DL2-ENET0			✓	✓ ✦	

➢ For use only with DPI External Communications Kits 20-XCOMM-DC-BASE.
⌘ Only Modbus RTU can be used (PowerFlex 700 - Vector Control only).
❄ For use with DriveLogix option only. Requires Logix Expansion Board (20D-DL2-LEB0).
‡ Requires a Communication Carrier Card (20-750-20COMM). Refer to page 6-67 for compatibility details.
✦ When using a PowerFlex 700S control.

Feedback Options

Description	Cat. No.	Used with PowerFlex Drive				
		70	700H	700S	700L	753/755
5V/12V Encoder ❖	20A-ENC-1	✓				
12V/5V Encoder	20B-ENC-1				✓ ♠	
12V/5V Encoder with Conformal Coat	20B-ENC-1-MX3					
Multi-Device Interface ➢	20D-MDI-C2			✓	✓ ✦	
2nd Encoder, 5V/12V ➢	20D-P2-ENC0			✓	✓ ✦	
Resolver ➢	20D-RES-A1			✓	✓ ✦	
Stegmann High Resolution Hyperface Encoder ➢	20D-STEG-B1			✓	✓ ✦	
Heidenhain High Resolution EnDat Encoder	20D-HEID-D0			✓	✓ ✦	
Incremental Encoder	20-750-ENC-1					✓
Dual Incremental Encoder	20-750-DENC-1					✓
Universal Feedback (includes Stegmann, Heidenhain, SSI, Biss, Incremental)	20-750-UFB-1					✓ ✶

❖ Works only with PowerFlex 70 Enhanced Control.
➢ Requires Expanded Cassette
♠ When using a PowerFlex 700 with Vector Control.
✶ PowerFlex 755 only.
✦ When using a PowerFlex 700S control.

PowerFlex 750-Series Legacy Communication Options

Most legacy communication adapters (20-COMM) can be used with the PowerFlex 755. However, the restrictions stated below do apply.

Adapter	Accesses Ports 1…6 for I/O	Accesses Port 7…14 Devices	Supports Drive Add On Profiles	Supports Asian-Languages ➢
20-COMM-B	Not Compatible			
20-COMM-C	✓❄	✓ v3.001 §	✓ ♣	✓ v3.001 §
20-COMM-D		✓ v2.005 §	Not Compatible	
20-COMM-E		✓ v4.001 §	✓ ♣	✓ v4.001 §
20-COMM-H	✓‡	Not Compatible		
20-COMM-I	✓❄			
20-COMM-K				
20-COMM-L	Not Compatible			
20-COMM-M	✓❄	✓ v2.001 §	Not Compatible	✓ v2.001 §
20-COMM-P		Not Compatible		
20-COMM-Q		✓ v3.001 §	✓ ♣	✓ v3.001 §
20-COMM-R		Not Compatible		
20-COMM-S				

❄ Controller must be capable of reading/writing 32-bit floating point (REAL) values.
‡ Only works in the Modbus RTU mode.
§ Requires this adapter firmware version or higher.
♣ Requires firmware version v1.05 or higher of the drive Add On Profiles for RSLogix 5000 version v16 or higher.
➢ Chinese, Japanese, and Korean languages are supported at the time of publication.

I/O Option Kits

Description	Cat. No.	Used with PowerFlex Drive				
		70	700H	700S	700L	753/755
24V DC Digital Inputs (6) w/Analog I/O (4), Slot A ⌘	20C-DA1-A		✓			
115V AC Digital Inputs (6) w/Analog I/O (4), Slot A ⌘	20C-DA1-B		✓			
115V AC Digital Outputs (3), Slot B ⌘	20C-DO1		✓			
24V DC I/O with 2 Analog In, 2 Analog Out, 6 Digital In and 2 Relay Outputs	20-750-2262C-2R					✓
115V AC I/O with 2 Analog In, 2 Analog Out, 6 Digital In and 2 Relay Outputs	20-750-2262D-2R					✓
24V DC I/O with 2 Analog In, 2 Analog Out, 6 Digital In, 3 Digital Out, 1 Relay & 2 Transistor Outputs	20-750-2263C-1R2T					✓

⌘ Only one card allowed per slot.

Safety Options

Description	Cat. No.	Used with PowerFlex Drive				
		70	700H	700S	700L	753/755
DriveGuard Safe Torque-Off	20A-DG01	✓				
DriveGuard Safe Torque-Off w/2nd Encoder	20D-P2-DG01			✓	✓ ✦	
DriveGuard Safe Torque-Off (ATEX capable) ⌘	20C-DG1		✓			
Safe Torque-Off	20-750-S					✓
Safe Speed Monitor	20-750-S1					✓

⌘ Only one card allowed per slot.
✦ When using PowerFlex 700S control.

PowerFlex 750-Series Option Kits

Description		Frame	Cat. No.	Used with PowerFlex Drive				
				70	700H	700S	700L	753/755
Flange Adapter Kits	Converts Open Type drive to external heatsink (flange) with NEMA/UL Type 1 integrity backside ✶	2	20-750-FLNG1-F2					✓
		3	20-750-FLNG1-F3					✓
		4	20-750-FLNG1-F4					✓
		5	20-750-FLNG1-F5					✓
	Converts Open Type drive to external heatsink (flange) with NEMA/UL Type 4X/12 integrity backside	6	20-750-FLNG4-F6					✓
		7	20-750-FLNG4-F7					✓
EMC Option Kits	EMC Plate with Core	2	20-750-EMC1-F2					✓
	EMC Plate with Core	3	20-750-EMC1-F3					✓
	EMC Plate with Cores	4	20-750-EMC1-F4					✓
	EMC Plate with Cores	5	20-750-EMC1-F5					✓
	EMC Core	2	20-750-EMC2-F2					✓
	EMC Core	3	20-750-EMC2-F3					✓
	EMC Cores	4…5	20-750-EMC2-F45					✓
NEMA/UL Type 1 Option Kits	NEMA/UL Type 1 Kit	2	20-750-NEMA1-F2					✓
	NEMA/UL Type 1 Kit	3	20-750-NEMA1-F3					✓
	NEMA/UL Type 1 Kit	4	20-750-NEMA1-F4					✓
	NEMA/UL Type 1 Kit	5	20-750-NEMA1-F5					✓
	NEMA/UL Type 1 Kit	6	20-750-NEMA1-F6					✓
	NEMA/UL Type 1 Kit	7	20-750-NEMA1-F7					✓
DC Bus Bar Option Kits	DC Bus Bars	6	20-750-DCBB1-F6					✓
		7	20-750-DCBB1-F7					✓

✶ This kit is for use with IP20, NEMA/UL Type 0 drives and **will not provide** an air-tight or water-tight seal. Where sealing is required (e.g. contaminated, dirty or wet environments), a drive with an "F" enclosure option must be used.

Other Options

Description	Cat. No.	Used with PowerFlex Drive				
		70	700H	700S	700L	753/755
115V AC Interface	AK-M9-115VAC-1	✓				
Frame E Flange Gasket	AK-M9-GASKET1-E4	✓				
Service Connection Board ❄	SK-M9-SCB1	✓				
Removable I/O Terminal Block	SK-G9-TB1-S1					
Removable Encoder Terminal Block	SK-G9-TB1-ENC1					
Touch Cover - Converts IP00/Open Type drive to IP20/NEMA/UL Type 1. No wiring space provided.	20-OPT-TC		✓			
Top Hat- Converts IP00/Open Type drive to IP20/NEMA/UL Type 1. Allows for wiring space.	20-OPT-TH		✓			
Auxiliary Control Power Supply	20-24V-AUX1			✓		
24V Aux Power Supply	20-750-APS					✓
PowerFlex 700S Phase II Control with Expanded Cassette	20D-P2-CKE1			✓	✓ ✦	
PowerFlex 700S Phase II Control with Slim Cassette	20D-P2-CKS1			✓		
PowerFlex 700S DriveLogix5730 Phase II Control with Expanded Cassette	20D-DL2-CKE1			✓	✓ ✦	
PowerFlex 700S DriveLogix5730 Phase II Control with Slim Cassette	20D-DL2-CKS1			✓		

❄ Provides temporary DPI/HIM connection for NEMA/UL Type 1 and Flange drives with cover removed.
✦ When using PowerFlex 700S control and Expanded Cassette.

SynchLink™ Accessories

Description ✶	Cat. No.	Used with PowerFlex Drive				
		70	700H	700S	700L	753/755
SynchLink Board	20D-P2-SLB0			✓	✓ ✦	
SynchLink Fiber Base Block	1751-SLBA			✓	✓ ✦	
SynchLink 4-port Fiber Splitter Block	1751-SL4SP			✓	✓ ✦	
SynchLink Fiber Bypass Switch Block	1751-SLBP			✓	✓ ✦	
2x1 Meter Fiber Link for Power Monitor/SynchLink	1403-CF001			✓	✓ ✦	
2x3 Meter Fiber Link for Power Monitor/SynchLink	1403-CF003			✓	✓ ✦	
2x5 Meter Fiber Link for Power Monitor/SynchLink	1403-CF005			✓	✓ ✦	
10 Meter Fiber Link for Power Monitor/SynchLink	1403-CF010			✓	✓ ✦	
20 Meter Fiber Link for Power Monitor/SynchLink	1403-CF020			✓	✓ ✦	
50 Meter Fiber Link for Power Monitor/SynchLink	1403-CF050			✓	✓ ✦	
100 Meter Fiber Link for Power Monitor/SynchLink	1403-CF100			✓	✓ ✦	
250 Meter Fiber Link for Power Monitor/SynchLink	1403-CF250			✓	✓ ✦	

✶ Refer to publication number 1769-SG001 for details on SynchLink.
✦ When using PowerFlex 700S control.

DriveLogix Option Kits

Description	Cat. No.	Used with PowerFlex Drive				
		70	700H	700S	700L	753/755
Logix Expansion board for DriveLogix5730 ➢	20D-DL2-LEB0			✓	✓ ✦	
Industrial Compact Flash 64 MB Memory Card for DriveLogix5730	1784-CF64			✓	✓ ✦	

➢ Requires Expanded Cassette.
✦ When using PowerFlex 700S control.

DriveLogix I/O Cables

Description	Cat. No.	Used with PowerFlex Drive				
		70	700H	700S	700L	753/755
DriveLogix5730 - Compact I/O cable, 3.28 ft. (1 meter), Left Bus Cap ➢§	20D-DL2-CL3			✓	✓ ✦	
DriveLogix5730 - Compact I/O cable, 3.28 ft. (1 meter), Right Bus Cap ➢§	20D-DL2-CR3			✓	✓ ✦	
Logix5000 RS-232 Programming Cable	1756-CP3			✓	✓ ✦	

➢ Requires Expanded Cassette.
§ Refer to Publication 1769-SG001 for details and selection of Compact I/O.
✦ When using PowerFlex 700S control.

PowerFlex 70 Small Duty Internal Dynamic Brake Resistors

Limited duty resistors mount directly to the back surface of the drive and require no extra panel space. Internal resistors are non-destructive and do not require a resistor overheat external safety circuit.

PowerFlex 70 AC Drive			Small Duty Internal DB Resistor								
								Application Type 1		Application Type 2	
Normal Duty∗ [kW (Hp)]	Heavy Duty∗ [kW (Hp)]	Min DB Res [Ohms ±10%]	Cat. No.	Resistance ❄ [Ohms ±5%]	Continuous Power [kW]	Max Energy [kJ]	Max Braking Torque [% of ND Motor]	Braking Torque [% of ND Motor]	Duty Cycle	Braking Torque [% of ND Motor]	Duty Cycle
200…240 Volt AC Input Drives											
0.37 (0.5)	0.25 (0.33)	33	20AB-DB1-A	62	0.048	8.3	307%	100%	25.9%	150%	17.3%
0.75 (1.0)	0.55 (0.75)	33	20AB-DB1-A	62	0.048	7.3	300%	100%	12.8%	150%	8.5%
1.5 (2.0)	1.1 (1.5)	33	20AB-DB1-B	62	0.028	0.8	160%	100%	3.7%	150%	2.5%
2.2 (3.0)	1.5 (2.0)	33	20AB-DB1-B	62	0.028	0.8	109%	100%	2.5%	109%	2.3%
4.0 (5.0)	3.0 (3.0)	30	20AB-DB1-C	62	0.040	0.8	60%	60%	3.3%	N/A	N/A
5.5 (7.5)	4.0 (5.0)	21	20AB-DB1-D	22	0.036	0.9	117%	100%	1.3%	117%	1.1%
7.5 (10)	5.5 (7.5)	21	20AB-DB1-D	22	0.036	0.9	86%	86%	1.1%	N/A	N/A
400…480 Volt AC Input Drives											
0.37 (0.5)	0.25 (0.33)	68	20AD-DB1-A	115	0.048	8.3	320%	100%	25.9%	150%	17.3%
0.75 (1.0)	0.55 (0.75)	68	20AD-DB1-A	115	0.048	9.0	259%	100%	12.8%	150%	8.5%
1.5 (2.0)	1.1 (1.5)	68	20AD-DB1-A	115	0.048	2.4	243%	100%	6.4%	150%	4.3%
2.2 (3.0)	1.5 (2.0)	68	20AD-DB1-B	115	0.028	0.9	206%	100%	2.5%	150%	1.7%
4.0 (5.0)	3.0 (3.0)	68	20AD-DB1-B	115	0.028	0.9	129%	100%	1.4%	129%	1.1%
5.5 (7.5)	4.0 (5.0)	74	20AD-DB1-C	115	0.04	0.9	94%	94%	1.5%	N/A	N/A
7.5 (10)	5.5 (7.5)	74	20AD-DB1-C	115	0.04	0.9	69%	69%	1.5%	N/A	N/A
11 (15)	7.5 (10)	44	20AD-DB1-D	62	0.036	0.8	87%	87%	0.8%	N/A	N/A
15 (20)	11 (15)	31	20AD-DB1-D	62	0.036	0.8	64%	64%	0.8%	N/A	N/A
500…600 Volt AC Input Drives											
0.37 (0.5)	0.25 (0.33)	117	20AD-DB1-A	115	0.048	8.3	287%	100%	25.9%	150%	17.3%
0.75 (1.0)	0.55 (0.75)	117	20AD-DB1-A	115	0.048	9.0	263%	100%	12.8%	150%	8.5%
1.5 (2.0)	1.1 (1.5)	117	20AD-DB1-A	115	0.048	2.4	243%	100%	6.4%	150%	4.3%
2.2 (3.0)	1.5 (2.0)	117	20AD-DB1-B	115	0.028	0.9	202%	100%	2.5%	150%	1.7%
4.0 (5.0)	3.0 (3.0)	80	20AD-DB1-B	115	0.028	0.9	193%	100%	1.4%	150%	0.9%
5.5 (7.5)	4.0 (5.0)	80	20AD-DB1-C	115	0.04	0.9	147%	100%	1.5%	147%	1.0%
7.5 (10)	5.5 (7.5)	80	20AD-DB1-C	115	0.04	0.9	108%	100%	1.1%	108%	1.0%
11 (15)	7.5 (10)	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
15 (20)	11 (15)	48	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

∗ Duty cycle listed is based on full speed to zero speed deceleration. For constant regen at full speed, duty cycle capability is half of what is listed. Application Type 1 represents maximum capability up to 100% braking torque where possible. Application Type 2 represents more than 100% braking torque where possible, up to a maximum of 150%.

❄ Always check resistor Ohms against minimum resistance for drive being used.

PowerFlex 70 Medium Duty External Dynamic Brake Resistors

These resistors provide a larger duty cycle capability than the internal type. Includes an internal thermal switch for use in external safety circuit.

PowerFlex 70 AC Drive			Medium Duty External DB Resistor								
								Application Type 1		Application Type 2	
Normal Duty✶ [kW (Hp)]	Heavy Duty✶ [kW (Hp)]	Min DB Res [Ohms ±10%]	Cat. No.	Resistance ❄ [Ohms ±5%]	Continuous Power [kW]	Max Energy [kJ]	Max Braking Torque [% of ND Motor]	Braking Torque [% of ND Motor]	Duty Cycle	Braking Torque [% of ND Motor]	Duty Cycle
200…240 Volt AC Input Drives											
0.37 (0.5)	0.25 (0.33)	33	AK-R2-091P500	91	0.086	17	293%	100%	46%	150%	31%
0.75 (1.0)	0.55 (0.75)	33	AK-R2-091P500	91	0.086	17	218%	100%	23%	150%	15%
1.5 (2.0)	1.1 (1.5)	33	AK-R2-091P500	91	0.086	17	109%	100%	11%	109%	11%
2.2 (3.0)	1.5 (2.0)	33	AK-R2-047P500	47	0.166	33	144%	100%	15%	144%	11%
4.0 (5.0)	3.0 (3.0)	30	AK-R2-047P500	47	0.166	33	79%	79%	11%	N/A	N/A
5.5 (7.5)	4.0 (5.0)	23	AK-R2-030P1K2	30	0.26	52	90%	90%	10%	N/A	N/A
7.5 (10)	5.5 (7.5)	23	AK-R2-030P1K2	30	0.26	52	66%	66%	10%	N/A	N/A
400…480 Volt AC Input Drives											
0.37 (0.5)	0.25 (0.33)	68	AK-R2-360P500	360	0.086	17	305%	100%	47%	150%	31%
0.75 (1.0)	0.55 (0.75)	68	AK-R2-360P500	360	0.086	17	220%	100%	23%	150%	15%
1.5 (2.0)	1.1 (1.5)	68	AK-R2-360P500	360	0.086	17	110%	100%	12%	110%	11%
2.2 (3.0)	1.5 (2.0)	68	AK-R2-120P1K2	120	0.26	52	197%	100%	24%	150%	16%
4.0 (5.0)	3.0 (3.0)	68	AK-R2-120P1K2	120	0.26	52	124%	100%	13%	124%	10%
5.5 (7.5)	4.0 (5.0)	74	AK-R2-120P1K2	120	0.26	52	90%	90%	10%	N/A	N/A
7.5 (10)	5.5 (7.5)	74	AK-R2-120P1K2	120	0.26	52	66%	66%	10%	N/A	N/A
11 (15) ‡	7.5 (10) ‡	44	‡	60	0.52	104	90%	90%	10%	N/A	N/A
15 (20) ‡	11 (15) ‡	31	‡	60	0.52	104	66%	66%	10%	N/A	N/A
500…600 Volt AC Input Drives											
0.37 (0.5)	0.25 (0.33)	117	AK-R2-360P500	360	0.086	17	274%	100%	46%	150%	31%
0.75 (1.0)	0.55 (0.75)	117	AK-R2-360P500	360	0.086	17	251%	100%	23%	150%	15%
1.5 (2.0)	1.1 (1.5)	117	AK-R2-360P500	360	0.086	17	172%	100%	11%	150%	8%
2.2 (3.0)	1.5 (2.0)	117	AK-R2-120P1K2	120	0.26	52	193%	100%	24%	150%	16%
4.0 (5.0)	3.0 (3.0)	80	AK-R2-120P1K2	120	0.26	52	185%	100%	13%	150%	9%
5.5 (7.5)	4.0 (5.0)	80	AK-R2-120P1K2	120	0.26	52	141%	100%	9%	141%	7%
7.5 (10)	5.5 (7.5)	80	AK-R2-120P1K2	120	0.26	52	103%	100%	7%	103%	7%
11 (15) ‡	7.5 (10) ‡	48	‡	60	0.52	104	141%	100%	9%	141%	7%
15 (20) ‡	11 (15) ‡	48	‡	60	0.52	104	103%	100%	7%	103%	7%

✶ Duty cycle listed is based on full speed to zero speed deceleration. For constant regen at full speed, duty cycle capability is half of what is listed. Application Type 1 represents maximum capability up to 100% braking torque where possible. Application Type 2 represents more than 100% braking torque where possible, up to a maximum of 150%.

❄ Always check resistor Ohms against minimum resistance for drive being used.

‡ For 11 and 15 kW (15 and 20 Hp) applications, use two 7.5 kW (10 Hp) size resistors wired in parallel.

Internal Dynamic Brake Resistor Kits

These resistors have a limited duty cycle. Refer to the PowerFlex Dynamic Braking Selection Guide to determine if an internal resistor will be sufficient for your application. An external resistor may be required.

Drive Input Voltage	Brake Resistance [Ω]	Frame	Cat. No.	Used with PowerFlex Drive				
				70	700H	700S	700L	753/755
208…240V AC	62	0	20BB-DB1-0			✓		
	62	1 (except 7.5 Hp)	20BB-DB1-1			✓		
	22	1 (7.5 Hp)	20BB-DB2-1			✓		
	22	2	20BB-DB1-2			✓		
380…600V AC	115	0	20BD-DB1-0			✓		
	115	1	20BD-DB1-1			✓		
	68	2	20BD-DB1-2			✓		
	68	2	20-750-DB1-D2					✓

Dynamic Brake, Chopper Only Kits

Voltage	Rating	Peak Transistor Current Rating [A]	Minimum DB Resistance [Ohms]	Cat. No.	Used with PowerFlex Drive				
					70	700H	700S	700L	753/755
200…240V AC	18A	50	9	1336-WA018			✓		
	70A	200	2.3	1336-WA070			✓		
	115A	400	1.25	1336-WA115			✓		
380…480V AC	9A	25	37	1336-WB009		✓	✓		✓
	35A	100	9	1336-WB035		✓	✓		✓
	110A	400	2.5	1336-WB110		✓	✓		✓
500…600V AC	9A	25	46	1336-WC009		✓	✓		
	35A	75	15.5	1336-WC035		✓	✓		
	85A	400	3	1336-WC085		✓	✓		

Terminators

Description ❄	Cat. No.	Used with PowerFlex Drive				
		70	700H	700S	700L	753/755
for use with 3.7 kW (5 Hp) & below drives	1204-TFA1	✓		✓	✓	✓
for use with 1.5 kW (2 Hp) & up drives	1204-TFB2	✓	✓	✓	✓	✓

❄ Refer to Appendix A of publication Drives-IN001 for selection information.

Reflected Wave Reduction Modules w/Common Mode Choke

Description ❄	Cat. No.	Used with PowerFlex Drive				
		70	700H	700S	700L	753/755
17A with Common Mode Choke	1204-RWC-17-A	✓	✓	✓		✓

❄ Refer to Appendix A of publication Drives-IN001 for selection information.

Reflected Wave Reduction Modules

Voltage	ND kW	ND Hp	Cat. No.	Used with PowerFlex Drive				
				70	700H	700S	700L	753/755
380…480V AC	4	5	1321-RWR8-DP	✓		✓		✓
	5.5	7.5	1321-RWR12-DP	✓		✓		✓
	7.5	10	1321-RWR18-DP	✓		✓		✓
	11	15	1321-RWR25-DP	✓		✓		✓
	15	20	1321-RWR35-DP	✓		✓		✓
	18.5	25	1321-RWR35-DP	✓		✓		✓
	22	30	1321-RWR45-DP	✓		✓		✓
	30	40	1321-RWR55-DP	✓		✓		✓
	37	50	1321-RWR80-DP	✓		✓		✓
	45	60	1321-RWR80-DP			✓		✓
	55	75	1321-RWR100-DP			✓		✓
	75	100	1321-RWR130-DP			✓		✓
	75	100	1321-RWR160-DP			✓		
	90	125	1321-RWR160-DP			✓		✓
	110	150	1321-RWR200-DP			✓		✓
	149	200	1321-RWR250-DP		✓	✓		✓
	149	200	1321-RWR320-DP			✓		
	187	250	1321-RWR320-DP		✓	✓		✓
500…600V AC	4	5	1321-RWR8-EP	✓		✓		
	5.5	7.5	1321-RWR8-EP			✓		
	5.5	7.5	1321-RWR12-EP	✓				
	7.5	10	1321-RWR12-EP	✓		✓		
	11	15	1321-RWR18-EP	✓		✓		
	15	20	1321-RWR25-EP	✓		✓		
	18.5	25	1321-RWR25-EP			✓		
	18.5	25	1321-RWR35-EP	✓				
	22	30	1321-RWR35-EP	✓		✓		
	30	40	1321-RWR45-EP	✓		✓		
	37	50	1321-RWR55-EP	✓		✓		
	45	60	1321-RWR80-EP			✓		
	55	75	1321-RWR80-EP			✓		
	75	100	1321-RWR100-EP			✓		
	90	125	1321-RWR130-EP			✓		
	110	150	1321-RWR160-EP			✓		
	110	150	1321-RWR200-EP			✓		
	149	200	1321-RWR200-EP			✓		

1492 Wiring System Modules and Cables

Wiring System Modules and Cables provide an easy means to extend drive control wiring. A pre-wired cable (available in various lengths) plugs into the appropriate drive I/O terminal block. The remaining cable end plugs into the Wiring Module which provides a terminal block for direct I/O connection. See publication 1492-TD008 for detailed information.

1492 Wiring Module and Cable Selection

Drive I/O	Wiring Module Description	Wiring Module Cat. No.		PowerFlex 700H Cable (see below)	PowerFlex 700S Cable (see below)	Used with PowerFlex Drive				
		Fixed Terminal Block	Removable Terminal Block			70	700H	700S	700L	753/755
Analog I/O (TB1)	6 Channel Isolated - 3 Terminals/Ch.	1492-AIFM6S-3	1492-RAIFM6S-3	1492-ACABxxxZ7H	1492-ACABxxxZ7S		✓	✓		
DC Discrete Digital I/O (TB2)	Standard, 264V AC/DC	1492-IFM20F	1492-RIFM20F	1492-CABxxxA7H	1492-CABxxxA7S		✓	✓		
	Narrow Standard, 132V AC/DC	1492-IFM20FN	1492-RIFM20FN	1492-CABxxxA7H	1492-CABxxxA7S		✓	✓		
	Extra Terminals (2 per I/O), 264V AC/DC	1492-IFM20F-2	1492-RIFM20F-2	1492-CABxxxA7H	1492-CABxxxA7S		✓	✓		
AC Discrete Digital I/O (20C-DA1-B & 20C-DO1)	Standard, 264V AC/DC	1492-IFM20F	1492-RIFM20F	1492-CABxxxB7H	1492-CABxxxB7H		✓			
	Narrow Standard, 132V AC/DC	1492-IFM20FN	1492-RIFM20FN	1492-CABxxxB7H	1492-CABxxxB7H		✓			
	Extra Terminals (2 per I/O), 264V AC/DC	1492-IFM20F-2	1492-RIFM20F-2	1492-CABxxxB7H	1492-CABxxxB7H		✓			
Encoder	2 Channel Encoder Input - 4 Outputs	1492-AIFMCE4	–	1492-ACABxxxX7S	1492-ACABxxxX7S			✓		
	2 Channel Fused Encoder Input - 4 Fused Outputs	1492-AIFMCE4-F	–	1492-ACABxxxX7S	1492-ACABxxxX7S			✓		

1492 Pre-Wired Cable Assemblies

Description	PowerFlex 700H Cat. No.	PowerFlex 700S Cat. No.	Used with PowerFlex Drive				
			70	700H	700S	700L	753/755
Pre-Wired Cable for Analog I/O							
0.5 m (1.6 ft)	1492-ACAB005Z7H	1492-ACAB005Z7S		✓	✓		
1.0 m (3.3 ft)	1492-ACAB010Z7H	1492-ACAB010Z7S		✓	✓		
2.5 m (8.2 ft)	1492-ACAB025Z7H	1492-ACAB025Z7S		✓	✓		
5.0 m (16.4 ft)	1492-ACAB050Z7H	1492-ACAB050Z7S		✓	✓		
Pre-Wired Cable for Discrete DC I/O							
0.5 m (1.6 ft)	1492-CAB005A7H	1492-CAB005A7S		✓	✓		
1.0 m (3.3 ft)	1492-CAB010A7H	1492-CAB005A7S		✓	✓		
2.5 m (8.2 ft)	1492-CAB025A7H	1492-CAB025A7S		✓	✓		
5.0 m (16.4 ft)	1492-CAB050A7H	1492-CAB050A7S		✓	✓		
Pre-Wired Cable for Discrete AC I/O							
0.5 m (1.6 ft)	1492-CAB005B7H	–		✓			
1.0 m (3.3 ft)	1492-CAB010B7H	–		✓			
2.5 m (8.2 ft)	1492-CAB025B7H	–		✓			
5.0 m (16.4 ft)	1492-CAB050B7H	–		✓			
Pre-Wired Cable for Encoder							
0.5 m (1.6 ft)	–	1492-ACAB005X7S			✓		
1.0 m (3.3 ft)	–	1492-ACAB010X7S			✓		
2.5 m (8.2 ft)	–	1492-ACAB025X7S			✓		
5.0 m (16.4 ft)	–	1492-ACAB050X7S			✓		

Servo Drive Comparison

Kinetix® Integrated Motion systems help increase machine productivity with GuardMotion™ technology. GuardMotion is the basis for safety innovations integrated into Kinetix motion products. Safe-off, also known as Safe Torque-off, helps machine builders and manufacturers implement machine solutions that provide safety and maximum availability. Tasks such as machine setup, cleaning, removal of jams and other typical maintenance work that previously required power-down conditions can now be accomplished without removing power from the entire machine. With the Safe-off capability, the drive output is safely disabled to eliminate motor torque. As a result, users enjoy faster machine restart and shorter machine downtime. In addition, components such as output contactors can be eliminated, simplifying machine design and reducing both panel space requirements and overall system cost.

Kinetix 6200 and Kinetix 6500 drives offer Safe Speed Monitoring, as well as Safe-off capability.

GuardMotion drives can be identified by the GuardMotion logo on the front label of the drive.

Drive Features	Kinetix 300	Kinetix 6500	Kinetix 6200	Kinetix 6000	Kinetix 7000
Main Characteristics	• Single-axis • EtherNet/IP • Safe Torque-off Control	• Multi-axis • Common Bus • Modular Design • Safe Speed Monitoring		• Multi-axis • Common Bus • Safe-Off Control	• Multi-axis • Common Bus • Safe-Off Control
Drive Configuration	Single-axis	1…8 axes on Bulletin 2094 power rail		1…8 axes on Bulletin 2094 power rail	Single-axis
Input Voltage	120V/240V/480V	324…528V AC, Three-phase (460V systems)		195…265V AC, Three-phase (230V systems) 324…528V AC, Three-phase (460V systems)	324…528V AC, Three-phase
Common Bus Follower Input Voltage	Not Applicable	458…747V DC (460V systems)		275…375V DC (230V systems) 458…747V DC (460V systems)	450…750V DC
Continuous Output Power (inverter)	0.4…3 kW	1.8…6.6 kW (460V systems)		1.2…11 kW (230V systems) 1.8…22 kW (460V systems)	22…149 kW
Continuous Output Current (inverter)	2…12 A rms	2.8…10.3 A rms (460V systems)		3.7…34.6 A rms (230V systems) 2.8…34.6 A rms (460V systems)	40…248 A rms
Drive Digital Inputs	• Enable, Overtravel ± • High Speed Registration (1) • Configurable (8)	• Enable, Home, Overtravel ± • High Speed Registration (2/axis)			• Enable, Home, Overtravel ± • High Speed Registration (2)
Drive Digital Outputs	• Ready • Configurable (4)	Motor Brake Relay Output (with suppression)			
DPI Connector	Not applicable	Not applicable		• DriveExplorer • HIM	
Programming	• Built-in Web Server • RSLogix 5000 Software (Ladder Diagram, Structured Text, and Sequential Function Charts)	RSLogix 5000 Software (Ladder Diagram, Structured Text, and Sequential Function Charts)			
Logix Module Compatibility	• ControlLogix® and CompactLogix™ EtherNet/IP Adapter Modules	• 1756-EN2F, 1756-EN2T, 1756-EN2TR, 1756-EN3TR	• 1756-M03SE, 1756-M08SE, 1756-M16SE • 1768-M04SE		
I/O Control	EtherNet/IP	EtherNet/IP	Fiber-optic SERCOS	Fiber-optic SERCOS	
Feedback	• High-resolution absolute multi-turn and single-turn encoder • Incremental Encoder • Auxiliary axis for master gearing mode	• High-resolution absolute multi-turn and single-turn encoder • Incremental Encoder • Heidenhain EnDat Encoder • Feedback-only auxiliary axis		• High-resolution absolute multi-turn and single-turn encoder • Incremental encoder • Resolver • Feedback-only auxiliary axis	• High-resolution absolute multi-turn and single-turn encoder • Incremental encoder • Feedback-only auxiliary axis
Rotary Motor Compatibility	• MP-Series (Bulletin MPL/MPF/MPS/MPM) • TL-Series (Bulletin TLY)	• MP-Series (Bulletin MPL/MPF/MPS/MPM) • RDD-Series Direct Drive Motors		• MP-Series (Bulletin MPL/MPF/MPS/MPM) • RDD-Series Direct Drive Motors • TL-Series	• HPK-Series • MP-Series (Bulletin MPL and MPM) • RDD-Series Direct Drive Motors
Linear Motor Compatibility	Not applicable	• LDC-Series		• LDC-Series	Not applicable
Linear Actuator Compatibility	• MP-Series Linear Stages • MP-Series Electric Cylinders • TL-Series Electric Cylinders	• MP-Series Linear Stages • MP-Series Multi-axis Linear Stages • MP-Series Electric Cylinders		• MP-Series Linear Stages • MP-Series Multi-axis Linear Stages • MP-Series Electric Cylinders	Not applicable
Accessory Compatibility	• 2097 Shunt Resistors • 2097 AC Line Filter Modules • 2097 I/O Terminal Block • 2097 Memory Module Programmer	• 2094 Line Interface Modules • 2090 Resistive Brake Modules • 1394 External Shunt Modules • 1336 External Active Shunt Modules (dynamic brake)		• 2094 Line Interface Modules • 2090 Resistive Brake Modules • 1394 External Shunt Modules • 1336 External Active Shunt Modules (dynamic brake)	• 8720MC Regenerative PS • 8720MC Line Reactor • 1336 External Active Shunt • 1336 Brake Chopper Module • 2094 Line Interface Modules

Safety Solutions for Kinetix® Servo Drives

Kinetix 300 Drives

Features

- PLd, Category 3 per ISO 13849-1
- Stop Category 0 per EN 60204-1
- Removable terminals
- Common solution for any power range

Kinetix 300 Specifications

Standards	IEC/EN 60204-1, ISO 13849-1
Category	PLd, Category 3 per ISO 13849-1
Certifications	CE, cUL, and TÜV functional safety
Safety Inputs	Insulated, compatible with single-ended output (+24V DC)
Enable Voltage Range	20…24V DC
Disable Voltage Range	0…1.0V DC
Input Impedance	6.8 k Ω
Safety Status	Isolated Open Collector (Emitter is grounded.)
Output Load Capability	100 mA
Response Time	Less than 1 ms
Recommended Conductor Size Terminal Screw	Stranded Wire with Ferrule: 0.75 mm² (18 AWG) Solid Wire: 1.5 mm² (16 AWG)
Recommended Torque Terminal Screw	0.2 N•m (1.8 lb•in)
Safety Status	Isolated Open Collector (Emitter is grounded.)
User Manual	Kinetix® 300 User Manual, publication 2097-UM001

Description

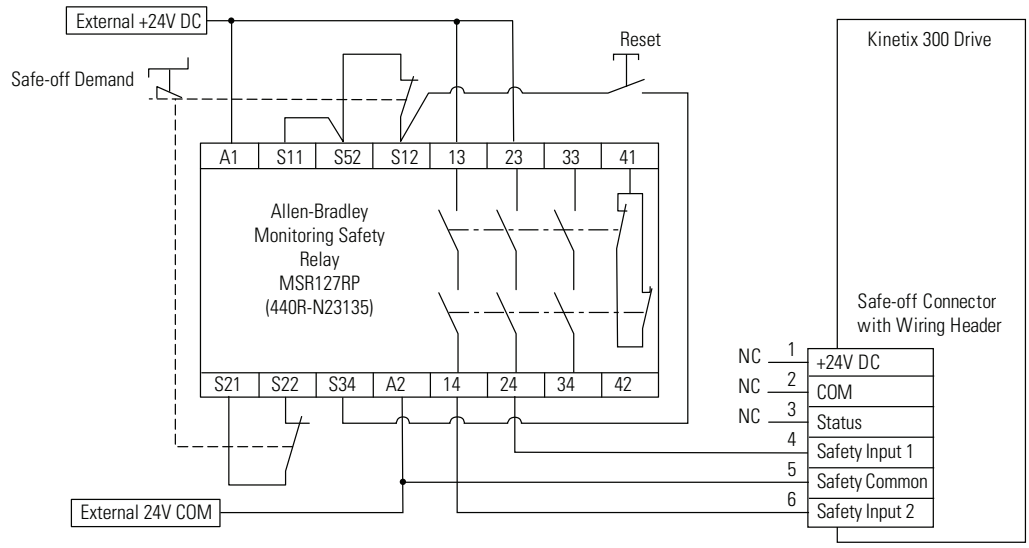
Kinetix® 300 EtherNet/IP Indexing servo drives help protect personnel and increase machine productivity with Safe Torque-off functionality. The Kinetix 300 drive implements solid-state safety circuits for excellent reliability.

Cat. No. 2097-	V31-PR0	V31-PR2	V32-PR0	V32-PR2	V32-PR4	V33-PR1	V33-PR3	V33-PR5	V33-PR6	V34-PR3	V34-PR5	V34-PR6
AC Input Voltage	120/240V rms (1-Phase)		240V rms (1-Phase)			240V rms (1-Phase or 3-Phase)				480V rms (3-Phase)		
AC Input Frequency	48…62 Hz											
Main AC Input Current Nominal (rms)	9.7 A (120V input) 5.0 A (240V input)	16.8 A (120V input) 8.6 A (240V input)	5.0 A	8.6 A	15 A	3.0 A	5.0 A	8.7 A	13.9 A	2.7 A	5.5 A	7.9 A
Back-up Control Power Input	20…26V DC											
Continuous Power Output	400 W	800 W	400 W	800 W	1.7 kW	500 W	1.0 kW	2.0 kW	3.0 kW	1.0 kW	2.0 kW	3.0 kW
Continuous Output Current (rms)	2.0 A	4.0 A	2.0 A	4.0 A	8.0 A	2.0 A	4.0 A	8.0 A	12.0 A	2.0 A	4.0 A	6.0 A
Peak Current (rms) 3 s	6.0 A	12.0 A	6.0 A	12.0 A	24.0 A	6.0 A	12.0 A	24.0 A	36.0 A	6.0 A	12.0 A	18.0 A
Module Size Specifications												
Height (mm)	190.5	190.5	190.5	190.5	190.5	190.5	190.5	190.5	190.5	190.5	190.5	190.5
Width (mm)	68	68.5	68	68.5	86.8	68	68.5	94.4	68	68.5	94.4	68
Depth (mm)	185.1	185.1	229.6	229.6	229.6	185.1	185.1	185.1	229.6	185.1	185.1	229.6

Kinetix 300 Stop Category 0 Configuration

The Kinetix 300 drive is shown with a single-axis relay in a Stop Category 0 configuration.

Kinetix 300 Relay Configuration Stop Category 0



Accessories

Safe-off Headers for Kinetix 300 Drives

Description	Cat. No.
Spare Connector Header Set	2097-CONN1

Safety Solutions for Kinetix® Servo Drives

Kinetix 6200 and Kinetix 6500 Drives

Kinetix 6200

Kinetix 6500

Safe Speed Servo Drives

Description

Kinetix® 6200 and Kinetix® 6500 servo drives have safety features that help improve machine operating efficiencies by providing safer access to guarded areas while a machine or process continues operation under limited conditions. Leveraging the proven performance of the Kinetix 6000 family, these drives include features such as safe stop, zero speed monitoring, safe direction monitoring, and safe maximum acceleration monitoring. Control modules couple with IAM and AM power modules to provide drive status indicators and an interface to I/O, communication, safety functionality, and feedback.

The Kinetix 6200 features a SERCOS interface, while the Kinetix 6500 provides EtherNet/IP network connectivity. Both drives offer Safe Torque-off or Safe Speed Monitoring options.

Features

- TÜV-certified up to and including SIL3 per IEC 61508 and PLe per ISO 13849-1
- Reduce panel space and eliminate wiring between external safety monitor and the drive because of the drive's embedded safety
- Interchangeable control modules let you easily transform from Safe-off to Safe Speed functionality or from SERCOS interface™ to EtherNet/IP networking
- Embedded, dual-channel monitoring capability
- Includes automatic, manual, or manual monitored reset
- Supports cascaded system via solid state safety outputs
- Uses the same Allen-Bradley motors and actuators as the Kinetix 6000, including the MP-series low inertia, medium inertia, stainless steel and food grade motors, RDD-series direct drive motors, LDC-series linear motors, MP-series linear stages, MP-series electric cylinders

Kinetix 6200 and Kinetix 6500 Specifications

Standards	IEC/EN 60204-1, ISO12100, IEC 61508, IEC 61800-5-2
Category	PLe and Cat. 4 per EN ISO 13849-1
Safety Integrity Level	SIL3 per IEC 61508 and EN62061
Certifications	C-Tick, CE, cUL, and TÜV functional safety
Safety Inputs	5
PFd(t) for 20-year interval	Single-encoder configuration: 10.3E-04 Dual-encoder configuration: 4.15E-04
PFh(t) for 20-year interval	Single-encoder configuration: 5.88E-09 Dual-encoder configuration: 2.37E-09
Overspeed Response Time	user-configurable
Recommended Conductor Size Terminal Screw	0.25…0.75 mm² (24…18 AWG)
Recommended Torque Terminal Screw	0.22…0.25 N•m (1.9…2.0 lb•in)
Safety Reference Manual	• Kinetix 6200 and Kinetix 6500 Safe Speed Monitoring Safety Reference Manual, Publication 2094-RM001 • Kinetix 6200 and Kinetix 6500 Safe Torque-off Safety Reference Manual, Publication 2094-RM002

Kinetix 6200 and Kinetix 6500 IAM Power Module (460V) Specifications

IAM Power Module	2094-BC01-MP5-M	2094-BC01-M01-M	2094-BC02-M02-M
AC Input Voltage	324…528V rms 3-Phase (360…480 nom)		
AC Input Frequency	47…63 Hz		
Main AC Input Current Nominal (rms)	10 A	10 A	24 A
DC Input Voltage (Common Bus follower)	458…747V DC		
DC Input Current (Common Bus follower)	9 A	9 A	22.6 A
Control Power AC Input Voltage	95…264V rms single-phase (230V nominal)		
Continuous Output Current to Bus (Adc)	9 A	9 A	22.6 A
Intermittent Output Current to Bus (Adc)	20 A	20 A	38 A
Continuous Power Output to Bus (nominal)	6 kW	6 kW	15 kW
Module Size Specifications			
Height (mm)	290	290	290
Width (mm)	125	125	125
Depth (mm)	290	290	290

Kinetix 6200 and Kinetix 6500 AM Power Module (460V) Specifications

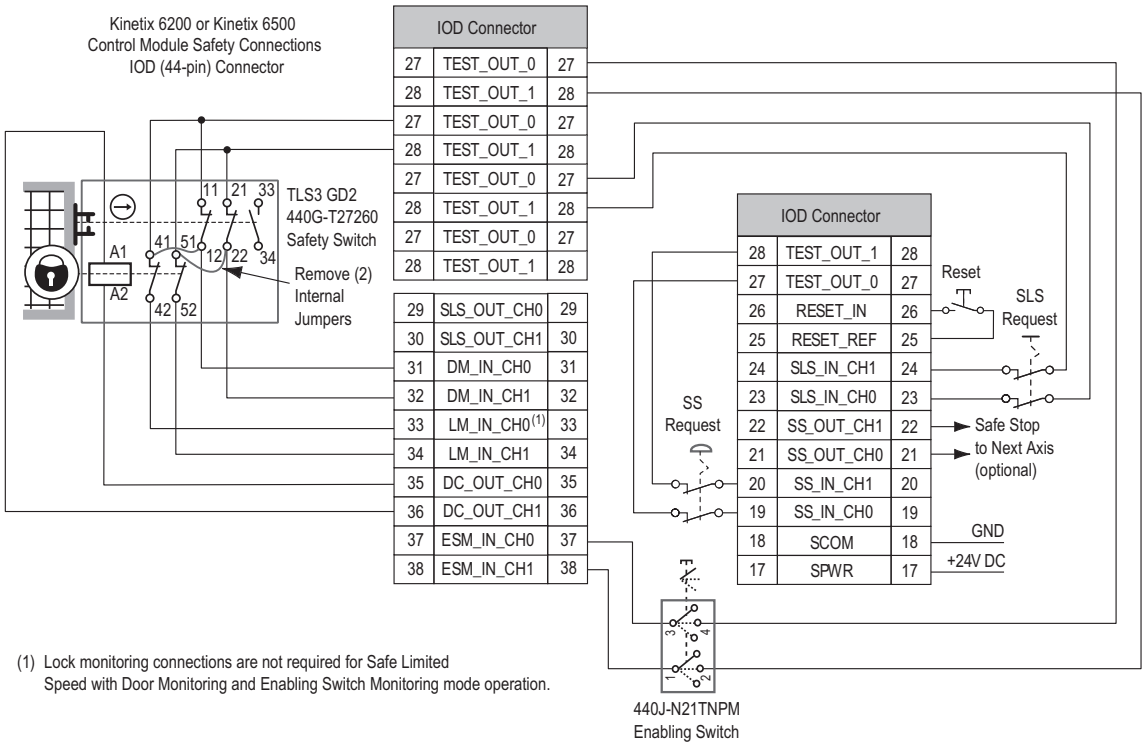
AM Power Modules	2094-BMP5-M (2094-BC01-MP5-M)	2094-BM01-M (2094-BC01-M01-M)	2094-BM02-M (2094-BC02-M02-M)
Continuous Output Current (rms)	2.8 A	6.1 A	10.3 A
Continuous Output Current (0-peak)	4.0 A	8.6 A	14.6 A
Peak Output Current (rms)	7.0 A	15.3 A	25.8 A
Peak Output Current (0-peak)	9.9 A	21.6 A	36.4 A
Maximum Seconds at Peak			
Continuous Power Output (nominal)	1.8 kW	3.9 kW	6.6 kW
Module Size Specifications			
Height (mm)	290	290	290
Width AM (mm)	70	70	70
Depth (mm)	290	290	290

Kinetix 6200 and Kinetix 6500 Control Module Specifications

Cat. No.	2094-SE02F-M00-S1	2094-SE02F-M00-S0	2094-EN02D-M01-S1	2094-EN02D-M01-S0
Drive Family	Kinetix 6200		Kinetix 6500	
Control/Communication	SERCOS interface		EtherNet/IP networking	
Safety Features	Safe Speed Monitoring	Safe Torque-off	Safe Speed Monitoring	Safe Torque-off
Connectors	• IOD connector for I/O, safety, and auxiliary feedback • MF connector for motor feedback			

Kinetix 6200 Safe Limited Speed with Door Monitoring and Enabling Switch Monitoring Configuration

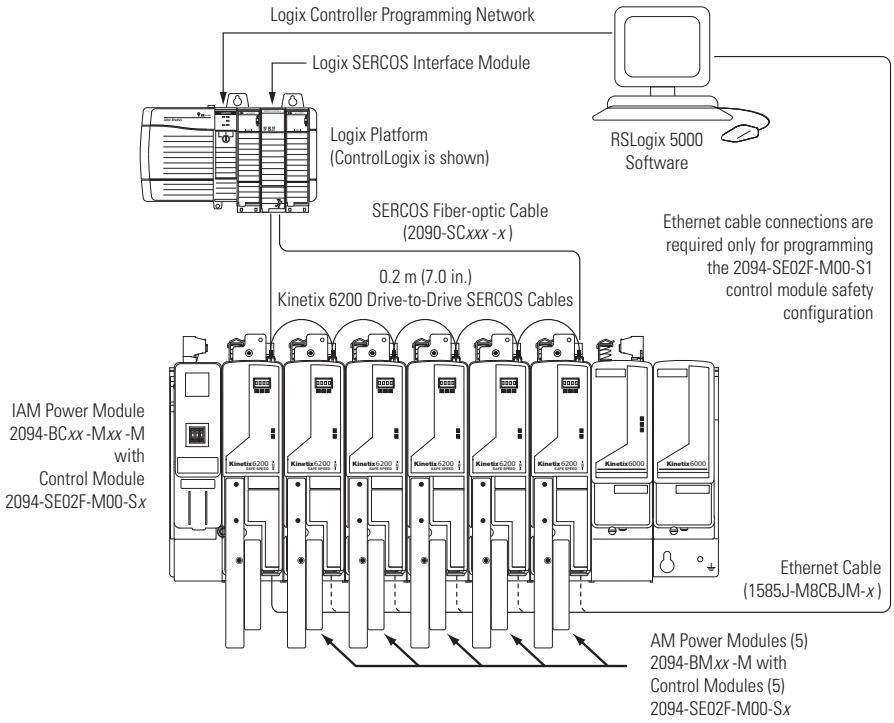
The Kinetix 6200 drive is shown wired for Safe Limited Speed with Door Monitoring and Enabling Switch Monitoring, one of 11 user-selectable operating modes, based on combinations of available safety functions. The proper configuration of this speed monitoring mode in RSLogix™ 5000 software is required.



(1) Lock monitoring connections are not required for Safe Limited Speed with Door Monitoring and Enabling Switch Monitoring mode operation.

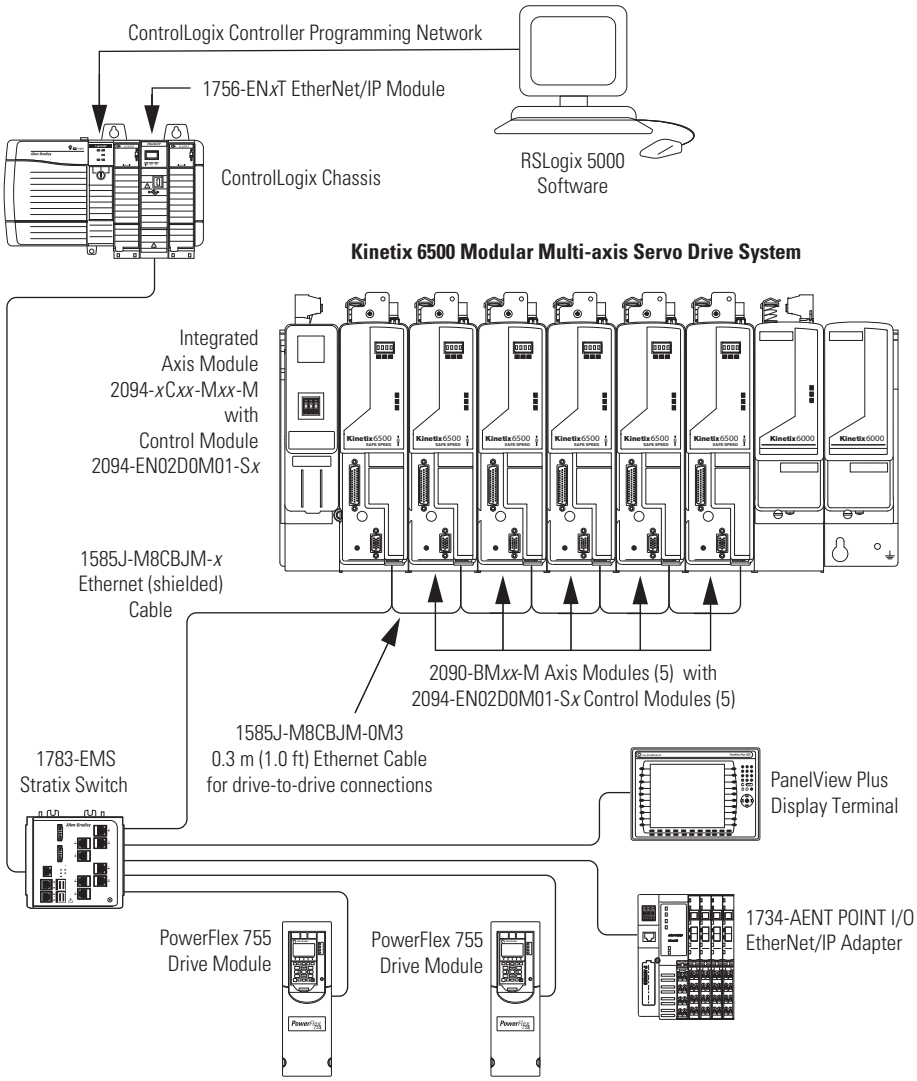
Kinetix 6200 Communication Configuration (SERCOS)

This Kinetix 6200 drive configuration uses the SERCOS interface for configuring the Logix module and Ethernet for diagnostics and configuring safety functions.



Kinetix 6500 Star Communication Configuration (EtherNet/IP)

In this Kinetix 6500 drive configuration, the devices are connected using star topology. Each device is connected directly to the switch, making this topology fault tolerant. The 2094 power rail modules and other devices operate independently. The loss of one device does not impact the operation of the other devices.



Accessories

Drive-to-drive SERCOS Cables for Kinetix 6200 Drives

From this drive	To this drive	Cat. No.
2094-BCxx-Mxx-M or 2094-BMxx-M	2094-BMxx-M	2090-SCEPO-2
2094-BCxx-Mxx-M or 2094-BMxx-M	2094-BMxx-S	2090-SCEPO-1
2094-BCxx-Mxx-S or 2094-BMxx-S	2094-BMxx-S	2090-SCEPO-1
2094-BCxx-Mxx-S or 2094-BMxx-S	2094-BMxx-M	2090-SCEPO-2

For I/O, Safety, Motor Feedback, and Auxiliary Feedback connections on Kinetix 6200 and Kinetix 6500 Safe Speed drives, use the 44-pin Low-profile Connector Kit, catalog number 2090-K6CK-D44M.

A 1585J-M8CBJM-x (shielded) Ethernet cable is required for programming and safety configuration of the Kinetix 6200 and Kinetix 6500 drive via RSLogix 5000 software.

Safety Solutions for Kinetix® Servo Drives

Kinetix 6000 and Kinetix 7000 Drives

Kinetix 6000

Kinetix 7000

Description

The Kinetix® 6000 multi-axis servo drive provides power simplicity to handle even the most demanding applications quickly, easily, and cost-effectively. The compact size, simplified wiring, easy-to-use components, and integrated Safe-off capability make Kinetix 6000 drives an ideal choice for both OEMs and end-users.

The Kinetix® 7000 high power servo drive is designed to accommodate the most demanding requirements and extends the benefits of Kinetix Integrated Motion, and Safe-off capability to applications up to 149 kW. The Kinetix 7000 high power drive supports three-phase AC input power (380…480V AC) and DC input for common bus applications.

Features

- Category 3 per EN 954-1
- SIL3 per IEC 61508
- Stop Category 0 per EN 60204-1
- Stop Category 1 per EN 60204-1 (requires safety relay with time delay outputs)
- Two positive-guided, mechanically linked safety auxiliary contacts for monitoring
- Removable terminals
- Common solution for any power range

Kinetix 6000 and Kinetix 7000 Specifications

Standards	EN 954-1, EN ISO 13849-2, EN 60204-1, EN 50178, EN 61800-3, IEC 61508
Category	PLe and Cat. 3 per EN ISO 13849-1
Safety Integrity Level	SIL3 per IEC 61508
Certifications	C-Tick, CE, cUL, and TÜV functional safety
Safety Inputs	Two N.C.
PFd(t) for 20-year interval	4.75E-07
PFh(t) for 20-year interval	5.43E-12
Coil Pull-in Voltage	24V DC (Nom.), 18V DC (Min.), 26.4V DC (Max.)
Coil Drop-out Voltage	0V DC (Min.), 2.4V DC (Max.)
Coil Resistance	720 Ω (Nom.), 648 Ω (Min.), 792 Ω (Max.)
Coil Current	33.3 mA (Nom.), 55.0 mA (Max.)
Coil Pull-in Time:	25 ms
Coil Drop-out Time:	20 ms
Response Time	25 ms
Recommended Conductor Size Terminal Screw	Stranded Wire with Ferrule: 0.75 mm² (18 AWG) Solid Wire 1.5 mm² (16 AWG)
Recommended Torque Terminal Screw	0.235 N•m (2.0 lb•in)
Mechanical Life	10,000,000 operations
Safety Reference Manual	Publication GMC-RM002

Kinetix 6000 (230V Models) with GuardMotion Specifications

IAM Converters (2094-)	AC05-MP5-S	AC05-M01-S	AC09-M02-S	AC16-M03-S	AC32-M05-S
AC Input Voltage	195…264V rms 3-Phase				
AC Input Frequency	47…63 Hz				
Main AC Input Current Nominal (rms)	10 A	10 A	19 A	36 A	71 A
DC Input Voltage (Common Bus follower)	275…375V DC				
DC Input Current (Common Bus follower)	10 A	10 A	19 A	36 A	71 A
Control Power AC Input Voltage	95…264V rms Single-Phase (115/230V nominal)				
Continuous Output Current to Bus (Adc)	10 A	10 A	19 A	36 A	71 A
Intermittent Output Current to Bus (Adc)	20 A	20 A	38 A	72 A	142 A
Continuous Power Output to Bus (nominal)	3 kW	3 kW	6 kW	11.3 kW	22.5 kW
IAM and AM Inverters (2094-)	**AC05-MP5-S and AMP5-S**	**AC05-M01-S and AM01-S**	**AC09-M02-S and AM02-S**	**AC16-M03-S and AM03-S**	**AC32-M05-S and AM05-S**
Continuous Output Current (rms)	3.7 A	6.0 A	10.6 A	17.3 A	34.6 A
Continuous Output Current (0-peak)	5.2 A	8.5 A	15 A	24.5 A	48.9 A
Peak Output Current (rms)	7.4 A	12.0 A	21.2 A	34.6 A	51.9 A
Peak Output Current (0-peak)	10.5 A	17.0 A	30.0 A	48.9 A	73.4 A
Maximum Seconds at Peak	2.5	2.5	2.5	2.5	2.5
Continuous Power Output (nominal)	1.2 kW	1.9 kW	3.4 kW	5.5 kW	11 kW
Module Size Specifications					
Height (mm)	200	200	200	300	300
Width AM (mm)	70	70	70	70	70
Width IAM (mm)	125	125	125	125	195
Depth (mm)	195	195	195	195	195

Kinetix 6000 (460V Models) with GuardMotion Specifications

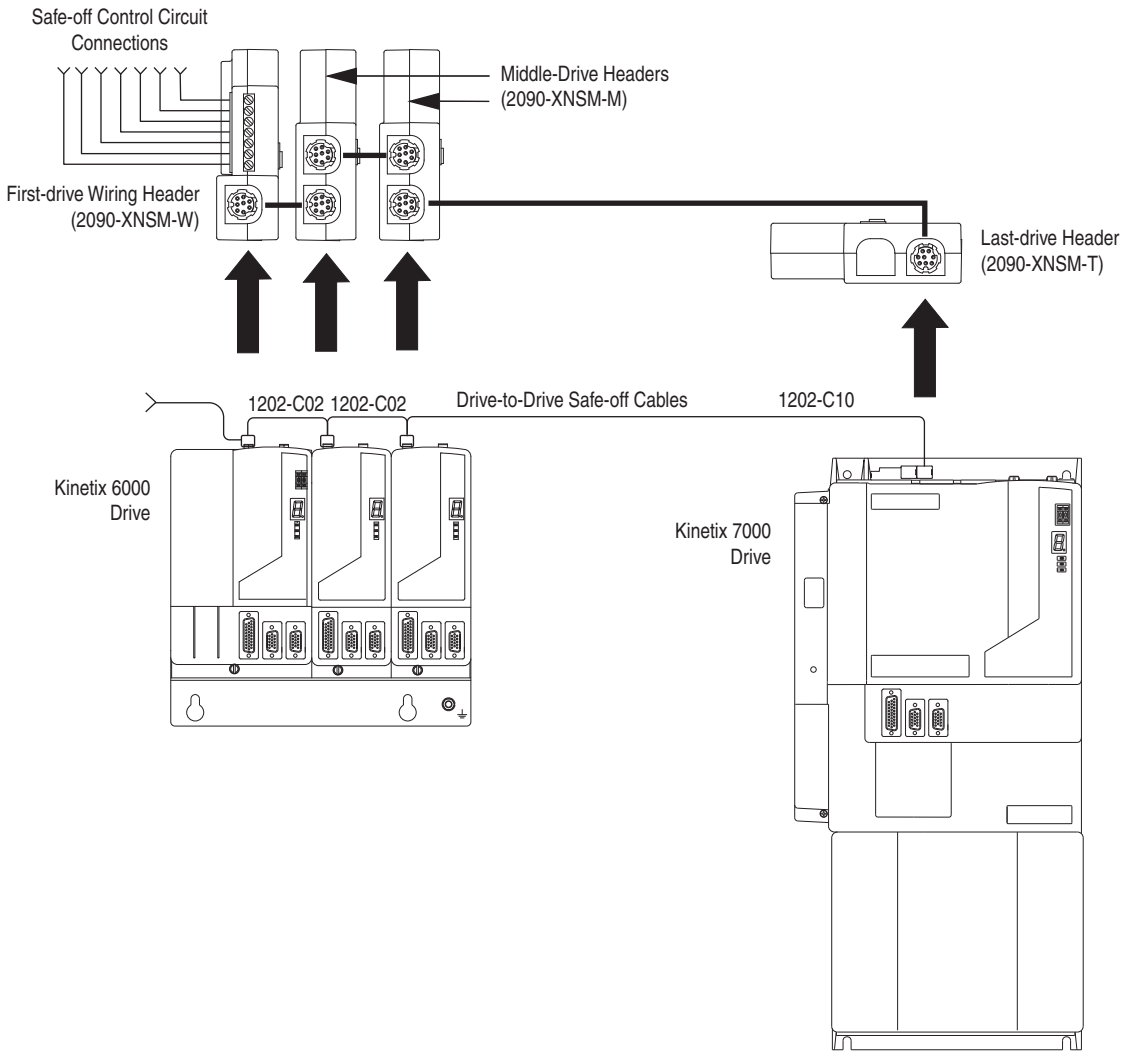
IAM Converters (2094-)	BC01-MP5-S	BC01-M01-S	BC02-M02-S	BC04-M03-S	BC07-M05-S
AC Input Voltage	324-528V rms 3-Phase				
AC Input Frequency	47…63 Hz				
Main AC Input Current Nominal (rms)	10 A	10 A	24 A	44 A	71 A
DC Input Voltage (Common Bus follower)	458…747V DC				
DC Input Current (Common Bus follower)	10 A	10 A	24 A	43 A	71 A
Control Power AC Input Voltage	95…264V rms Single-Phase (115/230V nominal)				
Continuous Output Current to Bus (Adc)	10 A	10 A	24 A	43 A	71 A
Intermittent Output Current to Bus (Adc)	20 A	20 A	48 A	86 A	142 A
Continuous Power Output to Bus (nominal)	6 kW	6 kW	15 kW	27.6 kW	45 kW
IAM and AM Inverters (2094-)	**BC01-MP5-S and BMP5-S**	**BC01-M01-S and BM01-S**	**BC02-M02-S and BM02-S**	**BC04-M03-S and BM03-S**	**BC07-M05-S and BM05-S**
Continuous Output Current (rms)	2.8 A	6.1 A	10.3 A	21.2 A	34.6 A
Continuous Output Current (0-peak)	4.0 A	8.6 A	14.6 A	30.0 A	48.9 A
Peak Output Current (rms)					
Series A	4.2 A	9.2 A	15.5 A	31.8 A	51.9 A
Series B	7.0 A	15.3 A	25.8 A	31.8 A	51.9 A
Peak Output Current (0-peak)					
Series A	5.9 A	12.9 A	21.8 A	45.0 A	73.4 A
Series B	9.9 A	21.6 A	36.4 A	45.0 A	73.4 A
Maximum Seconds at Peak	2.5	2.5	2.5	2.5	2.5
Continuous Power Output (nominal)	1.8 kW	3.9 kW	6.6 kW	13.5 kW	22 kW
Module Size Specifications					
Height (mm)	250	250	250	250	310
Width AM (mm)	70	70	70	140	140
Width IAM (mm)	125	125	125	195	195
Depth (mm)	260	260	260	260	260

Kinetix 7000 Specifications

2099-	BM06-S	BM07-S	BM08-S	BM09-S	BM10-S	BM11-S	BM12-S
AC Input Voltage @ 47…63 Hz	380…480V AC +/- 10%						
AC Input Frequency	47…63 Hz						
DC Input Voltage	450…750V DC						
Main AC Input Current (rms)	36.7 A	47.7 A	59.6 A	90.1 A	117 A	169 A	233 A
DC Input Current	42.9 A	55.7 A	69.7 A	105 A	137 A	204 A	281 A
Control Power Input	18…30V DC						
Continuous Power Output	22 kW	30 kW	37 kW	56 kW	75 kW	112 kW	149 kW
Continuous Power Output	30 Hp	40 Hp	50 Hp	75 Hp	100 Hp	150 Hp	200 Hp
Continuous Output Current (rms)	40 A	52 A	65 A	96 A	125 A	180 A	248 A
Continuous Output Current (0-peak)	56 A	73 A	92 A	135 A	176 A	254 A	351 A
Peak Current (rms) 60 s	51 A	60 A	78 A	115 A	138 A	234 A	273 A
Peak Current (0-peak) 60 s	72 A	84.8 A	110 A	162.6 A	195 A	331 A	386 A
Peak Current (rms) 3 s	68 A	80 A	104 A	154 A	163 A	312 A	372 A
Peak Current (0-peak) 3 s	96 A	113 A	147 A	217.7 A	230.5 A	441 A	526 A
Drive Height (mm)	517.5	517.5	517.5	644.5	690.3	977.1	977.1
Drive Depth (mm)	224	224	224	287	287	283	283
Drive Width (mm)	254	254	254	332	332	429	429

Safe-off Multi-Axis Configuration

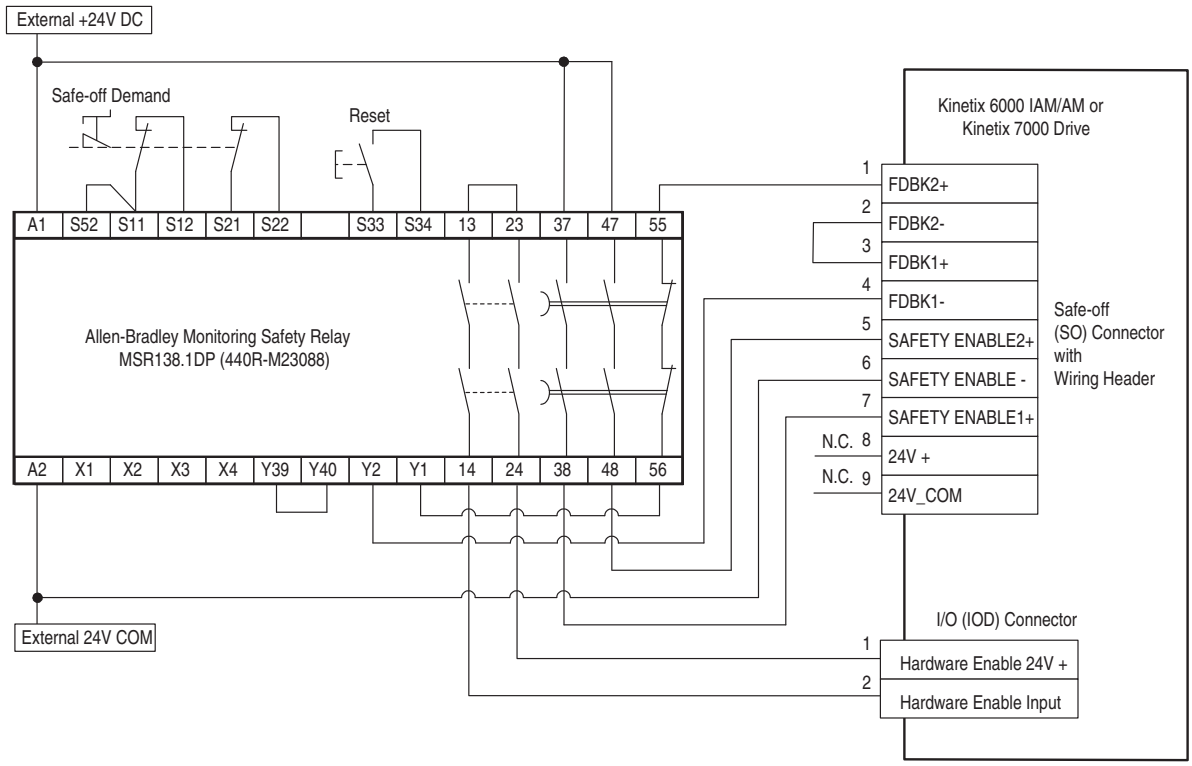
Kinetix 6000 to Kinetix 7000 Safe-off Multi-Axis Configuration



Stop Category 1 Configuration (Kinetix 6000 or Kinetix 7000)

Single-Axis Relay Configuration

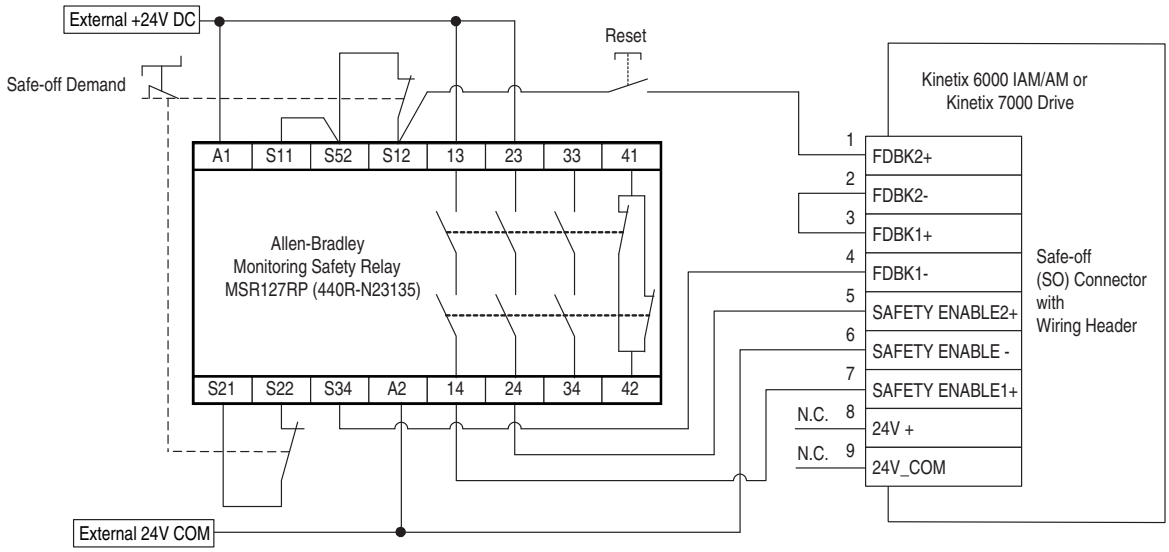
The Kinetix 6000 or Kinetix 7000 drive Safe-off connector is wired to an Allen-Bradley safety relay. The proper configuration in RSLogix™ 5000 software is required.



Stop Category 0 Configuration (Kinetix 6000 or Kinetix 7000)

Single-Axis Relay Configuration

The Kinetix 6000 or Kinetix 7000 drive Safe-off connector is wired to an Allen-Bradley safety relay.



You can use an Allen-Bradley GuardPLC™ or GuardLogix® controller instead of the safety relay to provide the safety logic for more complex safety systems.

Accessories

Safe-off Headers for Kinetix 6000 or Kinetix 7000 Drives

Description	Cat. No.
Safe-off wiring header for the first drive in multiple safety drive configurations (optional)	2090-XNSM-W
Safe-off middle header for the first drive-to-drive connections in multiple safety drive configurations with three or more drives (optional)	2090-XNSM-M
Safe-off terminating header for the last in multiple safety drive configurations (optional)	2090-XNSM-T

Safe-off Interface Cables for Kinetix 6000 or Kinetix 7000 Drives

Safe-off interface cables are required for making connections with 2090-XNSM-W, -M, and -T headers.

Description	Cat. No.
Drive-to-drive safety cable, 200 mm (7.9 in.), for connecting single-wide Kinetix 6000 modules.	1202-C02
Drive-to-drive safety cable, 350 mm (13.8 in.), for connecting double-wide Kinetix 6000 modules.	1202-C03
Drive-to-drive safety cable, 1050 mm (41.3 in.), for connections. • between Kinetix 6000 power rail and Kinetix 7000 drive. • between two Kinetix 6000 power rails. • between two Kinetix 7000 drives.	1202-C10

Because of the current capacity limitation of the Safe-off cable connectors, multiple Safe-off drive configurations must not exceed eight Kinetix 6000 or Kinetix 7000 drive modules.

The Allen-Bradley CENTERLINE ArcShield arc-resistant controller provides rugged process control for applications requiring a higher level of personnel protection. ArcShield products are compliant to the IEEE C37.20.7 standard, and provide Type 2 protection during an arc flash.

The ArcShield controller safely redirects the arc flash energy out the top of the unit and away from personnel. This level of protection is also maintained when the low voltage door is open for maintenance purposes.

The ArcShield products have a robust enclosure design which contain the arc flash energy and exhaust materials until vents on top of the enclosure open. Once opened, the vents provide a path for materials to exit the enclosure. An overhead plenum is used to direct the materials to a safe location, away from personnel near the equipment. The low voltage panel is reinforced and sealed, to prevent arc flash exhaust materials from entering this compartment.

As standard, a plenum exhaust section is provided with each new ArcShield order. The plenum exhaust section can be mounted on either the left or right end of the line-up, and it extends 1016 mm (40 in.) past the end of the line-up.

As the ArcShield may have an impact on horsepower ratings, please contact your local Rockwell Automation sales office or Allen-Bradley distributor to confirm.

Features

- Reinforced cabinet and power cell door closure mechanism
- Multi-point latching mechanism, reinforced cross bracing and gasket sealing
- Reinforced back plates — added support plates secured with multiple bolts increase rigidity and security
- Reinforced low voltage panel to withstand arc flash energy and shield maintenance personnel while working in the isolated low voltage compartment
- Arc “Pressure Relief” vent to direct gases and material away from personnel during an arc flash
- Available with removable arc exhaust plenum

ArcShield Controller Specifications

Bulletin Number	Controller Size	Approximate Mounting Dimensions [mm (in.)]			Approx. Weight [kg (lb)]
		Width	Depth ♣	Height	
1512A	200/400/450 ✶	660 (26)/ 914 (36)	914 (36)	3264 (128.5)	627 (1380)/ 860 (1900)
	200/400/450 ❄	1118 (44)	914 (36)	3264 (128.5)	1107 (2435)
	600 ✶	914 (36)	914 (36)	3264 (128.5)	773 (1700)
	600 ❄	1372 (54)	914 (36)	3264 (128.5)	1250 (2750)
	800	1575 (62)	914 (36)	3264 (128.5)	907 (2000)
1512AT	200/400/450 ✶	660 (26)/	914 (36)	3264 (128.5)	627 (1380)/ 773 (1700)
	600 ✶	914 (36)	914 (36)	3264 (128.5)	773 (1700)
	800 ✶	1575 (62)	914 (36)	3264 (128.5)	907 (2000)
1512B	200/400 ✶	914 (36)	914 (36)	3264 (128.5)	1050 (2310)
	200/400 ❄	1372 (54)	914 (36)	3264 (128.5)	1530 (3365)
1512BT	200/400 ✶	914 (36)	914 (36)	3264 (128.5)	1050 (2310)
1562E	200/400 ✶	914 (36)	914 (36)	3264 (128.5)	886 (1950)
	200/400 ❄	1372 (54)	914 (36)	3264 (128.5)	1364 (3000)
1591A	457 (18) ‡	457 (18)	914 (36)	2311 (91)	432 (950)
	457 (18) §	457 (18)	914 (36)	3264 (128.5)	464 (1020)
	914 (36) ✶	914 (36)	914 (36)	3264 (128.5)	732 (1610)
	914 (36) §	914 (36)	914 (36)	3264 (128.5)	732 (1610)

✶ Arc resistant with plenum.
❄ Arc resistant with plenum, plus PFCC option.
‡ Arc resistant without plenum.
§ Arc resistant with plenum c/w low voltage panel.
♣ Overhead arc plenums are 1168 mm (460 in.), mounted on top and flush to the rear of the structures.

Medium Voltage Arc Resistant Motor Control Center Specifications

		CENTERLINE 1500 Motor Control Center with ArcShield	CENTERLINE 1500 Motor Control Center with IntelliCENTER Technology and ArcShield
General	Enclosure Types Available	Arc Resistant NEMA/UL Type 12	Arc Resistant NEMA/UL Type 12
	Section Height	2300 mm (91 in.) plus Plenum	2300 mm (91 in.) plus Plenum
	Section Width	660, 914, 1372, 1575, 2032, 2540 mm (26, 36, 54, 62, 80, 100 in.)	660, 914, 1372, 1575, 2032, 2540 mm (26, 36, 54, 62, 80, 100 in.)
	Section Depth	914 mm (36 in.)	914 mm (36 in.)
	Horizontal Bus Current Rating	1200, 2000, or 3000 A	1200, 2000, or 3000 A
	Vertical Bus Current Rating	400, 600, or 800 A	400, 600, or 800 A
	Bus Short Circuit Rating	60 kA RMS SYM	60 kA RMS SYM
MCC Units Available	ArcShield Controllers	Yes	Yes
	Full Voltage Non-reversing Starters	Yes	Yes
	Full Voltage Reversing Starters	Yes	Yes
	Starters for 2-Speed Motors	Yes	Yes
	Electronic Soft Starters	Yes	Yes
	Variable Speed Drives	N/A	N/A
	Power Monitoring Equipment	Yes	Yes
	PLC and Controller Units	Yes	Yes
	Transformer Units	Yes	Yes
Intelligent Motor Control Features	Built-in Network Media	No	Yes
	IntelliCENTER Software	No	Yes, preconfigured software with: • Elevation View • Monitor View • Event Logger • Electronic System Documentation • ActiveX Objects for HMI use
Preconfigured Network	Pre-Tested Network Connections	No	Yes
	Rich Data	No	Yes
	Advanced Diagnostics	No	Yes
	Network Interfaces	No	• DeviceNet™ • Ethernet • ControlNet™ • PROFIBUS • Modbus Plus™
	Remote Access Motor Control Data	No	Yes

CENTERLINE 2100 Motor Control Centers with ArcShield

Reduce your risk of arc flash injury through the use of the industry leading arc containment design, which has been tested to meet the arc resistant standards for medium voltage equipment, IEEE C37.20.7: IEEE Guide for Testing Medium-Voltage Metal- Enclosed Switchgear for Internal Arcing Faults.

ArcShield enhances the CENTERLINE 2100 Motor Control Center (MCC) and is the first low voltage MCC to offer arc-containing features. ArcShield helps provide you with Type 2 accessibility and improves protection for your personnel against internal arcing faults. With Type 2 accessibility, personnel are shielded at the front, rear and sides of the enclosure in the unlikely event of an arcing fault.

Arc resistant baffles for the CENTERLINE 2100 MCCs with ArcShield allow you to have an arc resistant MCC with a wider range of MCC units, even units that require venting, such as variable frequency drives (VFDs). Arc resistant baffles allow air flow to help dissipate the heat and still provide Type 2 accessibility.

CENTERLINE 2100 MCCs with ArcShield are available on the quick delivery program; allowing your order to go directly to the factory and ship in as little as four weeks.

Contain Arc Flashes

Arc-containment door latches help deliver an extra level of protection by allowing pressure relief and keeping the doors from detaching from the structure. Manual or automatic shutters and insulated bus covers help reduce fault propagation within your MCC. The lower horizontal bus ratings and incoming protection sized for your MCC, help reduce the amount of arc flash energy in your application. By containing an arc flash, your potential exposure to hazardous conditions can be reduced.

Reduce Electrical Shock Hazards

CENTERLINE 2100 MCCs are designed to enhance safe operation by helping isolate you from potentially hazardous voltages by providing a solid grounding system and helping minimize potential electrical shock hazards. Additional options such as IntelliCENTER® software, DeviceNet™ ports, blown fuse indicators, exterior windows on unit doors, infrared inspection ports and finger-safe component barriers can help you create a safer working environment by reducing your potential to make contact with energized components.

CENTERLINE 2500 Motor Control Centers with ArcShield

The CENTERLINE 2500 MCC is designed to meet the needs of your global facilities operating in Latin America, Asia, Europe and other areas of the world where motor control centers must meet IEC standards. With more intelligent components and more options than other MCC manufacturers, you get a total power, control and information solution packaged for your local specifications, built on a common platform.

CENTERLINE 2500 MCCs with ArcShield offers you better protection against harmful arc flash hazards. Using a CENTERLINE 2500 MCC with ArcShield helps protect your personnel if an arc flash were to occur within an MCC.

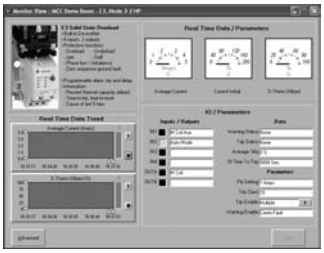
CENTERLINE 2500 MCC with ArcShield provides personnel and assembly protection per IEC/TR 61641:2008 for arcing durations up to 300 ms (available for systems at 415V (max), with 65 kA (max) available current).

In combination with the standard safety features built into every CENTERLINE 2500 MCC, choosing ArcShield provides additional benefits, including:

- Enclosures with no front ventilation
- Pressure relief system designed to exhaust gases through the top of the enclosure, away from personnel
- Arc containment latches on all doors capable of withstanding the high internal pressure generated by an arc blast
- Insulated power bus closing plates included at the ends of each MCC lineup
- For even more protection, optical and current sensing technology for use with crowbar or shunt trip devices is available as an option.

IntelliCENTER Technology

Minimize Entry into Arc Flash Boundary



IntelliCENTER technology helps enhance personnel safety

- Advanced diagnostics of IntelliCENTER software provide remote access to your MCC data for troubleshooting, minimizing your need for entry in the arc flash boundary zone
- With the ability to remotely monitor MCC, you can perform many routine maintenance tasks without "suiting up," reducing personnel exposure to hazardous energy levels
- IntelliCENTER Software can warn of failures before they occur – increasing your ability to respond proactively before a hazardous situation occurs

Low Voltage Arc Resistant Motor Control Center Specifications

		CENTERLINE 2100 Motor Control Center with ArcShield		CENTERLINE 2500 Motor Control Center with ArcShield
General	Enclosure Types	NEMA 1, 1G, 3R, 4, 12		IP 20, 40, 42, 54
	Section Height	2286 mm (90 in.)		2300 mm (91 in.)
	Section Width (for plug-in units)	508 mm (20 in.) - 635 mm (25 in.) available with 229 mm (9 in.) wireway		700, 800, 900 or 1000 mm (28, 32, 36, or 40 in.)
	Section Load Capacity	600 or 1200 A		600 or 1200 A
	Arc Resistant Rating	**Device Limited**	**Arc Duration 100 ms or less**	N/A
	Rated Voltage	600V	480V	up to 690V
	Horizontal Bus Current Rating	600…1200 A	600…3000 A	800…3200 A
	Section Depth (for plug-in units)	381 or 508 mm (15 or 20 in.)	508 mm (20 in.)	600 or 800 mm (24 or 32 in.)
	Short Circuit Withstand Rating	42000 or 65000 A rms symmetrical		Up to 65000 A rms symmetrical
Available Equipment for MCC Units	Full Voltage Non-reversing Starters	Yes		Yes
	Full Voltage Reversing Starters	Yes		Yes
	Starters for 2-speed motors	Yes		Yes
	Soft Starters	Yes		Yes
	Variable Frequency Drives	Yes		Yes
	Mains and Feeders	Yes		Yes
	PLC & Controller Units	Yes		Yes
	Lighting Panels	Yes		Yes
	Transformer Units	Yes		Yes
IntelliCENTER Technology	Built-in Network	Yes, DeviceNet™ Class 1, 600V, 8 A		Yes, DeviceNet Class 1, 600V, 8 A
	Network Interfaces	• EtherNet/IP • ControlNet™ • PROFIBUS • Modbus Plus™		• EtherNet/IP • ControlNet • PROFIBUS • Modbus Plus
	Preconfigured Network	Yes		Yes
	Pre-tested Network Connections	Yes		Yes
	Advanced Diagnostics	Yes		Yes
	IntelliCENTER Software	Preconfigured Software with • Elevation View • Monitor View • Event Log • Electronic System Documentation • ActiveX Objects for HMI Use		Preconfigured Software with • Elevation View • Monitor View • Event Log • Electronic System Documentation • ActiveX Objects for HMI Use
	Remote Access to Motor Control Data	Yes		Yes
	Detailed Device Information	Yes		Yes

Bulletin 100S/104S Safety Contactors

Bulletin 100S-C/104S-C safety contactors provide mechanically linked positively guided contacts, required in feedback circuits of modern safety applications. The mechanically linked N.C. auxiliary contacts will not change state when a power pole welds. In addition, the gold-plated bifurcated auxiliary contacts are ideally suited for low-energy applications or feedback control circuits with multiple series-connected N.C. auxiliary contacts.

- Mechanically linked N.C. auxiliary contacts
- Front-mounted auxiliary contacts:
  Gold bifurcated
  Permanently fixed
  Protective cover to prevent manual operation
  Red contact housing foreasy identification
  Incorporates IEC 60947-5-1 “Mechanically Linked” or IEC 60947-4-1 "Mirror Contact" symbol
- AC and DC operating coils
- SUVA Third-Party certification

Standards Compliance

EN50205
CSA C22.2 No. 14
UL 508
EN/IEC 60947-4
IEC 60947-4-1 Annex H — Mirror Contacts
IEC 60947-5-1 Annex L — Mechanically Linked Contacts

Certifications

SUVA Third-Party Certified
CE Marked
cULus Listed (File No. E3125;
Guide NLDX, NLDX7)

Your order must include: cat. no. of the contactor specified with coil voltage code and, if required, cat. no. of any accessories and/or replacement coils.

3-Pole AC- and DC-Operated Contactors

I_e [A]		Ratings for Switching AC Motors — AC-2, AC-3, AC-4										Aux. Contacts		Cat. No.✶❄
		3-Phase kW (50 Hz)				Hp (60 Hz)								
						1-Phase		3-Phase						
AC-3	AC-1	230V	400V/ 415V	500V	690V	115V	230V	200V	230V	460V	575V	N.O.	N.C.	
9	32	3	4	4	4	1/2	1-1/2	2	2	5	7-1/2	0	5	100S-C09⊗05BC
												1	4	100S-C09⊗14BC
12	32	4	5.5	5.5	5.5	1/2	2	3	3	7-1/2	10	0	5	100S-C12⊗05BC
												1	4	100S-C12⊗14BC
16	32	5.5	7.5	7.5	7.5	1	3	5	5	10	15	0	5	100S-C16⊗05BC
												1	4	100S-C16⊗14BC
23	32	7.5	11	13	10	2	3	5	7-1/2	15	15	0	5	100S-C23⊗05BC
												1	4	100S-C23⊗14BC
30	65	10	15	15	15	2	5	7-1/2	10	20	25	0	4	100S-C30⊗04BC
												1	4	**100S-C30⊗14BC**
37	65	11	18.5/20	20	18.5	3	5	10	10	25	30	0	4	100S-C37⊗04BC
												1	4	**100S-C37⊗14BC**
43	85	13	22	25	22	3	7-1/2	10	15	30	30	0	4	100S-C43⊗04BC
												1	4	**100S-C43⊗14BC**
60	100	18.5	32	37	32	5	10	15	20	40	50	0	4	‡ 100S-C60⊗04BC
												1	4	‡ **100S-C60⊗14BC**
72	100	22	40	45	40	5	15	20	25	50	60	0	4	‡ 100S-C72⊗04BC
												1	4	‡ **100S-C72⊗14BC**
85	100	25	45	55	45	7-1/2	15	25	30	60	60	0	4	‡ 100S-C85⊗04BC
												1	4	‡ **100S-C85⊗14BC**
97	130	30	55	55	55	10	15	30	30	75	75	0	4	‡ **100S-C97⊗04BC**
												1	4	‡ **100S-C97⊗14BC**

✶ For other contact configurations and full product details, please contact your local Rockwell Automation sales office or Allen-Bradley distributor.
❄ If standard cross-stamped front-mount auxiliary contacts are required, remove the letter "B" before the letter "C" in the cat. no. Example: Cat. No. **100S-C09⊗05BC** becomes Cat. No. **100S-C09⊗05C**.
‡ Bifurcated front-mount auxiliary contacts on Cat. Nos. **100S-C60…C97** conform to mirror contact performance only.
⊗ Coil Voltage Code, see page 6-94

4-Pole AC- and DC-Operated Contactors

Ratings for Switching AC Motors												Contact Configuration				
		AC-2, AC-3, AC-4				Hp (60 Hz)						Main Pole		Auxillary Contacts		
I_e [A]		3-Phase kW (50 Hz)❄														
						1-Phase		3-Phase ❄								
AC-3	AC-1	230V	400V/ 415V	500V	690V	115V	230V	200V	230V	460V	575V	N.O.	N.C.	N.O.	N.C.	Cat. No.✶‡
9	32	3	4	4	4	1/2	1-1/2	2	2	5	7-1/2	4	0	0	4	100S-C09⊗404BC
												3	1	0	4	100S-C09⊗304BC
12	32	4	5.5	5.5	5.5	1/2	2	3	3	7-1/2	10	4	0	0	4	100S-C12⊗404BC
												3	1	0	4	100S-C12⊗304BC
16	32	5.5	7.5	7.5	7.5	1	3	5	5	10	15	4	0	0	4	100S-C16⊗404BC
												3	1	0	4	100S-C16⊗304BC
23	32	7.5	11	13	10	2	3	5	7-1/2	15	15	4	0	0	4	100S-C23⊗404BC
												3	1	0	4	100S-C23⊗304BC

✶ For other contact configurations, please contact your local Rockwell Automation sales office or Allen-Bradley distributor.

❄ Three-phase ratings only apply to contactors with at least three N.O. power poles.

⊗ Coil Voltage Code, see page 6-94

‡ If standard cross-stamped front-mount auxiliary contacts are required, remove the letter "B" before the letter "C" in the cat. no. Example: Cat. No. **100S-C09⊗404BC** becomes Cat. No. **100S-C09⊗404C**.

Reversing AC- and DC-Operated Contactors

- 3 Main Contacts
- Includes Mechanical/Electrical Interlock
- Includes Reversing Power Wiring

I_e [A]		Ratings for Switching AC Motors AC-2, AC-3, AC-4										Aux. Contacts Installed per Contactor		
		3-Phase kW (50 Hz)				Hp (60 Hz)								
						1-Phase		3-Phase						
AC-3	AC-1	230V	400V/ 415V	500V	690V	115V	230V	200V	230V	460V	575V	N.O.	N.C. ‡	Cat. No.∗❄
9	32	3	4	4	4	1/2	1-1/2	2	2	5	7-1/2	0	6	104S-C09⊗012BC
												1	5	104S-C09⊗210BC
12	32	4	5.5	5.5	5.5	1/2	2	3	3	7-1/2	10	0	6	104S-C12⊗012BC
												1	5	104S-C12⊗210BC
16	32	5.5	7.5	7.5	7.5	1	3	5	5	10	15	0	6	104S-C16⊗012BC
												1	5	104S-C16⊗210BC
23	32	7.5	11	13	10	2	3	5	7-1/2	15	15	0	6	104S-C23⊗012BC
												1	5	104S-C23⊗210BC
30	65	10	15	15	15	2	5	7-1/2	10	20	25	0	5	104S-C30⊗010BC
												1	5	104S-C30⊗210BC
37	65	11	18.5/20	20	18.5	3	5	10	10	25	30	0	5	104S-C37⊗010BC
												1	5	104S-C37⊗210BC
43	85	13	22	25	22	3	7-1/2	10	15	30	30	0	5	104S-C43⊗010BC
												1	5	104S-C43⊗210BC
60	100	18.5	32	37	32	5	10	15	20	40	50	0	5	§ 104S-C60⊗010BC
												1	5	§ 104S-C60⊗210BC
72	100	22	40	45	40	5	15	20	25	50	60	0	5	§ 104S-C72⊗010BC
												1	5	§ 104S-C72⊗210BC
85	100	25	45	55	45	7-1/2	15	25	30	60	60	0	5	§ 104S-C85⊗010BC
												1	5	§ 104S-C85⊗210BC
97	130	30	55	55	55	10	15	30	30	75	75	0	5	§ 104S-C97⊗010BC
												1	5	§ 104S-C97⊗210BC

∗ For other contact configurations, please contact your local Rockwell Automation sales office or Allen-Bradley distributor.

❄ If standard cross-stamped front-mount auxiliary contacts are required, remove the letter "B" before the letter "C" in the cat. no. Example: Cat. No. **104S-C09⊗05BC** becomes Cat. No. **104S-C09⊗05C**.

‡ One of the N.C. auxiliary contacts is supplied as part of the mechanical/electrical interlock.

§ Bifurcated front-mount auxiliary contacts on Cat. Nos. **104S-C60…C97** conform to mirror contact performance only.

⊗ Coil Voltage Code, see page 6-94

⊗ Coil Voltage Code and Terminal Position

The Cat. No. as listed is incomplete. Select a coil voltage code from the table below to complete the Cat. No. Example: 120V, 60Hz: **Cat. No. 100S-C09⊗05BC** becomes **Cat. No.100S-C09D05BC.**

[V]	12	24	32	36	42	48	100	100-110	110	120	127	200	200-220	208	208-240	220-230
AC, 50 Hz	R	K	V	W	X	Y	KP	—	D	P	S	KG	L	—	—	F
AC, 60 Hz	Q	J	—	V	—	X	—	KP	—	D	—	—	KG	H	L	—
AC, 50/60 Hz	–	KJ	—	—	—	KY	KP	—	KD	—	—	KG	KL‡	—	—	KL‡

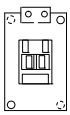
[V]	230	230-240	240	277	347	380	380-400	400	400-415	440	480	500	550	600
AC, 50 Hz	—	VA	T	—	—	—	N	—	G	B	—	M	C	—
AC, 60 Hz	—	—	A	T	I	E	—	—	—	N	B	—	—	C
AC, 50/60 Hz	KF	—	KA	—	—	—	—	KN	—	KB	—	—	—	—

‡ Not available in 100S/104S-C97 contactors

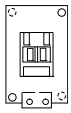
[V]			9	12	24	36	48	60	64	72	80	110	115	125	220	230	250
100S/104S-C09…C43	Standard	DC	ZR	ZQ	ZJ	ZW	ZY	ZZ	ZB	ZG	ZE	ZD	ZP	ZS	ZA	ZF	ZT
	with Integrated Diode		—	—	DJ	—	—	—	—	—	—	—	—	—	—	—	—
	Electronic with Integrated Diode		—	—	EJ	—	—	—	—	—	—	—	—	—	—	—	—
100S/104S-C60…C97	with Integrated Diode		DR	DQ	DJ	DW	DY	DZ	DB	DG	DE	DD	DP	DS	DA	DF	DT

Coil Terminal Position

- All contactors are delivered with the coil terminals located on the **line side.**
- For **load side** coil terminations, insert a **U** prior to the coil voltage code.
  Example: **Cat. No. 100S-C09UD05BC.**

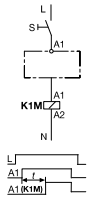
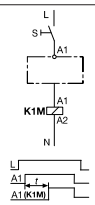
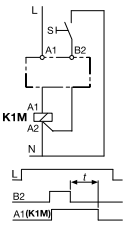
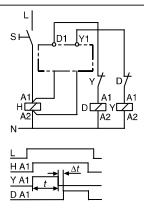
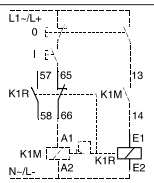


Cat. No. 100S-C09⊗05C Line Side



Cat. No. 100S-C09U⊗05C Load Side

Control Modules (For 100S-C09…C97 contactors)

	Description		Connection Diagrams	For Use With	Cat. No.
	Pneumatic Timing Modules Pneumatic timing element contacts switch after the delay time. The contacts on the main control relay continue to operate without delay.	**On-Delay** 0.3…30 s Range 1.8…180 s Range		100-C or 700-CF with AC or 24V DC electronic coils	100-FPTA30 100-FPTA180
		Off-Delay 0.3…30 s Range 1.8…180 s Range		100-C all, 700-CF all	100-FPTB30 100-FPTB180
	Electronic Timing Modules — On-Delay Delay of the contactor or control relay solenoid. The contactor or control relay is energized at the end of the delay time.	**On-Delay** 1…30 s Range 1…30 s Range 10…180 s Range 110…240V, 50/60 Hz 110…250V DC		100-C with 24…48V DC coils, 700-CF with DC coils	100-ETA3 100-ETA30 100-ETA180
		On-Delay 0.1…3 s Range 1…30 s Range 10…180 s Range 24…48V DC		100-C with 24…48V DC coils, 700-CF with DC coils	100-ETAZJ3 100-ETAZJ30 100-ETAZJ180
	Electronic Timing Modules — Off-Delay Delay of the contactor or control relay solenoid. After interruption of the control signal, the contactor or control relay is deenergized at the end of the delay time.	**Off-Delay** 0.3…3 s Range 1…30 s Range 10…180 s Range 24V, 50/60 Hz		100-C09…C37, 700-CF with 24V 50/60 Hz coils	100-ETBKJ3 100-ETBKJ30 100-ETBKJ180
		Off-Delay 0.3…3 s Range 1…30 s Range 10…180 s Range 110…240V, 50/60 Hz		100-C, 700-CF with 110…240V 50/60 Hz coils	100-ETB3 100-ETB30 100-ETB180
	Electronic Timing Modules Delay of the contactor solenoid. Contactor K 3 (Y) is de-energized (off) and K 2 (D) is energized (on) after the end of the set Y end time. (Switching delay at 50 ms.) Continuous adjustment range High repeat accuracy	**Transition Time Y Contactor** 1…30 s Range 110…240V, 50/60 Hz		100-C with 110…240V AC, 50/60 Hz coils	100-ETY30
	Mechanical Interlocks For interlocking of two contactors. Common interlock for all Bul. 100-C contactor sizes Interlocking of different sizes possible Mechanical and electrical interlocking possible in one module by means of integrated auxiliary contacts 9 mm dovetail connector included	Mechanical only without auxiliary contacts		100-C (except 100-C40, -C90)	100-MCA00
		Mechanical/ electrical with 2 N.C. auxiliary contacts		100-C (except 100-C40, -C90)	100-MCA02
	Mechanical Latch Following contactor latching, the contactor coil is immediately de-energized (off) by the N.C. auxiliary contact (65-66). Electrical or manual release 1 N.O. + 1 N.C. auxiliary contacts Suitable for all Bul. 100-C contactor sizes, 9…97 A	Maximum command duration 0.03…10 s		100-C with AC coils (except 100-C90)	100-FL11⊗

Package Quantity = 1

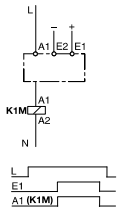
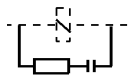
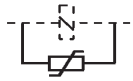
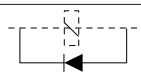
⊗ Coil Voltage Code

The cat. no. as listed is incomplete. Select a voltage suffix code from the table below to complete the Cat. No. Example: 120V, 60 Hz: **Cat. No. 100-FL11**⊗ becomes **Cat. No. 100-FL11D**.

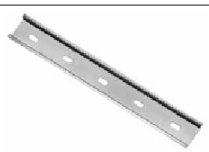
[V]∗	24V	48V	100V	110V	120V	230-240V	240V	277V	380-400V	400-415V	440V	480V
AC, 50 Hz	K	Y	KP	D	—	VA	T	—	N	G	B	—
AC, 60 Hz	J	—	—	—	D	—	A	T	—	—	N	B

∗ For special voltages, please contact your local Rockwell Automation sales office or Allen-Bradley distributor.

Control Modules (For 100S-C09…C97 contactors), Continued

	Description		Voltage Range	Connection Diagrams	For Use With	Cat. No.
	DC Interface (Electronic) Interface between the DC control signal (PLC) and the AC operating mechanism of the contactor. Requires no additional surge suppression on the relay coils		Input: 12V DC Output: 110…240V AC		100-C with AC coils 110…240V AC	100-JE12
			Input: 18…30V DC Output: 110…240V AC			100-JE
			Input: 48V DC Output: 110…240V AC			100-JE48
	Surge Suppressors For limitation of coil switching transients. Plug-in, coil mounted. Suitable for all 100-C contactor sizes, 9…85 A. RC, varistor, and diode versions.	**RC Module** AC operating mechanism	24…48V AC, 50/60 Hz		100-C with AC coils	100-FSC48
			110…280V AC, 50/60 Hz			100-FSC280
			380…480V AC, 50/60 Hz			100-FSC480
		Varistor Module AC/DC operating mechanism	12…55V AC/ 12…77V DC		100-C with AC or DC coils	100-FSV55
			56…136V AC/ 78…180V DC		100-C with AC or DC coils	100-FSV136
			137…277V AC/ 181…350V DC		100-C with AC or DC coils	100-FSV277
			278…575V AC		100-C with AC or DC coils	100-FSV575
		Diode Module DC operating mechanism	12…250V DC		100-C with DC coils	100-FSD250

Assembly Components (For 100S-C09…C97 contactors)

	Description	For Use With	Pkg. Quantity*	Cat. No.
Cat. No. 100-S0	**Dovetail Connectors** For use in contactor and starter assemblies. Single Connector — 0 mm Spacing	100-C	10	100-S0
	Dovetail Connectors For use in contactor and starter assemblies. Dual Connector — 9 mm Spacing			100-S9
Cat. No. 100-SCCA	**Protective Covers** Provides protection against unintended manual operation For contactors and front mounted auxiliary contacts, pneumatic timers and latches	100-C all	1	**100-SCCA**
Cat. No. 100-SCFA		100-FA, -FB, -FC, -FP, -FL;	10	**100-SCFA**
Cat. No. 105-PW23	**Reversing Power Wiring Kits** For reversing connection with a solid-state or thermal overload relay	100-C09…C23	1	105-PW23
		100-C30…C37		105-PW37
		100-C43		105-PW43
		100-C60…C97		105-PW85
	**DIN (#3) symmetrical rail** 35 x 7.5 x 1 m	100-C	10	199-DR1

* Must be ordered in multiples of package quantities.

Marking Systems (For 100S-C09…C97 contactors)

	Description	Pkg. Qty.∗	Cat. No.
	Label Sheet 105 self-adhesive paper labels each, 6 x 17 mm	10	100-FMS
	Marking Tag Sheet 160 perforated paper labels each, 6 x 17 mm, to be used with a transparent cover	10	100-FMP
	Transparent Cover To be used with marking tag sheets	100	100-FMC
	Marking Tag Adapters To be used with marking tag: System V4/V5	100	100-FMA1
	Marking Tag Adapters To be used with marking tag: System 1492 W	100	100-FMA2

∗ Must be ordered in multiples of package quantities.

Terminal Kits (For 100S-C09…C97 contactors)

	Description	Max. Current Ratings and Wire Sizes		Pkg. Qty.∗	Cat. No.
	Stab Connector Kit Dual stab (0.250 in.) for 100-C coil terminals For 100-C09…C97 contactors			20	199-SC2
	Stab Connector Kit Dual stab (0.250 in.) for 100-C power terminals For 100-C09…C23 contactors			100	199-SC10
	3-Pole Terminal Lug Kit For Cat. No. 100-C09…C23 (Line side)	IEC @ 40 °C IEC @ 40 °C UL/CSA (Encl.)	45 A (4…16 mm²❄, fine stranded w/ferrule) 45 A (4…25 mm², coarse stranded/solid) 40 A (#10…4 AWG, stranded/solid)	1	100-CTN23
	3-Pole Terminal Lug Kit For Cat. No. 100-C09…C23 (Load side)	IEC @ 40 °C IEC @ 40 °C UL/CSA (Encl.)	45 A (4…16 mm²❄, fine stranded w/ferrule) 45 A (4…25 mm², coarse stranded/solid) 40 A (#10…4 AWG, stranded/solid)	1	100-CTL23
	3-Pole Terminal Lug Kit For Cat. No. 100-C30…C37 (Line side)	IEC @ 40 °C IEC @ 40 °C UL/CSA (Encl.)	60 A (4…16 mm²❄, fine stranded w/ferrule) 60 A (4…25 mm², coarse stranded/solid) 55 A (#10…4 AWG, stranded/solid)	1	100-CT37
	1-Pole Terminal Lug Kit For Cat. No. 100-C43	IEC @ 40 °C IEC @ 40 °C UL/CSA (Encl.)	90 A (6…35 mm², fine stranded w/ferrule) 90 A (6…50 mm², coarse stranded/solid) 75 A (#8…2 AWG, stranded/solid)	3	100-CT43
	1-Pole Terminal Lug Kit For Cat. No. 100-C60…C97	IEC @ 40 °C IEC @ 40 °C UL/CSA (Encl.)	130 A (10…70 mm², fine stranded w/ferrule) 130 A (10…95 mm², coarse stranded/solid) 130 A (#8…2/0 AWG, stranded/solid)	3	100-CT85
	3-Pole Paralleling Kit For Cat. No. 100-C09…C23	IEC @ 40 °C IEC @ 40 °C UL/CSA (Encl.)	100 A (35…70 mm², fine stranded w/ferrule) 100 A (35…95 mm², coarse stranded/solid) 100 A (#0…2/0 AWG, stranded/solid)	2	100-CP23
	3-Pole Paralleling Kit For Cat. No. 100-C30…C37	IEC @ 40 °C IEC @ 40 °C UL/CSA (Encl.)	150 A (35…70 mm², fine stranded w/ferrule) 150 A (35…95 mm², coarse stranded/solid) 150 A (#0…2/0 AWG, stranded/solid)	2	100-CP37

∗ Must be ordered in package quantities.
❄ 16 mm² max. according to IEC 60947; actual max. 25 mm².

Bulletin 100S-D Safety Contactors

Bulletin 100S-D safety contactors were designed to address the needs of modern safety applications requiring feedback and monitoring of the energy isolating switchgear used in hazardous motion loads. The 100S-D meets these needs through its "mirror contact" design. If a power contact welds, the N.C. auxiliary contacts will not change state. This feature provides reliable indication about the open/closed status of the main power poles. In addition, the gold-plated bifurcated auxiliary contacts are ideally suited for low-energy applications or feedback control circuits with multiple series-connected N.C. auxiliary contacts.

- 63…500 kW @400V
- 75…600 Hp @460V
- 100…700 Hp @575V
- Electronic and conventional coils
  - AC & DC
  - Integrated PLC interface
  - Low power pick-up & hold-in
  - Wide voltage ranges
- Complete range of accessories
- Environmentally friendly
- Compact dimensions

Standards Compliance

IEC 60947-4-1
IEC 60947-4 Annex F
IEC 60947 Type “2” Coordination
CSA C22.2 No. 14
UL 508

Certifications

CE Marked
cULus Listed (File No. E 41850, Guide NLDX, NLDX7)
SUVA Certified

Your order must include: cat. no. of the contactor specified with coil voltage code and, if required, cat. no. of any accessories and/or replacement coils.

Product Selection

3-Pole AC-Operated Contactors

I_e [A]		Switching of 3-phase motors AC-2, AC-3										Coil Type	Auxiliary contacts		Cat. No.➢
60 °C	40 °C	kW (50 Hz)∗						Hp (60 Hz)					N.O.	N.C.❄	
AC-3	AC-1	230V	400V	415V	500V	690V	1000V	200V	230V	460V	575V				
115	250	37	63	66/75§	80	110	55	40	40	75	100	Conventional	2	2	100S-D115⊗22BC
115	250	37	63	66/75§	80	110	55	40	40	75	100	Electronic	2	2	100S-D115⊗22BC
140	250	45	78	82/90§	80/100 ‡	110/132 ‡	75	40	50	100	125	Conventional	2	2	100S-D140⊗22BC
140	250	45	78	82/90§	80/100 ‡	110/132 ‡	75	40	50	100	125	Electronic	2	2	100S-D140⊗22BC
180	250	55	101	100§	90/125 ‡	132/160 ‡	90	50	60	150	150	Conventional	2	2	100S-D180⊗22BC
180	250	55	101	100§	90/125 ‡	132/160 ‡	90	50	60	150	150	Electronic	2	2	100S-D180⊗22BC
210	350	63	118	110§	205	200	110	60	75	150	200	Electronic	2	2	100S-D210⊗22BC
250	350	80	140	150§	250	250	133	75	100	200	250	Electronic	2	2	100S-D250⊗22BC
300	450	90	170	160§	290	300	160	100	125	250	300	Electronic	2	2	100S-D300⊗22BC
420	540	132	238	250	420	425	220	150	175	350	400	Electronic	2	2	100S-D420⊗22BC
630	800	200	355	355	500	500	—	200	250	500	600	Electronic	2	2	100S-D630⊗22BC
860	1000	250	500	500	500	600	—	250	300	600	700	Electronic	2	2	100S-D860⊗22BC

∗ Preferred values according to IEC 60072-1.
❄ The N.C. contacts meet IEC 60947-4 Annex F requirements for mirror contact performance. The N.C. mirror contacts are wired in series or parallel and must be used as monitoring contacts with feedback to the safety circuit.
‡ Higher kW rating only applies to contactors with electronic coil.
➢ If standard cross-stamped front-mount auxiliary contacts are required, remove the letter "B" before the letter "C" in the cat. no. Example: Cat. No. **100S-D95⊗22BC** becomes Cat. No. **100S-D95⊗22C**.
§ 415V: Values for AC-3 and AC-4 lifespan -25%

⊗ **Coil Voltage Codes: see page 6-99**

3-Pole DC-Operated Contactors

I_e [A]		Switching of 3-phase motors AC-2, AC-3										Auxiliary contacts		Coil Type	Conventional Coil Cat. No.❄	Electronic Coil Cat. No.➢
60 °C	40 °C	kW (50 Hz) ✶						Hp (60 Hz)				N.O.	N.C. ❄ ✶			
AC-3	AC-1	230V	400V	415V	500V	690V	1000 V	200V	230V	460V	575V					
115	250	37	63	75	80	110	63	40	40	75	100	3	2/1L	Conventional	100S-D115⊗33LC‡ ❄	100S-D115⊗22BC
140	250	45	78	75	80/100§	110/132§	75	40	50	100	125	3	2/1L	Conventional	100S-D140⊗33LC‡ ❄	100S-D140⊗22BC
180	250	55	101	100	90/125§	132/160§	90	50	60	150	150	3	2/1L	Conventional	100S-D180⊗33LC‡ ❄	100S-D180⊗22BC
210	350	63	118	110	205	200	110	60	75	150	200	2	2	Electronic	—	100S-D210⊗22BC
250	350	80	140	150	250	250	133	75	100	200	250	2	2	Electronic	—	100S-D250⊗22BC
300	450	90	170	160	290	300	160	100	125	250	300	2	2	Electronic	—	100S-D300⊗22BC
420	540	132	238	250	420	425	220	150	175	350	400	2	2	Electronic	—	100S-D420⊗22BC
630	800	200	355	355	500	500	—	200	250	500	600	2	2	Electronic	—	100S-D630⊗22BC
860	1000	250	500	500	500	600	—	250	300	600	700	2	2	Electronic	—	100S-D860⊗22BC

✶ Preferred values according to IEC 60072-1.
❄ The N.C. contacts meet IEC 60947-4 Annex F requirements for mirror contact performance. The N.C. mirror contacts are wired in series or parallel and must be used as monitoring contacts with feedback to the safety circuit.
‡ For conventional DC coil only. The pickup winding must be interconnected with the N.C. late-breaking auxiliary contacts.
§ Higher kW rating only applies to contactors with electronic coil.
➢ If standard cross-stamped front-mount auxiliary contacts are required, remove the letter "B" before the letter "C" in the Cat. No. Example: Cat. No. **100S-D95⊗22BC** becomes Cat. No. **100S-D95⊗22C**.

⊗ Coil Voltage Codes

Conventional Coil	[V]	24	48	100	110	120	200	208	220 …230	230	240	277	380 …400	415	440	480	500	550	600
100S-D115…100S-D180	AC, 50 Hz	K	Y	—	D	—	—	—	A	—	T	—	N	B	G	—	M	C	—
	AC, 60 Hz	J	X	—	—	D	—	H	—	—	A	T	—	—	N	B	—	—	C
100S-D115	AC, 50/60 Hz	—	—	KP	KN	—	KG	—	KL	KF	KA	KT	—	—	—	—	—	—	—

Electronic Coil w/ PLC Interface§	[V]	24	42…64	100	110… 130	200	208… 277	200… 220	230… 250	277	380… 415	380… 440	440… 480	380… 500	500
100S-D115…100S-D300	AC, 50/60 Hz	EJ♣	EY	EP	ED	EG	EA	—	—	—	—	VN	—	EN	—
100S-D420	AC, 50/60 Hz	—	—	EP	ED	EG	EA	—	—	—	—	—	—	EN	—
100S-D630…100S-D860	AC, 50/60 Hz	—	—	EP	ED	EG	—	EG	EA	ET	EN	—	EB	—	EM

Conventional Coil	[V]	24	48	110	125	220	250
100S-D115…100S-D180 ‡	DC	ZJ	ZY	ZD	ZS	ZA	ZT

Electronic Coil w/ EI Interface ♣	[V]	24	48…72	110…130	200…255
100S-D115…100S-D300	DC	EZJ	EZY	EZD	EZA
100S-D420	DC	—	—	EZD	EZA
100S-D630…860	DC	—	—	ED	EA

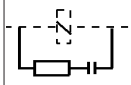
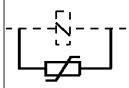
§ Signal voltage of the Cat. No. 100S-D… electronic interface U_e: 24V DC/I^e: 15 mA
Pick-up voltage: 13.0V DC…30.2V DC
Drop-out voltage: -3.0V DC…+5.0V DC
♣ Not available with 100S-D300.

Marking Systems (For 100S-D95…D860 contactors)

	Description	Pkg. Qty.§	Cat. No.
	Label Sheet 105 self-adhesive paper labels each, 6 x 17 mm	10	100-FMS
	Marking Tag Sheet 160 perforated paper labels each, 6 x 17 mm, to be used with a transparent cover	10	100-FMP
	Transparent Cover To be used with marking tag sheets	100	100-FMC
	Marking Tag Adapters To be used with marking tag: System V4/V5 System V4 / V5	100	100-FMA1
	System 1492 W	100	100-FMA2

❧ ★◆▲▼ ❁❄ ❑❒❄❄❒❄❄ ✻■ ❒❁❄❄❁❁❄ ❑◆❁■▼✻▼✻❄▲✎

Suppressor Modules

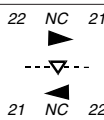
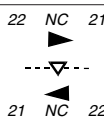
	Description	Connection Diagram	Suppressor Rating	For Use With	Cat. No.
	Suppressor Module for Bul. 100-D Contactors • For limiting surge voltage when coil circuits are interrupted • Supplied as standard on all conventional DC coil contactors and all electronic coil contactors (as part of the supply module or delivered with separate suppressor module)		**RC Module (AC control) for contactors with conventional coil** 21...48V, 50 Hz; 24...55V, 60 Hz	100-D115...100-D180	100-DFSC48
			95...110V, 50 Hz; 110...127V, 60 Hz		100-DFSC110
			180...277V, 50 Hz; 208...277V, 60 Hz		100-DFSC240
			380...550V, 50 Hz; 440...600V, 60 Hz		100-DFSC550
			**Varistor Module for contactors with conventional coil** 55V AC	100-D115...100-D180	100-DFSV55
			56...136V AC		100-DFSV136
			137...277V AC		100-DFSV277
			278...600V AC		100-DFSV575
			208...277V AC∗	100-D115...100-D180	100-DFSV550

∗ For overvoltage category IV (IEC 947 for 100-D...-EI) e.g., lightning protection requirements.
Package Quantity = 1

Connecting Components

	Description	For Use With		Cat. No.
	Terminal Lugs Set of two Protection class IP2X per IEC 60529 and DIN 40 050	100-D115		100-DTB110
		100-D140, 100-D180, 100-D115E…D180E, 193-EC_F, 193-EE_F		100-DTB180
		100-D210...100-D420, 193-EC_G, 193-EF2C, 193-EE_G		100-DTB420
	Terminal Lugs (UL/CSA), Copper Frame Set of three	100-D115		**100-DL110**
		100-D115E, 193-EC_F, 193-EE_F		**100-DLE110**
		100-D140, 100-D180, 193-EC_F, 193-EE_F		**100-DL180**
		100-D210…100-D420, 193-EC_G, 193-EE_G		**100-DL420**
		100-D630, 100-D860, 193-EC_H, 193-EE_H		**100-DL630**
		100-D630, 100-D860, 193-EC_H, 193-EE_H		**100-DL860**
	Control Circuit Terminal 2 x 2.5 mm²	Connects to Cat. Nos. 100-D115...D180		100-DAT1
		Connects to Cat. Nos. 100-D210...D420		100-DAT2
	Terminal Shields Set of two Protection class IP10 per IEC 60529 and DIN 40 050 For direct-on-line, reversing, two-speed, and wye-delta/star-delta assemblies	100-D115		100-DTS110
		100-D140, 100-D180, 100-D115-E…100-D180-E		100-DTS180
		100-D210...100-D420		100-DTS420
	Terminal Covers Protection class IP20 per IEC 60529 and DIN 40 050 For direct-on-line, reversing, two-speed, and wye-delta/star-delta assemblies	100-D115…100-D180, 193-EC_F, 193-EE_F		100-DTC180
		100-D210...100-D420, 193-EC_G, 193-EE_G		100-DTC420
		100-D630…100-D860, 193-EC_H, 193-EE_H		100-DTC860
	Mounting Plate Galvanized steel plate for starter combinations For direct-on-line, reversing, two-speed, wye-delta/star-delta, and Dahlander assemblies	100-D115...100-D180	Direct-on-line	100-DMS180
			Reversing, two-speed or changeover	100-DMU180
			Y-Δ or Dahlander	100-DMY180
		100-D210...100-D420	Direct-on-line	100-DMS420
			Reversing, two-speed or changeover	100-DMU420
			Y-Δ or Dahlander	100-DMY420
		100-D630...100-D860	Direct-on-line	100-DMS860
			Reversing, two-speed or changeover	100-DMU860
			Y-Δ or Dahlander	100-DMY860
	Mounting Plate For two-speed or changeover switches	For interlocking between 100-C60…C97 and 100-D115…D180 contactors		100-DMU85

Interlocks

	Description	Circuit Diagram	For Use With	Cat. No.
	Interlock — Mechanical Only No additional space required		100-D115…100-D420	100-DMA00
	Interlock — Dual Electrical/Mechanical No additional space required Two N.C. auxiliary contacts		100-D115…100-D860	100-DMD02
	Interlock — Mechanical Only No additional space required		100-D115…100-D860	100-DMD00
	Interlock — Mechanical Only Provides interlocking between Bul. 100-C and Bul. 100-D contactors		100-C60…100-C97 between 100-D115…100-D180	100-DMC00
	Interlock — Dual Electrical/Mechanical Provides interlocking between Bul. 100-C and Bul. 100-D contactors Two N.C. auxiliary contacts		100-C60…100-C97 between 100-D115…100-D180	100-DMC02

Package Quantity = 1

Specifications

Coil Type :	Conventional	100S/104S-C										
		09	12	16	23	30	37	43	60	72	85	97
	Conventional	X	X	X	X	X	X	X	X	X	X	X
	Electronic — EI	—	—	—	—	—	—	—	—	—	—	—
Conductor Cross Sections - Main Contacts Terminal type					✶			❄			‡	
(1) conductor [mm²]		1…4				2.5…10		2.5…16	2.5…35			2.5…35
(2) conductors [mm²]		1…4				2.5…10		2.5…10	2.5…25			2.5…35
(1) conductor [mm²]		1.5…6				2.5…16		2.5…25	2.5…50			2.5…50
(2) conductors [mm²]		1.5…6				2.5…16		2.5…16	2.5…35			2.5…50
b max. [mm]		—				—		—	—			
c max. [mm]		—				—		—	—			
s max. [mm]		—				—		—	—			
Ø min. [mm]		—				—		—	—			
Recommended torque	[N•m]	1.5…2.5				2.5…3.5		2.5…3.5	4…6			
Cross section per UL/CSA	[AWG]	16…10				14…4		14…4	14…1			
Recommended torque	[lb•in]	13.3…22				22…31		22…31	40…53			
With terminal lug kit		—				—		—	—			
Cross section per UL/CSA	[AWG]	—				—		—	—			
Recommended torque	[lb•in]	—				—		—	—			
With Frame Terminal Block		—				—		—	—			
top opening [mm²]		—				—		—	—			
bottom opening [mm²]												
top opening [mm²]		—				—		—	—			
bott. opening [mm²]												
b max. [mm]		—				—		—	—			
s top [mm]												
s bottom [mm]												
Recommended torque	[N•m]	—				—		—	—			
Cross section per UL/CSA top	[AWG]	—				—		—	—			
bottom	[AWG]	—				—		—	—			
Recommended torque	[lb•in]	—				—		—	—			

✶ Pozidriv No. 2 / Blade No. 3 screw
❄ Pozidriv No. 2 / Blade No. 4 screw
‡ Hexagonal socket screw

100S-D									
115	115	140	180	210	250	300	420	630	860
X	—	X	X	—	—	—	—	—	—
—	X	X	X	X	X	X	X	X	X
§	§			§				§	
— —	— —			— —				— —	— —
— —	— —			— —				— —	— —
20	25			30				52	52
10	12.5			15				22	22
5	5			6				2 x 8	2 x 8
6.1	8.3			10.5				13	13
8…10	10…12			16				68	68
—	—			—				—	—
70…90	90…110			130…150				600	600
100-DL110‡	100-DLE110‡	100-DL180‡		100-DL420‡				100-DL630	100-DL860
8…2/0	8…2/0	6…300 MCM		(2x) 4…350 MCM				(2X) 2/0… 500MCM	(4X) 2/0… 500MCM
90	90	250		250				400	400
100-DTB110‡	100-DTB180‡			100-DTB420✶				—	—
16…35 16…70	16…35 16…95			25…240♣ 25…240				—	—
16…50 16…95	16…50 16…120			25…300 25…300				—	—
16 3…9 3…12	20 3…9 3…14			25 4…20 4…20				—	—
8…10	10…12			20…25				—	—
6…1 / 0 AWG	6…1 / 0 AWG			4 AWG…600 MCM				—	—
6…3 / 0 AWG	6 AWG…250 MCM			4 AWG…600 MCM				—	—
70…90	90…110			180…220				—	—

✶ Pozidriv No. 2 / Blade No. 3 screw
‡ Hexagonal socket screw
§ Hexagonal screw
♣ 25…95 mm² with sleeve per DIN 46228

Coil Data

			100S/104S-C										
			09	12	16	23	30	37	43	60	72	85	97
	Conventional		X	X	X	X	X	X	X	X	X	X	X
Coil Type	Electronic — EI		—	—	—	—	—	—	—	—	—	—	—
Operating Limits													
50 Hz, 60 Hz, 50/60 Hz	pick-up	[x *Us*]	0.85…1.1						0.85….1.1				
	dropout	[x *Us*]	0.3…0.6						0.3…0.6				
DC (conventional)	pick-up	[x *Us*]	0.8…1.1						0.8…1.1				
	dropout	[x *Us*]	0.1…0.6						0.1…0.6				
DC (electronic)	pick-up	[x *Us*]	0.7…1.25							—			
	dropout	[x *Us*]	0.1…0.5							—			
Coil Consumption													
50 Hz, 60 Hz, 50/60 Hz	pick-up	[VA/W]	70/50			70/50	80/60		130/90	200/110			
	hold-in	[VA/W]	8/2.6			9/3	9/3		10/3.2	16/4.5			
DC (conventional)	pick-up	[W]	6.5			9.2	9.2		10.1	200			
	hold-in	[W]	6.5			9.2	9.2		10.1	4.5			
DC (electronic)	pick-up (avg/peak)	[W]	10/22				10/22		10.1	—			
	hold-in	[W]	1.5						10.1	—			
Operating Times													
AC	closing delay	[ms]	15…30			15…30	15…30		15…30	20…40			
	opening delay	[ms]	10…60			10…60	10…60		10…60	10…60			
With RC module	opening delay	[ms]	10…60			10…60	10…60		10…60	10…60			
DC (conventional)	closing delay	[ms]	40…70			40…70	50…80		50…80	20…40			
	opening delay	[ms]	7…15			7…15	7…15		7…15	—			
With integ. diode	opening delay	[ms]	14…20			17…23	17…23		17…23	≤ 220V 20…35			
With external diode	opening delay	[ms]	70…95			80…125	80…125		80…125	≤ 220V 80…125			
DC (electronic)	closing delay	[ms]	20…40							—			
	opening delay	[ms]	20…40							—			
Max. Ripple			± 15%							—			

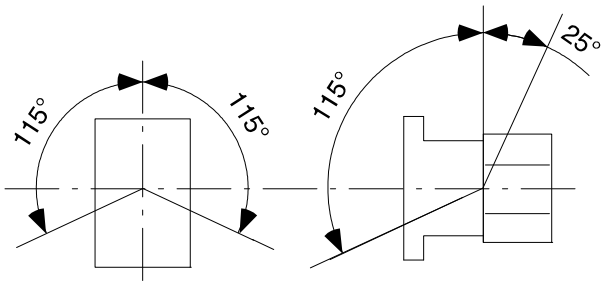
			100S-D										
			115	140/180	95	110	140	180	210	250	300	420	630	860
		Conventional	X	X	—	—	—	—	—	—	—	—	—	—
Coil Type		Electronic — EI	—	—	X	X	X	X	X	X	X	X	X	X
Operating Limits														
50 Hz, 60 Hz, 50/60 Hz	pick-up	[x *Us*]	0.85…1.1		0.85…1.1								0.8…1.1	
	dropout	[x *Us*]	0.3…0.6		0.3…0.5								0.3…0.8	
DC control	pick-up	[x *Us*]	0.85…1.1		0.85…1.1								0.85…1.1	
	dropout	[x *Us*]	0.3…0.6		0.3…0.5								0.3…0.8	
Coil Consumption														
50 Hz, 60 Hz, 50/60 Hz	pick-up	[VA/W]	650/310		380/240∗							490/270∗	1915/1720∗	
	hold-in	[VA/W]	50/10		13/6							18/7	33/30	
DC control	pick-up	[W]	540		265∗							340∗	1980∗	
	hold-in	[W]	8		6							7	30	
Operating Times														
AC	closing delay	[ms]	20…47		20…45								60…100	
	opening delay	[ms]	6…12		25…110								70…145	
With RC module	opening delay	[ms]	9…18		—								—	
DC	closing delay	[ms]	27…47		25…50								60…100	
	opening delay	[ms]	12…20		35…110								70…145	
With integrated diode	opening delay	[ms]	12…20		—								—	
With external diode	opening delay	[ms]	—		—							—	—	

∗ Electronic coil drives are designed to minimize power requirements, but this control may exhibit a higher inrush (540 W, < 10 ms) when energizing. This must be taken into account for the proper sizing of supply devices, all-or-nothing relays and cross-sections of coil supply lines. Please contact your local Rockwell Automation sales office or Allen-Bradley distributor for detailed information.

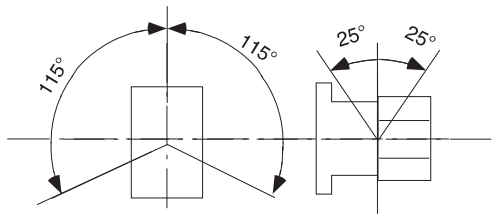
Bulletin 100S-C/104S-C Approximate Dimensions

Approximate dimensions are shown in millimeters (inches) and not intended for manufacturing purposes.

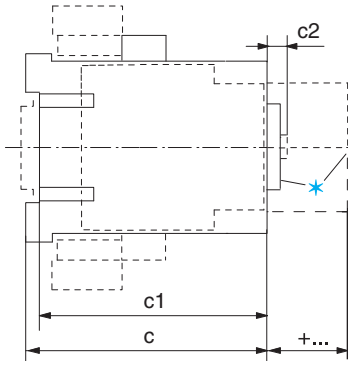
Mounting Position



AC contactors and DC contactors with electronic coils



DC contactors



AC Contactors and DC Contactors with Electronic Coils

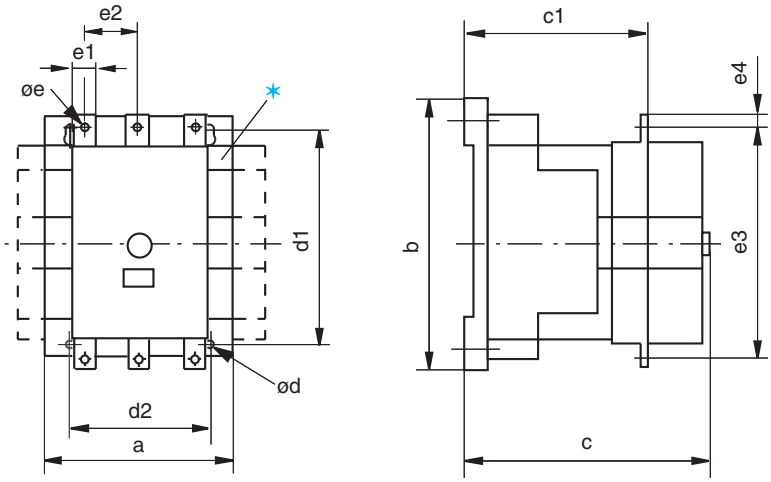
Cat. No.	a	b	c	c1	c2	Ød	d1	d2
100S-C09...100S-C23	45 (1-25/32)	81 (3-3/16)	119.5 (4-3/4)	114.5 (4-43/64)	6 (15/64)	2-4.5 (2-3/16)	60 (2-23/64)	35 (1-3/8)
100S-C30, 100S-C37	45 (1-25/32)	81 (3-3/16)	136.5 (5-37/64)	131.6 (5-11/32)	6.5 (1/4)	2-4.5 (2-3/16)	60 (2-23/64)	35 (1-3/8)
100S-C43	54 (2-1/8)	81 (3-3/16)	139.5 (5-11/16)	134.6 (5-29/64)	6.5 (1/4)	2-4.5 (2-3/16)	60 (2-23/64)	45 (1-25/32)
100S-C60...100S-C97	72 (2-53/64)	122 (4-51/64)	156 (6-11/32)	150.5 (6-1/8)	8.5 (21/64)	4-5.4 (4-7/32)	100 (3-15/16)	55 (2-11/64)

DC Contactors

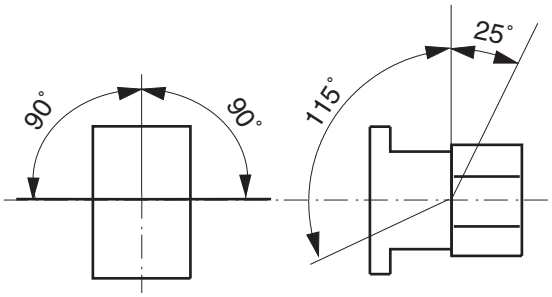
Cat. No.	a	b	c	c1	c2	Ød	d1	d2
100S-C09Z...100S-C16Z	45 (1-25/32)	81 (3-3/16)	145.5 (5-49/64)	140.5 (5-37/64)	6 (15/64)	2-4.5 (2-3/16)	60 (2-23/64)	35 (1-3/8)
100S-C23Z	45 (1-25/32)	81 (3-3/16)	162.5 (6-7/16)	158 (6-1/4)	6 (15/64)	2-4.5 (2 -3/16)	60 (2-23/64)	35 (1-3/8)
100S-C30Z...100S-C37Z	45 (1-25/32)	81 (3-3/16)	180.5 (7-5/32)	175.5 (6-61/64)	6.5 (1/4)	2-4.5 (2-3/16)	60 (2-23/64)	35 (1-3/8)
100S-C43Z	54 (2-1/8)	81 (3-3/16)	183.5 (7-17/64)	179 (7-3/32)	6.5 (1/4)	2-4.5 (2-3/16)	60 (2-23/64)	45 (1-25/32)
100S-C60D...100S-C97D	72 (2-53/64)	122 (4-51/64)	156 (6-11/32)	150.5 (6-1/8)	8.5 (21/64)	4-5.4 (4-7/32)	100 (3-15/16)	55 (2-11/64)

Bulletin 100S-D Contactors and Accessories

Approximate dimensions are shown in millimeters (inches) and not intended for manufacturing purposes.



Mounting Position



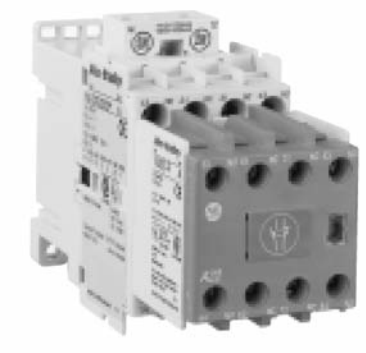
Cat. No.	a	b	c	c1	Ød	d1	d2	Øe	e1	e2	e3	e4
100S-D115	120	170	156	110.5	5.2	145	100	M6	16	38.5	147	8
100S-D115E...100S-D180E, 100S-D140, 100S-D180	120	170	156	110.5	5.2	145	100	M8	20	39	160	10
100S-D210E...100S-D420E	155	205	180	110.5	6.5	180	130	M10	25	48	193	12.5
100S-D630E...100S-D860E	255	310	265	110.5	10	230	225	M12	40	70	291	22

Contactor with		mm
Auxiliary contact block ∗	100-DS1... 100-DS2...	a a + 13.5 each
Mechanical Interlock	100-DM...	a + a
Frame terminal block	100-DTB110 100-DTB180 100-DTB420	b + 7 each b + 7 each b + 8.5 each
Label holder		c...+ 5

∗ Conventional DC coil contactors will have an additional auxiliary contact block that will add 13.5 mm to the “a” dimension on the right-hand side.

Safety Control Relays

Bulletin 700S-CF



Description

Bulletin 700S-CF Safety Control Relays provide mechanically or mirror contact performance, which are required in feedback circuits for safety applications. Bifurcated contacts are ideal for low energy feedback safety dircuits where high contact reliability is required.

Features

- IEC industrial safety relay
- Mechanically linked contacts as per IEC 60947-5-1
- Third party certification SUVA
- Red cover and mechanically linked contact symbol on front face
- Gold plated, bifurcated version for low level switching applications
- Permanently fixed front mounted auxiliary contact block

Standards Compliance

EN/IEC 60947-1, -5-1
UL 508
CSA C22.2 No. 14

Certifications

cULus Listed (File No. E14840, Guide NKCR/NKCR7)
CE Marked

Product Selection

Type CF and CFB Safety Control Relays — 8-Pole AC Coil Voltage (Ratings for 700S-CF Only)

AC-12			AC-15							Connection Diagrams		Contacts		Standard Contacts (Main) Gold-Plated Bifurcated (Front) Cat. No.	Gold-Plated Bifurcated, All Contacts Cat. No.❄
I_{th} [A]			I_e [A]												
	40 °C	60 °C	24/48V	120V	240V	400V	500V	600V	690V	Main Contacts	Auxiliary Contacts	N.O.	N.C.		
Main Contacts	20	20	10	10	10	6	2.5	1	1			4	4	**700S-CF440⊗BC**	**700S-CFB440⊗C**
												5	3	700S-CF530⊗BC	700S-CFB530⊗C
Adder Deck Contacts	10	6	6	6	5	3	1.6	1	1			6	2	**700S-CF620⊗BC**	700S-CFB620⊗C

❄ Ratings for Bulletin 700CFB and CFM are on page 6-104

⊗ AC Coil Voltage Code

The cat. no. as listed is incomplete. Select a coil voltage code from the table below to complete the cat. no. Example: **Cat. No. 700S-CF440⊗BC** becomes **Cat. No. 700S-CF440DBC** for 120V, 60 Hz.

[V]	12	24	32	36	42	48	100	100-110	110	120	127	200	200-220	208	208-240	220-230
50 Hz	R	K	V	W	X	Y	KP	—	D	P	S	KG	L	—	—	F
60 Hz	Q	J	—	V	—	X	—	KP	—	D	—	—	KG	H	L	—
50/60 Hz	—	KJ	—	—	—	KY	KP	—	KD	—	—	KG	KL	—	—	KL

[V]	230	230-240	240	277	347	380	380-400	400	400-415	440	480	500	550	600
50 Hz	—	VA	T	—	—	—	N	—	G	B	—	M	C	—
60 Hz	—	—	A	T	I	E	—	—	—	N	B	—	—	C
50/60 Hz	KF	—	KA	—	—	—	—	KN	—	KB	—	—	—	—

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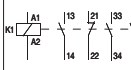
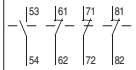
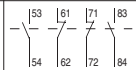
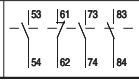
Publication S117-CA001A-EN-P

Type CF and CFB Safety Control Relays — 8-Pole DC Coil Voltage (Ratings for 700S-CF Only)

AC-12			AC-15							Connection Diagrams		Contacts		Standard Contacts (Main) Gold-Plated Bifurcated (Front) Cat. No.∗	Gold Plated Bifurcated, All Contacts Cat. No.∗
I_{th} [A]			I_e [A]												
	40 °C	60 °C	24/48V	120V	240V	400V	500V	600V	690V	Main Contacts	Auxiliary Contacts	No. of N.O. Contacts	No. of N.C. Contacts		
Main Contacts	20	20	10	10	10	6	2.5	1	1			4	4	**700S-CF440⊗BC**	**700S-CFB440⊗C**
												5	3	700S-CF530⊗BC	700S-CFB530⊗C
Adder Deck Contacts	10	6	6	6	5	3	1.6	1	1			6	2	**700S-CF620⊗BC**	700S-CFB620⊗C

∗ Ratings for Bulletin 700-CFB and 700-CFM are on page 6-104

⊗ DC Coil Voltage Code

The cat. no. as listed is incomplete. Select a coil voltage code from the table below to complete the cat. no. Example: **700S-CF440⊗C** becomes **Cat. No. 700S-CF440ZJC** for 24V DC.

[V]	9	12	24	36	48	60	64	72	80	110	115	125	220	230	250
Standard	ZR	ZQ	ZJ	ZW	ZY	ZZ	ZB	ZG	ZE	ZD	ZP	ZS	ZA	ZF	ZT
Standard with diode	—	—	DJ	—	—	—	—	—	—	—	—	—	—	—	—
Electronic with diode	—	—	EJ	—	—	—	—	—	—	—	—	—	—	—	—

Specifications

			Cat. No. 700S-CF	Aux. Contact (Front-mounted)
Mechanical Life		[Mil]	15	15
Electrical Life	AC-15 (240V, 3 A)	[Mil]	1.5	1.5
Weight	AC Coil	[g]	390	—
Terminal Cross-Sections				
Terminal Type				
Terminal Size per IEC 60947-1			2 x A4	2 x A4
Solid/ Stranded‡	1 Conductor	[mm²]	1.5…6	0.5…2.5
	2 Conductor	[mm²]	1.5…6	0.75…2.5
Max. Wire Size per UL/CSA		**[AWG]**	16…10	18…14
Tightening Torque		[lb·in]	13.3…22	8.9…13.3
Tightening Torque		[N·m]	1.5…2.5	1…1.5

‡ For 16 or more strands, end ferrule is required

DC Switching Ratings for 700S-CF Main Poles in Series (Resistive Load at 60 °C)

	1 pole	2 poles	3 poles
24/48V	25/20 A	25 A	25 A
125V	6 A	25 A	25 A
220V	1.5 A	8 A	25 A
440V	0.4 A	1 A	3 A

Specifications, Continued

			Main Relay Cat. Nos. 700-CF, 700S-CF	Front Mounted Standard Auxiliary Contacts	Main Relay Cat. No. 700-CFB, 700S-CFB	Master Relay Cat. No. 700-CFM	Front Mounted Bifurcated Auxiliary Contacts	Side-mounted Auxiliary Contacts
Contact Ratings — NEMA			A600, P600	A600, Q600	A600, Q600	2 x A600, P600	A600, Q600	A600, Q600
Min. Contact Rating			17V, 10 mA	17V, 5 mA	8V, 5 mA	—	5V, 3 mA	17V, 10 mA
Contact Ratings — IEC AC-15 (solenoids, contactors) at rated voltage IEC 60947-5-1		24V	10 A	6 A	3 A	15 A	3 A	6 A
		48V	10 A	6 A	3 A	15 A	3 A	6 A
		120V	10 A	6 A	3 A	15 A	3 A	6 A
		240V	10 A	5 A	3 A	15 A	3 A	5 A
		400V	6 A	3 A	2 A	7.5 A	2 A	3 A
		480V/500V	2.5 A	1.6 A	1.2 A	5 A	1.2 A	1.6 A
		600V	1 A	1 A	0.7 A	2 A	0.7 A	1 A
		690V	1 A	1 A	0.7 A	2 A	0.7 A	1 A
AC-12 (Control of resistive loads) IEC 60947-5-1	**40 °C**	***I*th**	20 A	10 A	10 A	20 A	10 A	10 A
		230 V	8 kW					
		400 V	14 kW					
		690 V	24 kW					
	60 °C	***I*th**	20 A	6 A	6 A	20 A	6 A	6 A
		230V	8 kW					
		400V	14 kW					
		690V	24 kW					
DC-12 Switching DC Loads L/R < 1ms, Resistive Loads IEC 60947-5-1		24V	15 A	10 A	6 A	20 A	6 A	6 A
		48V	10 A	9 A	3.2 A	20 A	3.2 A	3.2 A
		110V	6 A	3.5 A	1 A	8 A	1 A	1 A
		220V	1 A	0.7 A	0.5 A	1.5 A	0.5 A	0.5 A
		440V	0.4 A	0.2 A	0.2 A	0.4 A	0.2 A	0.2 A
DC-13 IEC 60947-5-1, Solenoids and contactors		24V	5 A	5 A	2.5 A	5 A	2.5 A	5 A
		48V	3 A	3 A	1.5 A	3 A	1.5 A	3 A
		110V	1.2 A	1.2 A	0.6 A	1.2 A	0.6 A	1.2 A
		220V	0.6 A	0.6 A	0.3 A	0.6 A	0.3 A	0.6 A
		440V	0.3 A	0.15 A	0.15 A	0.3 A	0.15 A	0.15 A

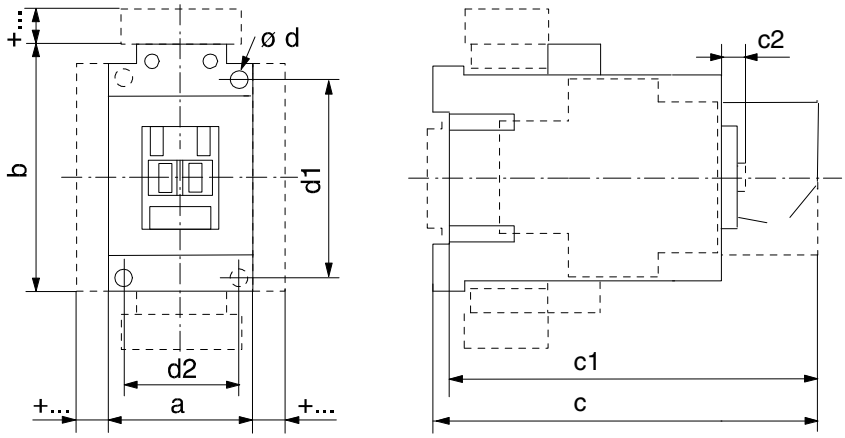
∗ Side mounted auxiliary contacts provide “mirror contact” performance with main poles only.

	Location of welded N.O. contacts	State of N.C. Contacts if N.O. contact welds		
		Main	Front aux.	Side aux.
Mechanically Linked Contacts❄	Main	Open	Open	Open∗
	Front aux.	Open	Open	—

❄ Defined in IEC 60947-5-1 annex L. Mechanically linked is a relationship between contacts of opposite types (i.e., N.O. and N.C.).

Approximate Dimensions

Approximate Dimensions are shown in millimeters (inches). Approximate Dimensions are not intended for manufacturing purposes.



AC and DC EJ Safety Control Relays

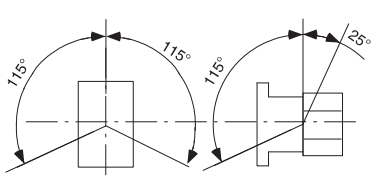
Cat. No.	a	b	c	c1	c2	Ød	d1	d2
700S-CF	45	81	119.5	114.5	6	2 - 4.5	60	35
	(1-25/32)	(3-3/16)	(4-3/4)	(4-43/64)	(1/4)	(2 - 3/16)	(2-23/64)	(1-25/64)

DC Safety Control Relays

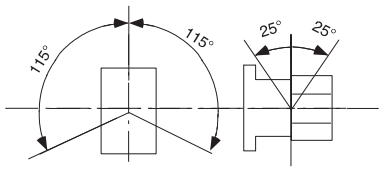
Cat. No.	a	b	c	c1	c2	Ød	d1	d2
700S-CF	45	81	145.5	140.5	6	2 - 4.5	60	35
	(1-25/32)	(3-3/16)	(5-49/64)	(5-37/64)	(1/4)	(2 - 3/16)	(2-23/64)	(1-25/64)

Safety Control Relays with	mm	[in.]
Auxiliary contact block for side mounting 1- or 2-pole	a + 9	(a + 23/64)
Electronic Timing Module on coil terminal side	b + 24	(b + 15/16)
Interface Module on coil terminal side	b + 9	(b + 23/64)
Surge Suppressor on coil terminal side	b + 3	(b + 1/8)
Labeling with label sheet	+ 0	(+ 0)
Marking tag sheet with clear cover	+ 0	(+ 0)
Marking tag adapter for System Bul. 1492W	+ 5.5	(+ 7/32)

Mounting Position



AC and DC E Safety Control Relays



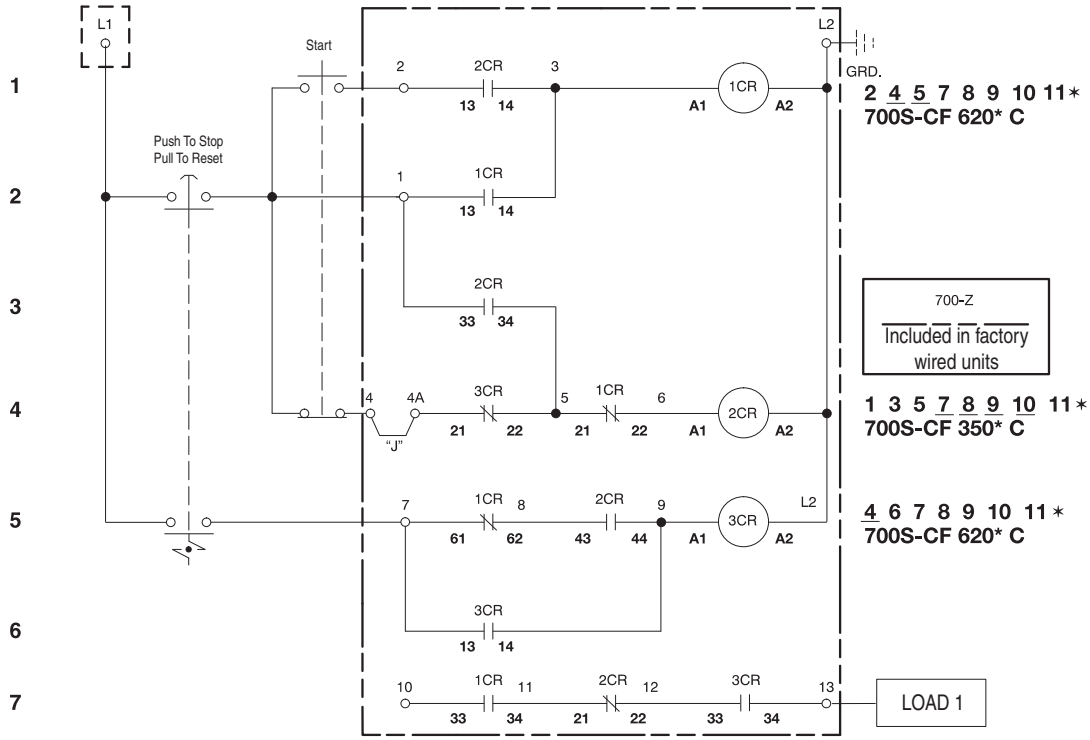
DC Safety Control Relays

Safety Relay Circuit With 5 Safety Outputs

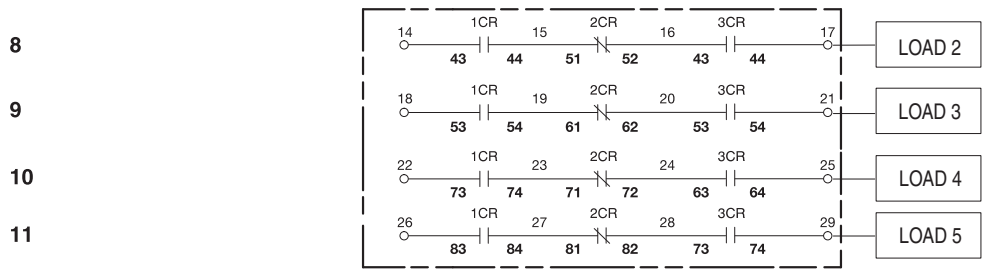
- Use for E-stop control. E-stop will work properly if any one fault occurs (a fault could be one welded contact or one undesired open connection such as a loose wire).
- High output switching capability and long contact life.
- Circuit complies with EN 954 categories 1, 2, 3, 4.
- Helps prevent restart of the 5 safety outputs if there is a single fault anywhere in the system.
- Use (3) 700S-CF relays and this diagram to construct the circuit

Basic Circuit
(1) Output Circuit (3 Relays, 9 Terminal Blocks)

Basic Circuit
(1) Output Circuit (3 Relays, 9 Terminal Blocks)



(5) Output Circuit (3 Relays, 17 Terminal Blocks)



* Numbers shown are the line numbers where the contacts for this relay appear.
Contact your local Rockwell Automation sales office or Allen-Bradley distributor for availability.

Features

- Mechanically linked contacts meet IEC 947-5-1-L
- 2…12 poles – all mechanically linked
- Red cover for easy identification of safety circuits
- Tamper resistant cover helps prevent changes which could jeopardize safety
- IEC mechanically linked contacts symbol displayed on front
- Visual indication of contact state
- Ideal for use in safety circuits

Certifications

cULus Listed (File No. E14840, Guide NKCR/NKCR7)
CE Certified
ABS Certified

Standards Compliance

UL 508
CSA C22.2 No. 14

Product Selection

Bulletin 700S-P (10 A) Safety Control Relays — AC and DC Coil Voltages

Contacts		AC Coils	24V DC Coils	
		Open Type Panel Mount Relay Rail Mount	Open Type Panel Mount Relay Rail Mount	Open Type DIN Rail Mount
N.O.	N.C.	Cat. No.∗	Cat. No.∗	Cat. No.∗
3	1	700S-P310⊗	700S-DCP310Z24	700S-DCP310DZ24
2	2	**700S-P220⊗**	700S-DCP220Z24	700S-DCP220DZ24
7	1	700S-P710⊗	700S-DCP710Z24	700S-DCP710DZ24
6	2	700S-P620⊗	700S-DCP620Z24	700S-DCP620DZ24
5	3	700S-P530⊗	700S-DCP530Z24	700S-DCP530DZ24
4	4	**700S-P440⊗**	700S-DCP440Z24	700S-DCP440DZ24
3	5	700S-P350⊗	700S-DCP350Z24	700S-DCP350DZ24
10	2	700S-P1020⊗	700S-DCP1020Z24	700S-DCP1020DZ24

Bulletin 700S-PK (20 A) Safety Control Relays

Contacts		Coil Voltage	Cat. No.
N.O.	N.C.		
7	1	110V AC	700S-PK710A1
6	2	110V AC	700S-PK620A1
5	3	110V AC	700S-PK530A1
4	4	110V AC	700S-PK440A1
3	5	110V AC	700S-PK350A1
10	2	110V AC	700S-PK1020A1
3	1	110V AC	700S-PK310A1
7	1	24V DC	700S-DCPK710Z24
6	2	24V DC	700S-DCPK620Z24
5	3	24V DC	700S-DCPK530Z24
4	4	24V DC	700S-DCPK440Z24
3	5	24V DC	700S-DCPK350Z24
10	2	24V DC	700S-DCPK1020Z24
3	1	24V DC	700S-DCPK310Z24

⊗AC Coil Voltage Code

The Cat. No. as listed is incomplete. Select a coil voltage code from the table below to complete the Cat. No.
Example: **Cat. No. 700S-P310** becomes **Cat. No. 700S-P310A1** for a 120V AC coil.

[V]	24	115...120	230...240	460...480
60 Hz	A24	**A1**	A2	A4

∗ For other coil voltages, consult your local Rockwell Automation sales office or Allen-Bradley distributor.

IEC 947-5-1 Annex L has 2 requirements for a relay to meet for mechanically linked contacts:
1.) If a N.O. contact welds, all the N.C. contacts will remain open and meet a 2500V impulse test.
2.) If a N.C. contact welds, all the N.O. contacts will remain open and meet a 2500V impulse test.
Bul. Nos. 700S-P and 700S-DCP relays meet these requirements including the 2500V impulse test.
The relays shown on this page are shipped from the factory with the Bul. 700-CPS safety cartridge installed and cannot be converted to N.O. or N.C. in the Field.

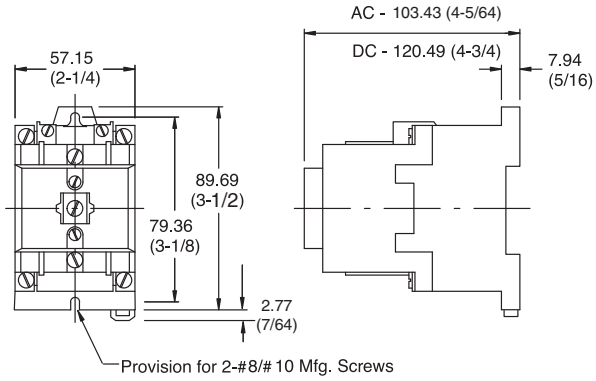
Specifications

Type			700S-P						700S-PK					
Electrical														
Contact Rating Continuous			10 A @ 600V AC 5 A @ 600V DC						20 A @ 600V AC 10 A @ 600V DC					
Ratings Make/Break	AC		NEMA A600						NEMA A600					
	DC		NEMA P600						NEMA P600					
Minimum Contact Switching Ratings			10V, 50 mA						3 Hp @ 240V AC - N.O. 2 Hp @ 240V AC - N.O./N.C. 1 HP @ 120V AC - N.O./N.C. 20 A resistive heating to 600V AC 20 A Tungsten lighting load to 480V AC					
DC Switching	Contacts in Series		Volts DC						Volts DC					
			24V	64V	125V	250V	500V	600V	24V	64V	125V	250V	500V	600V
	1		5 A	2.2 A	1.1 A	0.55 A	0.24 A	0.2 A	10 A	5 A	2.2 A	0.55 A	0.24 A	0.2 A
	2		10 A	10 A	5 A	2 A	0.7 A	0.5 A	20 A	10 A	5 A	2 A	0.7 A	0.5 A
	3		—	—	7 A	3 A	1.5 A	1.0 A	—	15 A	7 A	3 A	1.5 A	1.0 A
	4		—	—	10 A	5 A	2.5 A	1.5 A	—	20 A	10 A	5 A	2.5 A	1.5 A
Coil Voltage Range*	AC		85…110%						85…110%					
	DC		80…110%						80…110%					
	Battery Charging		85…115%						85…115%					
Coil Consumption			50 Hz			60 Hz			50 Hz			60 Hz		
	AC	Inrush	132 VA			138 VA			132 VA			138 VA		
		Sealed	19.3 VA			19 VA			19.3 VA			19 VA		
	DC	Inrush	12.7 W						12.7 W					
		Sealed	12.7 W						12.7 W					
Additional Contact Rating for AC Single-Phase Loads			—						3 HP @ 240V AC - N.O. 2 HP @ 240V AC - N.O./N.C. 1 HP @ 130V AC - N.O./N.C. 20 A Resistive Heating to 600V AC 20 A Tungsten Lighting Load to 480V AC Cartridge Cat. No. Bulletin 700S-CMS					
Mechanical														
Mechanically Linked Contacts			All contacts are mechanically linked per IEC 947-5-1 annex L for 2 to 12 poles						All contacts are mechanically linked per IEC 947-5-1 annex L for 2 to 12 poles					
Operating Time	Pickup		AC – 10…20 ms DC – 30…50 ms						AC – 10…20 ms DC – 30…50 ms					
	Dropout		AC – 10…20 ms DC – 20…33 ms						AC – 10…20 ms DC – 20…33 ms					
Mechanical Life			10 million operations											
Construction														
Contact Arrangement			2 to 12 Poles, Double Break Contacts N.O. or N.C. (8 N.C. Maximum)						2 to 12 Poles, Convertible to N.O. or N.C. (8 N.C. Maximum)					
Contact Material/Design			Silver Nickel/Bifurcated						Silver Cadmium Oxide					
Mounting			Panel mount or mount on 700-MP Relay or DIN Rail Horizontal Mounting Recommended						Panel mount or mount on 700-MP Relay or DIN Rail Horizontal Mounting Recommended					
Environmental														
Temperature	Operating‡		–20…+65 °C (–4…+149 °F)						–20…+65 °C (–4…+149 °F)					
	Storage		–40…+65 °C (–40…+149 °F)						–40…+65 °C (–40…+149 °F)					
Wire Terminations														
Wire size per UL/CSA			#18 AWG…(2) #12 AWG						#18 AWG…(2) #12 AWG					
Tightening Torque			8…12 lb•in (0.9…1.4 N•m)						8…12 lb•in (0.9…1.4 N•m)					

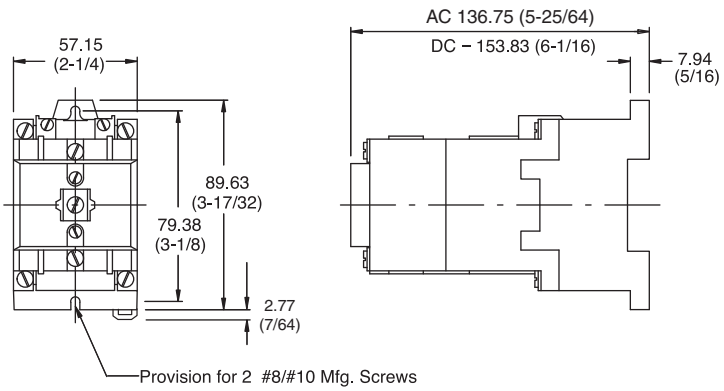
* Coil voltage required for proper operation (percent of rated coil voltage).
‡ Temperature inside the panel.

Approximate Dimensions

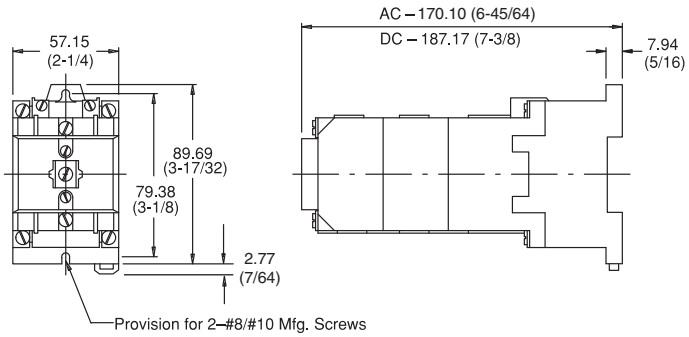
Dimensions are shown in millimeters (inches). Dimensions are not intended for manufacturing purposes.



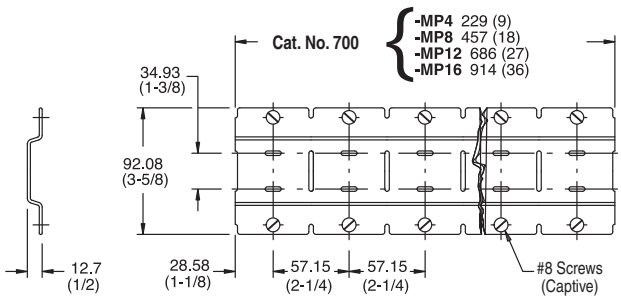
2- and 4-pole Bulletin 700S-P Relay — Approximate Shipping Weight AC – 0.68 kg (1.5 lb), DC – 1.34 kg (2.95 lb)



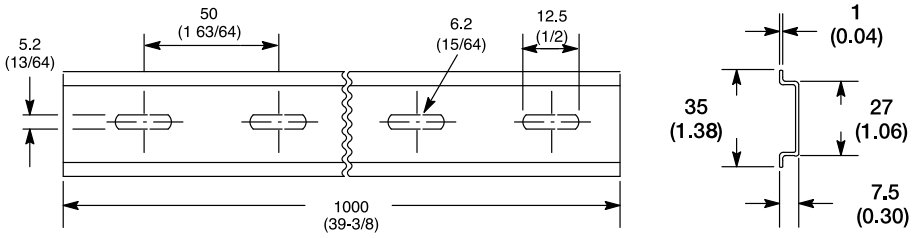
6- and 8-pole Bulletin 700S-P Relay Approximate Shipping Weight AC – 0.79 kg (1.75 lb), DC – 1.45 kg (3.20 lb)



10- and 12-pole Bulletin 700S-P, Approximate Shipping Weight AC – 1.02 kg (2.25 lb), DC – 1.68 kg (3.7 lb)



Relay Rail



DIN Rail

Safety Starter

Bulletin 109S

Description

The Bulletin 109S Safety Starter combines many features of the standard Bulletin 109 Enclosed Starter with a redundant contactor. The redundant safety contactor makes the Bulletin 109S suitable for use in Category 3 and 4 safety circuits. The safety circuit interface is designed to work with Safety Monitoring Relays, Safety PLC and GuardLogix, allowing the typical safety circuit to control higher switching currents and motor loads (9…860 A). This makes the safety system integration quicker and easier to apply by using a modular approach to the safety solution.

Features

- Positive-guided auxiliary contacts (9…85 A) and mirrored auxiliary contacts (95…860 A)
- 24V DC or 120V AC (50/60 Hz) control voltage
- Cover-mounted green pilot light (illuminated when output is on)
- Up to 600V line voltage
- Options similar to the standard Bulletin 109 enclosed starters
- Optional overload relay (E1 Plus and E3)

Specifications

Input Line Voltage Range	600V AC maximum
Control Voltage Range	24V DC or 110/120V AC (50/60 Hz)
Enclosure Rating	Type 12 (IP54) Open frame
System Operational Limits	+10%, -15% of the line voltage
Estimated Component Life	1,000,000 operations
Storage Temperature [C (F)]	-40…+80° (-40…176°)
Operating Temperature, Ambient—C (F)	-25…+40° (-13…104°)
Relative Humidity	90% noncondensing
Approvals	CE Marked for all applicable directives cULus
Standards/Certifications	Redundant contactors suitable for use in Category 3 or 4 systems UL 508A

Product Selection

Bulletin 109S cat. nos. can be configured by selecting the appropriate codes from the tables below.

109S — C30 J 1 1CD — 1E
a b c d e

a

Contactor Size	
Code	Amps [A]
C09	9
C12	12
C16	16
C23	23
C30	30
C37	37
C43	43
C60	60
C72	72
C85	85
D95	95
D110	110
D140	140
D180	180
D210	210
D250	250
D300	300
D420	420
D630	630
D860	860

b

Enclosure Type∗	
Code	Description
J	Type 12/IP54
N	Open (no enclosure) Components are mounted on a sub-panel

∗ Other enclosure types are available upon request.

c

Control Voltage	
Code	Description
1	24V DC DJ = 9…85 A EZJ = 95…300 A 420…860 = Not available
2	120V AC D = 9…85 A ED = 95…860 A

d

E3 Plus Overload Relay (193-ECxxx)❄		
Code	Load Rating Amps [A]	Starter
1PB	0.4…2.0	C09…C23
1AB	1…5	
1BB	3…15	
1CB	5…25	
1AD	1…5	C30…C43
1BD	3…15	
1CD	5…25	
1DD	9…45	
1DE	9…45	C60…C85
1EE	18…90	
1FF	28…140	D95…D180
1GF	42…210	
1GG	42…210	D210…D420
1HG	60…302	
1JG	84…420	
1KH	125…630	D630…D860
1LH	172…860	

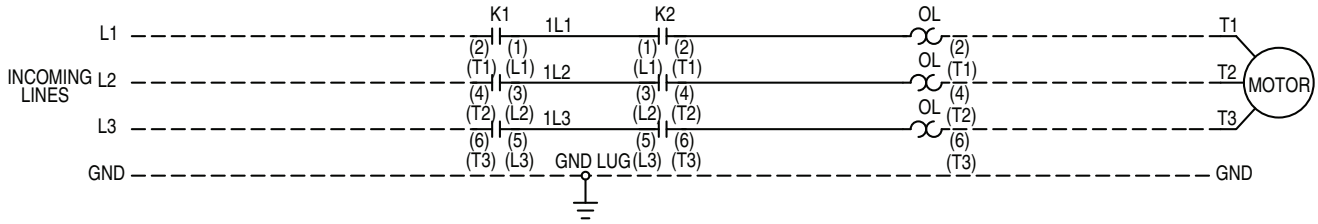
E1 Plus Overload Relay (193-Exxx)❄		
Code	Load Rating Amps [A]	Starter
EAB	0.1…0.5	C09…C23
EBB	0.2…1.0	
ECB	1…5	
EDB	3.2…16	
EEB	5.4…27	
EED	5.4…27	C30…C43
EFD	9…45	
EGE	18…90	C60…C85
EHF	30…150	D95…D180
EJF	40…200	
EJG	40…200	D210…D420
EKG	60…100	
ELG	100…500	
EMH	120…600	D630…D860
ENH	160…800	

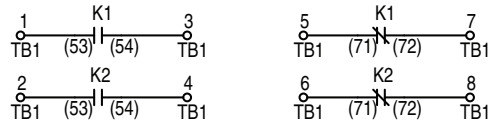
❄ If the overload relay configuration code field is left blank, an overload relay will not be provided.

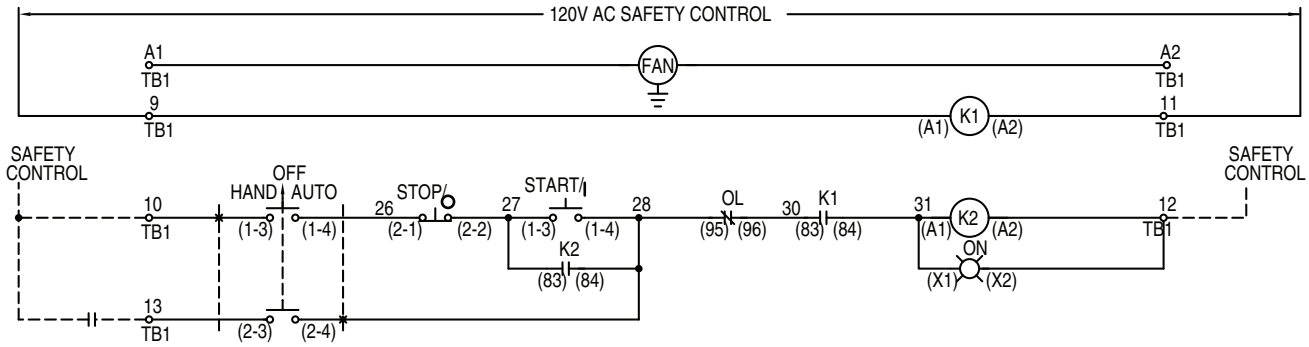
e

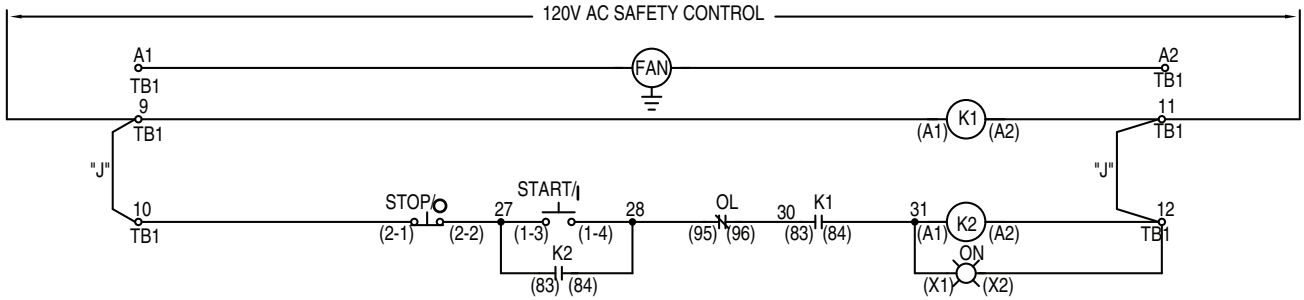
Operator Devices	
Code	Description
1	Stop/Start PB
1E	On/Off PB
3	Hand/Off/Auto SS
3E	On/Off SS
4R	Red Pilot Light
Blank	No options

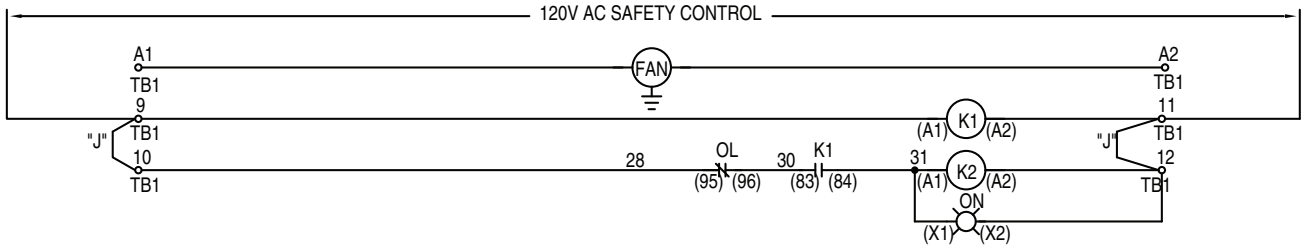
Typical Wiring Diagrams











Description

The Bulletin 2041 Safety Power Control combines safety circuits and power control of the redundant contactors and a safety relay. The Bulletin 2041 is TÜV certified for category 4 safety circuits. The safety circuit interface is designed to work with either light curtain outputs or safety interlock switches. The Bulletin 2041 also interfaces with Safety Monitoring Relays, Safety PLC, and GuardLogix solutions to allow for control of power circuits from 9…860 A at 600V maximum. This makes system integration quicker and easier by using a modular approach to the safety solution.

Features

- Positive-guided auxiliary contacts (9…85 A) and mirrored auxiliary contacts (95…860 A)
- 24V DC or 120V AC (50/60 Hz) control voltage
- Cover-mounted green pilot light (illuminated when output is on)
- Up to 600V line voltage
- Optional overload relay (E1 Plus and E3)

Specifications

Input Line Voltage Range	600V AC maximum
Control Voltage Range	24V DC or 110/120V AC (50/60 Hz)
Enclosure Rating	Type 12 (IP54) Open Frame
System Operational Limits	+10%, -15% of the line voltage
Estimated Component Life	1,000,000 operations
Storage Temperature [C (F)]	-40…+80° (-40…176°)
Operating Temperature, Ambient [C (F)]	-25…+40° (-13…104°)
Relative humidity	90% noncondensing
Approvals	CE Marked for all applicable directives TÜV Category 4 cULus
Standards/Certifications	Category 4 systems UL 508A

Product Selection

Bulletin 2041 cat. nos. can be configured by selecting the appropriate codes from the tables below.

2041 — C30 J 1 1CD — 7B
a b c d e

a

Contactor Size	
Code	Amps [A]
C09	9
C12	12
C16	16
C23	23
C30	30
C37	37
C43	43
C60	60
C72	72
C85	85
D95	95
D110	110
D140	140
D180	180
D210	210
D250	250
D300	300
D420	420
D630	630
D860	860

b

Enclosure Type	
Code	Description
J	Type 12/IP54
N	Open (no enclosure) components are mounted on a sub-panel

c

Control Voltage	
Code	Description
1	24V DC DJ = 9…85 A EZJ = 95…300 A 420…860 = Not available
2	120V AC D = 9…85 A ED = 95…860 A

d

E3 Plus Overload Relay (193-ECxxx)*		
Code	Load Rating Amps [A]	Starter
1PB	0.4…2.0	C09…C23
1AB	1…5	
1BB	3…15	
1CB	5…25	
1AD	1…5	C30…C43
1BD	3…15 A	
1CD	5…25	
1DD	9…45	
1DE	9…45	C60…C85
1EE	18…90	
1FF	28…140	D95…D180
1GF	42…210	
1GG	42…210	D210…D420
1HG	60…302	
1JG	84…420	
1KH	125…630	D630…D860
1LH	172…860	

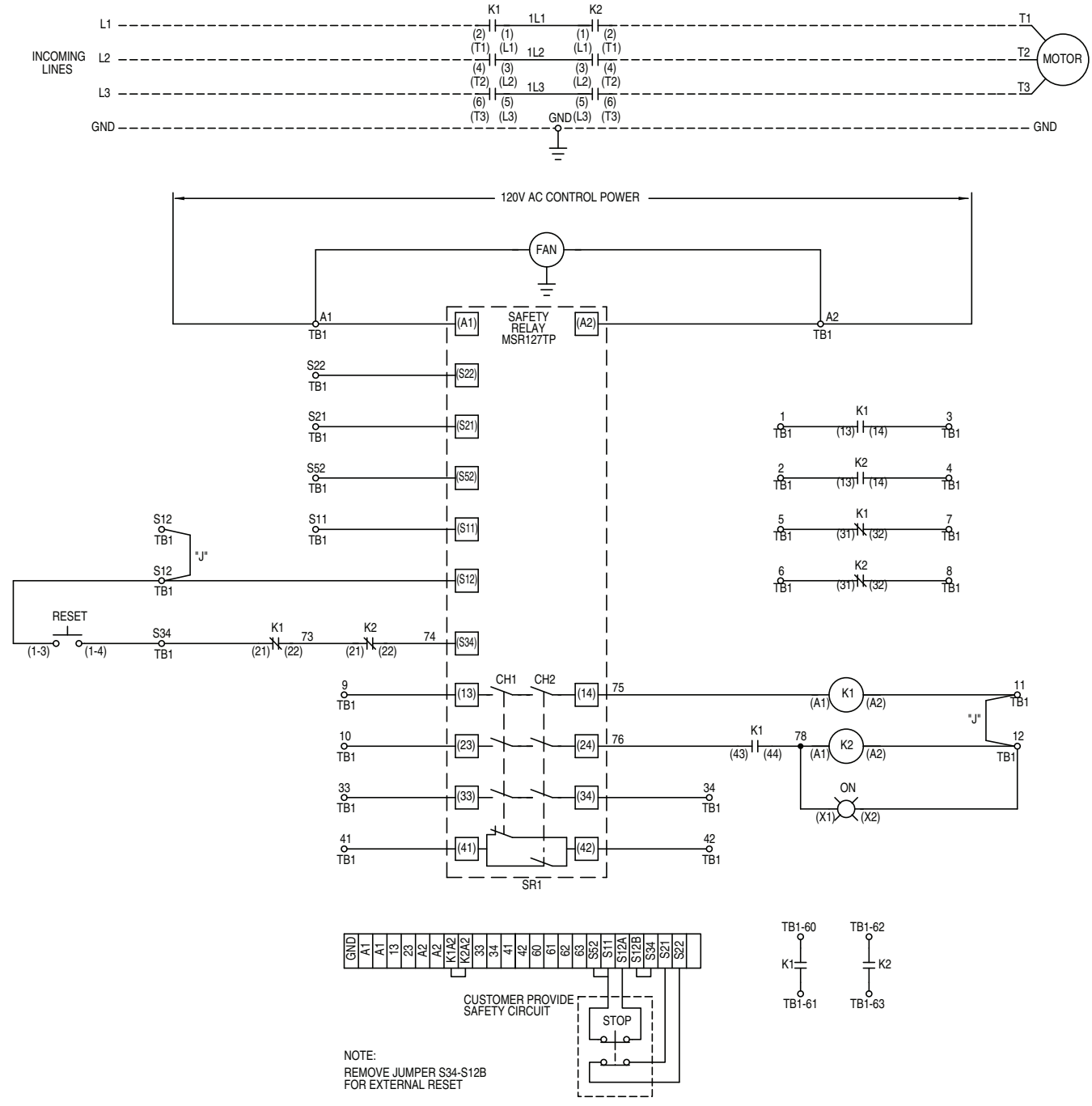
E1 Plus Overload Relay (193-Exxx)*		
Code	Load Rating Amps [A]	Starter
EAB	0.1…0.5	C09…C23
EBB	0.2…1.0	
ECB	1…5	
EDB	3.2…16	
EEB	5.4…27	
EED	5.4…27	C30…C43
EFD	9…45	
EGE	18…90	C60…C85
EHF	30…150	D95…D180
EJF	40…200	
EJG	40…200	D210…D420
EKG	60…100	
ELG	100…500	
EMH	120…600	D630…D860
ENH	160…800	

* If the overload relay configuration code field is left blank, an overload relay will not be provided.

e

Operator Devices	
Code	Description
Blank	No options
7B	Front mount safety reset
4R	Red pilot light (replaces standard green)

Typical Wiring Diagram

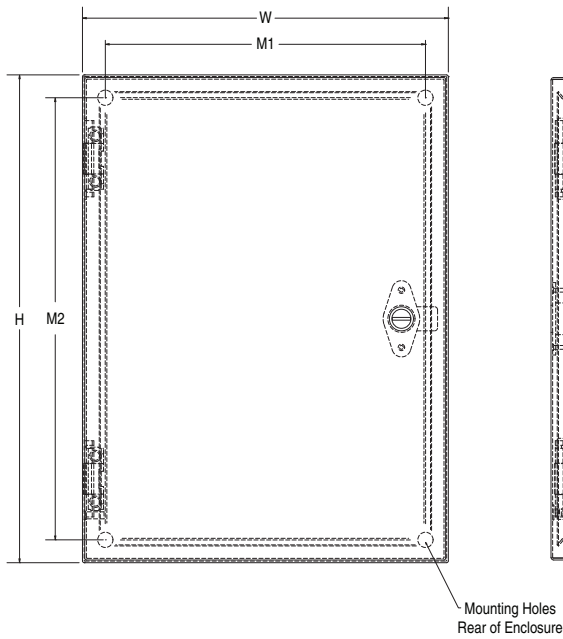


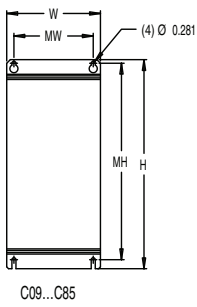
Approximate Dimensions [mm (in.)]

Dimensions are not intended to be used for manufacturing purposes.

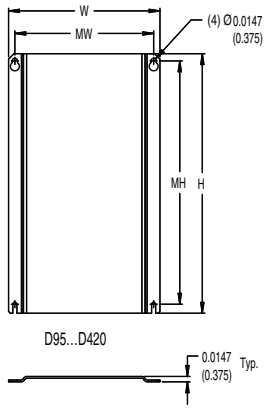
Type 12 Enclosure				
Contactor Size	Panel Dimensions (H x W x D)	(M2) Height [mm (in.)]	(M1) Width [mm (in.)]	Mounting Holes [mm (in.)]
C09…C16	12 x 10 x 8	324 (12.75)	203 (8.0)	8 (0.31)
C23…C30	16 x 12 x 10	368 (14.5)	267 (10.5)	13 (0.5)
C37…C43	16 x 12 x 10	368 (14.5)	267 (10.5)	13 (0.5)
C60…C85	16 x 12 x 10	368 (14.5)	267 (10.5)	13 (0.5)
C95…D180	24 x 24 x 10	572 (22.5)	572 (22.5)	13 (0.5)
D210	24 x 24 x 10	572 (22.5)	572 (22.5)	13 (0.5)
D250…D300	24 x 24 x 10	572 (22.5)	572 (22.5)	13 (0.5)
D420	24 x 24 x 10	572 (22.5)	572 (22.5)	13 (0.5)
D630…D860	36 x 30 x 12	572 (22.5)	724 (28.5)	13 (0.5)

Open Panel				
Contactor Size	Panel Dimensions (H x W x D)	(MH) Height [mm (in.)]	(MW) Width [mm (in.)]	Mounting Holes [mm (in.)]
C09…C16	14.5 x 6.5 x 6.1	349 (13.75)	140 (5.5)	7 (0.281)
C23…C30	14.5 x 6.5 x 7.5	349 (13.75)	140 (5.5)	7 (0.281)
C37…C43	14.5 x 6.5 x 7.6	349 (13.75)	140 (5.5)	7 (0.281)
C60…C85	14.5 x 6.5 x 6.5	349 (13.75)	140 (5.5)	7 (0.281)
C95…D180	18 x 10.5 x 6.5	429 (16.875)	242 (9.525)	9.5 (0.375)
D210	23 x 12 x 7.5	538 (21.175)	283 (11.125)	9.5 (0.375)
D250…D300	23 x 12 x 7.5	538 (21.175)	283 (11.125)	9.5 (0.375)
D420	23 x12 x 7.5	538 (21.175)	283 (11.125)	9.5 (0.375)
D630…D860	35 x 17 x 11.3	432 (17.0)	410 (16.125)	9.5 (0.375)

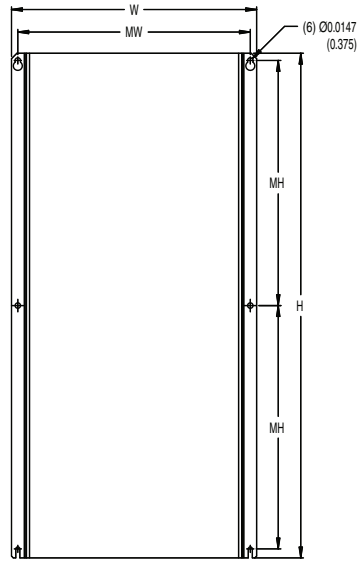




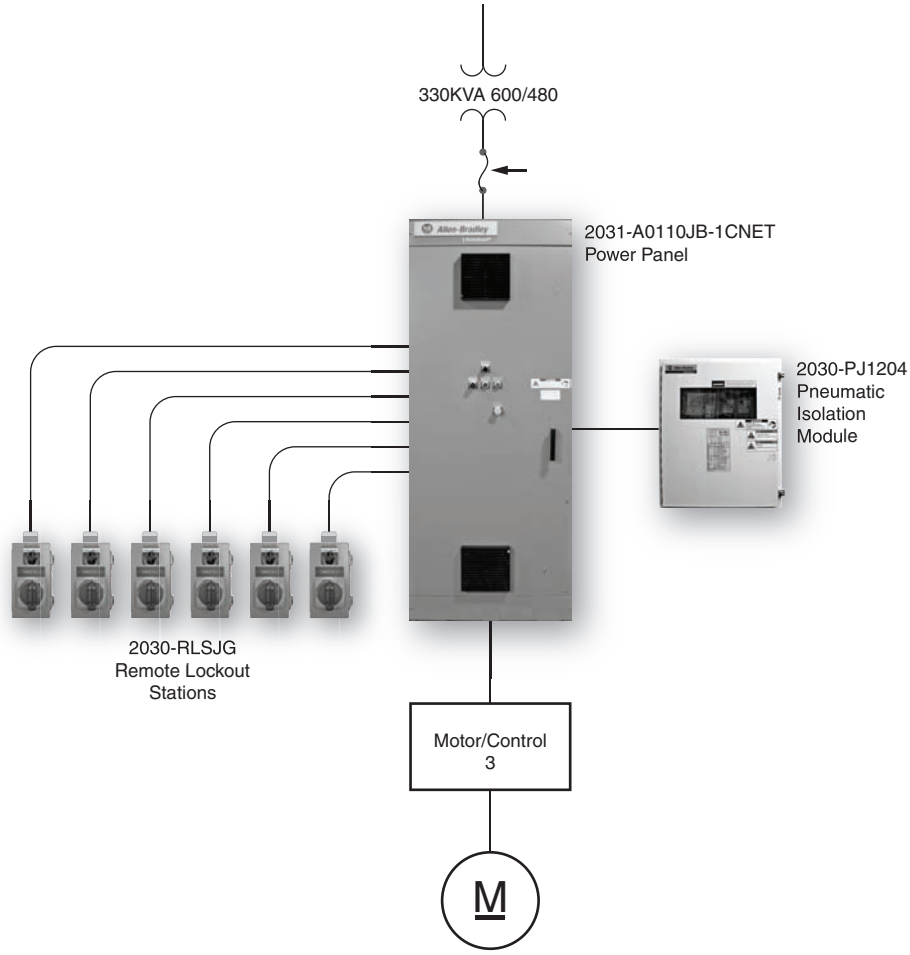
C09...C85



D95...D420



D630...D860



Typical System

Description

The ElectroGuard system is designed to simplify the Lock Out/Tag Out (LOTO) task performed by a machine operator or maintenance personnel. The ElectroGuard system can control single or multiple energy sources simultaneously. Simplifying the procedure helps increase the likelihood that personnel will perform the LOTO on large processors or drive systems.

The ElectroGuard system can be configured with modules to provide:

- Electrical energy isolation (ElectroGuard Power Panel).
- Pneumatic energy isolation (Pneumatic Isolation Module).
- Hydraulic energy isolation (Hydraulic Isolation Module).
- Multiple lockout points (Remote Lockout Stations).
- Control of multiple systems (System Multiplexer/Permissive or Dual RLS).
- Interface to safety-gate interlocks (Verification Module).

The ElectroGuard allows the system engineer to design LOTO into the system. Locating the Remote Lockout Stations (RLS) at hazard entry points can result in the shortest down time during set-up or maintenance.

Standard Features

- System is designed to prevent accumulation of faults.
- Standard system provides for four RLS on the 23…85 A systems and up to six RLS on the 110…1200 A systems.
- Verification light on the RLS (no light means no entry).
- Meets International Standard EN 954-1/ISO 13849-1, TÜV certified Category 4 system.
- Pneumatic and hydraulic ready.

Optional Features

- Expansion modules allow for additional RLS connections.
- Pneumatic and hydraulic energy isolation.
- System multiplexer/permissive module allows for control of multiple energy sources simultaneously.
- Network communication option provides the control system with status.

Specifications

Certifications	cULus TÜV Rheinland Certified CE marked for all applicable directives
Standards	IEC/EN 60204-1 IEC/EN 60439-1 Category 4 to EN 954-1/ISO 13849-1 98/37/EC Machinery Directive 89/336/EC EMC Directive 73/23/EC Low Voltage Directive UL508A
Estimated Component Life Remote Lockout Station Power Contactors (Isolation & Grounding)	23… 85 A: 2,000,000 operations 110…1200 A: 1,000,000 operations
Storage Temperature [C (F)]	-10…+60° (14…140°)
Operating Temperature [C (F)]	0…+40° (32…104°)
Relative Humidity (noncondensing)	90% (Ambient)
Power Panel Construction	NEMA Type 12/IP54 UL Type 4/IP66 UL Type 4x MCC (Bulletin 2100) with and without Bus
Expansion Module Construction	4-port: Supports up to 4 remote lockout stations 10 port: Supports up to 10 remote lockout stations
Safety Isolation System Inputs	Remote Lockout Stations
Input Options	Safety Mats, Light Curtains, and E-Stop Stations
System Operational Limits	+10%, -15% of the line voltage

Sequence of Operation

After using the normal stopping method of the machine or process, the machine operator turns a Remote Lockout Station (RLS) handle from the ON to the OFF position.

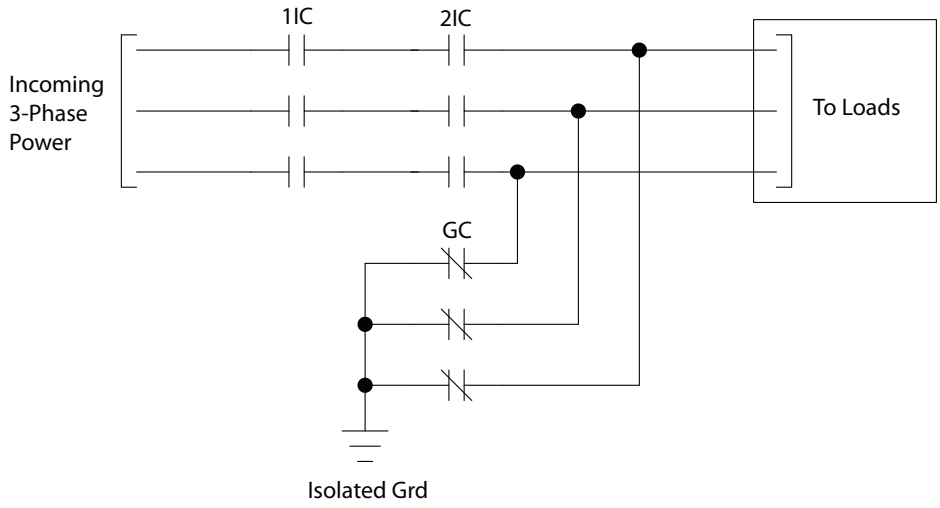
The RLS signals the:

1. Isolation contactors (1IC and 2IC) to drop out, isolating the supply voltage from the loads (see Power Circuit below).

2. The grounding contactor (GC) is then energized, connecting the load to ground (see Power Circuit). The grounding contactor and the isolation contactors are both electrically and mechanically interlocked.

3. The System Isolated light will then illuminate on the RLS to indicate the system is isolated.

4. The person performing the LOTO then applies a lock to the RLS, locking it in the OFF position. The equipment is now locked out.



Power Circuit

Communication

The optional Communication Module allows the ElectroGuard system to communicate status to the process or machine control system. Although the communication module can be field installed, it is recommended that this option be ordered as part of the ElectroGuard system. The customer is responsible for configuring and programming their control system to receive the status signals from the ElectroGuard.

Status signals available:
- Overall system status
- Remote lockout station (status of each station)
- Pneumatic or hydraulic isolation modules (if used)
- Other optional safety input devices

Current networks available*:
- DeviceNet™
- Remote I/O
- ControlNet™
- Ethernet IP
- PROFIBUS

See the ElectroGuard or accessories for ordering instructions.

IMPORTANT	The communication option allows a remote PLC to receive status signals from the ElectroGuard safety isolation system.

Door Mounted Metering

Optional door mounted ampere meter, volt meter, or both, are available as factory installed options. They provide visual indication of line side system current and voltage. See the ElectroGuard or accessories for ordering instructions.

Expansion Module

Expansion Modules are used to add more Remote Lockout Stations in addition to the base inputs (four remote lockout stations for 23…85 A units and six for the 110…1200 A systems). See expansion module section for details.

Multiplexer and Multiplexer Permissive

The Multiplexer Module allows the Remote Lockout Station to control two or more ElectroGuard systems. The permissive function allows the equipment control system to determine if the ElectroGuard can be locked out. See Multiplexer and Multiplexer Permissive section for sequence of operation and details.

IMPORTANT	Only one of these options can be installed in the power panel, and are not available on the 23…85 A units, or 2031-A0630JX or 2031-A860JX units.

Product Selection

ElectroGuard cat. nos. can be configured by selecting the appropriate codes from the tables below.

2302	—	A	0420	J	B	—	29J	—	1TD
a		*b*	*c*	*d*	*e*		*f*		*g*

a

Safety Type	
Code	Description
2031	Noncombination
2032	Fusible Disconnect
2033	Thermal-Magnetic Circuit Breaker

b

Construction Code	
Code	Description
A	Free-standing enclosure
B§	Motor control center enclosure for North America with line side incoming power cables and 1200 A load side outgoing bus∗.
F§	Motor control center enclosure for North America with line side incoming power cables and 600 A load side outgoing bus∗.
M§	Motor control center enclosure for North America with 600 A line side incoming bus∗ and outgoing power cables.
S§	Motor control center enclosure for North America with 1200 A line side incoming bus∗ and outgoing power cables.

∗ Bus Type: copper with tin plating.
§ Only available in NEMA Type 12/IP54.

c

Ampere Rating (AC-3)	Ratings∗ 3-Phase Max. Hp rating (60Hz)				3-Phase Max. kW rating (50 Hz)				2032 Fuse Clip Options❄	2033 Circuit Breaker Options‡
	200V	230V	460V	575V	230V	400V	500V	600V		
0023	5	7.5	15	15	7.5	11	11	11	24B, 24J, 25B, 25J	39, 39k, 40, 40k, 41, 41k, 42, 42k
0043	10	15	30	30	13	22	22	22	25B, 25J, 26B, 26J	40, 40k, 41, 41k, 42, 42k, 43, 43k, 44, 44k, 45
0085	25	30	60	60	25	45	45	45	26B, 26J, 27B, 27D, 27J	42, 42k, 43, 43k, 44, 44k, 45, 46, 46k, 47, 47k, 48, 48k
0110	40	40	74	100	32	55	63	100	27B, 27D, 27J, 28B, 28D, 28J	45, 46, 46k, 49, 49k, 50k
0180	50	60	150	150	55	90	110	160	27B, 27D, 27J, 28B, 28D, 28J	47, 47k, 48, 48k, 50k, 51, 51k, 52, 52k, 55k
0210	60	75	—	200	63	110	150	200	28B, 28D, 28J	48, 48k, 49, 49k, 53, 53k, 54, 54k, 59k
0300	100	125	250	300	90	160	200	300	28B, 28D, 28J, 29B, 29D, 29J	49, 49k, 50k, 51, 51k, 53, 53k, 54, 54k, 55k, 56, 56k, 57, 57k, 58, 58k, 59, 59k
0420	150	175	350	400	132	220	300	425	29B, 29D, 29J, 30B, 30D, 30L	51, 51k, 52, 52k, 53, 53k, 55k, 57, 57k, 58, 58k, 59, 59k, 60, 60k, 61, 61k, 62, 62k, 63, 63k, 64k
0630	200	250	500	600	200	355	450	500	30B, 30D, 30L, 31B, 31D, 32B, 34L	53, 53k, 54, 54k, 55k, 56, 56k, 59, 59k, 60, 60k, 61, 61k, 62, 62k, 63, 63k, 64k, 65k, 66k
0860	250	300	600	700	250	500	560	600	31D, 32B, 34L	56, 56k, 57, 57k, 58k, 59k, 60k, 61k, 62k, 63, 63k, 64k, 65k, 66k
1200	450	450	900	900	391	710	888	1043	31D, 34L	57, 57k, 58, 58k, 59, 59k, 60, 60k, 61k, 62k, 63, 63k, 64k, 65k, 66k

∗ Consult your local Rockwell Automation sales office or Allen-Bradley distributor for additional options.
❄ Available for 2032 fusible discconect only.
‡ Available for 2033 Thermal-Magnetic circuit breaker. Consult your local Rockwell Automation sales office or Allen-Bradley distributor for additional options.

d

Enclosure Type	
Code	Description
C§	Type 4X watertight stainless steel
F§	Type 4 watertight painted steel/IP65
J	Type 12 dusttight/IP54

§ Cooling to be supplied by customer.

e

Input Line Voltage	
Code	Description
A	240V 60 Hz/220V 50 Hz
B	480V 60 Hz/440V 50 Hz
C	600V 60 Hz/550V 50 Hz
G	400…415V 50 Hz
H	208V/60 Hz
M	500V 50 Hz
N	380…400V 50 Hz

f

2032 Fuse Clip Rating/Type♣		
Code	Rated Amps [A]	Fuse Type
24B	32 A	BS88
24J	30 A	Class J
25B	60 A	BS88
25J	60 A	Class J
26B	100 A	BS88
26J	100 A	Class J
27B	200 A	BS88
27D	160 A	DIN
27J	200 A	Class J
28D	250 A	DIN
28J	400 A	Class J
29B	400 A	BS88
29D	400 A	DIN
29J	600 A	Class J
30B	600 A	BS88
30D	630 A	DIN
30L	800 A	Class L
31B	800 A	BS88
1D	1600 A	DIN
32B	1250 A	BS88
34L	2000 A	Class L

♣ Fuse to be supplied by customer per local electrical code.

f

2033 Circuit Breaker Hp/kW Rating➢			
Code	Hp	Code	Power
39	5 Hp	39k	4 kW
40	7.5 Hp	40k	5.5 kW
41	10 Hp	41k	7.5 kW
42	15 Hp	42k	11 kW
43	20 Hp	43k	13 kW
44	25 Hp	44k	15 kW
45	30 Hp	—	—
46	40 Hp	46k	22 kW
47	50 Hp	47k	25 kW
48	60 Hp	48k	32 kW
49	75 Hp	49k	37 kW
—	—	50k	45 kW
51	125 Hp	51k	55 kW
52	150 Hp	52k	63 kW
53	175 Hp	53k	75 kW
54	200 Hp	54k	90 kW
—	—	55k	100 kW
56	250 Hp	56k	110 kW
57	300 Hp	57k	132 kW
58	350 Hp	58k	150 kW
59	400 Hp	59k	160 kW
60	450 Hp	60k	185 kW
61	500 Hp	61k	200 kW
62	600 Hp	62k	220 kW
63	700 Hp	63k	250 kW
—	—	64k	300 kW
—	—	65k	355 kW
66	900 Hp	66k	390 kW

➢ Consult your local Rockwell Automation sales office or Allen-Bradley distributor for additional circuit breaker options.

g

Factory-Installed Options	
Code	Description
1AM⌘	Single-phase ampere meter
3AM⌘	3-phase ampere meter
1VM✦	Single-phase voltmeter
3VM✦	3-phase voltmeter
1COM❖	Remote I/O module (16 points of I/O)
1CNET❖	ControlNet™ module (16 points of I/O)
1DNET❖	DeviceNet™ module (16 points of I/O)
1ENET❖	EtherNet module (16 points of I/O)
1PNET❖	PROFIBUS module (16 points of I/O)
1TD	Control module with factory-set 30-second time delay
1EUF♠	Four port expansion module
1EUT♠	Ten port expansion module
1SYS♠	System multiplexer module
1SYSP♠	System multiplexer permissive module
1HPM♠	Hydraulic/pneumatic multiplexer module

⌘ Only one can be selected for current monitoring.
✦ Only one can be selected for voltage monitoring.
❖ Only one of these can be installed in ElectroGuard.
♠ No module can be installed in the 23 A, 43 A and 85 A units and the 2031-x0630xx and 2931-x860xx units.

Replacement Control Module

2030-CH0085x

2030-CH0085x-ITD

2030-CH1200x

2030-CH1200x-ITD

x = See table "e" for input line voltages

1-1/2 in. Pneumatic Isolation Module

Pneumatic Isolation Module

The ElectroGuard Safety Isolation System is available with an optional means of isolating the pneumatic energy source for the machine or process. The Pneumatic Isolation Module is designed to work in conjunction with the power panel. This option blocks the pneumatic line leading to the pneumatic hazard. The valve then bleeds or dumps the residual pneumatic energy leading to the machine. After the valve is in the blocked position and the pressure drops to less than five psi (pounds per square inch), a signal is sent to the power panel indicating the pneumatic energy is isolated. The system isolated light, located on the Remote Lockout Station (RLS) that was switched to the OFF position, is then illuminated.

Hydraulic Isolation Module

Hydraulic Isolation Module

The ElectroGuard Safety Isolation System is available with an optional means of isolating the hydraulic energy source for the machine or process. The Hydraulic Isolation Module is designed to work in conjunction with the power panel. The valve blocks the hydraulic line leading to the hydraulic hazard. Then the residual hydraulic energy is returned to the tank. After the valve is in the blocked position and the pressure drops to less than 100 psi (pounds per square inch), a signal is sent to the power panel indicating the hydraulic energy is isolated. The system isolated light, located on the RLS that was switched to the OFF position, is then illuminated.

Bulletin 2030 Pneumatic and Hydraulic Isolation Modules

2030—	P	J	120	4
	a	*b*		*c*

a

Product Descriptor	
Code	Description
P	Pneumatic isolation module
H	Hydraulic isolation module

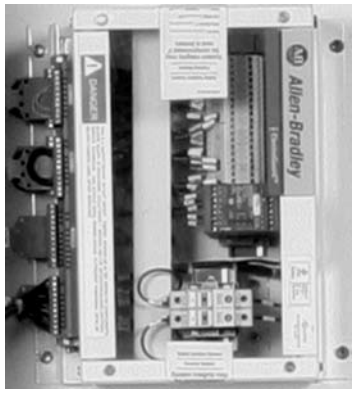
b

Enclosure Type	
Code	Description
C	Type 4X watertight stainless steel
F	Type 4 watertight painted steel/IP65
J	Type 12 dusttight/IP54

c

Port Size			
Code	Description	Pneumatic CFM at 90 PSI	Hydraulic GPM
2	1/2 in. NPT	160	❄
3	3/4 in. NPT	380	25
4	1 in. NPT	650	❄
5	1-1/4 SAE #20 straight thread	✶	120
6	1-1/2 in. NPT	1750	❄

✶ Not available in Pneumatic Isolation Module
❄ Not available in Hydraulic Isolation Module
CFM = Cubic feet per minute
GPM = Gallons per minute
NPT = National pipe thread
SAE = Society of Automotive Engineers



4-Port Expansion Module

Optional Expansion Module

Optional Expansion Modules are available for applications requiring more than the maximum allowable Remote Lockout Stations (RLS) (e.g. more than four for 23…85 A systems or more than six for 110…1200 A systems). The Expansion Modules are available in 4- or 10-port configurations. This allows up to four RLSs for a 4-port and ten RLSs for a 10-port module. An example would be adding a 4-port expansion module to a 23A ElectroGuard. This then allows up to seven RLSs to connect to the system.

Expansion Modules may be ordered with an adjustable time-delay feature (1…30 seconds) in order to allow time for the machine operator to shut down drives or other equipment that requires a controlled stop after a RLS handle has been turned to the OFF position. Consult your Rockwell Automation sales office or Allen-Bradley distributor for other time settings. Enclosed Expansion Modules are available with optional Flex modules to provide status communication to a remote PLC. Communication can be via ethernet, ControlNet, DeviceNet, Profibus or Remote I/O.

NOTE: The status communication option allows a remote PLC to receive status signals from the Expansion Module.

Bulletin 2030 Expansion Module

2030—	EU	N	F	1CNET	1TD
	a	*b*	*c*	*d*	*d*

a

Product Descriptor	
Code	**Description**
EU	Expansion module

b

Enclosure Type	
Code	**Description**
C	Type 4X watertight stainless steel
F	Type 4 watertight painted steel/IP65
J	Type 12 dusttight/IP54
N	Open type

c

Number of Expansion Ports	
Code	**Description**
F	4-port
T	10-port

d

Options	
Code	**Description**
1COM	Flex I/O module (16 points of I/O)
1CNET	ControlNet™ module
1DNET	DeviceNet™ module
1ENET	EtherNet module
1PNET	PROFIBUS module
1TD	Expansion module with factory-set 30-second time delay

Remote Lockout Station

Remote Lockout Station

The Remote Lockout Station (RLS) is a key component of the ElectroGuard system. The RLS is typically located at the hazard location and provides the signal to the power panel to initiate the LOTO process. The RLS is available in several configuration and enclosure types.

Dual Remote Lockout Station

The Dual Remote Lockout Station functions the same as a single or standard Remote Lockout Station. The difference between a single and a dual RLS is that the dual RLS can be used to control two ElectroGuard systems from the same RLS. A good example of this is a machine that has two separate incoming power sources. Using a dual RLS and two ElectroGuard both ElectroGuard can be controlled from the same station.

Bulletin 2030 Remote Lockout Station

2030 — RLS	J	G	D
	a	*b*	*c*

a

Enclosure Type	
Code	Description
C	Type 4X watertight stainless steel
F	Type 4 watertight painted steel/IP65
J	Type 12 dusttight/IP54
E	Type 7 and 9 hazardous location bolted

b

System Isolated Light Color	
Code	Color
G	Green

c

Dual RLS	
Code	Description
D	Dual
Blank	Single

Replacement Switch Module: 2030-RSA1

Verification Module

Bulletin 2030 Verification Module

2030 — VM (*a*) C (*b*)

a

Product Description	
Code	Description
VM	Verification module

b

Enclosure Type	
Code	Description
C	Type 4X watertight stainless steel
J	Type 12 dusttight/IP54

Verification Module

The optional Verification Module (VM) is connected between the solenoid locking safety switch, similar to a Guardmaster Atlas™ 5 and the Remote Lockout Station (RLS) input on an ElectroGuard system. When the VM receives the system isolated signal from the ElectroGuard, the VM provides the signal to the solenoid on the Atlas 5, unlocking the Atlas 5 and allowing access to the machine.

Once the Atlas 5 is unlocked, the VM provides a redundant signal to the ElectroGuard emulating a RLS that has been switched to the OFF position. The emulated signal is then switched to the on state, to indicate the gate has been closed. If all of the RLSs connected to the ElectroGuard are switched to the ON position and the safety gate is closed, the ElectroGuard will attempt to lock the gate and restore energy the machine. If the verification module has not verified the gate is locked, the energy is removed from the machine and the locking process is repeated.

Specifications

Dry Contact (B300 6A/125V AC or P300 3A/24V DC) provided to control solenoid voltage.

Multiplexer/Permissive Module

When multiple energy sources must be controlled simultaneously or the system must be stopped at a pre-determined stopping point, the LOTO process becomes more complicated with multi-step procedures and locks. The Hydraulic/Pneumatic Multiplexer and the system Multiplexer/Permissive Module were developed to help provide simultaneous control of multiple hazards from a single lockout point.

Coordination between the process or drive system control and the LOTO process, is a concern. In a typical system, a signal from the LOTO device is sent to the control system. This provides indication that the device has been switched to the OFF position. This requires the person switching the device to ensure the process or machine has stopped. Ideally this would be coordinated so the power is not disconnected until the process or drive system is at an acceptable stopping point. The addition of the Permissive function to the System Multiplexer allows the control system to signal the ElectroGuard system when it is at the desired stopping point. This function would only allow the stopping function (i.e., the control system can not restore power). That function can only be accomplished via the RLSs attached to the System Multiplexer/Permissive Module.

The diagram below depicts a system with multiple motors or drives that require a synchronized lockout. This system also requires that the power to the drives must be maintained during certain phases of the process. The control system is interfaced with the ElectroGuard systems via the Permissive option in the System Multiplexer/Permissive Module. This allows the control system to delay disconnecting power until the drives are at an allowable point in the process.

Functional Description

The System Multiplexer Module allows a Remote Lockout Station (RLS) to control up to four ElectroGuard systems simultaneously. The System Multiplexer Module will accept up to six RLS inputs. If there is a need to control more than four ElectroGuard systems, the System Multiplexer Modules can be daisy-chained as shown in the drawing below. For applications where more than four RLSs are required, an expansion module may be used.

The System Multiplexer Module is also available with a Permissive option. The Permissive option allows the machine controlling the process or drive system to bring the machine or process to a pre-determined stopping point prior to removal of power by the ElectroGuard system. Once the ElectroGuard system isolates the energy, the machine control can not re-energize the ElectroGuard.

Bulletin 2030 Multiplexer/Permissive Module

2030-MLX — J (a) F (b) SYS (c)

a

Enclosure Type	
Code	Description
C	Type 4X watertight stainless steel
F	Type 4 watertight painted steel/IP65
J	Type 12 dusttight/IP54
N	Open
M	Open Type installed in ElectroGuard∗

∗ Can be installed in most 110…1200 A systems

b

Number of Systems to Control	
Code	Description
F	4 systems

c

System Type	
Code	Description
SYS	EG system
SYSP	EG system with permissive option
HPM	Hydraulic/pneumatic module

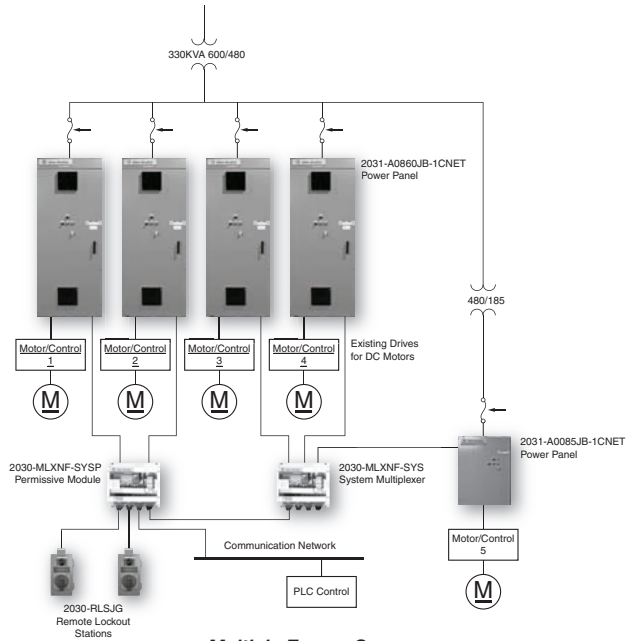
Sequence of Events for System Multiplexer Module:

1. When a RLS is turned OFF, the outputs of the System Multiplexer Module are switched to the off or open state, see diagram below.
2. This signal is connected to the input of the ElectroGuard systems initiating the isolation process.
3. When all of the ElectroGuard systems are in the isolated state the System Multiplexer Module sends the Isolated signal to the RLS and the RLS System Isolated pilot light will be illuminated.

Sequence of Events for System Multiplexer Module with Permissive Option:

1. A PLC output is connected to the System Multiplexer/Permissive Module. This signal is used by the System Multiplexer/Permissive Module as a heart beat. This holds the output of the System Multiplexer/Permissive Module in the on or closed state, holding the ElectroGuard system in the on or non-isolated state.
2. When a RLS is turned OFF, a signal is transmitted to the control system via a PLC connection on the RLS auxiliary contacts, see diagram below. Note that the outputs of the System Multiplexer/Permissive Module remain in the on or closed state.
3. When the customer's control system is at a predetermined stopping point, the control system, via the PLC output, is turned to an off state (no heart beat) and the outputs of the System Multiplexer/Permissive Module are then switched to the off or open state.
4. The system isolation function is then initiated on all of the ElectroGuard systems simultaneously.
5. When all of the ElectroGuard systems are in the isolated state, the System Multiplexer/Permissive Module sends the Isolated signal to the RLS and the RLS System Isolated pilot light on the RLS will be illuminated. The RLS now has control of the ElectroGuard and the energy can only be restored to the machine or process by switching all of the RLSs connected to the multiplexers to the on state.

   NOTE: Modification to the logic in the customer's control system is required if the Permissive option is used. See user manual for details.



Multiple Energy Sources

System Selection Process

1. Determine the catalog number of the Safety Isolation System based on the rating of the load(s) to which it will be connected as follows:
   — If the Safety Isolation System is connected to a single motor load, the horsepower or kilowatt rating of the system should be determined as follows:
   a. Select the Safety Isolation System that meets or exceeds the horsepower or kilowatt rating of the load at the required voltage and frequency.
   — If the Safety Isolation System is connected to two or more motors or one or more motors in combination with other loads; the horsepower or kilowatt rating of the system should be determined as follows:
   b. Identify the types of loads (i.e. motor, resistive) and the values of the currents of each of the loads (i.e. steady-state current for resistive loads, full-load and locked-rotor currents for motor loads) to be connected to the Safety Isolation System.
   c. Sum the full-load currents of all the motor loads to be connected to the Safety Isolation System. To this value add the current values of all resistive loads to be connected to the Safety Isolation System. This value is the combined load full-load current.
   d. Find the horsepower or kilowatt rating of a single motor with a full-load current value greater than or equal to the combined load full-load current value determined in step b.
   e. Select the Safety Isolation System that meets or exceeds this horsepower or kilowatt rating at the required voltage and frequency.
   f. Sum the locked-rotor currents of all the motor loads to be connected to the Safety Isolation System. To this value add the current values of all resistive loads to be connected to the Safety Isolation System. This value is the combined load locked-rotor current.
   g. Find the horsepower or kilowatt rating of a single motor with a locked-rotor current value greater than or equal to the combined load locked-rotor current value determined in step e.
   h. Select the Safety Isolation System that meets or exceeds this horsepower or kilowatt rating at the required voltage and frequency.
   i. Compare the ratings of the Safety Isolation Systems selected in steps d and g. Select the larger of the two systems for your application.
2. Determine how many Remote Lockout Stations are required for the application.
3. Determine how many Expansion Modules (if any) are required for the application.
4. Pick suitable enclosure type(s) for the Safety Isolation System Power Panel, Remote Lockout Stations and enclosed modules (e.g., Expansion Modules, Pneumatic and Hydraulic Isolation Module).
5. Determine what, if any, factory-installed options are required for the application (e.g. Pneumatic Isolation, Hydraulic Isolation, Status Communication to remote PLC, metering).

Bulletin 194E IEC Load Switches

Description

Bulletin 194E load switches are designed for use as local motor isolation and disconnect switch applications. Available with 3- and 6-pole versions with add-on additional poles, grounding and neutral terminals and auxiliary contacts, Bulletin 194Es share the same operating handles as the Bulletin 194L Control and Load Switches. Bulletin 194E switches are offered in two mounting styles, Front/Door and Base/DIN configurations for a variety of installations. Switch body styles for Bulletin 194E base-mounted switches include standard interlock shaft; Bulletin 194E front-mounted switches include standard shaft. Two-position OFF-ON switch is used to connect or disconnect a variety of inductive loads, including solenoids, valves, magnetic starters, relays, and motors. Handles featuring marked legend plates are available in Selector-Knob, Disk-Style, Rectangular-Style and Key-Operated versions. Selector-Knob versions are available in three sizes. Most handles are available in colors of Grey/Black or Red/Yellow and have padlockable versions.

- Suitable as At-Motor Disconnect Switch (UL508)
- 16, 25, 32, 40, 63, 80, 100 A Inductive Load-Rated Switches
- IP66/ UL Type 1/3/3R/12 Operating Handles
- IP2LX Finger-Safe Terminals
- 3- and 6-Pole Versions; Add-on Accessory Poles to Make 4-, 5-, 7- and 8-Pole Units
- Front/Door or DIN/Base Mounting Configurations
- Available in OFF-ON and Changeover Configurations
- 3- and 6-Pole Enclosed Switches
- Optional Thermoplastic Enclosures
- Positive-Guided Actuation
- Padlockable Handles Available (up to 3 padlocks)

Standards Compliance

IEC 60947-1
IEC 60947-3 Low-voltage switchgear and control gear part 3
UL 508
CSA: C22.2 No. 14

Certifications

UL Listed (File No. E14841, Guide NLRV)
CSA Certified (LR 13908)
IEC, VDE and BS
CE
RINA — Italian Naval Registry

Cat. No. Explanation

194E 16…100 A Small-Frame Switches (Handles listed on page 6-137)

3-Pole Base Mount

3-Pole Front Mount

6-Pole Base Mount

6-Pole Front Mount

194E – A 32 –1753

a b c

a

Installation Type	
Code	Description
A	Base/DIN Mounting
E	Front/Door Mounting

b

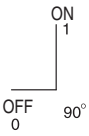
Load Size	
Code	Description
16	16 A
25	25 A
32	32 A
40	40 A
63	63 A
80	80 A
100	100 A

c

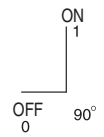
Function/Circuit Diagram Ref. #		
Code	Function	Description
1753	OFF/ON	3-Pole, 2-Position (90°)
1756	OFF/ON	6-Pole, 2-Position (90°)
1783	OFF/ON	3-Pole, 2-Position (90° - inverted)
3753	Changeover	3-Pole, 3-Position (90°)

Product Selection

Frequently Ordered* OFF-ON 3-Pole Switch (includes operating shaft) (Handles listed on page 6-137)

Function Switching Angle	Contact Target Configuration X = Contact Closed O = Contact Open			Rated Current [A]	AC23A Rated Power [kW] at 690V AC 50 Hz	Hp @ 480V AC 60 Hz 3 Ø	OFF-ON 3-Pole Switch (includes operating shaft)	
		Handle Position					Base-Mounted	Front-Mounted
	No. of Circuits	OFF/0	ON/1				Cat. No.	Cat. No.
	1 2 3	O O O	X X X	16	7.5	7.5	194E-A16-1753	194E-E16-1753
				25	11	10	194E-A25-1753	194E-E25-1753
				32	15	15	194E-A32-1753	194E-E32-1753
				40	18.5	20	194E-A40-1753	194E-E40-1753
				63	22	25	194E-A63-1753	194E-E63-1753
				80	37	40	194E-A80-1753	194E-E80-1753
				100	45	50	194E-A100-1753	194E-E100-1753

Frequently Ordered* OFF-ON 6-Pole Switch (includes operating shaft) (Handles listed on page 6-137)

Function Switching Angle	Contact Target Configuration X = Contact Closed O = Contact Open			Rated Current [A]	AC23A Rated Power [kW] at 690V AC 50 Hz	Hp @ 480V AC 60 Hz 3 Ø	OFF-ON 6-Pole Switch (includes operating shaft)	
		Handle Position					Base-Mounted	Front-Mounted
	No. of Circuits	OFF/0	ON/1				Cat. No.	Cat. No.
	1 2 3 4 5 6	O O O O O O	X X X X X X	16	7.5	7.5	**194E-A16-1756**	**194E-E16-1756**
				25	11	10	**194E-A25-1756**	**194E-E25-1756**
				32	15	15	**194E-A32-1756**	**194E-E32-1756**
				40	18.5	20	**194E-A40-1756**	**194E-E40-1756**
				63	22	25	**194E-A63-1756**	**194E-E63-1756**
				80	37	40	**194E-A80-1756**	**194E-E80-1756**
				100	45	50	**194E-A100-1756**	**194E-E100-1756**

* See Catalog No. Explanation for more load size and change-over switch options.

Bulletin 194E/194L Handles (for use with Bulletin 194E Switches)

Color	Handles (Includes Legend Plate and Control Knob)			
Red/Yellow (Emergency Stop colors)	*Type I (IP66, UL Type 3/3R/12)*	*Type L (IP66, UL Type 3/3R/12) With Locking For One Padlock (Padlock Not Included)*	*Type N (IP66, UL Type 3/3R/12)*	**Bulletin 194L handles are available in both screw fixing and 22.5 mm mounting hole style.**
Black/Grey (Standard Operation colors)	*Type A (IP66, UL Type 3/3R/12)*	*Type E (IP66, UL Type 3/3R/12) With Locking For One Padlock (Padlock Not Included)*	*Type G (IP66, UL Type 3/3R/12)*	*Type S (IP66, UL Type 3/3R/12)*

Cat. No. Explanation

194L – HE 6 N – 175

a b c d

a

Code	Installation Type
HC	22.5 mm Mounting Hole Style Handle✶ (for use with front-mounted switches)
HE	Screw-Mounting Handle (for use with front- and base-mounted switches)

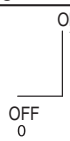
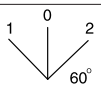
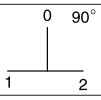
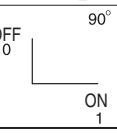
b

Code	Use with Handle Type	Handle Legend Plate Size	Use With 194E Switch Size
4	A, E, I, L❄	48 x 48 mm (1-57/64 x 1-57/64 in.)	194E-16…63 A
	S	48 x 62 mm (1-57/64 x 2-7/16 in.)	194E-25…63 A
6	A, E, I, L	64 x 64 mm (2-33/64 x 2-33/64 in.)	194E-25…100 A
	G, N❄‡	67 x 67 mm (2-41/64 x 2-41/64 in.)	194E-25…100 A
	S	64 x 78 mm (2-33/64 x 3-5/64 in.)	194E-25…100 A
8	A, I	88 x 88 mm (3-15/32 x 3-15/32 in.)	194E-40…100 A
	G, N	90 x 90 mm (3-35/64 x 3-35/64 in.)	194E-40…100 A

c

Code	Legend Plate Type	Color
A	Square	Grey/Black
I	Square	Red/Yellow
E	Square/Lockable	Grey/Black
L	Square/Lockable	Red/Yellow
G	Disc/Lockable (up to 3 locks)	Grey/Black
N	Disc/Lockable (up to 3 locks)	Red/Yellow
S	Large Square with extra legend area	Grey/Black

d

Code	Description	Legend Marking
175	O-I	
175I	OFF-ON	
350	1-0-2 (Reversing)	
375	0-1-2 (90 degrees) (Changeover)	
178	O-I	
178I	OFF-ON	

✶ For 22.5 mm mounting hole style handle (code HC), select either handle type A, E, I, or L with 48 x 48 mm legend plate size (code 4) only or handle type G or N with 64 x 64 mm legend plate size (code 6) only.

❄ Order 194E- 16A Type G and N handles as Cat. No. 194**E**-HE4N-175 or 194**E**-HE4G-175

‡ Use Type G and N with ON-OFF function only (table "d", code -175)

Frequently Ordered 194L Handles — OFF-ON Base/Front-Mounted 3- and 6-Pole Switch Handles (Switch Body listed on page 6-136)

Handle Type	Degree of Protection	Handle Color	Bezel Plate Size	For Use With	Legend Plate Marking	Cat. No.
E	IP66 (UL Type 1) (UL Type 3/3R/12)	Black/Grey	48 x 48 mm (1-57/64 x 1-57/64 in.)	194E-16…63 A 194L-E12…40 A, -1753 194L-A12…40 A, -1753	0-1	194L-HE4E-175
					OFF-ON	**194L-HE4E-175I**
L		Red/Yellow	48 x 48 mm (1-57/64 x 1-57/64 in.)	194E-16…63 A 194L-E12…40 A, -1753 194L-A12…40 A, -1753	0-1	194L-HE4L-175
					OFF-ON	**194L-HE4L-175I**
G	IP66 (UL Type 3/3R/12)	Black/Grey	54 x 54 mm (2-1/8 x 2-1/8 in.)	194E-16 A	0-1 OFF-ON	194E-HE4G-175
			67 x 67 mm (2-41/64 x 2-41/64 in.)	194E-25…100 A 194L-E12…40 A, -1753 194L-A12…40 A, -1753	0-1 OFF-ON	194L-HE6G-175
			88 x 88 mm (3-15/32 x 3-15/32 in.)	194E-40…100 A	0-1 OFF-ON	194L-HE8G-175
N		Red/Yellow	54 x 54 mm (2-1/8 x 2-1/8 in.)	194E-16 A	0-1 OFF-ON	194E-HE4N-175
			67 x 67 mm (2-41/64 x 2-41/64 in.)	194E-25…100 A 194L-E12…40 A, -1753 194L-A12…40 A, -1753	0-1 OFF-ON	194L-HE6N-175
			88 x 88 mm (3-15/32 x 3-15/32 in.)	194E-40…100 A	0-1 OFF-ON	**194L-HE8N-175**
L	IP66 (UL Type 3/3R/12)	Red/Yellow	48 x 48 mm (1-57/64 x 1-57/64 in.)	194L-E12…40 A, -1753	0-1	194L-HC4L-175
					OFF-ON	**194L-HC4L-175I**

Bulletin 194E Open and Enclosed Switch Kits Cat. No. Explanation

194E – Y 32 –1753– 6N

a b c d

a

Code	Installation Type
A	Base/DIN Mounting, open type switch
E	Front/Door Mounting, open type switch
Y	Enclosed Base Mounting Switch With Handle (Uses IP66 ABS thermoplastic enclosure)

c

Code	Configuration
1753	3-Pole OFF/ON (90°)
1756	6-Pole OFF/ON (90°)

b

Code	Load Size
16	16 A*
25	25 A
32	32 A
40	40 A
63	63 A
80	80 A
100	100 A

* For 16 A Enclosed Switch: use "16M" (3-pole enclosure has M16/20 knockouts, 6-pole 16 A enclosure has M25/32 knockouts). For 25/32 A Enclosed Switch with M20/25 metric knockouts: use “25M” or “32M”.

d

Code	Handle Style
4N	194E-HE4N-175 (use with 16 A Switch)
4G	194E-HE4G-175 (use with 16 A Switch)
4A	194L-HE4A-175 (use with 16…100 A Switch)
6N	194L-HE6N-175 (use with 25…100 A Switch)
6G	194L-HE6G-175 (use with 25…100 A Switch)
6A	194L-HE6A-175 (use with 25…100 A Switch)

Frequently Ordered Switch Kits — OFF-ON Front- and Base-Mounted 3-Pole Switch With Cat. No. 194L-HE6N-175 Red/Yellow Handle

	Function Switching Angle	Rated Current [A]	AC23A Rated Power [kW] at 690V AC	HP @ 480V AC 60 Hz, 3-Phase	Base-Mounted Cat. No.	Front-Mounted Cat. No.
		25	7.5	10	**194E-A25-1753-6N**	**194E-E25-1753-6N**
		32	11	15	**194E-A32-1753-6N**	**194E-E32-1753-6N**
		63	18.5	25	194E-A63-1753-6N	**194E-E63-1753-6N**

Base-Mounting Distribution Switches (handles are pre-assembled to switch)

	Function Switching Angle	No. of Circuits	Contact Target OFF/0	Contact Target ON/1	Handle Color	Legend Plate Marking	Lockable (One Padlock)	Rated Current [A]	AC23A Rated Power [kW] at 690V AC	Hp @ 480V AC 60 Hz, 3-Phase	Cat. No.
		1 2 3	O O O	X X X	Red/Yellow	0-1	Yes	25	11	—	**194E-A25-1753-R**
					Black/Grey	0-1	No			—	**194E-A25-1753-Q**
					Red/Yellow	0-1	Yes	32	15	—	**194E-A32-1753-R**
					Black/Grey	0-1	No			—	**194E-A32-1753-Q**

Frequently Ordered Enclosures — 3- and 6-Pole Enclosed Switches With Cat. No. 194L-HE6N-175 Red/Yellow Operating Handles

	No. of Poles	Function Switching Angle	Rated Current [A]	Handle Color	Cat. No.
Uses Base-Mounted Switches	3		16	Red/Yellow	**194E-Y16-1753-4N**
			25		**194E-Y25-1753-6N**
			32		**194E-Y32-1753-6N**
			40		**194E-Y40-1753-6N**
	6		25	Red/Yellow	**194E-Y25-1756-6N**

IEC Load Switches

Bulletin 194E

Bulletin 194E Enclosed Disconnect Load Switches with 194R Handles (with Defeater, suitable for 3 padlocks)

194E-FA Painted Steel Enclosure UL Type 3/4/12, IP66	194E-CA Stainless Steel Enclosure UL Type 4/4X, IP66	194E-KA Non-Metallic Enclosure UL Type 3/4/4X, IP66	194E-AA Metallic Enclosure UL Type 1, IP54	194E-GA Painted Steel Enclosure UL Type 3/4/12, IP66	194E-DA Stainless Steel Enclosure UL Type 4/4X, IP66

Cat. No. Explanation ⁎❄

194E – FA 32 E – P11 – P11 – 6

a b c d d e

a

Code	Enclosure Type
FA	UL Type 3/4/12, IP66 Painted Steel, Hinged, for 16…100 A switches
GA	UL Type 3/4/12, IP66 Painted Steel, Hinged, in 6 x 6 x 4 in. size, for 16…32 A 3-pole switches ‡
CA	UL Type 4/4X, IP66 Stainless Steel, Hinged, for 16…100 A switches
DA	UL Type 4/4X, IP66 Stainless Steel, Hinged, in 6 x 6 x 4 in. size, for 16…32 A 3-pole switches ‡
KA	UL Type 3/4/4X, IP66 Non-Metallic, for 16…100 A switches
AA	UL Type 1, IP54 Painted Steel, Hinged, for 16…100 A switches (Same enclosure as FA without gasketing)

b

Code	Load Size
16	16 A
20	25 A
32	32 A
40	40 A
63	63 A
80	80 A
00	100 A

c

Code	Handle Color (194R-HS _ _)
Blank	Grey/Black
E	Red/Yellow

d

Code	Left Side + Right Side Modifications⁎
Blank	No Option
-P11	1 N.O. + 1 N.C. Auxiliary Contacts
-PL11	1 N.O. + 1 N.C.L.B. Auxiliary Contacts
-P22	2 N.O. + 2 N.C. Auxiliary Contacts
-PD10	1 N.O. E.B.
-NP	Additional Pole
-PE	Grounding Pole
-TN	Neutral Pole

e

Code	Switch Type
Blank	3-pole switch
-6	6-pole switch§

⁎ Modifications: Up to two suffix codes may be added to an enclosed disconnect load switch. See Guidelines, page 6-141. If only one accessory is chosen, it is mounted on the left side of the switch.
❄ To order the cat. no. 194E-FA40/FA63 or 194E-CA40/CA63 in the larger 80/100A sized enclosure, add an "X" after the handle color. For example, Cat. No. **194E-FA40E** becomes Cat. No. **194E-FA40**EX.
‡ GA and DA type enclosures: use with 3-pole 16…32 A switches only.
§ Special order; allow for longer delivery time.

Frequently Ordered Bulletin 194E Enclosed Switches with Bulletin 194R Handle

Description	Rated Current [A]	Dimension Reference	Handle Color	Cat. No.⁎
Stainless steel enclosure, IP66/Type 4/4X	25	A1	Black	194E-CA20
			Red/Yellow	194E-CA20E
	32	A1	Black	194E-CA32
			Red/Yellow	194E-CA32E
	63	A1	Black	194E-CA63
			Red/Yellow	194E-CA63E
	25	A1	Black	194E-FA20
			Red/Yellow	194E-FA20E
	32	A1	Black	194E-FA32
			Red/Yellow	194E-FA32E
	40	A1	Black	**194E-FA40**
			Red/Yellow	194E-FA40E
	25	C1	Black	194E-KA20
			Red/Yellow	194E-KA20E

⁎ Modifications: Up to two suffix codes may be added to an enclosed disconnect load switch. See Guidelines, page 6-141. If only one accessory is chosen, it is mounted on the left side of the switch.

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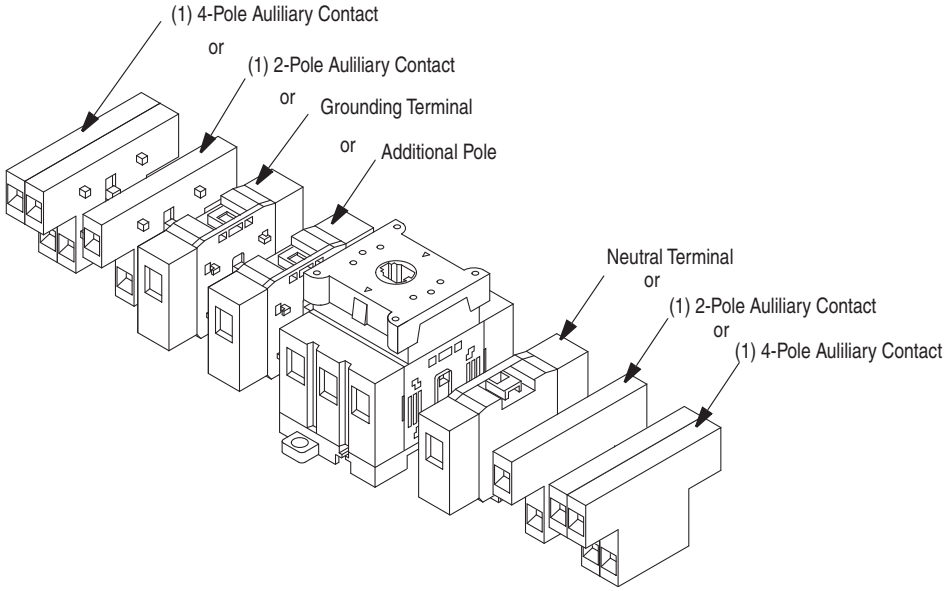
Publication S117-CA001A-EN-P

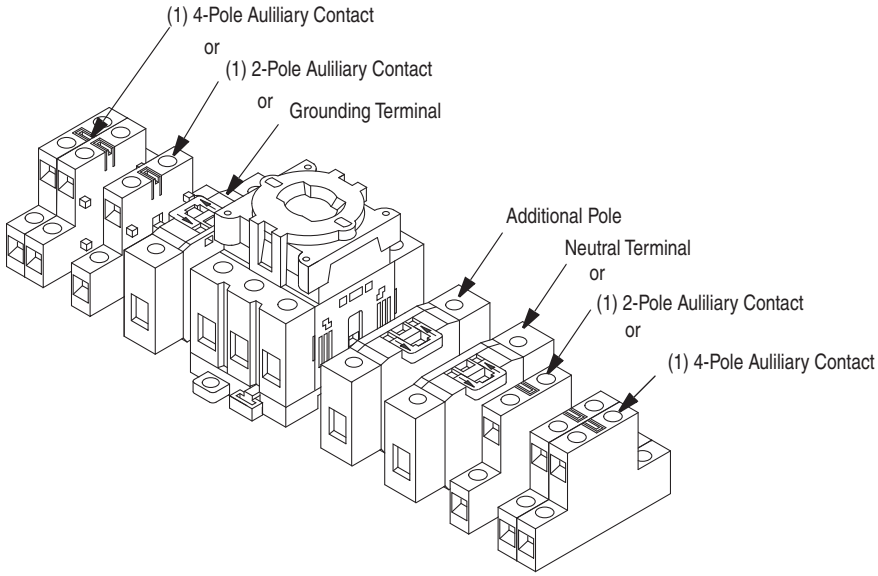
Accessories

IEC Load Switch Accessories

194E-E16...100 A, Front/Door Mounting



194E-A16...100 A, Base/DIN Rail Mounting



Accessory Configuration Guidelines

Accessory drawings represent modular, snap-on features of Bulletin 194E accessories. They are not suggesting possible accessory configurations. Use the following guidelines for choosing 194E accessory configurations.

- Up to two accessories may be added to the Bulletin 194E switch body.
- For the 194E 25, 32, 40, or 63 A switches, the early break auxiliary contact (-PD10) may only be used in the following configurations:
  As a single unit on either side of the switch
  As a single unit on a side when used with a switch + 4th pole (-NP)
  As a single unit on a side when used with a switch + ground terminal (-PE)
  As a single unit on a side when used with a switch + neutral terminal (-TN)
  No other auxiliary contact may be used in combinations with an early break auxiliary contact (-PD10)
- Other combinations of auxiliary contacts are permissable.
- For the 194E 80 and 100 A switches, any combination of auxiliary contacts, 4th pole, ground terminal, neutral terminal, and -PD10 is permissable.

IEC Load Switches

Bulletin 194E

Auxiliary Contacts	No. of Auxiliary Contacts	For Use With	Cat. No.∗
	1 N.O. + 1 N.C.	194E-A16...100	194E-A-P11
		194E-E16...100	194E-E-P11
	1 N.O. + 1 N.C.L.B.	194E-A16...100	194E-A-PL11
		194E-E16...100	194E-E-PL11
	2 N.O. + 2 N.C.	194E-A16...100	194E-A-P22
		194E-E16...100	194E-E-P22
	1 N.O.E.B.	194E-A16	194E-A16-PD10
		194E-A25...100	194E-A-PD10
		194E-E16	194E-E16-PD10
		194E-E25...100	194E-E-PD10

Additional Pole, 1 N.O.	For Use With	Cat. No.∗
	194E-A16	194E-A16-NP
	194E-A25	194E-A25-NP
	194E-A32	194E-A32-NP
	194E-A40	194E-A40-NP
	194E-A63	194E-A63-NP
	194E-A80	194E-A80-NP
	194E-A100	194E-A100-NP
	194E-E16	194E-E16-NP
	194E-E25	194E-E25-NP
	194E-E32	194E-E32-NP
	194E-E40	194E-E40-NP
	194E-E63	194E-E63-NP
	194E-E80	194E-E80-NP
	194E-E100	194E-E100-NP

Earthing/Grounding Terminal	For Use With	Cat. No.∗
	194E-A16	194E-A16-PE
	194E-A25/32	194E-A32-PE
	194E-A40/63	194E-A63-PE
	194E-A80/100	194E-A100-PE
	194E-E16	194E-E16-PE
	194E-E25/32	194E-E32-PE
	194E-E40/63	194E-E63-PE
	194E-E80/100	194E-E100-PE

Neutral Terminal	For Use With	Cat. No.∗
	194E-A16	194E-A16-TN
	194E-A25/32	194E-A32-TN
	194E-A40/63	194E-A63-TN
	194E-A80/100	194E-A100-TN
	194E-E16	194E-E16-TN
	194E-E25/32	194E-E32-TN
	194E-E40/63	194E-E63-TN
	194E-E80/100	194E-E100-TN

∗ A maximum of two side-mount accessories may be added to a Bulletin 194E switch (one on each side).

6-Pole Mechanical Coupling∗❄	For Use With	Cat. No.
	194E-16	**194E-G3821**
	194E-25/32	**194E-G3660**
	194E-40/63	**194E-G3661**
	194E-80/100	**194E-G3662**

∗ User must order (2) Bulletin 194E 3-Pole Switches separately.

❄ Coupling for changeover switch not available. Changeover switch must be ordered as a factory-assembled device (e.g., 194E-A25-3753).

ABS Thermoplastic Enclosure — IP66, For High-Impact Applications (grounding screw included)	No. of Poles	For Use With	Cat. No.
	3…4	194E-A25/32	**194L-G3572**
	3…4	194EA-40/63	**194E-G3663**
	6	194EA-25/32	
	6	194EA-40/63	**194E-G3665**
	3…4	194EA-80/100	

Noryl Thermoplastic Enclosures — IP66, For Corrosion-Prone Applications (grounding screw included)	No. of Poles	For Use With	Cat. No.
	3…4	194E-A25/32	**194L-G3576**
	6	194EA-25/32	**194E-G3664**
	3…4	194EA-40/63	
	6	194EA-40/63	**194E-G3666**
	3…4	194EA-80/100	

Description	For Use With	Pkg. Qty.	Cat. No.
Additional Earth/Ground and Neutral Terminals — For Thermoplastic Enclosure	194L-G3663, G3664, G3665, G3666	5	**194E-G3673**
	194L-G3572 and G3676	5	**194E-G3653**

Terminal Covers	No. of Poles	For Use With	Cat. No.
	1	194E-16	194E-16-C1
	3	194E-16	194E-16-C3
		194E-25/32	194E-25-C3
		194E-40/63	194E-40-C3
		194E-80/100	194E-80-C3
	4	194E-25/32	194E-25-C4
		194E-40/63	194E-40-C4
		194E-80/100	194E-80-C4

Operating Shafts

	Length	Construction	Pkg. Qty.	Cat. No.
Standard Shaft (for front-mount switches)	34 mm (1-11/32 in.)	Plastic	5	**194L-G3380**
	36.5 mm (1-7/16 in.)	Metal	5	**194E-G3688**
Interlock Shaft (for base-mount switches)	44 mm (1-47/64 in.) (Standard Length)	Plastic	5	194L-G2830
		Metal		**194E-G3687**
	52 mm (2-3/64 in.)	Plastic		194L-G3194
		Metal		**194E-G3707**
	57 mm (2-15/64 in.)	Plastic		194L-G3195

Bulletin 194E Load Switch Cat. No. Shaft Selection for use with 194E and 194L Thermoplastic Enclosures

Rated Current [A]	3-Pole Switches (-1753 suffix)		6-Pole Switches (-1756 suffix)		Changeover Switches (-3753 suffix)	
	194E-E…	194E-A…	194E-E…	194E-A…	194E-E…	194E-A…
16	plastic shaft (Cat. No. 194L-G3380)	plastic shaft (Cat. No. 194L-G2830)	metallic shaft (Cat. No. 194E-G3688)	metallic shaft (Cat. No. 194E-G3687)	metallic shaft (Cat. No. 194E-G3688)	metallic shaft (Cat. No. 194E-G3687)
25	plastic shaft (Cat. No. 194L-G3380)	plastic shaft (Cat. No. 194L-G2830)	metallic shaft (Cat. No. 194E-G3688)	metallic shaft (Cat. No. 194E-G3687)	metallic shaft (Cat. No. 194E-G3688)	metallic shaft (Cat. No. 194E-G3687)
32	plastic shaft (Cat. No. 194L-G3380)	plastic shaft (Cat. No. 194L-G2830)	metallic shaft (Cat. No. 194E-G3688)	metallic shaft (Cat. No. 194E-G3687)	metallic shaft (Cat. No. 194E-G3688)	metallic shaft (Cat. No. 194E-G3687)
40	plastic shaft (Cat. No. 194L-G3380)	plastic shaft (Cat. No. 194L-G2830)	metallic shaft (Cat. No. 194E-G3688)	metallic shaft (Cat. No. 194E-G3687)	metallic shaft (Cat. No. 194E-G3688)	metallic shaft (Cat. No. 194E-G3687)
63	plastic shaft (Cat. No. 194L-G3380)	plastic shaft (Cat. No. 194L-G2830)	metallic shaft (Cat. No. 194L-G3688)	metallic shaft (Cat. No. 194E-G3687)	metallic shaft (Cat. No. 194E-G3688)	metallic shaft (Cat. No. 194E-G3687)
80	metallic shaft (Cat. No. 194E-G3688)	metallic shaft (Cat. No. 194E-G3687)	metallic shaft (Cat. No. 194E-G3688)	metallic shaft (Cat. No. 194E-G3687)	metallic shaft (Cat. No. 194E-G3688)	metallic shaft (Cat. No. 194E-G3687)
100	metallic shaft (Cat. No. 194E-G3688)	metallic shaft (Cat. No. 194E-G3687)	metallic shaft (Cat. No. 194E-G3688)	metallic shaft (Cat. No. 194E-G3687)	metallic shaft (Cat. No. 194E-G3688)	metallic shaft (Cat. No. 194E-G3687)

Shaft Extension Kits

Shaft Extension

Length	For Use With	Pkg. Qty.	Cat. No.
24 mm (15/16 in.) Per Extension	194E-A…	10	194L-G2853

Length	For Use With	Pkg. Qty.	Cat. No.
110…235 mm (4-21/64…9-1/4 in.)	194E-A…	1	194L-G3393
230…350 mm (9-3/64…13-51/64 in.)			194L-G3394

Metal Shaft Adaptor Kits — For use with 194R Type 4/4X Handles

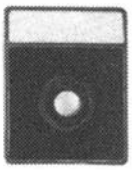
	For Use With	Pkg. Qty.	Cat. No.
Metal shaft adaptor kits — for use with 194R Type 4/4X handles kit includes bezel adapter and 194R-R1 operating shaft. Operating handle (Cat. No. 194R-HS4) must be ordered separately.	194E-A…	1	**194E-G3675**
Metal Shaft Extension For modification of Cat. No. 194L-G3393/ G3394 when used with any switches other than 2-position, 90° rotation.	194E-A…	10	**194L-G3399**

Other Accessories

194L/194E 22.5 mm Mounting Hole Style Handles (Type B, D) (For Front-Mounted Switches)

	Description		Cat. No.
Type B	22.5 mm Mounting Hole Style Handles (IP65) Handle Style: Knob Lever with Latch (For Use With 194E-E25…100 A, -1753) or 194L-E12…40 A		194L-HCB-001
Type D	22.5 mm Mounting Hole Style Handles Key Removal Position (Includes Latch) For Use With 194L-E 12…40 A, 194E-E16…63 A, -1753		194L-HCDC-001
	22.5 mm Mounting Hole Style Handles Key Removal Position (Includes Latch) For Use With 194L-E 12…40 A, 194E-E16…63 A, -1753		194L-HCDD-001
	22.5 mm Mounting Hole Style Handles Key Removal Position (Includes Latch) For Use With 194L-E 12…40 A, 194E-E16…63 A, -1753		194L-HCDG-001

Accessory Description		Pkg. Qty.	Cat. No.
	Control Knob, Black, with Locking Facility (Use 1/4 in. max. hasp lock.) (Locks in 0°, 90°, 180°, and 270° positions)	10	**194L-G2864N**
	Control Knob, Red, with Locking Facility (Use 1/4 in. max. hasp lock)		**194L-G2864R**

Accessory Description			Pkg. Qty.	Cat. No.
		Control Knob, Type P Control Knob, Black, 31 mm (1-7/32 in.) Diameter	5	**194L-G2888N**
		Control Knobs, Type P Control Knob, Red, 31 mm (1-7/32 in.) Diameter		**194L-G2888R**
Standard Black Control Knob	 *Rectangular Front Frame*	Control Knob, Black, L = 37.5 mm (1-31/64 in.)	5	**194L-G3154N**
		Control Knob, Black, L = 48 mm (1-57/64 in.)		**194L-G3155N**
		Control Knob, Red, L = 37.5 mm (1-31/64 in.)		**194L-G3154R**
		Control Knob, Red, L = 48 mm (1-57/64 in.)		**194L-G3155R**
		Rectangular front frame with blank nameplate L = 48 x 62 mm (1-57/64 x 2-7/16 in.)	10	**194L-G3196**
		Rectangular front frame with blank nameplate L = 64 mm x 78 mm (2-33/64 in. x 3-5/64 in.)		**194L-G3197**

Additional Legend Plates/Frames

Color	Legend Size	For Use With	Pkg. Quantity	Legend Plate Marking	Cat. No.
Black/Grey	19.2 mm x 49 mm 3/4 in. x 1-59/64 in.	Size 6 Type G and N style handles, Cat. Nos. 194L-HE6G/N	5	(Blank)	194L-G3667
				MAIN SWITCH	**194L-G3667A**
				HAUPSCHALTER	**194L-G3667B**
				INTERR. PRINCIPALE	**194L-G3667C**
				INTERR. PRINCIPAUX	**194L-G3667D**
				INTERR. PRINCIPAL	**194L-G3667E**
				HUVUDBRYTARE	**194L-G3667F**
				WAHLSCHALTER	**194L-G3667G**
				EMERGENCY OFF	**194L-G3667H**
Black/Grey	18 mm x 84 mm 11/16 in. x 3-5/16 in.	Size 8 Type G and N style handles, Cat. Nos. 194L-HE8G/N	5	(Blank)	194L-G3515
				MAIN SWITCH	**194L-G3515A**
				HAUPTSCHALTER	**194L-G3515B**
				INTERR. PRINCIPALE	**194L-G3515C**
				INTERR. PRINCIPAUX	**194L-G3515D**
				INTERR. PRINCIPAL	**194L-G3515E**
				HUVUDBRYTARE	**194L-G3515F**
				WAHLSCHALTER	**194L-G3515G**
				EMERGENCY OFF	**194L-G3515H**

Legend Plates with Bezel	Legend Plate Color	Pkg. Quantity	Legend Plate Marking ∗		
			0-1	OFF-ON	Blank Legend Plate
			Cat. No.	Cat. No.	Cat. No.
	Silver	10	**194L-A4-175**	**194L-A4-175I**	**194L-A4-000**
			194L-A6-175	**194L-A6-175I**	**194L-A6-000**
			194L-A8-175	**194L-A8-175I**	**194L-A8-000**
	Yellow		**194L-I4-175**	**194L-I4-175I**	**194L-I4-000**
			194L-I6-175	**194L-I6-175I**	**194L-I6-000**
			194L-I8-175	**194L-I8-175I**	**194L-I8-000**

∗ Custom-Engraved legend plates available. To order, use publication 194L-PP002*.

Shaft for Enclosures

Enclosure Type	Suitable For			Suitable For		
	194L (Base-Mounted Switches)	No. of Contacts	Shaft	Use with 194E Switch	No. of Poles	Shaft Required
194L-G3572	194L-A12(16)	1/2	194L-G3195	194E-A25(32)	3 and 4	194L-G3194
194L-G3576	194L-A12(16)	3/4	Standard			
	194L-A20(25)	1/2	194L-G3194			
(95 x 150 x 86 mm)	194L-A20(25)	3/4	Standard			
194L-G3573	194L-A12(16)	5/6	194L-G3195			
194L-G3577	194L-A12(16)	7/8	194L-G3194			
	194L-A12(16)	9/10	Standard	—	—	—
	194L-A20(25)	5/6	194L-G3194			
(95 x 150 x 111 mm)	194L-A20(25)	7/8	Standard			
194E-G3663				194E-A40(63)	3 and 4	194L-G3194
194E-G3664	—	—	—	194E-A25(32)	6	Standard
(125 x 180 x 105 mm)						
194E-G3665				194E-A80(100)	3 and 4	194E-G3707
194E-G3666	—	—	—	194E-A40(63)	6	Standard
(175 x 230 x 120 mm)						

Accessory Combinations in Enclosure

Enclosure Type	Switch	No. of Poles	Shaft	Aux. Contacts (single or double)	Additional Pole Block	On Switch		On Enclosure	
						Neutral Terminal Block	Ground Terminal Block	Neutral Terminal Block	Ground Terminal Block
194L-G3572 (ABS) 194L-G3576 (Noryl) (95 x 150 x 86 mm)	194E-A25(32)	3	194L-G3194	X	X				
				X		X			
				X			X		
					X		X		
						X	X		
				X				X	
				X					X
								X	X
194E-G3663 (ABS) 194E-G3664 (Noryl) (125 x 180 x 105 mm)	194E-A40(63)	3	194L-G3194	X	X			X	X
				X		X		X	X
				X			X	X	X
					X		X	X	X
						X	X	X	X
					X		X	X	X
	194E-A25(32)	6	194E-G3707					X	X
194E-G3665 (ABS) 194E-G3666 (Noryl) (175 x 230 x 120 mm)	194E-A80(100)	3	194E-G3707	X	X			X	X
				X		X		X	X
				X			X	X	X
					X		X	X	X
						X	X	X	X
					X		X	X	X
	194E-A40(63)	6	194E-G3707	1L+1R				X	X

Electrical Ratings

Performance Data				16 A	25 A	32 A	40 A	63 A	80 A	100 A	Aux. Contacts
				IEC Applications							
Rated operational voltage (U_e): IEC✶			[V]	690	690	690	690	690	690	690	690
Rated operational voltage (U_e): UL, CSA			[V]	600	600	600	600	600	600	600	600
Rated isolation voltage (U_i): IEC/UL, CSA			[V]	690/600	690/600	690/600	690/600	690/600	690/600	690/600	690/600
Rated impulse voltage (U_{imp}): UL, CSA			[kV]	8	8	8	8	8	8	8	8
Test voltage, (U_i) 1 minute			[kV]	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Lost power per pole			[W]	0.58	1.0	1.5	1.6	2.4	3.6	5.5	0.4
Rated frequency			[Hz]	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60
Conventional free air thermal current I^{th}✶			[A]	25	40	50	63	75	100	120	12
Conventional enclosed thermal current I^e✶			[A]	20	32	40	50	63	80	100	10
Rated current I^e✶											
AC-1/ AC-21A	Non-inductive or only slightly inductive loads / Switching of resistive loads with slight overload		[A]	16	25	32	40	63	80	100	10
Rated power P_e											
AC-23A	Occasional switching of 3Ø motors and other highly inductive loads (criterion for selecting main switches)	230V	[kW]	5.5	7.5	7.5	15	18.5	22	30	—
		400V	[kW]	7.5	11	15	22	30	37	55	—
		690V	[kW]	7.5	11	15	18.5	22	37	45	—
AC-3	Squirrel-cage motors; starting and stopping of running motors	230V	[kW]	4	5.5	7.5	11	15	18.5	22	—
		400V	[kW]	5.5	7.5	11	15	18.5	30	37	—
		690V	[kW]	5.5	7.5	11	15	18.5	30	22	—
Short circuit current (co-ordination type 2)			[kA]	20	20	15	20	15	30	25	—
Rated conditional short-circuit current			[A]	20	25	35	50	63	80	100	—
Maximum fuse rating of circuit (type g,G)		400/415V	[A]	800	900	900	1300	1300	2500	2500	—
Rated short-time current I_{cw} (1 s)											
Rated breaking capacity AC23A (cosϕ 0.45)		230V	[A]	156	296	296	484	484	780	780	—
		400V	[A]	120	256	256	504	504	800	800	—
		690V	[A]	70	136	136	196	196	376	376	—
DC switching capacity											
Rated current I^e	1 pole	48V	[A]	20	25	32	40	63	80	100	—
		110V	[A]	5	5	6	8	10	16	20	
		220V	[A]	1	1	1	1.5	15	3	3	
		440V	[A]	0.5	0.5	0.5	0.6	0.6	0.7	0.7	
DC-21A For resistive loads, T ≤ 1 ms U_e max = 660V	2 poles in series	96V	[A]	20	25	32	40	63	80	100	—
		110V	[A]	20	23	25	32	50	70	80	
		220V	[A]	5	5	6	8	10	16	20	
		440V	[A]	1	1	1	1.5	1.5	3	3	
		600V	[A]	0.6	0.6	0.6	0.8	0.8	1	1	
	3 poles in series	110V	[A]	20	25	32	40	63	80	100	—
		220V	[A]	13	13	15	20	28	50	63	
		440V	[A]	2.2	2.2	2.2	3.6	3.6	6.5	6.5	
		600V	[A]	1.3	1.5	1.5	2	2	3	3	
Rated power P_e											
DC-23A, DC-3, DC-5											
For inductive loads, T ≤ 15 ms	3 poles in series	90V	[kW]	1	1.3	1.5	2.9	4.1	5.1	7.2	—
		110V	[kW]	1	1.1	1.3	2.2	3.3	5.5	7	
		220V	[kW]	0.8	0.9	1.1	1.7	2	3.5	4.4	
		440V	[kW]	0.6	0.6	0.6	0.9	0.9	1.1	1.1	
		600V	[kW]	0.4	0.4	0.4	0.5	0.5	0.9	0.9	

✶ See standards compliance listed on page 6-134.
❄ Suitable also for SEV 500.

Electrical Ratings, Continued

Performance Data			16 A	25 A	32 A	40 A	63 A	80 A	100 A	Aux. Contacts
UL/CSA Applications										
Continuous current		[A]	16	25	32	40	63	80	100	—
Heavy Pilot Duty		[AC]	A600	A600	A600	—	—	—	—	A600
Standard Duty		[DC]	—	—	—	—	—	—	—	Q600
Motor rating 60 Hz	120V, 1P	FLA	16	16	16	24	34	56	80	
		Hp	1	1	1	2	3	5	7.5	
	240V, 1P	FLA	12	12	17	17	28	50	68	
		Hp	2	2	3	3	5	10	15	—
Single-phase (2 poles)	480V, 1P	FLA	8.5	8.5	14	21	26	34	68	
		Hp	3	3	5	7.5	10	15	30	
	600V, 1P	FLA	11.2	11.2	11.2	16	20	27	44	
		Hp	5	5	5	7.5	10	15	25	
Three-phase	120V, 3P	FLA	13.6	13.6	19.2	30.4	40	56	84	
		Hp	2	2	3	5	7.5	10	15	
	240V, 3P	FLA	9.6	15.2	22	28	42	68	80	
		Hp	3	5	7.5	10	15	25	30	
	480V, 3P	FLA	11	14	21	27	34	52	65	—
		Hp	7.5	10	15	20	25	40	50	
	600V, 3P	FLA	11	11	17	22	27	52	52	
		Hp	10	10	15	20	25	50	50	

Mechanical Data

Performance Data			16 A	25…32 A	40…63 A	80…100 A	Aux. Contacts
Protection class according to IEC 529							
Motor rating 60 Hz							
handles			IP66	IP66	IP66	IP66	IP66
switch bodies			IP20	IP20	IP20	IP20	IP20
Mechanical life		[million operations]	0.2	0.2	0.2	0.2	0.2
Max wire gauges							
Terminal size per IEC 947-1			A4	A6	A7	A9	2xA2
rigid wire	1/2 conductor	AWG mm²	(1)16…10/(2)16…12 (1)1…10/(2)1…4	(1)14…8/(2)14…10 (1)1.5…16/(2)1.5…6	(1)12…4/(2)12…8 (1)2.5…25/(2)2.5…16	(1)10…1/(2)10…4 (1)4…50/(2)4…25	18…14 0.75…2.5
fine strands	1/2 conductor	AWG mm²	(1)16…8/(2)16…12 (1)1.5…6/(2)1.5…4	(1)14…8/(2)14…10 (1)1.5…10/(2)1…6	(1)12…4/(2)12…8 (1)2.5…16/(2)2.5…10	(1)10…1/(2)10…6 (1)4…35/(2)4…16	18…14 0.5…2.5

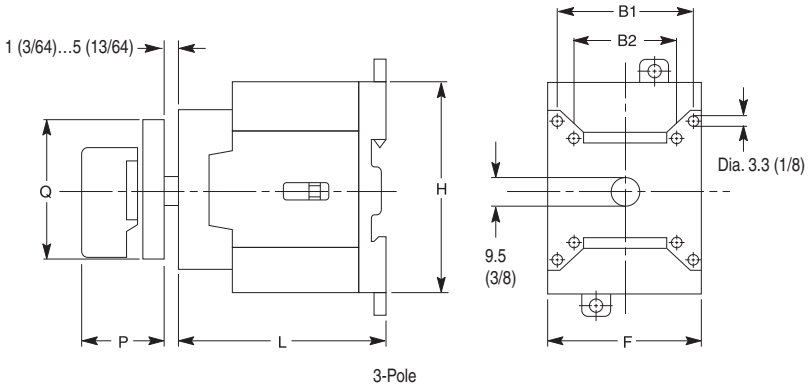
Environmental Data

Storage	–40…+80 °C (–40…+176 °F)
Operation	–25…+60 °C (–13…+140 °F)

Approximate Dimensions

Dimensions are shown in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

Front Installation Cat. No. 194E-E...

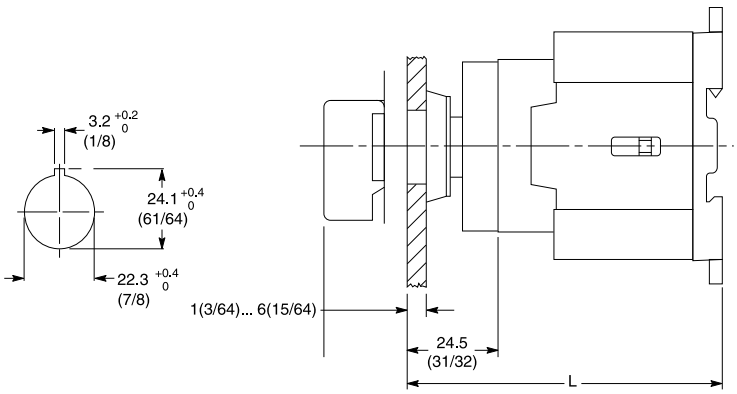


Handles		
Cat. No.	P	Q
194L-HE4A	28 (1-7/64)	48 x 48 (1-57/64 x 1-57/64)
194L-HE4I	28 (1-7/64)	48 x 48 (1-57/64 x 1-57/64)
194L-HE4S	28 (1-7/64)	48 x 62 (1-57/64 x 2-7/16)
194E-HE4N	34 (1-11/32)	54 x 54 (2-1/8 x 2-1/8)
194E-HE4G	34 (1-11/32)	54 x 54 (2-1/8 x 2-1/8)
194L-HE6A	28 (1-7/64)	64 x 64 (2-33/64 x 3-5/64)
194L-HE6I	28 (1-7/64)	64 x 64 (2-33/64 x 3-5/64)
194L-HE6S	28 (1-7/64)	64 x 78 (2-33/64 x 3-5/64)
194L-HE6N	34 (1-11/32)	67 x 67 (2-41/64 x 2-41/64)
194L-HE6G	34 (1-11/32)	67 x 67 (2-41/64 x 2-41/64)

Switch Body						
Use with Cat. No.	B1✶	B2	F	H	L ❄	G
194E-E16	28 (1-7/64)	N/A	36 (1-37/64)	63 (2-31/64)	51 (2)	90 (3-35/64)
194E-E25/32	36 (1-27/64)	N/A	45 (1-25/32)	64 (2-33/64)	60 (2-3/8)	90 (3-1/2)
194E-E40/63	48 (1-57/64)	36 (1-27/64)	54 (2-1/8)	72 (2-27/32)	74 (2-29/32)	108 (4-1/4)
194E-E80/100	48 (1-57/64)	36 (1-27/64)	72 (2-27/32)	90 (3-35/64)	90 (3-35/64)	144 (5-11/16)

✶ Does not apply to 194E-40/63A, 6-Pole Switches. Use B2 dimensions for 6-pole devices.
❄ For 6-pole switches, add 1 in. to the "L" dimension.

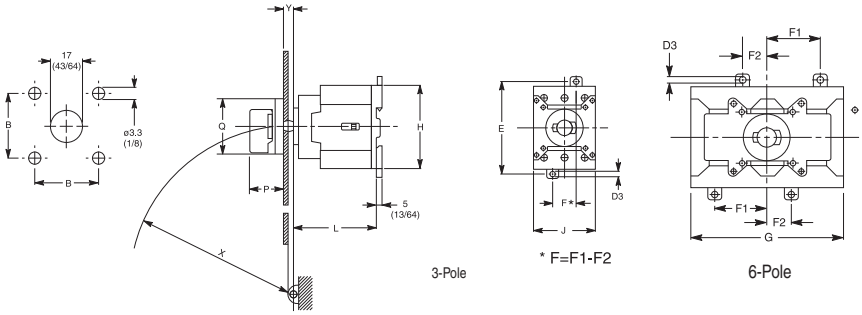
Cat. No. 194E-E Switch Body with Cat. No. 194L-HC4A Handle for 22.5 mm Hole Mounting Style



Type	L
194E-E16	76 (3)
194E-E25/32	84.5 (3-21/64)
194E-E40/63	98.5 (3-7/8)
194E-E80/100	114.5 (4-33/64)

Dimensions are shown in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

Base Mounting Cat. No. 194E-A...



Handles		
Cat. No.	P	Q
194L-HE4A	28 (1-7/64)	48 x 48 (1-57/64 x 1-57/64)
194L-HE4I	28 (1-7/64)	48 x 48 (1-57/64 x 1-57/64)
194L-HE4S	28 (1-7/64)	48 x 62 (1-57/64 x 2-7/16)
194E-HE4N	34 (1-11/32)	54 x 54 (2-1/8 x 2-1/8)
194E-HE4G	34 (1-11/32)	54 x 54 (2-1/8 x 2-1/8)
194L-HE6A	28 (1-7/64)	64 x 64 (2-33/64 x 3-5/64)
194L-HE6I	28 (1-7/64)	64 x 64 (2-33/64 x 3-5/64)
194L-HE6S	28 (1-7/64)	64 x 78 (2-33/64 x 3-5/64)
194L-HE6N	34 (1-11/32)	67 x 67 (2-41/64 x 2-41/64)
194L-HE6G	34 (1-11/32)	67 x 67 (2-41/64 x 2-41/64)

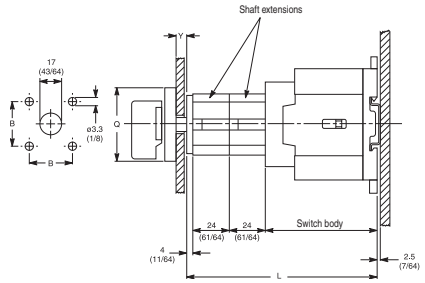
Cover Requirements				
For Use With	Y min.	X ≥	Y max.	X ≥
194E-A16	5 (13/64)	142 (5-19/32)	9.5 (3/8)	90 (3-35/64)
194E-A25/32	5 (13/64)	142 (5-19/32)	9.5 (3/8)	90 (3-35/64)
194E-A40/63	2.5 (7/64)	150 (5-29/32)	9.5 (3/8)	90 (3-35/64)
194E-A80/100	2.5 (7/64)	150 (5-29/32)	9.5 (3/8)	90 (3-35/64)

Switch Body								
Use With Cat. No.	D3	E	F1	F2	G	H	L❄	J
194E-A16	4.5 (3/16)	70 (2-49/64)	45 (1-25/32)	12.5 (31/64)	90 (3-35/64)	63 (2-31/64)	80 (3-5/32)	36 (1-27/64)
194E-A25/32	4.5 (3/16)	70 (2-49/64)	30 (1-3/16)	15 (19/32)	90 (3-1/2)	64 (2-33/64)	59 (2-5/16)	45 (1-25/32)
194E-A40/63	4.5 (3/16)	80 (3-5/32)	37 (1-15/32)	17 (43/64)	108 (4-1/4)	72 (2-27/32)	73 (2-55/64)	54 (2-1/8)
194E-A80/100	5.6 (7/32)	95 (3-3/4)	48.5 (1-29/32)	23.5 (59/64)	144 (5-11/16)	90 (3-35/64)	89 (3-1/2)	72 (2-27/32)

❄ For 6-pole switches, add 1 in. to the "L" dimension.

Base Mounting Cat. No. 194E-A...

Cat. No. 194E-A... Switch Body with Cat. No. 194L-G2853 Shaft Extension



Shaft	Y
194L-G2830	2.5...9.5 (7/64...3/8)
194L-G3194	9...18 (23/64...23/32)
194L-G3195	14...23 (9/16)...(29/32)

Switch Body				
	Cat. No.			
L ✶	194E-A 16	194E-A 25/32	194E-A 40/63	194E-A 80/100
With 1 shaft extension	79 (3-7/64)	88 (3-15/32)	102 (4-1/32)	118 (4-21/32)
With 2 shaft extensions	103 (4-37/64)	112 (4-27/64)	126 (4-31/32)	142 (5-19/32)
With 3 shaft extensions	127 (5)	136 (5-23/64)	150 (5-29/32)	166 (6-35/64)
With 4 shaft extensions	151 (6-61/64)	160 (6-5/16)	174 (6-55/64)	190 (7-31/64)
With 5 shaft extensions	175 (7-57/64)	184 (7-1/4)	198 (7-51/64)	214 (8-7/16)
With 6 shaft extensions	199 (8-27/32)	208 (8-13/64)	222 (8-3/4)	238 (9-3/8)

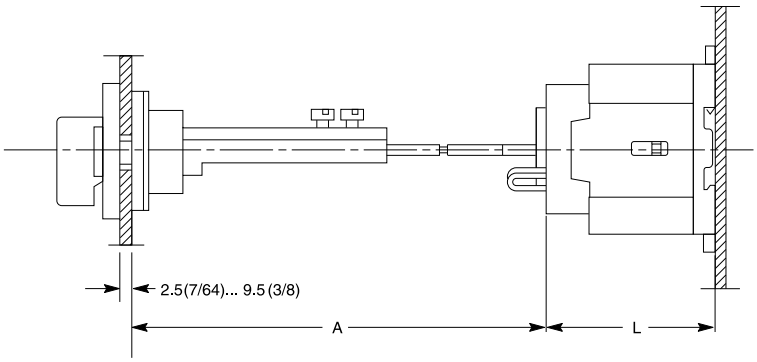
✶ For 6-pole switches, add 1 in. to the "L" dimension.

Handles			
Type	B	Q	P
194L-HE4A	36 (1-27/64)	48 x 48 (1-57/64 x 1-57/64)	28 (1-7/64)
194L-HE4I	36 (1-27/64)	48 x 48 (1-57/64 x 1-57/64)	28 (1-7/64)
194E-HE4G	28 (1-7/64)	54 x 54 (2-1/8 x 2-1/8)	34 (1-11/32)
194E-HE4N	28 (1-7/64)	54 x 54 (2-1/8 x 2-1/8)	34 (1-11/32)
194L-HE6A	48 (1-57/64)	64 x 64 (2-33/64 x 2-33/64)	28 (1-7/64)
194L-HE6I	48 (1-57/64)	64 x 64 (2-33/64 x 2-33/64)	28 (1-7/64)
194L-HE6N	48 (1-57/64)	67 x 67 (2-41/64 x 2-41/64)	34 (1-11/32)
194L-HE6G	48 (1-57/64)	67 x 67 (2-41/64 x 2-41/64)	34 (1-11/32)

Dimensions are shown in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

Base Installation Cat. No. 194E-A...

Cat. No. 194E-A Switch Body with Metal Shaft Extension



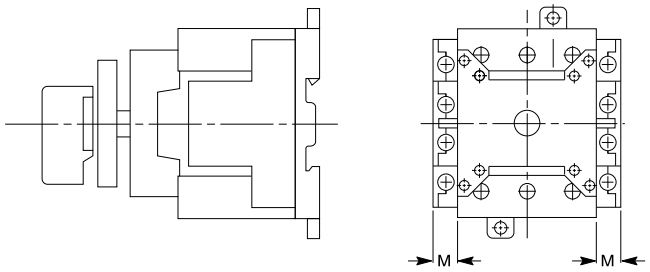
Cat. No.	A
194L-G3393	110...235 (4-11/32...9-1/4)
194L-G3394	230...350 (9-1/16...13-25/32)

Cat. No.	L*
194E-A16	51 (2)
194E-A25/32	60 (2-3/8)
194E-A40/63	74 (2-59/64)
194E-A80/100	90 (3-35/64)

* For 6-pole switches, add 1 in. to the "L" dimension.

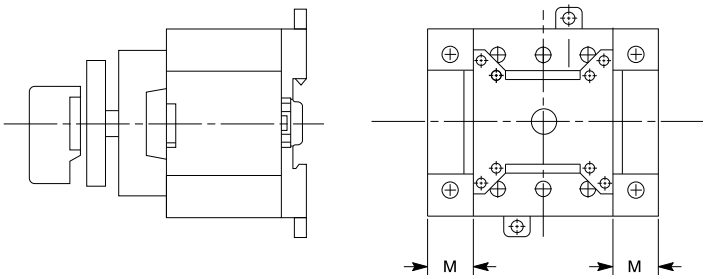
Base and Front Installation

Cat. No. 194E... with Auxiliary Contact Block Installed



Contacts	M
1 N.O. + 1 N.C.	9 (23/64)
2 N.O. + 2 N.C.	18 (23/32)

Cat. No. 194E... with 4-Pole, Ground and Neutral Terminals

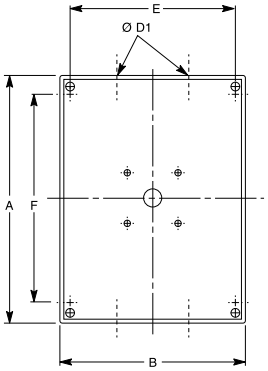


Cat. No.	M
194E-16	12.5 (31/64)
194E-25/32	14 (9/16)
194E-40/63	17.5 (11/16)
194E-80/100	22 (7/8)

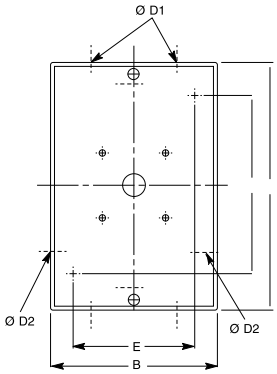
Dimensions are shown in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

Base Mounting Cat. No. 194E-A...

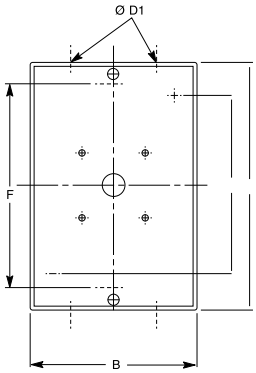
Thermoplastic Enclosures



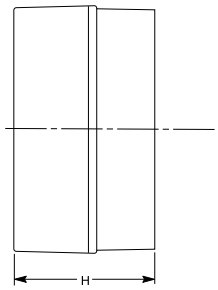
Cat. No. 194L-3665



Cat. No. 194L-3572



Cat. No. 194L-3563



Enclosure Base View

Complete Switches		Enclosures		Height A	Width B	Knockouts❄ ØD1		Mounting Holes‡ E	Mounting Holes‡ F	Depth H
Cat. No.	Poles	ABS Cat. No.	Noryl Cat. No.							
194E-Y16	3 and 4	✶	✶	118 (4-21/32)	66 (2-19/32)	M16/M20 16/20 mm	PG11/PG16 18.5/22.5 mm	50 (1-31/32)	105 (4-9/65)	70 (2-49/65)
	6	194E-G3663	194E-G3664	180 (7-3/32)	125 (4-59/64)	M25/M30 25/30 mm	PG21/PG29 28.5/37.5 mm	On Center	145 (5-23/32)	105 (4-1/8)
194E-Y25/32	3 and 4	194L-G3572	194L-G3576	150 (5-29/32)	95 (3-3/4)	PG16/PG21 22.5/28.5 mm		60 (2-3/8)	115 (4-17/32)	86 (3-3/8)
	6	194E-G3663	194E-G3664	180 (7-3/32)	125 (4-59/64)	PG21/PG29 28.5/37.5 mm		On Center	145 (5-23/32)	105 (4-1/8)
194E-Y40/63	3 and 4	194E-G3663	194E-G3664	180 (7-3/32)	125 (4-59/64)	PG21/PG29 28.5/37.5 mm		On Center	145 (5-23/32)	105 (4-1/8)
	6	194E-G3665	194E-G3666	230 (9-1/16)	175 (6-57/64)	PG29/PG36 37.5/47.5 mm		155 (6-3/32)	195 (4-11/16)	120 (4-47/64)
194E-Y80/100	3 and 4	194E-G3665	194E-G3666	230 (9-1/16)	175 (6-57/64)	PG29/PG36 37.5/47.5 mm		155 (6-3/32)	195 (4-11/16)	120 (4-47/64)

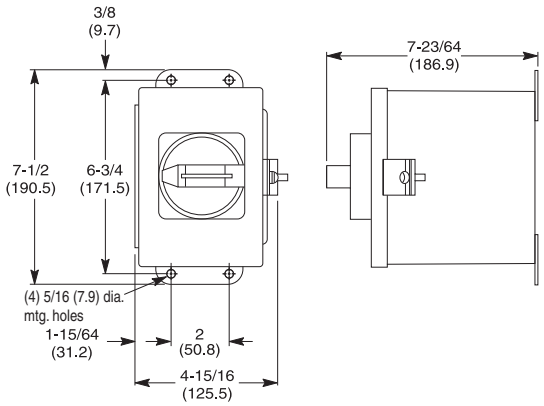
✶ Empty enclosures not available for purchase.
❄ Cat. No. 194E-A16 units have 1 knockout on each end. all others have 2 knockouts on each end. A letter "M" in the catalog number indicates metric knockouts; the unit is otherwise supplied with PG knockouts.
‡ All mounting holes have a 4.2 mm (5/32 in.) diameter.

No. of Extensions	Cat. No. 194E-A 20/32...	Cat. No. 194E-A 40/63...	Cat. No. 194E-A 80/00...
With 1 extension	96 (3-25/32)	107 (4-7/32)	114 (4-31/64)
With 2 extensions	120 (4-23/32)	131 (5-5/32)	138 (5-7/16)
With 3 extensions	144 (5-43/64)	155 (6-7/64)	162 (6-3/8)
With 4 ✶ extensions	168 (6-39/64)	179 (7-3/64)	186 (7-21/64)
With 5 ✶ extensions	192 (7-9/16)	203 (8)	210 (8-17/64)
With 6 ✶ extensions	216 (8-1/2)	227 (8-15/16)	234 (9-7/32)

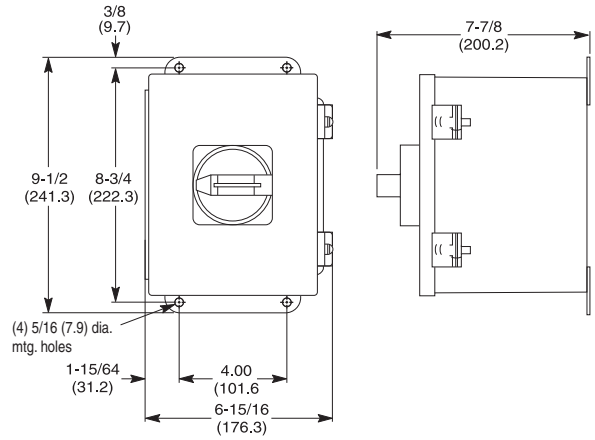
✶ When more than 4 modules are used, attach the first one to the switch body using the screws supplied with the extension (Cat. No. 194L-G2853).

Dimensions are shown in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

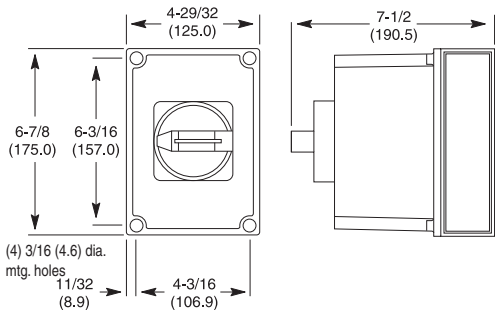
194E Enclosed Switches with 194R Handles



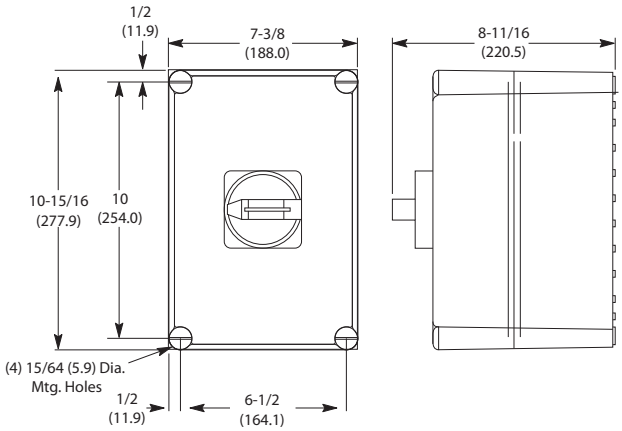
Cat. Nos. 194E-CA16...63, 194E-FA16...63, 194E-AA16...63



Cat. Nos. 194E-CA80...00, 194E-FA80...00, 194E-AA80...00
Cat. Nos. 194E-CA40X...63X, 194E-FA40X...63X, 194E-AA40X...63X



Cat. No. 194E-KA16...63



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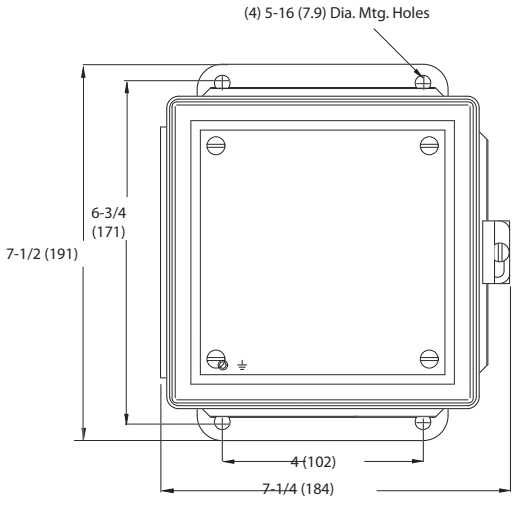
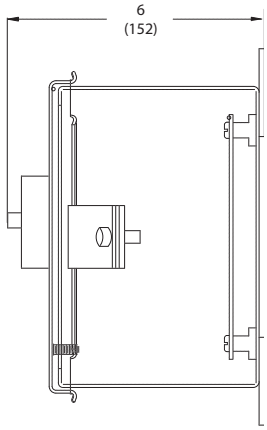
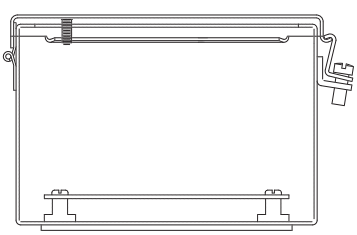






Cat. No. 194E-DA16...32, 194E-GA16...32

Bulletin 194E IEC Load Switches

Bulletin 194E load switches are designed for use as local motor isolation and for disconnect switch applications. They are available in 3- and 4-pole versions with add-on grounding and neutral terminals and auxiliary contacts.

Bulletin 194E switches are offered in two mounting styles, Front/Door and Base/DIN configurations, for a variety of installations. Switch body styles for Bulletin 194E base-mounted switches include standard interlock shaft; Bulletin 194E front-mounted switches include standard shaft.

- At-Motor Disconnect Switch (UL508)
- 125, 160, 250, 315 A Versions of Inductive Load-Rated Switches
- IP66/UL Type 1/3/3R/12 Operating Handles
- IP2LX Finger-Safe Terminals
- 3- and 4-Pole Versions
- Front/Door or DIN/Base Mounting Configurations
- OFF-ON Configurations
- Box Lug and Bolt-on Terminals Available
- Switches Include Operating Shaft
- Suitable as Motor Disconnect

Standards Compliance

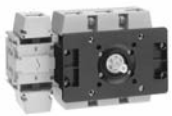
IEC 207
IEC 60947-1
IEC 60947-3 Low-voltage switchgear and control gear part 3
UL 508
CSA C22.2, No. 14

Certifications

cULus Listed (Box Lug Version) (UL File No. E14841, Guide NLRV, NLRV7)
UR Recognized (Bolt-on Version) (UL File No. E 14841 NLRV2, NLRV8)
CE

Overview

Bulletin 194E Switches — 125...315 A

OFF-ON Switch — with Box Lugs (UL Listed)		OFF-ON Switch — with Bolt-on Wiring (UR Recognized))	
3-pole Base Mounted	*3-pole Front Mounted*	*3-pole Base Mounted*	*3-pole Front Mounted*
4-pole Base Mounted	 *4-pole Front Mounted*	*4-pole Base Mounted*	*4-pole Front Mounted*

Cat. No. Explanation

194E – A 125 –1753
a b c

a

Installation Type	
Code	Description
A	Base Mounting w/Box Lugs — UL Listed*
B	Base Mounting w/Bolt-on Wiring — UR Recognized*
E	Front Mounting w/Box Lugs — UL Listed
F	Front Mounting w/Bolt-on Wiring — UR Recognized

* 20 cm shaft included with switch

b

Load Size	
Code	Description
125	125 A
160	160 A
250	250 A
315	315 A

c

Configuration		
Code	Function	Description
1753	OFF-ON	3-Pole, 2-position (90 degrees)
1754	OFF-ON	4-Pole, 2-position (90 degrees)

Product Selection

Frequently Ordered 194E Switches

(see Cat. No. Explanation for additional load sizes in 3- and 4-pole configurations)

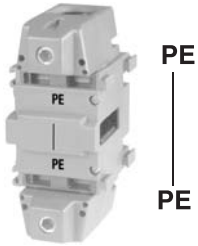
Description	No. of Poles	Rated Current	AC23 Rated kw 690V AC 50 Hz	Hp @ 480V AC 60 Hz 3 Ø	Cat. No.
Base-mounting switch w/ box lugs — 125 A	3	125	45	60	* 194E-A125-1753
Base-mounting switch w/ box lugs — 160 A		160	55	60	* 194E-A160-1753
Base-mounting switch w/ box lugs — 250 A		250	90	75	* 194E-A250-1753
Base-mounting switch w/ box lugs — 315 A	4	315	110	100	* 194E-A315-1754
Base-mounting switch w/ bolt-on wiring — 250 A	3	250	45	75	* **194E-B250-1753**
Base-mounting switch w/ bolt-on wiring — 315 A		315	45	100	* **194E-B315-1753**
Front-mounting switch w/ box lugs — 160 A		160	37	60	194E-E160-1753
Front-mounting switch w/ bolt-on wiring — 160 A	4	160	37	60	**194E-F160-1754**
Front-mounting switch w/ bolt-on wiring — 250 A		250	45	75	**194E-F250-1754**
Front-mounting switch w/ bolt-on wiring — 315 A		315	45	100	**194E-F315-1754**

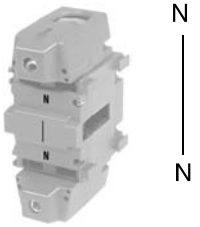
* 20 cm shaft included with switch.

Accessories
Handles 194E - 125...315 A

Handles with Screw Fixing (Includes Legend Plate and Control Knob)	Degree of Protection	Color	Legend Plate Size	For Use With	Legend Marking	Cat. No.
Type A	IP65 (UL Type 3/3R/12)	Black/Grey	88 x 88 mm 3-15/32 x 3-15/32 in.	194E-125...315 A		194E-HE8A-175
			130 x 130 mm 5-1/8 x 5-1/8 in.			194E-HE13A-175
Type I		Red/Yellow	88 x 88 mm 3-15/32 x 3-15/32 in.			194E-HE8I-175
			130 x 130 mm 5-1/8 x 5-1/8 in.			194E-HE13I-175
Type G		Black/Grey	90 x 90 mm 3-35/64 x 3-35/64 in.	194E-125...315 A		194E-HE8G-175
			135 x 135 mm 5-5/16 x 5-5/16 in.			194E-HE13G-175
Type N		Red/Yellow	90 x 90 mm 3-35/64 x 3-35/64 in.			194E-HE8N-175
			135 x 135 mm 5-5/16 x 5-5/16 in.			194E-HE13N-175

Auxiliary Contacts - 2 N.O. / 1 N.C.	For Use With	Cat. No.
	194E-A125-160,194E-B125-160	194E-AB-P21-160
	194E-A250-315,194E-B250-315	194E-AB-P21-315
	194E-E125-160,194E-F125-160	194E-EF-P21-160
	194E-E250-315,194E-F250-315	194E-EF-P21-315

Earthing/Grounding Terminal	For Use With	Cat. No.
	194E-A125-160,194E-E125-160	194E-AE160-PE
	194E-A250-315,194E-E250-315	194E-AE315-PE
	194E-B125-160,194E-F125-160	**194E-BF160-PE**
	194E-B250,194E-F250	**194E-BF250-PE**
	194E-B315,194E-F315	**194E-BF315-PE**

Neutral Terminal	For Use With	Cat. No.
	194E-A125-160,194E-E125-160	194E-AE160-TN
	194E-A250-315,194E-E250-315	194E-AE315-TN
	194E-B125-160,194E-F125-160	**194E-BF160-TN**
	194E-B250,194E-F250	**194E-BF250-TN**
	194E-B315,194E-F315	**194E-BF315-TN**

Shaft Extension	Length	For Use With	Cat. No.
	40 cm	194E-A or 194E-B 125…315 A Base-Mounted Switches	194E-AB40

Terminal Cover	For Use With		Cat. No.
	194E-A125-160 194E-E125-160	2 covers per pole	194E-AE125-C1
	194E-A250-315 194E-E250-315	2 covers per pole	194E-AE250-C1
	194E-B125-160 194E-F125-160	2 covers per pole	194E-BF125-C1
	194E-B250-315 194E-F250-315	2 covers per pole	194E-BF250-C1

Legend

Additional Name Plate and Frame

	Color	Legend Size	For Use With	Legend Marking	Pkg. Qty.	Cat. No.
	Black/Grey	18 x 84 mm 11/16 x 3-5/16 in.	Size 8 Type G and N Style Handles, Cat. Nos. 194L-HE8G/N 88 mm x 88 mm 90 mm x 90 mm 130 mm x 130 mm 135 mm x 135 mm legend frames	MAIN SWITCH	5	**194L-G3515A**
				HAUPTSCHALTER		**194L-G3515B**
				INTERR. PRINCIPALE		**194L-G3515C**
				INTERR. PRINCIPAUX		**194L-G3515D**
				INTERR. PRINCIPAL		**194L-G3515E**
				HUVUDBRYTARE		**194L-G3515F**
				WAHLSCHALTER		**194L-G3515G**
	Black/Grey			EMERGENCY OFF		**194L-G3515H**

Specifications

IEC Performance Data for 194E

				194E-125	194E-160	194E-250	194-315
Rated insulation voltage U_i: ✶			[V]	1000	1000	1000	1000
Rated impulse withstand voltage U_{imp}			[kV]	8	8	8	8
Test voltage 1 min			[kV]	3.5	3.5	3.5	3.5
Rated voltage U_e ✶❄			[V]	1000	1000	1000	1000
Rated frequency			[Hz]	50/60	50/60	50/60	50/60
Rated thermal current I^{th} open			[A]	125	160	250	315
Rated thermal current I_{the} enclosed			[A]	125	160	250	315
Rated current I^e							
AC-1 /	Non-inductive or slightly induc. load		[A]	125	160	250	315
AC-21A	Switching of resistive loads with slight overload						
Rated power P_e							
AC-23A	Occasional switching of motor and other highly inductive loads	230V	[kW]	30	30	37	55
		400V	[kW]	45	55	90	110
		690V	[kW]	37	37	45	45
AC-3	Squirrel-cage motors: starting and stopping of running motors	230V	[kW]	22	30	37	45
		400V	[kW]	37	45	55	75
		690V	[kW]	30	37	45	45
Conditional rated short-circuit current		400/415V	[kA]	30	30	30	30
Max. fuse rating of circuit (type gG)			[A]	125	160	250	315
Rated short-time current I_{cw} 1S			[A]	2500	3000	4600	5800
Rated breaking capacity		230V	[A]	800	900	1600	1800
AC-23A (cos ϕ 0.45)		400V	[A]	750	850	1380	1650
		690V	[A]	340	340	400	400

✶ Valid for line with grounded common neutral termination, overvoltage category III, pollution degree 3. Other values on request.
❄ Not suitable for load-switching applications (AC-20 A) above 690V.

IEC Performance Data for 194E, Continued

DC Switching Capacity							
				194E-125	194E-160	194E-250	194E-315
Rated current I^e							
	Rated voltage [V]	No. Poles in series					
DC-21A	60	3	[A]	125	160	250	315
For resistive loads T≤1 ms	110	3	[A]	110	140	220	280
	220	3	[A]	45	55	85	110
	Rated voltage [V]	No. Poles in series					
	110	4	[A]	125	160	250	315
	220	4	[A]	80	100	150	200
	440	4	[A]	16	20	32	40
Rated power P_e							
	Rated voltage [V]	No. Poles in series					
DC-22A, DC-3	24	4	[kW]	3	3.8	6	7.5
For Inductive loads T≤2.5 ms	48	4	[kW]	6	7.5	12	15
	60	4	[kW]	7.5	9.5	15	19
	110	4	[kW]	10	12.5	20	25
	220	4	[kW]	4.5	5.5	8	10
Rated Power P_e							
	Rated voltage [V]	No. Poles in series					
DC-23A, DC-5	24	4	[kW]	3	3.8	6	7.5
For Inductive loads T≤15 ms	48	4	[kW]	6	7.5	12	15
	60	4	[kW]	7.5	9.5	15	19
	110	4	[kW]	8.8	11	17.5	22
	220	4	[kW]	2.5	3.5	5.5	7

UL CSA Performance Data for 194E

			194E-125	194E-160	194E-250	194E-315
Rated Insulation Voltage		[V]	600	600	600	600
Rated voltage		[V]	600	600	600	600
Continuous current		[A]	150	200	250	300
Ampere rating for general use		[A]	150	200	250	300
Heavy Pilot Duty		[AC]				
Standard Duty		[DC]				
Motor rating 60Hz						
1-phase (2 poles)	120V, 1 P	[FLA]	80	100	135	180
		[Hp]	7.5	10	15	20
	240V, 1 P	[FLA]	88	110	136	155
		[Hp]	20	25	30	35
	480V, 1 P	[FLA]	78	88	99	108
		[Hp]	35	40	45	50
	600V, 1 P	[FLA]	62	70	86	104
		[Hp]	35	40	50	60
3-Phase	120V, 3 P	[FLA]	84	108	160	208
		[Hp]	15	20	30	40
	240V, 3 P	[FLA]	8	104	154	192
		[Hp]	30	40	60	75
	480V, 3 P	[FLA]	77	77	96	124
		[Hp]	60	60	75	100
	600V, 3 P	[FLA]	62	62	77	99
		[Hp]	60	60	75	100

Mechanical Data

				194E-125	194E-160	194E-250	194E-315
Handles				IP66	IP66	IP66	IP66
Protection class according to IEC 529				—	—	—	—
Front side Front unit				IP66	IP66	IP66	IP66
Box lugs∗				IP20	IP20	IP20	IP20
Bolt-on	straight version∗			IP20	IP20	IP20	IP20
	bent version			—	—	—	—
Mechanical life			[Million operations]	0.1	0.1	0.075	0.075
Box lugs — max. wire gauges				—	—	—	—
Terminal sizes according to IEC 947-1		Gauge No.		B11	B11	B14	B14
Fine strands, 1 conductor		Max.	mm^2	70	70	150	150
		Min.	mm^2	16	16	25	25
Rigid wire, 1 conductor		Max.	mm^2	95	95	185	185
		Min.	mm^2	10	10	16	16
Wire gauges according to UL/CSA		Max.	AWG	3/0	3/0	—	—
			MCM	—	—	350	350
		Min.	AWG	8	8	4	4

∗ When provided with terminal covers.

Certifications

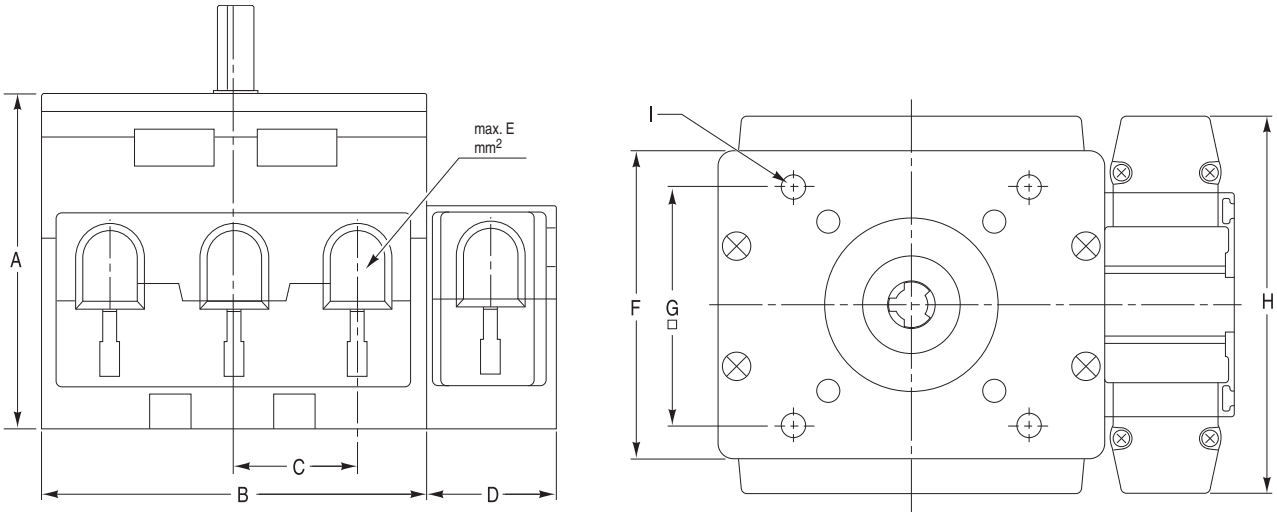
Catalog No. or Designation		UL-Listed (marked with UL)	UR-Recognized (marked with UR)	UL-Listed for Canada (marked with cUL)	UR-Recognized for Canada (marked with cUR)	CE
194E-A125	194E-E125	A	—	A	—	A
194E-A160	194E-E160	A	—	A	—	A
194E-A250	194E-E250	A	—	A	—	A
194E-A315	194E-E315	A	—	A	—	A
194E-B125	194E-F125	—	A	—	A	A
194E-B160	194E-F160	—	A	—	A	A
194E-B250	194E-F250	—	A	—	A	A
194E-B315	194E-F315	—	A	—	A	A
Aux. switch blocks		Z	Z	Z	Z	Z
Ground terminal		Z	Z	Z	Z	Z
Neutral terminal		Z	Z	Z	Z	Z

A = Certified
Z = accessories are covered by the approval for the switch

Approximate Dimensions

Dimensions are shown in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

Front-Installation Box Lugs, 3- and 4-Pole

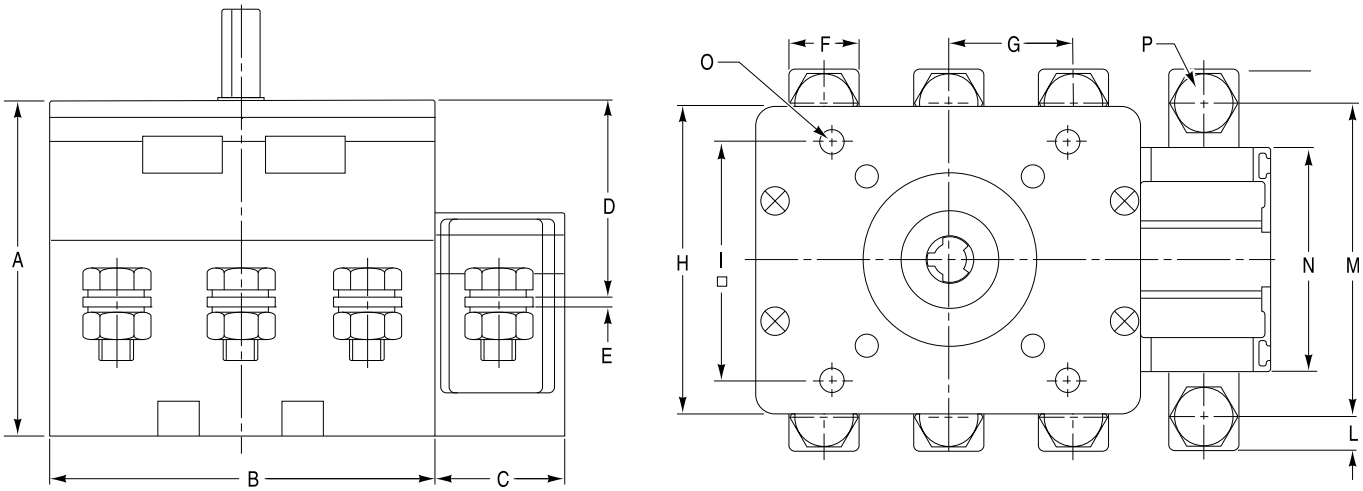


Switch Body 194E-E

[A]	A	B	C	D	E	F	G	H	I∗
125	91 (3-19/32)	112 (4-13/32)	36 (1-13/32)	38 (1-1/2)	95 (3-23/64)	88 (3-7/16)	68 (2-11/16)	108 (4-1/4)	M5
160	91 (3-19/32)	112 (4-13/32)	36 (1-13/32)	38 (1-1/2)	95 (3-23/64)	88 (3-7/16)	68 (2-11/16)	108 (4-1/4)	M5
250	103 (4-3/64)	145 (5-23/32)	44 (1-23/32)	52.5 (2-1/16)	185 (7-9/32)	88 (3-7/16)	68 (2-11/16)	120 (4-11/16)	M5
315	103 (4-3/64)	145 (5-23/32)	44 (1-23/32)	52.5 (2-1/16)	185 (7-9/32)	88 (3-7/16)	68 (2-11/16)	120 (4-11/16)	M5

∗ M5 x 0.8 bolts supplied with switch. Threaded hole.

Front-Installation Bolt-on Terminals, 3- and 4-Pole



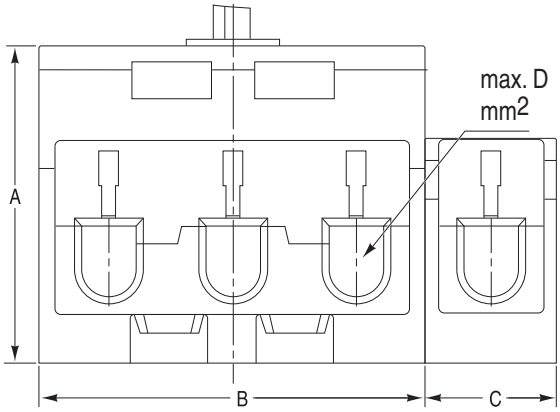
Switch Body 194E-F

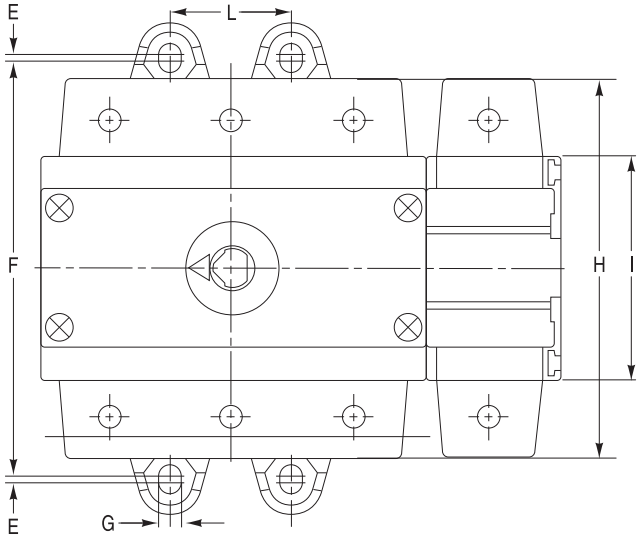
[A]	A	B	C	D	E	F	G	H	I	L	M	N	O∗	P❄
125	91 (3-19/32)	112 (4-3/32)	38 (1-1/2)	65.5 (2-9/16)	3 (1/8)	2 (3/32)	36 (1-13/32)	88 (3-7/16)	68 (2-11/16)	10 (13/32)	90 (3-17/32)	64 (2-17/32)	M5	M10
160	91 (3-19/32)	112 (4-3/32)	38 (1-1/2)	65.5 (2-9/16)	3 (1/8)	2 (3/32)	36 (1-13/32)	88 (3-7/16)	68 (2-11/16)	10 (13/32)	90 (3-17/32)	64 (2-17/32)	M5	M10
250	103 (4-3/64)	145 (5-23/32)	52.5 (1-22/32)	60.4 (2-3/8)	4 (5/32)	2 (3/32)	44 (1-23/32)	88 (3-7/16)	68 (2-11/16)	13 (1/2)	100 (3-15/16)	70 (2-3/4)	M5	M12
315	103 (4-3/64)	145 (5-23/32)	52.5 (1-22/32)	60.4 (2-3/8)	4 (5/32)	2 (3/32)	52 (2-1/16)	88 (3-7/16)	68 (2-11/16)	13 (1/2)	100 (3-15/16)	70 (2-3/4)	M5	M12

∗ M5 x 0.8 bolts supplied with switch. Threaded hole.
❄ Bolts and nuts supplied with switch. Through-hole.

Dimensions are shown in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

Base-Mounting Box Lugs, 3- and 4-Pole

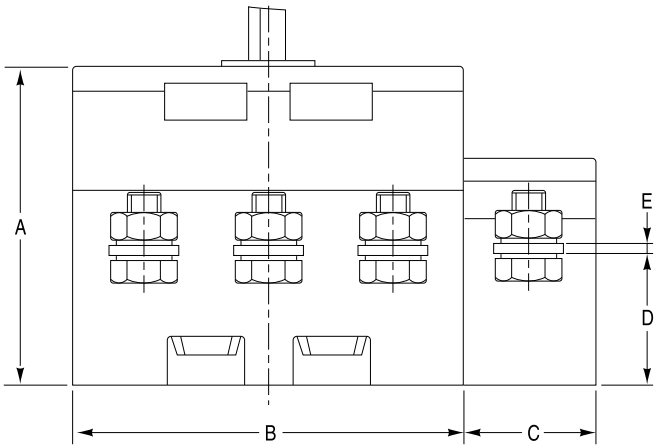


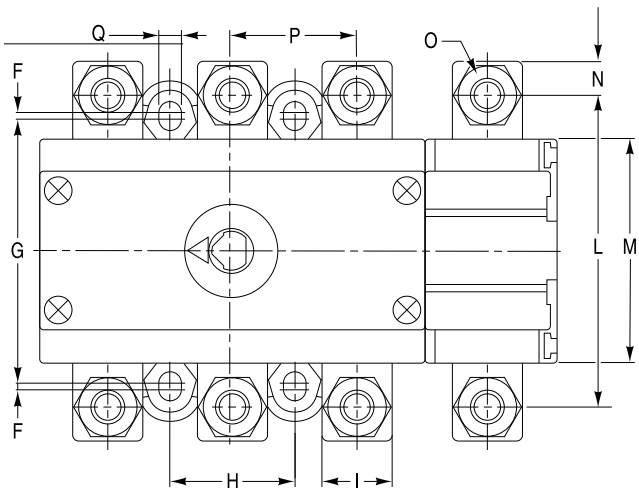


Switch Body 194E-A

[A]	A	B	C	D	E	F	G	H	I	L
125	91 (3-19/32)	112 (4-13/32)	38 (1-1/2)	95 (3-23/64)	2 (3/32)	118 (4-5/8)	6.4 (1/4)	108 (4-1/4)	64 (2-17/32)	36 (1-13/32)
160	91 (3-19/32)	112 (4-13/32)	38 (1-1/2)	95 (3-23/64)	2 (3/32)	118 (4-5/8)	6.4 (1/4)	108 (4-1/4)	64 (2-17/32)	36 (1-13/32)
250	98 (3-27/32)	145 (5-23/32)	52.5 (1-23/32)	185 (7-9/32)	2 (3/32)	140 (5-1/2)	6.4 (1/4)	126 (4-15/16)	70 (2-3/4)	44 (2-1/16)
315	98 (3-27/32)	145 (5-23/32)	52.5 (1-23/32)	185 (7-9/32)	2 (3/32)	140 (5-1/2)	6.4 (1/4)	126 (4-15/16)	70 (2-3/4)	44 (2-1/16)

Base-Mounting Bolt-on Terminals, 3- and 4-Pole



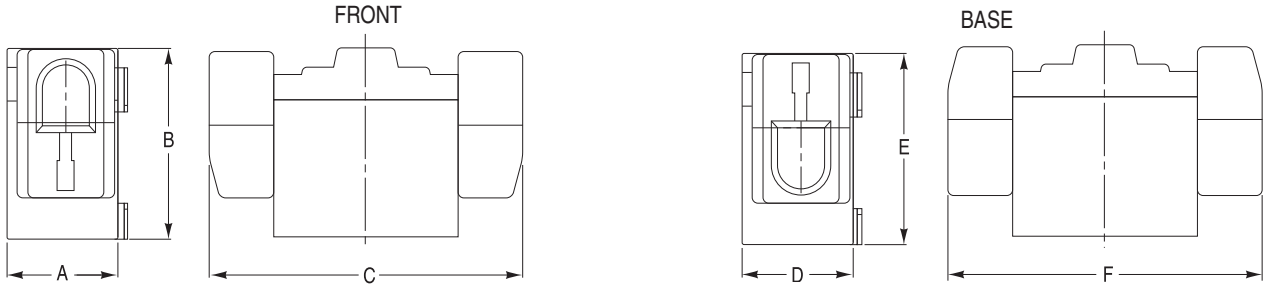


Switch Body 194E-B

[A]	A	B	C	D	E	F	G	H	I	L	M	N	O	P	Q
125	91 (3-19/32)	112 (4-3/32)	38 (1-1/2)	36.5 (1-7/16)	3 (1/8)	2 (3/32)	76 (3)	36 (1-13/32)	20 (3/4)	90 (3-17/32)	64 (2-17/32)	10 (13/32)	M10 (3/8)	36 (1-13/32)	6.4 (1/4)
160	91 (3-19/32)	112 (4-3/32)	38 (1-1/2)	36.5 (1-7/16)	3 (1/8)	2 (3/32)	76 (3)	36 (1-13/32)	20 (3/4)	90 (3-17/32)	64 (2-17/32)	10 (13/32)	M10 (3/8)	36 (1-13/32)	6.4 (1/4)
250	98 (3-27/64)	145 (5-23/32)	52.5 (1-22/32)	38.6 (1-1/2)	4 (5/32)	2 (3/32)	80 (3-1/8)	44 (1-23/32)	26 (1-1/64)	100 (3-15/16)	70 (2-3/4)	13 (1/2)	M12 (15/32)	44 (1-23/32)	6.4 (1/4)
315	98 (3-27/64)	145 (5-23/32)	52.5 (1-22/32)	38.6 (1-1/2)	4 (5/32)	2 (3/32)	80 (3-1/8)	44 (1-23/32)	26 (1-1/64)	100 (3-15/16)	70 (2-3/4)	13 (1/2)	M12 (15/32)	52 (2-1/16)	6.4 (1/4)

Dimensions are shown in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

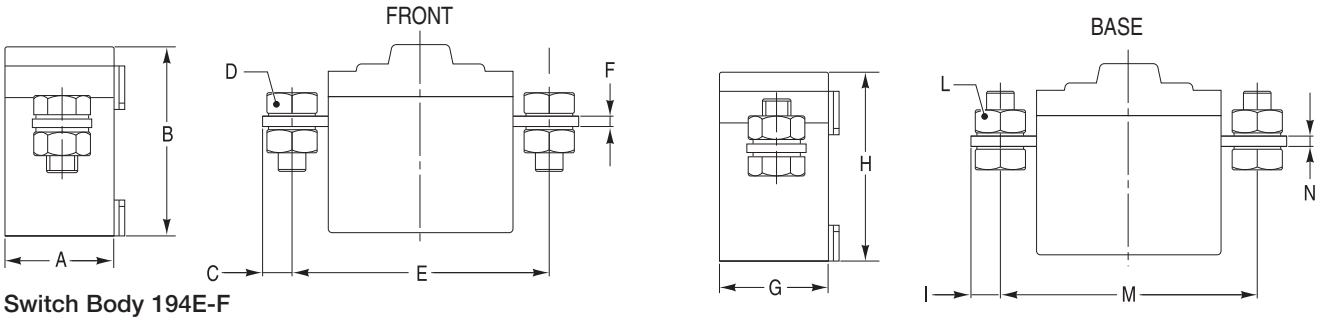
Box Ground and Neutral Terminal



Switch Body 194E-F

[A]	A	B	C	D	E	F
125	37.8 (1-1/2)	64 (2-17/32)	108 (4-1/4)	37.8 (1-1/2)	64 (2-17/32)	108 (4-1/4)
160	37.8 (1-1/2)	64 (2-17/32)	108 (4-1/4)	37.8 (1-1/2)	64 (2-17/32)	108 (4-1/4)
250	52.3 (2-1/16)	71.1 (2-25/32)	126 (4-15/16)	52.3 (2-1/16)	80.6 (3-1/8)	126 (4-15/16)
315	52.3 (2-1/16)	71.1 (2-25/32)	126 (4-15/16)	52.3 (2-1/16)	80.6 (3-1/8)	126 (4-15/16)

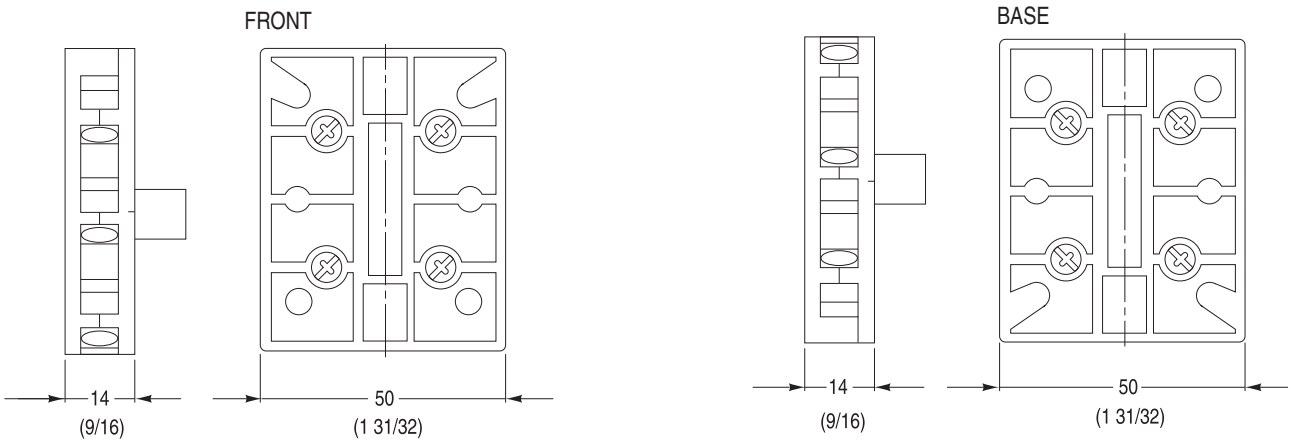
Bolt Ground and Neutral Terminal



Switch Body 194E-F

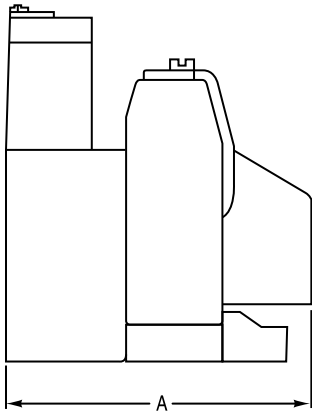
[A]	A	B	C	D	E	F	G	H	I	L	M	N
125	37.8 (1-1/2)	64 (2-17/32)	10 (13/32)	M10 (13/32)	90 (3-17/32)	3 (1/8)	37.8 (1-1/2)	64 (2-17/32)	10 (13/32)	M10 (13/32)	90 (3-17/32)	3 (1/8)
160	37.8 (1-1/2)	64 (2-17/32)	10 (13/32)	M10 (13/32)	90 (3-17/32)	3 (1/8)	37.8 (1-1/2)	64 (2-17/32)	10 (13/32)	M10 (13/32)	90 (3-17/32)	3 (1/8)
250	52.3 (2-1/16)	68 (2-21/32)	13 (1/2)	M12 (15/32)	100 (3-15/16)	4 (5/32)	52.3 (2-1/16)	68 (2-21/32)	13 (1/2)	M12 (15/32)	100 (3-15/16)	4 (5/32)
315	52.3 (2-1/16)	68 (2-21/32)	13 (1/2)	M12 (15/32)	100 (3-15/16)	4 (5/32)	52.3 (2-1/16)	68 (2-21/32)	13 (1/2)	M12 (15/32)	100 (3-15/16)	4 (5/32)

Auxiliary Contacts

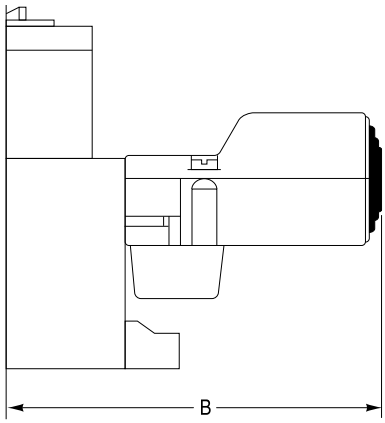


Dimensions are shown in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

Terminal Cover

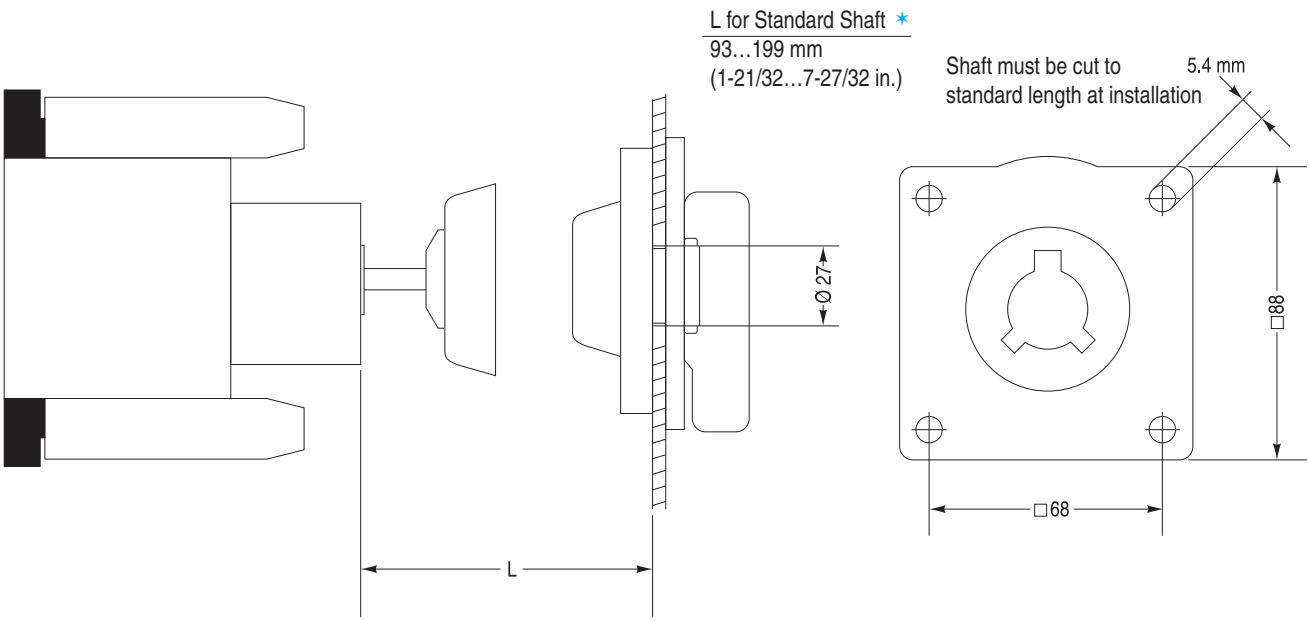


Switch Body 194E-F



[A]	A	B
125	76.2 (3)	95 (3-3/4)
160	76.2 (3)	95 (3-3/4)
250	88 (3-15/32)	109.5 (4-5/16)
315	88 (3-15/32)	109.5 (4-5/16)

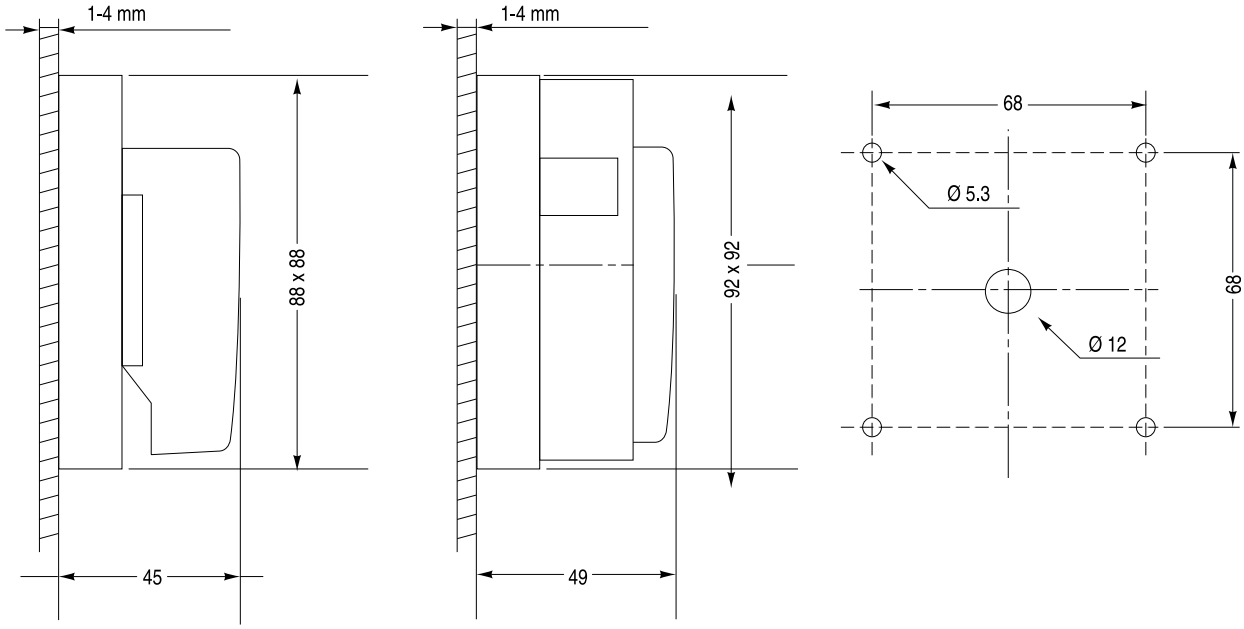
Door Clutches



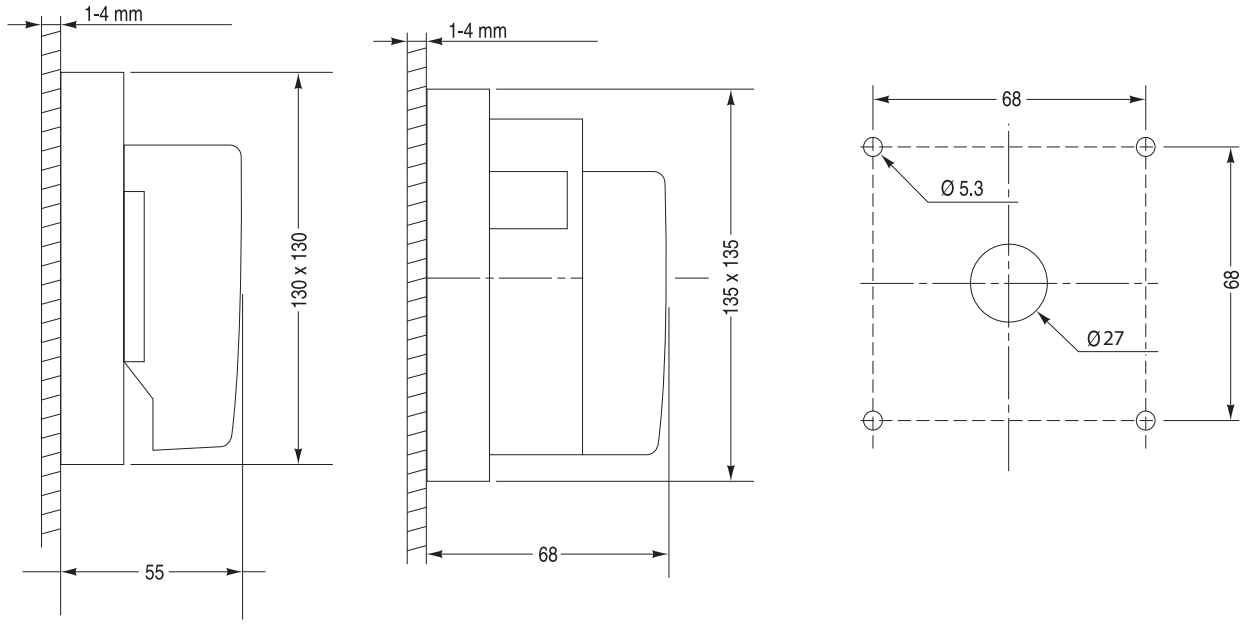
* Use Cat. No. 194E-AB40 shaft extension accessory to extend beyond the standard shaft length.

Dimensions are shown in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

Handles (Type 194E-HE-8A-8I-8G-8N)



Handles (Type 194E-HE-13A-13I-13G-13N)

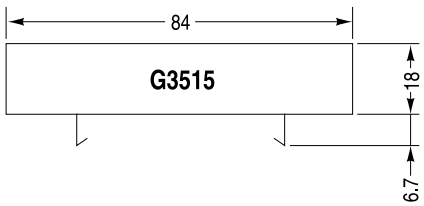


Type A and I

Type G and N

Additional Name Plate

Frame and legend snaps on to handle bezel. Fits size 8 and 13 handles.



Connection Systems

Overview 7-2

Safety Wiring Systems

Safety Wired T-Port, DC Micro 7-6
Safety Wired Distribution Box, DC Micro 7-7
Safety Wired Distribution Box, AC Micro 7-10
Safety Wired Shorting Plug, DC Micro & AC Micro 7-11

Cables

Cordsets & Patchcords, DC Micro Style 7-12
Cordsets & Patchcords, AC Micro Style 7-16
Cordsets & Patchcords, Mini Style 7-18
Cordsets & Patchcords, Mini-Plus Style 7-20
Cordsets & Patchcords, M23 Style 7-22

Connectors

Field Attachable, DC Micro Style, Screw Terminal 7-24
Field Attachable, DC Micro Style, Insulation Connector 7-26
Field Attachable, M23 Style, Solder Connector 7-27
Receptacles, DC & AC Micro Male Style 7-28
Receptacles, M23 Male 7-29

Overview

The Allen-Bradley Guardmaster® Safety Connection Systems are complete wiring solutions dedicated to machine safety. These quick disconnect-based systems consist of safety wired T-Ports and distribution boxes as well as patchcords and shorting plugs. Specifically intended for use with dry-contact safety switches, Safety Connection Systems provide flexible and reliable connections between safety interlock switches, E-stops, cable pull switches and safety relays. And while this system is ideal for use with these components, it is not suitable for use with light curtains, safety mats or pressure sensitive safety edges.

Allen-Bradley Guardmaster Safety Connection Systems are designed to:

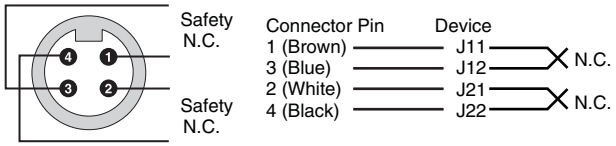
- Reduce installation cost
- Ease system expansion
- Simplify troubleshooting
- Promote system modularity
- Provide for Safety PLC input expansion
- Support systems up to Category 3 (per EN954-1)

Safety Connection Systems layouts are available with or without enunciation capabilities, allowing the user the option of direct feedback for the status of individual switches in the system. Enunciation systems utilize an auxiliary contact as input to tower lights, audible alarms, PLC input cards, etc.

Systems without Enunciation

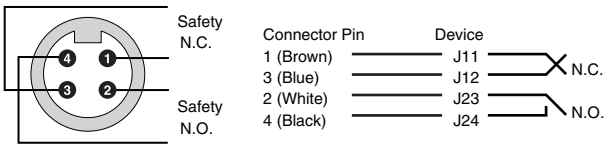
As illustrated in the example layout below, wiring systems for applications not requiring enunciation use a combination of patchcords, shorting plugs, safety wired distribution boxes and T-ports for series wiring of safety circuits. Distribution boxes for such an application are dual channel models with 2 N.C. or 1 N.C. + 1 N.O. contact configurations. See the wiring diagrams below for connector pin assignments.

Dual Channel 2 N.C.



Male Connector (On Switch)

Dual Channel 1 N.C./1 N.O.



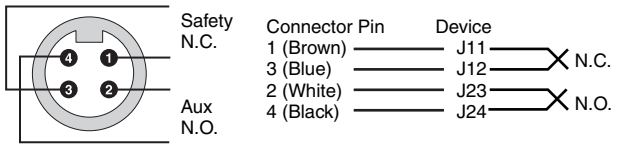
Male Connector (On Switch)

Note: Shorting plugs must be used on all unused ports for the system to operate.

Systems with Enunciation

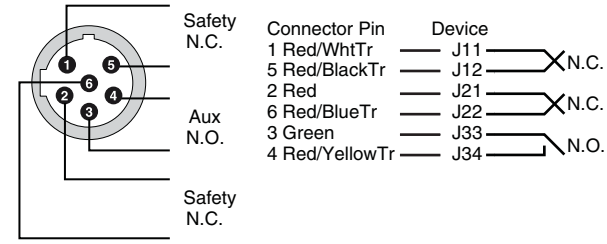
As shown below, system layouts with enunciation require patchcords, shorting plugs and distribution boxes, which allow for series wiring of the safety circuits while providing a separate circuit for enunciation. Distribution boxes are offered for these applications in two contact configurations: dual channel with 2 N.C. or single channel with 1 N.C. Each type also provides a N.O. auxiliary contact that is interfaced with the enunciation device to provide visual or audible alarm indication. In addition, LEDs on the distribution boxes assist in the troubleshooting of this system. See the wiring diagrams below for the associated connector pin configurations.

Single Channel 1 N.C./1 N.O.



Male Connector (On Switch)

Dual Channel 2 N.C./1 N.O.



Male Connector (On Switch)

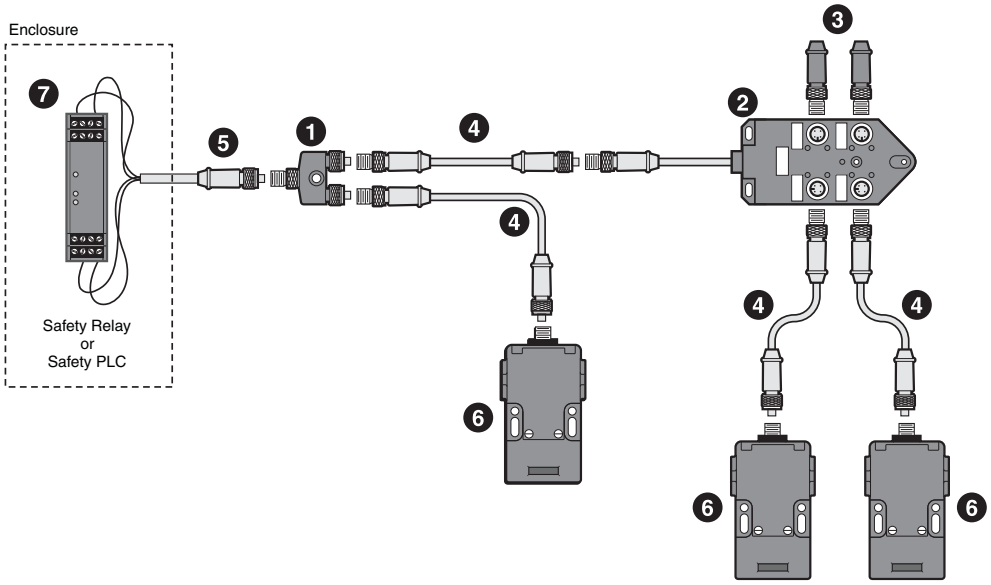
Note: Shorting plugs must be used on all unused ports for the system to operate.

Installation Considerations

Some important notes regarding Safety Connection Systems:

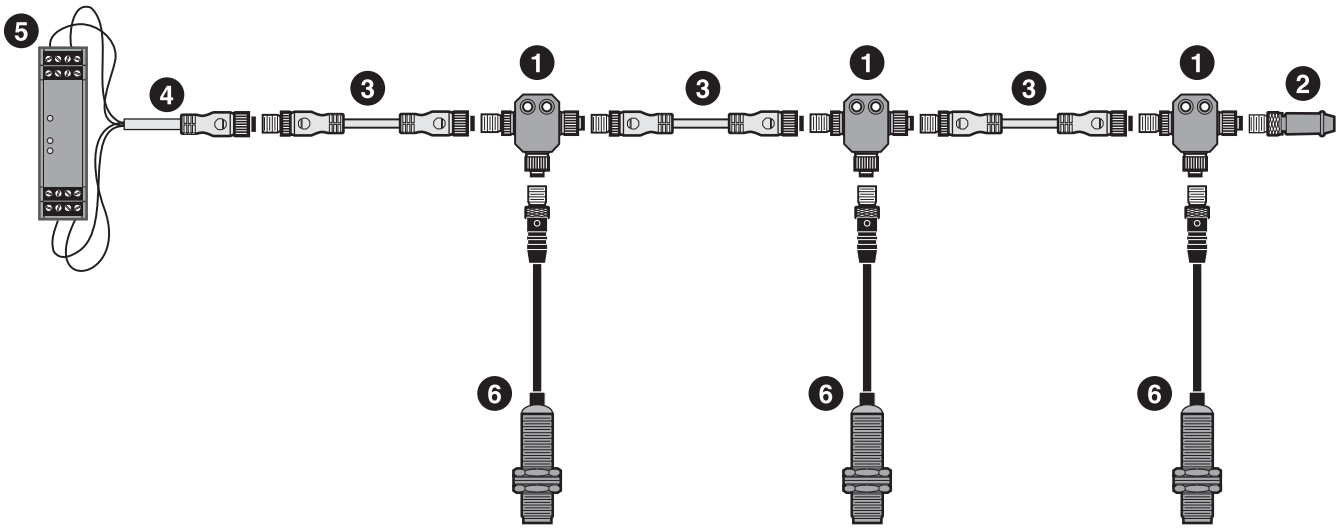
- To help ensure that only authorized personnel can access the connections, safety distribution boxes should be mounted in the 'guarded' area as defined in the risk assessment for the application.
- The safety connection system is designed to simplify the installation of safety devices—it does ***not*** control the safety circuit.
- Since the safety circuits are wired in series, shorting plugs must be installed in all unused distribution box ports in order for the system to operate.

Example Layout without Enunciation



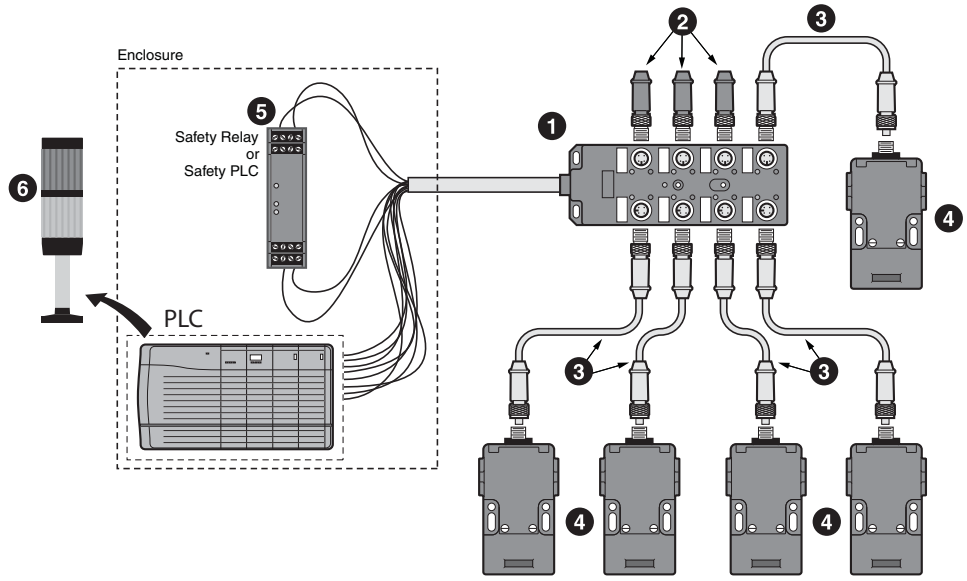
1. Safety-Wired Splitter/T-Port 7-6
2. Safety-Wired Distribution Box 7-7
3. Shorting Plug 7-11
4. Device Patchcord 7-12
5. Device Cordset 7-12
6. Safety Switch with QD 3-1
7. Safety Relay 5-2

SensaGuard Units Wired in Series without Enunciation



1. Safety-Wired Splitter/T-Port 7-6
2. Shorting Plug 7-11
3. Device Patchcord 7-12
4. Device Cordset 7-12
5. Safety Relay 5-2
6. SensaGuard with QD 3-56

Example Layout with Enunciation



1. Safety-Wired Distribution Box 7-7
2. Shorting Plug 7-11
3. Device Patchcord 7-12
4. Safety Switch with QD..... 3-1
5. Safety Relay..... 5-2
6. Tower Light ..... See *Industrial Controls* catalog

Safety Wired T-Port, DC Micro Style

Dual Channel, No Enunciation

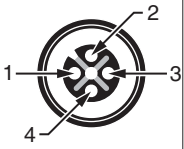
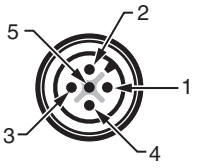
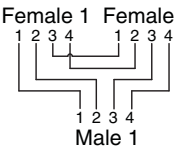
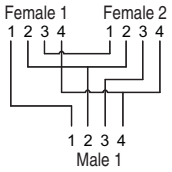
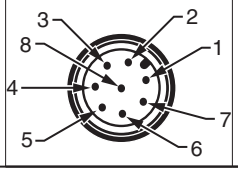
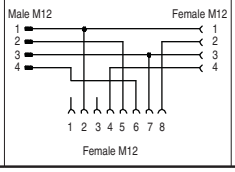
Specifications

Connector Shell Material	Epoxy coated zinc
Contact Material	Brass, gold over nickel plating
O-Ring Material	Fluorelastomer
Enclosure Type Rating	IP67, NEMA 6P
Operating Temperature [C (F)]	-20…105° (-13…221°)

Features

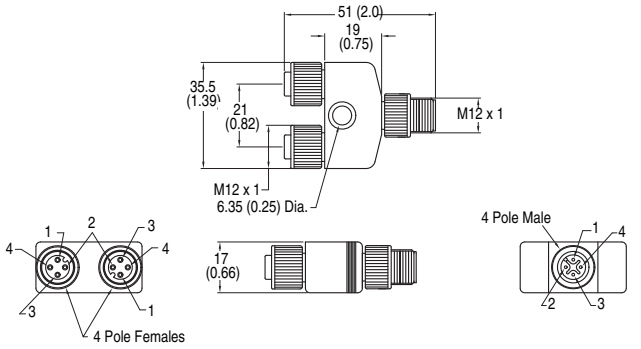
- T-port/splitter designed for use with dual-channel safety devices with 4-pin DC micro connector
- PUR body offers good oil and chemical resistance
- Ratcheting coupling nut for vibration resistance
- For use in Category 2 or 3 systems per EN 954-1
- SensaGuard units may be wired in series maintaining a Cat. 4/SIL 3 rating

Product Selection

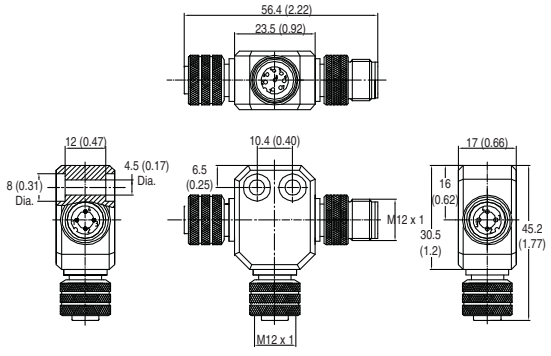
Face View of Female (2)	Rating	Face View of Male (1)	Configuration	Wiring	Dimensions	Housing Material	Connector Insert Material	Cat. No.
	10…30V DC 3 A		2 N.C.		A	Red PUR	PUR	898D-43LY-D4
			1 N.O. & 1 N.C.		A	Red PUR	PUR	898D-43KY-D4
			For use with SensaGuard switches only		B	Black PVC	Polyamide	898D-438Y-D8

Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



A



B

Safety Wired Distribution Box, DC Micro Style

Dual-Channel N.C., No Enunciation

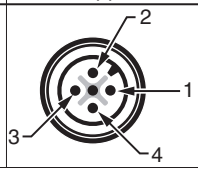
Specifications

Housing Material	Red PBT
Connector Insert Material	PBT
Connector Shell Material	Nickel-plated brass
Contact Material	Gold-plated palladium/nickel
Cable O.D.	9.8 mm (0.39 in.)
Cable Type	Oil-resistant yellow PVC jacket, 22 AWG conductors
Enclosure Type Rating	IP67
Operating Temperature [C (F)]	-20…105° (-13…221°)

Features

- Prewired for dual-channel N.C. safety
- 4 or 8 safety wired 4-pin DC micro connectors
- 4-pin male DC micro pigtail main connection
- For use in category 2 or 3 systems per EN 954-1

Product Selection

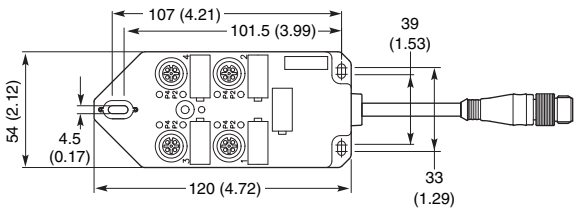
Face View of Female	No. of Ports	Illuminated	Rating	Face View of Male (1)	Cable Length	Cat. No.
	4	No LED	10…30V DC		0.2 m (8 in.)	898D-44LT-DM4
	8					898D-48LT-DM4
Shorting plug for unused ports						898D-41LU-DM
Patchcord, straight to straight DC Micro						889D-F4ACDM-∗

∗ Length in meters (1, 2, 3, 5, 10 standard).

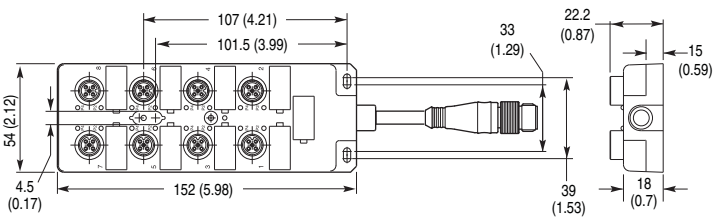
Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.

4-Port

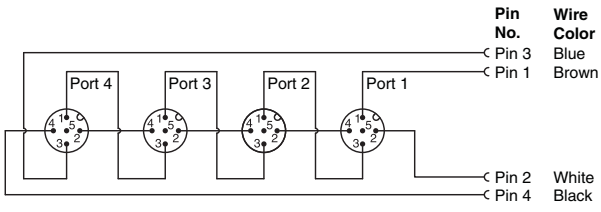


8-Port

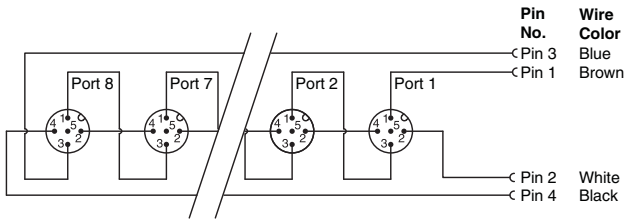


Wiring Diagrams

4-Port



8-Port



Safety Wired Distribution Box, DC Micro Style

Dual-Channel N.C./N.O., No Enunciation

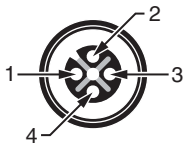
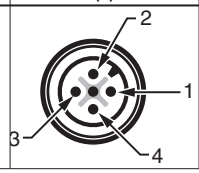
Specifications

Housing Material	Red PBT
Connector Insert Material	PBT
Connector Shell Material	Nickel-plated brass
Contact Material	Gold-plated palladium/nickel
Cable O.D.	9.8 mm (0.39 in.)
Cable Type	Oil-resistant yellow PVC jacket, 22 AWG conductors
Enclosure Type Rating	IP67
Operating Temperature [C (F)]	-20…105° (-13…221°)

Features

- Prewired for dual-channel (one N.O./one N.C.) safety
- 4 or 8 safety wired 4-pin DC micro connectors
- 4-pin male DC micro pigtail main connection
- For use in category 2 or 3 systems per EN 954-1

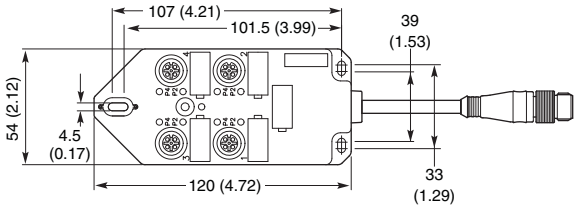
Product Selection

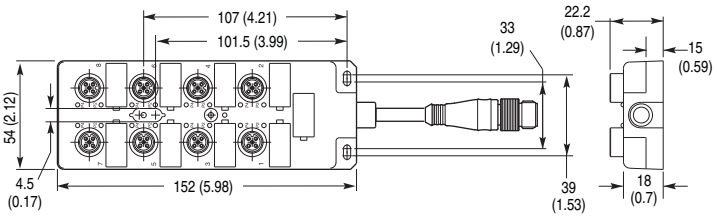
Face View of Female	No. of Ports	Illuminated	Rating	Face View of Male (1)	Cable Length	Cat. No.
	4	No LED	10…30V DC		0.2 m (8 in.)	898D-44KT-DM4
	8					898D-48KT-DM4
Shorting plug for unused ports						898D-41KU-DM
Patchcord, straight to straight DC Micro						889D-F4ACDM-∗

∗ Length in meters (1, 2, 3, 5, 10 standard).

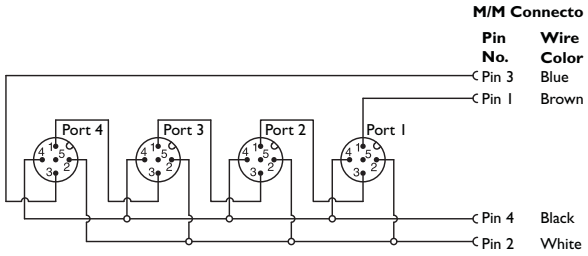
Approximate Dimensions

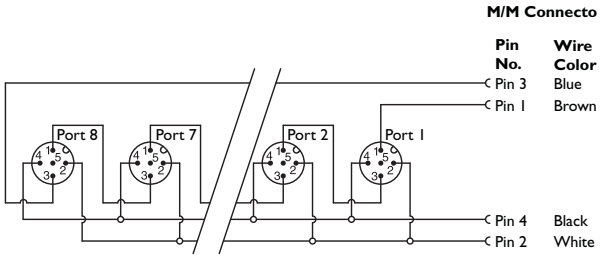
Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.





Wiring Diagrams





Safety Wired Distribution Box, DC Micro Style

Single-Channel N.C. plus Individual N.O. Enunciation

Specifications

Housing Material	Red PBT
Connector Insert Material	PBT
Connector Shell Material	Nickel-plated brass
Contact Material	Gold-plated palladium/nickel
Cable O.D.	9.8 mm (0.39 in.)
Cable Type	Oil-resistant yellow PVC jacket, (12) 18 AWG conductors
Enclosure Type Rating	IP67
Operating Temperature [C (F)]	-20…105° (-13…221°)

Features

- Prewired for single-channel (N.C.) safety with enunciation
- 8 safety wired 4-pin DC micro connectors
- Individual enunciation output for each port
- For use in category 2 or 3 systems per EN 954-1

Product Selection

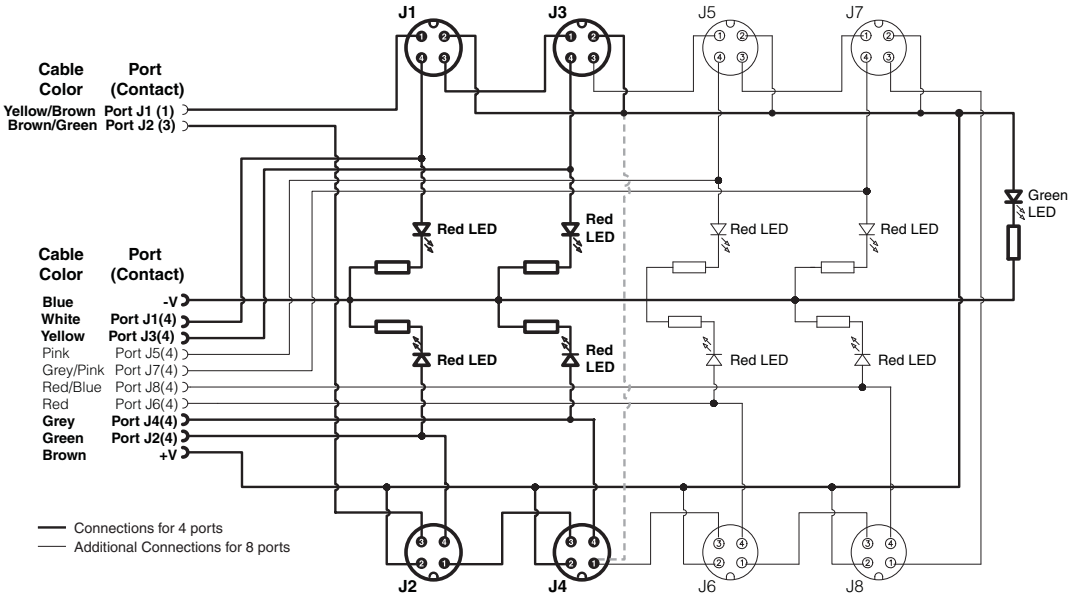
Face View of Female	No. of Ports	Illuminated	Rating	Face View of Male (1)	Cable Length	Cat. No.
	4	LEDs	10…30V DC	Cable	5 m (16.4 ft)	898D-P44JT-A5
					10 m (32.8 ft)	898D-P44JT-A10
	8				5 m (16.4 ft)	898D-P48JT-A5
					10 m (32.8 ft)	898D-P48JT-A10
Shorting plug for unused ports						898D-41KU-DM
Patchcord, straight to straight DC Micro						889D-F4ACDM-∗

∗ Length in meters (1, 2, 3, 5, 10 standard).

Approximate Dimensions

See 8-port dimensions on page 7-7.

Wiring Diagrams



Safety Wired Distribution Box, AC Micro Style

8-Port, Dual-Channel (2 N.C.) plus Individual N.O. Enunciation

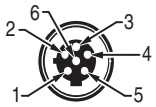
Specifications

Housing Material	Red PBT
Connector Insert Material	PBT
Connector Shell Material	Nickle-plated brass
Contact Material	Gold-plated palladium/nickel
Cable O.D.	9.8 mm (0.39 in.) OD
Cable Type	Oil-resistant yellow PVC jacket, (6) 19 AWG conductors and (8) 22 AWG conductors
Enclosure Type Rating	IP67
Operating Temperature [C (F)]	-20…105° (-13…221°)

Features

- Prewired for dual-channel N.C. safety plus individual N.O. enunciation
- Eight 6-pin AC micro connectors
- 14-conductor main cable
- Individual enunciation output for each port
- For use in category 2 or 3 systems per EN 954-1

Product Selection

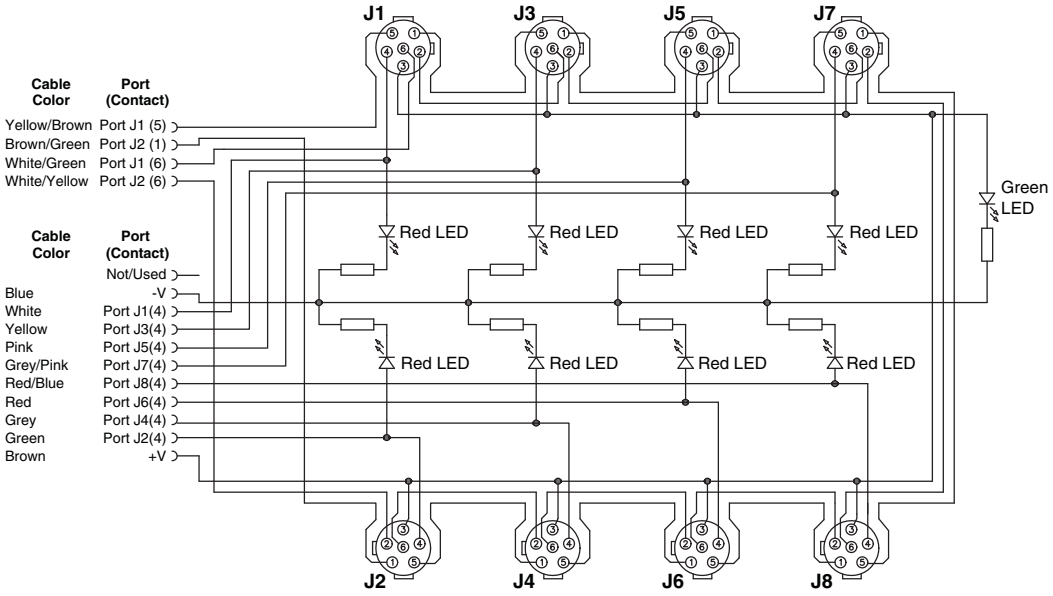
Face View of Female	No. of Ports	Illuminated	Rating	Face View of Male (1)	Cable Length	Cat. No.
	8	LEDs	10…30V DC	Cable	5 m (16.4 ft)	898R-P68MT-A5
					10 m (32.8 ft)	898R-P68MT-A10
Shorting plug for unused ports						898R-61MU-RM
Patchcord, straight to straight DC Micro						889R-F6ECRM-∗

∗ Length in meters (1, 2, 3, 5, 10 standard).

Approximate Dimensions

See 8-port dimensions on page 7-7.

Wiring Diagrams



Visit our website: www.ab.com/catalogs
Publication S117-CA001A-EN-P

Allen-Bradley

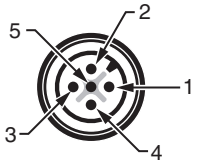
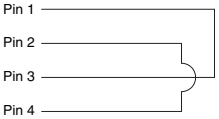
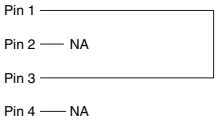
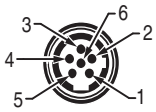
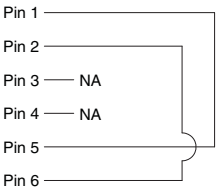
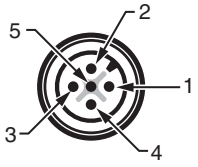
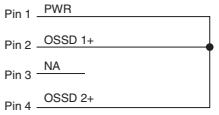
Specifications

Connector Insert Material	PUR
Connector Shell Material	RED PVC
Contact Material	Brass, gold over nickel plating
O-Ring Material	Fluorelastomer
Enclosure Type Rating	IP67, NEMA 6P
Operating Temperature [C (F)]	-20…105° (-13…221°)

Features

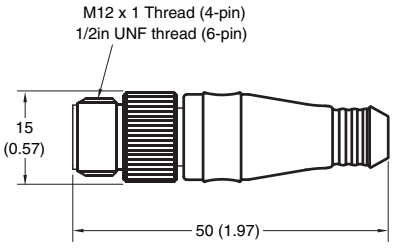
- Shorting plug designed for use with safety-wired distribution boxes
- PVC body offers good oil and chemical resistance
- Ratcheting coupling nut on 4-pin models for vibration resistance

Product Selection

Face View of Male	Rating	Configuration	Wiring	Coupling Nut Material	Cat. No.
	10…30V DC 4 A	2 N.C.		Epoxy-coated zinc	898D-41LU-DM
		1 N.O. & 1 N.C.		Epoxy-coated zinc	898D-41KU-DM
		2 N.C. & 1 N.O.		Nickel-plated brass	898R-61MU-RM
		For use with SensaGuard compatible T-Ports only		Nickel-plated brass	898D-418U-DM

Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



Cordsets & Patchcords, DC Micro Style

18 and 22 AWG, Yellow, Black, or Blue PVC

Features

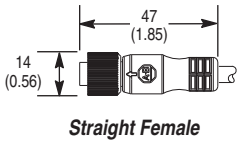
- Ratcheting coupling nut
- Subtle black or highly visible yellow PVC jacket offers good oil and chemical resistance
- Blue jacket models for intrinsically safe applications

Specifications

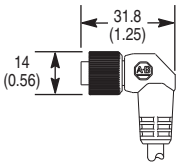
Certifications	UL Recognized and CSA Certified
Mechanical	
Coupling Nut Material	Epoxy-coated zinc
Connector Shell Material	Molded oil resistant PVC or PUR
Contact Material	Gold over nickel-plated brass
Cable Type	Oil resistant yellow PVC jacket, 20 AWG stranded copper, 300V, UL Recognized and CSA Certified
Home Run Connection	10 x diameter
Cable Diameter	4/c = 5 mm (0.21 in.); 5/c = 6.5 mm (0.25 in.)
Electrical	
Cable Rating	LED models: UL AWM style 2661 VW-1 105C 300V, CSA AWM A/B I/II 80C 300V FT1, UV oil and water resistant
Assembly Rating	250V, 4 A
Environmental	
Enclosure Type Rating	IP67 and IP69K, NEMA 6P
Operating Temperature [C (F)]	-20…+105° (-4…+221°)

Approximate Dimensions

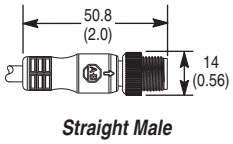
Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



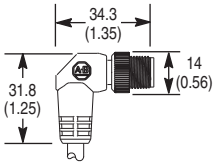
Straight Female



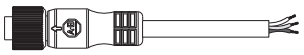
Right Angle Female



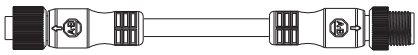
Straight Male



Right Angle Male

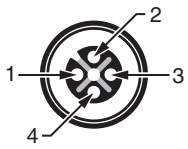
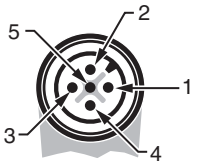


Example of Cordset



Example of Patchcord

Pinout and Color Code

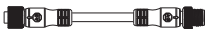
Color Code	Face View Pinout			
	4-Pin		5-Pin	
				
A	1 Brown 2 White 3 Blue	4 Black 5 NA	1 Brown 2 White 3 Blue	4 Black 5 Grey

Product Selection

Cordsets

Pin Count	Color Code	Jacket Color	Wire Size	Cat. No.			
				Straight Female	Right Angle Female	Straight Male	Right Angle Male
4-Pin	A	Yellow	22 AWG	889D-F4AC-2∗	889D-R4AC-2∗	889D-M4AC-2∗	889D-E4AC-2∗
		Yellow	18 AWG	889D-F4AE-2∗	889D-R4AE-2∗	889D-M4AE-2∗	889D-E4AE-2∗
		Black	22 AWG	889D-F4BC-2∗	889D-R4BC-2∗	889D-M4BC-2∗	889D-E4BC-2∗
		Blue		889D-F4LC-2∗	889D-R4LC-2∗	889D-M4LC-2∗	889D-E4LC-2∗
5-Pin		Yellow	22 AWG	889D-F5AC-2∗	**889D-R5AC-2∗**	889D-M5AC-2∗	889D-E5AC-2∗
		Black		889D-F5BC-2∗	889D-R5BC-2∗	889D-M5BC-2∗	889D-E5BC-2∗

Patchcords



Pin Count	Color Code	Jacket Color	Wire Size	Cat. No.			
				Straight Female Straight Male	Straight Female Right Angle Male	Right Angle Female Straight Male	Right Angle Female Right Angle Male
4-Pin	A	Yellow	22 AWG	889D-F4ACDM-2❄	889D-F4ACDE-2❄	889D-R4ACDM-2❄	889D-R4ACDE-2❄
		Yellow	18 AWG	889D-F4AEDM-2❄	889D-F4AEDE-2❄	889D-R4AEDM-2❄	889D-R4AEDE-2❄
		Black	22 AWG	889D-F4BCDM-2❄	889D-F4BCDE-2❄	889D-R4BCDM-2❄	889D-R4BCDE-2❄
		Blue	22 AWG	889D-F4LCDM-2❄	889D-F4LCDE-2❄	889D-R4LCDM-2❄	889D-R4LCDE-2❄
5-Pin		Yellow	22 AWG	889D-F5ACDM-2❄	889D-F5ACDE-2❄	889D-R5ACDM-2❄	889D-R5ACDE-2❄
		Yellow	22 AWG	889D-F5BCDM-2❄	889D-F5BCDE-2❄	889D-R5BCDM-2❄	889D-R5BCDE-2❄

∗ Replace 2 (2 m) with 5 (5 m) or 10 (10 m) for standard cable lengths.
❄ Replace 2 (2 m) with 0M3 (1 ft), 1 (1 m), 5 (5 m) or 10 (10 m) for standard lengths.

Note: Stainless steel connectors may be ordered by adding an "S" to the cat. no. (e.g. 889D**S**-F4AC-∗).

Cordsets & Patchcords, DC Micro Style

18 and 22 AWG, PUR, TPE, or TPR

Features

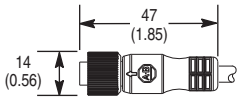
- PUR jacket provides good oil and chemical resistance
- TPE jacket material for good oil, chemical, and weld slag resistance
- 8-pin/7-wire configuration for Sipha safety switches and other applications
- Ratcheting coupling nuts for vibration resistance

Specifications

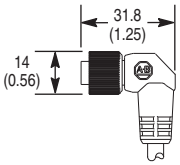
Certifications	UL Recognized and CSA Certified
Mechanical	
Coupling Nut Material	Epoxy-coated zinc
Connector Shell Material	Molded oil-resistant PVC or PUR
Contact Material	Gold over nickel-plated brass
Cable Type	Oil-resistant PVC jacket, 18 & 22 AWG or 24 AWG conductors, 300V; UL Recognized and CSA Certified
Cable Diameter	4/c (PUR); 5 mm (0.21 in.); 4/c (18 AWG TPE); 7 mm (0.28 in.); 5/c 6.5 mm (0.25 in.); 7/c 7.4 mm (0.29 in.); 8/c 7.4 mm (0.29 in.)
Electrical	
Cable Rating	UL AWM style 2661 VW-1 105C 300V, CSA AWM A/B I/II 80C 300V FT1, UV oil and water resistant
Assembly Rating	250V, 4 A
Environmental	
Enclosure Type Rating	IP67, NEMA 6P, 1200 psi (8270 kPa) washdown
Operating Temperature [C (F)]	PUR: -20…+80° (-4…+176°); TPE: -20…+105° (-4…+221°); TPR: -25…+125° (-13…+256°)

Approximate Dimensions

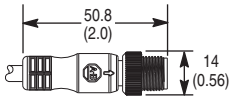
Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



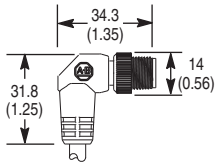
Straight Female



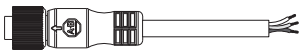
Right Angle Female



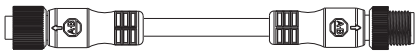
Straight Male



Right Angle Male

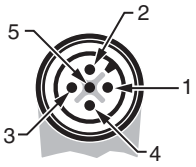
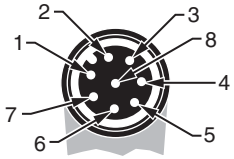
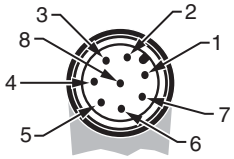


Example of Cordset



Example of Patchcord

Pinout and Color Code

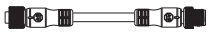
Color Code	Face View Pinout			
	4-Pin	5-Pin	8-Pin	
				
A	1 Brown 2 White 3 Blue 4 Black 5 NA	1 Brown 2 White 3 Blue 4 Black 5 Grey	1 Red 2 Blue 3 Green 4 Yellow	5 Black 6 White 7 N.C. 8 Grey
B	—	—	1 White 2 Brown 3 Green 4 Yellow	5 Grey 6 Pink 7 Blue 8 Red

Product Selection

Cordsets

Pin Count	Cable Type	Wire Size	Assembly Rating	Color Code	Cat. No.			
					Straight Female	Right Angle Female	Straight Male	Right Angle Male
4-Pin	TPE	18 AWG	18 AWG, 250V, 4 A	A	889D-F4HJ-2∗	889D-R4HJ-2∗	889D-M4HJ-2∗	889D-E4HJ-2∗
		22 AWG		A	889D-F4HL-2∗	889D-R4HL-2∗	889D-M4HL-2∗	889D-E4HL-2∗
	PUR	22 AWG	22 AWG, 250V, 4 A	A	889D-F4UC-2∗	889D-R4UC-2∗	889D-M4UC-2∗	889D-E4UC-2∗
5-Pin					889D-F5UC-2∗	889D-R5UC-2∗	889D-M5UC-2∗	889D-E5UC-2∗
8-Pin	TPR	24 AWG	30V AC/36V DC 1.5 A	A	889D-F8AC-2∗	—	—	—
	PUR			B	889D-F8AB-2∗	889D-R8AB-2∗	889D-M8AB-2∗	—

Patchcords



Pin Count	Cable Type	Wire Size	Assembly Rating	Cat. No.			
				Straight Female Straight Male	Straight Female Right Angle Male	Right Angle Female Straight Male	Right Angle Female Right Angle Male
4-Pin	PUR	22 AWG	22 AWG, 250V, 4 A	889D-F4UCDM-2❄	889D-F4UCDE-2❄	889D-R4UCDM-2❄	889D-R4UCDE-2❄
5-Pin		22 AWG	22 AWG, 250V, 4 A	889D-F5UCDM-2❄	889D-F5UCDE-2❄	889D-R5UCDM-2❄	889D-R5UCDE-2❄
8-Pin		24 AWG	30V AC/36V DC 1.5 A	889D-F8ABDM-2❄	—	—	—

∗ Replace 2 (2 m) with 5 (5 m) or 10 (10 m) for standard cable lengths.
❄ Replace 2 (2 m) with 0M3 (1 ft), 1 (1 m), 5 (5 m) or 10 (10 m) for standard lengths.

Note: Stainless steel connectors may be ordered by adding an "S" to the cat. no. (e.g. 889D**S**-F4UCDM-∗).

Cordsets & Patchcords, AC Micro Style

22 AWG, PVC

Features

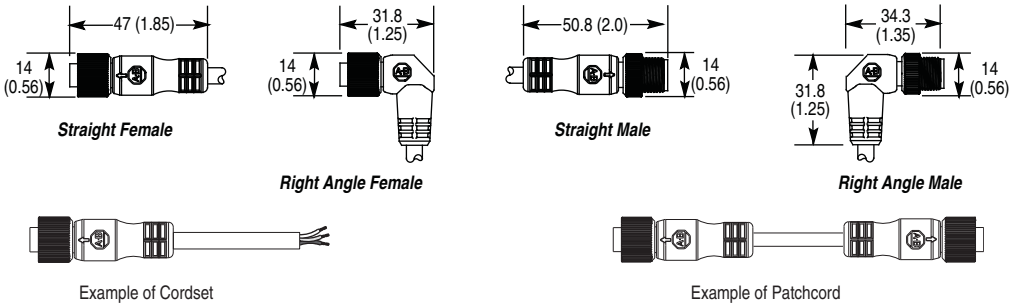
- Highly visible yellow PVC jacket offers good oil and chemical resistance
- Heavy-duty re-inforcing braiding can be used as a grounded shield to reduce noise
- Ratcheting coupling nut for vibration resistance

Specifications

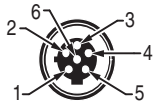
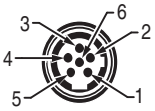
Certifications	UL Recognized and CSA Certified
Mechanical	
Coupling Nut Material	Epoxy-coated zinc
Connector Material	Molded oil-resistant polyurethane
Contact Material	Gold over nickel-plated brass
Cable Type	Oil-resistant yellow PVC jacket, 22 AWG conductors, 300V, UL Recognized and CSA Certified
Home Run Connection	10x diameter
Cable Diameter	6/c (22 AWG) = 6.7 (0.26)
Braiding	Tinned copper braid
Cable Rating	UL AWM style 2661 VW-1 105C 300V, CSA AWM A/B I/II 80C 300V FT1, UV oil and water resistant
Assembly Rating	Braided 22 AWG, 250V, 4 A
Environmental	
Enclosure Type Rating	IP67
Operating Temperature [C (F)]	-20…+105° (-4…+221°)

Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



Pinout and Color Code

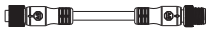
Color Code	Face View Pinout 6-Pin	
		
A	1 Red/White Tr. 2 Red 3 Green	4 Red/Yellow Tr. 5 Red/Black Tr. 6 Red/Blue Tr.

Product Selection

Cordsets

Pin Count	Wire Size	Assembly Rating	Color Code	Cat. No.			
				Straight Female	Right Angle Female	Straight Male	Right Angle Male
6-Pin	Braided 22 AWG	Braided 22 AWG, 250V, 4 A	A	889R-F6ECA-2∗	889R-R6ECA-2∗	889R-M6ECA-2∗	889R-E6ECA-2∗

Patchcords



Pin Count	Wire Size	Assembly Rating	Color Code	Cat. No.			
				Straight Female to Straight Male	Straight Female to Right Angle Male	Right Angle Female to Straight Male	Right Angle Female to Right Angle Male
6-Pin	Braided 22 AWG	Braided 22 AWG, 250V, 4 A	A	889R-F6ECRM-2❄	889R-F6ECRE-2❄	889R-R6ECRM-2❄	889R-R6ECRE-2❄

∗ Replace 2 (2 m) with 5 (5 m) or 10 (10 m) for standard cable lengths.
❄ Replace 2 (2 m) with 0M3 (1 ft), 1 (1 m), 5 (5 m) or 10 (10 m) for standard lengths.

Cordsets & Patchcords, Mini Style

18 AWG, PVC

Features

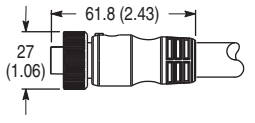
- General purpose 18 AWG cable
- Highly visible yellow PVC jacket offers good oil and chemical resistance
- 2-, 3-, 4-, 5-, and 6-pin configurations
- Ratcheting coupling nut for vibration resistance

Specifications

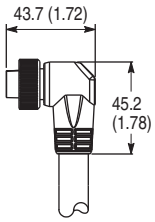
Certifications	UL Recognized and CSA Certified
Mechanical	
Coupling Nut Material	Epoxy-coated zinc
Connector Material	Molded oil-resistant PVC
Contact Material	Gold over nickel-plated brass
Cable Type	Oil-resistant yellow PVC jacket, 18 AWG stranded copper, 300V; UL Recognized and CSA Certified
Home Run Connection	10x diameter
Cable Diameter	4/c = 7 mm (0.27 in.) 5/c = 8 mm (0.31 in.)
Electrical	
Cable Rating	UL AWM style 2661 VW-1 105C 300V, CSA AWM A/B I/II 80C 300V FT1, UV oil and water resistant
Assembly Rating	4-pin = 300V, 7 A 5-pin = 300V, 5.6 A
Environmental	
Enclosure Type Rating	NEMA 4, 6P, 12, 13; IP67 and IP69K; 1200 psi washdown
Operating Temperature [C (F)]	-20…105° (-4…221°)

Approximate Dimensions

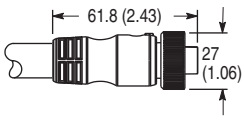
Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



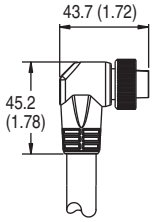
Straight
Female



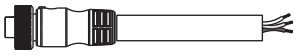
Right Angle Female



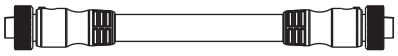
Straight Male



Right Angle Male

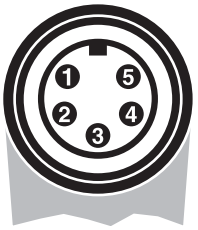


Example of Cordset



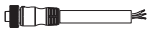
Example of Patchcord

Pinout and Color Code

Color Code	Face View Pinout			
	4-Pin		5-Pin	
				
C (IEC)	1 Black 2 Blue	3 Brown 4 White	1 Black 2 Blue 3 Grey	4 Brown 5 White

Product Selection

Cordsets



Pin Count	Assembly Rating	Color Code	Cat. No.			
			Straight Female	Right Angle Female	Straight Male	Right Angle Male
4-Pin	300V, 7 A	C	889N-F4AE-6F∗	889N-R4AE-6F∗	889N-U4AE-6F∗	889N-V4AE-6F∗
5-Pin	300V, 5.6 A		889N-F5AE-6F∗	889N-R5AE-6F∗	889D-M5UC-2‡	889N-V5AE-6F∗

Patchcords

Pin Count	Assembly Rating	Cat. No.			
		Straight Female Straight Male	Straight Female Right Angle Male	Right Angle Female Straight Male	Right Angle Female Right Angle Male
4-Pin	300V, 7 A	889N-F4AENU-6F❄	889N-F4AENV-6F❄	889N-R4AENU-6F❄	889N-R4AENV-6F❄
5-Pin	300V, 5.6 A	889N-F5AENU-6F❄	889N-F5AENV-6F❄	889N-R5AENU-6F❄	889N-R5AENV-6F❄

∗ Replace 6 (6 ft) with 12 (12 ft), or 20 (20 ft) for standard cable lengths.
‡ Replace 2 (2 m) with 5 (5 m) or 10 (10 m) for standard cable lengths.
❄ Replace 6 (6 ft) with 3 (3 ft), 12 (12 ft), or 20 (20 ft) for standard cable lengths.

Note: Stainless steel connectors may be ordered by adding an "S" to the cat. no. (e.g. 889N**S**-F3AEC-∗F).

Cordsets and Patchcords, Mini-Plus Style

18 AWG

Features

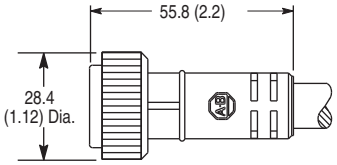
- Highly visible yellow PVC jacket offers good oil and chemical resistance

Specifications

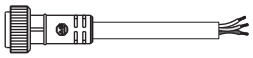
Certifications	UL Recognized and CSA Certified
Mechanical	
Coupling Nut Material	Epoxy-coated zinc, 18 AWG
Connector Material	Molded oil-resistant PVC
Contact Material	Gold over nickel-plated brass
Cable Type	Oil-resistant yellow PVC jacket, 18 AWG stranded copper, 300V; UL Recognized and CSA Certified, STOOW
Cable Diameter	7/c = 14 mm (0.55 in.) 8/c = 15 mm (0.59 in.)
Electrical	
Cable Rating	18 AWG: UL AWM style 2517 or 2661 105C 300V, CSA AWM A/B I/II 105C 300V FT1
Assembly Rating	(5) 18 AWG/(2) 20 AWG, 300V, 3 A
Environmental	
Enclosure Type Rating	NEMA 4, 6P, 12, 13; IP67; 1200 psi washdown
Operating Temperature [C (F)]	-40…+105° (-40…+221°)

Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



Straight Female



Example of Cordset

Pinout and Color Code

Color Code	Face View Pinout			
	7-Pin		8-Pin	
B	1 Black 2 White 3 Blue 4 Brown	5 Grey❄ 6 Yellow❄ 7 Green	1 Red 2 White 3 Blue 4 Brown	5 Grey 6 Yellow 7 Green 8 Pink

❄ 20 AWG conductors

Product Selection

Cordsets

Pin Count	Wire Size	Assembly Rating	Color Code	Cat. No.
				Straight Female
7-Pin	(5) 18 AWG (2) 20 AWG	(5) 18 AWG/(2) 20 AWG, 300V, 3 A	B	889N-F7AG-2∗
8-Pin	18 AWG			889N-F8AE-2∗

∗ Replace 2 (2 m) with 5 (5 m), 10 (10 m), 20 (20 m), or 30 (30 m) for standard cable lengths.

Cordsets & Patchcords, M23 Style

18 or 18/22 AWG, Yellow PVC

Features

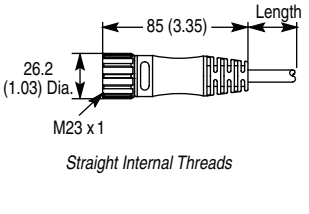
- 12-pin configuration for SafeShield light curtains and other applications
- Highly visible yellow PVC jacket offers good oil and chemical resistance

Specifications

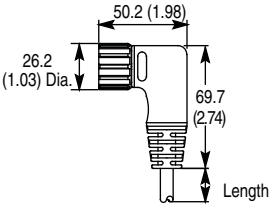
Certifications	UL Recognized and CSA Certified
Mechanical	
Coupling Nut Material	Nickel-plated brass
Connector Material	Molded oil-resistant PUR
Contact Material	Gold over nickel-plated brass
Cable Type	Oil-resistant yellow PVC jacket, 18 AWG conductors, 60V, UL Recognized and CSA Certified
Home Run Connection	10x diameter
Cable Diameter	10 mm (0.41 in.)
Electrical	
Cable Rating	300V
Assembly Rating	9- & 12-pin: 300V, 4 A; 11-pin: 63V, 6 A; 19-pin: 63V, 12 A
Environmental	
Enclosure Type Rating	IP67, NEMA 6P, 1200 psi (8270 kPa) washdown
Operating Temperature [C (F)]	-20…+80° (-4…+176°)

Approximate Dimensions

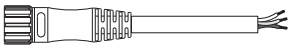
Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



Straight Internal Threads



Right Angle Internal Threads



Example of Cordset

Example of Patchcord

Pinout and Color Code

Color Code	Face View Pinout 9-, 11-, or 12-Pin		
A	1 Brown 2 NA 3 Blue 4 White	5 NA 6 Green 7 Yellow 8 Grey	9 Pink 10 Red 11 NA 12 Green/Yellow
B	1 Brown 2 Blue 3 Grey 4 Pink	5 Red 6 Yellow 7 White 8 Red/Blue	9 Black 10 Violet 11 Grey/Pink 12 Green

Product Selection

Cordsets

No. of Pins	Color Code	Jacket Color	Wire Size	Cat. No. Straight Female	Cat. No. Right Angle Female
9-Pin	A	Yellow	18 AWG	889M-FX9AE-2∗	889M-RX9AE-2∗
12-Pin	B	Yellow	18 AWG	**889M-F12AH-2∗**	889M-R12AH-2∗

Patchcords

Pin Count	Jacket Color	Wire Size	Cat. No. Straight Female Straight Male
12-Pin	Yellow	18 AWG	889M-F12AHMU-2❄

∗ Replace 2 (2 m) with 5 (5 m) or 10 (10 m) for standard cable lengths.
❄ Replace 2 (2 m) with 0M3 (1 ft), 0M6 (0.6 m), 1 (1 m), or 3 (3 m) for standard cable lengths.

Field Attachables, DC Micro Style

Screw Terminal Connector

Features

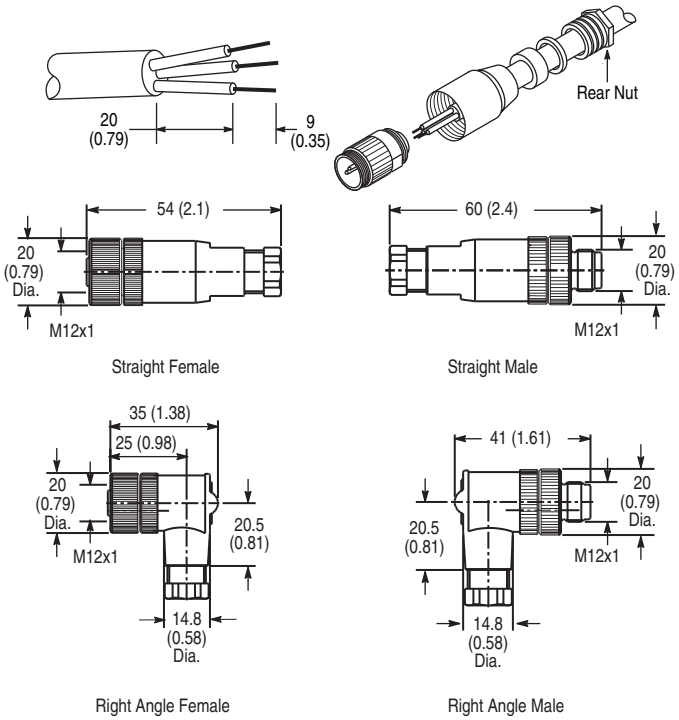
- Field installable
- 4- or 5-pin DC micro style
- Single cable or dual cable models
- Screw terminals provide simple and secure installation
- Allows easy modification of existing cable installations
- Embedded thermistor models designed for use with ArmorPoint thermocoupling input modules provide cold junction compensation capability

Specifications

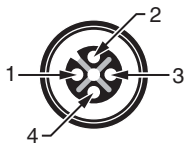
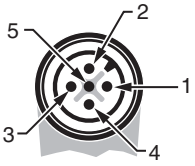
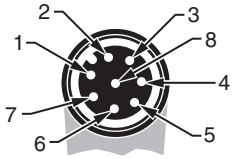
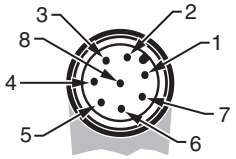
Mechanical	
Coupling Nut Material	Nickel-plated brass
Connector Shell Material	PBT, except embedded thermistor models: Nylon
Contact Material	Gold plated palladium nickel
Wire Rating	18 AWG (0.75 mm²)
Electrical	
Assembly Rating	4- or 5-pin: 250V, 4 A; 8-pin: 60V, 2 A
Environmental	
Enclosure Type Rating	IP67
Operating Temperature [C (F)]	-40…88° (-40…185°)

Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



Pinout and Color Code

Face View Pinout			
4-Pin	5-Pin	8-Pin	
			
Female	Male	Female	Male

Product Selection

Single-Cable Model Terminal Chambers

Pin Count	Cable Diameter [mm (in.)]	Assembly Rating	Thread Size	Cat. No.			
				Straight Female	Right Angle Female	Straight Male	Right Angle Male
4-Pin	4.0…6.0 (0.16…0.24)	250V, 4 A	PG 7	871A-TS4-D	**871A-TR4-D**	871A-TS4-DM	**871A-TR4-DM**
	6.0…8.0 (0.24…0.32)		PG 9	871A-TS4-D1	871A-TR4-D1	871A-TS4-DM1	871A-TR4-DM1
5-Pin	4.0…6.0 (0.16…0.24)		PG 7	871A-TS5-D	871A-TR5-D	871A-TS5-DM	871A-TR5-DM
	—		PG 9	871A-TS5-D1	871A-TR5-D1	871A-TS5-DM1	871A-TR5-DM1
8-Pin	6.0…8.0 (0.24…0.32)	60V, 2 A	PG 9	871A-TS8-D1	—	871A-TS8-DM1	—

Dual-Cable Model Terminal Chambers

Pin Count	Cable Diameter [mm (in.)]	Assembly Rating	Thread Size	Cat. No.	
				Straight Male	Right Angle Male
4-Pin	Two cables 2.1…3.0 (0.08…0.12) or 3.5…5.2 (0.14…0.21)	250V, 4 A	PG 9	**871A-VS4-DM**	871A-VR4-DM
5-Pin				871A-VS5-DM	871A-VR5-DM

Note: Stainless steel coupling nuts are available, add an "S" to the cat. no. (e.g. 871A**S**-TS4-DM).

Field Attachables, DC Micro Style

Insulation Displacement Connector

Features

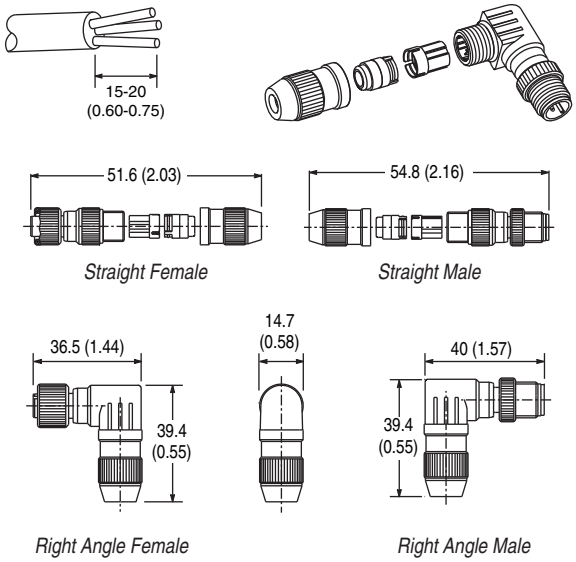
- Field installable with no hand tools required
- 4-pin DC micro style
- Straight or right angle, male or female
- Allows easy modification of existing cable installations
- Insulation displacement technology for secure and reliable installation

Specifications

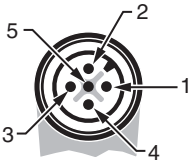
Coupling Nut Material	Zinc die-cast
Connector Shell Material	Zinc die-cast or polyamide
Connector Material	Hytrel
Contact Material	Gold-plated palladium nickel
Enclosure Type Rating	IP67
Operating Temperature [C (F)]	-25…85° (-13…185°)
Installation Temperature [C (F)]	-5…50° (23…185°)
IDC Installations	10 max.
Cable Diameter [mm (in.)]	4.0…5.1 (0.16…0.20)
Wire Size	1.2…1.6 (0.047…0.063) 26…22 AWG

Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



Product Selection

Connector Style	Cable Diameter [mm (in.)]	Wire Rating	Face View		Cat. No.	
			Female	Male	Female	Male
Straight Male	4.0…5.1 (0.16…0.20)	32V, 4 A			889D-F4DC-H	889D-M4DC-H
Right Angle Male					889D-R4DC-H	889D-E4DC-H

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Publication S117-CA001A-EN-P

Specifications

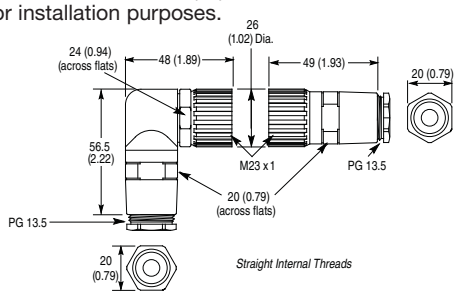
Coupling Nut Material	Nickel-plated brass
Connector Shell Material	Nickel-plated brass
Contact Material	Gold-plated palladium/nickel
Wire Rating	18 AWG (1.0 mm²), max.
Enclosure Type Rating	IP65
Operating Temperature [C (F)]	-20…+105° (-4…221°)

Features

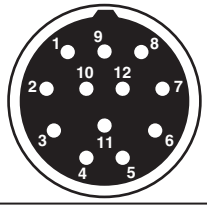
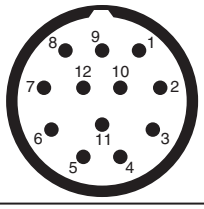
- Straight or right angle, male or female
- 12-pin M23 style for standard connectivity
- Allows modification of existing cable installations and field creation of special cable lengths
- Solder connector for secure and reliable installation

Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



Product Selection

Connector Style	Cable Diameter [mm (in.)]	Face View			Cat. No.	
		Wire Rating	Female	Male	Female	Male
Straight Male	10…14 (0.39…0.55)	60V 4 A			889M-F12AH-T	889M-M12AH-T
Right Angle Male					889M-R12AH-T	889M-E12AH-T

Receptacles, DC Micro Male

4-Pin, 5-Pin or 8-Pin and AC Micro Male, 6-Pin

Specifications

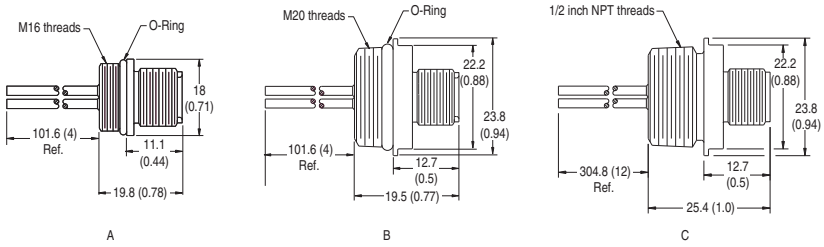
Connector Shell Material	Nickel-plated brass
Connector Insert Material	Nylon
Contact Type	Machined brass with gold over nickel plating
Wire Insulation	Oil resistant PVC, 22 AWG stranded copper, 300V
Operating Temperature [C (F)]	-20…+105° (-4…+221°)

Features

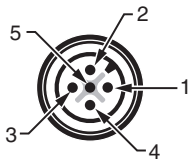
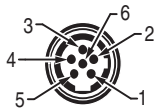
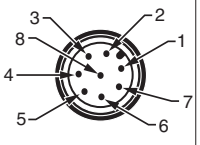
- Male bulkhead receptacles
- 4-, 5- or 8-pin DC micro configuration
- M16, M20 or 1/2 inch-14 NPT mounting threads

Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



Product Selection

Face View of Male	Wire Color	Wire Rating	Length [m (ft)]	Panel Mount Thread Size	Drawing	Cat. No.
	1 Brown 2 White 3 Blue 4 Black	22 AWG 300V 3 A	0.1 (0.3)	M16 x 1	A	888D-M4AC9-4N
				M20 x 1.5	B	888D-M4AC8-4N
			0.3 (1)	1/2 inch-14 NPT	C	888D-M4AC1-0M3
	1 Brown 2 White 3 Blue 4 Black 5 Grey		0.1 (0.3)	M16 x 1	A	888D-M5AC9-4N
				M20 x 1.5	B	888D-M5AC8-4N
			0.3 (1)	1/2 inch-14 NPT	C	888D-M5AC1-0M3
	1 Red/White Tr 2 Red 3 Green 4 Red/Yellow Tr 5 Red/Black Tr 6 Red/Blue Tr	22 AWG 300V 3 A	0.1 (0.3)	M16 x 1	A	888R-M6AC9-4N
				M20 x 1.5	B	888R-M6AC8-4N
			0.3 (1)	1/2 inch-14 NPT	C	888R-M6AC1-0M3
	1 White 2 Brown 3 Green 4 Yellow 5 Grey 6 Pink 7 Blue 8 Red	24 AWG 36V DC/30V AC 1.5 A	0.1 (0.3)	M16 x 1	A	888D-M8AC9-4N
				M20 x 1.5	B	888D-M8AC8-4N

Specifications

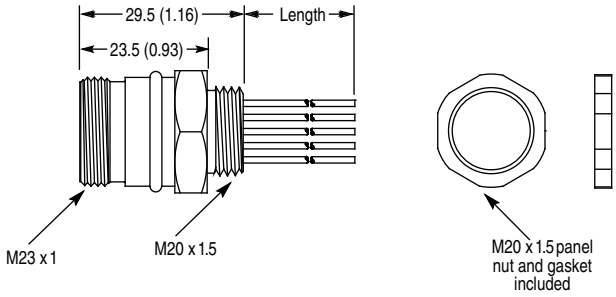
Connector Shell Material	Nickel-plated brass
Connector Insert Material	Nylon
Contact Material	Machined brass with gold over nickel plating
Wire Size	Oil resistant PVC, 18 AWG stranded copper, 300V
Certifications	Cable: UL Recognized and CSA Certified
Enclosure Type Rating	IP67, NEMA 6P, 1200 psi (8270 kPa) washdown
Operating Temperature [C (F)]	-20…+105° (-4…+221°)

Features

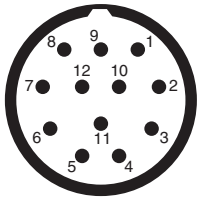
- 18 AWG conductors for ease of wiring
- 12-pin configuration provides standard connectivity
- M20 x 1.5 threads for convenient mounting to safety switches
- Mounting nut and rubber sealing washer included

Approximate Dimensions

Dimensions are shown in mm (in.). Dimensions are not intended to be used for installation purposes.



Product Selection

Face View of Male	Cable			Panel Mount Thread Size	Cat. No.
	Wire Color	Wire Rating	Length [m (ft)]		
	1 Brown 2 Blue 3 Grey 4 Pink 5 Red 6 Yellow 7 White 8 Red/Blue 9 Black 10 Violet 11 Grey/Pink 12 Green	18 AWG 60V 4 A	0.15 (0.5)	M20 x 1.5	888M-M12AE-0F5
	1 Brown 2 NA 3 Blue 4 White 5 NA 6 Green 7 Yellow 8 Grey 9 Pink 10 Red 11 NA 12 Green/Yellow				888M-M12X9AE-0F5

Notes

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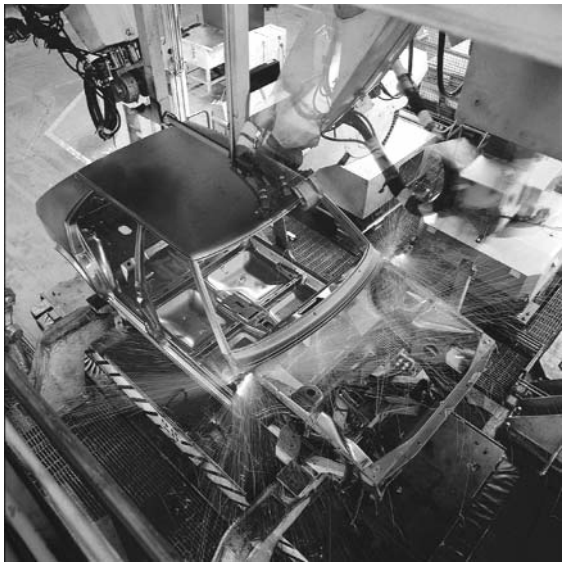
Machine Safety Services

Overview



Risk assessments, risk reduction planning and project services allow companies to plan and implement safety programs for machine safeguarding applications to help reduce costs, improve compliance and enhance plant floor safety.

System Description

Rockwell Automation's Machine Safety Services include consulting, system integration and long-term support services for machines that must meet standards set forth by OSHA and ANSI in the United States. These services complement Rockwell Automation's expertise in metal forming and automation projects, including over 15 years of experience in automating mechanical and hydraulic stamping presses.

Rockwell Automation's Machine Safety Services include:

- Standards Training
  - Customer training on current standards and industry accepted interpretations
  - Standards updates as necessary
- Risk Assessment and Risk Reduction Planning
  - Coach/train client through procedures of risk assessment
  - Provide assistance with interpretation of standards and documentation of assessments
  - Facilitate an iterative process of mitigating each identified hazard by redesign or additional measures
- Technical Specification Development
  - Assist with the development of a machine safety standard that addresses safety solutions for an entire company, facility or machine
- Conformity Audits
  - Machine audits to verify and document compliance; a complete step-by-step assessment determines which standards are applicable and whether or not they have been satisfied
- Stop Time Measurements and Safety Distance Calculations
  - Help assess compliancy of light curtain and area guarding device installations
  - Help determine ergonomic and operational advantages of safeguarding options
- Safety Circuit Design
  - Including limited and sequential shutdown and applications
- Probability of Failure on Demand Calculations
  - Assist with obtaining a desired Safety Integrity Level (SIL) based on IEC 61508

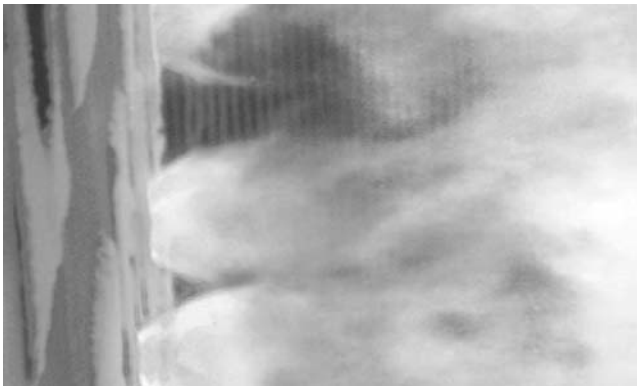
The implementation of a comprehensive machine safety program will involve many disciplines. Rockwell Automation has the entire spectrum covered. From the design and integration of safety critical circuits using the most advanced controls to the implementation of hard guarding. Rockwell Automation has the experience necessary to fulfill all your needs.

Typical machine system integration services can include:

- System Integration Services
- Project management
  - System architecture design
  - Panel design
  - Material procurement
  - RA products
  - Third party products (including hard guarding solutions)
  - Assembly
  - Software development
  - Hardware/software integration testing
  - Factory acceptance
  - Start-up assistance

Rockwell Automation's support and follow through are available at every stage and can include:

- On-Site Training
- Maintenance and operator training for our installed machine safety solutions
- Preventive Maintenance Programs
- Verify installed safety systems are operating within defined parameters
- Field Service
- Field work to be done on a contractual or as needed basis



System Description

Rockwell Automation burner management systems are engineered to provide igniter (pilot) and main flame detection, as well as control and monitoring of burner start-up and shutdown sequences including master fuel trip and purge.

The systems can help you:

- Protect against damage to your combustion process equipment and surrounding areas due to explosion or other undesirable event
- Qualify for lower insurance premiums resulting from compliance with applicable industry standards such as NFPA, IRI and FM
- Reduce installation times because our systems are fully assembled, programmed, thoroughly tested, and designed for immediate field installation
- Simplify unit operation through alarm management and operator displays
- Reduce start-up time with advanced diagnostics and operator help messages
- Reduce critical troubleshooting time through the use of pinpoint diagnostic messaging
- Enhance communication and reporting capabilities to other systems in your facility

Our BurnerMaster™ concept of burner management systems are designed for single burner applications for boilers, process heaters, furnaces, kilns and natural gas.

In addition to our family of burner management systems, Rockwell Automation offers related systems for control of combustion related processing including:

- Combustion temperature/pressure control
- Coal handling
- Ash handling and emission control systems
- Soot blowing
- Demineralizer control

Keep your combustion process safe and minimize fuel usage on the same platform!

Overview

Rockwell Automation offers various systems, bundled packages, and kits for meeting the safety-related control standards for the clutch/brake of mechanical stamping presses. These solutions are designed to meet the safety requirements of ANSI B11.1, OSHA 1910.217, CAN/CSA Z142-M90, IEC-61508, EN-954 and EN-692.

The 6556 Clutch/Brake kits are bundled packages consisting of redundant PLC components with application software, wiring diagrams, relays and documentation. Each solution is designed with independent redundant programmable controllers with additional electromechanical components and the application software to provide the necessary monitoring, self testing, security, and verification that make up a control-reliable design.

The PLC-5/x6 based kits come with the clutch/brake software secured in program file #16, and the user can add other logic to other files. The PLC-5-based kits are designed for large presses with extensive automation.

The MicroLogix™ kits are pre-programmed with the ladder program locked in flash memory. Certain features in the fixed kits are configurable. The MicroLogix-based Compact PressMaster™ kit, for example, has a variety of standard features to control ancillary functions such as lube and programmable limit switch that can be configured through pre-programmed PanelView screens. The fixed kits are easy to use, require no programming, and are designed for small to medium-size presses retrofitted by the user.

The StamPro™ system is a complete, ready-to-install, Logix-based press control system that comes with controllers and hardware for controlling a stamping press. Ancillary control functions, which can be purchased from Rockwell Automation or supplied by the user, are integrated into the system hardware and software designs. The StamPro system is designed for end users, OEMs and integrators. The system can be purchased either with pre-programmed optional functions or can be programmed by the user.

Some press functions which can be integrated with our solutions include:

- **Clutch/Brake.** The Allen-Bradley controller designed system that controls the dual-valve clutch/brake mechanism as found on all mechanical stamping presses. This system includes dual redundant controllers with application software for monitoring and self-testing to achieve safety regulation compliance.
- **Programmable Limit Switch (PLS).** Ladder Logic for switching outputs according to crankshaft position. The PLS is often used to integrate and synchronize other press auxiliary functions such as feeders, grippers, blow-off and ejector valves. This feature requires a resolver position input for accuracy. The PLS is usually pre-programmed and configured by the user for each job or die.
- **Die Monitoring.** Logic that monitors a variety of in-die sensors to determine misalignment, double blanks, misfeeds, part positioning, plus other critical conditions. The die monitor function requires a resolver input and is generally pre-programmed and configured for each job or tool.

Modes of Operation

The following table lists the modes of operation for each Rockwell Automation press control solution.

Press Modes of Operation	MicroLogix™ Clutch Brake	Clutch Pro™	Compact Press Master™	StamPro™ System
Off	X	X	X	X
Inch	X	X	X	X
Micro Inch			X	X
Single	X	X	X	X
Continuous	X	X	X	X
Remote & Auto Single				X

Contact your local Rockwell Automation sales office or Allen-Bradley distributor for pricing and order information.

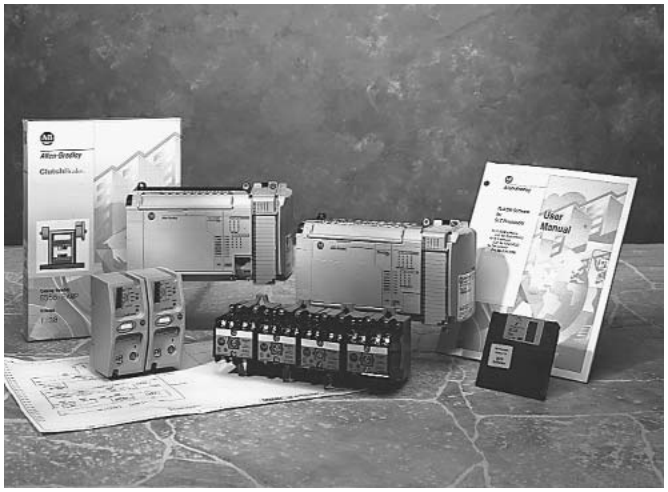
Press Features/Functions

The table below summarizes the various press control functions available for each press control solution.

(S = Standard, O = Optional, P = User Programmable, Blank table cell = Function not available).

Press Control Features	MicroLogix™ Clutch Brake	Clutch Pro™	Compact Press Master™	StamPro™ System
Clutch/Brake Control	S	S	S	S
Operator Interface	O	O	S/P	S/P
E-Stop & MCR Relays	S	S	S	S
Run Sta. Monitored	4	4	4	4+
Main Motor Control		S		S/P
RCLS Position Capable	S	S	S	S/P
Resolver Capable	O	O	O	O/P
Brake Time Monitor	S	S	S	S
Var. Speed Top Stop	S	S	S	S/P
Production Counters		S		S/P
Prog. Limit Switch			O	O/P
Die Protection Mon.			O	O/P
Recipe Storage			S/30	S/99
Var. Speed Comp.		S	S	S
Lubrication Control			S	S/P
Tonnage Monitoring			O	O/P
Auto Counterbalance			O	O/P
Shut Height Adjust			S	S/P
Var. Speed Drive Interf.			O	O/P
Servo Feed Interface			O	O/P
Robot Interface			O	O/P
Coil Feed Interface			O	O/P
Die Cushion Control			O	O/P
Die Clamp Control			O	O/P
Bolster/Die Cart Cntl.			O	O/P
Aux. Automation Intrf.			O	O/P
Prod. Monitoring/OEE			S	S/P
Hydric. Overload Cntl.			O	O/P
Light Curtain Interface			S	S
Disconnect/Starters			O	O
Open Net. Interface Capable‡	S	S	S	S
User Prog. Capable		S		S
Enclosure Assembled	O	O	O	O
Complete System	O	O	O	O

‡ Ethernet, DeviceNet, Controlnet, RS-232



Description

A MicroLogix™ 1500 processor-based Clutch/Brake Package is a bundle of hardware, software, and documentation that controls the basic clutch/brake mechanisms on mechanical stamping presses. This package requires no user programming. It can be interfaced with other controllers such as the ControlLogix system.

The package uses redundant MicroLogix 1500 processors with application software for self testing and verification to help meet the safety requirements of ANSI B11.1, OSHA 1910.217 and CAN/CSA Z142-M90 press safety regulations for mechanical stamping presses. Each MicroLogix 1500 processor has the basic clutch/brake functionality as well as the basic diagnostics to interface to several display options making it an easy-to-use cost-effective solution for small presses. Since you don't need programmable controller experience; you can just wire and mount the equipment.

For other press functions such as programmable limit switch, automation control, die protection monitoring and resolver based, consider using the Compact PressMaster system. If you require more automation flexibility or need a custom system, consider using the StamPro system.

Control Features

- Four sets of Run buttons monitored
- One set of Inch buttons monitored
- AC and DC versions
- Hard wired cross-checking
- Open communication for diagnostics

Modes of operation:
  – Off
  – Inch
  – Single
  – Continuous (Armed)
- Brake monitoring
- Top stop overrun and anti-repeat protection

System Requirements

- Rotary Cam Limit Switch or Allen-Bradley Encoder
- Motion detection device
- Self-checking valve

Ordering Information

The purchase of one kit includes the license to use this control on one stamping press.

- Contact your local Rockwell Automation Sales office or Allen-Bradley distributor.
- Email inquiries to: metalforming@ra.Rockwell.com
- FAX inquiries to: 440-646-4843
  Attention: Metalforming Group

The **HMI** option, which must be ordered in addition to the basic Clutch/Brake package, includes installed software, communication modules, and necessary cables.

New—Enhanced Options for MicroLogix Clutch/Brake Controllers

Option Description	Option Number
HMI Option — Includes PanelView™ Plus 400, network hardware for Ethernet/IP and software for diagnostics, brake monitor setup, and encoder configuration.	PV400
Encoder, scanner module, and software to create a dual encoder feedback system for press position.	PF1
One operator run station on T-stand with run, top stop, and E-stop pushbuttons	RS1

Press Control Systems

PressMaster™

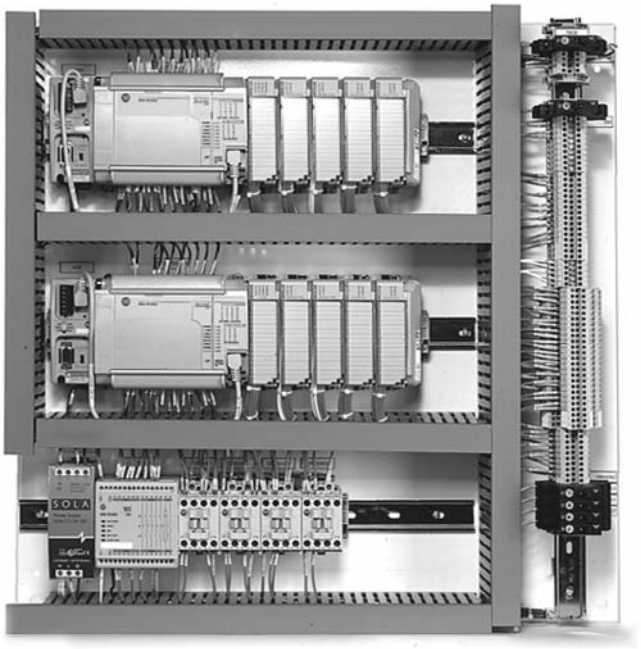
Help reduce operating costs and downtime with flexible press controls.

The Rockwell Automation Compact PressMaster™ System is a cost competitive, programmable controller-based system used for the control and monitoring of mechanical stamping presses. Help reduce cost and risk by purchasing a complete system, pre-wired and tested, ready for installation. The system is designed to modernize your press controls, increase control system reliability, and help reduce downtime by providing comprehensive operator diagnostics. Compact PressMaster provides press users, rebuilders, and OEMs a low cost PLC based control system to remain competitive and reduce risk.

System Description

The Compact PressMaster System is an expandible press control system based on standard Rockwell Automation components available locally and supported worldwide. Compact PressMaster Systems provide press control, operator interface with comprehensive diagnostics, expandability, and motor controls in a single integrated package. The system is provided, ready to install, with a complete set of documentation.

The Compact PressMaster System is based on the standard Bulletin 6556 clutch/brake control with dual processors and software designed by Rockwell Automation to help customers comply with ANSI B11.1, OSHA 1910.217, CSAZ142-2002, and EN 954. An Allen-Bradley PanelView operator interface is included to complete the system and provide maximum reliability.



Standard Features

Standard features include:

- Safety interlocks and light curtain interface
- Clutch/brake safety control with inch, single stroke, continuous, modes of operation
- Main motor control
- Lubrication control
- Slide adjust control
- Operator fault and prompt messages, alarm status operator screen
- One industrial absolute encoder
- Brake time monitoring and 90° stop test
- Interface for four run stations with anti-tiedown protection
- Press stroking anti-repeat and top stop overrun protection
- Clutch/brake and counterbalance air pressure monitoring
- User immediate and top stop control interlocks
- Production counters
- Variable speed compensation

Optional features available:

- Automatic slide adjust
- Sixteen channels of die protection
- Eight programmable limit switch outputs
- Hydraulic overload control
- Light curtains with muting
- OEM packages
- Automatic counterbalance control
- 6-inch color operator display terminal

Results

A Compact PressMaster System helps provide:

- Reduced downtime through advanced diagnostic messages, helpful operator prompts, and on-line control system troubleshooting.
- Improved system reliability through the use of standard Rockwell Automation industrial control hardware and software.
- Increased operational flexibility and expandability, while reducing costs and risk.
- Compliance with ANSI, OSHA, and CSA regulations.
- A press control that can grow with your stamping operations.

Ordering Information

- Contact your local Rockwell Automation sales office or Allen-Bradley distributor.
- Email inquiries to: metalforming@ra.Rockwell.com
- FAX inquiries to: 440-646-4843
  Attention: Metalforming Group

Help reduce operating costs and downtime with flexible programmable press controls.

The Rockwell Automation StamPro™ System is an advanced programmable controller-based system used for the control and monitoring of mechanical and hydraulic stamping presses. The StamPro control system is for customers who want to help reduce cost and risk by purchasing a complete pre-engineered system, ready for installation.

System Description

The StamPro System is a flexible, pre-engineered press control system based on standard Rockwell Automation components available locally and supported worldwide. StamPro Systems provide press control, operator interface, and magnetics in an integrated package with a complete set of documentation. The use of field-proven hardware and software helps users minimize cost and risk, while also helping to comply with the necessary ANSI, OSHA and CSA standards.

System Architecture

The StamPro System uses the Allen-Bradley Logix family of processors. The safety kernel, executed in dual Logix processors, is based on the standard Bulletin 6556 clutch/brake control with dual processors and software designed by Rockwell Automation to help customers comply with ANSI B11.1/B11.2, OSHA 1910.217, CSAZ142-2002, and EN 954.

This safety kernel is coupled with optional application software that provides all other press automation control, monitoring, information and network requirements. The Logix programming environment allows the user to add their own additional custom software into the same processors where the safety kernel resides, to help minimize control hardware costs. The standard operator interface is a pre-programmed color PanelView™ Plus 1000. The system is available in a freestanding console or an upright enclosure with a press mounted operator station.

Features

The StamPro System is modular, which allows each system to be configured to the requirements of each specific application and easily accommodates control expansion for future needs.

Standard features include:

- Stop time monitoring for hands in die
- Safety Interlocks and Light Curtain interface
- Main Motor/Pump control
- Lubrication control
- Manual Slide Adjust/ Ram Profile Control
- A 10-in. color operator interface terminal with Alarm Status/History and Fault/Prompt
- Clutch/Brake Safety Control
- Interface for four run stations with anti-tiedown protection

Optional features include:

- Fully assembled and mounted in a NEMA 12 rated industrial enclosure with one set of operator run palm-buttons
- Automatic Slide Adjust Control
- Die Protection Monitoring
- Programmable Limit Switch
- Tonnage Monitoring
- Die Clamp Control
- Die Cushion Control
- Bolster Control
- Light Curtain with muting
- Hydraulic Overload Control
- Recipe Management
- Automatic Die Change
- Automatic Counterbalance Air Pressure Control

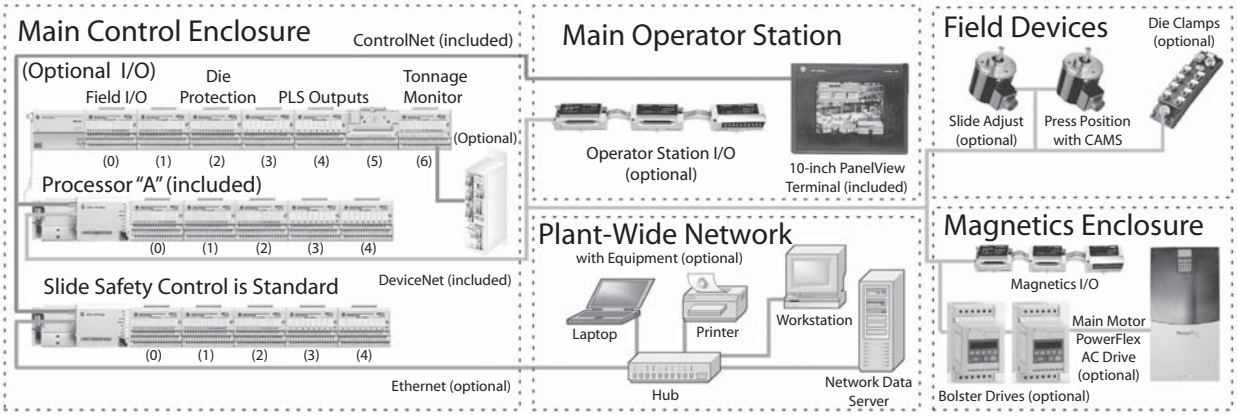
Results

A StamPro System will help provide:

- Reduced downtime through comprehensive operator diagnostic messages, on-line control system troubleshooting and replaceable modular components available worldwide.
- Increased flexibility through open integration of press control functions and industry-standard connectivity to other equipment including coil feeds, computers, drives, robots and servo transfer feeds.
- Improved quality through recipe-based control of process parameters such as shut height, counterbalance air pressure, motor speed, die protection and programmable limit switch.
- Reduced costs through the use of standard Rockwell Automation industrial control hardware, field-proven application software, and a comprehensive documentation package.

Ordering Information

- Contact your local Rockwell Automation Sales office or Allen-Bradley distributor.
- Email inquiries to: metalforming@ra.rockwell.com
- FAX inquiries to: 440-646-4843
  Attention: Metalforming Group



Notes

Visit our website: www.ab.com/catalogs
Publication S117-CA001A-EN-P

Other Safety Related Products

Explosion Proof

Ex Range 9-2

Intrinsically Safe Galvanic Isolators

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Pneumatic

Lifeline™ 4 and Rotacam™ 9-10

Ex Range

Description

The Guardmaster Ex Range of safety switches are specifically designed for potentially explosive atmospheres. They retain the safety features and operating principles of the conventional Guardmaster switches. They incorporate a sealed flameproof contact block, making them suitable for use in European Zone 1 and Zone 2 environments. In the US and Canada, these products can be used in areas classified as Class 1, Division 2 in Groups A (acetylene), B (hydrogen), C (ethylene) and D (propane). All the Guardmaster Ex switches conform to the exacting standards required by the European harmonized standards. The contact block in these switches has the following approvals: 112G EExd IIC T6 or T5 and 11 2D T80°C IP66.

EEx equipment conforms to types of protection standardised by CENELEC (European standards), EN50014 and EN50018 respectively and BS5501 parts 1-V.

The d suffix indicates that the contact block in the switch is a flameproof enclosure and is designed to ensure that if an internal explosion occurs it will be contained with the enclosure. The designation II indicates use in surface industries and c refers to the group of gases for which the switches are suitable. The designation T represents the surface temperature classification of the switch. These switches have been tested with an ambient temperature of 60°C as opposed to the normal test limit of only 40°C, allowing them to be used in gases having a low flash point.

It should be noted that these groups refer to the explosion-proof qualities of the switches and not corrosion-resistance characteristics. Special precautions may be required to protect the vulnerable parts such as PVC-covered cables against attack by certain corrosive elements and physical damage.

Features

- For use in potentially explosive atmospheres
- Positive mode action, flameproof contact block
- Suitable for use in European Zone 1 and 2 environments
- US and Canada: Class 1, Division 2 in Groups A, B, C and D

Specifications

All switches excluding Ferrogard GS2	
Contact Block Electrical Specifications	
Certifications	112G EExd 11C T6 or T5 112D T80°C IP 66 under ATEX
Safety Contacts	1 N.C. & 1 N.O. or 2 N.C.
Enclosure Protection	IP66
Rated Voltage	250V AC and 250V DC
Rated Current	5 A AC and 0.25 A DC
AC Ratings, Resistive	6 A @ 250V, 6 A @ 125V
AC Ratings, Inductive	2.5 A @ 250V, 3 A @ 125V
DC Ratings, Resistive	0.25 A @ 250V, 0.5 A @ 125V, 1 A @ 75V, 7 A @ 30V
DC Ratings, Inductive	0.1 A @ 250V, 0.2 A @ 125V, 1 A @ 75V, 5 A @ 30V
Contact Block Technical Specifications	
Operating Force	1.6 N - 0.4/ - 0.2 N
Release Force	0.4 N
Pre-travel	0.8 mm (0.03 in.)
Over Travel	0.6 mm (0.02 in.)
Return Travel	1.1 mm (0.04 in.)
Differential Travel	0.5 mm (0.19 in.)
Release Travel	0.2 mm (0.007 in.)
Positive Break Travel	0.4 mm (0.01 in.)
Repeatability	+0.01 mm (0.0003 in.)
Switching Speed, Min.	1 mm (0.039 in.)
Switching Frequency, Max.	3000 operations/hour
Mechanical Life	2,000,000 operations
Electrical Life	Dependent on loading
Operating Temperature [C (F)]	-25…70° (-10…284°)
Electrical Connection	Potted in leads. Flexible 4 x 0.75 mm^2, 2 m long
Ferrogard GS2	
Certifications	EExd IIC T6 Baseefa. Not suitable for Group 1 gases
Safety Contacts	1 N.C.
Enclosure Protection	IP67 (NEMA 6P)
Rated Voltage	250V AC
Rated Current	2 A
Rated VA	100V A max @ 50V 200V A max @ 110V 500V A max @ 250V
Operating Distance, Make [mm (in.)]	15 (0.59)
Operating Distance, Break [mm (in.)]	26 (1.02)
Closing Time	3.0 ms
Drop-Out Time	2.1 ms
Bounce Time	0.7 ms
Shock	<50 g
Vibration	15 g, 20…1000 Hz
Contact Resistance, Initial	0.07 Ω (excluding cable)
Mechanical Life	100,000,000 operations
Electrical Life	5,000,000 operations
Operating Temperature [C (F)]	-10…40° (14…104°)
Housing Material	Brass or Stainless Steel
Cable Length	3 m (9.8 ft), 5 m (32.8 ft), or 10 m (32.8 ft)
Cable Type	Termorad

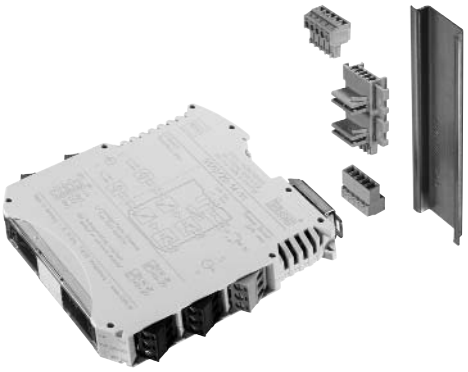
Product Selection

Switch	Description	Type	Safety Contacts	Cable Length	Cat. No.
	Ex Trojan 5. Explosion proof tongue operated safety interlock switch.	Trojan 5-EX	2 N.C.	2 m (6.5 ft)	440K-H11145
				6 m (19.7 ft)	440K-H11160
				15 m (39.2 ft)	440K-H11161
	Ex Ferrogard GS2. Explosion proof magnetically actuated, noncontact safety interlock switches.	GS2-Ex (stainless steel)	1 N.C.	3 m (9.8 ft)	440N-H02047
		Ferrogard GS2-EX (stainless steel)		10 m (32.8 ft)	440N-H02087
	Ex Lifeline 4. Explosion proof, cable and push button actuated Emergency Stop switch.	Lifeline 4-EX	1 N.C. & 1 N.O.	2 m (6.5 ft)	440E-H13046
			2 N.C.		440E-H13069
	Ex Rotacam. Explosion proof, hinge actuated safety interlock switch.	Rotocam-HS-2-EX	1 N.C. & 1 N.O.		440H-H03077

Intrinsically Safe Galvanic Isolators

Overview

Intrinsically Safe Galvanic Isolators



Accessories

Description

For applications involving sensor use in hazardous locations, Rockwell Automation offers a line of Intrinsic Galvanic Isolators, which offer economical solutions for instrumentation and control systems in hazardous locations as defined by NEC article 500 and CEC Part I, Section 18.

Intrinsically Safe or Galvanic Isolators are active protective interface assemblies that limit the amount of energy allowed to enter a hazardous area under fault conditions. Sometimes called Transformer Isolated Barriers, they separate intrinsically safe wiring from non–intrinsically safe wiring through the use of the same isolation coils found in power transformers as defined in FM Class No. 3610 and CSA 22.2 No. 157.

Galvanic isolators, unlike zener diode barriers, do not require grounding—therefore they may reduce ground loop problems as well as installation and maintenance costs. The solid state output version isolators can be located in a Division 2 area. The slim ¾ inch wide housing on DC models also conserves valuable mounting space, while providing 1500 Volt isolation between hazardous area and nonhazardous area terminals and 500 Volt isolation between input/output and external power terminals. DIP switches provide convenient programming of output and diagnostic functions while multiple LEDs provide visual indication of module and circuit status.

Rockwell Automation's zener diode barriers and galvanic isolators are DIN-rail mountable and designed primarily for use with intrinsically safe proximity sensors and photoelectrics. All of Rockwell Automation's barriers and isolators are FM and CENELEC approved, CSA certified and CE marked for all applicable directives.

Intrinsically Safe Galvanic Isolators

Features

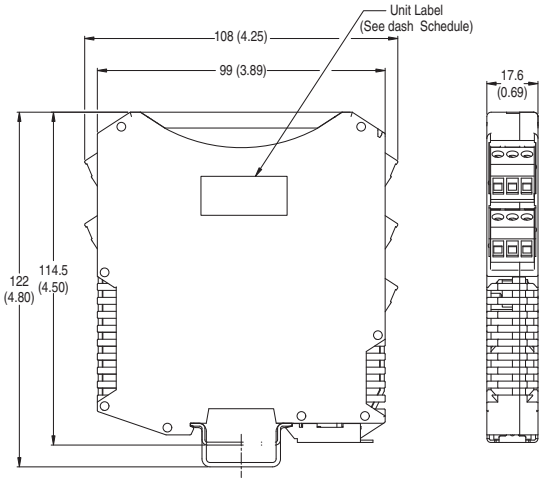
- DIN rail mounting with power bus option
- Removable field connection terminals
- Single- and two-input versions
- Variety of output types
- Approvals to worldwide standards
- SIL 2 and 3 rated
- Intrinsically safe connections for Class I, II, III, Div 1; Groups A-G (EExIa), IIC/IIB

Specifications

Certifications	FM,CSA, UL, CENELEC (PTB) approved and CE marked for all applicable directives
Number of Inputs	2
Switching Current @ Voltage, Max.	8V @ 8.2 mA (to EN 60947-5-6 NAMUR)
Input Current	On > 2.1 mA; Off < 1.2 mA
Input Resistance	1000 Ω
Switching Frequency (Hz)	< 15 Hz
Switch Delay	On to Off: 15 ms; Off to On: 15 ms
Status Indicators	Green = Power; Yellow = Output Closed; Red = Wire Break/Short
Operating Temperature [C (F)]	-20…+65° (-4…+149°)
Relative Humidity	<95% RH
Housing Material	Polyamide 6GF
Enclosure Type Rating	IP 30
Mounting	35 mm DIN rail
Conductor Size, Max.	0.2…2.5 mm² (24-14 AWG)
Weight [g (lbs)]	160 (0.35)

Approximate Dimensions [mm (in.)]

Dimensions are not intended to be used for installation purposes.



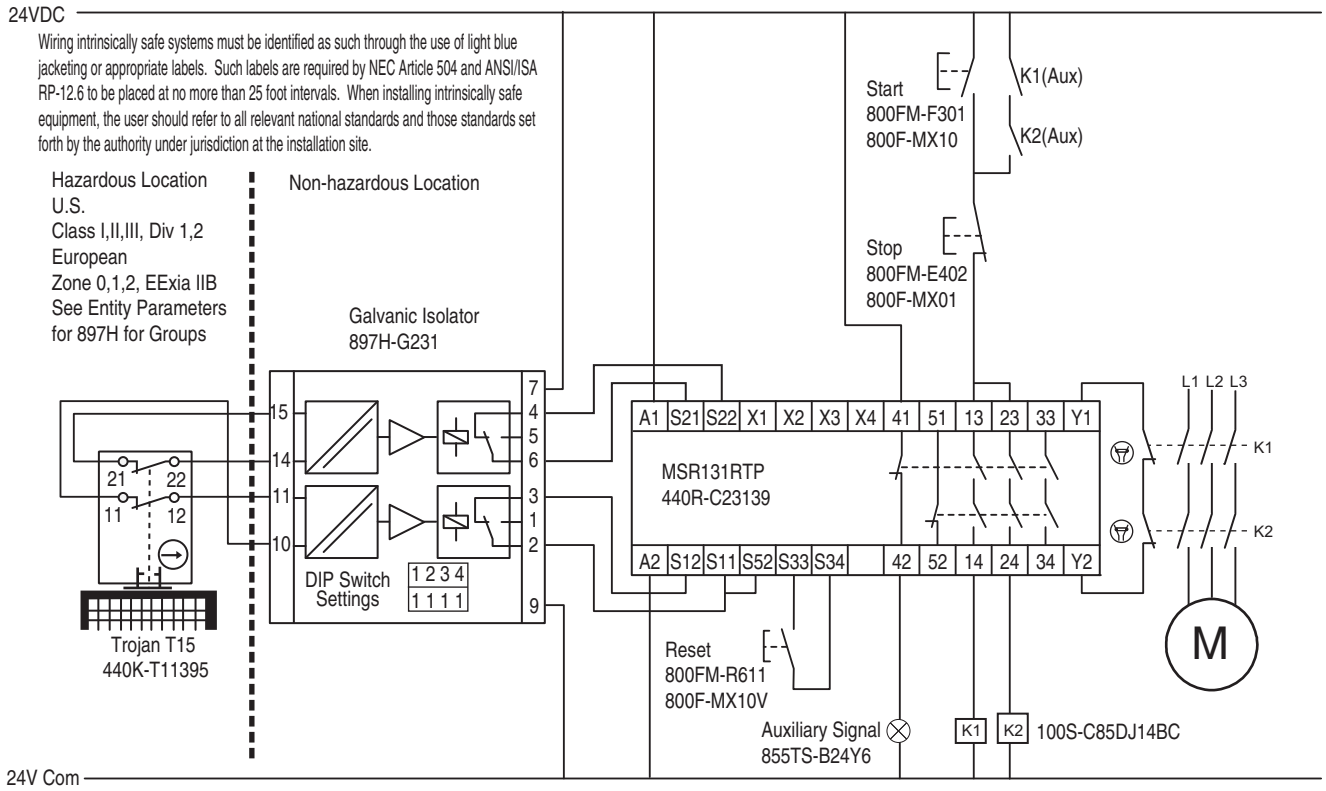
Product Selection

Power Supply	Input Type	Output Type/ Output Rating/ Response Time	Classifi-cation	FM Entity Parameters					ATEC Certified Stahl Cat. No.	Cat. No.
				Voltage, Max.	Current, Max.	Power, Max.	Max. Permiss. External Capacity	Max. Permiss. External Inductance		
120…230V AC	(2) NAMUR Sensors or Dry-Contacts	SPDT Relay/ 250V AC @ 4 A/ 10 ms	A, B, E	10.6V	24 mA	64 mW	2.32 µF	63 mH	9170/20-12-21s	897H-G232
			D, F, G				16.2 µF	230 mH		
24V DC		SPDT Relay/ 250V AC @ 4 A/ 10 ms	A, B, E				2.32 µF	63 mH	9170/20-12-11s	897H-G231
			D, F, G				16.2 µF	230 mH		
24V DC		Transistor, Open Collector/ 35V DC @ 50 mA/ 30 µs	A, B, E				2.32 µF	63 mH	9170/20-14-11s	897H-G211
			D, F, G				16.2 µF	230 mH		

Note: Safety parameters stated above are per input.

Intrinsically Safe Galvanic Isolators

Safeguarding Applications



Circuit Status

Circuit shown with the safety gate closed. The motor is ready for starting.

Operating Principle

The galvanic isolator limits energy to the interlock switch, which is considered a simple apparatus in the hazardous location. The MSR131RTP safety relay checks the outputs of the galvanic isolator upon power-up and each time the gate/e-stop is actuated. The Minotaur safety relay also monitors the status of the safety contactors (or safety control relays).

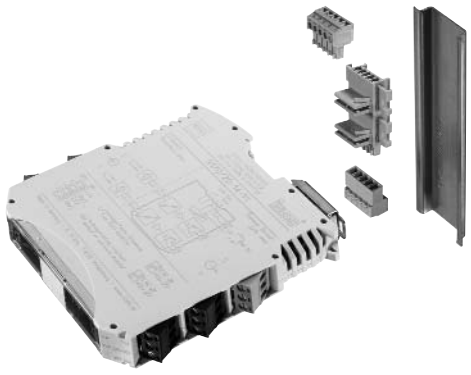
STARTING: Press and release the Reset button to energize the safety outputs (13/14 and 23/24) of the MSR131RTP. Press the Start button to start the motor.
STOPPING: Opening the safety gate or pressing the stop button will stop the motor. If the gate is opened, the gate must be reclosed and the reset button then pressed to energize the outputs of the MSR131RTP.

Fault Detection

The DIP switch setting of the galvanic isolator allows for open and short circuit detection of the tongue interlock switch, as well as opening the gate. The tongue interlock switch should be wired to both inputs (terminals 7 and 8) of the galvanic isolator to drive both outputs (1/5 and 2/3) of the galvanic isolator. A single fault will not cause a loss of safety function. If one output of the galvanic isolator fails in the closed state, the Minotaur safety relay will detect opening of the 2nd output and turn the motor off. The motor will remain off until the fault is corrected or power is cycled. If either contactor K1 or K2 sticks ON - the motor will stop on command due to the other contactor, but the Minotaur safety relay cannot be reset (thus the fault is revealed to the operator). The manual Reset button will prevent the motor from starting in the event of a shorted Start switch.
A single fault detected on the Minotaur safety input circuits will result in the lock-out of the system to a safe state (OFF) at the next operation of the safety gate or e-stop device.

Ratings

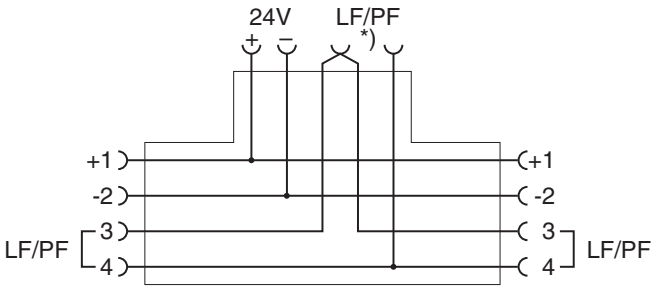
This circuit meets the safety performance requirements of Category 3 of EN954-1:1996. This circuit executes a Category 0 stop.



Description

Rockwell Automation Galvanic Isolators can be daisy chained together via power bus connectors. The snap-on connectors save time and simplify wiring for power distribution and error identification on a series of modules. Each end on a string of bussed isolators is terminated with a screw terminal connector. The line fault and power supply failure line are bridged on these connectors to close the current.

Typical Wiring Diagrams



Approximate Dimensions [mm (in.)]

Dimensions are not intended to be used for installation purposes.

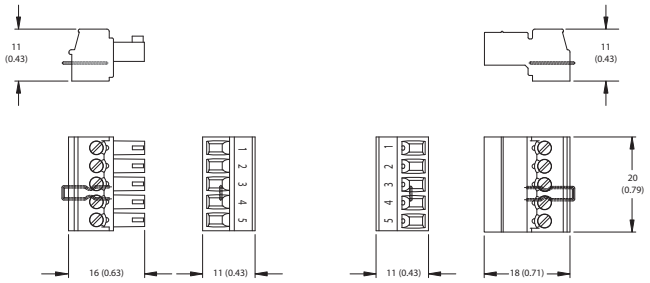


Figure 1: Power Bus Screw Terminal Connector

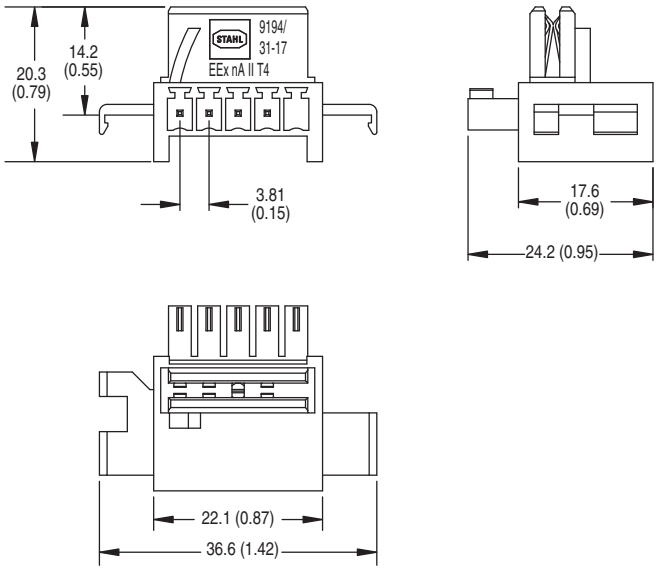


Figure 2: Power Bus T-Connector

Product Selection

Description	Approximate Dimensions [mm (in.)]	Cat. No.
Power Bus Screw Terminal Connector	See Figure 1	897H-GDRCT
Power Bus T-Connector	See Figure 2	897H-GDRC

Accessories

Intrinsically Safe Wiring Labels/DIN Mounting Rail

Intrinsically Safe Wiring Labels

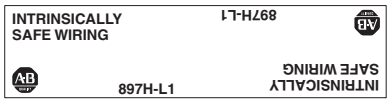


Figure 1

Figure 2

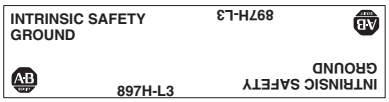


Figure 3

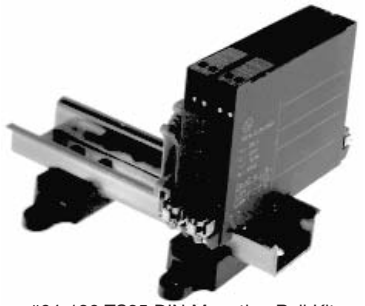
Description

It is recommended that wiring for intrinsically safe systems be identified as such through the use of light blue jacketing and/or through appropriate labels. Such labels are required by NEC Article 504 and ANSI/ISA RP–12.6 to be placed at no more than 25 foot intervals. When installing intrinsically safe equipment the user should refer to all relevant national standards and/or those standards set forth by the "authority having jurisdiction" at the installation site.

Product Selection

Pkg. Quantity	Description	Figure	Cat. No.
25	Intrinsically Safe Wiring	Figure 1	897H-L1-25
100	Intrinsically Safe Wiring		897H-L1-100
25	Intrinsically Safe Wiring	Figure 2	897H-L2-25
100	Intrinsically Safe Wiring		897H-L2-100
25	Intrinsically Safe Wiring	Figure 3	897H-L3-25

DIN Mounting Rail



#64-136 TS35 DIN Mounting Rail Kit
(Barriers not included)

#64-134 TS35 DIN Mounting Rail

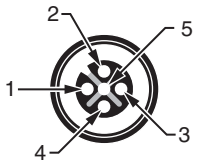
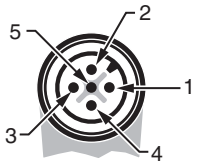
Description

DIN rail provides convenient and simple mounting of barriers, isolators, and other control equipment. DIN rail is available from Rockwell Automation/Allen-Bradley in one meter sections (Cat. No. **64-134**) or as part of a mounting kit (Cat. No. **64-136**). By isolating the DIN rail from the mounting surface, the mounting kit allows 897H- series shunt diode barriers to be grounded directly to the rail.

Product Selection

Description	Cat. No.
1 m (3.3 in) prepunched zinc-jplated and chromated steel mounting rail per EN 50022/DIN 46277 (TS35)	64-134
DIN Rail Mounting Kit includes 12 inch DIN rail, two insulated standoffs, and two grounding terminals	64-136

Pinout and Color Code

	Face View Pinout	
	4-Pin	
		
	Female	Male
Color Code	1 Brown 2 White 3 Blue 4 Black 5 NA	

Description

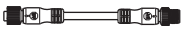
As defined in the National Electric Code (NEC), intrinsically safe wiring must be identified by color coding with light blue jacketed cable or by labeling at regular 25 foot or less intervals. When installing intrinsically safe equipment, the user should refer to all relevant national standards and/or those standards set forth by the "authority having jurisdiction" at the installation site. Rockwell Automation cordsets and patchcords with blue PVC jacketing provide a cost effective solution for easy identification of intrinsically safe wiring. Unlike tags, that may fall off or become unreadable, this rugged cable maintains its visibility, even in harsh environments. No labor time is required for labeling the cable while it is being installed or during maintenance.

Product Selection

Cordsets

Pin Count	Color Code	Jacket Color	Wire Gauge	Cat. No.			
				Straight Female	Right Angle Female	Straight Male	Right Angle Male
4-Pin	A	Blue	22 AWG	889D-F4LC-∗	889D-R4LC-∗	889D-M4LC-∗	889D-E4LC-∗

Patchcords



Pin Count	Color Code	Jacket Color	Wire Gauge	Cat. No.			
				Straight Female Straight Male	Straight Female Right Angle Male	Right Angle Female Straight Male	Right Angle Female Right Angle Male
4-Pin	A	Blue	22 AWG	889D-F4LCDM-❄	889D-F4LCDE-❄	889D-R4LCDM-❄	889D-R4LCDE-❄

∗ Replace symbol with 2 (2 m), 5 (5 m) or 10 (10 m) for standard cable lengths.
❄ Replace symbol with 0M3 (1 ft), 1 (1 m), 2 (2 m), 5 (5 m) or 10 (10 m) for standard cable lengths.

Note: See DC Micro Style Cordsets and Patchcords on page 7-12 for complete specifications.

Lifeline 4 and Rotacam

Description

Pneumatic Rotacam

Based on the highly successful conventional Rotacam, the Pneumatic Rotacam has the same design features except that it gives positive acting isolation of a machine's compressed air supply instead of an electrical power source.

The switch is mounted at the hinge point of the guard door. The bored stainless steel operating shaft is mounted in a sealed bearing which is so robust that it enables the switch itself to be used as the hinge pin if necessary.

The pneumatic valve specifications are shown below. The external switch dimensions and operating shaft specifications are the same as the conventional Rotacam.

Note: The Pneumatic Rotacam does not have the adjustable cam used with the standard Rotacam.

Pneumatic Lifeline 4

Based on the conventional Lifeline 4 this rope operated pneumatic safety switch can be used for guarding exposed pneumatic machinery and conveyor equipment.

The Pneumatic Lifeline 4 is immune to machine vibration thus overcoming the problem of nuisance tripping.

The pneumatic valve specifications are shown below. The external switch dimensions are the same as the conventional Lifeline 4.

Features

Pneumatic Rotacam

- Can be used as a hinge pin with light and medium weight guard doors on pneumatic machinery
- Isolates pneumatic power within 5° of guard movement

Pneumatic Lifeline 4

- Switches pneumatic power with up to 75 meter span
- Lid mounted emergency stop button, designed to EN418
- Switch lockout with indication of rope pulled and rope slack

Specifications

Standards Pnuematic Rotacam	IEC 60947-5-1, ISO 14119, ISOTR 12100
Standards Pneumatic Lifeline 4	IEC 60204-1, IEC 60947-5-1, ISO 14119, ISOTR 12100, IEC 60204-1, ISO 13850
Pneumatic Fluid	Compressed air or neutral gas
Pressure Range	2…8 bars
Passage Diameter	2.7 mm
Connection Type	Push in fittings for standard 4 mm Ø nylon tube, internal Ø 2.5 mm
Flow Rate	138 NL/min. (ie., number of liters of air at normal atmospheric pressure obtained with the output open to atmosphere and the supply pressure at 4 bars).
Mechanical Life	1,000,000 operations
Operating Temperature [C (F)]	10…60° (50…140°)

Note: For other specifications and dimensions see relevant specifications of standard product.

Product Selection

Type	Cat. No.
Rotacam	440H-P03035
Lifeline 4	440E-P13045

Note: See standard Lifeline 4 for installation kits, etc.

Safeguarding Applications and Wiring Diagrams

Application Selection Table 10-2

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Four Sensor Muting with Micro 400 Light Curtain . . . 10-40

Application Selection

Page No.	SIL CL	PL	Cat.*	Stop Cat.	Light Curtain Guard-Shield	Mat	Laser Scanner	Tongue Switch	Non-Contact	Guard Locking	E-Stop 800F	Cable Pull Lifeline
					Input Device							
5	3	e	4	0	•						•	
6	2	d	3	0							•	•
7	2	d	4	0				Trojan 5	SensaGuard			
8	2	d	3	0	•							
9	3	e	4	0	•	•			Sipha		•	
10	2	d	3	0				Elf Trojan 15			•	
11	3	e	4	0	•	•			Sipha		•	
12	2	d	3	0				MT-GD2				
13	3	e	3/4	0/1						TLS-GD2	•	
14	3	e	4	0	•						•	
15	2	d	3	0				Cadet 3 Trojan 5 MT-GD2				
16	2	d	3	0				Trojan 5				
17	2	d	3	1							•	
18	2	d	3	0				Trojan 15				
19	3	e	3/4	0							•	
20	3	e	3/4	1							•	
21	3	e	4	0							•	
22	3	e	4	0	•		•		SensaGuard	440G-MT	•	
23	3	e	3/4	0/1	•		•		SensaGuard	440G-MT	•	
24	3	e	3/4	0/1	•	•			SensaGuard	440G-MT	•	
25	3	e	3/4	0/1	•		•		SensaGuard	440G-MT	•	
26	3	e	4	0/1	•					440G-MT		
27	3	e	4	0							•	
28	3	e	4	1								
29	2	d	3	1						TLS3-GD2	•	
30	2	d	3	0	•							
31	3	e	4	0	•							
32	3	e	4	0	•							
33	3	e	4	0								
34	3	e	4	0	•					TLS3-GD2		
35	3	e	4	1							•	
36	3	e	4	0/1							•	
37	2	d	3	1		•						
38	3	e	4	0	•							
39	3	e	4	0	•							
40	3	e	4	0	•							

* These ratings are general guidelines that would likely apply in most instances. Safety performance ratings are applied to safety functions. The safety rating must be applied from an input device through a logic device to an output device. Many of the application examples contain multiple devices and may have mulitple safety functions. Therefore, a detailed analysis of the application and complete implementation of the standard is required and may result in ratings that differ from the guidelines provided.

Enabling Device										Drive	Motion	
Grip Switch	Standard PLC	100 Series	Specialty	200 Series	300 Series	GuardPLC	SmartGuard	Guard I/O	Contactors	Drive-Guard	Guard-Motion	
Input Device		Logic							Output Devices			Page No.
		MSR127							100S			5
		MSR127							100S			6
	•	MSR127							100S			7
		MSR126	MSR35H						100S			8
				•					700S			9
	•	MSR127							100S			10
					•				100S-700S			11
•		MSR127	MSR178							•		12
		MSR138							700S			13
					•				100S			14
		MSR127								•		15
	•	MSR127			•					•		16
								CompactBlock		•		17
		MSR126							Flex I/O			18
		MSR138							100S		•	19
		MSR138									•	20
								CompactBlock	100S		•	21
						1600			100S			22
						1800			100S-700S			23
							•		100S			24
								CompactBlock	100S-700S			25
								CompactBlock	100S-700S			26
		MSR142							Valve			27
•		MSR138	MSR178						100S			28
•			MSR57							•		29
				MSR211					100S			30
			MSR22LM						100S			31
									100S			32
					•				100S			33
		MSR138							100S			34
		MSR144							100S-700S			35
		MSR210		MSR230/ MSR238					100S			36
			Mat Manager						100S			37
			MSR41						100S			38
			MSR42						100S			39
			MSR42						100S			40

Notes for Use with Application Circuit Examples

Note 1

In the following circuits the type of Allen-Bradley/Guardmaster device is shown as an example to illustrate the circuit principle. For specific applications the choice of device type should be based on the suitability of its characteristics for its intended use.

Note 2

In most of the following examples showing dual channel applications, one interlock switch is shown switching both channels (one contact set per channel). If it is foreseeable that damage to the guard (e.g., at the actuator mounting point) could allow it to be opened without operating the switch then two separate switches may be required. The electrical principle of the circuit will remain the same.

Note 3

In most cases the circuits are shown with the guard door closed and ready for motor starting by operating the normal start control.

It must be possible to start the machine only by voluntary actuation of the control provided for the purpose (see ISO 12100-2 4.11.8). For the purposes of these examples the use of a conventional contactor latching circuit has been assumed. If this is not the case, then a restart interlock will be required to prevent an automatic or unintended starting of the motor when the guard is closed. For example, a Minotaur safety relay with a momentary action push button installed in the output monitoring circuit can be used to achieve this.

If the guard is designated as a Control Guard (see ISO 12100-2 5.3.2.5) these requirements do not apply but the use of control guards is only allowed under certain conditions including:

- A control guard can only be used where there is no possibility of an operator or part of his body staying in or reaching into the danger zone whilst the guard is closed.
- The control guard must be the only access to the hazard area.
- The interlocking system must have the highest possible reliability. It is often advisable to use a solenoid locking switch such as the Guardmaster Atlas or TLS-GD2.

Note 4

Safety monitoring relay units used in dual channel circuits with infrequent operation or with more than one switching device connected. This note applies to all monitoring devices which use the technique of comparing the signal at the change of state of dual channels.

Certain faults are only detected at a change of state of the input switching device (interlock switch or E-Stop switch). If there are long periods (e.g. months as opposed to days) between switching actions, it may be possible for multiple faults to accumulate which could lead to a dangerous situation. Therefore a regular check should be performed on the system in order to detect single faults before an accumulation occurs. This check may be manual or initiated by part of the machines control system.

If, for example, 3 interlock switches are connected to the monitoring unit, certain faults will only be detected at the switch on the first guard to be opened and the switch on the last guard to be closed. This is because any switching between the first opening/last closing will not change the state of the monitoring unit input circuits. Therefore in some applications it may be necessary to use one monitoring device per switch.

Most of the following examples show an interlock switch and an emergency stop switch combined in the circuit. When a monitoring safety relay (e.g. Guardmaster Minotaur) is used for fault detection it is important to note the following:

- All safety critical single faults, except for certain faults over the contact sets at the E-Stop, will be detected at the next opening of the guard.
- All safety critical single faults, except for certain faults over the contact sets at the interlock switch, will be detected at the next operation of the E-Stop.
- Because the E-Stop device is not likely to be operated frequently, it is recommended that its function is checked (with the guard closed) on a regular basis (start of shift or daily) to enable the Minotaur to detect single faults. If the guard is rarely opened, the interlock switch should be checked in a similar manner.

Note 5

This symbol indicates that the associated component or device features direct opening (positive opening) operation. In the event of a fault, welded contacts will be forced open by the motion of the safety guard.

This symbol denotes mechanically linked contacts; if one contact welds closed, all other dependent (auxiliary) contacts remain in position, i.e. they cannot change state.

General Safety Information

IMPORTANT This application example is for advanced users and assumes that you are trained and experienced in safety system requirements. Contact Rockwell Automation to find out more about our safety risk assessment services.

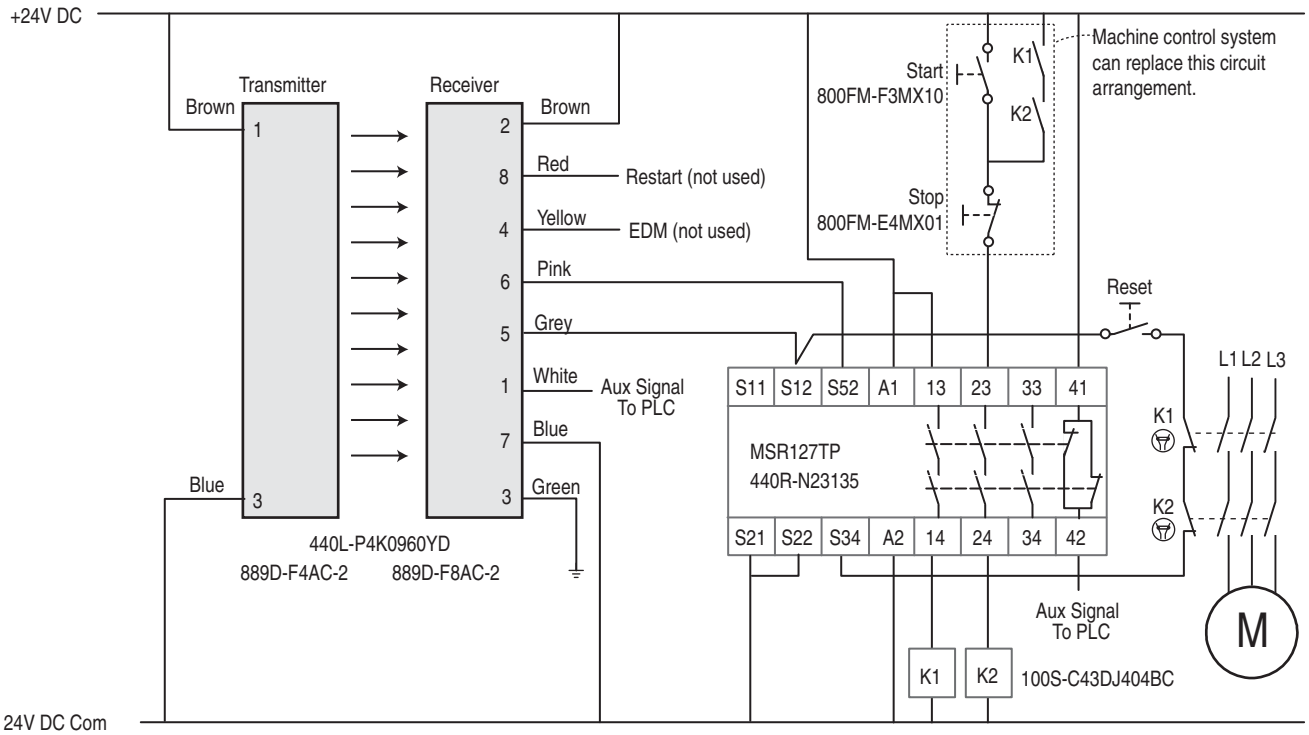
ATTENTION

A risk assessment should be performed to make sure all tasks and hazard combinations have been identified and addressed. The risk assessment may require additional circuitry to reduce the risk to a tolerable level. Safety circuits must take into consideration safety distance calculations which are not part of the scope of this document.

For other Important User Information and Safety Guidelines, please review pages G-2 and G-3 in the General section of this catalog.

Light Curtain—Point of Operation Control

GuardShield, 800F, MSR127, 100S



Circuit Status

The light curtain is configured with the factory default settings (Guard only mode) and is unobstructed. The outputs of the safety relay are open. The motor is off and ready to run.

Operating Principle

STARTING: Press the Reset button to close the outputs of the MSR127. Press the Start button to energize contactors K1 and K2. The motor starts with the two normally open contacts of K1 and K2 holding the circuit energized.
STOPPING: Obstructing the light curtain de-energizes the safety outputs of the MSR127, which in turn drops out K1 and K2. The contactors disconnect the motor from its power source, and the motor coasts to a stop. Clearing the obstruction in the light curtain does not cause the motor to energize (the Reset and Start buttons must be pressed). The motor can also be turned off by pressing the stop button.

Fault Detection

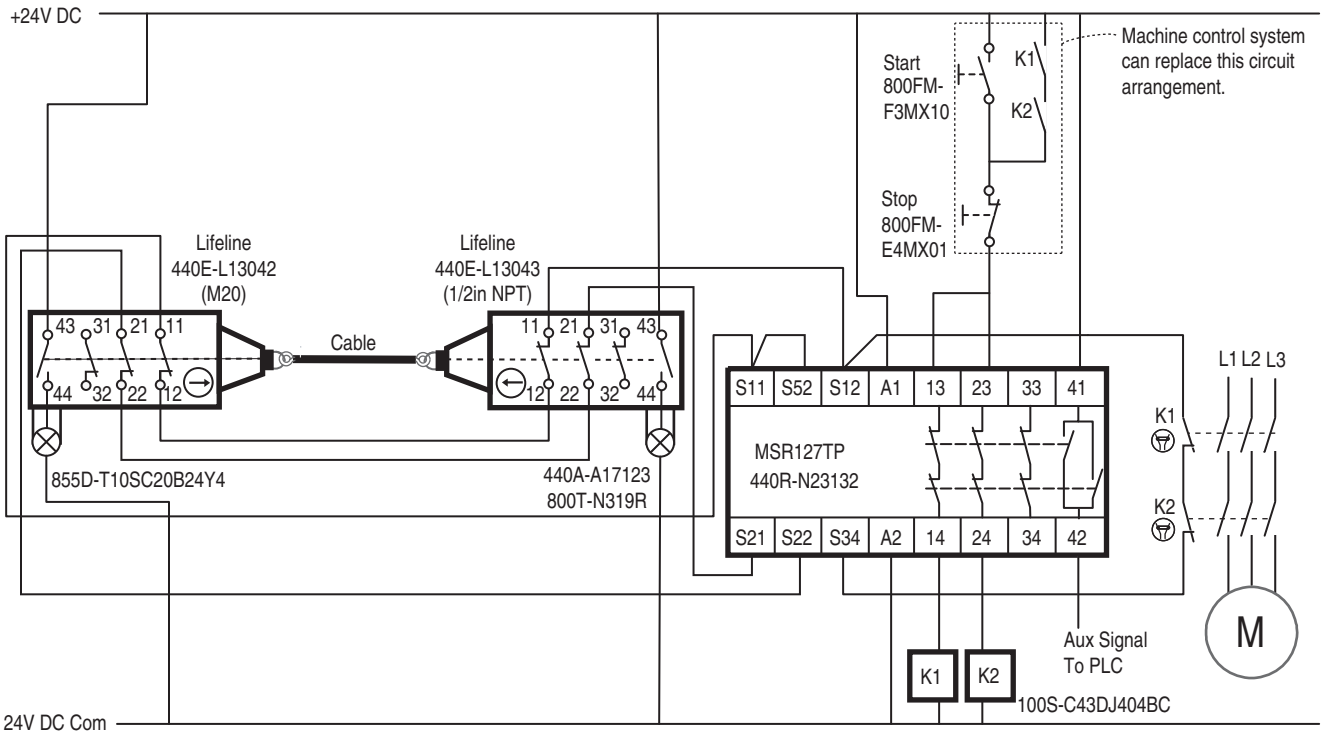
Upon successful completion of internal checks on power up, the GuardShield light curtain energizes its outputs with no objects present. The GuardShield light curtain outputs turn on. If a crossfault is detected, the GuardShield light curtain goes to a lockout state with its outputs off. After successful completion of internal checks, the MSR127 checks the signals from the light curtain. If OK, the MSR127 then checks the status of the K1 and K2 contactors. If either K1 or K2 fails in the actuated state, the other contactor will disconnect the motor. The MSR127 will detect the faulted contactor and will not allow the motor to restart until the fault is corrected.
Contactors K1 and K2 are controlled by the safety system. Contactor K2 is controlled by both the machine control system and the safety system. This increases the probability of performance of the safety function because K1 is significantly less likely to weld at the same time as K2 due to the diversity of expected wear out times.

Ratings

The safety function intiated by the GuardShield light curtain meets the safety performance requirements of SIL CL 3 per IEC 62061:2005 and has a Category 4 structure that can be used in systems requiring Performance Levels up to PLe per ISO 13849-1:2006. This circuit executes a Category 0 stop.

Cable Pull

Lifeline, 800F, MSR127, 100S



Circuit Status

Both Lifeline cable pull switches are taut and reset; their contacts are closed. The MSR127 safety relay is energized, as its inputs and monitoring circuits are satisfied. The motor is off and ready to run.

Operating Principle

Two cable pull switches are used to protect an area over 10 meters in length. Auxiliary lights provide indication as to which switch has been actuated to stop the motor. The difference between the two switches is the conduit thread and is shown for example purposes.

STARTING: Press the Start button to energize contactors K1 and K2. The motor starts and the two normally open contacts of K1 and K2 close to hold the circuit energized across the Start button.

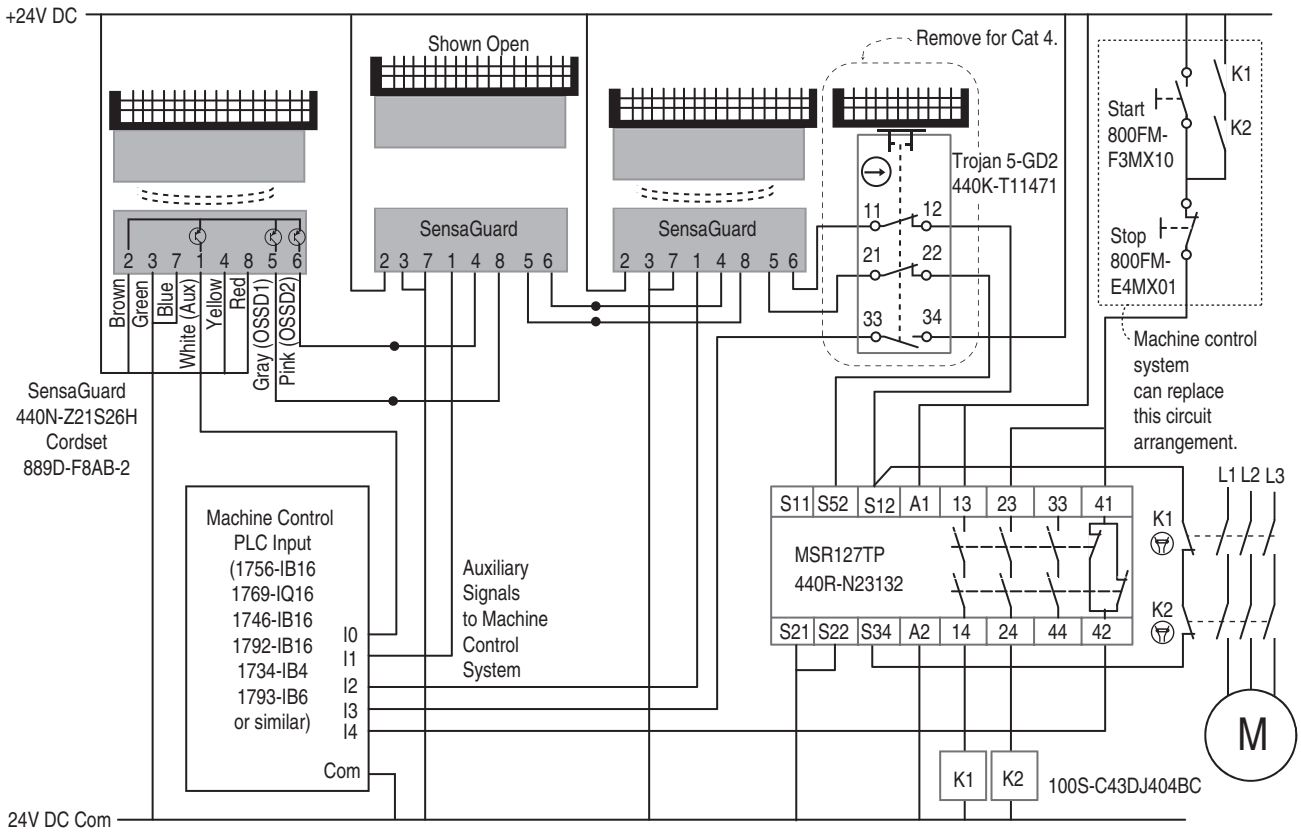
STOPPING: Pull the Lifeline cable or press the e-stop button on the Lifeline switch to de-energize the outputs of the MSR127 and turn off the motor. To restart the motor, make sure the area is clear of hazards, pull out the e-stop button (if pressed) and rotate the reset knob on the Lifeline 4 to the Run position. Then press the Start button to start the motor. As an alternative, the motor can be stopped by pressing the Stop pushbutton. It can then be restarted by pressing the Start pushbutton.

Fault Detection

Upon successful completion of internal checks on power up, the MSR127 checks its input circuits. With both Lifeline switches reset, the MSR127 checks the output contactors through the S12/S34 circuit. If the contactors are off, the MSR127 energizes its outputs and turns on the contactors which turn on the motor. A short or open circuit fault in the Lifeline cable pull switches will be detected by the MSR127. If either the K1 or K2 faults in the energized state, the motor will be stopped by the other contactor and the fault will be detected by the MSR127 on the next attempt to restart. An internal fault in the MSR127 will be detected by itself. Depending on the type of fault, the result will be de-energization of the K1 and K2 contactors or prevention of re-start.

Ratings

The safety function initiated by the Lifeline cable pull switches meets the safety performance requirements of SIL CL 2 per IEC 62061:2005 and has Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1: 2006. The series connection of the Lifeline cable switches limits the circuit to SIL CL2 and Category 3. This circuit executes a Category 0 stop.



Circuit Status

The first, third and fourth gates are closed. The second gate is open. The MSR127 safety relay S12 and S52 inputs are open due to the open gate, and therefore, the MSR127 safety outputs are open. The machine control PLC has a 24V auxiliary signal at terminal I1 from the second gate because the gate is open. The 1st, 3rd and 4th auxiliary signals are off, as their gates are closed. The PLC also has an auxiliary signal from the MSR127 indicating that the safety system is not ready. The motor is off.

Operating Principle

STARTING: Closing the second gate satisfies the input of the MSR127. The MSR127 verifies that both K1 and K2 contactors are off and energizes its safety outputs. Pressing the start button energizes the motor. The Stop/Start circuit is not part of the safety system and can be replaced by the machine control system (e.g., a PLC).
STOPPING: Press the Stop button to turn the motor off, without affecting the status of the safety system. Opening any of the gates will cause the safety system to stop the motor.

Fault Detection

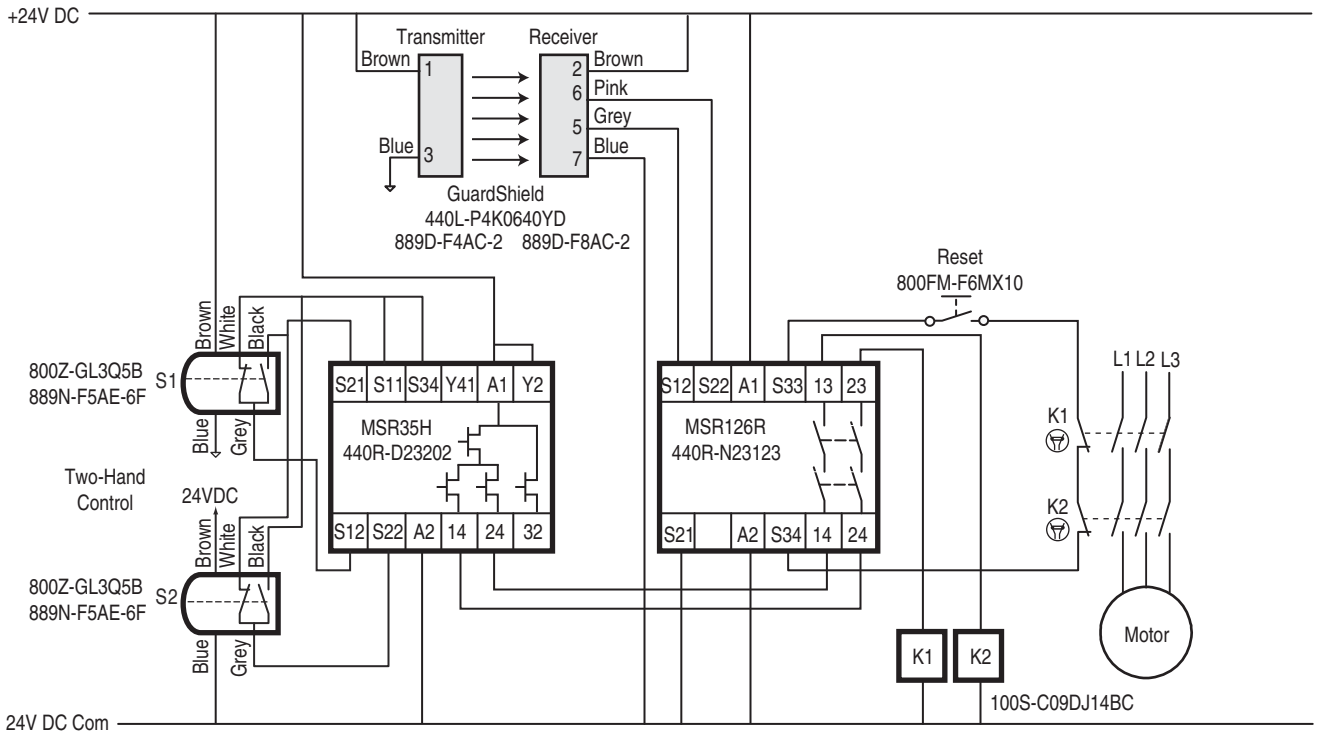
Upon successful completion of internal checks on power up, the SensaGuard interlocks check for 24V at pins 4 and 8. If the actuator is within range, the SensaGuard will activate its OSSD outputs. The OSSD outputs perform continuous checking for short circuits to 24V, ground and crossfaults. Upon detection of a fault, the OSSD outputs turn off. The MSR127 also performs internal checks on power-up. It then checks for input signals. If okay, the MSR127 checks the S12/S34 monitoring circuit to determine whether both contactors are off. If one of the contactors gets stuck on, the other contactor will de-energize the motor, and the MSR127 will detect the fault at the next attempt to start the motor. The contactors have mechanically linked auxiliary contacts to help ensure fault detection of the contactors. Contactors K1 and K2 are controlled by the safety system. Contactor K2 is controlled by both the machine control system and the safety system. This increases the probability of performance of the safety function because K1 is significantly less likely to weld at the same time as K2 due to the diversity of expected wear out times.

Ratings

The safety function initiated by the Lifeline cable pull switches meets the safety performance requirements of SIL CL 2 per IEC 62061:2005 and has Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1: 2006. When a device with two mechanically operated contacts is connected in series with the SensaGuard, the maximum rating is Category 3. If the Trojan 5 GD2 were removed from the circuit, the safety performance meets the requirements of Category 4. The SensaGuard interlocks are designed to meet Category 4 when connected in series. The MSR127 is rated to Category 4. The design and connection of the contactors meets category 4. This example circuit performs a Stop Category 0 function (coast to stop).

Light Curtain & Two-Hand Control—Punch Press

GuardShield, 800Z, MSR35H, MSR126, 100S



Circuit Status

The operator's hands are not on the two 800Z palm buttons. The outputs of the MSR35H are off. The light curtain is configured with the factory default settings (Guard only mode) and is unobstructed. The outputs of the MSR126R safety relay are off. The motor is off and ready to run.
The light curtain is protecting one portion of the machine. An operator, using two-hand control is accessing a different portion of the machine and has full view of his or her area.

Operating Principle

STARTING: Press the Reset button to energize the output of the MSR126. The operator places both hands on the 800Z buttons simultaneously (within 0.5 s). The outputs of the MSR35H (terminals 14, 24) energize the 100S contactors, which start the motor.
STOPPING: Removing one or both hands from the 800Z palm buttons causes the outputs of the MSR35H to turn off, which drops out K1 and K2 and stops the motor. Obstructing the light curtain de-energizes the safety outputs of the MSR126R, which in turn drops out K1 and K2 and turns the motor off. Clearing the light curtain does not restart the motor, even if the operator has their hands on the palm buttons. The reset button must be pressed after the light curtain is cleared.

Fault Detection

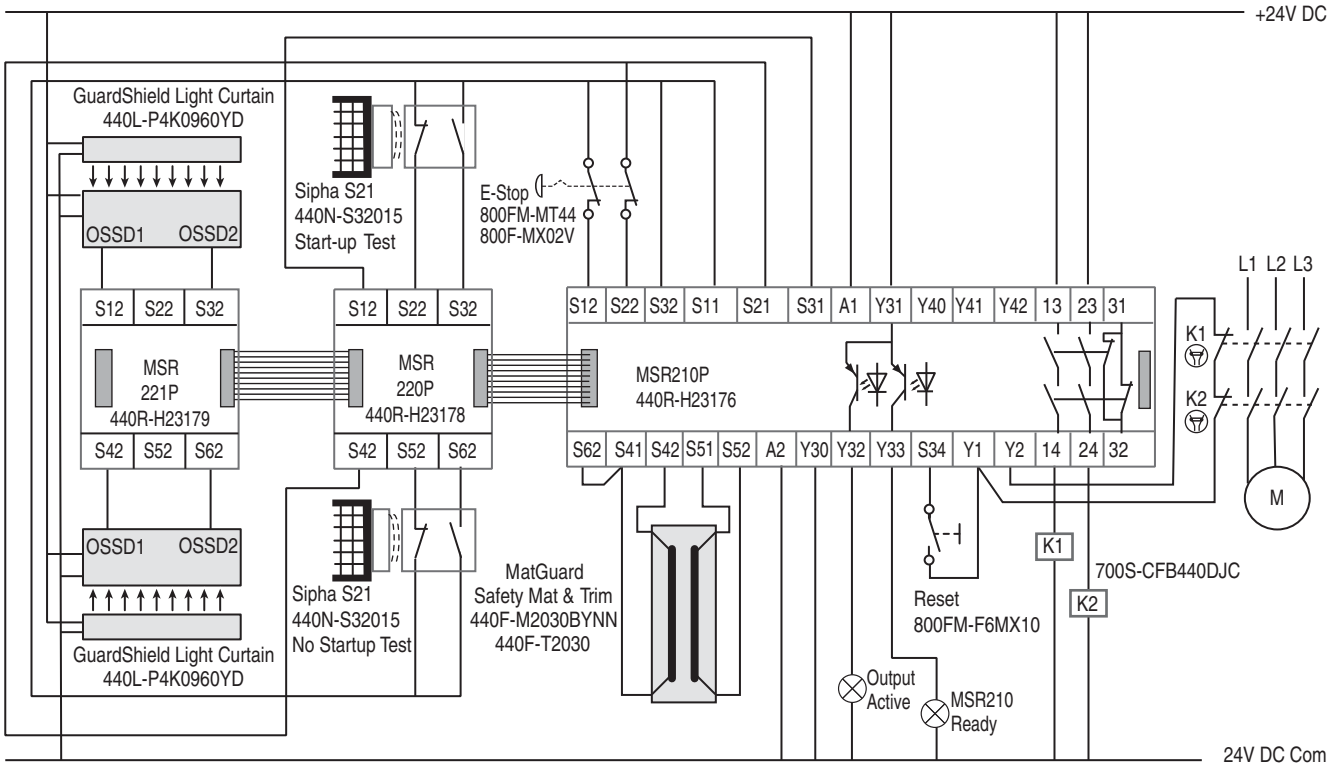
Upon power up, the 800Z, GuardShield, MSR35H and MSR126 perform internal checks. After passing internal checks, the MSR35H waits for a change of state of its inputs. Faults (opens and shorts) at the inputs will be detected by the MSR35H and prevent the outputs from being energized. The GuardShield light curtain also performs checks on its OSSD output signals for crossfaults, shorts and opens. The MSR126 looks for dual signals at its inputs. It then checks the status of the contactors. If one contactor fails in the actuated state, the other contactor will stop the motor. The MSR126 will detect if one of the contactors are stuck in the energized position, and prevents restart.

Ratings

The safety function initiated by the light curtain meets the safety performance requirements of SIL CL 3 per IEC 62061:2005 and has a Category 4 structure, which can be used in systems requiring Performance Levels up to PLe per ISO 13849-1: 2006. The safety function initiated by the 800Z palm buttons meets the safety performance requirements of SIL CL 2 per IEC 62061:2005 and has a Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1:2006. This circuit executes a Category 0 stop.

Configurable Relay—Two Zones

GuardShield, Sipha, MatGuard, 800F, MSR310P, MSR320P, 100S, 700S



Circuit Status

The light curtains are unobstructed. The safety gates are closed. The e-stop is reset and the safety mat is unoccupied. The MSR210 outputs are off. The motor is ready to run.

Operating Principle

The MSR200 is chosen as the safety relay for its modularity and ability to handle diverse devices, and to allow each device to be connected to individual inputs. The MSR200 has communication modules (not shown) to allow individual status information to be transmitted to the machine control system.
STARTING: Press the reset button to energize the outputs of the MSR210 and turn the motor on.
STOPPING: Activating any one of the safety devices (light curtain, e-stop, safety mat, or gate) de-energizes the MSR210 outputs and the motor coasts to a stop. If a safety device is activated, the motor cannot start.

Fault Detection

Upon successful completion of internal checks on power up, the MSR210P checks the input circuits. Shorts from the inputs to power, to ground or to other inputs will be detected immediately by the MSR210P and will prevent energization or will de-energize all of its outputs. If one of the 700S safety control relays (K1 or K2) fails in an actuated state, the motor will be able to stop by the 2nd relay (K2 or K1). This type of fault will be detected by the MSR210P on the next attempt to restart, and the MSR210P will not energize its outputs when the reset button is pressed. Upon power-up, one of the safety gates must be opened and closed to confirm proper operation.

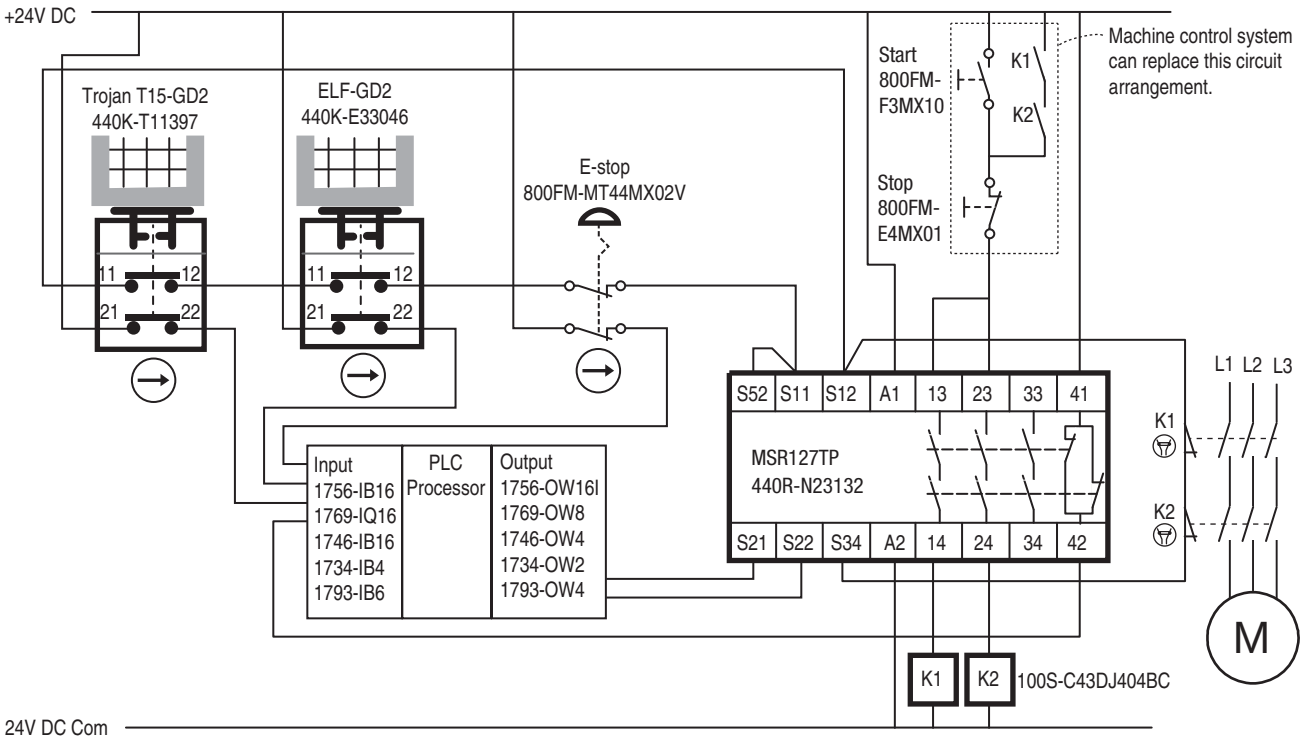
Since the noncontact sensor uses a N.O. contact, a broken wire may exist prior to usage. A startup test confirms the operation of the N.O. contact. For Start-up test, connect terminal S12 or S42 to terminal S31. If startup test is not desired, connect S12 or S42 to S21. With the start-up test, the gates must be opened and closed to confirm operation of both the N.O. and N.C. contacts. After successful completion of the start-up test, the reset button must be pressed momentarily to energize the outputs of the MSR210P.

Ratings

The safety functions initiated by the GuardShield light curtains, Sipha non-contact interlocks, and the 800F e-stop button meet the safety performance requirements of SIL CL 3 per IEC 62061:2005 and has Category 4 structure that can be used in systems requiring Performance Levels up to PLe per ISO 13849-1: 2006. The safety functions initiated by the safety mat are limited to SIL CL 2 and Category 3, PLd. This example circuit performs a Stop Category 0 function (coast to stop).

Interlock Switches—Multiple Gate Access

Trojan T15, Elf-GD2, 800F, MSR127, 100S



Circuit Status

Circuit shown with the safety gates closed and e-stop released. The safety relay is de-energized. The motor is off.

Operating Principle

With 2 N.C. + 1 N.O. interlocks, a potential exists for the gate to be slightly open which results in the auxiliary contact being closed and the safety being open. The machine cannot start and the PLC does not know which gate is open. By sending the second safety channel through the PLC, the machine control system knows which door is open, when the safety system is off due to a gate that may be slightly open. The infinite simultaneity feature of safety relays like the MSR127 allow enough time for the PLC to process all the gates and close the second channel of the safety relay without creating a lockout condition.

When a safety gate is opened, the interlock opens Ch1 directly to the safety relay and opens Ch2 which is connected to the input of a PLC. The PLC must then open Ch2 of the safety relay. The logic in the PLC must open the Ch2 signal if any one or more of the safety gates are open and must only close the Ch2 circuit when all of the safety gates and e-stop are closed. The PLC can also use the information on the inputs on PanelView or similar device. The auxiliary signal (41/42) from the MSR127 must be an input to the PLC. This PLC program must only close its output when all the safety inputs are closed and the auxiliary signal from the MSR127 is closed. This allows the PLC to indirectly confirm that its own output is working properly.

STARTING: Channel 1 input (S11/S12) of the MSR127 is satisfied. Using isolated relay contacts in its output module, the PLC closes the second safety channel (21/22 of the MSR127). The safety outputs of the MSR127 close. Press the Start button to start the motor.
STOPPING: Opening any one of the safety gates or pressing the e-stop causes the motor to turn off. Closing the gate or releasing the e-stop does not cause the motor to start due to the start-stop interlocking circuit. To restart the motor, close the safety gate or release the e-stop. Then press the start button.

Fault Detection

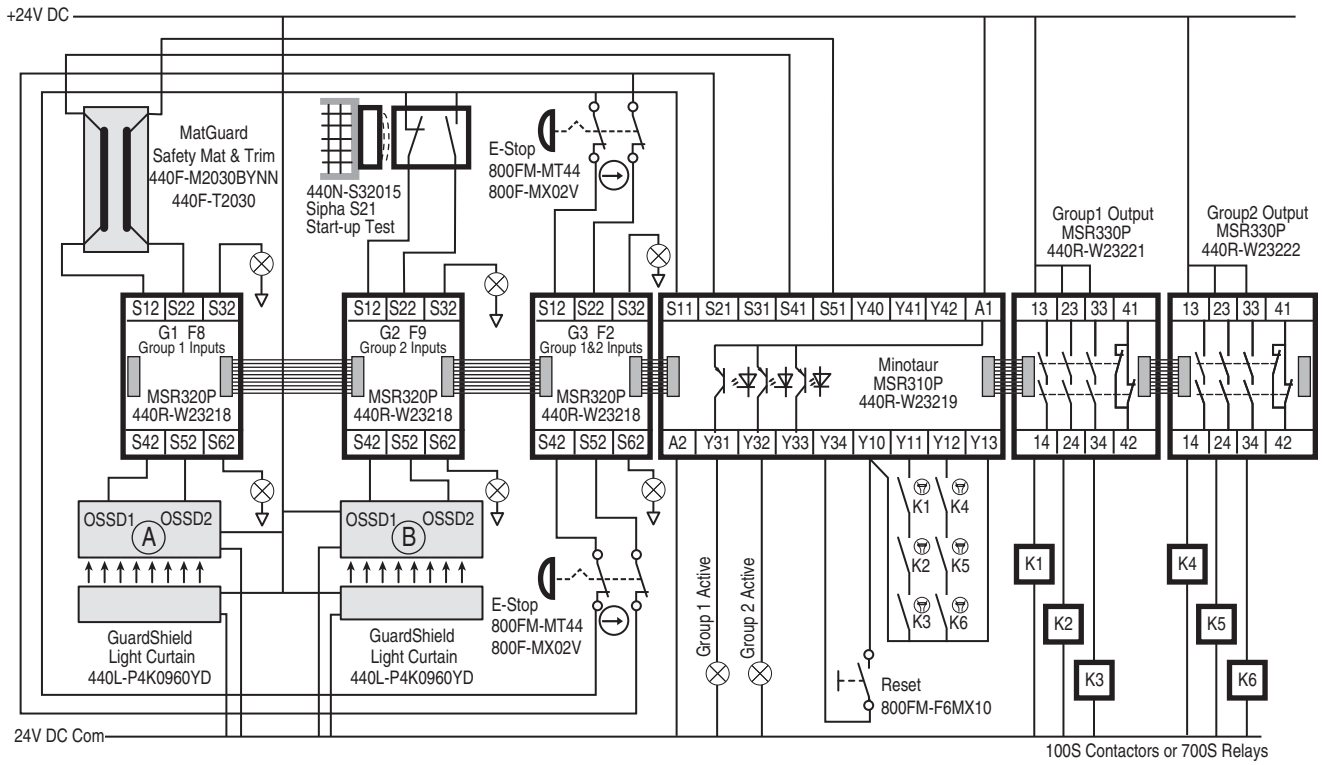
If the PLC fails with its output closed, the safety relay will detect the difference between the safety gate and the PLC and stop the motor. A single fault (open or short) across one of the interlocks will be detected by the safety relay and the motor will be turned off. The motor will remain off until the fault is corrected or power is cycled. If either contactor K1 or K2 sticks ON—the motor will stop on command due to the other contactor, but the MSR127 cannot be reset (thus the fault is revealed to the operator). A single fault detected on the MSR127 input circuits will result in the lock-out of the system to a safe state (OFF) at the next operation of the safety gate or e-stop device.

Ratings

The safety function initiated by the Trojan T15 safety gate interlocks and the 800F e-stop meets the safety performance requirements of SIL CL 2 per IEC 62061:2005 and has a Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1: 2006. This circuit executes a Category 0 stop.

Configurable Relay—Two Zones

GuardShield, Sipha, MatGuard, 800F, MSR310P, MSR320P, 100S, 700S



Circuit Status

The light curtains are unobstructed. The safety gate is closed. The e-stops are reset, and the safety mat is unoccupied. The MSR330P outputs are off. K1-K6 are ready to be energized.

Operating Principle

The MSR300 is chosen as the safety relay for its zoning capability. The two e-stops operate globally—turning off both sets of outputs for Groups 1 and 2. The light curtain A and safety mat control the outputs of Group 1. The light curtain B and safety gate control the outputs of Group 2. With no connections to Y40-Y42, all outputs have monitored manual reset.

STARTING: Press the reset button to energize all MSR330P outputs.

STOPPING: Obstructing the light curtain A or stepping on the safety mat turns off the Group 1 outputs while leaving the Group 2 outputs energized. The reset button must be pressed to re-energize the Group 1 outputs after light curtain A and safety mat are cleared. Obstructing the light curtain B or opening the safety gate turns off the Group 2 outputs. The reset button must be pressed to re-energize the Group 2 outputs after light curtain B is cleared and the safety gate is closed. Pressing either e-stop de-energizes both Group 1 and Group 2 outputs. The e-stop must be released and the reset button must be pressed to re-energize the Group 1 and 2 outputs.

Fault Detection

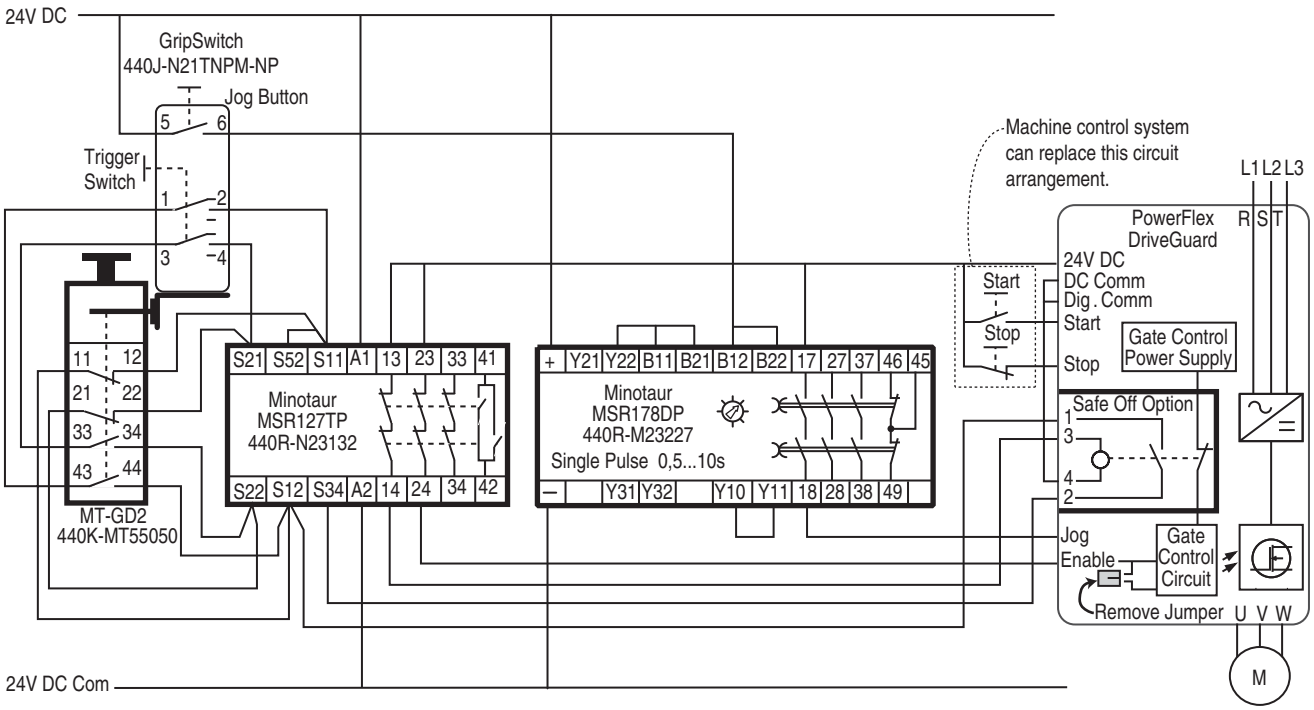
Upon successful completion of internal checks on power up, the MSR310P checks the input circuits. Shorts from the inputs to power, ground or other inputs will be detected immediately and will prevent energization or will de-energize the MSR330P outputs. If one of the 100S or 700S output devices (K1-K6) is stuck in an actuated state, the MSR310P will prevent startup because the Y11 or Y12 feedback loop will remain open.

Ratings

The rating assumes that two contactors are connected in series to power a hazard (not shown). The safety function initiated by the GuardShield light curtains, Sipha interlocks and 800F e-stop meet the safety performance requirements of SIL CL 3 per IEC 62061:2005 and has a Category 4 structure that can be used in systems requiring Performance Levels up to PLe per ISO 13849-1: 2006. The safety function initiated by MatGuard safety mats meet the safety performance requirements of SIL CL 2 per IEC 62061:2005 and has a Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1:2006. This circuit executes a Category 0 stop.

Enabling Device & Drive—Safe Jog

440G-MT, GripSwitch, MSR127, MSR178, PowerFlex DriveGuard



Circuit Status

The 440J GripSwitch is held by the MT-GD2. The MSR127 safety outputs are closed. The PowerFlex Enable and Safe-off option are energized. The MSR178 safety outputs are de-energized. The motor is ready to run.

Operating Principle

The MSR178 is chosen for its ability to perform timing functions. In this case, the MSR178 is set up to jog the PowerFlex drive with a single pulse having a duration set between 0.5 to 10 s (no jumpers form Y10 to Y31 or Y32 and fine adjustment made by potentiometer on front of MSR178). While in the MT-GD2 holder, the GripSwitch is disabled, and the drive can be controlled by the machine control system (not shown).

STARTING: Close the three-position trigger switch to the mid-position. Remove the enabling switch from the MT-GD2 holder. Press and hold the Jog button on the GripSwitch to initiate the operation of the MSR178. The MSR178 closes its safety outputs for the set duration.

STOPPING: The jog function stops after the set time expires. To restart, momentarily release the jog button and then re-close it to repeat the jog. Releasing or squeezing the three-position switch opens the outputs of the MSR127, and the PowerFlex drive executes a coast to stop.

Fault Detection

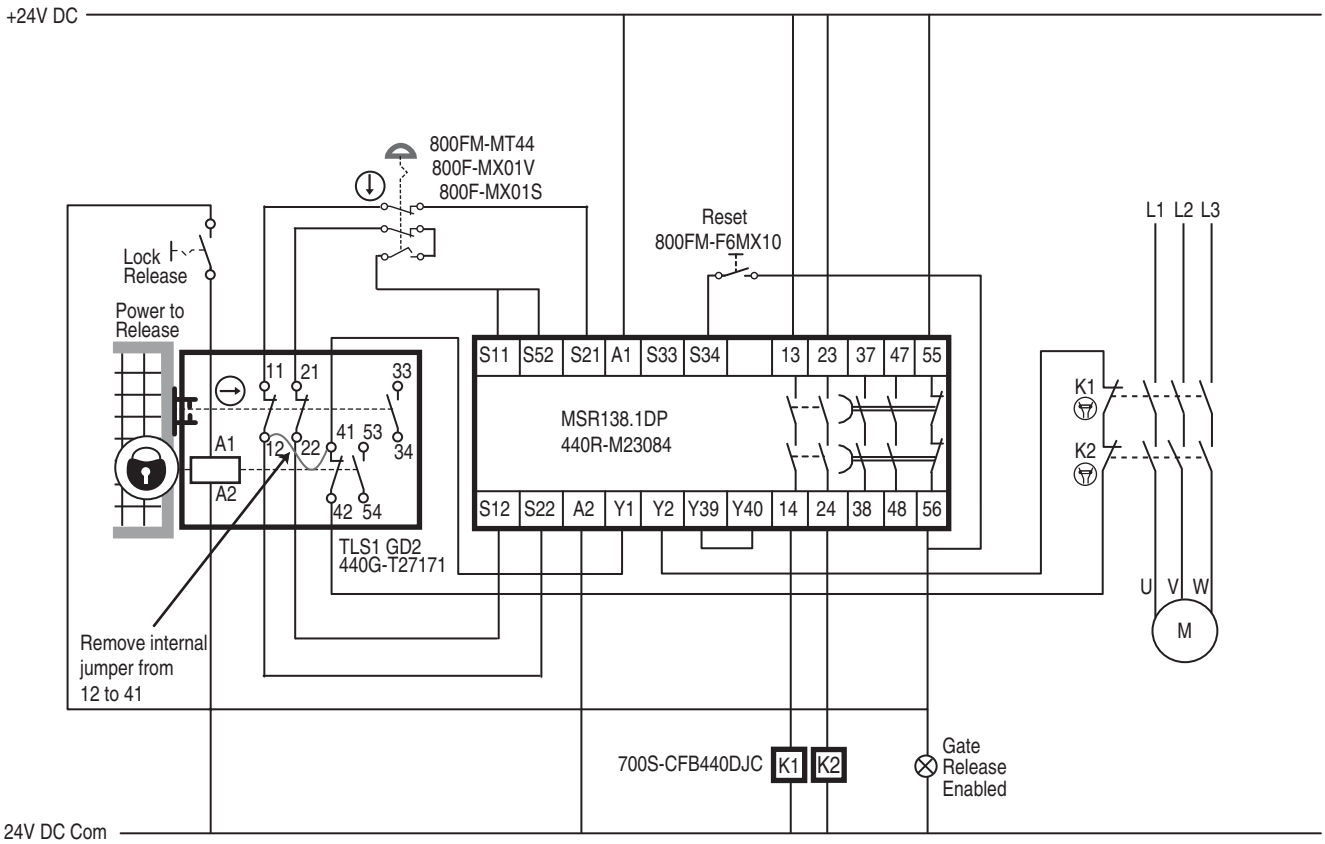
Upon successful completion of internal checks by the MSR127, MSR178 and the PowerFlex drive, the drive awaits the closure of the MSR127 safety outputs. If the MSR127 fails, the drive will not energize the motor and the fault will be detected by non-operation of the motor. The MSR127 uses dual channel to detect faults to power, ground and cross channel faults on the GripSwitch or the MT-GD2. A short across the jog switch will be detected as a subsequent jog attempt will be prevented by the MSR178. A fault in the Safe-Off option of the drive will be detected by the MSR127 on the next attempt to restart the drive. Internal faults in the MSR127 will result in non-operation of the motor. Internal faults of the MSR178 will result in non-operation of the jog function.

Ratings

The safety function initiated by GripSwitch enabling device meets the safety performance requirements of SIL CL 2 per IEC62061:2005 and has a Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO13849-1:2006. This circuit executes a Category 0 stop.

Interlock Switches—Guard Locking with Time Delay

800F, MSR138, TLS1 GD2, 700S



Circuit Status

The e-stop is reset and the safety gate is closed. The outputs of the safety relay are open and the motor is off.

Operating Principle

STARTING: Press the Reset button to energize the outputs of the MSR138. The immediate outputs of the MSR138 energize the 700S control relays and start the motor.
STOPPING: When the e-stop is pressed, the immediate outputs of the MSR138 open and the motor coasts to stop. After the time delay of the MSR138 expires, the delayed N.C. output closes and provides voltage to the Lock Release button. Press the Lock Release button to power the solenoid and open the Gate.

Closing the Gate or resetting the e-stop does not re-energize the 700S safety control relays. Press the reset to re-energize the 700S control relays.

Fault Detection

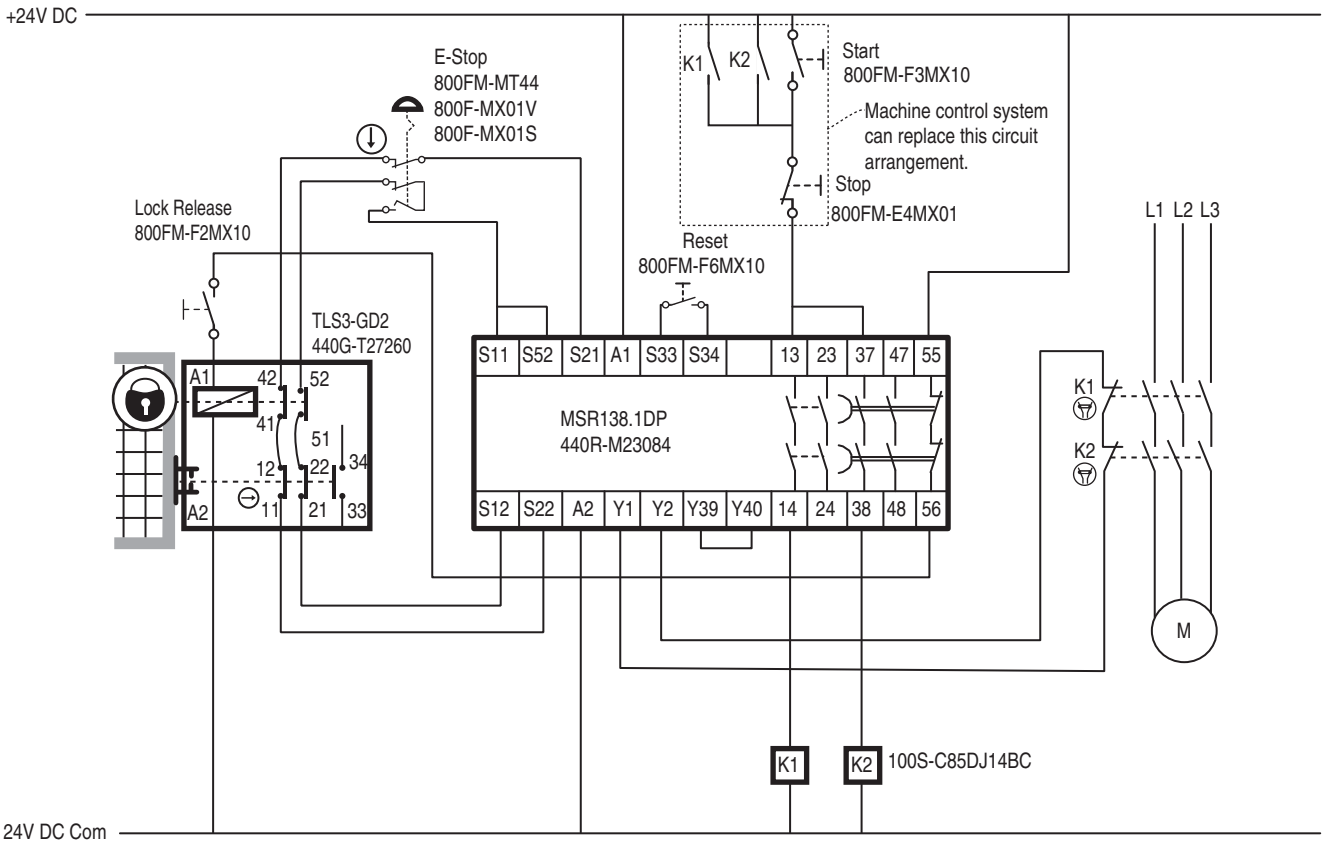
Upon power-up, the MSR138 perform internal checks. The MSR138 then looks for dual signals from the e-stop and the TLS1 GD2. The e-stop has a self-monitoring contact, which opens if the contact block falls off the control panel. With the e-stop signals made, the MSR138 checks the Y1/Y2 monitoring circuit when the reset button is pressed. If these checks are okay, the output energizes. The Reset button is linked to the delayed N.C. output in order to supply +24V for reset only when delay time has lapsed. If any of the MSR138 contacts faults to the ON state, the motor is stopped by the redundant outputs. The fault will be detected by the S56/S34 monitoring circuit on the next attempt to re-start. If the Gate is not interlocked by the TLS1 solenoid or one of the 700S control relays faults to the ON state, the MSR138 will detect the fault in the Y1/Y2 circuit on the next attempt to start. Single point failures related to the tongue interlock are excluded if actuator speed, alignment and mechanical stops meet installation instruction requirements, and a periodic proof test confirms proper operation.

Ratings

The safety function intiated by TLS1-GD2 guard locking interlock and the 800F e-stop meets the safety performance requirements of SIL CL 2 per IEC 62061:2005 and has a Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1:2006. This circuit executes a Category 0 stop.

Interlock Switch—Guard Locking with Time Delay

TLS3-GD2, 800F, MSR138, 100S



Circuit Status

The e-stop is reset and the safety gate is closed. The outputs of the safety relay are open, and the motor is off.

Operating Principle

The guard locking interlock and delayed outputs of the safety relay keep the guard closed and locked during the rundown time of the motor.
STARTING: Press the reset button to energize both the immediate and delayed outputs of the MSR138. Press the start button to energize contactors K1 and K2, which start the motor.
STOPPING: Press the e-stop to initiate a stop command. The immediate outputs of the MSR138 de-energize and the MSR138 timing cycle starts. Contactor K1 drops out and the motor begins a coast to stop. After the time delay of the MSR138 expires, the N.C. output closes and provides voltage to the lock release button. Press the lock release button to power the solenoid and open the gate. After the time delay, the normally open safety contact opens, dropping out K2.

Fault Detection

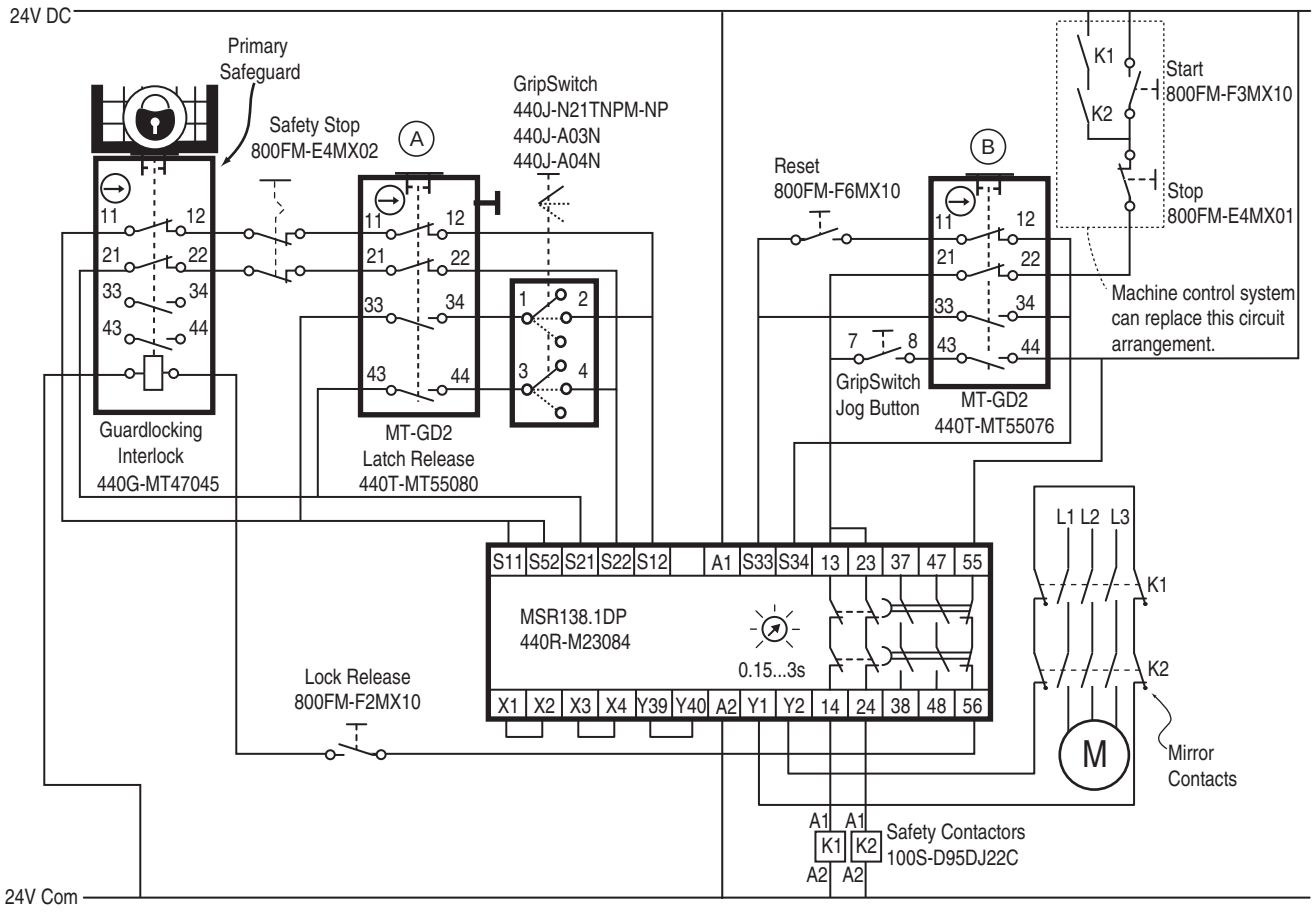
Upon power-up, the MSR138 performs internal checks. The MSR138 then looks for dual signals from the e-stop and the TLS3 GD2. The e-stop has a self-monitoring contact, which opens if the contact block falls off the control panel. With the e-stop signals made, the MSR138 checks the Y1/Y2 monitoring circuit when the reset button is pressed. If these checks are OK, the output energizes. If any of the MSR138 contacts faults to the ON state, the motor is stopped by the redundant outputs. The fault will be detected by internal crosschecking in the MSR138. With K1 on the immediate output of the MSR138, if performs the primary breaking of the motor circuit. If K1 fails due to welded contacts, the K2 will break the motor circuit. The failure of K1 will be detected by the Y1/Y2 monitoring circuit on the next attempt to restart the motor. Single point failures related to the tongue interlock are excluded if actuator speed, alignment and mechanical stops meet installation instruction requirements, and a periodic proof test confirms proper operation.

Ratings

The safety function initiated by the TLS3-GD2 guard locking interlock and the 800F e-stop button meets the safety performance requirements of SIL CL 2 per IEC 62061:2005 and has Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1: 2006. This example circuit performs a Stop Category 0 function (coast to stop).

Interlock Switch and Enabling Device—Guard Locking with Time Delay

GripSwitch, MT-GD2, 400G-MT, 800F, MSR138, 100S



Circuit Status

The 440J GripSwitch is held by two MT-GD2 tongue interlocks by its mounting plate accessories. The safety gate is closed and the 440G-MT guard locking interlock is locked. The MSR138DP safety outputs are open. Contactors K1 and K2 are de-energized. The motor is off and the application ready to run.

Operating Principle

The GripSwitch enabling device is used to access the hazardous area while the motor is running. The access is of the full body type. With the safety gate unlocked, the operator walks into the hazardous area with the GripSwitch. Before accessing the hazard area, the motor must be stopped. After entering the hazard area, the motor can be restarted with the GripSwitch. One MT-GD2 interlock is used to bypass the gate interlock safety circuit. The other MT-GD2 is used to reset the safety system and prevent the starting of the motor from outside the cell, when the GripSwitch is used.

STOPPING: Press the Safety Stop. The immediate outputs of the MSR138.1DP open and the motor initiates a coast to stop. After the time expires on the MSR138.1DP, the delayed outputs change state. The contacts across 55 and 56 close and the safety gate can be unlocked. Press the lock release button to momentarily power the solenoid of the 440G-MT and open the gate.
STARTING: Remove the enabling switch from the MT-GD2 holders. Squeeze the GripSwtich trigger to the middle position. The MSR138.1DP resets and closes its safety outputs and the motor is ready to run. Press the jog button on the GripSwitch to momentarily turn on the motor.
STOPPING DURING ENABLING: Release the jog switch to stop the motor. Releasing or applying further pressure to the trigger switch on the GripSwitch will stop the motor.

Fault Detection

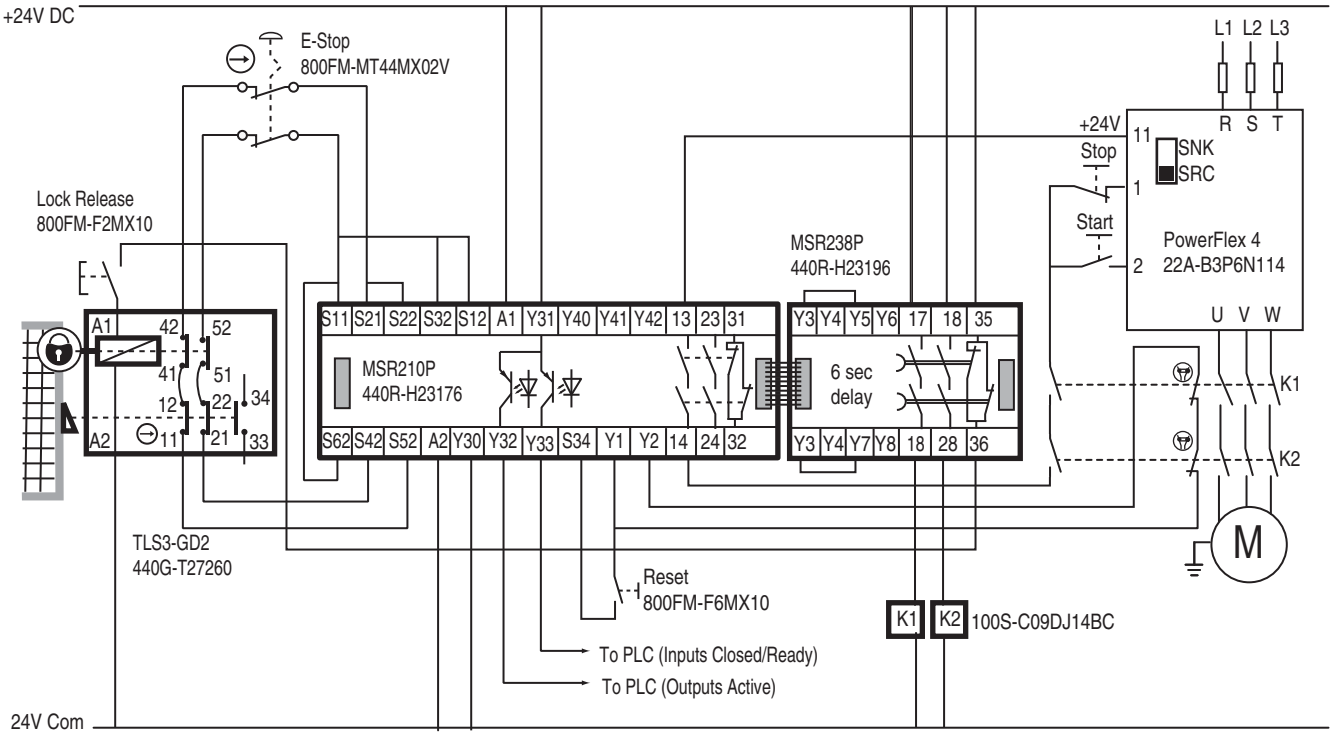
Upon successful completion of internal checks on power-up, the MSR138.1DP checks the gate and GripSwitch circuit. If both circuits have been closed, the MSR138.1DP checks the reset circuit. Upon closure of the reset button, the MSR138.1DP checks the status of the contactors. Due to the size of the 100S-D contactors, mirrored contacts (on either side of the unit) are used to safely reflect the staus of the armature. If all mirrored contacts are closed, then the MSR138.1DP energizes its outputs. If one contactor welds in the closed state, the second contactor will shut off the motor and the fault will be detected by the MSR138.1DP, upon the next attempt to start the motor. Single channel faults on the input devices (GripSwitch, Interlocks and Stop switch) will be detected by the MSR138.1DP either on or before a demand is placed on the safety system (depending on the nature of the fault).

Ratings

The safety function initiated by the MT-GD2 guard locking interlock and the GripSwitch button meets the safety performance requirements of SIL CL 2 per IEC62061:2005 and has Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1: 2006. This example circuit performs a Stop Category 0 function (coast to stop).

Interlock Switch & Modular Relay—Guard Locking with Standard Drive

TLS-GD2, 800F, MSR200, 100S, PowerFlex 4



Circuit Status

The guard door is closed and locked (mechanical lock, power to release). The e-stop is released. K1 and K2 are off. The drive is powered, but not enabled. The motor is off.

Operating Principle

Access to the hazard is prevented (i.e., locked) by the guard locking TLS3-GD2 while the motor is running and for a fixed duration (controlled by the MSR238) after the e-stop command is initiated.

STARTING: Momentarily press the reset button. The contacts in the MSR210P and MSR238P close. K1 and K2 energize and connect the motor to the drive and also connects 24V to the start button. This ensures that the motor is connected to the drive, before the start button becomes effective. The PowerFlex 4 drive is allowed to start. Start the motor by momentarily pressing the start switch. The motor can be stopped by momentarily pressing the stop switch. The start and stop switches can be replaced by more elaborate control devices (like a PLC).

STOPPING: Press the e-stop. The MSR210P opens its immediate output (13-14) and begins the timing sequence in the MSR238. The PowerFlex 4 also begins its programmed deceleration as the stop signal is opened. After six seconds, the MSR238 times out and contacts 17-18 and 27-28 open. K1 and K2 de-energize and disconnect the motor from the drive. Contacts 35-36 close and provide power to the release button of the TLS3-GD2. Press and hold the release button to open the gate.

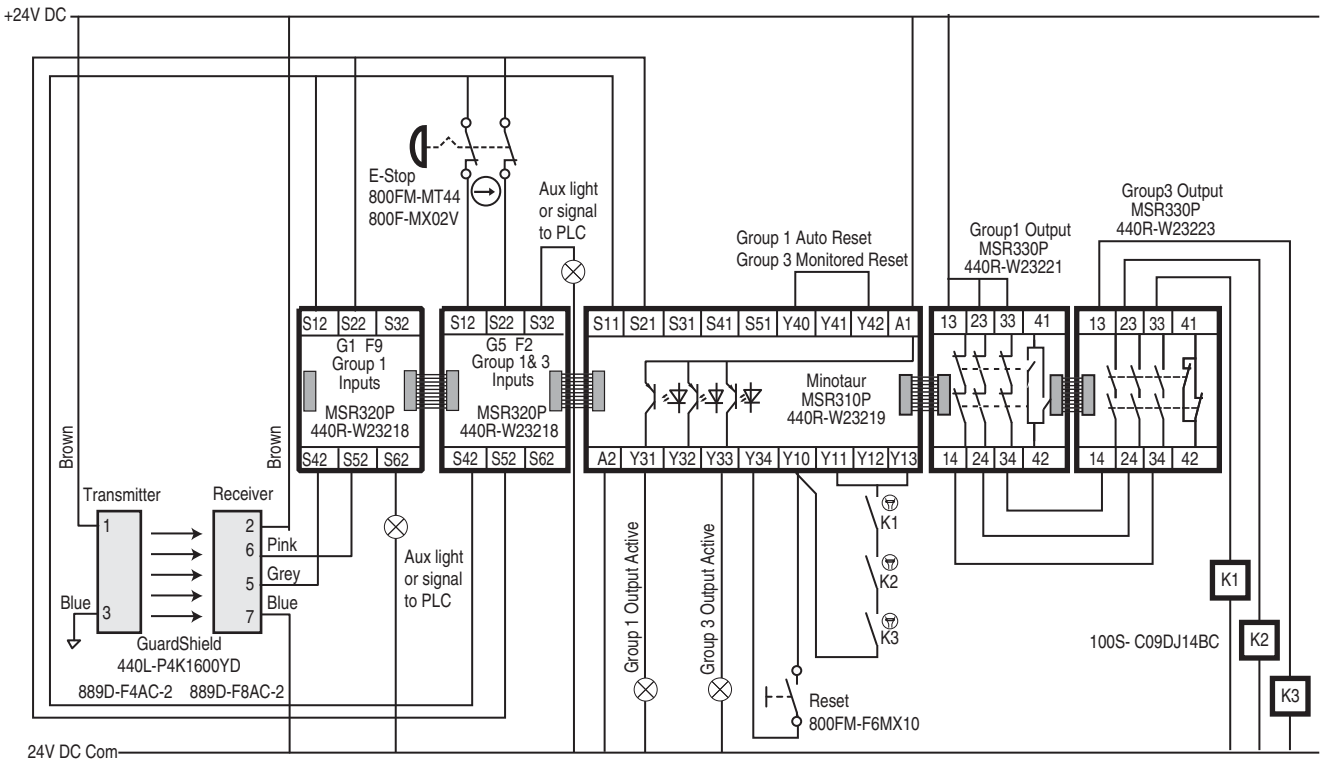
Closing the gate or releasing the e-stop will not cause the motor to turn on. Two separate and deliberate actions are needed: 1) momentarily press the reset button to activate the safety relay and then 2) momentarily close the start switch to turn the motor on. In this application, the user must ensure that the time delay of the MSR238P provides sufficient time for the hazards, driven by the motor, to stop. Ramping to stop or dynamic braking are recommended to speed up the braking process. The time delay of the MSR238P should be set longer than the stopping time of the PowerFlex 4 or the motor will coast to its final stop. The PowerFlex 4 will not be able to start while the K1 and K2 contactors are de-energized.

Fault Detection

If the drive output faults to an energized state, the motor can be turned off by pressing the e-stop. If K1 welds in an energized state, the motor can be stopped by K2. If either K1 or K2 welds closed, the MSR210P will not be able to start due to the feedback loop (Y1-Y2) being open. A short across the interlock or e-stop will be detected by the MSR210P. The MSR210P will also detect if the reset is held or stuck in the closed position, and will prevent the motor from starting.

Ratings

The safety function initiated by the TLS3-GD2 guard locking interlock and the 800F e-stop button meets the safety performance requirements of SIL CL 2 per IEC 62061:2005 and has Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1: 2006. This example circuit performs a Stop Category 1 function (brake and then remove power to motor).



Circuit Status

The light curtain is set at the factory default setting (guard only) and is unobstructed. The e-stop is reset. The Group 1 MSR330P safety outputs (13/14, 23/24, 33/34) are on. The Group 3 MSR330P safety outputs are off. K1-K3 are off and ready to be energized.

Operating Principle

Since the safety outputs of the two MSR330P modules are connected in series, both the light curtain and e-stop will control (turn on and off) the K1-K3 loads. The light curtain is set to automatic reset mode. The e-stop stop operates in monitored reset mode. The jumper from Y40 to Y42 sets the Group 1 output to automatic reset and the Group 3 output to monitored reset. The MSR310P must have the monitoring circuit connected to both Y11 and Y13 to allow both the Group1 and Group 3 outputs to energize.

STARTING: Press the reset button to energize the Group 3 outputs, which energize the loads K1-K3.

STOPPING: Obstructing the light curtain turns off the Group 1 safety outputs and de-energizes K1-K3. Clearing the light curtain automatically re-energizes K1-K3. This arrangement is known as presence sensing device initiation, and additional precautions (e.g., limited to partial body access, part sensing, limited speed) may be necessary to ensure safe operation of the machine. Pressing the e-stop turns off both the Group 1 and Group 3 safety outputs and de-energizes K1-K3. Resetting the e-stop re-energizes the Group 1 outputs, but the Group 3 outputs remain off. The Reset button must be pressed to turn on the Group 3 outputs and energize the loads K1-K3.

Fault Detection

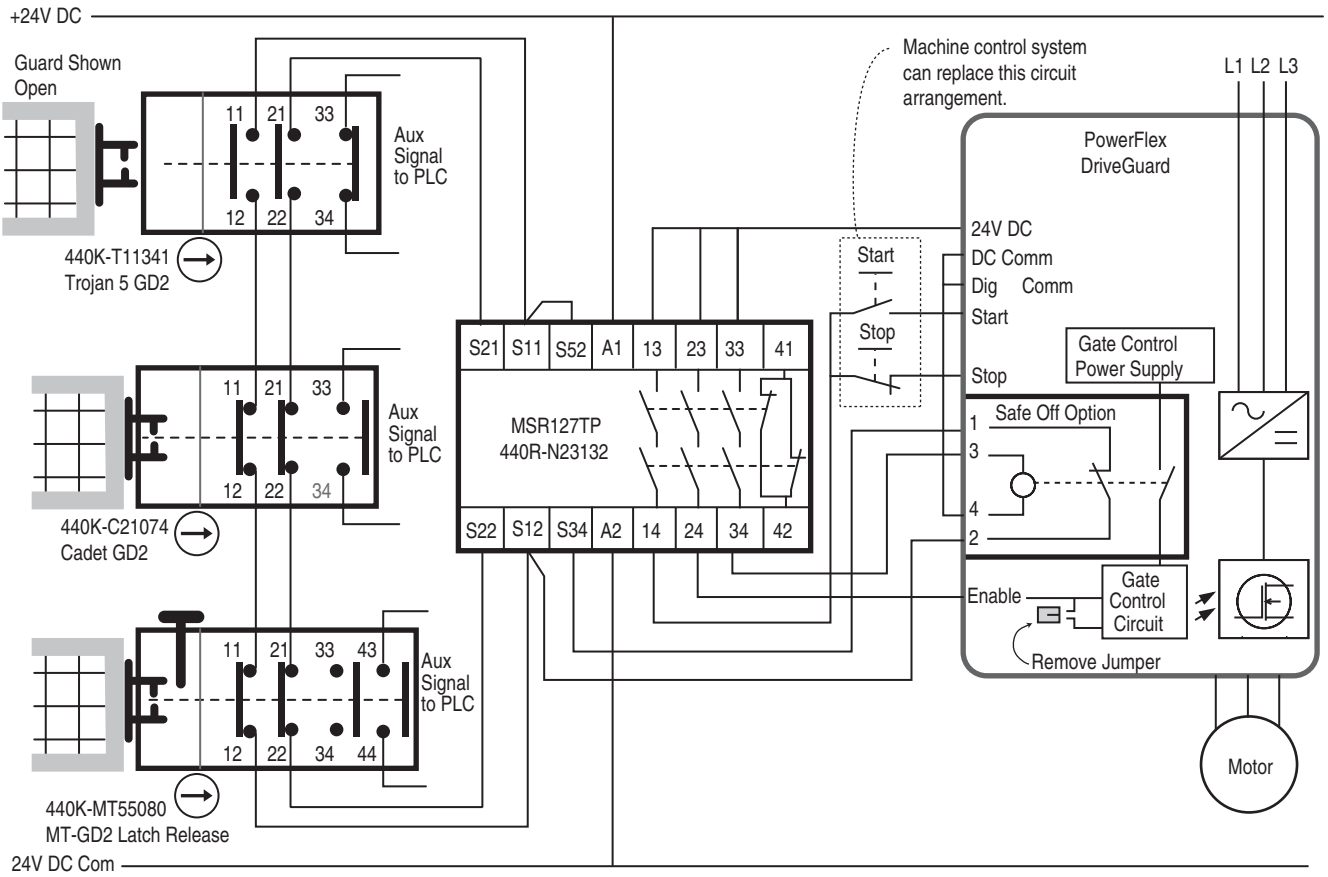
Upon successful completion of internal checks on power up, the GuardShield energizes its outputs. Cross-channel shorts and shorts to ground or power are detected by the GuardShield. The MSR310P also performs internal checks, and then scans the input circuits. The MSR310P uses pulse testing from S11 and S21 to detect shorts from the inputs to power, ground or other inputs. These faults will be detected immediately and will prevent energizating or will de-energize the MSR330P outputs. If one of the 100S output devices (K1-K3) is stuck in an actuated state, the MSR310P will prevent start-up because the Y10/Y11/Y13 feedback loop will remain open.

Ratings

When two contactors are connected in series to power a hazard (not shown), the safety functions intiated by GuardShield light curtains and the 800F e-stop meet the safety performance requirements of SIL CL 3 per IEC 62061:2005 and has a Category 4 structure that can be used in systems requiring Performance Levels up to PLe per ISO 13849-1:2006. If only one contactor is used to power a hazard, the safety function can meet SIL CL 2, Category 2 structure and PLd.

Drive—Multiple Gate Access

Trojan 5 GD2, Cadet GD2, MT-GD2, MSR127, PowerFlex DriveGuard



Circuit Status

One of the gates is open. The safety outputs of the MSR127 are de-energized. The PowerFlex with DriveGuard is de-energized and not enabled. The motor is off.

Operating Principle

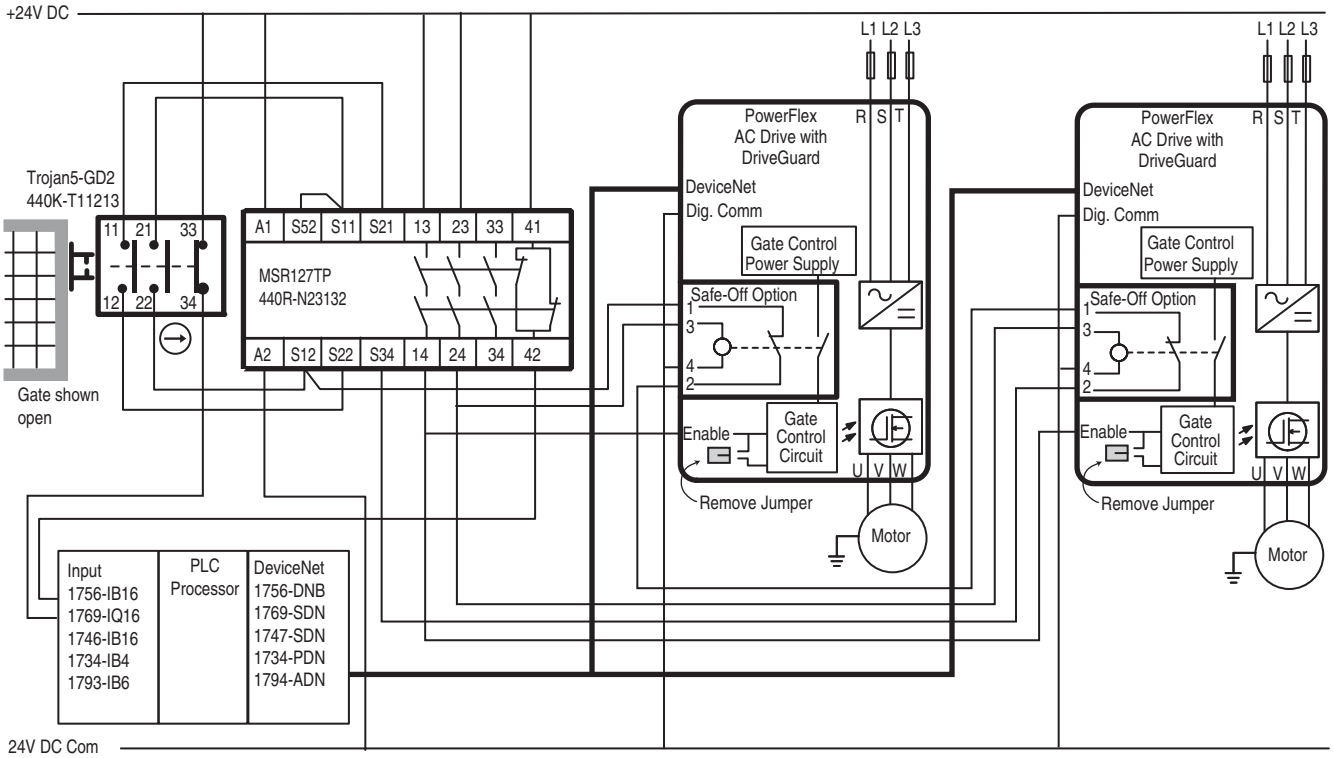
STARTING: When the last gate closes, the safety outputs of the MSR127 close and apply power to the drive enable circuit, Safe-Off option, Start and Stop buttons. Pressing the Start and Stop buttons turns the motor on and off. The motor is controlled by parameters set within the PowerFlex drive.
STOPPING: Opening any of the guard doors causes the MSR127 safety outputs to de-energize. This removes power to the PowerFlex enable, Safe-Off, Start, and Stop circuits. The motor performs a coast to stop.

Fault Detection

Upon power-up the PowerFlex drive and MSR127 perform internal checks. The MSR127 then looks for dual signals from the gate interlocks. With the gates closed, the MSR127 checks the wiring of the drive Safe-Off option. If closed, then the MSR127 energizes its outputs and the motor can be started. A single open circuit fault at the gate interlocks will be detected immediately, and the motor will coast to a stop. A crossfault (channel 1 to channel 2) at the gate interlocks will be detected immediately. A short across one gate interlock contact will be detected when an attempt to re-start is made. This type of short can be masked by opening and closing another gate interlock and may result in a loss of the safety function due to an accumulation of contact shorts. The MSR127 is rated for Category 4 and will not lose the safety function due to an accumulation of faults. The PowerFlex 70 DriveGuard is rated at Category 3, as it will perform the safety function in the presence of a single internal fault.

Ratings

The safety function intiated by gate interlocks meets the safety performance requirements of SIL CL 2 per IEC 62061:2005 and has a Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1:2006. This circuit executes a Category 0 stop.



Circuit Status

The safety gate is open. The MSR127TP safety outputs (13/14, 23/24, 33/34) are open. The Enable and Safe-Off Option on both PowerFlex drives are off. Auxiliary signals from the Trojan 5 GD2 (33/34) and the MSR127 (41/42) inform the PLC that the safety system is OFF. The motors of both drives are off.

This circuit is intended to show that multiple drives can be connected in parallel. The number of drives that can be connected in parallel is dependent on: the load (the safe-off option plus the enable of each drive), appropriate de-rating to prevent early wear out of the MSR127TP contacts, the application requirements (e.g., zoning) and the risk assessment (e.g., some drives may require separate safety systems).

Operating Principle

STARTING: Upon closing the gate, the Trojan 5 GD2 closes the safety inputs of the MSR127TP (S11/S12 and S21/S22) and opens the signal to the PLC. The safety outputs of the MSR127TP close and enable both PowerFlex drives. The auxiliary signal of the MSR127TP opens. The PLC compares the gate and safety relay auxiliary signals. When both signals are open, the PLC knows that the safety system is ready. The PLC can now start and control the drives over the DeviceNet network. The PLC must ensure that the drives are not started upon the closing of the gate; a separate, intentional action must initiate the motor movement (this is not shown in the diagram).
STOPPING: Normal stopping is performed by the PLC. If the gate is opened, the input signals to the MSR127TP open. The MSR127TP opens its safety outputs which disable all the drives connected to them via the Safe-Off option. The drives perform an immediate coast to stop.

Fault Detection

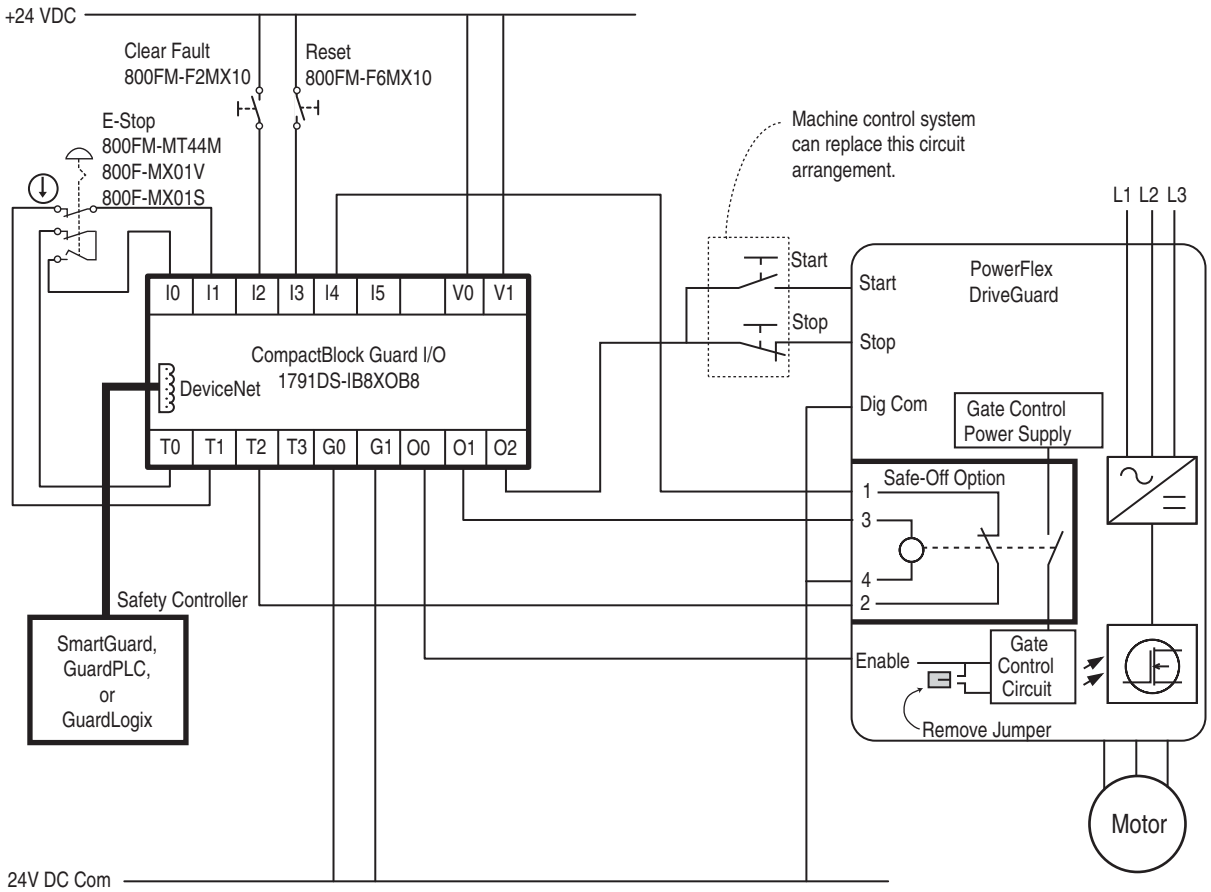
Upon power-up, the MSR127TP performs internal checks. The MSR127TP then looks for dual signals from the Trojan5-GD2. If only one signal is present, or a crossfault exists, the MSR127TP assumes a fault is present and does not energize its safety outputs. With the gate closed, the MSR127TP checks the S12/S34 monitoring circuit. If the Safe-Off options are de-energized, the MSR127TP assumes the drives are off and are ready to be enabled. The MSR127TP energizes its safety outputs. If the monitoring circuit remains open, the MSR127TP will assume a fault is present and not allow its safety outputs to energize. Single point failures related to the tongue interlock are excluded if actuator speed, alignment and mechanical stops meet installation instruction requirements, and a periodic proof test confirms proper operation.

Ratings

The safety function intiated by the Trojan 5-GD2 gate interlocks meets the safety performance requirements of SIL CL 2 per IEC 62061:2005 and has a Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1:2006. This circuit executes a Category 0 stop.

Drive & Safety I/O—Integrated Architecture

800F, CompactBlock Guard I/O, PowerFlex DriveGuard



Circuit Status

The e-stop is reset. The outputs of the CompactBlock Guard I/O are off. The PowerFlex output is off. The motor is off.

Operating Principle

STARTING: Press and release the reset button to energize the outputs of the 1791DS. This action energizes the Safe-Off option which connects the Gate Control Power Supply to the Gate Control Circuit. It also provides the Enable signal which allows the Gate Control Circuit to turn the output drive transistor on and off. Output O2 applies power to the Start and Stop controls, which can then be used to control the drive for production operations.

STOPPING: When the e-stop is pressed, the O2 output sends a stop command to the drive, which executes its pre-programmed stopping routine. After a short delay (programmed in the safety controller), the O0 and O1 outputs turn off. This disables the drive. The normally closed contact in the Safe-Off option closes and sends a signal back to terminal I4 to inform the safety system that the drive is ready for restart.

Fault Detection

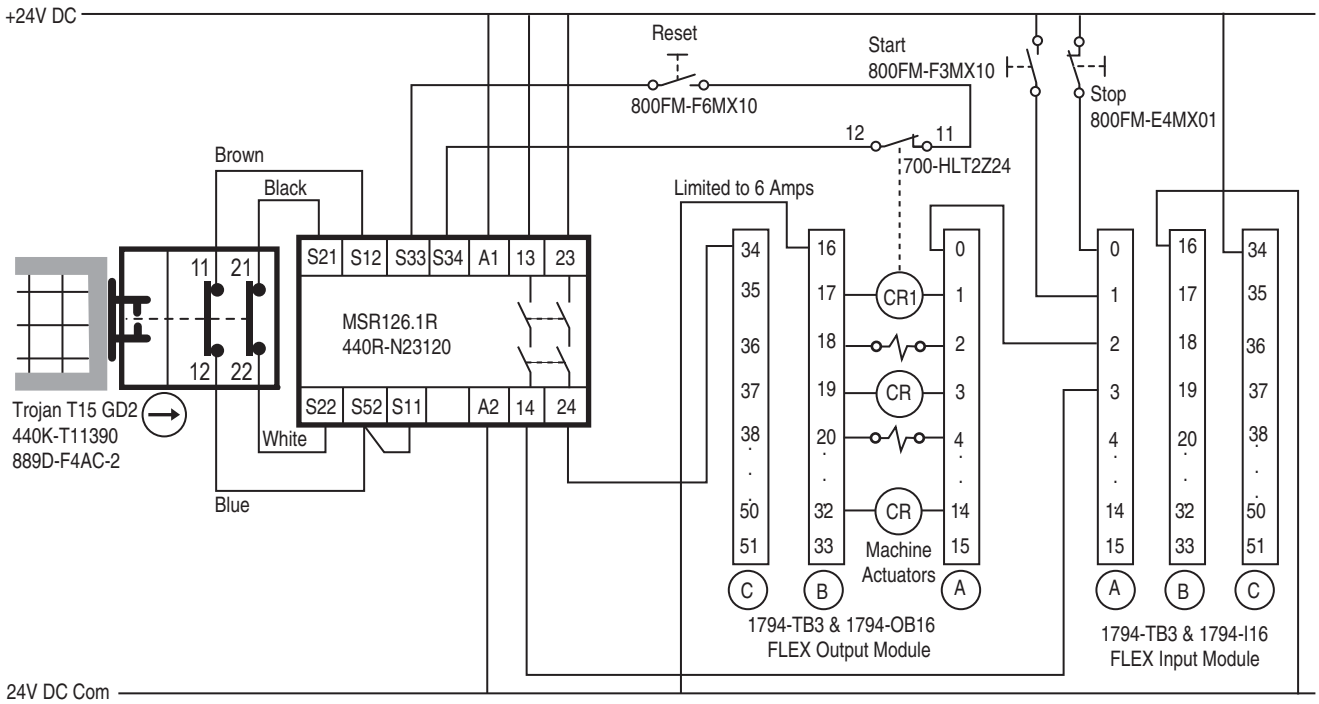
Upon power-up, the PowerFlex drive and 1791DS perform internal checks. The 1791DS then looks for dual signals from the e-stop. The pulsed outputs T0 and T1 are used to help check for open and short circuit fault conditions in the e-stop circuit. The e-stop has a self-monitoring contact, which opens if the contact block falls off the control panel. With the e-stop signals made, the 1791DS checks the monitoring circuit (terminal I4) when the reset button is pressed. If these checks are OK, the outputs energize. If the O2 output of the 1791DS faults to the ON state, the motor is stopped by the O0 and O1 outputs, and the fault will be detected on the next attempt to re-start by the self-checking in the 1791DS. If the drive control faults to an ON state, the motor will stop because the power to the drive control circuit will be removed by the Safe-Off option.

Ratings

The safety function intiated by the 800F e-stop meets the safety performance requirements of SIL CL 2 per IEC 62061:2005 and has a Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1:2006. This circuit executes a Category 1 stop, by the program in the safety controller.

Interlock Switch Gater with High Current Outputs

Trojan T15 GD2, 800F, MSR126, Flex I/O



Circuit Status

The safety gate is closed. The outputs of the MSR126.1R safety relay are open and the machine actuators are off. Control Relay CR1 is de-energized and its 11/12 contact is closed.

Operating Principle

The MSR126.1R is chosen for this application because its thermal (non-switching) current carrying capacity is 6 A in one circuit. The Flex output module performs the normal switching of the machine actuators during the manufacturing process. The safety system enables the machine functions by providing power to the FLEX Output Module. One of the Flex outputs must drive an electro-mechanical output whose normally closed contact is in the monitoring loop of the safety relay. The machine logic must energize this output while the machine is running, as it is used by the MSR126.1R to confirm that power is removed from the output module, before restarting.

STARTING: Press the reset button to energize the output contacts 13/14 of the MSR126.1R. This connects the 24V supply to terminal C34 of Flex 1974-OB16 output module and also sends a signal to the A3 terminal of the 1794-IB16. The logic system is informed that the gate is closed and the machine is ready to run. Press the Start button to start the machine process.
STOPPING: Press the Stop button to stop the machine. Then, open the gate to access the machine. While the gate is open, the machine actuators cannot operate because power is removed from the output module. If the gate is inadvertently opened while the machine is running, power will be removed from output module and the machine actuators will be de-energized.

Fault Detection

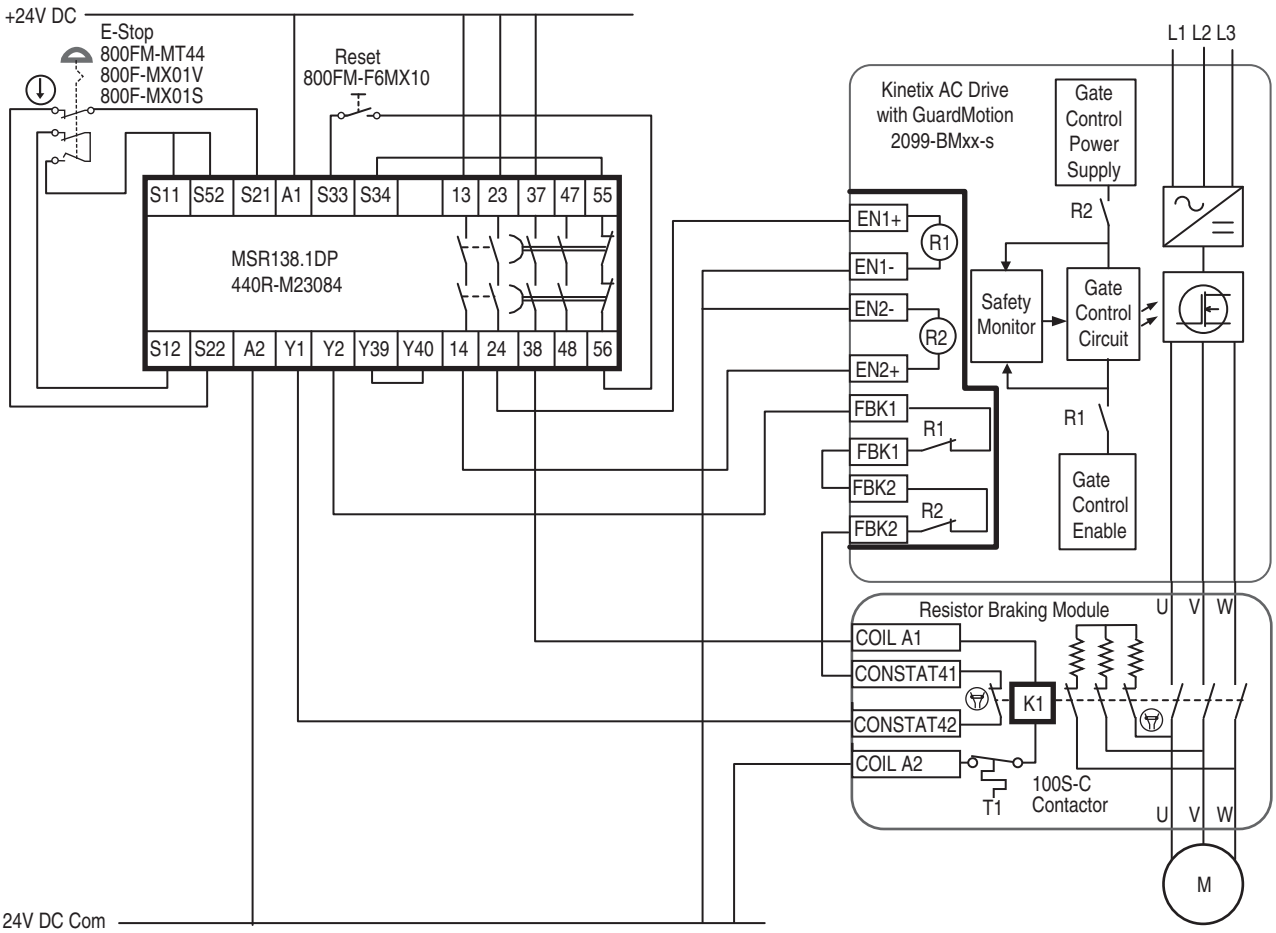
Upon successful completion internal checks on power up, the MSR126.1R checks the input circuits. With the gates closed, the MSR126.1R checks the dual circuits and then waits for the reset signal. A single fault, a short from 24V to terminal 14 of the MSR126.1R, may lead to the loss of the safety function. With the MSR126.1R and Flex system mounted in the same cabinet and with proper validation, this fault may be excluded. If not mounted in the same cabinet, a signal from the output (A0) should be fed back into the input module (A2). The logic can perform a comparison of input A2 and A3, and turn the machine off if these signals are not in agreement. If CR1 is not de-energized when the gate is closed, the MSR126.1R will not close its outputs.

Ratings

The safety function intiated by the Trojan T15-GD2 gate interlocks meets the safety performance requirements of SIL CL 2 per IEC 62061:2005 and has a Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1:2006. This circuit executes a Category 0 stop.

Safety Motion—Delayed Braking

800F, MSR138, Kinetix GuardMotion, RBM



Circuit Status

The e-stop is reset. The outputs of the safety relay are open, and the motor is off.

Operating Principle

STARTING: Press and release the reset button to energize the outputs of the MSR138. This action energizes the 100S contactor in the resistor braking module, which connects the motor to the drive and enables the operation of the Kinetix drive. When the Kinetix drive is enabled, an internal signal is sent back to its controller (not shown) to inform it that the drive is enabled. The motor is then controlled by its controller.

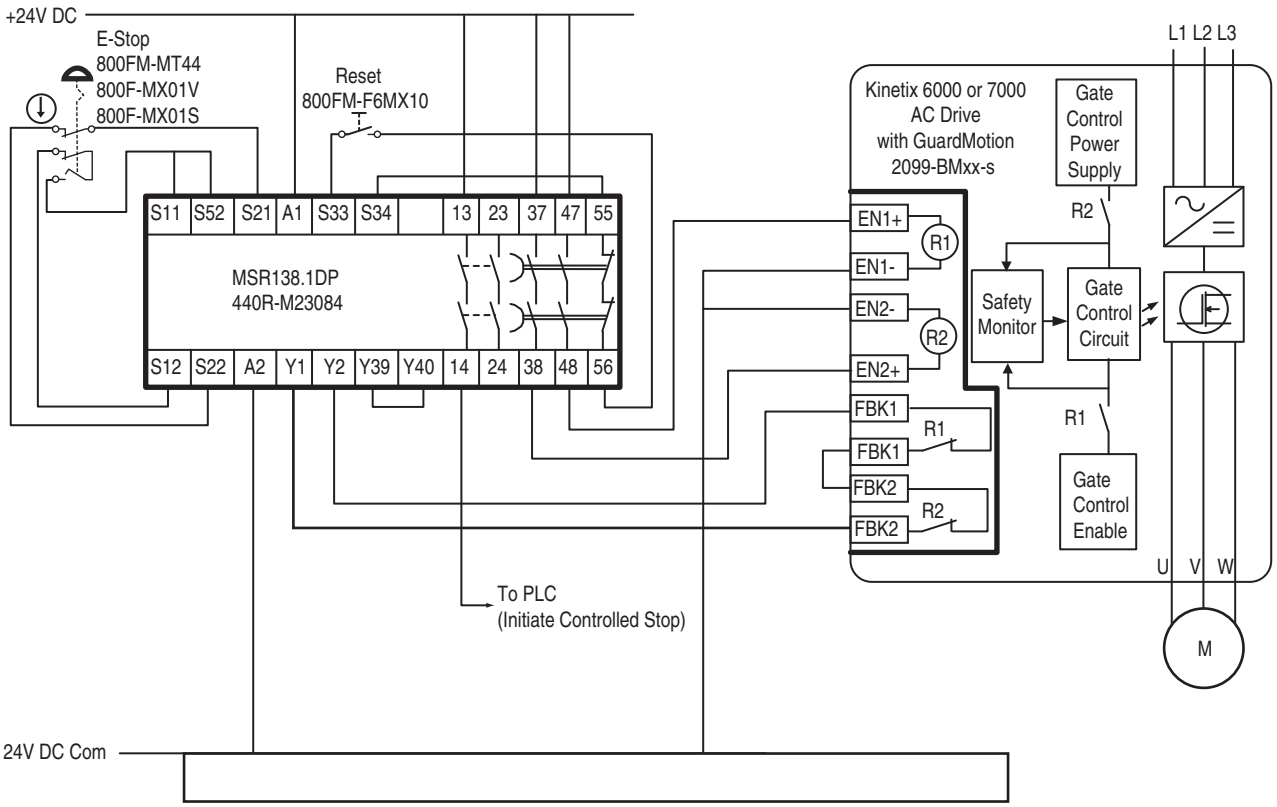
STOPPING: When the e-stop is pressed, the immediate outputs of the MSR138 open and disable the drive. The motor begins to coast to a stop. After the time delay of the MSR138 expires, the delayed outputs open and drop out the 100S contactor in the Resistor Braking Module. This disconnects the motor from the drive and engages the braking resistors, which rapidly stop the motor.

Fault Detection

Upon power-up, the Kinetix drive and MSR138 perform internal checks. The MSR138 then looks for dual signals from the e-stop. The e-stop has a self-monitoring contact, which opens if the contact block falls off the control panel. With the e-stop signals made, the MSR138 checks the Y1/Y2 monitoring circuit when the reset button is pressed. If these checks are OK, the output energizes. If the delayed outputs of the MSR138 fault to the ON state, the motor is stopped by the MSR138 immediate outputs. The fault will be detected by the Y1/Y2 monitoring circuit on the next attempt to re-start because K1 will remain energized. If the drive faults to an ON state, the motor will stop because it will be disconnected by K1. This fault will be detected by the Y1/Y2 monitoring circuit on the next attempt to re-start because the Kinetix feedback circuit will remain off. If K1 gets stuck or welded closed, the motor will stop by the drive and the fault will be detected by the Y1/Y2 monitoring circuit of the MSR138 on the next attempt to re-start.

Ratings

The safety function intiated by the 800F e-stop meets the safety performance requirements of SIL CL 2 per IEC 62061:2005 and has a Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1:2006. This circuit executes a Category 1 stop.



Circuit Status

The e-stop is reset. The outputs of the safety relay are open, and the motor is off.

Operating Principle

STARTING: Press and release the reset button to energize the outputs of the MSR138. This action enables the operation of the Kinetix drive. When the Kinetix drive is enabled, an internal signal is sent back to its controller (not shown) to inform it that the drive is enabled. The motor is then controlled by its controller.
STOPPING: When the e-stop is pressed, the immediate outputs of the MSR138 open and sends a signal the to the machine control PLC to initiate a controlled stop. After the time delay of the MSR138 expires, the delayed outputs open and drop out the GuardMotion feature which disables the drive.

Fault Detection

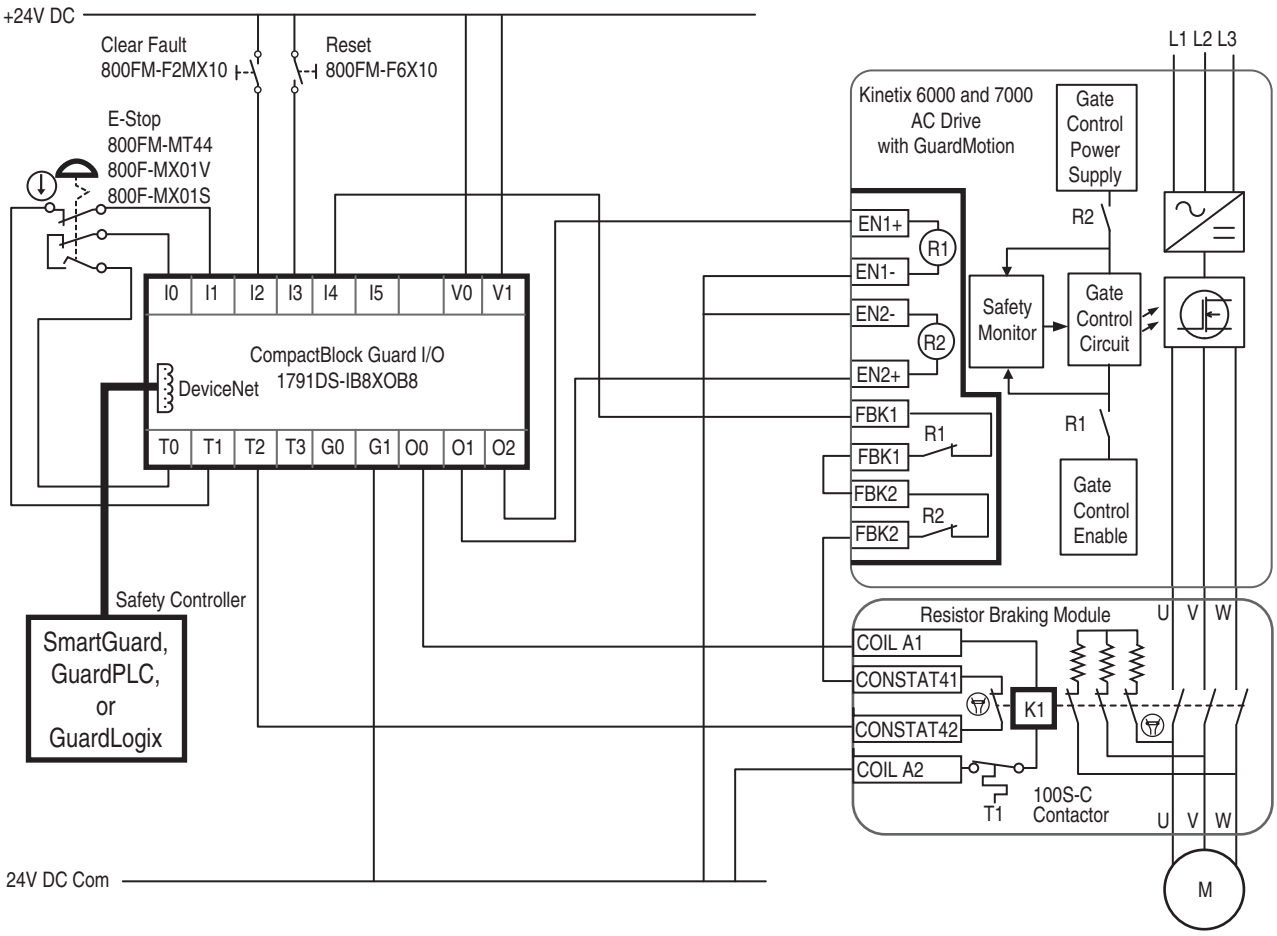
Upon power-up, the Kinetix drive and MSR138 perform internal checks. The MSR138 then looks for dual signals from the e-stop. The e-stop has a self-monitoring contact, which opens if the contact block falls off the control panel. With the e-stop signals made, the MSR138 checks the Y1/Y2 monitoring circuit when the reset button is pressed. If these checks are OK, the output energizes. If the delayed outputs of the MSR138 fault to the ON state, the motor is stopped by the MSR138 immediate outputs. The fault will be detected by the S33/S34 monitoring circuit on the next attempt to re-start. If one of the safe-off relays faults to the ON state, the MSR138 will detect the fault in the Y1/Y2 circuit on the next attempt to start the drive.

Ratings

The safety function intiated by the 800F e-stop meets the safety performance requirements of SIL CL 2 per IEC 62061:2005 and has a Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1:2006. This circuit executes a Category 1 stop.

Safety Motion & Safety I/O—Integrated Architecture

800F, CompactBlock Guard I/O, Kinetix GuardMotion, RBM



Circuit Status

The e-stop is reset. The outputs of the CompactBlock Guard I/O are off. The Kinetix outputs are off. The Resistor Braking Module is off. The motor is off.

Operating Principle

STARTING: Press and release the reset button to energize the outputs of the CompactBlock Guard I/O. This action energizes the 100S contactor in the resistor braking module, which connects the motor to the drive and enables the operation of the Kinetix drive. When the Kinetix drive is enabled, an internal signal is sent back to its controller (not shown) to inform it that the drive is enabled. The motor is then controlled by its controller.

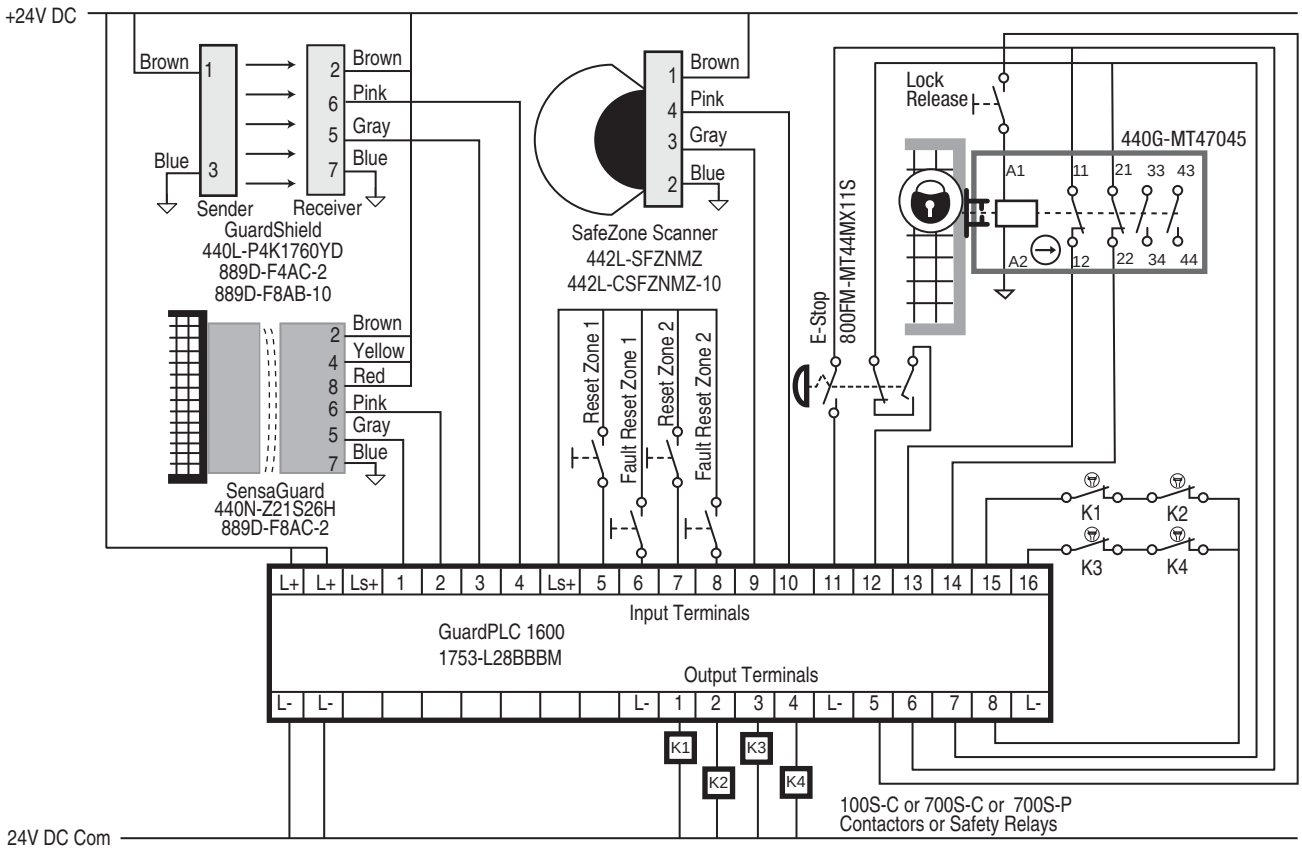
STOPPING: When the e-stop is pressed, the O1 and O2 outputs of the 1791DS open and disable the drive. The motor begins to coast to a stop. After a short delay (determined by a risk assessment or stop time measurement and programmed in the safety controller), the O0 output turns off and drops out the 100S contactor in the resistor braking module. This disconnects the motor from the drive and engages the braking resistors, which rapidly stop the motor.

Fault Detection

Upon power-up, the Kinetix drive and 1791DS perform internal checks. The 1791DS then looks for dual signals from the e-stop. The pulsed outputs T0 and T1 are used to help check for open and short circuit fault conditions in the e-stop circuit. The e-stop has a self-monitoring contact, which opens if the contact block falls off the control panel. With the e-stop signals made, the 1791DS checks the monitoring circuit when the reset button is pressed. If these checks are OK, the outputs energize. If the O0 output of the 1791DS faults to the ON state, the motor is stopped by the O1 and O2 outputs. The fault will be detected by the safety controller on the next attempt to re-start because K1 will remain energized. If the drive faults to an ON state, the motor will still be able to stop because it will be disconnected by K1. This fault will be detected on the next attempt to re-start because the Kinetix feedback circuit will remain off. If K1 gets stuck or welded closed, it will still be possible to stop the motor by the drive, and the fault will be detected by the safety controller on the next attempt to re-start.

Ratings

The safety function intiated by the 800F e-stop meets the safety performance requirements of SIL CL 3 per IEC 62061:2005 and has a Category 4 structure that can be used in systems requiring Performance Levels up to PLe per ISO 13849-1:2006. This circuit executes a Category 0 stop. To achieve a Category 1 stop, the machine control system must be notified of the e-stop command through DeviceNet, command the Kinetix to execute a stop, and delay the outputs O0, O1, and O2 until the stop condition is completed.



Circuit Status

The GuardPLC is programmed to control two zones without a DIO connection. The GuardShield and SensaGuard are associated with Zone 1 and contactors K1 and K2. The SafeZone Laser Scanner and 440G-MT are associated with Zone 2 and contactors K3 and K4. The SafeZone, located behind the locked safety gate, is used to detect someone in the hazard area. The E-Stop applies to both zones. The two safety gates are closed, the light curtain and zone scanner are clear and the e-stop is released. Both zones are ready to be activated.

Operating Principle

STARTING: Press the reset button for each zone to energize the safety outputs of the GuardPLC. The safety contactors K1 through K4 become energized and allow the zones to operate. The GuardPLC signals the machine control system over an Ethernet/IP connection that the zones are ready to run. The machine control system (not shown) controls the zones.

STOPPING: Obstructing the light curtain or opening the SensaGuard gate will de-energize the K1 and K2 contactors. Clearing the light curtain or closing the gate will not cause the contactors to re-energize. The Zone 1 Reset button must be pressed to restart Zone 1. The e-stop acts as a global stop. When pressed, both zones are de-energized. The GuardPLC energizes Output 5 to provide voltage for the 440G-MT guard locking solenoid. Pressing the Gate Release button allows the gate to be opened. Closing the gate or resetting the e-stop does not re-energize the K1-K4 contactors. The respective Zone Reset buttons must be pressed after the input devices are cleared.

Fault Detection

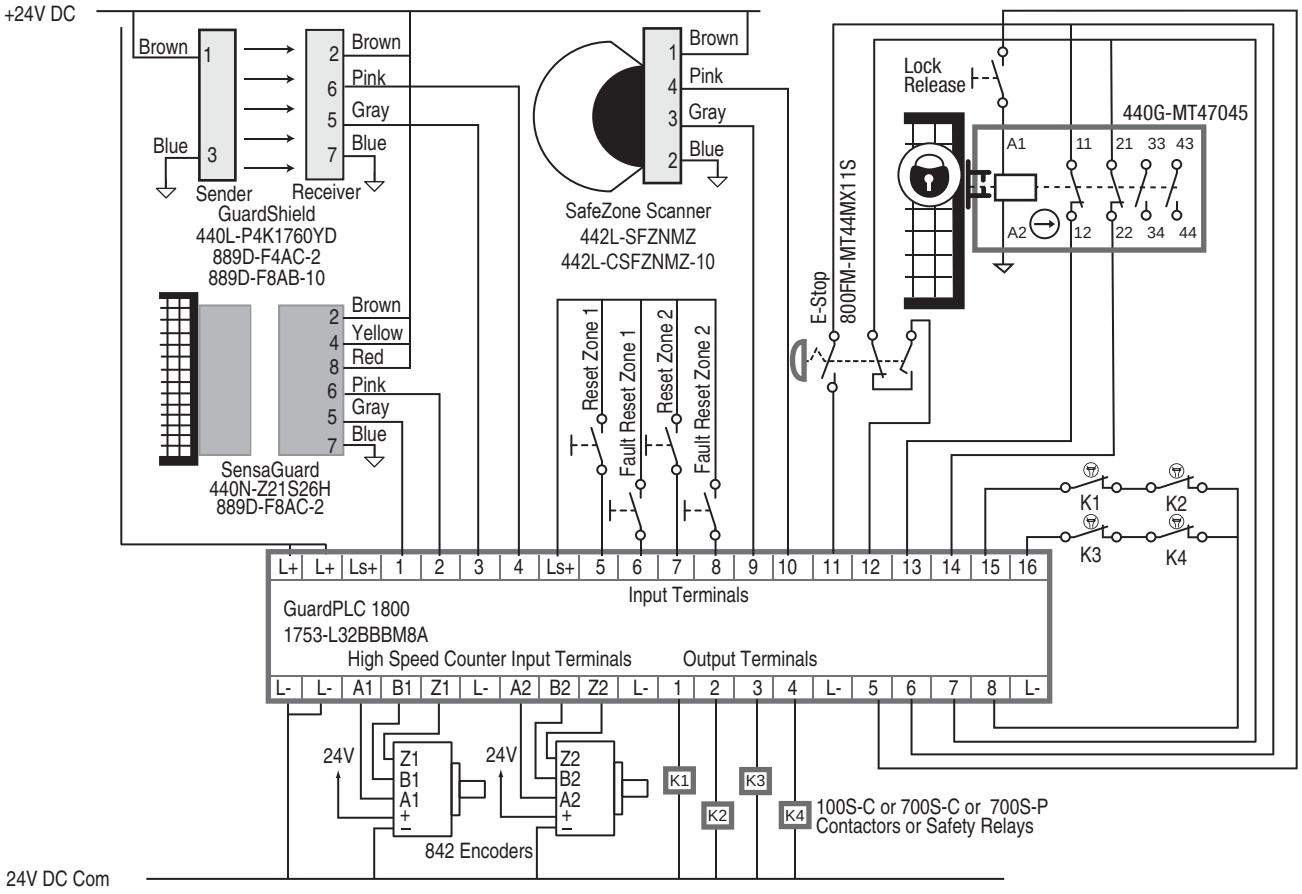
Upon successful completion of internal checks on power up, the GuardPLC checks the input devices. Outputs 6 and 7 are configured as pulse test sources and are used by the GuardPLC to help check for open and short-circuit fault conditions of the E-Stop and 440G-MT interlock. If a fault is detected, the GuardPLC will not energize the respective outputs. The GuardPLC checks the status of the K1-K4 contactors. If the contactors are energized, stuck or welded closed, the GuardPLC will detect this due to the open circuit to Inputs 15 or 16, and will not energize the respective zone. Output 8 is configured as a pulse test source to help detect wiring faults on these contactor feedback circuits. The programmable safety function blocks associated with each device performs self checking. If a fault occurs, the respective Fault Reset button must be pressed, after the fault is cleared. Then, the Reset button must be pressed and released for the machine to restart.

Ratings

The ratings assume that two contactors are connected in series to power the hazards. The safety function intiated by the SensaGuard interlock, GuardShield light curtains, and 800F e-stop meet the safety performance requirements of SIL CL 3 per IEC 62061:2005 and has a Category 4 structure that can be used in systems requiring Performance Levels up to PLe per ISO 13849-1:2006. The safety functions initiated by the SafeZone scanner and 440G-MT interlock meet the safety performance requirements of SIL CL 2 per IEC 62061:2005 and have a Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1:2006. This circuit executes a Category 0 stop.

Safety PLC—Two Zones with Encoders

GuardShield, SensaGuard, SafeZone, 800F, 440G-MT, 842 Encoders, GuardPLC 1800, 100S, 700S



Circuit Status

The GuardPLC is programmed to control two zones. The GuardShield and SensaGuard control Zone 1 with contactors K1 and K2. The SafeZone Laser Scanner and 440G-MT control Zone 2 with contactors K3 and K4. The SafeZone, located behind the locked safety gate, is used to detect someone in the hazard area. The E-Stop applies to both zones. The dual encoders monitor the machine for zero speed and safe speed. The safety gates are closed; the light curtain and zone scanner are clear; the machine is at zero speed; and the e-stop is released. Both zones are ready to be activated.

Operating Principle

STARTING: Press the reset button for each zone to energize the safety outputs of the GuardPLC. The safety contactors K1 through K4 become energized and allow the zones to operate. The GuardPLC signals the machine control system over an Ethernet/IP connection that the zones are ready to run. The machine control system (not shown) controls the zones.

STOPPING: Obstructing the light curtain or opening the SensaGuard gate will de-energize the K1 and K2 contactors. Clearing the light curtain or closing the gate will not cause the contactors to re-energize. The Zone 1 Reset button must be pressed to restart Zone 1. The e-stop acts as a global stop. When pressed, both zones are de-energized. The GuardPLC energizes Output 5 to provide voltage for the 440G-MT guard locking solenoid. Pressing the Lock Release button allows the gate to be opened. Closing the gate or resetting the e-stop does not re-energize the K1-K4 contactors. The respective Zone Reset buttons must be pressed after the input devices are cleared.

Fault Detection

Upon successful completion of internal checks on power up, the GuardPLC checks the input devices. Outputs 6 and 7 are configured as pulse test sources and are used by the GuardPLC to help check for open and short-circuit fault conditions of the E-Stop and 440G-MT interlock. If a fault is detected, the GuardPLC will not energize the respective outputs. The GuardPLC checks the status of the K1-K4 contactors. If the contactors are energized, stuck or welded closed, the GuardPLC will detect this due to the open circuit to Inputs 15 or 16, and will not energize the respective zone. Output 8 is configured as a pulse test source to help detect wiring faults on these contactor feedback circuits. The programmable safety function blocks associated with each device performs self checking. If a fault occurs, the respective Fault Reset button must be pressed, after the fault is cleared.

Ratings

The ratings assume that two contactors are connected in series to power the hazards. The safety function intiated by the SensaGuard interlock, GuardShield light curtains, and 800F e-stop meet the safety performance requirements of SIL CL 3 per IEC 62061:2005 and has a Category 4 structure that can be used in systems requiring Performance Levels up to PLe per ISO 13849-1:2006. The safety functions initiated by the SafeZone scanner and 440G-MT interlock meet the safety performance requirements of SIL CL 2 per IEC 62061:2005 and have a Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1:2006. This circuit executes a Category 0 stop.

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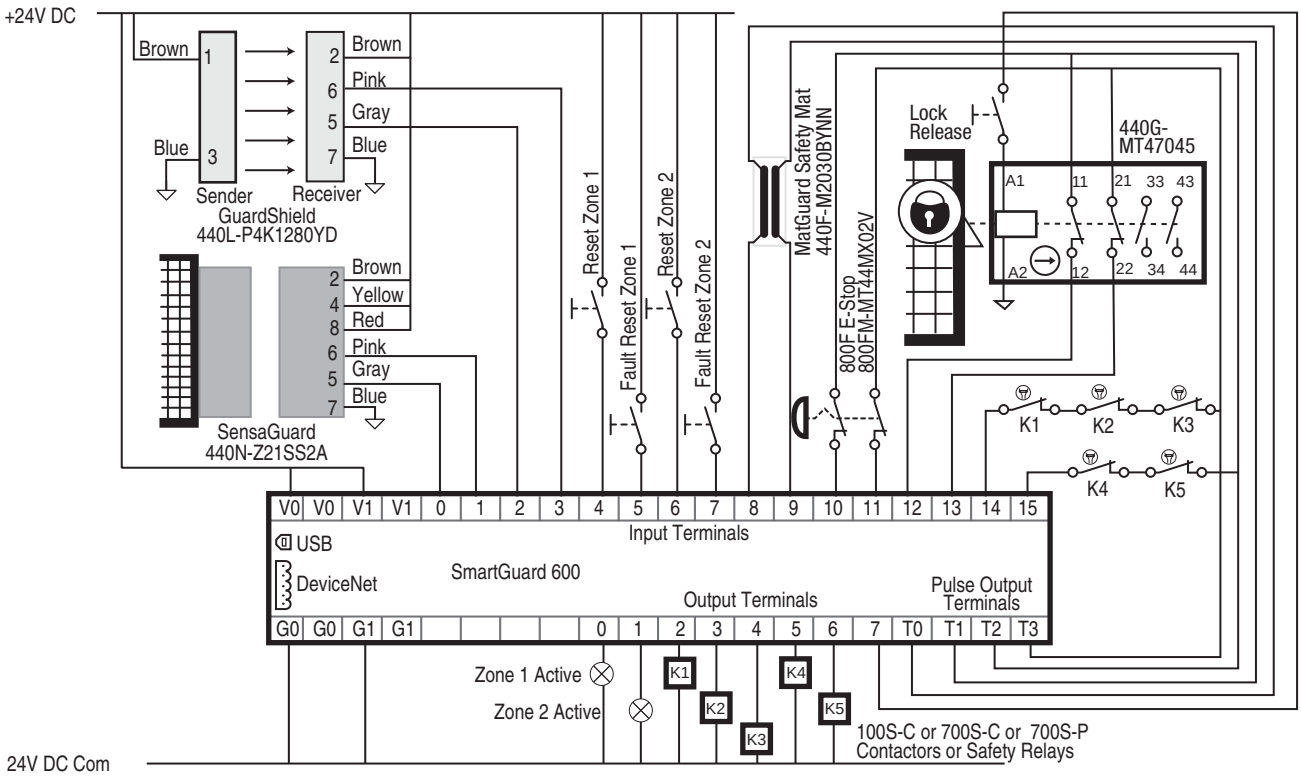
Allen-Bradley
GuardMaster®

Safety PLC—Two Zones

GuardShield, SensaGuard, MatGuard, 800F, 440G-MT, SmartGuard 600, 100S, 700S



Circuit Status

The SmartGuard is programmed to control two zones without a DeviceNet connection. The GuardShield and SensaGuard control zone 1 with contactors K1, K2 and K3. The MatGuard and the 440G-MT control zone 2 with contactors K4 and K5. The MatGuard, located behind the locked safety gate, is used to detect someone in the hazard area. The e-stop applies to both zones. The two safety gates are closed, the light curtain and safety mat are clear and the e-stop is released. Both zones are ready to be activated.

Safety Mat Principles

Outputs T0 and T1 are configured as standard diverse outputs to source the 24V for the safety mat circuits. When a demand is placed on the mat, the circuits short together and both inputs (IN8 and IN9) are HI. Software detects the non-diversity and de-energizes zone 2. In this application, stepping on the mat cannot be differentiated from an actual channel to channel short between the mat circuits. Due to this, stepping on the mat must stop the hazard, and a manual reset is required to restart after each demand on the mat.

Operating Principle

STARTING: Press the reset button for each zone to energize the safety outputs of the SmartGuard. Two indicators are illuminated to show the zones are active. The safety contactors K1 through K5 become energized and allow the zones to operate. Spare contacts (not shown) on the K1-K5 devices signal the machine control system that the zones are ready to run. The machine control system (not shown) controls the zones.

STOPPING: Obstructing the light curtain or opening the SensaGuard gate will de-energize the K1-K3 contactors. Clearing the light curtain or closing the gate will not cause the contactors to energize. The zone 1 Reset button must be pressed to restart zone 1. The e-stop acts as a global stop. When pressed, both zones are de-energized. The guard locking gate is associated with the e-stop. After pressing the e-stop, the SmartGuard energizes output 7 which provides voltage for the guard locking solenoid. Press the Lock Release push button to power the solenoid and open the gate. Closing the gate or resetting the e-stop does not re-energize the K1-K5 contactors. The respective zone reset buttons must be pressed after the input devices are cleared.

Fault Detection

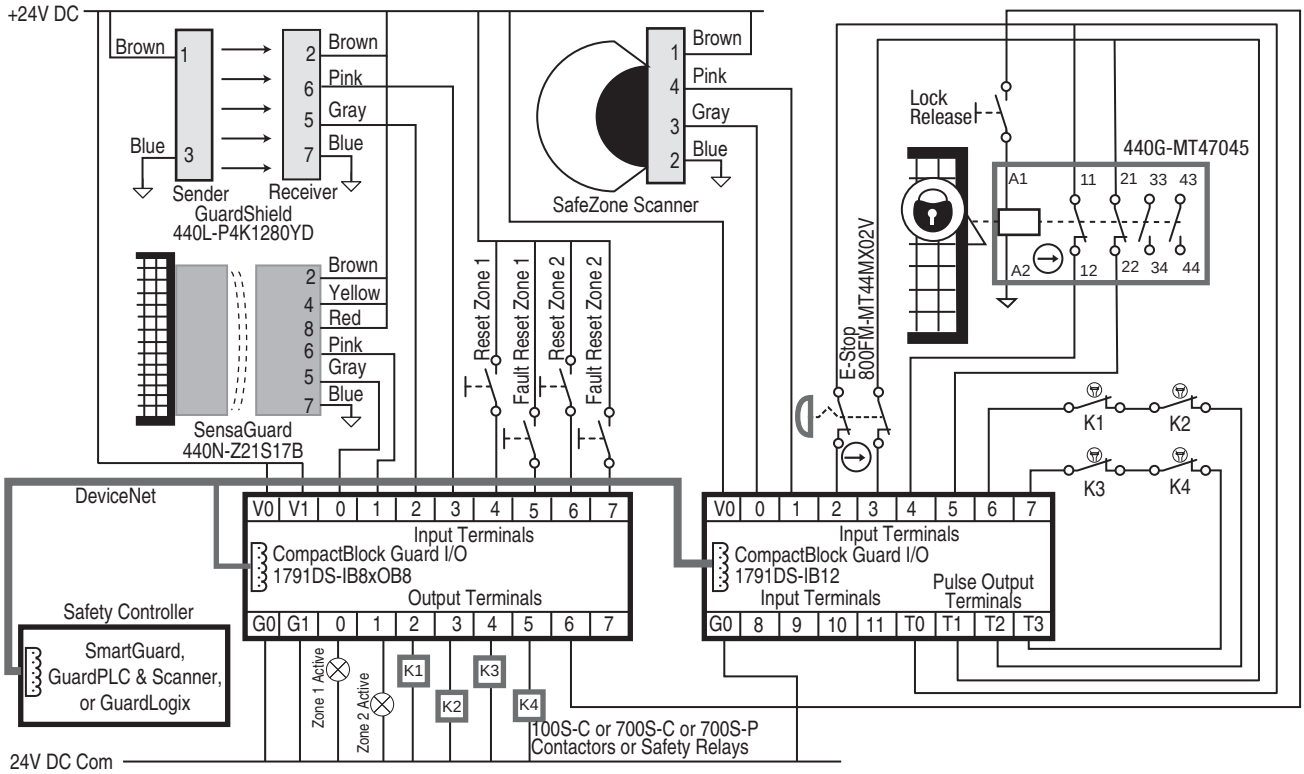
Upon successful completion of internal checks on power up, the SmartGuard checks the input devices. The pulsed outputs T2-T3 are used by the SmartGuard to help check for open and short-circuit fault conditions. If a fault is detected, the SmartGuard will not energize the respective outputs. When the zone reset buttons are pressed, the SmartGuard checks the status of the K1-K5 contactors. If the contactors are energized, stuck or welded closed, the SmartGuard will detect this due to the open circuit to Inputs 14 or 15, and will not energize the respective zone. The programmable safety function blocks associated with each device performs self-checking. If a fault occurs, the respective fault reset button must be pressed, after the fault is cleared.

Ratings

The ratings assume that two contactors are connected in series to power the hazards. The safety function intiated by the SensaGuard interlock, GuardShield light curtains, and 800F e-stop meet the safety performance requirements of SIL CL 3 per IEC 62061:2005 and has a Category 4 structure that can be used in systems requiring Performance Levels up to PLe per ISO 13849-1:2006. The safety functions initiated by the MatGuard safety mat and 440G-MT interlock meet the safety performance requirements of SIL CL 2 per IEC 62061:2005 and have a Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1:2006. This circuit executes a Category 0 stop. If only one contactor is used to power a hazard, the safety function can meet SIL CL 2, Category 2 structure and PLd.

Safety I/O—Two Zones Distributed

GuardShield, SensaGuard, SafeZone, 800F, 440G-MT, CompactBlock Guard I/O, 100S, 700S



Safety Control System

Compact Block Guard I/O resides on a DeviceNet safety network and operates as a safety slave. Safety Masters that can 'own' the Compact Block Guard I/O modules include GuardLogix, SmartGuard, and the GuardPLC safety controllers. Note the GuardPLC requires a 1753-DNSI Safety Scanner to 'own' Compact Block Safety I/O. For the remainder of this application note, the Safety Master will be referred to as the 'safety controller.' Since the various Safety Controllers have varied communication interfaces to the standard machine control system, this application note will make no references to this link.

Circuit Status

The safety controller is programmed to control two zones. The GuardShield and SensaGuard control zone 1 with contactors K1 and K2. The SafeZone Laser Scanner and 440G-MT control zone 2 with contactors K3 and K4. The SafeZone, located behind the locked safety gate, is used to detect someone in the hazard area. The E-Stop applies to both zones. The two safety gates are closed, the light curtain and laser scanner are cleared and the e-stop is released. Both zones are ready to be activated.

Operating Principle

STARTING: Press the reset button for each zone to allow the safety controller to energize the safety outputs of the CompactBlock Guard I/O. The safety contactors K1 through K4 become energized and allow the zones to operate. The safety controller signals the machine control system that the zones are ready to run. The machine control system (not shown) controls the zones.

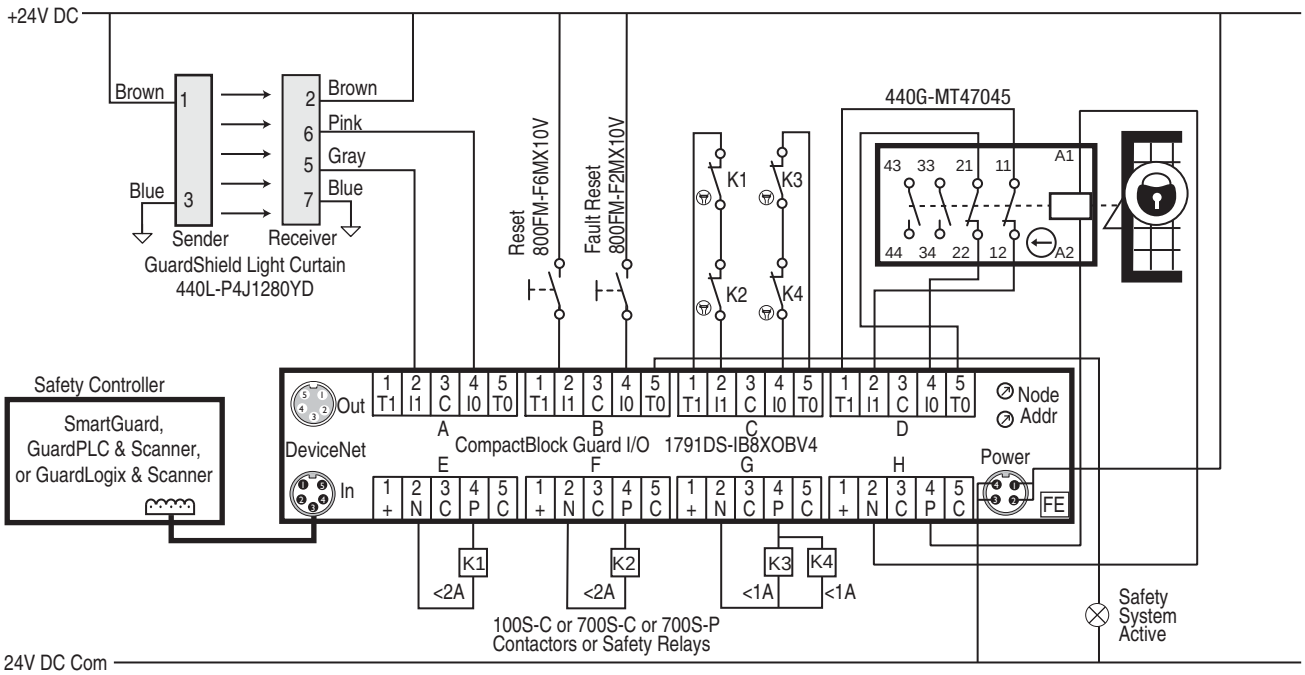
STOPPING: Obstructing the light curtain or opening the SensaGuard gate will de-energize the K1 and K2 contactors. Clearing the light curtain or closing the gate will not cause the contactors to energize the zone 1 Reset button must be pressed to restart zone 1. The e-stop acts as a global stop. When pressed, both zones are de-energized. The safety controller energizes Output 6 to provide voltage for the 440G-MT guard locking solenoid. Press the Lock Release button and open the gate. Closing the gate or resetting the e-stop does not re-energize the K1-K4 contactors. The zone reset buttons must be pressed after clearing the input devices.

Fault Detection

Upon successful completion of internal checks on power up, the CompactBlock Guard I/O checks the input devices. Test outputs T2 and T1 are configured as pulse test sources and are used by the CompactBlock Guard I/O to help check for open and short-circuit fault conditions of the E-Stop and Gateswitch. If a fault is detected, the safety controller will not energize or will de-energize the respective outputs. The safety controller checks the status of the K1-K4 contactors. If the contactors are energized, stuck or welded closed, the safety controller will detect this due to the open circuit to Inputs 6 or 7 on the IB12, and will not energize the respective zone. Test outputs T2 and T3 are used to help detect wiring faults on these contactor feedback circuits. The programmable safety function blocks associated with each device performs self checking. If a fault occurs, the respective Fault Reset button must be pressed, after the fault is cleared.

Ratings

The ratings assume that two contactors are connected in series to power the hazards. The safety function intiated by the SensaGuard interlock, GuardShield light curtains, and 800F e-stop meet the safety performance requirements of SIL CL 3 per IEC 62061:2005 and has a Category 4 structure that can be used in systems requiring Performance Levels up to PLe per ISO 13849-1:2006. The safety functions initiated by the SafeZone scanner and 440G-MT interlock meet the safety performance requirements of SIL CL 2 per IEC 62061:2005 and have a Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1:2006. This circuit executes a Category 0 stop.



Circuit Status

The light curtain is cleared, and the 440G-MT guard locking switch is closed and locked. The contactors K1-K4 are off. The safety system is ready to be energized.

Operating Principle

The 1791DS-IB8X0BV4 has bi-polar outputs, which allows the module to switch both the positive and negative side of the load device (e.g. contactors and solenoids) and to check for faults on both the positive and negative side of the load.
STARTING: Press the reset button to energize the contactors K1-K4. The safety controller verifies that the monitoring circuits at terminals in the "C" connector are closed. The safety contactors K1 through K4 become energized and allow the machine to run. The Safety System Active indicator is turned on by the safety controller. The safety controller signals the machine control system that the safety system is ready to run. The machine control system (not shown) controls the machine.
STOPPING: Obstructing the light curtain de-energizes contactors K1-K4. The contactors may also be de-energized by the safety controller due to other safety demands (like a system level e-stop). When the contactors K1-K4 are de-energized, the solenoid of the 440G-MT can be energized and allow the gate to be opened. While the gate is open, the program in the safety controller must not allow the contactors to re-energize. Closing the gate or clearing the light curtain do not re-energize the contactors. Press the reset button to re-energize the contactors.

Fault Detection

Upon successful completion of internal checks on power up, the safety controller checks the input devices. Test outputs T0 and T1 in the "D" connector are configured as pulse test sources and are used by the safety controller to help check for open and short-circuit fault conditions of the 440G-MT gateswitch. If a fault is detected, the safety controller will not energize the K1-K4 contactors. The safety controller checks the status of the K1-K4 contactors. The safety controller will detect contactors that are energized, stuck or welded closed by the open circuits at inputs I0 and I1 and will not energize the respective zone. The contactors and the 440G-MT solenoid are switched on both the positive and negative side, so shorts to either the supply voltage or to ground will be detected. After clearing a fault, press the Fault Reset button to reset the module. Press the Reset button to allow the contactors to be energized.

Programming

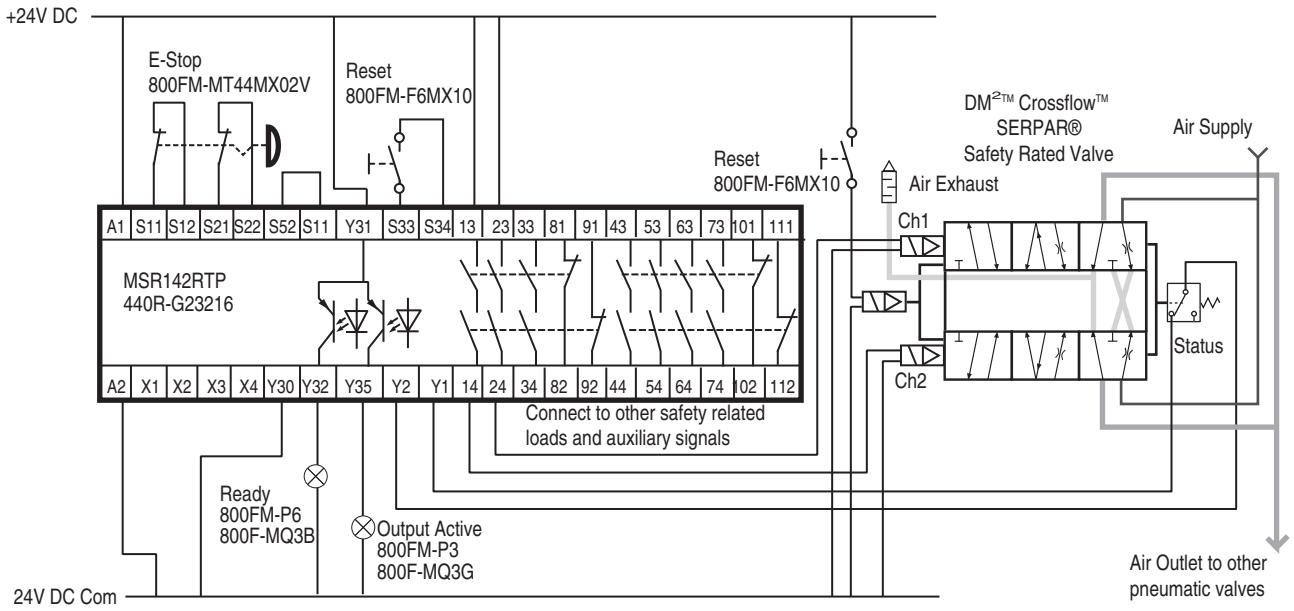
The safety outputs of the 1791DS-IB8XOBV4 are configured in firmware as four (4) dual channel pairs. Both outputs in the pair must be complementary or a fault occurs. Outputs TO and T` in the "D" connector must be configured as pulse outputs. Test outputs T0 in the "B" connector must be configured in software as 'standard outputs' to drive the Safety System Active indicators.

Ratings

The ratings assume that two contactors are connected in series to power the hazards. The safety function intiated by the GuardShield light curtain meets the safety performance requirements of SIL CL 3 per IEC 62061:2005 and has a Category 4 structure that can be used in systems requiring Performance Levels up to PLe per ISO 13849-1:2006. The safety functions initiated by the 440G-MT interlock meet the safety performance requirements of SIL CL 2 per IEC 62061:2005 and have a Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1:2006. This circuit executes a Category 0 stop. If only one contactor is used to power a hazard, the safety function can meet SIL CL 2, Category 2 structure and PLd.

Safety Valve & E-Stop—Air Supply Release

800F, MSR142, Pneumatic Safety Valve



Circuit Status

The e-stop button is released, the MSR142 safety relay outputs are off and the pneumatic valve is closed.

Operating Principle

STARTING: Press the reset button to energize the output contacts of the safety relay. The two solenoids in the valve energize and allow air to flow from the Air Supply to the Air Outlet.

STOPPING: Pressing the e-stop button de-energizes the safety outputs of the MSR142, which in turn drops out the solenoids of the safety valve. The valve closes the Air Supply and releases the air pressure to the Air Exhaust. Releasing the e-stop button does not cause the valve to turn back on.

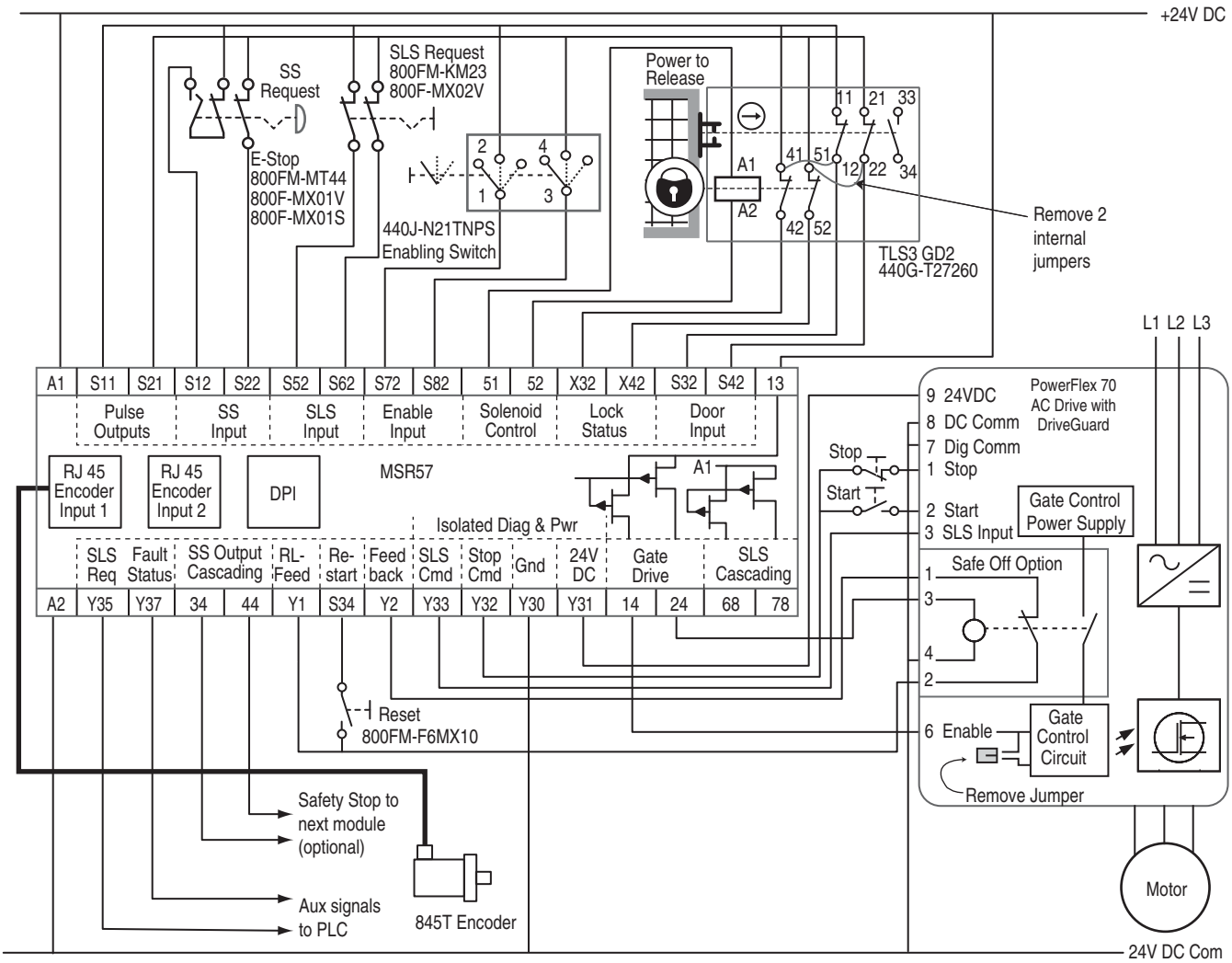
Fault Detection

Upon successful completion of internal checks on power up, the MSR142 checks the e-stop status. If an open or short circuit is detected, the MSR142 will not energize its outputs. If both input circuits are properly closed, the MSR142 checks the status of the safety valve. If one or both solenoids of the safety valve are energized, the Status contact will be open, and the MSR142 will not energize its outputs. If both solenoids are de-energized, Status contact will be closed and the MSR142 will turn on its Ready LED. Pressing the Reset button energizes the MSR142 safety outputs and opens the safety valve.

The safety valve performs its own internal checks. If one of the valves remains actuated, gets stuck or moves too slowly, the Air Outlet flow will be re-directed to the exhaust. To clear the fault condition, both valves must be de-energized and the valve reset button pressed.

Ratings

The safety function initiated by the 800F e-stop button meets the safety performance requirements of SIL CL 3 per IEC 62061:2005 and has Category 4 structure that can be used in systems requiring Performance Levels up to PLe per ISO 13849-1: 2006. The MSR142 has seven safety rated outputs. To maintain the highest safety levels, these outputs must drive redundant actuators which must be monitored for proper performance. This example circuit performs a Stop Category 0 function (coast to stop).



Circuit Status

The safe stop (SS) request e-stop button is released. The safe limited speed (SLS) request button is released. The enabling switch is released. The guard locking interlock is closed and locked. The safety outputs (Gate Drive) of the MSR57 are off. The motor is off.

Operating Principle

The MSR57 performs the safe limited speed function. It provides a signal to the drive to initiate the slow speed. The MSR57 accepts encoder signals to monitor the speed. When the speed is within the safe speed limit, the guard locking device is allowed to open. If the speed exceeds the limit, a safe shutdown is initiated.
STARTING: Press the reset button to energize outputs of the MSR57. Then press the start button to turn on the motor. The motor will execute its programmed function.
SAFE LIMITED SPEED: Turn the key operated selector switch to the SLS position and remove the key. The MSR57 sends a command to the drive to go to its configured safe limited speed. When the motor reaches and stays at the limited speed, the guard locking door becomes unlocked. Grip the enabling switch to the middle position and enter the hazard area. Exit the hazard area while holding the GripSwitch. Switch the SLS request to run. Then press the reset button to allow the drive to rotate the motor at high speeds. The GripSwitch can then be released.
STOPPING: The e-stop can be pressed at any time to initiate a stop. If the speed exceeds the limit or the GripSwitch is released, a safe-off stop is initiated.

Fault Detection

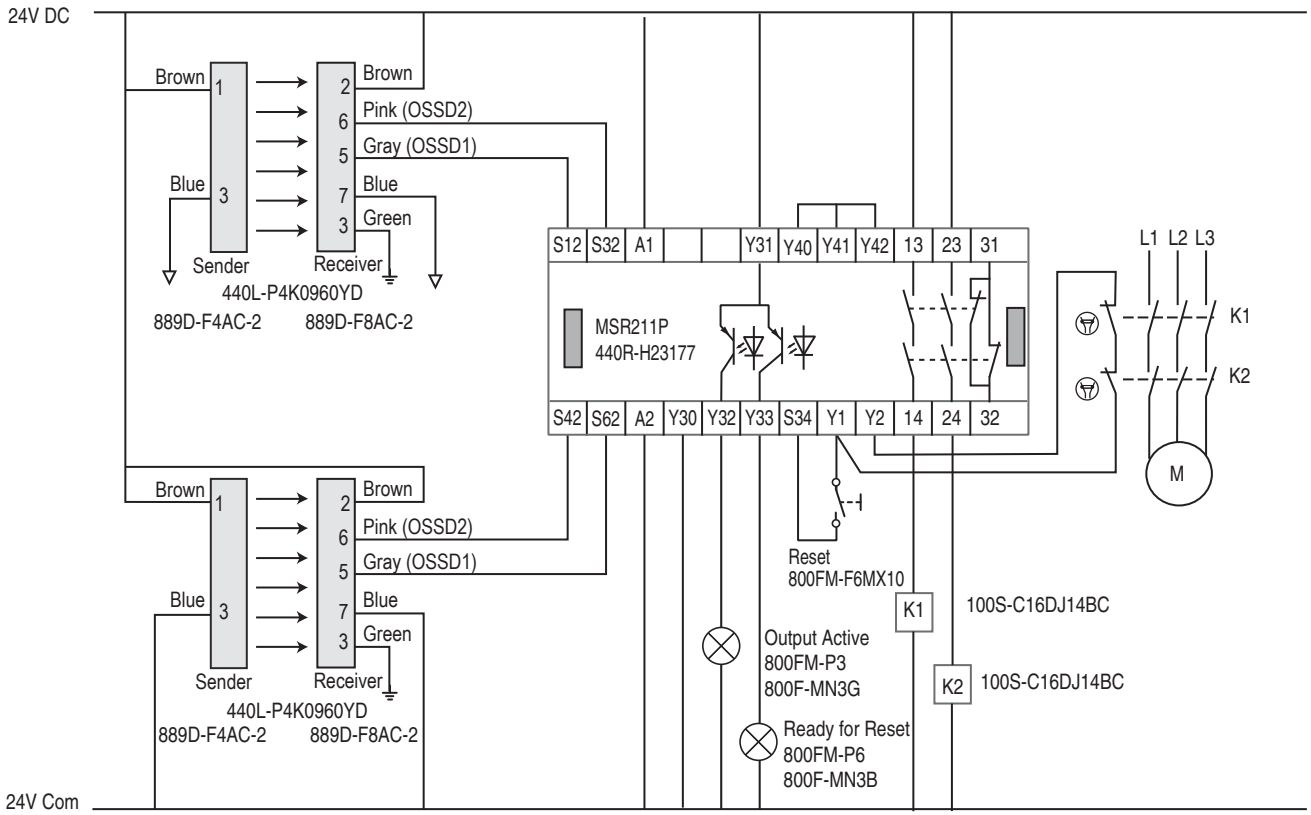
Upon power-up the MSR57 and PowerFlex 70 perform internal checks. The MSR57 generates continuous test pulses to check for short circuit at the input devices. Dual channel inputs and outputs provide single fault tolerance.

Ratings

The safety functions initiated by the 800F e-stop and TLS3-GD2 guardlocking device meet the safety performance requirements of SIL CL 2 per IEC 62061:2005 and has Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1: 2006. This example circuit performs a Stop Category 1 function (brake and then remove power to motor).

Modular Relay—Single Zone

GuardShield, 800F, MSR211, 100S



Circuit Status

Both light curtains are clear. The MSR211P output contacts are de-energized. The motor is off and ready to run.

Operating Principle

The MSR211P accepts two light curtains and functions as an alternative to a cascaded arrangement of light curtains.
STARTING: Press the reset button to energize the outputs of the MSR211P, which turns the motor on.
STOPPING: Obstructing either light curtain causes the motor to stop.

Fault Detection

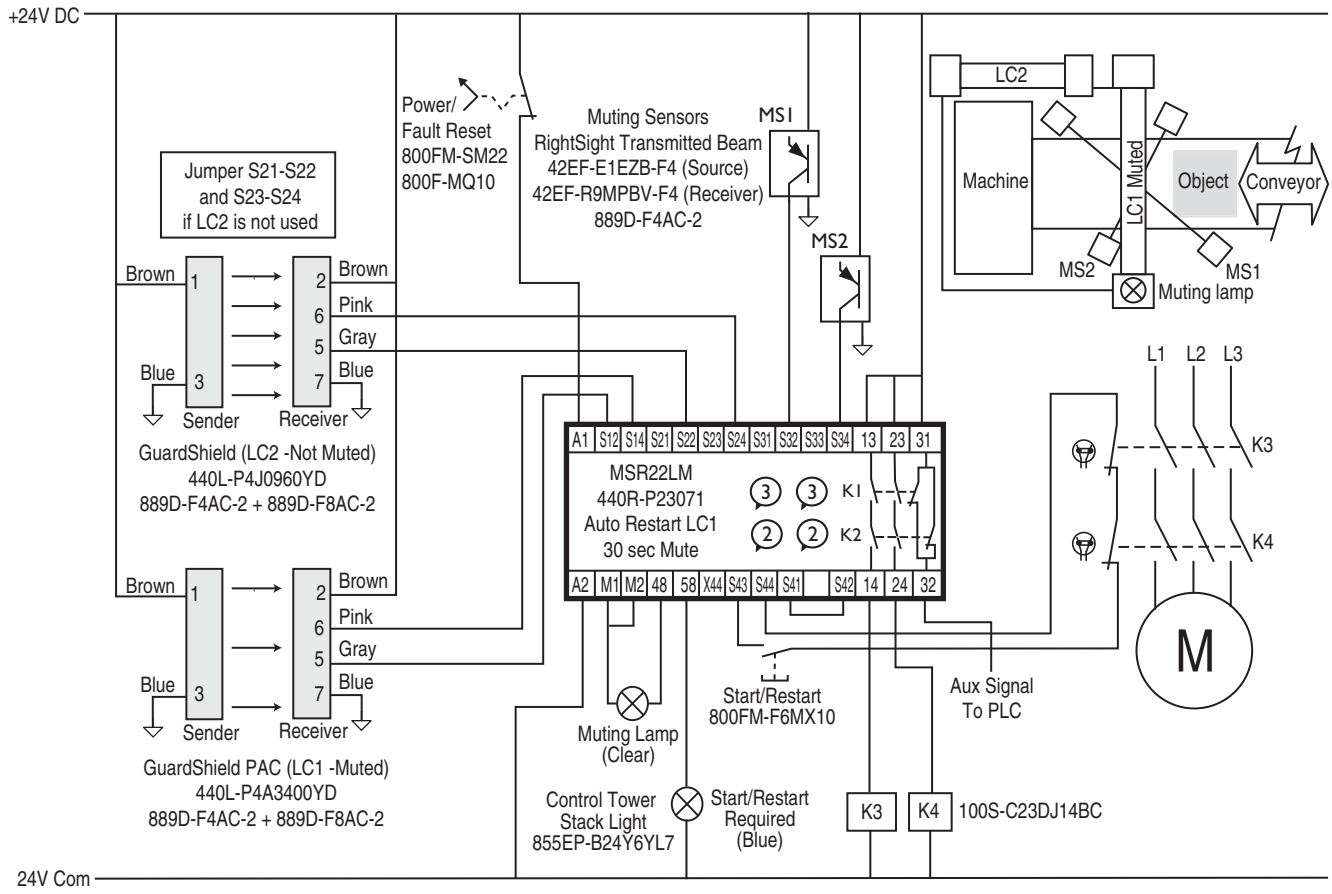
Upon successful completion of internal checks on power-up, the MSR211 checks the input signals from the GuardShield light curtains. If all four signals from the light curtains are present and no shorts exist, the MSR211P checks for the reset button. With the jumper from Y40 to Y42, the MSR211P checks to make sure the reset button is not held closed. When the reset button is pressed, the MSR211P checks the status of the two contactors. If the circuit on Y1/Y2 is closed, the MSR211 energizes its output. With the jumper from Y40 to Y41, the MSR2f11P confirms that both contactors are energized within 300 ms.

Ratings

The safety functions initiated by the two GuardShield light curtains meet the safety performance requirements of SIL CL 3 per IEC 62061:2005 and has Category 4 structure that can be used in systems requiring Performance Levels up to PLe per ISO 13849-1: 2006. This example circuit performs a Stop Category 0 function (coast to stop).

Light Curtain—Muting with Two Sensors

GuardShield, RightSight, 800F, Control Tower, MSR22LM, 100S



Circuit Status

The light curtain is clear. The muting sensors are clear. The outputs of the safety relay are de-energized, and the motor is off.

Operating Principle

The MSR22LM is designed for automated conveyor applications, where an object moves through a light curtain into or out of a hazardous area. With two sensor muting, the object can move in both directions.

STARTING: Upon initial power-up, the start/restart button must be pressed to energize the outputs of the MSR22LM and start the motor.

MUTING: The object must block the sensor MS1 and then MS2 prior to passing through the light curtain. After passing through the light curtain, the object must clear MS2 and then MS1 for the motor to continue running during the muting operation.

STOPPING: Obstructing the light curtain without blocking sensors MS1 and MS2 de-energizes the MSR22LM safety outputs. After clearing the light curtain, press the start/restart button to re-energize the safety outputs of the MSR22LM.

Fault Detection

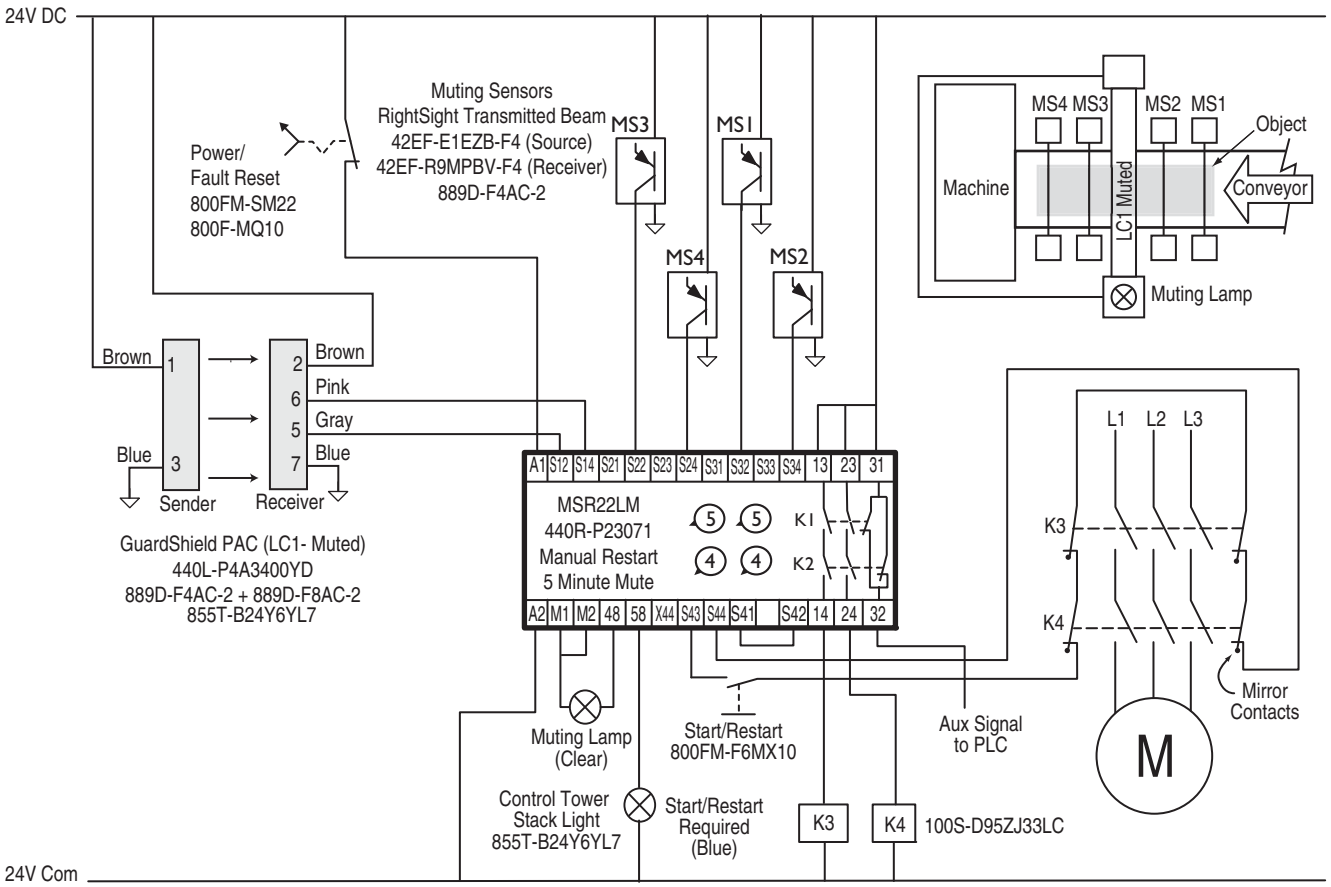
Upon power-up, the GuardShield and MSR22LM perform internal checks. If OK and clear, the GuardShield outputs turn on. The MSR22LM checks the muting inputs. If OK, the MSR22LM checks the light curtain for dual channel signals. If OK, the muting lamp blinks continuously and the start/restart required lamp turns on to indicate that the MSR22LM is ready to start. While running, an incorrect sequence of the muting sensors and light curtain operation or excessive time to move the object through the light curtain will de-energize the safety outputs of the MSR22LM. The run LEDs or the muting lamp blink at certain rates to indicate the type of fault that has occurred. The start/restart button can be held down for three seconds to manually move material through the conveyor. The motor will then run for 12 seconds. Some faults can be cleared by removing the object from the sensors. The start/restart required indicator will turn on when the MSR22LM is ready to go. Other faults may have to be cleared by cycling the power to the MSR22LM. The MSR22LM monitors the 100S contactors through mechanically linked contacts connected in series. If one contactor welds closed, the second contactor will stop the motor, and the MSR22LM will detect the fault at the next attempt to start the motor.

Ratings

The safety functions initiated by the two GuardShield light curtains meet the safety performance requirements of SIL CL 3 per IEC 62061:2005 and has Category 4 structure that can be used in systems requiring Performance Levels up to PLe per ISO 13849-1: 2006. This example circuit performs a Stop Category 0 function (coast to stop).

Light Curtain—Muting with Four Sensors

GuardShield, RightSight, 800F, Control Tower, MSR22LM, 100S



Circuit Status

The light curtain is cleared. The muting sensors are cleared. The outputs of the safety relay are de-energized, and the motor is off.

Operating Principle

The MSR22LM is designed for automated conveyor applications, where an object moves through a light curtain into or out of a hazardous area. With four sensor muting, the object can only move in one direction.

STARTING: Upon initial power-up, the start/restart button must be pressed to energize the outputs of the MSR22LM and start the motor.

MUTING: The object must block the sensors MS1 and MS2 prior to passing through the light curtain. The object must be large enough to block all four sensors, for the motor to continue running during the muting operation.

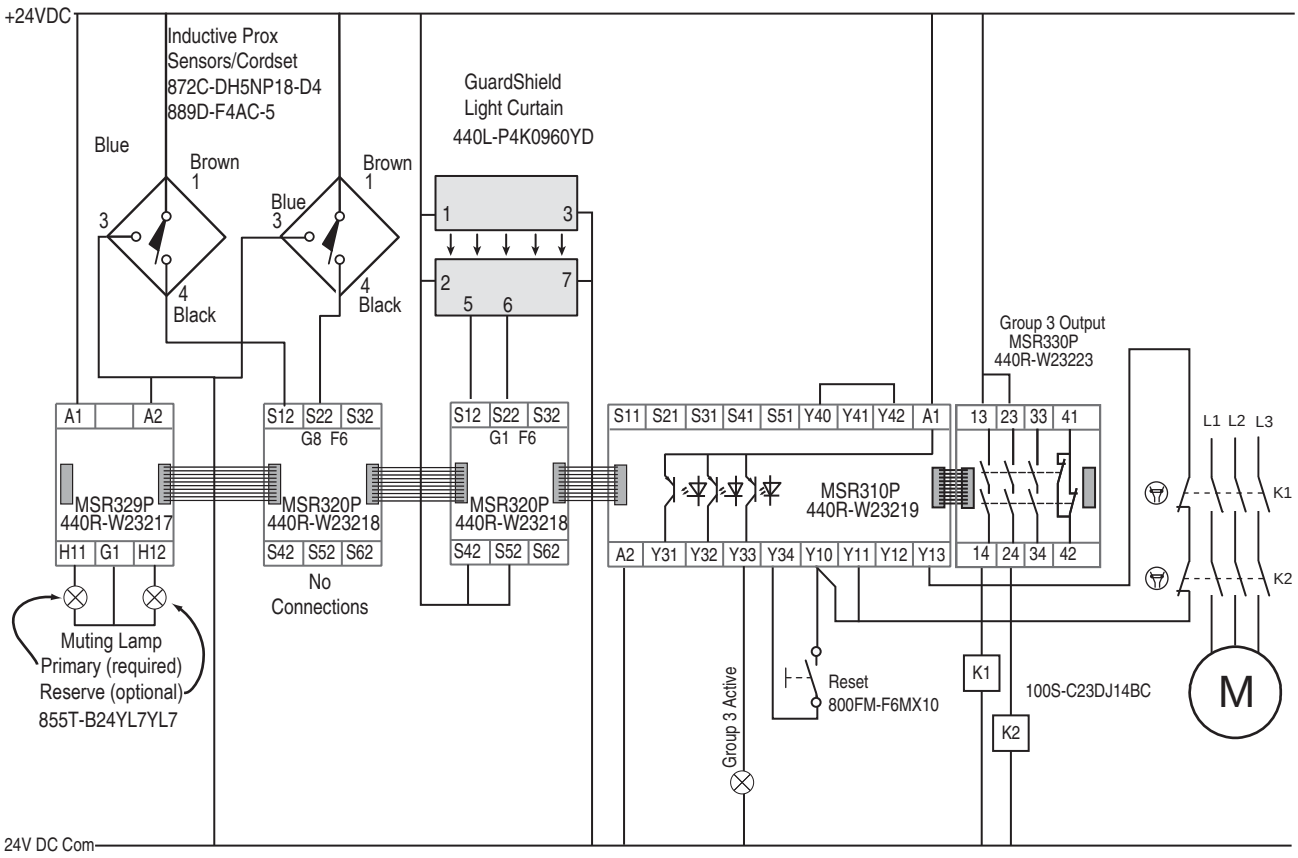
STOPPING: Obstructing the light curtain without blocking sensors MS1 and MS2 de-energizes the MSR22LM safety outputs. After clearing the light curtain, press the start/restart button to re-energize the safety outputs of the MSR22LM.

Fault Detection

Upon power-up, the GuardShield and MSR22LM perform internal checks. If OK and clear, the GuardShield outputs turn on. The MSR22LM checks the muting inputs. If OK, the MSR22LM checks the light curtain for dual channel signals. If OK, the muting lamp blinks continuously and the start/restart required lamp turns on to indicate that the MSR22LM is ready to start. While running, an incorrect sequence of the muting sensors and light curtain operation or excessive time to move the object through the light curtain will de-energize the safety outputs of the MSR22LM. The run LEDs or the muting lamp blink at certain rates to indicate the type of fault that has occurred. The start/restart button can be held down for three seconds to manually move material through the conveyor. The motor will then run for 12 seconds. Some faults can be cleared by removing the object from the sensors. The start/restart required button will turn on when the MSR22LM is ready to go. Other faults may have to be cleared by cycling the power to the MSR22LM. The MSR22LM monitors the 100S-D contactors through the mechanically linked "mirrored" contacts connected in series. If one contactor welds closed, the second contactor will stop the motor, and the MSR22LM will detect the fault at the next attempt to start the motor.

Ratings

The safety function initiated by the GuardShield light curtain meets the safety performance requirements of SIL CL 3 per IEC 62061:2005 and has Category 4 structure that can be used in systems requiring Performance Levels up to PLe per ISO 13849-1: 2006. This example circuit performs a Stop Category 0 function (coast to stop).



Circuit Status

The light curtain is clear. The inductive proximity sensors are clear. The MSR330P outputs are de-energized. The motor is off.

Operating Principle

The MSR300 is configured for a muting function. When both proximity sensors detect appropriate targets, the light curtain function is muted. The proximity sensors operate as a pair and do not have to operate in a specific sequence. The application must be an automatic process where the muting function is temporary. A muting lamp indicates when the muting function is active. The muting lamp is monitored. If the muting lamp burns out, the MSR300 will continue to function if a reserve lamp is present; otherwise the output stay off until the primary muting lamp is replaced.

STARTING: Press the reset button to energize all MSR330P outputs. The contactors K1 and K2 energize and the motor is turned on.

STOPPING: Obstructing the light curtain when the proximity sensors are not active will cause the MSR310P to de-energize and stop the motor.

Fault Detection

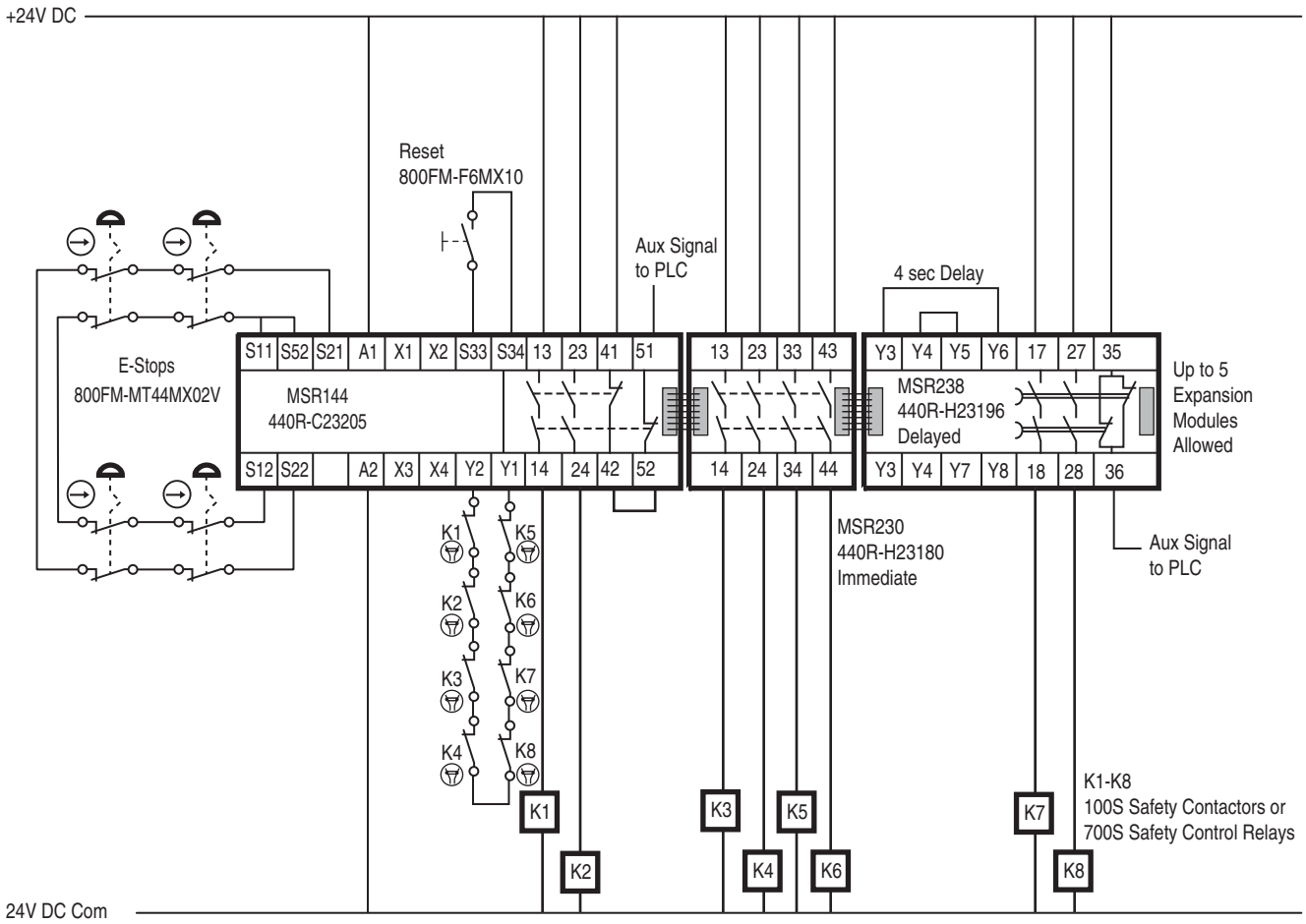
Upon successful completion of internal checks on power up, the MSR310P checks the input circuits. Shorts from the inputs to power, ground or other inputs will be detected immediately and will prevent energizing or will de-energize the MSR330P outputs. If one of the 100S output devices (K1 or K2) is stuck in an actuated state, the MSR310P will prevent startup because the Y10/Y13 feedback loop will remain open. The proximity sensors must be located in a way that prevents easy bypassing with spare targets.

Ratings

The safety function initiated by the GuardShield light curtain meets the safety performance requirements of SIL CL 3 per IEC 62061:2005 and has Category 4 structure that can be used in systems requiring Performance Levels up to PLe per ISO 13849-1: 2006. This example circuit performs a Stop Category 0 function (coast to stop).

Expandable Outputs—E-Stop with Immediate and Delayed Outputs

800F, MSR144, MSR230, MSR238, 100S, 700S



Circuit Status

The e-stop is reset. The safety outputs of the MSR144, MSR230 and MSR238 are de-energized. The motor is off.

Operating Principle

The MSR144 was chosen for its ability to expand its outputs with a combination of MSR230 and MSR238 modules. Up to five modules can be added to one MSR144. Ribbon cables on the front of the relay extend control of the MSR144 to MSR230 and MSR238. Without jumpers to X1/X2 and X3/X4, the MSR144 is set to monitored manual reset.

STARTING: Press and release the reset button to energize the outputs of the MSR144, MSR230 and MSR238. K1-K8 safety contactors or safety control relays energize to control the hazardous portion of the machine.

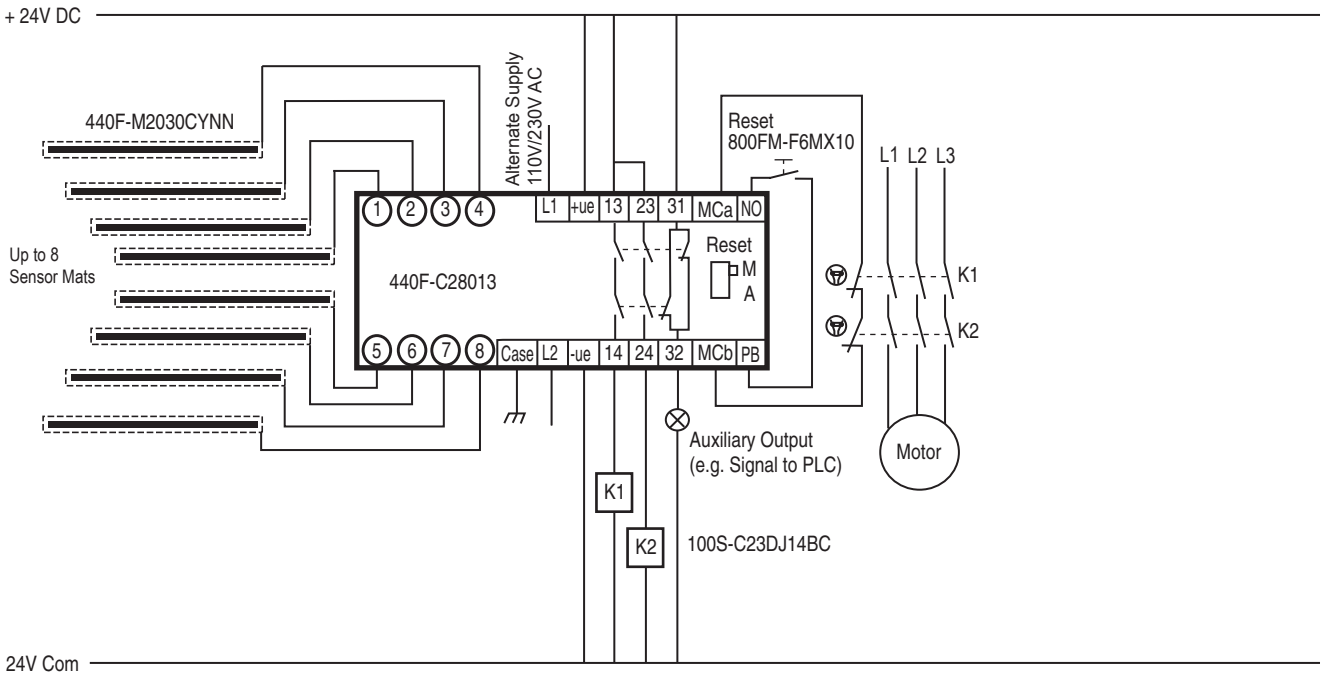
STOPPING: When an e-stop is pressed, the safety outputs of the MSR144 and MSR230 immediately turn off and de-energize K1-K6. Four seconds later, the safety outputs of the MSR238 turn off and de-energize K7 and K8.

Fault Detection

Upon power-up, the MSR144 performs internal checks. The checks also include verification that the MSR230 and MSR238 modules are in the off state. The MSR144 then looks for dual signals from the e-stop circuit. A crossfault on the e-stop circuit will be detected by the MSR144. With the e-stop signals made, closing the reset button places a voltage to the Y2 terminal. The external devices (K1 through K8) are checked to confirm they are off. A fault in K1 through K8 will cause their normally closed contacts to remain open, and this fault will be detected by the MSR144.

Ratings

The safety function initiated by the series connection of 800F e-stop buttons meets the safety performance requirements of SIL CL 2 per IEC 62061:2005 and has Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1: 2006. The Category 3 rating requires the redundant usage of K1-K8 to de-energize the machine actuators, and the contactors must be monitored by the safety system. This example circuit performs a Stop Category 0 function (coast to stop).



Circuit Status

There is no presence on the safety mats. The safety outputs of the Mat Manager are de-energized. The motor is off.

Operating Principle

The Mat Manager monitors up to eight mats, which are individually connected to the Mat Manager by M12 connectors. LEDs on the front of the Mat Manager indicate which mat is actuated as well as providing status LED for power and safety outputs.
STARTING: Press the reset button to energize the outputs of the Mat Manager.
STOPPING: Stepping on any of the safety mats will turn off the safety outputs of the Mat Manager and de-energize the K1 and K2 contactors.

Fault Detection

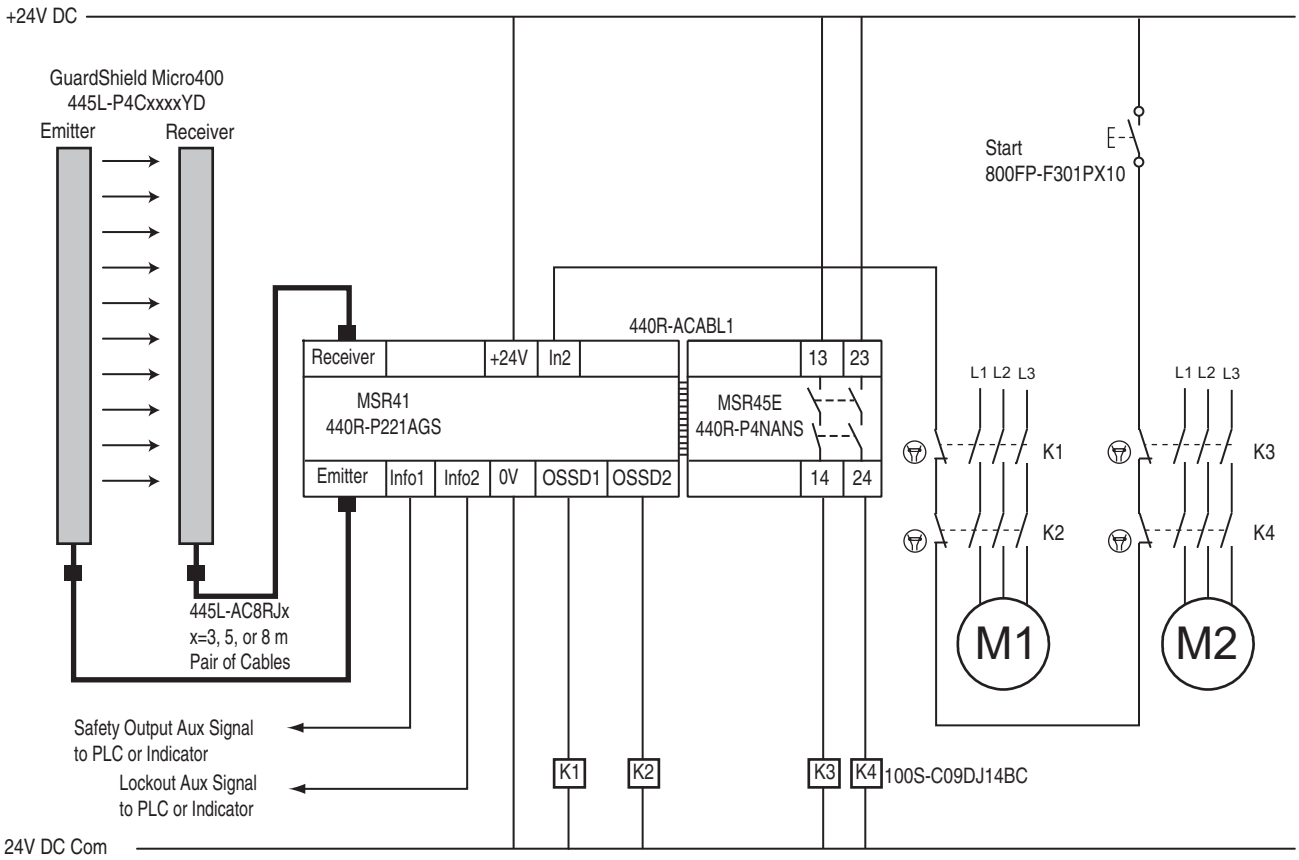
Upon power-up, the Mat Manager performs internal checks. The Mat Manager then looks for current flowing through each of the safety mats. A short or open circuit on any of the safety mats will be detected by the Mat Manager. With the safety mat signals made, the Mat Manager checks the reset button. With monitored manual reset selected, a short circuit or stuck pushbutton will be detected by the Mat Manager. Pressing the reset button, the Mat Manager checks the K1 and K2 contactors. A stuck or welded contactor will be detected by an open normally closed contact.

Ratings

The safety function initiated by the MatGuard safety mat meets the safety performance requirements of SIL CL 2 per IEC 62061:2005 and has Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1: 2006. This example circuit performs a Stop Category 0 function (coast to stop).

Micro400 Light Curtain with Controller and Expansion Module

Micro400, MSR41, MSR45E, 100S



Circuit Status

The light curtain is clear. K1, K2, K3 and K4 are off. The motors are off and ready to run.

Operating Principle

STARTING: Momentarily press the Start button. The OSSD safety outputs and the safety contacts 13/14 and 23/24 close. The contactors K1-K4 energize, and the motors M1 and M2 start.
STOPPING: Breaking the light curtain causes the OSSD safety outputs and the safety contacts 13/14 and 23/24 to open. The contactors K1-K4 drop out and the motors coast to a stop.

Removing the object from the light curtain will not cause the motor to run. The operator must momentarily close the Start switch to turn the motor on.

Fault Detection

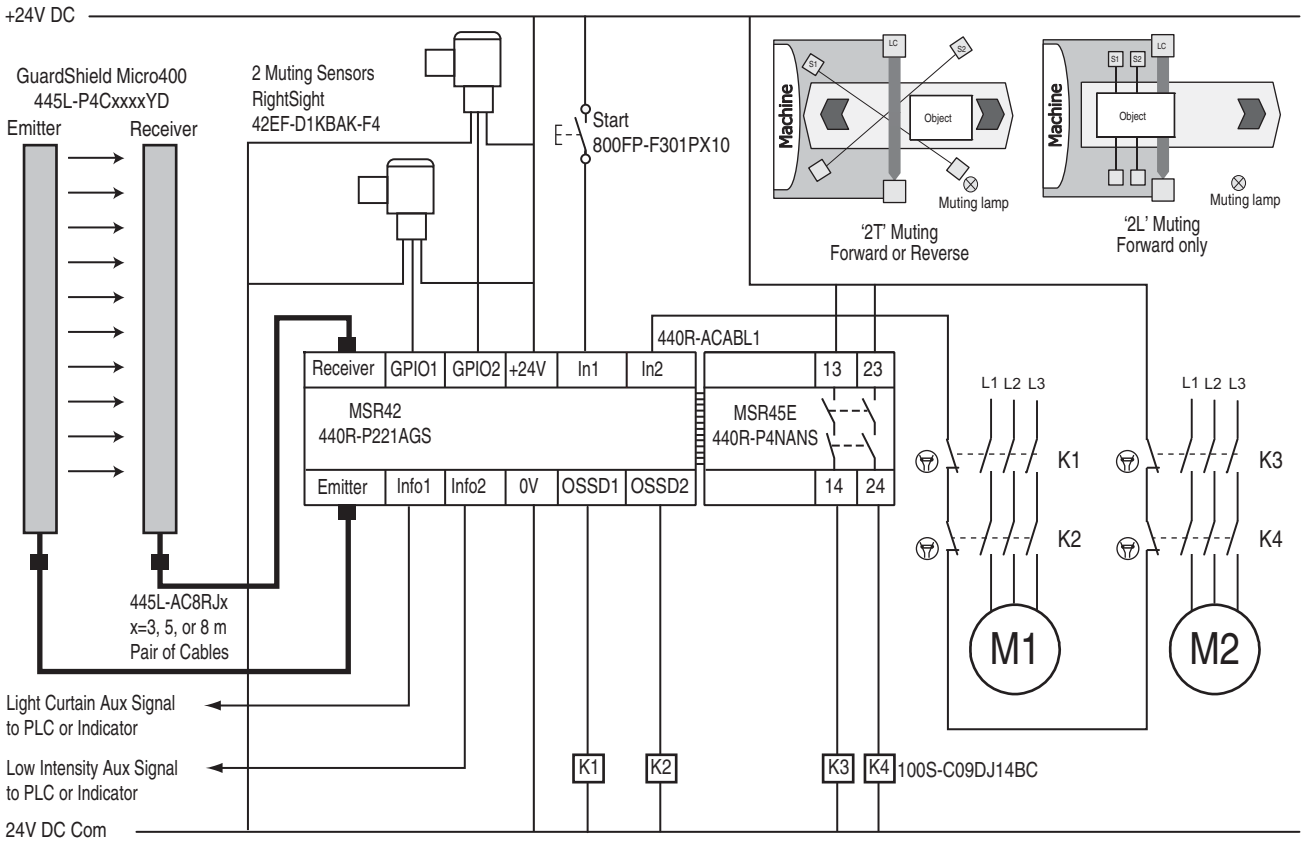
Upon successful completion of internal checks on power up, the GuardShield light curtain energizes its outputs with no objects present. The GuardShield light curtain outputs turn on. If a crossfault is detected, the GuardShield light curtain goes to a lockout state with its outputs off. After successful completion of internal checks, the MSR41 checks the signals from the light curtain. If it's okay, the MSR41 then checks the status of the K1-K4 contactors. If one of the pair of contactors fails in the actuated state, the other contactor will disconnect the motor. The MSR41 will detect the faulted contactor and will not allow the motor to restart until the fault is corrected.

Ratings

This circuit can meet the safety performance requirements of PLe per ISO13849-1: 2006 and SIL CL3 per IEC62061:2005. This circuit executes a Category 0 stop.

Two Sensor Muting with Micro400 Light Curtain

42EF, Micro400, MSR42, 100S



Circuit Status

The light curtain and muting sensors are clear. K1, K2, K3 and K4 are off. The motors are off and ready to run.

Operating Principle

STARTING: Momentarily press the Start button. The OSSD safety outputs turn on and the safety contacts 13/14 and 23/24 close. The contactors K1-K4 energize, and the motors M1 and M2 start.

MUTING: The MSR42 must be configured for two sensor L-type or T-type sensing. When the object passes by the sensors in the proper sequence, the light curtain becomes muted. The muting process is complete when the object passes by both sensors, and the light curtain becomes active again.

STOPPING: Breaking the light curtain causes the OSSD safety outputs and the safety contacts 13/14 and 23/24 to open. The contactors K1-K4 drop out and the motors coast to a stop.

Fault Detection

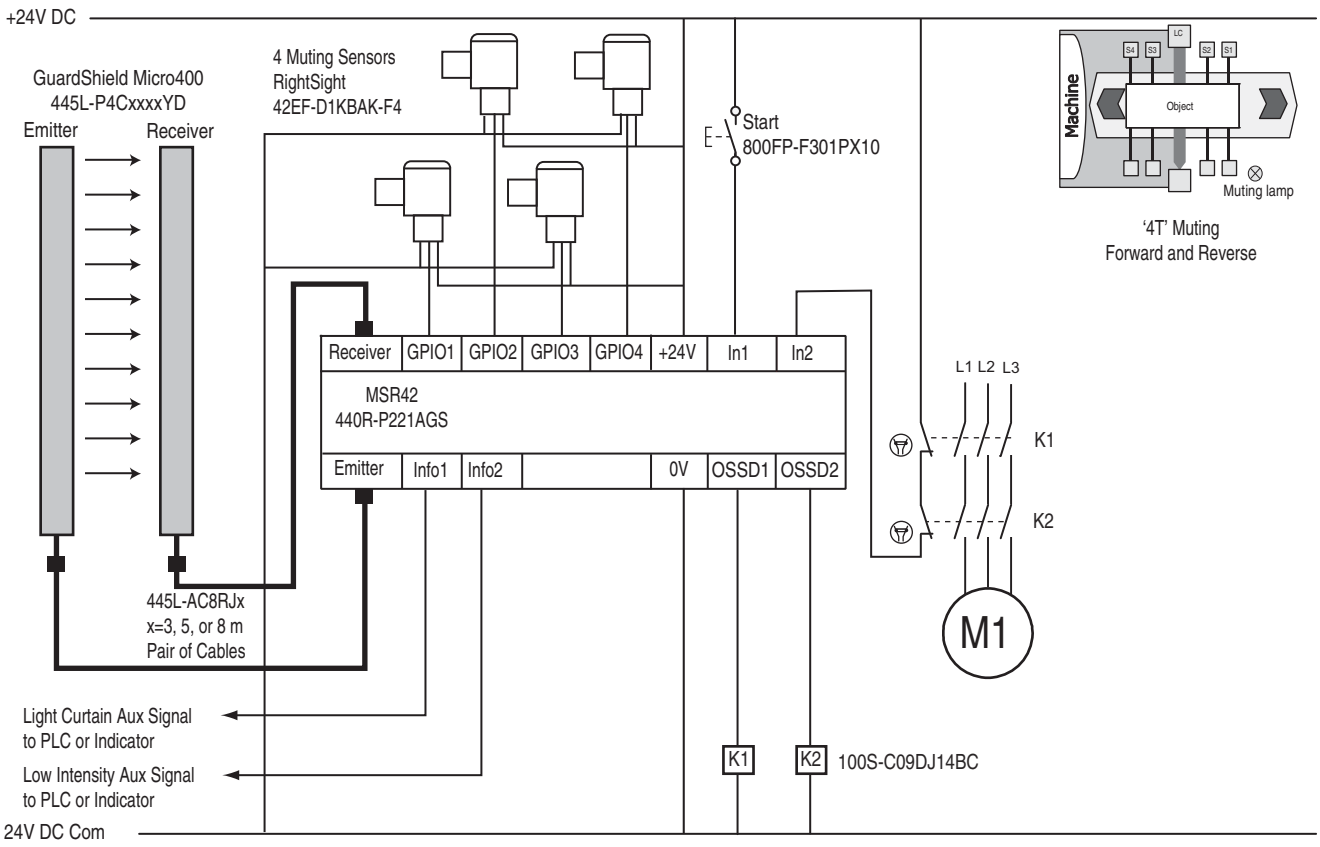
Upon successful completion of internal checks on power up, the GuardShield light curtain energizes its outputs with no objects present. The GuardShield light curtain outputs turn on. If a crossfault is detected, the GuardShield light curtain goes to a lockout state with its outputs off. After successful completion of internal checks, the MSR42 checks the signals from the light curtain. If it's okay, the MSR42 then checks the status of the four sensors and the K1 and K2 contactors. If a sensor is shorted in the ON state, the MSR42 will not allow the OSSD outputs to turn ON. If one of the contactors fails in the actuated state, the other contactor will disconnect the motor. The MSR42 will detect the faulted contactor and will not allow the motor to restart until the fault is corrected.

Ratings

This circuit can meet the safety performance requirements of PLe per ISO13849-1: 2006 and SIL CL3 per IEC62061:2005. This circuit executes a Category 0 stop.

Four Sensor Muting with Micro400 Light Curtain

42EF, Micro400, MSR42, 100S



Circuit Status

The light curtain and muting sensors are clear. K1 and K2 are off. The motor is off and ready to run.

Operating Principle

STARTING: Momentarily press the Start button. The OSSD safety outputs turn on. The contactors K1-K2 energize, and the motor M1 starts.
MUTING: The MSR42 must be configured for four sensor T-type sensing, with appropriate time settings. When the object passes by the sensors in the proper sequence, the light curtain becomes muted. The muting process is complete when the object passes by all the sensors and the light curtain becomes active again.
STOPPING: Violating the muting timing constraints and breaking the light curtain causes the OSSD outputs to turn off. The contactors K1-K2 drop out and the motors coast to a stop. If the object stops in the light curtain, the Start button can be used to temporarily override the muting function and energize the OSSD outputs.

Fault Detection

Upon successful completion of internal checks on power up, the GuardShield light curtain energizes its outputs with no objects present. The GuardShield light curtain outputs turn on. If a crossfault is detected, the GuardShield light curtain goes to a lockout state with its outputs off. After successful completion of internal checks, the MSR42 checks the signals from the light curtain. If it's okay, the MSR42 then checks the status of the four sensors and the K1 and K2 contactors. If a sensor is shorted in the ON state, the MSR42 will not allow the OSSD outputs to turn ON. If one of the contactors fails in the actuated state, the other contactor will disconnect the motor. The MSR42 will detect the faulted contactor and will not allow the motor to restart until the fault is corrected.

Ratings

This circuit can meet the safety performance requirements of PLe per ISO13849-1: 2006 and SIL CL3 per IEC62061:2005. This circuit executes a Category 0 stop.

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Patent Information

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Australia
AU2632199, AU4337393, AU4337493, AU5009296, AU5420790, AU6739598, AU7051591, AU7631996, AU7701196, AU7944794, AU8661891, AU8875098

Germany
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JP11503867T, JP2000501224T, JP2001311454, JP2001312930, JP2002373552, JP3007413B2, JP3281384B2, JP4504792T, JP7507416T , JP9507333T

U. S.
US2002175058, US4963706, US5254879, US5587569, US5777284, US5977500, US6135417, US6213148, US6365850, US6418592, US6446666, US6474120, US6483049

Worldwide
WO9008396, WO9013180, WO9110250, WO9207374, WO9324946, WO9324947, WO9518457, WO9633504, WO9719285, WO9720334, WO9842937, WO9913254, WO9943915

Trademark Information

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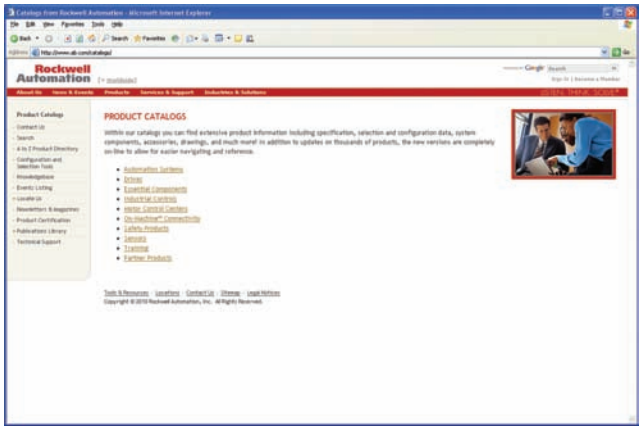
On-Line Resources



Safety Products Catalog
www.ab.com/catalogs

For the most current version of the Safety Products catalog, visit the Allen-Bradley catalog web site at www.ab.com/catalogs. With our on-line catalog, you can search for information by product type or by catalog number.

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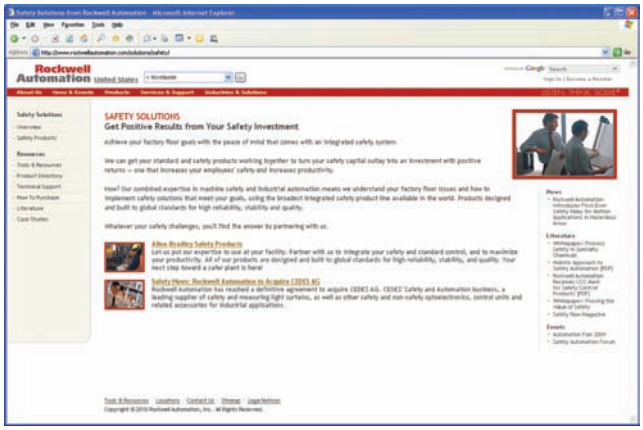

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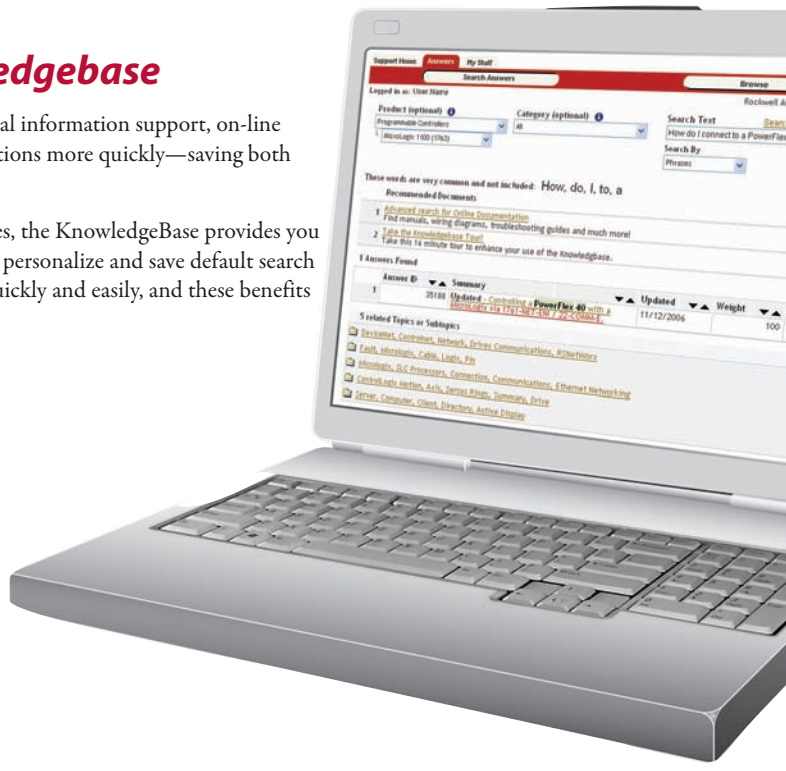
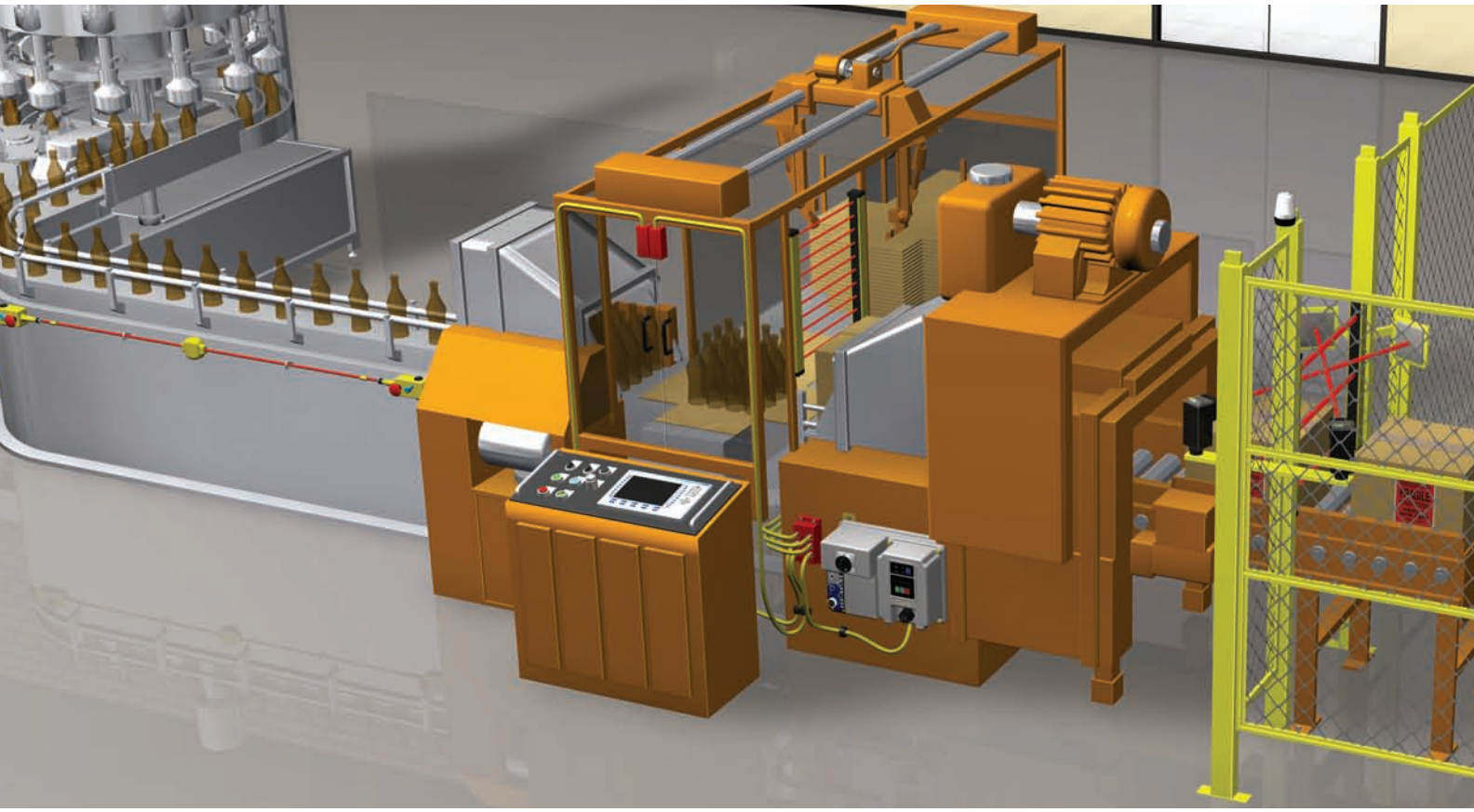
The Rockwell Automation KnowledgeBase is your first resource for technical information support, on-line 24x7x365. Increase your productivity by finding solutions to technical questions more quickly—saving both time and money.

Maintained by highly trained support engineers who use this tool themselves, the KnowledgeBase provides you with search functions including a natural language option and the ability to personalize and save default search criteria easily. These functions help you to find answers and resolve issues quickly and easily, and these benefits only improve with time as you use the tool!



Product Catalogs

- Industrial Controls
- Automation Systems
- Sensors
- The Motion Book
- AC & DC Adjustable Speed Drives
- Control-Matched Variable Speed AC & DC Motors
- On-Machine™ Connectivity
- **Safety Products**
- Rockwell Software



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Allen-Bradley
Guardmaster®

MINOTAUR MSR121RT

(a) **MONITORING SAFETY RELAY**
ÜBERWACHUNGS-/SICHERHEITSRELAIS
RELAIS DE SECURITE POUR CONTROLE

(b) Installation Instructions — Einbauanleitung — Notice D'installation

RETAIN THESE INSTRUCTIONS

Installation must be in accordance with the following steps and must be carried out by suitably competent personnel.
This device is intended to be part of the safety related control system of a machine. Before installation, a risk assessment should be performed to determine whether the specifications of this device are suitable for all foreseeable operational and environmental characteristics of the machine to which it is to be fitted.
At regular intervals during the life of the machine check whether the characteristics foreseen remain valid.
Guardmaster cannot accept responsibility for a failure of this device if the procedures given in this sheet are not implemented or if it is used outside the recommended specifications in this sheet.
Exposure to shock and/or vibration in excess of those stated in IEC 68 part: 2-6/7 should be prevented.
Adherence to the recommended inspection and maintenance instructions forms part of the warranty.

DIESE ANLEITUNG AUFBEWAHREN

Die Installation muß unter Einhaltung der nachstehend beschriebenen Schritte, und durch geeignetes, fachlich qualifiziertes Personal erfolgen.
Diese Vorrichtung ist als Teil des sicherheitsrelevanten Kontrollsystems einer Maschine vorgesehen. Vor der Installation sollte eine Risikobewertung zur Festlegung dessen erfolgen, ob die Spezifikationen dieser Vorrichtung für alle vorhersehbaren betrieblichen und umweltbezogenen Eigenschaften der jeweiligen Maschine geeignet sind, an der sie installiert werden soll.
In regelmäßigen Abständen während der Lebensdauer der Maschine ist zu überprüfen, ob die vorhergesehenen Eigenschaften weiterhin gültig sind.
Guardmaster kann keinerlei Verantwortung für ein Versagen dieser Vorrichtung übernehmen, wenn die in diesem Schriftblatt gegebenen Verfahrensweisen nicht implementiert wurden, oder wenn sie außerhalb der auf diesem Schriftblatt empfohlenen Spezifikationen verwendet wird.
Eine Aussetzung an Stoßbelastungen und/oder Vibrationen, die überhalb den in IEC 68, Teil 2-6/7 angegebenen Werten liegen, sollte verhindert werden.
Die Einhaltung der empfohlenen Inspektions- und Wartungsvorschriften ist Teil der Garantie.

CONSERVEZ CES INSTRUCTIONS

L'installation doit être effectuée conformément aux instructions suivantes, par des membres qualifiés du personnel.
Ce dispositif est étudié pour être incorporé dans le système de contrôle pour la sécurité d'une machine. Avant l'installation, on doit effectuer une évaluation des risques pour déterminer si les spécifications de ce dispositif sont appropriées pour toutes les caractéristiques de service et du milieu d'utilisation prévues pour la machine sur laquelle il sera monté.
Vérifier, à des échéances régulières au cours de la vie de la machine, que les caractéristiques prévues sont toujours valables. Guardmaster décline toute responsabilité pour les défaillances de cet appareil si les procédures décrites dans la présente notice ne sont pas appliquées ou si l'appareil est utilisé hors des spécifications recommandées dans cette même notice.
Eviter toute exposition à des chocs et/ou des vibrations supérieurs à ceux qui sont spécifiés dans la norme IEC 68 part. 1-6/7.
Le respect des instructions relatives à l'inspection, au contrôle et à l'entretien de cet appareil rentre dans l'application de la garantie.

(c) Mode of Operation — Funktionsweise — Mode de Fonctionnement

The dual channel operation shown in wiring example 1 includes crossfault monitoring between both E-stop circuits. That means in case of shorts between the two E-stop channels the **MSR121** will de- activate the outputs. This is achieved by an electronic protection circuit in the safety relay. The LEDs CH1 and CH2 will go out and power LED will start flashing during the activation. After elimination of the malfunction, the MSR121 is ready for operation again. The application with monitored start checks the start circuit (S33/S34) and will only activate the MSR121 if there is a leading edge in this circuit. If wired for autostartfunction the **MSR121** will be activated automatically by the supply voltage if the E-stop circuits and the feedback loop (X5/S33) are closed. In applications, where both E-stop circuits are not closed simultaneously, (e.g. safety gates) channel 2 has to be activated before channel 1. If the inputs will be activated with external 24VDC , the negative pole has to be connected to A2 (Light curtain application). The open collector semiconductor output may transfer the status of the MSR121 via the terminals Y31-Y32 direct to a PLC. To control NC contacts from external contactors the feedback loop has to be wired in series between the start button respectively X5 and S33 (Autostart).

Bei 2-kanaliger Ansteuerung gemäß Schaltungsbeispiel 1 besteht Querschlußsicherheit. Das heißt, bei Betätigung einer Schaltmatte in Vierleitertechnik (Schaltungsbeispiel 2) oder einem Leitungsschluß spricht eine elektronische Sicherung im Gerät an und schaltet das **MSR121** aus.
Während des Querschlusses erlöschen die LEDs CH1 und CH2 und LED PWR beginnt zu blinken. Nach Beseitigung der Ursache bzw. Freigabe der Schaltmatte ist das **MSR121** sofort wieder betriebsbereit.
Die Funktion des Starttasters wird bei jedem Einschaltvorgang überprüft.
Ist der Eintaster vor dem Entriegeln der Not-Aus-Taster oder Anlegen der Versorgungsspannung geschlossen, ist kein Start möglich. Soll das Gerät automatisch über die Versorgungsspannung eingeschaltet werden, so sind die Kontakte X5 und S33 zu brücken. Werden beide Not-Aus Kreise nicht gleichzeitig angesteuert (z.B. bei einer Schutztür überwachung), so muß Kanal 2 vor Kanal 1 geschlossen werden. Werden die Eingänge des **MSR121** extern mit 24 VDC angesteuert (Lichtgitteransteuerung), so ist *das negative Potential mit A2 zu verbinden. Der Open- Collector* Halbleiterausgang kann über die Klemmen Y31-Y32 direkt den *Schaltzustand des **MSR121** an eine SPS melden. Zu überwachende* Öffnerkontakte von externen Erweiterungen sind in Reihe mit dem *Starttaster bzw. zwischen X5 und S33 (bei Auto-Start) zu schalten.*

Le fonctionnement bi-canal illustré dans l'exemple de câblage nº1 prévoit le contrôle des défaillances entre les deux circuits d'arrêt d'urgence. En cas de court-circuit entre les deux canaux d'arrêt d'urgence, le **MSR121** désactive les sorties grâce à un circuit de protection électronique prévu dans le relais de sécurité. Après élimination de la défaillance, le **MSR121** est à nouveau prêt à fonctionner. L'application à démarrage contrôlé vérifie le circuit de démarrage (S33/S34) et active uniquement le **MSR121** en présence d'un front d'attaque dans le circuit. Si la fonction de démarrage automatique est prévue, le **MSR121** est automatiquement activé à la mise sous tension si les circuits d'arrêt d'urgence et la boucle de feed-back (X5/S33) sont fermés. Dans les applications où les deux circuits d'arrêt d'urgence se ferment simultanément (par ex. les portes de sécurité), le canal 2 doit être activé avant le canal 1. Si les entrées sont activées par une alimentation externe de 24 V c.c., le pole négatif doit être connecté à la borne A2 (barrières photoélectriques). La sortie à semi-conducteur à collecteur ouvert peut directement transmettre à un PC l'état du MSR121 à partir des bornes Y31-Y32. Pour commander les contacts normalement fermés à partir de contacteurs externes, câbler la boucle de feed-back en série entre le bouton de démarrage, soit respectivement X5 et S33 (démarrage automatique).

Deutsch / *Français*

1

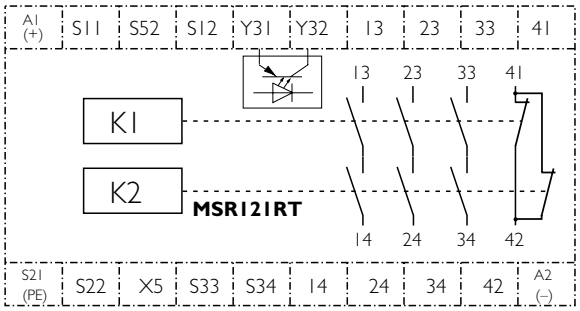
(a) **Rückansicht** / *Vue de l'arrière*
(b) **Spannung abschalten**/ *Isoler les alimentations*
(c) **Auf 35mm-Normschiene anbringen** / *Montage sur rail DIN 35mm*
(d) **In Einbaugehäuse nach mind. IP 54 montieren** / *Monter dans un coffret conforme au minimum à la norme IP 54*

2

(b)
A1 & A2 = Strom
S11 & S12 = Sicherheitseingang Ruhekontakt
S21 & S22 = Sicherheitseingang Ruhekontakt
S33 & S34 = Überwachung Rückmeldungsschleife, mit Rückstellungsknopf
13 & 14 = Sicherheitsausgang 1 (Arbeitskontakt).
23 & 24 = Sicherheitsausgang 2 (Arbeitskontakt).
33 & 34 = Sicherheitsausgang 3 (Arbeitskontakt).
41 & 42 = Hilfsausgang (Ruhekontakt).
Y31 & Y32 = Hilfsausgang Halbleiter PNP

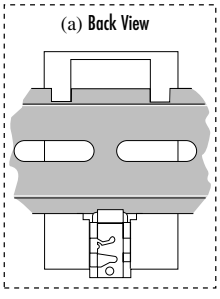
Connexions :
A1 & A2 = Alimentation
S11 & S12 = Entrée de sécurité N/F
S21 & S22 = Entrée de sécurité N/F
S33 & S34 = Boucle de feed-back de contrôle avec bouton Init
13 & 14 = Sortie de sécurité 1 (N/O)
23 & 24 = Sortie de sécurité 2 (N/O)
33 & 34 = Sortie de sécurité 3 (N/O)
41 & 42 = Sortie auxiliaire (N/F)
Y31 & Y32 = Sortie auxiliaire semi-conducteur PNP

(d) CIRCUIT DIAGRAM/ANSCHLUSSDIAGRAMM/SCHEMA DES CONNEXIONS



(c) **LED-Anzeigen**
CH2 (GRÜN) - Leuchtet auf, wenn K2 geschlossen ist
CH1 (GRÜN) - Leuchtet auf, wenn K1 geschlossen ist
STROM (GRÜN) - Leuchtet auf, wenn Strom ein ist
/
DEL:
CH2 (VERT) - S'allume lorsque K2 est fermée
CH1 (VERT) - S'allume lorsque K1 est fermée
ALIMENTATION (VERT) - S'allume à la mise sous tension

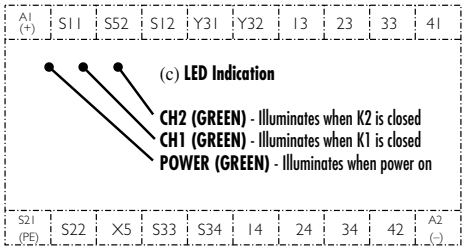
1



(b) **Isolate power**
(c) **Mount on 35mm DIN rail.**
(d) **Mount in enclosure to a min. of IP 54.**

2 (a) **Connections / Anschlüsse / Connexions**

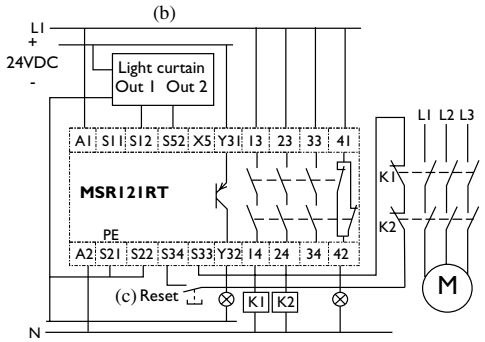
(b)
A1 & A2 = Power
S11 & S12 = Safety Input N/C
S21 & S22 = Safety Input N/C
S33 & S34 =Monitoring Feedback Loop, incorporating Reset Button
13 & 14 = Safety output 1 (N/O).
23 & 24 = Safety output 2 (N/O).
33 & 34 = Safety output 3 (N/O).
41 & 42 = Auxiliary output (N/C).
Y31 & Y32 = Auxiliary output Semi Conductor PNP



3

(b) **Lichtschranke Ausgang 1 Ausgang 2 /** *Barrière photoélectrique Out 1 Out 2*
(c) **Rückstellung /** *Initialisation*
(d) **24V DC Lichtschranke, 115/230V AC Sicherheitsrelais, überwachte manuelle Rückstellung, überwachter Ausgang /** *Barrière photoélectrique 24 V c.c., relais de sécurité 115/230 V c.a., initialisation manuelle contrôlée, sortie contrôlée*

3 (a) Wiring example 1 / Anschlußbeispiel 1 / Exemples de câblage 1

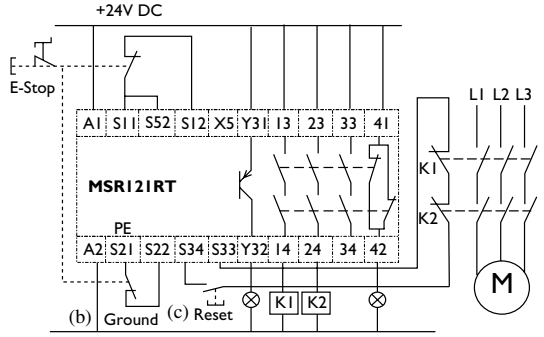


(d) **24V DC Light Curtain, 115/230V AC Safety Relay, Monitored Manual Reset, Monitored Output**

4

(b) **Erde /** *Terre*
(c) **Rückstellung /** *Initialisation*
(d) **Zweikanal-Notaus, überwachte manuelle Rückstellung, überwachter Ausgang /** *Arrêt d'urgence bi-canal, initialisation manuelle contrôlée, sortie contrôlée*

4 (a) Wiring example 2 / Anschlußbeispiel 2 / Exemples de câblage 2

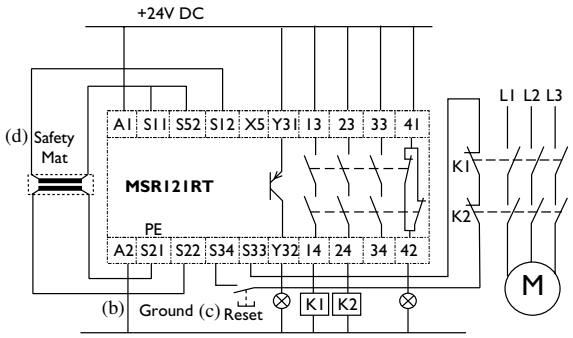


(d) **Dual Channel E-Stop, Monitored Manual Reset, Monitored Output**

5

(b) **Erde /** *Terre*
(c) **Rückstellung /** *Initialisation*
(d) **Rückstellung /** *Initialisation*
(e) **Sicherheitsmatte überwachte manuelle Rückstellung, überwachter Ausgang /** *Tapis de sécurité, Initialisation manuelle contrôlée, sortie contrôlée*

5 (a) Wiring example 3 / Anschlußbeispiel 3 / Exemples de câblage 3

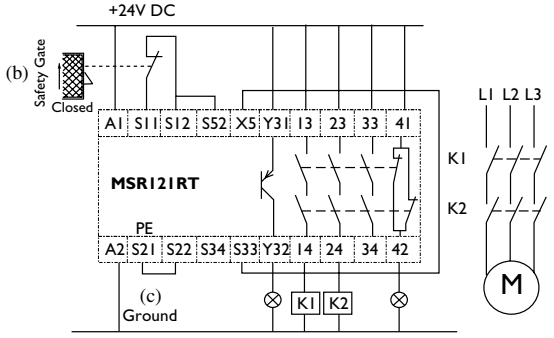


(e) **Safety Mat Monitored Manual Reset, Monitored Output**

6

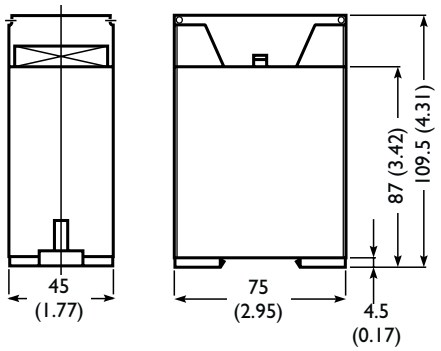
(b) **Sicherheitstor /** *Porte de sécurité*
(c) **Erde /** *Terre*
(d) **Einkanal-Sicherheitstor, automatische Rückstellung, keine Ausgangsüberwachung /** *Porte de sécurité monocanal, autoinitialisation, sortie non contrôlée*

6 (a) Wiring example 4 / Anschlußbeispiel 4 / Exemples de câblage 4



(d) **Single Channel Safety Gate, Automatic Reset, No Output Monitoring**

(e) DIMENSION DIAGRAM/ABMESSUNGSDIAGRAMM/SCHEMA COTÉ



(f) Technical Specifications

Standards	IEC/EN60204-1, ISOTR12100 ISO13849-1 (EN954-1)
Safety Category	Cat. 4 per EN954-1
Approvals	CE marked for all applicable directives
Power Supply	24V AC/DC, 115/230V AC 0.8 to 1.1 x rated voltage 50/60 Hz
Power Consumption	4W
Safety Inputs	1 N.C., 2 N.C. or light curtain
Input Simultaneity	Infinite
Maximum Input Resistance	45 ohms
Reset	Auto./Manual or Monitored Manual
Outputs	3 N.O. Safety, 1 N.C. Auxiliary 1 S.S. PNP Aux.
Output Rating EM-Relay	A300, AC-15, 6A/250V AC
A300/N300 ref.: I_{th}, U_i	N300,DC-13, 3A/24V DC
SS	20mA@24V DC
Fuses Output (external)	6A Slow Blow or 10A Quick Blow
Contact Material	$AgSnO_2$ + 0.5µAu
Min. Switched Current/Voltage	10mA/10V
Power On Delay	1s
Response Time 24V DC	15ms
24/115/230V AC	20ms
Recovery Time	> 2s
Impulse Withstand Voltage	2500V
Operating Temperature	-5°C to +55°C (+23°F to 131°F)
Humidity	90% RH
Enclosure Protection	IP40 (NEMA 1), DIN 0470
Terminal Protection	IP20, DIN 0470
Electronic Short Circuit protection	Inputs & solid state output
Conductor Size	0.2-4mm² (24-12AWG)
Installation Group	C in accordance with VDE 0110
Pollution Degree	2
Mounting	35mm DIN rail
Weight 24V DC	290g (0.64 lbs)
110 and 230V AC	370g (0.82 lbs)
Electrical Life	
220V AC/4A/880VA cosφ=0.35	100,000 operations
220V AC/1.7A/375VA cosφ=0.6	500,000 operations
30V DC/2A/60W	1,000,000 operations
10V DC/0.01A/0.1W	2,000,000 operations
Mechanical Life	2,000,000 operations
Vibration	10-55 Hz, 0.35mm
Shock	10g, 16ms, 100 shocks

Technische Daten

Normen	IEC/EN60204-1, ISOTR12100 ISO13849-1 (EN954-1)
Schutzkategorie	Kat. 4 nach EN954-1
Zulassungen	CE-Kennzeichnung für alle zutreffenden Direktiven
Spannungsversorgung	24V AC/DC, 115/230V AC 0,8 bis 1,1 x Nennspannung, 50/60 Hz
Leistungsverbrauch	4W
Schutzeingänge	1 oder 2 Ruhekontakte oder Lichtschranke
Eingangsgleichzeitigkeit	Unbegrenzt
Max. Eingangswiderstand	45 ohms
Rückstellung	automatische/manuelle oder überwachte manuelle
Ausgänge	3 Arbeitskontakt-Sicherheitsausgänge, 1 Ruhekontakt-Hilfsausgang
	1 Halbleiterausgang PNP
Ausgangsnennbelastung EM-Relais	A300, AC-15, 6A/250V AC
A300/N300 ref.: I_{th}, U_i	N300, DC-13, 3A/24V DC
Halbleiter	20mA@24V DC
Sicherungen Ausgang (extern)	6A träge oder 10A flinke
Kontaktmaterial	$AgSnO_2$ + 0.5µAu
Min. geschalteter Strom/Spannung	10mA/10V
Strom-ein-Verzögerung	1s
Reaktionszeit 24V DC	15ms
24/115/230V AC	20ms
Erholungszeit	> 2s
Stehstossspannung	2500V
Betriebstemperatur	-5°C bis +55°C (+23°F bis 131°F)
Feuchtigkeit	90% RF
Gehäuseschutz	IP40 (NEMA 1), DIN 0470
Klemmenschutz	IP20, DIN 0470
Elektronischer Kurzschlussschutz	Eingänge & Halbleiterausgänge
Leiterquerschnitt	0.2-4mm² (24-12AWG)
Installationsgruppe	C gemäß VDE 0110
Verschmutzungsgrad	2
Befestigung	35mm DIN-Schiene
Gewicht 24V DC	290g (0.64 lbs)
110 and 230V AC	370g (0.82 lbs)
Elektrische Lebensdauer	
220V AC/4A/880VA cosφ=0.35	100.000 Betätigungen
220V AC/1.7A/375VA cosφ=0.6	500.000 Betätigungen
30V DC/2A/60W	1,000,000 Betätigungen
10V DC/0.01A/0.1W	2,000,000 Betätigungen
Mechanische Lebensdauer	2,000,000 Betätigungen
Vibration	10g 10-55 Hz
Stösse	10g, 16ms, 100 Stösse

Spécifications Techniques

Normes	IEC/EN60204-1, ISOTR12100 ISO13849-1 (EN954-1)
Classe de sécurité	Cat. 4 selon EN954-1
Homologations	label CE pour toutes les directives applicables
Alimentation électrique	24V c.a./c.c., 42/115/230V c.a. 0,8 à 1,1 x tension nominale, 50/60 Hz
Consommation	4W
Contacts d'entrée de sécurité	1 ou 2 contacts N/F ou barrière photoélectrique
Simultanéité des entrées	infinie
Résistance maximale d'entrée	45 ohms
Entrées de sécurité	Auto / manuelle ou manuelle contrôlée
Contacts de sortie	3 N/O sécurité, 1 auxiliaire N/F 1 S.S. PNP Aux.
Puissance nominale contacts sortie	A300, c.a.-15, 6 A / 250 V c.a.
relais ME, A300/N300 ref.: I_{th}, U_i	N300, c.c.-13, 3 A / 24 V c.c.
SS	20mA@24V c.c.
Fusibles Sortie (externe)	6 A à fusion retardée ou 10 A à fusion rapide
Matière de contact	$AgSnO_2$ + 0.5µAu
Intensité/tension commutée min.	10mA/10V
Délai de mise sous tension	1s
Temps de réponse 24V c.c.	15ms
24/115/230V c.a.	20ms
Temps de rétablissement	> 2s
Tension impulsionnelle admise	2500V
Température de service	-5°C to +55°C
Humidité	90% HR
Indice de protection enceinte	IP40 (NEMA 1), DIN 0470
Protection aux bornes	IP20, DIN 0470
Protection contre les courts-circuits électroniques	Entrées et sortie à semi-conducteur
Diamètre conducteur	0.2-4mm² (24-12AWG)
Groupe de montage	C selon VDE 0110
Indice de pollution	2
Montage	rail DIN de 35 mm
Poids 24V c.c.	290g
110 and 230V c.a.	370g
Durée de vie électrique	
220V c.a./4A/880VA cosφ=0.35	100,000 d'opérations
220V c.a./1.7A/375VA cosφ=0.6	500,000 d'opérations
30V c.c./2A/60W	1,000,000 d'opérations
10V c.c./0.01A/0.1W	2,000,000 d'opérations
Durée de vie mécanique	2,000,000 d'opérations
Vibrations	10g, 10-55 Hz
Chocs	10g, 16ms, 100 chocs

(g) REPAIR

If there is any malfunction or damage, no attempts should be made to repair it. The unit should be replaced before machine operation is allowed.
DO NOT DISMANTLE THE UNIT.

REPARATUR

Falls Fehlfunktionen oder Schäden auftreten, keine Versuche zur Reparatur unternehmen. Der Schalter muß ersetzt werden, bevor die Maschine wieder gestartet wird.
GERÄT DARF NIEMALS GEÖFFNET WERDEN!

REPARATION

Dans l'éventualité d'un problème technique ou d'une détérioration de cet appareil, il doit être remplacé immédiatement avant la remise en production de la machine.
DANS TOUS LES CAS, NE DISLOQUEZ PAS L'APPAREIL.

CE Declaration of Conformity / Konformitätserklärung / Déclaration de conformité

This is to declare that the MSR121RT conforms with the Essential Health & Safety Requirements (EHSR's) of the European Machinery Directive (98/37/EC), the relevant requirements of the Low Voltage Directive (73/23/EEC as amended by 93/68 EEC) and the essential protection requirements of the EMC Directive (89/336/EEC as amended by 92/31 EEC). The MSR121RT also conforms to EN 292, EN 60204-1, EN 954-1, UL 508.

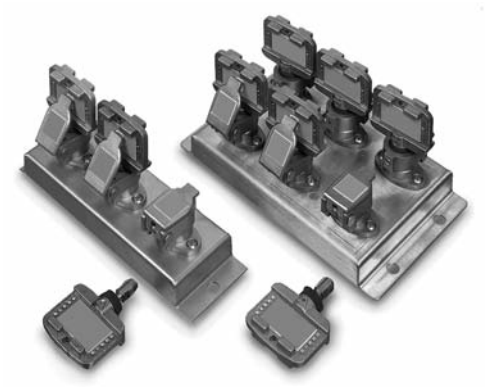
Signed for EJA Ltd
S. F. Mitchell
Managing Director

S.F. Mitchell

Allen-Bradley

Guardmaster®

Drg No: 57525 / Issue No: 1 /07/02
Change No:



Description

The key exchange unit (KEX) is used in an interlocking sequence to link together other devices in the Prosafe range and caters to more complex operating sequences.

The operating principle is such that no secondary keys can be removed from the unit until all primary keys have been inserted, rotated, and trapped. The primary keys remain trapped until all secondary keys have been re-inserted, rotated, and trapped.

It is typically used in applications where there is more than one access way to the hazardous area, and each access way must be open at the same time. The key exchange unit accomplishes this by allowing one or more keys to be inserted which then releases multiple keys out.

A typical process may require a rotary key switch to turn a motor off. The key from the rotary switch is removed and inserted into a KEX. The KEX then releases three keys which would allow simultaneous access to the hazard area through three different gates. This KEX is described as 1 key in 3 keys out. The keys in are considered primary codes, so the keys are not included in the KEX. The keys out are considered secondary codes, so the keys are included.

Features

- A range of off-the-shelf units in various combinations
- 316L stainless steel construction
- Primary key(s) in release secondary keys simultaneously on units up to six ways
- Weatherproof stainless steel dust cap as standard
- Replaceable code barrel assembly

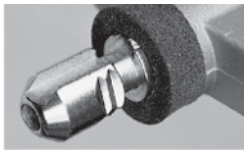
Specifications

Safety Ratings	
Standards	EN1088, ISO12100-1&2, ISO14119, AS4024.1
Category	Cat. 3 per EN 954-1 (ISO 13849-1) cULus and TÜV
Certifications	CE Marked for all applicable directives and BG; C-Tick not required
Operating Characteristics	
Operating Temperature [C (F)]	-40…+200 ° (-40…+392 °)
Mechanical Life	100,000 operations
Environmental & Physical Characteristics	
Shear Force to Key	15.1 k•N (3398 lbs), max.
Torque to Key	14 N•m (124 lb•in), max.
Relative Humidity	95%
Material	316L stainless steel

Optional Key Exchange Cabinets

Number of Keys	Length [mm (in.)]	Width [mm (in.)]	Depth [mm (in.)]	Cat. No.
Painted Mild Steel				
7…11 way (max)	400 (15.7)	300 (11.8)	200 (7.87)	440T-AIPB30
12…15 way (max)	400 (15.7)	400 (15.7)	210 (8.26)	440T-AIPB33
16…25 way (max)	600 (23.6)	600 (23.6)	210 (8.26)	440T-AIPB34
Stainless Steel				
12…15 way (max)	400 (15.7)	400 (15.7)	210 (8.26)	440T-AIPB40
16…25 way (max)	600 (23.6)	600 (23.6)	210 (8.26)	440T-AIPB44

The Prosafe Advantage



Stainless steel construction.

Exchange Units

Product Selection

Key Exchange Units		
Number of Keys	Keys In and Out	Cat. No.
2 way	1 key in 1 key out	440T-MKEXE10‡
3 way	1 key in 2 keys out	440T-MKEXE11‡
4 way	1 key in 3 keys out	440T-MKEXE12‡
5 way	1 key in 4 keys out	440T-MKEXE13‡
6 way	1 key in 5 keys out	440T-MKEXE14‡
4 way	2 key in 2 keys out	440T-MKEXE15‡
5 way	2 key in 3 keys out	440T-MKEXE16‡
6 way	2 key in 4 keys out	440T-MKEXE17‡
6 way	3 key in 3 keys out	440T-MKEXE18‡
7 way	1 key in 6 keys out	440T-MKEXE19‡
8 way	1 key in 7 keys out	440T-MKEXE20‡
9 way	1 key in 8 keys out	440T-MKEXE22‡
10 way	1 key in 9 keys out	440T-MKEXE23‡
11 way	1 key in 10 keys out	440T-MKEXE24‡
12 way	1 key in 11 keys out	440T-MKEXE25‡
13 way	1 key in 12 keys out	440T-MKEXE26‡
14 way	1 key in 13 keys out	440T-MKEXE27‡
15 way	1 key in 14 keys out	440T-MKEXE28‡
16 way	1 key in 15 keys out	440T-MKEXE29‡
17 way	1 key in 16 keys out	440T-MKEXE30‡
18 way	1 key in 17 keys out	440T-MKEXE33‡
19 way	1 key in 18 keys out	440T-MKEXE34‡
20 way	1 key in 19 keys out	440T-MKEXE35‡
21 way	1 key in 20 keys out	440T-MKEXE36‡
22 way	1 key in 21 keys out	440T-MKEXE37‡
23 way	1 key in 22 keys out	440T-MKEXE38‡
24 way	1 key in 23 keys out	440T-MKEXE39‡
25 way	1 key in 24 keys out	440T-MKEXE40‡

‡ Specify the codes individually for each primary key in (key not included) and for each secondary key (key included). See 3-107 for code selection.
Consult factory for other configurations of keys in and keys out.

Accessories

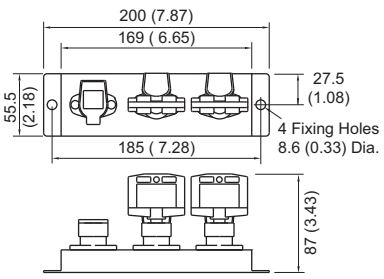
Description	Additional Information	Cat. No.
Stainless steel key	3-140	440T-AKEYE10⁎
Stainless steel replacement code barrel with dust cap		440T-ASCBE14⁎
Stainless steel weatherproof replacement dust cap		440T-ASFC10⁎
Optional Key Exchange Cabinet	Mild steel cabinet for 7-…11-way units	440T-AIPB30
	Mild steel cabinet for 12-…15-way units	440T-AIPB33
	Mild steel cabinet for 16-…25-way units	440T-AIPB34
	Stainless steel cabinet for 12-…15-way units	440T-AIPB40
	Stainless steel cabinet for 16-…25-way units	440T-AIPB44

⁎ Substitute the desired primary code for this symbol (key not included). See 3-107 for code selection.

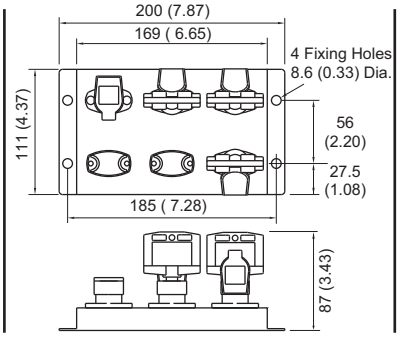
Approximate Dimensions [mm (in.)]

Dimensions are not intended to be used for installation purposes.

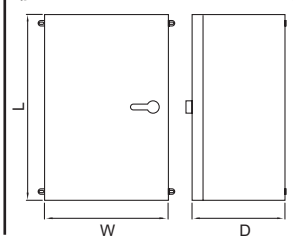
(2) 3 Way Key Exchange Unit



(4, 5 or) 6 Way Key Exchange Unit



Key Exchange Cabinets
(painted mild steel or stainless steel)



Duct Heater

20 Bethridge Rd
Toronto ON M9W 1N1
Tel: 416 743-9977
Fax: 416 743-9424
Toll Free: 800 265-9699

Band Heaters
Band Heaters Introduction
Aluminum Flex Band Heaters
Ceramic Band Heaters
Mica Band Heaters
Mineral Insulated Band Heater

CalRod® Heaters
See Tubular Heaters

Cartridge Heaters
Cartridge Heaters Introduction
Lead Configurations
Metric Diameters
c/w Immersion Fittings
c/w Built-In Thermocouple

Drum Heaters
Direct Immersion Heaters
Mica Band Heaters
Silicone Rubber Band Heaters

Duct Heaters
Duct Heaters
Medium Temperature
up to 400°C (750°F)
High Temperature
up to 560°C (1040°F)

Finned Tubular Elements
See Tubular Elements

Immersion Heaters
Immersion Heaters Introduction
Circulation Heater
Dry Well Heater
Flange Heater
Indirect Heater
Over The Side Heater
Pipe Insert Heater
Screw Plug Heater

Mould Heaters
Tubular Heaters
Formed to AutoCAD Drawings

Radiant Heaters
Black Body

Duct Heater - All applications must consider the airflow velocity, the desired outlet temperature, the correct watt density, and the mounting support.

Call ASB Heating Elements Ltd., for Technical Assistance: 1-800-265-9699

Duct Heater

Forced Air Duct Heater - for Industrial Process Heating Only

Ovens often require re-circulated air, or forced circulation, to perform the desired heating task. A duct heater mounted in this re-circulated air stream is an effective way to provide this heat, without having any electrical connections inside your oven.

Typical Applications

- heat treating, up to1000°F (540°C)
- curing
- baking
- drying
- batch heating
- conveyor systems

Typical Air Heat Calculation

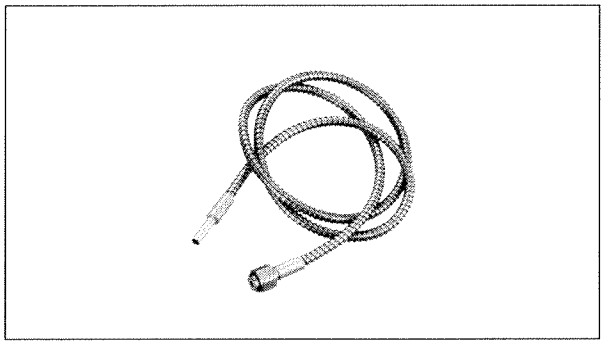
$$kW = \frac{SCFM \times temperature\ rise}{3000}$$

kW - kilowatts
SCFM - standard cubic feet per minute
Temperature rise - number of degrees Fahrenheit increase required

A 20% safety factor is highly recommended

REQ INFO

Photoelectrics
Accessories
Type OFMS1, Fiber Optics (Through-beam)



- Range up to 8 m
- Glass fiber optics
- Stainless steel sleeve
- Temperature up to 300°C
- ∅ 6 x 19.5 mm detection head
- For photoelectric switches types MH, MHF or MOF

Product Description

Glass fiber optics adaptable on through-beam photoelectric switches in M 12 cylindrical housing. MH series, selfcontained types, or for highpower applications MHF types with separate amplifier. Stainless steel sleeves allow heavy duty applications up to 300°C. Different lengths available.

Ordering Key

OFMS1-05

Type
Length

Type Selection

Detection head size	Ordering no. Length: 0.5 m	Ordering no. Length: 1.0 m
∅ 6 x 19.5 mm	**OFMS1-05**	**OFMS1-10**

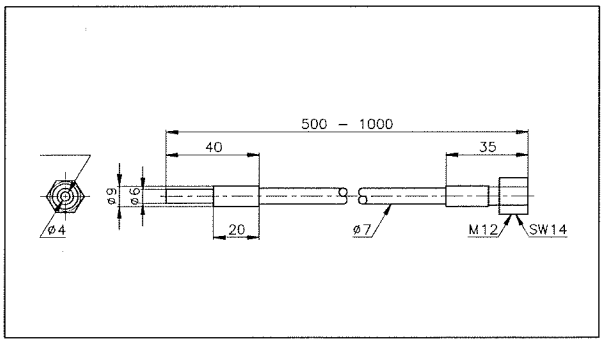
Note: Other lengths available on request.

Specifications

Rated operating dist. (S_n)	**0.5 m fiber**	**1.0 m fiber**
MOFTR5 (2°)	0.25 m	0.18 m
MOFTR20 (2°)	1.00 m	0.75 m
MOFTR50 (2°)	2.50 m	1.80 m
MHF	8.00 m	6.00 m
MH	1.80 m	1.60 m
Temperature		
Operating	-40° to +300°C (-40° to +572°F)	
Storage	-40° to +300°C (-40° to +572°F)	

Material	
Fiber	Glass, ∅ 4 mm
Sleeve	Stainless steel
Sleeve nut	Stainless steel
Detection head	Stainless steel

Dimensions



Delivery Contents

- Fiber optics OFMS1-.. (1 Fiber)
- **Packaging:** plastic bag

Note: Other data, please refer to photoelectric switch data sheets MH, MHF or MOF

Photoelectrics
Amplifier
Types S1420, S1421

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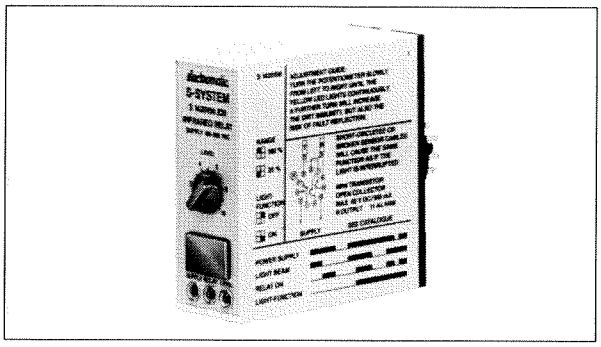

- Amplifier relay for photoelectric switches
- Sensivity range DIP-switch selectable
- Sensivity adjustment by potmeter
- Dirt accumulation alarm and alignment control
- Timer functions
- Modulated and synchronized light
- Make and break switching funct. DIP-switch selectable
- Rated operational voltage:
  24 VDC or VAC, 115 VAC, 230 VAC
- Output 10 A/250 V SPDT relay and 100 mA NPN
- LED indications: Power supply, output, level
- Plug-in module

Product Description

Amplifier relay for long-range photoelectric switch types MIF, MKF, MHF, MCF, MDF, MMF, MNF and MFFD. Carlo Gavazzi "S-System" plug-in housing. Adjustable sensitivity, high and low range selection with LED indication. Misalignment and dirt accumulation alarm output. Make and break switching function DIP-switch selectable. Short-circuit protected supply to photoelectric switches. ON-delay and OFF-delay adjustable from 0 to 10 s on S1421 types.

Ordering Key

S142 1 156 724

- **Type**
- **Special function**
- **Output type**
- **Power supply**

Type Selection

Plug type	Function	Ordering no. Supply: 24 VDC	Ordering no. Supply: 24 VAC	Ordering no. Supply: 115 VAC	Ordering no. Supply: 230 VAC
Circular 11 pins	Adjustable sensitivity, dirt alarm, alignment indication	**S 1420 156 724**	**S 1420 156 024**	**S 1420 156 115**	**S 1420 156 230**
Circular 11 pins	Adjustable sensitivity, dirt alarm, alignment indication, ON delay & OFF delay	**S 1421 156 724**	**S 1421 156 024**	**S 1421 156 115**	**S 1421 156 230**

Specifications

Rated operational volt. AC types (U_B)		
pins 2 & 10	230	195 to 265 VAC, 45 to 65 Hz
	115	98 to 132 VAC, 45 to 65 Hz
	024	20.4 to 27.6 VAC, 45 to 65 Hz
Voltage Interruption		≤ 40 ms
Dielectric voltage		≥ 2.0 kVAC (rms)
Rated impulse withstand volt.		4 kV (1.2/50 µs)
Rated operational volt. DC types (U_B)		
pins 2 positive & 10 negative	724	20.4 to 27.6 VDC
Dielectric voltage		None
Rated impulse withstand volt.		800 V (1.2/50 µs)
Rated operational power		
AC supply		2.5 VA
DC supply		3 W

Supply to photoelectric switch	
Emitter	Pins 5 & 7
Supply voltage (open loop)	8 V square wave
Current	≤ 100mA short-circuit protected
Light modulation frequensy	35 kHz
Output resistance	47 Ω
Receiver	Pins 6 & 8
Supply voltage (open loop)	8 VDC
Short circuit current	18 mA
Input resistance	470 Ω

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Specifications (cont.)

Output Specifications	
Switching function	
Contact output current (1 & 3)	
Continuous AC (I_e)	10 A/250 VAC ohmic load (2500 VA)
Continuous DC (I_e)	1 A/250 VDC ohmic load (250 W)
Contact life mechanical	30 x 10^6 operations
Contact life electrical	2.5 x 10^5 operations
NPN Output (Pin 9)	
Continuous (I_e)	100 mA/40 VDC not protected
Short-time (I)	100 mA/40 VDC
Alarm function (Pin 11)	
NPN Output	
Continuous (I_e)	100 mA/40 VDC, not protected
Short-time (I)	100 mA/40 VDC
Rated insulation volt. (U_i)	250 VAC (rms)
Dielectric voltage	≥ 2.0 kVAC (rms) (contact/electronics)
Rated impulse withstand volt.	4 kV (1.2/50µs) (contact/electronics) (IEC 664)
Sensitivity (% of S_n)	• 2 ranges, DIP-switch selectable - low sensitivity (25%) - high sensitivity (100%) • Fine adjustment with 270° turn knob
Sensitivity (cont.)	Note: • Maximum range indicated on photoelectric switch data sheet in high sensitivity range only • Operation within low sensitivity range, increases ambient light and crosstalk immunity.

Operating frequency (f)	**S 1420**	**S 1421**
Light/dark ratio 1:1		
Contact output	15 Hz	5 Hz delayset
NPN output	15 Hz	5 Hz delayset
Response time		
OFF-ON (t_{ON})	33 ms	0.1 to 14 s +/- 4 s
ON-OFF (t_{OFF})	33 ms	0.1 to 14 s +/- 4 s ON and OFF delay

Power ON delay (t_v)	< 300 ms
Output function	Make and break switching DIP-switch selectable
Indication	
Supply ON	LED, green
Output ON	LED, red
Alignment/dirt accumulation (sensitivity level)	LED, yellow (Steadily on if sensitivity adjusted properly)
Environment	
Overvoltage category	III (IEC 664)
Degree of protection	IP 20 (IEC 529, 947-1)
Pollution degree	3 (IEC 664/664A, 947-1)
Temperature	
Operating	-20° to +50°C (-4° to +122°F)
Storage	-50° to +85°C (-58° to 185°F)
Weight	
AC supply	200 g
DC supply	125 g

Truth Table

	Make switching			Break switching		
Object present	Yes	No	No	Yes	No	No
Dirt on lenses, misaligned or sensitivity too low	--	No	Yes[1)]	--	No	Yes[1)]
Output LED red	OFF	ON	ON	ON	OFF	OFF
Level LED yellow	OFF	ON steadily	OFF or weakly OFF	OFF	ON steadily	OFF or weakly OFF
Load Pins 1& 3	N-act.	Active	Active	Active.	N-act.	N-act.
Output NPN Pi. 9&7	High	Low	Low	Low	High	High
Alarm Output [2)] NPN Pins 11&7	High	High	Low	High	High	Low

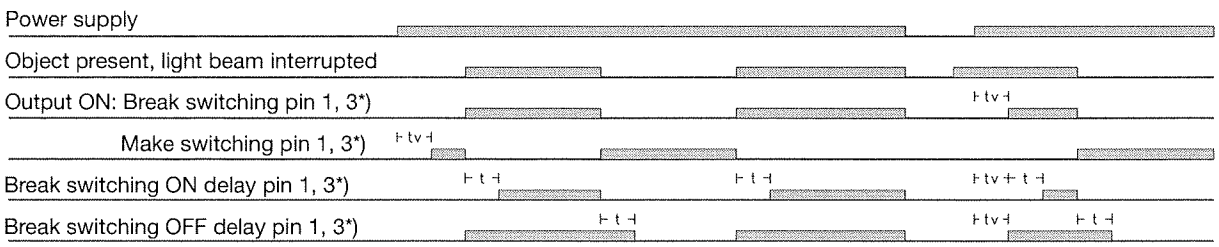
[1)] Under normal operating conditions, the yellow level indication LED has to be on steadily (bright) and alarm output has to be high.

[2)] The alarm output will turn on shortly each time an object enters or exits the sensing zone, even if the photoelectric switch is correctly installed and adjusted. To avoid false signals, the alarm functions should be delayed with an external ON delay timer (i.e. Carlo Gavazzi timer S111 series).

Specifications are subject to change without notice

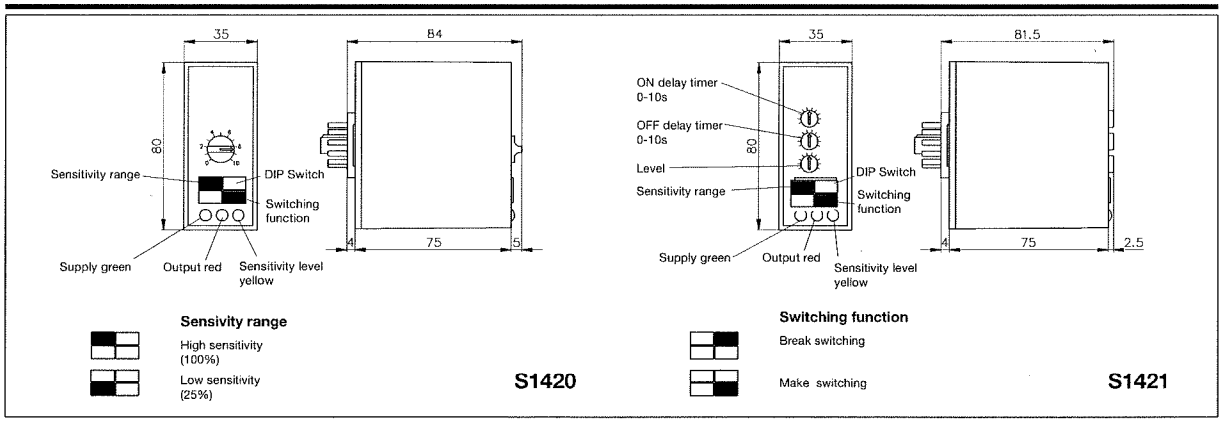
CARLO GAVAZZI

Operation Diagram

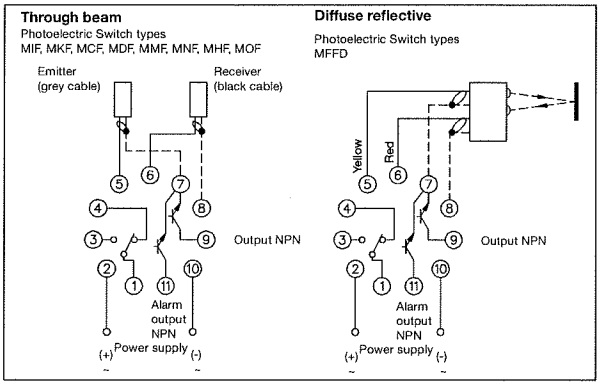


*) Switching function selected by DIP-switch, inverted function on pin 1, 4

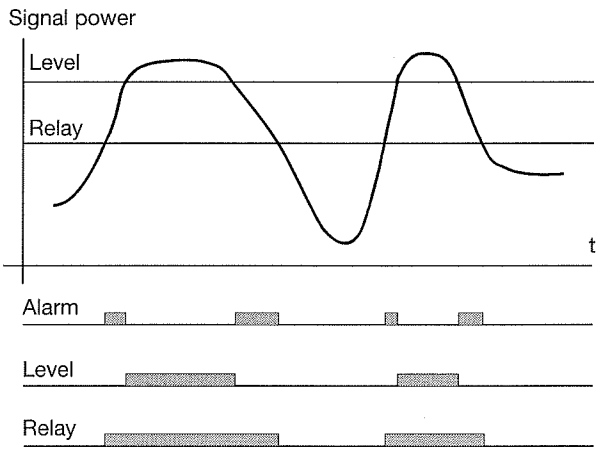
Dimensions



Wiring Diagrams



Alarm Diagram



Accessories

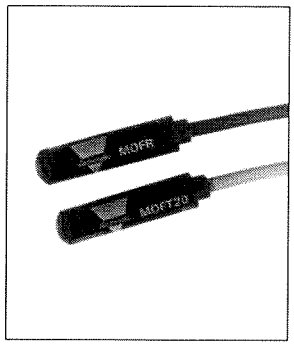
- 11 pole circular socket	S111, S111A, S411, ZPD11
- Socket cover for S111	BB1
- Socket cover for S411	BB4
- Holding down spring	HF
- Mounting rack	SM13
- Front panel mounting bezel	FRS2
- Potentiometer knob lock	PL1

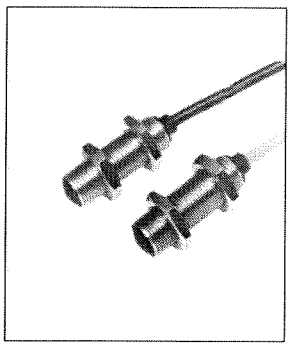
Delivery Contents

- Amplifier
- **Packaging:** styropor box

Photoelectrics
Through-beam for Separate Amplifier
Types MOFT, MOFR

CARLO GAVAZZI





- Built-in lens: 2°, 5° or 8°
- Range: 5 m, 20 m or 50 m
- Modulated infrared light
- High immunity to ambient light
- For amplifier series S142. and S143.
- Degree of protection IP 66/IP 67
- For harsh environment
- High penetration power
- 15 m shielded PVC cable
- Ø 10 mm polycarbonate housing or M12 or M14 stainless steel

Product Description

Small through beam photoelectric switch. Range up to 50 m. 3 beam angles. Waterproof, for dirty environment, i.e. water, dust, steam etc. To be used with amplifiers series S142. - S143. 15 m shielded cable, PVC. Ø 10 x 42 mm polycarbonate or M12 or M14 stainless steel housing. Straight optical axis.

Ordering Key

MOF T 20-M12-2

- Type
- Emitter
- Range
- Housing diameter
- Optical angle

Type Selection

Housing diameter	Rated operating dist. (S_n)	Optical angle	Ordering no.: Emitter	Ordering no.: Receiver
Ø 10 mm	5 m	2°	MOFT 5	MOFR
	20 m	2°	MOFT 20	
	20 m	5°	MOFT 20-5	MOFR-5
	20 m	8°	MOFT 20-8	MOFR-8
	50 m	2°	MOFT 50	
M12	5 m	2°	MOFT 5-M12-2	MOFR-M12-2
	5 m	5°		MOFR-M12-5
	5 m	8°		MOFR-M12-8
	20 m	2°	MOFT 20-M12-2	
	20 m	5°	MOFT 20-M12-5	
	20 m	8°	MOFT 20-M12-8	
	50 m	2°	MOFT 50-M12-2	
M14	20 m	8°	MOFT 20-M14-8	MOFR-M14-8

Specifications Emitter

Rated operational volt. (U_e)	3 V, (square wave) supplied by amplifier
Supply current (I_O)	MOFT 5 ≤ 10 mA MOFT 20 ≤ 15 mA MOFT 20-5 ≤ 50 mA MOFT 20-8 ≤ 50 mA MOFT 50 ≤ 50 mA
Light source **Light type** **Optical angle**	GaAlAs LED, 880 nm Infrared, modulated ±2°, ±5°, ±8°
Indications	On amplifier
Protection	Short-circuit, reverse polarity

Specifications Receiver

Rated operational volt. (U_e)	8 VDC supplied by amplifier R_{source} 470Ω
Supply current (I_O)	≤ 11 mA
Sensitivity	Adjustable on amplifier
Optical angle	±2°,±5°, ±8°
Ambient light	10,000 lux (sensitivity ±5%) **Note:** The actual range will be within ±5% of the set range at an ambient light of 10,000 lux
Operating frequency (f) **Response time** (t_{OFF} & t_{ON})	See amplifier data See amplifier data
Power ON delay (t_v)	See amplifier data
Indications	On amplifier
Protection	Short-circuit, reverse polarity

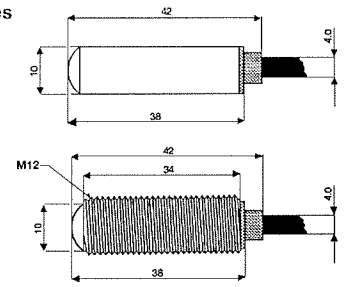
CARLO GAVAZZI

General Specifications

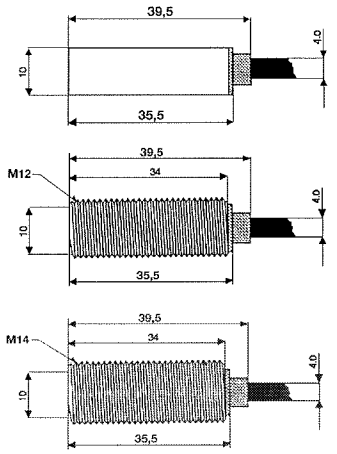
Environment	
Overvoltage category	III (IEC 60664/60664A; 60947-1)
Pollution degree	3 (IEC 60664/60664A; 60947-1)
Degree of protection	IP 66/IP 67 (IEC 60529; 60947-1)
Temperature	
Operating	-20° to +60°C (-4° to +140°F)
Storage	-40° to +80°C (-40° to +176°F)
Vibration	10 to 150 Hz, 0.5 mm/7.5 g (IEC 60068-2-6)
Shock	2 x 1 m & 100 x 0.5 m (IEC 60068-2-6)
Dielectric voltage	500 VAC (rms)
Housing material	Polycarbonate, black
Connection cable	
Emitter	Grey, 15 m oilproof PVC, Ø 4 mm, 1 x 0.25 mm², shielded
Receiver	Black, 15 m oilproof PVC, Ø 4 mm, 1 x 0.25 mm², shielded
Weight (cable incl.)	347 g emitter 347 g receiver
CE-marking	Yes

Dimensions

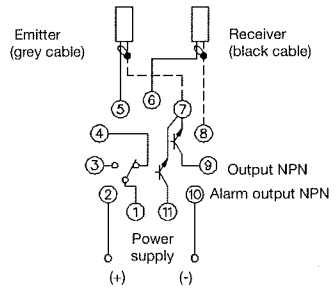
2° and 5° types



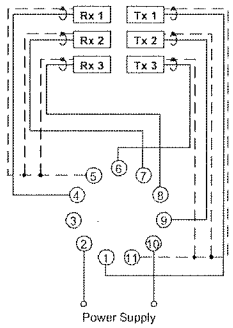
8° types



Wiring Diagrams



S142....



S143....

Delivery Contents

- MOFT.. and MOFR
- All M12-types: 2 pcs. M12 nuts
- All M14-types: 2 pcs. M14 nuts
- **Packaging**: Plastic bag, emitter and receiver packed separately

Monitoring Relays
1-Phase True RMS AC/DC Over or Under Current
Types DIB02, PIB02

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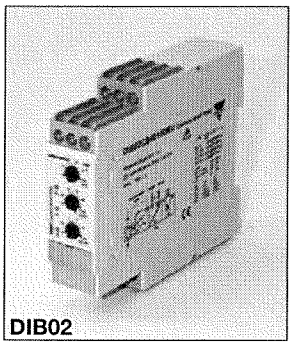
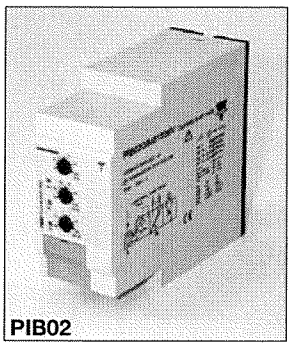

DIB02


PIB02

- TRMS AC/DC over or under current monitoring relays
- Current measuring through external shunt or CT
- Selection of measuring range by DIP-switches
- Measuring ranges from 6 to 150 mV AC/DC and 0.4 to 4 V_p AC (MI or MP range)
- Adjustable current on relative scale
- Adjustable hysteresis on relative scale
- Adjustable delay function (0.1 to 30 s)
- Programmable latching or inhibit at set level
- Output: 8 A SPDT relay N.D. or N.E. selectable
- For mounting on DIN-rail in accordance with DIN/EN 50 022 (DIB02) or plug-in module (PIB02)
- 22.5 mm Euronorm housing (DIB02) or 36 mm plug-in module (PIB02)
- LED indication for relay, alarm and power supply ON
- Galvanically separated power supply

Product Description

DIB02 and PIB02 are precise TRMS AC/DC over or under current (selectable by DIP-switch) monitoring relays.
The current is measured through an external shunt. 1-phase and 3-phase current up to 500 AAC can be monitored connecting MI or MP current transformers.

Owing to the built-in latch function, the ON-position of the relay output can be maintained. Inhibit function can be used to avoid relay operation when not desired (maintenance, transitions).
The LED's indicate the state of the alarm and the output relay.

Ordering Key

DIB 02 C B23 150mV

- **Housing**
- **Function**
- **Type**
- **Item number**
- **Output**
- **Power supply**
- **Range**

Type Selection

Mounting	Output	Supply: 24 VDC	Supply: 48 VDC	Supply: 24/48 VAC	Supply: 115/230 VAC
DIN-rail	SPDT	**DIB 02 C 724 150MV**	**DIB 02 C 748 150MV**	**DIB 02 C B48 150MV**	**DIB 02 C B23 150MV**
Plug-in	SPDT	**PIB 02 C 724 150MV**	**PIB 02 C 748 150MV**	**PIB 02 C B48 150MV**	**PIB 02 C B23 150MV**

Input Specifications

Input

Voltage level	DIB02: Terminals Y1, Y2 PIB02: Terminals 5, 7

Measuring ranges	**Internal resis.**	**Max. volt.**
6 to 60 mV AC/DC	1 kΩ	2 V
15 to 150 mV AC/DC	1 kΩ	2 V
Max. voltage for 1 s		15 V
0.4 to 4 V_p AC	50 kΩ	50 V
Max. voltage for 1 s		100 V

MI and MP CT ranges		**AAC rms**	**Max. curr.**
1-ph.:	3-ph.:		
MI 5	MP 3005	0.5 to 5 A	20 AAC
MI 20	MP 3020	2 to 20 A	50 AAC
MI 100	MP 3100	10 to 100 A	250 AAC
MI 500	MP 3500	50 to 500 A	750 AAC

Note:
The input voltage cannot raise over 300 VAC/DC with respect to ground (PIB02 only)

Input Specifications (cont.)

Note:
MP3... current transformers not suitable for under current measurement due to the output signal of the device (see data sheet)

Contact input	
DIB02	Terminals Z1, Y1
PIB02	Terminals 8, 9
Disabled	> 10 kΩ
Enabled	< 500 Ω
Latch disable	> 500 ms

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Output Specifications

Output	SPDT relay
Rated insulation voltage	250 VAC
Contact ratings ($AgSnO_2$)	μ
Resistive loads AC 1	8 A @ 250 VAC
DC 12	5 A @ 24 VDC
Small inductive loads AC 15	2.5 A @ 250 VAC
DC 13	2.5 A @ 24 VDC
Mechanical life	≥ 30 x 10^6 operations
Electrical life	≥ 10^5 operations (at 8 A, 250 V, cos φ = 1)
Operating frequency	≤ 7200 operations/h
Dielectric strength	
Dielectric voltage	≥ 2 kVAC (rms)
Rated impulse withstand volt.	4 kV (1.2/50 μs)

Supply Specifications

Power supply		Overvoltage cat. III (IEC 60664, IEC 60038)
Rated operational voltage through terminals:		
A1, A2 or A3, A2	(DIB02)	
2, 10 or 11, 10	(PIB02)	
	724:	24 VDC ± 20%, insulated
	748:	48 VDC ± 20%, insulated
	B48:	24/48 VAC ± 15% 45 to 65 Hz, insulated
	B23:	115/230 VAC ± 15% 45 to 65 Hz, insulated

Dielectric voltage	**DC supply**	**AC supply**
Supply to input	2 kV	4 kV
Supply to output	4 kV	4 kV
Input to output	4 kV	4 kV

Rated operational power	
AC	4 VA
DC	3 W

General Specifications

Power ON delay	1 s ± 0.5 s or 6 s ± 0.5 s
Reaction time	(input signal variation from -20% to +20% or from +20% to -20% of set value)
Alarm ON delay	< 100 ms
Alarm OFF delay	< 100 ms
Accuracy	(15 min warm-up time)
Temperature drift	± 1000 ppm/°C
Delay ON alarm	± 10% on set value ± 50 ms
Repeatability	± 0.5% on full-scale
Indication for	
Power supply ON	LED, green
Alarm ON	LED, red (flashing 2 Hz during delay time)
Output relay ON	LED, yellow
Environment	(EN 60529)
Degree of protection	IP 20
Pollution degree	3 (DIB02), 2 (PIB02)
Operating temperature	-20 to 60°C, R.H. < 95%
Storage temperature	-30 to 80°C, R.H. < 95%
Housing dimensions	
Din-rail version	22.5 x 80 x 99.5 mm
Plug-in version	36 x 80 x 87 mm
Weight	Approx. 150 g
Screw terminals	
Tightening torque	Max. 0.5 Nm acc. to IEC 60947
Approvals	UL, CSA (except 748)
CE Marking	Yes
EMC	Electromagnetic Compatibility
Immunity	According to EN 61000-6-2
Emission	According to EN 50081-1

Mode of Operation

DIB02 and PIB02 monitor both AC and DC over or under current through an external shunt.

When connected with MI or MP current transformer (using the 0.4 to 4 V_p range) they can monitor 1-phase or 3-phase AC current up to 500 A.

Example 1
(connection between terminals Z1, Y1 or 8, 9 - latching function enabled)

The relay operates and latches in operating position when the measured value exceeds (or drops below) the set level for more than the set delay time.
Provided that the current has dropped below (or has exceeded) the set point (see hysteresis setting), the relay releases when the interconnection between terminals Z1, Y1 or 8, 9 is interrupted or the power supply is interrupted as well.
The red LED flashes until the delay time has expired or the measured value comes back to a non-alarm value (see hysteresis setting).

Example 2 (MI CT)
(no connection between terminals Z1, Y1 or 8, 9 - latch function disabled)

The relay operates when the current flowing in the CT exceeds (or drops below) the set level for more than the set delay time.
It releases when the current drops below (or exceeds) the set level (see hysteresis setting) or when power supply is interrupted.

Example 3 (MP CT)
(no connection between terminals Z1, Y1 or 8, 9 - latch function disabled - over current measurement)
The relay operates when the maximum current flowing in the CT exceeds the set level for more than the set delay time.
It releases when the maximum current drops below the set level (see hysteresis setting) or when power supply is interrupted.

Note
When the inhibit contact is opened, if the input signal is already in alarm position, the delay time needs to elapse before relay activation.

Specifications are subject to change without notice (27.02.04)

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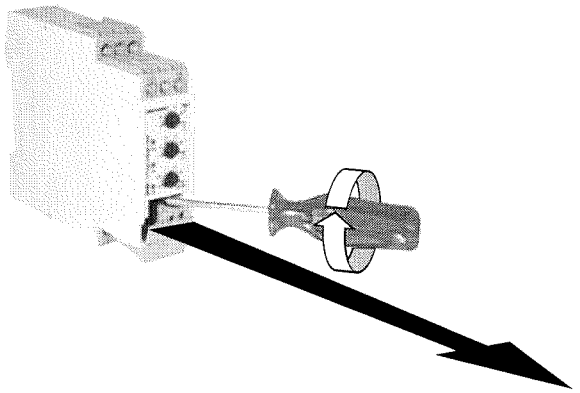
Function/Range/Level and Time Delay Setting

Adjust the measuring range setting the DIP switches 1 and 2 and select the desired function setting the DIP switches 3 to 6 as shown below.

To access the DIP switches open the grey plastic cover as shown below.

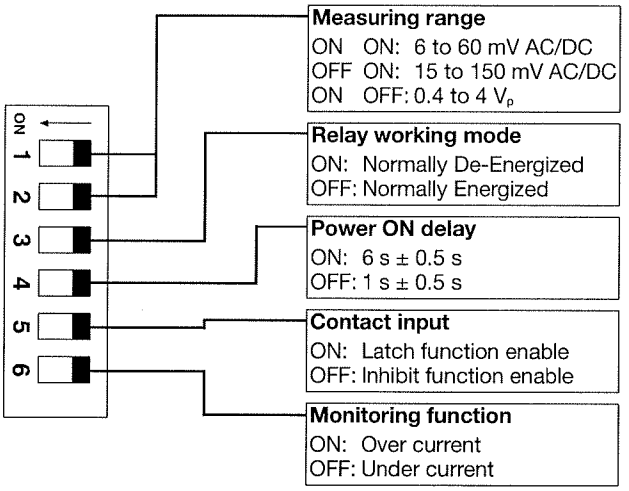


Selection of level and time delay:

Upper knob:
Setting of hysteresis on relative scale: 0 to 30% on set value.

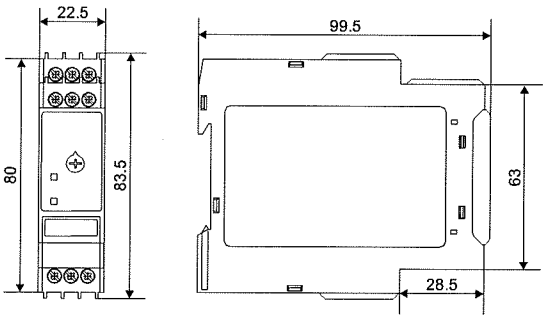
Centre knob:
Current level setting on relative scale: 10 to 110% on full scale.

Lower knob:
Setting of delay on alarm time on absolute scale (0.1 to 30 s).

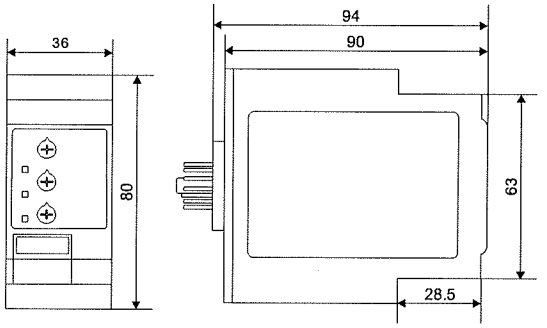


Dimensions

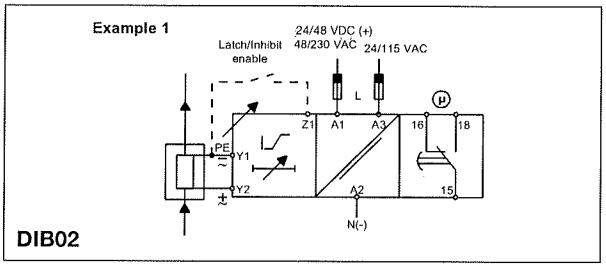
DIN-rail

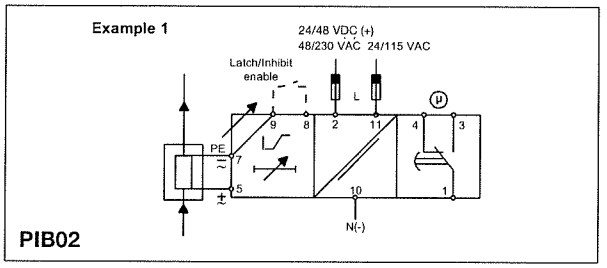


Plug-in



Wiring Diagrams





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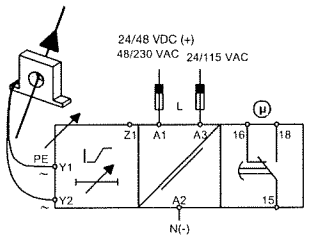
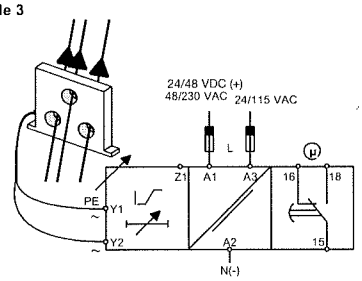
Wiring Diagrams (cont.)

Example 2

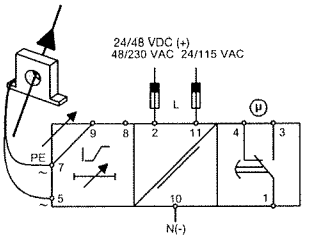


Example 3

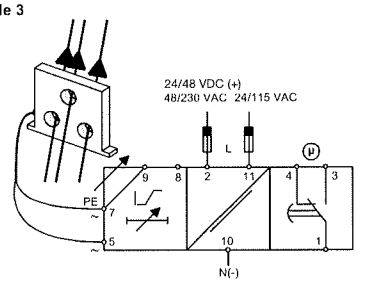


DIB02

Example 2



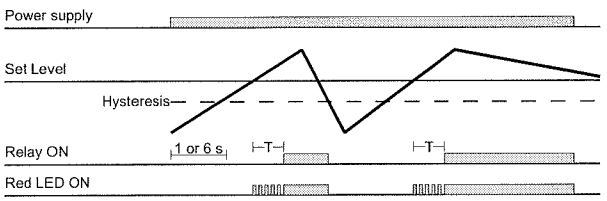
Example 3



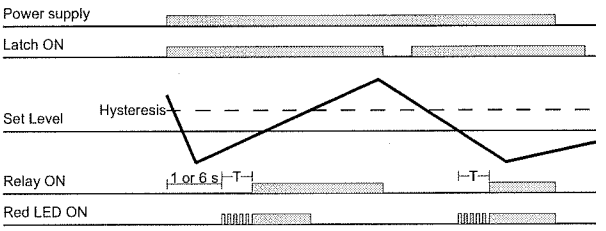
PIB02

Operation Diagrams

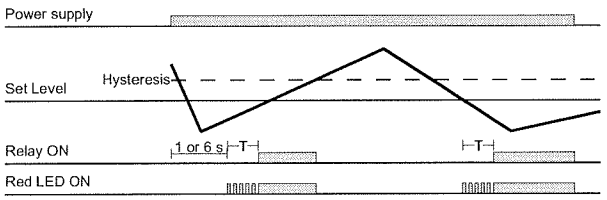
Over current - N.D. relay



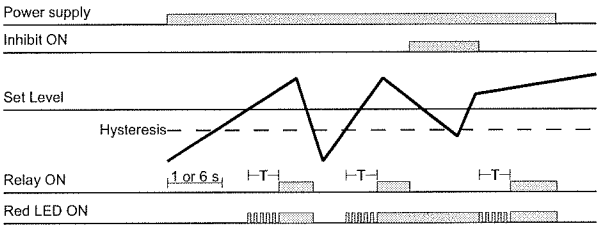
Under current - Latch function - N.D. relay



Under current - N.D. relay



Over current - Inhibit function - N.D. relay



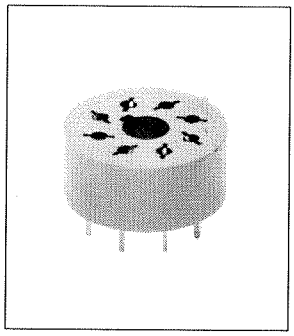
General Accessories
Sockets
Types S, D, ZPD, ZVD

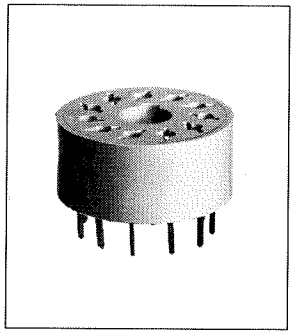
CARLO GAVAZZI

Socket types S 008, S 011
For mounting on printed circuits.

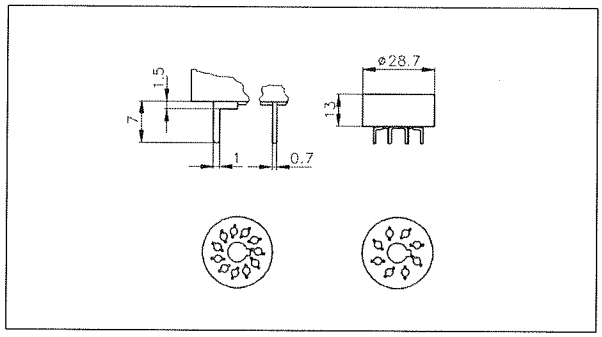
S 008
8-pole circular socket.

S 011
11-pole circular socket.





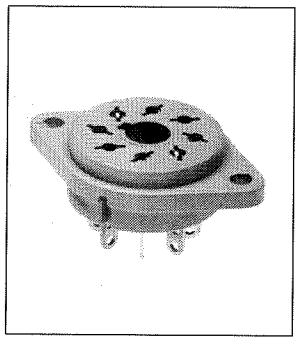
Material	Glasfilled Noryl SE 1
Colour	Light grey
Material of spring	Tin-plated brass
Printed circuit hole diameter	Min. 1.5 mm
Approvals	UL, CSA, SEV

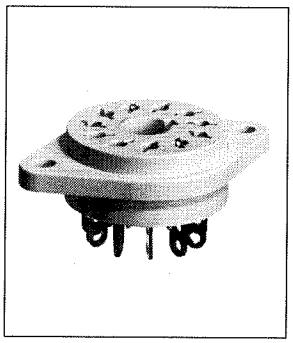


Socket types S 108, S 111
For mounting on or below a chassis with soldering and plug connections (AMP 187).

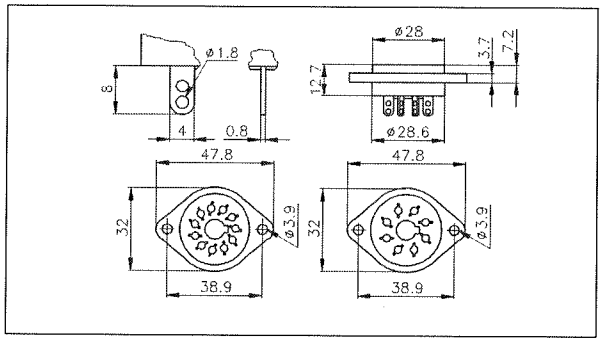
S 108
8-pole circular socket.

S 111
11-pole circular socket.





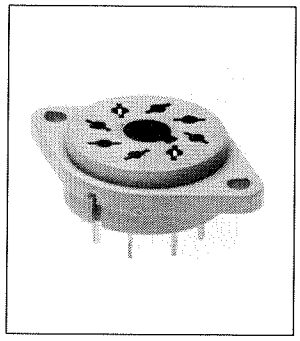
Material	Glasfilled Noryl SE 1
Colour	Light grey
Material of spring	Tin-plated brass
Approvals	UL, CSA, SEV

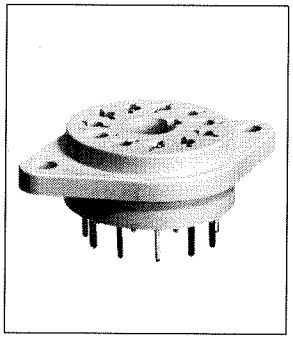


Socket types S 108 A, S 111 A
For mounting on or below a chassis or printed circuits.

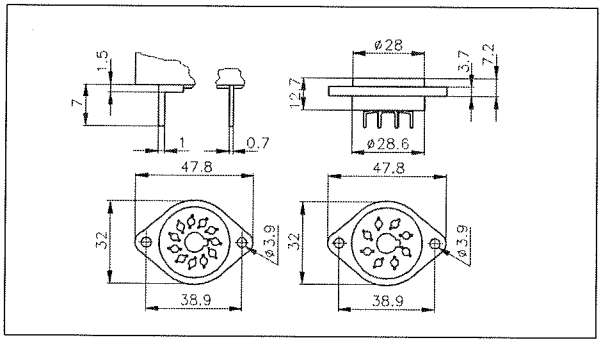
S 108 A
8-pole circular socket.

S 111 A
11-pole circular socket.





Material	Glasfilled Noryl SE 1
Colour	Light grey
Material of spring	Tin-plated brass
Approvals	UL, CSA, SEV



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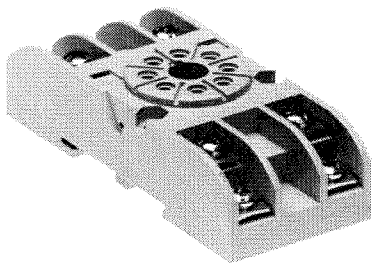
Sockets (cont.)

Socket types S 408, S 411
Socket with front screw connections. For mounting by two front screws or for snap-mounting on DIN-rail (DIN EN 50 022). With captive cable clamps and cross-cut terminal screws. For devices with circular plugs.
Text markers, type no. tags: e.g. Weidmüller type SG 10

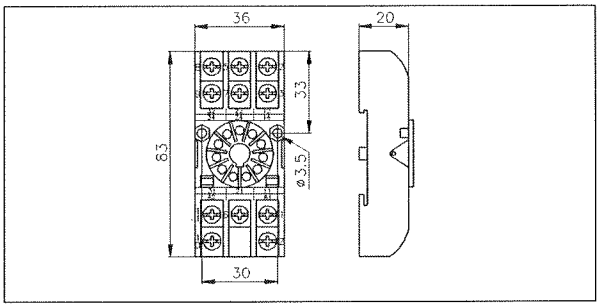
S 408
8-pole circular socket.

S 411
11-pole circular socket.



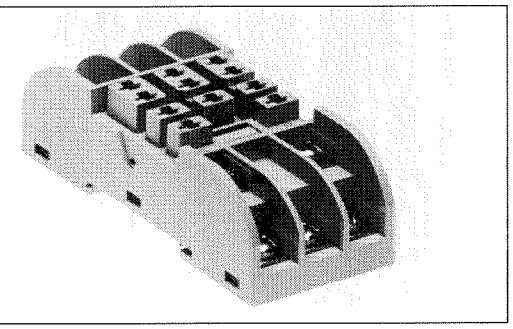
S 408

Rating	10 A/250 VAC (IEC 664)
Installation/pollution deg.	Cat. III/2
Degree of protection	IP 10 (IEC 529)
Material	
Socket	Light grey, Noryl SE1
Contact spring	Tin-plated brass
DIN-rail retaining spring	Stainless steel wire
Approvals	UL, CSA, SEV

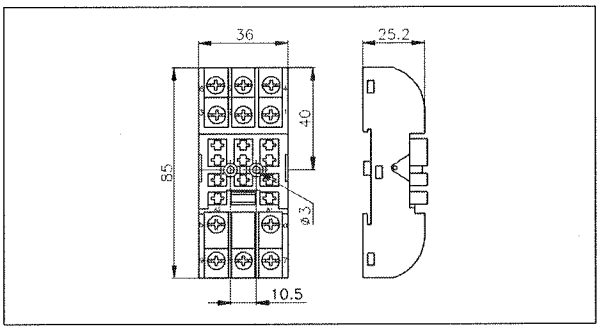


Socket type D 411 B
Socket with front screw connections. For mounting by two front screws or for snap-mounting on DIN-rail (DIN EN 50 022). With captive cable clamps and cross-cut terminal screws. For devices with spade plugs (4.8 x 0.5 mm).
Text markers, type no. tags: e.g. Weidmüller type SG 10

D 411 B
11-pole spade socket.



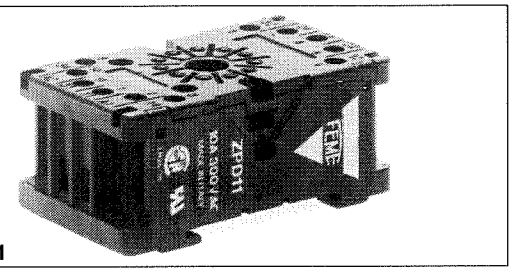
Rating	10 A/250 VAC (IEC 664)
Installation/pollution deg.	Cat. III/3
Degree of protection	IP 10 (IEC 529)
Material	
Socket	Black, Noryl SE1
Contact spring	Tin-plated brass
DIN-rail retaining spring	Stainless steel wire
Approvals	UL, CSA, SEV



Socket types ZPD 8, ZPD 11,
Socket for mounting on DIN-rail (DIN EN 50 022).
Text markers, type no. tags: e.g. Weidmüller type SG 10

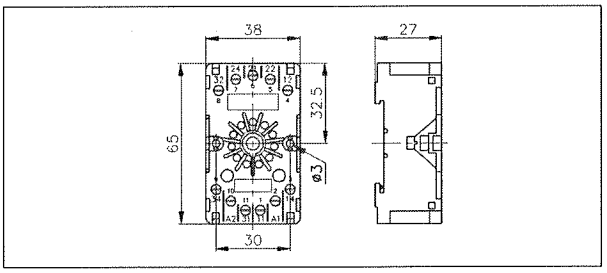
ZPD 8
8-pole circular socket.

ZPD 11
11-pole circular socket.



ZPD 11

Rating	10 A/300 VAC (IEC 664)
Installation/pollution deg.	Cat. III/2
Degree of protection	IP 20 (IEC 529)
Material: Socket	Black, thermoplast. resin (UL 9040 HB)
Contact spring	Nickel-plated copper alloy
DIN-rail retaining spring	Stainless steel wire
Approvals	UL, CSA



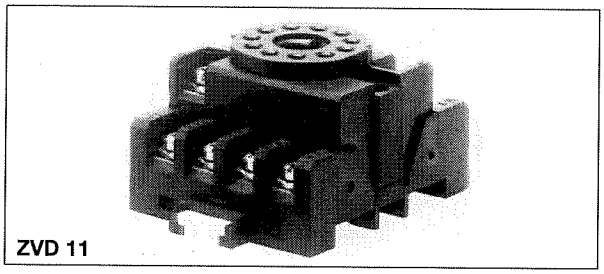
Specifications are subject to change without notice

CARLO GAVAZZI

Sockets (cont.)

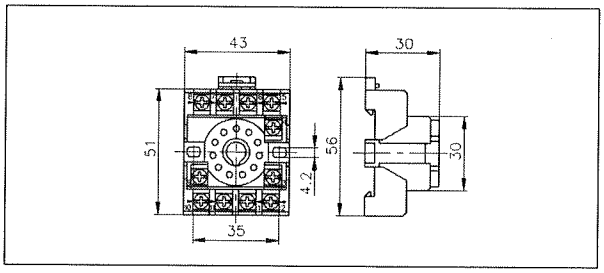
Socket types ZVD 8, ZVD 11,
Socket for mounting on DIN-rail (DIN EN 50 022).

ZVD 8	8-pole circular socket.
ZVD 11	11-pole circular socket.



ZVD 11

Rating	10 A/300 VAC (IEC 60664)
Installation/pollution deg.	Cat. III/2
Degree of protection	IP 10 (IEC 60529)
Material - Socket	Black, thermoplast. resin (UL 94 V-1)
Contact spring	Nickel-plated copper alloy
DIN-rail retaining spring	Polyester



SAFEBLOC Acier - 40 à 1600 A
Steel sheet SAFEBLOC - 40 to 1600 A

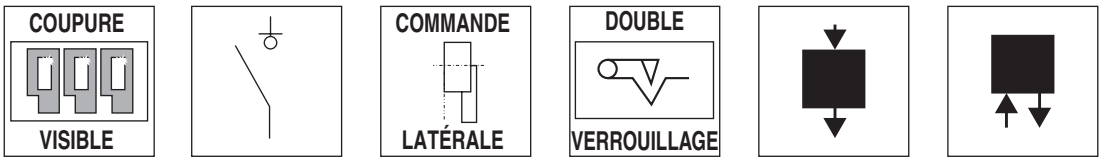
COUPURE VISIBLE
VISIBLE BREAKING

VISION DES COUTEAUX
INTERRUPTEUR OUVERT
VISION OF CONTACTS
WHEN SWITCH IS OPEN

Coffret équipé d'un interrupteur IM 40 A 3 pôles. Raccordement B/B.
Enclosure equipped with switch IM 40 A 3 phases. Down/down connection.

- Particulièrement reconnu pour sa solidité en milieu industriel.

- Especially appreciated for its robustness in industrial environment.



Visible breaking — *Lateral handle* — *With double safety interlock*

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APPLICATIONS

Installation :
intérieure et extérieure.

Domaines d'utilisation :
l'industrie lourde (mines, carrières, sucreries, cimenteries, papeteries, sidérurgie,…).

Avantages de la gamme :
avec son enveloppe très robuste réalisée en acier ép. 2 mm, monobloc, entièrement soudée. Cette gamme de par sa conception allie robustesse, fiabilité et fonctionnalité.

CARACTÉRISTIQUES

Interrupteurs sectionneurs :
IM de 40 à 1600 A à commande latérale droite et coupure visible.

Poignée de manœuvre :
latérale isolante, couleur rouge, cadenassable par 3 cadenas en position circuit « ouvert » et indémontable de l'extérieur.

Raccordements :
Haut/Bas ou Bas/Bas avec précâblage des bornes amont par jeu de barres à partir de 160 A.

Double verrouillage de porte :
avec impossibilité d'ouvrir la porte lorsque l'interrupteur est fermé et impossibilité de fermer l'interrupteur lorsque la porte est ouverte.

Coupure visible :
au travers d'une fenêtre en verre Triplex de 6 mm d'épaisseur et indémontable de l'extérieur.

Fermeture :
par serrure triangulaire de 7 mm (autre sur demande).

Enveloppe :
- enveloppe en tôle acier électrozinguée ép. 2 mm,
- **INOX 316 L sur demande**,
- peinture époxy ep 70 microns ± 5, de couleur gris clair RAL 7035,
- toit de protection incliné dépassant de 35 mm,
- porte montée sur charnières en Zamak chromé et broche inox, autorisant une ouverture à gauche de 180°,
- ensemble coffret IP 55,
- plaque de fond passes câbles en acier ép. 2 mm peint RAL 7035,
- résistance à la température : - 40° à + 130°C,
- résistance aux chocs IK10 : 20 joules,
- fixation murale par 4 pattes de fixation acier soudées au coffret.

Mise à la terre :
un boulon de mise à la terre extérieur soudé sur le coffret. Deux points de mise à la terre à l'intérieur des coffrets. Une tresse de masse en cuivre étamé réalise la liaison de masse entre la porte et le coffret.

APPLICATIONS

Installation:
inside and outside.

Main uses:
heavy industry (mines, quarries, sugar, cement, paper, iron and steel,…).

Benefits:
very solid enclosure made at once with 2 mm thick steel, all welded. This range, through its design, matches reliability, commodity and robustness requirements.

CHARACTERISTICS

Load-break switches:
IM from 40 to 1600 A with right lateral handle and visible breaking.

Handle:
lateral operated, isolating, red, lockable with 3 locks on "open" position, can not be unfixed from the outside.

Connexions:
up/down or down/down with pre-cabling of upper terminals using connexion bars from 160 A.

Double safety interlock:
impossible to open the door when switch is "on" and impossible to turn on the switch when door is open.

Visible breaking:
through window protected by 6 mm thick Triplex glass, can not be unfixed from the outside.

Locking:
using 7 mm triangular lock (other possibilities on request).

Enclosure:
- *2 mm thick steel sheet,*
- ***INOX 316 L on request**,*
- *epoxy paint thickness 70 microns ± 5, colour : bright grey RAL 7035,*
- *35 mm.protruding leaning roof to avoid water and dust ingress,*
- *door fixed on Zamak stainless steel hinges, with 180° opening on left side,*
- *IP 55 overall protection,*
- *removable bottom plate for cable glands, 2 mm thick, aluminium made, RAL 7035 painted,*
- *temperature resistant: - 40° up to + 130°C,*
- *chocks resistant: IK10: 20 joules,*
- *wall fixing using 4 welded fixations.*

Earth connexion:
an earth connexion is welded on the enclosure. 2 earth connexions inside the enclosure. An earting copper braid is connecting the enclosure and its door.

SAFEBLOC Acier - 40 à 1600 A
Steel sheet SAFEBLOC - 40 to 1600 A

RÉFÉRENCES / *REFERENCES*

INTERRUPTEUR - SECTIONNEUR IM de 40 à 1600 A
SWITCH DISCONNECTORS IM 40 to 1600 A

- Interrupteurs 5 et 6 pôles et plus : veuillez nous consulter.
- Différentes tailles de coffrets et options disponibles sur demande.

- *Switch disconnectors 5 and 6 poles and more : on request.*
- *Other enclosures sizes and options available on request.*

IM 40 A 3 pôles ACIER B/B

IM 315 A 3 pôles ACIER B/B

IM 500 A 3 pôles ACIER B/B

Calibre *Rating*	Pôles *Phases*	Raccordement H/B *Up/down connexion*	Raccordement B/B *Down/down connexion*
40 A	3 P	→	Y081602
	4 P	→	Z081603
	6 P	→	S096386
63 A	3 P	→	H081611
	4 P	→	J081612
	6 P	→	N091552
80 A	3 P	→	W081623
	4 P	→	Y081625
	6 P	→	G203096
160 A	3 P	Z092114	D091313
	4 P	A092115	E091314
	6 P	C600044	F091499
200 A	3 P	Z096783	E091084
	4 P	A096784	F091085
	6 P	C600049	C502963
270 A	3 P	C600442	C600443
	4 P	C600444	C600445
315 A	3 P	C202977	E202979
	4 P	D202978	F202980
500 A	3 P	C600446	Q090979
	4 P	C600448	C600449
630 A	3 P	C600450	C600451
	4 P	C600452	C600453
720 A	3 P	C600454	C600455
	4 P	C600456	C600457
800 A	3 P	C600068	B096440
	4 P	J091065	P091093
1250 A	3 P	L091067	R091095
	4 P	M091068	S091096
1600 A	3 P	D096856	H092329
	4 P	E096857	B096854

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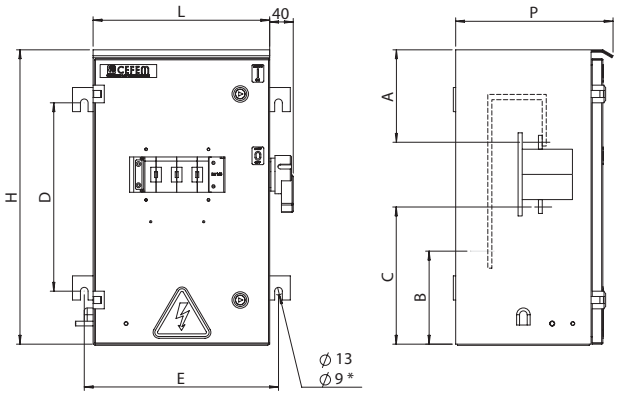
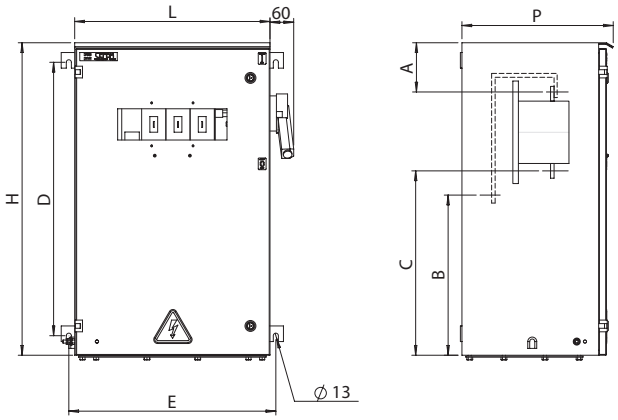
DIMENSIONS / *DIMENSIONS*

IM de 40 à 315 A



IM de 500 à 1600 A



				Haut/Bas / *Up/down*			Bas/Bas / *Down/down*			
Calibre *Rating*	**Pôles** *Phases*	**H x L x P (mm)**	**D x E**	**A**	**C**	**Poids /** *Weight* (kg)	**B**	**C**	**Poids /** *Weight* (kg)	**Section racc. Maxi Type bornes** *Max connect. Terminal type*
40 A *	3 et 4 P	330 x 210 x 155	195 x 240	85	153	7,5	-	-	-	Multi 10 mm²
	6 P	400 x 300 x 250	300 x 330	120	192	9	-	-	-	
63 / 80 A *	3 et 4 P	330 x 210 x 155	195 x 240	85	153	7,5	-	-	-	Multi 25 mm²
	6 P	400 x 300 x 250	300 x 330	120	192	9	-	-	-	
160 A	3 et 4 P	500 x 300 x 303	320 x 330	155	235	17,6	162	235	18,5	Multi 95 mm² Plage de 20 mm, vis M8
	6 P	500 x 400 x 303	320 x 430	155	235	19,6	162	235	20,5	
200 A	3 et 4 P	500 x 300 x 303	320 x 330	151	231	20,1	162	231	21	Multi 95 mm² Plage de 20 mm, vis M8
	6 P	500 x 400 x 303	320 x 430	151	231	21,1	162	231	22	
270 A	3 et 4 P	500 x 400 x 303	320 x 430	161	202	22	265	202	23	Multi 120 mm² Plage de 25 mm, vis M10
315 A	3 et 4 P	500 x 400 x 303	320 x 430	161	202	22	265	202	23	Multi 150 mm² Plage de 25 mm, vis M10
500 A	3 et 4 P	600 x 400 x 303	420 x 430	148	272	30	207	272	32	Unip 2 x 185 mm² Plage de 25 mm, vis M10
630 A	3 et 4 P	800 x 500 x 343	620 x 530	196	420	41,2	360	420	43,2	Unip 2 x 300 mm² Plage de 40 mm, vis M12
720 A	3 et 4 P	800 x 500 x 343	620 x 530	196	420	41,2	360	420	43,2	Unip 2 x 300 mm² Plage de 40 mm, vis M12
800 A	3 P	1100 x 700 x 523	920 x 730	160	731	68	591	731	72,5	Unip 4 x 185 mm² Plage de 100 mm, 2 vis M12
	4 P	1100 x 700 x 523	920 x 730	160	731	71	591	731	75,5	
1250 A	3 P	1100 x 700 x 523	920 x 730	160	731	68	591	731	72,5	Unip 4 x 185 mm² Plage de 100 mm, 2 vis M12
	4 P	1100 x 700 x 523	920 x 730	160	731	71	591	731	75,5	
1600 A	3 P	1100 x 800 x 523	920 x 830	160	731	78,5	591	731	84,5	Unip 6 x 240 mm² Plage de 150 mm, 3 vis M12
	4 P	1100 x 800 x 523	920 x 830	160	731	81,5	591	731	87,5	

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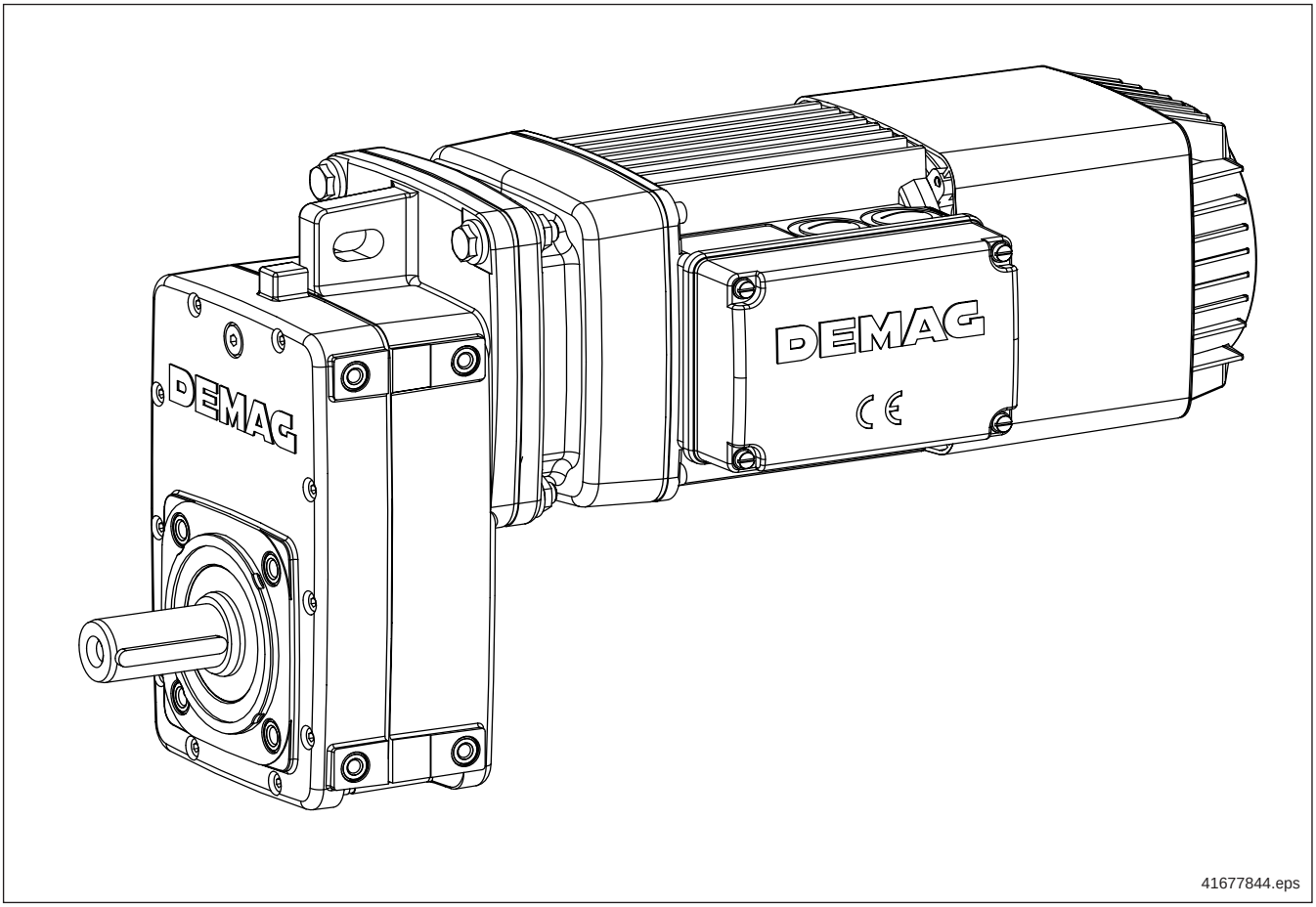
Operating instructions

Offset geared motors AU – AD – AG – AF – AM gearbox range
NA – BA – BF motor range



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Manufacturer

Mannesmann Dematic AG

P.O. Box 67, D-58286 Wetter
Telephone (+49 2335) 92-0, Telefax (+49 2335) 927676
http://www.dematic.com

Further literature

Document	Part no.			
	DE	EN	FR	ES
Geared motors – with prices		203 150 44		–
Geared motors – with price code		203 250 44		–
Geared motors – with price code	–	203 251 44	–	203 251 44
Geared motors for travel drive applications – volume 2 – with prices		203 355 44		–
Geared motors for travel drive applications – volume 2 – with price code		203 356 44		–
NA - BA - BF motor range operating instructions	214 227 44	214 228 44	214 229 44	214 230 44
Brake motor operating instructions, KBA, KBF, KBS, SBA, SBS ranges	214 317 44	214 318 44	214 319 44	214 320 44
Component parts list offset gearbox si e 10 - 90				
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A 30	222 828 44	222 829 44	222 830 44	222 831 44
A 40	222 832 44	222 833 44	222 834 44	222 835 44
A 50	222 836 44	222 837 44	222 838 44	222 839 44
A 60	222 840 44	222 841 44	222 842 44	222 843 44
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0 Foreword

CE

You have purchased a Mannesmann Dematic product. This equipment was manufactured in accordance with state-of-the-art engineering principles.

These operating instructions are designed to provide the operator with appropriate instructions for safe and correct operation and to facilitate maintenance.

Every individual given the task of transporting, installing, commissioning, operating, maintaining and repairing our geared motors and additional equipment must have read and understood

- the operating instructions
- the safety regulations and
- safety instructions in the individual chapters and sections.

The operating instructions must be available to the operating personnel at all times in order to prevent operating errors and to ensure smooth and trouble-free operation of our products.

0.1 Copyright

These operating instructions must be treated confidentially. They should only be used by authorized personnel. They may only be entrusted or made available to third parties with the prior written consent of Mannesmann Dematic. All documents are protected within the sense of copyright law.

No part of this documentation may be reproduced, utilized or transmitted without specific prior consent. Infringements are an offence resulting in obligatory compensatory damages. All industrial rights reserved.

0.2 After-sales service

For technical information on Mannesmann Dematic products and their systematic application, please refer to one of our after-sales service stations, the relevant representative or to our main office in Wetter.

0.3 Guarantee

These operating instructions must be read carefully before installing and putting the product into operation.

We assume no liability for damage and malfunctions resulting from failure to comply with the operating instructions.

Wearing parts are not subject to the guarantee, guarantee claims must be made by quoting the order number to Mannesmann Dematic immediately on detecting the defect.

The guarantee is cancelled, for example, in the event of:

- inappropriate use,
- faulty devices or equipment connected or attached to the product which are not part of our scope of supplies and services,
- use of non-genuine spare parts and accessories,
- refurbishment or modification of the product unless approved in writing by Mannesmann Dematic.

0.4 Liability

All technical information, data and instructions for operation contained in these operating instructions were up-to-date on going to print and are compiled on the basis of our experience and to the best of our knowledge.

We reserve the right to incorporate technical modifications within the scope of further development of the geared motors which are the subject of these operating instructions.
Therefore, no claims can be derived from the information, illustrations and descriptions contained in these operating instructions.

The descriptions and illustrations contained in this documentation do not necessarily correspond to the scope of delivery or any subsequent spare part delivery, either; the drawings and illustrations are not to scale.
Only documentation belonging to the actual order is valid.

We assume no liability for damage and malfunctions caused as a result of operating errors, noncompliance with these operating instructions or inappropriate repairs and maintenance.
We expressly point out that only Mannesmann Dematic spare parts and accessories approved by us may be used.

Accordingly, this also applies to other manufacturers' parts used.
For safety reasons, the fitting and use of spare parts or accessories which have not been approved and unauthorized modification and conversion of the product are not permitted and exempt Mannesmann Dematic from any liability for damages resulting therefrom.

With the exclusion of any further claims, Mannesmann Dematic is liable for any faults or omissions on our part within the scope of the warranty obligations entered into in the original contract. Claims for damages – except for legal claims resulting from product liability legislation – are excluded, irrespective of the legal reason from which such claims are derived.

0.5 Definitions

Owner

Owners (employer, company) are defined as persons who own the product and who use it appropriately or allow it to be operated by suitable persons.

Operating personnel

Operating personnel are defined as persons assigned by the owner of the product to carry out special tasks such as installation, operation, setting-up, maintenance including cleaning, fault elimination and transportation of the product.

Specialist personnel

Specialist personnel are defined as persons assigned by the owner to carry out specific tasks.

- **ualified personnel**

  Qualified personnel are defined as persons, who, owing to their technical training, knowledge and experience as well as knowledge of the relevant standards, are able to assess the tasks given to them and identify potential hazards.

- **Trained person**

  Trained persons are defined as persons who have been instructed and trained for the tasks assigned to them and on the possible hazards resulting from incorrect handling and who have been informed about the required protective devices, protective measures, relevant regulations, codes of practice, accident prevention regulations and operating conditions and who have proven their qualifications.

- **Experienced technician**
  Experienced technicians are defined as persons, who, owing to their technical training and experience, have sufficient knowledge of the product and are familiar with the relevant national industrial safety regulations, codes of practice, accident prevention regulations, directives and generally accepted engineering standards (e.g. EC Directives, German VDE and VBG regulations) enabling them to judge the safe operating condition of geared motors.

1 Safety

1.1 Symbols

The following symbols and recommendations indicate potential safety hazards or causes of damage or provide useful information.

a ard warning

This symbol appears in the operating instructions next to all instructions relating to safety at work wherever a potential hazard to life and limb exists if the instructions are not complied with.

Follow these instructions at all times and be particularly careful and cautious.

Pass on safety instructions to all persons entrusted with working on geared motors including the power supply.

In addition to the safety instructions, observe all general safety regulations and codes of practise at all times.

Warning against electrical ha ards

Contact with live parts can result in immediate death. Protective covers (e.g. covers and enclosures) marked with this sign may only be opened by qualified electricians. Before opening, all relevant operating, control, feed or other voltages must be disconnected.

Operating ha ard for the installation

This symbol in the operating instructions indicates all warnings which, if not complied with, may result in damage to geared motors.

1.2 Intended use

Geared motors are intended for all travel, lifting and turning motions in industrial applications. Compliance with the permitted operating conditions must be ensured for operation of these drives (e.g. enclosure type, ambient temperature, installation height).

1.3 Prohibited practises, improper use

Under certain conditions, operation of geared motors is prohibited as this could result in malfunctions, faults in the equipment or hazard to life and limb, e.g.:

- Acidic, corrosive air as coolant
- Operation outside the permitted temperature range
- Operation beyond the normal air pressure. Otherwise, power adjustments are necessary
- Operation under conditions of high humidity or splashwater
- Manipulation of electrical modules

Safety devices must not be rendered inoperable or modified or used in any way other than that for which they have been designed.

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1.4 Safety instructions

The relevant national accident prevention regulations and the general safety conditions must always be observed when our products are operated in order to avoid accidents and damage to machinery. If the safety instructions given in these operating instructions are not observed in any way, personal injury or even death can result.

Dangerous voltage.

Geared motors are connected to a mains power supply. Any contact with live parts can lead to very serious injury or even death.

Putting offset geared motors into operation

Do this only

- if you have read the operating instructions and the owner has instructed you in all details,
- if the operating instructions are available for reference at the place of operation,
- if you are qualified personnel,
- if you are not under the influence of drugs, alcohol or medication that can adversely affect your ability to react,
- if the general accident prevention, operating and installation regulations (e.g. DIN-VDE 0100/0113/0160) have been observed.

Additional safety instructions

Only carry out maintenance and installation work

- if you are qualified specialist personnel,
- if the motors are at zero voltage,
- if no hazard exists (e.g. crushing hazard, slipping hazard, etc.),
- if the motors are secured against restoration of the power supply,
- if all cables and motor terminals are at zero potential (establish with a voltmeter),
- with insulated tools,
- using genuine spare parts.

2 Receiving, transport and storage

2.1 Receiving

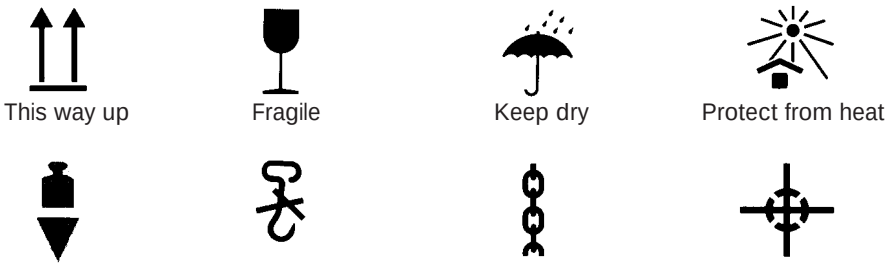
The scope of delivery is specified in the shipping papers. Check the delivery immediately on receipt to ensure that it is complete and examine it for damage caused in transit. If necessary, a damage report must be made out in the presence of the transport contractor's representative as otherwise it will not be possible to rectify the damage at no cost to you.

2.2 Transport

The drive is supplied made up into one unit. Additional equipment may be supplied in separate packaging.

The drive is packed depending on the transport method and its weight. Unless otherwise agreed in the purchase contract, the packaging corresponds to the packaging guidelines of Mannesmann Dematic AG.

Symbols used on the packing



Handle geared motors with utmost care to avoid damage caused by careless loading and unloading, for example.

2.3 Storage

Geared motors must be stored as follows:

- in dry places with low temperature fluctuations
- in the same position as for operation
- protected against dust and moisture
- on a wooden support
- free from vibration (no impacts)

Drives must not be stacked on top of each other.

Unless otherwise agreed in the purchase contract, standard conservation is guaranteed for a period of 6 months. The guarantee period begins on the day the unit is delivered.

Contact Mannesmann Dematic AG in Wetter, Germany, if geared motors are to be stored for periods of longer than 6 months.

Important Geared motor units may otherwise be damaged.

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3 Product description

3.1 Gearbox

Demag offset geared motors offer the optimum solution for space-saving requirements owing to their compact design. The variety of drive shafts – hollow or solid shaft – and the possible mounting variants as a hollow-shaft geared motor of torque bracket, foot or flange-mounted design make it possible to implement cost-effective solutions for the given drive requirement.

For these reasons, the offset geared motor design is used for travel drive applications all over the world.

The range includes 9 gearbox sizes. Sizes A10 to A40 feature a dimensionally stable, vertically split housing of high quality pressure die-cast aluminium alloy. This guarantees high stability for high performance and low dead weight.

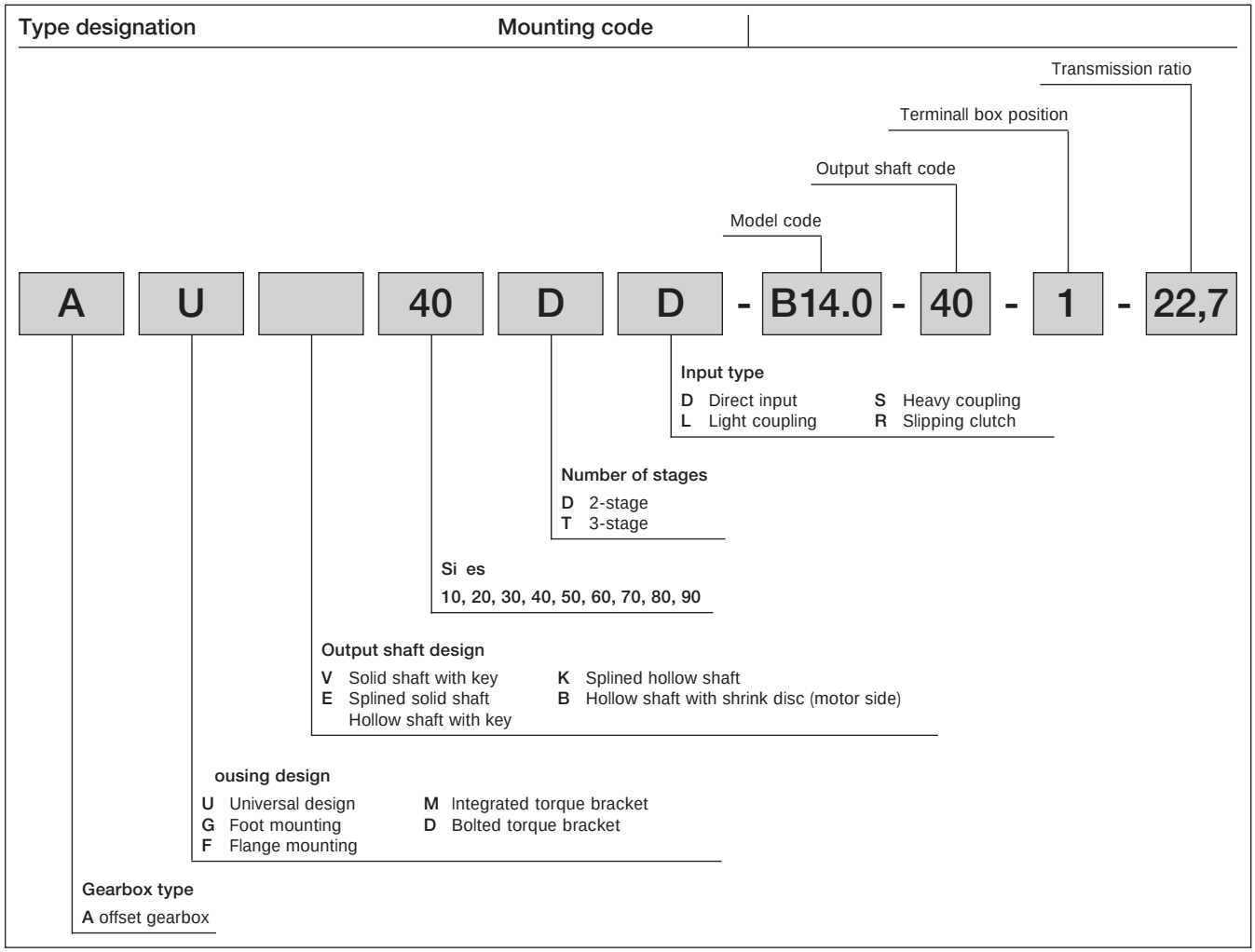
Sizes A50 to A90 feature a grey cast iron housing. Size A10 is of two-stage design, sizes A20 to A90 are two or three-stage depending on the transmission ratio.

3.1.1 Motor to gearbox connection

The motor either drives the gearbox via a **direct drive input** or **coupling** connection.

- **Direct drive input** means that the motor is flanged to the gearbox.
- The **coupling** connection means that the motor is bolted to the coupling enclosure of the gearbox and drives the gearbox via a coupling. Couplings are available in various designs. The various model types are coded by a letter for the drive input connection in the “Type” line on the gearbox rating plate (see section 3.1.3).

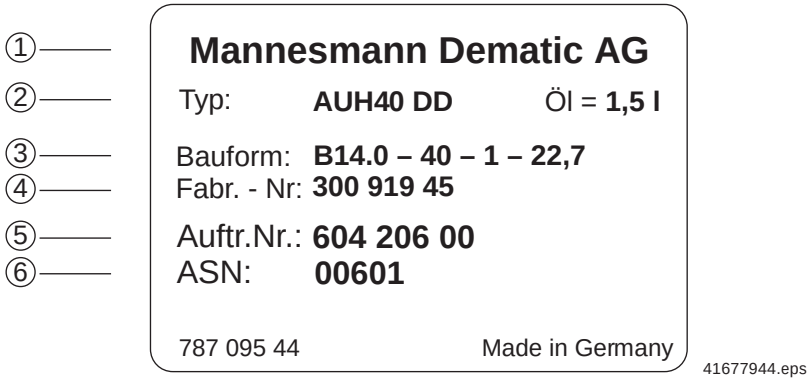
3.1.2 Gearbox type designation



3.1.3 Gearbox rating plate

All gearbox features can be found in the form of a model code on the gearbox rating plate.

See the legend for the example below:



① **Manufacturer**

② **Type**

AU	Gearbox type designation	
40	Size	
D	Number of stages	
D	Input design	“Direct input”
L	Input design	“Coupling, light”
S	Input design	“Coupling, heavy”
R	Input design	“Slipping clutch”

Oil Lubricant and quantify

③ **Model**

B14.0	Model and position
40	Output shaft code
1	Terminal box position
22,7	Transmission ratio

④ **Serial number**

⑤ **Order number**

⑥ **Entry number**

Notes:

- The rating plate is attached to the side of the gearbox housing.
- The type and model code are necessary for general questions concerning the housing, mounting position, transmission ratio, etc. For more detailed information on the drive, e.g. for spare parts, the order, serial and entry number (ASN) are required.

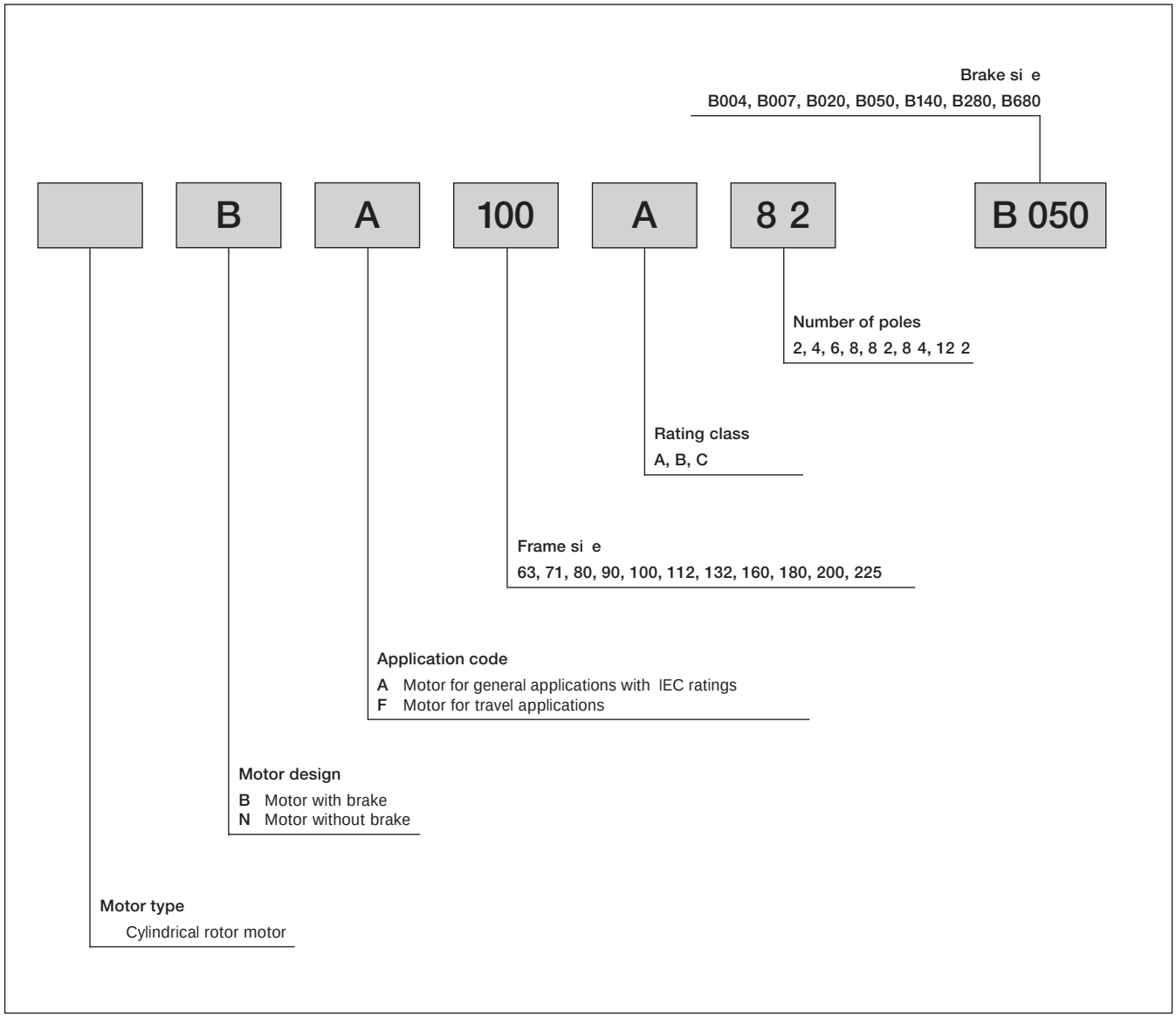
3.2 Motor

Demag type Z cylindrical rotor motors can be supplied with or without brake (ZB and ZN motors). The motor range includes frame sizes Z..63 to Z..225. The output ratings of the 2, 4, 6 and 8-pole motors are graded according to the IEC classification. The motor range includes pole-changing designs and motors with integrated fly wheels for particularly smooth load movement.

The housings of motor frame sizes Z..63 to Z..132 are of a high quality aluminium alloy with an integrated terminal box base. The terminal box cover and fan cover are made of plastic.

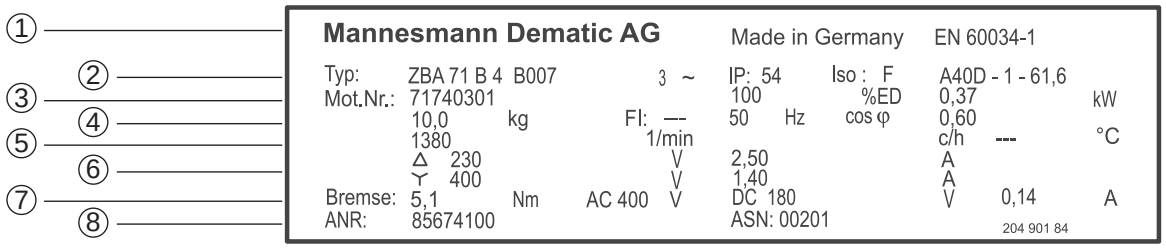
Motor frame sizes Z..160 to Z..225 have a grey cast iron housing with a fitted terminal box.

3.2.1 Motor type designation



3.2.2 Motor rating plate

Rating plate of .. 63 A to .. 71 B with without brake



41808544.eps

① Manufacturer, country of origin, regulation

② Type designation, number of phases, enclosure, temperature class, model

③ Motor number, duty factor, power factor

④ Motor weight, inertia factor, frequency, power factor

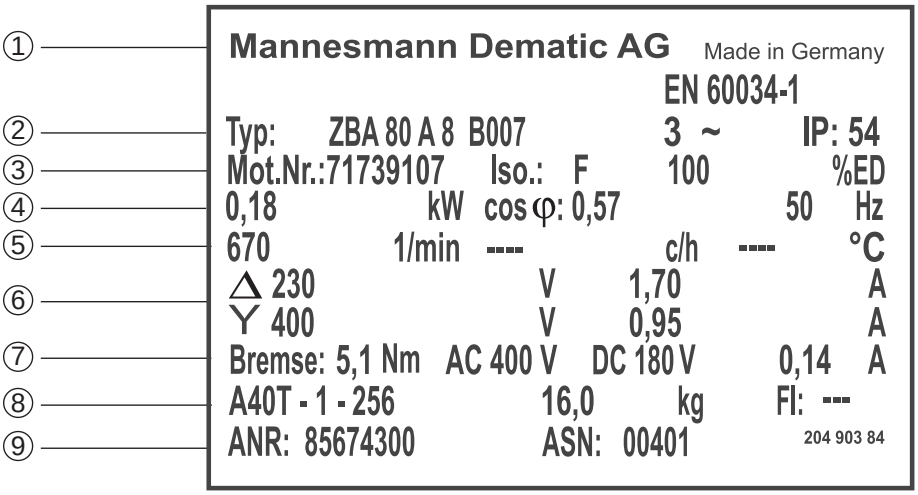
⑤ Speed, switching frequency, ambient temperature > 40 °C

⑥ Connection, voltage, current

⑦ Brake: brake torque, supply voltage, coil voltage, coil current

⑧ Order number, entry number

Rating plate of 80 A to 132 C with without brake



41808644.eps

① Manufacturer, country of origin, regulation

② Type designation, number of phases, enclosure

③ Motor number, temperature class, duty factor

④ Rating, power factor, frequency

⑤ Speed, switching frequency, ambient temperature > 40 °C

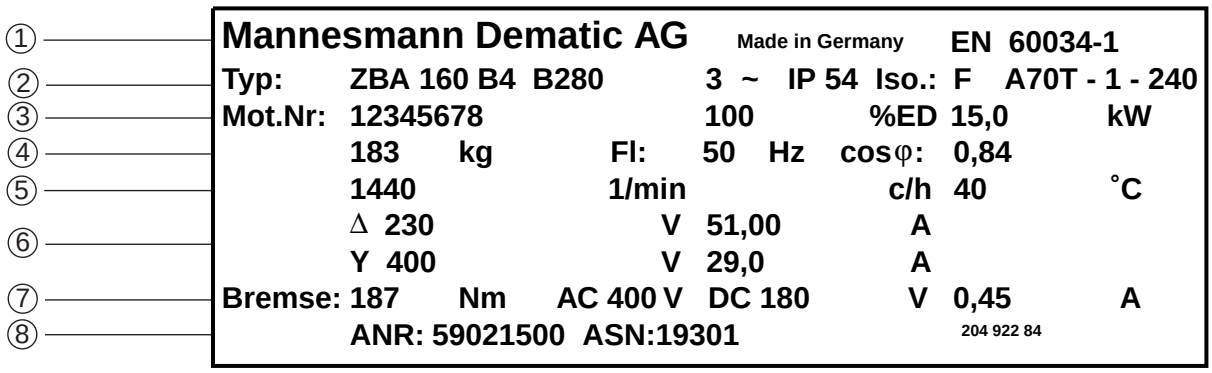
⑥ Connection, voltage, current

⑦ Brake: brake torque, supply voltage, coil voltage, coil current

⑧ Model, motor weight, inertia factor

⑨ Order number, entry number

Rating plate of .. 160 A to .. 225 B, with without brake



42002744.eps

① Manufacturer, country of origin, regulation

② Type designation, number of phases, enclosure, temperature class, model

③ Motor number, duty factor, power factor

④ Motor weight, inertia factor, frequency, power factor

⑤ Speed, switching frequency, ambient temperature

⑥ Connection, voltage, current

⑦ Brake: brake torque, supply voltage, coil voltage, coil current

⑧ Order number, entry number

3.3 B.. motor brake

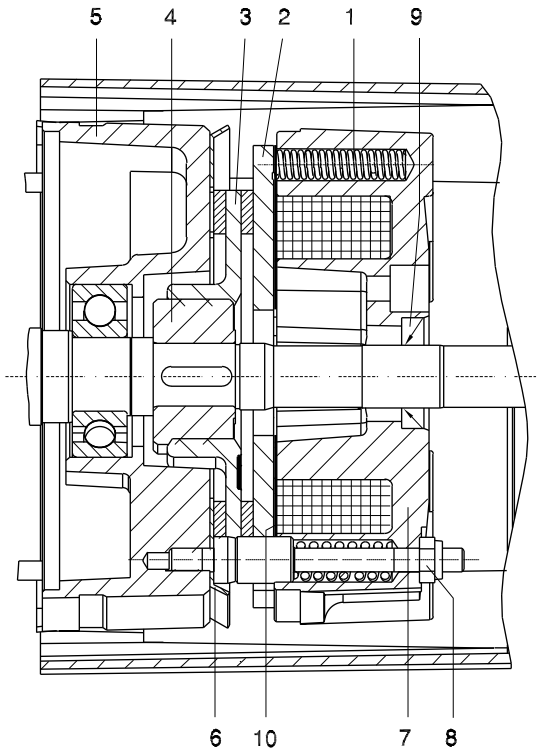
Demag B004 to B680 disk brakes are spring-actuated brakes featuring electromagnetic brake release. The brake fitted under the fan cover can be controlled independently of the motor and causes no axial movement of the rotor shaft or forces on the bearings.

The diagram shows the function elements of the disk brake, which operates is spring-actuated with electromagnetic release. When the voltage supply to the brake coil is interrupted, the brake is applied. This operating principle is also known as a fail-safe brake.

Brakes B004 to B680 can be released by a rectifier integrated in the terminal box of the motor or by applying DC voltage direct to the brake coil.

Two brake sizes are available for each motor frame size to cover a large brake torque range for various applications.

B004 – B680 DC brakes



1 Brake spring
2 Pressure plate
3 Brake disc
4 Carrier
5 End shield BS
6 Friction plate
7 Electromagnet
8 Ad usting nut
9 Radial shaft sealing ring
10 Stop plate

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4 Installation

4.1 Transport

Use the lifting eyes provided for transport purposes.

4.2 Checking the condition of the motor

Before installing the motor, check whether it has suffered any damage during transportation or while in storage, such as corrosion, leaks, deformation or breakage.

Do not clean drives with compressed air.

4.3 Checking the installation site

The standard drive is suitable for operation in normal industrial conditions. If the ambient temperature, atmosphere or humidity are other than indicated on the rating plate, the geared motor unit must only be operated with special equipment or features (see rating plate).

Ambient temperature	**from –10 C to 40 C**
Installation height	**up to 1000 m above sea level**

The site at which the geared motor is installed must be designed in such a way that

- air may circulate to allow heat to be exchanged,
- no residue from operating processes can accumulate on the geared motor, fall between the drive elements or damage the sealing ring,
- the oil inlet and outlet and rating plate are accessible.

4.4 Installing the offset geared motor

Before installing the geared motor, check that it will be operated in the mounting position specified on the rating plate. The quantity of oil depends on the mounting position.

Gearbox si es A10 - A40

These gearbox sizes are not vented.

If the gearbox has to be vented (breather screw or valve) – non-standard design – the oil fill screw at the highest point of the gearbox must be replaced by the breather screw or valve.

For arrangement see section 4.4.1, table 2.

For tightening torque see section 6.3, table 11.

Gearbox si es A50 - A90

A breather valve is supplied as standard. This must be fitted at the highest point of the gearbox in place of the oil fill screw.

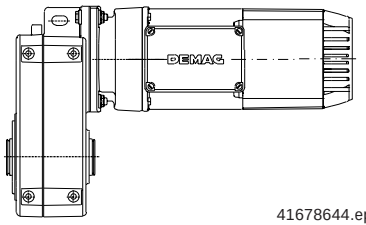
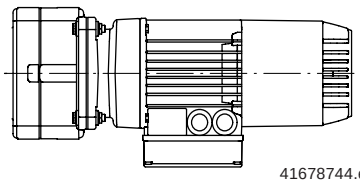
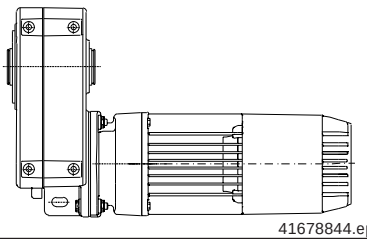
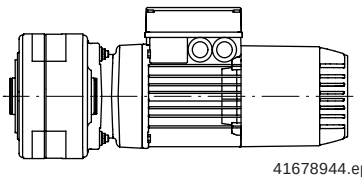
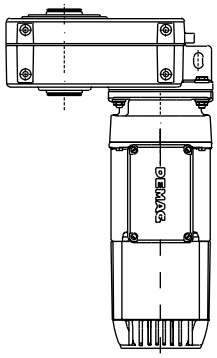
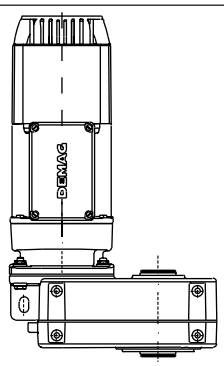
For arrangement see section 4.4.1, table 2.

For tightening torque see section 6.3, table 11.

Note The breather screw or valve is enclosed together with the operating instructions and parts lists separate from the delivery.

4.4.1 uantity of lubricant dependent on si e and model code mounting position

Table 1 — Oil quantity in litres

Model code mounting position		Frame si es AU, AD, AG, AF and AM										
		10	20	30	40	50	60	70	80		90	
									2-stage	3-stage	2-stage	3-stage
B14.0 B 6.0 B 7.1 B 5.0 M 0 D 1.0	 41678644.eps	0,35	0,5	0,9	1,5	2,2	4,0	9,5	16	16	24	25
B14.1 B 8.0 B 3.1 B 5.1 M 1 D 1.1	 41678744.eps	0,35	0,5	0,9	1,5	2,2	4,5	8,0	11	11	25	23
B14.2 B 7.0 B 6.1 B 5.2 M 2 D 1.2	 41678844.eps	0,35	0,5	0,9	1,5	2,5	5,0	9,0	18	16	30	29
B14.3 B 3.0 B 8.1 B 5.3 M 3 D 1.3	 41678944.eps	0,35	0,5	0,9	1,5	2,2	4,0	8,0	11	12	17	25
V19 V 6.0 V 6.1 V 3 M 4 D 1.4	 41679244.eps	0,4	0,6	1,1	2,0	2,5	5,5	10	19	20	39	38
V18 V 5.0 V 5.1 V 1 M 5 D 1.5	 41679344.eps	0,4	0,6	1,0	1,9	2,5	5,0	10	17	16	39	38

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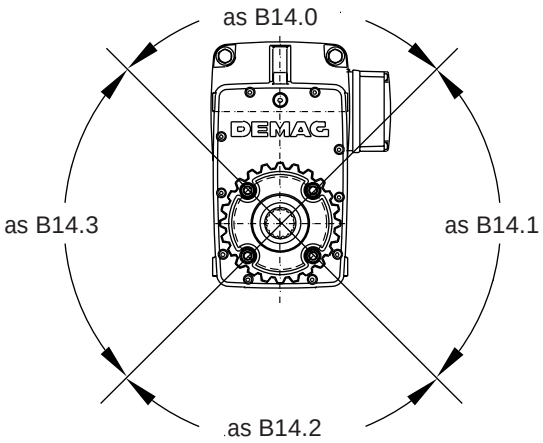
uantities of lubricant in inclined mounting positions

The quantities of lubricant in inclined mounting positions correspond to the following model codes/mounting positions:



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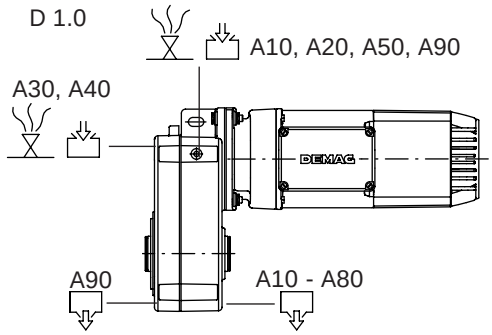
A10 – A90 model code mounting position overview

Geared motors must be operated according to the model code and the mounting position specified on the rating plate. This ensures the optimum quantity of lubricant is used.

Breather Oil fill screw Oil drain screw

Table 2

B14.0 B 6.0 B 7.1
B 5.0 M 0 D 1.0



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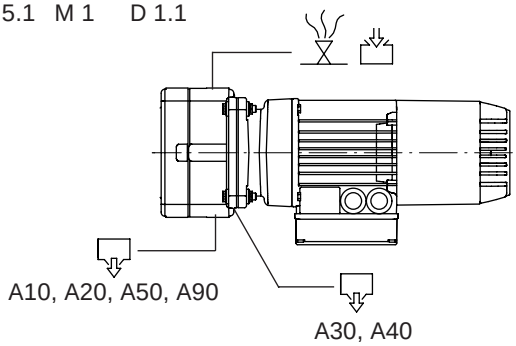
B14.1 B 8.0 B 3.1
B 5.1 M 1 D 1.1



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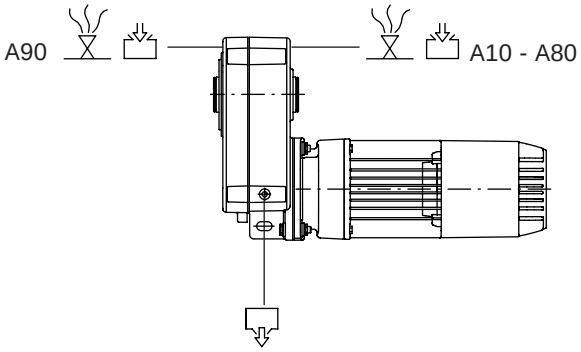
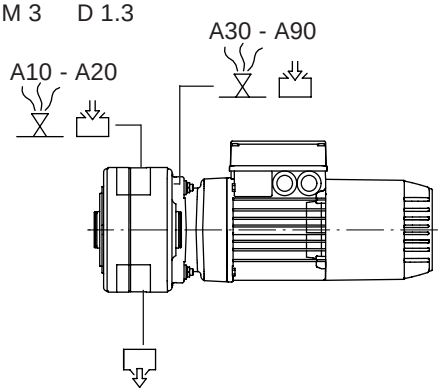
B14.2 B 7.0 B 6.1
B 5.2 M 2 D 1.2



41678855.eps

B14.3 B 3.0 B 8.1
B 5.3 M 3 D 1.3



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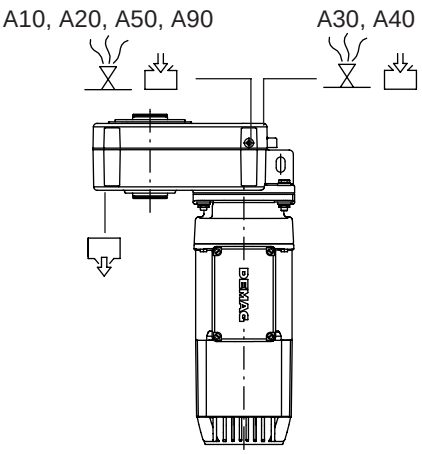
V19 V 6.0 V 6.1
V 3 M 4 D 1.4



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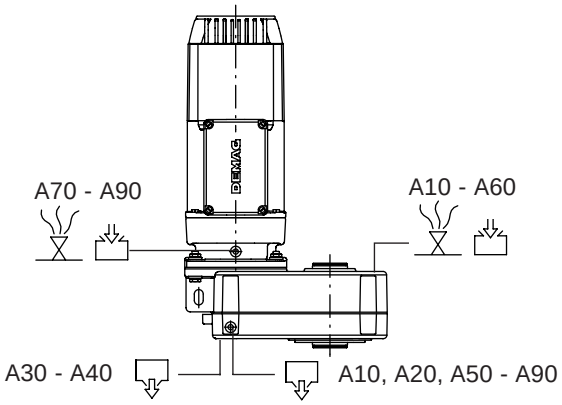
V18 V 5.0 V 5.1
V 1 M 5 D 1.5



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4.4.2 Mounting position of offset geared motors with solid shaft

The support or flange surface must be designed in such a way that no forces are transmitted to the gearbox housing as a result of mounting distortions. The following conditions must be satisfied by the bolted connections to the supporting structure to ensure correct functioning of the offset geared motor unit:

Table 3

Tightening torques for foot mounting

Gearbox si e	Bolt [1] DIN 912 or 931	Washer DIN 125	Tightening torque Nm	Bolt [1] Locking bolt	Tightening torque Nm
A 10	–	–	–	–	–
A 20	–	–	–	–	–
AG 30	(4x) M8, grade 8.8	A 8,4	25	(4x) M8	35
AG 40	(4x) M10, grade 8.8	A 10,5	51	(4x) M10	75
AG 50	(4x) M12, grade 8.8	A 13	87	(4x) M12	115
AG 60	(4x) M16, grade 8.8	A 17	215	(4x) M16	300
AG 70	(4x) M20, grade 8.8	A 21	430	(4x) M20	720
AG 80	(4x) M24, grade 8.8	A 25	670	–	–
AG 90	(4x) M30, grade 8.8	A 31	1500	–	–

[1] optional

Table 4

Tightening torques for flange mounting

Gearbox si e	Bolt [1] DIN 912 or 931	Washer DIN 125	Tightening torque Nm	Bolt [1] Locking bolt	Tightening torque Nm
A 10	–	–	–	–	–
AF 20	(4x) M8, grade 8.8	A 8,4	23	(4x) M8	35
AF 30	(4x) M10, grade 8.8	A 10,5	46	(4x) M10	75
AF 40	(4x) M12, grade 8.8	A 13	79	(4x) M12	115
AF 50	(4x) M12, grade 8.8	A 13	79	(4x) M12	115
AF 60	(4x) M16, grade 8.8	A 17	195	(4x) M16	300
AF 70	(8x) M16, grade 8.8	A 17	195	(8x) M16	300
AF 80	(8x) M16, grade 8.8	A 17	195	(8x) M16	300
AF 90	(8x) M16, grade 8.8	A 17	195	(8x) M16	300

[1] optional

Flanges:

Centre edge tolerance to DIN 42948

- ISO j6 for b1 ≤ 230 mm
- ISO h6 for b1 > 230 mm

The drive shaft must be carefully cleaned to remove the corrosion protection before drive elements such as clutches, chain sprockets, gear wheels or belt pulleys are fitted.

Ensure the cleaning agent used will not damage the sealing ring.

Drive elements may only be fitted or removed with suitable devices, using a centre bore hole to DIN 332 in the journal shaft, if required. It is advisable to heat the hub to approx. 100° C.

The drive element must fixed on the shaft in the position specified for the drive arrangement. The manufacturer's recommendations relating to pretension settings and maintenance must be complied with in the case of chains and wheels.

4.4.3 Fitting offset geared motors with hollow shaft, key or splined profile shaft

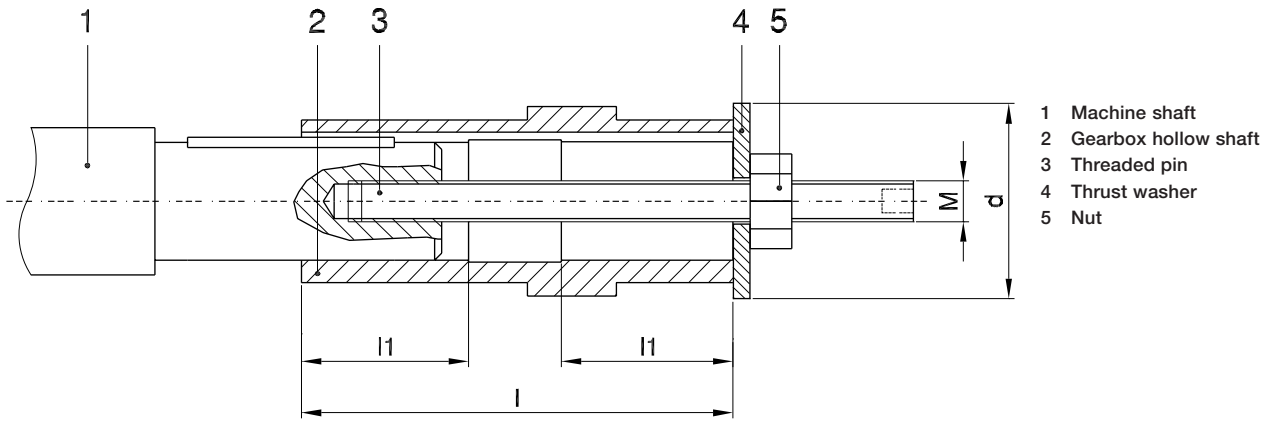
Before fitting the geared motor unit, ensure the machine shaft and the hollow shaft of the gearbox are undamaged and free of burrs and foreign particles. The machine shaft must feature a centre bore hole with a thread to DIN 332 and be lubricated with a commercially available lubricant.

Fitting the offset geared motor

- The offset geared motor must be fitted using the threaded pin and relevant thrust washer as indicated in the “Fitting dimensions” overview.
- The machine shaft must be guided on both sides in the hollow shaft.

Fitting with threaded pin

Fitting arrangement diagram



The scope of delivery does not include the threaded pin and thrust washer

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Overview Fitting dimensions

Table 5

Gearbox si e	d mm	M	l mm	l1 mm
A 10	35	M8	90	25
A 20	40	M8	96	25
A 30	50	M12	116	30
A 40	55	M16	133	35
A 50	70	M16	157	40
A 60	90	M20	187	40
A 70	100	M20	240	50
A 80	120	M24	274	50
A 90	140	M24	332	70

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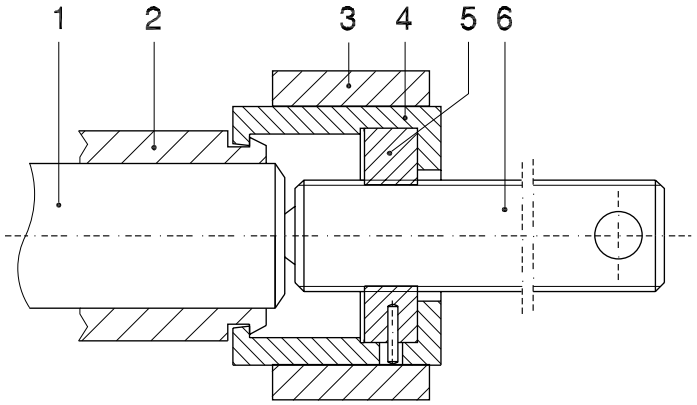
Removing the gearbox

A special extractor can be used to remove the offset geared motor. The extractor engages the groove which holds the protective cap.

Diagram of extractor



1 Machine shaft
2 Gearbox hollow shaft
3 Retaining ring
4 2-part outer section
5 Threaded section
6 Spindle

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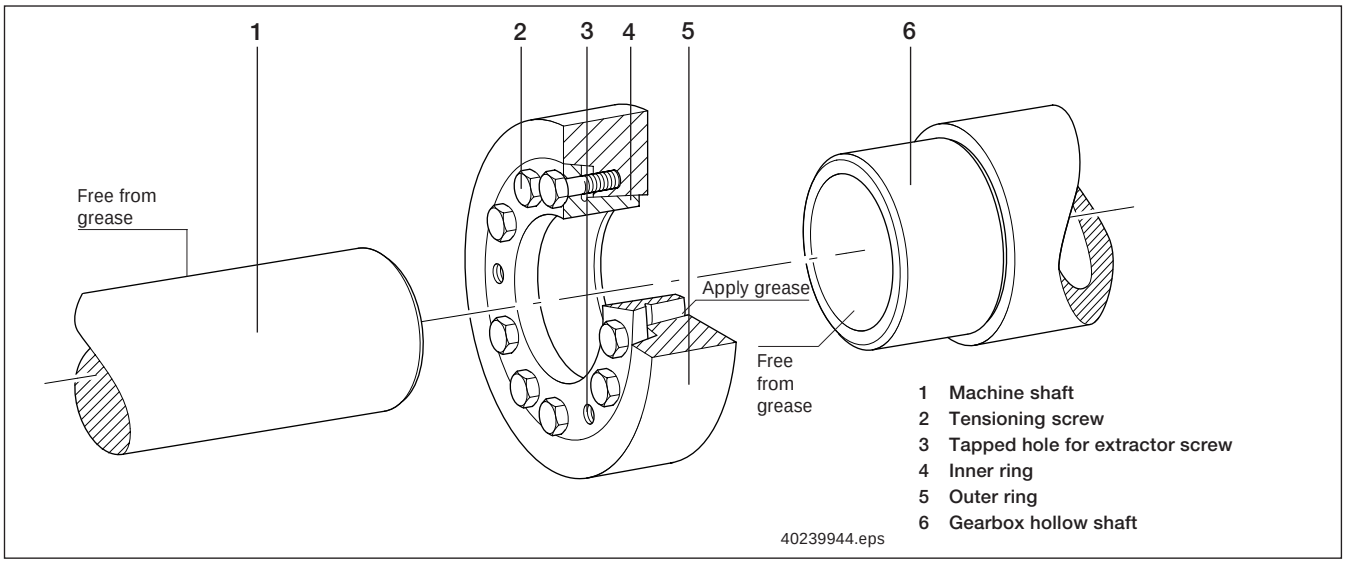
It may be assumed that splined shaft connections are easier to disconnect than shaft connections with a key.

4.4.4 Fitting offset geared motors with hollow shaft and shrink disk connection

ollow shaft with shrink disk connection

The same procedure applies for fitting the gearbox on the machine shaft as for splined profile shafts and hollow shafts with key.

Fitting and removing the shrink disk connection



General

As standard, the shrink disk is fitted to the hollow shaft of the gearbox and only lightly tightened for transport.

Fitting

1. Before the gearbox is placed on the mating shaft, the inside of the hollow shaft and the outside of the mating shaft must be degreased using a solvent.
2. Release the tension in the shrink disk by unscrewing all tensioning screws a few turns anticlockwise, and slide the gearbox, together with the shrink disk, onto the mating shaft and position them. Slide the shrink disk inner ring up to the stop on the hollow shaft.
3. Tighten all tensioning screws. It will be necessary to go round the pitch circle several times until all the front faces of the outer and inner rings are flush. The correct tightness of the HSD shrink disk can be easily checked at any time, since when correctly fitted, the front faces of the outer and inner rings must be flush.

Removal

1. Loosen all tensioning screws by unscrewing them anticlockwise. If necessary, the outer ring can be released from the inner ring by tightening screws in the tapped holes provided. The tensioning screws can be used for this purpose.
2. Any rust which may have formed on the mating shaft in front of the hollow shaft must be removed.
3. Remove the gearbox from the mating shaft.

Cleaning and lubrication

Shrink disks which have been removed do not need to be disassembled and relubricated before they are fitted again.

Shrink disks must only be cleaned and relubricated if they are dirty.

One of the following solid lubricants should be used for the conical surfaces.

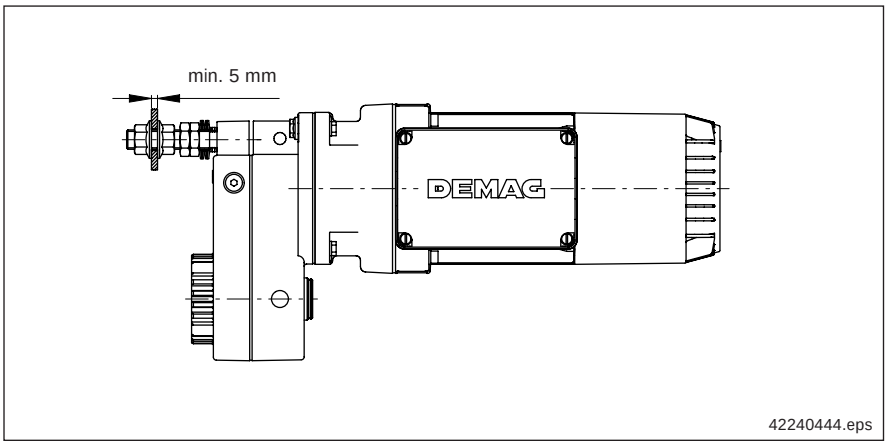
Table 6

Commercially available lubricants with high MoS2 content	
Molykote 321 R (lubricating varnish) Part no. 972 398 44	Spray
Molykote Spray (powder spray)	Spray
Molykote G Rapid	Spray or paste

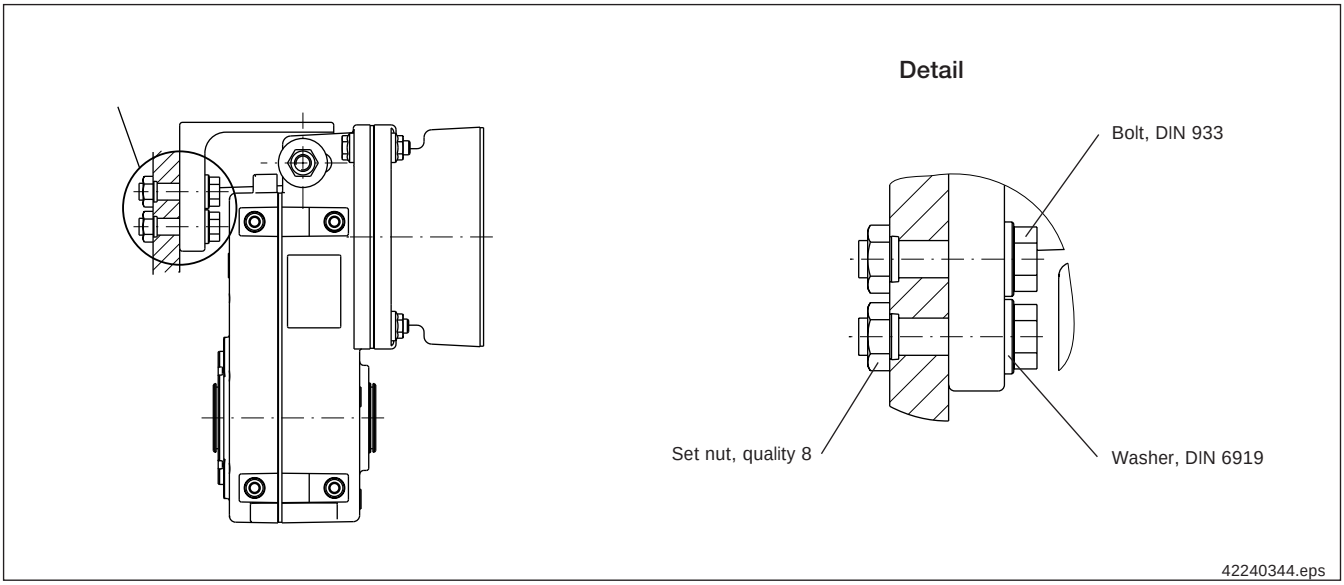
4.4.5 Torque bracket connection

4.4.5.1 D2 torque bracket for AM10

The torque bracket is inserted into the opening in the gearbox housing and compressed to retain it in the opening by tightening a nut.



4.4.5.2 Torque bracket AM20, AU20 30, AU AD40, AU AD50



4.4.5.3 Torque bracket, tightening torques

Table 7	Gearbox si e	Support structure - torque bracket			Gearbox - torque bracket	
		Si e	uantity	Tightening torque Nm	Si e	Tightening torque Nm
	AM10	M16	1	200	M16	14
	AU20	M12	2	115	M12	50
	AU30	M12	4	115	M12	100
	AU AD40	M12	4	115	M12	100
	AU AD50	M16	4	300	M16	200

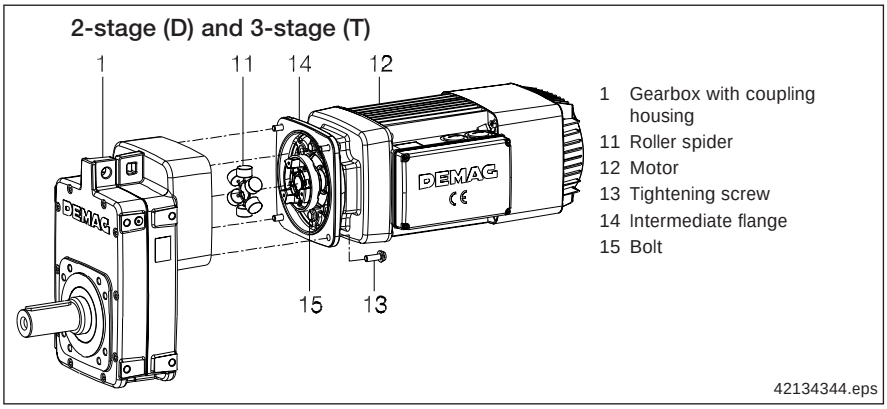
The paint finish thickness between the torque bracket and connecting surface must not exceed 60 m.

4.5 Assembling, disassembling the motor and gearbox

It is important to establish whether the geared motor was supplied with a coupling or direct input connection for assembling/disassembling the motor.

The gearbox type designation can be found on the rating plate (see section 3.1.3).

4.5.1 Coupling connection A10 to A60



Disassembly

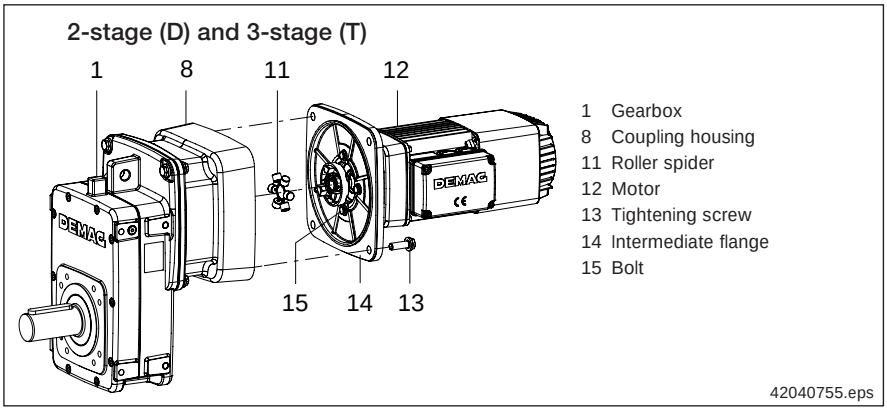
1) Undo the 4 connecting screws (13).
2) Remove motor (12) from coupling (8). Roller spider (11) will lie loose in the coupling half.

Assembly

3) Place roller spider (11) into the gearbox coupling half.
4) Fit motor (12) into coupling (8) and attach using the 4 connecting screws (13).
5) When replacing the motor, undo screws (15) connecting the gearbox to intermediate flange (14) and retighten following replacement of the motor.

For tightening torques see table 8.

4.5.2 Coupling connection A70 to A90



Disassembly

1) Undo the 4 connecting screws (13).
2) Remove motor (12) from coupling (8). Roller spider (11) will lie loose in the coupling half.

Assembly

3) Place roller spider (11) into the gearbox coupling half.
4) Fit motor (12) into coupling (8) and attach using the 4 connecting screws (13).
5) When replacing the motor, undo screws (15) connecting the gearbox to intermediate flange (14) and retighten following replacement of the motor.

For tightening torques see table 8.

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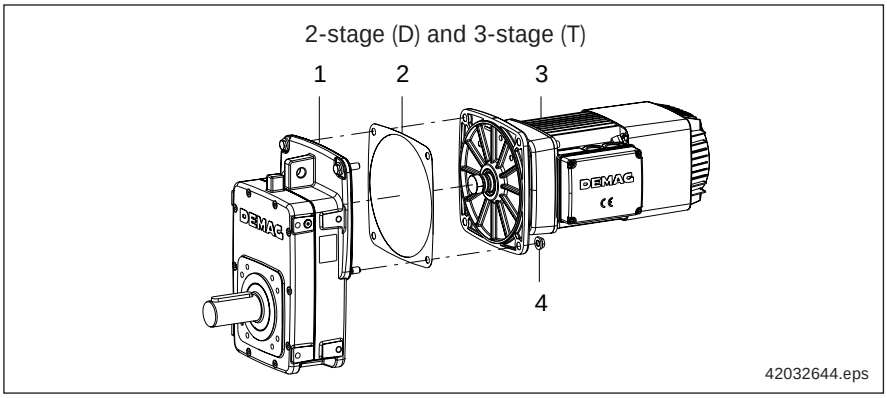
Table 8

Gearbox	Si e Fitted motor type ..	Fitted motor type KB.	Tightening torque in Nm Bolted connection Intermediate flange - gearbox	Bolted connection Intermediate flange - motor
A10	63A/B, 71A/B	71	45	18
	80A/B, 90A	80		35
A20	63A/B, 71A/B	71	45	18
	80A/B, 90A	80, 90		45
A30	63A/B, 71A/B	71	75	18
	80A/B, 90A	80, 90		45
	90B, 100A/B	100		75
A40	63A/B, 71A/B	71	75	18
	80A/B, 90A	80, 90		45
	90B, 100A/B	100, 112		75
A50	63A/B, 71A/B	71	75	16
	80A/B, 90A	80, 90		35
	90B, 100A/B	100, 112		75
	112A, 132A/B/C	125, 140		115
A60	63A/B, 71A/B	71	115	16
	80A/B, 90A	80, 90		35
	90B, 100A/B	100, 112		75
	112A, 132A/B/C	125, 140		115
	160A/B, 180A	–		300
A70	63A/B, 71A/B	71	75	16
	80A/B, 90A	80, 90		35
	90B, 100A/B	100		75
	–	112	115	75
	112A, 132A/B/C	125, 140		115
	160A/B, 180A	160		300
A80	80A/B, 90A	80, 90	75	35
	90B, 100A/B	100		75
	–	112	300	115
	112A, 132A/B/C	125, 140		300
	160A/B, 180A	160, 180		300
	180B, 200	200		300
A90	–	112	300	75
	112A, 132A/B/C	125, 140		115
	160A/B, 180A	160, 180		300
	180B, 200	200		300
	225	225		300

4.5.3 Direct connection

Gearbox si es A10 – A 50



Disassembly

1) Drain the oil (see section 6.3).
2) Undo connecting screws/nuts (4).
3) Remove motor (3).
4) Remove seal (2) and clean the sealing surface.

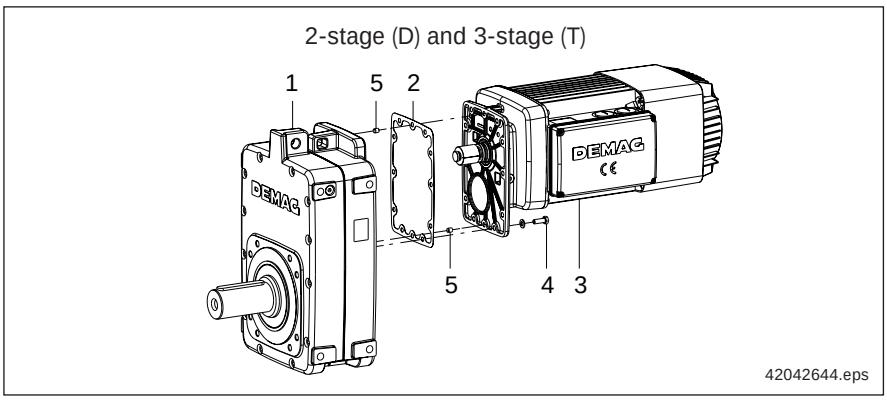
Assembly

5) Place seal (2) on gearbox sealing surface. Fit motor (3) to gearbox (1). Tighten connecting screws/nuts (4).

For tightening torque see table 9.

6) Fill with oil (see sections 4.4.1 and 6.3).
7) Put geared motor into operation and check for leaks.

Gearbox si es A60 – A90



Disassembly

1) Drain the oil (see section 6.3).
2) Undo connecting screws/nuts (4)
3) Remove motor (3. Leave centring pin (5) in remaining half.
4) Remove seal (2) and clean the sealing surface.

Assembly

5) Place seal (2) on gearbox sealing surface. Fit motor (8) to gearbox (1). Tighten connecting screws/nuts (5) with washers (4).

For tightening torque see table 9.

6) Fill with oil (see sections 4.4.1 and 6.3).
7) Put geared motor into operation and check for leaks

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Table 9	Direct input connection tightening torque		
	Gearbox size	Motor - gearbox housing bolted connection Motor size	Tightening torque of bolted connection Nm
	A10	Z.. 63 – Z.. 90 A	45
	A20	Z.. 63 – Z.. 100	45
	A30	Z.. 63 – Z.. 100	75
	A40	Z.. 63 – Z.. 132	75
	A50	Z.. 80 – Z.. 160	120
	A60	Z.. 80 – Z.. 180 A	120
	A70	Z.. 80 – Z.. 225	75
	A80	Z.. 80 – Z.. 132	51
		Z.. 160 - Z.. 225	75
	A90	Z.. 100 – Z.. 132	87
		Z.. 160 - Z.. 225	115

4.6 Installing the offset geared motor

Before installing the offset geared motor, check that it will be operated in the mounting position specified on the rating plate.

4.7 Special instructions for installing the offset geared motor

If the motor is operated outdoors in vertical mounting position IM V1 or in an inclined mounting position with the shaft facing downwards, it should be protected by a canopy.

For motors with condensation water openings which can be closed with a threaded plug, the drain holes must be arranged at the lowest point of the motor as otherwise water may enter. If the mounting position of the motor is changed and the drain holes are no longer required, the openings must be permanently sealed.

4.8 Requirements for connecting the offset geared motor

- You must be a trained electrician and familiar with the relevant accident prevention regulations and codes of practice.
- The motor and connecting cable must be disconnected from the supply.
- The frequency and voltage specified on the rating plate must correspond to the line frequency and voltage.

The motor must be connected as described in section 7 **Motor brake connection diagrams** .

To change the direction of rotation of the motor, two of the three phase conductors must be interchanged.

The instructions contained in section 5 Commissioning must be followed.

5 Commissioning

5.1 Requirements

Before the drive unit is put into service:

- the terminal box be must be closed,
- the fan cover must be fitted,
- the line voltage and frequency specified on the rating plate must match the given power supply,
- the motor must be checked for correct connection (check direction of rotation),
- heat must be able to dissipate (e.g. air vent slits must be free),
- it must be ensured that the drive unit does not constitute a hazard (e.g. no hazards caused by rotating or live parts),
- it must be ensured that there are no other hazard sources.

5.2 Check when commissioning

Check that:

- the motor runs correctly (e.g. no speed fluctuations or excessive noise),
- no oil escapes from the unit,
- there is no extreme vibration.

6 Maintenance

6.1 Checking before and during operation

If defects or damage are detected, the offset geared motor must not be put into operation or taken out of service. It may only be put back into service when the defect has been eliminated.

	Check		Action
Check the gearbox for	• External damage	→	Inform person responsible
	• Oil leaks	→	Inform person responsible
	• Unusual noises during operation	→	Inform person responsible
	• Dirt accumulation	→	Remove dirt
Check the motor for	• External damage	→	Inform person responsible
	• Unusual noises during operation	→	Inform person responsible
	• Dirt accumulation	→	Remove dirt

6.2 Maintenance schedule

Table 10 Maintenance schedule

Interval	Part	Maintenance	See section
According to operating conditions, at least every 3000 operating hours.	Brake	Check brake of motors fitted with brake.	6.4 or. 6.5
According to operating conditions, at least every 3000 operating hours.	Coupling	Check roller spider or elastic transmission element for play, deformation or initial wear.	3.1.1 or. 4.5.1, 4.5.2
Every 10 000 operating hours.	Motor	Inspect the motor and clean the cooling air channels.	
Every 10 000 operating hours or after 4 years.	Gearbox	Oil change (Under extreme operating conditions, such as increased ambient temperatures or extreme temperature fluctuations, the oil change must be carried out sooner.).	6.3

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6.3 Gearbox oil lubrication

Gearboxes are filled with lubricant before leaving the factory. The quantity of oil depends on the model and mounting position of the geared motor unit. The quantity of oil is indicated on the rating plate. Standard lubricant is used unless specified otherwise.

Oil grade

A mineral oil to DIN 51 502, CLP 220 is used as standard, e.g.

BP ENERGOL GR- P 220
ESSO Spartan EP 220
S ELL Omala Oil 220
Mobilgear 630
Aral Degol BG 220

Information for re-ordering	
uantity	Part no.
1 l – pack	472 902 44
2,5 l – pack	472 900 44

Oil change intervals

Under normal operating conditions, the lubricant must be replaced every 10000 hours of operation, however at least every 4 years.

Under unusual operating conditions, such as increased ambient temperatures or extreme temperature fluctuations, the oil must be changed sooner.

Checking condition of oil

The oil should only be checked when the gearbox is at operating temperature immediately after switching off to ensure optimum distribution of the oil.

Risk of burning from hot gearbox oil.

- Take an oil sample at the oil drain screw (screw to DIN 908).
- Check the oil (colour, consistency, metal abrasion).
- Change the oil if it is not clean.
- Dispose of drained oil in an environment-friendly manner.

Oil change sequence

Only change the oil when the gearbox is at operating temperature to ensure all the oil is fully drained (cold oil flows poorly).

Risk of burning from hot gearbox oil.

- Place a container below the oil drain screw.
- Remove the oil drain screw and an oil inlet screw.
- Drain all the oil.
  Flush as necessary if the old oil is very dirty (see Flushing).
- Tighten the oil drain screw with a tightening torque according to table 11.
- Fill new oil at oil inlet (oil quantity as specified on the rating plate).
- Tighten the oil inlet screw with a tightening torque according to table 11.

Table11

Tightening torque – oil inlet screw, oil drain screw breather screw, valve		
Gearbox si e	Bolt	Tightening torque Nm
A10 - A50	M10 x 1	5
A60	M12 x 1,5	10
A70 - A90	M16 x 1,5	15

Flushing

If the old oil is particularly contaminated when it is replaced, it is advisable to flush the gearbox before filling it with new oil.

The flushing oil should have a viscosity of 46 – 68 mm²/s at 40° C. The quantity of flushing oil used should be approximately twice that specified for the gearbox. Run the gearbox for a few minutes at no load and then drain the flushing oil. By flushing several times, also with the gearbox running at no load and preferably in alternate directions of rotation, the rest of the old lubricant can be flushed out and drained.

Note

Dispose of drained oil in an environment-friendly manner.

6.4 B004–B680 brakes

The following work may only be carried out by qualified personnel.
Observe relevant safety regulations and codes of practise and the instructions contained in section 1.4 “Safety instructions”.

6.4.1 Measuring the brake displacement

Apart from wear, the brake is virtually maintenance-free. The organic/mineral brake lining is designed in such a way that worn surface particles are only given off as minimal abrasion. This built-in regeneration of the brake lining surface ensures constant braking characteristics. It is advisable to check the brake air gap at certain intervals and to adjust it as necessary to ensure the brake releases reliably. When the brake is released (voltage applied to brake coil), the brake disk can be freely turned.

Guide values for the air gap and brake operation until adjustment are contained in the “Brake settings” tables in section 6.5.

It is only possible to give guide values for brake operation until adjustment as they depend on the given operating conditions.

When the brake has been adjusted several times, the remaining thickness b_{min} of the brake disk must be checked. The guide pins feature an easily visible marking which clearly indicates the minimum dimension. The brake rotor must be replaced when this mark is exceeded. For this purpose, a maintenance and spare part set is available which not only contains the brake rotor, but also the required small parts and installation instructions.

6.4.2 Ad usting the brake air gap

The air gap must be adjusted when the max. permissible value given in the “Brake settings” tables in section 6.5 has been reached, (however, immediately if the brake no longer releases). The time to adjust the brake can be determined using the “Adjustment monitoring” option, estimated from the work done by the brake according to the “Brake settings” tables in section 6.5, or established by regular inspections.

If the brake is not ad usted, it will no longer release after further wear. If the motor then operates against the applied brake, the brake and motor may be damaged and fail.

Condition: Brake and fan cover fully fitted

Tools required:
- Open wrench, feeler gauges, pliers for retaining rings to DIN 5254
- Long hexagon socket key

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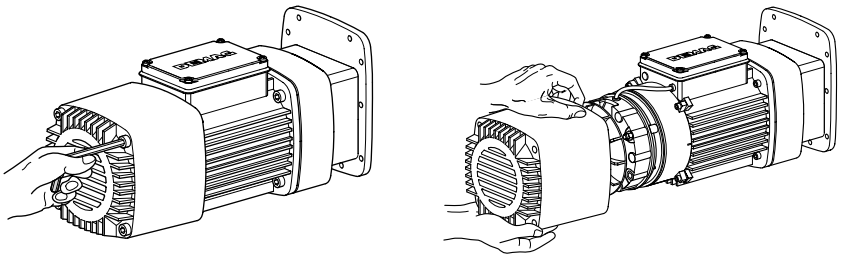

Undo the four screws and remove the fan cover.

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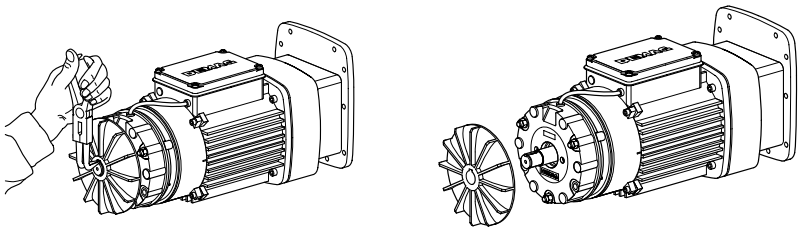

If the adjusting nuts are not accessible, remove the fan.
[For **Sealing arrangement** option remove the fan.]
Remove or suck the loose brake abrasion from the inside of the brake enclosure.
Beware of the dust if the abrasion is blown out of the enclosure.

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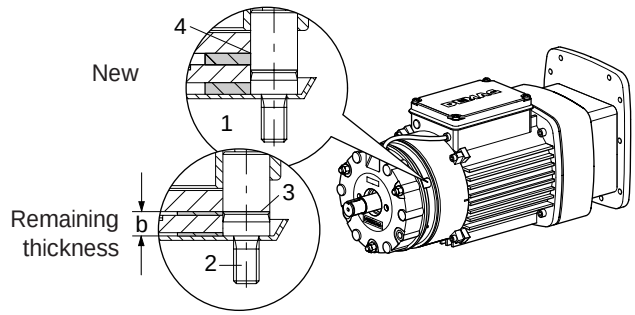

Check the remaining thickness of the brake disk with friction linings (1). The guide pins (2) feature a mark (3) which the armature disk edge (4) must not cover. If the armature disk edge (4) has reached the mark (3), the brake disk (1) must be replaced.
(For instructions refer to section 6.4.3 **Replacing the brake disk** .)

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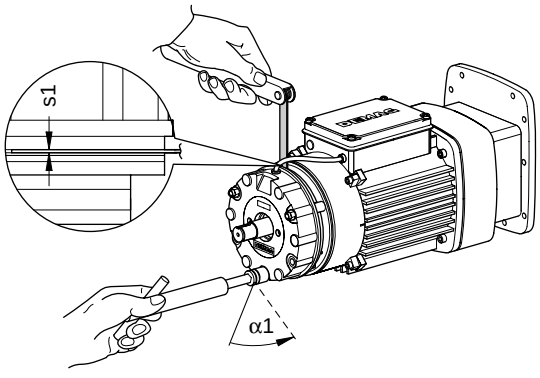

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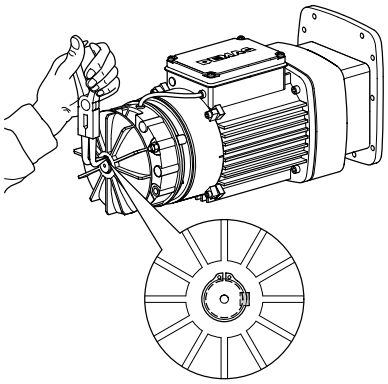
If the remaining thickness of the brake disk (1) is sufficient, adjust the brake as follows:
Tighten the three self-locking nuts uniformly until the air gap is zero. Loosen the nuts by angle α_1 given in the **Brake settings** table in section 6.5 to set the air gap to s_{1min}.
Check air gap s_1 using a feeler gauge at three points around the circumference (adjust again if necessary).
Note The rotor shaft must be able to turn freely when the brake is released.
Check the brake for correct functioning.



[For **Sealing arrangement** option, replace the covering tape.]
If the fan has been removed: fit the fan and, if applicable, the key.
Secure the fan with the retaining ring. Ensure the retaining ring clicks correctly into place (see diagram).

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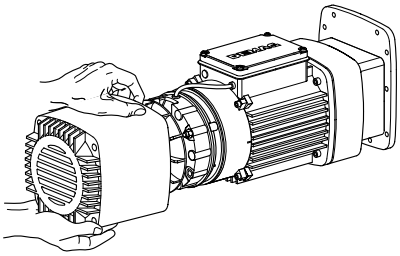

Align the fan cover as appropriate for the model.

Secure the fan cover with the four screws.

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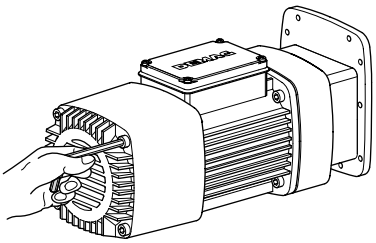

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6.4.3 Replacing the brake disk

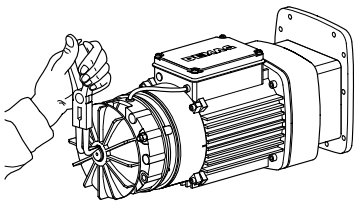
Note: **Damaged brakes may only be repaired by a Mannesmann Dematic authorised workshop.**

To ensure reliable functioning of the brake, the lining must be of a thickness defined as the minimum remaining thickness in the **Brake settings** tables in section 6.5.

The brake disk is a wearing part and **must** therefore **be replaced** on reaching its minimum thickness. The friction plate and armature disk must be checked and replaced, if necessary.

Condition: Fan cover and covering tape removed
(see section 6.4.2 **Ad usting the brake air gap**).

Tools required:
- Open wrench, wearing part kit, feeler gauges, pliers for retaining rings to DIN 5254
- Long hexagon socket key



Remove the retaining ring and fan.

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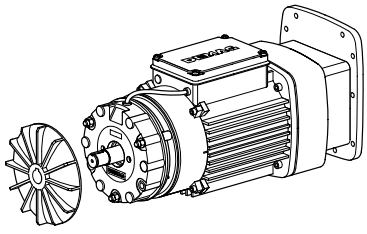

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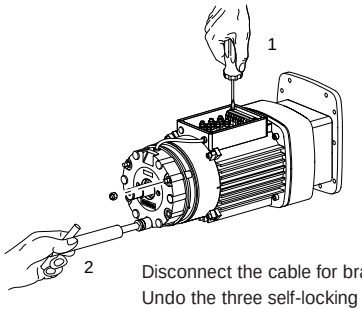

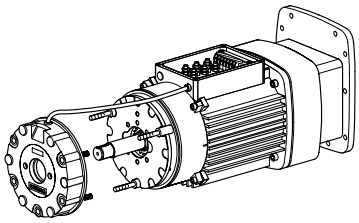

Disconnect the cable for brake coil and microswitch (1), if applicable. Pull the cable out of the terminal box far enough to do the following.

Undo the three self-locking nuts (2) used for adjustment (pay attention to tension of brake and distance springs). The collared pins must not be unscrewed, tighten them to the tightening torque specified in section 6.5 if necessary.

Carefully pull the magnet assembly off the three collared pins and the motor shaft.

For vertical mounting arrangement (brake at the top): fix the brake springs and, if applicable, the plunger (microswitch option) in place with strips of adhesive tape or a rubber band.

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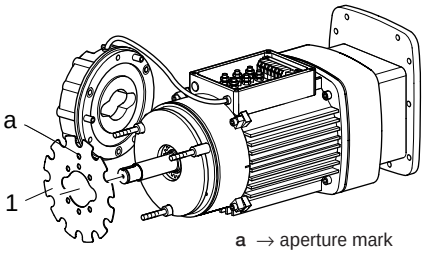
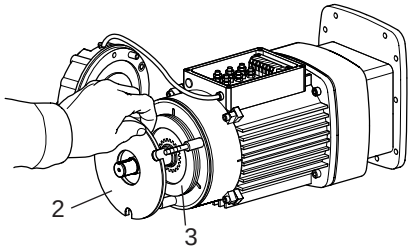


a → aperture mark



Remove stop plate (1). Pay attention to the distance springs, these can remain on collared pins. (Replace the brake springs when changing the brake disk.)

Remove armature disk (2) (both disks for the **Reduced noise level** and **Manual brake release** options) and brake disk (3).

Remove or suck the loose brake abrasion from the inside of the brake enclosure. **Beware of the dust if the abrasion is blown out of the enclosure.**

Check the armature disk and, up to size B050, the friction plate for damage, excessive scoring or similar, also check the friction plate (fitted up to size B050) for deformation and the collared pins for extreme differences in diameter.

Replace worn or damaged parts.

Ensure that the outside circumference is not damaged when fitting a new collared pin (use a counter-nut).
Attention must also be paid to the tightening torques as specified in the tables in section 6.5.

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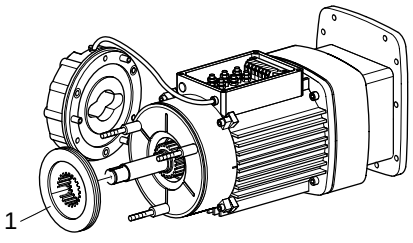

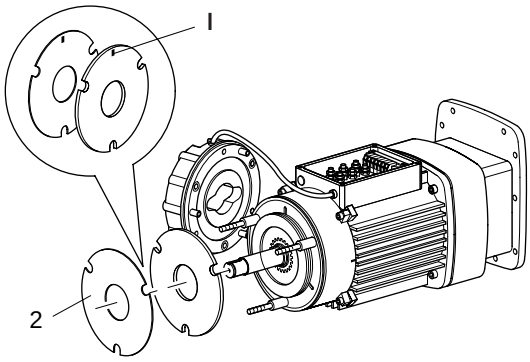

Place brake disk (1) centrally on the carrier. **Pay attention to correct alignment and do not use force. Keep the friction surfaces clean (no grease on the friction surfaces) as the initial friction coefficient will otherwise be changed.**

Align armature disk (2) (the thicker disk first for the **Reduced noise level** and **Manual brake release** options) with marker **I** facing the terminal box and then fit the armature disk on the collared pins.

(The end shield must have been fitted correctly with the mark in the right position.)

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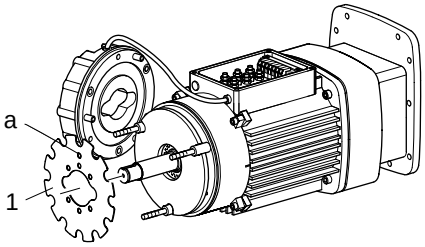

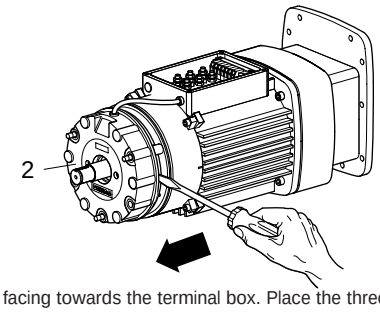

Align stop plate (1) and place it on the collared pins in such a way that aperture mark **a** is facing towards the terminal box. Place the three distance springs on the threaded ends of the collared pins. Fit brake springs symmetrically into the magnet as before or as specified in the **Brake settings** table in section 6.5. For the vertical mounting arrangement with the brake at the top, prevent the springs from falling out using rubber bands or similar (rubber band grips the outside of the brake springs). Align magnet (2) (with the opening for the operating lever facing towards the terminal box for the **Manual brake release** option) and push it into place. Fit the self-locking nuts on the collared pins. Ensure the stop plate is guided by the three collared pins and does not get caught in the distance springs before the collared pins engage the magnet.

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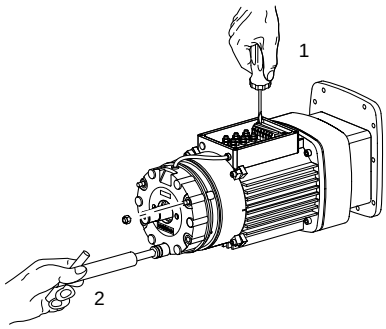
41433144.eps



Pull the cable back into the terminal box. Connect the cable for the brake coil and, if applicable, microswitch (1).

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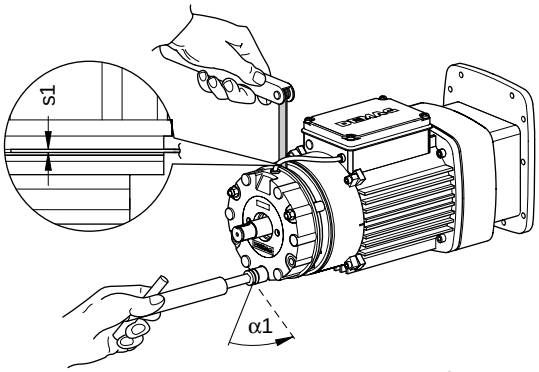


41444245.eps

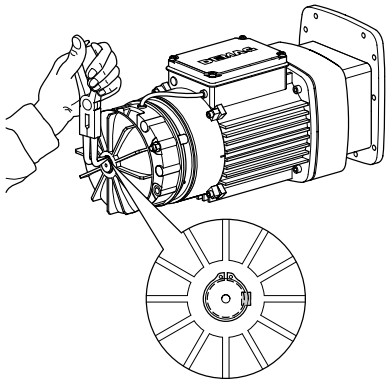
Adjust the brake as follows:

Tighten the three self-locking nuts uniformly until the air gap is zero. Loosen the nuts by angle α_1 given in the **Brake settings** tables in section 6.5 to set the air gap to s_{1min}.

Check air gap s_1 using a feeler gauge at three points around the circumference (adjust again if necessary).

Note The rotor shaft must be able to turn freely when the brake is released.

Check the brake for correct functioning after reconnecting the brake coil.



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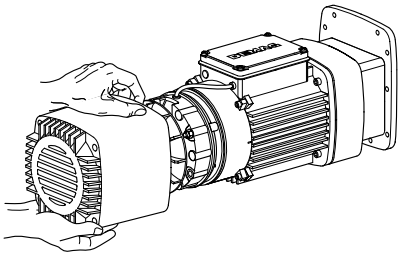
For **Sealing arrangement** option, replace the covering tape.

Fit the fan and, if applicable, the key.

Secure the fan with the retaining ring. Ensure the retaining ring clicks correctly into place (see diagram).



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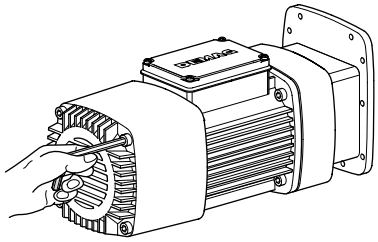
Align the fan cover as appropriate for the model.



41431944.eps

Secure the fan cover with the four screws.

6.5 Brake settings tables

6.5.1 for BA motors

Brake size				B004	B007	B020	B050	B140	B280	B680
Quantity of springs [1]				Brake torque M_B in Nm						
white	red	blue								
6	0	0		–	7,6	20	50	140	280	680
4	2	0		–	5,9	16	39	105	220	530
3	3	0		–	5,1	13	33	94	185	450
3	0	0		–	3,8	10	25	70	140	340
2	2	0		–	3,4	9	22	62	125	300
0	6	0		–	2,5	6,6	17	47	93	230
0	4	0		1,7	1,7	4,4	11	31	62	150
0	3	0		1,3	1,3	3,3	8,3	23	46	115
0	4	2		2,3	–	–	–	–	–	–
0	0	6		1,8	–	–	–	–	–	–
0	0	4		1,2	–	–	–	–	–	–
0	0	3		0,9	–	–	–	–	–	–
Minimum brake air gap			$s_{1\,min}$ in mm	0,3	0,3	0,3	0,3	0,35	0,4	0,4
Maximum brake air gap			$s_{1\,max}$ in mm	0,65	0,65	0,65	0,65	1,3	1,3	1,3
Air gap adjusting angle			α_1 in °	120	120	120	90	80	70	60
Manual release axial play			s_2 in mm	1,5	1,5	1,5	1,5	2	2	2
Manual release adjusting angle			α_2 in °	20	20	20	20	20	20	20
Brake disk remaining thickness			b_{min} in mm	5	5	6	7	8,5	10	11
Braking work until re-adjustment			W_N in Ws	$100 \cdot 10^6$	$100 \cdot 10^6$	$120 \cdot 10^6$	$200 \cdot 10^6$	$1000 \cdot 10^6$	$1500 \cdot 10^6$	$2500 \cdot 10^6$
Collared pin pre-tension torques			in Nm	2,3	2,3	4,0	9,0	30	70	140

[1] Only applies for brakes without brake release device

6.4.2 For BF motors

Brake size				B004	B020	B050	B140
Quantity of springs [1]				Brake torque M_B in Nm			
white	red	blue					
–	4	2		2,3	5,6	13	37
–	4	0		1,7	4,4	11	31
–	3	0		1,3	3,3	8,3	23
–	0	6		1,8	(3,3)	6,3	18
–	0	4		1,2	2,2	4,2	12
–	0	3		0,9	1,7	3,2	8,8
Minimum brake air gap			$s_{1\,min}$ in mm	0,35	0,35	0,35	0,35
Maximum brake air gap			$s_{1\,max}$ in mm	1,2	1,2	1,2	1,2
Air gap adjusting angle			α_1 in °	120	120	90	80
Manual release axial play			s_2 in mm	1,5	1,5	1,5	2
Manual release adjusting angle			α_2 in °	20	20	20	20
Brake disk remaining thickness			b_{min} in mm	5	6	7	8,5
Braking work until re-adjustment			W_N in Ws	$200 \cdot 10^6$	$300 \cdot 10^6$	$500 \cdot 10^6$	$900 \cdot 10^6$
Collared pin pre-tension torques			in Nm	2,3	4,0	9,0	30

[1] Only applies for brakes without brake release device

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6.6 Bolt tightening torques

The bolts on Demag Z.. range motors must be tightened with the torques given in the table below. This also applies when high tensile bolts are used.

Bolt tightening torques

For hexagon socket bolts to DIN 912 and to DIN 6912 for IM B 14 flange mounting

Bolt size	M 5	M 6	M 8	M 10	M 12	M 16
Tightening torque	6,0-7,5 Nm	10,5-14 Nm	25-30 Nm	50-60 Nm	86-100 Nm	215-255 Nm

For Verbus-Ripp self-locking bolts for IM B 3 foot mounting
IM B 5 flange mounting

Bolt size	M 5	M 6	M 8	M 10	M 12	M 16
Tightening torque for cast iron	7,5 Nm	14 Nm	30 Nm	65 Nm	100 Nm	270 Nm
Tightening torque for cast aluminium	9 Nm	18 Nm	45 Nm	75 Nm	–	–

7 Motor brake connection diagrams

7.1 Brake control

Various control modules are available which are fitted in the brake motor terminal box as standard for controlling Demag B004 to B680 disk brakes with DC magnets. Brakes up to size

- B050 for ZBA motors
- B140 for ZBF motors

featuring **24 V DC coil voltage** must be supplied and controlled by the installation control system.

All rectifiers feature varistor protection against overvoltage at the AC input and on the switching contact terminal as standard. GE, GS and GP brake rectifiers can be used for voltages from 42 V AC to 500 V AC.

GE, GS and GP brake rectifiers can be fed separately with alternating current or connected parallel to the motor winding. AC or DC brake control is possible with all brake rectifiers depending on the connection.

The control system is of modular design. SE or VE modules for fast DC interruption of the brake current can be added to brake motors fitted with GE, GS or GP brake rectifiers, also at a later date, without the need for additional cables and switching devices.

Operation with frequency inverters

If B cylindrical rotor brake motors are operated together with inverters, the brake must be provided with a separate power supply and control.
Brake application times are highly dependent on the way in which the brake is connected.

Supply and brake voltage:

U_{line} **[AC]**	U_{brake} **[DC]**
230 V	104 V
400 V	180 V

Brake control modules

GE brake rectifiers (normal excitation)

GE half-wave brake rectifiers are used for single-speed motors as standard, and for pole-changing motors featuring separate power supply up to brake size

– B050 for ZBA motors
– B140 for ZBF motors.

They mainly consist of a half-wave rectifier with integrated free-wheeling circuit.

Important **When used with a pole-changing motor, GE modules must be provided with a separate power supply or according to diagram 037 860 84 (see section 7.5).**

Note When SE or VE units are used, no additional cables are necessary.

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GS brake rectifiers (high-speed excitation)

GS brake rectifiers are used for ZBA motors with brakes as of size B140 as standard. They can be used for single-speed motors as well as for pole-changing motors with a separate power supply

GS brake rectifiers can be used as an option for brake sizes B004 to B050. This makes it possible to achieve shorter brake release times and higher motor starting frequencies.

Up to brake size B050, two leads are sufficient for control (over-excitation factor of 2), from brake size B140 on, three leads are required (over-excitation factor of 2,5).

GS modules include a reversible rectifier which overexcites the brake for approx. 0,3 seconds to release it and then supplies it with the appropriate holding voltage from a half-wave rectifier.

Important **When used with a pole-changing motor, GS modules must be provided with a separate power supply or according to diagrams 037 886 84, 038 001 84 and 038 017 84 (see section 7.5).**

Note When SE or VE units are used, no additional cables are necessary.

GP brake rectifiers (normal excitation for pole-changing motors)

GP brake rectifiers can be used parallel to the motor winding for pole-changing motors with separate windings. For this, it is necessary for both windings to be connected to one phase on the terminal board (e.g. 1U & 2U). The advantage of using a GP brake rectifier compared to a GE module is that no additional cables are required for the power supply. GP rectifiers mainly consist of two half-wave rectifiers which are connected depending on the winding being used.

Note When SE or VE units are used, no additional cables are necessary.

SE current relays (motor current-dependent high-speed trip relay)

SE current relays can be combined with GE, GS and GP brake rectifiers. They are used for rapid demagnetization of the brake to achieve fast brake application times without the need for additional wiring for brake switch-off in the DC circuit. SE current relays are connected to one motor current phase. When the motor is switched off, the relay demagnetizes the brake by opening the contact in the DC circuit.

When SE units are used, no additional cables are necessary to interrupt the power supply for the brake.

Important **SE modules must not be used together with inverters. We recommend the use of VE voltage relays for these applications.**

SE current relays can be used for rated motor currents up to 50 A.

VE voltage relays (voltage-dependent high-speed trip relay)

VE voltage relays can be combined with GE, GS and GP brake rectifiers. In contrast to SE current relays, **VE voltage relays must only be used for brakes with a separate power supply**.
These modules may preferably be used for inverter-fed motors. They are used for high-speed demagnetization of the brake to achieve fast brake application times without the need for additional wiring for brake switch-off in the DC circuit. VE voltage relays are connected to the brake power supply. The contact in the DC circuit is opened when the brake is switched off.

Brake control module technical data

Module	Ident. no.	Voltage range in V [1]	Max. continuous brake direct current A	Remarks	
GE	260 892 84	110 ... 500	1,5		
	260 890 84	42 ... 500	3		
GP	260 893 84	110 ... 500	1,5		
	260 891 84	42 ... 500	3		
GS	260 894 84	110 ... 500	1,5	[2] Over-excitation factor: 2 or 2,5	
VE	260 897 84	42 ... 500	2		
SE				[3] Control current range (single phase motor current)	motor frame si e
	260 864 84	42 ... 500	2	0,25 ... 4 A	63 – 71
	260 870 84			0,8 ... 16 A	80 – 100
	260 896 84			1,2 ... 50 A	112 – 225

[1] Sinusoidal voltages

[2] • 2 leads → Over-excitation factor of 2
• 3 leads → Over-excitation factor of 2,5 (required as of brake size B 140 when maximum number of springs are fitted)

[3] Standard: → Rated motor current equal to or smaller than the higher value stated under **Control current range** of the SE current relay.

Note If the rated motor current is higher than the higher value stated under **Control current range** of the SE current relay
→ **use next higher SE current relay**

Field of application of the brake control modules

GE, GP, GS brake rectifiers

Brake voltage		Brake si e						
U AC V	U DC V	B004	B007	B020	B050	B140	B280	B680
42 – 109	19 – 49	GE 3 A GP 3 A						
110 – 500	50 – 225	GE 1,5 A GP 1,5 A GS 1,5 A				GS 1,5 A		
200 – 500	90 – 225							GS 1,5 A

U AC = Brake control module input voltage
U DC = Brake control module output voltage → brake supply voltage

SE current relays, VE voltage relays

Brake si e							
B004	B007	B020	B050		B140	B280	B680
Brake voltage			Brake voltage		Brake voltage		
U AC V	U DC V		U AC V	U DC V	U AC V	U DC V	
42 - 500	19 - 225		53 - 500	24 - 225	110 - 500	50 - 225	
SE 2A VE 2A							

U AC = Brake control module input voltage
U DC = Brake control module output voltage → brake supply voltage

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Brake selection table

Standard braking torque		Brake	Supply voltage	Allocated standard modules						Remark
				BA		BF				
BA	BF		[V AC]	Single -speed or pole-changing	Part no.	Single-speed	Part no.	Pole-changing	Part no.	
≤ 2,3 Nm	≤ 2,3 Nm	B004	42 - 109	GE [3 A]	260 890 84	GE [3 A] + SE [1]	260 890 84	GP [3 A] + SE [1]	260 891 84	Supply from a separate DC voltage source is possible without any limitations. Voltage range: **19 - 225 V DC**
			110 - 500	GE [1,5 A]	260 892 84	GE [1,5 A] + SE [1]	260 892 84	GP [1,5 A] + SE [1]	260 893 84	
≤ 7,6 Nm	–	B007	42 - 109	GE [3 A]	260 890 84	GE [3 A] + SE [1]	260 890 84	GP [3 A] + SE [1]	260 891 84	
			110 - 500	GE [1,5 A]	260 892 84	GE [1,5 A] + SE [1]	260 892 84	GP [1,5 A] + SE [1]	260 893 84	
≤ 20 Nm	≤ 5,5 Nm	B020	42 - 109	GE [3 A]	260 890 84	GE [3 A] + SE [1]	260 890 84	GP [3 A] + SE [1]	260 891 84	
			110 - 500	GE [1,5 A]	260 892 84	GE [1,5 A] + SE [1]	260 892 84	GP [1,5 A] + SE [1]	260 893 84	
≤ 50 Nm	≤ 13,2 Nm	B050	42 - 109	GE [3 A]	260 890 84	GE [3 A] + SE [1]	260 890 84	GP [3 A] + SE [1]	260 891 84	
			110 - 500	GE [1,5 A]	260 892 84	GE [1,5 A] + SE [1]	260 892 84	GP [1,5 A] + SE [1]	260 893 84	
≤ 140 Nm	≤ 37,3 Nm	B140	42 - 109	–	–	GE [3 A] + SE [1]	260 890 84	GP [3 A] + SE [1]	260 891 84	Supply from a separate DC voltage source is **not** possible Exception: B140 brake with braking torque ≤ 37,3 Nm Voltage range: **19 - 225 V DC**
			110 - 500	GS	260 894 84	GE [1,5 A] + SE [1]	260 892 84	GP [1,5 A] + SE [1]	260 893 84	
≤ 280 Nm	–	B280	42 - 109	–	–	–	–	–	–	
			110 - 500	GS	260 894 84	–	–	–	–	
≤ 680 Nm	–	B680	42 - 109	–	–	–	–	–	–	
			200 - 500	GS	260 894 84	–	–	–	–	

[1] The SE modules are allocated as follows depending on the rated motor current:

Rated motor current	Module	Part no.
≤ **4 A**	SE	260 864 84
≤ **16 A**		260 870 84
≤ **50 A**		260 896 84

7.2 Brake operating times

Brake application times are highly dependent on the way in which the brake is connected.

- **Direct current connection**

  The coil circuit is interrupted when the brake module contact opens at the relevant terminal. The magnetic field rapidly decreases and the brake torque rapidly rises. Mannesmann Dematic rectifiers are protected against overvoltage at the switching contact by varistors.

  Interruption of the DC circuit between the module and the coil connections is not permitted.

- **Connection in the AC circuit**

  When the brake voltage is switched off, i.e. on the supply side before the rectifier, an inductive coil current continues to flow through the rectifier diodes for a short time. The magnet field decreases more slowly. The braking operation begins more smoothly.

  This connection type is not suitable for hoist drives.

- **Connection in the motor circuit**

  The rectifier is connected directly to the motor terminals. When the motor is switched off, the residual motor voltage results in significantly longer switch-off times compared to switch-off in the AC circuit.

  Unless provided with switch-off in the DC circuit using a contact or the SE current relay, this type of connection is not suitable for drives with overhauling loads, e.g. hoists, and may not be used in these applications.

Depending on the type of connection, the release and braking operation of B004 to B680 DC brakes can generally be characterized by the following values:

- t_{11} Brake release time with normal excitation (GE, GP) [1)]
- t_{12} Brake release time with high-speed excitation (GS) [1)]
- t_{21} Brake application time for switch-off in the AC circuit
- t_{22} Brake application time for switch-off in the DC circuit (contact)
- t_{23} Brake application time for switch-off in the DC circuit (SE, VE)

[1)] Definition: **The brake release time is the period of time which elapses until the full accelerating torque of the motor is available.**

Brake release times may be reduced using high-speed excitation modules with which a higher voltage is temporarily applied to the brake coil when the brake is turned on and the magnetic field is built up more quickly.

7.2.1 BA range brake operating times

Size	Release times in ms		Application times in ms		
	t_{11}	t_{12}	t_{21}	t_{22}	t_{23}
B004	60	35	250	55	85
B007	120	60	90	30	60
B020	130	90	40	20	30
B050	120	100	90	30	80
B140	–	110	60	30	60
B280	–	140	300	90	160
B680	–	140	300	150	225

The brake release and application times given are guide values for the maximum brake torque. In the case of lower brake torques, these values may change, particularly t_{21} for switch-off in the AC circuit.

7.2.2 BF range brake operating times

Table 10

Si e	Release times in ms		Application times in ms		
	t_{11}	t_{12}	t_{21}	t_{22}	t_{23}
B004	30	25	200	30	40
B020	60	40	300	50	60
B050	80	65	300	60	70
B140	110	90	350	100	100

The brake release and application times given are guide values for the maximum brake torque (see table 9). In the case of lower brake torques, these values may change, particularly t_{21} for switch-off in the AC circuit.

7.3 Selection criteria

The following criteria must be considered when selecting the connection diagram:

- **Brake motor or motor without brake**
- **Motor to be operated with**
  - one line voltage (e.g. 400 V, 50 Hz) or
  - two line voltages (e.g. Δ/Y 230/400 V 50 Hz or YY/Y 240/480 V 60 Hz)
- **Brake type**
  - B007 to B140 DC brake
  - B002 AC brake
- **Motor designed for one or two speeds**
- **Common or separate power supply to motor and brake**
- **Control module selected**
  - GE for normal excitation
  - GS for high-speed excitation
  - GP for normal excitation for pole-changing motors
- **Switch-off**
  - in the DC circuit for short operating times (e.g. hoist drives, positioning drives)
  - in the AC circuit for medium operating times (e.g. travel drives, conveyor belts)
  - in the motor circuit for stopping the motor in an uncritical time.

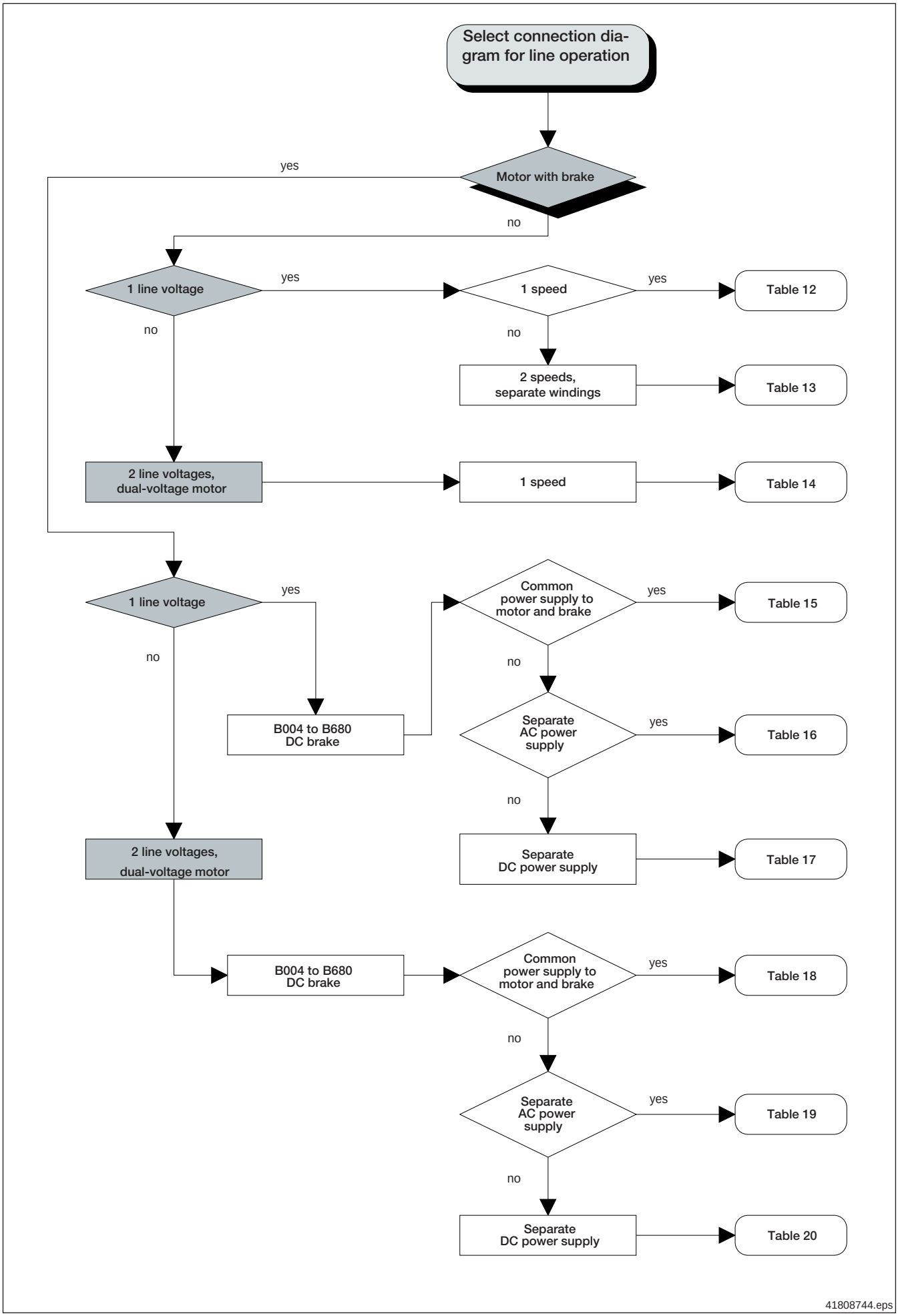
Refer to the following flow chart.

Notes

- The motor and brake of inverter-fed drives must have **separate** power supplies
- **SE modules** must **not** be used with inverter-fed drives.
- **Connection diagrams**
  - Connection diagram selection (flow chart) for line and inverter-fed drives and related tables → section 7.4.
  - Connection diagrams → section 7.5.
    Diagrams shown in numerical order according to ident. no.
  - Connection diagrams arranged in the motor terminal box.
- **Condition when supplied for inverter operation**
  When motors are supplied for **inverter operation**, **GE**, **GS** or **GP** Brake control modules are **not** connected with the motor winding as shown in the individual connection diagrams which document the motor connection on delivery.
  The brake control module must be provided with a **separate AC power supply**.

7.4 Connection diagram selection

7.4.1 Line operation



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Tables 12 – 14 Motors with no brake

12 Motor for one line voltage	Motor type one speed
	020 323 84

13 Motor for one line voltage	Motor type		
	two speeds (separate windings)		two speeds (Dahlander winding)
		Δ	
	020 332 84	028 857 84	020 328 84

14 Motor for two line voltages (.B. Δ 230 400 V 50 oder 240 480 V 60)	Motor type one speed
Δ	
020 323 84	020 337 84

Tables 15 – 20 Motors with a brake

15 Common motor and brake power suppoly (not suitable for inverter opation)				Motor type					
				one speed		two speeds (separate windings)			
Switch-off in	Switching element	Brake si e for		Control module in terminal box					
		BA	BF	GE	GS	GP	GE	GS	
									Δ
DC circuit	Contact	≤ B050	≤ B140	037 875 84	037 892 84	037 872 84	037 860 84	037 886 84	–
		≥ B140	–	–	038 006 84	–	–	038 001 84	038 017 84
	SE [1) 2)]	≤ B050	≤ B140	037 882 84	037 894 84	037 873 84	–	–	–
		≥ B140	–	–	038 008 84	–	–	–	–
AC circuit	Contact	≤ B050	≤ B140	037 875 84	037 892 84	037 872 84	037 860 84	037 886 84	–
		≥ B140	–	–	038 006 84	–	–	038 001 84	038 017 84
motor circuit	–	≤ B050	≤ B140	037 875 44	037 892 84	037 872 84	–	–	–
		≥ B140	–	–	038 006 84	–	–	–	–

[1)] Fitted in the terminal box
[2)] Not for inverter operation

16 Separate AC brake supply				Motor type						
				one speed		two speeds (separate windings)			two speeds (Dahlander windings)	
Switch-off in	Switching element	Brake si e for		Control module in terminal box						
		BA	BF	GE	GS	GE	GS		GE	GS
								Δ		
DC circuit	Contact	≤ B050	≤ B140	037 875 84	037 892 84	037 860 84	037 886 84	–	037 880 84	037 885 84
		≥ B140	–	–	038 006 84	–	038 001 84	038 017 84	–	038 015 84
	SE [1) 2)]	≤ B050	≤ B140	037 882 84	037 894 84	037 861 84	037 887 84	–	–	–
		≥ B140	–	–	038 008 84	–	038 002 84	038 018 84	–	–
	VE [1)]	≤ B050	≤ B140	037 876 84	037 893 84	037 862 84	037 888 84	–	037 891 84	037 895 84
		≥ B140	–	–	038 007 84	–	038 003 84	038 020 84	–	038 016 84
AC circuit	Contact	≤ B050	≤ B140	037 875 84	037 892 84	037 860 84	037 886 84	–	037 880 84	037 885 84
		≥ B140	–	–	038 006 84	–	038 001 84	038 017 84	–	038 015 84

[1)] Fitted in the terminal box
[2)] Not for inverter operation

17 Separate DC brake supply

Switch-off in	Switching element	Brake size for		Motor type		
				one speed	two speeds (separate windings)	two speeds (Dahlander windings)
		ZBA	ZBF	No control module in terminal box		
DC circuit	Contact	≤ B050	≤ B140	037 897 84	037 898 84	037 871 84

18 Common motor and brake power supply (not suitable for inverter operation)

Switch-off in	Switching element	Brake size for		Motor connection Δ			
				Control module in terminal box			
		BA	BF	GE	GS	GE	GS
DC circuit	Contact	≤ B050	≤ B140	037 857 84	037 883 84	037 863 84	037 889 84
		≥ B140	–	–	037 859 84	–	038 004 84
	SE [1] [2]	≤ B050	≤ B140	037 858 84	037 884 84	037 864 84	037 890 84
		≥ B140	–	–	037 865 84	–	038 005 84
AC circuit	Contact	≤ B050	≤ B140	037 857 84	037 883 84	037 863 84	037 889 84
		≥ B140	–	–	037 859 84	–	038 004 84
motor cirucit	–	≤ B050	≤ B140	037 857 84	037 883 84	037 863 84	037 889 84
		≥ B140	–	–	037 859 84	–	038 004 84

[1] Fitted in the terminal box
[2] Not for inverter operation

19 Separate AC brake supply

Switch-off in	Switching element	Brake size for		Motor connection Δ			
				Control module in terminal box			
		BA	BF	GE	GS	GE	GS
DC circuit	Contact	≤ B050	≤ B140	037 857 84	037 883 84	037 863 84	037 889 84
		≥ B140	–	–	037 859 84	–	038 004 84
	SE [1] [2]	≤ B050	≤ B140	037 858 84	037 884 84	037 864 84	037 890 84
		≥ B140	–	–	037 865 84	–	038 005 84
	VE [1]	≤ B050	≤ B140	037 876 84	037 893 84	037 881 84	037 896 84
		≥ B140	–	–	038 007 84	–	038 014 84
AC circuit	Contact	≤ B050	≤ B140	037 857 84	037 883 84	037 863 84	037 889 84
		≥ B140	–	–	037 859 84	–	038 004 84

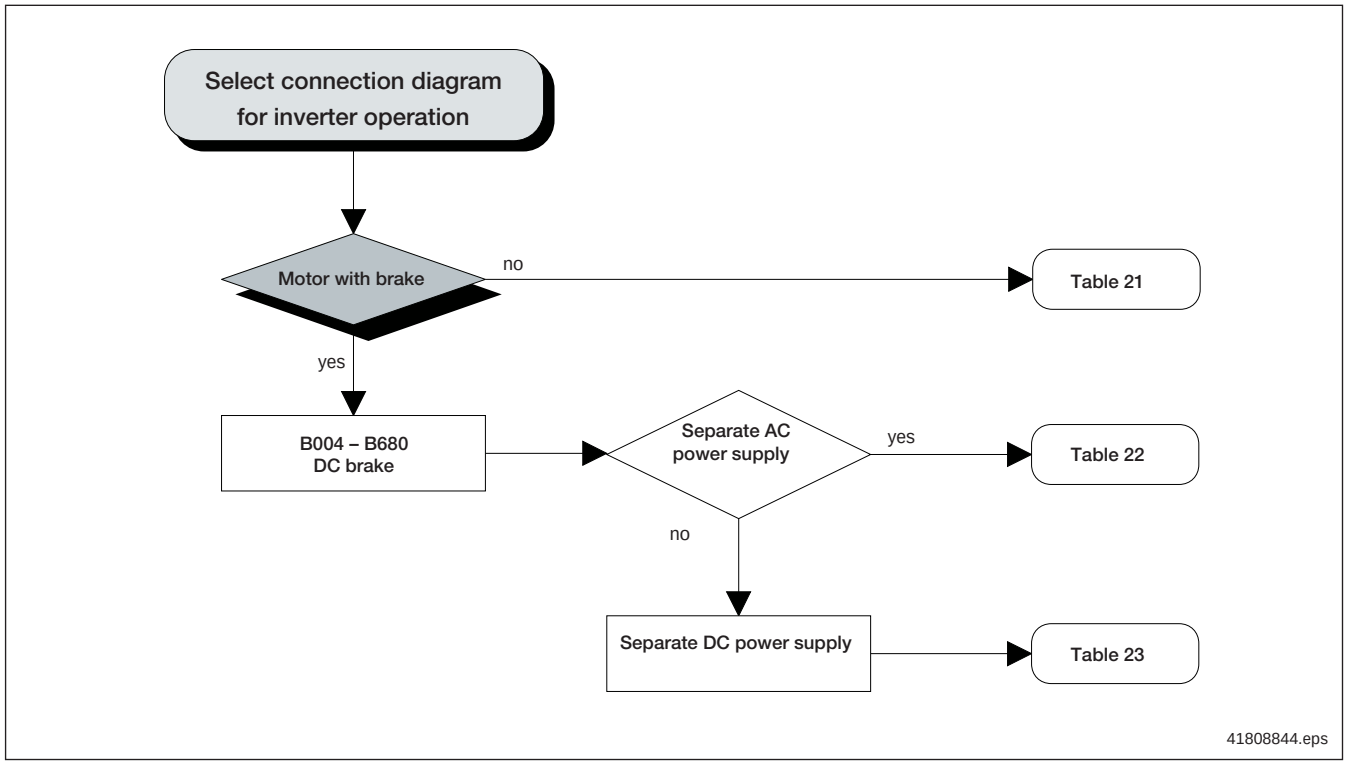
[1] Fitted in the terminal box
[2] Not for inverter operation

20 Separate DC brake supply

Switch-off in	Switching element	Brake size for		Motor connection Δ	
				No control module in terminal box	
		BA	BF		
DC circuit	Contact	≤ B050	≤ B140	037 897 84	037 899 84

214206k4.p65/0999

7.4.2 Inverter operation



Tabes 21 – 23

21 Motor with no brake	Motor type	
	one speed Δ	one speed
	020 323 84	020 337 84

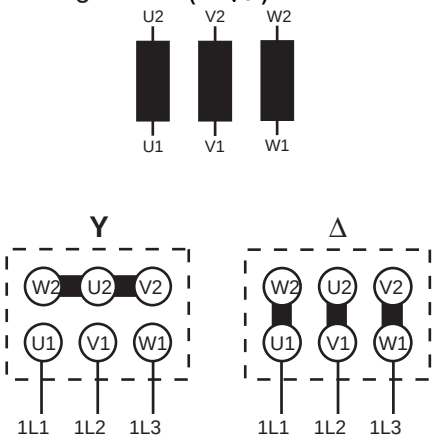
22 Separate AC brake supply				Motor type			
				one speed Δ		one speed Y/YY	
Switch-off in	Switching element	Brake si e for		Control module in terminal box			
		BA	BF	GE	GS	GE	GS
DC circuit	Contact	≤ B050	≤ B140	037 875 84	037 892 84	037 863 84	037 889 84
		≥ B140	–	–	038 006 84	–	038 004 84
	VE [1]	≤ B050	≤ B140	037 876 84	037 893 84	037 881 84	037 896 84
		≥ B140	–	–	038 007 84	–	038 014 84
AC circuit	Contact	≤ B050	≤ B140	037 875 84	037 892 84	037 863 84	037 889 84
		≥ B140	–	–	038 006 84	–	038 004 84

[1] Fitted in the terminal box

23 Separate DC brake supply				Motor type	
				one speed Δ	one speed Y/YY
Switch-off in	Switching element	Brake si e for		No control module in terminal box	
		BA	BF		
DC circuit	Contact	≤ B050	≤ B140	037 897 84	037 899 84

7.5 Connection circuit diagrams

Motor for one line voltage or dual voltage motor (1 √3)



Y high voltage
Δ low voltage

For inverter operation, connect motor with or Δ connection according to inverter settings.

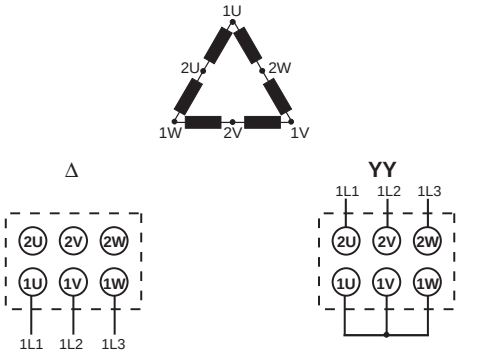
Motor supplied with

Jumper parts to connect the motor winding with Y or Δ connection enclosed.

020 323 84

02032384.eps

Motor for one line voltage Pole-changing, Dahlander winding



Δ for low speed
YY for high speed

Switch-over to high speed winding via external supply switch-over and jumper.

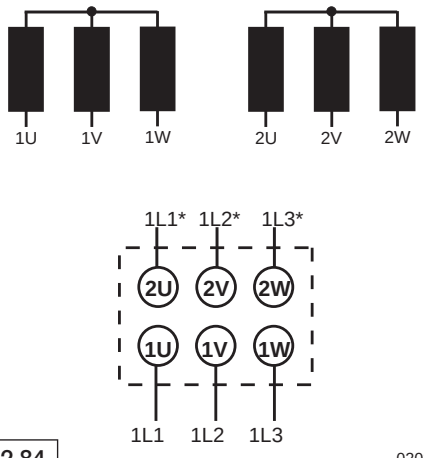
02032884.eps

Motor supplied with

Motor connection ends connected to terminal board as shown.

020 328 84

Motor for one line voltage Pole-changing, separate windings



1U, 1V, 1W for low speed
2U, 2V, 2W for high speed

* = Supply to high speed winding via external switch-over

Motor supplied with

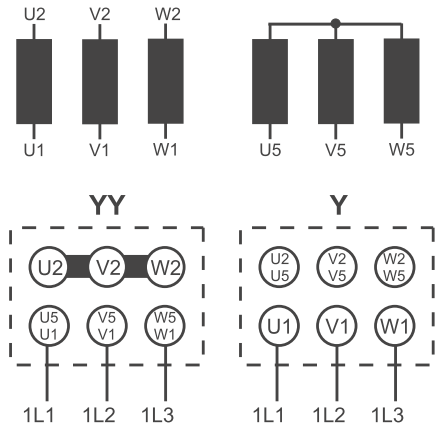
Jumper parts to connect the motor winding enclosed.

020 332 84

02033284.eps

214206k5.p65/0999

Dual voltage motor (1 2)



02033784.eps

YY low voltage
Y high voltage

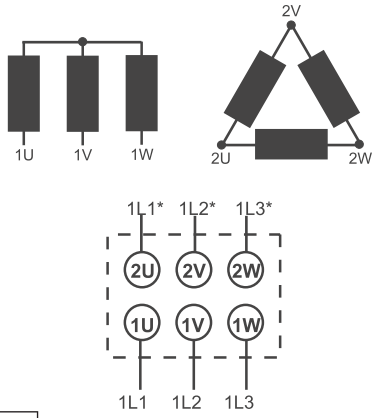
For inverter operation, connect motor with YY or Y connection according to inverter settings.

Motor supplied with

- Motor winding connected with Y connection.
- Jumper parts to connect the motor winding with YY connection enclosed.

020 337 84

Motor for one line voltage
Pole-changing, separate windings



02885784.eps

1U, 1V, 1W for low speed
2U, 2V, 2W for high speed

* = Supply to high speed winding via external switch-over

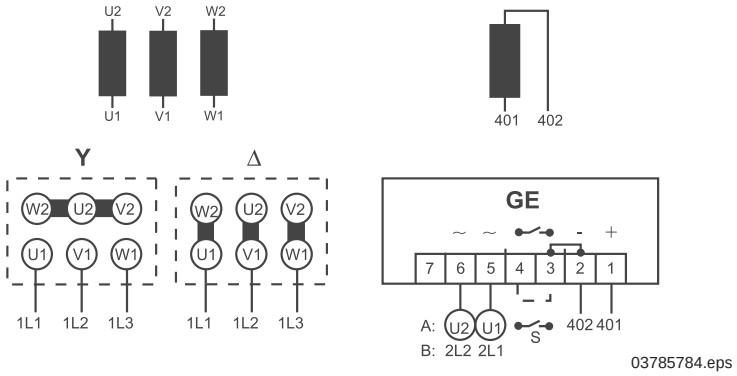
Motor supplied with

Jumper parts to connect the motor winding enclosed.

028 857 84

Dual voltage motor (1 $\sqrt{3}$)

Y high voltage Δ low voltage
Brake coil rated for the low voltage.



03785784.eps

Motor supplied with

- Jumper parts to connect the motor winding with Y or Δ connection enclosed.
- Brake connected to terminals 1 and 2 of the GE module.
- Jumper between terminals 3 and 4 of the GE module.
- **Mains operation** GE module connected with the motor winding according to variant A.
- **Inverter operation** – GE module **not** connected to the motor winding.
  – Power supply by the customer according to variant B.

037 857 84

A Common power supply to motor and brake

Not suitable for inverter operation.

B Separate power supply to brake

For inverter operation, connect the motor with Y or Δ connection according to inverter settings.

Switch-off in the DC circuit

- Remove jumper between terminals 3 and 4.
- Connect a contactor between terminals 3 and 4.

Switch-off in the AC circuit

- Jumper between terminals 3 and 4.
- Contactor in the power line behind terminal 5.

Motor current switch-off

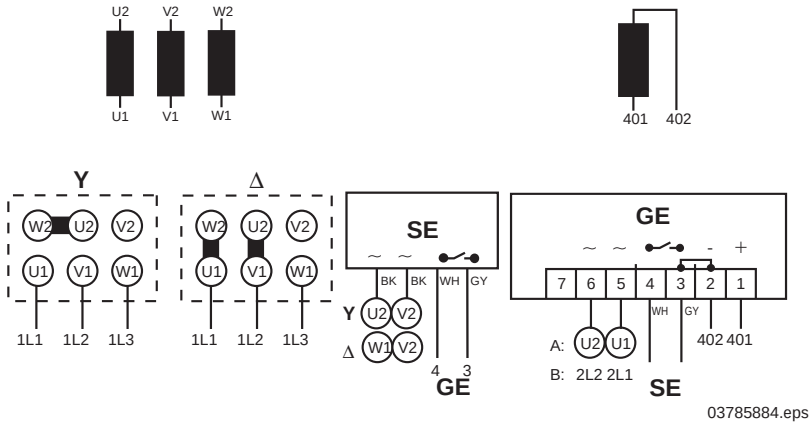
Jumper between terminals 3 and 4
→ **not possible for separate power supply to the brake**

Dual voltage motor (1 $\sqrt{3}$)

A Common power supply to motor and brake
B Separate power supply to brake

Y high voltage
Δ low voltage

Brake coil rated for the low voltage.



03785884.eps

Switch-off in the DC circuit dependent on motor current

Not suitable for inverter operation.

Motor supplied with

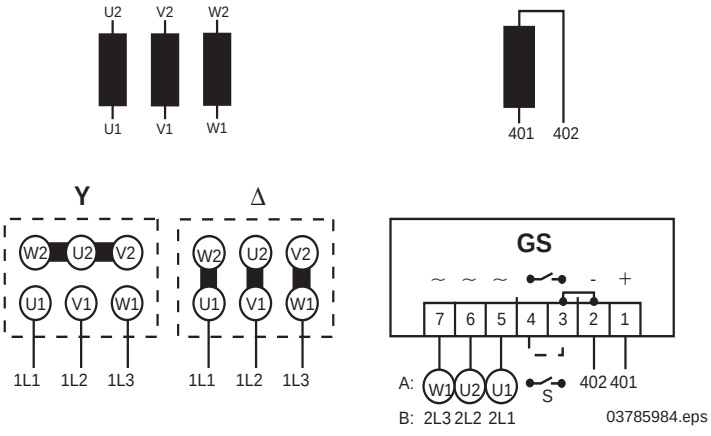
- Jumper parts to connect the motor winding with Y or Δ connection enclosed.
- Brake connected to terminals 1 and 2 of the GE module.
- SE module connected to terminals 3 and 4 of the GE module.
- SE module connected with the motor winding according to variant Y.
- GE module connected with the motor winding according to variant A.

037 858 84

Dual voltage motor (1 $\sqrt{3}$)

Y high voltage Δ low voltage

Brake coil rated for the low voltage.



03785984.eps

A Common power supply to motor and brake

Not suitable for inverter operation.

B Separate power supply to brake

For inverter operation, connect the motor with Y or Δ connection according to inverter settings.

Switch-off in the DC circuit

- Remove jumper between terminals 3 and 4.
- Connect a contactor between terminals 3 and 4.

Switch-off in the AC circuit

- Jumper between terminals 3 and 4.
- Contactors in the power lines behind terminals 5 and 6.

Motor current switch-off

Jumper between terminals 3 and 4
→ **not possible for separate power supply to the brake**

Motor supplied with

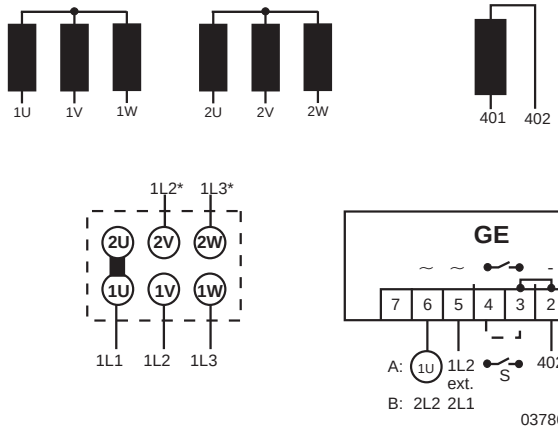
- Jumper parts to connect the motor winding with Y or Δ connection enclosed.
- Brake connected to terminals 1 and 2 of the GS module.
- Jumper between terminals 3 and 4 of the GS module.
- **Mains operation** GE module connected with the motor winding according to variant A.
- **Inverter operation** – GE module **not** connected to the motor winding.
  – Power supply by the customer according to variant B.

037 859 84

214206k5.p65/0999

Motor for one line voltage, pole-changing, separate windings

* = Supply to high speed winding via external switch-over
1U, 1V, 1W for low speed
2U, 2V, 2W for high speed



03786084.eps

Motor supplied with

- Jumper parts to connect the motor winding enclosed.
- Brake connected to terminals 1 and 2 of the GE module.
- Jumper between terminals 3 and 4 of the GE module.
- **Mains operation** GE module connected with the motor winding according to variant A (1U connected to terminal 6; terminal 5 free).

Important The brake will not function without an external power supply to terminal 5 of the GE module.

- **Inverter operation** – GE module **not** connected to the motor winding.
  – Power supply by the customer according to variant B.

A Common power supply to motor and brake

Not suitable for inverter operation.

B Separate power supply to brake

Switch-off in the DC circuit

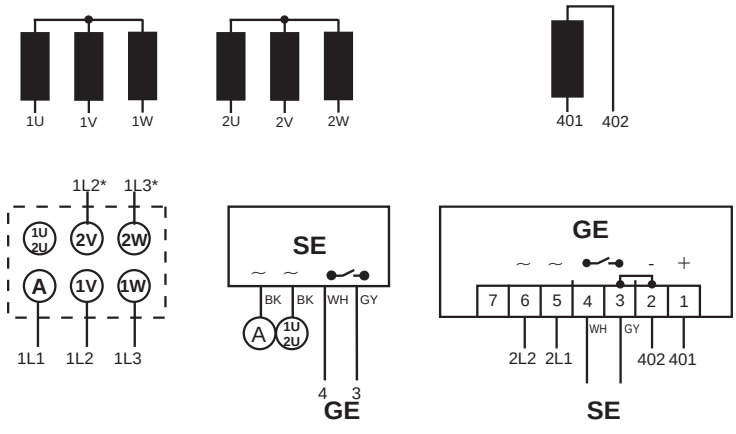
- Remove jumper between terminals 3 and 4.
- Connect a contactor between terminals 3 and 4.

Switch-off in the AC circuit

- Jumper between terminals 3 and 4.
- Contactor in the power line behind terminal 5

037 860 84

Motor for one line voltage, pole-changing, separate windings
Separate power supply to brake



03786144.eps

Motor supplied with

- Motor winding connected as in connection diagram (1U and 2U connected to one terminal)
- Brake connected to terminals 1 and 2 of the GE module.
- SE module connected to terminals 3 and 4 of the GE module.
- SE module connected with the motor winding via intermediate terminal A and terminal 1U 2U

Important The brake will not function without a separate power supply to terminals 5 and 6 of the GE module.

* = Supply to high speed winding via external switch-over.

1U, 1V, 1W for low speed
2U, 2V, 2W for high speed

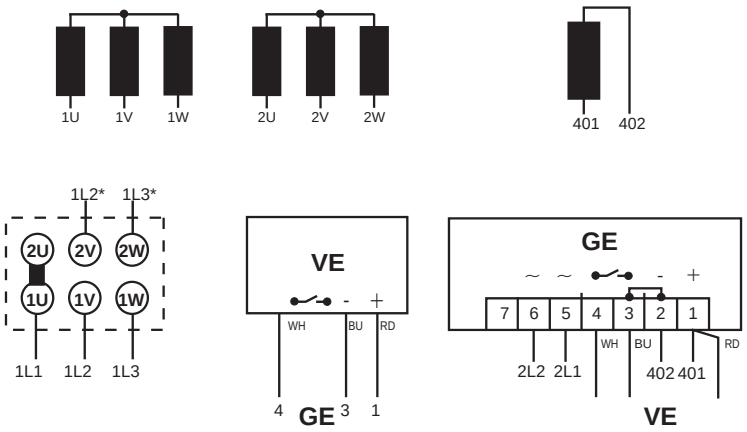
Switch-off in the DC circuit dependent on motor current

Not suitable for inverter operation.

Ⓐ Intermediate terminal

037 861 84

Motor for one line voltage, pole-changing, separate windings
Separate power supply to brake



03786244.eps

* = Supply to high speed winding via external switch-over.

1U, 1V, 1W for low speed
2U, 2V, 2W for high speed

Voltage-dependent switch-off in the DC circuit

Motor supplied with

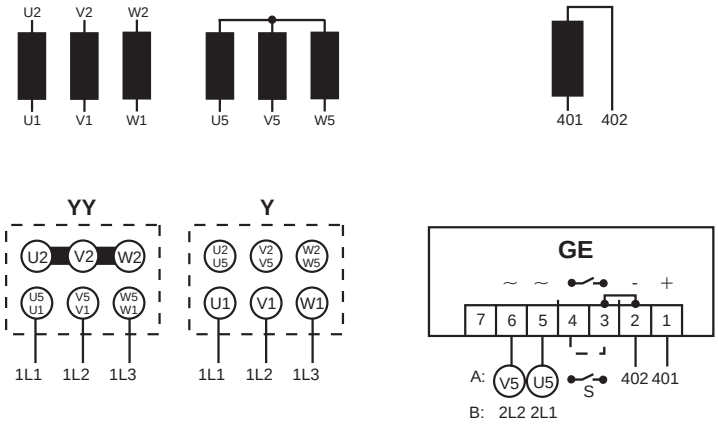
- Jumper parts to connect the motor winding enclosed.
- Brake connected to terminals 1 and 2 of the GE module.
- VE module connected to terminals 1, 3 and 4 of the GE module.

Important **The brake will not function without a separate power supply to terminals 5 and 6 of the GE module.**

037 862 84

Dual voltage motor 1 2

YY low voltage Y high voltage



03786344.eps

Motor supplied with

- Motor winding connected with Y connection.
- Jumper parts to connect the motor winding with YY connection enclosed.
- Brake connected to terminals 1 and 2 of the GE module.
- Jumper between terminals 3 and 4 of the GE module.
- **Mains operation** GE module connected with the motor winding according to variant A.
- **Inverter operation** – GE module **not** connected to the motor winding.
  – Power supply by the customer according to variant B.

037 863 84

A Common power supply to motor and brake
Brake coil rated for the low voltage.

Not suitable for inverter operation.

B Separate power supply to brake
For inverter operation, connect the motor with YY or Y connection according to inverter settings

Switch-off in the DC circuit

- Remove jumper between terminals 3 and 4
- Connect a contactor between terminals 3 and 4

Switch-off in the AC circuit

- Jumper between terminals 3 and 4
- Contactor in the power line behind terminal 5

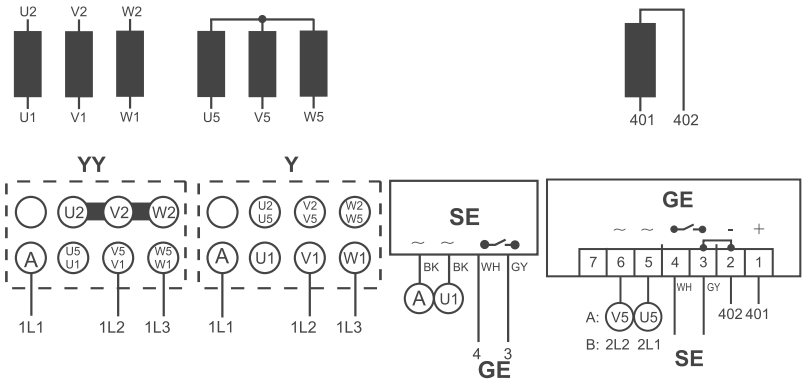
Motor current switch-off

- Jumper between terminals 3 and 4

→ **not possible for separate power supply to the brake**

214206k5.p65/0999

Dual voltage motor 1 2



03786484.eps

YY low voltage
Y high voltage

A Common power supply to motor and brake
Brake coil rated for the low voltage

B Separate power supply to brake

Switch-off in the DC circuit dependent on motor current

Not suitable for inverter operation.

Ⓐ **Intermediate terminal**

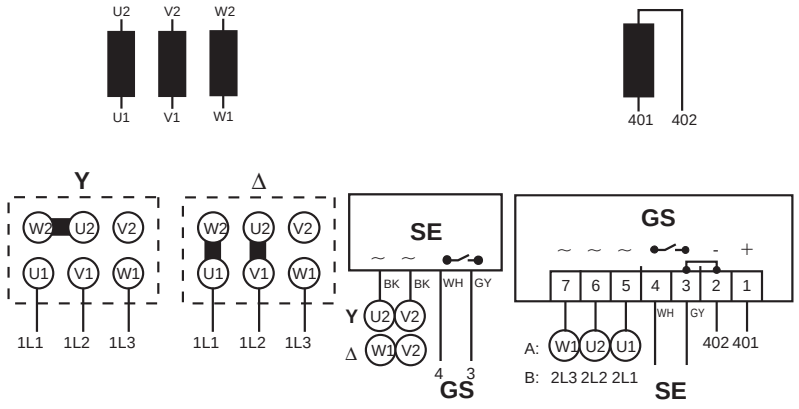
Motor supplied with

- Motor winding connected with Y connection.
- Jumper parts to connect the motor winding with YY connection enclosed.
- Brake connected to terminals 1 and 2 of the GE module.
- SE module connected to terminals 3 and 4 of the GE module.
- SE module connected with intermediate terminal A and with the motor winding via U1.
- GE module connected with the motor winding according to variant A.

037 864 84

Dual voltage motor (1 $\sqrt{3}$)

A Common power supply to motor and brake
B Separate power supply to brake



03786584.eps

Y high voltage
Δ low voltage

Brake coil rated for the low voltage.

Switch-off in the DC circuit dependent on motor current

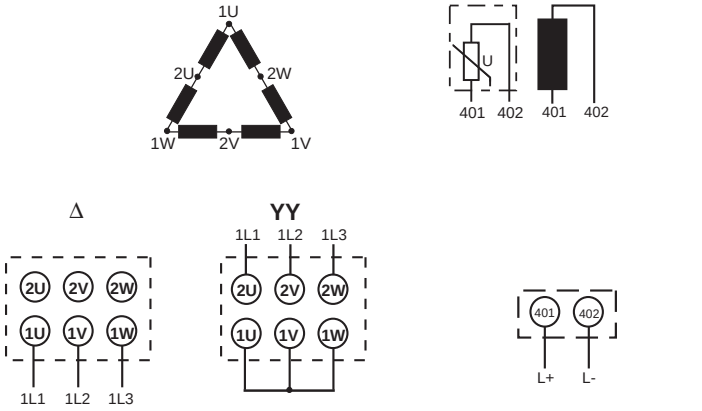
Not suitable for inverter operation.

Motor supplied with

- Jumper parts to connect the motor winding with Y or Δ connection enclosed.
- Brake connected to terminals 1 and 2 of the GS module.
- SE module connected to terminals 3 and 4 of the GS module.
- SE module connected with the motor winding according to variant Y.
- GS module connected with the motor winding according to variant A.

037 865 84

Motor for one line voltage, Pole-changing, Dahlander winding



03787184.eps

Δ for low speed
YY for high speed

Switch-over to high speed winding via external supply switch-over and jumper.

Separate DC supply to brake

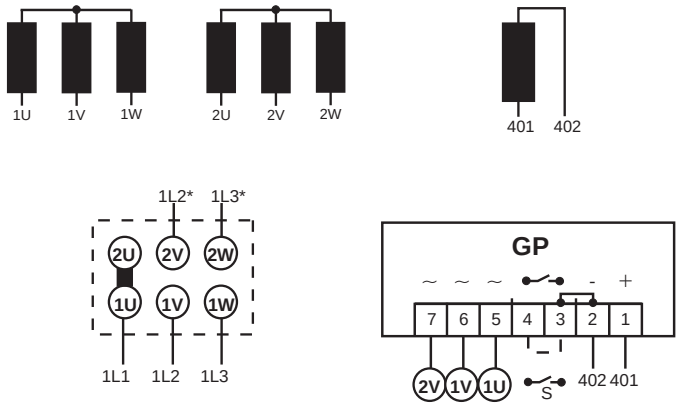
Motor supplied with

Brake connected to Euro terminals.

Important **The brake will not function without a separate DC supply to the brake.**

037 871 84

Motor for one line voltage, pole-changing, separate windings Common power supply to motor and brake



03787284.eps

* = Supply to high speed winding via external switch-over.

1U, 1V, 1W for low speed
2U, 2V, 2W for high speed

Not suitable for inverter operation.

Switch-off in the DC circuit

- Remove jumper between terminals 3 and 4
- Connect contactor between terminals 3 and 4

Switch-off in the AC circuit

- Jumper between terminals 3 and 4
- Contactor in the power line behind terminal 5

Motor current switch-off

Jumper between terminals 3 and 4

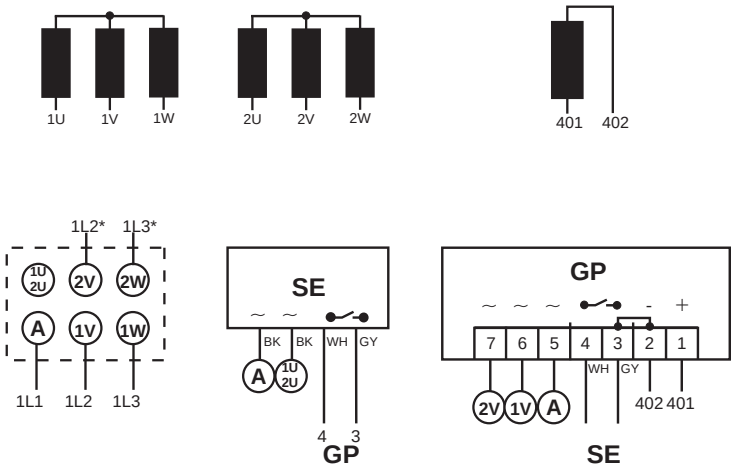
Motor supplied with

- Jumper parts to connect the motor winding enclosed.
- Brake connected to terminals 1 and 2 of the GP module.
- Jumper between terminals 3 and 4 of the GP module.
- GP module connected with the motor winding as in the connection diagram.

037 872 84

214206k5.p65/0999

Motor for one line voltage, pole-changing, separate windings
Common power supply to motor and brake



03787384.eps

* = Supply to high speed winding via external switch-over.

1U, 1V, 1W for low speed
2U, 2V, 2W for high speed

Switch-off in the DC circuit dependent on motor current

Not suitable for inverter operation.

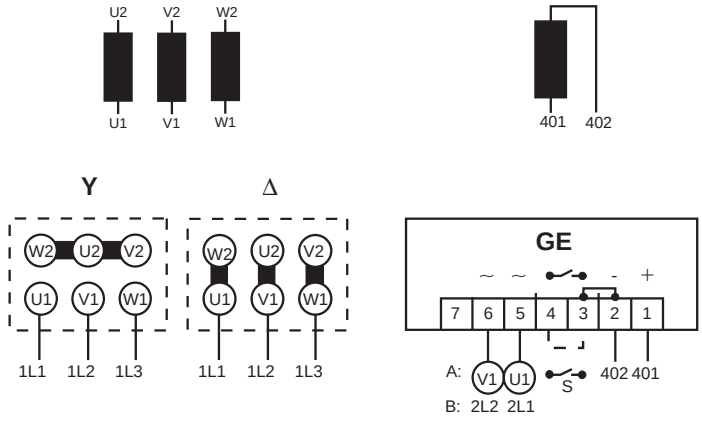
Ⓐ **Intermediate terminal**

Motor supplied with

- Motor winding connected as in connection diagram (1U and 2U connected to one terminal).
- Brake connected to terminals 1 and 2 of the GP module.
- SE module connected to terminals 3 and 4 of the GP module.
- SE module connected with intermediate terminal A and the motor winding via terminal 1U 2U.
- GP module connected with the motor winding and intermediate terminal A as in the connection diagram.

037 873 84

Motor for one line voltage



03787584.eps

A Common power supply to motor and brake

Not suitable for inverter operation.

B Separate power supply to brake

For inverter operation, connect the motor with Y or Δ connection according to inverter settings.

Switch-off in the DC circuit

- Remove jumper between terminals 3 and 4
- Connect a contactor between terminals 3 and 4

Switch-off in the AC circuit

- Jumper between terminals 3 and 4
- Contactor in the power line behind terminal 5

Motor current switch-off

Jumper between terminals 3 and 4
→ **not possible for separate power supply to the brake**

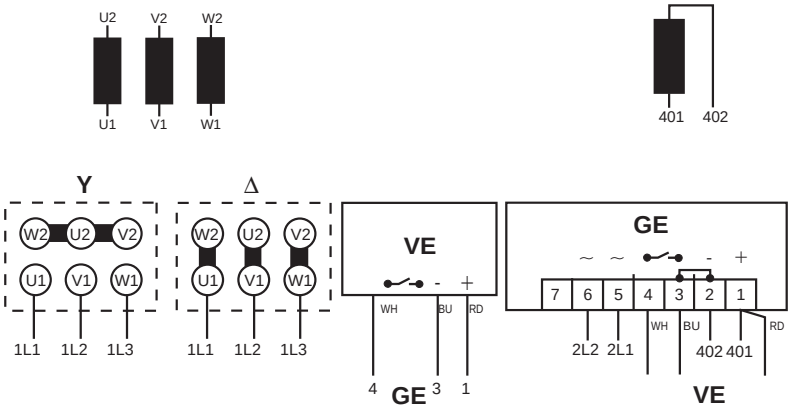
Motor supplied with

- Jumper parts to connect the motor winding with Y or Δ connection enclosed.
- Brake connected to terminals 1 and 2 of the GE module.
- Jumper between terminals 3 and 4 of the GE module.
- **Mains operation** GE module connected with the motor winding according to variant A.
- **Inverter operation** – GE module **not** connected to the motor winding.
  – Power supply by the customer according to variant B.

037 875 84

Motor for one line voltage or dual voltage motor (1 $\sqrt{3}$)

Y high voltage
Δ low voltage



03787644.eps

Voltage-dependent switch-off in the DC circuit

Separate power supply to brake

For inverter operation, connect motor with Y or Δ connection according to inverter settings.

Motor supplied with

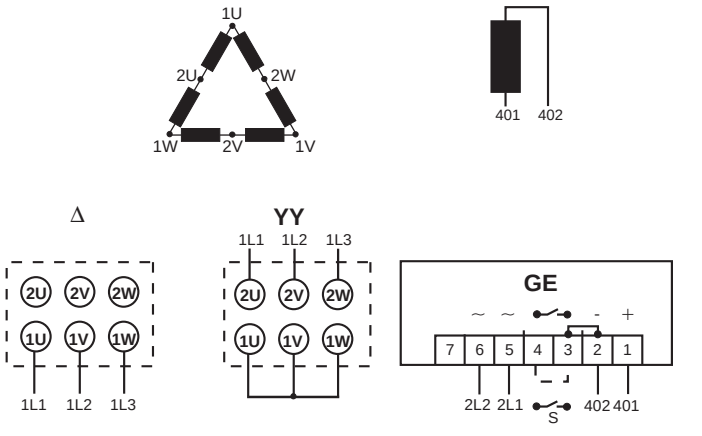
- Jumper parts to connect the motor winding with Y or Δ connection enclosed.
- Brake connected to terminals 1 and 2 of the GE module.
- VE module connected to terminals 1, 3 and 4 of the GE module.

Important **The brake will not function without a separate power supply to terminals 5 and 6 of the GE module.**

037 876 84

Motor for one line voltage, Pole-changing, Dahlander winding

Δ for low speed
YY for high speed



03788084.eps

Switch-over to high speed winding via external supply switch-over and jumper.

Separate power supply to brake.

Switch-off in the DC circuit

- Remove jumper between terminals 3 and 4
- Connect contactor between terminals 3 and 4

Switch-off in the AC circuit

- Jumper between terminals 3 and 4
- Contactor in the power line behind terminal 5

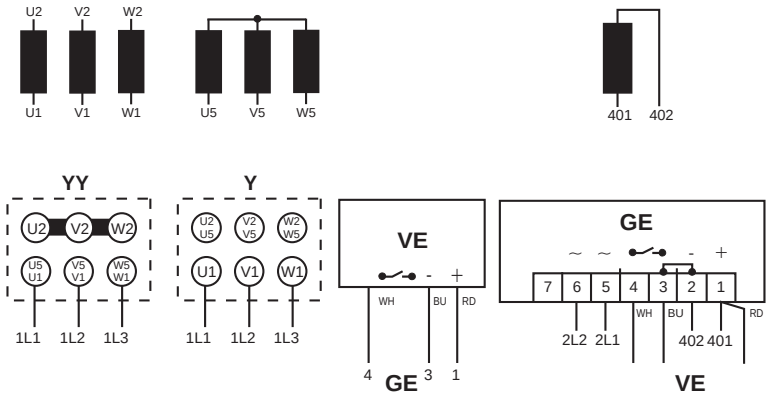
Motor supplied with

- Brake connected to terminals 1 and 2 of the GE module.
- Jumper between terminals 3 and 4 of the GE module.

Important **The brake will not function without a separate power supply to terminals 5 and 6 of the GE module.**

Dual voltage motor 1 2

YY low voltage
Y high voltage



03788184.eps

Voltage-dependent switch-off in the DC circuit

Separate power supply to brake

For inverter operation, connect motor with YY or Y connection according to inverter settings.

Motor supplied with

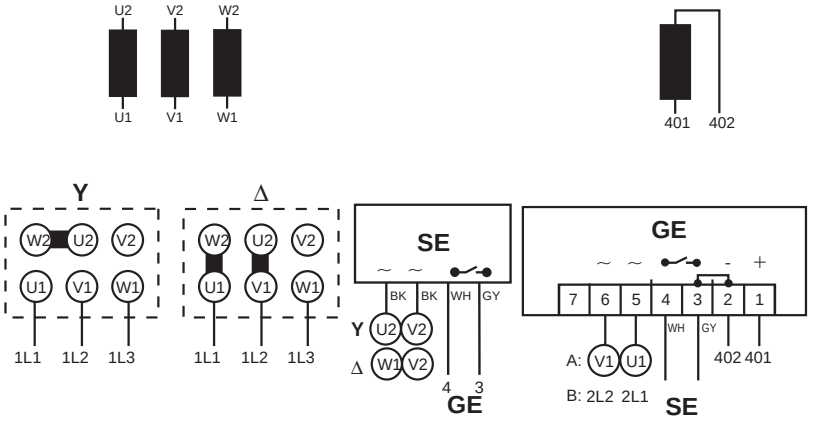
- Motor winding connected with Y connection
- Jumper parts to connect the motor winding with YY connection enclosed.
- Brake connected to terminals 1 and 2 of the GE module.
- VE module connected to terminals 1, 3 and 4 of the GE module.

Important **The brake will not function without a separate power supply to terminals 5 and 6 of the GE module.**

037 881 84

Motor for one line voltage

A Common power supply to motor and brake
B Separate power supply to brake



03788284.eps

Switch-off in the DC circuit dependent on motor current

Not suitable for inverter operation.

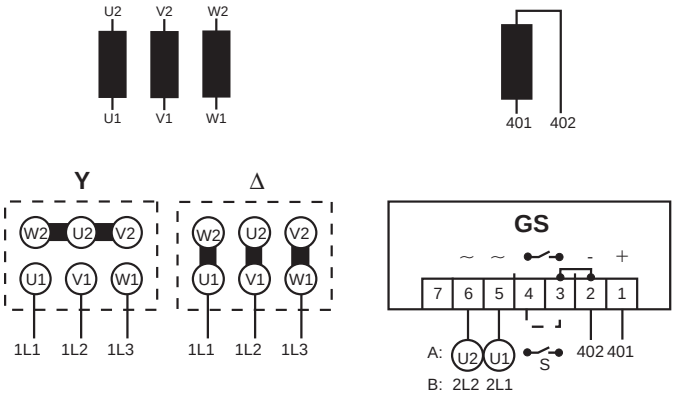
Motor supplied with

- Jumper parts to connect the motor winding with Y or Δ connection enclosed.
- Brake connected to terminals 1 and 2 of the GE module.
- SE module connected to terminals 3 and 4 of the GE module.
- SE module connected with the motor winding according to variant Y.
- GE module connected with the motor winding according to variant A.

037 882 84

Dual voltage motor (1 $\sqrt{3}$)

Y high voltage Δ low voltage
Brake coil rated for the low voltage.



03788384.eps

Motor supplied with

- Jumper parts to connect the motor winding with Y or Δ connection enclosed.
- Brake connected to terminals 1 and 2 of the GS module.
- Jumper between terminals 3 and 4 of the GS module.
- **Mains operation** GE module connected with the motor winding according to variant A.
- **Inverter operation** – GE module **not** connected to the motor winding.
  – Power supply by the customer according to variant B.

A Common power supply to motor and brake

Not suitable for inverter operation.

B Separate power supply to brake

For inverter operation, connect the motor with Y or Δ connection according to inverter settings.

Switch-off in the DC circuit

- Remove jumper between terminals 3 and 4
- Connect a contactor between terminals 3 and 4

Switch-off in the AC circuit

- Jumper between terminals 3 and 4
- Contactor in the power line behind terminal 5

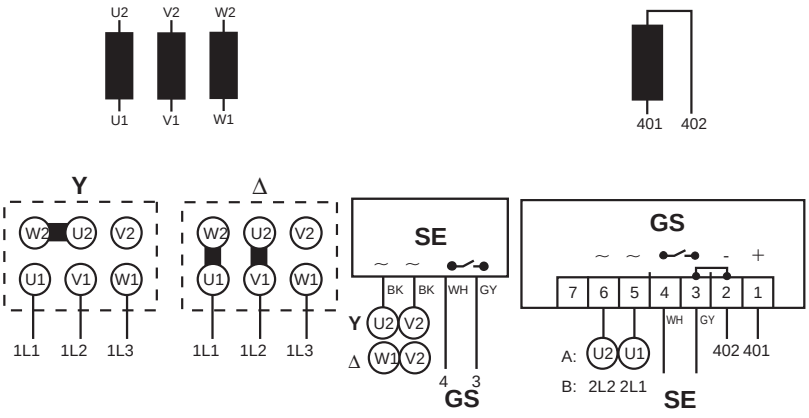
Motor current switch-off

Jumper between terminals 3 and 4
→ **not possible for separate power supply to the brake**

037 883 84

Dual voltage motor (1 $\sqrt{3}$)

A Common power supply to motor and brake
B Separate power supply to brake



03788484.eps

Y high voltage
Δ low voltage
Brake coil rated for the low voltage.

Switch-off in the DC circuit dependent on motor current

Not suitable for inverter operation.

Motor supplied with

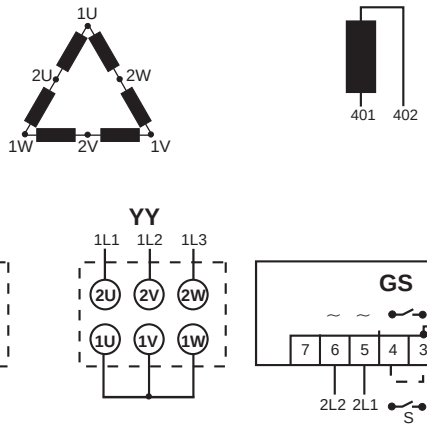
- Jumper parts to connect the motor winding with Y or Δ connection enclosed.
- Brake connected to terminals 1 and 2 of the GS module.
- SE module connected to terminals 3 and 4 of the GS module.
- SE module connected with the motor winding according to variant Y.
- GS module connected with the motor winding according to variant A.

037 884 84

214206k5.p65/0999

Motor for one line voltage, Pole-changing, Dahlander winding

Δ for low speed
YY for high speed



03788584.eps

Switch-over to high speed winding via external supply switch-over and jumper.

Separate power supply to brake.

Switch-off in the DC circuit

- Remove jumper between terminals 3 and 4
- Connect contactor between terminals 3 and 4

Switch-off in the AC circuit

- Jumper between terminals 3 and 4
- Contactor in the power line behind terminal 5

Motor supplied with

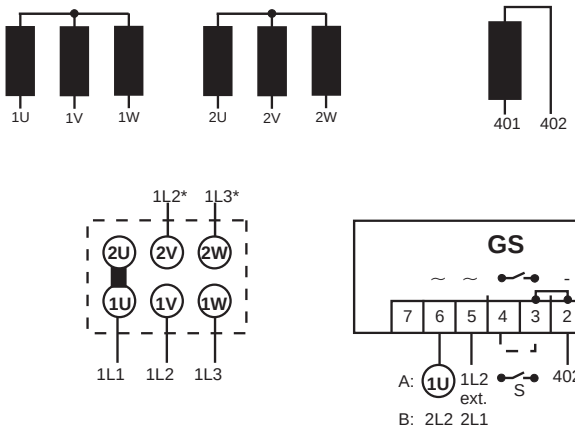
- Brake connected to terminals 1 and 2 of the GS module.
- Jumper between terminals 3 and 4 of the GS module.

Important **The brake will not function without a separate power supply to terminals 5 and 6 of the GS module.**

037 885 84

Motor for one line voltage, pole-changing, separate windings

* = Supply to high speed winding via external switch-over
1U, 1V, 1W for low speed
2U, 2V, 2W for high speed



03788684.eps

A Common power supply to motor and brake

Not suitable for inverter operation.

B Separate power supply to brake

Switch-off in the DC circuit

- Remove jumper between terminals 3 and 4.
- Connect a contactor between terminals 3 and 4.

Switch-off in the AC circuit

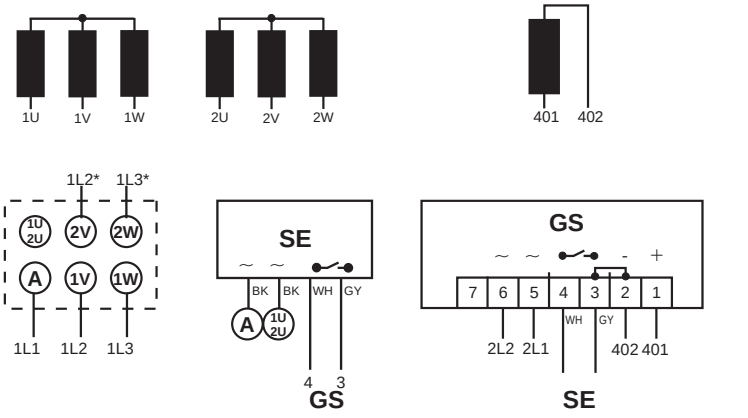
- Jumper between terminals 3 and 4.
- Contactor in the power line behind terminal 5.

Motor supplied with

- Jumper parts to connect the motor winding enclosed.
- Brake connected to terminals 1 and 2 of the GS module.
- Jumper between terminals 3 and 4 of the GS module.
- **Mains operation** GE module connected with the motor winding according to variant A (1U connected to terminal 6; terminal 5 free).
  Important **The brake will not function without an external power supply to terminal 5 of the GS module.**
- **Inverter operation** – GE module **not** connected to the motor winding.
  – Power supply by the customer according to variant B.

037 886 84

Motor for one line voltage, pole-changing, separate windings
Separate power supply to brake



03788784.eps

* = Supply to high speed winding via external switch-over.

1U, 1V, 1W for low speed
2U, 2V, 2W for high speed

Switch-off in the DC circuit dependent on motor current

Not suitable for inverter operation.

Ⓐ **Intermediate terminal**

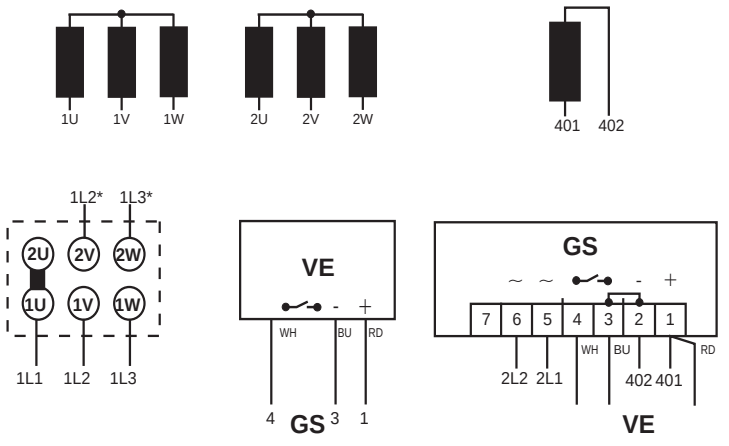
Motor supplied with

- Motor winding connected as in connection diagram (1U and 2U connected to one terminal).
- Brake connected to terminals 1 and 2 of the GS module.
- SE module connected to terminals 3 and 4 of the GS module.
- SE module connected with the motor winding via intermediate terminal A and terminal 1U 2U.

Important **The brake will not function without a separate power supply to terminals 5 and 6 of the GS module.**

037 887 84

Motor for one line voltage, pole-changing, separate windings
Separate power supply to brake



03788884.eps

* = Supply to high speed winding via external switch-over.

1U, 1V, 1W for low speed
2U, 2V, 2W for high speed

Voltage-dependent switch-off in the DC circuit

Motor supplied with

- Jumper parts to connect the motor winding enclosed.
- Brake connected to terminals 1 and 2 of the GS module.
- VE module connected to terminals 1, 3 and 4 of the GS module.

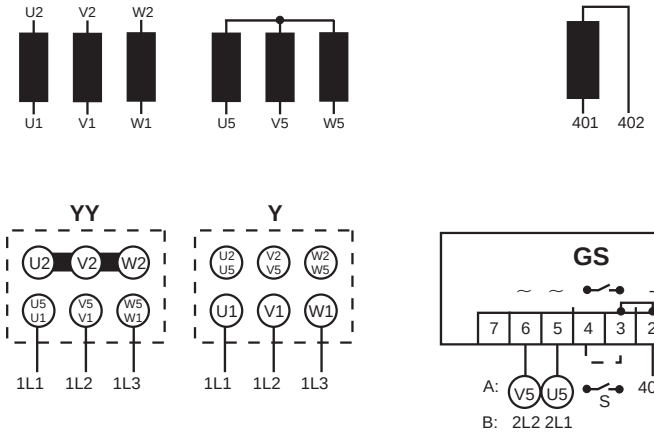
Important **The brake will not function without a separate power supply to terminals 5 and 6 of the GS module.**

037 888 84

214206k5.p65/0999

Dual voltage motor (1 2)

YY low voltage Y high voltage



03788984.eps

Motor supplied with

- Motor winding connected with Y connection.
- Jumper parts to connect the motor winding with YY connection enclosed.
- Brake connected to terminals 1 and 2 of the GS module.
- Jumper between terminals 3 and 4 of the GS module.
- **Mains operation** GE module connected with the motor winding according to variant A.
- **Inverter operation** – GE module **not** connected to the motor winding.
  – Power supply by the customer according to variant B.

A Common power supply to motor and brake
Brake coil rated for the low voltage.

Not suitable for inverter operation.

B Separate power supply to brake
For inverter operation, connect the motor with YY or Y connection according to inverter settings.

Switch-off in the DC circuit
- Remove jumper between terminals 3 and 4.
- Connect a contactor between terminals 3 and 4.

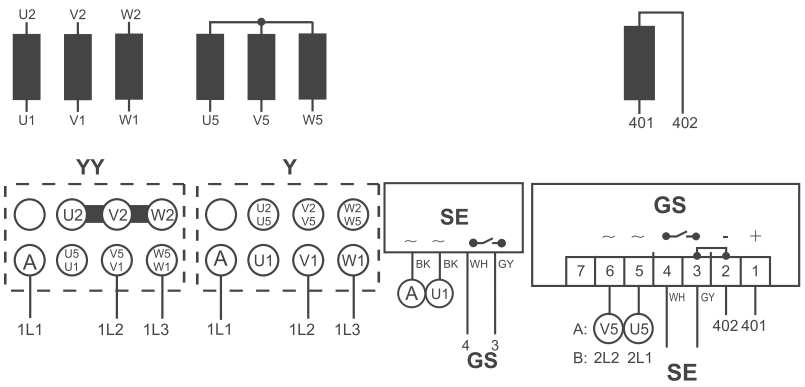
Switch-off in the AC circuit
- Jumper between terminal 3 and 4
- Connect a cantactor contact in the cable behind terminal 5

Motor current switch-off
Jumper between terminals 3 and 4
→ **not possible for separate power supply.**

037 889 84

Dual voltage motor (1 2)

YY low voltage
Y high voltage



03789084.eps

A Common power supply to motor and brake
Brake coil rated for the low voltage

B Separate power supply to brake

Switch-off in the DC circuit dependent on motor current

Not suitable for inverter operation.

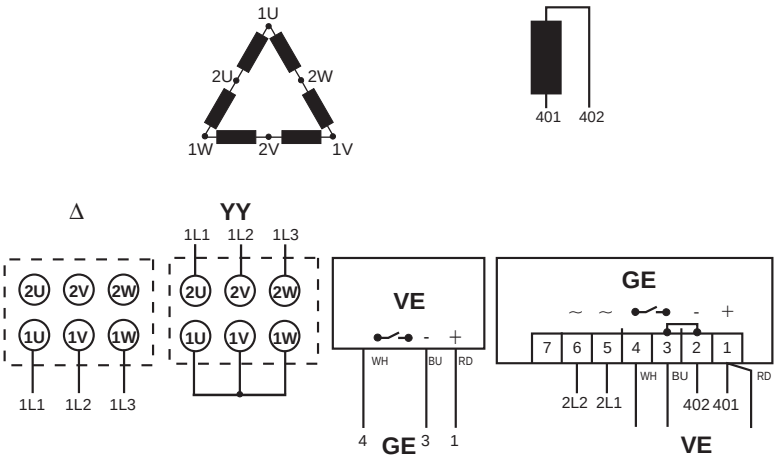
Ⓐ **Intermediate terminal**

Motor supplied with

- Motor winding connected with Y connection.
- Jumper parts to connect the motor winding with YY connection enclosed.
- Brake connected to terminals 1 and 2 of the GS module.
- SE module connected to terminals 3 and 4 of the GS module.
- SE module connected with intermediate terminal A and the motor winding via U1.
- GS module connected with the motor winding according to variant A.

037 890 84

Motor for one line voltage, Pole-changing, Dahlander winding



03789184.eps

Δ for low speed
YY for high speed

Switch-over to high speed winding via external supply switch-over and jumper.

Separate power supply to brake.

Voltage-dependent switch-off in the DC circuit.

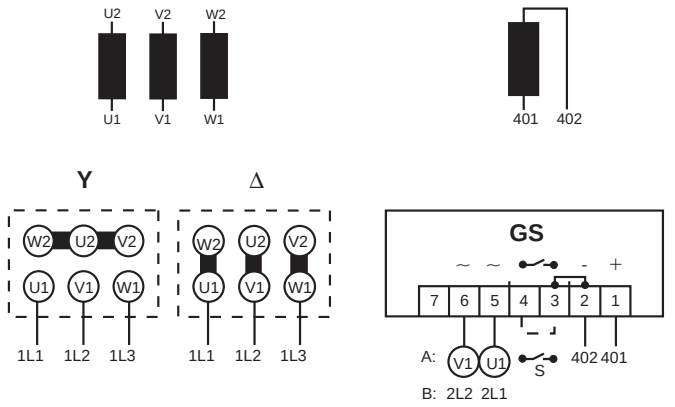
Motor supplied with

- Brake connected to terminals 1 and 2 of the GE module.
- VE module connected to terminals 1, 3 and 4 of the GE module.

Important **The brake will not function without a separate power supply to terminals 5 and 6 of the GE module.**

037 891 84

Motor for one line voltage



03789284.eps

A Common power supply to motor and brake

Not suitable for inverter operation.

B Separate power supply to brake
For inverter operation, connect the motor with Y or Δ connection according to inverter settings

Switch-off in the DC circuit

- Remove jumper between terminals 3 and 4
- Connect a contactor between terminals 3 and 4

Switch-off in the AC circuit

- Jumper between terminals 3 and 4
- Contactor in the power line behind terminal 5

Motor current switch-off

Jumper between terminals 3 and 4
→ **not possible for separate power supply to the brake**

Motor supplied with

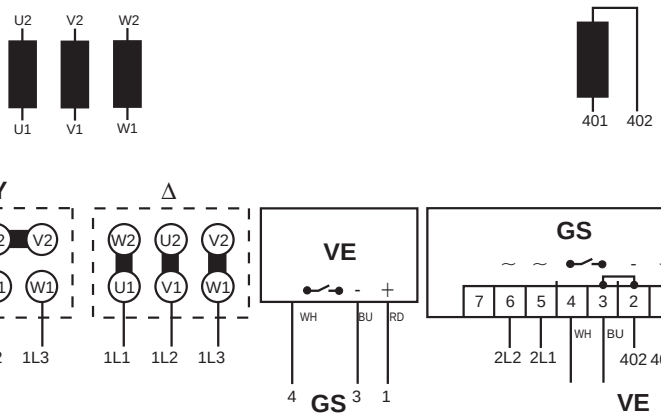
- Jumper parts to connect the motor winding with Y or Δ connection enclosed.
- Brake connected to terminals 1 and 2 of the GS module.
- Jumper between terminals 3 and 4 of the GS module.
- **Mains operation** GE module connected with the motor winding according to variant A.
- **Inverter operation** – GE module **not** connected to the motor winding.
  – Power supply by the customer according to variant B.

037 892 84

214206k5.p65/0999

Motor for one line voltage or dual voltage motor (1 $\sqrt{3}$)

Y high voltage
Δ low voltage



03789384.eps

Separate power supply to brake

For inverter operation, connect motor with Y or Δ connection according to inverter settings.

Voltage-dependent switch-off in the DC circuit

Motor supplied with

- Jumper parts to connect the motor winding with Y or Δ connection enclosed.
- Brake connected to terminals 1 and 2 of the GS module.
- VE module connected to terminals 1, 3 and 4 of the GS module.

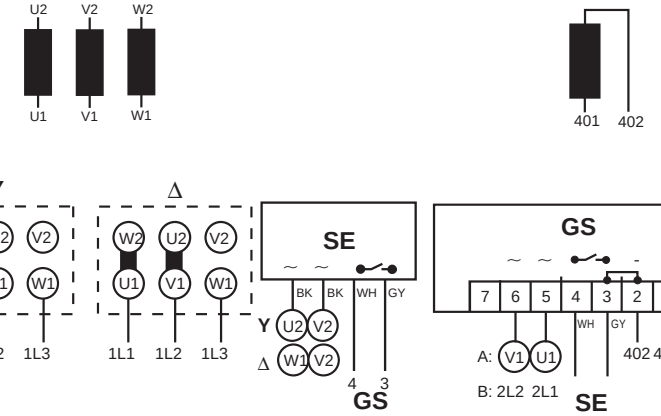
Important **The brake will not function without a separate power supply to terminals 5 and 6 of the GS module.**

037 893 84

Motor for one line voltage

A Common power supply to motor and brake
B Separate power supply to brake

Switch-off in the DC circuit dependent on motor current



03789484.eps

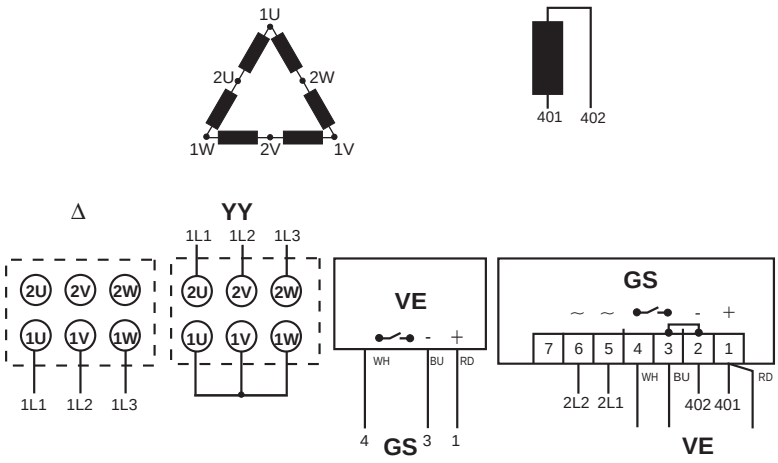
Not suitable for inverter operation.

Motor supplied with

- Jumper parts to connect the motor winding with Y or Δ connection enclosed.
- Brake connected to terminals 1 and 2 of the GS module.
- SE module connected to terminals 3 and 4 of the GS module.
- SE module connected with the motor winding according to variant Y.
- GS module connected with the motor winding according to variant A.

037 894 84

Motor for one line voltage, Pole-changing, Dahlander winding



03789584.eps

Δ for low speed
YY for high speed

Switch-over to high speed winding via external supply switch-over and jumper.

Separate power supply to brake.

Voltage-dependent switch-off in the DC circuit.

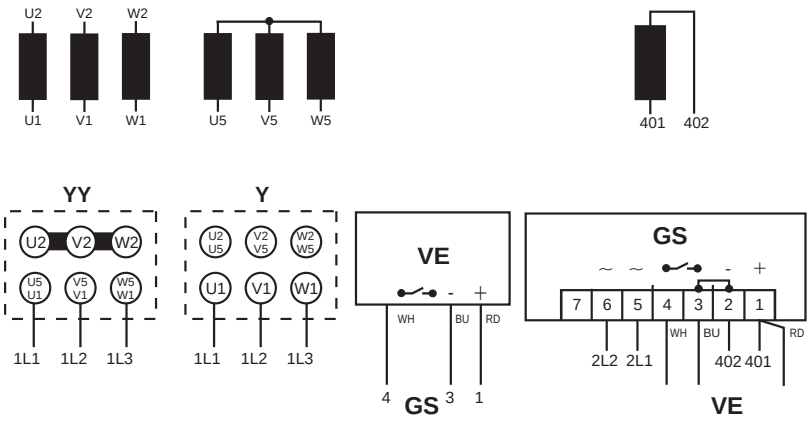
Motor supplied with

- Brake connected to terminals 1 and 2 of the GS module.
- VE module connected to terminals 1, 3 and 4 of the GS module.

Important **The brake will not function without a separate power supply to terminals 5 and 6 of the GE module**

037 895 84

Dual voltage motor (1 2)



03789684.eps

YY low voltage
Y high voltage

Separate power supply to brake

For inverter operation, connect the motor with YY or Y connection according to inverter settings.

Voltage-dependent switch-off in the DC circuit

Motor supplied with

- Motor winding connected with Y connection.
- Jumper parts to connect the motor winding with YY connection enclosed.
- Brake connected to terminals 1 and 2 of the GS module.
- VE module connected to terminals 1, 3 and 4 of the GS module.

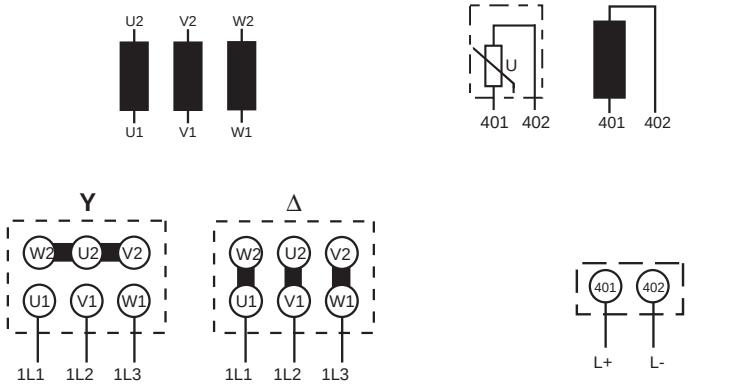
Important **The brake will not function without a separate power supply to terminals 5 and 6 of the GS module.**

037 896 84

214206k5.p65/0999

Motor for one line voltage or dual voltage motor (1 $\sqrt{3}$)

Y high voltage
Δ low voltage



03789784.eps

Separate DC supply to brake

For inverter operation, connect motor with Y or Δ connection according to inverter settings.

Motor supplied with

- Jumper parts to connect the motor winding with Y or Δ connection enclosed.
- Brake connected to Euro terminals.

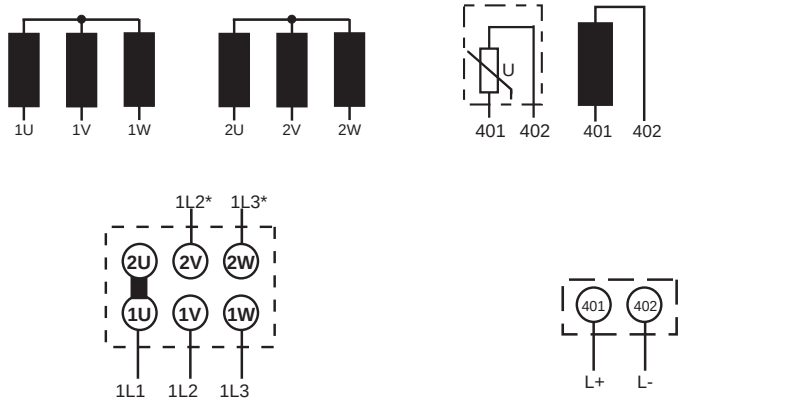
Important **The brake will not function without a separate DC supply to the brake**

037 897 84

Motor for one line voltage, pole-changing, separate windings Separate DC supply to brake

* = Supply to high speed winding via external switch-over.

1U, 1V, 1W for low speed
2U, 2V, 2W for high speed



03789884.eps

Motor supplied with

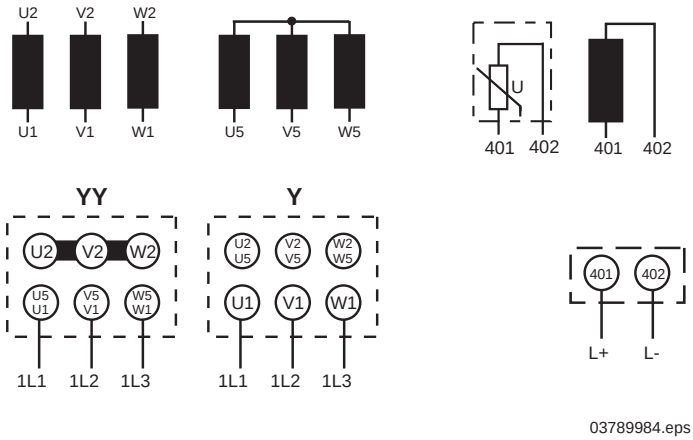
- Jumper parts to connect the motor winding enclosed.
- Brake connected to Euro terminals.

Important **The brake will not function without a separate DC supply to the brake**

037 898 84

Dual voltage motor (1 2)

YY low voltage
Y high voltage



03789984.eps

Separate DC supply to brake

For inverter operation, connect motor with YY or Y connection according to inverter settings.

Motor supplied with

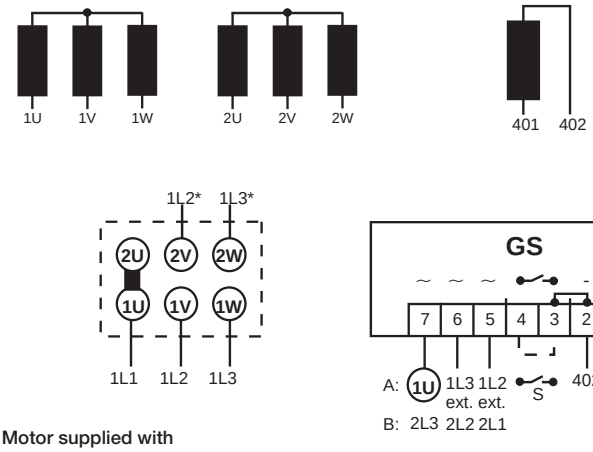
- Motor winding connected with Y connection.
- Jumper parts to connect the motor winding with YY connection enclosed.
- Brake connected to Euro terminals.

Important **The brake will not function without a separate DC supply to the brake**

037 899 84

Motor for one line voltage, pole-changing, separate windings

* = Supply to high speed winding via external switch-over
1U, 1V, 1W for low speed
2U, 2V, 2W for high speed



03800184.eps

Motor supplied with

- Jumper parts to connect the motor winding enclosed.
- Brake connected to terminals 1 and 2 of the GS module.
- Jumper between terminals 3 and 4 of the GS module.
- **Mains operation** GE module connected with the motor winding according to variant A
  (1U connected to terminal 7; terminals 5 and 6 free).
  Important **The brake will not function without an external power supply to terminals 5 and 6 of the GS module.**
- **Inverter operation** – GE module **not** connected to the motor winding.
  – Power supply by the customer according to variant B.

A Common power supply to motor and brake

Not suitable for inverter operation.

B Separate power supply to brake

Switch-off in the DC circuit

- Remove jumper between terminals 3 and 4.
- Connect a contactor between terminals 3 and 4.

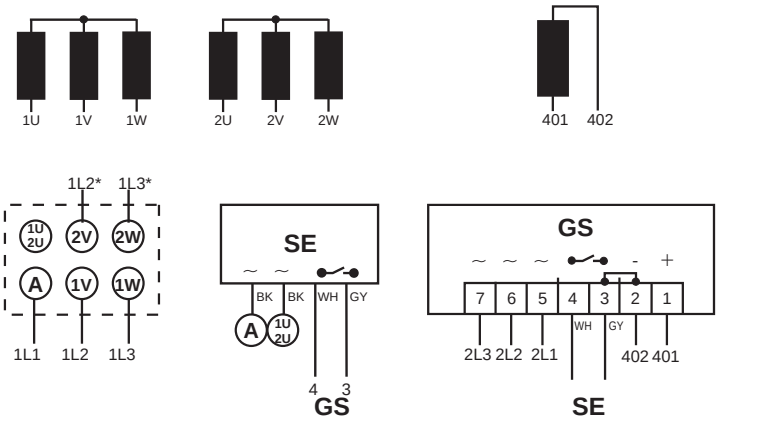
Switch-off in the AC circuit

- Jumper between terminals 3 and 4.
- Contactors in the power lines behind terminals 5 and 6.

038 001 84

214206k5.p65/0999

Motor for one line voltage, pole-changing, separate windings
Separate power supply to brake



03800284.eps

* = Supply to high speed winding via external switch-over.

1U, 1V, 1W for low speed
2U, 2V, 2W for high speed

Switch-off in the DC circuit dependent on motor current

Not suitable for inverter operation.

Ⓐ **Intermediate terminal**

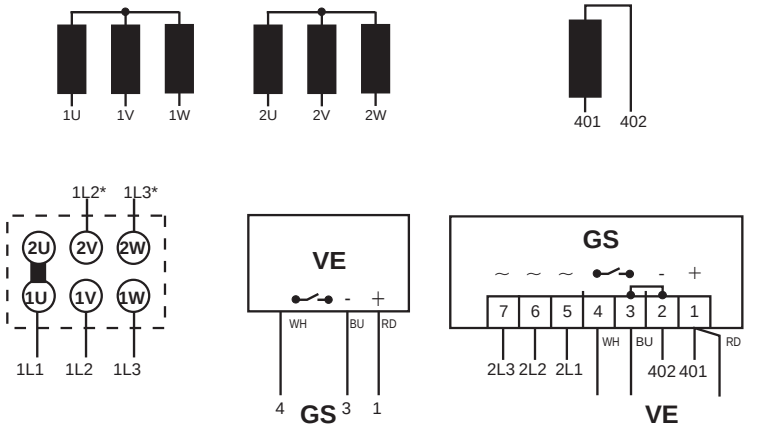
Motor supplied with

- Motor winding connected as in connection diagram (1U and 2U connected to one terminal).
- Brake connected to terminals 1 and 2 of the GS module.
- SE module connected to terminals 3 and 4 of the GS module.
- SE module connected with the motor winding via intermediate terminal A and terminal 1U 2U.

Important **The brake will not function without a separate power supply to terminals 5, 6 and 7 of the GS module.**

038 002 84

Motor for one line voltage, pole-changing, separate windings
Separate power supply to brake



03800384.eps

* = Supply to high speed winding via external switch-over.

1U, 1V, 1W for low speed
2U, 2V, 2W for high speed

Voltage-dependent switch-off in the DC circuit

Motor supplied with

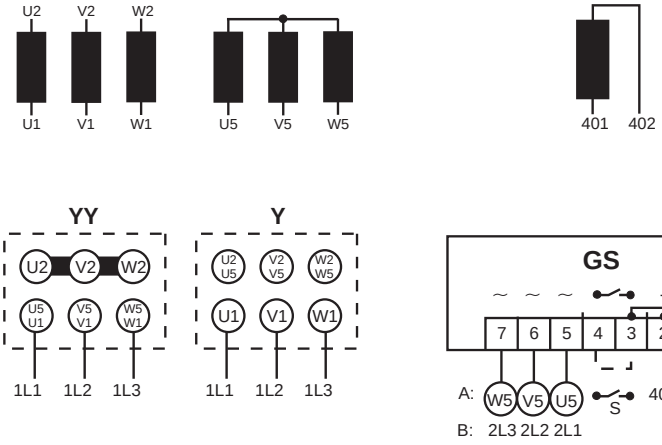
- Jumper parts to connect the motor winding enclosed.
- Brake connected to terminals 1 and 2 of the GS module.
- VE module connected to terminals 1, 3 and 4 of the GS module.

Important **The brake will not function without a separate power supply to terminals 5, 6 and 7 of the GS module.**

038 003 84

Dual voltage motor (1 2)

YY low voltage Y high voltage



03800484.eps

Motor supplied with

- Motor winding connected with Y connection.
- Jumper parts to connect the motor winding with YY connection enclosed.
- Brake connected to terminals 1 and 2 of the GS module.
- Jumper between terminals 3 and 4 of the GS module.
- **Mains operation** GE module connected with the motor winding according to variant A..
- **Inverter operation** – GE module **not** connected to the motor winding.
  – Power supply by the customer according to variant B.

A Common power supply to motor and brake
Brake coil rated for the low voltage.

Not suitable for inverter operation.

B Separate power supply to brake
For inverter operation, connect the motor with YY or Y connection according to inverter settings

Switch-off in the DC circuit

- Remove jumper between terminals 3 and 4.
- Connect a contactor between terminals 3 and 4.

Switch-off in the AC circuit

- Jumper between terminals 3 and 4.
- Contactors in the power lines behind terminals 5 and 6.

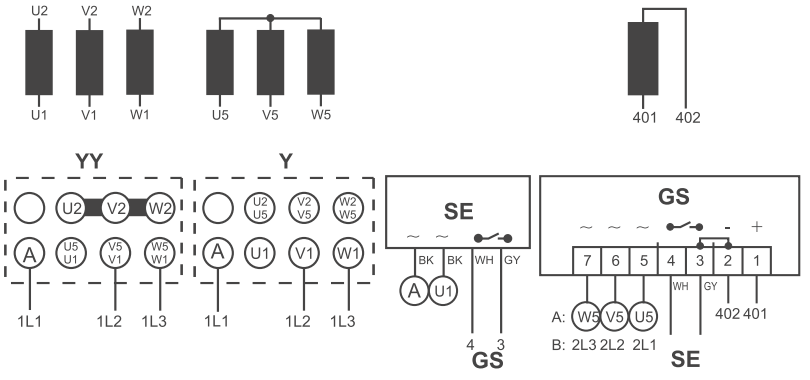
Motor current switch-off

Jumper between terminals 3 and 4
→ **not possible for separate power supply to the brake**

038 004 84

Dual voltage motor (1 2)

YY low voltage
Y high voltage



03800584.eps

Motor supplied with

- Motor winding connected with Y connection.
- Jumper parts to connect the motor winding with YY connection enclosed.
- Brake connected to terminals 1 and 2 of the GS module.
- SE module connected to terminals 3 and 4 of the GS module.
- SE module connected with intermediate terminal A and the motor winding via U1.
- GS module connected with the motor winding according to variant A.

YY low voltage
Y high voltage

A Common power supply to motor and brake
Brake coil rated for the low voltage

B Separate power supply to brake

Switch-off in the DC circuit dependent on motor current

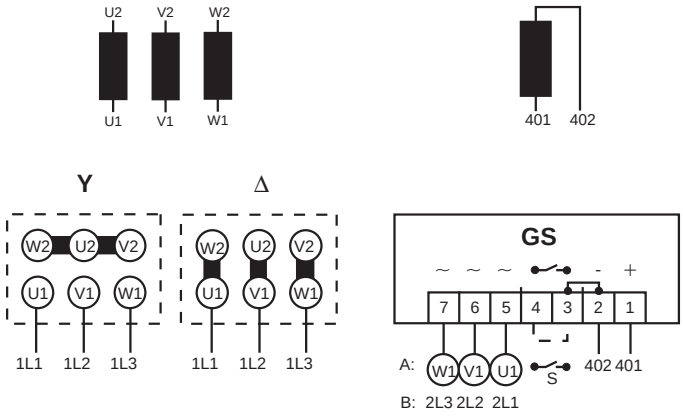
Not suitable for inverter operation.

Ⓐ **Intermediate terminal**

038 005 84

214206k5.p65/0999

Motor for one line voltage



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Motor supplied with

- Jumper parts to connect the motor winding with Y or Δ connection enclosed.
- Brake connected to terminals 1 and 2 of the GS module.
- Jumper between terminals 3 and 4 of the GS module.
- **Mains operation** GE module connected with the motor winding according to variant A.
- **Inverter operation**
  - GE module **not** connected to the motor winding.
  - Power supply by the customer according to variant B.

A Common power supply to motor and brake
Brake coil rated for the low voltage

Not suitable for inverter operation.

B **Separate power supply to brake**
For inverter operation, connect the motor with Y or Δ connection according to inverter settings

Switch-off in the DC circuit

- Remove jumper between terminals 3 and 4.
- Connect a contactor between terminals 3 and 4.

Switch-off in the AC circuit

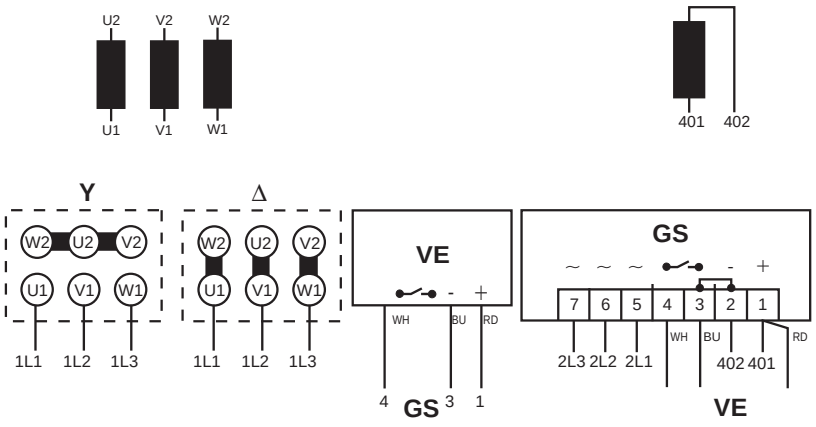
- Jumper between terminals 3 and 4.
- Contactors in the power lines behind terminals 5 and 6.

Motor current switch-off

Jumper between terminals 3 and 4
→ **not possible for separate power supply to the brake**

038 006 84

Motor for one line voltage or dual voltage motor (1 √3)



03800784.eps

Motor supplied with

- Jumper parts to connect the motor winding with Y or Δ connection enclosed.
- Brake connected to terminals 1 and 2 of the GS module.
- VE module connected to terminals 1, 3 and 4 of the GS module.

Important **The brake will not function without a separate power supply to terminals 5, 6 and 7 of the GS module.**

Y high voltage
Δ low voltage

Separate power supply to brake

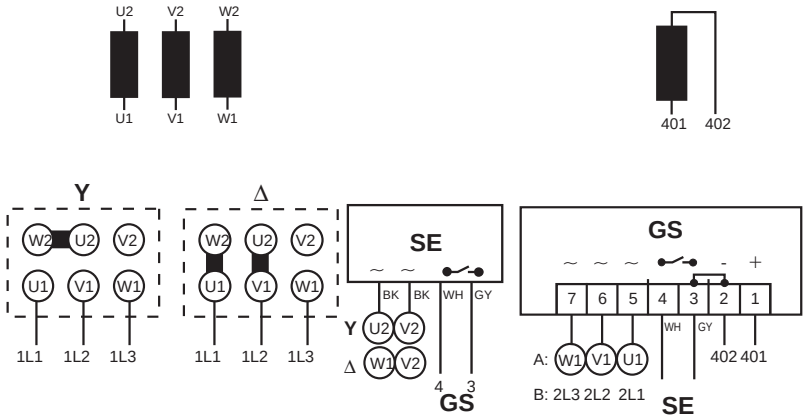
For inverter operation, connect motor with Y or Δ connection according to inverter settings.

Voltage-dependent switch-off in the DC circuit

038 007 84

Motor for one line voltage

A Common power supply to motor and brake
B Separate power supply to brake



03800884.eps

Switch-off in the DC circuit dependent on motor current

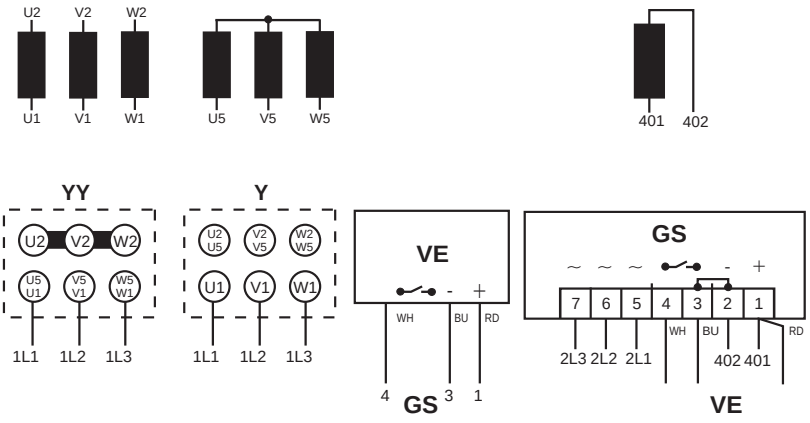
Not suitable for inverter operation.

Motor supplied with

- Jumper parts to connect the motor winding with Y or Δ connection enclosed.
- Brake connected to terminals 1 and 2 of the GS module.
- SE module connected to terminals 3 and 4 of the GS module.
- SE module connected with the motor winding according to variant Y.
- GS module connected with the motor winding according to variant A.

038 008 84

Dual voltage motor (1 2)



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YY low voltage
Y high voltage

Separate power supply to brake

For inverter operation, connect the motor with YY or Y connection according to inverter settings.

Voltage-dependent switch-off in the DC circuit

Motor supplied with

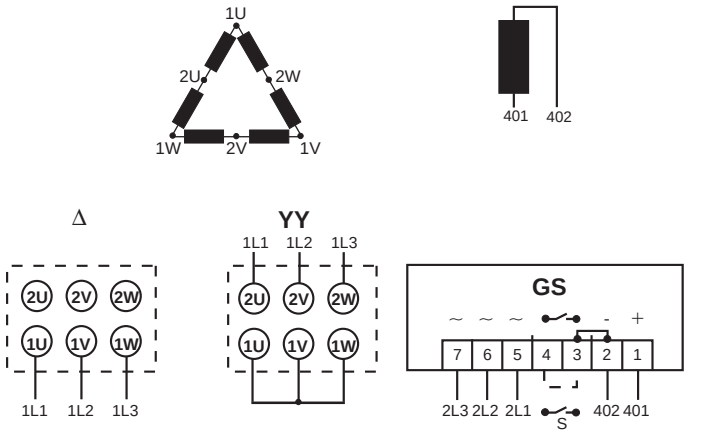
- Motor winding connected with Y connection.
- Jumper parts to connect the motor winding with YY connection enclosed.
- Brake connected to terminals 1 and 2 of the GS module.
- VE module connected to terminals 1, 3 and 4 of the GS module.

Important **The brake will not function without a separate power supply to terminals 5, 6 and 7 of the GS module.**

038 014 84

Motor for one line voltage, Pole-changing, Dahlander winding

Δ for low speed
YY for high speed



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Switch-over to high speed winding via external supply switch-over and jumper.

Separate power supply to brake.

Switch-off in the DC circuit

- Remove jumper between terminals 3 and 4
- Connect contactor between terminals 3 and 4

Switch-off in the AC circuit

- Jumper between terminals 3 and 4
- Contactors in the power lines behind terminals 5 and 6

Motor supplied with

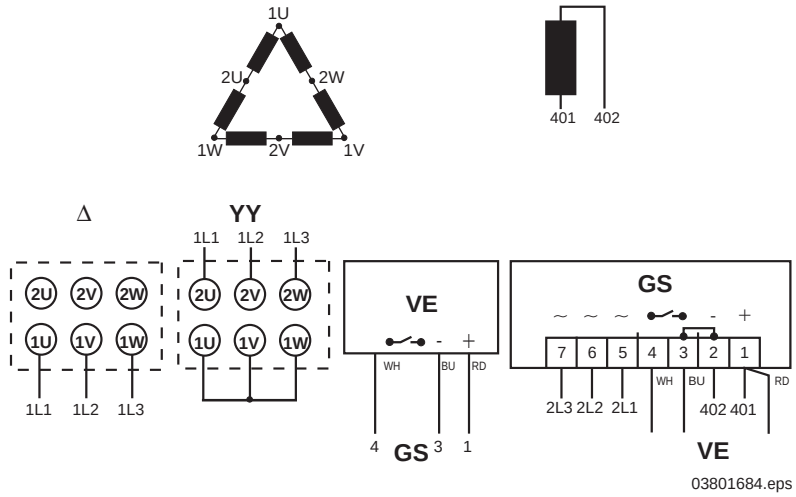
- Brake connected to terminals 1 and 2 of the GS module.
- Jumper between terminals 3 and 4 of the GS module.

Important The brake will not function without a separate power supply to terminals 5, 6 and 7 of the GS module.

038 015 84

Motor for one line voltage, Pole-changing, Dahlander winding

Δ for low speed
YY for high speed



03801684.eps

Switch-over to high speed winding via external supply switch-over and jumper.

Separate power supply to brake.

Voltage-dependent switch-off in the DC circuit.

Motor supplied with

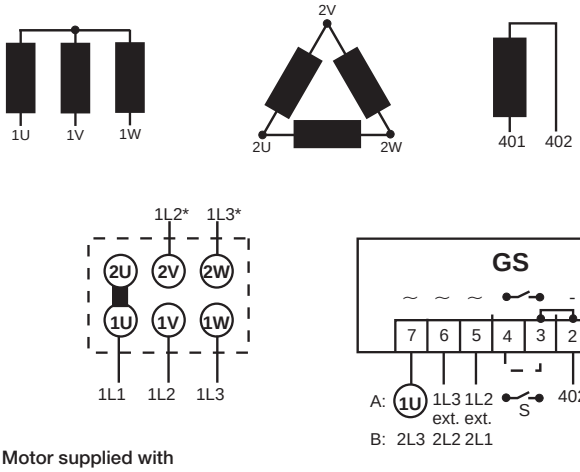
- Brake connected to terminals 1 and 2 of the GS module.
- VE module connected to terminals 1, 3 and 4 of the GS module.

Important The brake will not function without a separate power supply to terminals 5, 6 and 7 of the GE module.

038 016 84

Motor for one line voltage, pole-changing, separate windings

* = Supply to high speed winding via external switch-over
1U, 1V, 1W for low speed
2U, 2V, 2W for high speed



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Motor supplied with

- Jumper parts to connect the motor winding enclosed.
- Brake connected to terminals 1 and 2 of the GS module.
- Jumper between terminals 3 and 4 of the GS module.
- **Mains operation** GE module connected with the motor winding according to variant A (1U connected to terminal 6; terminals 5 and 6 free).
  Important **The brake will not function without an external power supply to terminals 5 and 6 of the GS module.**
- **Inverter operation** – GE module **not** connected to the motor winding.
  – Power supply by the customer according to variant B.

A Common power supply to motor and brake

Not suitable for inverter operation.

B Separate power supply to brake

Switch-off in the DC circuit

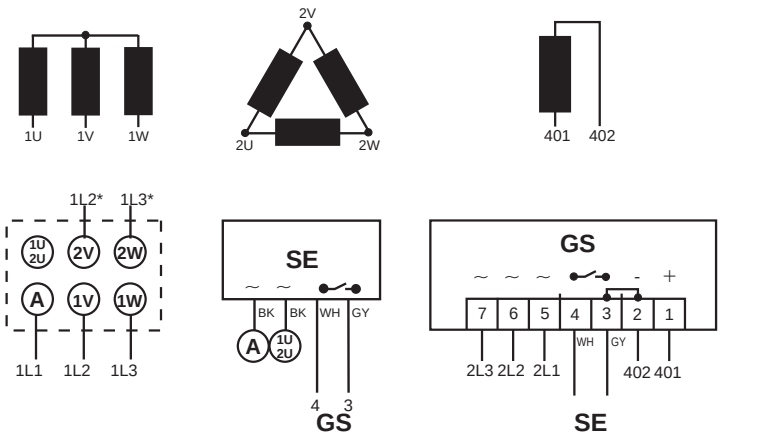
- Remove jumper between terminals 3 and 4.
- Connect a contactor between terminals 3 and 4.

Switch-off in the AC circuit

- Jumper between terminals 3 and 4.
- Contactor in the power line behind terminals 5 and 6.

038 017 84

Motor for one line voltage, pole-changing, separate windings
Separate power supply to brake



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* = Supply to high speed winding via external switch-over.

1U, 1V, 1W for low speed
2U, 2V, 2W for high speed

Switch-off in the DC circuit dependent on motor current

Not suitable for inverter operation.

Ⓐ **Intermediate terminal**

Motor supplied with

- Motor winding connected as in connection diagram (1U and 2U connected to one terminal).
- Brake connected to terminals 1 and 2 of the GS module.
- SE module connected to terminals 3 and 4 of the GS module.
- SE module connected with the motor winding via intermediate terminal A and terminal 1U 2U.

Important **The brake will not function without a separate power supply to terminals 5, 6 and 7 of the GS module.**

038 018 84

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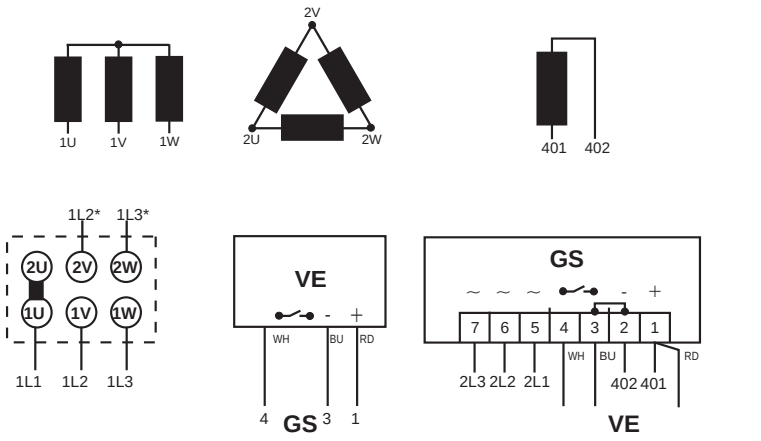
Motor for one line voltage, pole-changing, separate windings
Separate power supply to brake



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* = Supply to high speed winding via external switch-over.

1U, 1V, 1W for low speed
2U, 2V, 2W for high speed

Voltage-dependent switch-off in the DC circuit

Motor supplied with

- Jumper parts to connect the motor winding enclosed.
- Brake connected to terminals 1 and 2 of the GS module.
- VE module connected to terminals 1, 3 and 4 of the GS module.

Important **The brake will not function without a separate power supply to terminals 5, 6 and 7 of the GS module.**

038 020 84

7.6 Connecting temperature and brake monitoring devices

Depending on the motor features, the connections for temperature monitoring and/or brake monitoring are brought out on Euro terminals in the terminal box.

The following connection designations are used:

PTC thermistor

– Switch-off: **101 - 102** and **201 - 202**
– Warning: **111 - 112**

Important PTC thermistors to DIN 44081 are suitable for tripping devices with 2,5 V DC output voltage and 4 kΩ tripping resistance.
PTC thermistors may only be continuity tested with max. 2,5 V DC. Do not use a buzzer (voltage peaks) or similar devices. The resistance of **one** PTC thermistor is 20 ... 250 Ω at temperatures of –20 °C to ϑ_{TNF} – 20K. (TNF = rated operating temperature).

Temperature detector (bimetallic switch) **601 – 602**

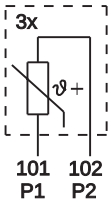
Brake monitoring

– Release monitoring: **801 – 802 – 803**
Contact 2 (802 – 803) closed:
Brake not released, brake in applied position
Contact 4 (801 – 803) closed:
Brake released

– Adjustment monitoring: **804 – 805 – 806**
Contact 2 (805 – 806) closed:
Brake must be adjusted
Contact 4 (804 – 806) closed:
Normal operating condition

The diagrams below show the most important single connections.
When several monitoring devices are used (such as PTC thermistors for the motor and release monitoring for the brake), the individual circuits are combined in one connection diagram which can be found inside the motor terminal box.

PTC thermistor



Switch-off

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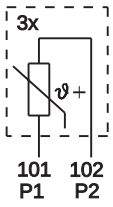
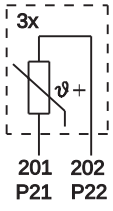
PTC thermistor



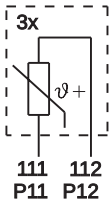
Switch-off 1



Switch-off 2

03782044.eps

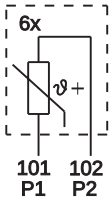
PTC thermistor



Warning

03782144.eps

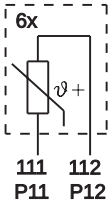
PTC thermistorr



Switch-off

03782344.eps

PTC thermistor



Warning

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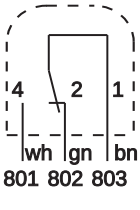
Brake monitoring
Release monitoring



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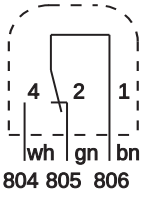
Brake monitoring
Ad ustment monitoring



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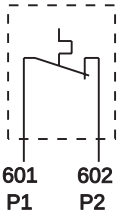
Temperature detector



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214206k5.p65/0999

8 Technical data

Motor

Function conditions for standard design

Conditions			
Transport temperature	-20 ... +40°C		
Storage temperature	0 ... +40°C		
Storage conditions	Dry, indoors		
Ambient operating temperature	-20 ... +40°C		
Environment	Acid-free		
Coolant	Air		
Coolant temperature	max. +40°C		
Temperature rise limit of winding	105K		
Installation site height	max. 1000 m above sea level		
Air circuit	Ensure by w orking clearance, unrestricted air intake		
Enclosure	IP54		
Mounting arrangement	Low vibration		
Working clearance at fan end	150 mm at rear		
Line voltage	400V/50Hz	480V/60Hz	500V/50Hz
Voltage tolerance	±10% of the line voltage		
Max. speed	3600 rpm		

Gearbox

Function conditions for standard design

Conditions	
Transport temperature	-20 ... +40°C
Storage temperature	0 ... +40°C
Storage conditions	Dry, indoors
Ambient operating temperature	-10 ... +50°C
Environment	Low dust level, acid free
Coolant	Air
Coolant temperature	max. +40°C
Installation site height	max. 1000 m above sea level
Air circuit	Free circulation
Enclosure	IP 55
Mounting arrangement	Low vibration
Working clearance	Ensure free air circulation
Max. input speed	3600 rpm
Lubrication	see rating plate

9 Troubleshooting

Item	Problem	Possible cause	Solution
1	Motor does not start.	Fuse has tripped.	Replace fuse.
		Power supply line interrupted	Check connections.
		Motor protection has tripped.	Check motor protection for correct setting.
		Control defective.	Check motor connection.
		Brake does not release.	See section 10 **Brake does not release**
2	Motor does not start or or starts slowly.	Motor for delta connection connected in star	Correct motor connection.
		Extreme voltage or frequency deviation from setpoint value.	Improve quality of power supply; check power supply line cross-section.
3	Motor will not start in star connection, only starts in delta connection.	Insufficient torque in star connection.	If the delta starting current is too high, start up direct in star connection, otherwise use larger motor or special design (contact manufacturer).
		Contact fault in star-delta starter.	Eliminate fault.
4	Motor runs in wrong direction.	Motor incorrectly connected.	Interchange two supply leads.
5	Motor hums and has high power consumption.	Winding defective.	Motor must be sent to specialist workshop for repair.
6	Fuses trip or motor protection trips immediately.	Short-circuit in the supply line.	Eliminate short-circuit.
		Short-circuit in the motor.	Motor must be sent to specialist workshop for repair.
		Power supply cable incorrectly connected.	Correct connection.
		Short-circuit to earth in the motor.	Motor must be sent to specialist workshop for repair.
7	Extreme loss of speed under load.	Overload.	Measure power, use larger motor or reduce load, if necessary.
		Voltage drop.	Increase power supply line cross section.
8	Excessive motor temperature rise (measure temperature).	Overload.	Measure power, use larger motor or reduce load, if necessary.
		Insufficient cooling.	Correct cooling air circulation or clear air circulation channels, fit separate fan, if necessary.
		Separate fan not running.	Check connection, correct if necessary.
		Ambient temperature too high.	Reduce power, use larger motor, if necessary
		Delta connection instead of star connection as specified.	Correct connection.
		Temporary two-phase operation.	Intermittent electrical contact in the power supply line.
		Fuse has tripped.	Replace fuse.
		Mains voltage differs from the rated motor voltage by more than 10%. Higher voltages are particularly unfavourable for low-speed motors as their no-load current is close to the rated current even at normal voltage.	Match motor to power supply voltage.
		Duty type (S1 - S10, EN 60034-1) exceeded, e.g. starting frequency too high.	Adapt operating conditions to corresponding motor duty type.
9	Excessive noise.	Friction bearing distorted, dirty or damaged.	Realign motor, inspect friction bearings, replace if necessary.
		Rotating parts vibrating.	Correct any imbalance.
		Foreign bodies in cooling air circuit.	Clean cooling air circuit.
10	Brake does not release.	Incorrect voltage applied to brake control unit.	Apply correct voltage (see rating plate).
		Brake control unit failure.	Change brake control unit, check brake coil (resistance), check switchgear.
		Max. permissible air gap exceeded because the brake lining is worn out.	Adjust the brake (replace the complete brake lining carrier if the lining is worn out).
		Voltage drop in the power supply line > 10 %.	Ensure correct supply voltage is applied.
		Brake coil short-circuit with the winding or housing.	Change complete brake with control unit (specialist workshop), check switchgear.
11	Motor does not brake.	Brake lining worn out.	Replace the complete brake lining carrier.
		Manual brake release device incorrectly adjusted.	Set adjusting nuts to correct setting.
		Manual brake release device locked.	Release lock, remove lever.
		Incorrect brake torque.	Change brake torque.

engineering mannesmann Dematic D-58286 Wetter	**EC conformity declaration** **Demag AC motor type , M** **in accordance with EC directive 89 336 EEC, Appendix I, and 73 23 EEC, Appendix III**	1 page(s)	Page 1
		Ident. no.	**205 211 44**
		Issue 0899	EN

Hereby we,

CE

Mannesmann Dematic AG
Antriebstechnik,

declare that the product

Demag AC motor

of the

, M #

type of serial design, with or without the relevant gearbox, has been declared in conformity with the provisions of the following relevant regulations:

EC EMC Directive	**89 336 EEC**
amended by	**92 31 EEC and 93 68 EEC**
EC Low Voltage Directive	**73 23 EEC**
amended by	**93 68 EEC**

Applied harmonised standards:

EN 50081-2	**Electromagnetic compatibility**
EN 50082-2	**Electromagnetic compatibility**
EN 60034	**Rotating electrical machines**
EN 60034-1	**Rating and performance**
EN 60034-5	**Types of enclosures for rotating electrical machines**
EN 60034-7	**Types of construction and mounting arrangements (IM code)**
EN 60034-8	**Terminal markings and direction of rotation**
EN 60034-9	**Noise limits**
EN 60034-14	**Mechanical vibration measurements, evaluation and limits of vibration severity**
EN 60034-18-1	**Functional assessment of insulation systems**
EN 60529	**Types of enclosure (IP code)**

Wetter, 1 August 1999

Place and date of issue

i.V. Ropelius
Technik und Entwicklung
Motoren

ppa. Weihmann
Vertrieb
Antriebstechnik

# = Modifications compared to previous issue	7550 Normung	Class. no. 715 **IS** 919

Subject to alteration

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Hereby we,

Mannesmann Dematic AG
Antriebstechnik,

declare that the products

Demag helical gearboxes D
angular gearboxes W
offset gearboxes A

of serial design, with or without the serial motors, is intended to be incorporated into machinery and that the machinery must not be put into service until the machinery into which this product is to be incorporated has been declared in conformity with the provisions of the following relevant regulations:

EC Machinery Directive	**98 37 EC**

Applied harmonised standards:

EN 292-1, 292-2	**Safety of Machinery**

Applied standards and technical specifications:

ISO 281 - 1990	**Roller bearings, dynamic load ratings and rated life**

Wetter, 28 anuary 1999

Place and date of issue

ppa. Dr. Schiemann
Produktgruppe
Getriebe und Komponenten

ppa. Peters
Vertrieb
Antriebstechnik

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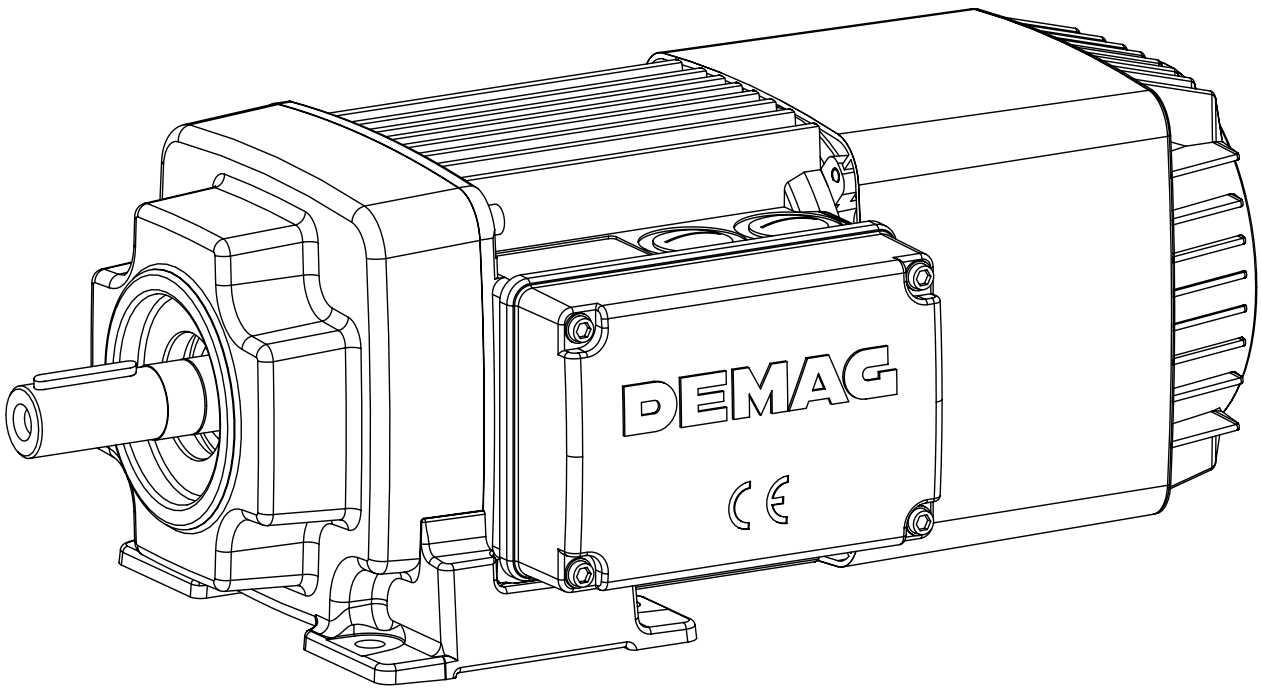
Dematic

Operating instructions

NA – BA – BF motor range



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0 Foreword

You have purchased a Mannesmann Dematic product. This equipment was manufactured in accordance with state-of-the-art engineering principles.

These operating instructions are designed to provide the operator with appropriate instructions for safe and correct operation and to facilitate maintenance.

Every individual given the task of transporting, installing, commissioning, operating, maintaining and repairing our motors and additional equipment must have read and understood

- the operating instructions
- the safety regulations and
- safety instructions in the individual chapters and sections.

The operating instructions must be available to the operating personnel at all times in order to prevent operating errors and to ensure smooth and trouble-free operation of our products.

0.1 Copyright

These operating instructions must be treated confidentially. They should only be used by authorized personnel. They may only be entrusted or made available to third parties with the prior written consent of Mannesmann Dematic. All documents are protected within the sense of copyright law.

No part of this documentation may be reproduced, utilized or transmitted without specific prior consent. Infringements are an offence resulting in obligatory compensatory damages. All industrial rights reserved.

0.2 After-sales service

For technical information on Mannesmann Dematic products and their systematic application, please refer to one of our after-sales service stations, the relevant representative or to our main office in Cleveland, Ohio.

0.3 Guarantee

These operating instructions must be read carefully before installing and putting the product into operation.

We assume no liability for damage and malfunctions resulting from failure to comply with the operating instructions.

Wearing parts are not subject to the guarantee, guarantee claims must be made by quoting the order number to Mannesmann Dematic immediately on detecting the defect.

The guarantee is cancelled, for example, in the event of:

- inappropriate use,
- faulty devices or equipment connected or attached to the product which are not part of our scope of supplies and services,
- use of non-genuine spare parts and accessories,
- refurbishment or modification of the product unless approved in writing by Mannesmann Dematic.

0.4 Liability

All technical information, data and instructions for operation contained in these operating instructions were up-to-date on going to print and are compiled on the basis of our experience and to the best of our knowledge.

We reserve the right to incorporate technical modifications within the scope of further development of the geared motors which are the subject of these operating instructions. Therefore, no claims can be derived from the information, illustrations and descriptions contained in these operating instructions.

The descriptions and illustrations contained in this documentation do not necessarily correspond to the scope of delivery or any subsequent spare part delivery, either; the drawings and illustrations are not to scale. Only documentation belonging to the actual order is valid.

We assume no liability for damage and malfunctions caused as a result of operating errors, noncompliance with these operating instructions or inappropriate repairs and maintenance. We expressly point out that only Mannesmann Dematic spare parts and accessories approved by us may be used. Accordingly, this also applies to other manufacturers' parts used. For safety reasons, the fitting and use of spare parts or accessories which have not been approved and unauthorized modification and conversion of the product are not permitted and exempt Mannesmann Dematic from any liability for damages resulting therefrom.

With the exclusion of any further claims, Mannesmann Dematic is liable for any faults or omissions on our part within the scope of the warranty obligations entered into in the original contract. Claims for damages – except for legal claims resulting from product liability legislation – are excluded, irrespective of the legal reason from which such claims are derived.

0.5 Definitions

Owner

Owners (employer, company) are defined as persons who own the product and who use it appropriately or allow it to be operated by suitable persons.

Operating personnel

Operating personnel are defined as persons assigned by the owner of the product to carry out special tasks such as installation, operation, setting-up, maintenance including cleaning, fault elimination and transportation of the product.

Specialist personnel

Specialist personnel are defined as persons assigned by the owner to carry out specific tasks.

- **ualified personnel**

  Qualified personnel are defined as persons, who, owing to their technical training, knowledge and experience as well as knowledge of the relevant standards, are able to assess the tasks given to them and identify potential hazards.
- **Trained person**

  Trained persons are defined as persons who have been instructed and trained for the tasks assigned to them and on the possible hazards resulting from incorrect handling and who have been informed about the required protective devices, protective measures, relevant regulations, codes of practice, accident prevention regulations and operating conditions and who have proven their qualifications.
- **Experienced technician**

  Experienced technicians are defined as persons, who, owing to their technical training and experience, have sufficient knowledge of the product and are familiar with the relevant national industrial safety regulations, codes of practice, accident prevention regulations, directives and generally accepted engineering standards enabling them to judge the safe operating condition of the motors.

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1 Safety

1.1 Symbols

The following symbols and recommendations indicate potential safety hazards or causes of damage or provide useful information.

a ard warning

This symbol appears in the operating instructions next to all instructions relating to safety at work wherever a potential hazard to life and limb exists if the instructions are not complied with.

Follow these instructions at all times and be particularly careful and cautious.

Pass on safety instructions to all persons entrusted with working on motors including the power supply.

In addition to the safety instructions, observe all general safety regulations and codes of practise at all times.

Warning against electrical ha ards

Contact with live parts can result in immediate death. Protective covers (e.g. covers and enclosures) may only be opened by qualified electricians. Before opening, all relevant operating, control, feed or other voltages must be disconnected.

Operating ha ard for the installation

This symbol in the operating instructions indicates all warnings which, if not complied with, may result in damage to motors.

1.2 Intended use

These motors may be used for all travel, lifting and turning motions in industrial applications. Compliance with the permitted operating conditions must be ensured for operation of these drives (e.g. enclosure type, ambient temperature, installation height).

1.3 Prohibited practises, improper use

Under certain conditions, operation of standard motors is prohibited as this could result in malfunctions, faults in the equipment or hazard to life and limb, e.g.:

- Acidic, corrosive air as coolant
- Operation outside the permitted temperature range
- Operation beyond the normal air pressure. Otherwise, power adjustments are necessary
- Operation under conditions of high humidity or splashwater
- Manipulation of electrical modules

Safety devices must not be rendered inoperable or modified or used in any way other than that for which they have been designed.

1.4 Safety instructions

The relevant national accident prevention regulations and the general safety conditions must always be observed when our products are operated in order to avoid accidents and damage to machinery. If the safety instructions given in these operating instructions are not observed in any way, personal injury or even death can result.

Dangerous voltage

Motors are connected to a mains power supply. Any contact with live parts can lead to very serious injury or even death.

Putting motors into operation

Do this only

- if you have read the operating instructions and the owner has instructed you in all details,
- if the operating instructions are available for reference at the place of operation,
- if you are qualified personnel (electrician),
- if you are **not** under the influence of drugs, alcohol or medication that can adversely affect your ability to react,
- if the general accident prevention, operating and installation regulations have been observed.

Additional safety instructions

Only carry out maintenance and installation work

- if you are qualified personnel (electrician),
- if the motors are at zero voltage,

- if no hazard exists (e.g. crushing hazard, slipping hazard, etc.),
- if the motors are secured against restoration of the power supply,
- if all cables and motor terminals are at zero potential (establish with a voltmeter),
- with insulated tools,
- using genuine spare parts.

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2 Receiving, transport and storage

2.1 Receiving

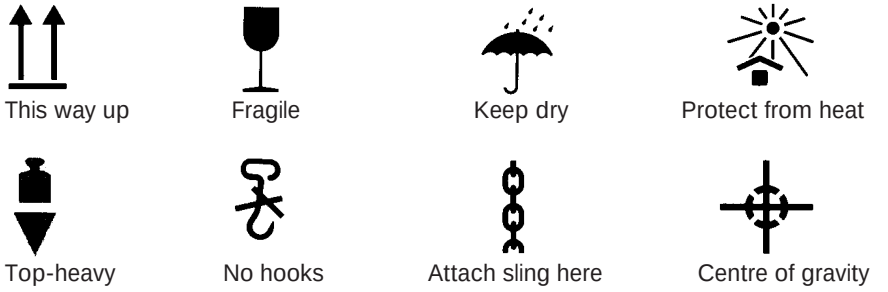
The scope of delivery is specified in the shipping papers. Check the delivery immediately on receipt to ensure that it is complete and examine it for damage caused in transit. If necessary, a damage report must be made out in the presence of the transport contractor's representative as otherwise it will not be possible to rectify the damage at no cost to you.

2.2 Transport

The drive is supplied made up into one unit. Additional equipment may be supplied in separate packaging.

The drive is packed depending on the transport method and its weight. Unless otherwise agreed in the purchase contract, the packaging corresponds to the packaging guidelines of Mannesmann Dematic.

Symbols used on the packing



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Handle motors with utmost care to avoid damage caused by careless loading and unloading, for example.

2.3 Storage

Motors must be stored as follows:

- in dry places with low temperature fluctuations
- in the same position as for operation
- protected against dust and moisture
- on a wooden support
- free from vibration (no impacts)

Drives must not be stacked on top of each other.

Unless otherwise agreed in the purchase contract, standard conservation is guaranteed for a period of 6 months. The guarantee period begins on the day the unit is delivered.

Contact Mannesmann Dematic in Cleveland, Ohio, if the motors are to be stored for periods of longer than 6 months.

Important **Motors may otherwise be damaged.**

3 Product description

3.1 Motor

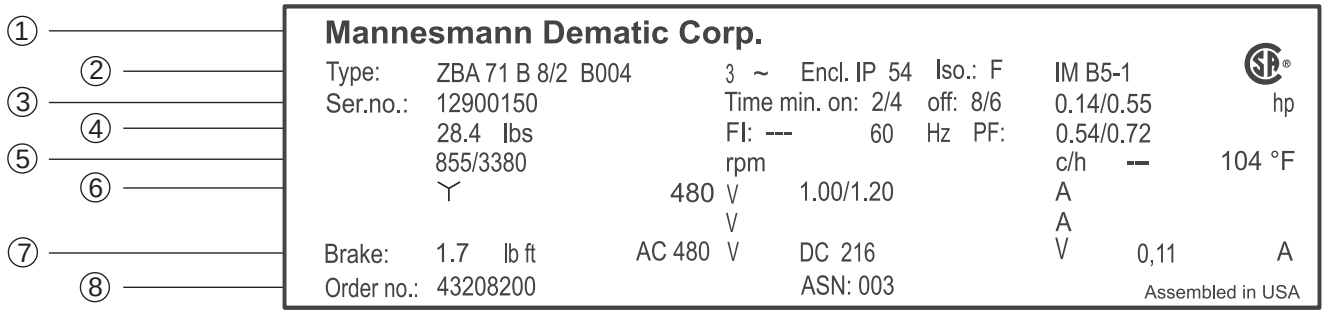
Demag type Z cylindrical rotor motors can be supplied with or without brake (ZB and ZN motors). The ZBA and ZNA motor range includes frame sizes Z..63 to Z..225. The motor range includes pole-changing designs and motors with integrated fly wheels for particularly smooth load movement.

- The housings of motor frame sizes Z..63 to Z..132 are of a high quality aluminium alloy with an integrated terminal box base. The terminal box cover and fan cover are made of plastic.
- Motor frame sizes Z..160 to Z..225 have a grey cast iron housing with a fitted terminal box. The fan cover is made up of sheet metal.

All motors can also be supplied with gearbox or flange and foot design with shafts largely corresponding to IEC shaft dimensions.

Rating plate for .. 63 A to .. 71 B motors with without brake

The rating plate is fitted on the drive-side motor end shield to the right or left of the terminal box, e.g.



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① ——— **Manufacturer**

② ——— **Type designation, number of phases, enclosure, temperature class, model**

③ ——— **Serial number, duty factor, power**

④ ——— **Motor weight, inertia factor, frequency, power factor**

⑤ ——— **Speed, switching frequency, ambient temperature 104°F**

⑥ ——— **Connection, voltage, current**

⑦ ——— **Brake brake torque, supply voltage, coil voltage, coil current**

⑧ ——— **Order number, entry number**

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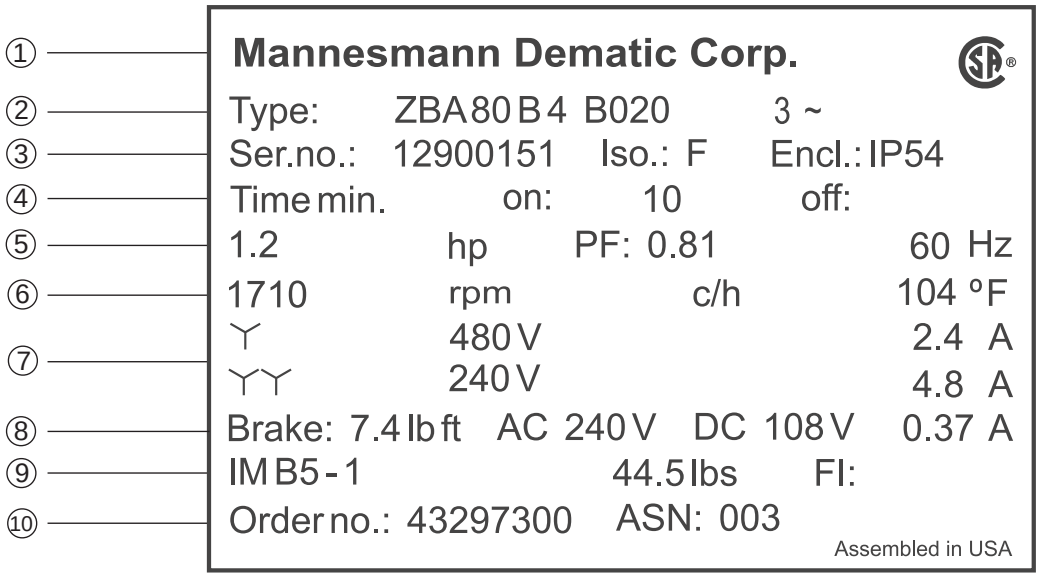
Rating plate for .. 80A to .. 132C motors with without brake

The rating plate is attached to the right or left of the terminal box base, e.g.



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① Manufacturer

② Type designation, no. of phases

③ Serial number, temperature class, enclosure

④ Duty factor

⑤ Power, power factor, frequency

⑥ Speed, switching frequency, ambient temperature 104 F

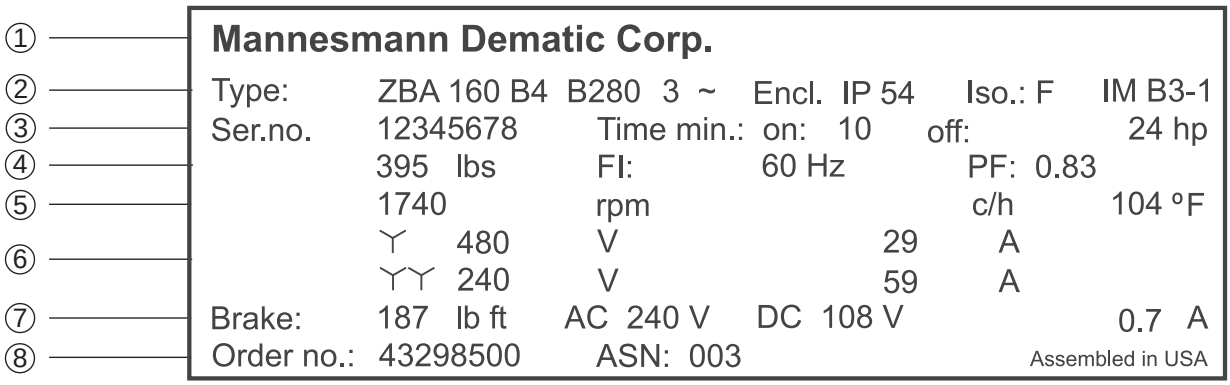
⑦ Connection, voltage, current

⑧ Brake: brake torque, supply voltage, coil voltage, coil current

⑨ Model, motor weight, inertia factor

⑩ Order number, entry number

Rating plate for .. 160 A to .. 225 B motors with wihout brake, e.g.



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① ——— Manufacturer

② ——— Type designation, no. of phases, enclosure, temperature class, model

③ ——— Serial number, duty factor, power

④ ——— Motor weight, inertia factor, frequency, power factor

⑤ ——— Speed, switching frequency, ambient temperature

⑥ ——— Connection, voltage, current

⑦ ——— Brake: brake torque, supply voltage, coil voltage, coil current

⑧ ——— Order number, entry number

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3.2 Brake B.-Motors

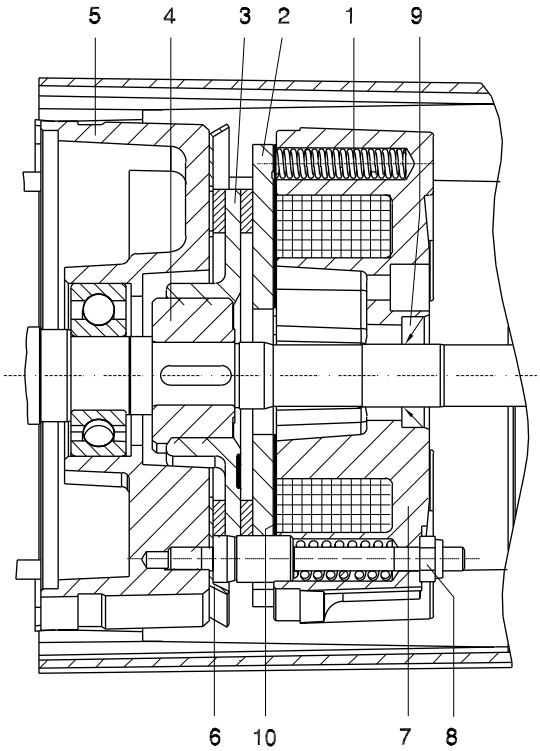
Demag B004 to B680 disk brakes are spring-actuated brakes featuring electromagnetic brake release. The brake fitted under the fan cover can be controlled independently of the motor and causes no axial movement of the rotor shaft or forces on the bearings.

The diagram shows the function elements of the disk brake, which is spring-actuated with electromagnetic release. When the power supply to the brake coil is interrupted, the brake is applied. This operating principle is also known as a fail-safe brake.

Brakes B004 to B680 can be released by a rectifier integrated in the terminal box of the motor or by applying DC voltage direct to the brake coil.

Two brake sizes are available for each motor frame size to cover a large brake torque range for various applications.

B004 – B680 DC brakes



1 Brake spring
2 Pressure plate
3 Brake disk
4 Carrier
5 Motor end cap, brake side
6 Friction plate
7 Electromagnet
8 Ad usting nut
9 Radial shaft sealing ring
10 Stop plate

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4 Installation

4.1 Checking the condition of the motor

Before installing the motor, check whether it has suffered any damage during transportation or while in storage, such as corrosion, leaks, deformation or breakage.

Do not clean drives with compressed air

4.2 Checking the installation site

The standard drive is suitable for operation in normal industrial conditions. If the ambient temperature, atmosphere or humidity are other than indicated on the rating plate, the motors must only be operated with special equipment or features (see rating plate).

Ambient temperature	**from –10 C to 40 C (18 F to 104 F)**
Installation height	**up to 1000 m (3300 ft) above sea level**

The site at which motors are installed must be designed in such a way that

- air may circulate to allow heat to be exchanged and that warm air is not inducted again immediately,
- no residue from operating processes can accumulate on the motor, fall between the drive elements or damage the sealing ring,
- the rating plate is accessible.

4.3 Motor mounting position

Before installing the motor, check that it will be operated in the mounting position specified on the rating plate.

4.4 Special instructions for installing the motor

If the motor is operated outdoors in vertical mounting position IM V1 or in an inclined mounting position with the shaft facing downwards, it should be protected by a canopy provided by the customer.

For motors with condensation water openings which can be closed with a threaded plug, the drain holes must be arranged at the lowest point of the motor as otherwise water may enter. If the mounting position of the motor is changed and the drain holes are no longer required, the openings must be closed.

4.5 Requirements for connecting the motor

- You must be a trained electrician and familiar with the relevant accident prevention regulations and codes of practise.
- The motor and connecting cable must be disconnected from the supply.
- The frequency and voltage specified on the rating plate must correspond to the line frequency and voltage.

The motor must be connected as described in section 7 **Motor brake connection diagrams** .

To change the direction of rotation of the motor, two of the three phase conductors must be interchanged.

The instructions contained in section 5 Commissioning must be followed

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5 Commissioning

5.1 Requirements

Before the drive unit is put into service:

- the terminal box be must be closed,
- the fan cover must be fitted,
- the line voltage and frequency specified on the rating plate must match the given power supply,
- the motor must be checked for correct connection (check direction of rotation),
- heat must be able to dissipate (e.g. air vent slits must be free),
- it must be ensured that the drive unit does not constitute a hazard (e.g. no hazards caused by rotating or live parts),
- it must be ensured that there are no other hazard sources.

5.2 Check when commissioning

Check that:

- the motor runs correctly (e.g. no speed fluctuations or excessive noise),
- there is no extreme vibration.

6 Maintenance

6.1 Checking before and during operation

If defects or damage are detected, the motor must not be put into operation or taken out of service. It may only be put back into service when the defect has been eliminated.

Check the motor for

Check		Action
• External damage	→	Inform person responsible
• Unusual noises during operation	→	Inform person responsible
• Dirt accumulation	→	Remove dirt

6.2 Maintenance schedule

Maintenance schedule

Interval	Part	Maintenance	See section
In accordance with the operating conditions, at least every 3000 hours of operation.	Brake	Check brake of motors fitted with brake	6.3 or 6.4
Every 10 000 hours of operation.	Motor	Inspect the motor and clean the cooling air channels	

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6.3 B004-B680 brakes

The following work may only be carried out by qualified personnel.
Observe relevant safety regulations and codes of practise and the instructions contained in section 1.4 “Safety instructions”.

6.3.1 Measuring the brake displacement

Apart from wear, the brake is virtually maintenance-free. The organic/mineral brake lining is designed in such a way that worn surface particles are only given off as minimal abrasion. This built-in regeneration of the brake lining surface ensures constant braking characteristics. It is advisable to check the brake air gap at certain intervals and to adjust it as necessary to ensure the brake releases reliably. When the brake is released (power applied to brake coil), the brake disk can be freely turned.

Guide values for the air gap and bbraking work until adjustment are contained in the “Brake settings” tables in section 6.4.

Note: It is only possible to give guide values for braking work until adjustment as they depend on the given operating conditions.

When the brake has been adjusted several times, the remaining thickness b_{min} of the brake disk must be checked. The guide pins feature an easily visible marking which clearly indicates the minimum dimension. The brake rotor must be replaced when this mark is exceeded. For this purpose, a maintenance and spare part set is available which not only contains the brake rotor, but also the required small parts and installation instructions.

6.3.2 Ad usting the brake air gap

The air gap must be adjusted when the max. permissible value given in the “Brake settings” tables in section 6.4 has been reached, (however, immediately if the brake no longer releases).

The time to adjust the brake can be determined using the “Adjustment monitoring” option, estimated from the work done by the brake according to the “Brake settings” tables in section 6.4, or established by regular inspections.

If the brake is not ad usted, it will no longer release after further wear. If the motor then operates against the applied brake, the brake and motor may be damaged and fail.

Condition: Brake and fan cover fully fitted

Tools required:
- Open wrench, feeler gauges, pliers for retaining rings
- Long hexagon socket key

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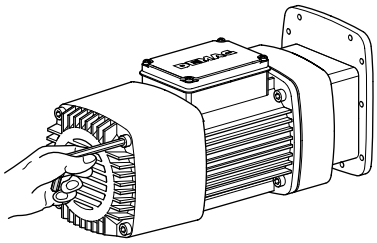

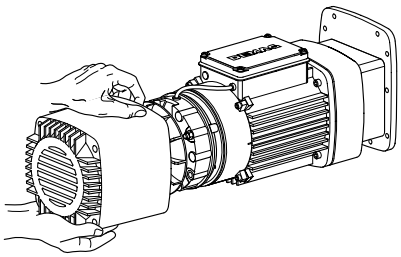

Undo the four screws and remove the fan cover.

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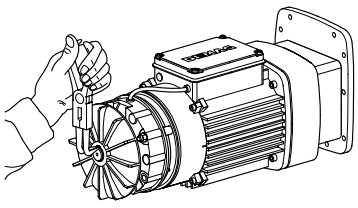

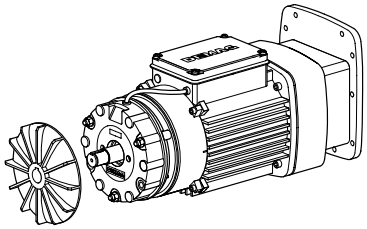

If the adjusting nuts are not accessible, remove the fan.
[For “Sealing arrangement” option, remove the covering tape.]
Remove or suck the loose brake abrasion from the inside of the brake enclosure.
Beware of the dust if the abrasion is blown out of the enclosure.

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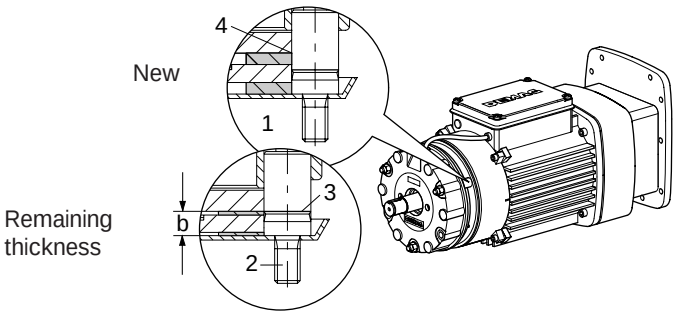

Check the remaining thickness of the brake disk with friction linings (1). The guide pins (2) feature a mark (3) which the armature disk edge (4) must not cover. If the armature disk edge (4) has reached the mark (3), the brake disk (1) must be replaced.

(For instructions refer to section 6.3.3 “Replacing the brake disk”.)

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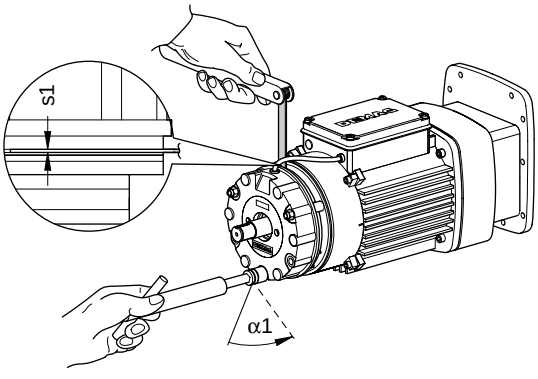

If the remaining thickness of the brake disk (1) is sufficient, adjust the brake as follows:
Tighten the three self-locking nuts uniformly until the air gap is zero. Loosen the nuts by angle α_1 given in the “Brake settings” tables in section 6.4 to set the air gap to s_{1min}.
Check air gap s_1 using a feeler gauge at three points around the circumference (adjust again if necessary).
Note The rotor shaft must be able to turn freely when the brake is released.
Check the brake for correct functioning.

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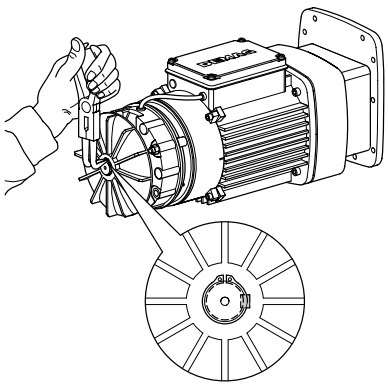

[For “Sealing arrangement” option, replace the covering tape.]
If the fan has been removed: fit the fan and, if applicable, the key.
Secure the fan with the retaining ring. Ensure the retaining ring clicks correctly into place (see diagram).

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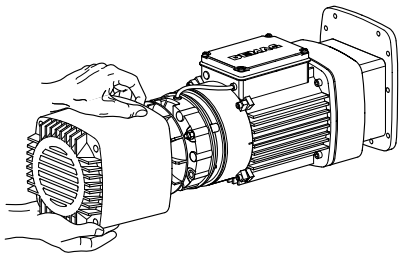

Align the fan cover as appropriate for the model.
Secure the fan cover with the four screws.

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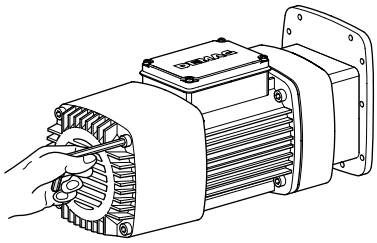

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6.3.3 Replacing the brake disk

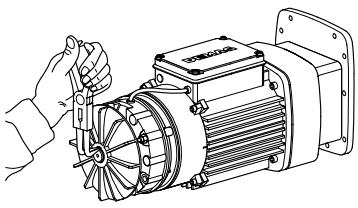
Note: **Damaged brakes may only be repaired by a Mannesmann Dematic authorised workshop.**

To ensure reliable functioning of the brake, the lining must be of a thickness defined as the minimum remaining thickness in the “Brake settings” tables in section 6.4.

The brake disk is a wearing part and must therefore be **replaced** on reaching its minimum thickness. The friction plate and armature disk must be checked and replaced, if necessary.

Condition: Fan cover and covering tape (IP 55) removed (see section 6.3.2 “Adjusting the brake air gap”).

Tools required:
- Open wrench, feeler gauges, pliers for retaining rings to DIN 5254
- Long hexagon socket key



Remove the retaining ring and fan.

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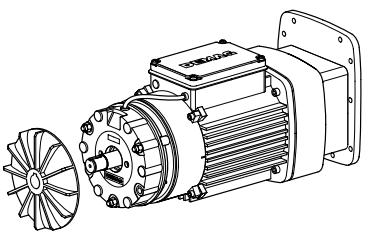

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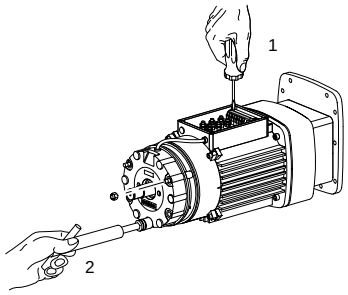

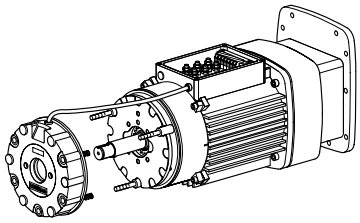

Disconnect the cable for brake coil and microswitch (1), if applicable. Pull the cable out of the terminal box far enough to do the following.

Undo the three self-locking nuts (2) used for adjustment (pay attention to tension of brake and distance springs). The collared pins must not be unscrewed, tighten them to the tightening torque specified in section 6.4 if necessary.

Carefully pull the magnet assembly off the three collared pins and the motor shaft.

For vertical mounting arrangement (brake at the top): fix the brake springs and, if applicable, the plunger (microswitch option) in place with strips of adhesive tape or a rubber band.

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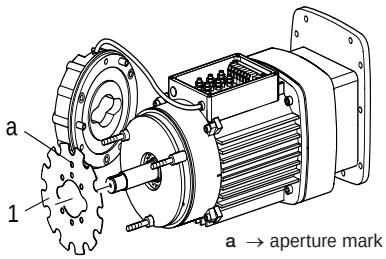
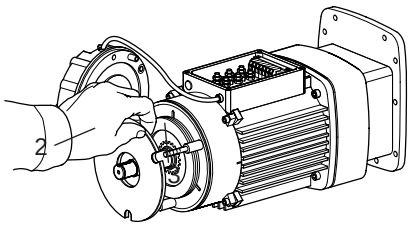




Remove stop plate (1). Pay attention to the distance springs, these can remain on the collared pins. (Replace the brake springs when changing the brake disk.)

Remove armature disk (2) (both disks for the “Reduced noise level” and “Manual brake release” options) and brake disk (3).

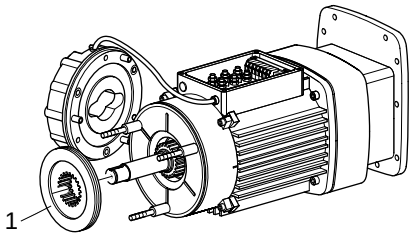
Remove or suck the loose brake abrasion from the inside of the brake enclosure. **Beware of the dust if the abrasion is blown out of the enclosure.**

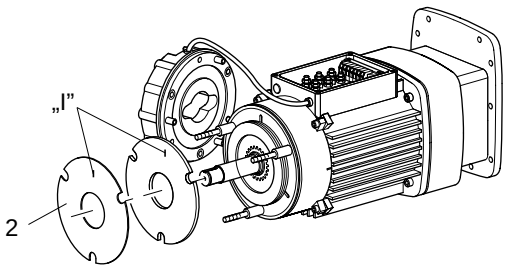
Check the armature disk and the friction plate for damage, excessive scoring or similar, also check the friction plate for deformation and the collared pins for extreme differences in diameter.

Replace worn or damaged parts.

When fitting new collared pins, ensure that the outside diameter is not damaged (use a counter-nut). Also pay attention to the tightening torques given in the tables in section 6.4.

41432544.eps 41432844.eps





Place brake disk (1) centrally on the carrier. Pay attention to correct alignment and do not use force. Keep the friction surfaces clean (no grease on the friction surfaces) as the initial friction coefficient will otherwise be changed.

Align armature disk (2) (the thicker disk first for the **Reduced noise level** and **Manual brake release** options) with marker **I** facing the terminal box and then fit the armature disk on the collared pins.

(The motor end shield must first be fitted with the marker in the right position)

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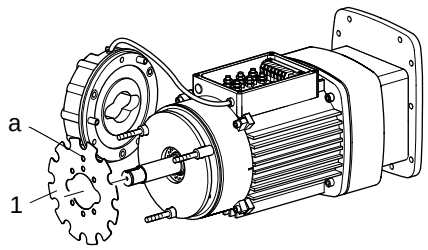

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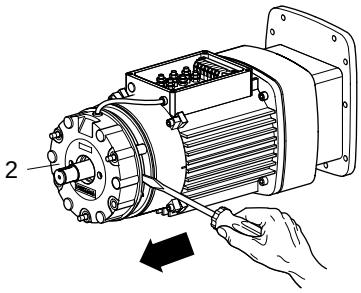
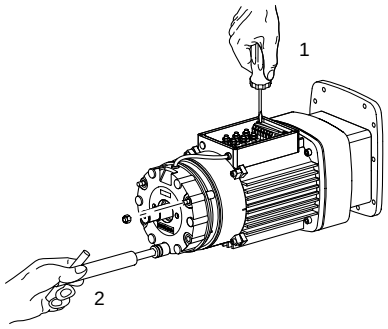


41433144.eps

Align stop plate (1) and place it on the collared pins in such a way that aperture mark **a** is facing towards the marker on the end shield. Place the three distance springs on the threaded ends of the collared pins. Fit brake springs symmetrically into the magnet as before or as specified in the “Brake settings” tables in section 6.4. For the vertical mounting arrangement with the brake at the top, prevent the springs from falling out using rubber bands or similar (rubber band grips the outside of the brake springs). Align magnet (2) (with the opening for the operating lever facing towards the marker on the end shield for the Manual brake release option) and push it into place. Fit the self-locking nuts on the collared pins. Ensure the stop plate is guided by the three collared pins and does not get caught in the distance springs before the collared pins engage the magnet.



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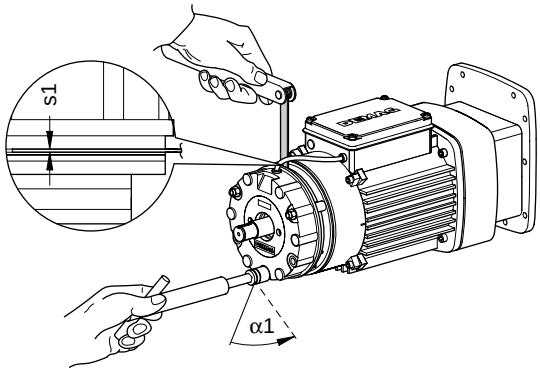
Pull the cable back into the terminal box.

Pull the cable back into the terminal box. Connect the cable for the brake coil and, if applicable, microswitch (1).



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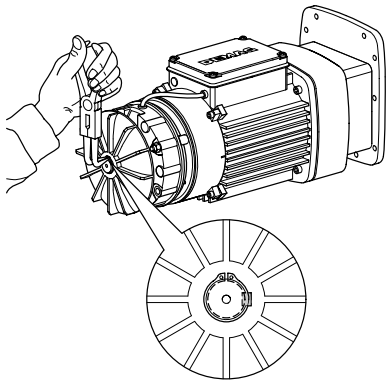
Adjust the brake as follows:

Tighten the three self-locking nuts uniformly until the air gap is zero. Loosen the nuts by angle α_1 given in the “Brake settings” tables in section 6.4 to set the air gap to s_{1min}.

Check air gap s_1 using a feeler gauge at three points around the circumference (adjust again if necessary).

Note The rotor shaft must be able to turn freely when the brake is released.

Check the brake for correct functioning after reconnecting the brake coil.



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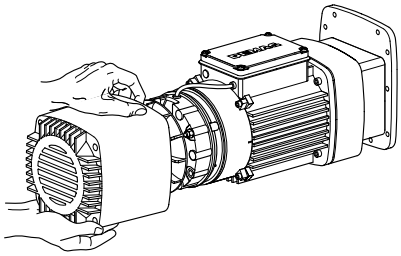
For “Sealing arrangement” option, replace the covering tape.

Fit the fan and, if applicable, the key.

Secure the fan with the retaining ring. Ensure the retaining ring clicks correctly into place (see diagram).



Align the fan cover as appropriate for the model.

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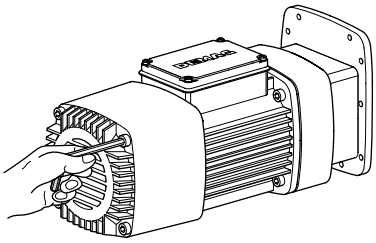

Secure the fan cover with the four screws.

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6.4 Brake settings tables

6.4.1 For BA motors

Brake size				B004	B007	B020	B050	B140	B280	B680
Quantity of springs [1]				Brake torque M_B in Nm (lb ft)						
white	red	blue								
6	0	0		–	7.6 (5.60)	20 (15)	50 (37)	140 (105)	280 (210)	680 (500)
4	2	0		–	5.9 (4.40)	16 (12)	39 (29)	109 (80)	218 (160)	529 (390)
3	3	0		–	5.1 (3.80)	13 (9.60)	33 (24)	94 (69)	187 (140)	454 (330)
3	0	0		–	3.8 (2.80)	10 (7.40)	25 (18.5)	70 (52)	140 (105)	340 (250)
2	2	0		–	3.4 (2.50)	9.0 (6.60)	22 (16.0)	62 (46)	124 (91)	302 (220)
0	6	0		–	2.5 (1.85)	6.6 (4.90)	17 (12.50)	47 (35)	93 (69)	226 (165)
0	4	0		1.7 (1.25)	1.7 (1.25)	4.4 (3.20)	11 (8.10)	31 (23)	62 (46)	151 (110)
0	3	0		1.3 (0.95)	1.3 (0.95)	3.3 (2.40)	8,3 (6.10)	23 (17)	46 (34)	113 (83)
0	4	2		2.3 (1.70)	–	–	–	–	–	–
0	0	6		1.8 (1.35)	–	–	–	–	–	–
0	0	4		1.2 (0.90)	–	–	–	–	–	–
0	0	3		0.9 (0.65)	–	–	–	–	–	–
Minimum brake air gap			s_{1min} in mm (in)	0.3 (0.0118)	0.3 (0.0118)	0.3 (0.0118))	0.3 (0.0118)	0.35 (0.0138)	0.4 (0.0157)	0.4 (0.0157)
Maximum brake air gap			s_{1max} in mm (in)	0.65 (0.0256)	0.65 (0.0256	0.65 (0.0256)	0.65 (0.0256)	1.3 (0.0512)	1.3 (0.0512)	1.3 (0.0512)
Air gap adjusting angle			α_1 in °	120	120	120	90	80	70	60
Manual release axial play			s_2 in mm (in)	1.5 (0.0591)	1.5 (0.0591)	1.5 (0.0591)	1.5 (0.0591)	2 (0.0787)	2 (0.0787)	2 (0.0787)
Manual release adjusting angle			α_2 in °	20	20	20	20	20	20	20
Brake disk remaining thickness			b_{min} in mm (in)	5 (0.197)	5 (0.197)	6 (0.236)	7 (0.276)	8.5 (0.335)	10 (0.394)	11 (0.433)
Braking work until re-adjustment			W_N in Ws	$100 \cdot 10^6$	$100 \cdot 10^6$	$120 \cdot 10^6$	$200 \cdot 10^6$	$1000 \cdot 10^6$	$1500 \cdot 10^6$	$2500 \cdot 10^6$
Collared pin pre-tension torques			in Nm (lb ft)	2,3 (1.7)	2.3 (1.7)	4.0 (2.95)	9.0 (6.64)	30 (22.1)	70 (51.7)	140 (103)

[1] Only applies for brakes without brake release device

6.4.2 For BF motors

Brake size				B004	B020	B050	B140
Quantity of springs [1]				Brake torque M_B in Nm (lb ft)			
white	red	blue					
–	4	2		2.3 (1.70)	5.5 (4.10)	13.2 (9.60)	37.3 (27)
–	4	0		1.7 (1.25)	4.4 (3.20)	11 (8.10)	31 (23)
–	3	0		1.3 (0.95)	3.3 (2.40)	8.3 (6.10)	23 (17)
–	0	6		1.8 (1.35)	3.3 (2.40)	6.3 (4.60)	18 (13.5)
–	0	4		1.2 (0.90)	2.2 (1.60)	4.2 (3.1)	12 (8.90)
–	0	3		0.9 (0.65)	1.7 (1.25)	3.2 (2.40)	8.8 (6.50)
Minimum brake air gap			s_{1min} in mm (in)	0.35 (0.0138)	0.35 (0.0138)	0.35 (0.0138)	0.35 (0.0138)
Maximum brake air gap			s_{1max} in mm (in)	1.2 (0.0472)	1.2 (0.0472)	1.2 (0.0472)	1.2 (0.0472)
Air gap adjusting angle			α_1 in °	120	120	90	80
Manual release axial play			s_2 in mm (in)	1.5 (0.0591)	1.5 (0.0591)	1.5 (0.0591)	2 (0.0787)
Manual release adjusting angle			α_2 in °	20	20	20	20
Brake disk remaining thickness			b_{min} in mm (in)	5 (0.197)	6 (0.236)	7 (0.276)	8,5 (0.335)
Braking work until re-adjustment			W_N in Ws	$200 \cdot 10^6$	$300 \cdot 10^6$	$500 \cdot 10^6$	$900 \cdot 10^6$
Collared pin pre-tension torques			in Nm (lb ft)	2.3 (1.70)	4.0 (2.95)	9.0 (6.64)	30 (22.1)

[1] Only applies for brakes without brake release device

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6.5 Tightening torques

The bolts on Demag Z.. range motors must be tightened with the torques given in the table below. This also applies when high tensile bolts are used.

Bolt tightening torques

For hexagon socket bolts to DIN 912 and to DIN 6912 for IM B 14 flange mounting

Bolt si e	M 5	M 6	M 8	M 10	M 12	M 16
Tightening torque	6.2 Nm (4.58 lb ft)	10.5 Nm (7.75 lb ft)	25 Nm (18.5 lb ft)	50 Nm (36.9 lb ft)	86 Nm (63.5 lb ft)	215 Nm (159 lb ft)

For VERBUS RIPP self-locking bolts for IM B 3 foot mounting
IM B 5 flange mounting

Bolt si e	M 5	M 6	M 8	M 10	M 12	M 16
Tightening torque for cast iron	7.5 Nm (5.54 lb ft)	14 Nm (10.3 lb ft)	30 Nm (22.1 lb ft)	65 Nm (48.0 lb ft)	100 Nm (73.8 lb ft)	270 Nm (199 lb ft)
Tightening torque for cast aluminum	9 Nm (6.64 lb ft)	18 Nm (13.3 lb ft)	45 Nm (33.2 lb ft)	75 Nm (55.4 lb ft)	–	–

7 Motor brake connecting diagrams

7.1 Brake control

Various control modules are available which are fitted in the brake motor terminal box as standard for controlling Demag B004 to B680 disk brakes with DC magnets. Brakes up to size

- B050 for ZBA motors
- B140 for ZBF motors

featuring **24 V DC coil voltage** can be supplied and controlled by the installation control system.

All rectifiers feature varistor protection against overvoltage at the AC input and on the switching contact terminal as standard. GE, GS and GP brake rectifiers can be used for voltages from 42 V AC to 500 V AC.

GE, GS and GP brake rectifiers can be fed separately with alternating current or connected parallel to the motor winding. AC or DC brake control is possible with all brake rectifiers depending on the connection.

The control system is of modular design. SE or VE modules for fast DC interruption of the brake current can be added to brake motors fitted with GE, GS or GP brake rectifiers, also at a later date, without the need for additional cables and switching devices.

Operation with frequency inverters

If B cylindrical rotor brake motors are operated together with inverters, the brake must be provided with a separate power supply and control.

Brake application times are highly dependent on the way in which the brake is connected.

Supply and brake voltage

U_{line} [AC]	U_{brake} [DC]
240 V and 240/480 V	108 V
480 V	216 V
330/575 V	150 V

Direct DC current supply to brake coil with 24V DC

Direct supply with 24V DC is possible for

- ZBA-motors up to brake size B050
- ZBF-motors up to brake size B140.

A brake control module is not necessary. The brake coil is protected with varistor against overvoltage.

Brake control modules

- **GE brake rectifier (normal excitation)**

  GE half-wave brake rectifiers are used for single-speed motors as standard, and for pole-changing motors featuring separate power supply for brake size
  - B050 for ZBA motors
  - B140 for ZBF motors.

  They mainly consist of a half-wave rectifier with integrated free-wheeling circuit.

Important **When used with a pole-changing motor, the GE module must be provided with a separate power supply or in USA according to diagram 037 980 84 (see section 7.7).**

Note When SE or VE units are used, no additional cables are necessary.

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GS brake rectifier (high-speed excitation)

GS brake rectifiers are used for motors with brakes as of size B140 as standard. They can be used for single-speed motors as well as for pole-changing motors with a separate power supply. These rectifiers are used to temporally overexcited the brake to relaease it and then to supply it with the appropriate holding voltage.

GS brake rectifiers can be used as an option for brake sizes B004 to B050. This makes it possible to achieve shorter brake release times and higher motor starting frequencies.

Up to brake size B050, two leads are sufficient for control (over-excitation factor of 2), from brake size B140, on three leads are required (over-excitation factor of 2,5).

GS modules include a reversible rectifier which overexcites the brake for approx. 0,3 seconds to release it and then supplies it with the appropriate holding voltage from a half-wave rectifier.

Important **When used with a pole-changing motor, the GS module must be provided with a separate power supply or according to diagrams 037 981 84 and 038 025 84 (see section 7.7).**

Note When SE or VE units are used, no additional cables are necessary.

GP brake rectifiers (normal excitation for pole-changing motors)

GP brake rectifiers can be used as an option for simple control with pole-changing motors together with switch-off in the DC circuit. In contrast to GE rectifiers, no further supply line is required for voltage control.

The motor and brake control module are connected to the same power supply.

Note When SE or VE units are used, no additional cables are necessary.

SE current relays (motor current-dependent high-speed trip relay)

SE current relays can be combined with GE, GS and GP brake rectifiers. They are used for rapid demagnetization of the brake to achieve fast brake application times without the need for additional wiring for brake switch-off in the DC circuit. SE current relays are connected to one motor current phase. When the motor is switched off, the relay demagnetizes the brake by opeining the contact in the DC circuit.

When SE units are used, no additional cables are necessary to interrupt the power supply for the brake.

Important **SE modules must not be used together with inverters. We recommend the use of VE voltage relays for these applications.**

SE current relays can be used for rated motor currents up to 50 A.

VE voltage relays (voltage-dependent high-speed trip relay)

VE voltage relays can be combined with GE, GS and GP brake rectifiers. In contrast to SE current relays, **VE voltage relays must only be used for brakes with a separate power supply**. These modules may preferably be used for inverter-fed motors. They are used for high-speed demagnetization of the brake to achieve fast brake application times without the need for additional wiring for brake switch-off in the DC circuit. VE voltage relays are connected to the brake power supply. The contact in the DC circuit is opened when the brake is switched off.

Brake control module technical data

Module	Ident. no.	Voltage range in V [1]	Max. continous brake direct current A	Remarks	
GE	260 892 84	110 ... 500	1,5		
	260 890 84	42 ... 500	3		
GP	260 893 84	110 ... 500	1,5		
	260 891 84	42 ... 500	3		
GS	260 894 84	110 ... 500	1,5	[2] Over-exitation factor: 2 oder 2,5	
VE	260 897 84	42 ... 500	2		
SE				[3] Control current range (Single phase motor current)	Motor si es motors
	260 864 84	42 ... 500	2	0,25 ... 4 A	63 – 71
	260 870 84			0,8 ... 16 A	80 – 100
	260 896 84			1,2 ... 50 A	112 – 225

[1] Sinusoidal Voltages

[2] •2 leads → Over-exitation factor of 2
•3 leads → Over-exitation factor of 2.5 (required for ZBA-motor with brake size B140 and larger).

[3] Standard: → Motor rated current is less than or equal to the higher value for the SE current relay in **Control current range**".

Note If the motor rated current is greater than the higher value for the SE current relay in **Control current range** :
→ **use next largest SE module.**

Brake control module operating range

GE, GP, GS brake rectifiers

Brake voltage		Brake si e						
U AC V	U DC V	B004	B007	B020	B050	B140	B280	B680
42 – 109	19 – 49	GE 3 A GP 3 A						
110 – 500	50 – 225	GE 1,5 A GP 1,5 A GS 1,5 A				GS 1,5 A		
200 – 500	90 – 225							GS 1,5 A

U AC = Brake control module input voltage
U DC = Brake control module output voltage → brake supply voltage

SE current relay, VE voltage relay

Brake si e							
B004	B007	B020	B050		B140	B280	B680
Brake voltage			Brake voltage		Brake voltage		
U AC V	U DC V		U AC V	U DC V	U AC V	U DC V	
42 - 500	19 - 225		53 - 500	24 - 225	110 - 500	50 - 225	
SE 2A VE 2A							

U AC = Brake control module input voltage
U DC = Brake control module output voltage → brake supply voltage

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Bremsen-Auswahltabelle

Standard-Bremsmoment BA	Standard-Bremsmoment BF	Bremse	Versorgungs-Spannung [V AC]	ugeordnete Standardbausteine BA: eintourig oder polumschaltbar	BA: Bestell-Nr.	BF: eintourig	BF: Bestell-Nr.	BF: polumschaltbar	BF: Bestell-Nr	Bemerkung
≤ 2,3 Nm	≤ 2,3 Nm	B004	42 - 109	GE [3 A]	260 890 84	GE [3 A] + SE 1)	260 890 84	GP [3 A] + SE 1)	260 891 84	Die Versorgung über eine separate Gleichspannungsquelle ist ohne Einschränkung möglich. Spannungsbereich: **19 - 225 V DC**
			110 - 500	GE [1,5 A]	260 892 84	GE [1,5 A] + SE 1)	260 892 84	GP [1,5 A] + SE 1)	260 893 84	
≤ 7,6 Nm	–	B007	42 - 109	GE [3 A]	260 890 84	GE [3 A] + SE 1)	260 890 84	GP [3 A] + SE 1)	260 891 84	
			110 - 500	GE [1,5 A]	260 892 84	GE [1,5 A] + SE 1)	260 892 84	GP [1,5 A] + SE 1)	260 893 84	
≤ 20 Nm	≤ 5,5 Nm	B020	42 - 109	GE [3 A]	260 890 84	GE [3 A] + SE 1)	260 890 84	GP [3 A] + SE 1)	260 891 84	
			110 - 500	GE [1,5 A]	260 892 84	GE [1,5 A] + SE 1)	260 892 84	GP [1,5 A] + SE 1)	260 893 84	
≤ 50 Nm	≤ 13,2 Nm	B050	42 - 109	GE [3 A]	260 890 84	GE [3 A] + SE 1)	260 890 84	GP [3 A] + SE 1)	260 891 84	
			110 - 500	GE [1,5 A]	260 892 84	GE [1,5 A] + SE 1)	260 892 84	GP [1,5 A] + SE 1)	260 893 84	
≤ 140 Nm	≤ 37,3 Nm	B140	42 - 109	–	–	GE [3 A] + SE 1)	260 890 84	GP [3 A] + SE 1)	260 891 84	Die Versorgung über eine separate Gleichspannungsquelle ist **nicht** möglich. Ausnahme: Bremse B140 mit Bremsmoment ≤ 37,3 Nm Spannungsbereich: **19 - 225 V DC**
			110 - 500	GS	260 894 84	GE [1,5 A] + SE 1)	260 892 84	GP [1,5 A] + SE 1)	260 893 84	
≤ 280 Nm	–	B280	42 - 109	–	–	–	–	–	–	
			110 - 500	GS	260 894 84	–	–	–	–	
≤ 680 Nm	–	B680	42 - 109	–	–	–	–	–	–	
			200 - 500	GS	260 894 84	–	–	–	–	

1) Die SE-Bausteine werden entsprechend dem Motor-Bemessungsstrom wie folgt zugeordnet:

Motor-Bemessungsstrom	Baustein	Bestell-Nr
≤ **4 A**	SE	260 864 84
≤ **16 A**		260 870 84
≤ **50 A**		260 896 84

7.2 Brake operating times

Brake application times are highly dependent on the way in which the brake is connected.

- **Direct current connection**

  The coil circuit is interrupted when the brake module contact opens at the relevant terminal. The magnetic field rapidly decreases and the brake torque rapidly rises. Mannesmann Dematic rectifiers are protected against overvoltage at the switching contact by varistors.

  Interruption of the DC circuit between the module and the coil connections is not permitted.

- **Connection in the AC circuit**

  When the brake voltage is switched off, i.e. on the supply side before the rectifier, an inductive coil current continues to flow through the rectifier diodes for a short time. The magnet field decreases more slowly. The braking operation begins more smoothly.

  This connection type is not suitable for hoist drives.

- **Connection in the motor circuit**

  The rectifier is connected directly to the motor terminals. When the motor is switched off, the residual motor voltage results in significantly longer switch-off times compared to switch-off in the AC circuit.

  Unless provided with switch-off in the DC circuit using a contact or the SE current relay, this type of connection is not suitable for drives with overhauling loads, e.g. hoists, and may not be used in these applications.

Depending on the type of connection, the release and braking operation of B004 to B680 DC brakes can generally be characterized by the following values:

- t_{11} Brake release time with normal excitation (GE, GP) [1)]
- t_{12} Brake release time with high-speed excitation (GS) [1)]
- t_{21} Brake application time for switch-off in the AC circuit
- t_{22} Brake application time for switch-off in the DC circuit (contact)
- t_{23} Brake application time for switch-off in the DC circuit (SE, VE)

1) Definition: **Release time is the time it takes to reach the full acceleration torgue of the motor.**

Brake release times may be reduced using high-speed excitation modules with which a higher voltage is temporarily applied to the brake coil when the brake is turned on and the magnetic field is built up more quickly.

7.2.1 BA range brake operating times

Table 9

Si e	Release times in ms		Application times in ms		
	t_{11}	t_{12}	t_{21}	t_{22}	t_{23}
B004	60	35	250	55	85
B007	120	60	90	30	60
B020	130	90	40	20	30
B050	120	100	90	30	80
B140	–	110	60	30	60
B280	–	140	300	90	160
B680	–	140	300	150	225

The brake release and application times given are guide values for the maximum brake torque. In the case of lower brake torques, these values may change, particularly t_{21} for switch-off in the AC circuit.

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7.2.2 BF range brake operating times

Table 10	Si e	Release times in ms		Application times in ms		
		t_{11}	t_{12}	t_{21}	t_{22}	t_{23}
	B004	60	40	200	30	40
	B020	60	40	300	50	60
	B050	80	65	300	60	70
	B140	110	90	350	100	100

The brake release and application times given are guide values for the maximum brake torque (see table 10). In the case of lower brake torques, these values may change, particularly t_{21} for switch-off in the AC circuit.

7.3 Selection criteria

The following criteria must be considered when selecting the connection diagram:

- **Motor for use in USA or Canada**
- **Motor for inverter operation if applicable**
- **Brake motor or motor without brake**
- **Motor to be operated with**
  - one line voltage, e.g. 240, 480, 575 V, 60 Hz or
  - two line voltages,e.g. - USA: YY/Y 240/480 V, 60 Hz
    - Canada: Δ/Y 330/575 V, 60 Hz.
- **Motor designed for one or two speeds**
- **Common or separate power supply to motor and brake**
- **Control module selected**
  - GE for normal excitation
  - GS for high-speed excitation
  - GP for normal excitation for pole-changing motors
- **Switch-off**
  - in the DC circuit for short operating times (e.g. hoist drives, positioning drives
  - in the AC circuit for medium operating times (e.g. travel drives, conveyor belts)
  - in the motor circuit for stopping the motor in an uncritical time.

Refer to the following flow charts.

Notes

- The motor and brake of inverter-fed drives must have **separate** power supplies.
- **SE modules** must **not** be used with inverter-fed drives.
- **GE**, **GS** or **GP application** for a maximum voltage of **500 V**.
- **Connection diagrams**
  - Connection diagram selection (flow chart) for line-fed drives in USA and related tables → section 7.4.
  - Connection diagram selection (flow chart) for line-fed drives in Canada and related tables → section 7.5.
  - Connection diagram selection (flow chart) for inverter-fed drives and related tables → section 7.6.
  - Connection diagrams→ section 7.7.
    Diagrams shown in numerical order according to ident. no.
  - Connection diagrams arranged in the motor terminal box.
- **Condition when supplied for inverter operation**
  When motors are supplied for **INVERTER OPERATION**, **GE** or **GS** brake control modules are **NOT** connected with the motor winding as shown in the individual connection diagrams which document the motor connection on delivery.
  The brake control module must be provided with a **separate AC power supply**.

7.4 Connecting diagram selection for USA 240 480 V 60

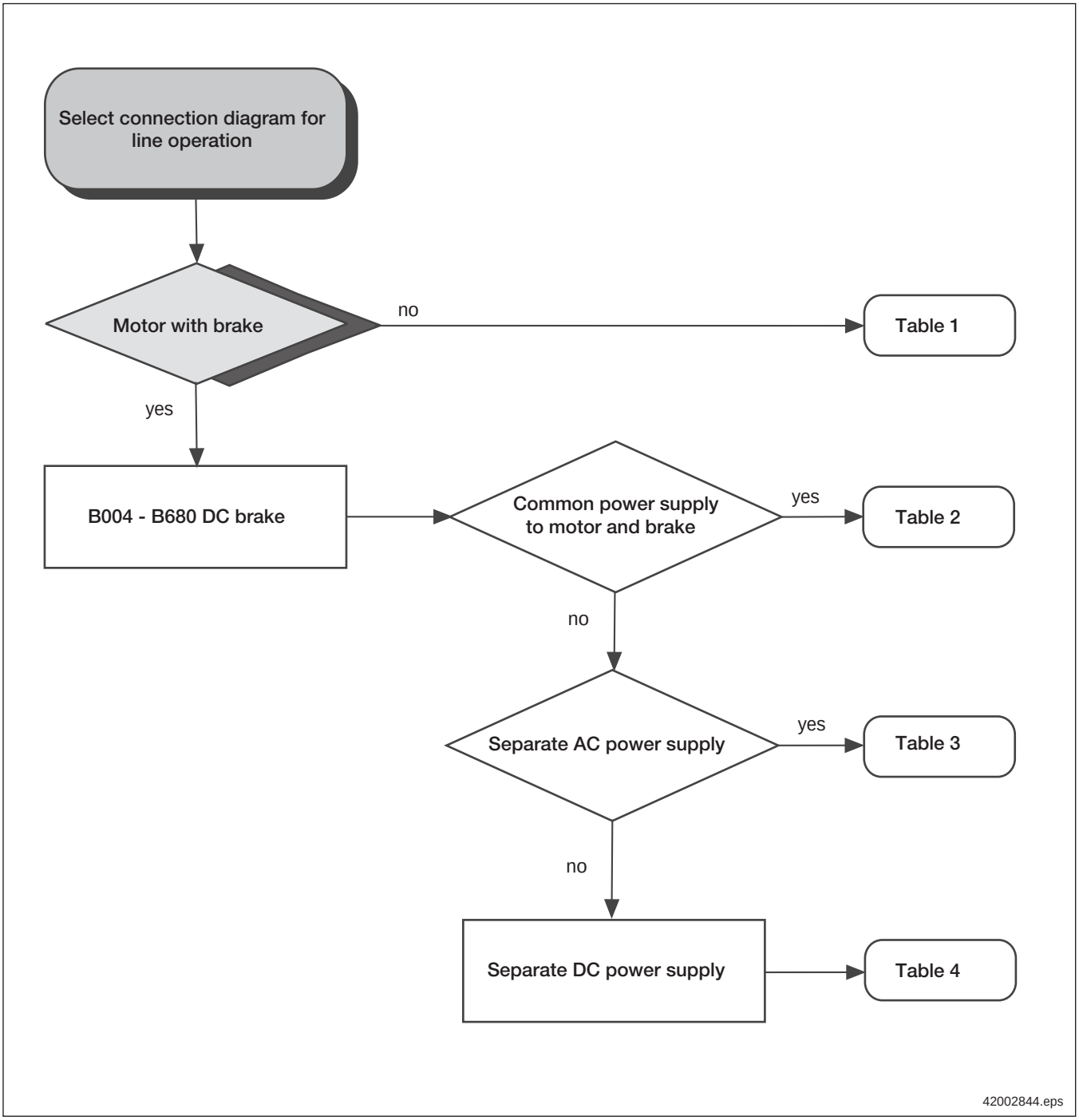

Table 1 Motors with no brake

1 Motor for one or two speeds	Motor type			
	one speed	two speeds		
		separate windings		Dahlander winding
	} /} }	} /}	{ /}	
	020 338 84	020 333 84	031 849 84	023 331 84

Tables 2 – 4 Motors with a brake

2 Common motor and brake power supply (not suitable for inverter operation)				Motor type					
				one speed	two speeds (separate windings)				
				} /} }	} /}				{ /}
Switch-off in	Switching element	Brake si e for		Control module in terminal box					
		BA	BF	GE	GS	GP	GE	GS	
DC circuit	Contact	≤ B050	≤ B140	037 986 84	037 987 84	037 978 84	037 980 84	037 981 84	–
		≥ B140	–	–	038 028 84	–	–	038 025 84	038 060 84
	SE 1) 2)	≤ B050	≤ B140	037 988 84	037 989 84	037 979 84	–	–	–
		≥ B140	–	–	038 029 84	–	–	–	–
AC circuit	Contact	≤ B050	≤ B140	037 986 84	037 987 84	037 978 84	037 980 84	037 981 84	–
		≥ B140	–	–	038 028 84	–	–	038 025 84	038 060 84
motor circuit	–	≤ B050	≤ B140	037 986 44	037 987 84	037 978 84	–	–	–
		≥ B140	–	–	038 028 84	–	–	–	–

1) Fitted in the terminal box
2) Not for inverter operation

3 Separate AC brake supply				Motor type						
				one speed	two speeds					
					separate windings				Dahlander winding	
				} /} }	} /}		{ /}			
Switch-off in	Switching element	Brake si e for		Control module in terminal box						
		BA	BF	GE	GS	GE	GS		GE	GS
DC circuit	Contact	≤ B050	≤ B140	037 986 84	037 987 84	037 980 84	037 981 84	–	037 992 84	037 993 84
		≥ B140	–	–	038 028 84	–	038 025 84	038 060 84	–	038 031 84
	SE 1) 2)	≤ B050	≤ B140	037 988 84	037 989 84	037 982 84	037 983 84	–	–	–
		≥ B140	–	–	038 029 84	–	038 026 84	038 061 84	–	–
	VE 1)	≤ B050	≤ B140	037 990 84	037 991 84	037 984 84	037 985 84	–	037 994 84	037 995 84
		≥ B140	–	–	038 030 84	–	038 027 84	038 062 84	–	038 032 84
AC circuit	Contact	≤ B050	≤ B140	037 986 84	037 987 84	037 980 84	037 981 84	–	037 992 84	037 993 84
		≥ B140	–	–	038 028 84	–	038 025 84	038 060 84	–	038 031 84

1) Fitted in the terminal box
2) Not for inverter operation

4 Separate DC brake supply				Motor connection		
				one speed	two speeds	
					separate windings	Dahlander winding
				} /} }	} /}	
Switch-off in	Switching element	Brake si e for		No control module lin terminal box		
		BA	BF			
DC circuit	Contact	≤ B050	≤ B140	037 997 84	037 996 84	037 998 84

7.5 Connecting diagram selection for Canada 330 575 V 60

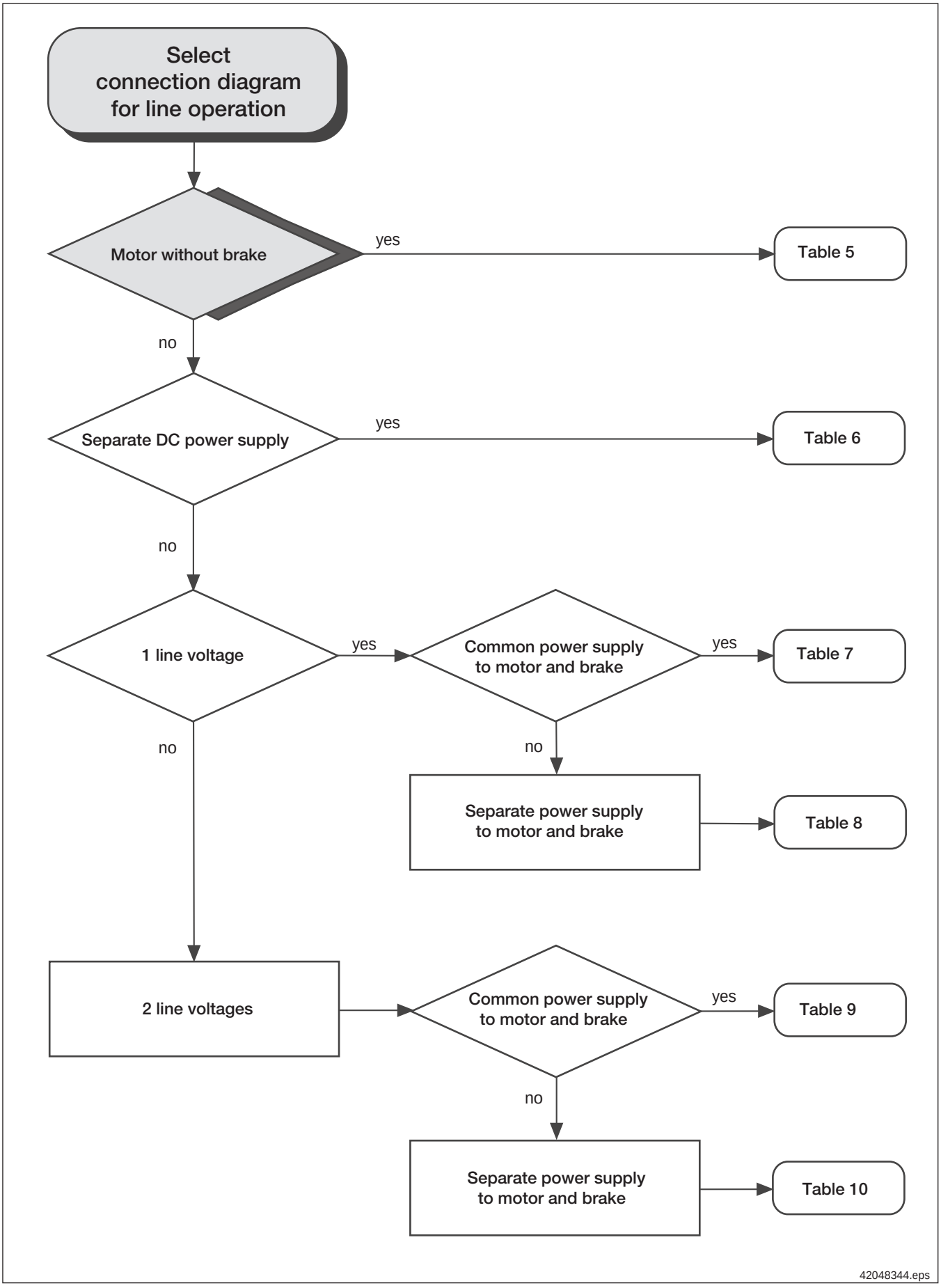

Table 5 Motors with no brake

5 Motor for one or two speeds	Motor type			
	one speed	two speeds		
		separate windings		Dahlander winding
	{ /}	} /}	{ /}	
	020 324 84	038 114 84	031 849 84	023 331 84

Tables 6 - 10 Motors with a brake

6 Separate DC brake supply				Motor connection		
				one speed	two speeds	
					separate windings	Dahlander winding
				{ }	} }	
Switch-off in	Switching element	Brake si e		No control module in terminal box		
		ZBA	ZBF			
DC circuit	Contact	≤ B050	≤ B140	038 106 84	038 107 84	037 998 84

7 Common motor and brake power supply (not suitable for inverter operation)				Motor connection two speeds – separate windings } }
Switch-off in	Switching element	Brake si e for		Control module in terminal box
		BA	BF	GP
DC circuit	Contact	≤ B050	≤ B140	038 100 84
		≥ B140	–	–
	SE 1) 2)	≤ B050	≤ B140	038 101 84
		≥ B140	–	–
AC circuit	Contact	≤ B050	≤ B140	038 100 84
		≥ B140	–	–
motor circuit	–	≤ B050	≤ B140	038 100 84
		≥ B140	–	–

1) Fitted in the terminal box
2) Not for inverter operation

8 Separate AC brake supply				Motor connection two speeds				
				separate windings			Dahlander winding	
				} /}		{ /}		
Switch-off in	Switching element	Brake si e for		Control module in terminal box				
		BA	BF	GE	GS		GE	GS
DC circuit	Contact	≤ B050	≤ B140	038 102 84	038 103 84	–	037 992 84	037 993 84
		≥ B140	–	–	038 104 84	038 105 84	–	038 031 84
	SE 1) 2)	≤ B050	≤ B140	038 108 84	038 110 84	–	–	–
		≥ B140	–	–	038 112 84	038 061 84	–	–
	VE 1)	≤ B050	≤ B140	038 109 84	038 111 84	–	037 994 84	037 995 84
		≥ B140	–	–	038 113 84	038 062 84	–	038 032 84
AC circuit	Contact	≤ B050	≤ B140	038 102 84	038 103 84	–	037 992 84	037 993 84
		≥ B140	–	–	038 104 84	038 105 84	–	038 031 84

1) Fitted in the terminal box
2) Not for inverter operation

9	Common motor and brake power supply (not suitable for inverter operation)			Motor connection one speed { /}	
Switch-off in	Switching element	Brake si e for		Control module in terminal box	
		BA	BF	GE	GS
DC circuit	Contact	≤ B050	≤ B140	038 092 84	038 094 84
		≥ B140	–	–	–
	SE [1) 2)]	≤ B050	≤ B140	038 091 84	038 093 84
		≥ B140	–	–	–
AC circuit	Contact	≤ B050	≤ B140	038 092 84	038 094 84
		≥ B140	–	–	–
motor circuit	–	≤ B050	≤ B140	038 092 84	038 094 84
		≥ B140	–	–	–

1) Fitted in the terminal box
2) Not for inverter operation

10	Separate AC brake supply			Motor connection one speed { /}	
Switch-off in	Switching element	Brake si e for		Control module in terminal box	
		BA	BF	GE	GS
DC circuit	Contact	≤ B050	≤ B140	038 092 84	038 094 84
		≥ B140	–	–	038 097 84
	SE [1) 2)]	≤ B050	≤ B140	038 091 84	038 093 84
		≥ B140	–	–	038 098 84
	VE [1)]	≤ B050	≤ B140	038 095 84	038 096 84
		≥ B140	–	–	038 099 84
AC circuit	Contact	≤ B050	≤ B140	038 092 84	038 094 84
		≥ B140	–	–	038 097 84

1) Fitted in the terminal box
2) Not for inverter operation

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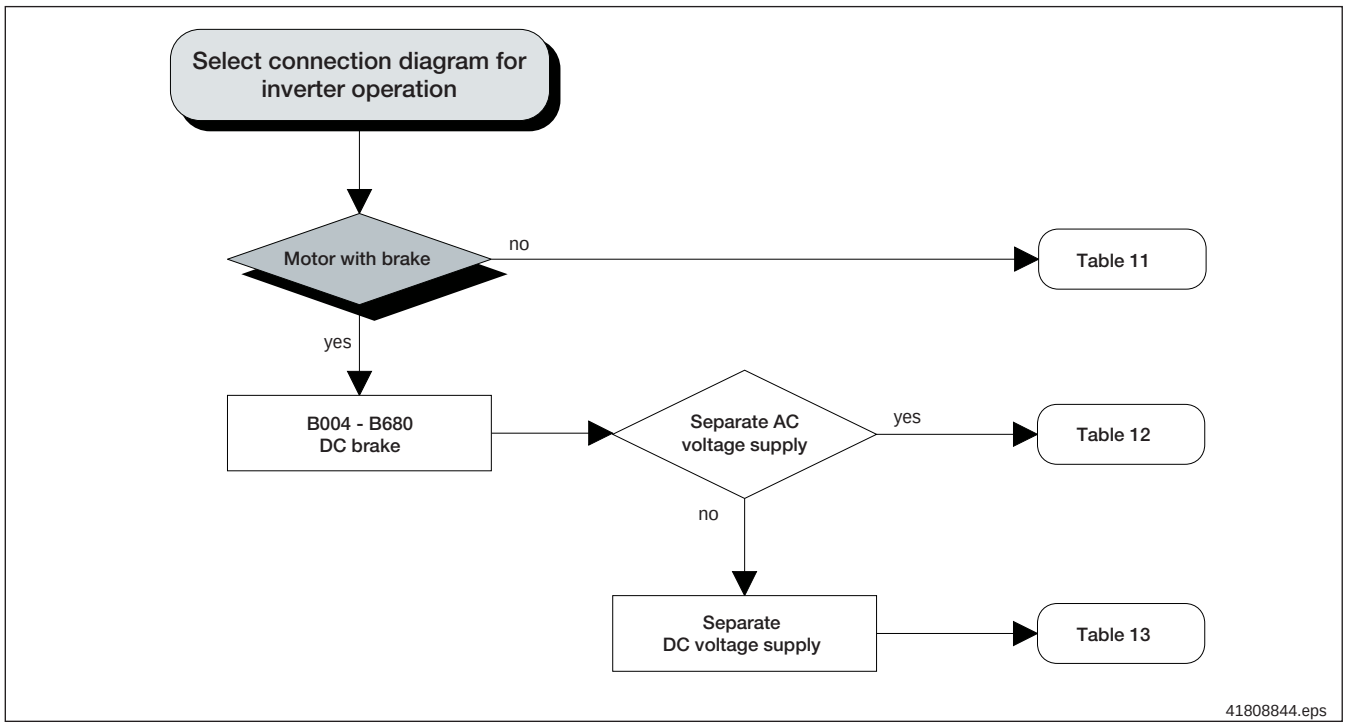
7.6 Inverter operation



Tables 11 - 13

11 Motor with no brake	Motor connection	
	Canada one speed { /}	USA one speed } /} }
	020 324 84	020 338 84

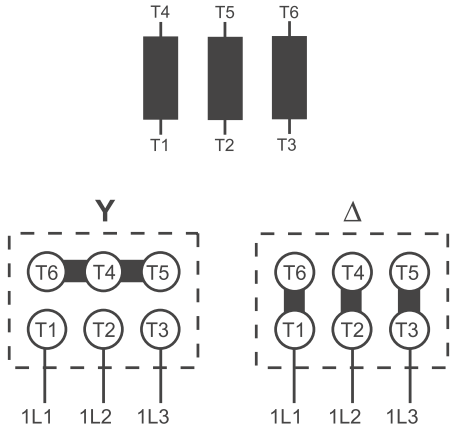
12 Separate AC brake supply				Motor type			
				Canada one speed { /}		USA one speed } /} }	
Switch-off in	Switching element	Brake si e for		Control module in terminal box			
		BA	BF	GE	GS	GE	GS
DC circuit	Contact	≤ B050	≤ B140	038 092 84	038 094 84	037 986 84	037 987 84
		≥ B140	–	–	038 097 84	–	038 028 84
	VE [1]	≤ B050	≤ B140	038 095 84	038 096 84	037 990 84	037 991 84
		≥ B140	–	–	038 099 84	–	038 030 84
AC circuit	Contact	≤ B050	≤ B140	037 092 84	038 094 84	037 986 84	037 987 84
		≥ B140	–	–	038 097 84	–	038 028 84

[1] Fitted in the terminal box

13 Separate DC brake supply				Motor type	
				Canada one speed { /}	USA one speed } /} }
Switch-off in	Switching element	Brake si e for		No control module in terminal box	
		BA	BF		
DC circuit	Contact	≤ B050	≤ B140	038 106 84	037 997 84

7.7 Connection circuit diagrams

Motor for one line voltage or dual voltage motor (1 √3)



Y high voltage
Δ low voltage

For inverter operation, connect motor with or Δ connection according to inverter settings

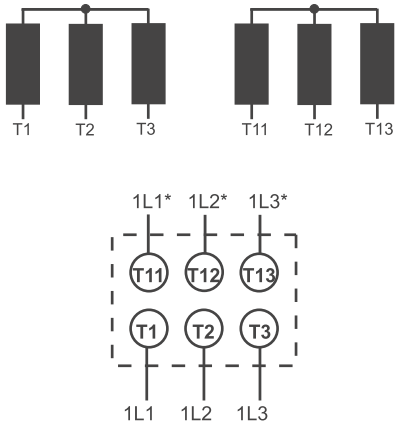
Motor supplied with

Jumper parts to connect the motor winding with Y or Δ connection enclosed.

020 324 84

02032484.eps

Motor for one line voltage
Pole-changing, separate windings



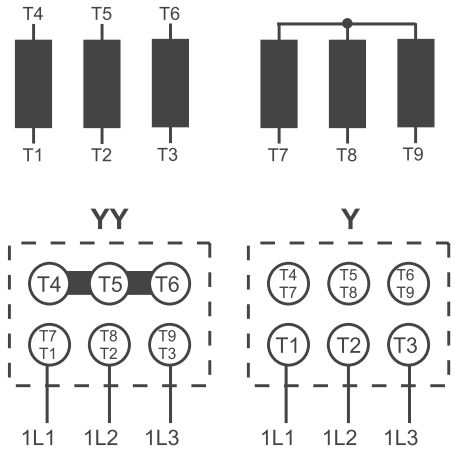
T1, T2, T3 for low speed
T11, T12, T13 for high speed

Supply to high speed winding via external switch-over

020 333 84

02033384.eps

Dual voltage motor (1 2)



YY low voltage
Y high voltage

For inverter operation, connect motor with or connection according to inverter settings.

Motor supplied with

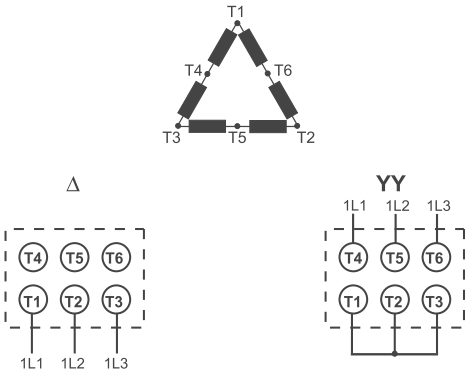
- Motor winding connected with Y connection.
- Jumper parts to connect the motor winding with YY connection enclosed.

020 338 84

02033884.eps

229203K4.p65/1099

Motor for one line voltage
Pole-changing, Dahlander winding



Δ for low speed
YY for high speed

Switch-over to high speed winding via external supply switch-over and umper.

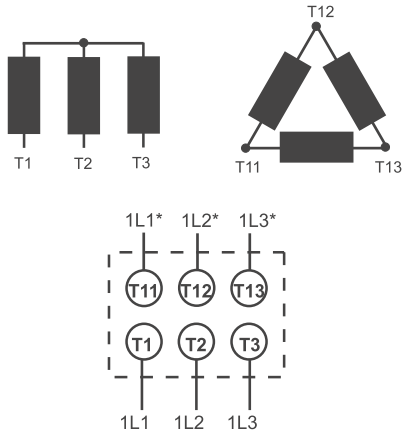
Motor supplied with

Motor connection ends connected to terminal board as shown.

023 331 84

02333184.eps

Motor for one line voltage
Pole-changing, separate windings



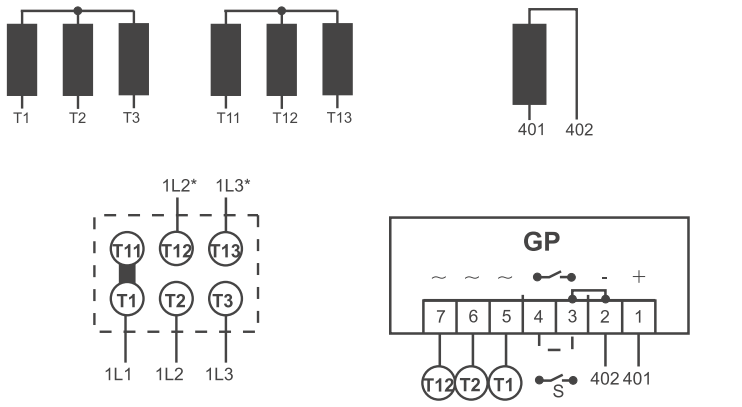
T1, T2, T3 for low speed
T11, T12, T13 for high speed

Supply to high speed winding via external switch-over

031 849 84

03184984.eps

Motor for one line voltage, pole-changing, separate windings
Common power supply to motor and brake



03797884.eps

Supply to high speed winding via external switch-over.

T1, T2, T3 for low speed
T11, T12, T13 for high speed

Not suitable for inverter operation

Switch-off in the DC circuit

- Remove jumper between terminals 3 and 4
- Connect contactor between terminals 3 and 4

Switch-off in the AC circuit

- Jumper between terminals 3 and 4
- Contactor in the power line behind terminal 5

Motor current switch-off

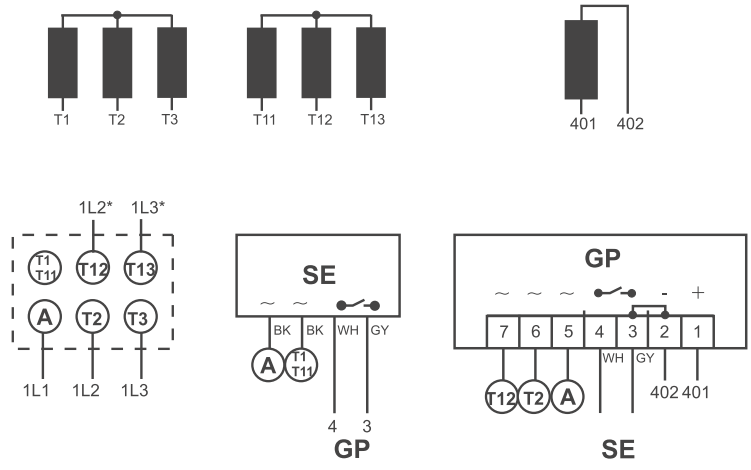
Jumper between terminals 3 and 4

Motor supplied with

- Jumper parts to connect the motor winding enclosed.
- Brake connected to terminals 1 and 2 of the GP module.
- Jumper between terminals 3 and 4 of the GP module.
- GP module connected with the motor winding as in the connection diagram.

037 978 84

Motor for one line voltage, pole-changing, separate windings
Common power supply to motor and brake



03797984.eps

Supply to high speed winding via external switch-over.

T1, T2, T3 for low speed
T11, T12, T13 for high speed

Switch-off in the DC circuit dependent on motor current

Not suitable for inverter operation

Ⓐ **Intermediate terminal**

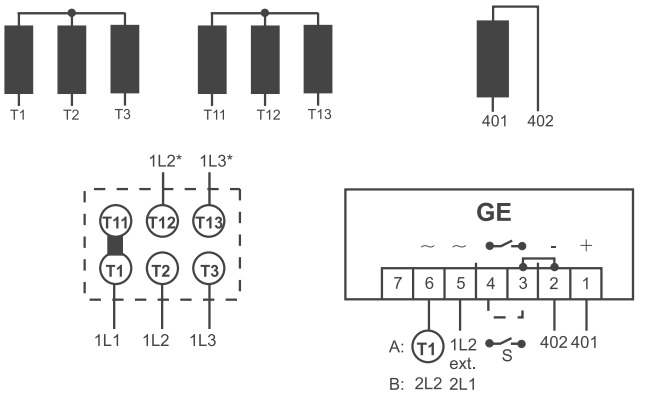
Motor supplied with

- Motor winding connected as in connection diagram (T1 and T11 connected to one terminal).
- Brake connected to terminals 1 and 2 of the GP module.
- SE module connected to terminals 3 and 4 of the GP module.
- SE module connected with intermediate terminal A and the motor winding via terminal T1 T11.
- GP module connected with the motor winding and intermediate terminal A as in the connection diagram.

037 979 84

229203K4.p65/1099

Motor for one line voltage, pole-changing, separate windings



03798084.eps

Motor supplied with

- Jumper parts to connect the motor winding enclosed.
- Brake connected to terminals 1 and 2 of the GE module.
- Jumper between terminals 3 and 4 of the GE module.
- **Line-powered** GE module connected with the motor winding according to variant A (T1 connected to terminal 6; terminal 5 free).
  Important **The brake will not function without an external power supply to terminal 5 of the GE module.**
- **Inverter operation** – GE module **not connected** to motor winding
  – Power supply by customer thru variation B

Supply to high speed winding via external switch-over

T1, T2, T3 for low speed
T11, T12, T13 for high speed

A Common power supply to motor and brake

Not suitable for inverter operation.

B Separate power supply to brake

Switch-off in the DC circuit

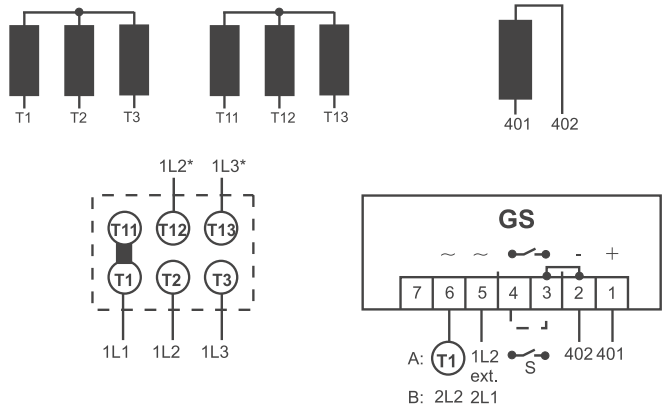
- Remove jumper between terminals 3 and 4.
- Connect a contactor between terminals 3 and 4.

Switch-off in the AC circuit

- Jumper between terminals 3 and 4.
- Contactor in the power line behind terminal 5

037 980 84

Motor for one line voltage, pole-changing, separate windings



03798184.eps

Motor supplied with

- Jumper parts to connect the motor winding enclosed.
- Brake connected to terminals 1 and 2 of the GS module.
- Jumper between terminals 3 and 4 of the GS module.
- **Line-powered** GS module connected with the motor winding according to variant A (T1 connected to terminal 6; terminal 5 free).
  Important **The brake will not function without an external power supply to terminal 5 of the GS module.**
- **Inverter operation** – GE module **not connected** to motor winding
  – Power supply by customer thru variation B

Supply to high speed winding via external switch-over

T1, T2, T3 for low speed
T11, T12, T13 for high speed

A Common power supply to motor and brake

Not suitable for inverter operation.

B Separate power supply to brake

Switch-off in the DC circuit

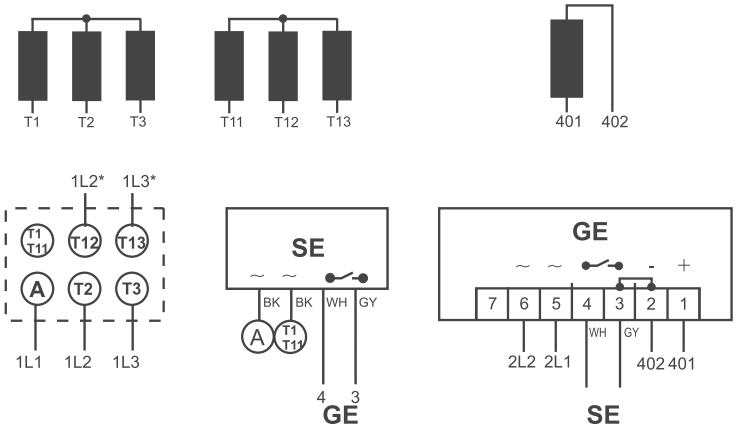
- Remove jumper between terminals 3 and 4.
- Connect a contactor between terminals 3 and 4.

Switch-off in the AC circuit

- Jumper between terminals 3 and 4.
- Contactor in the power line behind terminal 5.

037 981 84

Motor for one line voltage, pole-changing, separate windings
Separate power supply to brake



03798244.eps

* = Supply to high speed winding via external switch-over.

T1, T2, T3 for low speed
T11, T12, T13 for high speed

Switch-off in the DC circuit dependent on motor current

Not suitable for inverter operation.

Ⓐ **Intermediate terminal**

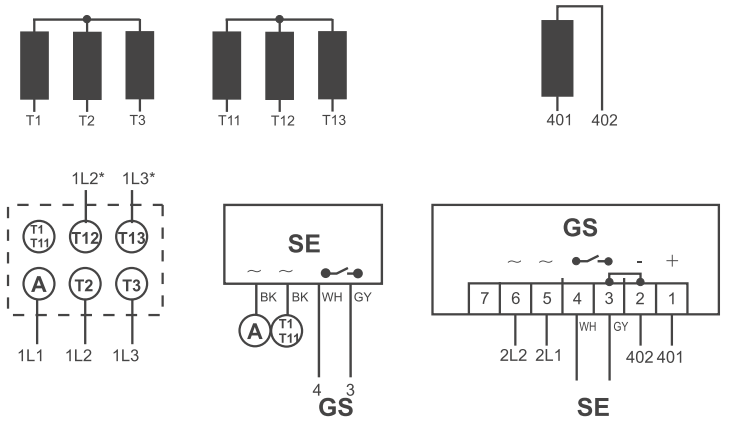
Motor supplied with

- Motor winding connected as in connection diagram (T1 and T11 connected to one terminal)
- Brake connected to terminals 1 and 2 of the GE module.
- SE module connected to terminals 3 and 4 of the GE module.
- SE module connected with the motor winding via intermediate terminal A and terminal T1 T11

Important **The brake will not function without a separate power supply to terminals 5 and 6 of the GE module.**

037 982 84

Motor for one line voltage, pole-changing, separate windings
Separate power supply to brake



03798384.eps

Supply to high speed winding via external switch-over.

T1, T2, T3 for low speed
T11, T12, T13 for high speed

Switch-off in the DC circuit dependent on motor current

Not suitable for inverter operation.

Ⓐ **Intermediate terminal**

Motor supplied with

- Motor winding connected as in connection diagram (T1 and T11 connected to one terminal).
- Brake connected to terminals 1 and 2 of the GS module.
- SE module connected to terminals 3 and 4 of the GS module.
- SE module connected with the motor winding via intermediate terminal A and terminal T1 T11.

Important **The brake will not function without a separate power supply to terminals 5 and 6 of the GS module.**

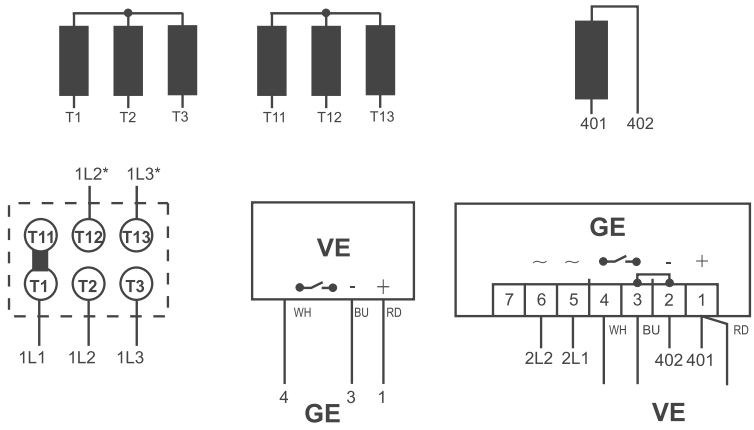
037 983 84

229203k4.p65/1099

Motor for one line voltage, pole-changing, separate windings
Separate power supply to brake

Supply to high speed winding via external switch-over.

T1, T2, T3 for low speed
T11, T12, T13 for high speed



Voltage-dependent switch-off in the DC circuit

03798444.eps

Motor supplied with

- Jumper parts to connect the motor winding enclosed.
- Brake connected to terminals 1 and 2 of the GE module.
- VE module connected to terminals 1, 3 and 4 of the GE module.

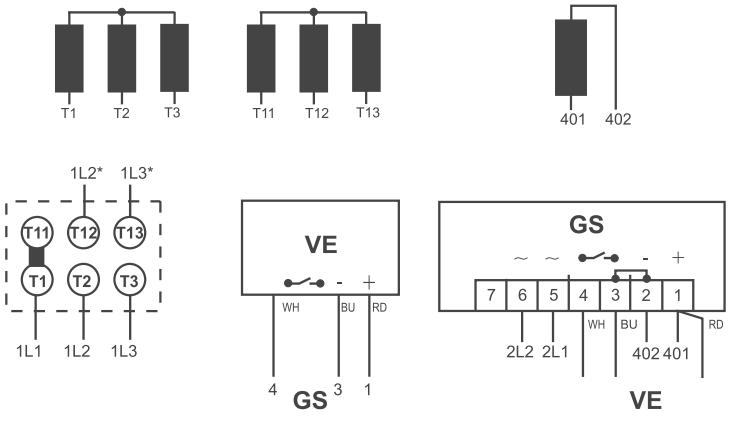
Important **The brake will not function without a separate power supply to terminals 5 and 6 of the GE module.**

037 984 84

Motor for one line voltage, pole-changing, separate windings
Separate power supply to brake

* = Supply to high speed winding via external switch-over.

T1, T2, T3 for low speed
T11, T12, T13 for high speed



Voltage-dependent switch-off in the DC circuit

03798584.eps

Motor supplied with

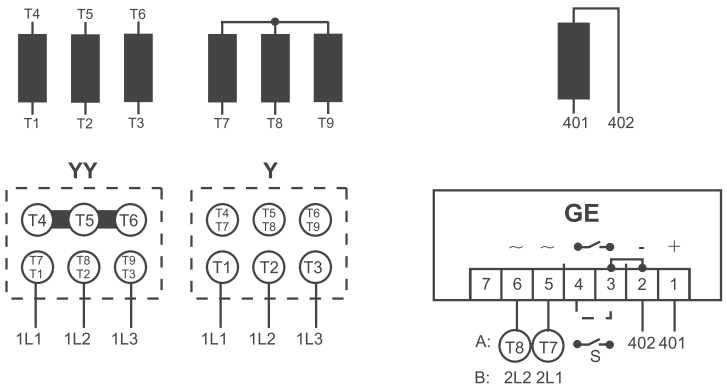
- Jumper parts to connect the motor winding enclosed.
- Brake connected to terminals 1 and 2 of the GS module.
- VE module connected to terminals 1, 3 and 4 of the GS module.

Important **The brake will not function without a separate power supply to terminals 5 and 6 of the GS module.**

037 985 84

Dual voltage motor 1 2

YY low voltage Y high voltage



03798644.eps

Motor supplied with

- Motor winding connected with Y connection.
- Jumper parts to connect the motor winding with YY connection enclosed.
- Brake connected to terminals 1 and 2 of the GE module.
- Jumper between terminals 3 and 4 of the GE module.
- **Line powered** GE module connected with the motor winding according to variant A.
- **Inverter operation** – GE• module **not connected** to motor winding
  – Power supply by customer thru variation B

A Common power supply to motor and brake
Brake coil rated for the low vo

Not suitable for inverter operation.

B Separate power supply to brake
For inverter operation, connect the motor with YY or Y connection according to inverter settings

Switch-off in the DC circuit

- Remove jumper between terminals 3 and 4
- Connect a contactor between terminals 3 and 4

Switch-off in the AC circuit

- Jumper between terminals 3 and 4
- Contactor in the power line behind terminal 5

Motor current switch-off

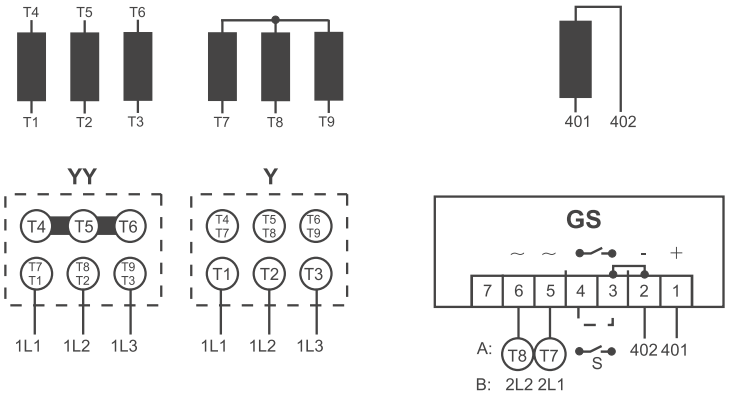
- Jumper between terminals 3 and 4

→ **not possible for separate power supply to the brake**

037 986 84

Dual voltage motor (1 2)

YY low voltage Y high voltage



03798784.eps

Motor supplied with

- Motor winding connected with Y connection.
- Jumper parts to connect the motor winding with YY connection enclosed.
- Brake connected to terminals 1 and 2 of the GS module.
- Jumper between terminals 3 and 4 of the GS module.
- **Line-powered** GS module connected with the motor winding according to variant A.
- **Inverter operation** – GS module **not connected** to motor winding
  – Power supply by customer thru variation B

A Common power supply to motor and brake
Brake coil rated for the low voltage.

Not suitable for inverter operation.

B Separate power supply to brake
For inverter operation, connect the motor with YY or Y connection according to inverter settings

Switch-off in the DC circuit

- Remove jumper between terminals 3 and 4.
- Connect a contactor between terminals 3 and 4.

Switch-off in the AC circuit

- Jumper between terminals 3 and 4
- Contactor in the power line behind terminal 5

Motor current switch-off

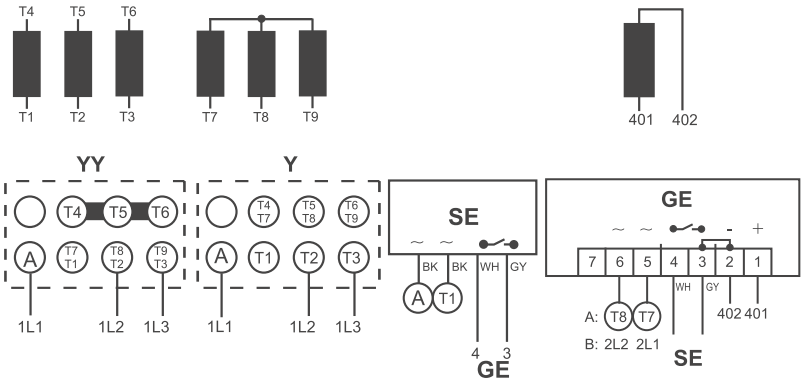
Jumper between terminals 3 and 4
→ **not possible for separate power supply.**

037 987 84

229203k4.p65/1099

Dual voltage motor (1 2)

YY low voltage
Y high voltage



03798884.eps

A Common power supply to motor and brake
Brake coil rated for the low voltage

B Separate power supply to brake

Switch-off in the DC circuit dependent on motor current

Not suitable for inverter operation.

Ⓐ **Intermediate terminal**

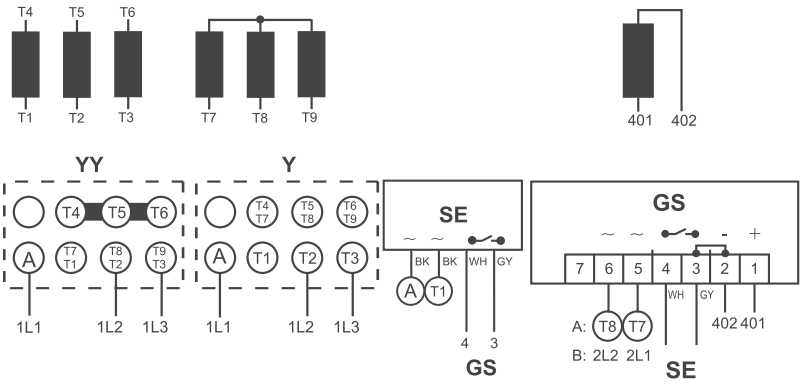
Motor supplied with

- Motor winding connected with Y connection.
- Jumper parts to connect the motor winding with YY connection enclosed.
- Brake connected to terminals 1 and 2 of the GE module.
- SE module connected to terminals 3 and 4 of the GE module.
- SE module connected with intermediate terminal A and with the motor winding via T1.
- GE module connected with the motor winding according to variant A.

037 988 84

Dual voltage motor (1 2)

YY low voltage
Y high voltage



03798984.eps

A Common power supply to motor and brake
Brake coil rated for the low voltage

B Separate power supply to brake

Switch-off in the DC circuit dependent on motor current

Not suitable for inverter operation.

Ⓐ **Intermediate terminal**

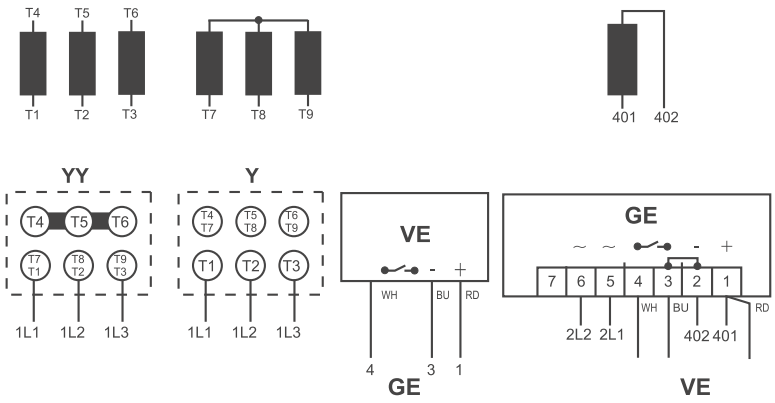
Motor supplied with

- Motor winding connected with Y connection.
- Jumper parts to connect the motor winding with YY connection enclosed.
- Brake connected to terminals 1 and 2 of the GS module.
- SE module connected to terminals 3 and 4 of the GS module.
- SE module connected with intermediate terminal A and the motor winding via T1.
- GS module connected with the motor winding according to variant A.

037 989 84

Dual voltage motor (1 2)

YY low voltage
Y high voltage



03799084.eps

Voltage-dependent switch-off in the DC circuit

Separate power supply to brake

For inverter operation, connect motor with YY or Y connection according to inverter settings.

Motor supplied with

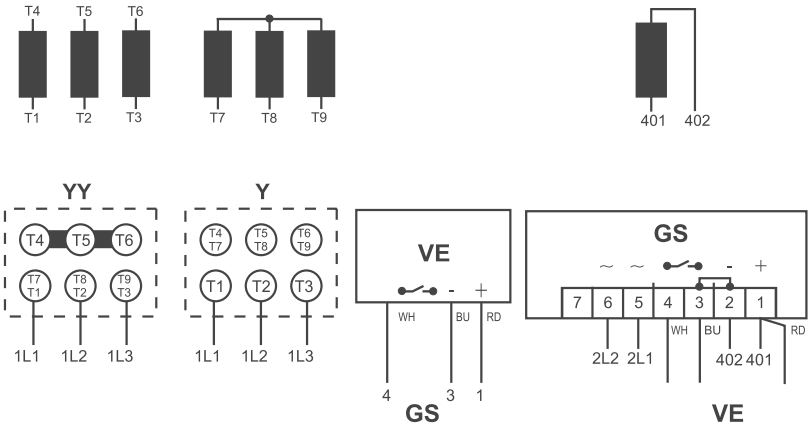
- Motor winding connected with Y connection
- Jumper parts to connect the motor winding with YY connection enclosed.
- Brake connected to terminals 1 and 2 of the GE module.
- VE module connected to terminals 1, 3 and 4 of the GE module.

Important **The brake will not function without a separate power supply to terminals 5 and 6 of the GE module.**

037 990 84

Dual voltage motor (1 2)

YY low voltage
Y high voltage



03799184.eps

Separate power supply to brake

For inverter operation, connect the motor with YY or Y connection according to inverter settings.

Voltage-dependent switch-off in the DC circuit

Motor supplied with

- Motor winding connected with Y connection.
- Jumper parts to connect the motor winding with YY connection enclosed.
- Brake connected to terminals 1 and 2 of the GS module.
- VE module connected to terminals 1, 3 and 4 of the GS module.

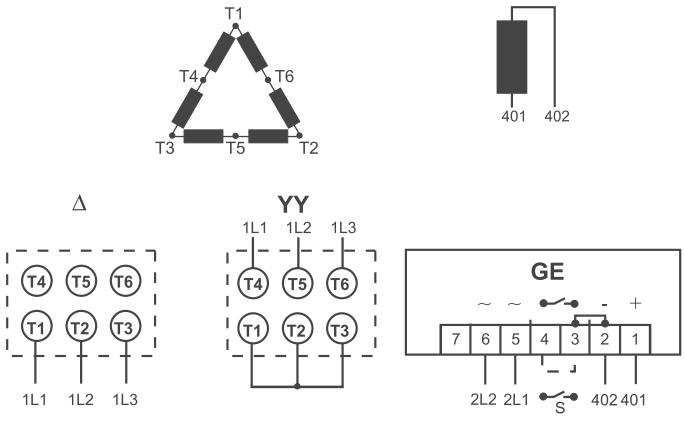
Important **The brake will not function without a separate power supply to terminals 5 and 6 of the GS module.**

037 991 84

229203k4.p65/1099

Motor for one line voltage, Pole-changing, Dahlander winding

Δ for low speed
YY for high speed



03799284.eps

Switch-over to high speed winding via external supply switch-over and jumper.

Separate power supply to brake.
Maximale Versorgungsspannung 500 V AC.

Switch-off in the DC circuit

- Remove jumper between terminals 3 and 4
- Connect contactor between terminals 3 and 4

Switch-off in the AC circuit

- Jumper between terminals 3 and 4
- Contactor in the power line behind terminal 5

Motor supplied with

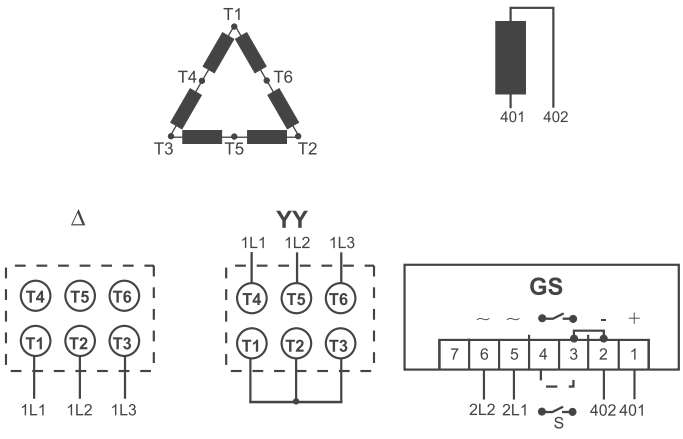
- Brake connected to terminals 1 and 2 of the GE module.
- Jumper between terminals 3 and 4 of the GE module.

Important **The brake will not function without a separate power supply to terminals 5 and 6 of the GE module.**

037 992 84

Motor for one line voltage, Pole-changing, Dahlander winding

Δ for low speed
YY for high speed



03799384.eps

Switch-over to high speed winding via external supply switch-over and jumper.

Separate power supply to brake.
Maximale Versorgungsspannung 500 V AC.

Switch-off in the DC circuit

- Remove jumper between terminals 3 and 4
- Connect contactor between terminals 3 and 4

Switch-off in the AC circuit

- Jumper between terminals 3 and 4
- Contactor in the power line behind terminal 5

Motor supplied with

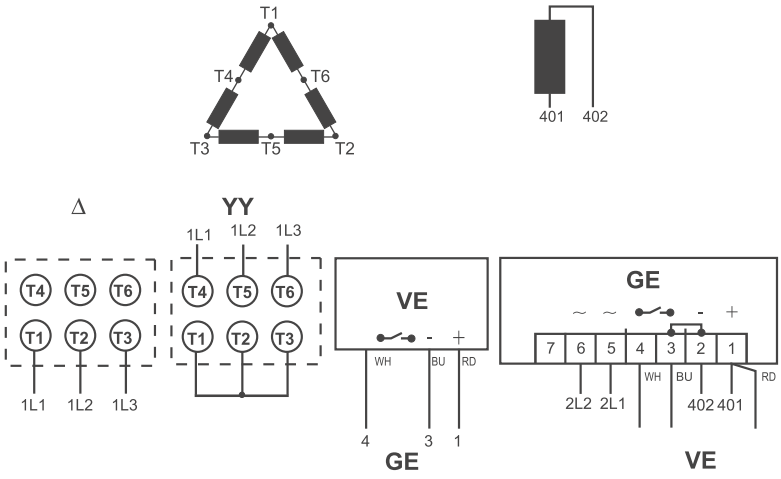
- Brake connected to terminals 1 and 2 of the GS module.
- Jumper between terminals 3 and 4 of the GS module.

Important **The brake will not function without a separate power supply to terminals 5 and 6 of the GS module.**

037 993 84

Motor for one line voltage, Pole-changing, Dahlander winding

Δ for low speed
YY for high speed



03799484.eps

Switch-over to high speed winding via external supply switch-over and jumper.

Separate power supply to brake.
Maximale Versorgungsspannung 500 V AC.

Voltage-dependent switch-off in the DC circuit.

Motor supplied with

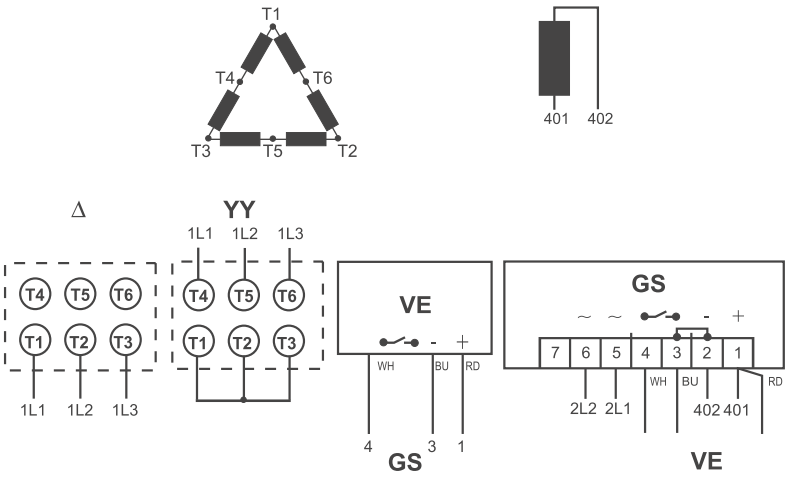
- Brake connected to terminals 1 and 2 of the GE module.
- VE module connected to terminals 1, 3 and 4 of the GE module.

Important **The brake will not function without a separate power supply to terminals 5 and 6 of the GE module.**

037 994 84

Motor for one line voltage, Pole-changing, Dahlander winding

Δ for low speed
YY for high speed



03799584.eps

Switch-over to high speed winding via external supply switch-over and jumper.

Separate power supply to brake.
Maximale Versorgungsspannung 500 V AC.

Voltage-dependent switch-off in the DC circuit.

Motor supplied with

- Brake connected to terminals 1 and 2 of the GS module.
- VE module connected to terminals 1, 3 and 4 of the GS module.

Important **The brake will not function without a separate power supply to terminals 5 and 6 of the GS module**

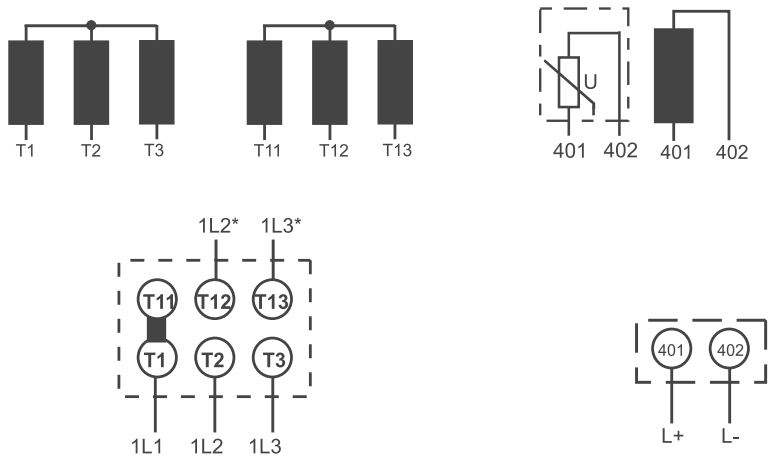
037 995 84

229203k4.p65/1099

Motor for one line voltage, pole-changing, separate windings
Separate DC supply to brake

* = Supply to high speed winding via external switch-over.

T1, T2, T3 for low speed
T11, T12, T13 for high speed



0379964.eps

Motor supplied with

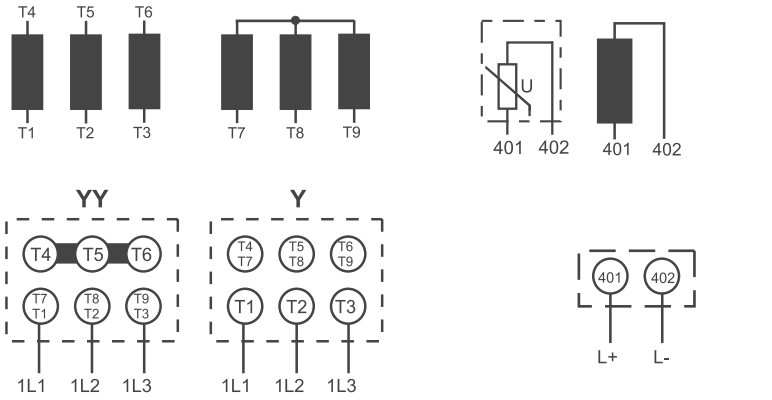
- Jumper parts to connect the motor winding enclosed.
- Brake connected to Euro terminals.

Important **The brake will not function without a separate DC supply to the brake**

037 996 84

Motor umschaltbar f r wei Net spannungen (1 2)

YY low voltage
Y high voltage



03799784.eps

Separate DC supply to brake

For inverter operation, connect motor with YY or Y connection according to inverter settings.

Motor supplied with

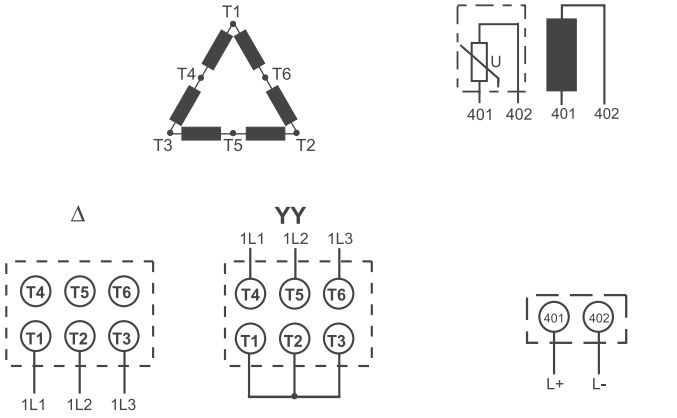
- Motor winding connected with Y connection.
- Jumper parts to connect the motor winding with YY connection enclosed.
- Brake connected to Euro terminals.

Important **The brake will not function without a separate DC supply to the brake**

037 997 84

Motor for one line voltage, Pole-changing, Dahlander winding

Δ for low speed
YY for high speed



03799884.eps

Switch-over to high speed winding via external supply switch-over and jumper.

Separate DC supply to brake

Motor supplied with

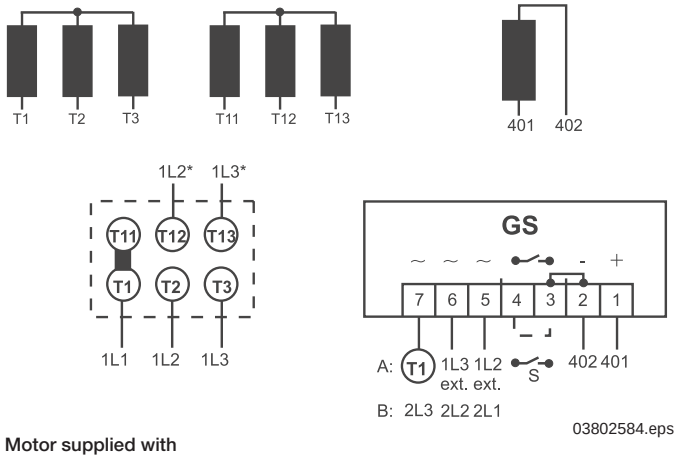
Brake connected to Euro terminals.

Important **The brake will not function without a separate DC supply to the brake.**

037 998 84

Motor for one line voltage, pole-changing, separate windings

* = Supply to high speed winding via external switch-over
T1, T2, T3 for low speed
T11, T12, T13 for high speed



03802584.eps

A Common power supply to motor and brake

Not suitable for inverter operation.

B Separate power supply to brake

Switch-off in the DC circuit

- Remove jumper between terminals 3 and 4.
- Connect a contactor between terminals 3 and 4.

Switch-off in the AC circuit

- Jumper between terminals 3 and 4.
- Contactors in the power lines behind terminals 5 and 6.

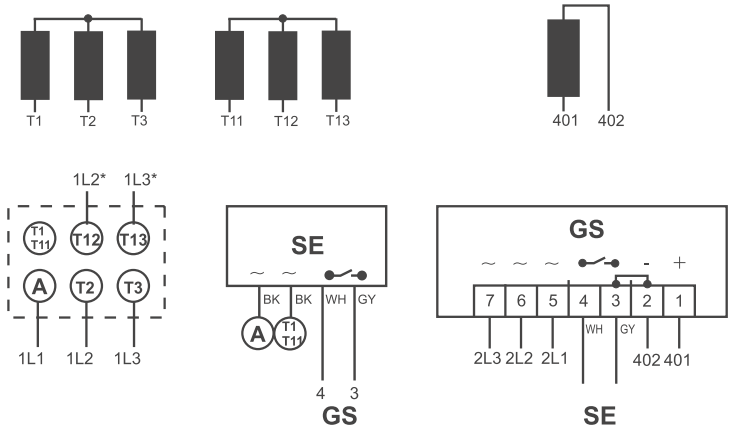
Motor supplied with

- Jumper parts to connect the motor winding enclosed.
- Brake connected to terminals 1 and 2 of the GS module.
- Jumper between terminals 3 and 4 of the GS module.
- **Line-powered** GS module connected with the motor winding according to variant A (T1 connected to terminal 7; terminals 5 and 6 free).
  Important **The brake will not function without an external power supply to terminals 5 and 6 of the GS module.**
- **Inverter operation** – GS module **not connected** to motor winding
  – Power supply by customer thru variation B

038 025 84

229203K4.p65/1099

Motor for one line voltage, pole-changing, separate windings
Separate power supply to brake



03802684.eps

* = Supply to high speed winding via external switch-over.

T1, T2, T3 for low speed
T11, T12, T13 for high speed

Switch-off in the DC circuit dependent on motor current

Not suitable for inverter operation.

Ⓐ **Intermediate terminal**

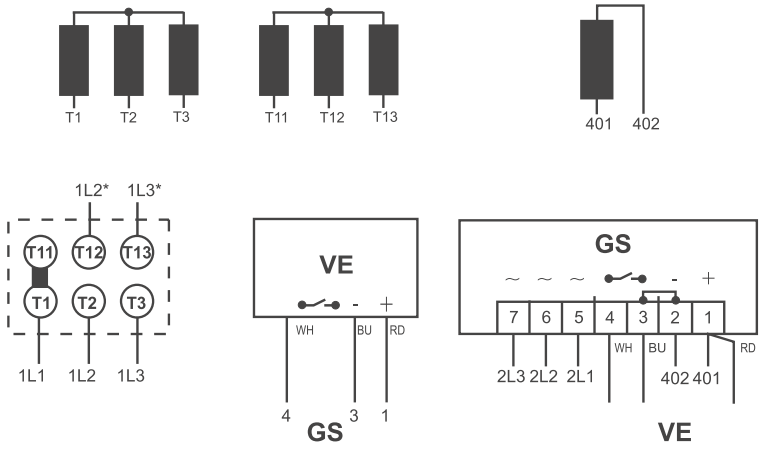
Motor supplied with

- Motor winding connected as in connection diagram (T1 and T11 connected to one terminal).
- Brake connected to terminals 1 and 2 of the GS module.
- SE module connected to terminals 3 and 4 of the GS module.
- SE module connected with the motor winding via intermediate terminal A and terminal T1 T11.

Important **The brake will not function without a separate power supply to terminals 5, 6 and 7 of the GS module.**

038 026 84

Motor for one line voltage, pole-changing, separate windings
Separate power supply to brake



03802784.eps

* = Supply to high speed winding via external switch-over.

T1, T2, T3 for low speed
T11, T12, T13 for high speed

Voltage-dependent switch-off in the DC circuit

Motor supplied with

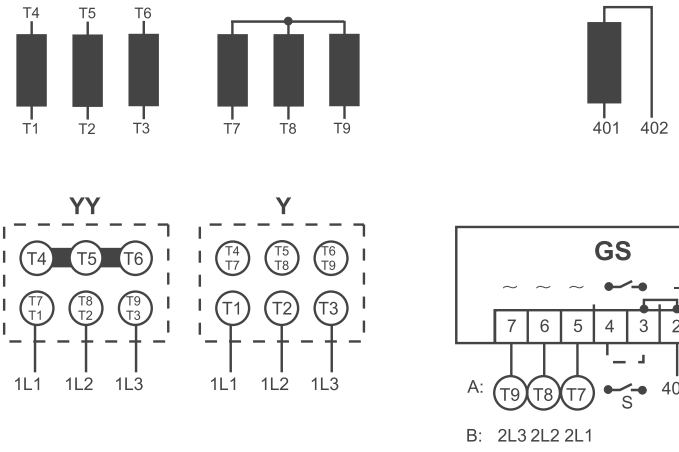
- Jumper parts to connect the motor winding enclosed.
- Brake connected to terminals 1 and 2 of the GS module.
- VE module connected to terminals 1, 3 and 4 of the GS module.

Important **The brake will not function without a separate power supply to terminals 5, 6 and 7 of the GS module.**

038 027 84

Dual voltage motor (1 2)

YY low voltage Y high voltage



03802884.eps

Motor supplied with

- Motor winding connected with Y connection.
- Jumper parts to connect the motor winding with YY connection enclosed.
- Brake connected to terminals 1 and 2 of the GS module.
- Jumper between terminals 3 and 4 of the GS module.
- **Net betrieb** GS module connected with the motor winding according to variant A.
- **Umrichterbetrieb** – GS-Baustein **nicht** mit der Motorwicklung verbunden.
  – Spannungsversorgung durch den Kunden nach Variante B.

A Common power supply to motor and brake
Brake coil rated for the low voltage.

Not suitable for inverter operation.

B Separate power supply to brake
For inverter operation, connect the motor with YY or Y connection according to inverter settings

Switch-off in the DC circuit

- Remove jumper between terminals 3 and 4.
- Connect a contactor between terminals 3 and 4.

Switch-off in the AC circuit

- Jumper between terminals 3 and 4.
- Contactors in the power lines behind terminals 5 and 6.

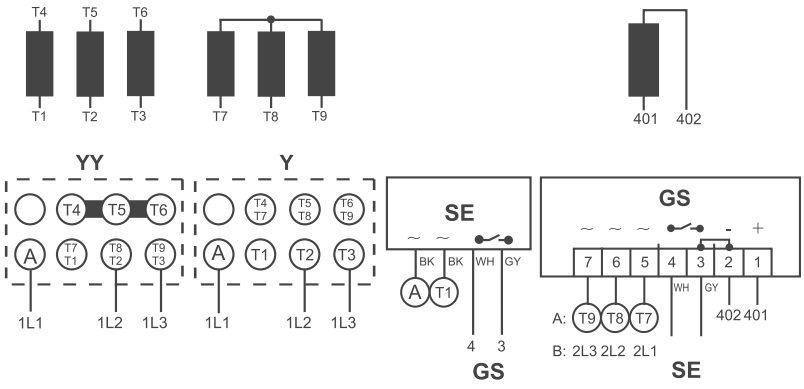
Motor current switch-off

Jumper between terminals 3 and 4
→ **not possible for separate power supply to the brake**

038 028 84

Dual voltage motor (1 2)

YY low voltage
Y high voltage



03802984.eps

A Common power supply to motor and brake
Brake coil rated for the low voltage

B Separate power supply to brake

Switch-off in the DC circuit dependent on motor current

Not suitable for inverter operation.

Ⓐ **Intermediate terminal**

Motor supplied with

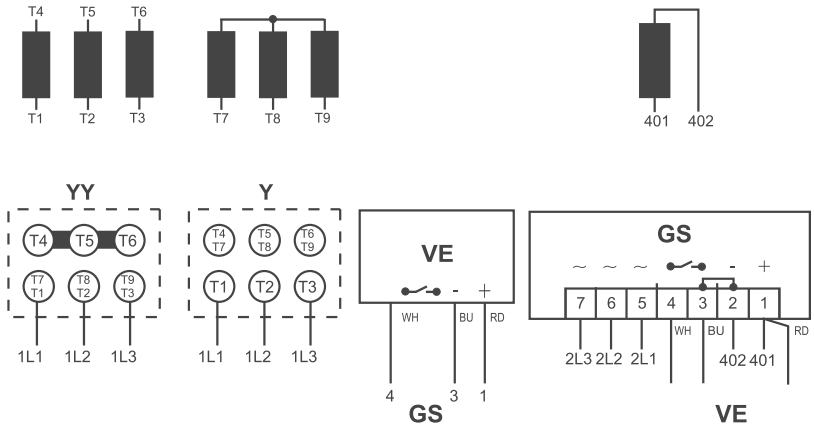
- Motor winding connected with Y connection.
- Jumper parts to connect the motor winding with YY connection enclosed.
- Brake connected to terminals 1 and 2 of the GS module.
- SE module connected to terminals 3 and 4 of the GS module.
- SE module connected with intermediate terminal A and the motor winding via T1.
- GS module connected with the motor winding according to variant A.

038 029 84

229203k4.p65/1099

Dual voltage motor (1 2)

YY low voltage
Y high voltage



03803084.eps

Separate power supply to brake

For inverter operation, connect the motor with YY or Y connection according to inverter settings.

Voltage-dependent switch-off in the DC circuit

Motor supplied with

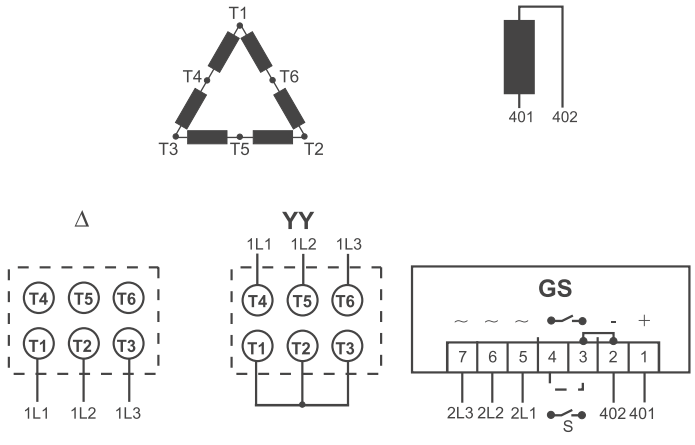
- Motor winding connected with Y connection.
- Jumper parts to connect the motor winding with YY connection enclosed.
- Brake connected to terminals 1 and 2 of the GS module.
- VE module connected to terminals 1, 3 and 4 of the GS module.

Important **The brake will not function without a separate power supply to terminals 5, 6 and 7 of the GS module.**

038 030 84

Motor for one line voltage, Pole-changing, Dahlander winding

Δ for low speed
YY for high speed



03803184.eps

Switch-over to high speed winding via external supply switch-over and jumper.

Separate power supply to brake.
Maximale Versorgungsspannung 500 V AC.

Switch-off in the DC circuit

- Remove jumper between terminals 3 and 4
- Connect contactor between terminals 3 and 4

Switch-off in the AC circuit

- Jumper between terminals 3 and 4
- Contactors in the power lines behind terminals 5 and 6

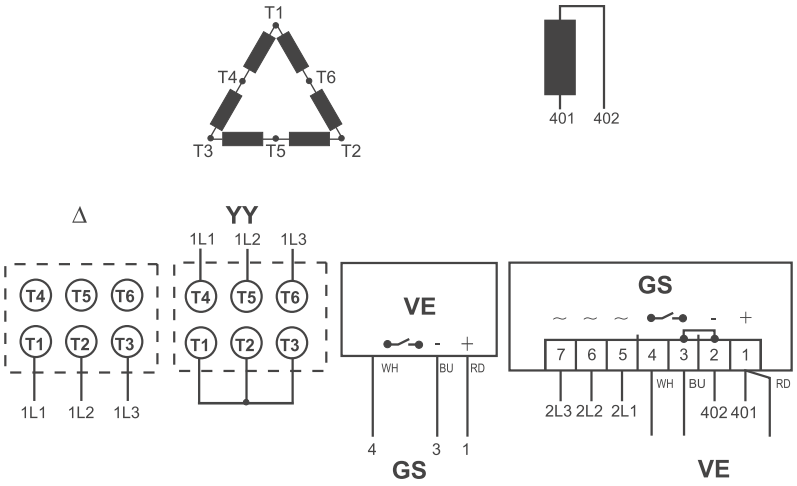
Motor supplied with

- Brake connected to terminals 1 and 2 of the GS module.
- Jumper between terminals 3 and 4 of the GS module.

Important **The brake will not function without a separate power supply to terminals 5, 6 and 7 of the GS module.**

038 031 84

Motor for one line voltage, Pole-changing, Dahlander winding



03803284.eps

Δ for low speed
YY for high speed

Switch-over to high speed winding via external supply switch-over and jumper.

Separate power supply to brake.
Maximale Versorgungsspannung 500 V AC.

Voltage-dependent switch-off in the DC circuit.

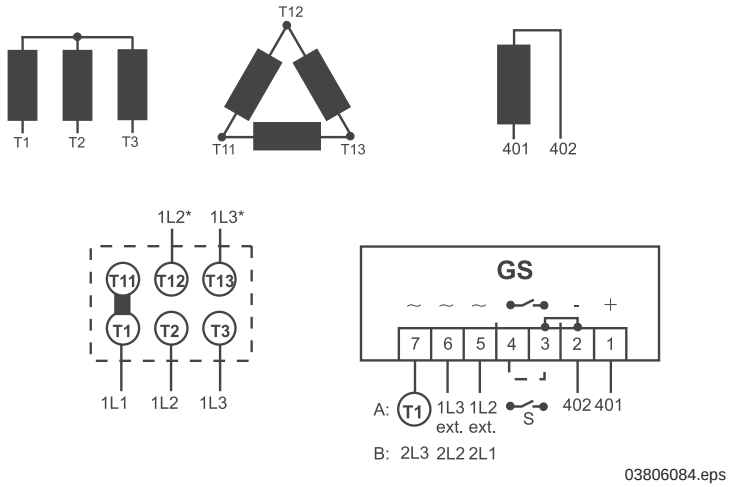
Motor supplied with

- Brake connected to terminals 1 and 2 of the GS module.
- VE module connected to terminals 1, 3 and 4 of the GS module.

Important **The brake will not function without a separate power supply to terminals 5, 6 and 7 of the GE module.**

038 032 84

Motor for one line voltage, pole-changing, separate windings



03806084.eps

* = Supply to high speed winding via external switch-over

T1, T2, T3 for low speed
T11, T12, T13 for high speed

A Common power supply to motor and brake

Not suitable for inverter operation.

B Separate power supply to brake

Motor supplied with

- Jumper parts to connect the motor winding enclosed.
- Brake connected to terminals 1 and 2 of the GS module.
- Jumper between terminals 3 and 4 of the GS module.
- **Line-powered** GS module connected with the motor winding according to variant A (T1 connected to terminal 6; terminals 5 and 6 free).
  Important **The brake will not function without an external power supply to terminals 5 and 6 of the GS module.**
- **Inverter operation** – GS module **not connected** to motor winding
  – Power supply by customer thru variation B

Switch-off in the DC circuit

- Remove jumper between terminals 3 and 4.
- Connect a contactor between terminals 3 and 4.

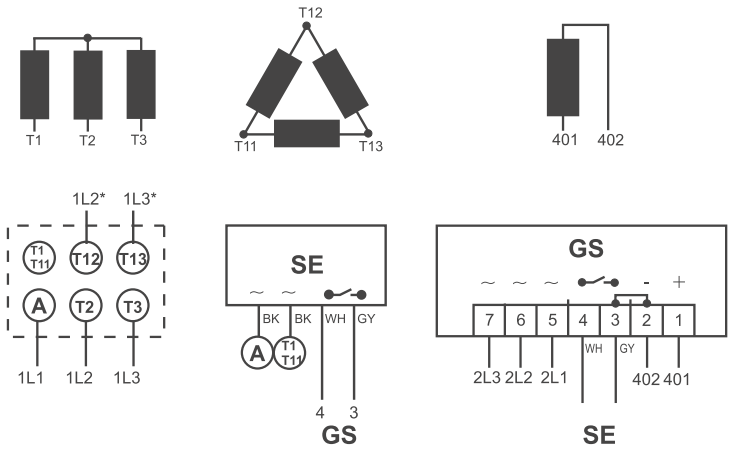
Switch-off in the AC circuit

- Jumper between terminals 3 and 4.
- Contactor in the power line behind terminals 5 and 6.

038 060 84

229203K4.p65/1099

Motor for one line voltage, pole-changing, separate windings



03806184.eps

* = Supply to high speed winding via external switch-over.

T1, T2, T3 for low speed
T11, T12, T13 for high speed

Separate power supply to brake.
Maximale Versorgungsspannung 500 V AC.

Switch-off in the DC circuit dependent on motor current

Not suitable for inverter operation.

Ⓐ **Intermediate terminal**

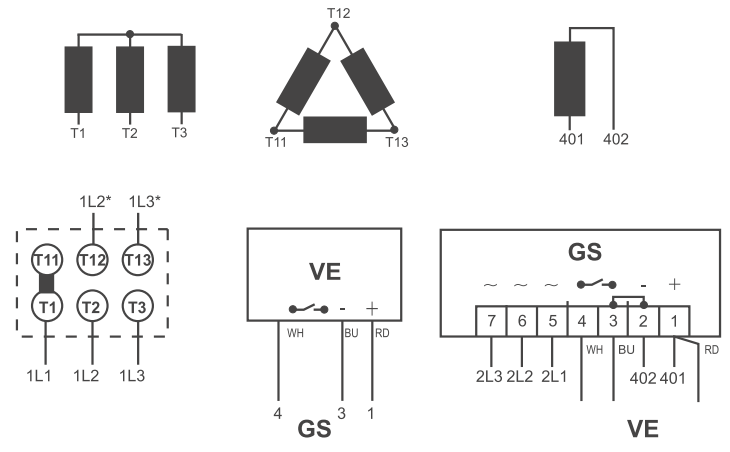
Motor supplied with

- Motor winding connected as in connection diagram (T1 and T11 connected to one terminal).
- Brake connected to terminals 1 and 2 of the GS module.
- SE module connected to terminals 3 and 4 of the GS module.
- SE module connected with the motor winding via intermediate terminal A and terminal T1 T11.

Important **The brake will not function without a separate power supply to terminals 5, 6 and 7 of the GS module.**

038 061 84

Motor for one line voltage, pole-changing, separate windings



03806284.eps

* = Supply to high speed winding via external switch-over.

T1, T2, T3 for low speed
T11, T12, T13 for high speed

Separate power supply to brake.
Maximale Versorgungsspannung 500 V AC.

Voltage-dependent switch-off in the DC circuit

Motor supplied with

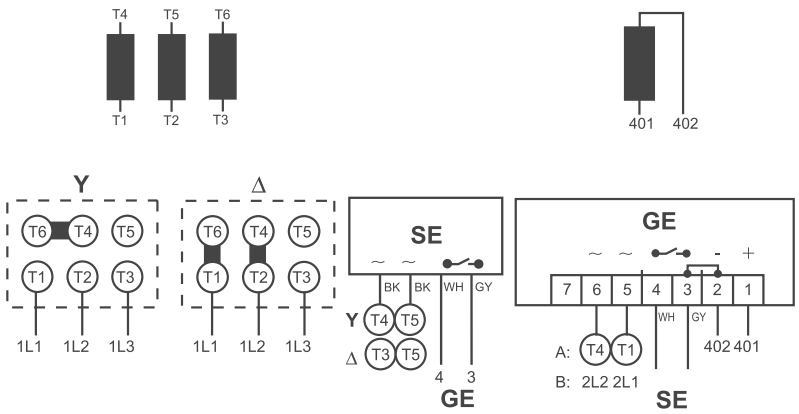
- Jumper parts to connect the motor winding enclosed.
- Brake connected to terminals 1 and 2 of the GS module.
- VE module connected to terminals 1, 3 and 4 of the GS module.

Important **The brake will not function without a separate power supply to terminals 5, 6 and 7 of the GS module.**

038 062 84

Dual voltage motor (1 $\sqrt{3}$)

Y high voltage Δ low voltage



03809184.eps

A Common power supply to motor and brake
Brake coil rated for the low voltage.

Not suitable for inverter operation.

B Separate power supply to brake

Maximale Versorgungsspannung 500 V AC.

Switch-off in the DC circuit dependent on motor current

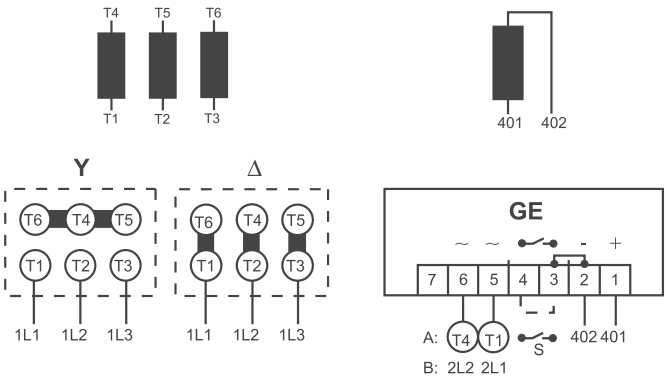
Motor supplied with

- Jumper parts to connect the motor winding with Y or Δ connection enclosed.
- Brake connected to terminals 1 and 2 of the GE module.
- SE module connected to terminals 3 and 4 of the GE module.
- SE module connected with the motor winding according to variant Y.
- GE module connected with the motor winding according to variant A.

038 091 84

Dual voltage motor (1 $\sqrt{3}$)

Y high voltage Δ low voltage



03809284.eps

A Common power supply to motor and brake
Brake coil rated for the low voltage.

Not suitable for inverter operation.

B Separate power supply to brake

Maximale Versorgungsspannung 500 V AC.

For inverter operation, connect the motor with Y or Δ connection according to inverter settings.

Switch-off in the DC circuit

- Remove jumper between terminals 3 and 4.
- Connect a contactor between terminals 3 and 4.

Switch-off in the AC circuit

- Jumper between terminals 3 and 4.
- Contactor in the power line behind terminal 5.

Motor current switch-off

Jumper between terminals 3 and 4
→ **not possible for separate power supply to the brake.**

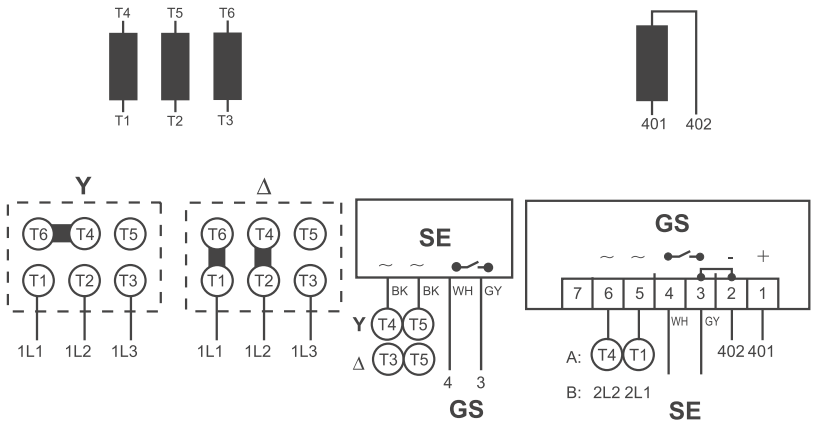
Motor supplied with

- Jumper parts to connect the motor winding with Y or Δ connection enclosed.
- Brake connected to terminals 1 and 2 of the GE module.
- Jumper between terminals 3 and 4 of the GE module.
- **Line-powered** GE module connected with the motor winding according to variant A.
- **Inverter operation** – GE module **not connected** to motor winding
  – Power supply by customer thru variation B

038 092 84

229203K4.p65/1099

Dual voltage motor (1 √3)



03809384.eps

A Common power supply to motor and brake
Brake coil rated for the low voltage.

Not suitable for inverter operation.

B Separate power supply to brake

Maximale Versorgungsspannung 500 V AC.

Switch-off in the DC circuit dependent on motor current

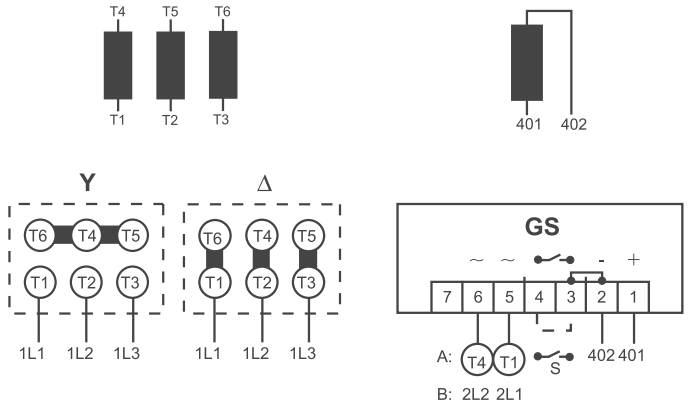
Motor supplied with

- Jumper parts to connect the motor winding with Y or Δ connection enclosed.
- Brake connected to terminals 1 and 2 of the GS module.
- SE module connected to terminals 3 and 4 of the GS module.
- SE module connected with the motor winding according to variant Y.
- GS module connected with the motor winding according to variant A.

038 093 84

Dual voltage motor (1 √3)

Y high voltage Δ low voltage



03809484.eps

A Common power supply to motor and brake
Brake coil rated for the low voltage.

Not suitable for inverter operation.

B Separate power supply to brake

Maximale Versorgungsspannung 500 V AC.

For inverter operation, connect the motor with Y or Δ connection according to inverter settings.

Switch-off in the DC circuit

- Remove jumper between terminals 3 and 4.
- Connect a contactor between terminals 3 and 4.

Switch-off in the AC circuit

- Jumper between terminals 3 and 4.
- Contactor in the power line behind terminal 5.

Motor current switch-off

Jumper between terminals 3 and 4
→ **not possible for separate power supply to the brake.**

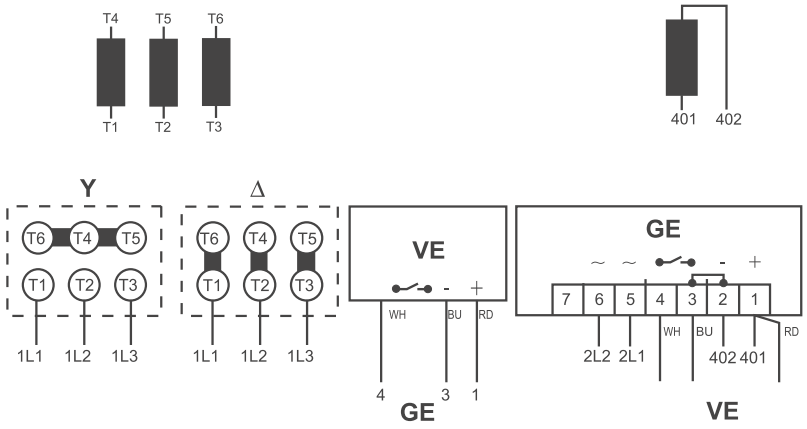
Motor supplied with

- Jumper parts to connect the motor winding with Y or Δ connection enclosed.
- Brake connected to terminals 1 and 2 of the GS module.
- Jumper between terminals 3 and 4 of the GS module.
- **Line-powered** GS module connected with the motor winding according to variant A.
- **Inverter operation** – GS module **not connected** to motor winding
  – Power supply by customer thru variation B

038 094 84

Motor for one line voltage or dual voltage motor (1 $\sqrt{3}$)

Y high voltage Δ low voltage



03809544.eps

Motor supplied with

- Jumper parts to connect the motor winding with Y or Δ connection enclosed.
- Brake connected to terminals 1 and 2 of the GE module.
- VE module connected to terminals 1, 3 and 4 of the GE module.

Important **The brake will not function without a separate power supply to terminals 5 and 6 of the GE module.**

038 095 84

Separate power supply to brake.

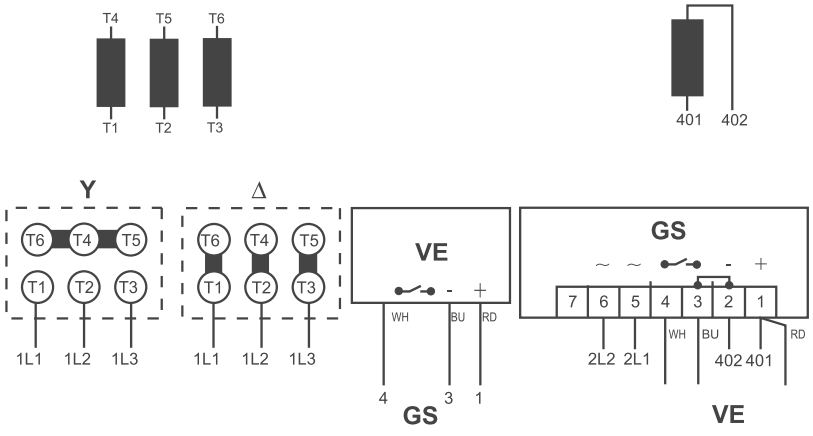
Maximale Versorgungsspannung 500 V AC.

For inverter operation, connect motor with Y or Δ connection according to inverter settings.

Voltage-dependent switch-off in the DC circuit

Motor for one line voltage or dual voltage motor (1 $\sqrt{3}$)

Y high voltage Δ low voltage



03809684.eps

Motor supplied with

- Jumper parts to connect the motor winding with Y or Δ connection enclosed.
- Brake connected to terminals 1 and 2 of the GS module.
- VE module connected to terminals 1, 3 and 4 of the GS module.

Important **The brake will not function without a separate power supply to terminals 5 and 6 of the GS module.**

038 096 84

Separate power supply to brake.

Maximale Versorgungsspannung 500 V AC.

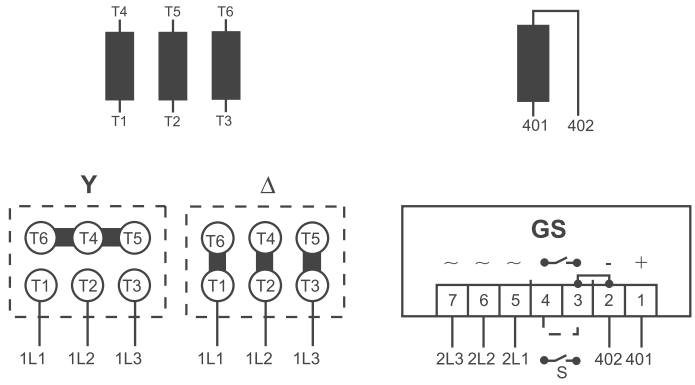
For inverter operation, connect motor with Y or Δ connection according to inverter settings.

Voltage-dependent switch-off in the DC circuit

229203K4.p65/1099

Motor for one line voltage or dual voltage motor (1 $\sqrt{3}$)

Y high voltage Δ low voltage



03809784.eps

Motor supplied with

- Jumper parts to connect the motor winding with Y or Δ connection enclosed.
- Brake connected to terminals 1 and 2 of the GS module.
- Jumper between terminals 3 and 4 of the GS module.
- **Line-powered** GS module connected with the motor winding according to variant A.

  Important **The brake will not function without an external power supply to terminals 5, 6 and 7 of the GS module.**
- **Inverter operation** – GS module **not connected** to motor winding
  – Power supply by customer

Separate power supply to brake.

Maximale Versorgungsspannung 500 V AC.

For inverter operation, connect the motor with Y or Δ connection according to inverter settings.

Switch-off in the DC circuit

- Remove jumper between terminals 3 and 4.
- Connect a contactor between terminals 3 and 4.

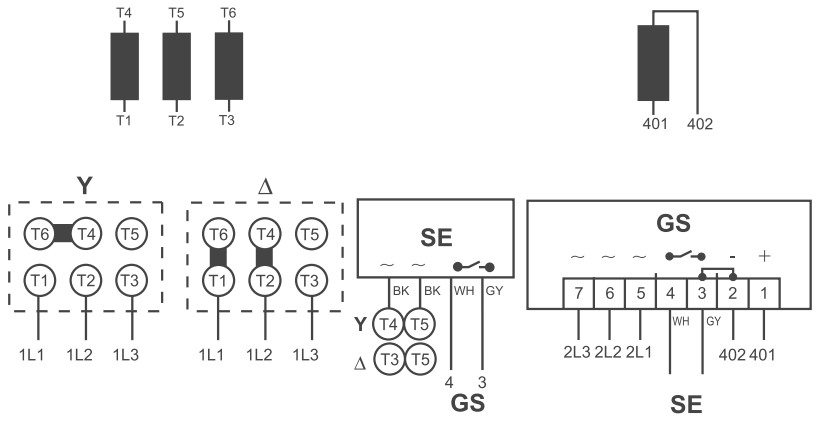
Switch-off in the AC circuit

- Jumper between terminals 3 and 4.
- Contactors in the power lines behind terminals 5 and 6.

038 097 84

Motor for one line voltage or dual voltage motor (1 $\sqrt{3}$)

Y high voltage Δ low voltage



03809884.eps

Motor supplied with

- Jumper parts to connect the motor winding with Y or Δ connection enclosed.
- Brake connected to terminals 1 and 2 of the GS module.
- SE module connected to terminals 3 and 4 of the GS module.
- SE module connected with the motor winding according to variant Y.
- GS module connected with the motor winding according to variant A.

Separate power supply to brake

Not suitable for inverter operation.

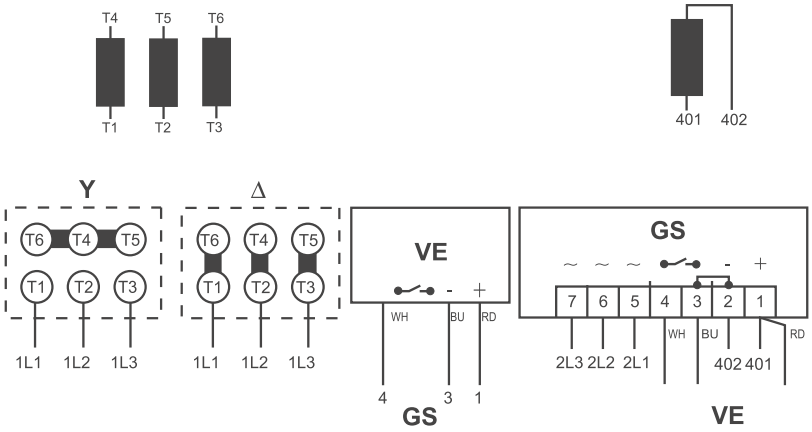
Maximale Versorgungsspannung 500 V AC.

Switch-off in the DC circuit dependent on motor current

038 098 84

Motor for one line voltage or dual voltage motor (1 $\sqrt{3}$)

Y high voltage Δ low voltage



03809984.eps

Separate power supply to brake.

Maximale Versorgungsspannung 500 V AC.

For inverter operation, connect the motor with Y or Δ connection according to inverter settings.

Voltage-dependent switch-off in the DC circuit

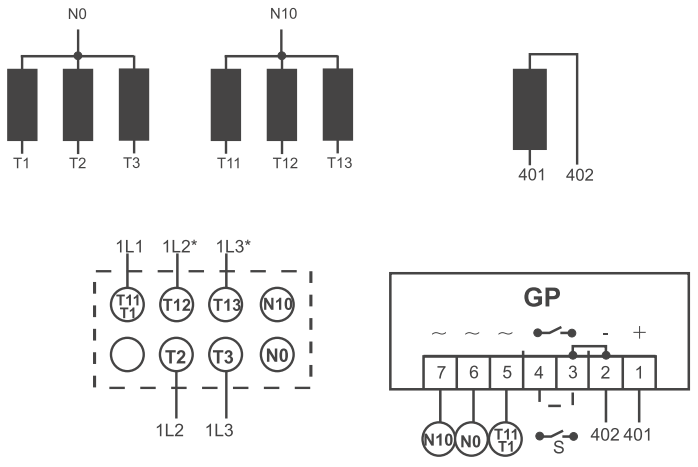
Motor supplied with

- Jumper parts to connect the motor winding with Y or Δ connection enclosed.
- Brake connected to terminals 1 and 2 of the GS module.
- VE module connected to terminals 1, 3 and 4 of the GS module.

Important **The brake will not function without a separate power supply to terminals 5, 6 and 7 of the GS module.**

038 099 84

Motor for one line voltage, pole-changing, separate windings Common power supply to motor and brake



03810084.eps

* = Supply to high speed winding via external switch-over.

T1, T2, T3 for low speed
T11, T12, T13 for high speed

Not suitable for inverter operation

Switch-off in the DC circuit

- Remove jumper between terminals 3 and 4
- Connect contactor between terminals 3 and 4

Switch-off in the AC circuit

- Jumper between terminals 3 and 4
- Schützkontakt in die Zuleitung zur Klemme 5

Motor current switch-off

Jumper between terminals 3 and 4

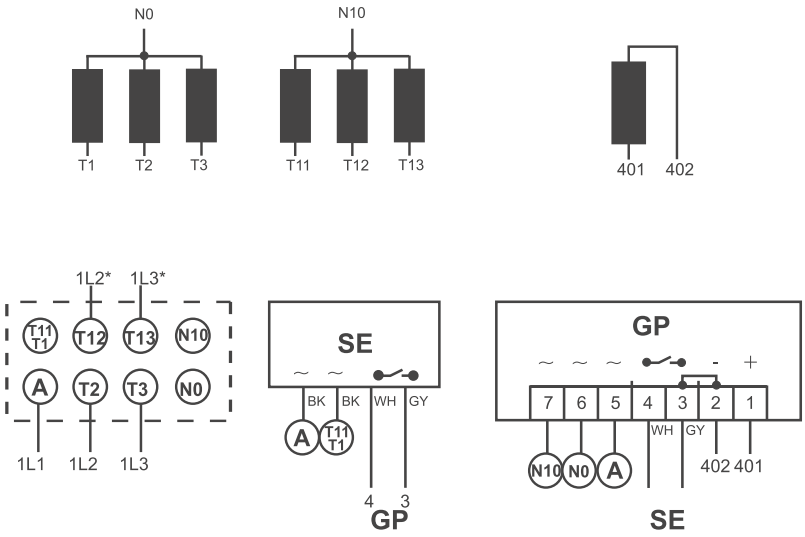
Motor supplied with

- Brake connected to terminals 1 and 2 of the GP module.
- Jumper between terminals 3 and 4 of the GP module.
- GP module connected with the motor winding as in the connection diagram.

038 100 84

229203k4.p65/1099

Motor for one line voltage, pole-changing, separate windings
Common power supply to motor and brake



03810184.eps

* = Supply to high speed winding via external switch-over.

T1, T2, T3 for low speed
T11, T12, T13 for high speed

Switch-off in the DC circuit dependent on motor current

Not suitable for inverter operation.

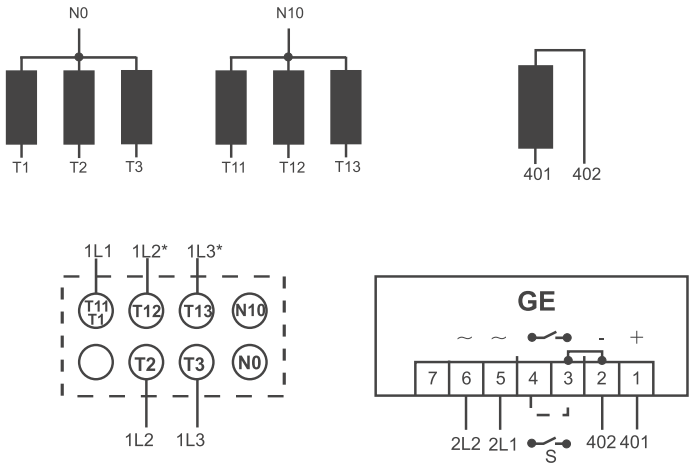
(A) **Intermediate terminal**

Motor supplied with

- Motor winding connected as in connection diagram (T1 and T11 connected to one terminal).
- Brake connected to terminals 1 and 2 of the GP module.
- SE module connected to terminals 3 and 4 of the GP module.
- SE module connected with intermediate terminal A and the motor winding via terminal T1 T11.
- GP module connected with the motor winding and intermediate terminal A as in the connection diagram.

038 101 84

Motor for one line voltage, pole-changing, separate windings



03810284.eps

* = Supply to high speed winding via external switch-over

T1, T2, T3 for low speed
T11, T12, T13 for high speed

Separate power supply to brake, Spannung max. 500 V AC

Switch-off in the DC circuit

- Remove jumper between terminals 3 and 4.
- Connect a contactor between terminals 3 and 4.

Switch-off in the AC circuit

- Jumper between terminals 3 and 4.
- Schützkontakt in die Zuleitung zur Klemme 5

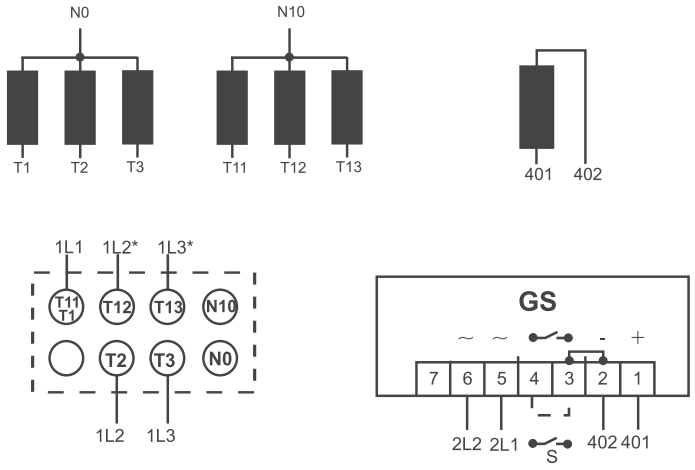
Motor supplied with

- Motorwicklung wie im Anschlußplan angeschlossen.
- Brake connected to terminals 1 and 2 of the GE module.
- Jumper between terminals 3 and 4 of the GE module.

Important **The brake will not function without an external power supply to terminals 5 and 6 of the GE module.**

038 102 84

Motor for one line voltage, pole-changing, separate windings



03810384.eps

* = Supply to high speed winding via external switch-over

T1, T2, T3 for low speed
T11, T12, T13 for high speed

Separate power supply to brake, Spannung max. 500V AC

Switch-off in the DC circuit

- Remove jumper between terminals 3 and 4.
- Connect a contactor between terminals 3 and 4.

Switch-off in the AC circuit

- Jumper between terminals 3 and 4.
- Contactor in the power line behind terminal 5.

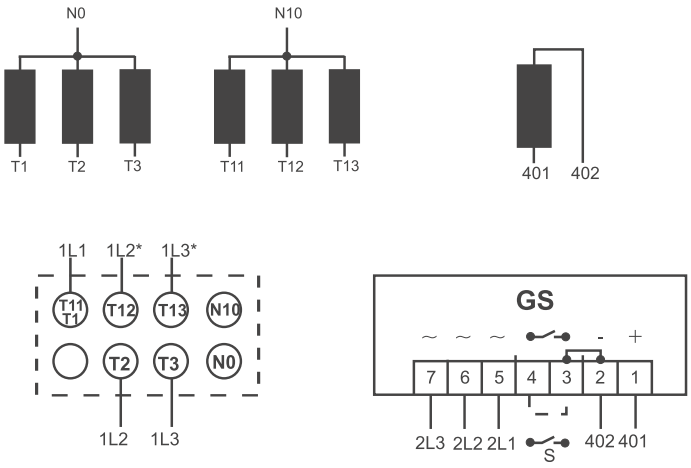
Motor supplied with

- Motorwicklung wie im Anschlußplan angeschlossen.
- Brake connected to terminals 1 and 2 of the GS module.
- Jumper between terminals 3 and 4 of the GS module.

Important **The brake will not function without an external power supply to terminals 5 and 6 of the GS module.**

038 103 84

Motor for one line voltage, pole-changing, separate windings



03810484.eps

* = Supply to high speed winding via external switch-over

T1, T2, T3 for low speed
T11, T12, T13 for high speed

Separate power supply to brake, Spannung max. 500V AC

Switch-off in the DC circuit

- Remove jumper between terminals 3 and 4.
- Connect a contactor between terminals 3 and 4.

Switch-off in the AC circuit

- Jumper between terminals 3 and 4.
- Contactor in the power line behind terminal 5 and 6.

Motor supplied with

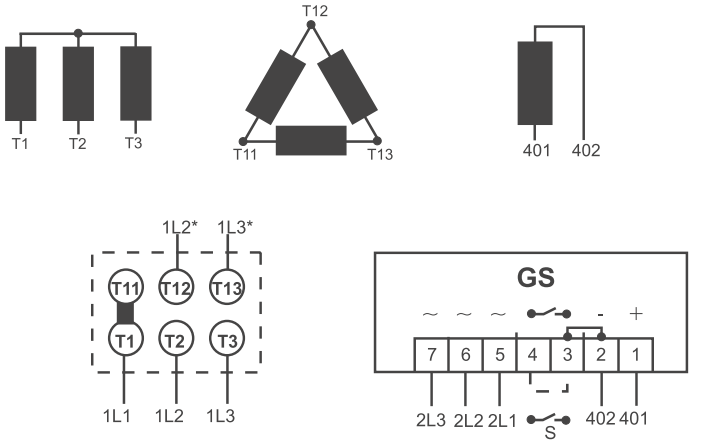
- Motorwicklung wie im Anschlußplan angeschlossen.
- Brake connected to terminals 1 and 2 of the GS module.
- Jumper between terminals 3 and 4 of the GS module.

Important **The brake will not function without an external power supply to terminals 5, 6 and 7 of the GS module.**

038 104 84

229203k4.p65/1099

Motor for one line voltage, pole-changing, separate windings



03810584.eps

* = Supply to high speed winding via external switch-over

T1, T2, T3 for low speed
T11, T12, T13 for high speed

Separate power supply to brake, Voltage max. 500V AC

Switch-off in the DC circuit

- Remove jumper between terminals 3 and 4.
- Connect a contactor between terminals 3 and 4.

Switch-off in the AC circuit

- Jumper between terminals 3 and 4.
- Contactor in the power line behind terminal 5 and 6.

Motor supplied with

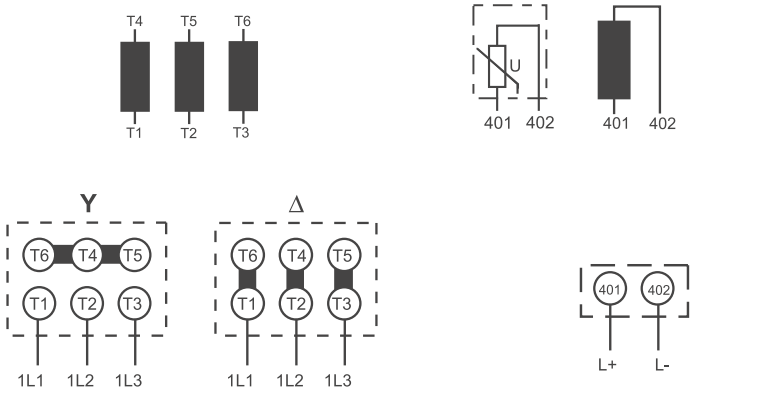
- Jumper parts to connect the motor winding enclosed.
- Brake connected to terminals 1 and 2 of the GS module.
- Jumper between terminals 3 and 4 of the GS module.

Important **The brake will not function without an external power supply to terminals 5, 6 and 7 of the GS module.**

038 105 84

Motor for one line voltage or dual voltage motor (1 $\sqrt{3}$)

Y high voltage Δ low voltage



03810684.eps

Separate DC supply to brake

For inverter operation, connect motor with Y or Δ connection according to inverter settings.

Motor supplied with

- Jumper parts to connect the motor winding with Y or Δ connection enclosed.
- Brake connected to Euro terminals.

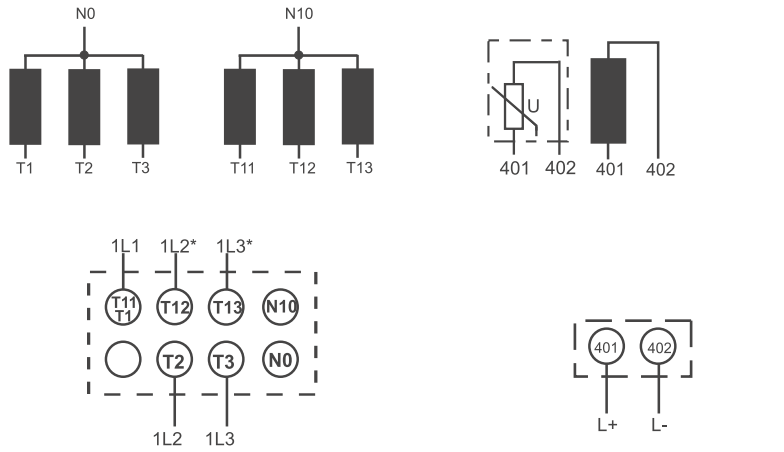
Important **The brake will not function without a separate DC supply to the brake.**

038 106 84

Motor for one line voltage, pole-changing, separate windings
Separate DC supply to brake

* = Supply to high speed winding via external switch-over.

T1, T2, T3 for low speed
T11, T12, T13 for high speed



03810784.eps

Motor supplied with

- Motor winding connected as in connection diagram.
- Brake connected to Euro terminals.

Important **The brake will not function without a separate DC supply to the brake**

038 107 84

Motor for one line voltage, pole-changing, separate windings
Separate power supply to brake

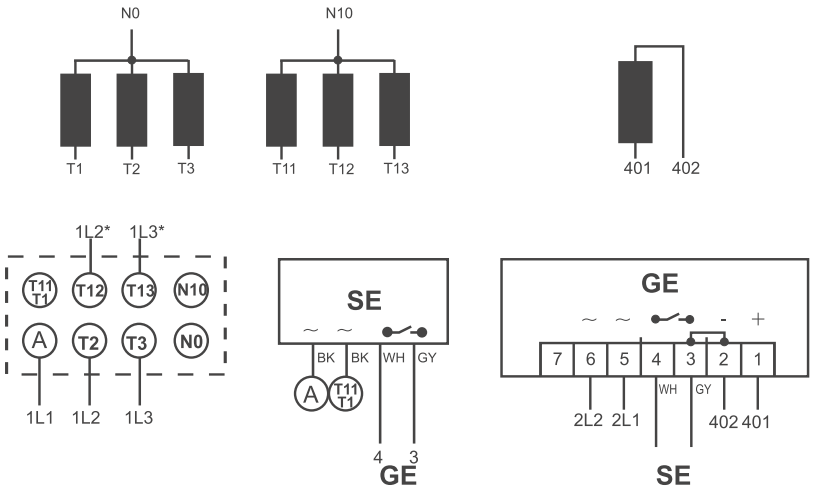
* = Supply to high speed winding via external switch-over.

T1, T2, T3 for low speed
T11,T12, T13 for high speed

Switch-off in the DC circuit dependent on motor current

Not suitable for inverter operation

Ⓐ **Intermediate terminal**



03810884.eps

Motor supplied with

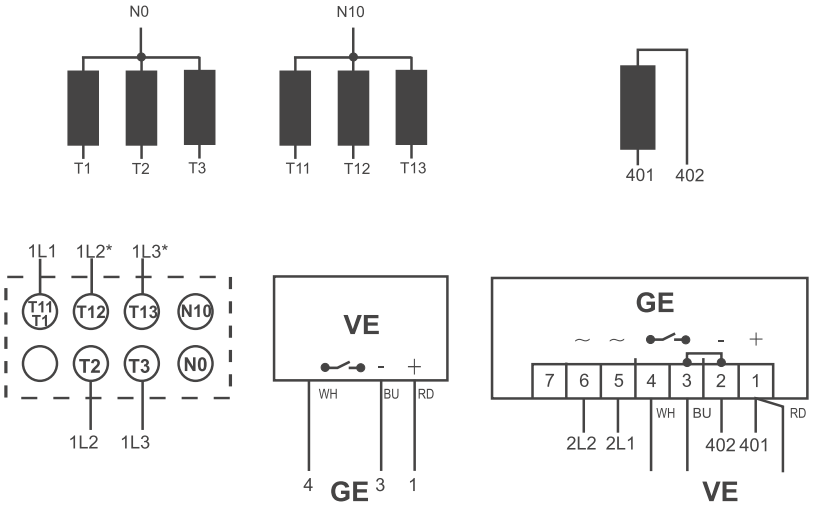
- Motor winding connected as in connection diagram (T1 and T11 connected to one terminal).
- Brake connected to terminals 1 and 2 of the GE module.
- SE module connected to terminals 3 and 4 of the GE module.
- SE module connected with the motor winding via intermediate terminal A and terminal T1 T11.

Important **The brake will not function without a separate power supply to terminals 5 and 6 of the GE module.**

038 108 84

229203k4.p65/1099

Motor for one line voltage, pole-changing, separate windings



03810984.eps

* = Supply to high speed winding via external switch-over

T1, T2, T3 for low speed
T11, T12, T13 for high speed

Voltage-dependent switch-off in the DC circuit

Separate power supply to brake, Voltage max. 500V AC

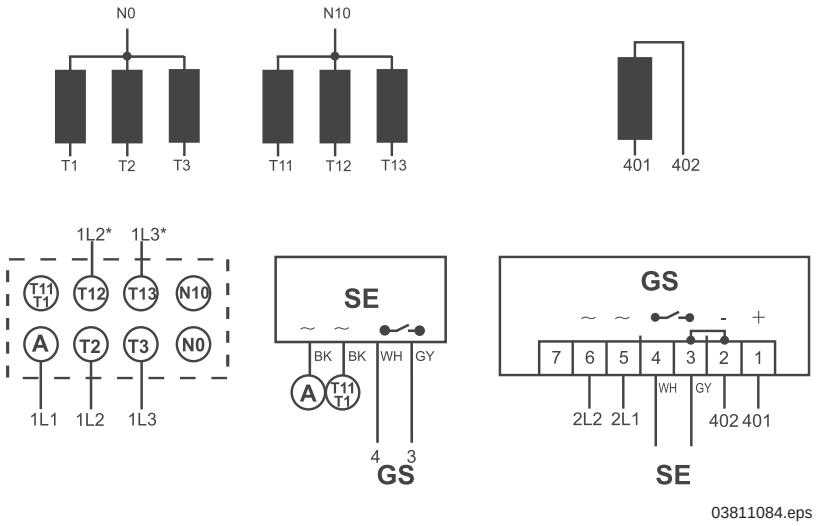
Motor supplied with

- Motor winding connected as in connection diagram.
- Brake connected to terminals 1 and 2 of the GE module.
- VE module connected to terminals 1, 3 and 4 of the GE module.

Important **The brake will not function without a separate power supply to terminals 5 and 6 of the GE module.**

038 109 84

Motor for one line voltage, pole-changing, separate windings



03811084.eps

* = Supply to high speed winding via external switch-over.

T1, T2, T3 for low speed
T11, T12, T13 for high speed

Switch-off in the DC circuit dependent on motor current

Not suitable for inverter operation

Separate power supply to brake, Voltage max. 500V AC

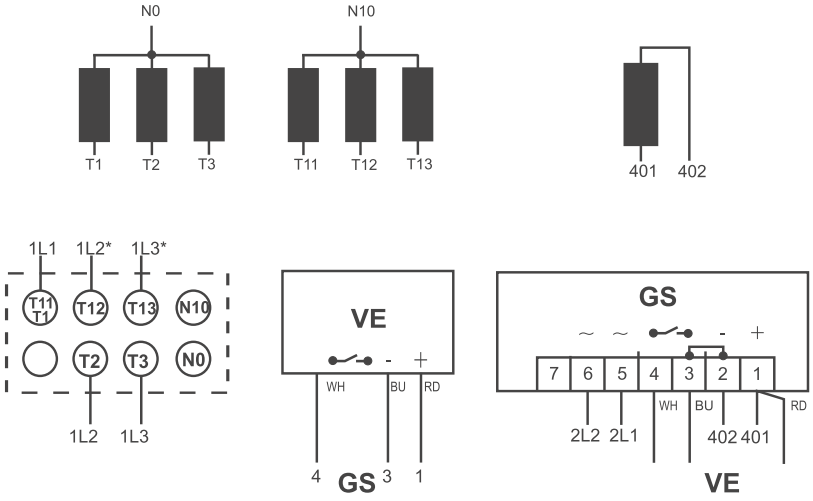
Motor supplied with

- Motor winding connected as in connection diagram (T1 and T11 connected to one terminal).
- Brake connected to terminals 1 and 2 of the GS module.
- SE module connected to terminals 3 and 4 of the GS module.
- SE module connected with the motor winding via intermediate terminal A and terminal T1 T11.

Important **The brake will not function without a separate power supply to terminals 5 and 6 of the GS module.**

038 110 84

Motor for one line voltage, pole-changing, separate windings



03811184.eps

* = Supply to high speed winding via external switch-over.

T1, T2, T3 for low speed
T11, T12, T13 for high speed

Voltage-dependent switch-off in the DC circuit

Separate power supply to brake, Voltage max. 500V AC

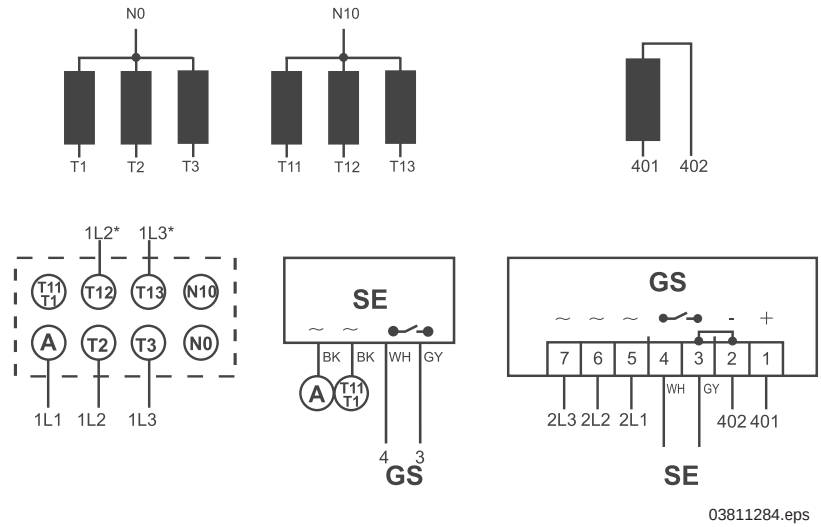
Motor supplied with

- Motor winding connected as in connection diagram.
- Brake connected to terminals 1 and 2 of the GS module.
- VE module connected to terminals 1, 3 and 4 of the GS module.

Important **The brake will not function without a separate power supply to terminals 5 and 6 of the GS module.**

038 111 84

Motor for one line voltage, pole-changing, separate windings



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* = Supply to high speed winding via external switch-over.

T1, T2, T3 for low speed
T11, T12, T13 for high speed

Switch-off in the DC circuit dependent on motor current

Not suitable for inverter operation

Separate power supply to brake, Voltage max. 500V AC

Ⓐ Intermediate terminal

Motor supplied with

- Motor winding connected as in connection diagram (T1 and T11 connected to one terminal).
- Brake connected to terminals 1 and 2 of the GS module.
- SE module connected to terminals 3 and 4 of the GS module.
- SE module connected with the motor winding via intermediate terminal A and terminal T1 T11.

Important **The brake will not function without a separate power supply to terminals 5, 6 and 7 of the GS module.**

038 112 84

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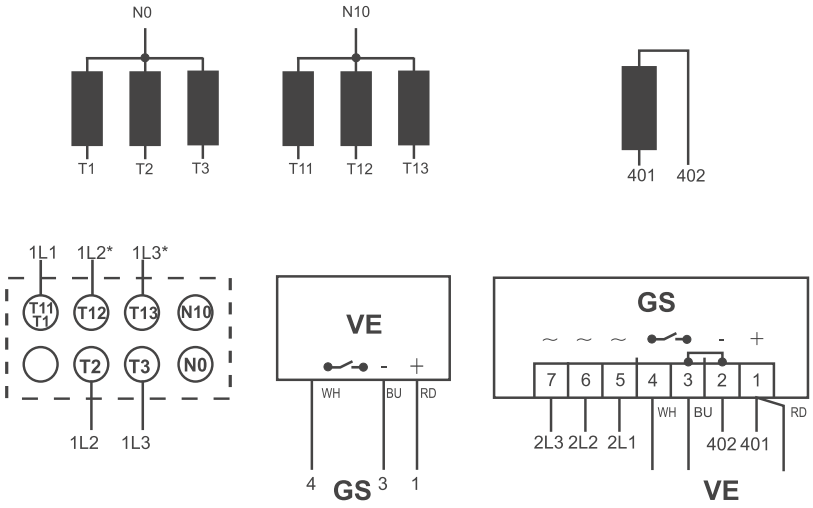
Motor for one line voltage, pole-changing, separate windings



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* = Supply to high speed winding via external switch-over

T1, T2, T3 for low speed
T11, T12, T13 for high speed

Voltage-dependent switch-off in the DC circuit

Separate power supply to brake, Voltage max. 500 V AC

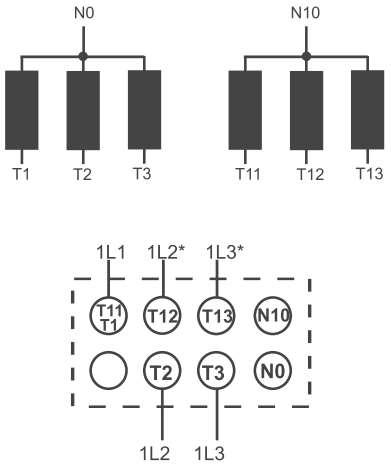
Motor supplied with

- Motor winding connected as in connection diagram.
- Brake connected to terminals 1 and 2 of the GS module.
- VE module connected to terminals 1, 3 and 4 of the GS module.

Important **The brake will not function without a separate power supply to terminals 5, 6 and 7 of the GS module.**

038 113 84

Motor for one line voltage, pole-changing, separate windings



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* = Supply to high speed winding via external switch-over

T1, T2, T3 for low speed
T11, T12, T13 for high speed

Motor supplied with

Motor winding connected as in connection diagram.

038 114 84

7.8 Connecting temperature and brake monitoring devices

Depending on the motor features, the connections for temperature monitoring and/or brake monitoring are brought out on Euro terminals in the terminal box.

The following connection designations are used:

PTC thermistor

– Switch-off: **P1 - P2** and **P21 - P22**
– Warning: **P11 - P12**

Important PTC thermistors to DIN 44081 are suitable for tripping devices with 2.5 V DC output voltage and 4 kΩ tripping resistance.
PTC thermistors may only be continuity tested with max. 2.5 V DC. Do not use a buzzer (voltage peaks) or similar devices. The resistance of **one** PTC thermistor is 20 ... 250 Ω at temperatures of –20 °C to ϑ_{TNF} – 20K. (TNF = rated operating temperature).

Temperature detector (bimetallic switch) **P1 – P2**

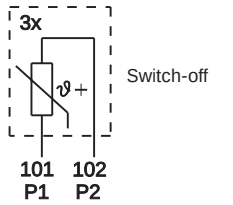
Brake monitoring

– Release monitoring: **801 – 802 – 803**
Contact 2 (802 – 803) closed:
Brake not released, brake in applied position
Contact 4 (801 – 803) closed:
Brake released

– Adjustment monitoring: **804 – 805 – 806**
Contact 2 (805 – 806) closed:
Brake must be adjusted
Contact 4 (804 – 806) closed:
Normal operating condition

The diagrams below show the most important single connections.
When several monitoring devices are used (such as temperature detectors for the motor and release monitoring for the brake), the individual circuits are combined in one connection diagram which can be found inside the motor terminal box.

PTC thermistor



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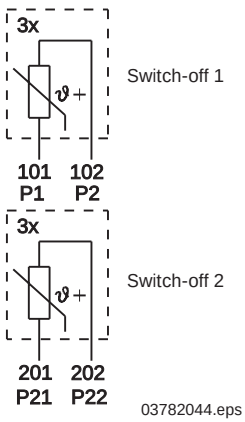
PTC thermistor



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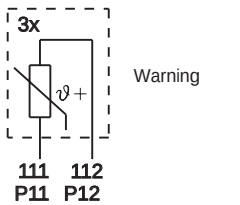
PTC thermistor



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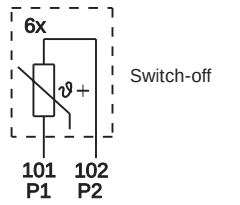
PTC thermistorr



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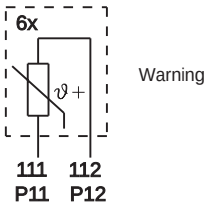
PTC thermistor



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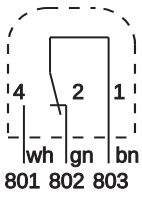
Brake monitoring
Release monitoring



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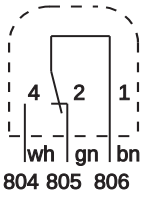
Brake monitoring
Ad ustment monitoring



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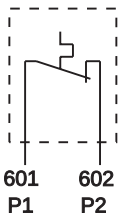
Temperature detector



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8 Technical data

Function conditions for standard design			
Conditions		**range**	
Transport temperature		–20 ... +40°C (–4 to +104°F)	
Storage temperature		0 ... +40°C (+32 to +104°F)	
Storage conditions		Dry, indoors	
Ambient operating temperature		–20 ... +40°C (–4 to +104°F)	
Environment		Acid-free	
Coolant		Air	
Coolant temperature		max. +40°C (+104°F)	
Temperature rise limit of winding		105 K	
Installation site height		max. 1000 m (3300 ft) above sea level	
Air circuit		Ensure by working clearance, unrestricted air intake	
Enclosure		IP 54	
Mounting arrangement		Low vibration	
Working clearance at fan end		150 mm (5.91 in) at rear	
Line voltage	USA:	480 V 60 Hz (two speeds)	240/480 V 60 Hz (one speed)
	Canada:	575 V 60 Hz (two speeds)	330/575 V 60 Hz (one speed)
Voltage tolerance		±10% of the line voltage	
Max. speed		3600 rpm	

9 Troubleshooting

Pos.	Problem	Possible cause	Solution
1	Motor does not start.	Fuse has tripped.	Replace fuse.
		Power supply line interrupted	Check connections.
		Motor protection has tripped.	Check motor protection for correct setting.
		Control defective.	Check motor connection.
		Brake does not release.	See section 9 **Brake does not release**
2	Motor does not start or starts slowly.	USA: Motor for YY connection connected in star	Correct motor connection.
		Canada: Motor for Δ connection connected in star	
		Extreme voltage or frequency deviation from setpoint value.	Improve quality of power supply; check power supply line cross-section.
3	Motor runs in wrong direction.	Motor incorrectly connected.	Interchange two supply leads.
4	Motor hums and has high power consumption.	Winding defective.	Motor must be sent to specialist workshop for repair.
5	Fuses trip or motor protection trips immediately.	Short-circuit in the supply line.	Eliminate short-circuit.
		Short-circuit in the motor.	Motor must be sent to specialist workshop for repair.
		Power supply cable incorrectly connected.	Correct connection.
		Short-circuit to ground in the motor.	Motor must be sent to specialist workshop for repair.
6	Extreme loss of speed under load.	Overload.	Measure power, use larger motor or reduce load, if necessary.
		Voltage drop.	Increase power supply line cross section.
7	Excessive motor temperature rise (measure temperature).	Overload.	Measure power, use larger motor or reduce load, if necessary.
		Insufficient cooling.	Correct cooling air circulation or clear air circulation channels, fit separate fan, if necessary.
		Separate fan not running.	Check connection, correct if necessary.
		Ambient temperature too high.	Reduce power, use larger motor, if necessary
		USA: YY connection instead of star connection as specified.	Correct connection.
		Canada: Δ connection instead of star connection as specified.	
		Temporary two-phase operation.	Intermittent electrical contact in the power supply line.
		Fuse has tripped.	Replace fuse.
		Mains voltage differs from the rated motor voltage by more than 10%. Higher voltages are particularly unfavourable for low-speed motors as their no-load current is close to the rated current even at normal voltage.	Match motor to power supply voltage.
		Duty type exceeded, e.g. starting frequency too high.	Adapt operating conditions to corresponding motor duty type.
8	Excessive noise.	Friction bearing distorted, dirty or damaged.	Realign motor, inspect friction bearings, replace if necessary.
		Rotating parts vibrating.	Correct any imbalance.
		Foreign bodies in cooling air circuit.	Clean cooling air circuit.
9	Brake does not release	Incorrect voltage applied to brake control unit.	Apply correct voltage (see rating plate).
		Brake control unit failure.	Change brake control unit, check brake coil (resistance), check switchgear.
		Max. permissible air gap exceeded because the brake lining is worn out.	Adjust the brake (replace the complete brake lining carrier if the lining is worn out).
		Voltage drop in the power supply line > 10 %.	Ensure correct supply voltage is applied.
		Brake coil short-circuit with the winding or housing.	Change complete brake with control unit (specialist workshop), check switchgear.
10	Motor does not brake.	Brake lining worn out.	Replace the complete brake lining carrier
		Manual brake release device incorrectly adjusted.	Set adjusting nuts to correct setting.
		Manual brake release device locked.	Release lock, remove lever.
		Incorrect brake torque.	Change brake torque.

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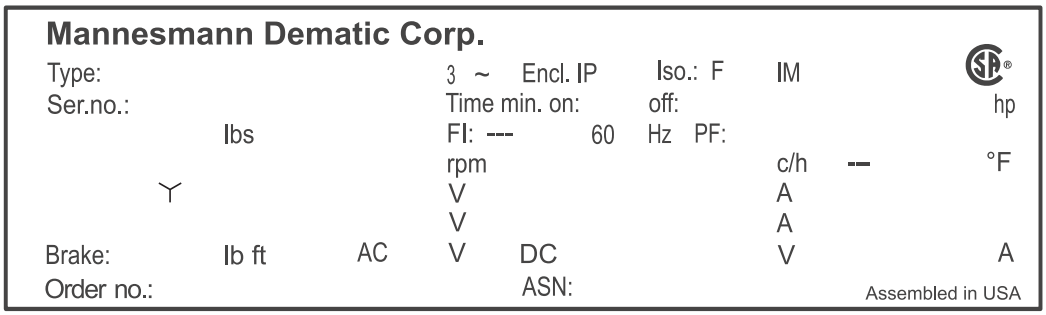
10 Forms for documenting the installation, rating plates

.. 63 A to .. 71 B motors, with without brake

Installation designation



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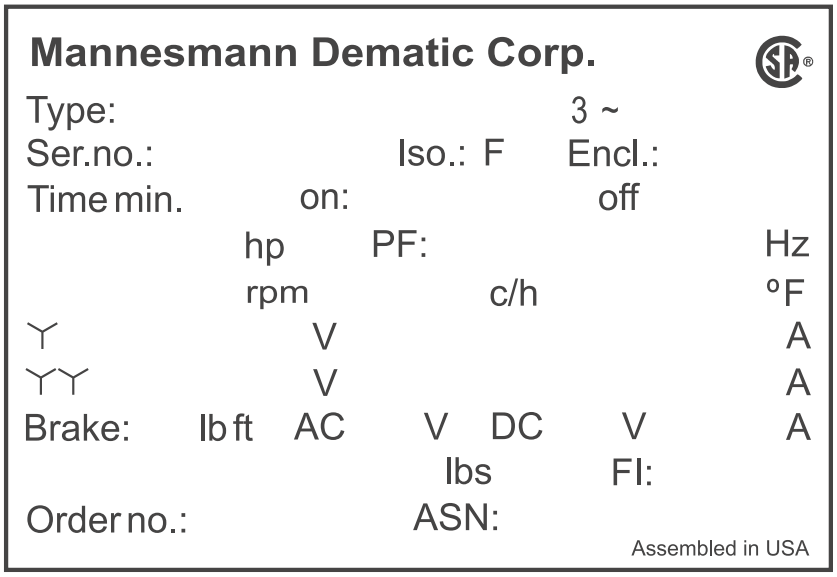
.. 80 A bis .. 132 C motors, with without brake

Installation designation



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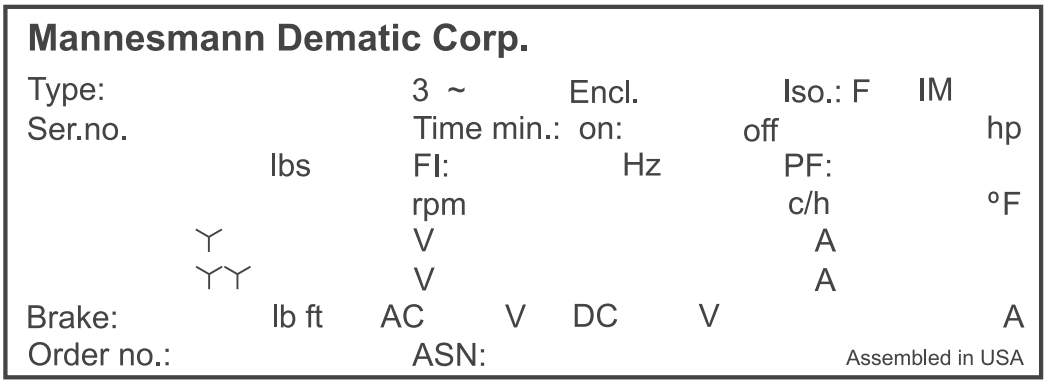
.. 160 A bis .. 225 B motors, with without brake

Installation designation



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Improvements will be incorporated without prior notice

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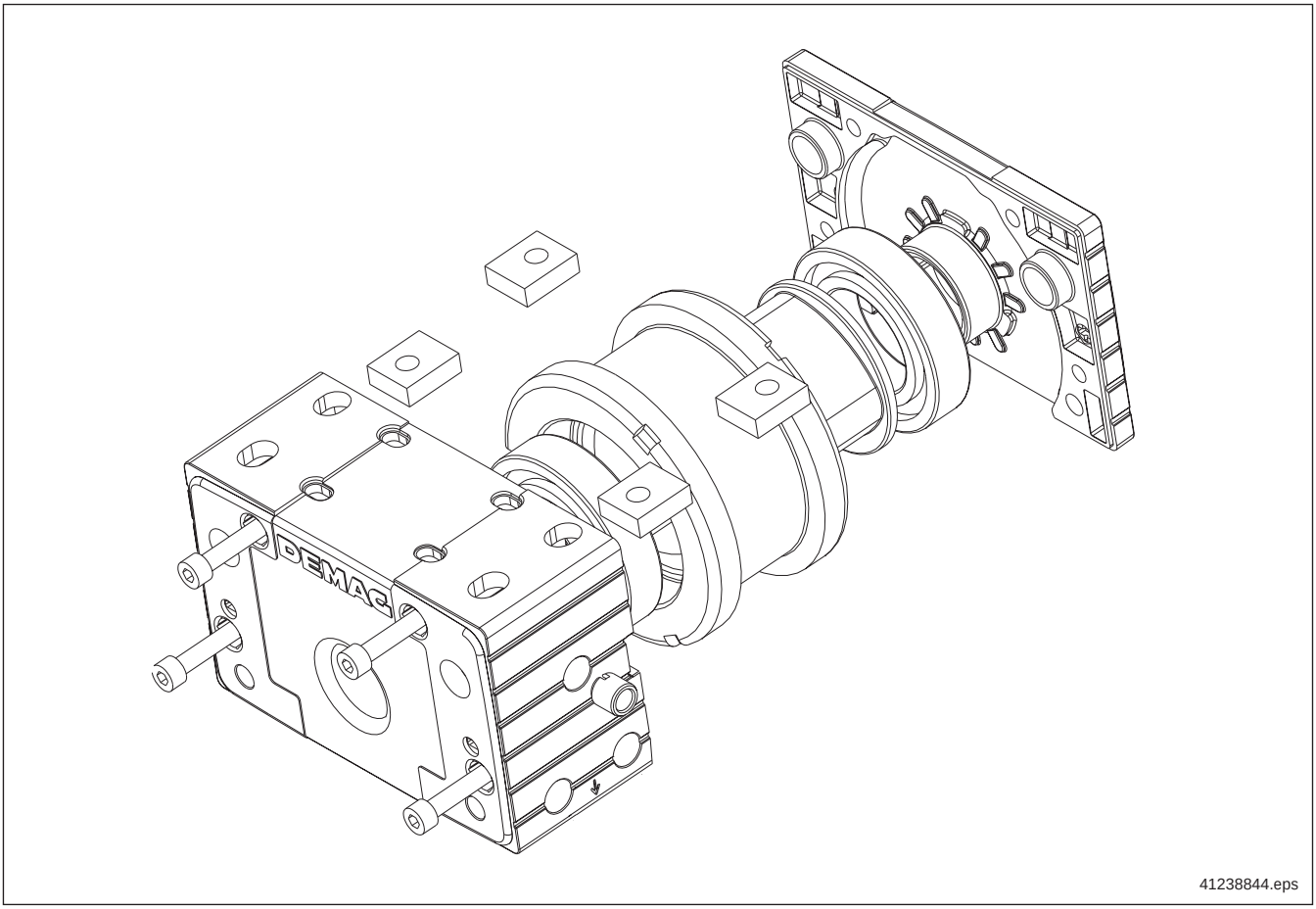
Dematic

Assembly, installation and operating instructions

DRS 112, 125, 160, 200 wheel block system



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Manufacturer

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Internet http://www.dematic.com

Further literature

Document	Ident. no.			
	DE	EN	FR	ES
Geared motors for travel drive applications Demag DRS wheel block system - with price code (volume 1)	203 351 44	203 352 44	203 353 44	203 354 44
Geared motors for travel drive applications Demag DRS wheel block system - with price code (volume 2)		203 356 44		--
Components parts lists for wheel blocks sizes 112 - 200				
DRS 112	222 912 44	222 913 44	222 914 44	222 915 44
DRS 125	222 916 44	222 917 44	222 918 44	222 919 44
DRS 160	222 920 44	222 921 44	222 922 44	222 923 44
DRS 200	222 924 44	222 925 44	222 926 44	222 927 44

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0 Foreword

You have purchased a Mannesmann Dematic product. This equipment was manufactured in accordance with state-of-the-art engineering principles.

These operating instructions are designed to provide the operator with appropriate instructions for safe and correct operation and to facilitate maintenance.

Every individual given the task of transporting, installing, commissioning, operating, maintaining and repairing our DRS wheel block system and additional equipment must have read and understood

- the operating instructions
- the safety regulations and
- safety instructions in the individual chapters and sections.

The operating instructions must be available to the operating personnel at all times in order to prevent operating errors and to ensure smooth and trouble-free operation of our products.

0.1 Copyright

These operating instructions must be treated confidentially. They should only be used by authorized personnel. They may only be entrusted or made available to third parties with the prior written consent of Mannesmann Dematic. All documents are protected within the sense of copyright law.

No part of this documentation may be reproduced, utilized or transmitted without specific prior consent. Infringements are an offence resulting in obligatory compensatory damages. All industrial rights reserved.

0.2 After-sales service

For technical information on Mannesmann Dematic products and their systematic application, please refer to one of our after-sales service stations, the relevant representative or to our main office in Wetter.

0.3 Guarantee

These operating instructions must be read carefully before installing and putting the product into operation.

We assume no liability for damage and malfunctions resulting from failure to comply with the operating instructions.

Wearing parts are not subject to the guarantee, guarantee claims must be made by quoting the order number to Mannesmann Dematic immediately on detecting the defect.

The guarantee is cancelled, for example, in the event of:

- inappropriate use,
- faulty devices or equipment connected or attached to the product which are not part of our scope of supplies and services,
- use of non-genuine spare parts and accessories,
- refurbishment or modification of the product unless approved in writing by Mannesmann Dematic.

0.4 Limitations of liability

All technical information, data and instructions for operation contained in these operating instructions were up-to-date on going to print and are compiled on the basis of our experience and to the best of our knowledge.

We reserve the right to incorporate technical modifications within the scope of further development of the hoist units which are the subject of these operating instructions. The information, illustrations and descriptions contained in these operating instructions are therefore only intended for information purposes.

The descriptions and illustrations contained in this documentation do not necessarily correspond to the scope of delivery or any subsequent spare part delivery, either; the drawings and illustrations are not to scale.

Only documentation belonging to the actual order is valid.

We assume no liability for defects, damage and malfunctions caused as a result of operating errors, noncompliance with these operating instructions or omitted and/or inappropriate repairs and maintenance.

We expressly point out that only Mannesmann Dematic spare parts and accessories approved by us may be used. Accordingly, this also applies to other manufacturers' parts supplied by us.

For safety reasons, the fitting and use of spare parts or accessories which have not been approved and unauthorized modification and conversion of the hoist unit are not permitted; we assume no liability for defects or damages resulting therefrom.

With the exclusion of any further claims, our warranty and liability obligations for any defects pertaining to the products supplied or faults in the documentation delivered or any negligence on our part are exclusively based on the stipulations of the original contract. Any further claims, in particular any and all claims for damages, are excluded with the exception of legal claims in accordance with product liability legislation.

0.5 Definitions

Owner

Owners (employer, company) are defined as persons who own the product and who use it appropriately or allow it to be operated by suitable persons.

Operating personnel

Operating personnel are defined as persons assigned by the owner of the product to carry out special tasks such as installation, operation, setting-up, maintenance including cleaning, fault elimination and transportation of the product.

Specialist personnel

Specialist personnel are defined as persons assigned by the owner to carry out specific tasks.

- **ualified personnel**

  Qualified personnel are defined as persons, who, owing to their technical training, knowledge and experience as well as knowledge of the relevant standards, are able to assess the tasks given to them and identify potential hazards.

- **Trained person**

  Trained persons are defined as persons who have been instructed and trained for the tasks assigned to them and on the possible hazards resulting from incorrect handling and who have been informed about the required protective devices, protective measures, relevant regulations, codes of practice, accident prevention regulations and operating conditions and who have proven their qualifications.

- **Experienced technician**

  Experienced technicians are defined as persons, who, owing to their technical training and experience, have sufficient knowledge of the product and are familiar with the relevant national industrial safety regulations, codes of practice, accident prevention regulations, directives and generally accepted engineering standards (e.g. EC Directives, German VDE and VBG regulations) enabling them to judge the safe operating condition of the DRS wheel block system.

1 Safety

1.1 Symbols

The following symbols and recommendations indicate potential safety hazards or causes of damage:

a ard warning

This symbol appears in the operating instructions next to all instructions relating to safety at work wherever a potential hazard to life and limb exists if the instructions are not complied with.

Follow these instructions at all times and be particularly careful and cautious.

Pass on safety instructions to all persons entrusted with working on the product including the power supply.

In addition to the safety instructions, observe all general safety regulations and codes of practise at all times.

Warning against electrical ha ards

Contact with live parts (e.g. motors connected to the wheel block) can result in immediate death. Protective covers (e.g. covers and enclosures) marked with this sign may only be opened by **qualified electricians**. Before opening, all relevant operating, control, feed or other voltages must be disconnected.

Operating ha ard for the installation

This symbol in the operating instructions indicates all warnings which, if not complied with, may result in damage to the product, the installation or the goods to be transported.

1.2 Intended use

Demag DRS wheel blocks are complete travel units for materials handling installations and general engineering applications, designed for moving loads over a wide range of speeds. They feature prepared connecting surfaces and are ready for fitting to adjoining structures.

The relevant engineering guidelines must be observed when specifying the design.. Refer to the **Demag DRS wheel block system** catalogue, ident. no. 203 352 44 (volume 1) and 203 355 44 (volume 2).

1.3 Prohibited practises, improper use

Under certain conditions, operation of the DRS wheel block system is prohibited as this could result in malfunctions, equipment failure or hazard to life and limb, e.g. in the case of:

1.3.1 Design limits

- Exceeding permissible loads
- Exceeding the design service life
- Occurrence of peak loads which were not considered in the design

1.3.2 Assembly

- Use of connecting elements not designed for use with the wheel block
- Use of non-genuine Demag parts
- Not complying with the assembly instructions
- Tightening bolted connections without using a torque wrench
- Incomplete assembly of connecting elements

Note: Safety measures must not be rendered inoperative or modified or used contrary to the purposes for which they are intended.

1.3.3 Influence of the environment

- Acidic, corrosive air as coolant
- Explosion hazard atmospheres
- Operation outside the permissible temperature range
- Operation under prohibited ambient conditions

Note: Measures must be taken to ensure the travel wheels do not freeze up under conditions of high humidity and low temperatures.

1.3.4 Maintenance

- Exceeding the design service life

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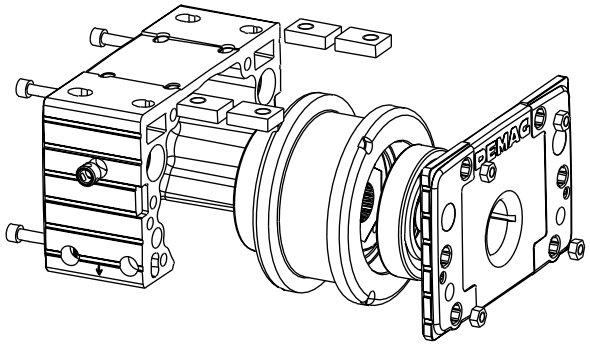
2 Brief technical description

2.1 Overview



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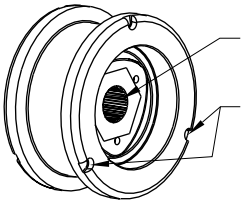
The Demag DRS 112 to 200 wheel block system, suitable for loads up to 10,000 kg, is a concept designed to meet customer wishes.

The advantages of the system are:

- Most favourable ground clearance conditions with Demag offset gearboxes.
- Robust aluminium housing with very good shape and position tolerances.
- Variable basic design by fitting various travel wheel materials and shapes.
- Weather-resistant due to surface powder coating (see section 2.4).
- Travel wheel and friction bearing can be disassembled with the housing still connected to the support structure.
- High availability owing to generously dimensioned bearings.
- Minimum maintenance due to bearings lubricated for life.
- High installation availability since the housing does not necessarily need to be removed to replace the travel wheel. Not having to realign the housing saves time.

Flange wear indicator



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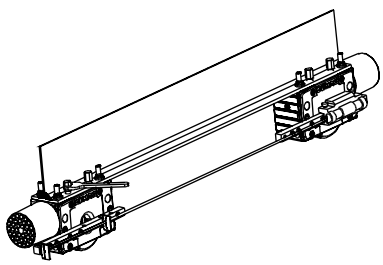
The flange wear indicator facilitates preventive maintenance without any hazard to the installation.

Alignment



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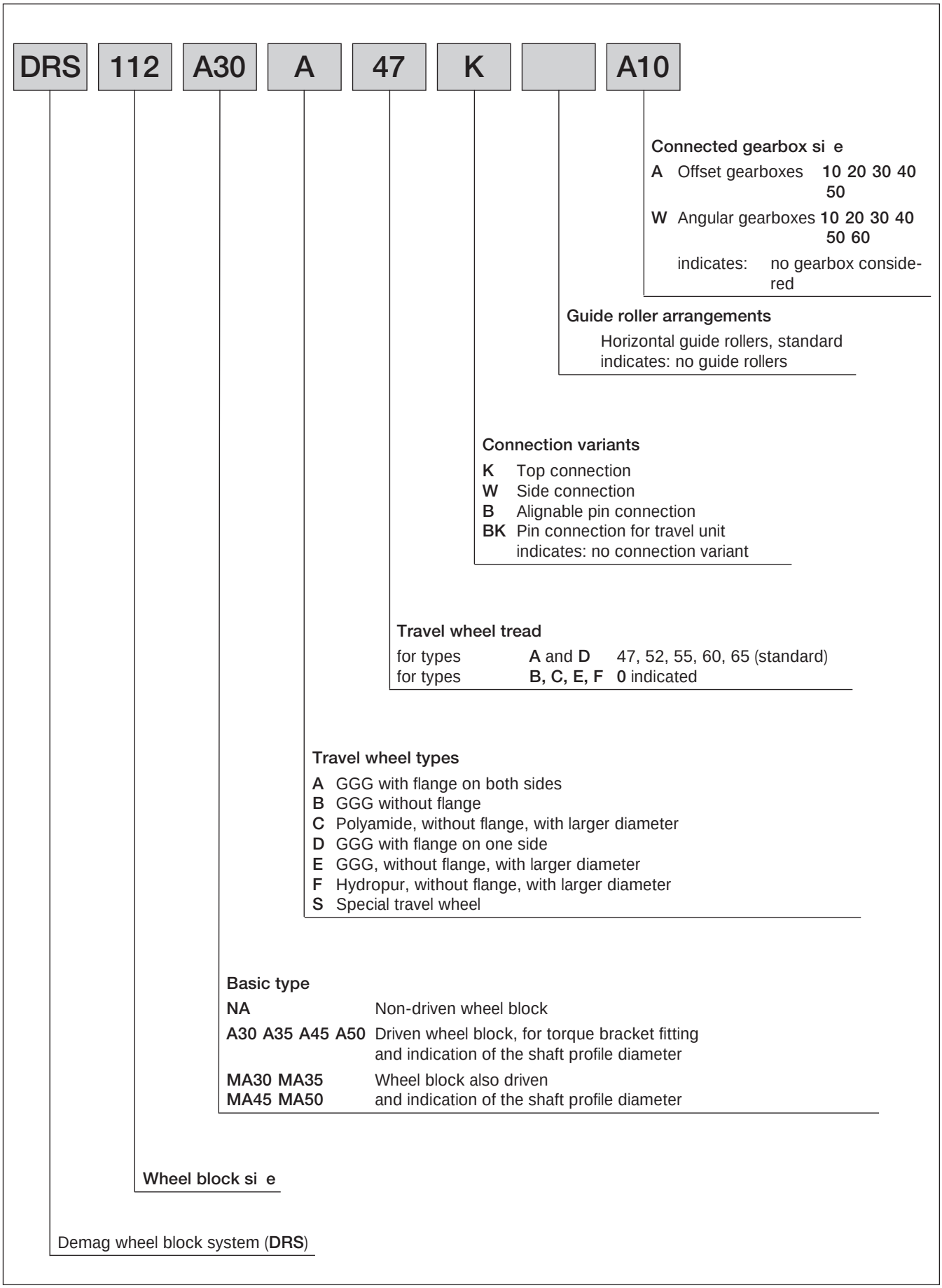
Fast and optimum alignment of wheel blocks using the Demag alignment device with sliding nuts and prepared connection openings in the wheel block housing.

- Only well aligned wheels reduce wear to a minimum.
- Sliding nut arrangement, used for alignment, offers a lateral alignment path of ± 3 mm.

  Achievable accuracy: 1,6 ‰.

2.2 Type designation key (example) for basic wheel blocks



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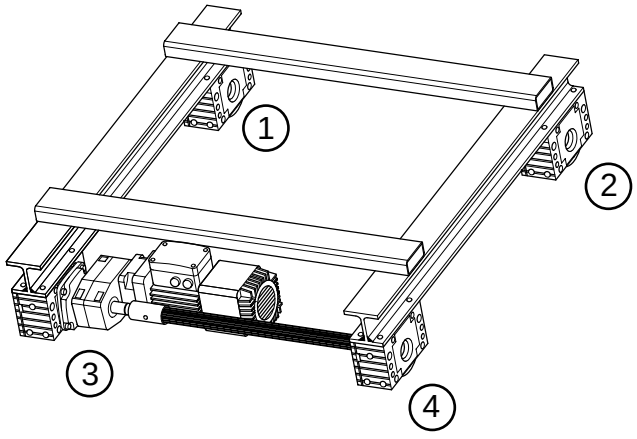
Example for using the type designation key

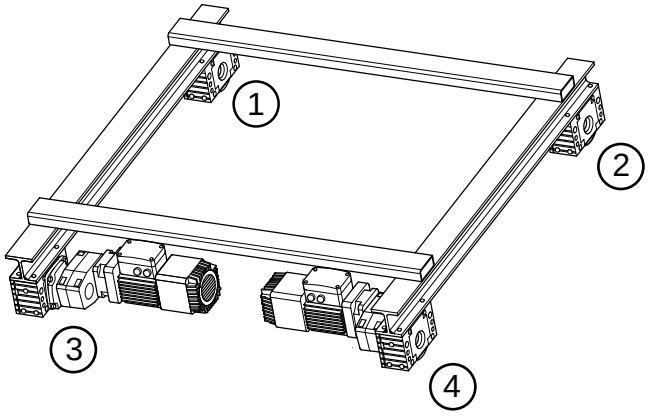
Travel carriage with 4 wheel blocks and a central drive unit



41239655.eps

① DRS125-NA-A-47-K- -
② DRS125-NA-A-47-K- -
③ DRS125-A35-A-47-K- -A20
④ DRS125-MA35-A-47-K- -

Travel carriage with 4 wheel blocks and 2 individual drive units



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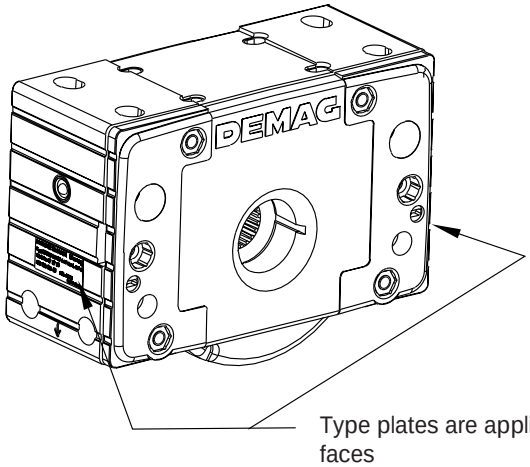
① DRS125-NA-A-47-K- -
② DRS125-NA-A-47-K- -
③ DRS125-A47-A-47-K- -A20
④ DRS125-A47-A-47-K- -A20

2.3 Type plate

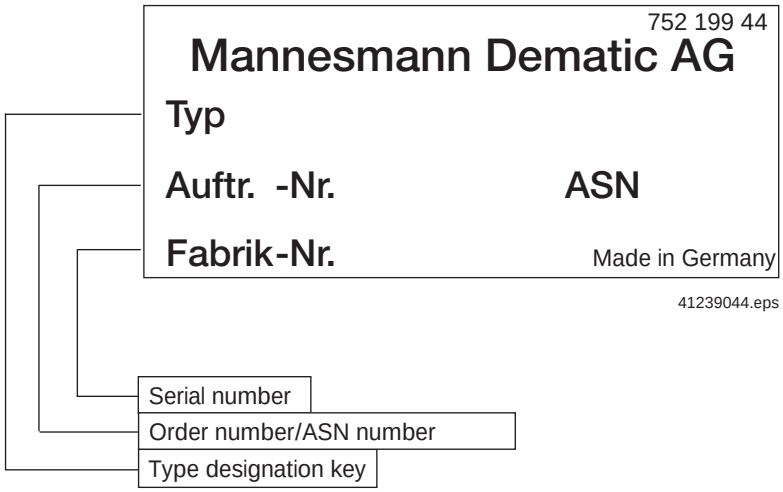
A type plate is applied to each of the end faces of DRS wheel blocks to identify the unit for possible spare part orders.



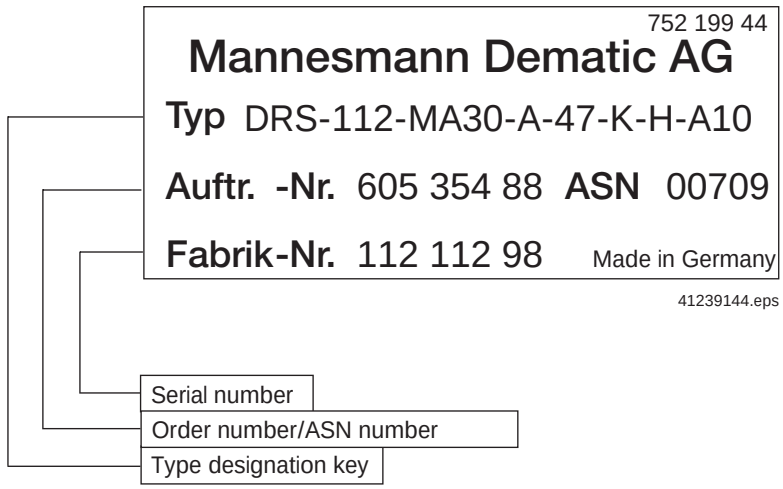
41239344.eps

The type plate may be covered by buffer or guide roller assemblies on one side depending on the design of the wheel block. In this case, the information can be read off the second type plate or relevant fittings can be relatively easily disassembled.

Forms for type plates and type designation keys can be found in section 9 for use in your documentation. Fill in the data of the wheel blocks used in your installation.



Example



2.4 Paint finish

The aluminium wheel block housings are provided with a weather-resistant powder coating in RAL 7001 (silver grey) with a minimum thickness of 90 µm before leaving the factory.

A uniform coating quality is ensured by a works standard oriented to meet wheel block housing requirements (ident no. 012 326 99).

For special paint finishes, wheel blocks can be supplied with a dual component PUR finish coat at the request of the customer.

If the paint finish is to be applied by the customer, attention must be paid to works standard for special paint finish on powder-coated wheel block surfaces (ident no. 012 327 99).

3 Receiving and storage

3.1 Checking goods on receiving

- The scope of delivery is specified in the shipping papers.
- Check the delivery **immediately** on receipt to ensure that it is complete and examine it for damage caused in transit.
- In any case, leave the goods and the packaging material unchanged. Do not use the goods yet!
- Report the damage to the forwarding agent and request the required papers as listed below!
- Then contact the supplier!
- Never return the damaged goods prior to agreement with the supplier!

For transport outside Germany, the relevant country-specific conditions have to be adhered to.

3.2 Transport

The wheel block is supplied made up into one unit. Additional equipment may be supplied in separate packaging.

The wheel block is packed depending on the transport method and its weight. Unless otherwise agreed in the purchase contract, the packaging corresponds to the packaging guidelines of Mannesmann Dematic AG, ident no. 236 070 44.

Symbols used on the packing

412 83944 - 41284644.eps

Handle wheel block units with utmost care to avoid damage caused by careless loading and unloading, for example.

3.3 Storage

Wheel blocks must be stored in dry places which are not subject to extreme temperature fluctuations, e.g. on a wooden support.

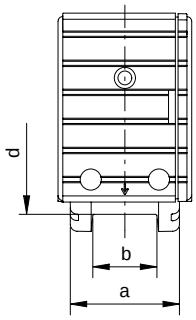
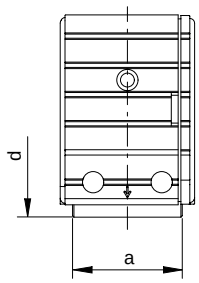
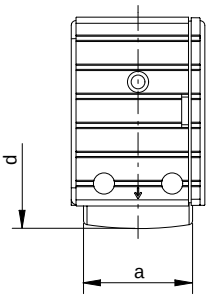
Unpacked wheel blocks must not be stacked on top of each other.

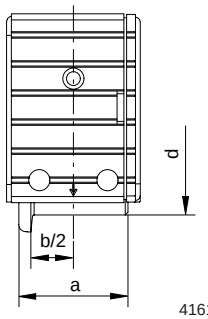
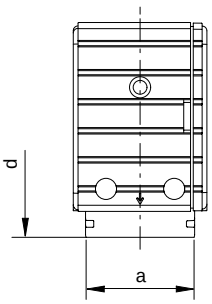
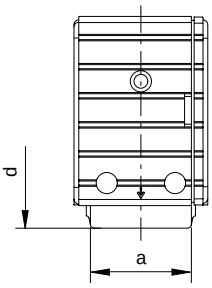
Note: **Do not damage the paint finish.**
Mechanical (scratches), chemical (acid, alkaline) or thermal (sparks, welding beads, heat) damage will result in corrosion and failure of the exterior protection.

4 Assembly and alignment

4.1 Travel wheel types

Standard DRS112 – DRS200 designs

Travel wheel type	A				B			C		
	Flange-guided travel wheel Spheroidal graphite cast iron  41618744.eps				Travel wheel without flange Spheroidal graphite cast iron  41618844.eps			Travel wheel without flange Polyamide  41618944.eps		
Wheel block si e	Max. wheel load 2)	d 1)	a	b_{max}	Max. wheel load 2)	d 1)	a	Max. wheel load 2)	d 1)	a
	t	mm	mm	mm	t	mm	mm	t	mm	mm
DRS 112	2,75	112	80	60	2,75	112	80	0,75	130	80
DRS 125	5,0	125	80	60	5,0	125	80	1,0	140	80
DRS 160	7,0	160	89	65	7,0	160	89	1,7	180	90
DRS 200	10,0	200	101	65	10,0	200	101	2,7	225	102

Travel wheel type	D				E			F		
	Travel wheel with one flange Spheroidal graphite cast iron  41619044.eps				Travel wheel without flange Spheroidal graphite cast iron  41619144.eps			Travel wheel without flange ydropur  41619244.eps		
Wheel block si e	Max. wheel load 2)	d 1)	a	b/2	Max. wheel load 2)	d 1)	a	Max. wheel load 2)	d 1)	a
	t	mm	mm	mm	t	mm	mm	t	mm	mm
DRS 112	2,75	112	80	30	2,75	126	80	0,59	130	68
DRS 125	5,0	125	80	30	5,0	145	80	0,79	140	68
DRS 160	7,0	160	89	32,5	7,0	183	89	1,18	180	75
DRS 200	10,0	200	101	32,5	10,0	226	101	1,7	225	86

1) Diameter

2) Maximum wheel load in Group of mechanisms 1Bm, 40 m/min, 40 °C

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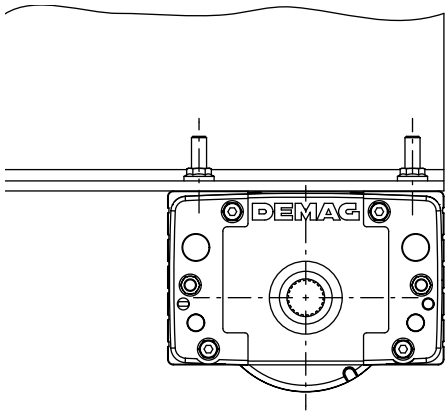
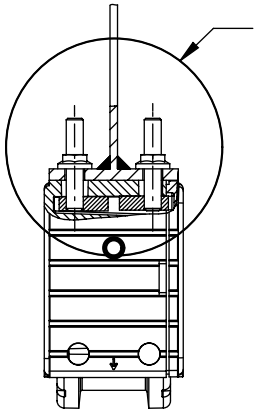
4.2 Assembly instructions

4.2.1 Top connection



41620055.eps



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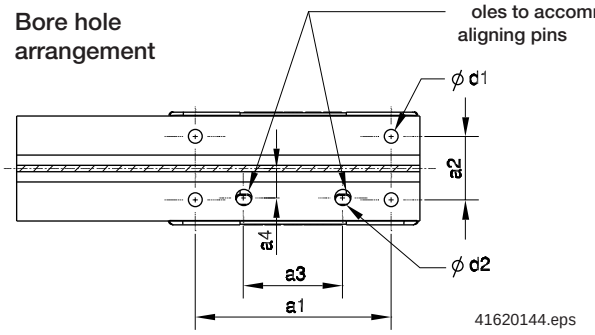
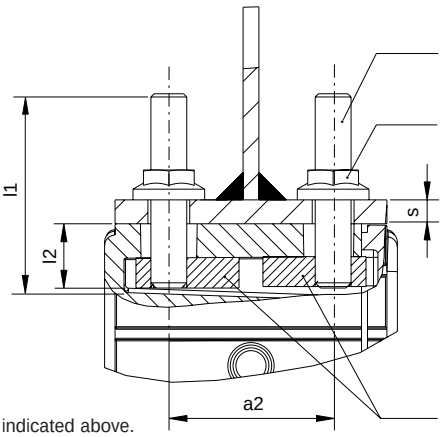
Bore hole arrangement



41620144.eps

Detail



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Tool

Torque wrench, ring type
Hexagon socket screw key

Preparation

- Drill bore holes in connecting structure according to bore hole pattern indicated above.
- The bore holes to accommodate the eccentric aligning arrangement are only required in connection with the aligning device, part no. 752 100 44 (see section 4.4 **Alignment**).

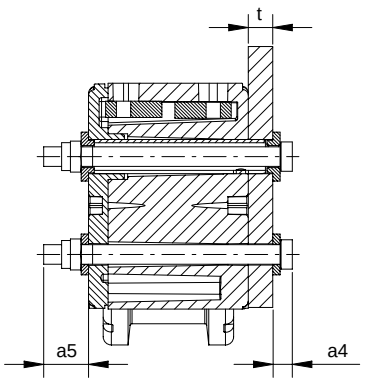
Assembly

- Screw the threaded pins by hand into the sliding nuts already fitted in the factory until they stop, and then screw them back out by a quarter of a turn.
- Fit and tighten the locknuts by hand (counter by holding the threaded pin). Then position and align the wheel block (see section 4.4 **Alignment**).
- Counter the threaded pins (by holding in place using the hexagon socket at the end of the pin) and tighten the locknuts with the corresponding tightening torque (see table below).
- After fitting, close all unused through holes with the plastic plugs included in the supply.

Wheel block si e	Dimensions in mm									
	a1	a2	a3	a4	l1	l2 max.	d1	d2	s	
DRS 112	145	45	70	22,5	65	19	14	14,5	8	25
DRS 125	170	55	86	27,5	65	22	14	14,5	8	25
DRS 160	220	55	118	27,5	75	24	18	14,5	15	25
DRS 200	275	65	175	32,5	75	24	18	14,5	20	25

Wheel block si e	Scope of delivery	
	Threaded pin	Locknut/tightening torque
DRS 112	(4 x) M12 x 65	(4 x) M12 Verbus Ripp / 130 Nm
DRS 125	(4 x) M12 x 65	(4 x) M12 Verbus Ripp / 130 Nm
DRS 160	(4 x) M16 x 75	(4 x) M16 Verbus Ripp / 330 Nm
DRS 200	(4 x) M16 x 75	(4 x) M16 Verbus Ripp / 330 Nm

4.2.2 Side connection



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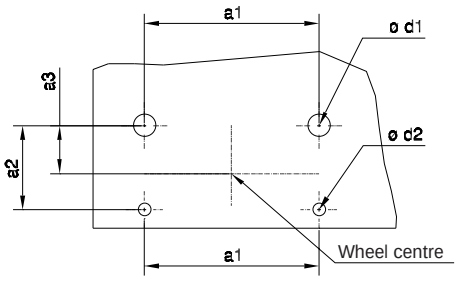
Bore hole arrangement of the connecting structure



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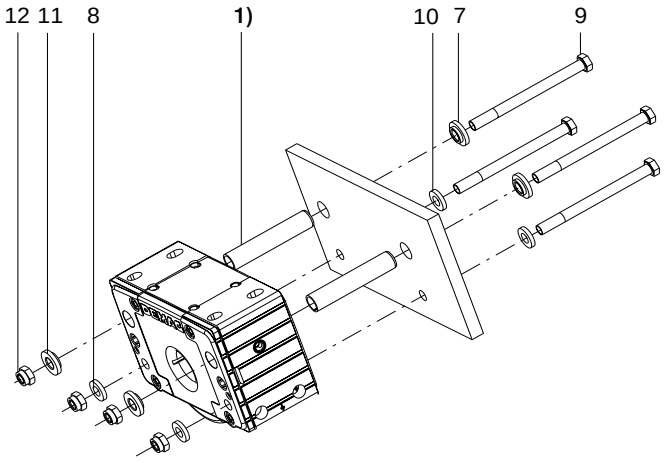
Wheel block size	Dimensions in mm									
	Bore hole diameter for connecting structure		a1 ± 0,1	a2 ± 0,1	a3 ± 0,1	a4	a5		t	
	d1	d2					min.	max.	min.	max.
DRS 112	18,5 D9	10,5	145	70	40	10,4	20	23	12	15
DRS 125	21 D9	13	175	60	40	12	24,5	27,5	15	18
DRS 160	30 D9	16,5	220	80	55	14,5	25,5	31,5	14	20
DRS 200	35 D9	20,5	275	110	75	20,5	37	42	20	25



1 Roll pin → fitted in wheel block in the factory
7 Flanged washer
8 Washer
9 Hexagon bolt
10 Washer
11 Flanged washer
12 Locknut

41619544.eps

Tool

Torque wrench

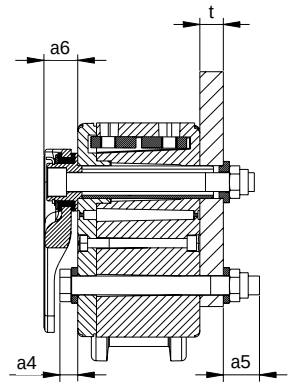
Assembly

- When the hexagon bolts are tightened, the roll pins fitted in the upper part of the wheel block are pulled into the mounting plate of the steel support structure by the flange washers. The bevel on the roll pins must face towards the connecting structure.
- Then fit two further hexagon bolts to the lower part of the wheel block with washers on both sides.
- See table below for tightening torques.
- After fitting, close all unused through holes with the plastic plugs included in the supply.

Wheel block size	Scope of delivery				
	Hexagon bolt	Roll pin 1)	Washer	Flanged washer	Nut/tightening torque
DRS 112	(4 x) M10 x 135	(2 x) 18 x 100	(4 x) 10,5 x 21 x 4	(4 x) 25/17,5 x 10,5 x 7,5	(4 x) V M10 / 70 Nm
DRS 125	(4 x) M12 x 140	(2 x) 21 x 105	(4 x) 12,5 x 25 x 6	(4 x) 30/20 x 13,5 x 8	(4 x) V M12 / 105 Nm
DRS 160	(4 x) M16 x 160	(2 x) 30 x 115	(4 x) 16,5 x 33 x 4,5	(4 x) 40/29 x 17 x 9	(4 x) V M16 / 215 Nm
DRS 200	(4 x) M20 x 200	(2 x) 35 x 140	(4 x) 20,5 x 38 x 8	(4 x) 44/34 x 21 x 11	(4 x) V M20 / 425 Nm

1) Pre-assembled in the wheel block

Side connection A 50 offset gearbox - W 60 angular gearbox



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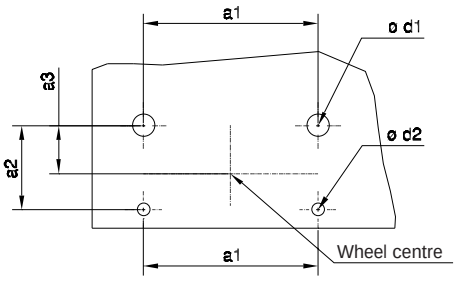
Bore hole arrangement of the connecting structure



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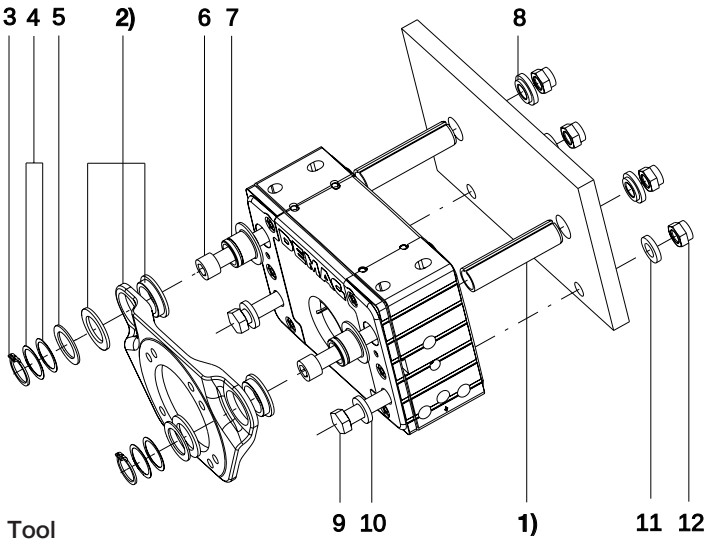
Wheel block size	Dimensions in mm										
	Bore hole diameter for connecting structure		a1 ± 0,1	a2 ± 0,1	a3 ± 0,1	a4	a5		a6	t	
	d1	d2					min.	max.		min.	max.
DRS 200	35 D9	20,5	275	110	75	20,5	37	42	36	20	25



1 Roll pin → fitted in the factory
2 Component parts → included in the torque bracket set
3 Retaining ring
4 Shim
5 Thrust washer
6 Hexagon socket screw
7 Adapter sleeve
8 Flanged washer
9 Hexagon bolt
10 Washer
11 Washer
12 Locknut

41833644.eps

Tool

Torque wrench

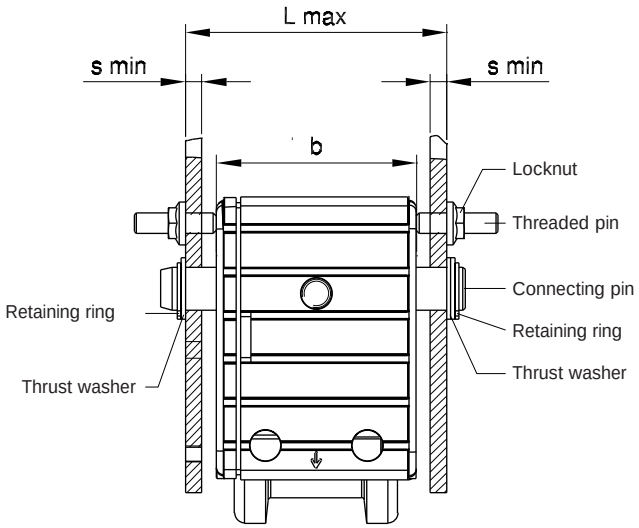
Assembly

- When the hexagon bolts are tightened, the roll pins fitted in the upper part of the wheel block are pulled into the mounting plate of the steel support structure by the adapter sleeves. The bevel on the roll pins must face towards the connecting structure.
- Then fit two further hexagon bolts to the lower part of the wheel block with washers on both sides.
- See table below for tightening torques.
- After fitting, close all unused through holes with the plastic plugs included in the supply.

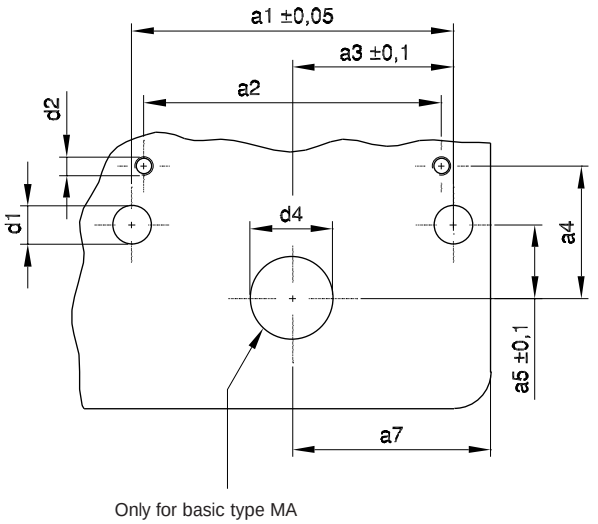
Wheel block size	Scope of delivery									
	Hexagon bolt	Hexagon socket bolt	Roll pin	Adapter sleeve	Flanged washer	Washer	Special retaining ring	Thrust washer	Shim	Nut/ tightening torque
DRS 200	(2 x) M20 x 200	(2 x) M20 x 220	(2 x) 35 x 140	(2 x) 40/35 x 33	(2 x) 44/34 x 21 x 11	(4 x) 20,5 x 38 x 8	(2 x) 40 x 2,5	(2 x) 40 x 58 x 2,5	(4 x) 40 x 50 x 0,5	(4 x) VM 20 / 425 Nm

4.2.3 Pin connection BK (travel unit design) DRS 112 – 200

Basic type NA (non-driven)



41643744.eps



Only for basic type MA

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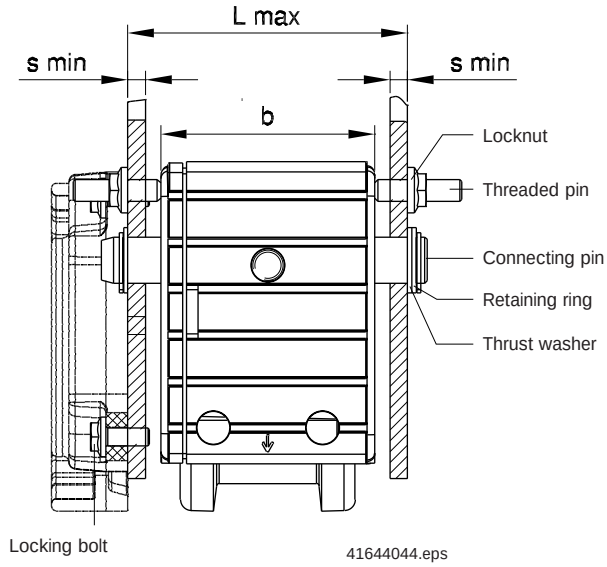
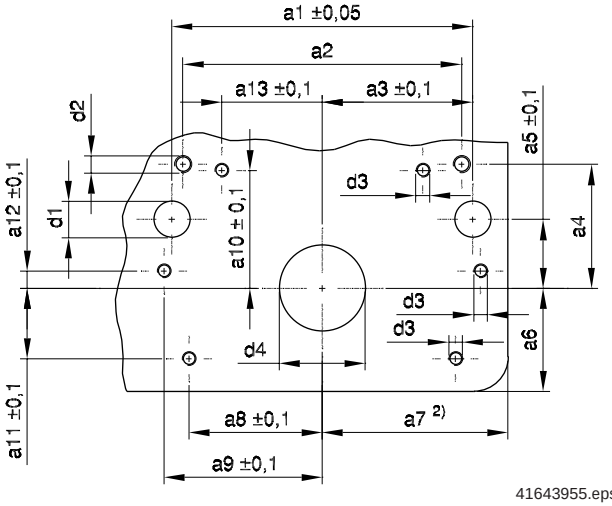
Basic type A (driven)
MA (also driven)



Locking bolt

41644044.eps



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Tapped bore holes dia. d3 are not required for basic type MA.

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Tools

Torque wrench, hexagon socket key

Preparation

Drill holes (bore holes must be free of paint) in the connecting structure (hollow profile section or similar) according to the above bore hole pattern taking the basic types into consideration.

Assembly

- Fit the wheel block into the prepared hollow profile section and connect with the pin.
- Fit the retaining rings and thrust washers included in the supply to secure against axial movement and to fix the connecting pin in position free of play.
- Adjust the track gauge dimension by screwing the threaded pins into the hollow profile section above the connecting pin.
- Secure the threaded pins using the locknuts.
- Fit the geared motor unit (with torque bracket fitted as in section 5) by bolting the complete drive to the hollow profile section using the locking bolts included in the scope of supply.

Wheel block size	Dimensions in mm												
	a1	a2	a3	a4	a5	a6 [1]	a7 [2]	a8	a9	a10	a11	a12	a13
DRS 112	145	148	72,5	64	40	52	93	79	–	60	10	–	50
DRS 125	175	162	87,5	72	40	60	108	77,5	92	68,5	41	10	58,5
DRS 160	220	206	110	90	55	70	135	97,5	110	90	56	12	75
DRS 200	275	266	137,5	118	75	90	168	120	140	115	70	10	105

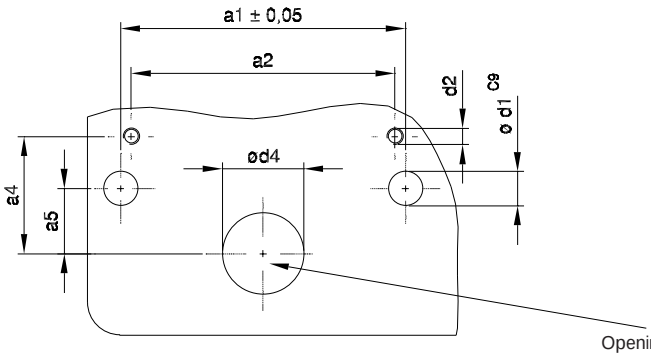
Wheel block size	Dimensions in mm						
	d1	d2	d3	d4+1,5	$L_{max.}$	$s_{min.}$	b
DRS 112	18,5 D9	M10	M8	50	126	8	96
DRS 125	21 D9	M10	M8	60	132	8	98
DRS 160	30 D9	M12	M10	80	148	10	110
DRS 200	35 D9	M12	M10	80	178	10	130

Wheel block size	Scope of delivery					
	Connecting pin	Thrust washer	Retaining ring	Threaded pin	Locknut	Locking screw micro-encapsulated [3]
DRS 112	(2x) Ø18,5 x 143,5	(16x) 19 x 26 x 1,5	(4x) 18 x 1,5	(4x) M10 x 40	(4x) M10	(4x) M8 x 20
DRS 125	(2x) Ø21 x 149	(12x) 22 x 30 x 2 (4x) 22 x 30 x 1	(4x) 22 x 1,75	(4x) M10 x 40	(4x) M10	(6x) M8 x 20
DRS 160	(2x) Ø30 x 165	(12x) 30 x 42 x 2,5 (8x) 30 x 42 x 1	(4x) 30 x 2	(4x) M12 x 50	(4x) M12	(6x) M10 x 25
DRS 200	(2x) Ø35 x 198	(20x) 35 x 45 x 2,5 (8x) 35 x 45 x 1	(4x) 35 x 2,5	(4x) M12 x 50	(4x) M12	(6x) M10 x 25

1) Dimension must be maintained for driven type.
2) Dimension must be maintained for guide roller assembly.
3) Only for driven type
Tightening torque M 8 = 36 Nm
M10 = 65 Nm.

4.2.4 Pin connection B (alignable) DRS 112 – 200

Bore hole arrangement for side without welding plate



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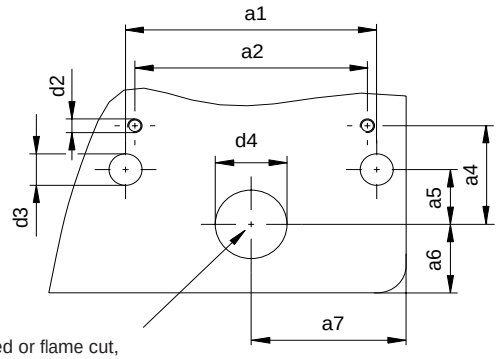
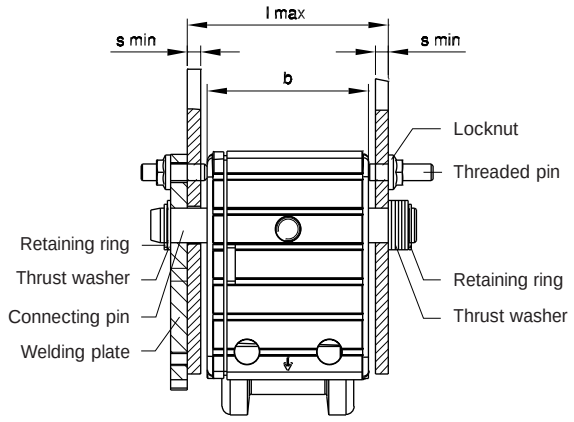
Bore hole arrangement for side with welding plate



Opening drilled or flame cut,
only necessary for basic types A, MA, MAD

41644355.eps

Wheel block size	Dimensions in mm												
	a1	a2	a4	a5	a6 [1]	a7 [2]	b	d1	d2	d3	d4+1,5	L_{max}	s_{min}
DRS 112	145	148	64	40	45	93	96	18,5 C9	M10	20	50	118	8
DRS 125	175	162	72	40	50	108	98	21 C9	M10	23	60	122	8
DRS 160	220	206	90	55	70	135	110	30 C9	M12	32	80	136	10
DRS 200	275	266	118	75	90	168	130	35 C9	M12	38	80	166	10



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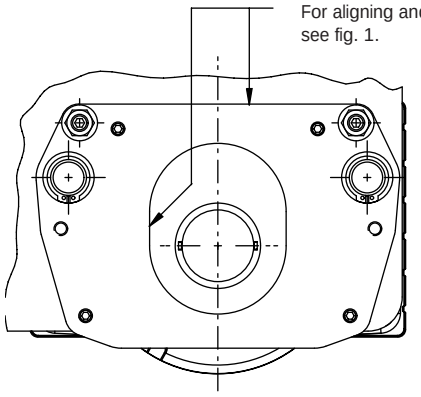
For aligning and welding instructions, see fig. 1.



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Wheel block size	Scope of delivery for pin connection fittings					
	Connecting pin	Thrust washer	Retaining ring	Threaded pin (1)	Locknut (1)	Welding plate
DRS 112	(2x) Ø18,5 x 152	(16x) 19 x 26 x 1,5	(4x) 18 x 1,5	(4x) M10 x 40	(4x) M10	DRS 112
DRS 125	(2x) Ø21 x 161	(12x) 22 x 30 x 2 (4x) 22 x 30 x 1	(4x) 22 x 1,75	(4x) M10 x 40	(4x) M10	DRS 125
DRS 160	(2x) Ø30 x 182	(12x) 30 x 42 x 2,5 (8x) 30 x 42 x 1	(4x) 30 x 2	(4x) M12 x 50	(4x) M12	DRS 160
DRS 200	(2x) Ø35 x 213	(22x) 35 x 45 x 2,5 (8x) 35 x 45 x 1	(4x) 35 x 2,5	(4x) M12 x 50	(4x) M12	DRS 200

For fitting the gearbox, the following fittings are included in the torque bracket set for the pin connection B scope of delivery:

Wheel block size	Threaded pin (1)	Locknut (2) [3]	Locking bolt (3) [3]
DRS 112	(4x) M8 x 30	(4x) M8	–
DRS 125	(6x) M8 x 30	(6x) M8	–
DRS 160	–	–	(6x) M10 x 25 mk
DRS 200	–	–	(6x) M10 x 25 mk

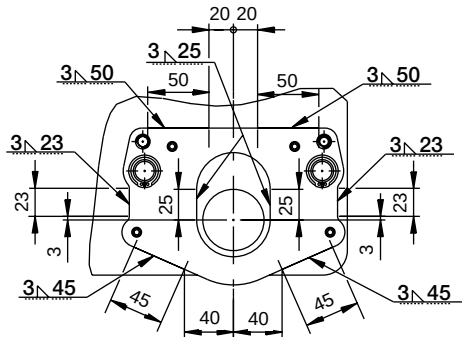
1) Dimension must be maintained for driven type.

2) Dimension must be maintained for guide roller assembly.

3) Only for driven type
Tightening torque M8 = 36 Nm
M10 = 65 Nm.

Welding instructions for welding plate, pin connection B

DRS 112



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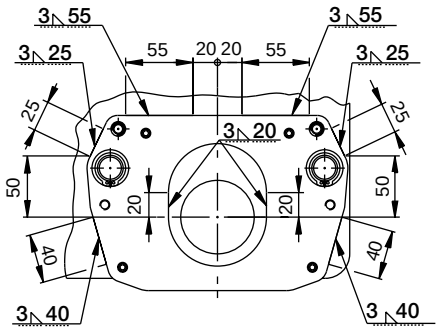
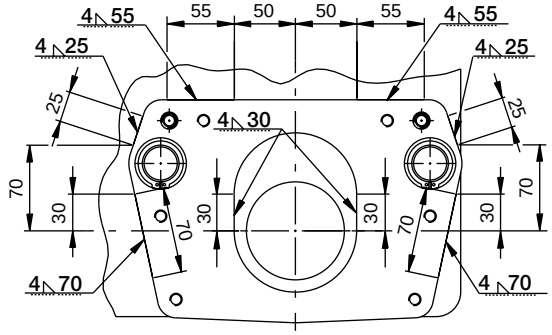
DRS 125



41833344.eps

DRS 160



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DRS 200

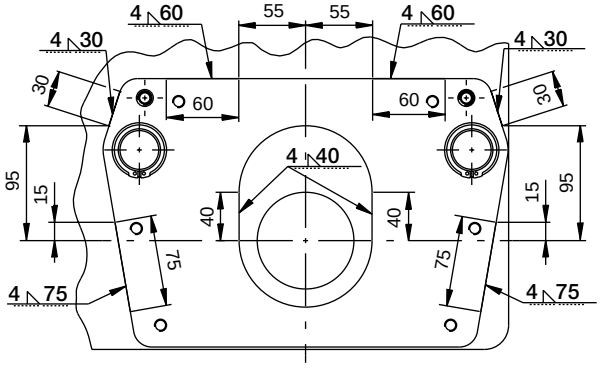

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Fig. 1

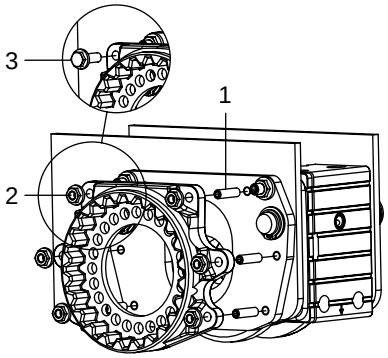
Tools

Torque wrench, hexagon socket key

Preparation

Drill holes (bore holes must be free of paint) in the connecting structure (hollow profile section or similar) according to the above bore hole pattern taking the basic types (NA, A, MA, MAD) into consideration.

Assembly



for • DRS 112/125 threaded pin (1) + locknut (2)
• DRS 160/200 locking bolt (3)

41644544.eps

- Fit the wheel block into the prepared hollow profile section and connect with the pin.
- Place the welding plate on the correspondingly drilled side.
- Fit the retaining rings and thrust washers included in the supply to secure against axial movement and to fix the connecting pin in position free of play.
- Align the wheel block.
- Tack the welding plate to fix it in position and then weld according to the welding instructions (fig. 1).
- Adjust the track gauge dimension by screwing threaded pins (1) into the hollow profile section above the connecting pin.
- Secure threaded pins (1) using locknuts (1).
- Fit the geared motor unit (with torque bracket fitted as in section 5) by bolting the complete drive to the welded plate using threaded pins (1) with locknuts (2) for DRS 112/125 and locking bolts (3) for DRS 160/200.

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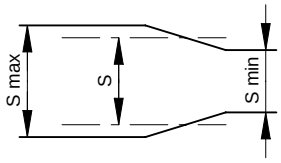
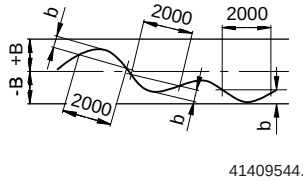
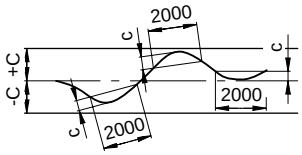
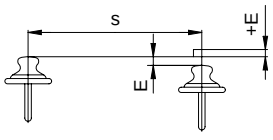
4.3 Manufacturer s tolerances for crane runways

Tolerance		Crane runways		
Designation	Diagram	Tolerance class 1	Tolerance class 2	Tolerance class 3
Tolerance A of track gauge dimension s of crane rails with reference to the rail centre and crane runway length	 41409444.eps $S_{max} = s + A$ $S_{min} = s - A$	for s ≤ 16 m: A = ± 3 mm for s > 16 m: A = ± [3 + 0,25 (s – 16)] A in mm use s in m	for s ≤ 16 m: A = ± 5 mm for s > 16 m: A = ± [5 + 0,25 (s – 16)] A in mm use s in m	for s ≤ 16 m: A = ± 8 mm for s > 16 m: A = ± [8 + 0,25 (s – 16)] A in mm use s in m
Tolerance B of the lateral straightness of the rail head with reference to the crane runway length Tolerance b of the lateral straightness with reference to 2000 mm measured length (sample length) at any point of the rail head	 41409544.eps Position of a rail seen in plan	B = ± 5 mm b = 1 mm	B = ± 10 mm b = 1 mm	B = ± 20 mm b = 2 mm
Tolerance C of the straightness with reference to the height of the crane rail centre and crane rail length Tolerance c of the straightness with reference to 2000 mm measured length (sample measurement) at any point of the crane runway	 41409644.eps Position of a rail seen in elevation (longitudinal slope)	C = ± 5 mm c = 1 mm	C = ± 10 mm c = 2 mm	C = ± 20 mm c = 4 mm
Tolerance E of the height with reference to perpendicular measuring points at every point of the crane runway	 41409744.eps Position of rails in relation to one another in elevation (transverse slope)	E = ± 0,5º/% x s in mm use s in mm E_{max} = ± 5 mm	E = ±1º/% x s in mm use s in mm E_{max} = ± 10 mm	E = ±2º/% x s in mm use s in mm E_{max} = ± 20 mm

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Source: VDI 3576

Recommended: **Tolerance class 2**

4.4 Alignment for top connection

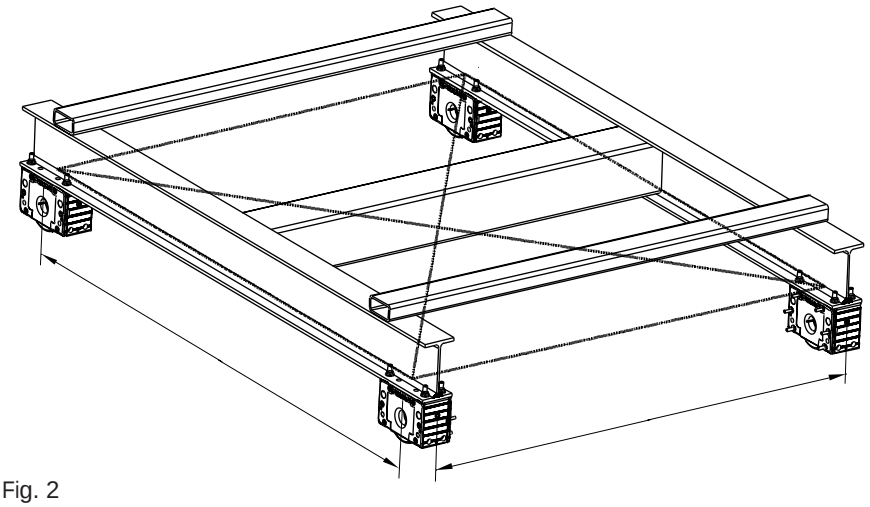

Fig. 2

41642644.eps

Wheel blocks must be precisely aligned to prevent bearing damage and, therefore, premature travel wheel wear.

Make up the frame (frame assemblies) or the support superstructure and roughly align them with the DRS mounting positions. Use the arrow markers on the wheel block end faces.

Example for aligning a travel carriage.

Installation set

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A laser measuring device is available for aligning.

Part no.: **752 100 44**

Refer to figs 3 – 9 on the following pages for use of the laser measuring device.

Contents of the installation set

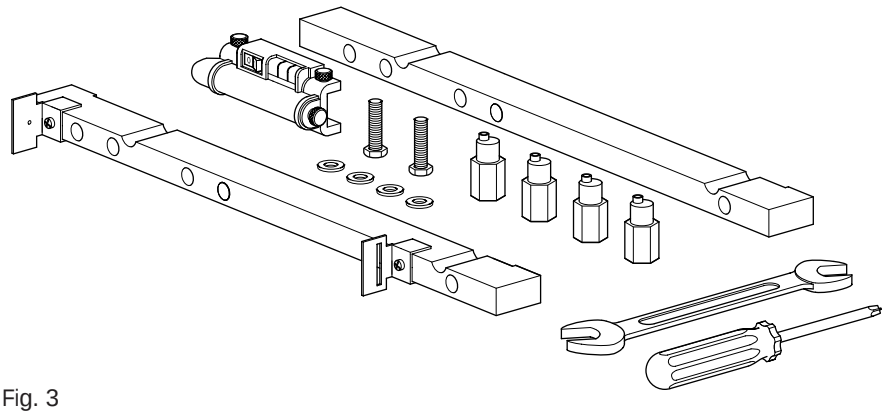

Fig. 3

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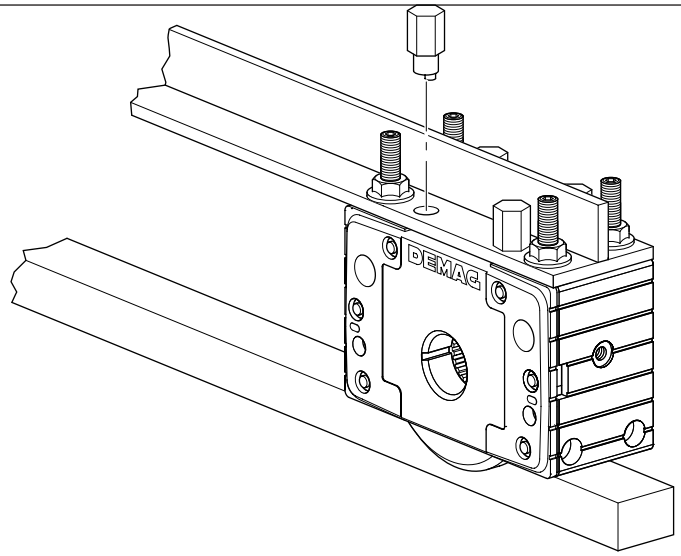
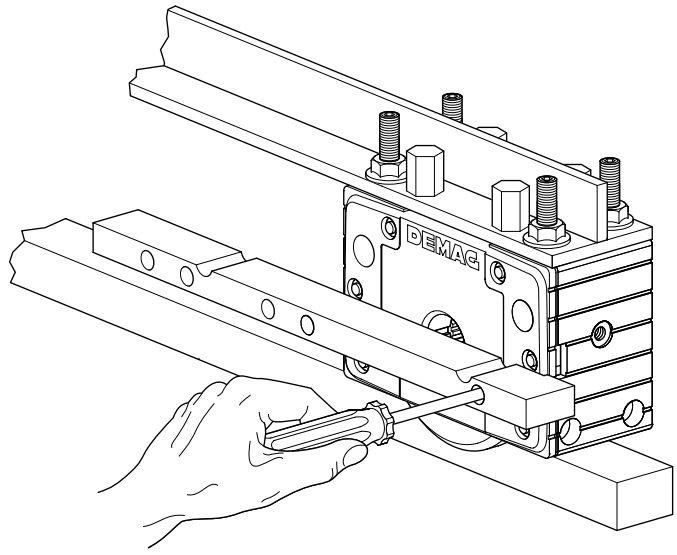


Fit the aligning pin. There must be no load acting on the wheel blocks and the wheel blocks must be bolted to the travel carriage with the connections tightened only by hand.

Fig. 4

41444444.eps



Fit the rail for the laser unit to the first wheel block.

Fig. 5

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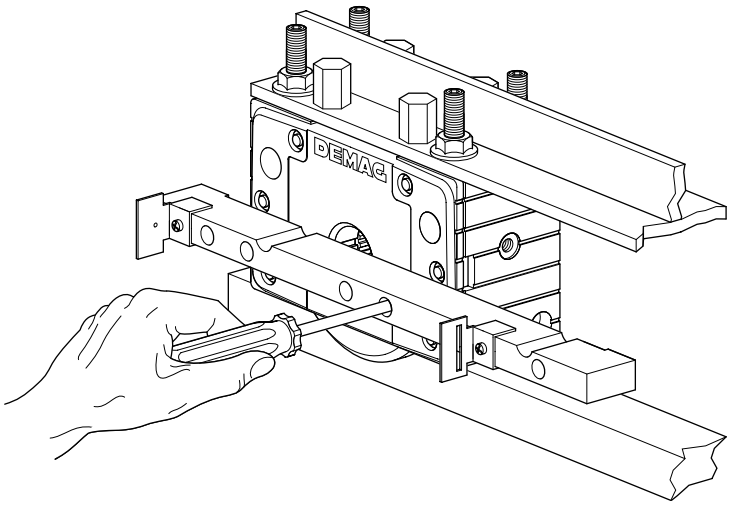

Fit the rail with the slot aperture and target marker to the second wheel block.

Fig. 6

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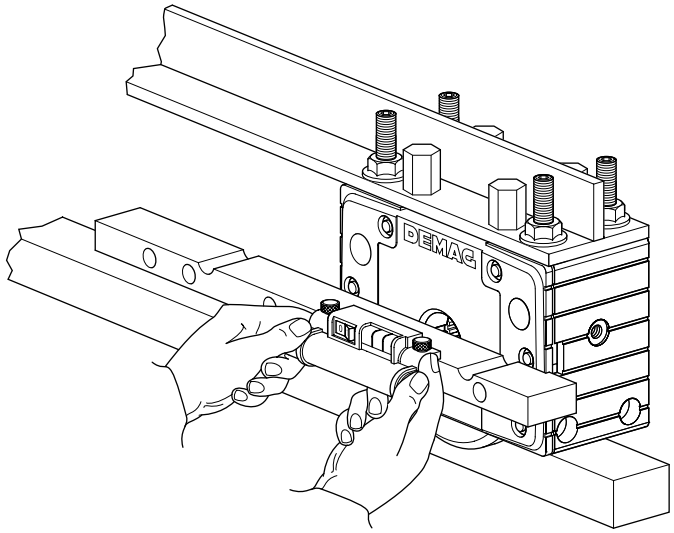

Fig. 7

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Put the laser on the rail in the centre of the wheel block. Then turn on the laser.

Safety note:

Pay attention to the laser unit operating instructions.

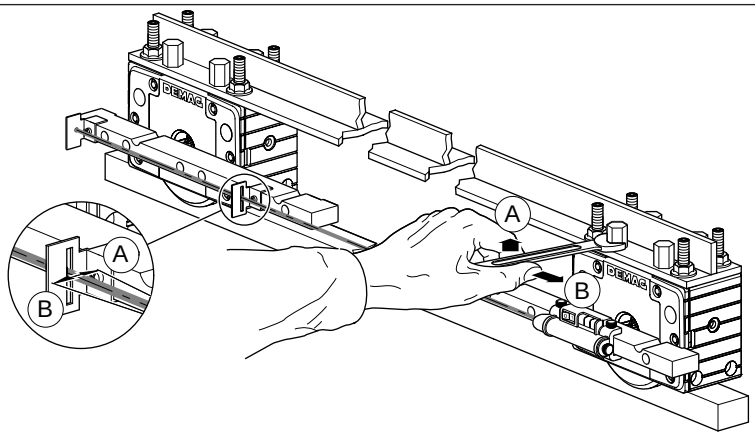

Fig. 8

41445144.eps

Align the wheel blocks using the wrench and the aligning pin. First roughly align the wheel blocks by hand so that the laser beam passes through the slot aperture and hits the target marker. Use the aligning pin for fine adjustment.

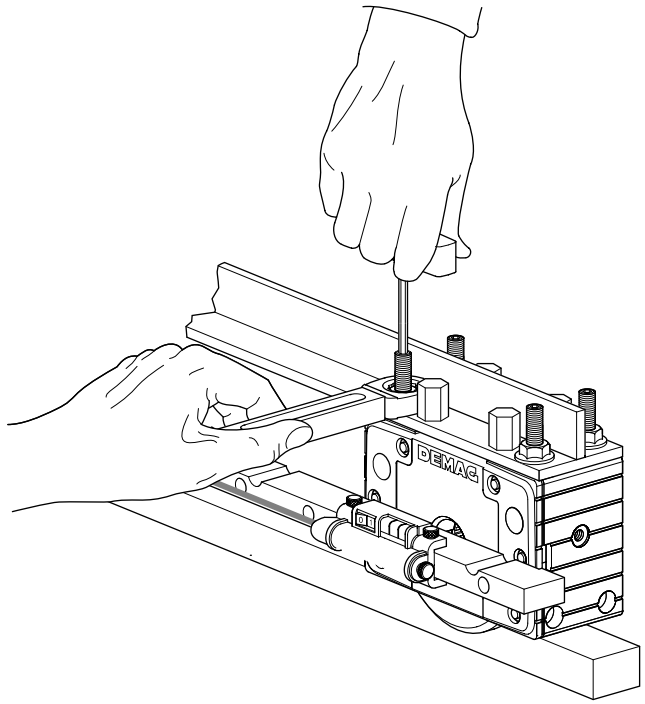

Fig. 9

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Secure the wheel blocks using the hexagon socket key and the torque wrench according to the assembly instructions in section 4.2.1.

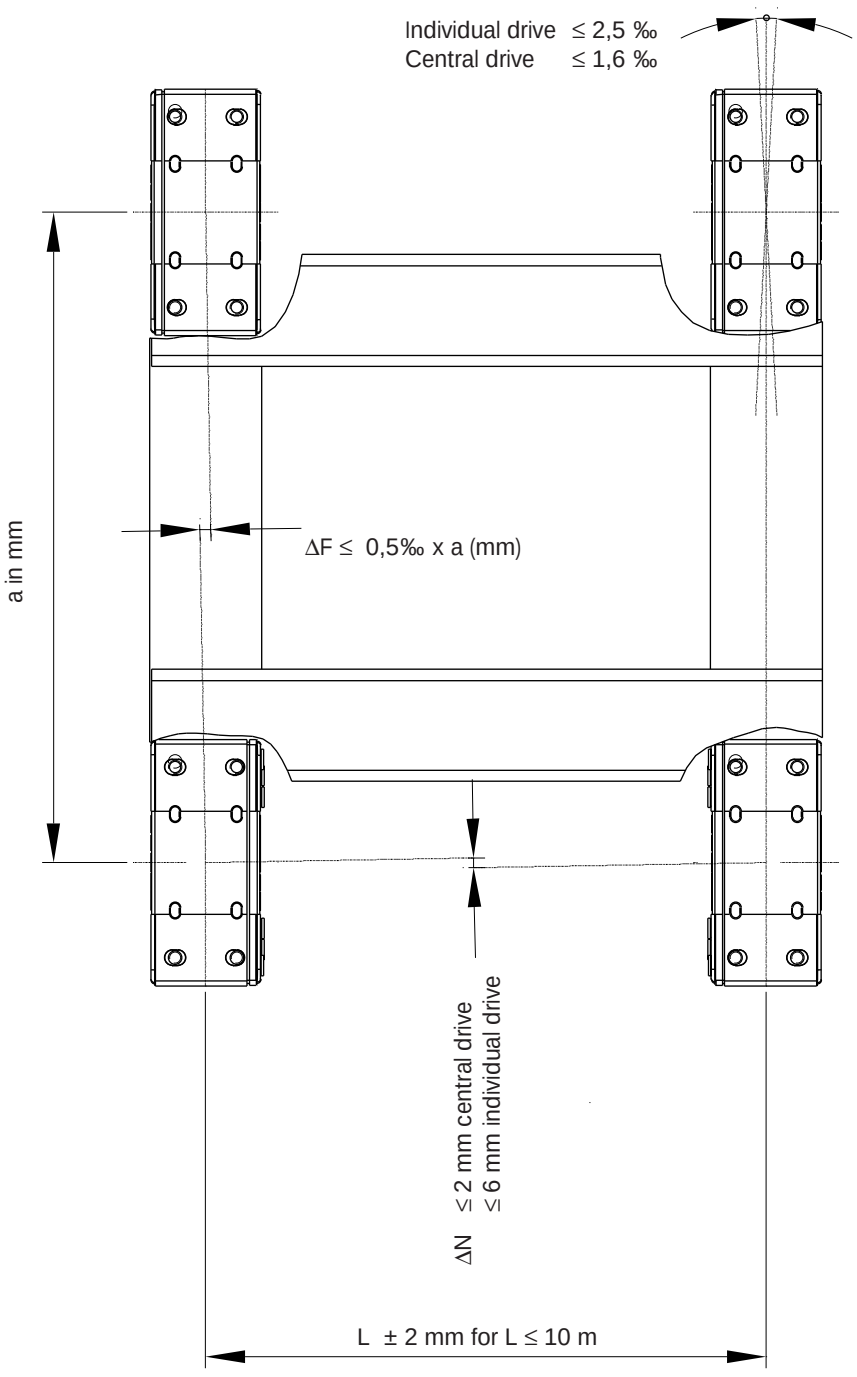

Fig. 10

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The values given in figure 10 are sufficient for normal applications.

Further information on tolerance is given in the relevant standards and guidelines.

DIN 7168	General tolerances (clearance tolerances) Lengths and angles
DIN 8570	Clearance tolerances for welded structures
Sheet 1	Lengths and angles
Sheet 3	Shape and position
VDI 3571	Manufacturing tolerances for bridge cranes
VDI 3576	Rails for crane installations, rail connections, rail mountings, tolerances

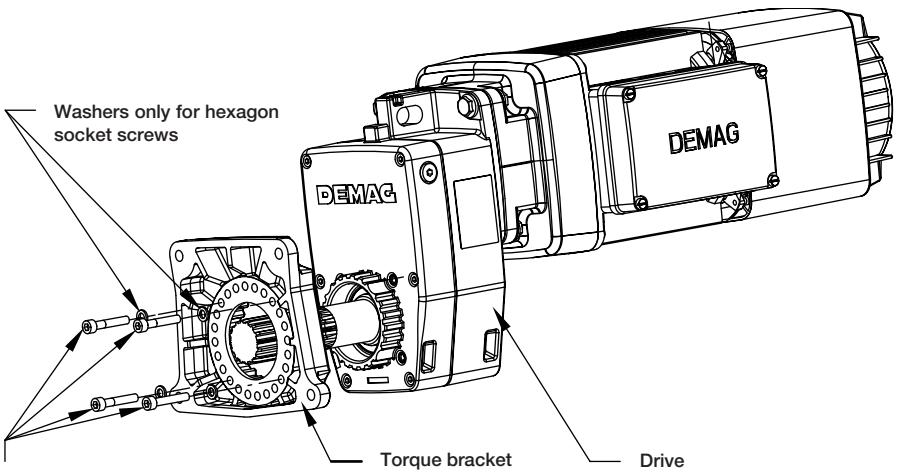
5 Assembling drive elements

5.1 Torque brackets for individual and central drive units

5.1.1 A type offset gearboxes

Fitting for top, side and pin connection arrangements
MA112 – MA200 torque bracket connection

Fitting the torque bracket to the gearbox using the locking bolts included in the supply [1)]



1) In the required mounting position (24 positions possible).

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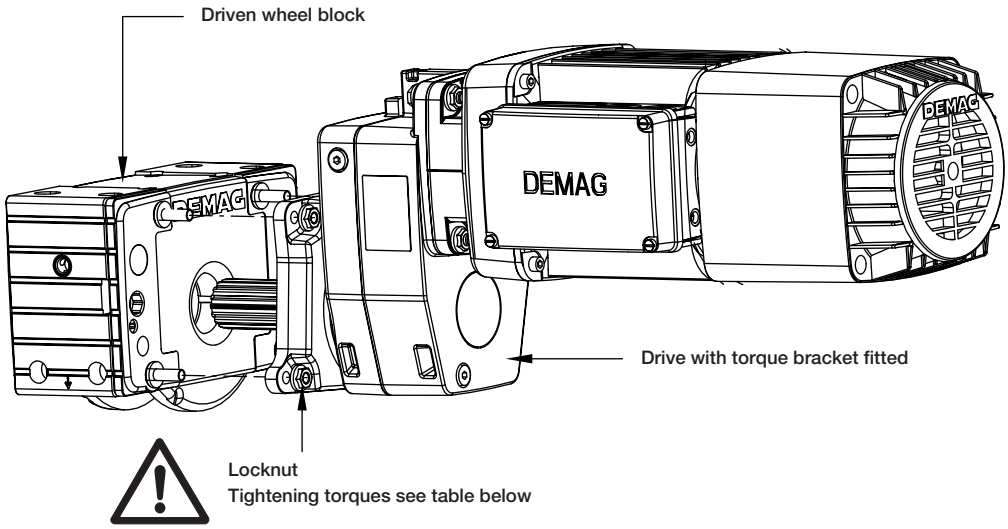
Fitting the drive with torque bracket to the wheel block using the locknuts included in the supply



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Size		Torque bracket	Locking bolt tightening torque	Locknut tightening torque
Wheel block	Gearbox			
DRS 112	AM 10 AM 20	MA112 – 1	Hexagon socket bolt, micro-encapsulated (with washer) (4x) M6 x 35 / 8 Nm	(4x) M8 / 35 Nm
DRS 125	AM 10 AM 20	MA125 – 1		(4x) M8 / 35 Nm
	AM 30	MA125 – 2		(6x) M8 / 35 Nm
DRS 160	AM 20 AM 30	MA160 – 1		(4x) M10 / 65 Nm
	AM 40	MA160 – 2	Verbus Ripp, micro-encapsulated (4x) M10 x 20 / 60 Nm	(6x) M10 / 65 Nm
DRS 200	AM 30 AM 40	MA200 – 1		(6x) M10 / 65 Nm

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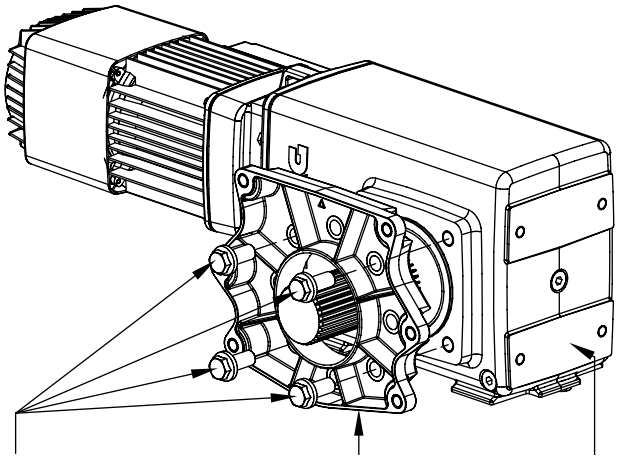
5.1.2 W type angular gearboxes

Fitting for top, side and pin connection arrangements
MW112 – MW200 torque bracket connection

Fitting the torque bracket to the gearbox using the locking bolts included in the supply [1)]



1) In the required mounting position (8 positions possible).

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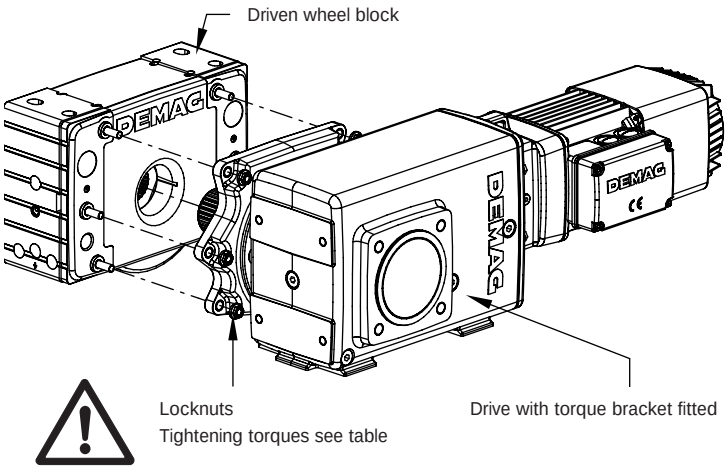
Fitting the drive with torque bracket to the wheel block using the locknuts included in the supply



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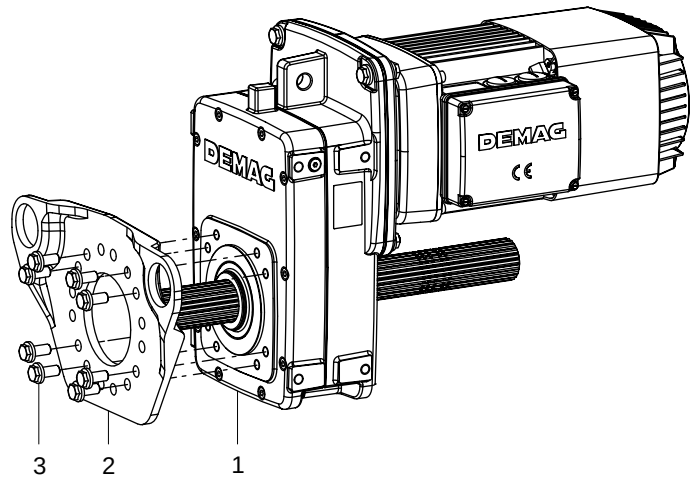
Size		Torque bracket	Locking bolt tightening torque	Locknut tightening torque
Wheel block	Gearbox			
DRS 112	WU 10	MW112 – 1	(4x) M8 x 25 / 42 Nm	(6x) M8 / 35 Nm
	WU 20	MW112 – 2	(4x) M10 x 30 / 85 Nm	(6x) M8 / 35 Nm
DRS 125	WU 10	MW125 – 1	(4x) M8 x 25 / 42 Nm	(6x) M8 / 35 Nm
	WU 20 WU 30	MW125 – 2	(4x) M10 x 30 / 85 Nm	(6x) M8 / 35 Nm
DRS 160	WU 20 WU 30	MW160 – 1	(4x) M10 x 35 / 85 Nm	(6x) M10 / 65 Nm
	WU 40	MW160 – 2	(4x) M12 x 35 / 130 Nm	(6x) M10 / 65 Nm
DRS 200	WU 30	MW200 – 1	(4x) M10 x 35 / 85 Nm	(6x) M10 / 65 Nm
	WU 40	MW200 – 2	(4x) M12 x 35 / 130 Nm	(6x) M10 / 65 Nm
	WU 50	MW200 – 3	(4x) M16 x 35 / 330 Nm	(6x) M10 / 85 Nm [2)]

2) After having tightened the nuts, please check the bolted connections of the wheel block (see also sections 5.2.2 and 5.3.2)!

5.1.3 A 50 type offset gearboxes

Fitting for top, side and pin connection arrangements
MA200-2 torque bracket connection



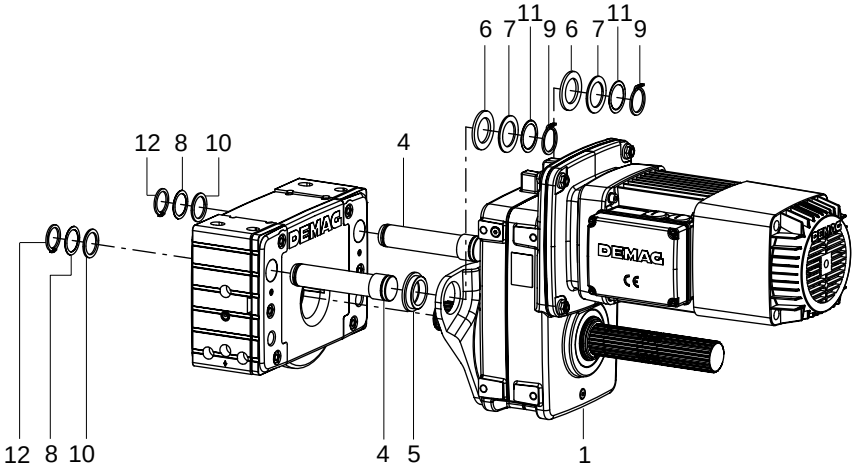
1 Offset gearboxes
2 Torque bracket
3 Locking bolt

Tightening torque
see table below

42115244.eps

Assembly

- Remove corrosion protection and paint from contact surface of gearbox and torque bracket.
- Fit torque bracket (2) to gearbox (1) using locking bolts (3) included in the supply.



1 Offset gearbox
4 Pin (adapter sleeve for side connection)
5 Polyamide collared sleeve
6 Polyamide washer
7 Thrust washer
8 Thrust washer
9 Retaining ring
10 Shim
11 Shim
12 Retaining ring

42115144.eps

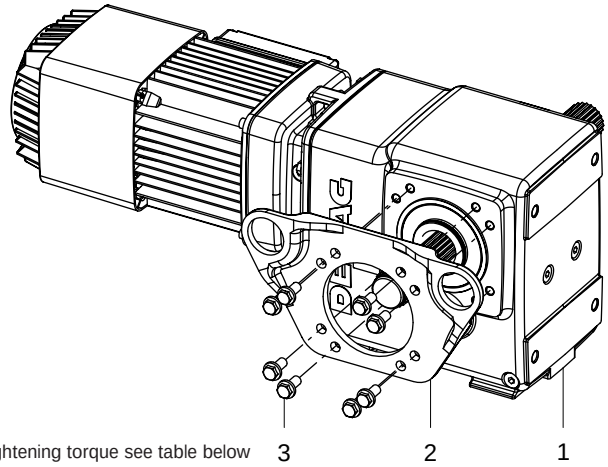
Assembly

- Insert pin (4) into wheel block and secure against axial movement with thrust washers (8), shims (10) and retaining ring (12).
- Place polyamide collared sleeves (5) and drive unit (1) onto pin (4).
- Fit polyamide washer (6), thrust washer (7), shim (11) and retaining ring (9) in the sequence indicated.

Size		Torque bracket	Locking bolt (3)	
Wheel block	Gearbox		Number dimension	Tightening torque
DRS 200	AD 50	MA200-2	8x / M12x25	130 Nm

5.1.4 W 60 angular gearboxes

Fitting for top, side and pin connection arrangements
MW200-4 torque bracket connection



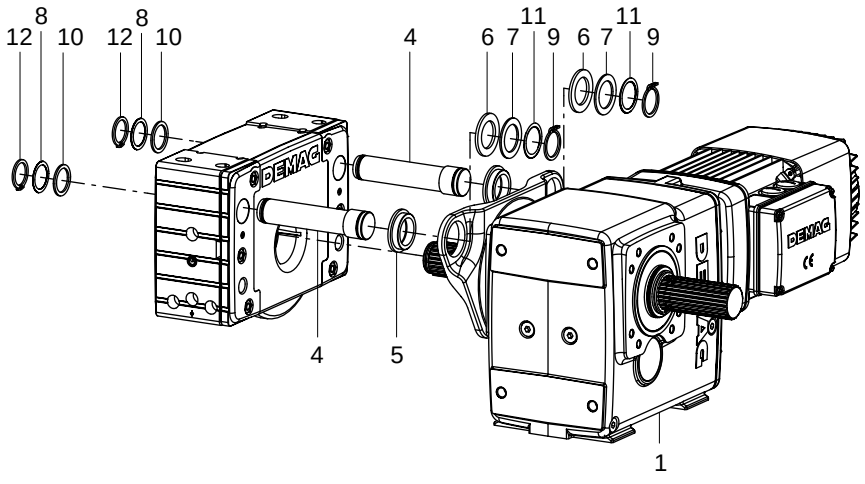
1 Angular gearbox
2 Torque bracket
3 Locking bolt

Tightening torque see table below

42116744.eps

Assembly

- Remove corrosion protection and paint from contact surface of gearbox and torque bracket.
- Fit torque bracket (2) to gearbox (1) using locking bolts (3) included in the supply.



1 Angular gearbox
4 Pin (adapter sleeve for side connection)
5 Polyamide collared sleeve
6 Polyamide washer
7 Thrust washer
8 Thrust washer
9 Retaining ring
10 Shim
11 Shim
12 Retaining ring

42116644.eps

Assembly

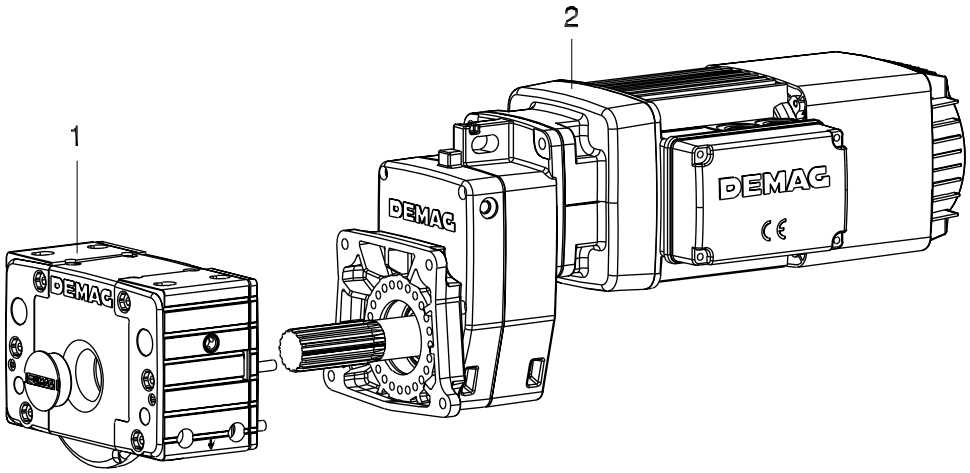
- Insert pin (4) into wheel block.
- Place polyamide collared sleeves (5) and drive unit (1) onto pin (4).
- Fit polyamide washer (6), thrust washer (7), shim (11) and retaining ring (9) in the sequence indicated.
- Secure pin (4) against axial displacement with thrust washers (8), shims (10) and retaining ring (12) on the second side.

Size		Torque bracket	Locking bolt (3)	
Wheel block	Gearbox		Number dimension	Tightening torque
DRS 200	WU 60	MW200-4	8x / M12x25	130 Nm

5.2 Individual drive units

5.2.1 With A type offset gearboxes ournal shaft on one side with involute splines

Clean drive shaft before fitting, check splined profile section and grease with DG 69 grease.



Assembly

Connect travel drive (2) with wheel block (1) as in section 5.1

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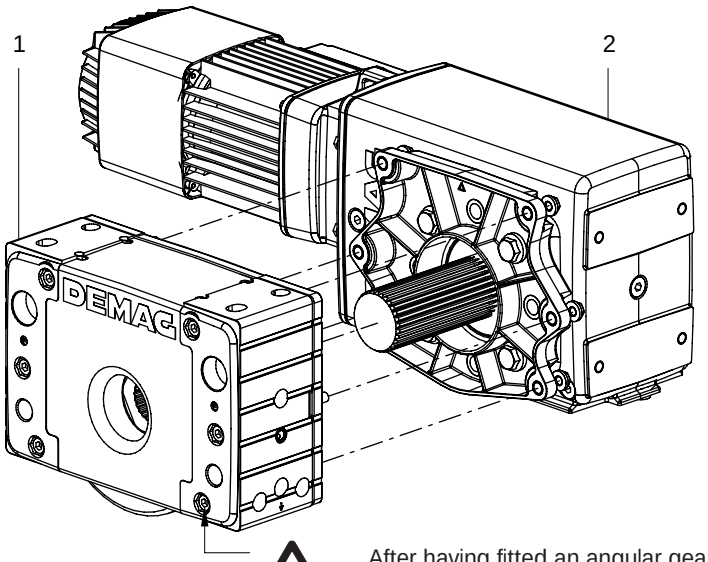
5.2.2 With W type angular gearboxes

Clean drive shaft before fitting, check splined profile section and grease with DG 69 grease.



After having fitted an angular gearbox type W 50, check the bolted connections of the wheel block for the correct tightening torque (72 Nm)!

Assembly

Connect travel drive (2) with wheel block (1) as in section 5.1

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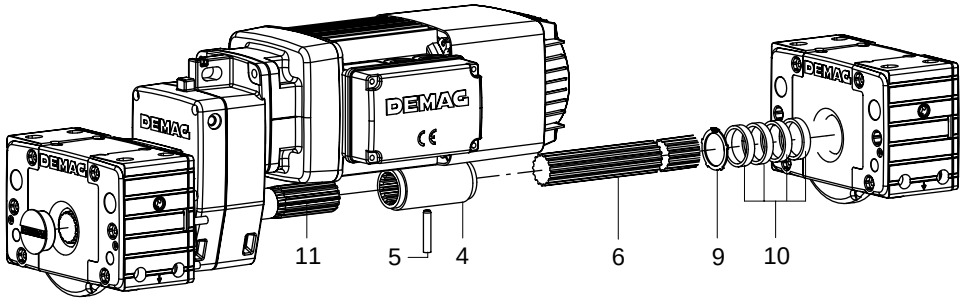
5.3 Central drive units

5.3.1 With A type offset gearboxes

Clean drive shaft before fitting, check splined profile section and grease with DG 69 grease.

Drive arrangement **ournal shaft on both sides with involute splines**



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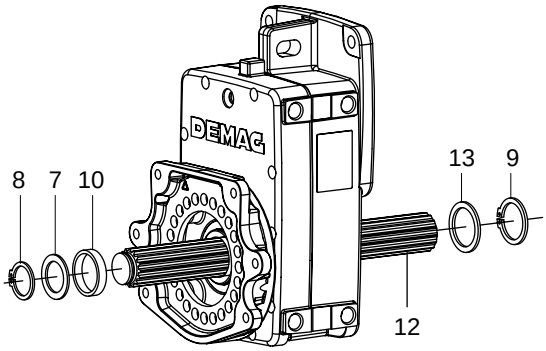
Drive arrangement **ollow shaft with solid shaft**



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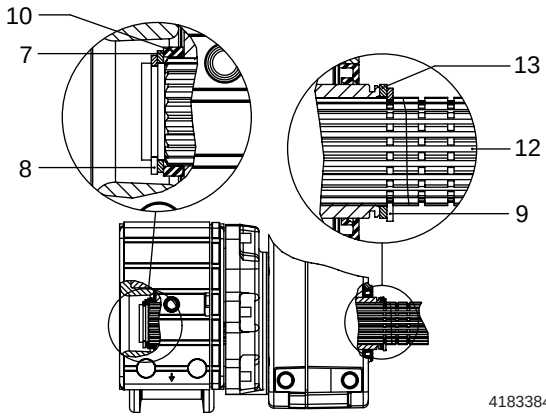

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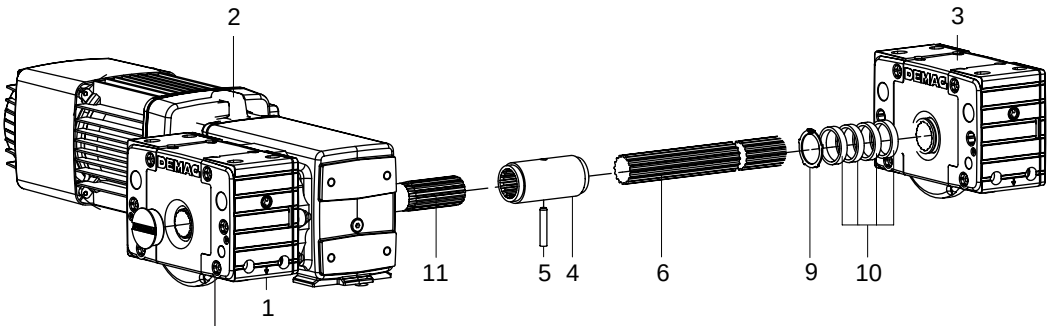
Assembly

- Connect travel drive (2) with wheel block (1) as described in section 5.1.
  Journal drive shaft arrangements do not need to be secured against axial displacement. Hollow drive shaft arrangements (12) must be secured against axial displacement by fitting retaining rings (8/9) and thrust washers (7/13) as well as spacer ring (10) included in the supply.
- Insert roll pin (5) into connector (4).
- Slide connector (4) onto drive shaft (11/12).
- Insert central drive shaft (6) into wheel block (3).
- Place spacer rings (10) onto central drive shaft (6) and push the shaft into the connector until it stops against the roll pin.
- Determine the quantity of spacer rings (10) required until the retaining ring groove is reached.
- Secure central drive shaft (6) against axial displacement by fitting retaining ring (9).

5.3.2 With W type angular gearboxes

Clean drive shaft before fitting, check splined profile section and grease with DG 69 grease.

Drive arrangement ournal shaft on both sides with involute splines



After having fitted an angular gearbox type W 50, check the bolted connections of the wheel block for the correct tightening torque (72 Nm)!

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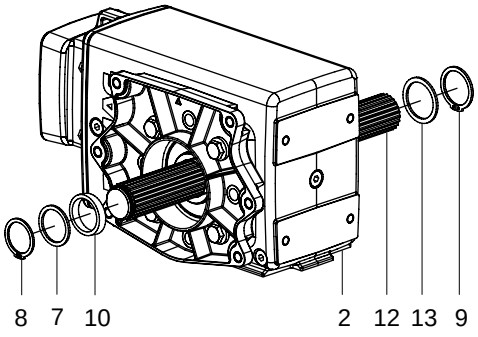
Drive arrangement ollow shaft with solid shaft



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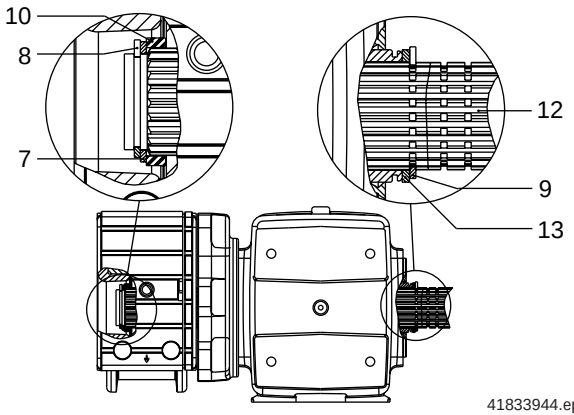

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Assembly

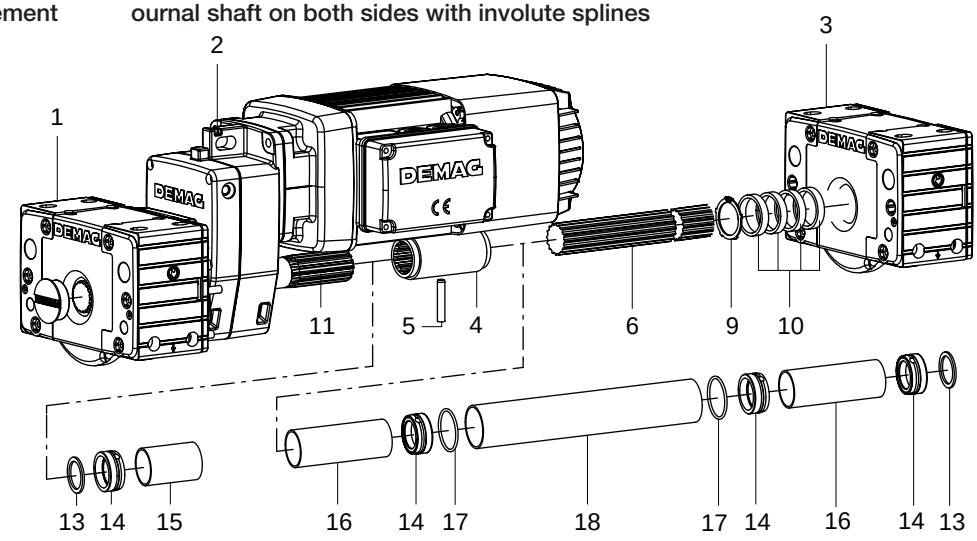
- Connect travel drive (2) with wheel block (1) as described in section 5.1.
  Journal drive shaft arrangements do not need to be secured against axial displacement. Hollow drive shaft arrangements (12) must be secured against axial displacement by fitting retaining rings (8/9) and thrust washers (7/13) as well as spacer ring (10) included in the supply.
- Insert roll pin (5) into connector (4).
- Slide connector (4) onto drive shaft (11/12).
- Insert central drive shaft (6) into wheel block (3).
- Place spacer rings (10) onto central drive shaft (6) and push the shaft into the connector until it stops against the roll pin.
- Determine the quantity of spacer rings (10) required until the retaining ring groove is reached.
- Secure central drive shaft (6) against axial displacement by fitting retaining ring (9).

5.4 Central drive units with shaft protection

5.4.1 With A type offset gearboxes

Clean drive shaft before fitting, check splined profile section and grease with DG 69 grease.

Drive arrangement ournal shaft on both sides with involute splines



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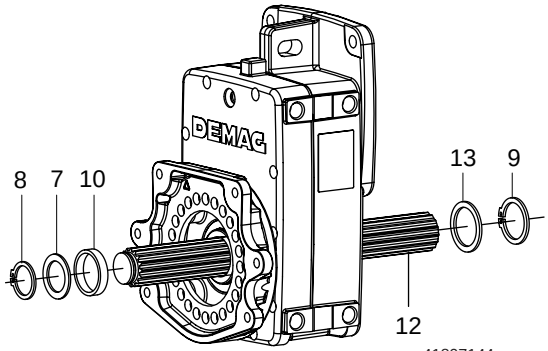
Drive arrangement ollow shaft with solid shaft



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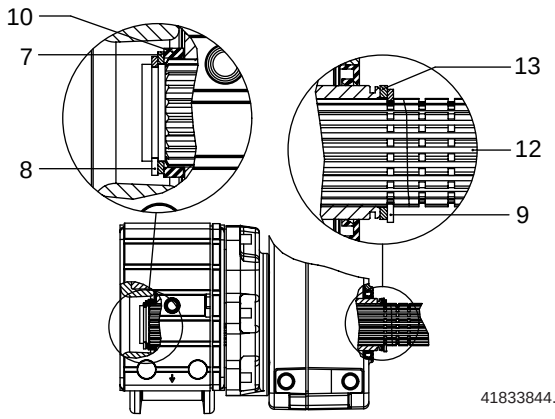

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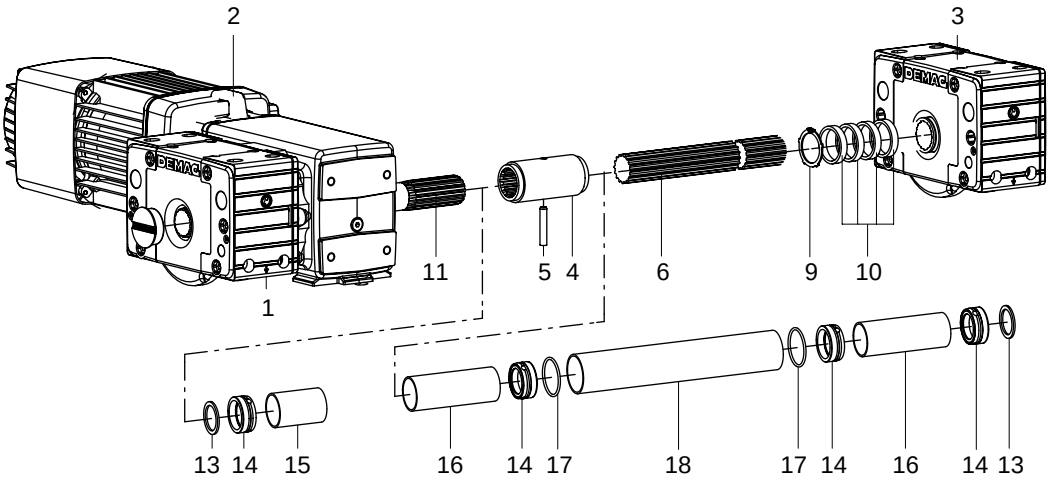
Assembly of central drive unit with shaft protection

- Connect travel drive (2) with wheel block (1) as described in section 5.1. Journal drive shaft arrangements do not need to be secured against axial displacement. Hollow drive shaft arrangements (12) must be secured against axial displacement by fitting retaining rings (8/9) and thrust washers (7/13) as well as spacer ring (10) included in the supply.
- Push adapter (14) onto tube I (15) and slide this unit onto drive shaft (11/12) with thrust washer (13).
- Insert roll pin (5) into connector (4).
- Slide connector (4) onto drive shaft (11/12) and push recessed end into tube I (15).
- Pre-assemble 2 x shaft protection tube II (16) with adapter (14).
- Roll O rings (17) onto both ends of tube III (18).
- Insert central drive shaft into wheel block (3).
- Place spacer rings (10) onto central drive shaft (6) and push the shaft into the connector until it stops against the roll pin. Determine the quantity of spacer rings (10) required until the retaining ring groove is reached.
- Push through central drive shaft (6) in the direction of wheel block (3) and slide on pre-assembled shaft protection tubes II and III over the shaft with thrust washer (13) and retaining ring (9).
- Slide back central drive shaft (6) until reaching stop in adapter (4) and secure against axial displacement by fitting spacer rings (10) and retaining ring (9).
- Position the shaft protection tubes. Roll O rings (17) off tube III and place into grooves of adapters (14) to secure them against displacement.

5.4.2 With W type angular gearboxes

Clean drive shaft before fitting, check splined profile section and grease with DG 69 grease.

Drive arrangement ournal shaft on both sides with involute splines



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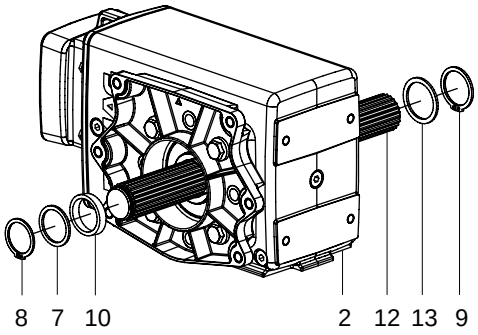
Drive arrangement ollow shaft with solid shaft



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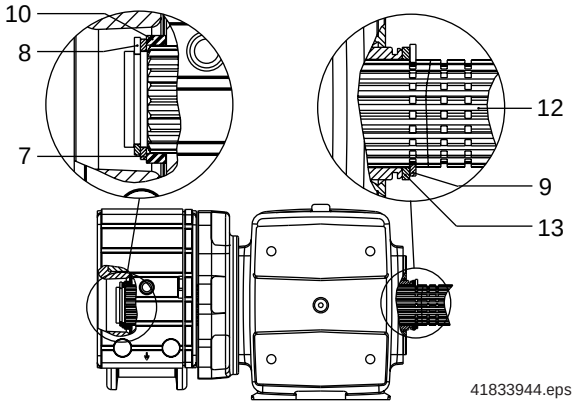

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Assembly of central drive unit with shaft protection

- Connect travel drive (2) with wheel block (1) as described in section 5.1. Journal drive shaft arrangements do not need to be secured against axial displacement. Hollow drive shaft arrangements (12) must be secured against axial displacement by fitting retaining rings (8/9) and thrust washers (7/13) as well as spacer ring (10) included in the supply.
- Push adapter (14) onto tube I (15) and slide this unit onto drive shaft (11/12) with thrust washer (13).
- Insert roll pin (5) into connector (4).
- Slide connector (4) onto drive shaft (11/12) and push recessed end into tube I (15).
- Pre-assemble 2 x shaft protection tube II (16) with adapter (14).
- Roll O rings (17) onto both ends of tube III (18).
- Insert central drive shaft into wheel block (3).
- Place spacer rings (10) onto central drive shaft (6) and push the shaft into the connector until it stops against the roll pin. Determine the quantity of spacer rings (10) required until the retaining ring groove is reached.
- Push through central drive shaft (6) in the direction of wheel block (3) and slide on pre-assembled shaft protection tubes II and III over the shaft with thrust washer (13) and retaining ring (9).
- Slide back central drive shaft (6) until reaching stop in adapter (4) and secure against axial displacement by fitting spacer rings (10) and retaining ring (9).
- Position the shaft protection tubes. Roll O rings (17) off tube III and place into grooves of adapters (14) to secure them against displacement.

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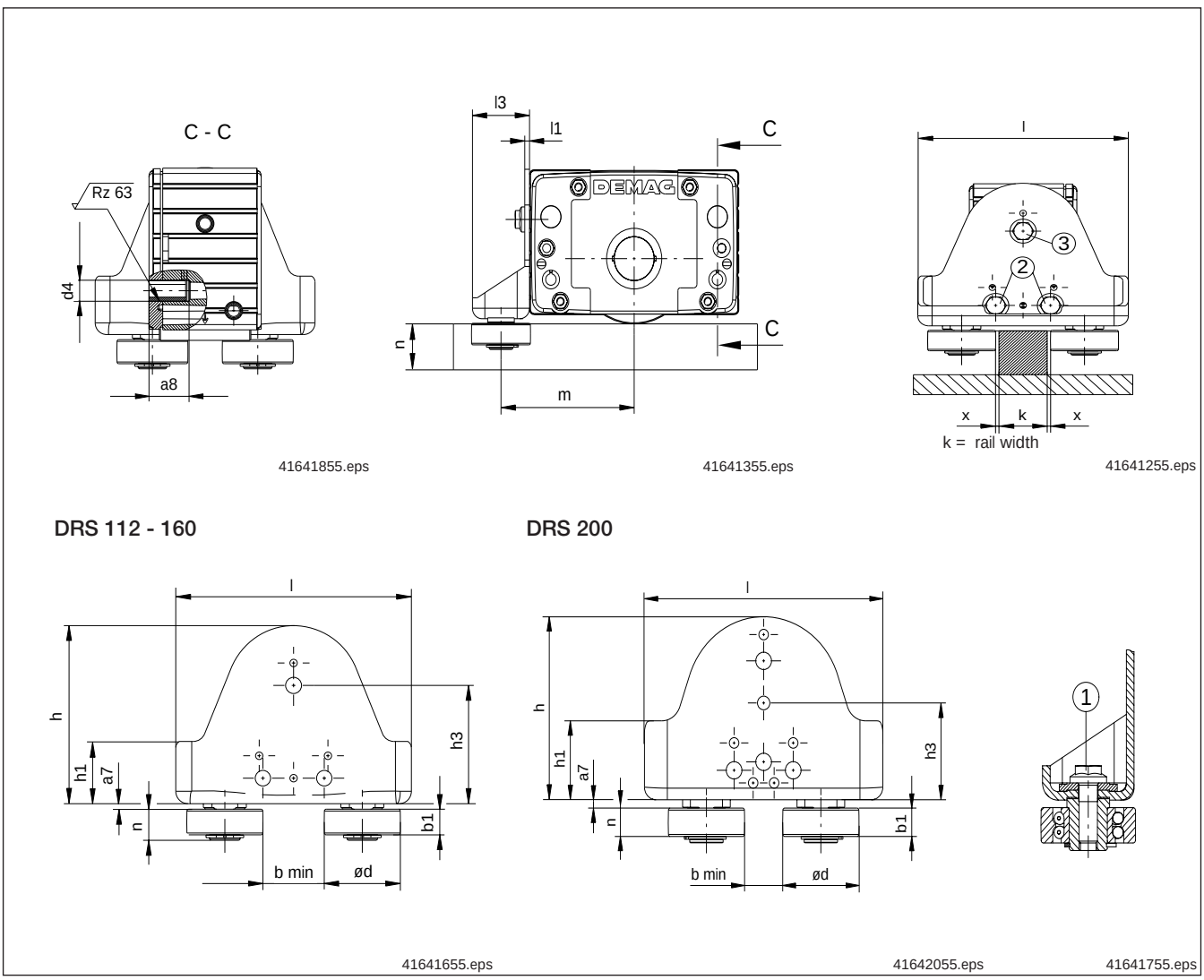
6 Fittings

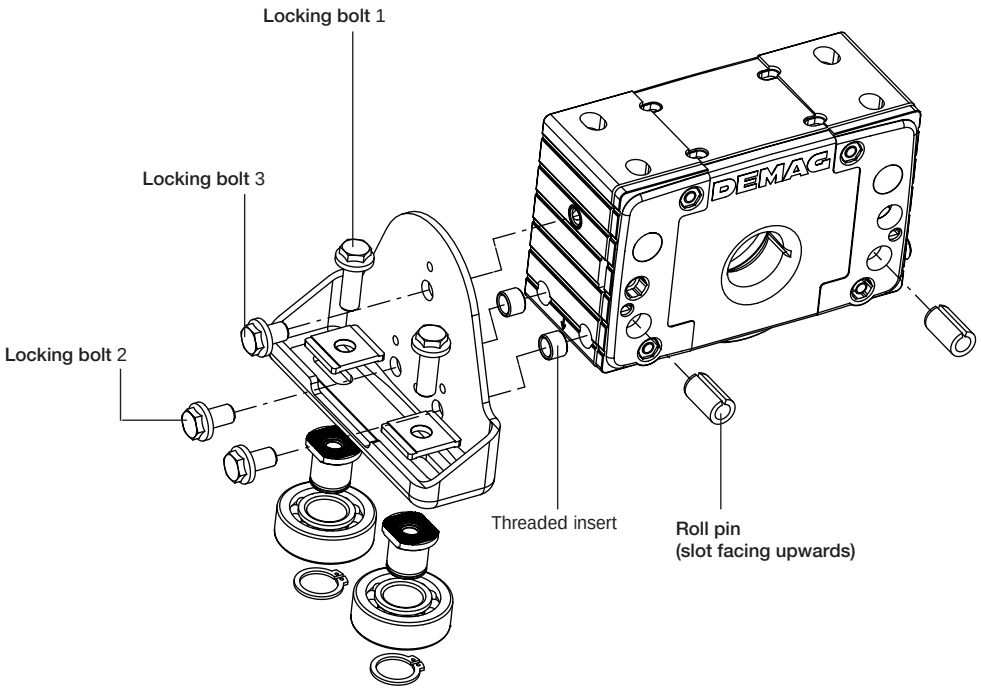
6.1 ori ontal guide rollers

6.1.1 Fitting to wheel blocks

Permissible horizontal load: **Maximum 15 of the wheel load**



Wheel block si e	Tightening torque Locking bolt			Dimensions in mm																
	1	2	3	x_{min}	x_{max}	a7	a8	b_{max}	b_{min}	b1	d	d4	h	h1	h2	l	l1	l3	m	n
DRS 112	130 Nm			1	5	4,5	35	70	30	20,6	52	13	126,5	38,2	24,5	180	5	60	125	24,5
DRS 125	130 Nm			1	5	4,5	35	70	30	20,6	62	18	143	50	25	192	5	60	140	25
DRS 160	330 Nm		130 Nm	1	5	8,5	40	80	30	23,8	72	25	162	65	29	230	6	72	173,5	29
DRS 200	330 Nm		130 Nm	1	5	8	45	90	40	27	80	28	174	75	33	250	6	80	210	33



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Fitting

- Fit guide rollers to wheel block as shown above and tighten by hand.
- Tighten locking bolts (2/3) with specified tightening torque (see table).
- Adjust roller distance dimension “x” and align guide rollers to rail.
- Tighten locking bolts (1) with specified torque (see table).

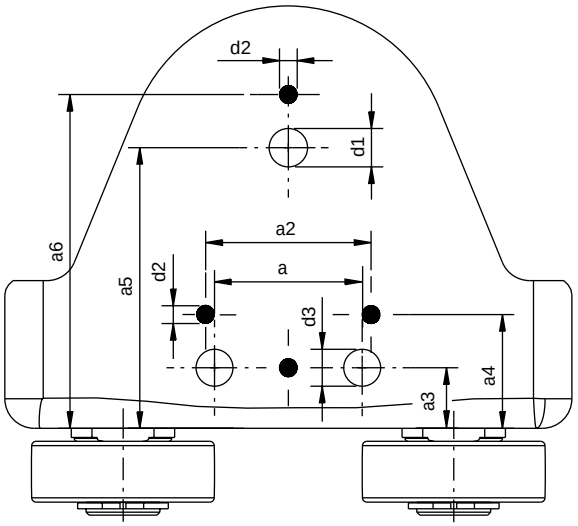
Fitting for wheel block not prepared before leaving the factory

If a wheel block is fitted with a roller guide arrangement at a later date, the following additional measures must be carried out:

- Drill bore holes on cover side to diameter d4 and depth a8 and fit roll pins with slot facing **upwards** .
- Fit two threaded inserts into the end face.

Wheel block size	Tightening torque Locking bolt			Dimensions in mm			
	1	2	3	x_{min}	x_{max}	a8	d4
DRS 112	130 Nm			1	5	35	13
DRS 125	130 Nm			1	5	35	18
DRS 160	330 Nm		130 Nm	1	5	40	25
DRS 200	330 Nm		130 Nm	1	5	45	28

6.1.2 Fitting to steel superstructures Permissible horizontal load: Maximum 20% of the wheel load



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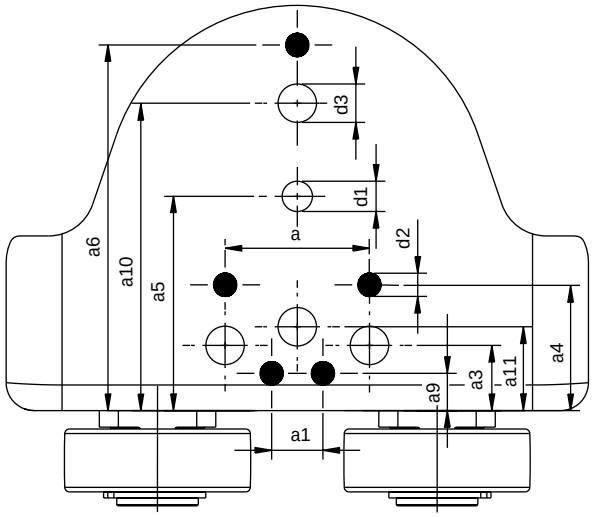

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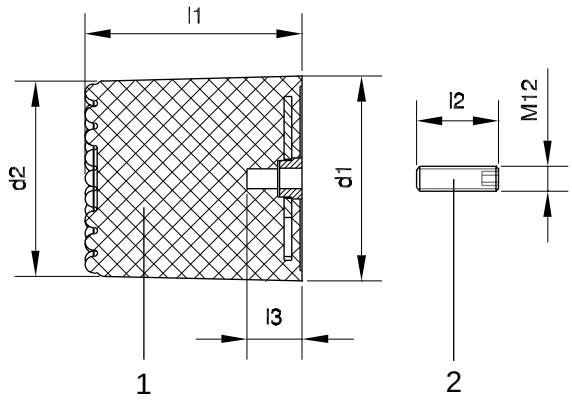
● → Drill out holes for roll pins to d_5^{H12} after fitting.

Wheel block si e	Dimensions in mm													
	a	a1	a2	a3	a4	a5	a6	a9	a10	a11	d1	d2	d3	d5
DRS 112	40	–	48	22	40	76	102	–	–	–	13	6	12,5	8
DRS 125	50	–	56	20,5	38,5	95	113	–	–	–	13	6	12,5	8
DRS 160	54	–	58	26	49,5	93,5	148,5	–	–	–	13	8	16,5	10
DRS 200	62	22	62	28	54	92	157	16	132	36	13	10	16,5	12

6.2 Buffer elements

DP cellular foam buffer



1 Buffer
2 Gewindestift

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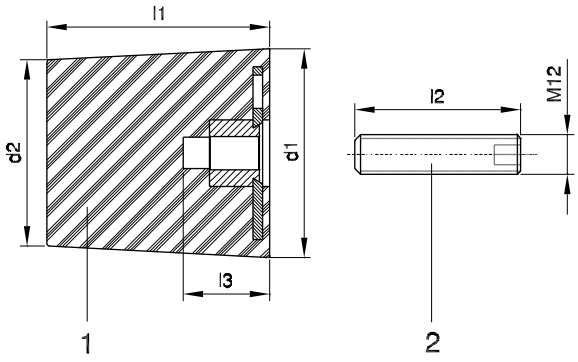
DPG rubber buffer



1 Buffer
2 Gewindestift

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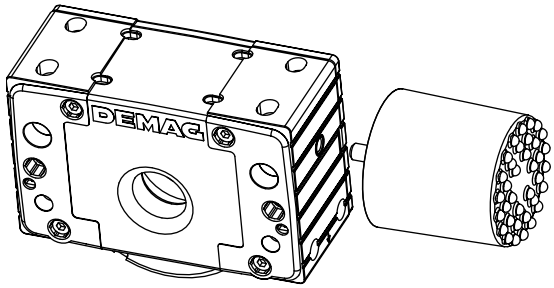
Wheel block size	Buffer	Dimensions in mm						
		d1	d2	l1	l2		l3	l4
					w/o guide rollers	with guide rollers		
DRS 112 DRS 125	DP 70	70	65	70	30	55	25	11 ± 0,5
	DP 100	100	95	106	30	55	30	11 ± 0,5
	DPG63	63	56	67	35	55	26	11 ± 0,5
	DPG80	80	71	84	35	55	26	11 ± 0,5
DRS 160	DP 70	70	65	70	30	55	25	14 ± 0,5
	DP 100	100	95	106	30	55	30	14 ± 0,5
	DP 130	130	122	126	30	55	30	14 ± 0,5
	DPG63	63	56	67	35	55	26	14 ± 0,5
	DPG80	80	71	84	35	55	26	14 ± 0,5
	(DPG100)	100	90	105	35	55	26	14 ± 0,5
DRS 200	DP 70	70	65	70	30	55	25	14 ± 0,5
	DP 100	100	95	106	30	55	30	14 ± 0,5
	DP 130	130	122	126	30	55	30	14 ± 0,5
	DP 160	160	155	157,5	30	55	40	14 ± 0,5
	DPG63	63	56	67	35	55	26	14 ± 0,5
	DPG80	80	71	84	35	55	26	14 ± 0,5
	DPG100	100	90	105	35	55	26	14 ± 0,5

( ) = limited

Possible fitting arrangement to end of DRS 112 – 200 wheel blocks without hori ontal guide roller arrangement



- Screw threaded pin (2) into buffer (1) until maximum l3 dimension is reached.
- Screw buffer into threaded insert in wheel block.

Fig. 11

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Possible fitting arrangement to end of DRS 112 – 200 wheel blocks with hori ontal guide roller arrangement (figs. 12 – 13)

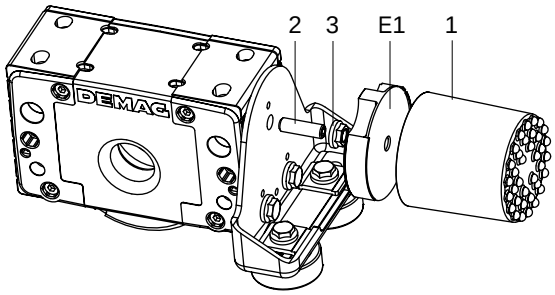

Fig. 12

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- Remove the locking bolt and screw threaded pin (2) up to max. dimension l4 into the tapped insert in the wheel block.
- Tighten locknut (3) on threaded pin and counter using hexagon socket (tightening torque 130 Nm).
- Fit shim (4), type E1, with the ribs facing the wheel block side and screw the buffer onto the threaded pin.

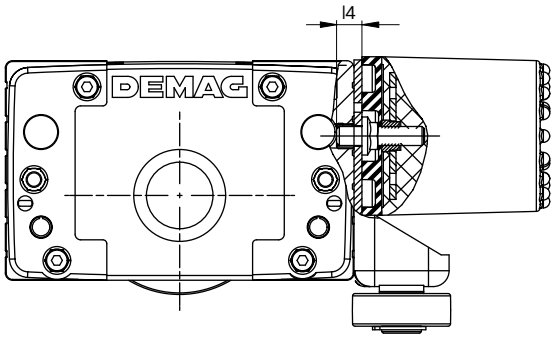

Fig. 13

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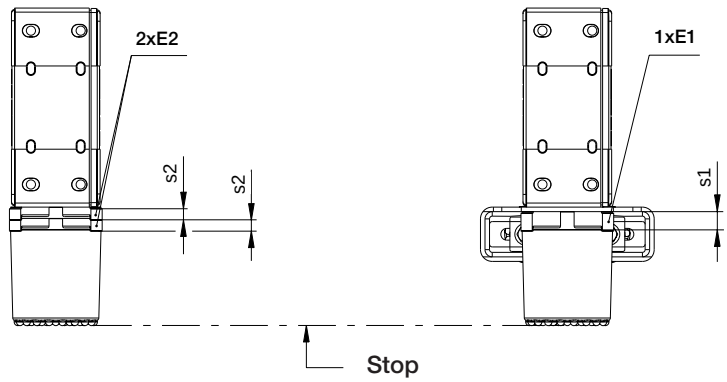

Fig. 14

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To ensure uniform buffer impact with a horizontal guide roller arrangement fitted to only one wheel block, two shims, type E2 must be fitted between the buffer and wheel block on the opposite side.

Buffer type	Shim type	
	E1	E2
	s1	s2
DPG63 DP 70	14	10
DPG80 DPG100 DP 100	20	12,5
DP 130	25	16
DP 160 [1)]	14	21

1) Only one type E2 shim required.

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7 Maintenance

7.1 Maintenance instructions

DRS wheel blocks

Owing to their design, DRS wheel blocks are maintenance free.

NA – BA – BF motors

See Operating instructions ident no. 214 228 44

AU – AD – AG – AF – AM offset geared motors

See Operating instructions ident no. 214 206 44

WU – WG – WF angular geared motors

See Operating instructions ident no. 214 058 44

Refer to the above mentioned operating instructions for information on gearbox lubrication intervals, lubricants and quantities of lubricants.

Shafts

Lubrication interval: 10000 hours of operation, at least every 4 years.
Under extreme operating conditions (e.g. multiple shift operation) shorter intervals (every quarter) must be selected.

Lubricant: DG 69 grease
Part no. 472 915 44 (0,4 kg)

Bolted connections

Bolted connections must be inspected annually.
Under extreme operating conditions (e.g. multiple shift operation) shorter intervals (every quarter) must be selected.

Comparable lubricants

DG 60 oil

e.g. Aral Degol BG 220, Esso Spartan EP220,
BP Energol GR-XP 220, Shell Omala Oil 220,
Mobilgear 630

DG 69 grease

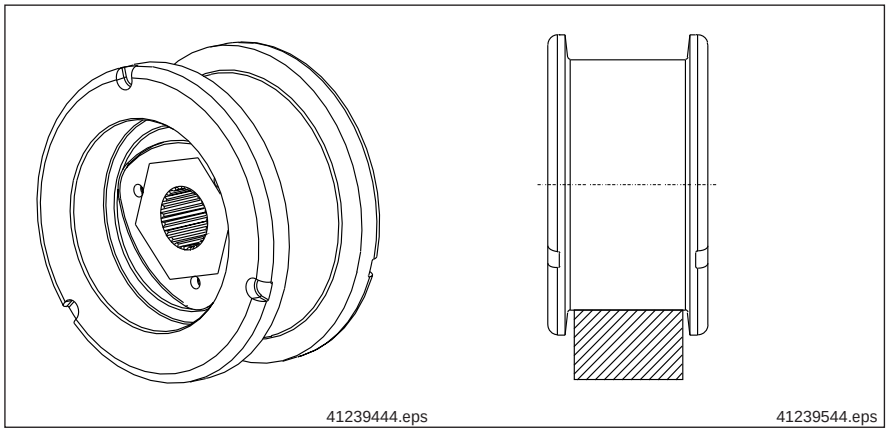
e.g. Esso-PEN-O-LED EP Grease Shell Alranina G2
BP Energrease LS 2 Aral Aralub HL 2

7.2 Travel wheel wear

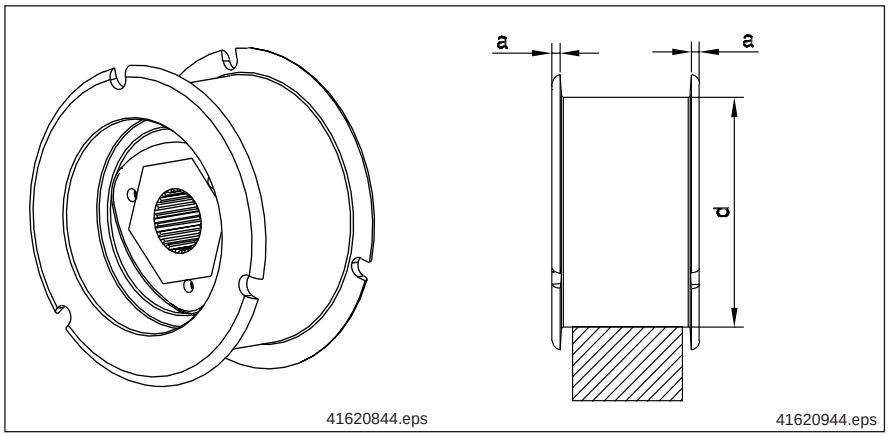
7.2.1 Flange wear

The wear indicator on the flange facilitates preventive inspections of the installation.

Travel wheel when new



Worn travel wheel



The travel wheel must already be replaced even if only **one** segment of the wear indicator is open.

7.2.2 Tread wear

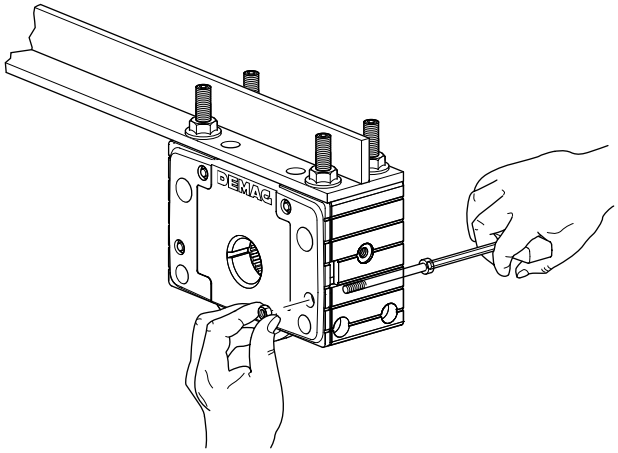
Travel wheels must be replaced when the following limit values are reached:

Nominal travel wheel diameter	Minimum remaining flange width a	Minimum travel wheel diameter d	Max. difference in travel wheel diameters for coupled wheels
		Dimensions in mm	
112	5,0	105,4	0,1
125	6,0	118,4	0,1
160	7,0	153,4	0,15
200	8,4	193,0	0,15

7.3 Possible problems

Description of problem	Possible cause	Remedy
Increased travel wheel wear (tread or flange)	Wheel block is misaligned	Re-align the wheel blocks
	Rail is dirty	Clean the rail
Running noises	Wheel block is misaligned	Re-align the wheel blocks
	Rail is dirty	Clean the rail
	Defective bearing	Replace the travel wheel

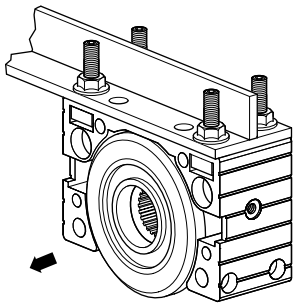
8 Removing and fitting travel wheels



Remove the cover

Undo the cover screws and lever off using the recess on the side of the wheel block.

41445544.eps

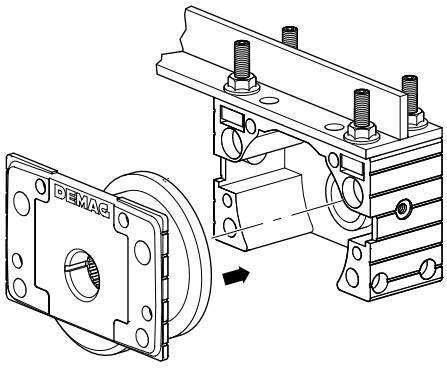


Remove the travel wheel

Remove the travel wheel with the ball bearings.

41445344.eps

Fig. 15



Fit the travel wheel and bearings in the reverse order to disassembly.

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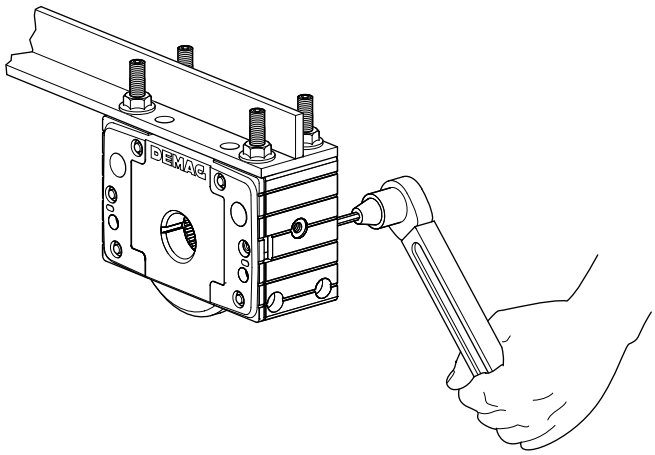

Bolt the cover and housing together with the corresponding tightening torque (see table below).

Wheel block si e	Tightening torque
DRS 112	36 Nm
DRS 125	36 Nm
DRS 160	72 Nm
DRS 200	72 Nm

41458444.eps

Fig. 16

9 Forms

9.1 Forms for documenting the installation

9.1.1 Type plates

752 199 44
Mannesmann Dematic AG
Typ
Auftr. -Nr. ASN
Fabrik-Nr. Made in Germany

41239044.eps

752 199 44
Mannesmann Dematic AG
Typ
Auftr. -Nr. ASN
Fabrik-Nr. Made in Germany

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752 199 44
Mannesmann Dematic AG
Typ
Auftr. -Nr. ASN
Fabrik-Nr. Made in Germany

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752 199 44
Mannesmann Dematic AG
Typ
Auftr. -Nr. ASN
Fabrik-Nr. Made in Germany

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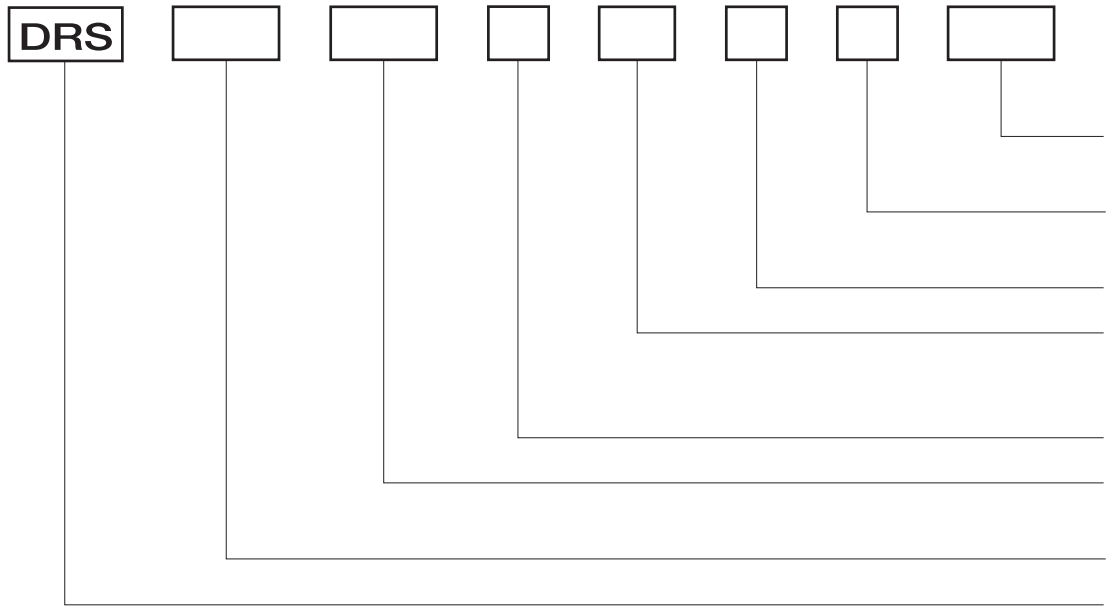


Gearbox size fitted: **A 10 ... A50**
W 10 ... W60
No gearbox specified: indicate
Horizontal guide rollers: , standard
No horizontal guide rollers: indicate

Connection variant: **K, W, B, BK**
No connection variant indicate
Travel wheel tread:
for types **A** and **D** **47 52 55 60 65 (standard)**
for types **B**, **C**, **E**, **F**: indicate **00**

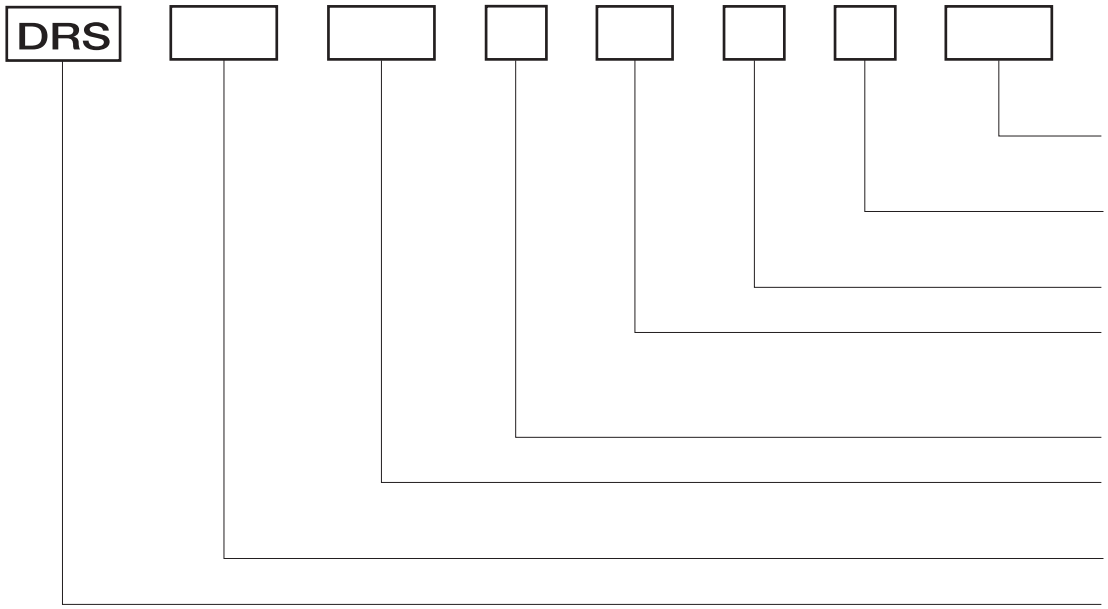
Travel wheel type: **A, B, C, D, E, F, S**

Basic type: **NA A 30 ... 50 MA 30 ... 50**

Wheel block size

Wheel block system

41239244.eps



Gearbox size fitted: **A 10 ... A50**
W 10 ... W60
No gearbox specified: indicate
Horizontal guide rollers: , standard
No horizontal guide rollers: indicate

Connection variant: **K, W, B, BK**
No connection variant: indicate
Travel wheel tread:
for types **A** and **D** **47 52 55 60 65 (standard)**
for types **B**, **C**, **E**, **F**: indicate **00**

Travel wheel type: **A, B, C, D, E, F, S**

Basic type: **NA A 30 ... 50 MA 30 ... 50**

Wheel block size

Wheel block system

41239244.eps

9.2 Fax form

Fax order

Simply copy, fill in and fax

To _____

_____ Fax no. _____

_____ Contact _____

_____

Item	Part no.	Designation	uantity

Company address (stamp)

_____
Customer number (if known)

_____
Company/Dept.

_____
Street

_____
Town/post code

_____
Contact

_____
Tel./fax no.

Delivery address (if different)

_____
Company/Dept.

_____
Street

_____
Town/post code

_____
Remarks

Customer order no. .....

Required delivery date .....

_____
Date

_____
Signature

214276K4.p65/1098

Hereby we,

Mannesmann Dematic AG
Antriebstechnik,

declare that the product

Demag DRS RS wheel block

of serial design is intended to be incorporated into machinery and that the machinery must not be put into service until the machinery into which this product is to be incorporated has been declared in conformity with the provisions of the following relevant regulations:

EC Machinery Directive	**89 392 EEC**
amended by	**91 368 EEC**

Applied harmonised standards:

EN 292	**Safety of Machinery**

Wetter, 27 anuary 1997

Place and date of issue

ppa. Dr. Schiemann	**ppa. Peters**
Produktgruppe **Getriebe und Komponenten**	**Vertrieb** **Antriebstechnik**

Subject to alteration

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Subject to alteration

Printed in Germany DZS/0499/2T

Differential pressure switch for air, flue and exhaust gases

AA-A2…

DUNGS®
Combustion Controls

Approvals

UL Listed
- UL 353
- File # MH 16628

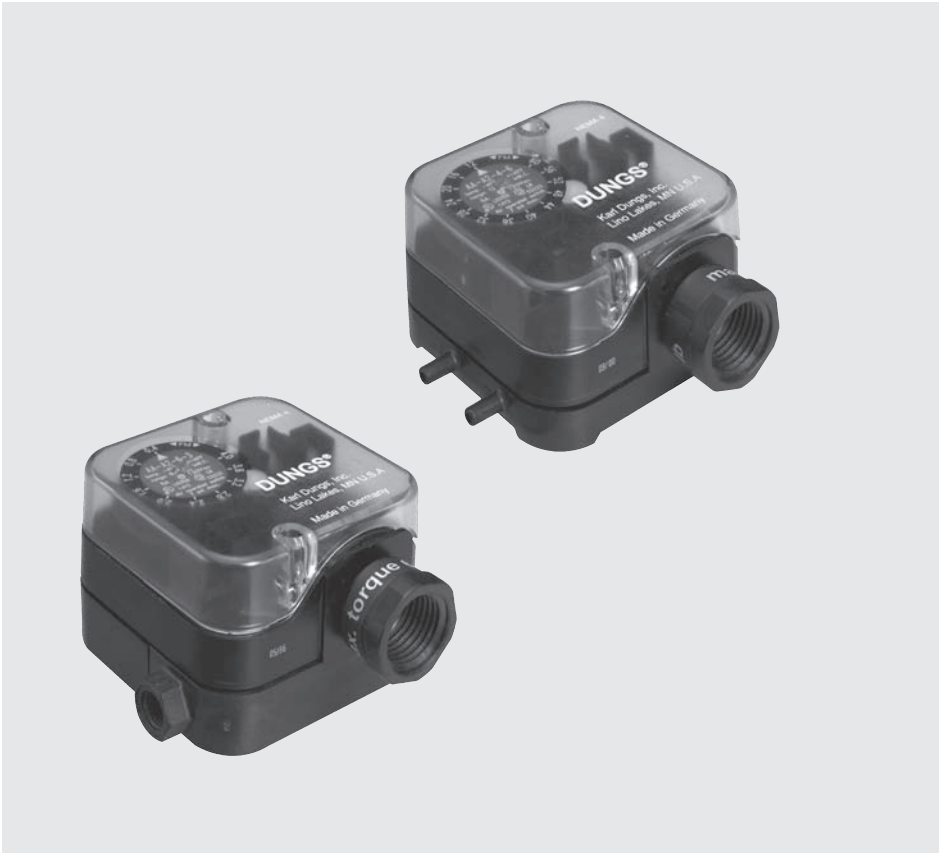
CSA Certified
- CSA C22.2 No. 14
- File # 201527

FM Approved
- Class 3510, 3530
- File # J.I. 0D6A1.AF

Commonwealth of Massachusetts Approved Product
- Approval code G3-0106-191
- Air pressure switch for differential, vacuum or pressure

Codes and Standards
This product is recommended for installations covered by but not limited to NFPA 85, NFPA 86, ANSI Z83.4/CSA 3.7, ANSI Z83.18/CSA 4.9, ANSI Z21.13, CSD-1, UL 795, CSA B149.1, CSA B149.3 and CSA B149.6.

DUNGS is an ISO 9001 manufacturing facility.



Description

AA-A2… differential pressure switches are field adjustable, compact pressure switches for automatic burner controls. Available with hose or NPT threaded connections.

AA-A2-4… differential pressure switches are suitable for making and/or breaking a circuit when the medium pressure changes relative to the set point. AA-A2-4… versions feature hose connections.

AA-A2-6… differential pressure switches are suitable for making and/or breaking a circuit when the medium pressure changes relative to the set point. AA-A2-6… versions feature NPT threaded connections that also include a test button in the lower housing.

Application

Differential pressure monitoring in firing, ventilation and air-conditioning systems. The AA-A2… can be used as a pressure, vacuum or differential pressure switch for air and non-aggressive gases. Not suitable for natural gas, propane, butane and other combustable gases.

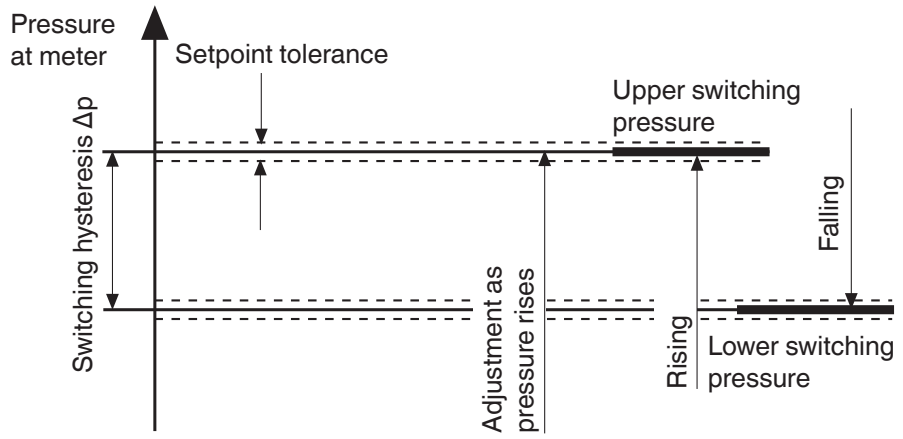
AA-A2… SPDT differential pressure switch in pressure and vacuum ranges. The differential pressure acts via the diaphragm against the force of the setting spring on the microswitch. The pressure switch operates without any auxiliary power

Specifications

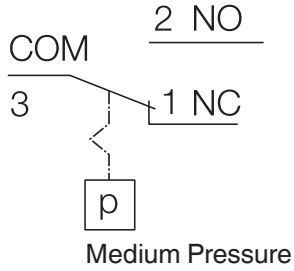
Max. operating pressure	7 PSI (500 mbar)	
Pressure connection	**AA-A2-4 Hose connection** 5/32" (4.6 mm) dia. positive 5/32" (4.6 mm) dia. negative	**AA-A2-6 Threaded connection** 1/4" NPT positive 1/8" NPT negative 5/32" (4.6 mm) test connection
Temperature range	Ambient temperature Medium temperature	-40 °F to +140 °F (-40 °C to +60 °C) -40 °F to +140 °F (-40 °C to +60 °C)
Materials	Housing: Switch: Diaphragm: Switching contact:	Polycarbonate Polycarbonate NBR-based rubber Silver (Ag)
Electrical ratings	AC eff. DC	min. 24 V max. 250 V min. 24 V max. 48 V
Current ratings	AC 5A resistive @ 120 VAC AC 3A inductive @ 120 VAC DC min. 20 mA @ 24 VDC DC max. 1A @ 12 - 48 VDC	
Electrical connection	Screw terminals via 1/2" NPT conduit connection	
Enclosure rating	NEMA Type 4	
Setting tolerance	±15% switching point deviation referred to set point, adjusted as pressure rises, vertical diaphragm position	
Installation position	Multipoised	

⚠ Installation position: Standard installation position is vertical upright diaphragm. When installed horizontally, the pressure switch switches at a pressure higher by approx. 0.2 in. W.C. When installed upside down, the pressure switch switches at a pressure lower by approx. 0.2 in. W.C. When installed in other positions, the pressure switch switches at pressure deviating from the set reference value by max. ± 0.2 in. W.C.

Definition of switching hysteresis Δp
The pressure difference between the upper and lower switching pressures.



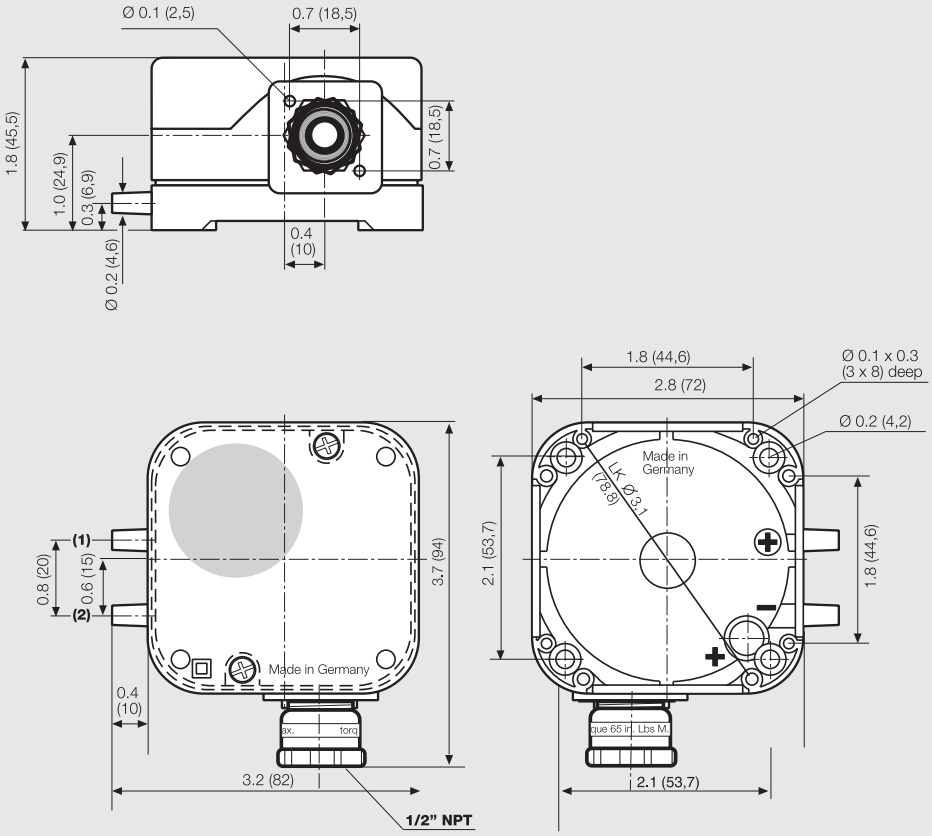
AA-A2… switching function
As pressure rises:
1 NC opens, 2 NO closes
As pressure falls:
1 NC closes, 2 NO opens



Dimensions inch (mm)

1 Pressure connection (+)
2 Pressure connection (–)
3 Test nipple p(+)

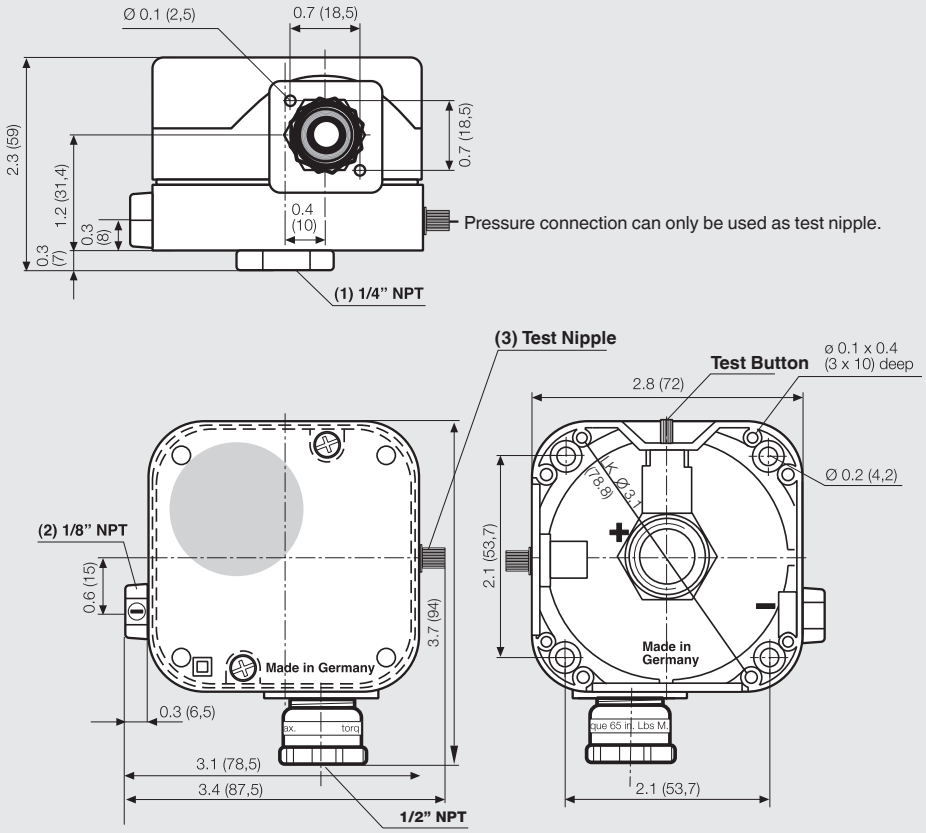
AA-A2-4… Hose connection



Dimensions inch (mm)

1 Pressure connection (+)
2 Pressure connection (–)
3 Test nipple p(+)

AA-A2-6… Threaded connection



Test button

The AA-A2-6… threaded version is equipped with a test button. When the test button is pressed, the connection to the 1/4" NPT pressure connection is interrupted and the pressure below the diaphragm is relieved. The microswitch of the pressure switch changes the contact position from NO to NC.

If the test button is released, the pressure below the diaphragm is built up again and the microswitch changes to its original position.

Differential pressure switch for air, flue and exhaust gases

AA-A2…

DUNGS®
Combustion Controls

Type	Version	Description	Order No.	Setting range in. W.C	Switching hysteresis in. W.C.	Factory Calibration
AA-A2-4-...	AA-A2-4-2	Hose connection	217-060A	0.16 - 1.20	≤ 0.12	
	AA-A2-4-3	Hose connection	217-061A	0.40 - 4.00	≤ 0.20	
	AA-A2-4-5	Hose connection	217-062A	2.00 - 20.00	≤ 0.40	
	AA-A2-4-6	Hose connection	217-063A	12.00 - 60.00	≤ 1.20	
AA-A2-6-...	AA-A2-6-2	Threaded connection	217-329A	0.16 - 1.20	≤ 0.12	
	AA-A2-6-3	Threaded connection	217-330A	0.40 - 4.00	≤ 0.20	
	AA-A2-6-5	Threaded connection	217-331A	2.00 - 20.00	≤ 0.40	
	AA-A2-6-6	Threaded connection	217-332A	12.00 - 60.00	≤ 1.20	

Accessories for pressure switch	Order No.
Klima-Set (Duct mounting kit)	217-897
Replacement cover	228-732
Mounting plate (plastic)	230-301 (recommended mounting bracket)
Mounting bracket (plastic)	230-273 (optional mounting bracket)
120 VAC light mounting set (orange)	231-772
120 VAC light only (for switches with kit 231-772 already installed)	244-156
24 VDC/VAC light mounting set (orange)	231-774
Replacement conduit adapter PG 11 to 1/2" NPT	220-566
Replacement conduit adapter M 20 to 1/2" NPT	240-671
DIN connector (female plug)	210-318
Male plug for DIN connector	219-659

We reserve the right to make any changes in the interest of technical progress.

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Fax +49 (0)7181-804-166
e-mail info@dungs.com
Internet http://www.dungs.com

Pressure switch for gas and air

GAO-A4…
GMH-A4…
GML-A4…

DUNGS®
Combustion Controls

UL Listed
- UL 353
- File # MH 16628

CSA Certified
- CSA C22.2 No. LR 53222
- Certification file # 201527

FM Approved
- Class 3510, 3530
- File # J.I. 1Y919.AF

Commonwealth of Massachusetts Approved Product
- Approval code G3-0106-191
- Gas pressure switch

Codes and Standards
This product is intended for installations covered by but not limited to NFPA 85, NFPA 86, UL 795, CSD-1, ANSI Z83.4, ANSI Z83.18, ANSI Z21.13, CSA B149.1, CSA B149.3 and CSA B149.6.

DUNGS is an ISO 9001 manufacturing facility.

Description
The GAO-, GMH- and GML-A4… ventless pressure switches are adjustable pressure switches for automatic burner controls.

These pressure switches are suitable for making and/or breaking a circuit when the medium pressure changes relative to the set point. The set point can be set in the field by an adjustable dial with an integrated scale. Test nipple integrated in metal housing to verify set point.

Application
The GAO-, GMH-, and GML-A4… pressure switch is recommended for industrial and commercial heating, ventilation and air-conditioning systems.

The GAO-, GMH-, and GML-A4… pressure switch is suitable for dry natural gas, propane, butane, air and other inert gases. Suitable for up to 0.1 % by volume, dry H_2S.

A “dry” gas has a dew point lower than +15 °F and its relative humidity is less than 60 %.

GAO-A4… SPDT pressure switch requires no auxiliary power. The GAO-A4… is suitable for making and/or breaking a circuit when the set point is exceeded or undershot. A tripped switch is indicated by a neon light after set point is exceeded or undershot. Automatic reset when pressure returns below or above set point.

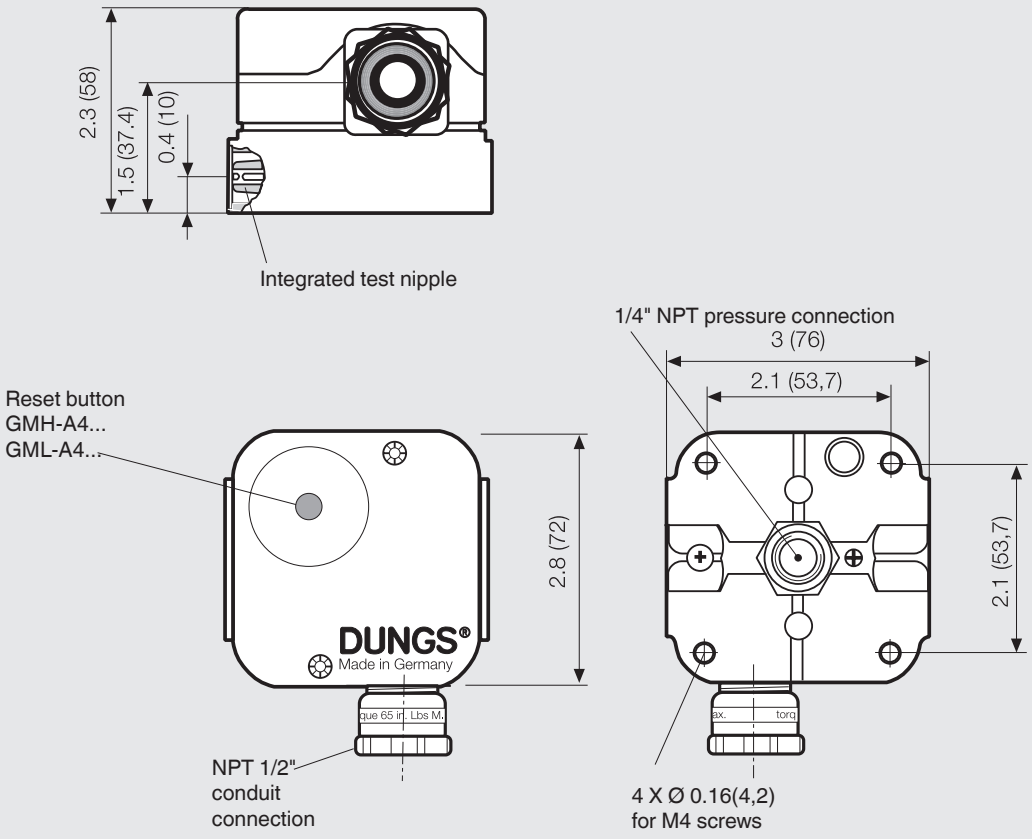
GMH-A4… SPDT pressure switch requires no auxiliary power. The GMH-A4… is suitable for making and/or breaking a circuit when the set point is exceeded. A tripped switch is indicated by a neon light after set point is exceeded. Manual reset is required to reset the switch.

GML-A4… SPDT pressure switch requires no auxiliary power. The GML-A4… is suitable for making and/or breaking a circuit when the set point is undershot. A tripped switch is indicated by a neon light after set point is undershot. Manual reset is required to reset the switch.

Specifications

Max. operating pressure	GAO-A4-4-2,3,5,6	7 PSI (500mbar)
	GMH- and GML-A4-4-4,6	7 PSI (500mbar)
	GAO-, GMH- and GML-A4-4-8	14 PSI (1000 mbar)
Max. body pressure	15 PSI (1033 mbar)	
Pressure connection	Standard: 1/4" NPT female thread centered underside of housing.	
Temperature range:		
GAO-, GMH- and GML-A4-4	Ambient temperature	-40 °F to +140 °F (-40 °C to +60 °C)
	Medium temperature	-40 °F to +140 °F (-40 °C to +60 °C)
GAO-, GMH- and GML-A4-4-8	Ambient temperature	-22 °F to +140 °F (-30 °C to +60 °C)
	Medium temperature	-22 °F to +140 °F (-30 °C to +60 °C)
Materials	Housing	Aluminium
	Switch	Polycarbonate
	Diaphragm	NBR-based rubber
	Switching contact	Silver or Gold
Electrical ratings	AC eff.	min. 24 V max. 240 V
	DC	min. 24 V max. 48 V
Nominal current	Silver (Ag) contact ratings	Gold (Au) contact ratings
	AC 10 A resistive @ 120 VAC	
	AC 8 A inductive @ 120 VAC	
	DC min. 20 mA @ 24 VDC	DC max. 5 mA @ 5 VDC
	DC max. 1 A @ 24 VDC & 48 VDC	DC max. 20 mA @ 24 VDC
Indication light	0.30 W energy consumption	
Electrical connection	Screw terminals via 1/2" NPT conduit connection	
Enclosure rating	NEMA Type 4	
Setting tolerance	±15% switching point deviation referred to set point. Adjusted as pressure rises or as pressure falls, vertical diaphragm position.	
Vent Limiter	Incorporates a vent limiter as per UL 353 and limits the escape of gas less than 1.0 CFH of natural gas at 7 PSI if internal switch diaphragm ruptures	

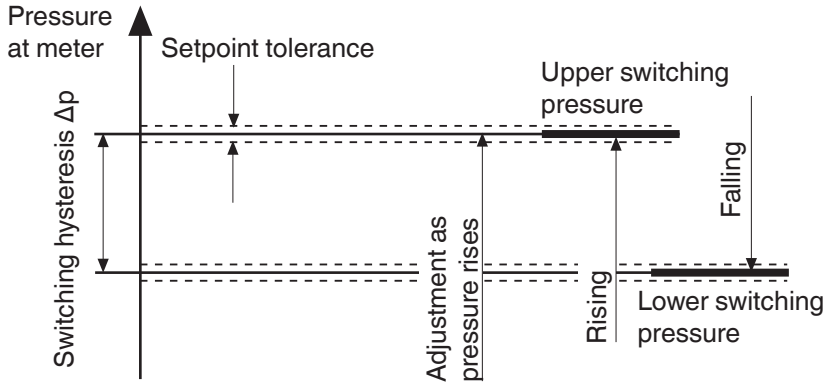
Dimensions inch (mm)
GAO-, GMH-, GML-A4…



Adapters / Replacement parts / Accessories	Order No.	For equipment	Notes
Replacement conduit adapter	220-566	GAO, GMH, GML	1/2" NPT
Replacement cover	228-732	GAO	
Replacement cover	233-113	GMH, GML	
Replacement light	244-156	GAO, GMH, GML	120 VAC, yellow bulb
Replacement light	248-240	GAO, GMH, GML	24 VAC/VDC, green bulb
Replacement light	244-157	GAO, GMH, GML Gold contact versions	24 VAC/VDC, yellow blulb
Replacement conduit adapter	220-566	GAO, GMH, GML	Pg 11 to 1/2" NPT adapter
Replacement conduit adapter	240-671	GAO, GMH, GML	M20 to 1/2" NPT adapter
Electrical plug for A4 (For usw with 210-318)	219-659	GAO	
Electrical plug for A4 (For usw with 210-318)	227-644	GMH, GML	
DIN connector for A4 (For use with 219-659 or 227-644)	210-318	GAO, GMH, GML	

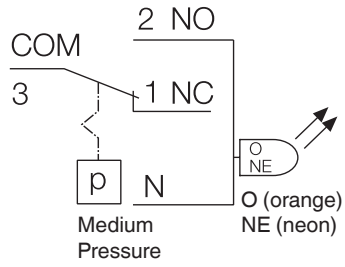
Definition of switching hysteresis Δp

The pressure difference between the upper and lower switching pressures



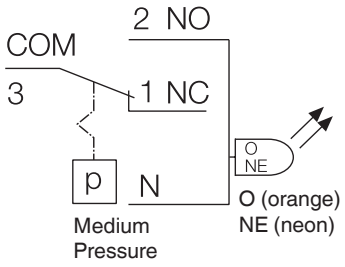
GAO (Shown as a high gas limit)

As pressure rises above set point, 1 NC opens, 2 NO closes, Neon light ON (fault). **As pressure falls** below setpoint, switch resets: 1 NC closes and 2 NO opens, Neon light off.



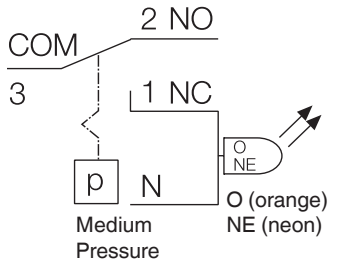
GMH (Operating state shown)

As pressure rises, 2 NO closes, 1 NC opens, and Neon light ON (fault), switch trips and locks out.

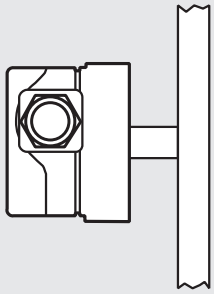


GML (**Operating state shown)**

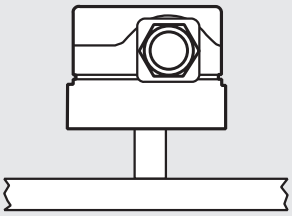
As pressure falls, 2 NO opens, 1 NC closes, Neon light ON (fault), switch trips and locks out.



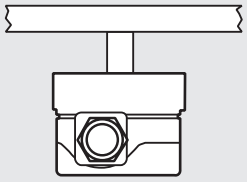
Installation position



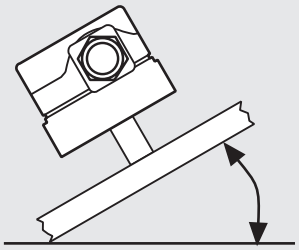
Standard installation position



When installed horizontally, the pressure switch switches at a pressure higher by approximately 0.2 in. W.C. (0.5 mbar).



When installed upside down, the pressure switch switches at a pressure lower by approximately 0.2 in. W.C. (0.5 mbar).



When installed in other position the pressure switch switches at pressure deviating from the set reference value by max. ±0.2 in. W.C. (0.5 mbar).

⚠ NOTE: Always calibrate the switch in the desired mounting position

Pressure switch
for gas and air

GAO-A4…
GMH-A4…
GML-A4…

DUNGS®
Combustion Controls

Type	Version	Order No.	Setting range in. W.C.	Switching hysteresis in. W.C.	Factory Calibration
GAO-A4… pressure switch	GAO-A4-4-2	217-090A	0.16 - 1.20	≤ 0.12	
	GAO-A4-4-3	217-091A	0.40 - 4.00	≤ 0.20	
	GAO-A4-4-5	217-092A	2.00 - 20.00	≤ 0.40	
	GAO-A4-4-6	217-093A	12.00 - 60.00	≤ 1.2	
	GAO-A4-4-8	217-094A	40.00 - 200.00	≤ 4.0	
	GAO-A4-4-2 Gold	223-525A	0.16 - 1.20	≤ 0.12	
	GAO-A4-4-3 Gold	222-267A	0.40 - 4.00	≤ 0.20	
	GAO-A4-4-5 Gold	222-268A	2.00 - 20.00	≤ 0.40	
	GAO-A4-4-6 Gold	222-269A	12.00 - 60.00	≤ 1.2	
	GAO-A4-4-8 Gold	223-526A	40.00 - 200.00	≤ 4.0	
GMH-A4… pressure switch	GMH-A4-4-4	217-326A	1.00 - 20.00	--	
	GMH-A4-4-6	217-327A	12.00 - 60.00	--	
	GMH-A4-4-8	217-328A	40.00 - 200.00	--	
	GMH-A4-4-4 Gold	222-270A	1.00 - 20.00		
	GMH-A4-4-6 Gold	222-271A	12.00 - 60.00		
GML-A4… pressure switch	GML-A4-4-4	217-340A	1.00 - 20.00	--	
	GML-A4-4-6	217-341A	12.00 - 60.00	--	
	GML-A4-4-8	217-342A	40.00 - 200.00	--	
	GML-A4-4-4 Gold	222-272A	1.00 - 20.00		

All switches with Silver contacts have 120 VAC neon lights factory installed
All switches with Gold contacts have 24 V lights factory installed

Accessories for pressure switch	Order No.
Replacement cover (screws not included)	228-732 (for GAO switches) and 233-113 (for GMH and GML switches)
Screw for replacement cover	237-675
PG 11 - 1/2" NPT conduit adapter	220-566
M 20 - 1/2" NPT conduit adapter	240-671
120 VAC neon light (orange)	244-156
24 VAC/VDC light (orange)	244-157
24 VAC/VDC light (green)	248-240
DIN connector (female plug)	210-318
Male plug for DIN connector	219-659 (for GAO switches) and 227-644 (for GMH and GML switches)

We reserve the right to make any changes in the interest of technical progress.

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Dual Modular Safety Shutoff Valves

DMV-D/602 Series
DMV-DLE/602 Series

DUNGS®
Combustion Controls

Two normally closed safety shutoff valves in one housing; each with the following approvals.

UL Recognized
- UL 429
- File # MH16727

CSA Certified
- ANSI Z21.21
- CSA 6.5
- Marked C/I
- File # 1010989

FM Approved
- Class 7411
- File # J.I.1Z6A0.AF

Commonwealth of Massachusetts Approved Product
- Approval code G1-1107-35
- Gas Safety Shutoff Valve

US, Canadian and EU Models
- DMV-D 701/602, 702/602, 703/602
- DMV-DLE 701/602, 702/602, 703/602
- 1/2 in. NPT - 2 in. NPT
- Rp1/2 - Rp2

Codes and Standards
This product is intended for installations covered by but not limited to NFPA 37, NPFA 86, ANSI Z83.4, ANSI Z83.18, ANSI Z21.13, CSD-1, UL 795, CSA B149.1 and CSA B149.3.

DUNGS is an ISO 9001 manufacturing facility.

Description
The Dual Modular Valve (DMV) combines two automatic shutoff valves in one compact housing, which can be wired independently or in parallel.

Valve 1 (V1) of the DMV-D and DMV-DLE series is fast opening and fast closing. Valve 2 (V2) of the DMV-D is fast opening, while V2 of the DMV-DLE is slow-opening for smoother light-off. Max. flow adjustment on V2 provides variable main flow on both models.

Internal profiles and compact design optimize flow and provide a low pressure drop. Three body styles reduce inventory.

Directly mounting the following accessories creates a compact valve train without additional piping:
- Pressure regulator
- High and low gas pressure switches
- Valve proving system
- Vent line adapter

Application
The DMV is recommended for industrial and commercial heating applications that require two safety shutoff valves. The DMV is suitable for dry natural gas, propane, butane, air and inert gases.

A “dry” gas has a dew point lower than +15 °F and its relative humidity is less than 60 %.

DMV-D…/602	Two normally closed safety shutoff valves in one housing. V1 and V2 are fast opening, fast closing. Adjustable max. flow with V2.
DMV-DLE…/602	Two normally closed safety shutoff valves in one housing. V1 fast opening, fast closing. V2 is slow opening, fast closing. Adjustable max. flow and adjustable initial lift with V2.

Specifications

Body sizes Pipe size / Thread	DMV 701 1/2" - 1" NPT or Rp	DMV 702 1" - 2" NPT or Rp	DMV 703 1" - 2" NPT or Rp
Max. operating pressure	7 PSI (500 mbar) UL, FM	5 PSI (360 mbar) CSA	
Max. body pressure	15 PSI (1000 mbar)		
Max. close off pressure	7 PSI (500 mbar) UL, FM	5 PSI (360 mbar) CSA	
Electrical ratings (+10 % / -15 %)	110 - 120 VAC @ 50 - 60 Hz 24 VAC @ 50 - 60 Hz; 24 VDC		
Power ratings	DMV 701: 45 VA Ratings shown are total power consumption for both valves inclusive. Inrush and full load current have the same VA rating.	DMV 702: 65 VA	DMV 703: 90 VA
Enclosure rating	NEMA Type 12		
Electrical connection	DIN-connector with 1/2" NPT conduit adapter		
Operating time	100 % duty cycle		
Closing time	< 1 s		
Opening time (to max. flow)	DMV-D 525/11 DMV-DLE 525/11	V1 & V2 < 1 s V1 < 1 s; V2 Adjustable to approx. 10 to 20 s at 70 °F	
Initial lift adjustment	Adjustable on V2	DLE only; 0 to 70 % of total flow; 0 to 35% of stroke	
Max. flow adjustment	Adjustable on V2	<10 to 100 % of total flow; <10 to 100% of stroke	
Materials in contact with gas	Housing: Aluminium, Steel; free of non-ferrous metals Sealings on valve seats: NBR-based rubber		
Ambient temperature rating	-40 °F to +150 °F (-40 °C to +65 °C)		
Installation position	Safety shutoff valve from vertically upright to horizontal		
Gas filter (optional)	Replaceable integral gas filter (50 micron) in inlet of DMV or Pre-Mount Filter Block for DMV 702 and 703. (Cannot be used with FRI directly mounted to the DMV)		
Gas strainer (standard)	Installed in the housing upstream V1 (23 mesh)		
Position indication (order separately)	CPI 400 with indication lamps and SPDT interlock switch or Visual indicator (VI)		
Test ports / Pressure switch mounting ports	G 1/8 ISO 228 ports available on both sides. Each side has one port upstream V1, one between V1 and V2, one downstream V2, and one on each flange.		
Valve proving system	Requires VPS 504; mounts directly to either side of DMV		

FRI Gas pressure regulator
Mounting the FRI series gas pressure regulator directly to the DMV dual safety shutoff valve is possible with a mounting kit.
The FRI pressure regulator can be installed upstream or downstream of the DMV dual safey shutoff valve depending on application requirements.

Replacement FRI to DMV mounting kit
FRI 705 - 707/6 to DMV 701/602
Order No. 219-967

FRI 710-712/6 to DMV 702/602 & 703/602
Order No. 219-968

Additional Accessories

VPS 504
Valve proving system (approved by some authorities having jurisdiction in lieu of vent valve and "proof of closure").

Integral gas filter (optional)
50 micron gas filter

Pre-Mount Filter (optional)
50 micron gas filter

GAO/GMH/GML A2
gas pressure switch

Position indication
CPI 400 with indication lamps and SPDT interlock switch, or visual indicator (VI)

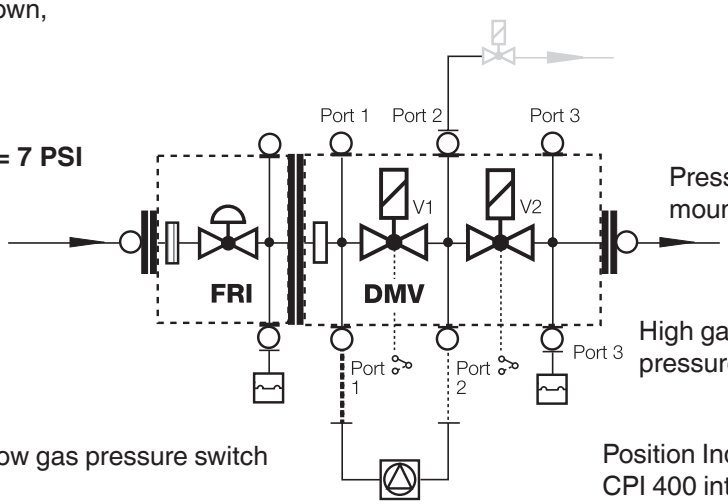
DMK butterfly control valve
Mounts directly downstream of DMV to modulate gas flow. Requires actuator. Use DMA actuator with DMK butterfly valve.

DMV D(LE) 7xx/602 VL (with vent line adapter)
Factory installed vent line adapter which integrates a vent line connection with the DMV series.

Adapters
- 1/4" NPT adapter (225-047)
- 1/2" NPT Pilot gas adapter; Check flow requirements. (225-043)
- G 1/8" Test nipple (219-008)
- Port 3 Pressure switch mounting adapter (214-975)

DMV dual safety shutoff valve modular system
Optional mounting system shown,
other configurations possible

DMV dual safety shutoff valve with upstream FRI pressure regulator



Pressure switch can be mounted on flange

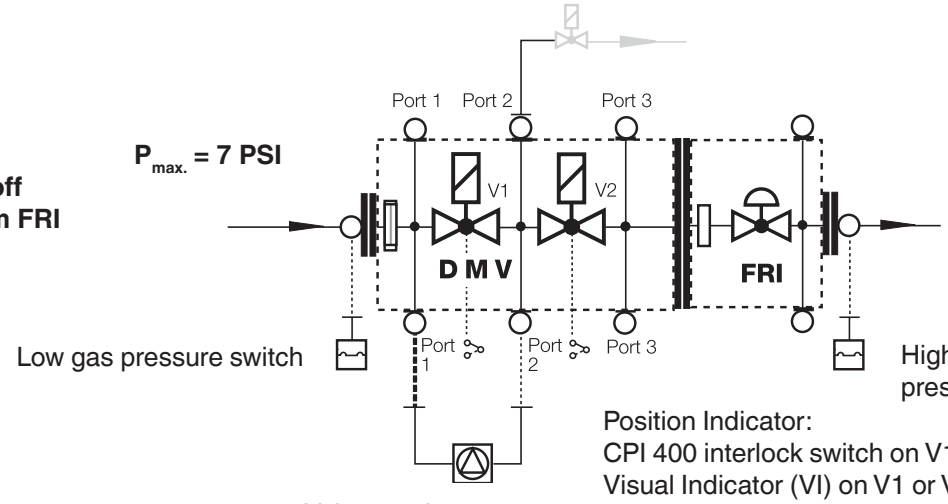
High gas pressure switch

Low gas pressure switch

Position Indicator:
CPI 400 interlock switch on V1 or V2
Visual Indicator (VI) on V1 or V2, or on both

Valve proving system (VPS 504)

DMV dual safety shutoff valve with downstream FRI pressure regulator



Low gas pressure switch

High gas pressure switch

Position Indicator:
CPI 400 interlock switch on V1 or V2
Visual Indicator (VI) on V1 or V2, or on both

Valve proving system (VPS 504)

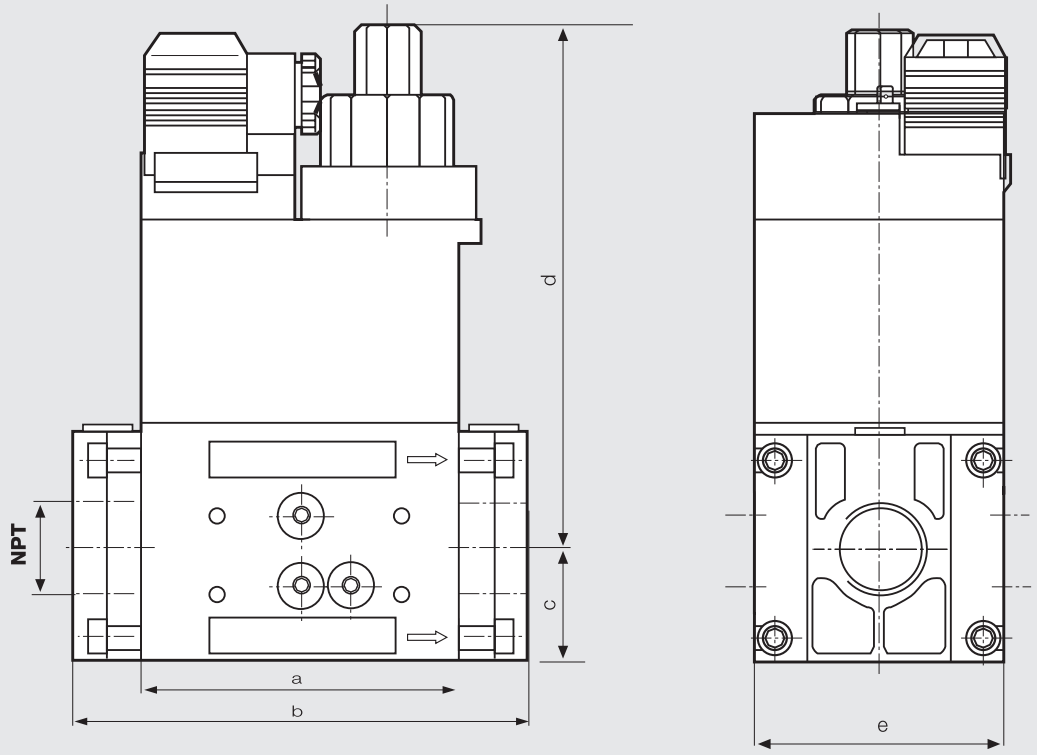
When an accessory is added to the DMV, it may not be possible to mount other devices.

Valve Description	Flange	NPT Part No.	Rp Part No.	O-ring and bolt kit P/N*	FRI mounting Kit P/N**	Integral filter & strainer replacement
DMV-701/602	**1/2”**	222-371	222-341	224-093	219-967	230-440
DMV-701/602	**3/4”**	222-368	222-342	224-093	219-967	230-440
DMV-701/602	**1”**	221-999	222-001	224-093	219-967	230-440
DMV-702/602 & 703/602	**1”**	222-369	222-343	224-094	219-968	230-441
DMV-702/602 & 703/602	**1 1/4”**	222-370	222-344	224-094	219-968	230-441
DMV-702/602 & 703/602	**1 1/2”**	222-003	221-884	224-094	219-968	230-441
DMV-702/602 & 703/602	**2”**	221-997	221-926	224-094	219-968	230-441

Accessories/Adapters	P/N
DIN-Electrical Connector	210-319
CPI 400 valve switch	224-253A
Visual indicator	217-665
1/4” NPT adapter	225-047

Accessories/Adapters	P/N
1/2” NPT Pilot gas adapter: Check flow requirements	225-043
G1/8 Test nipple	219-008
Port 3 Pressure switch mounting adapter	214-975

Dimensions inch (mm)



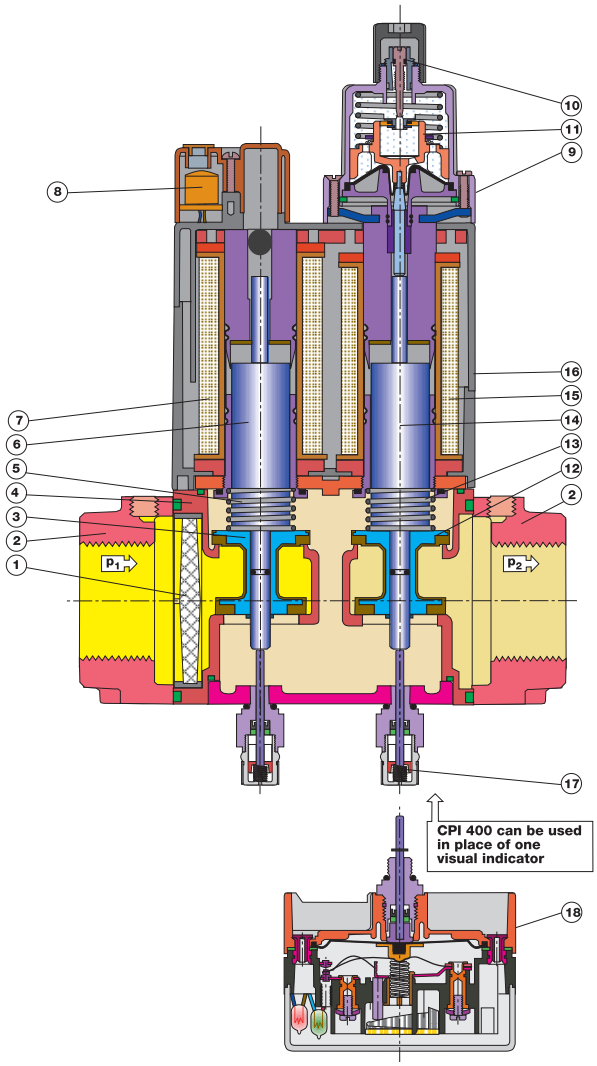
Please order flanges, position indicators and gas filters separately

Type	110-120 VAC @ 50-60 Hz Order No.	24 VAC 50-60 Hz Order No.	24 VDC Order No.	Power* [VA]	Dimensions [inch] Dimensions [mm] a	b**	c****	d	e	Weight [lbs] [kg]
DMV-D 701/602	224-842	228-220	226-990	45	**3.7** 93	**5.6** 141	**1.4** 35	**1.4** 35	**1.4** 35	**4.6** 2,1
DMV-D 702/602	224-843	228-221	226-991	65	**4.9** 124	**6.9 / 7.9** 174 / 201	**1.8** 45	**5.9** 150	**3.9** 101	**10.1** 4,6
DMV-D 703/602	224-844	228-222	226-992	90	**4.9** 124	**6.9 / 7.9** 174 / 201	**1.8** 45	**7.5** 190	**3.9** 101	**12.1** 5,6
DMV-DLE 701/602	224-845	228-223	226-993	45	**3.7** 93	**5.6** 141	**1.4** 35	**5.9** 160	**2.9** 73	**4.8** 2,2
DMV-DLE 702/602	224-846	228-224	226-994	65	**4.9** 124	**6.9 / 7.9** 174 / 201	**1.8** 45	**6.7** 179	**3.9** 101	**10.3** 4,7
DMV-DLE 703/602	224-847	228-225	226-995	90	**4.9** 124	**6.9 / 7.9** 174 / 201	**1.8** 45	**8.6** 218	**3.9** 101	**12.3** 5,7

* Inrush current and full load current have the same VA rating.
** DMV 702/703 with 1" or 1 - 1/4" flange: 6.9" / DMV 702/703 with 1 - 1/2" or 2" flange: 8.1"
*** When using the CPI Closed Position Indicator switch add. 3". When using with the vent line adapter assembly, add 1.65" to dimension c. (see vent line adapter information sheet)

Flow (CFH) of natural gas, s.g. 0.65 at 60 °F with 1 in. W.C. pressure drop @ 1.25 psi inlet pressure.	1/2 "	3/4"	1"	1-1/4"	1-1/2"	2"
DMV 701	345	429	457	–	–	–
DMV 702	–	–	1065	1277	1368	1430
DMV 703	–	–	1230	1532	1698	1795

DMV-D(LE)…/602 sectional drawing



1 Strainer
2 Flange
3 Valve V1
4 Housing
5 Closing spring V1
6 Plunger V1
7 Solenoid V1
8 Electrical connection
9 Max flow adjustment
10 Initial lift adjustment (DMV-DLE)
11 Hydraulic brake (DMV-DLE)
12 Valve V2
13 Closing spring V2
14 Plunger V2
15 Solenoid V2
16 Solenoid housing
17 Visual indicator (VI)
18 CPI 400 interlock switch

Pressure drop for other gases
To determine the pressure drop when using a gas other than natural gas, use the flow formula below and f value located in the table below to determine the "corrected" flow rate in CFH through the valve for the other gas used. For example, when using propane, divide the volume (CFH) of propane required for the application by the calculated value f (f = 0.66 for propane). Use this "corrected" flow rate and the flow curve on the next page to determine pressure drop for propane.

Determining equivalent flow through valves using another gas

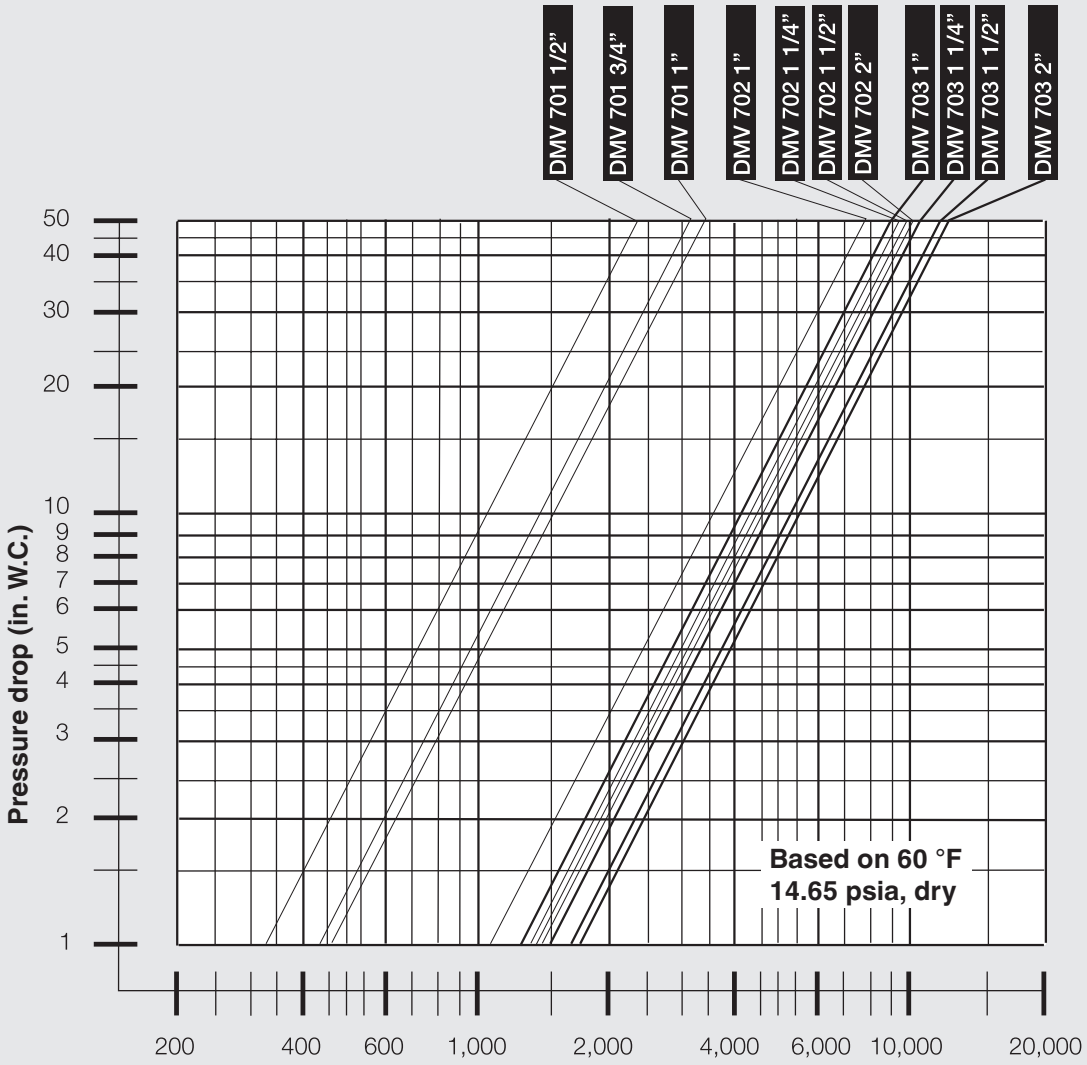
$$\dot{V}_{\text{gas used}} = \dot{V}_{\text{Natural gas}} \times f$$

$$f = \sqrt{\frac{\text{Density of Natural gas}}{\text{Density of gas used}}}$$

Type of gas	Density [kg/m³]	s.g.	f
Natural gas	0.81	0.65	1.24
Butane	2.39	1.95	0.58
Propane	1.86	1.50	0.66
Air	1.24	1.00	1.00

DUNGS®
Combustion Controls

Flow curve



Flow (CFH) of natural gas; s.g. 0.65 at 60 °F

20 in W.C.

We reserve the right to make any changes in the interest of technical progress.

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Pressure switch for dual modular valves

GAO-A2…
GMH-A2…
GML-A2…

DUNGS®

UL Listed
- **UL 353**
- **File # MH 16628**

CSA Certified
- **CSA C22.2 No. LR 53222**
- **Certification # 201527**

FM Approved
- **Class 3510, 3530**
- **File # J.I. 1T7A8.AF**

European models tested to EN1854 per Gas Appliance Directive 90/396/EEC and per Pressure Equipment Directive 97/23/EC.

DUNGS is an ISO 9001 manufacturing facility.

Description
The GAO-, GMH-, and GML-A2… pressure switches are compact pressure switches for DUNGS modular valve train components.

A2 pressure switches are suitable for making and/or breaking a circuit when the medium pressure changes relative to the set point. The set point can be set in the field by an adjustable dial with an integrated scale.

Application
The DUNGS GAO-, GMH-, and GML-A2… pressure switches are recommended for industrial and commercial heating applications with DUNGS DMV dual modular valves and DUNGS FRI modular pressure regulators. Various mounting options allow direct mounting on the housing.

The GAO-, GMH-, and GML-A2… pressure switches are suitable for natural gas, propane, butane, air and other inert gases.

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GAO-A2… SPDT pressure switch requires no auxiliary power. The GAO-A2… is suitable for making and/or breaking a circuit when the set point is exceeded or undershot. A tripped switch is indicated by a neon light after set point is exceeded or undershot. **Automatic reset** when pressure returns below or above set point.

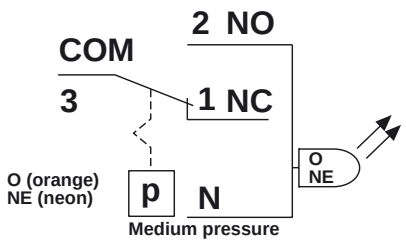
GMH-A2… SPDT pressure switch requires no auxiliary power. The GMH-A2… is suitable for making and/or breaking a circuit when the set point is exceeded. A tripped switch is indicated by a neon light after set point is exceeded. **Manual reset** is required to reset the switch.

GML-A2… SPDT pressure switch requires no auxiliary power. The GML-A2… is suitable for making and/or breaking a circuit when the set point is undershot. A tripped switch is indicated by a neon light after set point is undershot. **Manual reset** is required to reset the switch.

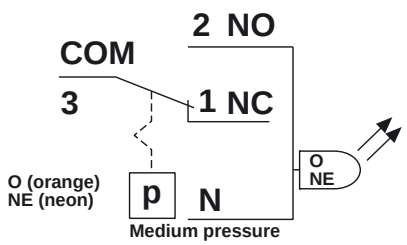
Specifications

Max. operating pressure	GAO-A2-4-2,3,5,6	7 PSI (500mbar)
	GMH- and GML-A2-4-4,6	7 PSI (500mbar)
	GAO-, GMH- and GML-A2-4-8	14 PSI (1000 mbar)
Pressure connection	O ring flange connection on underside of pressure switch	
Temperature range		
GAO-, GMH- and GML-A2-4	Ambient temperature	-40 °F to +140 °F (-40 °C to +60 °C)
	Medium temperature	-40 °F to +140 °F (-40 °C to +60 °C)
GAO-, GMH- and GML-A2-4-8	Ambient temperature	-22 °F to +140 °F (-30 °C to +60 °C)
	Medium temperature	-22 °F to +140 °F (-30 °C to +60 °C)
Materials	Housing	Aluminium
	Switch	Polycarbonate
	Diaphragm	NBR-based rubber
	Switching contact	Silver or Gold
Electrical ratings	AC eff.	min. 24 V max. 240 V
	DC	min. 24 V max. 48 V
Nominal current	Silver (Ag) contact ratings	Gold (Au) contact ratings
	AC 10A resistive @ 120 VAC	
	AC 8A inductive @ 120 VAC	
	DC min. 20 mA @ 24 VDC	DC max. 5m A @ 5 VDC
	DC max. 1 A @ 48 VDC	DC max. 20m A @ 24 VDC
Electrical connection	Screw terminals via 1/2" NPT conduit connection	
Enclosure rating	NEMA Type 4	
Setting tolerance	±15% switching point deviation referred to set point. Adjusted as pressure rises or as pressure falls, vertical diaphragm position.	

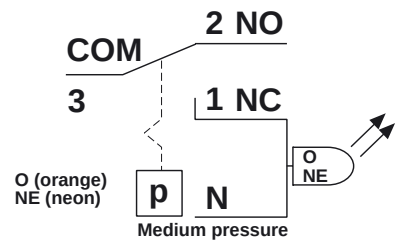
GAO switching function (upper)
As pressure rises:
1 NC opens, 2 NO closes
As pressure falls:
1 NC closes, 2 NO opens



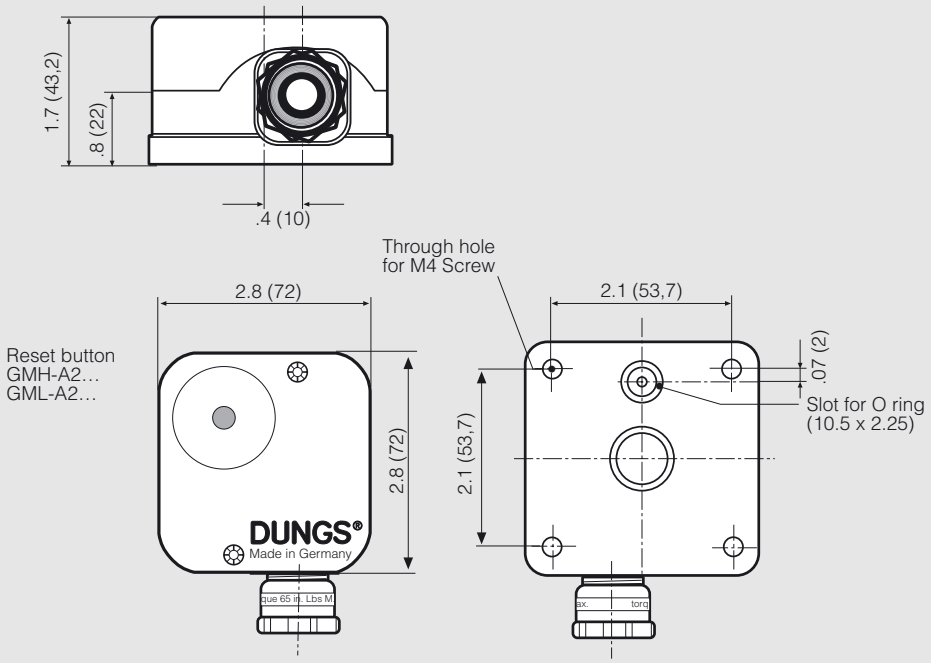
GMH switching function
As pressure rises
2 NO closes, 1 NC opens
Neon light ON, tripped.



GML switching function
shown in Operating state.
As pressure falls
2 NO opens, 1 NC closes
Neon light ON, tripped.

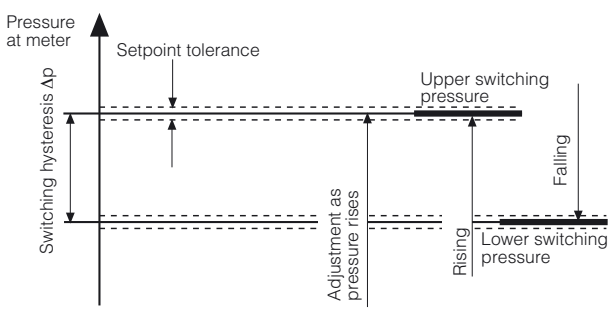


Dimensions inch (mm)
GAO-, GMH-, GML-A2…



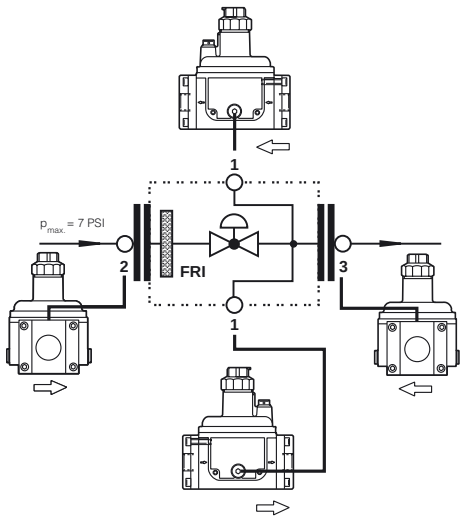
Adapters / replacement parts / Accessories	Order No.	For equipment	Notes
A2 Mounting kit (included)	D226 188	GAO, GMH, GML	M4 Screws, 10.5 x 2.25 O-ring
DMV Port 3 adapter (DMV side mount for high pressure switch)	D214 975	DMV-D(LE) 701 - 703	NPT 1/2“ - NPT 2“
Replacement conduit adapter	46000-14	GAO, GMH, GML	1/2“ NPT
Replacement cover	D228 732	GAO	
Replacement cover	D233 113	GMH, GML	
Replacement light	D244 156	GAO, GMH, GML	120 VAC, Red bulb
Replacement light	D244 157	GAO, GMH, GML Gold contact versions	24 V, Red bulb
Electrical plug for A2 (For use with D210318)	D219 659	GAO	N/A
Electrical plug for A2 (For use with D210318)	D227 644	GMH, GML	N/A
DIN Connector for A2 (For use with D219 659 & D227 644)	D210 318	GAO, GMH, GML	N/A

Definition of switching hysteresis Δp
The pressure difference between the upper and lower switching pressures



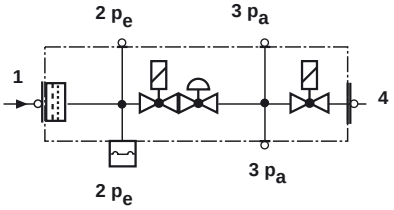
A2 mounting options
FRI gas pressure regulator

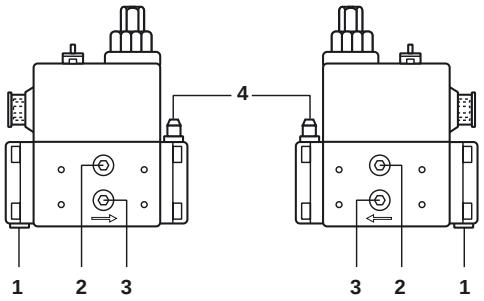
Pressure tap	mounting possible…
1	yes
2	yes
3	yes



A2 mounting options
MB 053-403 GasMultiBloc

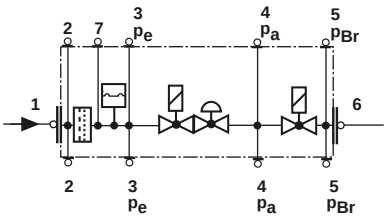
Pressure tap	mounting possible…
1	yes, with #D221630
2	yes
3	yes
4	yes, with #D221630

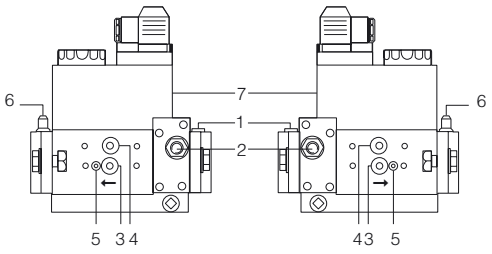


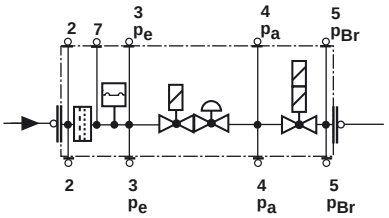


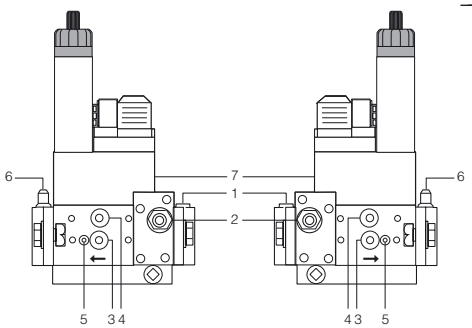
A2 mounting options
MB-D GasMultiBloc; MB-Z 405-412

Pressure tap	mounting possible…
1	alternativ to 7
2	no
3	yes
4	yes
5	yes, with #D214975
6	yes, with #D221630
7	yes



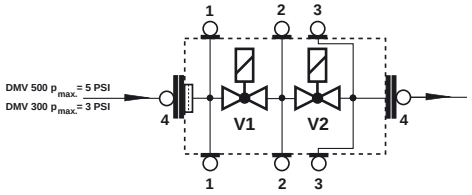


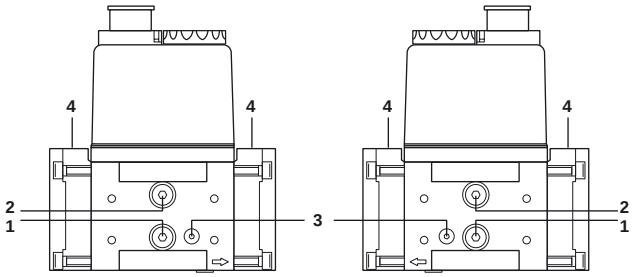




A2 mounting options
DMV 300/500 Dual modular valve

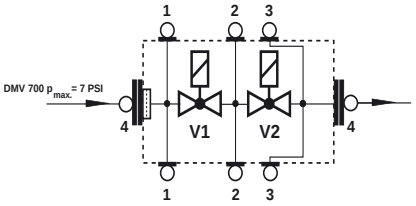
Pressure tap	mounting possible…
1	yes
2	yes
3	yes, with # D214 975
4	yes, horizontal yes, with # D221 630

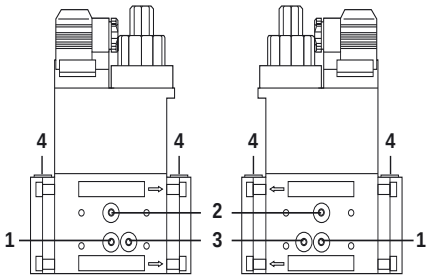




A2 mounting options
DMV 701-703 Dual modular valve

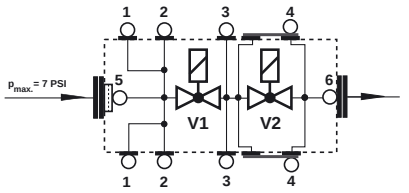
Pressure tap	mounting possible…
1	yes
2	yes
3	yes, with # D214 975
4	yes, horizontal yes, with # D221 630

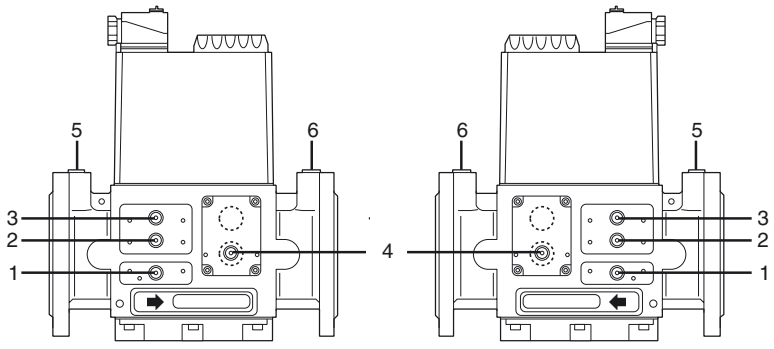




A2 mounting options
DMV 525,5040-5125/11Dual modular valve

Pressure tap	mounting possible…
1	yes
2	yes
3	yes
4	yes
5	no
6	no





Pressure switch for dual modular valves

GAO-A2…
GMH-A2…
GML-A2…

DUNGS®

Technical data

Type	Version	Order No.	Setting range In. W.C	Switching hysteresis Δp In. W.C (calibrated at)	
GAO-A2… pressure switch	GAO-A2-4-2	D217 085	0.16 - 1.20“	≤ 0.12“	
	GAO-A2-4-3	D217 086	0.40 - 4.00“	≤ 0.20“	
	GAO-A2-4-5	D217 087	2.00 - 20.00“	≤ 0.40“	
	GAO-A2-4-6	D217 088	12.0 - 60.00“	≤ 1.20“	
	GAO-A2-4-8	D217 089	40.00 - 200.00“	≤ 4.00“	
GMH-A2… pressure switch	GMH-A2-4-4	D217 323	1.00 - 20.00“	--	
	GMH-A2-4-6	D217 324	12.00 - 60.00“	--	
	GMH-A2-4-8	D217 325	40.00 - 200.00“	--	
GML-A2… pressure switch	GML-A2-4-4	D217 337	1.00 - 20.00“	--	
	GML-A2-4-6	D217 338	12.00 - 60.00“	--	
	GML-A2-4-8	D217 339	40.00 - 200.00“	--	
All switches have 120 VAC neon lights factory installed					

We reserve the right to make any changes in the interest of technical progress.

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DMV 701
DMV 702
DMV 703
Installation Manual

DUNGS®

SPECIFICATIONS

DMV-D .../6 Two normally closed safety shut off valves in one housing. Fast opening, fast closing. Main flow adjustable with valve 2.

DMV-DLE .../6 Two normally closed safety shut off valves in one housing. Valve 1 fast opening, fast closing. Valve 2 slow opening, fast closing. Main flow and initial lift adjustable.

Body size	**Flange Size**
DMV 701	1/2" - 1" NPT
DMV 702	1" - 2" NPT
DMV 703	1" - 2" NPT

Gases
natural gas, propane, other noncorrosive gases and air

Maximum Operating Pressure
7 psi

Ambient / Fluid Temperature
-40 °F to +150 °F

Electrical Ratings
110 to 120 Vac / 50 to 60 Hz
220 to 240 Vac / 50 to 60 Hz
24 Vdc

Power Consumption
DMV 701: 45 VA
DMV 702: 65 VA
DMV 703: 90 VA

Electrical Connection
DIN-Connector

Operating Time
100 % duty cycle

Classification Valve V1
Safety Shut Off Valve: UL 429, FM 7400

Classification Valve V2
Safety Shut Off Valve: UL 429, FM 7400

Closing Time
< 1 second

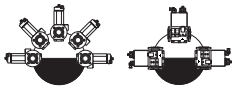
Opening Time
DMV-D: V1 & V2 < 1 sec.
DMV-DLE: V1 < 1 sec.; V2 about 20 sec. (70 °F)

Main Flow Setting (DMV-D & DMV-DLE)
adjustable on V2: 10 to 100% of total flow

Initial Lift Adjustment (DMV-DLE)
adjustable on V2: 0 to 70 % of total flow

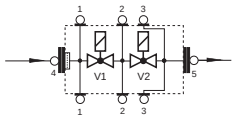
Materials in contact with Gas
housing: Aluminium, Steel
sealings on valve seats: NBR-based rubber

Mounting Position
solenoid upright vertical
to solenoid horizontal



Strainer
23 Mesh, installed in the housing upstream V1

Test Port
G 1/8 ISO 228 taps available on both sides upstream V1, between V1 and V2, downstream V2, and on both flanges



Position Indication
Visual Indicator standard;
Closed Position Indicator CPI 400 w/ visual indication and electrical switch (SPDT) optional

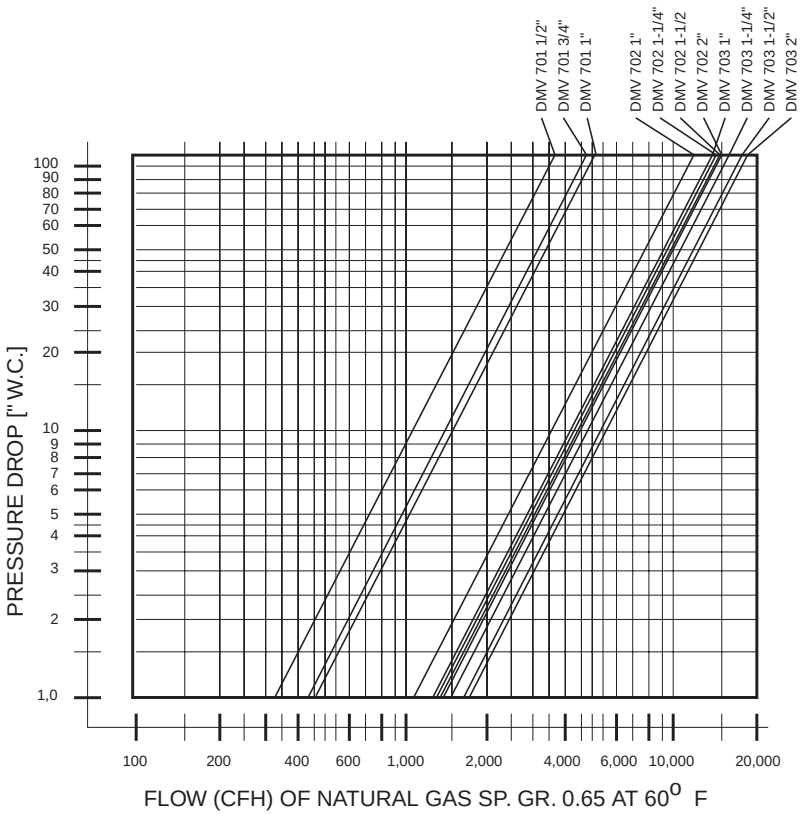
Approvals
UL Recognized Component: File No. MH16727 (YIOZ2)
FM Approved: Report J.I. 1Z6A0.AF
AGA/CGA: pending

CAPACITY

Capacity in cfh at pressure drop of 1 inch water column; natural gas, sp. gr. = 0.64

	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"
DMV 701/6	**345**	**429**	**457**	**-**	**-**	**-**
DMV 702/6	**-**	**-**	**1065**	**1277**	**1368**	**1430**
DMV 703/6	**-**	**-**	**1230**	**1532**	**1698**	**1795**

Edition 8/13/97 DMV 700 Installation Guide



INSTALLATION

- **Read these instructions carefully.**
- **Failure to follow them and/or improper installation may cause explosion, property damage and injuries.**
- **Installation must be done with the supervision of a licensed burner technician.**
- **The system must meet all applicable national and local code requirements.**
- **Check the ratings given in the specifications and on the DMV to make sure that it is suitable for your application.**
- **Never perform work if gas pressure or power is applied, or in the presence of an open flame.**
- **Protect surfaces. Make sure that seals and O-rings are clean and in good condition.**
- **Once installed, perform a complete checkout including a gas leak test.**
- **Label all wires prior to disconnection when servicing the DMV. Wiring errors can cause improper and dangerous operation.**
- **Verify proper operation after servicing.**

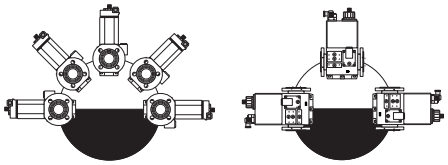
• The main gas supply must be shut off before starting the installation.
• Read these installation instructions carefully.
• Examine the DMV for shipping damage.
• The inside of the DMV, the flanges, and piping must be clean and free of dirt.
• Remove all dirt and debris before installing the DMV. Failure to remove dirt/debris could result in valve damage or improper performance.

Recommended Procedure to Mount the Flanges

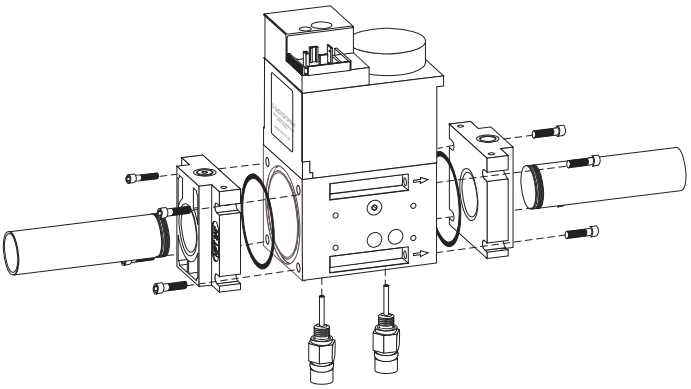
• Use new, properly reamed and threaded pipe free of chips.
• Apply good quality pipe sealant, putting a moderate amount on the male threads only. If pipe sealant lodges on the valve seat, it will prevent proper operation. If using LP gas, use pipe sealant rated for use with LP gas.
• Do not thread pipe too far. Valve distortion and/or malfunction may result from excess pipe in the DMV body.
• Apply counter pressure when screwing the pipe into the flanges.
• Apply a parallel jaw wrench only to the flats on the flange.
• Do not overtighten the pipe. Follow the maximum torque values listed below.

1/2"	3/4"	1"	1-1/4"	1-1/2"	2"	NPT pipe
375	560	750	875	940	1190	[lb-in]

• Unpack the DMV 701 (702/703) and remove the 8 M6 (M8) socket cap head screws using a 5 mm (6 mm) Allen wrench.
• Remove the two white protective plastic covers from the DMV body.
• Make sure the O-rings and the grooves are clean and in good condition.
• Install the DMV with the gas flow matching the direction indicated by the arrows on the casting.
• **CAUTION:** If the flow is not in the same direction of the arrows, the valves may not operate properly.
• Mount the DMV only with the solenoid vertical upright to horizontal.



• Clean the mounting surface of the flanges. Make sure they are in good condition.
• Attach the DMV to the flanges using the M6 (M8) socket cap screws supplied.



• Use a 5 mm (6 mm) Allen wrench for the DMV 701 (DMV 702/703) mounting screws.
• Tighten the screws in crisscross pattern.
• Do not overtighten the screws. Follow the maximum torque values listed below.

M6	M8	screw size
62	134	[lb-in] maximum torque

• After installation is completed perform a leak test to verify that no leakage occurs.

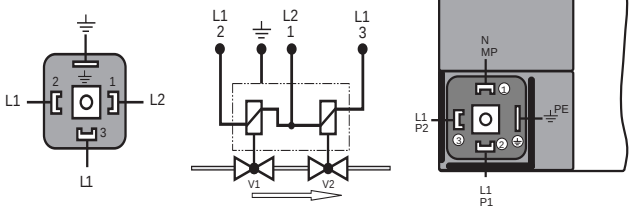
POSITION INDICATION

Valve position indication is required by various authorities having jurisdiction.
Two indicators, one of which might be the CPI 400, are shipped with, but not attached to, the DMV series valve to insure that the indicators are not damaged during shipment. Therefore install the indicators onto the DMV after mounting the DMV into the gas train and before the DMV is put into service.
• **CAUTION**: The valves must be de-energized and their gas supply shut off before installing the Position Indicators.

• **Installation**
• Remove the two plugs and O-rings in the bottom of the valve with a 3/16” (5mm) hex key wrench. These are the taps were the Indicators go.
• Insert the Visual Indicator and its attached O-ring using a 5/8" (16 mm) open end wrench.
• Turn clockwise until the Visual Indicator is sufficiently tightened.
• DO NOT overtighten or you will destroy the rubber O-ring.
• Apply the adhesive-backed stickers supplied which show what the colors of the indicator signify to the DMV. The stickers should be applied on each side of the valve body so the operator can refer to either of them while viewing the Visual Indicator.
• After installation is completed perform a leak test to verify that no leakage occurs.
• For installation of a CPI 400 follow the instructions supplied with the CPI 400.

WIRING

• Disconnect all power to the valves before beginning the wiring to prevent electrical shock and equipment damage.
• Do not exceed the electrical ratings given in the specifications and on the DMV.
• Attach a flexible 1/2” NPT conduit to the DIN connector.
• Route the wires through the conduit and the DIN connector.
• Use 14 or 16 gauge wire suitable for at least 75 °C (167 °F).
• Connect the wiring to the appropriate screw terminals in the DIN connector.
• Plug the DIN connector onto the AMP terminals. Fasten the DIN connector with the screw supplied.
• **CAUTION:** All wiring must comply with local electrical codes, ordinances, and regulations. An ultimate electrical enclosure must be provided.

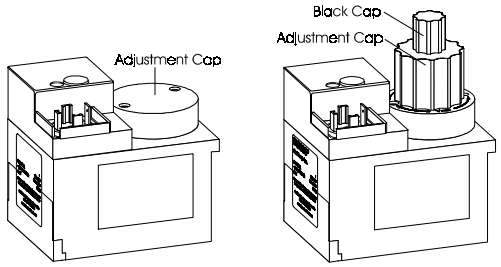


OPERATION

Main Flow Setting

The valves are supplied with the main flow adjustment fully open. To adjust the gas flow proceed as follows:

- **CAUTION:** Make sure the flow of gas does not create a hazard.
- Locate the flow adjustment cap on top of the DMV. There are two screws in the cap. The holding screw is recessed and has a blue sealing compound on it, while the pan head screw protrudes from the cap.
- **CAUTION**: Do not adjust or remove any screws or bolts which are sealed with a red or blue colored compound. Doing so will void all approvals and warranties.
- Loosen the pan head screw until you can manually rotate the flow adjustment cap for 1-1/2 to 2 turns.
- Turn the cap clockwise for less gas or counterclockwise for more gas.
- Check the flow at the burner with an orifice or flow meter until you have achieved the desired flow.
- Tighten the pan head screw on the adjustment cap.



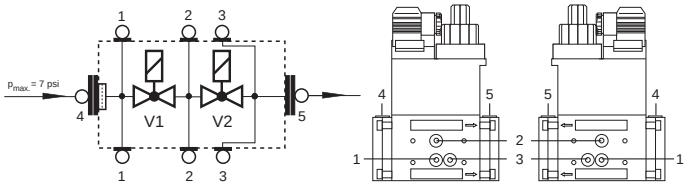
Initial Fast Lift Adjustment (DMV-DLE .../6 only)

The initial fast lift adjustment varies the initial gas flow through the valve as the valve seat begins to open. This adjustment can vary the initial flow between 0 % and 70% of the total gas flow. All DMV-DLE valves are shipped from the factory with no initial fast lift. To adjust the lift proceed as follows:

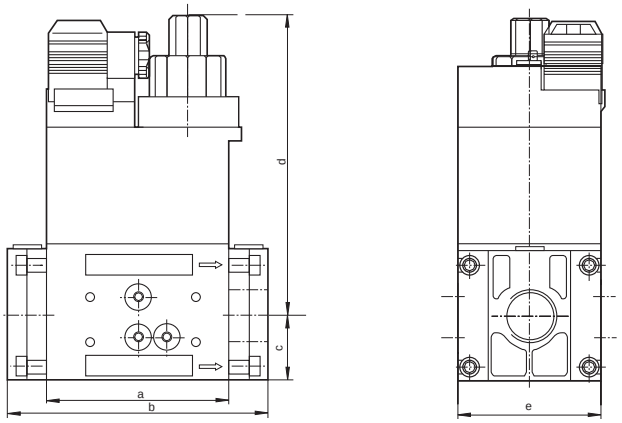
- Unscrew the small black cap on top of the flow adjustment cap to expose the initial lift adjustment knob.
- The black cap also serves as tool; turn the cap over and insert it into the corresponding slot on the adjustment knob.
- Turn the knob clockwise for a shorter initial lift or counter-clockwise for a longer initial lift.
- Once the desired initial fast lift has been achieved, reinstall the black cap.

Test Port

The G 1/8 ISO 228 taps are available on both sides upstream V1, between V1 and V2, downstream V2, and on both flanges. The G 1/8 test nipple (Ordering Number: D 219 008) can be screwed in any of these pressure tap ports.



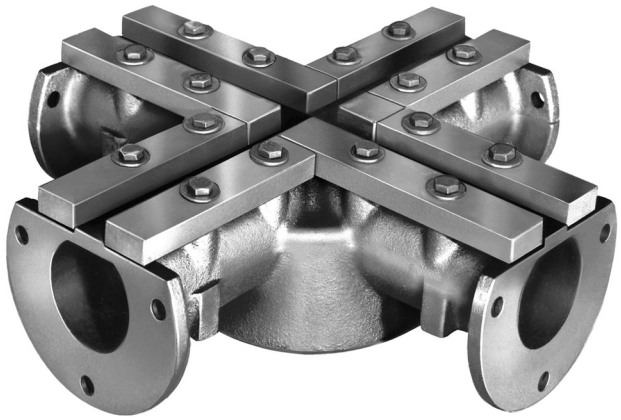
DIMENSIONS & FLANGES



Flange	NPT	Rp	for DMV.../6
1/2”	D 222 371	D 222 341	DMV 701
3/4”	D 222 368	D 222 342	DMV 701
1”	D 221 999	D 222 001	DMV 701
1”	D 222 369	D 222 343	DMV 702 & 703
1-1/4”	D 222 370	D 222 344	DMV 702 & 703
1-1/2”	D 222 003	D 221 884	DMV 702 & 703
2”	D 221 997	D 221 926	DMV 702 & 703

	A	B	C	D	E	Weight	Order #		
			[inches]			[lb]	120 Vac/ 60 Hz	230 Vac / 50 Hz	24 Vdc
DMV-D 701	3-5/8	5-5/8	1-3/8	5-3/8	2-7/8	4.6	D 224 842		
DMV-D 702	4-7/8	6-7/8	1-7/8	5-7/8	3-7/8	10.1	D 224 843		
DMV-D 703	4-7/8	6-7/8	1-7/8	7-1/2	3-7/8	12.1	D 224 844	available on request	
DMV-DLE 701	3-5/8	5-5/8	1-3/8	5-3/8	2-7/8	4.8	D 224 845		
DMV-DLE 702	4-7/8	7-7/8	1-7/8	5-7/8	3-7/8	10.3	D 224 846		
DMV-DLE 703	4-7/8	7-7/8	1-7/8	7-1/2	3-7/8	12.3	D 224 847		

Eclipse Line Burners



Eclipse Line Burners are premix, retention type burners designed for applications where heat must be distributed over a large area. They are especially suited for oven, kettle, and either recirculating or non-recirculating air heating applications. Several types of line burner sections are available, making a variety of flame patterns possible. Capacities range from 19,000 to 335,000 BTU/hr per lineal foot (based on 70% of required air in premix) depending upon the mixture pressure used.

Assemblies

Eclipse Line Burners are available in 6" and 12" straight sections; side and bottom inlet straight sections; bottom inlet crosses and tees; and 6" 90-degree elbows. Each line burner section is supplied with the nuts and bolts necessary for assembly. In some cases, factory assembly is available. When selecting Line Burners for a system, the total port area must not exceed the cross sectional area of the mixture inlets. Based on a 70% premix using natural gas, the total capacity of the ports should not exceed 385,000 BTU/hr for each 2" mixture inlet or 850,000 BTU/hr for each 3" mixture inlet. Accessory flanges to aid in piping and brackets for mounting flame monitoring and piloting equipment to the burners are also available.

Design Features

Eclipse Line Burner bodies are made of cast iron for durability and flanged for easy assembly. The drilled ports and steel retention lips provide flame stability with mixture pressures up to 30" w.c. and velocities past the burner up to 3600 fpm (burner firing parallel to the air stream). Maximum ambient temperatures should not exceed 800°F.

Line Burners can fire with rich, neutral or lean mixtures. Suitable air/gas mixtures can be supplied by a variety of Eclipse mixing equipment including: High Pressure Injectors, Bulletin 650; Low Pressure Proportional Mixers, Bulletin 652; Vari-Set® Mixers, Bulletin 654.

Advantages

- Excellent flame retention
- Wide range of capacities
- Adaptable to many piping arrangements
- Heavy duty construction

Ignition and Flame Monitoring

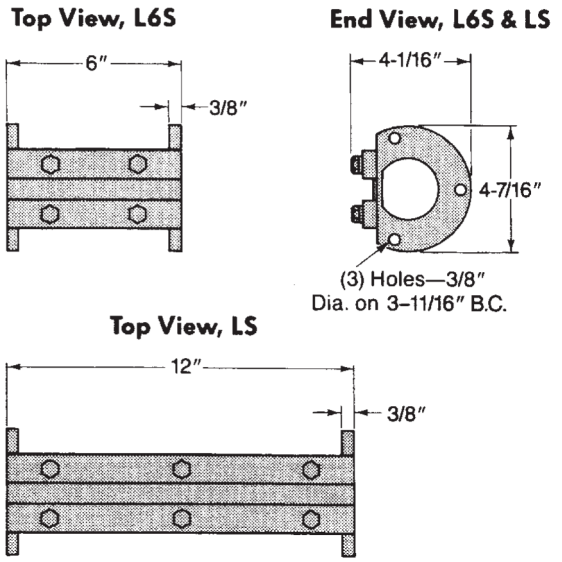
Reliable ignition from a single point can be provided by using the optional pilot / flame sensor bracket to mount a blast or atmospheric pilot at one end of the burner. A second pilot / flame sensor bracket can be used to mount a flame monitoring device at the opposite end of the burner.

⚠ CAUTION

- **It is dangerous to use any fuel burning equipment unless it is equipped with suitable flame sensing device(s) and automatic fuel shut-off valve(s). Eclipse can supply such equipment or information on alternate sources.**

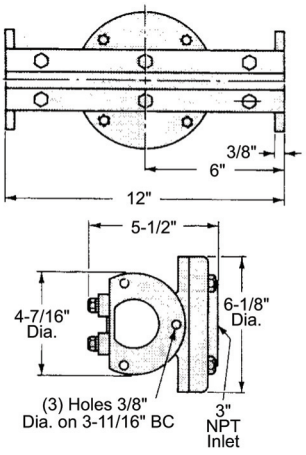
Dimensions and Capacities

6" x 12" Straight Sections



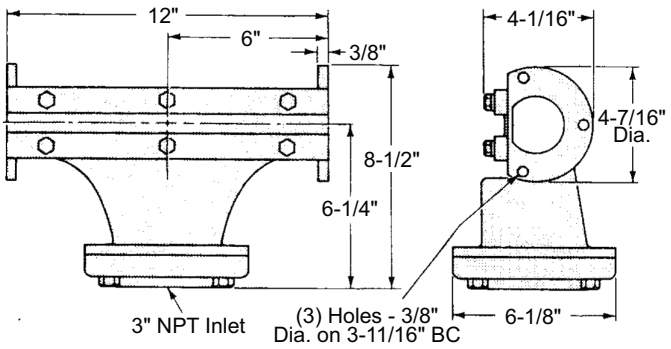
Catalog Number	Assembly Number	Total Port Area Sq. Inches	Capacity on 1000 BTU/hr Based on 70% Total Air Mixture @ Various Mix. Press.			
			2"	4"	6"	8"
6" Straight Section						
0L6S	180136	0.0502	10	14	17	20
1L6S	180027	0.1008	20	28	35	40
2L6S	180028	0.1344	25	38	46	50
3L6S	180029	0.2565	46	66	81	92
4L6S	180030	0.3444	67	91	118	134
5L6S	180031	0.4320	84	121	148	168
12" Straight Section						
0LS	180135	0.1008	19	28	34	40
1LS	180022	0.2016	39	56	69	78
2LS	180023	0.2688	52	75	92	104
3LS	180024	0.5136	92	132	162	184
4LS	180025	0.6888	134	192	236	268
5LS	180026	0.8640	168	241	296	336

12" Bottom Inlet Straight Sections



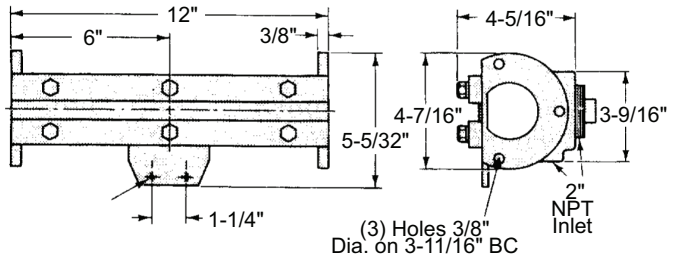
Catalog Number	Assembly Number	Total Port Area Sq. Inches	Capacity on 1000 BTU/hr Based on 70% Total Air Mixture @ Various Mix. Press.			
			2"	4"	6"	8"
0LSB	180141	0.1008	19	28	34	40
1LSB	180052	0.2016	39	56	69	78
2LSB	180053	0.2688	52	75	92	104
3LSB	180054	0.5136	92	132	162	184
4LSB	180055	0.6888	134	192	236	268
5LSB	180056	0.8640	168	241	296	336

12" Side Inlet Straight Sections



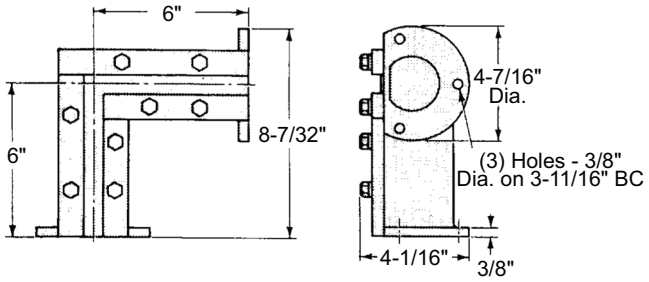
Catalog Number	Assembly Number	Total Port Area Sq. Inches	Capacity on 1000 BTU/hr Based on 70% Total Air Mixture @ Various Mix. Press.			
			2"	4"	6"	8"
0LSS	180140	0.1008	19	28	34	40
1LSS	180047	0.2016	39	56	69	78
2LSS	180048	0.2688	52	75	92	104
3LSS	180049	0.5136	92	132	162	184
4LSS	180050	0.6888	134	192	236	268
5LSS	180051	0.8640	168	241	296	336

12" Side or Bottom Inlet Straight Sections



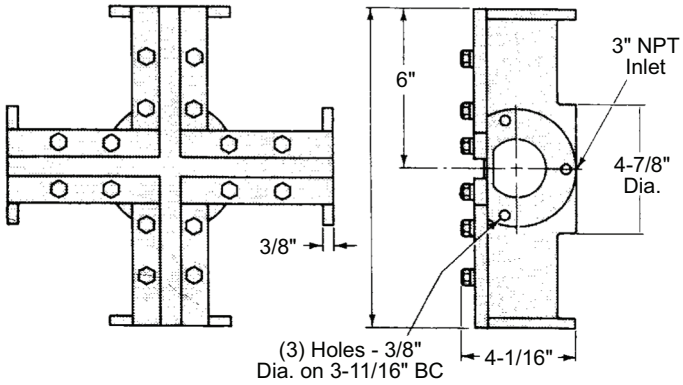
Catalog Number	Assembly Number	Total Port Area Sq. Inches	Capacity on 1000 BTU/hr Based on 70% Total Air Mixture @ Various Mix. Press.			
			2"	4"	6"	8"
1LSBS	180100	0.2016	39	56	69	78
2LSBS	180101	0.2688	52	75	92	104
3LSBS	180102	0.5136	92	132	162	184
4LSBS	180103	0.6888	134	192	236	268
5LSBS	180104	0.8640	168	241	296	336

6" x 6" Flame Elbow



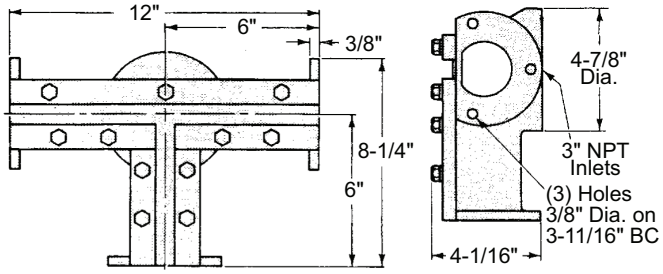
Catalog Number	Assembly Number	Total Port Area Sq. Inches	Capacity on 1000 BTU/hr Based on 70% Total Air Mixture @ Various Mix. Press.			
			2"	4"	6"	8"
0LE	180137	0.1008	19	28	34	40
1LE	180032	0.2016	39	56	69	78
2LE	180033	0.2688	52	75	92	104
3LE	180034	0.5136	92	132	162	184
4LE	180035	0.6888	134	192	236	268
5LE	180036	0.8640	168	241	296	336

12" x 12" Bottom Inlet Flame Cross



Catalog Number	Assembly Number	Total Port Area Sq. Inches	Capacity on 1000 BTU/hr Based on 70% Total Air Mixture @ Various Mix. Press.			
			2"	4"	6"	8"
0LC	180139	0.2079	37	53	64	75
1LC	180037	0.4158	74	106	129	148
2LC	180038	0.5446	106	152	186	212
3LC	180039	1.0138	196	281	345	392
4LC	180040	1.3496	263	377	463	526
5LC	180041	1.6854	330	472	580	660

12" x 6" Bottom Inlet Flame "T"



Catalog Number	Assembly Number	Total Port Area Sq. Inches	Capacity on 1000 BTU/hr Based on 70% Total Air Mixture @ Various Mix. Press.			
			2"	4"	6"	8"
0LFT	180138	0.1491	29	41	51	57
1LFT	180042	0.2982	58	83	102	116
2LFT	180043	0.3962	77	110	135	154
3LFT	180044	0.7532	147	210	258	294
4LFT	180045	1.0087	196	280	345	392
5LFT	180046	1.2642	247	353	434	494

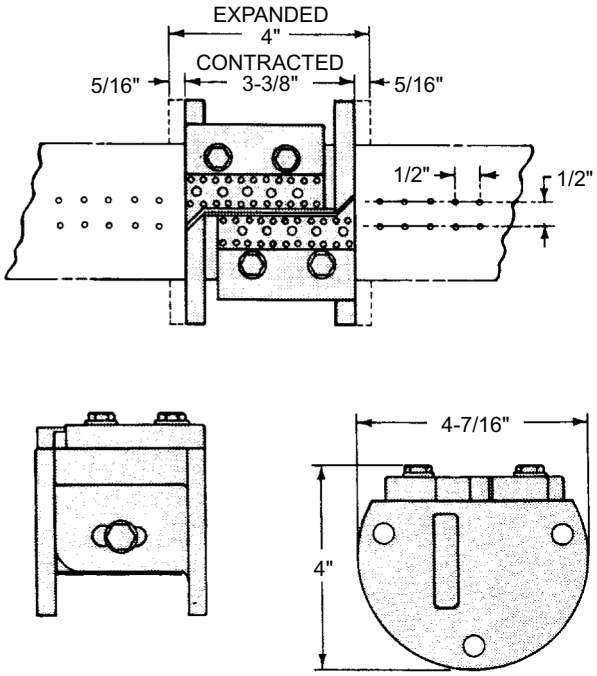
Accessories for Line Burners

Expansion Joint — Assembly Number 181014

Eclipse Line Burner Expansion Joints are used in the center of a row of line burners to eliminate the possibility of bowing or buckling due to burner expansion. They are also used to relieve stress on mixture piping when a row of burners is fed by two mixture lines from a common manifold. When an expansion joint is used, it is necessary to have gas / air mixture fed to burners on both sides of the joint as the mixture will not pass through it.

Maximum velocity past the expansion joint should be limited to 3600 fpm and ambient temperature limited to 800°F.

Expansion joints are furnished with number 3 L drillings. Using 70% premix, capacity is 57,000 BTU/hr at 4" w.c. mixture pressure, using natural gas of 0.6 specific gravity.



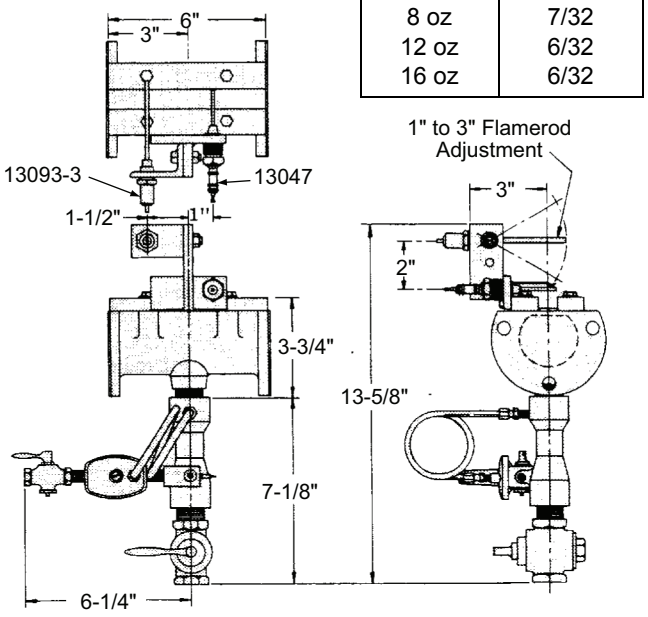
Pilot Section — Assembly Number 180192, Catalog Number 2L6SP

Eclipse Line Burner Pilot Sections are composed of a 6" Eclipse Line Burner, a 131 Pilot Mixer, and a combination ignition electrode and flamerod mounting bracket. The assembly also includes a 6" flamerod and a self-grounding ignition electrode. By simply loosening a nut on the flamerod bracket, the flamerod may be adjusted to obtain the best flame signal output.

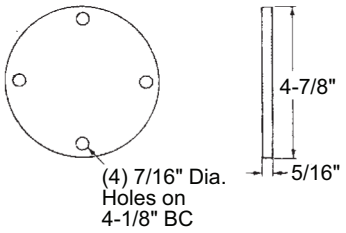
Two divider plates are supplied with each pilot section. It is important that these plates are assembled between the pilot section and adjoining burners as the pilot has its own source of gas / air mixture. If the pilot section is to be used at either end of a row of burners, it must be ordered with a plain end flange, assembly number 180006. See "Accessories" section.

The Line Burner Pilot Section is rated at 25,000 BTU/hr at 2" w.c. mixture pressure and with 70% of required air through the mixer. When ordering, be sure to specify jet size required or air pressure available to the pilot mixer, as indicated in the following table:

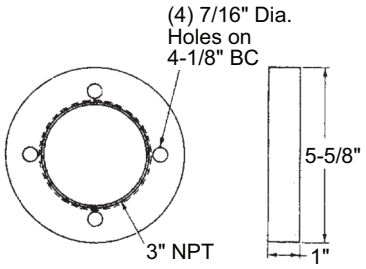
Air Press.	Jet Size
4 oz	9/32
8 oz	7/32
12 oz	6/32
16 oz	6/32



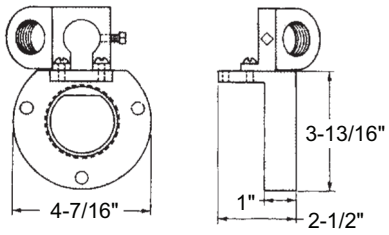
Flanges and Adapters



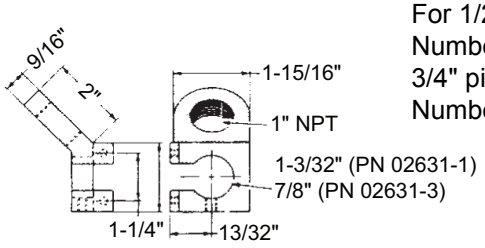
Plain Bottom Flange. For closing off bottom inlet on 12 x 12" CROSS or 12 x 6" TEE. Assembly Number 180007.



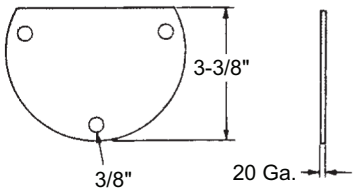
3" Bottom Inlet Flange. Add to 12 x 12" CROSS or 12 x 6" TEE when flanged inlet is desired. Part Number 00514.



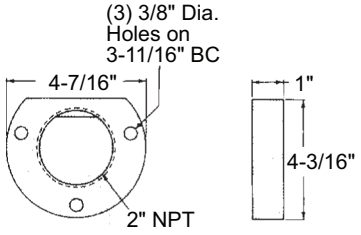
Inlet Flange with Pilot / Flame Sensor Mounting Bracket. For 1-1/2" NPT and 3/4" pilot. Assembly Number 180017.



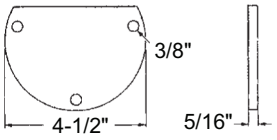
Pilot/Flame Sensor Mounting Bracket. For 1/2" pilot. Part Number 2631-3. For 3/4" pilot. Part Number 2631-1.



Divider Plate. For separating zones. Part Number 10591.

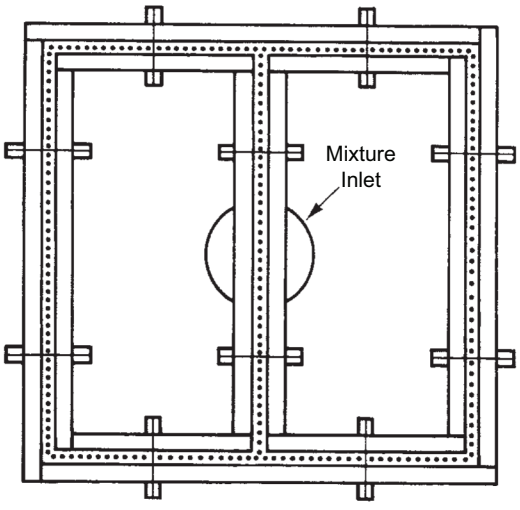


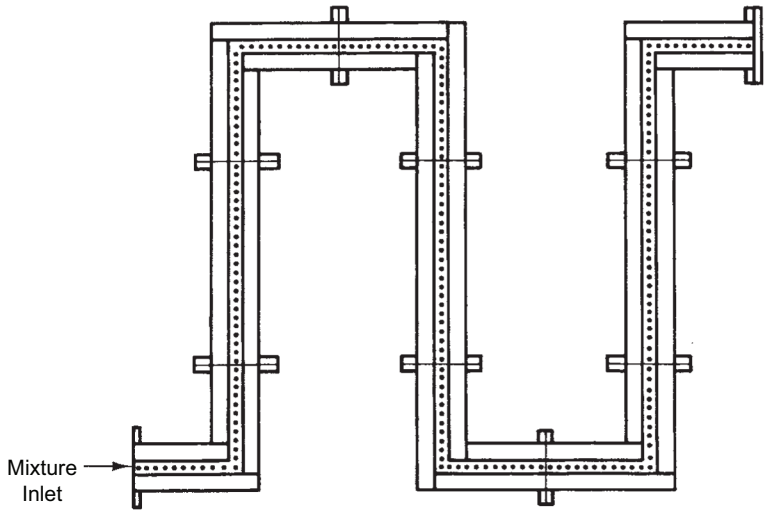
Inlet End Flange. For 1-1/2" NPT. Assembly Number 180008. For 2" NPT. Assembly Number 180009.



Plain End Flange. For closing off end of burner section. Assembly Number 180006.

Typical Line Burner Configurations





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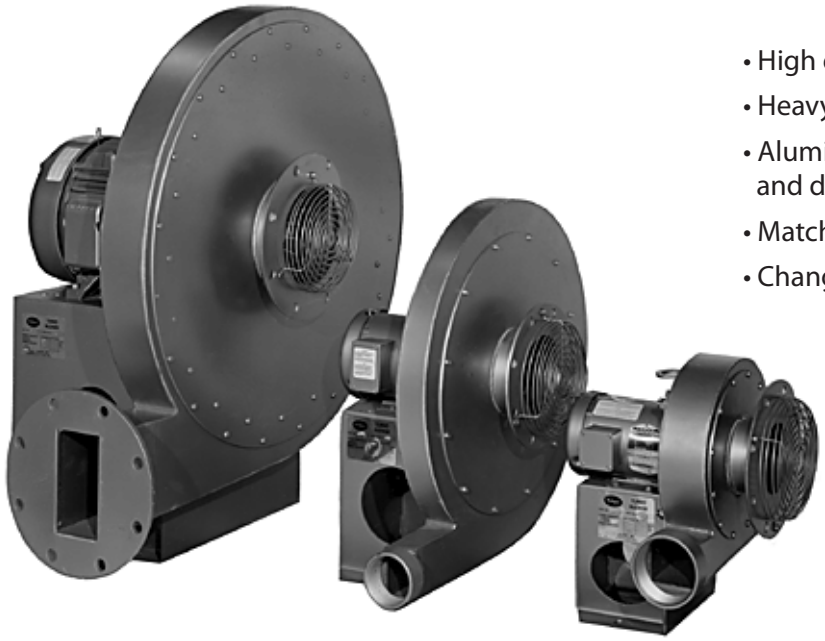
Innovative Thermal Solutions
www.eclipsenet.com

ECLIPSE TURBO BLOWERS
SERIES "SMJ"



- High efficiency
- Heavy gauge steel base and housing
- Aluminum impellers balanced statically and dynamically
- Matching air filters available
- Changeable outlet positions

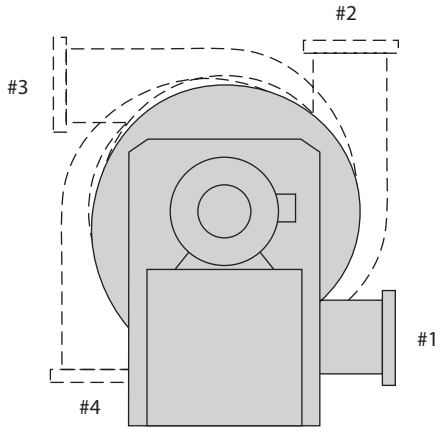
Eclipse "SMJ" Blowers are centrifugal blowers that provide low pressure air for industrial combustion systems. They are also used for cooling, conveying, drying, liquid agitation, smoke abatement, vacuum cleaning, fume and dust exhaust-ing, and other appli-cations where air temperatures are under 220ûF (104ûC).

All "SMJ" Blowers are constructed of continuous welded, heavy gauge steel. The impellers are made of lightweight, high strength, riveted aluminum. Outlets on 3" and 4" models are threaded, while all others are flanged for a standard 125# ANSI companion flange. Discharge ports are sized to keep pressure losses within reasonable limits.

Blower inlet flanges are equipped with a grill that complies with OSHA regulations. If desired, the grill may be removed and the inlet bolted to a standard ANSI companion flange. Eclipse-supplied motors are standard shaft and starting torque, ball bearing, 3600 rpm units. On any blower requiring 3/4 HP or more, Eclipse recommends that polyphase motors be used.

There are four possible outlet positions. Any exist-ing position is easily changed by removing the hous-ing from the blower base and remounting it in the desired position. Positions 1 through 3 can be speci-fied for any blower. Position 4, however, requires fac-tory approval before ordering. Position 1 is the stan-dard assembly (bottom, horizontal) unless otherwise specified.

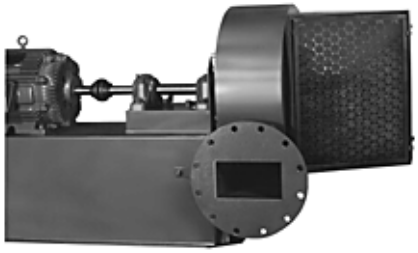
"SMJ" Blowers can be supplied with counterclock-wise (CCW) or clockwise (CW) rotation as viewed from the motor side. CCW rotation is furnished stan-dard unless otherwise specified.



Outlet Positions

ECLIPSE®
Innovative Thermal Solutions

Model Variations



Type "D"
A.M.C.A. Arrangement #8

Type "D" construction features a separate impeller shaft connected to the motor shaft by a flexible coupling. It is often used where immediate interchangibility of motors is required (photo shows inlet filter installed).

Type "P"
A.M.C.A. Arrangement #1

Type "P" construction permits the blower to be driven by a gasoline engine, line shaft or other separate power source.

Type "V"
A.M.C.A. Arrangement #9

Type "V" construction is normally used when 60 cycle AC current is not available and motor speeds result in less than standard rpm. The V-belt drives the impeller at standard rpm regardless of motor speed.

Air Inlet Filters

Filters must be ordered separately.

Single
Washable Element
(Double Also Available)
Bulletin 615

Non-washable
Cylindrical Element
Bulletin 616

Round
Replaceable Element
Bulletin 614

Pressure Switches

Model AA-A2-6
Bulletin I-354

Eclipse-Dungs
Air Pressure Switch

Model A2 is available in a wide selection of setpoint pressure ranges for a maximum pressure of 7 PSI (498 mbar). This pressure switch is CSA certified, FM approved and UL listed. Its calibrated blue knob provides easy and accurate adjustment. A 1/4" N.P.T. high pressure air inlet connection is located on the switch bottom.

Round Filters

Catalog Number	Assembly Number	Blower Inlet Size	Max. Capacity	
			SCFH	m3/hr.
25FAJ-S	200758	4"	25,000	707
25FAJ-M	200757	6" & 8"	25,000	707
50FAJ	200756	6" & 8"	50,000	1,413
150FAJ-S	200754	6" & 8"	150,000	4,248
150FAJ-M	200755	10" & 12"	150,000	4,248
250FAJ-L	200753	10" & 12"	250,000	7,065

The discharge pressure of the blower will be reduced by approximately .15" w.c. (.37 mbar) with the filter assembly installed.

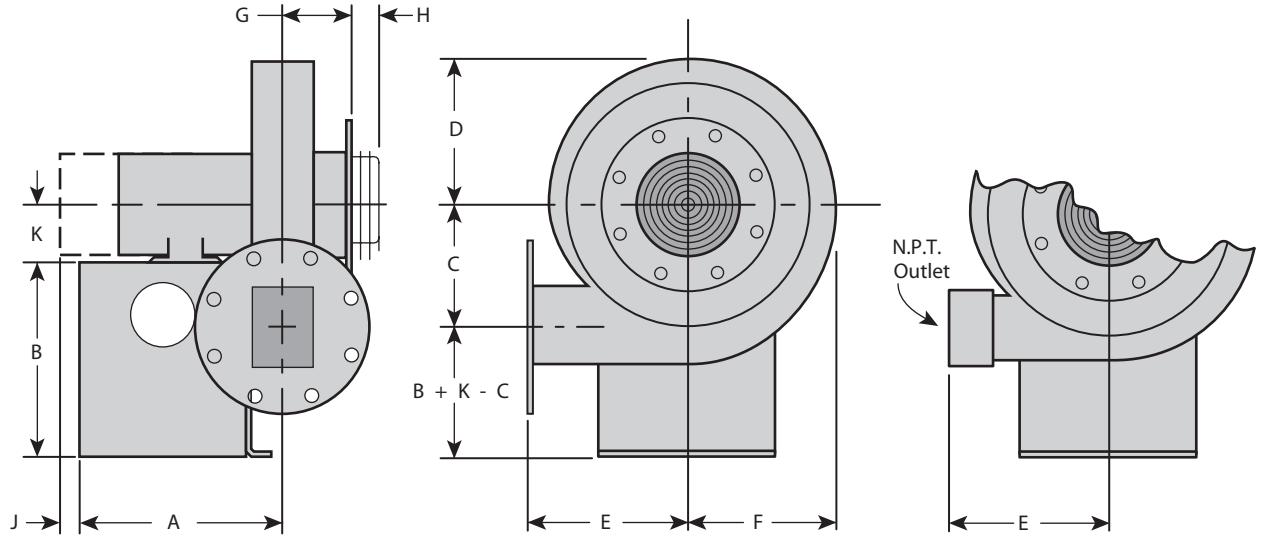
Capacities - 3600 rpm Motor

Blower Catalog No.	Motor HP	Service Factor	Inlet Size	Nominal Rating			
				"w.c.	SCFH	mbar	m3/hr.
SMJ 4610	1/3	1.35	6	7.0	6,900 *	17.4	195 *
SMJ 4610	1/2	1.25	6	7.0	15,000 *	17.4	425 *
SMJ 6812	1-1/2	1.15	8	9.5	40,300 *	23.7	1,141 *
SMJ 3412	1/3	1.35	4	10.0	4,800 *	24.9	136 *
SMJ 4412	1/2	1.25	4	10.0	8,600 *	24.9	243 *
SMJ 4412	3/4	1.25	4	10.0	14,000 *	24.9	396 *
SMJ 6812	1	1.25	8	10.0	32,800	24.9	929
SMJ 6812	2	1.15	8	10.0	45,000 *	24.9	1,274 *
SMJ 8815	5	1.15	8	10.4	92,500	25.9	2,620
SMJ 8814	3	1.15	8	11.0	69,000	27.4	1,954
SMJ 8813	3	1.15	8	11.5	72,000	28.6	2,039
SMJ 6614	2	1.15	6	11.6	44,600	28.9	1,263
SMJ 6614	1-1/2	1.15	6	13.0	37,000	31.1	1,048
SMJ 3414	3/4	1.25	4	14.0	10,000 *	34.9	283 *
SMJ 4614	1	1.25	6	14.0	21,200	34.9	600
SMJ 101016	7-1/2	1.15	10	14.1	140,400	35.1	3,976
SMJ 3414	1/2	1.25	4	14.7	7,530	36.6	213
SMJ 6615	2	1.15	6	15.0	32,000	37.4	906
SMJ 4615	1	1.25	6	15.5	23,000	38.6	651
SMJ 4616	1-1/2	1.15	6	15.5	27,000	38.6	765
SMJ 121217	15	1.15	12	15.6	223,000	38.9	6,315
SMJ 4615	3/4	1.25	6	15.8	13,600	39.4	385
SMJ 101016	10	1.15	10	16.0	163,000	39.9	4,616
SMJ 8816	5	1.15	8	17.0	70,000 *	42.3	1,982 *
SMJ 101016	7-1/2	1.15	10	17.0	86,000 *	42.3	2,436 *
SMJ 8815	3	1.15	8	17.1	52,000	42.6	1,473
SMJ 121217	10	1.15	12	19.1	150,000	47.6	4,248
SMJ 6617	2	1.15	6	19.6	25,700	48.8	728
SMJ 6617	3	1.15	6	19.9	38,000	49.6	1,076
SMJ 4617	1-1/2	1.15	6	20.0	15,000 *	49.8	425 *
SMJ 8817	7-1/2	1.15	8	20.0	85,000 *	49.8	2,407 *
SMJ 101018	15	1.15	10	20.0	165,000 *	49.8	4,673 *
SMJ 4616	1	1.25	6	20.2	16,500	50.3	467
SMJ 8817	5	1.15	8	21.2	67,500	52.8	1,912
SMJ 121220	20	1.15	12	26.0	202,000	64.8	5,721
SMJ 3619	1-1/2	1.15	6	27.0	15,300	67.3	433
SMJ 3619	2	1.15	6	27.0	20,000	67.3	566
SMJ 4619	2	1.15	6	27.0	20,000	67.3	566
SMJ 6619	5	1.15	6	27.4	49,100	68.3	1,391
SMJ 6619	3	1.15	6	27.8	27,300	69.2	773
SMJ 8819	7-1/2	1.15	8	27.8	70,500	69.2	1,997
SMJ 121219	15	1.15	12	27.8	150,000	69.2	4,248
SMJ 101019	10	1.15	10	28.4	87,500	70.7	2,478
SMJ 121221	25	1.15	12	30.0	209,000 *	74.7	5,919 *
SMJ 6621	3	1.15	6	31.0	18,300	77.2	518
SMJ 6621	5	1.15	6	31.5	36,800	78.5	1,042
SMJ 4621	2	1.15	6	32.1	9,100	80.0	258
SMJ 8821	7-1/2	1.15	8	32.3	48,000	80.5	1,359
SMJ 8821	10	1.15	8	32.6	74,500	81.2	2,110
SMJ 101021	20	1.15	10	34.0	133,000 *	84.7	3,767 *
SMJ 101021	15	1.15	10	34.2	121,500	85.2	3,441
SMJ 121222	25	1.15	12	35.4	213,000	88.2	6,032
SMJ 4623	3	1.15	6	37.2	11,600	92.7	328
SMJ 101023	25	1.15	10	38.6	178,000	96.1	5,041
SMJ 8823	15	1.15	8	38.9	102,000	96.9	2,889
SMJ 6623	7-1/2	1.15	6	39.0	42,500	97.1	1,204
SMJ 101023	20	1.15	10	39.8	136,000	99.1	3,852
SMJ 8823	10	1.15	8	40.5	60,000	100.9	4,531
SMJ 4623	5	1.15	6	41.1	29,500	102.4	835
SMJ 8828	10	1.15	8	54.8	40,000	136.5	1,133
SMJ 4628	5	1.15	6	55.0	14,500	137.0	411
SMJ 4628	7-1/2	1.15	6	55.8	28,100	139.0	796
SMJ 8828	15	1.15	8	58.5	63,000	145.7	1,784
SMJ 8828	25	1.15	8	59.0	95,000 *	147.0	2,690 *
SMJ 8828	20	1.15	8	60.0	91,000	149.5	2,577

Pressures are corrected for an air inlet temperature of 70°F (21°C) and a barometric pressure of 29.92" Hg (1.01 bar).

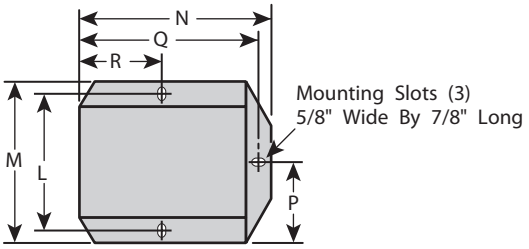
*Greater flows available at reduced pressure. See blower curves for details (Data 610).

Dimensions & Specifications –English Units



Flanged Outlet

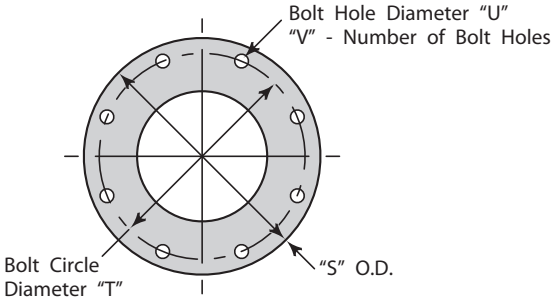
Threaded Outlet



Base*	Dimensions, In Inches						Bolt Dia.
	L	M	N	P	Q	R	
1	7-3/4	9-3/4	10	4-7/8	9	3-7/8	1/2
2	9-1/4	11-1/4	11	5-5/8	10	4-3/8	1/2
3	10	12	11-1/2	6	11	4-5/8	1/2
4	11	13	12	6-1/2	11	4-7/8	1/2
5	12	14	15-1/2	7	14-1/2	6-5/8	1/2
6	13-3/4	15-3/4	17-1/2	7-7/8	16-1/2	7-5/8	1/2
7	17	19	19-1/2	9-1/2	18-1/2	8-5/8	1/2

* See the main dimension table to find the base used on each blower.

Flange Dimensions



Nominal Pipe Size	Dimensions, In Inches				Bolt Dia.
	S	T	U	V	
3	7-1/2	6	3/4	4	5/8
4	9	7-1/2	3/4	8	5/8
6	11	9-1/2	7/8	8	3/4
8	13-1/2	11-3/4	7/8	8	3/4
10	16	14-1/4	1	12	7/8
12	19	17	1	12	7/8

Flange bolt patterns match ANSI 125# standards.

Dimension "K" And Blower Motor Specifications

All motors are 3600 RPM.

HP	Encl.	Frame Size	S.F.	Dim. "K" (Inches)	V./Ph./Hz.	Part
1/3	Open	48	1.35	3	115/230/1/60	11175
1/3	TEFC	48	1.35	3	115/230/1/60	10755
1/3	Open	48	1.35	3	230/460/3/60	17745
1/3	TEFC	48	1.35	3	230/460/3/60	10448
1/2	Open	48	1.25	3	115/230/1/60	11180
1/2	TEFC	48	1.25	3	115/230/1/60	18776
1/2	Open	48	1.25	3	230/460/3/60	11178
1/2	TEFC	48	1.25	3	230/460/3/60	10449
1/2	Open	56	1.25	3-1/2	230/460/3/60	10047
1/2	TEFC	56	1.25	3-1/2	230/460/3/60	10032
3/4	Open	56	1.25	3-1/2	115/230/1/60	11182
3/4	TEFC	56	1.25	3-1/2	115/230/1/60	18777
3/4	Open	56	1.25	3-1/2	230/460/3/60	11183
3/4	TEFC	56	1.35	3-1/2	230/460/3/60	17723
1	Open	56	1.25	3-1/2	115/230/1/60	11187
1	TEFC	56	1.25	3-1/2	230/460/3/60	18881
1	Open	56	1.25	3-1/2	230/460/3/60	11189
1-1/2	Open	56	1.15	3-1/2	115/230/1/60	16742
1-1/2	Open	143T	1.15	3-1/2	230/460/3/60	11192
1-1/2	TEFC	143T	1.15	3-1/2	230/460/3/60	11197
2	Open	145T	1.15	3-1/2	230/460/3/60	11203
2	TEFC	145T	1.15	3-1/2	230/460/3/60	11199
3	Open	145T	1.15	3-1/2	230/460/3/60	11207
3	TEFC	182T	1.15	4-1/2	230/460/3/60	11209
5	Open	182T	1.15	4-1/2	230/460/3/60	11213
5	TEFC	184T	1.15	4-1/2	230/460/3/60	11210
7-1/2	Open	184T	1.15	4-1/2	230/460/3/60	11214
7-1/2	TEFC	213T	1.15	5-1/4	230/460/3/60	11215
10	Open	213T	1.15	5-1/4	230/460/3/60	11216
10	TEFC	215T	1.15	5-1/4	230/460/3/60	11217
15	Open	215T	1.15	5-1/4	230/460/3/60	11221
15	TEFC	254T	1.15	6-1/4	230/460/3/60	11220
20	Open	254T	1.15	6-1/4	230/460/3/60	11224
20	TEFC	256T	1.15	6-1/4	230/460/3/60	19894
25	Open	256T	1.15	6-1/4	230/460/3/60	14072
25	TEFC	284T	1.15	7	230/460/3/60	16764

Dimensions & Specifications –English Units (continued)

Blower Catalog No.	Motor HP[1]	Inlet	Outlet	Dimensions In Inches									Base[1]
				A	B	C	D	E	F	G	H	J	
SMJ 3412[3]	1/3	4	3	9-3/16	9-1/2	7-1/2	8-3/8	10-1/8	8-11/16	4	1-7/8	—	1
SMJ 3414[3]	1/2 & 3/4	4	3	10	9-1/2	8-5/16	9-3/16	10-9/16	9-9/16	3-13/16	1-7/8	—	2
SMJ 3414	1/2 & 3/4	4	3	10	9-1/2	8-5/16	9-3/16	10-9/16	9-9/16	3-13/16	1-7/8	—	2
SMJ 3619[3]	1-1/2 & 2	6	3	11-3/16	12-1/2	11-3/4	13	15-5/8	13-5/16	4	1-7/8	—	4
SMJ 4412[3]	1/2	4	4	9-5/8	9-1/2	6-1/2	7-7/8	10-13/16	8-1/16	4-7/16	1-7/8	—	1
SMJ 4412[3]	3/4	4	4	10-5/8	9-1/2	6-1/2	7-7/8	10-13/16	8-1/16	4-7/16	1-7/8	—	1
SMJ 4610[3]	1/3 & 1/2	6	4	9-13/16	9-1/2	5-13/16	6-11/16	9-13/16	6-7/8	4-5/8	1-7/8	1-1/4	1
SMJ 4614[3]	1	6	4	11-1/2	12-1/2	8-11/16	10	13-13/16	10-3/16	4-5/16	1-7/8	—	4
SMJ 4615[3]	3/4 & 1	6	4	11-1/2	12-1/2	8-11/16	10	13-13/16	10-3/16	4-5/16	1-7/8	—	4
SMJ 4616[3]	1 &1-1/2	6	4	11-3/8	12-1/2	9-1/2	11-1/8	14-13/16	11-5/16	4-3/16	1-7/8	—	4
SMJ 4617[3]	1-1/2	6	4	11-3/8	12-1/2	9-1/2	11-1/8	14-13/16	11-5/16	4-3/16	1-7/8	—	4
SMJ 4619[3]	2	6	4	11-1/4	12-1/2	11-3/4	13	15-13/16	13-5/16	4	1-7/8	—	4
SMJ 4621	2	6	4	15-3/16	15-1/2	12-3/4	14-3/8	16-7/8	14-1/2	4-1/2	1-7/8	—	5
SMJ 4623	3	6	4	15-5/16	15-1/2	13-9/16	14-11/16	15-3/8	15-3/8	4-5/8	1-7/8	—	5
SMJ 4623	5	6	4	15-5/16	15-1/2	14	15-1/16	15-3/8	15-3/8	4-5/8	1-7/8	—	5
SMJ 4628	5 & 7-1/2	6	4	17-1/16	19	16-7/8	18-3/16	18-3/8	18-1/2	4-9/16	1-7/8	—	6
SMJ 6614	1-1/2 & 2	6	6	12-7/16	12-1/2	8-1/4	9-13/16	12-3/8	10	5-1/4	1-7/8	—	4
SMJ 6615	2	6	6	12-7/16	12-1/2	8-1/4	9-13/16	12-3/8	10	5-1/4	1-7/8	—	4
SMJ 6617	2 & 3D	6	6	11-7/8	12-1/2	9-3/8	11-1/8	13-3/8	11-1/4	4-3/4	1-7/8	—	4
SMJ 6617	3E	6	6	11-7/8	12-1/2	9-3/8	11-1/8	13-3/8	11-1/4	4-3/4	1-7/8	1/2	5
SMJ 6619	3	6	6	15-3/16	15-1/2	11-3/4	13	14-3/8	13-5/16	4-1/2	1-7/8	—	5
SMJ 6619	5	6	6	15-3/16	15-1/2	11-3/4	13	14-3/8	13-5/16	5-3/4	1-7/8	—	5
SMJ 6621	3 & 5	6	6	14-3/4	15-1/2	12	14-1/16	14-3/8	14-9/16	4-1/16	1-7/8	—	5
SMJ 6623	7-1/2	6	6	15-15/16	15-1/2	12-9/16	15	17-3/8	15-1/4	5-3/16	1-7/8	—	5
SMJ 6812	1,1-1/2,2D	8	6	12	12-1/2	7-5/16	8-7/16	10-3/8	8-13/16	5-1/4	1-7/8	—	3
SMJ 6812	2E	8	6	12	12-1/2	7-5/16	8-7/16	10-3/8	8-13/16	5-1/4	1-7/8	1/2	3
SMJ 8813	3D	8	8	14-1/2	12-1/2	8-7/8	10	12-3/8	10-9/16	7-5/16	1-7/8	—	4
SMJ 8813	3E	8	8	14-1/2	12-1/2	8-7/8	10	12-3/8	10-9/16	7-5/16	1-7/8	9/16	4
SMJ 8814	3	8	8	16	15-1/2	9-11/16	11-1/4	12-3/8	12-1/16	5-1/4	1-7/8	—	5
SMJ 8815	3 & 5	8	8	16	15-1/2	9-11/16	11-1/4	12-3/8	12-1/16	5-1/4	1-7/8	—	5
SMJ 8816	5	8	8	16	15-1/2	9-11/16	11-1/4	12-3/8	12-1/16	5-1/4	1-7/8	—	5
SMJ 8817	5 & 7-1/2	8	8	16-7/16	15-1/2	9-7/8	11	13-7/8	11-7/8	5-3/4	1-7/8	—	5
SMJ 8819	7-1/2 & 10	8	8	16-1/8	15-1/2	13	14-5/16	15-3/8	15-3/16	5-7/16	1-7/8	—	5
SMJ 8821	7-1/2 & 10	8	8	18-1/2	19	14	15-1/2	15-3/8	16-7/16	5-3/4	1-7/8	—	6
SMJ 8823	10 & 15	8	8	20-1/8	19	14-9/16	16	16-3/8	16-7/8	5-1/2	1-7/8	—	7
SMJ 8828	10 & 15D	8	8	19-1/2	19	15-1/4	18-1/8	22-3/8	18-3/8	4-7/8	1-7/8	—	7
SMJ 8828	15E,20,25D	8	8	19-1/2	19	15-1/4	18-1/8	22-3/8	18-3/8	4-7/8	1-7/8	1-9/16	7
SMJ 8828	25E	8	8	19-1/2	19	15-1/4	18-1/8	22-3/8	18-3/8	4-7/8	1-7/8	3-1/8	7
SMJ 101016	7-1/2	10	10	18-11/16	15-1/2	10-13/16	12	14-3/8	12-3/4	8	2-3/8	—	5
SMJ 101016	10	10	10	20-11/16	19	10-13/16	12	14-3/8	12-3/4	8	2-3/8	—	6
SMJ 101018	15D	10	10	20-1/4	19	12-1/4	13-1/4	14-3/8	14-9/16	7-9/16	2-3/8	—	6
SMJ 101018	15E	10	10	20-1/4	19	12-1/4	13-1/4	14-3/8	14-9/16	7-9/16	2-3/8	1-7/8	6
SMJ 101019	10	10	10	19-3/4	19	13	14-3/8	15-3/8	15-1/4	7-1/16	2-3/8	—	6
SMJ 101021	15 & 20	10	10	21-7/16	19	14	15-1/2	15-3/8	16-7/16	6-3/4	2-3/8	—	7
SMJ 101023	20	10	10	20-13/16	19	14-3/16	16	18-3/8	17	6-3/16	2-3/8	—	7
SMJ 101023	25D	10	10	20-13/16	19	14-3/16	16	18-3/8	17	6-3/16	2-3/8	1-5/8	7
SMJ 101023	25E	10	10	20-13/16	19	14-3/16	16	18-3/8	17	6-3/16	2-3/8	3-1/8	7
SMJ 121217	10 & 15D	12	12	20-11/16	19	10-13/16	12	14-3/8	12-3/4	8	2-3/8	—	6
SMJ 121217	15E	12	12	20-11/16	19	10-13/16	12	14-3/8	12-3/4	8	2-3/8	1-3/4	6
SMJ 121219	15D	12	12	23	19	13	14-1/2	15-3/8	15-1/4	8-1/4	2-3/8	—	7
SMJ 121219	15E	12	12	23	19	13	14-1/2	15-3/8	15-1/4	8-1/4	2-3/8	—	7
SMJ 121220	20	12	12	23	19	13	14-1/2	15-3/8	15-1/4	8-1/4	2-3/8	—	7
SMJ 121221	25D	12	12	22-1/16	19	14	15-9/16	15-3/8	16-7/16	7-3/8	2-3/8	1-5/8	7
SMJ 121221	25E	12	12	22-1/16	19	14	15-9/16	15-3/8	16-6/16	7-3/8	2-3/8	3-1/8	7
SMJ 121222	25D	12	12	22-1/16	19	14	15-9/16	15-3/8	16-7/16	7-3/8	2-3/8	1-5/8	7
SMJ 121222	25E	12	12	22-1/16	19	14	15-9/16	15-3/8	16-7/16	7-3/8	2-3/8	3-1/8	7

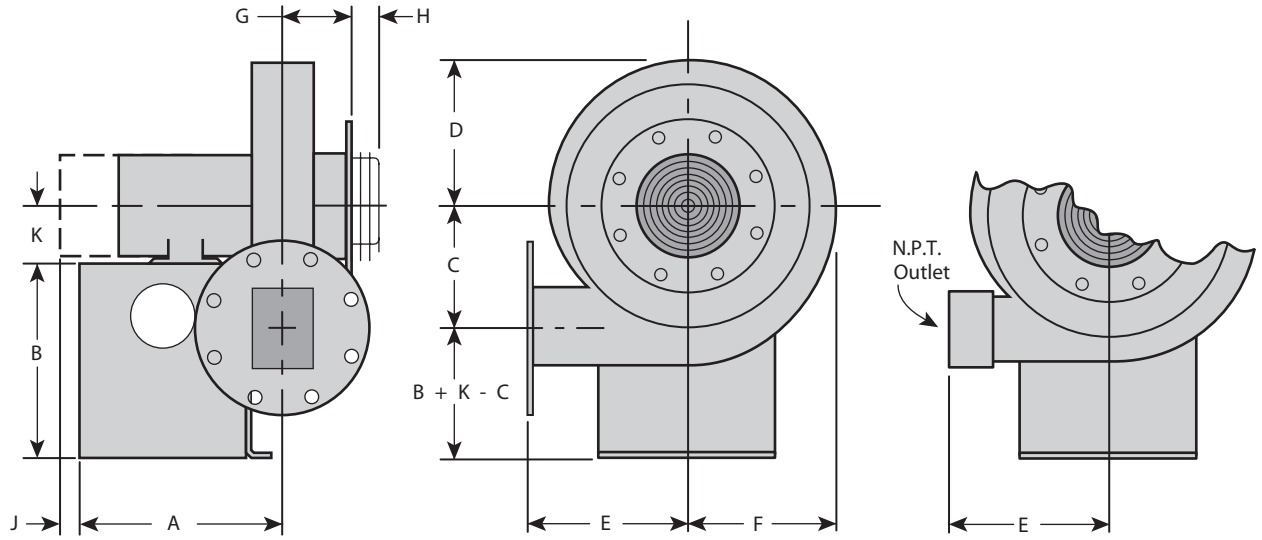
[1]D=open motor; E=enclosed motor. Horsepowers with no letter suffix are either open or enclosed.

[2]Refer to the base chart on page 4 for base mounting dimensions.

[3]Signifies an N.P.T. threaded outlet. All other blowers have flanged outlets with standard ANSI 125# bolt patterns. All inlets are flanged. Companion flanges are not standard, but are available at a nominal cost.

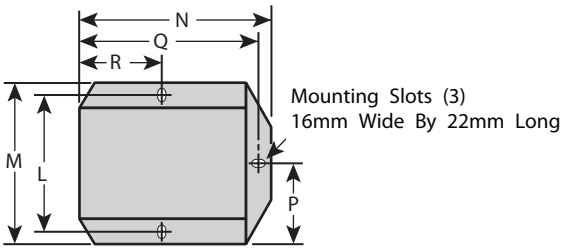
To Order: Specify blower catalog number, CW or CCW rotation, motor HP, open or TEFC, voltage and frame size.

Dimensions & Specifications –Metric Units



Flanged Outlet

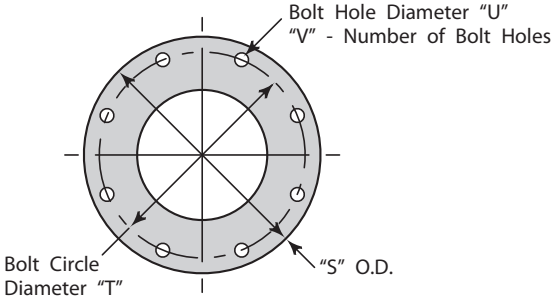
Threaded Outlet



Base*	Dimensions (mm)						Bolt Dia.
	L	M	N	P	Q	R	
1	197	248	254	124	229	98	14
2	235	286	279	143	254	111	14
3	254	305	292	152	279	117	14
4	279	330	305	165	279	124	14
5	305	356	394	178	368	168	14
6	349	400	445	200	419	194	14
7	432	483	495	241	470	219	14

* See the main dimension table to find the base used on each blower.

Flange Dimensions



Nominal Pipe Size	Dimensions (mm)				Bolt Dia.
	S	T	U	V	
76	191	152	19	4	16
102	229	191	19	8	16
152	279	241	22	8	19
203	343	298	22	8	19
254	406	362	25	12	22
305	483	432	25	12	22

Flange bolt patterns match ANSI 125# standards.

Dimension "K" And Blower Motor Specifications

All motors are 3600 RPM

HP	Encl.	Frame Size	S.F.	Dim. "K" (mm)	V./Ph./Hz.	Part
1/3	Open	48	1.35	76	115/230/1/60	11175
1/3	TEFC	48	1.35	76	115/230/1/60	10755
1/3	Open	48	1.35	76	230/460/3/60	17745
1/3	TEFC	48	1.35	76	230/460/3/60	10448
1/2	Open	48	1.25	76	115/230/1/60	11180
1/2	TEFC	48	1.25	76	115/230/1/60	18776
1/2	Open	48	1.25	76	230/460/3/60	11178
1/2	TEFC	48	1.25	76	230/460/3/60	10449
1/2	Open	56	1.25	89	230/460/3/60	10047
1/2	TEFC	56	1.25	89	230/460/3/60	10032
3/4	Open	56	1.25	89	115/230/1/60	11182
3/4	TEFC	56	1.25	89	115/230/1/60	18777
3/4	Open	56	1.25	89	230/460/3/60	11183
3/4	TEFC	56	1.35	89	230/460/3/60	17723
1	Open	56	1.25	89	115/230/1/60	11187
1	TEFC	56	1.25	89	230/460/3/60	18881
1	Open	56	1.25	89	230/460/3/60	11189
1-1/2	Open	56	1.15	89	115/230/1/60	16742
1-1/2	Open	143T	1.15	89	230/460/3/60	11192
1-1/2	TEFC	143T	1.15	89	230/460/3/60	11197
2	Open	145T	1.15	89	230/460/3/60	11203
2	TEFC	145T	1.15	89	230/460/3/60	11199
3	Open	145T	1.15	89	230/460/3/60	11207
3	TEFC	182T	1.15	114	230/460/3/60	11209
5	Open	182T	1.15	114	230/460/3/60	11213
5	TEFC	184T	1.15	114	230/460/3/60	11210
7-1/2	Open	184T	1.15	114	230/460/3/60	11214
7-1/2	TEFC	213T	1.15	133	230/460/3/60	11215
10	Open	213T	1.15	133	230/460/3/60	11216
10	TEFC	215T	1.15	133	230/460/3/60	11217
15	Open	215T	1.15	133	230/460/3/60	11221
15	TEFC	254T	1.15	159	230/460/3/60	11220
20	Open	254T	1.15	159	230/460/3/60	11224
20	TEFC	256T	1.15	159	230/460/3/60	19894
25	Open	256T	1.15	159	230/460/3/60	14072
25	TEFC	284T	1.15	178	230/460/3/60	16764

Dimensions & Specifications –Metric Units (continued)

Blower Catalog No.	Motor HP[1]	Inlet	Outlet	Dimensions In Millimeters									Base[2]
				A	B	C	D	E	F	G	H	J	
SMJ 34123	1/3	102	3" NPT	233	241	191	213	257	221	102	48	—	1
SMJ 34143	1/2 & 3/4	102	3" NPT	254	241	211	233	268	243	97	48	—	2
SMJ 3414	1/2 & 3/4	102	76	254	241	211	233	268	243	97	48	—	2
SMJ 36193	1-1/2 & 2	152	3" NPT	284	318	298	330	397	338	102	48	—	4
SMJ 44123	1/2	102	4" NPT	244	241	165	200	275	206	113	48	—	1
SMJ 44123	3/4	102	4" NPT	270	241	165	200	275	206	113	48	—	1
SMJ 46103	1/3 & 1/2	152	4" NPT	249	241	148	170	249	175	117	48	32	1
SMJ 46143	1	152	4" NPT	292	318	221	254	351	259	110	48	—	4
SMJ 46153	3/4 & 1	152	4" NPT	292	318	221	254	351	259	110	48	—	4
SMJ 46163	1 &1-1/2	152	4" NPT	289	318	241	283	376	303	106	48	—	4
SMJ 46173	1-1/2	152	4" NPT	289	318	241	283	376	303	106	48	—	4
SMJ 46193	2	152	4" NPT	286	318	298	330	402	338	102	48	—	4
SMJ 4621	2	152	102	386	394	324	365	429	368	114	48	—	5
SMJ 4623	3	152	102	389	394	344	373	391	391	117	48	—	5
SMJ 4623	5	152	102	389	394	356	383	391	391	117	48	—	5
SMJ 4628	5 & 7-1/2	152	102	433	483	429	462	467	470	116	48	—	6
SMJ 6614	1-1/2 & 2	152	152	316	318	210	249	314	254	133	48	—	4
SMJ 6615	2	152	152	316	318	210	249	314	254	133	48	—	4
SMJ 6617	2 & 3D	152	152	302	318	238	283	340	286	121	48	13	4
SMJ 6617	3E	152	152	302	318	238	283	340	286	121	48	—	4
SMJ 6619	3	152	152	386	394	298	330	365	338	114	48	—	4
SMJ 6619	5	152	152	386	394	298	330	365	338	146	48	—	5
SMJ 6621	3 & 5	152	152	375	394	305	357	365	370	103	48	—	5
SMJ 6623	7-1/2	152	152	405	394	319	381	441	387	132	48	—	5
SMJ 6812	1,1-1/2,2D	203	152	305	318	186	214	264	224	133	48	—	3
SMJ 6812	2E	203	152	305	318	186	214	264	224	133	48	13	3
SMJ 8813	3D	203	203	368	318	225	254	314	268	186	48	—	4
SMJ 8813	3E	203	203	368	318	225	254	314	268	186	48	14	4
SMJ 8814	3	203	203	406	394	246	286	314	306	133	48	—	5
SMJ 8815	3 & 5	203	203	406	394	246	286	314	306	133	48	—	5
SMJ 8816	5	203	203	406	394	246	286	314	306	133	48	—	5
SMJ 8817	5 & 7-1/2	203	203	418	394	251	279	352	302	146	48	—	5
SMJ 8819	7-1/2 & 10	203	203	410	394	330	364	391	386	138	48	—	5
SMJ 8821	7-1/2 & 10	203	203	470	483	356	394	391	418	133	48	—	6
SMJ 8823	10 & 15	203	203	511	483	370	406	416	429	140	48	—	7
SMJ 8828	10 & 15D	203	203	495	483	387	460	568	467	124	48	—	7
SMJ 8828	15E,20,25D	203	203	495	483	387	460	568	467	124	48	40	7
SMJ 8828	25E	203	203	495	483	387	460	568	467	124	48	79	7
SMJ 101016	7-1/2	254	254	475	394	275	305	365	324	203	60	—	5
SMJ 101016	10	254	254	525	483	275	305	365	324	203	60	—	6
SMJ 101018	15D	254	254	514	483	311	337	365	370	192	60	—	6
SMJ 101018	15E	254	254	514	483	311	337	365	370	192	60	48	6
SMJ 101019	10	254	254	502	483	330	365	391	387	179	60	—	6
SMJ 101021	15 & 20	254	254	545	483	356	394	391	418	171	60	—	7
SMJ 101023	20	254	254	529	483	376	406	467	432	157	60	—	7
SMJ 101023	25D	254	254	529	483	376	406	467	432	157	60	41	7
SMJ 101023	25E	254	254	529	483	376	406	467	432	157	60	79	7
SMJ 121217	10 & 15D	305	305	525	483	275	305	365	324	203	60	—	6
SMJ 121217	15E	305	305	525	483	275	305	365	324	203	60	44	6
SMJ 121219	15D	305	305	584	483	330	368	391	387	210	60	—	7
SMJ 121219	15E	305	305	584	483	330	368	391	387	210	60	—	7
SMJ 121220	20	305	305	584	483	330	368	391	387	210	60	—	7
SMJ 121221	25D	305	305	560	483	356	395	391	418	187	60	41	7
SMJ 121221	25E	305	305	560	483	356	395	391	418	187	60	79	7
SMJ 121222	25D	305	305	560	483	356	395	391	418	187	60	41	7
SMJ 121222	25E	305	305	560	483	356	395	391	418	187	60	79	7

[1]D=open motor; E=enclosed motor. Horsepowers with no letter suffix are either open or enclosed.

[2]Refer to the base chart on page 4 for base mounting dimensions.

[3] Signifies an N.P.T. threaded outlet. All other blowers have flanged outlets with standard ANSI 125# bolt patterns. All inlets are flanged. Companion flanges are not standard, but are available at a nominal cost.

To Order: Specify blower catalog number, CW or CCW rotation, motor HP, open or TEFC, voltage and frame size.

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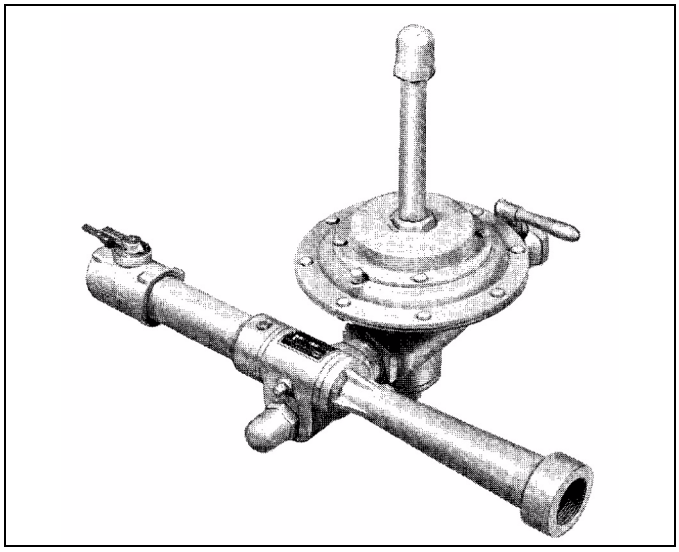
Bulletin 652
5/21/2010

Eclipse Low Pressure Proportional Mixers

LP Series

Version 1



Eclipse Series “LP” Low Pressure Proportional Mixers are used to mix low pressure air (2 oz. to 4 psi) and any commercially available fuel gas at low pressure (4" w.c. to 16 oz.) and deliver the mixture under pressure to open or sealed premix type gas burners.

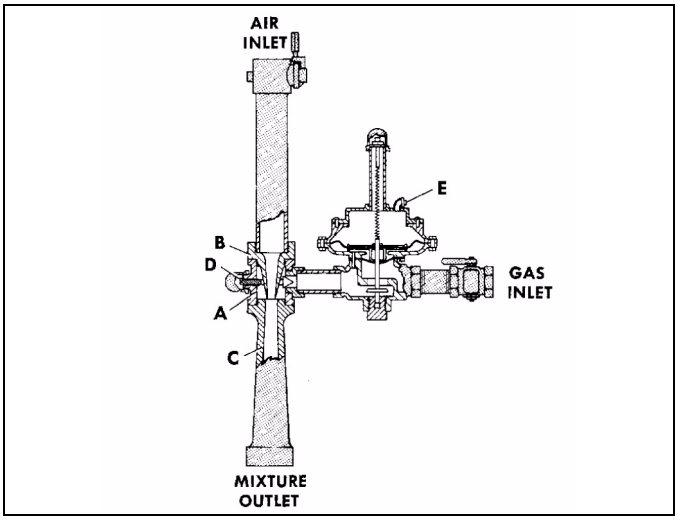
The gas is automatically entrained and mixed with the air in the correct gas:air ratio over the entire range of operation. The amount of air pressure that should be provided from the combustion air blower (Bulletin 610) will depend on the turndown range required, and this will vary according to the application.

Single valve control, as provided by the “LP” Mixer, eliminates the need for the operator to regulate both the gas and air valves as the heat requirements change. Efficiency losses invariably result when manual adjustment of both air and gas valves is dependent on gas:air ratio control. A slight excess air or excess gas condition can cause serious losses in efficiency of operation and extend length of heat-up time. When these losses are eliminated by the Series “LP” Mixer, the investment in equipment is soon repaid in fuel savings.

By providing single valve control, the proportional mixer makes temperature control adaptation very simple. It is necessary to control the air flow only, using a single control valve, and the gas flow automatically changes in direct proportion.

Operation

The complete mixer, series “LPBG”, consists of a manual butterfly valve, a venturi tube and air jet combined to create a suction, an accurate cone-type valve for gas:air ratio adjustment, a zero gas governor, and a lever handle gas shut-off cock. The gas cock is provided to shut off the gas supply when the system is not in operation, as the zero governor is not a tight shut-off valve.



Referring to the sketch, as the air flows through the jet “B” into the venturi tube “C”, a suction is created in the suction tee “A”. This suction will vary with the velocity of the air flow through the jet. The gas is entrained and mixed inside the venturi sleeve. Its flow into the tee is set by the ratio adjuster valve “D” and will vary directly in proportion to the air flow. If the gas varies in calorific value or specific gravity, a simple change in the setting of the cone adjuster “D” will again provide the correct mixture.

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To secure highly accurate gas:air ratio control, the gas pressure must be reduced either to atmospheric or to the same pressure or suction condition as exists in the combustion chamber. If the burners being used are firing in the open or into a furnace at zero pressure, the governor is used with the breathing vent “E” open to the atmosphere. If a suction or pressure condition exists, a pipe or tubing should be run from “E” to the combustion chamber. The governor will then deliver gas only when air flows through the mixer.

If only very low air pressure is available (4 oz. or under), the suction in the entrainment tee may be sufficient to draw enough gas through the governor to maintain proper gas:air ratio. In this case, an impulse line with bleed fitting should be installed between the air manifold, downstream of control valve, and the top diaphragm chamber of zero governor. As a result, any change in air flow is transmitted to the zero governor, and gas:air ratio is maintained throughout the range of operation. Mixers are available from the factory complete with impulse line and bleed fitting installed.

The “LP” mixer can be turned to discharge the mixture in any direction for flexibility of piping, as long as the zero gas governor is in the horizontal position with spring stem upright so that the balancing spring hangs vertically. Several mixers may be manifolded to one zero governor if located reasonably close together. Each size of “LP” mixer is available in four different assemblies for ease in selecting the mixer and accessory combinations to fit your particular needs.

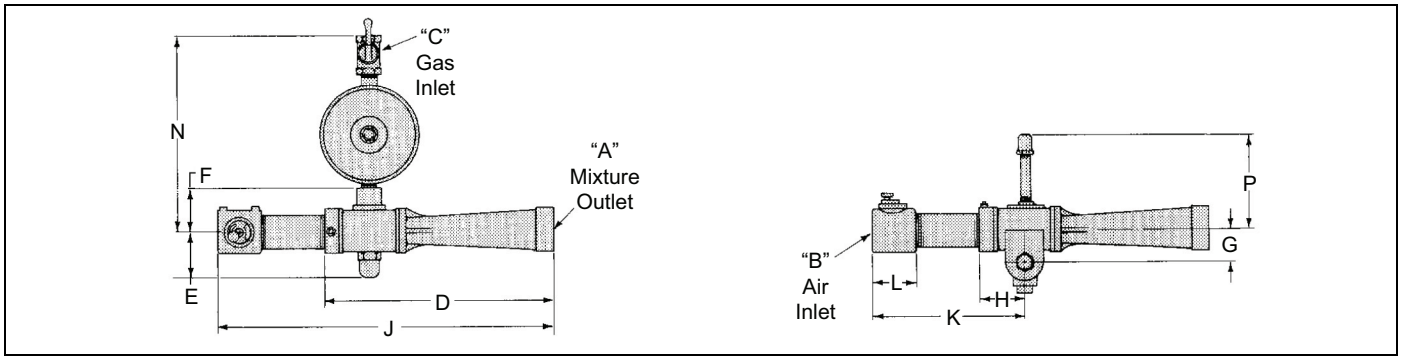
Selection

Selection Tables 652-1 through 652-5 give mixer selection information for various commercially available fuel gases.

Locate required gas capacity (CFH) in left-hand vertical column of appropriate selection table, locate air pressure available at mixer in upper horizontal column, and select mixer. Approximate mixture pressure is shown in the bottom horizontal column.

Tables are based on all air for combustion taken through the mixer (100% aeration). When less than 100% aeration is used, as in the case of open burners, correct the capacity for the amount of aeration and use corrected capacity for selecting mixer. (Correction factor for 80% aeration = 0.80; 70% aeration = 0.70; etc.) For smaller capacity mixers, see Bulletin 812, Pilot Mixers.

Dimensions & Specifications



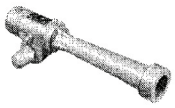
Mixer No.	Mixture Outlet A	Air Inlet B	Gas Inlet C	Dimensions in Inches D	E	F	G	H	J	K	L	N	P	Approx. Ship Wt. LPBG
44-(5-16)	1	1	1	12-9/16	2-19/32	2-5/16	1-1/4	2-17/32	20-1/16	10-1/32	2-7/8	11-1/2	12-5/16	36
64-(12-25)	1-1/2	1-1/2	1	14-17/32	3	5-5/8	1-1/2	2-21/32	22-9/32	10-13/32	3-1/8	11-13/16	12-5/16	36
66-(12-25)	1-1/2	1-1/2	1-1/2	14-17/32	3	2-1/2	1-1/2	2-21/32	22-9/32	10-13/32	3-1/8	12-7/8	12-7/8	52
84-(20-38)	2	2	1	16-1/2	3-15/16	3-1/8	2-3/8	3-3/8	24-1/8	11	3-1/8	12-5/16	12-5/16	53
86-(20-38)	2	2	1-1/2	16-1/2	3-15/16	3	2-3/8	3-3/8	24-1/8	11	3-1/8	13-3/8	12-7/8	62
88-(20-38)	2	2	2	16-1/2	3-15/16	2-15/16	2-3/8	3-3/8	24-1/8	11	3-1/8	17-7/16	14-7/8	90
124-(31-56)	3	3	1	25-9/16	2-1/8	3-11/16	2-3/4	4-13/16	39-3/16	18-7/16	3-7/8	12-7/8	12-15/16	94
126-(31-56)	3	3	1-1/2	25-9/16	2-1/8	3-1/2	2-3/4	4-13/16	39-3/16	18-7/16	3-7/8	13-7/8	12-7/8	97
128-(31-56)	3	3	2	25-9/16	2-1/8	3-7/16	2-3/4	4-13/16	39-3/16	18-7/16	3-7/8	17-15/16	14-7/8	119
1212-(31-56)	3	3	3	25-9/16	2-1/8	4-1/16	2-3/4	4-13/16	39-3/16	18-7/16	3-7/8	24-7/16	16-3/4	200
166-(32-80)	4	4	1-1/2	28-9/16	2-3/8	4-1/2	4	4-15/16	43-1/16	19-7/16	5	14-7/8	12-7/8	167
168-(32-80)	4	4	2	28-9/16	2-3/8	4-1/4	4	4-15/16	43-1/16	19-7/16	5	18-3/4	14-7/8	228
1612-(32-80)	4	4	3	28-9/16	2-3/8	4-7/8	4	4-15/16	43-1/16	19-7/16	5	25-1/4	16-3/4	300
1616-(32-80)	4	4	4	28-9/16	2-3/8	5-1/8	4	4-15/16	43-1/16	19-7/16	5	31-7/8	18-3/4	378

* Numbers in parentheses show the range of available air jet diameters in 1/32". For exact jet diameters please contact Eclipse.

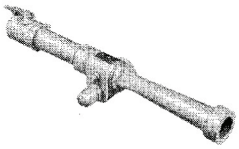
128-48 LPBG

Mixture outlet and air inlet in 1/4"	Gas inlet in 1/4"	Air jet dia. in 1/32"	Assembly designation
12 = 12/4 = 3"	8 = 8/4 = 2"	48 = 48/32 = 1-1/2" dia	(see below)

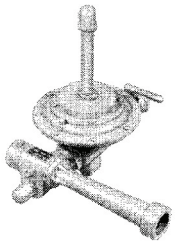
Assemblies Available



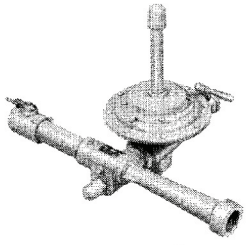
Assembly “LP”
Basic Mixer Only



Assembly “LPB”
Assembly “LP” Plus
Manual Air Valve



Assembly “LPG”
Assembly “LP” Plus Gas Zero
Governor and Gas Cock



Assembly “LPBG”
Complete Mixer - Assembly “LPB”
Plus Zero Governor and Gas Cock

NOTE: All assemblies are furnished complete with pipe fittings shown in the above photos.

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Data 720
9/13/2010

Eclipse Butterfly Valves

Full Port & Reduced Port

Version 2

Manual Control BV

Automatic Control BV

(Shown with Optional Crank Arm)

Product Description

Eclipse Butterfly Valves are designed to control air and gas flow to all types of combustion systems. They **should not** be used as tight shut-off valves.

Types Available

Valves are available for either manual or automatic control in pipe sizes 1/2" to 8". Full port, reduced port and high pressure drop constructions are available depending on pipe size and connection.

Thread Connections

The 1/2" through 4" valves are available with either NPT or Rc threads. The 6" and 8" valves are wafer type butterfly valves designed to be sandwiched between flanges on connecting pipes.

Disks

NPT Versions: Furnished with beveled or non-beveled disks, according to the selection table.

Rc Versions: Furnished with non-beveled disks.

Indication

All Eclipse butterfly valves feature an easy to read indicator plate and a slot on the end of the shaft to provide visual indication of the disk position.

Control

Manual butterfly valves 4" and smaller have an adjusting cover for setting disk position. A locking screw secures the cover at the desired setting.

Automatic control butterfly valves can be fitted with an optional crank arm or coupling. This allows integration with a variety of position control devices.

Manual wafer butterfly valves are adjusted by rotating a control arm which can be locked to the indicating plate after positioning.

Accessories

Eclipse stocks a selection of electric operators and mounting kits which can be ordered separately. The extended shaft length on the automatic butterfly valves allows the addition of either a second control arm for simultaneous automatic operation in dual valve applications, or a cam for a high/low fire microswitch arrangement.

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Main Specifications

Parameter	Specifications	
Maximum Operating Pressure	1/2" - 4" (15 - 100 mm)	5 psig (350 mbarg)
	6" - 8" (150 - 200 mm)	3 psig (210 mbarg)
Operating Temperature Range	NPT Version	-40 to 140°F (-40 to 60°C)
	Rc Version	32 to 140°F (0 to 60°C)
Materials of Construction	Body	Powder Coated Cast Iron
	Shaft	Zinc Plated Steel
	Disk	Carbon Steel
	Shaft Packing Seal	Nitrile Rubber (Buna-N)
Approvals	(UL) (only 1/2" thru 4" models)	
Typical Application	Control of air or gas flow in a combustion system	
Notes on European Applications	4" thread not acceptable for gas use. 3" thread is acceptable if pressure is limited to 100 mbar (1.5 psig)	

NPT Model Selection

	Full Port Valves						Reduced Port Valves			
	Manual		Automatic				Manual		Automatic	
	Beveled Disk 75° Rotation		Beveled Disk 75° Rotation		Non-Beveled Disk 360° Rotation		Beveled Disk 75° Rotation		Beveled Disk 75° Rotation	
NPT Size	Catalog Number	Item Code	Catalog Number	Item Code	Catalog Number	Item Code	Catalog Number	Item Code	Catalog Number	Item Code
1/2"*	102BV-B	501238	2BV-AB	501239	--------	--------	--------	--------	--------	--------
3/4"	103BV-B	501215	3BV-AB	501223	3BV-A	501200	--------	--------	--------	--------
1"	104BV-B	501216	4BV-AB	501224	4BV-A	501201	104BV-RB	501208	4BV-ARB	501231
1-1/4"	105BV-B	501217	5BV-AB	501225	5BV-A	501202	105BV-RB	501209	5BV-ARB	501232
1-1/2"	106BV-B	501218	6BV-AB	501226	6BV-A	501203	106BV-RB	501210	6BV-ARB	501233
2"	108BV-B	501219	8BV-AB	501227	8BV-A	501204	108BV-RB	501211	8BV-ARB	501234
2-1/2"	110BV-B	501220	10BV-AB	501228	10BV-A	501205	110BV-RB	501212	10BV-ARB	501235
3"	112BV-B	501221	12BV-AB	501229	12BV-A	501206	112BV-RB	501213	12BV-ARB	501236
4"	116BV-B	501222	16BV-AB	501230	16BV-A	501207	116BV-RB	501214	16BV-ARB	501237
6" wafer	124BV-B	500915	24BV-AB	500998	--------	--------	124BV-RB	500690	24BV-ARB	500975
8" wafer	132BV-B	500913	32BV-AB	500999	--------	--------	132BV-RB	500691	32BV-ARB	500976

* See note below.

	High Pressure Drop Valves			
	Manual		Automatic	
	Non-Beveled Disk 90° Rotation		Non-Beveled Disk 360° Rotation	
NPT Size	Catalog Number	Item Code	Catalog Number	Item Code
1/2"*	402BV-HD	100129	402BV-AHD	100130
3/4"	403BV-HD	100133	403BV-AHD	100134
1"	404BV-HD	100119	404BV-AHD	100123

* See note below.

***NOTE:** Beveled disks physically stop against the body in the closed position. ALL 1/2" Butterfly Valves (NPT/Rc, Manual/Automatic, Beveled/Non-beveled) DO NOT have a mechanical stop limiting the travel to 75° rotation. The effective travel for flow control is 75° but the shaft will rotate 360°. The terms beveled and non-beveled do not apply to any of the 1/2" Butterfly Valves covered in this datasheet.

NOTE: Wafer Butterfly Valves are not threaded. For dimensional information, see page 7.

NPT Model Capacities

Multiply Capacity by the Factors Below for Gases Other than Air			
Gas - Sp. Gr.	**Natural - .6**	**Propane - 1.5**	**Butane - 2.0**
Multifactor	1.29	0.81	0.70

NPT Size	Flow Coefficient Cv-Full Open	Full Port								
		Capacity scfh air - "w.c. pressure drop								
		0.5	0.75	1	1.5	2	3	4	6	8
1/2"	5.5	173	212	244	299	345	422	487	595	685
3/4"	15.9	500	612	706	865	998	1,221	1,408	1,720	1,982
1"	29.7	933	1,143	1,319	1,615	1,864	2,280	2,630	3,213	3,702
1-1/4"	65.9	2,071	2,536	2,927	3,583	4,135	5,059	5,835	7,129	8,213
1-1/2"	111.0	3,489	4,272	4,931	6,036	6,965	8,521	9,828	12,009	13,834
2"	180.0	5,657	6,927	7,996	9,788	11,295	13,818	15,937	19,473	22,433
2-1/2"	322.0	10,121	12,391	14,304	17,509	20,206	24,719	28,510	34,836	40,131
3"	457.0	14,364	17,587	20,301	24,850	28,677	35,082	40,462	49,441	56,956
4"	819.0	25,741	31,517	36,383	44,534	51,394	62,871	72,513	88,604	102,072
6" wafer	2600.0	81,718	100,055	115,501	141,377	163,154	199,591	230,201	281,283	324,039
8" wafer	4200.0	132,007	161,628	186,578	228,379	263,557	322,417	371,864	454,380	523,448

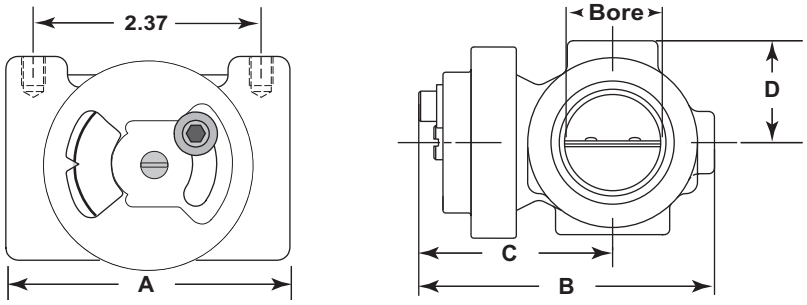
NPT Size	Flow Coefficient Cv-Full Open	Reduced Port								
		Capacity scfh air - "w.c. pressure drop								
		0.5	0.75	1	1.5	2	3	4	6	8
1"	14.1	443	543	626	767	885	1,082	1,248	1,525	1,757
1-1/4"	22.8	717	877	1,013	1,240	1,431	1,750	2,019	2,467	2,842
1-1/2"	31.4	987	1,208	1,395	1,707	1,970	2,410	2,780	3,397	3,913
2"	62.7	1,971	2,413	2,785	3,409	3,935	4,813	5,551	6,783	7,814
2-1/2"	87.9	2,763	3,383	3,905	4,780	5,516	6,748	7,783	9,510	10,955
3"	149.0	4,683	5,734	6,619	8,102	9,350	11,438	13,192	16,120	18,570
4"	244.0	7,669	9,390	10,839	13,268	15,311	18,731	21,604	26,397	30,410
6" wafer	553.0	17,381	21,281	24,566	30,070	34,702	42,452	48,962	59,827	68,921
8" wafer	721.5	22,677	27,765	32,051	39,232	45,275	55,387	63,881	78,056	89,921

NPT Size	Flow Coefficient Cv-Full Open	High Pressure Drop								
		Capacity scfh air - "w.c. pressure drop								
		0.5	0.75	1	1.5	2	3	4	6	8
1/2"	2.7	85	104	120	147	169	207	239	292	337
3/4"	3.2	101	123	142	174	201	246	283	346	399
1"	4.2	132	162	187	228	264	322	372	454	523

Dimensions, Manual Valves with NPT Threads

NPT Size	Full Port, Beveled Disk 75° Rotation: Catalog Number	Item Code	Bore Inches	Reduced Port, Beveled Disk 75° Rotation: Catalog Number	Item Code	Bore Inches	High Pressure Drop, 90° Rotation: Catalog Number	Item Code	Bore Inches	Dimensions, Inches: A	B	C	D
1/2"*	102BV-B	501238	0.61	-	-	-	402BV-HD	100129	0.44	3.00	3.05	2.05	1.19
3/4"	103BV-B	501215	0.87	-	-	-	403BV-HD	100133	0.55	3.00	3.07	2.07	1.06
1"	104BV-B	501216	1.10	104BV-RB	501208	0.87	404BV-HD	100119	2 x 0.44	2.87	3.33	2.14	1.31
1-1/4"	105BV-B	501217	3.12	105BV-RB	501209	1.02				3.12	3.58	2.26	1.50
1-1/2"	106BV-B	501218	1.46	106BV-RB	501210	1.18				3.12	3.82	2.38	1.63
2"	108BV-B	501219	2.13	108BV-RB	501211	1.53				3.12	4.45	2.70	1.94
2-1/2"	110BV-B	501220	2.64	110BV-RB	501212	1.77				3.87	5.09	3.09	2.25
3"	112BV-B	501221	3.23	112BV-RB	501213	2.24				3.87	5.58	3.33	2.50
4"	116BV-B	501222	4.17	116BV-RB	501214	2.80				5.00	6.65	3.84	3.06

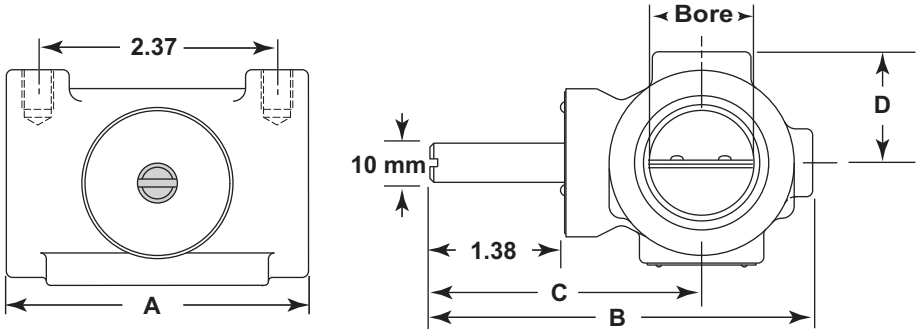
* See note below.



Dimensions, Automatic Valves with NPT Threads

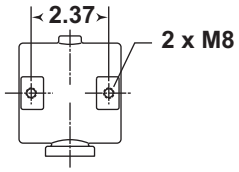
NPT Size	Full Port, Beveled Disk 75° Rotation: Catalog Number	Item Code	Non-Beveled Disk 360° Rotation: Catalog Number	Item Code	Bore Inches	Reduced Port, Beveled Disk 75° Rotation: Catalog Number	Item Code	Bore Inches	High Pressure Drop, 360° Rotation: Catalog Number	Item Code	Bore Inches	Dimensions, Inches: A	B	C	D
1/2"*	2BV-AB	501239	-	-	0.61	-	-	-	402BV-AHD	100130	0.44	3.00	3.66	2.66	1.19
3/4"	3BV-AB	501223	3BV-A	501200	0.87	-	-	-	403BV-AHD	100134	0.55	3.00	3.60	2.60	1.06
1"	4BV-AB	501224	4BV-A	501201	1.10	4BV-ARB	501231	0.87	404BV-AHD	100123	2 x 0.44	2.87	3.90	2.78	1.31
1-1/4"	5BV-AB	501225	5BV-A	501202	1.46	5BV-ARB	501232	1.02				3.12	4.22	2.90	1.50
1-1/2"	6BV-AB	501226	6BV-A	501203	1.65	6BV-ARB	501233	1.18				3.12	4.47	3.03	1.63
2"	8BV-AB	501227	8BV-A	501204	2.13	8BV-ARB	501234	1.54				3.12	5.09	3.34	1.94
2-1/2"	10BV-AB	501228	10BV-A	501205	2.64	10BV-ARB	501235	1.77				3.87	5.72	3.72	2.25
3"	12BV-AB	501229	12BV-A	501206	3.23	12BV-ARB	501236	2.24				3.87	6.22	3.97	2.50
4"	16BV-AB	501230	16BV-A	501207	4.17	16BV-ARB	501237	2.80				5.00	7.28	4.47	3.06

* See note below.

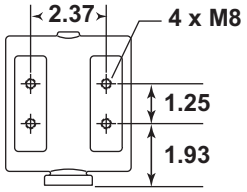


Actuator Bracket Mounting Holes

1/2" thru 2-1/2"



3" & 4"



<u>*NOTE:</u> Beveled disks physically stop against the body in the closed position. ALL 1/2" Butterfly Valves (NPT/Rc, Manual/Automatic Beveled/Non-beveled) DO NOT have a mechanical stop limiting the travel to 75° rotation. The effective travel for flow control is 75° but the shaft will rotate 360°. The terms beveled and non-beveled do not apply to any of the 1/2" Butterfly Valves covered in this datasheet.

Rc Model Selection

Rc Size	Full Port Valves				Reduced Port Valves			
	Manual		Automatic		Manual		Automatic	
	Non-Beveled Disk 90° Rotation		Non-Beveled Disk 360° Rotation		Non-Beveled Disk 90° Rotation		Non-Beveled Disk 360° Rotation	
	Catalog No	Item Code	Catalog No	Item Code	Catalog No	Item Code	Catalog No	Item Code
1/2"*	102BVM	101103	2BVM-A	202081	--------	--------	--------	--------
3/4"	103BVM	101104	3BVM-A	101248	--------	--------	--------	--------
1"	104BVM	101105	4BVM-A	101249	104BVM-R	101255	4BVM-AR	101261
1-1/4"	--------	--------	--------	--------	--------	--------	--------	--------
1-1/2"	106BVM	101106	6BVM-A	101250	106BVM-R	101256	6BVM-AR	101262
2"	108BVM	101107	8BVM-A	101251	108BVM-R	101257	8BVM-AR	101263
2-1/2"	110BVM	101108	10BVM-A	101252	110BVM-R	101258	10BVM-AR	101264
3"	112BVM	101109	12BVM-A	101253	112BVM-R	101259	12BVM-AR	101265
4"	116BVM	101110	16BVM-A	101254	116BVM-R	101260	16BVM-AR	101266
6" wafer	**NOTE:** Selection information for these valves appears on page 2. Wafer BV Valves are not threaded and may be used with DN 150 and DN 200 flanged fittings. See dimensions on page 7.							
8" wafer								

* See note below.

Rc Size	High Pressure Drop Valves			
	Manual		Automatic	
	Non-Beveled Disk 90° Rotation		Non-Beveled Disk 360° Rotation	
	Catalog No	Item Code	Catalog No	Item Code
1/2"*	402BVM-HD	100131	402BVM-AHD	100132
3/4"	403BVM-HD	100135	403BVM-AHD	100136
1"	404BVM-HD	100120	404BVM-AHD	100100

* See note to the right.

***NOTE**: Beveled disks physically stop against the body in the closed position. ALL 1/2" Butterfly Valves (NPT/Rc, Manual/Automatic Beveled/Non-beveled) DO NOT have a mechanical stop limiting the travel to 75° rotation. The effective travel for flow control is 75° but the shaft will rotate 360°. The terms beveled and non-beveled do not apply to any of the 1/2" Butterfly Valves covered in this datasheet.

Rc Model Capacities

Multiply Capacity by the Factors Below for Gases Other than Air			
Gas - Sp. Gr.	Natural - .6	Propane - 1.5	Butane - 2.0
Multifactor	1.29	0.81	0.70

Rc Size	Flow Coefficient CV-Full Open	Full Port							
		Capacity nm^3/h air - mbar pressure drop							
		1	2	3	5	8	10	13	15
1/2"	4.7	4	6	7	9	12	13	15	16
3/4"	13.7	12	17	21	27	34	38	43	46
1"	25.5	22	32	39	50	63	70	80	86
1-1/2"	95.8	84	118	145	187	236	264	300	322
2"	155.0	136	192	234	302	382	427	486	521
2-1/2"	277.0	242	342	419	541	683	763	868	932
3"	393.0	344	486	595	767	969	1,082	1,232	1,322
4"	704.0	615	870	1,065	1,374	1,735	1,938	2,207	2,368
6" wafer	2251.0	1,968	2,782	3,405	4,392	5,548	6,197	7,056	7,572
8" wafer	3637.0	3,180	4,495	5,502	7,097	8,964	10,013	11,400	12,234

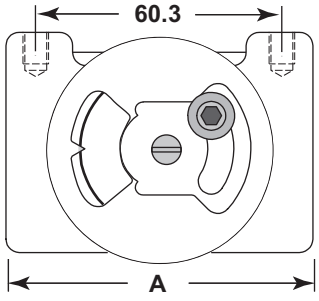
Rc Size	Flow Coefficient Kv-Full Open	Reduced Port							
		Capacity nm^3/h air - mbar pressure drop							
		1	2	3	5	8	10	13	15
1"	12.1	11	15	18	24	30	33	38	41
1-1/2"	27.0	24	33	41	53	67	74	85	91
2"	53.9	47	67	82	105	133	148	169	181
2-1/2"	75.9	66	94	115	148	187	209	238	255
3"	128.0	112	158	194	250	315	352	401	431
4"	210.0	184	260	318	410	518	578	658	706
6" wafer	479.0	419	592	725	935	1,181	1,319	1,501	1,611
8" wafer	625.0	546	772	946	1,220	1,540	1,721	1,959	2,102

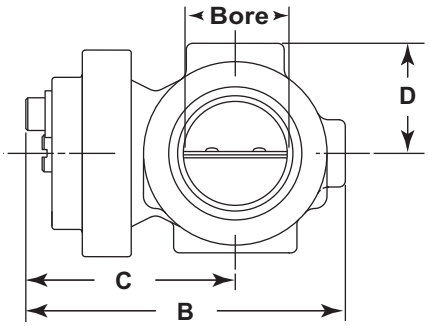
Rc Size	Flow Coefficient Kv-Full Open	High Pressure Drop							
		Capacity nm^3/h air - mbar pressure drop							
		1	2	3	5	8	10	13	15
1/2"	2.3	2.0	2.8	3.5	4.5	5.7	6.3	7.2	7.7
3/4"	2.8	2.4	3.5	4.2	5.5	6.9	7.7	8.8	9.4
1"	3.6	3.1	4.4	5.4	7.0	8.9	9.9	11.3	12.1

Dimensions, Manual Valves with Rc Threads

Rc Size	Full Port Non-Beveled Disk 90° Rotation			Reduced Port Non-Beveled Disk 90° Rotation			High Pressure Drop 90° Rotation			Dimensions, mm			
	Catalog Number	Item Code	Bore mm	Catalog Number	Item Code	Bore mm	Catalog Number	Item Code	Bore mm	A	B	C	D
1/2"*	102BVM	101103	15.5	-	-	-	402BVM-HD	100131	11.1	76.2	77.5	52.1	30.2
3/4"	103BVM	101104	22	-	-	-	403BVM-HD	100135	13.9	76.2	77.9	52.5	27.0
1"	104BVM	101105	28	104BVM-R	101255	22	404BVM-HD	100120	2 x 11.1	73.0	84.7	54.5	33.3
1-1/2"	106BVM	101106	42	106BVM-R	101256	30				79.4	97.0	60.5	41.3
2"	108BVM	101107	54	108BVM-R	101257	39				79.4	113.0	68.5	49.2
2-1/2"	110BVM	101108	67	110BVM-R	101258	45				98.4	129.2	78.5	57.2
3"	112BVM	101109	82	112BVM-R	101259	57				98.4	141.7	84.5	63.5
4"	116BVM	101110	106	116BVM-R	101260	71				127.0	168.9	97.5	77.8

* See note below.

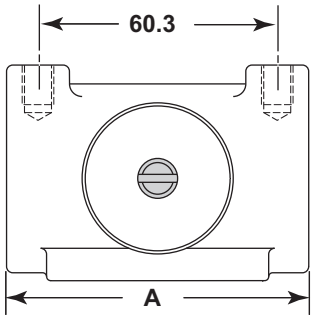


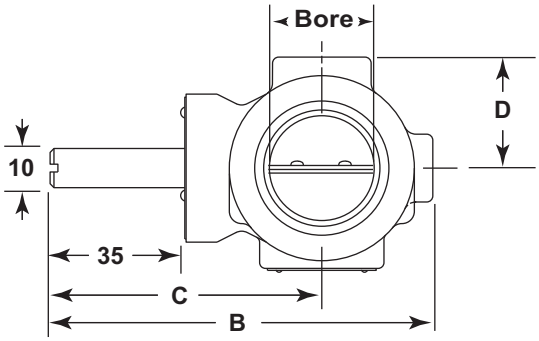


Dimensions, Automatic Valves with Rc Threads

Rc Size	Full Port Non-Beveled Disk 360° Rotation			Reduced Port Non-Beveled Disk 360° Rotation			High Pressure Drop 360° Rotation			Dimensions, mm			
	Catalog Number	Item Code	Bore mm	Catalog Number	Item Code	Bore mm	Catalog Number	Item Code	Bore mm	A	B	C	D
1/2"*	2BVM-A	202081	15.5	-	-	-	402BVM-AHD	100132	11.1	76.2	93.0	67.7	30.2
3/4"	3BVM-A	101248	22	-	-	-	403BVM-AHD	100136	13.9	76.2	91.3	65.9	27.0
1"	4BVM-A	101249	28	4BVM-AR	101261	22	404BVM-AHD	100100	2 x 11.1	73.0	99.2	70.6	33.3
1-1/2"	6BVM-A	101250	42	6BVM-AR	101262	30				79.4	113.5	77.0	41.3
2"	8BVM-A	101251	54	8BVM-AR	101263	39				79.4	129.4	84.9	49.2
2-1/2"	10BVM-A	101252	67	10BVM-AR	101264	45				98.4	145.3	94.5	57.2
3"	12BVM-A	101253	82	12BVM-AR	101265	57				98.4	158.0	100.8	63.5
4"	16BVM-A	101254	106	16BVM-AR	101266	71				127.0	184.9	113.5	77.8

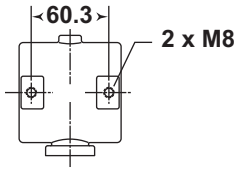
* See note below.



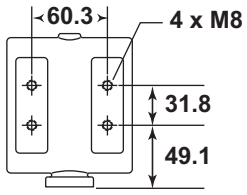


Actuator Bracket Mounting Holes

1/2" thru 2-1/2"



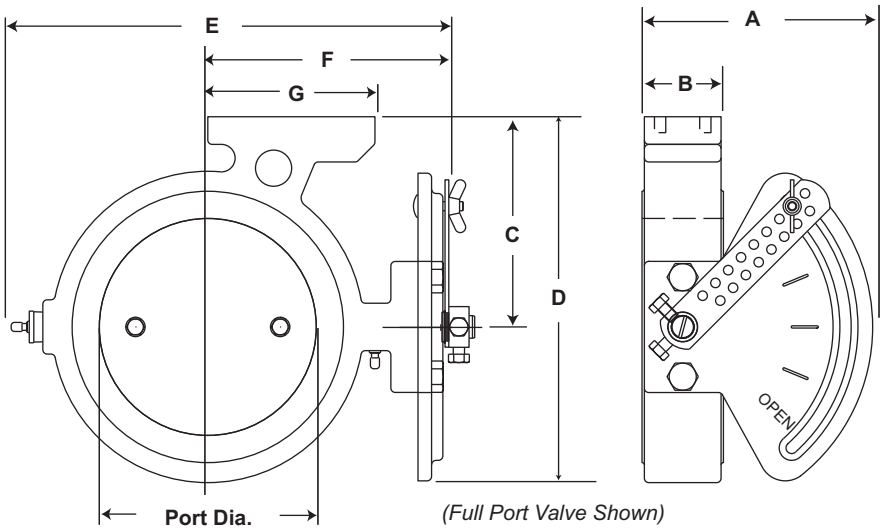
3" & 4"



***NOTE:** Beveled disks physically stop against the body in the closed position. ALL 1/2" Butterfly Valves (NPT/Rc, Manual/Automatic Beveled/Non-beveled) DO NOT have a mechanical stop limiting the travel to 75° rotation. The effective travel for flow control is 75° but the shaft will rotate 360°. The terms beveled and non-beveled do not apply to any of the 1/2" Butterfly Valves covered in this datasheet.

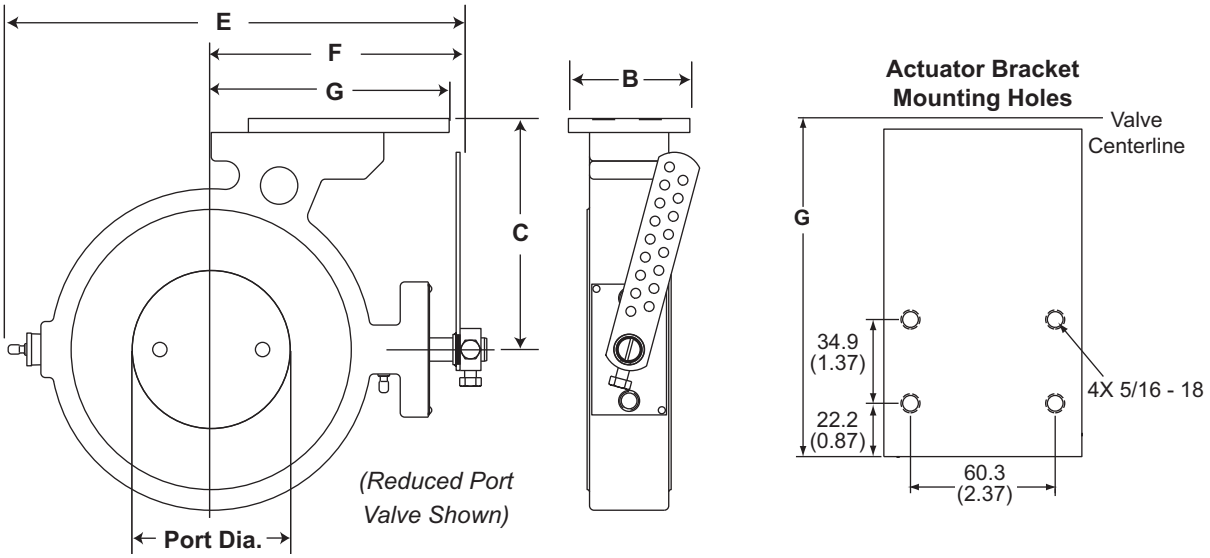
Dimensions, Wafer Type Valves

Manual Valves



Size	Catalog Number	Item Code	Dimensions mm (in)								
			A	B	C	D	E	F	G	Port Diameter	Approx. Weight
Full Port Manual											
6"	124BV-B	500915	162 (6.38)	57 (2.25)	148 (5.81)	257 (10.13)	289 (11.38)	97 (3.81)	117 (4.63)	152 (6.00)	13 (28
8"	132BV-B	500913	162 (6.38)	57 (2.25)	178 (7.00)	317 (12.47)	351 (13.81)	206 (8.13)	130 (5.13)	203 (8.00)	16 (36)
Reduced Port Manual											
6"	124BV-RB	500690	162 (6.38)	57 (2.25)	148 (5.81)	257 (10.13)	289 (11.38)	97 (3.81)	117 (4.63)	108 (4.25)	16 (35)
8"	132BV-RB	500691	162 (6.38)	57 (2.25)	178 (7.00)	317 (12.47)	351 (13.81)	206 (8.13)	130 (5.13)	130 (5.12)	23 (50)

Automatic Valves



Size	Catalog Number	Item Code	Dimensions mm (in)								
			A	B	C	D	E	F	G	Port Diameter	Approx. Weight
Full Port Auto											
6"	24BV-AB	500998	162 (6.38)	83 (3.25)	157 (6.18)	257 (10.13)	289 (11.38)	97 (3.81)	162 (6.38)	152 (6.00)	13 (28)
8"	32BV-AB	500999	162 (6.38)	83 (3.25)	187 (7.38)	317 (12.47)	351 (13.83)	206 (8.13)	193 (7.60)	203 (8.00)	16 (36)
Reduced Port Auto											
6"	24BV-ARB	500975	162 (6.38)	83 (3.25)	157 (6.18)	257 (10.13)	289 (11.38)	97 (3.81)	162 (6.38)	108 (4.25)	16 (35)
8"	32BV-ARB	500976	162 (6.38)	83 (3.25)	187 (7.38)	317 (12.47)	351 (13.81)	206 (8.13)	193 (7.60)	130 (5.12)	23 (50)

Accessories for Automatic BV's

Control Motor Mounting Kits	Major Components				
Eclipse Trilogy T500 Actuator	**Kit Item Code**	**Bracket**	**Drive Pin**	**Coupling**	**Crank Arm**
1/2 inch thru 3/4 inch	10047900	10047436	10050816	00.4095056.40	Crank arms not required
1 inch	10047901	10047437	10050816	00.4095056.40	
1-1/4 inch	10047902	10047867	10050816	00.4095056.40	
1-1/2 inch	10047903	10047438	10050816	00.4095056.40	
2 inch	10047904	10047439	10050816	00.4095056.40	
2-1/2 inch	10047905	10047440	10050816	00.4095056.40	
3 inch	10047906	10047441	10050816	00.4095056.40	
4 inch	10047907	10047442	10050816	00.4095056.40	
For assembled T500 and valve, see catalog 725, BV-Pak.					
Eclipse PRA6 Rotary Actuator	**Kit Item Code**	**Bracket**	**Control Rod**	**Coupling**	**Crank Arm**
RH mount, 1/2 thru 4, ver. 2	100127	21695	Rod not required	21048	Crank arms not required
LH mount, 1/2 thru 4, ver. 2	100128	21696		21048	
Perpendicular mount, 1/2 thru 1-1/2, ver. 2	100190	21934		21048	
Perpendicular mount, 2 & 2-1/2, ver. 2	100191	21935		21048	
Perpendicular mount, 3 & 4, ver. 2	100192	21936		21048	

Siemens SQM5	**Kit Item Code**	**Bracket**	**Control Rod**	**Coupling, 10 mm**	**Coupling, 3/8 sq**	**Crank Arm**
1/2"	n/a	10009523	n/a	10040580	10034079	n/a
3/4"	n/a	10009537	n/a	10040580	10034079	n/a
1"	n/a	10009541	n/a	10040580	10034079	n/a
1-1/2"	n/a	10009600	n/a	10040580	10034079	n/a
2"	n/a	10009606	n/a	10040580	10034079	n/a
3"	n/a	10017267	n/a	10040580	10034079	n/a

EMP/EMA, Honeywell Mod IV	**Kit Item Code**	**Bracket**	**Control Rod**	**Coupling**	**Crank Arm**
1/2 thru 4 ver. 2	100099	13095	12730-1	14264	102265
1/2 thru 4 ver. 2, with 18093 crank arm	100099-1	13095	12730-1	14264	102265/18093
1/2 thru 4 ver. 2, automotive	100099-AUTO	13095	10024156-6	10017978	102265
1/2 thru 4 ver. 2,	10025305	13095	12730-1	14264	11652-6/18093
6 and 8 valves	500928-1	13095	12730-2	14264	500537
Honeywell M640 & M940	**Kit Item Code**	**Bracket**	**Control Rod**	**Coupling**	**Crank Arm**
1/2 thru 4 ver. 2	120079	13095 & 12758	12730-1	14264	102265

NOTES:

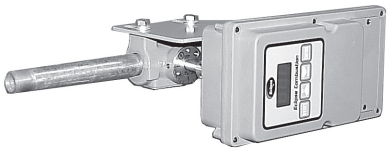
- Control Motor Mounting Kits contain brackets, couplings and miscellaneous screws and washers.
- The kits used with EMP/EMA and Honeywell valves also contain a control rod and crank arm.
- These mounting kits are designed to work in a majority of installations. Some applications may require special components.
- Items in the kit not listed are not available for individual sale.
- Contact the factory or your Eclipse representative for more detailed information.

Brackets for Eclipse T500 Actuator

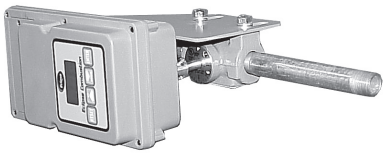
Bracket Item Code - see table above
Butterfly Valve with T500 actuator and bracket/coupling

T500 actuator can be mounted parallel or perpendicular to piping.

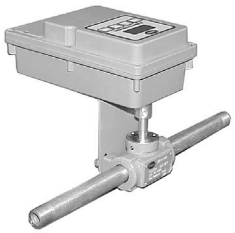
Accessories for Automatic BV's (continued)
Brackets for Eclipse PRA Rotary Actuator



Bracket Item Code 21695
Right hand mounting bracket for Eclipse Rotary Actuator



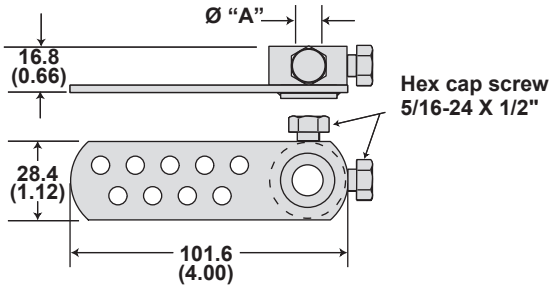
Bracket Item Code 21696
Left hand mounting bracket for Eclipse Rotary Actuator



Bracket Item Code 21934
for 1/2" to 1-1/2" valves
Bracket Item Code 21935
for 2" to 4" valves
Perpendicular mounting bracket for Eclipse Rotary Actuator

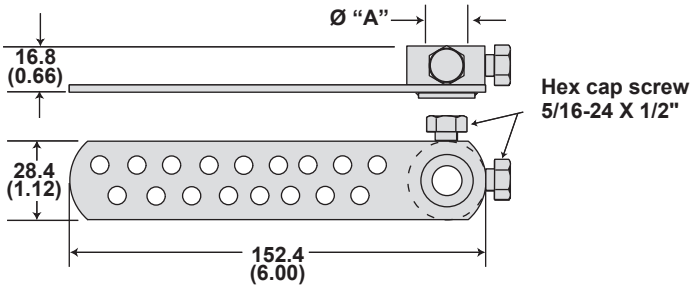
Crank Arms for General Use

Crank Arm Item Code	DIM "A"	
	mm	(in.)
500527	9.6	(0.380)
500535	12.8	(0.505)
500536	16.0	(0.630)



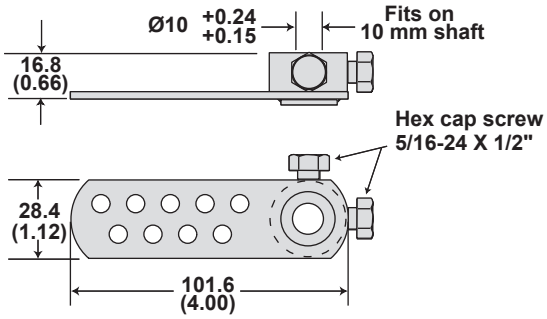
Materials: Zinc plated carbon steel

Crank Arm Item Code	DIM "A"	
	mm	(in.)
500537	16.0	(0.630)
500538	9.6	(0.380)
500539	12.8	(0.505)



Materials: Zinc plated carbon steel

Item Code 102265 **Dims: mm (in.)**



Materials: Zinc plated carbon steel

Linkage control rods

Zinc plated cold rolled steel				Stainless steel			
Dia. Inches	Item Code	Length mm	Length in	Dia. Inches	Item Code	Length mm	Length in
5/16	12730	203	(8)	1/2	10175-1	305	(12)
	12730-1	254	(10)		10175-2	381	(15)
	12730-2	381	(15)		10175-3	457	(18)
	12730-3	610	(24)		10175-4	610	(24)
	12730-5	152	(6)		10175-5	762	(30)
					10175-6	914	(36)
					10175-7	1219	(48)
					10175-8	1524	(60)
					10175-9	1829	(72)

Swivel Connectors for 5/16" Diameter Control Rods

Item Code 500558 is a rotating swivel block connector assembly for joining control rod to control arm. It allows 360° rotation.

Item Code 500569 serves to connect two control rods to one control arm and also allows 360° rotation.

Item Code 14316 swivel connector allows 360° rotation. It provides a 20° flex from the swivel center line to accommodate an angular approach of a linkage control rod, but immediacy of response is less positive than Item Code 14264 (at right).

Item Code 14264 is a non-flexing swivel connector that allows 360° rotation around swivel center line. It provides a more positive positioning and immediacy of response than Item Code 14316 (at left).

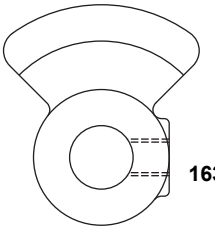
Swivel Connectors for 1/2" Diameter Control Rods

Item Code 500542 is a swivel block that rotates 360°.

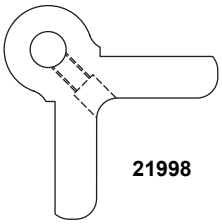
Item Code 500543 is a single ball swivel that rotates 360° while permitting an angular approach of rod toward control arm.

Item Code 500544 is a double ball swivel that connects two rods to one control arm. Allows angular approach of rod to arm, rotates 360°.

Cams for High/Low Fire Microswitch



1631/1632



21998

Item Code	Description
1631-1	3/8" Shaft
1631-3	10 mm Shaft
1631-2	1/2" Shaft
1632-1	5/8" Shaft
21998	10 mm Shaft

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Data 205-2
12/8/2010

Eclipse ThermJet

Burners

Model TJ0025

Version 2

Parameter	Burner Velocity		Model TJ0025
Maximum Input BTU/hr (kW)	Medium & High Velocity		250,000 (73)
Minimum Input, On-Ratio BTU/hr (kW)	Medium & High Velocity		25,000 (7.3)
Minimum Input, Fixed Air BTU/hr (kW)	Medium & High Velocity		6,250 (1.8)
Gas Inlet Pressure Required "w.c. (mbar) **Fuel Pressure at Gas Inlet** **(Tap "B" - see page 3)**	High Velocity	Natural Gas	14.0 (34.9)
		Propane	15.0 (37.3)
		Butane	15.0 (37.3)
	Medium Velocity	Natural Gas	6.8 (16.9)
		Propane	7.4 (18.4)
		Butane	7.0 (17.4)
Air Inlet Pressure Required "w.c. (mbar) **15% Excess Air at Maximum Input** **(Tap "A" - see page 3)**	High Velocity	Natural Gas	17.0 (42.3)
		Propane	18.0 (44.8)
		Butane	18.0 (44.8)
	Medium Velocity	Natural Gas	10.0 (24.9)
		Propane	10.0 (24.9)
		Butane	10.0 (24.9)
High Fire Flame Length Inches (mm) **(Measured from End of Combustor)**	High Velocity	Natural Gas	12.0 (305)
		Propane	12.0 (305)
		Butane	13.0 (330)
	Medium Velocity	Natural Gas	14.0 (356)
		Propane	14.0 (356)
		Butane	14.0 (356)
Maximum Flame Velocity ft/s (m/s) **15% Excess Air at Maximum Input**	High Velocity		500 (152.4)
	Medium Velocity		250 (76.2)
Maximum Combustion Air Temperature	300°F (149°C). For higher temperatures, use TJPCA (Data 206).		
Flame Detection	UV scanner and flamerod available for all combustors for application under 2,200°F (1,204°C). Flamerod available for all combustors.		
Fuel	Natural gas, propane, or butane. For any other mixed gas, contact Eclipse for orifice sizing.		
Approvals	AH30		

- All information is based on laboratory testing in neutral (0.0" w.c.) pressure chamber. Different chamber size and conditions may affect the data.
- All information is based on standard combustor design. Changes in combustor will alter performance and pressures.
- All inputs based upon gross calorific values.
- Eclipse reserves the right to change the construction and/or configuration of our products at any time without being obliged to adjust earlier supplies accordingly.
- Plumbing of air and gas will affect accuracy of orifice readings. All information is based on generally acceptable air and gas piping practices.

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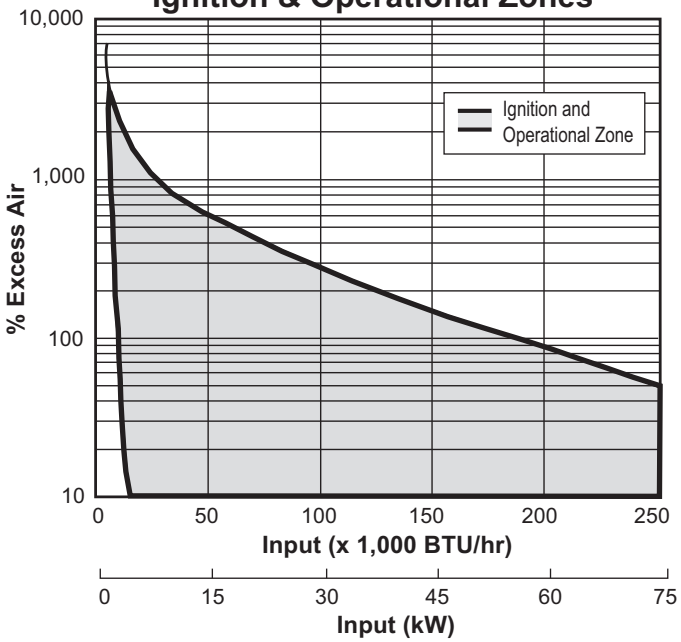
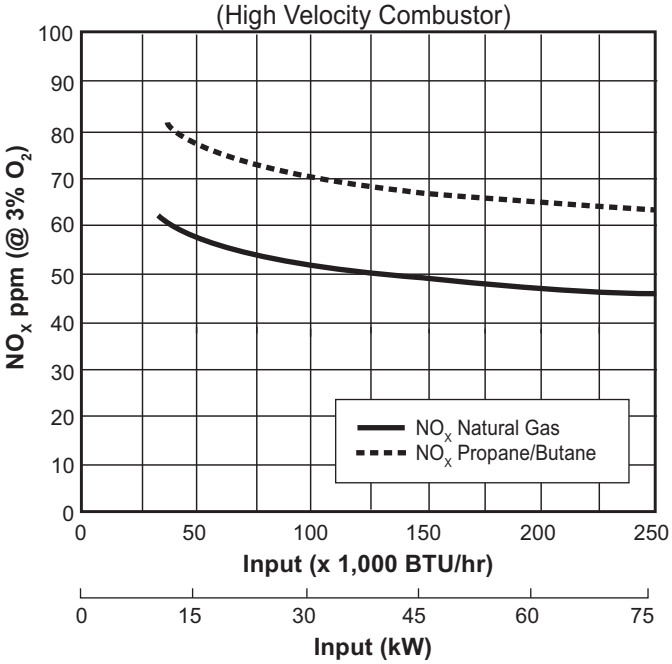
Performance Graphs

Ignition & Operational Zones



NO_x Emissions

(High Velocity Combustor)



Correction factor for medium velocity combustor is 1.20. Emissions data based on on-ratio control, firing 15% excess air, corrected to 3% O_2.

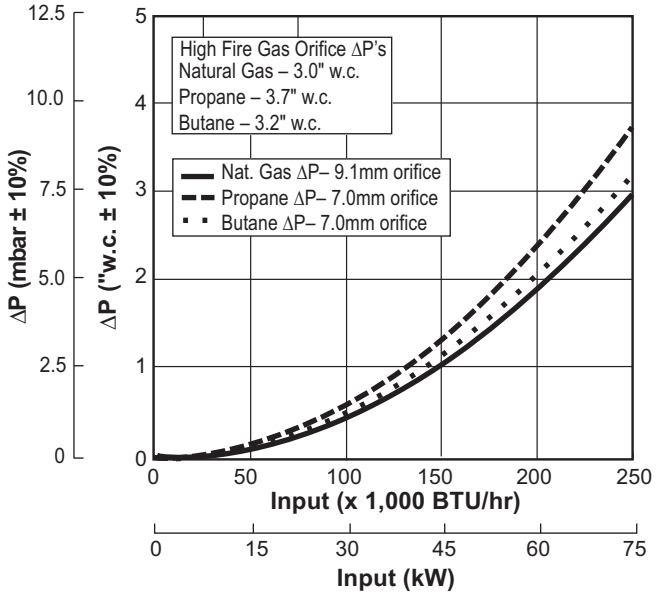
Emissions from the burner are influenced by:

- Fuel type
- Combustion air temperature
- Firing rate
- Chamber conditions
- Percent of excess air

For estimates of other emissions, contact Eclipse.

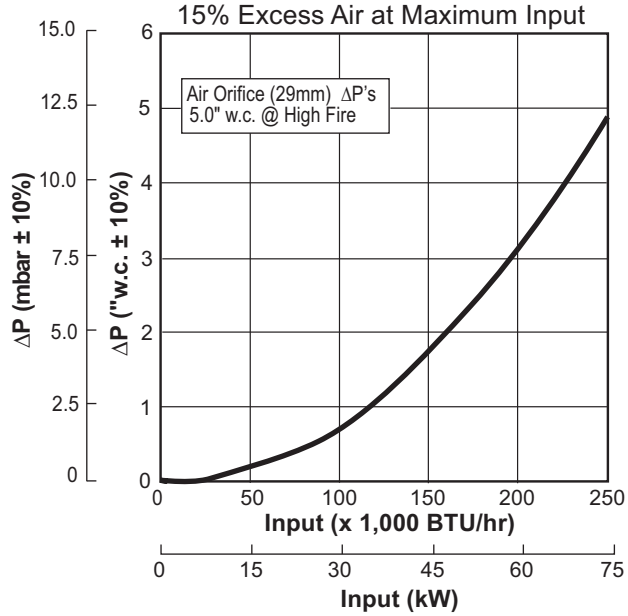
Gas Orifice ΔP vs. Input

(Measured from Tap B to Tap D)



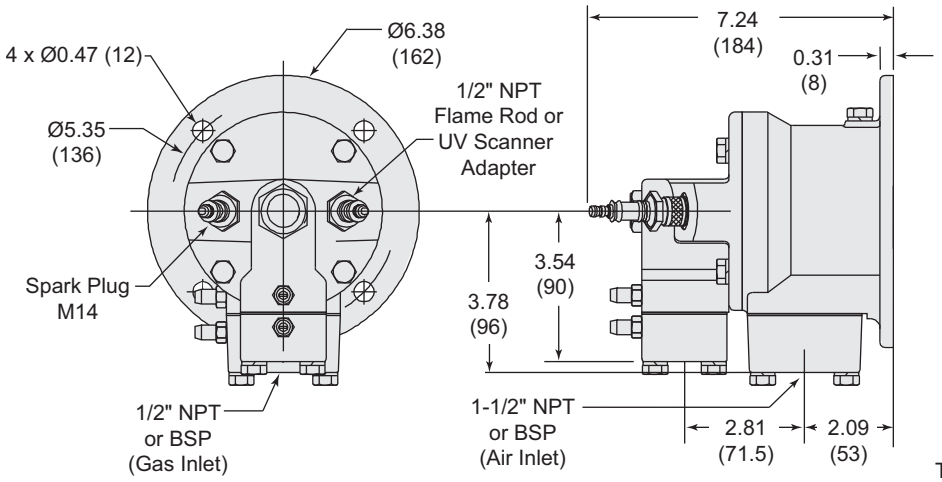
Air Orifice ΔP vs. Input

(Measured from Tap A to Tap C)
15% Excess Air at Maximum Input

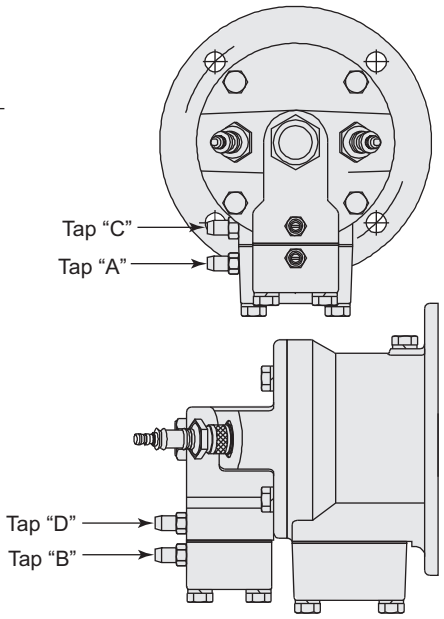


Dimensions in inches (mm)

Burner Housing



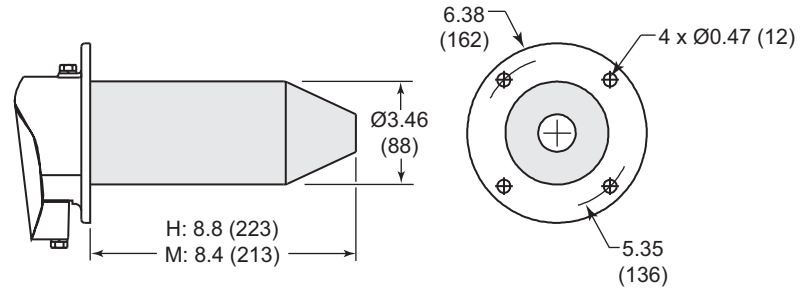
Tap Locations



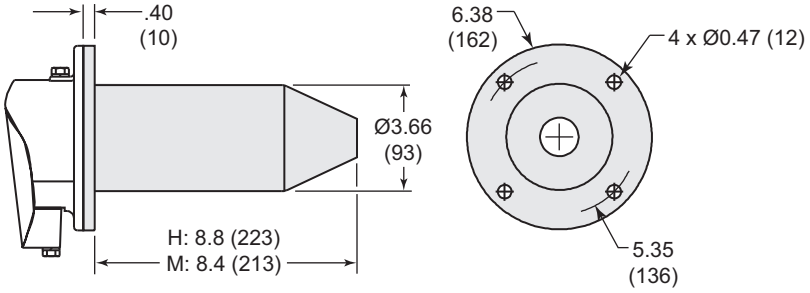
Burner weight less combustor: 17.9 lbs (8.1 kg)

Combustor

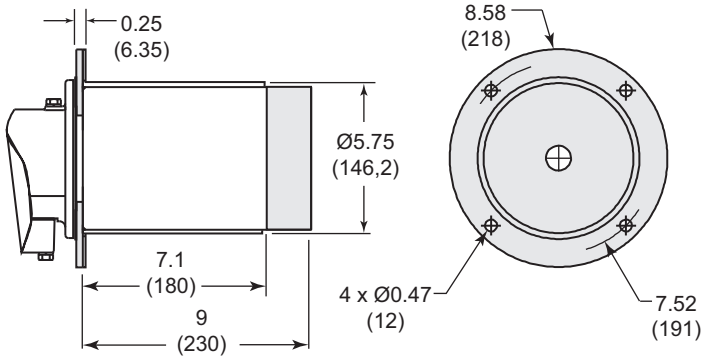
Exhaust Outlet Diameter: High Velocity(H): Ø1.26 (32)
Medium Velocity (M): Ø1.65 (42)



Alloy Tube (AISI 310)
Weight: 2.1 lbs (0.95 kg)
Max. Chamber Temp: 1,750°F (950°C)



Silicon Carbide Tube
Weight: 3.6 lbs (1.63 kg)
Max. Chamber Temp: 2,500°F (1371°C)



Refractory Block (w/330 SS wrapper)
Weight: 14 lbs (6.35 kg)
Max. Chamber Temp: 2,800°F (1538°C)

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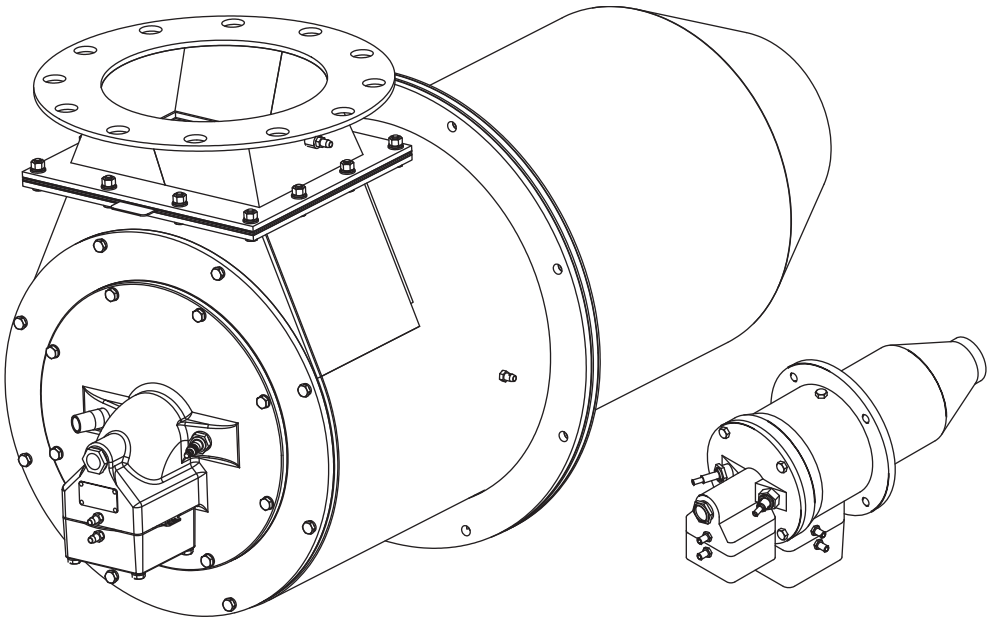
205 Design Guide
2/22/2010

Eclipse ThermJet

Burners

Models TJ0015 - TJ2000

Version 2



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In accordance with the manufacture's policy of continual product improvement, the product presented in this brochure is subject to change without notice or obligation.

The material in this manual is believed adequate for the intended use of the product. If the product is used for purposes other than those specified herein, confirmation of validity and suitability must be obtained. Eclipse warrants that the product itself does not infringe upon any United States patents. No further warranty is expressed or implied.

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Any operation expressly prohibited in this manual, any adjustment, or assembly procedures not recommended or authorized in these instructions shall void the warranty.

Document Conventions

There are several special symbols in this document. You must know their meaning and importance.

The explanation of these symbols follows below. Please read it thoroughly.

How To Get Help

If you need help, contact your local Eclipse representative. You can also contact Eclipse at:

1665 Elmwood Rd.
Rockford, Illinois 61103 U.S.A.
Phone: 815-877-3031
Fax: 815-877-3336
http://www.eclipsenet.com

Please have the information on the product label available when contacting the factory so we may better serve you.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

DANGER Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE Is used to address practices not related to personal injury.

NOTE Indicates an important part of text. Read thoroughly.

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Introduction 1

Product Description

The ThermJet is a nozzle-mix burner that is designed to fire an intense stream of hot gases through a combustor using ambient combustion air.

The high velocity of the gases improves temperature uniformity product quality and system efficiency.

The ThermJet Burner comes in two types:

- High Velocity (HV)
- Medium Velocity (MV)

The gas velocity can be as high as 500 ft/sec for the High Velocity burner and 250 ft/sec for the Medium Velocity burner.

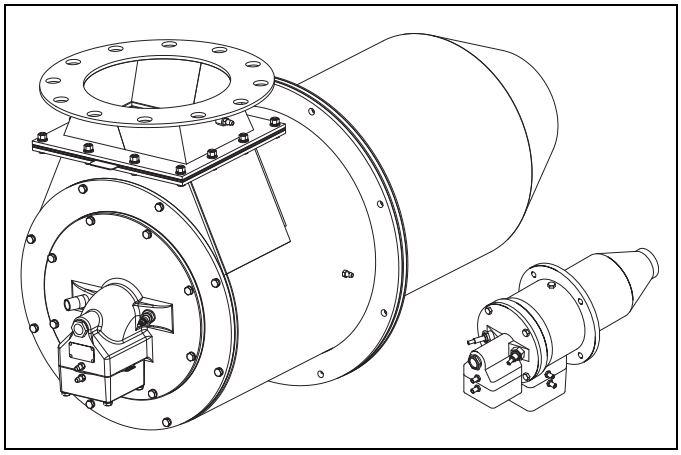


Figure 1.1. Eclipse ThermJet Burner

Audience

This manual has been written for people who are already familiar with all aspects of a nozzle-mix burner and its add-on components, also referred to as “the burner system”.

These aspects are:

- Design/Selection
- Use
- Maintenance

The audience is expected to have previous experience with this type of equipment.

Purpose

The purpose of this manual is to make sure that you carry out the installation of a safe, effective, and trouble-free system.

ThermJet Documents

Design Guide No. 205

- This document

Datasheet No. 205-1 through 205-13

- Available for individual TJ models
- Required to complete design calculations in this guide

Installation Guide No. 205

- Used with Datasheets to complete installation

Related Documents

- EFE 825 (Combustion Engineering Guide)
- Eclipse Bulletins and Information Guides: 610, 710, 720, 730, 742, 744, 760, 930

Safety

2

Important notices for safe burner operation can be found in this section. To avoid personal injury, damage to property or the facility, the following warnings must be observed. Read this entire manual before attempting to start the system. If any part of the information in this manual is not understood, contact Eclipse before continuing.

Safety Warnings

⚠ DANGER

- **The burners covered in this manual are designed to mix fuel with air and burn the resulting mixture. All fuel handling devices are capable of producing fires and explosions if improperly applied, installed, adjusted, controlled, or maintained.**
- **Do not bypass any safety feature; fire or explosion could result.**
- **Never try to light a burner if it shows signs of damage or malfunction.**

⚠ WARNING

- **The burner might have HOT surfaces. Always wear protective clothing when approaching the burner.**
- **Eclipse products are designed to minimize the use of materials that contain crystalline silica. Examples of these chemicals are: respirable crystalline silica from bricks, cement or other masonry products and respirable refractory ceramic fibers from insulating blankets, boards, or gaskets. Despite these efforts, dust created by sanding, sawing, grinding, cutting, and other construction activities could release crystalline silica. Crystalline silica is known to cause cancer, and health risks from the exposure to these chemicals vary depending on the frequency and length of exposure to these chemicals. To reduce this risk, limit exposure to these chemicals, work in a well-ventilated area and wear approved personal protective safety equipment for these chemicals.**

NOTICE

- **This manual provides information in the use of these burners for their specific design purpose. Do not deviate from any instructions or application limits described herein without written advice from Eclipse.**

Capabilities

Adjustment, maintenance and troubleshooting of the mechanical and the electrical parts of this system should be done by qualified personnel with good mechanical aptitude and experience with combustion equipment.

Operator Training

The best safety precaution is an alert and trained operator. Train new operators thoroughly and have them demonstrate an adequate understanding of the equipment and its operation. A regular retraining schedule should be administered to ensure operators maintain a high degree of proficiency.

Replacement Parts

Order replacement parts from Eclipse only. All Eclipse approved, customer supplied valves, or switches should carry UL, FM, CSA, CGA, and/or CE approval, where applicable.

System Design 3

Design

Designing a burner system is a straight-forward exercise of combining modules that add up to a reliable and safe system.

The design process is divided into the following steps:

1. Burner model selection:
   a. The burner size and quantity
   b. The flame velocity
   c. The fuel type and pressure
   d. The combustor type
2. Control methodology
3. Ignition system
4. Flame monitoring system
5. Combustion air system: blower & air pressure switch
6. Main gas shut-off valve train selection
7. Process temperature control system

Step 1: Burner Model Selection

Burner Size & Quantity

Select the size and number of burners based on the heat balance. For heat balance calculations, refer to the Combustion Engineering Guide (EFE 825).

Use the ThermJet Price List 205 and Datasheet series 205 for performance data, dimensions, and specifications.

Flame Velocity

Each burner size comes in two versions, High or Medium Velocity. Select the version needed based on requirements for temperature uniformity, circulation, chamber size, air pressure and overall operating costs.

Flame velocity information is available in Datasheets 205-1 through 205-13.

Fuel Type & Fuel Pressure

The usable fuel types are:

- Natural gas
- Propane
- Butane

For other fuels less than 800 Btu/ft (330 MJ/m^3) contact Eclipse with an accurate breakdown of the fuel contents.

The gas pressure must be at the minimum level shown.

The required gas pressure at the burner can be found in ThermJet Datasheets 205-1 through 205-13.

Combustor

The combustor that you choose depends on the temperature and the construction of the furnace.

The furnace temperature limits of the combustors can be found in ThermJet Datasheets 205-1 through 205-13.

⚠ CAUTION

- **For tangential firing furnaces, do not use alloy combustors.**

Step 2: Control Methodology

The control methodology is the basis for the rest of the design process. Once it is known what the system will look like, the components that are in it can be selected. The control methodology chosen depends on the type of process to be controlled.

NOTE: The stated operational characteristics only apply if the described control circuits are followed. Use of different control methods will result in unknown operational performance characteristics. Use the control circuits contained within this section or contact Eclipse for written, approved alternatives.

There are two main methods to control the input of a ThermJet system. Each of these methods also has two variants. These methods may be applied to single burner as well as multiple burner systems.

The methods and variants are:

1. Modulating control:
   a. Modulating gas & air, on-ratio control or excess air @ low fire on page 7.
   b. Modulating gas with fixed-air control on page 8.
2. High/low control:
   a. High/low air & gas control (pulse firing) on page 8.
   b. High/low gas with fixed-air control (Can also be used for pulse firing) on page 9.

NOTE: Use of a ratio regulator in a fixed-air system is optional. However, eliminating the ratio regulator will

adversely affect the ignition reliability at inputs greater than 40% of maximum.

Use of a ratio regulator in a fixed-air system also provides automatic gas modulation if system air flow changes over time (such as a clogged air filter).

In the pages that follow you will find schematics of these control methods. The symbols in the schematics are explained in the “Key to System Schematics” (see Appendix).

Automatic Gas Shut-Off by Burner or Shut-Off by Zone

The automatic gas shut-off valve can be installed in two operational modes:

1. Automatic Gas Shut-Off by Burner:

   If the flame monitoring system detects a failure, the gas shut-off valves close the gas supply to the burner that caused the failure.

2. Automatic Gas Shut-Off by Zone:

   If the flame monitoring system detects a failure, the gas shut-off valves close the gas supply to all the burners in the zone that caused the failure.

NOTE: All ThermJet control schematics on the following pages reflect a single gas automatic shut-off valve. This may be changed to conform to local safety and/or insurance requirements. (Refer to the ThermJet Installation Guide No. 205.)

Modulating Gas & Air On-ratio Control or Excess Air @ Low Fire (Figure 3.1)

A burner system with modulating control gives an input that is in proportion with the demands of the process. ANY input between high and low fire is possible.

1. Air:

   The control valve ❶ is in the air line. It can modulate air flow to any position between low and high fire air.

2. Gas:

   The ratio regulator ❷ allows the on-ratio amount of gas to go to the burner. Low fire gas is limited by the ratio regulator ❷. High fire gas is limited by the manual butterfly valve ❸.

NOTE: The ratio regulator can be biased to give excess air at low fire.

NOTE: Do not use an adjustable limiting orifice (ALO) as the high fire gas limiting valve ❸. ALO’s require too much pressure drop for use in a proportional system.

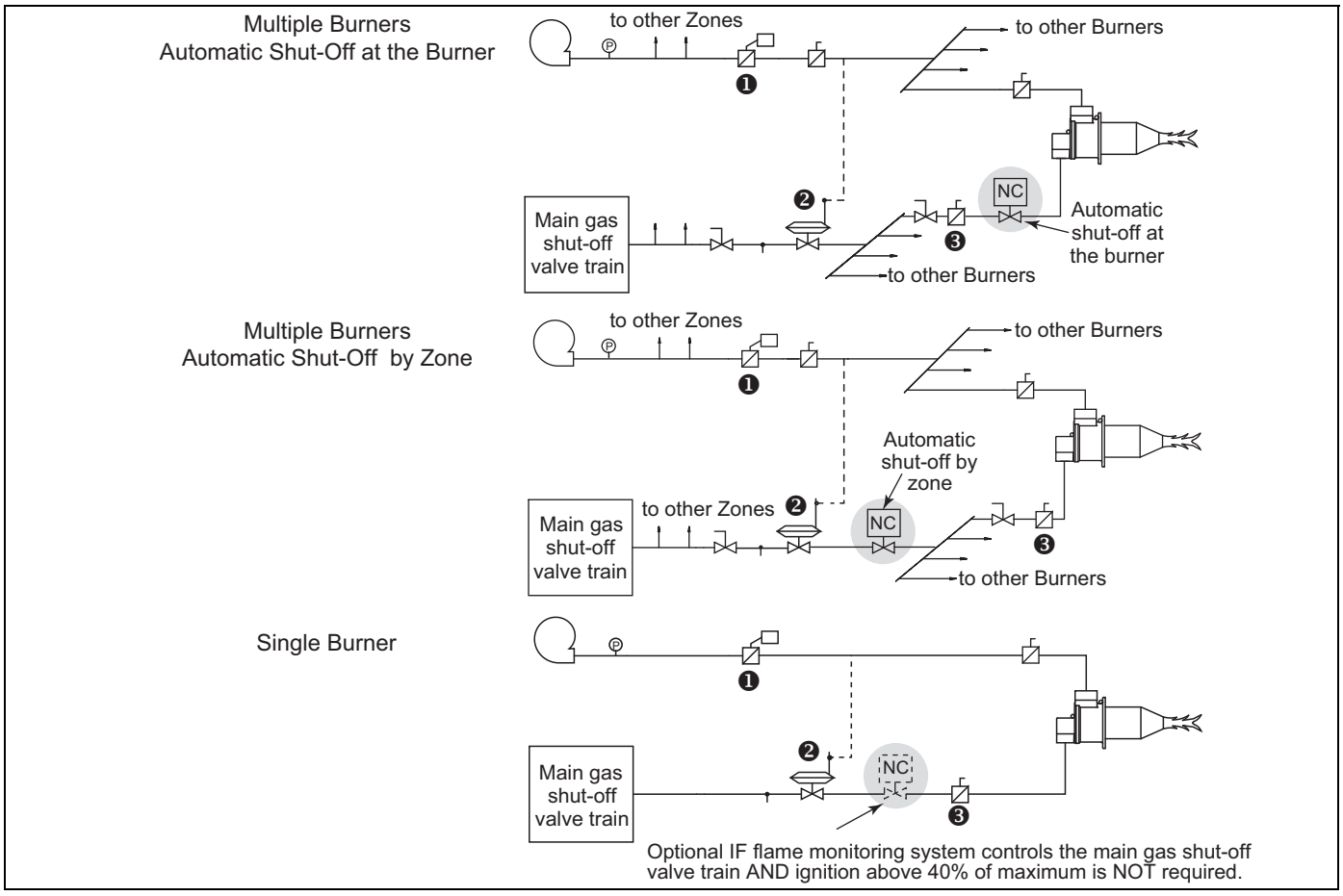


Figure 3.1 Modulating Gas & Air (On-Ratio Control or Excess Air @ Low Fire)

Modulating Gas with Fixed-Air Control (Figure 3.2)

A burner system with modulating control gives an input that is in proportion with the demands of the process. ANY input between high and low fire is possible.

1. Air:

   The amount of air to the burner is fixed.

2. Gas:

   The control valve ❶ is in the gas line. It can modulate to any position between low and high fire.

NOTE: Use of a ratio regulator ❷ in a fixed-air system is optional on a single burner system only. However, eliminating the ratio regulator will adversely affect the ignition reliability at inputs greater than 40% of maximum.

High/Low Air & Gas Control (Pulse Firing) (Figure 3.3)

A burner system with high/low control gives a high or low fire input to the process. No input between high and low fire is possible.

1. Air:

   a. Low fire: A control input closes the solenoid valve ❹. As a result the CRS valve ❺ quickly moves to low fire.

   b. High fire: A control input opens the solenoid valve ❹. As a result the CRS valve ❺ quickly moves to high fire.

2. Gas:

   a. Low fire: A control input closes the solenoid valve ❶. Low fire gas passes through the butterfly valve ❸.

   b. High fire:A control input opens the solenoid valve ❶.

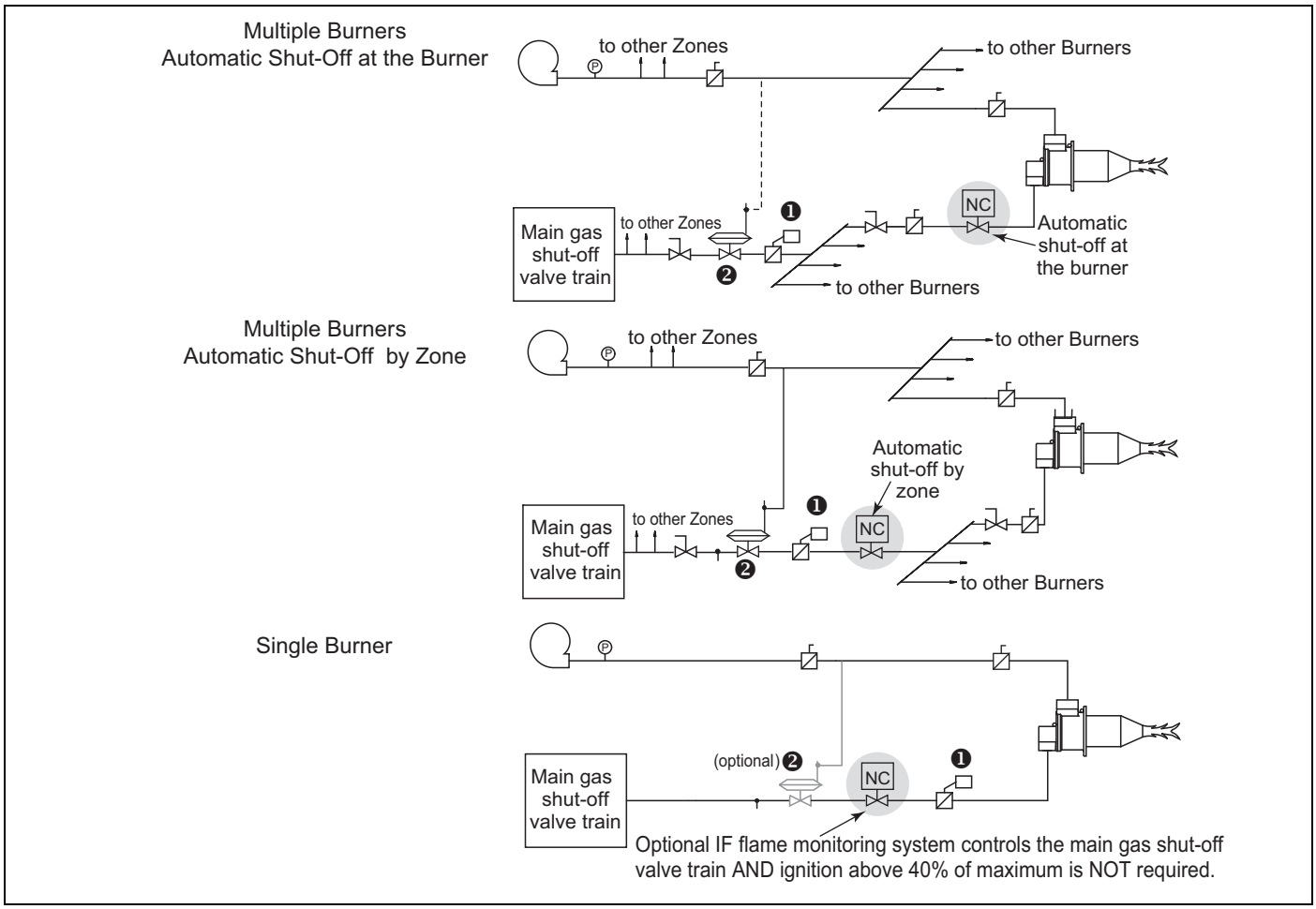


Figure 3.2 Modulating Gas with Fixed-Air Control

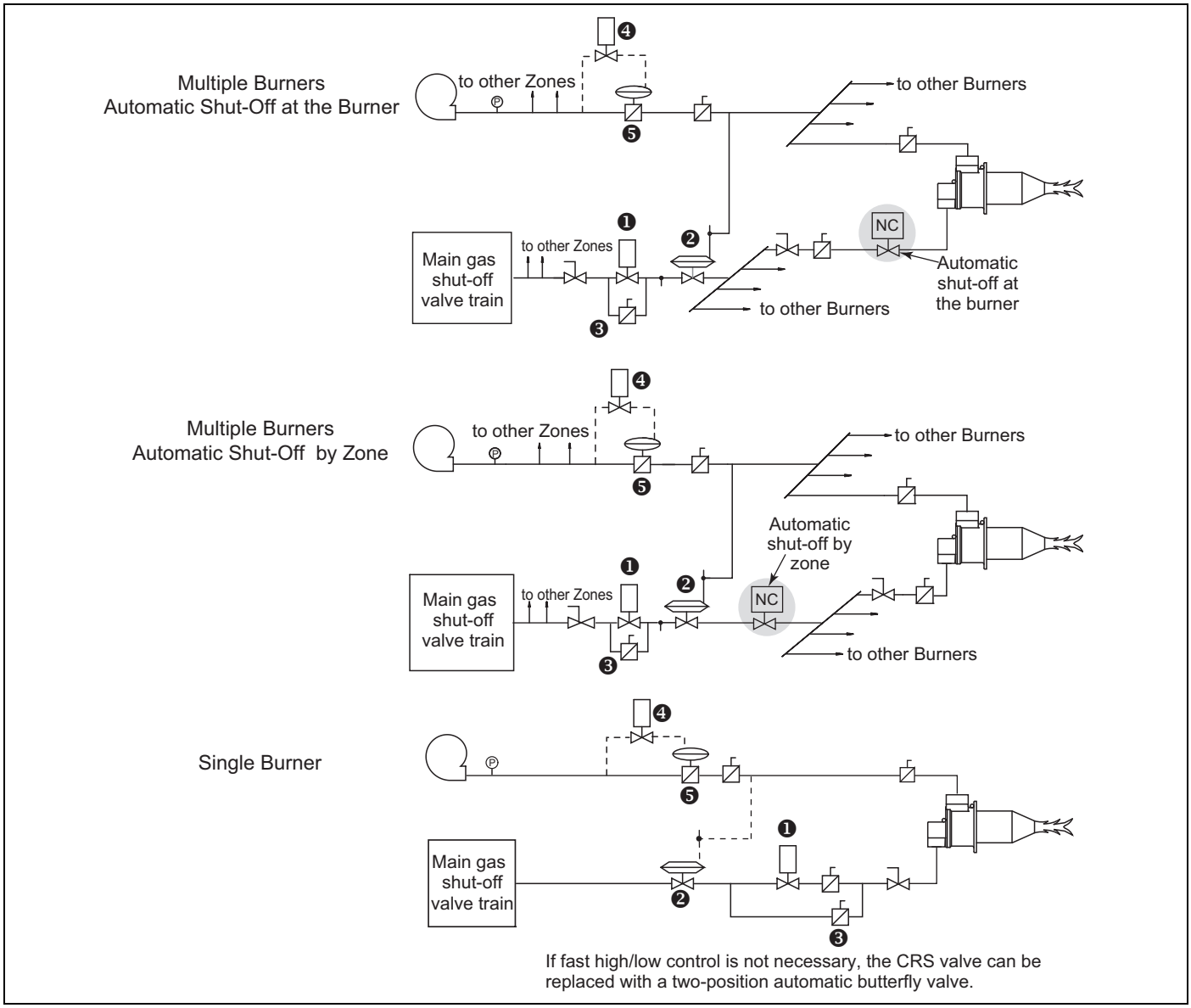


Figure 3.3 High/Low Air & Gas Control (Pulse Firing)

High/Low Gas with Fixed-Air Control

(Can also be used for pulse firing.)

A burner system with high/low control gives a high or a low input to the process. NO input between high and low fire is possible.

1. Air:

   The amount of air to the burner is fixed.

2. Gas:

   a. Low fire: A control input closes the solenoid valve ❶. Low fire gas passes through the butterfly valve ❸.

   b. High fire: A control input opens the solenoid valve ❶. High fire gas passes through the open solenoid valve ❶.

NOTE: Use of a ratio regulator ❷ in a fixed-air system is optional on a single burner system only. However, eliminating the ratio regulator will adversely affect the ignition reliability at inputs greater than 40% of maximum.

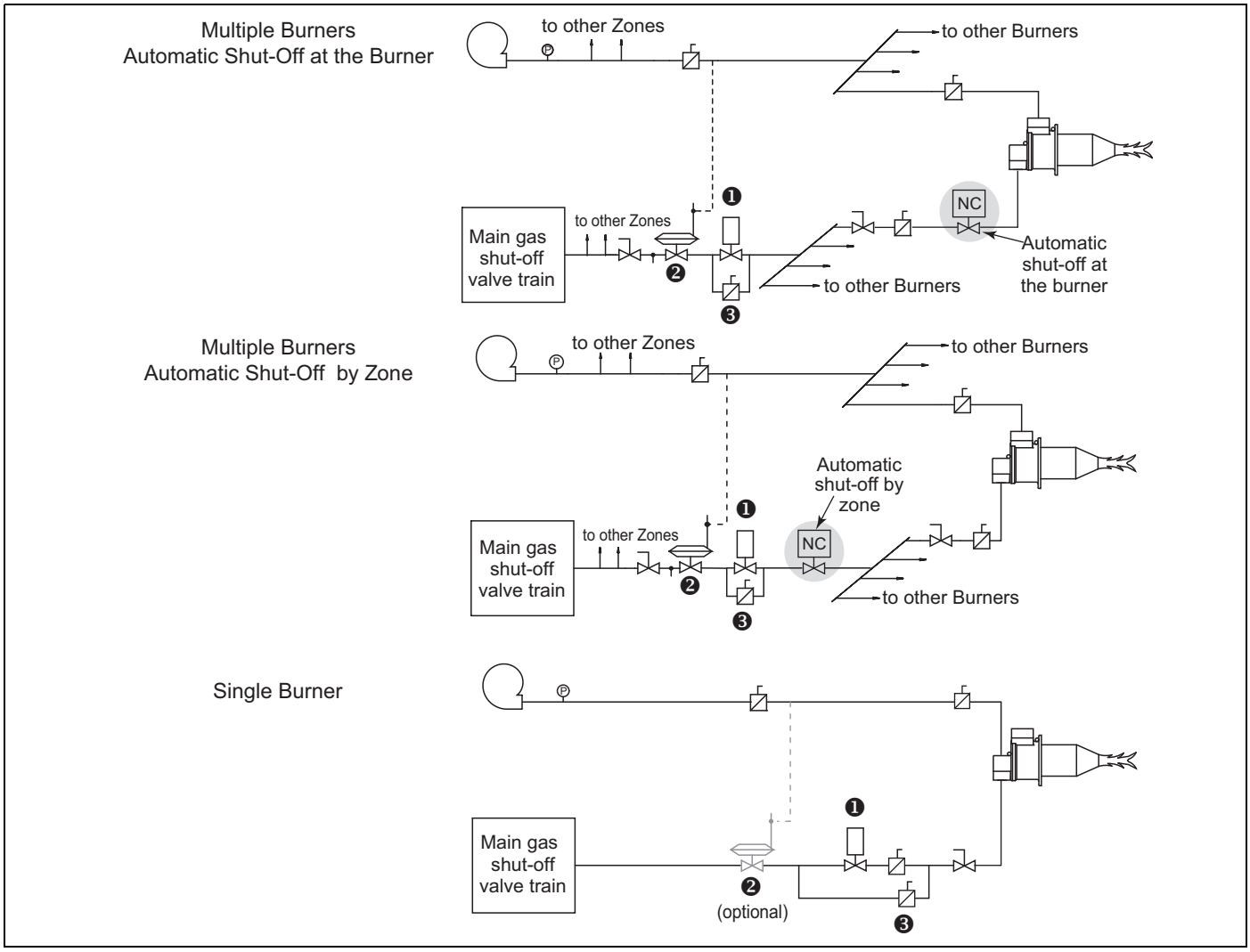


Figure 3.4 High/Low Gas with Fixed-Air Control

Step 3: Ignition System

For the ignition system use:

- 6,000 VAC transformer
- Full-wave spark transformer
- One transformer per burner

DO NOT USE:

- 10,000 VAC transformer
- Twin outlet transformer
- Distributor type transformer
- Half-wave transformer

It is recommended that low fire start be used, however, ThermJet burners are capable of direct spark ignition anywhere within the operating range.

NOTE: You must follow the control circuits described in the previous section, “Control Methodology,” to obtain reliable ignition.

Local safety and insurance require limits on the maximum trial for ignition time. These time limits vary from country to country.

The time it takes for a burner to ignite depends on:

- The distance between the gas shut-off valve and the burner.
- The air/gas ratio.
- The gas flow at start conditions.

It is possible to have the low fire too low to ignite within the trial for ignition period. Under these circumstances you must consider the following options:

- Start at higher input levels.
- Resize and/or relocate the gas controls.
- Use bypass start gas. (See the circuit schematics on the next page.)

Bypass Start Gas (Optional) (Figure 3.5)

A bypass start gas circuit provides gas flow around zone gas control valves during the trial for ignition period. This should only be used if excess air (proportional or fixed air control) is being used on low fire; it should NOT be used with on-ratio low fire systems.

During the trial for ignition period, the solenoid valve in the bypass line plus the automatic gas shut-off valve (either at each burner or each zone) are opened. If a flame is established, the bypass solenoid valve closes at the end of the trial for ignition period. If a flame is not established, then the bypass solenoid valve and the automatic gas shut-off valve close.

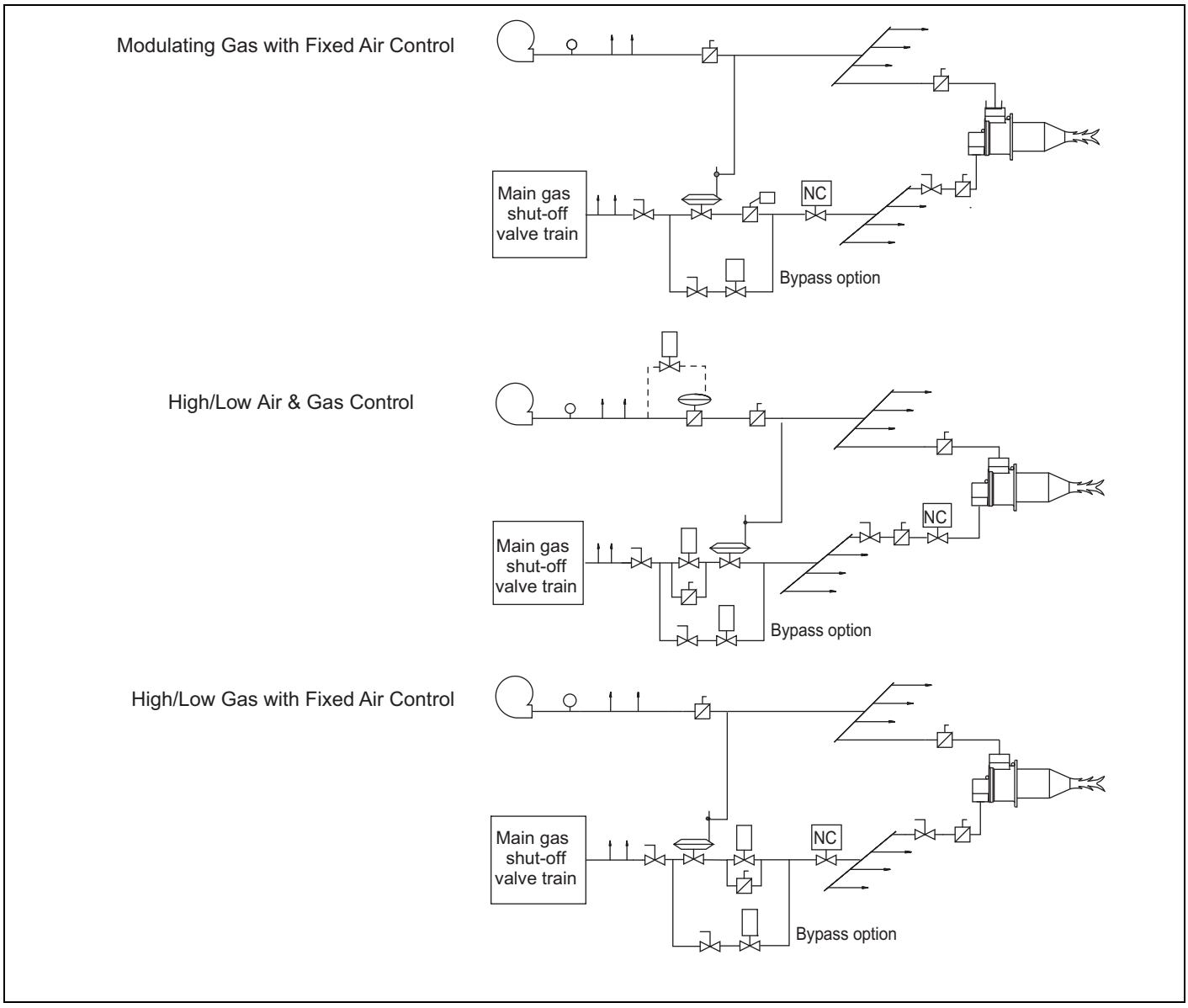


Figure 3.5 Bypass Start Gas Circuit Schematics

Step 4: Flame Monitoring System

A flame monitoring system consists of two main parts:

- A flame sensor
- Flame monitoring control

Flame Sensor

There are two types that you can use for a ThermJet burner:

- UV scanner
- Flame rod

A UV scanner can be used with all combustor types.

The UV scanner must be compatible to the flame monitoring control that is used. Refer to the manual of your selected control for proper selection of the scanner.

NOTE: Flame rod option is not available for the TJ300 and larger.

- The standard flame rod is used with natural gas and pre-heated air up to 300ºF.
- The high-grade flame rod is used with propane, butane, and preheated air up to 700ºF.

You can find more information in Info Guide 832.

Flame Monitoring Control

The flame monitoring control is the equipment that processes the signal from the flame rod or the UV scanner. For flame monitoring control you may select several options:

- Flame monitoring control for each burner (if one burner goes down, only that burner will be shut off)
- Multiple-burner flame monitoring control (if one burner goes down, all burners will be shut off)

Eclipse recommends the following:

- Trilogy series T400; see Instruction Manual 830
- Bi-flame series; see instruction manual 826
- Multi-flame series 6000; see Instruction Manual 820
- Veri-flame; see Instruction Manual 818

If other controls are considered, contact Eclipse to determine how burner performance may be affected. Flame monitoring controls that have lower sensitivity flame detecting circuits may limit burner turndown and change the requirements for ignition. Flame monitoring controls that stop the spark as soon as a signal is detected may prevent establishment of flame, particularly when using UV scanners. The flame monitoring control must maintain the spark for a fixed time interval that is long enough for ignition.

DO NOT USE the following:

- Flame monitoring relays which interrupt the trial for ignition when the flame is detected
- Flame sensors which supply a weak signal
- Flame monitoring relays with low sensitivity

⚠ WARNING

- **A UV scanner can possibly detect another burner's flame if it is in the line of sight, and falsely indicate flame presence. Use a flame rod in this situation. This helps prevent accumulation of unburned fuel which, in extreme situations, could cause a fire or an explosion.**

Step 5: Combustion Air System: Blower & Air Pressure Switch

Effects of Atmospheric Conditions

The blower data is based on the International Standard Atmosphere (ISA) at Mean Sea Level (MSL), which means that it is valid for:

- Sea level
- 29.92" Hg (1,013 mbar)
- 70ºF (21ºC)

The makeup of the air is different above sea level or in a hot area. The density of the air decreases, and as a result, the outlet pressure and the flow of the blower decrease. An accurate description of these effects is in the Eclipse Combustion Engineering Guide (EFE 825). The Guide contains tables to calculate the effect of pressure, altitude and temperature on air.

Blower

The rating of the blower must match the system requirements. You can find all the blower data in: Bulletin/ Info Guide 610.

Follow these steps:

1. Calculate the outlet pressure.

   When calculating the outlet pressure of the blower, the total of these pressures must be calculated.

   - The static air pressure required at the burner
   - The total pressure drop in the piping
   - The total of the pressure drops across the valves
   - The pressure in the chamber (suction or pressurized)
   - Recommend a minimum safety margin of 10%

2. Calculate the required flow:

   The blower output is the air flow delivered under standard atmospheric conditions. It must be enough to feed all the burners in the system at high fire.

Combustion air blowers are normally rated in terms of standard cubic feet per hour (SCFH) of air. An example calculation follows the informations tables below:

Table 3.1 Required Calculation Information

Description	Unit of Measure	Formula Symbol
Number of burners	-	-
Type of fuel	-	-
Gross heating value of fuel	Btu/ft^3 (MJ/m^3)	q
Desired excess air percentage (Typical excess air percentage @ high fire is 15%)	percent	%
Air/Gas ratio (Fuel specific, see table below)	-	α
Air flow	scfh (Nm^3/hr)	V_{air}
Gas flow	scfh (Nm^3/hr)	V_{gas}

Table 3.2 Fuel Gas Heating Values

Fuel Gas	Stoichiometric* Air/Gas Ratio α(ft^3_{air}/ft^3_{gas})	Gross Heating Value q (Btu/ft^3)
Natural Gas (Birmingham, AL)	9.41	1,002 (40 MJ/m^3)
Propane	23.82	2,564 (102,5 MJ/m^3)
Butane	30.47	3,333(133,3 MJ/m^3)

*Stoichiometric: No excess air. The precise amount of air and gas are present for complete combustion.

Example Blower Calculation

A batch furnace requires a gross heat input of 2,900,000 Btu/hr (based on 45% efficiency). The designer decides to provide the required heat input with four burners operating on natural gas using 15% excess air.

Calculation Example:

a. Decide which ThermJet burner model is appropriate:

$$\frac{\text{Q (total heat input) of 2,900,000 Btu/hr}}{\text{4 burners}} = \frac{\text{725,000}}{\text{Btu/hr/burner}}$$

- Select 4 model TJ0075 ThermJet burners based on the required heat input of 725,000 Btu/hr for each burner.

b. Calculate required gas flow:

$$V_{gas} = \frac{Q}{q} = \frac{2{,}900{,}000 \text{ Btu/hr}}{1{,}002 \text{ Btu/ft}^3} = 2{,}894 \text{ ft}^3\text{/hr}$$

- Gas flow of 2,894 ft^3/hr is required.

c. Calculate required stoichiometric air flow:

$$V_{air\text{-}stoichiometric} = \alpha \text{ (air/gas ratio)} \times V_{gas}$$

$$= 9.41 \times 2{,}894 \text{ ft}^3\text{/hr} = 27{,}235 \text{ ft}^3\text{/hr}$$

- Stiochiometric air flow of 27,235 SCFH required.

d. Calculate final blower air flow requirement based on the desired amount of excess air:

$$V_{air} = (1 + \text{excess air\%}) \times V_{air\text{-}stoichiometric}$$

$$= (1 + 0.15) \times 27{,}235 \text{ ft}^3\text{/hr} = 31{,}320 \text{ ft}^3\text{/hr}$$

- For this example, final blower air flow requirement is 31,320 SCFH at 15% excess air.

NOTE: It is common practice to add an additional 10% to the final blower air flow requirement as a safety margin.

1. Find the blower model number and motor horsepower (hp). With the output pressure and the specific flow, you can find the blower catalog number and the motor hp in Bulletin 610.
2. Eclipse recommends that you select a totally enclosed fan cooled (TEFC) motor.
3. Select the other parameters:
   - inlet filter or inlet grille
   - Inlet size (frame size)
   - voltage, number of phases, frequency
   - blower outlet location, and rotation direction clockwise (CW) or counter-clockwise (CCW).

NOTE: The use of an inlet air filter is strongly recommended. The system will perform longer and the settings will be more stable.

NOTE: When selecting a 60 Hz Blower for use on 50 Hz, a pressure and capacity calculation is required. See Eclipse Engineering Guide (EFE 825).

The total selection information you should now have:

- blower model number
- motor hp
- motor enclosure (TEFC)
- voltage, number of phases, frequency
- outlet position and rotation direction (CW or CCW)

Air Pressure Switch

The air pressure switch gives a signal to the monitoring system when there is not enough air pressure from the blower. You can find more information on pressure switches in Blower Bulletin 610.

WARNING

- **Eclipse supports NFPA and EN regulations, which require the use of an air pressure switch in conjunction with other safety components, as a minimum standard for main gas safety shut-off systems.**

Step 6: Main Gas Shut-Off Valve Train

Consult Eclipse

Eclipse can help you design and obtain a main gas shut-off valve train that complies with the current safety standards.

The shut-off valve train must comply with all the local safety standards set by the authorities that have jurisdiction.

For details, please contact your local Eclipse representative or Eclipse.

NOTE: Eclipse supports NFPA regulations (two shut-off valves) as a minimum standard for main gas safety shut-off systems.

Step 7: Process Temperature Control System

The process temperature control system is used to control and monitor the temperature of the system. There is a wide variety of control and measuring equipment available.

For details, please contact your Eclipse.

Appendix

Conversion Factors

Metric to English

From	To	Multiply By
cubic meter (m^3)	cubic foot (ft^3)	35.31
cubic meter/hr (m^3/h)	cubic foot/hr (cfh)	35.31
degrees Celsius (°C)	degrees Fahrenheit (°F)	(°C x 9/5) + 32
kilogram (kg)	pound (lb)	2.205
kilowatt (kW)	BTU/hr	3414
meter (m)	foot (ft)	3.28
millibar (mbar)	inches water column ("w.c.)	0.401
millibar (mbar)	pounds/sq in (psi)	14.5×10^{-3}
millimeter (mm)	inch (in)	3.94×10^{-2}
MJ/Nm^3	BTU/ft^3 (standard)	2.491×10^{-2}

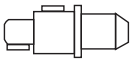
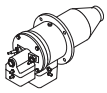
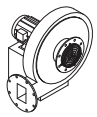
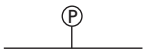
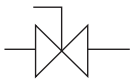
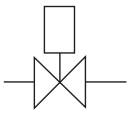
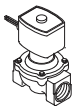
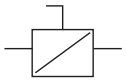
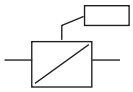
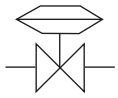
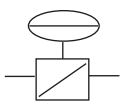
Metric to Metric

From	To	Multiply By
kiloPascals (kPa)	millibar (mbar)	10
meter (m)	millimeter (mm)	1000
millibar (mbar)	kiloPascals (kPa)	0.1
millimeter (mm)	meter (m)	0.001

English to Metric

From	To	Multiply By
BTU/hr	kilowatt (kW)	0.293×10^{-3}
cubic foot (ft^3)	cubic meter (m^3)	2.832×10^{-2}
cubic foot/hour (cfh)	cubic meter/hour (m^3/h)	2.832×10^{-2}
degrees Fahrenheit (°F)	degrees Celsius (°C)	(°F - 32) ÷ 5/9
foot (ft)	meter (m)	0.3048
inch (in)	millimeter (mm)	25.4
inches water column ("w.c.)	millibar (mbar)	2.49
pound (lb)	kilogram (kg)	0.454
pounds/sq in (psi)	millibar (mbar)	68.95
BTU/ft^3 (standard)	MJ/Nm^3	40.14

Key to System Schematics

Symbol	Appearance	Name	Remarks	Bulletin/ Info Guide
		ThermJet Burner		
		Main Gas Shut-Off Valve Train	Eclipse strongly endorses NFPA as a minimum.	756
		Combustion Air Blower	The combustion air blower provides the combustion air pressure to the burner(s).	610
		Air Pressure Switch	The air pressure switch gives a signal to the safety system when there is not enough air pressure from the blower.	610
		Gas Cock	Gas cocks are used to manually shut off the gas supply on both sides of the main gas shut-off valve train.	710
		Solenoid Valves (normally closed)	Solenoid valve automatically shut off the gas supply on a bypass gas system or on small capacity burner systems.	760
		Manual Butterfly Valve	Manual butterfly valves are used to balance the air or gas flow at each burner, and/or to control the zone flow.	720
		Automatic Butterfly Valve	Automatic butterfly valves are typically used to set the output of the system.	720
		Ratio Regulator	A ratio regulator is used to control the air/gas ratio. The ratio regulator is a sealed unit that adjusts the gas flow in ratio with the air flow. To do this, it measures the air pressure with a pressure sensing line, the impulse line. This impulse line is connected between the top of the ratio regulator and the air supply line. The cap must stay on the ratio regulator after adjustment.	742
		CRS Valve	A CRS valve is used in a high/low time-proportional control system to quickly open and close the air supply.	744
		Pressure Taps	The schematics show the advised positions of the pressure taps.	
		Impulse Line	The impulse line connects the ratios regulator to the air supply line.	

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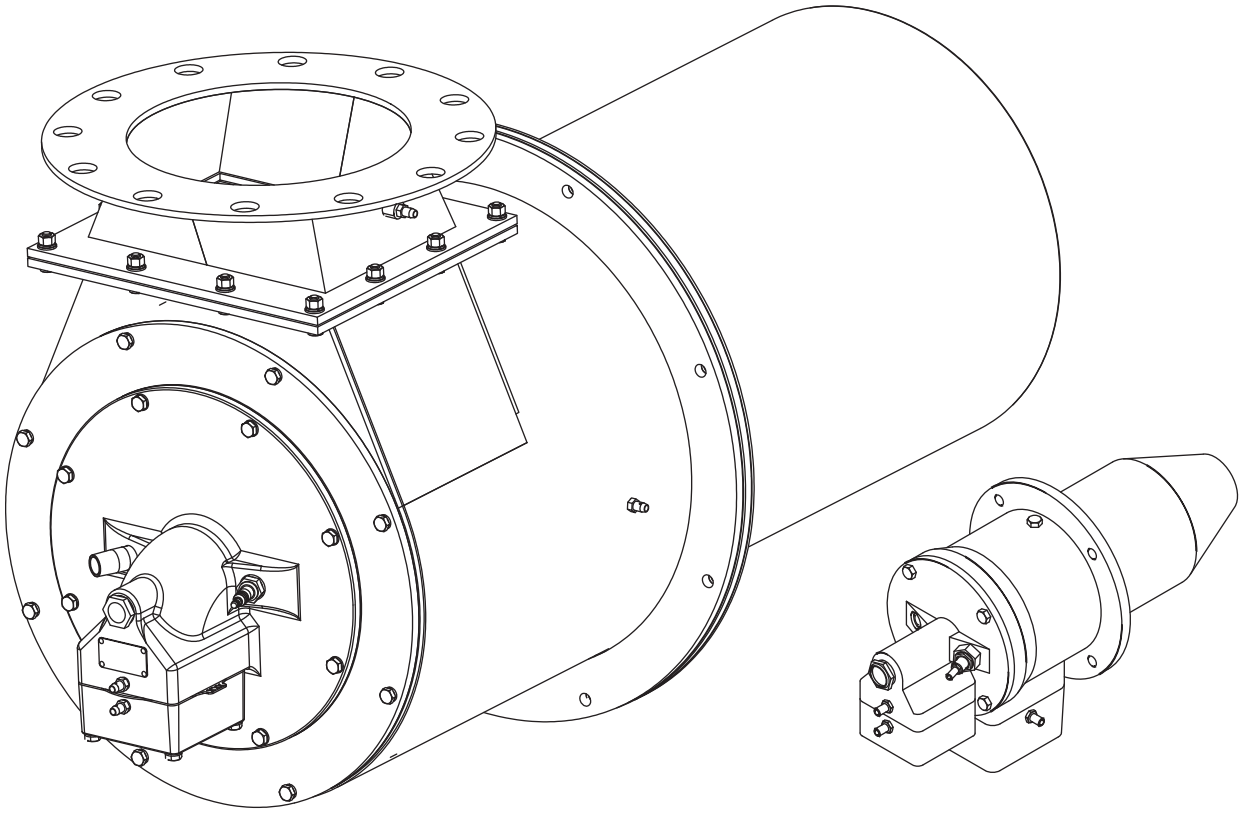
Installation Guide 205
1/21/2011

Eclipse ThermJet

Burners

Models TJ0015 - TJ2000

Version 2



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The material in this manual is believed adequate for the intended use of the product. If the product is used for purposes other than those specified herein, confirmation of validity and suitability must be obtained. Eclipse warrants that the product itself does not infringe upon any United States patents. No further warranty is expressed or implied.

Liability & Warranty

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Any operation expressly prohibited in this manual, any adjustment, or assembly procedures not recommended or authorized in these instructions shall void the warranty.

Document Conventions

There are several special symbols in this document. You must know their meaning and importance.

The explanation of these symbols follows below. Please read it thoroughly.

How To Get Help

If you need help, contact your local Eclipse representative. You can also contact Eclipse at:

1665 Elmwood Rd.
Rockford, Illinois 61103 U.S.A.
Phone: 815-877-3031
Fax: 815-877-3336
http://www.eclipsenet.com

Please have the information on the product label available when contacting the factory so we may better serve you.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

DANGER Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE Is used to address practices not related to personal injury.

NOTE Indicates an important part of text. Read thoroughly.

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Introduction 1

Product Description

The ThermJet is a nozzle-mix burner that is designed to fire an intense stream of hot gases through a combustor using ambient combustion air.

The high velocity of the gases improves temperature uniformity, product quality and system efficiency.

The ThermJet burner comes in two types:

- High Velocity (HV)
- Medium Velocity (MV)

The gas velocity can be as high as 500 ft/s for the High Velocity burner, and 250 ft/s for the Medium Velocity burner.

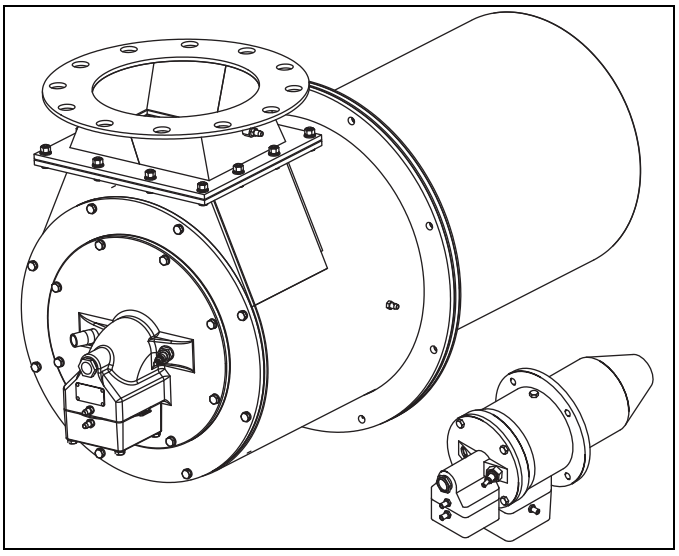


Figure 1.1. ThermJet Burner

Audience

This manual has been written for people who are already familiar with all aspects of a nozzle-mix burner and its add-on components, also referred to as “the burner system”.

These aspects are:

- Installation
- Use
- Maintenance

The audience is expected to have previous experience with this type of equipment.

ThermJet Documents

Installation Guide No. 205

- This document

Datasheet, Series No. 205-1 through 205-13

- Available for individual ThermJet models
- Required to complete installation

Design Guide No. 205

- Used with Datasheet to complete installation

Related Documents

- EFE 825 (Combustion Engineering Guide)
- Eclipse Bulletins and Info Guides: 610, 710, 720, 730, 742, 744, 760, 930, I-354

Purpose

The purpose of this manual is to ensure that you carry out the installation of a safe, effective, and trouble free combustion system.

Safety

2

Important notices about safe burner operation will be found in this section. Read this entire manual before attempting to start the system. If any part of the information in this manual is not understood, contact Eclipse before continuing.

Safety

DANGER

- **The burners covered in this manual are designed to mix fuel with air and burn the resulting mixture. All fuel burning devices are capable of producing fires and explosions when improperly applied, installed, adjusted, controlled or maintained.**
- **Do not bypass any safety feature. Fires and explosions can be caused.**
- **Never try to light the burner if the burner shows signs of damage or malfunctioning.**

WARNING

- **The burner might have HOT surfaces. Always wear protective clothing when approaching the burner.**
- **Eclipse products are designed to minimize the use of materials that contain crystalline silica. Examples of these chemicals are: respirable crystalline silica from bricks, cement or other masonry products and respirable refractory ceramic fibers from insulating blankets, boards, or gaskets. Despite these efforts, dust created by sanding, sawing, grinding, cutting, and other construction activities could release crystalline silica. Crystalline silica is known to cause cancer, and health risks from the exposure to these chemicals vary depending on the frequency and length of exposure to these chemicals. To reduce this risk, limit exposure to these chemicals, work in a well-ventilated area and wear approved personal protective safety equipment for these chemicals.**

NOTICE

- **This manual provides information in the use of these burners for their specific design purpose. Do not deviate from any instructions or application limits described herein without written advice from Eclipse.**
- **Read entire manual before attempting to start this system. If you do not understand any part of the information contained in this manual, contact Eclipse before continuing.**

Capabilities

Adjustment, maintenance and troubleshooting of the mechanical and the electrical parts of this system should be done by qualified personnel with good mechanical aptitude and experience with combustion equipment.

Operator Training

The best safety precaution is an alert and trained operator. Train new operators thoroughly and have them demonstrate an adequate understanding of the equipment and its operation. A regular retraining schedule should be administered to ensure operators maintain a high degree of proficiency.

Replacement Parts

Order replacement parts from Eclipse only. All Eclipse approved, customer supplied valves or switches should carry UL, FM, CSA, CGA, and/or CE approval, where applicable.

Installation 3

In this section you will find the information and instructions that you need to install the burner.

Handling

- Make sure that the area is clean.
- Protect the components from the weather, damage, dirt and moisture.
- Protect the components from excessive temperatures and humidity.
- Take care not to drop or damage components.

Storage

- Make sure that the components are clean and free of damage.
- Store the components in a cool, clean, dry room.
- After you have made sure that everything is present and in good condition, keep the components in the original package as long as possible.

NOTICE

- **When the refractory combustion block is supplied with the burner, it is critical that the instructions for handling and storage are followed. The refractory should be considered fragile; improper handling and storage will cause premature failure.**

Position of Components

The position and amount of components are determined by the kind of control method chosen. All the control methods can be found in Design Guide 248. Follow one of the schematics in the System Design chapter to build your system.

Approval of Components

Limit Controls & Safety Equipment

All limit controls and safety equipment must comply with all applicable local codes and/or standards and must be listed for combustion safety by an independent testing agency. Typical application examples include:

- American: NFPA 86 with listing marks from UL, FM, CSA
- European: EN 746-2 with CE mark from TuV, Gastec, Advantica

Electrical Wiring

All the electrical wiring must comply with all applicable local codes and/or standards such as:

- NFPA Standard 70
- IEC60364
- CSA C22
- BS7671

Gas Piping

All the gas piping must comply with all applicable local codes and/or standards such as:

- NFPA Standard 54
- ANSI Z223
- EN 746-2

Where to Get the Standards:

The NFPA Standards are available from:
National Fire Protection Agency
Batterymarch Park
Quincy, MA 02269
www.nfpa.org

The ANSI Standards are available from:
American National Standard Institute
1430 Broadway
New York, NY 10018
www.ansi.org

The UL Standards are available from:
333 Pfingsten Road
Northbrook, IL 60062
www.ul.com

The FM Standards are available from:
1151 Boston-Providence Turnpike
PO Box 9102
Norwood, MA 02062
www.fmglobal.com/approvals

Information on the EN standards and where to get them is available from:
Comité Européen de Normalisation
Stassartstraat 36
B-1050 Brussels
Phone: +32-25196811
Fax: +32-25196819
www.cen.eu

Comité Européen de Normalisation Electronique
Stassartstraat 36
B-1050 Brussels
Phone: +32-25196871
Fax: +32-25196919
www.cenelec.org

Checklist Before Installation

Intake

To admit fresh combustion air from outdoors, provide an opening in the room of at least one square inch per 4,000 BTU/hr. If there are corrosive fumes or materials in the air, then supply the burner with clean air from an uncontaminated area, or provide a sufficient air filtering system.

Exhaust

Do not allow exhaust to accumulate in the work area. Provide some positive means for exhausting them from the furnace and the building.

Access

Make sure that you install the burner in such a way that you can get easy access for inspection and maintenance.

Environment

Make sure the local environment matches the original operating specifications. Check the following items:

- Voltage, frequency and stability of the electrical power
- Type and supply pressure of the fuel
- Availability of enough fresh, clean combustion air
- Humidity, altitude and temperature of air
- Presence of damaging corrosive gases in the air

Prepare the Burner

Several components must be installed on a burner before it can operate. Installation instructions follow.

It is possible to change the relative position of the gas inlet with respect to the air inlet. This can be convenient for the routing of the piping.

Rotate the Rear Cover (Optional)

To rotate the rear cover, do the following (see Figure 3.1):

1. Disconnect the piping at a union in the piping or the inlet flanges ❶ provided on the burner.

NOTE: Be careful not to lose or damage the orifice plate or the o-rings.

2. Remove the four bolts ❷.
3. Remove the rear cover ❸ from the burner housing ❹.
4. Rotate the rear cover ❸ to the position that you want.
5. Put the rear cover ❸ in position against the burner housing ❹.
6. Install the four bolts ❷.
7. Reconnect the piping. Make sure that the o-rings show no signs of damage.

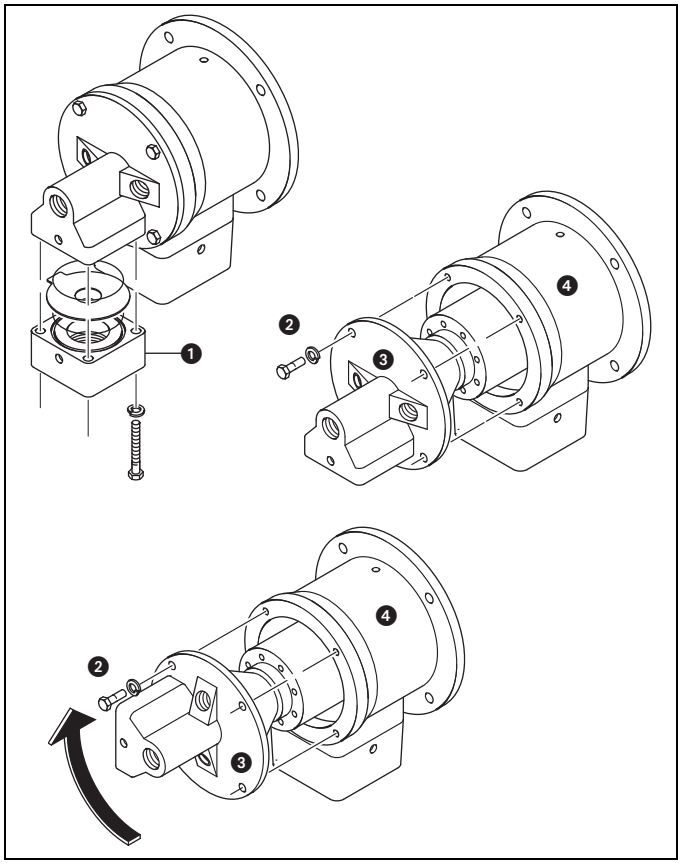


Figure 3.1. Rotate the Rear Cover

Installing the Flame Sensor

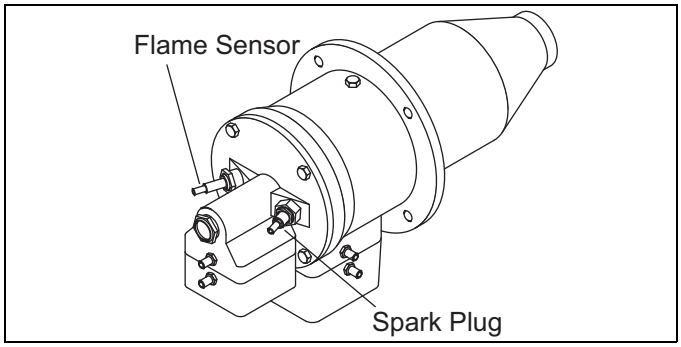


Figure 3.2. Installing the Flame Sensor

1. Install the flame sensor into the 1/2" NPT opening in the rear cover.

2. Make sure that you connect the flame sensor of a burner to the electrical circuit of that burner.

⚠ DANGER

- **If you connect the flame sensor of a burner to the electrical circuit of the wrong burner, then you can cause fires and explosions.**

There are two different types of flame sensors; UV scanner and flamerod.

NOTICE

- **Adjustments may vary from Eclipse published values if the flame controls other than those recommended in the Design Guide are used. Consult with the engineer who specified the alternate control for limitations.**

UV Scanner

For detailed information on how to install and connect a UV scanner, refer to scanner information guide.

Flame Rod

NOTE: Only specific burner sizes with alloy or silicon carbide combustors can use a flamerod (see specific burner datasheets).

For detailed information on how to install and connect a flamerod, refer to Bulletin/Info guide 832.

Installing the Spark Plug

Install the spark plug into the opening in the rear cover.

NOTE: Do ***not*** apply any grease to the threads of the spark plug. You can cause bad grounding of the spark plug if you apply grease to it. Bad grounding of the spark plug results in a weak spark.

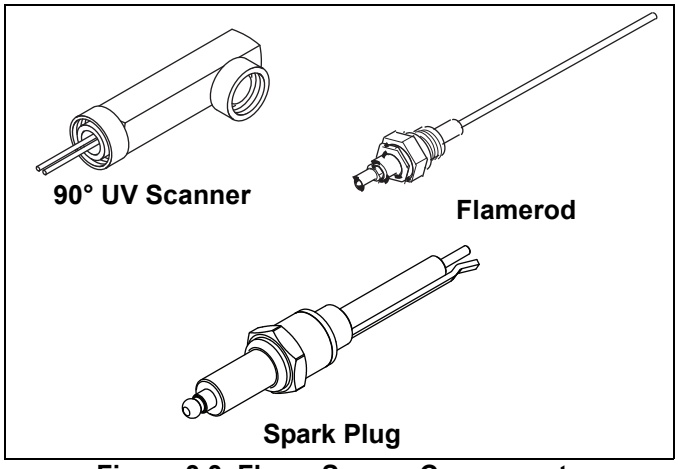


Figure 3.3. Flame Sensor Components

Burner Installation

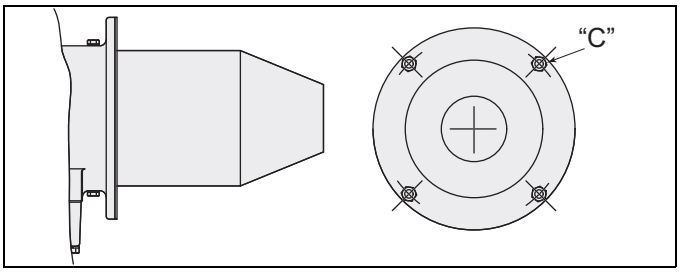


Figure 3.4. Burner Attachment

Dimensions

The burner attaches to the wall of the chamber with bolts through holes “C”. For full information on the burner dimensions, refer to specific datasheets.

Chamber Wall

Make sure that the wall of the chamber is strong enough to support the weight of the burner. If necessary, reinforce the area where you plan to install the burner to support the weight of the burner.

Refractory furnace walls must allow for thermal expansion as recommended by the refractory supplier – the wall should apply no stress on the burner block or refractory layer surrounding the burner block. Expansion joints built into the furnace wall should permit the furnace shell, burner block holder, combustor or burner block and surrounding refractory to move as a unit in the event of unequal expansion of the refractory wall and furnace shell.

The combustor or combustion block must not extend beyond the inside of the furnace wall more than 1". Beyond this length it is necessary to add a spacer on the outside of the furnace to keep the end of the combustor or combustion block within 1/2" of the end of the wall.

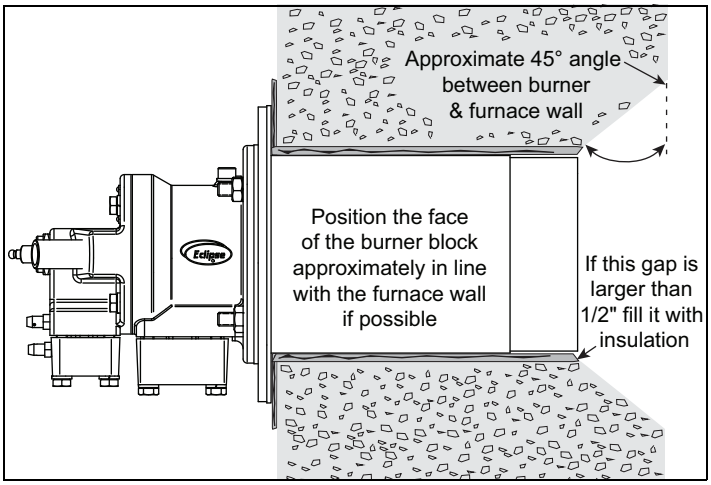


Figure 3.5. ThermJet Combustor Position

If the combustor or burner block is shorter than the furnace wall thickness the block or combustor should be recessed into the wall. To prevent refractory overheating, a 45° chamfer should be applied.

Avoid Losses

To make sure that heat does not go back to the casing of the chamber, it is important that the radial clearance around the firing tube is filled with ceramic fiber.

Alloy Combustor (Figure 3.6)

1. Make sure the gasket ❶ is installed between the burner and the chamber wall ❷.

2. Make sure that gasket ❶ does not leak.

3. Check the size of the clearance. If the gap ❸ around the firing tube is larger than 1/2", then pack the gap with ceramic fiber ❹.

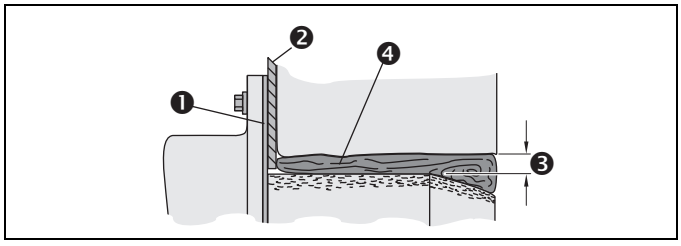


Figure 3.6. Alloy Combustor

Silicon Carbide (SiC) Combustor Only (Figure 3.7)

1. Make sure the gasket ❶ is installed between the burner flange and chamber wall ❷.

2. Make sure gasket ❺ is installed between SiC tube and flange ❻.

3. Make sure neither gasket ❶ nor ❺ leaks.

4. Check the size of the clearance. If the gap ❸ around the firing tube is larger than 1/2", pack the gap with ceramic fiber ❹ over a maximum length of 4" (100mm). Maintain a clearance of at least 3/16" (5mm) over the remaining straight length of the firing tube. Do not wrap the cone.

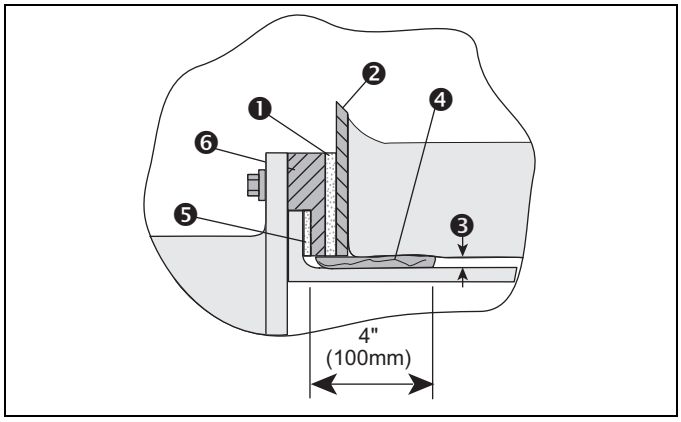


Figure 3.7. Silicon Carbide

Refractory Block (Figure 3.8)

1. Make sure gasket ❶ is installed between burner ❷ and block holder ❸.

2. Make sure gasket ❹ is installed between block holder ❸ and chamber wall ❺.

3. Support the weight of refractory block ❻ with hard brick work anchored to the furnace shell ❼. Fill the 1/2" space between block ❻ and the three unsupported sides with soft gasket material ❽.

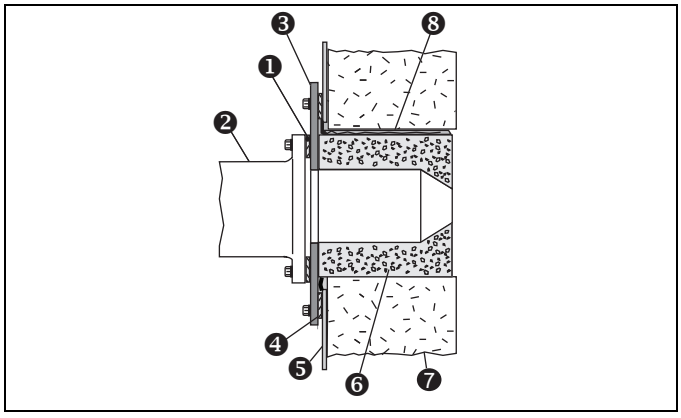


Figure 3.8. Refractory Block

Large Refractory Blocks

On sizes TJ0500 thru TJ2000; the block must be surrounded by a collar made of brick, plastic refractory, or a castable refractory of at least 4" (10 cm) minimum thickness on all sides of the block. If the collar is cast around the block, a thin plastic film (i.e. Saran Wrap® or Glad Wrap®) should be wrapped around the block to keep moisture from leaching into it. The collar should be

anchored to the furnace shell with suitable anchors and must be constructed to rest on a surface capable of supporting its weight, such as a hearth or a solid refractory or brick wall. For furnaces that are unable to support the weight of the refractory block, a stainless steel shelf can be welded to the shell to support the collar.

NOTE: All large refractory blocks are cured at a minimum temperature of 550°F (300°C) prior to shipment.

NOTE: The correct insulation of burner combustion blocks in furnaces results in longer block life and adds value by reducing downtime and maintenance.

Block Holder Temperature

Excessive block holder temperatures can cause problems. Overheating can be reduced by carefully sealing the burner blocks in the wall to prevent the leakage of hot gases back to the furnace shell.

In high temperature (>1,400°F, 760°C) fiber-wall furnace installations, the length of the metallic wrapper should extend no farther than the point in the wall where the interface temperature is higher than 1800°F (760°C).

Vertical Down Firing Blocks (Figure 3.9)

1. Down firing blocks may be suspended by customer supplied hangers ❷ attached to the burner body mounting bolts.
2. Hangers should be attached to structural support ❶.

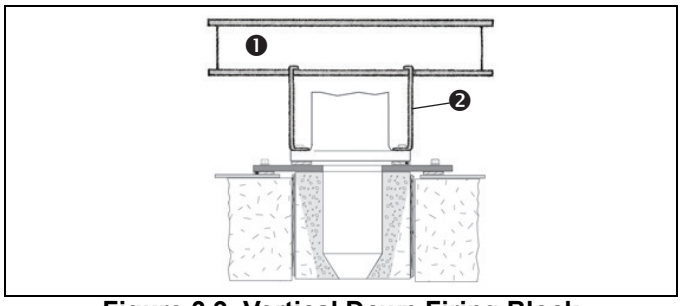


Figure 3.9. Vertical Down Firing Block

Piping Installation

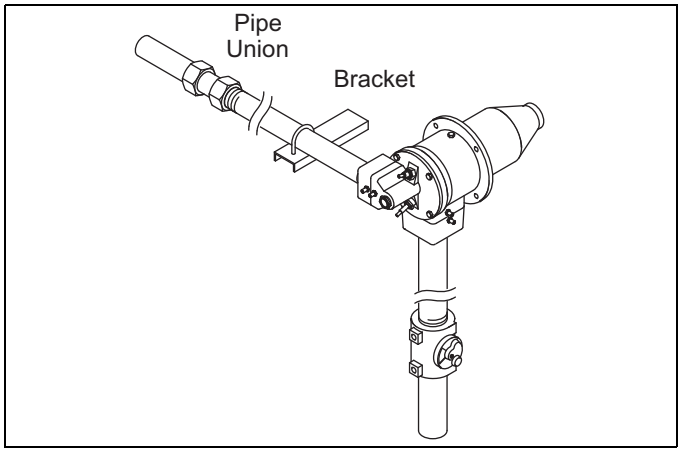


Figure 3.10. Piping Installation

Layout

Install the piping as shown in the schematics. Refer to Chapter 3 of the ThermJet Design Guide No. 205.

Support the Piping

Use brackets or hangers to support the gas piping. If you have questions, consult your local gas company.

Straight Run of Pipe Before a Metering Orifice

NOTE: There must be a run of pipe with a straight length of at least 10 pipe diameters before the burner metering orifice. If you do not do this, the pressure readings ***will*** be inaccurate.

Pipe Connections

Install a pipe union in the gas line to the burner. This simplifies removal of the burner.

The use of flexible pipe nipples in the gas line to the burner is optional. Flexible nipples can absorb stress due to heat expansion and slight misalignment.

NOTE: Flexible pipe nipples will cause inaccurate metering orifice readings and may cause higher pressure drops than equivalent standard pipe. Consider this when you size the gas lines.

Avoid Large Pressure Drops

NOTE: The pressure drop of the gas in the piping is a critical parameter. Make sure that the size of all the piping is large enough to prevent excessive pressure losses.

Valve Installation

Valve Orientation

Install all the valves in such a way that the arrow (if present) on the valve body points in the direction of flow.

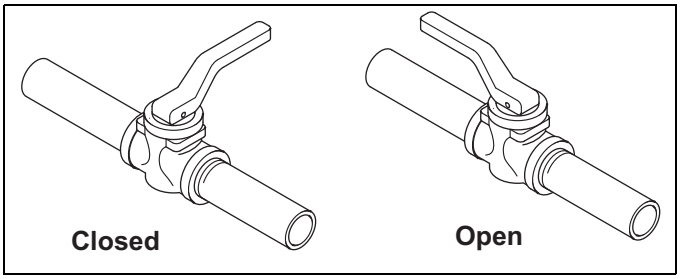


Figure 3.11. Valve Orientation

Gas Cocks

Make sure that the handle of a gas cock is at a right angle to the valve body when the valve is in the closed position. This is an important position indicator. If you do not do this, someone may think that the gas cock is in the closed position, while it is actually in the open position.

Gas Balancing Valves

A gas balancing valve is typically the same as a manual butterfly valve. For more information, refer to "Manual Butterfly Valves" below.

Manual Butterfly Valves

1. Install manual butterfly valves in accordance with Bulletin/Info Guide 720.

2. Install manual butterfly valves in the gas line to the burner (optional).

NOTE: It is recommended that there is a run of pipe with a length of at least 10 pipe diameters between any flow altering device and metering orifice on the burner.

Automatic Butterfly Valve

An automatic butterfly is driven by an actuator. Install the control valve in accordance with Bulletin/Info Guide 720.

Ratio Regulator

- Connect an impulse line to the ratio regulator and air supply line.
- Install the ratio regulator in accordance with Bulletin/Info Guide 742.

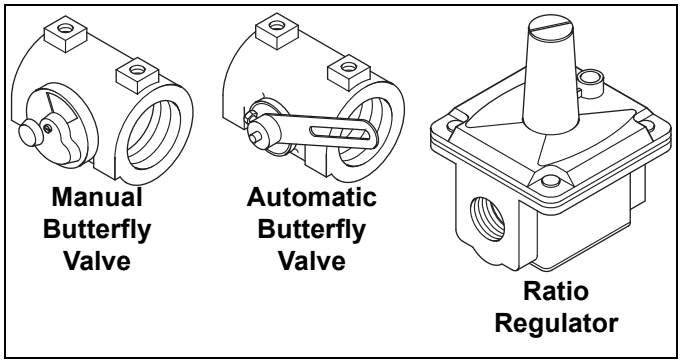


Figure 3.12. Valves

Checklist After Installation

To verify proper system installation, do the following:

1. Make sure that there are no leaks in the gas and air lines.

2. Make sure all the components of the flame monitoring control system are properly installed. This includes verifying that all switches are installed in correct locations and all wiring, pressure and impulse lines are properly connected.

3. Make sure components of spark ignition system are installed and functioning properly.

4. Make sure that the blower rotates in the correct direction. If incorrect, have a qualified electrician rewire the blower to reverse its rotation.

5. Make sure all valves are installed in the proper location and correctly oriented relative to the gas or air flow direction.

Prepare for Adjustment

After installation of the burner system components is complete, the following steps should be followed in order to prepare for adjustment:

1. Set the air pressure switch so that it drops out at 4" w.c. (10 mbar) below the pressure rating of the blower.

2. Set the low gas pressure switch at 4" w.c. (10 mbar) below the gas pressure measured at the inlet to the main gas valve train.

3. Set the high gas pressure switch so that it comes on at 4" w.c. (10 mbar) above the gas pressure measured at the inlet to the main gas valve train.

4. Close all the burner gas cocks.

5. Try to light a burner before the purge and other timers have finished their cycles. Make sure that the flame monitoring system indicates a flame failure.

6. Trip out pressure switches and other limit interlocks. Make sure that the main gas valve train closes.

⚠ DANGER

- **If simulated limits or simulated flame failures do not shut down the fuel system within the required failure response time, immediately correct the problem before proceeding.**

Adjustment, Start & Stop

4

In this chapter you will find instructions on how to adjust a system, and how to start and stop a system.

⚠ DANGER

- **Do not bypass any safety feature. You can cause fires and explosions.**

Adjustment

There are two adjustment procedures. To adjust a modulating gas and air ratio system, refer to “Modulating Gas & Air Ratio System”. For a fixed-air system, refer to “Fixed-Air System”.

Modulating Gas & Air Ratio System

If you adjust an on-ratio system for the first time, you must follow these steps: (Refer to Figures in the ThermJet Design Guide No. 205)

Step 1: Reset the System

1. Close the automatic gas valves and gas cocks.
2. Fully open the manual air butterfly valve at each burner.
   a. Drive the automatic zone air control valve to high fire.
   b. Adjust the automatic zone air control valve so that it is fully open.
3. Start the blower.

NOTICE

- **Make sure that the blower rotates in the correct direction. If incorrect, have a qualified electrician rewire the blower to reverse its rotation.**

Step 2: Set High Fire Air

1. Set the system to high fire, but **DO NOT** ignite the burner(s).
2. Use the air curves from the appropriate ThermJet datasheet to find the differential air pressure needed at high fire. This is the target value for high fire.
3. Set high fire air using the instructions for either a single burner system or multiple burner system below. (See Figure 4.1)

   To set high fire air on a single burner system:

   NOTE: A pressure tap is open when the screw inside the tap is unscrewed approximately half a turn.

   a. Make sure that pressure taps A and C are open.
   b. Connect the manometer to taps A and C (across the air orifice).
   c. Adjust the manual butterfly valve until the high fire differential air pressure is at the target value.
   d. Remove the manometer.
   e. Close the pressure taps.

   To set high fire air on a multiple burner system:

   a. Make sure that pressure taps A and C of the first burner are open.
   b. Connect the manometer to taps A and C of the first burner (across the air orifice).
   c. Adjust the zone air manual butterfly valve to achieve the target value for the first burner.
   d. Measure and note the differential air pressure across the next burner in the zone.
   e. Repeat step d for all the burners in the zone.
   f. If all the measured differential pressures are within 0.3" w.c. (0.75 mbar) of each other, then proceed to the next section. If the variation is greater than 0.3" w.c. (0.75 mbar) it will be necessary to adjust the manual air butterfly valve at each burner to improve the balance.
   g. Make sure that all the pressure taps are closed.
4. Repeat step 3 for other zones (if any).

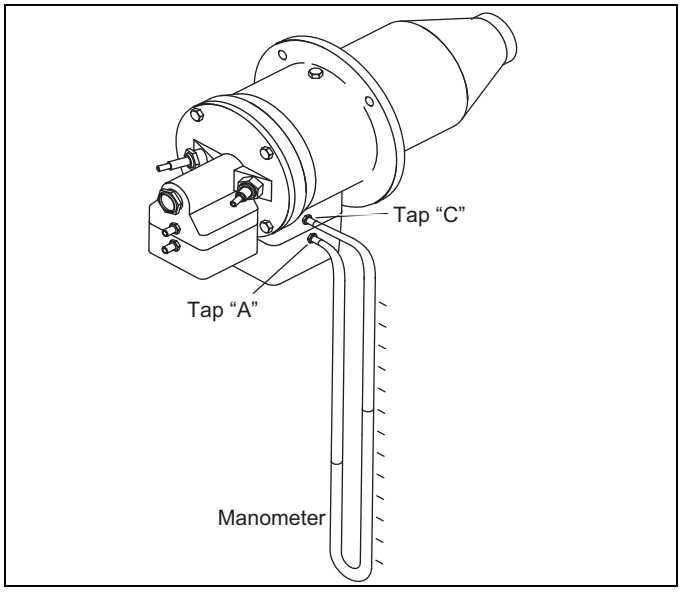


Figure 4.1. Set High Fire Air

Step 3: Set Low Fire Air

1. Set the system to low fire.
2. Connect the manometer to tap A (air inlet pressure tap).
3. Adjust the automatic zone air control valve until the low fire static air pressure is 0.2" w.c. This is the initial setting only. Further adjustment may be required.
4. Repeat 2 and 3 for the other zones (if any).

Step 4: Verify the Air Settings

Make sure all the settings are still the same after you cycle the system several times between high and low fire.

Step 5: Ignite the Burners

WARNING

- **This procedure assumes that a flame monitoring control system is installed and is serviceable. It also assumes that normal low fire start is being used. If low fire gas is too low to be used for ignition, refer to options in “Set the Bypass Pilot Gas (Optional)” on page 16.**

1. Drive the zone air automatic control valve to low fire.
2. Make sure the combustion air blower is running.
3. Set the manual gas butterfly valve at each burner to 50% open.
4. Set the adjusting screw on the ratio regulator six full (360°) turns down from the top (initial setting).

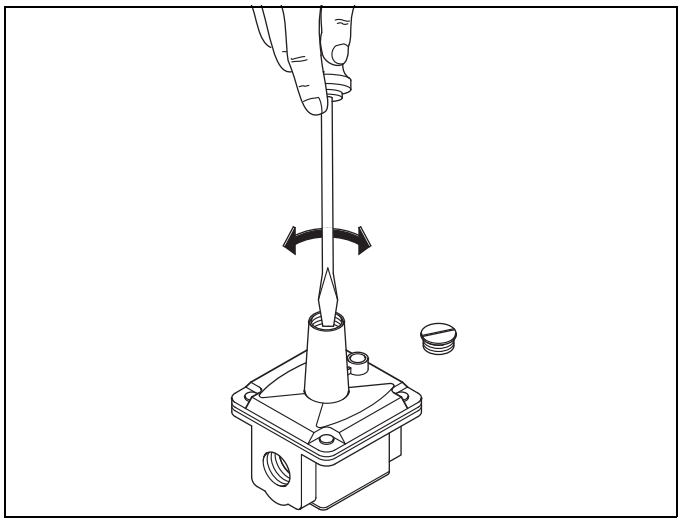


Figure 4.2. Adjusting Ratio Regulator Screw

5. Open zone manual gas cock.
6. Open manual gas cock at each burner.
7. Initiate the ignition sequence through the flame monitoring control system.
   a. Check that all the burners in the zone have ignited.
   b. If safety shut-off solenoid valves are installed at each burner, then repeat 6 and 7 for all the burners in the zone.
8. If all the burners have ignited, drive the zone air butterfly valve to high fire. Verify flame is present at each burner. If burners do not light, add a 1/2 turndown on the proportionator, and repeat steps 7 and 8.
9. Verify that air pressure drops have remained the same.
10. If air pressure drop is too high, close down the zone manual air butterfly valve.
11. If air pressure drop is too low, open the zone manual air butterfly valve.

Step 6: Set High Fire Gas (Figure 4.3)

1. Use the gas curve from the appropriate ThermJet datasheet for the gas being used to find the differential gas pressure needed at high fire. This is the target value for high fire.
2. Connect the manometer to taps B and D (across the gas orifice, see Figure 4.3).

3. Measure the high fire differential gas pressure for the first burner.

4. Adjust the gas butterfly valve at the burner until the gas flow is at the target value.

5. Repeat 3 thru 4 for the other burners in the zone.

6. Check the gas pressure at the inlet to the zone ratio regulator. This should be at least 5" w.c. (12.5 mbar) higher than the loading line pressure. It should not exceed the maximum pressure rating of the ratio regulator.

⚠ WARNING

- **Insufficient gas inlet pressure may cause the proportionator to remain fully open as the burner system turns down from high fire, causing excess fuel operation and possible accumulation of unburned fuel in the chamber. In extreme cases, this may cause explosions or fires.**

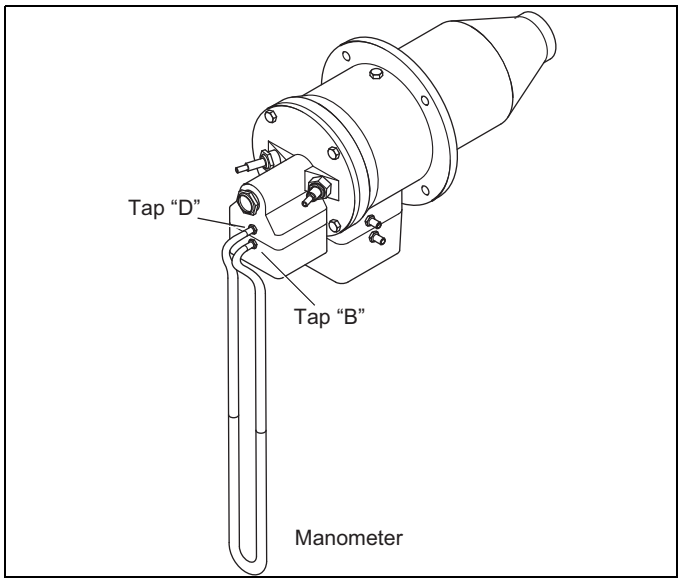


Figure 4.3. Set High Fire Gas

Step 7: Set Low Fire Gas

1. Drive the system to low fire.

2. Use the gas curve from the appropriate ThermJet datasheet for the gas being used to determine the differential gas pressure required for low fire. This is your target value for low fire.

3. Measure the gas pressure at the first burner.

4. Adjust the ratio regulator until the gas flow is on the target value. (Refer to Bulletin 742 for adjustment.)

NOTE: It is very difficult to measure the very low pressures experienced at low fire, and it may be necessary to rely on visual inspection. This is especially true when gas turndowns in excess of 10:1 are being used. The main intent is to provide a clean stable flame with a good flame signal that will not cause the furnace temperature to overshoot.

If the pressure required is too low to be measured, adjust the ratio regulator until a gas flow is obtained that will provide a clean stable flame with a strong flame signal.

Step 8: Verify the Gas Settings

Make sure that all settings are still the same after cycling the system several times between high and low fire.

NOTE: When all the settings have been completed, mark the position of the indicator on the butterfly valves to indicate valve position.

Fixed Air System

When you adjust a fixed-air system for the first time, you must follow these steps:

Step 1: Reset the System

1. Close the automatic gas valves and gas cocks.

2. Fully open the manual air butterfly valve at each burner.
   a. Drive the automatic zone air control valve to high fire.
   b. Adjust the automatic zone air control valve so that it is fully open.

3. Set the manual gas butterfly valve at each burner to 50% open.

4. Start the blower.

NOTE: Make sure that the blower rotates in the correct direction. If incorrect, have a qualified electrician rewire the blower to reverse its rotation.

Step 2: Set High Fire Air (Figure 4.1)

1. Set the system to high fire, but **DO NOT** ignite the burner(s).

2. Use the air curves in “Orifice Curves” from the appropriate ThermJet datasheet to find the differential air pressure needed at high fire. This is now the target value for high fire.

3. Set high fire air using the instructions for either a single burner system or multiple burner system below.

NOTE: A pressure tap is open when the screw inside the tap is unscrewed approximately half a turn.

Single Burner System:

a. Make sure that pressure taps A and C of the burner are open.

b. Connect the manometer to taps A and C (across the air orifice).

c. Adjust the manual butterfly valve until the high fire differential air pressure is at the target value.

d. Remove the manometer.

e. Close the pressure taps.

Multiple Burner System:

a. Make sure that pressure taps A and C of the first burner are open.

b. Connect the manometer to taps A and C of the first burner (across the air orifice).

c. Adjust the manual butterfly valve for the zone, until the high-fire differential air pressure is at the target value for the first burner.

d. Measure the differential air pressure across the next burner in the zone.

e. Repeat step **d** for all the burners in the zone.

f. If all the measured differential pressures are within 0.3" w.c (0.75 mbar) of each other, then proceed to the next section. If the variation is greater than 0.3" w.c. (0.75 mbar) it is necessary to adjust the manual air butterfly valve at each burner to improve the balance.

g. Make sure that all the pressure taps are closed.

4. Repeat 3 for other zones (if any).

Step 3: Ignite the Burners

⚠ WARNING

- **This procedure assumes that a flame monitoring control system is installed and is serviceable. It also assumes that normal low fire start is being used. If low fire gas is too low to be used for ignition, refer to options in "Set the Bypass Pilot Gas (Optional)" on page 16.**

1. Drive the zone gas automatic butterfly valve to low fire.

2. Make sure the combustion air blower is running.

3. Set the burner manual gas butterfly valve to low fire.

4. Set the adjusting screw on the ratio regulator six full (360°) turns down from the top (initial setting).

5. Select the valve according to the control method:

   a. **With high/low control:**
   Set the gas bypass butterfly valve 25% open.

   b. **With modulating gas control:**
   Set the zone gas automatic butterfly value to approximately 10% open. Stroke the valve to the open position to ensure 100% open. Readjust if necessary.

6. Open the zone gas manual gas cock.

7. Open the manual gas cock at each burner.

8. Initiate the ignition sequence through the flame monitoring control system.

9. Check that all the burners in the zone have ignited.

10. If shut-off solenoid valves are installed at each burner, then repeat 6 and 7 for all the burners in the zone.

11. If all the burners have ignited, drive the zone to high fire. Verify flame is present at each burner.

Step 4: Set High Fire Gas (Figure 4.1)

1. Use the gas curves from the appropriate ThermJet datasheet for the gas being used to find the differential gas pressure needed at high fire. This is the target value for high fire.

2. Connect the manometer to taps B and D (across the gas orifice, see Figure 4.3).

3. Measure the high fire differential gas pressure for the first burner.

4. Adjust the gas butterfly valve at the burner until the gas flow is at the target value.

5. Repeat 3 and 4 for the other burners in the zone.

6. Check the gas pressure at the inlet to the zone ratio regulator. This should be at least 5" w.c. (12.5 mbar) higher than the loading line pressure. It should not exceed the maximum pressure rating of the ratio regulator (optional).

⚠ WARNING

- **Insufficient gas inlet pressure may cause the proportionator to remain fully open as the burner**

system turns down from high fire, causing excess fuel operation and possible accumulation of unburned fuel in the chamber. In extreme cases, this may cause explosions or fires.

Step 5: Set Low Fire Gas

1. Drive the system to low fire.
2. Measure the gas pressure drop at the first burner.
3. Select the valve according to the control method:

   a. **With high/low control:**
   Adjust the gas bypass butterfly valve (see ThermJet Design Guide No. 205) until the minimum fire that will still maintain a strong flame signal is obtained.

   b. **With modulating gas control:**
   Adjust the zone gas automatic butterfly valve (see ThermJet Design Guide No. 205) until the minimum fire that will still maintain a strong flame signal is obtained.

NOTE: It is very difficult to measure the very low pressures experienced at low fire, and it may be necessary to rely on visual inspection. This is especially true when gas turndowns in excess of 10:1 are being used. The main intent is to provide a clean stable flame with a good flame signal that will not cause the furnace temperature to overshoot.

Step 6: Verify the Gas Settings

Make sure that all the settings are still the same after you have cycled the system several times between high and low fire.

NOTE: When all the settings have been completed, mark the position of the indicator on the butterfly valves to indicate valve position.

Set the Bypass Pilot Gas (Optional)

1. Set the system to low fire.
2. Make sure that the blower is on.

⚠ WARNING

- **Before you perform this procedure, make sure the flame monitoring control system is working.**

3. Use the flame monitoring control system to start the ignition and the bypass pilot gas for all the burners in the zone.
4. Adjust the manual butterfly valve in the bypass line until you obtain reliable ignition within the required trial for ignition time limit.
5. Repeat 4 for all the other burners and zones (if any).

Start Procedure

1. Start the blower.
2. Open all the gas cocks.
3. Start the ignition sequence.
4. Verify that flame is present at each burner.

⚠ DANGER

- **If a burner does not light, and the system does not shut down automatically, then you must close the main gas cock. An uncontrolled flow of gas can cause fires and explosions.**
- **Do not touch the ignition plug or the ignition wire when the ignition is on. You will get a shock.**

Stop Procedure

1. Close the following valves:
   - The manual gas cock for each burner or zone
   - The manual gas cock at the main control valve
   - All the manual shut-off valves in the gas line upstream of the burner gas cock
2. Let the burners cool down. Keep the blower on until the chamber temperature is less than 1000°F (500°C) and then stop the blower.

NOTICE

- **Keeping the blower on after the burner is off protects the burner and the other components from hot gases that flow back through the burner.**

Maintenance & Troubleshooting

5

This chapter is divided into two sections:

- Maintenance procedures
- Troubleshooting guide

Maintenance

Preventive maintenance is the key to a reliable, safe and efficient system. The core of any preventive maintenance system is a list of periodic tasks.

The following are suggestions for a monthly list and a yearly list.

NOTE: The monthly list and yearly lists are an average interval. If your environment is dirty, the intervals may be shorter.

Monthly Checklist

1. Test (leak test) safety shut-off valves for tightness of closure.
2. Test air pressure switch settings by checking switch movements against pressure settings and comparing with actual impulse pressure.
3. Visually check ignition cable and connectors.
4. Inspect impulse piping for leaks.
5. Clean and inspect all the burners.
6. Make sure that the following components are not damaged or distorted:
   - burner nozzle
   - spark plugs
   - flame sensors
   - flame tube or combustion block
7. If applicable, remove and clean all the orifice plates.

Yearly Checklist

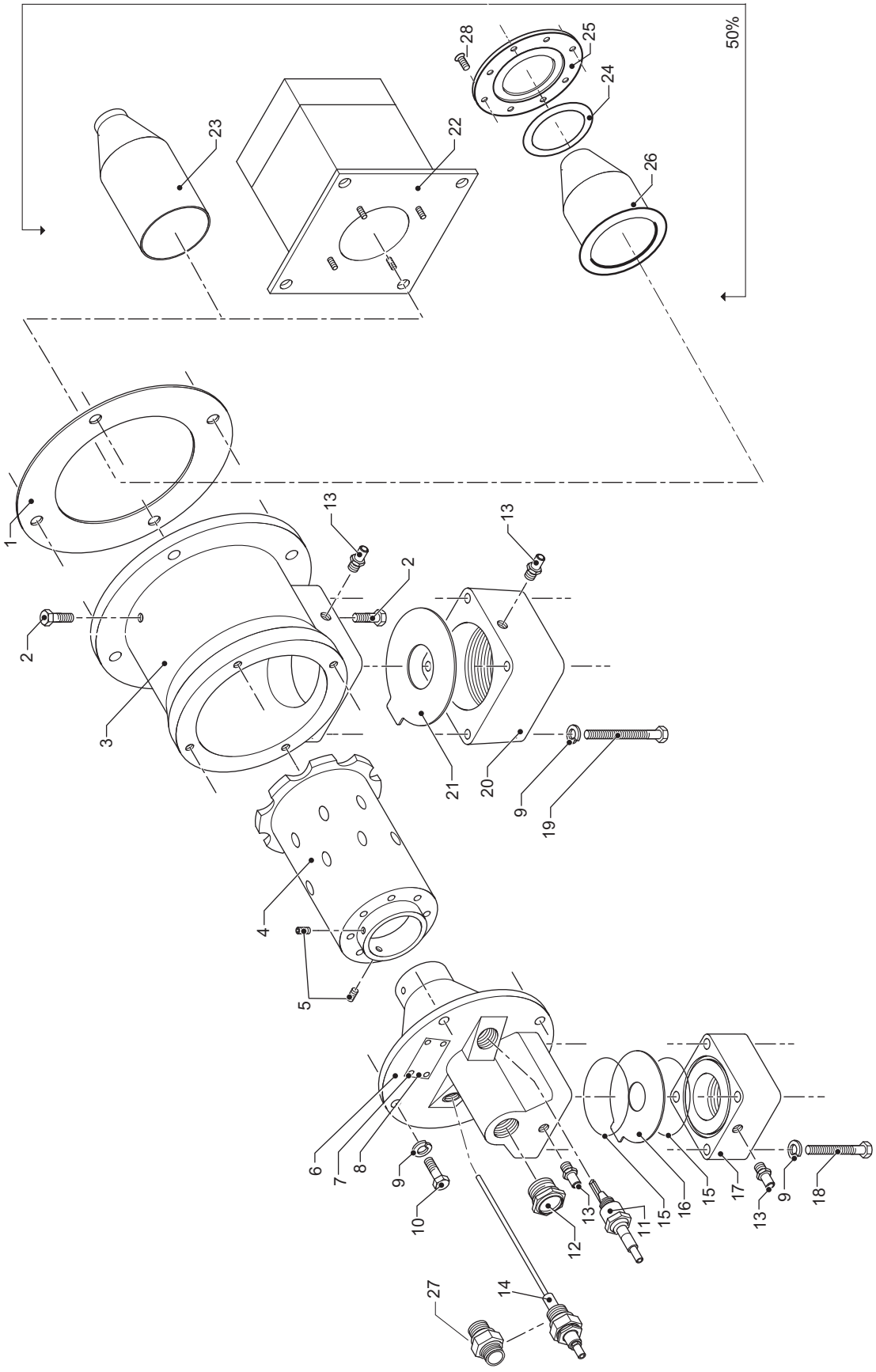
1. Inspect flame-sensing devices for good condition and cleanliness.
2. Check for proper inlet air/gas ratios.
3. Test all the alarm systems for proper signals.
4. Check ignition spark plugs and proper gap.
5. Check valve motors and control valves for free, smooth action and adjustment.
6. Check for proper operation of the ventilating equipment.
7. Test the interlock sequence of all safety equipment; manually make each interlock fail, noting that related equipment closes or stops as specified by the manufacturer.
8. Test flame monitoring control system by manually shutting off gas to burner.
9. Test main fuel hand-valves for operation.
10. Clean or replace the combustion air blower filter.

Troubleshooting Procedures

Problem	Possible Cause	Solution
Cannot initiate start sequence	Air pressure switch has not made contact	Check air pressure switch adjustment. Check air filter. Check blower rotation. Check outlet pressure from blower.
	High gas pressure switch has tripped	Check incoming gas pressure. Adjust gas pressure if necessary. Check pressure switch setting and operation.
	Low gas pressure switch has tripped	Check incoming gas pressure. Adjust gas pressure if necessary. Check pressure switch setting and operation.
	Malfunction of flame monitoring control system such as shorted out flame sense or electrical noise in the sensor line	Have a qualified electrician investigate and rectify.
	Purge cycle not completed	Check flame monitoring control system or purge timer.
	Main power is off	Make sure power is on to control system.
	No power to control unit	Call qualified electrician to investigate.
Start-up sequence runs but burner does not light	No ignition: There is no power to the ignition transformer	Restore power to the ignition transformer.
	No ignition: Open circuit between the ignition transformer and the spark plug	Repair or replace the wiring to the spark plug.
	No ignition: The spark plug needs cleaning	Clean the spark plug.
	No ignition: The spark plug is not correctly grounded to the burner	Clean the threads of the spark plug and the burner. Do not apply grease to the thread of the spark plug.
	Too much gas: Improper gas valve train sequence	Verify solenoid valve is down-stream of proportionator.
	Too much gas: Manual gas butterfly valves have been opened too far	Check pressures and settings against start-up report and adjust as necessary.
	Too much gas: Gas pressure out of the main gas pressure regulator is too high	Check start-up setting. If necessary, remove regulator and investigate.
	Not enough gas: The gas pressure out of the main gas pressure regulator is too low	Check start-up setting. Check regulator and adjust if necessary.
	Not enough gas: Start gas solenoid valve does not open.	Check solenoid valve coil for proper orientation. Replace if necessary.
	Not enough gas: Gas valve not open	Check wiring to the automatic gas shut-off valve.
	Not enough gas: Air in the gas line	Check output from the flame safeguard. Open gas cock. Purge gas line.

Problem	Possible Cause	Solution
The low fire flame is weak or unstable	Low fire adjusted too slow	Increase low fire gas setting.
	Not enough gas	Check start-up settings and adjust to increase low gas flow.
	Not enough air	Check start-up settings. Investigate any change, i.e. blocked filter, loose connections.
The burner goes off when it cycles to high fire	Insufficient air (flame too rich)	Check start-up settings. Check air filter, clean or replace if required.
The burner is erratic and does not respond to adjustment	Flame signal weak	Check condition of flame monitoring device.
	Internal damage to the burner. Some parts inside the burner may be loose or dirty.	Contact Eclipse.
The burner is unstable or produces soot or smoke	The air/gas ratio is out of adjustment	Measure all gas pressures and air pressures. Compare to initial start-up settings, and adjust them where necessary.
Cannot achieve full capacity	Air filter is blocked	Clean or replace the air filter.
	Gas pressure is too low into the main gas pressure regulator	Adjust gas pressure.
	Increase furnace/chamber pressures	Re-check setup pressures.
	Poor piping practices	Contact Eclipse.

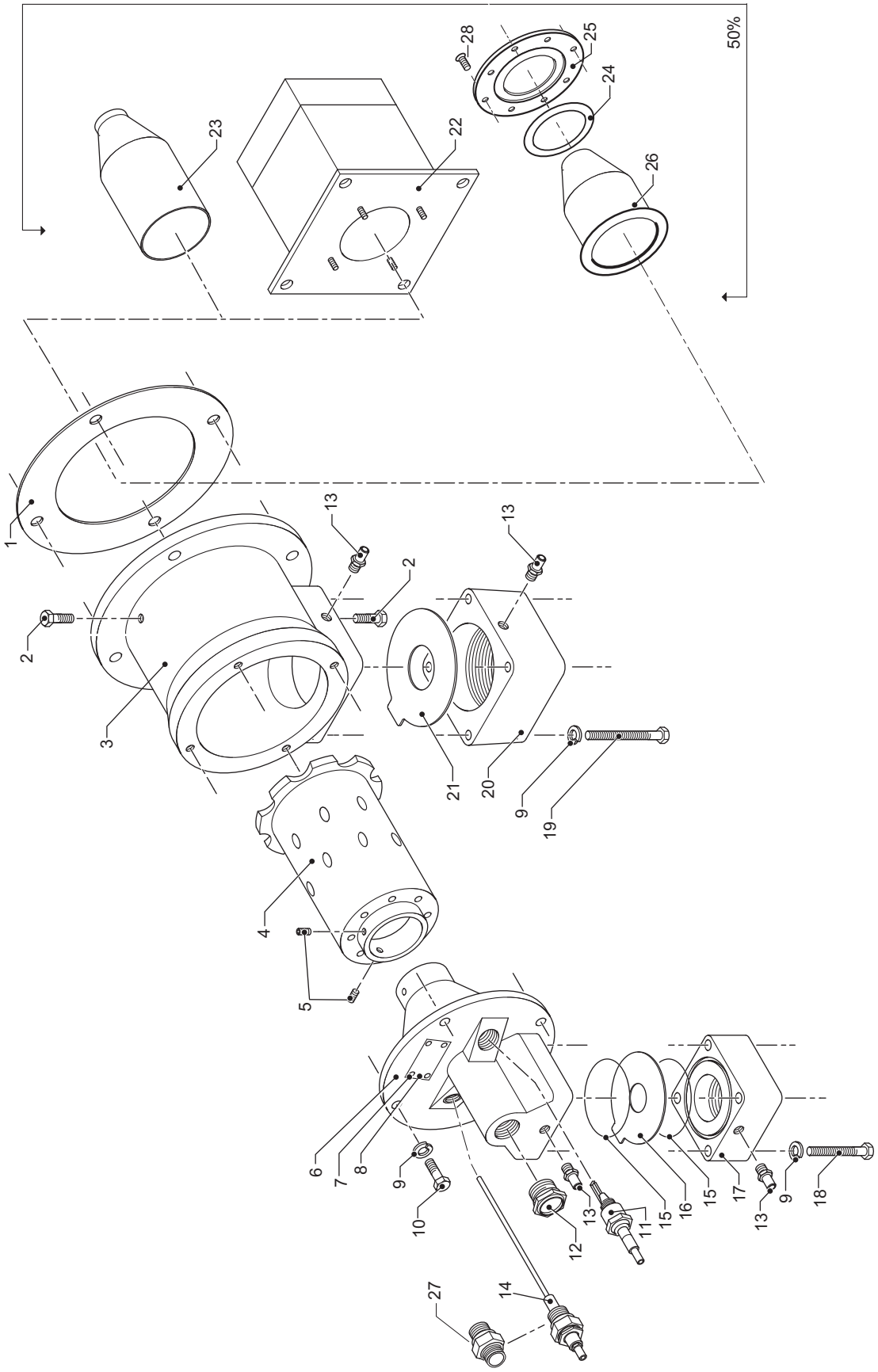
Parts List Models TJ0015 thru TJ1000



Parts List Models TJ0015 thru TJ0100

Ref No	Part Description	Qty	TJ0015	TJ0025	TJ0040	TJ0050	TJ0075	TJ0100
1	Gasket, Mounting	1	17054	17054	17054	20422	20422	14932
2	Screw	2	16022	16022	16022	16022	16022	16022
3	Body	1	7031-1	7031-1	7118-1	7046-1	7046-1	3994
4	Nozzle, Cast Iron	1	7033-1	7033-2	7033-3	7133-1	7133-2	3997-1
4	Nozzle, Stainless Steel	1	7125-1	7135-1	7125-2	7126-1	7137-1	7127-1
4	Nozzle for Flamerod, Cast Iron	1	10026919	10026920	10026921	10026923	10026924	10026925
4	Nozzle for Flamerod, Stainless	1	10026926	10026927	10026928	10026929	10026930	10026931
5	Set Screw	2	19969	19969	19969	15885	15885	15885
5	Stainless Set Screw	2	10024662	10024662	10024662	10024356	10024356	10024356
6	Rear Cover	1	7032-1	7032-1	7032-1	3998-1	3998-1	3995
7	Screw #2 Drive	4	18933	18933	18933	18933	18933	18933
8	Nameplate	1	20729	20729	20729	20729	20729	20729
9	Lock Washer M8	13	15222	15222	15222	15222	15222	15222
10	Screw M8	4	15886	15886	15886	16021	16021	15886
11	Spark Plug	1	23045	23045	23045	10019728	10019728	10019728
12	Peepsight	1	10509	10509	10509	10509	10509	10509
13	Pressure Tap	4	13445	13445	13445	13445	13445	13445
14	Flamerod	1	10002242-1	10002242-1	10002242-1	10002242-1	10002242-1	10002242-2
15	O-ring	2	14777	14777	14777	17037	17037	14778
16	Orifice Plate, NG	1	14191-13	14191-8	14191-6	14934-17	14934-10	14188-4
16	Orifice Plate, PR	1	14191-14	14191-13	14191-8	14934-13	14934-3	14188-7
16	Orifice Plate, BU	1	14191-14	14191-13	14191-8	14934-12	14934-2	14188-7
17	Inlet Block, Gas NPT	1	3974-4	3974-4	3974-2	7001-1	7001-1	3973-3
17	Inlet Block, Gas Rc	1	3974-3	3974-3	3974-1	7001-3	7001-3	3973-1
18	Screw M8	4	15887	15887	15887	15893	15893	15893
19	Screw M8	4	15893	15893	15893	20890	20890	15888
19	Thread Insert	8	N/A	N/A	N/A	N/A	N/A	N/A
20	Inlet Block, Air NPT	1	7001-2	7001-2	3973-2	7108-2	7108-2	3996-1
20	Inlet Block, Air Rc	1	7001-4	7001-4	3973-10	7108-3	7108-3	3996-2
20	Inlet, Welded Air	1	N/A	N/A	N/A	N/A	N/A	N/A
20	Inlet, Flanged Air	1	N/A	N/A	N/A	N/A	N/A	N/A
21	Orifice Plate, Air	1	14934-6	14934-7	14188-5	20362-5	20362-6	14802-1
22	Block & Holder Asy, HV	1	187265-1	187265-2	100234-1	187329-68	187328-68	187302-68
22	Block & Holder Asy, MV	1	187265-2	187265-3	100234-2	187328-68	187330-68	187300-68
22	Down Fired Block & Holder HV	1	N/A	N/A	N/A	10025728	10025726	10025724
22	Down Fired Block & Holder MV	1	N/A	N/A	N/A	10025726	10025727	10025725
23	Combustor, Alloy HV	1	108715-1	108715-2	108715-3	21747-2	21747-1	17182
23	Combustor Alloy MV	1	108715-2	108715-3	108715-4	21747-1	21747-3	17183
24	Silicon Carbide Gasket	1	19971	19971	19971	10005080	10005080	10005
25	Retaining Ring, SiC	1	19970	19970	19970	20464	20464	10003
26	Combustor, SiC HV	1	17046-1	17046-2	17046-3	21793-2	21793-1	17180
26	Combustor, SiC MV	1	17046-2	17046-3	17046-4	21793-1	21793-3	17181
27	UV Scanner Adapter	1	18720	18720	18720	18720	18720	18720
28	Screw FH	4	10001	10001	10001	10001	10001	10001
29	Gasket, Air Inlet	2	N/A	N/A	N/A	N/A	N/A	N/A
30	Gasket, Alloy Tube, Body	1	N/A	N/A	N/A	N/A	N/A	N/A
31	Gasket Body, Adapter Plate	1	N/A	N/A	N/A	N/A	N/A	N/A
32	Gasket Rear Cover	1	N/A	N/A	N/A	N/A	N/A	N/A
33	1/8" Plug	1	N/A	N/A	15398	15398	15398	15398
34	Flat Washer	12	N/A	N/A	N/A	N/A	N/A	N/A
35	Nut M8	12	N/A	N/A	N/A	N/A	N/A	N/A
36	Rear Cover Adapter Plate	1	N/A	N/A	N/A	N/A	N/A	N/A

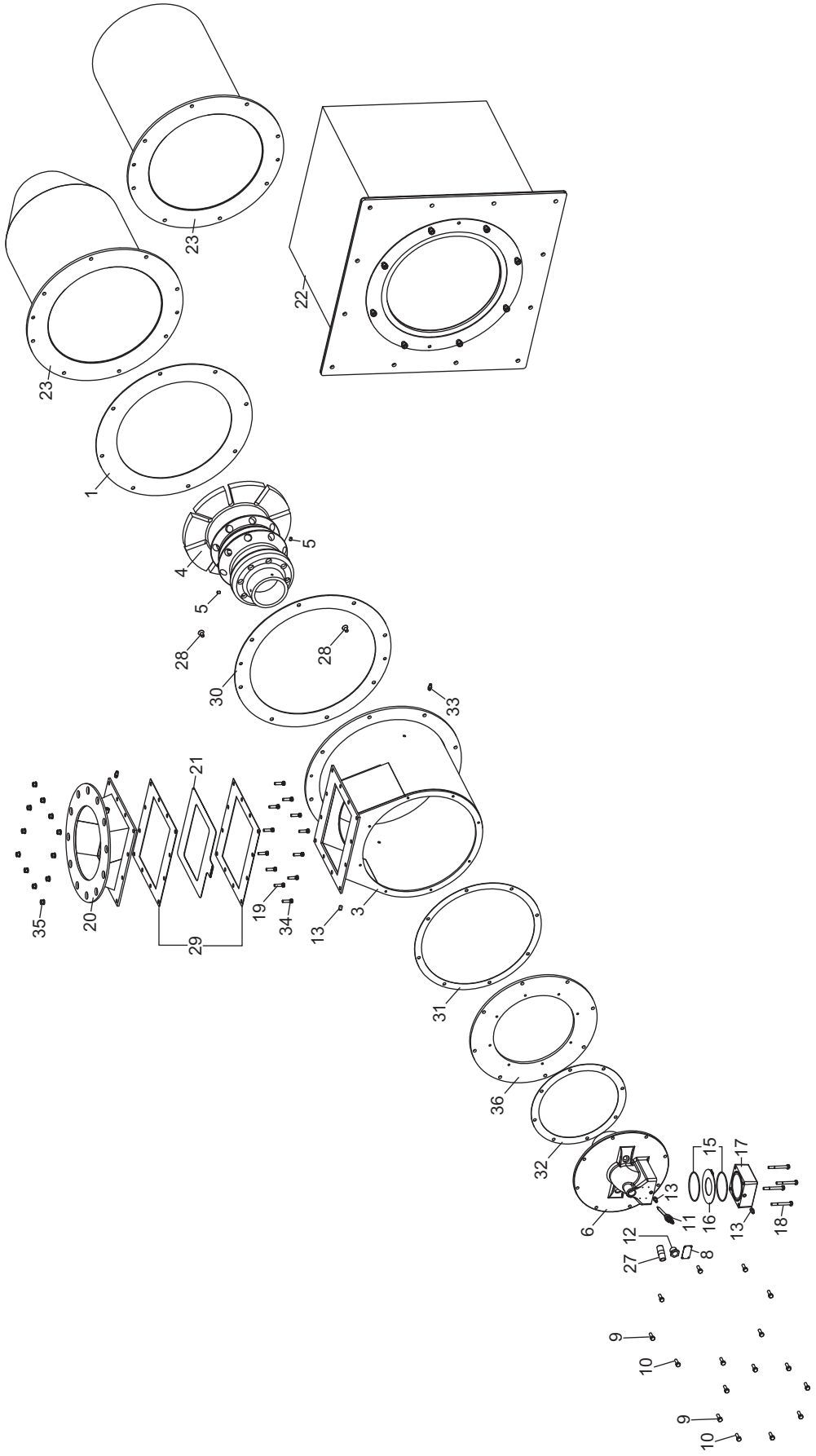
Parts List Models TJ0150 thru TJ1000



Parts List Models TJ0150 thru TJ1000

Ref No	Part Description	Qty	TJ0150	TJ0200	TJ0300	TJ0500	TJ0750	TJ1000
1	Gasket, Mounting	1	14932	14932	10027	20151	10002831	10002831
2	Screw	2	16022	16022	N/A	N/A	N/A	N/A
3	Body	1	3994	3994	7036-1	7111-1	7124-3	7124-3
4	Nozzle, Cast Iron	1	3997-1	3997-1	7038-1	7116-1	10002813-1	10002813-1
4	Nozzle, Stainless Steel	1	7127-1	7127-1	7128-1	7129-1	10007413-1	10007413-1
4	Nozzle for Flamerod, Cast Iron	1	10026925	10026925	N/A	N/A	N/A	N/A
4	Nozzle for Flamerod, Stainless	1	10026931	10026931	N/A	N/A	N/A	N/A
5	Set Screw	2	15885	15885	15885	15885	21598	21598
5	Stainless Set Screw	2	10024356	10024356	10024356	10024356	10024663	10024663
6	Rear Cover	1	3995	3995-1	7037-1	7037-2	10002812	10002812
7	Screw #2 Drive	4	18933	18933	18933	18933	18933	18933
8	Nameplate	1	20729	20729	20729	20729	20729	20729
9	Lock Washer M8	13	15222	15222	15222 (12)	15222 (16)	15222 (20)	15222 (20)
10	Screw M8	4	15886	15886	15886	15886 (8)	15892 (8)	15892 (8)
11	Spark Plug	1	10019728	10019728	23045	23045	23045	23045
12	Peepsight	1	10509	10509	13225	13225	10509	10509
13	Pressure Tap	4	13445	13445	13445	13445	13445	13445
14	Flamerod	1	10002242-2	10002242-2	N/A	N/A	N/A	N/A
15	O-ring	2	14778	14778	14778	14778	14781	14781
16	Orifice Plate, NG	1	14188-9	14188-1	14188-3	14188-5	14802-14	14802-15
16	Orifice Plate, PR	1	14188-4	14188-4	14188-19	14188-3	14802-17	14802-19
16	Orifice Plate, BU	1	14188-8	14188-4	14188-19	14188-3	14802-16	14802-18
17	Inlet Block, Gas NPT	1	3973-3	3973-3	3973-2	3973-2	3996-3	3996-3
17	Inlet Block, Gas Rc	1	3973-1	3973-1	3973-10	3973-10	3996-4	3996-4
18	Screw M8	4	15893	15893	15893	15893	15888	15888
19	Screw M8	4	15888	15888	15892	15892	15892 (8)	15892 (8)
19	Thread Insert	8	N/A	N/A	N/A	20304 (6)	20304	20304
20	Inlet Block, Air NPT	1	3996-1	3996-1	100041	N/A	N/A	N/A
20	Inlet Block, Air Rc	1	3996-2	3996-2	100041-1	N/A	N/A	N/A
20	Inlet, Welded Air	1	N/A	N/A	100040	100044	101111	101111
20	Inlet, Flanged Air	1	N/A	N/A	N/A	N/A	N/A	N/A
21	Orifice Plate, Air	1	14802-3	14802-8	10039-1	20152-1	10002627-3	10002627-2
22	Block & Holder Asy, HV	1	187299-68	187317-68	187315-68	100015-68	10004465-68	10004466-68
22	Block & Holder Asy, MV	1	187298-68	187316-68	187314-68	100016-68	10004466-68	10004467-68
22	Down Fired Block & Holder HV	1	10025722	10025720	10025718	10025716	10025715	10025712
22	Down Fired Block & Holder MV	1	10025723	10025721	10025719	10025717	10025712	10025713
23	Combustor, Alloy HV	1	15214	15260	108721	100042	10003218-1	10003218-2
23	Combustor Alloy MV	1	15213	15259	108721-1	100043	10003218-2	10003218-3
24	Silicon Carbide Gasket	1	10005	10005	N/A	N/A	N/A	N/A
25	Retaining Ring, SiC	1	10003	10003	N/A	N/A	N/A	N/A
26	Combustor, SiC HV	1	15217	15262	N/A	N/A	N/A	N/A
26	Combustor, SiC MV	1	15216	15261	N/A	N/A	N/A	N/A
27	UV Scanner Adapter	1	18720	18720	18720	18720	18743	18743
28	Screw FH	4	10001	10001	10001	10001	10001	10001
29	Gasket, Air Inlet	2	N/A	N/A	N/A	N/A	N/A	N/A
30	Gasket, Alloy Tube, Body	1	N/A	N/A	N/A	N/A	N/A	N/A
31	Gasket Body, Adapter Plate	1	N/A	N/A	N/A	N/A	N/A	N/A
32	Gasket Rear Cover	1	N/A	N/A	N/A	N/A	N/A	N/A
33	1/8" Plug	1	15398	15398	15398	15398	15398	15398
34	Flat Washer	12	N/A	N/A	N/A	N/A	N/A	N/A
35	Nut M8	12	N/A	N/A	N/A	N/A	N/A	N/A
36	Rear Cover Adapter Plate	1	N/A	N/A	N/A	20150	N/A	N/A

Part List Models TJ1500 thru TJ2000



Part List Models TJ1500 thru TJ2000

Ref No	Part Description	Qty	TJ1500	TJ2000
1	Gasket, Mounting	1	10007206	10007206
2	Screw	2	N/A	N/A
3	Body	1	10006927	10006927
4	Nozzle, Cast Iron	1	10006112	10006112
4	Nozzle, Stainless Steel	1	10007512	10007512
4	Nozzle for Flamerod, Cast Iron	1	N/A	N/A
4	Nozzle for Flamerod, Stainless	1	N/A	N/A
5	Set Screw	2	21598	21598
5	Stainless Set Screw	2	10024663	10024663
6	Rear Cover	1	10002812	10002812
7	Screw #2 Drive	4	18933	18933
8	Nameplate	1	20729	20729
9	Lock Washer M8	13	15222 (32)	15222 (32)
10	Screw M8	4	15892 (16)	15892 (16)
11	Spark Plug	1	23045	23045
12	Peepsight	1	10509	10509
13	Pressure Tap	4	13445	13445
14	Flamerod	1	N/A	N/A
15	O-ring	2	14781	14781
16	Orifice Plate, NG	1	14802-4	14802-7
16	Orifice Plate, PR	1	14802-20	14802-13
16	Orifice Plate, BU	1	14802-19	14802-20
17	Inlet Block, Gas NPT	1	3996-3	3996-3
17	Inlet Block, Gas Rc	1	3996-4	3996-4
18	Screw M8	4	15888	15888
19	Screw M8	4	20579 (12)	20579 (12)
19	Thread Insert	8	N/A	N/A
20	Inlet Block, Air NPT	1	N/A	N/A
20	Inlet Block, Air Rc	1	N/A	N/A
20	Inlet, Welded Air	1	N/A	N/A
20	Inlet, Flanged Air	1	10005018	10005018
21	Orifice Plate, Air	1	10005107-1	10005107-4
22	Block & Holder Asy, HV	1	10007035-68	10007036-68
22	Block & Holder Asy, MV	1	10007632-68	10007632-68
22	Down Fired Block & Holder HV	1	10025711	10025708
22	Down Fired Block & Holder MV	1	10025710	10025710
23	Combustor, Alloy HV	1	10005394-1	10005394-2
23	Combustor Alloy MV	1	10007168	10007168
24	Silicon Carbide Gasket	1	N/A	N/A
25	Retaining Ring, SiC	1	N/A	N/A
26	Combustor, SiC HV	1	N/A	N/A
26	Combustor, SiC MV	1	N/A	N/A
27	UV Scanner Adapter	1	18743	18743
28	Screw FH	4	21587 (2)	21587 (2)
29	Gasket, Air Inlet	2	10006989	10006989
30	Gasket, Alloy Tube, Body	1	10006940	10006940
31	Gasket Body, Adapter Plate	1	10007000	10007000
32	Gasket Rear Cover	1	10007002	10007002
33	1/8" Plug	1	15398	15398
34	Flat Washer	12	15643	15643
35	Nut M8	12	90804	90804
36	Rear Cover Adapter Plate	1	10004488	10004488

Appendix

Notes

Conversion Factors

Metric to English

From	To	Multiply By
cubic meter (m^3)	cubic foot (ft^3)	35.31
cubic meter/hr (m^3/h)	cubic foot/hr (cfh)	35.31
degrees Celsius (°C)	degrees Fahrenheit (°F)	(°C x 9/5) + 32
kilogram (kg)	pound (lb)	2.205
kilowatt (kW)	BTU/hr	3414
meter (m)	foot (ft)	3.28
millibar (mbar)	inches water column ("w.c.)	0.401
millibar (mbar)	pounds/sq in (psi)	14.5×10^{-3}
millimeter (mm)	inch (in)	3.94×10^{-2}
MJ/Nm^3	BTU/ft^3 (standard)	2.491×10^{-2}

Metric to Metric

From	To	Multiply By
kiloPascals (kPa)	millibar (mbar)	10
meter (m)	millimeter (mm)	1000
millibar (mbar)	kiloPascals (kPa)	0.1
millimeter (mm)	meter (m)	0.001

English to Metric

From	To	Multiply By
BTU/hr	kilowatt (kW)	0.293×10^{-3}
cubic foot (ft^3)	cubic meter (m^3)	2.832×10^{-2}
cubic foot/hour (cfh)	cubic meter/hour (m^3/h)	2.832×10^{-2}
degrees Fahrenheit (°F)	degrees Celsius (°C)	(°F - 32) ÷ 5/9
foot (ft)	meter (m)	0.3048
inch (in)	millimeter (mm)	25.4
inches water column ("w.c.)	millibar (mbar)	2.49
pound (lb)	kilogram (kg)	0.454
pounds/sq in (psi)	millibar (mbar)	68.95
BTU/ft^3 (standard)	MJ/Nm^3	40.14

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Type HSR Pressure Reducing Regulator for Residential, Commercial, or Industrial Applications

Figure 1. Type HSR Pressure Regulator

Introduction

Scope of Manual

This manual provides instructions for the installation, adjustment, maintenance, and parts ordering for the Type HSR residential and/or industrial/commercial pressure regulator.

Description

The Type HSR direct-operated, spring-loaded regulators provide economical pressure reducing control in a variety of residential, commercial, and industrial applications. These regulators can be used with natural, manufactured, or liquefied petroleum gases. In addition, the Type HSR regulator has internal relief across the diaphragm to help minimize overpressure. Any outlet pressure above the start-to-discharge point of the nonadjustable relief valve spring moves the diaphragm off the relief valve seat, allowing excess pressure to bleed out through the screened spring case vent.

Specifications

Specifications for the Type HSR constructions are given on page 2. The following information is located on the spring case: type number, orifice size, spring range, and date of manufacture.

D103074X012

Specifications

Available Configurations

Type HSR: Service regulator with internal relief; this regulator meets ANSI B109.4 / CGA 6.18

Body Sizes (Inlet x Outlet) and End Connection Styles

3/4 x 3/4-inch (DN 20 x 20), 3/4 x 1-inch (DN 20 x 25), and 1 x 1-inch (DN 25 x 25) NPT
All sizes available in Globe or Angle body.

Allowable Inlet Pressures(1)

Emergency: 150 psig (10,3 bar)
Maximum Operating Pressure: See table 1

Allowable Outlet Pressures(1)

Emergency (Casing): 25 psig (1,7 bar)
Maximum Operating Pressure to Avoid Internal Parts Damage: 3 psi (0,21 bar) differential above outlet pressure setting

Outlet Pressure Ranges

See table 2

Spring Case Vent Connection

Standard: 1-inch NPT with removable screen
Optional: 3/4-inch NPT with removable screen

Internal Relief Performance

Approximate Internal Relief Start-To-Discharge Point: 6 to 12-inches w.c. (15 to 30 mbar) above outlet pressure setting
Relief Performance: See figures 3 and 4

Lockup Performance During Normal Operation

ORIFICE SIZE, INCHES (mm)	LOCKUP ABOVE SETPOINT, INCHES W.C. (mbar)
1/8 (3,2)	1 (2,5)
3/16 (4,8)	1 (2,5)
1/4 (6,3)	2 (5,0)
3/8 (9,5)	2.5 (6,2)
1/2 (12,7)	3 (7,5)

Material Temperature Capabilities(2)

-20° to 160°F (-29° to 71°C)

Pressure Setting Adjustment

Adjusting Screw

Pressure Registration

Internal

Approximate Weight

4 pounds (1,8 kg)

1. End connections for other than U.S. standards can usually be provided, consult the Fisher Sales Office or Sales Representative.
2. The pressure/temperature limits in this instruction manual and any applicable standard or code limitation should not be exceeded.

Table 1. Maximum Operating Inlet Pressure

ORIFICE SIZE, INCH (mm)	WIDE-OPEN C_g FOR RELIEF SIZING	MAXIMUM OPERATING INLET PRESSURE TO OBTAIN GOOD REGULATING PERFORMANCE
1/8 (3,2)	12.5	125 (8,6)
3/16 (4,8)	28.2	100 (6,9)
1/4 (6,4)	50.0	60 (4,1)
3/8 (9,5)	105	30 (2,1)
1/2 (12,7)	185	20 (1,4)

Table 2. Outlet Pressure Ranges

OUTLET PRESSURE RANGE	SPRING PART NUMBER	SPRING COLOR	CLOSING CAP	SPRING WIRE DIAMETER, INCH (cm)	SPRING FREE LENGTH, INCH (cm)
6 to 8-inches w.c. (15 to 20 mbar)	T14399T0012	Yellow	Black	0.067 (0,17)	3.6 (9,1)
10 to 12.5-inches w.c. (25 to 31 mbar)	T14400T0012	Silver	Black	0.072 (0,18)	4.1 (10)
12.5 to 20-inches w.c. (31 to 50 mbar)	T14401T0012	Gray	Black	0.080 (0,20)	3.6 (9,1)
20 to 35-inches w.c. (50 to 87 mbar)	T14402T0012	Pink	Black	0.93 (0,24)	3.5 (8,9)
1.25 to 2.2 psig (0,08 to 0,15 bar)	T14403T0012	Lt. Blue	Red	0.105 (0,27)	3.7 (9,3)

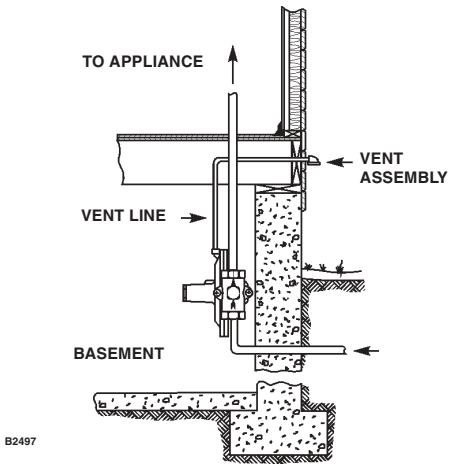

Figure 2. Typical Vent Line Installation

Installation

WARNING

Personal injury, equipment damage, or leakage due to escaping gas or bursting of pressure-containing parts might result if these regulators are overpressured or installed where service conditions could exceed the limits for which the regulators were designed, or where conditions exceed any ratings of the adjacent piping or piping connections. To avoid such injury or damage, provide pressure-relieving or pressure-limiting devices (as required by the appropriate code, regulation or standard) to prevent service conditions from exceeding those limits.

Additionally, physical damage to a regulator could cause personal injury and property damage due to escaping gas. To avoid such injury and damage, install the regulator in a safe location.

A regulator may vent some gas to the atmosphere in hazardous or flammable gas service, vented gas might accumulate and cause personal injury, death or property damage due to fire or explosion. Vent a regulator in hazardous gas service to a remote, safe location away from air intakes or any hazardous location. The vent line must be protected against condensation or clogging.

Before installing the regulator, check for damage which might have occurred in shipment. Also check for dirt or foreign matter which may have accumulated in the regulator body or in the pipeline. Apply pipe compound to the male threads of the pipeline and install the regulator so that the flow is in the direction of the arrow cast on the side of the body. The diaphragm actuator assembly can be rotated to any position relative to the body, in 90° increments. ***Remove the two cap screws (key 17) that hold the body to the actuator in order to rotate the diaphragm actuator assembly.***

Do not install the regulator in a location where there can be excessive water accumulation, such as directly beneath a downspout or in an undrained pit.

To obtain the maximum flow capacities or other performance characteristics, the length of pipe from the regulator outlet to the meter—or for the first 18 inches (457 mm), whichever is closer—should have no bends and should be the same size as the regulator outlet. Replace the regulator if water gets into the spring case or the lower casing of the regulator.

HSR Series regulators have a spring case vent (1-inch NPT female or 3/4-inch NPT female) which is screened to prevent insects or foreign material from entering.

CAUTION

You are advised to use new vent piping because defective threads on the relief vent piping may interfere with the venting assembly if the piping obstructs the movement of the vent flapper.

On indoor installations, the vent should be piped outside the building, see figure 2. Remove the screen from the regulator vent connection and connect vent piping from that connection to the outdoors. Vent piping should be as large in diameter as practical, be as short as possible, and have a minimum number of bends and elbows. Install a weather and insect resistant vent assembly on the outside end of the pipe, such as a Fisher Type Y602. The same installation precautions apply to vent assemblies as the integral regulator vents described previously.

A program of regular inspection of the vent opening should be established to see that it has not become plugged by foreign material. On some installations, such as in areas of heavy snowfall, it may be necessary to install the regulator beneath a protective hood. If other protection is provided from the elements, the vent should be pointing or sloping down sufficiently to allow any condensate to drain. Also check the regulator periodically for external or internal corrosion.

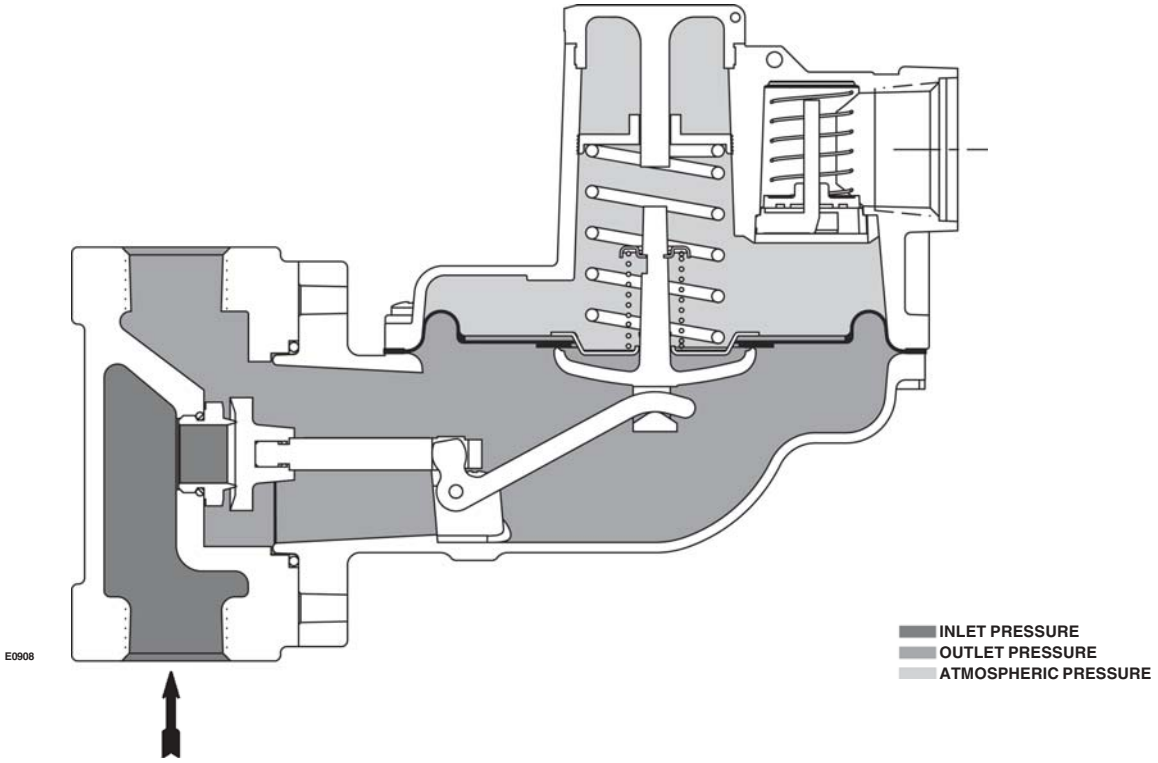

Figure 3. Type HSR Pressure Regulator Operational Schematic

Principle of Operation

Refer to figure 3. When downstream demand decreases, the pressure under the diaphragm increases. This pressure overcomes the regulator setting (which is set by a spring). Through the action of the pusher post assembly, the valve disk moves closer to the orifice and reduces gas flow. If demand downstream increases, pressure under the diaphragm decreases.

Spring force pushes the pusher post assembly downward and the valve disk moves away from the orifice.

The Type HSR regulators include an internal relief valve for overpressure protection. If the downstream pressure exceeds the regulator setting by 7-inches w.c. to 1.25 psig (17 to 86 mbar), depending on the main spring used, the relief valve opens and excess gas escapes through the vent in the upper spring case.

Overpressure Protection

WARNING

Some type of overpressure protection is needed if actual inlet pressure can exceed the outlet pressure rating. Overpressuring any portion of this equipment above the limits given in the Specification section and tables 1 and 2 may cause damage to regulator parts, leaks in the regulator, or personal injury due to bursting of pressure-containing parts or explosion of accumulated gas.

Table 3. Relief Performance

ORIFICE SIZE, INCH (mm)	MAXIMUM ALLOWABLE INLET PRESSURE IF OUTLET PRESSURE IS HELD AT OR BELOW 2 PSIG (140 mbar), PSIG (bar)
1/8 (3,2)	125 (3,6)
3/16 (4,8)	65 (4,5)
1/4 (6,4)	30 (2,1)
3/8 (9,5)	10 (0,69)
1/2 (12,7)	7 (0,48)

1. The relief performance testing is in accordance with ANSI B109.4 and CGA 6.18, with the regulator set at 7-inch (17 mbar), stem linkage disconneced, and vented directly to atmosphere using the 3/4 or 1-inch vent.

Type HSR regulators provide internal relief that limits the total outlet pressure buildup over setpoint. This internal relief may be adequate for the application, if not, provide additional pressure relief or a pressure-limiting device downstream. Regulators should be inspected for damage after any overpressure condition.

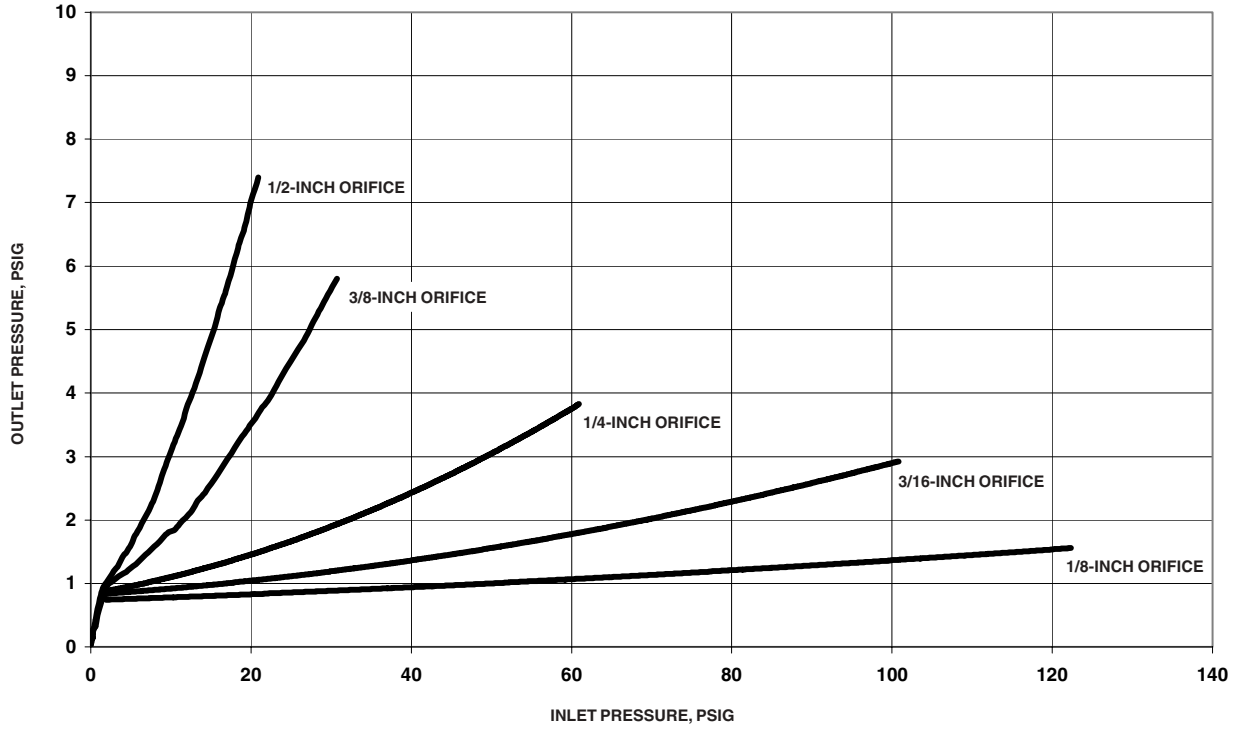

Figure 4. 7-inch w.c. Setpoint Relief Curves (with lever disconnected, no vent piping, and 3/4 or 1-inch vent)

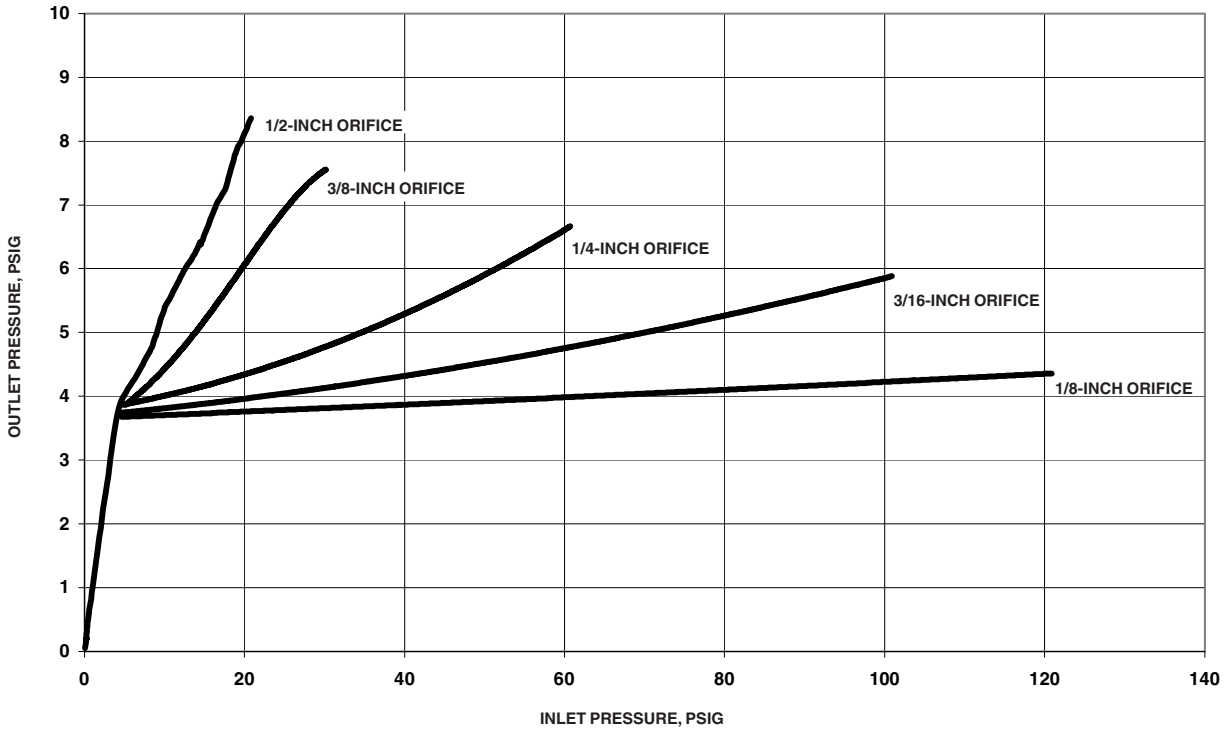

Figure 5. 2 psig Setpoint Relief Curves (with lever disconnected, no vent piping, and 3/4 or 1-inch vent)

WARNING

To avoid personal injury or property damage due to explosion or damage to regulator or downstream components during startup, release downstream pressure to prevent an overpressure condition on the diaphragm of the regulator.

In order to avoid an overpressure condition and possible equipment damage, pressure gauges should always be used to monitor pressures during startup.

Startup

1. Check to see that all appliances are turned off.
2. Slowly open the upstream shutoff valve.
3. Slowly open the downstream shutoff valve
4. Check all connections for leaks.
5. Make final control spring adjustments according to the adjustment procedures.
6. Light the appliance pilots.

Adjustment

To increase the outlet pressure setting of the regulator, the adjusting screw (key 26, figure 6) must be turned clockwise. This requires removal of the closing cap (key 8, figure 6). To reduce the outlet pressure setting, turn the adjusting screw counterclockwise. A pressure gauge should always be used to monitor downstream pressure while adjustments are being made. Do not adjust the spring to produce an outlet pressure setting above the limit identified on the information label. If the required pressure setting is not within the range of the spring being used, substitute with the correct spring, see table 2. When changing the spring, also change the range identified on the information label to indicate the actual pressure range of the spring in use. After the spring adjustment has been completed, replace the closing cap.

Shutdown

WARNING

To avoid personal injury or property damage due to explosion or damage to regulator or downstream components during shutdown, release downstream pressure to prevent an overpressure condition on the regulator diaphragm.

Installation arrangements may vary, but in any installation it is important that the valves be opened or closed slowly. These steps apply to the typical installation.

1. Slowly close the downstream shutoff valve.
2. Slowly close the upstream shutoff valve.
3. Open vent valves downstream of the regulator.
4. Open vent valves upstream of the regulator.

Maintenance

WARNING

Avoid personal injury or damage to property from sudden release of pressure or uncontrolled gas or other process fluid. Before starting to disassemble, isolate the regulator from all pressure and cautiously release trapped pressure from the regulator. Use gauges to monitor inlet, loading and outlet pressures while releasing these pressures.

These procedures are for gaining access to the diaphragm, valve disk and orifice. All pressure must be released from the diaphragm actuator assembly before the following steps can be performed.

While using the following procedures, refer to figure 6 for key number locations.

Diaphragm Replacement

1. Remove the closing cap (key 8) and adjusting screw (key 26).
2. Remove the spring case machine screws (key 9) out of the spring case (key 1), and remove the spring case and control spring (key 25).
3. Lift the diaphragm slightly, and slide it away from the lever (key 4), so that the pusher post (key 12) releases the lever.
4. Remove the spring retainer (key 14). Note the direction of the spring retainer assembly to aid in proper reassembly. Remove the relief spring (key 10).
5. Remove the diaphragm (key 11). Examine the diaphragm and replace if necessary.

6. Reassemble in the reverse order of the above procedures. Before attaching the spring retainer (key 14) to the pusher post (key 12) to secure the new diaphragm, place the loosely assembled diaphragm into position in the lower casing (key 2), being sure the pusher post is properly hooked on the lever (key 4). Rotate the diaphragm so that the diaphragm and lower casing holes align. Check the diaphragm for proper orientation. The open slot in the spring retainer is inserted from the notched side of the pusher post. Install the spring retainer (key 14) and proceed with reassembly. Tighten the spring case cap screws (key 9) to 15 to 30 inch-pounds (1,7 to 3,9 N•m).

Valve Disk and Orifice Replacement

1. Remove the cap screws (key 17) which hold the actuator assembly to the body.

2. The regulator can be removed from the body, exposing the disk (key 23) and the orifice (key 22).

3. Examine the disk. If it is nicked, cut, or otherwise damaged, the disk (key 23) should be removed from the valve stem (key 5) and replaced with a new part.

4. Examine the seating edge of the orifice (key 22). If it is nicked or rough, it should be unscrewed from the body with a thin wall 7/8-inch socket wrench and replaced with a new orifice to provide proper shutoff. Treat the male threads of the new orifice with lubricant before reassembling, tightening to 35 to 45 foot-pounds (48 to 61 N•m) of torque.

5. Reassemble in the reverse order of the above procedures. Tighten the cap screws (key 16) to 6 to 10 foot-pounds (8,1 to 13,6 N•m).

Parts Ordering

The type number, orifice size, spring range, and date of manufacture are located on the spring case. Always provide this information in any correspondence with your Fisher Sales Representative regarding replacement parts or technical assistance. If construction changes are made in the field, be sure that the information label is also changed to reflect the most recent construction.

Part List

Key	Description	Part Number
1	Spring Case Assembly	
	3/4-inch Vent	T40655T0GY2
	1-inch Vent	T40656T0GY2
2	Lower Casing	T80565T0GY2
3	Screen	T1121338982
4	Lever	T21184T0012
5	Stem	T14385T0012
6	Straight Pin	T14397T0012
7	Machine Screw (2 required)	1E175828982
8	Closing Cap	
	Black	T21187T0012
	Red	T21187T0022
9	Machine Screw (8 required)	T13526T0012
10	Relief Valve Spring, silver	T14406T0012
11	Diaphragm	T21163T0012
12	Pusher Post	T40653T0012
13	Lower Spring Seat	T14396T0012
14	Relief Spring Retainer	T13613T0012
15	Body	
	Globe Body	
	3/4 x 3/4-inch NPT	T21183T0GY2
	3/4 x 1-inch NPT	T21199T0GY2
	1 x 1-inch NPT	T21182T0GY2
	Angle Body	
	3/4 x 3/4-inch NPT	T21193T0GY2
	3/4 x 1-inch NPT	T21200T0GY2
	1 x 1-inch NPT	T21194T0GY2
16	O-Ring	12A9480X012
17	Cap Screw (2 required)	1A352624052
22	Orifice	
	1/8-inch	1A936709012
	3/16-inch	00991209012
	1/4-inch	0B042009012
	3/8-inch	0B042209012
	1/2-inch	1A928809012
23	Disc	T14386T0012
25	Spring	
	6 to 8-inches w.c., yellow	T14398T0012
	10 to 12.5-inches w.c., silver	T14400T0012
	12.5 to 20-inches w.c., gray	T14401T0012
	20 to 35-inches w.c., pink	T14402T0012
	1.25 to 2.2 psig, lt. blue	T14403T0012
26	Adjusting Screw	T21186T0012
27	Information Label	----------

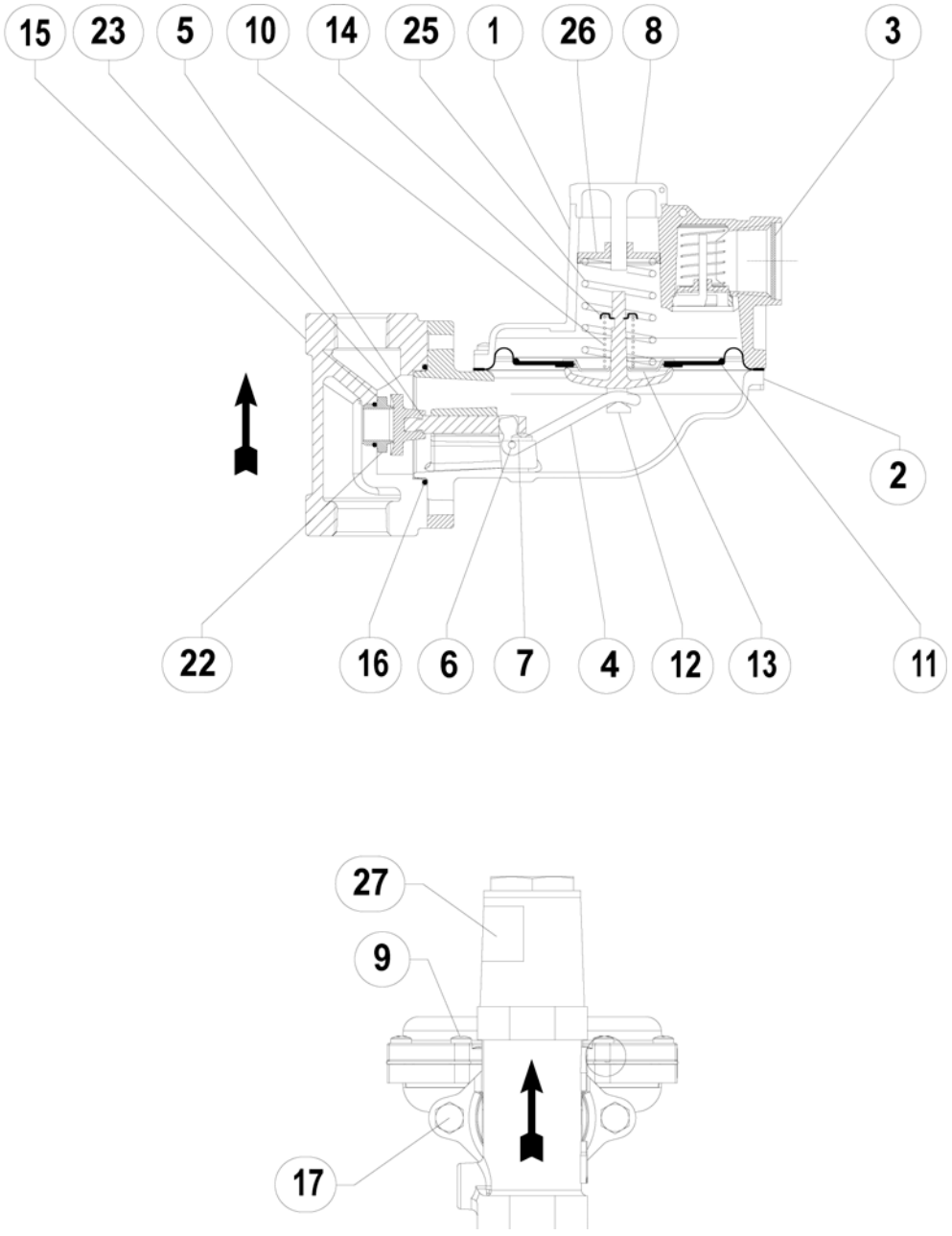

Figure 6. Type HSR Regulator Assembly

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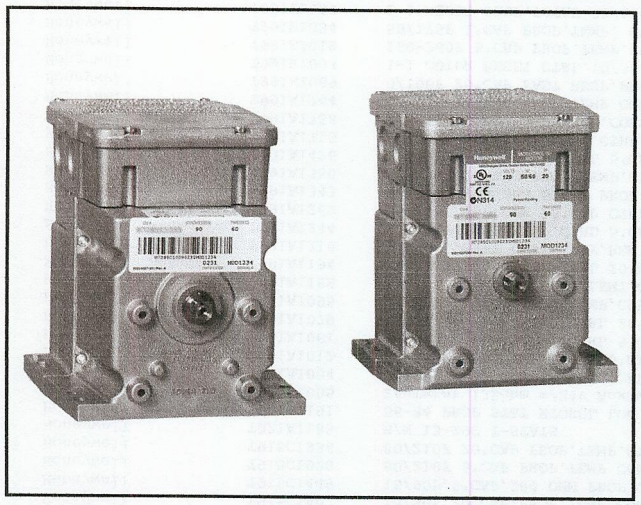
Honeywell

Series 71, 72, and 76 Modutrol IV™ Motors

PRODUCT DATA



APPLICATION

The Series 71, 72 and 76 Modutrol IV Motors are spring return and non-spring return motors used to control dampers and valves. The motors accept a current or voltage signal from an electronic controller to position a damper or valve at any point between open and closed.

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FEATURES

- **Replaces M734H,J,; M744S,T,Y; and M745L,S,T,Y Motors.**
- **M7164, M7261, M7284, and M7294 are non-spring return motors; M7282, M7285, M7286 and M7685 are spring return motors.**
- **Integral spring return returns motor to normal position when power is interrupted.**
- **Integral junction box provides NEMA 3 weather protection.**
- **Motor and circuitry operate from 24 Vac. Models available with factory installed transformer, or a field added internal transformer.**
- **Quick-connect terminals are standard—screw terminal adapter is available.**
- **Adapter bracket for matching shaft height of older motors is available.**
- **Most motors have field adjustable stroke (90° to 160°).**
- **Die-cast aluminum housing.**
- **Integral auxiliary switches are available factory mounted, or can be field added.**
- **Nominal timing standard of 30 seconds (90° stroke), and 60 seconds (160° stroke). Other timings available.**
- **Spring return motors can operate valve linkages from power end or auxiliary end shafts for normally closed or normally open valve applications.**
- **All models have dual shafts (slotted and tapped on both ends).**
- **All models have auxiliary switch cams.**
- **Fixed torque throughout the entire voltage range.**
- **Motors are designed for either normally open or normally closed valves and dampers.**
- **Models available with adjustable start (zero) and span.**
- **Models available with 4 to 20 mA input signal.**
- **Models available with 2 to 10 Vdc input signal.**

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Features 1
Specifications 2
Ordering Information 2
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Settings and Adjustments 8
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63-2640-06

SPECIFICATIONS

Models: TRADELINE models are selected and packaged to provide ease of stocking, ease of handling and maximum replacement value. TRADELINE model specifications are the same as those of standard models unless specified otherwise.

IMPORTANT

The specifications given in this publication do not include normal manufacturing tolerances. Therefore, an individual unit may not exactly match the listed specifications. Also, this product is tested and calibrated under closely controlled conditions and some minor differences in performance can be expected if those conditions are changed.

Modutrol IV Order Number Guide: See Table 4.

Dimensions: See Fig. 2.

Controller: These motors can be used with any electronic controller that provides a stable noise-free proportional current output as specified in Electrical Ratings, Input Range below.

Electrical Ratings:
Power Consumption: See Table 1.
Input Range:
- Current, Nonadjustable: 4 to 20 mA nominal, 25 mA maximum.
- Current, Adjustable: 4 to 20 mA adjustable, 50 mA maximum.
- Zero/Null (Motor Closed): 0.0 to 18 mA.
- Span: 1.8 to 20 mA.
- Voltage, Nonadjustable: 2 to 10 Vdc.

Input Impedance:
- 4 to 20 mA Input: 100 ohms.
- 2 to 10 Vdc Input: 400K ohms.

Auxiliary Switch Ratings (in Amps): See Table 2.

Stroke: Most models available with field adjustable strokes from 90° to 160°. Stroke adjusted by means of potentiometers located in the wiring compartment.

Timing: Nominal 30 seconds for 90° stroke and 60 seconds for 160° stroke.

Dead Weight Load On Shaft: 200 lb (91 kg) on motor power or auxiliary end; maximum combined load of 300 lb (136 kg).

Ambient Temperature Ratings: -40 to 150°F (-40 to 66°C).

Shaft: 3/8 in. (9.5 mm) square.

Motor Rotation:
Closed: Counterclockwise rotation limit as viewed from motor power end.
Mechanically Normally Closed: Spring return. Normally closed motors rotate to closed position on power loss.
Electrically Normally Closed: Both spring return and non-spring motors return to closed position on minimum signal.

Table 1. Series 72 Modutrol IV Motor Power Consumption Ratings (at 120 Vac, 50/60 Hz).

Model	Power Consumption	
	VA	Watts
M7261	15	13
M7282	20	18
M7284	15	13
M7285	20	18
M7286	20	18
M7294	15	13

Table 2. Auxiliary Switch Ratings (in Amps).

One Contact Rating[a]	120V	240V
Full Load	7.2	3.6
Locked Rotor	43.2	21.6

[a] 40 VA pilot duty, 120/240 Vac on opposite contact.

Approvals:
Underwriters Laboratories Inc. Listed: File No. E4436; Guide No. XAPX for USA and Canada.
U.S. Patents: pending

Table 3. Primary 50017460-001 Color Code

Lead Color	Primary Voltage
Brown	24 VAC
White	120 VAC
Blue	230 VAC
Black	Common

ORDERING INFORMATION

When purchasing replacement and modernization products from your TRADELINE® wholesaler or distributor, refer to the TRADELINE® Catalog or price sheets for complete ordering number.

If you have additional questions, need further information, or would like to comment on our products or services, please write or phone:

1. Your local Honeywell Automation and Control Products Sales Office (check white pages of your phone directory).
2. Honeywell Customer Care
   1885 Douglas Drive North
   Minneapolis, Minnesota 55422-4386

In Canada—Honeywell Limited/Honeywell Limitée, 35 Dynamic Drive, Toronto, Ontario M1V 4Z9.
International Sales and Service Offices in all principal cities of the world. Manufacturing in Australia, Canada, Finland, France, Germany, Japan, Mexico, Netherlands, Spain, Taiwan, United Kingdom, U.S.A.

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Fig. 1. Stroke

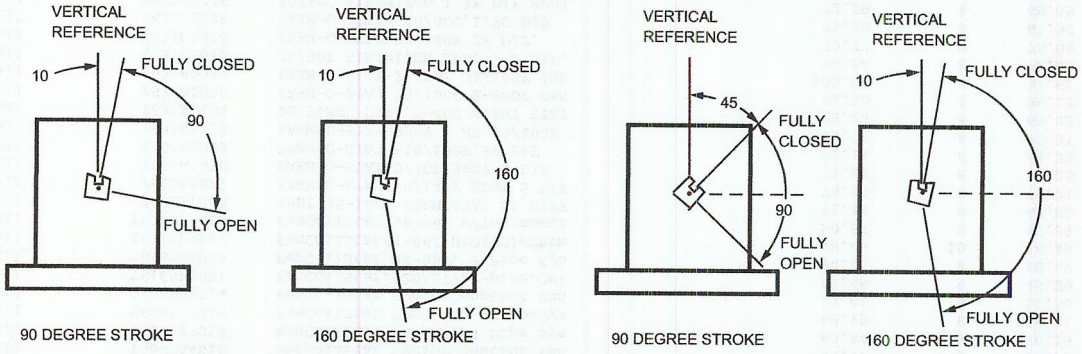

Table 4. Modutrol IV Motors Series 2 Version Order Number Guide.

M	Motor						
	71	10.5 - 13.5 Vdc voltage input					
	72	4-20 mA or 2-10 Vdc Control					
	76	14-17 dc voltage control with minimum position capability					
		6	—		35 lb-in. Non-Spring Return		
		7	—		75 lb-in. Non-Spring Return		
		8	60 lb-in. Spring Return		150 lb-in. Non-Spring Return		
		9	—		300 lb-in. Non-Spring Return		
			2	Dual-ended shaft		Normally Closed Spring Return	
			4			Non-Spring Return	
			5			Normally Closed Spring Return	
				A	0 Auxiliary Switches	Adjustable Stroke *	Normally Closed
				B	1 Auxiliary Switch		
				C	2 Auxiliary Switches		
				D	0 Auxiliary Switch		
				Q[a]	2 Auxiliary Switches		

M	**72**	**8**	**4**	**A**	**XXXX**	See Tradeline Catalog for Complete Model Number

[a] Adjustable zero and span.
* Fixed stroke on M7284C1083, M7284C1091, M7284Q1082, and M7284Q1090

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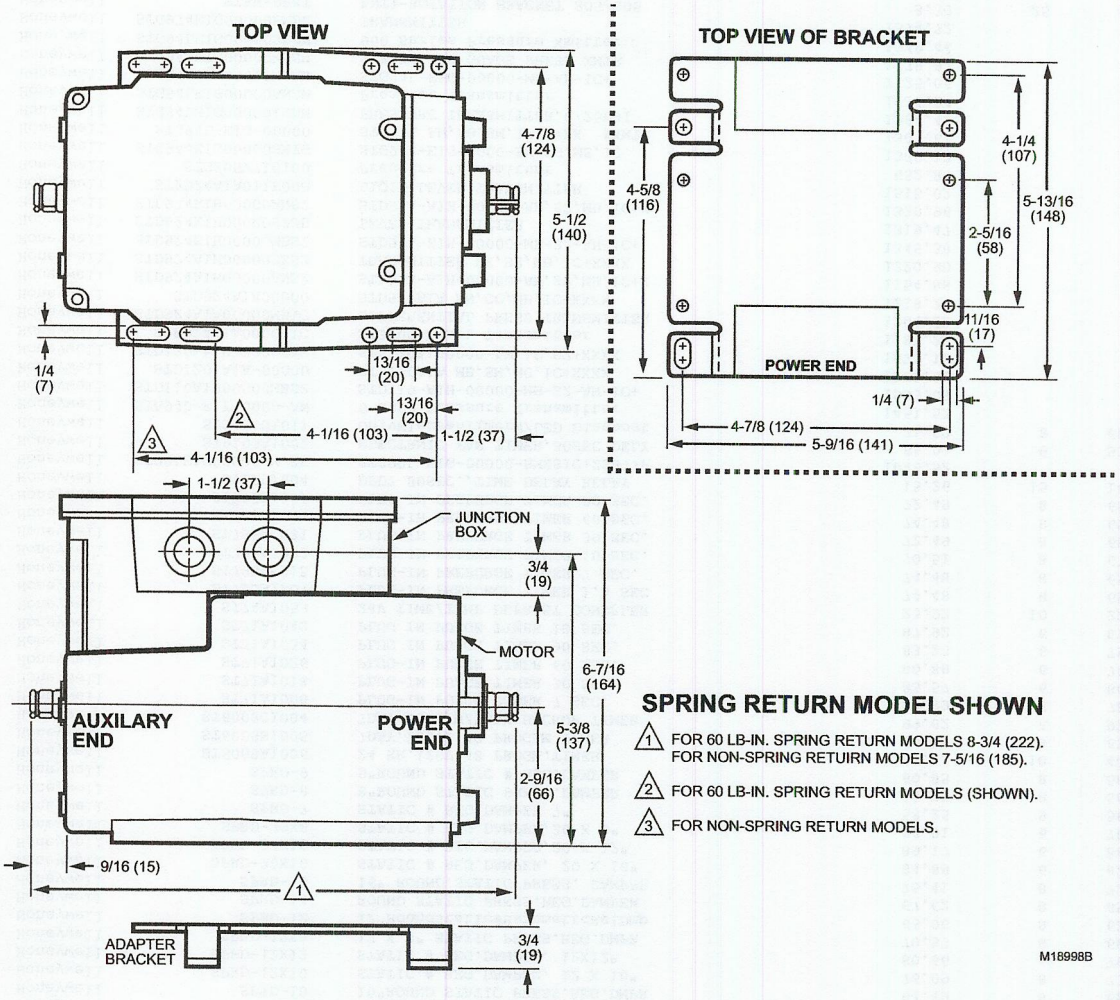

Fig. 2. Series 72 Modutrol IV Motor dimensions in inches (mm).

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Accessories:
220736A Internal Auxiliary Switch Kit; one switch. Can be field-installed.
220736B Internal Auxiliary Switch Kit; two switches, can be field-installed on TRADELINE models.
220738A Adapter Bracket raises motor shaft height by 3/4 in (19 mm) to match that of previous Modutrol Motor models.
220741A Screw Terminal Adapter converts the standard quick-connect terminals to screw terminals.
221455A Infinitely Adjustable Crank Arm, can rotate through downward position and clear motor base without requiring an adapter bracket.
4074ERU Weatherproofing Kit provides NEMA 3 rating for Modutrol IV Motors mounted in position other than upright.
50017460-001 Internal Transformer; 24/120/230 Vac 50/60 Hz primary, 24 Vac secondary, quick connect terminals.
50017460-003 Internal Transformer; 120 Vac 50/60 Hz primary, 24 Vac secondary, quick connect terminals.
7617ADW Crank Arm, can rotate through downward position and clear motor base without requiring an adapter bracket.
Q100 Linkage connects Modutrol Motor to V51 Butterfly Valve. Requires the 220738A Adapter Bracket.
Q181 Auxiliary Potentiometer for sequence or unison control of 1 to 4 additional modulating (Series 90) motors.
Q209E,F Manual Potentiometer for Modutrol Motors
Q5001 Bracket and Linkage Assembly connects Modutrol IV Motor to water or steam valve.
Q605 Damper Linkage connects motor to damper. Includes motor crank arm.
Q607 External Auxiliary Switch controls auxiliary equipment as a function of motor position.
ES650-117 Explosion-Proof Housing encloses motor for use in explosive atmospheres. Not for use with Q5001 (or any other valve linkages).
Order separately from EGS Enclosures in Houston, TX.
To order contact
Karen Barfield
Phone: (281) 774-3763
Email: Karen.barfield@egseg.com
http://www.appletonelec.com
Part number ES-650-117
You need to order a 7617DM coupling assembly from Honeywell to use with the cover.

INSTALLATION

When Installing this Product...

1. Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.
2. Check the ratings given in the instructions and on the product to make sure the product is suitable for your application.
3. Installer must be a trained, experienced service technician.
4. After installation is complete, check out product operation as provided in these instructions.

⚠ CAUTION

Electrical Shock or Equipment Damage Hazard.
Can shock individuals or short equipment circuitry.
Disconnect all power supplies before installation. Motors with auxiliary switches can have more than one disconnect.

⚠ CAUTION

Equipment Damage Hazard.
Can damage the motor beyond repair.
Never turn the motor shaft by hand or with a wrench. Forcibly turning the motor shaft damages the gear train and stroke limit contacts.

IMPORTANT

Always conduct a thorough checkout when installation is complete.

Location

Allow enough clearance for accessory installation and motor servicing when selecting a location (see Fig. 2). If located outdoors, use liquid-tight conduit connectors with the junction box to provide NEMA 3 weather protection. If mounted outdoors in a position other than upright, install a 4074ERU Weatherproofing Kit and liquid-tight connectors to provide NEMA 3 protection.

⚠ CAUTION

Motor Damage Hazard.
Deteriorating vapors and acid fumes can damage metal parts.
Install motor in areas free of acid fumes and other deteriorating vapors.

In excessive salt environments, mounting base and screws should be zinc or cadmium plated, not stainless steel or brass. Use the 220738A Adapter Bracket for mounting on these surfaces.

Mounting

Use the following guidelines for proper motor mounting:
- Always install motors with the crankshaft horizontal.
- Mounting flanges extending from motor housing base are drilled for 1/4 inch (6.4 mm) machine screws or bolts.
- Non-Spring Return Motors are shipped from the factory in the closed position (at the counterclockwise rotation limit, as viewed from the motor power end).
- Spring Return Motors are shipped from the factory in their normal position.
- Normally closed models are shipped at the counterclockwise rotation limit, as viewed from the motor power end.

Adapter Bracket

The 220738A Adapter Bracket, positioned between the motor and the equipment, raises motor shaft height by 0.75 in. (19 mm) to match that of previous Modutrol Motor models.

The following applications require this bracket:
- Q607 External Auxiliary Switch.
- Damper linkage applications requiring added clearance to allow:
  - — Crank arm rotation through the downward position.
  - — Sufficient damper linkage to reach the motor shaft.
- All valve linkages except the Q5001.

NOTE: When the bracket is not used in a replacement application, the damper linkage requires adjustment for the new shaft position.

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To mount the motor with the bracket:

1. Mount the bracket to the equipment with existing or standard bolts.
2. Using the provided bolts, mount the motor to the bracket threaded holes. See Fig. 3.

For valve linkage applications (other than the Q5001):

1. Mount the bracket to the linkage.
2. Position the motor on the bracket to align the motor shaft with the linkage.
3. Attach the motor to the bracket with the four bolts provided. See Fig. 4.

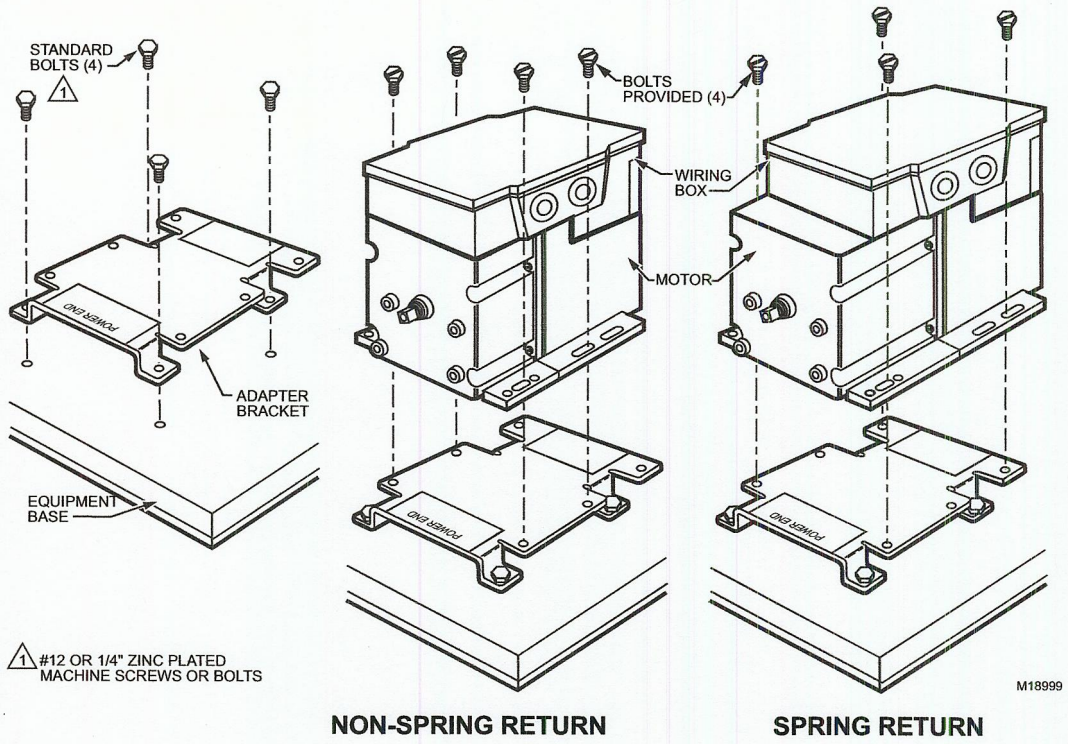

Fig. 3. Mounting the motor with an adapter bracket.

Damper Linkages

The motor does not include a crank arm. Order the crank arm separately (see Accessories in the Specifications section). For detailed instructions on the assembly of specific linkages, refer to the Installation Instructions packed with the linkage.

⚠ CAUTION

Equipment Damage Hazard.
Stalling a motor can damage the drive shaft.
Ensure installation of motors and linkages allows the motor to drive through full stroke without obstruction.

Valve Linkages

The Q100 Linkage requires a 220738A Adapter Bracket for all valve applications. Applications with the Q5001 Valve Linkage do not require the 220738A Adapter Bracket (see Fig. 4).

For detailed instructions on specific linkage assemblies, refer to the instruction sheet packed with the linkage. In general, check the following points when installing a motor and linkage:

- Adjust valve and louver-type damper linkages so the damper or valve moves through only the maximum required distance while the motor moves through its full stroke.
- With modulating control, maximum damper opening should be no more than 60 degrees. Little additional airflow is provided beyond this point.
- Do not exceed load and torque ratings in any application.

Junction Box

When used with liquid-tight conduit connectors, the junction box provides NEMA 3 weather protection for the motor. The junction box, standard with replacement motors, encloses the terminals and provides knockouts for wiring conduits. Housing an internal transformer or internal auxiliary switches requires using a junction box.

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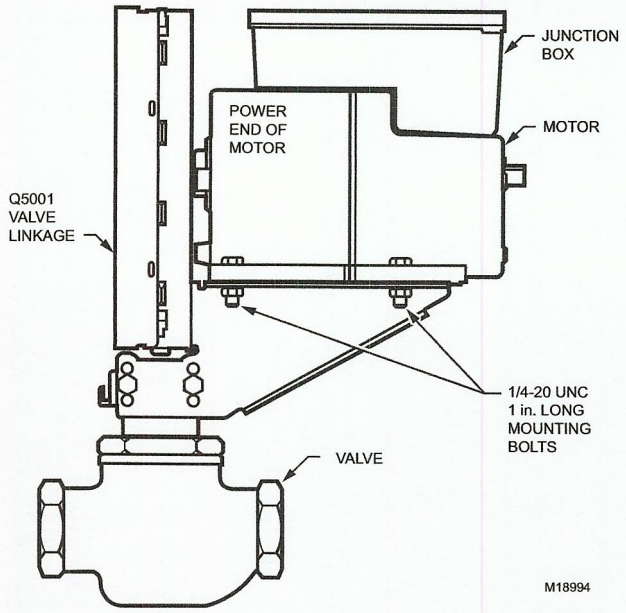

Fig. 4. Mounting the motor on a Q5001 Valve Linkage.

Wiring

⚠ CAUTION

Electrical Shock or Equipment Damage Hazard.
Can shock individuals or short equipment circuitry.
Disconnect all power supplies before installation.
Motors with auxiliary switches can have more than one disconnect.

IMPORTANT

All wiring must agree with applicable codes, ordinances and regulations.

1. Ensure that the voltage and frequency stamped on the motor correspond with the power supply characteristics.
2. When connecting several motors in parallel, ensure that the power supply VA rating is large enough to provide power to all motors used without overloading.
3. Fig. 10 shows that motor terminals are quick-connects located on top of the printed circuit board.
4. To access the wiring compartment:
   a. Remove the four screws from the junction box top.
   b. Lift off the cover.
5. Refer to Fig. 5 through 8 for wiring.

Wire the motor as follows:

1. Remove the wiring box cover by removing the four screws holding the cover to the motor.
2. Wire motor to system using quick-connect terminals in wiring box.
3. Replace wiring box cover.

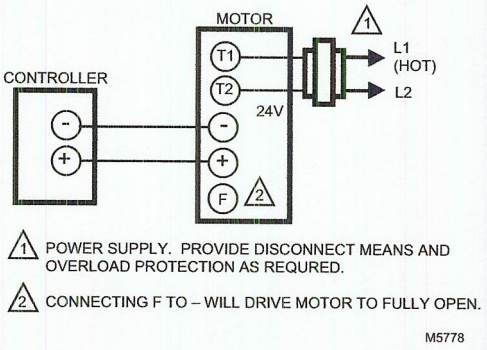

Fig. 5. Typical system wiring.

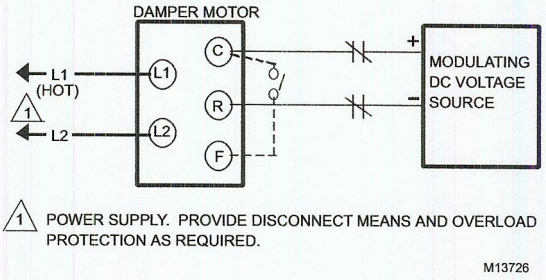

Fig. 6. Series 71 optional override switches to drive motor open or closed.

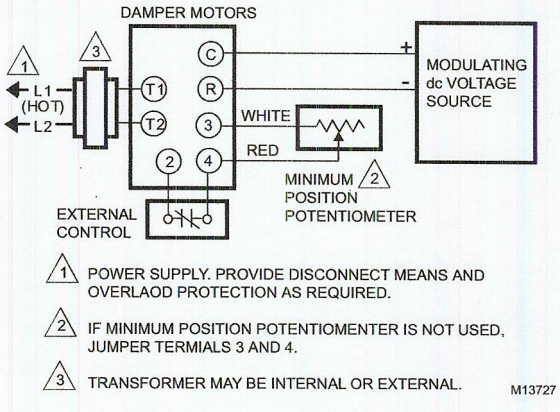

Fig. 7. M7685 Typical application wiring.

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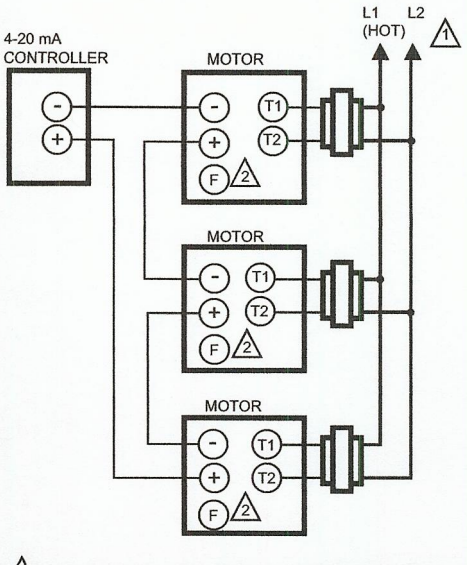

Fig. 8. Driving up to six motors from one 4 to 20 mA controller.

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SETTINGS AND ADJUSTMENTS

Before Setting Stroke

1. Remove the top cover from the motor.
2. Disconnect the controller from the motor.
3. For models with an internal transformer (line voltage motors), ensure that power (and nothing else) remains connected to the motor.

IMPORTANT

Detach linkage from motor before adjusting stroke.

⚠ CAUTION

Careless Installation Hazard.
Use of excessive force while adjusting cams damages the motor.
To avoid damaging motor end switches, set cams by moving only the screwdriver top.

⚠ CAUTION

Equipment Damage Hazard.
Can damage the motor beyond repair.
Never turn the motor shaft by hand or with a wrench. Forcibly turning the motor shaft damages the gear train and stroke limit contacts.

Adjustable Stroke

All models except for M7284C1083, M7284C1091, M7284Q1082, and M7284Q1090.

When viewing from the power end of the motor, the stroke potentiometer is to the far left. To set the stroke to 160° (maximum position) turn the potentiometer fully clockwise ↷, using a 1/8 in. straight-blade screwdriver. To set the stroke at 90° (minimum position) turn the potentiometer fully counter-clockwise ↶. Setting the potentiometer anywhere between fully clockwise and fully counter-clockwise will set the stroke between 160° and 90°.

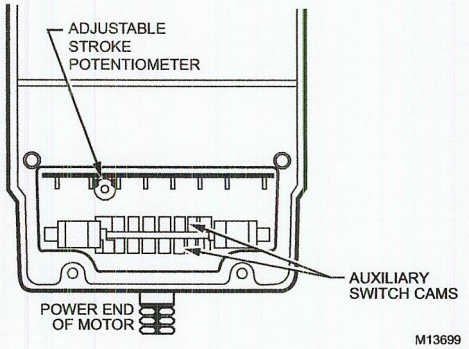

Fig. 9. Stroke adjustment setup

Zero and Span Adjustment for M7284Q, M7285Q, and M7294Q

M7284Q, M7285Q, and M7294Q actuators have the capability of adjustable zero and span. Fig. 10 shows the module with the zero and span potentiometers.

Zero: Sets input voltage to define the 0% angle of rotation. It is factory set to minimum position and can be adjusted to the maximum position of 20mA or 10V.

Span: Adjusts motor response to travel a full stroke through the selected input span. It is factory set to maximum position, and is adjustable from 4-20mA or 2-10Vdc.

1. Adjust the start potentiometer fully clockwise (maximum zero) and the span potentiometer fully counterclockwise (minimum span). See Fig. 10.
2. Set the controller current to the value required to drive the motor to the closed position.
3. Turn the start potentiometer slowly counterclockwise until the motor begins to open. This is defined as the start or zero setting.
4. Set the controller current to the value required to drive the motor to the fully open position. The motor will open.
5. Turn the span potentiometer clockwise until the motor starts to close. The difference between the fully open span position current and the zero position current is defined as the operating span.
6. Recheck the start and readjust the span potentiometer if necessary. Turn the start potentiometer clockwise to increase the zero position.
7. Recheck the span and readjust the span potentiometer if necessary. Turn it clockwise to increase the full span position.
8. For sequential operation, as shown in Fig. 11, repeat the above steps for each motor.

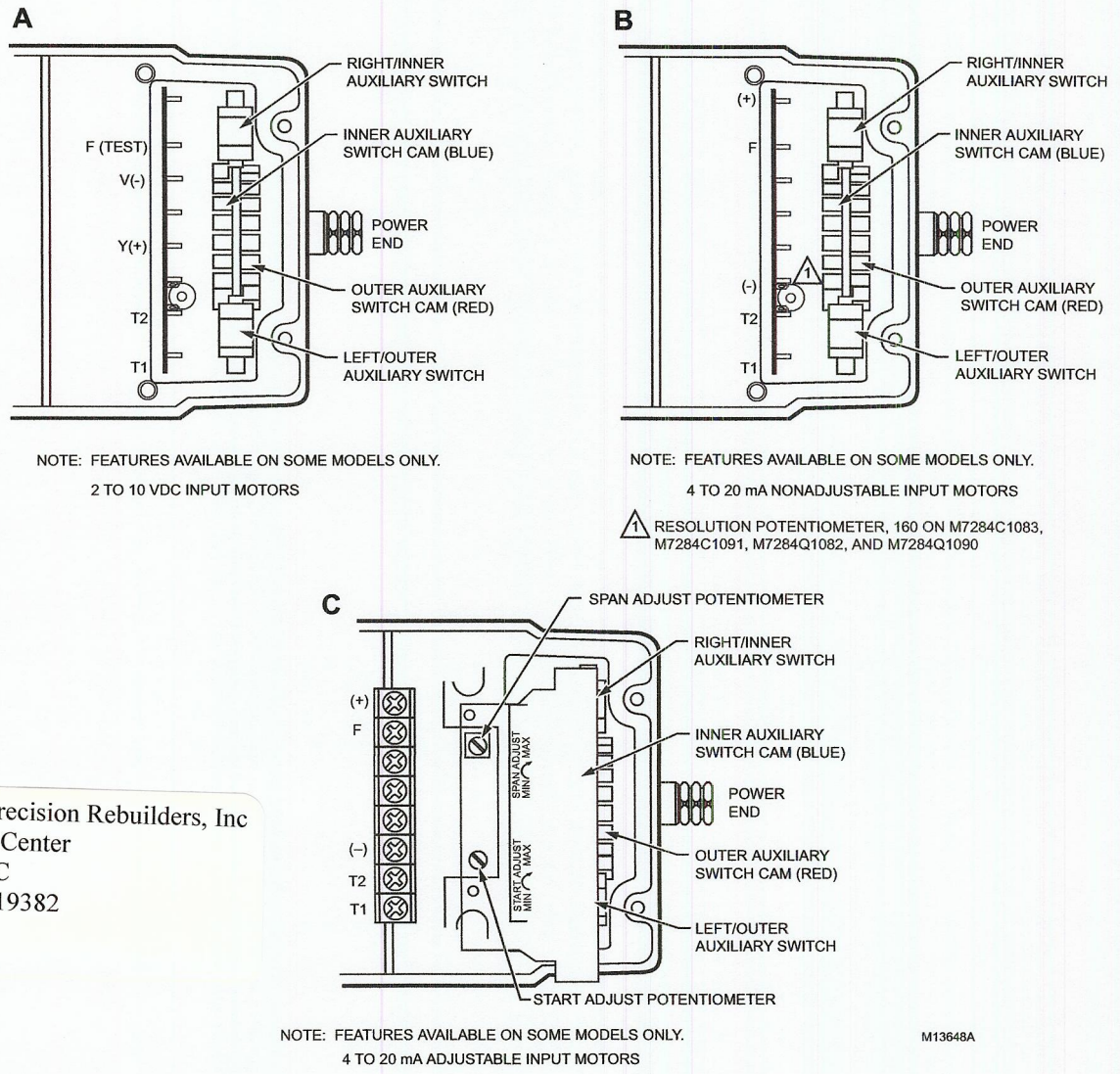

Fig. 10. Terminals and adjustments.

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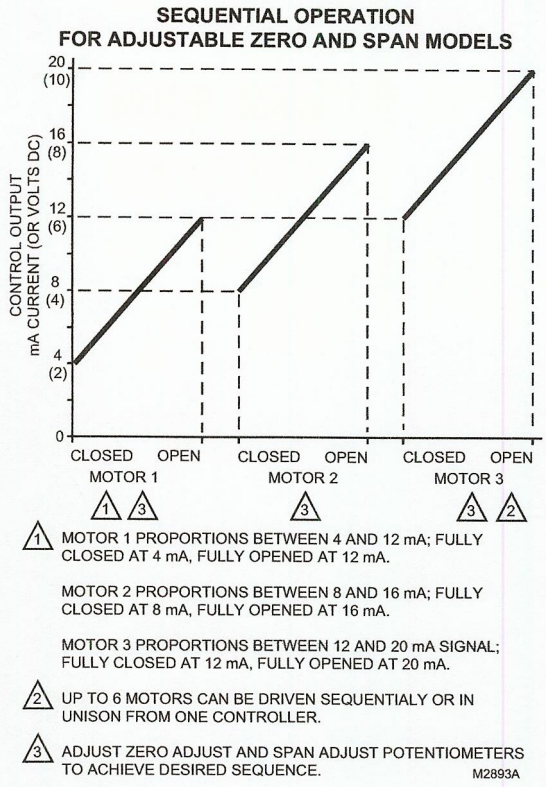

Fig. 11. Sequential operation of motors.

Enhanced Resolution M7284C1083, M7284C1091, M7284Q1082, and M7284Q1090

These four motors have enhanced resolution with 160 repositions (steps) from 90 degrees to 160 degrees stroke.

Auxiliary Switches

⚠ CAUTION

Electrical Shock or Equipment Damage Hazard.
Can shock individuals or short equipment circuitry.
Disconnect all power supplies before installation.
Motors with auxiliary switches can have more than one disconnect.

⚠ CAUTION

Equipment Damage Hazard.
Can damage the motor beyond repair.
Never turn the motor shaft by hand or with a wrench. Forcibly turning the motor shaft damages the gear train and stroke limit contacts.

Adjustable cams actuate the auxiliary switches. These cams can be set to actuate the switches at any angle within the motor stroke. Select switch differential of 1° or 10°.

Motors with factory added auxiliary switches are shipped in the closed position (fully counterclockwise, as viewed from the motor power end) with auxiliary cams set to actuate switches 30° from the closed position and to provide 1° degree differential. With the motor in the closed (fully counter-clockwise) position, the auxiliary switch breaks contacts R-B. See Fig. 12 for auxiliary switch wiring.

Series 2 Motors are shipped with auxiliary switch cams that permit acceptance of 220736A,B Internal Auxiliary Switch Kits. Refer to form 63-2228 for 220736A,B Installation Instructions.

Auxiliary Switch Adjustment

IMPORTANT

When adjusting the auxiliary switch cams use the following procedure:

1. *Insert 1/8 in. screwdriver blade into a slot on cam and move the screwdriver top as far as possible in the required direction. See Fig. 12.*
2. *Repeat step 1 in successive cam slots until the cam is in the required position.*

NOTE: Series 2 Motors are shipped with auxiliary switch cams that permit acceptance of 220736A,B Internal Auxiliary Switch Kits. Refer to Form no. 63-2228 for 220736A,B Installation Instructions.

Use the following procedure to obtain the desired auxiliary switch settings:

1. Remove the top cover from the motor to gain access to the motor terminals and auxiliary cams.
2. Disconnect the controller from the motor.
3. Connect a current source to the positive and negative terminals.
4. Drive the motor to the position where the auxiliary equipment is to be switched by increasing or decreasing the current.
5. For a switch differential of 1°, check continuity of auxiliary switch contacts R-B and rotate the cam as follows:
   a. If the contacts are open, rotate the cam clockwise until the R-B contacts close.
   b. If the contacts are closed, rotate the cam counterclockwise until the R-B contacts open.
6. For a switch differential of 10° rotate the cam approximately 180° so the slow-rise portion of the cam actuates the switch.
7. Check continuity of the auxiliary switch contacts R-B.
8. Rotate the cam as follows:
   a. If the contacts are open, rotate the cam counterclockwise until the R-B contacts close.
   b. If the contacts are closed, rotate the cam clockwise until the R-B contacts open.
   c. Make final adjustment in the proper direction to obtain contact make or break at the desired position.
9. Check for the proper differential and switching of the auxiliary equipment by driving the motor though the full stroke in both directions.
10. Disconnect power, remove current source, reconnect the controller, and replace the top cover on the motor.

NOTE: Changing the differential from 1° to 10° reverses the switching action. For example, with a 10° differential, switch contacts R-B make and R-W break on a counterclockwise (closed) rotation. With a 1° differential, switch contacts R-W make and R-B break on a counterclockwise (closed) rotation.

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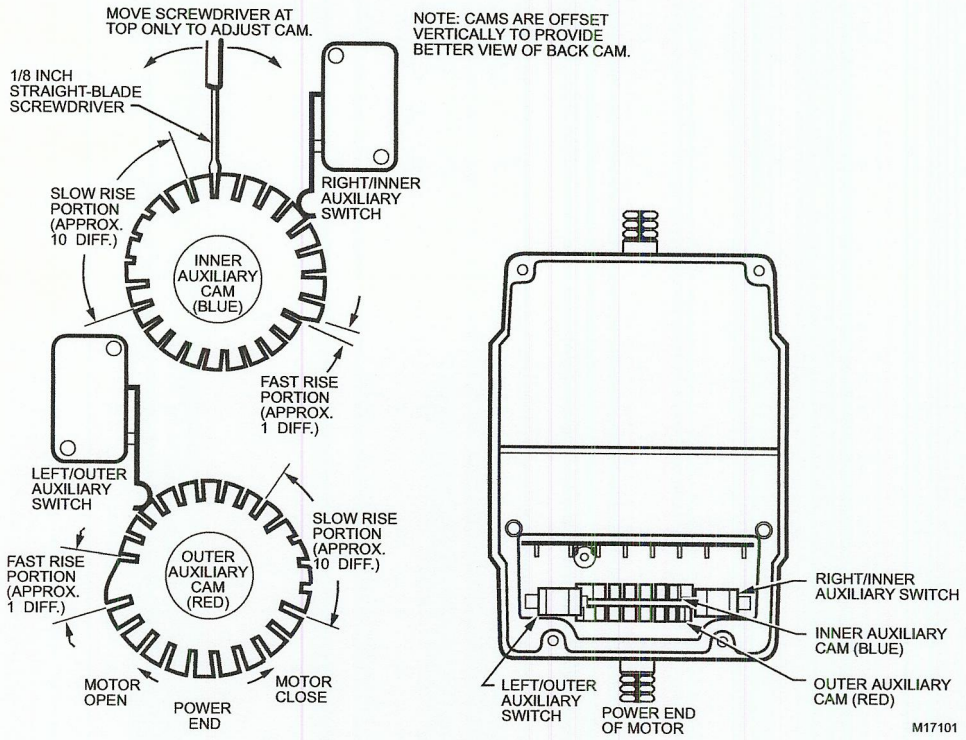

Fig. 12. Auxiliary switch adjustment.

OPERATION AND CHECKOUT

Operation

The internal shaft position feedback potentiometer in conjunction with the actuator microprocessor and modulating input circuit form a control loop. When the external controller's output remains at a fixed amplitude the actuator's shaft position is held at a position proportional to that input amplitude. When the value of the external controllers output changes the actuator responds by initiating movement of the motor to proportionately compensate for the change in input amplitude. When the motor reaches the control loop balance point the system is again in a static state and the actuator holds position until the next change of input from the external controller.

M7685 motor also have a minimum position feature. An external 130 ohm potentiometer wired to terminals 3 and 4 establishes a position beyond which the control input cannot close the motor. If power to the T1-T2 is interrupted the M7685 motor will spring close.

Checkout

After installation and linkage adjustment, operate the motor through the controller. Make sure that:

- The motor properly operates the damper or valve.
- The motor responds properly as the input is varied.
- The auxiliary switch, if used, operates at the desired point of motor rotation.

Inspect the motor, linkage, and valve or damper to see that all mechanical connections are correct and secure.

In damper installations, the pushrod should not extend more than a few inches past the ball joints. Check to see that there is adequate clearance for the linkage to move through its stroke without binding or striking other objects.

See controller or system instructions for additional checkout procedures.

Motor Operation Checkout

Check motor operation as follows:

1. To close the motor, open terminals +, -, and F.
2. To open the motor, connect terminal F to the negative (-) motor terminal.

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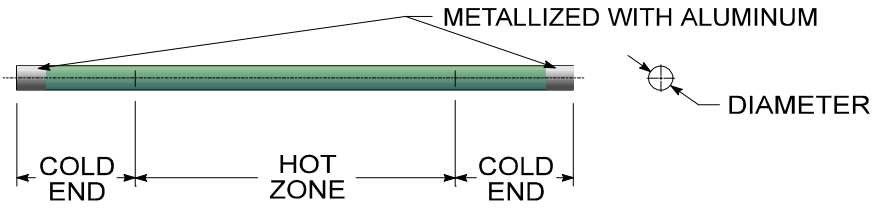
TYPE RR , SILICON CARBIDE HEATING ELEMENTS

GENERAL DESCRIPTION

The RR Starbar is a resistance type silicon carbide heating element. Starbars are rod shaped or tubular depending on the diameter. They have a central heating section referred to as a hot zone and two terminal sections called cold ends. There are two types of RR Starbars. (1)The cold ends are impregnated with silicon metal -- referred to as *one piece*, and (2) low resistance cold ends which are furnace welded to the hot zone -- referred to as a *three piece* or LRE (Low Resistance End) type. This lower electrical resistance cold end causes them to operate at a lower temperature. The extremities of the elements are metallized with aluminum to provide a low resistance contact surface to which the electrical connections are made using braided aluminum straps.



RR Starbars are described by giving the overall length, the heating section length, and the diameter. As an example, RR 43 x 24 x 1 is a Starbar 43" overall with a 24" hot zone, and 1" in diameter.

SUPERIOR PERFORMANCE

Starbars will give you superior performance due to their high density -- approximately 2.4 gms/cc. This gives the Starbar very slow aging characteristics and additional strength.

INTERCHANGEABILITY

Starbars are interchangeable with all silicon carbide heating elements manufactured in the United States as well as higher resistance heating elements manufactured for the Asian and European markets. It is important to provide the nominal electrical resistance when ordering Starbars. Please contact us, before attempting to substitute

SIZES AVAILABLE

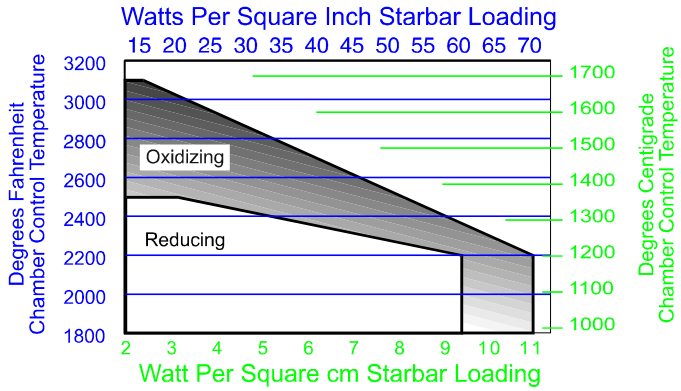
Starbars can be manufactured in any length up to 130 inches (3300mm). The maximum hot zone length is 98 inches (2500mm).

Starbar®

Silicon Carbide Heating Elements

I SQUARED R ELEMENT CO., INC.

Recommended Maximum Watt Loading
(Figure 1)



OPERATING TEMPERATURES

In an air or inert atmosphere of argon or helium the one piece Starbars can be operated at furnace control temperatures up to 3100°F (1700°C), the *three piece* Starbar up to 2600°F (1425°C). In reducing atmospheres the maximum operating temperature is 2500°F (1370°C), see Figure 1. There is a protective coating of silicon dioxide on the silicon carbide. Hydrogen reduces this coating and causes the Starbar to deteriorate. Very dry or very wet hydrogen is detrimental to long service life.

Nitrogen atmosphere applications are limited to 2500°F (1370°C) and 20 to 30 watts per square inch (3.1 to 4.6 watts per square centimeter) maximum surface watt loading. Too high of a surface temperature will result in a silicon nitride reaction. A thermally insulative layer forms around the Starbar resulting in very high surface temperatures which damage the Starbars.

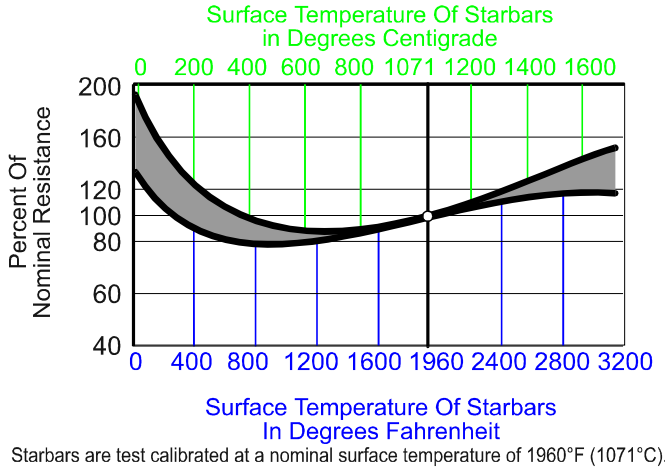
ELECTRICAL CHARACTERISTICS

The silicon carbide Starbar is a linear type resistance heater that converts electrical energy to heat energy -- Joule's Law $W = I^2 \times R$, (W = power in watts, I = current in amperes, R = resistance in ohms).

The Starbar hot zone is a self bonded silicon carbide. The lattice structure or bonds that hold the silicon carbide grain together are formed by recrystallizing the silicon carbide at very high temperatures. Starbars are manufactured of green silicon carbide that is classed as an excess electron type semiconductor.

The electrical resistance of a Starbar is difficult to measure at room temperature due to minor impurities, self heating, and contact resistance. Also the green silicon carbide has a negative resistance temperature characteristic from

Resistance Temperature Characteristics
(Figure 2)



Starbars are test calibrated at a nominal surface temperature of 1960°F (1071°C).

room temperature to approximately 1200°F (650ºC). It turns positive at this point and remains so throughout its normal operating temperature range. A typical resistance temperature characteristic curve of a Starbar is shown in Figure 2.

Nominal Starbar resistance is measured at the calibrating temperature of 1960ºF (1071°C). Nominal resistance values of Starbars in ohms per unit of length are shown in Table A, page 5.

ELECTRICAL LOADING

Starbars are not sized to a specific wattage output like metallic heating elements. The amount of energy that a Starbar is capable of converting from electrical to heat energy depends on the ambient furnace temperature and atmosphere in which the Starbar is operating.

When calculating the wattage capabilities of a Starbar, the unit of watts output per unit of radiating surface area is used. Figure 1 shows the recommended watt loading for a square inch or square centimeter of radiating surface as a function of furnace temperature.

To determine the recommended wattage capabilities of the Starbars start with Figure 1, knowing the furnace temperature and atmosphere in which the Starbars will be operated. Follow the temperature line until you intersect the heavy black line (choosing the appropriate line according to the atmosphere in which the Starbar will be operating). Read the loading in watts per square unit of radiating surface that can be applied to the Starbar. To find the total amount of power one Starbar could supply under these conditions, multiply this value by the radiating surface of the Starbar. The radiating surface area is calculated by multiplying the diameter times the hot zone length times pi (3.14).

Example: At 2750°F the Starbar could be loaded to 35 watts per square inch. Therefore, a Starbar with 10 square inches of radiating surface could supply 350 watts, whereas a Starbar with 200 square inches of radiating surface could supply 7000 watts.

(At 1500°C the Starbar could be loaded to 6 watts per square centimeter. Therefore, a Starbar with 100 square centimeters of radiating surface could supply 600 watts, whereas a Starbar with 2000 square centimeters of radiating surface could supply 12,000 watts).

Example of radiating area:
The RR 43 x 24 x 1 has a hot zone length of 24 inches on a diameter of 1 inch. The radiating surface area is 24 x 1 x 3.14, or 75.4 square inches. (The RR 1092 x 610 x 25 has a hot zone length of 610mm and a diameter of 25mm. The radiating surface area is 610 x 25 x 3.14 or 47,885 square mm, converted to centimeters is 478 square centimeters).

POWER SUPPLY

In the previous paragraph we explained how to calculate the recommended wattage output of the Starbar. Now we shall explain how to compute the electrical requirements to provide the recommended power.

Knowing the wattage output and the resistance of the Starbar you have two parts of an equation with three unknowns. This equation is
$E = \sqrt{}$ (W x R), (E = nominal full load voltage, W = rating of the Starbar in watts, R = resistance of the Starbar in ohms). The resistance of the Starbar can be calculated using the values found in Table A.

When solving for E, you would obtain the voltage required on a nominal resistance Starbar to provide the wattage output desired.

Example: A Starbar RR 43 x 24 x 1 has a resistance of 1.21 ohms and 75 square inches of radiating surface. Loading to 40 watts per square inch, this Starbar could provide 3000 watts. To find the nominal voltage solve for E.

$E = \sqrt{}$ (W x R)
$E = \sqrt{}$ (3000 x 1.21)
E = 60 volts

Starbars may be connected in parallel, series, or combination thereof. Parallel connections are preferred.

In a parallel arrangement the voltage across all the Starbars is the same. In the formula $W = E^2 \div R$, (W = watts, E = voltage, R = resistance) it can be seen that the greater the resistance, the lower the wattage output. The Starbars in the parallel circuit with the lowest resistance will supply more heat energy and therefore operate at a higher temperature. This higher Starbar temperature will cause it to gradually increase in resistance until all the Starbars have the same resistance. At this time the Starbars should all have approximately the same resistance values and surface temperatures and therefore remain in balance.

To compute the network resistance of a group of Starbars the following formula may be used: $Rn = R \times S \div P$ (Rn = network resistance, R = resistance of Starbar, S = number of Starbars connected in a series, P = number of parallel circuits).

Example: Eight Starbars RR 43 x 24 x 1 (R = 1.21 ohms) connected 2 in series (S = 2) and 4 parallel groups (P = 4).

$Rn = R \times S \div P$
$Rn = 1.21 \times 2 \div 4$
$Rn = 0.6$ ohms

To compute the nominal voltage required to power a set of Starbars, we shall use a combination of the formulas used in the two previous examples. $En = \sqrt{(Wt \times Rn)}$, (En = nominal network voltage, Rn = network resistance, Wt = total wattage output).

Example: Eight Starbars RR 43 x 24 x 1 (R= 1.21 ohms) connected 2 in series, 4 parallel groups. Each Starbar provides 3000 watts. Wt = 8 x 3000 = 24,000 watts. Rn = 0.60 ohms.

$En = \sqrt{(Wt \times Rn)}$
$En = \sqrt{(24{,}000 \times 0.6)}$
$En = 120$ volts

The resistance of Starbars increases gradually during their useful life. Therefore, some means of keeping the power input to the kiln or furnace at a level sufficiently high to maintain the desired temperature is required.

Historically, expensive voltage varying equipment such as multiple tap transformers or saturable reactors were recommended for all but the very low temperature applications.

Starbars can be used directly on the line (fixed voltages) at temperatures up to 2400°F (1315°C). To compensate for the reduced output as the Starbars gradually age or increase in resistance, the furnace or kiln is initially overpowered by 25% to 50%. This type of arrangement eliminates the expensive voltage varying equipment and has proven very satisfactory in many applications. It is not recommended when fine process temperature control is required.

Assume a furnace will require approximately 24,000 watts after all heat losses and load factors have been considered. Increasing this 24,000 by 25% to 50% gives a wattage requirement of between 30,000 and 36,000 watts.

By taking another look at the previous examples it can be seen that 10 Starbars RR 43 x 24 x 1 connected two in series, five parallel groups on 120 volts would supply the 30,000 watts. If 12 Starbars of the same size were used, the output would be 36,000 watts. Twelve Starbars connected four in series per phase on 240 volts would make a balanced three phase 240 volt network.

The temperature of the kiln or furnace is controlled by an off-on controller. When the Starbars are new they will only be powered for 24/30 or 24/36 of an hour. As the Starbars increase in resistance they will be on for a greater percentage of the time. When they have increased in resistance to a point at which they supply 24,000 watts, they will be on 100% of the time. A SCR (silicon controlled rectifier) or thyrister can also be used.

For applications where close temperature control is desired and/or for temperatures above 2400ºF (1315ºC) a device for increasing the voltage to the Starbars is required. There are several methods of providing this variable voltage source:

(1) The multiple tap transformer is the most common, because it is usually the least expensive. The secondary of the transformer is provided with taps which usually vary in number from 10 to 36. By carefully selecting the voltage taps, the correct voltage output to match the resistance of the Starbars over their complete useful life can be made.

(2) Saturable reactors and induction regulators are used to provide a stepless voltage control. They are also sometimes used with multiple tap transformers.

(3) Capacitor controls are used infrequently. They, of course, will tend to improve a power factor, which makes their use desirable in some areas.

(4) Silicon controlled rectifiers, (SCR) have become quite popular with the advances in solid state devices.

To compensate for the reduced output as the Starbars increase in resistance, a voltage range is required that will compensate for a 100% increase in the Starbar resistance. The following formula may be used to calculate Emax : Emax = $\sqrt{}$(Wt x Rn) x 1.5, (Emax = recommended maximum voltage required to compensate for increase in resistance due to aging and resistance tolerance, Wt = rating of transformer in watts, Rn = network resistance of the Starbars, 1.5 = minimum margin to accommodate the doubling of the Starbar resistance and the +20% resistance tolerance). A higher value will offer slightly longer usable service life.

Example: The transformer is rated at 24 KVA and has a computed nominal full load voltage of 120 volts. (Rn = 0.6, Wt = 24,000).

Emax = $\sqrt{}$ (Wt x Rn) x 1.5
Emax = $\sqrt{}$ (24,000 x 0.6) x 1.5
Emax = 180 volts

Table A

RR Starbar Dimensions				**** RR Electrical Resistance**			
Diameter		* Maximum Overall Length		Ohms Hot Zone		Ohms Cold Ends	
MM	Inch	MM	Inch	Ohms / MM	Ohms / Inch	Ohms / MM	Ohms / Inch
10	3/8	660	26	0.01372	0.3486	0.000686	0.01743
11	7/16	915	36	0.01009	0.2563	0.000505	0.01282
13	1/2	1090	42	0.00773	0.1963	0.000387	0.00982
16	5/8	1250	50	0.00497	0.1262	0.000248	0.00631
19	3/4	1575	62	0.00341	0.0865	0.000170	0.00433
25	1	1900	74	0.00197	0.0500	0.000098	0.00250
32	1-1/4	2210	86	0.00134	0.0343	0.000067	0.00171
35	1-3/8	2290	90	0.00106	0.0270	0.000053	0.00135
38	1-1/2	2340	92	0.00092	0.0234	0.000046	0.00117
45	1-3/4	2670	104	0.00065	0.0165	0.000032	0.00082
54	2-1/8	3300	130	0.00059	0.0150	0.000030	0.00075

* Recommended overall length = 70% of listed maximum length
** All resistance values are +/-20%

The nominal full load voltage and maximum voltage have been computed. When specifying the transformer the nominal full load voltage is usually reduced by 5% to 10% to allow for the minus 20% resistance tolerance of the Starbars. Also, lower voltage taps are usually provided for idling and slow heatups.

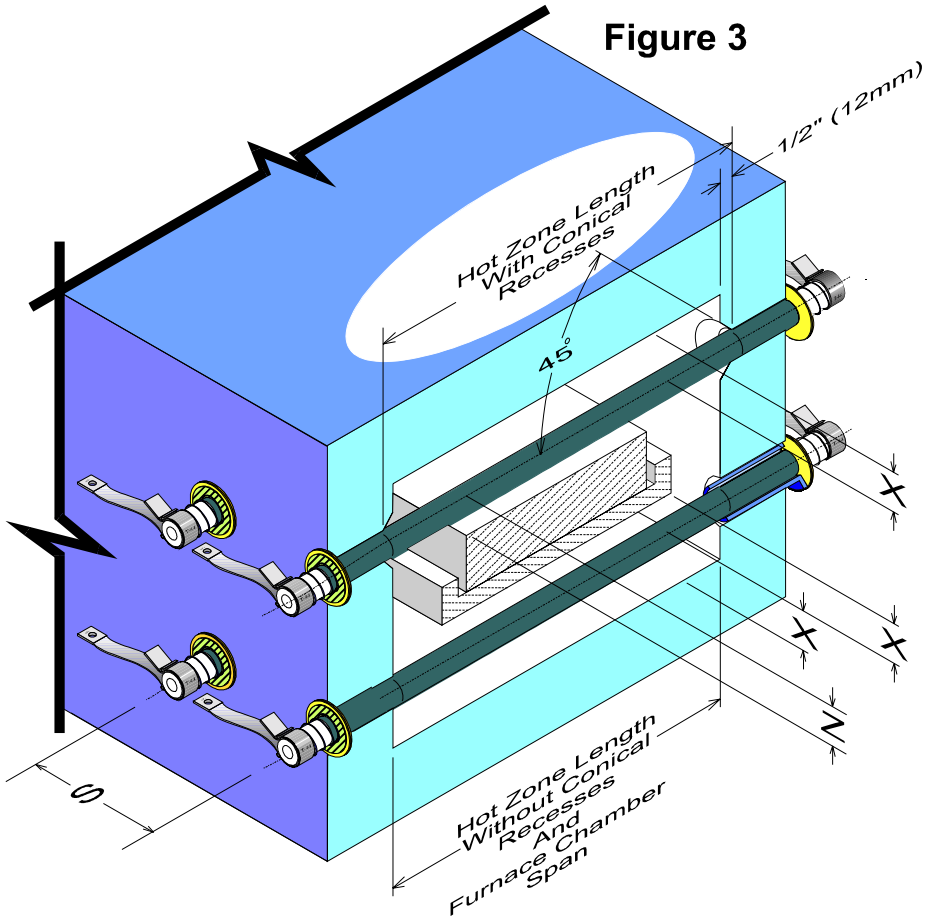
To calculate the minimum voltage, take 70% of the nominal voltage. For periodic applications, take 30% of the nominal full load voltage.

Auto transformers may be used if primary voltage is 230 volts or less. They should not be used in a three phase arrangement. Accepted practice limits the secondary voltage on all transformers to 300 volts. Above this refractory voltage leakage becomes a problem. When computing the size of the voltage steps between taps, a value of 5% of the nominal full load voltage is often used. When SCR or thyrister controls are used on the primary, fewer taps are required. For example, if 6 taps are used, the idling tap can be 0.7 x nominal voltage, then each consecutive tap would be 14% higher. For 8 taps, the idling tap would again be 0.7 x nominal voltage, each consecutive tap at 9.1% higher than the preceding.

EASE OF REPLACEMENT

Starbars can be replaced while the furnace is at operating temperature. The power to the Starbars being changed should be shut off, the spring clips and aluminum braid released, and the old Starbar removed. The new Starbar should be inserted smoothly through the hot furnace with sufficient speed to insure that the aluminum is not melted off the terminal end but not so fast as to cause thermal shock.

Figure 3



Recommended Starbar Spacing

X = 2 x Starbar Diameter is the Minimum, 1.5 x Starbar Diameter is the absolute Minimum and requires a reduced Starbar Surface Watt Loading

Z = S ÷ 1.41 Minimum for Stationary Loads

Z = S ÷ 1.73 Minimum for Moving Loads

S = 2 x Starbar Diameters Minimum

X - is the distance from the centerline of the Starbar to any other reflecting surface, such as a refractory wall or product

Z - is the distance from the centerline of the Starbar to a moving or stationary load

S - is the distance from the centerline of the Starbar to the centerline of an adjacent Starbar

SERVICE LIFE

Starbars increase gradually in resistance with use. This characteristic of increasing in resistance is called aging. Aging is a function of the following:

(1) Operating temperature
(2) Electrical loading (usually expressed in watts per square inch or watts per square centimeter of Starbar radiating surface)
(3) Atmosphere
(4) Type of operation (continuous or intermittent)
(5) Operating and maintenance techniques

MOUNTING

There are no restrictions on the mounting positions of Starbars, although the horizontal and vertical positions are the more common. Extreme caution should be used when mounting to ensure that the Starbars are not placed in tension. There should be adequate freedom to allow for the furnace and Starbars expand and contract independently.

When mounting Starbars vertically they must be supported on the lower end by electrically insulated supports.

Starbars should have their heating sections centered in the furnace chamber so that no portion of the heating section extends into the furnace wall. A conical or truncated cone shaped recess 1/2 inch (13mm) deep is sometimes located on each interior wall where the Starbar passes through. This allows the hot zone to radiate properly and helps maintain a uniform temperature in the kiln.

FURNACE HEATING CHAMBER

The furnace heated chamber dimension, which the Starbar spans, can be the same as the hot zone length of the Starbar as shown by the Starbars under the load in Figure 3. Alternately the furnace heating chamber dimension, which the Starbar spans, can be one inch (25mm) less than the effective heating length of the Starbar. In this case there must be a 45° conical recess in the furnace wall as shown in Figure 3 for the Starbars above the load. Recommended terminal hole diameters for various refractory walls and Starbar sizes are shown in Table B.

Starbars should not be placed closer than two Starbar diameters to each other or one and one half Starbar diameters to a wall or other reflecting body. If the Starbar is not able to dissipate heat energy equally in all directions, it may cause local overheating and possible failure.

Table B
Recommended Minimum Refractory Hole Size

		Minimum Hole Diameter Based on Refractory Wall Thickness									
Starbar Diameter		*100*	*150*	*200*	*300*	*400*	*3*	*5*	*6.5*	*9*	*13.5*
MM	Inch	MM	MM	MM	MM	MM	Inch	Inch	Inch	Inch	Inch
10	3/8	15	15	16			9/16	9/16	5/8		
11	7/16	16	17	18	20		5/8	11/16	11/16	3/4	
13	1/2	18	19	20	22	--	11/16	3/4	3/4	13/16	--
16	5/8	21	22	23	25	--	13/16	7/8	7/8	15/16	--
19	3/4	25	25	26	28	--	15/16	1	1	1-1/16	--
25	1	31	32	33	35	37	1-3/16	1-3/16	1-1/4	1-1/4	1-7/16
32	1-1/4	38	39	40	42	44	1-1/2	1-1/2	1-9/16	1-9/16	1-11/16
35	1-3/8	41	42	43	45	47	1-5/8	1-5/8	1-11/16	1-11/16	1-13/16
38	1-1/2	44	44	46	48	50	1-3/4	1-3/4	1-13/16	1-7/8	1-15/16
45	1-3/4	51	52	53	55	57	2	2-1/16	2-1/16	2-1/8	2-3/16
54	2-1/8	61	62	63	65	67	2-3/8	2-7/16	2-7/16	2-1/2	2-9/16

The formula for computing the recommended Starbar spacing to obtain an even temperature gradient on the product being heated is shown in Figure 3.

SPECIFICATIONS AND MATCHING

Starbars have a manufactured tolerance of plus or minus 20% on the nominal resistance. All Starbars are calibrated at least twice prior to shipping to ensure their being within specifications. The calibrated amperage of each Starbar is marked on the carton and right hand end of each Starbar. When installing, arrange Starbars with amperage values as close to each other as available. Longer service life will be obtained when series connected Starbars are matched in resistance. Starbars are shipped as closely matched as possible.

AVAILABILITY

Starbars can be shipped from stock, or two to three weeks after receipt of an order.

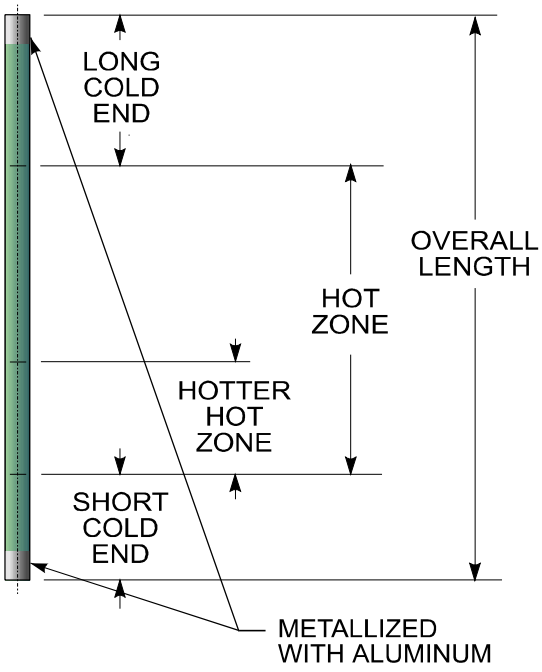
CUSTOM CONFIGURATIONS

Special sizes and shapes are available. Cold ends can be different lengths. This, for example, would be applicable for furnaces with arched roofs that require longer cold ends through the roof and shorter through the floor.

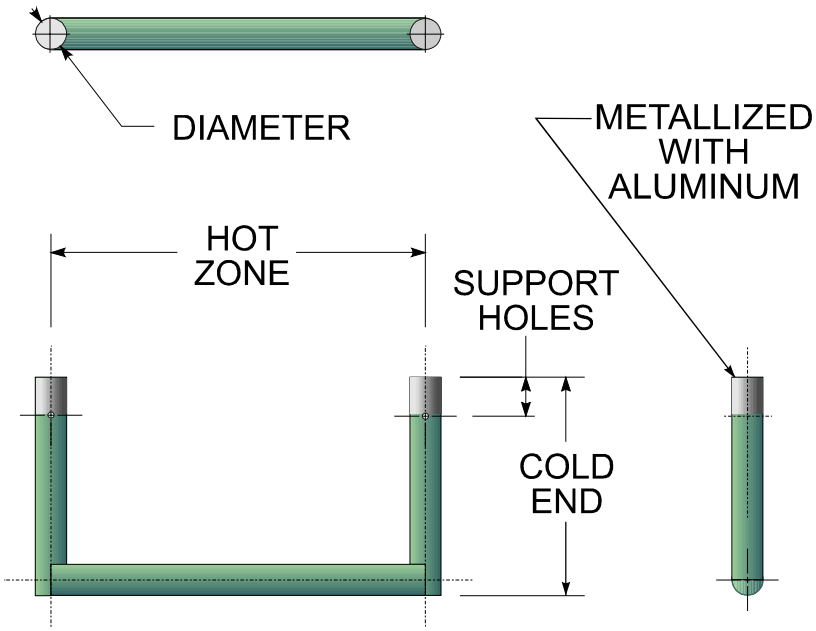
Another modification is a two-temperature hot zone. This, for example, would be helpful to get additional heat energy into the lower, more densely loaded tunnel kiln. While this special modified hot zone will not create a specific temperature differential, it does offer a convenient way to get more heat energy into a specific area of a furnace.

The right angle (RA) shown here, has all the electrical characteristics of the RR. The cold ends are attached perpendicular to the hot zone. The RA is normally installed with the cold end through the roof of the furnace.

TWO TEMPERATURE
ODD ENDED STARBAR



RA



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TERMINAL GASKET ASSEMBLY:

The TGA consists of two ceramic fiber washers, one steel washer, and a spring.

The TGA is used as an alternative to packing ceramic fiber insulation around the Starbar cold end. Ceramic fiber insulation is often used at the cold face of the furnace to help reduce furnace energy losses.

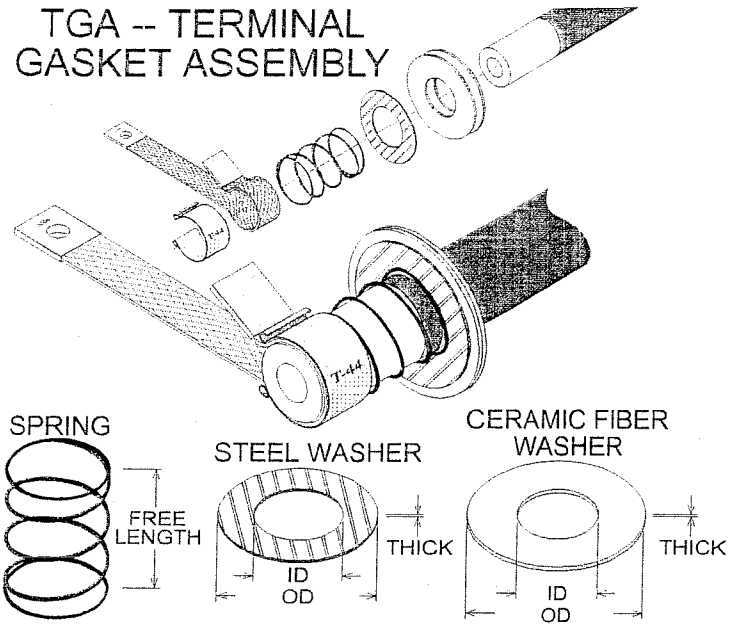
There are advantages to using the TGA rather than packing ceramic fiber insulation around the Starbar. Because the TGA is spring-loaded it allows the Starbar freedom of movement. If ceramic fiber is packed too tightly it can cause tremendous physical stresses to be exerted to the Starbars, possibly leading to failures due to breakage. Freedom of movement is important because there is movement between the Starbars and the furnace walls created by different thermal expansion rates.

Installing of TGA is also quicker than packing with ceramic fiber.

Neither of these methods are intended to be an atmosphere seal. It is to help reduce radiant energy losses, and to a smaller degree some convection heat losses.

There are two free spring lengths, 1 inch (25mm) and 3 inches (75mm). The last digit of the part number is used to call out the free spring length.

AVAILABILITY: Most sizes are available from stock. Others can be shipped in one week, or quicker for emergencies.



Note: The strap and clamp are shown for illustrative purposes and are not supplied with the TGA assembly.

TERMINAL GASKET ASSEMBLY

Starbar Diameter		* Part Number	Steel Washer ID		Steel Washer OD		Ceramic Fiber Washer ID		Ceramic Fiber Washer OD	
MM	Inch		MM	Inch	MM	Inch	MM	Inch	MM	Inch
10	0.38	TGA-10-_	11	7/16	25	1	9.5	3/8	32	1-1/4
11	0.44	TGA-11-_	13	1/2	32	1-1/4	11	7/16	38	1-1/2
13	0.50	TGA-13-_	14	9/16	32	1-1/4	13	1/2	38	1-1/2
16	0.63	TGA-16-_	17	21/32	35	1-3/8	16	5/8	45	1-7/8
19	0.75	TGA-19-_	21	13/16	38	1-1/2	19	3/4	51	2
25	1.00	TGA-25-_	27	1-1/16	51	2	25	1	64	2-1/2
32	1.25	TGA-32-_	33	1-5/16	70	2-3/4	30	1-3/16	83	3-1/4
35	1.38	TGA-35-_	36	1-7/16	70	2-3/4	35	1-3/8	83	3-1/4
38	1.50	TGA-38-_	40	1-9/16	70	2-3/4	37	1-7/16	83	3-1/4
44	1.75	TGA-44-_	47	1-7/8	83	3-1/4	43	1-11/16	95	3-3/4
54	2.12	TGA-54-_	56	2-7/32	89	3-1/2	51	2	101	4
64	2.50	TGA-64_	63	2-1/2	105	4-1/8	63	2-1/2	114	4-1/2
70	2.75	TGA-70-	73	2-7/8	105	4-1/8	70	2-3/4	114	4-1/2

For All TGA:	MM	Inch
Free Spring Length	25 or 75	1 or 3
Ceramic Fiber Washer Thickness	approx. 3.2	approx. 1/8

* The last digit of the part number represents the Free Spring Length in Inches, either 1 or 3.

Parts can also be purchased separately. When ordering separately the steel washers, ceramic fiber washers, and springs are designated by TW-_ _, TG-_ _, and TS-_ _-1 or TS-_ _-3 respectivelv.

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Conforms to MSS SP-110

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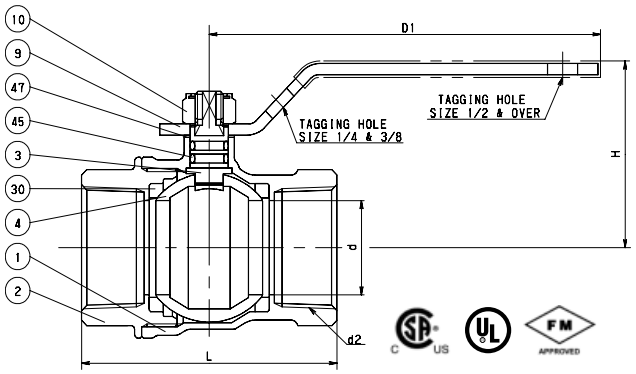

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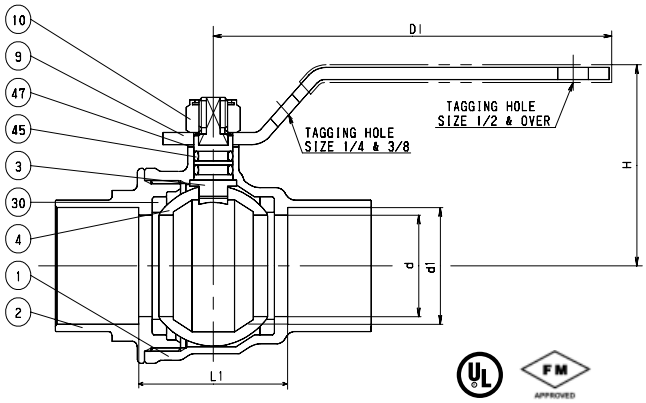

STANDARDS	
END TO END	KITZ
THREADED ENDS	ANSI B1.20.1
SOLDER JOINT ENDS	ANSI B16.18
WALL THICKNESS	KITZ
DESIGN	MSS SP-110

PRESSURE/TEMPERATURE
150 PSI SATURATED STEAM TO 366ºF
600 PSI - NON-SHOCK COLD WATER, OIL OR GAS

**SEE VALVE INSTALLATION INSTRUCTIONS/PRESSURE TEMPERATURE LIMITATIONS FOR COPPER TUBE AND SOLDER JOINT VALVES - Page P-29 & 30.*

MATERIAL LIST

NO.	NAME OF PART	SPECIFICATION
1	BODY	FORGED BRASS (B283, C37700)
2	BODY CAP	FORGED BRASS (B283, C37700)
3	STEM	(1) BRASS ROD (B16)
4	BALL	(2) FORGED BRASS (B283, C37700) STRAIGHT OR HOLLOW BALL
9	HANDLE	(3) CARBON STEEL
10	HANDLE NUT	CARBON STEEL
30	BALL SEATS	PTFE
45	O-RINGS	FPM
47	THRUST WASHER	PBT

NOTES:
(1) Ni PLATING
(2) CR. PLATING
(3) ELECTROPLATED ZINC WITH PLASTIC COVERING

DIMENSIONS - WEIGHTS - QUANTITIES

d2 SIZE	d	H	D1	L	L1	d1 Max.	d1 Min.	APPROX. NET WT.	CARTON QTY
1/4	.39	1.46	2.76	-	1.11	-		29	120
3/8	.39	1.46	2.76	1.65	1.04	.506	.502	29	120
1/2	.59	1.57	3.15	2.08	1.13	.631	.627	29	96
3/4	.79	1.69	3.15	2.36	1.37	.881	.877	45	60
1	.98	1.97	4.33	2.83	1.64	1.132	1.128	60	36
1 1/4	1.26	2.16	4.33	3.31	1.99	1.382	1.378	68	24
1 1/2	1.57	2.52	5.90	3.62	2.35	1.633	1.628	50	16
2	1.97	2.83	5.90	4.33	2.85	2.133	2.128	71	16

OPTIONS :
OVAL HANDLE
EXTENDED STEM
MEMORY STOP

CERTIFICATIONS:
**CSA (US/C):
ASME B16.33 – 125G
AGA 3-88 – 2/5G
CGA 9.1 M97/ANSI 21.15-1997 – .5G
CGA 3.16-M88 – 125G
CGA CR 91-002 - 2G
CGA 9.2 M-88 – .5G
UL-258 – 175 WWP (Fire Protection Trim Valves)
FM-1140 – 175 WWP (Fire Protection Systems)

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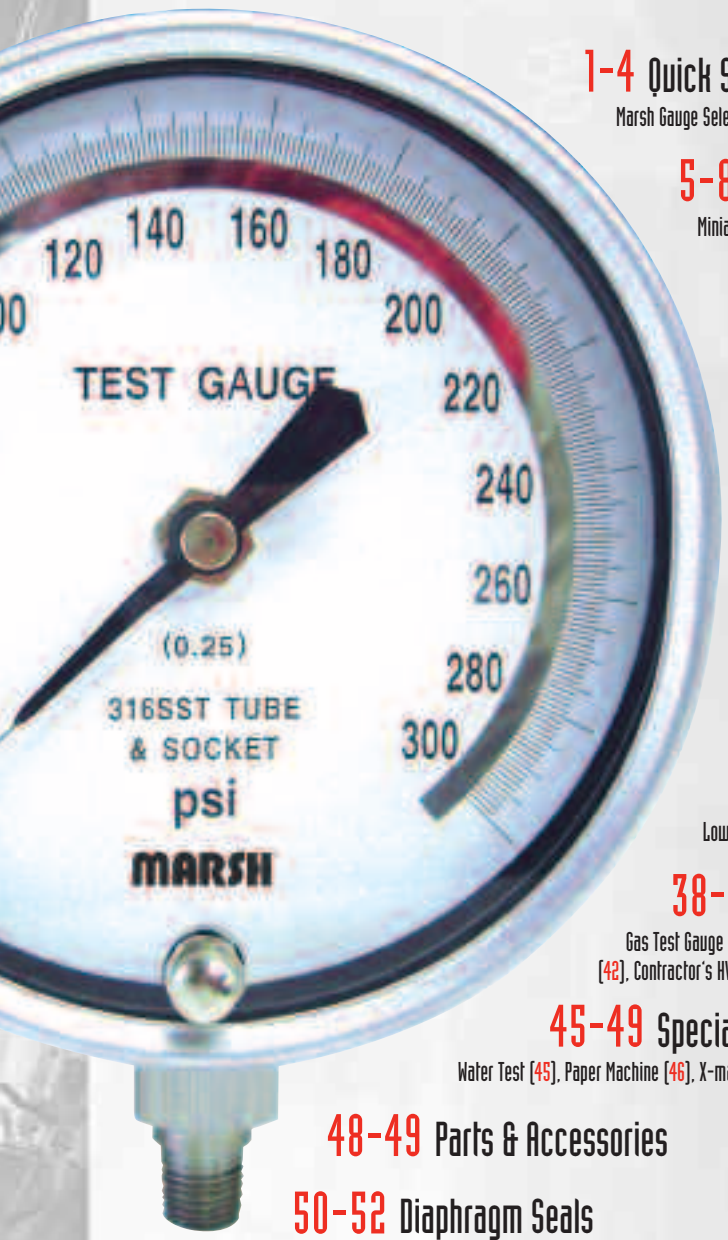

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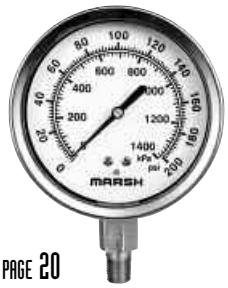
GAUGE SERIES: **MARSHALLTOWN VALUE SERIES**	GAUGE SERIES: **GENERAL SERVICE**	GAUGE SERIES: **40/50MM LIQUID FILLED**	GAUGE SERIES: **SEVERE SERVICE 63MM & 100MM**	GAUGE SERIES: **63MM & 100MM BRASS GAUGE**
ACCURACY ASME: Grade B = ±3/2/3 (±2% of range across middle half of scale)	ACCURACY ASME: Grade B = ±3/2/3 (±2% of range across middle half of scale)	ACCURACY ASME: ±2.5% of range across full scale	ACCURACY ASME: 63mm: Grade B = ±3/2/3 (±2% of range across middle half of scale) 100mm: Grade A ±2/1/2 (±1% of range across middle half of scale)	ACCURACY ASME: 63mm: ±1.6% of range across full scale 100mm: Grade 1A-±1% of range across full scale
CASE SIZE: 1½" & 2" diameter	CASE SIZE: 1½", 2", 2½", 3½", & 4½" diameter	CASE SIZE: 40mm & 50mm diameter	CASE SIZE: 63mm diameter 100mm diameter	CASE SIZE: 63mm diameter (2.5") 100mm diameter (4.0")
CASE MATERIAL: Steel. black painted	CASE MATERIAL: Steel, black painted	CASE MATERIAL: 304 Stainless Steel	CASE MATERIAL: 304 Stainless Steel	CASE MATERIAL: Forged brass
CASE STYLES: Lower Mount, Center Back Mount, Right & Left Mounts	CASE STYLES: Lower Mount, Center Back, U-Clamp & Front Flange Mounts	CASE STYLES: Center Back Mount	CASE STYLES: Rolled ring, hermetically sealed case; Lower Mount, Center Back, U-Clamp & Front Flange Mount	CASE STYLES: Lower mount
TUBE & SOCKET: Copper Alloy	TUBE & SOCKET: Copper Alloy	TUBE & SOCKET: Copper Alloy tube with nickel plated brass socket	TUBE & SOCKET: Copper Alloy or 316 Stainless steel	TUBE & SOCKET: Copper Alloy
MOVEMENT: Brass	MOVEMENT: Brass	MOVEMENT: Brass	MOVEMENT: Brass	MOVEMENT: Brass
CONNECTIONS: ⅛ or ¼ NPT	CONNECTIONS: ⅛ or ¼ NPT	CONNECTIONS: 40mm: ⅛ NPT 50mm: ¼ NPT	CONNECTIONS: ¼ NPT	CONNECTIONS: 63mm: ¼ NPT 100mm: ½ NPT
RANGES: 15 to 160 psi	RANGES: 0-30" Hg vacuum; compound ranges 30" Hg vacuum to 400 psi; and 15 to 5,000 psi	RANGES: 15 to 160 psi	RANGES: 0-30" Hg vacuum; compound ranges 30" Hg vacuum to 400 psi; and 15-10,000 psi	RANGES: 0 to 30" Hg vacuum; compound ranges 30" Hg vacuum to 200 psi; 15-10,000 psi
STANDARD DIAL: Dual Scale psi and kPa	STANDARD DIAL: Dual scale psi and kPa	STANDARD DIAL: Triple scale psi/BAR/kPa	STANDARD DIAL: Dual scale psi and kPa	STANDARD DIAL: Single scale psi
DIAL COLOR: Black markings on white	DIAL COLOR: Black markings on white	DIAL COLOR: Black markings on white	DIAL COLOR: Black markings on white	DIAL COLOR: Black markings on white
POINTER: Aluminum, black painted	POINTER: Aluminum, black painted	POINTER: Aluminum, black painted	POINTER: Aluminum, black painted	POINTER: Aluminum, black painted
WINDOW: Flat plastic with steel friction ring	WINDOW: 1½", 2", 2½", 3½" Acrylic, twist-in Clearlok; 4½" flat glass window with steel friction ring	WINDOW: Acrylic	WINDOW: Polycarbonate	WINDOW: Acrylic
FILL MEDIUM: N/A	FILL MEDIUM: N/A	FILL MEDIUM: Glycerine	FILL MEDIUM: Dry, glycerine, or silicone	FILL MEDIUM: Glycerine
VENT: N/A	VENT: N/A	VENT: Filler/Pressure relief plug	VENT: Rubber plug with snip-off feature	VENT: Rubber plug with snip-off feature

Quick Selector

 PAGE 20	PAGE 21	PAGE 23	PAGE 24	PAGE 25
GAUGE SERIES: **100MM STAINLESS STEEL**	GAUGE SERIES: **100MM STAINLESS STEEL NACE**	GAUGE SERIES: **'HW' 160MM STAINLESS STEEL**	GAUGE SERIES: **100MM ELITE**	GAUGE SERIES: **QUALITY GAUGE**
ACCURACY ASME: Grade 1A = ±1% full scale	ACCURACY ASME: Grade 1A = ±1% full scale	ACCURACY ASME: Grade 1A = ±1% full scale	ACCURACY ASME: Grade 1A = ±1% full scale	ACCURACY ASME: Grade A = ±2/1/2 (±1% of range across middle half of scale)
CASE SIZE: 100mm diameter	CASE SIZE: 100mm diameter	CASE SIZE: 160mm diameter	CASE SIZE: 100mm diameter	CASE SIZE: 3½" and 4¼" diameter
CASE MATERIAL: 304 Stainless steel	CASE MATERIAL: 304 Stainless steel	CASE MATERIAL: 304 Stainless steel	CASE MATERIAL: 304 Stainless steel	CASE MATERIAL: Steel, black painted
CASE STYLES: Lower Mount, Panel Mount with U-Clamp and three hole Front Flange Mount	CASE STYLES: Lower Mount	CASE STYLES: Lower Mount	CASE STYLES: Safecase with blow-out back construction; Lower Mount	CASE STYLES: Lower Mount, Flush case (Front Flange w/U-Clamp), Back Flange with Lower or Lower Back Mounts
TUBE & SOCKET: 316 Stainless steel	TUBE & SOCKET: 316 Stainless steel	TUBE & SOCKET: 316 Stainless steel with socket welded to the case	TUBE & SOCKET: 316 Stainless steel	TUBE & SOCKET: Copper Alloy up to 1,000 psi. Stainless steel tube, above 1,000 psi
MOVEMENT: Stainless steel	MOVEMENT: Stainless steel	MOVEMENT: Stainless steel	MOVEMENT: Stainless steel rotary movement	MOVEMENT: Stainless steel
CONNECTIONS: ¼ NPT	CONNECTIONS: ½ NPT	CONNECTIONS: ½ NPT	CONNECTIONS: ½ NPT	CONNECTIONS: ¼ or ½ NPT
RANGES: 30-10,000 PSI	RANGES: 15-20,000 PSI	RANGES: 15-20,000 PSI	RANGES: 0-30" Hg vacuum 30-10,000 PSI	RANGES: 0-30" Hg vacuum; compound ranges 30" Hg vacuum to 300 PSI; 15-20,000 PSI
STANDARD DIAL: Dual scale PSI and kPa	STANDARD DIAL: Dual scale PSI and kPa	STANDARD DIAL: Dual scale PSI and kPa	STANDARD DIAL: Dual scale psi and kPa	STANDARD DIAL: Single scale PSI
DIAL COLOR: Black markings on white	DIAL COLOR: Black markings on white	DIAL COLOR: Black markings on white	DIAL COLOR: Black markings on white	DIAL COLOR: Black markings on white
POINTER: Aluminum, black painted	POINTER: Aluminum, Adjustable Micrometer, black painted	POINTER: Aluminum, black painted	POINTER: Aluminum, black painted	POINTER: 3½": Aluminum, black painted with recalibrator. 4½": Aluminum, black painted, micro-adjustable
WINDOW: Acrylic	WINDOW: Safety glass	WINDOW: Safety glass	WINDOW: Safety glass	WINDOW: Glass
FILL MEDIUM: Dry, glycerine or silicone	FILL MEDIUM: Dry, glycerine, or silicone	FILL MEDIUM: Dry, glycerine, or silicone	FILL MEDIUM: Dry, glycerine or silicone	FILL MEDIUM: N/A
VENT: Rubber plug with snip-off feature	VENT: Rubber plug with snip-off feature	VENT: Rubber plug with snip-off feature	VENT: Internal compensating diaphragm	VENT: N/A

PAGE 27	PAGE 29	PAGE 30	PAGE 31	PAGE 35
GAUGE SERIES: **TEST GAUGE**	GAUGE SERIES: **MASTER TEST GAUGE**	GAUGE SERIES: **INSPECTOR'S TEST GAUGE**	GAUGE SERIES: **PROCESS GAUGE**	GAUGE SERIES: **DIAPHRAGM GAUGE**
ACCURACY ASME: Grade 2A = ±0.50% full scale	ACCURACY ASME: Grade 3A = ±0.25% full scale	ACCURACY ASME: Grade 2A = ±0.50% full scale	ACCURACY ASME: Grade 2A = ±0.50% full scale	ACCURACY ASME: Grade A = ±2/1/2 (±1% of range across middle half of scale) and Grade B = ±3/1/3 (±2% of range for ranges below 30" H_2O)
CASE SIZE: 4½" diameter	CASE SIZE: 6" diameter	CASE SIZE: 3" diameter	CASE SIZE: 4½" and 6" diameter	CASE SIZE: 2½", 3½", & 4½" diameter
CASE MATERIAL: Steel, black painted	CASE MATERIAL: 304 Stainless steel	CASE MATERIAL: Brass, nickel plated	CASE MATERIAL: Safecase polypropylene (turret style only) & aluminum	CASE MATERIAL: Steel, black painted
CASE STYLES: Lower Mount, Flush Mount (Front Flange with U-clamp & hinged ring)	CASE STYLES: Lower Mount	CASE STYLES: Lower Mount	CASE STYLES: Turret, Back Flange case, Front Flange Mount, Lower or Lower Back Mount	CASE STYLES: Lower Mount, Center Back, U-Clamp & Front Flange Mount
TUBE & SOCKET: Copper Alloy or 316 Stainless steel	TUBE & SOCKET: Copper Alloy	TUBE & SOCKET: Copper Alloy	TUBE & SOCKET: Copper Alloy or 316 Stainless steel	TUBE & SOCKET: Phosphor bronze diaphragm soft-soldered to brass socket
MOVEMENT: Stainless steel	MOVEMENT: Stainless steel	MOVEMENT: Brass	MOVEMENT: Stainless steel	MOVEMENT: Brass sector and pinion
CONNECTIONS: ¼ or ½ NPT	CONNECTIONS: ¼ or ½ NPT	CONNECTIONS: ¼ NPT	CONNECTIONS: ¼ or ½ NPT	CONNECTIONS: ⅛ or ¼ NPT and special connections
RANGES: 0 to 30" Hg vacuum; compound ranges 30" Hg vacuum to 300 psi; 15-10,000 psi	RANGES: 0 to 30" Hg vacuum; compound ranges 30" Hg vacuum to 300 psi; 15-10,000 psi	RANGES: 0 to 30" Hg vacuum; 15 to 1,000 psi	RANGES: 0 to 30" Hg vacuum; compound 30" Hg vacuum to 300 psi; 15 to 20,000 psi	RANGES: Dual scale with kPa; 0 to 200" H_2O vacuum; 0 to 300" H_2O, 0 to 10 psi, 0 to 160 oz/in^2. Triple scale 0-58 oz/in^2, inches H_2O & kPa
STANDARD DIAL: Single scale psi	STANDARD DIAL: Single scale psi	STANDARD DIAL: Dual scale psi and kPa	STANDARD DIAL: Single scale psi	STANDARD DIAL: Dual scale in. H_2O & kPa, psi & kPa, or Triple scale oz/in^2 in. H_2O, & kPa
DIAL COLOR: Black markings on white with mirrored dial to avoid parallax	DIAL COLOR: Black markings on white with mirrored dial to avoid parallax	DIAL COLOR: Black markings on white	DIAL COLOR: Black markings on white	DIAL COLOR: Black markings on white
POINTER: Aluminum, black painted, micro-adjustable, knife-edge	POINTER: Aluminum, black painted, knife-edge	POINTER: Aluminum, black painted, knife-edge	POINTER: Aluminum, black painted, micro-adjustable	POINTER: Aluminum, black painted
WINDOW: Glass	WINDOW: Glass	WINDOW: Beveled glass	WINDOW: Acrylic	WINDOW: 2½" & 3½": Acrylic twist-in Clearlok 4½": Flat acrylic with steel friction ring
FILL MEDIUM: N/A	FILL MEDIUM: N/A	FILL MEDIUM: N/A	FILL MEDIUM: Dry, glycerine, or silicone	FILL MEDIUM: N/A
VENT: Blowout disc	VENT: Blowout disc	VENT: N/A	VENT: Internal compensating diaphragm	VENT: N/A

Quick Selector

PAGE 37	PAGE 38	PAGE 46	PAGE 54
GAUGE SERIES: **GAS PRESSURE TEST SET**	GAUGE SERIES: **GAS TEST GAUGES**	GAUGE SERIES: **PAPER MACHINE GAUGE**	GAUGE SERIES: **BIMETAL THERMOMETERS**
ACCURACY ASME: Grade A = ±2/1/2 (± 1% of range across middle half of scale) and Grade B = ±3/1/3% for ranges (below 30" H_2O)	ACCURACY ASME: Grade B ±3/2/3% (±2% of range across middle half of scale)	ACCURACY ASME: Grade A = ±2/1/2 (±1% of range across middle half of scale)	ACCURACY ASME: ±1% of span
CASE SIZE: 2½"	CASE SIZE: 2" Diameter	CASE SIZE: 3½" diameter	CASE SIZE: 2", 3" & 5", standard stem lengths of 2½" to 24"
CASE MATERIAL: Provided in grey polyethylene case with 3 ft. of rubber tubing	CASE MATERIAL: Steel, black painted	CASE MATERIAL: Steel, chrome plated	CASE MATERIAL: 304 Stainless steel
	CASE STYLES: Mounting-Reducing Bell or Hex Style Housing Material-Reducing Bell: Iron, Black Painted Hex Body: Steel, Zinc Dichromate Plated	CASE STYLES: Lower Back Mount; Hinged ring case & moisture-proof with weep hole	CASE STYLES: Hermetically sealed; Center Back or Adjustable
TUBE & SOCKET: Phosphor bronze diaphragm soft-soldered to brass socket	TUBE & SOCKET: Copper Alloy	TUBE & SOCKET: Copper Alloy	TUBE & SOCKET: 304 Stainless steel stems
MOVEMENT: Brass sector and pinion	MOVEMENT: Brass	MOVEMENT: Stainless steel	MOVEMENT: Bimetal sensing element with external reset feature
	CONNECTIONS: ¾ NPTF	CONNECTIONS: ¼ NPT	CONNECTIONS: ¼ NPT (2" case only); ½ NPT (3" & 5" cases)
RANGES: 0 to 8.75 oz/in² 0 to 20 oz/in² 0 to 58 oz/in²	RANGES: Bell Type / Hex Type 0-15 psi / 0-15 psi 0-30 psi / 0-30 psi 0-60 psi / 0-60 psi 0-100 psi / 0-100 psi	RANGES: 30 to 1,000 psi	RANGES: 11 dual scale ranges from -50° F through 1000°F (-50° C through 550° C)
STANDARD DIAL: Triple scale oz/in² in. H_2O, & kPa	STANDARD DIAL: Single Scale psi	STANDARD DIAL: Single scale psi	STANDARD DIAL: Dual scale in degrees Celsius & Fahrenheit
DIAL COLOR: Black markings on white	DIAL COLOR: Black markings on white	DIAL COLOR: Black markings on white	DIAL COLOR: Black markings on white
POINTER: Aluminum, black painted	POINTER: Aluminum, black painted	POINTER: Aluminum, black painted with recalibrator	POINTER: Aluminum, black painted
WINDOW: Acrylic, twist-in Clearlok	WINDOW: Polycarbonate	WINDOW: Glass lens, chrome plated brass ring with weather-tight seal	WINDOW: Glass

	TYPE M1–MINI	TYPE M2–STANDARD
FILTERS		
Port Size	⅛, ¼ NPT	¼, ⅜, ½ NPT
Filtration (micron)	5μ, 25μ, 50μ	5μ, 25μ, 50μ
Maximum Supply Pressure	1.0 MPa 10 BAR 145 psi	1.0 MPa 10 BAR 145 psi
Temperature Range	41º–140º F / 5º–60º C	41º–140º F / 5º–60º C
Drain	Manual / Semi-Auto	Manual / Semi-Auto / Auto
Bowl Capacity	0.75 inch^3	2.75 inch^3
Flow (based on 100 psi inlet pressure with 50 micron filter)	55, 85 SCFM	120, 120, 120 SCFM
REGULATORS		
Effect of Supply Pressure variation (25 psig) on Outlet Pressure	< 0.2 psig (13.8 mBAR)	< 0.2 psig (13.8 mBAR)
Exhaust Capacity (5 psig above 20 psig set point)	<0.25 SCFM (<7 LPM)	<0.25 SCFM (<7 LPM)
Max. Supply Pressure	145 psig (10 BAR)	145 psig (10 BAR)
Flow Capacity at 100 psig (6.9 BAR) supply and 70 psig (4.8 BAR) outlet	40, 60 SCFM	90, 120, 120 SCFM
Output Pressure Ranges	0-10 psig (0-0.69 BAR) 0-30 psig (0-2.1 BAR) 0-60 psig (0-4.1 BAR) 0-120 psig (0-8.3 BAR)	0-10 psig (0-0.69 BAR) 0-30 psig (0-2.1 BAR) 0-60 psig (0-4.1 BAR) 0-120 psig (0-8.3 BAR)
Total Air Consumption @ Maximum Output	0.3 SCFH (0.14 LPM)	0.3 SCFH (0.14 LPM)
Port Size	⅛, ¼ NPT	¼, ⅜, ½ NPT
Mounting Options	Pipe, Panel or Bracket	Pipe, Panel or Bracket
FILTER-REGULATORS		
Port Size	⅛, ¼ NPT	¼, ⅜, ½ NPT
Filtration (micron)	5μ, 25μ, 50μ	5μ, 25μ, 50μ
Maximum Supply Pressure	1.0 MPa 10 BAR 145 psi	1.0 MPa 10 BAR 145 psi
Temperature Range	41º–140º F / 5º–60º C	41º–140º F / 5º–60º C
Drain	Manual / Semi-Auto	Manual / Semi-Auto / Auto
Bowl Capacity	0.75 inch^3	2.75 inch^3
Regulator Output Range	0-10, 0-30, 0-60, 0-120 psi	0-10, 0-30, 0-60, 0-120 psi
Flow (based on 100 psi supply/70 psi out)	40, 60 SCFM	90, 120, 120 SCFM
LUBRICATORS		
Port Size	⅛, ¼ NPT	¼, ⅜, ½ NPT
Lubrication	Mist	Mist
Maximum Supply Pressure	1.0 MPa 10 BAR 145 psi	1.0 MPa 10 BAR 145 psi
Temperature Range	41º–140º F / 5º–60º C	41º–140º F / 5º–60º C
Bowl Capacity	1.22 inch^3	5.18 inch^3
Flow (based on 100 psi inlet pressure)	55, 115 SCFM	125, 125, 125 SCFM

FRL FEATURES

Modular design for service & interchangeability

Miniature (M1), Standard (M2)

Small package size and light weight construction

Competitively priced

FILTERS

M1 has polycarbonate bowl, M2 have polycarbonate bowl with metal guard

STOCK ELEMENTS - 5, 25 or 50 micron

Manual, semi-auto or auto drain available

REGULATORS

Bellofram® Rolling Diaphragm for superior regulator performance

Panel, pipe, or bracket (included) mounting

Metal body, polycarbonate bonnet and knob

Non-rising adjustment knob with push-pull lock ring feature

FILTER REGULATORS

Aluminum and polycarbonate construction

Manual, semi-auto or autodrain available

M1 has polycarbonate bowl; M2 has polycarbonate bowl with metal guard

Non-rising adjustment knob with push-pull lock ring feature

For panel or bracket mounting

Bellofram® Rolling Diaphragm for superior regulator performance

LUBRICATORS

M1 has polycarbonate bowl; remove bowl for filling.

M2 has polycarbonate bowl with metal guard; top plug permits filling without removing bowl or shutting off air

Adjust drip rate by hand, using graduated ring on M1, with screwdriver on M2

FRL ORDERING INFORMATION

SIZE	
Miniature Series	M1
Standard Series	M2

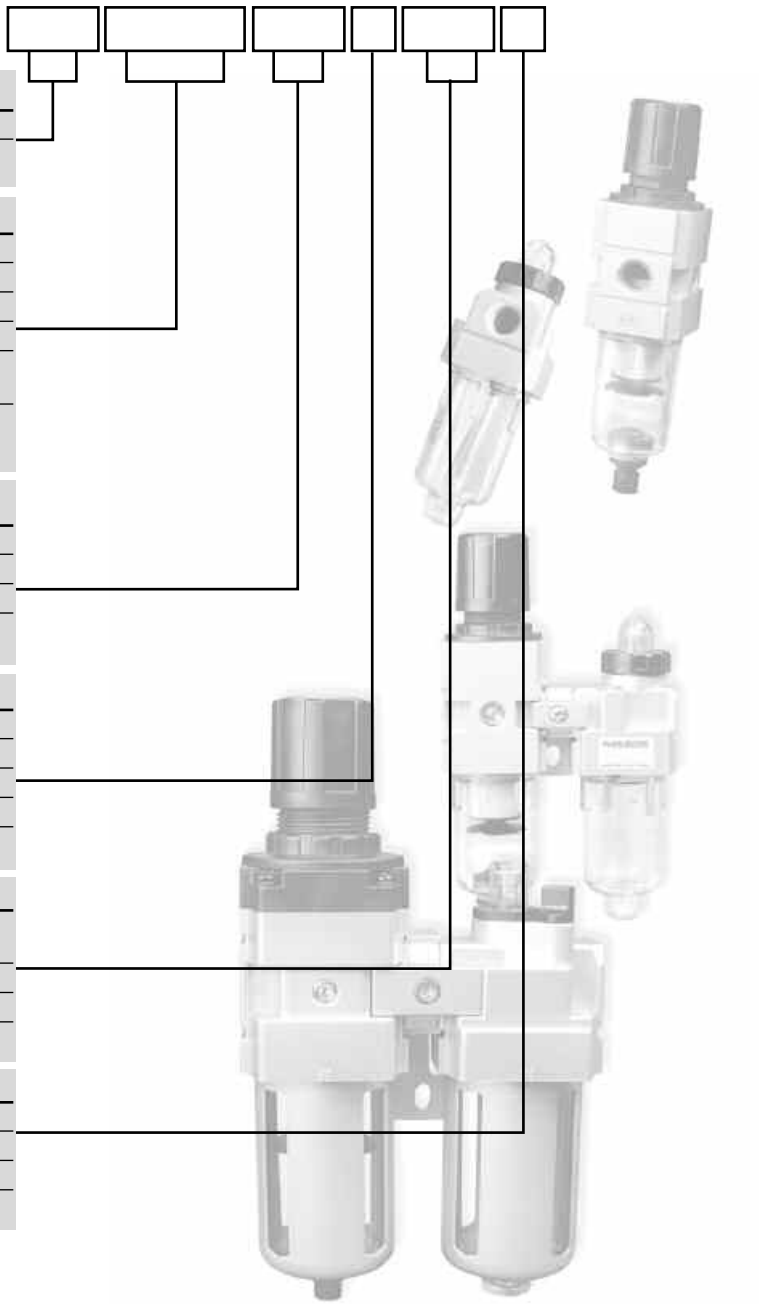
DESCRIPTION	
Filter	F
Regulator	R
Lubricator	L
Filter Regulator	FR
Filter Regulator PLUS Lubricator	FRP
Filter, Regulator, Lubricator	FRL

PORT SIZE	
⅛ NPT (M1 only)	1N
¼ NPT	2N
⅜ NPT (M2 only)	3N
½ NPT (M2 only)	4N

PRESSURE RANGES	
0-10 psi	A
0-30 psi	L
0-60 psi	M
0-120 psi, Standard	H
Omit for Filters & Lubricators	

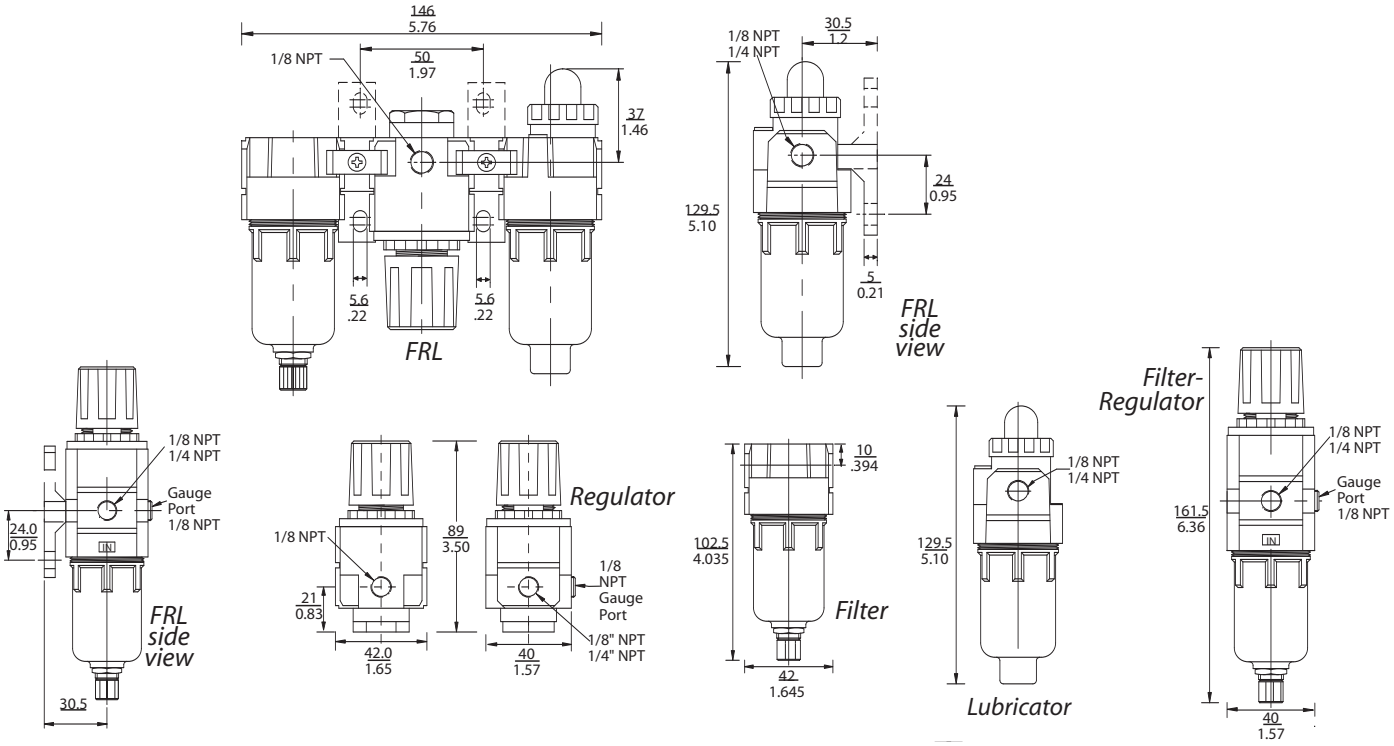
FILTERS	
50 Micron Filter, Standard	C
25 Micron Filter	B
5 Micron Filter	F
Omit for Regulators & Lubricators	

DRAIN	
Manual Drain, Standard	M
Semi-Automatic Drain	S
Auto Drain (M2 only)	A
Omit for Regulators & Lubricators	



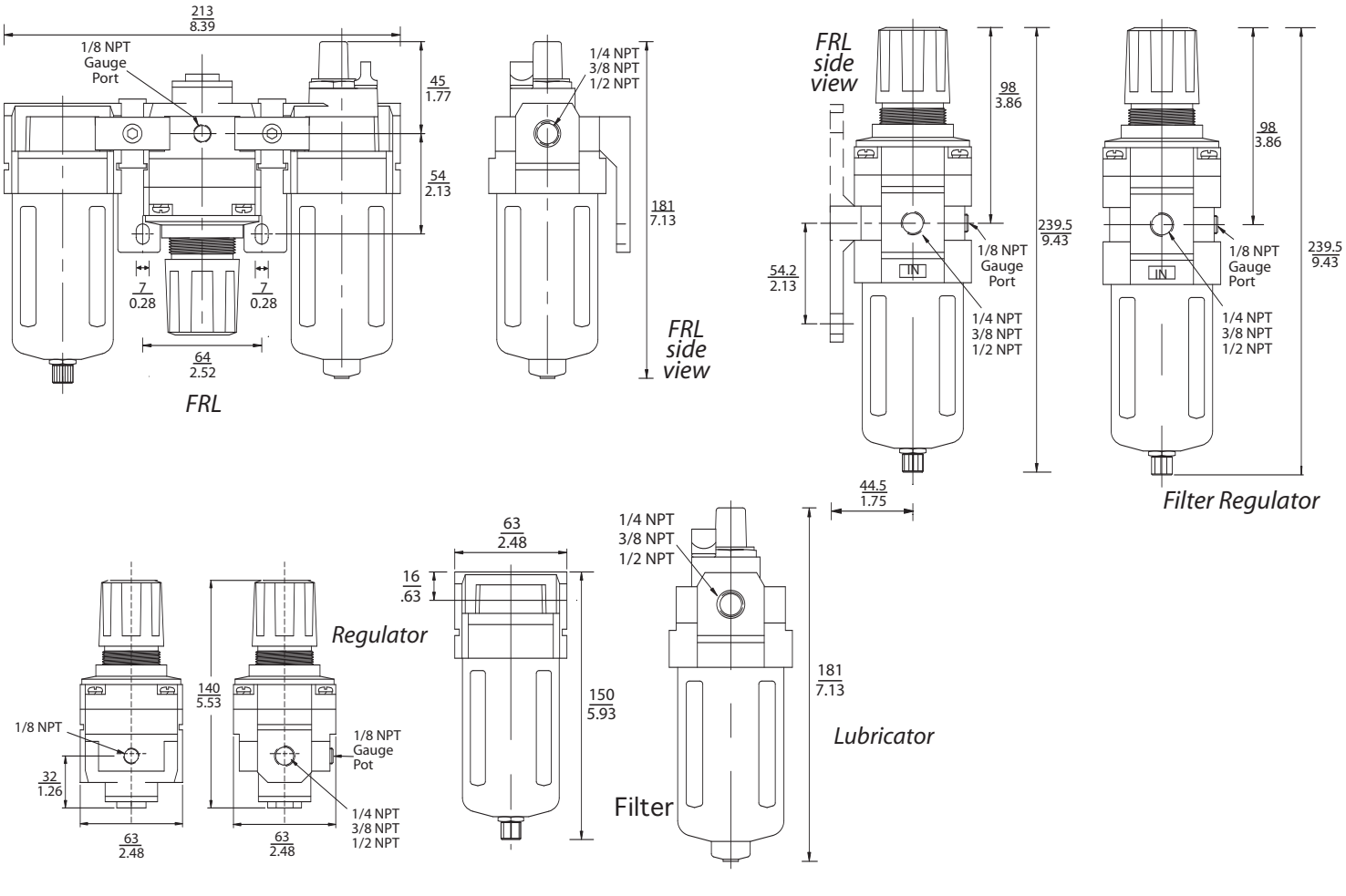
NOTE: Individual regulators, FRs, filters, and lubricators come complete with bracket .

FRL assemblies come complete with all bracket/connectors.

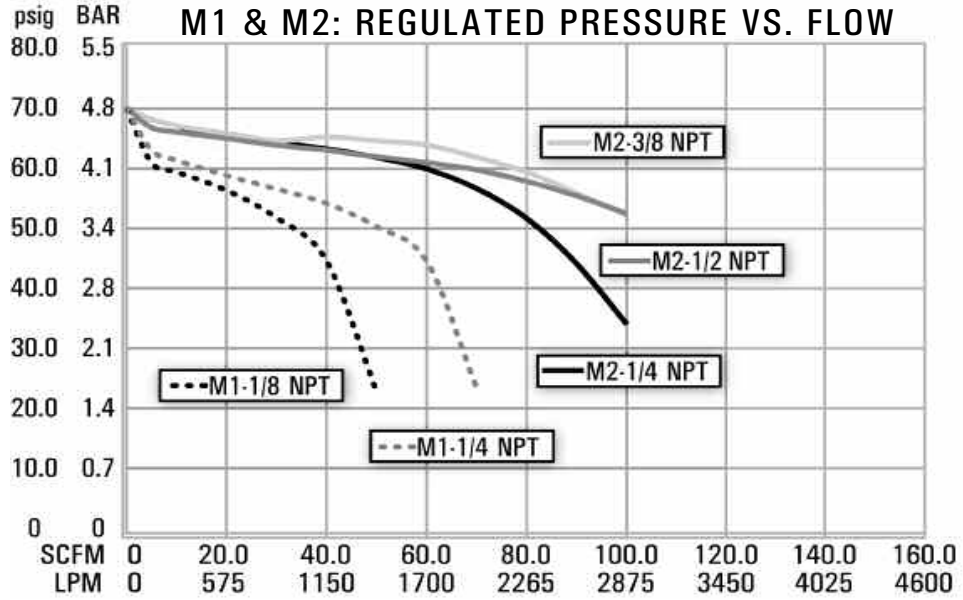


TYPE M1

TYPE M2



M1 & M2: REGULATED PRESSURE VS. FLOW



REPLACEMENT PARTS

Description		Model #
Miniature Size Connector Kit		M1K
Miniature Size Connector Kit	FR+L	M1K2
Standard Size Connector Kit		M2K
Standard Size Connector Kit	FR+L	M2K2

Miniature Size Filter or Lubricator Bracket	M1FB
Standard Size Filter or Lubricator Bracket	M2FB
Miniature Size Regulator or Filter Regulator Bracket	M1RB
Standard Size Regulator or Filter Regulator Bracket	M2RB

Description	Model #
Miniature 5 micron Filter Element	M1FK05
Miniature 25 micron Filter Element	M1FK25
Miniature 50 micron Filter Element	M1FK50
Standard 5 micron Filter Element	M2FK05
Standard 25 micron Filter Element	M2FK25
Standard 50 micron Filter Element	M2FK50

Miniature Bowl / Manual Drain Assembly	M1DM
Miniature Bowl / Semi-Automatic Drain Assembly	M1DSA
Standard Bowl / Manual Drain Assembly	M2DM
Standard Bowl / Semi-Automatic Drain Assembly	M2DSA
Standard Bowl / Automatic Drain Assembly	M2DA

Pressure Gauges - "GG" Series Gauges pg. 9

MARSHALLTOWN VALUE SERIES GAUGE

- ASME Grade B Accuracy
- Extra Savings with Quantity Pricing
- 4 Standard Mounting Options: LM, CB, Right & Left

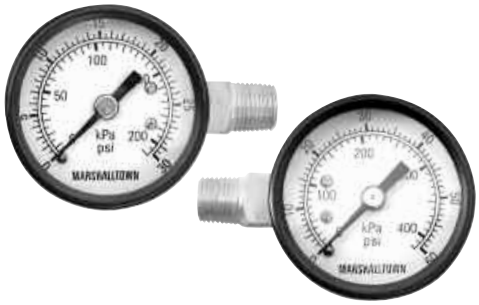
Marshalltown Value Series are the most economical, general purpose gauges in the Marsh gauge line. Suited for use with water, oil, air, gas, or other non-corrosive media.

Typical applications include FRL's, compressors, pumps, boilers, regulators, dryers as well as commercial and industrial equipment.

STANDARD RANGES & PART NUMBERS

TYPE	MARSHALLTOWN VALUE SERIES GAUGES							
Size	1½"				2"			
Mounting	LM	CB	Right	Left	LM	CB	LM	CB
Connection	⅛ NPT	⅛ NPT	⅛ NPT	⅛ NPT	¼ NPT	¼ NPT	⅛ NPT	⅛ NPT
0 to 15 psi		GG1515C8						
0 to 30 psi	GG1530L8	GG1530C8	GG1530G8	GG1530F8	GG2030L4	GG2030C4	GG2030L8	GG2030C8
0 to 60 psi	GG1560L8	GG1560C8	GG1560G8	GG1560F8	GG2060L4	GG2060C4		
0 to 100 psi	GG15100L8	GG15100C8			GG20100L4	GG20100C4	GG20100L8	GG20100C8
0 to 160 psi	GG15160L8	GG15160C8			GG20160L4	GG20160C4	GG20160L8	GG20160C8
0 to 200 psi		GG15200C8				GG20200C4		GG20200C8
0 to 300 psi						GG20300C4		

Consult Factory for additional ranges.



SPECIFICATIONS

ACCURACY
ASME Grade B = ±3/2/3% (±2% of range across middle half of scale)

CASE SIZES
1½" and 2" diameter

CASE MATERIAL
Steel, black painted

CASE STYLE
CB – Center Back Mount
LM – Lower Mount
Right Mount
Left Mount

TUBE & SOCKET
Copper alloy

MOVEMENT
Brass

CONNECTION
⅛ & ¼ NPT

RANGES
15 to 200 psi

DIAL STANDARD
Dual scale psi and kPa

DIAL COLOR
Black markings on white

POINTER
Aluminum, Black painted

WINDOW
Flat plastic with steel friction ring

GENERAL SERVICE GAUGE

- Dial Sizes: 1½", 2", 2½", 3½" & 4½"
- Superb quality, economical price
- Pressure ranges to 5000 psi

Marsh Instruments General Service Steel Case Gauges are an economical, general purpose gauge for pressure measurement from vacuum/compound through 5,000 psi. Suited for use with water, oil, air, gas, or other non-corrosive media.

Typical applications include FRLs, compressors, pumps, boilers, regulators, dryers as well as commercial and industrial equipment.

SPECIFICATIONS

ACCURACY
ASME Grade B–±3/2/3% (±2% of range across middle half of scale)

CASE SIZES
1½", 2", 2½", 3½", 4½" diameter

CASE MATERIAL
Steel, black painted

CASE STYLE
CB – Center Back Mount
LM – Lower Mount
UC – U-Clamp Mount
See option tables for Front Flange

TUBE & SOCKET
Copper alloy

MOVEMENT
Brass

CONNECTION
⅛ & ¼ NPT

RANGES
0 to 30" Hg VAC; Compound 30" Hg vac to 400 psi; 15 to 5,000 psi

DIAL STANDARD
Dual scale psi and kPa

DIAL COLOR
Black markings on white

POINTER
Aluminum, black painted

WINDOW
1½", 2", 2½", 3½": acrylic, twist-in Clearlok
4½": flat glass window with steel friction ring

RESTRICTOR
Standard for ranges 1,000 psi and above

STANDARD RANGES & PART NUMBERS

TYPE	GENERAL SERVICE GAUGES						
Size	1½"			2"			
Case Material	Steel			Steel			
Internals	Copper Alloy			Copper Alloy			
Mounting / Case Style	LM	UC	CB	LM	LM	CB	CB
Connection	⅛ NPT	⅛ NPT	⅛ NPT	⅛ NPT	¼ NPT	⅛ NPT	¼ NPT
Scale Standard	psi/kPa			psi/kPa			
0 to 30" Hg VAC	J0405	J0505	J0605	J1105	J1405	J1805	J2005
30" Hg VAC to 15 psi							
30" Hg VAC to 30 psi					J1412		
30" Hg VAC to 60 psi					J1414		
30" Hg VAC to 100 psi							
30" Hg VAC to 150 psi	J0418	J0518	J0618	J1118	J1418	J1818	J2018
30" Hg VAC to 200 psi	J0420	J0520	J0620	J1120	J1420	J1820	J2020
30" Hg VAC to 300 psi	J0424	J0524	J0624	J1124	J1424	J1824	J2024
30" Hg VAC to 400 psi				J1126	J1426	J1826	J2026
0 to 15 psi	J0440	J0540	J0640	J1140	J1440	J1840	J2040
0 to 30 psi	J0442	J0542	J0642	J1142	J1442	J1842	J2042
0 to 60 psi	J0446	J0546	J0646	J1146	J1446	J1846	J2046
0 to 100 psi	J0448	J0548	J0648	J1148	J1448	J1848	J2048
0 to 160 psi	J0452	J0552	J0652	J1152	J1452	J1852	J2052
0 to 200 psi	J0454	J0554	J0654	J1154	J1454	J1854	J2054
0 to 300 psi	J0458	J0558	J0658	J1158	J1458	J1858	J2058
0 to 400 psi				J1160	J1460	J1860	J2060
0 to 600 psi					J1464	J1864	
0 to 1,000 psi							
0 to 1,500 psi							
0 to 2,000 psi							
0 to 3,000 psi					J1478	J1878	J2078
0 to 5,000 psi					J1482		

STANDARD RANGES & PART NUMBERS

TYPE	GENERAL SERVICE GAUGES											
Size	2"		2½"						3½"			4½"
Case Material	Steel		Steel						Steel			Steel
Internals	Copper Alloy		Copper Alloy						Copper Alloy			
Mounting / Case Style	UC	UC	LM	LM	CB	CB	UC	UC	LM	CB	UC	LM
Connection	⅛ NPT	¼ NPT	⅛ NPT	¼ NPT	⅛ NPT	¼ NPT	⅛ NPT	¼ NPT	¼ NPT	¼ NPT	¼ NPT	¼ NPT
Scale Standard	psi/kPa		psi/kPa						psi/kPa			psi/kPa
0 to 30" Hg VAC	J2405	J2605	J4005	J4605	J5005	J5405	J6005	J6205	J8005	J8605	J8805	J9005
30" Hg VAC to 15 psi												
30" Hg VAC to 30 psi				J4612					J8012			
30" Hg VAC to 60 psi				J4614					J8014			J9014
30" Hg VAC to 100 psi												
30" Hg VAC to 150 psi	J2418	J2618	J4018	J4618	J5018	J5418	J6018	J6218	J8018	J8618	J8818	J9018
30" Hg VAC to 200 psi	J2420	J2620	J4020	J4620	J5020	J5420	J6020	J6220	J8020	J8620	J8820	J9020
30" Hg VAC to 300 psi	J2424	J2624	J4024	J4624	J5024	J5424	J6024	J6224	J8024	J8624	J8824	J9024
30" Hg VAC to 400 psi	J2426	J2626	J4026	J4626	J5026	J5426	J6026	J6226	J8026	J8626	J8826	J9026
0 to 15 psi	J2440	J2640	J4040	J4640		J5440		J6240	J8040	J8640	J8840	J9040
0 to 30 psi	J2442	J2642	J4042	J4642	J5042	J5442	J6042	J6242	J8042	J8642	J8842	J9042
0 to 60 psi	J2446	J2646	J4046	J4646	J5046	J5446	J6046	J6246	J8046	J8646	J8846	J9046
0 to 100 psi	J2448	J2648	J4048	J4648	J5048	J5448	J6048	J6248	J8048	J8648	J8848	J9048
0 to 160 psi	J2452	J2652	J4052	J4652	J5052	J5452	J6052	J6252	J8052	J8652	J8852	J9052
0 to 200 psi	J2454	J2654	J4054	J4654	J5054	J5454	J6054	J6254	J8054	J8654	J8854	J9054
0 to 300 psi	J2458	J2658	J4058	J4658	J5058	J5458	J6058	J6258	J8058	J8658	J8858	J9058
0 to 400 psi	J2460	J2660	J4060	J4660	J5060	J5460	J6060	J6260	J8060	J8660	J8860	J9060
0 to 600 psi				J4664					J8064	J8664	J8864	J9064
0 to 1,000 psi			J4072	J4672		J5472		J6272		J8672	J8872	J9072
0 to 1,500 psi				J4674					J8074			
0 to 2,000 psi				J4676		J5476		J6276				J9076
0 to 3,000 psi	J2478	J2678		J4678	J5078	J5478	J6078	J6278				
0 to 5,000 psi				J4682						J8682	J8882	J9082

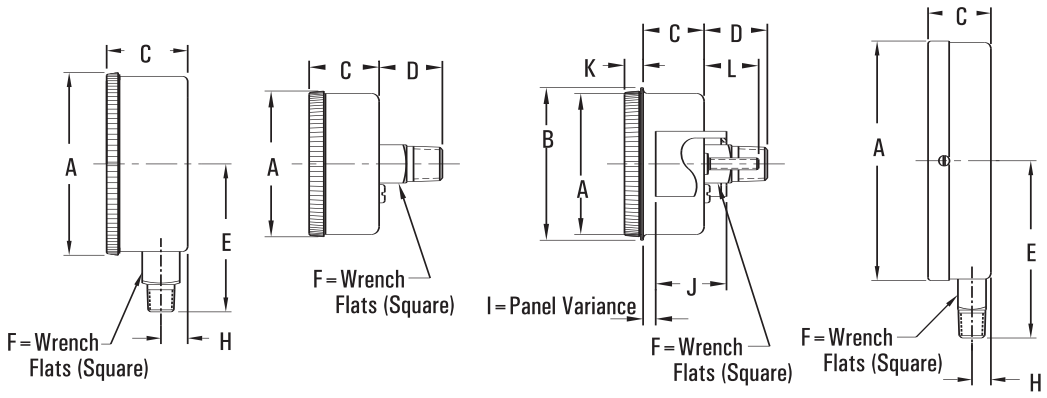
General Service

Dial Divisions	General Service 3/2/3% of Span			
Ranges	Figure Intervals		Minor Gradua -tions	
Vacuum	5		1	
COMPOUND				
30" Hg VAC to 15 psi	10	5	2	1
30" Hg VAC to 30 psi	10	10	2	1
30" Hg VAC to 60 psi	10	10	2	2
30" Hg VAC to 150 psi	30	30	5	5
30" Hg VAC to 300 psi	30	50	–	10
PRESSURE				
0 to 15 psi	3		0.2	
0 to 30 psi	5		1	
0 to 60 psi	10		1	
0 to 100 psi	10		2	
0 to 160 psi	20		2	
0 to 200 psi	50		4	
0 to 300 psi	50		5	
0 to 400 psi	50		5	
0 to 600 psi	50		10	
HIGH PRESSURE				
0 to 1,000 psi	200		20	
0 to 1,500 psi	300		20	
0 to 2,000 psi	400		40	
0 to 3,000 psi	500		100	
0 to 4,000 psi	1,000		100	
0 to 5,000 psi	1,000		100	

GENERAL SERVICE GAUGE OPTIONS

OPTION	TYPE	SUFFIX	AVAILABLE ON MODELS
Restrictors	Add restrictor	H	All models – Consult factory for other sizes
Catalog Dials	psi only	E	See Marsh Price List for minimums
	bar only	L1	
	kg/cm^2 only	L2	
	kPa only	L3	
	MPa only	L4	
	psi & bar	W1	
	psi & kg/cm^2	W2	
	psi & MPa	W4	
Custom Dials	Custom face	M	See Marsh Price List for minimums
Window	Instrument glass w/ring (GS)	F1	1½"- 3½" Consult factory for availability
	Acrylic	F2	4½" Consult factory for availability
Pointer	Adjustable (slotted) pointer (AD)	Z1	2"- 4½" Consult factory for availability
	Max. Hand Assembly (MX)	Z2	2"- 3½" CB or LM only, Consult factory for availability
Increased Accuracy	Grade A: (2/1/2%)	B	All models - 10 piece minimum order
Cases	3 hole front flange (FF)		1½" - 3½" See below for part number
	Part Numbers: 1½"x ⅛" (J07XX), 2"x ⅛" (J25XX), 2"x ¼" (J29XX), 2½" x ⅛" (J61XX), 2½"x ¼" (J63XX), 3½"x ⅛" (J85XX), 3½"x ¼" (J89XX). Consult factory for availability.		
	Stainless steel (SS)	J1	Consult factory for availability
	Brass (BR)	J2	
Rings	Friction ring (external), Polished stainless steel (FC)	A1	1½" to 3½" CB or LM only
	Friction ring (external), black (FB)	A2	1½" to 3½" CB or LM only
	Press ring, black (PB)	A3	2" to 3½" [Panel mount]
	Press ring, chrome (PC)	A4	2" to 3½" [Panel mount]
Special Connections			Consult Factory for availability

(J90XX Only)



GENERAL SERVICE CASE DIMENSIONS													
Part#	Dial Size	Mount	A	B	C	D	E	F	H	I	J	K	L
J04xx	1½	⅛" LM	1.67		.90		1.50	7/16"	.26				
J05xx	1½	⅛" UC	1.60	1.75	.71	.72		7/16"		.06-.37	.81	.19	.63
J06xx	1½	⅛" CB	1.67		.90	.72		7/16"					
J11xx	2.0	⅛" LM	2.20		1.22		1.82	9/16"	.40				
J14xx	2.0	¼" LM	2.20		1.22		1.82	9/16"	.40				
J18xx	2.0	⅛" CB	2.20		1.22	.82		9/16"					
J20xx	2.0	¼" CB	2.20		1.22	.82		9/16"					
J24xx	2.0	⅛" UC	2.06	2.25	.94	.88		9/16"		0-0.43	1.22	.20	.92
J26xx	2.0	¼" UC	2.06	2.25	.94	.88		9/16"		0-0.43	1.22	.20	.92
J40xx	2½	⅛" LM	2.73		1.22		2.10	9/16"	.40				
J46xx	2½	¼" LM	2.73		1.22		2.10	9/16"	.40				
J50xx	2½	⅛" CB	2.73		1.23	.82		9/16"					
J54xx	2½	¼" CB	2.73		1.23	.82		9/16"					
J60xx	2½	⅛" UC	2.58	2.81	.94	.88		9/16"		0-0.43	1.22	.20	.92
J62xx	2½	¼" UC	2.58	2.81	.94	.88		9/16"		0-0.43	1.22	.20	.92
J80xx	3½	¼" LM	3.71		1.22		2.77	9/16"	.40				
J86xx	3½	¼" CB	3.71		1.15	.80		9/16"					
J88xx	3½	¼" UC	3.65	3.98	.91	.87		9/16"		0-0.49	1.10	.24	.92
J90xx	4½	¼" LM	4.53		1.22		3.16	9/16"	.40				

40MM & 50MM SEVERE SERVICE GAUGE

- Copper Alloy Internals
- Glycerine Filled
- Center Back Mount Only

Marsh Instruments Liquid-Filled Gauges are designed to perform in rugged and harsh environmental conditions - especially where pulsation and vibration is a problem. Liquid Filled Gauges offer a significant cushioning and dampening effect, reducing pointer flutter and internal gauge damage. Liquid Filled Gauges feature a ventable top fill plug and can be mounted on a horizontal or vertical plane. The hermetically sealed construction reduces the chance of leaks and makes field filling an easy option.

Typical applications include refineries, chemical, oil & gas, marine and OEM processes.

SPECIFICATIONS

ACCURACY
±2.5% of range across full scale

CASE SIZES
40 or 50 mm diameter

CASE MATERIAL
304 Stainless Steel

CASE STYLE
CB – Center Back mount

TUBE & SOCKET
Copper Alloy tube
with nickel plated brass socket

MOVEMENT
Brass

CONNECTION
⅛ NPT & ¼ NPT

RANGES
15 to 160 psi

DIAL STANDARD
Triple scale psi/BAR/kPa

DIAL COLOR
Black markings on white

POINTER
Aluminum, black painted

WINDOW
Acrylic

FILL MEDIUM
Glycerine Standard

RESTRICTOR
Standard, all ranges

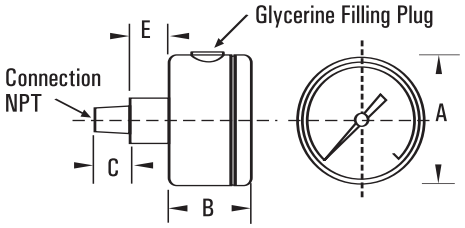
VENT PLUG
Filler/pressure relief plug

TEMPERATURE LIMITS
0 – 140° F (filled)

STANDARD RANGES & PART NUMBERS

TYPE	40MM & 50MM GAUGES	
Size	40mm	50mm
Case Material	304 Stainless Steel	304 Stainless Steel
Internals	Copper Alloy	Copper Alloy
Mounting / Case Style	CB	CB
Connection	⅛ NPT	¼ NPT
Scale Standard	psi/BAR/kPa	psi/BAR/kPa
0 to 15 psi	M4040P	M5040P
0 to 30 psi	M4042P	M5042P
0 to 60 psi	M4046P	M5046P
0 to 100 psi	M4048P	M5048P
0 to 160 psi	M4052P	M5052P

40MM AND 50MM GAUGE OPTIONS			
OPTION	TYPE	SUFFIX	AVAILABLE ON MODELS
Custom Dials	Custom face	M	See Marsh Price List for minimums
Other Ranges			Consult factory for availability
Fill Medium	Silicone (SL)	I	Consult factory



A-Size	B	C	E
40mm Dia	27.00mm 1.06"	11.5mm 0.45"	13.00mm 0.51"
50mm Dia	30.00mm 1.18"	11.5mm 0.45"	10.00mm 0.39"

63MM SEVERE SERVICE GAUGE

- 3 Standard Mounting Options: LM, CB and U-Clamp
- Glycerine Filled
- Ranges to 10,000 psi

Marsh Instruments Liquid-Filled Gauges are designed to perform in rugged applications and harsh environmental conditions - especially where pulsation and vibration are a problem. Liquid Filled Gauges offer a significant cushioning and dampening effect, reducing pointer flutter and internal gauge damage; also lubricating the internals, and reducing corrosion.

All stainless steel Liquid Filled Gauges feature a ventable top fill plug for pressure relief and ease of venting after installation. Pressure ranges are available through 10,000 psi, with high pressure ranges offering a Helical Bourdon Tube for longer gauge life and increased durability. The hermetically sealed construction reduces the chance of leaks, and makes field filling an easy option.

Typical applications include refineries, chemical plants, offshore platforms, oil rigs, marine applications, general industrial application and OEM processes.

STANDARD RANGES & PART NUMBERS

TYPE	63MM SEVERE SERVICE GAUGES					
Size	63mm			63mm		
Case Material	304 Stainless Steel			304 Stainless Steel		
Internals	Copper Alloy			Stainless Steel		
Mounting / Case Style	LM	UC	CB	LM	UC	CB
Connection	¼ NPT	¼ NPT	¼ NPT	¼ NPT	¼ NPT	¼ NPT
Scale Standard	psi/kPa			psi/kPa		
0 to 30" Hg VAC	J7605P	J7205P	J6405P	J7805P	J7405P	J6605P
30" Hg VAC to 15 psi						
30" Hg VAC to 30 psi	J7612P					
30" Hg VAC to 60 psi	J7614P					
30"Hg VAC to 100 psi						
30" Hg VAC to 150 psi	J7618P	J7218P	J6418P	J7818P	J7418P	J6618P
30" Hg VAC to 200 psi	J7620P	J7220P	J6420P	J7820P	J7420P	J6620P
30" Hg VAC to 300 psi	J7624P	J7224P	J6424P	J7824P	J7424P	J6624P
30" Hg VAC to 400 psi	J7626P	J7226P	J6426P	J7826P	J7426P	J6626P
0 to 15 psi	J7640P	J7240P	J6440P	J7840P	J7440P	J6640P
0 to 30 psi	J7642P	J7242P	J6442P	J7842P	J7442P	J6642P
0 to 60 psi	J7646P	J7246P	J6446P	J7846P	J7446P	J6646P
0 to 100 psi	J7648P	J7248P	J6448P	J7848P	J7448P	J6648P
0 to 160 psi	J7652P	J7252P	J6452P	J7852P	J7452P	J6652P
0 to 200 psi	J7654P	J7254P	J6454P	J7854P	J7454P	J6654P
0 to 300 psi	J7658P	J7258P	J6458P	J7858P	J7458P	J6658P
0 to 400 psi	J7660P	J7260P	J6460P	J7860P	J7460P	J6660P
0 to 600 psi	J7664P	J7264P	J6464P	J7864P	J7464P	J6664P
0 to 1,000 psi	J7672P	J7272P	J6472P	J7872P	J7472P	J6672P
0 to 1,500 psi	J7674P	J7274P	J6474P	J7874P	J7474P	J6674P
0 to 2,000 psi	J7676P	J7276P	J6476P	J7876P	J7476P	J6676P
0 to 3,000 psi	J7678P	J7278P	J6478P	J7878P	J7478P	J6678P
0 to 5,000 psi	J7682P	J7282P	J6482P	J7882P	J7482P	J6682P
0 to 6,000 psi	J7684P	J7284P	J6484P	J7884P	J7484P	J6684P
0 to 10,000 psi				J7890P	J7490P	J6690P

NOTE: Items are available on special order. However, minimums and lead times apply. Consult factory.

SPECIFICATIONS

ACCURACY
ASME Grade B – ±3/2/3% (±2% of range across middle half of scale)

CASE SIZES
63mm (2.47") diameter

CASE MATERIAL
304 Stainless Steel

CASE STYLE
Rolled ring, hermetically sealed case
CB – Center Back Mount
LM – Lower Mount
UC – U-Clamp Mount

TUBE & SOCKET
Copper alloy or 316 stainless steel

MOVEMENT
Brass

CONNECTION
¼ NPT

RANGES
0 to 30" Hg VAC; Compound 30" Hg to 400 psi; 15 to 10,000 psi

DIAL STANDARD
Dual scale psi and kPa

DIAL COLOR
Black markings on white

POINTER
Aluminum, black painted

WINDOW
Polycarbonate

FILL MEDIUM
Glycerine Standard

RESTRICTOR
Standard for all ranges

VENT PLUG
Rubber plug with snip-off feature

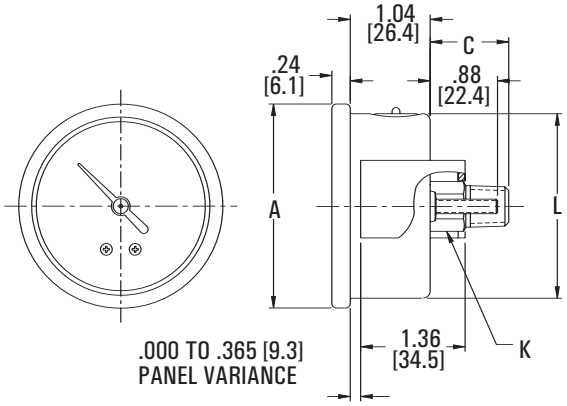
Severe Service

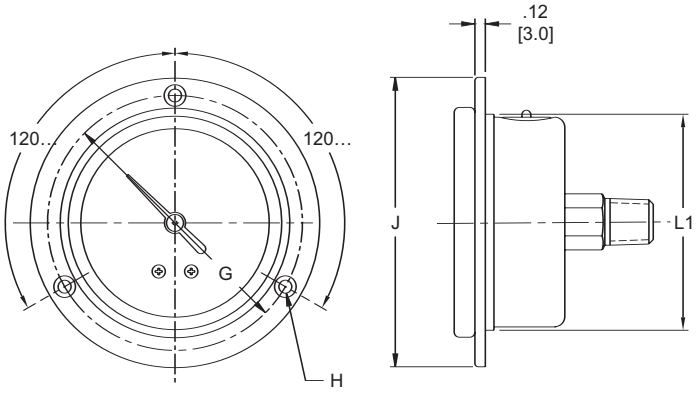
front flange mount

63MM SEVERE SERVICE GAUGE OPTIONS			
OPTION	TYPE	SUFFIX	AVAILABLE ON MODELS
Fill Medium	Dry (no fill)	Delete suffix P	All models
	Silicone (SL)	I	All models
Front Flange	Adapter ring (3 hole)	R1	Center Back & U-Clamp only (factory Installed)
	Adapter ring (no holes)	R2	U-Clamp only (factory Installed)
Bayonet Case & Ring w/Safety Glass		J	Center Back or Lower Mount (consult factory)
Catalog Dials	psi only	E	See Marsh Price List for minimum
	bar only	L1	
	kg/cm^2 only	L2	
	kPa only	L3	
	MPa only	L4	
	psi & bar	W1	
	psi & kg/cm^2	W2	
	psi & MPa	W4	
Custom Dials	Logo or Custom face	M	Consult factory for colors and minimums
Restrictor	Special restrictor	H	All models - See Marsh Price List for minimum
	Restrictor removed	H1	
Increased Accuracy	Grade A (2/1/2%)	B	All models - See Marsh Price List for minimum
Special Connections			Consult Factory

Dimension Table

Gauge Size	Connection	A	C	G	H	K	J	L	L1
63mm	¼"	2.66" / 68mm	1.03" / 26mm	2.95" / 75mm	0.15" / 4mm	0.56" / 14mm	3.35 / 85mm	2.43" / 62mm	2.5" / 64mm





100MM SEVERE SERVICE GAUGE

- Brass or Stainless Steel Internals
- Ranges to 10,000 psi
- Glycerine Filled

Marsh Instruments Liquid Filled Gauges are designed to perform in rugged applications and harsh environmental conditions - especially where pulsation and vibration are a problem. Liquid Filled Gauges offer a significant cushioning and dampening effect, reducing pointer flutter and internal gauge damage; also lubricating the internals, and reducing corrosion. All stainless steel Liquid Filled Gauges feature a ventable top fill plug for pressure relief and ease of venting after installation. The hermetically sealed construction reduces the chance of leaks, and makes field filling an easy option.

Typical applications include refineries, chemical plants, offshore platforms, oil rigs, marine applications, general industrial application and OEM processes.

STANDARD RANGES & PART NUMBERS

TYPE	100MM SEVERE SERVICE GAUGES					
Size	100mm			100mm		
Case Material	Stainless Steel			Stainless Steel		
Internals	Copper Alloy			Stainless Steel		
Mounting / Case Style	LM	CB	UC	LM	CB	UC
Connections (NPT)	¼ NPT	¼ NPT	¼ NPT	¼ NPT	¼ NPT	¼ NPT
Scale Standard	psi/kPa			psi/kPa		
0 to 30" Hg VAC	X32965P			X32967P		
30" Hg VAC to 30 psi	X32501P					
30" Hg VAC to 60 psi	X32502P					
30" Hg VAC to 100 psi						
30" Hg VAC to 150 psi	X32887P	X32901P	X32894P	X32929P	X32941P	X32935P
30" Hg VAC to 200 psi	X32888P	X32902P	X32895P	X32930P	X32942P	X32936P
30" Hg VAC to 300 psi	X32889P	X32903P	X32896P	X32931P	X32943P	X32937P
0 to 15 psi	X32504P	X32546P	X32525P	X32630P	X32678P	X32654P
0 to 30 psi	X32505P	X32547P	X32526P	X32631P	X32679P	X32655P
0 to 60 psi	X32506P	X32548P	X32527P	X32632P	X32680P	X32656P
0 to 100 psi	X32507P	X32549P	X32528P	X32633P	X32681P	X32657P
0 to 160 psi	X32508P	X32550P	X32529P	X32634P	X32682P	X32658P
0 to 200 psi	X32509P	X32551P	X32530P	X32635P	X32683P	X32659P
0 to 300 psi	X32510P	X32552P	X32531P	X32636P	X32684P	X32660P
0 to 400 psi	X32511P	X32553P	X32532P	X32637P	X32685P	X32661P
0 to 600 psi	X32512P	X32554P	X32533P	X32638P	X32686P	X32662P
0 to 1,000 psi	X32513P	X32555P	X32534P	X32639P	X32687P	X32663P
0 to 1,500 psi	X32514P	X32556P	X32535P			
0 to 2,000 psi	X32515P	X32557P	X32536P	X32641P	X32689P	X32665P
0 to 3,000 psi	X32516P	X32558P	X32537P	X32642P	X32690P	X32666P
0 to 5,000 psi	X32518P	X32560P	X32539P	X32644P	X32692P	X32668P
0 to 6,000 psi	X32519P	X32561P	X32540P	X32645P	X32693P	X32669P
0 to 10,000 psi				X32647P	X32695P	X32671P

NOTE: Items are available on special order. However, minimums and lead times apply. Consult factory.

SPECIFICATIONS

ACCURACY
ASME Grade A – ±2/1/2% (±1% of range across middle half of scale)

CASE SIZES
100mm (3.89") diameter

CASE MATERIAL
304 Stainless Steel

CASE STYLE
Rolled ring, hermetically sealed case
CB – Center Back Mount
LM – Lower Mount
UC– U-Clamp Mount

TUBE & SOCKET
Copper alloy or 316 stainless steel

MOVEMENT
Brass

CONNECTION
¼ NPT

RANGES
0 to 30" Hg VAC
Compound 30" Hg VAC to 300 psi
15 to 10,000 psi

DIAL STANDARD
Dual scale psi & kPa

DIAL COLOR
Black markings on white

POINTER
Aluminum, black painted

WINDOW
Polycarbonate

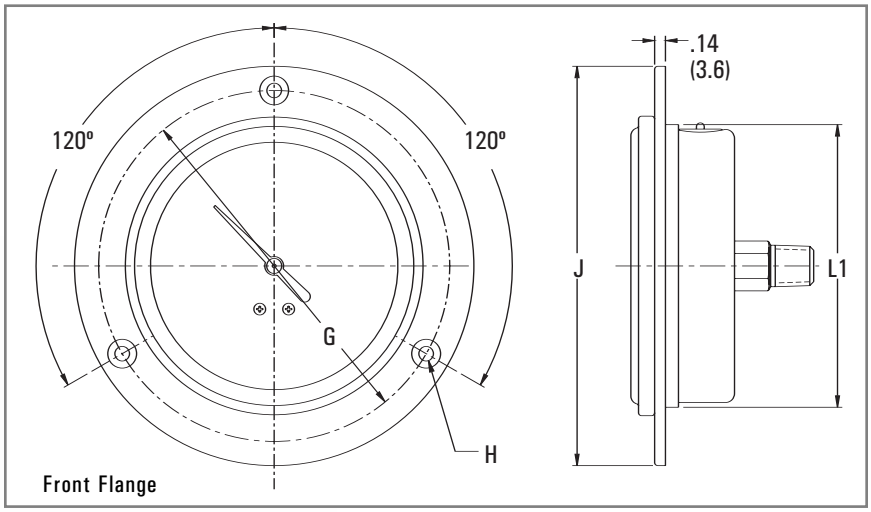
FILL MEDIUM
Glycerine Standard

RESTRICTOR
Standard for all ranges

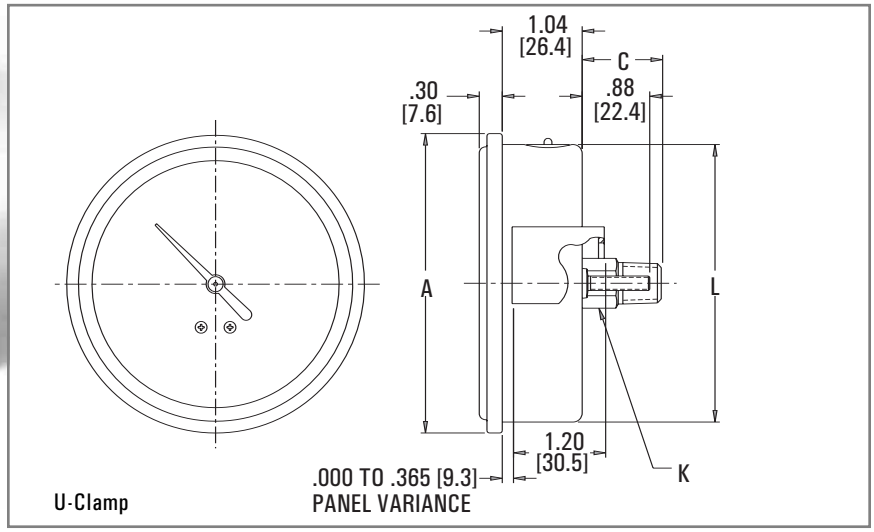
VENT PLUG
Rubber plug with snip-off feature

Severe Service

100MM SEVERE SERVICE GAUGE OPTIONS			
OPTION	TYPE	SUFFIX	AVAILABLE ON MODELS
Fill Medium	Dry (no fill)	Delete suffix P	All models
	Silicone (SL)	I	All models
Front Flange	Adapter Ring (3 hole)	R	U-Clamp & Center Back only (factory installed)
Catalog Dials	psi only	E	See Marsh Price List for minimum
	bar only	L1	
	kg/cm^2	L2	
	kPa only	L3	
	MPa	L4	
	psi & bar	W1	
	psi & kg/cm^2	W2	
	psi & MPa	W4	
Custom Dials	Logo or custom face	M	Consult factory for colors and minimums.
Restrictor	Special restrictor	H	All models - See Marsh Price List for minimum
	Restrictor removed	H1	All models - See Marsh Price List for minimum
Increased Accuracy	Grade 1A ±1% full scale	B	All models - See Marsh Price List for minimum
Special Connections			Consult factory for Availability



Front Flange



U-Clamp

Dimension Table

Gauge Size	Conn-ection	A	C	G	H	K	J	L	L1
100mm	¼"	3.90" 99mm	1.03" 26mm	4.57" 116mm	0.19" 5mm	9/16" 14mm	5.20" 132mm	3.62" 92mm	3.68" 94mm

63MM & 100MM BRASS GAUGE

- Forged Brass case (one piece construction)
- Ranges to 10,000PSI
- Heavy Duty Performance

Marsh forged brass gauges are designed for top performance in rugged applications and harsh environments, where corrosive gas or media is not an issue. Applications include Oil patch, Hydraulics, Natural gas, OEM and General Industrial applications where superior quality is required. Liquid Filling protects against pulsation and vibration offering a cushioning and dampening effect. The hermetically sealed one piece design reduces the chance of leaks and allows field filling as an easy option.

STANDARD RANGES & PART NUMBERS

TYPE	63MM BRASS	100MM BRASS
Size	63mm	100mm
Case Material	Forged Brass	Forged Brass
Internals	Copper Alloy	Copper Alloy
Mounting / Case Style	LM	LM
Connection	¼ NPT	½ NPT
Scale Standard	psi	psi
0 to 30" Hg VAC	W9005PE	W9405PE
30" Hg VAC to 30 psi	W9012PE	W9412PE
30" Hg VAC to 60 psi	W9014PE	W9414PE
30" Hg VAC to 100 psi	W9016PE	W9416PE
30" Hg VAC to 200 psi	W9020PE	W9420PE
0 to 15 psi	W9040PE	W9440PE
0 to 30 psi	W9042PE	W9442PE
0 to 60 psi	W9046PE	W9446PE
0 to 100 psi	W9048PE	W9448PE
0 to 160 psi	W9052PE	W9452PE
0 to 200 psi	W9054PE	W9454PE
0 to 300 psi	W9058PE	W9458PE
0 to 400 psi	W9060PE	W9460PE
0 to 600 psi	W9064PE	W9464PE
0 to 1,000 psi	W9072PE	W9472PE
0 to 1,500 psi	W9074PE	W9474PE
0 to 2,000 psi	W9076PE	W9476PE
0 to 3,000 psi	W9078PE	W9478PE
0 to 5,000 psi	W9082PE	W9482PE
0 to 10,000 psi	W9090PE	W9490PE

63MM &100MM BRASS GAUGE OPTIONS			
OPTION	TYPE	SUFFIX	AVAILABLE ON MODELS
Fill Medium	Dry (no fill)	Delete Suffix P	Consult factory for minimums
	Glycerine	Standard	
	Silicone (SL)	I	
Catalog Dials	Bar only	L1	
	kg/cm² only	L2	
	kPa only	L3	
	MPa only	L4	
	psi & BAR	W1	
	psi & kg/cm²	W2	
	psi & kPa	W3	
	psi & MPa	W4	
Custom Dials	Logo or Custom Face	M	Consult factory for minimums.

SPECIFICATIONS

ACCURACY
63mm: ±1.6% of range across full scale
100mm: ASME Grade 1A - ±1% of range across full scale

CASE SIZES
63mm: diameter (2.5")
100mm: diameter (4.0")

CASE MATERIAL
Forged Brass

CASE STYLES
LM – Lower Mount

TUBE & SOCKET
Copper alloy

MOVEMENT
Brass

CONNECTION
63mm: ¼ NPT
100mm: ½ NPT

RANGES
0-30" Hg vacuum;
compound ranges 30" Hg vacuum to 200 psi; and 15-10,000 psi

DIAL STANDARD
Single Scale psi

DIAL COLOR
Black markings on white

POINTER
Aluminum, black painted

WINDOW
Acrylic

RING
63mm: Gold Plated ABS
100mm: Chrome Plated

FILL MEDIUM
Glycerine Standard

VENT
Rubber plug with snip-off feature

100MM STAINLESS STEEL GAUGE

- Liquid Filled or Dry
- Field Fillable
- Ranges to 10,000 psi
- Heavy Duty Stainless Steel

Marsh Instruments Stainless Steel Gauges are built for extended life, and designed for harsh and corrosive environments. These stainless steel gauges feature top fill plugs and are field fillable. Pressure ranges are available to 10,000 psi. Marsh Liquid Filled Gauges offer significant cushioning and dampening which reduces pointer flutter and internal gauge damage.

Typical applications include refineries, chemical plants, offshore platforms, oil rigs, marine applications, general industrial application and OEM processes.

SPECIFICATIONS

ACCURACY
ASME Grade 1A – ±1.0% of range across full scale

CASE SIZES
100mm diameter (4")

CASE MATERIAL
304 Stainless Steel

CASE STYLES
LM – Lower Mount
UC – U-Clamp Mount
FF – Front Flange Mount

TUBE & SOCKET
316 Stainless Steel

MOVEMENT
Stainless Steel

CONNECTION
¼" NPT lower or lowerback connection

RANGES
30 to 10,000 psi

DIAL STANDARD
Dual scale psi and kPa

DIAL COLOR
Black markings on white

POINTER
Aluminum, black painted

WINDOW
Acrylic

FILL MEDIUM
See options

VENT
Rubber plug with snip-off feature

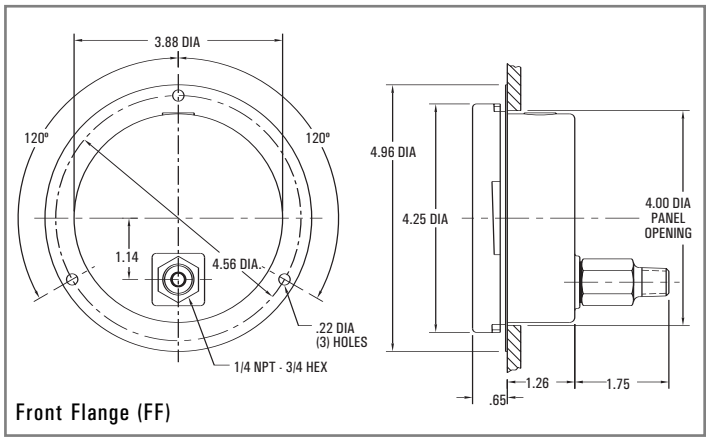
STANDARD RANGES & PART NUMBERS

TYPE	100MM STAINLESS STEEL GAUGES		
Size	100mm	100mm	100mm
Case Material	Stainless Steel	Stainless Steel	Stainless Steel
Internals	316 Stainless Steel	316 Stainless Steel	316 Stainless Steel
Mounting / Case Style	LM	UC	FF
Connection	¼ NPT	¼ NPT	¼ NPT
Scale Standard	psi/kPa	psi/kPa	psi/kPa
0 to 30 psi	H10742	H10842	H10842R
0 to 60 psi	H10746	H10846	H10846R
0 to 100 psi	H10748	H10848	H10848R
0 to 160 psi	H10752	H10852	H10852R
0 to 200 psi	H10754	H10854	H10854R
0 to 300 psi	H10758	H10858	H10858R
0 to 400 psi	H10760	H10860	H10860R
0 to 600 psi	H10764	H10864	H10864R
0 to 1,000 psi	H10772	H10872	H10872R
0 to 1,500 psi	H10774	H10874	H10874R
0 to 2,000 psi	H10776	H10876	H10876R
0 to 3,000 psi	H10778	H10878	H10878R
0 to 5,000 psi	H10782	H10882	H10882R
0 to 10,000 psi	H10790	H10890	H10890R

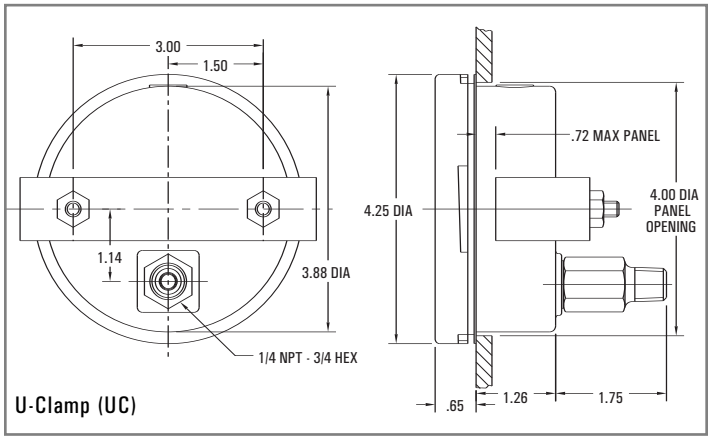
To order filled, see filling chart below.

100MM STAINLESS STEEL GAUGE OPTIONS			
OPTION	TYPE	SUFFIX	AVAILABLE ON MODELS
Fill Medium	Dry (no fill)	Standard	All ranges
	Glycerine (GL)	Add suffix P	
	Silicone (SL)	Add suffix PI	

DIMENSIONS



Front Flange (FF)



U-Clamp (UC)

QUALITY SERIES 100MM STAINLESS STEEL INTERNAL GAUGE

- Liquid Filled or Dry - Field Fillable
- Adjustable Micrometer Pointer
- Ranges to 15,000 psi
- Safety Glass Window

Marsh Stainless Steel gauges are built for extended life and are designed for harsh and corrosive environments.They feature a top fill plug, polished bayonet ring and are field fillable. Liquid filled gauges offer significant cushioning and dampening plus extend the life of a gauge.

Typical applications include Oil patch, Refineries, Oil Rigs, Control Panels, Offshore Platforms, Marine and General Industrial.

STANDARD RANGES & PART NUMBERS

TYPE	QUALITY SERIES 100MM STAINLESS STEEL INTERNAL GAUGES	
Size	100mm	**NACE** 100mm
Case Material	Stainless Steel	Stainless Steel
Internals	316 Stainless Steel	316 Stainless Steel
Mounting / Case Style	LM	LM
Connection	½ NPT	½ NPT
Scale Standard	psi/kPa	psi/kPa
0 to 30" Hg Vacuum	H20905	
0 to 15 psi	H20940	HN20940
0 to 30 psi	H20942	HN20942
0 to 60 psi	H20946	HN20946
0 to 100 psi	H20948	HN20948
0 to 160 psi	H20952	HN20952
0 to 200 psi	H20954	HN20954
0 to 300 psi	H20958	HN20958
0 to 400 psi	H20960	HN20960
0 to 600 psi	H20964	HN20964
0 to 1,000 psi	H20972	HN20972
0 to 1,500 psi	H20974	HN20974
0 to 2,000 psi	H20976	HN20976
0 to 3,000 psi	H20978	HN20978
0 to 5,000 psi	H20982	HN20982
0 to 10,000 psi	H20990	HN20990
0 to 15,000 psi	H20992	HN20992
0 to 20,000 psi	H20994	HN20994

To order filled, see filling chart below.

SPECIFICATIONS

ACCURACY
ASME Grade 1A – ±1.0% of range across full scale

CASE SIZES
100mm diameter (4")

CASE MATERIAL
304 Stainless Steel

CASE STYLES
LM – Lower Mount

TUBE & SOCKET
316 Stainless Steel Welded to Case

MOVEMENT
Stainless Steel

CONNECTION
½ NPT

RANGES
Vacuum to 15,000 psi

DIAL STANDARD
Dual scale psi and kPa

DIAL COLOR
Black markings on white

POINTER
Aluminum, black painted, micro-adjustable

WINDOW
Safety Glass

FILL MEDIUM
See options

VENT
Rubber plug with snip-off feature

QUALITY SERIES 100MM STAINLESS STEEL INTERNAL GAUGE OPTIONS			
OPTION	TYPE	SUFFIX	AVAILABLE ON MODELS
Fill Medium	Dry (no fill)	Standard	All ranges
	Glycerine (GL)	Add suffix P	
	Silicone (SL)	Add suffix PI	
Catalog Dials	psi only	E	
	Bar only	L1	
	kg/cm² only	L2	
	kPa only	L3	
	MPa only	L4	
	psi & BAR	W1	
	psi & kg/cm²	W2	
	psi & MPa	W4	

QUALITY SERIES 100MM COPPER ALLOY INTERNAL GAUGE

- Liquid Filled or Dry
- Removable polished bayonet ring
- Ranges to 10,000 psi
- Safety Glass Window

Stainless steel case with copper alloy internals. Ideal for heavy duty service in industrial and commercial environments. Features robust design with removable polished bayonet ring and adjustable pointer. Field fillable.

Typical applications include industrial machinery, oil field equipment and controls, wellheads, pipeline and general industrial.

SPECIFICATIONS

ACCURACY
ASME Grade 1A – ±1.0% of range across full scale

CASE SIZES
100mm diameter (4")

CASE MATERIAL
304 Stainless Steel

CASE STYLES
LM – Lower Mount

TUBE & SOCKET
Copper alloy

MOVEMENT
Stainless Steel

CONNECTION
½ NPT lower mount

RANGES
Vacuum to 10,000 psi

DIAL STANDARD
Single scale psi

DIAL COLOR
Black markings on white

POINTER
Aluminum, black painted, micro-adjustable

WINDOW
Safety Glass

FILL MEDIUM
See options

VENT
Rubber plug with snip-off feature

STANDARD RANGES & PART NUMBERS

TYPE	QUALITY SERIES 100MM COPPER ALLOY INTERNAL GAUGES
Size	100mm
Case Material	Stainless Steel
Internals	Copper Alloy
Mounting / Case Style	LM
Connection	½ NPT
Scale Standard	psi
0 to 30" Hg Vacuum	H20505
0 to 15 psi	H20540
0 to 30 psi	H20542
0 to 60 psi	H20546
0 to 100 psi	H20548
0 to 160 psi	H20552
0 to 200 psi	H20554
0 to 300 psi	H20558
0 to 400 psi	H20560
0 to 600 psi	H20564
0 to 1,000 psi	H20572
0 to 1,500 psi	H20574
0 to 2,000 psi	H20576
0 to 3,000 psi	H20578
0 to 5,000 psi	H20582
0 to 10,000 psi	H20590

To order filled, see filling chart below.

QUALITY SERIES 100MM COPPER ALLOY INTERNAL GAUGE OPTIONS			
OPTION	TYPE	SUFFIX	AVAILABLE ON MODELS
Fill Medium	Dry (no fill)	Standard	All ranges
	Glycerine (GL)	Add suffix P	
	Silicone (SL)	Add suffix PI	
Catalog Dials	bar only	L1	
	kg/cm^2 only	L2	
	kPa only	L3	
	MPa only	L4	
	psi & BAR	W1	
	psi & kg/cm^2	W2	
	psi & kPa	W3	
	psi & MPa	W4	

'HW' 160MM STAINLESS STEEL GAUGE

- Liquid Filled or Dry - Field Fillable
- Socket Welded to the Case
- Ranges to 20,000 psi
- Heavy Duty All Stainless Steel

Marsh Instruments Stainless Steel Gauges are built for extended life, and designed for harsh and corrosive environments. These stainless steel gauges feature top fill plugs and are field fillable. Pressure ranges are available to 20,000psi. Marsh Liquid Filled Gauges offer significant cushioning and dampening which reduces pointer flutter and internal gauge damage.

Typical applications include refineries, chemical plants, offshore platforms, oil rigs, marine applications, general industrial application and OEM processes.

SPECIFICATIONS

ACCURACY
ASME Grade 1A – ±1.0% of range across full scale

CASE SIZES
160mm diameter (6")

CASE MATERIAL
304 Stainless Steel

CASE STYLES
LM – Lower Mount

TUBE & SOCKET
316 Stainless steel welded to the case

MOVEMENT
Stainless Steel

CONNECTION
½ NPT

RANGES
15 to 20,000 psi

DIAL STANDARD
Dual scale psi and kPa

DIAL COLOR
Black markings on white

POINTER
Aluminum, black painted

WINDOW
Safety glass

FILL MEDIUM
See options

VENT
Rubber plug with snip-off feature

STANDARD RANGES & PART NUMBERS

TYPE	'HW' 160MM STAINLESS STEEL GAUGES
Size	160mm
Case Material	304 Stainless Steel
Internals	316 Stainless Steel
Mounting / Case Style	LM
Connection	½ NPT
Scale Standard	psi/kPa
0 to 15 psi	
0 to 30 psi	HW30942
0 to 60 psi	HW30946
0 to 100 psi	HW30948
0 to 160 psi	HW30952
0 to 200 psi	HW30954
0 to 300 psi	HW30958
0 to 400 psi	HW30960
0 to 600 psi	HW30964
0 to 1,000 psi	HW30972
0 to 1,500 psi	HW30974
0 to 2,000 psi	HW30976
0 to 3,000 psi	HW30978
0 to 5,000 psi	HW30982
0 to 10,000 psi	HW30990
0 to 20,000 psi	HW30994

NOTE: Items are available on special order. However, minimums and lead times apply. Consult factory.

NOTE: To order filled, consult filling chart below.

'HW' 160MM STAINLESS STEEL GAUGE OPTIONS			
OPTION	TYPE	SUFFIX	AVAILABLE ON MODELS
Fill Medium	Dry (no fill)	Standard	All ranges
	Glycerine (GL)	Add suffix P	
	Silicone (SL)	Add suffix PI	
Catalog Dials	psi only	E	
	BAR only	L1	
	kg/cm^2 only	L2	
	kPa only	L3	
	MPa only	L4	
	psi & BAR	W1	
	psi & kg/cm^2	W2	
	psi & MPa	W4	

100MM ELITE STAINLESS STEEL GAUGE

- All Stainless Steel
- Field Fillable
- Ranges to 10,000 psi
- Liquid Filled or Dry
- Solid Front Design — Safecase

Marsh Instruments all stainless steel gauges are built for extended life, and designed for harsh and corrosive environments. These stainless steel gauges feature top fill plugs and are field fillable. Marsh Liquid Filled Gauges offer significant cushioning and dampening which reduces pointer flutter and internal gauge damage.

Typical applications include refineries, chemical plants, offshore platforms, oil rigs, marine applications, general industrial application and OEM processes.

SPECIFICATIONS

ACCURACY
ASME Grade 1A – ±1.0% of range across full scale

CASE SIZES
100mm diameter (4")

CASE MATERIAL
304 Stainless Steel

CASE STYLE
Solid front & blow-out back
Safecase construction
LM – Lower Mount

TUBE & SOCKET
316 Stainless Steel

MOVEMENT
Stainless Steel

CONNECTION
½ NPT

RANGES
30 to 10,000 psi
and 0 to 30" VAC Hg

DIAL STANDARD
Dual scale psi and kPa

DIAL COLOR
Black markings on white

POINTER
Aluminum, black painted

WINDOW
Safety glass

FILL MEDIUM
See Options

VENT
Internal compensating diaphragm

STANDARD RANGES & PART NUMBERS

TYPE	100MM ELITE STAINLESS STEEL GAUGES
Size	100mm
Case Material	304 Stainless Steel
Internals	316 Stainless Steel
Mounting/Case Style	LM
Connection	½ NPT
Scale Standard	psi/kPa
0 to 30" Hg VAC	W9605
0 to 30 psi	W9642
0 to 60 psi	W9646
0 to 100 psi	W9648
0 to 200 psi	W9654
0 to 300 psi	W9658
0 to 600 psi	W9664
0 to 1,000 psi	W9672
0 to 1,500 psi	W9674
0 to 2,000 psi	W9676
0 to 3,000 psi	W9678
0 to 5,000 psi	W9682
0 to 10,000 psi	W9690

NOTE: To order filled, consult filling chart below.

100MM ELITE STAINLESS STEEL GAUGE OPTIONS			
OPTION	TYPE	SUFFIX	AVAILABLE ON MODELS
Fill Medium	Dry (no fill)	Standard	All ranges
	Glycerine (GL)	Add suffix P	All ranges
	Silicone (SL)	Add suffix PI	All ranges

QUALITY GAUGE

- Dial Sizes: 3½" and 4½"
- Stainless Steel Movement
- 3 Case Styles
- Recalibrator Standard on 3½"; Adjustable pointer standard on 4½"
- Ranges to 20,000 psi

Marsh Quality Gauges feature the exclusive recalibrator and the accuracy is within ±1% in the middle half of span. These gauges provide continuous service at an economical price.

Typical applications include air compressors, reciprocating pumps, boilers, engines, hydraulic presses and countless other industrial and OEM applications.

STANDARD RANGES & PART NUMBERS

TYPE	QUALITY GAUGES						
	With Recalibrator				With Adjustable Pointer		
Size	3½"				4½"		
Internals	Copper Alloy				Copper Alloy		
Case Material	Steel				Steel		
Mounting	LM	LM	LBM	LBM	LM	LM	LBM
Connection	¼ NPT	¼ NPT	¼ NPT	¼ NPT	¼ NPT	½ NPT	¼ NPT
Case Style	P	G	G	F	P	P	F
Scale Standard	psi	psi	psi	psi	psi	psi	psi
0 to 30" Hg VAC	H0205	H1205	H1805	H2005	H4205	H4805	H6005
30" Hg VAC to 30 psi	H0212	H1212	H1812	H2012	H4212	H4812	H6012
30" Hg VAC to 60 psi	H0214	H1214	H1814	H2014	H4214	H4814	H6014
30" Hg VAC to 150 psi	H0218	H1218	H1818	H2018	H4218	H4818	H6018
30" Hg VAC to 300 psi	H0224	H1224	H1824	H2024	H4224	H4824	H6024
0 to 15 psi	H0240						
0 to 30 psi	H0242	H1242	H1842	H2042	H4242	H4842	H6042
0 to 60 psi	H0246	H1246	H1846	H2046	H4246	H4846	H6046
0 to 100 psi	H0248	H1248	H1848	H2048	H4248	H4848	H6048
0 to 160 psi	H0252	H1252	H1852	H2052	H4252	H4852	H6052
0 to 200 psi	H0254	H1254	H1854	H2054	H4254	H4854	H6054
0 to 300 psi	H0258	H1258	H1858	H2058	H4258	H4858	H6058
0 to 400 psi	H0260	H1260	H1860	H2060	H4260	H4860	H6060
0 to 600 psi	H0264	H1264	H1864	H2064	H4264	H4864	H6064
0 to 1,000 psi	H0272	H1272	H1872	H2072	H4272	H4872	H6072
0 to 1,500 psi	H0274	H1274	H1874	H2074		H4874	
0 to 2,000 psi	H0276	H1276	H1876	H2076		H4876	
0 to 3,000 psi	H0278	H1278	H1878	H2078		H4878	
0 to 4,000 psi	H0280	H1280	H1880	H2080			
0 to 5,000 psi	H0282	H1282	H1882	H2082		H4882	
0 to 6,000 psi	H0284	H1284	H1884	H2084			
0 to 10,000 psi	H0290	H1290	H1890	H2090		H4890	
0 to 15,000 psi	H0292	H1292	H1892	H2092			
0 to 20,000 psi	H0294	H1294	H1894	H2094			

NOTE: Items are available on special order. However, minimums and lead times apply. Consult factory.

SPECIFICATIONS

ACCURACY
ASME Grade A – ± 2/1/2% (±1% of range in middle half of scale)

CASE SIZES
3½" and 4½" diameter
6" diameter (see options)

CASE MATERIAL
Steel, black painted

CASE STYLE
F – Front Flanged, Lower Back Mount with U-Clamp; 4½" has Hinged Ring (LBM)
G – Back Flanged case
P – Plain Case, Lower Mount

TUBE & SOCKET
Copper alloy

MOVEMENT
Stainless Steel

RECALIBRATOR
Standard 3½" only, 4½" has adjustable pointer

CONNECTION
¼ or ½ NPT

RANGES
0 to 30" Hg VAC; Compound 30" Hg VAC to 300 psi; 15 to 20,000 psi

DIAL STANDARD
Single scale psi

DIAL COLOR
Black markings on white

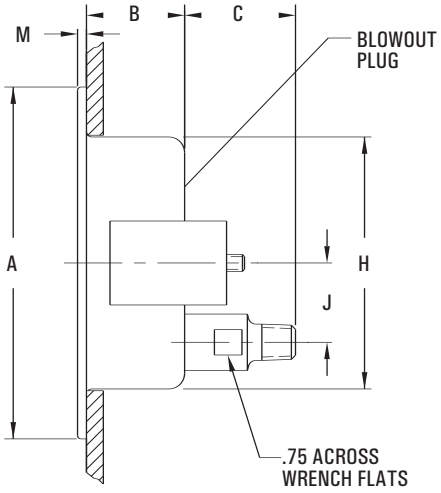
POINTER
Aluminum, black painted

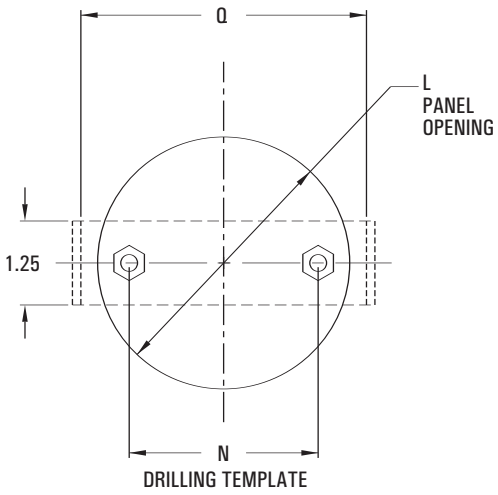
WINDOW
Instrument Glass

QUALITY GAUGES				
Dial Divisions	Quality Gauge 2/1/2% of Span			
Ranges	Figure Intervals		Minor Graduations	
Vacuum	3		0.2	
COMPOUND				
30" Hg VAC to 15 psi	5	3	0.5	0.2
30" Hg VAC to 30 psi	10	5	1	0.5
30" Hg VAC to 60 psi	10	10	1	0.5
30" Hg VAC to 150 psi	30	30	2	1
30" Hg VAC to 300 psi	30	30	5	2
PRESSURE				
0 to 15 psi	1		0.1	
0 to 30 psi	5		0.2	
0 to 60 psi	5		0.5	
0 to 100 psi	10		1	
0 to 160 psi	20		2	
0 to 200 psi	20		2	
0 to 300 psi	50		2	
0 to 400 psi	50		2	
0 to 600 psi	50		5	
HIGH PRESSURE				
0 to 1,000 psi	100		10	
0 to 1,500 psi	300		20	
0 to 2,000 psi	200		20	
0 to 3,000 psi	500		20	
0 to 4,000 psi	500		50	
0 to 5,000 psi	500		50	
0 to 6,000 psi	1,000		50	
0 to 10,000 psi	1,000		100	
0 to 15,000 psi	3,000		200	
0 to 20,000 psi	2,000		200	

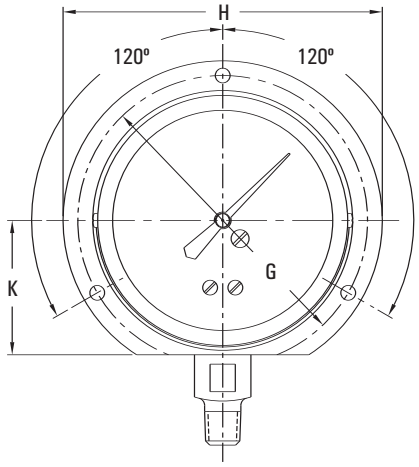
QUALITY GAUGE OPTIONS			
OPTION	TYPE	SUFFIX	AVAILABLE ON MODELS
Restrictors	Add restrictor	H	All ranges
Catalog Dials	bar only	L1	See Marsh Price List for minimum
	kg/cm² only	L2	
	kPa only	L3	
	MPa only	L4	
	psi & bar	W1	
	psi & kg/cm²	W2	
	psi & kPa	W3	
	psi & MPa	W4	
Custom Dials	Logo or Custom Face	M	All models - consult factory
Window	Acrylic (AY)	F2	3½" - 4½"
	Safety Glass (SG)	F3	3½" - 4½"
Increased Accuracy	Grade 1A: ±1% full scale	B	All models
Cases	Aluminum Back Flange	J	4½"– 6" consult factory
	Steel Hinged Ring Case	J	6" consult factory

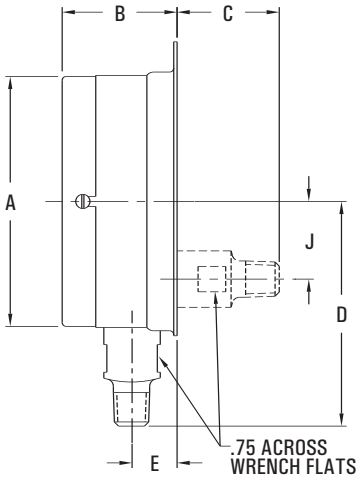
CASE PATTERNS & DIMENSIONS





Size	A	B	C	H	J	L	M	N	Q
3½"	4.86	1.66	1.55	3.75	1.16	3.75	.11	2.81	4.25
4½"	6.31	1.39	2.15	4.81	1.27	4.88	.11	3.88	5.31





Size	A	B	C	D	E	G	J	K	Panel Mounting
3½"	3.72	1.69	1.55	3.34	.67	4.31	1.16	2.00	.22

TEST GAUGE +/- 0.5%

- Adjustable Micrometer Knife-Edge Pointer with Mirror Dial
- Stainless Steel Movement
- Dial Size: 4½"
- Ranges to 10,000 psi

The Marsh Test Gauge is designed with a black painted steel housing and the choice of copper alloy or 316 stainless steel tube and socket to meet the demanding service needs of various test gauge applications. Accuracy is ±0.5% of full span. A highly polished integral mirror is positioned between the two graduation arcs on the dial face The knife-edge pointer is reflective so that, when the pointer and its reflection are in alignment, parallax is virtually eliminated and a true dial reading is assured.

Typical applications include test stands, aviation ground support, petroleum, chemical, utilities, industrial vessels and panel builders.

STANDARD RANGES & PART NUMBERS

TYPE	TEST GAUGES						
Size	4½"			4½"			
Internals	Copper Alloy			Stainless Steel			
Case Material	Steel	Steel	Steel	Steel	Steel	Steel	Steel
Mounting	LM	LM	LBM	LM	LM	LBM	LBM
Case Style	P	P	F	P	P	F	F
Connection	¼ NPT	½ NPT	¼ NPT	¼ NPT	½ NPT	¼ NPT	½ NPT
Scale Standard	psi			psi			
0 to 30" Hg VAC	D0205	D0605	D1205	D5205	D5605	D6105	D6405
30" Hg VAC to 15 psi	D0210	D0610	D1210	D5210	D5610	D6110	D6410
30" Hg VAC to 30 psi	D0212	D0612	D1212	D5212	D5612	D6112	D6412
30" Hg VAC to 60 psi	D0214	D0614	D1214	D5214	D5614	D6114	D6414
0 to 15 psi	D0240	D0640	D1240	D5240	D5640	D6140	D6440
0 to 30 psi	D0242	D0642	D1242	D5242	D5642	D6142	D6442
0 to 60 psi	D0246	D0646	D1246	D5246	D5646	D6146	D6446
0 to 100 psi	D0248	D0648	D1248	D5248	D5648	D6148	D6448
0 to 160 psi	D0252	D0652	D1252	D5252	D5652	D6152	D6452
0 to 200 psi	D0254	D0654	D1254	D5254	D5654	D6154	D6454
0 to 300 psi	D0258	D0658	D1258	D5258	D5658	D6158	D6458
0 to 400 psi	D0260	D0660	D1260	D5260	D5660	D6160	D6460
0 to 600 psi	D0264	D0664	D1264	D5264	D5664	D6164	D6464
0 to 1,000 psi				D5272	D5672	D6172	D6472
0 to 1,500 psi				D5274	D5674	D6174	D6474
0 to 2,000 psi				D5276	D5676	D6176	D6476
0 to 3,000 psi				D5278	D5678	D6178	D6478
0 to 5,000 psi				D5282	D5682	D6182	D6482
0 to 10,000 psi				D5290	D5690	D6190	D6490

SPECIFICATIONS

ACCURACY
ASME Grade 2A – ±0.5% of range across full scale

CASE SIZE
4½" diameter

CASE MATERIAL
Steel, Black Painted

CASE STYLE
F – Front Flanged with U-clamp and hinged ring (LBM)
P – Plain Case Lower Mount (LM)

TUBE & SOCKET
Copper alloy or 316 Stainless Steel

MOVEMENT
Stainless Steel

CONNECTION
¼ or ½ NPT

RANGES
0 to 30" Hg VAC; Compound 30" Hg to 60 psi; 15 to 10,000 psi

DIAL STANDARD
single scale psi

DIAL COLOR
Black markings on white with mirror dial to avoid parallax

POINTER
Aluminum, black painted, micro-adjustable, knife-edge

WINDOW
Instrument Glass

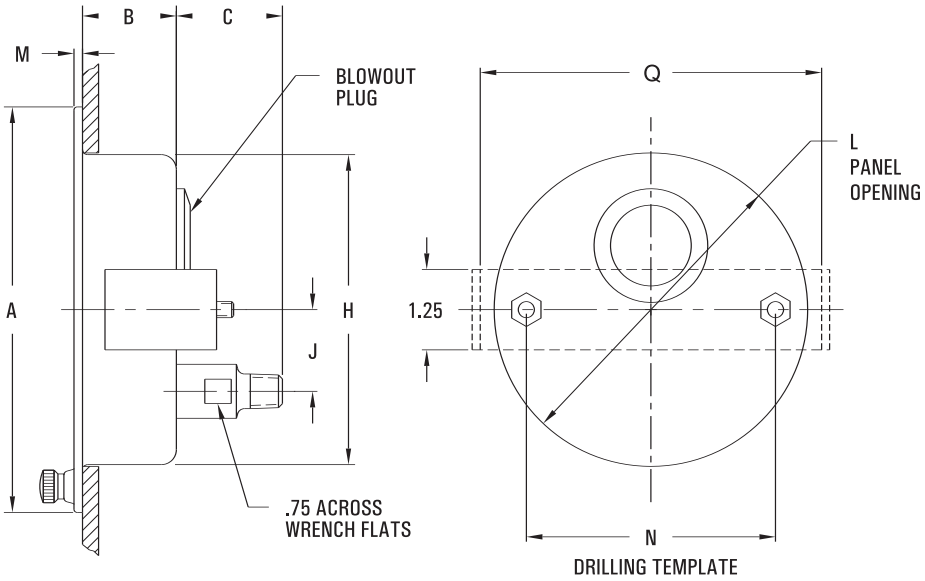
PRESSURE RELIEF
Blowout plug

Dial Divisions	Test Gauge 0.50% of Span			
Ranges	Figure Intervals		Minor Graduations	
Vacuum	2		0.1	
COMPOUND				
30" Hg VAC to 15 psi	5	3	0.2	0.1
30" Hg VAC to 30 psi	10	5	0.5	0.1
30" Hg VAC to 60 psi	10	5	1	0.2
30" Hg VAC to 150 psi	30	10	2	0.5
30" Hg VAC to 300 psi	30	30	5	1
PRESSURE				
0 to 15 psi	1		0.5	
0 to 30 psi	2		0.1	
0 to 60 psi	5		0.2	
0 to 100 psi	10		0.5	
0 to 160 psi	10		0.5	
0 to 200 psi	20		1	
0 to 300 psi	50		1	
0 to 400 psi	50		2	
0 to 600 psi	50		2	
HIGH PRESSURE				
0 to 1,000 psi	100		5	
0 to 1,500 psi	100		5	
0 to 2,000 psi	200		10	
0 to 3,000 psi	500		10	
0 to 4,000 psi	500		20	
0 to 5,000 psi	500		20	
0 to 6,000 psi	500		20	
0 to 10,000 psi	1,000		50	

TEST GAUGE OPTIONS

OPTION	TYPE	SUFFIX	AVAILABLE ON MODELS
Restrictors	Add restrictor	H	All ranges
Catalog Dials	bar only	L1	See Marsh Price List for minimum
	kg/cm^2 only	L2	
	kPa only	L3	
	MPa only	L4	
	psi & bar	W1	
	psi & kg/cm^2	W2	
	psi & kPa	W3	
	psi & MPa	W4	
Custom Dials	Logo or Custom Face	M	All models - consult factory
Window	Acrylic (AY)	F2	4½"
	Safety Glass (SG)	F3	4½"
Cases	4½" Polypropylene (TR)	J1	Consult Factory
	4½" Aluminum Back Flange	J2	
	4½" Aluminum Front Flange	J3	

CASE PATTERNS & DIMENSIONS



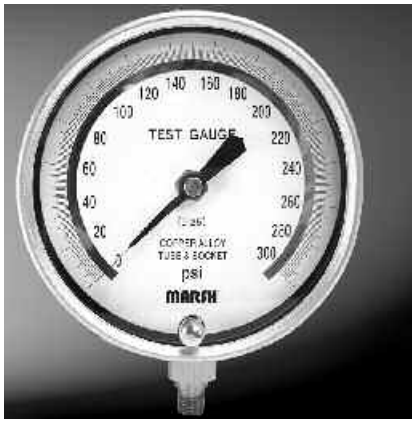
Size	A	B	C	H	J	L	M	N	Q
4½"	6.31	1.39	2.31	4.81	1.27	4.88	.11	3.88	5.31

MASTER TEST GAUGE (SERIES 'D')

- Knife-Edge Pointer with Mirror Dial
- External Dial Adjustment
- Dial Size: 6"
- Ranges to 10,000 psi

Marsh Master Test Gauges are used in precision laboratory applications and industrial environments where precise accuracy is demanded. For pressure readings to 10,000 psi, Marsh Master Test Gauges offer dependable, consistent accuracy within ±0.25% of span, meeting all requirements of ASME Grade 3A specifications. The pressure relieving blowout plug provides the increased safety required for potentially dangerous applications.

Typical applications include lab's, universities, automotive testing, government test facilities and pharmaceutical.



STANDARD RANGES & PART NUMBERS

TYPE	MASTER TEST GAUGES	
Size	6" (160mm)	
Case Material	Stainless Steel	
Internals	Copper Alloy	
Mounting / Case Style	LM	LM
Connection	¼ NPT	½ NPT
Scale Standard	psi	psi
0 to 30" Hg VAC	D31405	
30" Hg VAC to 15 psi	D31410	
30" Hg VAC to 30 psi	D31412	
30" Hg VAC to 60 psi	D31414	
0 to 15 psi	D31440	
0 to 30 psi	D31442	
0 to 60 psi	D31446	
0 to 100 psi	D31448	
0 to 160 psi	D31452	
0 to 200 psi	D31454	
0 to 300 psi	D31458	
0 to 400 psi	D31460	
0 to 600 psi	D31464	
0 to 1,000 psi		D31472
0 to 1,500 psi		D31474
0 to 2,000 psi		D31476
0 to 3,000 psi		D31478
0 to 5,000 psi		D31482
0 to 10,000 psi		D31490

SPECIFICATIONS

ACCURACY
ASME Grade 3A – ±0.25% of range across full scale

CASE SIZE
6" (160mm) diameter

CASE MATERIAL
304 Stainless Steel

CASE STYLE
LM–Lower Mount

TUBE & SOCKET
Copper alloy

MOVEMENT
Stainless Steel

CONNECTION
¼" NPT through 600 psi
½" NPT 1000 psi & above

RANGES
0 to 30" Hg VAC; Compound 30" Hg to 60 psi; 15 to 10,000 psi

DIAL STANDARD
Single scale psi

DIAL COLOR
Black markings on white with mirror dial to avoid parallax

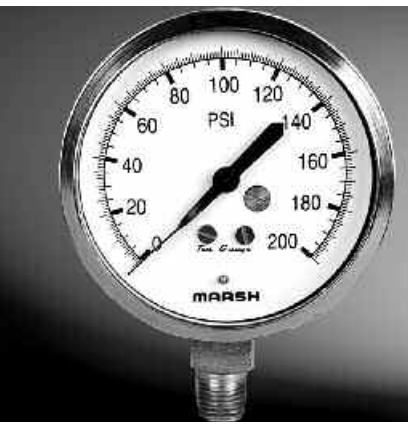
POINTER
Aluminum, black painted, knife-edge

WINDOW
Instrument Glass

PRESSURE RELIEF
Blowout plug

MASTER TEST GAUGE OPTIONS

OPTION	TYPE	SUFFIX	AVAILABLE ON MODELS
Catalog Dials	bar only	L1	Consult Factory
	kg/cm² only	L2	
	kPa only	L3	
	MPa only	L4	
	psi & bar	W1	
	psi & kg/cm²	W2	
	psi & kPa	W3	
	psi & MPa	W4	
Custom Dials	Logo or Custom Face	M	
Window	Acrylic (AY)	F2	
	Safety Glass (SG)	F3	
Tube & Socket	Stainless Steel		



INSPECTOR'S TEST GAUGE

- 3" Dial
- Vacuum to 1,000 psi Range
- Recalibrator on Dial Face
- ASME Grade 2A Accuracy

Marsh Inspector's Test Gauges are specifically designed for use by steam boiler, air brake and pressure system inspectors. The rugged 3" Inspector's Test Gauge features a nickel-plated case and an accuracy of ±0.5% of span. The bushed Mastergauge movement with Recalibrator is standard for these gauges. Mating parts are of dissimilar metals to prevent seizing. Bearing sleeves are of bronze, and the sector is brass.

Typical applications include steam boiler, air brakes, pressure system inspectors, and for use on other testing applications.

SPECIFICATIONS

ACCURACY
ASME Grade 2A – ±0.5% of span across full scale

CASE SIZES
3" diameter

CASE MATERIAL
Brass, Nickel Plated

CASE STYLE
Lower Mount with threaded ring

TUBE & SOCKET
Copper alloy

MOVEMENT
Brass

RECALIBRATOR
Standard

CONNECTION
¼ NPT

RANGES
0 to 30" Hg VAC; 15 to 1,000 psi

DIAL STANDARD
Dual Scale psi/kPa

DIAL COLOR
Black markings on white

POINTER
Aluminum, black painted, knife-edge

WINDOW
Beveled glass

PROTECTIVE COVER
Opaque plastic lens cover

STANDARD RANGES & PART NUMBERS

TYPE	INSPECTOR'S TEST GAUGES
Size	3"
Case Material	Nickel Plated Brass
Internals	Copper Alloy
Mounting / Case Style	LM
Connection	¼ NPT
Scale Standard	psi/kPa
0 to 30" Hg VAC	D1505
0 to 15 psi	D1540
0 to 30 psi	D1542
0 to 60 psi	D1546
0 to 100 psi	D1548
0 to 160 psi	D1552
0 to 200 psi	D1554
0 to 300 psi	D1558
0 to 600 psi	D1564
0 to 1,000 psi	D1572

INSPECTOR'S TEST GAUGE OPTIONS			
OPTION	TYPE	SUFFIX	AVAILABLE ON MODELS
Restrictors	Add restrictor	H	All ranges
Catalog Dials	psi only	E	See Marsh Price List for minimum
	bar only	L1	
	kg/cm^2 only	L2	
	kPa only	L3	
	MPa only	L4	
	psi & bar	W1	
	psi & kg/cm^2	W2	
	psi & MPa	W4	
Custom Dials	Logo or Custom Face	M	All models - consult factory

PROCESS GAUGE

- 4½" and 6" Dials
- 4 Safecase Designs
- Pressure Ranges Vacuum to 20,000 psi
- Dry or Liquid Filled
- Micrometer Pointer

Marsh Process Gauges are the industry standard in performance. With over 125 years of proven experience, Marsh offers the most complete line of process instrumentation in the industry. An extensive list of designs and options makes the Marsh line of Process Gauges the intelligent and practical choice in process instrumentation. All case styles feature safecase solid-front construction.

Typical applications include chemical and petroleum chemical processes, compressors, power plants and oil platforms.

STANDARD RANGES & PART NUMBERS

TYPE	PROCESS GAUGES					
Size	4½"				4½"	
Case Material	Polypropylene				Polypropylene	
Internals	Copper Alloy				Stainless Steel	
Mounting	LM	LBM	LM	LBM	LM	LBM
Case Style	T	T	T	T	T	T
Connection	¼ NPT	¼ NPT	½ NPT	½ NPT	¼ NPT	¼ NPT
Scale Standard	psi	psi	psi	psi	psi	psi
0 to 30" Hg VAC	P0105	P0205	P0505	P0605	P5105	P5205
30" Hg VAC to 15 psi	P0110	P0210	P0510	P0610	P5110	P5210
30" Hg VAC to 30 psi	P0112	P0212	P0512	P0612	P5112	P5212
30" Hg VAC to 60 psi	P0114	P0214		P0614	P5114	P5214
30" Hg VAC to 100 psi	P0116	P0216	P0516	P0616	P5116	P5216
30" Hg VAC to 200 psi	P0120	P0220	P0520	P0620	P5120	P5220
30" Hg VAC to 300 psi	P0124	P0224	P0524	P0624	P5124	P5224
0 to 15 psi	P0140	P0240	P0540	P0640	P5140	P5240
0 to 30 psi	P0142	P0242	P0542	P0642	P5142	P5242
0 to 60 psi	P0146	P0246	P0546	P0646	P5146	P5246
0 to 100 psi	P0148	P0248	P0548	P0648	P5148	P5248
0 to 160 psi	P0152	P0252	P0552	P0652	P5152	P5252
0 to 200 psi	P0154	P0254	P0554	P0654	P5154	P5254
0 to 300 psi	P0158	P0258	P0558	P0658	P5158	P5258
0 to 400 psi	P0160	P0260	P0560	P0660	P5160	P5260
0 to 600 psi	P0164	P0264	P0564	P0664	P5164	P5264
0 to 1,000 psi	P0168	P0268	P0568	P0668	P5168	P5268
0 to 1,500 psi			P0574		P5174	P5274
0 to 2,000 psi			P0576		P5176	P5276
0 to 3,000 psi			P0578		P5178	P5278
0 to 5,000 psi			P0582		P5182	P5282
0 to 10,000 psi			P0590		P5190	P5290
0 to 15,000 psi					P5192	P5292
0 to 20,000 psi					P5194	P5294

Add "P" Suffix to P/N for Liquid Filling with Glycerine, add "PI" for Silicone.
NOTE: Lower back mount gauges are not fillable

NOTE: Items are available on special order. However, minimums and lead times apply. Consult factory.

SPECIFICATIONS

ACCURACY
ASME Grade 2A – ±0.5% of full scale

CASE SIZES
4½" and 6" diameter

CASE MATERIAL
Safecase polypropylene (turret style only) & safecase aluminum

CASE STYLE
4½": G – Back flanged case (aluminum)
H – Front flange hinged ring (aluminum)
T – Turret (polypropylene)
6": G – Back flanged case

TUBE & SOCKET
Copper alloy or 316 stainless steel

MOVEMENT
Stainless Steel

CONNECTION
¼ or ½ NPT
LM –Lower Mount
LBM – Lower Back Mount

RANGES
0 to 30" Hg VAC; Compound 30" Hg VAC to 300 psi; 15 to 20,000 psi

DIAL STANDARD
Single Scale psi

DIAL COLOR
Black markings on white

POINTER
Aluminum, black painted, micro-adjustable

WINDOW
Acrylic

FILL MEDIUM
Dry or filled. Note: ALL 4½" lower mount Process Gauges are field-fillable. Optional factory filled glycerin or silicone

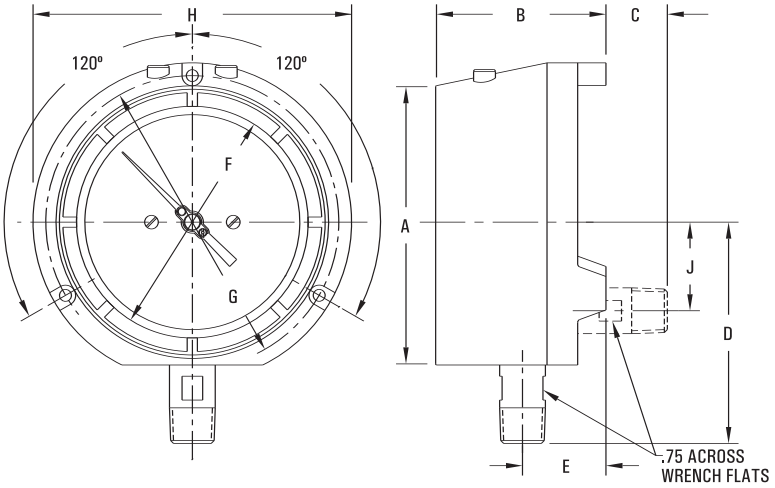
SAFECASE
Safecase construction standard on all Process Gauges

VENT
Internal compensating diaphragm

Process Gauges

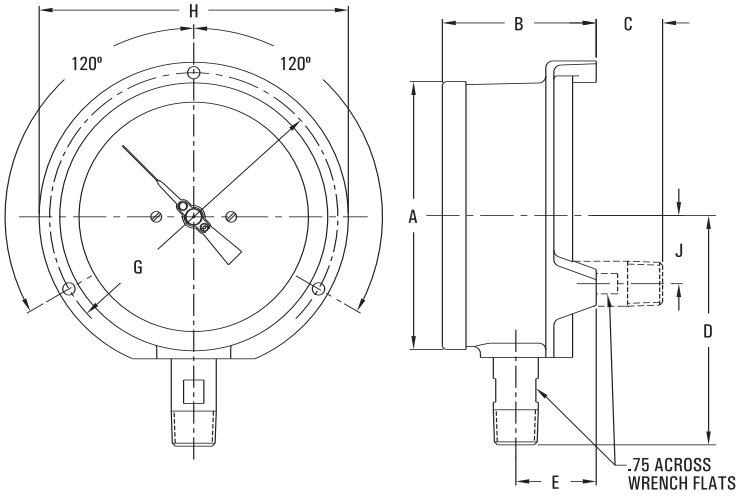
TYPE	PROCESS GAUGES - STANDARD RANGES & PART NUMBERS									
Size	4½"		4½"						4½"	
Case Material	Polypropylene		Aluminum						Aluminum	
Internals	Stainless Steel		Copper Alloy						Stainless Steel	
Mounting	LM	LBM	LM	LM	LBM	LBM	LBM	LBM	LM	LM
Case Style	T	T	G	G	G	G	H	H	G	G
Connection	½ NPT	½ NPT	¼ NPT	½ NPT	¼ NPT	½ NPT	¼ NPT	½ NPT	¼ NPT	½ NPT
Scale Standard	psi	psi	psi	psi	psi	psi	psi	psi	psi	psi
0 to 30" Hg VAC	P5605	P5705	P10005	P10505	P11005	P11505	P16005	P16505	P14005	P14505
30" Hg VAC to 15 psi	P5610	P5710	P10010	P10510	P11010	P11510	P16010	P16510	P14010	P14510
30" Hg VAC to 30 psi	P5612	P5712	P10012	P10512	P11012	P11512	P16012	P16512	P14012	P14512
30" Hg VAC to 60 psi	P5614	P5714	P10014	P10514	P11014	P11514	P16014	P16514	P14014	P14514
30" Hg VAC to 100 psi	P5616	P5716	P10016	P10516	P11016	P11516	P16016	P16516	P14016	P14516
30" Hg VAC to 200 psi	P5620	P5720	P10020	P10520	P11020	P11520	P16020	P16520		
30" Hg VAC to 300 psi	P5624	P5724	P10024	P10524	P11024	P11524	P16024	P16524		
0 to 15 psi	P5640	P5740	P10040	P10540	P11040	P11540	P16040	P16540	P14040	P14540
0 to 30 psi	P5642	P5742	P10042	P10542	P11042	P11542	P16042	P16542	P14042	P14542
0 to 60 psi	P5646	P5746	P10046	P10546	P11046	P11546	P16046	P16546	P14046	P14546
0 to 100 psi	P5648	P5748	P10048	P10548	P11048	P11548	P16048	P16548	P14048	P14548
0 to 160 psi	P5652	P5752	P10052	P10552	P11052	P11552	P16052	P16552	P14052	P14552
0 to 200 psi	P5654	P5754	P10054	P10554	P11054	P11554	P16054	P16554	P14054	P14554
0 to 300 psi	P5658	P5758	P10058	P10558	P11058	P11558	P16058	P16558	P14058	P14558
0 to 400 psi	P5660	P5760	P10060	P10560	P11060	P11560	P16060	P16560	P14060	P14560
0 to 600 psi	P5664	P5764	P10064	P10564	P11064	P11564	P16064	P16564	P14064	P14564
0 to 1,000 psi	P5668	P5768	P10068	P10568	P11068	P11568	P16068	P16568	P14068	P14568
0 to 1,500 psi	P5674	P5774								P14574
0 to 2,000 psi	P5676	P5776								P14576
0 to 3,000 psi	P5678	P5778								P14578
0 to 5,000 psi	P5682	P5782								P14582
0 to 10,000 psi	P5690	P5790								P14590
0 to 15,000 psi	P5692	P5792								P14592
0 to 20,000 psi	P5694	P5794								P14594

Size	4½"				6"				6"			
Case Material	Aluminum				Aluminum				Aluminum			
Internals	Stainless Steel				Copper Alloy				Stainless Steel			
Mounting	LBM	LBM	LBM	LBM	LM	LM	LBM	LBM	LM	LM	LBM	LBM
Case Style	G	G	H	H	G	G	G	G	G	G	G	G
Connection	¼ NPT	½ NPT	¼ NPT	½ NPT	¼ NPT	½ NPT	¼ NPT	½ NPT	¼ NPT	½ NPT	¼ NPT	½ NPT
Scale Standard	psi	psi	psi	psi	psi	psi	psi	psi	psi	psi	psi	psi
0 to 30" Hg VAC	P15005	P15505	P18005	P18505	P20005	P20505	P21005	P21505	P24005	P24505	P25005	P25505
30" Hg VAC to 15 psi	P15010	P15510	P18010	P18510	P20010	P20510	P21010	P21510	P24010		P25010	P25510
30" Hg VAC to 30 psi	P15012	P15512	P18012	P18512	P20012	P20512	P21012	P21512	P24012	P24512	P25012	P25512
30" Hg VAC to 60 psi	P15014	P15514	P18014	P18514	P20014	P20514	P21014	P21514	P24014	P24514	P25014	P25514
30" Hg VAC to 100 psi	P15016	P15516	P18016	P18516	P20016	P20516	P21016	P21516	P24016	P24516	P25016	P25516
30" Hg VAC to 200 psi	P15020	P15520	P18020	P18520								
30" Hg VAC to 300 psi	P15024	P15524	P18024	P18524								
0 to 15 psi	P15040	P15540	P18040	P18540	P20040	P20540	P21040	P21540	P24040	P24540	P25040	P25540
0 to 30 psi	P15042	P15542	P18042	P18542	P20042	P20542	P21042	P21542	P24042	P24542	P25042	P25542
0 to 60 psi	P15046	P15546	P18046	P18546	P20046	P20546	P21046	P21546	P24046	P24546	P25046	P25546
0 to 100 psi	P15048	P15548	P18048	P18548	P20048	P20548	P21048	P21548	P24048	P24548	P25048	P25548
0 to 160 psi	P15052	P15552	P18052	P18552	P20052	P20552	P21052	P21552	P24052	P24552	P25052	P25552
0 to 200 psi	P15054	P15554	P18054	P18554	P20054	P20554	P21054	P21554	P24054	P24554	P25054	P25554
0 to 300 psi	P15058	P15558	P18058	P18558	P20058	P20558	P21058	P21558	P24058	P24558	P25058	P25558
0 to 400 psi	P15060	P15560	P18060	P18560	P20060	P20560	P21060	P21560	P24060	P24560	P25060	P25560
0 to 600 psi	P15064	P15564	P18064	P18564	P20064	P20564	P21064	P21564	P24064	P24564	P25064	P25564
0 to 1,000 psi	P15068	P15568	P18068	P18568	P20068	P20568	P21068	P21568	P24068	P24568	P25068	P25568
0 to 1,500 psi	P15074	P15574	P18074	P18574					P24074	P24574	P25074	P25574
0 to 2,000 psi	P15076	P15576	P18076	P18576					P24076	P24576	P25076	P25576
0 to 3,000 psi	P15078	P15578	P18078	P18578					P24078	P24578	P25078	P25578
0 to 5,000 psi	P15082	P15582	P18082	P18582					P24082	P24582	P25082	P25582
0 to 10,000 psi	P15090	P15590	P18090	P18590					P24090	P24590	P25090	P25590
0 to 15,000 psi	P15092	P15592	P18092	P18592					P24092	P24592	P25092	P25592
0 to 20,000 psi	P15094	P15594	P18094	P18594					P24094	P24594	P25094	P25594



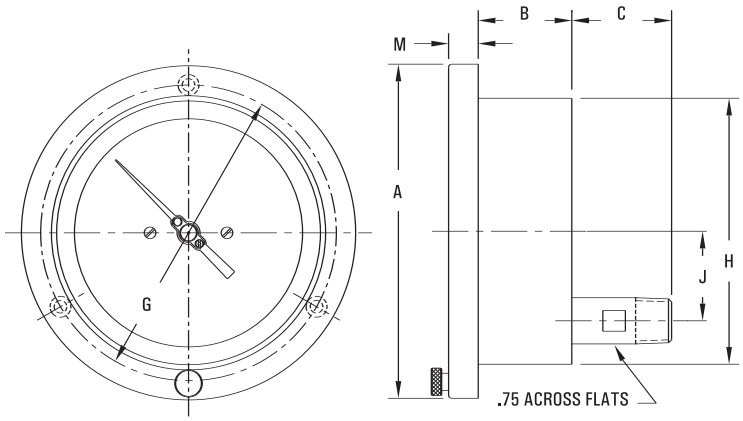
TURRET CASE

Turret Panel Mounting Holes 0.22	Size	A	B	C	D	E	F	G	H	J
	4½"	5.00	3.13	1.13	4.28	1.53	4.13	5.38	5.85	1.27



BACK FLANGE CASE

	Size	A	B	C	D	E	G	H	J	23
Back Flanged	4½"	4.94	2.88	1.19	4.28	1.50	5.38	5.78	1.27	.23
	6"	6.63	2.88	1.19	4.97	1.50	7.00	7.50	1.27	.28



FRONT FLANGE CASE

Front Flanged Panel Mounting Holes 0.23	Size	A	B	C	G	H	J	M
	4½"	6.08	1.70	1.88	5.38	4.88	1.27	0.54

Process Gauges

Dial Divisions	Process Gauge Series "P" 0.5% of Span			
Ranges	Figure Intervals		Minor Graduations	
Vacuum	3		0.2	
COMPOUND				
30" Hg VAC to 15 psi	5	3	0.5	0.2
30" Hg VAC to 30 psi	10	5	1	0.5
30" Hg VAC to 60 psi	10	10	1	0.5
30" Hg VAC to 150 psi	30	30	2	1
30" Hg VAC to 300 psi	30	30	5	2
PRESSURE				
0 to 15 psi	1		0.1	
0 to 30 psi	5		0.2	
0 to 60 psi	5		0.5	
0 to 100 psi	10		1	
0 to 160 psi	20		1	
0 to 200 psi	20		2	
0 to 300 psi	50		2	
0 to 400 psi	50		2	
0 to 600 psi	50		5	
HIGH PRESSURE				
0 to 1,000 psi	100		10	
0 to 1,500 psi	300		10	
0 to 2,000 psi	200		20	
0 to 3,000 psi	500		20	
0 to 4,000 psi	500		20	
0 to 5,000 psi	500		50	
0 to 6,000 psi	1,000		50	
0 to 10,000 psi	1,000		100	
0 to 15,000 psi	3,000		100	
0 to 20,000 psi	2,000		200	

PROCESS GAUGE OPTIONS			
OPTION	TYPE	SUFFIX	AVAILABLE ON MODELS
Restrictors	Add restrictor	H	All ranges
Fill Medium	Glycerine (GL)	P	4½" Lower Mount only (all ranges)
	Silicone (SL)	PI	4½" Lower Mount only (all ranges)
Catalog Dials	bar only	L1	See Marsh Price List for minimum
	kg/cm^2 only	L2	
	kPa only	L3	
	MPa only	L4	
	psi & bar	W1	
	psi & kg/cm^2	W2	
	psi & kPa	W3	
	psi & MPa	W4	
Window	Instrument Glass (GS)	F1	4½" & 6"
	Safety Glass (SG)	F3	4½" & 6"
Cases	Phenolic Turret (PH)	J1	4½"
	4½" Steel Case (LM or LBM)	J	4½" (Adjustable pointer only)
	6" Hinged Ring Steel Case with U-Clamp	J	6" (Adjustable pointer only)
Custom Dials	Logo or Custom Face	M	Consult factory for colors and minimums.

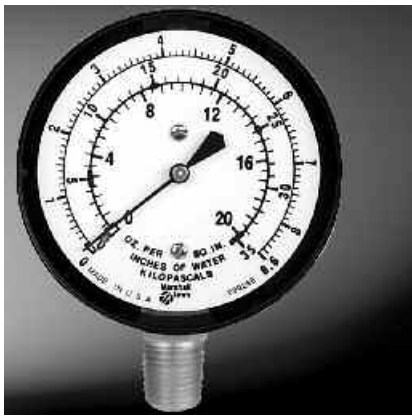
NOTE: 4½" Lower back mount, 6" Lower mount and 6" Lower back are not fillable (only available dry).

DIAPHRAGM GAUGES

- Dial Sizes: 2½", 3½", 4½"
- Four Case Styles
- Accuracy: ASME B40.1 - 2/1/2%

Marsh Instruments Low Pressure Diaphragm Gauges are universally known for their dependable performance and accuracy. Incorporating a unique design feature, the diaphragm element in this gauge allows accurate low pressure readings in a variety of applications. Featuring a bronze diaphragm element, the gauge is capable of ASME Grade A-1% accuracy for ranges above 30" of water. Ranges are available in vacuum and pressure in inches of water, ounces per square inch and millimeters of mercury.

Typical applications include HVAC systems and low pressure gas burner systems.



STANDARD RANGES & PART NUMBERS

TYPE	DIAPHRAGM GAUGES								
Size	2½"							3½"	4½"
Case Material	Steel							Steel	
Internal	Copper Alloy							Copper Alloy	
Mounting/Case	LM	LM	U	U	CB	CB	FF	LM	LM
Connection	¼ NPT	⅛ NPT	¼ NPT	⅛ NPT	¼ NPT	⅛ NPT	¼ NPT	¼ NPT	¼ NPT
0 to 10" H_2O	G22675	G22711	G11181	G11248	G22747	G27110	G11578	G24608	G25756
0 to 15" H_2O	G24500	G24503	G11246	G11313	G26504	G30237	G11642	G24631	G25981
0 to 30" H_2O	G22704	G22740	G11189	G11256	G22776	G11652	G11586	G24625	G25749
0 to 60" H_2O	G22705	G22741	G11208	G11314	G22777	G11671	G11605	G24626	G25844
0 to 100" H_2O	G22687	G22723	G11217	G11284	G22759	G11675	G11609	G24613	G25982
0 to 160" H_2O	G22695	G22731	G11232	G11299	G22767	G11695	G11628	G24617	G25980
0 to 200" H_2O	G22696	G22732	G11233	G11300	G22768	G11696	G33412	G24618	G26021
0 to 300" H_2O	G22697	G22733	G11236	G11303	G22769	G11699	G33413	G24619	G25755
0 to 3 psi	G22685	G22721	G11215	G11282	G22757	G11678	G11612	G24612	G33414
0 to 5 psi	G22702	G22738	G10623	G11310	G22774	G22810	G10619	G24624	G26018
0 to 10 psi	G22699	G22735	G11239	G11306	G22771	G11702	G11635	G24621	G25754
0 to 10 oz/in^2	G22677	G22713	G11186	G11253	G22749	G11649	G11583	G24609	G33415
0 to 15 oz/in^2	G22680	G22716	G11194	G11261	G22752	G11657	G11591	G24610	G25753
0 to 30 oz/in^2	G24501	G33404	G11206	G11273	G24504	G11669	G11603	G24632	G25750
0 to 60 oz/in^2	G22684	G22720	G11213	G11280	G22756	G11676	G11610	G24611	G25757
0 to 100 oz/in^2	G22691	G22727	G11226	G11293	G22763	G33411	G11622	G24615	G26025
0 to 160 oz/in^2	G26062	G33405	G11237	G11304	G33410	G11700	G11633	G26894	G33416
8.75 oz/in^2 and 15" H_2O	G22706	G22742	G11185	G11252	G22778	G11648	G11582	G24627	G33417
20 oz/in^2 and 35" H_2O	G22709	G22745	G11200	G11267	G22781	G11663	G11597	G24629	G25748
32 oz/in^2 and 55" H_2O	G22707	G22743	G11195	G11262	G22779	G11658	G11592	G24628	G25984
58 oz/in^2 and 100" H_2O	G22710	G22746	G11214	G11281	G22782	G22947	G11611	G24630	G33418
0 to 15" H_2O VAC	G22912	G33406	G11873	G11906	G22942	G12104	G12071	G24708	G26023
0 to 30" H_2O VAC	G22914	G29804	G11876	G11909	G22944	G12107	G12074	G24709	G26020
0 to 60" H_2O VAC	G22918	G33407	G11884	G11917	G22948	G12115	G12082	G24710	G26016
0 to 100" H_2O VAC	G24502	G26962	G11885	G11918	G22949	G12116	G12083	G24716	G26019
0 to 200" H_2O VAC	G22921	G33409	G11892	G11925	G22951	G12123	G12090	G24711	G33420

NOTE: Items are available on special order. However, minimums and lead times apply. Consult factory.

SPECIFICATIONS

ACCURACY
For ranges 30" H_2O & above: ASME Grade A = ±2/1/2% (±1% of range across middle half of scale). For ranges below 30" H20: ±3/1/3% (±1% of range across middle half of scale)

CASE SIZES
2½", 3½", 4½" diameter

CASE MATERIAL
Steel, black painted

CASE STYLE
CB – Center Back Mount
FF – Three-holed Front Flanged Mount
LM – Lower Mount
UC – U-Clamp Mount

DIAPHRAGM & SOCKET
Phosphor bronze diaphragm soft-soldered to brass socket

MOVEMENT
Brass sector and pinion

CONNECTION
⅛ & ¼ NPT

DIAL STANDARD
Dual Scale with kPa
Triple Scale: oz/in^2, in H_2O, & kPa

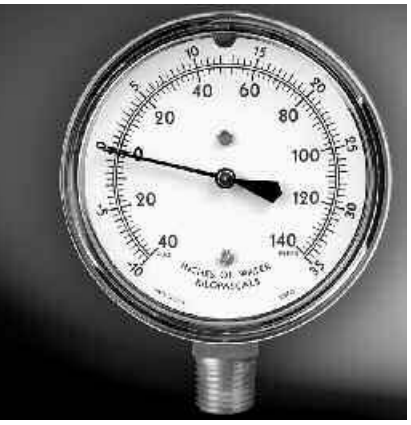
DIAL COLOR
Black markings on white

POINTER
Aluminum, black painted

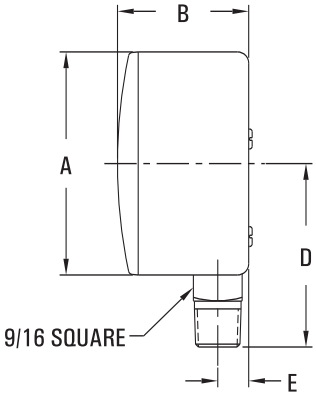
WINDOW
2½" & 3½": Acrylic twist-in Clearlok
4½": flat acrylic with steel friction ring

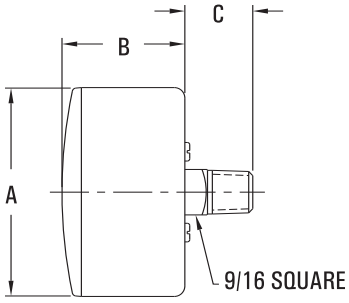
RESTRICTOR
0.013" standard. No restrictor on 0 to 10" H_2O range

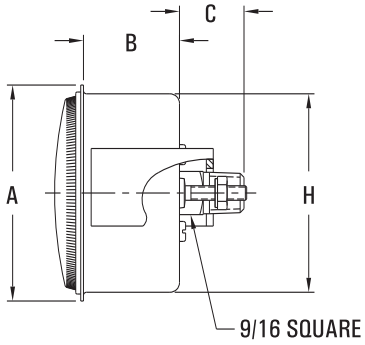
Diaphragm



DIAPHRAGM GAUGE OPTIONS		
OPTION	TYPE	AVAILABLE ON MODELS
Window	Acrylic (knurled edge)	all models
Restrictors	0.008 Restrictor	all models
	0.016 Restrictor	
	0.018 Restrictor	
	0.025 Restrictor	
Ring	Press ring, chrome	2½" to 3½" Panel Mount
Ring / Window	Glass & Black Steel Ring	2½" to 3½" all models
Cases	Stainless Steel	2½"- Lower Mount or Panel Mount
	Brass	2½"- Lower Mount or Centerback
	Chrome plated	Lower Mount or Centerback
3½" Case	Center Back (CB)	3½"
	U-Clamp (UC)	3½"
Connections	Hose Barb (⅛" OD & ¼" OD)	All models (10 pc. minimum)
Compound Ranges	Vacuum & Pressure with front zero adjustment	All models (10 pc. minimum)
Custom Dials	Logo or custom face	Consult factory for colors and minimums.



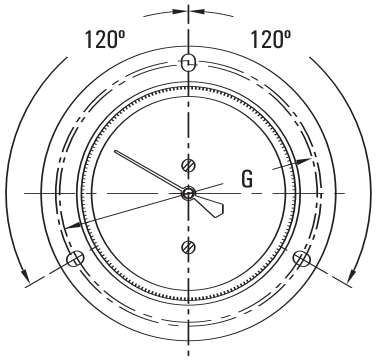


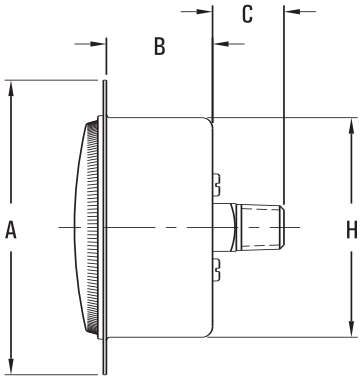


Back Flanged	SIZE	A	B	D	E
	2½"	2.63	1.50	2.19	.38
	3½"	3.69	1.59	2.72	.38
	4½"	4.78	1.47	3.38	.81

Center Back	Size	A	B	C
	2½"	2.63	1.50	.84
	3½"	3.69	1.59	.84

U-Clamp	Size	A	B	C	H
	2½"	2.81	1.25	.84	2.59
	3½"	3.98	1.69	.84	3.66





VACUUM CLEANER TEST GAUGE

- Includes 2½" dial size gauge
- Dual Scale: in. H_2O & kPa vacuum
- Complete with rubber plug to fit vacuum cleaner intake opening

TYPE	82K
Range	Part No.
0 to 60" H_2O	G32426
0 to 100" H_2O	G24505
0 to 160" H_2O	G25759
0 to 200" H_2O	G26098

GAS PRESSURE TEST SET

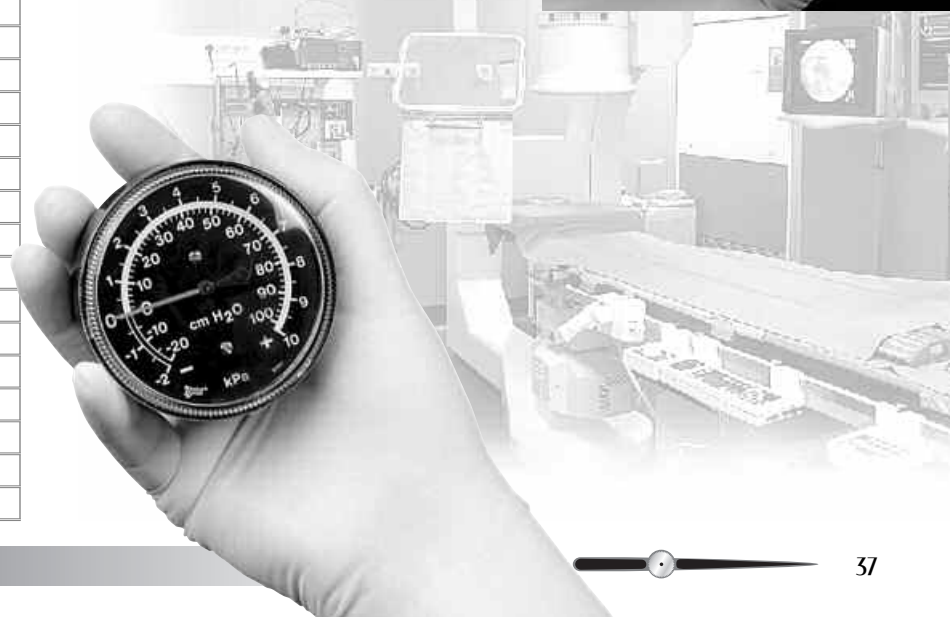
- Includes 2½" dial size gauge
- Provided in grey polyethylene case with 3 ft. of rubber tubing

TYPE			84K
Range			Part No.
0 to 15" H_2O		0 to 4.0 kPa	G28145
0 to 8.75 oz/in^2	0 to 15" H_2O	0 to 4.0 kPa	G33421
0 to 20 oz/in^2	0 to 30" H_2O	0 to 8.6 kPa	G24507
0 to 58 oz/in^2	0 to 100" H_2O	0 to 25 kPa	G27038

Ranges	Figure Intervals	Minor Graduations
0 to 10" H_2O	1	0.1
0 to 15" H_2O	3	0.2
0 to 30" H_2O	5	0.5
0 to 60" H_2O	10	1
0 to 100" H_2O	10	1
0 to 160" H_2O	20	2
0 to 200" H_2O	20	2
0 to 300" H_2O	50	5
0 to 3 psi	0.5	0.05
0 to 5 psi	1	0.1
0 to 10 psi	1	0.1
0 to 10 psi oz/in2	1	0.1
0 to 15 psi oz/in2	3	0.2
0 to 30 psi oz/in2	5	0.5
0 to 60 psi oz/in2	10	1
0 to 100 psi oz/in2	10	1
0 to 160 psi oz/in2	20	2
8.75 oz/in2 and 15" H_2O	1/3	0.2/0.2
20 oz/in2 and 35" H_2O	4/5	0.5/1
32 oz/in2 and 55" H_2O	4/10	1/1
58 oz/in2 and 100" H_2O	10/20	1/2
0 to 15" H_2O VAC	3	0.2
0 to 30" H_2O VAC	5	0.5
0 to 60" H_2O VAC	10	1
0 to 100" H_2O VAC	10	1
0 to 160" H_2O VAC	20	2
0 to 200" H_2O VAC	20	2

SPECIAL MEDICAL GAUGES

Consult Factory
800-727-5646



GAS TEST GAUGE

- Hex or Bell Type mounting
- 15 to100 Psi pressure ranges
- Steel case and brass internals

Use to pressure test all new gas installations for leaks and passing inspection codes. After installing Gas Test Gauge, the system is pressurized with air. Any leakage will be indicated by a pressure drop on the gauge.

Typical applications include testing of gas and other pressure media.

SPECIFICATIONS

ACCURACY
ASME Grade ±3/2/3%(±2% of range across middle half of scale)

CASE SIZES
2" diameter

CASE MATERIAL
Steel, black painted

MOUNTING STYLE
Reducing Bell or Hex Style

HOUSING MATERIAL
Reducing Bell: Iron, black painted
Hex Body: Steel, Zinc Dichromate Plated

TUBE & SOCKET
Copper alloy

MOVEMENT
Brass

CONNECTION
¼" FPT

RANGES
15 to 100 psi

DIAL STANDARD
Single Scale psi

DIAL COLOR
Black markings on white

POINTER
Aluminum, black painted

WINDOW
Polycarbonate

STANDARD RANGES & PART NUMBERS

TYPE	GAS TEST GAUGES	
Size	2"	
Case Material	Steel	
Internals	Copper Alloy	
Connection	¼" FPT	
Scale Standard	psi	
Mounting style	Bell Type	Hex Type
0 to 15 psi	G33522	G33526
0 to 30 psi	G33523	G33527
0 to 60 psi	G33524	G33528
0 to 100 psi	G33525	G33529

SERVICEMAN'S TEST GAUGE

- Recalibrator and Restrictor Standard
- Heavy Duty Brass Case
- Clam Shell Packaging Optional

Marsh Instruments Deluxe Serviceman's Test Gauge is designed to assure the modern serviceman the best possible gauge for testing refrigeration equipment. Corresponding, easy-to-read temperature scales are printed in red on the inner arcs of the dial face.

Typical applications include testing, servicing and recharging AC and R systems.

STANDARD RANGES & PART NUMBERS

TYPE	SERVICEMAN'S TEST GAUGES		
Size	2½"		
Case Material	Brass		
Internals	Copper Alloy		
Mounting/Case Style	LM		
Connection	⅛ NPT		
Scale Standard	psi & temperature (°F)		
30" X 350 psi	W0070	R-12, 22, 502	Carton
30" X 350 psi	W0070Q	R-12, 22, 502	Clam Shell
0 to 500 psi	W0072	R-12, 22, 502	Carton
0 to 500 psi	W0072Q	R-12, 22, 502	Clam Shell
Set of (2) W0070 & W0072	W0074	R-12, 22, 502	Carton Only
30" X 350 psi	W8070	R-134a, 404A, 507	Carton
30" X 350 psi	W8070Q	R-134a, 404A, 507	Clam Shell
0 to 500 psi	W8072	R-134a, 404A, 507	Carton
0 to 500 psi	W8072Q	R-134a, 404A, 507	Clam Shell
30" x 500 psi	W8115	R-22, 407C, 410A	Carton
30" x 500 psi	W8115Q	R-22, 407C, 410A	Clam Shell
0 to 800 psi	W8127	R-22, 407C, 410A	Carton
0 to 800 psi	W8127Q	R-22, 407C, 410A	Clam Shell

SPECIFICATIONS

ACCURACY
ASME Grade B - ±3/2/3% (±2% of range across middle half of scale)

CASE SIZE
2½" diameter

CASE MATERIAL
Polished brass

CASE STYLE
LM – Lower Mount

TUBE & SOCKET
Copper Alloy

MOVEMENT
Brass with recalibrator

CONNECTION
⅛ NPT

RANGES
0-500 psi, 30" Hg VAC to 120 psi retarded to 350 psi

DIAL STANDARD
psi with corresponding temperature scales

DIAL COLOR
Black markings on white with red or blue temperature scales

POINTER
Aluminum, black painted

WINDOW
Beveled glass

MANIFOLD GAUGE

- Recalibrator and Restrictor Standard
- Color Coded Cases, "Reds" & "Blues"
- Overpressure Protection to 350 psi

These gauges are designed for the pressure measurement of refrigeration systems. All dials are furnished with corresponding temperature scales for the various refrigerants. Dials feature R-12, R-22, and R-502. Standard connections are ⅛ NPT lower mount with your choice of red or blue case.

Marsh Manifold Gauges are used in refrigeration applications for testing, servicing, and recharging AC and R Systems.

SPECIFICATIONS

ACCURACY
ASME Grade B - ±3/2/3% (2% of range across middle half of scale)

CASE SIZE
2½" diameter

CASE MATERIAL
Steel, red or blue painted

TUBE & SOCKET
Copper alloy

MOVEMENT
Brass with recalibrator

CONNECTION
⅛ NPT

RANGES
0-500 psi, 30" Hg VAC to 120 psi retarded to 350 psi

DIAL STANDARD
psi with corresponding temperature scales

DIAL COLOR
Black markings on white with red or blue temperature scales

POINTER
Aluminum, black painted

WINDOW
Impact resistant plastic

STANDARD RANGES & PART NUMBERS

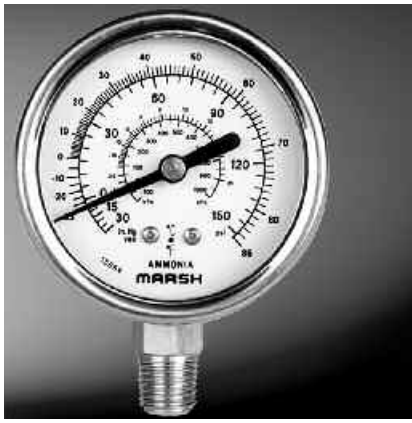
TYPE	MANIFOLD GAUGES				
Size	2½"				
Case Material	Steel				
Internals	Copper Alloy				
Mounting/Case Style	LM				
Connection	⅛ NPT				
Scale Standard	psi & temperature (°F)				
30" X 350 psi	W0011	R-12, 22, 502	Blue Case	Carton	
30" X 350 psi	W0011Q	R-12, 22, 502	Blue Case	Clam Shell	
0 to 500 psi	W0023	R-12, 22, 502	Red Case	Carton	
0 to 500 psi	W0023Q	R-12, 22, 502	Red Case	Clam Shell	
30" X 350 psi	W8011	R-134a, 404A & 507	Blue Case	Carton	
30" X 350 psi	W8011Q	R-134a, 404A & 507	Blue Case	Clam Shell	
0 to 500 psi	W8023	R-134a, 404A & 507	Red Case	Carton	
0 to 500 psi	W8023Q	R-134a, 404A & 507	Red Case	Clam Shell	
30" X 500 psi	W8015	R-22, 407C & 410A	Blue Case	Carton	
30" X 500 psi	W8015Q	R-22, 407C & 410A	Blue Case	Clam Shell	
0 to 800 psi	W8027	R-22, 407C & 410A	Red Case	Carton	
0 to 800 psi	W8027Q	R-22, 407C & 410A	Red Case	Clam Shell	
30" X 350 psi	J7622PQ-001	R-12, 22, 502	S/S Case	Clam Shell	Liquid Filled
0 to 500 psi	J7662PQ-001	R-12, 22, 502	S/S Case	Clam Shell	Liquid Filled
30" X 350 psi	J7622PQ-002	R-134a, 404A & 507	S/S Case	Clam Shell	Liquid Filled
0 to 500 psi	J7662PQ-002	R-134a, 404A & 507	S/S Case	Clam Shell	Liquid Filled

REFRIGERATION AMMONIA GAUGE

- Range 30" Hg to 150 psi or 300 psi
- Case Sizes: 63mm and 3½"
- ASME Grade B

Marsh Ammonia Gauges include a restrictor that protects the gauge against sudden shock or pulsating pressure. The inner dial arc shows pressure, outer arc shows the corresponding temperature scale. Marsh Refrigeration Ammonia Gauges are available in a stainless steel case.

Marsh Instruments Refrigeration Ammonia Gauges are designed for use on ammonia compressors and other ammonia refrigeration equipment.



STANDARD RANGES & PART NUMBERS

TYPE	REFRIGERATION AMMONIA GAUGES	
Size	63mm	3½"
Case Material	Stainless Steel	Stainless Steel
Internals	Stainless Steel	Stainless Steel
Mounting / Case Style	LM	LM
Scale Standard	psi & Ammonia (°F)	psi & Ammonia (°F)
Connection	¼ NPT	¼ NPT
30" Hg VAC to 150 psi	W0104	W0112
30" Hg VAC to 150 psi	W0104Q	
30" Hg VAC to 300 psi	W0108	W0116
30" Hg VAC to 300 psi	W0108Q	

NOTE: Items are available on special order. However, minimums and lead times apply. Consult factory.

REFRIGERATION AMMONIA GAUGE OPTIONS			
OPTION	TYPE	SUFFIX	
Fill Medium	Glycerine (GL)	P	All Models
	Silicone (SL)	PI	All Models
Custom Dials	Logo or Custom face	M	Consult factory for colors and minimums

SPECIFICATIONS

ACCURACY
ASME Grade B – ±3/2/3% (±2% of range across middle half of scale)

CASE SIZES
63mm and 3½" diameter

CASE MATERIAL
304 Stainless steel

CASE STYLE
LM – Lower Mount

TUBE & SOCKET
Stainless steel

MOVEMENT
Brass

CONNECTION
¼ NPT

RANGES
Compound 30" Hg Vac to 150 psi or 30" Hg Vac to 300 psi

DIAL STANDARD
Single scale psi with corresponding Ammonia temperature scales

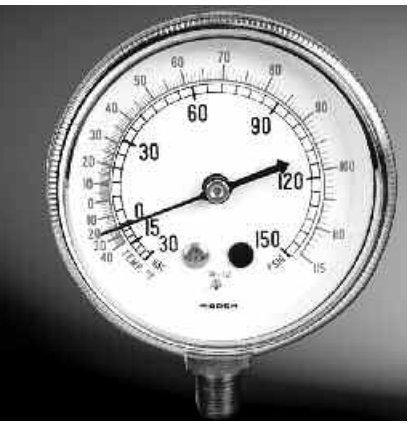
DIAL COLOR
Black markings on white

POINTER
Aluminum, black painted

WINDOW
Polycarbonate

RESTRICTORS
Standard

PACKAGING
Optional clam shell packed gauges are on 4½" X 6⅝" cards, pre-punched for pegboard hanging



REFRIGERATION GAUGE

- Color Coded Dial
- Adjustable Pointer Standard

Marsh Refrigeration Gauges are sturdily constructed and tested to give long, continuous, accurate service. In addition to the standard pressure or compound scale, dials also show the corresponding temperature scales for R-12, R-22, and R-502, in the various combinations shown in the chart below. Dial markings are sharp, clear and easy to read.

Marsh Instruments Refrigeration Gauges are designed specifically for use on refrigeration systems.

SPECIFICATIONS

ACCURACY
ASME Grade B – ±3/2/3% (2% of range across middle half of scale)

CASE SIZES
2½" and 3½" diameter

CASE MATERIAL
Steel, black painted

CASE STYLE
LM – Lower Mount

TUBE & SOCKET
Copper alloy

MOVEMENT
Brass

CONNECTION
⅛ or ¼ NPT

RANGES
Compound 30" Hg Vac to 150 psi, 30" Hg Vac to 300 psi, 0 to 300 psi

DIAL STANDARD
psi with corresponding temperature scales

DIAL COLOR
Black markings on white with red temperature scales

POINTER
Aluminum, black painted, adjustable

WINDOW
Acrylic Clearlok

RESTRICTORS
Standard

OPTIONS
Consult factory

STANDARD RANGES & PART NUMBERS

TYPE	REFRIGERATION GAUGES	
Size	2½"	3½"
Case Material	Steel	
Internals	Copper Alloy	
Mounting/Case Style	LM	LM
Connection	⅛ NPT	¼ NPT
Scale Standard	psi and temperature (°F)	
R-12		
30" Hg VAC 150 psi	W0002	W0030
0 to 300 psi	W0016	W0034
R-22		
30" Hg VAC to 150 psi		W0032
R-12 & R-22		
30" Hg VAC 150 psi	W0004	
30" Hg VAC 300 psi	W0012	
0 to 300 psi	W0018	

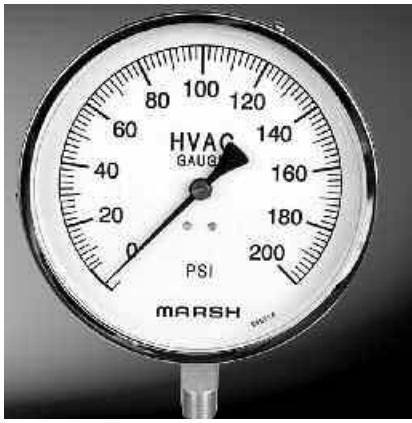
NOTE: Items are available on special order. However, minimums and lead times apply. Consult factory.

CONTRACTOR'S GAUGE

- 4½" Dial
- Polished Stainless Steel Case
- Adjustable Pointer
- 1% Accuracy

Marsh Instruments Contractor's HVAC Service Gauge is a newly redesigned gauge with a long-life movement to meet the needs of contractors in air conditioning, heating, plumbing and refrigeration. This rugged and reliable gauge is economically priced and offers many features normally found on more expensive gauges such as adjustable pointer, acrylic lens and polished stainless steel case.

Marsh Instruments Contractor's Gauges are designed for use on plumbing and HVAC equipment.



STANDARD RANGES & PART NUMBERS

TYPE	CONTRACTOR'S GAUGES
Size	4½"
Case Material	Polished Stainless Steel
Internals	Copper Alloy
Mounting / Case Style	LM
Connection	¼ NPT
Scale Standard	psi
30" Hg VAC to 30 psi	W0480
30" Hg VAC to 160 psi	W0487
0 to 30 psi	W0481
0 to 60 psi	W0483
0 to 100 psi	W0484
0 to 160 psi	W0486
0 to 200 psi	W0488
0 to 300 psi	W0490
0 to 600 psi	W0492

CONTRACTOR'S GAUGE OPTIONS			
OPTION	TYPE	SUFFIX	AVAILABLE ON MODELS
Restrictors	Push Fit .008 or .018	H	all models
Catalog dials	psi and kPa	W3	all models
All other dials - consult factory for lead time			25 Piece minimum

SPECIFICATIONS

ACCURACY
ASME Grade A – ±2/1/2% (1% of range across middle half of scale)

CASE SIZE
4½" diameter

CASE MATERIAL
Polished stainless steel

CASE STYLE
LM – Lower Mount

TUBE & SOCKET
Copper alloy

MOVEMENT
Brass sector and pinion

CONNECTION
¼ NPT

RANGES
Compound 30" Hg Vac to160 psi; 30 to 600 psi

DIAL STANDARD
Single scale psi

DIAL COLOR
Black markings on white

POINTER
Aluminum, black painted, adjustable

WINDOW
Acrylic

HEATING SYSTEM GAUGE

- Adjustable Set Hand
- Ranges to 300 psi and 690 Feet of Water
- 3½" and 4½" Dials

Marsh Instruments Heating System Gauges are available in 3½" and 4½" dial sizes in the most popular ranges. An adjustable red altitude pointer is standard on feet-of-water gauges. This feature allows the user to indicate the head of water to be maintained in the system.

Marsh Instruments Heating System Gauges provide accurate psi and feet-of-water measurements in elevated tanks, reservoirs, standpipes, and similar applications where reliability and dependability are crucial in heating system equipment.

SPECIFICATIONS

ACCURACY
3½" ASME Grade B – ±3/2/3% (2% of range across middle half of scale)
4½" ASME Grade A – ±2/1/2% (1% of range across middle half of scale)

CASE SIZE
3½" and 4½" diameter

CASE MATERIAL
3½": Steel, black painted
4½": Aluminum back flange case, black painted

CASE STYLE
LM – Lower Mount

TUBE & SOCKET
Copper alloy

MOVEMENT
3½": Brass
4½": Stainless steel

CONNECTION
¼ NPT

RANGES
Dual Scale 15 to 300 psi and 300 to 690 ft. H_2O

DIAL STANDARD
psi, ft. H_2O and metric

DIAL COLOR
Black markings on white

POINTER
Aluminum, black painted with red set hand

WINDOW
3½": Acrylic Clearlok
4½": Instrument Glass

STANDARD RANGES & PART NUMBERS

TYPE	HEATING SYSTEM HVAC/R GAUGES	
Size	3½"	4½"
Case Material	Steel	Aluminum
Internals	Copper Alloy	Copper Alloy
Mounting / Case Style	LM	LM
Connection	¼ NPT	¼ NPT
Scale Standards	psi, ft. H_2O and metric	psi, ft. H_2O and metric
0 to 15 psi and 0 to 30 ft H_2O		W0456
0 to 30 psi and 0 to 70 ft H_2O	W0450	W0457
0 to 100 psi and 0 to 230 ft H_2O	W0451	W0458
0 to 150 psi and 0 to 345 ft H_2O		W0459
0 to 160 psi and 0 to 370 ft H_2O	W0452	
0 to 200 psi and 0 to 460 ft H_2O	W0453	W0460
0 to 300 psi and 0 to 690 ft H_2O	W0454	W0461

NOTE: Items are available on special order. However, minimums and lead times apply. Consult factory.

HEATING SYSTEM GAUGE OPTIONS			
OPTION	TYPE	SUFFIX	AVAILABLE ON MODELS
Restrictors	Special Restrictor	H	All models
Custom Dials	Logo or Custom face	M	Consult factory for colors and minimums

WATER TEST GAUGE

- Connects Directly to Standard Water Faucet or Hose
- Measures Commercial & Residential Water Pressure
- Dual Scale Dial

Marsh Water Test Gauge is designed to connect directly to a standard ¾" water faucet or hose. The maxi pointer included on the Water Test Gauge allows you to monitor a peak operating or surge pressure point.

Typical applications include measuring residential and commercial water pressure, also selection and adjustment of valves, regulators, and other controls.

STANDARD RANGES & PART NUMBERS

TYPE	WATER TEST GAUGES	
Size	2½"	
Internals	Copper Alloy	
Case Materials	Steel	
Mounting/Case Style	Top mount	
Connection	¾"-11½" NH female hosebib	
Scale Standard	psi/kPa	
Window	Acrylic	Acrylic w/maxhand
Part Number	G24545	G24545-001

SPECIFICATIONS

ACCURACY ASME
Grade B – ±3/2/3% (±2% of range across middle half of scale)

CASE SIZES
2½" diameter

CASE MATERIAL
Steel, black painted

CASE STYLE
Top mount

TUBE & SOCKET
Copper alloy

MOVEMENT
Brass

CONNECTION
¾" – 11½" NH Female hosebib

RANGES
0 to 300 psi

DIAL STANDARD
Dual scale psi and kPa

DIAL COLOR
Black markings on white

POINTER
Aluminum, black painted

WINDOW
Acrylic with or without red maximum indicating pointer

OPTIONS
Other ranges are available
Consult factory

PAPER MACHINE GAUGE

- Hinged Ring Chrome Plated Steel Case
- Protective Weather Tight Seal
- Restrictor is Standard

Marsh Instruments Chrome Plated Paper Machine Gauges are available in nine ranges and fit existing panel cutouts. The heavy-duty case features a front flanged/ hinged ring design which allows easy access to the recalibrator and a weephole that prevents condensation buildup. A restrictor is standard. The Marsh Paper Machine Gauge is available in 3½" size only. Each gauge has a weather-tight seal to protect against dust and atmospheric contaminates.

Marsh Instruments Paper Machine gauges are specifically designed to meet the demands of the pulp and paper industry.

SPECIFICATIONS

ACCURACY
ASME Grade A – ±2/1/2% (±1% of range across middle half of scale)

CASE SIZES
3½" diameter

CASE MATERIAL
Steel, chrome plated

CASE STYLE
LBM – Lower Back Mount

TUBE & SOCKET
Copper alloy

MOVEMENT
Stainless Steel with recalibrator

CONNECTION
¼ NPT

RANGES
30 to 1,000 psi

DIAL STANDARD
Single scale psi

DIAL COLOR
Black markings on white

POINTER
Aluminum, black painted

WINDOW
Glass lens, chrome plated brass ring with weather-tight seal

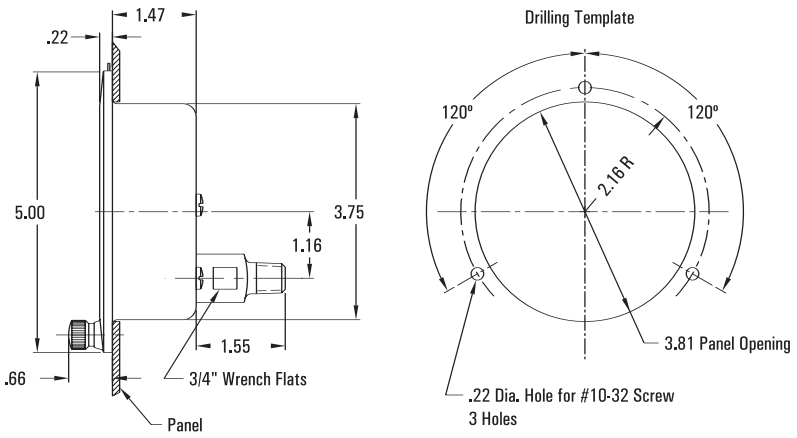
RESTRICTOR
Standard

STANDARD RANGES & PART NUMBERS

TYPE	PAPER MACHINE GAUGES
Size	3½"
Case Material	Steel, Chrome Plated
Internals	Copper Alloy
Mounting / Case Style	LBM
Connection	¼ NPT
Scale Standard	psi
0 to 30 psi	W6042
0 to 60 psi	W6046
0 to 100 psi	W6048
0 to 160 psi	W6052
0 to 200 psi	W6054
0 to 300 psi	W6058
0 to 400 psi	W6060
0 to 600 psi	W6064
0 to 1,000 psi	W6072

PAPER MACHINE GAUGE OPTIONS			
OPTION	TYPE	SUFFIX	AVAILABLE ON MODELS
Restrictor	Special Restrictor	H	
	No restrictor	H1	
Catalog Dials	bar only	L1	See Marsh Price List for minimum
	kg/cm^2 only	L2	
	kPa only	L3	
	MPa only	L4	
	psi & bar	W1	
	psi & kg/cm^2	W2	
	psi & kPa	W3	
	psi & MPa	W4	
Custom Dials	Logo or custom face	M	Consult factory for colors and minimums

PAPER MACHINE GAUGE DIMENSIONS



X-MAS TREE GAUGE

- Accuracy ±1%
- Polished Stainless Steel Case
- Ranges to 10,000 psi
- Adjustable Micrometer Pointer

Marsh Instruments has been on top of X-mas Trees and well-heads longer than any other name. Marsh offers the same high-performance gauge for replacement. Other gauge manufacturers can state X-mas Tree Gauge on their products but only Marsh Instruments can offer you all the special features, and dependability, that you expect! Features include a polished stainless steel case with stainless steel tube, tip, and socket, and an easy to adjust micrometer pointer.

Marsh Instruments X-mas Tree gauges are designed for the oil patch, well heads and offshore oil platforms.

STANDARD RANGES & PART NUMBERS

TYPE	X-MAS TREE GAUGE
Size	4½"
Case Material	304 Stainless Steel
Internals	Stainless Steel
Mounting / Case Style	LM
Connection	½ NPT
Scale Standard	psi
0 to 1,000 psi	W0574
0 to 1,500 psi	W0578
0 to 2,000 psi	W0582
0 to 3,000 psi	W0586
0 to 5,000 psi	W0590
0 to 10,000 psi	W0594

SPECIFICATIONS

ACCURACY
ASME Grade A – ±1%
(±1% of range across full scale)

CASE SIZES
4½" diameter

CASE MATERIAL
304 Stainless Steel

CASE STYLE
LBM – Lower Mount
with blowout plug

TUBE & SOCKET
Stainless Steel

MOVEMENT
316 Stainless Steel

CONNECTION
½ NPT

RANGES
1,000 to 10,000 psi

DIAL STANDARD
Single scale psi

DIAL COLOR
Black markings on white

POINTER
Aluminum, black painted,
micro-adjustable.

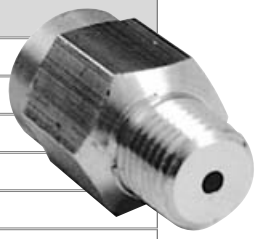
WINDOW & RING
Acrylic window with bayonet ring

PART#	DESCRIPTION
	GAUGE COCK AND SIPHONS
111025	¼" F x ¼"F Brass Gauge Cock (T-Handle #123)
111028	¼" M union x ¼" F Brass Gauge Cock (Lever Handle #125)
111029	¼"M x ¼"M Steel Straight Siphon (600psi @ 400°F)
111030	¼"M x ¼"M Brass Straight Siphon (250psi @ 400°F)
111031	¼"M x ¼"M Steel Angle Type Siphon (600psi @ 400°F)
111032	¼"M x ¼"M Brass Angle Type Siphon (250psi @ 400°F)
	CLEARLOK (ACRYLIC) CONVEX WINDOW INTERNAL THREAD "G" Series Fig. 83 Diaphragm Gauges
124602	2½" for 83K & 83KC
127985	2½" for 83KB & 83KD
125448-001	3½" for all models (knurled edge)
	CLEARLOK (ACRYLIC) WINDOWS (INTERNAL THREAD) "J" SERIES
W15CL	1½" for LM or CB
W20CL	2" for LM or CB
W20CLUC	2" for U-Clamp or Front Flange
W25CL	2½" for LM or CB
W25CLUC	2½" for U-Clamp or Front Flange
W35CL	3½" for LM or CB
W35CLUC	3½" for U-Clamp or Front Flange
	RESTRICTOR SCREWS ⅛" & ¼" NPT Threaded Brass 8-40
100116-008	AIR (.008)
100116-013	WATER (.013)
100116-016	OIL (.016)
	RESTRICTOR SCREWS LARGE DIAL (D, E, H, & P) ¼" & ½" NPT Threaded Brass M5 X 0.8
RES008BRLD	AIR (.008)
RES013BRLD	WATER (.013)
RES016BRLD	OIL (.016)
	RESTRICTOR SCREWS LARGE DIAL (D, E, H, & P) ¼" & ½" NPT Threaded 316 SST M5 X 0.8
RES018SSLD	All Apps. (.018)
	RESTRICTOR SCREWS GENERAL SERVICE (J)
150139-013	Air (.013)
150139-018	"Standard" (.018)
150139-025	Water (.025)
150139-040	Oil (.040)
	RESTRICTOR SCREWS SEVERE SERVICE SERIES (J & X) ⅛", ¼" & ½" NPT Push-In Brass
RES018PB	"Standard" (.018)
RES013PB	AIR (.013)
RES025PB	WATER (.025)
RES040PB	OIL (.040)

PART#	DESCRIPTION
	RESTRICTOR SCREWS SEVERE SERVICE SERIES J & X ⅛", ¼" & ½" Push-In 316 SST
RES018PBSS	"Standard" (.018)
	FRONT FLANGE (3-HOLE) CASE & WINDOW ASS'Y FOR BACK CONNECT (CB) "J" Series Gauge
CS25FF	2½" Front Flange Case
W25CLUC	2½" Window Assembly
CS35FF	3½" Front Flange Case
W35CLUC	3½" Window Assembly
	LIQUID FILL CONVERSION KIT
9-79999-93	Liquid Fill Kit
127656	Silicone, 1000 cc, 1 quart
133426	Glycerine, 1 quart
	MAX. HAND ASSEMBLY WITH THUMB SCREW
W20CLMAX	2" Steel Case (J) LM & CBM only
W25CLMAX	2½" Steel Case (J) LM & CBM only
W35CLMAX	3½" Steel Case (J&W) LM & CBM only
128311-001	3½" Large Dial (H)
128311-002	4½" Large Dial (D, H, & P)
	HAND JACK & DUPLEX HAND JACK
110983	Duplex Hand Jack/Driver Set
110985	Hand Jack (Pointer Remover)
	ADJUSTABLE (SLOTTED) POINTER
PTR20ADJ-B	Adjustable Pointer - 2"
PTR25ADJ-B	Adjustable Pointer - 2½"
PTR35ADJ-B	Adjustable Pointer - 3½"
PTR45ADJ-B	Adjustable Pointer - 4½"
	MICROMETER POINTER, LARGE DIAL SERIES
PTRP45	4½" Dial (D, H & P)
PTRP60	6" Dial (D, H & P)

PART#	DESCRIPTION
SEVERE SERVICE GAUGE ACCESSORIES	
127794	Adapter ring, 63mm to 2½"
Flange63	Front Flange for 63mm: C Case
133279	Front Flange for 63mm: CB or UC case (no holes)
Flange100	Front Flange for 100mm: C Case
CERTIFICATION FORMS	
134476	Material Certification
134477	Certificate of Conformance
134478	Certificate of Compliance
134479	Certificate of Origin
134480	Certificate of Calibration
134481	Certificate of Accuracy

PART#	DESCRIPTION	MEDIA	MAXIMUM PRESSURES
INDUSTRIAL PRESSURE SNUBBERS			
S20BD	¼ NPT, Brass	Heavy Oil	5,000 psi
S20BE	¼ NPT, Brass	Water & Light Oil	5,000 psi
S20BG	¼ NPT, Brass	Air & Gases	5,000 psi
S20SD	¼ NPT, 303SS	Heavy Oil	15,000 psi
S20SE	¼ NPT, 303SS	Water & Light Oil	15,000 psi
S20SG	¼ NPT, 303SS	Air & Gases	15,000 psi
S40BD	½ NPT, Brass	Heavy Oil	5,000 psi
S40BE	½ NPT, Brass	Water & Light Oil	5,000 psi
S40BG	½ NPT, Brass	Air & Gases	5,000 psi
S40SD	½ NPT, 303SS	Heavy Oil	15,000 psi
S40SE	½ NPT, 303SS	Water & Light Oil	15,000 psi
S40SG	½ NPT, 303SS	Air & Gases	15,000 psi



Diaphragm Seals

MODEL 12000 MINI SERVICEABLE RUBBER DIAPHRAGM SEAL

The Model 12000 Serviceable Mini Diaphragm Seal is designed for gauges and instruments with operating pressures of 2500 psi with stainless and 500 psi with PVC models. Ideally suited for small applications and corrosive installations. The optional 'Easy Clean Out' feature allows the removal of the process side housing without losing the instrument side fill fluid. Fill / bleed screw port in the instrument side housing, and stainless steel build screws are standard.

FILLED & CALIBRATED TO GAUGES ONLY.

MODEL B8498 GAUGE PROTECTOR WITH RUBBER DIAPHRAGM SEAL

The Model B8498 Gauge Protector is designed for extremely high volume displacement. Ideally suited for gauges and instruments with operating pressures up to 200 psi and vacuum applications. Available in ¼" threaded connections and chrome plated zinc construction. A ⅜" flush plug is standard in the process side housing.

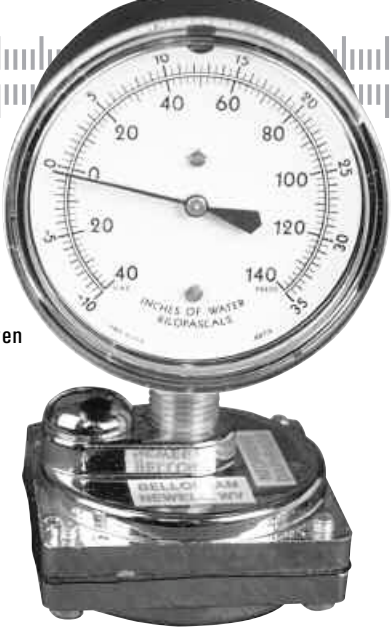
FILLED & CALIBRATED TO GAUGES ONLY.

Diaphragm seals are isolation devices which separate pressure gauges and other instruments from the process media while allowing the instrument to measure the process pressure. The service life of the instrument is greatly extended, because it is protected from corrosion, clogging, freezing, or pulsation.

LIQUID FILLINGS

The selection of the fill depends on the temperature expected in any given application. Temperature ratings for available fillings are listed below.

Glycerine	0 to 400°F
Silicone	–40 to 600°F
Sylltherm	–40 to 750°F



12000 [ ] [ ] [ ] [ ] [ ]

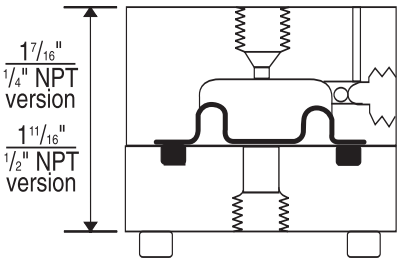
UPPER 316SS	
¼"	22
½"	24
PVC	
¼"	52
½"	54

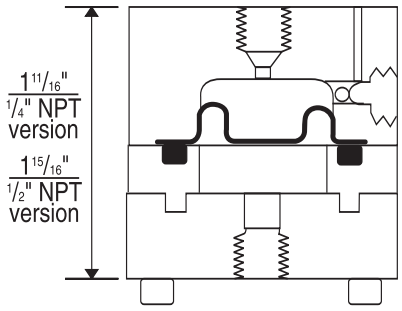
LOWER 316SS	
¼"	22
½"	24
PVC	
¼"	52
½"	54

DIAPHRAGM	
Nitrile	3
Fluorocarbon	4
Neoprene	5

EASY CLEAN OUT	
None	0
Clean Out	2

FILL	
No Fill	0
Glycerine	G
Silicone	S
Sylltherm	Y



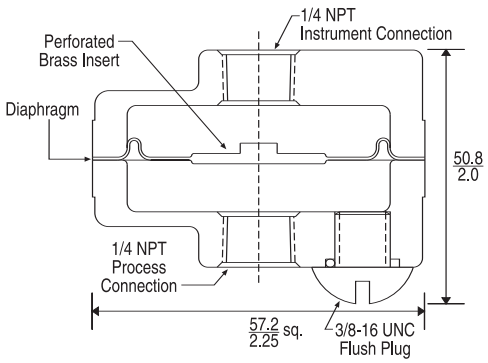


B8498 [ ] [ ] [ ]

ASSEMBLY	
¼"	22

DIAPHRAGM	
Nitrile	3
Fluorocarbon	4
Neoprene	5

FILL	
No Fill	0
Glycerine	G
Silicone	S
Sylltherm	Y



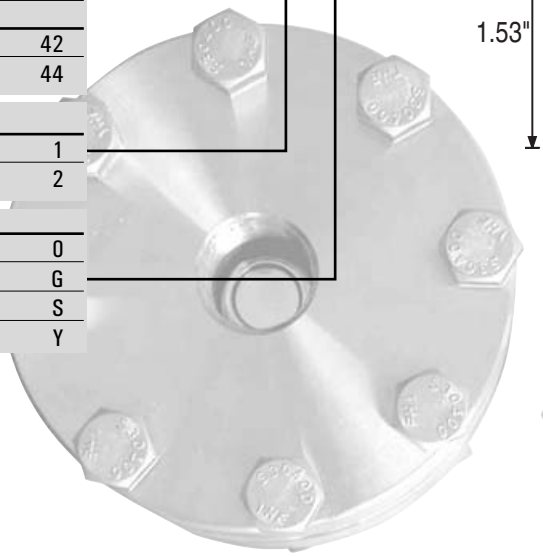
13000 | | | | |

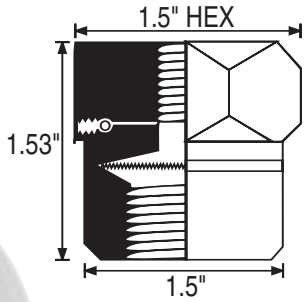
UPPER 316SS	
¼"	22

LOWER 316SS	
¼"	22
½"	24
Hastelloy	
¼"	42
½"	44

DIAPHRAGM	
316SS	1
Hastelloy C	2

FILL	
No Fill	0
Glycerine	G
Silicone	S
Syltherm	Y





MODEL 13000 MINI / ALL WELDED DIAPHRAGM SEAL

The Model 13000 Mini Welded Seal is designed for 2" to 3½" bourdon tube gauges with a minimum pressure of 100 psi. The maximum operating pressure is 2000 psi at 100º F. Available in all 316 SS or Hastelloy C process housing and diaphragm.

FILLED & CALIBRATED TO GAUGES ONLY.

13040 | | | | | |

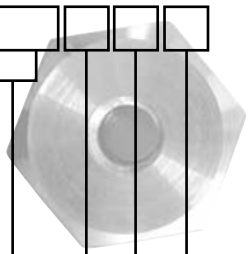
UPPER 316SS	
¼"	22
½"	24

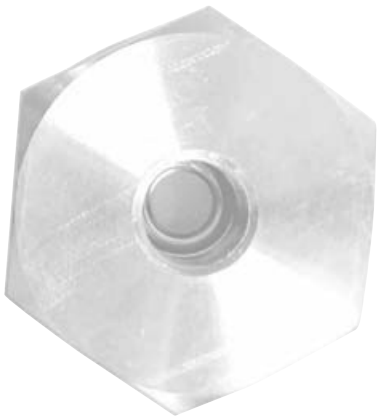
LOWER 316SS	
¼"	22
½"	24
¾"	26
1"	28
Hastelloy	
¼"	42
½"	44
¾"	46
1"	48

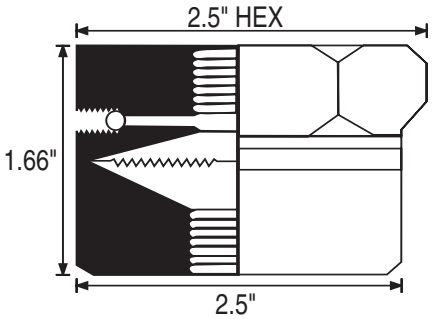
DIAPHRAGM 316SS	1
Hastelloy C	2

FLUSH CONNECTION	
None	0
¼"	2

FILL	
No Fill	0
Glycerine	G
Silicone	S
Syltherm	Y







MODEL 13040 ALL WELDED DIAPHRAGM SEAL

The Model 13040 All Welded Seal is designed for 2" to 4½" bourdon tube gauges with pressure ranges from vacuum to 1000 psi. Available in all 316SS or Hastelloy C process housing and diaphragm, with threaded connections. Optional flushing connections also available.

FILLED & CALIBRATED TO GAUGES ONLY.

Diaphragm Seals

MODEL 14000 REMOVABLE DIAPHRAGM SEAL

The Model 14000 Diaphragm Seal is a clamped metal design featuring interlocking construction inside the bolt circle for perfect alignment. The upper and lower housings clamp the diaphragm in place and allow for field servicing. The 14000 is available in threaded connections for pressures from vacuum to 2500 psi. Fill/bleed port screw in the upper is standard and an optional flush connection is available.

FILLED & CALIBRATED TO GAUGES ONLY.

MODEL 14040 WELDED DIAPHRAGM SEAL

The Model 14040 Welded Diaphragm Seal is a welded diaphragm-to-upper design allowing the upper housing to be removed with the instrument in place without losing fill. The same interlocking feature as the 14000 is used to assure alignment of the upper to the lower. Available in threaded connections for pressures from vacuum to 2500 psi. Fill/bleed port screw in the upper is standard and an optional flush connection is available.

FILLED & CALIBRATED TO GAUGES ONLY

14000 [ ] [ ] [ ] [ ] [ ] [ ]

UPPER Steel	
¼"	12
½"	14
316SS	
¼"	22
½"	24

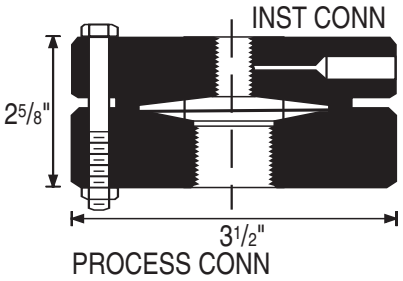
LOWER Steel	
¼"	12
½"	14
¾"	16
1"	18
316SS	
¼"	22
½"	24
¾"	26
1"	28

DIAPHRAGM	
316SS	1
Hastelloy C	2
Tantalum	3

FLUSH CONNECTION	
None	0
¼"	2

BOLTS & NUTS	
Steel	0
Stainless	1

FILL	
No Fill	0
Glycerine	G
Silicone	S
Sylltherm	Y



14040 [ ] [ ] [ ] [ ] [ ] [ ] [ ]

UPPER Steel	
¼"	12
½"	14
316SS	
¼"	22
½"	24

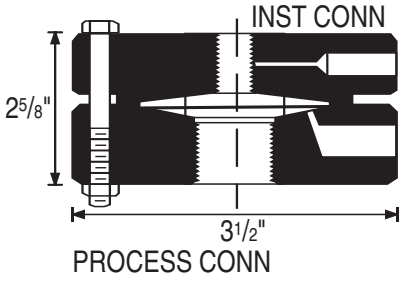
LOWER Steel	
¼"	12
½"	14
¾"	16
1"	18
316SS	
¼"	22
½"	24
¾"	26
1"	28

DIAPHRAGM	
316SS	1
Hastelloy C	2
Tantalum	3

FLUSH CONNECTION	
None	0
¼"	2

BOLTS & NUTS	
Steel	0
Stainless	1

FILL	
No Fill	0
Glycerine	G
Silicone	S
Sylltherm	Y



HOT WATER THERMOMETER

- ±1% of span throughout entire range
- Aluminum stem and case material
- Bi-metallic element

Thermometer is available with standard ½" or ¾" NPT male separable socket or ½" or ¾" sweatwell connection that allows easy thermometer removal while maintaining a "sealed" system.

Marsh Instruments Hot Water Thermometers are designed for accurate temperature readings in hot water lines, boilers and hydronic systems.

DESCRIPTION	P/N
½ NPT	L8004-1
¾ NPT	L8004-2
½" sweatwell	L8004-3
¾" sweatwell	L8004-4

SPECIFICATIONS

ACCURACY
±1% of span throughout entire range

CASE SIZE
2½" Diameter

CASE MATERIAL
Aluminum

STEM
Aluminum

MOVEMENT
Bi-metallic element

CONNECTION
½ or ¾ NPT Center Back,
½ or ¾" Sweatwell Center Back

RANGE
30-250˚F & 0-120˚C

DIAL COLOR
White with Black & Red Markings

POINTER
Aluminum, Black Painted

RECALIBRATOR
Standard

BIMETAL THERMOMETERS

- External Reset Feature for Field Recalibration (3" & 5")
- 9 Dual Scale Ranges to 1,000°F (525°C)
- Hermetically Sealed Case Design
- 2", 3" and 5" Dials
- Stem Lengths to 24"
- 1% Full Scale Accuracy

Marsh Instruments Bimetal Thermometers combine the benefits of economy and reliability for local mounted temperature indication in the dual scale ranges from -50° to 1,000°F (-40° to 525°C). Additional advantages offered by the Series "L" Bimetal Thermometers include an easy-to-read dual scale, fast speed of response, and accurate temperature indication. The hermetically sealed and ruggedly built case is resistant to shock, vibration, dust and moisture. Corrosion resistance to most chemicals is provided by the all welded type 304 Stainless Steel construction. The extremely responsive bimetal sensing element provides an accuracy to within ±1% of scale. An external adjustment screw on the back of the 3" and 5" case provides convenient reset and field recalibration. Built-in over range protection is a standard feature.

Typical applications include process, offshore, power, chemical industries, HVAC and OEM applications.

SPECIFICATIONS

ACCURACY
±1% of span throughout entire range for 2" immersion in liquids, 4" in gases

CASE SIZES
2", 3", and 5" sizes

CASE MATERIAL
304 Stainless steel

STEM
2½", 4", 6", 9", 12", 15", 18" & 24" Stainless Steel; ¼" diameter

CONNECTIONS
¼" NPT: CB–Center Back connection (2" case only)
½" NPT: CB–Center Back connection or AJ–Adjustable connection (3" & 5")

DIALS
Dual scale in degrees Celsius and Fahrenheit

WINDOW
Glass, hermetically sealed

STANDARD RANGES & PART NUMBERS

TYPE	BIMETAL THERMOMETERS					
Size	2"					
Connection	¼ NPT					
Mounting	CB	CB	CB	CB	CB	
Stem Length	2½"	4"	6"	9"	12"	
-50° to 120°F /-40° to 50°C	L11101	L11201	L11301	L11401	L11501	
-40° to 160°F /-40° to 70°C	L11102	L11202	L11302	L11402	L11502	
0° to 200°F /-20° to 90°C	L11104	L11204	L11304	L11404	L11504	
0° to 250°F /-20° to 120°C	L11105	L11205	L11305	L11405	L11505	
50° to 300°F / 10° to 150°C	L11106	L11206	L11306	L11406	L11506	
50° to 400°F / 10° to 200°C	L11107	L11207	L11307	L11407	L11507	
50° to 550°F / 10° to 300°C	L11108	L11208	L11308	L11408	L11508	
150° to 750°F / 70° to 400°C	L11110	L11210	L11310	L11410	L11510	
200° to 1000°F / 100° to 525°C	L11111	L11211	L11311	L11411	L11511	
Size	3"					
Connection	½ NPT					
Mounting	CB	CB	CB	CB	CB	CB
Stem Length	2½"	4"	6"	9"	12"	15"
-50° to 120°F /-40° to 50°C	L31101	L31201	L31301	L31401	L31501	L31601
-40° to 160°F /-40° to 70°C	L31102	L31202	L31302	L31402	L31502	L31602
0° to 200°F /-20° to 90°C	L31104	L31204	L31304	L31404	L31504	L31604
0° to 250°F /-20° to 120°C	L31105	L31205	L31305	L31405	L31505	L31605
50° to 300°F / 10° to 150°C	L31106	L31206	L31306	L31406	L31506	L31606
50° to 400°F / 10° to 200°C	L31107	L31207	L31307	L31407	L31507	L31607
50° to 550°F / 10° to 300°C	L31108	L31208	L31308	L31408	L31508	L31608
150° to 750°F / 70° to 400°C	L31110	L31210	L31310	L31410	L31510	L31610
200° to 1000°F / 100° to 525°C	L31111	L31211	L31311	L31411	L31511	L31611

STANDARD RANGES & PART NUMBERS

TYPE	BIMETAL THERMOMETERS							
Size	3" Adjustable Angle							
Connection	½ NPT							
Mounting	AJ	AJ	AJ	AJ	AJ	AJ		
Stem Length	2½"	4"	6"	9"	12"	15"		
–50° to 120°F/-40° to 50°C	L33101	L33201	L33301	L33401	L33501	L33601		
–40° to 160°F/-40° to 70°C	L33102	L33202	L33302	L33402	L33502	L33602		
0° to 200°F/-20° to 90°C	L33104	L33204	L33304	L33404	L33504	L33604		
0° to 250°F/-20° to 120°C	L33105	L33205	L33305	L33405	L33505	L33605		
50° to 300°F/ 10° to 150°C	L33106	L33206	L33306	L33406	L33506	L33606		
50° to 400°F/ 10° to 200°C	L33107	L33207	L33307	L33407	L33507	L33607		
50° to 550°F/ 10° to 300°C	L33108	L33208	L33308	L33408	L33508	L33608		
150° to 750°F/ 70° to 400°C	L33110	L33210	L33310	L33410	L33510	L33610		
200° to 1000°F/ 100° to 525°C	L33111	L33211	L33311	L33411	L33511	L33611		
Size	5"							
Connection	½ NPT							
Mounting	CB	CB	CB	CB	CB	CB	CB	CB
Stem Length	2½"	4"	6"	9"	12"	15"	18"	24"
–50° to 120°F/-40° to 50°C	L51101	L51201	L51301	L51401	L51501	L51601	L51701	L51801
–40° to 160°F/-40° to 70°C	L51102	L51202	L51302	L51402	L51502	L51602	L51702	L51802
0° to 200°F/-20° to 90°C	L51104	L51204	L51304	L51404	L51504	L51604	L51704	L51804
0° to 250°F/-20° to 120°C	L51105	L51205	L51305	L51405	L51505	L51605	L51705	L51805
50° to 300°F/ 10° to 150°C	L51106	L51206	L51306	L51406	L51506	L51606	L51706	L51806
50° to 400°F/ 10° to 200°C	L51107	L51207	L51307	L51407	L51507	L51607	L51707	L51807
50° to 550°F/ 10° to 300°C	L51108	L51208	L51308	L51408	L51508	L51608	L51708	L51808
150° to 750°F/ 70° to 400°C	L51110	L51210	L51310	L51410	L51510	L51610	L51710	L51810
200° to 1000°F/ 100° to 525°C	L51111	L51211	L51311	L51411	L51511	L51611	L51711	L51811
Size	5" Adjustable Angle							
Connection	½ NPT							
Mounting	AJ	AJ	AJ	AJ	AJ	AJ	AJ	AJ
Stem Length	2½"	4"	6"	9"	12"	15"	18"	24"
–50° to 120°F/-40° to 50°C	L53101	L53201	L53301	L53401	L53501	L53601	L53701	L53801
–40° to 160°F/-40° to 70°C	L53102	L53202	L53302	L53402	L53502	L53602	L53702	L53802
0° to 200°F/-20° to 90°C	L53104	L53204	L53304	L53404	L53504	L53604	L53704	L53804
0° to 250°F/-20° to 120°C	L53105	L53205	L53305	L53405	L53505	L53605	L53705	L53805
50° to 300°F/ 10° to 150°C	L53106	L53206	L53306	L53406	L53506	L53606	L53706	L53806
50° to 400°F/ 10° to 200°C	L53107	L53207	L53307	L53407	L53507	L53607	L53707	L53807
50° to 550°F/ 10° to 300°C	L53108	L53208	L53308	L53408	L53508	L53608	L53708	L53808
150° to 750°F/ 70° to 400°C	L53110	L53210	L53310	L53410	L53510	L53610	L53710	L53810
200° to 1000°F/ 100° to 525°C	L53111	L53211	L53311	L53411	L53511	L53611	L53711	L53811

POCKET THERMOMETER

- 1" Dial
- 304 Stainless Steel Hermetically Sealed Case
- 5" long stem
- Protective Case with Stainless Steel Clip

Marsh pocket thermometers have a 1" dial, 304SS hermetically sealed case, 304SS 0.4mm diameter 5" long stem, and plastic lens. The accuracy is ±1.5% of scale range. Each unit comes with a protective case with SS clip, that allows it to be safely carried in your pocket and also can be used to hold the thermometer in the medium to be tested.

Typical applications include the food industries, HVAC/R industries, and any applications requiring fast and accurate temperature.

SPECIFICATIONS

ACCURACY
±1.5% of span throughout entire range

CASE MATERIAL
304 Stainless Steel

RANGES
-40/160°F, 0/220°F, 50/550°F

STANDARD RANGES & PART NUMBERS

PART NUMBER	DESCRIPTION & RANGE
L020E	1" dial, 5" stem, -40/160°F
L041E	1" dial, 5" stem, 0/220°F
L080E	1" dial, 5" stem, 50/550°F

DIGITAL POCKET THERMOMETER

- 3.5 Digit LCD display
- ABS Plastic Case
- 5" long stem
- Protective Case with Stainless Steel Clip

Marsh Digital Pocket Thermometers have a 3.5 digit LCD display, ABS case and a 304SS 5"long stem. The accuracy is ±2 °F with an update time of 10 seconds. Each unit has an on-off switch for longer battery life and comes with the protective carrying case.

Typical applications include the food industries, HVAC/R industries, and any applications requiring fast and accurate temperature.

SPECIFICATIONS

ACCURACY
±2 °F

CASE MATERIAL
ABS Plastic

RANGE
-58 to 302 °F / -50 to 150 °C

STANDARD RANGES & PART NUMBERS

PART NUMBER	DESCRIPTION & RANGE
L021DG	3.5 digit display, 5" stem, -58 to 302 °F / -50 to 150 °C

INDUSTRIAL THERMOMETER

- Standard Well & Lagging Well Option
- Mounting Options: Adjustable Angle
- Easy to Read Dual Scale
- 5 Temperature Ranges
- Aluminum or Molded Glass Fiber Case

Marsh Industrial Thermometers are designed for demanding applications. The large 9" scale permits easy reading at longer distances. The glass-reinforced nylon case is lightweight yet rugged enough for demanding installations. The adjustable stem can be locked into any position through a 180° arc. These thermometers are commonly used on hot or chilled water lines in commercial/industrial buildings.

The Marsh Industrial Thermometers have a compact design that is well suited for limited space applications such as diesel engines, steam turbines, reduction gears, pumps, condensers and pipelines.

SPECIFICATIONS

ACCURACY
±1% of scale range

INDICATING COLUMN
Blue liquid fill

SCALE
Dual scale °F & °C.
White coated aluminum

SCALE LENGTH
9 inches

CASE MATERIAL
Molded black nylon, glass fiber reinforced

WINDOW
Glass

CONNECTION & STEM
1¼"-18 swivel nut, for use with separable socket. Adjustable aluminum 3½" or 6" stem with 360° rotation

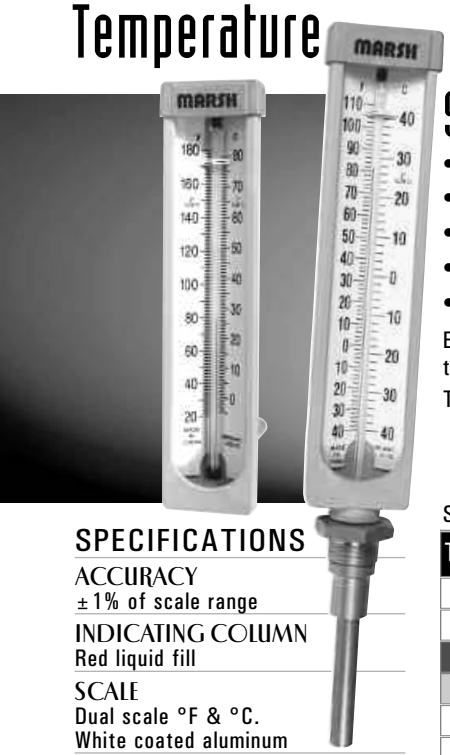
SEPARABLE SOCKET (THERMO-WELL) Choice of (NO) well, (SW) Standard Brass Well, or (LW) 2" Lagging Brass Extension Well.

STANDARD RANGES & PART NUMBERS

TYPE	INDUSTRIAL THERMOMETERS 9" ADJUSTABLE		
	With 3½" Stem		
Stem & Well	3½" (NO)	3½" SW	3½" LW
Dual Scale	°F & °C	°F & °C	°F & °C
Range			
-40° to 110°F /-40° to 40°C	Y1210	Y1202	Y1242
0° to 120°F /-15° to 45°C	Y1211	Y1203	Y1243
0° to 160°F /-15° to 65°C	Y1212	Y1204	Y1244
30° to 240°F /0° to 115°C	Y1214	Y1206	Y1246
30° to 300°F /0° to 150°C	Y1216	Y1208	Y1248
	With 6" Stem		
Stem & Well	6" (NO)	6" SW	6" LW
Dual Scale	°F & °C	°F & °C	°F & °C
Range			
-40° to 110°F /-40° to 40°C	Y1218	Y1226	Y1234
0° to 120°F /-15° to 45°C	Y1219	Y1227	Y1235
0° to 160°F /-15° to 65°C	Y1220	Y1228	Y1236
30° to 240°F /0° to 115°C	Y1222	Y1230	Y1238
30° to 300°F /0° to 150°C	Y1224	Y1232	Y1240

TYPE	SEPARABLE SOCKETS (THERMOWELLS)	
Process Connection	¾ NPT	¾ NPT
Material	Brass	304 SST
Stem Length & Well Style		
3½" Standard	223499-001	223502
6" Standard	223371	223512
6" with 2" Lagging	223389	223538

INDUSTRIAL THERMOMETER OPTIONS			
Option	Type	Suffix	Available on Models
Case	Aluminum	A	All Models



SUBMARINE THERMOMETER

- 5" Scale Size
- V-Shaped aluminum scale with black markings
- Lens front, red reading organic filled tube
- Gray ABS Case
- 2" nominal stem length for 31/4" OA socket

Each thermometer is manufactured to a standard accuracy of 1% of span. Gray case with red reading spirit filled tube with magnifying lens for easy readability. White aluminum scale with bold black graduations and figures.

Typical applications include diesel engines, steam turbines, pumps, condensers, pipelines, boilers and chillers.

SPECIFICATIONS

ACCURACY
±1% of scale range

INDICATING COLUMN
Red liquid fill

SCALE
Dual scale °F & °C.
White coated aluminum

SCALE LENGTH
5 inches

CASE MATERIAL
Gray ABS

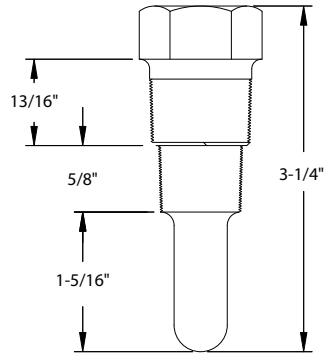
WINDOW
Glass

CONNECTION & STEM
¾"-28" swivel nut, for use with separable socket (thermowell).

STANDARD RANGES & PART NUMBERS

TYPE	SUBMARINE THERMOMETERS	
Stem Length	2"	
Dual Scale	°F & °C	
	STRAIGHT	90° BACK ANGLE
Range		
-40° to 110°F /-40° to 40°C	Y1402	Y1412
20° to 180°F /-6° to 82°C	Y1404	Y1414
30° to 240°F /0° to 114°C	Y1406	Y1416
50° to 400°F /10° to 200°C	Y1408	Y1418

TYPE	THERMOWELL
Connection	½ and ¾ NPT
Material	Brass
Stem/Well Length	
2"/3¼" OA	223666



THERMOWELL DIMENSIONS–¾"-28" Female Thread (internal)

TRIDICATORS

- Back and Bottom Mounting Options
- Rotatable Set Pointer
- Rugged Construction
- Three-Color Dial
- Three Pressure Ranges
- 2½" & 3½" Sizes

Marsh Instruments Tridicators (Boiler Gauges) are designed and suitable for hot water heating systems. These instruments indicate pressure in psi and altitude for pools and spa's in feet of H_2O; in °F and °C. All models feature a set hand for setting the desired pressure and altitude of the installation.

Typical applications include hot water boilers, heated pools, spa's and hot tubs.

STANDARD RANGES & PART NUMBERS

TYPE	TRIDICATORS		
Size	2½"	3½"	3½"
Case Material	Steel	Steel	Steel
Internals	Copper Alloy	Copper Alloy	Copper Alloy
Mounting/Case Style	CB	LBM	LM
Connection	¼ NPT	½ NPT	½ NPT
Scale Standard	psi/Feet of Water	psi/Feet of Water	psi/Feet of Water
0 to 60 psi / 0 to 130 ft H_2O	Y22026	Y22006	Y22002
0 to 100 psi / 0 to 230 ft H_2O		Y22008	Y22004
0 to 200 psi / 0 to 460 ft H_2O		Y22016	Y22012
0 to 300 psi / 0 to 680 ft H_2O		Y22018	Y22014

SPECIFICATIONS

ACCURACY
ASME Grade B= ±3/2/3% (±2% of range across middle half of scale)

CASE SIZE
2½" Round & 3½" Square

CASE MATERIAL
Steel, black painted

CONNECTION
2½" case: ¼ NPT Center Back Mount, 3½" case: ½ NPT Lower Mount or Lower Back Mount

PRESSURE RANGES
Dual scale in 4 ranges:
0 to 60 psi & 0 to 130 ft. of water
0 to 100 psi & 0 to 230 ft. of water
0 to 200 psi & 0 to 480 ft. of water
0 to 300 psi & 0 to 680 ft. of water

TEMPERATURE RANGE
60° to 260°F & 20° to 120°C

DIALS
Black markings on white

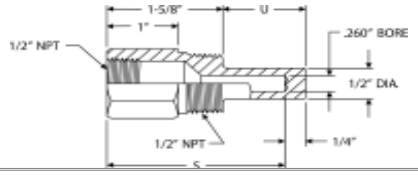
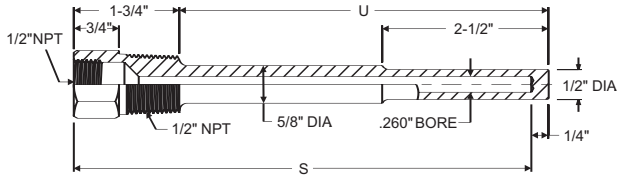
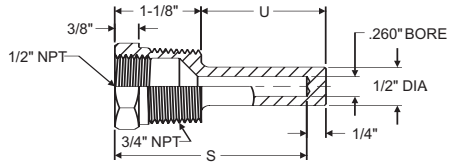
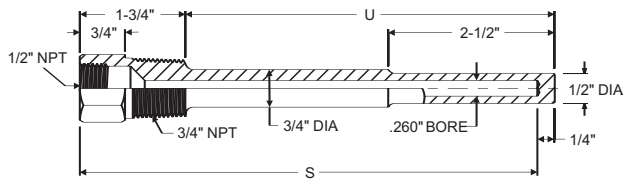
TUBE & SOCKET
Copper Alloy

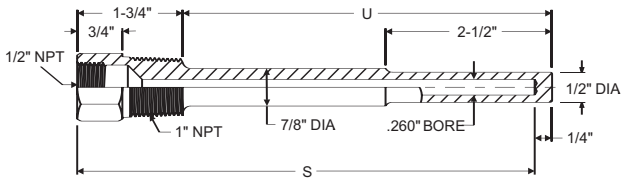
POINTERS
Aluminum, red painted with black painted set pointer

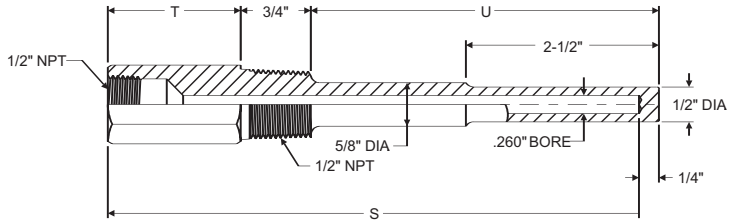
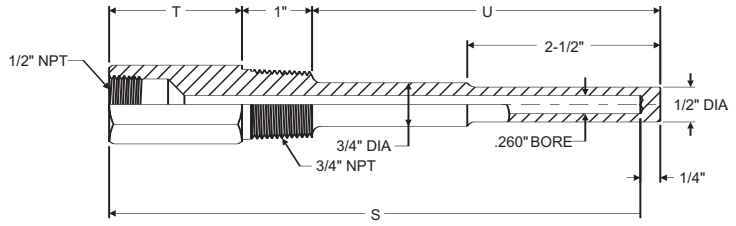
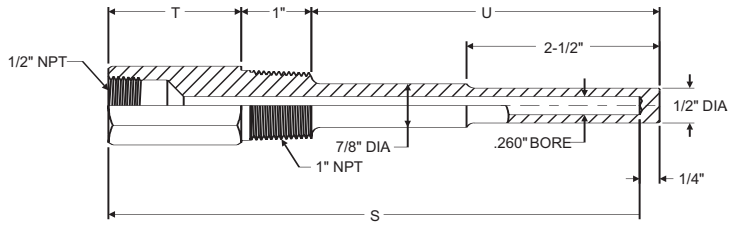
WINDOW
3½" Glass
2½" Acrylic

THERMOWELLS

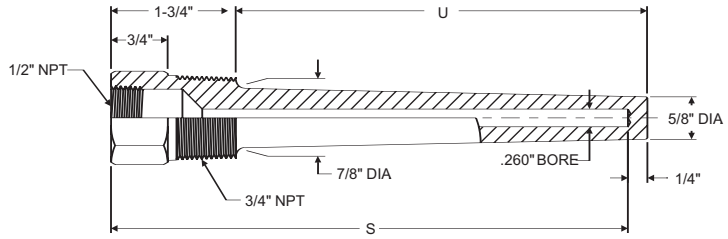
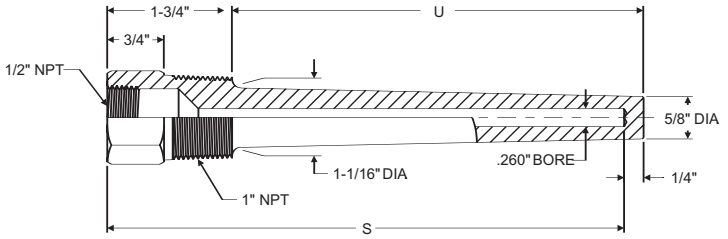
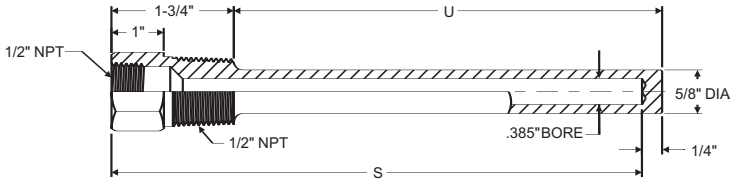
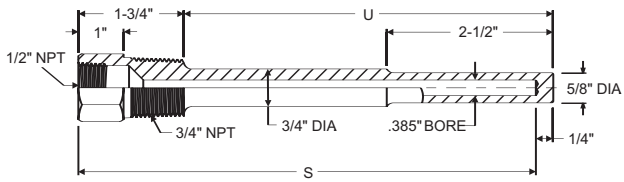
- In-Stock Thermowells for fast delivery
- Brass, 304 Stainless Steel or 316 Stainless Steel
- Tapered or Straight Shank
- 0.260/0.385 Standard Bore Sizes
- Threaded for easy connection

THERMOWELLS	PART #	"S" STEM	"U" INSERTION	WELL MATERIAL
	M3957K67	2½	1⅛	Brass
	M3957K68	2½	1⅛	304SS
	M3957K69	2½	1⅛	316SS
	M3957K64	4	2½	Brass
	M3957K65	4	2½	304SS
	M3957K66	4	2½	316SS
	M3957K37	6	4½	Brass
	M3957K38	6	4½	304SS
	M3957K51	6	4½	316SS
	M3957K39	9	7½	Brass
	M3957K41	9	7½	304SS
	M3957K52	9	7½	316SS
	M3957K42	12	10½	Brass
	M3957K43	12	10½	304SS
	M3957K53	12	10½	316SS
	M3957K71	18	16½	Brass
	M3957K72	18	16½	304SS
	M3957K73	18	16½	316SS
	M3957K75	24	22½	304SS
	M3957K76	24	22½	316SS
	M3957K77	2½	1⅝	Brass
	M3957K78	2½	1⅝	304SS
	M3957K79	2½	1⅝	316SS
	M3957K11	4	2½	Brass
	M3957K21	4	2½	304SS
	M3957K54	4	2½	316SS
	M3957K12	6	4½	Brass
	M3957K22	6	4½	304SS
	M3957K55	6	4½	316SS
	M3957K13	9	7½	Brass
	M3957K23	9	7½	304SS
	M3957K56	9	7½	316SS
	M3957K44	12	10½	Brass
	M3957K45	12	10½	304SS
	M3957K57	12	10½	316SS
	M3957K84	18	16½	Brass
	M3957K85	18	16½	304SS
	M3957K86	18	16½	316SS
	M3957K87	24	22½	Brass
	M3957K88	24	22½	304SS
	M3957K89	24	22½	316SS

THERMOWELLS	PART #	"S" STEM	"U" INSERTION	WELL MATERIAL
	M3957K46	4	2½	Brass
	M3957K47	4	2½	304SS
	M3957K58	4	2½	316SS
	M3957K48	6	4½	Brass
	M3957K49	6	4½	304SS
	M3957K59	6	4½	316SS
	M3957K91	9	7½	Brass
	M3957K92	9	7½	304SS
	M3957K93	9	7½	316SS
	M3957K94	12	10½	Brass
	M3957K95	12	10½	304SS
	M3957K96	12	10½	316SS
	M3957K14	18	16½	Brass
	M3957K15	18	16½	304SS
	M3957K16	18	16½	316SS
	M3957K18	24	22½	304SS
	M3957K19	24	22½	316SS

THERMOWELLS	PART #	"S" STEM	"U" INSERTION	"T" LAG	WELL MATERIAL
	M3957K24	9	4½	4	Brass
	M3957K25	9	4½	4	304SS
	M3957K26	9	4½	4	316SS
	M3957K27	12	7½	4	Brass
	M3957K28	12	7½	4	304SS
	M3957K29	12	7½	4	316SS
	M3957K4	18	13½	4	Brass
	M3957K5	18	13½	4	304SS
	M3957K6	18	13½	4	316SS
	M3957K8	24	19½	4	304SS
	M3957K9	24	19½	4	316SS
	M3957K31	6	2½	2¾	Brass
	M3957K32	6	2½	2¾	304SS
	M3957K61	6	2½	2¾	316SS
	M3957K33	9	4½	3¾	Brass
	M3957K34	9	4½	3¾	304SS
	M3957K62	9	4½	3¾	316SS
	M3957K35	12	7½	3¾	Brass
	M3957K36	12	7½	3¾	304SS
	M3957K63	12	7½	3¾	316SS
	M3957K115	18	13½	3¾	304SS
	M3957K116	18	13½	3¾	316SS
	M3957K117	24	19½	3¾	Brass
	M3957K118	24	19½	3¾	304SS
	M3957K119	24	19½	3¾	316SS
	M3957K121	9	4½	3¾	Brass
	M3957K122	9	4½	3¾	304SS
	M3957K123	9	4½	3¾	316SS
	M3957K124	12	7½	3¾	Brass
	M3957K125	12	7½	3¾	304SS
	M3957K126	12	7½	3¾	316SS
	M3957K131	18	13½	3¾	Brass
	M3957K132	18	13½	3¾	304SS
	M3957K133	18	13½	3¾	316SS
	M3957K134	24	19½	3¾	Brass
	M3957K135	24	19½	3¾	304SS
	M3957K136	24	19½	3¾	316SS

Thermowells

THERMOWELLS	PART #	"S" STEM	"U" INSERTION	WELL MATERIAL
	M3957K137	4	2½	Brass
	M3957K138	4	2½	304SS
	M3957K139	4	2½	316SS
	M3957K141	6	4½	Brass
	M3957K142	6	4½	304SS
	M3957K143	6	4½	316SS
	M3957K144	9	7½	Brass
	M3957K145	9	7½	304SS
	M3957K146	9	7½	316SS
	M3957K147	12	10½	Brass
	M3957K148	12	10½	304SS
	M3957K149	12	10½	316SS
	M3957K162	4	2½	Brass
	M3957K163	4	2½	304SS
	M3957K164	4	2½	316SS
	M3957K165	6	4½	Brass
	M3957K166	6	4½	304SS
	M3957K167	6	4½	316SS
	M3957K168	9	7½	Brass
	M3957K169	9	7½	304SS
	M3957K171	9	7½	316SS
	M3957K172	12	10½	Brass
	M3957K173	12	10½	304SS
	M3957K174	12	10½	316SS
	M3957K221	4	2½	Brass
	M3957K222	4	2½	304SS
	M3957K223	4	2½	316SS
	M3957K231	6	4½	Brass
	M3957K232	6	4½	304SS
	M3957K233	6	4½	316SS
	M3957K241	9	7½	Brass
	M3957K242	9	7½	304SS
	M3957K243	9	7½	316SS
	M3957K261	4	2½	Brass
	M3957K262	4	2½	304SS
	M3957K263	4	2½	316SS
	M3957K271	6	4½	Brass
	M3957K272	6	4½	304SS
	M3957K273	6	4½	316SS
	M3957K281	9	7½	Brass
	M3957K282	9	7½	304SS
	M3957K283	9	7½	316SS

DIGITAL PRESSURE INDICATOR

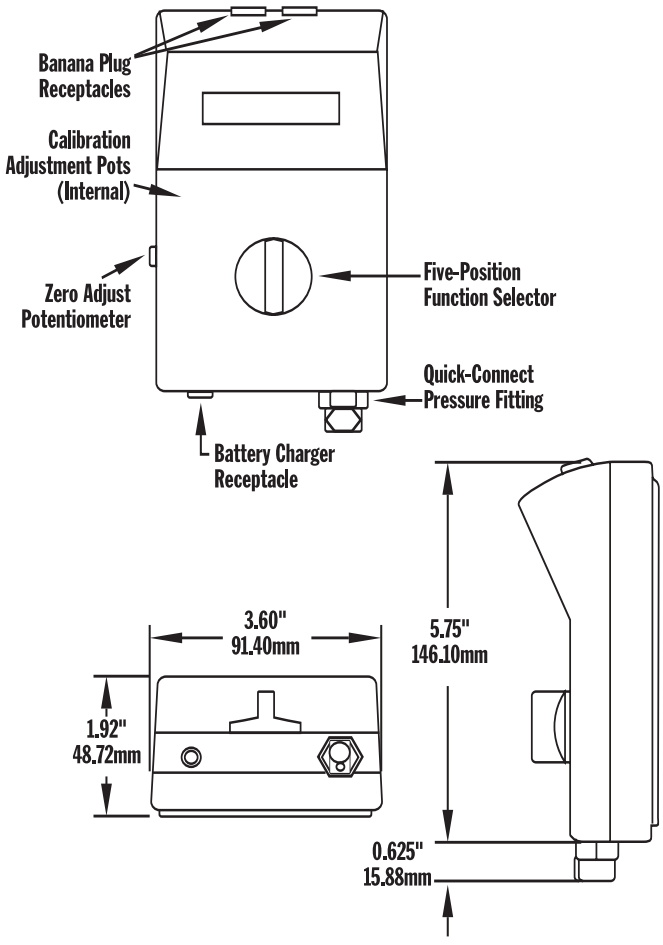
- Converts Pressure Input to LCD Digital Readout
- High Accuracy in Lightweight, Portable Package
- State of the Art Semi-Conductor

The Marsh Instruments Digital Pressure Indicator is portable, lightweight, hand-held testing and calibrating instrument indicates pressure to 50 psig at accuracy levels of ±0.50% of reading ±1 count. A state-of-the-art semiconductor-type pressure transducer converts pressure input to analog voltage, which is displayed on a 3½ digit LCD readout. Internal 9-volt rechargeable battery powers the indicator, and a zero adjust potentiometer standardizes the transducer bridge at zero pressure for higher accuracy.

Marsh Instruments Handheld Digital Pressure Indicator and Calibrator is ideal for calibrating DP cells, I/P's and P/I's. The indicator tests installed instruments and transmitters, verifies operation and settings of valves and switches, detects system leaks, and is used for other testing or maintenance applications.

	DIGITAL PRESSURE INDICATOR
RANGE	PART NUMBER
-14.7 to 50p	4-DPP-20050-BBC
-14.7 to 60p	4-DPP-20060-B3
-14.7 to 200p	4-DPP-20200-BBC

NOTE: Connection: 5/16" quick connect tube fitting
Elec. Range: 0-200 MA



SPECIFICATIONS

PNEUMATIC RANGE
Range:–14.7 to 200 psig; with corresponding inches of water column and inches of mercury

WETTED MATERIAL
Brass fitting, silicone wafer diaphragm, suitable for instrument air (clean & dry) or any clean, non-conductive fluid

PRESSURE FITTING
5/16" quick-connect tube fitting standard, with mating nickel-plated brass locking quick-connector. 8" plastic hose with ferruleless ¼" OD has to coupling insert with shutoff valve

DISPLAY
3½" digit LCD, ½" high black numerals on light background, with polarity and low battery indicators

ACCURACY
±0.5% of reading ±1 count, must be zeroed at barometric pressure

TEMPERATURE
Calibration range: 50°-90°F.
Operating range: 30°-130°F.
Effect of temperature outside calibration range is ±0.01% per degree F

POWER
Internal: 9-volt transistor battery, Ni-Cad chargeable. External: 12-volt adapter will power unit or charge battery in approx. 14 hours. Approximate operation is 8-10 hours per charge

CASE SIZE
3.60" wide x 5¾" long x 1.92"high, ABS plastic

INCLUDES
Carrying case, battery charger, 8" plastic hose, quick-connect fitting, and technical manual

SELECTION AND USE OF A PRESSURE GAUGE

When selecting a pressure gauge, it is important to consider the following factors to insure safety and accuracy:

1. Pressure range
2. Temperature range
3. Conditions affecting wear of the system
4. Case venting
5. Pressure fluid composition
6. Pressure fluid temperature
7. Ambient conditions
8. Method of mounting
9. Required accuracy

PRESSURE RANGE: A range of 2 times the operating pressure is recommended for safety and extended gauge life. The operating pressure should be limited to the middle 75% of range.

TEMPERATURE RANGE: Ambient temperature for General Service ("J") is -40° to 160°F. Ambient temperature for Severe Service ("J" & "X"), for Dry Gauges is -40° to 160°F and for Liquid Filled is 0° to 140°F.

SHOCK, VIBRATION, PULSATION, OR CORROSIVE ATMOSPHERE CONDITIONS: Liquid Filled Gauges have a fill material to lubricate the movement and reduce friction and wear. When used with a restrictor these gauges absorb vibration and dampen pressure shock and spikes. Liquid filling also prevents moisture or a corrosive atmosphere from affecting the gauge internals.

CASE VENTING: Process (Series "P") and Elite (Series "W") have a internal diaphragm which compensates for atmospheric changes that could affect the calibration of the filled gauge. Severe Service (Series "J" & "X") and 100mm (Series "HW") liquid filled gauges have an elastomeric vent fill plug tip which can be easily cut to permit case venting.

PRESSURE FLUID COMPOSITION: Since the sensing element of a pressure gauge may be exposed directly to the measured medium, consider the characteristics of this medium. It may be corrosive, it may solidify at various temperatures, or it may contain solids that will leave deposits inside the sensing element. For pressure fluids that will not solidify under normal conditions or leave deposits, a Bourdon Tube Gauge is acceptable Diaphragm Chemical Seals should be considered when gauge wetted parts are not compatible with the measured media. A chemical compatibility chart follows this section to aid in the selection of the proper sensing element or diaphragm seal material.

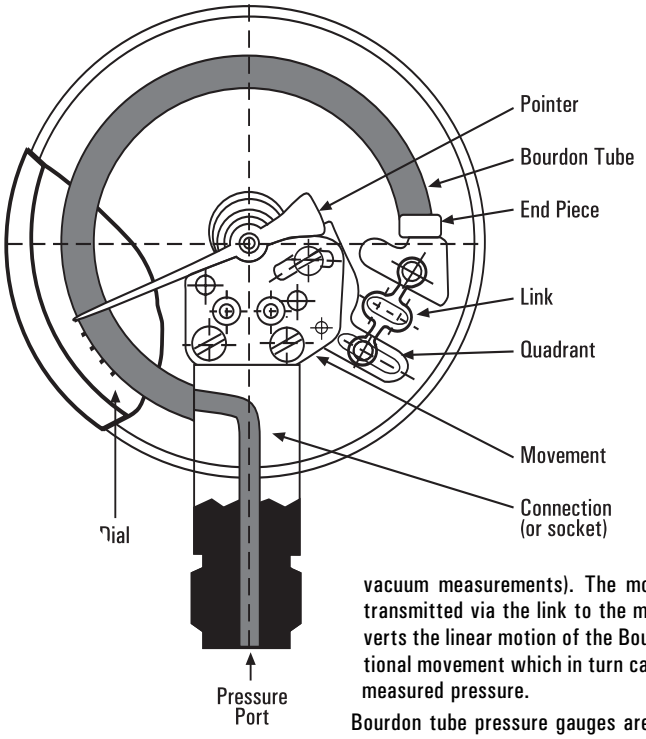
PRESSURE FLUID TEMPERATURE: Steam and other hot media may raise the temperature of the gauge components above safe working limits of the sealed joints. In these cases it is recommended that a syphon, cooling tower or chemical seal be used in conjunction with the pressure gauge Diaphragm Seals and remote capillary can also be considered for use with gauges or transducers which are subjected to very low or high ambient temperature.

AMBIENT CONDITIONS: The normal ambient temperature range for Marsh Instruments gauges is -40° to 160°F (-40° to +71°C) for Dry Gauges, –4° to 140°F (–20° to 60°C) for Glycerine filled gauges, and –40° to 140 °F (–40° to 60° C) for Silicone filled gauges. The error caused by temperature changes is ±0.3% per 18°F rise or fall, respectively. The reference temperature is 70°F (20°C). The correction is for the temperature of the gauge, and not the temperature of the measured medium. Remote gauge mounting using a diaphragm seal and capillary line is one alternative for applications involving extreme ambient temperature.

Moisture and weather effects must also be considered. Liquid Filled Gauges prevent condensation build up. For outdoor use, stainless steel, brass, or plastic cased gauges are recommended.

1-800-727-5646 SALES
1-304-387-4417 SALES FAX

PRESSURE GAUGE OPERATING PRINCIPLE



Bourdon tube pressure gauges are widely used in all branches of industry. The construction is simple yet rugged, and operation does not require any additional power source. The Bourdon tube element is directly exposed to the medium being measured and is normal made of copper alloy (brass) or stainless steel as the application demands.

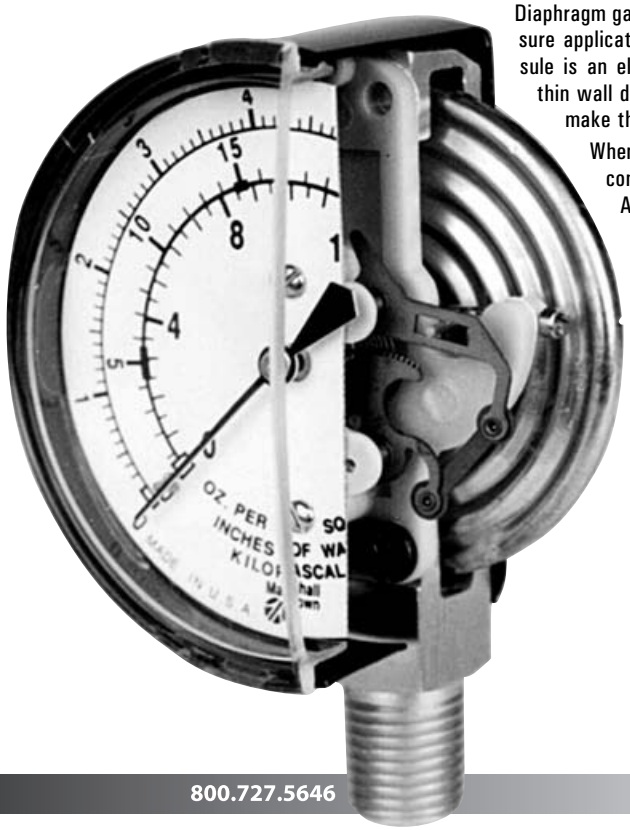
The Bourdon tube measuring element is made of a thin walled tube that is either bent into a semi-circle (C-Shape tube) or spirally wound (coiled safety tube). When pressure is applied to the measuring system through the pressure port, the pressure causes the Bourdon tube to straighten itself, thus causing the end piece to move upward (or downward for vacuum measurements). The movement of the end piece is transmitted via the link to the movement. The movement converts the linear motion of the Bourdon tube end piece to a rotational movement which in turn causes the pointer to indicate the measured pressure.

Bourdon tube pressure gauges are designed for the measurement of pressure and vacuum and are generally suitable for all clean and non-clogging liquid and gaseous media.

Various types of Bourdon tubes are used. C-shape Bourdon tubes are typically used for ranges to 1,000 psi. Higher ranges use coiled Bourdon tubes for safety.

Bourdon tube pressure gauges are available to measure full vacuums, compound and pressure ranges from 0-10 psi to 0-20,000 psi with an accuracy from ±0.25% to ±3/2/3% of span (ASME Grade 3A to Grade B).

HOW THE DIAPHRAGM GAUGE WORKS



Diaphragm gauges are sensitive instruments used in low pressure applications not exceeding 10 psi. The diaphragm capsule is an elastic metal sensing element comprised of two thin wall diaphragms whose sides are soldered together to make the capsule.

Whenever air or gas enters the intake port (gauge connection), it travels into the diaphragm capsule. As vacuum or pressure is applied to the diaphragm capsule, the walls of the capsule expand and contract in response to the change in pressure. This change is then transferred to a rotating rod and arm that rest on the outside of the capsule. The rotating rod is connected to a geared movement through a linkage system. Connected to a shaft, this system then drives the pointer over a dial marked in appropriate pressure or vacuum units.

CHEMICAL COMPATIBILITY TABLE

The media being measured must be compatible with the wetted parts of the pressure instrument. To use the chart below, locate the media whose pressure is to be measured and select a suitable material from those available. This is a simplified chart and assumes the media temperature is 200ºF except for media with a "*" which must be below 100ºF, Throttling devices and/or a liquid-filled instrument are recommended in applications with pulsation or vibration. These recommendations are only a guide, as service life is dependent on temperature, concentrations, catalysts that may be added, or other conditions beyond our control. Consult factory for specific applications and for any services not listed.

	Pressure Instrument Material					Pressure Instrument Material					Pressure Instrument Material			
Media Application	Brass or Bronze	316 SS	Monel	Diaphragm Seals**	Media Application	Brass or Bronze	316 SS	Monel	Diaphragm Seals**	Media Application	Brass or Bronze	316 SS	Monel	Diaphragm Seals**
Acetone*2	•	•	•		Ethyl Oxide >99%	•	•	•		Palmitic Acid >99%*2		•		
Acetic Acid <40%		•			Ferric Chloride <40%				•	Paraffin	•			
Acetic Anhydride				•	Ferric Sulfate <10%		•			Phosphoric Acid <80%*2		•		
Acetylene (Dry)		•			Ferrous Chloride <30%				•	Photographic Solutions		•		
Acrolein 100%				•	Ferrous Sulfate <50%				•	Pickling Solutions		•		
Air	•	•	•		Flurine Gas (Dry)		•	•		Picric Acid 10%		•		
Alcohol, Ethyl	•	•	•		Formaldehyde <95%		•	•		Propane (Dry)		•	•	
Aluminum Chloride.10%				•	Formic Acid*2				•	Potassium Chloride	Consult Factory			
Aluminum Sulfate 10-50%		•			Freons		•			Potassium Cyanide		•		
Ammonia Gas		•			Furfural <10%				•	Potassium Permanganate		•		
Ammonium Chloride <40%				•	Gallic Acid		•			Sea Water (Flowing)			•	
Ammonium Nitrate <50%		•			Gas (for lighting)	•				Silver Nitrate <70%				•
Ammonium Sulfate <60%				•	Gasoline		•			Sodium Bicarbonate <20%		•	•	
Aniline >99%		•			Glucose			•		Sodium Bisulfate<30%				•
Argon	•	•	•		Glycerine >99%	•	•	•		Sodium Carbonate <40%	Consult Factory			
Beer		•			Hydrobromic Acid				•	Sodium Chromate <60%	•	•	•	
Benzidine>99%				•	Hydrochloric Acid				•	Sodium Cyanide	Consult Factory			
Benzene <50%		•	•		Hydrofluoric Acid				•	Sodium Hydroxide		•	•	
Benzoic Acid <70%		•			Hydroflusilic Acid				•	Sodium Hypochlorite <25%				•
Benzol	•				Hydrogen 2	•	•			Sodium Phosphate, Tri <60%		•	•	
Bordeaus Mixture	•				Hydrogen Peroxide <50%		•			Sodium Silicate <50%		•	•	
Boric Acid <25%		•			Kerosene	•	•	•		Sodium Sulfide <50%	Consult Factory			
Bromine (Dry)				•	Lacquers	•				Stannous Chloride <10%		•		
Butane	•	•	•		Lactic Acid <70%*2		•			Steam (Use siphon)	•	•	•	
Butanol	•				Lysol		•			Stearic Acid		•	•	
Butyric Acid <25%		•			Magnesium Chloride <40%				•	Sulfur Dioxide (Dry) >99%				•
Calcium Chloride <80%				•	Magnesium Sulfate		•			Sulfur Trioxide (Dry) >99%				•
Calcium Hydroxide <50%				•	Mercuric Chloride <60%		•			Sulfurous Acid				•
Carbon Dioxide	•	•	•		Mercury >99%				•	Tannic Acid <80%	•	•	•	
Carbon Monoxide >99%	•	•	•		Methyl Chloride	Consult Factory				Tanning Liquors	Consult Factory			
Chlorine (Dry)				•	Methyl Salicylate	Consult Factory				Tartaric Acid <50%		•	•	
Chlorine (Moist)*2				•	Milk		•			Tin Chloride (ous) <10%		•		
Chloroform (Dry)		•	•		Naphtha >99%	•	•	•		Toluene >99%	•	•	•	
Chromic Acid				•	Naphthalene >99%		•			Turpentine >98%	•	•	•	
Citric Acid 10-50%		•			Nickel Chloride >99%				•	Vegetable Oils		•		
Corn Oil		•			Nitric Acid <95%*2		•			Vinegar		•		
Cottonseed Oil		•			Nitrogen	•	•	•		Water	•	•	•	
Creosote (Crude)		•			Nitrous Oxide	Consult Factory				Whiskey		•		
Crude Oil (Sour) (Use NACE)		•	•		Oleic Acid	•	•			Zinc Chloride <35%*2				•
Crude Oil (Sweet)		•	•		Oxalic Acid*2				•	Zinc Sulphate <40%				•
Ethyl Acetate	•	•	•		Oxygen (Gas)1	•	•	•						

1. Bronze and 316 Stainless Steel are acceptable for oxygen service, provided the instrument has been-cleaned for service and is free from oil.
2. Over 1000 psi – entire system must be 316 Stainless Steel.

*Media temperature must be below 100ºF

**Any standard bourdon tube or material may be used in conjunction with a diaphragm seal the gauge selection should be taken into consideration the corrosive environment in which it is to operate.

ACCURACY TABLE										
GAUGE PRODUCT	PAGE #	ACCURACY	1½"(40MM)	2 (50MM)	2½""	63MM	3½"	100MM	4½"	6" (160MM)
GENERAL SERVICE										
GG Gauges	9	B	•	•						
General Service Gauges	10	B	•	•	•		•		•	
SEVERE SERVICE										
40/50mm Severe Service	14	B	•	•						
63mm Severe Service	15	B				•				
100mm Severe Service	17	A						•		
63mm Brass	19	A				•				
100mm Brass	19	1A						•		
PRECISION SERVICE										
Elite Stainless Steel	24	1A						•		
100mm Stainless Steel	20	1A						•		
Quality Series 100mm	21	1A						•		
"HW" Stainless Steel	23	1A						•		•
Quality	25	A					•		•	•
Test	27	2A							•	•
Master Test	29	3A								•
Inspector's Test	30	2A					3.0			
PROCESS										
Process	31	2A							•	•
DIAPHRAGM GAUGE										
Low Pressure	35	A			•		•		•	
HVAC/R										
Contractor's HVAC	43	A							•	
Heating (Ft. H_2O)	44	A & B					•		•	
Refrigeration Ammonia	41	B				•	•			
Refrigeration	42	B			•		•			
Serviceman	39	B			•					
Manifold	40	B			•					
SPECIAL APPLICATION										
Water Test	45	B			•					
Paper Machine	46	A					•			
X-mas Tree Gauge	47	1A							•	

ASME B40.1 GRADE		ACCURACY
3A	±0.25%	Full Scale
2A	±0.50%	Full Scale
1A	±1.0%	Full Scale
A	±2/1/2%	±1% over middle half of scale
B	±3/2/3%	±2% over middle half of scale

PRESSURE UNITS CROSS REFERENCE CHART

psi	atms.	"H_2O	mmH_2O	cmH_2O	oz./in^2	Kg/cm^2	"Hg	mmHg (Torr)	cm Hg	mbar	bar	Pa (N/m^2)	kPa	MPa
1	0.0681	27.71	703.8	70.38	16	0.0704	2.036	51.715	5.17	68.95	0.0689	6895	6.895	0.0069
14.7	1	407.2	10,343	1,034.3	235.1	1.033	29.92	760	76	1013	1.013	101,325	101.3	0.1013
0.0361	0.00246	1	25.4	2.54	0.5775	0.00254	0.0795	1.866	0.187	2.488	0.00249	248.8	0.249	0.00025
0.001421	0.000097	0.0394	1	0.1	0.0227	0.001	0.00289	0.0735	0.00735	0.098	0.000098	9.8	0.0098	0.00001
0.01421	0.000967	0.3937	10	1	0.227	0.001	0.0289	0.735	0.0735	0.98	0.00098	98	0.098	0.0001
0.0625	0.00425	1.732	43.986	4.40	1	0.0044	0.1273	3.232	0.323	4.31	0.00431	431	0.431	0.00043
14.22	0.968	394.1	100,010	1,001	227.6	1	28.96	735.6	73.56	980.7	0.981	98,067	98.07	0.0981
0.4912	0.03342	13.61	345.7	34.57	7.858	0.0345	1	25.4	2.54	33.86	0.0339	3386	3.386	0.00339
0.01934	0.001316	0.536	13.61	1.361	0.310	0.00136	0.0394	1	0.1	1.333	0.001333	133.3	0.1333	0.000133
0.1934	0.01316	5.358	136.1	13.61	3.10	0.0136	0.394	10	1	13.33	0.01333	1333	1.333	0.00133
0.0145	0.000987	0.4012	10.21	1.021	0.2321	0.00102	0.0295	0.75	0.075	1	0.001	100	0.1	0.0001
14.504	0.987	401.9	10,210	1021	232.1	1.02	29.53	750	75	1000	1	100,000	100	0.1
0.000145	0.00001	0.00402	0.102	0.0102	0.00232	0.00001	0.000295	0.0075	0.00075	0.01	0.00001	1	0.001	0.000001
0.14504	0.00987	401.9	102.07	10.207	2.321	0.0102	0.295	7.05	0.75	10	0.01	1,000	1	0.001
145.04	9.869	4019	102,074	10,207	2321	10.22.036	295.3	7500	750	10,000	10	1,000,000	1,000	1

To use this chart:
1. Find the column with the units you want to convert from
2. Move down that column until you find the "1"
3. Staying in the same row, move horizontally to the column with the units you are converting to
4. Multiply the number in that box by the amount you are changing from to get the converted value

PART NUMBER PREFIX GUIDE

Marsh Instrument part numbers begin with a letter prefix which helps identify the product

PREFIX	PRODUCT TYPE	SEE PAGES
D	Test Gauges	30
D	Inspector's Test Gauges	33
G	Diaphragm Gauges	38
G	Water Test Gauges	49
H	Quality Gauges	28
H	100mm Stainless Steel (L.F.)	22
HW	100mm Welded Socket	25
J	General Service Gauges	12
J	63mm Severe Service Gauges (L.F.)	17
L	Bimetal Thermometers	58
P	Process Gauges	34
W	100mm Elite Gauges (L.F.)	27
W	HVAC/R (Heating System, Contractor's, Refrigeration Ammonia, Manifold)	41-47
W	Paper Machine, X-Tree, Sprinkler	50, 51, 48
X	100mm Severe Service Gauges (L.F.)	19
Y	Tridicators, Industrial Thermometers	63, 61
M	40mm & 50mm Severe Service	16
GG	Marshalltown Value Series	11

PART NUMBER SUFFIX GUIDE

Marsh Instruments part numbers end with a letter suffix to denote a special feature or options.

SUFFIX	OPTION	DESCRIPTION
A	Ring Options	Friction-Black (FB)
		Press-Black (PB)
		Press-Chrome (PC)
		Friction Chrome (FC)
B	Accuracy	ASME Grade 2A 0.5% (H%F);
		ASME Grade 1A, 1.0% (1%F);
		ASME Grade A 2-1-2% (1%H)
D	Oxygen Cleaned	
E	Single Scale psi only Dial	
F	Window Options	Safety Glass (SG)
		Acrylic (AY)
		Instrument Glass (GS)
G	Weatherproof case	
H	Restrictors	
I	Fill Options	Silicone (SL)
		Glycerine (GL)
J	Case Options	Phenolic (PH); Brass (BR)
		Chrome (CR); Stainless Steel (SS)
		Polypropylene Turret (TR)
L	Metric Dial	L1 -Bar Only
		L2-kg/cm^2 Only
		L3-kPa Only
		L4-MPa only
M	Custom Name on Dial or Service Printing	
P	Liquid Filled product	
R	Front Flange	
W	Dual Scale	W1 -psi & Bar
		W2-psi & kg/cm^2
		W3-psi & kPa
		W4-psi & MPa
Z	Pointers	Adjustable Pointers (AD)
		Max. Hand Assembly (MX)

NOTE: Not all options are available on all products, please consult factory

ABBREVIATIONS AND TERMS USED

p or psi	Pounds per square inch
kPa	kilopascals
Case	The case style
oz/in^2	Ounces per square inch
H_2O	Inches of water
ft. H_2O	Feet of water
Hg	Inches of mercury
VAC	Range is in vacuum
NOTE: Compound Ranges, where the gauge measures both vacuum and pressure are designated as: 30" Hg VAC to 100p = measures from 30 inches of mercury vacuum to 100psi pressure.	
P	plain case (no flange or clamps)
F	front flange case (with U-clamp)
R	3 holed front flange (no clamp)
G	back flange case
H	hinged ring case (front flange case with U-clamp and removable cover)
UC	U-clamp case
CONNECTION : The process connection ⅛", ¼", ½" – NPT diameter of connection (National Pipe Thread Standard)	
LM	lower mount
LBM	lower back mount
CB	center back mount
REGISTERED TRADEMARKS: Viton®, Teflon®, & Delrin® are registered trademarks of the E.I. Dupont family of companies.	

MARSHALLTOWN CROSSOVER GUIDE

FIGURE #	MARSH SERIES
16	"G" Water Test
22 & 23K, KB, KC, KD	"J" General Service
22 & 23P, PC	N/A
24 & 25	"H" Quality
38	"W" Ammonia
42 (compound)	"H" Quality
44, 44K (ft. of H20)	"W" Heating System
45K (compound)	"J" General Service
50K, 51 (High Pressure)	"X" Series and "J" Severe Service
52, B, C, & D	"J" 63mm SST Case (L.F.)
54, 58	"W" Ammonia Refrigeration
60	"D" Test
63	"D" Inspector's Test
71	"W" Heating System
82, 83K, 84 (Diaphragm)	"G" Diaphragm
98, 99, 100	"L" Bimetal
105,107,117	"Y" Tridicators
175, 179, 180-184	"P" Process
185-188 (Severe Service)	"J" & "X" 63 & 100mm Case (L.F.)
224 WF	"W" Contractors HVAC
254	"L" Bimetal (Adjustable)
286P	N/A
400-413	"P" Process

MARSH BELLOFRAM TERMS & CONDITIONS

I. GENERAL

A. Customer purchase orders are binding only after written acceptance by Marsh Bellofram. Verbal orders shall not be accepted as binding until confirmed in writing by Marsh Bellofram.

B. Prices are effective from date of publication and are subject to change without notice.

C. Marsh Bellofram reserves the right, without prior notice to:

1. Change and/or revoke any price.
2. Change and /or revoke any provisions contained herein.
3. Discontinue shipments to any customers.
4. Resolve any inconsistencies, conflicts or ambiguities.

D. Special production runs or product orders are subject to Marsh Bellofram requirements such as, but not limited to, minimum quantities and extended delivery times. On special production run products Marsh Bellofram reserves the right to over ship or under ship the purchase order quantity by up to 5% and invoice accordingly. Special orders are subject to cancellation charges.

E. Minimum billing: $60 net per order.

II. PAYMENT TERMS

A. For customer with established credit terms: Net 30 days from shipment date.

B. If credit is not established, payment plus estimated (By Marsh Bellofram) freight charges shall accompany order or arrangements shall be made for collect on delivery (C.O.D.)

C. Marsh Bellofram reserves the right to revoke any credit extended to a customer if the customer fails to pay for any shipments when due. If in Marsh Bellofram's opinion there is a material adverse chance in customer's financial condition, Marsh Bellofram shall have the right to suspend further shipments until receipt of adequate assurance of customer's ability to pay therefor.

D. All shipments are F.O.B. Plant of Manufacture.

E. The shipment is deemed accepted in good condition by the common carrier and title and all risk of loss or damage is transferred to customer upon that acceptance by the carrier. The customer is responsible for inspection the merchandise upon receipt. The customer shall insist that visible damage be noted on its copy of the freight bill. If the product has been lost or damaged in transit, the customer must file the claim with the carrier, as Marsh Bellofram bears no responsibility for any such loss or damage.

F. All freight, handling and insurance charges shall be invoiced to the customer or shipped freight collect.

G. All shipments are made by carriers of Marsh Bellofram's choice. Any special arrangements requested by customer shall be at customer's additional expense.

H. Any quantity shortages, incorrect items, or billing errors shall be reported in writing to Marsh Bellofram within 15 days of delivery. Sales order and invoice numbers are to be furnished on all claims.

I. Marsh Bellofram reserves the right to make delivery in installments. All such installments shall be separately invoiced and paid for when due, without regard to subsequent deliveries. Delay in delivery of any installment shall not relieve customer of his obligation to accept remaining deliveries.

J. Marsh Bellofram shall not be liable for failure to deliver or delay in delivery occasioned by causes beyond Marsh Bellofram's control, including without limitation, lockouts, fires, embargoes, war or other breakouts of hostilities, act of inability to obtain shipping space, machinery breakdowns, delays of suppliers, and domestic or foreign governmental acts or regulations. In the event of any delay in delivery due to such causes, unless otherwise agreed, time of delivery shall be deemed extended for a period of sixty (60) days. Customer shall extend the letter of credit if payment is to be made by letter of credit. If delivery is not made within such extended sixty (60) day period, contract shall be deemed cancelled without liability to either party.

III. CANCELED ORDERS

ORDER CANCELLATIONS CAN ONLY BE ACCEPTED BY WRITTEN REQUEST via FAX or MAIL.

All order cancellations result in a cancellation fee of at least 25% of the appropriate invoice of the finished item. Additional cancellation fees are:

1. Catalog Stock Items
   - If cancelled less than 1 week before ship date, 25% cancellation fee.
2. Catalog Non-Stock Items
   - If cancelled less than 30 days before ship date, full price.
3. Customer Specials
   - If cancelled at any time, full price.

IV. LIMITED WARRANTY

A. All Marsh Bellofram products are warranted against defects in workmanship materials under normal use for 1 year after date of purchase from Marsh Bellofram unless otherwise stated. (Proof of purchase is required). Any product which is determined by Marsh Bellofram to be defective in material or workmanship and returned to Marsh Bellofram, shipping costs prepaid, shall be, as the sole remedy, repaired or replaced at Marsh Bellofram's option.

B. This warranty is expressly in lieu of all other warranties expressed or implied, including the warranties of merchantability and fitness for use and all other obligations or liabilities on the part of Marsh Bellofram, and Marsh Bellofram neither assumes nor authorizes any other person to assume for it, and other liability in connection with the sale hereunder. Marsh Bellofram disclaims any liability for product defects that are due to product misuse, improper product selection or misapplication.

C. Marsh Bellofram shall not be liable for customer's costs, lost profits, good will or other special or consequential damages Marsh Bellofram's liability in all events is limited and shall not exceed, the value of merchandise involved.

D. Remedies - Any controversy or claim arising out of or relating to the contract, or the breach thereof, shall be settled by arbitration in Hancock County, State of West Virginia in accordance with the commercial arbitration Rule of the American Arbitration Association, and judgement on the award render by the arbitrator(s) may be entered in a court having jurisdiction thereof.

V. MODIFICATION OF TERMS

This contract constitutes the entire agreement between the parties, all private representations and understanding having been merged herein. It may not be modified or terminated except in writing signed by a duly authorized representative of Marsh Bellofram. This contract shall be governed by and construed according to the laws of the State of West Virginia.

DISTRIBUTOR RETURN POLICY FOR PRESSURE GAUGES & ACCESSORIES

I. RETURN GOODS AUTHORIZATION (RGA)

A. Merchandise returned to Marsh Bellofram for any reason must have a Marsh Bellofram Returned Goods Authorization (RGA) number. Warranty returns also require proof of purchase (invoice number, date, and an RGA number).

B. An RGA is valid for 45 days from issuance and merchandise must arrive at Marsh Bellofram within that validity period.

C. All material must be shipped freight prepaid.

D. The RGA number must be clearly visible on the outside of the package. A packing list must be included which clearly shows the RGA number, quantity, product description and reason for return.

E. No returns will be accepted without an authorized RGA (Return Goods Authorization)

II. MARSH BELLOFRAM CANNOT BE HELD RESPONSIBLE FOR ANY MERCHANDISE RETURNED WITHOUT AN RGA NUMBER.

A. An RGA number is issued in good faith based upon customer's representation of the merchandise quantity, condition, age and reason for return. All returned material is subject to inspection by Marsh Bellofram. If the material is found to be other than that originally represented, the shipment will be returned at the customer's expense.

B. An RGA may be requested by mail, fax or by telephoning Marsh Bellofram at 304-387-1200.

1. Warranty Returns (see Warranty Policy): Limited in-warranty merchandise must have an RGA number and be returned freight prepaid. The merchandise will be repaired or replaced under Marsh Bellofram's warranty terms, it will be returned freight prepaid to the customer.
2. Incorrect Shipments: For short shipments or incorrectly supplied merchandise, discrepancies must be reported within 15 days of receipt. For short shipments, a debit memo should be issued to Marsh Bellofram. Marsh Bellofram will then issue a credit memo, ship the missing merchandise freight prepaid and issue an invoice. For incorrectly supplied merchandise, all returns require an RGA number and must be returned freight prepaid. A debit memo should be issued to Marsh Bellofram for the freight. If a replacement is required, Marsh Bellofram will ship freight prepaid and invoice for the new product plus freight.
3. General Terms for Returns (Exchange or Credit): Material requested to be returned will be considered if the following conditions are met:
   a. Merchandise is unused, current standard catalog stock of latest design, with both product and packaging in saleable condition.
   b. Merchandise shall have been purchased directly from Marsh Bellofram in the last 12 months.
   c. Merchandise shall not have been purchased on a "product promotion" or other special pricing.
4. Marsh Bellofram reserves the right to reject any return request. If accepted, the return will be under the terms specified herein. The following products are not returnable:

   a. Annual Merchandise Exchange Policy for Marsh Bellofram Distributors: Marsh Bellofram will normally accept one stock exchange in a 12 month period, for the purpose of increasing the flexibility of distributor's stock This annual exchange is limited to distributors who are in good standing and whose accounts are current. The merchandise is subject to the product restrictions listed previously and limited to no more than 2% of the net invoiced sales from Marsh Bellofram to the distributor location during the previous 12 months. The value of the exchange will be determined by the current list price and current maximum published discount.

      <u>An offsetting order equal to the return is required.</u>

      1. The distributor shall issue a written request for an RGA number for the annual exchange showing quantity, product catalog number and description.
      2. The exchange is subject to Marsh Bellofram approval and may be subject to an on-site inspection by Marsh Bellofram personnel. Please allow minimum 2 weeks for approval. Non-stock product or custom product is not returnable.
      3. Upon approval of the exchange, Marsh Bellofram will inform the distributor of the net amount of the exchange for the scheduled date for return. The RGA number will be issued only upon receipt of a purchase order for an equal (net) value, calculated on current list price, current maximum published discount.
      4. Upon receipt of RGA number, the distributor shall then package the authorized material and return freight prepaid to Marsh Bellofram, Newell, WV. The distributors bears liability for lost shipments or shipping damage.
      5. All merchandise is subject to inspection upon receipt. Merchandise which is found to be damaged, modified, or in any other way ineligible for exchange, will be returned at the customer's expense and the value will be deducted from the exchange. A credit memo will then be issued for the net value of the exchange.
      6. The replacement order will be shipped and invoiced against the new purchase order with freight at distributor's expense.

   b. Merchandise Returns for Credit: Merchandise returned for credit requires an RGA number, and is subject to a 25% restocking charge and must be returned freight prepaid. The amount of the credit will be determined as follows:

      1. Items returned within 90 days of purchase and with proof of purchase (copy of invoice) will be at invoiced price less applicable charges.
      2. All other will be calculated at current list price and current maximum published discount less 25% restocking fee.
      3. In addition to the standard restocking fee, gauges with accessories will be subject to a removal charge equal to the difference between the "installed" and "sold separately" prices.
      4. Solid fill thermometry products are non-returnable.

   c. Credit Memos:

      1. Where required, Marsh Bellofram will issue a credit memo for the returned or exchanged merchandise less any applicable restocking or removal charges.
      2. The credit memo will be issued only after receipt and inspection of merchandise.
      3. Deduction from payments shall not be made until the Marsh Bellofram issued credit memo has been received.

PRODUCT CLASSES AND OPTIONS

A. Stock items: Shipped in 7 days or less, with no minimum quantity. *(Large quantities may require extended lead times.)*

B. Non-stock items: Consult factory for quantities and lead times.

C. Custom options on stock items: Dials, rings, windows, restrictors, and cosmetic changes - 4 weeks.

E. Customer special class: Special connections and materials consult factory for quantities and lead times.

PRODUCT WARNINGS, CLAIMS, RECOMMENDATIONS AND NOTICES

WARNING: A failure resulting in injury or damage may be caused by pressure beyond top of scale, excessive vibration or pressure pulsation, excessive instrument temperature, corrosion of the pressure containing parts, or other misuse. For correct use and application of pressure gauges, refer to ASME standard B40.1 1998, entitled 'Gauges: Pressure Indicating Type: Elastic Element.' This document is available from The American Society of Mechanical Engineers, United Engineering Center, 345 East 47th Street, New York, NY 10007.

WARNING: LIQUID FILL: Glycerine or Silicone when combined with strong oxidizing agents, including but not limited to chlorine, nitric acid, and hydrogen peroxide, can result in a spontaneous chemical reaction, ignition, or explosion which can cause property damage and personal injury. If gauges are to be used in such service, do not use glycerine or silicone fill. Consult factory for proper fill medium.

IMPORTANT NOTICE: Our recommendations, if any, for the use of these products are believed to be reliable. The greatest care is exercised in the selection of our raw materials and in our manufacturing operations. However, since the use of this product is beyond the control of the manufacturer, no guarantee or warranty, express or implied, is made to such use or effects incidental to such use, handling or possession or the results to be obtained whether in accordance with the directions claimed so to be. The manufacturer expressly disclaims responsibility therefor. Furthermore, nothing contained herein shall be construed as a recommendation to use any product in conflict with existing laws and/or patents covering any material or use.

LIMITED WARRANTY:

(1) All Marsh Instruments products are warranted against defects in workmanship or materials under normal use for one year after date of purchase from Marsh Instruments unless otherwise stated. (Proof of purchase is required). Any product which is determined by Marsh Instruments to be defective in material or workmanship and is returned to Marsh Instruments with shipping costs prepaid, shall be, as the sole remedy, repaired or replaced at Marsh Instruments' option.

(2) THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES EXPRESSED OR IMPLIED, INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR USE AND OF ALL OTHER OBLIGATIONS OR LIABILITIES ON THE PART OF MARSH INSTRUMENTS, AND MARSH INSTRUMENTS NEITHER ASSUMES NOR AUTHORIZES ANY OTHER PERSON TO ASSUME FOR IT ANY OTHER LIABILITY IN CONNECTION WITH THE SALE HEREUNDER. MARSH INSTRUMENTS DISCLAIMS ANY LIABILITY FOR PRODUCT DEFECTS THAT ARE DUE TO PRODUCT MISUSE, IMPROPER PRODUCT SELECTION OR MISAPPLICATION.

(3) Marsh Instruments shall not be liable for customer's costs, lost profits, good will or other special or consequential damages incurred in any way. Marsh Instruments' liability in all events is limited to, and shall not exceed, the value of merchandise involved.

NOTE: ALL MARSH INSTRUMENT PRODUCTS ARE SUBJECT TO CONTINUOUS IMPROVEMENT. THEREFORE, MATERIAL AND SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

LT0375 10m 2/09

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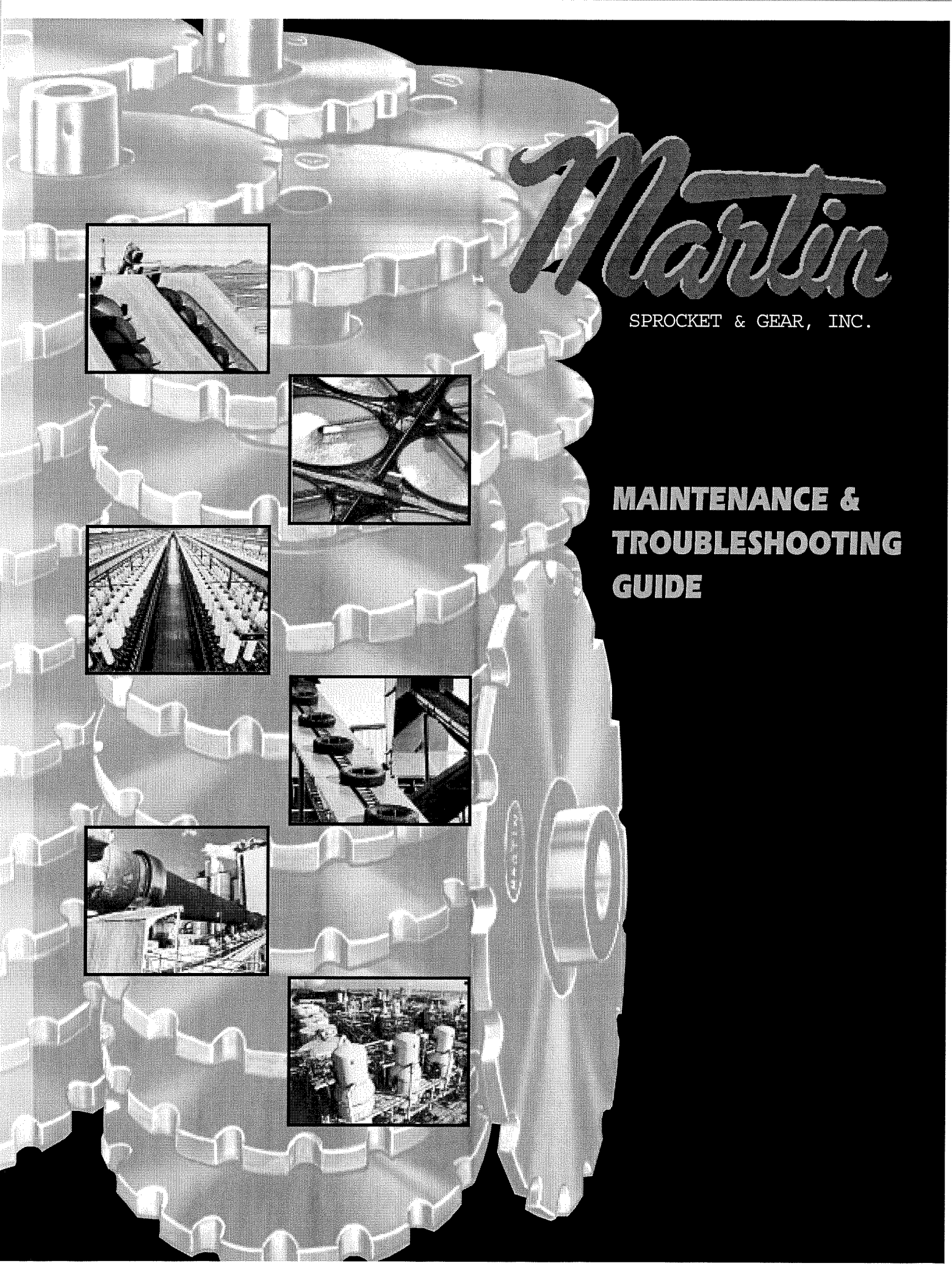

Martin

SPROCKET & GEAR, INC.

MAINTENANCE & TROUBLESHOOTING GUIDE

WARNING & SAFETY REMINDER

Safety must be considered a basic factor in machinery operation at all times. **Most accidents are the results of carelessness or negligence**. All rotating power transmission products are potentially dangerous and must be guarded by the contractor, installer, purchaser, owner, and user as required by applicable laws, regulations, standards, and good safety practice. Additional specific information must be obtained from other sources including the latest editions of American Society of Mechanical Engineers; Standard A.N.S.I. B15.1. A copy of this standard may be obtained from the American Society of Mechanical Engineers at 345 East 47th Street New York, NY 10017 (212705-7722).

It is the responsibility of the contractor, installer, purchaser, owner, and user to install, maintain, and operate the parts or components manufactured and supplied by Martin Sprocket & Gear, Inc., in such a manner as to comply with the Williams-Steiger Occupational Safety Act and with all state and local laws, ordinances, regulations, and the American National Standard Institute Safety Code.

CAUTION

Guards, access doors, and covers must be securely fastened before operating any equipment.

If parts are to be inspected, cleaned, observed, or general maintenance performed, **the motor driving the part or components is to be locked out electrically in such a manner that it cannot be started by anyone,** however remote from the area. Failure to follow these instructions may result in personal injury or property damage.

WARNING

NOTE: CATALOG DIMENSIONS

Every effort is made to keep all catalog dimensions and styles current; however, from time to time, it is necessary because of manufacturing changes to alter stock products dimensionally.

If any stock product dimension or style shown in this catalog is critical to your application please consult factory for certification.

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Introduction to Martin Sprocket & Gear Indexed Troubleshooting Guide

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- Screw Conveyor . . . . . page 8
- Safety Page . . . . . inside front cover
- Nationwide Service Centers . . . . . back cover

CHAIN DRIVES

Type Maintenance	What To Do
Lubrication — Type A	Manual Lubrication, oil applied periodically brush or spout can. Drip lubrication, oil applied between link plates edges from a drip lubricator.
Lubrication — Type B	Oil bath or oil slinger, oil level maintained in casing at predetermined height.
Lubrication — Type C	Oil stream, oil supplied by circulating pump inside chain loop on lower span.
Check for Chain Stretch	If elongation is in excess of 3%, replace with new chain. Check length after first 1,000 hours.
Check Sprocket	If teeth have a hooked appearance, replace. Initial inspection 24 hours, second 100 hours, third 500 hours. Periodically thereafter, check chain length, may be elongated.
Check Alignment	If wear is apparent on inner surface of roller link side-bars and on sides of sprocket teeth, there is misalignment. Realign sprockets.

Troubleshooting	Corrective Action
Broken Sprocket Teeth	If cast iron, replace with Martin stock steel sprockets (available hardened in pinion sizes). Reduce shock load or redesign and replace with a larger drive. Correct any misalignment. Replace sprocket, might be excessively hardened. Should be RC40-50.
Wear on Sprockets or Rollers Nonsymmetrical	Realigning nonparallel shafts or shafts not in same plane. Shafts might be bent, or shaft bearings worn.
Wear on Side of Sprocket Teeth or Inside of Roller Plates	Sprockets are offset or not parallel and should be realigned.
Wear on Tips of Sprocket Teeth	Chain elongation is excessive and chain should be replaced.
Chain Climbs Sprocket	Chain does not properly fit sprocket. Check sprocket bottom diameters and replace if necessary. Chain may be stretched more than 3%. If sprocket worn, replace chain and sprocket or replace chain if worn. Redesign drive for more teeth in contact if insufficient chain wrap. Or use Martin chain tighteners. Should have at least 17 teeth in small sprocket. Provide cover for chain drive when material builds up in the tooth pocket of the sprocket. Or "mud reliefs" may be helpful.
Excessive Noise	Check sprocket alignment. Lubricate chain and sprocket drive. Replace chain and/or sprocket(s) if worn. Driver should have hardened teeth. Tighten and align supports, casing, and chain when moving parts contact stationary parts.
Excessive Link Plate Wear and/or Sides of Sprocket Teeth	Realign drive.
Excessive Vibration	Possible broken or missing roller. Replace or repair chain. Check shaft bearing supports, bearings may be worn or broken.

GEAR DRIVES

Type Maintenance	What To Do
Proper Lubrication	As recommended by your lubrication supplier, contact for details.
Inspect for Wear and Alignment	Initial inspection 24 hours, second 100 hours, third 500 hours. Once a year thereafter. Check tooth contact pattern for full face contact.

Troubleshooting	Corrective Action
Excessive Gear Wear	Check H.P. requirement for possible replacement with hardened gears of same size. Or replace with gears having greater face width. See Martin Catalog - Gear Section. Possible redesign of drive with more capacity. Check Martin Catalog - Gear Section. Check environmental abrasiveness, provide cover as needed with replacement of hardened gears. Check for proper lubrication.
Excessive Drive Noise	Check gear set for proper backlash. Adjust as necessary. Misaligned drive. Worn gears, replace as necessary. Drive speed too high, check pitch line velocity.
Gear Breakage	Eliminate overload or shock load conditions. Replace drive with wider gears or 20° P.A. gears. Provide adequate cover for environmental material surrounding drive.
Disfiguration of Gear Tooth	Remove overload condition. Replace with hardened gears or wider gears.

CHAIN COUPLINGS

Type Maintenance	What To Do
Lubrication	Check after initial 100 hours for leakage. Change lubricant once per year thereafter.
Check Alignment	Disassemble after initial 100 hours, check for excessive wear. If misaligned, wear patterns will appear very uneven. If necessary, realign shafts and replace worn coupling parts.

Troubleshooting	Corrective Action
Premature Chain Wear	Provide adequate lubrication, provide with sealed cover for longer life. Check for excessive radial misalignment and/or excessive end float. Realign shafts to eliminate most of misalignment. Check for sudden shock loads. If they are present then it may be necessary to change from chain couplings to more flexible type couplings such as Martin "Q.D." Flex or Quadra-Flex.
Chain Breakage	Provide adequate lubrication, provide with sealed cover for longer life. Check for excessive radial misalignment and/or excessive end float. Realign shafts to eliminate most of misalignment. If not provided with cover, check for foreign objects near or in coupling, provide with cover. Check for sudden shock loads, if present go to larger coupling or go to more flexible type couplings such as Martin "Q.D." Flex or Quadra-Flex.
Excessive Noise	Check chain and sprockets to make sure not worn, or have broken pin link. Replace if necessary, chain may be striking inside of cover.

JAW COUPLINGS

Type Maintenance	What To Do
Jaw Breakage	Buna-N Insert failed causing metal to metal contact. Replace with hytrel or urethane spiders. Hytrel withstands oil products better than urethane or Buna-N. Hytrel will not withstand hot water. Urethane withstands water better. Eliminate overload or shock load conditions. Replace drive with new MS jaw coupling. Carries approximately 20% higher capacity.
Rubber Element Failure	Buna-N insert failed due to horsepower applied to coupling greater than insert can withstand. Replace with Hytrel spider, which can withstand 3 times Buna-N horsepower capacity. Check misalignment. Coupling can only handle up to 1° angular misalignment.
Excessive Drive Noise	Check jaw set for proper fit. May have wrong insert in coupling. Misaligned drive. Worn couplings, replace as necessary. Drive speed too high, check shaft rpm.

QUADRA-FLEX COUPLINGS

Type Maintenance	What To Do
Element Failure	Check for alignment. Can handle up to 1° angular and up to .062 parallel offset misalignment. Check for proper installation. May be installed in an application not suited for the coupling; i.e., an internal combustion engine, reciprocating pump, compressor, or fan and propeller blades.
Teeth Worn on One or Both Sides of Sleeve	Caused by excessive misalignment. Realign coupling. Improper service factor. Check design, go to larger coupling.
Sleeve Ruptured	Caused by shock loads. Use a larger coupling. Critical speed. Check for excessive vibrations.
Wire Ring Comes Loose	Caused by overload. Use a larger coupling.
Excessive Compression Set or Permanent Wind-up	Caused by overload. Use a larger coupling.
Crack in Sleeve at 45°	Caused by flex fatigue. Normal mode of failure, if premature use a larger coupling.
Sleeve Thrown Out of Coupling	Caused by shock load. Unjam machine, check for misalignment. Caused by overspeed. Reduce speed of coupling.
Element Deteration	TPR (Thermo-Plastic Rubber) can operate in conditions of extreme temperatures -50°F to +250°F and in oily or wet conditions. Neoprene can operate in temperatures of 0°F to +250°F. Hytrel can operate in temperatures of -65°F to +250°F and oily conditions. Hytrel will not withstand hot water. If elements are deteriorating due to heat or solvents check sleeve chemical resistance from table in Martin catalog #1090 page C8.

Type of Failure	Probable Cause	Corrective Action
Excessive Edge Wear (Exposed Tensile Member)	Misalignment or nonrigid centers.	Check alignment and/or reinforce mounting.
	Bent flange.	Straighten flange.
Jacket Wear on Pressure-Face Side of Belt Tooth	Excessive overload and/or excessive belt tightness.	Reduce installation tension and/or increase drive load-carrying capacity.
Excessive Jacket Wear Between Belt Teeth (Exposed Tension Members)	Excessive installation tension.	Reduce installation tension.
Cracks in Neoprene Backing	Exposure to excessive low temperature (below 30°F).	Eliminate low temperature condition or consult factory for proper belt construction.
Softening of Neoprene Backing	Exposure to excessive heat (+200°F) and/or oil.	Eliminate high temperature and oil condition or consult factory for proper belt construction.
Tensile or Tooth Shear Failure	Small or sub-minimum diameter pulley.	Increase pulley diameter of use next smaller pitch with same P.D.
Indicating Corrosion of Tension Member (rust)	Extreme humidity.	Eliminate humidity or refer to factory for belt construction.
	Acid or caustic atmosphere.	Refer to factory for belt construction.
Excessive Pulley Tooth Wear (On Pressure-Face and/or O.D.)	Excessive overload and/or excessive belt tightness.	Reduce installation tension and/or increase drive load-carrying capacity.
	Insufficient hardness of pulley material.	Surface-harden pulley or use harder material.
Unmounting of Flange	Incorrect flange installation.	Reinstall flange correctly.
	Misalignment.	Correct alignment.
Excessive Drive Noise	Misalignment.	Correct alignment.
	Excessive installation tension.	Reduce tension.
	Excessive load.	Increase drive load-carrying capacity.
	Sub-minimum pulley diameter.	Increase pulley diameter.
Tooth Shear	Less than 6 teeth in mesh (TIM).	Increase TIM or use next smaller pitch with same P.D.
	Excessive load.	Increase drive load-carrying capacity.
Apparent Belt Stretch	Reduction of center distance or nonrigid mounting.	Retension drive and/or reinforce mounting.
Cracks or Premature Wear at Belt Tooth Root	Improper pulley groove top radius.	Regroove or install new pulleys.
Tensile Break	Excessive load.	Increase load-carrying capacity of drive.
	Sub-minimum diameter.	Increase pulley diameters.

Note: When HP rating is adequate, using multiple belts in matched sets rather than a single wide belt will reduce sound emission. Effective noise reduction for power transmission drives can be accomplished by incorporating a flexible noise-absorbing material such as acoustical-grade glass fiber with the protective guard. The guard design must allow a cooling air passage on the top and bottom to prevent overheating the drive.

SYNCHRONOUS DRIVES
TIMING BELT DRIVES

Type of Failure	Probable Cause	Corrective Action
Teeth Wearing Unevenly	Shafts might not be parallel causing belt to pull one side. Abrasion material may be on teeth or enmeshed into belt.	Check alignment of shafts.
Belt Breakage	Improper sized for torque loading.	Check proper sizing procedures.
	Too much load.	May be severe shock load, may need to go to chain drive instead of belt drives.
	Underdesigned drive.	Redesign drive.
	Sharp bend damaged tensile cord.	Follow proper storage and handling procedures.
	Belt was pried or forced on the drive.	Follow proper installation procedures.
	Foreign object in drive.	Shield drive.
	Belt runs onto pulley flange.	Align pulleys.
Apparent Belt Stretch	Reduction of center distance or nonrigid mounting.	Retension drive and/or reinforce mounting.
	Pulley teeth poorly machined or worn.	Replace pulleys. Install cover if drive is dusty.
	Sudden equipment stops.	Increase deceleration time or redesign drive.
	Belt does not engage pulley teeth.	Retension drive.
Tooth Shear	Less than 6 teeth in mesh.	Redesign drive, install back side idler, or use next smaller pitch.
	Excessive load.	Redesign drive.
Tensile or Tooth Shear Failure	Pulley diameter too small.	Increase pulley diameter or use next smaller pitch.
	Exposure to acid or caustic atmosphere.	Protect drive or ask Martin about special construction belt.
Excessive Pulley Tooth Wear (On Pressure Face and/or O.D.)	Drive overload and/or excess belt tension.	Reduce installation tension and/or increase drive load carrying capacity.
	Insufficient hardness of pulley material.	Use harder material or surface-hardened pulley.
Excessive Jacket Wear Between Teeth, Exposed Tensile Cord	Excessive installation tension.	Reduce installation tension.
Excessive Noise	Misalignment.	Realign drive.
	Excessive installation tension.	Reduce tension.
	Excessive load.	Increase drive load carrying capacity.
	Pulley diameter too small.	Increase pulley diameter.
Cracks in Belt Backing	High temperatures.	Improve ventilation, remove heat source, or check with Martin for special construction belt.
Softening of Backing	Excess heat (over 200°F) and/or oil.	Lower ambient temperature, protect from oil, or ask Martin about special belt construction.
Excessive Edge Wear	Misalignment or nonrigid centers.	Realign drive and/or reinforce mounting.
	Bent flange.	Straighten flange.
Unmounting of Flange or Flange Wear	Incorrect flange installation.	Install flange correctly.
	Misalignment.	Realign drive.

V-BELT DRIVES

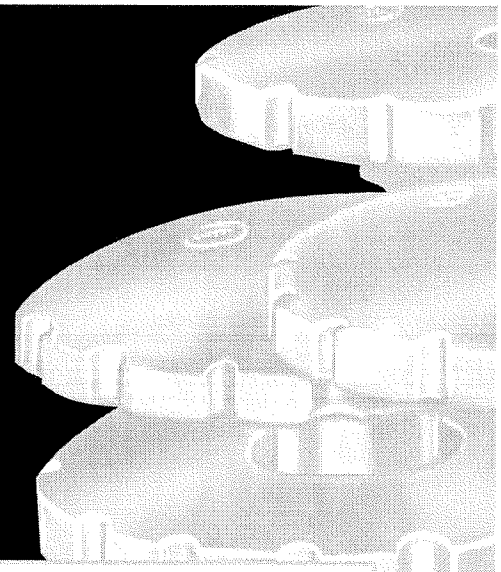
Type of Failure	Probable Cause	Corrective Action
V-BELTS — Short Belt Life		
Rapid Failure With No Visible Reason	Worn sheave grooves (Use groove gauge to check).	Replace sheaves.
	Tensile cord damage through improper installation.	Replace all belts with a new set, check for proper installation.
	Drive is underdesigned.	Redesign drive.
	Wrong type or cross section belt.	Replace all belts with correct type, check for proper installation.
	Sheave diameter too small.	Redesign drive.
	Foreign substance caught between belts and sheave.	Shield the drive with drive guard.
Soft, Sticky, Swollen Sidewalls Low Adhesion Between Plies	Oil or grease on belt or sheave.	Clean belts and sheave with degreasing agent or detergent and water. Remove source of oil or grease.
Dry, Hard Sidewalls. Use Low Adhesion Between Plies. Cracked Belt Bottom	Excessive high temperature.	Remove heat source. Improve ventilation.
Deteration of Rubber	Belt dressing being used.	Don't use belt dressing. Clean belts and sheaves with degreasing agent or detergent and water. Tension belts properly.
Rapid Sidewall Wear	Worn or damaged sheaves.	Replace sheaves.
Broken Belts	Foreign object in drive.	Shield drive with drive guard.
Spin Burns	Belts slip under starting or stalling load.	Check belt tension — retension drive if necessary.
	Sheave diameter too small.	Redesign drive.
	Load miscalculated — drive underdesigned.	Redesign drive.
Cut Bottom	Improper installation.	Replace all belts with a new set, check for properly installation.
	Foreign object in drive.	Shield drive with drive guard.
	Belt was run off sheave.	Check for proper tension and alignment.
Cracked Bottom	Excessive high temperature.	Remove heat source. Improve ventilation.
	Back side idler too small.	Replace with an inside idler on slack side, or redesign.
	Sheave diameter too small.	Redesign drive. Use cogged belts.
	Slippage.	Retension drive.
Extreme Cover Wear, Worn Corners	Sheaves rusted, sharp corners or burrs on sheaves.	Repair or replace sheaves.
	Dirt on belt.	Clean belt, shield drive.
	Sheaves misaligned.	Realign sheaves.
	Belts rub against guard or other obstruction.	Remove obstruction or check drive alignment.
	Improper tension.	Retension drive.

V-BELTS — Short Belt Life

Type of Failure	Probable Cause	Corrective Action
Belts Stretch		
Belts Stretch Equally	Overloaded or under-designed drive.	Redesign drive.
	Insufficient take-up allowance.	Check take-up and follow guidelines.
Belts Stretch Unequally	Tensile cord broken from improper installation.	Replace all belts with a new set, check for proper installation.
	Misaligned drive.	Realign drive.
Belt Turnover	Misaligned sheaves.	Realign sheaves.
	Belt undertensioned.	Retension drive.
	Severe vibration and shock loads.	Use Combo belts.
	Incorrectly placed flat pulley.	Position idler on slack side of drive, as close as possible to driveR sheave.
	Worn sheave grooves (Use groove gauge to check).	Replace sheaves.
	Foreign material in grooves.	Shield drive with drive guard.
	Tensile cord broken from improper installation.	Replace all belts with a new set, check for proper installation.
Belt Noise	Belt slip.	Retension.
	Misaligned sheaves.	Realign sheaves.
	Wrong belt type.	Replace cut edge with wrapped belt.
Belt Vibration	Shock loads.	Use Banded or Combo belts.
	Incorrectly placed flat idler pulley.	Position idler on slack side of drive, as close as possible to driveR sheave.
	Distance between shafts too long.	Install idler.
	Belt lengths uneven.	Replace all belts with a new matched set.
	Belt too loose.	Retension drive.
Severe Slippage	Spin burns.	Retension drive.
	Too few belts.	Redesign drive.
	Arc of contact too small.	Install back side idler on slack side, or use timing belt.
	Oil or water on belt.	Clean belts and sheave, shield drive with drive guard.
Installation Problems		
Belts Too Long or Short at Installation	Design and/or belt selection error.	Check catalog for proper design and selection.
Belts Mismatched at Installation	Worn sheave grooves.	Replace sheaves.
	Mixed used and new belts.	Replace all belts with new belts.
	Mixed belts from different manufacturers.	Replace belts from the same manufacturer.
Hot Bearings		
Drive Overtensioned	Worn sheave grooves, belts bottom out.	Replace sheaves.
Sheave Diameter Too Small	Design error.	Redesign drive.
Sheaves Too Far Out On Shaft	Design error or obstruction.	Place sheaves as close to bearing as possible.
Improper DriveN Speed		
Incorrect DriveR to DriveN Ratio	Design error.	Redesign drive.

SCREW CONVEYOR

Type of Failure	Probable Cause	Corrective Action
SCREW CONVEYOR — Product Failure		
Premature Trough Failure	Gauge too light.	Increase thickness. Consult Martin catalog materials table/component series for recommendation.
	Screw deflection.	Eliminate excessive deflection. Consult Martin catalog for calculation procedure to determine proper pipe size and screw length.
	Bent screw.	Straighten or replace. Check before operation.
Accelerated Flight Tip Wear	Gauge too light.	Increase thickness. Consider hardfacing.
	RPM too high.	Slow conveyor down. Consult Martin catalog engineering section to determine proper trough loading.
Coupling Shaft Breakage	Torque capacity insufficient.	Increase torque capacity or use larger shaft. Check motor amp demand for torque requirements.
Shaft Hole Elongation	Insufficient number of bolts.	Increase number of bolts.
	Conveyor subject to "jogging" or too frequent stop/start, or frequent overloads.	Cease jogging or frequent stop/start or overload. If this is not possible increase bearing capacity of shaft and/or increase number of bolts.
Drive Shaft Breakage	Excessive torque.	Recalculate HP requirements.
	Insufficient torque capacity.	Increase torque capacity.
	Obstruction in conveyor.	Check screw alignment.
Motor/Heaters Overload	Amp. demand excessive for motor.	Recheck horsepower calculations. Check material characteristics. Check capacity. Regulate feed.
Inlet Trough End Bearing Failure	Material getting into bearing.	Add or upgrade seal to keep material out of bearing. Change to outboard bearing.
	Insufficient lubrication.	Lubricate properly.
	Shaft slope.	Align screw. Check for excessive screw deflection and for bent screw.
Discharge Trough End Bearing Failure	Material getting into bearing.	Add or upgrade seal. Change to outboard bearing. Cut off flight at center of discharge.
Hanger Bearing Failure	Incorrect alignment.	Align hanger.
	Heat due to hot material being conveyed.	Use appropriate bearing material.
	Heat due to insufficient lubrication.	Properly lubricate.
	Thrust due to pipe pressing on bearing insert.	Check coupling bolts and holes for elongation and wear. Replace as necessary. Readjust screw/hanger assembly to get proper clearances.
	Improper material causing premature wear.	Consult Martin catalog for proper material due to temperature, trough loading, and speed. Check to ensure coupling shaft material and bearing material are compatible.



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Floor Scales

VLC

Industrial Floor Scales

Commercial Duty

Rugged Floor Scales

for Demanding Industrial Applications

METTLER TOLEDO

A Versatile Weighing Solution for All Types of Environments

- **Rugged industrial scales designed to handle forklift traffic**
- **Stainless steel designs meet food industry standards**
- **Adjustable feet for leveling the scale on uneven floors**

Our 2256 VLC floor scales are fully electronic with a low profile that makes them easy to load and unload. They are rugged enough to stand up to tough industrial environments. Optional 304 and 316 stainless steel versions are designed specifically for the harsh, wet environments of the food industry. Capable of withstanding 100% end loading, these floor scales are ideal for handling the forklift traffic and concentrated-load applications that are common to shipping and receiving operations.

For All Environments
No matter what industrial environment you work in, we have a weighing solution. VLC floor scales are available in three types of material:

- Carbon steel painted with a durable, two-part epoxy finish for industrial environments.
- 304 stainless steel for extra protection in washdown and corrosive environments.
- 316 stainless steel for caustic and extreme cleaning applications.

All VLC floor scales are equipped with stainless steel load cells that are hermetically sealed and IP69K stainless steel junction boxes.

For All Applications
VLC floor scales can be installed in a pit, on top of the floor, or used as portable scales. Our Quick-Pit frames ensure a perfectly square pit installation that is flush with the floor. For permanent, top-of-floor installations, locating plates can be used to keep the scale in position. Adjustable feet make it easy to level the scales on uneven floors, simplifying the task of setting them up in a variety of locations. Top-of-floor installations can be equipped with ramps to make them easily accessible from all four sides. Our standard tread-plate surface on mild steel products provides safe footing for workers.

Custom Designs
VLC floor scales are available in a wide range of standard sizes and capacities. Plus, we can engineer and manufacture custom scales to meet your specific requirements. With our design technology and world class manufacturing capabilities, we can deliver the highest quality custom scales to you in the shortest time possible.

Scales are manufactured to strict quality standards in our ISO 9001 certified plant.

Factory Calibration
For the ultimate in quick and easy setup, we can supply your VLC floor scale with a terminal that is wired and calibrated at the factory. This option makes the scale fully operational right out of the box, so that you can set it up and start weighing immediately. Choose from an IND221 terminal for desktop use or a stainless steel IND226 terminal for wall mounting and use in harsh environments.

VLC Accessories

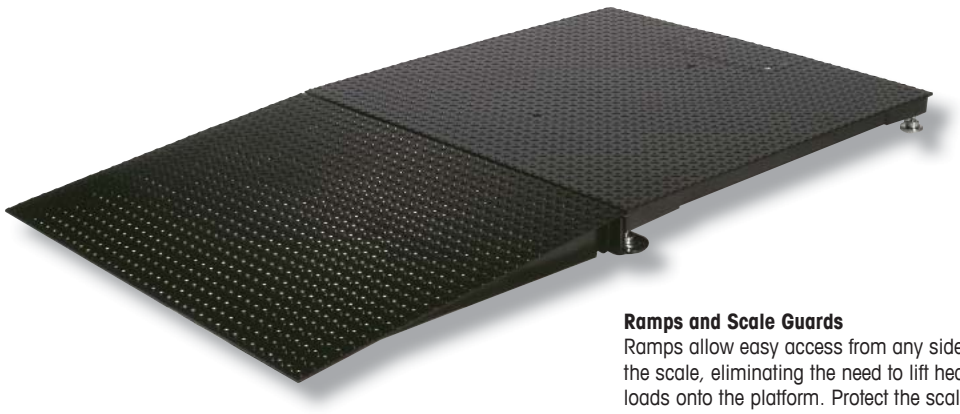
Quick-Pit Frames
Our Quick-Pit frame makes it easy to install a pit scale that is square and flush with the floor. Just level the frame in the rough floor opening and pour concrete. The Quick-Pit frame creates its own form. After the concrete has cured, install the scale.

Mild steel scales are rugged enough for use in tough industrial environments.

Instrument Columns
Instrument columns are available in carbon steel and stainless steel. They are equipped with the bracket required for mounting your scale terminal.

Stainless Steel Pit Liners
Stainless steel pit liners are ideal for hygienic applications where bacteria and cross-contamination are not acceptable. They make pit construction simple and easy.

Stainless steel scales are designed for the food industry's harsh, wet environments.



Ramps and Scale Guards
Ramps allow easy access from any side of the scale, eliminating the need to lift heavy loads onto the platform. Protect the scale from side-impact damage by installing scale guards on sides of the scale that do not have ramps. The angled guards prevent costly damage to scale frames and load cells.

VLC scales are designed for 100% end loading to handle forklift traffic.

Specifications

Standard Platform Size	3x3 to 5x7 ft (914x914 to 1524x2134 mm)
Available Capacities	2500 to 10,000 lb (1000 to 6000 kg)
Platform Height	3.5 in (89 mm)
Construction	Two-part, epoxy-painted mild steel, 304 stainless steel, or 316 stainless steel
Load Cell Type	Hermetically sealed stainless steel, four 350-ohm load cells
Load Cell Suspension	Rocker-foot suspension
Junction Box	Top access, stainless steel IP69K
End Loading	100% end loading
Standard Operating Temp.	14°F to 104°F (-10°C to 40°C)
Metrological Approvals	NTEP, Measurement Canada, OIML
Hazardous Area Approvals	FM, CSA, Ex, ATEX
Shipping Weight	250 to 925 lb (113 to 420 kg)
Compatible METTLER TOLEDO Instruments	Any METTLER TOLEDO terminal

Options

- Ramps: standard or low angle
- Instrument columns
- Foot-locating plates
- Optional load cell cable lengths
- Custom sizes
- Quick-Pit frames
- Stainless steel pit liners
- Scale side guards
- Remote junction box mounting
- Safety tread or smooth deck plate
- Deck finish: electropolish or mechanical polish Ra 35

IP69K junction box for extra protection.

www.mt.com

For more information

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Specifications subject to change without notice.
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METTLER TOLEDO

2256 VLC

WEIGHT-PLATE®
Analog Floor Scale
Installation and Service Manual

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METTLER TOLEDO

Publication Revision History

An overview of this manual's revision history is compiled below.

Publication Name: 2256 VLC WEIGHT-PLATE Analog Floor Scale Installation and Service Manual

Publication Part Number: A14914100A Publication Date: 8/97

Part Number	Date	Revisions
B14914100A	11/98	Added Class III acceptable readability data on page 1-1.
C14914100A	8/02	Revised manual so that it covers the new 2256 VLC design.
D14914100A	8/04	Added information about new leveling foot.
E14914100A	2/08	Added information about Revision 4 version of scale, including new leveling foot, junction box, and 745A load cell with retaining clip.
E14914100A.01	1/10	Removed warranty information. Updated hazardous area and parts information.

INTRODUCTION

This publication is provided solely as a guide for individuals who have received Technical Training in servicing the METTLER TOLEDO product.

Information about METTLER TOLEDO Technical Training can be obtained by writing, calling, or faxing:

METTLER TOLEDO
1900 Polaris Parkway
Columbus, Ohio 43240 USA
Phone: (614) 438-4511
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www.mt.com

FCC Notice

This device complies with Part 15 of the FCC Rules and the Radio Interference Requirements of the Canadian Department of Communications. Operation is subject to the following conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

METTLER TOLEDO RESERVES THE RIGHT TO MAKE REFINEMENTS OR CHANGES WITHOUT NOTICE.

DECLARATION OF CONFORMITY

Konformitätserklärung
Déclaration de conformité
Declaración de Conformidad
Conformiteitsverklaring
Dichiarazione di conformità

METTLER TOLEDO

We/Wir/Nous/Wij/Noi: **Mettler-Toledo, Inc.**
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declare under our sole responsibility that the product,
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dichiariamo sotto nostra unica responsabilitá, che il prodotto,

Type: **Analog Load Cell**
Model/Type: **744, 745 and 745A**

to which this declaration relates is in conformity with the following standard(s) or other normative document(s).
auf das sich diese Erklärung bezieht, mit der/den folgenden Norm(en) oder Richtlinie(n) übereinstimmt.
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A cui si riferisce questa dichiarazione è conforme alla/e sequente/i norma/e o documento/i normativo/i.

in combination with a weighing terminal produced by Mettler-Toledo is in conformity with the following directives and standards.

Council directive on the harmonization of the laws of the Member states:	**standards:**	**Certificate number (if applicable)**
relating to non-automatic weighing instruments (90/384/EEC) amended by directive (93/68/EEC)	EN 45501 : 1992 Article 1.2.a	TC2154
relating to electromagnetic compatibility (89/336/EEC) amended by directive (93/68/EEC; 92/31/EEC)	EN 55022, B: 1987 EN 50082-2: 1995	
Relating to electrical equipment designed for use in potentially explosive atmospheres (76/117/EEC)	EN 50 014 : 1977 + A1...A5, General requirements EN 50 020 : 1977 + A1...A5, Intrinsic safety "i"	Model 744 and 745 Ex-95.D.2051 Model 745A Ex-98.D.0965
Relating to electrical equipment designed for use in potentially explosive atmospheres (94/9/EC) **ATEX Certification applies to Model 745A Only**	EN 50014 : 1997 EN 50020 : 2002 EN 50281-1-1 : 1998	KEMA 03ATEX1069 (Category 2 Approval)
	EN 50021 : 1999 EN 50281-1-1 : 1998	KEMA 03ATEX1070 (Category 3 Approval)

Worthington, Ohio USA, May, 2003 **Mettler-Toledo, Inc.**

Darrell Flocken, Manager - Weights & Measures
Office of Weights and Measures

Original issue: September, 1996

Revised: January, 1999 Added: model 745A, conformity to 89/336/EU – 73/23/EU – 76/117/EEC
May, 2003 added compliance to ATEX Directive 94/9/EC for both Category 2 and 3.

According to EN 45014

Precautions

READ this manual BEFORE operating or servicing this equipment.

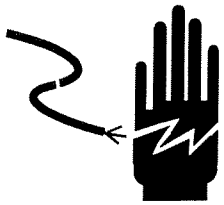
FOLLOW these instructions carefully.

SAVE this manual for future reference.

DO NOT allow untrained personnel to operate, clean, inspect, maintain, service, or tamper with this equipment.

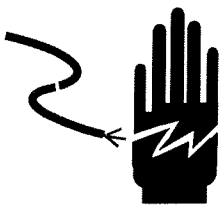
ALWAYS DISCONNECT this equipment from the power source before cleaning or performing maintenance.

CALL METTLER TOLEDO for parts, information, and service.



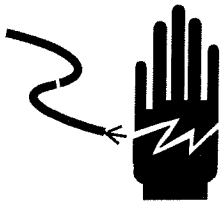
⚠ WARNING

PERMIT ONLY QUALIFIED PERSONNEL TO SERVICE THIS EQUIPMENT. EXERCISE CARE WHEN MAKING CHECKS, TESTS, AND ADJUSTMENTS THAT MUST BE MADE WITH POWER ON. FAILING TO OBSERVE THESE PRECAUTIONS CAN RESULT IN BODILY HARM.



⚠ CAUTION

FOR CONTINUED PROTECTION AGAINST SHOCK HAZARD, CONNECT TO PROPERLY GROUNDED OUTLET ONLY. DO NOT REMOVE THE GROUND PRONG.



⚠ WARNING

DISCONNECT ALL POWER TO THIS UNIT BEFORE INSTALLING, SERVICING, CLEANING, OR REMOVING THE FUSE. FAILURE TO DO SO COULD RESULT IN BODILY HARM AND/OR PROPERTY DAMAGE.

⚠ CAUTION

BEFORE CONNECTING OR DISCONNECTING ANY INTERNAL ELECTRONIC COMPONENTS OR INTERCONNECTING WIRING BETWEEN ELECTRONIC EQUIPMENT, ALWAYS REMOVE POWER AND WAIT AT LEAST THIRTY (30) SECONDS. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN BODILY HARM OR DAMAGE TO OR DESTRUCTION OF THE EQUIPMENT.

⚠ CAUTION

OBSERVE PRECAUTIONS FOR HANDLING ELECTROSTATIC SENSITIVE DEVICES.

⚠ WARNING

USE EXTREME CAUTION WHEN LIFTING AND MOVING THE SCALE TO THE DESIRED LOCATION. DO NOT ATTEMPT TO LIFT AND MOVE THE SCALE BY YOURSELF OR INJURY COULD OCCUR.

Disposal of Electrical and Electronic Equipment

In conformance with the European Directive 2002/96 EC on Waste Electrical and Electronic Equipment (WEEE) this device may not be disposed of in domestic waste. This also applies to countries outside the EU, per their specific requirements.

Please dispose of this product in accordance with local regulations at the collecting point specified for electrical and electronic equipment.

If you have any questions, please contact the responsible authority or the distributor from which you purchased this device.

Should this device be passed on to other parties (for private or professional use), the content of this regulation must also be related.

Thank you for your contribution to environmental protection.

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1 Introduction

General

Model 2256 VLC WEIGHT-PLATE® floor scales are fully electronic scales for general-purpose weighing. They are designed for top-of-floor installations and can be used as portable or permanently mounted scales.

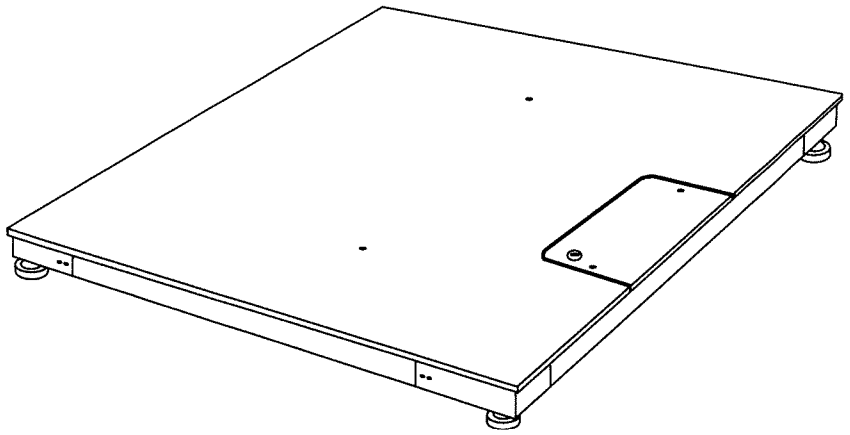


Figure 1-1: 2256 VLC Floor Scale

Model Numbers

The following table shows how standard model numbers are determined for currently available 2256 VLC floor scales.

XXXX	X	X	X	X	X	X	-X
Model	**Revision**	**Platform**	**Load Cell Metrology**	**Junction Box**	**Size**	**Scale Capacity**	**Scale Metrology**
2256	4	0 = Mild steel, tread plate 1 = Mild steel, smooth plate 2 = Stainless steel, tread plate 3 = Stainless steel, smooth plate	2 = H44	0 = Analog	1 = 3x3 feet 2 = 4x4 feet 3 = 4x5 feet 4 = 5x5 feet 5 = 4x6 feet 6 = 5x7 feet	1 = 1,000 lb 2 = 2,500 lb 3 = 5,000 lb 4 = 10,000 lb	-A = 5,000d

Load Cells

Model 2256 VLC floor scales include stainless steel, cantilever-beam load cells with integral, four-conductor, shielded cables (see note). Individual load cell capacities are listed below:

NOTE: Scales measuring 5' x 7' use cables that are 15' long. Smaller scales use cables that are 7.5' long. DO NOT mix cables of different lengths within a platform.

Scale Platform Capacity	Capacity of Each Load Cell	Minimum Approved Graduation Size
1,000 lb	500 lb	0.2 lb
2,500 lb	1,250 lb	0.5 lb
5,000 lb	2,500 lb	1.0 lb
10,000 lb	5,000 lb	2.0 lb

Load Cell Specifications

NOTE: Revision 3 versions of the 2256 floor scale (Model 22563XXXXX-A) used 3-mV/V load cells.

Model Number	745A
Rated Capacity (RC)	500 lb, 1,250 lb, 2,500 lb, 5,000 lb
Rated Output	2 mV/V
Maximum Excitation Voltage*	15 VDC or VAC rms
Recommended Excitation Voltage	15 VDC
Input Terminal Resistance	385 ohms minimum
Output Terminal Resistance	350 ± 2 ohms
Temperature Range (compensated)	+14°F to +104°F (-10°C to +40°C)
Safe Overload	150% RC
Safe Side Load	100% RC
Zero Balance	± 0.02 mV/V

*The power supply to the load cells is provided by the METTLER TOLEDO indicator.

Approvals

NTEP Certification

Model 745A load cells meet or exceed NIST Handbook-44 requirements for Class III 5,000 divisions (multiple cell). A Certificate of Conformance was issued under the National Type Evaluation Program (NTEP) of the National Conference of Weights and Measures (certificate number 92-108A3).

OIML Certification

Model 745A metric capacity load cells meet or exceed OIML requirements for R60 C3 3000 divisions (TC2154).

Entity Approval

Entity approval permits the application of individually approved components (even from various manufacturers) to be used together to build a solution that is approved. When installing equipment in hazardous areas, it is necessary to compare the entity values of the load cells, junction boxes, connecting cables, and other components. Those entity values include voltage, current, power, capacitance, and inductance.

The components must compare as follows in order for the wiring to be considered intrinsically safe:

V_{max} or U_i (Maximum voltage permitted) ≥ V_t or U_o (Total voltage output)

I_{max} or I_i (Maximum current permitted) ≥ I_t or I_o (Total current output)

P_{max} or P_i (Maximum power permitted) ≥ P_t or P_o (Total power output)

C_i (Unprotected capacitance) + C_{cable} (Cable capacitance) ≤ C_a or C_o (Allowable capacitance)

L_i (Unprotected inductance) + L_{cable} (Cable inductance) ≤ L_a or L_o (Allowable inductance)

If the above conditions are not true, then the circuit will not be intrinsically safe and must not be installed in a hazardous area. If the parameters compare favorably as shown above, then the circuit is intrinsically safe and can be installed in a hazardous area. Always refer to the electrical regulations for the country of installation for specific wiring requirements.

United States Approval

The United States safety approvals are based on entity values. Reports on the 745A load cells were submitted to Factory Mutual for compliance with FM Approval Standards Class No. 3600, 3610, and 3810. They were approved as intrinsically safe devices and issued the following certificate:

FM Original Approval Job Identification #3005885
IS/I,II,III/1/ABCDEFG/T4 Ta=40°C – 158574R/5; ENTITY; NI/I/2/ABCD/T6 Ta=40°C; S/II,III/2/FG/T6 Ta=40°C

The following chart lists the Factory Mutual entity values for the load cells.

Electrical Data	745A
V_t (Total voltage output)	25 V
I_t (Total current output)	600 mA
P_t (Total power output)	1.25 W
C_a (Allowable capacitance)	0
L_a (Allowable inductance)	29 µH

When used in hazardous areas, the load cells must be installed according to control drawing 158574R (see Figure 1-2).

European Approval

The European safety approvals are based on entity values. The 745A load cells were submitted to KEMA for compliance with EN60079-0, EN60079-11, EN60079-15, EN61241-0, and EN61241-1. They were approved as intrinsically safe devices and issued the following certificates:

KEMA 03ATEX1069
II 2 G Ex ia IIC T4
II 2 D Ex tD A21 IP6X T100°C

KEMA 03ATEX1070
II 3 G Ex nA II T4
II 3 G Ex nL IIC T4
II 3 D Ex tD A22 IP6X T100°C

The following chart lists the entity values for the load cells.

U_o (Total voltage output)	25 V
I_o (Total current output)	600 mA
P_o (Total power output)	1.25 W
C_o (Allowable capacitance)	5 nF
L_o (Allowable inductance)	30 µH

When used in hazardous areas, the load cells must be installed according to installation instructions document 16792100A (see Figure 1-3).

Junction Boxes

TA100831 junction boxes were submitted to KEMA for compliance with EN60079-0, EN60079-11, EN60079-15, EN61241-0, EN61241-1, and EN61241-11. They were approved as intrinsically safe devices and issued the following certificates:

KEMA 03ATEX1396 X
II 2 G Ex ia IIC T4
II 2 D Ex ibD 21 IP65 T70°C...T90°C

KEMA 03ATEX1397 X
II 3 G Ex nL IIC T4
II 3 G Ex nA II T4
II 3 D Ex tD A22 IP65 T70°C...T90°C

TA100831 junction boxes have been certified to IP69K ingress protection.

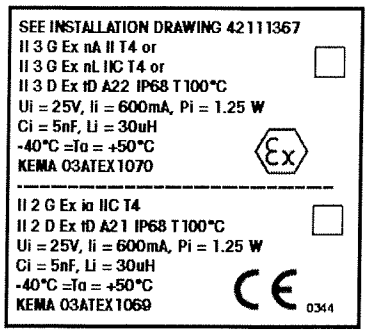
The following chart lists the entity values for the junction boxes.

U_o (Total voltage output)	30 V
I_o (Total current output)	1 A
P_o (Total power output)	0
C_o (Allowable capacitance)	0
L_o (Allowable inductance)	0

When used in hazardous areas, the junction boxes must be installed according to installation instructions document C16953600A (see Figure 1-4).

Product Markings

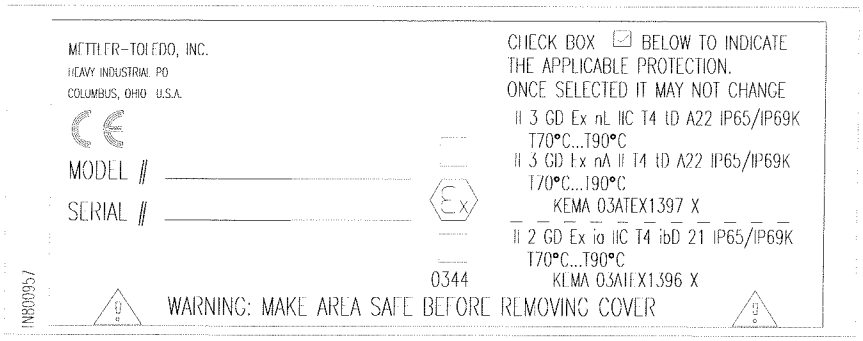
METTLER TOLEDO is not responsible for classifying hazardous areas. Each 745A load cell should have the following label attached to it:



If you install a load cell in a hazardous area, use a permanent marker to place a mark in the check box on the label that indicates the applicable protection (KEMA 03ATEX1069 or KEMA 03ATEX1070). Once the label has been marked, it may not be changed.

Junction Boxes

TA100831 junction boxes should have the following label attached:



If you install a junction box in a hazardous area, use a permanent marker to place a mark in the check box on the label that indicates the applicable protection (KEMA 03ATEX1396 X or KEMA 03ATEX1397 X). Once the label has been marked, it may not be changed.

Grounding

Make sure that all hazardous area installations are properly grounded. All grounding and equal potential bonding connections must be made according to local regulations based upon the country of installation. Refer to local codes and the control drawing provided in this manual for information about grounding.

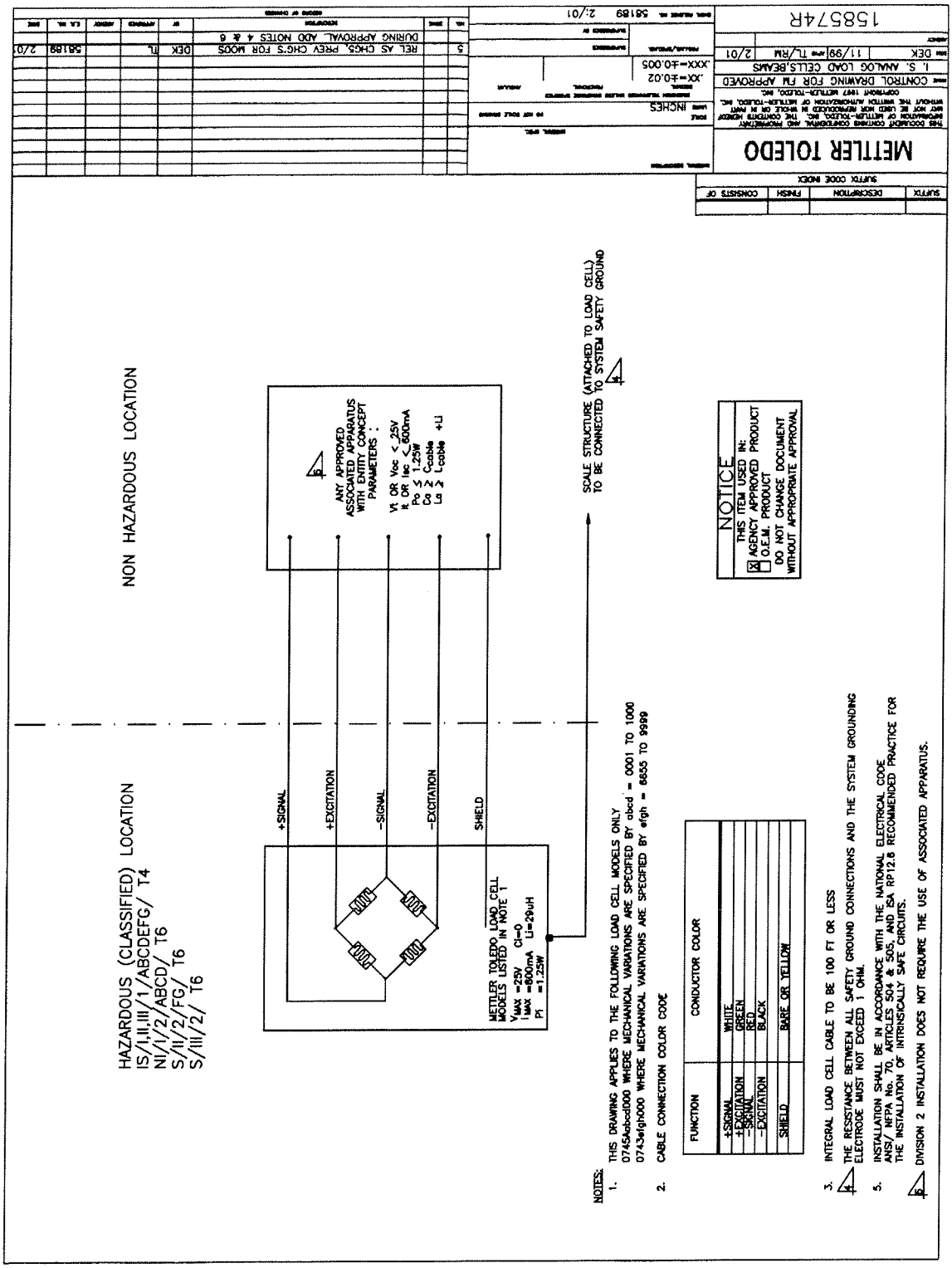


Figure 1-2: Control Drawing for 745A Load Cell

Mettler-Toledo, Inc.
1900 Polaris Pkwy
Columbus, Ohio 43240
USA

Installationsanleitung
Installation Instruction

Lastzellen Typen: 0743, 0743-SBK, 0745A
Load cell model numbers: 0743, 0743-SBK, 0745A

Anschlußplan bzw. Farbcodetabelle:
Wire according to the following color code:

Deutsch		English	
Farbe	Zustand	Colour	Function
Grün	+ Spannung	Green	+ Excitation
Schwarz	- Spannung	Black	- Excitation
Weiss	+ Signal	White	+ Signal
Rot	- Signal	Red	- Signal
Gelb	Schirm	Yellow	Shield

Installation
Installation
Installation wie in den Konformitätsbescheinigungen KEMA 03ATEX1069 oder KEMA 03ATEX1070 beschrieben.
Install according to Certificate Number KEMA 03ATEX1069 or KEMA 03ATEX1070.

When load cells are considered in type of protection non-sparking Ex nA II, they need to be fitted in an enclosure that complies with the requirements of clause 6 of EN 60079-15.
Wenn Wägezellen aus der Sicht des Schutzes als nicht-funkend EX nA II betrachted werden, müssen sie in ein Gehäuse eingebaut werden, das die Anforderungen in Artikel 6 von EN 60079-15 erfüllt.

Markieren Sie mit einem wasserfesten Stift den Einsatzbereich (KEMA 03ATEX1069 or KEMA 03ATEX1070) der Messzelle auf dem dafür vorgesehenen Feldern des Hinweisschildes. Wurde bereits eine Zuordnung vorgenommen, darf diese nicht mehr verändert werden.
With a permanent marker place a mark (✓) in the box on the load cell label to indicate the applicable protection (KEMA 03ATEX1069 or KEMA 03ATEX1070). Once selected it may not be changed.

Certifications, Markings & Standards
Zertifikationen, Zeichnungen & Normen

KEMA 03ATEX1069	KEMA 03ATEX1070
II 2 G EX ia IIC T4	II 3 G Ex nA II T4 or
II 2 D Ex tD A21 IP6X T100°C	II 3 G Ex nL IIC T4 or
	II 3 D Ex tD A22 IP6X T100°C
Ui=25V; Ii=600mA; Pi=1.25W;	Ui=25V; Ii=600mA; Pi=1.25W;
Ci=5nF; Li=30uH	Ci=5nF; Li=30uH
EN60079-0:2006, EN 60079-11:2007	EN 60079-0:2006, EN 60079-15:2005
EN 61241-0:2006, EN 61241-1:2004	EN 61241-0:2006, EN 61241-1:2004

Jahr der Herstellung:
Year of Manufacture:
Das Herstellungsjahr wird mit der letzten Stelle der Seriennummer (S/N) wie folgt gekennzeichnet:
The year of manufacture is indicated by the last character of the load cell Serial Number (S/N) as follows:

Letzter Buchstabe Last Character	D	E	F	G	H	J	K	L	M	N	P	Q	R	S	T
Jahr Year	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16

16792100A

Figure 1-3: Installation Instructions for 745A Load Cell

Mettler-Toledo, Inc.
Columbus, Ohio
USA

Installationsanleitung
Installation Instructions

Typennummer des Anschlusskastens: TB100771-X, TB100772-X, TB100777-X, TB100778-X, TA100831-SSA, TA100831-S6A
X ist die Nummer der Abschlusskastenlöcher
Junction Box Model Numbers: TB100771-X, TB100772-X, TB100777-X, TB100778-X, TA100831-SSA, TA100831-S6A
where: -X designates the number of holes in the junction box

Schließen Sie die Kabel laut Farbcodetabelle bzw Anschlussplan an:
Wire according to the following color codes:

	Farbcode der Wägezelle Load Cell Color Code		Farbcode des Kabels zum Terminal Home Run Cable Color Code
ANALOG			
Beschreibung/Description	Farbe/Color	Farbe/Color	Farbe/Color
+ Excitation	rosa/Pink	grün/Green	weiss/White
- Excitation	grau/Grey	schwarz/Black	blau/Blue
+ Signal	braun/Brown	weiss/White	grün/Green
- Signal	weiss/White	rot/Red	schwarz/Black
Shield	durchsichtig/Clear	gelb/Yellow	orange/weiss/Orange/White
+ Sense	nicht verwendet/Not Used		gelb/Yellow
- Sense	nicht verwendet/Not Used		rot/Red

POWERCELL and MTX		
Beschreibung/Description	Farbe/Color	Farbe/Color
A	gelb/Yellow	
B	blau/Blue	
N.C.	weiss/White	
+V	rot/Red	
GND	grün/Green	
CGND	orange/Orange	
A		gelb/Yellow
B		blau/Blue
GND		schwarz/Black
GND		braun/Brown
GND		grün/Green
+VC		orange/Orange
+VB		rot/Red
+VA		weiss/White

Installation/Installation

Installation wie im EG-Baumusterprüfbescheinigung KEMA03ATEX1396X oder Baumusterprüfbescheinigung KEMA 03ATEX1397X.

Install according to EC-Type Examination Certificate KEMA03ATEX1396X or Type Examination Certificate KEMA 03ATEX1397X.

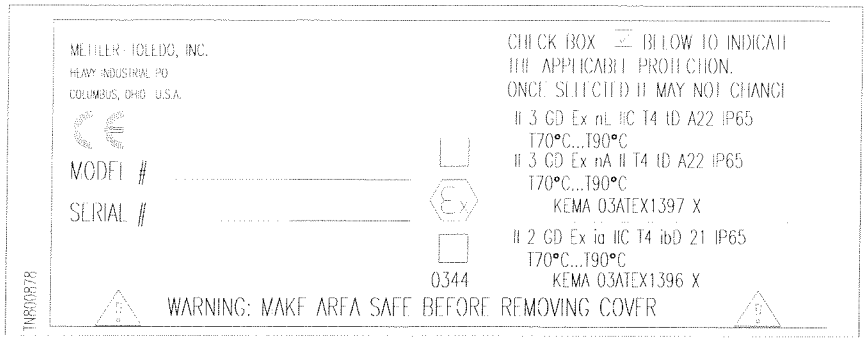
Markieren Sie mit einem wasserfesten Stift den Einsatzbereich (KEMA03ATEX1396X oder KEMA 03ATEX1397X) des Anschlusskastens auf dem dafür vorgesehenen Feldern des Hinweisschildes. Wurde bereits eine Zuordnung vorgenommen, darf diese nicht mehr verändert werden.

With a permanent marker, a mark (√) must be placed in the location on the junction box label which indicates the applicable protection (KEMA03ATEX1396X or KEMA 03ATEX1397X). Once selected it may not be changed.

C16953600A

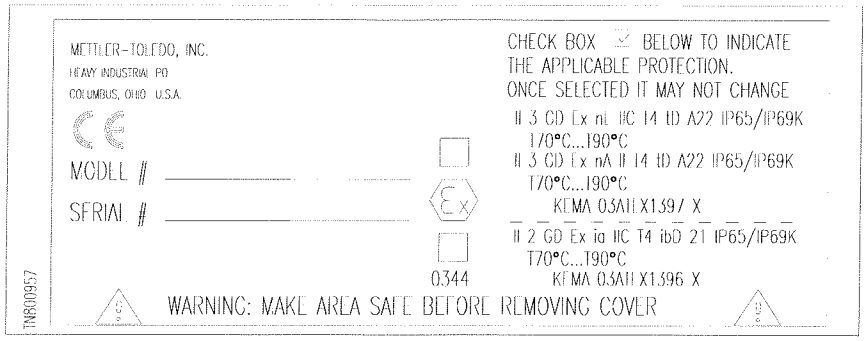
Figure 1-4: Installation Instructions for Junction Box

Typennummer des Anschlusskastens: TB100771-X, TB100772-X, TB100777-X, TB100778-X
X ist die Nummer der Abschlusskastenlöcher
Junction Box Model Numbers: TB100771-X, TB100772-X, TB100777-X, TB100778-X
where: -X designates the number of holes in the junction box



Typennummer des Anschlusskastens: TA100831-SSA, TA100831-S6A

Junction Box Model Numbers: TA100831-SSA, TA100831-S6A



Kabelverschraubungen dürfen nur mit Kabel der folgenden Größen verwendet werden:
klein/PG7 (.12-.26 inch / 3-6.5mm) gross/PG9 (.16-.31 inch / 4-8mm)
Die Schrauben periodisch anziehen um sicherzustellen, dass der Deckel fest montiert ist.

Cable glands are to be used only with cables that have the following cable diameter ranges:
small/PG7 (.12-.26in / 3-6.5mm) large/PG9 (.16-.31in / 4-8mm).
Periodically tighten cover screws to ensure cover is secured properly.

Jahr der Herstellung:
Year of manufacture:
Das Herstellungsjahr wird mit der letzten Stelle der Seriennummer (S/N) des Anschlusskastens wie folgt gekennzeichnet:
The year of manufacture is indicated by the last character on the junction box serial number (S/N) as follows:

Jahr/Year	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Buchstabe/Character	D	E	F	G	H	J	K	L	M	N	P	Q	R	S	T

C16953600A

Figure 1-4: Installation Instructions for Junction Box

2 Inspection and Site Selection

Inspection

When the 2256 VLC floor scale is delivered, visually inspect it for any damage that might have occurred during shipping and handling. Inspect the following:

1. Platform assembly
2. Load cells and leveling feet
3. Load cell cables
4. Load cell summing junction box

If you find any damage, contact your freight carrier immediately.

Site Selection

Many problems associated with floor scale installations are caused by improper site conditions. Before installing the scale, check the proposed location for the following conditions:

1. The area where the scale will be located should be level. The scale's leveling feet can be adjusted to compensate for floors that are slightly out of level.
2. The floor/support at each corner of the scale must be strong enough to support weight equal to the maximum weighing capacity of the scale.
3. There should be proper drainage away from the scale.
4. There should be no heavy vibrations or wind currents at or near the scale.
5. The scale should not be subjected to excessive or unusual loading due to the location or type of equipment used.

If the site is acceptable, proceed with the installation. If not, choose a new location or select another scale.

3 Installation

Leveling Feet

Set up the scale in the location where it will be used. To move the scale, install 3/4-10 eyebolts (P/N MZ0905000003) in the threaded holes in the top of the scale platform. Attach a chain to the eyebolts, and use it to lift the scale with a forklift.

1. Remove the corner guard from each corner of the scale (see Figure 3-1).
2. Install a retaining clip in the holes in the side of each load cell. Insert one end of the clip into one hole, and then stretch the clip just enough to insert the opposite end into the other hole. Be careful not to bend the clip.
3. Install a leveling foot in the loading hole in each load cell. Shift the retaining clip to one side of the load cell, and insert the rocker foot into the loading hole at an angle. Rotate the foot until it is fully installed.
4. Install a corner guard at each corner of the scale. Make sure that the corner guard is flush against the load cell mounting block.

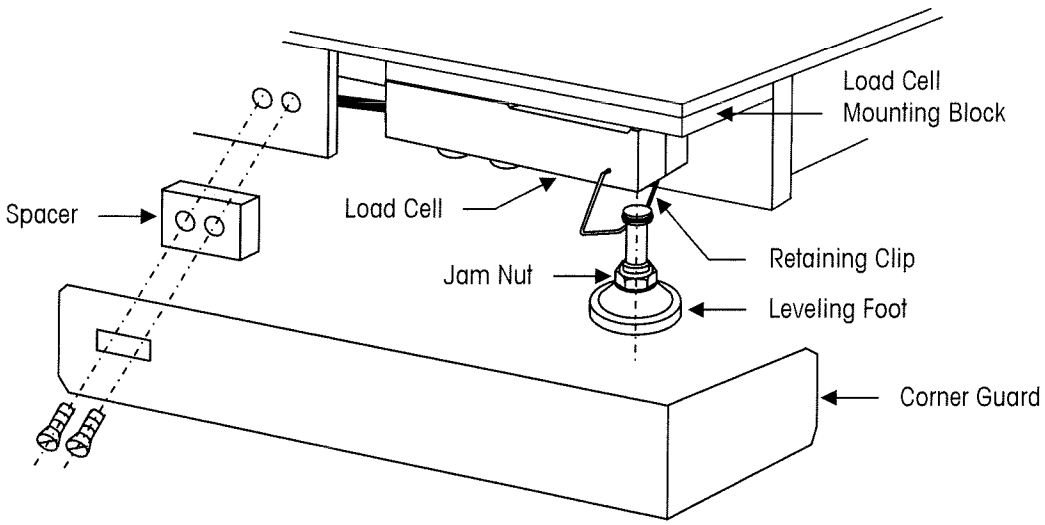


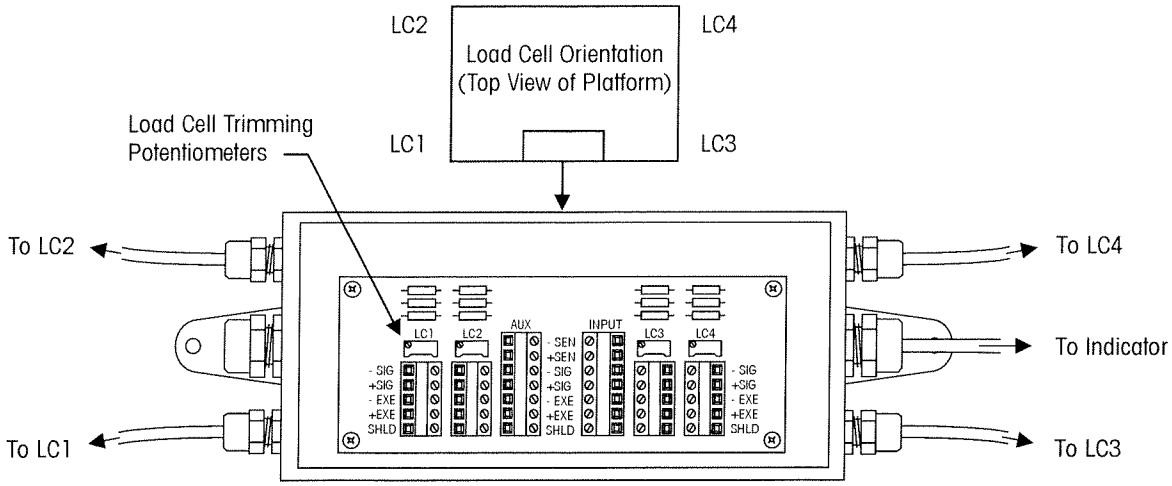
Figure 3-1: Leveling Foot Assembly

5. Make sure the scale platform is level. Adjust the leveling feet as needed to level it. All four feet should touch the floor so that the scale does not rock.

- To adjust a leveling foot upward or downward, use a 3/4-inch wrench to loosen the jam nut on the foot. Turn the foot until it is positioned correctly, and then tighten the jam nut so that it is snug against the foot.
- Check the level that is located on the scale platform's junction box cover. Adjust the leveling feet until the bubble on the level is centered.
- You must level the scale each time you move it to a new location.

Junction Box Wiring

A 2256 VLC floor scale must be used with a compatible analog indicator. The scale's load cell outputs are summed by an analog junction box. Open the junction box, and connect the home run cable from the scale indicator to the input terminals on the junction box PCB. See Figure 3-2 and Table 3-1 for the correct cable connections.



NOTE: Do not cut load cell cables. Cutting a cable will affect compensation and void the warranty.

Figure 3-2: Analog Junction Box Detail

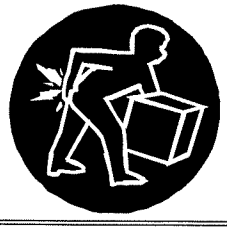
NOTE: Turn all potentiometers fully clockwise prior to calibration.

Load Cell Wiring		Instrument Cable Wiring*	
Function	**Color**	**Function**	**Color**
-Sense	Not Used	-Sense	Red
+Sense	Not Used	+Sense	Yellow
-Signal	Red	-Signal	Black
+Signal	White	+Signal	Green
-Excitation	Black	-Excitation	Blue
+Excitation	Green	+Excitation	White
Shield	Yellow	Shield	Orange
*Instrument cable color code based on METTLER TOLEDO cable no. 510624370			

Table 3-1: Analog Junction Box Wiring Codes

Optional Locating Plates

Locating plates are available for scales that will be mounted permanently. Two locating plates installed at adjacent corners of a scale are usually sufficient.



⚠ WARNING

USE EXTREME CAUTION WHEN LIFTING AND MOVING THE SCALE TO THE DESIRED LOCATION. DO NOT ATTEMPT TO LIFT AND MOVE THE SCALE BY YOURSELF OR INJURY COULD OCCUR.

1. Remove the rubber pads from the scale's leveling feet, and position the scale in the location where it will be installed.
2. Lift the scale enough to position the locating plates under the corners of the scale.
3. Lower the scale carefully so that its leveling feet fit inside the large holes in the locating plates.
4. Drill holes in the floor for the anchor bolts (two for each locating plate). Use the bolt holes in the plates as guides (see Figure 3-3).
5. Install 1/2-inch insert-type anchor bolts through the bolt holes in the locating plates to anchor the plates to the floor.

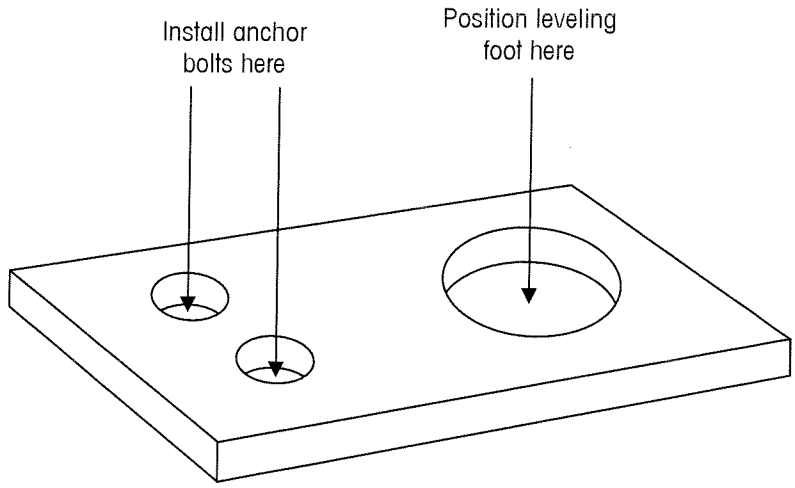


Figure 3-3: Locating Plate Installation

Optional Ramps

You can install one or more ramps with a floor scale. Standard ramps are available in widths of 36, 48, and 60 inches.

⚠ WARNING

USE EXTREME CAUTION WHEN LIFTING AND MOVING THE SCALE TO THE DESIRED LOCATION. DO NOT ATTEMPT TO LIFT AND MOVE THE SCALE BY YOURSELF OR INJURY COULD OCCUR.

1. Remove the rubber pads from the scale's leveling feet.
2. Position the ramp in the location where it will be installed. Make sure there is enough room for the scale and for any other ramps that will be installed.
3. Drill holes in the floor for the two anchor bolts. Use the bolt holes in the flanged portion of the ramp as guides (see Figure 3-4).
4. Install 1/2-inch insert-type anchor bolts through the bolt holes in the flange to anchor the ramp to the floor.
5. Lower the scale carefully so that its leveling feet fit inside the large holes in the flange.

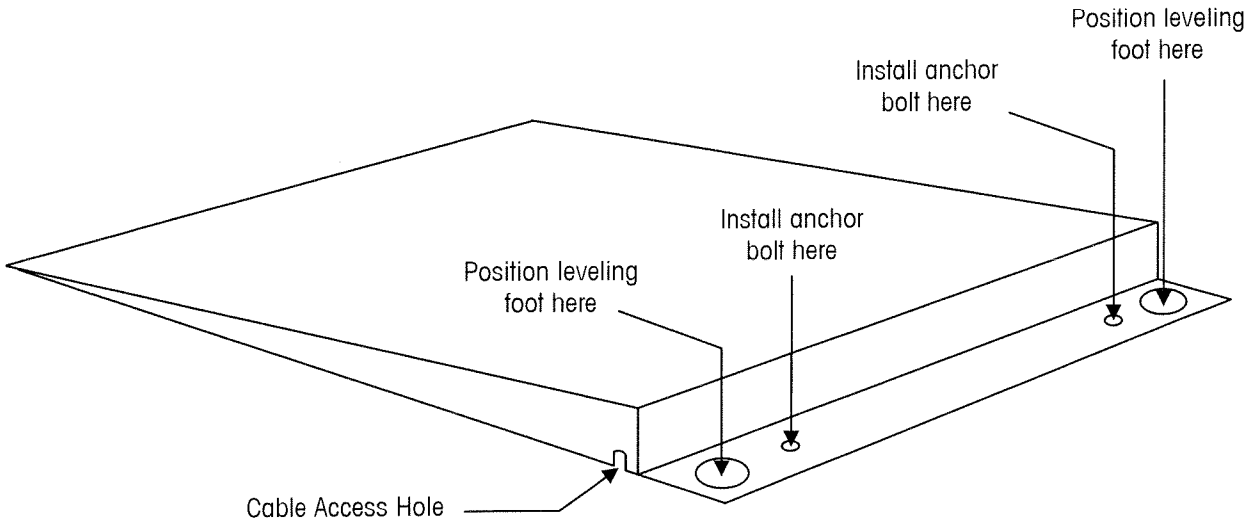
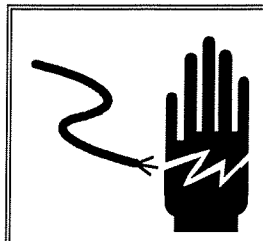


Figure 3-4: Ramp Installation

If you will be installing a second ramp, lift the scale and position the large holes in the ramp's flange under the leveling feet on the opposite side of the scale. Then move the scale out of the way. Drill bolt holes, install anchor bolts, and then lower the scale carefully so that its leveling feet fit inside the large holes in the ramp flanges.

4 Calibration

Shift Adjust



⚠ WARNING

PERMIT ONLY QUALIFIED PERSONNEL TO SERVICE THIS EQUIPMENT. EXERCISE CARE WHEN MAKING CHECKS, TESTS, AND ADJUSTMENTS THAT MUST BE MADE WITH POWER ON. FAILING TO OBSERVE THESE PRECAUTIONS CAN RESULT IN BODILY HARM.

When you shift adjust a scale, you are adjusting the output voltage (signal) of each load cell so that all load cells in the system produce a consistent signal. A correctly adjusted scale will give the same weight reading no matter where on the platform you place a test weight. Each floor scale is shift adjusted at the factory. For a new installation, the only adjustment that should be needed is minor load cell trimming.

After the scale has been installed, check all mechanical parts to make sure that they work properly. Then check the scale's repeatability by placing a test weight on the same location on the platform several times to make sure that you get the same weight reading each time. After checking for repeatability, adjust the load cell trimming potentiometers as needed.

Analog Junction Box Shift Adjustment

Use the following procedure to trim the load cells:

1. Remove the access plate from the scale platform, and open the junction box.
2. Figure 4-1 shows test weight locations (A, B, C, and D) at the center of each quadrant of the scale platform. Place a test weight equal to 1/2 of the rated scale capacity at location A and record the weight reading. Then move the test weight to location B and record the weight reading. Continue until you have taken a weight reading at each of the four locations.

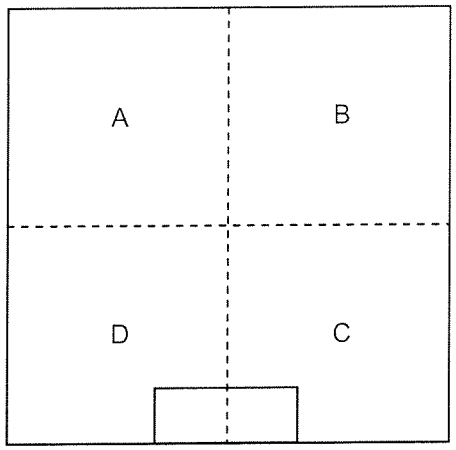


Figure 4-1: Test Weight Locations

3. Place the test weight at the location immediately clockwise from the location at which you got the lowest weight reading. Then adjust the trimming potentiometer for the load cell that corresponds to the corner of the scale where the test weight is positioned (see Figure 4-2). Make the adjustment by turning the potentiometer until the weight reading matches the lowest reading.

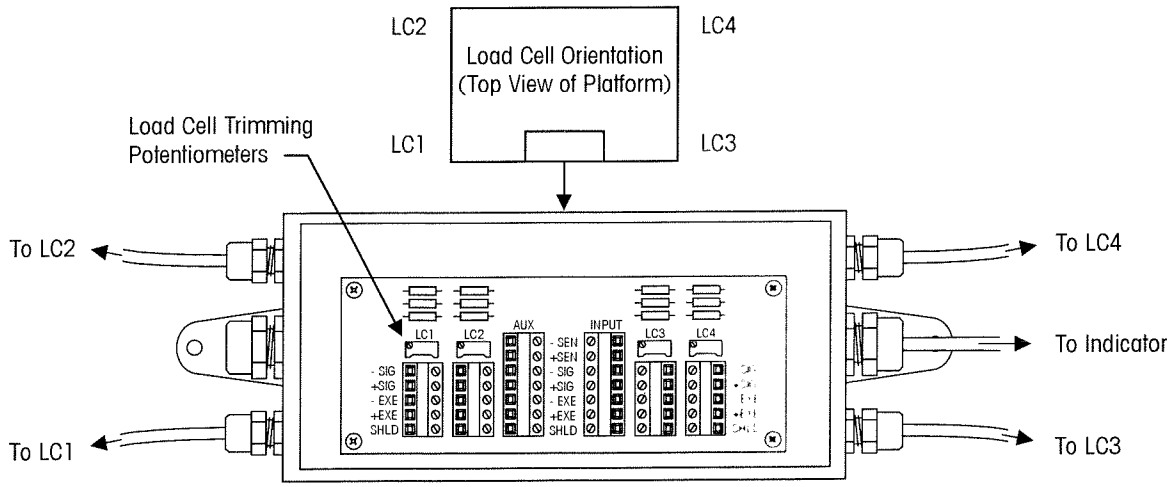


Figure 4-2: Load Cell Trimming Potentiometers

4. Proceeding clockwise, repeat the adjustment described in Step 3 for the next two test weight locations.

   NOTE: Because the trimming potentiometers interact with each other, any adjustment will affect the weight readings at all four corners of the scale.

5. Repeat Steps 2 to 4 until the weight readings at all corners of the platform are the same or are within the specified National Institute of Standards and Technology (NIST) Handbook 44 Scale Accuracy Requirements.

6. Replace the junction box lid and the access plate.

Scale Calibration

METTLER TOLEDO recommends calibrating the scale using test weights equal to the scale's capacity. Follow the calibration instructions in the manual provided with the scale indicator.

5 Routine Care and Maintenance

General

Once the scale has been installed, have an authorized METTLER TOLEDO representative inspect and calibrate it periodically. If the scale is used for legal-for-trade purposes, consult the local weights and measures authorities for minimum inspection requirements. Contact your local authorized METTLER TOLEDO service representative for information about periodic inspection and calibration services.

Site Inspection

Make sure that the scale site remains in good condition. Check for alterations in the surrounding floor, excessive vibrations, and possible overloading conditions.

Platform Inspection

During periodic inspections of the scale, check the following:

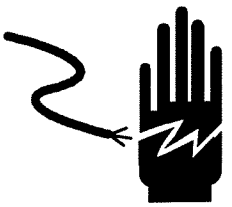
1. Are there any unusual wear points, paths, or marks on the weighing platform?
2. Is the junction box lid properly sealed and are all cable connectors tight against the enclosure?
3. Is there any moisture or foreign material around or inside the junction box assembly?
4. Is the instrument cable damaged or binding the scale?
5. Is there any debris or material build-up under or around the platform that could prevent the platform from moving freely?
6. Visually inspect the load cells and leveling feet for signs of unusual wear.
7. Check repeatability and shift of the scale.

6 Troubleshooting

General

If the scale does not operate properly, find out as much about the problem as possible. Try to determine whether the problem is constant or intermittent. Mechanical and electrical influences can cause malfunctions, so be patient and use sound logic when troubleshooting.

When troubleshooting a 2256 VLC floor scale, examine the scale's physical location. Check for the presence of water, corrosive materials, unlevel floors, high vibrations, air currents, or physical damage to the scale platform or frame. Also check the instrument cable for damage, and check all connections for loose or improper wiring.



⚠ WARNING

PERMIT ONLY QUALIFIED PERSONNEL TO SERVICE THIS EQUIPMENT. EXERCISE CARE WHEN MAKING CHECKS, TESTS, AND ADJUSTMENTS THAT MUST BE MADE WITH POWER ON. FAILING TO OBSERVE THESE PRECAUTIONS CAN RESULT IN BODILY HARM.

⚠ CAUTION

BEFORE CONNECTING/DISCONNECTING ANY INTERNAL ELECTRONIC COMPONENTS OR INTERCONNECTING WIRING BETWEEN ELECTRONIC EQUIPMENT, ALWAYS REMOVE POWER AND WAIT AT LEAST THIRTY (30) SECONDS. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN BODILY HARM OR DAMAGE TO OR DESTRUCTION OF THE EQUIPMENT.

Isolate the Problem

Determine whether the problem is in the scale or the indicator.

1. Remove power from the system, and then disconnect the indicator from the scale.
2. Connect the indicator to a load cell simulator (analog simulator available from METTLER TOLEDO).
3. Reapply power and test the indicator. If the problem persists, consult the indicator manual for further troubleshooting assistance.
4. If the problem is NOT present with the load cell simulator attached to the indicator, remove power, disconnect the simulator, and reconnect the scale. If the problem persists, continue troubleshooting the scale.

Check Wiring

1. Remove power from the system.
2. Remove the access cover plate from the scale platform.
3. Remove the lid from the junction box and check the interior for moisture and foreign material.
4. Make sure that all wiring connections are tight and that no insulation material is touching the terminal contacts.
5. Check all cable connections to make sure they are wired correctly. The wiring color codes are given in Table 6-1:

Load Cell Wiring		Instrument Cable Wiring*	
Function	**Color**	**Function**	**Color**
-Sense	Not Used	-Sense	Red
+Sense	Not Used	+Sense	Yellow
-Signal	Red	-Signal	Black
+Signal	White	+Signal	Green
-Excitation	Black	-Excitation	Blue
+Excitation	Green	+Excitation	White
Shield	Yellow	Shield	Orange
*Instrument cable color code based on METTLER TOLEDO cable no. 510624370			

Table 6-1: Load Cell Wiring Color Codes

6. Check all cable connectors and cord grip caps on the junction box.
7. Tighten any loose connectors.

Check Load Cells

1. Remove power from the system. Fully disconnect each load cell and check for proper input/output resistances (see Table 6-2).

NOTE: The information in this section is for 2-mV/V load cells.

Measuring Points	Resistance
+Exc (Green) to -Exc (Black)	385 ohms minimum
+Sig (White) to -Sig (Red)	348-352 ohms

Table 6-2: Load Cell Measuring Points

2. If resistance is within specification, perform a shorted-signal symmetry test.
   - Short the signal leads together and place one multimeter lead on the shorted signals and one lead on the +Excitation wire. Note the resistance value.
   - Remove the lead from the +Excitation wire and place it on the -Excitation wire. The two resistance values should be approximately equal.
3. If the load cells pass the shorted-signal test, reconnect them and reapply power to the scale. Confirm that the proper excitation voltage is reaching the load cells by placing multimeter leads on the excitation positions of each load cell terminal.
4. If proper excitation voltage is reaching the load cells, check the output signal from each cell by disconnecting the signal leads and measuring voltage output. If one cell has a particularly high or low dead-load output, it is suspect. The maximum output possible from any cell is 30 mV at 15 VDC excitation and loaded to gross capacity.
5. If any load cell has an unusual signal, remove all load from that cell by raising the platform.

NOTE: Remove signal leads from terminals to measure output.

   - With the power on, measure the output from the suspect load cell. The no-load zero output should be ± 1.5% of the full scale output. For example, if the excitation voltage is 15 VDC, then the full scale output would be 30 mV and the no-load zero output should be within ± 0.45 mV.
6. If a load cell fails any of the above tests, replace it.

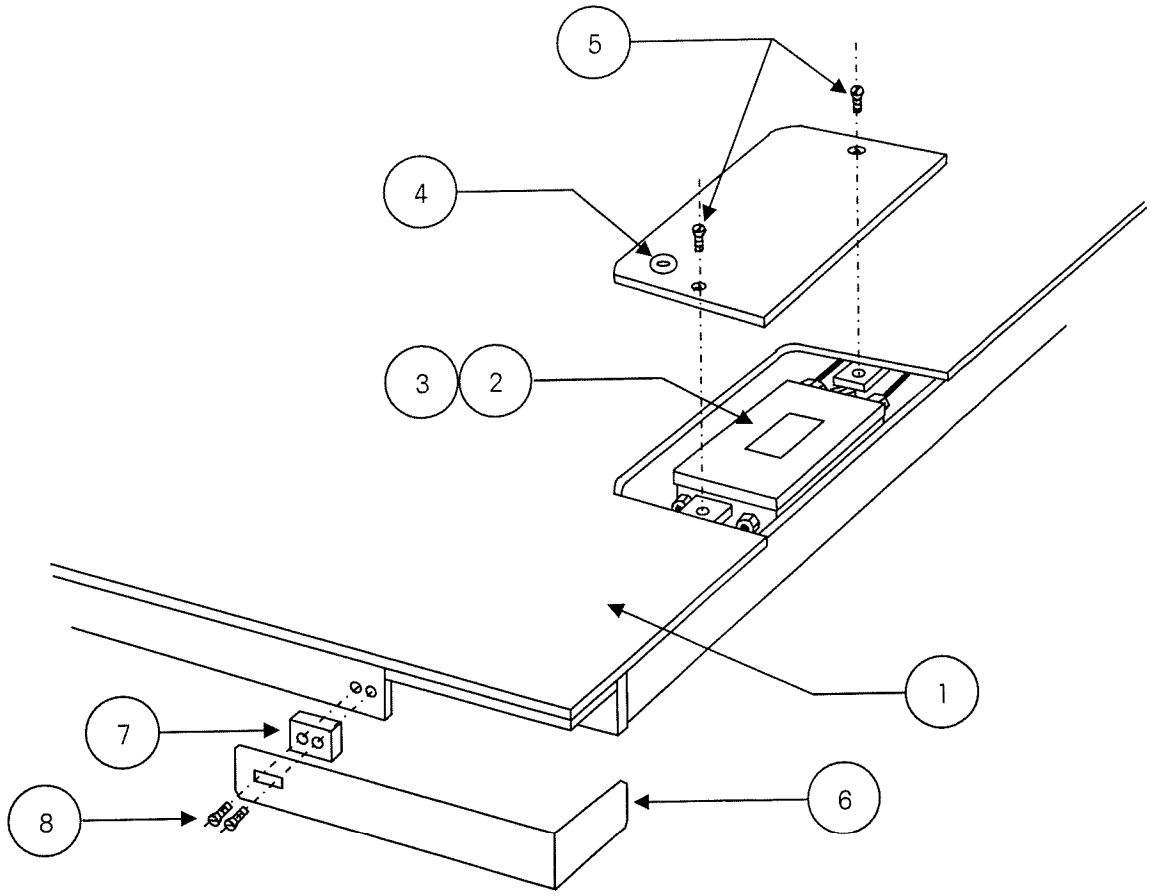


Figure 7-2: Platform and Junction Box Assembly (22564XXXXX-A)

Ref. No.	Part Number	Description	Qty.
1	TC207096-MT-56	36-inch x 36-inch Platform, Carbon Steel, Tread Plate (1K, 2.5K, 5K)	1
	TC207097-MT-56	48-inch x 48-inch Platform, Carbon Steel, Tread Plate (1K, 2.5K, 5K)	
	TC207102-MT-56	48-inch x 48-inch Platform, Carbon Steel, Tread Plate (10K)	
	TC207154-MT-56	48-inch x 60-inch Platform, Carbon Steel, Tread Plate (2.5K and 5K)	
	TC207103-MT-56	48-inch x 60-inch Platform, Carbon Steel, Tread Plate (10K)	
	TC207100-MT-56	60-inch x 60-inch Platform, Carbon Steel, Tread Plate (2.5K and 5K)	
	TC207105-MT-56	60-inch x 60-inch Platform, Carbon Steel, Tread Plate (10K)	
	TC207099-MT-56	48-inch x 72-inch Platform, Carbon Steel, Tread Plate (2.5K and 5K)	
	TC207104-MT-56	48-inch x 72-inch Platform, Carbon Steel, Tread Plate (10K)	
	TC207155-MT-56	60-inch x 84-inch Platform, Carbon Steel, Tread Plate (2.5K and 5K)	
	TC207106-MT-56	60-inch x 84-inch Platform, Carbon Steel, Tread Plate (10K)	
	TC207096-SS-56	36-inch x 36-inch Platform, Stainless Steel, Smooth Plate (1K, 2.5K, 5K)	
	TC207097-SS-56	48-inch x 48-inch Platform, Stainless Steel, Smooth Plate (1K, 2.5K, 5K)	
	TC207102-SS-56	48-inch x 48-inch Platform, Stainless Steel, Smooth Plate (10K)	
	TC207154-SS-56	48-inch x 60-inch Platform, Stainless Steel, Smooth Plate (2.5K and 5K)	
	TC207103-SS-56	48-inch x 60-inch Platform, Stainless Steel, Smooth Plate (10K)	
	TC207100-SS-56	60-inch x 60-inch Platform, Stainless Steel, Smooth Plate (2.5K and 5K)	
	TC207105-SS-56	60-inch x 60-inch Platform, Stainless Steel, Smooth Plate (10K)	
	TC207099-SS-56	48-inch x 72-inch Platform, Stainless Steel, Smooth Plate (2.5K and 5K)	
	TC207104-SS-56	48-inch x 72-inch Platform, Stainless Steel, Smooth Plate (10K)	
	TC207155-SS-56	60-inch x 84-inch Platform, Stainless Steel, Smooth Plate (2.5K and 5K)	
	TC207106-SS-56	60-inch x 84-inch Platform, Stainless Steel, Smooth Plate (10K)	
2	TA100831-SS*	Analog Junction Box Assembly Includes: TC100814 Analog PCB TA800218 Desiccant Bag	1
3	MZ0901010379	1/4-20 Phillips Head Screw x 1/4 inch long, Stainless Steel	2
4	TN206847	Circular Bubble Level	1
5	MZ0901010035	3/8-16 Flat Head Screw x 3/4 inch long, Stainless Steel	2
6	TN207225-SSE	Corner Guard	4
7	TN207223-SSE	Spacer	4
8	MZ0901010667	1/4-20 Flat Head Screw x 0.75 inches long, Stainless Steel	8

* Some scales are equipped with a TB100481 junction box, which includes a 13640300A analog PCB.

Table 7-2: Platform and Junction Box Assembly (22564XXXXX-A)

Model 22563XXXXX-A

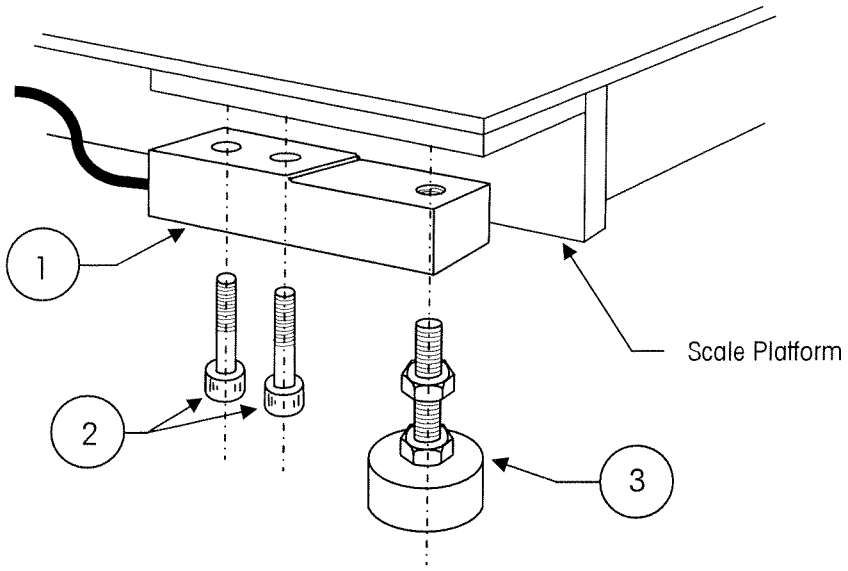


Figure 7-3: Load Cell and Leveling Foot Assembly (22563XXXXX-A)

Ref. No.	Part Number	Description	Qty.
1	TB601015-XXX*	Model 793 Load Cell, 1,000 lb (3 mV/V)	4
	TB601016-XXX*	Model 793 Load Cell, 2,500 lb (3 mV/V)	
	TB601018-XXX*	Model 793 Load Cell, 5,000 lb (3 mV/V)	
2	TN800647	1/2-13 Socket Head Cap Screw x 1.75 inches long, Black Oxide	8
	TN800648	1/2-13 Socket Head Cap Screw x 1.75 inches long, Stainless Steel	
3	TN206043-SS	Leveling Foot, Stainless Steel	4

* -XXX specifies the length of the load cell cable: -008 = 8 feet (for 36x36, 48x48, 48x60, 60x60, and 48x72 scales) and -020 = 20 feet (for 60x84 scales).

Table 7-3: Load Cell and Leveling Foot Assembly (22563XXXXX-A)

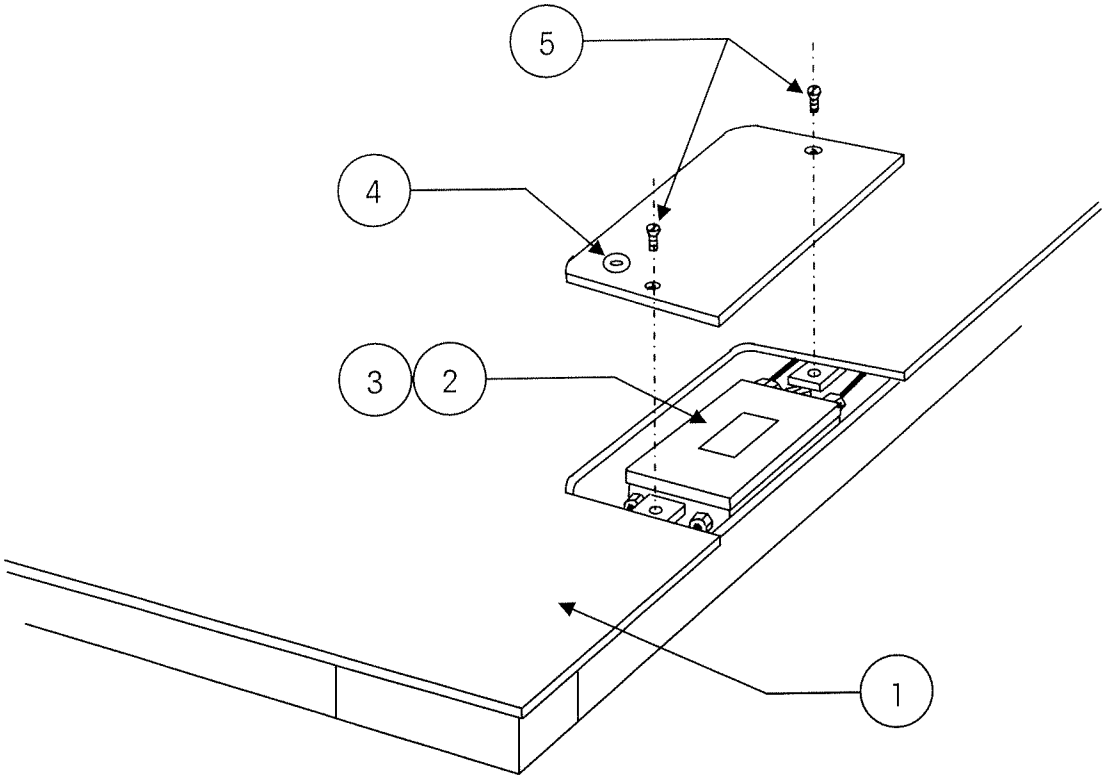


Figure 7-4: Platform and Junction Box Assembly (22563XXXXX-A)

Ref. No.	Part Number	Description	Qty.
1	TC205104-1	36-inch x 36-inch Platform, Carbon Steel (2.5K and 6K)	1
	TC205105-1	48-inch x 48-inch Platform, Carbon Steel (2.5K and 6K)	
	TC205106-1	48-inch x 48-inch Platform, Carbon Steel (10K)	
	TC205107-1	48-inch x 60-inch Platform, Carbon Steel (2.5K and 6K)	
	TC205108-1	48-inch x 60-inch Platform, Carbon Steel (10K)	
	TC205109-1	60-inch x 60-inch Platform, Carbon Steel (2.5K and 6K)	
	TC205110-1	60-inch x 60-inch Platform, Carbon Steel (10K)	
	TC205111-1	48-inch x 72-inch Platform, Carbon Steel (2.5K and 6K)	
	TC205112-1	48-inch x 72-inch Platform, Carbon Steel (10K)	
	TC205113-1	60-inch x 84-inch Platform, Carbon Steel (2.5K and 6K)	
	TC205114-1	60-inch x 84-inch Platform, Carbon Steel (10K)	
	TC205115-1	36-inch x 36-inch Platform, Stainless Steel (2.5K and 6K)	
	TC205116-1	48-inch x 48-inch Platform, Stainless Steel (2.5K and 6K)	
	TC205117-1	48-inch x 48-inch Platform, Stainless Steel (10K)	
	TC205118-1	48-inch x 60-inch Platform, Stainless Steel (2.5K and 6K)	
	TC205119-1	48-inch x 60-inch Platform, Stainless Steel (10K)	
	TC205120-1	60-inch x 60-inch Platform, Stainless Steel (2.5K and 6K)	
	TC205121-1	60-inch x 60-inch Platform, Stainless Steel (10K)	
	TC205122-1	48-inch x 72-inch Platform, Stainless Steel (2.5K and 6K)	
	TC205123-1	48-inch x 72-inch Platform, Stainless Steel (10K)	
	TC205124-1	60-inch x 84-inch Platform, Stainless Steel (2.5K and 6K)	
	TC205125-1	60-inch x 84-inch Platform, Stainless Steel (10K)	
2	TB100481	Analog Junction Box Assembly Consists of: *13640300A Analog PCB TA800218 Desiccant Bag	1
3	MZ0901010379	1/4-20 Phillips Head Screw x 1/4 inch long, Stainless Steel	4
4	TN201817	Circular Bubble Level	1
5	MZ0901010035	3/8-16 Flat Head Screw x 3/4 inch long, Stainless Steel	2

* May have a letter prefix.

Table 7-4: Platform and Junction Box Assembly (22563XXXXX-A)

Model 22562XXXXX-A

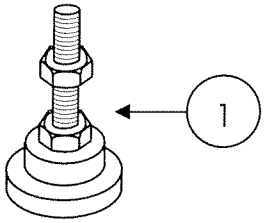


Figure 7-5: Leveling Foot (Model 22562XXXXX-A)

Ref. No.	Part Number	Description	Qty.
1	TN203980	Leveling Foot, Zinc Plated	4
	TN203980-SS	Leveling Foot, Stainless Steel	

Table 7-5: Leveling Foot (22562XXXXX-A)

Model 22561XXXXX-A

NOTE: Reference drawing TB203366).

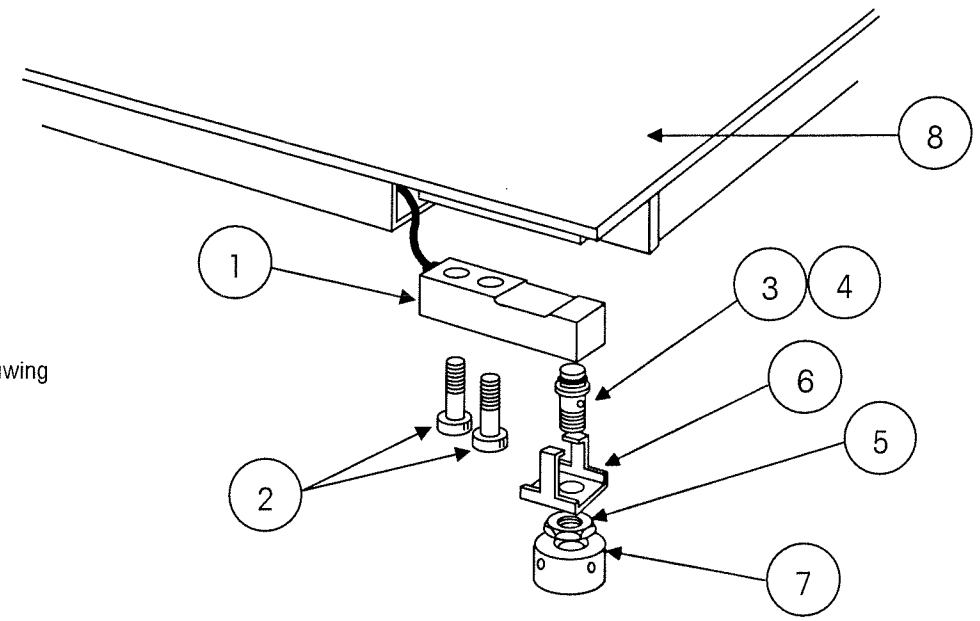


Figure 7-6: Load Cell and Leveling Foot Assembly (Model 22561XXXXX-A)

Ref. No.	Part Number	Description	Qty.
1	TB600363-1	Model 745 Load Cell, 1,250 lb (2 mV/V)	4
	TB600342-1	Model 745 Load Cell, 2,500 lb (2 mV/V)	
	TB600343-1	Model 745 Load Cell, 5,000 lb (2 mV/V)	
2	MZ0901010333	1/2-13 Socket Head Screw x 1.75 inches long	8
	MZ0901010409	1/2-13 Socket Head Screw x 2 inches long	
	MZ0901010384	1/2-13 Hex. Head Screw x 1.75 inches long, Stainless Steel	
	MZ0901010441	1/2-13 Hex. Head Screw x 2 inches long, Stainless Steel	
3	TA203345	Mounting Foot Load Pin, 3K and 6K	4
	TA203346	Mounting Foot Load Pin, 10K	
4	MZ0909000005	O-Ring	4
5	MZ0901020087	Hex. Jam Nut, 7/16-20, Stainless Steel	4
6	TA203104	Mounting Foot Retainer Clip (3K and 6K)	4
	TA203347	Mounting Foot Retainer Clip (10K)	
7	TN203103	Mounting Foot Base	4
8	TB203359-1	36-inch x 36-inch Platform, Carbon Steel (3K and 6K)	1
	TB203095	48-inch x 48-inch Platform, Carbon Steel (3K and 6K)	
	TB203417-1	48-inch x 48-inch Platform, Carbon Steel (10K)	
	TB203096	48-inch x 60-inch Platform, Carbon Steel (3K and 6K)	
	TB203418-1	48-inch x 60-inch Platform, Carbon Steel (10K)	
	TB203097	60-inch x 60-inch Platform, Carbon Steel (3K and 6K)	
	TB203331-1	60-inch x 60-inch Platform, Carbon Steel (10K)	
	TB203419-1	36-inch x 36-inch Platform, Stainless Steel (3K and 6K)	
	TB203098	48-inch x 48-inch Platform, Stainless Steel (3K and 6K)	
	TB203420-1	48-inch x 48-inch Platform, Stainless Steel (10K)	
	TB203099	48-inch x 60-inch Platform, Stainless Steel (3K and 6K)	
	TB203421-1	48-inch x 60-inch Platform, Stainless Steel (10K)	
	TB203100	60-inch x 60-inch Platform, Stainless Steel (3K and 6K)	
	TB203422-1	60-inch x 60-inch Platform, Stainless Steel (10K)	

Table 7-6: Load Cell and Leveling Foot Assembly (Model 22561XXXXX-A)

8 Reference Material

Reference Drawings

Scale Capacity	General Dimensions	Wiring Diagram
1,000 lb, 2,500 lb, 5,000 lb, 10,000 lb	TB207177	TB100505

Recommended Spare Parts

For part numbers, refer to the service parts list (Chapter 7).

Quantity	Description
1	Load cell (capacity of cell required depends on scale capacity)
1	Junction box circuit board
1	Junction box desiccant bag

METTLER TOLEDO

Publication Suggestion Report

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Publication Name: 2256 VLC WEIGHT-PLATE Analog Floor Scale Installation and Service Manual

Publication Part Number: E14914100A Publication Date: 1/10

PROBLEM(S) TYPE:	DESCRIBE PROBLEM(S):	INTERNAL USE ONLY
☐ Technical Accuracy	☐ Text ☐ Illustration	
☐ **Completeness** What information is missing?	☐ Procedure/step ☐ Illustration ☐ Definition ☐ Example ☐ Guideline ☐ Feature ☐ Explanation ☐ Other (please explain below)	☐ *Information in manual* ☐ *Information not in manual*
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INSTALLATION MAINTENANCE, OPERATING INSTRUCTIONS

IM-190

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PLENUM FANS

⚠ WARNING

THIS FAN HAS MOVING PARTS THAT CAN CAUSE SERIOUS BODILY INJURY. BEFORE OPERATING OR STARTING MAINTENANCE READ THE INSTALLATION AND MAINTENANCE INSTRUCTIONS AND THE AMCA SAFETY PRACTICES MANUAL PROVIDED WITH THIS FAN.

DURING OPERATION

1. KEEP BODY, HANDS, AND FOREIGN OBJECTS AWAY FROM THE INLET, THE OUTLET, AND THE OTHER MOVING PARTS OF THE FAN SUCH AS SHAFTS, BELTS, AND PULLEYS.

2. DO NOT OPERATE AT EXCESSIVE SPEEDS OR TEMPERATURES.

BEFORE STARTING MAINTENANCE WORK:

LOCK POWER SUPPLY IN OFF POSITION AND IMMOBILIZE FAN WHEEL.

98-0250

A WORD ABOUT SAFETY

The above **WARNING** decal appears on all **nyb** fans. Air moving equipment involves electrical wiring, moving parts, sound, and air velocity or pressure which can create safety hazards if the equipment is not properly installed, operated and maintained. To minimize this danger, follow these instructions as well as the additional instructions and warnings on the equipment itself.

All installers, operators and maintenance personnel should study AMCA Publication 410, "Recommended Safety Practices for Air Moving Devices", which is included as part of every shipment. Additional copies can be obtained by writing to New York Blower Company, 7660 Quincy St., Willowbrook, IL 60521.

ELECTRICAL DISCONNECTS

Every motor driven fan should have an independent disconnect switch to isolate the unit from the electrical supply. It should be near the fan and must be capable of being locked by maintenance personnel while servicing the unit, in accordance with OSHA procedures.

MOVING PARTS

All moving parts must have guards to protect personnel. Safety requirements vary, so the number and type of guards needed to meet company, local and OSHA standards must be determined and specified by the user. Never start a fan without having all safety guards installed. Check regularly for damaged or missing guards and do not operate any fan with guards removed. Fans can also become dangerous because of potential "windmilling", even though all electrical power is disconnected. Always block the rotating assembly before working on any moving parts.

SOUND

Some fans can generate sound that could be hazardous to exposed personnel. It is the responsibility of the system designer and user to determine sound levels of the system, the degree of personnel exposure, and to comply with applicable safety requirements to protect personnel from excessive noise. Consult **nyb** for fan sound power level ratings.

AIR PRESSURE AND SUCTION

In addition to the normal dangers of rotating machinery, fans present another hazard from the suction created at the fan inlet. This suction can draw materials into the fan where they become high velocity projectiles at the outlet. It can also be extremely dangerous to persons in close proximity to the inlet, as the forces involved can overcome the strength of most individuals. Inlets and outlets that are not ducted should be screened to prevent entry and discharge of solid objects.

⚠ DANGER

DO NOT OPEN UNTIL THE POWER SUPPLY HAS BEEN LOCKED OFF AND THE SHAFT HAS STOPPED ROTATING.
FAILURE TO DO THIS CAN RESULT IN SERIOUS BODILY INJURY. 98-0249

ACCESS DOORS

The above DANGER decal is placed on all **nyb** cleanout doors. These doors, as well as access doors to the duct system, should never be opened while the fan is in operation. Serious injury could result from the effects of air pressure or suction.

Quick-opening doors must have the door handle bolts securely tightened to prevent accidental or unauthorized opening. Bolted doors must be tightened for the same reason.

RECEIVING AND INSPECTION

The fan and accessories should be inspected on receipt for any shipping damage. Turn the wheel by hand to see that it rotates freely and does not bind.

F.O.B. factory shipping terms require that the receiver be responsible for inspecting the equipment upon arrival. Note damage or shortages on the Bill of Lading and file any claims for damage or loss in transit. **nyb** will assist the customer as much as possible; however, claims must be originated at the point of delivery.

HANDLING AND STORAGE

Fans should be lifted by the base, mounting supports, or lifting eyes only. Never lift a fan by the wheel, shaft, motor, motor bracket, or any fan part not designed for lifting. A spreader should be used to avoid damage.

Whenever possible, fans and accessories should be stored in a clean, dry location to prevent rust and corrosion of steel components. If outdoor storage is necessary, protection should be provided. Cover the entire fan to prevent the accumulation of dirt and moisture in the housing. Cover motors with waterproof material. Refer to the bearing section for further storage instructions. Inspect the stored unit periodically. **Rotate the wheel by hand every two weeks to redistribute grease on internal bearing parts.**

FAN INSTALLATION

nyb wheels are dynamically balanced when fabricated. Fully assembled fans are test run at operating speeds to check the entire assembly for conformance to **nyb** vibration limits. Nevertheless, all units must be adequately supported for smooth operation. **Ductwork or stacks should be independently supported as excess weight may distort the fan housing and cause contact between moving parts.** Where vibration isolators are used, consult the **nyb** certified drawing for proper location and adjustment.

nyb fans are designed for smooth operation throughout the cataloged speed range. Vibration levels are dependent upon the rigidity of the support structure on which the fan is mounted. The optimum installation is one in which the Plug Fan mounting panel or Plenum Fan base is bolted directly to the main supporting structurals of the particular system (see Figure 1). By doing so, the entire machine provides the mass and rigidity necessary to insure smooth operation.

The Plug Fan mounting panel has a formed edge to add strength and the face of the panel is provided with prepunched holes. The Plenum Fan base is also provided with predrilled holes. These holes are large enough to allow alignment at the time of installation yet still accept a large enough mounting bolt or stud to ensure ample security. All of the mounting holes should be used.

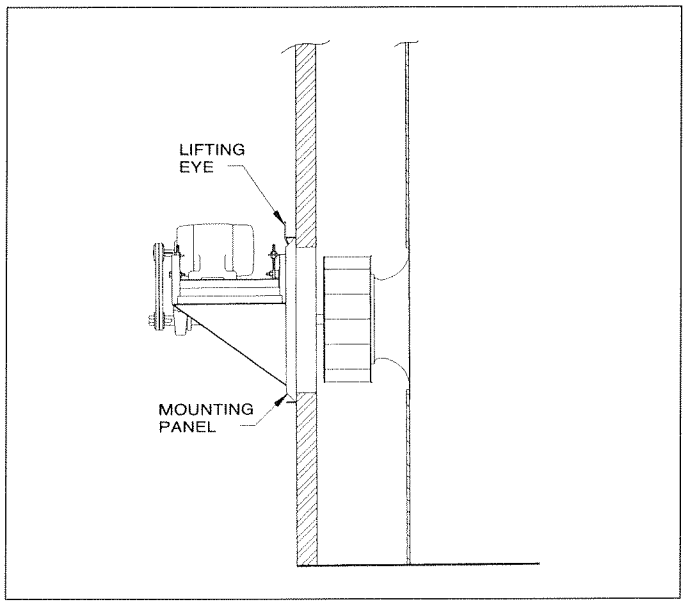


Figure 1

Typical Plug Fan Installation

For Plug Fans, the inlet cone support must be supplied by the user. In most cases, this is an internal baffle or plenum wall. The baffle or wall must be properly located and be straight to ensure optimum wheel-to-inlet cone clearance. It must also be sufficiently rigid to prevent movement of the cone during operation.

V-BELT DRIVE

Installation

1. Remove all foreign material from the fan and motor shafts. Coat shafts with machine oil for easier mounting. Mount all guards at this time if partial installation is required prior to sheave mounting.
2. Mount sheaves on shafts after checking sheave bores and bushings for nicks or burrs. Avoid using force. If resistance is encountered, lightly polish the shaft with emery cloth until the sheave slides on freely. Tighten tapered bushing bolts sequentially so that equal torque is applied to each.
3. Adjust the motor on its base to a position closest to the fan shaft. Install belts by working each one over the sheave grooves until all are in position. Never pry the belts into place. On **nyb** packaged fans, sufficient motor adjustment is provided for easy installation of the proper size belts.
4. Adjust sheaves and the motor shaft angle so that the sheave faces are in the same plane. Check this by placing a straightedge across the face of the sheave. Any gap between the edge and sheave faces indicates misalignment. Important: This method is only valid when the width of the surface between the belt edge and the sheave face is the same for both sheaves. When they are not equal, or when using adjustable-pitch sheaves, adjust so that all belts have approximately equal tension. Both shafts should be at the right angles to the center belt.

Belt Tensioning

1. Check belt tension with a tensioning gage and adjust using the motor slide base. Excess tension shortens bearing life while insufficient tension shortens belt life, can reduce fan performance and may cause vibration. The lowest allowable tension is that which prevents slippage under full load. Belts may slip during start-up, but slipping should stop as soon as the fan reaches full speed. For more precise tensioning methods, consult the drive manufacturer's literature.
2. Recheck setscrews, rotate the drive by hand and check for rubbing, then complete the installation of the belt guard.
3. Belts tend to stretch somewhat after installation. Recheck tension after several days of operation. Check sheave alignment as well as setscrew and/or bushing bolt tightness.

START-UP

Safe operation and maintenance includes the selection and use of appropriate safety accessories for the specific installation. This is the responsibility of the system designer and requires consideration of equipment location and accessibility as well as adjacent components. All safety accessories must be installed properly prior to start-up.

Safe operating speed is a function of system temperature and wheel design. Do not under any circumstances exceed the maximum safe fan speed published in the **nyb** bulletin, which is available from your **nyb** field sales representative.

Procedure

1. If the drive components are not supplied by **nyb**, verify with the manufacturer that the starting torque is adequate for the speed and inertia of the fan.
2. Inspect the installation prior to starting the fan. Check for any loose items or debris that could be drawn into the fan or dislodged by the fan discharge. Check the interior of the fan as well. Turn the wheel by hand to check for binding.

⚠ CAUTION

BEFORE INITIAL OPERATION:

1. **TIGHTEN ALL SET SCREWS IN FAN WHEEL.**
2. **TIGHTEN ALL SET SCREWS IN BEARINGS.**
3. **REPEAT AFTER 8 HOURS OF OPERATION.**
4. **REPEAT AGAIN AFTER TWO WEEKS OPERATION.**

98-0271

3. Check drive installation and belt tension.
4. Check the tightness of all setscrews, nuts and bolts. When furnished, tighten hub setscrews with the wheel oriented so that the setscrew is positioned underneath the shaft.
5. Install all remaining safety devices and guards. Verify that the supply voltage is correct and wire the motor. "Bump" the starter to check for proper wheel rotation.
6. Use extreme caution when testing the fan with plenum ducting disconnected. Apply power and check for unusual sounds or excessive vibration. If either exists, see the section on Common Fan Problems. To avoid motor overload, do not run the fan for more than a few seconds if plenum is not fully installed. Without plenum ductwork, normal operating speed may not be obtained without motor overload. Once plenum ductwork is complete, check for correct fan speed and complete installation. Plenum ductwork and guards must be fully installed for safety.
7. Setscrews should be rechecked after a few minutes, eight hours and two weeks of operation (see Tables 1 & 2 for correct tightening torques).

NOTE: Shut the fan down immediately if there is any sudden increase in fan vibration.

Table 1 - WHEEL SETSCREW TORQUES

Setscrew Size Diameter (in.)	Carbon Steel Setscrew Torque*	
	lb.-in.	lb.-ft.
1/4	75	6.2
5/16	144	12
3/8	252	21
7/16	396	33
1/2	600	50
5/8	1164	97
3/4	2016	168
7/8	3204	267
1	4800	400

*** Stainless Steel setscrews are not hardened and should not be tightened to more than 1/2 the values shown.**

Table 2 - BEARING SETSCREW TORQUE, lb.-in.

Setscrew Diameter	Manufacturer				
	Link-Belt	Sealmaster	SKF	McGill	Dodge
#10	40	--	35	35	--
1/4	90	65	50	85	--
5/16	185	125	165	165	160
3/8	325	230	290	290	275
7/16	460	350	350	--	--
1/2	680	500	620	--	600
5/8	1350	1100	1325	--	1200
3/4	2350	--	--	--	2000

FAN MAINTENANCE

nyb fans are manufactured to high standards with quality materials and components. Proper maintenance will ensure a long and trouble-free service life.

Do not attempt any maintenance on a fan unless the electrical supply has been completely disconnected and locked. In many cases, a fan can windmill despite removal of all electrical power. The rotating assembly should be blocked securely before attempting maintenance of any kind.

The key to good fan maintenance is regular and systematic inspection of all fan parts. Inspection frequency is determined by the severity of the application and local conditions. Strict adherence to an inspection schedule is essential.

Regular fan maintenance should include the following:

1. Check the fan wheel for any wear or corrosion, as either can cause catastrophic failures. Check also for the build-up of material which can cause unbalance resulting in vibration, bearing wear and serious safety hazards. Clean or replace the wheel as required.
2. Check the V-belt drive for proper alignment and tension (see section on V-belt drives). If belts are worn, replace them as a set, matched to within manufacturer's tolerances. Lubricate the coupling of direct-drive units and check for alignment (see section on couplings).
3. Lubricate the bearings, but do not over lubricate (see the bearing section for detailed specifications).
4. Ceramic-felt shaft seals require no maintenance, although worn seals should be replaced.
5. During any routine maintenance, all setscrews and bolts should be checked for tightness. See tables for torques.
6. When installing a new wheel or cone, the proper wheel-to-inlet cone clearance must be maintained (see Figure 2).

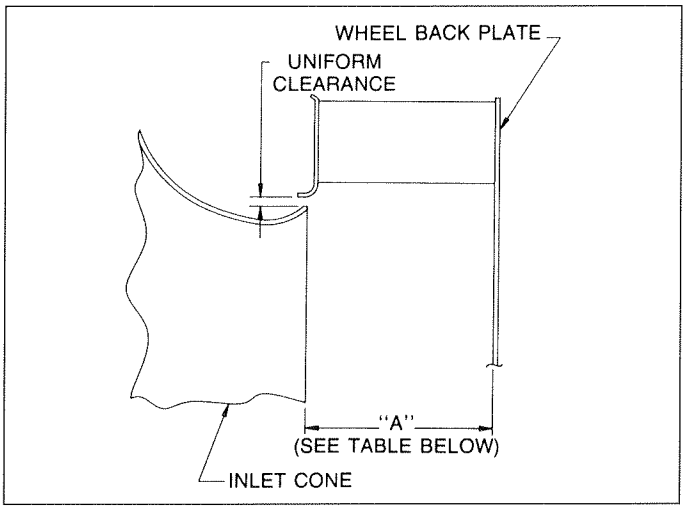
WHEEL BALANCE

Airstreams containing particulate or chemicals can cause abrasion or corrosion of the fan parts. This wear is often uneven and can lead to significant wheel unbalance over time. When such wear is discovered, a decision must be made as to whether to rebalance or replace the wheel.

The soundness of all parts should be determined if the original thickness of components is reduced. Be sure there is no hidden structural damage. The airstream components should also be cleaned to remove any build-up of foreign material. Specialized equipment can be used to rebalance a cleaned wheel that is considered structurally sound.

Balance weights should be rigidly attached at a point that will not interfere with the housing nor disrupt airflow. Remember that centrifugal forces can be extremely high at the outer radius of a fan wheel. Welding is the preferred method of balance weight attachment. Be sure to ground the welder directly to the fan wheel. Otherwise, the welding current could pass through the fan bearings and damage them.

WHEEL-CONE CLEARANCES



Fan Size	"A" Dimension	Fan Size	"A" Dimension
12	4 1/2	30	11 1/4
13	5	33	12 1/4
15	5 1/2	36	13 3/8
16	6 1/2	40	14 3/4
18	7	44	16 1/4
20	7 1/2	49	17 7/8
22	8 1/4	54	19 3/4
24	9 1/4	60	21 3/4
27	10 1/8	66	24
		73	26 1/2

Figure 2

BEARINGS

Storage

Any stored bearing can be damaged by condensation caused by temperature variations. Therefore, **nyb** fan bearings are filled with grease at the factory to exclude air and moisture. Such protection is adequate for shipment and subsequent immediate installation.

For long term or outdoor storage, mounted bearings should be regreased and wrapped with plastic for protection. **Rotate the fan wheel by hand at least every two weeks to redistribute grease on internal bearing parts.** Each month the bearings should be purged with new grease to remove condensation, since even a filled bearing can accumulate moisture. Use caution when purging, as excessive pressure can damage the seals. Rotate the shaft while slowly adding grease.

Operation

Check the setscrew torque before start-up (see Table 2 for correct values). Since bearings are completely filled with grease at the factory, they may run at an elevated temperature during initial operation. Surface temperatures may reach 180°F. and grease may bleed from the bearing seals. This is normal and no attempt should be made to replace lost grease. Bearing surface temperatures will decrease when the internal grease quantity reaches a normal operating level. Relubrication should follow the recommended schedule.

Lubrication

Use the table for relubrication scheduling according to operating speed and shaft diameter. Bearings should be lubricated with a premium quality lithium-based grease conforming to NLGI Grade 2 or 3. Examples are:

Mobil	-	Mobilith AW2
Texaco	-	Premium RB
Gulf Oil	-	Gulf Crown #2 or #3
Shell	-	Alvania #2 or #3

Do not use "high temperature" greases, as many are not formulated to be compatible with fan bearings.

Add grease to the bearing while running the fan or rotating the shaft by hand. Be sure all guards are in place if lubrication is performed while the fan is operating. Add just enough grease to cause a slight purging at the seals. Do not over lubricate.

COMMON FAN PROBLEMS

Excessive Vibration

A common complaint regarding industrial fans is "excessive vibration". **nyb** is careful to ensure that each unit is precisely balanced prior to shipment; however, there are many other causes of vibration including:

1. Loose mounting bolts, setscrews, bearings or couplings.
2. Misalignment or excessive wear of couplings or bearings.
3. Misaligned or unbalanced motor.
4. Bent shaft due to mishandling or material impact.
5. Accumulation of foreign material on the wheel.
6. Excessive wear or erosion of the wheel.
7. Excessive system pressure or restriction of airflow due to closed dampers.
8. Inadequate structural support, mounting procedures or materials.
9. Externally transmitted vibration.

Inadequate Performance

1. Incorrect testing procedures or calculations.
2. Fan running too slowly.
3. Fan wheel rotating in wrong direction.
4. Wheel not properly centered relative to inlet cone.
5. Poor system design, closed dampers, air leaks, clogged filters, or coils.
6. Obstructions or sharp elbows near inlets.
7. Sharp deflection of airstream at fan outlet.

Excessive Noise

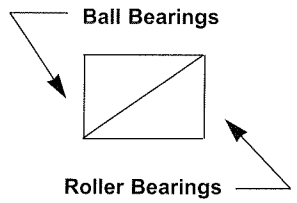
1. Fan operating near "stall" due to incorrect system design or installation.
2. Vibration originating elsewhere in the system.
3. System resonance or pulsation.
4. Improper location or orientation of fan intake and discharge.
5. Inadequate or faulty design of supporting structures.
6. Nearby sound reflecting surfaces.
7. Loose accessories or components.
8. Loose drive belts.
9. Worn bearings.

Premature Component Failure

1. Prolonged or major vibration.
2. Inadequate or improper maintenance.
3. Abrasive or corrosive elements in the airstream or surrounding environment.
4. Misalignment or physical damage to rotating components or bearings.
5. Bearing failure from incorrect or contaminated lubricant or grounding through the bearings while arc welding.
6. Excessive fan speed.
7. Extreme ambient or airstream temperatures.
8. Improper belt tension.
9. Improper tightening of wheel setscrews.

BEARING LUBRICATION INTERVAL
(months)

Shaft \ RPM	1-500	501-1000	1001-1500	1501-2000	2001-2500	2501-3000	3001-3500	3501-4000	4001-4500	4501-5000
5/8 thru 1	6 / 6	6 / 4	5-6 / 4	5-6 / 2	4-6 / 2	4-6 / 1	3-4 / 1	3-4 / 1	2 / 1	2 / 1/2
1 3/16 thru 1 7/16	6 / 6	6 / 4	5-6 / 4	4-6 / 2	4-6 / 2	3-5 / 1	2-4 / 1	2-4 / 1	1-2 / 1	1 / 1/2
1 11/16 thru 1 15/16	6 / 6	6 / 4	4-6 / 2	4-6 / 1	2-4 / 1	2-4 / 1	2 / 1/2	1-2 / 1/2	1-2 /	1 /
2 3/16	6 / 6	5-6 / 4	4-6 / 2	3-4 / 1	2-4 / 1	1-2 / 1/2	1-2 /	1-2 /		
2 7/16	6 / 4	4-6 / 2	4-6 / 1	3-4 / 1	2 / 1/2	1-2 / 1/2	1-2 /	1 /		
2 11/16 & 2 15/16	5-6 / 4	4-6 / 2	2-4 / 1	2 / 1	1-2 / 1/2	1 /				
3 3/16	6 /	6 /	4 /	2 /	2 /					
3 7/16 thru 4 3/16	4-6 / 4	3-5 / 2	2-4 / 1	1-2 / 1/2	1 /					



NOTE:

1. **These are general recommendations only; specific manufacturer's recommendations may vary slightly.**
2. **Assumes clean environment, 0°F. to 120°F.**
   a. **Consult The New York Blower Company for operation below 0°F. ambient.**
   b. **Ambient temperatures greater than 120°F. will shorten bearing life.**
   c. **Under extremely dirty conditions, lubricate more frequently.**
3. **Assumes horizontal mounting configuration. For vertically mounted applications, lubricate twice as frequently.**

LIMITED PRODUCT WARRANTY

All products are warranted by **nyb** to be free from defects in materials and workmanship for a period of one (1) year after shipment from its plant, provided buyer demonstrates to satisfaction of **nyb** that the product was properly installed and maintained in accordance with **nyb**'s instructions and recommendations and that it was used under normal operating conditions.

This warranty is limited to the replacing and/or repairing by **nyb** of any part or parts which have been returned to **nyb** with **nyb**'s written authorization and which in **nyb**'s opinion are defective. Parts not manufactured by **nyb** but installed by **nyb** in equipment sold to the buyer shall carry the original manufacturer's warranty only. All transportation charges and any and all sales and use taxes, duties, imports or excises for such part or parts shall be paid for by the buyer. **nyb** shall have the sole right to determine whether defective parts shall be repaired or replaced.

This warranty does not cover any customer labor charges for replacement of parts, adjustments or repairs, or any other work unless such charges shall be assumed or authorized in advance, in writing, by **nyb**.

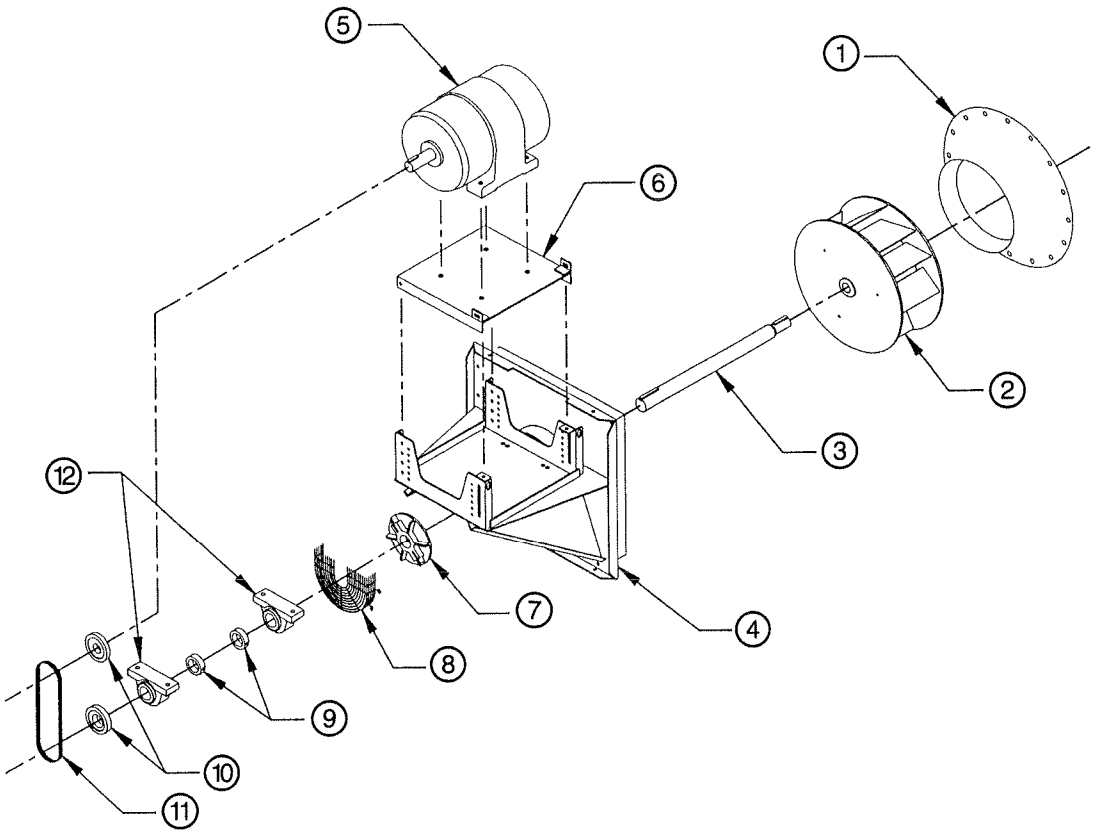
This warranty does not cover any product which, in the judgement of **nyb**, has been subject to misuse or neglect, or which has been repaired or altered outside **nyb**'s plant in any way which may have impaired its safety, operation or efficiency, or any product which has been subject to accident.

This warranty shall be null and void if any part not manufactured or supplied by **nyb** for use in any of its products shall have been substituted and used in place of a part manufactured or supplied by **nyb** for such use.

There are no warranties, other than those appearing on the acknowledgement form **INCLUDING NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE**, given in connection with the sale of the goods sold hereunder. The buyer agrees that his sole and exclusive remedy, and the limit of **nyb**'s liability for loss from any cause whatsoever, shall be the purchase price of the goods sold hereunder for which a claim is made.

SPECIFY ROTATION AS VIEWED FROM DRIVE SIDE

ARROW INDICATES COUNTERCLOCKWISE ROTATION



REPLACEMENT PARTS

It is recommended that only factory-supplied replacement parts be used. **nyb** fan parts are built to be fully compatible with the original fan, using specific alloys and tolerances. These parts carry a standard **nyb** warranty.

When ordering replacement parts, specify the part name, **nyb** shop control number, fan size, type, rotation (viewed from drive end), and bearing size or bore. Most of this information is on the metal nameplate attached to the fan base.

For assistance in selecting replacement parts, contact your local **nyb** representative or visit: http://www.nyb.com.

Example: Part required: Wheel
Shop/control number: B-10106-100
Fan description: Size 27 Plug Fan
Wheel: PLR
Rotation: Clockwise

Parts List

1.	Inlet Cone	7.	Shaft Cooler
2.	Wheel*	8.	Shaft Cooler Guard
3.	Shaft	9.	Shaft Set Collars
4.	Base and Mounting Panel	10.	Sheaves
5.	Motor	11.	V-Belts
6.	Motor Platform	12.	Bearings

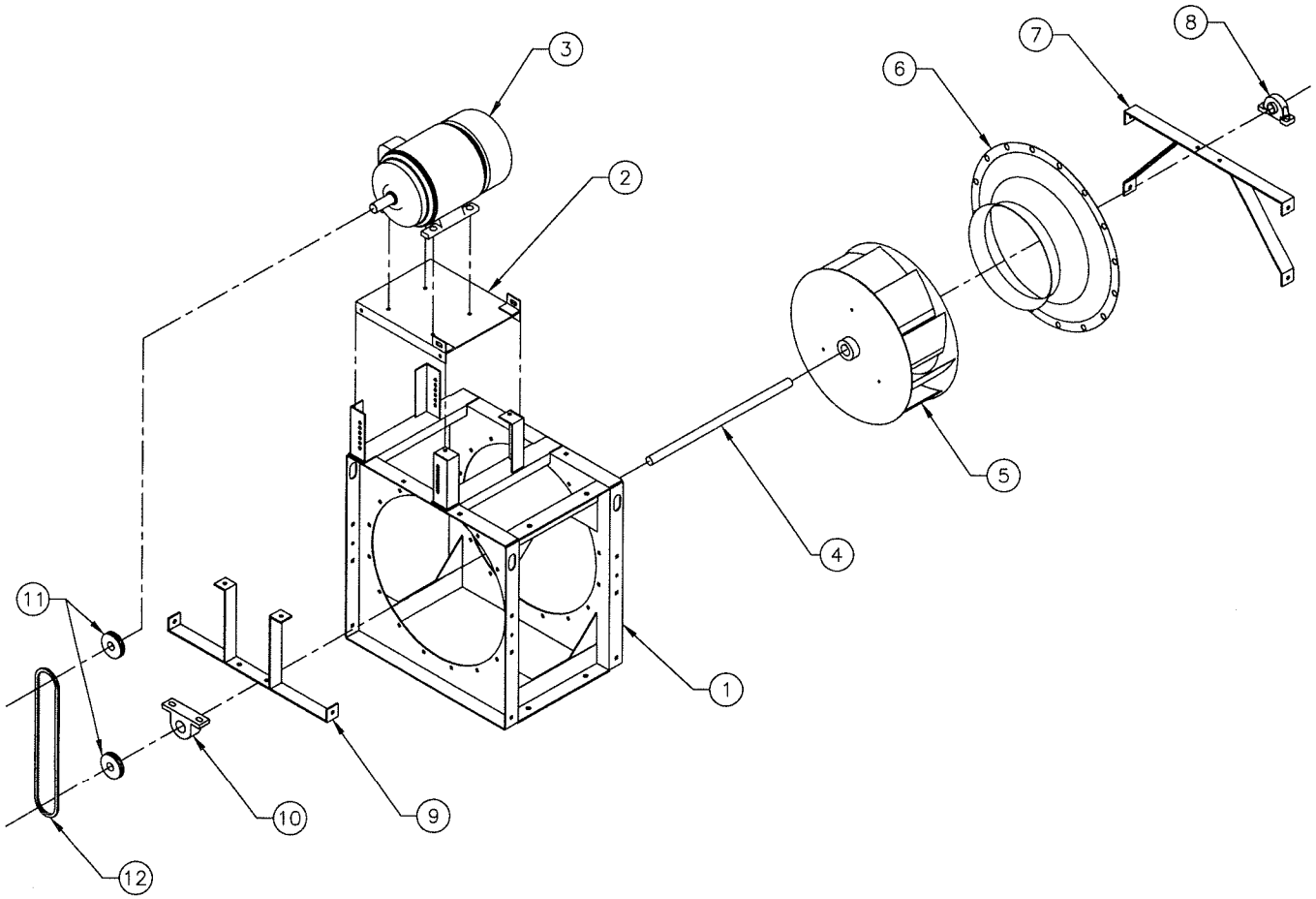
* Order for parts must specify rotation.

Suggested spare parts include:

Wheel
Shaft
Bearings
Shaft Seal
Shaft Cooler

Component Parts:
Motor
Sheaves
V-Belts

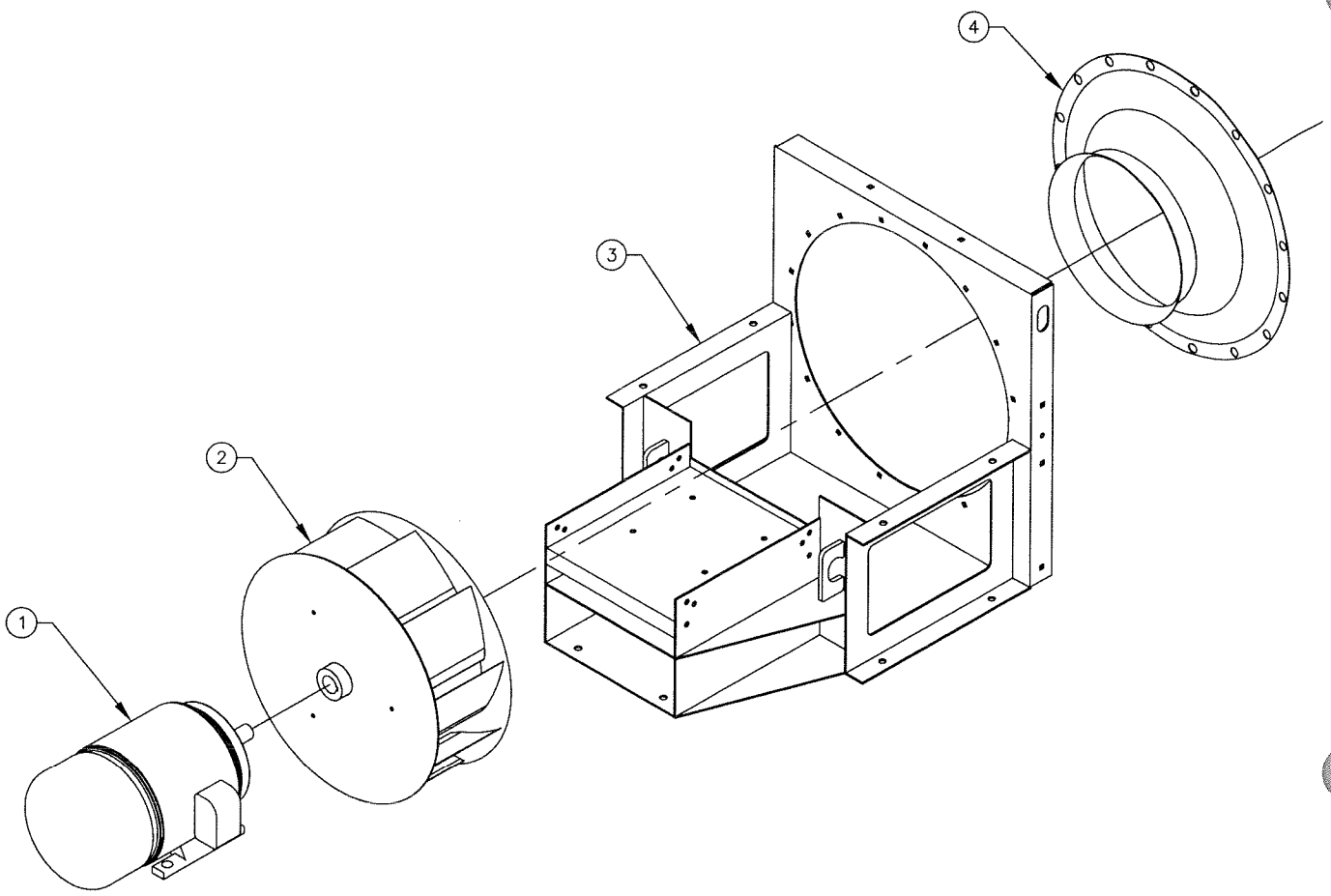
ARRANGEMENT 3P
PLENUM FAN



Parts List

1. Base Mounting Panel
2. Motor Platform
3. Motor
4. Shaft
5. Wheel
6. Inlet Cone
7. Inlet Side Bearing Support
8. Inlet Side Bearing
9. Drive Side Bearing Support
10. Drive Side Bearing
11. Sheaves
12. V-Belts

ARRANGEMENT 4
PLENUM FAN



Parts List

1. Motor
2. Wheel
3. Base Mounting Panel
4. Inlet Cone

Suggested spare parts include:

Wheel	Component Parts:
Shaft	Motor
Bearings	Sheaves
Shaft Seal	V-Belts
Shaft Cooler	

Form 798 GPB 5M ABP
Printed in U.S.A.

CMDG VENTILATEURS INC.,
7333 Des Roseraies, S.100,
ANJOU, QUEBEC - H1M 2X6
TEL: (514)- 354-0033
FAX: (514)- 354-2801

The New York Blower Company

SPARE PARTS LIST

IDENTIFICATION/ REF. SYSTEME ▸			
ROUE WHEEL			
ROTATION	ROTATION	CLOCKWISE AND COUNTERCLOCKWISE	
GRANDEUR	SIZE	338	
STYLE	STYLE	'PLR'	
CLASSE	CLASS	CLASS III PLUG FAN	
ALÉSAGE	BORE	2-15/16"	
MATÉRIEL	MATERIAL	316 STAINLESS STEEL	
ARBRE SHAFT			
DIAMETRE	DIAMETER	2-15/16"	
LONGUEUR	LENGTH		
CHEMIN DE CLEF	KEYWAY	SQ. KEY DRIVE 3/4" SQ.KEY WHEEL 5/8"	
MATÉRIEL	MATERIAL	316 STAINLESS STEEL	
ROULEMENT BEARINGS			
MARQUE	MANUFACTURER	LINK BELT	
SÉRIE	SERIES	PU-300	
ALÉSAGE	BORE	2-15/16"	
QUANTITÉ	QUANTITY	2	
INLET **CONE D'ENTRÉE** CONE			
GRANDEUR	SIZE	308	
MATÉRIEL	MATERIAL	316 STAINLESS STEEL	
REGISTRE INTERNE D'ENTRÉE VIV		NOT APPLICABLE	
MOTEUR MOTOR			
HP	HP	20 HP	
MARQUE	MANUFACTURER	TECO-WESTINGHOUSE	
COURANT	VOLTAGE	400/3/50	
TPM	RPM	1500 RPM	
BATIE	FRAME	256T	
ENVELOPPE	ENCLOSURE	TEFC SEVERE DUTY	
ENTRAINEMENT DRIVE			
MENEUR DRIVE	ALESAGE BORE	5B54SK x 1-5/8"	
MENÉ DRIVEN	ALESAGE BORE	5B70SF x 2-15/16"	
COURROIES	BELTS	BX55	
NO. CANNELURE	NO. GROOVES	5	
MANCHON SLEEVE			
NO. OU DIMENSION	TYPE OR SIZE	SF	
ALÉSAGE	BORE	2-15/16"	
DIVERS VARIOUS			

PROJECT: / PROJET: SOHAR ALUMINUM SMELTER

SERIAL NO. / S.O.: A-11581

CUSTOMER: / CLIENT: GNA ALUTECH INC.

PURCHASE ORDER NO. / NO. COMM. DU CLIENT: 4732

- ***One-half SAE 100R1 minimum bend radius – Flexible, easy to work with and install***
- ***Specially engineered TC and ST covers prolong hose life***
- ***3,000 psi constant working pressure in all sizes***
- ***Exceeds SAE 100R17 specification***

Product Bulletin

Parker 451TC and 451ST Constant Working Pressure Hoses

We Keep Ideas Flowing™

Bulletin No. 4480-B21-US September, 2001

Parker Hannifin Corporation
Hose Products Division
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Parker FluidConnectors

451TC and 451ST Hydraulic Hoses: abrasion resistance and versatility

Parker 451TC and 451ST hydraulic hoses are what to specify when abrasion resistance and ease of use are required. Plus, you can choose the cover that provides the abrasion resistance for your application.

- **Tough Cover —** 451TC features a specially formulated MSHA-accepted cover that offers exceptional protection from hose-to-hose or hose-to-object abrasion. Hose lines last longer, minimizing maintenance and down time.
- **Super Tough cover —** When only maximum abrasion resistance will do, specify 451ST with the polymeric cover.
- **Flexible —** 451 features a one-half SAE 100R1 minimum bend radius, making installation in tight spaces fast and simple.
- **Constant pressure rating in all sizes —** With a 3,000 psi constant working pressure through all sizes, 451 is the one hose you can specify to cover almost every hydraulic application. So you can stock fewer hose types and simplify your inventory.

Construction

Synthetic rubber tube compatible with most petroleum-base hydraulic fluids; high-tensile steel wire reinforcement; and an oil-, weather-, and an abrasion-resistant black synthetic MSHA-accepted rubber cover or a high abrasion-resistant polymeric cover.

Applications and temperature ranges

- Most petroleum-based hydraulic fluids and lubrication oils within a temperature range of -40˚F to +212˚F (-40˚C to +100˚C).
- Water, water/oil emulsion, and water/glycol hydraulic fluids up to +185˚F (+85˚C).
- Air up to +158˚F (+70˚C).

Parkrimp compatible

Parker 43 Series crimp fittings, 451TC hose, and 451ST hose are compatible with the Parkrimp system of crimpers. So assembly is as simple as 1-2-3.

Part Number		Hose		Hose		Maximum Working Pressure		Minimum Burst Pressure		Minimum Bend Radius		Weight		Crimp Fitting
		inch	mm	inch	mm	psi	MPa	psi	MPa	inch	mm	lbs/ft	kg/m	Series
451TC-4	451ST-4	1/4	6,3	0.52	13	3000	21,0	12000	84,0	2	50	0.16	0,24	43
451TC-6	451ST-6	3/8	10	0.68	17	3000	21,0	12000	84,0	2 1/2	65	0.23	0,34	43
451TC-8	451ST-8	1/2	12,5	0.80	20	3000	21,0	12000	84,0	3 1/2	90	0.35	0,52	43
451TC-10	451ST-10	5/8	16	0.94	24	3000	21,0	12000	84,0	4	100	0.44	0,66	43
451TC-12	451ST-12	3/4	19	1.09	28	3000	21,0	12000	84,0	4 3/4	120	0.58	0,86	43
451TC-16	451ST-16	1	25	1.40	36	3000	21,0	12000	84,0	6	150	0.79	1,17	43
451TC-20*	451ST-20*	1 1/4	31,5	1.85	47	3000	21,0	12000	84,0	8 1/4	210	1.50	2,23	43

NOTE: The silver die ring must be used when crimping 43 Series Parkrimp fittings onto 451TC and 451ST hoses.
*-20 sizes must use Karrykrimp 2, Superkrimp, Parkrimp 2, or PHastkrimp.

Distributed by:

⚠ DANGER

FAILURE OR IMPROPER SELECTION OR IMPROPER USE OF THE PRODUCTS AND/OR SYSTEMS DESCRIBED HEREIN OR RELATED ITEMS CAN CAUSE DEATH, PERSONAL INJURY AND PROPERTY DAMAGE.

Before selecting or using any Parker hose or fittings or related accessories, it is important that you read and follow Parker Safety Guide for Selecting and Using Hoses, Fittings, and Related Accessories (Parker Publication No. 4400-B.1).

Parker Hannifin Corporation
Hose Products Division
30240 Lakeland Blvd.
Wickliffe, Ohio 44092
Phone: (440) 943-5700
Fax: (440) 943-3129
www.parkerhose.com

The World Standard

Parker FluidConnectors

Bulletin 4480-B21-US GL 7.5M 9/01
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Parker Heavy Duty Hydraulic Cylinders

Series 2H

Exclusive with the Parker Stepped Cushion for increased performance and productivity

- **Faster cycle time**
- **Reduced hydraulic shock**
- **Reduced machine noise**
- **Lower machine maintenance**

- **Heavy Duty Service – Industrial Tie-Rod Construction**
- **Nominal Pressure – 3000 PSI**
- **Standard Bore Sizes – 1-1/2" through 6"**
- **Piston Rod Diameters – 5/8" through 4"**
- **18 Standard Mounting Styles**

For Cylinder Division Plant Locations – See Page II.

Parker Cylinder

The heavy-duty hydraulic cylinder with features only Parker can promise – and deliver!

Series 2H cylinders keep on performing like you expect from Parker — producing more power per pound, more power per dollar — over millions of trouble-free cycles. Everything you need for reliable 3,000 psi performance. Patented “Jewel” rod gland for longer life and lower operating costs. Chrome-plated, case hardened piston rods. Rod end studs of high yield-strength steel, with rolled threads for added strength. Tie rods with rolled threads and steel nuts. Floating cushions with float-check action and positive metal-to-metal seal. And every Parker cylinder is *individually* tested before it leaves our plant.

For additional information – call your local Parker Cylinder Distributor.

Series 2H
Heavy Duty Hydraulic Cylinders

Standard Specifications

- Heavy Duty Service – ANSI/(NFPA) T3.6.7R2 - 1996 Specifications and Mounting Dimension Standards
- Standard Construction – Square Head – Tie Rod Design
- Nominal Pressure – 3000 P.S.I.*
- Standard Fluid – Hydraulic Oil
- Standard Temperature – -10° F to +165° F**
- Bore Sizes – 1 1/2" through 6" (Larger sizes available)
- Piston Rod Diameter – 5/8" through 4"
- Mounting Styles – 18 standard styles at various application ratings
- Strokes – Available in any practical stroke length
- Cushions – Optional at either end or both ends of stroke. "Float Check" at cap end.
- Rod Ends – Three Standard Choices – Specials to Order

*If hydraulic operating pressure exceeds 3000 P.S.I., send application data for engineering evaluation and recommendation. See section C, page 84 for actual design factors.

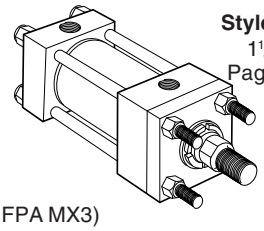
** See section C, page 83 for higher temperature service.

In line with our policy of continuing product improvement, specifications in this catalog are subject to change.

Note: Series 2H Hydraulic Cylinders fully meet ANSI/(NFPA) T3.6.7R2 - 1996 Specifications and Mounting Dimension Standards for Square Head Industrial Fluid Power Cylinders.

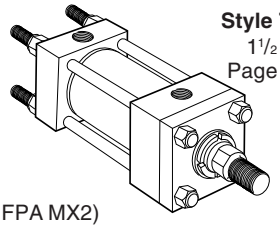
Available Mounting Styles

Tie Rods Extended Head End



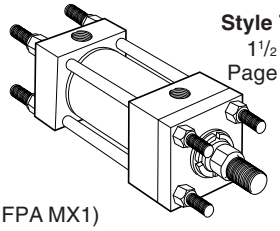
Style TB
1 1/2-6"
Page 44
(NFPA MX3)

Tie Rods Extended Cap End



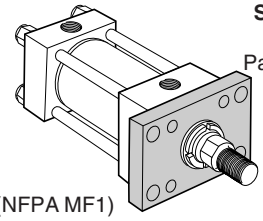
Style TC
1 1/2-6"
Page 44
(NFPA MX2)

Tie Rods Extended Both Ends



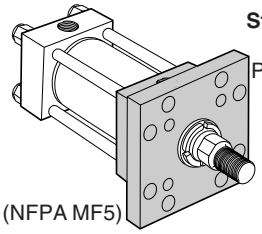
Style TD
1 1/2-6"
Page 44
(NFPA MX1)

Head Rectangular Flange



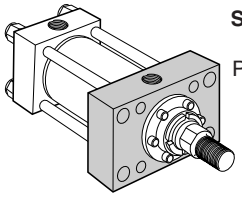
Style J
1 1/2-6"
Page 46
(NFPA MF1)

Head Square Flange



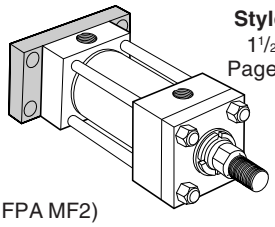
Style JB
1 1/2-6"
Page 46
(NFPA MF5)

Head Rectangular



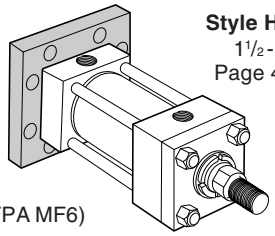
Style JJ
1 1/2-6"
Page 46
(NFPA ME5)

Cap Rectangular Flange



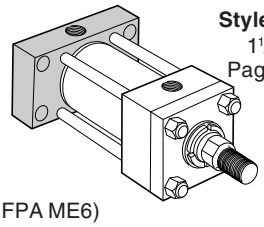
Style H
1 1/2-6"
Page 48
(NFPA MF2)

Cap Square Flange



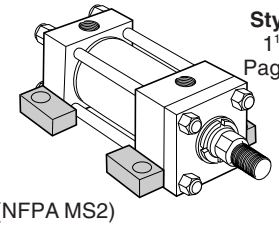
Style HB
1 1/2-6"
Page 48
(NFPA MF6)

Cap Rectangular



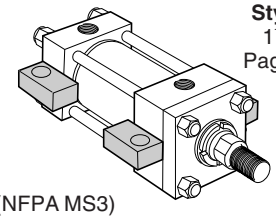
Style HH
1 1/2-6"
Page 48
(NFPA ME6)

Side Lug



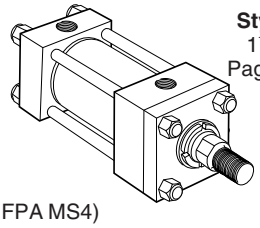
Style C
1 1/2-6"
Page 50
(NFPA MS2)

Centerline Lugs



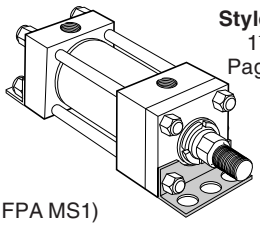
Style E
1 1/2-6"
Page 50
(NFPA MS3)

Side Tapped



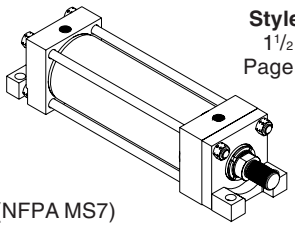
Style F
1 1/2-6"
Page 50
(NFPA MS4)

Side End Angles



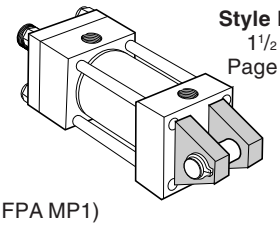
Style CB
1 1/2-6"
Page 52
(NFPA MS1)

Side End Lugs



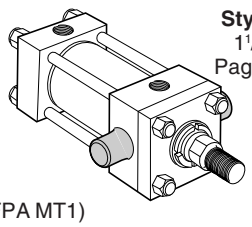
Style G
1 1/2-6"
Page 52
(NFPA MS7)

Cap Fixed Clevis



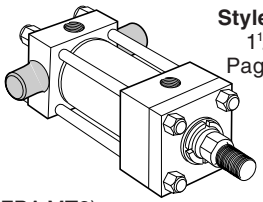
Style BB
1 1/2-6"
Page 52
(NFPA MP1)

Head Trunnion



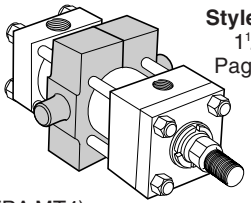
Style D
1 1/2-6"
Page 54
(NFPA MT1)

Cap Trunnion



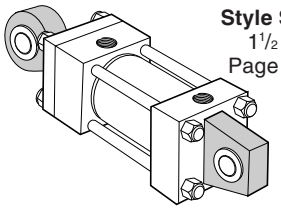
Style DB
1 1/2-6"
Page 54
(NFPA MT2)

Intermediate Fixed Trunnion



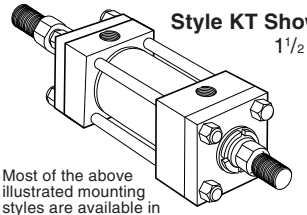
Style DD
1 1/2-6"
Page 54
(NFPA MT4)

Spherical Bearing



Style SB
1 1/2-6"
Page 56

Double Rod Cylinders



Style KT Shown
1 1/2-6"

Most of the above illustrated mounting styles are available in double rod cylinders. See Catalog Page 58.

For Cylinder Division Plant Locations – See Page II.

Parker Cylinder

The inside story on why series 2H is your best choice in heavy duty hydraulic cylinders

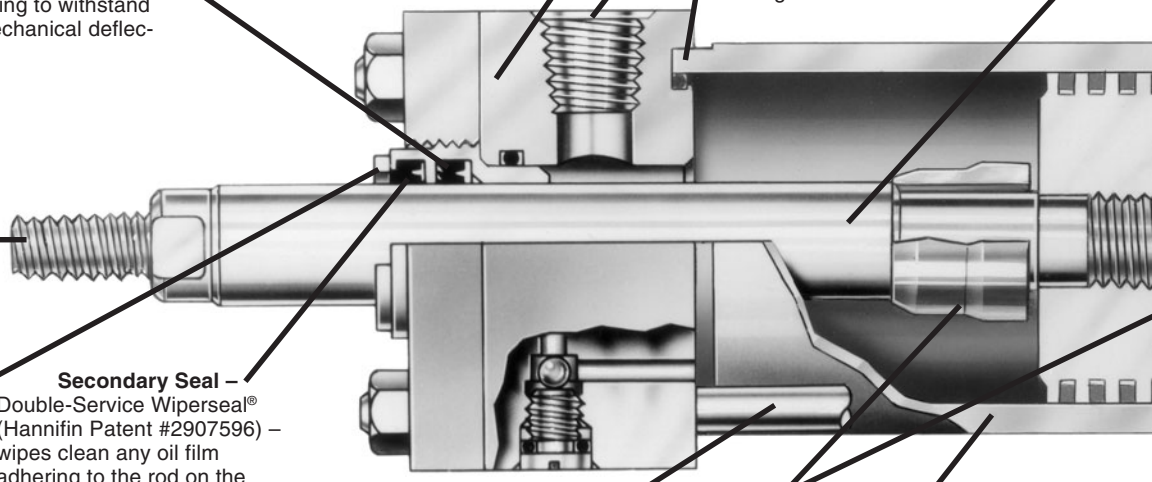
Steel Head – Bored and grooved to provide concentricity for mating parts.

Ports – S.A.E. "O" ring ports are standard.

End Seals – Pressure-actuated cylinder body-to-head and cap "O" rings.

Primary Seal – New TS-2000 Rod Seal is a proven leakproof design – completely self-compensating and self-relieving to withstand variations and conform to mechanical deflection that may occur.

Piston Rod Stud – Furnished on 2" diameter rods and smaller when standard style #4 rod end threads are required or on $1^{3}/_{8}$" diameter rods and smaller when style #8 threads are required. Also available in 2 times the catalog "A" dimension length. Studs have rolled threads and are made from high strength steel. Anaerobic adhesive is used to permanently lock the stud to the piston rod.

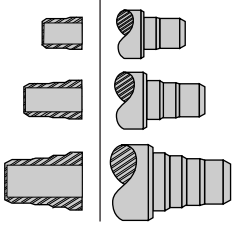


"Jewel" Rod Gland Assembly – Externally removable without cylinder disassembly. Long bearing surface is inboard of the seals, assuring positive lubrication from within the cylinder. An "O" ring is used as a seal between gland and head, and also serves as a prevailing torque-type lock.

Secondary Seal – Double-Service Wiperseal® (Hannifin Patent #2907596) – wipes clean any oil film adhering to the rod on the extend stroke and cleans the rod on the return stroke.

Stepped Cushions

Sleeve Design | Spear Design



High Strength Tie Rods – Made from 100,000 psi minimum yield steel with rolled threads for added strength.

The Cylinder Body – Heavy-wall steel tubing, honed to a micro finish bore.

Adjustable Floating Stepped Cushions – For maximum performance – economical and flexible for even the most demanding applications – provides superior performance in reducing shock. Cushions are optional and can be supplied at head end, cap end, or both ends without change in envelope or mounting dimensions.

Parker's New, Exclusive
Stepped floating cushions combine the best features of known cushion technology.

Deceleration devices or built-in "cushions" are optional and can be supplied at head end, cap end, or both ends without change in envelope or mounting dimensions. Parker cylinder cushions are a stepped design and combine the best features of known cushion technology.

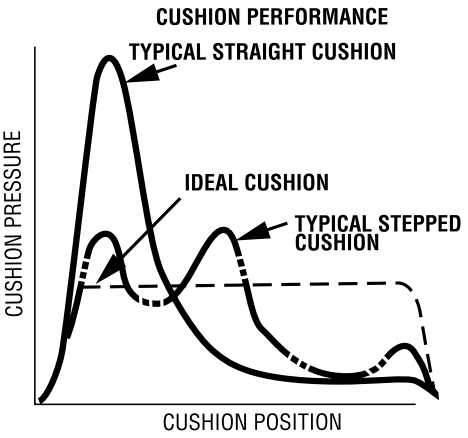
Standard straight or tapered cushions have been used in industrial cylinders over a very broad range of applications. Parker research has found that both designs have their limitations.

As a result, Parker has taken a new approach in cushioning of industrial hydraulic cylinders and for specific load and velocity conditions have been able to obtain deceleration curves that come very close to the ideal. The success lies in a stepped sleeve or spear concept where the steps are calculated to approximate theoretical orifice areas curves.

In the cushion performance chart, pressure traces show the results of typical orifice flow conditions. Tests of a three-step sleeve or spear show three pressure pulses coinciding with the steps. The deceleration cushion plunger curves shape comes very close to being theoretical, with the exception of the last $^{1}/_{2}$ inch of travel. This is a constant shape in order to have some flexibility in application. The stepped cushion design shows reduced pressure peaks for most load and speed conditions, with comparable reduction of objectionable stopping forces being transmitted to the load and the support structure.

All Parker Hannifin cushions are adjustable.

The Series 2H cylinder design incorporates the longest cushion sleeve and cushion spear that can be provided in the standard envelope without decreasing the rod bearing and piston bearing strengths.



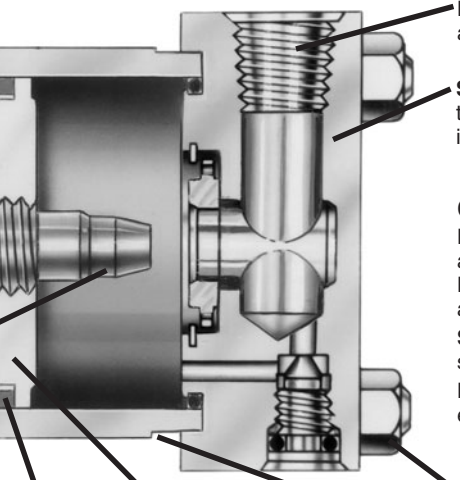
(1) When a cushion is specified at the head end:

a. A self-centering stepped sleeve is furnished on the piston rod assembly.

b. A needle valve is provided that is flush with the side of the

For additional information – call your local Parker Cylinder Distributor.

Piston Rod – Medium carbon steel, induction case-hardened to 54 Rc, hard chrome-plated and polished to 10 RMS finish. Piston rods are made from 90,000 to 100,000 psi minimum yield material in 5/8" through 4" diameters. Larger diameters vary between 57,000 and 90,000 psi minimum material, depending on rod diameter. The piston thread equals the catalog style #4 rod end thread for each rod diameter to assure proper piston-to-rod thread strength. Two wrench flats are provided for rod end attachment.



Ports – S.A.E. "O" ring ports are standard.

Steel Cap – Bored and grooved to provide concentricity for mating parts.

Optional Ports

Ports – N.P.T.F. ports are optional at no extra charge. Oversize N.P.T.F. and S.A.E. ports are available at extra charge.

Seals – Buna-N (Nitrile) seals are standard.

Fluorocarbon Seals – Optional at extra charge.

Alloy Steel Tie Rod Nuts

Align-A-Groove – (Patent #3043639) – A 3/16" wide surface machined at each end of the cylinder body. Makes precise mounting quick and easy.

One-Piece Nodular Iron Piston – The wide piston surface contacting cylinder bore reduces bearing loads. Anaerobic adhesive is used to permanently lock and seal the piston to the rod.

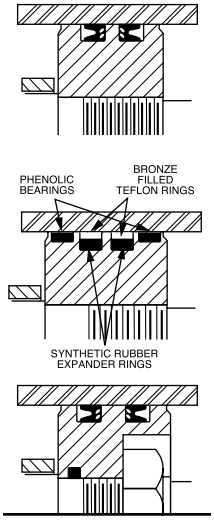
Step Cut Iron Piston Rings are standard.

The exclusive "Jewel" gland gives you longer cylinder life, better performance and lower costs.

An extra-long inboard bearing surface insures lubrication from within the cylinder. Outboard of the bearing surface are two leakproof seals – The TS-2000 and Wiperseal. The serrated TS-2000 (primary seal) is completely self-compensating and self-relieving. It adjusts to mechanical deflections or any pressure variation from near-zero to rated operating pressure. The result is positive, no-leak sealing – regardless of conditions.

The Wiperseal does double duty. On the advance stroke, it acts as a secondary pressure seal. On the return, it wipes away any dirt on the rod. This means less wear on bearing surfaces and internal parts. Longer life for working parts. And, less loss of fluid. Plus, you can replace a "Jewel" gland without removing the tie rods or the retainer. Just a few twists with a spanner wrench does the job.

Optional Pistons



Lipseal® Piston – Optional at no extra charge. Zero leakage under static conditions for hydraulic pressures up to 3000 psi. Seals are self-compensating to conform to variations in pressure, mechanical deflection, and wear. Back-up washers prevent extrusion.

Hi Load Piston – Optional at extra charge. Includes wear rings and bronze-filled PTFE seals. Two wear rings serve as bearings which deform radially under side-loading, enabling the load to be spread over a larger area and reduce unit loading. Bronze-filled PTFE seals are designed for extrusion-free, leak-proof service and longer cylinder life than the lipseal type piston.

Nut Retained Piston – Optional at extra charge.

B

head even when wide open. It may be identified by the fact that it is socket-keyed. It is located on side number 2, in all mounting styles except D, DB, DD, JJ, HH and E. In these styles it is located on side number 3.

c. On 6" bore and larger cylinders (except for 2½" bore with code 2 rod), a springless check valve is provided that is also flush with the side of the head and is mounted adjacent to the needle valve except on mounting style C, where it is mounted opposite the needle valve. It may be identified by the fact that it is slotted.

d. On 1½" - 5" bore cylinders a slotted sleeve design is used in place of the check valve.

e. 1½" - 2½" bore cylinders use a cartridge style needle valve (see Figure A).

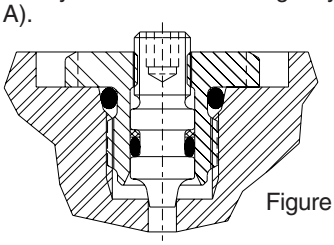


Figure A

(2) When a cushion is specified at the cap end:

a. A cushion stepped spear is provided on the piston rod.

b. A "float check" self-centering bushing is provided which incorporates a large flow check valve for fast "out-stroke" action.

c. A socket-keyed needle valve is provided that is flush with the side of the cap when wide open. It is located on side number 2 in all mounting styles except D, DB, DD, JJ, HH and E. In these styles it is located on side number 3.

Cushion Length

Cyl. Bore In.	Rod Dia. In.	Rod No.	Cushion Length – Inch Head*	Cap
1½	5/8	1	1 1/8	1 3/16
	1	2	1 1/8	1 3/16
2	1	1	1 1/8	1 1/8
	1 3/8	2	1 1/8	1 1/8
2½	1	1	1 1/8	1 1/8
	1 3/4	2	1 1/8	1 1/8
3¼	1 3/8	1	1 3/8	1 5/16
	2	2	1 1/16	1 5/16
4	1 3/4	1	1 3/8	1 1/4
	2½	2	1 1/16	1 1/4
5	2	1	1 1/16	1 1/8
	3½	2	1 1/16	1 1/8

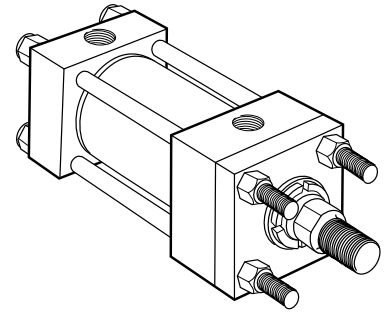
Cyl. Bore In.	Rod Dia. In.	Rod No.	Cushion Length – Inch Head*	Cap
6	2½	1	1 5/16	1 1/2
	4	2	1 5/16	1 1/2
7	3	1	1 13/16	1 15/16
	5	2	1 11/16	1 15/16
8	3½	1	2 1/16	2
	5½	2	1 15/16	2

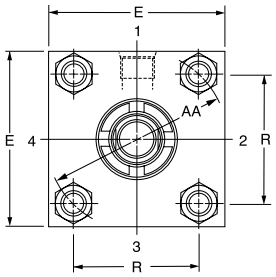
*Head end cushions for rod diameters not listed have cushion lengths with the limits shown.

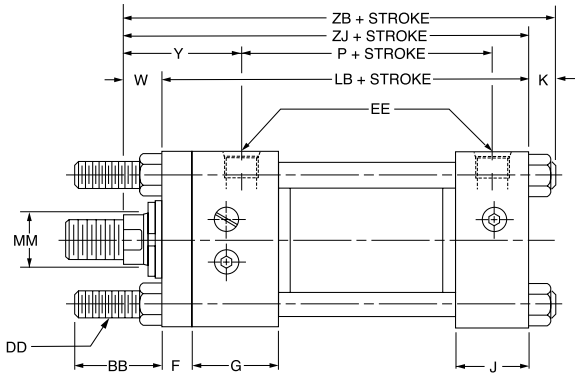
For Cylinder Division Plant Locations – See Page II.

Parker Cylinder

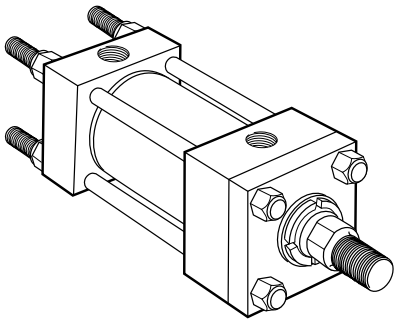
Tie Rods Extended Head End
Style TB
(NFPA Style MX3)

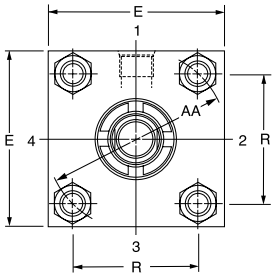


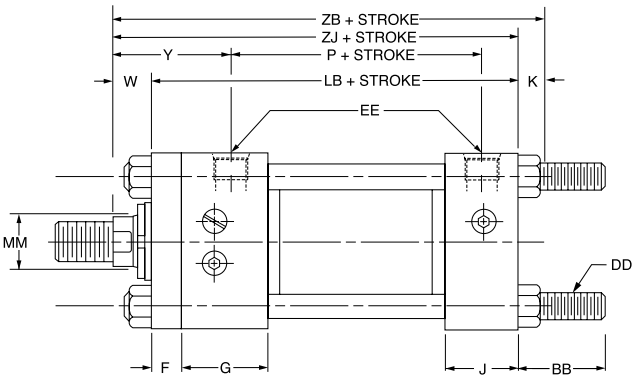




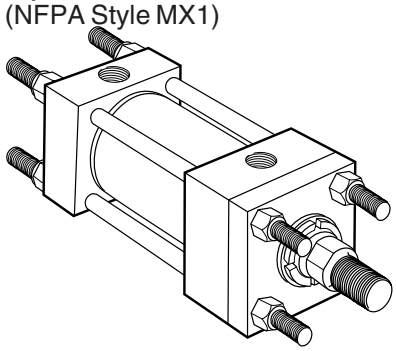
Tie Rods Extended Cap End
Style TC
(NFPA Style MX2)

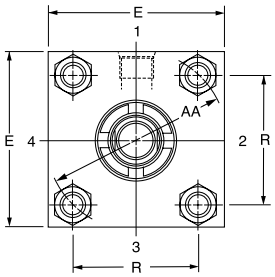


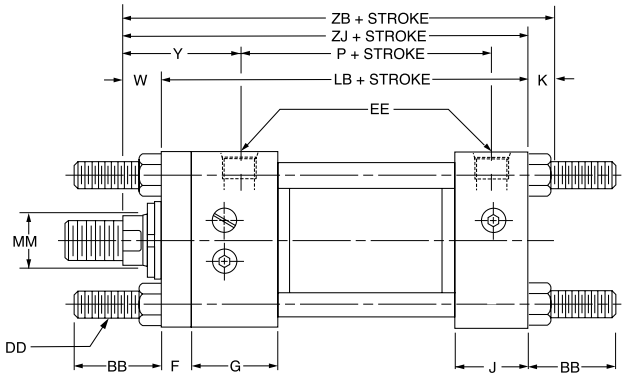




Tie Rods Extended Both Ends
Style TD
(NFPA Style MX1)



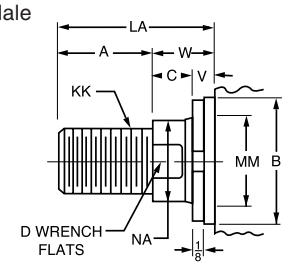




Basic Mounting (T) — NFPA MXO — Not shown is no tie rod extended and can be supplied upon request.

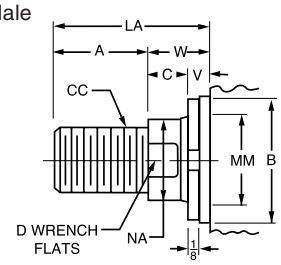
Rod End Dimensions — see table 2

Thread Style 4
(NFPA Style SM)
Small Male



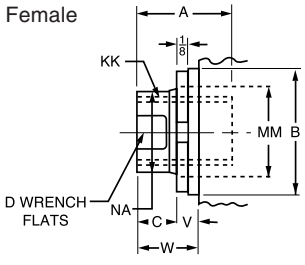
A high strength rod end stud is supplied on thread style 4 through 2" diameter rods and on thread style 8 through 1⅜" diameter rods. Larger sizes or special rod ends are cut threads. Style 4 rod ends are recommended where the workpiece is secured against the rod shoulder.

Thread Style 8
(NFPA Style IM)
Intermediate Male



When the workpiece is not shouldered, style 4 rod ends are recommended through 2" piston rod diameters and style 8 rod ends are recommended on larger diameters. Use style 9 for applications where female rod end threads are required. If rod end is not specified, style 4 will be supplied.

Thread Style 9
(NFPA Style SF)
Small Female



"Special" Thread Style 3

Special thread, extension, rod eye, blank, etc., are also available.

To order, specify "Style 3" and give desired dimensions for CC or KK, A and LA. If otherwise special, furnish dimensioned sketch.

For additional information – call your local Parker Cylinder Distributor.

Table 1—Envelope and Mounting Dimensions

Bore	AA	BB	DD	E	EE NPTF⊖	EE SAE★	F	G	J	K	R	Add Stroke LB	Add Stroke P
1½	2.3	1⅜	⅜-24	2½	½	10	⅜	1¾	1½	⅜	1.63	5	2⅞
2	2.9	1 13/16	½-20	3	½	10	⅝	1¾	1½	7/16	2.05	5¼	2⅞
2½	3.6	1 13/16	½-20	3½	½	10	⅝	1¾	1½	7/16	2.55	5⅜	3
3¼	4.6	2 5/16	⅝-18	4½	¾	12	¾	2	1¾	9/16	3.25	6¼	3½
4	5.4	2 5/16	⅝-18	5	¾	12	⅞	2	1¾	9/16	3.82	6⅝	3¾
5	7.0	3 3/16	⅞-14	6½	¾	12	⅞	2	1¾	13/16	4.95	7⅛	4¼
6	8.1	3⅝	1-14	7½	1	16	1	2¼	2¼	⅞	5.73	8⅜	4⅞

★ SAE straight thread ports are standard and are indicated by port number.
⊖ NPTF ports are available at no extra charge.

Table 2—Rod Dimensions

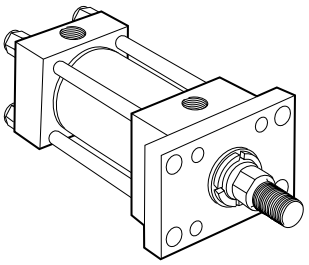
Bore	Rod No.	Rod Dia. MM	Thread Style 8 CC	Thread Style 4 & 9 KK	Rod Extensions and Pilot Dimensions A	+.000 -.002 B	C	D	LA	NA	V	W	Y	Add Stroke ZB	Add Stroke ZJ
1½	1(Std.)	⅝	½-20	7/16-20	¾	1.124	⅜	½	1⅜	9/16	¼	⅝	2	6	5⅝
	2	1	⅞-14	¾-16	1⅛	1.499	½	⅞	2⅛	15/16	½	1	2⅜	6⅜	6
2	1(Std.)	1	⅞-14	¾-16	1⅛	1.499	½	⅞	1⅞	15/16	¼	¾	2⅜	6 7/16	6
	2	1⅜	1¼-12	1-14	1⅝	1.999	⅝	1⅛	2⅝	1 5/16	⅜	1	2⅝	6 11/16	6¼
2½	1(Std.)	1	⅞-14	¾-16	1⅛	1.499	½	⅞	1⅞	15/16	¼	¾	2⅜	6 9/16	6⅛
	2	1¾	1½-12	1¼-12	2	2.374	¾	1½	3¼	1 11/16	½	1¼	2⅞	7 1/16	6⅝
	3	1⅜	1¼-12	1-14	1⅝	1.999	⅝	1⅛	2⅝	1 5/16	⅜	1	2⅝	6 13/16	6⅜
3¼	1(Std.)	1⅜	1¼-12	1-14	1⅝	1.999	⅝	1⅛	2½	1 5/16	¼	⅞	2¾	7 11/16	7⅛
	2	2	1¾-12	1½-12	2¼	2.624	⅞	1 11/16	3½	1 15/16	⅜	1¼	3⅛	8 1/16	7½
	3	1¾	1½-12	1¼-12	2	2.374	¾	1½	3⅛	1 11/16	⅜	1⅛	3	7 15/16	7⅜
4	1(Std.)	1¾	1½-12	1¼-12	2	2.374	¾	1½	3	1 11/16	¼	1	3	8 3/16	7⅝
	2	2½	2¼-12	1⅞-12	3	3.124	1	2 1/16	4⅜	2⅜	⅜	1⅜	3⅜	8 9/16	8
	3	2	1¾-12	1½-12	2¼	2.624	⅞	1 11/16	3⅜	1 15/16	¼	1⅛	3⅛	8 5/16	7¾
5	1(Std.)	2	1¾-12	1½-12	2¼	2.624	⅞	1 11/16	3⅜	1 15/16	¼	1⅛	3⅛	9 1/16	8¼
	2	3½	3¼-12	2½-12	3½	4.249	1	3	4⅞	3⅜	⅜	1⅜	3⅜	9 5/16	8½
	3	2½	2¼-12	1⅞-12	3	3.124	1	2 1/16	4⅜	2⅜	⅜	1⅜	3⅜	9 5/16	8½
	4	3	2¾-12	2¼-12	3½	3.749	1	2⅝	4⅞	2⅞	⅜	1⅜	3⅜	9 5/16	8½
6	1(Std.)	2½	2¼-12	1⅞-12	3	3.124	1	2 1/16	4¼	2⅜	¼	1¼	3½	10½	9⅝
	2	4	3¾-12	3-12	4	4.749	1	3⅜	5¼	3⅞	¼	1¼	3½	10½	9⅝
	3	3	2¾-12	2¼-12	3½	3.749	1	2⅝	4¾	2⅞	¼	1¼	3½	10½	9⅝
	4	3½	3¼-12	2½-12	3½	4.249	1	3	4¾	3⅜	¼	1¼	3½	10½	9⅝

Table 3 — Envelope and Mounting Dimensions

B

Head Rectangular Flange Mounting

Style J
(NFPA Style MF1)

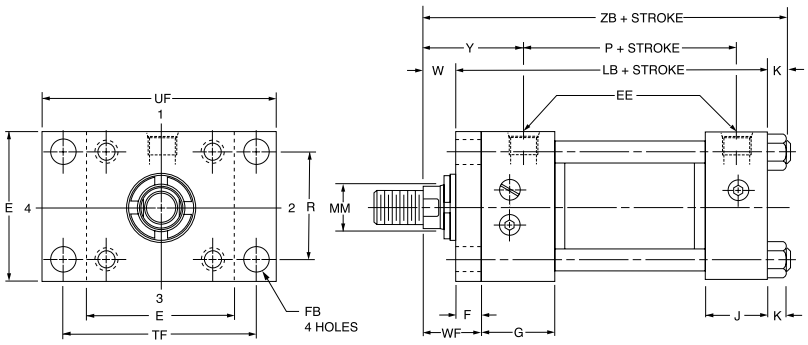


For Style "J" Mount

Bore Size	Max. PSI - Push* Rod Code 1	2	3	4
1 1/2	1500	1000	–	–
2	2000	1200	–	–
2 1/2	2000	1100	1500	–
3 1/4	1800	1300	1400	–
4	1800	1300	1700	–
5	1300	800	1200	1000
6	1200	800	1000	900

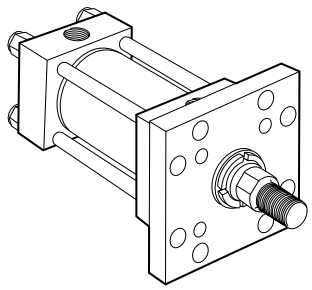
*Maximum pressure rating — push application.

For pressures exceeding those shown use mounting styles JB or JJ.



Head Square Flange Mounting

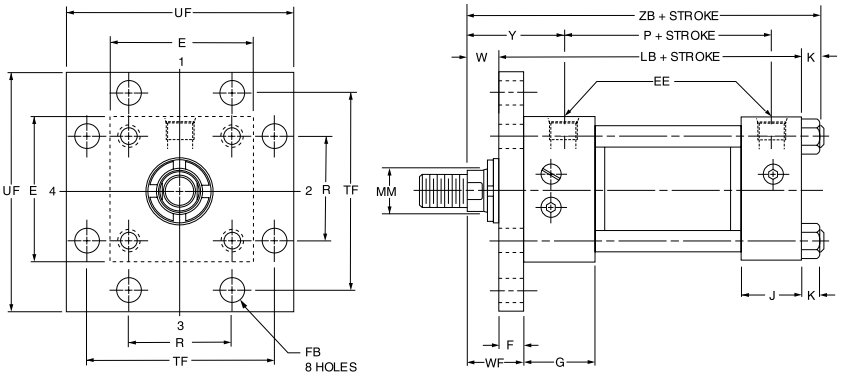
Style JB
(NFPA Style MF5)



For Style "JB" Mount

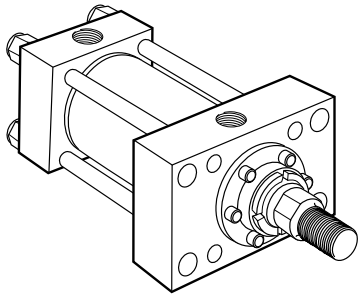
Bore Size	Max. PSI - Push* Rod Code 1	2	3	4
1 1/2	3000	3000	–	–
2	3000	3000	–	–
2 1/2	3000	3000	3000	–
3 1/4	3000	3000	3000	–
4	3000	3000	3000	–
5	3000	3000	3000	3000
6	3000	2700	3000	2700

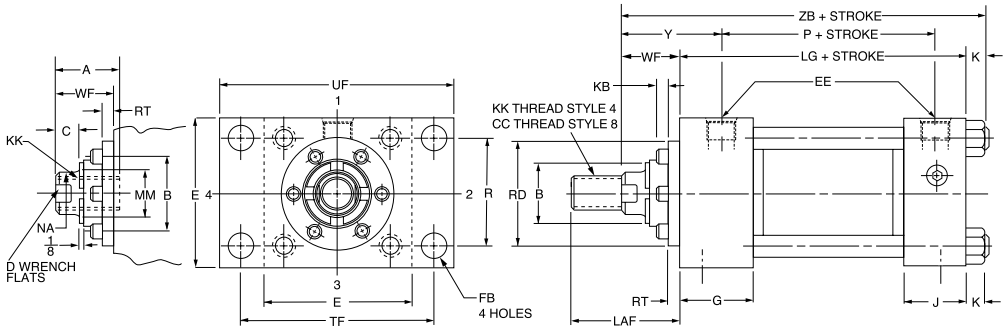
*Maximum pressure rating — push application.



Head Rectangular Mounting

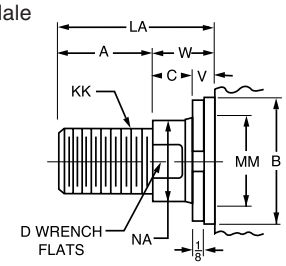
Style JJ
(NFPA Style ME5)





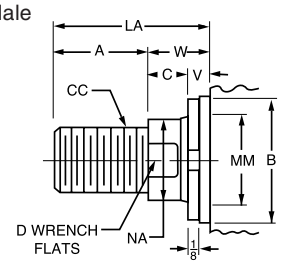
Rod End Dimensions — see table 2

Thread Style 4
(NFPA Style SM)
Small Male



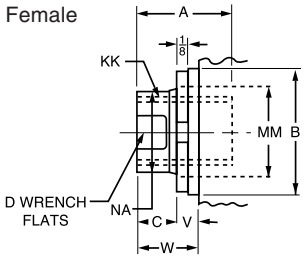
A high strength rod end stud is supplied on thread style 4 through 2" diameter rods and on thread style 8 through 1⅜" diameter rods. Larger sizes or special rod ends are cut threads. Style 4 rod ends are recommended where the workpiece is secured against the rod shoulder.

Thread Style 8
(NFPA Style IM)
Intermediate Male



When the workpiece is not shouldered, style 4 rod ends are recommended through 2" piston rod diameters and style 8 rod ends are recommended on larger diameters. Use style 9 for applications where female rod end threads are required. If rod end is not specified, style 4 will be supplied.

Thread Style 9
(NFPA Style SF)
Small Female



"Special" Thread Style 3

Special thread, extension, rod eye, blank, etc., are also available.

To order, specify "Style 3" and give desired dimensions for CC or KK, A and LA. If otherwise special, furnish dimensioned sketch.

For additional information – call your local Parker Cylinder Distributor.

Table 1—Envelope and Mounting Dimensions

Bore	E	EE NPTF⊖	EE SAE★	F	FB	G	J	K	R	TF	UF	Add Stroke LB	Add Stroke LG	Add Stroke P
1½	2½	½	10	⅜	7/16	1¾	1½	⅜	1.63	3 7/16	4¼	5	4 5/8	2 7/8
2	3	½	10	⅝	9/16	1¾	1½	7/16	2.05	4⅛	5⅛	5¼	4 5/8	2 7/8
2½	3½	½	10	⅝	9/16	1¾	1½	7/16	2.55	4 5/8	5 5/8	5 3/8	4¾	3
3¼	4½	¾	12	¾	11/16	2	1¾	9/16	3.25	5⅞	7⅛	6¼	5½	3½
4	5	¾	12	⅞	11/16	2	1¾	9/16	3.82	6⅜	7 5/8	6 5/8	5¾	3¾
5	6½	¾	12	⅞	15/16	2	1¾	13/16	4.95	8 3/16	9¾	7⅛	6¼	4¼
6	7½	1	16	1	1 1/16	2¼	2¼	⅞	5.73	9 7/16	11 1/4	8⅜	7⅜	4 7/8

★ SAE straight thread ports are standard and are indicated by port number.
⊖ NPTF ports are available at no extra charge.

Table 2—Rod Dimensions

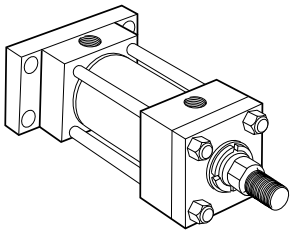
Bore	Rod No.	Rod Dia. MM	Thread Style 8 CC	Thread Style 4 & 9 KK	Rod Extensions and Pilot Dimensions A	+.000 -.002 B	C	D	KB	LA	LAF	NA	V	W	RD	RT	WF	Y	Add Stroke ZB
1½	1(Std.)	⅝	½-20	7/16-20	¾	1.124	⅜	½	0	1⅜	1¾	9/16	¼	⅝	2⅛	⅜	1	2	6
	2	1	⅞-14	¾-16	1⅛	1.499	½	⅞	0	2⅛	2½	15/16	½	1	2½	⅜	1⅜	2⅜	6⅜
2	1(Std.)	1	⅞-14	¾-16	1⅛	1.499	½	⅞	0	1⅞	2½	15/16	¼	¾	2½	⅜	1⅜	2⅜	6 7/16
	2	1⅜	1¼-12	1-14	1⅝	1.999	⅝	1⅛	¼	2⅝	3¼	15/16	⅜	1	3	⅜	1⅝	2⅝	6 11/16
2½	1(Std.)	1	⅞-14	¾-16	1⅛	1.499	½	⅞	0	1⅞	2½	15/16	¼	¾	2½	⅜	1⅜	2⅜	6 9/16
	2	1¾	1½-12	1¼-12	2	2.374	¾	1½	¼	3¼	3⅞	1 11/16	½	1¼	3½	⅜	1⅞	2⅞	7 1/16
	3	1⅜	1¼-12	1-14	1⅝	1.999	⅝	1⅛	¼	2⅝	3¼	15/16	⅜	1	3	⅜	1⅝	2⅝	6 13/16
3¼	1(Std.)	1⅜	1¼-12	1-14	1⅝	1.999	⅝	1⅛	¼	2½	3¼	15/16	¼	⅞	3	⅜	1⅝	2¾	7 11/16
	2	2	1¾-12	1½-12	2¼	2.624	⅞	1 11/16	⅛	3½	4¼	1 15/16	⅜	1¼	4	⅝	2	3⅛	8 1/16
	3	1¾	1½-12	1¼-12	2	2.374	¾	1½	¼	3⅛	3⅞	1 11/16	⅜	1⅛	3½	⅜	1⅞	3	7 15/16
4	1(Std.)	1¾	1½-12	1¼-12	2	2.374	¾	1½	¼	3	3⅞	1 11/16	¼	1	3½	⅜	1⅞	3	8 3/16
	2	2½	2¼-12	1⅞-12	3	3.124	1	2 1/16	¼	4⅜	5¼	2⅜	⅜	1⅜	4½	⅝	2¼	3⅜	8 9/16
	3	2	1¾-12	1½-12	2¼	2.624	⅞	1 11/16	⅛	3⅜	4¼	1 15/16	¼	1⅛	4	⅝	2	3⅛	8 5/16
5	1(Std.)	2	1¾-12	1½-12	2¼	2.624	⅞	1 11/16	⅛	3⅜	4¼	1 15/16	¼	1⅛	4	⅝	2	3⅛	9 1/16
	2	3½	3¼-12	2½-12	3½	4.249	1	3	¼	4⅞	5¾	3⅜	⅜	1⅜	5¾	⅝	2¼	3⅜	9 5/16
	3	2½	2¼-12	1⅞-12	3	3.124	1	2 1/16	¼	4⅜	5¼	2⅜	⅜	1⅜	4½	⅝	2¼	3⅜	9 5/16
	4	3	2¾-12	2¼-12	3½	3.749	1	2⅝	¼	4⅞	5¾	2⅞	⅜	1⅜	5¼	⅝	2¼	3⅜	9 5/16
6	1(Std.)	2½	2¼-12	1⅞-12	3	3.124	1	2 1/16	¼	4¼	5¼	2⅜	¼	1¼	4½	⅝	2¼	3½	10½
	2	4	3¾-12	3-12	4	4.749	1	3⅜	¼	5¼	6¼	3⅞	¼	1¼	6½	¾	2¼	3½	10½
	3	3	2¾-12	2¼-12	3½	3.749	1	2⅝	¼	4¾	5¾	2⅞	¼	1¼	5¼	⅝	2¼	3½	10½
	4	3½	3¼-12	2½-12	3½	4.249	1	3	¼	4¾	5¾	3⅜	¼	1¼	5¾	⅝	2¼	3½	10½

Table 3 — Envelope and Mounting Dimensions

B

Cap Rectangular Flange Mounting

Style H
(NFPA Style MF2)

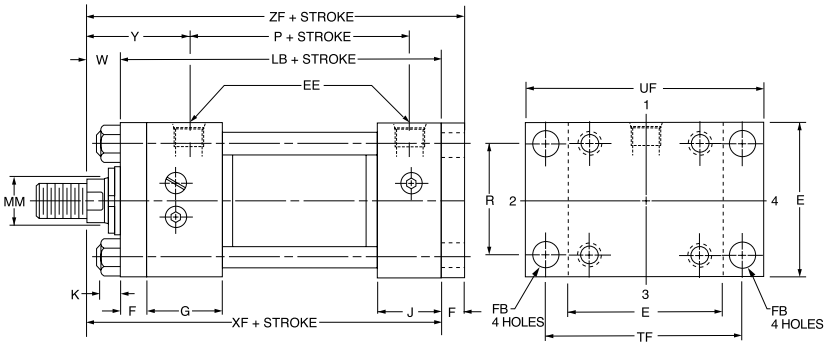


For Style "H" Mount

Bore Size	Max. PSI - Pull* Rod Code 1	2	3	4
1 1/2	2500	3000	–	–
2	3000	3000	–	–
2 1/2	3000	3000	3000	–
3 1/4	3000	3000	3000	–
4	3000	3000	3000	–
5	2000	3000	2000	2500
6	1800	2500	2000	2000

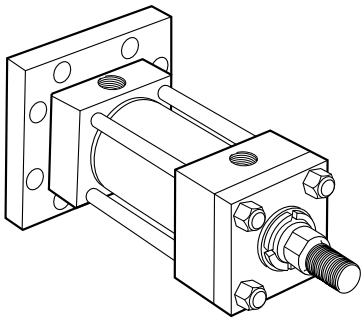
*Maximum pressure rating — pull application.

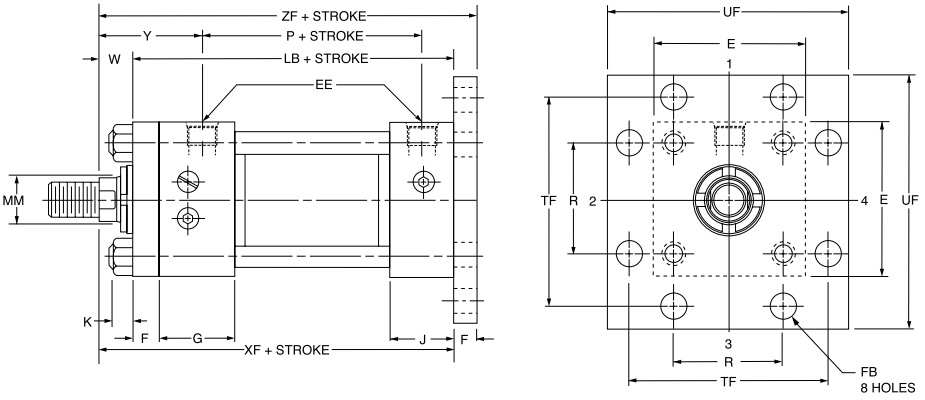
For pressures exceeding those shown use mounting styles HB or HH.



Cap Square Flange Mounting

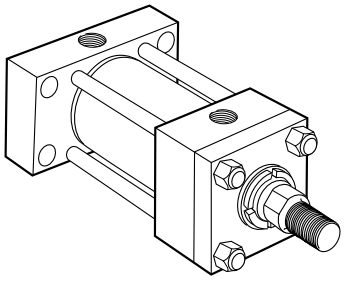
Style HB
(NFPA Style MF6)

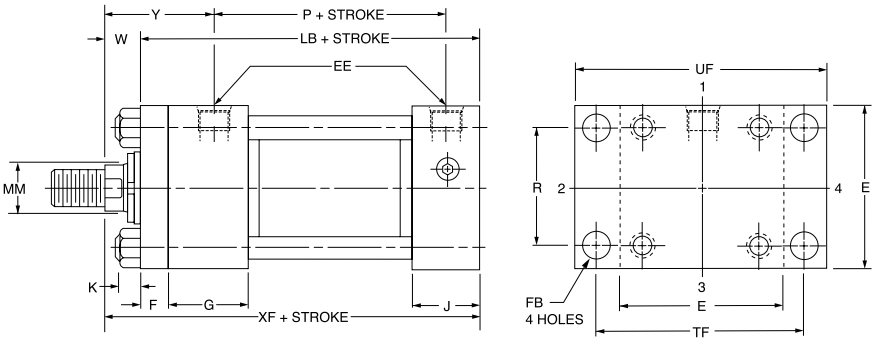




Cap Rectangular Mounting

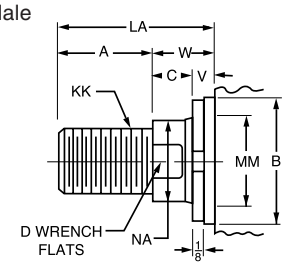
Style HH
(NFPA Style ME6)





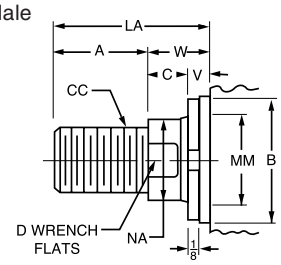
Rod End Dimensions — see table 2

Thread Style 4
(NFPA Style SM)
Small Male



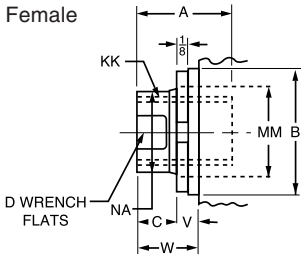
A high strength rod end stud is supplied on thread style 4 through 2" diameter rods and on thread style 8 through 1⅜" diameter rods. Larger sizes or special rod ends are cut threads. Style 4 rod ends are recommended where the workpiece is secured against the rod shoulder.

Thread Style 8
(NFPA Style IM)
Intermediate Male



When the workpiece is not shouldered, style 4 rod ends are recommended through 2" piston rod diameters and style 8 rod ends are recommended on larger diameters. Use style 9 for applications where female rod end threads are required. If rod end is not specified, style 4 will be supplied.

Thread Style 9
(NFPA Style SF)
Small Female



"Special" Thread Style 3

Special thread, extension, rod eye, blank, etc., are also available.

To order, specify "Style 3" and give desired dimensions for CC or KK, A and LA. If otherwise special, furnish dimensioned sketch.

For additional information – call your local Parker Cylinder Distributor.

Table 1—Envelope and Mounting Dimensions

Bore	E	EE NPTF⊖	EE SAE★	F	FB	G	J	K	R	TF	UF	Add Stroke LB	Add Stroke P
1½	2½	½	10	⅜	7/16	1¾	1½	⅜	1.63	3 7/16	4¼	5	2⅞
2	3	½	10	⅝	9/16	1¾	1½	7/16	2.05	4⅛	5⅛	5¼	2⅞
2½	3½	½	10	⅝	9/16	1¾	1½	7/16	2.55	4⅝	5⅝	5⅜	3
3¼	4½	¾	12	¾	11/16	2	1¾	9/16	3.25	5⅞	7⅛	6¼	3½
4	5	¾	12	⅞	11/16	2	1¾	9/16	3.82	6⅜	7⅝	6⅝	3¾
5	6½	¾	12	⅞	15/16	2	1¾	13/16	4.95	8 3/16	9¾	7⅛	4¼
6	7½	1	16	1	1 1/16	2¼	2¼	⅞	5.73	9 7/16	11¼	8⅜	4⅞

★ SAE straight thread ports are standard and are indicated by port number.
⊖ NPTF ports are available at no extra charge.

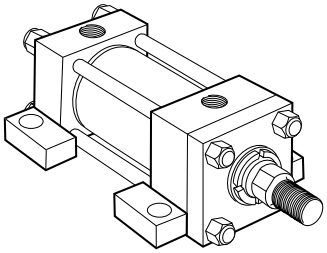
Table 2—Rod Dimensions

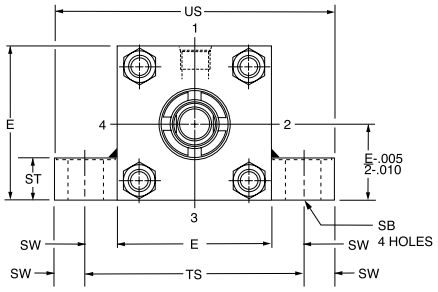
Bore	Rod No.	Rod Dia. MM	Thread Style 8 CC	Thread Style 4 & 9 KK	Rod Extensions and Pilot Dimensions A	+.000 -.002 B	C	D	LA	NA	V	W	WF	Y	Add Stroke XF	Add Stroke ZF
1½	1(Std.)	⅝	½-20	7/16-20	¾	1.124	⅜	½	1⅜	9/16	¼	⅝	1	2	5⅝	6
	2	1	⅞-14	¾-16	1⅛	1.499	½	⅞	2⅛	15/16	½	1	1⅜	2⅜	6	6⅜
2	1(Std.)	1	⅞-14	¾-16	1⅛	1.499	½	⅞	1⅞	15/16	¼	¾	1⅜	2⅜	6	6⅝
	2	1⅜	1¼-12	1-14	1⅝	1.999	⅝	1⅛	2⅝	1 5/16	⅜	1	1⅝	2⅝	6¼	6⅞
2½	1(Std.)	1	⅞-14	¾-16	1⅛	1.499	½	⅞	1⅞	15/16	¼	¾	1⅜	2⅜	6⅛	6¾
	2	1¾	1½-12	1¼-12	2	2.374	¾	1½	3¼	1 11/16	½	1¼	1⅞	2⅞	6⅝	7¼
	3	1⅜	1¼-12	1-14	1⅝	1.999	⅝	1⅛	2⅝	1 5/16	⅜	1	1⅝	2⅝	6⅜	7
3¼	1(Std.)	1⅜	1¼-12	1-14	1⅝	1.999	⅝	1⅛	2½	1 5/16	¼	⅞	1⅝	2¾	7⅛	7⅞
	2	2	1¾-12	1½-12	2¼	2.624	⅞	1 11/16	3½	1 15/16	⅜	1¼	2	3⅛	7½	8¼
	3	1¾	1½-12	1¼-12	2	2.374	¾	1½	3⅛	1 11/16	⅜	1⅛	1⅞	3	7⅜	8⅛
4	1(Std.)	1¾	1½-12	1¼-12	2	2.374	¾	1½	3	1 11/16	¼	1	1⅞	3	7⅝	8½
	2	2½	2¼-12	1⅞-12	3	3.124	1	2 1/16	4⅜	2⅜	⅜	1⅜	2¼	3⅜	8	8⅞
	3	2	1¾-12	1½-12	2¼	2.624	⅞	1 11/16	3⅜	1 15/16	¼	1⅛	2	3⅛	7¾	8⅝
5	1(Std.)	2	1¾-12	1½-12	2¼	2.624	⅞	1 11/16	3⅜	1 15/16	¼	1⅛	2	3⅛	8¼	9⅛
	2	3½	3¼-12	2½-12	3½	4.249	1	3	4⅞	3⅜	⅜	1⅜	2¼	3⅜	8½	9⅜
	3	2½	2¼-12	1⅞-12	3	3.124	1	2 1/16	4⅜	2⅜	⅜	1⅜	2¼	3⅜	8½	9⅜
	4	3	2¾-12	2¼-12	3½	3.749	1	2⅝	4⅞	2⅞	⅜	1⅜	2¼	3⅜	8½	9⅜
6	1(Std.)	2½	2¼-12	1⅞-12	3	3.124	1	2 1/16	4¼	2⅜	¼	1¼	2¼	3½	9⅝	10⅝
	2	4	3¾-12	3-12	4	4.749	1	3⅜	5¼	3⅞	¼	1¼	2¼	3½	9⅝	10⅝
	3	3	2¾-12	2¼-12	3½	3.749	1	2⅝	4¾	2⅞	¼	1¼	2¼	3½	9⅝	10⅝
	4	3½	3¼-12	2½-12	3½	4.249	1	3	4¾	3⅜	¼	1¼	2¼	3½	9⅝	10⅝

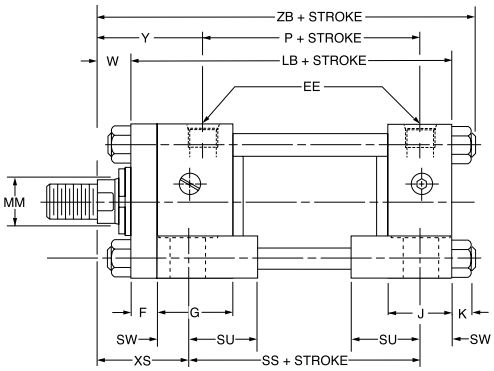
Table 3 — Envelope and Mounting Dimensions

B

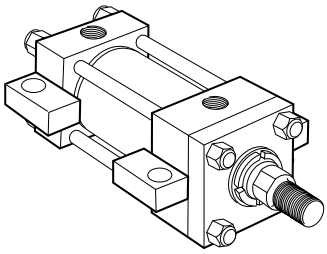
Side Lug Mountings
Style C
(NFPA Style MS2)

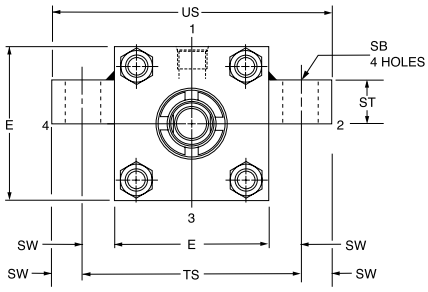


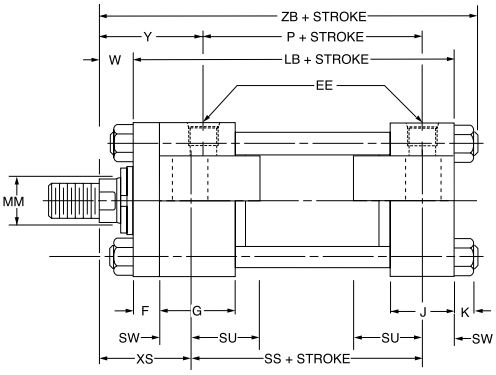




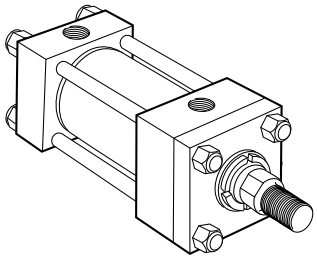
Centerline Lugs Mounting
Style E
(NFPA Style MS3)

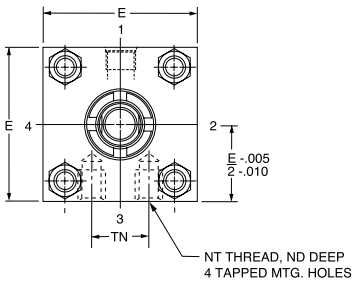


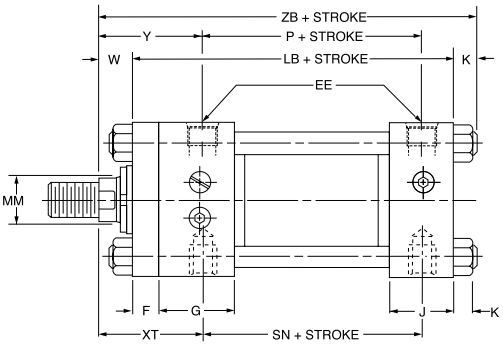




Side Tapped Mounting
Style F
(NFPA Style MS4)

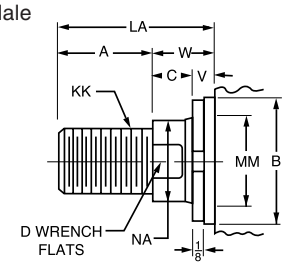






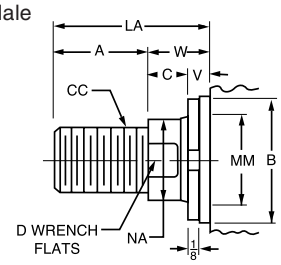
Rod End Dimensions — see table 2

Thread Style 4
(NFPA Style SM)
Small Male



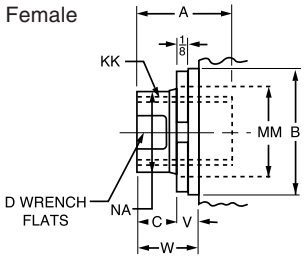
A high strength rod end stud is supplied on thread style 4 through 2" diameter rods and on thread style 8 through 1⅜" diameter rods. Larger sizes or special rod ends are cut threads. Style 4 rod ends are recommended where the workpiece is secured against the rod shoulder.

Thread Style 8
(NFPA Style IM)
Intermediate Male



When the workpiece is not shouldered, style 4 rod ends are recommended through 2" piston rod diameters and style 8 rod ends are recommended on larger diameters. Use style 9 for applications where female rod end threads are required. If rod end is not specified, style 4 will be supplied.

Thread Style 9
(NFPA Style SF)
Small Female



"Special" Thread Style 3
Special thread, extension, rod eye, blank, etc., are also available.

To order, specify "Style 3" and give desired dimensions for CC or KK, A and LA. If otherwise special, furnish dimensioned sketch.

For additional information – call your local Parker Cylinder Distributor.

Table 1—Envelope and Mounting Dimensions

Bore	E	EE NPTF⊖	EE SAE★	F	G	J	K	NT	SB*	ST	SU	SW	TN	TS	US	Add Stroke LB	P	SN	SS
1½	2½	½	10	⅜	1¾	1½	⅜	⅜-16	7/16	½	15/16	⅜	¾	3¼	4	5	2⅞	2⅞	3⅞
2	3	½	10	⅝	1¾	1½	7/16	½-13	9/16	¾	1¼	½	15/16	4	5	5¼	2⅞	2⅞	3⅝
2½	3½	½	10	⅝	1¾	1½	7/16	⅝-11	13/16	1	1 9/16	11/16	1 5/16	4⅞	6¼	5⅜	3	3	3⅜
3¼	4½	¾	12	¾	2	1¾	9/16	¾-10	13/16	1	1 9/16	11/16	1½	5⅞	7¼	6¼	3½	3½	4⅛
4	5	¾	12	⅞	2	1¾	9/16	1-8	1 1/16	1¼	2	⅞	2 1/16	6¾	8½	6⅝	3¾	3¾	4
5	6½	¾	12	⅞	2	1¾	13/16	1-8	1 1/16	1¼	2	⅞	2 15/16	8¼	10	7⅛	4¼	4¼	4½
6	7½	1	16	1	2¼	2¼	⅞	1¼-7	1 5/16	1½	2½	1⅛	3 5/16	9¾	12	8⅜	4⅞	5⅛	5⅛

★ SAE straight thread ports are standard and are indicated by port number.
⊖ NPTF ports are available at no extra charge.
* Upper surface spotfaced for socket head screws.

Table 2—Rod Dimensions

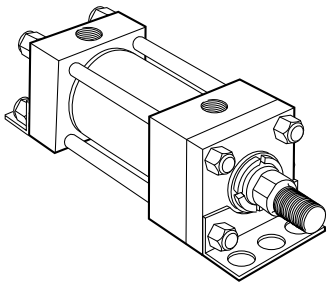
Bore	Rod No.	Rod Dia. MM	Thread Style 8 CC	Thread Style 4 & 9 KK	Rod Extensions and Pilot Dimensions A	+.000 -.002 B	C	D	LA	NA	V	W	ND	XS	XT	Y	Add Stroke ZB
1½	1(Std.)	⅝	½-20	7/16-20	¾	1.124	⅜	½	1⅜	9/16	¼	⅝	⅜	1⅜	2	2	6
	2	1	⅞-14	¾-16	1⅛	1.499	½	⅞	2⅛	15/16	½	1	⅜	1¾	2⅜	2⅜	6⅜
2	1(Std.)	1	⅞-14	¾-16	1⅛	1.499	½	⅞	1⅞	15/16	¼	¾	7/16	1⅞	2⅜	2⅜	6 7/16
	2	1⅜	1¼-12	1-14	1⅝	1.999	⅝	1⅛	2⅝	1 5/16	⅜	1	7/16	2⅛	2⅝	2⅝	6 11/16
2½	1(Std.)	1	⅞-14	¾-16	1⅛	1.499	½	⅞	1⅞	15/16	¼	¾	½	2 1/16	2⅜	2⅜	6 9/16
	2	1¾	1½-12	1¼-12	2	2.374	¾	1½	3¼	1 11/16	½	1¼	½	2 9/16	2⅞	2⅞	7 1/16
	3	1⅜	1¼-12	1-14	1⅝	1.999	⅝	1⅛	2⅝	1 5/16	⅜	1	½	2 5/16	2⅝	2⅝	6 13/16
3¼	1(Std.)	1⅜	1¼-12	1-14	1⅝	1.999	⅝	1⅛	2½	1 5/16	¼	⅞	11/16	2 5/16	2¾	2¾	7 11/16
	2	2	1¾-12	1½-12	2¼	2.624	⅞	1 11/16	3½	1 15/16	⅜	1¼	11/16	2 11/16	3⅛	3⅛	8 1/16
	3	1¾	1½-12	1¼-12	2	2.374	¾	1½	3⅛	1 11/16	⅜	1⅛	11/16	2 9/16	3	3	7 15/16
4	1(Std.)	1¾	1½-12	1¼-12	2	2.374	¾	1½	3	1 11/16	¼	1	11/16	2¾	3	3	8 3/16
	2	2½	2¼-12	1⅞-12	3	3.124	1	2 1/16	4⅜	2⅜	⅜	1⅜	11/16	3⅛	3⅜	3⅜	8 9/16
	3	2	1¾-12	1½-12	2¼	2.624	⅞	1 11/16	3⅜	1 15/16	¼	1⅛	11/16	2⅞	3⅛	3⅛	8 5/16
5	1(Std.)	2	1¾-12	1½-12	2¼	2.624	⅞	1 11/16	3⅜	1 15/16	¼	1⅛	1	2⅞	3⅛	3⅛	9 1/16
	2	3½	3¼-12	2½-12	3½	4.249	1	3	4⅞	3⅜	⅜	1⅜	1	3⅛	3⅜	3⅜	9 5/16
	3	2½	2¼-12	1⅞-12	3	3.124	1	2 1/16	4⅜	2⅜	⅜	1⅜	1	3⅛	3⅜	3⅜	9 5/16
	4	3	2¾-12	2¼-12	3½	3.749	1	2⅝	4⅞	2⅞	⅜	1⅜	1	3⅛	3⅜	3⅜	9 5/16
6	1(Std.)	2½	2¼-12	1⅞-12	3	3.124	1	2 1/16	4¼	2⅜	¼	1¼	1¼	3⅜	3½	3½	10½
	2	4	3¾-12	3-12	4	4.749	1	3⅜	5¼	3⅞	¼	1¼	1¼	3⅜	3½	3½	10½
	3	3	2¾-12	2¼-12	3½	3.749	1	2⅝	4¾	2⅞	¼	1¼	1¼	3⅜	3½	3½	10½
	4	3½	3¼-12	2½-12	3½	4.249	1	3	4¾	3⅜	¼	1¼	1¼	3⅜	3½	3½	10½

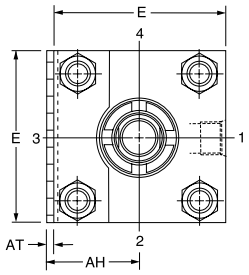
Table 3 — Envelope and Mounting Dimensions

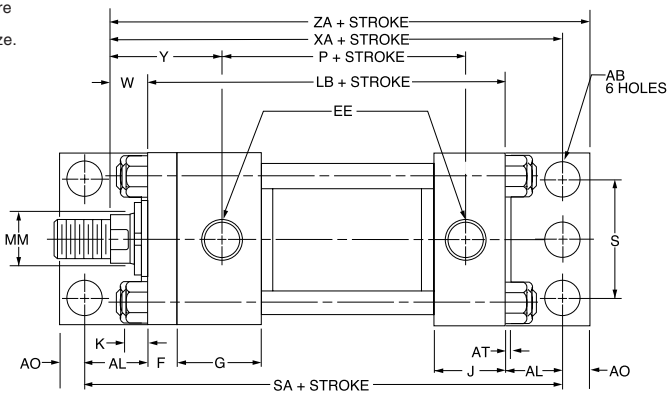
B

Side End Angles Mounting
Style CB
(NFPA Style MS1)

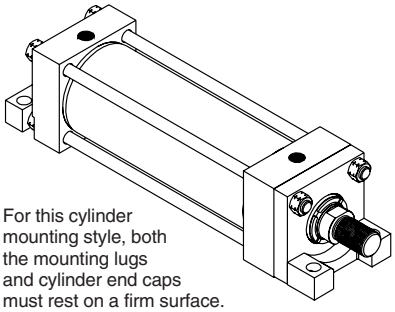
The maximum recommended operating pressure for Style CB is 500 psi. The recommended minimum stroke length is two times the bore size.



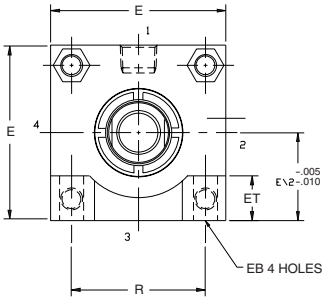


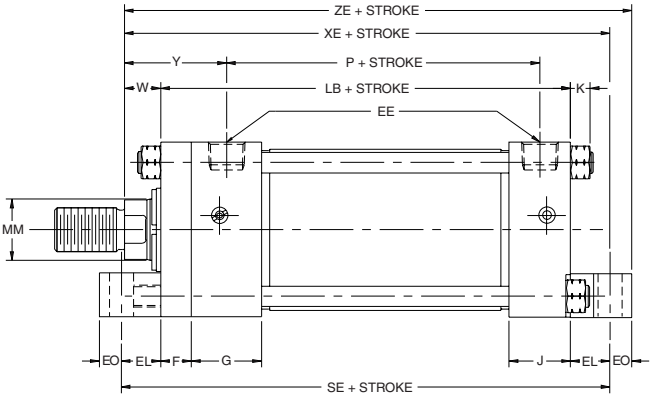


Side End Lugs Mounting
Style G
(NFPA Style MS7)



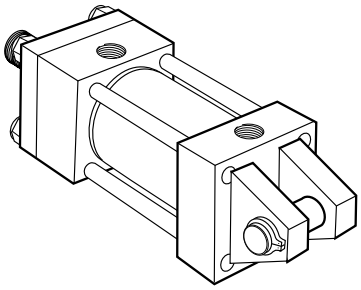
For this cylinder mounting style, both the mounting lugs and cylinder end caps must rest on a firm surface.

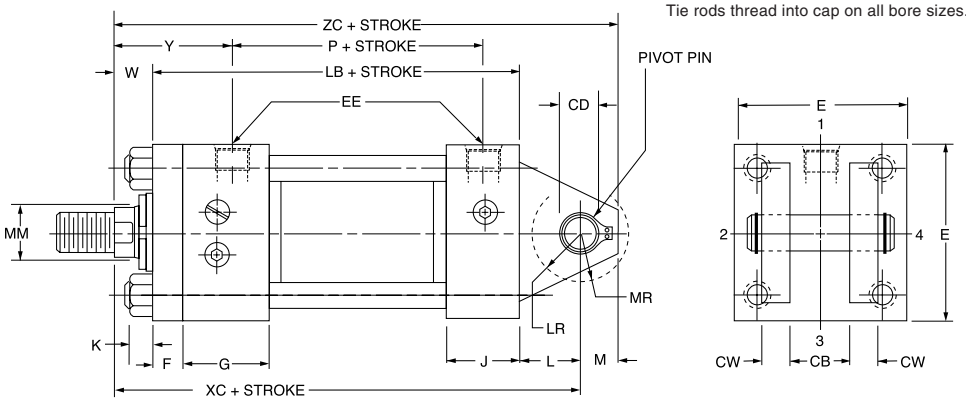




Cap Fixed Clevis Mounting
Style BB
(NFPA Style MP1)

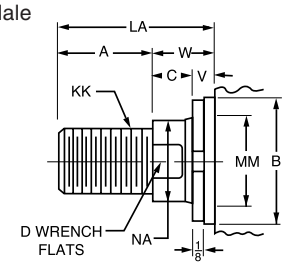
Tie rods thread into cap on all bore sizes.





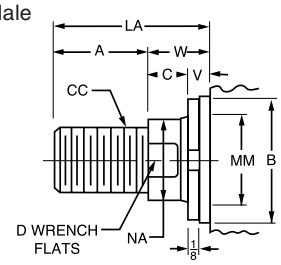
Rod End Dimensions — see table 2

Thread Style 4
(NFPA Style SM)
Small Male



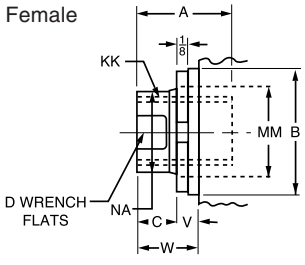
A high strength rod end stud is supplied on thread style 4 through 2" diameter rods and on thread style 8 through 1⅜" diameter rods. Larger sizes or special rod ends are cut threads. Style 4 rod ends are recommended where the workpiece is secured against the rod shoulder.

Thread Style 8
(NFPA Style IM)
Intermediate Male



When the workpiece is not shouldered, style 4 rod ends are recommended through 2" piston rod diameters and style 8 rod ends are recommended on larger diameters. Use style 9 for applications where female rod end threads are required. If rod end is not specified, style 4 will be supplied.

Thread Style 9
(NFPA Style SF)
Small Female



"Special" Thread Style 3

Special thread, extension, rod eye, blank, etc., are also available.

To order, specify "Style 3" and give desired dimensions for CC or KK, A and LA. If otherwise special, furnish dimensioned sketch.

For additional information – call your local Parker Cylinder Distributor.

Table 1—Envelope and Mounting Dimensions

Bore	AB	AH	AL	AO	AT	CB	+.000 -.002 CD*	CW	E	EB	EE ⊖NPTF	EE ★SAE	EL	EO	ES	ET	F	G	J	K	L	LR	M	MR	R	S	Add Stroke LB	P	SA	SE
1½	7/16	1 3/8	1	3/8	1/8	3/4	.501	1/2	2 1/2	7/16	1/2	10	7/8	3/8	7/8	3/4	3/8	1 3/4	1 1/2	3/8	3/4	9/16	1/2	5/8	1.63	1 3/4	5	2 7/8	7	6 3/4
2	9/16	1 11/16	1 1/4	1/2	1/8	1 1/4	.751	5/8	3	9/16	1/2	10	15/16	1/2	15/16	7/8	5/8	1 3/4	1 1/2	7/16	1 1/4	1	3/4	15/16	2.05	2	5 1/4	2 7/8	7 3/4	7 1/8
2 1/2	11/16	1 15/16	1 3/16	9/16	1/8	1 1/4	.751	5/8	3 1/2	9/16	1/2	10	15/16	1/2	15/16	7/8	5/8	1 3/4	1 1/2	7/16	1 1/4	15/16	3/4	15/16	2.55	2 3/8	5 3/8	3	7 3/4	7 1/4
3 1/4	13/16	2 9/16	1 13/16	11/16	1/4	1 1/2	1.001	3/4	4 1/2	11/16	3/4	12	1 1/8	5/8	1 1/4	1 1/4	3/4	2	1 3/4	9/16	1 1/2	1 1/4	1	1 3/16	3.25	3 1/8	6 1/4	3 1/2	9 7/8	8 1/2
4	1 1/16	2 13/16	2 1/8	7/8	1/4	2	1.376	1	5	11/16	3/4	12	1 1/8	5/8	1 1/4	1 1/4	7/8	2	1 3/4	9/16	2 1/8	1 3/4	1 3/8	1 5/8	3.82	3 1/4	6 5/8	3 3/4	10 7/8	8 7/8
5	1 1/16	3 11/16	2 1/8	7/8	5/16	2 1/2	1.751	1 1/4	6 1/2	15/16	3/4	12	1 1/2	3/4	1 1/2	1 1/2	7/8	2	1 3/4	13/16	2 1/4	2 1/16	1 3/4	2 1/8	4.95	4 3/4	7 1/8	4 1/4	11 3/8	10 1/8
6	1 5/16	4 1/4	2 7/16	1 1/16	3/8	2 1/2	2.001	1 1/4	7 1/2	1 1/16	1	16	1 11/16	7/8	1 3/4	1 3/4	1	2 1/4	2 1/4	7/8	2 1/2	2 5/16	2	2 3/8	5.73	5 3/8	8 3/8	4 7/8	13 1/4	11 3/4

★ SAE straight thread ports are standard and are indicated by port number.
⊖ NPTF ports are available at no extra charge.
* Dimension CD is pin diameter.

Table 2—Rod Dimensions

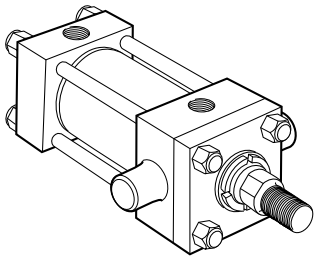
Bore	Rod No.	Rod Dia. MM	Thread Style 8 CC	Thread Style 4 & 9 KK	Rod Extensions and Pilot Dimensions A	+.000 -.002 B	C	D	LA	NA	V	W	Y	Add Stroke XA	XC	XE	ZA	ZC	ZE
1½	1(Std.)	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	1 3/8	9/16	1/4	5/8	2	6 5/8	6 3/8	6 1/2	7	6 7/8	6 7/8
	2	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	2 1/8	15/16	1/2	1	2 3/8	7	6 3/4	6 7/8	7 3/8	7 1/4	7 1/4
2	1(Std.)	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	1 7/8	15/16	1/4	3/4	2 3/8	7 1/4	7 1/4	6 15/16	7 3/4	8	7 7/16
	2	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 5/8	1 5/16	3/8	1	2 5/8	7 1/2	7 1/2	7 3/16	8	8 1/4	7 11/16
2 1/2	1(Std.)	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	1 7/8	15/16	1/4	3/4	2 3/8	7 5/16	7 3/8	7 1/16	7 7/8	8 1/8	7 9/16
	2	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/4	1 11/16	1/2	1 1/4	2 7/8	7 13/16	7 7/8	7 9/16	8 3/8	8 5/8	8 1/16
	3	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 5/8	1 5/16	3/8	1	2 5/8	7 9/16	7 5/8	7 5/16	8 1/8	8 3/8	7 13/16
3 1/4	1(Std.)	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 1/2	1 5/16	1/4	7/8	2 3/4	8 15/16	8 5/8	8 1/4	9 5/8	9 5/8	8 7/8
	2	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 1/2	1 15/16	3/8	1 1/4	3 1/8	9 5/16	9	8 5/8	10	10	9 1/4
	3	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/8	1 11/16	3/8	1 1/8	3	9 3/16	8 7/8	8 1/2	9 7/8	9 7/8	9 1/8
4	1(Std.)	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3	1 11/16	1/4	1	3	9 3/4	9 3/4	8 3/4	10 5/8	11 1/8	9 3/8
	2	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 3/8	2 3/8	3/8	1 3/8	3 3/8	10 1/8	10 1/8	9 1/8	11	11 1/2	9 3/4
	3	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 3/8	1 15/16	1/4	1 1/8	3 1/8	9 7/8	9 7/8	8 7/8	10 3/4	11 1/4	9 1/2
5	1(Std.)	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 3/8	1 15/16	1/4	1 1/8	3 1/8	10 3/8	10 1/2	9 3/4	11 1/4	12 1/4	10 1/2
	2	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	4 7/8	3 3/8	3/8	1 3/8	3 3/8	10 5/8	10 3/4	10	11 1/2	12 1/2	10 3/4
	3	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 3/8	2 3/8	3/8	1 3/8	3 3/8	10 5/8	10 3/4	10	11 1/2	12 1/2	10 3/4
	4	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	4 7/8	2 7/8	3/8	1 3/8	3 3/8	10 5/8	10 3/4	10	11 1/2	12 1/2	10 3/4
6	1(Std.)	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 1/4	2 3/8	1/4	1 1/4	3 1/2	12 1/16	12 1/8	11 5/16	13 1/8	14 1/8	12 3/16
	2	4	3 3/4-12	3-12	4	4.749	1	3 3/8	5 1/4	3 7/8	1/4	1 1/4	3 1/2	12 1/16	12 1/8	11 5/16	13 1/8	14 1/8	12 3/16
	3	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	4 3/4	2 7/8	1/4	1 1/4	3 1/2	12 1/16	12 1/8	11 5/16	13 1/8	14 1/8	12 3/16
	4	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	4 3/4	3 3/8	1/4	1 1/4	3 1/2	12 1/16	12 1/8	11 5/16	13 1/8	14 1/8	12 3/16

Caution: When using mounting styles CB and G, check clearance between mounting members and rod attachment or accessory. If necessary, specify longer rod extension to avoid interference with mounting members.

Table 3 — Envelope and Mounting Dimensions

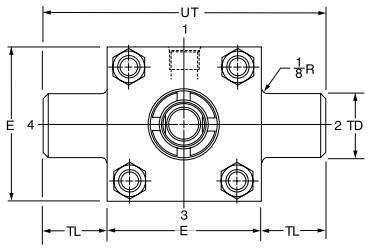
B

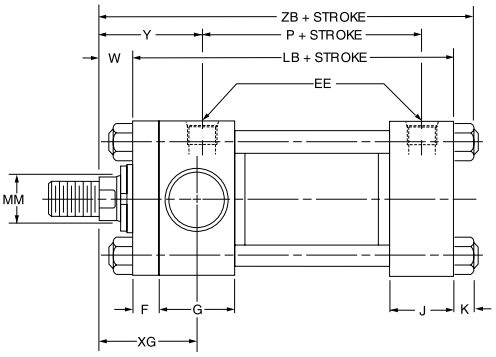
Head Trunnion Mounting
Style D
(NFPA Style MT1)



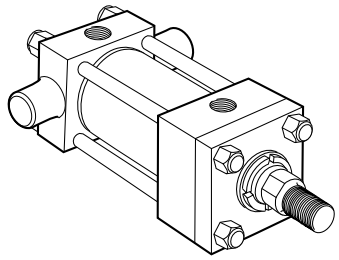
For "D" Style Mount
Maximum Pressure Rating - PSI

Bore	PSI
1 1/2	3000
2	3000
2 1/2	3000
3 1/4	2800
4	1800
5	1200
6	1000



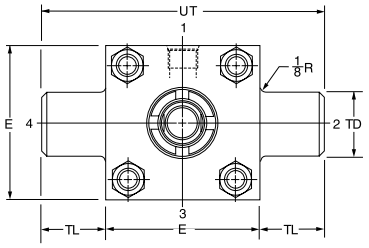


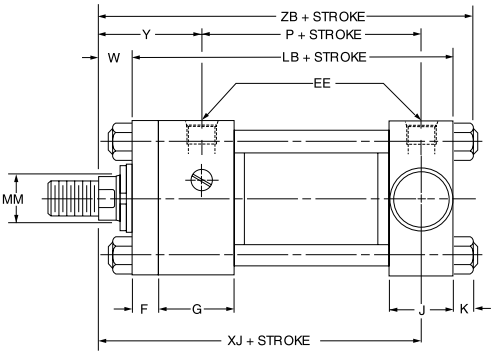
Cap Trunnion Mounting
Style DB
(NFPA Style MT2)



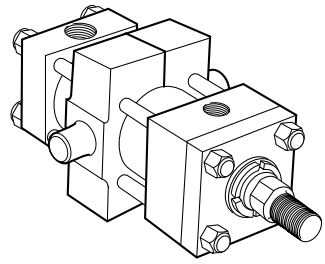
For "DB" Style Mount
Maximum Pressure Rating - PSI

Bore	PSI
1 1/2	3000
2	3000
2 1/2	3000
3 1/4	2800
4	1800
5	1200
6	1000



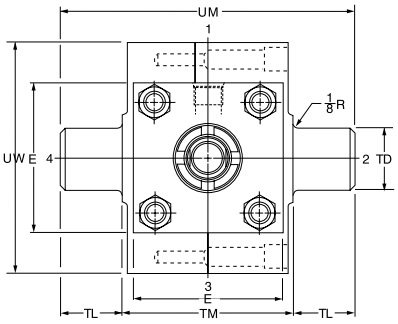


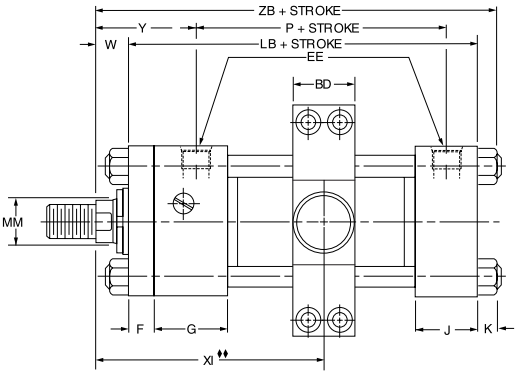
Intermediate Fixed Trunnion Mounting
Style DD
(NFPA Style MT4)



For "DD" Style Mount
Maximum Pressure Rating - PSI

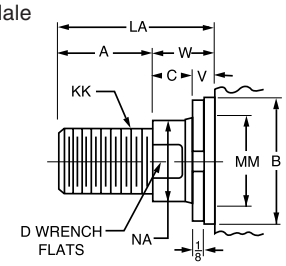
Bore	PSI
1 1/2	3000
2	3000
2 1/2	3000
3 1/4	2800
4	1800
5	1200
6	1000





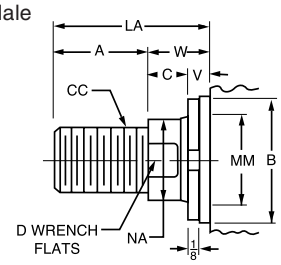
Rod End Dimensions — see table 2

Thread Style 4
(NFPA Style SM)
Small Male



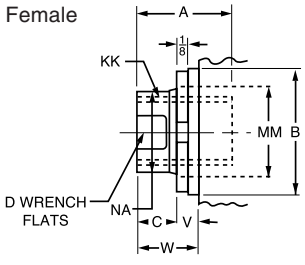
A high strength rod end stud is supplied on thread style 4 through 2" diameter rods and on thread style 8 through 1⅜" diameter rods. Larger sizes or special rod ends are cut threads. Style 4 rod ends are recommended where the workpiece is secured against the rod shoulder.

Thread Style 8
(NFPA Style IM)
Intermediate Male



When the workpiece is not shouldered, style 4 rod ends are recommended through 2" piston rod diameters and style 8 rod ends are recommended on larger diameters. Use style 9 for applications where female rod end threads are required. If rod end is not specified, style 4 will be supplied.

Thread Style 9
(NFPA Style SF)
Small Female



"Special" Thread Style 3
Special thread, extension, rod eye, blank, etc., are also available.

To order, specify "Style 3" and give desired dimensions for CC or KK, A and LA. If otherwise special, furnish dimensioned sketch.

For additional information – call your local Parker Cylinder Distributor.

Table 1—Envelope and Mounting Dimensions

Bore	BD	E	EE NPTF⊖	EE SAE★	F	G	J	K	+.000 -.001 TD	TL	TM	UM	UT	UW	Add Stroke LB	Add Stroke P	Style DD Minimum Stroke
1½	1¼	2½	½	10	⅜	1¾	1½	⅜	1.000	1	3	5	4½	3⅜	5	2⅞	0
2	1½	3	½	10	⅝	1¾	1½	7/16	1.375	1⅜	3½	6¼	5¾	4⅛	5¼	2⅞	¼
2½	1½	3½	½	10	⅝	1¾	1½	7/16	1.375	1⅜	4	6¾	6¼	4⅝	5⅜	3	⅛
3¼	2	4½	¾	12	¾	2	1¾	9/16	1.750	1¾	5	8½	8	5 13/16	6¼	3½	⅜
4	2	5	¾	12	⅞	2	1¾	9/16	1.750	1¾	5½	9	8½	6⅜	6⅝	3¾	⅛
5	2	6½	¾	12	⅞	2	1¾	13/16	1.750	1¾	7	10½	10	7¾	7⅛	4¼	0
6	3	7½	1	16	1	2¼	2¼	⅞	2.000	2	8½	12½	11½	10⅜	8⅜	4⅞	¼

★ SAE straight thread ports are standard and are indicated by port number.
⊖ NPTF ports are available at no extra charge.

Table 2—Rod Dimensions

Bore	Rod No.	Rod Dia. MM	Thread Style 8 CC	Thread Style 4 & 9 KK	Rod Extensions and Pilot Dimensions A	+.000 -.002 B	C	D	LA	NA	V	W	XG	Min. ◆◆ XI	Y	Add Stroke XJ	Add Stroke ZB
1½	1(Std.)	⅝	½-20	7/16-20	¾	1.124	⅜	½	1⅜	9/16	¼	⅝	1⅞	3 7/16	2	4⅞	6
	2	1	⅞-14	¾-16	1⅛	1.499	½	⅞	2⅛	15/16	½	1	2¼	3 13/16	2⅜	5¼	6⅜
2	1(Std.)	1	⅞-14	¾-16	1⅛	1.499	½	⅞	1⅞	15/16	¼	¾	2¼	3 15/16	2⅜	5¼	6 7/16
	2	1⅜	1¼-12	1-14	1⅝	1.999	⅝	1⅛	2⅝	1 5/16	⅜	1	2½	4 3/16	2⅝	5½	6 11/16
2½	1(Std.)	1	⅞-14	¾-16	1⅛	1.499	½	⅞	1⅞	15/16	¼	¾	2¼	3 15/16	2⅜	5⅜	6 9/16
	2	1¾	1½-12	1¼-12	2	2.374	¾	1½	3¼	1 11/16	½	1¼	2¾	4 7/16	2⅞	5⅞	7 1/16
	3	1⅜	1¼-12	1-14	1⅝	1.999	⅝	1⅛	2⅝	1 5/16	⅜	1	2½	4 3/16	2⅝	5⅝	6 13/16
3¼	1(Std.)	1⅜	1¼-12	1-14	1⅝	1.999	⅝	1⅛	2½	1 5/16	¼	⅞	2⅝	4 11/16	2¾	6¼	7 11/16
	2	2	1¾-12	1½-12	2¼	2.624	⅞	1 11/16	3½	1 15/16	⅜	1¼	3	5 1/16	3⅛	6⅝	8 1/16
	3	1¾	1½-12	1¼-12	2	2.374	¾	1½	3⅛	1 11/16	⅜	1⅛	2⅞	4 15/16	3	6½	7 15/16
4	1(Std.)	1¾	1½-12	1¼-12	2	2.374	¾	1½	3	1 11/16	¼	1	2⅞	4 15/16	3	6¾	8 3/16
	2	2½	2¼-12	1⅞-12	3	3.124	1	2 1/16	4⅜	2⅜	⅜	1⅜	3¼	5 5/16	3⅜	7⅛	8 9/16
	3	2	1¾-12	1½-12	2¼	2.624	⅞	1 11/16	3⅜	1 15/16	¼	1⅛	3	5 1/16	3⅛	6⅞	8 5/16
5	1(Std.)	2	1¾-12	1½-12	2¼	2.624	⅞	1 11/16	3⅜	1 15/16	¼	1⅛	3	5 1/16	3⅛	7⅜	9 1/16
	2	3½	3¼-12	2½-12	3½	4.249	1	3	4⅞	3⅜	⅜	1⅜	3¼	5 5/16	3⅜	7⅝	9 5/16
	3	2½	2¼-12	1⅞-12	3	3.124	1	2 1/16	4⅜	2⅜	⅜	1⅜	3¼	5 5/16	3⅜	7⅝	9 5/16
	4	3	2¾-12	2¼-12	3½	3.749	1	2⅝	4⅞	2⅞	⅜	1⅜	3¼	5 5/16	3⅜	7⅝	9 5/16
6	1(Std.)	2½	2¼-12	1⅞-12	3	3.124	1	2 1/16	4¼	2⅜	¼	1¼	3⅜	6 1/16	3½	8⅜	10½
	2	4	3¾-12	3-12	4	4.749	1	3⅜	5¼	3⅞	¼	1¼	3⅜	6 1/16	3½	8⅜	10½
	3	3	2¾-12	2¼-12	3½	3.749	1	2⅝	4¾	2⅞	¼	1¼	3⅜	6 1/16	3½	8⅜	10½
	4	3½	3¼-12	2½-12	3½	4.249	1	3	4¾	3⅜	¼	1¼	3⅜	6 1/16	3½	8⅜	10½

◆◆ Dimension XI to be specified by customer.

Table 3 — Envelope and Mounting Dimensions

Bore	Max. Op. PSI†
1½	1500
2	2200
2½	1450
3¼	1500
4	1850
5	2000
6	1800

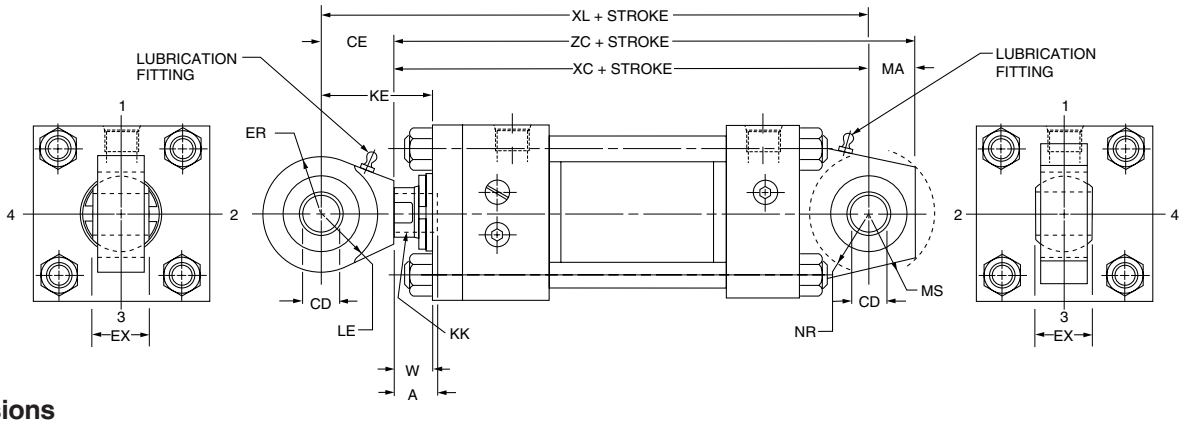


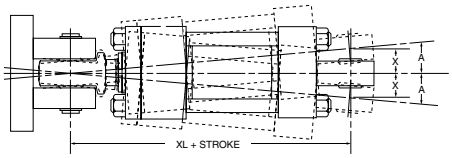
Table 1 — Dimensions

Bore	Rod No.	Rod Dia. MM	Thread Style 9 KK	Thread Style 7 KK	A	W	Add Stroke XC	Add Stroke XL	Add Stroke ZC	KE	CD*	CE	ER	EX	LE	MA	MS	NR
1½	1(Std.)	⅝	7/16-20	—	¾	⅝	6⅜	7¼	7⅛	1½	-.0005	⅞	13/16	7/16	¾	¾	15/16	⅝
	2	1	—	7/16-20	¾	1	6¾	7⅝	7½	1⅞	.5000							
2	1(Std.)	1	¾-16	—	1⅛	¾	7¼	8½	8¼	2	-.0005	1¼	1⅛	21/32	1 1/16	1	1⅜	1
	2	1⅜	—	¾-16	1⅛	1	7½	8¾	8½	2¼	.7500							
2½	1(Std.)	1	¾-16	—	1⅛	¾	7⅜	8⅝	8⅜	2	-.0005	1¼	1⅛	21/32	1 1/16	1	1⅜	1
	2	1¾	—	¾-16	1⅛	1¼	7⅞	9⅛	8⅞	2½	.7500							
	3	1⅜	—	¾-16	1⅛	1	7⅝	8⅞	8⅝	2¼								
3¼	1(Std.)	1⅜	1-14	—	1⅝	⅞	8⅝	10½	9⅞	2¾	-.0005	1⅞	1¼	⅞	1 7/16	1¼	1 11/16	1¼
	2	2	—	1-14	1⅝	1¼	9	10⅞	10¼	3⅛	1.0000							
	3	1¾	—	1-14	1⅝	1⅛	8⅞	10¾	10⅛	3								
4	1(Std.)	1¾	1¼-12	—	2	1	9¾	11⅞	11⅝	3⅛	-.0005	2⅛	1 11/16	1 3/16	1⅞	1⅞	2 7/16	1⅝
	2	2½	—	1¼-12	2	1⅜	10⅛	12¼	12	3½	1.3750							
	3	2	—	1¼-12	2	1⅛	9⅞	12	11¾	3¼								
5	1(Std.)	2	1½-12	—	2¼	1⅛	10½	13	13	3⅝								
	2	3½	—	1½-12	2¼	1⅜	10¾	13¼	13¼	3⅞	-.0005	2½	2 1/16	1 17/32	2⅛	2½	2⅞	2 1/16
	3	2½	—	1½-12	2¼	1⅜	10¾	13¼	13¼	3⅞	1.7500							
	4	3	—	1½-12	2¼	1⅜	10¾	13¼	13¼	3⅞								
6	1(Std.)	2½	1⅞-12	—	3	1¼	12⅛	14⅞	14⅝	4								
	2	4	—	1⅞-12	3	1¼	12⅛	14⅞	14⅝	4	-.0005	2¾	2½	1¾	2½	2½	3 5/16	2⅜
	3	3	—	1⅞-12	3	1¼	12⅛	14⅞	14⅝	4	2.0000							
	4	3½	—	1⅞-12	3	1¼	12⅛	14⅞	14⅝	4								

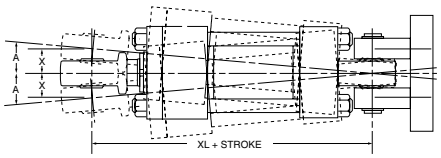
†Maximum operating pressure at 4:1 design factor is based on tensile strength of material. Pressure ratings are based on standard commercial bearing ratings.
Note: for additional dimensions see Series 2H Style BB mount.
Rod No. 1 is standard.
*Dimension "CD" is hole diameter.

Mounting Information

Head End Mounting



Cap End Mounting



Recommended maximum swivel angle on each side of the cylinder centerline.

Table 1

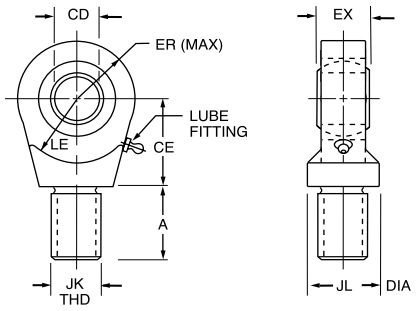
Bore	Head End Mounted Angle a	Head End Mounted Tan. of a	Cap End Mounted Angle a	Cap End Mounted Tan. of a
1½	2°	.035	2°	.035
2	2½°	.044	4½°	.079
2½	2½°	.044	4½°	.079
3¼	3°	.052	3°	.052
4	2½°	.044	3°	.052
5	3°	.052	3°	.052
6	3°	.052	3°	.052

Note: Dimension X is the maximum off center mounting of the cylinder. To determine dimension X for various stroke lengths multiply the distance between pivot pin holes by tangent of angle a. For extended position use X = XL times 2X stroke.

For additional information – call your local Parker Cylinder Distributor.

Parker offers a complete range of Cylinder Accessories to assure you of the greatest versatility in present or future cylinder applications. Accessories offered for the respective cylinder include the Rod Eye, Pivot Pin and Clevis Bracket. To select the proper part number for any desired accessory refer to the charts below.

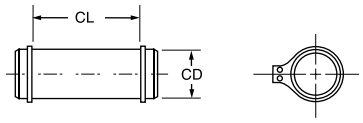
Spherical Rod Eye



Bore Sizes	Series 2H	1 1/2	2 & 2 1/2	3 1/4	4	5	6
Rod Eye	Part No.	132290	132291	132292	132293	132294	132295
	CD	.5000-0005	.7500-0005	1.0000-0005	1.3750-0005	1.7500-0005	2.0000-0005
	A	11/16	1	1 1/2	2	2 1/8	2 7/8
	CE	7/8	1 1/4	1 7/8	2 1/8	2 1/2	2 3/4
	EX	7/16	21/32	7/8	1 3/16	1 17/32	1 3/4
	ER	13/16	1 1/8	1 1/4	1 11/16	2 1/16	2 1/2
	LE	3/4	1 1/16	1 7/16	1 7/8	2 1/8	2 1/2
	JK	7/16-20	3/4-16	1-14	1 1/4-12	1 1/2-12	1 7/8-12
	JL	7/8	1 5/16	1 1/2	2	2 1/4	2 3/4
	LOAD CAPACITY LBS.	2644	9441	16860	28562	43005	70193

Order to fit Piston Rod Thread Size.

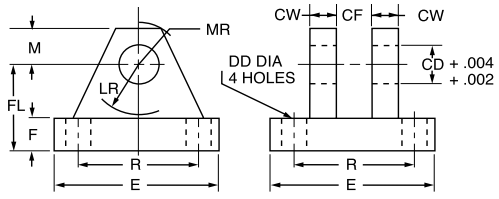
Pivot Pin



Bore Sizes	Series 2H	1 1/2	2 & 2 1/2	3 1/4	4	5	6
Pivot Pin	Part No.	83962	83963	83964	83965	83966	83967
	CD	.4997-0004	.7497-0005	.9997-0005	1.3746-0006	1.7496-0006	1.9996-0007
	CL	1 9/16	2 1/32	2 1/2	3 5/16	4 7/32	4 15/16
	SHEAR CAPACITY LBS.	8600	19300	34300	65000	105200	137400

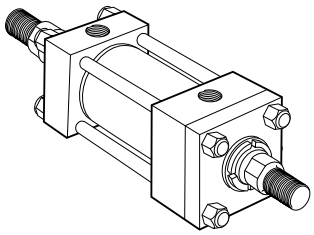
Pivot Pins are furnished with (2) Retainer Rings.

Clevis Bracket



Bore Sizes	Series 2H	1 1/2	2 & 2 1/2	3 1/4	4	5	6
Clevis Bracket	Part No.	83947	83948	83949	83950	83951	83952
	CD	1/2	3/4	1	1 3/8	1 3/4	2
	CF	7/16	21/32	7/8	1 3/16	1 17/32	1 3/4
	CW	1/2	5/8	3/4	1	1 1/4	1 1/2
	DD	13/32	17/32	17/32	21/32	29/32	29/32
	E	3	3 3/4	5 1/2	6 1/2	8 1/2	10 5/8
	F	1/2	5/8	3/4	7/8	1 1/4	1 1/2
	FL	1 1/2	2	2 1/2	3 1/2	4 1/2	5
	LR	15/16	1 3/8	1 11/16	2 7/16	2 7/8	3 5/16
	M	1/2	7/8	1	1 3/8	1 3/4	2
	MR	5/8	1	1 3/16	1 5/8	2 1/16	2 3/8
	R	2.05	2.76	4.10	4.95	6.58	7.92
	LOAD CAPACITY LBS.	5770	9450	14300	20322	37800	50375

Order to fit Mounting Plate or Rod Eye.



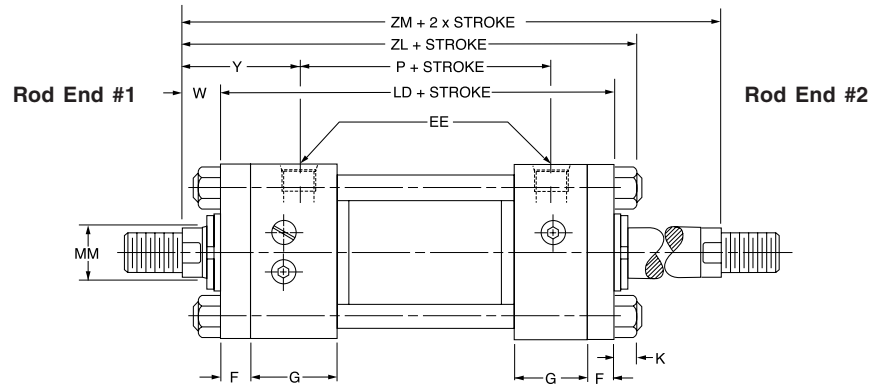
Mounting Styles for Single Rod Models	Mounting Styles for Corresponding Double Rod Models*	Dimensions Shown on This Page Supplement Dimensions on Pages Listed Below
		1½" - 6" Bores Page No.
T	KT	44
TB	KTB	44
TD	KTD	44
J	KJ	46
JB	KJB	46
JJ	KJJ	46
C	KC	50
E	KE	50
F	KF	50
CB	KCB	52
G	KG	52
D	KD	54
DD	KDD‡	54

*If only one end of these Double Rod Cylinders is to be cushioned, be sure to specify clearly which end this will be.

‡Specify XI dimension from rod end #1.

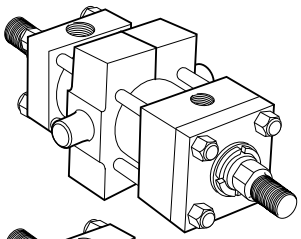
How to Use Double Rod Cylinder Dimensioned Drawings

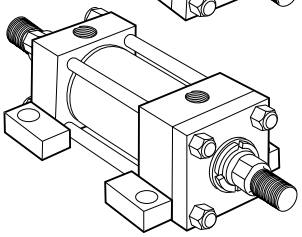
1½" to 6" Bores

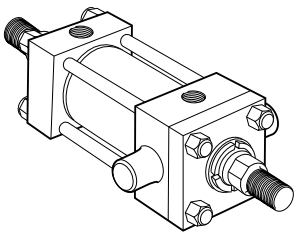


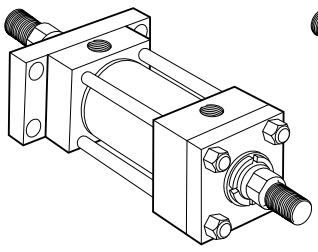
To determine dimensions for a double rod cylinder, first refer to the desired single rod mounting style cylinder shown on preceding pages of this catalog. (See table at left.) After selecting necessary dimensions from that drawing, return to this page supplement the single rod dimensions with those shown on drawing at right and dimension table below. Note that double rod cylinders have a head (Dim. G) at both ends and that dimension LD replaces LB and ZL replaces ZB, etc. The double rod dimensions differ from, or are in addition to those for single rod cylinders shown on preceding pages and provide the information needed to completely dimension a double rod cylinder.

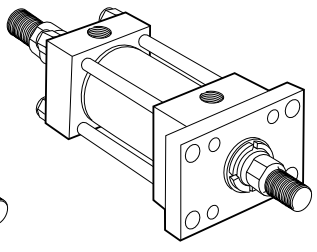
On a double rod cylinder where the two rod ends are different, be sure to clearly state which rod end is to be assembled at which end. Port position 1 is standard. If other than standard, specify pos. 2, 3 or 4 when viewed from rod end #1 only. See port position information in Section C.











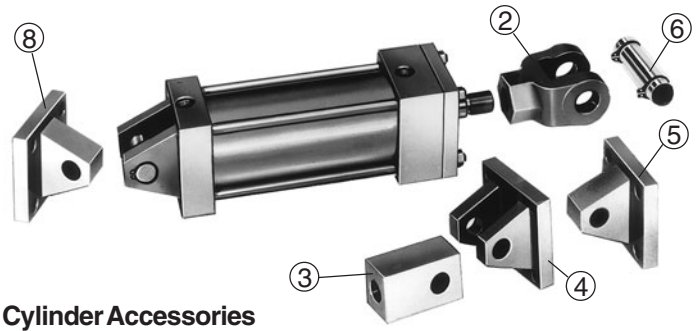
All dimensions are in inches and apply to Code 1 rod sizes only. For alternate rod sizes, determine all envelope dimensions (within LD dim.) as described above and then use appropriate rod end dimensions for proper rod size from single rod cylinder.

Bore	Rod No.	Rod Dia. MM		Add stroke									Add 2X Stroke
			LD	ZL	SAK	XAK	ZAK	SNK	SSK	SEK	XEK	ZEK	ZM
1½	1	5/8	5 5/8	6 1/4	7 5/8	7 1/4	7 5/8	2 7/8	4 1/8	7 3/8	7 1/8	7 1/2	6 7/8
2	1	1	6 1/8	6 7/8	8 5/8	8 1/8	8 5/8	2 7/8	3 7/8	8	7 13/16	8 5/16	7 5/8
2½	1	1	6 1/4	7	8 5/8	8 3/16	8 3/4	3	3 5/8	8 1/8	7 15/16	8 7/16	7 3/4
3¼	1	1 3/8	7 1/4	8 1/8	10 7/8	9 15/16	10 5/8	3 1/2	4 3/8	9 1/2	9 1/4	9 7/8	9
4	1	1 3/4	7 3/4	8 3/4	12	10 7/8	11 3/4	3 3/4	4 1/4	10	9 7/8	10 1/2	9 3/4
5	1	2	8 1/4	9 3/8	12 1/2	11 1/2	12 3/8	4 1/4	4 3/4	11 1/4	10 7/8	11 5/8	10 1/2
6	1	2½	9 3/8	10 5/8	14 1/4	13 1/16	14 1/8	4 7/8	5 1/8	12 3/4	12 5/16	13 3/16	11 7/8
Replaces:			**LB**	**ZB**	**SA**	**XA**	**ZA**	**SN**	**SS**	**SE**	**XE**	**ZE**	—
On single rod mounting styles:			All Mtg. Styles		CB			F	C,E	G			All Mtgs.

For additional information – call your local Parker Cylinder Distributor.

NOTES

Series 2H
Heavy Duty Hydraulic Cylinders



Cylinder Accessories

Parker offers a complete range of cylinder accessories to assure you of greatest versatility in present or future cylinder applications.

Rod End Accessories

Accessories offered for the rod end of the cylinder include Rod Clevis, Eye Bracket, Knuckle, Clevis Bracket and Pivot Pin. To select the proper part number for any desired accessory, refer to Chart A below and look opposite the thread size of the rod end as indicated in the first column. The Pivot Pins, Eye Brackets and Clevis Brackets are listed opposite the thread size which their mating Knuckles or Clevises fit.

Chart A

Thread Size	Mating Parts			Mating Parts			Alignment Coupler
	Rod Clevis	Eye Bracket	Pin	Knuckle	Clevis Bracket	Pin	
5/16-24	51221	74077	—	74075	74076	74078	134757 0031
7/16-20	50940	69195	68368	69089	69205	68368	134757 0044
1/2-20	50941	69195	68368	69090	69205	68368	134757 0050
3/4-16	50942	69196	68369	69091	69206	68369	134757 0075
3/4-16	133284	69196	68369	69091	69206	68369	134757 0075
7/8-14	50943	*85361	68370	69092	69207	68370	134757 0088
1-14	50944	*85361	68370	69093	69207	68370	134757 0100
1-14	133285	*85361	68370	69093	69207	68370	134757 0100
1 1/4-12	50945	69198	68371	69094	69208	68371	134757 0125
1 1/4-12	133286	69198	68371	69094	69208	68371	134757 0125
1 1/2-12	50946	*85362	68372	69095	69209	68372	133739 0150
1 3/4-12	50947	*85363	68373	69096	69210	69215	133739 0175
1 7/8-12	50948	*85363	68373	69097	69210	69215	133739 0188
2 1/4-12	50949	*85364	68374	69098	69211	68374	Consult Factory
2 1/2-12	50950	*85365	68375	69099	69212	68375	
2 3/4-12	50951	*85365	68375	69100	69213	69216	
3 1/4-12	50952	73538	73545	73536	73542	73545	
3 1/2-12	50953	73539	73547	73437	73542	73545	
4-12	50954	73539	73547	73438	73543	82181	

For alignment coupler dimensions, see section C.

*Cylinder accessory dimensions conform to NFPA recommended standard NFPA/T3.6.8 R1-1984, NFPA recommended standard fluid power systems — cylinder — dimensions for accessories for cataloged square head industrial types. Parker adopted this standard in April, 1985. Eye Brackets or Mounting Plates shipped before this date may have different dimensions and will not necessarily interchange with the NFPA standard. For dimensional information on older style Eye Brackets or Mounting Plates consult Drawing #144805 or previous issues of this catalog.

Accessory Load Capacity

The various accessories on this and the following pages have been load rated for your convenience. The load capacity in lbs., shown on the following page is the recommended maximum load for that accessory based on a 4:1 design factor in tension. (Pivot Pin is rated in shear.) Before specifying, compare the actual load or the tension (pull) force at maximum operating pressure of the cylinder with the load capacity of the accessory you plan to use. If load or pull force of cylinder exceeds load capacity of accessory, consult factory.

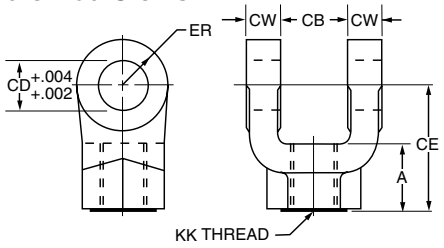
Chart B

Mtg. Plate Part No.	Series 2H Bore Size
69195	1 1/2"
69196	2", 2 1/2"
*85361	3 1/4"
69198	4"
*85362	5"
*85363	6"

Mounting Plates

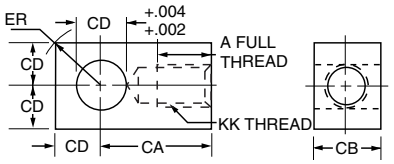
Mounting Plates for Style BB (clevis mounted) cylinders are offered. To select proper part number for your application, refer to Chart B, above right.

② Female Rod Clevis



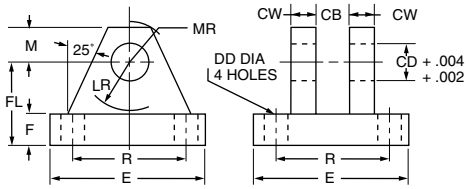
Order to fit thread size.

③ Knuckle (Female Rod Eye)



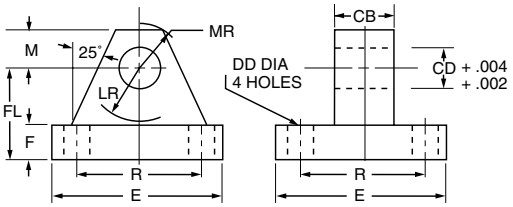
Order to fit thread size.

④ Clevis Bracket for Knuckle



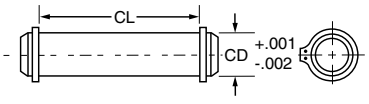
Order to fit Knuckle.

⑧ Mounting Plate or ⑤ Eye Bracket



1. When used to mate with the Rod Clevis, select from Chart A.
2. When used to mount the Style BB cylinders, select from the Mounting Plate Selection Table. See Chart B at lower left.

⑥ Pivot Pin



1. Pivot Pins are furnished with Clevis Mounted Cylinders as standard.
2. Pivot Pins are furnished with (2) Retainer Rings.
3. Pivot Pins must be ordered as separate item if to be used with Knuckles, Rod Clevises, or Clevis Brackets.

For additional information – call your local Parker Cylinder Distributor.

	Female Rod Clevis Part Number																		
	51221†	50940	50941	50942	133284	50943	50944	133285	50945	133286	50946	50947	50948	50949	50950	50951	50952	50953	50954
A	13/16	3/4	3/4	1 1/8	1 1/8	1 5/8	1 5/8	1 5/8	1 7/8	2	2 1/4	3	3	3 1/2	3 1/2	3 1/2	3 1/2‡†	4‡†	4‡†
CB	11/32	3/4	3/4	1 1/4	1 1/4	1 1/2	1 1/2	1 1/2	2	2	2 1/2	2 1/2	2 1/2	3	3	3	4	4 1/2	4 1/2
CD	5/16	1/2	1/2	3/4	3/4	1	1	1	1 3/8	1 3/8	1 3/4	2	2	2 1/2	3	3	3 1/2	4	4
CE	2 1/4	1 1/2	1 1/2	2 1/8	2 3/8	2 15/16	2 15/16	3 1/8	3 3/4	4 1/8	4 1/2	5 1/2	5 1/2	6 1/2	6 3/4	6 3/4	7 3/4	8 13/16	8 13/16
CW	13/64	1/2	1/2	5/8	5/8	3/4	3/4	3/4	1	1	1 1/4	1 1/4	1 1/4	1 1/2	1 1/2	1 1/2	2	2 1/4	2 1/4
ER	19/64	1/2	1/2	3/4	3/4	1	1	1	1 3/8	1 3/8	1 3/4	2	2	2 1/2	2 3/4	2 3/4	3 1/2	4	4
KK	5/16-24	7/16-20	1/2-20	3/4-16	3/4-16	7/8-14	1-14	1-14	1 1/4-12	1 1/4-12	1 1/2-12	1 3/4-12	1 7/8-12	2 1/4-12	2 1/2-12	2 3/4-12	3 1/4-12	3 1/2-12	4-12
Load Capacity Lbs. ⊖	2600	4250	4900	11200	11200	18800	19500	19500	33500	33500	45600	65600	65600	98200	98200	98200	156700	193200	221200

	Knuckle Part Number																
	74075	69089	69090	69091	69092	69093	69094	69095	69096	69097	69098	69099	69100	73536	73437	73438	73439
A	3/4	3/4	3/4	1 1/8	1 1/8	1 5/8	2	2 1/4	2 1/4	3	3 1/2	3 1/2	3 5/8	4 1/2	5	5 1/2	5 1/2
CA	1 1/2	1 1/2	1 1/2	2 1/16	2 3/8	2 13/16	3 7/16	4	4 3/8	5	5 13/16	6 1/8	6 1/2	7 5/8	7 5/8	9 1/8	9 1/8
CB	7/16	3/4	3/4	1 1/4	1 1/2	1 1/2	2	2 1/2	2 1/2	2 1/2	3	3	3 1/2	4	4	4 1/2	5
CD	7/16	1/2	1/2	3/4	1	1	1 3/8	1 3/4	2	2	2 1/2	3	3	3 1/2	3 1/2	4	4
ER	19/32	23/32	23/32	1 1/16	1 7/16	1 7/16	1 31/32	2 1/2	2 27/32	2 27/32	3 9/16	4 1/4	4 1/4	4 31/32	4 31/32	5 11/16	5 11/16
KK	5/16-24	7/16-20	1/2-20	3/4-16	7/8-14	1-14	1 1/4-12	1 1/2-12	1 3/4-12	1 7/8-12	2 1/4-12	2 1/2-12	2 3/4-12	3 1/4-12	3 1/2-12	4-12	4 1/2-12
Load Capacity Lbs. ⊖	3300	5000	5700	12100	13000	21700	33500	45000	53500	75000	98700	110000	123300	161300	217300	273800	308500

	Clevis Bracket for Knuckle Part Number												
	74076	69205	69206	69207	69208	69209	69210	69211	69212	69213	73542	73543	73544
CB	15/32	3/4	1 1/4	1 1/2	2	2 1/2	2 1/2	3	3	3 1/2	4	4 1/2	5
CD	7/16	1/2	3/4	1	1 3/8	1 3/4	2	2 1/2	3	3	3 1/2	4	4
CW	3/8	1/2	5/8	3/4	1	1 1/4	1 1/2	1 1/2	1 1/2	1 1/2	2	2	2
DD	17/64	13/32	17/32	21/32	21/32	29/32	1 1/16	1 3/16	1 5/16	1 5/16	1 13/16	2 1/16	2 1/16
E	2 1/4	3 1/2	5	6 1/2	7 1/2	9 1/2	12 3/4	12 3/4	12 3/4	12 3/4	15 1/2	17 1/2	17 1/2
F	3/8	1/2	5/8	3/4	7/8	7/8	1	1	1	1	1 11/16	1 15/16	1 15/16
FL	1	1 1/2	1 7/8	2 1/4	3	3 5/8	4 1/4	4 1/2	6	6	6 11/16	7 11/16	7 11/16
LR	5/8	3/4	1 3/16	1 1/2	2	2 3/4	3 3/16	3 1/2	4 1/4	4 1/4	5	5 3/4	5 3/4
M	3/8	1/2	3/4	1	1 3/8	1 3/4	2 1/4	2 1/2	3	3	3 1/2	4	4
MR	1/2	5/8	29/32	1 1/4	1 21/32	2 7/32	2 25/32	3 1/8	3 19/32	3 19/32	4 1/8	4 7/8	4 7/8
R	1.75	2.55	3.82	4.95	5.73	7.50	9.40	9.40	9.40	9.40	12.00	13.75	13.75
Load Capacity Lbs. ⊖	3600	7300	14000	19200	36900	34000	33000	34900	33800	36900	83500	102600	108400

	Eye Bracket and Mounting Plate Part Number										
	74077	69195	69196	85361*	69198	85362*	85363*	85364*	85365*	73538	73539
CB	5/16	3/4	1 1/4	1 1/2	2	2 1/2	2 1/2	3	3	4	4 1/2
CD	5/16	1/2	3/4	1	1 3/8	1 3/4	2	2 1/2	3	3 1/2	4
DD	17/64	13/32	17/32	21/32	21/32	29/32	1 1/16	1 3/16	1 5/16	1 13/16	2 1/16
E	2 1/4	2 1/2	3 1/2	4 1/2	5	6 1/2	7 1/2	8 1/2	9 1/2	12 5/8	14 7/8
F	3/8	3/8	5/8	7/8	7/8	1 1/8	1 1/2	1 3/4	2	1 11/16	1 15/16
FL	1	1 1/8	1 7/8	2 3/8	3	3 3/8	4	4 3/4	5 1/4	5 11/16	6 7/16
LR	5/8	3/4	1 1/4	1 1/2	2 1/8	2 1/4	2 1/2	3	3 1/4	4	4 1/2
M	3/8	1/2	3/4	1	1 3/8	1 3/4	2	2 1/2	2 3/4	3 1/2	4
MR	1/2	9/16	7/8	1 1/4	1 5/8	2 1/8	2 7/16	3	3 1/4	4 1/8	5 1/4
R	1.75	1.63	2.55	3.25	3.82	4.95	5.73	6.58	7.50	9.62	11.45
Load Capacity Lbs. ⊖	1700	4100	10500	20400	21200	49480	70000	94200	121900	57400	75000

	Pivot Pin Part Number													
	74078	68368	68369	68370	68371	68372	68373	69215	68374	68375	69216	73545	82181	73547•
CD	7/16	1/2	3/4	1	1 3/8	1 3/4	2	2	2 1/2	3	3	3 1/2	4	4
CL	1 5/16	1 7/8	2 5/8	3 1/8	4 1/8	5 3/16	5 3/16	5 11/16	6 3/16	6 1/4	6 3/4	8 1/4	8 5/8	9
Shear Capacity Lbs.⊖	6600	8600	19300	34300	65000	105200	137400	137400	214700	309200	309200	420900	565800	565800

*Cylinder accessory dimensions conform to NFPA recommended standard NFPA/T3.6.8 R1-1984, NFPA recommended standard fluid power systems — cylinder — dimensions for accessories for cataloged square head industrial types. Parker adopted this standard in April, 1985. Eye Brackets or Mounting Plates shipped before this date may have different dimensions and will not necessarily interchange with the NFPA standard. For dimensional information on older style Eye Brackets or Mounting Plates consult Drawing #144805 or previous issues of this catalog.

⊖ See Accessory Load Capacity note on previous page.

•These sizes supplied with cotter pins.

†Includes Pivot Pin.

Consult appropriate cylinder rod end dimensions for compatibility.

For Cylinder Division Plant Locations – See Page II.

How to Order Series "2H" Cylinders

When ordering Series 2H cylinders, please review the following:

Note: Duplicate cylinders can be ordered by giving the SERIAL NUMBER from the nameplate of the original cylinder. Factory records supply a quick positive identification.

Piston Rods: Specify rod code number based on diameter. Give thread style number for a standard thread or specify dimensions. See "Style 3 Rod End" below.

Cushions: If cushions are required specify according to the model number on the next page. If the cylinder is to have a double rod and only one cushion is required, be sure to specify clearly which end of the cylnder is to be cushioned.

Special Modifications: Additional information is required on orders for cylinders with special modifications. This is best handled with descriptive notes. For further information, consult factory.

Additional Lipseal® Piston (if desired): Parker Lipseal® pistons are offered as an option at no extra cost in the Series 2H cylinders. With this feature, zero leakage under static holding conditions is attained. Call out "with Lipseal piston" if this type of piston is desired. If not specified, the ring type piston will be furnished. Hi Load piston seals are available for an additional charge. Refer to the beginning of Section C for the benefits of this piston seal assembly.

Fluid Medium: Series 2H hydraulic cylinders are equipped with seals for use with hydraulic oil. If other than hydraulic oil will be used, specify class of fluid (See Catalog section C.)

Water Service Modifications

Standard – When requested, Parker can supply Series 2H cylinders with standard modifications that make the cylinders more nearly suitable for use with water as the fluid medium. The modifications include chrome-plated cylinder bore; electroless nickel-plated, non-wearing internal surfaces; Lipseal style piston, Buna N Seals and chrome-plated, stainless steel piston rod. On orders for water service cyinders, be sure to specify the maximum operating pressure.

(These factors must be taken into account because of the lower tensile strength of stainless steels available for use in piston rods.)

Warranty– Parker will warrant Series 2H cylinders modified for water service to be free of defects in materials or workmanship. On the other hand, Parker cannot accept responsibility for premature failure of cylinder function, where failure is caused by corrosion, electrolysis or mineral deposits within the cylinder.

Class 1 Seals

Class 1 seals are the seals provided as standard in a cylinder assembly unless otherwise specified. For further information on fluid compatibility or operating limitations of all components, see section C.

For the 2H series cylinders the following make-up Class 1 Seals:
Primary Piston Rod Seal – Enhanced Polyurethane
Piston Rod Wiper – Nitrile
Piston Seals – Cast Iron Rings
Option – Nitrile lipseals with polymyte back-up washers
Option – Hi-Load. Filled P.T.F.E. seals with a nitrile expander
O-Rings – Nitrile (nitrile back-up washer when used)

Combination Mountings

Single Rod End The first mounting is the one called out on the head end of the cylinder. The second or subsequent mountings are called out as they appear in the assembly moving away from the rod end. Exception: When tie rod mountings are part of a combination, the model number should contain an "S" (Special) in the model code and a note in the body of the order clarifying the mounting arrangement. The "P" is used to define a thrust key and is not considered to be a mounting. However, it is located at the primary end.

Example: 4.00 CCBB2HLTS14AC x 10.000

Combination "C" mounting head only. "BB" mounting cap end
This cylinder is also cushioned at both ends.

Double Rod End In general, the model number is read left to right corresponding to the cylinder as viewed from left to right with the primary end at rod end #1. See Double Rod Models information page in this section. For this option the piston rod number, piston rod end, and piston rod threads are to be specified for both ends. The simplest are for symmetric cylinders such as: TD, C, E, F, G, and CB mounts. All other mounting styless, the description of the first rod end will be at the mounting end. In the case of multiple mounts, the description of the first rod end will be at the primary mounting end. For "DD" mounts, the description of the first rod end will be the same location as the "XI" dimension.

Example: 4.00 KDD2HLT24A/18A x 10.000 XI=8

This is a center trunnion mounting cylinder with the XI dimension measured from the code 2 rod side of the cylinder which has the style 4 thread. The opposite end code 1 rod with the style 8 thread.

Style 3 Rod End

A style 3 rod end indicates a special rod end configuration. All special piston rod dimensions must have **all three:** KK; A; W/WF or LA/LAF specified with the rod fully retracted. A sketch or drawing should be submitted for rod ends requiring special machining such as snap ring grooves, keyways, tapers, multiple diameters, etc. It is good design practice to have this machining done on a diameter at least 0.065 inches smaller than the piston rod diameter. This allows the piston rod to have a chamfer preventing rod seal damage during assembly or maintenance. Standard style 55 rod ends with a longer than standard WG dimension should call out a style 3 rod end and the note: **same as 55 except WG=____**. A drawing should be submitted for special 55 rod ends that have specific tolerances or special radii. Special rod ends that have smaller than standard male threads, larger than standard female threads, or style 55 rod ends with smaller than standard AF or AE dimensions are to be reviewed by Engineering for proper strength at operating pressure.

Service Policy

On cylinders returned to the factory for repairs, it is standard policy for the Cylinder Division to make such part replacements as will put the cylinder in as good as new condition. Should the condition of the returned cylinder be such that expenses for repair would exceed the costs of a new one, you will be notified.

Address all correspondence and make shipments to, Service Department at your nearest regional plant listed in the pages of this catalog.

Certified Dimensions

Parker Cylinder Division guarantees that all cylinders ordered from this catalog will be built to dimensions shown. All dimensions are certified to be correct, and thus it is not necessary to request certified drawings.

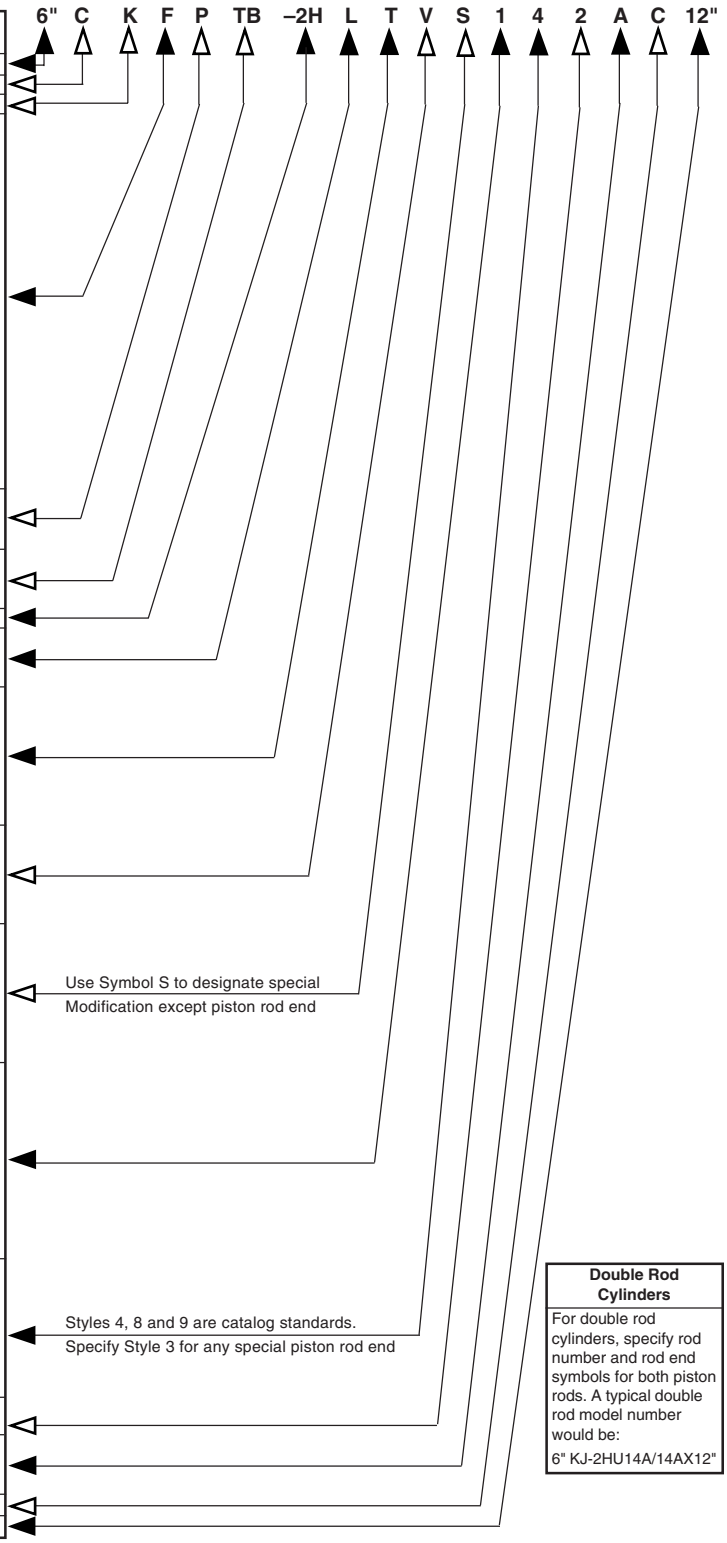
For additional information – call your local Parker Cylinder Distributor.

Series "2H" Model Numbers – How to Develop Them – How to "Decode" Them

Parker Series 2H cylinders can be completely and accurately described by a model number consisting of coded symbols. To develop a model number, select only those symbols that represent the cylinder required, and place them in the sequence indicated below.

Note: Page numbers with a letter prefix, ie: C77, are located in section C of this catalog.

Feature	Description	Page No.	Symbol
Bore*	Specify in inches		
Cushion-Head	Used **only** if cushion required	C94,42 & 43	C
Double-Rod	Used **only** if double-rod cylinder is required	58	K
Mounting* Style	Head Tie Rods Extended	44	TB
	Cap Tie Rods Extended	44	TC
	Both End Tie Rods Extended	44	TD
	Head Rectangular Flange	46	J
	Head Square Flange	46	JB
	Head Rectangular	46	JJ
	Cap Rectangular Flange	48	H
	Cap Square Flange	48	HB
	Cap Rectangular	48	HH
	Side Lugs	50	C†
	Centerline Lugs	50	E
	Side Tapped	50	F†
	Side End Angles	52	CB
	Side End Lugs	52	G†
	Cap Fixed Clevis	52	BB
	Head Trunnion	54	D
	Cap Trunnion	54	DB
	Intermediate Fixed Trunnion‡	54	DD
	Spherical Bearing	56	SB
Modifications Mounting	Used **only** for Thrust Key (Styles C,F,G, & CB)	C93	P
	Used **only** for Manifold Port O-Ring Seal (Style C)	C91	M
Combination Mounting Style	Any Practical Mounting Style	–	As
	Listed Above	–	listed
		–	above
Series*	Used in **all** 2H Model Numbers	–	–2H
Piston	Ring packed piston standard	–	C
	Used **only** for Lipseal® Piston	43	L
	Used **only** for Hi-Load Piston	43	K
Ports*	SAE Straight Thread O-Ring Port (Standard)	C89	T
	Used **only** for NPTF (Dry Seal Pipe Thread)	C89	U
	Used **only** for BSP (Parallel Thread ISO 228)	C89	R
	Used **only** for SAE Flange Ports (3000 psi)	C89	P
	Used **only** for BSPT (Taper Thread)	C89	B
	Used **only** for Metric Thread	C89	G
	Used **only** for Metric Thread per ISO 6149	C89	Y
Common Modifications	High Water Content Fluid	C83	J
	Nut Retained Piston	43	F
	Fluorocarbon Seals	C83	V
	Water Service	C83	W
	EPR Seals	C83	X
Special Modifications	Used **only** if special Modifications are required: Oversize Ports	C91	S
	Port Position Change	C89	
	Special Seals	C83	
	Stop Tube•	C95	
	Stroke Adjuster	C93	
	Tie Rod Supports	C93	
Piston Rod* Number	For Single Rod Cylinders, select one only.	–	1
	Refer to Rod number listing, Table 2,	–	2
	Pages 44 through 55	–	3
	See chart in Section C for minimum piston rod	–	4
	diameter	–	5
		–	6
		–	7
		–	8
		–	9
		–	0
Piston* Rod End	Select:		
	Style 4 Small Male	C92	4
	Style 7 Female Thread for Spherical Rod Eye	B56	7
	Style 8 Intermediate Male	C92	8
	Style 9 Short Female	C92	9
	Style 55 Rod End for Flange Coupling	C19	55
	Style 3 Special (Specify)	C92	3
Piston Rod Alternate Thds.	Used **only** for stud two times longer than standard.	C92	2
Piston Rod* Threads	UNF Standard	C92	A
	BSF (British Fine)	C92	W
	Metric	C92	M
Cushion-Cap	Used **only** if cushion required	C94, 42 & 43	C
Stroke* •	Specify in inches	C93	–



Double Rod Cylinders

For double rod cylinders, specify rod number and rod end symbols for both piston rods. A typical double rod model number would be:

6" KJ-2HU14A/14AX12"

*Required for Basic Cylinder Model Number

•In case of Stop Tube, call out Gross Stroke Length

†Cylinders with these mounting styles should have a minimum stroke length equal to or greater than their bore size.

Dark Arrows Indicate Basic Minimum Model Number

‡Specify XI dimension

For Cylinder Division Plant Locations – See Page II.

Parker TS-2000 seal designed to eliminate cylinder rod seal leakage.

Parker Series 2H Heavy Duty and Series 3L Medium Duty Hydraulic Cylinders with the TS-2000 seal offers positive protection against cylinder rod leakage under the most demanding applications.

The TS-2000 seal is the product of countless hours of research, development and extensive field testing and is only available on Parker Cylinders.

Based on the popular Parker Serrated Lipseal rod design, the TS-2000 incorporates the pressure-compensated, uni-directional characteristics of a U-cup with the multiple edge sealing effectiveness of compression-type stacked-packings.

The goal for the Parker team was to design a rod seal suitable for all types of applications, regardless of pressure profile. It had to be composed of a material that would not react chemically with hydraulic fluids. And it had to produce better and more reliable "dry rod" performance than the standard serrated lip-seal design in a broad range of applications.

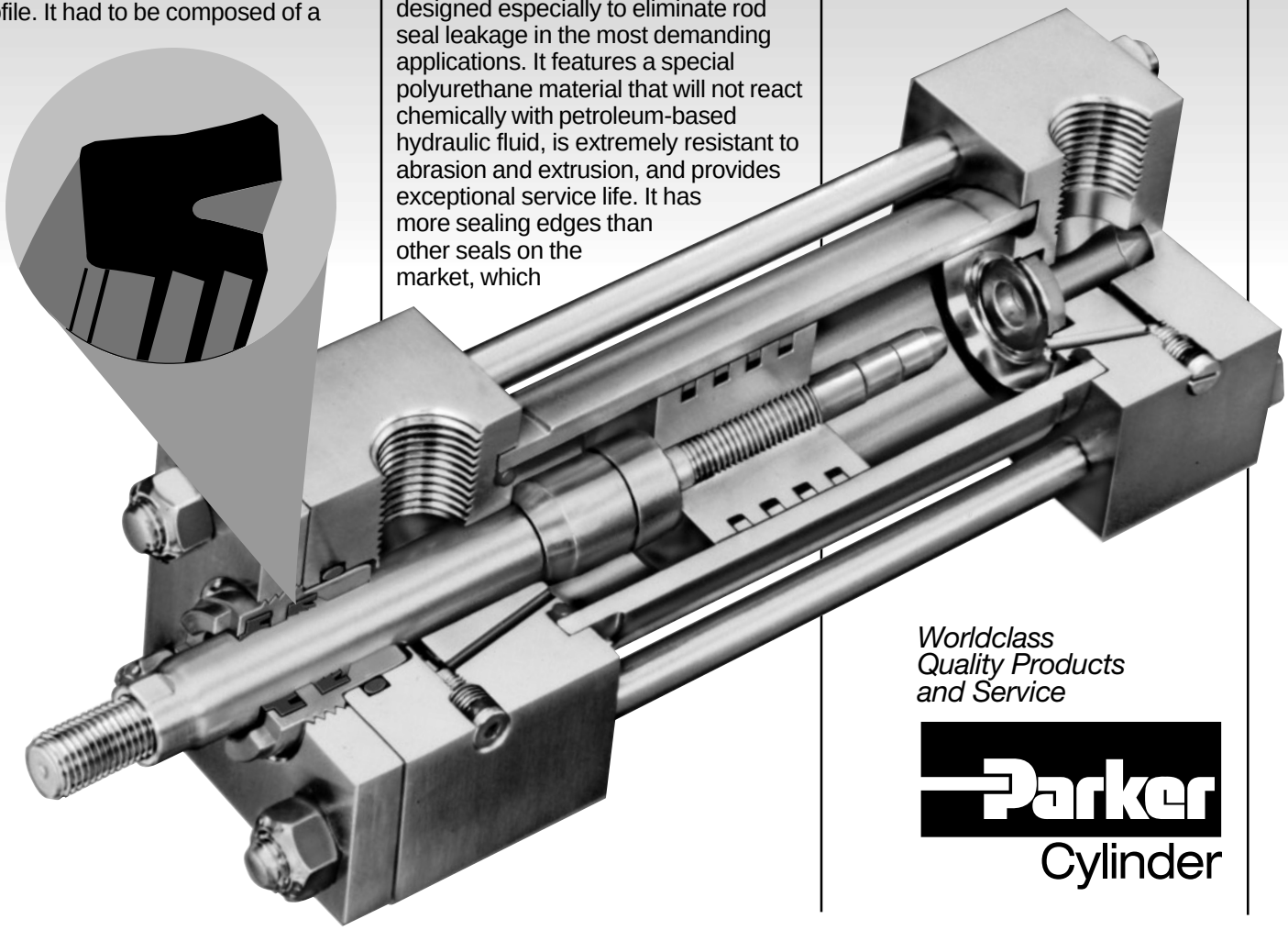
"Jewel" gland with wiperseal and TS-2000 cylinder rod seal.

The result is the TS-2000 seal, designed especially to eliminate rod seal leakage in the most demanding applications. It features a special polyurethane material that will not react chemically with petroleum-based hydraulic fluid, is extremely resistant to abrasion and extrusion, and provides exceptional service life. It has more sealing edges than other seals on the market, which in turn produces "dry rod" performance. The seal geometry was refined for maximum stability in the groove and has excellent performance characteristics throughout a broad range of pressures and piston rod velocities.

The Parker design team was successful!

TS-2000 rod seal has not failed in any of the test applications in the lab or on the job, no matter how tough or demanding.

For more information on the TS-2000 call or write your local Parker distributor or Parker Hannifin Corporation, Cylinder Division, 500 S. Wolf Road, Des Plaines, IL 60016, 847-298-2400.



Worldclass Quality Products and Service

Parker Cylinder

For additional information – call your local Parker Cylinder Distributor.

Inch Tube Pressure Ratings

Inch Tubes*						
			Design Pressure (4:1 Design Factor), PSI			
Tube O.D. (in.)	Wall Thick. (in.)	Tube I.D. (in.)	Steel 1010	Steel 1021	Stainless Steel 304 & 316, 4130, HSLA	Copper
0.125	0.010	0.105	2150	2600	3250	1050
0.125	0.020	0.085	4600	5500	6900	2200
0.125	0.028	0.069	6650	8000	10000	3200
0.125	0.035	0.055	8450	10150	12700	4050
0.188	0.010	0.168	1400	1700	2100	650
0.188	0.020	0.148	2950	3550	4450	1400
0.188	0.028	0.132	4250	5100	6400	2050
0.188	0.035	0.118	5450	6550	8200	2600
0.188	0.049	0.090	7850	9400	11800	3750
0.250	0.020	0.210	2150	2600	3250	1050
0.250	0.028	0.194	3100	3700	4650	1500
0.250	0.035	0.180	3950	4750	5950	1900
0.250	0.049	0.152	5750	6900	8650	2750
0.250	0.058	0.134	6900	8300	10400	3300
0.250	0.065	0.120	7800	9350	11750	3750
0.250	0.083	0.084	9950	11950	15000	4800
0.313	0.020	0.273	1700	2050	2550	800
0.313	0.028	0.257	2450	2950	3650	1150
0.313	0.035	0.243	3100	3700	4650	1500
0.313	0.049	0.215	4500	5400	6750	2150
0.313	0.058	0.197	5400	6500	8150	2600
0.313	0.065	0.183	6150	7400	9250	2950
0.313	0.072	0.169	6850	8200	10350	3300
0.313	0.083	0.147	8000	9600	12050	3850
0.313	0.095	0.123	9150	11000	13800	4400
0.375	0.020	0.335	1400	1700	2100	650
0.375	0.028	0.319	2000	2400	3000	950
0.375	0.035	0.305	2550	3050	3850	1200
0.375	0.049	0.277	3650	4400	5550	1750
0.375	0.058	0.259	4450	5350	6650	2100
0.375	0.065	0.245	5000	6000	7550	2400
0.375	0.072	0.231	5600	6700	8450	2700
0.375	0.083	0.209	6550	7900	9900	3150
0.375	0.095	0.185	7600	9100	11450	3650
0.375	0.109	0.157	8750	10500	13200	4200
0.500	0.028	0.444	1500	1800	2200	700
0.500	0.035	0.430	1850	2200	2800	900
0.500	0.049	0.402	2700	3250	4050	1300
0.500	0.058	0.384	3250	3900	4850	1550
0.500	0.065	0.370	3650	4400	5500	1750
0.500	0.072	0.356	4100	4900	6150	1950
0.500	0.083	0.334	4800	5750	7200	2300
0.500	0.095	0.310	5550	6650	8350	2650
0.500	0.109	0.282	6450	7750	9750	3100
0.500	0.120	0.260	7200	8650	10800	3450
0.500	0.134	0.232	8050	9650	12150	3850
0.500	0.148	0.204	8950	10750	13450	4300
0.500	0.188	0.124	11050	13250	16600	5300

Inch Tubes*						
			Design Pressure (4:1 Design Factor), PSI			
Tube O.D. (in.)	Wall Thick. (in.)	Tube I.D. (in.)	Steel 1010	Steel 1021	Stainless Steel 304 & 316, 4130, HSLA	Copper
0.625	0.028	0.569	1150	1400	1750	550
0.625	0.035	0.555	1500	1800	2200	700
0.625	0.049	0.527	2100	2500	3200	1000
0.625	0.058	0.509	2550	3050	3800	1200
0.625	0.065	0.495	2850	3400	4300	1350
0.625	0.072	0.481	3200	3850	4800	1550
0.625	0.083	0.459	3750	4500	5650	1800
0.625	0.095	0.435	4350	5200	6550	2100
0.625	0.109	0.407	5050	6050	7600	2450
0.625	0.120	0.385	5600	6700	8450	2700
0.625	0.134	0.357	6350	7600	9550	3050
0.750	0.035	0.680	1200	1450	1850	600
0.750	0.049	0.652	1750	2100	2600	850
0.750	0.058	0.634	2100	2500	3150	1000
0.750	0.065	0.620	2350	2800	3550	1150
0.750	0.072	0.606	2650	3200	3950	1250
0.750	0.083	0.584	3050	3650	4600	1450
0.750	0.095	0.560	3550	4250	5350	1700
0.750	0.109	0.532	4150	5000	6200	2000
0.750	0.120	0.510	4600	5500	6900	2200
0.750	0.134	0.482	5200	6250	7800	2500
0.750	0.148	0.454	5800	7000	8700	2800
0.750	0.188	0.374	7500	9000	11300	3600
0.875	0.035	0.805	1050	1250	1550	500
0.875	0.049	0.777	1500	1800	2200	700
0.875	0.058	0.759	1750	2100	2650	850
0.875	0.065	0.745	2000	2400	3000	950
0.875	0.072	0.731	2200	2650	3350	1050
0.875	0.083	0.709	2600	3100	3900	1250
0.875	0.095	0.685	3000	3600	4500	1450
0.875	0.109	0.657	3500	4200	5250	1650
0.875	0.120	0.635	3900	4700	5850	1850
0.875	0.134	0.607	4400	5300	6600	2100
0.875	0.148	0.579	4900	5900	7350	2350
1.000	0.035	0.930	900	1100	1350	450
1.000	0.049	0.902	1300	1550	1950	600
1.000	0.058	0.884	1550	1850	2300	750
1.000	0.065	0.870	1750	2100	2600	850
1.000	0.072	0.856	1950	2350	2900	950
1.000	0.083	0.834	2250	2700	3400	1100
1.000	0.095	0.810	2600	3100	3900	1250
1.000	0.109	0.782	3000	3600	4550	1450
1.000	0.120	0.760	3350	4000	5050	1600
1.000	0.134	0.732	3800	4550	5700	1800
1.000	0.148	0.704	4200	5050	6350	2000
1.000	0.156	0.688	4450	5350	6700	2150
1.000	0.188	0.624	5500	6600	8250	2650
1.000	0.220	0.560	6550	7850	9800	3150

* See Table U8 for tube specifications.

Table U15 — Inch Tube Pressure Ratings

Parker Hannifin Corporation
Tube Fittings Division
Columbus, Ohio
www.parker.com/tfd

Inch Tube Pressure Ratings (cont'd.)

Inch Tubes*						
			Design Pressure (4:1 Design Factor), PSI			
Tube O.D. (in.)	Wall Thick. (in.)	Tube I.D. (in.)	Steel 1010	Steel 1021	Stainless Steel 304 & 316, 4130, HSLA	Copper
1.250	0.049	1.152	1000	1200	1550	500
1.250	0.058	1.134	1200	1450	1850	600
1.250	0.065	1.120	1350	1600	2050	650
1.250	0.072	1.106	1500	1800	2300	750
1.250	0.083	1.084	1750	2100	2650	850
1.250	0.095	1.060	2050	2450	3050	1000
1.250	0.109	1.032	2350	2800	3550	1150
1.250	0.120	1.010	2650	3200	3950	1250
1.250	0.134	0.982	2950	3550	4450	1400
1.250	0.148	0.954	3300	3950	4950	1600
1.250	0.156	0.938	3500	4200	5250	1700
1.250	0.188	0.874	4300	5150	6450	2050
1.250	0.22	0.810	5100	6100	7700	2450
1.500	0.065	1.370	1150	1400	1700	550
1.500	0.072	1.356	1250	1500	1900	600
1.500	0.083	1.334	1450	1750	2200	700
1.500	0.095	1.310	1700	2050	2550	800
1.500	0.109	1.282	1950	2350	2950	950
1.500	0.120	1.260	2150	2600	3250	1050
1.500	0.134	1.232	2450	2950	3650	1150
1.500	0.148	1.204	2700	3250	4050	1300
1.500	0.156	1.188	2850	3400	4300	1350
1.500	0.188	1.124	3500	4200	5300	1700
1.500	0.220	1.060	4150	5000	6300	2000
1.500	0.250	1.000	4800	5750	7250	2300
2.000	0.065	1.870	850	1000	1250	400
2.000	0.072	1.856	950	1150	1400	450
2.000	0.083	1.834	1100	1300	1600	500
2.000	0.095	1.810	1250	1500	1850	600
2.000	0.109	1.782	1450	1750	2150	700
2.000	0.120	1.760	1600	1900	2400	750
2.000	0.134	1.732	1800	2150	2700	850
2.000	0.148	1.704	2000	2400	3000	950
2.000	0.156	1.688	2100	2500	3150	1000
2.000	0.188	1.624	2550	3050	3850	1250
2.000	0.220	1.560	3050	3650	4600	1450
2.000	0.250	1.500	3500	4200	5250	1700
2.000	0.281	1.438	4000	4800	6000	1900

* See Table U8 for tube specifications.

Table U15 — Inch Tube Pressure Ratings, cont'd.

Parker Hannifin Corporation
Tube Fittings Division
Columbus, Ohio
www.parker.com/tfd

Parker Series 2A Air Cylinder

When the job calls for reliable, heavy-duty performance, specify Series 2A. A 100,000 psi yield strength chrome-plated, case-hardened piston rod. A 125,000 psi yield strength rod-end stud with rolled threads. 100,000 psi yield strength tie rods. With construction like this, the Parker Series 2A is rated for air service to 250 psi. This is one heavy-duty air cylinder that's really heavy duty.

They're truly premium quality cylinders, factory prelubricated for millions of maintenance-free cycles. And to make sure every cylinder is premium quality, we subject each and every one – not just batch samples – to tough inspection and performance tests. See pages 18 and 19 for the inside story on all the features that make Series 2A the high performance, long lasting choice for all your heavy-duty air applications.

For additional information – call your local Parker Cylinder Distributor.

Standard Specifications

- Heavy Duty Service – ANSI/(NFPA) T3.6.7R2-1996 Specifications and Mounting Dimension Standards
- Standard Construction – Square Head – Tie Rod Design
- Nominal Pressure – Up to 250 PSI Air Service
- Standard Fluid – Filtered Air
- Standard Temperature – -10°F. to +165°F.
- Bore Sizes – 1" through 14" (Larger sizes available)

In line with our policy of continuing product improvement, specifications in this catalog are subject to change.

- Piston Rod Diameter – 1/2" through 5 1/2"
- Mounting Styles – 17 standard styles at various application ratings
- Strokes – Available in any practical stroke length
- Cushions – Optional at either end or both ends of stroke. "Float Check" at cap end.
- Rod Ends – Three Standard Choices – Specials to Order

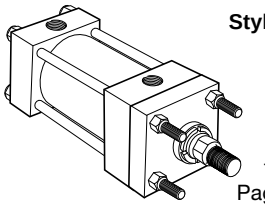
*See section C, "Operating Fluids and Temperature Range" for higher temperature service.

Note: Series 2A Air Cylinders fully meet ANSI/(NFPA) T3.6.7R2-1996 Specifications and Mounting Dimension Standards for Square Head Industrial Fluid Power Cylinders.
Parker Style TB, JB, HB, C, DB, and BB are available in 7" bore size, see page 32.

A

Available Mounting Styles

Tie Rods Extended Head End
Style TB



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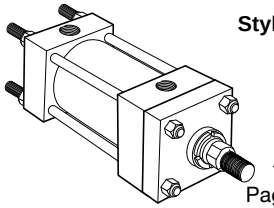
(NFPA MX3) 8"-14", Page 34

Tie Rods Extended Cap End
Style TC



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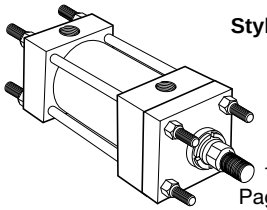
(NFPA MX2) 8"-14", Page 34

Tie Rods Extended Both Ends
Style TD



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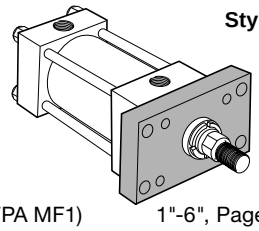
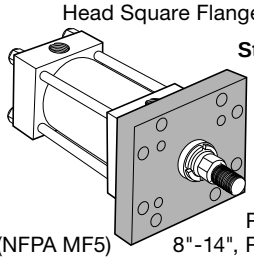
(NFPA MX1) 8"-14", Page 34

Head Rectangular Flange
Style J



(NFPA MF1) 1"-6", Page 20

Head Square Flange
Style JB



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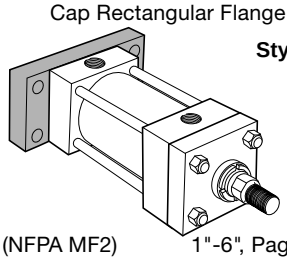
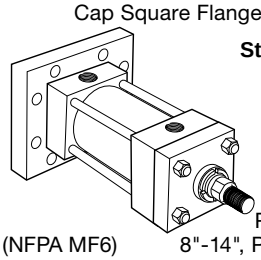
(NFPA MF5) 8"-14", Page 34

Cap Rectangular Flange
Style H



(NFPA MF2) 1"-6", Page 20

Cap Square Flange
Style HB



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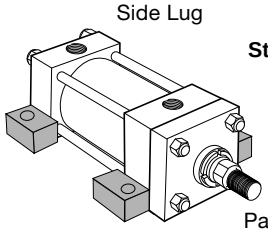
(NFPA MF6) 8"-14", Page 34

Side Lug
Style C



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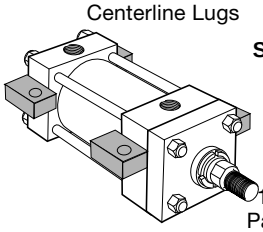
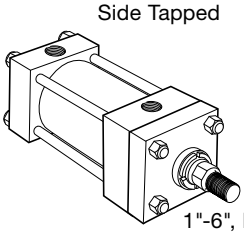
(NFPA MS2) 8"-14", Page 36

Centerline Lugs
Style E



1 1/2"-6", Page 24
(NFPA MS3) 8"-14", Page 36

Side Tapped
Style F



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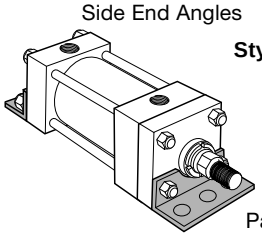
(NFPA MS4) 8"-14", Page 38

Side End Angles
Style CB



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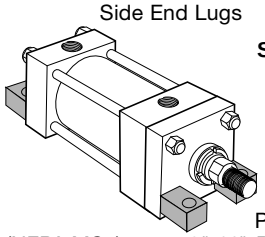
(NFPA MS1) 8"-14", Page 40

Side End Lugs
Style G



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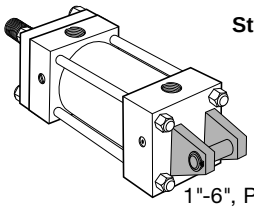
(NFPA MS7) 8"-14", Page 38

Cap Fixed Clevis
Style BB



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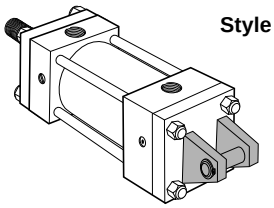
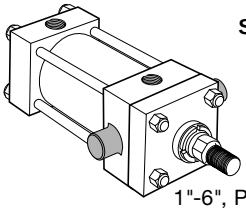
(NFPA MP1) 8"-14", Page 40

Cap Detachable Clevis
Style BC



(NFPA MP2) 1"-6", Page 30

Head Trunnion
Style D



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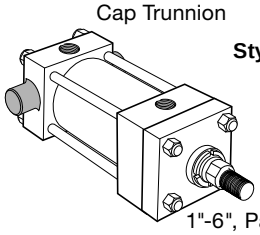
(NFPA MT1) 8"-14", Page 42

Cap Trunnion
Style DB



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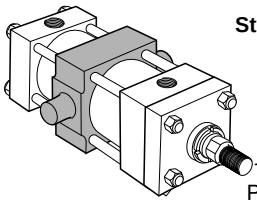
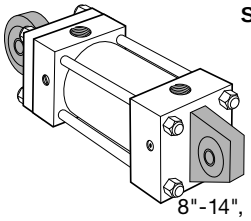
Intermediate Fixed Trunnion
Style DD



1 1/2"-6", Page 28
(NFPA MT4) 8"-14", Page 42

Spherical Bearing
Style SB



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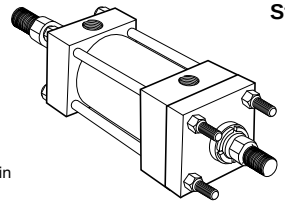
8"-14", Page 45

Double Rod Cylinders
Style KTB Shown



Most of the above illustrated mounting styles are available in double rod cylinders.
See Catalog Page 46.

For Cylinder Division Plant Locations – See Page II.

Parker Cylinder

The inside story on why Series 2A is your best choice in heavy duty pneumatic cylinders

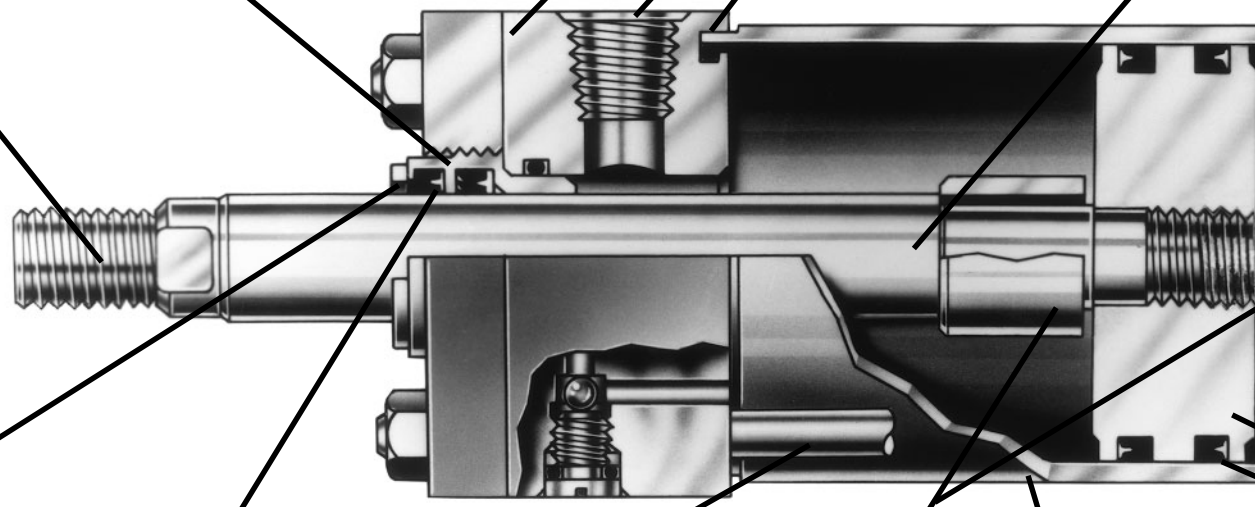
Steel Head – Bored and grooved to provide concentricity for mating parts.

Ports – NPTF ports are standard.

End Seals – Pressure-actuated cylinder body-to-head and cap "O" rings.

Primary Seal – Unique Serrated Lipseal® is a proven leakproof design, (Parker Patent #2997318) – completely self-compensating and self-relieving to withstand variations and conform to mechanical deflection that may occur.

Piston Rod Stud – Furnished on 2" diameter rods and smaller when standard style #4 rod end threads are required or on $1^{3}/_{8}$" diameter rods and smaller when style #8 threads are required. Also available in 2 times the catalog "A" dimension length. Studs have rolled threads and are made from high strength steel. Anaerobic adhesive is used to permanently lock the stud to the piston rod.



"Jewel" Rod Gland Assembly – Externally removable without cylinder disassembly. Long bearing surface is inboard of the seals, assuring positive lubrication from within the cylinder. An "O" ring is used as a seal between gland and head, and also serves as a prevailing torque-type lock.

Secondary Seal – Double-Service Wiperseal® (Parker Patent #2907596) – acts as a secondary pressure seal on the extend stroke and cleans the rod on the return stroke.

High Strength Tie Rods – Made from 100,000 psi minimum yield steel with rolled threads for added strength.

Adjustable Floating Cushions – Cushions are optional and can be supplied at head end, cap end, or both ends without change in envelope or mounting dimensions.

The Cylinder Body – Hard chrome-plated bore, steel tubing honed to a 15 micro inch finish on $1^{1}/_{2}$" through 14" bore sizes. 1" bore size is aluminum with hard-coated bore.

Adjustable floating cushions

Cushions are optional, and can be supplied at head end, cap end, or both ends without change in envelope or mounting dimensions. All Parker cushions are adjustable.

The Series 2A cylinder design incorporates the longest cushion sleeve and cushion spear that can be provided in the standard envelope without decreasing the rod bearing and piston bearing lengths.

(1) When a cushion is specified at the head end:

a. A self-centering sleeve is furnished on the piston rod assembly.

b. A needle valve is provided that is flush with the side of the head when wide open. It may be identified by the fact that it is socket-keyed. It is located on side number 2, in all mounting styles except D, DB, DD, and E. In these styles it is located on side number 3.

c. A springless check valve is provided that is also flush with the side of the head and is mounted adjacent to the needle valve except on certain bores of mounting style C where it is mounted opposite the needle valve. It may be identified by the fact that it is slotted.

d. The check and needle valves are interchangeable in the head.

(2) When a cushion is specified at the cap end:

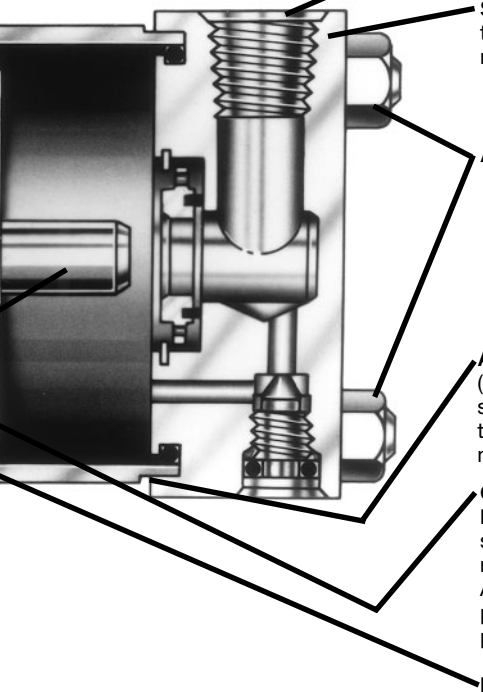
a. A cushion spear is provided on the piston rod assembly.

b. A "float check" self-centering bushing is provided which incorporates a large flow check valve for fast "out-stroke" action.

c. A socket-keyed needle valve is provided that is flush with the side of the cap when wide open. It is located on side number 2 in all mounting styles except D, DB, DD, and E. In these styles it is located on side number 3.

For additional information – call your local Parker Cylinder Distributor.

Piston Rod – Medium carbon steel, induction case-hardened to 54 R_C, hard chrome-plated and polished to 10 RMS finish. Piston rods are made from 90,000 to 100,000 psi minimum yield material in 1/2" through 4" diameters. Larger diameters vary between 57,000 and 90,000 psi minimum material, depending on rod diameter. The piston thread equals the catalog style #4 rod end thread for each rod diameter to assure proper piston-to-rod thread strength. Two wrench flats are provided for rod end attachment.



Ports – NPTF ports are standard.

Steel Cap – Bored and grooved to provide concentricity for mating parts.

Alloy Steel Tie Rod Nuts

Align-A-Groove – (Patent #3043639) – A 3/16" wide surface machined at each end of the cylinder body. Makes precise mounting quick and easy.

One-Piece Nodular Iron Piston – The wide piston surface contacting cylinder bore reduces bearing loads. Anaerobic adhesive is used to permanently lock and seal the piston to the rod.

Piston Lipseal – Fully dynamic and self-compensating for variations in pressure, mechanical deflections and wear.

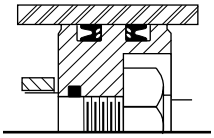
The exclusive "Jewel" gland gives you longer cylinder life, better performance and lower costs.

An extra-long inboard bearing surface insures lubrication from within the cylinder. Outboard of the bearing surface are two leakproof seals – The Lipseal and Wiperseal. The serrated Lipseal (primary seal) is completely self-compensating and self-relieving. It adjusts to mechanical deflections or any pressure variation from near-zero to rated operating pressure. The result is positive, no-leak sealing – regardless of conditions.

The Wiperseal does double duty. On the advance stroke, it acts as a secondary pressure seal. On the return, it wipes away any dirt on the rod. This means less wear on bearing surfaces and internal parts. Longer life for working parts. And, less loss of fluid. Plus, you can replace a "Jewel" gland without removing the tie rods or the retainer. Just a few twists with a spanner wrench does the job.

Prelubricated Wearing Surfaces

Parker Series 2A Air Cylinders are factory prelubricated. Lube-A-Cyl applied to seals, piston, cylinder bore, piston rod and gland surfaces provides lubrication for normal operation. Lube-A-Cyl has been field and laboratory tested, and is recommended by Parker for air cylinders where lubricant should remain in the cylinder and not be expelled into the atmosphere.



Piston with Retainer Nut – Optional at extra charge.

A

Cushion Length

Cylinder Bore (Inches)	Rod Diameter* (Inches)	Rod Number	Cushion Length (Inches)	
			Head*	Cap
1 1/2	5/8	1	7/8	13/16
	1	2	7/8	13/16
2	5/8	1	7/8	13/16
	1 3/8	2	7/8	13/16
2 1/2	5/8	1	7/8	13/16
	1 3/4	2	7/8	13/16
3 1/4	1	1	1 1/8	1
	2	2	13/16	1
4	1	1	1 1/8	1
	2 1/2	2	13/16	1
5	1	1	1 1/8	1
	3 1/2	2	13/16	1

Cylinder Bore (Inches)	Rod Diameter* (Inches)	Rod Number	Cushion Length (Inches)	
			Head*	Cap
6	1 3/8	1	1 3/8	1 1/4
	4	2	1 1/16	1 1/4
7	1 3/8	1	1 1/16	1 1/4
	2	4	1 1/16	1 1/4
8	1 3/8	1	1 1/16	1 1/4
	5 1/2	2	15/16	1 1/4
10	1 3/4	1	1 5/16	1 3/4
	5 1/2	0	1 3/16	1 3/4
12	2	1	1 5/16	1 3/4
	5 1/2	9	1 3/16	1 3/4
14	2 1/2	1	1 3/4	2
	5 1/2	8	1 11/16	2

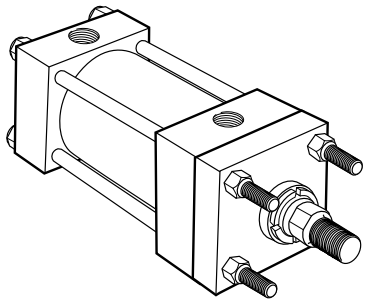
*Head end cushions for rod diameters not listed have cushion lengths with the limits shown.
For cushion selection and sizing see Section C.

For Cylinder Division Plant Locations – See Page II.

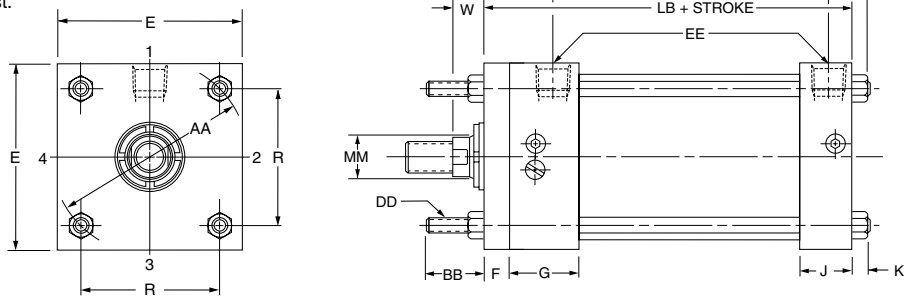
Parker Cylinder

Tie Rods Extended

Style TB
(NFPA Style MX3)



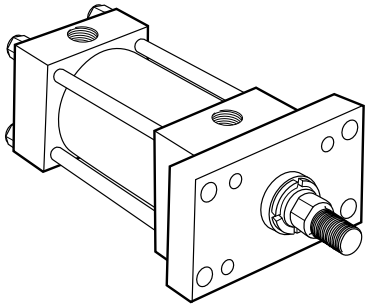
Basic Mounting (T) —
NFPA MX0 — no tie rods extended can be supplied upon request.

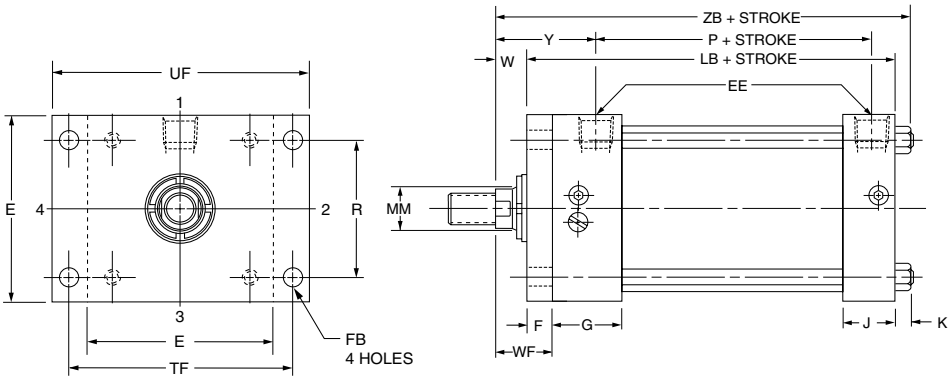


Style TB (NFPA MX3). Head Tie Rods Extended, illustrated: Style TC (NFPA MX2), Cap Tie Rods Extended; and Style TD (NFPA MX1), Both Ends Tie Rods Extended are also available. All "T" styles can be dimensioned from Style TB drawing at right.

Head Rectangular Flange

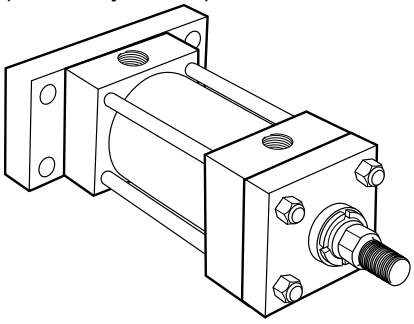
Style J
(NFPA Style MF1)

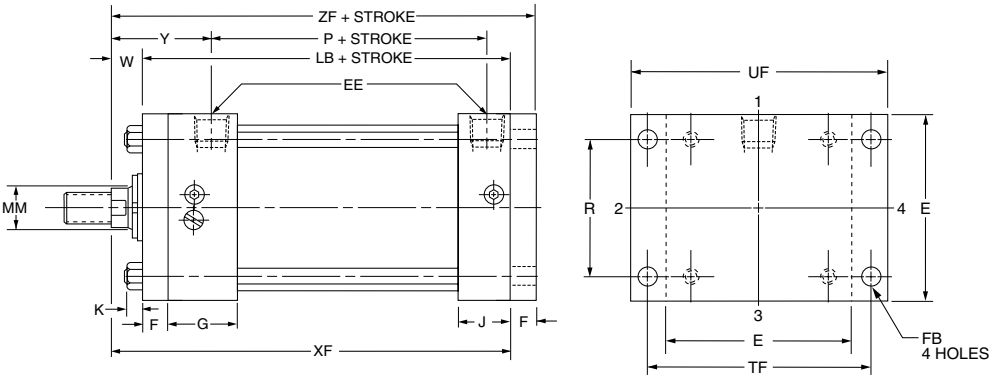




Cap Rectangular Flange

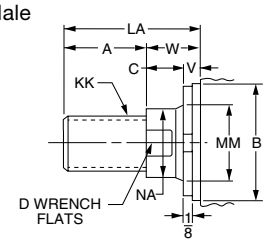
Style H
(NFPA Style MF2)



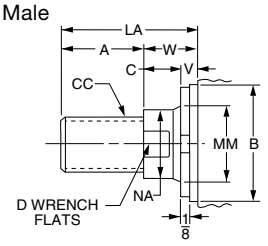


Rod End Dimensions — see table 2

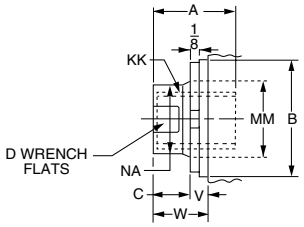
Thread Style 4
(NFPA Style SM)
Small Male



Thread Style 8
(NFPA Style IM)
Intermediate Male



Thread Style 9
(NFPA Style SF)
Small Female



A high strength rod end stud is supplied on thread style 4 through 2" diameter rods and on thread style 8 through 1 3/8" diameter rods. Larger sizes or special rod ends are cut threads. Style 4 rod ends are recommended where the workpiece is secured against the rod shoulder. When the workpiece is not shouldered, style 4 rod ends are recommended through 2" piston rod diameters and style 8 rod ends are recommended on larger diameters. Use style 9 for applications where female rod end threads are required. If rod end is not specified, style 4 will be supplied.

"Special" Thread Style 3

Special thread, extension, rod eye, blank, etc., are also available.

To order, specify "Style 3" and give desired dimensions for CC or KK, A and LA. If otherwise special, furnish dimensioned sketch.

For additional information – call your local Parker Cylinder Distributor.

Table 1—Envelope and Mounting Dimensions

Bore	AA	BB	DD	E	EE NPTF	F	FB	G	J	K	R	TF	UF	Add Stroke LB	Add Stroke P
1*	1.53	3/4	10-24	■	1/4	3/8	1/4	1 1/2	1	3/16	1.08	2	2 1/2	3 7/8	2 1/8
1 1/2	2.02	1	1/4-28	2	3/8**	3/8	5/16	1 1/2	1	1/4	1.43	2 3/4	3 3/8	4	2 1/4
2	2.6	1 1/8	5/16-24	2 1/2	3/8**	3/8	3/8	1 1/2	1	5/16	1.84	3 3/8	4 1/8	4	2 1/4
2 1/2	3.1	1 1/8	5/16-24	3	3/8**	3/8	3/8	1 1/2	1	5/16	2.19	3 7/8	4 5/8	4 1/8	2 3/8
3 1/4	3.9	1 3/8	3/8-24	3 3/4	1/2	5/8	7/16	1 3/4	1 1/4	3/8	2.76	4 11/16	5 1/2	4 7/8	2 5/8
4	4.7	1 3/8	3/8-24	4 1/2	1/2	5/8	7/16	1 3/4	1 1/4	3/8	3.32	5 7/16	6 1/4	4 7/8	2 5/8
5	5.8	1 13/16	1/2-20	5 1/2	1/2	5/8	9/16	1 3/4	1 1/4	7/16	4.10	6 5/8	7 5/8	5 1/8	2 7/8
6	6.9	1 13/16	1/2-20	6 1/2	3/4	3/4	9/16	2	1 1/2	7/16	4.88	7 5/8	8 5/8	5 3/4	3 1/8

* Cushions not available on 1" bore.
** On 1", 1 1/2", 2" and 2 1/2" bore sizes, the head-end (only) pipe thread is not full depth on cylinders with No. 2 rods. Minimum of three full threads available.
■ 1" bore head dimension is 1 3/4" x 1 1/2". See page B20.

Table 2—Rod Dimensions

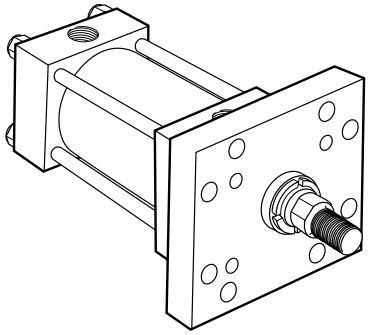
Bore	Rod No.	Rod Dia. MM	Thread Style 8 CC	Thread Style 4 & 9 KK	Rod Extensions and Pilot Dimensions A	+.000 -.002 B	C	D	LA	NA	V	W
1	1(Std.)	1/2	7/16-20	5/16-24	5/8	.999	3/8	3/8	1 1/4	7/16	1/4	5/8
	2	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	1 3/8	9/16	1/4	5/8
1 1/2	1(Std.)	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	1 3/8	9/16	1/4	5/8
	2	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	2 1/8	15/16	1/2	1
2	1(Std.)	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	1 3/8	9/16	1/4	5/8
	2	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 7/8	1 5/16	5/8	1 1/4
	3	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	2 1/8	15/16	1/2	1
2 1/2	1(Std.)	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	1 3/8	9/16	1/4	5/8
	2	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/2	1 11/16	3/4	1 1/2
	3	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	2 1/8	15/16	1/2	1
	4	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 7/8	1 5/16	5/8	1 1/4
3 1/4	1(Std.)	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	1 7/8	15/16	1/4	3/4
	2	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 5/8	1 15/16	1/2	1 3/8
	3	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 5/8	1 5/16	3/8	1
	4	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/4	1 11/16	1/2	1 1/4
4	1(Std.)	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	1 7/8	15/16	1/4	3/4
	2	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 5/8	2 3/8	5/8	1 5/8
	3	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 5/8	1 5/16	3/8	1
	4	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/4	1 11/16	1/2	1 1/4
	5	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 5/8	1 15/16	1/2	1 3/8
5	1(Std.)	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	1 7/8	15/16	1/4	3/4
	2	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	5 1/8	3 3/8	5/8	1 5/8
	3	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 5/8	1 5/16	3/8	1
	4	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/4	1 11/16	1/2	1 1/4
	5	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 5/8	1 15/16	1/2	1 3/8
	6	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 5/8	2 3/8	5/8	1 5/8
	7	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	5 1/8	2 7/8	5/8	1 5/8
6	1(Std.)	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 1/2	1 5/16	1/4	7/8
	2	4	3 3/4-12	3-12	4	4.749	1	3 3/8	5 1/2	3 7/8	1/2	1 1/2
	3	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/8	1 11/16	3/8	1 1/8
	4	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 1/2	1 15/16	3/8	1 1/4
	5	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 1/2	2 3/8	1/2	1 1/2
	6	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	5	2 7/8	1/2	1 1/2
	7	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	5	3 3/8	1/2	1 1/2

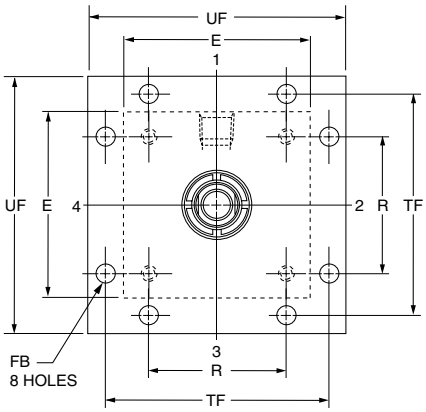
Table 3 — Envelope and Mounting Dimensions

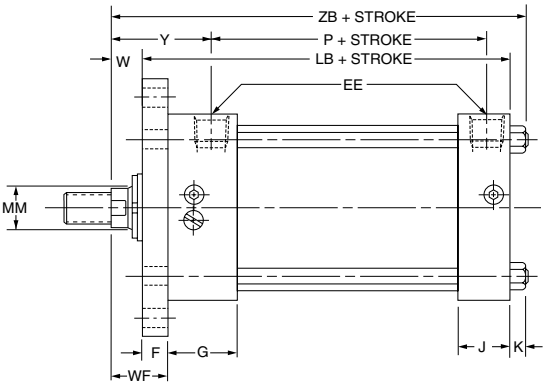
Bore	Rod No.	WF	Y	Add Stroke XF	Add Stroke ZB	Add Stroke ZF
1	1(Std.)	1	1 15/16	4 1/2	4 11/16	4 7/8
	2	1	1 15/16	4 1/2	4 11/16	4 7/8
1 1/2	1(Std.)	1	1 15/16	4 5/8	4 7/8	5
	2	1 3/8	2 5/16	5	5 1/4	5 3/8
2	1(Std.)	1	1 15/16	4 5/8	4 15/16	5
	2	1 5/8	2 9/16	5 1/4	5 9/16	5 5/8
	3	1 3/8	2 5/16	5	5 5/16	5 3/8
2 1/2	1(Std.)	1	1 15/16	4 3/4	5 1/16	5 1/8
	2	1 7/8	2 13/16	5 5/8	5 15/16	6
	3	1 3/8	2 5/16	5 1/8	5 7/16	5 1/2
	4	1 5/8	2 9/16	5 3/8	5 11/16	5 3/4
3 1/4	1(Std.)	1 3/8	2 7/16	5 5/8	6	6 1/4
	2	2	3 1/16	6 1/4	6 5/8	6 7/8
	3	1 5/8	2 11/16	5 7/8	6 1/4	6 1/2
	4	1 7/8	2 15/16	6 1/8	6 1/2	6 3/4
4	1(Std.)	1 3/8	2 7/16	5 5/8	6	6 1/4
	2	2 1/4	3 5/16	6 1/2	6 7/8	7 1/8
	3	1 5/8	2 11/16	5 7/8	6 1/4	6 1/2
	4	1 7/8	2 15/16	6 1/8	6 1/2	6 3/4
	5	2	3 1/16	6 1/4	6 5/8	6 7/8
5	1(Std.)	1 3/8	2 7/16	5 7/8	6 5/16	6 1/2
	2	2 1/4	3 5/16	6 3/4	7 3/16	7 3/8
	3	1 5/8	2 11/16	6 1/8	6 9/16	6 3/4
	4	1 7/8	2 15/16	6 3/8	6 13/16	7
	5	2	3 1/16	6 1/2	6 15/16	7 1/8
	6	2 1/4	3 5/16	6 3/4	7 3/16	7 3/8
	7	2 1/4	3 5/16	6 3/4	7 3/16	7 3/8
6	1(Std.)	1 5/8	2 13/16	6 5/8	7 1/16	7 3/8
	2	2 1/4	3 7/16	7 1/4	7 11/16	8
	3	1 7/8	3 1/16	6 7/8	7 5/16	7 5/8
	4	2	3 3/16	7	7 7/16	7 3/4
	5	2 1/4	3 7/16	7 1/4	7 11/16	8
	6	2 1/4	3 7/16	7 1/4	7 11/16	8
	7	2 1/4	3 7/16	7 1/4	7 11/16	8

Head Square Flange

Style JB
(NFPA Style MF5)

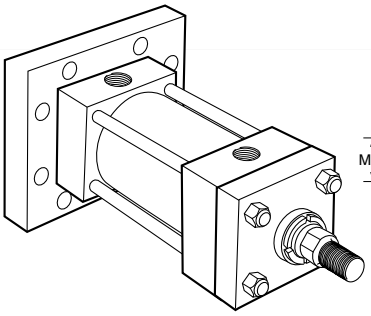


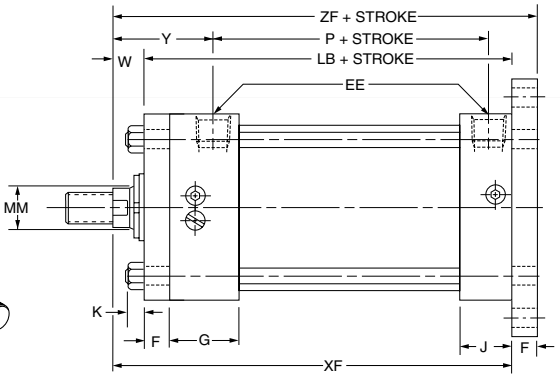


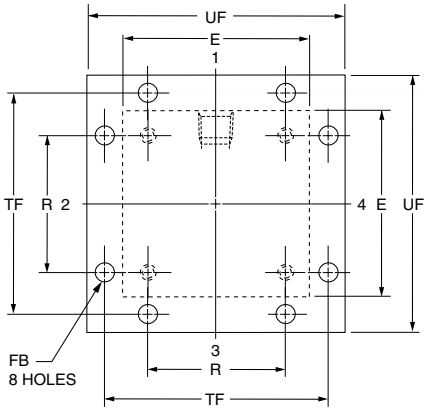


Cap Square Flange

Style HB
(NFPA Style MF6)

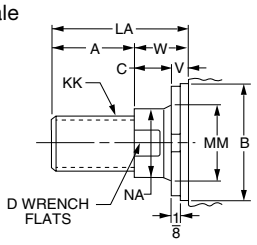




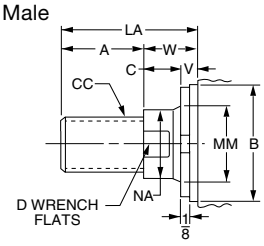


Rod End Dimensions — see table 2

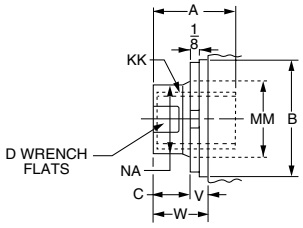
Thread Style 4
(NFPA Style SM)
Small Male



Thread Style 8
(NFPA Style IM)
Intermediate Male



Thread Style 9
(NFPA Style SF)
Small Female



A high strength rod end stud is supplied on thread style 4 through 2" diameter rods and on thread style 8 through 1 3/8" diameter rods. Larger sizes or special rod ends are cut threads. Style 4 rod ends are recommended where the workpiece is secured against the rod shoulder. When the workpiece is not shouldered, style 4 rod ends are recommended through 2" piston rod diameters and style 8 rod ends are recommended on larger diameters. Use style 9 for applications where female rod end threads are required. If rod end is not specified, style 4 will be supplied.

"Special" Thread Style 3

Special thread, extension, rod eye, blank, etc., are also available.

To order, specify "Style 3" and give desired dimensions for CC or KK, A and LA. If otherwise special, furnish dimensioned sketch.

For additional information – call your local Parker Cylinder Distributor.

Table 1—Envelope and Mounting Dimensions

Bore	E	EE NPTF	F	FB	G	J	K	R	TF	UF	Add Stroke LB	Add Stroke P
1*	■	1/4	3/8	1/4	1 1/2	1	3/16	1.08	2	2 1/2	3 7/8	2 1/8
1 1/2	2	3/8**	3/8	5/16	1 1/2	1	1/4	1.43	2 3/4	3 3/8	4	2 1/4
2	2 1/2	3/8**	3/8	3/8	1 1/2	1	5/16	1.84	3 3/8	4 1/8	4	2 1/4
2 1/2	3	3/8**	3/8	3/8	1 1/2	1	5/16	2.19	3 7/8	4 5/8	4 1/8	2 3/8
3 1/4	3 3/4	1/2	5/8	7/16	1 3/4	1 1/4	3/8	2.76	4 11/16	5 1/2	4 7/8	2 5/8
4	4 1/2	1/2	5/8	7/16	1 3/4	1 1/4	3/8	3.32	5 7/16	6 1/4	4 7/8	2 5/8
5	5 1/2	1/2	5/8	9/16	1 3/4	1 1/4	7/16	4.10	6 5/8	7 5/8	5 1/8	2 7/8
6	6 1/2	3/4	3/4	9/16	2	1 1/2	7/16	4.88	7 5/8	8 5/8	5 3/4	3 1/8

* Cushions not available on 1" bore.
** On 1", 1 1/2", 2" and 2 1/2" bore sizes, the head-end (only) pipe thread is not full depth on cylinders with No. 2 rods. Minimum of three full threads available.
■ 1" bore head dimension is 1 3/4" x 1 1/2". See page B20.

A

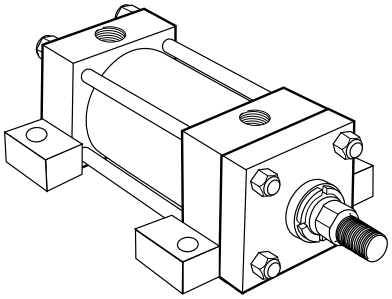
Table 2—Rod Dimensions

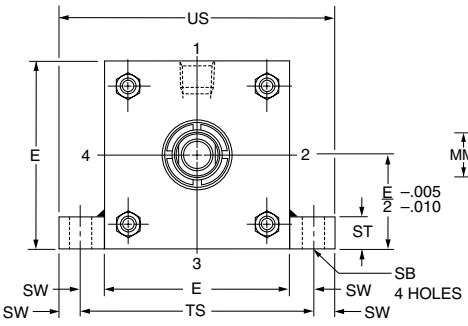
Bore	Rod No.	Rod Dia. MM	Thread Style 8 CC	Thread Style 4 & 9 KK	Rod Extensions and Pilot Dimensions A	+.000 -.002 B	C	D	LA	NA	V	W
1	1(Std.)	1/2	7/16-20	5/16-24	5/8	.999	3/8	3/8	1 1/4	7/16	1/4	5/8
	2	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	1 3/8	9/16	1/4	5/8
1 1/2	1(Std.)	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	1 3/8	9/16	1/4	5/8
	2	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	2 1/8	15/16	1/2	1
2	1(Std.)	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	1 3/8	9/16	1/4	5/8
	2	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 7/8	1 5/16	5/8	1 1/4
	3	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	2 1/8	15/16	1/2	1
2 1/2	1(Std.)	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	1 3/8	9/16	1/4	5/8
	2	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/2	1 11/16	3/4	1 1/2
	3	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	2 1/8	15/16	1/2	1
	4	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 7/8	1 5/16	5/8	1 1/4
3 1/4	1(Std.)	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	1 7/8	15/16	1/4	3/4
	2	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 5/8	1 15/16	1/2	1 3/8
	3	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 5/8	1 5/16	3/8	1
	4	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/4	1 11/16	1/2	1 1/4
4	1(Std.)	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	1 7/8	15/16	1/4	3/4
	2	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 5/8	2 3/8	5/8	1 5/8
	3	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 5/8	1 5/16	3/8	1
	4	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/4	1 11/16	1/2	1 1/4
	5	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 5/8	1 15/16	1/2	1 3/8
5	1(Std.)	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	1 7/8	15/16	1/4	3/4
	2	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	5 1/8	3 3/8	5/8	1 5/8
	3	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 5/8	1 5/16	3/8	1
	4	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/4	1 11/16	1/2	1 1/4
	5	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 5/8	1 15/16	1/2	1 3/8
	6	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 5/8	2 3/8	5/8	1 5/8
	7	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	5 1/8	2 7/8	5/8	1 5/8
6	1(Std.)	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 1/2	1 5/16	1/4	7/8
	2	4	3 3/4-12	3-12	4	4.749	1	3 3/8	5 1/2	3 7/8	1/2	1 1/2
	3	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/8	1 11/16	3/8	1 1/8
	4	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 1/2	1 15/16	3/8	1 1/4
	5	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 1/2	2 3/8	1/2	1 1/2
	6	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	5	2 7/8	1/2	1 1/2
	7	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	5	3 3/8	1/2	1 1/2

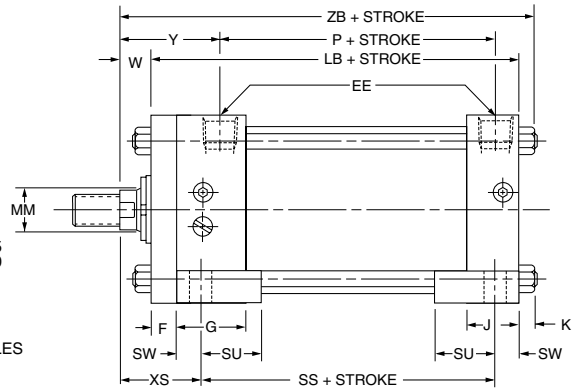
Table 3 — Envelope and Mounting Dimensions

Bore	WF	Y	Add Stroke XF	Add Stroke ZB	Add Stroke ZF
1	1	1 15/16	4 1/2	4 11/16	4 7/8
	1	1 15/16	4 1/2	4 11/16	4 7/8
1 1/2	1	1 15/16	4 5/8	4 7/8	5
	1 3/8	2 5/16	5	5 1/4	5 3/8
2	1	1 15/16	4 5/8	4 15/16	5
	1 5/8	2 9/16	5 1/4	5 9/16	5 5/8
	1 3/8	2 5/16	5	5 5/16	5 3/8
2 1/2	1	1 15/16	4 3/4	5 1/16	5 1/8
	1 7/8	2 13/16	5 5/8	5 15/16	6
	1 3/8	2 5/16	5 1/8	5 7/16	5 1/2
	1 5/8	2 9/16	5 3/8	5 11/16	5 3/4
3 1/4	1 3/8	2 7/16	5 5/8	6	6 1/4
	2	3 1/16	6 1/4	6 5/8	6 7/8
	1 5/8	2 11/16	5 7/8	6 1/4	6 1/2
	1 7/8	2 15/16	6 1/8	6 1/2	6 3/4
4	1 3/8	2 7/16	5 5/8	6	6 1/4
	2 1/4	3 5/16	6 1/2	6 7/8	7 1/8
	1 5/8	2 11/16	5 7/8	6 1/4	6 1/2
	1 7/8	2 15/16	6 1/8	6 1/2	6 3/4
	2	3 1/16	6 1/4	6 5/8	6 7/8
5	1 3/8	2 7/16	5 7/8	6 5/16	6 1/2
	2 1/4	3 5/16	6 3/4	7 3/16	7 3/8
	1 5/8	2 11/16	6 1/8	6 9/16	6 3/4
	1 7/8	2 15/16	6 3/8	6 13/16	7
	2	3 1/16	6 1/2	6 15/16	7 1/8
	2 1/4	3 5/16	6 3/4	7 3/16	7 3/8
	2 1/4	3 5/16	6 3/4	7 3/16	7 3/8
6	1 5/8	2 13/16	6 5/8	7 1/16	7 3/8
	2 1/4	3 7/16	7 1/4	7 11/16	8
	1 7/8	3 1/16	6 7/8	7 5/16	7 5/8
	2 1/4	3 7/16	7 1/4	7 11/16	7 3/4
	2 1/4	3 7/16	7 1/4	7 11/16	8
	2 1/4	3 7/16	7 1/4	7 11/16	8
	2 1/4	3 7/16	7 1/4	7 11/16	8

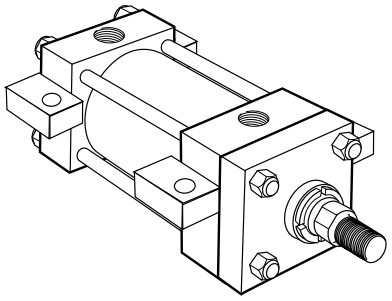
Side Lug
Style C
(NFPA Style MS2)

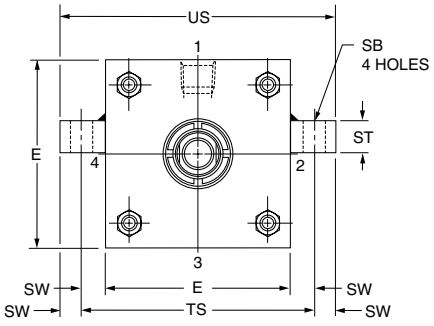


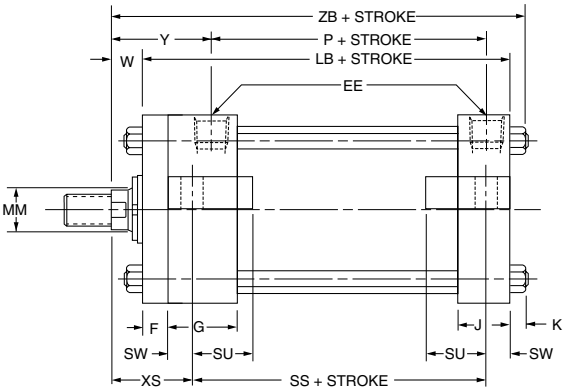




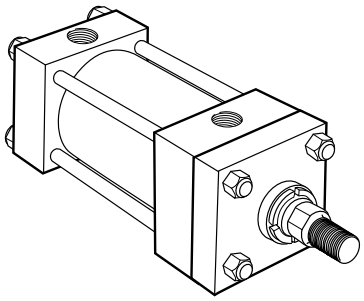
Centerline Lugs
Style E
(NFPA Style MS3)

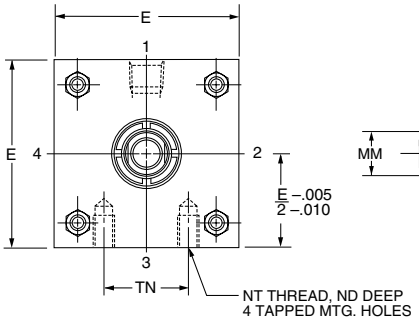


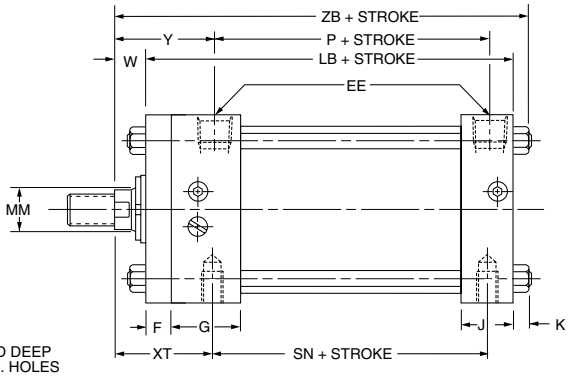




Side Tapped
Style F
(NFPA Style MS4)

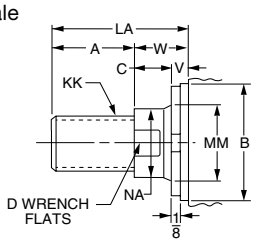




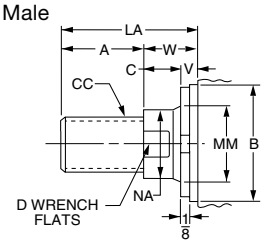


Rod End Dimensions — see table 2

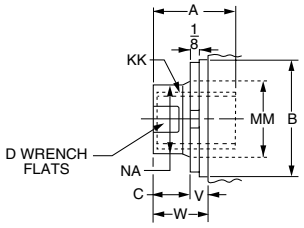
Thread Style 4
(NFPA Style SM)
Small Male



Thread Style 8
(NFPA Style IM)
Intermediate Male



Thread Style 9
(NFPA Style SF)
Small Female



A high strength rod end stud is supplied on thread style 4 through 2" diameter rods and on thread style 8 through 1 3/8" diameter rods. Larger sizes or special rod ends are cut threads. Style 4 rod ends are recommended where the workpiece is secured against the rod shoulder. When the workpiece is not shouldered, style 4 rod ends are recommended through 2" piston rod diameters and style 8 rod ends are recommended on larger diameters. Use style 9 for applications where female rod end threads are required. If rod end is not specified, style 4 will be supplied.

"Special" Thread Style 3
Special thread, extension, rod eye, blank, etc., are also available.

To order, specify "Style 3" and give desired dimensions for CC or KK, A and LA. If otherwise special, furnish dimensioned sketch.

For additional information – call your local Parker Cylinder Distributor.

A

Table 1—Envelope and Mounting Dimensions

Bore	E	EE NPTF	F	G	J	K	NT	SB•	ST	SU	SW	TN	TS	US	Add Stroke LB	P	SN	SS
1*	■	1/4	3/8	1 1/2	1	3/16	10-24	9/32†	5/16†	3/4†	5/16†	9/16	2 1/8†	2 3/4†	3 7/8	2 1/8	2 1/8	2 7/8†
1 1/2	2	3/8**	3/8	1 1/2	1	1/4	1/4-20	7/16	1/2	15/16	3/8	5/8	2 3/4	3 1/2	4	2 1/4	2 1/4	2 7/8
2	2 1/2	3/8**	3/8	1 1/2	1	5/16	5/16-18	7/16	1/2	15/16	3/8	7/8	3 1/4	4	4	2 1/4	2 1/4	2 7/8
2 1/2	3	3/8**	3/8	1 1/2	1	5/16	3/8-16	7/16	1/2	15/16	3/8	1 1/4	3 3/4	4 1/2	4 1/8	2 3/8	2 3/8	3
3 1/4	3 3/4	1/2	5/8	1 3/4	1 1/4	3/8	1/2-13	9/16	3/4	1 1/4	1/2	1 1/2	4 3/4	5 3/4	4 7/8	2 5/8	2 5/8	3 1/4
4	4 1/2	1/2	5/8	1 3/4	1 1/4	3/8	1/2-13	9/16	3/4	1 1/4	1/2	2 1/16	5 1/2	6 1/2	4 7/8	2 5/8	2 5/8	3 1/4
5	5 1/2	1/2	5/8	1 3/4	1 1/4	7/16	5/8-11	13/16	1	1 9/16	11/16	2 11/16	6 7/8	8 1/4	5 1/8	2 7/8	2 7/8	3 1/8
6	6 1/2	3/4	3/4	2	1 1/2	7/16	3/4-10	13/16	1	1 9/16	11/16	3 1/4	7 7/8	9 1/4	5 3/4	3 1/8	3 1/8	3 5/8

* Cushions not available on 1" bore.
** On 1", 1 1/2", 2" and 2 1/2" bore sizes, the head-end (only) pipe thread is not full depth on cylinders with No. 2 rods. Minimum of three full threads available.
• Upper surface spot-faced for socket head screws.
† Mounting style E not available in 1" bore. ■ 1" bore head dimension is 1 3/4" x 1 1/2". See page B20.

Table 2—Rod Dimensions

Bore	Rod No.	Rod Dia. MM	Thread Style 8 CC	Thread Style 4 & 9 KK	Rod Extensions and Pilot Dimensions A	+.000 -.002 B	C	D	LA	NA	V	W	Add Stroke ZB
1	1(Std.)	1/2	7/16-20	5/16-24	5/8	.999	3/8	3/8	1 1/4	7/16	1/4	5/8	4 11/16
	2	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	1 3/8	9/16	1/4	5/8	4 11/16
1 1/2	1(Std.)	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	1 3/8	9/16	1/4	5/8	4 7/8
	2	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	2 1/8	15/16	1/2	1	5 1/4
2	1(Std.)	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	1 3/8	9/16	1/4	5/8	4 15/16
	2	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 7/8	1 5/16	5/8	1 1/4	5 9/16
	3	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	2 1/8	15/16	1/2	1	5 5/16
2 1/2	1(Std.)	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	1 3/8	9/16	1/4	5/8	5 1/16
	2	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/2	1 11/16	3/4	1 1/2	5 15/16
	3	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	2 1/8	15/16	1/2	1	5 7/16
	4	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 7/8	1 5/16	5/8	1 1/4	5 11/16
3 1/4	1(Std.)	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	1 7/8	15/16	1/4	3/4	6
	2	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 5/8	1 15/16	1/2	1 3/8	6 5/8
	3	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 5/8	1 5/16	3/8	1	6 1/4
	4	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/4	1 11/16	1/2	1 1/4	6 1/2
4	1(Std.)	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	1 7/8	15/16	1/4	3/4	6
	2	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 5/8	2 3/8	5/8	1 5/8	6 7/8
	3	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 5/8	1 5/16	3/8	1	6 1/4
	4	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/4	1 11/16	1/2	1 1/4	6 1/2
	5	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 5/8	1 15/16	1/2	1 3/8	6 5/8
5	1(Std.)	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	1 7/8	15/16	1/4	3/4	6 5/16
	2	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	5 1/8	3 3/8	5/8	1 5/8	7 3/16
	3	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 5/8	1 5/16	3/8	1	6 9/16
	4	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/4	1 11/16	1/2	1 1/4	6 13/16
	5	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 5/8	1 15/16	1/2	1 3/8	6 15/16
	6	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 5/8	2 3/8	5/8	1 5/8	7 3/16
	7	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	5 1/8	2 7/8	5/8	1 5/8	7 3/16
6	1(Std.)	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 1/2	1 5/16	1/4	7/8	7 1/16
	2	4	3 3/4-12	3-12	4	4.749	1	3 3/8	5 1/2	3 7/8	1/2	1 1/2	7 11/16
	3	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/8	1 11/16	3/8	1 1/8	7 5/16
	4	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 1/2	1 15/16	3/8	1 1/4	7 7/16
	5	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 1/2	2 3/8	1/2	1 1/2	7 11/16
	6	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	5	2 7/8	1/2	1 1/2	7 11/16
	7	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	5	3 3/8	1/2	1 1/2	7 11/16

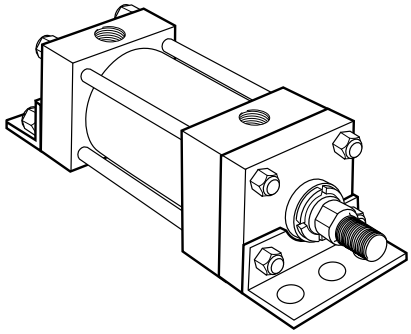
* Mounting style E not available in 1" bore.

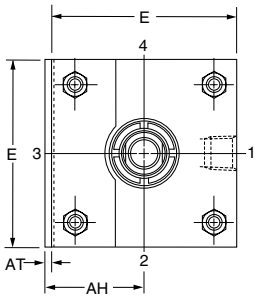
Table 3 — Envelope and Mounting Dimensions

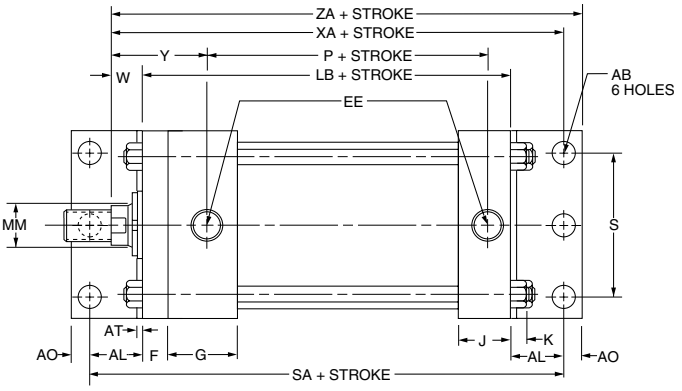
Bore	ND	XS	XT	Y
1	1/4	1 15/16*	1 15/16	1 15/16
1 1/2	5/16	1 3/8	1 15/16	1 15/16
2	11/32	1 3/8	1 15/16	1 15/16
2 1/2	7/16	1 3/8	1 15/16	1 15/16
3 1/4	1/2	1 7/8	2 7/16	2 7/16
4	5/8	1 7/8	2 7/16	2 7/16
5	3/4	2 1/16	2 7/16	2 7/16
6	7/8	2 5/16	2 13/16	2 13/16

Side End Angles

Style CB
(NFPA Style MS1)

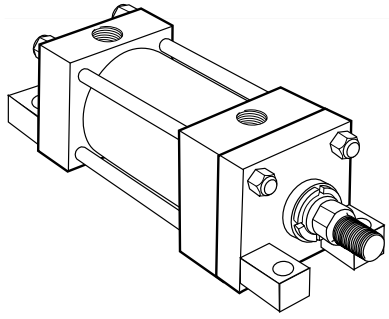


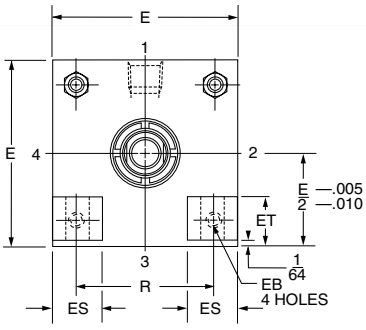


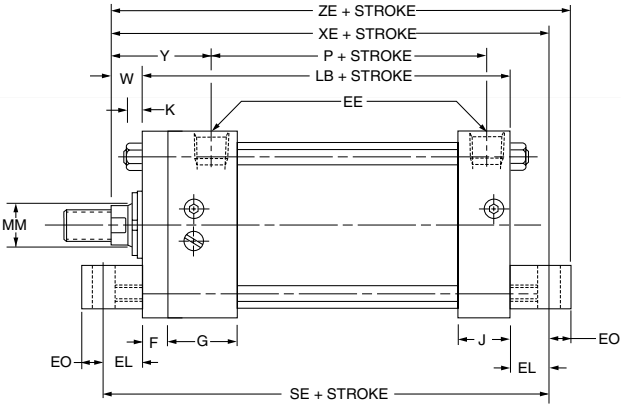


Side End Lugs

Style G
(NFPA Style MS7)

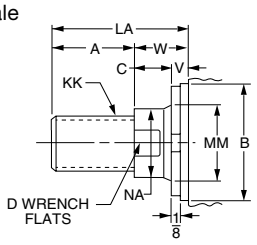




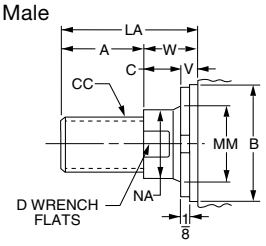


Rod End Dimensions — see table 2

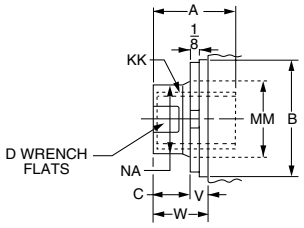
Thread Style 4
(NFPA Style SM)
Small Male



Thread Style 8
(NFPA Style IM)
Intermediate Male



Thread Style 9
(NFPA Style SF)
Small Female



A high strength rod end stud is supplied on thread style 4 through 2" diameter rods and on thread style 8 through 1 3/8" diameter rods. Larger sizes or special rod ends are cut threads. Style 4 rod ends are recommended where the workpiece is secured against the rod shoulder. When the workpiece is not shouldered, style 4 rod ends are recommended through 2" piston rod diameters and style 8 rod ends are recommended on larger diameters. Use style 9 for applications where female rod end threads are required. If rod end is not specified, style 4 will be supplied.

"Special" Thread Style 3

Special thread, extension, rod eye, blank, etc., are also available.

To order, specify "Style 3" and give desired dimensions for CC or KK, A and LA. If otherwise special, furnish dimensioned sketch.

For additional information – call your local Parker Cylinder Distributor.

Table 1—Envelope and Mounting Dimensions

Bore	AB	AH	AL	AO	AT	E	EB	EE NPTF	EL	EO	ES	ET	F	G	J	K	R	S	Add Stroke LB	P	SA	SE
1*	3/8†‡	1†	13/16†	5/16†	1/8†	■	•	1/4	•	•	•	•	3/8	1 1/2	1	3/16	1.08•	15/16†	3 7/8	2 1/8	5 1/2†	•
1 1/2	7/16	1 3/16	1	3/8	1/8	2	5/16	3/8**	3/4	1/4	9/16	17/32	3/8	1 1/2	1	1/4	1.43	1 1/4	4	2 1/4	6	5 1/2
2	7/16	1 7/16	1	3/8	1/8	2 1/2	3/8	3/8**	15/16	5/16	5/8	5/8	3/8	1 1/2	1	5/16	1.84	1 3/4	4	2 1/4	6	5 7/8
2 1/2	7/16	1 5/8	1	3/8	1/8	3	3/8	3/8**	1 1/16	5/16	13/16	25/32	3/8	1 1/2	1	5/16	2.19	2 1/4	4 1/8	2 3/8	6 1/8	6 1/4
3 1/4	9/16	1 15/16	1 1/4	1/2	1/8	3 3/4	7/16	1/2	7/8	3/8	1	15/16	5/8	1 3/4	1 1/4	3/8	2.76	2 3/4	4 7/8	2 5/8	7 3/8	6 5/8
4	9/16	2 1/4	1 1/4	1/2	1/8	4 1/2	7/16	1/2	1	3/8	1 1/4	1 5/32	5/8	1 3/4	1 1/4	3/8	3.32	3 1/2	4 7/8	2 5/8	7 3/8	6 7/8
5	11/16	2 3/4	1 3/8	5/8	3/16	5 1/2	9/16	1/2	1 1/16	1/2	1 3/8	1 3/8	5/8	1 3/4	1 1/4	7/16	4.10	4 1/4	5 1/8	2 7/8	7 7/8	7 1/4
6	13/16	3 1/4	1 3/8	5/8	3/16	6 1/2	9/16	3/4	1	1/2	1 3/4	1 19/32	3/4	2	1 1/2	7/16	4.88	5 1/4	5 3/4	3 1/8	8 1/2	7 3/4

* Cushions not available on 1" bore.
** On 1", 1 1/2", 2" and 2 1/2" bore sizes, the head-end (only) pipe thread is not full depth on cylinders with No. 2 rods. Minimum of three full threads available.
† Mounting style CB available in 1" bore for rod No. 1 only.
‡ Mounting style CB for 1" bore only is furnished with four mounting holes (two each end). Center holes omitted.
■ 1" bore head dimension is 1 3/4" x 1 1/2". See page B20.
• Mounting style G not available in 1" bore.

Table 2—Rod Dimensions

Bore	Rod No.	Rod Dia. MM	Thread Style 8 CC	Thread Style 4 & 9 KK	Rod Extensions and Pilot Dimensions A	+.000 -.002 B	C	D	LA	NA	V	W	Y	Add Stroke XA	XE	ZA	ZE
1	1(Std.)	1/2	7/16-20	5/16-24	5/8	.999	3/8	3/8	1 1/4	7/16	1/4	5/8	1 15/16	5 5/16*	•	5 5/8*	•
	2	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	1 3/8	9/16	1/4	5/8	1 15/16	*	•	*	•
1 1/2	1(Std.)	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	1 3/8	9/16	1/4	5/8	1 15/16	5 5/8	5 3/8	6	5 5/8
	2	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	2 1/8	15/16	1/2	1	2 5/16	6	5 3/4	6 3/8	6
2	1(Std.)	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	1 3/8	9/16	1/4	5/8	1 15/16	5 5/8	5 9/16	6	5 7/8
	2	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 7/8	1 5/16	5/8	1 1/4	2 9/16	6 1/4	6 3/16	6 5/8	6 1/2
	3	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	2 1/8	15/16	1/2	1	2 5/16	6	5 15/16	6 3/8	6 1/4
2 1/2	1(Std.)	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	1 3/8	9/16	1/4	5/8	1 15/16	5 3/4	5 13/16	6 1/8	6 1/8
	2	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/2	1 11/16	3/4	1 1/2	2 13/16	6 5/8	6 11/16	7	7
	3	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	2 1/8	15/16	1/2	1	2 5/16	6 1/8	6 3/16	6 1/2	6 1/2
	4	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 7/8	1 5/16	5/8	1 1/4	2 9/16	6 3/8	6 7/16	6 3/4	6 3/4
3 1/4	1(Std.)	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	1 7/8	1 5/16	1/4	3/4	2 7/16	6 7/8	6 1/2	7 3/8	6 7/8
	2	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 5/8	1 15/16	1/2	1 3/8	3 1/16	7 1/2	7 1/8	8	7 1/2
	3	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 5/8	1 5/16	3/8	1	2 11/16	7 1/8	6 3/4	7 5/8	7 1/8
	4	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/4	1 11/16	1/2	1 1/4	2 15/16	7 3/8	7	7 7/8	7 3/8
4	1(Std.)	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	1 7/8	1 5/16	1/4	3/4	2 7/16	6 7/8	6 5/8	7 3/8	7
	2	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 5/8	2 3/8	5/8	1 5/8	3 5/16	7 3/4	7 1/2	8 1/4	7 7/8
	3	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 5/8	1 5/16	3/8	1	2 11/16	7 1/8	6 7/8	7 5/8	7 1/4
	4	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/4	1 11/16	1/2	1 1/4	2 15/16	7 3/8	7 1/8	7 7/8	7 1/2
	5	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 5/8	1 15/16	1/2	1 3/8	3 1/16	7 1/2	7 1/4	8	7 5/8
5	1(Std.)	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	1 7/8	1 5/16	1/4	3/4	2 7/16	7 1/4	6 15/16	7 7/8	7 7/16
	2	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	5 1/8	3 3/8	5/8	1 5/8	3 5/16	8 1/8	7 13/16	8 3/4	8 5/16
	3	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 5/8	1 5/16	3/8	1	2 11/16	7 1/2	7 3/16	8 1/8	7 11/16
	4	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/4	1 11/16	1/2	1 1/4	2 15/16	7 3/4	7 7/16	8 3/8	7 15/16
	5	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 5/8	1 15/16	1/2	1 3/8	3 1/16	7 7/8	7 9/16	8 1/2	8 1/16
	6	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 5/8	2 3/8	5/8	1 5/8	3 5/16	8 1/8	7 13/16	8 3/4	8 5/16
	7	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	5 1/8	2 7/8	5/8	1 5/8	3 5/16	8 1/8	7 13/16	8 3/4	8 5/16
6	1(Std.)	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 1/2	1 5/16	1/4	7/8	2 13/16	8	7 5/8	8 5/8	8 1/8
	2	4	3 3/4-12	3-12	4	4.749	1	3 3/8	5 1/2	3 7/8	1/2	1 1/2	3 7/16	8 5/8	8 1/4	9 1/4	8 3/4
	3	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/8	1 11/16	3/8	1 1/8	3 1/16	8 1/4	7 7/8	8 7/8	8 3/8
	4	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 1/2	1 15/16	3/8	1 1/4	3 3/16	8 3/8	8	9	8 1/2
	5	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 1/2	2 3/8	1/2	1 1/2	3 7/16	8 5/8	8 1/4	9 1/4	8 3/4
	6	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	5	2 7/8	1/2	1 1/2	3 7/16	8 5/8	8 1/4	9 1/4	8 3/4
	7	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	5	3 3/8	1/2	1 1/2	3 7/16	8 5/8	8 1/4	9 1/4	8 3/4

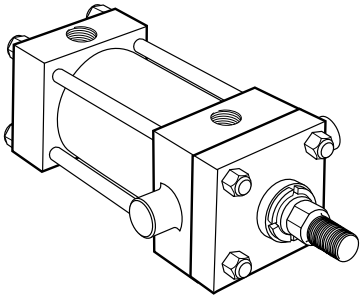
Table 3 — Envelope and Mounting Dimensions

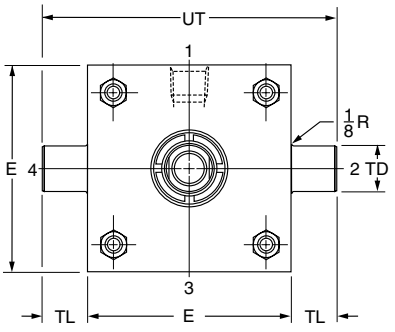
* Mounting style CB available in 1" bore for rod No. 1 only.
• Mounting style G not available in 1" bore.
Caution: When using mounting styles CB and G, check clearance between mounting members and rod attachment or accessory. If necessary, specify longer rod extension to avoid interference with mounting members.

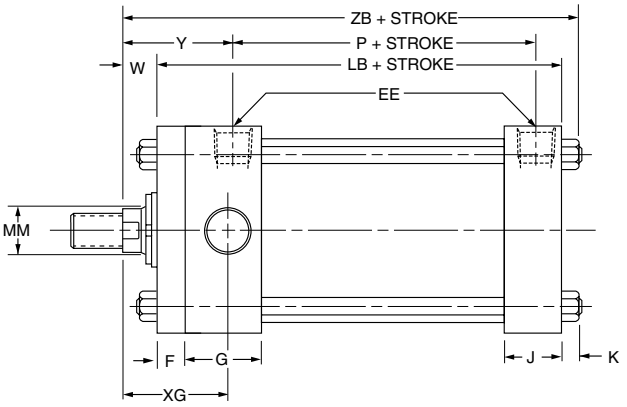
For Cylinder Division Plant Locations – See Page II.

Parker Cylinder

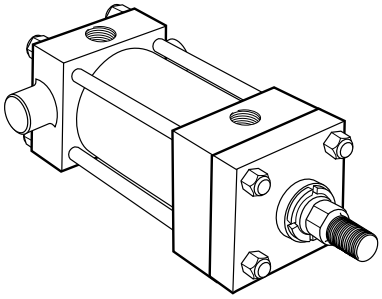
Head Trunnion
Style D
(NFPA Style MT1)

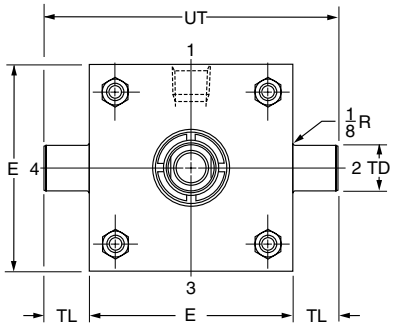


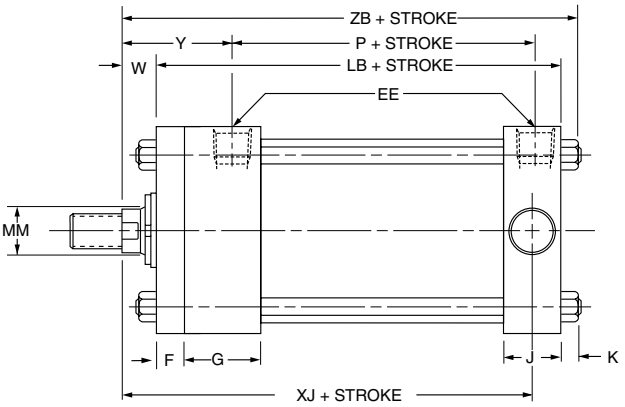




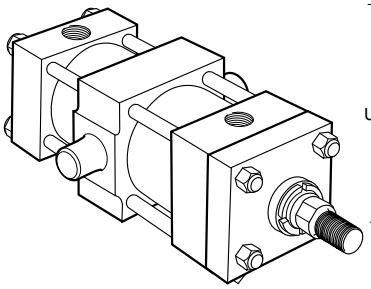
Cap Trunnion
Style DB
(NFPA Style MT2)

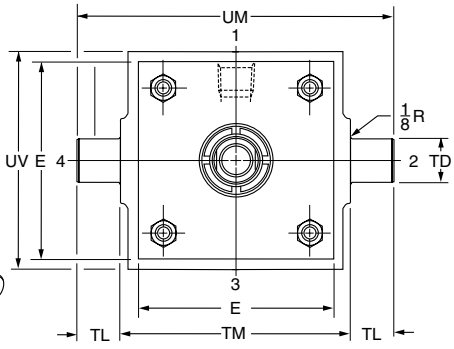


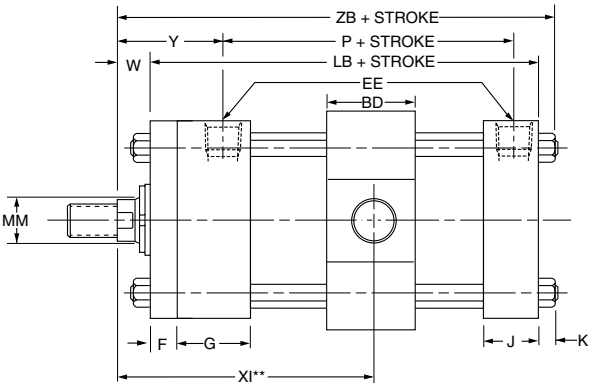




Intermediate Fixed Trunnion
Style DD
(NFPA Style MT4)

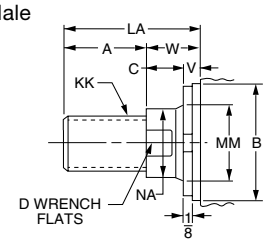




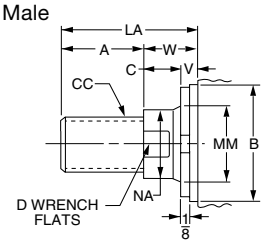


Rod End Dimensions — see table 2

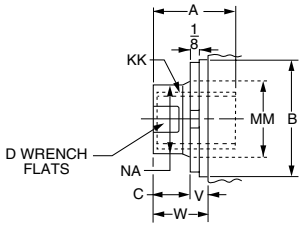
Thread Style 4
(NFPA Style SM)
Small Male



Thread Style 8
(NFPA Style IM)
Intermediate Male



Thread Style 9
(NFPA Style SF)
Small Female



A high strength rod end stud is supplied on thread style 4 through 2" diameter rods and on thread style 8 through 1 3/8" diameter rods. Larger sizes or special rod ends are cut threads. Style 4 rod ends are recommended where the workpiece is secured against the rod shoulder. When the workpiece is not shouldered, style 4 rod ends are recommended through 2" piston rod diameters and style 8 rod ends are recommended on larger diameters. Use style 9 for applications where female rod end threads are required. If rod end is not specified, style 4 will be supplied.

"Special" Thread Style 3
Special thread, extension, rod eye, blank, etc., are also available.

To order, specify "Style 3" and give desired dimensions for CC or KK, A and LA. If otherwise special, furnish dimensioned sketch.

For additional information – call your local Parker Cylinder Distributor.

Table 1—Envelope and Mounting Dimensions

Bore	BD	E	EE NPTF	F	G	J	K	+.000 TD -.001	TL	TM	UM	UT	UV	Add Stroke LB	Add Stroke P	Style DD Min. Stroke
1*	•	■	1/4	3/8	1 1/2	1	3/16	.750•	3/4•	•	•	3	•	3 7/8	2 1/8	•
1 1/2	1 1/4	2	3/8**	3/8	1 1/2	1	1/4	1.000	1	2 1/2	4 1/2	4	2 1/2	4	2 1/4	1/4
2	1 1/2	2 1/2	3/8**	3/8	1 1/2	1	5/16	1.000	1	3	5	4 1/2	3	4	2 1/4	1/2
2 1/2	1 1/2	3	3/8**	3/8	1 1/2	1	5/16	1.000	1	3 1/2	5 1/2	5	3 1/2	4 1/8	2 3/8	3/8
3 1/4	2	3 3/4	1/2	5/8	1 3/4	1 1/4	3/8	1.000	1	4 1/2	6 1/2	5 3/4	4 1/4	4 7/8	2 5/8	7/8
4	2	4 1/2	1/2	5/8	1 3/4	1 1/4	3/8	1.000	1	5 1/4	7 1/4	6 1/2	5	4 7/8	2 5/8	7/8
5	2	5 1/2	1/2	5/8	1 3/4	1 1/4	7/16	1.000	1	6 1/4	8 1/4	7 1/2	6	5 1/8	2 7/8	5/8
6	2 1/2	6 1/2	3/4	3/4	2	1 1/2	7/16	1.375	1 3/8	7 5/8	10 3/8	9 1/4	7	5 3/4	3 1/8	1 1/8

* Cushions not available on 1" bore.
** On 1", 1 1/2", 2" and 2 1/2" bore sizes, the head-end (only) pipe thread is not full depth on cylinders with No. 2 rods. Minimum of three full threads available.
• Mounting style not available in 1" bore.
■1" bore head dimension is 1 3/4" x 1 1/2". See page B20.

Table 2—Rod Dimensions

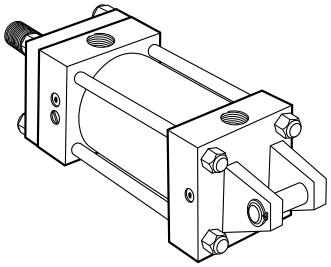
Bore	Rod No.	Rod Dia. MM	Thread Style 8 CC	Thread Style 4 & 9 KK	Rod Extensions and Pilot Dimensions A	+.000 -.002 B	C	D	LA	NA	V	W
1	1(Std.)	1/2	7/16-20	5/16-24	5/8	.999	3/8	3/8	1 1/4	7/16	1/4	5/8
	2	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	1 3/8	9/16	1/4	5/8
1 1/2	1(Std.)	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	1 3/8	9/16	1/4	5/8
	2	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	2 1/8	15/16	1/2	1
2	1(Std.)	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	1 3/8	9/16	1/4	5/8
	2	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 7/8	1 5/16	5/8	1 1/4
	3	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	2 1/8	15/16	1/2	1
2 1/2	1(Std.)	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	1 3/8	9/16	1/4	5/8
	2	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/2	1 11/16	3/4	1 1/2
	3	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	2 1/8	15/16	1/2	1
	4	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 7/8	1 5/16	5/8	1 1/4
3 1/4	1(Std.)	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	1 7/8	15/16	1/4	3/4
	2	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 5/8	1 15/16	1/2	1 3/8
	3	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 5/8	1 5/16	3/8	1
	4	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/4	1 11/16	1/2	1 1/4
4	1(Std.)	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	1 7/8	15/16	1/4	3/4
	2	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 5/8	2 3/8	5/8	1 5/8
	3	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 5/8	1 5/16	3/8	1
	4	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/4	1 11/16	1/2	1 1/4
	5	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 5/8	1 15/16	1/2	1 3/8
5	1(Std.)	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	1 7/8	15/16	1/4	3/4
	2	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	5 1/8	3 3/8	5/8	1 5/8
	3	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 5/8	1 5/16	3/8	1
	4	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/4	1 11/16	1/2	1 1/4
	5	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 5/8	1 15/16	1/2	1 3/8
	6	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 5/8	2 3/8	5/8	1 5/8
	7	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	5 1/8	2 7/8	5/8	1 5/8
6	1(Std.)	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 1/2	15/16	1/4	7/8
	2	4	3 3/4-12	3-12	4	4.749	1	3 3/8	5 1/2	3 7/8	1/2	1 1/2
	3	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/8	1 11/16	3/8	1 1/8
	4	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 1/2	1 15/16	3/8	1 1/4
	5	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 1/2	2 3/8	1/2	1 1/2
	6	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	5	2 7/8	1/2	1 1/2
	7	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	5	3 3/8	1/2	1 1/2

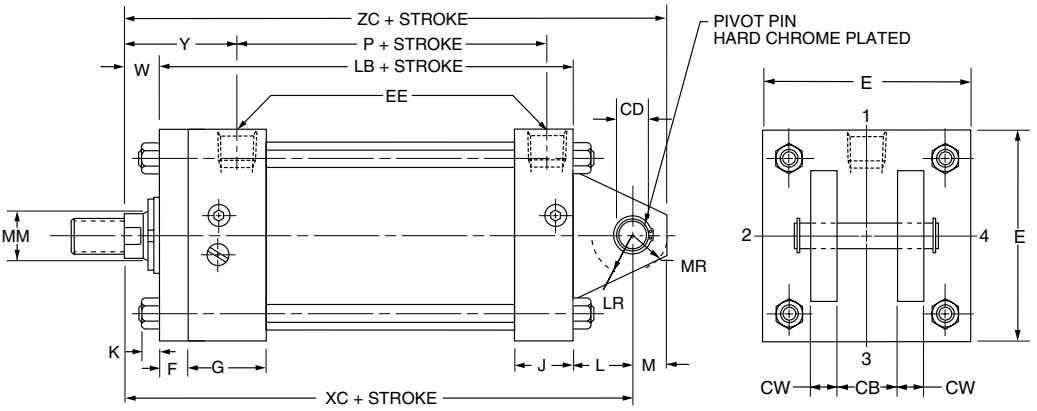
Table 3 — Envelope and Mounting Dimensions

Bore	XG	Min.** XI	Y	Add Stroke XJ	Add Stroke ZB
1	1 3/4	*	1 15/16	4	4 11/16
	1 3/4	*	1 15/16	4	4 11/16
1 1/2	1 3/4	3 3/16	1 15/16	4 1/8	4 7/8
	2 1/8	3 9/16	2 5/16	4 1/2	5 1/4
2	1 3/4	3 5/16	1 15/16	4 1/8	4 15/16
	2 3/8	3 15/16	2 9/16	4 3/4	5 9/16
	2 1/8	3 11/16	2 5/16	4 1/2	5 5/16
2 1/2	1 3/4	3 5/16	1 15/16	4 1/4	5 1/16
	2 5/8	4 3/16	2 13/16	5 1/8	5 15/16
	2 1/8	3 11/16	2 5/16	4 5/8	5 7/16
	2 3/8	3 15/16	2 9/16	4 7/8	5 11/16
3 1/4	2 1/4	4 3/16	2 7/16	5	6
	2 7/8	4 13/16	3 1/16	5 5/8	6 5/8
	2 1/2	4 7/16	2 11/16	5 1/4	6 1/4
	2 3/4	4 11/16	2 15/16	5 1/2	6 1/2
4	2 1/4	4 3/16	2 7/16	5	6
	3 1/8	5 1/16	3 5/16	5 7/8	6 7/8
	2 1/2	4 7/16	2 11/16	5 1/4	6 1/4
	2 3/4	4 11/16	2 15/16	5 1/2	6 1/2
	2 7/8	4 13/16	3 1/16	5 5/8	6 5/8
5	2 1/4	4 5/16	2 7/16	5 1/4	6 5/16
	3 1/8	5 1/16	3 5/16	6 1/8	7 3/16
	2 1/2	4 7/16	2 11/16	5 1/2	6 9/16
	2 3/4	4 11/16	2 15/16	5 3/4	6 13/16
	2 7/8	4 13/16	3 1/16	5 7/8	6 15/16
	3 1/8	5 1/16	3 5/16	6 1/8	7 3/16
	3 1/8	5 1/16	3 5/16	6 1/8	7 3/16
6	2 5/8	4 15/16	2 13/16	5 7/8	7 1/16
	3 1/4	5 9/16	3 7/16	6 1/2	7 11/16
	2 7/8	5 3/16	3 1/16	6 1/8	7 5/16
	3 1/4	5 9/16	3 7/16	6 1/4	7 7/16
	3 1/4	5 9/16	3 7/16	6 1/2	7 11/16
	3 1/4	5 9/16	3 7/16	6 1/2	7 11/16
	3 1/4	5 9/16	3 7/16	6 1/2	7 11/16

* Mounting style DD not available in 1" bore.
**Dimension XI to be specified by customer.

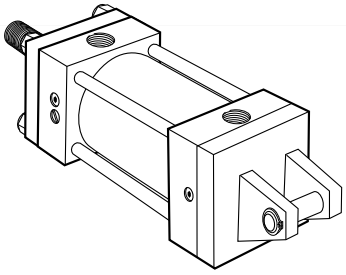
Cap Fixed Clevis
Style BB
(NFPA Style MP1)

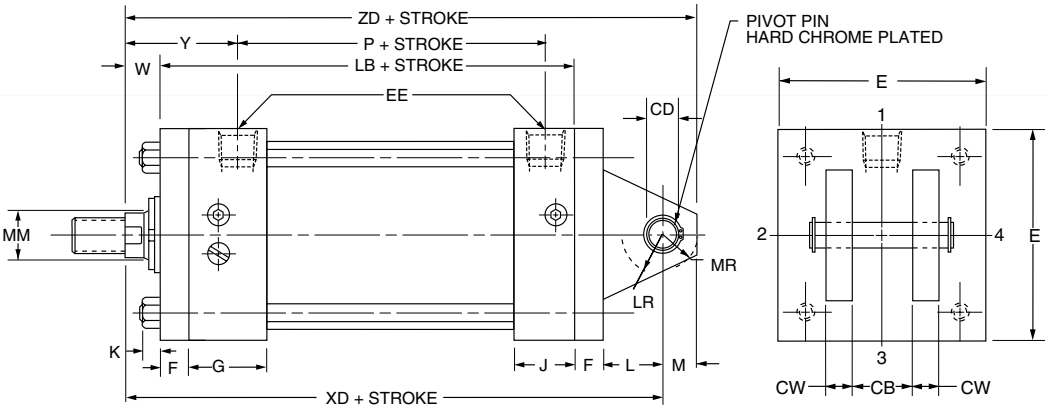




The 1", 4", 5" and 6" bore sizes have tie rod nuts at both ends as shown. Tie rods thread into cap on all other bore sizes.

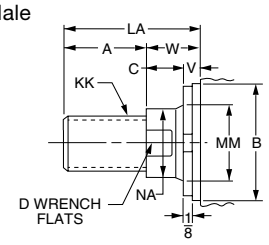
Cap Detachable Clevis
Style BC
(NFPA Style MP2)



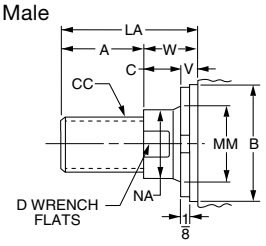


Rod End Dimensions — see table 2

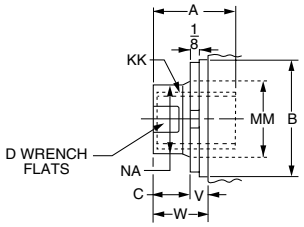
Thread Style 4
(NFPA Style SM)
Small Male



Thread Style 8
(NFPA Style IM)
Intermediate Male



Thread Style 9
(NFPA Style SF)
Small Female



A high strength rod end stud is supplied on thread style 4 through 2" diameter rods and on thread style 8 through 1 3/8" diameter rods. Larger sizes or special rod ends are cut threads. Style 4 rod ends are recommended where the workpiece is secured against the rod shoulder. When the workpiece is not shouldered, style 4 rod ends are recommended through 2" piston rod diameters and style 8 rod ends are recommended on larger diameters. Use style 9 for applications where female rod end threads are required. If rod end is not specified, style 4 will be supplied.

"Special" Thread Style 3
Special thread, extension, rod eye, blank, etc., are also available.

To order, specify "Style 3" and give desired dimensions for CC or KK, A and LA. If otherwise special, furnish dimensioned sketch.

For additional information – call your local Parker Cylinder Distributor.

Table 1—Envelope and Mounting Dimensions

Bore	CB	+.000 CD• -.002	CW	E	EE NPTF	F	G	J	K	L	LR	M	MR	Add Stroke LB	Add Stroke P
1*	†	.441†	†	■	1/4	3/8	1 1/2	1	3/16	1/2†	1/2†	7/16†	1/2†	3 7/8	2 1/8
1 1/2	3/4	.501	1/2	2	3/8**	3/8	1 1/2	1	1/4	3/4	3/4	1/2	5/8	4	2 1/4
2	3/4	.501	1/2	2 1/2	3/8**	3/8	1 1/2	1	5/16	3/4	3/4	1/2	5/8	4	2 1/4
2 1/2	3/4	.501	1/2	3	3/8**	3/8	1 1/2	1	5/16	3/4	3/4	1/2	5/8	4 1/8	2 3/8
3 1/4	1 1/4	.751	5/8	3 3/4	1/2	5/8	1 3/4	1 1/4	3/8	1 1/4	1	3/4	15/16	4 7/8	2 5/8
4	1 1/4	.751	5/8	4 1/2	1/2	5/8	1 3/4	1 1/4	3/8	1 1/4	1	3/4	15/16	4 7/8	2 5/8
5	1 1/4	.751	5/8	5 1/2	1/2	5/8	1 3/4	1 1/4	7/16	1 1/4	1	3/4	15/16	5 1/8	2 7/8
6	1 1/2	1.001	3/4	6 1/2	3/4	3/4	2	1 1/2	7/16	1 1/2	1 1/4	1	1 3/16	5 3/4	3 1/8

* Cushions not available on 1" bore.
** On 1", 1 1/2", 2" and 2 1/2" bore sizes, the head-end (only) pipe thread is not full depth on cylinders with No. 2 rods. Minimum of three full threads available.
† In 1" bore size model only, a single eye mounting, 7/16" thick, is used. Dimension CD (.441") is hole diameter – pin not supplied.
• Dimension CD is pin diameter except in 1" bore. ■1" bore head dimension is 1 3/4" x 1 1/2". See page B20.

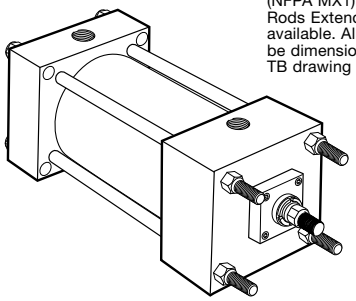
Table 2—Rod Dimensions

Bore	Rod No.	Rod Dia. MM	Thread Style 8 CC	Thread Style 4 & 9 KK	Rod Extensions and Pilot Dimensions A	+.000 -.002 B	C	D	LA	NA	V	W	Y
1	1(Std.)	1/2	7/16-20	5/16-24	5/8	.999	3/8	3/8	1 1/4	7/16	1/4	5/8	1 15/16
	2	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	1 3/8	9/16	1/4	5/8	1 15/16
1 1/2	1(Std.)	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	1 3/8	9/16	1/4	5/8	1 15/16
	2	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	2 1/8	15/16	1/2	1	2 5/16
2	1(Std.)	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	1 3/8	9/16	1/4	5/8	1 15/16
	2	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 7/8	1 5/16	5/8	1 1/4	2 9/16
	3	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	2 1/8	15/16	1/2	1	2 5/16
2 1/2	1(Std.)	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	1 3/8	9/16	1/4	5/8	1 15/16
	2	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/2	1 11/16	3/4	1 1/2	2 13/16
	3	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	2 1/8	15/16	1/2	1	2 5/16
	4	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 7/8	1 5/16	5/8	1 1/4	2 9/16
3 1/4	1(Std.)	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	1 7/8	15/16	1/4	3/4	2 7/16
	2	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 5/8	1 15/16	1/2	1 3/8	3 1/16
	3	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 5/8	1 5/16	3/8	1	2 11/16
	4	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/4	1 11/16	1/2	1 1/4	2 15/16
4	1(Std.)	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	1 7/8	15/16	1/4	3/4	2 7/16
	2	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 5/8	2 3/8	5/8	1 5/8	3 5/16
	3	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 5/8	1 5/16	3/8	1	2 11/16
	4	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/4	1 11/16	1/2	1 1/4	2 15/16
	5	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 5/8	1 15/16	1/2	1 3/8	3 1/16
5	1(Std.)	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	1 7/8	15/16	1/4	3/4	2 7/16
	2	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	5 1/8	3 3/8	5/8	1 5/8	3 5/16
	3	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 5/8	1 5/16	3/8	1	2 11/16
	4	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/4	1 11/16	1/2	1 1/4	2 15/16
	5	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 5/8	1 15/16	1/2	1 3/8	3 1/16
	6	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 5/8	2 3/8	5/8	1 5/8	3 5/16
	7	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	5 1/8	2 7/8	5/8	1 5/8	3 5/16
6	1(Std.)	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 1/2	1 5/16	1/4	7/8	2 13/16
	2	4	3 3/4-12	3-12	4	4.749	1	3 3/8	5 1/2	3 7/8	1/2	1 1/2	3 7/16
	3	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/8	1 11/16	3/8	1 1/8	3 1/16
	4	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 1/2	1 15/16	3/8	1 1/4	3 3/16
	5	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 1/2	2 3/8	1/2	1 1/2	3 7/16
	6	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	5	2 7/8	1/2	1 1/2	3 7/16
	7	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	5	3 3/8	1/2	1 1/2	3 7/16

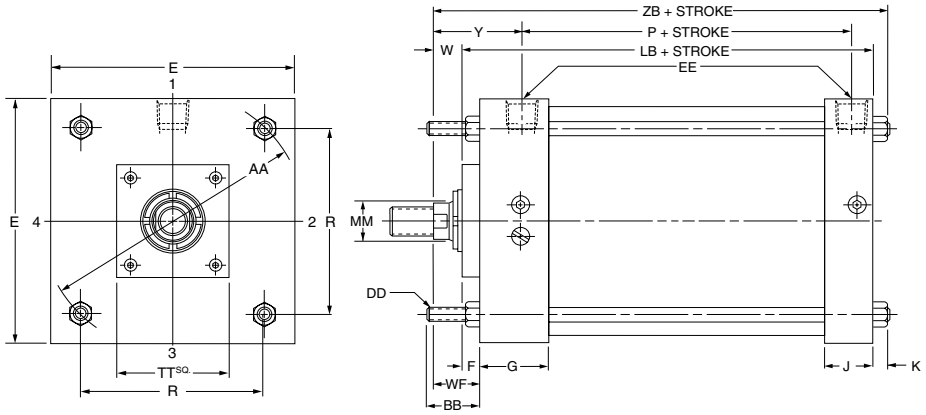
Table 3 — Envelope and Mounting Dimensions

Bore	Add Stroke XC	Add Stroke XD	Add Stroke ZC	Add Stroke ZD
1	5	5 3/8	5 7/16	5 13/16
	5	5 3/8	5 7/16	5 13/16
1 1/2	5 3/8	5 3/4	5 7/8	6 1/4
	6 3/4	6 1/8	6 1/4	6 5/8
2	5 3/8	5 3/4	5 7/8	6 1/4
	6	6 3/8	6 1/2	6 7/8
	6 3/4	6 1/8	6 1/4	6 5/8
2 1/2	5 1/2	5 7/8	6	6 3/8
	6 3/8	6 3/4	6 7/8	7 1/4
	5 7/8	6 1/4	6 3/8	6 3/4
	6 1/8	6 1/2	6 5/8	7
3 1/4	6 7/8	7 1/2	7 5/8	8 1/4
	7 1/2	8 1/8	8 1/4	8 7/8
	7 1/8	7 3/4	7 7/8	8 1/2
	7 3/8	8	8 1/8	8 3/4
4	6 7/8	7 1/2	7 5/8	8 1/4
	7 3/4	8 3/8	8 1/2	9 1/8
	7 1/8	7 3/4	7 7/8	8 1/2
	7 3/8	8	8 1/8	8 3/4
	7 1/2	8 1/8	8 1/4	8 7/8
5	7 1/8	7 3/4	7 7/8	8 1/2
	8	8 5/8	8 3/4	9 3/8
	7 3/8	8	8 1/8	8 3/4
	7 5/8	8 1/4	8 3/8	9
	7 3/4	8 3/8	8 1/2	9 1/8
	8	8 5/8	8 3/4	9 3/8
	8	8 5/8	8 3/4	9 3/8
6	8 1/8	8 7/8	9 1/8	9 7/8
	8 3/4	9 1/2	9 3/4	10 1/2
	8 3/8	9 1/8	9 3/8	10 1/8
	8 1/2	9 1/4	9 1/2	10 1/4
	8 3/4	9 1/2	9 3/4	10 1/2
	8 3/4	9 1/2	9 3/4	10 1/2
	8 3/4	9 1/2	9 3/4	10 1/2

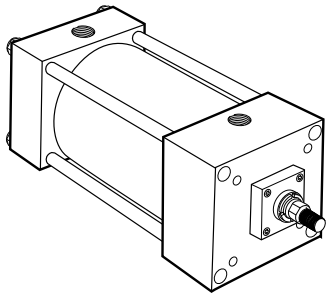
Tie Rods Extended
Style TB
(NFPA Style MX3)

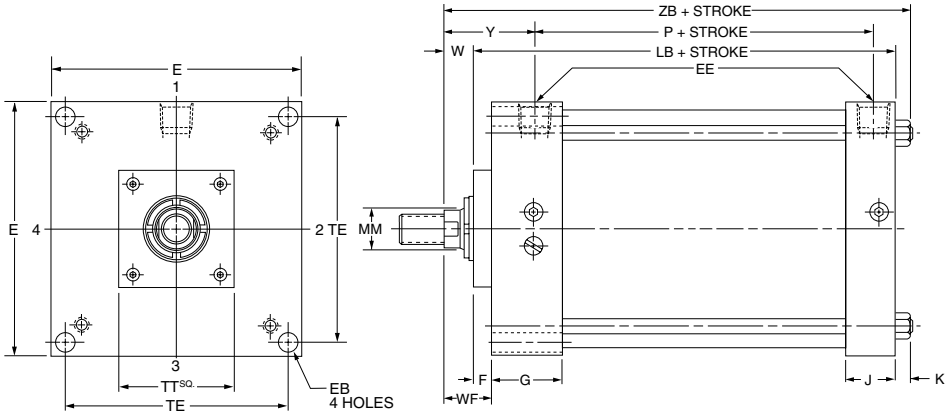


Style TB (NFPA MX3) Head Tie Rods Extended, illustrated: Style TC (NFPA MX2), Cap Tie Rods Extended; and Style TD (NFPA MX1), Both Ends Tie Rods Extended are also available. All "T" styles can be dimensioned from Style TB drawing at right.

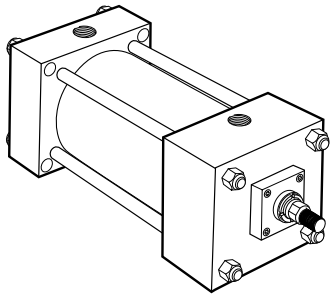


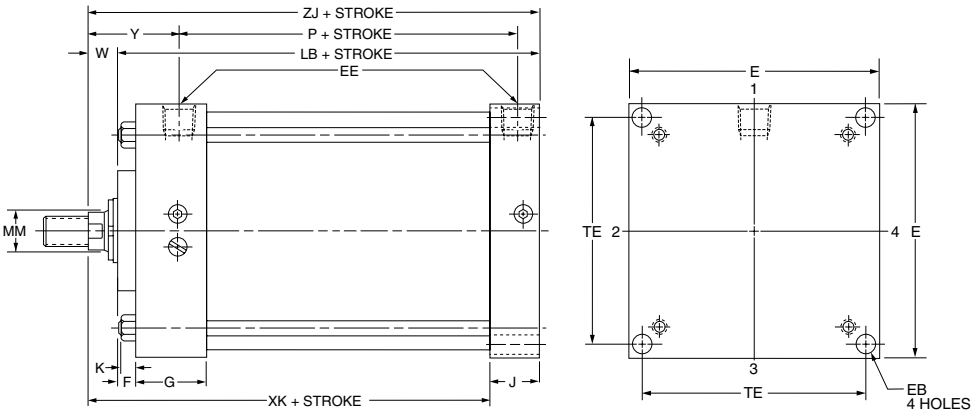
Head Square Flange
Style JB
(NFPA Style ME3)





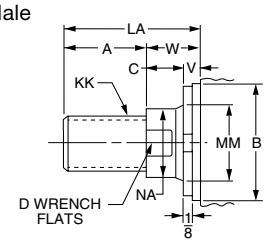
Cap Square Flange
Style HB
(NFPA Style ME4)



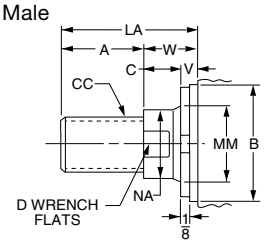


Rod End Dimensions — see table 2

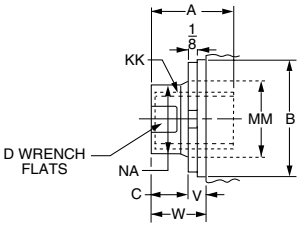
Thread Style 4
(NFPA Style SM)
Small Male



Thread Style 8
(NFPA Style IM)
Intermediate Male



Thread Style 9
(NFPA Style SF)
Small Female



A high strength rod end stud is supplied on thread style 4 through 2" diameter rods and on thread style 8 through 1 3/8" diameter rods. Larger sizes or special rod ends are cut threads. Style 4 rod ends are recommended where the workpiece is secured against the rod shoulder. When the workpiece is not shouldered, style 4 rod ends are recommended through 2" piston rod diameters and style 8 rod ends are recommended on larger diameters. Use style 9 for applications where female rod end threads are required. If rod end is not specified, style 4 will be supplied.

"Special" Thread Style 3

Special thread, extension, rod eye, blank, etc., are also available.

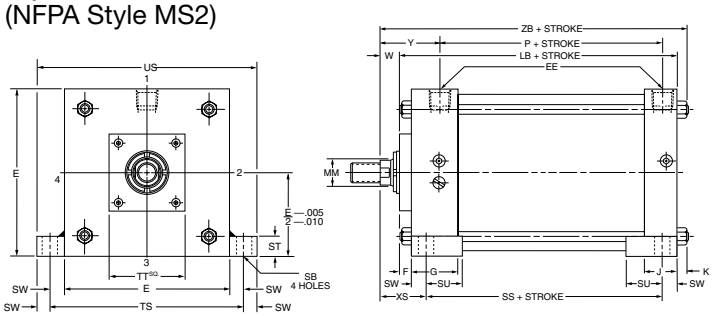
To order, specify "Style 3" and give desired dimensions for CC or KK, A and LA. If otherwise special, furnish dimensional sketch.

For additional information – call your local Parker Cylinder Distributor.

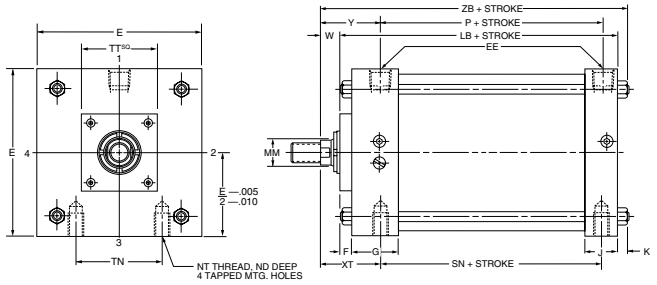
Series 2A
Heavy Duty Air Cylinders

**Side Lug, Side Tapped,
Cap Trunnion, Head Trunnion,
Cap Fixed Clevis Mountings
7" Bore Size**

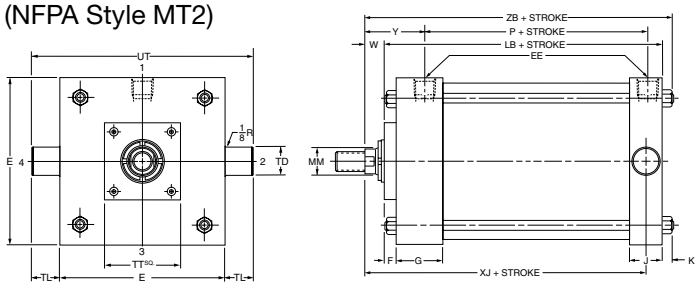
Side Lug
Style C
(NFPA Style MS2)



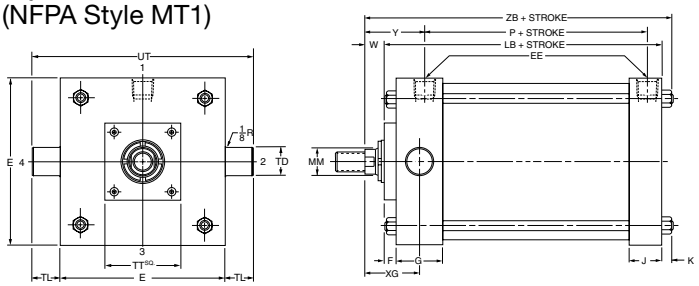
Side Tapped
Style F
(NFPA Style MS4)



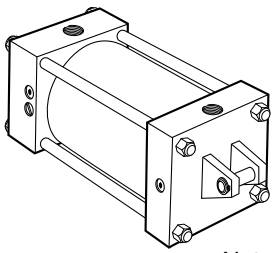
Cap Trunnion
Style DB
(NFPA Style MT2)

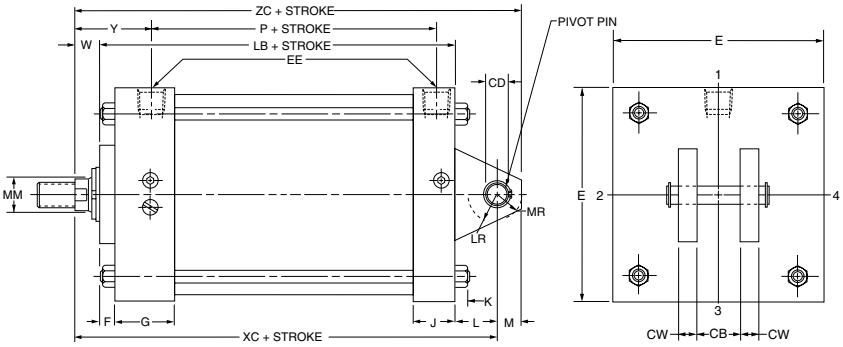


Head Trunnion
Style D
(NFPA Style MT1)



Cap Fixed Clevis
Style BB
(NFPA Style MP1)





Note: Other mounting styles and double rod end cylinders are available on request. Consult factory for details.

Table 1—Envelope and Mounting Dimensions

Bore	AA	BB	CB	+.000 CD -.002	CW	DD	E	EB	EE	F	G	J	K	L	LR	M	MR	ND	NT	R	SB	ST	SU	SW	+.000 TD -.001	TE	TL	TN	TS	US	UT	Add Stroke LB	P	SN	SS
7	8.1	2 5/16	1 1/2	1.001	3/4	5/8-18	7 1/2	9/16	3/4	3/4	2	1 1/2	9/16	1 1/2	1 1/4	1	1 3/16	1 1/8	3/4-10	5.73	13/16	1	1 9/16	11/16	1.375	6 3/4	1 3/8	3 1/2	8 7/8	10 1/4	10 1/4	5 7/8	3 1/4	3 1/4	3 3/4

Table 2—Rod Dimensions

Bore	Rod No.	Rod Dia. MM	Thread Style 8 CC	Thread Style 4 & 9 KK	Rod Extensions and Pilot Dimensions A	+.000 -.002 B	C	D	LA	NA	V	W	WF	Y
7	1	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 1/2	1 5/16	1/4	7/8	1 5/8	2 13/16
	3	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/8	1 11/16	3/8	1 1/8	1 7/8	3 1/16
	4	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 1/2	1 15/16	3/8	1 1/4	2	3 3/16

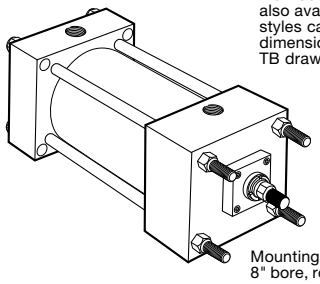
Table 3 — Envelope and Mounting Dimensions

Bore	TT	XG	XS	XT	Add Stroke XC	XJ	XK	ZB	ZC	ZJ
7	4	2 5/8	2 5/16	2 13/16	8 1/4	6	5 1/4	7 5/16	9 1/4	6 3/4
	4	2 7/8	2 9/16	3 1/16	8 1/2	6 1/4	5 1/2	7 9/16	9 1/2	7
	4	3	2 11/16	3 3/16	8 5/8	6 3/8	5 5/8	7 11/16	9 5/8	7 1/8

For Cylinder Division Plant Locations – See Page II.

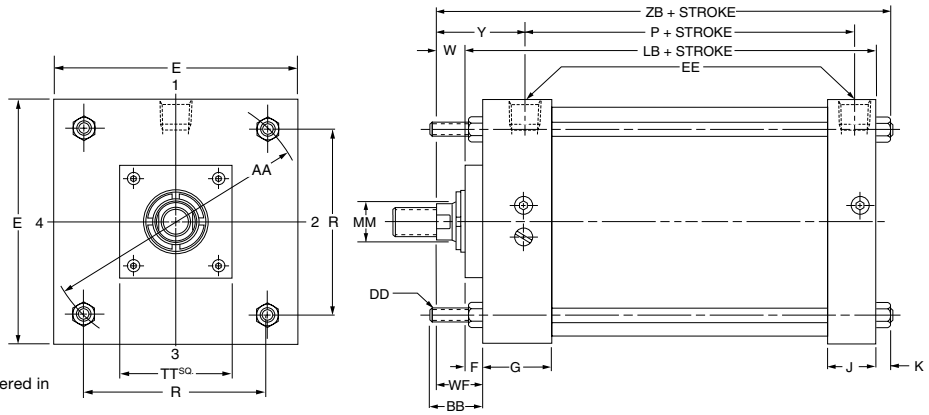
Parker Cylinder

Tie Rods Extended
Style TB
(NFPA Style MX3)

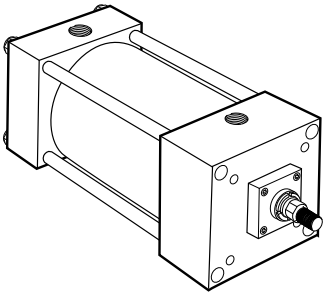


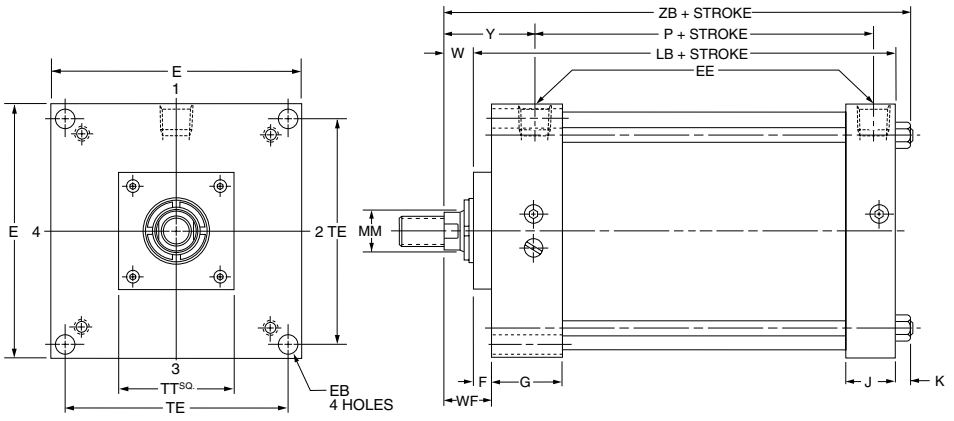
Style TB (NFPA MX3) Head Tie Rods Extended, illustrated: Style TC (NFPA MX2), Cap Tie Rods Extended; and Style TD (NFPA MX1), Both Ends Tie Rods Extended are also available. All "T" styles can be dimensioned from Style TB drawing at right.

Mounting styles TB & TD not offered in 8" bore, rod codes #2, 9 and 0.

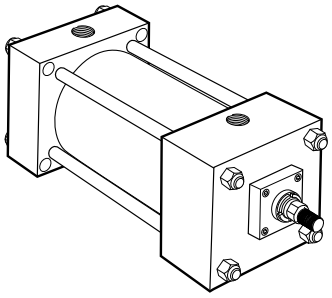


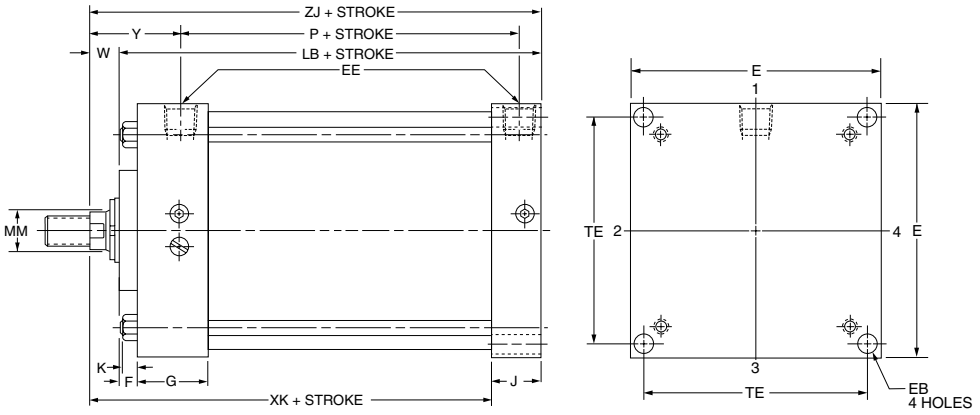
Head Square Flange
Style JB
(NFPA Style ME3)





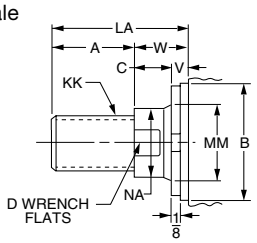
Cap Square Flange
Style HB
(NFPA Style ME4)



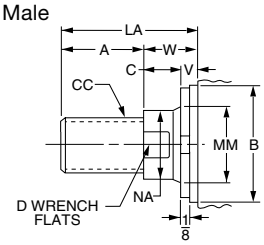


Rod End Dimensions — see table 2

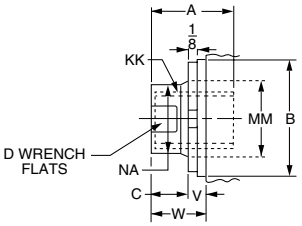
Thread Style 4
(NFPA Style SM)
Small Male



Thread Style 8
(NFPA Style IM)
Intermediate Male



Thread Style 9
(NFPA Style SF)
Small Female



A high strength rod end stud is supplied on thread style 4 through 2" diameter rods and on thread style 8 through 1 3/8" diameter rods. Larger sizes or special rod ends are cut threads. Style 4 rod ends are recommended where the workpiece is secured against the rod shoulder. When the workpiece is not shouldered, style 4 rod ends are recommended through 2" piston rod diameters and style 8 rod ends are recommended on larger diameters. Use style 9 for applications where female rod end threads are required. If rod end is not specified, style 4 will be supplied.

"Special" Thread Style 3

Special thread, extension, rod eye, blank, etc., are also available.

To order, specify "Style 3" and give desired dimensions for CC or KK, A and LA. If otherwise special, furnish dimensional sketch.

For additional information – call your local Parker Cylinder Distributor.

Table 1—Envelope and Mounting Dimensions

Bore	AA	BB	DD	E	EB	EE NPTF	F	G	J	K	R	TE	Add Stroke LB	Add Stroke P
8	9.1	2 5/16	5/8-18	8 1/2	11/16	3/4	3/4	2	1 1/2	9/16	6.44	7.57	5 7/8	3 1/4
10	11.2	2 11/16	3/4-16	10 5/8	13/16	1	3/4	2 1/4	2	11/16	7.92	9.40	7 1/8	4 1/8
12	13.3	2 11/16	3/4-16	12 3/4	13/16	1	3/4	2 1/4	2	11/16	9.40	11.10	7 5/8	4 5/8
14	15.4	3 3/16	7/8-14	14 3/4	15/16	1 1/4	3/4	2 3/4	2 1/4	3/4	10.90	12.87	8 7/8	5 1/2

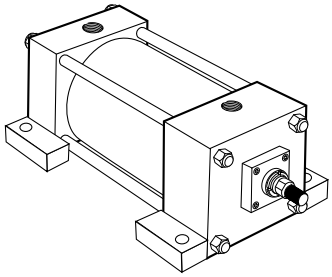
Table 2—Rod Dimensions

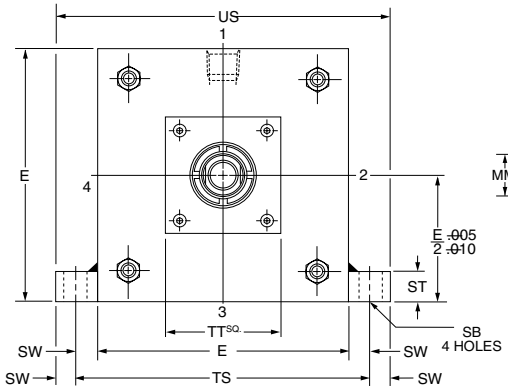
Bore	Rod No.	Rod Dia. MM	Thread Style 8 CC	Thread Style 4 & 9 KK	Rod Extensions and Pilot Dimensions A	+.000 -.002 B	C	D	LA	NA	V	W
8	1(Std.)	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 1/2	1 5/16	1/4	7/8
	2	5 1/2	5 1/4-12	4-12	5 1/2	6.249	1	4 5/8	7	5 3/8	1/2	1 1/2
	3	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/8	1 11/16	3/8	1 1/8
	4	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 1/2	1 15/16	3/8	1 1/4
	5	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 1/2	2 3/8	1/2	1 1/2
	6	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	5	2 7/8	1/2	1 1/2
	7	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	5	3 3/8	1/2	1 1/2
	8	4	3 3/4-12	3-12	4	4.749	1	3 3/8	5 1/2	3 7/8	1/2	1 1/2
	9	4 1/2	4 1/4-12	3 1/4-12	4 1/2	5.249	1	3 7/8	6	4 3/8	1/2	1 1/2
	0	5	4 3/4-12	3 1/2-12	5	5.749	1	4 1/4	6 1/2	4 7/8	1/2	1 1/2
10	1(Std.)	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/8	1 11/16	3/8	1 1/8
	3	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 1/2	1 15/16	3/8	1 1/4
	4	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 1/2	2 3/8	1/2	1 1/2
	5	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	5	2 7/8	1/2	1 1/2
	6	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	5	3 3/8	1/2	1 1/2
	7	4	3 3/4-12	3-12	4	4.749	1	3 3/8	5 1/2	3 7/8	1/2	1 1/2
	8	4 1/2	4 1/4-12	3 1/4-12	4 1/2	5.249	1	3 7/8	6	4 3/8	1/2	1 1/2
	9	5	4 3/4-12	3 1/2-12	5	5.749	1	4 1/4	6 1/2	4 7/8	1/2	1 1/2
	0	5 1/2	5 1/4-12	4-12	5 1/2	6.249	1	4 5/8	7	5 3/8	1/2	1 1/2
12	1(Std.)	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 1/2	1 15/16	3/8	1 1/4
	3	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 1/2	2 3/8	1/2	1 1/2
	4	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	5	2 7/8	1/2	1 1/2
	5	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	5	3 3/8	1/2	1 1/2
	6	4	3 3/4-12	3-12	4	4.749	1	3 3/8	5 1/2	3 7/8	1/2	1 1/2
	7	4 1/2	4 1/4-12	3 1/4-12	4 1/2	5.249	1	3 7/8	6	4 3/8	1/2	1 1/2
	8	5	4 3/4-12	3 1/2-12	5	5.749	1	4 1/4	6 1/2	4 7/8	1/2	1 1/2
	9	5 1/2	5 1/4-12	4-12	5 1/2	6.249	1	4 5/8	7	5 3/8	1/2	1 1/2
14	1(Std.)	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 1/2	2 3/8	1/2	1 1/2
	3	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	5	2 7/8	1/2	1 1/2
	4	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	5	3 3/8	1/2	1 1/2
	5	4	3 3/4-12	3-12	4	4.749	1	3 3/8	5 1/2	3 7/8	1/2	1 1/2
	6	4 1/2	4 1/4-12	3 1/4-12	4 1/2	5.249	1	3 7/8	6	4 3/8	1/2	1 1/2
	7	5	4 3/4-12	3 1/2-12	5	5.749	1	4 1/4	6 1/2	4 7/8	1/2	1 1/2
	8	5 1/2	5 1/4-12	4-12	5 1/2	6.249	1	4 5/8	7	5 3/8	1/2	1 1/2

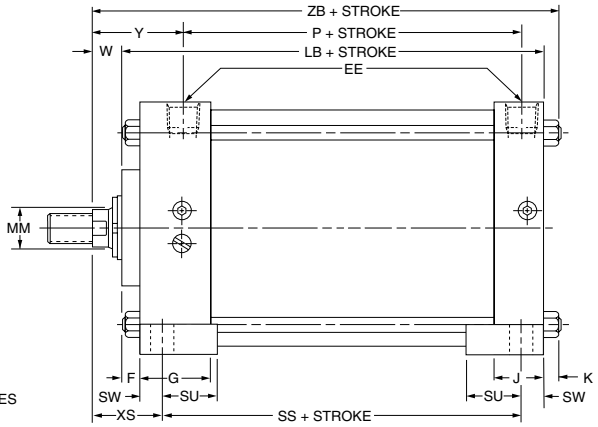
Table 3 — Envelope and Mounting Dimensions

Bore	TT	WF	Y	Add Stroke XK	Add Stroke ZB	Add Stroke ZJ
8	4	1 5/8	2 13/16	5 1/4	7 5/16	6 3/4
	7	2 1/4	3 7/16	5 7/8	7 15/16	7 3/8
	4	1 7/8	3 1/16	5 1/2	7 9/16	7
	4	2	3 3/16	5 5/8	7 11/16	7 1/8
	4	2 1/4	3 7/16	5 7/8	7 15/16	7 3/8
	5 1/2	2 1/4	3 7/16	5 7/8	7 15/16	7 3/8
	5 1/2	2 1/4	3 7/16	5 7/8	7 15/16	7 3/8
	5 1/2	2 1/4	3 7/16	5 7/8	7 15/16	7 3/8
	7	2 1/4	3 7/16	5 7/8	7 15/16	7 3/8
	7	2 1/4	3 7/16	5 7/8	7 15/16	7 3/8
	7	2 1/4	3 7/16	5 7/8	7 15/16	7 3/8
10	4	1 7/8	3 1/8	6 1/4	8 15/16	8 1/4
	4	2	3 1/4	6 3/8	9 1/16	8 3/8
	4	2 1/4	3 1/2	6 5/8	9 5/16	8 5/8
	5 1/2	2 1/4	3 1/2	6 5/8	9 5/16	8 5/8
	5 1/2	2 1/4	3 1/2	6 5/8	9 5/16	8 5/8
	5 1/2	2 1/4	3 1/2	6 5/8	9 5/16	8 5/8
	7	2 1/4	3 1/2	6 5/8	9 5/16	8 5/8
	7	2 1/4	3 1/2	6 5/8	9 5/16	8 5/8
	7	2 1/4	3 1/2	6 5/8	9 5/16	8 5/8
12	4	2	3 1/4	6 7/8	9 9/16	8 7/8
	4	2 1/4	3 1/2	7 1/8	9 13/16	9 1/8
	5 1/2	2 1/4	3 1/2	7 1/8	9 13/16	9 1/8
	5 1/2	2 1/4	3 1/2	7 1/8	9 13/16	9 1/8
	5 1/2	2 1/4	3 1/2	7 1/8	9 13/16	9 1/8
	7	2 1/4	3 1/2	7 1/8	9 13/16	9 1/8
	7	2 1/4	3 1/2	7 1/8	9 13/16	9 1/8
	7	2 1/4	3 1/2	7 1/8	9 13/16	9 1/8
14	4	2 1/4	3 13/16	8 1/8	11 1/8	10 3/8
	5 1/2	2 1/4	3 13/16	8 1/8	11 1/8	10 3/8
	5 1/2	2 1/4	3 13/16	8 1/8	11 1/8	10 3/8
	5 1/2	2 1/4	3 13/16	8 1/8	11 1/8	10 3/8
	7	2 1/4	3 13/16	8 1/8	11 1/8	10 3/8
	7	2 1/4	3 13/16	8 1/8	11 1/8	10 3/8
	7	2 1/4	3 13/16	8 1/8	11 1/8	10 3/8

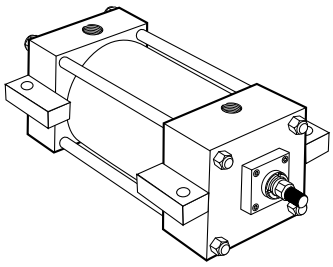
Side Lug
Style C
(NFPA Style MS2)

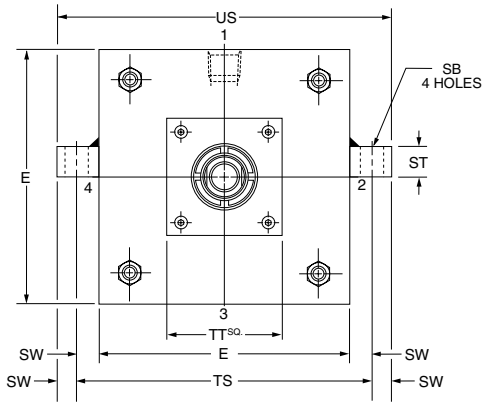


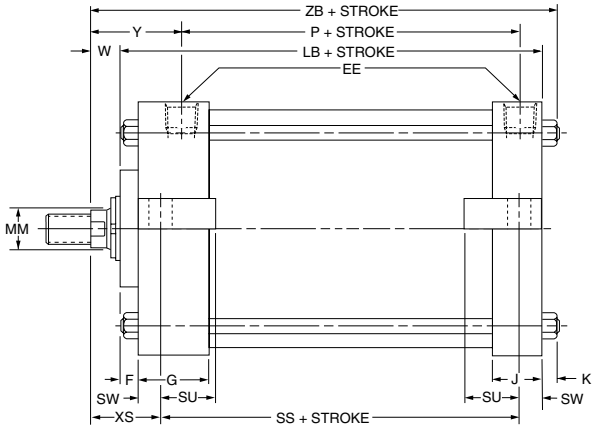




Centerline Lugs
Style E
(NFPA Style MS3)

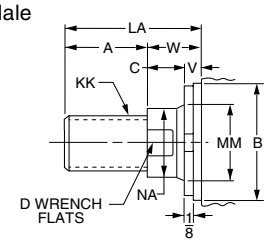




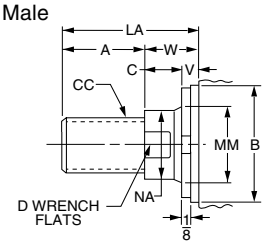


Rod End Dimensions — see table 2

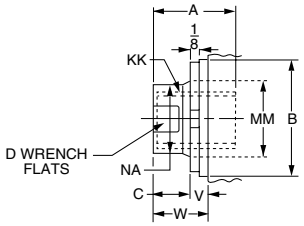
Thread Style 4
(NFPA Style SM)
Small Male



Thread Style 8
(NFPA Style IM)
Intermediate Male



Thread Style 9
(NFPA Style SF)
Small Female



A high strength rod end stud is supplied on thread style 4 through 2" diameter rods and on thread style 8 through 1 3/8" diameter rods. Larger sizes or special rod ends are cut threads. Style 4 rod ends are recommended where the workpiece is secured against the rod shoulder. When the workpiece is not shouldered, style 4 rod ends are recommended through 2" piston rod diameters and style 8 rod ends are recommended on larger diameters. Use style 9 for applications where female rod end threads are required. If rod end is not specified, style 4 will be supplied.

"Special" Thread Style 3
Special thread, extension, rod eye, blank, etc., are also available.

To order, specify Style 3"and give desired dimensions for CC or KK, A and LA. If otherwise special, furnish dimensional sketch.

For additional information – call your local Parker Cylinder Distributor.

Table 1—Envelope and Mounting Dimensions

Bore	E	EE NPTF	F	G	J	K	SB*	ST	SU	SW	TS	US	Add Stroke LB	Add Stroke P	Add Stroke SS
8	8 1/2	3/4	3/4	2	1 1/2	9/16	13/16	1	1 9/16	11/16	9 7/8	11 1/4	5 7/8	3 1/4	3 3/4
10	10 5/8	1	3/4	2 1/4	2	11/16	1 1/16	1 1/4	2	7/8	12 3/8	14 1/8	7 1/8	4 1/8	4 5/8
12	12 3/4	1	3/4	2 1/4	2	11/16	1 1/16	1 1/4	2	7/8	14 1/2	16 1/4	7 5/8	4 5/8	5 1/8
14	14 3/4	1 1/4	3/4	2 3/4	2 1/4	3/4	1 5/16	1 1/2	2 1/2	1 1/8	17	19 1/4	8 7/8	5 1/2	5 7/8

* Upper surface spotfaced for socket head screws.

A

Table 2—Rod Dimensions

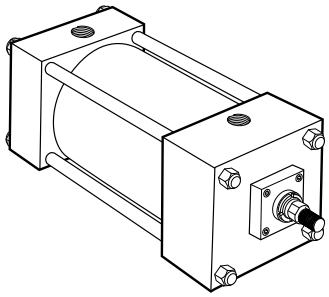
Bore	Rod No.	Rod Dia. MM	Thread Style 8 CC	Thread Style 4 & 9 KK	Rod Extensions and Pilot Dimensions A	+.000 -.002 B	C	D	LA	NA	V	W
8	1(Std.)	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 1/2	1 5/16	1/4	7/8
	2	5 1/2	5 1/4-12	4-12	5 1/2	6.249	1	4 5/8	7	5 3/8	1/2	1 1/2
	3	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/8	1 11/16	3/8	1 1/8
	4	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 1/2	1 15/16	3/8	1 1/4
	5	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 1/2	2 3/8	1/2	1 1/2
	6	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	5	2 7/8	1/2	1 1/2
	7	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	5	3 3/8	1/2	1 1/2
	8	4	3 3/4-12	3-12	4	4.749	1	3 3/8	5 1/2	3 7/8	1/2	1 1/2
	9	4 1/2	4 1/4-12	3 1/4-12	4 1/2	5.249	1	3 7/8	6	4 3/8	1/2	1 1/2
	0	5	4 3/4-12	3 1/2-12	5	5.749	1	4 1/4	6 1/2	4 7/8	1/2	1 1/2
10	1(Std.)	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/8	1 11/16	3/8	1 1/8
	3	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 1/2	1 15/16	3/8	1 1/4
	4	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 1/2	2 3/8	1/2	1 1/2
	5	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	5	2 7/8	1/2	1 1/2
	6	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	5	3 3/8	1/2	1 1/2
	7	4	3 3/4-12	3-12	4	4.749	1	3 3/8	5 1/2	3 7/8	1/2	1 1/2
	8	4 1/2	4 1/4-12	3 1/4-12	4 1/2	5.249	1	3 7/8	6	4 3/8	1/2	1 1/2
	9	5	4 3/4-12	3 1/2-12	5	5.749	1	4 1/4	6 1/2	4 7/8	1/2	1 1/2
	0	5 1/2	5 1/4-12	4-12	5 1/2	6.249	1	4 5/8	7	5 3/8	1/2	1 1/2
12	1(Std.)	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 1/2	1 15/16	3/8	1 1/4
	3	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 1/2	2 3/8	1/2	1 1/2
	4	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	5	2 7/8	1/2	1 1/2
	5	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	5	3 3/8	1/2	1 1/2
	6	4	3 3/4-12	3-12	4	4.749	1	3 3/8	5 1/2	3 7/8	1/2	1 1/2
	7	4 1/2	4 1/4-12	3 1/4-12	4 1/2	5.249	1	3 7/8	6	4 3/8	1/2	1 1/2
	8	5	4 3/4-12	3 1/2-12	5	5.749	1	4 1/4	6 1/2	4 7/8	1/2	1 1/2
	9	5 1/2	5 1/4-12	4-12	5 1/2	6.249	1	4 5/8	7	5 3/8	1/2	1 1/2
14	1(Std.)	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 1/2	2 3/8	1/2	1 1/2
	3	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	5	2 7/8	1/2	1 1/2
	4	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	5	3 3/8	1/2	1 1/2
	5	4	3 3/4-12	3-12	4	4.749	1	3 3/8	5 1/2	3 7/8	1/2	1 1/2
	6	4 1/2	4 1/4-12	3 1/4-12	4 1/2	5.249	1	3 7/8	6	4 3/8	1/2	1 1/2
	7	5	4 3/4-12	3 1/2-12	5	5.749	1	4 1/4	6 1/2	4 7/8	1/2	1 1/2
	8	5 1/2	5 1/4-12	4-12	5 1/2	6.249	1	4 5/8	7	5 3/8	1/2	1 1/2

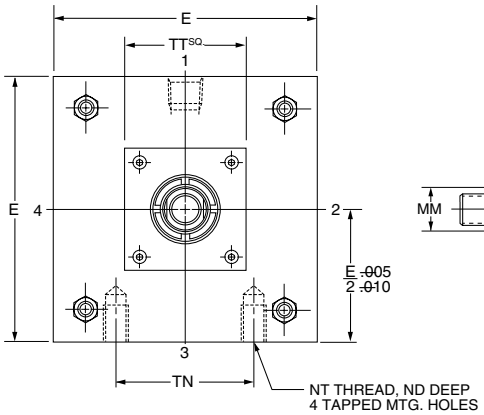
Table 3 — Envelope and Mounting Dimensions

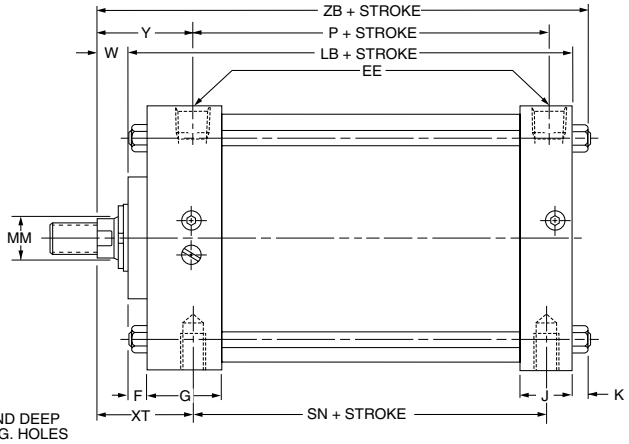
Bore	TT	XS	Y	Add Stroke ZB
8	4	2 5/16	2 13/16	7 5/16
	7	2 15/16	3 7/16	7 15/16
	4	2 9/16	3 1/16	7 9/16
	4	2 11/16	3 3/16	7 11/16
	4	2 15/16	3 7/16	7 15/16
	5 1/2	2 15/16	3 7/16	7 15/16
	5 1/2	2 15/16	3 7/16	7 15/16
	5 1/2	2 15/16	3 7/16	7 15/16
	7	2 15/16	3 7/16	7 15/16
	7	2 15/16	3 7/16	7 15/16
10	4	2 3/4	3 1/8	8 15/16
	4	2 7/8	3 1/4	9 1/16
	4	3 1/8	3 1/2	9 5/16
	5 1/2	3 1/8	3 1/2	9 5/16
	5 1/2	3 1/8	3 1/2	9 5/16
	5 1/2	3 1/8	3 1/2	9 5/16
	7	3 1/8	3 1/2	9 5/16
	7	3 1/8	3 1/2	9 5/16
	7	3 1/8	3 1/2	9 5/16
12	4	2 7/8	3 1/4	9 9/16
	4	3 1/8	3 1/2	9 13/16
	5 1/2	3 1/8	3 1/2	9 13/16
	5 1/2	3 1/8	3 1/2	9 13/16
	5 1/2	3 1/8	3 1/2	9 13/16
	7	3 1/8	3 1/2	9 13/16
	7	3 1/8	3 1/2	9 13/16
	7	3 1/8	3 1/2	9 13/16
14	4	3 3/8	3 13/16	11 1/8
	5 1/2	3 3/8	3 13/16	11 1/8
	5 1/2	3 3/8	3 13/16	11 1/8
	5 1/2	3 3/8	3 13/16	11 1/8
	7	3 3/8	3 13/16	11 1/8
	7	3 3/8	3 13/16	11 1/8
	7	3 3/8	3 13/16	11 1/8

Side Tapped

Style F
(NFPA Style MS4)



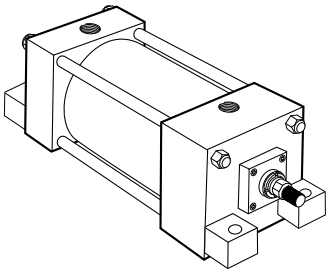


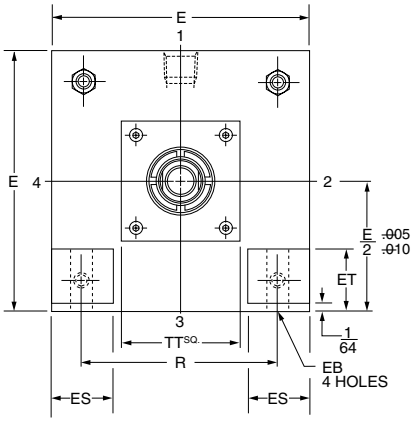


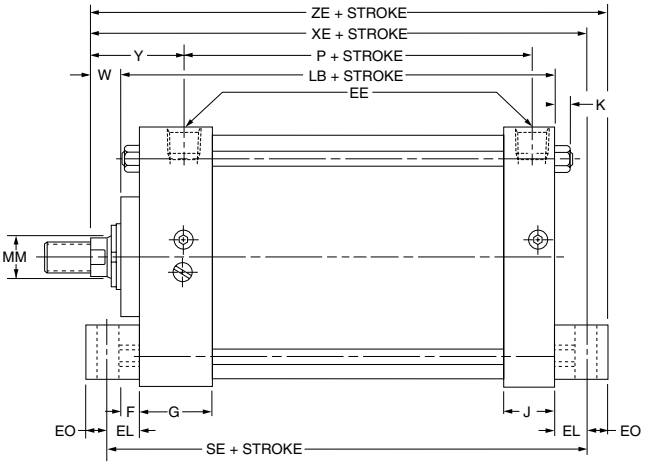
Side End Lugs

Style G
(NFPA Style MS7)

Cylinders with this mounting style are mounted on the precision ground surfaces of the head and cap. There must be a minimum gap of at least $^{1}/_{64}$ of an inch between the bottom of the lug and the mounting surface before the mounting bolts are tightened.



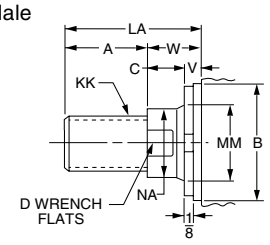




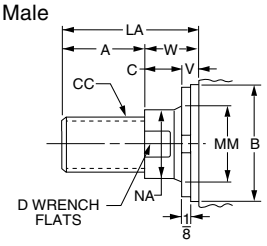
Not offered in the following sizes: 8" bore, rod codes #2, 6, 7, 8, 9 and 0; 10" bore, rod codes #8, 9 and 0; and 12" bore, rod codes #7, 8 and 9.

Rod End Dimensions — see table 2

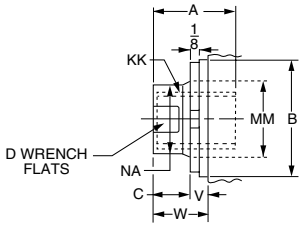
Thread Style 4
(NFPA Style SM)
Small Male



Thread Style 8
(NFPA Style IM)
Intermediate Male



Thread Style 9
(NFPA Style SF)
Small Female



A high strength rod end stud is supplied on thread style 4 through 2" diameter rods and on thread style 8 through $1^{3}/_{8}$" diameter rods. Larger sizes or special rod ends are cut threads. Style 4 rod ends are recommended where the workpiece is secured against the rod shoulder. When the workpiece is not shouldered, style 4 rod ends are recommended through 2" piston rod diameters and style 8 rod ends are recommended on larger diameters. Use style 9 for applications where female rod end threads are required. If rod end is not specified, style 4 will be supplied.

Special Thread Style 3

Special thread, extension, rod eye, blank, etc., are also available.

To order, specify "Style 3" and give desired dimensions for CC or KK, A and LA. If otherwise special, furnish dimensional sketch.

For additional information – call your local Parker Cylinder Distributor.

Table 1—Envelope and Mounting Dimensions

Bore	E	EB	EE NPTF	EL	EO	ES	ET	F	G	J	K	ND	NT	R	TN	Add Stroke LB	P	SE	SN
8	8 1/2	11/16	3/4	1 1/8	5/8	2 1/4	2 1/32	3/4	2	1 1/2	9/16	1 1/8	3/4-10	6.44	4 1/2	5 7/8	3 1/4	7 3/8	3 1/4
10	10 5/8	13/16	1	1 5/16	5/8	2 3/4	2 11/16	3/4	2 1/4	2	11/16	1 1/2	1-8	7.92	5 1/2	7 1/8	4 1/8	9	4 1/8
12	12 3/4	13/16	1	1 5/16	5/8	3 1/2	3 5/16	3/4	2 1/4	2	11/16	1 1/2	1-8	9.40	7 1/4	7 5/8	4 5/8	9 1/2	4 5/8
14	14 3/4	15/16	1 1/4	1 1/2	3/4	4	3 13/16	3/4	2 3/4	2 1/4	3/4	1 7/8	1 1/4-7	10.90	8 3/8	8 7/8	5 1/2	11 1/8	5 1/2

A

Table 2—Rod Dimensions

Bore	Rod No.	Rod Dia. MM	Thread Style 8 CC	Thread Style 4 & 9 KK	Rod Extensions and Pilot Dimensions A	+.000 -.002 B	C	D	LA	NA	V	W
8	1(Std.)	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 1/2	1 5/16	1/4	7/8
	2	5 1/2	5 1/4-12	4-12	5 1/2	6.249	1	4 5/8	7	5 3/8	1/2	1 1/2
	3	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/8	1 11/16	3/8	1 1/8
	4	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 1/2	1 15/16	3/8	1 1/4
	5	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 1/2	2 3/8	1/2	1 1/2
	6	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	5	2 7/8	1/2	1 1/2
	7	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	5	3 3/8	1/2	1 1/2
	8	4	3 3/4-12	3-12	4	4.749	1	3 3/8	5 1/2	3 7/8	1/2	1 1/2
	9	4 1/2	4 1/4-12	3 1/4-12	4 1/2	5.249	1	3 7/8	6	4 3/8	1/2	1 1/2
	0	5	4 3/4-12	3 1/2-12	5	5.749	1	4 1/4	6 1/2	4 7/8	1/2	1 1/2
10	1(Std.)	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/8	1 11/16	3/8	1 1/8
	3	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 1/2	1 15/16	3/8	1 1/4
	4	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 1/2	2 3/8	1/2	1 1/2
	5	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	5	2 7/8	1/2	1 1/2
	6	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	5	3 3/8	1/2	1 1/2
	7	4	3 3/4-12	3-12	4	4.749	1	3 3/8	5 1/2	3 7/8	1/2	1 1/2
	8	4 1/2	4 1/4-12	3 1/4-12	4 1/2	5.249	1	3 7/8	6	4 3/8	1/2	1 1/2
	9	5	4 3/4-12	3 1/2-12	5	5.749	1	4 1/4	6 1/2	4 7/8	1/2	1 1/2
	0	5 1/2	5 1/4-12	4-12	5 1/2	6.249	1	4 5/8	7	5 3/8	1/2	1 1/2
12	1(Std.)	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 1/2	1 15/16	3/8	1 1/4
	3	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 1/2	2 3/8	1/2	1 1/2
	4	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	5	2 7/8	1/2	1 1/2
	5	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	5	3 3/8	1/2	1 1/2
	6	4	3 3/4-12	3-12	4	4.749	1	3 3/8	5 1/2	3 7/8	1/2	1 1/2
	7	4 1/2	4 1/4-12	3 1/4-12	4 1/2	5.249	1	3 7/8	6	4 3/8	1/2	1 1/2
	8	5	4 3/4-12	3 1/2-12	5	5.749	1	4 1/4	6 1/2	4 7/8	1/2	1 1/2
	9	5 1/2	5 1/4-12	4-12	5 1/2	6.249	1	4 5/8	7	5 3/8	1/2	1 1/2
14	1(Std.)	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 1/2	2 3/8	1/2	1 1/2
	3	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	5	2 7/8	1/2	1 1/2
	4	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	5	3 3/8	1/2	1 1/2
	5	4	3 3/4-12	3-12	4	4.749	1	3 3/8	5 1/2	3 7/8	1/2	1 1/2
	6	4 1/2	4 1/4-12	3 1/4-12	4 1/2	5.249	1	3 7/8	6	4 3/8	1/2	1 1/2
	7	5	4 3/4-12	3 1/2-12	5	5.749	1	4 1/4	6 1/2	4 7/8	1/2	1 1/2
	8	5 1/2	5 1/4-12	4-12	5 1/2	6.249	1	4 5/8	7	5 3/8	1/2	1 1/2

Table 3 — Envelope and Mounting Dimensions

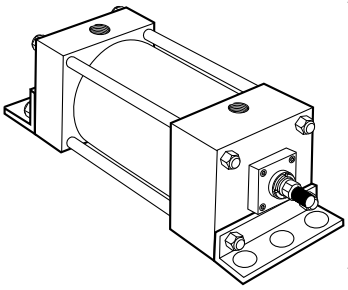
Bore	TT	XT	Y	Add Stroke XE	ZB	ZE
8	4	2 13/16	2 13/16	7 7/8	7 5/16	8 1/2
	7	3 7/16	3 7/16	*	7 15/16	*
	4	3 1/16	3 1/16	8 1/8	7 9/16	8 3/4
	4	3 3/16	3 3/16	8 1/4	7 11/16	8 7/8
	4	3 7/16	3 7/16	8 1/2	7 15/16	9 1/8
	5 1/2	3 7/16	3 7/16	*	7 15/16	*
	5 1/2	3 7/16	3 7/16	*	7 15/16	*
	5 1/2	3 7/16	3 7/16	*	7 15/16	*
	7	3 7/16	3 7/16	*	7 15/16	*
	7	3 7/16	3 7/16	*	7 15/16	*
10	4	3 1/8	3 1/8	9 9/16	8 15/16	10 3/16
	4	3 1/4	3 1/4	9 11/16	9 1/16	10 5/16
	4	3 1/2	3 1/2	9 15/16	9 5/16	10 9/16
	5 1/2	3 1/2	3 1/2	9 15/16	9 5/16	10 9/16
	5 1/2	3 1/2	3 1/2	9 15/16	9 5/16	10 9/16
	5 1/2	3 1/2	3 1/2	9 15/16	9 5/16	10 9/16
	7	3 1/2	3 1/2	*	9 5/16	*
	7	3 1/2	3 1/2	*	9 5/16	*
	7	3 1/2	3 1/2	*	9 5/16	*
12	4	3 1/4	3 1/4	10 3/16	9 9/16	10 13/16
	4	3 1/2	3 1/2	10 7/16	9 13/16	11 1/16
	5 1/2	3 1/2	3 1/2	10 7/16	9 13/16	11 1/16
	5 1/2	3 1/2	3 1/2	10 7/16	9 13/16	11 1/16
	5 1/2	3 1/2	3 1/2	10 7/16	9 13/16	11 1/16
	7	3 1/2	3 1/2	*	9 13/16	*
	7	3 1/2	3 1/2	*	9 13/16	*
	7	3 1/2	3 1/2	*	9 13/16	*
14	4	3 13/16	3 13/16	11 7/8	11 1/8	12 5/8
	5 1/2	3 13/16	3 13/16	11 7/8	11 1/8	12 5/8
	5 1/2	3 13/16	3 13/16	11 7/8	11 1/8	12 5/8
	5 1/2	3 13/16	3 13/16	11 7/8	11 1/8	12 5/8
	7	3 13/16	3 13/16	11 7/8	11 1/8	12 5/8
	7	3 13/16	3 13/16	11 7/8	11 1/8	12 5/8
	7	3 13/16	3 13/16	11 7/8	11 1/8	12 5/8

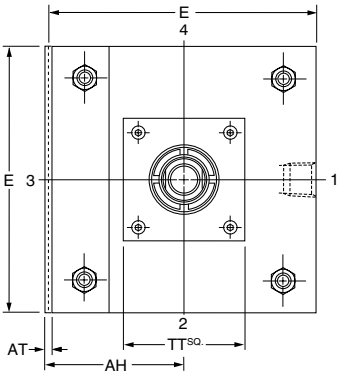
* Mounting style G not offered in this rod size.

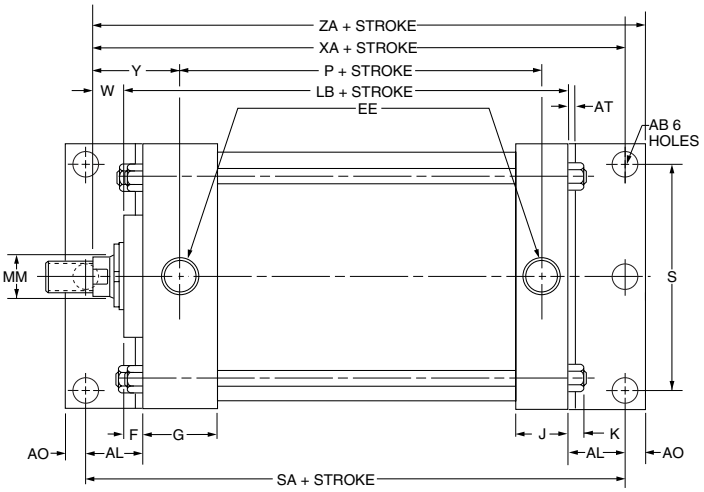
Caution: When using mounting style G, check clearance between mounting members and rod attachment or accessory. If necessary, specify longer rod extension to avoid interference with mounting members.

Side End Angles

Style CB
(NFPA Style MS1)



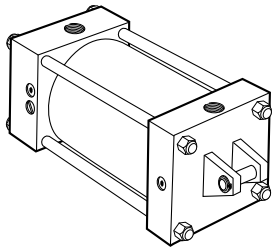


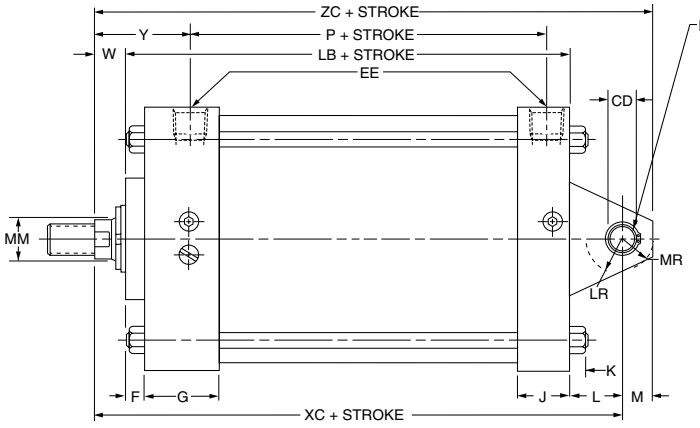


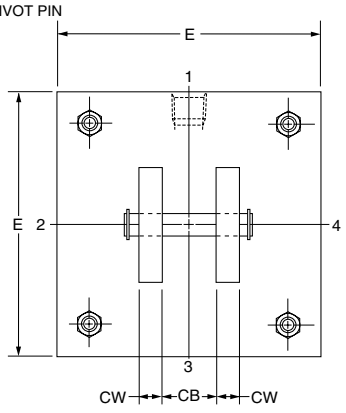
Not offered in the following sizes: 8" bore, rod codes #2, 6, 7, 8, 9 and 0; 10" bore, rod codes #8, 9 and 0.

Cap Fixed Clevis

Style BB
(NFPA Style MP1)

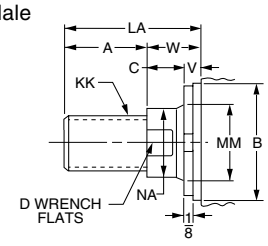




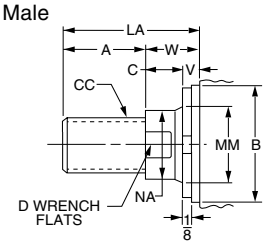


Rod End Dimensions — see table 2

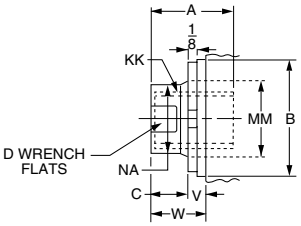
Thread Style 4
(NFPA Style SM)
Small Male



Thread Style 8
(NFPA Style IM)
Intermediate Male



Thread Style 9
(NFPA Style SF)
Small Female



A high strength rod end stud is supplied on thread style 4 through 2" diameter rods and on thread style 8 through 1 3/8" diameter rods. Larger sizes or special rod ends are cut threads. Style 4 rod ends are recommended where the workpiece is secured against the rod shoulder. When the workpiece is not shouldered, style 4 rod ends are recommended through 2" piston rod diameters and style 8 rod ends are recommended on larger diameters. Use style 9 for applications where female rod end threads are required. If rod end is not specified, style 4 will be supplied.

"Special" Thread Style 3

Special thread, extension, rod eye, blank, etc., are also available.

To order, specify "Style 3" and give desired dimensions for CC or KK, A and LA. If otherwise special, furnish dimensional sketch.

For additional information – call your local Parker Cylinder Distributor.

Table 1—Envelope and Mounting Dimensions

Bore	AB	AH	AL	AO	AT	CB	+.000 CD* -.002	CW	E	EE NPTF	F	G	J	K	L	LR	M	MR	S	Add Stroke LB	Add Stroke P	Add Stroke SA
8	13/16	4 1/4	1 13/16	11/16	1/4	1 1/2	1.001	3/4	8 1/2	3/4	3/4	2	1 1/2	9/16	1 1/2	1 1/4	1	1 3/16	7 1/8	5 7/8	3 1/4	8 3/4
10	1 1/16	5 5/16	2 1/8	7/8	1/4	2	1.376	1	10 5/8	1	3/4	2 1/4	2	11/16	2 1/8	1 7/8	1 3/8	1 5/8	8 7/8	7 1/8	4 1/8	10 5/8
12	1 1/16	6 3/8	2 1/8	7/8	3/8	2 1/2	1.751	1 1/4	12 3/4	1	3/4	2 1/4	2	11/16	2 1/4	2 1/8	1 3/4	2 1/8	11	7 5/8	4 5/8	11 1/8
14	1 5/16	7 3/8	2 7/16	1 1/16	3/8	2 1/2	2.001	1 1/4	14 3/4	1 1/4	3/4	2 3/4	2 1/4	3/4	2 1/2	2 3/8	2	2 3/8	12 5/8	8 7/8	5 1/2	13

* CD is pin diameter.

A

Table 2—Rod Dimensions

Bore	Rod No.	Rod Dia. MM	Thread Style 8 CC	Thread Style 4 & 9 KK	Rod Extensions and Pilot Dimensions A	+.000 -.002 B	C	D	LA	NA	V	W
8	1(Std.)	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 1/2	1 5/16	1/4	7/8
	2	5 1/2	5 1/4-12	4-12	5 1/2	6.249	1	4 5/8	7	5 3/8	1/2	1 1/2
	3	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/8	1 11/16	3/8	1 1/8
	4	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 1/2	1 15/16	3/8	1 1/4
	5	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 1/2	2 3/8	1/2	1 1/2
	6	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	5	2 7/8	1/2	1 1/2
	7	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	5	3 3/8	1/2	1 1/2
	8	4	3 3/4-12	3-12	4	4.749	1	3 3/8	5 1/2	3 7/8	1/2	1 1/2
	9	4 1/2	4 1/4-12	3 1/4-12	4 1/2	5.249	1	3 7/8	6	4 3/8	1/2	1 1/2
	0	5	4 3/4-12	3 1/2-12	5	5.749	1	4 1/4	6 1/2	4 7/8	1/2	1 1/2
10	1(Std.)	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/8	1 11/16	3/8	1 1/8
	3	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 1/2	1 15/16	3/8	1 1/4
	4	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 1/2	2 3/8	1/2	1 1/2
	5	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	5	2 7/8	1/2	1 1/2
	6	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	5	3 3/8	1/2	1 1/2
	7	4	3 3/4-12	3-12	4	4.749	1	3 3/8	5 1/2	3 7/8	1/2	1 1/2
	8	4 1/2	4 1/4-12	3 1/4-12	4 1/2	5.249	1	3 7/8	6	4 3/8	1/2	1 1/2
	9	5	4 3/4-12	3 1/2-12	5	5.749	1	4 1/4	6 1/2	4 7/8	1/2	1 1/2
	0	5 1/2	5 1/4-12	4-12	5 1/2	6.249	1	4 5/8	7	5 3/8	1/2	1 1/2
12	1(Std.)	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 1/2	1 15/16	3/8	1 1/4
	3	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 1/2	2 3/8	1/2	1 1/2
	4	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	5	2 7/8	1/2	1 1/2
	5	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	5	3 3/8	1/2	1 1/2
	6	4	3 3/4-12	3-12	4	4.749	1	3 3/8	5 1/2	3 7/8	1/2	1 1/2
	7	4 1/2	4 1/4-12	3 1/4-12	4 1/2	5.249	1	3 7/8	6	4 3/8	1/2	1 1/2
	8	5	4 3/4-12	3 1/2-12	5	5.749	1	4 1/4	6 1/2	4 7/8	1/2	1 1/2
	9	5 1/2	5 1/4-12	4-12	5 1/2	6.249	1	4 5/8	7	5 3/8	1/2	1 1/2
14	1(Std.)	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 1/2	2 3/8	1/2	1 1/2
	3	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	5	2 7/8	1/2	1 1/2
	4	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	5	3 3/8	1/2	1 1/2
	5	4	3 3/4-12	3-12	4	4.749	1	3 3/8	5 1/2	3 7/8	1/2	1 1/2
	6	4 1/2	4 1/4-12	3 1/4-12	4 1/2	5.249	1	3 7/8	6	4 3/8	1/2	1 1/2
	7	5	4 3/4-12	3 1/2-12	5	5.749	1	4 1/4	6 1/2	4 7/8	1/2	1 1/2
	8	5 1/2	5 1/4-12	4-12	5 1/2	6.249	1	4 5/8	7	5 3/8	1/2	1 1/2

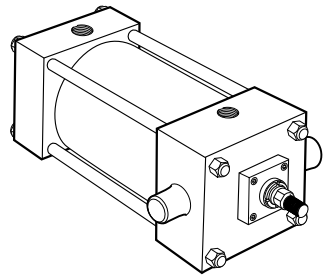
Table 3 — Envelope and Mounting Dimensions

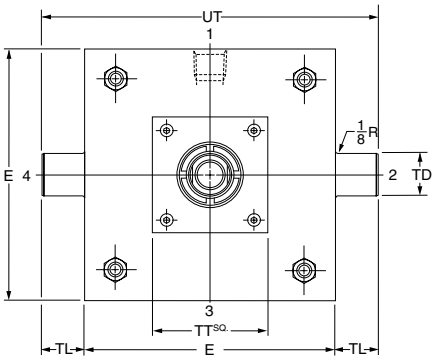
Bore	TT	Y	Add Stroke XA	Add Stroke XC	Add Stroke ZA	Add Stroke ZC
8	4	2 13/16	8 9/16	8 1/4	9 1/4	9 1/4
	7	3 7/16	*	8 7/8	*	9 7/8
	4	3 1/16	8 13/16	8 1/2	9 1/2	9 1/2
	4	3 3/16	8 15/16	8 5/8	9 5/8	9 5/8
	4	3 7/16	9 3/16	8 7/8	9 7/8	9 7/8
	5 1/2	3 7/16	*	8 7/8	*	9 7/8
	5 1/2	3 7/16	*	8 7/8	*	9 7/8
	5 1/2	3 7/16	*	8 7/8	*	9 7/8
	7	3 7/16	*	8 7/8	*	9 7/8
	7	3 7/16	*	8 7/8	*	9 7/8
10	4	3 1/8	10 3/8	10 3/8	11 1/4	11 3/4
	4	3 1/4	10 1/2	10 1/2	11 3/8	11 7/8
	4	3 1/2	10 3/4	10 3/4	11 5/8	12 1/8
	5 1/2	3 1/2	10 3/4	10 3/4	11 5/8	12 1/8
	5 1/2	3 1/2	10 3/4	10 3/4	11 5/8	12 1/8
	5 1/2	3 1/2	10 3/4	10 3/4	11 5/8	12 1/8
	7	3 1/2	*	10 3/4	*	12 1/8
	7	3 1/2	*	10 3/4	*	12 1/8
	7	3 1/2	*	10 3/4	*	12 1/8
12	4	3 1/4	11	11 1/8	11 7/8	12 7/8
	4	3 1/2	11 1/4	11 3/8	12 1/8	13 1/8
	5 1/2	3 1/2	11 1/4	11 3/8	12 1/8	13 1/8
	5 1/2	3 1/2	11 1/4	11 3/8	12 1/8	13 1/8
	5 1/2	3 1/2	11 1/4	11 3/8	12 1/8	13 1/8
	7	3 1/2	11 1/4	11 3/8	12 1/8	13 1/8
	7	3 1/2	11 1/4	11 3/8	12 1/8	13 1/8
	7	3 1/2	11 1/4	11 3/8	12 1/8	13 1/8
14	4	3 13/16	12 13/16	12 7/8	13 7/8	14 7/8
	5 1/2	3 13/16	12 13/16	12 7/8	13 7/8	14 7/8
	5 1/2	3 13/16	12 13/16	12 7/8	13 7/8	14 7/8
	5 1/2	3 13/16	12 13/16	12 7/8	13 7/8	14 7/8
	7	3 13/16	12 13/16	12 7/8	13 7/8	14 7/8
	7	3 13/16	12 13/16	12 7/8	13 7/8	14 7/8
	7	3 13/16	12 13/16	12 7/8	13 7/8	14 7/8

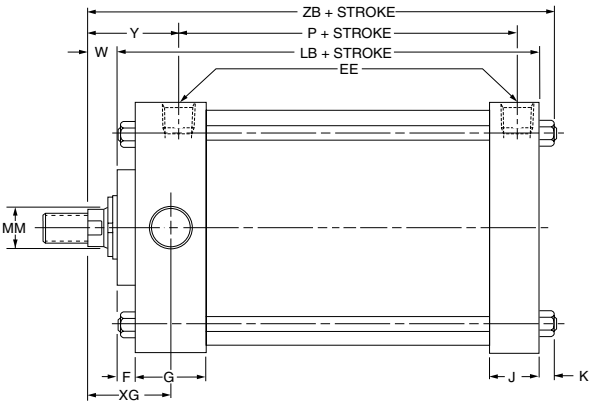
* Mounting style G not offered in this rod size.

Caution: When using mounting style G, check clearance between mounting members and rod attachment or accessory. If necessary, specify longer rod extension to avoid interference with mounting members.

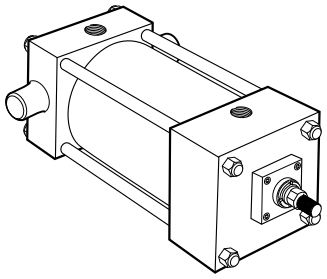
Head Trunnion
Style D
(NFPA Style MT1)

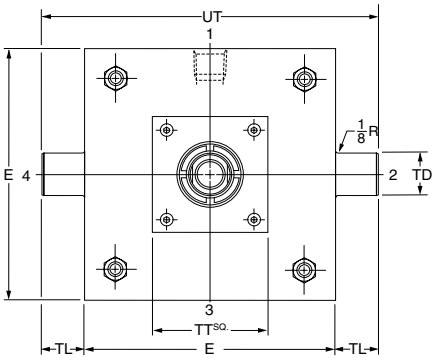


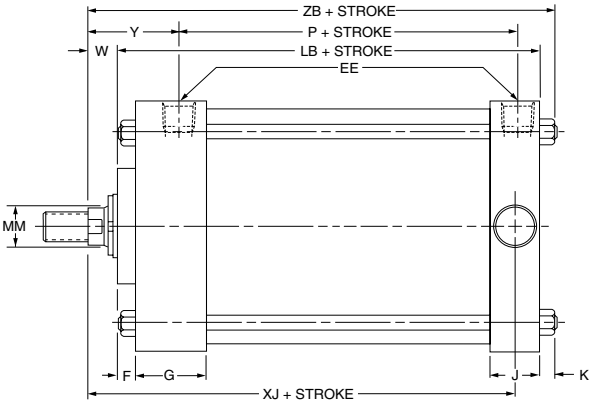




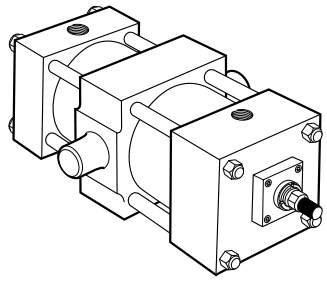
Cap Trunnion
Style DB
(NFPA Style MT2)

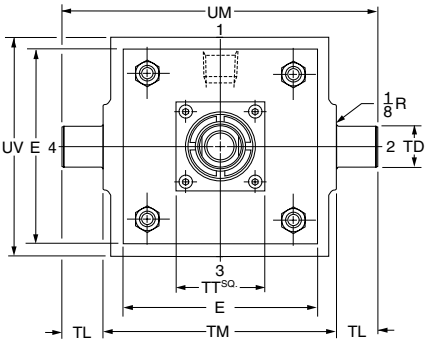


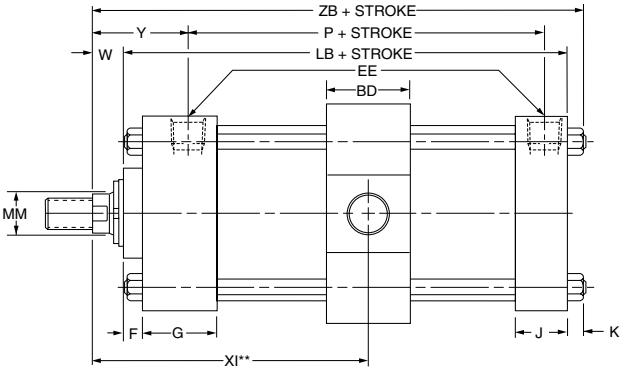




Intermediate Fixed Trunnion
Style DD
(NFPA Style MT4)

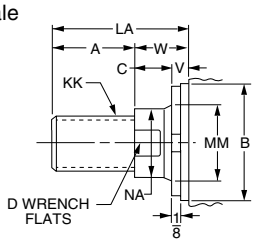




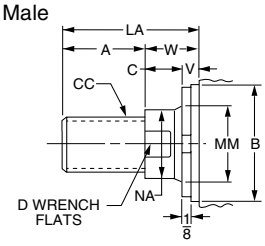


Rod End Dimensions — see table 2

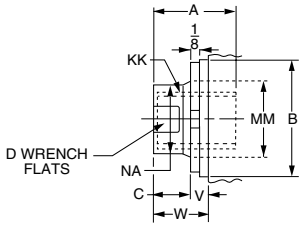
Thread Style 4
(NFPA Style SM)
Small Male



Thread Style 8
(NFPA Style IM)
Intermediate Male



Thread Style 9
(NFPA Style SF)
Small Female



A high strength rod end stud is supplied on thread style 4 through 2" diameter rods and on thread style 8 through 1 3/8" diameter rods. Larger sizes or special rod ends are cut threads. Style 4 rod ends are recommended where the workpiece is secured against the rod shoulder. When the workpiece is not shouldered, style 4 rod ends are recommended through 2" piston rod diameters and style 8 rod ends are recommended on larger diameters. Use style 9 for applications where female rod end threads are required. If rod end is not specified, style 4 will be supplied.

"Special" Thread Style 3
Special thread, extension, rod eye, blank, etc., are also available.

To order, specify "Style 3" and give desired dimensions for CC or KK, A and LA. If otherwise special, furnish dimensional sketch.

For additional information – call your local Parker Cylinder Distributor.

Table 1—Envelope and Mounting Dimensions

Bore	BD	E	EE NPTF	F	G	J	K	+.000 TD -.001	TL	TM	UM	UT	UV	Add Stroke LB	Add Stroke P	Style DD Min. Stroke
8	2 1/2	8 1/2	3/4	3/4	2	1 1/2	9/16	1.375	1 3/8	9 3/4	12 1/2	11 1/4	9 1/2	5 7/8	3 1/4	7/8
10	3	10 5/8	1	3/4	2 1/4	2	11/16	1.750	1 3/4	12	15 1/2	14 1/8	11 3/4	7 1/8	4 1/8	7/8
12	3	12 3/4	1	3/4	2 1/4	2	11/16	1.750	1 3/4	14	17 1/2	16 1/4	13 3/4	7 5/8	4 5/8	3/8
14	3 1/2	14 3/4	1 1/4	3/4	2 3/4	2 1/4	3/4	2.000	2	16 1/4	20 1/4	18 3/4	16	8 7/8	5 1/2	3/8

A

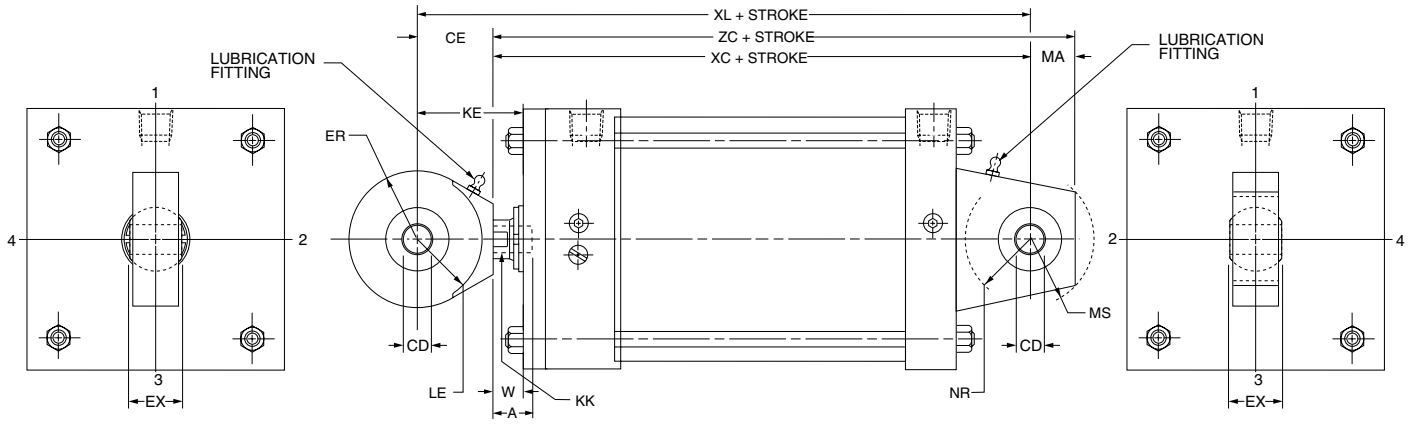
Table 2—Rod Dimensions

Bore	Rod No.	Rod Dia. MM	Thread Style 8 CC	Thread Style 4 & 9 KK	Rod Extensions and Pilot Dimensions A	+.000 -.002 B	C	D	LA	NA	V	W
8	1(Std.)	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 1/2	1 5/16	1/4	7/8
	2	5 1/2	5 1/4-12	4-12	5 1/2	6.249	1	4 5/8	7	5 3/8	1/2	1 1/2
	3	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/8	1 1/2	3 1/8	1 11/16	3/8	1 1/8
	4	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 1/2	1 15/16	3/8	1 1/4
	5	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 1/2	2 3/8	1/2	1 1/2
	6	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	5	2 7/8	1/2	1 1/2
	7	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	5	3 3/8	1/2	1 1/2
	8	4	3 3/4-12	3-12	4	4.749	1	3 3/8	5 1/2	3 7/8	1/2	1 1/2
	9	4 1/2	4 1/4-12	3 1/4-12	4 1/2	5.249	1	3 7/8	6	4 3/8	1/2	1 1/2
	0	5	4 3/4-12	3 1/2-12	5	5.749	1	4 1/4	6 1/2	4 7/8	1/2	1 1/2
10	1(Std.)	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/8	1 11/16	3/8	1 1/8
	3	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 1/2	1 15/16	3/8	1 1/4
	4	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 1/2	2 3/8	1/2	1 1/2
	5	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	5	2 7/8	1/2	1 1/2
	6	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	5	3 3/8	1/2	1 1/2
	7	4	3 3/4-12	3-12	4	4.749	1	3 3/8	5 1/2	3 7/8	1/2	1 1/2
	8	4 1/2	4 1/4-12	3 1/4-12	4 1/2	5.249	1	3 7/8	6	4 3/8	1/2	1 1/2
	9	5	4 3/4-12	3 1/2-12	5	5.749	1	4 1/4	6 1/2	4 7/8	1/2	1 1/2
	0	5 1/2	5 1/4-12	4-12	5 1/2	6.249	1	4 5/8	7	5 3/8	1/2	1 1/2
12	1(Std.)	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 1/2	1 15/16	3/8	1 1/4
	3	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 1/2	2 3/8	1/2	1 1/2
	4	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	5	2 7/8	1/2	1 1/2
	5	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	5	3 3/8	1/2	1 1/2
	6	4	3 3/4-12	3-12	4	4.749	1	3 3/8	5 1/2	3 7/8	1/2	1 1/2
	7	4 1/2	4 1/4-12	3 1/4-12	4 1/2	5.249	1	3 7/8	6	4 3/8	1/2	1 1/2
	8	5	4 3/4-12	3 1/2-12	5	5.749	1	4 1/4	6 1/2	4 7/8	1/2	1 1/2
	9	5 1/2	5 1/4-12	4-12	5 1/2	6.249	1	4 5/8	7	5 3/8	1/2	1 1/2
14	1(Std.)	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 1/2	2 3/8	1/2	1 1/2
	3	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	5	2 7/8	1/2	1 1/2
	4	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	5	3 3/8	1/2	1 1/2
	5	4	3 3/4-12	3-12	4	4.749	1	3 3/8	5 1/2	3 7/8	1/2	1 1/2
	6	4 1/2	4 1/4-12	3 1/4-12	4 1/2	5.249	1	3 7/8	6	4 3/8	1/2	1 1/2
	7	5	4 3/4-12	3 1/2-12	5	5.749	1	4 1/4	6 1/2	4 7/8	1/2	1 1/2
	8	5 1/2	5 1/4-12	4-12	5 1/2	6.249	1	4 5/8	7	5 3/8	1/2	1 1/2

Table 3 — Envelope and Mounting Dimensions

Bore	Rod No.	TT	XG	Min.** XI	Y	Add Stroke XJ	Add Stroke ZB
8	1(Std.)	4	2 5/8	4 15/16	2 13/16	6	7 5/16
	2	7	3 1/4	5 9/16	3 7/16	6 5/8	7 15/16
	3	4	2 7/8	5 3/16	3 1/16	6 1/4	7 9/16
	4	4	3	5 5/16	3 3/16	6 3/8	7 11/16
	5	4	3 1/4	5 9/16	3 7/16	6 5/8	7 15/16
	6	5 1/2	3 1/4	5 3/16	3 7/16	6 5/8	7 15/16
	7	5 1/2	3 1/4	5 9/16	3 7/16	6 5/8	7 15/16
	8	5 1/2	3 1/4	5 9/16	3 7/16	6 5/8	7 15/16
	9	7	3 1/4	5 9/16	3 7/16	6 5/8	7 15/16
	0	7	3 1/4	5 9/16	3 7/16	6 5/8	7 15/16
10	1(Std.)	4	3	5 11/16	3 1/8	7 1/4	8 15/16
	3	4	3 1/8	5 13/16	3 1/4	7 3/8	9 1/16
	4	4	3 3/8	6 1/16	3 1/2	7 5/8	9 5/16
	5	5 1/2	3 3/8	6 1/16	3 1/2	7 5/8	9 5/16
	6	5 1/2	3 3/8	6 1/16	3 1/2	7 5/8	9 5/16
	7	5 1/2	3 3/8	6 1/16	3 1/2	7 5/8	9 5/16
	8	7	3 3/8	6 1/16	3 1/2	7 5/8	9 5/16
	9	7	3 3/8	6 1/16	3 1/2	7 5/8	9 5/16
	0	7	3 3/8	6 1/16	3 1/2	7 5/8	9 5/16
12	1(Std.)	4	3 1/8	5 13/16	3 1/4	7 7/8	9 9/16
	3	4	3 3/8	6 1/16	3 1/2	8 1/8	9 13/16
	4	5 1/2	3 3/8	6 1/16	3 1/2	8 1/8	9 13/16
	5	5 1/2	3 3/8	6 1/16	3 1/2	8 1/8	9 13/16
	6	5 1/2	3 3/8	6 1/16	3 1/2	8 1/8	9 13/16
	7	7	3 3/8	6 1/16	3 1/2	8 1/8	9 13/16
	8	7	3 3/8	6 1/16	3 1/2	8 1/8	9 13/16
	9	7	3 3/8	6 1/16	3 1/2	8 1/8	9 13/16
14	1(Std.)	4	3 5/8	6 13/16	3 13/16	9 1/4	11 1/8
	3	5 1/2	3 5/8	6 13/16	3 13/16	9 1/4	11 1/8
	4	5 1/2	3 5/8	6 13/16	3 13/16	9 1/4	11 1/8
	5	5 1/2	3 5/8	6 13/16	3 13/16	9 1/4	11 1/8
	6	7	3 5/8	6 13/16	3 13/16	9 1/4	11 1/8
	7	7	3 5/8	6 13/16	3 13/16	9 1/4	11 1/8
	8	7	3 5/8	6 13/16	3 13/16	9 1/4	11 1/8

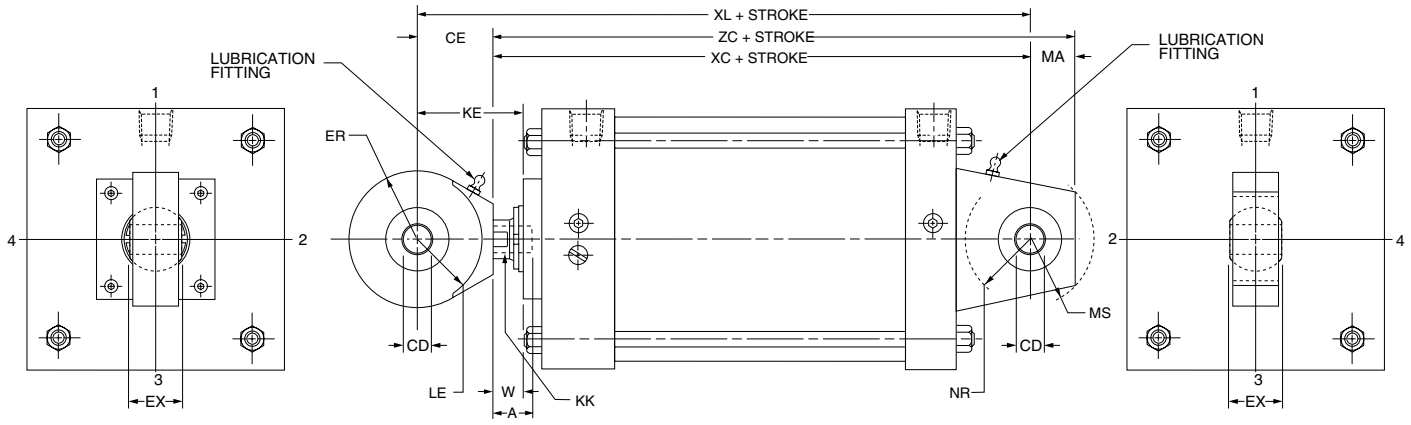
**Dimension XI to be specified by customer.



Bore	Rod No.	Rod Dia. MM	Thread Style 9 KK	Thread Style 7 KK	A	W	Add Stroke XC	Add Stroke XL	Add Stroke ZC	KE	CD*	CE	ER	EX	LE	MA	MS	NR	Max. Oper. PSI 2A
1½	1(Std.)	5/8	7/16-20	—	3/4	5/8	5 3/8	6 1/4	6 1/8	1 1/2	-.0005 .5000	7/8	13/16	7/16	3/4	3/4	15/16	5/8	250
	2	1	**	7/16-20	3/4	1	5 3/4	6 5/8	6 1/2	1 7/8									
2	1(Std.)	5/8	7/16-20	—	3/4	5/8	5 3/8	6 1/4	6 1/8	1 1/2	-.0005 .5000	7/8	13/16	7/16	3/4	3/4	15/16	5/8	250
	2	1 3/8	**	7/16-20	3/4	1 1/4	6	6 7/8	6 3/4	2 1/8									
	3	1	**	7/16-20	3/4	1	5 3/4	6 5/8	6 1/2	1 7/8									
2½	1(Std.)	5/8	7/16-20	—	3/4	5/8	5 1/2	6 3/8	6 1/4	1 1/2	-.0005 .5000	7/8	13/16	7/16	3/4	3/4	15/16	5/8	250
	2	1 3/4	**	7/16-20	3/4	1 1/2	6 3/8	7 1/4	7 1/8	2 3/8									
	3	1	**	7/16-20	3/4	1	5 7/8	6 3/4	6 5/8	1 7/8									
	4	1 3/8	**	7/16-20	3/4	1 1/4	6 1/8	7	6 7/8	2 1/8									
3¼	1(Std.)	1	3/4-16	—	1 1/8	3/4	6 7/8	8 1/8	7 7/8	2	-.0005 .7500	1 1/4	1 1/8	21/32	1 1/16	1	1 3/8	1	250
	2	2	**	3/4-16	1 1/8	1 3/8	7 1/2	8 3/4	8 1/2	2 5/8									
	3	1 3/8	**	3/4-16	1 1/8	1	7 1/8	8 3/8	8 1/8	2 1/4									
	4	1 3/4	**	3/4-16	1 1/8	1 1/4	7 3/8	8 5/8	8 3/8	2 1/2									
4	1(Std.)	1	3/4-16	—	1 1/8	3/4	6 7/8	8 1/8	7 7/8	2	-.0005 .7500	1 1/4	1 1/8	21/32	1 1/16	1	1 3/8	1	250
	2	2 1/2	**	3/4-16	1 1/8	1 5/8	7 3/4	9	8 3/4	2 7/8									
	3	1 3/8	**	3/4-16	1 1/8	1	7 1/8	8 3/8	8 1/8	2 1/4									
	4	1 3/4	**	3/4-16	1 1/8	1 1/4	7 3/8	8 5/8	8 3/8	2 1/2									
	5	2	**	3/4-16	1 1/8	1 3/8	7 1/2	8 3/4	8 1/2	2 5/8									
5	1(Std.)	1	3/4-16	—	1 1/8	3/4	7 1/8	8 3/8	8 1/8	2	-.0005 .7500	1 1/4	1 1/8	21/32	1 1/16	1	1 3/8	1	250
	2	3 1/2	**	3/4-16	1 1/8	1 5/8	8	9 1/4	9	2 7/8									
	3	1 3/8	**	3/4-16	1 1/8	1	7 3/8	8 5/8	8 3/8	2 1/4									
	4	1 3/4	**	3/4-16	1 1/8	1 1/4	7 5/8	8 7/8	8 5/8	2 1/2									
	5	2	**	3/4-16	1 1/8	1 3/8	7 3/4	9	8 3/4	2 5/8									
	6	2 1/2	**	3/4-16	1 1/8	1 5/8	8	9 1/4	9	2 7/8									
	7	3	**	3/4-16	1 1/8	1 5/8	8	9 1/4	9	2 7/8									
6	1(Std.)	1 3/8	1-14	—	1 5/8	7/8	8 1/8	10	9 3/8	2 3/4	-.0005 1.0000	1 7/8	1 1/4	7/8	1 7/16	1 1/4	1 11/16	1 1/4	250
	2	4	**	1-14	1 5/8	1 1/2	8 3/4	10 5/8	10	3 3/8									
	3	1 3/4	**	1-14	1 5/8	1 1/8	8 3/8	10 1/4	9 5/8	3									
	4	2	**	1-14	1 5/8	1 1/4	8 1/2	10 3/8	9 3/4	3 1/8									
	5	2 1/2	**	1-14	1 5/8	1 1/2	8 3/4	10 5/8	10	3 3/8									
	6	3	**	1-14	1 5/8	1 1/2	8 3/4	10 5/8	10	3 3/8									
	7	3 1/2	**	1-14	1 5/8	1 1/2	8 3/4	10 5/8	10	3 3/8									

Maximum operating pressure at 4:1 design factor is based on tensile strength of material. Pressure ratings are based on standard commercial bearing ratings.
Note: For additional dimensions see Series 2A, page 30.
* Dimension CD is hole diameter.
** Corresponding rod eye pin diameter may not match pin diameter of cap.
Rod No. 1 is standard.

For additional information – call your local Parker Cylinder Distributor.

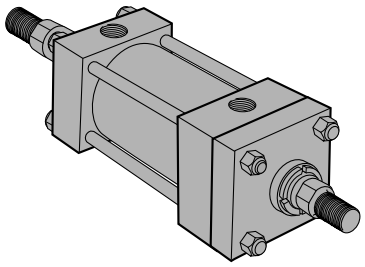


Bore	Rod No.	Rod Dia. MM	Thread Style 9 KK	Thread Style 7 KK	A	W	Add Stroke XC	Add Stroke XL	Add Stroke ZC	KE	CD*	CE	ER	EX	LE	MA	MS	NR	Max. Oper. PSI 2A
8	1(Std.)	1 3/8	1-14	–	1 5/8	7/8	8 1/4	10 1/8	9 1/2	2 3/4	-.0005 1.0000	1 7/8	1 1/4	7/8	1 7/16	1 1/4	1 11/16	1 1/4	250
	2	5 1/2	**	1-14	1 5/8	1 1/2	8 7/8	10 3/4	10 1/8	3 3/8									
	3	1 3/4	**	1-14	1 5/8	1 1/8	8 1/2	10 3/8	9 3/4	3									
	4	2	**	1-14	1 5/8	1 1/4	8 5/8	10 1/2	9 7/8	3 1/8									
	5	2 1/2	**	1-14	1 5/8	1 1/2	8 7/8	10 3/4	10 1/8	3 3/8									
	6	3	**	1-14	1 5/8	1 1/2	8 7/8	10 3/4	10 1/8	3 3/8									
	7	3 1/2	**	1-14	1 5/8	1 1/2	8 7/8	10 3/4	10 1/8	3 3/8									
	8	4	**	1-14	1 5/8	1 1/2	8 7/8	10 3/4	10 1/8	3 3/8									
	9	4 1/2	**	1-14	1 5/8	1 1/2	8 7/8	10 3/4	10 1/8	3 3/8									
	0	5	**	1-14	1 5/8	1 1/2	8 7/8	10 3/4	10 1/8	3 3/8									
10	1(Std.)	1 3/4	1 1/4-12	–	2	1 1/8	10 3/8	12 1/2	12 1/4	3 1/4	-.0005 1.3750	2 1/8	1 11/16	1 3/16	1 7/8	1 7/8	2 7/16	1 5/8	250
	3	2	**	1 1/4-12	2	1 1/4	10 1/2	12 5/8	12 3/8	3 3/8									
	4	2 1/2	**	1 1/4-12	2	1 1/2	10 3/4	12 7/8	12 5/8	3 5/8									
	5	3	**	1 1/4-12	2	1 1/2	10 3/4	12 7/8	12 5/8	3 5/8									
	6	3 1/2	**	1 1/4-12	2	1 1/2	10 3/4	12 7/8	12 5/8	3 5/8									
	7	4	**	1 1/4-12	2	1 1/2	10 3/4	12 7/8	12 5/8	3 5/8									
	8	4 1/2	**	1 1/4-12	2	1 1/2	10 3/4	12 7/8	12 5/8	3 5/8									
	9	5	**	1 1/4-12	2	1 1/2	10 3/4	12 7/8	12 5/8	3 5/8									
	0	5 1/2	**	1 1/4-12	2	1 1/2	10 3/4	12 7/8	12 5/8	3 5/8									
12	1(Std.)	2	1 1/2-12	–	2 1/4	1 1/4	11 1/8	13 5/8	13 5/8	3 3/4	-.0005 1.7500	2 1/2	2 1/16	1 17/32	2 1/8	2 1/2	2 7/8	2 1/16	250
	3	2 1/2	**	1 1/2-12	2 1/4	1 1/2	11 3/8	13 7/8	13 7/8	4									
	4	3	**	1 1/2-12	2 1/4	1 1/2	11 3/8	13 7/8	13 7/8	4									
	5	3 1/2	**	1 1/2-12	2 1/4	1 1/2	11 3/8	13 7/8	13 7/8	4									
	6	4	**	1 1/2-12	2 1/4	1 1/2	11 3/8	13 7/8	13 7/8	4									
	7	4 1/2	**	1 1/2-12	2 1/4	1 1/2	11 3/8	13 7/8	13 7/8	4									
	8	5	**	1 1/2-12	2 1/4	1 1/2	11 3/8	13 7/8	13 7/8	4									
	9	5 1/2	**	1 1/2-12	2 1/4	1 1/2	11 3/8	13 7/8	13 7/8	4									
14	1(Std.)	2 1/2	1 7/8-12	–	3	1 1/2	12 7/8	15 5/8	15 3/8	4 1/4	-.0005 2.0000	2 3/4	2 1/2	1 3/4	2 1/2	2 1/2	3 5/16	2 3/8	250
	3	3	**	1 7/8-12	3	1 1/2	12 7/8	15 5/8	15 3/8	4 1/4									
	4	3 1/2	**	1 7/8-12	3	1 1/2	12 7/8	15 5/8	15 3/8	4 1/4									
	5	4	**	1 7/8-12	3	1 1/2	12 7/8	15 5/8	15 3/8	4 1/4									
	6	4 1/2	**	1 7/8-12	3	1 1/2	12 7/8	15 5/8	15 3/8	4 1/4									
	7	5	**	1 7/8-12	3	1 1/2	12 7/8	15 5/8	15 3/8	4 1/4									
	8	5 1/2	**	1 7/8-12	3	1 1/2	12 7/8	15 5/8	15 3/8	4 1/4									

Maximum operating pressure at 4:1 design factor is based on tensile strength of material. Pressure ratings are based on standard commercial bearing ratings.
Note: For additional dimensions see Series 2A, page 40.
* Dimension CD is hole diameter.
** Corresponding rod eye pin diameter may not match pin diameter of cap. Rod No. 1 is standard.

For Cylinder Division Plant Locations – See Page II.

Parker Cylinder



Mounting Styles for Single Rod Models	Mounting Styles for Corresponding Double Rod Models*	Dimensions Shown on This Page Supplement Dimensions on Pages Listed Below	
		1"-6" Bores Page No.	8"-14" Bores Page No.
T	KT	20	34
TB**	KTB	20	34
TD	KTD	20	34
J	KJ	20	—
JB**	KJB	22	34
C**	KC	24	36
E	KE	24	36
F	KF	24	38
CB	KCB	26	40
G	KC	26	38
D	KD	28	42
DD	KDD†	28	42

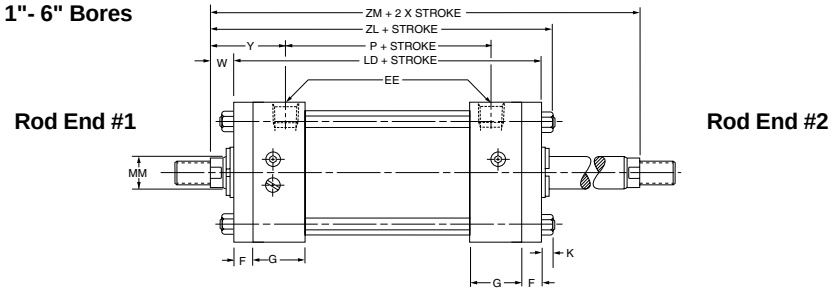
*If only one end of these Double Rod Cylinders is to be cushioned, be sure to specify clearly which end this will be.

**Available in 7" bore, page 32.

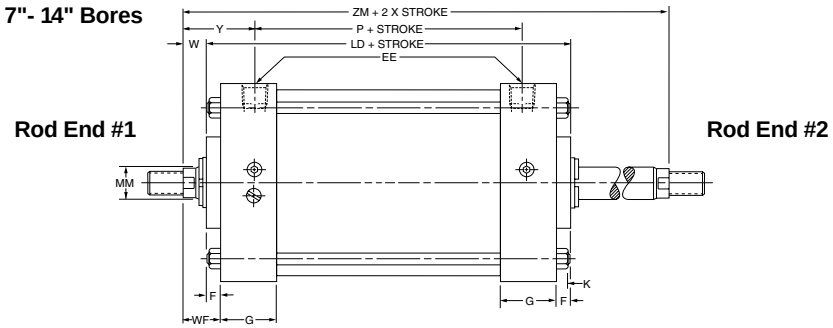
†Specify XI dimension from rod end #1.

How to Use Double Rod Cylinder Dimensioned Drawings

1"- 6" Bores

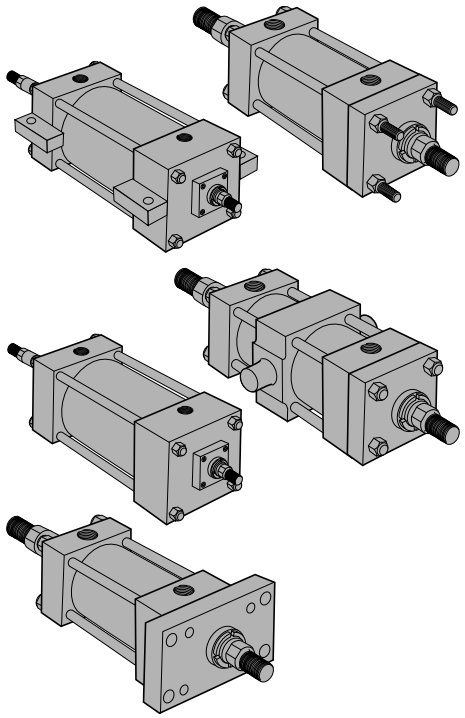


7"- 14" Bores



To determine dimensions for a double rod cylinder, first refer to the desired single rod mounting style cylinder shown on preceding pages of this catalog. (See table at left.) After selecting necessary dimensions from that drawing, return to this page supplement the single rod dimensions with those shown on drawings at right and dimension table below. Note that double rod cylinders have a head (Dim. G) at both ends and that dimension LD replace LB and ZL replaces ZB, etc. The double rod dimensions differ from, or are in addition to those for single rod cylinders shown on preceding pages and provide the information needed to completely dimension a double rod cylinder.

On a double rod cylinder where the two rod ends are different, be sure to clearly state which rod end is to be assembled at which end. Port position 1 is standard. If other than standard, specify pos. 2, 3 or 4 when viewed from rod end #1 only. See port position information in Section C.



All dimensions are in inches and apply to Code 1 rod sizes only. For alternate rod sizes, determine all envelope dimensions (within LD dim.) as described above and then use appropriate rod end dimensions for proper rod size from single rod cylinder.

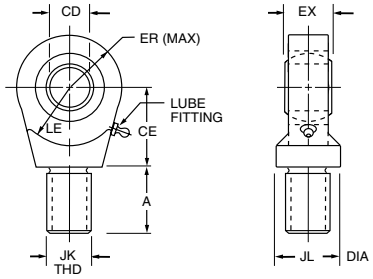
Bore	Rod No.	Rod Dia. MM	Add Stroke										Add 2X Stroke
			LD	ZL	SA K	XA K	ZA K	SS K	SN K	SE K	XE K	ZE K	ZM
1	1	1/2	4 3/4	5 1/2	6 3/8	6 3/16	6 1/2	3 3/8*	2 1/8	*	*	*	6
1 1/2	1	5/8	4 7/8	5 3/4	6 7/8	6 1/2	6 7/8	3 3/8	2 1/4	6 3/8	6 1/4	6 1/2	6 1/8
2	1	5/8	4 7/8	5 13/16	6 7/8	6 1/2	6 7/8	3 3/8	2 1/4	6 3/4	6 7/16	6 3/4	6 1/8
2 1/2	1	5/8	5	5 15/16	7	6 5/8	7	3 1/2	2 3/8	7 1/8	6 11/16	7	6 1/4
3 1/4	1	1	6	7 1/8	8 1/2	8	8 1/2	3 3/4	2 5/8	7 3/4	7 5/8	8	7 1/2
4	1	1	6	7 1/8	8 1/2	8	8 1/2	3 3/4	2 5/8	8	7 3/4	8 1/8	7 1/2
5	1	1	6 1/4	7 7/16	9	8 3/8	9	3 5/8	2 7/8	8 3/8	8 1/16	8 9/16	7 3/4
6	1	1 3/8	7	8 5/16	9 3/4	9 1/4	9 7/8	4 1/8	3 1/8	9	8 7/8	9 3/8	8 3/4
7	1	1 3/8	7 1/8	—	—	—	—	4 1/4	3 1/4	—	—	—	8 7/8
8	1	1 3/8	7 1/8	—	9 1/4	9 1/16	9 3/4	4 1/4	3 1/4	7 7/8	8 3/8	9	8 7/8
10	1	1 3/4	8 1/8	—	10 7/8	10 5/8	11 1/2	4 7/8	4 1/8	9 1/4	9 13/16	10 7/16	10 3/8
12	1	2	8 5/8	—	11 3/8	11 1/4	12 1/8	5 3/8	4 5/8	9 3/4	10 7/16	11 1/16	11 1/8
14	1	2 1/2	10 1/8	—	13 1/2	13 5/16	14 3/8	6 3/8	5 1/2	11 5/8	12 3/8	13 1/8	13 1/8
Replaces:			LB	ZB	SA	XA	ZA	SS	SN	SE	XE	ZE	—
On single rod mounting styles:			All Mtg. Styles		CB			C,E	F	G			All Mtgs.

* Mounting styles KE, KG and KDD not available in 1" and 7" bore sizes.

For additional information – call your local Parker Cylinder Distributor.

Parker offers a complete range of Cylinder Accessories to assure you of the greatest versatility in present or future cylinder applications. Accessories offered for the respective cylinder include the Rod Eye, Pivot Pin and Clevis Bracket. To select the proper part number for any desired accessory, refer to the charts below.

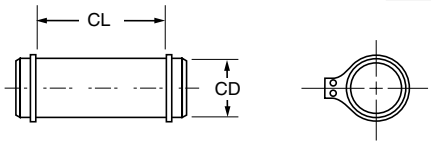
Spherical Rod Eye



Order to fit Piston Rod Thread Size.

Bore Sizes	Series 2A	1 1/2, 2 & 2 1/2	3 1/4, 4 & 5	6 & 8	10	12	14
Rod Eye	Part No.	132290	132291	132292	132293	132294	132295
	CD	.5000-0005	.7500-0005	1.0000-0005	1.3750-0005	1.7500-0005	2.0000-0005
	A	11/16	1	1 1/2	2	2 1/8	2 7/8
	CE	7/8	1 1/4	1 7/8	2 1/8	2 1/2	2 3/4
	EX	7/16	21/32	7/8	1 3/16	1 17/32	1 3/4
	ER	13/16	1 1/8	1 1/4	1 11/16	2 1/16	2 1/2
	LE	3/4	1 1/16	1 7/16	1 7/8	2 1/8	2 1/2
	JK	7/16-20	3/4-16	1-14	1 1/4-12	1 1/2-12	1 7/8-12
	JL	7/8	1 5/16	1 1/2	2	2 1/4	2 3/4
	LOAD CAPACITY LBS.	2644	9441	16860	28562	43005	70193

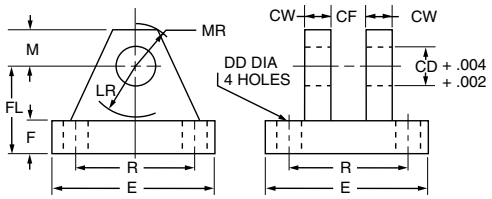
Pivot Pin



Bore Sizes	Series 2A	1 1/2, 2 & 2 1/2	3 1/4, 4 & 5	6 & 8	10	12	14
Pivot Pin	Part No.	83962	83963	83964	83965	83966	83967
	CD	.4997-0004	.7497-0005	.9997-0005	1.3746-0006	1.7496-0006	1.9996-0007
	CL	1 9/16	2 1/32	2 1/2	3 5/16	4 7/32	4 15/16
	LOAD CAPACITY LBS.	8600	19300	34300	65000	105200	137400

Pivot Pins are furnished with (2) Retainer Rings.

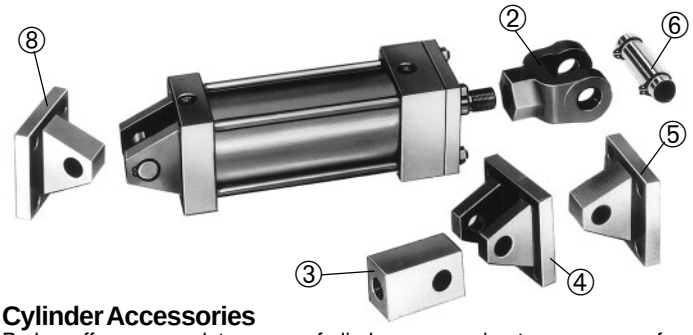
Clevis Bracket



Order to fit Mounting Plate or Rod Eye.

Bore Sizes	Series 2A	1 1/2, 2 & 2 1/2	3 1/4, 4 & 5	6 & 8	10	12	14
Clevis Bracket	Part No.	83947	83948	83949	83950	83951	83952
	CD	1/2	3/4	1	1 3/8	1 3/4	2
	CF	7/16	21/32	7/8	1 3/16	1 17/32	1 3/4
	CW	1/2	5/8	3/4	1	1 1/4	1 1/2
	DD	13/32	17/32	17/32	21/32	29/32	29/32
	E	3	3 3/4	5 1/2	6 1/2	8 1/2	10 5/8
	F	1/2	5/8	3/4	7/8	1 1/4	1 1/2
	FL	1 1/2	2	2 1/2	3 1/2	4 1/2	5
	LR	15/16	1 3/8	1 11/16	2 7/16	2 7/8	3 5/16
	M	1/2	7/8	1	1 3/8	1 3/4	2
	MR	5/8	1	1 3/16	1 5/8	2 1/16	2 3/8
	R	2.05	2.76	4.10	4.95	6.58	7.92
	LOAD CAPACITY LBS.	5770	9450	14300	20322	37800	50375

Series 2A
Heavy Duty Air Cylinders



Cylinder Accessories

Parker offers a complete range of cylinder accessories to assure you of greatest versatility in present or future cylinder applications.

Rod End Accessories

Accessories offered for the rod end of the cylinder include Rod Clevis, Eye Bracket, Knuckle, Clevis Bracket and Pivot Pin. To select the proper part number for any desired accessory, refer to Chart A below and look opposite the thread size of the rod end as indicated in the first column. The Pivot Pins, Eye Brackets and Clevis Brackets are listed opposite the thread size which their mating Knuckles or Clevises fit.

Chart A

Thread Size	Mating Parts			Mating Parts			Alignment Coupler
	Rod Clevis	Eye Bracket	Pin	Knuckle	Clevis Bracket	Pin	
5/16-24	51221	74077	—	74075	74076	74078	134757 0031
7/16-20	50940	69195	68368	69089	69205	68368	134757 0044
1/2-20	50941	69195	68368	69090	69205	68368	134757 0050
3/4-16	50942	69196	68369	69091	69206†	68369	134757 0075
3/4-16	133284	69196	68369	69091	69206	68369	134757 0075
7/8-14	50943	*85361	68370	69092	69207	68370	134757 0088
1-14	50944	*85361	68370	69093	69207	68370	134757 0100
1-14	133285	*85361	68370	69093	69207	68370	134757 0100
1 1/4-12	50945	69198	68371	69094	69208	68371	134757 0125
1 1/4-12	133286	69198	68371	69094	69208	68371	134757 0125
1 1/2-12	50946	*85362	68372	69095	69209	68372	133739 0150
1 3/4-12	50947	*85363	68373	69096	69210	69215	133739 0175
1 7/8-12	50948	*85363	68373	69097	69210	69215	133739 0188
2 1/4-12	50949	*85364	68374	69098	69211	68374	Consult Factory
2 1/2-12	50950	*85365	68375	69099	69212	68375	
2 3/4-12	50951	*85365	68375	69100	69213	69216	
3 1/4-12	50952	73538	73545	73536	73542	73545	
3 1/2-12	50953	73539	73547	73437	73542	73545	
4-12	50954	73539	73547	73438	73543	82181	
4 1/2-12	–	–	–	73439	73544	73547	

†For alignment coupler dimensions, see Section C.

*Cylinder accessory dimensions conform to NFPA recommended standard NFPA/T3.6.8 R1-1984, NFPA recommended standard fluid power systems - cylinder - dimensions for accessories for cataloged square head industrial types. Parker adopted this standard in April, 1985. Eye Brackets or Mounting Plates shipped before this date may have different dimensions and will not necessarily interchange with the NFPA standard. For dimensional information on older style Eye Brackets or Mounting Plates consult Drawing #144805 or previous issues of this catalog.

NOTE: For economical accessory selection, it is recommended that rod end style 4 be specified on your cylinder order.

Accessory Load Capacity

The various accessories on Pages 48 and 49 have been load rated for your convenience. The load capacity in lbs. shown on page 49, is the recommended maximum load for that accessory based on a 4:1 design factor in tensions. (Pivot Pin is rated in shear.) Before specifying, compare the actual load or the tension (pull) force at maximum operating pressure of the cylinder with the load capacity of the accessory you plan to use. If load or pull force of cylinder exceeds load capacity of accessory, consult factory.

Mounting Plates

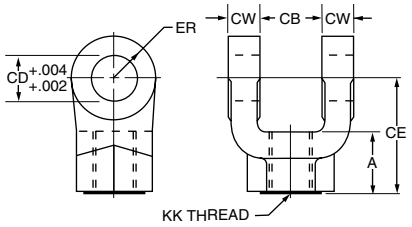
Mounting Plates for Style BB and Style BC (Clevis mounted) cylinders are offered. To select proper part number for your application, refer to Chart B, above right.

Chart B

Mtg. Plate Part No.	Series 2A Bore Size
74076‡	1"
69195	1 1/2", 2", 2 1/2"
69196	3 1/4", 4", 5"
*85361	6", 7", 8"
69198	10"
*85362	12"
*85363	14"

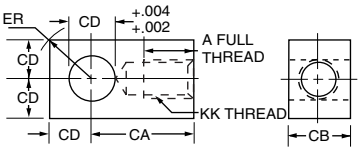
‡Mounting plate for 1" bore single lug BC & BB cylinder mounting style is Clevis Bracket P/N 74076.

② Female Rod Clevis



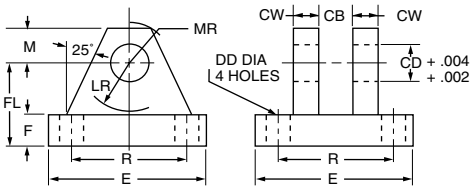
Order to fit thread size.

③ Knuckle (Female Rod Eye)



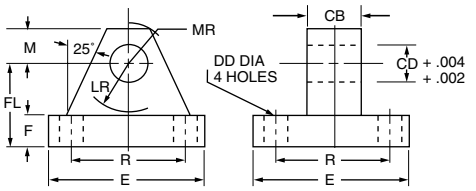
Order to fit thread size.

④ Clevis Bracket for Knuckle



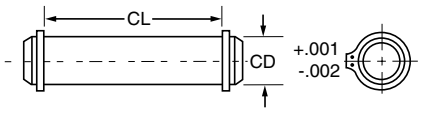
Order to fit Knuckle.

⑧ Mounting Plate or ⑤ Eye Bracket



1. When used to mate with the Rod Clevis, select from Chart A.
2. When used to mount the Style BB or BC cylinders, select from the Mounting Plate Selection Table. See Chart B at lower left.

⑥ Pivot Pin



1. Pivot Pins are furnished with Clevis Mounted Cylinders as standard.
2. Pivot Pins are furnished with (2) Retainer Rings.
3. Pivot Pins must be ordered as a separate item if to be used with Knuckles, Rod Clevises, or Clevis Brackets.

For additional information – call your local Parker Cylinder Distributor.

	Female Rod Clevis Part Number																		
	51221†	50940	50941	50942	133284	50943	50944	133285	50945	133286	50946	50947	50948	50949	50950	50951	50952	50953	50954
A	13/16	3/4	3/4	1 1/8	1 1/8	1 5/8	1 5/8	1 5/8	1 7/8	2	2 1/4	3	3	3 1/2	3 1/2	3 1/2	3 1/2‡	4‡	4‡
CB	11/32	3/4	3/4	1 1/4	1 1/4	1 1/2	1 1/2	1 1/2	2	2	2 1/2	2 1/2	2 1/2	3	3	3	4	4 1/2	4 1/2
CD	5/16	1/2	1/2	3/4	3/4	1	1	1	1 3/8	1 3/8	1 3/4	2	2	2 1/2	3	3	3 1/2	4	4
CE	2 1/4	1 1/2	1 1/2	2 1/8	2 3/8	2 15/16	2 15/16	3 1/8	3 3/4	4 1/8	4 1/2	5 1/2	5 1/2	6 1/2	6 3/4	6 3/4	7 3/4	8 13/16	8 13/16
CW	13/64	1/2	1/2	5/8	5/8	3/4	3/4	3/4	1	1	1 1/4	1 1/4	1 1/4	1 1/2	1 1/2	1 1/2	2	2 1/4	2 1/4
ER	19/64	1/2	1/2	3/4	3/4	1	1	1	1 3/8	1 3/8	1 3/4	2	2	2 1/2	2 3/4	2 3/4	3 1/2	4	4
KK	5/16-24	7/16-20	1/2-20	3/4-16	3/4-16	7/8-14	1-14	1-14	1 1/4-12	1 1/4-12	1 1/2-12	1 3/4-12	1 7/8-12	2 1/4-12	2 1/2-12	2 3/4-12	3 1/4-12	3 1/2-12	4-12
Load Capacity Lbs.⊖	2600	4250	4900	11200	11200	18800	19500	19500	33500	33500	45600	65600	65600	98200	98200	98200	156700	193200	221200

	Knuckle Part Number																
	74075	69089	69090	69091	69092	69093	69094	69095	69096	69097	69098	69099	69100	73536	73437	73438	73439
A	3/4	3/4	3/4	1 1/8	1 1/8	1 5/8	2	2 1/4	2 1/4	3	3 1/2	3 1/2	3 5/8	4 1/2	5	5 1/2	5 1/2
CA	1 1/2	1 1/2	1 1/2	2 1/16	2 3/8	2 13/16	3 7/16	4	4 3/8	5	5 13/16	6 1/8	6 1/2	7 5/8	7 5/8	9 1/8	9 1/8
CB	7/16	3/4	3/4	1 1/4	1 1/2	1 1/2	2	2 1/2	2 1/2	2 1/2	3	3	3 1/2	4	4	4 1/2	5
CD	7/16	1/2	1/2	3/4	1	1	1 3/8	1 3/4	2	2	2 1/2	3	3	3 1/2	3 1/2	4	4
ER	19/32	23/32	23/32	1 1/16	1 7/16	1 7/16	1 31/32	2 1/2	2 27/32	2 27/32	3 9/16	4 1/4	4 1/4	4 31/32	4 31/32	5 11/16	5 11/16
KK	5/16-24	7/16-20	1/2-20	3/4-16	7/8-14	1-14	1 1/4-12	1 1/2-12	1 3/4-12	1 7/8-12	2 1/4-12	2 1/2-12	2 3/4-12	3 1/4-12	3 1/2-12	4-12	4 1/2-12
Load Capacity Lbs.⊖	3300	5000	5700	12100	13000	21700	33500	45000	53500	75000	98700	110000	123300	161300	217300	273800	308500

	Clevis Bracket for Knuckle Part Number												
	74076	69205	69206	69207	69208	69209	69210	69211	69212	69213	73542	73543	73544
CB	15/32	3/4	1 1/4	1 1/2	2	2 1/2	2 1/2	3	3	3 1/2	4	4 1/2	5
CD	7/16	1/2	3/4	1	1 3/8	1 3/4	2	2 1/2	3	3	3 1/2	4	4
CW	3/8	1/2	5/8	3/4	1	1 1/4	1 1/2	1 1/2	1 1/2	1 1/2	2	2	2
DD	17/64	13/32	17/32	21/32	21/32	29/32	1 1/16	1 3/16	1 5/16	1 5/16	1 13/16	2 1/16	2 1/16
E	2 1/4	3 1/2	5	6 1/2	7 1/2	9 1/2	12 3/4	12 3/4	12 3/4	12 3/4	15 1/2	17 1/2	17 1/2
F	3/8	1/2	5/8	3/4	7/8	7/8	1	1	1	1	1 11/16	1 15/16	1 15/16
FL	1	1 1/2	1 7/8	2 1/4	3	3 5/8	4 1/4	4 1/2	6	6	6 11/16	7 11/16	7 11/16
LR	5/8	3/4	1 3/16	1 1/2	2	2 3/4	3 3/16	3 1/2	4 1/4	4 1/4	5	5 3/4	5 3/4
M	3/8	1/2	3/4	1	1 3/8	1 3/4	2 1/4	2 1/2	3	3	3 1/2	4	4
MR	1/2	5/8	29/32	1 1/4	1 21/32	2 7/32	2 25/32	3 1/8	3 19/32	3 19/32	4 1/8	4 7/8	4 7/8
R	1.75	2.55	3.82	4.95	5.73	7.50	9.40	9.40	9.40	9.40	12.00	13.75	13.75
Load Capacity Lbs.⊖	3600	7300	14000	19200	36900	34000	33000	34900	33800	36900	83500	102600	108400

	Eye Bracket and Mounting Plate Part Number										
	74077	69195	69196	85361*	69198	85362*	85363*	85364*	85365*	73538	73539
CB	5/16	3/4	1 1/4	1 1/2	2	2 1/2	2 1/2	3	3	4	4 1/2
CD	5/16	1/2	3/4	1	1 3/8	1 3/4	2	2 1/2	3	3 1/2	4
DD	17/64	13/32	17/32	21/32	21/32	29/32	1 1/16	1 3/16	1 5/16	1 13/16	2 1/16
E	2 1/4	2 1/2	3 1/2	4 1/2	5	6 1/2	7 1/2	8 1/2	9 1/2	12 5/8	14 7/8
F	3/8	3/8	5/8	7/8	7/8	1 1/8	1 1/2	1 3/4	2	1 11/16	1 15/16
FL	1	1 1/8	1 7/8	2 3/8	3	3 3/8	4	4 3/4	5 1/4	5 11/16	6 7/16
LR	5/8	3/4	1 1/4	1 1/2	2 1/8	2 1/4	2 1/2	3	3 1/4	4	4 1/2
M	3/8	1/2	3/4	1	1 3/8	1 3/4	2	2 1/2	2 3/4	3 1/2	4
MR	1/2	9/16	7/8	1 1/4	1 5/8	2 1/8	2 7/16	3	3 1/4	4 1/8	5 1/4
R	1.75	1.63	2.55	3.25	3.82	4.95	5.73	6.58	7.50	9.62	11.45
Load Capacity Lbs.⊖	1700	4100	10500	20400	21200	49480	70000	94200	121900	57400	75000

	Pivot Pin Part Number													
	74078	68368	68369	68370	68371	68372	68373	69215	68374	68375	69216	73545	82181	73547•
CD	7/16	1/2	3/4	1	1 3/8	1 3/4	2	2	2 1/2	3	3	3 1/2	4	4
CL	1 5/16	1 7/8	2 5/8	3 1/8	4 1/8	5 3/16	5 3/16	5 11/16	6 3/16	6 1/4	6 3/4	8 1/4	8 5/8	9
Shear Capacity Lbs.⊖	6600	8600	19300	34300	65000	105200	137400	137400	214700	309200	309200	420900	565800	565800

*Cylinder accessory dimensions conform to NFPA recommended standard NFPA/T3.6.8 R1-1984, NFPA recommended standard fluid power systems - cylinder - dimensions for accessories for cataloged square head industrial types. Parker adopted this standard in April, 1985. Eye Brackets or Mounting Plates shipped before this date may have different dimensions and will not necessarily interchange with the NFPA standard. For dimensional information on older style Eye Brackets or Mounting Plates consult Drawing #144805 or previous issues of this catalog.

⊖ See Accessory Load Capacity note on page 48.

† These sizes supplied with cotter pins.

‡ Includes Pivot Pin.

• Consult appropriate cylinder rod end dimensions for compatibility

How to Order Series "2A" Cylinders

When ordering Series 2A cylinders, please review the following:

Note: Duplicate cylinders can be ordered by giving the SERIAL NUMBER from the nameplate of the original cylinder. Factory records supply a quick positive identification.

Piston Rods: Specify rod code number based on diameter. Give thread style number for a standard thread or specify dimensions. See "Style 3 Rod End" below.

Cushions: If cushions are required specify according to the model number on the next page. If the cylinder is to have a double rod and only one cushion is required, be sure to specify clearly which end of the cylinder is to be cushioned.

Special Modifications: Additional information is required on orders for cylinders with special modifications. This is best handled with descriptive notes. For further information, consult factory

Fluid Medium: Series 2A hydraulic cylinders are equipped with seals for use with lubricated air.

Class 1 Seals

Class 1 seals are the seals provided as standard in a cylinder assembly unless otherwise specified. For further information on fluid compatibility or operating limitations of all components, see section C.

For the 2A series cylinders the following make-up Class 1 Seals:

Primary Piston Rod Seal – Nitrile with PTFE back-up washers
Piston Rod Wiper – Nitrile
Piston Seals – Nitrile with polyester back-up washers
O-Rings – Nitrile

Combination Mountings

Single Rod End The first mounting is the one called out on the head end of the cylinder. The second or subsequent mountings are called out as they appear in the assembly moving away from the rod end. Exception: When tie rod mountings are part of a combination, the model number should contain an "S" (Special) in the model code and a note in the body of the order clarifying the mounting arrangement. The "P" is used to define a thrust key and is not considered to be a mounting. However, it is located at the primary end.

Example: 4.00 CCBB2ALTS14AC x10.000

Combination "C" mounting head only "BB" mounting cap end
This cylinder is also cushioned at both ends.

Double Rod End In general, the model number is read left to right corresponding to the cylinder as viewed from left to right with the primary end at rod end #1. See Double Rod Models information page in this section. For this option the piston rod number, piston rod end, and piston rod threads are to be specified for both ends. The simplest are for symmetric cylinders such as: TD, C, E, F, G, and CB mounts. All other mounting styles, the description of the first rod end will be at the mounting end. In the case of multiple mounts, the description of the first rod end will be at the primary mounting end. For "DD" mounts, the description of the first rod end will be the same location as the "XI" dimension.

Example: 4.00 KDD2ALT24A/18A x10.000 XI=8

This is a center trunnion mounting cylinder with the XI dimension measured from the code 2 rod side of the cylinder which has the style 4 thread. The opposite end code 1 rod with the style 8 thread.

Style 3 Rod End

A style 3 rod end indicates a special rod end configuration. All special piston rod dimensions must have **all three:** KK; A; W/WF or LA/LAF specified with the rod fully retracted. A sketch or drawing should be submitted for rod ends requiring special machining such as snap ring grooves, keyways, tapers, multiple diameters, etc. It is good design practice to have this machining done on a diameter at least 0.065 inches smaller than the piston rod diameter. This allows the piston rod to have a chamfer preventing rod seal damage during assembly or maintenance. Standard style 55 rod ends with a longer than standard WG dimension should call out a style 3 rod end and the note: **same as 55 except WG=____**. A drawing should be submitted for special 55 rod ends that have specific tolerances or special radii. Special rod ends that have smaller than standard male threads, larger than standard female threads, or style 55 rod ends with smaller than standard AF or AE dimensions are to be reviewed by Engineering for proper strength at operating pressure.

Service Policy

On cylinders returned to the factory for repairs, it is standard policy for the Cylinder Division to make such part replacements as will put the cylinder in as good as new condition. Should the condition of the returned cylinder be such that expenses for repair would exceed the costs of a new one, you will be notified.

Address all correspondence and make shipments to, Service Department at your nearest regional plant listed in the pages of this catalog.

Certified Dimensions

Parker Cylinder Division guarantees that all cylinders ordered from this catalog will be built to dimensions shown. All dimensions are certified to be correct, and thus it is not necessary to request certified drawings.

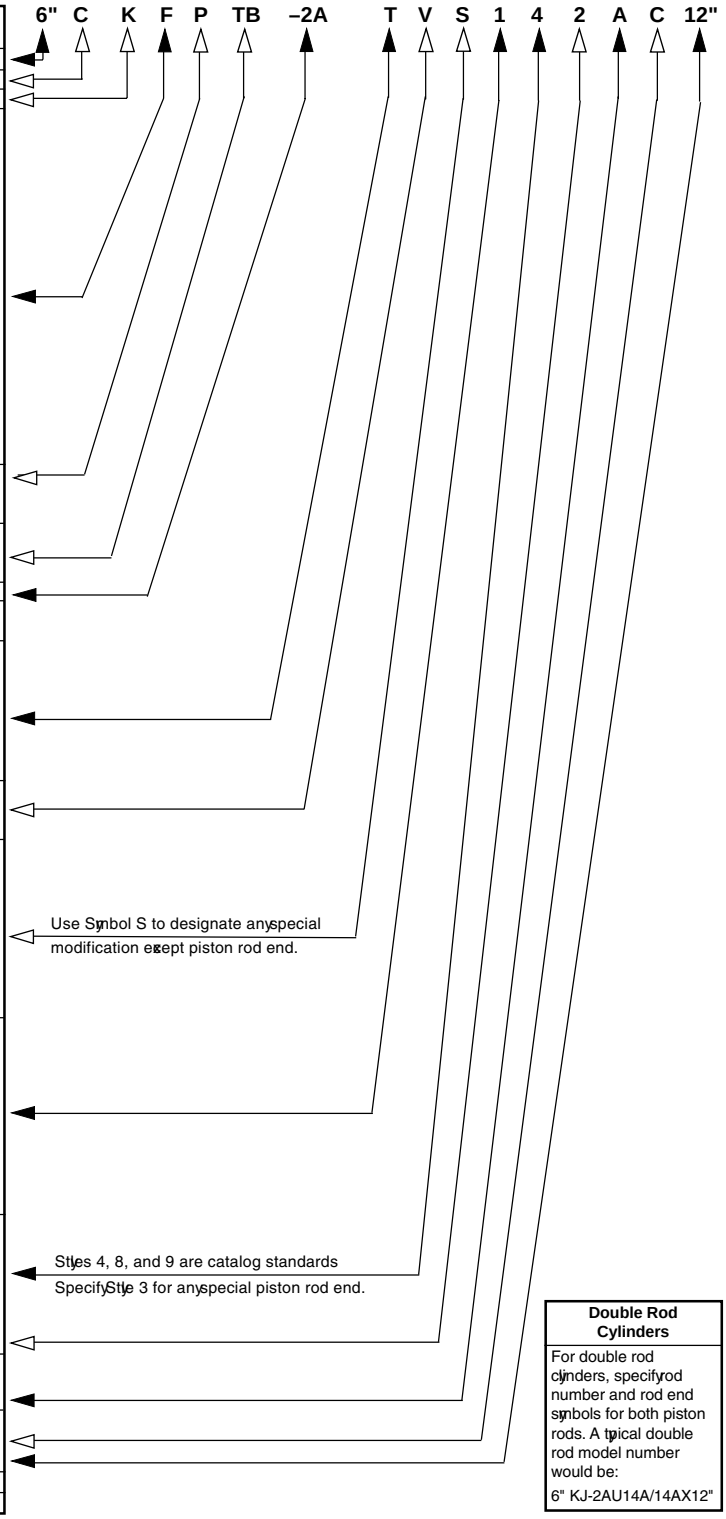
For additional information – call your local Parker Cylinder Distributor.

Series 2A Model Numbers – How to Develop Them – How to "Decode" Them

Parker Series 2A cylinders can be completely and accurately described by a model number consisting of coded symbols. To develop a model number, select only those symbols that represent the cylinder required, and place them in the sequence indicated below.

Note: Page numbers with a letter prefix, ie: C77, are located in section C of this catalog.

Feature	Description	Page No.	Symbol
Bore*	Specify in inches	—	—
Cushion-Head	Used **only** if cushion required	C101-103	C
Double-Rod	Used **only** if double-rod cylinder is required	A46	K
Mounting* Style	Head Tie Rods Extended	20 & 34	TB
	Cap Tie Rods Extended	20 & 34	TC
	Both End Tie Rods Extended	20 & 34	TD
	Head Rectangular Flange	20	J
	Cap Rectangular Flange	20	H
	Head Square Flange	22 & 34	JB
	Cap Square Flange	22 & 34	HB
	Side Lugs	24 & 36	C
	Centerline Lugs	24 & 36	E
	Side Tapped	24 & 38	F
	Side End Angles	26 & 40	CB
	Side End Lugs	26 & 38	G
	Cap Fixed Clevis	30 & 40	BB
	Head Trunnion	28 & 42	D
	Cap Trunnion	28 & 42	DB
	Intermediate Fixed Trunnion ‡	28 & 42	DD
	Cap Detachable Clevis	30	BC
	Spherical Bearing	44 & 45	SB
Mounting Modifications	Thrust Key (Styles C,F,G, & CB **only**)	C93	P
	Manifold Port O-Ring Seal (Style C **only**)	C89-91	M
	Removable Trunnions	C88	R
Combination Mounting Style	Any Practical Mounting Style	–	As
	Listed Above	–	listed
		–	above
Series*	Used in **all** 2A Model Numbers	–	2A
Piston	Lipseal® Piston standard. No need for symbol in model number.	–	–
Ports*	NPTF (Dry Seal Pipe Thread) is standard. Used **only** for SAE Straight Thread	C89-91	U
	O-Ring Port	C89-91	T
	Used **only** for BSP (Parallel Thread ISO 228)	C89-91	R
	Used **only** for BSPT (Taper Thread ISO 7-Rc)	C89-91	B
	Used **only** for Metric Thread	C89-91	G
	Used **only** for Metric Thread per ISO 6149	C89-91	Y
Common Modifications	Nut Retained Piston	A19	F
	Fluorocarbon Seals	C83	V
	Water Service	C83	W
Special Modifications	Used **only** if special Modifications are required: Oversize Ports	C89-91	
	Port Position Change	C89-91	
	Rod End Bellows	C104	
	Special Seals	C83	S
	Stop Tube†	C95	
	Stroke Adjuster	C93	
	Tie Rod Supports	C93	
	Water Service Modification	C83	
Piston Rod* Number	For Single Rod Cylinders, select one only	–	1
	Refer to Rod number listing, Table 2,	–	2
	Pages 20 through 43.	–	3
	Note: Check chart in Section C, page 96 for	–	4
	minimum piston rod diameter	–	5
		–	6
		–	7
		–	8
		–	9
		–	0
Piston* Rod End	Select:		
	Style 4 Small Male	C92	4
	Style 7 Female Thread for Spherical Rod Eye	A44, 45	7
	Style 8 Intermediate Male	C92	8
	Style 9 Short Female	C92	9
	Style 55 Rod End for Flange Coupling	C19	55
	Style 3 Special (Specify)	C92	3
Piston Rod Alternate Thread	Used **only** for stud two times longer than standard.	C92	2
Piston Rod* Threads	UNF Standard	C92	A
	BSF (British Fine)	C92	W
	Metric	C101-C103	M
Cushion-Cap	Used **only** if cushion required	C93	C
Stroke*†	Specify in inches		–



Double Rod Cylinders

For double rod cylinders, specify rod number and rod end symbols for both piston rods. A typical double rod model number would be:

6" KJ-2AU14A/14AX12"

*Required for Basic Cylinder Model Number

Dark Arrows Indicate Basic Minimum Model Number

‡Specify XI dimension

†In case of Stop Tube, call out gross stroke length.

Cylinder serial numbers are factory production record numbers and are assigned to each cylinder, in addition to the model number.

For Cylinder Division Plant Locations – See Page II.

Parker Cylinder

20 899-06
PNOZ X3P

- **D Betriebsanleitung**
- **GB Operating instructions**
- **F Manuel d`utilisation**
- **E Instrucciones de uso**
- **I Istruzioni per l`uso**
- **NL Gebruiksaanwijzing**

⚠ Sicherheitsbestimmungen

- Das Gerät darf nur von Personen installiert und in Betrieb genommen werden, die mit dieser Betriebsanleitung und den geltenden Vorschriften über Arbeitssicherheit und Unfallverhütung vertraut sind. Beachten Sie die VDE- sowie die örtlichen Vorschriften, insbesondere hinsichtlich Schutzmaßnahmen.
- Beim Transport, der Lagerung und im Betrieb die Bedingungen nach EN 60068-2-6 einhalten (s. technische Daten).
- Durch Öffnen des Gehäuses oder eigenmächtige Umbauten erlischt jegliche Gewährleistung.
- Montieren Sie das Gerät in einen Schaltschrank; Staub und Feuchtigkeit können sonst zu Beeinträchtigungen der Funktionen führen.
- Sorgen Sie an allen Ausgangskontakten bei kapazitiven und induktiven Lasten für eine ausreichende Schutzbeschaltung.
- Die Sicherheitsfunktion muss mindestens einmal im Monat ausgelöst werden.

⚠ Safety Regulations

- The unit may only be installed and operated by personnel who are familiar with both these instructions and the current regulations for safety at work and accident prevention. Follow VDE and local regulations especially as regards preventative measures.
- Transport, storage and operating conditions should all conform to EN 60068-2-6.
- Any guarantee is void following opening of the housing or unauthorised modifications.
- The unit should be panel mounted, otherwise dampness or dust could lead to function impairment.
- Adequate protection must be provided on all output contacts especially with capacitive and inductive loads.
- The safety function must be triggered at least once per month.

⚠ Conseils préliminaires

- La mise en oeuvre de l'appareil doit être effectuée par une personne spécialisée en installations électriques, en tenant compte des prescriptions des différentes normes applicables (NF, EN, VDE...) notamment au niveau des risques encourus en cas de défaillance de l'équipement électrique.
- Respecter les exigences de la norme EN 60068-2-6 lors du transport, du stockage et de l'utilisation de l'appareil.
- L'ouverture de l'appareil ou sa modification annule automatiquement la garantie.
- L'appareil doit être monté dans une armoire; l'humidité et la poussière pouvant entraîner des aléas de fonctionnement.
- Vérifiez que le pouvoir de coupure des contacts de sortie est suffisant en cas de circuits capacitifs ou inductifs.
- La fonctionn de sécurité doit être activée au moins une fois par mois.

Bestimmungsgemäße Verwendung

Das Sicherheitsschaltgerät PNOZ X3P ist bestimmt für den Einsatz in

- NOT-AUS-Einrichtungen
- Sicherheitsstromkreisen nach VDE 0113-1 und EN 60204-1 (z. B. bei beweglichen Verdeckungen)

Authorised Applications

The Safety Relay PNOZ X3P is for use in:

- Emergency Stop circuits
- Safety Circuits according to VDE 0113-1 and EN 60204-1 (e.g. with movable guards)

Domaines d'utilisation

Le bloc logique de sécurité PNOZ X3P est adapté pour :

- les circuits d'arrêt d'urgence
- les circuits de sécurité selon les normes NF 79-130 et EN 60204/1 (ex. protecteurs mobiles).

Gerätebeschreibung

Das Sicherheitsschaltgerät PNOZ X3P ist in einem P-99-Gehäuse untergebracht. Es kann mit 24 ... 240 V Gleichspannung oder Wechselspannung betrieben werden.
Merkmale:

- Relaisausgänge: 3 Sicherheitskontakte (Schließer) und ein Hilfskontakt (Öffner), zwangsgeführt
- Anschlußmöglichkeit für NOT-AUS-Taster, Schutztürgrenztaster und Starttaster
- Statusanzeige
- Überwachung externer Schütze möglich
- Halbleiterausgang meldet Betriebsbereitschaft

Das Schaltgerät erfüllt folgende Sicherheitsanforderungen:

- Schaltung ist redundant mit Selbstüberwachung aufgebaut (EN 954-1 Kategorie 4).
- Sicherheitseinrichtung bleibt auch bei Ausfall eines Bauteils wirksam.
- Bei jedem Ein-Aus-Zyklus der Maschine wird automatisch überprüft, ob die Relais der Sicherheitseinrichtung richtig öffnen und schließen.
- Das Gerät hat eine elektronische Sicherung.

Description

The Safety Relay PNOZ X3P is enclosed in a 45 mm P-99 housing. The unit can be operated with 24 ... 240 VAC/DC.
Features:

- Relay outputs: 3 safety contacts (N/O) and one auxiliary contact (N/C), positive-guided
- Connections for Emergency Stop Button, Safety Gate Limit Switch and Reset button
- Status Indicators
- Monitoring of external contactors/relays possible
- Semi-conductor outputs show ready for operation

The relay complies with the following safety requirements:

- The circuit is redundant with built-in self-monitoring (EN 954-1 Category 4).
- The safety function remains effective in the case of a component failure.
- The correct opening and closing of the safety function relays is tested automatically in each on-off cycle.
- The relays has an electronic fuse.

Description de l'appareil

Inséré dans un boîtier P-99, le bloc logique de sécurité PNOZ X3P peut être alimenté en 24 ... 240 VAC/DC.
Particularités :

- Sorties disponibles : 3 contacts à fermeture de sécurité et un contact à ouverture pour signalisation
- Bornes de raccordement pour poussoirs AU, détecteurs de position et poussoir de validation
- LEDs de visualisation
- Auto-contrôle possible des contacteurs externes
- Sorties statique d'information (relais en position travail)

Le relais PNOZ X3P répond aux exigences suivantes :

- conception redondante avec auto-surveillance (selon EN 954-1 cat. 4)
- sécurité garantie même en cas de défaillance d'un composant
- test cyclique (ouverture/fermeture des relais internes) à chaque cycle Marche/ Arrêt de la machine
- Le relais dispose d'un fusible électronique.

Funktionsbeschreibung

Das Schaltgerät PNOZ X3P dient dem sicherheitsgerichteten Unterbrechen eines Sicherheitsstromkreises. Nach Anlegen der Versorgungsspannung leuchtet die LED "Power". Das Gerät ist betriebsbereit, wenn der Startkreis S13-S14 geschlossen ist oder ein Startkontakt an S33-S34 geöffnet und wieder geschlossen wurde.

- Eingangskreis geschlossen (z. B. NOT-AUS-Taster nicht betätigt):
  Relais K1 und K2 gehen in Wirkstellung und halten sich selbst. Die Statusanzeigen für "CH. 1" und "CH. 2" leuchten. Die Sicherheitskontakte (13-14/23-24/33-34) sind geschlossen, der Hilfskontakt (41-42) ist geöffnet.
- Eingangskreis wird geöffnet (z. B. NOT-AUS-Taster betätigt):
  Relais K1 und K2 fallen in die Ruhestellung zurück. Die Statusanzeige für "CH. 1" und "CH. 2" erlischt. Die Sicherheitskontakte (13-14/23-24/33-34) werden redundant geöffnet, der Hilfskontakt (41-42) geschlossen.

Halbleiterausgang

Der Halbleiterausgang Y32 leitet, wenn die Relais K1 und K2 in Wirkstellung sind. Er sperrt, wenn die Relais in Ruhestellung sind.

Function Description

The relay PNOZ X3P provides a safety-oriented interruption of a safety circuit. When the operating voltage is supplied the LED "Power" is illuminated. The unit is ready for operation, when the reset circuit S13-S14 is closed or a reset contact at S33-S34 was opened and closed again.

- Input Circuit closed (e.g. the Emergency Stop button is not pressed):
  Relays K1and K2 energise and retain themselves. The status indicators for "CH. 1" and "CH. 2" illuminate. The safety contacts (13-14/23-24/33-34) are closed, the auxiliary contact (41-42) is open.
- Input Circuit is opened (e.g. Emergency Stop is pressed)
  Relays K1 and K2 de-energise. The status indicators for "CH.1" and "CH.2" go out. The safety contacts (13-14/23-24/33-34) will be opened (redundant), the auxiliary contact (41-42) closes.

Semi-conductor output

The semi-conductor Y32 conducts if the relays K1 and K2 are energised. Y32 switches off when the relays de-energise to rest position.

Description du fonctionnement

"Power" s'allume. Le relais est activé si le circuit de réarmement S13-S14 est fermé ou si le contact de réarmement sur S33-S34 a été ouvert puis refermé.

- Circuits d'entrée fermés (poussoir AU non actionné) :
  Les relais K1 et K2 passent en position travail et s'auto-maintiennent. Les LEDs "CH.1" et CH.2" s'allument. Les contacts de sécurité (13-14/23-24/33-34) sont fermés et le contact d'info. (41-42) est ouvert.
- Circuits d'entrée ouverts (poussoir AU actionné) :
  Les relais K1 et K2 retombent. Les LEDs "CH.1" et "CH.2" s'éteingnent. Les contacts de sécurité (13-14/23-24/33-34) s'ouvrent et le contact d'info. (41-42) se ferme.

Sortie statique

La sortie statique Y32 est passante si les relais K1 et K2 sont en position travail. Elle est bloquée si les relais sont en position repos.

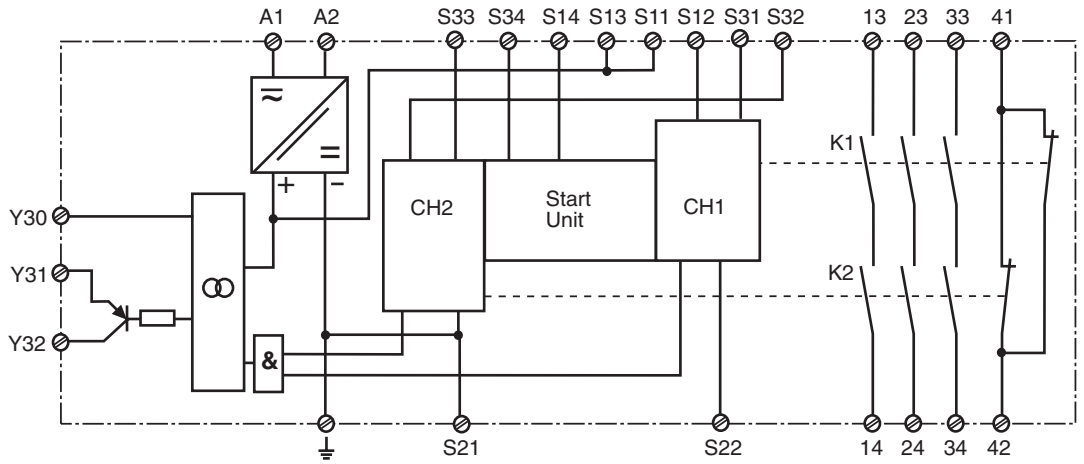


Fig. 1: Innenschaltbild/Internal Wiring Diagram/Schéma de principe

Betriebsarten:

- Einkanaliger Betrieb: Eingangsbeschaltung nach VDE 0113-1 und EN 60204-1, keine Redundanz im Eingangskreis, Erdschlüsse im Tasterkreis werden erkannt.
- Zweikanaliger Betrieb: Redundanter Eingangskreis, Erdschlüsse im Tasterkreis und Querschlüsse zwischen den Tasterkontakten werden erkannt.
- Automatischer Start: Gerät ist aktiv, sobald der Eingangskreis geschlossen ist.
- Manueller Start mit Überwachung: Gerät ist nur aktiv, wenn vor dem Schließen des Eingangskreises der Startkreis geöffnet wird und mindestens 300 ms nach dem Schließen des Eingangskreises der Startkreis geschlossen wird.
- Kontaktvervielfachung und -verstärkung durch Anschluß von externen Schützen

Operating Modes

- Single-channel operation: Input wiring according to VDE 0113-1 and EN 60204-1, no redundancy in the input circuit. Earth faults are detected in the emergency stop circuit.
- Two-channel operation: Redundancy in the input circuit. Earth faults in the Emergency Stop circuit and shorts across the emergency stop push button are also detected.
- Automatic reset: Unit is active as soon as the input circuit is closed.
- Manual reset with monitoring: The unit is only active if, the reset circuit is opened before closing the safety input circuit and then the reset circuit is closed at least 300 ms after closing the safety input circuit.
- Increase in the number of available contacts by connection of external contactors/relays.

Modes de fonctionnement

- Commande par 1 canal : conforme aux prescriptions de la EN 60204/1, pas de redondance dans le circuit d'entrée. La mise à la terre du circuit d'entrée est détectée
- Commande par 2 canaux: circuit d'entrée redondant. La mise à la terre et les courts-circuits entre les contacts sont détectés.
- Réarmement automatique : le relais est activé dès la fermeture des canaux d'entrée.
- Réarmement manuel auto-contrôlé: le relais n'est réarmé que si le circuit de réarmement est ouvert avant la fermeture du circuit d'entrée, puis refermé au min. 300 ms après la fermeture du circuit d'entrée.
- Augmentation du nombre de contacts ou du pouvoir de coupure par l'utilisation de contacteurs externes.

Montage

Das Sicherheitsschaltgerät muß in einen Schaltschrank mit einer Schutzart von mind. IP54 eingebaut werden. Zur Befestigung auf einer Normschiene dient ein Rastelement auf der Rückseite des Geräts.

Installation

The safety relay must be panel mounted (min. IP54). There is a notch on the rear of the unit for DIN-Rail attachment.

Montage

Le relais doit être monté en armoire ayant un indice de protection mini IP54. Sa face arrière permet un montage sur rail DIN.

Inbetriebnahme

Beachten Sie bei der Inbetriebnahme

- Auslieferungszustand: Brücke zwischen S11-S12 (Eingangskreis zweikanalig)
- Nur die Ausgangskontakte 13-14/23-24/33-34 sind Sicherheitskontakte. Ausgangskontakt 41-42 ist ein Hilfskontakt (z. B. für Anzeige).
- **Vor die Ausgangskontakte eine Sicherung (s. techn. Daten) schalten, um das Verschweißen der Kontakte zu verhindern.**
- Berechnung der max. Leitungslänge I_{max}:

$$I_{max} = \frac{R_{lmax}}{R_l / km}$$

R_{lmax} = max. Gesamtleitungswiderstand (s. technische Daten)
R_l /km = Leitungswiderstand/km

Da die Funktion Querschlußerkennung nicht einfehlersicher ist, wird sie von Pilz während der Endkontrolle geprüft. Eine Überprüfung nach der Installation des Geräts ist wie folgt möglich:
1. Gerät betriebsbereit (Ausgangskontakte geschlossen)
2. Die Testklemmen S22-S32 zur Querschlußprüfung kurzschließen.
3. Die Sicherung im Gerät muß auslösen und die Ausgangskontakte öffnen. Leitungslängen in der Größenordnung der Maximallänge können das Auslösen der Sicherung um bis zu 2 Minuten verzögern.
4. Sicherung wieder zurücksetzen: den Kurzschluß entfernen und die Betriebsspannung für ca. 1 Minute abschalten.

- Leitungsmaterial aus Kupferdraht mit einer Temperaturbeständigkeit von 60/75 °C verwenden.
- Angaben im Kapitel „Technische Daten“ unbedingt einhalten.

Ablauf:

- Versorgungsspannung:
  Versorgungsspannung an Klemmen A1 und A2 anlegen.
- Startkreis:
  - Automatischer Start: S13-S14 brücken.
  - Manueller Start mit Überwachung: Taster an S33-S34 anschließen (S13-S14 offen).
- Eingangskreis:
  - Einkanalig: S21-S22 und S31-S32 brücken. Öffnerkontakt von Auslöseelement an S11 und S12 anschließen.
  - Zweikanalig ohne Querschlußerkennung: S21-S22 brücken. Öffnerkontakt von Auslöseelement an S11-S12 und S11-S32 anschließen.
  - Zweikanalig mit Querschlusserkennung: S11-S12 brücken. Öffnerkontakt von Auslöseelement an S21-S22 und S31-S32 anschließen.
- Rückführkreis:
  Externe Schütze in Reihe zu Startkreis S13-S14 bzw. S33-S34 anschließen.
- 24 V Versorgungsspannung für Halbleiterausgang: +24 V DC an Klemme Y31 und 0 V an Klemme Y30 anschließen.

Die Sicherheitskontakte sind aktiviert (geschlossen) und der Hilfskontakt 41-42 ist geöffnet. Die Statusanzeige für "CH.1", "CH. 2", leuchten. Das Gerät ist betriebsbereit. Wird der Eingangskreis geöffnet, öffnen die Sicherheitskontakte 13-14/23-24/33-34 und der Hilfskontakt 41-42 schließt. Die Statusanzeige erlischt.

Operation

Please note for operation:

- Unit delivered with a bridge between S11-S12 (2-channel input circuit)
- Only the output contacts 13-14/23-24/33-34 are safety contacts. Output contact 41-42 is an auxiliary contact (e.g. for a display).
- **To prevent a welding together of the contacts, a fuse (see technical detail) must be connected before the output contacts.**
- Calculate the max. Cable runs I_{max}:

$$I_{max} = \frac{R_{lmax}}{R_l / km}$$

R_{lmax} = max. overall cable resistance (see Technical details)
R_l /km = Cable resistance/km

As the function for detecting shorts across the inputs is not failsafe, it is tested by Pilz during the final control check. However, a test is possible after installing the unit and it can be carried out as follows:
1. Unit ready for operation (output contacts closed)
2. Short circuit the test (connection) terminals S22-S32 for detecting shorts across the inputs.
3. The unit‘s fuse must be triggered and the output contacts must open. Cable lengths in the scale of the maximum length can delay the fuse triggering for up to 2 minutes.
4. Reset the fuse: remove the short circuit and switch off the operating voltage for approx. 1 minute.

- Use copper wiring that will withstand 60/75 °C.
- Important details in the section "Technical Data“ should be noted and adhered to.

To operate:

- Supply operating voltage
  Connect the operating voltage to terminals A1 and A2.
  - Reset circuit:
  - Automatic reset: Bridge S13-S14.
  - Manual reset with monitoring: Connect button to S33-S34 (S13-S14 open).
- Input circuit:
  - Single-channel: Bridge S21-S22 and S31-S32. Connect N/C contact from safety switch (e.g. Emergency-Stop) to S12 and S11.
  - Dual-channel, without short circuit detection: Link S21-S22. Connect N/C contact from safety switch (e.g. emergency stop) to S11-S12 and S11-S32
  - Dual-channel, with short circuit detection: Bridge S11-S12. Connect N/C contact from safety switch (e.g. emergency-stop) to S21-S22 and S31-S32.
- Feedback control loop:
  Connect external relays/contactors in series to reset circuit S13-S14 or S33-S34.
- 24 VDC supply voltage for semi-conductor output: Connect +24 VDC to terminals Y31 and 0 VDC to Y30.

The safety contacts are activated (closed) and the auxiliary contact (41-42) is open. The status indicators "CH.1"and "CH.2" are illuminated. The unit is ready for operation. If the input circuit is opened, the safety contacts 13-14/23-24, 33-34 open and the auxiliary contact 41-42 closes. The status indicator goes out.

Mise en oeuvre

Remarques préliminaires :

- Pontages présents à la livraison: S11-S12 (commande par 2 canaux)
- Seuls les contacts 13-14, 23-24, 33-34 sont des contacts de sécurité. Le contact 41-42 est un contact d’information (ex. voyant)
- **Raccordez une fusible (voir les caractéristiques techniques) avant les contacts de sortie afin d'éliminer tout risque de fusion.**
- Calculer les longueurs de câblage max I_{max} dans le circuit d’entrée:

$$I_{max} = \frac{R_{lmax}}{R_l / km}$$

R_{lmax} = Résistivité de câblage totale max. (voir les caractéristiques techniques)
R_l /km = résistivité de câblage/km

La fonction de détection de court-circuit est testé par Pilz lors du contrôle final. Un test sur site est possible de la façon suivante :
1. Appareil en fonction (contacts de sortie fermés)
2. Court-circuiter les bornes de raccordement nécessaires au test S22-S32.
3. Le fusible interne du relais doit déclencher et les contacts de sortie doivent s‘ouvrir. Le temps de réponse du fuisible peut aller jusqu‘à 2 min. si les longueurs de câblage sont proches des valeurs maximales.
4. Réarmement du fusible : enlever le court-circuit et couper l‘alimentation du relais pendant au moins 1 min.

- Utiliser uniquement des fils de cablâge en cuivre 60/75 °C.
- Respecter les données indiquées dans le chap. „Caractéristiques techniques“.

Mise en oeuvre :

- Tension d’alimentation
  amener la tension d’alimentation sur A1 et A2.
- Circuit de réarmement:
  - réarmement automatique: pontage des bornes S13-S14
  - réarmement manuel auto-côntrolé: câblage d'un poussoir sur S33-S34 (S13-S14 ouvert).
- Circuits d’entrée:
  - Commande par 1 canal : câblage du contact à ouverture entre S11-S12, pontage entre S21-S22 et S31-S32
  - Commande par 2 canaux sans détection des courts-circuits: câblage des contacts à ouverture entre S11-S12, S11-S32, pontage entre S21-S22
  - Commande par 2 canaux avec détection des courts-circuits: câblage des contacts à ouverture entre S21-S22 et S31-S32, pontage entre S11-S12
- Boucle de retour:
  câbler les contacts des contacteurs externes en série dans le circuit de réarmement S13-S14 ou S33-S34.
- Alimentation en 24 VCC de sortie statique: relier le +24 V DC à la borne Y31 et le 0 V à la borne Y30.

Les contacts de sécurité se ferment et le contact d’information 41-42 s’ouvre. Les LEDs "CH.1"et "CH.2" sont allumées. L’appareil est prêt à fonctionner.
Si le circuit d’entrée est ouvert, les contacts de sécurité retombent et le contact d’information 41-42 se ferme. Les LEDs s’éteignent.

Wieder aktivieren
- Eingangskreis schließen.
- Bei manuellem Start mit Überwachung Taster zwischen S33 und S34 betätigen.

Die Statusanzeigen leuchten wieder, der Eingangskreis ist aktiviert.

Reactivation
- Close the input circuit.
- For manual reset with monitoring, press the button between S33-S34.

The status indicators illuminate once more, the input circuit is activated.

Remise en route :
- fermer le circuit d'entrée.
- en cas de surveillance du circuit de réarmement, appuyer le poussoir de validation S33-S34.

Les LEDs sont à nouveau allumées. Les contacts de sortie sont fermées.

Anwendung

In Fig. 2 ... Fig. 10 sind Anschlußbeispiele für NOT-AUS-Beschaltung mit automatischem und überwachtem Start, Schutztüransteuerungen sowie Kontaktvervielfachung durch externe Schütze.
Bitte beachten Sie:
- Fig. 2 und 7: **keine** Verbindung S33-S34
- Fig. 3, 4, 5, 6, 8: **keine** Verbindung S13-S14
- Fig. 7: Automatischer Start bei Schutztürsteuerung: Das Gerät ist bei geöffneter Schutztür über den Startkreis S13-S14 startbereit. Nach Schließen der Eingangskreise S11-S12, S21-S22 und S31-S32 werden die Sicherheitskontakte geschlossen.

Beachten Sie bei Fig. 2 und 7: Das Gerät startet bei Spannungsausfall und -wiederkehr automatisch. Verhindern Sie einen unerwarteten Wiederanlauf durch externe Schaltungsmaßnahmen.

Application

In Fig. 2 ...Fig. 10 are connection examples for Emergency Stop wiring with automatic and monitored reset. Safety gate controls as well as contact expansion via external contactors.
- Fig. 2 and 7: S33-S34 **not** connected
- Fig. 3, 4, 5, 6, 8: S13-S14 **not** connected
- Fig. 7: Automatic reset with safety gate control: with the safety gate open the unit is ready for operation via reset circuit S13-S14. After closing the safety input circuit S11-S12, S21, S22 and S31-S32 the safety contacts will close.

Please note for Fig. 2 and 7: the device starts automatically after loss of power. You should prevent an unintended start-up by using external circuitry measures.

Utilisation

Les figures 2 à 10 représentent les différents câblages possibles du PNOZ X3P à savoir : poussoir AU avec réarmement automatique ou auto-côntrolé, interrupteurs de position et augmentation du nombre des contacts de sécurité par contacteurs externes.
- Fig. 2 et 7: **pas** de câblage sur S33-S34
- Fig. 3, 4, 5, 6, 8: **pas** de câblage sur S13-S14
- Fig. 7: Réarmement automatique en cas de surveillance protecteur: lorsque le protecteur est ouvert, le circuit S13-S14 se ferme et le relais est prêt à fonctionner. Dès la fermeture des canaux d'entrée S11-S12, S21-S22 et S31-S32, les contacts de sortie du relais se ferment.

Dans le cas de la figure 2 et 7, l'appareil se réarme automatiquement après une coupure et une remise sous tension. Evitez tout risque de redémarrage par un câblage externe approprié.

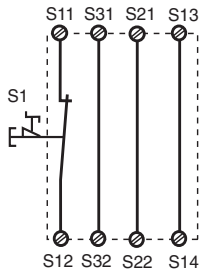


Fig. 2: Eingangskreis einkanalig, automat. Start/Single-channel input circuit, automatic reset/Commande par 1 canal, validation automatique

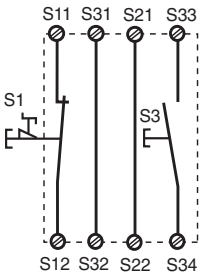


Fig. 3: Eingangskreis einkanalig, überwachter Start/Single-channel input circuit, monitored reset/Commande par 1 canal, surveillance du poussoir de validation

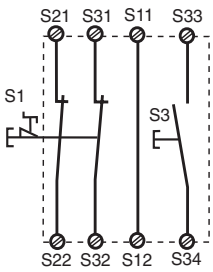


Fig.4: Eingangskreis zweikanalig, überwachter Start/Two-channel input circuit, monitored reset/Commande par 2 canaux, surveillance du poussoir de validation

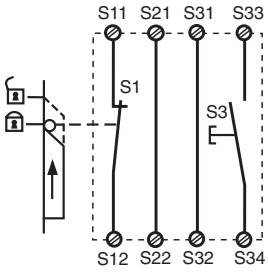


Fig. 5: Schutztürsteuerung einkanalig, überwachter Start/Single-channel safety gate control, monitored reset/Surveillance de protecteur, commande par 1 canal, surveillance du poussoir de validation

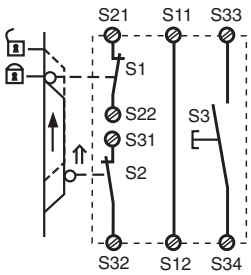


Fig. 6: Schutztürsteuerung zweikanalig, überwachter Start/Two-channel safety gate control, monitored reset/Surveillance de protecteur, commande par 2 canaux, surveillance du poussoir de validation

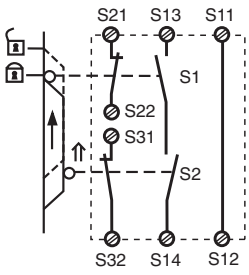


Fig. 7: Schutztürsteuerung zweikanalig, automatischer Start/Two channel safety gate control, automatic reset/Surveillance de protecteur, commande par 2 canaux, validation automatique

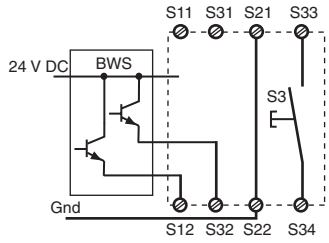


Fig. 8: Lichtschrankensteuerung, zweikanalig, Querschlußerkennung durch BWS, überwachter Start/Dual-channel light curtain control, short circuit detection via ESPE, monitored reset/Commande par 2 canaux par barrage immatériel ,surveillance du poussoir de validation

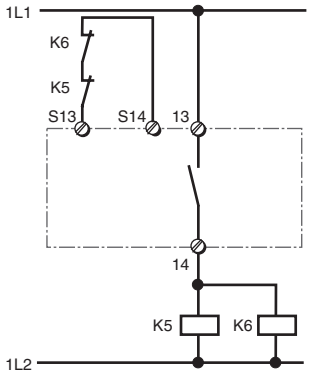


Fig. 9: Anschlußbeispiel für externe Schütze, einkanalig, automatischer Start/Connection example for external contactors/relays, single-channel, automatic reset/ Branchement contacteurs externes, commande par 1 canal, validation automatique

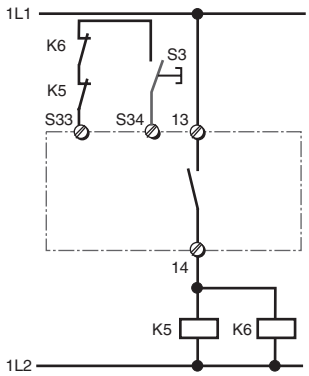


Fig. 10: wie Fig. 9 mit überwachtem Start/ Like Fig. 9 with monitored reset/comme Fig. 9 avec surveillance du poussoir de validation

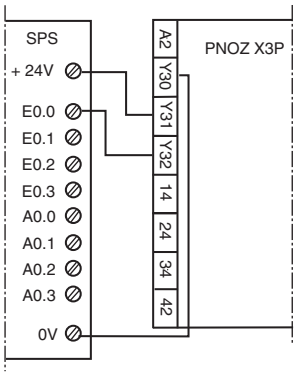


Fig. 11: Anschlußbeispiel für Halbleiterausgang/Connection of semiconductor output/ Câblage de la sortie statique

⇑ betätigtes Element/Switch activated/élément actionné

Tür nicht geschlossen/Gate open/porte ouverte

Tür geschlossen/Gate closed/ porte fermée

S1/S2: NOT-AUS- bzw. Schutztürschalter/Emergency Stop Button, Safety Gate Limit Switch/Poussoir AU, détecteurs de position
S3: Starttaster/Reset button/Poussoir de réarmement

Fehler - Störungen

- Erdschluß bei PNOZ X3P: Eine elektronische Sicherung bewirkt das Öffnen der Ausgangskontakte bei Fehlströmen ≥1,2 A. Nach Wegfall der Störungsursache und Abschalten der Versorgungsspannung für ca. 1 min ist das Gerät wieder betriebsbereit.
- Fehlfunktionen der Kontakte: Bei verschweißten Kontakten ist nach Öffnen des Eingangskreises keine neue Aktivierung möglich.
- LED "Power" leuchtet nicht: Kurzschluß oder Versorgungsspannung fehlt.

Faults

- Earth fault on PNOZ X3P: An electronic fuse causes the output contacts to open with fault currents ≥ 1.2 A. Once the cause of the fault has been removed and operating voltage is switched off, the unit will be ready for operation after approximately 1 minute.
- Contact failure: In the case of welded contacts, no further activation is possible following an opening of the input circuit.
- LED "Power" is not illuminated if short-circuit or the supply voltage is lost.

Erreurs - Défaillances

- Défaut de masse du PNOZ X3P: un fusible électronique entraîne l'ouverture des contacts de sortie si l'intensité est ≥ à 1,2 A. Une fois la cause du défaut éliminée et la tension d'alimentation coupée, l'appareil est à nouveau prêt à fonctionner après environ 1 minute.
- Défaut de fonctionnement des contacts de sortie: en cas de soudage d'un contact lors de l'ouverture du circuit d'entrée, un nouvel réarmement est impossible.
- LED "Power" éteinte: tension d'alimentation non présente ou court-circuit interne.

Technische Daten/Technical Data/Caractéristiques techniques

Versorgungsspannung U_B/Operating Voltage/Tension d'alimentation	24 - 240 V AC/DC
Spannungstoleranz/Voltage Tolerance/Plage de la tension d'alimentation	-15 ... +10 %
Leistungsaufnahme bei U_B/Power Consumption/Consommation	U_B DC: 2,5 W U_B AC: 5,0 VA
Frequenzbereich/Frequency Range/Fréquence	50 ... 60 Hz
Spannung und Strom an/Voltage, Current at //Tension et courant du	
Eingangskreis/Input circuit/circuit d'entrée	U_B = 24 V DC: 35 mA
Startkreis/reset circuit/circuit de réarmement	U_B = 24 V DC: 50 mA
Rückführkreis/feedback loop/boucle de retour	U_B = 24 V DC: 20 mA
Ausgangskontakte nach EN 954-1/Output Contacts to EN 954-1/ Contacts de sortie d'après EN 954-1	
Sicherheitskontakte (S), Kategorie 4/safety contacts N/O, category 4/ contacts de sécurité (F), catégorie 4	3
Hilfskontakte (Ö), auxilliary contacts N/C, contacts auxilliaires	1
Gebrauchskategorie nach/Utilization category to/Catégorie d'utilisation d'après	
EN 60947-4-1	
AC1: 240 V	I_{min}: 0,01 A, I_{max}: 8,0 A, P_{max}: 2000 VA
DC 1: 24 V	I_{min}: 0,01 A, I_{max}: 8,0 A, P_{max}: 200 W
EN 60947-5-1	
AC 15: 230 V	I_{max}: 5,0 A
DC13 (6 Schaltspiele/Min, 6 cycles/min, 6 manoeuvres/min): 24 V	I_{max}: 6,0 A
Kontaktmaterial/Contact material/Matériau contact	$AgSnO_2$+ 0,2 µm Au
Kontaktabsicherung extern nach/External Contact Fuse Protection/Protection des contacts EN 60 947-5-1	
Schmelzsicherung/Blow-out fuse/Fusibles	10 A flink/quick acting/rapide oder /or/ou 6 A träge/slow acting/normeaux
Sicherungsautomat/Safety cut-out/Dijoncteur	24 V AC/DC: 6 A Charakteristik / Characteristic/Caractéristiques B/C
Halbleiterausgänge (kurzschlussfest)/semiconductor outputs (short circuit-proof)/sorties statiques (protegées contre c.c.)	24 V DC, 20 mA
Externe Spannungsversorgung/external supply voltage/tension d'alimentation externe	24 V DC
Spannungstoleranz/Voltage Tolerance/Plage de la tension	-20 % / +20 %
Max. Gesamtleitungswiderstand R_{lmax} Eingangskreise/Max. overall cable resistance R_{lmax} input circuits/ Résistance de câblage totale max. R_{lmax} circuits d'entrée	
einkanalig DC/Single-channel DC/Commande par 1 canal DC	200 Ohm
einkanalig AC/Single-channel AC/Commande par 1 canal AC	200 Ohm
zweikanalig mit Querschlußerkennung DC/Dual-channel with detection of shorts across contacts DC/Commande par 2 canaux avec détection des court-circuits DC	30 Ohm
zweikanalig mit Querschlußerkennung AC/Dual-channel with detection of shorts across contacts AC/Commande par 2 canaux avec détection des court-circuits AC	30 Ohm
zweikanalig ohne Querschlußerkennung DC/Dual-channel without detection of shorts across contacts DC/Commande par 2 canaux sans détection des court-circuits DC	400 Ohm
zweikanalig ohne Querschlußerkennung AC/Dual-channel without detection of shorts across contacts AC/Commande par 2 canaux sans détection des court-circuits AC	400 Ohm
Einschaltverzögerung/Switch-on delay/Temps de réarmement U_B = 24 V AC/DC	
Automatischer Start/Automatic reset/Réarmement automatique	typ. 330 ms, max. 450 ms
Automatischer Start nach Netz-Ein/Automatic reset after Power-ON/ Réarmement automatique après mise sous tension	typ. 750 ms, max. 1.000 ms
Überwachter Start/Monitored manual reset/Réarmement manuel auto-contrôlé	typ. 35 ms, max. 50 ms
Rückfallverzögerung /Delay-on De-Energisation /Temps de retombée	
bei NOT-AUS/at E-STOP/en cas d'arrêt d'urgence,	typ.: 15 ms, max.: 30 ms
bei Netzausfall/with power failure/en cas de coupure d'alimentation U_B = 24 V AC/DC	typ.: 150 ms, max.: 180 ms
bei Netzausfall/with power failure/en cas de coupure d'alimentation U_B = 240 V AC/DC	typ.: 1.500 ms, max.: 2.200 ms
Wiederbereitschaftszeit bei max. Schaltfrequenz 1/s/recovery time at max. switching frequency 1/s/temps de remise en service en cas de fréquence de commutation max. 1/s	
nach NOT-AUS/after E-STOP/après l'arrêt d'urgence	50 ms
nach Netzausfall/after power failure/après une coupure d'alimentation U_B = 24 V DC	200 ms
nach Netzausfall/after power failure/après une coupure d'alimentation U_B = 240 V AC	2.250 ms
Gleichzeitigkeit Kanal 1 und 2/Simultaneity channel 1 and 2/désynchronisme canal 1 et 2	∞
Wartezeit bei überwachtem Start/Waiting period on monitored reset/Temps d'attente en cas d'un démarrage surveillé	200 ms
Min. Startimpulsdauer bei überwachtem Start/Min. start pulse duration with a monitored reset/ Durée minimale de l'impulsion pour un réarmement auto-contrôlé	30 ms
Überbrückung bei Spannungseinbrüchen/Max. supply interruption before de-energisation/tenue aux micro-coupures	20 ms
EMV/EMC/CEM	EN 60947-5-1, EN 61000-6-2 / -6-3
Schwingungen nach/Vibration to/Vibrations d'après EN 60068-2-6	Frequenz/Frequency/Fréquences: 10-55 Hz Amplitude/Amplitude/Amplitude: 0,35 mm
Klimabeanspruchung/Climate Suitability/Conditions climatiques	EN 60068-2-78
Luft- und Kriechstrecken/Airgap Creepage/Cheminement et claquage	VDE 0110-1
Umgebungstemperatur/Operating Temperature/Température d'utilisation	-20 ... +55 °C
Lagertemperatur/Storage Temperature/Température de stockage	-40 ... +85 °C

Schutzart/Protection/Indice de protection	
Einbauraum (z. B. Schaltschrank)/Mounting (eg. panel)/Lieu d'implantation (ex. armoire)	IP54
Gehäuse/Housing/Boîtier	IP40
Klemmenbereich/Terminals/Bornes	IP20
Gehäusematerial/housing material/matériau du boîtier	
Gehäuse/Housing/Boîtier	PPO UL 94 V0
Front/front panel/face avant	ABS UL 94 V0
Max.Querschnitt des Außenleiters (Schraubklemmen)/Max. cable cross section (screw terminals)/Capacité de raccordement (borniers à vis)	
1 Leiter, flexibel/1 core, flexible/1 conducteur souple	0,25 ... 2,5 mm^2
2 Leiter gleichen Querschnitts, flexibel mit Aderendhülse, ohne Kunststoffhülse/ 2 core, same cross section flexible with crimp connectors, without insulating sleeve/ 2 conducteurs de même diamètre souple avec embout, sans chapeau plastique	0,25 ... 1 mm^2
ohne Aderendhülse oder mit TWIN-Aderendhülse/without crimp connectors or with TWIN crimp connectors/souple sans embout ou avec embout TWIN	0,2 ... 1,5 mm^2
Max.Querschnitt des Außenleiters (Käfigzugfederklemmen)/Max. cable cross section (cage clamp terminals)/Capacité de raccordement (borniers à ressort)	
flexibel ohne Aderendhülse/flexible without crimp connectors/souple sans embout	0,2 ... 1,5 mm^2
Gehäuse mit Käfigzugfederklemmen/Housing with cage clamp terminals/ Boîtier avec borniers à ressort/	
Abisolierlänge/Stripping length/Longueur de dénudage	8 mm
Klemmstellen pro Anschluss/Termination points per connection/bornes par raccordement	2
Anzugsdrehmoment für Schraubklemmen/Torque setting for screw terminals/ couple de serrage (borniers à vis)	0,5 Nm
Abmessungen (Schraubklemmen) H x B x T/Dimensions H x W x D (screw terminals)/ Dimensions (borniers à vis) H x P x L	94 x 45 x 121 mm (3.70" x 1.77" x 4.76")
Abmessungen (Käfigzugfederklemmen) H x B x T/Dimensions (cage clamp terminals) H x W x D/ Dimensions (borniers à ressort) H x L x P	101 x 45 x 121 mm (3.98" x 1.77" x 4.76")
Einbaulage/Fitting Position/Position de travail	beliebig/any/indifférente
Gewicht/Weight/Poids	310 g

Es gelten die 11/03 aktuellen Ausgaben der Normen.

The version of the standards current at 11/03 shall apply.

Se référer à la version des normes en vigeur au 11/03.

Max. Dauerstrom bei gleichzeitiger Belastung mehrerer Kontakte/Total current switching capability across all contacts/Intensité commutée max. en cas de charge sur plusieurs contacts (AC1, DC1)

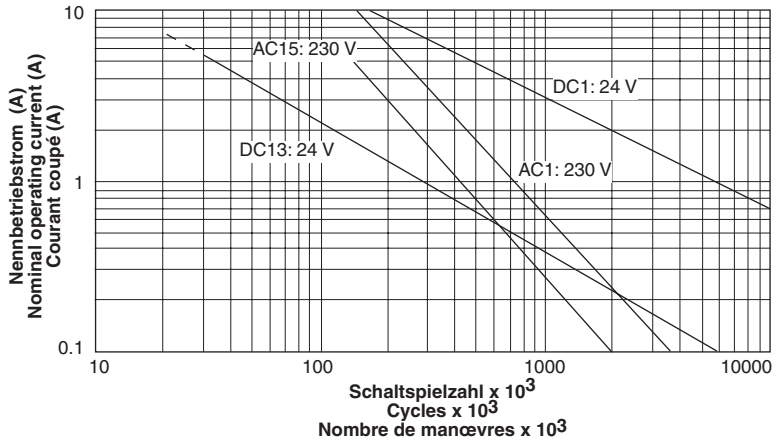
Anzahl der Kontakte/number of contacts/nombre des contacts	3	2	1
Imax (A) pro Kontakt bei Versorgungsspannung AC/per contact with operating voltage AC/par contact pour tension d'alimentation AC	6,0	7,0	8,0
Imax (A) pro Kontakt bei Versorgungsspannung DC/per contact with operating voltage DC/par contact pour tension d'alimentation DC	6,0	7,0	8,0

Um ein Versagen der Geräte zu verhindern, an allen Ausgangskontakten für eine ausreichende Funkenlöschung sorgen. Bei kapazitiven Lasten sind eventuell auftretende Stromspitzen zu beachten. Bei DC-Schützen Freilaufdioden zur Funkenlöschung einsetzen, um die Lebendauer der Schütze zu erhöhen.

To prevent failure of the unit, all output contacts should be fused adequately. With capacative loads, possible current peaks are to be avoided. With DC contactors/relays use suitable spark suppression to ensure extended life of the contactors/relays.

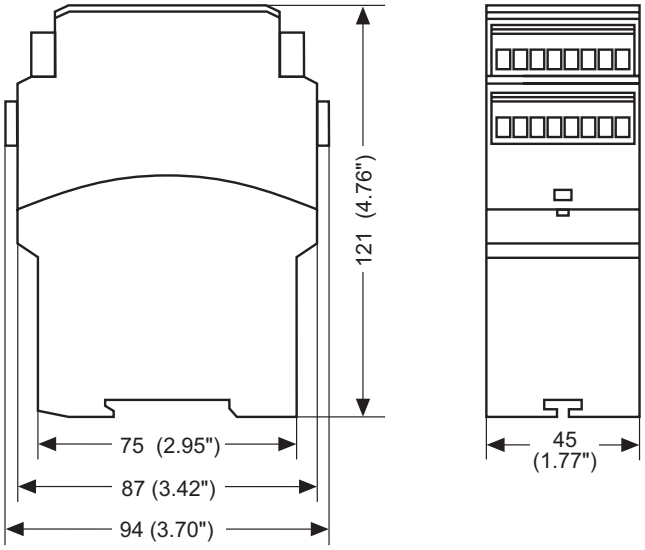
Prévoir un dispositif d'extinction d'arc sur les contacts de sortie pour éviter un éventuel disfonctionnement du relais.
Tenir compte des pointes d'intensité en cas de charge capacitive. Equiper les contacteurs DC de diodes de roue libre .

Lebensdauer der Ausgangsrelais/Service Life of Output relays/Durée de vie des relais de sortie

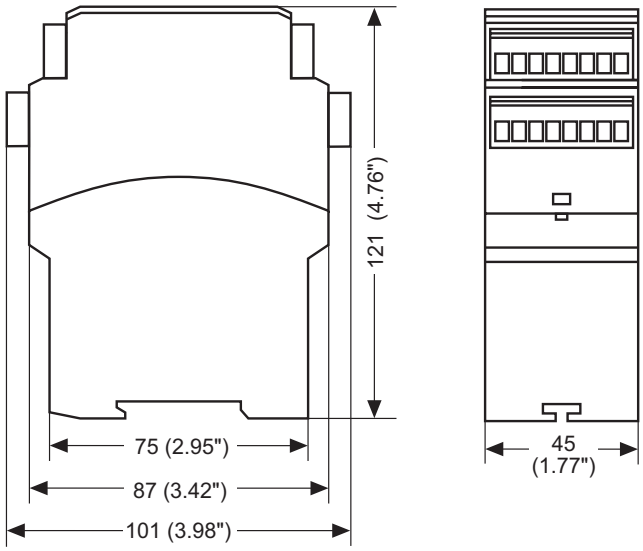


Abmessungen in mm (")**/Dimensions** in mm (")**/Dimensions** en mm (")

Gehäuse mit steckbaren Schraubklemmen/
Housing with plug-in screw terminals/
Boîtier avec borniers débrochables à vis



Gehäuse mit steckbaren Käfigzugfederklemmen/
Housing with plug-in cage clamp terminals/
Boîtier avec borniers débrochables à ressort/



Steckbare Klemmen abziehen

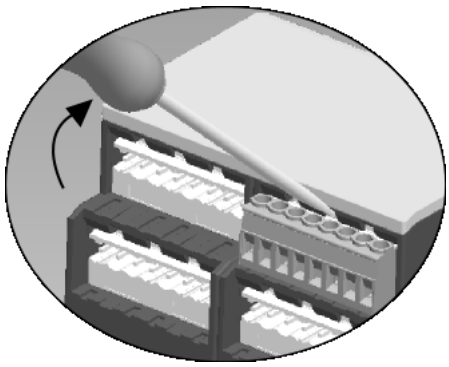
Schraubendreher in Gehäuseaussparung hinter der Klemme ansetzen und Klemme heraushebeln.
Klemmen **nicht** an den Kabeln abziehen!

Remove plug-in terminals

Insert screwdriver into the cut-out of the housing behind the terminal and lever the terminal.
Do not remove the terminals by pulling the cables!

Démonter les borniers débrochables

Placer un tournevis derrière les bornes et sortir le bornier.
Ne pas retirer les borniers en tirant sur les câbles !



Abziehen der Klemmen am Beispiel einer Schraubklemme

How to remove the terminals using a screw terminal as an example

Démontage d'un bornier à vis

▶ A Pilz Ges.m.b.H., ✆ 01 7986263-0, Fax: 01 7986264 ▶ AUS Pilz Australia, ✆ 03 95446300, Fax: 03 95446311 ▶ B ▶ L Pilz Belgium, ✆ 09 3217570, Fax: 09 3217571 ▶ BR Pilz do Brasil, ✆ 11 4337-1241, Fax: 11 4337-1242 ▶ CH Pilz Industrieelektronik GmbH, ✆ 062 88979-30, Fax: 062 88979-40 ▶ DK Pilz Skandinavien K/S, ✆ 74436332, Fax: 74436342 ▶ E Pilz Industrieelektronik S.L., ✆ 938497433, Fax: 938497544 ▶ F Pilz France Electronic, ✆ 03 88104000, Fax: 03 88108000 ▶ FIN Pilz Skandinavien K/S, ✆ 09 27093700, Fax: 09 27093709 ▶ GB Pilz Automation Technology, ✆ 01536 460766, Fax: 01536 460866 ▶ I Pilz Italia Srl, ✆ 031 789511, Fax: 031 789555 ▶ IRL Pilz Ireland Industrial Automation, ✆ 021 4346535, Fax: 021 4804994 ▶ J Pilz Japan Co., Ltd., ✆ 045 471-2281, Fax: 045 471-2283 ▶ MEX Pilz de Mexico, S. de R.L. de C.V., ✆ 55 5572 1300, Fax: 55 5572 4194 ▶ NL Pilz Nederland, ✆ 0347 320477, Fax: 0347 320485 ▶ NZ Pilz New Zealand, ✆ 09- 6345-350, Fax: 09-6345-352 ▶ P Pilz Industrieelektronik S.L., ✆ 229407594, Fax: 229407595 ▶ PRC Pilz China Representative Office, ✆ 021 62494658, Fax: 021 62491300 ▶ ROK Pilz Korea, ✆ 031 8159541, Fax: 031 8159542 ▶ SE Pilz Skandinavien K/S, ✆ 0300 13990, Fax: 0300 30740 ▶ TR Pilz Elektronik Güvenlik Ürünleri ve Hizmetleri Tic. Ltd. Şti., ✆ 0224 2360180, Fax: 0224 2360184 ▶ USA Pilz Automation Safety L.P., ✆ 734 354-0272, Fax: 734 354-3355 ▶ WWW www.pilz.com

▶ D Pilz GmbH & Co. KG, Sichere Automation, Felix-Wankel-Straße 2, 73760 Ostfildern, Deutschland, ✆ +49 711 3409-0, Fax: +49 711 3409-133, E-Mail: pilz.gmbh@pilz.de

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- **E Instrucciones de uso**
- **I Istruzioni per l`uso**
- **NL Gebruiksaanwijzing**

⚠ Normas de seguridad

- El dispositivo debe ser instalado y puesto en funcionamiento sólo por personas que tengan experiencia con estas instrucciones de uso y con las normativas de seguridad del trabajo y prevención de accidentes vigentes. Tenga en cuenta las normativas VDE, como también las normativas locales, especialmente en lo concerniente a medidas de protección.
- Respetar las exigencias de la norma EN 60068-2-6 referente al transporte, almacenaje y utilización del dispositivo (v. datos técnicos).
- Por apertura de la carcasa o modificaciones arbitrarias, caduca cualquier tipo de garantía.
- Instale el dispositivo en un armario de distribución; polvo y humedad pueden conducir, de lo contrario, a una merma de las funciones.
- Procúrese una conexión de protección adecuada, en todos los contactos de salida sometidos a cargas capacitivas e inductivas.
- La función de seguridad debe ejecutarse por lo menos una vez al mes.

Aplicación correcta

El dispositivo de seguridad PNOZ X3P está destinado para ser usado en

- Dispositivos para parada de emergencia
- Circuitos eléctricos de seguridad según VDE 0113-1 y EN 60204-1 (p. ej,. para cubiertas móviles)

Descripción del dispositivo

El dispositivo de seguridad PNOZ X3P está alojado en una carcasa P-99. Se puede hacer funcionar con tensión de corriente contínua o alterna de 24 ... 240 V.
Características:

- Salidas de relés: 3 contactos de seguridad (normalmente abierto) y un contacto auxiliar (normalmente cerrado), de guía forzosa
- Opción de conexión para pulsador de parada de emergencia, final de carrera de seguridad de puerta protectora y pulsador de rearme
- Indicador de estado
- Posibilidad de supervisión de contactores externos
- La salida de semiconductor comunica disposición para el funcionamiento

El dispositivo cumple los siguientes requisitos de seguridad:

- Concepción redundante con autosupervisión (EN 954-1, categoría 4).
- El dispositivo de seguridad permanece activo aún cuando falle un componente.
- En cada ciclo de marcha/parada de la máquina, se verifica automáticamente, si los relés del dispositivo de seguridad abren y cierran correctamente.
- El dispositivo tiene un fusible electrónico.

⚠ Norme di sicurezza

- Il dispositivo deve essere installato e messo in funzione solo da persone a conoscenza delle presenti istruzioni per l'uso e delle norme antinfortunistiche e di sicurezza del lavoro vigenti. Si devono inoltre rispettare le norme VDE, nonché le norme locali, soprattutto per quanto riguarda gli interventi di sicurezza.
- Per il trasporto, l'immagazzinamento ed il funzionamento, rispettare le norme EN 60068-2-6 (vedere i dati tecnici).
- In caso di apertura della custodia o di modifiche non autorizzate, non sarà riconosciuta alcuna garanzia.
- Montare il dispositivo in un armadio elettrico, perché la polvere e l'umidità potrebbero comprometterne il funzionamento.
- In caso di carichi capacitivi ed induttivi, assicurareuna adeguata protezione per tutti i contatti di uscita.
- La funzione di sicurezza deve essere attivata almeno una volta al mese.

Uso previsto

Il modulo di sicurezza PNOZ X3P è previsto per l'impiego nei

- Dispositivi di arresto di emergenza
- Circuiti elettrici di sicurezza secondo VDE 0113-1 ed EN 60204-1 (per es. per ripari mobili)

Descrizione del dispositivo

Il dispsositivo di sicurezza PNOZ X3P è inserito in una custodia P-99. Il dispositivo può funzionare con tensione continua, oppure con tensione alternata di 24 ... 240 V.
Caratteristiche:

- Uscite relè: 3 contatti di sicurezza (NA) ed un contatto ausiliario (contatto NC), a conduzione forzata
- Possibilità di collegamento per pulsanti di arresto di emergenza, finecorsa riparo mobile e pulsante di start
- LED di stato
- Possibilità di controllo dei relè esterni
- L'uscita a semiconduttore segnala il funzionamento

Il dispositivo elettrico è conforme ai seguenti requisiti di sicurezza:

- Concezione ridondante con autocontrollo (EN 954-1, categoria 4).
- Il dispositivo mantiene la sua funzione di sicurezza anche in caso di avaria di un componente.
- Ad ogni ciclo di inserimento-disinseri-mento della macchina, viene controllato automaticamente se i relè del dispositivo di sicurezza aprono e chiudono correttamente.
- Il dispositivo è dotato di un fusibile elettronico.

⚠ Veiligheidsvoorschriften

- Het apparaat mag uitsluitend worden geïnstalleerd en in bedrijf genomen door personen die vertrouwd zijn met deze gebruiksaanwijzing en met de geldende voorschriften op het gebied van arbeidsveiligheid en ongevallenpreventie. Neemt u de van toepassing zijnde Europese richtlijnen en de plaatselijke voorschriften in acht, in het bijzonder m.b.t. veiligheidsmaatregelen.
- Neemt u bij transport, opslag en in bedrijf de richtlijnen volgens EN 60068-2-6 in acht (zie technische gegevens).
- Het openen van de behuizing of het eigenmachtig veranderen van de schakeling heeft verlies van de garantie tot gevolg.
- Monteert u het apparaat in een schakelkast. Stof en vochtigheid kunnen anders de werking nadelig beïnvloeden.
- Zorgt u bij capacitieve of inductieve belasting van de uitgangscontacten voor adequate contactbeschermings-maatregelen.
- De veiligheidsfunctie moet ten minste een keer per maand geactiveerd worden.

Toegelaten applicaties

Het veiligheidsrelais PNOZ X3P is bestemd voor gebruik in

- noodstopvoorzieningen
- veiligheidscircuits volgens VDE 0113-1 en EN 60204-1
  (b.v. bij beweegbare afschermingen)

Apparaatbeschrijving

Het veiligheidsrelais PNOZ X3P is in een P-99-behuizing ondergebracht. Het kan met 24 ... 240 V gelijkspanning of wisselspanning gebruikt worden.
Kenmerken:

- Relaisuitgangen: 3 veiligheidscontacten (maakcontacten) en 1 hulpcontact (verbreekcontact), mechanisch gedwongen
- Aansluitmogelijkheid voor noodstop-knoppen, deurcontacten en de startknop
- Status-LED's
- Bewaking van externe magneetschakelaars mogelijk
- Halfgeleideruitgang geeft melding indien bedrijfsklaar

Het relais voldoet aan de volgende veiligheidseisen:

- De schakeling is redundant met zelfcontrole opgebouwd (EN 954-1 categorie 4).
- Ook bij uitvallen van een component blijft de veiligheidsschakeling werken.
- Bij elke aan/uit-cyclus van de machine wordt automatisch getest of de relais-contacten van de veiligheidsvoorziening correct openen en sluiten.
- Het apparaat heeft een elektronische zekering.

Descripción funcional

El dispositivo PNOZ X3P sirve para una interrupción por motivos de seguridad de un circuito eléctrico de seguridad. Después de aplicarse la tensión de alimentación se enciende el LED "Power". El dispositivo está listo para funcionar, cuando el circuito de rearme S13-S14 está cerrado o un contacto de rearme fue abierto y nuevamente cerrado en S33-S34.

- Circuito de entrada cerrado (p. ej., pulsador de parada de emergencia no accionado):
  Los relés K1 y K2 pasan a posición activa y se automantienen. Los indica-dores de estado para "CH.1" y "CH.2" se iluminan. Los contactos de seguridad (13-14/23-24/33-34) están cerrados, el contacto auxiliar (41-42) está abierto.
- Circuito de entrada es abierto (por ej., accionado el pulsador de parada de emergencia):
  Los relés K1 y K2 vuelven a la posición de reposo. Los indicadores de estado "CH.1" y "CH.2" se apagan. Los contactos de seguridad (13-14/23-24/33-34) se abren por redundancia, el contacto auxiliar (41-42) se cierra.

Salida de semiconductor

La salida de semiconductor Y32 conduce, cuando los relés K1 y K2 están en posición activa. Bloquea, cuando los relés están en posición de reposo.

Descrizione del funzionamento

Il dispositivo elettrico PNOZ X3P serve per interrompere in modo sicuro un circuito elettrico di sicurezza. Dopo l'applicazione della tensione di alimentazione si accende il LED «Power». Il dispositivo è pronto per il funzionamento dopo che è stato chiuso il circuito start S13-S14, o dopo che un contatto di start su S33-S34 è stato aperto e nuovamente chiuso.

- Circuito di ingresso chiuso (per es. pulsante di arresto di emergenza non azionato):
  i relè K1 e K2 si attivano automanten-endosi. I LED di stato per «CH.1» e «CH.2» sono accesi. I contatti di sicurezza (13-14/23-24/33-34) sono chiusi, il contatto ausiliario (41-42) è aperto.
- Apertura del circuito di ingresso (per es. in caso di azionamento del pulsante di arresto di emergenza):
  i relè K1 e K2 tornano nella posizione di riposo. I LED di stato per «CH.1» e «CH.2» si spengono. I contatti di sicurezza (13-14/23-24/33-34) vengono aperti in modo ridondante, il contatto ausiliario (41-42) viene chiuso.

Uscita a semiconduttore

L'uscita a semiconduttore Y32 è conducente quando i relè K1 e K2 sono attivati. L'uscita blocca quando i relè sono nella posizione di riposo.

Functiebeschrijving

Het relais type PNOZ X3P dient om een veiligheidscircuit veilig te onderbreken. Na het inschakelen van de voedingsspanning licht de LED „Power" op. Het apparaat is bedrijfsklaar wanneer het startcircuit S13-S14 gesloten is of een startcontact S33-S34 geopend en weer gesloten werd.

- Ingangscircuit gesloten (b.v. noodstopknop niet bediend):
  Relais K1 en K2 worden bekrachtigd en nemen zichzelf over. De status-LED's voor „CH. 1" en „CH. 2" lichten op. De veiligheidscontacten (13-14/23-24/33-34) zijn gesloten, het hulpcontact (41-42) is geopend.
- Ingangscircuit wordt geopend (b.v. noodstopknop bediend):
  Relais K1 en K2 vallen af. De status-LED's voor „CH. 1" en „CH. 2" doven. De veiligheidscontacten (13-14/23-24/33-34) worden redundant geopend, het hulpcontact (41-42) wordt gesloten.

Halfgeleideruitgang

De halfgeleideruitgang Y32 geleidt, als de relais K1 en K2 bekrachtigd zijn. Hij geleidt niet als de relais afgevallen zijn.

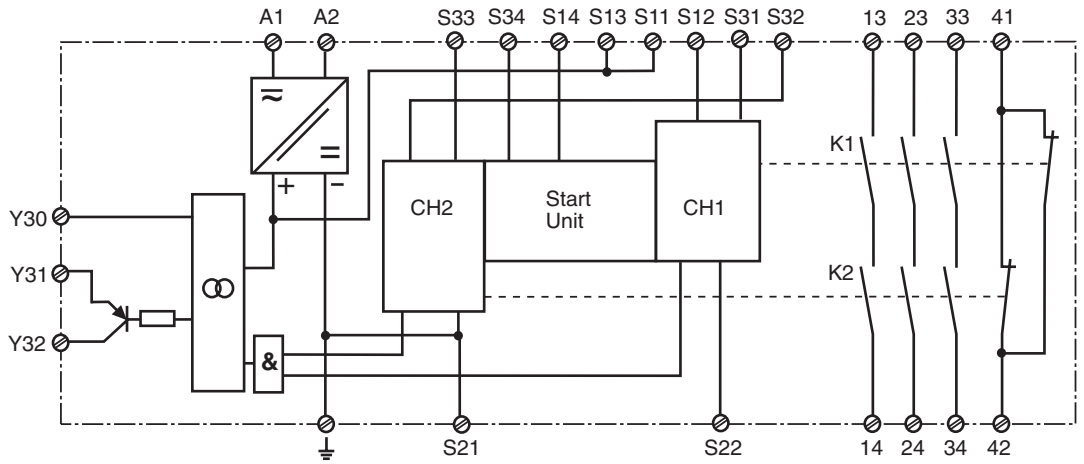


Fig. 1: Esquema de conexiones eléctricas/Schema di collegamento interno/ Intern schema

Modos de funcionamiento:

- Funcionamiento monocanal: Conexión de la entrada según VDE 0113-1 y EN 60204-1, no existe la redundancia en el circuito de entrada, son reconocidos los defectos a tierra en el circuito del pulsador.
- Funcionamiento bicanal: Circuito de entrada redundante, se detectan defectos a tierra en el circuito del pulsador y cortocircuitos transversales entre los contactos del pulsador.
- Rearme automático: El dispositivo se activa tan pronto como se cierra el circuito de entrada.
- Rearme manual con supervisión: El dispositivo se activa, sólo cuando antes del cierre del circuito de entrada, el circuito de rearme es abierto, y cerrado por lo menos 300 ms después del cierre del circuito de entrada.
- Multiplicación y refuerzo de contactos mediante la conexión de contactores externos.

Modalità operative

- Funzionamento monocanale: cablaggio di ingresso secondo VDE 0113-1 e EN 60204-1; senza ridondanza nel circuito di ingresso, le dispersioni verso terra nel circuito del pulsante vengono rilevate.
- Funzionamento bicanale: circuito di ingresso ridondante; vengono rilevate le dispersioni verso terra nel circuito del pulsante, nonché il cortocircuito trasversali tra i contatti del pulsante stesso.
- Start automatico: Il dispositivo è attivo non appena il circuito di ingresso è chiuso.
- Start manuale controllato: il dispositivo è attivo soltanto se prima di chiudere il circuito di ingresso viene aperto il circuito di start e se il circuito di start viene chiuso almeno 300 ms dopo la chiusura del circuito di ingresso.
- Aumento del numero e delle portate dei contatti mediante il collegamento di relè esterni.

Bedrijfsmodi:

- Eenkanalig bedrijf: ingangsschakeling volgens VDE 0113-1 en EN 60204-1, geen redundantie in het ingangscircuit, aardsluitingen in het ingangscircuit worden gedetecteerd.
- Tweekanalig bedrijf: redundant ingangs-circuit, aardsluitingen in het ingangscircuit en onderlinge sluitingen tussen de ingangscontacten worden gedetecteerd.
- Automatische start: apparaat is actief, zodra het ingangscircuit gesloten is.
- Handmatige start met bewaking: apparaat is alleen actief, als vóór het sluiten van het ingangscircuit het startcircuit geopend wordt en minstens 300 ms na het sluiten van het ingangscircuit het startcircuit gesloten wordt.
- Contactvermeerdering en -versterking door aansluiten van externe magneetschakelaars.

Montaje

El dispositivo de seguridad debe montarse en un armario de distribución con un grado de protección de por lo menos IP54. Para fijación sobre una guía normalizada sirve un elemento de enclavamiento en la parte posterior del dispositivo.

Puesta en marcha

Tenga en cuenta durante la puesta en marcha:

- Estado de entrega: Puente entre S11-S12 (circuito de entrada bicanal)
- Solamente los contactos de salida 13-14/ 23-24/33-34 son contactos de seguridad. El contacto de salida 41-42 es un contacto auxiliar (por ej., para indicador).
- **Para evitar contactos soldados por sobrecalentamiento, conectar un fusible (véanse datos técnicos) antes de los contactos de salida.**
- Cálculo de la longitud máxima de línea $I_{máx}$:

$$I_{max} = \frac{R_{lmax}}{R_l / km}$$

$R_{lmáx}$ = resistencia máx. del total de la línea (véanse datos técnicos)
R_l /km = resistencia de línea/km

Ya que la función detección de cortocircuito transversal no es libre de errores, es probada por Pilz en el control final. Una verificación después de la instalación del dispositivo es posible de la siguiente forma:
1º El dispositivo debe estar preparado para funcionar (contactos de salida cerrados).
2º Poner en cortocircuito los bornes de prueba S22-S32 para verificar el cortocircuito transversal.
3º El fusible en el dispositivo se debe disparar y los contactos de salida se abren. Longitudes de línea en el orden de la longitud máxima, pueden retardar el disparo del fusible en hasta 2 minutos.
4º Reponer nuevamente el fusible: retirar el cortocircuito y desconectar la tensión de funcionamiento por aprox. 1 minuto.

- Emplear sólo conductores de cobre con resistencia a la temperatura de 60/75 °C.
- Respetar necesariamente las indicaciones del capítulo “Datos Técnicos”.

Desarrollo:

- Tensión de alimentación:
  Aplicar la tensión de alimentación en los bornes A1 y A2.
- Circuito de rearme:
  - Rearme automático: Puentear S13-S14.
  - Rearme manual con supervisión: Conectar un pulsador entre S33-S34 (S13-S14 abiertos).
- Circuito de entrada:
  - Monocanal: Puentear S21-S22 y S31-S32. Conectar en S11 y S12 el contacto normalmente cerrado del elemento disparador.
  - Bicanal sin detección de cortocircuito transversal: Puentear S21-S22. Conectar el contacto normalmente cerrado del elemento disparador en S11-S12 y S11-S32.
  - Bicanal con detección de cortocircuito transversal: Puentear S11-S12. Conectar el contacto normalmente cerrado del elemento disparador en S21-S22 y S31-S32.

Montaggio

Il dispsositivo di sicurezza deve essere montato in un armadio elettrico con un grado di protezione di min. IP54. Per il fissaggio su una guida DIN è previsto un elemento di blocco sul lato posteriore del dispositivo.

Messa in funzione

Per la messa in funzione rispettare quanto segue:

- Stato alla consegna: ponticello tra S11-S12 (circuito di ingresso bicanale)
- Solo i contatti di uscita 13-14/23-24/33-34 sono dei contatti di sicurezza. Il contatto di uscita 41-42 è un contatto ausiliario (per es. per segnalazione).
- **A monte dei contatti di uscita si deve collegare un fusibile (v. Dati Tecnici) per impedire la saldatura tra i contatti stessi.**
- Calcolo lunghezza massima del conduttore I_{max}:

$$I_{max} = \frac{R_{lmax}}{R_l / km}$$

R_{lmax} = resistenza max. totale del conduttore (v. Dati tecnici)
R_l /km = resistenza del conduttore/km

Poiché la funzione di rilevamento del cortocircuito non è protetto da errori, esso viene controllata dalla Pilz durante il collaudo finale. Una verifica dopo l’installazione del dispositivo può essere eseguita nel modo seguente:
1. Dispositivo pronto per il funzionamento (contatti di uscita chiusi)
2. Cortocircuitare i morsetti di test S22-S32 per il controllo dei cortocircuiti.
3. Il fusibile nel dispositivo deve scattare ed i contatti di uscita si devono aprire. I cavi di massima lunghezza possono ritardare la commutazione del fusibile fino a 2 minuti.
4. Ripristinare il fusibile: eliminare il cortocircuito e disinserire per ca. 1 min la tensione di alimentazione.

- Usare conduttori di rame con una resistenza termica di 60/75 °C.
- Rispettare assolutamente le indicazioni riportate nel capitolo «Dati tecnici».

Procedura:

- Tensione di alimentazione:
  Applicare la tensione di alimentazione ai morsetti A1 e A2.
- Circuito di start:
  - Start automatico: ponticellare S13-S14.
  - Start manuale controllato: collegare il pulsante a S33-S34 (S13-S14 aperto)
- Circuito di ingresso:
  - Monocanale: ponticellare S21-S22 e S31-S32. Collegare il contatto NC a S11 e S12.
  - Bicanale senza rilevamento del cortocircuito trasversale: ponticellare S21-S22. Collegare il contatto NC a S11-S12 e S11-S32.
  - Bicanale con rilevamento cortocircuito trasversale: ponticellare S11-S12. Collegare il contatto NC a S21-S22 e S31-S32.

Montage

Het veiligheidsrelais moet ingebouwd worden in een schakelkast die minimaal voldoet aan beschermingsgraad IP54. Bevestiging op een DIN-rail is mogelijk via de daarvoor bestemde relaisvoet op de achterzijde van het apparaat.

Ingebruikname

Neemt u bij ingebruikname het volgende in acht:

- Toestand bij levering: brug tussen S11-S12 (tweekanalig ingangscircuit)
- Alleen de uitgangscontacten 13-14/23-24/ 33-34 zijn veiligheidscontacten. Uitgangscontact 41-42 is een hulpcontact (b.v. voor signalering).
- **Uitgangscontacten afzekeren (zie technische gegevens) om het verkleven van de contacten te voorkomen.**
- Berekening van de max. kabellengte I_{max}:

$$I_{max} = \frac{R_{lmax}}{R_l / km}$$

R_{lmax} = max. weerstand totale kabel (zie technische gegevens)
R_l /km = kabelweerstand/km

Omdat de functie detectie van onderlinge sluiting niet enkelfoutveilig is, wordt deze door Pilz tijdens de eindcontrole getest. Een controle na de installatie van het apparaat is als volgt mogelijk:
1. Apparaat bedrijfsklaar (uitgangscontacten gesloten)
2. De testklemmen S22-S32 kortsluiten om de detectie van onderlinge sluiting te testen.
3. De zekering in het apparaat moet geactiveerd worden en de uitgangscontacten moeten opengaan. Kabellengten van ongeveer de maximale lengte kunnen het activeren van de zekering met max. 2 minuten vertragen.
4. Zekering resetten: de kortsluiting ongedaan maken en de voedingsspanning voor ca. 1 minuut uitschakelen.

- Kabelmateriaal uit koperdraad met een temperatuurbestendigheid van 60/75 °C gebruiken.
- Aanwijzingen in het hoofdstuk “Technische gegevens” beslist opvolgen.

Instelprocedure:

- Voedingsspanning:
  voedingsspanning op klemmen A1 en A2 aansluiten.
- Startcircuit:
  - Automatische start: S13-S14 verbinden.
  - Handmatige start met bewaking: knop op S33-S34 aansluiten (S13-S14 open).
- Ingangscircuit:
  - Eenkanalig: S21 met S22 en S31 met S32 verbinden. Verbreekcontact van bedieningsorgaan op S11 en S12 aansluiten.
  - Tweekanalig zonder detectie van onderlinge sluiting: S21-S22 verbinden. Verbreekcontact van bedieningsorgaan op S11-S12 en S11-S32 aansluiten.
  - Tweekanalig met detectie van onderlinge sluiting: S11-S12 verbinden. Verbreekcontact van bedieningsorgaan op S21-S22 en S31-S32 aansluiten.

- Circuito de realimentación: Conectar contactores externos en serie al circuito de rearme S13-S14 o S33-S34.
- Tensión de alimentación de 24 V para la salida de semicond.: Conectar +24 V DC en el borne Y31 y 0 V en el borne Y30.

Los contactos de seguridad se activan (cerrados) y el contacto auxiliar 41-42 se abre. Se iluminan los indicadores de estado para “CH.1”, “CH. 2”. El dispositivo está listo para funcionar. Al abrirse el circuito de entrada, se abren los contactos de seguridad 13-14/23-24/33-34 y se cierra el contacto auxiliar 41-42. El indicador de estado se apaga.

Reactivación

- Cerrar el circuito de entrada.
- En caso de rearme man. con supervisión, accionar el pulsador entre S33 y S34.

Los indicadores de estado se iluminan nuevamente y se activa el circuito de entrada.

- Circuito di retroazione: Collegare in serie i relè esterni al circuito di start S13-S14 o S33-S34.
- Tensione di alimentazione di 24 V per l’uscita a semiconduttore: Collegare +24 V DC al morsetto Y31 e 0 V al morsetto Y30.

I contatti di sicurezza sono attivati (chiusi) ed il contatto ausiliario 41-42 è aperto. I LED di stato per «CH.1», «CH. 2» sono accesi. Il dispositivo è pronto per il funzionamento. Se viene aperto il circuito di ingresso i contatti di sicurezza 13-14/23-24/33-34 si aprono ed il contatto ausiliare 41-42 si chiude. Il LED di stato si spegne.

Riattivazione

- Chiudere il circuito di ingresso.
- In caso di start manuale controllato, azionare il pulsante tra S33 e S34.

I LED di stato si riaccendono ed il circuito di ingresso è attivato.

- Terugkoppelcircuit: Verbreekcontacten van externe magneetschakelaars in serie met het startcircuit S13-S14 dan wel S33-S34 aansluiten.
- 24 V voedingsspanning voor halfgeleideruitgang: +24 V DC op klem Y31 en 0 V op klem Y30 aansluiten.

De veiligheidscontacten zijn geactiveerd (gesloten) en het hulpcontact 41-42 is geopend. De status-LED’s voor „CH.1“, “CH. 2" lichten op. Het apparaat is bedrijfsklaar. Als het ingangscircuit geopend wordt, gaan de veiligheidscontacten 13-14/23-24/33-34 open en het hulpcontact 41-42 sluit. De status-LED’s doven.

Opnieuw activeren

- Ingangscircuit sluiten.
- Bij handmatige start met bewaking de knop tussen S33 en S34 bedienen.

De status-LED’s lichten weer op, het ingangscircuit is geactiveerd.

Aplicación

En las Fig. 2 ... a Fig. 11 se presentan ejemplos de conexión para modo de conexión de parada de emergencia con rearme automático y manual, control de puerta protectora así como multiplicación de contactos mediante contactores externos.
Por favor tenga en cuenta:

- Fig. 2 y 7: **no hay** conexión S33-S34
  Tenga en cuenta: En caso de caida de tensión y rearranque, el dispositivo se inicia automáticamente. Evite un arranque intempestivo mediante un cableado externo adecuado.
- Fig. 3, 4, 5, 6, 8:
  no hay conexión S13-S14
- Fig. 7: Rearme automático para el control de puerta protectora: El dispositivo está preparado para rearmarse con la puerta de protección abierta por medio del circuito de rearme S13-S14. Después de cerrarse los circuitos de entrada S11-S12, S21-S22 y S31-S32 se cerrarán los contactos de seguridad.

Uso

In Fig. 2 ... Fig. 11 sono riportati degli esempi di collegamento per il cablaggio dell’arresto di emergenza con start automatico e controllato, peril controllo finecorsa di ripari mobili, nonché per l’aumento del numero dei contatti mediante relè esterni.
Nota bene:

- Fig. 2 e 7: **nessun** collegamento S33-S34
  Il dispositivo si avvia automaticamente dopo la caduta ed il ritorno dell’alimentazione. Occorre prevenire un riavvio inatteso usando circuiti esterni di misura
- Fig. 3, 4, 5, 6, 8:
  nessun collegamento S13-S14
- Fig. 7: start automatico per controllo ripari mobili: Con riparo mobile aperto, il dispositivo è pronto per lo start attraverso il circuito di start S13-S14. Dopo la chiusura dei circuiti di ingresso S11-S12, S21-S22 e S31-S32 i contatti di sicurezza vengono chiusi.

Toepassing

In fig. 2 ... fig. 11 worden aansluitvoorbeelden gegeven van noodstopschakeling met automatische en bewaakte start, hekbewaking en contactvermeerdering door middel van externe magneetschakelaars.
Let u a.u.b. op het volgende:

- Fig. 2 en 7: **geen** verbinding S33-S34
  Het apparaat start automatisch bij uitvallen en terugkeren van de spanning. Vermijd een onverwacht heraanlopen door maatregelen in de externe schakeling.
- Fig. 3, 4, 5, 6, 8:
  geen verbinding S13-S14
- Fig. 7: Automatische start bij hekbewaking: Het apparaat is bij geopend hek via het startcircuit S13-S14 startklaar. Na sluiten van de ingangscircuits S11-S12, S21-S22 en S31-S32 worden de veiligheidscontacten gesloten.

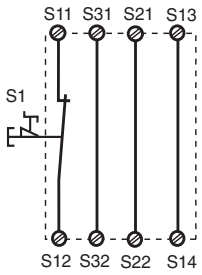


Fig. 2: Circuito de entrada monocanal, rearme automático/Circuito di ingresso monocanale, start automatico/Eenkanalig ingangscircuit, automatische start

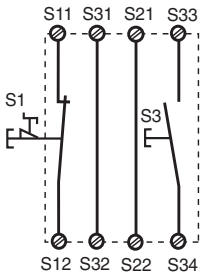


Fig. 3: Circuito de entrada monocanal, rearme supervisado/Circuito di ingresso monocanale, start controllato/Eenkanalig ingangscircuit, bewaakte start

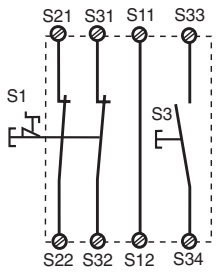


Fig.4: Circuito de entrada bicanal, rearme supervisado/Circuito di ingresso bicanale, start controllato/Tweekanalig ingangscircuit, bewaakte start

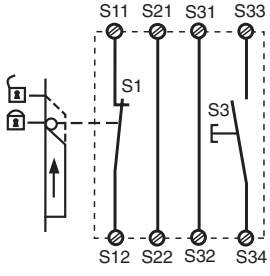


Fig. 5: Control de puerta protectora monocanal, rearme supervisado/Controllo monocanale riparo mobile, start controllato/Eenkanalige hekbewaking, bewaakte start

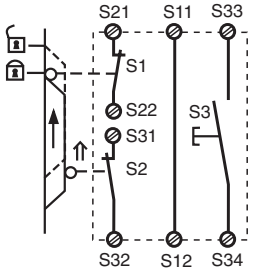


Fig. 6: Control de puerta protectora bicanal, rearme supervisado/Controllo bicanale riparo mobile, start controllato/ Tweekanalige hekbewaking, bewaakte start

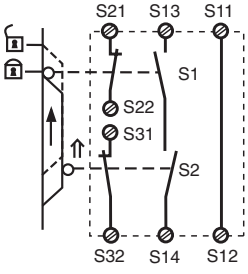


Fig. 7: Control de puerta protectora bicanal, rearme automático/Controllo bicanale riparo mobile, start automatico/ Tweekanalige hekbewaking, automatische start

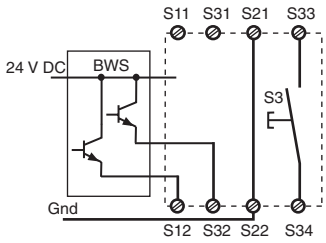


Fig. 8: Control de barrera fotoeléctrica, bicanal, detección de corto circuito transversal mediante BWS, rearme supervisado/Controllo barriera fotoelettrica, bicanale, rilevamento del cortocircuito trasversale mediante fotocellula, start controllato/Tweekanalige lichtschermbewaking, detectie van onderlinge sluiting door lichtscherm, bewaakte start

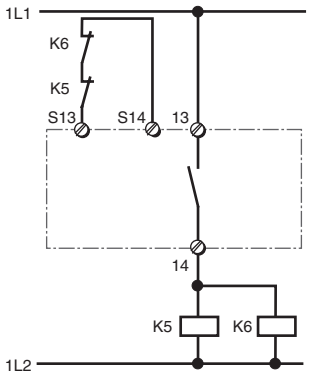


Fig. 9: Ejemplo de conexión para contactores externos, monocanal, rearme automático/Esempio di collegamento per relè esterni, monocanale, start automatico/Aansluitvoorbeeld van externe magneetschakelaars, eenkanalig, automatische start

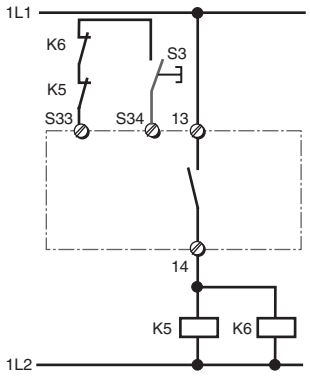


Fig.10: como la Fig. 9 con rearme supervisado/come Fig. 9 con start controllato/zoals fig. 9 met bewaakte start

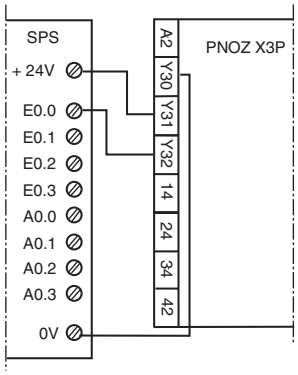


Fig. 11: Ejemplo de conexión para salida de semiconductor/Esempio di collegamento per uscita a semiconduttore/Aansluitvoorbeeld van halfgeleideruitgang

Elemento accionado/Elemento azionato/Bekrachtigd element

Puerta abierta/riparo aperto/Hek open

Puerta cerrada/riparo chiuso/Hek gesloten

S1/S2: Interruptor de parada de emergencia o de puerta protectora/Pulsante di arresto di emergenza o finecorsa riparo mobile/Noodstop- of hekschakelaar

S3: Pulsador de rearme/Pulsante di start/Startknop

Defectos - Averías

- Cortocircuito en el circuito de entrada: La tensión de alimentación cae y los contactos de seguridad se abren a través de un fusible electrónico. Una vez haya desaparecido la causa del error y se haya desconectado la tensión de alimentación durante aprox. 1 minuto, el dispositivo volverá a estar listo para el servicio.
- Funcionamiento defectuoso de los contactos: En contactos soldados por sobrecalentamiento no es posible reactivar el dispositivo después de abrirse el circuito de entrada.
- No está encendido el LED “Power”: Cortocircuito o falta la tensión de alimentación.

Errori - guasti

- Cortocircuito nel circuito d’ingresso: Un fusibile elettronico interrompe l’alimentazione ed i contatti di sicurezza si aprono. Una volta rimosso la causa del gausto e interrotto la tensione di alimentazione, il dispositivo sarà pronto al funzionamento dopo circa un minuto.
- Malfunzionamenti dei contatti: In caso di contatti saldati tra loro, non è possibile la riattivazione dopo l’apertura del circuito di ingresso.
- Il LED «Power» non si accende: cortocircuito o mancanza della tensione di alimentazione.

Fouten - Storingen

- Kortsluiting in het ingangscircuit: De voedingsspanning valt uit en de veiligheidscontacten worden via een elektronische zekering geopend. Na het wegvallen van de storingsoorzaak en het uitschakelen van de bedrijfsspanning voor ca. 1 minuut is het apparaat weer bedrijfsklaar.
- Contactfout: bij verkleefde contacten is na openen van het ingangscircuit geen nieuwe activering mogelijk.
- LED „Power“ licht niet op: kortsluiting of voedingsspanning ontbreekt.

Datos técnicos / Dati tecnici / Technische gegevens

Tensión de funcionamiento U_B/Tensione di alimentazione U_B/Voedingsspanning U_B	24 - 240 V AC/DC
Tolerancia de tensión/Tolleranza di tensione/Spanningstolerantie	-15 ... +10 %
Consumo de energía con U_B/Potenza assorbita con U_B/Opgenomen vermogen bij U_B	U_B DC: 2,5 W U_B AC: 5,0 VA
Rango de frequencia/Gamma di frequenza/Frequentiebereik	50 ... 60 Hz
Tensiòn y corriente en/Tensione e corrente su/Spanning en stroom op	
Circuito de entrada/Circuito di entrata/Ingangscircuit	U_B = 24 V DC: 30 mA
Circuito de rearme/Circuito di start/startcircuit	U_B = 24 V DC: 50 mA
Circuito de realimentaciòn/Circuito di retroazione/Terugkoppelcircuit	U_B = 24 V DC: 20 mA
Contactos de salida según EN 954-1/Contatti di uscita secondo EN 954-1/ Uitgangscontacten volgens EN 954-1	
Contactos de seguridad (N.A.), categoría 4/contatti di sicurezza (NA), categoria 4/ veiligheidscontacten (M), categorie 4	3
Contactos auxiliares (N.C.)/contatti ausiliari (NC)/hulpcontacten (V)	1
Categória de uso según/Categoria d' uso secondo/Gebruikscategorie volgens	
EN 60947-4-1	
AC1: 240 V	I_{min}: 0,01 A, I_{max}: 8,0 A, P_{max}: 2000 VA
DC 1: 24 V	I_{min}: 0,01 A, I_{max}: 8,0 A, P_{max}: 200 W
EN 60947-5-1	
AC 15: 230 V	I_{max}: 5,0 A
DC13 (6 ciclos/Min, 6 cicli di commutazione/min, 6 schakelingen/min): 24 V	I_{max}: 6,0 A
Materiál de contactos/materiale di contatto/Contactmateriaal	$AgSnO_2$+ 0,2 µm Au
Protección contactos externos/Protezione esterna dei contatti/Contactafzekering extern EN 60 947-5-1	
Fusible/Fusibile/Smeltzekering	10 A de acción rápida/rapido/snel ó/o/of 6 A de acción lenta/ritardato/traag
Fusible automático/Interuttore automatico/Zekeringautomaat	24 V AC/DC: 6 A Característica / Caratteristica/Karakteristiek B/C
Salida de semiconductor (resistente a cortocircuitos)/Uscite a semiconduttore (protette da corto circuito)/Halfgeleideruitgangen (kortsluitvast)	24 V DC, 20 mA
Alimentación de tensión externa/Alimentazione tensione esterna/Externe voedingsspanning	24 V DC
Tolerancia de la tensión de alimentatión/Tolleranza di alimentatzione/Spanningstolerantie	-20 % / +20 %
Resistencia de línea total max. R_{lmax} circuitos de entrada/Mass. resistenza cavo totale R_{lmax} circuito di ingresso/Max. weerstand totale kabel R_{lmax} ingangscircuits	
monocanal DC/canale singolo DC/eenkanalig DC	200 Ohm
monocanal AC/canale singolo AC/eenkanalig AC	200 Ohm
bicanal con detección de cortocircuitos DC/bicanale con riconoscimento di cortocircuito traversale DC/tweekanalig met detectie van onderlinge sluiting DC	30 Ohm
bicanal con detección de cortocircuitos AC/bicanale con riconoscimento di cortocircuito traversale AC/tweekanalig met detectie van onderlinge sluiting AC	30 Ohm
bicanal sin detección de cortocircuitos DC / bicanale senza riconoscimento di cortocircuito traversale DC/tweekanalig zonder detectie van onderlinge sluiting DC	400 Ohm
bicanal sin detección de cortocircuitos AC/bicanale senza riconoscimento di cortocircuito traversale AC/tweekanalig zonder detectie van onderlinge sluiting AC	400 Ohm
Retardo de la connexión/Ritardo dell' azionamento/Aantrekvertraging; U_B = 24 V AC/DC	
Rearme automático/Start automatico/Automatische start	typ. 330 ms, max. 450 ms
Rearme automático tras conexión de red/Start automatico dopo attivazione dell'alimentazione di rete/Automatische start na netinschakeling	typ. 750 ms, max. 1.000 ms
Rearme supervisado/Start controllato/Bewaakte start	typ. 35 ms, max. 50 ms
Retardo a la desconexión/Ritardo di sgancio/Afvalvertraging	
En parada de emergencia/In caso di arresto di emergenza/Bij noodstop	typ.: 15 ms, max.: 30 ms
En fallo de la red/In caso di mancanza di tensione/Bij uitvallen spanning U_B = 24 V AC/DC	typ.: 150 ms, max.: 180 ms
En fallo de la red/In caso di mancanza di tensione/Bij uitvallen spanning U_B = 240 V AC/DC	typ.: 1.500 ms, max.: 2.200 ms
Tiempo de recuperación con la frecuencia máxima de 1/s / Tempo di ripristino par frequenza di commutazione max. 1/s / Resettijd bij max. schakelfrequentie 1/s	
Después de una parada de emergencia/dopo un arresto di emergenza/Na noodstop	50 ms
Después de un fallo de la red /Dopo una mancanza di tensione/Na uitvallen van de spanning U_B = 24 V DC	200 ms
Después de un fallo de la red /Dopo una mancanza di tensione/Na uitvallen van de spanning U_B = 240 V AC	2.250 ms
Simultaneidad canal 1 y 2/Simultaneità canale 1 e 2/Gelijktijdigheit kanaal 1 en 2	∞
Tiempo de espera en caso de rearme supervisado/Intervallo di attesa in caso di start controllato/Wachttijd bej bewaakte start	200 ms
Duración mínima de la senal de arranque con arranque supervisado/Durata minima impulso di start con start controllato/Min. startpulsduur bij bewaakte start	30 ms
Immunidad a cortes de tensión/Cavallottamento durante le cadute die tensione/Overbrugging bij spanningstortingen	20 ms
CEM/Compatibilità elettromagnetica/EMC	EN 60947-5-1, EN 61000-6-2 / -6-3
Oscillaciones según/Vibrazioni secondo norma/Trillingen volgens EN 60068-2-6	Frecuencia/Frequ./Frequentie:10-55Hz Amplitud/Ampiezza/Amplitude: 0,35 mm
Condiciones climáticas/Sollecitazione climatica/Klimaacondities	EN 60068-2-78
Distancias de fuga y dispersión superficial/Intraferri d'aria e vie di dispersione/Lucht- en kruipwegen	VDE 0110-1

Temperatura ambiente/Temperatura ambiete/Omgevingstemperatuur	-20 ... +55 °C
Temperatura de almacenaje/Temperatura di magazzinaggio/Opslagtemperatuur	-40 ... +85 °C
Tipo de protección/Tipi di protezione/Veiligheidsklasse	
Lugar de montaje (p.e. armario de distribución)/Spazio di montaggio (p.e. quadro elettrico ad armadio)/Inbouwruimte (bijv. schakelast)	IP54
Carcassa/Alloggiamento/Kast	IP40
Zona de bornes/Terminali/Aansuitklemmen	IP20
Material de carcassa/materiale della custodia/Behuizingsmateriaal	
Carcassa/Alloggiamento/Behuizing	PPO UL 94 V0
Frente/Fronte/Front	ABS UL 94 V0
Seccion max. del conductor externo (bornes de tornillo)/Sezione max. del cavo esterno (morsetti a vite)/Max. doorsnede van de aansluitkabels (schroefklemmen)	
1 conductor flexible/1 conduttore flessibile/1 draad, flexibel	0,25 ... 2,5 mm^2
2 conductores de misma sección, flexible con terminal: sin revestimiento de plástico / 2 conduttori con lo stesso diametro, flessibile con capocorda senza manicotto di plastica/ 2 draaden mad dezelfde doorsnede, flexibel met adereindhuls zonder kunststoffhuls	0,25 ... 1 mm^2
flexible sin terminal o con terminal TWIN/flessibile senza capocorda o con capocorda TWIN/Flexibel zonder adereindhuls of met TWIN-Adereindhuls	0,2 ... 1,5 mm^2
Seccion max. del conductor externo (bornes de resorte)/Sezione max. del cavo esterno (morsetti a molla)/Max. doorsnede van de aansluitkabels (veerklemmen) flexible sin terminal/flessibile senza capocorda/flexibel zonder adereindhuls	0,2 ... 1,5 mm^2
Carcassa con bornes enchufables de resorte/Custodia con morsetti estraibili a molla/ Behuizing met steekbare veerklemmen	
Longitud para la eleminacion del aislamiento/Distanza di spelatura/striplengte	8 mm
Número de bornes por connector/Blocchi morsetti per collegamento/ Aansluitklemmen per aansluiting	2
Par de apriete para los bornes de tornillo/Coppia di serraggio per morsetti a vite/ Aanhaalmoment voor schoefklemmen	0,5 Nm
Dimensiones (bornes de tornillo) Al x An x Pr/Misure (morsetti a vite) altezza x larghezza x profondità/Afmetingen (schroefklemmen) h x b d	94 x 45 x 121 mm (3.70" x 1.77" x 4.76")
Dimensiones (bornes de resorte) Al x An x Pr/Misure (morsetti a molla) altezza x larghezza x profondità/Afmetingen (veerklemmen) h x b d	101 x 45 x 121 mm (3.98" x 1.77" x 4.76")
Posición de montaje/Posizione di montaggio/Inbouwpositie	cualquiera/a scelta/willekeurig
Peso/Peso/gewicht	310 g

Son válidas las versiones actuales de las normas 11/03.

Per le norme citate, sono applicate le versioi in vigore a 11/03.

Van toepassing zijn de in 11/03 actuele versies van de normen.

Corriente máxima permanente en carga simultanea de varios contactos/Corrente permanente max. con carico simultaneo di più contatti/Max. duurstroom bij gelijktijdige belasting van meerdere contacten (AC1, DC1)

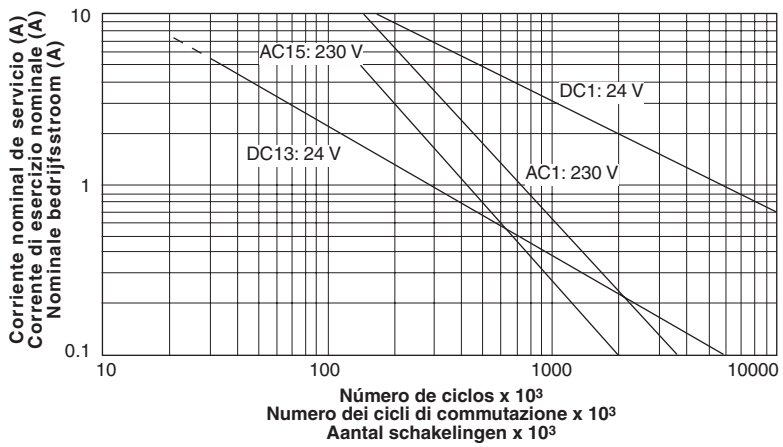
Número de contactos/Numero dei contatti/Aantal contacten	3	2	1
Imax (A) por contacto en tensión de alimentación AC/ per contatto con corrente AC/per contact bij een AC voedingsspanning	6,0	7,0	8,0
Imax (A) por contacto en tensión de alimentación DC/ per contatto con corrente DC/per contact bij een DC voedingsspanning	6,0	7,0	8,0

Para evitar una falla de los dispositivos, se debe procurar una suficiente extinción de chispas en todos los contactos de salida. En cargas capacitivas se deben tener en cuenta los picos de corriente. Con contactores de DC, utilizar diodos de marcha libre para la extinción de chispas, para aumentar la vida útil de los contactores.

Per impedire l'avaria dei dispositivi, assicu-rare su tutti i contatti di uscita un sufficiente spegnimento della scintilla. Per i carichi ca-pacitivi, rispettare gli eventuali picchi di cor-rente. Per i relè DC, utilizzare diodi auto-scillanti per lo spegnimento della scintilla per aumentare la durata dei relè stessi.

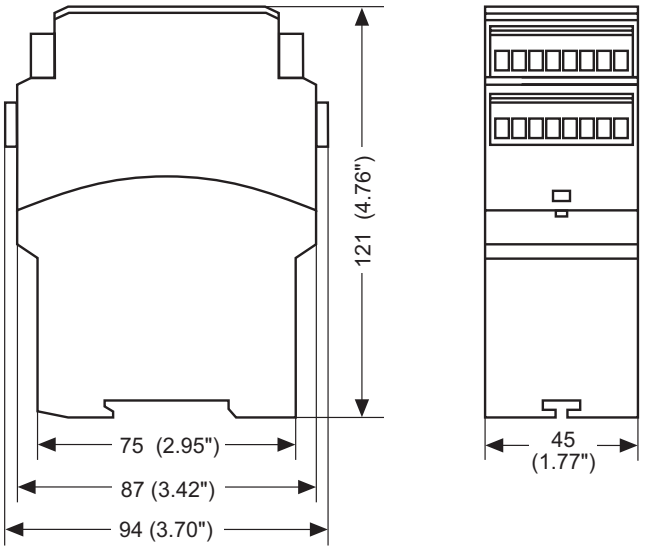
Om een falen van de relais te verhinderen, moet aan alle uitgangscontacten voor een adequate vonkblussing gezorgd worden. Bij capacitieve belasting dienen eventueel op-tredende stroompieken vermeden te wor-den. Bij DC-magneetschakelaars vrijloopdioden voor vonkblussing gebruiken om de levensduur van de magneetschakelaars te verlengen.

Vida útil de los relés de salida/Durata dei relè di uscita/Levensduur van de uitgangsrelais

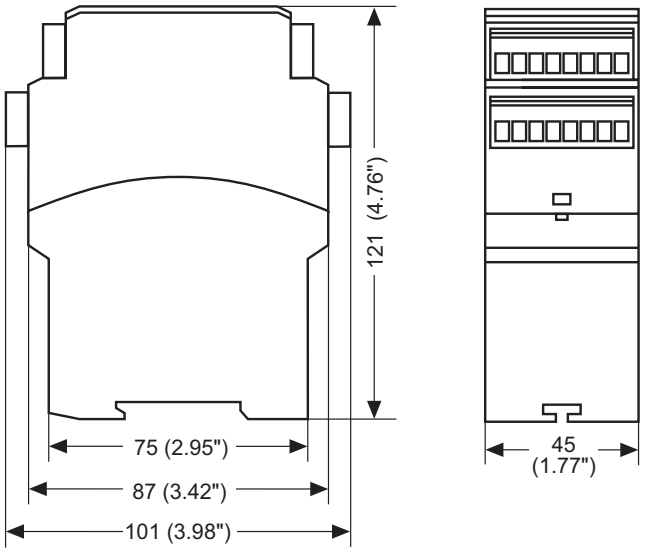


Dimensiones en mm (")/**Dimensioni** in mm (")/**Afmetingen** in mm (")

Carcasa con bornes de tornillo enchufables/
Custodia con morsetti estraibili a vite/
Behuizing met steekbare schroefklemmen/



Carcasa con bornes enchufables de resorte/
Custodia con morsetti estraibili a molla/
Behuizing met steekbare veerklemmen/



Extraer las bornas enchufables

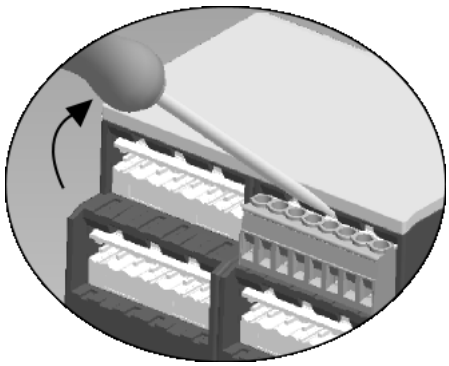
Colocar un destornillador en el hueco de la carcasa tras la borna y hacer palanca:
¡ **No** tirar de las bornas por el cable !

Rimozione dei morsetti estraibili

Inserire il cacciavite nell'incavo dietro il connettore e fare leva:
Non estrarre il connettore tirandolo per i cavi!

Steekbare klemmen uitnemen

Plaats de schroevendraaier in de uitsparing achter de klemmen en druk de klemmen naar buiten. De klemmen verwijderen door aan de kabels te trekken!



Ejemplo de extracción en una borna de tornillo

Esempio di come estrarre un connettore usando un cacciavite

Als voorbeeld ziet u het verwijderen van schroefklemmen.

▶ A Pilz Ges.m.b.H., ✆ 01 7986263-0, Fax: 01 7986264 ▶ AUS Pilz Australia, ✆ 03 95446300, Fax: 03 95446311 ▶ B ▶ L Pilz Belgium, ✆ 09 3217570, Fax: 09 3217571 ▶ BR Pilz do Brasil, ✆ 11 4337-1241, Fax: 11 4337-1242 ▶ CH Pilz Industrieelektronik GmbH, ✆ 062 88979-30, Fax: 062 88979-40 ▶ DK Pilz Skandinavien K/S, ✆ 74436332, Fax: 74436342 ▶ E Pilz Industrieelektronik S.L., ✆ 938497433, Fax: 938497544 ▶ F Pilz France Electronic, ✆ 03 88104000, Fax: 03 88108000 ▶ FIN Pilz Skandinavien K/S, ✆ 09 27093700, Fax: 09 27093709 ▶ GB Pilz Automation Technology, ✆ 01536 460766, Fax: 01536 460866 ▶ I Pilz Italia Srl, ✆ 031 789511, Fax: 031 789555 ▶ IRL Pilz Ireland Industrial Automation, ✆ 021 4346535, Fax: 021 4804994 ▶ J Pilz Japan Co., Ltd., ✆ 045 471-2281, Fax: 045 471-2283 ▶ MEX Pilz de Mexico, S. de R.L. de C.V., ✆ 55 5572 1300, Fax: 55 5572 4194 ▶ NL Pilz Nederland, ✆ 0347 320477, Fax: 0347 320485 ▶ NZ Pilz New Zealand, ✆ 09- 6345-350, Fax: 09-6345-352 ▶ P Pilz Industrieelektronik S.L., ✆ 229407594, Fax: 229407595 ▶ PRC Pilz China Representative Office, ✆ 021 62494658, Fax: 021 62491300 ▶ ROK Pilz Korea, ✆ 031 8159541, Fax: 031 8159542 ▶ SE Pilz Skandinavien K/S, ✆ 0300 13990, Fax: 0300 30740 ▶ TR Pilz Elektronik Güvenlik Ürünleri ve Hizmetleri Tic. Ltd. Şti., ✆ 0224 2360180, Fax: 0224 2360184 ▶ USA Pilz Automation Safety L.P., ✆ 734 354-0272, Fax: 734 354-3355 ▶ WWW www.pilz.com

▶ D Pilz GmbH & Co. KG, Sichere Automation, Felix-Wankel-Straße 2, 73760 Ostfildern, Deutschland, ✆ +49 711 3409-0, Fax: +49 711 3409-133, E-Mail: pilz.gmbh@pilz.de

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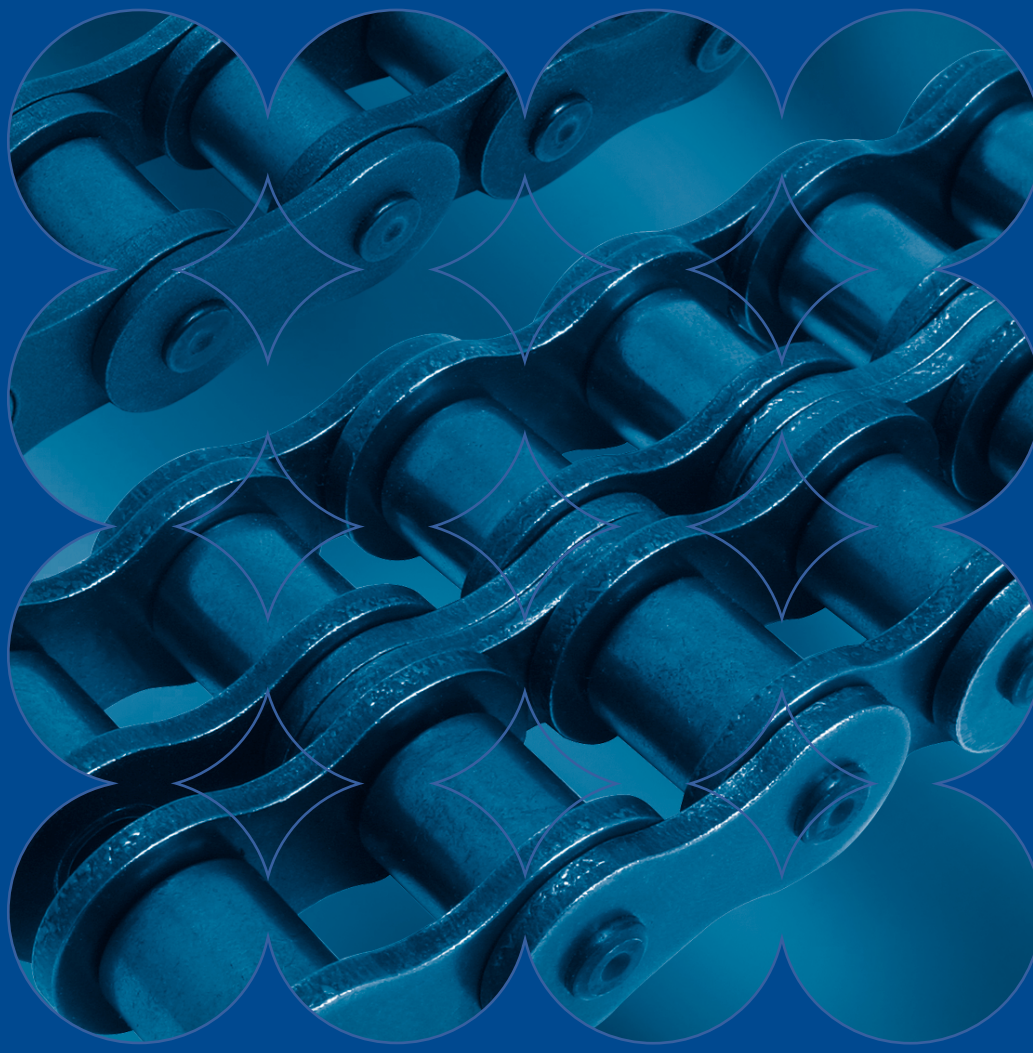
Roller chain catalogue



RENOLD

Superior Chain Technology

www.renold.com

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SECTION 2

CHAIN INSTALLATION & MAINTENANCE

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WARNING

HEALTH AND SAFETY WARNING

The following precautions must be taken before disconnecting and removing a chain from a system prior to replacement.

1. **Always isolate the power source from the drive or equipment.**
2. **Always wear safety glasses.**
3. **Always wear appropriate protective clothing, hats, gloves and safety shoes as warranted by the circumstances.**
4. **Always ensure tools are in good working condition and used in the proper manner.**
5. **Always loosen tensioning devices.**
6. **Always support the chain to avoid sudden unexpected movement of chain or components.**
7. **Never attempt to disconnect or reconnect a chain unless the chain construction is fully understood.**
8. **Always ensure that directions for the correct use of any tools are followed.**
9. **Never reuse individual components.**
10. **Never reuse a damaged chain or chain part.**

N.B. Breach of these practices could result in serious injury or death.

Chain Installation and Maintenance

Introduction

Renold Chain has over 100 years' experience in the operation and maintenance of transmission chain. Involvement with designers, manufacturers and users of all types of equipment has enabled Renold to develop this definitive guide, designed to pass on the preferred methods of correct handling, adjustment, installation and maintenance of transmission chain drives resulting in maximum chain life.

Should you require any further information, please contact our technical sales staff.

Equipment Needed

The breaking of chain can be achieved by using a Renold Chain Extractor, these being:-

- 311015 for light industrial chains up to 0.5" pitch.
- 10101 for chains from 0.375" to 0.625" pitch
- 10102 for chains from 0.75" to 1.25" pitch

For joining any chain up to 2.5" pitch, a drift punch will be required.

Erection of medium or heavy chain drives requires millwrighting equipment such as lifting tackle, slings, wedges, packing, etc.

OTHER USEFUL EQUIPMENT
Quantity of inner and outer links.
Straight edges and/or strong, fine line.
Spirit level.
Plumb line.
Selection of hammers, files, key blanks, etc.

Preparation

Check equipment to ensure that general transmission requirements are correct (e.g. flexible couplings, flywheel, means of drive adjustment).

Check condition and rigidity of the shafts and bearings, particularly if there has been considerable previous service with an alternative method of transmission. Replace or rectify if necessary.

Driver and driven shafts should be checked to ensure they are level and parallel to each other. This applies equally to the jockey shaft if present.

Use a spirit level and adjustable comparator bar or micrometer between shafts at extreme points on each side of the drive. Rectify any parallelism error present and mark a permanent datum line for the adjustable shaft.

Place sprockets or respective shafts in approximate alignment and fit the keys in accordance with correct engineering practice. Do not finally secure keys at this stage.

Care must be taken with sprockets of split design to ensure perfect abutting of the faces of each half. Proceed with the key fitting after the halves are finally bolted together, otherwise the key can prevent correct assembly and subsequently result in malgearing.

It should be verified that key heads will not project beyond the width of any chaincases.

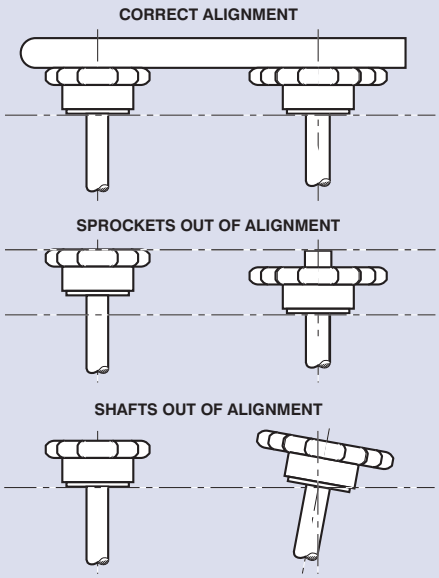
Checking Sprocket Alignment

Accurate alignment of shafts and sprocket tooth faces provides a uniform distribution of load across the entire chain width and contributes substantially to maximum drive life.

Use a straight edge across the machined faces of the sprockets in several different positions, if possible, as a check against wobble. A nylon or similar line is a good substitute for a straight edge particularly on longer centre distances.

Should endwise "float" of shafts be present, make due allowance so that sprocket alignment is correct at the mid position of "float".

When alignment is correct within closest practical limits, drive the keys home and take a final check on sprocket alignment.



IMPORTANT NOTE

Sprockets should always be designed to be as close to the supporting bearings as possible.

Installation of Chain

Renold Chain should not be assembled on the sprockets until attention has been paid to:

1. Cleanliness of the sprocket teeth, particularly if debris of an abrasive nature (cement dust, weld spatter, etc.), has been prevalent whilst work was in progress.

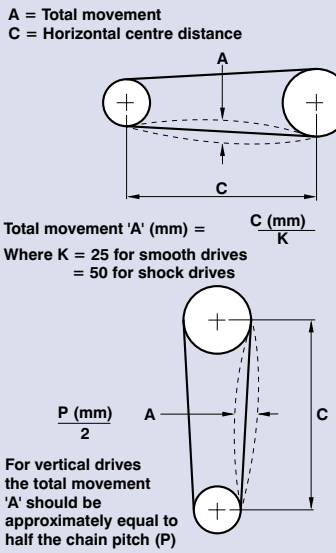
2. Temporary positioning of the lower section of a chaincase if present. In restricted spaces, manoeuvering of large sections is often simplified by using the spaces between shafts which will later be occupied by the chain.

Ensure the chain is clean and free from debris and place around the sprockets, observing instructions where matched strands are involved. In chain of two or more strands, joining is most easily accomplished at the mid span of the drive, drawing the chain ends together with a chain clamp or rope tackle block. Ensure that the strength of the drawing tackle is sufficient to hold the chain. Chain weights are shown in the Renold catalogue. When inserting the joining link of multiplex chain, ensure the intermediate plates are assembled. Do not detach the drawing tackle until the link is completely assembled. When only partially inserted through inner links, the weight of the chain on release can “splay” unsupported bearing pins.

Adjust the chain using the datum mark mentioned in the preparation section to retain shaft parallelism.

For a chain of average centre distance (30-50 x chain pitch) correct adjustment is when the mid point of the longest span can be fully moved by hand in accordance with dimension ‘A’ shown in diagram one.

Diagram one



Over-tensioning should be avoided in all cases.

CHAINCASES

- Position the chaincase bottom sections with the shafts concentric in their cavities.
- Manufacture suitable mountings and brackets to ensure rigidity.
- Assemble the oil supply and return pipe system and the drive to the oil pump.
- Assemble top section(s) of chaincase.
- Fill the oil sump and check delivery to the chain.

Chain Adjustment

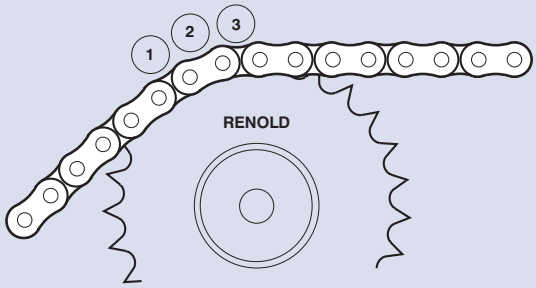
To maximise chain life, some form of chain length adjustment must be provided, preferably by moving one of the shafts. See diagram three. If shaft movement is not possible, an adjustable jockey sprocket engaging with the unloaded strand of the chain is recommended. Generally, the jockey should have the same number of teeth as the driver sprocket and care should be taken to ensure speed does not exceed the maximum ratings shown.

The chain should be adjusted regularly so that with one strand tight the slack strand can be moved a distance of 'A' at the mid point. See diagram one, on this page.

To cater for any eccentricities of mounting, the adjustment of the chain should be tried through a complete revolution of the large sprocket.

Adjustment, as shown in these diagrams, is achieved either by the movement of one of the shafts or by use of the jockey sprocket. The amount of the adjustment provided by either method should be sufficient to take up chain wear amounting to two pitches or two percent elongation above nominal chain length, whichever is the smaller.

Diagram two



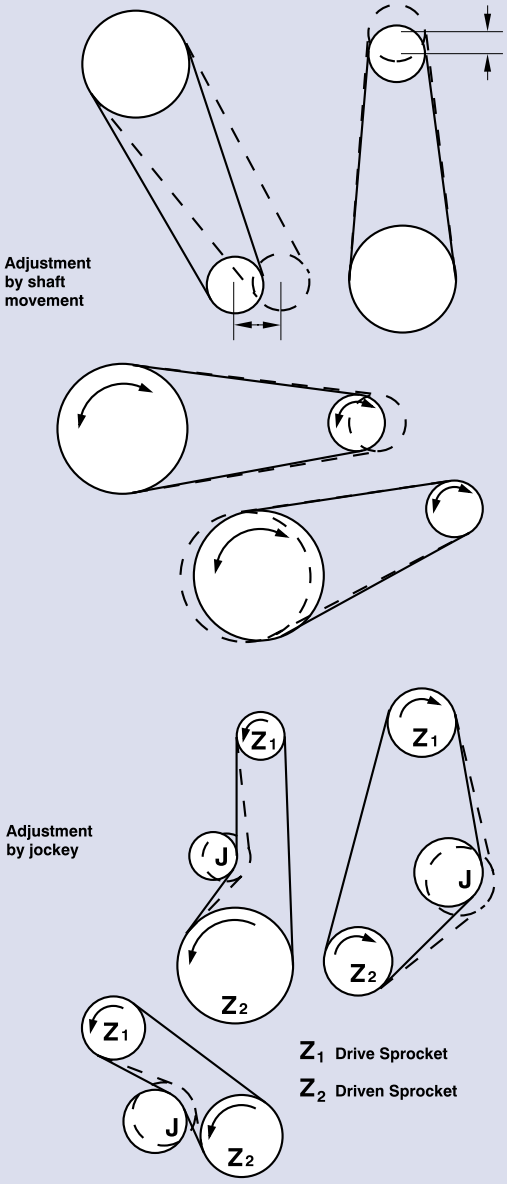
When used for adjustment, a jockey should be positioned on the unloaded side of the chain, preferably nearer to the driven sprocket and gearing with the outside of the chain; it should have an initial chain lap of at least three teeth and a free length of chain not less than four pitches between it and the nearest sprocket. See diagram two above.

Generally, the number of teeth in any jockey should not be less than the smallest sprocket and care should be taken to ensure that the speed does not exceed the maximum recommended. Where necessary, several sprockets can be used on a single drive, thereby meeting all possible needs for adjustment.

Chain Installation and Maintenance

All mountings for jockeys should be rigid and when manual adjustment is provided, the moving member must be securely locked in position after adjustments have been made.

Diagram three



AUTOMATIC ADJUSTMENT

Automatic adjustment can also be provided, but this adjustment generally demands a special study of the conditions to enable a suitable design to be provided.

Test Run

It is advisable to give the drive a short test run for the following reasons:

1. To regulate oil delivery to the chain.
2. To eliminate any oil weeps from the chain case and pipework.
3. To check for any unusual noise or vibration.

Maintenance Schedule

Regular chain maintenance is important if maximum life is to be achieved. In a correctly sized and installed drive the chain can be expected to last for approximately 15,000 hours.

The following maintenance schedule is suggested.

AFTER 3 MONTHS

- Check chain adjustment and rectify if necessary.
- Change oil, oil filter and clear the sump.

ANNUALLY

- Carry out the above checks.
- Check for wear on side plates.
- Check for chain elongation.
- Check cleanliness of components.
  - Remove any accumulation of dirt or foreign materials.
- Check for shaft and sprocket alignment.
- Check for wear on sprockets.
- Check the condition of the lubricant.
- Check the lubrication system.
  - Feed pipes are not clogged.
  - Lubrication schedule is being followed (manual lubrication).
  - Drip rate is sufficient (drip system).
  - Oil level is correct (drip, bath and disc systems).
  - Pump is working (stream system).

Chain Protection

A new Renold chain should always be stored in its box and/or bag until installation. Renold chain is lubricated at the factory, but this lubrication will not stand up to outdoor conditions, particularly where there is a salt water atmosphere.

Unprotected, lubricated chains will become contaminated with grit and other materials which will harm the chain and tend to clog strainers, filters and oil lines. A roller chain is a precision made series of bearings that will perform best if handled and stored in correct conditions.

Lubrication

Renold Chain drives should be protected against dirt and moisture and be lubricated with good quality, non-detergent petroleum based oil. A periodic change of oil is desirable as already outlined. Heavy oils and greases are generally too stiff to enter the chain working surfaces and should not be used.

Care must be taken to ensure that the lubricant reaches the bearing area of the chain. This can be done by directing the oil into the clearances between the inner and outer link plates, preferably at the point where the chain enters the sprocket on the bottom strand.

The table below indicates the correct lubricant viscosity for various ambient temperatures.

Ambient Temperature Celsius	Lubricant SAE	Rating BS4231
-5 to +5	20	46 to 68
5 to 40	30	100
40 to 50	40	150 to 220
50 to 60	50	320

For the majority of applications in the above temperature range, a multigrade SAE 20/50 oil would be suitable.

USE OF GREASE

As mentioned above, the use of grease is not recommended. However, if grease lubrication is essential the following points should be noted:

- Limit chain speed to 4 metre/sec.
- Applying normal greases to the outside surfaces of a chain only seals the bearing surfaces and will not work into them. This causes premature failure. Grease has to be heated until fluid and the chain are immersed and allowed to soak until all air bubbles cease to rise. If this system is used the chains need regular cleaning and regreasing at intervals, depending on the drives, power and speed.

ABNORMAL AMBIENT TEMPERATURES

For elevated temperatures up to 250°C, dry lubricants such as colloidal graphite or MoS_2 in white spirit or poly-alkaline glycol carriers are most suitable.

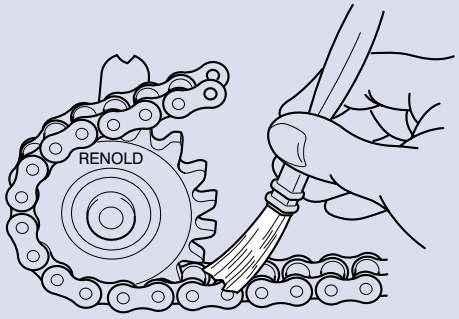
Conversely, at low temperatures between -5° and -40°C, special low temperature initial greases and subsequent oil lubricants are necessary. Lubricant suppliers will give recommendations.

LUBRICATING METHODS

There are four basic methods for lubricating chain drives. The recommended methods are shown in the rating charts which are determined by the chain speed and power transmitted.

TYPE 1, Manual Lubrication

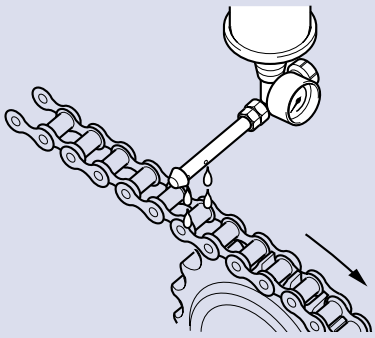
Oil is applied periodically with a brush or oil can, preferably once every 8 hours of operation. Volume and frequency should be sufficient to just keep the chain wet with oil and allow penetration of clean lubricant into the chain joints.



Applying lubricant by aerosol can be satisfactory under some conditions, but it is important that the aerosol lubricant is of an approved type for the application, such as that supplied by Renold. This type of lubricant penetrates into the pin/bush/roller clearances, resisting both the tendency to drip or drain when the chain is stationary and centrifugal "flinging" when the chain is moving.

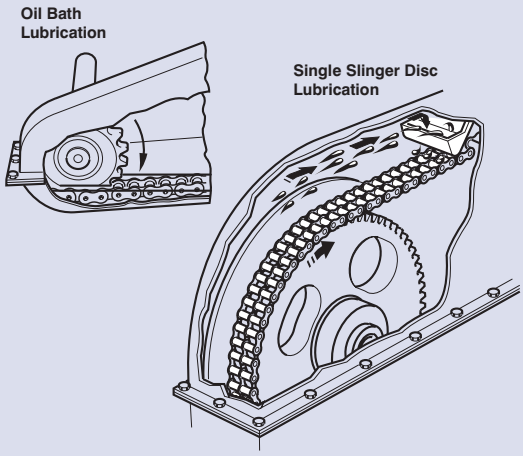
TYPE 2, Drip Lubrication

Oil drips are directed between the link plate edges from a drip lubricator. Volume and frequency should be sufficient to allow penetration of lubricant into the chain joints.



TYPE 3, Bath or Disc Lubrication

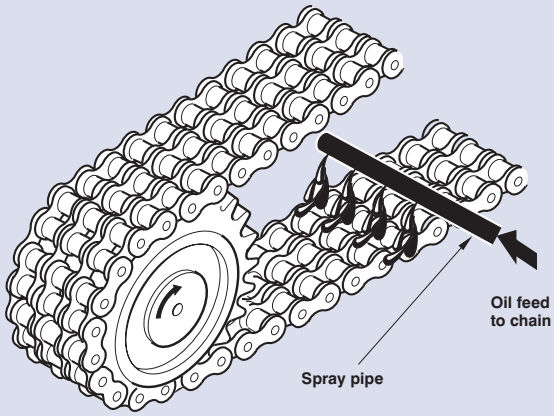
With oil bath lubrication, the lower strand of chain runs through a sump of oil in the drive housing. The oil level should cover the chain at its lowest point during operation.



Chain Installation and Maintenance

With slinger disc lubrication, an oil bath is used but the chain operates above the oil level. A disc picks up oil from the sump and deposits it on the chain by means of deflection plates. When such discs are employed they should be designed to have peripheral speeds between 180 to 2240 metre/min.

TYPE 4, Stream Lubrication
A continuous supply of oil from a circulating pump or central lubricating system is directed onto the chain. It is important to ensure that the spray holes from which the oil emerges are in line with the chain edges. The spray pipe should be positioned so that the oil is delivered onto the chain just before it engages with the driver sprocket.



This ensures that the lubricant is centrifuged through the chain and assists in cushioning roller impact on the sprocket teeth. Stream lubrication also provides effective cooling and impact damping at high speeds. It is, therefore, important that the method of lubrication specified is closely followed.

EFFECT OF TEMPERATURE

During operation an important factor to control in a drive system is the chain and chaincase temperature. Depending on the severity of the drive service, continuity of use, etc., special attention to the lubrication method may be required.

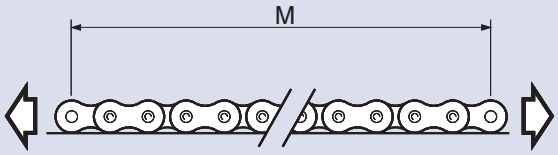
Chain temperatures above 100°C should be avoided if possible due to lubricant limitations, although chain can generally give acceptable performance up to around 250°C in some circumstances. A way of improving the effectiveness of the lubrication and its cooling effect is to increase the oil volume (up to 4.5 litres per minute per chain strand) and incorporate a method of external cooling for the oil.

To Measure Chain Wear

A direct measure of chain wear is the extension in excess of the nominal length of the chain and the chain wear can, therefore, be ascertained by length measurement in line with the instructions given below.

- Lay the chain, which should terminate at both ends with an inner link (part No. 4), on a flat surface and, after anchoring it at one end, attach to the other end a turnbuckle and a spring balance suitably anchored.
- Apply a tension load by means of the turnbuckle amounting to:

For simple chain: P^2 x 0,77 Newtons
For duplex chain: P^2 x 1,56 Newtons
For triplex chain: P^2 x 2,33 Newtons
Where P is the pitch in mm.



In the case of extended pitch chains (e.g. chains having the same breaking load and twice the pitch) apply a measuring load as for the equivalent short pitch chains.
As an alternative to the use of a turnbuckle and spring balance, the chain may be hung vertically and the equivalent weight attached to the lower end.

- Measure length 'M' (see diagram) in millimetres from which the percentage extension can be obtained from the following formula:

$$\text{Percentage extension} = \frac{M - (X \times P)}{X \times P} \times 100$$

Where X = number of pitches measured
P = pitch in mm

- As a general rule, the useful life of the chain is terminated and the chain should be replaced when the percentage extension reaches 2 per cent (1 per cent in the case of extended pitch chains). For drives with no provision for adjustment, the rejection limit is lower, dependent upon the speed and layout. A usual figure is between 0.7 and 1.0 per cent extension.

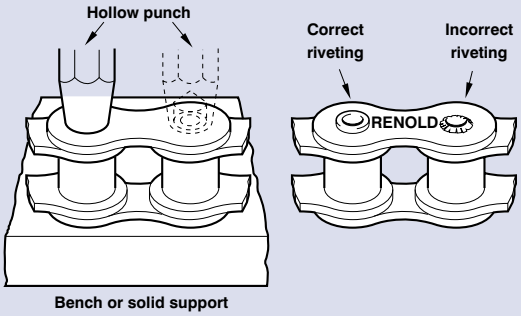
RENOLD CHAIN WEAR GUIDE

A simple to use chain wear guide is available from Renold Chain for most popular sizes of chain pitch. Please contact your sales office for details.

Riveting Chain Endless

TRANSMISSION CHAINS UP TO 63.5mm (2.5") PITCH

- Insert the bearing pins of the outer link (No. 107) through the inner links of the chain to be joined. If multiplex chain, assemble intermediate plates at the same time.
- Provide support for the outer link (No. 107) while assembling the separate outer plate. This has a force fit and is driven onto the bearing pins using a hollow punch alternatively on each pin. Drive up to the shoulder on the shouldered bearing pins. Where there is no shoulder the plate is driven to the point of similar clearance between outer and inner links as with the adjacent chain.



- Still supporting the outer link (No. 107), rivet the bearing pin ends, taking care to finish with a neat uniform spread having a similar appearance to the machine riveted pins in the adjacent chain. The force required to spread the pin end will vary with the pitch of the chain; excessive riveting force should always be avoided. Except where final chain joining in-situ is necessary, the work should be carried out on a bench.
- Check that the newly fitted link articulates freely in the adjacent inner links.

Chain Length Alterations

All drives should be designed wherever possible, with sufficient overall adjustment to ensure the use of an even number of pitches throughout the useful life of the chain. Cranked links should never be used on implusive, highly loaded or high speed chain drives.

In less arduous conditions where there is no other solution and the use of a cranked link is unavoidable, the diagrams show how length alteration can be accomplished.

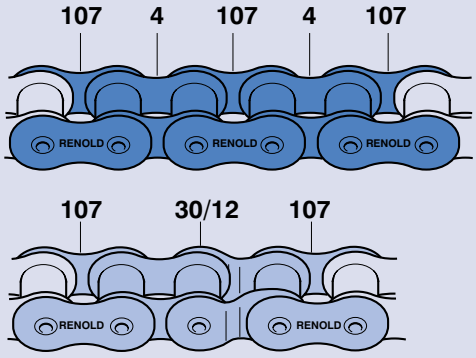
A chain having an even number of links requires the incorporation of a cranked link to effect an alteration of one pitch.

Chain having an odd number of links incorporates a cranked link which must be removed to effect an alteration of one pitch.

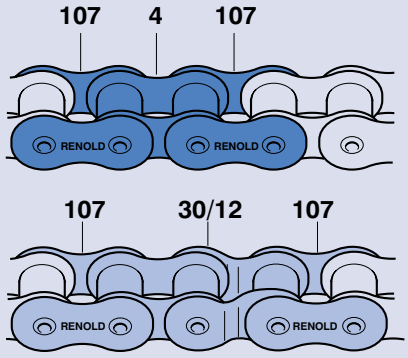
By removing the parts shown in dark shading and substituting those in light shading a chain can be shortened or lengthened by one pitch.

No joint which relies on a press fit for assembly should be reused after removal. A new joint should always be employed.

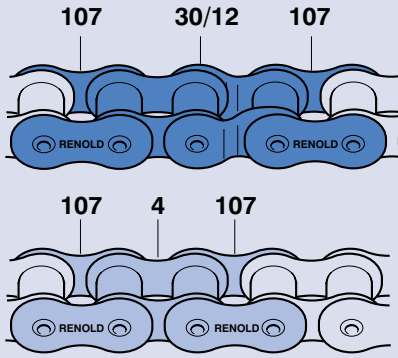
Using Cranked Link Double No. 30 (or No. 12 where 30's are not available).



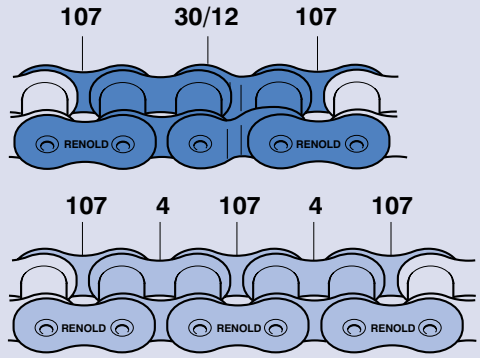
To shorten an even link chain by one pitch



To lengthen an even link chain by one pitch



To shorten an odd link chain by one pitch



To lengthen an odd link chain by one pitch

Pairing and Matching Chains

Any application in which two or more strands of transmission chain are required to operate side by side in a common drive or conveying arrangement, may involve the need for either pairing or matching, and such applications generally fall into one of the following categories:

Length Matching for Conveying and Similar Applications

Wherever length matching of transmission chain is necessary it is dealt with as follows:

- The chains are accurately measured in handling lengths between 3m to 8m as appropriate and then selected to provide a two (or more) strand drive having overall length uniformity within close limits. However, such length uniformity will not necessarily apply to any intermediate sections along the chains, but the actual length of all intermediate sections, both along and across the drive, will not vary more than our normal manufacturing limits. However, adapted transmission chains are usually manufactured to specific orders which are generally completed in one production run so that it is reasonable to assume that length differences of intermediate sections will be small.

- Chains are supplied in sets which are uniform in overall length within reasonably fine limits and will be within our normal manufacturing limits. It should be noted that chain sets supplied against different orders at different times may not have exactly the same lengths to those supplied originally, but will vary by no more than our normal tolerance of 0.0%, +0.15%.

Pitch Matching Transmission Drive Chains

Pitch matched chains are built up from shorter subsections (usually 300 to 600mm lengths) which are first measured and then graded for length. All subsections in each grade are of closely similar length and those forming any one group across the set of chains are selected from the same length grade.

The requisite number of groups are then connected to form a pitch matched set of chains, or alternatively, if this is too long for convenient handling, a set of handling sections for customer to assemble as a final set of pitch matched chain. Suitable tags are fixed to the chains to ensure they are connected together in the correct sequence.

Identification of Handling Lengths

	Handling Length 1	Handling Length 2	Handling Length 3
A Strand	A-A1	A1-A2	A2-A3
B Strand	B-B1	B1-B2	B2-B3
C Strand	C-C1	C1-C2	C2-C3

Long chains are made up in sections, each section being numbered on end links. Sections should be so joined up that end links with similar numbers are connected. Where chains are to run in sets of two or more strands, each strand is stamped on end links of each section with a letter, in addition to being numbered. Correct consecutive sections for each strand must be identified from the end links and joined up as indicated.

By these means, the actual length of any intermediate portion of one strand (as measured from any one pitch point to any other) will correspond closely with that of the transversely equivalent portion on the other strands, generally within 0.05mm, depending on the chain pitch size.

Pitch Matching Adapted Transmission Chains
(when attachments are fitted to chains)

With the sole exception of extended bearing pins, it is not possible to match the pitch of holes in attachments themselves to within very fine limits, due to the additional tolerances to be contended with (bending, holing, etc.).

Colour Coding

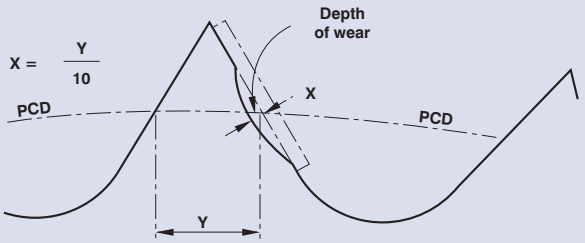
For customers who wish to match their chains, perhaps in order to fit special attachments in situ, Renold colour code short lengths of chain within specified tolerance bands. These will normally be RED, YELLOW or GREEN paint marks to indicate lower, mid and upper thirds of the tolerance band. For even finer tolerance bands additional colours can be used, but normally a maximum of five colours will be more than adequate.

COLOUR	RED	0.05%
	YELLOW	0.10%
	GREEN	0.15%
	BLUE	For Finer
	WHITE	Tolerances

Repair and Replacement

SPROCKETS
Examination of the tooth faces will give an indication of the amount of wear which has occurred. Under normal circumstances this will be evident as a polished worn strip about the pitch circle diameter on each of the sprocket teeth as shown below.

If the depth of this wear 'X' has reached an amount equal to 10% of the 'Y' dimension, then steps should be taken to replace the sprocket. Running new chain on sprockets having this amount of tooth wear will cause rapid chain wear.



It should be noted that in normal operating conditions, with correct lubrication the amount of wear 'X' will not occur until several chains have been used.

CHAIN
Chain repair should not as a rule be necessary. A correctly selected and maintained chain should gradually wear out over a period of time, approximately 15000 hours, but it should not fail. A length extension check as detailed on page 82 will give an indication of the service life remaining.

If a transmission chain sustains damage due to an overload, jam-up, or by riding over the sprocket teeth, it should be carefully removed from the drive and given a thorough visual examination. Remove the lubricating grease and oil to make the job easier.

Depending on the damage, it may be practicable to effect temporary repairs using replacement links (shown on page 5). It is not, however, a guarantee that the chain has not been overstressed and so made vulnerable to a future failure. The best policy therefore is to remove the source of trouble and fit a new chain.

If a chain has failed two or more times, it is certain the chain will fail again in time. If no replacement is immediately available repair the chain, but replace it at the nearest opportunity.

The entire chain should be replaced because of the following reasons:

- The cost of down time to the system or machine can often outweigh the cost of replacing the chain.
- A new or even used portion of chain or joints assembled into the failed chain will cause whipping and load pulsation. This can and probably will produce rapid failure of the chain and will accelerate wear in both the chain and its sprockets.

Assembling Connecting Links

When assembling a connecting link with a slip fit outer plate, it is necessary that this plate is pushed down on the pins to permit insertion of the fastener. Always ensure the No. 27 spring clip (as is illustrated on the No. 26 joint on page 5), has the closed end in the direction of rotation.

On a press fit connecting link it is necessary to drive the outer plate down far enough on the pins to allow insertion of the two split pins, but not so far as to create a tight joint.

By doing the above, three important things are accomplished.

- The desired clearances between the link plates across the chain width are maintained. Any outer link plate driven too far down the pins 'squeezes' the joint, so that no lubrication can get to the bearing surfaces. Such 'squeezing' of a joint prevents a chain articulating freely around the sprockets.
- Correct assembly of a connecting link into a chain will ensure a smooth gearing action with a minimum of whipping.
- With the split pins or spring clip snugly positioned against the side plate and the closed end of a spring clip fitted in the right direction, there will be less of a tendency for them to work loose and fall off.

Safety Warnings

CONNECTING LINKS
No. 11 or No. 26 joints (slip fit) should not be used where high speed or arduous conditions are encountered. In these or equivalent circumstances where safety is essential, a riveting link No. 107 (interference fit) must be used.

GOOD DESIGN PRACTICES
For high speed drives or drives operating in arduous conditions, a properly riveted outer link (No. 107) should always be used for optimum security, in preference to any other form of chain joint.

The use of other connectors and cranked links (No. 12 and No. 30) should always be restricted to light duty, non-critical applications, in drives where an odd number of pitches is absolutely unavoidable.

Wherever possible, drives should have sufficient overall adjustment to ensure the use of an even number of pitches throughout the useful life of the chain. A cranked link joint should only be used as a last resort.

Health and Safety Warning

The following precautions must be taken before disconnecting and removing a chain from a drive prior to replacement, repair or length alteration.

1. Always isolate the power source from the drive or equipment.
2. Always wear safety glasses.
3. Always wear appropriate protective clothing, hats, gloves and safety shoes as warranted by the circumstances.
4. Always ensure tools are in good working condition and used in the proper manner.
5. Always loosen tensioning devices.
6. Always support the chain to avoid sudden unexpected movement of chain or components.
7. Never attempt to disconnect or reconnect a chain unless the chain construction is fully understood.
8. Always ensure that directions for the correct use of any tools are followed.
9. Never reuse individual components.
10. Never reuse a damaged chain or chain part.
11. On light duty drives where a spring clip (No. 27) is used, always ensure that the clip is fitted correctly with the closed end pointing in the direction of travel.

Chain Installation and Maintenance

Troubleshooting

PROBLEM	PROBABLE CAUSE	SOLUTION
CHAIN CLIMBING OR JUMPING OFF THE SPROCKET TEETH	■ CHAIN OR SPROCKETS WORN	■ REPLACE THE CHAIN AND SPROCKETS IF NECESSARY
	■ CHAIN EXCESSIVELY SLACK	■ ADJUST THE CENTRE DISTANCE OR INTRODUCE A JOCKEY SPROCKET TO TAKE UP THE SLACK. IF ALLOWABLE, SHORTEN THE CHAIN
	■ INSUFFICIENT CHAIN WRAP	■ FOR LARGE RATIO DRIVES, THE DRIVER SPROCKET MAY NOT HAVE ENOUGH TEETH TO ABSORB THE WORKING TENSION. IF THE DRIVE CANNOT BE ALTERED, INTRODUCE A JOCKEY SPROCKET TO INCREASE THE CHAIN WRAP
	■ FOREIGN MATERIAL BUILD UP IN THE SPROCKET TOOTH GAPS	■ CLEAN THE SPROCKET TEETH OF ALL MATERIAL SO THAT THE CHAIN ENGAGES CORRECTLY
CHAIN DRIVE RUNNING HOT	■ LUBRICATION METHOD OR TYPE OF LUBRICATION IS UNSUITABLE FOR THE OPERATING SPEED AND POWER BEING TRANSMITTED	■ CHECK THE CATALOGUE SELECTION TABLES FOR THE CORRECT LUBRICATION METHOD
	■ INSUFFICIENT LUBRICATION	■ INCREASE THE FREQUENCY OF LUBRICATION IN LINE WITH GOOD MAINTENANCE PRACTICE
	■ CHAIN CONTINUALLY HITTING AN OBSTRUCTION	■ REMOVE THE OBSTRUCTION
	■ INCORRECT CHAIN SIZE SELECTED FOR THE SPEED AND TRANSMITTED POWER	■ CHECK THE CHAIN SELECTION AS A SMALLER PITCH OR MULTISTRAND CHAIN OF EQUIVALENT CAPACITY MAY BE REQUIRED
CHAIN ELONGATION (A GRADUAL INCREASE OVER ITS LIFE IS NORMAL)	■ LUBRICATION FAILURE	■ REPLACE CHAIN AND SPROCKETS
	■ AN OVERLOAD	■ CHECK LUBRICATION, DRIVE CONFIGURATION AND LOADINGS
	■ DISPLACEMENT OF THE BEARINGS	■ MONITOR DRIVE ELONGATION OVER A PERIOD OF 2-3 MONTHS BY CHECKING THE DEGREE OF SAG
	■ FAILURE OF THE TENSIONING DEVICE	■ CONTACT OUR TECHNICAL STAFF FOR ADVICE IF PROBLEM PERSISTS
CHAIN STIFFENS, STARTS TO WHIP	■ WORN CHAIN OR SPROCKETS	■ REPLACE CHAIN AND SPROCKETS
	■ EXCESSIVELY SLACK CHAIN	■ ADJUST CENTRES IF POSSIBLE OR INTRODUCE A TAKE-UP SYSTEM SUCH AS A JOCKEY SPROCKET. IT IS ALSO POSSIBLE TO SHORTEN THE CHAIN BY ONE OR MORE PITCHES
	■ HEAVY & IMPULSIVE LOAD	■ REDUCE THE LOADING
	■ CENTRE DISTANCE TOO LONG	■ ADD A JOCKEY SPROCKET ON LONG CENTRE DISTANCES
	■ ONE OR MORE STIFF JOINTS	■ REMOVE OR REPAIR STIFF JOINTS

Troubleshooting

PROBLEM	PROBABLE CAUSE	SOLUTION
EXCESSIVE NOISE	■ MISALIGNMENT OF SPROCKETS	■ MISALIGNMENT INTRODUCES ABNORMAL LOADING AND WEAR. RECHECK ALIGNMENT TO MAINTAIN NORMAL DRIVE CONDITIONS
	■ INADEQUATE LUBRICATION	■ IMPROVE THE LUBRICATION METHOD TO ENSURE THE PROPER AMOUNT OF LUBRICATION IS AVAILABLE IN THE BEARING AREAS
	■ WORN OR INCORRECTLY FITTED BEARINGS	■ REPLACE OR CORRECT THE BEARINGS AS THESE WILL MALIGN THE ENTIRE DRIVE
	■ CHAIN EXCESSIVELY SLACK OR TIGHT	■ ADJUST THE CENTRE DISTANCE IF POSSIBLE OR INTRODUCE A JOCKEY SPROCKET
	■ WORN CHAIN OR SPROCKETS	■ REPLACE THE CHAIN AND WHERE NECESSARY THE SPROCKETS. CONSIDER HARDENED TEETH
	■ TIGHT JOINTS	■ REPLACE OR REPAIR JOINTS
	■ HEAVY IMPULSIVE LOADS	■ REDUCE THE LOAD OR INTRODUCE A JOCKEY SPROCKET
	■ CHAIN PITCH SIZE TOO LARGE	■ CHECK THE CHAIN SELECTION OR CONTACT OUR TECHNICAL STAFF
	■ OBSTRUCTION IN THE CHAINS PATH	■ REMOVE THE OBSTRUCTION
HEAVY WEAR ON SPROCKET TEETH WORKING FACES. (A BRIGHT POLISHED APPEARANCE IS NORMAL)	■ POOR LUBRICATION	■ IMPROVE THE METHOD OF LUBRICATION, (SEE LUBRICATION SECTION)
	■ PRESENCE OF ABRASIVE	■ CHECK FOR PRESENCE OF FOREIGN MATERIALS AND ELIMINATE THE SOURCE. REPLACE SPROCKETS AND CHAIN IF NECESSARY
PIN FAILS	■ SYSTEM LOADING IS GREATER THAN THE CAPACITY OF THE CHAIN	■ CHECK THE KILOWATT RATING TABLE TO DETERMINE IF THE CHAIN CAPACITY HAS BEEN EXCEEDED. LARGER PITCH CHAIN OR A MULTISTRAND CHAIN MAY BE REQUIRED IF THE LOAD CONDITIONS CANNOT BE CORRECTED
ROLLER OR BUSH FAILS	■ CHAIN CAPACITY HAS BEEN EXCEEDED AT HIGH SPEED CAUSING IMPACT ON THE SPROCKET TEETH	■ CHECK THE DRIVE SELECTION. A SMALLER PITCH CHAIN, A MULTISTRAND CHAIN OR SPROCKETS WITH MORE TEETH MAY BE REQUIRED
	■ TOOTH MARKS ON THE OUTSIDE OF THE ROLLER DIAMETER CAN INITIATE FAILURE	■ IF THE ROLLERS ARE MARKED BY THE SPROCKET TEETH, ADJUST THE CENTRE DISTANCE

Chain Installation and Maintenance

Troubleshooting

PROBLEM	PROBABLE CAUSE	SOLUTION
RUST PRESENT ON CHAIN	■ INADEQUATE LUBRICATION. THIS WILL ALSO AFFECT THE JOINTS WHICH WILL BE DISCOLOURED, (LIGHT TO DARK BROWN) AND COULD BE ROUGH, GROOVED OR GALLED	■ REMOVE SEVERAL JOINTS AND CHECK THAT THE COMPONENTS ARE NOT SEVERELY DAMAGED. REPLACE CHAIN AND SPROCKETS AS NECESSARY. IMPROVE LUBRICATION METHOD.
SIDE PLATE FAILS	■ FATIGUE FAILURE IS CAUSED BY REPETITIVELY LOADING THE CHAIN ABOVE ITS LIMIT	■ CHECK THE DRIVE SELECTION, A LARGER PITCH CHAIN OR A MULTISTRAND CHAIN MAY BE REQUIRED
	■ IMPULSIVE DRIVE CONDITIONS CAN ALSO CAUSE FATIGUE FAILURE	■ IF NOT THE ABOVE, CHECK FOR EXCESSIVE SLACK. THIS MAY INDICATE WORN CHAIN AND SPROCKETS. REPLACE WHERE REQUIRED
SIDE PLATES ARE WORN	■ WEAR ON THE INSIDE OF THE PLATE IS CAUSED BY SPROCKET MISALIGNMENT	■ CHECK AND ADJUST SPROCKET AND SHAFT ALIGNMENT
	■ WEAR ON THE TOP OF THE SIDE PLATE IS CAUSED BY THE CHAIN RUBBING AGAINST THE CHAINCASE OR SOME OBSTRUCTION	■ REMOVE SOURCE OF RUBBING BY REMOVING THE OBSTRUCTION OR ADDING A JOCKEY SPROCKET TO CONTROL THE SLACK IN THE CHAIN
WEAR ON THE SIDES OF THE SPROCKET TEETH	■ DRIVE MISALIGNMENT	■ CHECK AND CORRECT SPROCKET AND SHAFT ALIGNMENT

Reference Manual
00809-0100-4728, Rev JA
January 2004

Rosemount 644 Head and Rail Mount Temperature Transmitters

FOUNDATION

HART® FIELD COMMUNICATIONS PROTOCOL

ROSEMOUNT®

www.rosemount.com

EMERSON™
Process Management

Rosemount 644 Temperature Transmitters

Rosemount 644 Hardware Revision	**26**
HART® Device Revision	**5.6**
HART Communicator Field Device Revision	**Dev v6, DD v1**
FOUNDATION fieldbus Hardware Revision	**5**
FOUNDATION fieldbus Device Revision	**1**

NOTICE

Read this manual before working with the product. For personal and system safety, and for optimum product performance, make sure to thoroughly understand the contents before installing, using, or maintaining this product.

The United States has two toll-free assistance numbers and one international number.

Customer Central
1-800-999-9307 (7:00 a.m. to 7:00 P.M. CST)

National Response Center
1-800-654-7768 (24 hours a day)
Equipment service needs

International
1-(952) 906-8888

⚠CAUTION

The products described in this document are NOT designed for nuclear-qualified applications.

Using non-nuclear qualified products in applications that require nuclear-qualified hardware or products may cause inaccurate readings.

For information on Rosemount nuclear-qualified products, contact a Emerson Process Management Sales Representative.

Rosemount 644 Smart Temperature Transmitters may be protected by one or more U.S. Patents pending. Other foreign patents pending.

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Section 1 Introduction

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SAFETY MESSAGES

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that potentially raises safety issues is indicated by a warning symbol (⚠). Please refer to the following safety messages before performing an operation preceded by this symbol.

Warnings

⚠WARNING

Failure to follow these installation guidelines could result in death or serious injury.

- Make sure only qualified personnel perform the installation.

Explosions could result in death or serious injury.

- Do not remove the connection head cover in explosive atmospheres when the circuit is live.
- Before connecting HART or FOUNDATION fieldbus in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-intrinsic field wiring practices.
- Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.
- All connection head covers must be fully engaged to meet explosion-proof requirements.

Process leaks could result in death or serious injury.

- Do not remove the thermowell while in operation.
- Install and tighten thermowells and sensors before applying pressure

Electrical shock could cause death or serious injury.

- Use extreme caution when making contact with the leads and terminals.

OVERVIEW

Manual

This manual is designed to assist in the installation, operation, and maintenance of Rosemount 644 head mount and 644 rail mount.

Section 1: Introduction

- Transmitter and Manual Overview
- Considerations
- Return of Material

Section 2: Installation

- Mounting
- Installation
- Wiring
- Power Supply
- Commissioning

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- Rosemount HART Communicator
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- Specifications
- Dimensional drawings
- Ordering Information
- Biotechnology, Pharmaceutical Industries, and Sanitary Applications

Appendix B: Approvals

- Product Certifications
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Appendix C: Foundation Fieldbus Block Information

- Information regarding the Function Blocks

Transmitter

Features of the Rosemount 644 include:

- Accepts inputs from a wide variety of sensors
- Configuration using HART protocol or FOUNDATION fieldbus
- Electronics that are completely encapsulated in epoxy and enclosed in a metal housing, making the transmitter extremely durable and ensuring long-term reliability
- A compact size and two housing options allowing mounting flexibility for the control room or the field

Refer to the following literature for a full range of compatible connection heads, sensors, and thermowells provided by Emerson Process Management.

- Temperature Sensors and Assemblies Product Data Sheet, Volume 1 (document number 00813-0100-2654)
- Temperature Sensors and Assemblies Product Data Sheet, Volume 2 (document number 00813-0200-2654)

CONSIDERATIONS

General

Electrical temperature sensors such as RTDs and thermocouples produce low-level signals proportional to their sensed temperature. The 644 converts the low-level sensor signal to a standard 4–20 mA dc, digital HART, or digital Foundation fieldbus signal that is relatively insensitive to lead length and electrical noise. This signal is then transmitted to the control room via two wires.

Commissioning

The transmitter can be commissioned before or after installation. It may be useful to commission it on the bench, before installation, to ensure proper operation and to become familiar with its functionality. Make sure the instruments in the loop are installed in accordance with intrinsically safe, FISCO, or non-incendive field wiring practices.

Mechanical

Location

When choosing an installation location and position, take into account the need for access to the transmitter.

Special Mounting

Special mounting hardware is available for mounting a 644 head mount transmitter to a DIN rail, or assembling a new 644 head mount to an existing threaded sensor connection head (former option code L1).

Electrical

Proper electrical installation is necessary to prevent errors due to sensor lead resistance and electrical noise. For best results, shielded cable should be used in electrically noisy environments.

Make wiring connections through the cable entry in the side of the connection head. Be sure to provide adequate clearance for cover removal.

Environmental

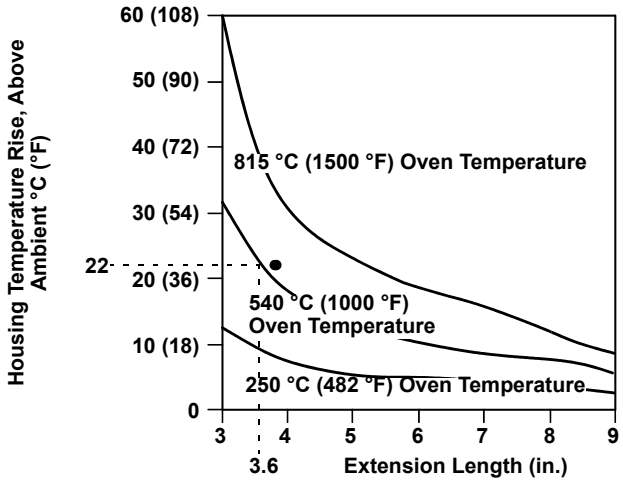
The transmitter electronics module is permanently sealed within the housing, resisting moisture and corrosive damage. Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.

Temperature Effects

The transmitter will operate within specifications for ambient temperatures between –40 and 185 °F (–40 and 85 °C). Heat from the process is transferred from the thermowell to the transmitter housing. If the expected process temperature is near or beyond specification limits, consider the use of additional thermowell lagging, and extension nipple, or a remote mounting configuration to isolate the transmitter from the process.

Figure 1-1 provides an example of the relationship between transmitter housing temperature rise and extension length.

Figure 1-1. 644 head mount Transmitter Connection Head Temperature Rise vs. Extension Length



Example

The transmitter specification limit is 85 °C. If the ambient temperature is 55 °C and the process temperature to be measured is 800 °C, the maximum permissible connection head temperature rise is the transmitter specification limit minus the ambient temperature (moves 85 to 55 °C), or 30 °C.

In this case, an extension of 100 mm meets this requirement, but 125 mm provides a margin of 8 °C, thereby reducing any temperature effects in the transmitter.

RETURN OF MATERIALS

To expedite the return process in North America, call the Emerson Process Management National Response Center toll-free at 800-654-7768. This center, available 24 hours a day, will assist you with any needed information or materials.

⚠ The center will ask for the following information:

- Product model
- Serial numbers
- The last process material to which the product was exposed

The center will provide

- A Return Material Authorization (RMA) number
- Instructions and procedures that are necessary to return goods that were exposed to hazardous substances

For other locations, please contact a Emerson Process Management sales representative.

NOTE
If a hazardous substance is identified, a Material Safety Data Sheet (MSDS), required by law to be available to people exposed to specific hazardous substances, must be included with the returned materials.

Section 2 Installation

Safety Messages . . . . . page 2-1
Mounting . . . . . page 2-3
Installation . . . . . page 2-4
Wiring . . . . . page 2-9
Power Supply . . . . . page 2-13

SAFETY MESSAGES

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that potentially raises safety issues is indicated by a warning symbol (⚠). Please refer to the following safety messages before performing an operation preceded by this symbol.

Warnings

⚠WARNING

Failure to follow these installation guidelines could result in death or serious injury.

- Make sure only qualified personnel perform the installation.

Explosions could result in death or serious injury.

- Do not remove the connection head cover in explosive atmospheres when the circuit is live.
- Before connecting a HART Communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with instrinsically safe or non-incendive field wiring practices.
- Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.
- All connection head covers must be fully engaged to meet explosion-proof requirements.

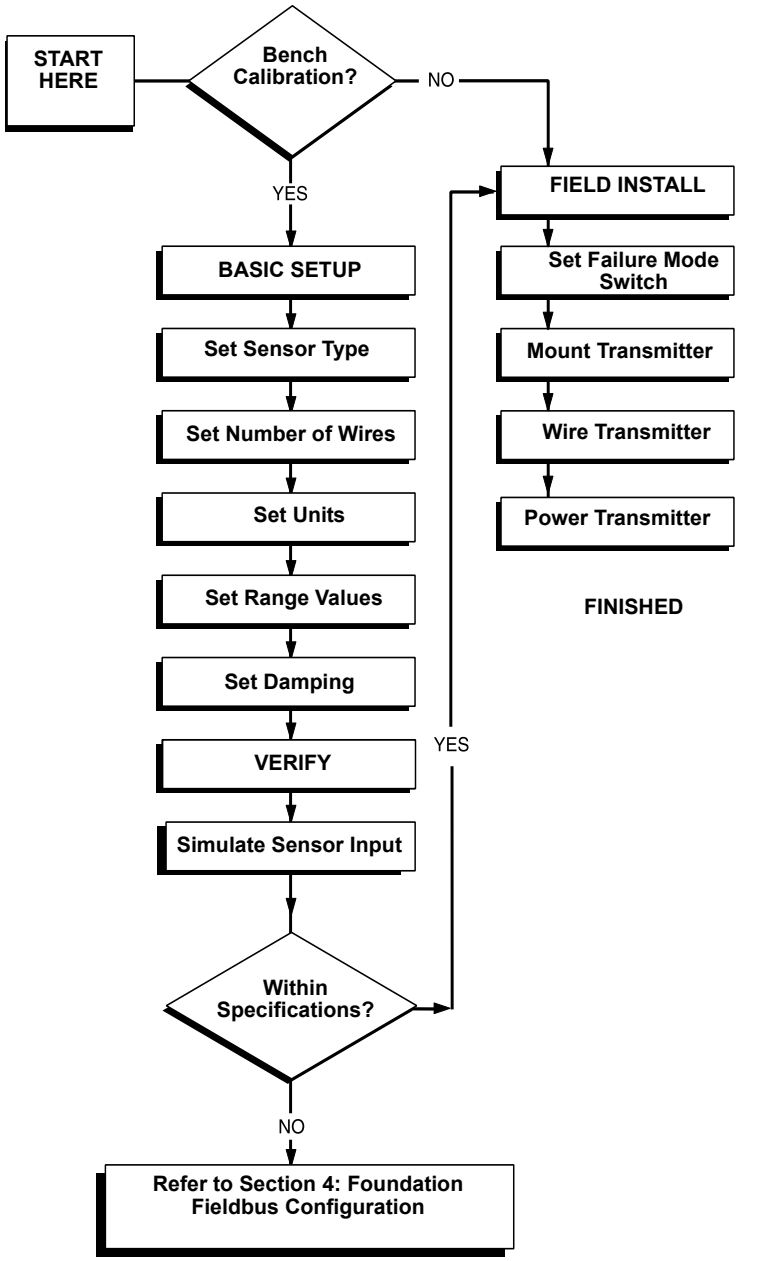
Process leaks could result in death or serious injury.

- Do not remove the thermowell while in operation.
- Install and tighten thermowells and sensors before applying pressure

Electrical shock could cause death or serious injury.

- Use extreme caution when making contact with the leads and terminals.

Figure 2-1. Installation Flowchart



MOUNTING

Mount the transmitter at a high point in the conduit run to prevent moisture from draining into the transmitter housing.

The 644 head mount installs

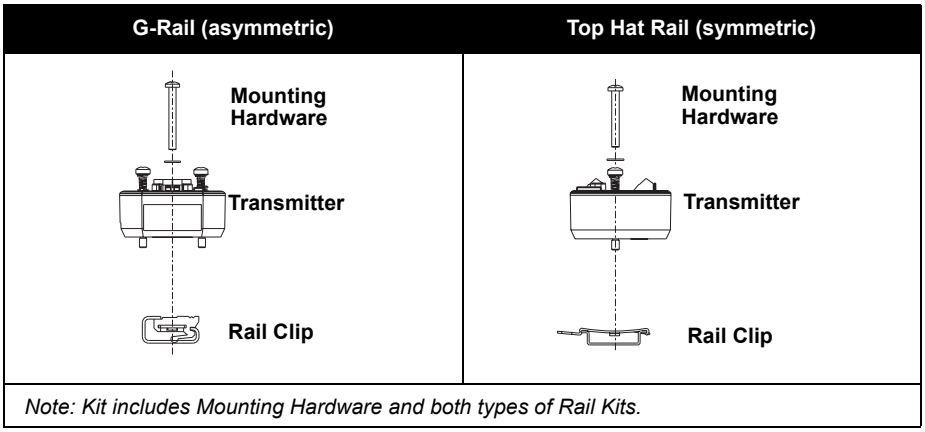
- In a connection head or universal head mounted directly on a sensor assembly
- Apart from a sensor assembly using a universal head
- To a DIN rail using an optional mounting clip.

The 644 rail mount attaches directly to a wall or to a DIN rail.

Mounting a 644H to a DIN Rail

To attach a head mount transmitter to a DIN rail, assemble the appropriate rail mounting kit (part number 00644-5301-0010) to the transmitter as shown in Figure 2-2. Follow the procedure under “Rail Mount Transmitter and Sensor (HART only)”.

Figure 2-2. Assembling Rail Clip Hardware to a 644H

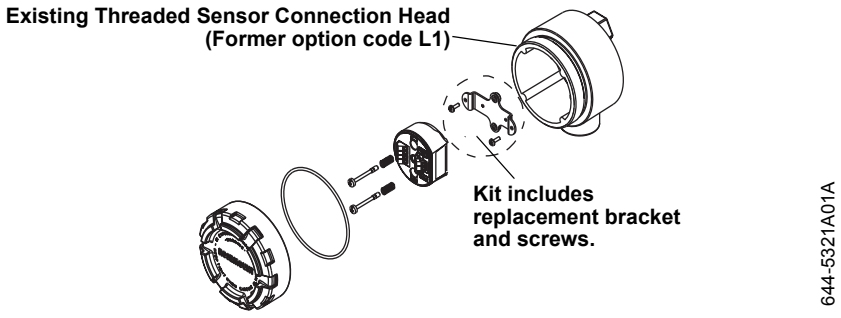


Note: Kit includes Mounting Hardware and both types of Rail Kits.

Retrofitting a 644H for Use in an Existing Threaded Sensor Connection Head

To mount a 644H in an existing threaded sensor connection head (former option code L1), order the 644H retrofit kit (part number 00644-5321-0010). The retrofit kit includes a new mounting bracket and all associated hardware necessary to facilitate the installation of the 644H in the existing head. See Figure 2-3.

Figure 2-3. Assembling 644H for Use in an Existing L1 Connection Head



INSTALLATION

Typical European Installation

Head Mount Transmitter with DIN Plate Style Sensor (HART and FOUNDATION fieldbus)

⚠ 1. Attach the thermowell to the pipe or process container wall. Install and tighten the thermowell before applying process pressure.

2. Verify the transmitter failure mode switch (HART only).

3. Assemble the transmitter to the sensor. Push the transmitter mounting screws through the sensor mounting plate and insert the snap rings (optional) into the transmitter mounting screw groove.

4. Wire the sensor to the transmitter (see Figure 2-9 on page 2-11).

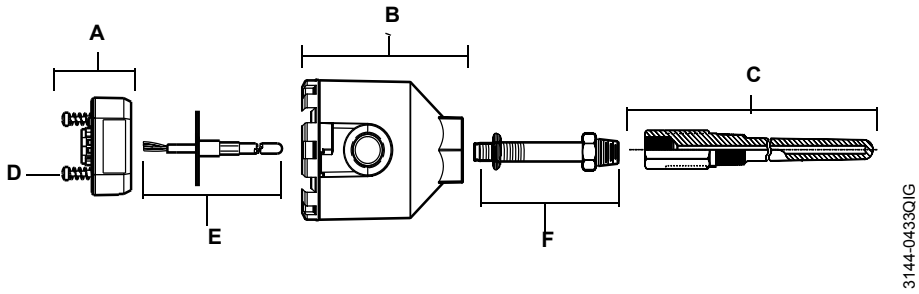
5. Insert the transmitter-sensor assembly into the connection head. Thread the transmitter mounting screw into the connection head mounting holes.Assemble the extension to the connection head. Insert the assembly into the thermowell.

6. Attach a cable gland into the shielded cable.

7. Insert the shielded cable leads into the connection head through the cable entry. Connect and tighten the cable gland.

⚠ 8. Connect the shielded power cable leads to the transmitter power terminals. Avoid contact with sensor leads and sensor connections.

⚠ 9. Install and tighten the connection head cover. Enclosure covers must be fully engaged to meet explosion-proof requirements.

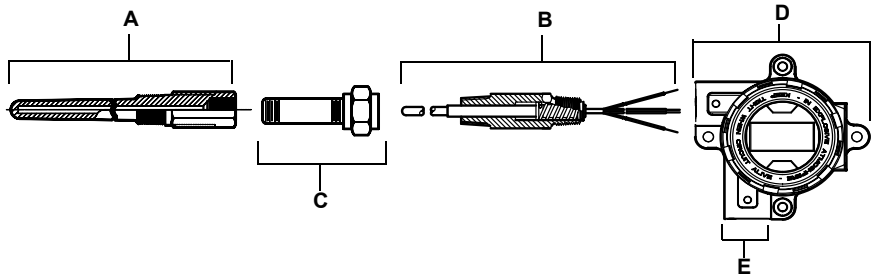


A = 644H Transmitter	D = Transmitter Mounting Screws
B = Connection Head	E = Integral Mount Sensor with Flying Leads
C = Thermowell	F = Extension

Typical North American Installation

Head Mount Transmitter with Threaded Sensor (HART and FOUNDATION fieldbus)

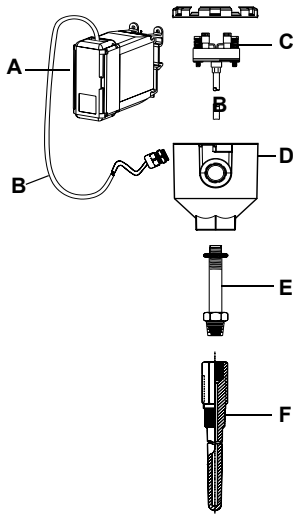
1. Attach the thermowell to the pipe or process container wall. Install and tighten thermowells before applying process pressure.
2. Attach necessary extension nipples and adapters to the thermowell. Seal the nipple and adapter threads with silicone tape.
3. Screw the sensor into the thermowell. Install drain seals if required for severe environments or to satisfy code requirements.
4. Verify the transmitter failure mode switch (HART only).
5. Pull the sensor wiring leads through the universal head and transmitter. Mount the transmitter in the universal head by threading the transmitter mounting screws into the universal head mounting holes.
6. Mount the transmitter-sensor assembly into the thermowell. Seal adapter threads with silicone tape.
7. Install conduit for field wiring to the conduit entry of the universal head. Seal conduit threads with silicone tape.
8. Pull the field wiring leads through the conduit into the universal head. Attach the sensor and power leads to the transmitter. Avoid contact with other terminals.
9. Install and tighten the universal head cover. Enclosure covers must be fully engaged to meet explosion-proof requirements.



A = Threaded Thermowell
B = Threaded Style Sensor
C = Standard Extension
D = Universal Head
E = Conduit Entry

Rail Mount Transmitter and Sensor (HART only)

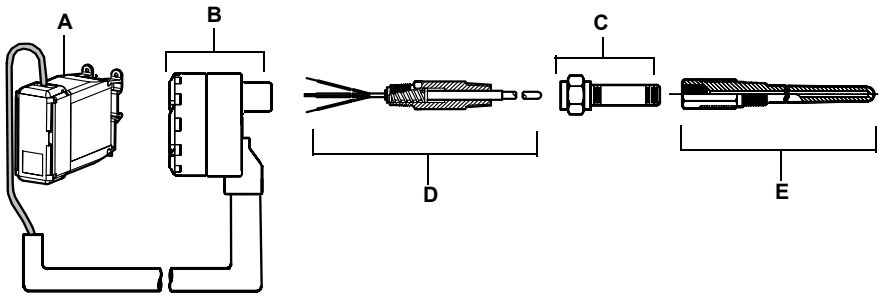
1. Attach the transmitter to a suitable rail or panel.
2. Attach the thermowell to the pipe or process container wall. Install and tighten the thermowell, according to plant standards, before applying pressure.
3. Attach the sensor to the connection head and mount the entire assembly to the thermowell.
4. Attach and connect sufficient lengths of sensor lead wire from the connection head to the sensor terminal block.
5. Tighten the connection head cover. Enclosure covers must be fully engaged to meet explosion-proof requirements.
6. Run sensor lead wires from the sensor assembly to the transmitter.
7. Verify the transmitter failure mode switch.
8. Attach the sensor wires to the transmitter (see Figure 2-9 on page 2-11).



A = Rail Mount Transmitter
B = Sensor Leads with Cable Glands
C = Integral Mount Sensor with Terminal Block
D = Connection Head
E = Standard Extension
F = Threaded Thermowell

Rail Mount Transmitter with Threaded Sensor (HART only)

1. Attach the transmitter to a suitable rail or panel.
2. Attach the thermowell to the pipe or process container wall. Install and tighten the thermowell before applying pressure.
3. Attach necessary extension nipples and adapters. Seal the nipple and adapter threads with silicone tape.
4. Screw the sensor into the thermowell. Install drain seals if required for severe environments or to satisfy code requirements.
5. Screw the connection head to the sensor.
6. Attach the sensor lead wires to the connection head terminals.
7. Attach additional sensor lead wires from the connection head to the transmitter.
8. Attach and tighten the connection head cover. Enclosure covers must be fully engaged to meet explosion-proof requirements.
9. Set the transmitter failure mode switch
10. Attach the sensor wires to the transmitter (see Figure 2-9 on page 2-11).



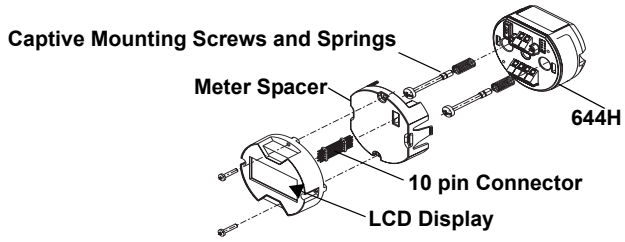
A = Rail Mount Transmitter
B = Threaded Sensor Connection Head
C = Standard Extension
D = Threaded Style Sensor
E = Threaded Thermowell

LCD Display Installation

The LCD display provides local indication of the transmitter output and abbreviated diagnostic messages governing transmitter operation. Transmitters ordered with the LCD display are shipped with the meter installed. After-market installation of the meter can be performed the transmitter has a meter connector (transmitter revision 5.5.2 or later). After-market installation requires the meter kit (part number 00644-4430-0001), which includes:

- LCD display assembly (includes LCD display, meter spacer, and 2 screws)
- Meter cover with O-ring in place

Figure 2-4. Installing the LCD Display



Use the following procedure to install the meter.

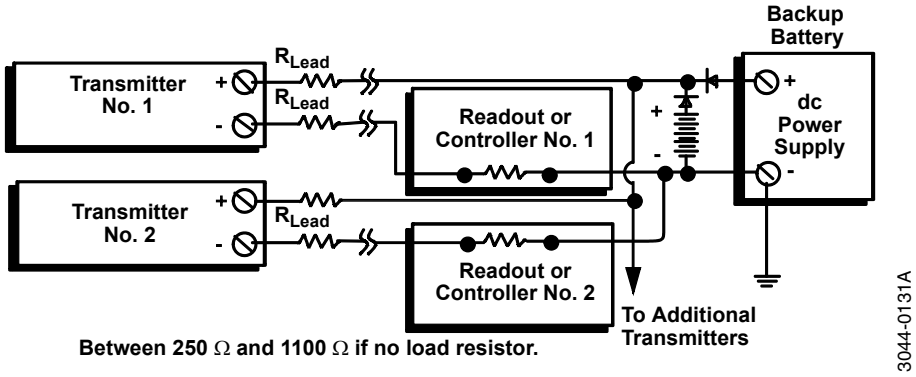
1. If the transmitter is installed in a loop, secure the loop and disconnect the power. If the transmitter is installed in an enclosure, remove the cover from the enclosure.
2. Decide meter orientation (the meter can be rotated in 90° increments). To change meter orientation, remove the screws located above and below the display screen. Lift the meter off the meter spacer. Remove the 8-pin plug and re-insert it in the location that will result in the desired viewing orientation.
3. Reattach the meter to the meter spacer using the screws. If the meter was rotated 90° from its original position it will be necessary to remove the screws from their original holes and re-insert them in the adjacent screws holes.
4. Line up the 10-pin connector with the 10-pin socket and push the meter into the transmitter until it snaps into place.
5. Attach the meter cover; tighten at least one-third turn after the O-ring contacts the transmitter housing. The cover must be fully engaged to meet explosion-proof requirements.
6. Use a HART Communicator, AMS software, or a FOUNDATION fieldbus Communication tool to configure the meter to the desired display. Refer to “LCD Meter Options (644H Only)” for information on configuring the LCD display.

NOTE
Observe the following LCD display temperature limits:
Operating: –4 to 185 °F (–20 to 85 °C)
Storage: –50 to 185 °F (–45 to 85 °C)

Multichannel Installations (HART)

In a HART installation, several transmitters can be connected to a single master power supply, as shown in Figure 2-5. In this case, the system may be grounded only at the negative power supply terminal. In multichannel installations where several transmitters depend on one power supply and the loss of all transmitters would cause operational problems, consider an uninterrupted power supply or a back-up battery. The diodes shown in Figure 2-5 prevent unwanted charging or discharging of the back-up battery.

Figure 2-5. Multichannel Installations



WIRING

⚠ All power to the transmitter is supplied over the signal wiring. Use ordinary copper wire of sufficient size to ensure that the voltage across the transmitter power terminals does not drop below 12.0 V dc for HART or 9 V dc for Foundation fieldbus.

⚠ If the sensor is installed in a high-voltage environment and a fault condition or installation error occurs, the sensor leads and transmitter terminals could carry lethal voltages. Use extreme caution when making contact with the leads and terminals.

NOTE
Do not apply high voltage (e.g., ac line voltage) to the transmitter terminals. Abnormally high voltage can damage the unit. (Sensor and transmitter power terminals are rated to 42.4 V dc. A constant 42.4 volts across the sensor terminals may damage the unit.)

For multichannel HART installations, see above. The transmitters will accept inputs from a variety of RTD and thermocouple types. Refer to Figure 2-6 on page 2-10 when making sensor connections. Refer to Figure 2-8 on page 2-10 for FOUNDATION fieldbus installations.

Use the following steps to wire the power and sensor to the transmitter:

1. Remove the terminal block cover (if applicable).
2. Connect the positive power lead to the "**+**" terminal. Connect the negative power lead to the "**–**" terminal (see Figure 2-7).
3. Tighten the terminal screws. When tightening the sensor and power wires, the max torque is 6-in.-lbs (0.7 N-m).
4. Reattach and tighten the cover (if applicable).
5. Apply power (see "Power Supply").

Figure 2-6. Transmitter Power, Communication, and Sensor Terminals

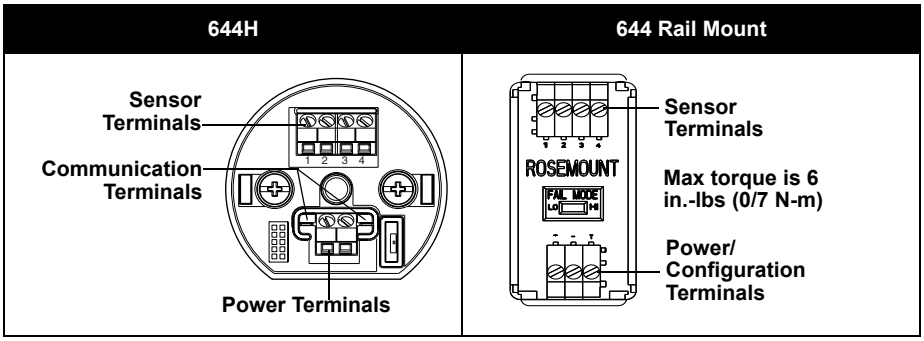
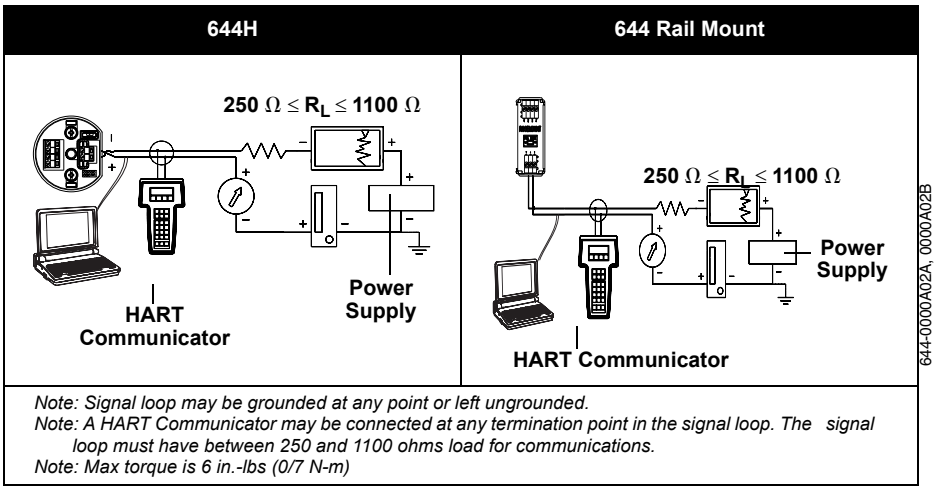
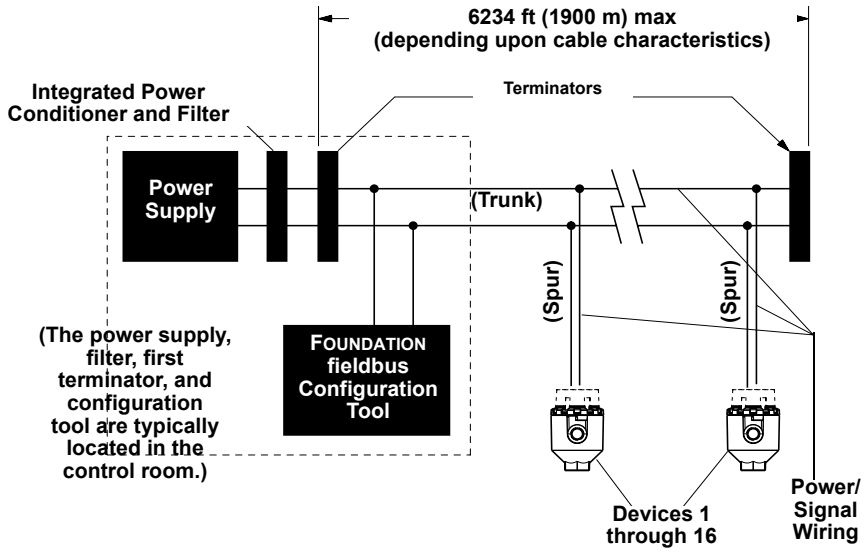


Figure 2-7. Connecting a HART Communication Tool to a Transmitter Loop



Note: Signal loop may be grounded at any point or left ungrounded.
Note: A HART Communicator may be connected at any termination point in the signal loop. The signal loop must have between 250 and 1100 ohms load for communications.
Note: Max torque is 6 in.-lbs (0/7 N-m)

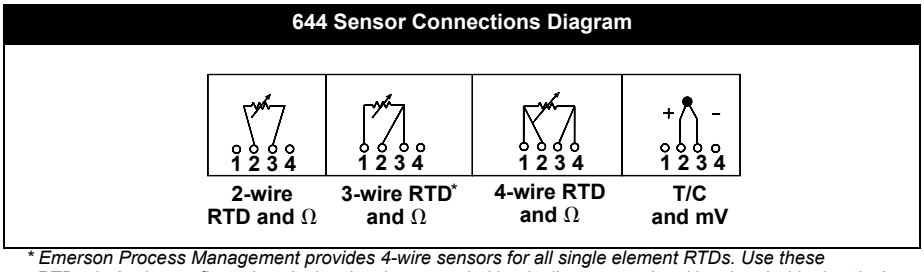
Figure 2-8. Connecting a FOUNDATION fieldbus Host System to a Transmitter Loop



Sensor Connections

⚠ The 644 is compatible with a number of RTD and thermocouple sensor types. Figure 2-9 shows the correct input connections to the sensor terminals on the transmitter. To ensure a proper sensor connection, anchor the sensor lead wires into the appropriate compression terminals and tighten the screws.

Figure 2-9. Sensor Wiring Diagrams



** Emerson Process Management provides 4-wire sensors for all single element RTDs. Use these RTDs in 3-wire configurations by leaving the unneeded leads disconnected and insulated with electrical tape.*

Thermocouple or Millivolt Inputs

The thermocouple can be connected directly to the transmitter. Use appropriate thermocouple extension wire if mounting the transmitter remotely from the sensor. Make millivolt inputs connections with copper wire. Use shielding for long runs of wire.

RTD or Ohm Inputs

The transmitters will accept a variety of RTD configurations, including 2-wire, 3-wire, 4-wire. If the transmitter is mounted remotely from a 3-wire or 4-wire RTD, it will operate within specifications, without recalibration, for lead wire resistances of up to 60 ohms per lead (equivalent to 6,000 feet of 20 AWG wire). In this case, the leads between the RTD and transmitter should be shielded. If using only two leads, both RTD leads are in series with the sensor element, so significant errors can occur if the lead lengths exceed three feet of 20 AWG wire (approximately 0.05 °C/ft). For longer runs, attach a third or fourth lead as described above.

Sensor Lead Wire Resistance Effect– RTD Input

When using a 4-wire RTD, the effect of lead resistance is eliminated and has no impact on accuracy. However, a 3-wire sensor will not fully cancel lead resistance error because it cannot compensate for imbalances in resistance between the lead wires. Using the same type of wire on all three lead wires will make a 3-wire RTD installation as accurate as possible. A 2-wire sensor will produce the largest error because it directly adds the lead wire resistance to the sensor resistance. For 2- and 3-wire RTDs, an additional lead wire resistance error is induced with ambient temperature variations. The table and the examples shown below help quantify these errors.

Table 2-1. Examples of Approximate Basic Error

Sensor Input	Approximate Basic Error
4-wire RTD	None (independent of lead wire resistance)
3-wire RTD	± 1.0 Ω in reading per ohm of unbalanced lead wire resistance (Unbalanced lead wire resistance = maximum imbalance between any two leads.)
2-wire RTD	1.0 Ω in reading per ohm of lead wire resistance

Examples of Approximate Lead Wire Resistance Effect Calculations

Given:

Total cable length:	150 m
Imbalance of the lead wires at 20 °C:	1.5 Ω
Resistance/length (18 AWG Cu):	0.025 Ω/m °C
Temperature coefficient of Cu (α_{Cu}):	0.039 Ω/Ω °C
Temperature coefficient of Pt(α_{Pt}):	0.00385 Ω/Ω °C
Change in Ambient Temperature (ΔT_{amb}):	25 °C
RTD Resistance at 0 °C (R_o):	100 Ω (for Pt 100 RTD)

- Pt100 4-wire RTD: No lead wire resistance effect.
- Pt100 3-wire RTD:

$$\text{Basic Error} = \frac{\text{Imbalance of Lead Wires}}{(\alpha_{Pt} \times R_o)}$$

$$\text{Error due to amb. temp. variation} = \frac{(\alpha_{Cu}) \times (\Delta T_{amb}) \times (\text{Imbalance of Lead Wires})}{(\alpha_{Pt}) \times (R_o)}$$

Lead wire imbalance seen by the transmitter = 0.5 Ω

$$\text{Basic error} = \frac{0.5\ \Omega}{(0.00385\ \Omega / \Omega\ °C) \times (100\ \Omega)} = 1.3\ °C$$

Error due to amb. temp. var. of ± 25 °C

$$= \frac{(0.0039\ \Omega / \Omega\ °C) \times (25\ °C) \times (0.5\ \Omega)}{(0.00385\ \Omega / \Omega\ °C) \times (100\Omega)} = \pm 13^{\cdot} °C$$

- Pt100 2-wire RTD:

$$\text{Basic Error} = \frac{\text{Lead Wire Resistance}}{(\alpha_{Pt} \times R_o)}$$

$$\text{Error due to amb. temp. variation} = \frac{(\alpha_{Cu}) \times (\Delta T_{amb}) \times (\text{Lead Wire Resistance})}{(\alpha_{Pt}) \times (R_o)}$$

Lead wire resistance seen by the transmitter = 150 m × 2 wires × 0.025 Ω/m = 7.5 Ω

$$\text{Basic error} = \frac{7.5\ \Omega}{(0.00385\ \Omega / \Omega\ °C) \times (100\ \Omega)} = 19.5\ °C$$

Error due to amb. temp. var. of ± 25 °C

$$= \frac{(0.0039\ \Omega / \Omega\ °C) \times (25\ °C) \times (7.5\ \Omega)}{(0.00385\ \Omega / \Omega\ °C) \times (100\Omega)} = \pm 1.9\ °C$$

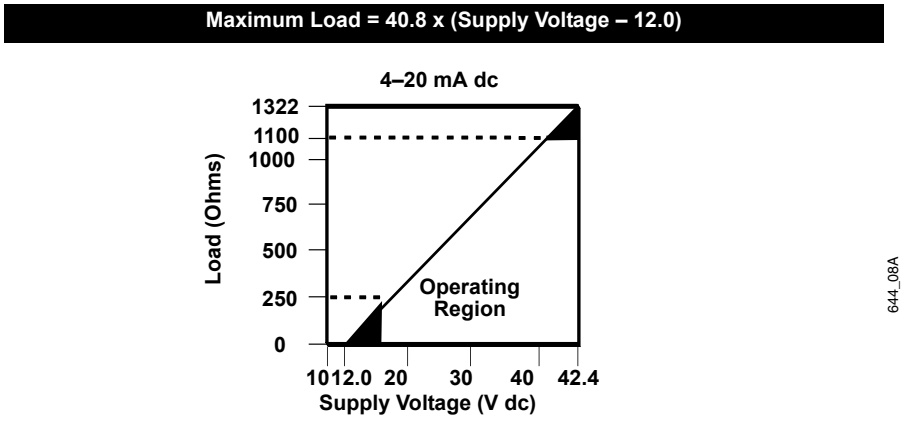
POWER SUPPLY

HART Installation

To communicate with a transmitter, a 18.1 V dc minimum power supply is required. The power supplied to the transmitter should not drop below the transmitter lift-off voltage (see Figure 2-10). If the power drops below the lift-off voltage while the transmitter is being configured, the transmitter may interpret the configuration information incorrectly.

The dc power supply should provide power with less than 2 percent ripple. The total resistance load is the sum of the resistance of the signal leads and the load resistance of any controller, indicator, or related pieces of equipment in the loop. Note that the resistance of intrinsic safety barriers, if used, must be included.

Figure 2-10. Load Limits



FOUNDATION fieldbus Installation

Powered over FOUNDATION fieldbus with standard fieldbus power supplies. The transmitter operates between 9.0 and 32.0 V dc, 11 mA maximum. Transmitter power terminals are rated to 42.4 VDC.

The power terminals on the 644 with FOUNDATION fieldbus are polarity insensitive.

Ground the Transmitter

The transmitter will operate with the current signal loop either floating or grounded. However, the extra noise in floating systems affects many types of readout devices. If the signal appears noisy or erratic, grounding the current signal loop at a single point may solve the problem. The best place to ground the loop is at the negative terminal of the power supply. Do not ground the current signal loop at more than one point.

The transmitter is electrically isolated to 500 V DC/AC rms (707 V dc), so the input circuit may also be grounded at any single point. When using a grounded thermocouple, the grounded junction serves as this point.

Neither side of the loop should be grounded on FOUNDATION fieldbus devices. Only the shield wire should be grounded.

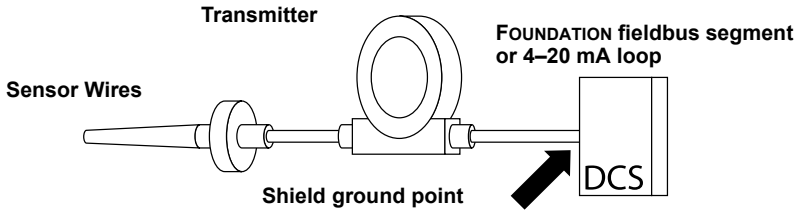
NOTE
Do not ground the signal wire at both ends.

Ungrounded Thermocouple, mV, and RTD/Ohm Inputs

Each process installation has different requirements for grounding. Use the grounding options recommended by the facility for the specific sensor type, or begin with grounding Option 1 (the most common).

Option 1:

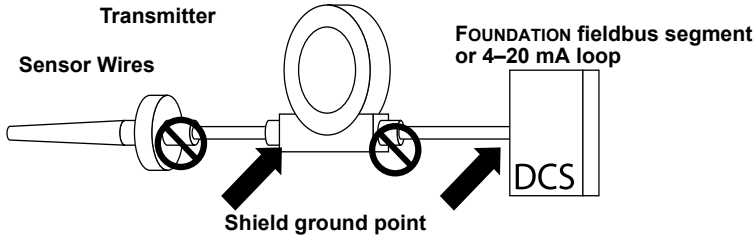
1. Connect signal wiring shield to the sensor wiring shield.
2. Ensure the two shields are tied together and electrically isolated from the transmitter housing.
3. Ground shield at the power supply end only.
4. Ensure that the sensor shield is electrically isolated from the surrounding grounded fixtures.



Connect shields together, electrically isolated from the transmitter

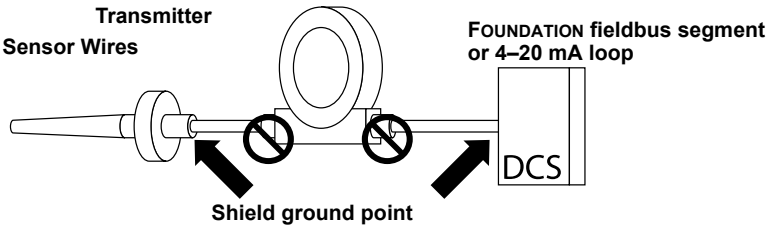
Option 2:

1. Connect sensor wiring shield to the transmitter housing (only if the housing is grounded).
2. Ensure the sensor shield is electrically isolated from surrounding fixtures that may be grounded.
3. Ground signal wiring shield at the power supply end.



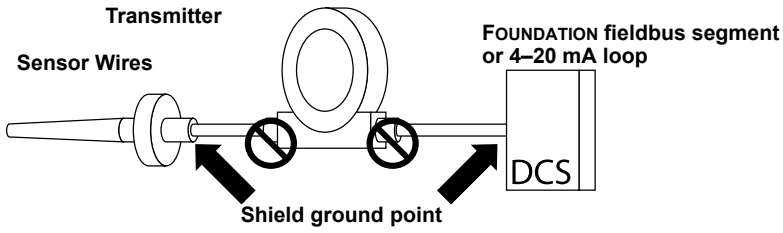
Option 3:

1. Ground sensor wiring shield at the sensor, if possible.
2. Ensure that the sensor wiring and signal wiring shields are electrically isolated from the transmitter housing.
3. Do not connect the signal wiring shield to the sensor wiring shield.
4. Ground signal wiring shield at the power supply end.



Grounded Thermocouple Inputs

1. Ground sensor wiring shield at the sensor.
2. Ensure that the sensor wiring and signal wiring shields are electrically isolated from the transmitter housing.
3. Do not connect the signal wiring shield to the sensor wiring shield.
4. Ground signal wiring shield at the power supply end.



Section 3 HART Configuration

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OVERVIEW

This section provides information on configuring, troubleshooting, operating, and maintaining the Rosemount 644 with HART protocol.

SAFETY MESSAGES

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that potentially raises safety issues is indicated by a warning symbol (⚠). Please refer to the following safety messages before performing an operation preceded by this symbol.

Warnings

⚠WARNING

Failure to follow these installation guidelines could result in death or serious injury.

- Make sure only qualified personnel perform the installation.

Explosions could result in death or serious injury.

- Do not remove the connection head cover in explosive atmospheres when the circuit is live.
- Before connecting a HART Communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with instrinsically safe or non-incendive field wiring practices.
- Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.
- All connection head covers must be fully engaged to meet explosion-proof requirements.

Process leaks could result in death or serious injury.

- Do not remove the thermowell while in operation.
- Install and tighten thermowells and sensors before applying pressure

Electrical shock could cause death or serious injury.

- Use extreme caution when making contact with the leads and terminals.

Surges/Transients

The transmitter will withstand electrical transients of the energy level encountered in static discharges or induced switching transients. However, high-energy transients, such as those induced in wiring from nearby lightning strikes, welding, heavy electrical equipment, or switching gears, can damage both the transmitter and the sensor. To protect against high-energy transients, install the transmitter into a suitable connection head with the Rosemount 470 Transient Protector. Refer to the 470 Transient Protector Product Data Sheet (document number 00813-0100-4191) for more information.

COMMISSIONING

The 644 must be configured for certain basic variables to operate. In many cases, all of these variables are pre-configured at the factory. Configuration may be required if the transmitter is not configured or if the configuration variables need revision.

Commissioning consists of testing the transmitter and verifying transmitter configuration data. Model 644 transmitters can be commissioned either before or after installation. Commissioning the transmitter on the bench before installation using a HART Communicator or AMS ensures that all transmitter components are in working order.

⚠ To commission on the bench, connect the transmitter and the HART Communicator or AMS as shown in Figure 2-7 on page 2-10. Make sure the instruments in the loop are installed according to intrinsically-safe or non-incendive field wiring practices before connecting a communication in an explosive atmosphere. Connect HART Communication leads at any termination point in the signal loop. For convenience, connect them to the terminals labeled “COMM” on the terminal block. Connecting across the “TEST” terminals will prevent successful communication. Avoid exposing the transmitter electronics to the plant environment after installation by setting all transmitter jumpers during the commissioning stage on the bench.

When using a HART Communicator, any configuration changes made must be sent to the transmitter by using the “Send” key (F2). AMS configuration changes are implemented when the “Apply” button is clicked.

For more information on using the HART Communicator with the 644 transmitter, see Section 3: HART Configuration.

Setting the Loop to Manual

When sending or requesting data that would disrupt the loop or change the output of the transmitter, set the process application loop to manual. The HART Communicator or AMS will prompt you to set the loop to manual when necessary. Acknowledging this prompt does not set the loop to manual. The prompt is only a reminder; set the loop to manual as a separate operation.

Failure Mode

As part of normal operation, each transmitter continuously monitors its own performance. This automatic diagnostics routine is a timed series of checks repeated continuously. If diagnostics detect an input sensor failure or a failure in the transmitter electronics, the transmitter drives its output to low or high depending on the position of the failure mode switch. Saturation levels are 3.90 mA for standard configuration (3.8 mA if configured for NAMUR-compliant operation) on the low end and 20.5 mA for standard or NAMUR-compliant configuration on the high end, if the sensor temperature is outside of range limits. These values are also custom configurable by the factory or using the HART Communicator.

The values to which the transmitter drives its output in failure mode depend on whether it is configured to standard, NAMUR-compliant, or custom operation. See “Hardware and Software Failure Mode” on page A-7 for standard and NAMUR-compliant operation parameters.

Changing Switch Positions

To change the failure mode on the 644 transmitter, follow the steps below.

⚠ 1. If applicable, remove the enclosure cover.

2. Locate the orange failure mode switch. On the 644H the switch is located near the power terminals and located in the center of the front panel on the 644 rail mount (see Figure 2-6).

3. Move the switch to the desired alarm setting. To set the failure mode to high alarm, position the switch toward the “HI” mark on the terminal block. To set the failure mode to low alarm, position the switch in the opposite direction.

⚠ 4. Replace the enclosure cover (if applicable). Enclosure covers must be fully engaged to meet explosion-proof requirements.

HART COMMUNICATOR

The HART Communicator exchanges information with the transmitter from the control room, the instrument site, or any wiring termination point in the loop. To facilitate communication, connect the HART Communicator in parallel with the transmitter (see Figure 2-11). Use the loop connection ports on the rear panel of the HART Communicator. The connections are non-polarized. Do not make connections to the serial port or the NiCad recharger jack in explosive atmospheres. Before connecting the HART communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.

For more information regarding the HART Communicator, please see the HART Communicator Reference Manual (document number 00809-0100-4275)

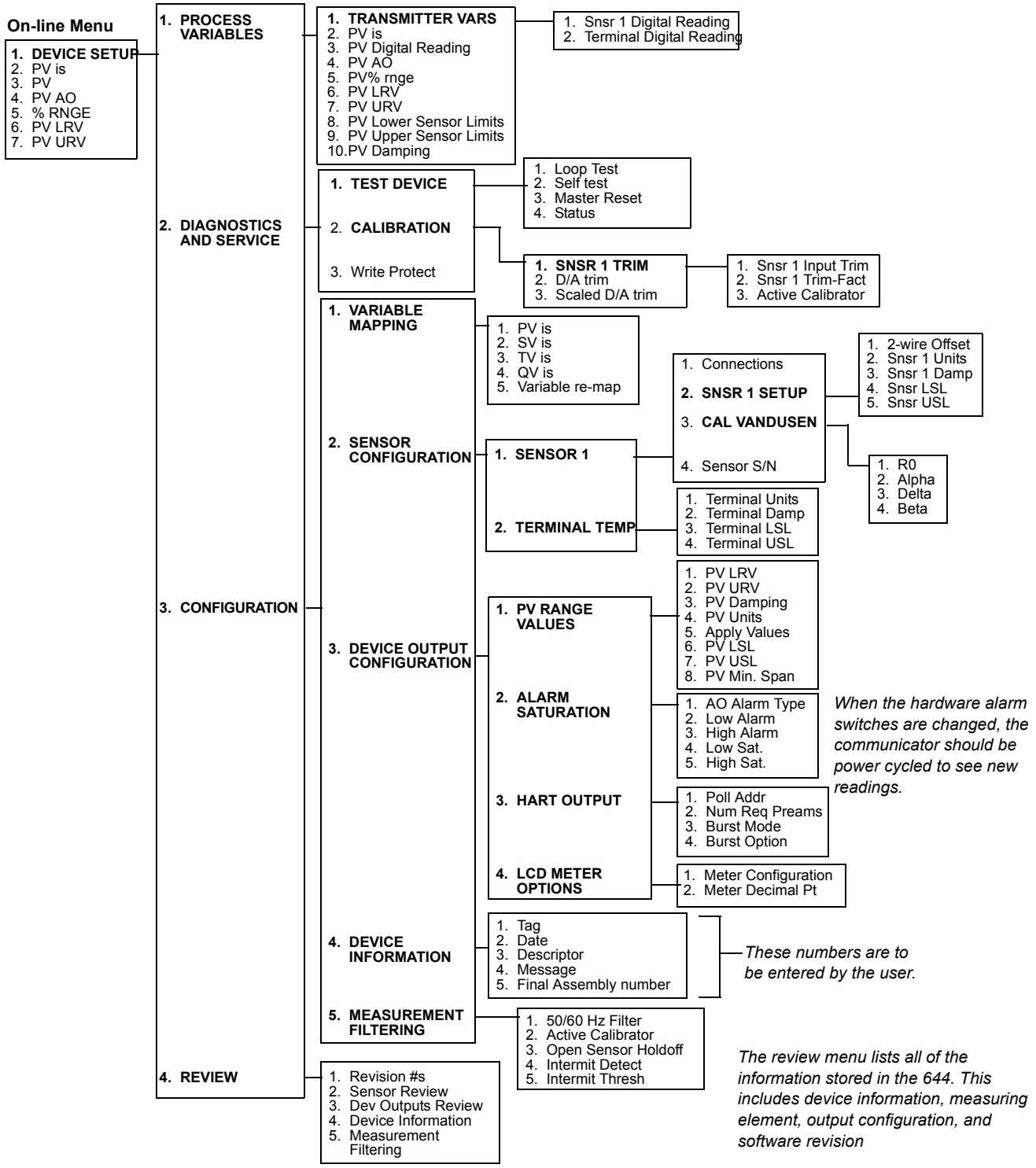
CONFIGURATION

The 644 transmitter can be configured either on-line or off-line using a HART Communicator or AMS. During on-line configuration, the transmitter is connected to a HART communicator. Data is entered in the working register of the communicator and sent directly to the transmitter. Off-line configuration consists of storing configuration data in a HART Communicator while it is not connected to a transmitter. Data is stored in nonvolatile memory and can be downloaded to the transmitter at a later time.

HART Menu Tree

Options listed in bold type indicate that a selection provides other options. For ease of operation, changing calibration and setup, such as sensor type, number of wires, and range values, can be completed in several locations.

Figure 3-1. HART Communicator Menu Tree



Fast Key Sequence

Table 3-1 lists the fast key sequences for common transmitter functions.

NOTE:
The fast key sequences assume that DD Dev v6, DD v1 is being used. Some features apply only to the 644H, as noted in the following pages. Table 3-1 provides alphabetical function lists for all HART Communicator tasks as well as their corresponding fast key sequences.

Table 3-1. 644 Fast Key Sequence

Function	Fast Keys
Active Calibrator	1, 2, 2, 1, 3
Alarm/Saturation	1, 3, 3, 2
AO Alarm Type	1, 3, 3, 2, 1
Burst Mode	1, 3, 3, 3, 3
Burst Option	1, 3, 3, 3, 4
Calibration	1, 2, 2
Callendar-Van Dusen	1, 3, 2, 1
Configuration	1, 3
D/A Trim	1, 2, 2, 2
Damping Values	1, 1, 10
Date	1, 3, 4, 2
Descriptor	1, 3, 4, 3
Device Info	1, 3, 4
Device Output Configuration	1, 3, 3
Diagnostics and Service	1, 2
Filter 50/60 Hz	1, 3, 5, 1
Hardware Rev	1, 4, 1
Hart Output	1, 3, 3, 3
Intermittent Detect	1, 3, 5, 4
LCD Display Options	1, 3, 3, 4
Loop Test	1, 2, 1, 1
LRV (Lower Range Value)	1, 1, 6
LSL (Lower Sensor Limit)	1, 1, 8
Measurement Filtering	1, 3, 5
Message	1, 3, 4, 4
Meter Configuring	1, 3, 3, 4, 1
Meter Decimal Point	1, 3, 3, 4, 2

Function	Fast Key
Num Req Preams	1, 3, 3, 3, 2
Open Sensor Holdoff	1, 3, 5, 3
Percent Range	1, 1, 5
Poll Address	1, 3, 3, 3, 1
Process Temperature	1, 1
Process Variables	1, 1
PV Damping	1, 3, 3, 1, 3
PV Unit	1, 3, 3, 1, 4
Range Values	1, 3, 3, 1
Review	1, 4
Scaled D/A Trim	1, 2, 2, 3
Sensor Connection	1, 3, 2, 1, 1
Sensor 1 Setup	1, 3, 2, 1, 2
Sensor Serial Number	1, 3, 2, 1, 4
Sensor 1 Trim	1, 2, 2, 1
Sensor 1 Trim-Factory	1, 2, 2, 1, 2
Sensor Type	1, 3, 2, 1, 1
Software Revision	1, 4, 1
Status	1, 2, 1, 4
Tag	1, 3, 4, 1
Terminal Temperature	1, 3, 2, 2,
Test Device	1, 2, 1
URV (Upper Range Value)	1, 1, 7
USL (Upper Sensor Limit)	1, 1, 9
Variable Mapping	1, 3, 1
Variable Re-Map	1, 3, 1, 5
Write Protect	1, 2, 3
2-Wire Offset	1, 3, 2, 1, 2, 1

AMS

One of the key benefits of intelligent devices is the ease of device configuration. When used with AMS, the 644 is easy to configure and provides instant and accurate alerts and alarms. The main configuration screen of the 644 is the “Configuration Properties” screen. From this screen, the transmitter set-up can easily be viewed and edited.

The screens use a color-coding to give visual indication of the transmitter health and to indicate any changes that may need to be made or written to the transmitter.

- Gray screens: indicates that all information has been written to the transmitter
- Yellow on screen: changes have been made in the software but not sent to the transmitter
- Green on screen: all current changes on screen have been written to the transmitter
- Red on screen: indicates an alarm or alert that requires immediate investigation

Apply AMS Changes

Changes made in the software must be *sent* to the transmitter in order for the changes to take effect in the process.

1. From the bottom of the “Configuration Properties” screen, click **Apply**.
2. An “Apply Parameter Modification” screen appears, enter desired information and click **OK**.
3. After carefully reading the warning provided, select **OK**.

Review Configuration Data

Before operating the 644 in an actual installation, review all of the factory-set configuration data to ensure that it reflects the current application.

Review

Fast Key Sequence	1, 4

When activating the *Review* function, scroll through the configuration data list to check each process variable. If changes to the transmitter configuration data are necessary, refer to “Configuration” below.

AMS
Right click on the device and select “Configuration Properties” from the menu. Select the tabs to review the transmitter configuration data.

Check Output

Before performing other transmitter on-line operations, review the 644 digital output parameters to ensure that the transmitter is operating properly.

Process Variables

Fast Key Sequence	1, 1

The *Process Variables* menu displays process variables, including sensor temperature, percent of range, analog output, and terminal temperature. These process variables are continuously updated. The primary variable is the 4 –20 mA analog signal. The secondary variable is the transmitter terminal temperature.

AMS
Right click on the device and select “Configuration Properties” from the menu. Select the Analog Output tab to review the transmitter Analog Output Range.

Configuration

The 644 must be configured for certain basic variables in order to be operational. In many cases, all of these variables are pre-configured at the factory. Configuration may be required if the transmitter is not configured or if the configuration variables need revision.

Variable Mapping

Fast Key Sequence	1, 3, 1

The *Variable Mapping* menu displays the sequence of the process variables. When using the 644H you can select *5 Variable Re-Map* to change this configuration. When the *Select PV* screen appears *Snsr 1* must be selected. Either *Sensor 1*, *Terminal Temperature*, or *not used* can be selected for the remaining variables. The primary variable is the 4–20 mA analog signal.

AMS
Right click on the device and select “Configuration Properties” from the menu. Select the Analog Output tab to review the Mapped Variable Output.

Apply changes made (see “Apply AMS Changes” on page 3-6).

Select Sensor Type

Fast Key Sequence	1, 3, 2, 1, 1

The *Connections* command allows selection of the sensor type and the number of sensor wires to be connected. Select from the following sensors:

- 2-, 3-, or 4-wire Pt 100, Pt 200, Pt 500, Pt 1000 RTDs: α = 0.00385 $\Omega/\Omega/°C$
- 2-, 3-, or 4-wire Pt 100: α = 0.003916 $\Omega/\Omega/°C$
- 2-, 3-, or 4-wire Ni 120 nickel RTDs
- 2-, 3-, or 4-wire Cu 10 RTDs
- IEC/NIST/DIN Type B, E, J, K, R, S, T thermocouples
- DIN type L, U thermocouples
- ASTM Type W5Re/W26Re thermocouple
- –10 to 100 millivolts
- 2-, 3-, or 4-wire 0 to 2000 ohms

Contact a Emerson Process Management representative for information on the temperature sensors, thermowells, and accessory mounting hardware that is available through Emerson Process Management.

AMS
Right click on the device and select “Sensor Connections,” then select “Sensor 1 Config.“Select “Sensor Connections.” The *wizard* will walk through the screens.

Sensor Serial Number

Fast Key Sequence	1, 3, 2, 1, 4

The *Sensor S/N* variable provides a location to list the serial number of the attached sensor. It is useful for identifying sensors and tracking sensor calibration information.

AMS
Right click on the device and select “Configuration Properties” from the menu. Select the Snsr 1 tab to configure the Snsr S/N.

Apply changes made (see “Apply AMS Changes” on page 3-6).

Set Output Units

Fast Key Sequence	1, 3, 2, 1, 2, 2

The *Set Output Unit* command sets the desired primary variable units. Set the transmitter output to one of the following engineering units:

- Degrees Celsius
- Degrees Fahrenheit
- Degrees Rankine
- Kelvin
- Ohms
- Millivolts

AMS
Right click on the device and select “Configuration Properties” from the menu. Select the Snsr 1 tab to configure the Sensor Output Units. Set the units to the desired output.

Apply changes made (see “Apply AMS Changes” on page 3-6).

50/60 Hz Filter

Fast Key Sequence	1, 3, 5, 1

The *50/60 Hz Filter* command sets the transmitter electronic filter to reject the frequency of the AC power supply in the plant.

AMS
Right click on the device and select “Configuration Properties” from the menu. Select the Electronics tab to configure the output frequency.

Apply changes made (see “Apply AMS Changes” on page 3-6).

Terminal Temperature

Fast Key Sequence	1, 3, 2, 2

The *Terminal Temp* command sets the terminal temperature units to indicate the temperature at the transmitter terminals.

AMS
Right click on the device and select “Configuration Properties” from the menu. Select the Electronics tab to configure the Terminal Temperature. In the Terminal Temperature box, set the Terminal Units to the desired output.

Apply changes made (see “Apply AMS Changes” on page 3-6).

LCD Meter Options (644H Only)

Fast Key Sequence	1, 3, 3, 4

The *LCD Meter Option* command sets the meter options, including engineering units and decimal point. Change the meter settings to reflect necessary configuration parameters when adding a meter or reconfiguring the transmitter.

To customize variables that the meter displays, follow the steps below:

1. From the home screen select *1 Device Setup*, *3 Configuration*, *3 Dev Output Config*, *4 LCD Meter Options*, and *1 Meter Config*.
2. Use the F2 key to turn each of the following options **OFF** or **ON**: Sensor 1, Terminal Temp, Percent Of Range, Analog Output. As many outputs as desired an be turned **ON** at once.
3. Press F4, **ENTER**, and then F2, **SEND**, to send the information to the transmitter. The LCD display will scroll through the outputs selected in step 2.

To change the decimal point configuration, perform the following steps:

1. From the home screen select *1 Device Setup*, *3 Configuration*, *3 Dev Output Config*, *4 LCD Meter Options*, and *1 Meter Decimal Pt*.
2. Choose from *Floating Precision* or *One-*, *Two-*, *Three-*, or *Four-Digit Precision* by pressing F4, **ENTER**. Press F2 to send the information to the transmitter.

AMS
Right click on the device and select “Configuration Properties” from the menu. Select the Device tab to configure the LCD. From the LCD Meter box, define the Meter Config, Meter Decimal Pt.

Apply changes made (see “Apply AMS Changes” on page 3-6).

Process Variable (PV) Damping

Fast Key Sequence	1, 3, 3, 1, 3

The *PV Damp* command changes the response time of the transmitter to smooth variations in output readings caused by rapid changes in input. Determine the appropriate damping setting based on the necessary response time, signal stability, and other requirements of the loop dynamics of the system. The default damping value is 5.0 seconds and can be reset to any value between 0 and 32 seconds.

The value chosen for damping affects the response time of the transmitter. When set to zero (or disabled), the damping function is off and the transmitter output reacts to changes in input as quickly as the intermittent sensor algorithm allows (refer to “Intermittent Threshold” on page 3-16 for a description of the intermittent sensor algorithm). Increasing the damping value increases the transmitter response time.

With damping enabled, if the temperature change is within 0.2% of the sensor limits, the transmitter measures the change in input every 500 milliseconds and outputs values according to the following relationship:

$$\text{Damped Value} = (N - P) \times \left(\frac{2T - U}{2T + U}\right) + P$$

P =previous damped value

N =new sensor value

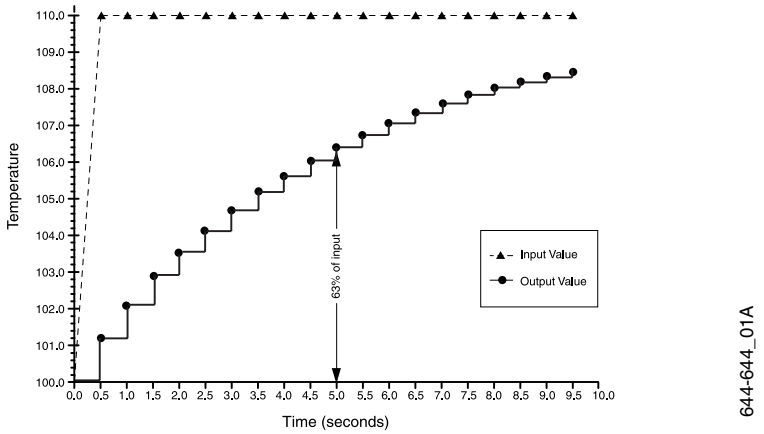
T = damping time constant

At the value to which the damping time constant is set, the transmitter output is at 63% of the input change and it continues to approach the input according to the damping equation above.

For example, as illustrated in Figure 3-2, if the temperature undergoes a step change—within 0.2% of the sensor limits—from 100 degrees to 110 degrees, and the damping is set to 5.0 seconds, the transmitter calculates and reports a new reading every 500 milliseconds using the damping equation. At 5.0 seconds, the transmitter outputs 106.3 degrees, or 63% of the input change, and the output continues to approach the input curve according to the equation above.

For information regarding the damping function when the input change is greater than 0.2% of the sensor limits, refer to “Intermittent Threshold” on page 3-16.

Figure 3-2. Change in Input vs. Change in Output with Damping Set to Five Seconds



AMS
Right click on the device and select “Configuration Properties” from the menu. Select the Snsr 1 tab and apply damping requirements.

Apply changes made (see “Apply AMS Changes” on page 3-6).

2-Wire RTD Offset

Fast Key Sequence	1, 3, 2, 1, 2, 1

The *2-Wire RTD Offset* command allows the user to input the measured lead wire resistance, which will result in the transmitter adjusting its temperature measurement to correct the error caused by this resistance. Due to a lack of lead wire compensation within the RTD, temperature measurement made with a 2-wire RTD are often inaccurate. See “Sensor Lead Wire Resistance Effect– RTD Input” on page 2-11 for more information.

To utilize this feature perform the following steps:

1. Measure the lead wire resistance of both RTD leads after installing the 2-wire RTD and the 644H.
2. From the HOME screen, select 1 *Device Setup*, *3 Configuration*, *2 Sensor Configuration, 1 Sensor 1, 2 Snsr 1 Setup,* and *1 2-Wire Offset*.
3. Enter the total measured resistance of the two RTD leads at the *2-Wire Offset* prompt. Enter this resistance as a negative (–) value to ensure proper adjustment.The transmitter then adjusts its temperature measurement to correct the error caused by lead wire resistance.

AMS
Right click on the device and select “Configuration Properties” from the menu. Select the Snsr 1 tab to configure the 2 Wire Offset.

Apply changes made (see “Apply AMS Changes” on page 3-6).

Information Variables

Access the transmitter information variables on-line using the HART Communicator or other suitable communications device. The following is a list of transmitter information variables. These variables include device identifiers, factory-set configuration variables, and other information. A description of each variable, the corresponding fast key sequence, and a review of its purposes are provided.

Tag

Fast Key Sequence	1, 3, 4, 1

The *Tag* variable is the easiest way to identify and distinguish between transmitters in multi-transmitter environments. Use it to label transmitters electronically according to the requirements of the application. The tag defined is automatically displayed when a HART Communicator establishes contact with the transmitter at power-up. The tag may be up to eight characters long and has no impact on the primary variable readings of the transmitter.

Date

Fast Key Sequence	1, 3, 4, 2

The *Date* command is a user-defined variable that provides a place to save the date of the last revision of configuration information. It has no impact on the operation of the transmitter or the HART Communicator.

Descriptor

Fast Key Sequence	1, 3, 4, 3

The *Descriptor* variable provides a longer user-defined electronic label to assist with more specific transmitter identification than is available with the tag variable. The descriptor may be up to 16 characters long and has no impact on the operation of the transmitter or the HART Communicator.

Message

Fast Key Sequence	1, 3, 4, 4

The *Message* variable provides the most specific user-defined means for identifying individual transmitters in multi-transmitter environments. It allows for 32 characters of information and is stored with the other configuration data. The message variable has no impact on the operation of the transmitter or the HART Communicator.

AMS

Right click on the device and select “Configuration Properties” from the menu. Select the Device tab to enter alphanumeric device information.

Apply changes made (see “Apply AMS Changes” on page 3-6).

Diagnostics and Service

Test Device

Fast Key Sequence	1, 2, 1

The *Test Device* command initiates a more extensive diagnostics routine than that performed continuously by the transmitter. The *Test Device* menu lists the following options:

- *1 Loop test* verifies the output of the transmitter, the integrity of the loop, and the operations of any recorders or similar devices installed in the loop. See “Loop Test” below for more information.
- *2 Self Test* initiates a transmitter self test. Error codes are displayed if there is a problem.
- *3 Master Reset* sends out a command that restarts and tests the transmitter. A master reset is like briefly powering down the transmitter. Configuration data remains unchanged after a master reset.
- *4 Status* lists error codes. **ON** indicates a problem, and **OFF** means there are no problems.

Loop Test

Fast Key Sequence	1, 2, 1, 1

The *Loop Test* command verifies the output of the transmitter, the integrity of the loop, and the operations of any recorders or similar devices installed in the loop. To initiate a loop test, perform the following procedure:

1. Connect a reference meter to the transmitter. To do so, shunt the transmitter power through the meter at some point in the loop.
2. 644H: From the **HOME** screen, select *1 Device Setup*, *2 Diag/Serv*, *1 Test Device*, *1 Loop Test* before performing a loop test.
   644 rail mount, select *1 Device Setup*, *2 Diagnostics and Service, 2 Loop Test*. Select **OK** after setting the control loop to manual. The communicator displays the loop test menu.
3. Select a discreet milliampere level for the transmitter to output. At the **CHOOSE ANALOG OUTPUT** prompt, select *1 4mA*, *2 20mA*, or select *3 other* to manually input a value between 4 and 20 mA.
4. Check the current meter installed in the test loop to verify that it reads the value that was commanded to output. If the readings do not match, either the transmitter requires an output trim or the current meter is malfunctioning.

After completing the test procedure, the display returns to the loop test screen and another output value can be chosen.

AMS

Right click and select “Diagnostics and Test.” Select “Loop Test.” The *loop test wizard* will walk through the process to fix the output for the sensor.

The transmitter must be returned to normal conditions (turn off loop test) before placing back in process

Right click and select “Diagnostics and Test.” Select “Loop Test.” The *loop test wizard* will walk through the process to fix the analog output. From the *loop test wizard* screen choose “END.” A message will appear indicating that it is OK to return to normal.

Master Reset

Fast Key Sequence	1, 2, 1, 3

Master Reset resets the electronics without actually powering down the unit. It does not return the transmitter to the original factory configuration.

AMS
Right click on the device and select “Diagnostics and Test” from the menu. Choose “Master Reset.”

The *wizard* will perform the reset.

Active Calibrator

Fast Key Sequence	1, 2, 2, 1, 3

The *Active Calibrator Mode* command enables or disables the pulsating current feature. The transmitter ordinarily operates with pulsating current so that sensor diagnostic functions, such as open sensor detection and EMF compensation, can be performed correctly. Some calibration equipment requires steady current to function properly. By enabling the Active Calibrator Mode the transmitter stops sending pulsating current to the sensor and supples a steady current. Disabling the Active Calibrator returns the transmitter to its normal operating state of sending a pulsating current to the sensor, thus enabling the sensor diagnostic functions.

The Active Calibrator Mode is volatile and will be automatically disabled when power is cycled or when a Master Reset is performed using the HART Communicator.

NOTE
The Active Calibrator Mode must be disabled before returning the transmitter to the process. This will ensure that the full diagnostic capabilities of the 644 are available.

Disabling or enabling the Active Calibrator Mode will not change any of the sensor trim values stored in the transmitter.

Sensor Review

Fast Key Sequence	1, 4, 2

The *Signal Condition* command allows viewing or changing the primary variable lower and upper range values, sensor percent of range, and sensor damping.

AMS
Right click on the device and select “Configuration Properties” from the menu. Select the Snsr 1 tab and review sensor configuration.

Apply changes made (see “Apply AMS Changes” on page 3-6).

Write Protect

Fast Key Sequence	1, 2, 3

The *Write Protect* command allows you to protect the transmitter configuration data from accidental or unwarranted changes. To enable the write protect feature, perform the following procedure:

1. From the **HOME** screen select *1 Device Setup*, *2 Diag/Service*, *3 Write Protect.*
2. Select *Enable WP.*

NOTE
To disable write protect on the 644, repeat the procedure, replacing *Enable WP* with *Disable WP*.

AMS
Right click on the device and select “Configuration Properties” from the menu. Select the Basic Setup tab and enable WP.

Apply changes made (see “Apply AMS Changes” on page 3-6).

HART Output

Fast Key Sequence	1, 3, 3, 3

The *HART Output* command allows the user to make changes to the multidrop address, specify the number of requested preambles, initiate burst mode, or make changes to the burst options.

AMS
Right click on the device and select “Configuration Properties” from the menu. Select the HART tab to configure HART multidrop addressing.

Apply changes made (see “Apply AMS Changes” on page 3-6).

Alarm and Saturation

Fast Key Sequence	1, 3, 3, 2

The *Alarm/Saturation* command allows the alarm settings (Hi or Low) and saturation values to be viewed and changed. To change the alarm values and saturation values, select the value to be changed, either *2 Low Alarm*, *3 High Alarm*, *4 Low Sat.*, or *5 High Sat*. Enter the desired new value, which must fall within the guidelines given below.

- The low alarm value must be between 3.30 and 3.75 mA
- The high alarm value must be between 21.0 and 23.0 mA
- The low saturation level must be between the low alarm value plus 0.1 mA and 3.9 mA.

Example: The low alarm value has been set to 3.7 mA. Therefore, the low saturation level, S, must be $3.8 \leq S \leq 3.9$ mA.

- The high saturation level must be between 20.5 mA and the high alarm value minus 0.1 mA.

Example: The high alarm value has been set to 20.8 mA. Therefore, the low saturation level, S, must be $20.5 \leq S \leq 20.7$ mA.

AMS
For AMS, configure the sensor as indicated above.

Right click on the device and select “Configuration Properties” from the menu. Select the Analog Output tab to define the alarm and saturation levels. From the Alarm box, enter the low and high alarm and the low and high saturation.

Apply changes made (see “Apply AMS Changes” on page 3-6).

Rerange

Reranging the transmitter sets the measurement range to the limits of expected readings. Setting the measurement range to the limits of expected readings maximizes transmitter performance; the transmitter is most accurate when operated within the expected temperature range for your application.

PV Range Values

Fast Key Sequence	1, 3, 3, 1

The *PV URV* and *PV LRV* commands, found in the *PV Range Values* menu screen, allow the user to set the transmitter’s lower and upper range values using limits of expected readings. The range of expected readings is defined by the Lower Range Value (LRV) and Upper Range Value (URV). The transmitter range values can be reset as often as necessary to reflect changing process conditions. From the *PV Range Values* screen select *1 PV LRV* to change the lower range value and *2 PV URV* to change the upper range value.

NOTE:
The rerange functions should not be confused with the trim functions. Although the rerange command matches a sensor input to a 4–20 mA output, as in conventional calibration, it does not affect the transmitter’s interpretation of the input.

AMS
Right click on the device and select “Configuration Properties” from the menu. Select the Basic Setup tab and set the URV and LRV.

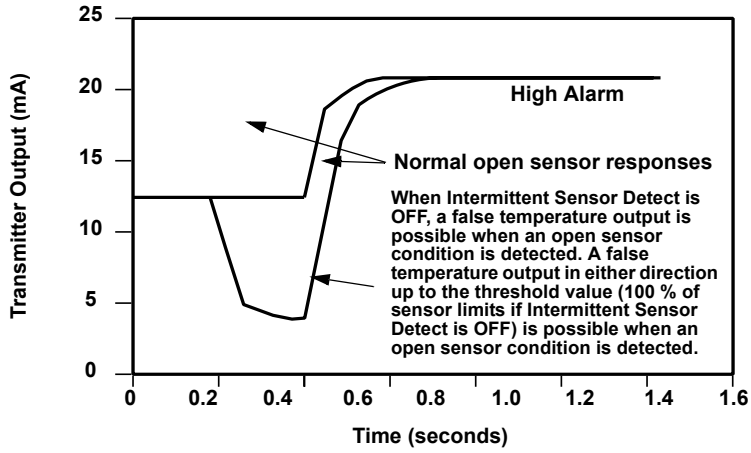
Apply changes made (see “Apply AMS Changes” on page 3-6).

Intermittent Threshold

Fast Key Sequence	1, 3, 5, 4

The threshold value can be changed from the default value of 2%. Turning the Intermittent Sensor Detect feature **OFF** or leaving it **ON** and increasing the threshold value above the default does not affect the time needed for the transmitter to output the correct alarm signal after detecting a true open sensor condition. However, the transmitter may briefly output a false temperature reading for up to one update in either direction (see Figure 3-4 on page 3-18) up to the threshold value (100% of sensor limits if Intermittent Sensor Detect is **OFF)**. Unless rapid response rate is necessary, the suggested setting of the Intermittent Sensor Detect mechanism is **ON** with 2% threshold.

Figure 3-3. Open Sensor Response



Intermittent Sensor Detect (Advanced Feature)

The Intermittent Sensor Detect feature is designed to guard against process temperature readings caused by intermittent open sensor conditions (an *intermittent* sensor condition is an open sensor condition that lasts less than one update). By default, the transmitter is shipped with the Intermittent Sensor Detect feature switched **ON** and the threshold value set at 2% of sensor limits. The Intermittent Sensor Detect feature can be switched **ON** or **OFF** and the threshold value can be changed to any value between 0 and 100% of the sensor limits with a HART communicator.

Transmitter Behavior with Intermittent Sensor Detect ON

When the Intermittent Sensor Detect feature is switched **ON**, the transmitter can eliminate the output pulse caused by intermittent open sensor conditions. Process temperature changes (ΔT) within the threshold value will be tracked normally by the transmitter's output. A ΔT greater than the threshold value will activate the intermittent sensor algorithm. True open sensor conditions will cause the transmitter to go into alarm.

The threshold value of the 644 should be set at a level that allows the normal range of process temperature fluctuations; too high and the algorithm will not be able to filter out intermittent conditions; too low and the algorithm will be activated unnecessarily. The default threshold value is 2% of the sensor limits.

Transmitter Behavior with Intermittent Sensor Detect OFF

When the Intermittent Sensor Detect feature is switched **OFF**, the transmitter tracks all process temperature changes, even if they are the consequence of an intermittent sensor. (The transmitter in effect behaves as though the threshold value had been set at 100%.) The output delay due to the intermittent sensor algorithm will be eliminated.

AMS

Right click on the device and select "Configuration Properties" from the menu. Select the Electronics tab. From the Measurement Filtering Box, configure the Intermit threshold.

Apply changes made (see "Apply AMS Changes" on page 3-6).

Open Sensor Holdoff

Fast Key Sequence	1, 3, 5, 3

The *Open Sensor Holdoff* option, at the normal setting, enables the 644 to be more robust under heavy EMI conditions. This is accomplished through the software by having the transmitter perform additional verification of the open sensor status prior to activating the transmitter alarm. If the additional verification shows that the open sensor condition is not valid, the transmitter will not go into alarm.

For users of the 644 that desire a more vigorous open sensor detection, the Open Sensor Holdoff option can be changed to a fast setting. With this setting, the transmitter will report an open sensor condition without additional verification of the open condition.

AMS
Right click on the device and select “Configuration Properties” from the menu. Select the Electronics tab. From the Measurement Filtering Box box, configure the Open Snsr Holdoff.

Apply changes made (see “Apply AMS Changes” on page 3-6).

MULTIDROP COMMUNICATION

Multidropping refers to the connection of several transmitters to a single communications transmission line. Communication between the host and the transmitters takes place digitally with the analog output of the transmitters deactivated.

Many Rosemount transmitters can be multidropped. With the HART communications protocol, up to 15 transmitters can be connected on a single twisted pair of wires or over leased phone lines.

A HART Communicator can test, configure, and format a multidropped 644 transmitter in the same way as in a standard point-to-point installation.

The application of a multidrop installation requires consideration of the update rate necessary from each transmitter, the combination of transmitter models, and the length of the transmission line. Each transmitter is identified by a unique address (1–15) and responds to the commands defined in the HART protocol.

Figure 3-4. Typical Multidropped Network

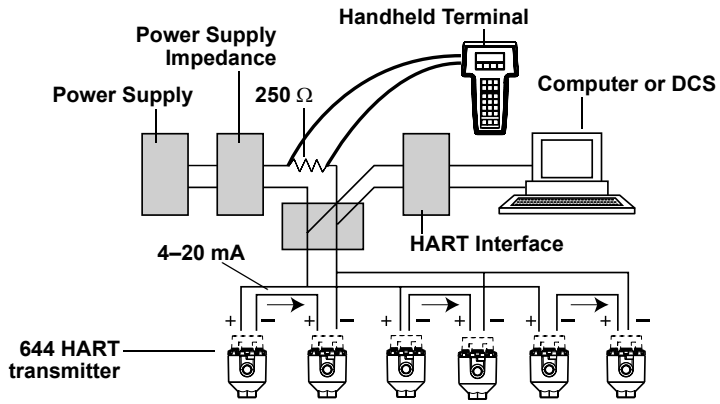


Figure 3-4 shows a typical multidrop network. Do not use this figure as an installation diagram. Contact Emerson Process Management product support with specific requirements for multidrop applications.

NOTE
644 transmitters are set to address 0 at the factory, allowing them to operate in the standard point-to-point manner with a 4–20 mA output signal. To activate multidrop communication, the transmitter address must be changed to a number between 1 and 15. This change deactivates the 4–20 mA analog output, sending it to 4 mA. The failure mode current also is disabled.

AMS
Right click and select “Configuration Properties” from the menu screen. Select the “HART” tab. From here, assign the polling address.

OPERATION AND MAINTENANCE

Calibration

Calibrating the transmitter increases the measurement precision by allowing corrections to be made to the factory-stored characterization curve by digitally altering the transmitter’s interpretation of the sensor input.

To understand calibration, it is necessary to understand that smart transmitters operate differently from analog transmitters. An important difference is that smart transmitters are factory-characterized, meaning that they are shipped with a standard sensor curve stored in the transmitter firmware. In operation, the transmitter uses this information to produce a process variable output, in engineering units, dependent on the sensor input.

Calibration of the 644 may include the following procedures:

- Sensor Input Trim: digitally alter the transmitter’s interpretation of the input signal
- Transmitter Sensor Matching: generates a special custom curve to match that specific sensor curve, as derived from the Callendar-Van Dusen constants
- Output Trim: calibrates the transmitter to a 4–20 mA reference scale
- Scaled Output Trim: calibrates the transmitter to a user-selectable reference scale.

Trim the Transmitter

One or more of the trim functions may be used when calibrating. The trim functions are as follows

- Sensor Input Trim
- Transmitter Sensor Matching
- Output Trim
- Output Scaled Trim

Sensor Input Trim

Fast Key Sequence	1, 2, 2, 1, 1

Perform a sensor trim if the transmitters digital value for the primary variable does not match the plant's standard calibration equipment. The sensor trim function calibrates the sensor to the transmitter in temperature units or raw units. Unless your site-standard input source is NIST-traceable, the trim functions will not maintain the NIST-traceability of the system.

The *Sensor Input Trim* command allows the transmitter's interpretation of the input signal to be digitally altered (see Figure 3-5). The sensor reference command trims, in engineering (F, °C, °R, K) or raw (Ω, mV) units, the combined sensor and transmitter system to a site standard using a known temperature source. Sensor trimming is suitable for validation procedures or for applications that require calibrating the sensor and transmitter together.

Use the following procedure to perform a sensor trim with a 644H.

1. Connect the calibration device or sensor to the transmitter. Refer to Figure 2-9 on page 2-11 or inside of the transmitter terminal side cover for sensor wiring diagrams. (If using an active calibrator, please see "Active Calibrator" on page 3-14)
2. Connect the communicator to the transmitter loop.
3. From the Home screen, select *1 Device Setup*, *2 Diag/Service*, *2 Calibration*, *1 Sensor 1 Trim*, *1 Sensor 1 Input Trim* to prepare to trim the sensor.
4. Set the control loop to manual and select **OK**.
5. Select the appropriate sensor trim units at the **ENTER SNSR 1 TRIM UNITS** prompt.
6. Select *1 Lower Only* or *2 Lower and Upper* at the **SELECT SENSOR TRIM POINTS** prompt.
7. Adjust the calibration device to the desired trim value (must be within the selected sensor limits). If a combined sensor and transmitter system are being trimmed, expose the sensor to a known temperature and allow the temperature reading to stabilize. Use a bath, furnace or isothermal block, measured with a site-standard thermometer, as the known temperature source.
8. Select **OK** once the temperature stabilizes. The communicator displays the output value the transmitter associates with the input value provided by the calibration device.
9. Enter the lower or upper trim point, depending on the selection in Step 6.

AMS
For AMS, configure the sensor as indicated above.

Right click on the device and select "Calibrate" from the menu. Select "Sensor 1 Trim," then "Sensor Input Trim."

The *wizard* will continue through the process.

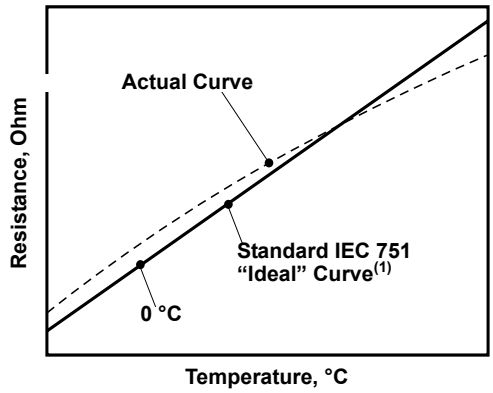
The transmitter may be restored to the factory default by selecting: "Calibration," "Sensor 1 Trim," "Revert to Factory Trim."

The *wizard* will recall the factory trim for a given sensor

Apply changes made (see “AMS” on page 3-5).

Transmitter-Sensor Matching
Perform the *Transmitter Sensor Matching* procedure to enhance the temperature measurement accuracy of the system (see the comparison below) and if you have a sensor with Callendar-Van Dusen constants. When ordered from Emerson Process Management, sensors with Callendar-Van Dusen constants are NIST-traceable.

The 644 accepts Callendar-Van Dusen constants from a calibrated RTD schedule and generates the actual curve to match that specific sensor curve.



(1) The Actual Curve is identified from the Callendar-Van Dusen equation.

System Accuracy Comparison at 150 °C Using a PT 100 (α=0.00385) RTD with a Span of 0 to 200 °C			
Standard RTD		Matched RTD	
644H	±0.15 °C	644H	±0.15 °C
Standard RTD	±1.05 °C	Matched RTD	±0.18 °C
Total System(1)	±1.06 °C	Total System(1)	±0.23 °C

(1) Calculated using root-summed-squared (RSS) statistical method

$$\text{TotalSystemAccuracy} = \sqrt{(\text{TransmitterAccuracy})^2 + (\text{SensorAccuracy})^2}$$

Callendar-Van Dusen equation:

$$R_t = R_o + R_o\alpha\,[t - \delta(0.01t-1)(0.01t) - \beta(0.01t - 1)(0.01t)^3]$$

The following input variables, included with specially-ordered Rosemount temperature sensors, are required:

R_0 = Resistance at Ice Point
Alpha = Sensor Specific Constant
Beta = Sensor Specific Constant
Delta = Sensor Specific Constant

To input Callendar-Van Dusen constants, perform the following procedure:

1. From the **HOME** screen, select *1 Device Setup*, *3 Configuration*, *2 Sensor Config*, *1 Chng Type/Conn*, *1 Sensor 1* or *2 Sensor 2.* Set the control loop to manual and select **OK**.
2. Select *Cal VanDusen* at the **ENTER SENSOR TYPE** prompt.
3. Select the appropriate number of wires at the **ENTER SENSOR CONNECTION** prompt.
4. Enter the R_o, Alpha, Delta, and Beta values from the stainless steel tag attached to the special-order sensor when prompted.
5. Return the control loop to automatic control and select **OK**.

To disable the transmitter-sensor matching feature from the **HOME** screen select *1 Device Setup*, *3 Configuration*, *2 Sensor Confi*g, *1 Chng Type/Conn*, *1 Sensor 1* or *2 Sensor 2*. Choose the appropriate sensor type from the **ENTER SENSOR TYPE** prompt.

NOTE
When the transmitter-sensor matching is disabled, the transmitter reverts to either user or factory trim, whichever was used previously. Make certain the transmitter engineering units default correctly before placing the transmitter into service.

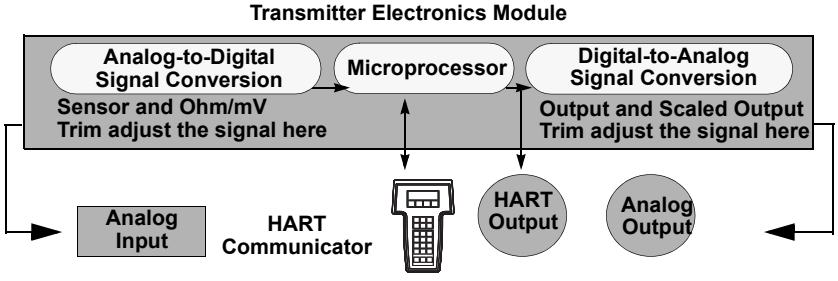
AMS
Right click on the device and select “Sensor Connections” from the menu. Select the “Sensor 1 Config.” Select “Sensor Connections.”

The *wizard* will go through the required changes.

NOTE
Under “Enter Sensor Type” select “Cal VanDusen.

Output Trim or Scaled Output Trim
Perform an output trim or a scaled output trim if the digital value for the primary variable matches the plant’s standards but the transmitter’s analog output does not match the reading on the output device. The output trim function calibrates the transmitter to a 4–20 mA reference scale; the scaled output trim function calibrates to a user-selectable reference scale. To determine the need for an output trim or a scaled output trim, perform a loop test (see “Loop Test” on page 3-13).

Figure 3-5. Dynamics of Smart Temperature Measurement



Output Trim

Fast Key Sequence	1, 2, 2, 2

The *D/A Trim* command allows the transmitter's conversion of the input signal to a 4–20 mA output to be altered (see Figure 3-5 on page 3-22). Adjust the analog output signal at regular intervals to maintain measurement precision. To perform a digital-to-analog trim, perform the following procedure:

1. From the **HOME** screen, select *1 Device setup*, *2 Diag/Service*, *2 Calibration*, *2 D/A trim*. Set the control loop to manual and select **OK**.
2. Connect an accurate reference meter to the transmitter at the **CONNECT REFERENCE METER** prompt. To do so, shunt the power to the transmitter through the reference meter at some point in the loop. Select **OK** after connecting the reference meter.
3. Select **OK** at the **SETTING FLD DEV OUTPUT TO 4 MA** prompt. The transmitter outputs 4.00 mA.
4. Record the actual value from the reference meter, and enter it at the **ENTER METER VALUE** prompt. The communicator prompts the user to verify whether or not the output value equals the value on the reference meter.
5. If the reference meter value equals the transmitter output value, then select *1 Yes* and go to step 6. If the reference meter value does not equal the transmitter output value, then select *2 No* and go to step 4.
6. Select **OK** at the **SETTING FLD DEV OUTPUT TO 20 MA** prompt and repeat steps 4 and 5 until the reference meter value equals the transmitter output value.
7. Return the control loop to automatic control and select **OK**.

AMS
Right click on the device and select "Calibrate" from the menu. Select "D/A Trim."

This *wizard* will go through the required changes.

Scaled Output Trim

Fast Key Sequence	1, 2, 2, 3

The *Scaled D/A Trim* command matches the 4 and 20 mA points to a user-selectable reference scale other than 4 and 20 mA (2–10 volts, for example). To perform a scaled D/A trim, connect an accurate reference meter to the transmitter and trim the output signal to scale as outlined in the "Output Trim" procedure.

AMS
Right click on the device and select "Calibrate" from the menu. Select "Scaled D/A Trim."

This *wizard* will go through the required changes.

Hardware

Maintenance

The 644H has no moving parts and requires minimal scheduled maintenance.

Sensor Checkout

⚠ To determine whether the sensor is at fault, replace it with another sensor or connect a test sensor locally at the transmitter to test remote sensor wiring. Select any standard, off-the-shelf sensor for use with a 644, or consult the factory for a replacement special sensor and transmitter combination.

Diagnostic Messages

Hardware

⚠ If a malfunction is suspected despite the absence of diagnostics messages on the HART Communicator or AMS display, follow the procedures described in Table 3-2 to verify that transmitter hardware and process connections are in good working order. Under each of four major symptoms, specific suggestions are offered for solving the problem.

Table 3-2. 644H Troubleshooting Chart

Symptom	Potential Source	Corrective Action
Transmitter Does Not Communicate with HART Communicator	Loop Wiring	• Check the revision level of the transmitter device descriptors (DDs) stored in the communicator. The communicator should report Dev v6, DD v1. • Check for a minimum of 250 ohms resistance between the power supply and HART Communicator connection. • Check for adequate voltage to the transmitter. If a HART Communicator is connected and 250 ohms resistance is in the loop, the transmitter requires a minimum of 12.0 V at the terminals to operate (over entire 3.75 to 23 mA operating range). • Check for intermittent shorts, open circuits, and multiple grounds. • Specify the transmitter by tag number. For certain non-standard transmitter installations, it may be necessary, because of excessive line length, to specify the transmitter tag number to initiate communications.
High Output	Sensor Input Failure or Connection	• Connect a HART Communicator and enter the transmitter test mode to isolate a sensor failure. • Check for a sensor open or short circuit. • Check the process variable to see if it is out of range.
	Loop Wiring	• Check for dirty or defective terminals, interconnecting pins, or receptacles.
	Power Supply	• Check the output voltage of the power supply at the transmitter terminals. It should be 12.0 to 42.4 V dc (over entire 3.75 to 23 mA operating range).
	Electronics Module	• Connect a HART Communicator and enter the transmitter status mode to isolate module failure. • Connect a HART Communicator and check the sensor limits to ensure calibration adjustments are within the sensor range.
Erratic Output	Loop Wiring	• Check for adequate voltage to the transmitter. It should be 12.0 to 42.4 V dc at the transmitter terminals (over entire 3.75 to 23 mA operating range). • Check for intermittent shorts, open circuits, and multiple grounds. • Connect a HART Communicator and enter the Loop test mode to generate signals of 4 mA, 20 mA, and user-selected values.
	Electronics Module	• Connect a HART Communicator and enter the transmitter test mode to isolate module failure.

Symptom	Potential Source	Corrective Action
Low Output or No Output	Sensor Element	• Connect a HART Communicator and enter the Transmitter test mode to isolate a sensor failure. • Check the process variable to see if it is out of range.
	Loop Wiring	• Check for adequate voltage to the transmitter. It should be 12.0 to 42.4 V dc (over entire 3.75 to 23 mA operating range). • Check for shorts and multiple grounds. • Check for proper polarity at the signal terminal. • Check the loop impedance. • Connect a HART Communicator and enter the Loop test mode. • Check wire insulation to detect possible shorts to ground.
	Electronics Module	• Connect a HART Communicator and check the sensor limits to ensure calibration adjustments are within the sensor range. • Connect a HART Communicator and enter the Transmitter test mode to isolate an electronics module failure.

HART Communicator

Table 3-3 provides a guide to diagnostic messages used by the HART Communicator.

Variable parameters within the text of a message are indicated with the notation <*variable parameter*>. Reference to the name of another message is identified by the notation *[another message]*.

Table 3-3. HART Diagnostics Messages

Message	Description
Add item for ALL device types or only for this ONE device type	Asks the user whether the hot key item being added should be added for all device types or only for the type of device that is connected.
Command Not Implemented	The connected device does not support this function.
Communication Error	Either a device sends back a response indicating that the message it received was unintelligible, or the HART Communicator cannot understand the response from the device.
Configuration memory not compatible with connected device	The configuration stored in memory is incompatible with the device to which a transfer has been requested.
Device Busy	The connected device is busy performing another task.
Device Disconnected	Device fails to respond to a command.
Device write protected	Device is in write-protect mode. Data can not be written.
Device write protected. Do you still want to shut off?	Device is in write-protect mode. Press YES to turn the HART Communicator off and lose the unsent data.
Display value of variable on hotkey menu?	Asks whether the value of the variable should be displayed adjacent to its label on the hotkey menu if the item being added to the hotkey menu is a variable.
Download data from configuration memory to device	Prompts user to press SEND softkey to initiate a memory to device transfer.
Exceed field width	Indicates that the field width for the current arithmetic variable exceeds the device- specified description edit format.
Exceed precision	Indicates that the precision for the current arithmetic variable exceeds the device- specified description edit format.
Ignore next 50 occurrences of status?	Asked after displaying device status. Softkey answer determines whether next 50 occurrences of device status will be ignored or displayed.
Illegal character	An invalid character for the variable type was entered.
Illegal date	The day portion of the date is invalid.
Illegal month	The month portion of the date is invalid.
Illegal year	The year portion of the date is invalid.
Incomplete exponent	The exponent of a scientific notation floating point variable is incomplete.
Incomplete field	The value entered is not complete for the variable type.
Looking for a device	Polling for multidropped devices at addresses 1–15.
Mark as read only variable on hotkey menu?	Asks whether the user should be allowed to edit the variable from the hotkey menu if the item being added to the hotkey menu is a variable.
No device configuration in configuration memory	There is no configuration saved in memory available to re-configure off-line or transfer to a device.
No Device Found	Poll of address zero fails to find a device, or poll of all addresses fails to find a device if auto-poll is enabled.
No hotkey menu available for this device.	There is no menu named “hotkey” defined in the device description for this device.
No offline devices available.	There are no device descriptions available to be used to configure a device offline.
No simulation devices available.	There are no device descriptions available to simulate a device.
No UPLOAD_VARIABLES in ddl for this device	There is no menu named “upload_variables” defined in the device description for this device. This menu is required for offline configuration.
No Valid Items	The selected menu or edit display contains no valid items.
OFF KEY DISABLED	Appears when the user attempts to turn the HART Communicator off before sending modified data or before completing a method.
Online device disconnected with unsent data. RETRY or OK to lose data.	There is unsent data for a previously connected device. Press RETRY to send data, or press OK to disconnect and lose unsent data.

Message	Description
Out of memory for hotkey configuration. Delete unnecessary items.	There is no more memory available to store additional hotkey items. Unnecessary items should be deleted to make space available.
Overwrite existing configuration memory	Requests permission to overwrite existing configuration either by a device-to-memory transfer or by an offline configuration. User answers using the softkeys.
Press OK.	Press the OK softkey. This message usually appears after an error message from the application or as a result of HART communications.
Restore device value?	The edited value that was sent to a device was not properly implemented. Restoring the device value returns the variable to its original value.
Save data from device to configuration memory	Prompts user to press SAVE softkey to initiate a device-to-memory transfer.
Saving data to configuration memory.	Data is being transferred from a device to configuration memory.
Sending data to device.	Data is being transferred from configuration memory to a device.
There are write only variables which have not been edited. Please edit them.	There are write-only variables which have not been set by the user. These variables should be set or invalid values may be sent to the device.
There is unsent data. Send it before shutting off?	Press YES to send unsent data and turn the HART Communicator off. Press NO to turn the HART Communicator off and lose the unsent data.
Too few data bytes received	Command returns fewer data bytes than expected as determined by the device description.
Transmitter Fault	Device returns a command response indicating a fault with the connected device.
Units for <variable label> has changed. Unit must be sent before editing, or invalid data will be sent.	The engineering units for this variable have been edited. Send engineering units to the device before editing this variable.
Unsent data to online device. SEND or LOSE data	There is unsent data for a previously connected device which must be sent or thrown away before connecting to another device.
Use up/down arrows to change contrast. Press DONE when done.	Gives direction to change the contrast of the HART Communicator display.
Value out of range	The user-entered value is either not within the range for the given type and size of variable or not within the min/max specified by the device.
<message> occurred reading/writing <variable label>	Either a read/write command indicates too few data bytes received, transmitter fault, invalid response code, invalid response command, invalid reply data field, or failed pre- or post-read method; or a response code of any class other than SUCCESS is returned reading a particular variable.
<variable label> has an unknown value. Unit must be sent before editing, or invalid data will be sent.	A variable related to this variable has been edited. Send related variable to the device before editing this variable.

AMS Software

The following is a list of messages used by AMS software. These are communicated through pop-up menus.

Message	Description
Command not implemented	The connected device does not support this function.
Communication error	Either a device sends back a response indicating that the message it received was unintelligible, or the HART Communicator cannot understand the response from the device.
Device busy	The connected device is busy performing another task.
Device disappears from list	Device fails to respond to a command.
Device write protected	Device is in write-protect mode. Data can not be written.
Illegal character	An invalid character for the variable type was entered.
Illegal date	The day portion of the date is invalid.
Illegal month	The month portion of the date is invalid.
Illegal year	The year portion of the date is invalid.
Incomplete exponent	The exponent of a scientific notation floating point variable is incomplete.
Incomplete field	The value entered is not complete for the variable type.
Sending data to device	Data is being transferred from configuration memory to a device.
There are write only variables which have not been edited. Please edit them	There are write-only variables that have not been set by the user. These variables should be set or invalid values may be sent to the device.
There is unsent data. Send it before shutting off?	Press YES to send unsent data and turn the HART Communicator off. Press NO to turn the HART Communicator off and lose the unsent data.
Too few data bytes received	Command returns fewer data bytes than expected as determined by the device description.
Transmitter fault	Device returns a command response indicating a fault with the connected device.
Units for <variable label> has changed. Unit must be sent before editing, or invalid data will be sent.	The engineering units for this variable have been edited. Send engineering units to the device before editing this variable.
Unsent data to online device. SEND or LOSE data	There is unsent data for a previously connected device which must be sent or thrown away before connecting to another device.
Value out of range	The user-entered value is either not within the range for the given type and size of variable or not within the min/max specified by the device.
<message> occurred reading/writing <variable label>	Either a read/write command indicates too few data bytes received, transmitter fault, invalid response code, invalid response command, invalid reply data field, or failed pre- or post-read method; or a response code of any class other than SUCCESS is returned reading a particular variable.
<variable label> has an unknown value. Unit must be sent before editing, or invalid data will be sent.	A variable related to this variable has been edited. Send related variable to the device before editing this variable.

LCD Display

The LCD display displays abbreviated diagnostic messages for troubleshooting the transmitter. To determine the cause of a message, use a HART Communicator to further interrogate the transmitter. A description of each diagnostic message is identified in Table 3-4. The device sometimes requires additional interrogation to determine the source of the warning. Contact Emerson Process Management Customer Central at (800) 999-9307 for further information.

Table 3-4. LCD Display Diagnostics

ALARM	Description
DEV FAIL	The top line of the display scrolls through the following three messages: • “BAD” • “DEV” • “FAIL” This message indicates one of several conditions. For example, the transmitter may have experienced an electronics failure while attempting to store information. If diagnostics indicate an electronics failure, replace the transmitter with a new one. Contact the nearest Emerson Process Management Field Service Center if necessary.
SNSR FAIL	The top line of the display scrolls through the following three messages: • “BAD” • “SNSR” • “FAIL” The bottom line display s the name of the sensor that has failed. This message indicates that the transmitter has detected an open or shorted sensor condition. The sensor may be disconnected, connected improperly, or malfunctioning. Check the sensor connections and sensor continuity.
UNCRN	The top line of the display alternates between “UNCRN” and the sensor value. The bottom line will display the name of the sensor for which this message applies. The uncertain message is displayed when the sensor reading is outside of the acceptable temperature range for the particular sensor type.
FIXED	During a loop test or a a 4–20 mA output trim, the analog output defaults to a fixed value. The top line of the display alternates between “FIXED” and the amount of current selected in milliamperes. The bottom line will hold on “AO mA.”
OFLOW	The location of the decimal point, as configured in the meter setup, is not compatible wit the value to be displayed by the meter. For example, if the meter is measuring a process temperature greater than 9.9999 degrees and the meter decimal point is set to 4-digit precision, the meter will display an “OFLOW” message because it is only capable of displaying a maximum of 9.9999 when set to 4-digit precision.
ALARM	When a failure occurs and the meter is configured to display Primary Variable Percent of Range and/or Analog Output, the top line o the meter will display “ALARM.” This indicates that the transmitter is in failure mode.
SAT	When the transmitter output saturates and the meter is configured to display Primary Variable Percent of Range and/or Analog Output, the top line of the meter will display “SAT.” This indicates that the transmitter output has reached saturation level.

Section 4 FOUNDATION Fieldbus Configuration

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Safety Messages . . . . . **page 4-1**
General Block Information . . . . . **page 4-2**
Foundation fieldbus function blocks . . . . . **page 4-4**
Operation and Maintenance . . . . . **page 4-14**

OVERVIEW

This section provides information on configuring, troubleshooting, operating, and maintaining the Rosemount 644 Temperature transmitter using FOUNDATION fieldbus protocol.

SAFETY MESSAGES

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that potentially raises safety issues is indicated by a warning symbol (⚠). Please refer to the following safety messages before performing an operation preceded by this symbol.

Warnings

⚠WARNING

Failure to follow these installation guidelines could result in death or serious injury.

- Make sure only qualified personnel perform the installation.

Explosions could result in death or serious injury.

- Do not remove the connection head cover in explosive atmospheres when the circuit is live.
- Before powering a FOUNDATION fieldbus segment in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with instrinsically safe or non-incendive field wiring practices.
- Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.
- All connection head covers must be fully engaged to meet explosion-proof requirements.

Process leaks could result in death or serious injury.

- Do not remove the thermowell while in operation.
- Install and tighten thermowells and sensors before applying pressure

Electrical shock could cause death or serious injury.

- Use extreme caution when making contact with the leads and terminals.

GENERAL BLOCK INFORMATION

Device Description

Before configuring the device, ensure the host has the appropriate Device Description file revision for this device. The device descriptor can be found on www.rosemount.com. The initial release of the Rosemount 644 with FOUNDATION fieldbus protocol is device revision 1.

Node Address

The transmitter is shipped at a temporary (248) address. This will enable FOUNDATION fieldbus host systems to automatically recognize the device and move it to a permanent address.

Modes

The Resource, Transducer, and all function blocks in the device have modes of operation. These modes govern the operation of the block. Every block supports both automatic (AUTO) and out of service (OOS) modes. Other modes may also be supported.

⚠ Changing Modes

To change the operating mode, set the MODE_BLK.TARGET to the desired mode. After a short delay, the parameter MODE_BLOCK.ACTUAL should reflect the mode change if the block is operating properly.

Permitted Modes

It is possible to prevent unauthorized changes to the operating mode of a block. To do this, configure MODE_BLOCK.PERMITTED to allow only the desired operating modes. It is recommended to always select OOS as one of the permitted modes.

Types of Modes

For the procedures described in this manual, it will be helpful to understand the following modes:

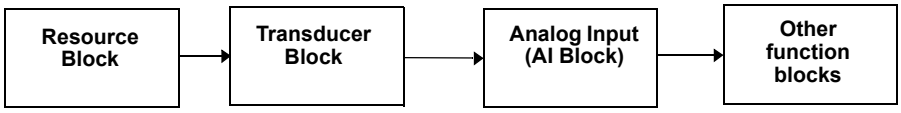
AUTO
The functions performed by the block will execute. If the block has any outputs, these will continue to update. This is typically the normal operating mode.

Out of Service (OOS)
The functions performed by the block will not execute. If the block has any outputs, these will typically not update and the status of any values passed to downstream blocks will be “BAD”. To make some changes to the configuration of the block, change the mode of the block to OOS. When the changes are complete, change the mode back to AUTO.

MAN
In this mode, variables that are passed out of the block can be manually set for testing or override purposes.

Other Types of Modes
Other types of modes are Cas, RCas, ROut, IMan and LO. Some of these may be supported by different function blocks in the 644. For more information, see the Function Block manual (document number 00809-0100-4783).

NOTE
When an upstream block is set to OOS, this will impact the output status of all downstream blocks. The figure below depicts the hierarchy of blocks:



Link Active Scheduler

The 644 can be designated to act as the backup Link Active Scheduler (LAS) in the event that the designated LAS is disconnected from the segment. As the backup LAS, the 644 will take over the management of communications until the host is restored.

The host system may provide a configuration tool specifically designed to designate a particular device as a backup LAS. Otherwise, this can be configured manually as follows:

⚠
1. Access the Management Information Base (MIB) for the 644. To activate the LAS capability, write 0x02 to the BOOT_OPERAT_FUNCTIONAL_CLASS object (Index 605). To deactivate, write 0x01.
2. Restart the device.

Block Installation

Rosemount devices are pre-configured with function blocks at the factory, the default permanent configuration for the 644 is listed below. The 644 can have up to ten additional instantiated function blocks.

- 2 Analog Input Blocks (tag names AI 1300, AI 1400)
- 1 Proportional/Integral/Derivative Block (tag name PID 1500)

The 644 supports the use of Function Block Instantiation. When a device supports block instantiation, the number of blocks and block types can be defined to match specific application needs.The number of blocks that can be instantiated is only limited by the amount of memory within the device and the block types that are supported by the device. Instantiation does not apply to standard device blocks like the Resource, Sensor Transducer, LCD Transducer, and Advanced Diagnostics Blocks.

By reading the parameter “FREE_SPACE” in the Resource block you can determine how many blocks you can instantiate. Each block that you instantiate takes up 4.5% of the “FREE_SPACE”.

Block instantiation is done by the host control system or configuration tool, but not all hosts are required to implement this functionality. Please refer to your specific host or configuration tool manual for more information.

Capabilities

Virtual Communication Relationship (VCRs)

There are a total of 12 VCRs. One is permanent and 11 are fully configurable by the host system. Sixteen link objects are available.

Network Parameter	Value
Slot Time	8
Maximum Response Delay	2
Maximum Inactivity to Claim LAS Delay	32
Minimum Inter DLPDU Delay	8
Time Sync class	4 (1ms)
Maximum Scheduling Overhead	21
Per CLPDU PhL Overhead	4
Maximum Inter-channel Signal Skew	0
Required Number of Post-transmission-gab-ext Units	0
Required Number of Preamble-extension Units	1

Block Execution times

Analog Input = 45 ms
PID = 60 ms

FOUNDATION FIELDBUS FUNCTION BLOCKS

For reference information on the Resource, Sensor Transducer, AI, LCD Transducer blocks refer to “Foundation Fieldbus Block Information” on page A-1. Reference information on the PID block can be found in the Function Block manual document number 00809-0100-4783.

Resource Block (index number 1000)

The Resource Function Block (RB) contains diagnostic, hardware and electronics information. There are no linkable inputs or outputs to the Resource Block.

Sensor Transducer Block (index number 1100)

The Sensor Transducer Function Block (STB) temperature measurement data, including sensor and terminal temperature, The STB also includes information about sensor type, engineering units, linearization, reranging, damping, temperature compensation, and diagnostics.

LCD Transducer Block (index number 1200)

The LCD Transducer Block is used to configure the LCD meter.

Analog Input Block (index number 1300 and 1400)

The Analog Input Function Block (AI) processes the measurements from the sensor and makes them available to other function blocks. The output value from the AI block is in engineering units and contains a status indicating the quality of the measurement. The AI block is widely used for scaling functionality.

PID Block (index number 1500)

The PID Function Block combines all of the necessary logic to perform proportional/integral/derivative (PID) control. The block supports mode control, signal scaling and limiting, feed forward control, override tracking, alarm limit detection, and signal status propagation.

The block supports two forms of the PID equation: Standard and Series. You can choose the appropriate equation using the MATHFORM parameter. The Standard ISA PID equation is the default selection.

Resource Block

FEATURES and FEATURES_SEL

The parameters FEATURES and FEATURE_SEL determine optional behavior of the 644.

FEATURES
The FEATURES parameter is read only and defines which features are supported by the 644. Below is a list of the FEATURES the 644 supports.

UNICODE
All configurable string variables in the 644, except tag names, are octet strings. Either ASCII or Unicode may be used. If the configuration device is generating Unicode octet strings, you must set the Unicode option bit.

REPORTS
The 644 supports alert reports. The Reports option bit must be set in the features bit string to use this feature. If it is not set, the host must poll for alerts.

SOFT W LOCK
Inputs to the security and write lock functions include the software write lock bits of the FEATURE_SEL parameter, the WRITE_LOCK parameter, and the DEFINE_WRITE_LOCK parameter.

The WRITE_LOCK parameter prevents modification of parameters within the device except to clear the WRITE_LOCK parameter. During this time, the block will function normally updating inputs and outputs and executing algorithms. When the WRITE_LOCK condition is cleared, a WRITE_ALM alert is generated with a priority that corresponds to the WRITE_PRI parameter.

The FEATURE_SEL parameter enables the user to select the software write lock or no write lock capability. In order to enable the software write lock, the SOFT_W_LOCK bit must be set in the FEATURE_SEL parameter. Once this bit is set, the WRITE_LOCK parameter may be set to “Locked” or “Unlocked.” Once the WRITE_LOCK parameter is set to “Locked” by the software, all user requested writes as determined by the DEFINE_WRITE_LOCK parameter shall be rejected.

The DEFINE_WRITE_LOCK parameter allows the user to configure whether the write lock function will control writing to all blocks, or only to the resource and transducer blocks. Internally updated data such as process variables and diagnostics will not be restricted.
N/A = No blocks are blocked
Physical = Locks resource and transducer block
Everything = Locks every block.

The following table displays all possible configurations of the WRITE_LOCK parameter.

FEATURE_SEL SW_SEL bit	WRITE_LOCK	WRITE_LOCK Read/Write	DEFINE_WRITE_LOCK	Write access to blocks
0 (off)	1 (unlocked)	Read only	NA	All
1 (on)	1 (unlocked)	Read/Write	NA	All
1 (on)	2 (locked)	Read/Write	Physical	Function Blocks only
1 (on)	2 (locked)	Read/Write	Everything	None

FEATURES_SEL
FEATURES_SEL is used to turn on any of the supported features. The default setting of the 644 does not select any of these features. Choose one of the supported features if any.

MAX_NOTIFY

The MAX_NOTIFY parameter value is the maximum number of alert reports that the resource can have sent without getting a confirmation, corresponding to the amount of buffer space available for alert messages. The number can be set lower, to control alert flooding, by adjusting the LIM_NOTIFY parameter value. If LIM_NOTIFY is set to zero, then no alerts are reported.

PlantWeb™ Alerts

The alerts and recommended actions should be used in conjunction with “Operation and Maintenance” on page 4-14.

The Resource Block will act as a coordinator for PlantWeb alerts. There will be three alarm parameters (FAILED_ALARM, MAINT_ALARM, and ADVISE_ALARM) which will contain information regarding some of the device errors which are detected by the transmitter software. There will be a RECOMMENDED_ACTION parameter which will be used to display the recommended action text for the highest priority alarm and a HEALTH_INDEX parameters (0 - 100) indicating the overall health of the transmitter. FAILED_ALARM will have the highest priority followed by MAINT_ALARM and ADVISE_ALARM will be the lowest priority.

FAILED_ALARMS
A failure alarm indicates a failure within a device that will make the device or some part of the device non-operational. This implies that the device is in need of repair and must be fixed immediately. There are five parameters associated with FAILED_ALARMS specifically, they are described below.

FAILED_ENABLED
This parameter contains a list of failures in the device which makes the device non-operational that will cause an alert to be sent. Below is a list of the failures with the highest priority first.

1. Electronics
2. NV Memory
3. HW / SW Incompatible
4. Primary Value
5. Secondary Value

FAILED_MASK
This parameter will mask any of the failed conditions listed in FAILED_ENABLED. A bit on means that the condition is masked out from alarming and will not be reported.

FAILED_PRI
Designates the alerting priority of the FAILED_ALM, see “Alarm Priority” on page 4-12. The default is 0 and the recommended value are between 8 and 15.

FAILED_ACTIVE
This parameter displays which of the alarms is active. Only the alarm with the highest priority will be displayed. This priority is not the same as the FAILED_PRI parameter described above. This priority is hard coded within the device and is not user configurable.

FAILED_ALM
Alarm indicating a failure within a device which makes the device non-operational.

MAINT_ALARMS
A maintenance alarm indicates the device or some part of the device needs maintenance soon. If the condition is ignored, the device will eventually fail. There are five parameters associated with MAINT_ALARMS, they are described below.

MAINT_ENABLED
The MAINT_ENABLED parameter contains a list of conditions indicating the device or some part of the device needs maintenance soon.

Below is a list of the conditions with the highest priority first.

1. Primary Value Degraded
2. Secondary Value Degraded
3. Diagnostic
4. Configuration Error
5. Calibration Error

MAINT_MASK
The MAINT_MASK parameter will mask any of the failed conditions listed in MAINT_ENABLED. A bit on means that the condition is masked out from alarming and will not be reported.

MAINT_PRI
MAINT_PRI designates the alarming priority of the MAINT_ALM, “Process Alarms” on page 4-12. The default is 0 and the recommended values is 3 to 7.

MAINT_ACTIVE
The MAINT_ACTIVE parameter displays which of the alarms is active. Only the condition with the highest priority will be displayed. This priority is not the same as the MAINT_PRI parameter described above. This priority is hard coded within the device and is not user configurable.

MAINT_ALM
An alarm indicating the device needs maintenance soon. If the condition is ignored, the device will eventually fail.

Advisory Alarms
An advisory alarm indicates informative conditions that do not have a direct impact on the device's primary functions There are five parameters associated with ADVISE_ALARMS, they are described below.

ADVISE_ENABLED
The ADVISE_ENABLED parameter contains a list of informative conditions that do not have a direct impact on the device's primary functions. Below is a list of the advisories with the highest priority first.

1. NV Writes Deferred
2. SPM Process Anomaly detected

ADVISE_MASK
The ADVISE_MASK parameter will mask any of the failed conditions listed in ADVISE_ENABLED. A bit on means the condition is masked out from alarming and will not be reported.

ADVISE_PRI
ADVISE_PRI designates the alarming priority of the ADVISE_ALM, see “Process Alarms” on page 4-12. The default is 0 and the recommended values are 1 or 2.

ADVISE_ACTIVE
The ADVISE_ACTIVE parameter displays which of the advisories is active. Only the advisory with the highest priority will be displayed. This priority is not the same as the ADVISE_PRI parameter described above. This priority is hard coded within the device and is not user configurable.

ADVISE_ALM
ADVISE_ALM is an alarm indicating advisory alarms. These conditions do not have a direct impact on the process or device integrity.

Recommended Actions for PlantWeb Alerts

RECOMMENDED_ACTION
The RECOMMENDED_ACTION parameter displays a text string that will give a recommended course of action to take based on which type and which specific event of the PlantWeb alerts are active.

Table 4-1.
RB.RECOMMENDED_ACTION

	Alarm Type	Failed/Maint/Advise Active Event	Recommended Action Text String
PlantWeb Alerts	None	None	No action required
	Advisory	NV Writes Deferred	Non-volatile writes have been deferred, leave the device powered until the advisory goes away
	Maintenance	Configuration Error	Re-write the Sensor Configuration
		Primary Value Degraded	Confirm the operating range of the applied sensor and/or verify the sensor connection and device environment
		Calibration Error	Retrim the device
		Secondary Value Degraded	Verify the ambient temperature is within operating limits
	Failed	Electronics Failure	Replace the Device
		HW / SW Incompatible	Verify the Hardware Revision is compatible with the Software Revision
		NV Memory Failure	Reset the device then download the Device Configuration
		Primary Value Failure	Verify the instrument process is within the Sensor range and / or confirm sensor configuration and wiring.
		Secondary Value Failure	Verify the ambient temperature is within operating limits

Sensor Transducer Block

NOTE
When the engineering units of the XD_SCALE are selected, the engineering units in the Transducer Block change to the same units. THIS IS THE ONLY WAY TO CHANGE THE ENGINEERING UNITS IN THE SENSOR TRANSDUCER BLOCK.

Damping

⚠ The damping parameter in the Transducer Block may be used to filter measurement noise. By increasing the damping time, the transmitter will have a slower response time, but will decrease the amount of process noise that is translated to the Transducer Block Primary Value. Because both the LCD and AI Block get input from the Transducer Block, adjusting the damping parameter will effect both blocks.

NOTE
The AI Block has it's own filtering parameter called PV_FTIME. For simplicity, it is better to do filtering in the Transducer Block as damping will be applied to primary value on every sensor update. If filtering is done in AI block, damping will be applied to output every macrocycle. The LCD will display value from Transducer block.

Analog Input (AI) Function Block

Configure the AI block

⚠ A minimum of four parameters are required to configure the AI Block. The parameters are described below with example configurations shown at the end of this section.

CHANNEL
Select the channel that corresponds to the desired sensor measurement. The 644 measures both sensor temperature (channel 1) and terminal temperature (channel 2).

L_TYPE
The L_TYPE parameter defines the relationship of the sensor measurement (sensor temperature) to the desired output temperature of the AI Block. The relationship can be direct or indirect.

Direct
Select direct when the desired output will be the same as the sensor measurement (sensor temperature).

Indirect
Select indirect when the desired output is a calculated measurement based on the sensor measurement (e.g. ohm or mV). The relationship between the sensor measurement and the calculated measurement will be linear.

XD_SCALE and OUT_SCALE
The XD_SCALE and OUT_SCALE each include four parameters: 0%, 100%, engineering units, and precision (decimal point). Set these based on the L_TYPE:

L_TYPE is Direct
When the desired output is the measured variable, set the XD_SCALE to represent the operating range of the process. Set OUT_SCALE to match XD_SCALE.

L_TYPE is Indirect
When an inferred measurement is made based on the sensor measurement, set the XD_SCALE to represent the operating range that the sensor will see in the process. Determine the inferred measurement values that correspond to the XD_SCALE 0 and 100% points and set these for the OUT_SCALE.

NOTE
To avoid configuration errors, only select Engineering Units for XD_SCALE and OUT_SCALE that are supported by the device. The supported units are:

Pressure (Channel 1)	Temperature (Channel 2)
°C	°C
°F	°F
K	K
R	R
Ω	Ω
mV	mV

When the engineering units of the XD_SCALE are selected, this causes the engineering units of the PRIMARY_VALUE_RANGE in the Transducer Block to change to the same units. THIS IS THE ONLY WAY TO CHANGE THE ENGINEERING UNITS IN THE SENSOR TRANSDUCER BLOCK, PRIMARY_VALUE_RANGE parameter.

Configuration Examples

4-wire, Pt 100 α = 385
AI1 = Process Temperature
AI2 = Terminal Temperature

Transducer Block
If Host System Supports Methods:
1. Click on Methods
2. Choose Sensor Connections
3. Follow on-screen instruction.

If Host System Doesn't Not Support Methods:
1. Put transducer block into OOS mode.
   a. Go to MODE_BLK.TARGET
   b. Choose OOS (0x80)
2. Go to SENSOR_CONNECTION.
   a. Choose 4-wire (0x4)
3. Go to SENSOR_TYPE.
   a. Choose PT100A385
4. Put the transducer block back into Auto mode.

AI Blocks (Basic Configuration)[1]

AI1 as Process Temperature

1. Put the AI Block into OOS mode.
   a. Go to MODE_BLK.TARGET
   b. Choose OOS (0x80)
2. Go to CHANNEL
   a. Choose Sensor 1
3. Go to L_TYPE
   a. Choose Direct
4. Go to XD_Scale
   a. Choose UNITS_INDEX to be °C
5. Go to OUT_SCALE
   a. Choose UNITS_INDEX to be °C
   b. Set the 0 and 100 scale to be the same as the PRIMARY_VALUE_RANGE
6. Put the AI Block back into Auto mode.
7. Follow Host Procedure Download Schedule into Block.

AI2 as Terminal Temperature

1. Put the AI Block into OOS mode.
   a. Go to MODE_BLK.TARGET
   b. Choose OOS (0x80)
2. Go to CHANNEL
   a. Choose Body Temperature
3. Go to L_TYPE
   a. Choose Direct
4. Go to XD_Scale
   a. Choose UNITS_INDEX to be °C
5. Go to OUT_SCALE
   a. Choose UNITS_INDEX to be °C
   b. Set the 0 and 100 scale to be the same as the SECONDARY_VALUE_RANGE
6. Put the AI Block back into Auto mode.
7. Follow Host Procedure Download Schedule into Block.

(1) Configure a minimum of four parameters to get a value out of the AI Block

Filtering

⚠ The filtering feature changes the response time of the device to smooth variations in output readings caused by rapid changes in input. Adjust the filter time constant (in seconds) using the PV_FTIME parameter. Set the filter time constant to zero to disable the filter feature.

Process Alarms

Process Alarm detection is based on the OUT value. Configure the alarm limits of the following standard alarms:

- High (HI_LIM)
- High high (HI_HI_LIM)
- Low (LO_LIM)
- Low low (LO_LO_LIM)

In order to avoid alarm chattering when the variable is oscillating around the alarm limit, an alarm hysteresis in percent of the PV span can be set using the ALARM_HYS parameter. The priority of each alarm is set in the following parameters:

- HI_PRI
- HI_HI_PRI
- LO_PRI
- LO_LO_PRI

Alarm Priority

Alarms are grouped into five levels of priority:

Priority Number	Priority Description
0	The alarm condition is not used.
1	An alarm condition with a priority of 1 is recognized by the system, but is not reported to the operator.
2	An alarm condition with a priority of 2 is reported to the operator.
3-7	Alarm conditions of priority 3 to 7 are advisory alarms of increasing priority.
8-15	Alarm conditions of priority 8 to 15 are critical alarms of increasing priority.

Status Options

Status Options (STATUS_OPTS) supported by the AI block are shown below:

Propagate Fault Forward
If the status from the sensor is Bad, Device failure or Bad, Sensor failure, propagate it to OUT without generating an alarm. The use of these sub-status in OUT is determined by this option. Through this option, the user may determine whether alarming (sending of an alert) will be done by the block or propagated downstream for alarming.

Uncertain if Limited
Set the output status of the Analog Input block to uncertain if the measured or calculated value is limited.

BAD if Limited
Set the output status to Bad if the sensor is violating a high or low limit.

Uncertain if Man Mode
Set the output status of the Analog Input block to uncertain if the actual mode of the block is Man.

NOTE
The instrument must be in Out of Service mode to set the status option.

Advanced Features

The AI Function Block provides added capability through the addition of the following parameters:

ALARM_TYPE
ALARM_TYPE allows one or more of the process alarm conditions detected by the AI function block to be used in setting its OUT_D parameter.

OUT_D
OUT_D is the discrete output of the AI function block based on the detection of process alarm condition(s). This parameter may be linked to other function blocks that require a discrete input based on the detected alarm condition.

LCD Transducer Block

The LCD meter connects directly to the 644 electronics FOUNDATION fieldbus output board. The meter indicates output and abbreviated diagnostic messages.

The first line of five characters displays the sensor being measured.

If the measurement is in error, “Error” appears on the first line. The second line indicates if the device or the sensor is causing the error.

Each parameter configured for display will appear on the LCD for a brief period before the next parameter is displayed. If the status of the parameter goes bad, the LCD will also cycle diagnostics following the displayed variable:

Custom Meter Configuration

Shipped from the factory, Parameter #1 is configured to display the Primary Variable (temperature) from the LCD Transducer Block. Parameters 2 – 4 are not configured. To change the configuration of Parameter #1 or to configure additional parameters 2 – 4, use the configuration parameters below.

The LCD Transducer Block can be configured to sequence four different process variables as long as the parameters are sourced from a function block that is scheduled to execute within the 644 temperature transmitter. If a function block is scheduled in the 644 that links a process variable from another device on the segment, that process variable can be displayed on the LCD.

DISPLAY_PARAM_SEL
The DISPLAY_PARAM_SEL parameter specifies how many process variables will be displayed. Select up to four display parameters.

BLK_TAG_#(1)
Enter the Block Tag of the function block that contains the parameter to be displayed. The default function block tags from the factory are:

TRANSDUCER
AI 1300
AI 1400
PID 1500

BLK_TYPE_#(1)
Enter the Block Type of the function block that contains the parameter to be displayed. This parameter is generally selected via a drop-down menu with a list of possible function block types. (e.g. Transducer, PID, AI, etc.)

PARAM_INDEX_#(1)
The PARAM_INDEX_# parameter is generally selected via a drop-down menu with a list of possible parameter names based upon what is available in the function block type selected. Choose the parameter to be displayed.

CUSTOM_TAG_#(1)
The CUSTOM_TAG_# is an optional user-specified tag identifier that can be configured to be displayed with the parameter in place of the block tag. Enter a tag of up to five characters.

UNITS_TYPE_#(1)
The UNITS_TYPE_# parameter is generally selected via a drop-down menu with three options: AUTO, CUSTOM, or NONE. Select AUTO only when the parameter to be displayed is pressure, temperature, or percent. For other parameters, select CUSTOM and be sure to configure the CUSTOM_UNITS_# parameter. Select NONE if the parameter is to be displayed without associated units.

CUSTOM_UNITS_#(1)
Specify custom units to be displayed with the parameter. Enter up to six characters. To display Custom Units the UNITS_TYPE_# must be set to CUSTOM.

OPERATION AND MAINTENANCE

Overview

This section contains information on operation and maintenance procedures.

METHODS AND MANUAL OPERATION
Each FOUNDATION fieldbus host or configuration tool has different ways of displaying and performing operations. Some hosts will use Device Descriptions (DD) and DD Methods to complete device configuration and will display data consistently across platforms. The DD can found on www.rosemount.com. There is no requirement that a host or configuration tool support these features.

The information in this section will describe how to use methods in a general fashion. In addition, if your host or configuration tool does not support methods this section will cover manually configuring the parameters involved with each method operation. For more detailed information on the use of methods, see your host or configuration tool manual.

(1) # represents the specified parameter number.

Troubleshooting Guides

Figure 4-1. 644 troubleshooting flowchart

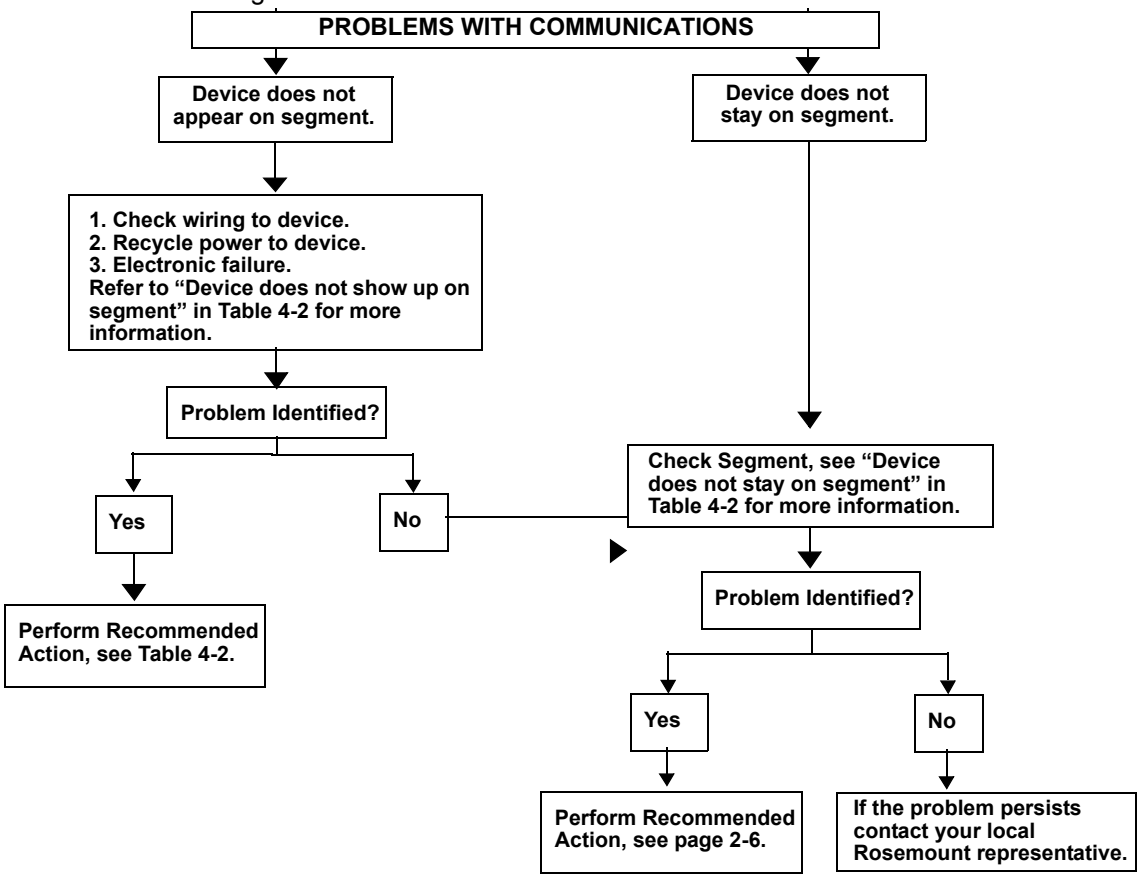
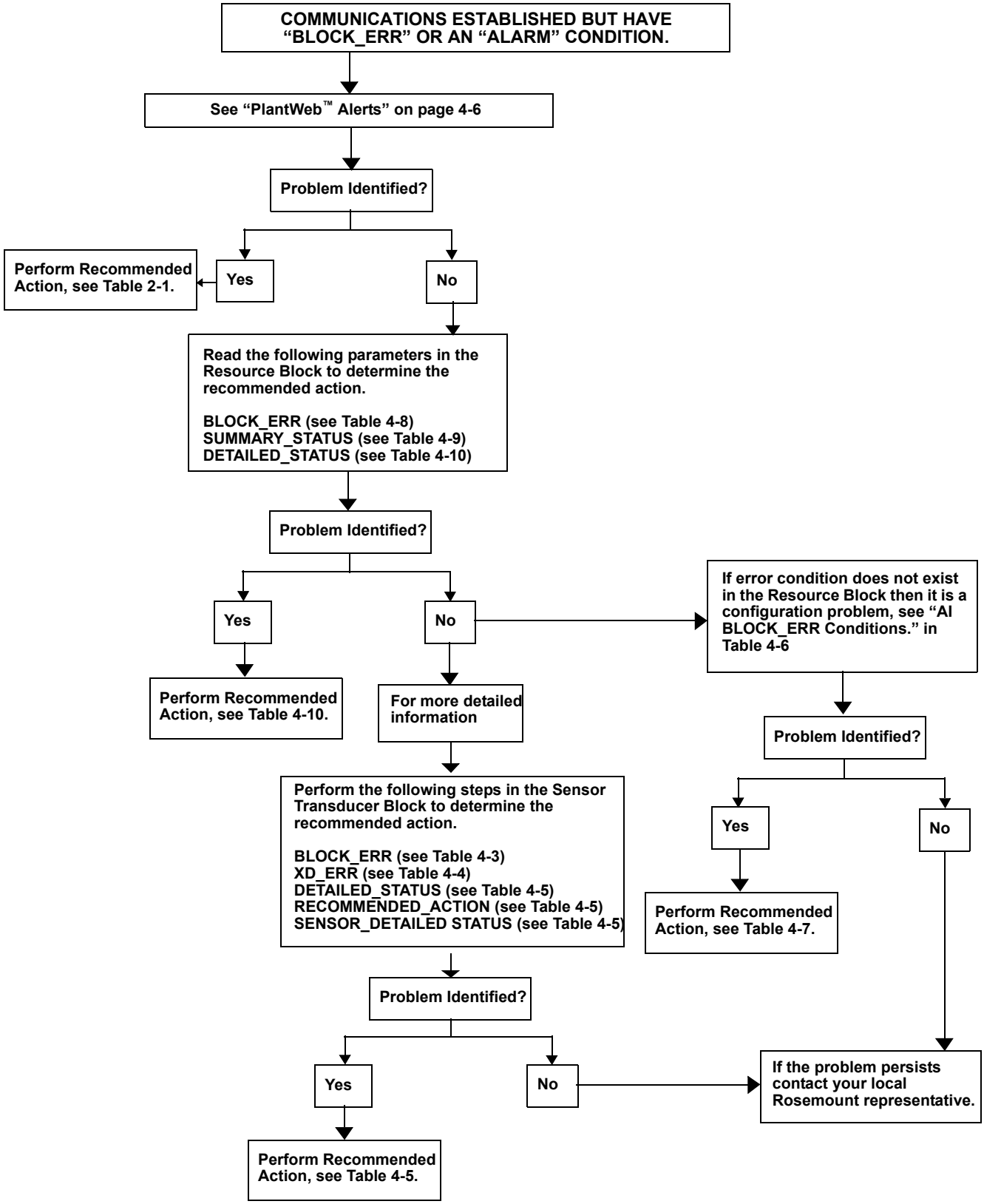


Table 4-2. Troubleshooting guide.

Symptom[1]	Cause	Recommended Actions
Device does not show up on segment	Unknown	Recycle power to device
	No power to device	1. Ensure the device is connected to the segment. 2. Check voltage at terminals. There should be 9–32Vdc. 3. Check to ensure the device is drawing current. There should be approximately 10.5 mA nominal (11 mA max.)
	Segment problems	
	Electronics failing	1. Replace device.
	Incompatible network settings	Change host network parameters. Refer to host documentation for procedure.
Device does not stay on segment[2]	Incorrect signal levels. Refer to host documentation for procedure.	1. Check for two terminators. 2. Excess cable length. 3. Bad Power supply or conditioner
	Excess noise on segment. Refer to host documentation for procedure.	1. Check for incorrect grounding. 2. Check for correct shielded wire. 3. Tighten wire connections. 4. Check for corrosion or moisture on terminals. 5. Check for Bad power supply.
	Electronics failing	1. Replace device.
	Other	1. Check for water around the transmitter.

(1) The corrective actions should be done with consultation of your system integrator.
(2) Wiring and installation 31.25 kbit/s, voltage mode, wire medium application guide AG-140 available from the fieldbus Foundation.

Figure 4-2. Problems with communications flowchart



Sensor Transducer Block

Sensor Calibration, Lower and Upper Trim Methods

⚠ In order to calibrate the transmitter, run the Lower and Upper Trim Methods. If your system does not support methods, manually configure the Transducer Block parameters listed below.

1. Set MODE_BLK.TARGET to OOS
2. Set SENSOR_CAL_METHOD to User Trim
3. Set CAL_UNIT to supported engineering units in the Transducer Block
4. Apply temperature that corresponds to the lower calibration point and allow the temperature to stabilize. The temperature must be between the range limits defined in PRIMRY_VALUE_RANGE.
5. Set values of CAL_POINT_LO to correspond to the temperature applied by the sensor.
6. Apply temperature, temperature corresponding to the upper calibration
7. Allow temperature to stabilize.
8. Set CAL_POINT_HI

NOTE
CAL_POINT_HI must be within PRIMARY_VALUE_RANGE and greater than CAL_POINT_LO + CAL_MIN_SPAN

9. Set SENSOR_CAL_DATE to the current date.
10. Set SENSOR_CAL_WHO to the person responsible for the calibration.
11. Set SENSOR _CAL_LOC to the calibration location.
12.
13. Set MODE_BLK.TARGET to AUTO

NOTE
If trim fails the transmitter will automatically revert to factory trim.

Excessive correction or sensor failure could cause device status to read “calibration error.” To clear this, trim the transmitter

Recall Factory Trim

⚠ To recall a factory trim on the transmitter, run the Recall Factory Trim. If your system does not support methods, manually configure the Transducer Block parameters listed below.

1. Set MODE_BLK.TARGET to OOS
2. Set SENSOR_CAL_METHOD to Factory Trim.
3. Set SET_FACTORY_TRIM to Recall.
4. Set SENSOR_CAL_DATE to the current date.
5. Set SENSOR_CAL_WHO to the person responsible for the calibration.
6. Set SENSOR _CAL_LOC to the calibration location.
7. Set MODE_BLK.TARGET to AUTO.

NOTE
When sensor type is changed, the transmitter reverts to the factory trim. Changing sensor type causes you to loose any trim performed on the transmitter.

Table 4-3. Sensor Transducer Block BLOCK_ERR messages

Condition Name and Description
Other
Out of Service: The actual mode is out of service.

Table 4-4. Sensor Transducer Block XD_ERR messages

Condition Name and Description
Electronics Failure: An electrical component failed.
I/O Failure: An I/O failure occurred.
Software Error: The software has detected an internal error.
Calibration Error: An error occurred during calibration of the device.
Algorithm Error: The algorithm used in the transducer block produced an error due to overflow, data reasonableness failure, etc.

Diagnostics

Table 4-5 lists the potential errors and the possible corrective actions for the given values. The corrective actions are in order of increasing system level compromises. The first step should always be to reset the transmitter and then if the error persists, try the steps in Table 4-5. Start with the first corrective action and then try the second.

Table 4-5. Sensor Transducer Block STB.SENSOR_ DETAILED_ STATUS messages

STB.SENSOR_DETAILED_STATUS	Description
Invalid Configuration	Wrong sensor connection with wrong sensor type
ASIC RCV Error	The micro detected a chksum or start/stop bit failure with ASIC communication
ASIC TX Error	The A/D ASIC detected a communication error
ASIC Interrupt Error	ASIC interrupts are too fast or slow
Reference Error	Reference resistors are greater than 25% of known value
ASIC Configuration Error	Citadel registers were not written correctly. (Also CALIBRATION_ERR)
Sensor Open	Open sensor detected
Sensor Shorted	Shorted sensor detected
Terminal Temperature Failure	Open PRT detected
Sensor Out of Operating Range	Sensor readings have gone beyond PRIMRY_VALUE_RANGE values
Sensor beyond operating limits	Sensor readings have gone below 2% of lower range or above 6% of upper range of sensor.
Terminal Temperature Out of Operating Range	PRT readings have gone beyond SECONDARY_VALUE_RANGE values
Terminal Temperature Beyond Operating Limits	PRT readings have gone below 2% of lower range or above 6% of upper range of PRT. (These ranges are calculated and are not the actual range of the PRT which is a PT100 A385)
Sensor Degraded	For RTDs, this is excessive EMF detected. This is thermocouple degradation for thermocouples.
Sensor Error	The user trim has failed due to excessive correction or sensor failure during the trim method

Analog Input (AI) Function Block

Status

Along with the measured or calculated PV value, every FOUNDATION Fieldbus block passes an additional parameter called STATUS. The PV and STATUS are passed from the Transducer Block to the Analog Input Block. The STATUS can be one of the following: GOOD, BAD, or UNCERTAIN. When there are no problems detected by the self-diagnostics of the block, the STATUS will be GOOD. If a problem occurs with the hardware in the device, or, the quality of the process variable is compromised for some reason, the STATUS will become either BAD or UNCERTAIN depending upon the nature of the problem. It is important that the Control Strategy that makes use of the Analog Input Block is configured to monitor the STATUS and take action where appropriate when the STATUS is no longer GOOD.

Simulation

⚠ Simulate replaces the channel value coming from the Sensor Transducer Block. For testing purposes, it is possible to manually drive the output of the Analog Input Block to a desired value. There are two ways to do this.

Manual Mode
To change only the OUT_VALUE and not the OUT_STATUS of the AI Block, place the TARGET MODE of the block to MANUAL. Then, change the OUT_VALUE to the desired value.

Simulate

1. If the SIMULATE switch is in the OFF position, move it to the ON position. If the SIMULATE jumper is already in the ON position, you must move it to off and place it back in the ON position.

NOTE
As a safety measure, the switch must be reset every time power is interrupted to the device in order to enable SIMULATE. This prevents a device that is tested on the bench from getting installed in the process with SIMULATE still active.

2. To change both the OUT_VALUE and OUT_STATUS of the AI Block, set the TARGET MODE to AUTO.
3. Set SIMULATE_ENABLE_DISABLE to ‘Active’.
4. Enter the desired SIMULATE_VALUE to change the OUT_VALUE and SIMULATE_STATUS_QUALITY to change the OUT_STATUS. If errors occur when performing the above steps, be sure that the SIMULATE jumper has been reset after powering up the device.

Table 4-6. AI BLOCK_ERR Conditions.

Condition Number	Condition Name and Description
0	Other
1	**Block Configuration Error:** the selected channel carries a measurement that is incompatible with the engineering units selected in XD_SCALE, the L_TYPE parameter is not configured, or CHANNEL = zero.
3	**Simulate Active:** Simulation is enabled and the block is using a simulated value in its execution.
7	**Input Failure/Process Variable has Bad Status:** The hardware is bad, or a bad status is being simulated.
14	**Power Up**
15	**Out of Service:** The actual mode is out of service.

Table 4-7. Troubleshooting the AI block

Symptom	Possible Causes	Recommended Actions
Bad or no temperature readings (Read the AI “BLOCK_ERR” parameter)	BLOCK_ERR reads OUT OF SERVICE (OOS)	1. AI Block target mode target mode set to OOS. 2. Resource Block OUT OF SERVICE.
	BLOCK_ERR reads CONFIGURATION ERROR	1. Check CHANNEL parameter (see “CHANNEL” on page 2-9) 2. Check L_TYPE parameter (see “L_TYPE” on page 2-9) 3. Check XD_SCALE engineering units. (see “XD_SCALE and OUT_SCALE” on page 2-10
	BLOCK_ERR reads POWERUP	Download Schedule into block. Refer to host for downloading procedure.
	BLOCK_ERR reads BAD INPUT	1. Sensor Transducer Block Out Of Service (OOS) 2. Resource Block Out of Service (OOS)
	No BLOCK_ERR but readings are not correct. If using Indirect mode, scaling could be wrong.	1. Check XD_SCALE parameter. 2. Check OUT_SCALE parameter. (see “XD_SCALE and OUT_SCALE” on page 2-10)
	No BLOCK_ERR. Sensor needs to be calibrated or Zero trimmed.	See Section 3: Operation and Maintenance to determine the appropriate trimming or calibration procedure.
OUT parameter status reads UNCERTAIN and substatus reads EngUnitRangViolation.	Out_ScaleEU_0 and EU_100 settings are incorrect.	See “XD_SCALE and OUT_SCALE” on page 2-10.

Resource Block

This section describes error conditions found in the Resource block. Read Table 4-8 through Table 4-10 to determine the appropriate corrective action.

Block Errors

Table 4-8. Resource Block BLOCK_ERR messages

Table 4-8 lists conditions reported in the BLOCK_ERR parameter.

Condition Name and Description
Other
Device Needs Maintenance Now
Memory Failure: A memory failure has occurred in FLASH, RAM, or EEPROM memory
Lost NV Data: Non-volatile data that is stored in non-volatile memory has been lost.
Device Needs Maintenance Now
Out of Service: The actual mode is out of service.

Table 4-9. Resource Block SUMMARY_STATUS messages

Condition Name
No repair needed
Repairable
Call Service Center

Table 4-10. Resource Block RB.DETAILED_STATUS

RB.DETAILED_STATUS	Description
Sensor Transducer block error.	Active when any SENSOR_DETAILED_STAUS bit is on
Manufacturing Block integrity error	The manufacturing block size, revision, or checksum is wrong
Hardware/software incompatible	Verify the manufacturing block revision and the hardware revision are correct/compatible with the software revision.
Non-volatile memory integrity error	Invalid checksum on a block of NV data
ROM integrity error	Invalid application code checksum
Lost deferred NV data	Device has been power-cycled while non-volatile writes were being deferred to prevent premature memory failure, the write operations have been deferred.
NV Writes Deferred	A high number of writes has been detected to non-volatile memory. To prevent premature failure, the write operations have been deferred.

LCD Transducer block

This section describes error conditions found in the LCD Transducer Block. Read Table 4-11 and to determine the appropriate corrective action.

Self Test Procedure for the LCD

The SELF_TEST parameter in the Resource block will test LCD segments. When running, the segments of the display should light up for about five seconds.

If your host system supports methods refer to your host documentation on how to run the “Self Test” method. If your host system does not support methods than you can run this test manually be following the steps below.

1. Put Resource block into “OOS” (Out of Service).
2. Go to the parameter called “SELF_TEST” and write the value Self test (0x2).
3. Observe the LCD screen when you are doing this. All of the segments should light up.
4. Put the Resource block back into “AUTO”.

Table 4-11. LCD Transducer Block BLOCK_ERR messages

Condition Name and Description
Other
Out of Service: The actual mode is out of service.

Symptom	Possible Causes	Recommended Action
The LCD displays “DSPLY#INVLID.” Read the BLOCK_ERR and if it says “BLOCK CONFIGURATION” perform the Recommended Action	One or more of the display parameters are not configured properly.	See “LCD Transducer Block” on page 2-16.
The Bar Graph and the AI.OUT readings do not match.	The OUT_SCALE of the AI block is not configured properly.	See “Analog Input (AI) Function Block” on page 2-9 and “Display bar graph” on page 2-18.
“644” is being displayed or not all of the values are being displayed.	The LCD block parameter “DISPLAY_PARAMETER_SELECT is not properly configured.	See “LCD Transducer Block” on page 2-16.
The display reads OOS	The resource and or the LCD Transducer block are OOS.	Verify that both blocks are in “AUTO,”
The display is hard to read.	Some of the LCD segments may have gone bad.	See XXXX (Self Test). If some of the segment is bad, replace the LCD.
	Device is out o the temperature limit for the LCD. (-20 to 80 °C)	Check ambient temperature of the device.

Appendix A Specifications and Reference Data

HART and Foundation Fieldbus Specifications . . . . . page A-1
Foundation Fieldbus Specifications . . . . . page A-4
4–20 mA / HART Specifications . . . . . page A-6
Dimensional Drawings . . . . . page A-10
Ordering Information . . . . . page A-12
Additional Information . . . . . page A-14
Stainless Steel Housing . . . . . page A-16

HART AND FOUNDATION FIELDBUS SPECIFICATIONS

Functional

Inputs
User-selectable; sensor terminals rated to 42.4 V dc. See “Accuracy” on page A-8 for sensor options.

Output
Single 2-wired device with either 4–20 mA/HART, linear with temperature or input; or a completely digital output with FOUNDATION fieldbus communication (ITK 4.5 compliant).

Isolation
Input/output isolation tested to 500 V DC/AC rms (707 V DA) at 50/60 Hz

Local Display
The optional five-digit integral LCD Display includes a floating or fixed decimal point. It can also display engineering units (°F, °C, °R, K, Ω, and millivolts), milliampere, and percent of span. The display can be configured to alternate between selected display options. Display settings are preconfigured at the factory according to the standard transmitter configuration. They can be reconfigured in the field using either HART or FOUNDATION fieldbus communications.

Humidity Limits
0–99% relative humidity

Update Time
≤ 0.5 seconds

Physical

Electrical Connections

Model	Power and Sensor Terminals
644H	Compression screws permanently fixed to terminal block
644R	Compression screw permanently fixed to front panel

WAGO® Spring clamp terminals are optional (option code G5)

HART Communicator Connections

Communication Terminals	
644H	Clips permanently fixed to terminal block
644R	Clips permanently fixed to front panel

Materials of Construction

Electronics Housing and Terminal Block	
644H	*Noryl*® glass reinforced
644R	*Lexan*® polycarbonate
Enclosure (Option code J5 or J6)	
Housing	Low-copper aluminum
Paint	Polyurethane
Cover O-ring	Buna-N

Mounting

The 644R attaches directly to a wall or a DIN rail. The 644H installs in a connection head or universal head mounted directly on a sensor assembly, apart from a sensor assembly using a universal head, or to a DIN rail using an optional mounting clip.

Weight

Code	Options	Weight
644H	HART, Head Mount Transmitter	96 g (3.39 oz)
644H	FOUNDATION fieldbus, Head Mount Transmitter	92 g (3.25 oz)
644R	HART, Rail Mount Transmitter	174 g (6.14 oz)
M5	LCD Display	38 g (1.34 oz)
J5, J6	Universal Head, Standard Cover	577 g (20.35 oz)
J5, J6	Universal Head, Meter Cover	667 g (23.53 oz)

Enclosure Ratings (644H)

All option codes (S1, S2, S3, S4, J5 and J6) are NEMA 4X, IP66, and IP68. Option code J6 is CSA Enclosure Type 4X.

Performance

EMC (ElectroMagnetic Compatibility) NAMUR NE 21 Standard

The 644H HART meets the requirements for NAMUR NE 21 Rating. (Hardware Rev 26 and later for HART devices.)

Susceptibility	Parameter	Influence
ESD	• 6 kV contact discharge • 8 kV air discharge	HART None
Radiated	• 80 – 1000 MHz at 10 V/m AM	< 0.5%
Burst	• 1 kV for I.O.	None
Surge	• 0.5 kV line–line • 1 kV line–ground (I.O. tool)	None
Conducted	• 150 kHz to 80 MHz at 10 V	< 0.5%

CE Mark

The 644 meets all requirements listed under IEC 61326: Amendment 1, 1998.

Power Supply Effect

Less than ±0.005% of span per volt

Stability

RTDs and thermocouples have a stability of ±0.15% of output reading or 0.15 °C (whichever is greater) for 24 months

Self Calibration

The analog-to-digital measurement circuitry automatically self-calibrates for each temperature update by comparing the dynamic measurement to extremely stable and accurate internal reference elements.

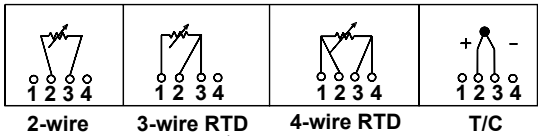
Vibration Effect

The 644 is tested to the following specifications with no effect on performance:

Frequency	Vibration
10 to 60 Hz	0.21 mm displacement
60 to 500 Hz	3 g peak acceleration

Sensor Connections

644244EH Sensor Connections Diagram



2-wire RTD and Ω | **3-wire RTD and Ω*** | **4-wire RTD and Ω** | **T/C and mV**

644-000B01A

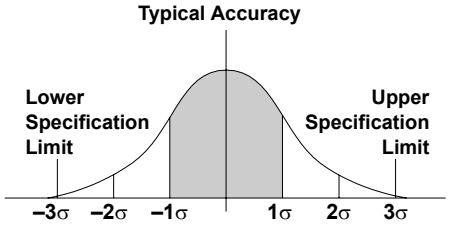
* *Rosemount Inc. provides 4-wire sensors for all single element RTDs. You can use these RTDs in 3-wire configurations by leaving the unneeded leads disconnected and insulated with electrical tape.*

Rosemount Conformance to Specifications

A Rosemount product not only meets its published specifications, but most likely exceeds them. Advanced manufacturing techniques and the use of Statistical Process Control provide specification conformance to at least ± 3σ[(1)]. Our commitment to continual improvement ensures that product design, reliability, and performance will improve annually.

For example, the Reference Accuracy distribution for the 644 is shown to the right. Our Specification Limits are ± 0.15 °C, but, as the shaded area shows, approximately 68% of the units perform three times better than the limits. Therefore, it is very likely that you will receive a device that performs much better than our published specifications.

Conversely, a vendor who "grades" product without using Process Control, or who is not committed to ± 3σ performance, will ship a higher percentage of units that are barely within advertised specification limits.



Accuracy distribution shown is for the 644, Pt 100 RTD sensor, Range 0 to 100 °C

(1) Sigma (σ) is a statistical symbol to designate the standard deviation from the mean value of a normal distribution.

FOUNDATION FIELDBUS SPECIFICATIONS

Function Blocks

Resource Block

- The resource block contains physical transmitter information including available memory, manufacture identification, device type, software tag, and unique identification.

Transducer Block

- The transducer block contains the actual temperature measurement data, including sensor 1 and terminal temperature. It includes information about sensor type and configuration, engineering units, linearization, reranging, damping, temperature correction, and diagnostics.

LCD Block

- The LCD block is used to configure the local display, if a LCD Display is being used.

Analog Input (AI)

- Processes the measurement and makes it available on the fieldbus segment
- Allows filtering, alarming, and engineering unit changes.

PID Block

- The transmitter provides control functionality with one PID function block in the transmitter. The PID block can be used to perform single loop, cascade, or feedforward control in the field.

Instantiable Function Blocks

- All the function blocks used by the transmitter are instantiable, meaning the total number of function blocks is only limited by the physical memory available in the transmitter. Since only the instantiable blocks can use physical memory, any combination of function blocks can be used at any given time as long as the physical memory size is not violated.

Block	Execution Time (milliseconds)
Resource	–
Transducer	–
LCD Block	–
Analog Input 1	45
Analog Input 2	45
PID 1	60

Turn-on Time

Performance within specifications in less than 20 seconds after power is applied, when damping value is set to 0 seconds.

Status

If self-diagnostics detect a sensor burnout or a transmitter failure, the status of the measurement will be updated accordingly. Status may also send the PID output to a safe value.

Power Supply

Powered over FOUNDATION Fieldbus with standard fieldbus power supplies. The transmitter operates between 9.0 and 32.0 VDC, 11 mA maximum. The power terminals are rated to 42.4 VDC max.

Alarms

The AI function block allows the user to configure the alarms to HI-HI, HI, LO, or LO-LO with a variety of priority levels and hysteresis settings.

Backup Link Active Scheduler (LAS)

The transmitter is classified as a device link master, which means it can function as a Link Active Scheduler (LAS) if the current link master device fails or is removed from the segment.

The host or other configuration tool is used to download the schedule for the application to the link master device. In the absence of a primary link master, the transmitter will claim the LAS and provide permanent control for the H1 segment.

FOUNDATION Fieldbus Parameters

Schedule Entries	25(1)
Links	16(1)
Virtual Communications Relationships (VCR)	12(1)

(1) Minimum quantity.

Software Upgrade in the Field

Software for the 644 with FOUNDATION fieldbus will be easy to upgrade in the field. Users will be able to take advantage of software enhancements by loading new application software into the device memory.

4–20 mA / HART SPECIFICATIONS

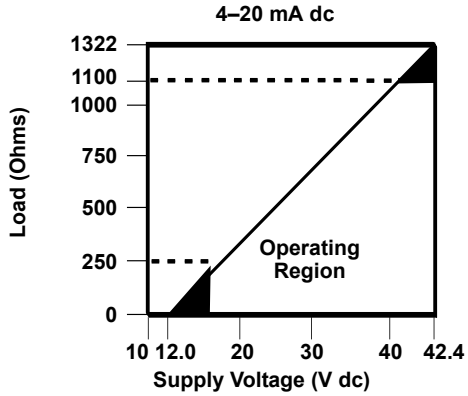
Communication Requirements

Transmitter power terminals are rated to 42.4 V DC. A HART Communicator requires a loop resistance between 250 – 1100 ohms. The 644 HART device does not communicate when power is below 12 V DC at the transmitter terminals.

Power Supply

An external power supply is required for HART devices. The transmitter operates on 12.0 to 42.4 VDC transmitter terminal voltage with load resistance between 250 and 660 ohms. A minimum of 17.75 VDC power supply is required with a load of 250 ohms. Transmitter power terminals are rated to 42.4 V DC.

Maximum Load = 40.8 x (Supply Voltage – 12.0)



Temperature Limits

	Operating Limit	Storage Limit
With LCD Display	–4 to 185 °F –20 to 85 °C	–50 to 185 °F –45 to 85 °C
Without LCD Display	–40 to 185 °F –40 to 85 °C	–58 to 248 °F –50 to 120 °C

Hardware and Software Failure Mode

The 644 features software driven alarm diagnostics. The independent circuit is designed to provide backup alarm output if the microprocessor software fails. The alarm directions (HIGH/LO) are user-selectable using the failure mode switch. If failure occurs, the position of the switch determines the direction in which the output is driven (HI or LO). The switch feeds into the digital-to-analog (D/A) converter, which drives the proper alarm output even if the microprocessor fails. The values at which the transmitter drives its output in failure mode depends on whether it is configured to standard, custom, or NAMUR-compliant (NAMUR recommendation NE 43, June 1997) operation. Table 1 shows the alarm ranges available for the device to be configured to.

TABLE 1. Available Alarm Range(1)

	Standard	NAMUR- NE 43 Compliant
Linear Output:	$3.9 \leq I^{(2)} \leq 20.5$	$3.8 \leq I \leq 20.5$
Fail High:	$21 \leq I \leq 23$	$21 \leq I \leq 23$
Fail Low:	$3.5 \leq I \leq 3.75$	$3.5 \leq I \leq 3.6$

(1) Measured in milliamperes.
(2) I = Process Variable (current output).

Custom Alarm and Saturation Level

Custom factory configuration of alarm and saturation level is available with option code C1 for valid values. These values can also be configured in the field using a HART Communicator.

Turn-on Time

Performance within specifications in less than 5.0 seconds after power is applied, when damping value is set to 0 seconds.

Transient Protection

The Rosemount 470 prevents damage from transients induced by lightning, welding, or heavy electrical equipment. For more information, refer to the 470 Product Data Sheet (document number 00813-0100-4191).

Accuracy

TABLE 2. Rosemount 644 Input Options and Accuracy.

Sensor Options	Sensor Reference	Input Ranges		Recommended Min. Span[1]		Digital Accuracy[2]		D/A Accuracy[3]
2-, 3-, 4-wire RTDs		°C	°F	°C	°F	°C	°F	
Pt 100	IEC 751, 1995 (α = 0.00385)	–200 to 850	–328 to 1562	10	18	± 0.15	± 0.27	±0.03% of span
Pt 100	JIS 1604, 1981 (α = 0.003916)	–200 to 645	–328 to 1193	10	18	± 0.15	± 0.27	±0.03% of span
Pt 200	IEC 751, 1995 (α = 0.00385)	–200 to 850	–328 to 1562	10	18	± 0.27	± 0.49	±0.03% of span
Pt 500	IEC 751, 1995 (α = 0.00385)	–200 to 850	–328 to 1562	10	18	± 0.19	± 0.34	±0.03% of span
Pt 1000	IEC 751, 1995 (α = 0.00385)	–200 to 300	–328 to 572	10	18	± 0.19	± 0.34	±0.03% of span
Ni 120	Edison Curve No. 7	–70 to 300	–94 to 572	10	18	± 0.15	± 0.27	±0.03% of span
Cu 10	Edison Copper Winding No. 15	–50 to 250	–58 to 482	10	18	±1.40	± 2.52	±0.03% of span
Thermocouples[4]								
Type B[5]	NIST Monograph 175, IEC 584	100 to 1820	212 to 3308	25	45	± 0.77	± 1.39	±0.03% of span
Type E	NIST Monograph 175, IEC 584	–50 to 1000	–58 to 1832	25	45	± 0.20	± 0.36	±0.03% of span
Type J	NIST Monograph 175, IEC 584	–180 to 760	–292 to 1400	25	45	± 0.35	± 0.63	±0.03% of span
Type K[6]	NIST Monograph 175, IEC 584	–180 to 1372	–292 to 2502	25	45	± 0.50	± 0.90	±0.03% of span
Type N	NIST Monograph 175, IEC 584	–200 to 1300	–328 to 2372	25	45	± 0.50	± 0.90	±0.03% of span
Type R	NIST Monograph 175, IEC 584	0 to 1768	32 to 3214	25	45	± 0.75	± 1.35	±0.03% of span
Type S	NIST Monograph 175, IEC 584	0 to 1768	32 to 3214	25	45	± 0.70	± 1.26	±0.03% of span
Type T	NIST Monograph 175, IEC 584	–200 to 400	–328 to 752	25	45	± 0.35	± 0.63	±0.03% of span
DIN Type L	DIN 43710	–200 to 900	–328 to 1652	25	45	± 0.35	± 0.63	±0.03% of span
DIN Type U	DIN 43710	–200 to 600	–328 to 1112	25	45	± 0.35	± 0.63	±0.03% of span
Type W5Re/W26Re	ASTM E 988-96	0 to 2000	32 to 3632	25	45	± 0.70	± 1.26	±0.03% of span
Millivolt Input		–10 to 100 mV		3 mV		±0.015 mV		±0.03% of span
2-, 3-, 4-wire Ohm Input		0 to 2000 ohms		20 ohm		±0.45 ohm		±0.03% of span

(1) No minimum or maximum span restrictions within the input ranges. Recommended minimum span will hold noise within accuracy specification with damping at zero seconds.
(2) The published digital accuracy applies over the entire sensor input range. Digital output can be accessed by HART or FOUNDATION fieldbus Communications or Rosemount control system.
(3) Total Analog accuracy is the sum of digital and D/A accuracies.
(4) Total digital accuracy for thermocouple measurement: sum of digital accuracy +0.5 °C.
(5) Digital accuracy for NIST Type B T/C is ±3.0 °C (±5.4 °F) from 100 to 300 °C (212 to 572 °F).
(6) Digital accuracy for NIST Type K T/C is ±0.70 °C (±1.26 °F) from –180 to –90 °C (–292 to –130 °F).

Accuracy Example (HART devices)

When using a Pt 100 (α = 0.00385) sensor input with a 0 to 100 °C span:

- Digital accuracy = ±0.15 °C
- D/A accuracy = ±0.03% of 100 °C or ±0.03 °C
- Total accuracy = ±0.18 °C.

Accuracy Example (Foundation fieldbus devices)

When using a Pt 100 (α = 0.00385) sensor input:

- Total accuracy = ±0.15 °C.
- No D/A accuracy effects apply

Ambient Temperature Effect

TABLE 3. Ambient Temperature Effect

Sensor Options	Temperature Effects per 1.0 °C (1.8 °F) Change in Ambient Temperature(1)	Range	D/A Effect
2-, 3-, 4-wire RTDs			
Pt 100 ((α = 0.00385)	0.003 °C (0.0054 °F)	Entire Sensor Input Range	0.001% of span
Pt 100 (α = 0.003916)	0.003 °C (0.0054 °F)	Entire Sensor Input Range	0.001% of span
Pt 200	0.004 °C (0.0072 °F)	Entire Sensor Input Range	0.001% of span
Pt 500	0.003 °C (0.0054 °F)	Entire Sensor Input Range	0.001% of span
Pt 1000	0.003 °C (0.0054 °F)	Entire Sensor Input Range	0.001% of span
Ni 120	0.003 °C (0.0054 °F)	Entire Sensor Input Range	0.001% of span
Cu 10	0.03 °C (0.054 °F)	Entire Sensor Input Range	0.001% of span
Thermocouples			
Type B	0.014 °C	R ≥ 1000°C	0.001% of span
	0.032 °C – (0.0025% of (R – 300))	300 °C ≤ R < 1000 °C	0.001% of span
	0.054 °C – (0.011% of (R – 100))	100 °C ≤ R< 300 °C	0.001% of span
Type E	0.005 °C +(0.00043% of R)	All	0.001% of span
Type J	0.0054 °C +(0.0029%of R)	R ≥ 0 °C	0.001% of span
	0.0054 °C + (0.0025% of absolute value R)	R < 0 °C	0.001% of span
Type K	0.0061 °C +(0.00054% of R)	R ≥ 0 °C	0.001% of span
	0.0061 °C + (0.0025% of absolute value R)	R < 0 °C	0.001% of span
Type N	0.0068 °C +(0.00036% of R)	All	0.001% of span
Type R, S, W5Re/W26Re	0.016 °C	R ≥ 200°C	0.001% of span
	0.023 °C – (0.0036% of R)	R < 200 °C	0.001% of span
Type T	0.0064 °C	R ≥ 0 °C	0.001% of span
	0.0064 °C +(0.0043% of absolute value R)	R < 0 °C	0.001% of span
DIN Type L	0.0054 °C + (0.00029% of R)	R ≥ 0 °C	0.001% of span
	0.0054 °C +(0.0025% of absolute value R)	R < 0 °C	0.001% of span
DIN Type U	0.0064 °C	R ≥ 0 °C	0.001% of span
	0.0064 °C +(0.0043% of absolute value R)	R < 0 °C	0.001% of span
Millivolt Input	0.0005 mV	Entire Sensor Input Range	0.001% of span
2-, 3-, 4-wire Ohm	0.0084 Ω	Entire Sensor Input Range	0.001% of span

(1) Change in ambient is with reference to the calibration temperature of the transmitter 68 °F (20 °C) from factory.

Transmitters can be installed in locations where the ambient temperature is between –40 and 85 °C (–40 and 185 °F). In order to maintain excellent accuracy performance, each transmitter is individually characterized over this ambient temperature range at the factory.

Temperature Effects Example (HART devices)

When using a Pt 100 (α = 0.00385) sensor input with a 0–100 °C span at 30 °C ambient temperature:

- Digital Temperature Effects: 0.003 °C x (30 - 20) = 0.03 °C
- D/A Effects: [0.001% of 100] x (30 - 20) = 0.01 °C
- Worst Case Error: Digital + D/A + Digital Temperature Effects + D/A Effects = 0.15 °C + 0.03 °C + 0.03 °C + 0.01 °C = 0.22 °C
- Total Probable Error: $\sqrt{0.15^2 + 0.03^2 + 0.03^2 + 0.01^2} = 0.16°C$

Temperature Effects Examples (Foundation fieldbus devices)

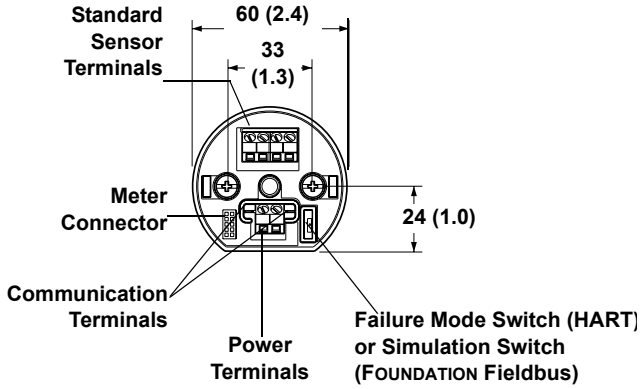
When using a Pt 100 (α = 0.00385) sensor input at 30 °C span at 30 °C ambient temperature:

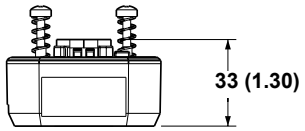
- Digital Temperature Effects: 0.003 °C x (30 - 20) = 0.03 °C
- D/A Effects: No D/A effects apply
- Worst Case Error: Digital + Digital Temperature Effects = 0.15 °C + 0.03 °C = 0.18 °C
- Total Probable Error: $\sqrt{0.15^2 + 0.03^2} = 0.153°C$

DIMENSIONAL DRAWINGS

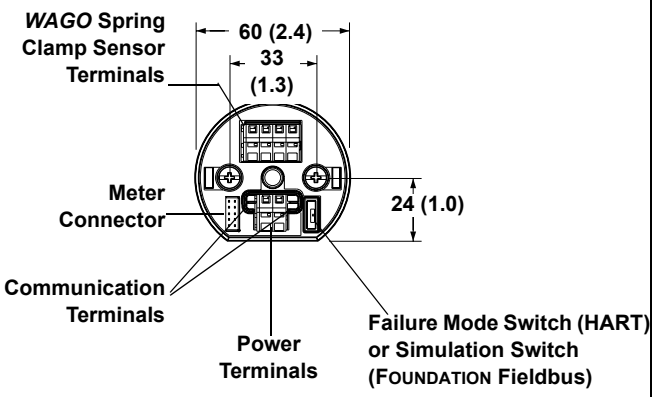
644H (DIN A Head Mount)

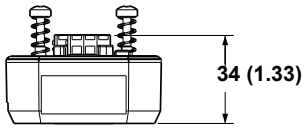
Shown with Standard Compression Screw Terminals



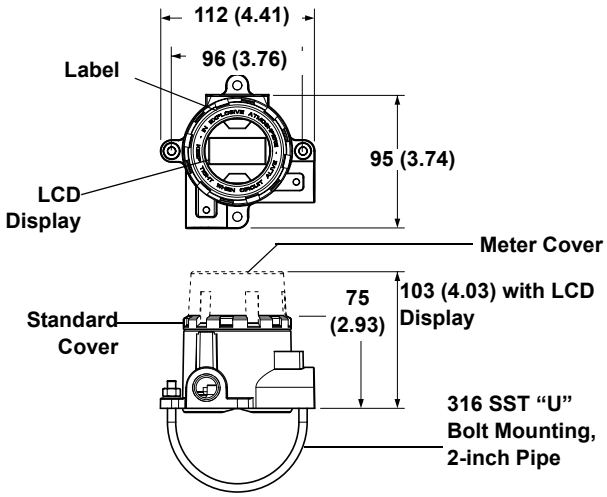


Shown with WAGO® Spring Clamp Terminals



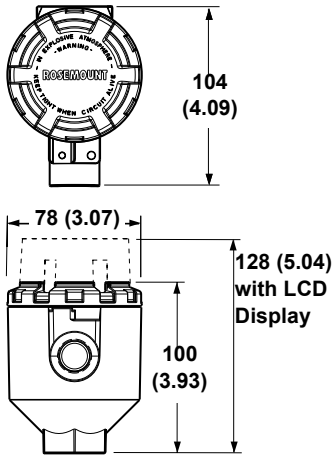


Threaded-Sensor Universal Head (Option code J5 or J6)



Note: A "U" Bolt is shipped with each universal head unless assembly option X1, X2, or X3 is ordered. Since the head is integrally mounted to the sensor, it may not need to be used.

Integral DIN Style Sensor Connection Head

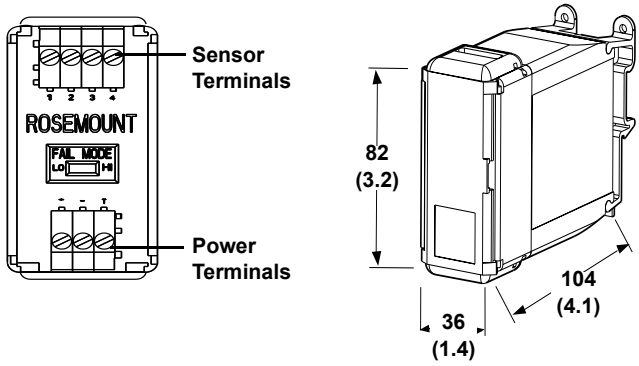


Note: The DIN Style Integral sensor connection head is only available through Volume 2 of the Rosemount Temperature Sensors and Accessories Product Data Sheet (document number 00810-0101-2654).

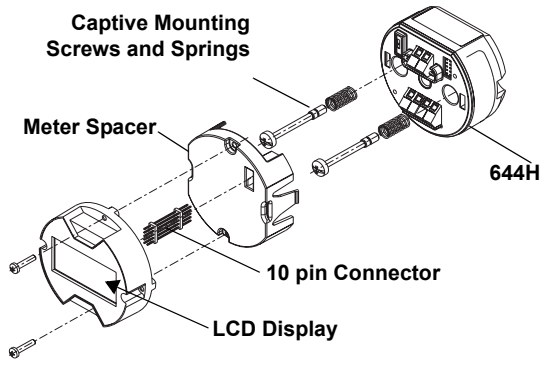
644-4420A02A, 4410A03A

Dimensions are in millimeters (inches)

644 Rail Mount
HART Protocol Only

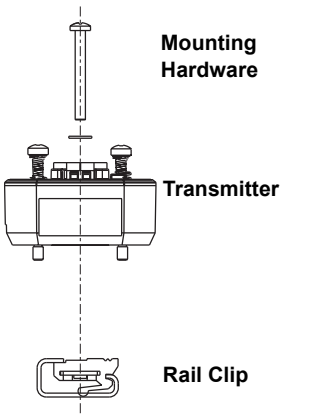


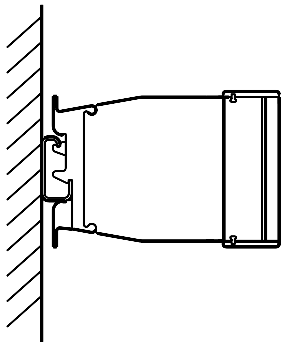
LCD Display
Head Mount Transmitter



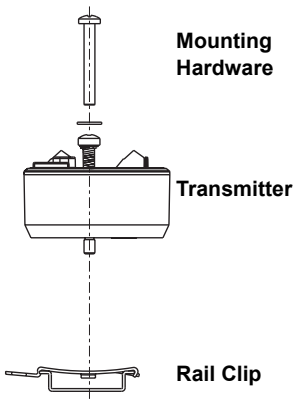
Mounting

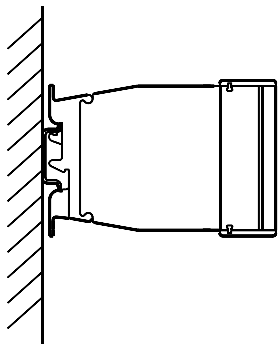
G-Rail (asymmetric)





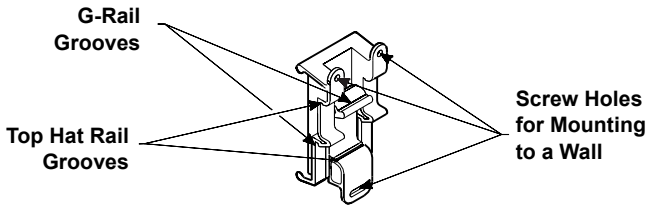
Top Hat Rail (symmetric)



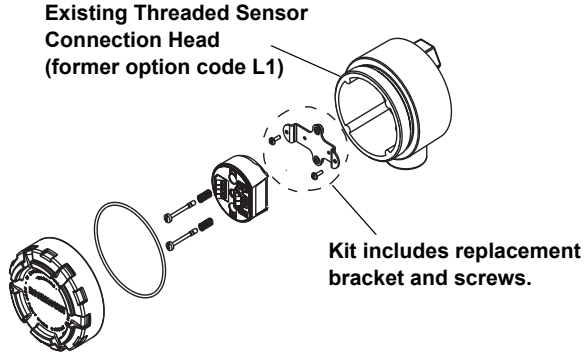


Note: Kit (part number 00644-5301-0010) includes mounting hardware and both types of rail kits.

Universal Clip for Mounting to a Wall or a Rail (part number 03044-4103-0001)



644H Retrofit Kit



Note: Kit (part number 00644-5321-0010) includes a new mounting bracket and the hardware necessary to facilitate the installation.

3044-4001A01B, 644-5302B01A, D02A

3044-0000C01B, D01B, 644-1041B02B,G02E

ORDERING INFORMATION

● = Available
– = Not Available

Model	Product Description				
644	Smart Temperature Transmitter				
Code	**Transmitter Type**				
H	Head Mount				
R	Rail Mount				
Code	**Output**	**Head**		**Rail**	
A	4–20 mA with digital signal based on HART protocol	●		●	
F	Foundation fieldbus digital signal (includes 2 AI function blocks and Backup Link Active Scheduler)	●		–	
Code	**Product Certifications**	**A**	**F**	**A**	**F**
Hazardous Locations Certificates (consult factory for availability)					
NA	No approval	●	●	●	–
E5	FM Explosion–Proof	●	●	–	–
I5(1)	FM Intrinsic Safety (includes standard I.S. and FISCO for Fieldbus units)	●	●	●	–
K5(1)	FM Intrinsic Safety and Explosion–Proof combination (includes standard I.S. and FISCO for Fieldbus units)	●	●	–	–
I6(1)	CSA Intrinsic Safety (includes standard I.S. and FISCO for Fieldbus units)	●	●	●	–
K6(1)	CSA Intrinsic Safety and Explosion–Proof combination (includes standard I.S. and FISCO for Fieldbus units)	●	●	–	–
E1	CENELEC ATEX Flame–Proof	●	●	–	–
N1	CENELEC ATEX Type n	●	●	–	–
NC	CENELEC ATEX Type n Component	●	●	●	–
ND	CENELEC ATEX Dust Ignition–Proof	●	●	–	–
I1(1)	CENELEC ATEX Intrinsic Safety (includes standard I.S. and FISCO for Fieldbus units)	●	●	●	–
E7	SAA Flame–Proof	●	●	–	–
I7(2)(1)	SAA Intrinsic Safety (includes standard I.S. and FISCO for Fieldbus units)	●	●	●	–
N7(2)	SAA Type n	●	●	–	–
I2(2)	CEPEL Intrinsic Safety	●	●	–	–
E4(2)	JIS Explosion–Proof	●	●	–	–
I4(2)	JIS Intrinsic Safety	●	●	●	–
Code	**Options**	**A**	**F**	**A**	**F**
Plant Web Software Functionality					
A01	Regulatory Control Suite – 1 PID Block	–	●	–	–
Assembly					
XA	Sensor specified separately and assembled to transmitter	●	●	–	–
Local Display (644H only)					
M5	LCD Display	●	●	–	–
Enclosure					
J5	Universal Head (junction box), aluminum alloy with 50.8 mm (2-in.) 316 SST pipe bracket (M20 entries)	●	●	–	–
J6	Universal Head (junction box), aluminum alloy with 50.8 mm (2-in.) 316 SST pipe bracket (1/2–14 NPT entries)	●	●	–	–
S1	Connection Head, Polished Stainless Steel (1/2–14 NPT entries)	●	●	–	–
S2	Connection Head, Polished Stainless Steel (1/2–14 NPSM entries)	●	●	–	–
S3	Connection Head, Polished Stainless Steel (M20 x 1.5 conduit and entries)	●	●	–	–
S4	Connection Head, Polished Stainless Steel (M20 x 1.5 conduit entries, M24 x 1.5 head entry)	●	●	–	–

● = Available
– = Not Available

		Head		Rail	
		A	F	A	F
Configuration Options					
C1	Factory configuration date, descriptor, and message fields (Configuration Data Sheet required).	●	●	●	–
C2	Transmitter-sensor matching, trim to specific Rosemount RTD calibration schedule (CVD constants)	●	●	●	–
A1	Analog output levels compliant with NAMUR-recommendations NE 43: June 1997: high alarm configuration	●	–	●	–
CN	Analog output levels compliant with NAMUR-recommendations NE 43: June 1997: low alarm configuration	●	–	●	–
C8	Low Alarm (standard Rosemount alarm and saturation values)	●	–	●	–
F6	60 Hz line voltage filter	●	●	●	–
Calibration Option					
C4	5-point calibration. *Use option code Q4 to generate a calibration certificate*	●	●	●	–
Q4	Calibration certificate. *3-Point calibration with certificate*	●	●	●	–
Accessory Options (644 only)					
G1	External ground lug assembly(3) (see “External Ground Screw Assembly” on page A-14)	●	●	–	–
G2	Cable gland(4)	●	●	–	–
G3	Cover chain. *Only available with enclosure option codes J5 or J6. Not available with LCD Display option code M5.*	●	●	–	–
G5	*WAGO* spring clamp terminals	●	●	–	–

Typical Rail Mount Model Number: 644 R A I5
Typical Head Mount Model Number: 644 H F I5 A01

(1) When IS approval is ordered on a Foundation fieldbus, both standard IS and FISCO IS approvals apply. The device label is marked appropriately.
(2) Consult factory for availability.
(3) Only available with Enclosure option code J5 or J6. For ATEX approved units the Ground Lug Assembly is included. It is not necessary to include code G1 for units with ATEX approvals.
(4) Only available with Enclosure option code J5.

TABLE 4. Transmitter Accessories

Part Description	Part Number
Aluminum alloy Universal Head, standard cover—M20 entries	00644-4420-0002
Aluminum alloy Universal Head, meter cover—M20 entries	00644-4420-0102
Aluminum alloy Universal Head, standard cover—1/2-14 NPT entries	00644-4420-0001
Aluminum alloy Universal Head, meter cover—1/2-14 NPT entries	00644-4420-0101
LCD Display (includes meter and meter spacer assembly)	00644-4430-0002
LCD Display kit (includes meter and meter spacer assembly, and meter cover)	00644-4430-0001
Ground screw assembly kit	00644-4431-0001
Kit, Hardware for mounting a 644H to a DIN rail (includes clips for symmetrical and asymmetrical rails)	00644-5301-0010
Kit, Hardware for retrofitting a 644H in an existing threaded sensor connection head (former option code L1)	00644-5321-0010
Kit, 316 U-Bolt for Universal Housing	00644-4423-0001
Blank transmitter configuration labels (sheet of 48)	00644-5154-0001
Universal clip for rail or wall mount	03044-4103-0001
24 Inches of symmetric (top hat) rail	03044-4200-0001
24 Inches of asymmetric (G) Rail	03044-4201-0001
Ground clamp for symmetric or asymmetric rail	03044-4202-0001
End clamp for symmetric or asymmetric rail	03044-4203-0001
Snap rings kit (used for assembly to a DIN sensor – quantity 12)	00644-4432-0001

ADDITIONAL INFORMATION

Tagging

Hardware

- No charge
- Tagged in accordance with customer requirements
- Tags are adhesive labels
- Permanently attached to transmitter
- Character height is 1/16-in (1.6 mm)

Software

- No charge
- The transmitter can store up to 30 characters. If no characters are specified, the first 8 characters of the hardware tag are the default.

Considerations

Special Mounting Considerations

See “Mounting” on page A-11 for the special hardware that is available to:

- Mount a 644H to a DIN rail.
- Retrofit a new 644H to replace an existing 644H transmitter in an existing threaded sensor connection head.

External Ground Screw Assembly

Specifying option code G1 to order the external ground screw assembly. It is not necessary to order option code G1 for those approvals that include the ground screw assembly, The table below identifies which approval options include the external ground screw assembly.

Approval Type	External Ground Screw Assembly Included?
E5, K5, I5, I6, K6, NC, NA	No–Order option code G1
N1, E1, ND, I1, E7, N7, I7, I4, and E4	Yes

Configuration

Transmitter Configuration

The transmitter is available with standard configuration setting for either HART (see “Standard HART Configuration”)or FOUNDATION fieldbus (see “Standard Foundation Fieldbus Configuration”). The configuration settings and block configuration may be changed in the field with the Fisher-Rosemount Systems DeltaV®, with AMS*inside*, or other FOUNDATION fieldbus host or configuration tool.

Custom Configuration

Custom configurations are to be specified when ordering. This configuration must be the same for all sensors. The following table lists the necessary requirements to specify a custom configuration.

	Option Code	Requirements/ Specification
	C1: Factory Configuration Data (CDS required)	Date: day/month/year Descriptor: 16 alphanumeric characters Message: 32 alphanumeric character Analog Output: Alarm and saturation levels
	C2:Transmitter – Sensor Matching	The transmitters are designed to accept Callendar-Van Dusen constants from a calibrated RTD. Using these constants, the transmitter generates a custom curve to match the sensor-specific curve. Specify a Series 65, 65, or 78 RTD sensor on the order with a special characterization curve (V or X8Q4 option). These constants will be programmed into the transmitter with this option
HART only	A1: NAMUR-Compliant, High Alarm	High Alarm = 21.5 mA Upscale Saturation = 20.5 mA
HART only	CN: NAMUR-Compliant, Low Alarm	Low Alarm = 3.6 mA Downscale Saturation = 3.8 mA
	C4: Five Point Calibration	Will include 5-point calibration at 0, 25, 50, 75, and 100% analog and digital output points. Use with Calibration Certificate Q4.
	F6: 60 Hz Line Filter	Calibrated to a 60 Hz line voltage filter instead of 50 Hz filter

Standard HART Configuration

Unless specified, the transmitter will be shipped as follows:

Sensor Type	RTD, Pt 100 (α=0.00385, 4-wire)
4 mA Value	0 °C
20 mA Value	100 °C
Damping	5 seconds
Output	Linear with temperature
Failure/Saturation Modes	High (21.75 mA) / Upscale (20.5 mA)
Line Voltage Filter	50 Hz
Tag	Configuration Data Sheet requires

Standard FOUNDATION Fieldbus Configuration

Unless otherwise specified, the transmitter will be shipped as follows for all sensors:

Sensor Type: 4-wire Pt 100 (α = 0.00385) RTD

Damping: 5 seconds

Units of Measurement: °C

Line Voltage Filter: 50 Hz

Software Tag: See “Tagging”

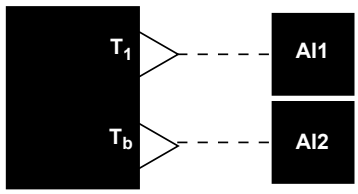
Function Blocks Tags:
- Resource Block: RB
- Transducer Block: TB
- LCD Block: LCD
- Analog Input Blocks: AI1, AI2

Alarm Range: 0

Alarm Limits of AI1 and AI2:
- HI-HI: 100 °C (212 °F)
- HI: 95 °C (203 °F)
- LO: 5 °C (41 °F)
- LO-LO: 0 °C (32 °F)

Local Display (when installed): Engineering Units of Temperature

Standard Block Configuration



Note:
T_1 = Sensor Temperature
T_b = Terminal Temperature

Final Station

AI Blocks are scheduled for 1 second. AI Blocks are linked as shown above.

STAINLESS STEEL HOUSING

The Stainless Steel Housing is ideal for Biotechnology, Pharmaceutical Industries, and Sanitary Applications

Weight

Option Code	Standard Cover	Meter Cover
S1	840 g (27 oz)	995 g (32 oz)
S2	840 g (27 oz)	995 g (32 oz)
S3	840 g (27 oz)	995 g (32 oz)
S4	840 g (27 oz)	995 g (32 oz)

Enclosure Rating

NEMA 4X, IP66, and IP68

Materials of Construction

Housing and Standard Meter Cover
- 316L SST

Cover O-Ring
- Buna-N

LCD Display Cover

- 316L SST
- Glass

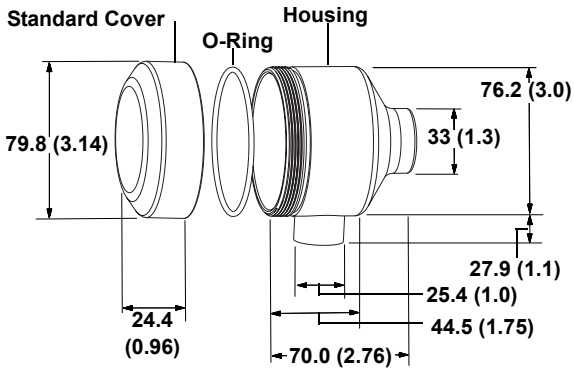
Surface

Surface finish is polished to 32 RMA. Laser etched product marking on housing and standard covers.

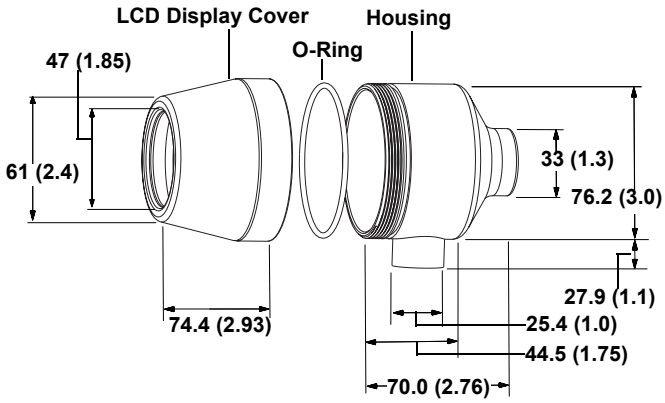
Dimensional Drawings

Sanitary Housing Covers

Standard Cover



LCD Display Cover



Dimensions are in millimeters (inches)

Appendix B Product Certifications

Approved Manufacturing Locations . . . . . page B-1
European Union Directive Information . . . . . page B-1
Hazardous Locations Certificates . . . . . page B-2
Installation Drawings . . . . . page B-8

APPROVED MANUFACTURING LOCATIONS

Emerson Process Management Rosemount Division. – Chanhassen, Minnesota, USA

Rosemount Temperature GmbH – Germany

Emerson Process Management Asia Pacific – Singapore

EUROPEAN UNION DIRECTIVE INFORMATION

The EC declaration of conformity for all applicable European directives for this product can be found on the Rosemount website at www.rosemount.com. A hard copy may be obtained by contacting our local sales representative.

ATEX Directive (94/9/EC)

Rosemount Inc. complies with the ATEX Directive.

Electro Magnetic Compatibility (EMC) (89/336/EEC)

644H and 644R – EN 50081-1: 1992; EN 50082-2:1995;
EN 61326-1:1997 +AI

HAZARDOUS LOCATIONS CERTIFICATES

Rosemount 644 with FOUNDATION Fieldbus

The product certifications for the Rosemount 644 with FOUNDATION fieldbus are pending. Consult the factory for additional information.

North American Certifications

Factory Mutual (FM) Approvals

I5 FM Intrinsic Safety
Intrinsically Safe (Entity) / FISCO for use in Class I/II/III, Division 1, Groups A, B, C, D, E, F, and G; when installed per control drawing 00644-2075.
Temperature Code: T4A (T_{amb} = – 50 °C to 40 °C).

Nonincendive for use in Class I, Division 2, Groups A, B, C, and D.
Temperature Code: T6 (T_{amb} = – 50 °C to 70 °C);
T5 (T_{amb} = – 50 °C to 85 °C)

E5 FM Explosion-Proof:
Explosion-Proof for Class I, Division 1, Groups B, C, and D. Dust Ignition Proof for Class II/III, Division 1, Groups E, F, G when installed per Rosemount Drawing 00644-1049.
Temperature Code: T5 (T_{amb}= –50°C to 85°C)

Canadian Standards Association (CSA) Approvals

I6 CSA Intrinsic Safety
Intrinsically Safe for Class I, Division 1, Groups A,B,C, and D when installed in accordance with Rosemount drawing 00644-2076.
Temperature Code: T4 (T_{amb} = –50 °C to 60 °C)

K6 CSA Intrinsic Safety, Explosion–Proof, and Non-incendive.
Combination of I6 and Explosion–proof for Class I, Division 1, Groups B, C, and D; Dust-ignition proof for Class II, Division 1, Groups E, F, and G; Class III, Division 1 hazardous locations, when installed in accordance with Rosemount drawing 00644–1059.
Temperature Code: T4 (T_{amb} = –50 °C to 85 °C)
Suitable for Class I, Division 2, Groups B, C, and D when installed in a suitable enclosure.
Temperature Code: Temperature Code: T4 (T_{amb} = –50 °C to 60 °C);
T5 (T_{amb} = –50 °C to 85 °C)

NOTE

K6 is only available with 644H option code J6.

European Certifications

ATEX Approvals

E1 ATEX Flame Proof
Certificate Number: KEMA99ATEX8715
ATEX Marking: ⟨Ex⟩ II 2 G
CE 1180
EEx d IIC T6 (–40 °C ≤ T_{amb} ≤ 65 °C)
U_i = 55 Vdc
I_i = 24.0 mA

I1 ATEX Intrinsic Safety/FISCO
Certificate Number: Baseefa03ATEX0499X
ATEX Marking: ⟨Ex⟩ II 1 G
CE 1180
EEx ia IIC T4 (–50 °C ≤ Tamb ≤ 60 °C)

TABLE 1. Entity Parameters

I.S. Power/Loop	FISCO	Sensor
Intrinsic Safety		
U_i = 30 V	U_i = 17.5 V	U_i = 13.9 V
I_i = 300 mA	I_i = 380 mA	I_i = 23 mA
P_i = 1.3 W	P_i = 5.32 W	P_i = 79 mW
C_i = 2.1 nF	C_i = 2.1 nF	C_i = 7.7 nF
L_i = 0	L_i = 0	L_i = 0

Special Conditions for Safe Use (X):

The apparatus must be installed in an enclosure which affords it a degree of protection of at least IP20. Non-metallic enclosures must have a surface resistance of less than 1Ω., light alloy or zirconium enclosures must be protected from impact and friction when installed.

N1 ATEX Type n
Certificate Number: BAS00ATEX3145
ATEX Marking: ⟨Ex⟩ II 3 G
EEx nL IIC T5(-40 °C ≤ Tamb ≤ 70 °C)
Max Input Voltage: U_i = 45 V dc

NC ATEX Type n Component
Certificate Number: BAS99ATEX3084U
ATEX Marking: ⟨Ex⟩ II 3 G
EEx nL IIC T5 (-40 °C ≤ Tamb ≤ 70 °C)

Special Conditions for Safe Use (X):
The equipment must be installed in an enclosure meeting the requirements of IP54 and the requirements of the impact tests described in EN 50021.

ND ATEX Dust Ignition-Proof
Certificate Number: KEMA99ATEX8715
ATEX Marking: ⟨Ex⟩ II 1 D
CE 1180
T95°C (-40°C < Tamb < +85°C)
IP66
Max Input: U_i = 55 Vdc
I_i = 24 mA

Australian Certifications

Standard Australia Quality Assurance Service (SAA) Approvals

I7 SAA Intrinsic Safety
Certificate Number: Consult factory
Ex ia IIC

E7 SAA Explosion-Proof
Certificate Number: AUS Ex3706X
Ex d IIC T6
Temperature Code: T6 (T_{amb}=–40°C to 65°C)

NOTE

Flame-Proof certification is only available as a complete assembly with Rosemount universal head – option codes J5 or J6.

N7 SAA Type n
Certificate Number: Consult factory
Ex n

Brazilian Certifications

Centro de Pesquisas de Energia Eletrica (CEPEL) Approval

I2 CEPEL Intrinsic Safety

Japanese Certifications

Japanese Industrial Standard (JIS) Approvals

I4 JIS Intrinsic Safety

E4 JIS Explosion Proof

Combination Approvals

K5 Combination of I5 and E5.

NOTE

K5 is only available with 644H option code J6.

Rosemount 644 with HART

North American Certifications

Factory Mutual (FM) Approvals

I5 FM Intrinsic Safety and Non-incendive:
Intrinsically Safe for Class I/II/III, Division 1, Groups A, B, C, D, E, F, and G.
Non-incendive for Class I, Division 2, Groups A, B, C, and D. Intrinsically Safe and non-incendive when installed in accordance with Rosemount drawing 00644-0009.

TABLE 2. Temperature Code

Pi	Temperature Code
0.67 W	T5 (T_{amb} = – 50 °C to 50 °C)
0.67 W	T6 (T_{amb} = – 50 °C to 40 °C)
1.0 W	T4 (T_{amb} = – 50 °C to 80 °C)
1.0 W	T5 (T_{amb} = – 50 °C to 40 °C)

E5 FM Explosion-Proof and Non-incendive:
Explosion-Proof for Class I, Division 1, Groups B, C, and D. Dust Ignition Proof for Class II/III, Division 1, Groups E, F, G when installed per Rosemount Drawing 00644-1049. Non-incendive for Class 1, Division 2, Groups A, B, C, and D. Temperature Code: T5 (T_{amb}= –50 °C to 85 °C) Conduit seal not required for compliance with NEC501–5a(1).

NOTE

Approval E5 is only available with 644H option codes J5 and J6.

K5 Combination of I5 and E5.

NOTE

K5 is only available with 644H option code J6.

Canadian Standards Association (CSA) Approvals

I6 CSA Intrinsic Safety
Intrinsically Safe for Class I, Division 1, Groups A, B, C, and D when installed in accordance with Rosemount drawing 00644–1064.

TABLE 3. Temperature Code

Pi	Temperature Code
0.67 W	T6 (T_{amb} = – 50 °C to 40 °C)
0.67 W	T5 (T_{amb} = – 50 °C to 60 °C)
1.0 W	T4 (T_{amb} = – 50 °C to 80 °C)

K6 CSA Intrinsic Safety, Explosion–Proof, and Non-incendive.
Combination of I6 and Explosion–proof for Class I, Division 1, Groups B, C, and D; Dust-ignition proof for Class II, Division 1, Groups E, F, and G; Class III, Division 1 hazardous locations, when installed in accordance with Rosemount drawing 00644–1059.
Temperature Code: T4(T_{amb} = -50 °C to 85 °C)
Suitable for Class I, Division 2, Groups B, C, and D when installed in a suitable enclosure.
Temperature Code: T5 (T_{amb} = -50 °C to 85 °C).

NOTE

K6 is only available with 644H option code J6.

European Certifications

ATEX Approvals

I1 ATEX Intrinsic Safety:
Certificate Number: BAS00ATEX1033X
ATEX Marking: ⟨Ex⟩ II 1 G EEx ia IIC T4/T5/T6
CE 1180

TABLE 4. Temperature Code

Pi	Temperature Code
0.67 W	T6 (– 60 °C ≤ T_{amb} ≤ 40 °C)
0.67 W	T5 (– 60 °C ≤ T_{amb} ≤ 50 °C)
1.0 W	T5 (– 60 °C ≤ T_{amb} ≤ 40 °C)
1.0 W	T4 (– 60 °C ≤ T_{amb} ≤ 80 °C)

TABLE 5. Entity Parameters

Loop/Power	Sensor
U_i = 30 V	U_o = 13.6 V
I_i = 200 mA	I_o = 80 mA
P_i = 0.67 W or 1.0 W	P_o = 80 mW
C_i = 10 nF	C_i = 75 nF
L_i = 0	L_i = 0

Special Conditions for Safe Use (X):

The transmitter must be installed so that its external terminals and communication pins are protected to at least IP20.
Non-metallic enclosures must have a surface resistance of less than 1GΩ. Light alloy or zirconium enclosures must be protected from impact and friction when installed.

E1 ATEX Flame-Proof:
Certificate Number: KEMA99ATEX8715
ATEX Marking: ⟨Ex⟩ II 2 G EEx d IIC T6
CE 1180
Temperature Code: T6 (–40°C ≤ T_{amb} ≤ 65°C)
Max Input: U_i=55Vdc
I_i = 24.0 mA

N1 ATEX Type n:
Certificate Number: BAS00ATEX3145
ATEX Marking: ⟨Ex⟩ II 3 G EEx nL IIC T5
Temperature Code: T5 (–40°C ≤ T_{amb} ≤ 70°C)
Max Input Voltage: U_i=45Vdc

NC ATEX Type n Component:
Certificate Number: BAS99ATEX3084U
ATEX Marking: ⟨Ex⟩ II 3 G EEx nL IIC T5
Temperature Code: T5 (–40°C ≤ T_{amb} ≤ 70°C)
Max Input Voltage: U_i=45Vdc

NOTE

The equipment must be installed in an enclosure meeting the requirements of IP54 and the requirements of the impact tests described in EN50021.

ND ATEX Dust Ignition-Proof
Certificate Number: KEMA99ATEX8715
ATEX Marking: ⟨Ex⟩ II 1 D
CE 1180
T95°C (-40°C < Tamb < +85°C)
IP66
Max Input: U_i = 55 Vdc
I_i = 24.0 mA

Australian Certifications

Standard Australia Quality Assurance Service (SAA) Approvals

E7 SAA Explosion-Proof
Certificate Number: AUS Ex3706X
Ex d IIC T6
Temperature Code: T6 (T_{amb}=–40°C to 65°C)

NOTE

Flame-Proof certification is only available as a complete assembly with Rosemount universal head – option codes J5 or J6.

I7 SAA Intrinsic Safety
Certificate Number: AUS Ex 03.3877X
Ex ia IIC
Temperature Code: T5 (T_{amb} = –60 to 75 °C)
T6 (T_{amb} = –60 to 50 °C)

TABLE 6. Input Entity Parameters

Loop / Power	Sensor
U_i = 30 V dc	U_o = 17.3 V
I_i = 200 mA	I_o = 247 mA
P_i = 1.0 W	P_o = 0.08 W
C_i = 5.3 nF	C_o = 0.70 µF
L_i = 0 mH	L_o = 3.13 mH

Special Condition for Safe Use (X):

1. It is a condition of safe use that for Ex ia applications, the equipment is to be housed in an enclosure that provides an ingress protection rating of not less than IP20.

2. It is a condition of safe use that the installation shall be carried out in according with Rosemount drawing 00644-1044.

3. It is a condition of safe use that a user may fit an optional LCD indicator to 644H Temperature Transmitter certified in this certificate after installation subject to the conditions requirement of this certificate.

N7 SAA Type n
Certificate Number: AUS Ex 03.3877X
Ex n IIC
Temperature Code: T5 (T_{amb} = –60 to 75 °C)
T6 (T_{amb} = –60 to 50 °C)

Special Condition for Safe Use (X):

1. It is a condition of safe use that for Ex n applications, the equipment is to be housed in an enclosure that provides an ingress protection rating of not less than IP54.

2. Input parameters for non-sparking protection model: Ex n
Input Parameters Power/Loop Terminals (Pins “+”, “-”, “T”):
Maximum Input Voltage U_n = 55 V
Maximum Input Power P_n = 1.3 W

Brazilian Certifications

Centro de Pesquisas de Energia Eletrica (CEPEL) Approval

I2 CEPEL Intrinsic Safety. Not available, consult factory

Russian Certifications

Gostandart

Tested and approved by the Russian Metrological Institute GOSTANDART.

Japanese Certifications

Japanese Industrial Standard (JIS) Approvals

E4 JIS Explosion-Proof

TABLE 7. Certificate and Description

Certificate	Description	Approval Group	Temp Code
C15744	644H with meter and no sensor	Ex d II C	T6
C15745	644H without meter and no sensor	Ex d II C	T6
C15910	644H without meter and with thermocouple	Ex d II B + H2	T4
C15911	644H with meter and thermocouple	Ex d II B + H2	T4
C15912	644H without meter and with RTD	Ex d II B + H2	T4
C15913	644H with meter and RTD	Ex d II B + H2	T4

INSTALLATION DRAWINGS

The installation guidelines presented by the drawings must be followed in order to maintain certified ratings for installed transmitters.

Rosemount Drawing 00644-1064, 1 Sheet,
Canadian Standards Association Intrinsic Safety Installation Drawing

Rosemount Drawing 00644-1059, 1 Sheet;
Canadian Standards Association Explosion-Proof Installation Drawing

Rosemount Drawing 00644-2076, 3 Sheets;
Canadian Standards Association 644 Fieldbus Intrinsic Safety/FISCO Installation Drawing

Rosemount Drawing 00644-0009, 2 Sheet
Factory Mutual Intrinsic Safety Installation Drawing

Rosemount Drawing 00644-1049, 1 Sheet;
Factory Mutual Explosion-proof Installation Drawing

Rosemount Drawing 00644-2075, 3 Sheets;
Factory Mutual 644 Fieldbus Intrinsic Safety/FISCO Installation Drawing

IMPORTANT
Once a device labeled with multiple approval types is installed, it should not be reinstalled using any of the other labeled approval types. To ensure this, the approval label should be permanently marked to distinguish the used from the unused approval type(s).

Figure B-1. CSA Intrinsic Safety Installation Drawing 00644-1064, Rev. AB

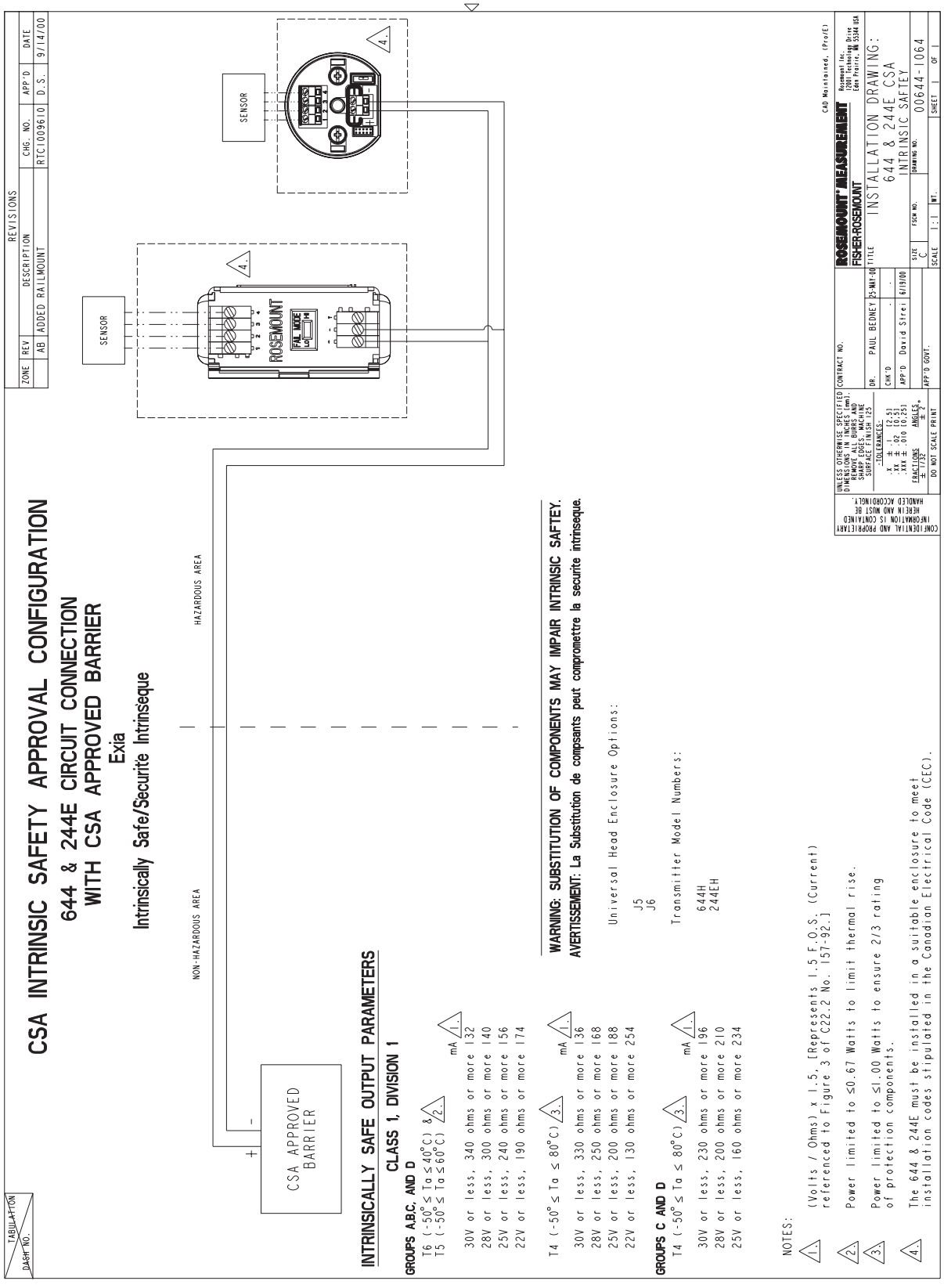
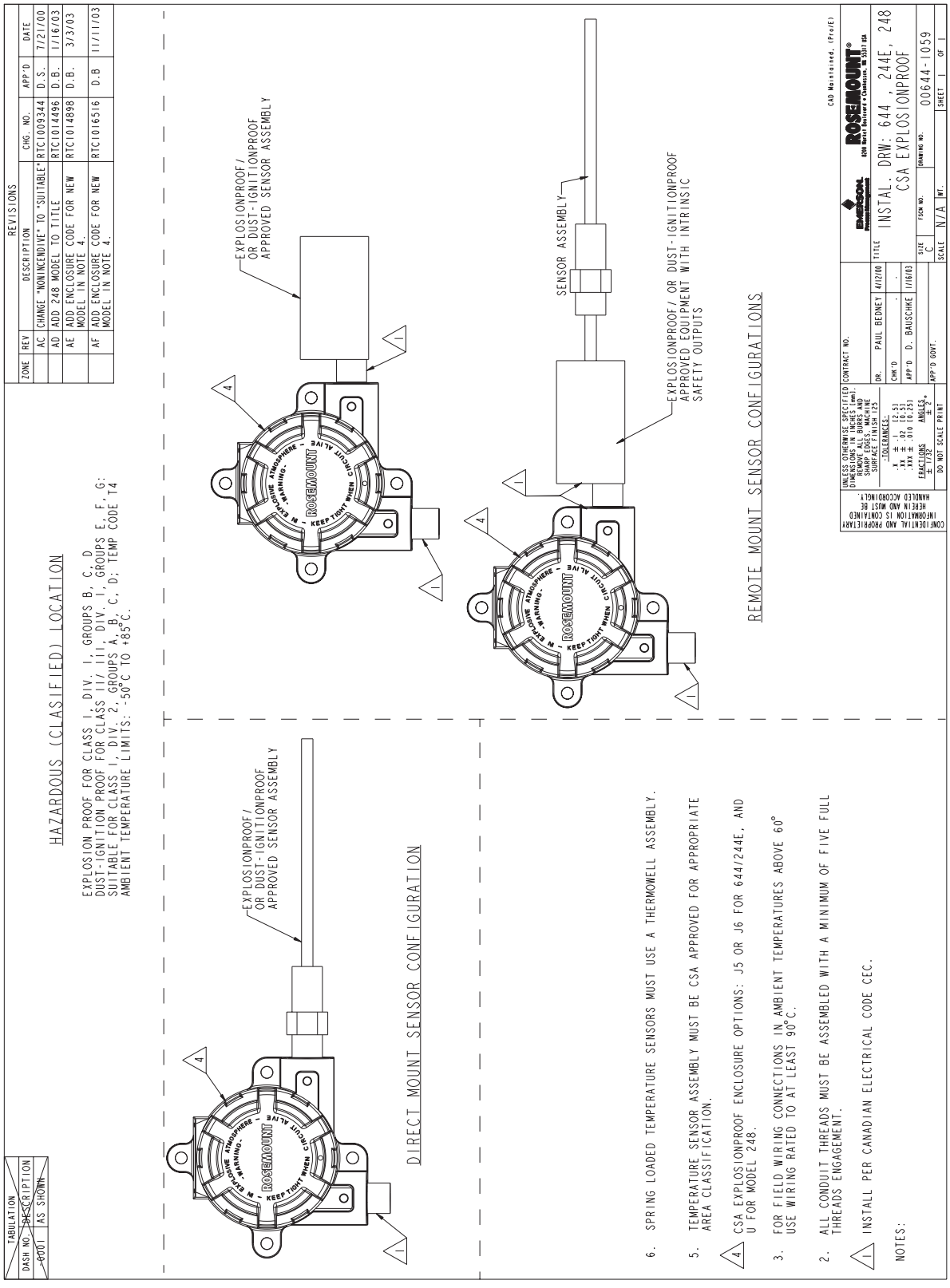
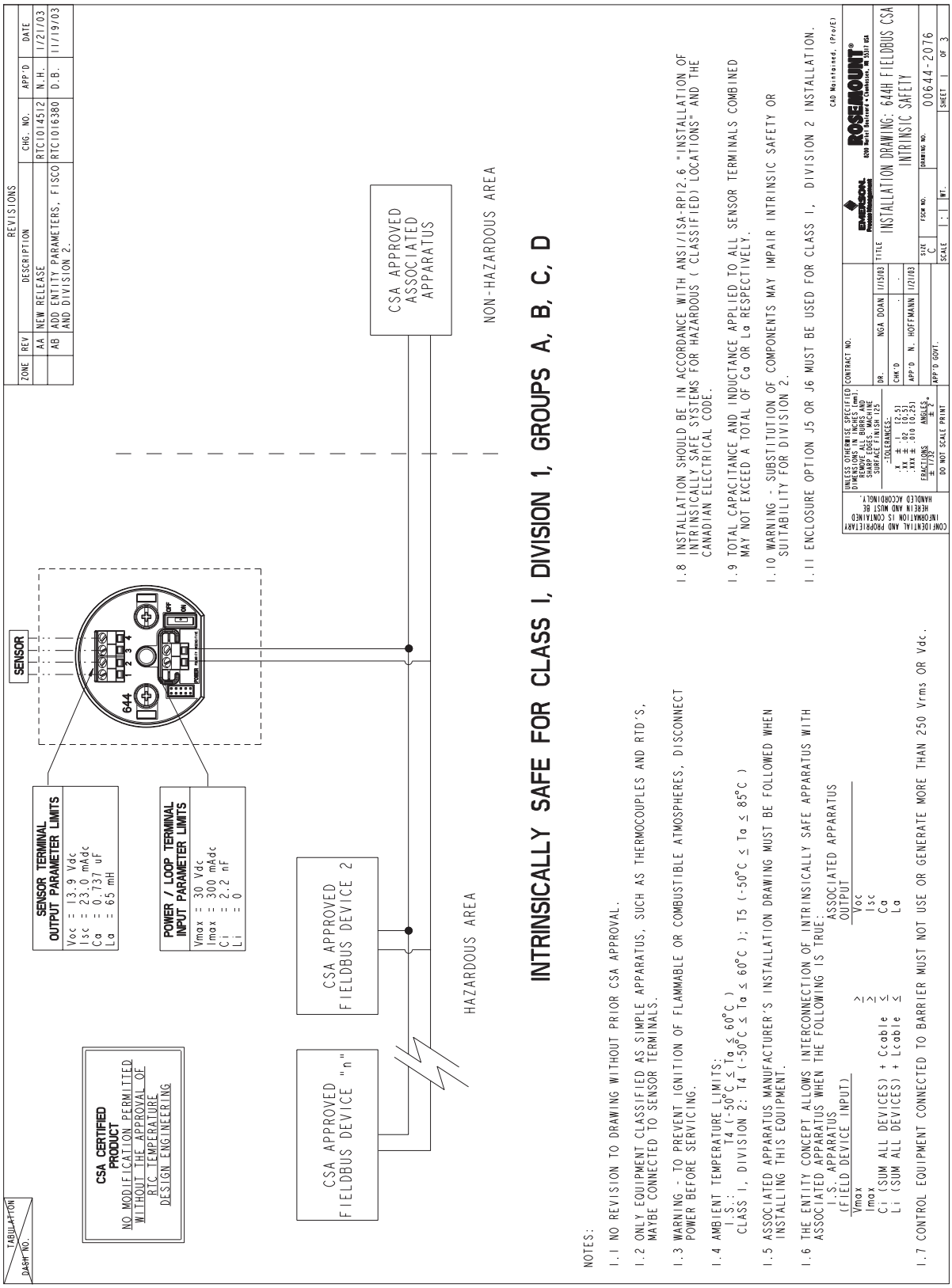


Figure B-2. CSA Explosion-Proof Installation Drawing 00644-1059, Rev. AF



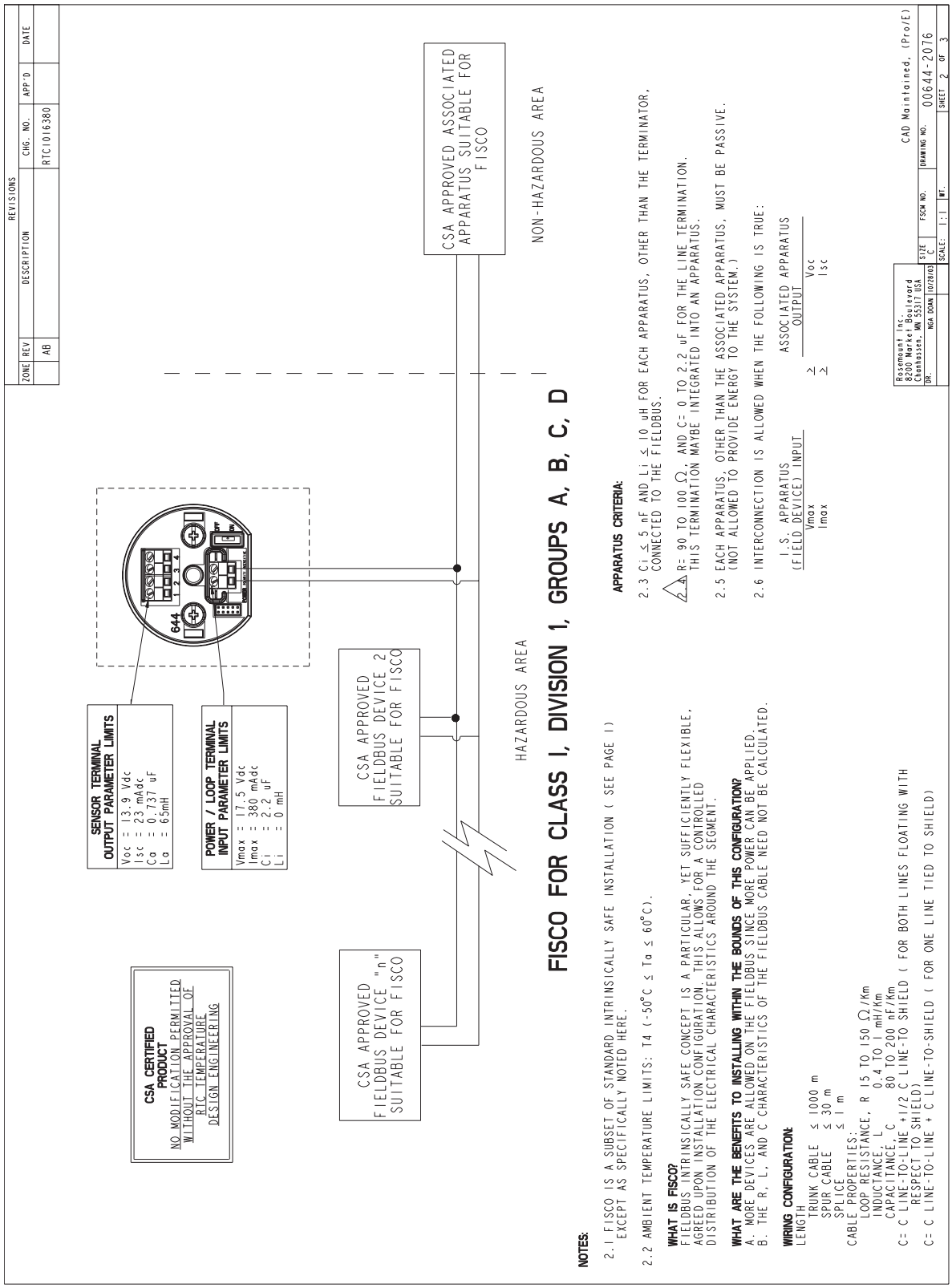
644-1059A01A

Figure B-3. CSA 644 Fieldbus Intrinsic Safety, FISCO Installation Drawing 00644-2076, Rev. AB Sheet 1 of 3



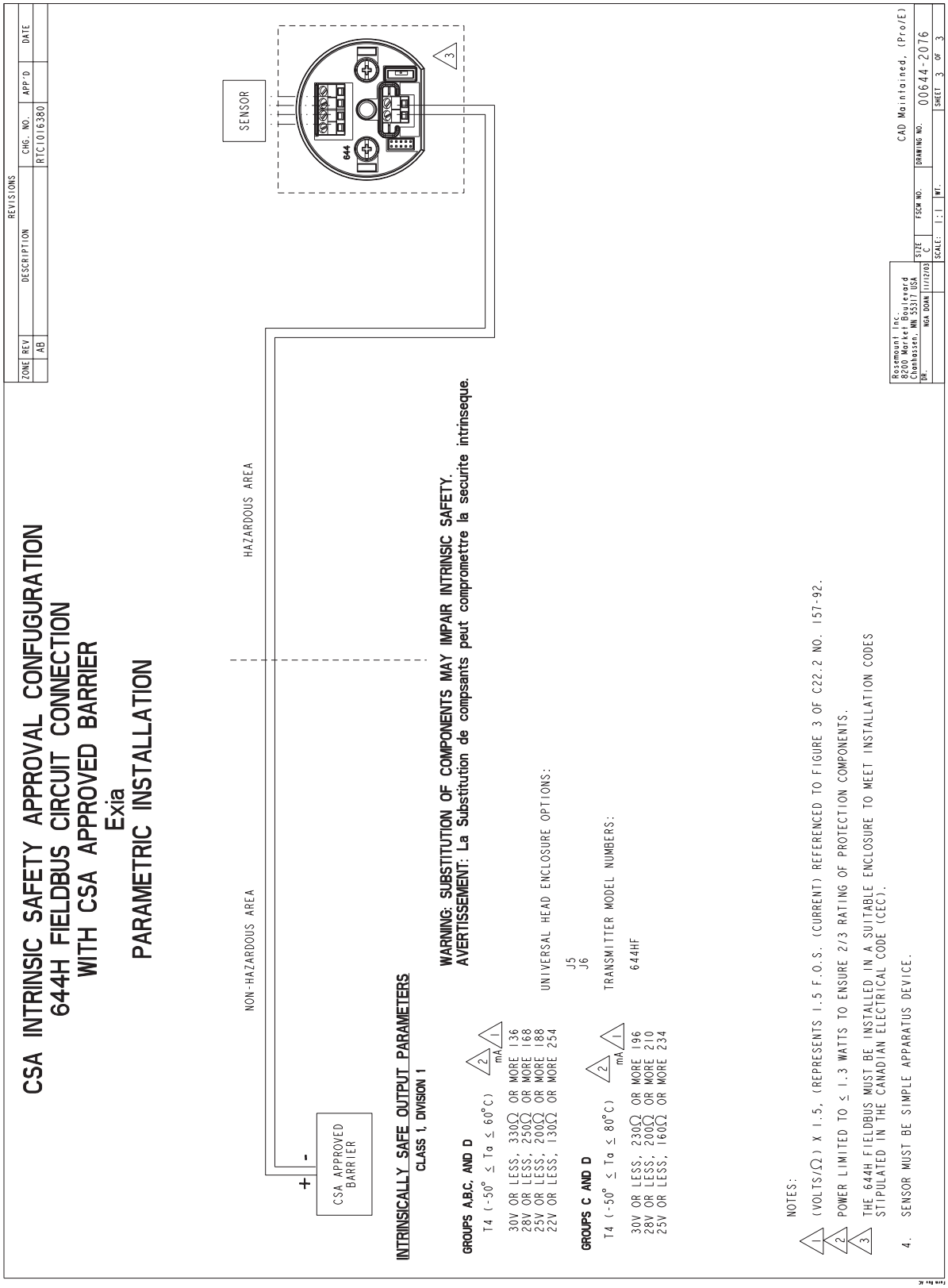
644-1049A01A

Sheet 2 of 3



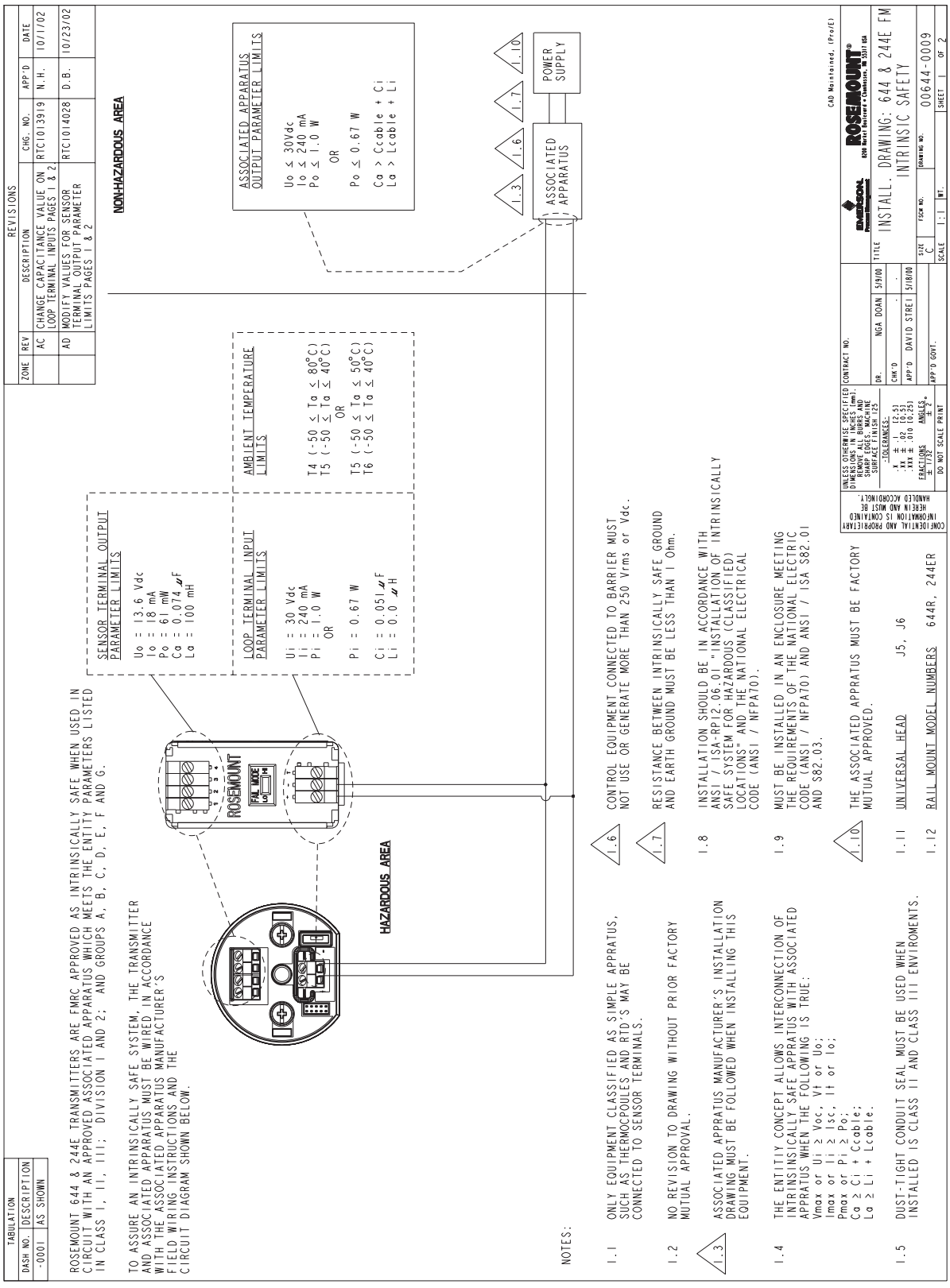
644-0009A01A

Sheet 3 of 3



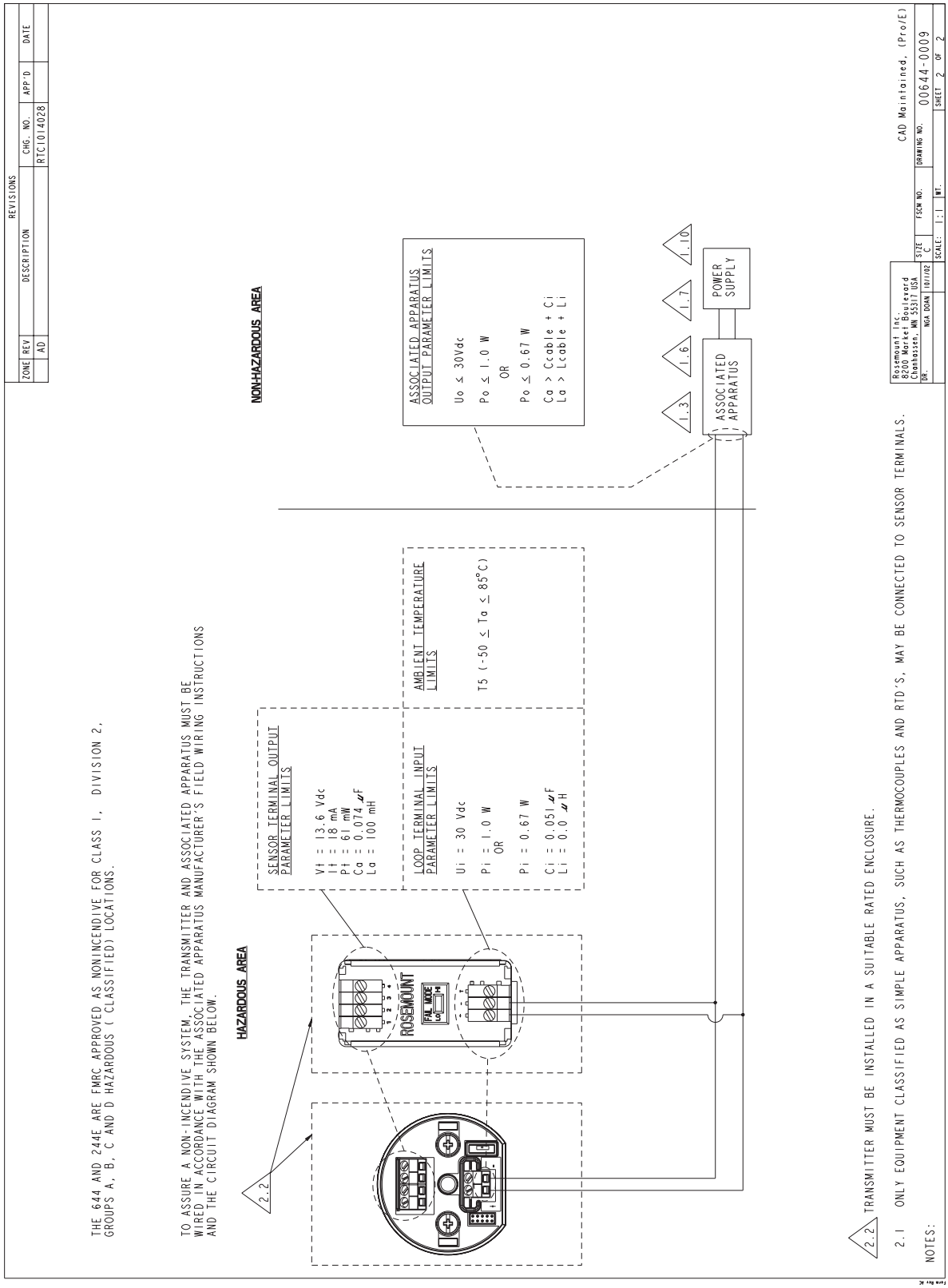
644-0009A01A

Figure B-4. FM Intrinsic Safety Installation Drawing 00644-0009, Rev. AD Sheet 1 of 2



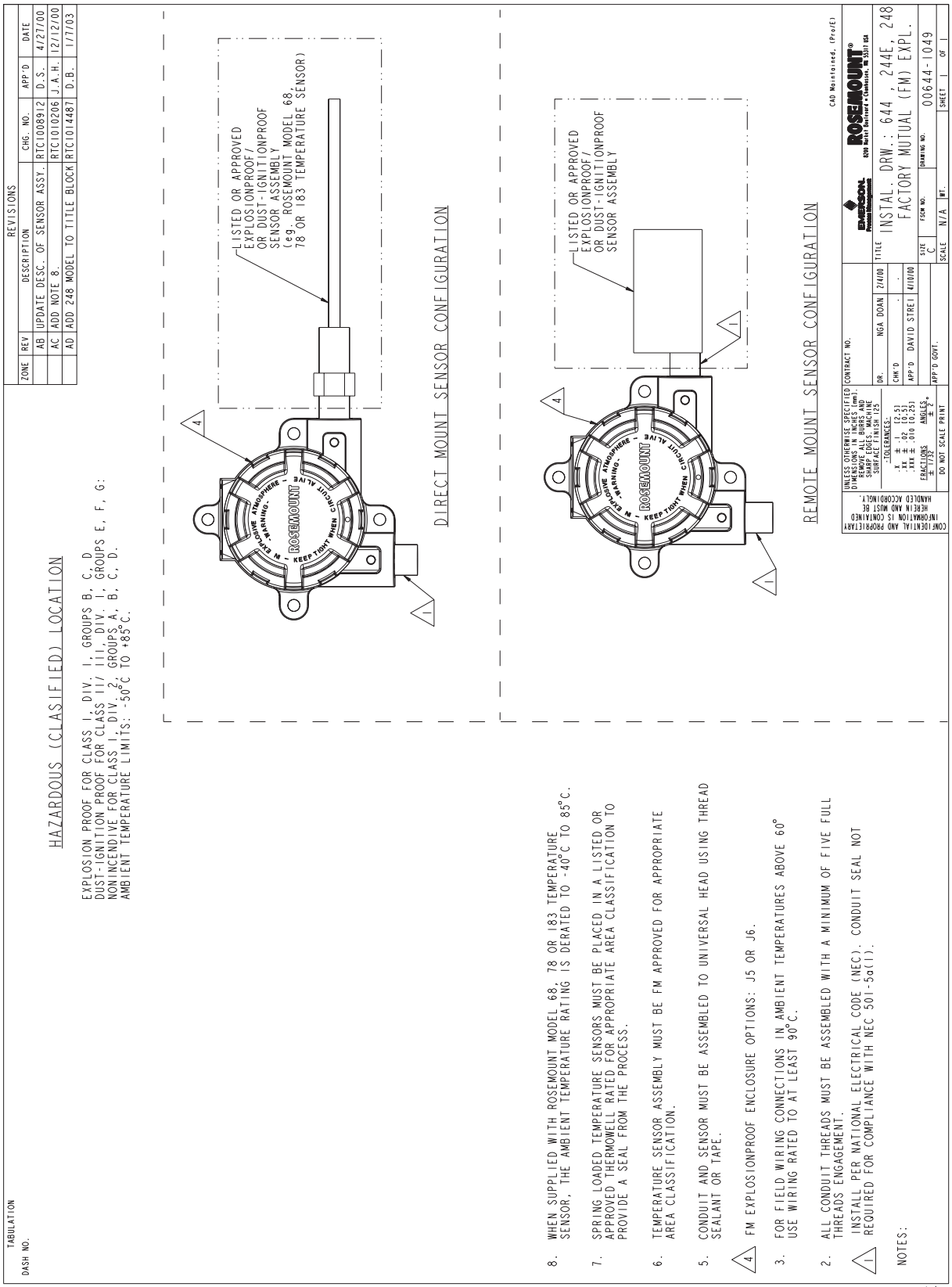
644-0009A01A

Sheet 2 of 2



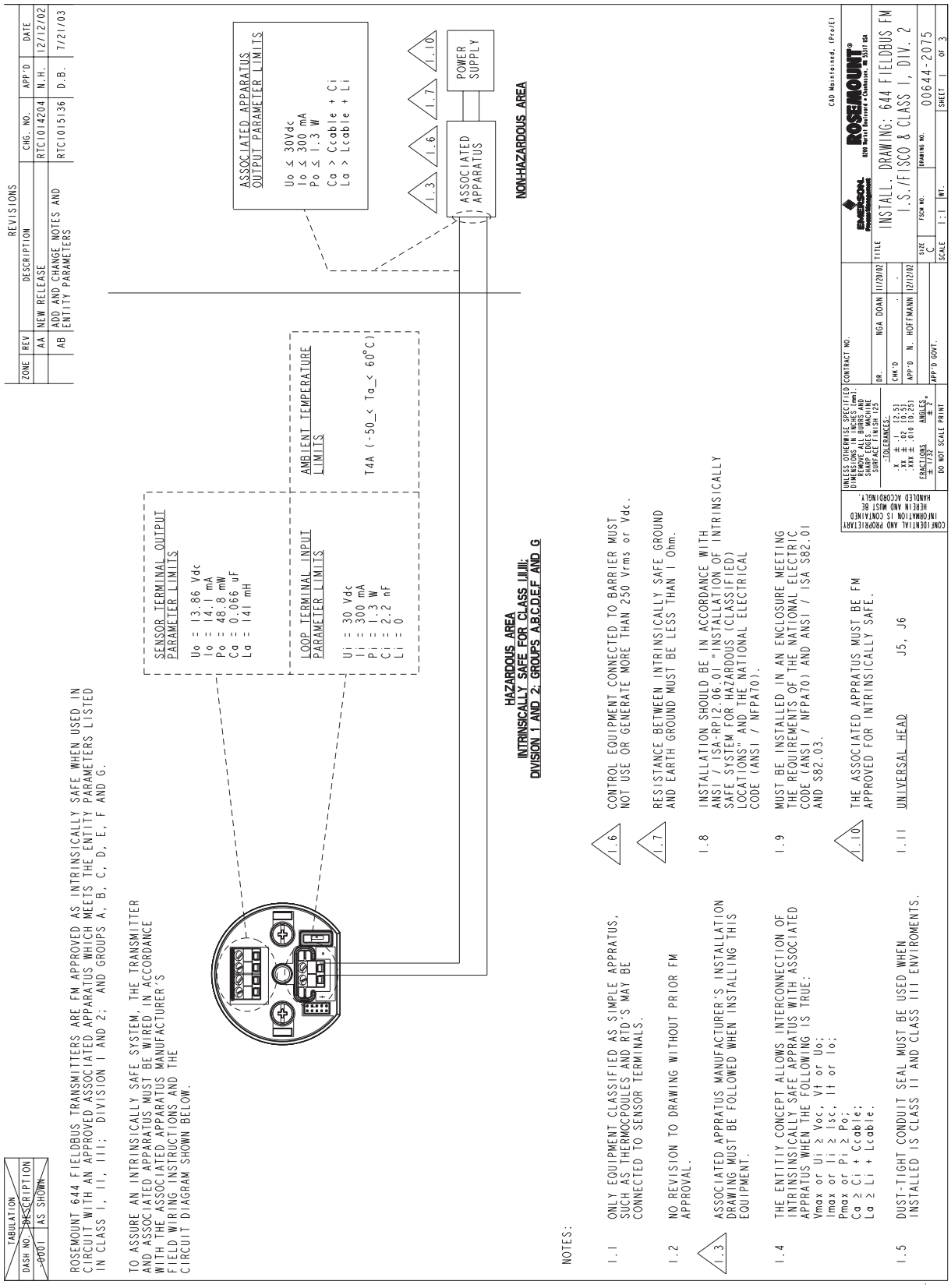
644-0009A01A

Figure B-5. FM Explosion-Proof Installation Drawing 00644-1049, Rev. AD



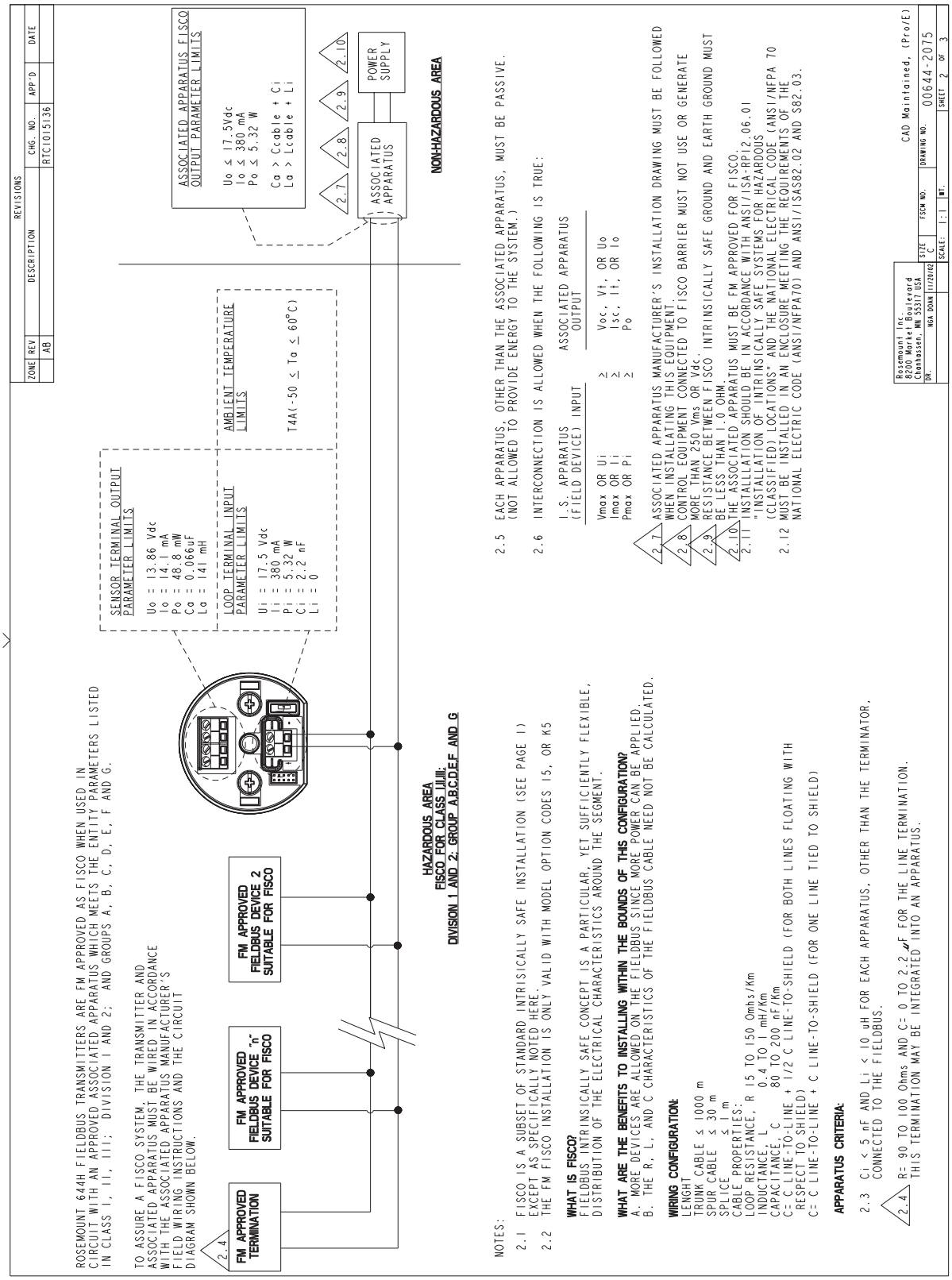
644-1049A01A

Figure B-6. FM 644 Fieldbus Intrinsic Safety and FISCO Installation Drawing 00644-2075, Rev. AB Sheet 1 of 3



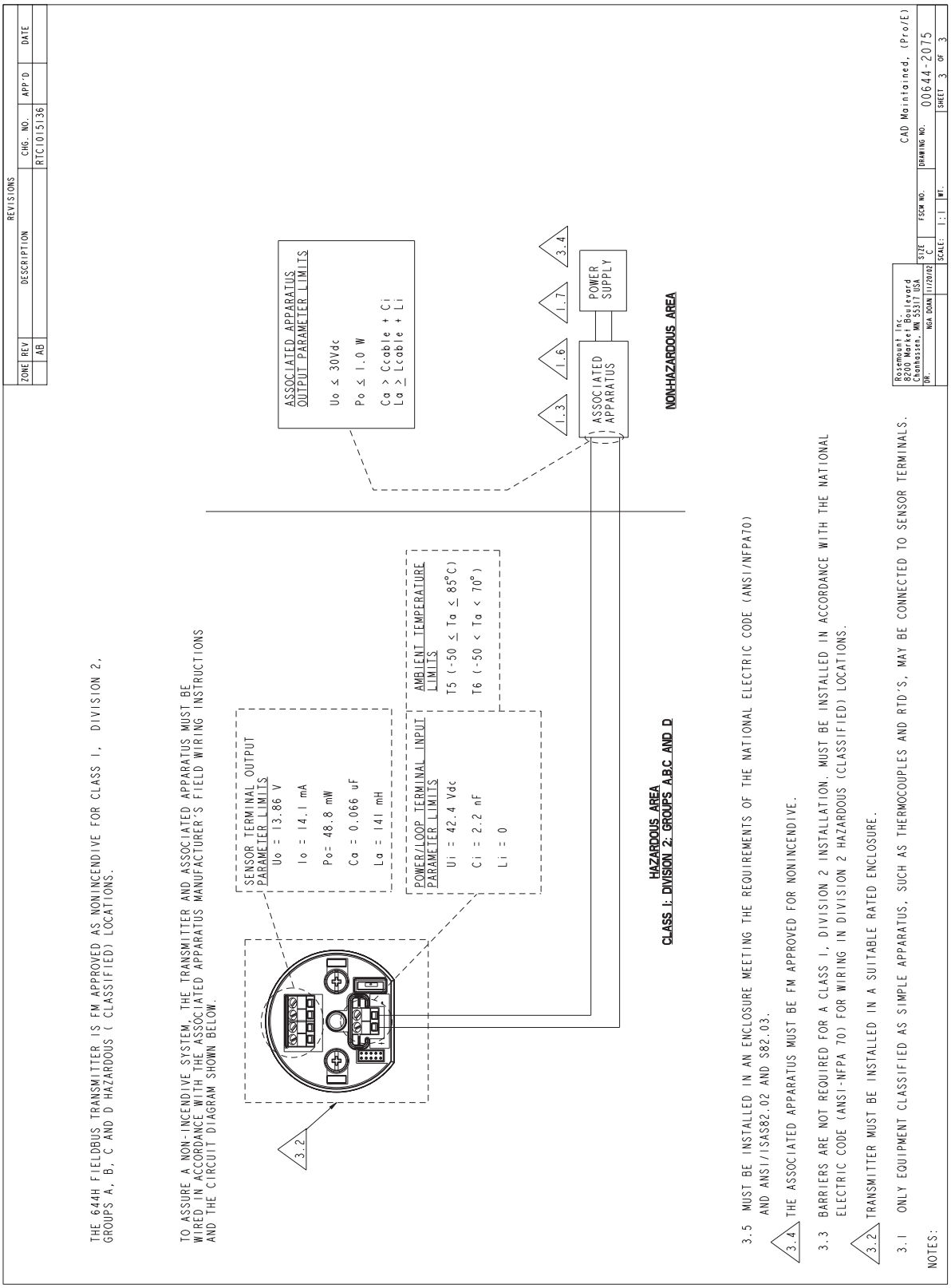
644-1049A01A

Sheet 2 of 3



644-0009A01A

Sheet 3 of 3



644-0009A01A

Appendix C FOUNDATION Fieldbus Block Information

Resource Block . . . . . page C-1
Sensor Transducer Block . . . . . page C-5
Analog Input (AI) Function Block . . . . . page C-8
LCD Transducer Block . . . . . page C-12
PID Block . . . . . page C-13

BASIC SETUP

RESOURCE BLOCK

This section contains information on the 644 Resource Block. Descriptions of all Resource Block Parameters, errors, and diagnostics are included. Also the modes, alarm detection, status handling, and troubleshooting are discussed.

Definition

The resource block defines the physical resources of the device. The resource block also handles functionality that is common across multiple blocks. The block has no linkable inputs or outputs.

Parameters and Descriptions

The table below lists all of the configurable parameters of the Resource Block, including the descriptions and index numbers for each.

Parameter	Index Number	Description
ACK_OPTION	38	Selection of whether alarms associated with the function block will be automatically acknowledged.
ADVISE_ACTIVE	82	Enumerated list of advisory conditions within a device.
ADVISE_ALM	83	Alarm indicating advisory alarms. These conditions do not have a direct impact on the process or device integrity.
ADVISE_ENABLE	80	Enabled ADVISE_ALM alarm conditions. Corresponds bit for bit to the ADVISE_ACTIVE. A bit on means that the corresponding alarm condition is enabled and will be detected. A bit off means the corresponding alarm condition is disabled and will not be detected.
ADVISE_MASK	81	Mask of ADVISE_ALM. Corresponds bit of bit to ADVISE_ACTIVE. A bit on means that the condition is masked out from alarming.
ADVISE_PRI	79	Designates the alarming priority of the ADVISE_ALM
ALARM_SUM	37	The current alert status, unacknowledged states, unreported states, and disabled states of the alarms associated with the function block.
ALERT_KEY	04	The identification number of the plant unit.
BLOCK_ALM	36	The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed.
BLOCK_ERR	06	This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.
CLR_FSTATE	30	Writing a Clear to this parameter will clear the device FAIL_SAFE if the field condition has cleared.
CONFIRM_TIME	33	The time the resource will wait for confirmation of receipt of a report before trying again. Retry will not happen when CONFIRM_TIME=0.
CYCLE_SEL	20	Used to select the block execution method for this resource. The 644 supports the following: Scheduled: Blocks are only executed based on the function block schedule. Block Execution: A block may be executed by linking to another blocks completion.
CYCLE_TYPE	19	Identifies the block execution methods available for this resource.
DD_RESOURCE	09	String identifying the tag of the resource which contains the Device Description for this resource.
DD_REV	13	Revision of the DD associated with the resource - used by an interface device to locate the DD file for the resource.
DEFINE_WRITE_LOCK	60	Allows the operator to select how WRITE_LOCK behaves. The initial value is “lock everything”. If the value is set to “lock only physical device” then the resource and transducer blocks of the device will be locked but changes to function blocks will be allowed.
DETAILED_STATUS	55	Indicateds the state of the transmitter. See Resource Block detailed status codes.
DEV_REV	12	Manufacturer revision number associated with the resource - used by an interface device to locate the DD file for the resource.
DEV_STRING	43	This is used to load new licensing into the device. The value can be written but will always read back with a value of 0.
DEV_TYPE	11	Manufacturer’s model number associated with the resource - used by interface devices to locate the DD file for the resource.
DIAG_OPTIONS	46	Indicates which diagnostics licensing options are enabled.
DISTRIBUTOR	42	Reserved for use as distributor ID. No Foundation enumerations defined at this time.
DOWNLOAD_MODE	67	Gives access to the boot block code for over-the-wire downloads. 0 = Uninitialized 1 = Run mode 2 = Download mode

Parameter	Index Number	Description
FAULT_STATE	28	Condition set by loss of communication to an output block, fault promoted to an output block or physical contact. When FAIL_SAFE condition is set, then output function blocks will perform their FAIL_SAFE actions.
FAILED_ACTIVE	72	Enumerated list of failure conditions within a device.
FAILED_ALM	73	Alarm indicating a failure within a device which makes the device non-operational.
FAILED_ENABLE	70	Enabled FAILED_ALM alarm conditions. Corresponds bit for bit to the FAILED_ACTIVE. A bit on means that the corresponding alarm condition is enabled and will be detected. A bit off means the corresponding alarm condition is disabled and will not be detected.
FAILED_MASK	71	Mask of FAILED_ALM. Corresponds bit of bit to FAILED_ACTIVE. A bit on means that the condition is masked out from alarming.
FAILED_PRI	69	Designates the alarming priority of the FAILED_ALM.
FB_OPTIONS	45	Indicates which function block licensing options are enabled.
FEATURES	17	Used to show supported resource block options. See Error! Reference source not found. The supported features are: SOFT_WRITE_LOCK_SUPPORT, HARD_WRITE_LOCK_SUPPORT, REPORTS, and UNICODE
FEATURE_SEL	18	Used to select resource block options.
FINAL_ASSY_NUM	54	The same final assembly number placed on the neck label.
FREE_SPACE	24	Percent of memory available for further configuration. Zero in a preconfigured device.
FREE_TIME	25	Percent of the block processing time that is free to process additional blocks.
GRANT_DENY	14	Options for controlling access of host computers and local control panels to operating, tuning, and alarm parameters of the block. Not used by device.
HARD_TYPES	15	The types of hardware available as channel numbers.
HARDWARE_REV	52	Hardware revision of the hardware that has the resource block in it.
ITK_VER	41	Major revision number of the inter operability test case used in certifying this device as interoperable. The format and range are controlled by the Fieldbus Foundation.
LIM_NOTIFY	32	Maximum number of unconfirmed alert notify messages allowed.
MAINT_ACTIVE	77	Enumerated list of maintenance conditions within a device.
MAINT_ALM	78	Alarm indicating the device needs maintenance soon. If the condition is ignored, the device will eventually fail.
MAINT_ENABLE	75	Enabled MAINT_ALM alarm conditions. Corresponds bit for bit to the MAINT_ACTIVE. A bit on means that the corresponding alarm condition is enabled and will be detected. A bit off means the corresponding alarm condition is disabled and will not be detected.
MAINT_MASK	76	Mask of MAINT_ALM. Corresponds bit of bit to MAINT_ACTIVE. A bit on means that the condition is masked out from alarming.
MAINT_PRI	74	Designates the alarming priority of the MAINT_ALM
MANUFAC_ID	10	Manufacturer identification number – used by an interface device to locate the DD file for the resource.
MAX_NOTIFY	31	Maximum number of unconfirmed notify messages possible.
MEMORY_SIZE	22	Available configuration memory in the empty resource. To be checked before attempting a download.
MESSAGE_DATE	57	Date associated with the MESSAGE_TEXT parameter.
MESSAGE_TEXT	58	Used to indicate changes made by the user to the device's installation, configuration, or calibration.
MIN_CYCLE_T	21	Time duration of the shortest cycle interval of which the resource is capable.
MISC_OPTIONS	47	Indicates which miscellaneous licensing options are enabled.
MODE_BLK	05	The actual, target, permitted, and normal modes of the block: Target: The mode to “go to” Actual: The mode the “block is currently in” Permitted: Allowed modes that target may take on Normal: Most common mode for actual
NV_CYCLE_T	23	Minimum time interval specified by the manufacturer for writing copies of NV parameters to non-volatile memory. Zero means it will never be automatically copied. At the end of NV_CYCLE_T, only those parameters which have changed need to be updated in NVRAM.
OUTPUT_BOARD_SN	53	Output board serial number.

Parameter	Index Number	Description
RB_SFTWR_REV_ALL	51	The string will contains the following fields: Major rev: 1-3 characters, decimal number 0-255 Minor rev: 1-3 characters, decimal number 0-255 Build rev: 1-5 characters, decimal number 0-255 Time of build: 8 characters, xx:xx:xx, military time Day of week of build: 3 characters, Sun, Mon,... Month of build: 3 characters, Jan, Feb. Day of month of build: 1-2 characters, decimal number 1-31 Year of build: 4 characters, decimal Builder: 7 characters, login name of builder
RB_SFTWR_REV_BUILD	50	Build of software that the resource block was created with.
RB_SFTWR_REV_MAJOR	48	Major revision of software that the resource block was created with.
RB_SFTWR_REV_MINOR	49	Minor revision of software that the resource block was created with.
RECOMMENDED_ACTION	68	Enumerated list of recommended actions displayed with a device alert.
RESTART	16	Allows a manual restart to be initiated. Several degrees of restart are possible. They are the following: 1 Run – nominal state when not restarting 2 Restart resource – not used 3 Restart with defaults – set parameters to default values. See START_WITH_DEFAULTS below for which parameters are set. 4 Restart processor – does a warm start of CPU.
RS_STATE	07	State of the function block application state machine.
SAVE_CONFIG_BLOCKS	62	Number of EEPROM blocks that have been modified since last burn. This value will count down to zero when the configuration is saved.
SAVE_CONFIG_NOW	61	Allows the user to optionally save all non-volatile information immediately.
SECURITY_IO	65	Status of security switch.
SELF_TEST	59	Instructs resource block to perform self-test. Tests are device specific.
SET_FSTATE	29	Allows the FAIL_SAFE condition to be manually initiated by selecting Set.
SHED_RCAS	26	Time duration at which to give up on computer writes to function block RCas locations. Shed from RCas shall never happen when SHED_ROUT = 0
SHED_ROUT	27	Time duration at which to give up on computer writes to function block ROut locations. Shed from ROut shall never happen when SHED_ROUT = 0
SIMULATE_IO	64	Status of simulate switch.
SIMULATE_STATE	66	The state of the simulate switch: 0 = Uninitialized 1 = Switch off, simulation not allowed 2 = Switch on, simulation not allowed (need to cycle jumper/switch) 3 = Switch on, simulation allowed
ST_REV	01	The revision level of the static data associated with the function block.
START_WITH_DEFAULTS	63	0 = Uninitialized 1 = do not power-up with NV defaults 2 = power-up with default node address 3 = power-up with default pd_tag and node address 4 = power-up with default data for the entire communications stack (no application data)
STRATEGY	03	The strategy field can be used to identify grouping of blocks.
SUMMARY_STATUS	56	An enumerated value of repair analysis.
TAG_DESC	02	The user description of the intended application of the block.
TEST_RW	08	Read/write test parameter - used only for conformance testing.
UPDATE_EVT	35	This alert is generated by any change to the static data.
WRITE_ALM	40	This alert is generated if the write lock parameter is cleared.
WRITE_LOCK	34	If set, no writes from anywhere are allowed, except to clear WRITE_LOCK. Block inputs will continue to be updated.
WRITE_PRI	39	Priority of the alarm generated by clearing the write lock.
XD_OPTIONS	44	Indicates which transducer block licensing options are enabled.

SENSOR TRANSDUCER BLOCK

The transducer block contains the actual measurement data, including a pressure and temperature reading. The transducer block includes information about sensor type, engineering units, linearization, reranging, temperature compensation, and diagnostics.

Parameters and Descriptions

Parameter	Index Number	Description	Notes on how changing this parameter effects transmitter operation.
ALERT_KEY	04	The identification number of the plant unit.	No effect on operation of transmitter but may affect the way alerts are sorted on the host end.
BLOCK_ALM	08	The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed.	No effect.
BLOCK_ERR	06	This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.	No effect.
CAL_MIN_SPAN	18	The minimum calibration span value allowed. This minimum span information is necessary to ensure when calibration is done, the two calibrated points are not too close together.	No effect.
CAL_POINT_HI	16	The highest calibrated value.	Assigns a value to the calibration high point.
CAL_POINT_LO	17	The lowest calibrated value.	Assigns a value to the calibration low point.
CAL_UNIT	19	The device description engineering units code index for the calibration values.	Device must be calibrated using the appropriate engineering units.
COLLECTION_DIRECTORY	12	A directory that specifies the number, starting indices, and DD Item ID's of the data collections in each transducer.	No effect.
ASIC_REJECTION	42	Indicates the type of material that the drain vents on the flange are made of. See Drain Vent Material Codes.	
FACTORY_CAL_RECALL	32	Recalls the sensor calibration set at the factory.	
USER_2W_OFFSET	36	Indicates the type of material that the flange is made of. See Flange Material Codes.	
INTER_DETECT_THRESH	35	Indicates the type of flange that is attached to the device. See Flange Type Codes.	
MODE_BLK	05	The actual, target, permitted, and normal modes of the block. Target: The mode to “go to” Actual: The mode the “block is currently in” Permitted: Allowed modes that target may take on Normal: Most common mode for target	Assigns the device mode.
CALIBRATOR_MODE	33	Indicates the type of sensor module.	
PRIMARY_VALUE	14	The measured value and status available to the function block.	No effect.

Parameter	Index Number	Description	Notes on how changing this parameter effects transmitter operation.
PRIMARY_VALUE_RANGE	15	The high and low range limit values, the engineering unit code, and the number of digits to the right of the decimal point to be used to display the final value. Valid engineering units are the following: 1130 = Pa 1133 = kPa 1137 = bar 1138 = mbar 1139 = torr 1140 = atm 1141 = psi 1144 = g/cm^2 1145 = kg/cm^2 1148 = inH_2O @ 68 °F 1151 = mmH_2O @ 68 °F 1154 = ftH_2O @ 68 °F 1156 = inHg @ 0 °C 1158 = mmHg @ 0 °C	No effect.
PRIMARY_VALUE_TYPE	13	Type of measurement represented by the primary value. 107 = Differential pressure 108 = Gage pressure 109 = Absolute pressure	No effect.
SENSR_DETAILED_STATUS	37	Indicates the number of remote seals that are attached to the device. See Remote Seal Number Codes.	
CAL_VAN_DUSEN_COEFF	38	Indicates the type of remote seals that are attached to the device. See Remote Seal Type Codes.	
SECONDARY_VALUE_RANG	30	The secondary value, related to the sensor.	No effect.
SECONDARY_VALUE_UNIT	29	Engineering units to be used with SECONDARY_VALUE. 1001 °C 1002 °F	No effect.
SENSOR_CAL_DATE	25	The last date on which the calibration was performed.This is intended to reflect the calibration of that part of the sensor that is usually wetted by the process.	No effect.
SENSOR_CAL_LOC	24	The last location of the sensor calibration. This describes the physical location at which the calibration was performed.	No effect.
SENSOR_CAL_METHOD	23	The method of last sensor calibration.	No effect.
OPEN_SNSR_HOLDOFF	34	The type of last sensor calibration.	No effect.
SENSOR_CAL_WHO	26	The name of the person responsible for the last sensor calibration.	No effect.
SECONDARY_VALUE	28	Defines the type of fill fluid used in the sensor.	No effect.
SENSOR_CONNECTION	27	Defines the construction material of the isolating diaphragms.	No effect.
SENSOR_RANGE	21	The high and low range limit values, the engineering units code, and the number of digits to the right of the decimal point for the sensor.	No effect.
SENSOR_SN	22	Serial number of the sensor.	No effect.
SENSOR_TYPE	20	Type of sensor connected with the transducer block.	No effect.
ST_REV	01	The revision level of the static data associated with the function block.	No effect.

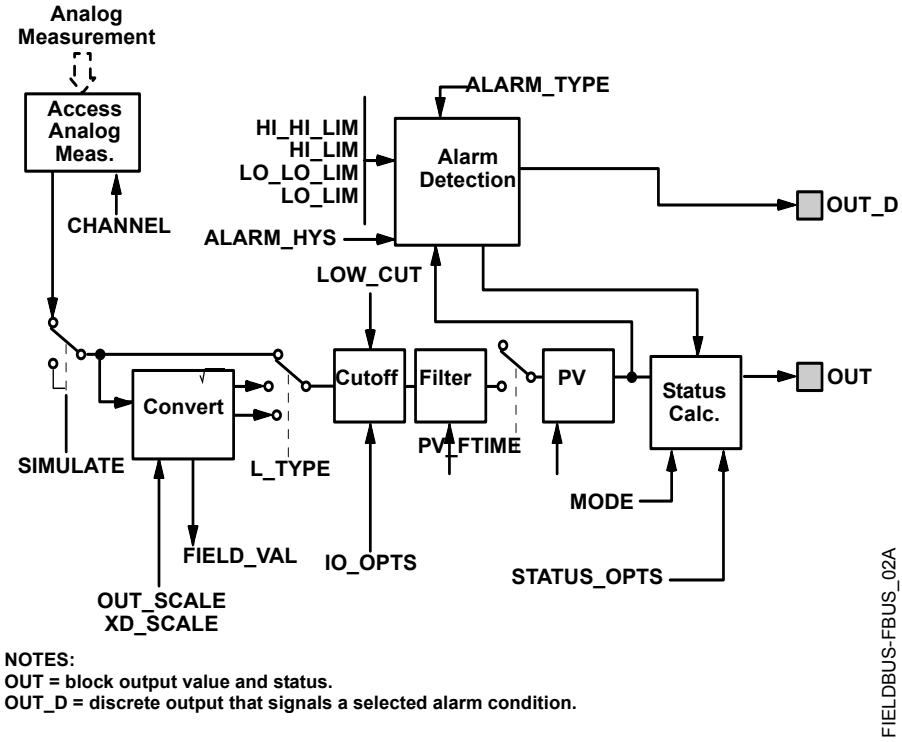
Parameter	Index Number	Description	Notes on how changing this parameter effects transmitter operation.
STRATEGY	03	The strategy field can be used to identify grouping of blocks.	No effect.
TAG_DESC	02	The user description of the intended application of the block.	No effect.
SESNOR_1_DAMPING	31	Indicates the state of the transmitter. The parameter contains specific codes relating to the transducer block and the pressure sensor specifically.	No effect.
TRANSDUCER_DIRECTORY	09	Directory that specifies the number and starting indices of the transducers in the transducer block.	No effect.
TRANSDUCER_TYPE	10	Identifies the transducer that follows.	No effect.
UPDATE_EVT	07	This alert is generated by any change to the static data.	No effect.
XD_ERROR	11	Provides additional error codes related to transducer blocks.	No effect.

ANALOG INPUT (AI) FUNCTION BLOCK

The Analog Input (AI) function block processes field device measurements and makes them available to other function blocks. The output value from the AI block is in engineering units and contains a status indicating the quality of the measurement. The measuring device may have several measurements or derived values available in different channels. Use the channel number to define the variable that the AI block processes.

The AI block supports alarming, signal scaling, signal filtering, signal status calculation, mode control, and simulation. In Automatic mode, the block's output parameter (OUT) reflects the process variable (PV) value and status. In Manual mode, OUT may be set manually. The Manual mode is reflected on the output status. A discrete output (OUT_D) is provided to indicate whether a selected alarm condition is active. Alarm detection is based on the OUT value and user specified alarm limits. Figure C-1 illustrates the internal components of the AI function block, and Table C-1 lists the AI block parameters and their units of measure, descriptions, and index numbers.

Figure C-1. AI Function Block



AI Parameter Table

Table C-1. Definitions of Analog Input Function Block System Parameters.

Parameter	Index No.	Available Values	Units	Default	Read/Write	Description
ACK_OPTION	23	0 = Auto Ack Disabled 1 = Auto Ack Enabled	None	0 all Disabled	Read and Write	Used to set auto acknowledgment of alarms.
ALARM_HYS	24	0 – 50	Percent	0.5	Read and Write	The amount the alarm value must return within the alarm limit before the associated active alarm condition clears.
ALM_SEL	38	HI_HI, HI, LO, LO_LO	None	Non selected	Read and Write	Used to select the process alarm conditions that will cause the OUT_D parameter to be set.
ALARM_SUM	22	Enable/Disable	None	Enable	Read and Write	The summary alarm is used for all process alarms in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed.
ALERT_KEY	04	1 – 255	None	0	Read and Write	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
BLOCK_ALM	21	Not applicable	None	Not applicable	Read only	The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed.
BLOCK_ERR	06	Not applicable	None	Not applicable	Read only	This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.
CAP_STDDEV	40	> = 0	Seconds	0	Read and Write	The time over which the VAR_INDEX is evaluated.
CHANNEL	15	1 = Pressure 2 = Housing temperature	None	AI[1]: Channel = 1 AI2: Channel = 2	Read and Write	The CHANNEL value is used to select the measurement value. Refer to the appropriate device manual for information about the specific channels available in each device. You must configure the CHANNEL parameter before you can configure the XD_SCALE parameter.
FIELD_VAL	19	0 – 100	Percent	Not applicable	Read only	The value and status from the transducer block or from the simulated input when simulation is enabled.
GRANT_DENY	12	Program Tune Alarm Local	None	Not applicable	Read and Write	Normally the operator has permission to write to parameter values, but Program or Local remove that permission and give it to the host controller or a local control panel.
HI_ALM	34	Not applicable	None	Not applicable	Read only	The HI alarm data, which includes a value of the alarm, a timestamp of occurrence and the state of the alarm.
HI_HI_ALM	33	Not applicable	None	Not applicable	Read only	The HI HI alarm data, which includes a value of the alarm, a timestamp of occurrence and the state of the alarm.
HI_HI_LIM	26	Out_Scale[2]	Out_Scale[2]	Not applicable	Read and Write	The setting for the alarm limit used to detect the HI HI alarm condition.
HI_HI_PRI	25	0 – 15	None	1	Read and Write	The priority of the HI HI alarm.
HI_LIM	28	Out_Scale[2]	Out_Scale[2]	Not applicable	Read and Write	The setting for the alarm limit used to detect the HI alarm condition.
HI_PRI	27	0 – 15	None	1	Read and Write	The priority of the HI alarm.
IO_OPTS	13	Low Cutoff Enable/Disable	None	Disable	Read and Write	Allows the selection of input/output options used to alter the PV. Low cutoff enabled is the only selectable option.

Parameter	Index No.	Available Values	Units	Default	Read/Write	Description
L_TYPE	16	Direct Indirect Indirect Square Root	None	Direct	Read and Write	Linearization type. Determines whether the field value is used directly (Direct), is converted linearly (Indirect), or is converted with the square root (Indirect Square Root).
LO_ALM	35	Not applicable	None	Not applicable	Read only	The LO alarm data, which includes a value of the alarm, a timestamp of occurrence and the state of the alarm.
LO_LIM	30	Out_Scale(2)	Out_Scale(2)	Not applicable	Read and Write	The setting for the alarm limit used to detect the LO alarm condition.
LO_LO_ALM	36	Not applicable	None	Not applicable	Read only	The LO LO alarm data, which includes a value of the alarm, a timestamp of occurrence and the state of the alarm.
LO_LO_LIM	32	Out_Scale(2)	Out_Scale(2)	Not applicable	Read and Write	The setting for the alarm limit used to detect the LO LO alarm condition.
LO_LO_PRI	31	0 – 15	None	1	Read and Write	The priority of the LO LO alarm.
LO_PRI	29	0 – 15	None	1	Read and Write	The priority of the LO alarm.
LOW_CUT	17	> = 0	Out_Scale(2)	0	Read and Write	If percentage value of transducer input fails below this, PV = 0.
MODE_BLK	05	Auto Manual Out of Service	None	Not applicable	Read and Write	The actual, target, permitted, and normal modes of the block. Target: The mode to “go to” Actual: The mode the “block is currently in” Permitted: Allowed modes that target may take on Normal: Most common mode for target
OUT	08	Out_Scale(2) ± 10%	Out_Scale(2)	Not applicable	Read and Write	The block output value and status.
OUT_D	37	Discrete_State 1 – 16	None	Disabled	Read and Write	Discrete output to indicate a selected alarm condition.
OUT_SCALE	11	Any output range	All available	none	Read and Write	The high and low scale values, engineering units code, and number of digits to the right of the decimal point associated with OUT.
PV	07	Not applicable	Out_Scale(2)	Not applicable	Read only	The process variable used in block execution.
PV_FTIME	18	> = 0	Seconds	0	Read and Write	The time constant of the first-order PV filter. It is the time required for a 63% change in the IN value.
SIMULATE	09	Not applicable	None	Disable	Read and Write	A group of data that contains the current transducer value and status, the simulated transducer value and status, and the enable/disable bit.
ST_REV	01	Not applicable	None	0	Read only	The revision level of the static data associated with the function block. The revision value will be incremented each time a static parameter value in the block is changed.
STATUS_OPTS	14	Propagate fault forward Uncertain if Limited Bad if Limited Uncertain if Man Mode		0	Read and Write	
STDDEV	39	0 – 100	Percent	0	Read and Write	The average absolute error between the PV and its previous mean value over that evaluation time defined by VAR_SCAN.
STRATEGY	03	0 – 65535	None	0	Read and Write	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.

Parameter	Index No.	Available Values	Units	Default	Read/Write	Description
TAG_DESC	02	32 text characters	None	none	Read and Write	The user description of the intended application of the block.
UPDATE_EVT	20	Not applicable	None	Not applicable	Read only	This alert is generated by any change to the static data.
XD_SCALE	10	Any sensor range	inH_2O (68 °F) inHg (0 °C) ftH_2O (68 °F) mmH_2O (68 °F) mmHg (0 °C) psi bar mbar g/cm^2 kg/cm^2 Pa kPa torr atm deg C deg F	AI1(1): Customer specification or inH_2O (68 °F) for DP/GP rng 1, 2, 3) or psi for DP/GP rng 4, 5 AP/644 all rng AI2 deg C		In all Rosemount devices the units of the transducer block is forced to match the unit code.

(1) The host system may write over default values pre-configured by Rosemount Inc.
(2) Assume that when L_Type = Direct, the user configures Out_Scale which is equal to XD_Scale

LCD TRANSDUCER BLOCK

Parameter	Index	Description
ALERT_KEY	4	The identification number of the plant unit.
BLK_TAG_1	15	The tag of the block containing DP1.
BLK_TAG_2	21	The tag of the block containing DP2.
BLK_TAG_3	27	The tag of the block containing DP3.
BLK_TAG_4	33	The tag of the block containing DP4.
BLK_TYPE_1	14	The enumerated block type for DP1's block.
BLK_TYPE_2	20	The enumerated block type for DP2's block.
BLK_TYPE_3	26	The enumerated block type for DP3's block.
BLK_TYPE_4	32	The enumerated block type for DP4's block.
BLOCK_ALM	8	The BLOCK_ALM is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status attribute. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed.
BLOCK_ERR	6	This parameter reflects the error status associated with the hardware or software components associated with a block. it is a bit string, so that multiple errors may be shown.
COLLECTION_DIRECTORY	12	A directory that specifies the number, starting indicies, and DD Item ID's of the data collections in each transducer block.
CUSTOM_TAG_1	17	The block description that is displayed for DP1.
CUSTOM_TAG _2	23	The block description that is displayed for DP2.
CUSTOM_TAG _3	29	The block description that is displayed for DP3.
CUSTOM_TAG _4	35	The block description that is displayed for DP4.
CUSTOM_UNITS_1	19	This is the user entered units that are displayed when UNITS_TYPE_1=Custom.
CUSTOM_UNITS _2	25	This is the user entered units that are displayed when UNITS_TYPE_2=Custom.
CUSTOM_UNITS _3	31	This is the user entered units that are displayed when UNITS_TYPE_3=Custom.
CUSTOM_UNITS _4	37	This is the user entered units that are displayed when UNITS_TYPE_4=Custom.
DISPLAY_PARAM_SEL	13	This will determine which Display Parameters are active. Bit 0 = DP1 Bit 1 = DP2 Bit 2 = DP3 Bit 3 = DP4 Bit 4 = Bar Graph enable
MODE_BLK	5	The actual, target, permitted, and normal modes of the block.
PARAM_INDEX_1	16	The relative index of DP1 within its block.
PARAM_INDEX_2	22	The relative index of DP2 within its block.
PARAM_INDEX_3	28	The relative index of DP3 within its block.
PARAM_INDEX_4	34	The relative index of DP4 within its block.
ST_REV	1	The revision level of the static data associated with the function block.
STRATEGY	3	The strategy field can be used to identify grouping of blocks.
TAG_DESC	2	The user description of the intended application of the block.
TRANSDUCER_DIRCTORY	9	A directory that specifies the number and starting indicies of the transducers in the transducer block.
TRANSDUCER_TYPE	10	Identifies the transducer that follows.
UNITS_TYPE_1	18	This parameter determines where the units for the display parameter come from.
UNITS_TYPE_2	24	This parameter determines where the units for the display parameter come from.
UNITS_TYPE_3	30	This parameter determines where the units for the display parameter come from.
UNITS_TYPE_4	36	This parameter determines where the units for the display parameter come from.
UPDATE_EVT	7	This alert is generated by any change to the staic data.
XD_ERROR	11	Provides additional error codes related to transducer blocks.

PID BLOCK

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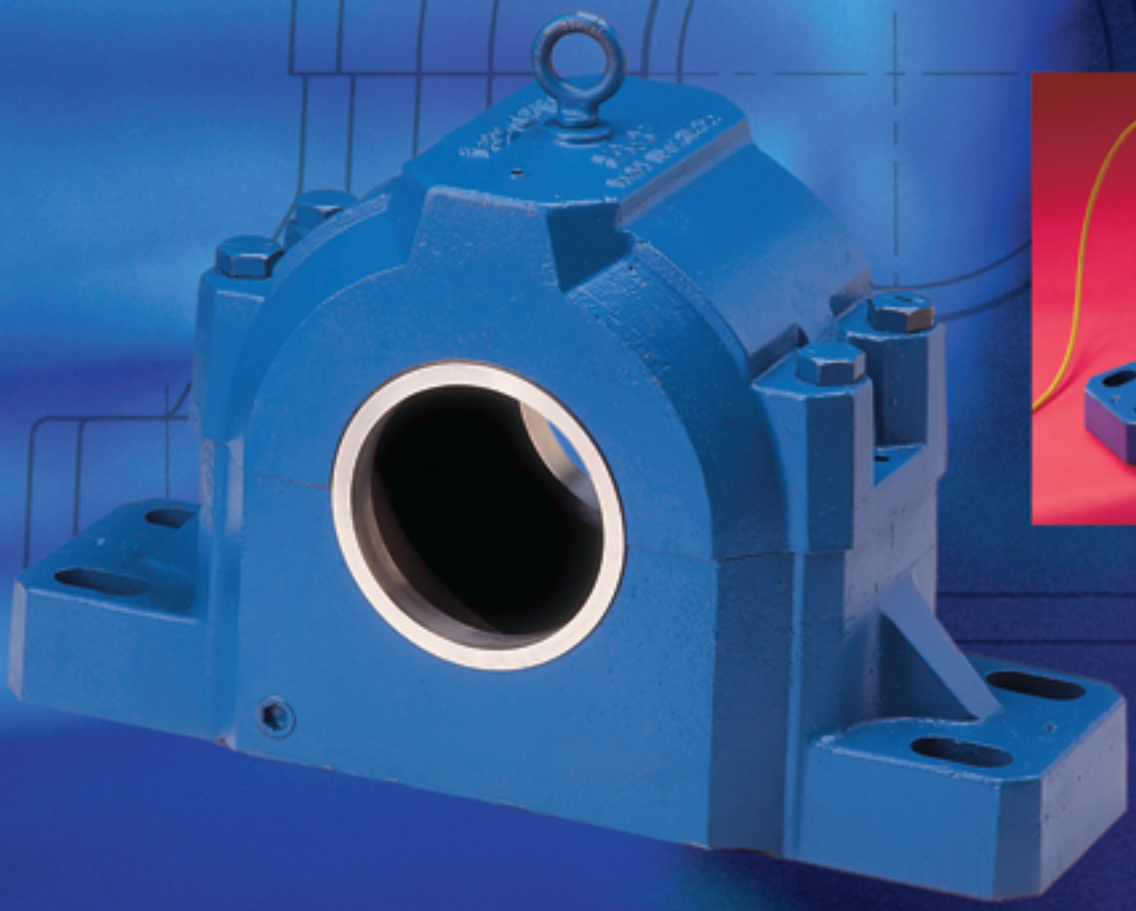
Heavy Duty Pillow Block
Maintenance Handbook

Catalogue No. CDN995



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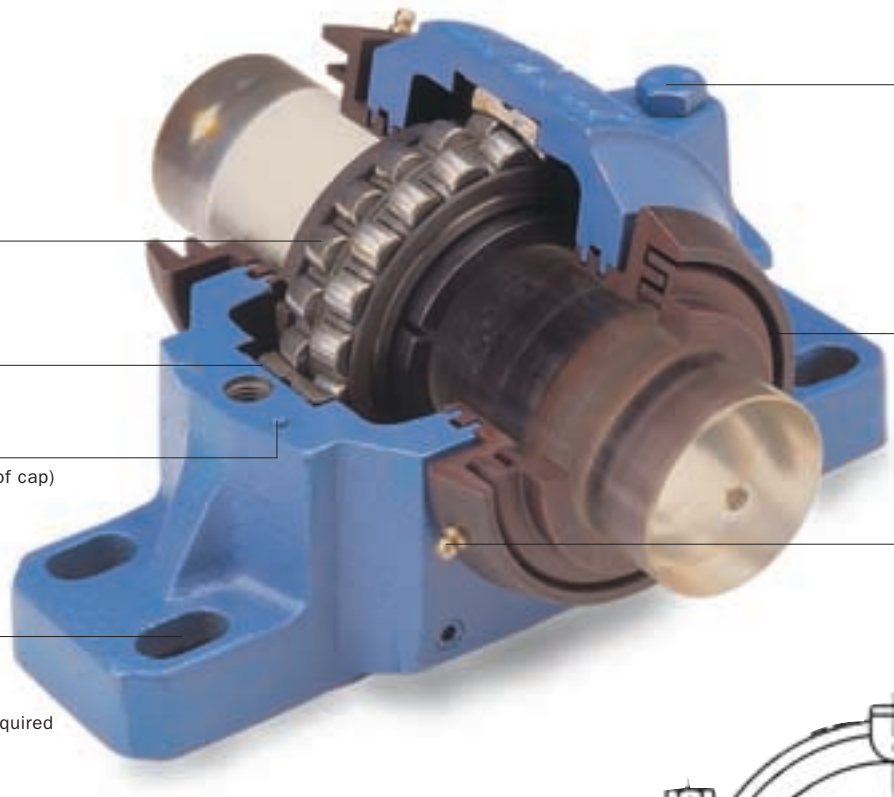
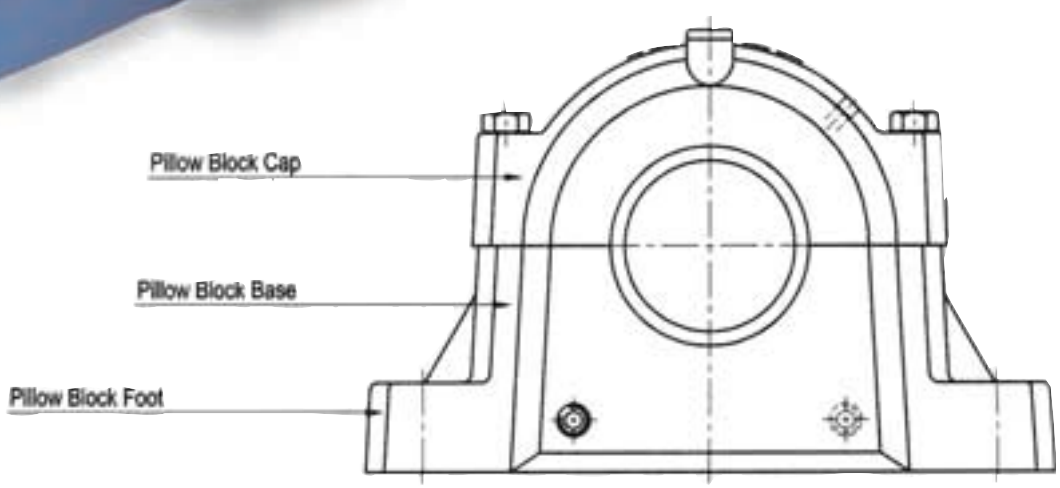
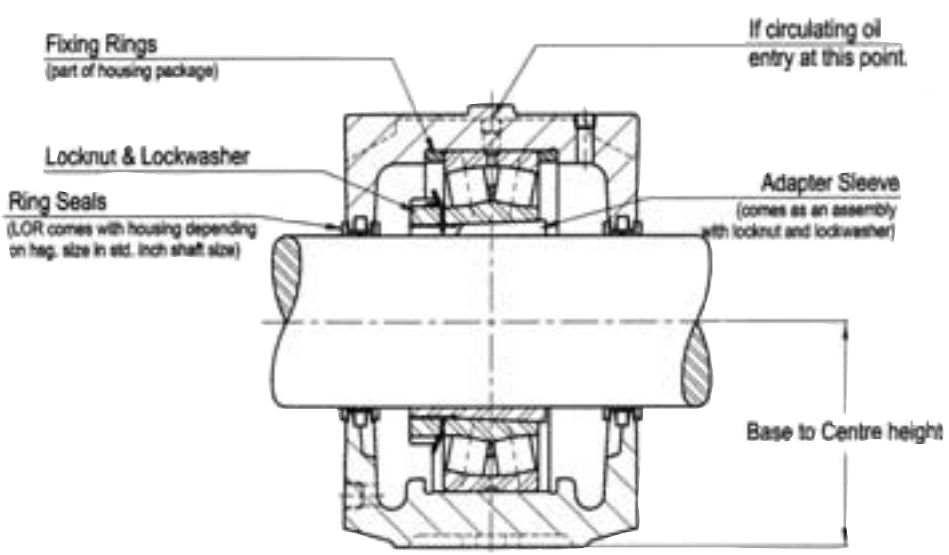
Correct names for Pillow Block parts:







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SNL, SSNHD	Triple Seal S	13 + 24
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SAFD	LOR, LORC, A9508/LER	17 + 20
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SAF, SAFS, SDAF	LOR, A9508/LER	19 + 20
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SNL

The new SNL pillow block housings enable the full service life potential of the incorporated bearing to be exploited with less need for maintenance. Among other enhancements, the housings have increased stiffness making them even more insensitive to uncontrolled and excessive tightening of the attachment bolts.

SAF
FSAF
SAFS

Standard SAF pillow blocks are made of cast iron with either self-aligning double row ball bearings for normal loads or self-aligning spherical roller bearings for heavy loads. Standard with triple ring seal. Alternative sealing arrangements such as taconite or contact seals are available.
SAFS: Same features, cast in steel.

SNH (Replaced by SNL)

SNH pillow blocks of cast iron with either self-aligning double roll ball bearing for normal loads or self-aligning spherical roller bearing for heavy loads. A variety of different sealing arrangements are available.

SSNHD

SSNHD pillow blocks feature the same sealing arrangements as SNH pillow blocks but the base is kept blank so mounting holes in the base can be drilled and machined for two or four bolt mounting. For added strength SSNHD housings are cast in ductile iron.

SAFD

Interchangeable with SAF and SNCD series blocks made by SKF and their competition. Supplied in ductile iron as standard and stronger than the old designs. These new housings will accommodate the old designs. The new housings will accommodate the standard LER triple ring seals and in addition, a new taconite service seal can be used with the same housing. Increased load capacity can be provided by specifying the 232 series bearing for which the new block has been designed as well as the 222 series. This block utilizes the same components, specifically adapter sleeves and fixing rings, as our popular SNL/ SNH series blocks.

SNCD

Canadian designed pillow blocks made of ductile iron. A variety of sealing arrangements are available but the D and E type seal are considered the standard. Excellent for extreme abrasive materials for instance taconite dust. These pillow blocks can also be supplied in steel. Consult SKF for availability.

SD

Standard SD pillow blocks are made of cast iron and designed for use with larger spherical roller bearings, shaft size 150mm (6") and up. The standard sealing arrangement is the triple ring seal.

SDAF

The SDAF pillow block is designed for applications where the loads require a housing of extra sturdy construction. SDAF pillow blocks can also be supplied in cast steel. Consult SKF for availability.

SDCD
SDCD/MC14

Canadian designed heavy duty pillow block is made of ductile iron to complement the well proven SD design. Sealing features are the same as the SD pillow block. For extreme operating conditions D and E type labyrinth seals are standard. Excellent for abrasive materials i.e. taconite dust. These pillow blocks can also be supplied in cast steel. Consult SKF for availability.

General Information and Housing Material

Some Words About SKF Pillow Blocks (Split Housing)

SKF's complete line of ball and roller bearings and pillow block housings are adaptable to every industrial purpose and offers these outstanding performance advantages:

Low Friction Characteristics
Inherent Self-Alignment
Ease of Assembly
No Adjustment
Infrequent Lubrication
Prevents Drip or Leak
No Intrusion of Abrasive and Corrosive Matter
Economical, Trouble-Free Operation

SKF bearing housings are made of grey cast iron, ductile iron and cast steel. The bearing seating of the housings is machined to tolerances such that a loose fit of the bearing outer ring is assured and in most cases the seating width is such that the bearing has axial freedom. Dimensional inaccuracies, slight positioning errors in mounting, and thermal elongation of the shaft can be accommodated in the pillow block housing itself.

Axial location of the bearings is achieved by inserting the fixing rings specified in the housing tables. If only one ring is to be used with a bearing having an adapter sleeve, the fixing ring should be positioned on the same side of the bearing as the locknut. The bearing is then displaced from its centre position in the housing by the distance equal to half the fixing rings and their designation should be stated.

Pillow block housings shown in the housing tables are horizontally split and are designated for use with self-aligning ball bearings and spherical roller bearings with either a tapered bore and mounted on an adapter sleeve or with a cylindrical bore. The elongated (slotted) bolt holes in the housing base permit slight adjustments to be made to the position of the pillow block. The housings are fitted with dowel pins, or the mating surfaces may be stepped to ensure correct location of the associated caps and bases, which are **NOT interchangeable.**

To ensure reliable function and long operational life of the bearing in the pillow block, the mating surface of the supporting component should be machined to a surface roughness of Ra=1.6 mm (63 RMS). For the flatness IT7 is recommended. When the demand is lower, IT8 can be used.

Comparison of Physical Properties of Typical Pillow Block Housing Material

SKF pillow blocks are usually made of cast iron and are mainly intended for grease lubricated ball or roller bearings. For extra heavy duty applications, ductile iron or cast steel pillow blocks are available.

MATERIAL	SPECIFICATION	ULTIMATE TENSILE STRENGTH		YIELD STRENGTH		MINIMUM ELONGATION %
		psi	Mpa	psi	Mpa	
Cast Iron	ASTM A48 Grade 35	35000	240	-	-	-
Cast Steel	ASTM A27 Grade 65-35	65000	450	34000	240	24
Ductile Iron	ASTM A536 Grade 65-45-12	65000	450	45000	310	12

The method of bearing and housing selection we recommend must only be used for general or standard applications. Where conditions such as high thrust loads, shock loads, extreme temperatures and speeds prevail, consult SKF for detailed recommendations.

SKF Pillow Block Identification

Bold = Prefix

SNL
Pillow block a split design inch and metric variety of sealing options. See page 2.

SNA
Discontinued design replaced by SNL.

SNH
Discontinued design, replaced by SNL.

SSN
Discontinued design, replaced by SSNHD which is ductile iron.

SSNHD
Same as SNL but with blank base, Materials: spheroidal cast iron (ductile iron).

SAF
Pillow block split design inch overall dimensions (North American standard) used for inch shafting. Variety of sealing arrangements available, see Page 8.
Material : Grey cast iron ASTMA 48 grade 35

SAFD
Pillow block split design inch overall dimensions (Canadian Standard) used for inch shafting. Variety of sealing arrangements available see Page 8.
Current standard product
Material: Ductile iron ASTMA 536 grade 65-45-12
Recommended for low temperatures -40°C (-40°F)

SAFS
Same as SAF dimensionally but material cast steel ASTMA 27 grade 65-35

SDAF
Pillow block split design inch overall dimensions (North American standard) heavier design than SAF. Used for inch shafting variety of sealing arrangements available, see Page 8.
Current standard product.
Material: Grey cast iron ASTMA 48 grade 35

SD
Pillow block split design metric overall dimensions can be used for metric or inch shafting (European standard) Current standard product
Available with triple ring seals only
Material: Grey cast iron GG 25 (ISO/DIS 185 grade 250)

SDD
Same as SD dimensionally but material spheroidal cast iron GGG 40 (ISO 1083-1976, 500-7)

SDCD
Pillow block split design metric overall dimensions can be used for metric or inch shafting (Canadian standard)
Current standard product
Available with triple seal rings only
Material: Ductile iron
ASTMA 536 grade 65-45-12
Recommended for low temperatures -40°C (-40°F)

SDCD/MC14
Same as SDCD dimensionally but modified to accept extreme service seals (Taconite), see Page 9

SDJC
Pillow block split design, metric overall dimensions (European standard), metric shafting. For reference only. Consult SKF for availability and technical specifications.

SNCD
Discontinued Canadian designed pillow block, dimensionally interchangeable with SAFD. Pillow block split design inch overall dimension can be used for metric or inch shafting. Available with variety of sealing arrangements see Page 9.
Material: ductile iron ASTMA 536 grade 65-45-12

SNCT
Same as SNCD dimensionally but material cast steel ASTMA 27 grade 65-35

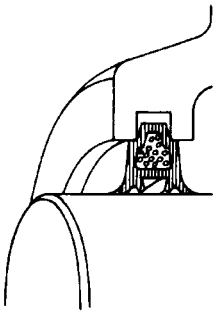
SKF Sealing Arrangements

Seals

There are many different types of seal designs for use in SKF Pillow Blocks. The many alternative choices available ensure that a correct or most suitable solution will be found to meet the condition surrounding a particular application.

If a contact (rubbing seal is selected, care must be taken with regard to the surface finish of the shaft. It is recommended that the shaft surface roughness does not exceed 125 RMS (t_a:3.2 µm ISO N8).

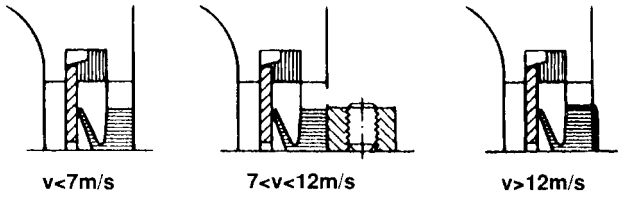
Double lip seal, Type G

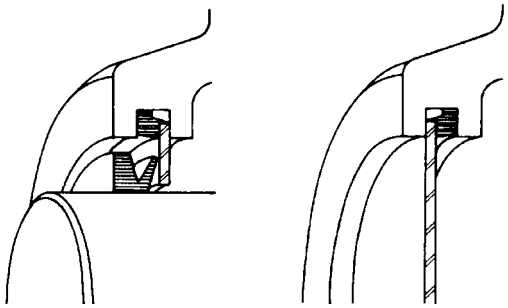


The G-seal is made of polyurethane, a wear resistant material with excellent resilience. The split design simplifies mounting. This seal can be used with grease lubrication at peripheral speeds up to 8 m/s (1600 ft/min). The maximum permissible misalignment of the shaft is approximately 1° up to shaft diameters of 100 mm (3.15/16") and 0.5° for larger sizes.

These seals can be used at temperatures between -40° and +100°C (-40° and +212°F). Double-lip seals are designated TSN followed by the housing number and suffix G, (ie. TNS 511 G).

V-Ring seals, Type A



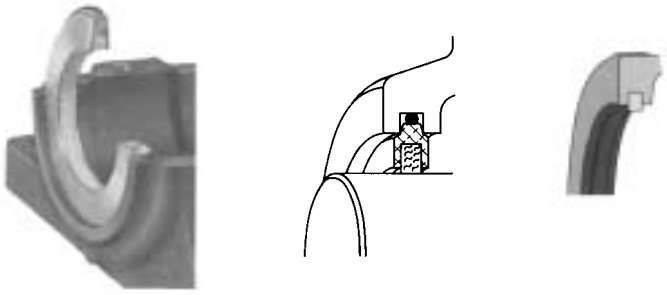


The V-Ring, of Nitrile rubber, has a thin sealing lip which functions in an axial direction. The ring also acts as a flinger as it rotates with the shaft. This type of seal can be used for both grease and oil lubrication and is extremely effective under most operating conditions including high speeds and shafts with rough sealing surfaces. V rings are normally suitable for peripheral speeds up to 7m/sec (1400 ft/min) and if axially clamped tolerate speeds up to 12m/sec (2400 ft/min). The maximum permissible misalignment of the shaft is approximately 1.5°. For a shaft diameter of 50mm, and approximately 1° for shaft diameter of 150mm.

For SNL pillow block housings, the V-rings seal against sheet metal washers which are coated with a rust inhibitor. Each washer has a rubber lip, bonded around its periphery which locates and seals in the housing groove. These seals can be used at temperatures between -40°C and +100°C (-40°F and +212°F). V-ring seals are designated TSN followed by the housing number and suffix A, for example TSN 511A.

Pillow Block Seal Arrangements

Felt Seals, Type C



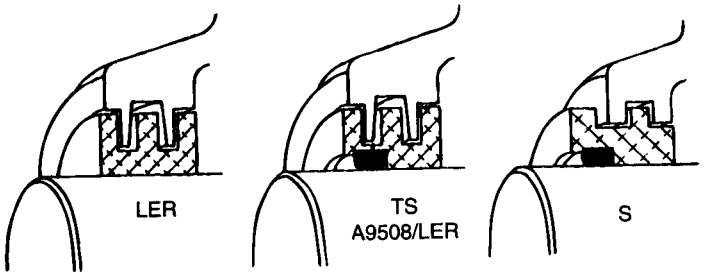
The felt seal is a simple and adequate seal which can be used with grease lubrication at peripheral speeds up to 4m/s (800 ft/min). Pillow block housings of series SNL 5 and SNL 6 are available with split felt seals consisting of oiled felt incorporated in halves of a light alloy ring, the seal halves are fitted into the housing grooves, the O-section cords provide an effective seal between the housing hub bore and the outside diameter of the seal inserts. Misalignment exceeding 0.5° would impair efficiency.

Felt seals are designated TSN followed by the housing number and suffix C, for example TSN 511 C.

Triple Ring Seals Types LOR, LORC, TS, S and A9508/LER

A labyrinth created between the rotating seal ring and its matching hub grooves results in an efficient seal, particularly if the labyrinth is filled with grease. The sliding fit of the rotating seal ring on the shaft ensures that it will automatically find its own proper location relative to the stationary hub grooves. For larger shaft diameters an O-sectioned cord is inserted between the seal ring and the shaft to ensure ring rotation and avoid possible lubricant leakage.

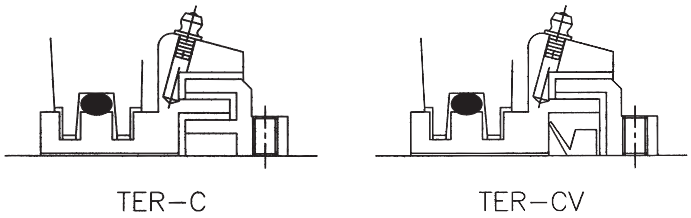
The maximum permissible misalignment between shaft and housing must be restricted to 0.25°.



Labyrinth Seal (Taconite Service Seal)

Type TER5-C and TER5-CV

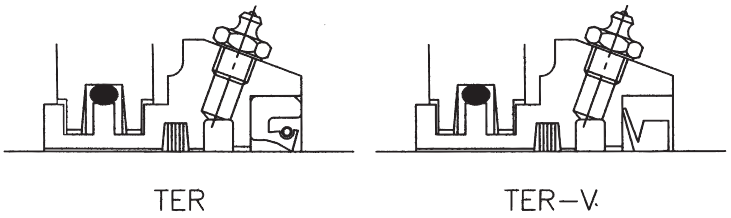
Optional Seal for SAF, SAFD, FSAF, FSAFD

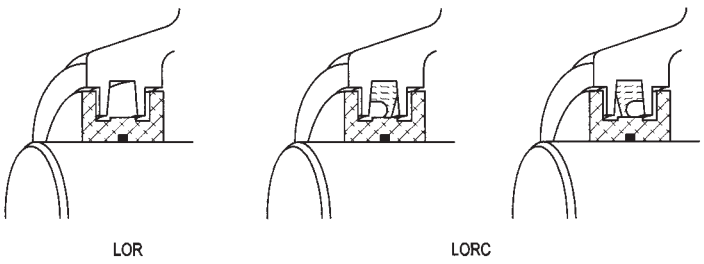


Taconite Service Seal

Type TER, and TER-V

These Taconite seals were developed as an alternative for the SAFD, SAF, SAFS and SDAF blocks without modifications having to be made. The TER and TER V with felt strip or garter spring seal are interchangeable with the TER-C and TER-CV..



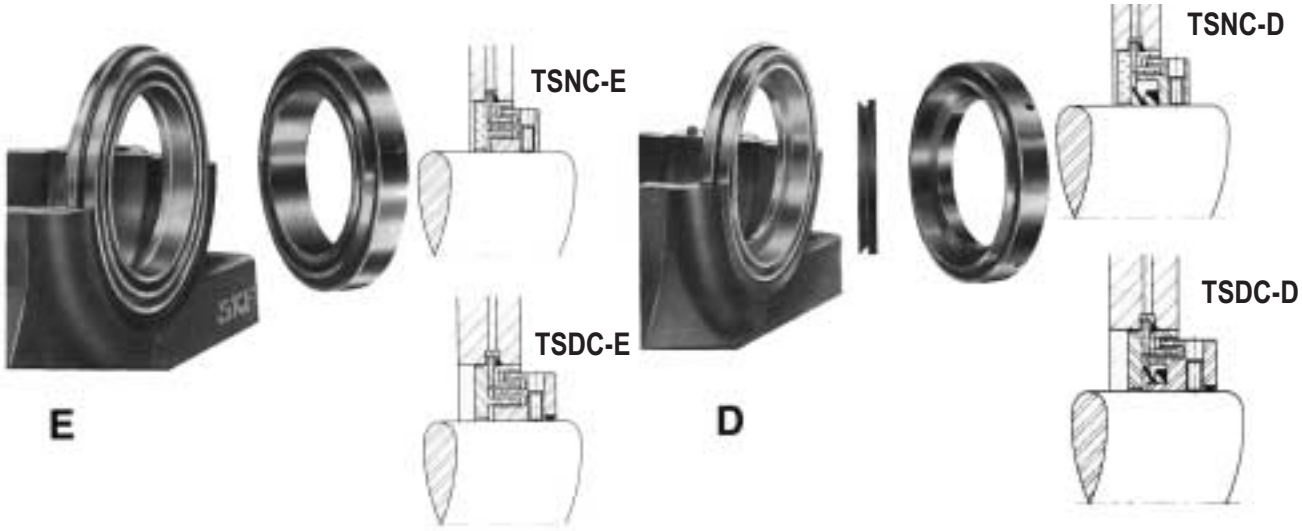


Labyrinth Seals Type D and E

Extreme service seals of D and E types were initially developed for the mining industry, where fine abrasive dusts were prevalent (e.g. taconite), but have since found usage in the pulp, paper, forest and other industries where water and water laden debris prevail. They are most commonly used in the SDCD and SNL series of housing which have additional grease fitting allowing the seals to be periodically purged. Their design offers the distinct advantage that housing caps may be removed for maintenance inspection of bearings with the seals remaining undisturbed.

NOTE: Pillow Blocks SNL and SSNHD must be modified to suffix MC 106 when using TSNC-D, TSNC-E and MC14 seals.

SAFD and FSAFD must be modified to MC 14 when using TSNC-D and TSNC-E. These seals available on special order only.



Seal Options Available for SKF Pillow Blocks						
SEAL DESIGN	**SNL SSNHD**	**SAFD FSAFD**	**SAF SAFS SDAF**	**SNCD SNCT**	**SD**	**SDCD SDCT SDHD**
G Double lip contact type	X	—	—	X	—	—
A V-ring seal contact type	X	—	—	X		
C Felt seal contact type	X	—	—	X		
E Labryinth type	X	X	—	X	—	X
D Labrynith with additional V-ring	X	X	—	X	—	X
TS, & LOR & LORC, S Triple seal Labryinth	S	LER, LOR,LORC A9508LER		LER	TS	TS
TER contact type	—	X	X		—	—
TER V contact type with V-ring	—	X	X		—	—
TER C	—	X	X		—	—
TER CV	—	X	X		—	—

For reference only (discontinued series)

Preparation before Mounting

Check shipment and make certain all assemblies are complete, and no short shipping has occurred on components.

The bearings should be left in their original packages until immediately before mounting so that they do not become dirty. Generally the preservative with which new bearings are coated before leaving the factory need only be removed from the outside cylindrical surface and bore of the bearing.

An exception is if the bearing is to be grease lubricated and used at very high or very low temperatures. In such cases the bearings should be washed and dried to prevent any detrimental effect on the lubricating properties of the greases. Bearings which have become contaminated because of improper handling (damaged package etc.) should be washed and dried before mounting.

Bearings which, when taken from their original package, have a relatively thick greasy layer of preservative, have been hot dipped and should also be washed and dried. Hot dipping is still used, principally on large-size bearings.

Clean shaft and housing*; remove all burrs and sharp edges. Check that the shaft diameter is to recommended tolerance.

Read and become familiar with the bearing mounting procedure and the installation instructions to be used for this assembly.

* NOTE: Caps and bases of housings are not interchangeable. Do not mix.

Adapter Sleeve Mounting – Spherical Roller Bearings

All spherical roller bearings with taper bore, to be mounted on adapter sleeves, have to be driven up the taper sufficiently to achieve the proper reduction of clearance.

The unmounted clearance of each bearing must be measured and recorded. Stand the bearing on the bench and insert progressively thicker feelers the full length of the roller between the unloaded roller and the outer ring at the top location. Never roll the rollers over the feelers as the wrong value will be obtained.

Position the adapter sleeve (less locknut and lockwasher) on the shaft in the correct position for the proposed bearing mounted center line. A light smear of spindle oil applied to the sleeve outside diameter, results in easier mounting/removal of bearing.

Mount bearing on adapter with the large bore side of the inner ring to match the taper on the outside diameter of the adapter. With bearing hand tight on the adapter, locate the bearing and adapter to the proper axial location on the shaft. Do not apply lockwasher. Drive up procedure could damage it. To avoid damage to the bearing it is most important during this and subsequent operations, that the shaft be blocked up so the bearing is unloaded.

Lubricate the chamfered face of the locknut and the threads (use Molykote for larger sizes), then apply locknut with chamfered face to bearing, tighten nut until sleeve is snug on the shaft. Wrenches are available for bearing drive up. For larger bearings, hydraulic mounting nuts are recommended to obtain required internal clearance reduction. Ref. page 42.

Never tighten the locknut with a hammer and drift. The locknut will be damaged and chips can enter the bearing. Continue tightening locknut and measure the internal clearance with feelers until the internal clearance is less than the recorded unmounted clearance figure by the amount shown in table on page 42. Remove locknut and install the washer with the inner prong located in the slot provided in the adapter and have the tabs facing away from the bearing. Re-apply the locknut and tighten until firmly seated against the lockwasher. If necessary tighten the locknut to a point where one of the tabs on the lock washer lines up with a slot in the locknut then bend this tab into that slot.

For a large size adapter sleeves (size 44 and up) the use of the oil injection mounting method is standard practice. For these adapter sizes the lockwasher is replaced with a lockplate. In these cases with the locknut tightened to achieve the proper reduction of internal clearance in the bearing, take lockplate and place its prong in the slot of the adapter sleeve. Note how much the locknut will have to be tightened for the holes in the locknut to align with the holes in the lockplate. Reverse the lockplate and observe how much the locknut will have to be tightened for the hole in the locknut to align with the holes in the lockplate. The lockplate is to be placed in the position requiring the least tightening to align the two sets of holes. When the locknut has been tightened to achieve this, then insert and tighten cap screws. Lock cap screws with lockwire through holes in heads. Do a final check on the mounted internal clearance of the bearing.

Adapter Sleeve Mounting Self-Aligning Ball Bearing

Position adapter sleeve (less locknut and lockwasher) on the shaft in the correct position for the proposed bearing mounted center line. A light smear of clean spindle oil applied to the sleeve outside diameter, results in easier mounting and removal of bearing.

Mount bearing on adapter with the large bore side of the inner ring to match the taper on the outside diameter of the adapter. With bearing hand tight on the adapter, relocate if necessary, the bearing and the adapter to the proper axial location on the shaft. Do not apply lockwasher. Drive up procedure could damage it. To avoid damage to the bearing it is most important during this subsequent operation that the shaft is blocked up so the bearing is not loaded.

Apply the locknut with the chamfered face toward the bearing after lubricating the face of the locknut next to the bearing. Hand tighten the nut with the spanner wrench until the adapter sleeve can neither be moved axially, nor rotated on the shaft. Then with the hammer hit the hook wrench until the locknut has been turned 90° or 1/4 turn on the adapter sleeve (varies with size).

Caution: A loose adapter sleeve can lead to the inner ring turning on the adapter sleeve and/or the adapter sleeve turning on the shaft. To insure that the nut is not excessively tight, make certain the outer ring of the bearing rotates freely.

When mounting a normal fit bearing, swiveling the outer ring will result in a slight drag. If the bearing is a C3 fit, the outer ring will swivel freely. Remove locknut and mount lockwasher with inner prong located in the slot provided in the adapter and the tabs on washer O.D. leaning away from the bearing. Re-apply locknut and tighten until firmly seated against lockwasher. Find lockwasher tab nearest one of the slots in the locknut. If slot is past tab, do not loosen nut, but tighten until a tab can be bent into a slot.

Cylindrical Bore Mounting Self-aligning Ball or Spherical Roller Bearings

Small bearings up to bore size 50mm (2in.)

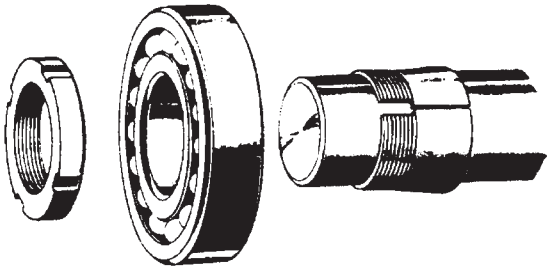
Apply a coat of light oil to the shaft and bearing bore. Fit a clean tube with one end squared and bore slightly larger than the bearing bore, against the bearing inner ring. With the bearing square on the shaft, apply pressure using a press. The bearing must be seated firmly against the shaft shoulder.

Mount lockwasher with inner prong located in the key slot provided in the shaft and tabs on washer O.D. leaning away from the bearing. Apply locknut with face lubricated, tighten with appropriate wrench until all components are locked up solid to shaft shoulder. It may be necessary to further tighten the nut to engage a washer tab with a slot in the nut. A very small movement of the nut will usually align a tab with a slot.

Large Bearings-Bore Size 50mm (2in) and larger

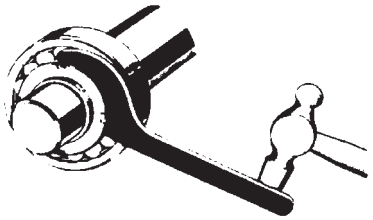
These bearings are not easily pressed on a shaft, and should therefore be heated using an induction heater, hot plate or temperature controlled oven. On very large bearings it may be necessary to use an “oil bath” using a 10%-15% mixture of soluble oil in water to approximately 100°C maximum. The bearing must be on supports to isolate it from direct contact with bottom of the tank, thereby preventing the possibility of localized overheating which could result in bearing damage. Never use an open flame to heat the bearing. Mount the bearing on the shaft firmly against the shoulder, immediately applying the locknut and tighten to prevent the bearing shrinking away from its proper position against the shoulder. When the bearing has cooled, remove the locknut and mount the lockwasher with inner prong located in the key slot provided in the shaft and the prongs on the O/D facing away from the bearing. Apply the locknut with the face lubricated and tighten with appropriate wrench until all components are locked up solid to shaft shoulder. It may be necessary to further tighten the nut to engage a washer tab with a slot in the nut, enabling the tab to be bent down into the slot in the nut. A very small movement of the nut will usually align these.

Recommended Method for Mounting Bearings

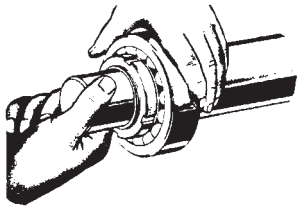


Place the bearing on the sleeve and screw on the nut with the nut chamfer toward the bearing. Tighten the nut just enough to ensure that the bearing and shaft make contact with the sleeve, but do not tighten to drive the bearing further up the sleeve.

Turn the nut with a hook spanner according to the illustration.



To achieve the right fit, turn the nut through the angle α. Then reposition the spanner 180° and tighten a few more degrees by rapping on the spanner with a hammer. SKF has a set of lock nut spanners which are clearly marked with the correct tightening gauge.



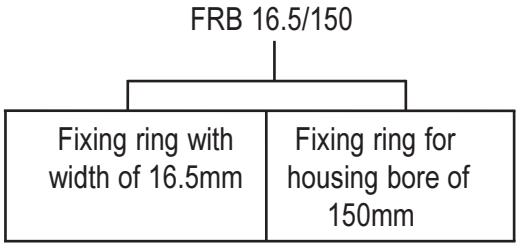
For a self-aligning bearing with normal clearance, the drive-up is correct when the outer ring easily rotates but resists swiveling. If the nut is placed inboard of the bearing, the locking washer must be mounted together with the nut. Lubricate the surfaces that slide against each other during tightening.

Special Note on Location of Bearings in Pillow Blocks

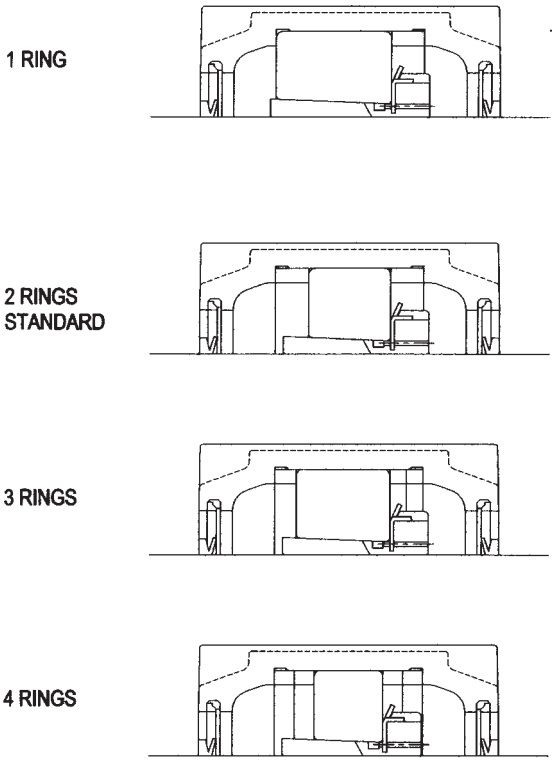
If the bearing is to be held (located), fixing rings are inserted between the side faces of the outer ring and the housing shoulders. If an adapter sleeve is used to secure the bearing to the shaft and only one fixing ring is required, it should be placed on the same side of the bearing as the locknut. The bearing is then displaced from its central position in the housing by a distance equal to half the fixing ring width.

1 ring - on the **same side as the sleeve nut**
2 rings - one on each side of the bearing
3 rings - two on the **same side as the sleeve nut**
4 rings - two on each side of the bearing

Example:

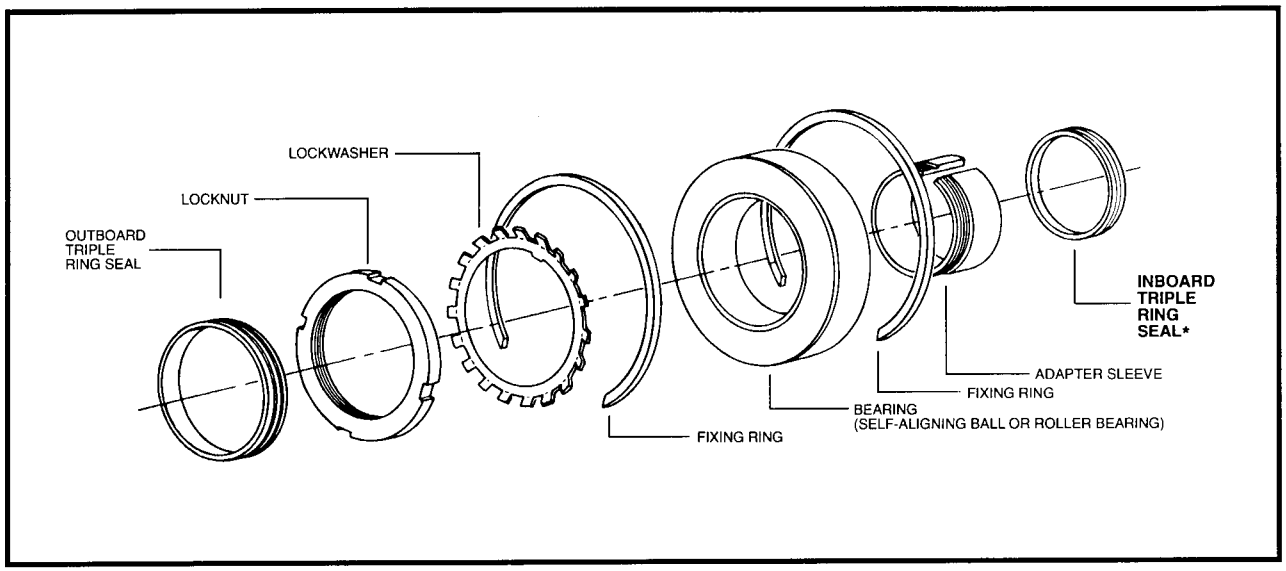


Note:
As opposed to a held bearing - a free bearing is mounted without fixing rings. The bearing positioned in the centre of the bearing seat in the pillow block housing will ensure proper lubrication as well as shaft expansion and contraction.

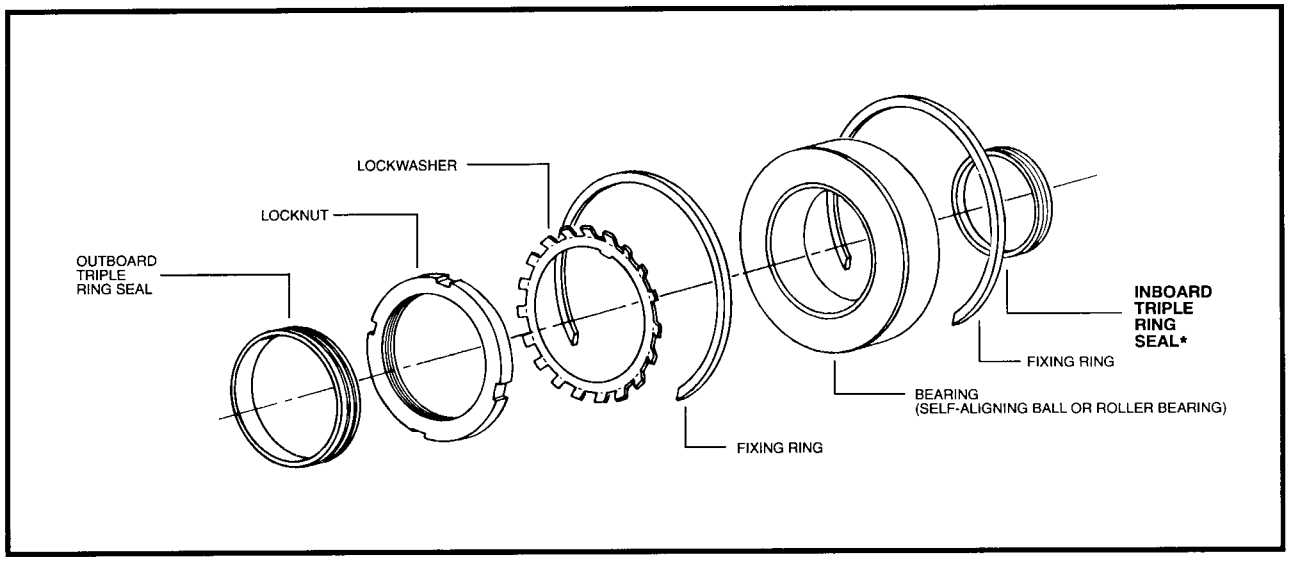


Basic Procedures For Mounting Bearings

Adapter Sleeve Mounting



Cylindrical Bore Mounting

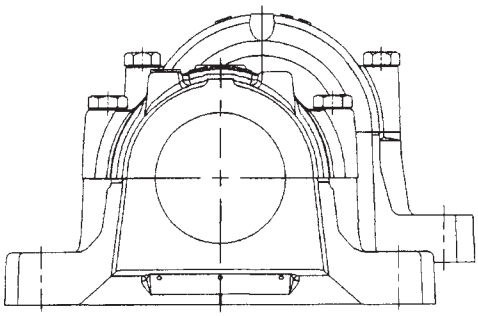


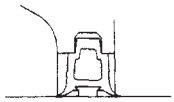
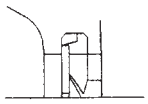
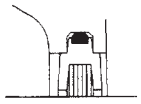
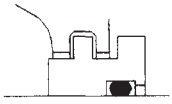
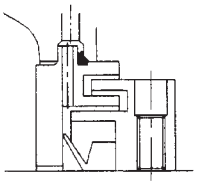
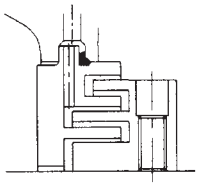
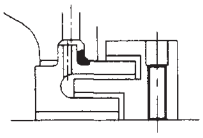
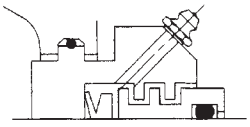
*** Note: Do not forget to mount this seal ring first!**

SKF

PILLOW BLOCK HOUSINGS

SNL, SSNHD



MATERIAL	SNL: cast iron GG20 (ISO/DIS 185 grade 200) SSNHD: Ductile iron	
BEARING SERIES USED	12K, 12EK, 13K, 22K, 22EK, 23K, 222CCK, 222EK, 223CCK, 223EK C 22K, C 23K, C 32K	
SHAFT SIZE RANGE	3/4" to 5-1/2"	20mm to 140mm
PILLOW BLOCK SIZE	505 - 532 (adapter mounting)	
PILLOW BLOCK LUBRICATION	Grease (for oil lubrication consult SKF)	
STANDARD SEALS	TSN-G 	
OPTIONAL SEALS	TSN-A 	TSN-C 
	TSN-S 	TSNC-D 
	TSNC-E 	TSNC/MC17 
	Taconite TSN-ND 	

Note : Pillow Block SNL & SSNHD must be modified to MC106 when using TSNC-D & E for sizes 520 through 532 and TSNC/MC17 for sizes 515 through 518.

Seal assembly and Mounting Procedure

G-Type Seal

1. The housing base is placed in position and the mounting bolts loosely fitted.

2. The halves of the seals are inserted in the housing grooves and the spaces between the lips of the seals are filled with grease.

3. The bearing is mounted on the shaft (directly or on an adapter sleeve) and filled with grease.

4. The shaft, complete with bearing assembly, is placed in the lower half of the housing.

5. For held unit, fixing rings are placed in position. For free unit, bearing must be located in center of bearing seat of housing for proper lubrication.

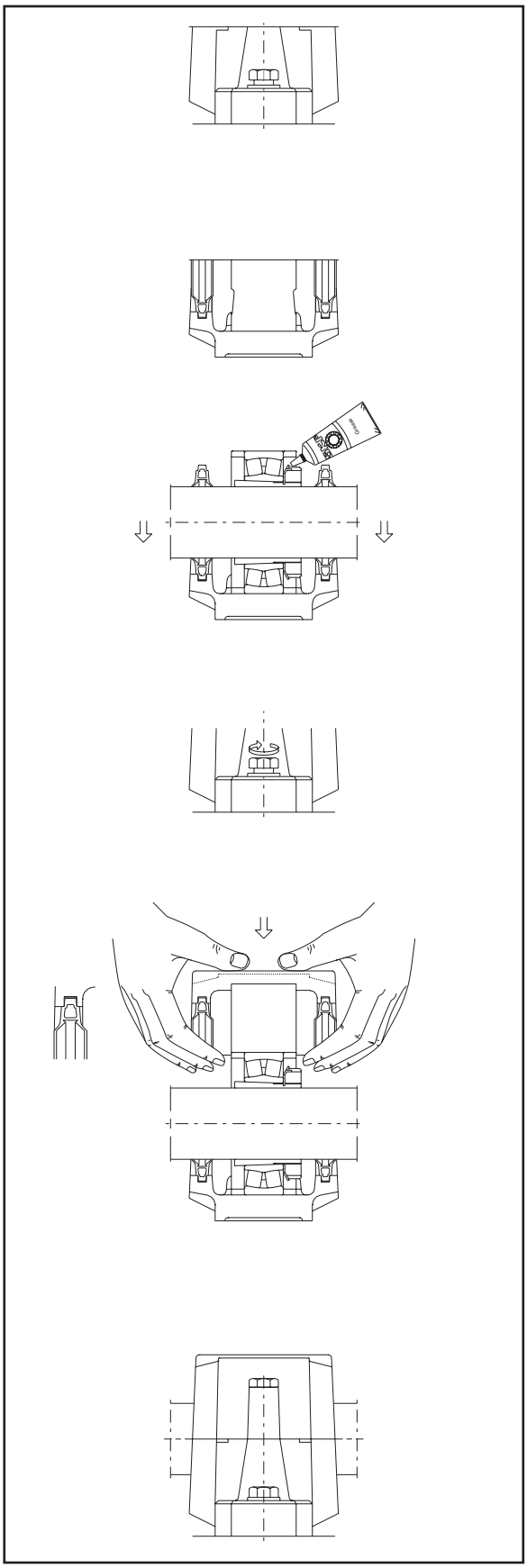
6. The housing base is checked for alignment, ensuring that it is within acceptable limits, and the mounting bolts are then slightly tightened.

7. The other halves of the seals are inserted in the cap and the space between the lips of the seals filled with grease. For sizes 528-532 and 616-620 the seal halves must be turned so that the spigots fit in the holes of the connecting seal halves.

8. At the first charge of grease, the bearing MUST be filled with grease (do not wash out the protective coating) and the housing will be filled one-third full. For greasing quantities, refer to Page 40.

9. The housing cap is fitted and the cap bolts tightened to the recommended torque, see table on Pages 26 through 37. Note that the cap **must not be interchanged** with that of other housings.

10. Finally the housing mounting bolts are tightened to the support.



Seal Assembly and Mounting Procedure

V-Ring Seal Type “A”

1. The housing base is placed in position and the mounting bolts loosely fitted.

2. One V-ring and one sheet metal washer are placed on the shaft. Care should be taken to position these correctly in relation to the housing. Do not allow the V-ring seal lip to pass through the sheet metal washer.

3. The bearing is mounted on the shaft (directly or on an adapter sleeve) and filled with grease.

4. The second V-ring and sealing washer are placed on the shaft.

5. The shaft, complete with bearing assembly and sealing components, is placed in the lower half of the housing.

6. For held unit, fixing rings are placed in position. For free unit, bearing must be located in center of bearing seat of housing for proper lubrication.

7. The housing base is checked for alignment, ensuring that it is within acceptable limits, and the mounting bolts are then slightly tightened.

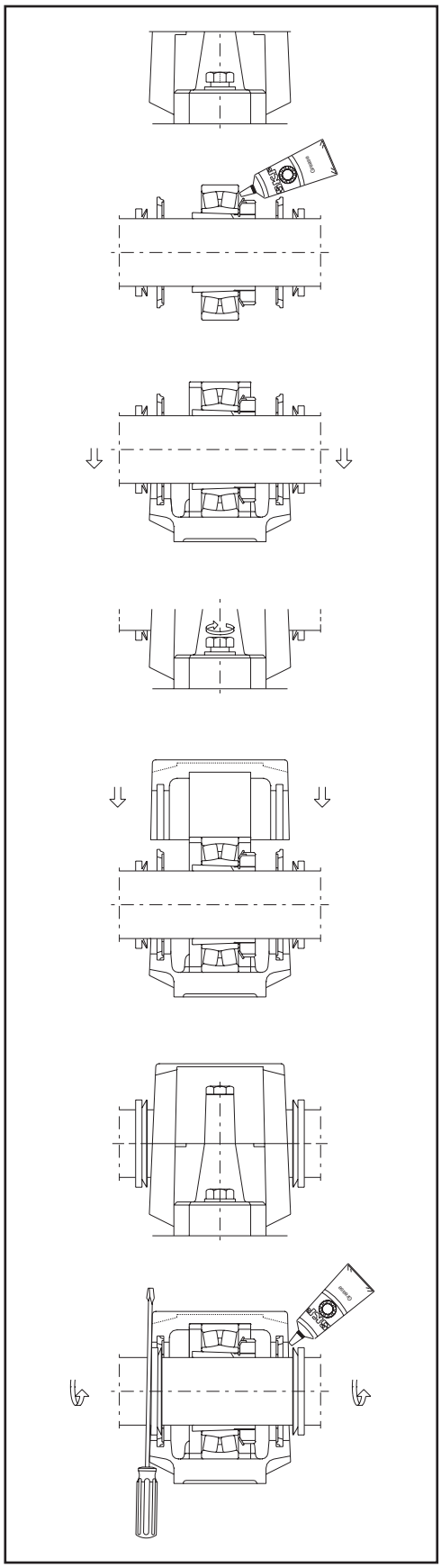
8. At the first charge of grease, the bearing must be filled with grease (do not wash out the protective coating) and the housing will be filled one-third full. For greasing quantities, refer to Page 40.

9. The housing cap is fitted and the cap bolts tightened to the recommended torque, see table on Pages 26 through 37. Note that the cap **must not be interchanged** with that of another housing.

10. The mounting bolts are tightened to the support.

11. The outer surfaces of the sealing washers are smeared with grease.

12. Finally the V-rings are pushed axially along the shaft until their sealing lips are aligned and in the correct working position relative to the sealing washer. The simplest way to move the V-rings is to use a screwdriver blade while rotating the shaft by hand. V-ring seals may be used for oil lubrication. The assembly shown at the right is for grease. When V-rings are used for oil, the seals are doubled up. Consult SKF for more detail.



Seal Assembly and Mounting Procedure

Felt Seal Type “C”

1. The housing base is placed in position and the attachment bolts loosely fitted.

2. The rubber O-section cords are placed in the grooves in the housing base.

3. The halves of the alloy ring with felt seals are mounted on the O-section cords in the grooves of the housing base.

4. The bearing is mounted on the shaft (directly or on an adapter sleeve) and filled with grease.

5. The shaft, complete with bearing assembly, is placed in the lower half of the housing.

6. For held unit, fixing rings are placed in position. For free unit, bearing must be located in center of bearing seat of housing for proper lubrication.

7. The housing base is checked for alignment, ensuring that the housing is within acceptable limits, and the mounting bolts are then slightly tightened.

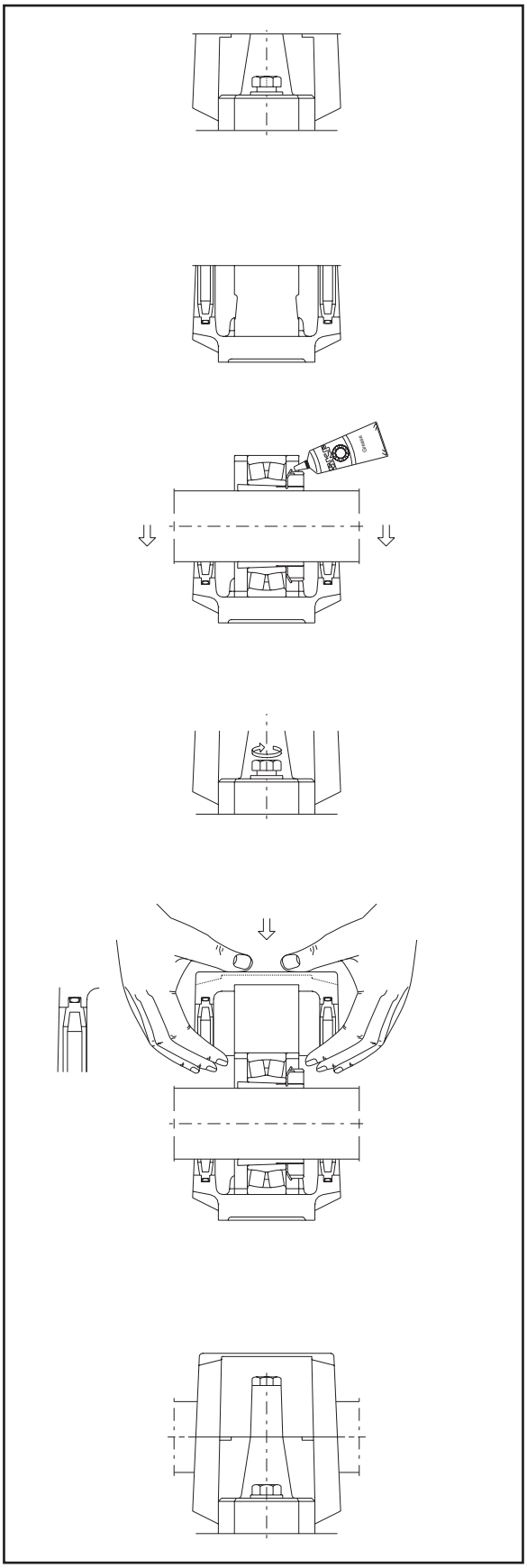
8. The rubber O-section cords are placed in the grooves in the housing cap.

9. The felt seals with the light alloy rings are mounted on the O-section cords in the grooves of the housing cap.

10. At the first charge of grease, the bearing MUST be filled with grease (do not wash out the protective coating) and the housing will be filled one-third full. For greasing quantities, refer to Page 40.

11. The housing cap is fitted and the cap bolts tightened to the recommended torque, see table on Pages 26 through 37. The seals in the housing cap are held in position while the cap is fitted on the housing base. Note that the cap **must not be interchanged** with that of another housing.

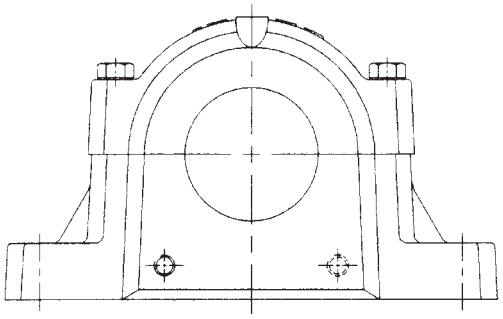
12. Finally, the mounting bolts are tightened to the support.

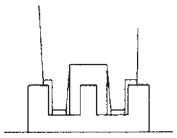
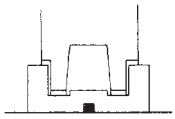
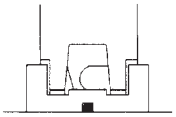
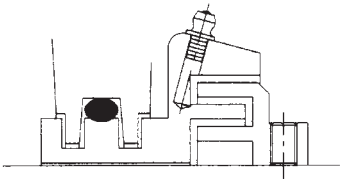
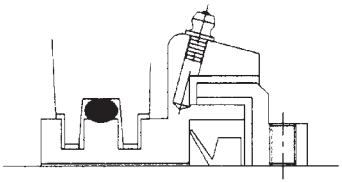
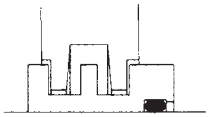
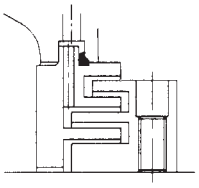
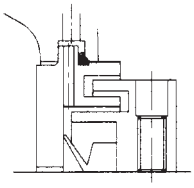


SKF

PILLOW BLOCK HOUSINGS

SAFD, FSAFD



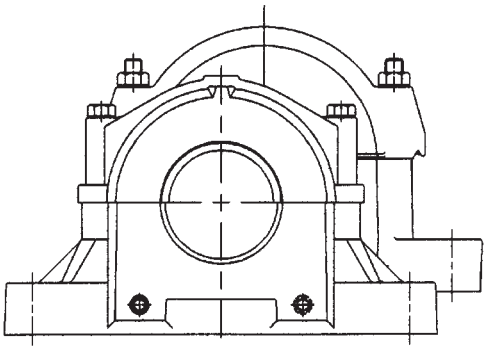
MATERIAL	Ductile Iron ASTM A536 grade 65-45-12	
BEARING SERIES USED	12K, 12EK, 22K, 22EK, 222CCK, 222EK, 232CCK	
SHAFT SIZE RANGE	1-3/16" to 8"	30mm to 203mm
PILLOW BLOCK SIZE	507 - 544 (adapter mounting)	
PILLOW BLOCK LUBRICATION	Grease or Oil	
STANDARD SEALS	LER 	LOR 
OPTIONAL SEALS	LORC 	TER-C 
	TER-CV 	
	A-9508/LER 	TSNC-E 
	TSNC-D 	

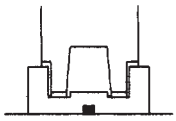
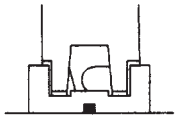
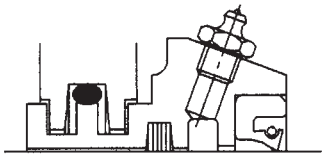
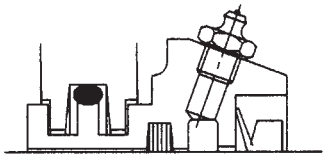
Note : Pillow Block SAFD & FSAFD must be modified to MC14 when using TSNC-D & E type seals sizes 520 through 532. Metric LOR & LORC seals are not available.

SKF

PILLOW BLOCK
HOUSINGS

SAF, FSAF, SAFS, FSAFS

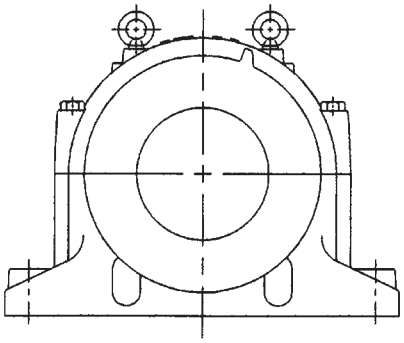


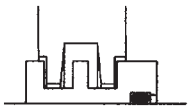
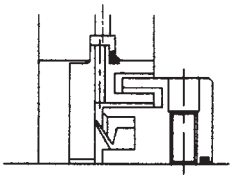
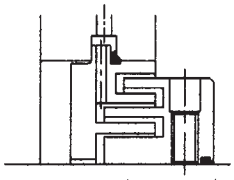
MATERIAL	SAF cast iron ASTM A48 grade 35 SAFS cast steel ASTM A27 grade 65-35
BEARING SERIES USED	12K, 12EK, 13K, 13EK, 222CCK, 222EK, 223CCK, 230CCK, 230CACK
SHAFT SIZE RANGE	1-3/8" to 10-1/2"
PILLOW BLOCK SIZE	024 - 056 (adapter mounting) 507 - 544 (adapter mounting) 609 - 640 (adapter mounting)
PILLOW BLOCK LUBRICATION	Grease or Oil
STANDARD SEALS	LOR 
OPTIONAL SEALS	LORC  TER  TER-V 

SKF

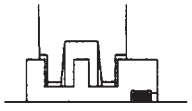
PILLOW BLOCK HOUSINGS

SD, SDCD, SDCD/MC14



MATERIAL	Ductile Iron ASTM A536 grade 65-45-12	
BEARING SERIES USED	230CCK, 231CCK, 232CCK	
SHAFT SIZE RANGE	5-15/16" to 16.142"	150mm to 410mm
PILLOW BLOCK SIZE	3036 - 3088 (adapter mounting) 3134 - 3188 (adapter mounting) 3234 - 3280 (adapter mounting)	
PILLOW BLOCK LUBRICATION	Grease or Oil	
STANDARD SEALS	TS 	
OPTIONAL SEALS	TSDC-D 	TSDC-E 

Note : Pillow Block SDCD must be modified to MC14 when using TSDC-D & E type seals.

MATERIAL	Grey cast iron GG 25 (ISO/DIS 185 grade 250)	
BEARING SERIES USED	231CCK,	
SHAFT SIZE RANGE	5-15/16" TO 11.811"	150mm TO 300mm
PILLOW BLOCK SIZE	3134 - 3164 (adapter mounting)	
PILLOW BLOCK LUBRICATION	Grease or Oil	
STANDARD SEAL	TS 	

Seal Assembly And Mounting Procedure
Triple Ring Seal “LOR, LORC and A 9508/LER”

1. The housing base is placed in position and the mounting bolts loosely fitted.

2. One labyrinth seal is placed on the shaft.

3. The bearing is mounted on the shaft (directly or on an adapter sleeve) and filled with grease.

4. The second labyrinth seal is placed on the shaft.

5. The shaft, complete with bearing assembly and labyrinth seals, is placed in the lower half of the housing.

6. For held unit, fixing rings are placed in position. For free unit, bearing must be located in center of bearing seat of housing for proper lubrication.

7. The housing base is checked for alignment, ensuring that it is within acceptable limits, and the mounting bolts are then slightly tightened.

8. At the first charge of grease, the bearing MUST be filled with grease (do not wash out the protective coating) and the housing will be filled one-third full. For greasing quantities, refer to Page 40.

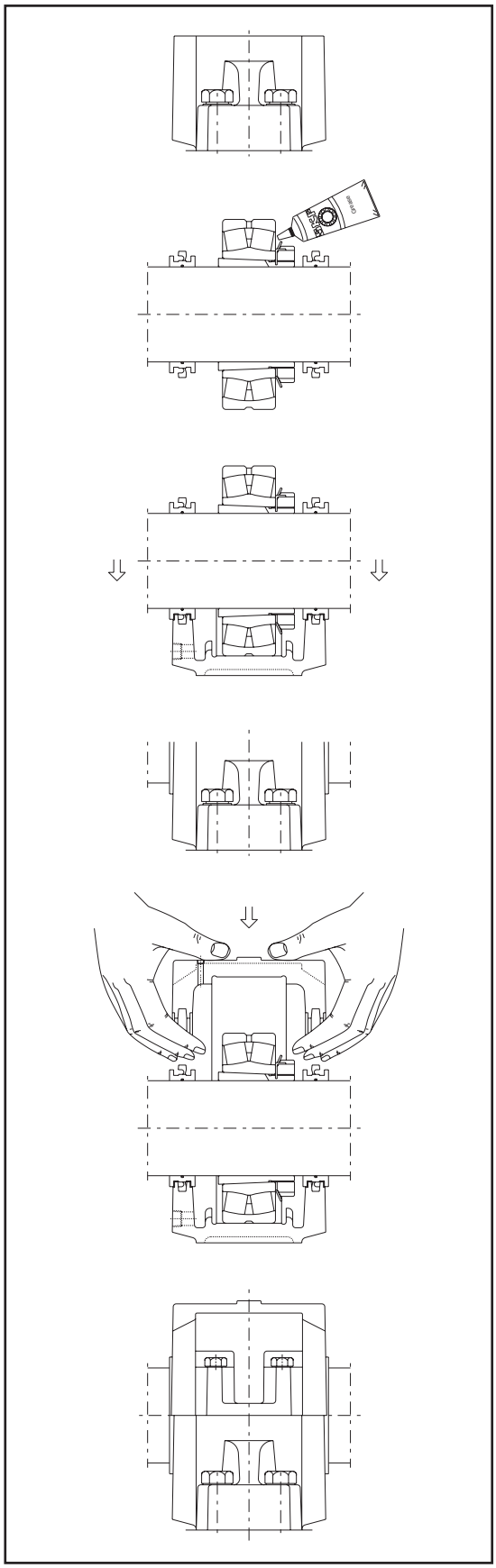
9. The housing cap is fitted and the cap bolts tightened to the recommended torque, see table on Pages 26 through 37. Note that the cap **must not be interchanged** with that of another housing.

10. The mounting bolts are tightened to the support.

11. Finally the silicon O-ring is placed in the grooves of the labyrinth seals. The simplest way to mount the O-ring is to use a screwdriver blade while rotating the shaft by hand.

12. For the LORC seal insert the inboard LOR seal with the added sealing component assuring that the rubber sealing component is facing in the correct orientation to make it either purgeable or non-purgeable.

NOTE: Instruction 11 is only required for A9508/LER Labyrinth Seal.



Seal Assembly and Mounting Procedure
Labyrinth Seals Type “TER-C”

1. The housing base is placed in position and the mounting bolts loosely fitted.

2. Slide one labyrinth seal, consisting of labyrinth flinger, with prongs pointed towards bearing location and labyrinth insert with O-ring installed on its O.D., in this order, on the shaft.

3. The bearing is mounted on the shaft (directly or on an adapter) and filled with grease.

4. The second labyrinth seal is placed on the shaft following instruction as described above under 2 except reverse sequence.

5. The shaft, complete with bearing assembly and labyrinth seal assemblies, is placed in the lower half of the housing.

6. For held unit, fixing rings are placed in position. For free unit, bearing must be located in center of bearing seat of housing for proper lubrication.

7. The housing base is checked for alignment, ensuring that is within acceptable limits, and the mounting bolts are then slightly tightened.

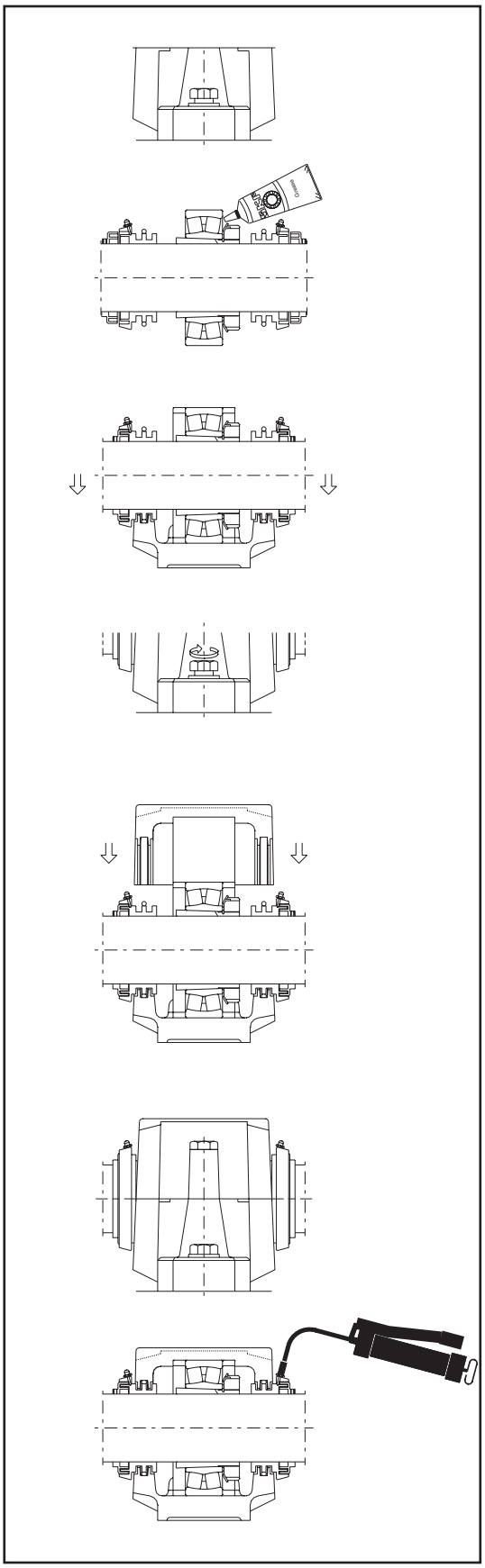
8. The housing must be filled 1/3 full with grease, by packing the free space on both sides of the bearing. See page 40. (Do not wash out the protective coating).

9. The housing cap is fitted, being careful not to damage the O-rings on the O.D. of the seal rings, and the cap bolts tightened to the recommended torque, see Tables on Pages 26 through 37. Note that the cap **must not be interchanged** with that of another housing. Also if shimming is required, only shims giving full mounting support must be used.

10. The mounting bolts are tightened to the support.

11. Fill seal labyrinth on insert and flinger with grease.

12. To adjust labyrinth seal flingers, move the flingers axially toward housing till they contact insert. Back flinger off 1/16” (1.6 mm) on “HELD” assembly. For “FREE” assembly back off the amount of the expected shaft expansion plus 1/32” (0.8 mm). Tighten the setscrews.



Seal Assembly and Mounting Procedure
Labyrinth Seals Type “TER-CV”

1. The housing base is placed in position and the mounting bolts loosely fitted.

2. Slide one labyrinth seal, consisting of labyrinth flinger and a V-ring. Note: Make sure seal lip of V-ring is away from flinger. Point prongs of flinger and V-ring towards bearing location. Slide labyrinth insert with O-ring installed on its O.D., in this order, on the shaft.

3. The bearing is mounted on the shaft (directly or on an adapter) and filled with grease.

4. The second labyrinth seal is placed on the shaft following instruction as described above under 2, except reverse sequence.

5. The shaft, complete with bearing assembly and labyrinth seal assemblies, is placed in the lower half of the housing.

6. For held unit, fixing rings are placed in position. For free unit, bearing must be located in center of bearing seat of housing for proper lubrication.

7. The housing base is checked for alignment, ensuring that it is within acceptable limits, and the mounting bolts are then slightly tightened.

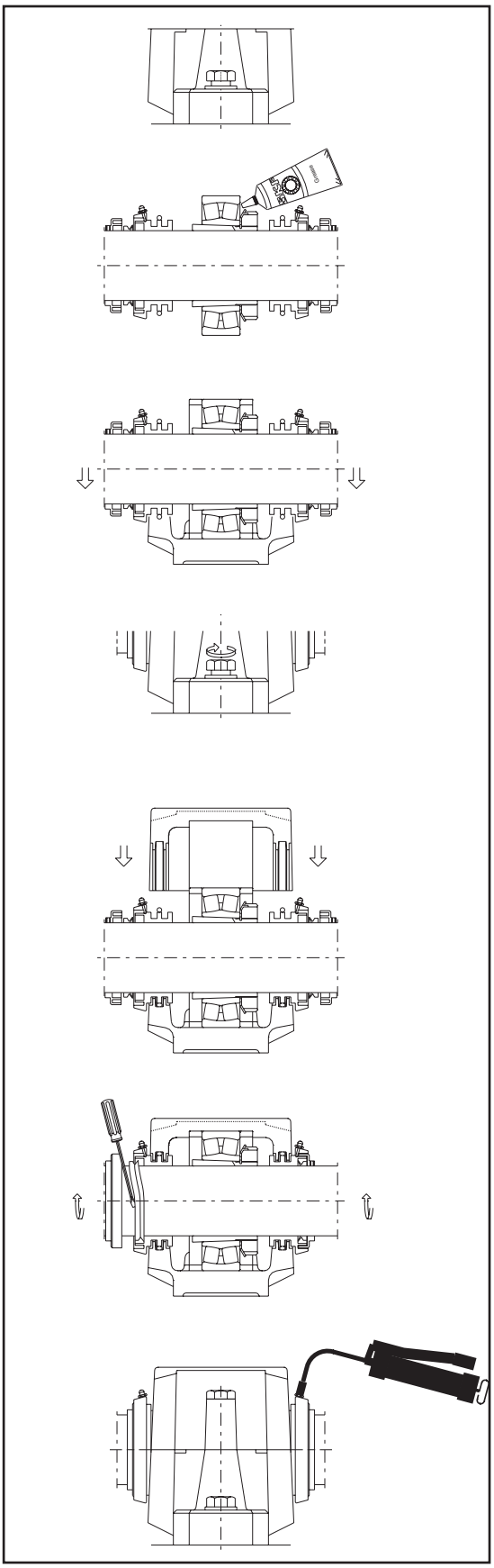
8. The housing must be filled 1/3 full with grease, by packing the free space on both sides of the bearing. See page 40. (Do not wash out the protective coating).

9. The housing cap is fitted, being careful not to damage the O-rings on the O.D. of the seal inserts, and the cap bolts tightened to the recommended torque, see Table on Pages 26 through 37. Note that the cap **must not be interchanged** with that of another housing.

10. The mounting bolts are tightened to the support.

11. Fill seal labyrinth on insert and flinger with grease.

12. To adjust labyrinth seal flingers, move the flingers axially toward housing till they contact insert. Back flinger off 1/16" (1.6 mm) on “HELD” assembly. For "FREE" assembly back off the amount of the expected shaft expansion plus 1/32” (0.8 mm). Tighten the set screws.



Seal Assembly and Mounting Procedure
Labyrinth Seal Type "S" and "TS"

1. The housing base is placed in position and the Mounting bolts loosely fitted.

2. One labyrinth seal is placed on the shaft.

3. The bearing is mounted on the shaft (directly or on an adapter sleeve) and filled with grease.

4. The second labyrinth seal is placed on the shaft.

5. The shaft, complete with bearing assembly and labyrinth seals, is placed in the lower half of the housing.

6. For held unit, fixing rings are placed in position. For free unit, bearing must be located in center of bearing seat of housing for proper lubrication.

7. The housing base is checked for alignment, ensuring that it is within acceptable limits, and the mounting bolts are then slightly tightened.

8. At the first charge of grease, the bearing MUST be filled with grease (do not wash out the protective coating) and the housing will be filled one-third full.
   * For greasing quantities, refer to Page 40.

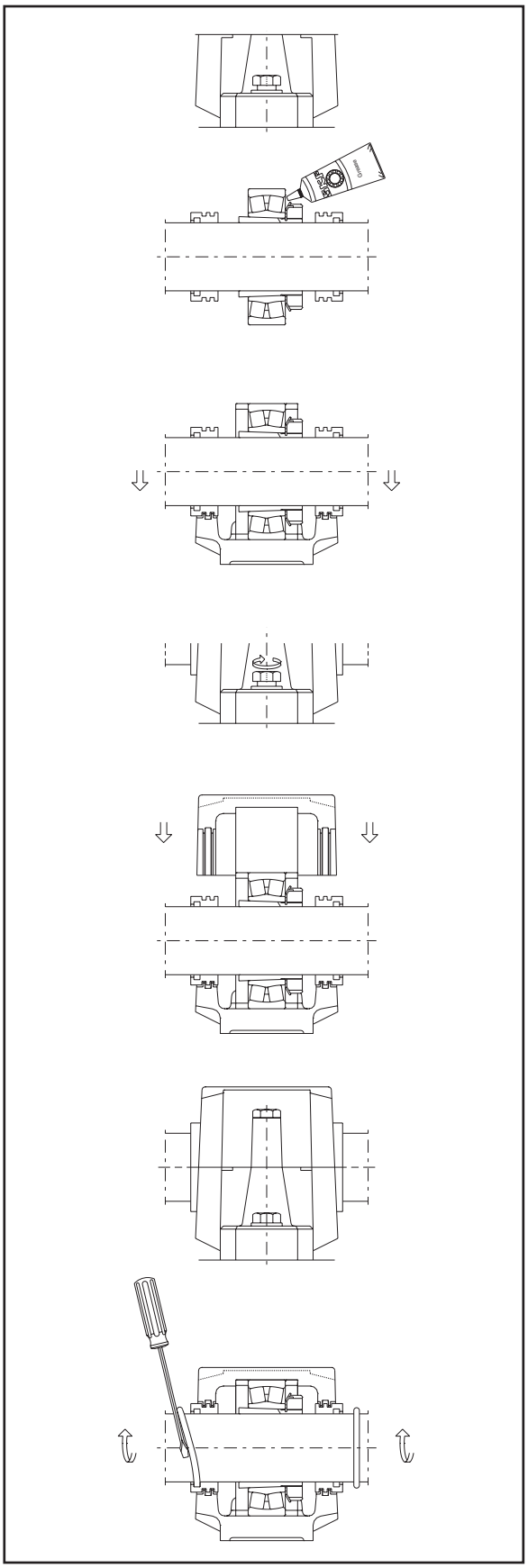
9. The housing cap is filled and the cap bolts tightened to the recommended torque, see Table on Pages 26 through 37. Note that the cap **must not be interchanged** with that of another housing.

10. The mounting bolts are tightened to the support.

11. Finally the silicon O-section cords are placed in the grooves of the labyrinth seals. The simplest way to mount the cords is to use a screwdriver blade while rotating the shaft by hand.

NOTE: Type S is used with SNH and SSNHD.
Type TS is used with SD, SDCD, SDCT and SDHD.

*The initial charge can be increased to half-full for slow to moderate speeds. For slower applications less than 10 rpm consult SKF Engineering Dept.



Seal Assembly and Mounting Procedure
Labyrinth Seals Type “E”

1. The housing base is placed in position and the mounting bolts loosely fitted.

2. Slide one labyrinth seal, consisting of labyrinth flinger, with prongs towards bearing location and labyrinth insert with O-ring installed on its O.D., in this order, on the shaft.

3. The bearing is mounted on the shaft (directly or on an adapter) and filled with grease.

4. The second labyrinth seal is placed on the shaft following instruction as described above under 2.

5. The shaft, complete with bearing assembly and labyrinth seal assemblies, is placed in the lower half of the housing.

6. For held unit, fixing rings are placed in position. For free unit, bearing must be located in center of bearing seat of housing for proper lubrication.

7. The housing base is checked for alignment, ensuring that it is within acceptable limits, and the mounting bolts are then slightly tightened.

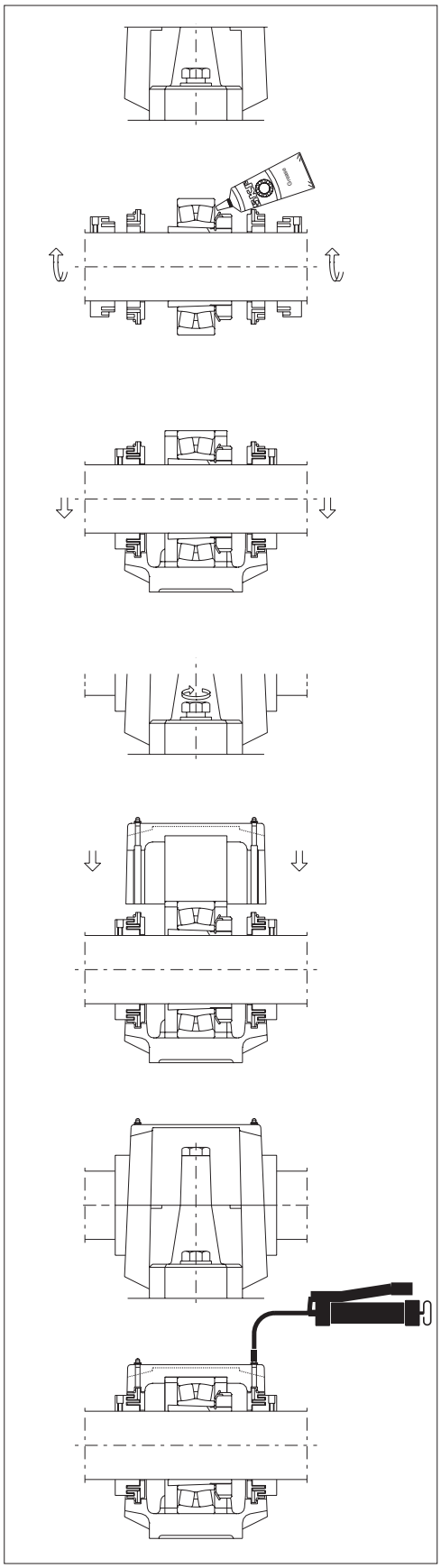
8. At the first charge of grease, the bearing MUST be filled with grease. See page 40. (do not wash out the protective coating) the housing will be filled one-third full.

9. The housing cap is fitted, being careful not to damage the O-rings on the O.D. of the seal inserts, and the cap bolts tightened to the recommended torque, see Table on Pages 26 through 37. Note that the cap **must not be interchanged** with that of another housing.

10. The mounting bolts are tightened to the support.

11. To adjust labyrinth seal flingers, move the flingers axially toward housing until they contact insert. Back flinger off 1/16” (1.6 mm) on “HELD” assembly. For "FREE" assembly back off the amount of the expected shaft expansion plus 1/32” (0.8mm). Tighten the setscrews which secure the flingers on the shaft. To complete the assembly in the case of SDCD housings with these labyrinth seal assemblies, take one half of the 4 mm rubber cord supplied and insert it in the counter bore of each flinger bore adjacent to the outer face.

12. At the initial startup, with shaft rotating, lubricate seals through grease fitting until a bead of grease appears around the periphery of the flingers. NOTE: Use same grease as for lubrication of bearing.



Seal Assembly and Mounting Procedure
Labyrinth Seals Type “D”

1. The housing base is placed in position and the mounting bolts loosely fitted.

2. Slide one labyrinth seal, consisting of labyrinth flinger and a V-ring. Note: Make sure seal lip of V-ring is away from flinger. Point prongs of flinger and V-ring towards bearing location. Slide labyrinth insert with O-ring installed on its O.D., in this order, on the shaft.

3. The bearing is mounted on the shaft (directly or on an adapter) and filled with grease.

4. The second labyrinth seal is placed on the shaft following instruction as described above under 2.

5. The shaft, complete with bearing assembly and labyrinth seal assemblies is placed in the lower half of the housing.

6. For held unit, fixing rings are placed in position. For free unit, bearing must be located in center of bearing seat of housing for proper lubrication.

7. The housing base is checked for alignment, ensuring that is within acceptable limits, and the mounting bolts are then slightly tightened.

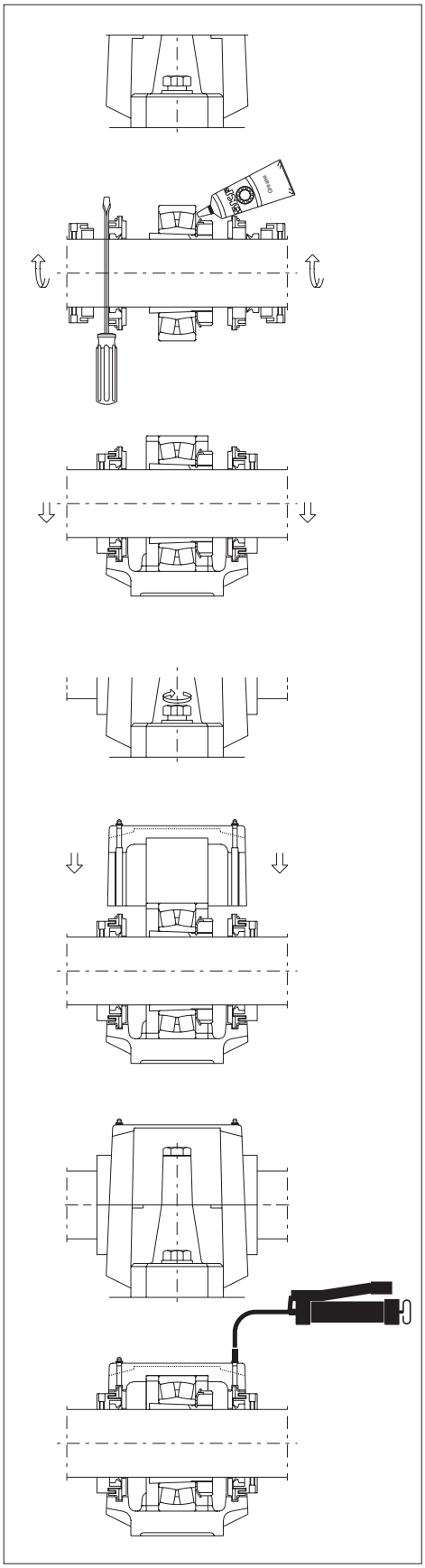
8. At the first charge of grease, the bearing MUST be filled with grease. See page 40. (do not wash out the protective coating) the housing will be filled one-third full.

9. The housing cap is fitted, being careful not to damage the O-rings on the O.D. of the seal inserts, and the cap bolts tightened to the recommended torque, see Pages 26 through 37. Note that the cap **must not be interchanged** with that of another housing.

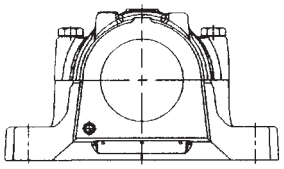
10. The mounting bolts are tightened to the support.

11. To adjust labyrinth seal flingers, move the flingers axially toward housing till they contact insert. Back flinger off 1/16” (1.6 mm) on “HELD” assembly. For “FREE” assembly back off the amount of the expected shaft expansion plus 1/32” (0.8 mm). Tighten the set screws which secure the flingers on the shaft. To complete the assembly in the case of SDCD housings with these labyrinth seal assemblies, take one half of the 4 mm rubber cord supplied and insert it in the counter bore of each flinger bore adjacent to the outer face.

12. At the initial start up, with shaft rotating, lubricate seals through grease fitting until a bead of grease appears around the periphery of the flingers. NOTE: Use same grease as for lubrication of bearing.

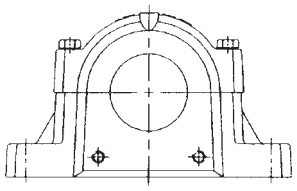


Series: **SNL 500 - 600, SNL 200 - 300**
SSNHD 500 - 600, SSNHD 200 - 300



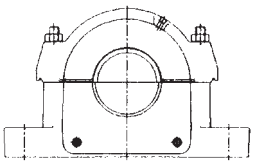
Suffix -VU Housing Size	Cap Bolt Information				Lubrication Fitting Hole Detail		Base or Attachment bolts Qty (2) or (4) inch/metric
	Size Qty. (2)	Recommended Tightening Torque		Grade			
	Metric	Ft/Lbs.	Nm	Metric ISO	Cap In	Base Out	
505 205	M10	37	50	8.8	$^1/_8$-27 NPSF M10 x 1 $R^1/_8$ May also be used in the same hole	$^1/_8$NPT	(2) $^1/_2$"/12 mm (4) $^3/_8$"/10 mm
506 - 605 206							
507 - 606 207							
508 - 607 208							
509 209							
510 - 608 210							
511 - 609 211 512 - 610 212 513 - 611 213 515 - 612 215	M12	60	80	8.8		$^1/_8$NPT	(2) $^5/_8$"/16 mm (4) $^1/_2$"/12 mm
516 -613 216 517 217	M12	60	80	8.8		$^1/_8$NPT	(2) $^3/_4$"/20 mm (4) $^5/_8$"/16 mm
518 - 615 218 519 - 616	M16	110	150	8.8		$^1/_8$NPT	(2) $^3/_4$"/20 mm (4) $^5/_8$"/16 mm
520 - 617 522 - 619 524 - 620	M20	150	200	8.8		$^1/_4$NPT	(2) $^7/_8$"/24 mm (4) $^5/_8$"/16 mm
526	M24	260	350	8.8		$^3/_8$NPT	(2) 1"/24 mm (4) $^3/_4$"/20 mm
528 530 532	M24	260	350	8.8		$^3/_8$NPT	(2) $1^1/_4$"/30 mm (4) $^7/_8$"/24 mm

Series: **SAFD 500**
SAFD 200



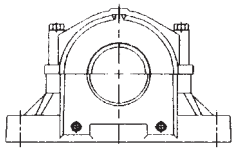
Housing Size	Cap Bolt Information				Lubrication Fitting Hole Detail		Base or Attachment bolts Qty (2) or (4) inch/metric
	Size Qty. (2) or (4)	Recommended Tightening Torque		Grade			
	Inch	Ft/Lbs.	Nm	SAE	Cap In	Base Out	
507	(2) $^3/_8$ - 16	40	55	8	$^1/_8$NPT	$^1/_4$NPT	(2) $^1/_2$"/12 mm
509	(2) $^7/_{16}$ - 14	80	110	8	$^1/_8$NPT	$^1/_4$NPT	(2) $^1/_2$"/12 mm
510	(2) $^7/_{16}$ - 14	80	110	8	$^1/_8$NPT	$^1/_4$NPT	(2) $^1/_2$"/12 mm
511	(2) $^1/_2$ - 13	110	150	8	$^1/_8$NPT	$^1/_4$NPT	(2) $^5/_8$"/16 mm
513	(2) $^1/_2$ - 13	110	150	8	$^1/_8$NPT	$^1/_4$NPT	(2) $^5/_8$"/16 mm (4) $^1/_2$"/12 mm
515 215	(2) $^1/_2$ - 13	110	150	8	$^1/_8$NPT	$^1/_4$NPT	(2) $^5/_8$"/16 mm (4) $^1/_2$"/12 mm
516 216	(2) $^5/_8$ - 11	220	300	8	$^1/_8$NPT	$^1/_4$NPT	(2) $^3/_4$"/20 mm (4) $^5/_8$"/16 mm
517 217	(2) $^5/_8$ - 11	220	300	8	$^1/_8$NPT	$^1/_4$NPT	(2) $^3/_4$"/20 mm (4) $^5/_8$"/16 mm
518 218	(4) $^5/_8$ - 11	220	300	8	$^1/_8$NPT	$^1/_4$NPT	(2) $^3/_4$"/20 mm (4) $^5/_8$"/16 mm
520 220	(4) $^5/_8$ - 11	220	300	8	$^1/_4$NPT	$^1/_2$NPT	(2) $^7/_8$"/24 mm (4) $^3/_4$"/20 mm
522 222	(4) $^5/_8$ - 11	220	300	8	$^1/_4$NPT	$^1/_2$NPT	(4) $^3/_4$"/20 mm
524 224	(4) $^5/_8$ - 11	220	300	8	$^1/_4$NPT	$^1/_2$NPT	(4) $^3/_4$"/20 mm
526 226	(4) $^3/_4$ - 10	380	520	8	$^1/_4$NPT	$^1/_2$NPT	(4) $^7/_8$"/24 mm
528 228	(4) $^7/_8$ - 9	600	820	8	$^1/_4$NPT	$^1/_2$NPT	(4) $^3/_4$"/20 mm
*530 230	(4) $^7/_8$ - 9	600	820	8	$^1/_4$NPT	$^1/_2$NPT	(4) 1"/24 mm
532 232	(4) $^7/_8$ - 9	600	820	8	$^1/_4$NPT	$^1/_2$NPT	(4) 1"/24 mm
534 234	(4) $^7/_8$ - 9	600	820	8	$^1/_4$NPT	$^3/_4$NPT	(4) 1"/24 mm
536 236	(4) $^7/_8$ - 9	600	820	8	$^1/_4$NPT	$^3/_4$NPT	(4) 1"/24 mm
538 238	(4) 1 - 8	900	1230	8	$^1/_4$NPT	$^3/_4$NPT	(4) $1^1/_4$"/30 mm
540 240	(4) 1 - 8	900	1230	8	$^1/_4$NPT	1NPT	(4) $1^1/_4$"/30 mm
544 244	(4) 1 - 8	900	1230	8	$^1/_4$NPT	1NPT	(4) $1^1/_2$"/36 mm

Series: **SAF 500**
SAF 200
SAF 0
N-Design 4 Hex. head cap bolts.



N-Design Housing Size	Cap Bolt Information				Lubrication Fitting Hole Detail		Base or Attachment bolts Qty (2) or (4) inch/metric
	Size Qty. (4)	Recommended Tightening Torque		Grade			
	Inch	Ft/Lbs.	Nm	SAE	Cap In	Base Out	
518 218	$^1/_2$ - 13	50	70	2	$^1/_8$NPT	$^3/_8$NPT	(2) $^3/_4$"/20 mm (2) $^5/_8$"/16 mm
520 220 024	$^5/_8$ - 11	100	140	2	$^1/_4$NPT	$^3/_8$NPT	(2) $^7/_8$"/24 mm (4) $^3/_4$"/20 mm
522 222 026	$^5/_8$ - 11	100	140	2	$^1/_4$NPT	$^3/_8$NPT	(4) $^3/_4$"/20 mm
524 224 028	$^5/_8$ - 11	100	140	2	$^1/_4$NPT	$^1/_2$NPT	(4) $^3/_4$"/20 mm
526 226 030 032	$^3/_4$ - 10	175	240	2	$^1/_4$NPT	$^1/_2$NPT	(4) $^7/_8$"/24 mm
528 228	$^7/_8$ - 9	165	220	2	$^1/_4$NPT	$^3/_4$NPT	(4) 1"/24 mm
530 230	$^7/_8$ - 9	165	220	2	$^1/_4$NPT	$^3/_4$NPT	(4) 1"/24 mm
532 232 036 038	$^7/_8$ - 9	165	220	2	$^1/_4$NPT	$^3/_4$NPT	(4) 1"/24 mm
534 234 040	1 - 8	250	340	2	$^1/_4$NPT	$^3/_4$NPT	(4) 1"/24 mm
536 236	1 - 8	250	340	2	$^1/_4$NPT	$^3/_4$NPT	(4) 1"/24 mm
538 238 044	$1^1/_8$ - 7	350	480	2	$^1/_4$NPT	1NPT	(4) $1^1/_4$"/30 mm
540 240 048	$1^1/_4$ - 7	500	680	2	$^1/_4$NPT	1NPT	(4) $1^1/_4$"/30 mm
544 244 052	$1^3/_8$ - 6	660	900	2	$^1/_4$NPT	1NPT	(4) $1^1/_2$"/36 mm

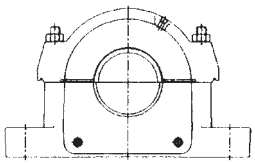
Series: **SAF 500**
SAF 200
A-Design



Note: To recognize A-design, cap of block is held down with 2 hex. Head bolts, except 532 which uses 4 bolts.

A-Design Housing Size	Cap Bolt Information				Lubrication Fitting Hole Detail		Base or Attachment bolts Qty (2) or (4) inch/metric
	Size Qty. (4) or (4)	Recommended Tightening Torque		Grade			
	Inch	Ft/Lbs.	Nm	SAE	Cap In	Base Out*	
507 509 510	$^3/_8$ - 16 $^7/_{16}$ - 14 $^7/_{16}$ - 14	40 80 80	55 110 110	8 8 8	$^1/_8$NPT $^1/_8$NPT $^1/_8$NPT	$^1/_8$NPT $^1/_8$NPT $^1/_8$NPT	(2) $^3/_8$"/10 mm (2) $^1/_2$"/12 mm (2) $^1/_2$"/12 mm
511 211	$^1/_2$ - 13	105	150	8	$^1/_8$NPT	$^1/_4$NPT	(2) $^5/_8$"/16 mm
513 213	$^1/_2$ - 13	105	150	8	$^1/_8$NPT	$^1/_8$NPT	(2) $^5/_8$"/16 mm
515 215	$^1/_2$ - 13	105	150	8	$^1/_8$NPT	$^1/_4$NPT	(2) $^5/_8$"/16 mm (4) $^1/_2$"/12 mm
516 216	$^5/_8$ - 11	210	300	8	$^1/_8$NPT	$^3/_8$NPT	(2) $^3/_4$"/20 mm (4) $^5/_8$"/16 mm
517 217	$^5/_8$ - 11	210	300	8	$^1/_8$NPT	$^3/_8$NPT	(2) $^3/_4$"/20 mm (4) $^5/_8$"/16 mm
518 218	$^5/_8$ - 11	210	300	8	$^1/_8$NPT	$^3/_8$NPT	(2) $^3/_4$"/20 mm (4) $^5/_8$"/16 mm
520 220	$^3/_4$ - 10	280	520	8	$^1/_4$NPT	$^3/_8$NPT	(2) $^7/_8$"/24 mm (4) $^3/_4$"/20 mm
522 222	$^3/_4$ - 10	280	520	8	$^1/_4$NPT	$^3/_8$NPT	(4) $^3/_4$"/20 mm
524 224	1 - 8	900	1200	8	$^1/_4$NPT	$^1/_2$NPT	(4) $^3/_4$"/20 mm
526 226	1 - 8	900	1200	8	$^1/_4$NPT	$^1/_2$NPT	(4) $^7/_8$"/24 mm
528 228	1 - 8	900	1200	8	$^1/_4$NPT	$^3/_4$NPT	(4) 1"/24 mm
532 232	$^3/_4$ - 10	380	520	8	$^1/_4$NPT	$^3/_4$NPT	(4) 1"/24 mm
534 234	(4) $^3/_4$ -10	380	520	8	$^1/_4$NPT	$^3/_4$NPT	(4) 1"/24 mm
536 236	(4) $^3/_4$ -10	380	520	8	$^1/_4$NPT	$^3/_4$NPT	(4) 1"/24 mm
538 238	(4) $^7/_8$ -9	600	820	8	$^1/_4$NPT	$^3/_4$NPT	(4) $1^1/_4$"/30 mm
540 240	(4) $^7/_8$ -9	600	820	8	$^1/_4$NPT	1NPT	(4) $1^1/_4$"/30 mm
544 244	(4) 1-8	900	1230	8	$^1/_4$NPT	1NPT	(4) $1^1/_2$"/36 mm

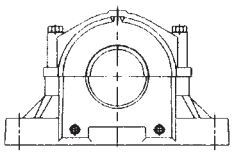
Series: **SAF 600**
SAF 300
SAF O KA
N-Design



Note: To recognize N-design, the block has 4 hex. Head nuts to hold down cap

N-Design Housing Size	Cap Bolt Information				Lubrication Fitting Hole Detail		Base or Attachment bolts Qty (2) or (4) inch/metric
	Size Qty. (4)	Recommended Tightening Torque		Grade			
	Inch	Ft/Lbs.	Nm	SAE	Cap In	Base Out*	
615 315	$^1/_2$ - 13	50	70	2	$^1/_8$NPT	$^3/_8$NPT	(2) $^3/_4$"/20 mm (4) $^5/_8$"/16 mm
616 316	$^1/_2$ - 13	50	70	2	$^1/_8$NPT	$^3/_8$NPT	(2) $^3/_4$"/20 mm (4) $^5/_8$"/16 mm
617 317	$^5/_8$ - 11	100	140	2	$^1/_4$NPT	$^3/_8$NPT	(2) $^7/_8$"/24 mm (4) $^3/_4$"/20 mm
618 318	$^5/_8$ - 11	100	140	2	$^1/_4$NPT	$^3/_8$NPT	(4) $^3/_4$"/20 mm
620 320	$^5/_8$ - 11	100	140	2	$^1/_4$NPT	$^1/_2$NPT	(4) $^3/_4$"/20 mm
622 322	$^3/_4$ - 10	175	240	2	$^1/_4$NPT	$^1/_2$NPT	(4) $^7/_8$"/24 mm
624 324	$^7/_8$ - 9	165	220	2	$^1/_4$NPT	$^3/_4$NPT	(4) 1"/24 mm
626 326	$^7/_8$ - 9	165	220	2	$^1/_4$NPT	$^3/_4$NPT	(4) 1"/24 mm
628 328	1 - 8	250	340	2	$^1/_4$NPT	$^3/_4$NPT	(4) 1"/24 mm
630 330	1 - 8	250	340	2	$^1/_4$NPT	$^3/_4$NPT	(4) 1"/24 mm
632 332	$1^1/_8$ - 7	350	480	2	$^1/_4$NPT	1NPT	(4) $1^1/_4$"/30 mm
634 334	$1^1/_4$ - 7	500	680	2	$^1/_4$NPT	1NPT	(4) $1^1/_4$"/30 mm
638 338	$1^3/_8$ - 6	660	900	2	$^1/_4$NPT	1NPT	(4) $1^1/_2$"/36 mm

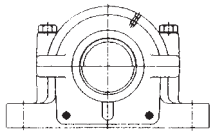
Series: **SAF 600**
SAF 300
SAF O KA
A-Design



Note: To recognize A-design, cap of block is held down with 2 hex. Head bolts

A-Design Housing Size	Cap Bolt Information				Lubrication Fitting Hole Detail		Base or Attachment bolts Qty (2) or (4) inch/metric
	Size Qty. (2)	Recommended Tightening Torque		Grade			
	Inch	Ft/Lbs.	Nm	SAE	Cap In	Base Out*	
613 313	$^5/_8$ - 11	220	300	8	$^1/_8$NPT	$^3/_8$NPT	(2) $^3/_4$"/20 mm (4) $^5/_8$"/16 mm
615 315	$^5/_8$ - 11	290	300	8	$^1/_8$NPT	$^3/_8$NPT	(2) $^3/_4$"/20 mm (4) $^5/_8$"/16 mm
620 320	1 - 8	900	1200	8	$^1/_4$NPT	$^1/_2$NPT	(4) $^3/_4$"/20 mm
622 322	1 - 8	900	1200	8	$^1/_4$NPT	$^1/_2$NPT	(4) $^7/_8$"/24 mm
024 KA	$^3/_4$ - 10	380	520	8	$^1/_4$NPT	$^3/_8$NPT	(2) $^7/_8$"/24 mm (4) $^3/_4$"/20 mm
026 KS	$^3/_4$ - 10	380	520	8	$^1/_4$NPT	$^3/_8$NPT	(4) $^3/_4$"/20 mm
028 KA	1 - 8	900	1200	8	$^1/_4$NPT	$^1/_2$NPT	(4) $^3/_4$"/20 mm
030 KA	1 - 8	900	1200	8	$^1/_4$NPT	$^1/_2$NPT	(4) $^7/_8$"/24 mm
032 KA	1 - 8	900	1200	8	$^1/_4$NPT	$^1/_2$NPT	(4) $^7/_8$"/24 mm
034 KA	1 - 8	900	1200	8	$^1/_4$NPT	$^3/_4$NPT	(4) $^7/_8$"/24 mm

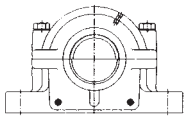
Series: **SAF 500**
SAF 200
L-Design



Note: To recognize L-design, which is the original design and still used for blocks made of steel, cap is held down with 2 hex. head bolts

L-Design Housing Size	Cap Bolt Information				Lubrication Fitting Hole Detail		Base or Attachment bolts Qty (2) or (4) inch/metric
	Size Qty. (2)	Recommended Tightening Torque		Grade			
	Inch	Ft/Lbs.	Nm	SAE	Cap In	Base Out	
507	$^{3}/_{8}$ - 16	20	27	2	$^{1}/_{8}$NPT	$^{1}/_{8}$NPT	(2) $^{3}/_{8}$"/10 mm
509	$^{7}/_{16}$ - 14	30	40	2	$^{1}/_{8}$NPT	$^{1}/_{8}$NPT	(2) $^{1}/_{2}$"/12 mm
510	$^{7}/_{16}$ - 14	30	40	2	$^{1}/_{8}$NPT	$^{1}/_{8}$NPT	(2) $^{1}/_{2}$"/12 mm
511	$^{1}/_{2}$ - 13	50	70	2	$^{1}/_{8}$NPT	$^{1}/_{4}$NPT	(4) $^{5}/_{8}$"/16 mm
513	$^{1}/_{2}$ - 13	50	70	2	$^{1}/_{8}$NPT	$^{1}/_{8}$NPT	(2) $^{5}/_{8}$"/16 mm (4) $^{1}/_{2}$"/12 mm
515	$^{1}/_{2}$ - 13	50	70	2	$^{1}/_{8}$NPT	$^{1}/_{4}$NPT	(2) $^{5}/_{8}$"/16 mm (4) $^{1}/_{2}$"/12 mm
516 216	$^{1}/_{2}$ - 13	50	70	2	$^{1}/_{8}$NPT	$^{3}/_{8}$NPT	(2) $^{3}/_{4}$"/20 mm (4) $^{5}/_{8}$"/16 mm
517 217	$^{5}/_{8}$ - 11	100	140	2	$^{1}/_{8}$NPT	$^{3}/_{8}$NPT	(2) $^{3}/_{4}$"/20 mm (4) $^{5}/_{8}$"/16 mm

Series: **SAF 600**
SAF 300
L-Design



Note: To recognize L-design, which is the original design and still used for blocks made of steel, cap is held down with 2 hex. head bolts

L-Design Housing Size	Cap Bolt Information				Lubrication Fitting Hole Detail		Base or Attachment bolts Qty (2) or (4) inch/metric
	Size Qty. (2)	Recommended Tightening Torque		Grade			
	Inch	Ft/Lbs.	Nm	SAE	Cap In	Base Out	
308	$^{7}/_{16}$ - 14	30	40	2	$^{1}/_{8}$NPT	$^{1}/_{8}$NPT	(2) $^{1}/_{2}$"/12 mm
609 309	$^{1}/_{2}$ - 13	50	70	2	$^{1}/_{8}$NPT	$^{1}/_{8}$NPT	(2) $^{5}/_{8}$"/16 mm
610 310	$^{1}/_{2}$ - 13	50	70	2	$^{1}/_{8}$NPT	$^{1}/_{8}$NPT	(2) $^{5}/_{8}$"/16 mm
611 311	$^{1}/_{2}$ - 13	50	70	2	$^{1}/_{8}$NPT	$^{1}/_{4}$NPT	(2) $^{5}/_{8}$"/16 mm (4) $^{1}/_{2}$"/12 mm
613 313	$^{5}/_{8}$ - 11	100	140	2	$^{1}/_{8}$NPT	$^{3}/_{8}$NPT	(2) $^{3}/_{4}$"/20 mm (4) $^{5}/_{8}$"/16 mm

Series: **SAFS 500, SAFS 200, SAFS O**

Note: To recognize A-design, cap of block is held down with 2 hex. Head bolts

Housing Size	Cap Bolt Information				Lubrication Fitting Hole Detail		Base or Attachment bolts Qty (2) or (4) inch/metric
	Size Qty. (2) or (4)	Recommended Tightening Torque		Grade			
	Inch	Ft/Lbs.	Nm	SAE	Cap In	Base Out*	
509 510	(2) $^{7}/_{16}$ - 14	70	110	8	$^{1}/_{8}$NPT	$^{1}/_{8}$NPT	(2) $^{7}/_{16}$"/12 mm
511	(2) $^{1}/_{2}$ - 13	110	150	8	$^{1}/_{4}$NPT	$^{1}/_{4}$NPT	(2) $^{5}/_{8}$"/16 mm
513 515	(2) $^{1}/_{2}$ - 13	110	150	8	$^{1}/_{4}$NPT	$^{1}/_{4}$NPT	(2) $^{5}/_{8}$"/16 mm (4) $^{1}/_{2}$"/12 mm
516 216	(2) $^{1}/_{2}$ - 13	110	150	8	$^{3}/_{8}$NPT	$^{3}/_{8}$NPT	(2) $^{5}/_{8}$"/16 mm (4) $^{5}/_{8}$"/16 mm
517 217	(2) $^{5}/_{8}$ - 11	220	300	8	$^{3}/_{8}$NPT	$^{3}/_{8}$NPT	(2) $^{3}/_{4}$"/20 mm (4) $^{5}/_{8}$"/16 mm
518 218	(4) $^{1}/_{2}$ - 13	110	150	8	$^{3}/_{8}$NPT	$^{3}/_{8}$NPT	(2) $^{3}/_{4}$"/20 mm (4) $^{5}/_{8}$"/16 mm
520 220 024	(4) $^{5}/_{8}$ - 11	220	300	8	$^{3}/_{8}$NPT	$^{3}/_{8}$NPT	(2) $^{7}/_{8}$"/24 mm (4) $^{3}/_{4}$"/20 mm
522 222 026	(4) $^{5}/_{8}$ - 11	220	300	8	$^{3}/_{8}$NPT	$^{3}/_{8}$NPT	(4) $^{3}/_{4}$"/20 mm
524 224 028	(4) $^{5}/_{8}$ - 11	220	300	8	$^{1}/_{2}$NPT	$^{1}/_{2}$NPT	(4) $^{3}/_{4}$"/20 mm
526 226 030 032	(4) $^{3}/_{4}$ - 10	380	520	8	$^{1}/_{2}$NPT	$^{1}/_{2}$NPT	(4) $^{7}/_{8}$"/24 mm
528 228 034	(4) $^{7}/_{8}$ - 9	600	820	8	$^{3}/_{4}$NPT	$^{3}/_{4}$NPT	(4) 1"/24 mm
530 230	(4) $^{7}/_{8}$ - 9 mm	600	820	8	$^{3}/_{4}$NPT	$^{3}/_{4}$NPT	(4) 1"/24 mm
532 232 036 038	(4) $^{7}/_{8}$ - 9 mm	600	820	8	$^{3}/_{4}$NPT	$^{3}/_{4}$NPT	(4) 1"/24 mm
534 234 040	(4) 1 - 8	900	1200	8	$^{3}/_{4}$NPT	$^{3}/_{4}$NPT	(4) 1"/24 mm
536 236	(2) $1^{3}/_{8}$ - 6	2380	3250	8	$^{3}/_{4}$NPT	$^{3}/_{4}$NPT	(4) 1"/24 mm
538 238 044	(4) $1^{1}/_{8}$ - 7	1280	1750	8	1NPT	1NPT	(4) $1^{1}/_{4}$"/30 mm
540 240 048	(4) $1^{1}/_{4}$ - 7	1820	2450	8	1NPT	1NPT	(4) $1^{1}/_{4}$"/30 mm
544 244 052	(2) $1^{3}/_{8}$ - 6	2380	3250	8	1NPT	1NPT	(4) $1^{1}/_{2}$"/36 mm

Series: SD 31

Housing Size	Cap Bolt Information				Lubrication Fitting Hole Detail		Base or Attachment bolts Qty (2) or (4)
	Size Qty. (4)	Recommended Tightening Torque		Grade			
	Inch	Ft/Lbs.	Nm	SAE	Cap In	Base Out	inch/metric
34	M24	260	350	8.8	*	*	(4) 1"/24 mm
36	M24	260	350	8.8	*	*	(4) 1"/24 mm
38	M24	260	350	8.8	*	*	(4) 1"/24 mm
40	M24	260	350	8.8	*	*	(4) $1\frac{1}{4}$"/30 mm
44	M24	260	350	8.8	*	*	(4) $1\frac{1}{4}$"/30 mm
48	M30	300	400	8.8	*	*	(4) $1\frac{1}{4}$"/30 mm
52	M30	300	400	8.8	*	*	(4) $1\frac{1}{2}$"/36 mm
56	M30	300	400	8.8	*	*	(4) $1\frac{1}{2}$"/36 mm
60	M30	300	400	8.8	*	*	(4) $1\frac{1}{2}$"/36 mm
64	M30	300	400	8.8	*	*	(4) $1\frac{1}{2}$"/36 mm

Series: SDCD 30, SDCD 30 / MC14
SDCD 0, SDCD0 / MC14

Housing Size	Cap Bolt Information				Lubrication Fitting Hole Detail		Base or Attachment bolts Qty (2) or (4)
	Size Qty. (4)	Recommended Tightening Torque		Grade			
	Inch	Ft/Lbs.	Nm	SAE	Cap In	Base Out	inch/metric
36	$\frac{7}{8}$ - 9	400	550	5	$\frac{1}{4}$NPT	*	1"/24 mm
38	$\frac{7}{8}$ - 9	400	550	5	$\frac{1}{4}$NPT	*	1"/24 mm
40	1 - 8	600	820	5	$\frac{1}{4}$NPT	*	1"/24 mm
44	1 - 8	600	820	5	$\frac{1}{4}$NPT	*	$1\frac{1}{4}$"/30 mm
48	1 - 8	600	820	5	$\frac{1}{4}$NPT	*	$1\frac{1}{4}$"/30 mm
52	$1\frac{1}{4}$ - 7	1100	1500	5	$\frac{1}{4}$NPT	*	$1\frac{1}{4}$"/30 mm
56	$1\frac{1}{4}$ - 7	1100	1500	5	$\frac{1}{4}$NPT	*	$1\frac{1}{4}$"/30 mm
60	$1\frac{1}{4}$ - 7	1100	1500	5	$\frac{1}{4}$NPT	*	$1\frac{1}{2}$"/36 mm
64	$1\frac{1}{4}$ - 7	1100	1500	5	$\frac{1}{4}$NPT	*	$1\frac{1}{2}$"/36 mm
68	$1\frac{1}{4}$ - 7	1100	1500	5	$\frac{1}{4}$NPT	*	$1\frac{1}{2}$"/36 mm
72	$1\frac{1}{4}$ - 7	1100	1500	5	$\frac{1}{2}$NPT	*	$1\frac{1}{2}$"/36 mm
76	$1\frac{1}{4}$ - 7	1100	1500	5	$\frac{1}{2}$NPT	*	$1\frac{1}{2}$"/36 mm
80	$1\frac{1}{2}$ - 6	*	*	5	$\frac{1}{2}$NPT	*	$1\frac{3}{4}$"/45 mm
84	$1\frac{3}{4}$ - 5	*	*	5	$\frac{1}{2}$NPT	*	2"/50 mm
88	$1\frac{3}{4}$ - 5	*	*	5	$\frac{1}{2}$NPT	*	2"/50 mm

Series: SDCD 31, SDCD 31 / MC14 SDHD (sizes 34 and 72 only)
SDCD 1, SDCD1 / MC14

Housing Size	Cap Bolt Information				Lubrication Fitting Hole Detail		Base or Attachment bolts Qty (2) or (4) inch/metric
	Size Qty. (4)	Recommended Tightening Torque		Grade			
	Inch	Ft/Lbs.	Nm	SAE	Cap In	Base Out	
34	$^{7}/_{8}$ - 9	600	820	8	$^{1}/_{4}$NPT	*	1"/24 mm
36	$^{7}/_{8}$ - 9	400	550	5	$^{1}/_{4}$NPT	*	1"/24 mm
38	1 - 8	600	820	5	$^{1}/_{4}$NPT	*	1"/24 mm
40	1 - 8	600	820	5	$^{1}/_{4}$NPT	*	$1^{1}/_{4}$"/30 mm
44	1 - 8	600	820	5	$^{1}/_{4}$NPT	*	$1^{1}/_{4}$"/30 mm
48	$1^{1}/_{4}$ - 7	1100	1500	5	$^{1}/_{4}$NPT	*	$1^{1}/_{4}$"/30 mm
52	$1^{1}/_{4}$ - 7	1100	1500	5	$^{1}/_{4}$NPT	*	$1^{1}/_{2}$"/36 mm
56	$1^{1}/_{4}$ - 7	1100	1500	5	$^{1}/_{4}$NPT	*	$1^{1}/_{2}$"/36 mm
60	$1^{1}/_{4}$ - 7	1100	1500	5	$^{1}/_{4}$NPT	*	$1^{1}/_{2}$"/36 mm
64	$1^{1}/_{4}$ - 7	1100	1500	5	$^{1}/_{2}$NPT	*	$1^{1}/_{2}$"/36 mm
68	$1^{1}/_{2}$ - 6	*	*	5	$^{1}/_{2}$NPT	*	$1^{3}/_{4}$"/45 mm
72	$1^{1}/_{2}$ - 6	*	*	8	$^{1}/_{2}$NPT	*	$1^{3}/_{4}$"/45 mm
76	$1^{3}/_{4}$ - 5	*	*	5	$^{1}/_{2}$NPT	*	2"/50 mm
80	$1^{3}/_{4}$ - 5	*	*	5	$^{1}/_{2}$NPT	*	2"/50 mm
84	$1^{3}/_{4}$ - 5	*	*	5	$^{1}/_{2}$NPT	*	2"/50 mm
88	$1^{3}/_{4}$ - 5	*	*	5	$^{1}/_{2}$NPT	*	2"/50 mm

Series: SDCD 32, SDCD 32 / MC14
SDCD 2, SDCD2 / MC14

Housing Size	Cap Bolt Information				Lubrication Fitting Hole Detail		Base or Attachment bolts Qty (2) or (4) inch/metric
	Size Qty. (4)	Recommended Tightening Torque		Grade			
	Inch	Ft/Lbs.	Nm	SAE	Cap In	Base Out	
34	1 - 8	600	820	5	$^{1}/_{4}$NPT	*	1"/24 mm
36	1 - 8	600	820	5	$^{1}/_{4}$NPT	*	1"/24 mm
38	1 - 8	600	820	5	$^{1}/_{4}$NPT	*	$1^{1}/_{4}$"/30 mm
40	$1^{1}/_{4}$ - 7	600	820	5	$^{1}/_{4}$NPT	*	$1^{1}/_{4}$"/30 mm
44	$1^{1}/_{4}$ - 7	1100	1500	5	$^{1}/_{4}$NPT	*	$1^{1}/_{4}$"/30 mm
48	$1^{1}/_{4}$ - 7	1100	1500	5	$^{1}/_{4}$NPT	*	$1^{1}/_{2}$"/36 mm
52	$1^{1}/_{4}$ - 7	1100	1500	5	$^{1}/_{4}$NPT	*	$1^{1}/_{2}$"/36 mm
56	$1^{1}/_{4}$ - 7	1100	1500	5	$^{1}/_{4}$NPT	*	$1^{1}/_{2}$"/36 mm
60	$1^{1}/_{4}$ - 7	1100	1500	5	$^{1}/_{2}$NPT	*	$1^{1}/_{2}$"/36 mm
64	$1^{1}/_{2}$ - 6	*	*	5	$^{1}/_{2}$NPT	*	$1^{3}/_{4}$"/45 mm
68	$1^{3}/_{4}$ - 5	*	*	5	$^{1}/_{2}$NPT	*	2"/50 mm

Series: **SDAF 500**
SDAF 200

Housing Size	Cap Bolt Information				Lubrication Fitting Hole Detail		Base or Attachment bolts Qty (2) or (4)
	Size Qty. (4)	Recommended Tightening Torque		Grade			
	Inch	Ft/Lbs.	Nm	SAE	Cap In	Base Out	inch/metric
520 220	$^{3}/_{4}$ - 10	175	240	2	$^{1}/_{4}$NPT	$^{1}/_{4}$NPT	(4) $^{3}/_{4}$"/20 mm
522 222	$^{7}/_{8}$ - 9	165	220	2	$^{1}/_{4}$NPT	$^{1}/_{4}$NPT	(4) $^{7}/_{8}$"/24 mm
524 224	$^{7}/_{8}$ - 9	165	220	2	$^{1}/_{4}$NPT	$^{1}/_{4}$NPT	(4) $^{7}/_{8}$"/24 mm
526 226	$^{7}/_{8}$ - 9	165	220	2	$^{1}/_{4}$NPT	$^{3}/_{8}$NPT	(4) 1"/24 mm
530 230	$1^{1}/_{8}$ - 7	350	480	2	$^{1}/_{4}$NPT	$^{3}/_{8}$NPT	(4)$1^{1}/_{8}$"/27 mm
532 232	$1^{1}/_{8}$ - 7	350	480	2	$^{1}/_{4}$NPT	$^{1}/_{2}$NPT	(4)$1^{1}/_{8}$"/27 mm
536 236	$1^{1}/_{4}$ - 7	500	680	2	$^{1}/_{4}$NPT	$^{3}/_{4}$NPT	(4)$1^{1}/_{4}$"/30 mm
538 238	$1^{1}/_{4}$ - 7	500	680	2	$^{1}/_{4}$NPT	$^{3}/_{4}$NPT	(4)$1^{3}/_{8}$"/36 mm
540 240	$1^{1}/_{4}$ - 7	500	680	2	$^{1}/_{4}$NPT	$^{3}/_{4}$NPT	(4)$1^{3}/_{8}$"/36 mm
544 244	$1^{3}/_{8}$ - 6	660	900	2	$^{1}/_{4}$NPT	$^{3}/_{4}$NPT	(4)$1^{1}/_{2}$"/36 mm

Series: **SDAF 600**
SDAF 300
SDAF 0

Housing Size	Cap Bolt Information				Lubrication Fitting Hole Detail		Base or Attachment bolts Qty (2) or (4)
	Size Qty. (4)	Recommended Tightening Torque		Grade			
	Inch	Ft/Lbs.	Nm	SAE	Cap In	Base Out	inch/metric
617 317	$^3/_4$ - 10	175	240	2	$^1/_4$NPT	$^1/_4$NPT	(4) $^3/_4$"/20 mm
618 318	$^3/_4$ - 10	175	240	2	$^1/_4$NPT	$^1/_4$NPT	(4) $^3/_4$"/20 mm
620 320	$^7/_8$ - 9	165	220	2	$^1/_4$NPT	$^1/_4$NPT	(4) $^7/_8$"/24 mm
622 322	$^7/_8$ - 9	165	220	2	$^1/_4$NPT	$^3/_8$NPT	(4) 1"/24 mm
624 324	$1^1/_8$ - 7	350	480	2	$^1/_4$NPT	$^3/_8$NPT	(4)$1^1/_8$"/27 mm
626 326	$1^1/_8$ - 7	350	480	2	$^1/_4$NPT	$^1/_2$NPT	(4)$1^1/_8$"/27 mm
628 328	$1^1/_8$ - 7	350	480	2	$^1/_4$NPT	$^1/_2$NPT	(4)$1^1/_4$"/30 mm
630 330	$1^1/_4$ - 7	500	680	2	$^1/_4$NPT	$^3/_4$NPT	(4)$1^1/_4$"/30 mm
632 332	$1^1/_4$ - 7	500	680	2	$^1/_4$NPT	$^3/_4$NPT	(4)$1^3/_8$"/36 mm
634 334	$1^1/_4$ - 7	500	680	2	$^1/_4$NPT	$^3/_4$NPT	(4)$1^3/_8$"/36 mm
636 336	$1^3/_8$ - 6	660	900	2	$^1/_4$NPT	$^3/_4$NPT	(4)$1^1/_2$"/36 mm
638 338	$1^3/_8$ - 6	660	900	2	$^1/_4$NPT	$^3/_4$NPT	(4)$1^1/_2$"/36 mm
640 340	$1^3/_8$ - 6	660	900	2	$^1/_4$NPT	$^3/_4$NPT	(4)$1^5/_8$"/39 mm
060	$1^3/_8$ - 6	660	900	2	*	*	(4)$1^5/_8$"/39 mm
064	$1^3/_8$ - 6	660	900	2	*	*	(4)$1^5/_8$"/39 mm
068	$1^3/_4$ - 5	1250	1700	2	*	*	(4)$1^7/_8$"/48 mm
072	$1^3/_4$ - 5	1250	1700	2	*	*	(4)$1^7/_8$"/48 mm
076	$1^3/_4$ - 5	1250	1700	2	*	*	(4)$1^7/_8$"/48 mm
080	$1^3/_4$ - 5	1250	1700	2	*	*	(4) 2"/50 mm
084	$1^3/_4$ - 5	1250	1700	2	*	*	(4) 2"/50 mm

LUBRICATION

General

It is necessary to lubricate rolling bearings to prevent metallic contact between rolling elements, raceways and cage.

The most favourable running (operating) conditions for a rolling bearing is obtained when the minimum quantity of lubricant necessary to ensure reliable operation is used.

However, the quantity used also depends on additional functions required of the lubricant, i.e. sealing and cooling.

Lubricating properties deteriorate as a result of aging and mechanical churning. When using labyrinth and taconite seals in severely contaminated environments, it is suggested to shorten the lubrication interval. Also certain operating conditions i.e. high speeds, high temperatures or heavy loads require more frequent lubrication.

The choice of lubricants depends primarily on the temperature range, operating speed and magnitude of the load.

Either oil or grease of proper quality can be considered for lubricating bearings. At low and medium speeds, grease usually permits a simpler method of obtaining reliable and durable lubrication. It requires a simpler sealing system and has an additional advantage of affording excellent protection to bearings against rust and intrusion of contaminates. With high speeds, it becomes necessary to add fresh grease and remove old grease more frequently to obtain safe operation. At some limiting speed, grease must be replaced so often that it becomes impractical. Then oil should be used.

When oil is used, it is advisable to employ an oil reservoir or an adequate supply of oil and effective housing seals so that the oil does not leak out. The level of oil should be about the center of the lowest ball or roller when the bearing is stationary.

Too high an oil level or too large a quantity of grease, usually results in a high operating temperature due to churning of the lubricant.

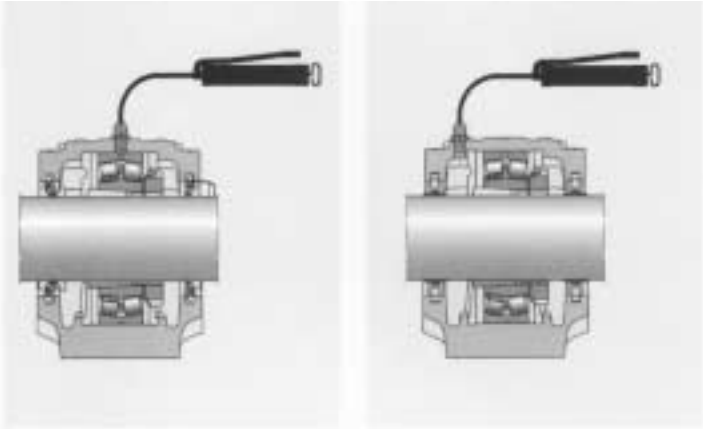
Grease Lubrication

SKF pillow block housings are primarily intended for grease lubrication. In the majority of cases it is sufficient to charge the housings with grease on mounting and to replace this grease periodically, either at specified time interval or when performing inspections.

Pillow block housings caps can be equipped with grease fittings. For spherical roller bearings with W33 or E suffix (groove in outer ring and three lubricating holes spaced at 120°) the center lubricating fitting must be used. For bearing without the E or W33 feature, either of the two side lubrication fitting are used to supply grease. Generally the side opposite the lock nut.

Lubrication through center fitting for W33

Non W33



If grease is used as a lubricant, at installation of bearing the lubricant must be worked in between the rolling elements. The housing should be packed 1/3 full. As a precaution, never mix greases with unlike base oils or incompatible thickeners. It should also be noted that bearings are generally lubricated after mounting. This ensures an accurate clearance measurement, avoids the mess in trying to handle a greasy bearing, and decreases the possibility of additional contamination being introduced into the bearing.

Only where, after mounting, an even distribution of grease in the bearing is not possible should one consider greasing prior to mounting.

Relubrication and Relubrication Intervals

Relubrication Intervals

The period during which a grease lubricated bearing will function satisfactorily without relubrication is dependent on the bearing type, size, operating conditions (load, speed, temperature, environment) and the grease used. The relubrication intervals (hours of operation) obtained from Diagram A are valid for bearings in stationary machines where loading conditions are normal. The diagram is based on the use of an age resistant, quality grease and is valid for bearing temperatures of +70°C. At temperatures over 70°C, the lubricating intervals should be halved for each 15°C rise, but the maximum permissible operating temperature for the grease should obviously not to be exceeded . Conversely, if operating temperatures are lower than 70°C, the intervals can be lengthened to about twice the 70°C values for operating temperatures of 50°C and below. It should be noted however that, relubrication intervals may vary significantly even where apparently similar greases are used.

Contaminated grease results in failures such as premature fatigue, polishing wear, etc. Where there is a risk of the grease becoming contaminated, the relubrication intervals should be reduced. This reduction also applies to applications where the grease is required to seal against moisture (e.g. bearings in paper making machines, where water runs over the bearing housings, relubrication should be done once a week).

The amount of grease

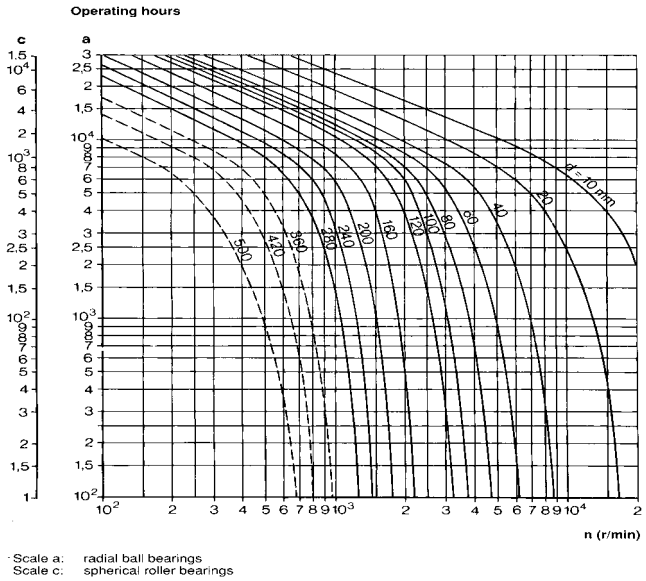
The amount of grease needed for relubrication can be estimated using the following formula:

G = 0,005 D B

where
G = grease quantity, g (for ozs, x 0.0353)
D = bearing outside diameter, mm
B = total bearing width, mm

If the relubrication interval is not specified we suggest at regular plant maintenance shutdown to remove and replace the lubricant. The cap of split housings and the cover of one-piece housing can usually be taken off to expose the bearing. After removing the used grease, fresh grease should be packed between the rolling elements.

If frequent relubrication is required a grease nipple should be fitted to the housing. A grease gun can then be used to ensure that fresh grease actually reaches the bearing and replaces the old grease. After a number of such relubrications, the housing should be opened and the used grease removed before fresh grease is added.



Scale a: radial ball bearings
Scale c: spherical roller bearings

Initial grease charges for split pillow blocks

The approximate intial grease charge (mass) for split pillow blocks is given in these tables. The recommended intial grease charge is one-third to one-half the volume of the free space in the pillow block, and the empty space between rolling elements and cage filled with grease (buttered). This recommendation is for moderate speeds and normal or light bearing loads (C/P>8.3).

Housing size and Series	Grease quantity	
SNL, SSNHD		
	g.	oz.
505	25	0.9
205		
506 - 605	40	1.4
206		
507 - 606	50	1.8
207		
508 - 607	60	2.1
208		
509	65	2.3
510 - 608	75	2.6
210		
511 - 609	100	3.5
211		
512 - 610	150	5.3
212		
513 - 611	180	6.4
213		
515 - 612	230	8.1
215		
516 - 613	280	9.9
216		
517	330	12
217		
518 - 615	430	15
218		
519 - 616	480	17
520 - 617	630	22
522 - 619	850	30
524 - 620	1000	35
526	1100	39
528	1400	49
530	1700	60
532	2000	70

Housing size and Series	Grease quantity	
SAF, SAFS, SAFD		
	g.	oz.
507	70	2.5
509	85	3.0
510	113	4.0
511	142	5.0
513	213	7.5
515	255	9.0
516, 216	369	13.0
517, 217	369	13.0
518, 218	397	14.0
520, 220	595	21.0
522, 222	794	28.0
524, 224	1134	40.0
526, 226	1475	52.0
528, 228	1475	52.0
530, 230	1700	60.0
532, 232	1930	68.0
534, 234	2381	84.0
536, 236	2722	96.0
538, 238	3290	116.0
540, 240	3860	136.0
544, 244	5200	184.0
SDAF		
520	571	20
522	771	27
524	914	32
526	1257	44
530	1371	48
532	1714	60
534	2171	76
536	2514	88
538	2971	104
540	3657	128
544	4800	168

Housing size and Series	Grease quantity	
SAF		
	g.	oz.
308	127	4.5
609, 309	142	5.0
610, 310	184	6.5
611, 311	227	8.0
312	283	10.0
613, 313	369	13.0
314	397	14.0
615, 315	397	14.0
616, 316	453	16.0
617, 317	567	20.0
618, 318	624	22.0
620, 320	1134	40.0
622, 322	1475	52.0
624, 324	1700	60.0
626, 326	1930	68.0
628, 328	2400	84.0
630, 330	2722	96.0
632, 332	3290	116
634, 334	3860	136
638, 338	5200	184
SAF-K		
024 KA	595	21.0
026 KA	794	28.0
028 KA	1134	40.0
030 KA	1475	52.0
032 KA	1475	52.0
034 KA	1475	52.0
036 KA	1930	68.0
038 KA	1930	68.0
040 KA	2381	84.0
044 KA	3290	116.0
048 KA	3860	136.0
052 KA	5200	184.0
056 KA	7000	248.0

Housing size and Series	Grease quantity	
SD 31, SDCD 30, SDCD 31		
	g.	oz.
34	1800	64
36	2200	78
38	2900	103
40	3800	134
44	4400	155
48	5500	194
52	7000	247
56	7400	260
60	10500	370
64	13000	460
68	17500	620
72	18400	650
76	19200	680
80	22200	790
84	29300	1050
88	30000	1070
SDCD 32		
34	2200	78
36	2900	103
38	3800	134
40	4400	155
44	5500	194
48	7000	247
52	7400	260
56	10500	370
60	13000	460
64	17500	620
68	18400	650
72	19200	680
76	22200	790
80	29300	1050
84	30000	1070
88	37000	1300

SKF Grease - Technical Specifications

Designation	Properties								
	Temperature range				Consistency acc. to NLGI	Thickener	Base oil	Base oil viscosity at	
	from		to					40°C	100°C
-	°C	°F	°C	°F	-	-	-	mm²/s	mm²/s
LGMT2	-30	-22	+120	+250	2	Lithium soap	Mineral oil	110	11
LGMT3	-30	-22	+120	+250	3	Lithium soap	Mineral oil	120	12
LGEP2	-30	-22	+110	+230	2	Lithium soap	Mineral oil	190	15
LGEM2	-20	-4	+120	+250	2	Lithium soap	Mineral oil	510	32
LGLT2	-55	-65	+110	+230	2	Lithium soap	Di-ester oil	15	3.7
LGHT3	-30	-22	+150	+300	3	Lithium complex	Mineral oil	110	13
LGWM1	-30	-22	+110	+230	1	Lithium soap	Mineral oil	200	16

With the help of the Table, the right grease can be selected with due consideration to the operating conditions.
For more detailed information on other SKF greases not listed and their recommended application, consult SKF.

Operating requirements	Designation						
	LGMT2	LGMT3	LGEP2	LGEM2	LGLT2	LGHT3	LGWM1
High temperature	xx	xx	xx	x	xx	xxx	
Low temperature	xx	xx	xx		xxx	xx	xxx
High speed	xx	xx	x		xxx	xx	
Low speed and/or vibrations	x	x	xx	xxx		x	xx
Low friction	xx	xx	x		xxx	xx	xx
Heavy load	xx	xx	xxx	xxx		x	xxx
Virations	xxx	xxx	xxx	xxx	x	xxx	
Resistance to water	xxx	xxx	xxx	xx	xxx	xxx	xxx
Rust protection	xx	xx	xxx	xx	x	xx	xxx

no cross = not suitable
x = suitable for normal requirements
xx = suitable for extreme requirements
xxx = very suitable for extreme requirements

Metric Measurement

Bearing bore diameter		Radial internal clearance (unmounted)						Reduction in radial internal clearance		Axial drive-up* Taper 1:12 on diameter		Minimum Permissible residual clearance after mounting bearings with initial clearance		
d		Normal		C3		C4								
over	incl.	min	max	min	max	min	max	min	max	min	max	Normal	C3	C4
mm		mm												
30	40	0.035	0.050	0.050	0.065	0.065	0.085	0.020	0.025	0.35	0.40	0.015	0.025	0.040
41	50	0.045	0.060	0.060	0.080	0.080	0.100	0.025	0.030	0.40	0.45	0.020	0.030	0.050
51	65	0.055	0.075	0.075	0.095	0.095	0.120	0.030	0.040	0.45	0.60	0.025	0.035	0.055
66	80	0.070	0.095	0.095	0.120	0.120	0.150	0.040	0.050	0.60	0.75	0.025	0.040	0.070
81	100	0.080	0.110	0.110	0.140	0.140	0.180	0.045	0.060	0.70	0.90	0.035	0.050	0.080
101	120	0.100	0.135	0.135	0.170	0.170	0.220	0.050	0.070	0.75	1.10	0.050	0.065	0.100
121	140	0.120	0.160	0.160	0.200	0.200	0.260	0.065	0.090	1.10	1.40	0.055	0.080	0.110
141	160	0.130	0.180	0.180	0.230	0.230	0.300	0.075	0.100	1.20	1.60	0.055	0.090	0.130
161	180	0.140	0.200	0.200	0.260	0.260	0.340	0.080	0.110	1.30	1.70	0.060	0.100	0.150
181	200	0.160	0.220	0.220	0.290	0.290	0.370	0.090	0.130	1.40	2.00	0.070	0.100	0.160
201	225	0.180	0.250	0.250	0.320	0.320	0.410	0.100	0.140	1.60	2.20	0.080	0.120	0.180
226	250	0.200	0.270	0.270	0.350	0.350	0.450	0.110	0.150	1.70	2.40	0.090	0.130	0.200
251	280	0.220	0.300	0.300	0.390	0.390	0.490	0.120	0.170	1.90	2.70	0.100	0.140	0.220
281	315	0.240	0.330	0.330	0.430	0.430	0.540	0.130	0.190	2.00	3.00	0.110	0.150	0.240
316	355	0.270	0.360	0.360	0.470	0.470	0.590	0.150	0.210	2.40	3.30	0.120	0.170	0.260
356	400	0.300	0.400	0.400	0.520	0.520	0.650	0.170	0.230	2.60	3.60	0.130	0.190	0.290
401	450	0.330	0.440	0.440	0.570	0.570	0.720	0.200	0.260	3.10	4.00	0.130	0.200	0.310
451	500	0.370	0.490	0.490	0.630	0.630	0.790	0.210	0.280	3.30	4.40	0.160	0.230	0.350
501	560	0.410	0.540	0.540	0.680	0.680	0.870	0.240	0.320	3.70	5.00	0.170	0.250	0.360
561	630	0.460	0.600	0.600	0.760	0.760	0.980	0.260	0.350	4.00	5.40	0.200	0.290	0.410
631	710	0.510	0.670	0.670	0.850	0.850	1.090	0.300	0.400	4.60	6.20	0.210	0.310	0.450
711	800	0.570	0.750	0.750	0.960	0.960	1.220	0.340	0.450	5.30	7.00	0.230	0.350	0.510
801	900	0.640	0.840	0.840	1.070	1.070	1.370	0.370	0.500	5.70	7.80	0.270	0.390	0.570
901	1000	0.710	0.930	0.930	1.190	1.190	1.520	0.410	0.550	6.30	8.50	0.300	0.430	0.640

Inch Measurement

Bearing bore diameter		Radial internal clearance (unmounted)						Reduction in radial internal clearance		Axial drive-up* Taper 1:12 on diameter		Minimum Permissible residual clearance after mounting bearings with initial clearance		
d		Normal		C3		C4								
over	incl.	min	max	min	max	min	max	min	max	min	max	Normal	C3	C4
mm		inches												
30	40	0.0014	0.0020	0.0020	0.0026	0.0026	0.0033	0.0008	0.0010	0.014	0.016	0.0006	0.0010	0.0016
41	50	0.0018	0.0024	0.0024	0.0031	0.0031	0.0039	0.0010	0.0012	0.016	0.018	0.0008	0.0012	0.0020
51	65	0.0022	0.0030	0.0030	0.0037	0.0037	0.0047	0.0012	0.0016	0.018	0.024	0.0010	0.0014	0.0022
66	80	0.0028	0.0037	0.0037	0.0047	0.0047	0.0059	0.0016	0.0020	0.024	0.030	0.0010	0.0016	0.0028
81	100	0.0031	0.0043	0.0043	0.0055	0.0055	0.0071	0.0018	0.0024	0.028	0.035	0.0014	0.0020	0.0031
101	120	0.0039	0.0053	0.0053	0.0067	0.0067	0.0087	0.0020	0.0028	0.030	0.043	0.0020	0.0026	0.0039
121	140	0.0047	0.0063	0.0063	0.0079	0.0079	0.0102	0.0026	0.0035	0.043	0.055	0.0022	0.0031	0.0043
141	160	0.0051	0.0071	0.0071	0.0091	0.0091	0.0118	0.0030	0.0039	0.047	0.063	0.0022	0.0035	0.0051
161	180	0.0055	0.0079	0.0079	0.0102	0.0102	0.0134	0.0031	0.0043	0.051	0.067	0.0024	0.0039	0.0059
181	200	0.0063	0.0087	0.0087	0.0114	0.0114	0.0146	0.0035	0.0051	0.055	0.079	0.0028	0.0039	0.0063
201	225	0.0071	0.0098	0.0098	0.0126	0.0126	0.0161	0.0039	0.0055	0.063	0.087	0.0031	0.0047	0.0071
226	250	0.0079	0.0106	0.0106	0.0138	0.0138	0.0177	0.0043	0.0059	0.067	0.094	0.0035	0.0051	0.0079
251	280	0.0087	0.0118	0.0118	0.0154	0.0154	0.0193	0.0047	0.0067	0.075	0.106	0.0039	0.0055	0.0087
281	315	0.0094	0.0130	0.0130	0.0169	0.0169	0.0213	0.0051	0.0075	0.079	0.118	0.0043	0.0059	0.0094
316	355	0.0106	0.0142	0.0142	0.0185	0.0185	0.0232	0.0059	0.0083	0.094	0.130	0.0047	0.0067	0.0102
356	400	0.0118	0.0157	0.0157	0.0205	0.0205	0.0256	0.0067	0.0091	0.102	0.142	0.0051	0.0075	0.0114
401	450	0.0130	0.0173	0.0173	0.0224	0.0224	0.0283	0.0079	0.0102	0.122	0.157	0.0051	0.0079	0.0122
451	500	0.0146	0.0193	0.0193	0.0248	0.0248	0.0311	0.0083	0.0110	0.130	0.173	0.0063	0.0091	0.0138
501	560	0.0161	0.0213	0.0213	0.0268	0.0268	0.0343	0.0094	0.0126	0.146	0.197	0.0067	0.0098	0.0142
561	630	0.0181	0.0236	0.0236	0.0299	0.0299	0.0386	0.0102	0.0138	0.157	0.213	0.0079	0.0114	0.0161
631	710	0.0201	0.0264	0.0264	0.0335	0.0335	0.0429	0.0118	0.0157	0.181	0.244	0.0083	0.0122	0.0177
711	800	0.0224	0.0295	0.0295	0.0378	0.0378	0.0480	0.0134	0.0177	0.209	0.276	0.0091	0.0138	0.0201
801	900	0.0252	0.0331	0.0331	0.0421	0.0421	0.0539	0.0146	0.0197	0.224	0.307	0.0106	0.0154	0.0224
901	1000	0.0280	0.0366	0.0366	0.0469	0.0469	0.0598	0.0161	0.0217	0.248	0.335	0.0118	0.0169	0.0252

1. * Valid for solid steel shafts only.

Shaft tolerances and fits

Shaft tolerance limites for adapter mounting

Nominal Shaft diameter		Diameter tolerances		Max permissible taper and ovality
over	incl.	max	min	on radius
in.				
0.3940	0.7090	+.000	-.0017	.00015
0.7090	1.1810	+.000	-.0020	.00020
1.1810	1.9690	+.000	-.0024	.00020
1.9690	3.1500	+.000	-.0029	.00025
3.1500	4.7240	+.000	-.0034	.00030
4.7240	7.0870	+.000	-.0039	.00035
7.0870	9.8430	+.000	-.0045	.00040
9.8430	12.402	+.000	-.0051	.00045
12.402	15.748	+.000	-.0055	.00050
15.748	19.685	+.000	-.0061	.00055

Nominal Shaft diameter		Diameter tolerances		Max. permissible taper and ovality
over	incl.	max	min	
mm		µm (.001 mm)		
10	18	+0	-43	4.0
18	30	+0	-52	4.5
30	50	+0	-62	5.5
50	80	+0	-74	6.5
80	120	+0	-87	7.5
120	180	+0	-100	9.0
180	250	+0	-115	10.0
250	315	+0	-130	11.5
315	400	+0	-140	12.5
400	500	+0	-155	13.5

Shaft tolerances for spherical roller bearings with cylindrical bore

Brg. Size	Inches		ISO Fit	Millimeters	
	Max.	Min.		Max.	Min
07	1.3785	1.3780	l5	35.013	35.002
08	1.5753	1.5749	lk5	40.013	40.002
09	1.7724	1.7720	k6	45.020	45.009
10	1.9693	1.9689	m5	50.020	50.009
11	2.1663	2.1658	m5	55.024	55.011
12	2.3631	2.3626	m5	60.024	60.011
13	2.5600	2.5595	m5	65.024	65.011
14	2.7571	2.7563	m6	70.030	70.011
15	2.9539	2.9532	m6	75.030	75.011
16	3.1508	3.1500	m6	80.030	80.011
17	3.3478	3.3470	m6	85.035	85.013
18	3.5447	3.5438	m6	90.035	90.013
19	3.7415	3.7407	m6	95.035	95.013
20	3.9384	3.9375	m6	100.035	100.013
22	4.3325	4.3316	n6	110.045	110.023
24	4.7262	4.7253	n6	120.045	120.023
26	5.1201	5.1192	n6	130.052	130.027
28	5.5138	5.5129	n6	140.052	140.027
30	5.9082	5.9072	p6	150.068	150.043
32	6.3019	6.3009	p6	160.068	160.043
34	6.6956	6.6946	p6	170.068	170.043
36	7.0893	7.0883	p6	180.068	180.043
38	7.4834	7.4823	p6	190.079	190.050
40	7.8771	7.8760	p6	200.079	200.050
44	8.6645	8.6634	p6	220.079	220.050
48	9.4519	9.4508	p6	240.079	240.050
52	10.2397	10.2384	p6	260.088	260.056
56	11.0271	11.0258	p6	280.088	280.056
60	11.8161	11.8149	r6	300.130	300.098
64	12.6041	12.6027	r6	320.144	320.108
68	13.3915	13.3901	r6	340.144	340.108
72	14.1791	14.1777	r6	360.150	360.114
76	14.9665	14.9651	r6	380.150	380.114
80	15.7539	15.7525	r6	400.150	400.114
84	16.5419	16.5404	r6	420.166	420.126
88	17.3293	17.3278	r6	440.166	440.126

Shaft tolerances for self aligning ball bearings with cylindrical bore

Brg. Size	Inches		ISO Fit	Millimeters	
	Max.	Min.		Max.	Min
05	0.9847	.9843	k5	25.011	25.002
06	1.1815	1.1812	k5	30.011	30.002
07	1.3785	1.3780	k5	35.013	35.002
08	1.5753	1.5749	k5	40.013	40.002
09	1.7722	1.7717	k5	45.013	45.002
10	1.9690	1.9686	k5	50.013	50.002
11	2.1659	2.1654	k5	55.015	55.002
12	2.3628	2.3623	k5	60.015	60.002
13	2.5596	2.5591	k5	65.015	65.002
14	2.7565	2.7560	k5	70.015	70.002
15	2.9533	2.9528	-	75.015	75.002
16	3.1502	3.1497	k5	80.015	80.002
17	3.3472	3.3466	k5	85.018	85.003
18	3.5440	3.5434	k5	90.018	90.003
19	3.7409	3.7403	k5	95.018	95.003
20	3.9377	3.9371	k5	100.018	100.003
22	4.3318	4.3312	m5	110.028	110.013

AUTOMATIC LUBRICATION, WHERE YOU WANT IT, 24 HOURS A DAY, 7 DAYS A WEEK.

Any bearing deprived of correct lubrication will fail well within its predicted lifespan. With that fundamental engineering principle in mind, SKF, the world's largest bearing manufacturer, has introduced SKF SYSTEM 24, a new generation of automatic lubricators that bridge the conflicting interests of commercial need and environmental pressures.

Mounted in seconds, SKF SYSTEM 24 provides constant lubrication at a predetermined rate to minimize downtime and reduce the costs of expensive manual maintenance procedures.

A range of advanced lubrication products is available such as LAGD 125/WA2, a grease for general purposes, wide temperature applications (has EP additives); LAGD 125/LG202 grease and LAGD 125/HFP 120 oil, both non-toxic, non-staining, food compatible products.

Practical benefits

SKF SYSTEM 24 sets new standards in lubrication management and efficiency:

- **Reliability - allowing fit and forget procedures until predetermined replacement time.**
- **Transparent container to check lubricant levels**
- **High capacity, compact size permits installation in restricted areas.**
- **Dispense rate setting is a simple part of the installation process.**
- **Can be temporarily deactivated**
- **Reduced inventory cost as one lubricator covers all time settings.**
- **Hermetic sealing prevents ingress of dirt or foreign matter.**
- **No harmful chemicals to generate the drive gas.**
- **Lubricator time set dial allows easy and accurate adjustment of lubrication flow**
- **Transparent container allows visual checking of dispense rate**
- **Cartridge neck screws into lubrication point or accessories**
- **Special piston shape ensures optimum emptying of lubricator**

TECHNICAL DATA

Grease capacity	125 ml, (4.25fl oz. US)
Nominal emptying time	Adjustable; 1 - 12 months
Ambient temperature range	-20° to +55°C (-5° to +130°F)
Maximum operating pressure	4 bar (60 psi)
Drive mechanism	Gas cell producing hydrogen gas (H_2)
Connection thread	1/4" BSP
Recommended storage temperature	+20°C (+70°F)
Storage life of lubricator	2 years
Gas cell life	3 year
Weight	Approx 190g (6.7 oz) lubricant included

For additional Maintenance Products Tooling, Heaters and Lubricants contact you local SKF sales office or www.skf.ca

SKF Shaft Alignment Tool TMEA 1

Simplified alignment of rotating machinery

Approximately 50% of breakdowns in rotating machinery are caused by misalignment of the shafts. Poor machine alignment generates additional loads and vibration, causing premature damage to bearings, seals and couplings. It also significantly increases the energy consumption.

Using only four buttons and the well proven laser alignment techniques, the SKF Shaft Alignment Tool TMEA 1, makes accurate machine alignment operation simpler and quicker than with traditional methods and equipment. The TMEA 1 is supplied in a sturdy portable carrying case equipped with all the necessary accessories.

High accuracy but simple to operate

The TMEA 1 alignment tool uses two measuring units, both provided with a laser diode and a positioning detector. After attaching the measuring units to the shafts the on-screen instructions guide you simply through the alignment prcedure. The machine can then be correctly positioned according to the calculated live values provided on the display.

SKF precut machinery shims are a timesaving accessory to any rotating machine alignment job.

Good alignment means:

- **Reduced maintenance costs**
- **Longer bearing, seal and coupling life**
- **Less vibration and noise**
- **Less energy consumption**
- **Fewer unplanned stops**

User-friendly tool:

- **Only four buttons to operate**
- **Spirit levels integrated in the unit**
- **On-screen instructions**
- **Displays live results**
- **Easy attachment of measuring units**
- **Basic set of shims included**
- **Weight only 4,5 kg**
- **Sturdy portable carrying case**

For additional Maintenance Products Tooling, Heaters and Lubricants contact you local SKF sales office or www.skf.ca

SKF's Belt Alignment Tool TMEB1

Laser technology combines precise accuracy with simple operation

Accurate pulley alignment ensuring well-aligned belts is the key to Trouble-Free Operation of your belt driven equipment. BeltAlign, SKF's belt alignment tool, is the most precise alignment tool for V-belt pulleys available. Its advanced lightweight design coupled with cutting-edge technology makes it an ideal solution to enhance performance and reduce down time of your machinery. With only two components, BeltAlign is fast and easy to attach, and requires no training to operate.

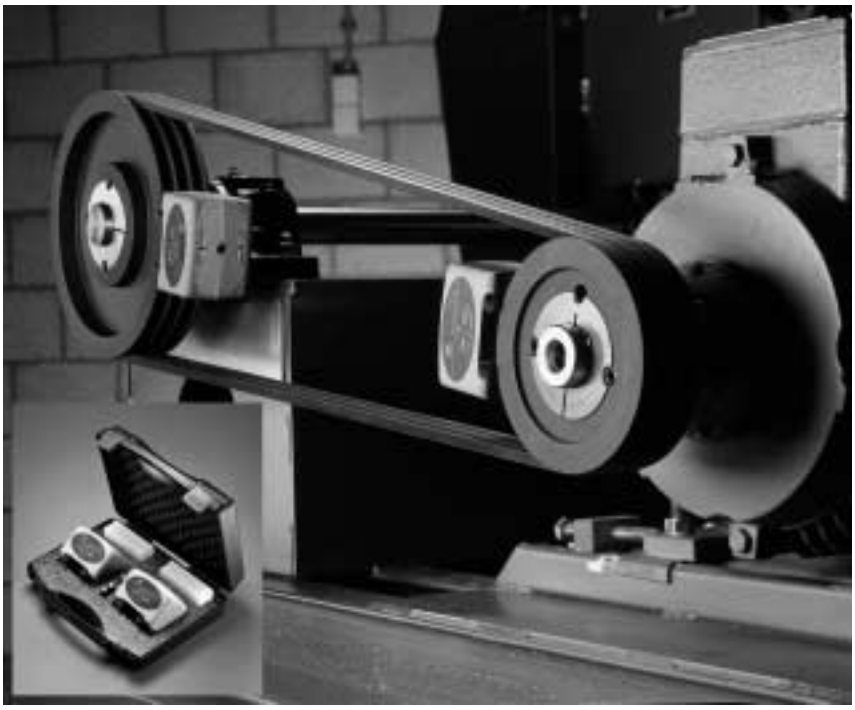
SKF BeltAlign attaches simply and securely to the pulley; two V-guides grip the groove while bar magnets hold the unit firmly in place.

Accurate alignment means:

- **Less wear on belt and pulley**
- **Less friction and therefore lower energy consumption**
- **Less vibration and noise**
- **Increased safety-prevents belt turnover in the pulley**
- **Increased up time**
- **Lower costs**

Advantages:

- **User-friendly tool**
- **Fast and easy to attach, easy to use**
- **Aligns grooves of the pulley rather than its face, allowing for alignment of pulleys of unequal width or with dissimilar faces even fits applications where pulley face cannot be used as a reference**
- **No trial and error. The laser position indicates the nature of misalignment allowing easy, accurate adjustment**
- **Facilitates simultaneous adjustment of tension and alignment**
- **V-guides allow for alignment of a wide range of V-belt pulleys**
- **The unique dual laser eliminates need for mirrors or reflectors, minimising diffusion of the beam over longer distances.**
- **Long (6 m) operating distance**
- **Only two components**
- **Lightweight**



For additional Maintenance Products Tooling, Heaters and Lubricants contact you local SKF sales office or www.skf.ca

TIH 015 Heater

Quality heater from SKF that does what heaters should do. And at a very competitive price!

SKF Bearing heaters are powerful, safe and have excellent long-term reliability.

SKF induction heater TIH 015 is made for heating bearings and other annular metal components up to approximately 40 lbs (20 kg), reaching a maximum temperature of approximately 600°F (300°C), depending on weight, geometry and material of the workpiece.

Induction heating

An induction heater is similar to a transformer, using the principle of a primary coil with a large number of windings and a secondary coil with a few windings on a mutual iron core. When heated by an SKF induction heater, the bearing becomes the short circuited, single turn secondary coil through which a high current flows at a low voltage, generating heat. The heater itself, as well as the yoke, remain at ambient temperature.

The SKF TIH 015 heater

The induction heater has a glass-fiber, reinforced housing in which a coil on a U-shaped iron core is mounted together with the START/STOP button. The heater is supplied with two top yokes suitable for bore diameters from 0.8 inch (20 mm) and 1.6 inch (40 mm). Every TIH 015 heater is provided with a 2 meter cable and a standard plug with a round grounding pin. Please note that the SKF TIH 015 is not equipped with automatic demagnetization, which instead must be done manually.

Safety feature

The TIH 015 is equipped with automatic overheating protection. With every heater, a free pair of heat resistant gloves is included.

This quality SKF heater comes with a 3 year warranty for long term reliability.

For additional Maintenance Products Tooling, Heaters and Lubricants contact you local SKF sales office or www.skf.ca

SKF New Puller Series: EasyPull TMMA

Safe and simple dismounting of bearings

Equipped with spring operated arms and safety pin, SKF's new patent-pending EasyPull is one of the most user-friendly and safe tools on the market today. Ergonomically designed, the spring-operated arms enable the user to position the puller behind the component with just one movement of the hand. Costs resulting from exchange of expensive spare parts are avoided with the EasyPull's unique safety pin which breaks instead of the pull itself, should excessive force be used. Additionally, hazardous slipping of the puller claws is avoided due to the special locking mechanism which ensures a tighter grip of the components as the pulling force increases.

EasyPull dismounts the most difficult bearings

Dismounting a bearing can be a demanding task for both user and puller. The new EasyPull, with its uniquely designed opening mechanism and safety pin, makes dismounting easy. Simply open the arms of the EasyPull by pressing the red rings together, place the EasyPull behind the component with one movement of your hand and pull either manually or with one of SKF's hydraulic tools. It's as easy as that.

• User-friendly:

- **Extremely user-friendly due to spring operated and self-locking arms, gripping behind the component with just one movement of the hand**
- **Ergonomic red-rings**
- **Available in three sizes with a maximum withdrawal force of 3, 5 or 8 tonnes (30, 50 or 80kN), enabling easy selection**
- **Hydraulic force generators available for the 8 tonne (80kN) EasyPull**
- **Light-weight**

• Safe:

- **Safety pin minimises any injury to the user and prevents damage to puller arms, rings and spindle**
- **Self-locking: Arms prevent risk of slipping of puller under load**

• Cost-saving:

- **No need to buy expensive spare-parts; a unique safety pin breaks should excessive force be used**
- **Service life of puller extended by safety pin**
- **Self-centering avoids damage to shaft**
- **Efficient use of time due to quick dismounting**

For additional Maintenance Products Tooling, Heaters and Lubricants contact you local SKF sales office or www.skf.ca

Bearing Working Conditions	Grease Selector Key ★ Recommended ○ Suitable × Not Suitable												
	LGMT 2	LGMT 3	LGEP 2	LGWM 1	LGHB 2	LGEM 2	LGEV 2	LGLT 2	LGLC 2	LGHQ 3	LGWA 2	LGFP 2	LGGB 2
High temperature above 120°C					★					★	★		
Low temperature				★				★	★				★
Very high speed	○	○	○		★	×	×	★	★		○		○
Very low speed and/or oscillating movements			○	○	★	★	★	×	×				
Low torque and friction requirements	★	○		○		×	×	★	★	○	○	○	
Vibration			★	×	○	★	★			○		○	
Heavy load	○	○	★	★	★	★	★	×	○	○	★	○	○
Rust inhibiting properties	○	○	★	★	★	○	★	○	★	○	★	★	×
Water resistance	○	○	★	★	★	○	★	★	★	○	★	★	×

Technical Specifications

Grease Type	Description	Temperature Range	Thickener/ Base Oil	Base Oil Viscosity (*1)	Available Pack Sizes
LGMT 2	All purpose Industrial and Automotive	-30°/+120°C -22°/+250°F	Lithium soap/ mineral oil	110	35-200g tube, 420 ml cartridge, 1-5-18-50-180 kg
LGMT 3	All purpose Industrial and Automotive	-30°/+120°C -22°/+250°F	Lithium soap/ mineral oil	120-130	420ml cartridge, 1-5-18-50-180kg
LGEP 2	Extreme pressure	-20°/+110°C -4°/+230°F	Lithium soap/ mineral oil	200	420 ml cartridge, 1-5-18-50-180 kg
LGWM 1	Extreme pressure low temperature	-30°/+110°C -22°/+230°F	Lithium soap/ mineral oil	200	420 ml cartridge, 5-50-180 kg
LGHB 2	EP high viscosity high temperature (*4)	-20°/+150°C -4°/+300°F	Complex calcium sulphonate/mineral oil	400-450	420ml cartridge, 1-5-18-50-180 kg SYSTEM 24
LGEM 2	High viscosity plus solid lubricants	-20°/+120°C -4°/+250°F	Lithium soap/ mineral oil	500	420ml cartridge, 5-18-180kg SYSTEM 24

Grease Type	Description	Temperature Range	Thickener/ Base Oil	Base Oil Viscosity (*1)	Available Pack Sizes
LGEV 2	Extremely high viscosity with solid lubricants	-10°/+120°C -14°/+250°F	Lithium-calcium soap/ mineral oil	1,020	35g tube, 5-18-50-180kg
LGLT 2	Low temperature	-55°/+110°C -65°/+230°F	Lithium soap/ di-ester oil	15	200g tube, 1-80kg
LGLC 2	Low temperature high speed	-40°/+120°C -40°/+250°F	Calcium complex soap/ ester-mineral oil	24	200g tube, 1-180kg
LGHQ 3	High temperature	-20°/+150°C -4°/+300°F	Lithium complex soap/ mineral oil	110	420ml cartridge, 1-5-18-50-180 kg
LGWA 2	Wide temperature (*3)	-30°/+140°C -22°/+284°F	Lithium complex soap/ mineral oil	185	35-200g tube, 420ml cartridge, 1-5-18-50-180 kg SYSTEM 24
LGFP 2	Food compatible	-20°/+110°C -4°/+230°F	Aluminum complex/ medical white oil	130	420ml cartridge, 5-18-180kg SYSTEM 24
LGGB 2	"Green" biodegradable low toxicity	-40°/+120°C (*2) -40°/+250°F	Lithium-calcium soap/ synthetic ester oil	110	420 ml cartridge, 18-180kg SYSTEM 24

(*1) mm^2 at 40°C/104°F=cSt.
(*2) For continuous operation: max. temperatures 90°C/194°F
(*3) LGWA 2 can withstand peak temperatures 90°C/194°F
(*4) LGHB 2 can withstand peak temperatures of 200°C/392°F

Powerful Electronic information tools from SKF
SKF Interactive Engineering Catalogue

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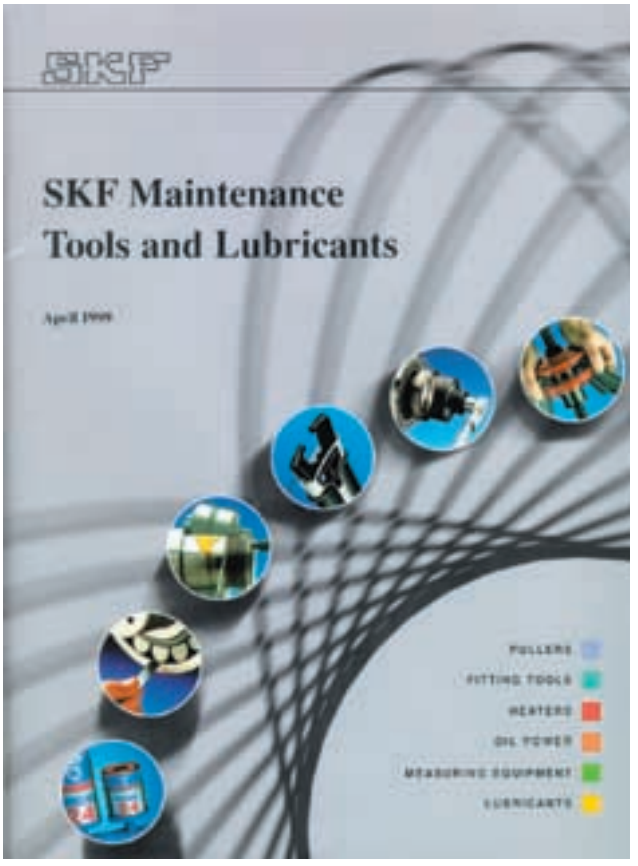
Maintenance Tools and Lubricants Catalogue (MP201)



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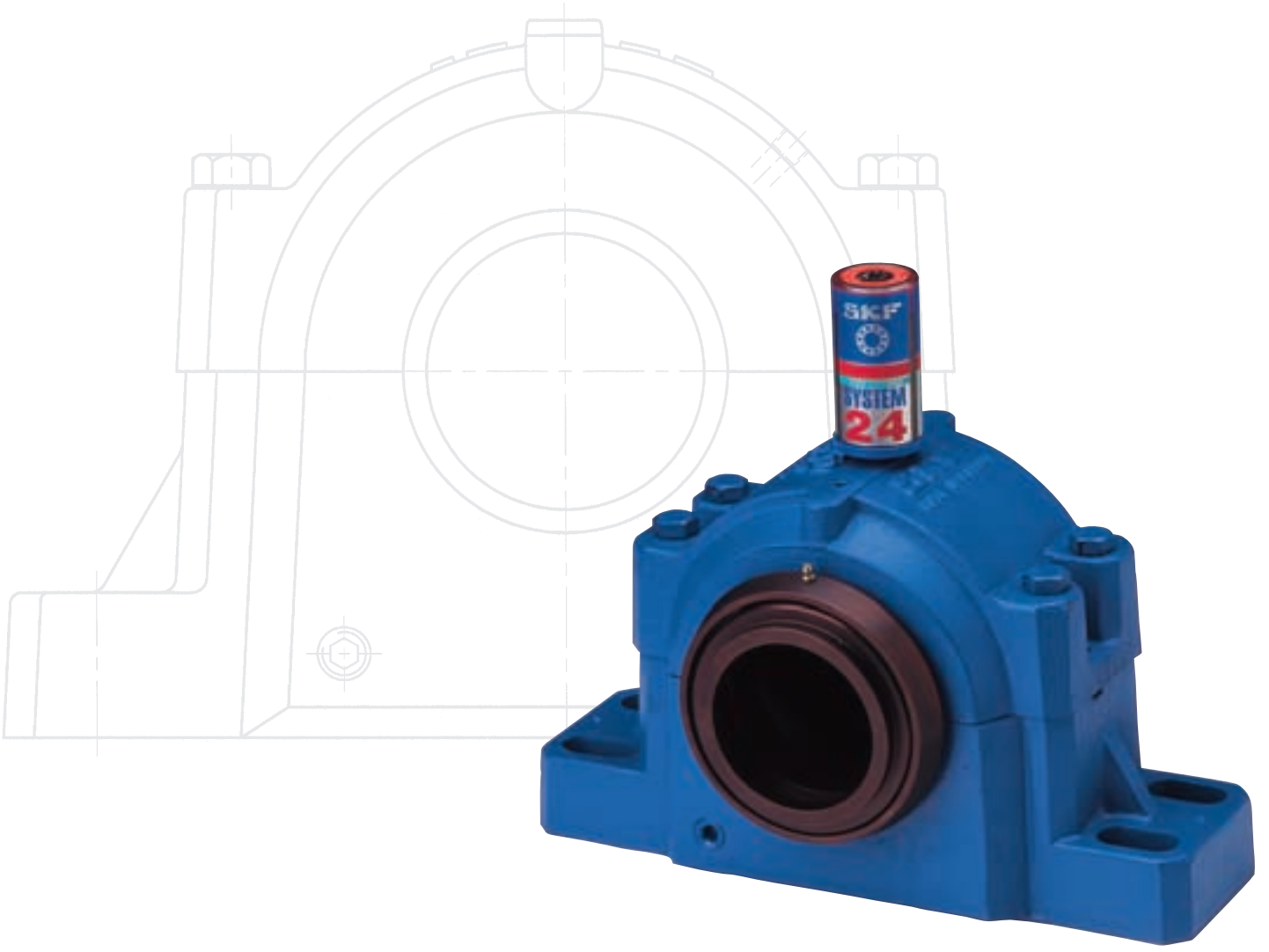

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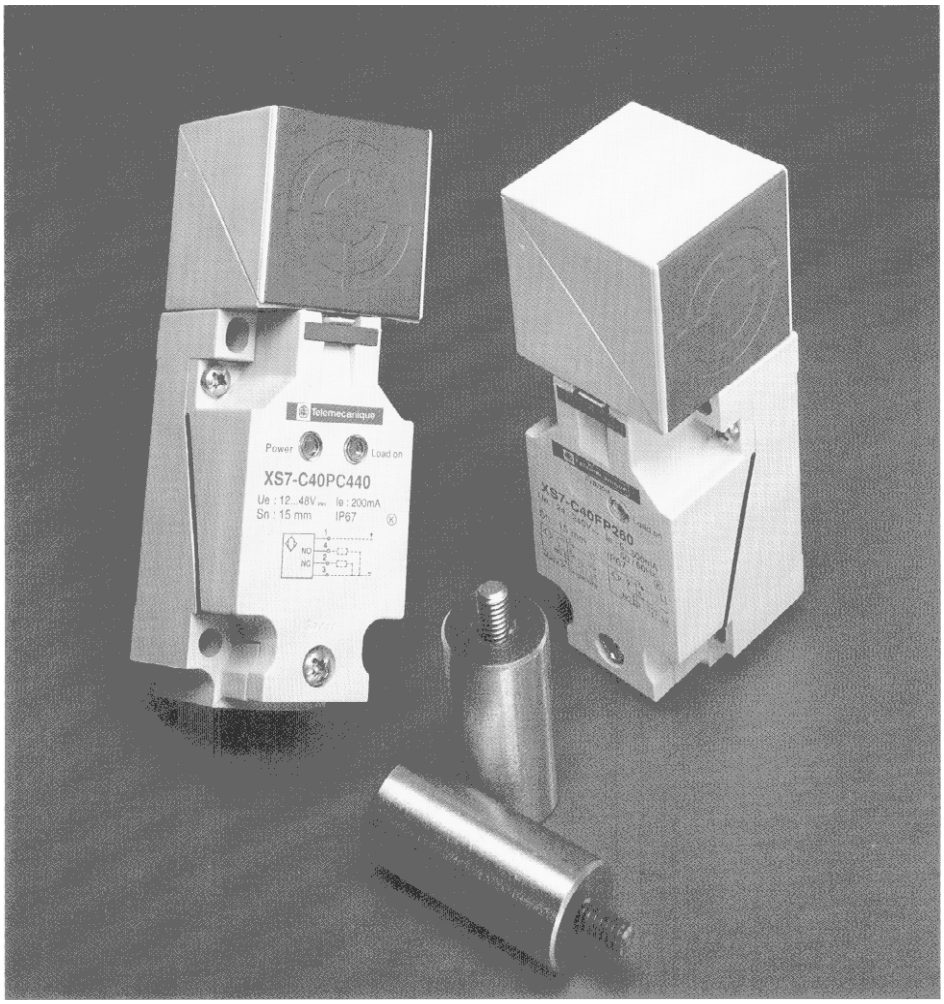
File 9006

XS7, XS8
Plastic Plug-in Limit Switch Style



The XS7/XS8 Limit Switch Style Proximity Sensor offers maximum flexibility and outstanding environmental protection with many universal features or just enough for the OEM.

- PBT plastic body with stainless steel screws for harsh environments, i.e. food processing
- Plug-in design for ease of replacement
- "Universal" 5 position turret head for reduced inventory
- Standard 1/2" NPT conduit entrance with many wiring and connecting options
- PLC compatible
- Led system on selected models indicates ON/OFF and POWER ON
- Available in a wide range of voltages
  - — 10-58 VDC two wire N.O. or N.C. selectable
  - — 10-58 VDC PNP N.O. and N.C. *or*
  - — NPN N.O. and N.C.
  - — 20-264 VAC two wire N.O. or N.C.
  - — selectable
  - — 10-38 VDC NPN N.O. or PNP N.0.
  - — 20-264 VAC N.O. or N.C. selectable
- Features:
  - — Radio frequency immunity (RFI) standard
  - — DC versions work with unfiltered power supply
  - — Noise and transient protection
  - — Reverse polarity protection (DC models)

XS7 and X38 sensors can be used in a wide variety of applications, including:

- –Machine Tool
- –Printing
- –Food Processing
- –Assembly
- –Packaging

SQUARE D
GROUPE SCHNEIDER

Selection

Circuit type	Output mode	Voltage range	Max load current	Residual (leakage) current	Operating frequency	LED/SCP	Catalog number	Price
15mm (.59") sensing range, shielded								
DC models, screw terminals								
2 wire	NO	10-58V	100mA	0.6mA	150Hz	Yes/No	**XS7C40DA210**	$79.00
2 wire	NO/NC	10-58V	100mA	0.6mA	150Hz	Yes/No	**XS7C40DP210**	83.00
PNP	NO	10-38V	200mA	-	250Hz	Yes/No	**XS7C40PA340**	75.00
NPN	NO	10-38V	200mA	-	250Hz	Yes/No	**XS7C40NA340**	75.00
PNP	NC+NC	10-58V	200mA	-	250Hz	2/Yes	**XS7C40PC440**	80.00
NPN	NO+NC	10-58V	200mA	-	250Hz	2/Yes	**XS7C40NC440**	80.00
AC models, screw terminals								
2 wire	NO/NC	20-264V	500mA	1.5mA	25Hz	Yes/No	**XS7C40FP260**	99.00
20mm (.79") sensing range, Un-shielded								
DC models, screw terminals								
2 wire	NO	10-58V	100mA	0.6mA	150Hz	Yes/No	**XS8C40DA210**	79.00
2 wire	NO/NC	10-58V	100mA	0.6mA	150Hz	Yes/No	**XS8C40DP210**	83.00
PNP	NO	10-38V	200mA	-	250Hz	Yes/No	**XS8C40PA340**	75.00
NPN	NO	10-38V	200mA	-	250Hz	Yes/No	**XS8C40NA340**	75.00
PNP	NO+NC	10-58V	200mA	-	250Hz	2/Yes	**XS8C40PC440**	80.00
NPN	NO+NC	10-58V	200mA	-	250Hz	2/Yes	**XS8C40NC440**	80.00
AC models, screw terminals								
2 wire	NO/NC	20-264V	500mA	1.5mA	25Hz	Yes/No	**XS8C40FP260**	99.00

Options

	Description	Suffix	Price adder
Extended temperature range	+185 F (+85C)	**TT**	$13.00
Extended temperature range	-40 F (-40C)	**TF**	13.00
3 pin mini style connector	Normally open	**R30**	27.00
3 pin mini style connector	Normaly closed	**R31**	27.00
5 pin mini style connector		**R5**	42.00
3 pin micro stye connector	AC only, wired Normally open	**K30**	27.00
3 pin micro style connector	AC only, wired Normally closed	**K31**	27.00

Class 9006
XS7, XS8
Plastic Plug-in Limit Switch Style

New Additions

- AC/DC "Universal" 2 wire extended voltage range for replacement applications
- Extended range DC in the same enclosure
- 2 Wire DC, shielded

Shielded

Circuit type	Output mode	Voltage range	Max load current	Residual (leakage) current	Operating frequency	LED/SCP	Catalog number	Price
15mm (.59") sensing range (1), **"Universal" AC/DC**								
2 wire	NO+NC	20-264VAC/DC	0.5/0.2A (4)	1.5mA ☆	25/50Hz	Yes/No	**XS7C40MP230**	149.00
20mm (.79") sensing range (2), **"Extended Range" DC**, 3 wire								
PNP	NO+NC	10-58V	200mA	-	250Hz	2/Yes	**XS7C40PC449**	109.00
NPN	NO+NC	10-58V	200mA	-	250Hz	2/Yes	**XS7C40NC449**	109.00
15mm (.59") sensing range (1), **DC**, 3 wire								
2 wire	NO+NC	10-58VAC/DC	100mA	0.7mA	150Hz	Yes/Yes	**XS7C40DP9B3**	97.00

Non-shielded

20mm (.79") sensing range (2), **"Universal" AC/DC**								
2 wire	NO+NC	20-264VAC/DC	0.5/0.2A (4)	1.5mA ☆	25/50Hz	Yes/No	**XS8C40MP230**	149.00
40mm (1.6") sensing range (3), **"Extended Range" DC**, 3 wire								
PNP	NO+NC	10-58VDC	200mA	-	150Hz	2/Yes	**XS8C40PC449**	113.00
NPN	NO+NC	10-58VDC	200mA	-	150Hz	2/Yes	**XS8C40NC449**	113.00

☆ 1.5 mA @ 120 VAC, 0.8 mA @ 24 VDC – PLC compatible
(1) Useable sensing range 0-12mm (0.47")
(2) Useable sensing range 0-16mm (0.63")
(3) Useable sensing range 0-32mm (1.26")
(4) AC/DC values

This document for use with Bulletin No. 9006HO9403.

SQUARE D
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Corrections to bulletin number 9006HO9403

Below is the corrected selection table shown on page 2 of the handout entitled *XS7, XS8 Plastic Plug-in Limit Switch Style* (attached). Please note that the following catalog numbers are no longer available and have been deleted: **XS7C40PA340, XS7C40NA340, XS8C40PA340, XS8C40NA340.**

If you have any questions, contact your local Square D field sales office.

Circuit type	Output mode	Voltage range	Max load current	Residual (leakage) current	Operating frequency	LED/SCP	Catalog number	Price
15mm (.59") sensing range, shielded								
DC models, screw terminals								
2 wire	NO	10-58V	100mA	0.6mA	150Hz	Yes/No	**XS7C40DA210**	$79.00
2 wire	NO+NC	10-58V	100mA	0.6mA	150Hz	Yes/No	**XS7C40DP210**	83.00
PNP	NC+NC	10-58V	200mA	-	250Hz	2/Yes	**XS7C40PC440**	80.00
NPN	NO+NC	10-58V	200mA	-	250Hz	2/Yes	**XS7C40NC440**	80.00
AC models, screw terminals								
2 wire	NO+NC	20-264V	500mA	1.5mA	25Hz	Yes/No	**XS7C40FP260**	129.00
20mm (.79") sensing range, Non-shielded								
DC models, screw terminals								
2 wire	NO	10-58V	100mA	0.6mA	150Hz	Yes/No	**XS8C40DA210**	79.00
2 wire	NO+NC	10-58V	100mA	0.6mA	150Hz	Yes/No	**XS8C40DP210**	83.00
PNP	NO+NC	10-58V	200mA	-	250Hz	2/Yes	**XS8C40PC440**	80.00
NPN	NO+NC	10-58V	200mA	-	250Hz	2/Yes	**XS8C40NC440**	80.00
AC models, screw terminals								
2 wire	NO+NC	20-264V	500mA	1.5mA	25Hz	Yes/No	**XS8C40FP260**	129.00

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September, 1995
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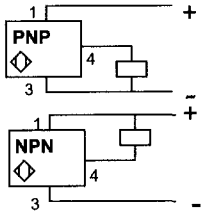
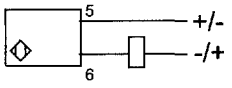
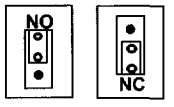
Wiring

3 wire NO

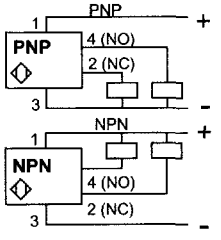


2 wire DC Non Polarized

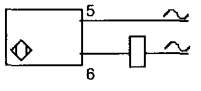




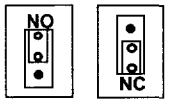
3 wire DC NO/NC



2 wire AC



NO/NC Selector Jumper



Mechanical

Usable sensing range	Shielded	0-12 mm (0.47")
	Unshielded	0-16 mm (0.63")
Standard temperature range		-13° F to +158° F (-25° C to +70° C)
Enclosure rating	• NEMA Type	4,6P,12 (UL test pending)
	• CENELEC Type	IP-67
Enclosure material	Body & sensing face	PBT
	Screws	Stainless Steel
Vibration resistance	IEC 68.2.6	25G, amplitude at 55 Hz, f=10-55 Hz
Shock resistance	IEC 68.2.27	50G duration 11 ms
Standard target size✦	Shielded	45 x 45 mm (1.8" x 1.8")
(steel)	Unshielded	60 x 60 mm (2.4" x 2.4")
Differential		Max. 20%
Repeatability		Max. 3%
Cable		Screw terminals

Electrical

		AC Models	DC Models		
			2 wire	3 wire	
				N.O.	N.O. & N.C. N.O./N.C.
Voltage range		24-240V 50/60 Hz	12-48 V	12-24 V	12-48 V
Voltage limit (including ripple)		20-264V 50/60 Hz	10-58 V	10-38 V	10-58 V
Voltage drop (across switch) closed state		5.5V	5.5 V	5.2 V	2V
Minimum load current		5 mA	1.5 mA	—	—
Current consumption (no load)		—	—	10 mA	10mA
On delay (max.)		30 ms	2 ms	2 ms	2 ms
Off delay (max.)	Shielded	20 ms	5 ms	5 ms	5 ms
	Unshielded	20 ms	7 ms	7 ms	7 ms
Power-up delay (max.)		120 ms	5 ms	5 ms	5 ms

Protective circuitry

Short circuit protection	Yes
Overload protection	Yes
Radio frequency immunity (RFI)	IEC 801-3 Level 3
Electrostatic; Transients; Impulse	IEC 801-2 Level 3; IEC 801-4 Level 3; IEC 801-5 Level 3 DC, Level 4 AC or AC/DC
Reverse polarity protection	DC Versions
Agency approvals	UL and CSA

✦ Target material correction coefficient Km

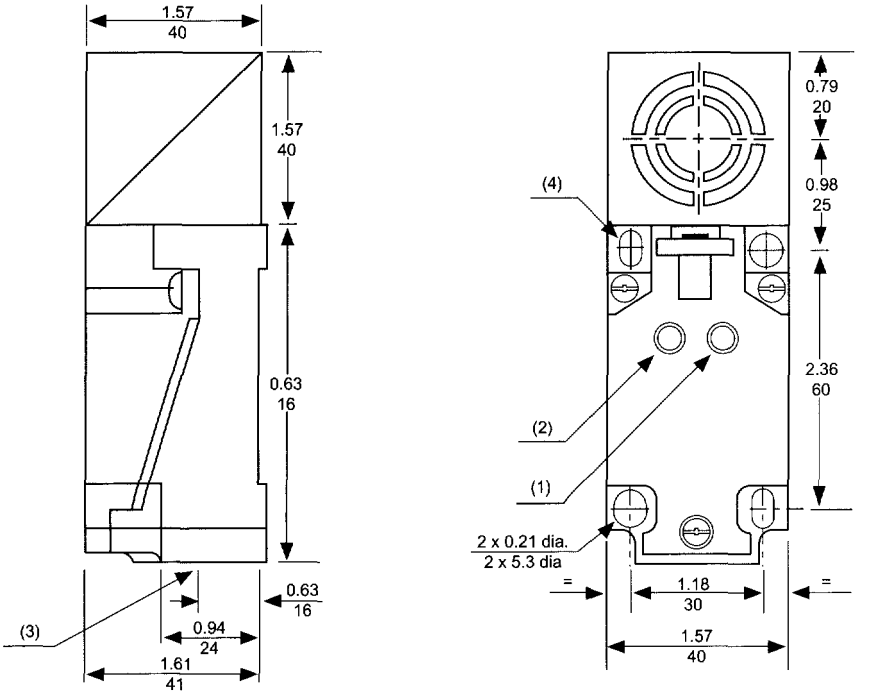
Target Material	Stainless Steel			Mild Steel	Brass	Aluminum	Copper
	Magn.	Type 316	Type 304	A37	UZ33	AU4G	CU
Km	1.00	0.30	1.00	1.00	0.37	0.35	0.30

For sensing metals other than mild steel, use the correction coefficient.

Example: Usable sensing range **x** Target material correction coefficient (Km) = Usable sensing distance

12 mm **x** 0.37 (Brass) = 4.44 mm

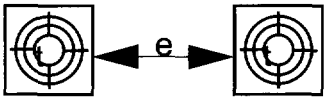
Dimensions



(1) Output LED
(2) Power On LED on N.O. and N.C. versions only
(3) 1/2" NPT conduit opening
(4) Oblong mounting hole: 0.21" x 0.28"
5.3 mm x 7 mm

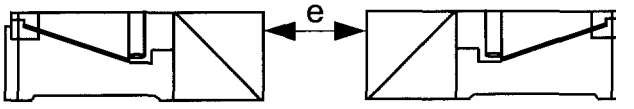
Minimum mounting clearances.

Side by side



Shielded
Unshielded

Face to Face



40mm (1.57")
80mm (3.15")

120mm (4.72")
160mm (6.30")

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August, 1994
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IEC Type Industrial Control Relays
TeSys D-Line, K-Line, and SK-Line

Class 8501

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Merlin Gerin
Modicon
Square D
Telemecanique
Schneider Electric Brands

SQUARE D
Schneider Electric

IEC Type Industrial Control Relays; TeSys D-Line, K-Line, and SK-Line
Overview

Description

TeSys D-Line Relays

These 600 volt relays are approved for use around the world. TeSys D-Line relays are usually mounted on 35 mm DIN 3 track, but can also be mounted directly to a panel. The fixed contacts in these relays have a NEMA A600 and Q600 ratings, in addition to the standard IEC ratings, making them suitable for use in most any control circuit. Low consumption versions of this relay are available for use with low level DC signals from a computer or a PLC. Adder decks can be added to a basic five pole relay to make it up to an 11 pole relay. The serrated silver-nickel contacts with wiping action provide excellent reliability in 12 or 24 volt control circuits. Special auxiliary contacts are available for switching low power down to 5 volts at 10 mA. Timer and mechanical latch attachments are available.

For more information on these relays, see pages 3 through 12.

K-Line Relays

These 600 volt relays are approved for use around the world. K-Line relays are usually mounted on 35mm DIN 3 track, but can also be mounted directly to a panel. One version of this relay can be printed circuit board mounted. A low power consumption version of this relay is available for use with low level DC signals from a computer or a PLC. The fixed contacts in these relays have a NEMA A600 and Q600 ratings, in addition to the standard IEC ratings, making them suitable for use in most any control circuit. Adder decks can be added to a basic four pole relay to make it up to a 8 pole relay. The serrated silver-nickel contacts with wiping action provide excellent reliability in 12 or 24 volt control circuits. An electronic timer attachment is available for this relay.

For more information on these relays, see pages 13 through 18.

SK-Line Relays

This two pole relay is the smallest IEC Type relay on the market. It is approved for use around the world. SK-Line relays are usually mounted on 35mm DIN 3 track. The fixed contacts in this relay have a NEMA A600 rating and a limited DC rating, in addition to the standard IEC ratings, making it suitable for use in most any AC control circuit and some DC control circuits. An adder deck can be added to the basic two pole AC relay to make it a 4 pole relay.

For more information on these relays, see pages 19 and 20.

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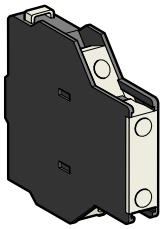
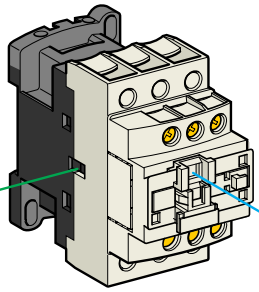
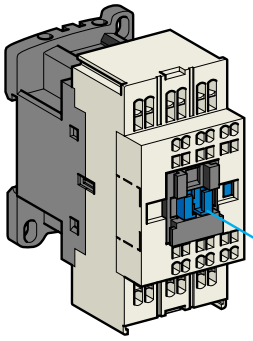


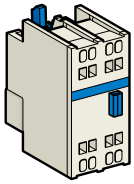
LAD8N20
LAD8N11
LAD8N02



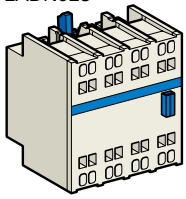
CAD32••
CAD50••



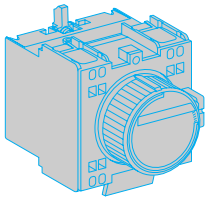
CAD323••
CAD503••



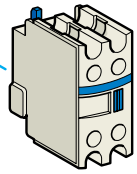
LADN203
LADN113
LADN023



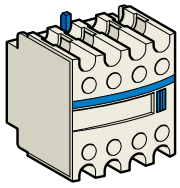
LADN•• 3
LADC223



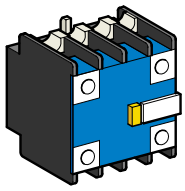
LADT• 3, LADR• 3, LADS23



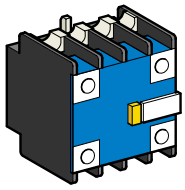
LADN20
LADN11
LADN02



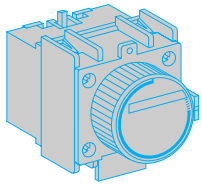
LADN••, LADC22



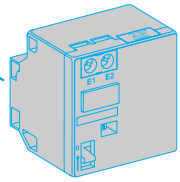
LA1DX20, LA1DZ40
LA1DX02, LA1DZ31



LA1DY20



LADT•, LADS2
LADR•



LA6DK10
or
LAD6K10

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CAD50

Instantaneous Control Relays

Terminal Type	Number of Contacts	Contact Composition		Catalog Number	Weight lb. (kg)
		Normally Open	Normally Closed		
Screw Clamp	5	5	0	**CAD50 ▲ ✳**	1.28 (0.580)
		3	2	**CAD32 ▲ ✳**	1.28 (0.580)
Spring Terminal	5	5	0	**CAD503 ▲ ✳**	1.28 (0.580)
		3	2	**CAD323 ▲ ✳**	1.28 (0.580)

CAD32

Instantaneous Auxiliary Contact Blocks (for use in normal operation environments)

Number of Contacts	Maximum Number per Device Clip-on Mounting		Termination Type	Contact Composition		Catalog Number	Weight lb. (kg)
	Front	Left Side Only		Normally Open	Normally Closed		
2	1	–	Screw Clamp	2	0	**LADN20**	0.07 (0.030)
				1	1	**LADN11**	0.07 (0.030)
				0	2	**LADN02**	0.07 (0.030)
			Spring Terminal	2	0	**LADN203**	0.07 (0.030)
				1	1	**LADN113**	0.07 (0.030)
				0	2	**LADN023**	0.07 (0.030)
	–	1	Screw Clamp	2	0	**LAD8N20**	0.07 (0.030)
				1	1	**LAD8N11**	0.07 (0.030)
				0	2	**LAD8N02**	0.07 (0.030)
4 ✚	1	–	Screw Clamp	4	0	**LADN40**	0.11 (0.050)
				3	1	**LADN31**	0.11 (0.050)
				2	2	**LADN22**	0.11 (0.050)
				1	3	**LADN13**	0.11 (0.050)
				0	4	**LADN04**	0.11 (0.050)
			Spring Terminal	4	0	**LADN403**	0.11 (0.050)
				3	1	**LADN313**	0.11 (0.050)
				2	2	**LADN223**	0.11 (0.050)
				1	3	**LADN133**	0.11 (0.050)
				0	4	**LADN043**	0.11 (0.050)
4 ✚	1	–	Screw Clamp	2 ■	2 ■	**LADC22**	0.11 (0.050)
			Spring Terminal	2 ■	2 ■	**LADC223**	0.11 (0.050)

CAD503

CAD323

Instantaneous Auxiliary Contacts
With Dust and Damp Protected Contacts (for use in particularly harsh industrial environments)

Number of Contacts	Maximum Number per Device	Contact Composition					Catalog Number	Weight lb. (kg)
	Front Mounting	Sealed		❖	Normal			
2	1	2	–	–	–	–	**LA1DX20**	0.09 (0.040)
		–	2	–	–	–	**LA1DX02**	0.09 (0.040)
		2	–	2	–	–	**LA1DY20**	0.09 (0.040)
4 ✚	1	2	–	–	2	–	**LA1DZ40**	0.11 (0.050)
		2	–	–	1	1	**LA1DZ31**	0.11 (0.050)

Common Coil Voltage Codes

ac 50/60 Hz Coil (for additional voltage code options see page 7).

Volts	12	24	48	120	208	240	277	480	600
Code	J7	B7	E7	G7	LE7	U7	W7	T7	X7

dc Coil (coils have built in suppression as standard)

Volts	12	24	36	48	60	72	110	125	220	250	440
Code	JD	BD	CD	ED	ND	SD	FD	GD	MD	UD	RD

dc Low Consumption Coil (coils have built in suppression as standard)

Volts	5	12	24	48	72
Code	AL	JL	BL	EL	SL

❖ Grounding terminal points (2 terminals jumpered together; see diagram on page 8).
✚ Auxiliary contact blocks with four contacts cannot be used on relays with low consumption coils.
▲ Add proper voltage code to end of catalog number.
■ Includes 1 N/O and 1 N/C overlapping contact.
✳ For ring terminal configuration add “6” before coil voltage suffix. For example CAD32B7 becomes CAD32**6**B7.

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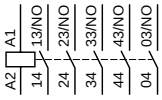
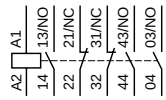
Control Relays Instantaneous

5 N/O
CAD50

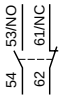


3 N.O + 2 N/C
CAD32

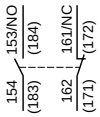


Instantaneous Auxiliary Contact Blocks

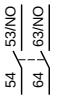
1 N/O + 1 N/C
LADN11



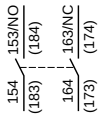
LAD8N11 ★



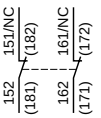
2 N/O
LADN20



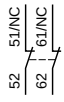
LAD8N20 ★



2 N/C
LAD8N02

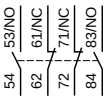


LADN02



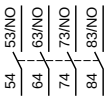
★ The figures in brackets are for the device mounted on the RH side of the relay.

2 N/O + 2 N/C
LADN22

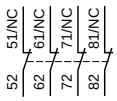


1 N/O + 3 N/C
LADN13

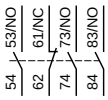
4 N/O
LADN40



4 N/C
LADN04

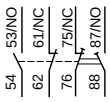


3 N/O + 1 N/C
LADN31

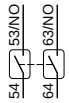


With Dust and Damp Protected Contacts

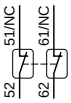
2 N/O + 2 N/C Including 1 N.O + 1 N/C
Make Before Break
LADC22



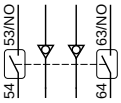
2 N/O Protected
LA1DX20



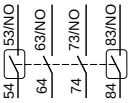
2 N/C Protected
LA1DX20



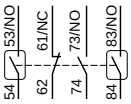
2 N/O Protected ▲
LA1DY20



2 N/O Protected +
2 N/O Non Protected
LA1DZ40



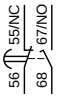
2 N/O Protected +
1 N/O + 1 N/C
Non Protected
LA1DZ31



▲ With grounding terminal points.

Time Delay Auxiliary Contact Blocks

On-Delay 1 N/O + 1 N/C
LADT

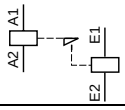


LADS

Off-Delay 1 N/O + 1 N/C
LADR

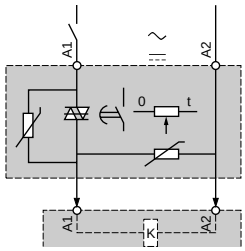
Mechanical Latch Blocks

LA6DK10

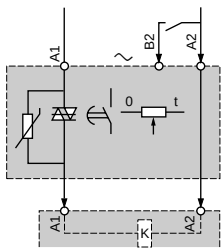


Electronic Serial Timer Modules

On-Delay
LA4DTU

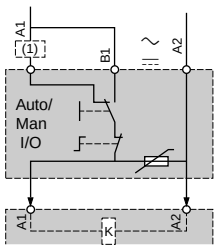


Off-Delay
LA4DRU



Auto-Man-Stop Modules

LA4DM



(1) PLC

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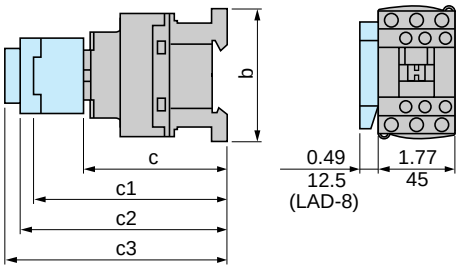
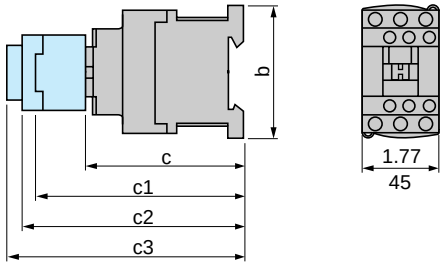
CAD (Vac Coil)



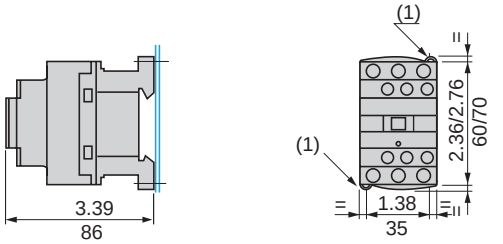
CAD -		32 50	323 503
b		3.03 (77)	3.90 (99)
c	without cover or add-on blocks	3.31 (84)	3.31 (84)
	with cover, without add-on blocks	3.39 (86)	3.39 (86)
c1	with LADN or C (2 or 4 contacts)	4.61 (117)	4.61 (117)
c2	with LA6DK10	5.08 (129)	5.08 (129)
c3	with LADT, R, S	5.39 (137)	5.39 (137)
	with LADT, R, S and sealing cover	5.55 (141)	5.55 (141)

CAD (Vdc Coil) or (Low Consumption Vdc Coil)



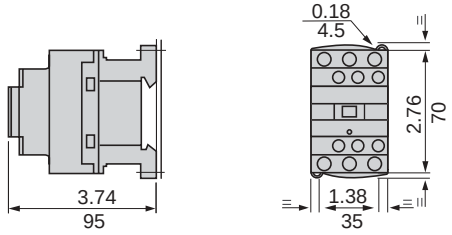
CAD -		32 50	323 503
b		3.03 (77)	3.90 (99)
c	without cover or add-on blocks	3.66 (93)	3.66 (93)
	with cover, without add-on blocks	3.74 (95)	3.74 (95)
c1	with LADN or C (2 or 4 contacts)	4.96 (126)	4.96 (126)
c2	with LA6DK10	5.43 (138)	5.43 (138)
c3	with LADT, R, S	5.75 (146)	5.75 (146)
	with LADT, R, S and sealing cover	5.91 (150)	5.91 (150)

CAD (Vac Coil)
Panel Mounted

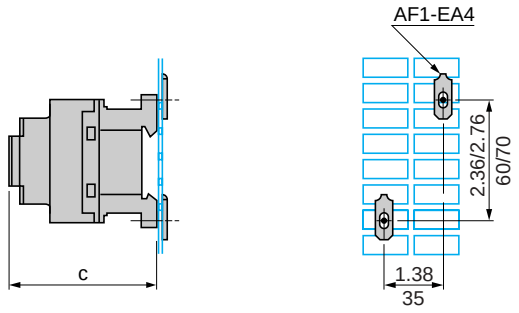


(1) Two elongated holes 0.18 x 0.35" (4.5 x 9 mm)

CAD (Vac Coil) or (Low Consumpsion Coil)
Panel Mounted

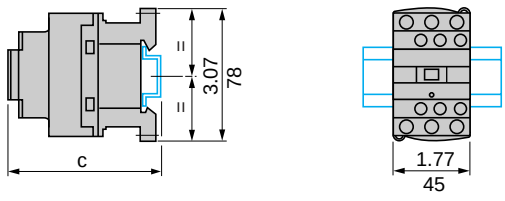


CAD
Mounted on AM1P Mounting Grid



		CAD (Vac)	CAD (Vdc or LC)
c	with cover	3.39 (86)	3.74 (95)

Mounted on AM1DP200 or DE200 Mounting Track



		CAD (Vac)	CAD (Vdc or LC)		
c	(AM1DP200) (1)	3.46 (88)	3.82 (97)		c
c	(AM1DE200) (1)	3.78 (96)	4.13 (105)		c

(1) With cover

Dimensions Inches / mm

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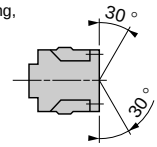
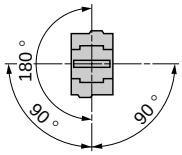
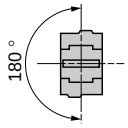
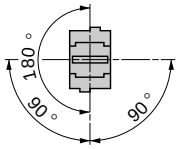
Type				CAD (Vac)	CAD (Vdc)	CAD (Vdc) Low Consumption
Rated Insulation Voltage (Ui)	Conforming to IEC 60947-1-1 Overvoltage category III and degree of pollution 3		V	690	690	690
	Conforming to UL, CSA		V	600	600	600
Rated Impulse Withstand Voltage (Uimp)	Conforming to IEC 60947-1-1		kV	6	6	6
Separation of Electrical Circuits	To IEC 536 and VDE 0106			Reinforced insulation up to 400 V		
Conforming to Standards				IEC 60947-1-1, N-F C 63-140, VDE 0660, BS 4794. EN 60947-5-15		
Approvals				UL File: E164353 CCN: NKCR CSA File: LR43364 Guide: 3211 03 CE		
Protective Treatment	Conforming to IEC 68			"TH" (Tropical Finish) See page 23 for details.		
Degree of Protection	Conforming to VDE 0106			Front face protected against direct finger contact IP 2X		Protection against direct finger contact
Ambient Air Temperature Around the Device	Storage		°F (°C)	- 76 to 176 (- 60 to + 80)	- 76 to 176 (- 60 to + 80)	- 76 to 176 (- 60 to + 80)
	Operation, conforming to IEC 255 (80 to 110% UC)		°F (°C)	23 to 140 (- 5 to + 60)	23 to 140 (- 5 to + 60)	23 to 140 (- 5 to + 60)
	For operation at Uc		°F (°C)	- 40 to 158 (- 40 to + 70)	- 40 to 158 (- 40 to + 70)	- 40 to 158 (- 40 to + 70)
Maximum Operating Altitude	Without derating		ft (m)	9843 (3000)	9843 (3000)	9843 (3000)
Operating Positions	Without derating, in the following positions: 					
Shock Resistance ▲ Half sine wave for 11ms	Control relay open			10 gn	10 gn	10 gn
	Control relay closed			15 gn	15 gn	15 gn
Vibration Resistance ▲ 5 to 300 Hz	Control relay open			2 gn	2 gn	2gn
	Control relay closed			4 gn	4 gn	4 gn
Connection to Screw Clamp Terminals	Stranded wire without cable end	1 conductor	AWG (mm^2)	# 18 to # 12 (1 to 4)	# 18 to # 12 (1 to 4)	# 18 to # 12 (1 to 4)
		2 conductors	AWG (mm^2)	# 18 to # 12 (1 to 4)	# 18 to # 12 (1 to 4)	# 18 to # 12 (1 to 4)
	Stranded wire without cable end	1 conductor	AWG (mm^2)	# 18 to # 12 (1 to 4)	# 18 to # 12 (1 to 4)	# 18 to # 12 (1 to 4)
		2 conductors	AWG (mm^2)	# 18 to # 14 (1 to 2.5)	# 18 to # 14 (1 to 2.5)	# 18 to # 14 (1 to 2.5)
	Solid wire without cable end	1 conductor	AWG (mm^2)	# 18 to # 12 (1 to 4)	# 18 to # 12 (1 to 4)	# 18 to # 12 (1 to 4)
		2 conductors	AWG (mm^2)	# 18 to # 12 (1 to 4)	# 18 to # 12 (1 to 4)	# 18 to # 12 (1 to 4)
	Tightening torque		lb-in (N●m)	15 (1.7)	15 (1.7)	15 (1.7)
Connection to Spring Terminals	1 or 2 stranded or solid without cable end		AWG (mm^2)	# 18 to # 14 (1 to 2.5)	# 18 to # 14 (1 to 2.5)	# 18 to # 14 (1 to 2.5)

▲ In the least favorable direction, without change of contact state, with coil supplied at Uc.

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Control Circuit Characteristics

Type				CAD (Vac)	CAD (Vdc)	CAD (Vdc) Low Consumption
Rated Control Circuit Voltage (Uc)			V	12 to 690	12 to 440	5 to 72
Control Voltage Limits						
Operation	With coil type:	Vac 50/60 Hz		80 to 110% Uc at 50 Hz	-	-
				85 to 110% Uc at 60 Hz	-	-
		Vdc standard, wide range		-	70 to 125% Uc	70 to 125% Uc
Drop-out				30 to 60% Uc	10 to 25% Uc	10 to 25% Uc
Average Consumption at 68 °F (20 °C) and at Uc	Vac Coil 50/60 Hz		VA	Inrush: 70	-	-
				Hold-in: 8	-	-
	Vdc Coil with standard coil		W	-	Inrush or hold-in: 5.4	Inrush or hold-in: 2.4
Operating Time	Between coil energization and					
(at rated control circuit voltage	- opening of the N/C contacts		ms	4 to 19	35 to 45	45 to 55
and at 68 °F (20 °C)	- closing of the N/O contacts		ms	12 to 22	50 to 55	60 to 70
	Between coil de-energization and					
	- opening of the N/O contacts		ms	4 to 12	6 to 14	10 to 15
	- closing of the N/C contacts		ms	6 to 17	20	25
Short Supply Failures	Maximum duration without affecting hold-in of the device		ms	2	2	2
Maximum Operating Rate	In operating cycles per second			3	3	3
Mechanical Durability	With coil type:	Vac 50/60 Hz		15	-	-
(in millions of operating cycles) ✚		Vdc standard, wide range		-	30	30
Time Constant L/R			ms	-	28	40

✚ The product life expressed above is based on average usage and normal operating conditions. Actual operating life will vary with conditions. The above statements are not intended to, nor shall they create any expressed or implied warranties as to product operation or life. For information on the listed warranty offered on this product, refer to the Square D terms and conditions of sale found in the Square D Digest.

Characteristics of Instantaneous Contacts incorporated in the Control Relay

Number of Contacts				5
Rated Operational Voltage (Ue)	Up to		V	690
Rated Insulation Voltage (Ui)	Conforming to IEC 60947-1-1		V	690
	Conforming to UL, CSA		V	600
Rated Conventional Thermal Current (Ith)	For ambient temperature ≤ 104 °F (40 °C)		A	10
Frequency of Operational Current			Hz	25 to 400
Minimum Switching Capacity	U min.		V	17
	I min.		mA	5
Short-circuit Protection	Conforming to IEC 60947-1-1			gG fuse: 10 A (10 Amp Class J Time delay)
Rated Making Capacity	Conforming to IEC 60947-1-1 I rms			140 Aac, 250 Adc
Short Time Rating	Permissible for	1 s	A	100
		500 ms	A	120
		100 ms	A	140
Insulation Resistance			MΩ	> 10
Non-overlap time	Guaranteed between N/O and N/C contacts		ms	1.5 (on energization and on de-energization)
Tightening Torque	Phillips n°2 and ∅ 6		lb-in (N●m)	10.6 (1.2)
Non-overlap Distance				Linked contacts in association with auxiliary contacts LADN
Linked Contacts	According to draft standard IEC 60947-4-5			The three “N/O” contacts and the two “N/C” contacts of CADN32 are linked mechanically by one mobile contact holder.

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Contact Ratings

AC Ratings								DC Ratings			
Volts	Inductive 35% Power Factor						Resistive 75% Power Factor	Volts	Inductive		
	UL Rating	Make		Break		Cont. Amps	Make, Break & Cont. Amps		UL Rating	Make & ▲ Break Amps	Cont. Amps
		Amps	VA	Amps	VA						
120	A600	60	7200	6	720	10	10	125	Q600	0.55	2.5
240		30	7200	3	720	10	10	250		0.27	2.5
480		15	7200	1.5	720	10	10	600		0.10	2.5
600		12	7200	1.2	720	10	10				

▲ 69 VA maximum up to 300 volts.

AC Supply, Categories AC-14 and AC-15 (conforming to IEC 60947-1-1)

Electrical durability (up to 3600 operating cycles/hours) on an inductive load such as the coil of an electromagnet: making power (cos φ 0.7) = 10 times the power broken (cos φ 0.4)

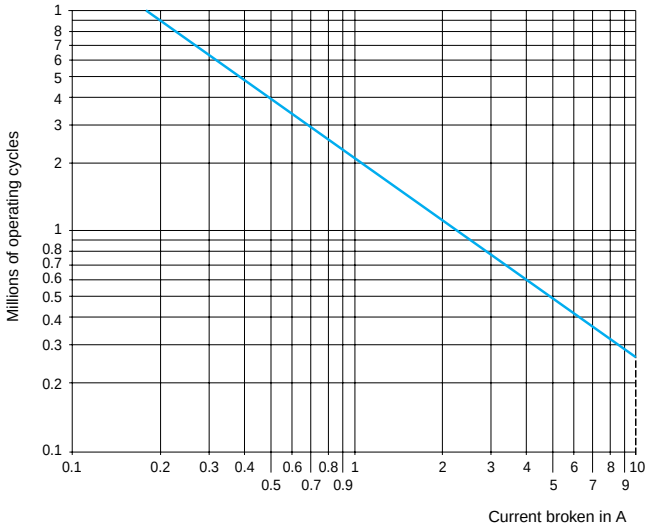
	V	24	48	115	230	400	440	600
1 million operating cycles ♠	VA	60	120	280	560	960	1050	1440
3 million operating cycles ♠	VA	16	32	80	160	280	300	420
10 million operating cycles ♠	VA	4	8	20	40	70	80	100

DC Supply, Categories DC-13

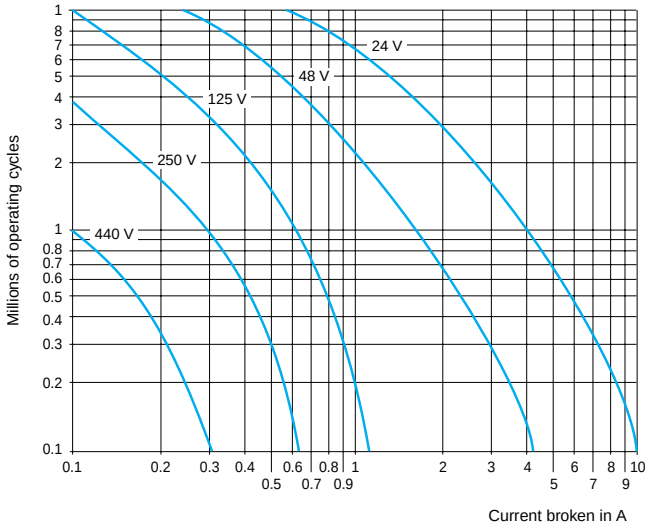
Electrical durability (up to 1200 operating cycles/hour) on an inductive load such as the coil of an electromagnet, without economy resistor, the time constant increasing with the power.

	V	24	48	125	250	440
1 million operating cycles ♠	W	120	90	75	68	61
3 million operating cycles ♠	W	70	50	38	33	28
10 million operating cycles ♠	W	25	18	14	12	10

Categories AC14 and AC15



Category DC13



Utilization Categories for Control Relays Conforming to IEC 60947-1-1

AC Applications		
	Category AC-14 (1)	This category applies to the switching of electromagnetic loads whose power drawn with the electromagnet closed is less than 72 VA. Application example: Switching the operating coil of contactors and relays.
	Category AC-15 (1)	This category applies to the switching of electromagnetic loads whose power drawn with the electromagnet closed is more than 72 VA. Application example: Switching the operating coil of contactors.
DC Applications		
	Category DC-13	This category applies to the switching of electromagnetic loads for which the time taken to reach 95% of the steady state current (T = 0.95) is equal to 6 times the power P drawn by the load (with P ≥ 50 W).

♠ The product life expressed above is based on average usage and normal operating conditions. Actual operating life will vary with conditions. The above statements are not intended to, nor shall they create any expressed or implied warranties as to product operation or life. For information on the listed warranty offered on this product, refer to the Square D terms and conditions of sale found in the Square D Digest.

(1) Replaces category AC-11

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Control Relays

CA2KN40••

CA2KN403••

CA3KN407••

- Mounting on 35 mm DIN3 track or 4 screw direct mounting.
- Screws in open "ready-to-tighten" position.

Control Circuit		Type of Termination	Contact Configuration		Catalog Number ♦	Weight lb (kg)
Supply	Consumption		N/O	N/C		
AC	4.5 VA	Screw clamp	4	0	**CA2KN40••**	0.40 (0.180)
			3	1	**CA2KN31••**	0.40 (0.180)
			2	2	**CA2KN22••**	0.40 (0.180)
		Spring Termination	4	0	**CA2KN403••**	0.40 (0.180)
			3	1	**CA2KN313••**	0.40 (0.180)
			2	2	**CA2KN223••**	0.40 (0.180)
		Faston 1 x 6.35 or 2 x 2.8	4	0	**CA2KN407••**	0.40 (0.180)
			3	1	**CA2KN317••**	0.40 (0.180)
			2	2	**CA2KN227••**	0.40 (0.180)
		Solder pins for printed circuit board	4	0	**CA2KN405••**	0.46 (0.210)
			3	1	**CA2KN315••**	0.46 (0.210)
			2	2	**CA2KN225••**	0.46 (0.210)
DC	3 W	Screw clamp	4	0	**CA3KN40••**	0.50 (0.225)
			3	1	**CA3KN31••**	0.50 (0.225)
			2	2	**CA3KN22••**	0.50 (0.225)
		Spring Termination	4	0	**CA3KN403••**	0.50 (0.225)
			3	1	**CA3KN313••**	0.50 (0.225)
			2	2	**CA3KN223••**	0.50 (0.225)
		Faston 1 x 6.35 or 2 x 2.8	4	0	**CA3KN407••**	0.50 (0.225)
			3	1	**CA3KN317••**	0.50 (0.225)
			2	2	**CA3KN227••**	0.50 (0.225)
		Solder pins for printed circuit board	4	0	**CA3KN405••**	0.56 (0.255)
			3	1	**CA3KN315••**	0.56 (0.255)
			2	2	**CA3KN225••**	0.56 (0.255)

Low Consumption Control Relays

CA4KN405•••

- Compatible with programmable controller outputs.
- LED indicator incorporated.
- Wide range coil (70 to 130% Uc), suppressor fitted as standard.
- Mounting on 35 mm DIN3 track or 4 screw direct mounting.
- Screws in open "ready-to-tighten" position.

DC	1.8 W	Screw clamp	4	0	**CA4KN40•••**	0.52 (0.235)
			3	1	**CA4KN31•••**	0.52 (0.235)
			2	2	**CA4KN22•••**	0.52 (0.235)
		Spring Termination	4	0	**CA4KN403•••**	0.52 (0.235)
			3	1	**CA4KN313•••**	0.52 (0.235)
			2	2	**CA4KN223•••**	0.52 (0.235)
		Faston 1 x 6.35 or 2 x 2.8	4	0	**CA4KN407•••**	0.52 (0.235)
			3	1	**CA4KN317•••**	0.52 (0.235)
			2	2	**CA4KN227•••**	0.52 (0.235)
		Solder pins for printed circuit board	4	0	**CA4KN405•••**	0.58 (0.265)
			3	1	**CA4KN315•••**	0.58 (0.265)
			2	2	**CA4KN225•••**	0.58 (0.265)

♦ Complete catalog number by adding proper voltage code from page 14.

Application Data 17
Dimensions. 16
Contact Configuration. 16
Accessories 14-15

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Instantaneous Auxiliary Contact Blocks

LA1KN20

LA1KN40

LA1KN403

LA1KN407

Clip-on Front Mounting, 1 Block Per Control Relay

Type of connection	Contact Configuration N/O	Contact Configuration N/C	Catalog Number	Weight lb (kg)
Screw clamp	2	0	**LA1KN20**	0.10 (0.045)
	0	2	**LA1KN02**	0.10 (0.045)
	1	1	**LA1KN11**	0.10 (0.045)
	4	0	**LA1KN40** ▲	0.10 (0.045)
	3	1	**LA1KN31** ▲	0.10 (0.045)
	2	2	**LA1KN22** ▲	0.10 (0.045)
	1	3	**LA1KN13** ▲	0.10 (0.045)
	0	4	**LA1KN04** ▲	0.10 (0.045)
Spring Termination	2	0	**LA1KN203**	0.10 (0.045)
	1	1	**LA1KN113**	0.10 (0/045)
	0	2	**LA1KN023**	0.10 (0.045)
	4	0	**LA1KN403** ▲	0.10 (0.045)
	3	1	**LA1KN313** ▲	0.10 (0.045)
	2	2	**LA1KN223** ▲	0.10 (0.045)
	1	3	**LA1KN133** ▲	0.10 (0.045)
	0	4	**LA1KN043** ▲	0.10 (0.045)
Faston 1 x 6.35 or 2 x 2.8	2	0	**LA1KN207**	0.10 (0.045)
	0	2	**LA1KN027**	0.10 (0.045)
	1	1	**LA1KN117**	0.10 (0.045)
	4	0	**LA1KN407** ▲	0.10 (0.045)
	3	1	**LA1KN317** ▲	0.10 (0.045)
	2	2	**LA1KN227** ▲	0.10 (0.045)
	1	3	**LA1KN137** ▲	0.10 (0.045)
	0	4	**LA1KN047** ▲	0.10 (0.045)

▲ Not to be used on CA4KN relays

Electronic Time Delay Attachment

- Relay output with common point changeover contact, 240 VAC or VDC, 2 A maximum.
- Control voltage: 85 to 110% Uc.
- Maximum switching capacity: 250 VA or 150 W.
- Operating temperature: 14 to 140°F (-10 to 60°C).
- Reset time: 1.5 s during the time delay period, 0.5 s after the time delay period.

Clip-on Front Mounting, 1 Block per Control Relay

Voltage	Type	Timing Range (s)	Contact Configuration	Catalog Number	Weight lb (kg)
24 to 48 Vac or Vdc	On-delay	1 to 30	1 N/O and 1 N/C with a common	**LA2KT2E**	0.09 (0.040)
110 to 240 Vac	On-delay	1 to 30	1 N/O and 1 N/C with a common	**LA2KT2U**	0.09 (0.040)

Coil Voltages

CA2K Control Relays

Volts ac 50/60 Hz	12	20	24	36	42	48	110	115	120	127	220/230	230	230/240	380/400	400	400/415	440	480	500	600	660/690
Code (85 to 110% Uc)	J7	Z7	B7	C7	D7	E7	F7	FE7	G7	FC7		P7			V7		R7	T7	S7	X7	
Code (80 to 115% Uc)											M7		U7	Q7		N7					Y7

Coils up through 240 V are available with built-in coil suppression. Add a **2** to the end of the appropriate voltage code. Example:**G72**.

CA3K Control Relays (80 to 115% Uc)

Volts dc	12	20	24	36	48	60	72	100	110	125	200	220	230	240	250
Code	JD	ZD	BD	CD	ED	ND	SD	KD	FD	GD	LD	MD	MPD	MUD	UD

Coils are available with built-in coil suppression. Add a **3** to the end of the appropriate voltage code. Example: **JD3**.

CA4K Low Consumption Control Relays (wide range coil: 70 to 130% Uc)

Volts dc	12	20	24	48	72	110	120
Code	JW3	ZW3	BW3	EW3	SW3	FW3	GW3

Relays 13
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Contact Configuration 16

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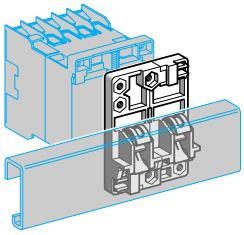
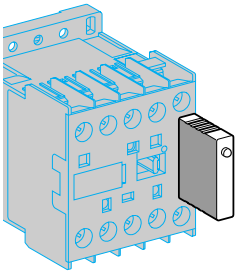


LA9D973



LA4K•••

Description	Application		Sold in Lots of	Catalog Number	Weight lb (kg)
Mounting Plates for Fixing	On 1 DIN1 track	Clip-on fixing	1	**LA9D973**	0.06 (0.025)
	On 2 DIN1 tracks	110/120 mm fixing centers	1	**DX1AP25**	0.14 (0.065)
Marker Holder	Clips onto Front of Relay		100	**LA9D90**	0.002 (0.001)
Clip-in Markers	See page 22				
Suppressor Modules Incorporating LED Indicator	Clips onto front of relay, with orientation device. No tools required for connection.	For ac and dc voltages 12 to 24 V (varistor)	5	**LA4KE1B** ▲	0.02 (0.010)
		For ac and dc voltages 32 to 48 V (varistor)	5	**LA4KE1E** ▲	0.02 (0.010)
		For ac and dc voltages 50 to 129 V (varistor)	5	**LA4KE1FC** ▲	0.02 (0.010)
		For ac and dc voltages 130 to 250 V	5	**LA4KE1UG** ▲	0.02 (0.010)
		For dc voltages 12 to 24 V (diode + Zener diode)	5	**LA4KC1B** ❊	0.02 (0.010)
		For dc voltages 32 to 48 V (diode + Zener diode)	5	**LA4KC1E** ❊	0.02 (0.010)
		For ac voltages 220 to 250 V (RC)	5	**LA4KA1U** ◗	0.02 (0.010)

▲ Protection by limitation of the transient voltage to 2 Uc maximum.
Maximum reduction of the transient voltage peaks.
Slight time delay on drop-out (1.1 to 1.5 times normal).

❊ No over voltage or oscillation frequency.
Polarized component.
Slight time delay on drop-out (1.1 to 1.5 times normal).

◗ Protection by limitation of the transient voltage to 3 Uc max. and limitation of the oscillation frequency.
Slight time delay on drop-out (1.2 times to 2 times normal).

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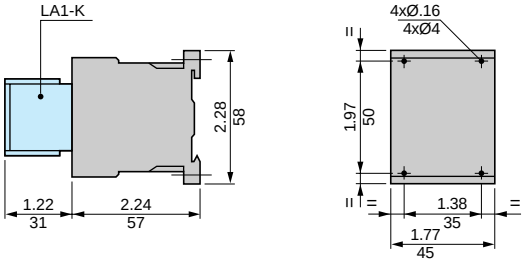
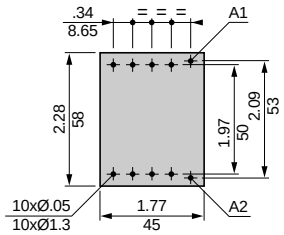
CA2, CA3, CA4K Control Relays

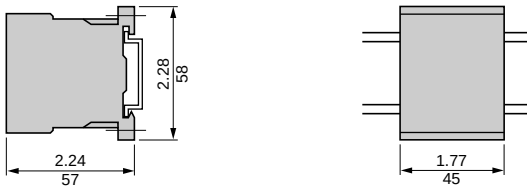
On Panel



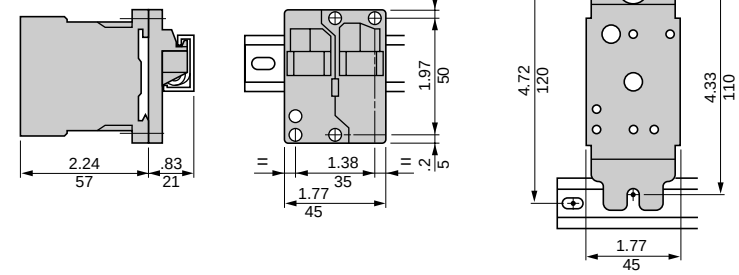
On Printed Circuit Board



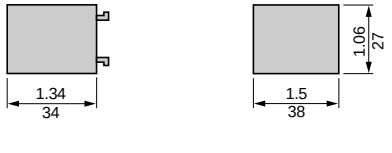
On AM1DP200 or AM1DE200 Track (35 mm DIN3)



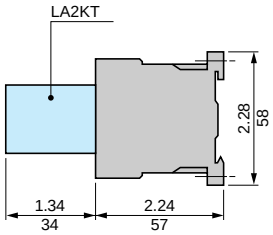
On Asymmetrical Rail with LA9D973 Clip-on Mounting Plate or DX1AP25 Mounting Plate (110/120 mm fixing centers)



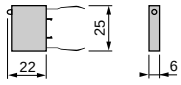
LA2KT Electronic Time Delay Contact Blocks



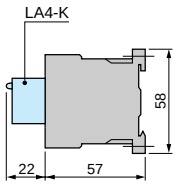
LA2KT



LA4K Suppressor Modules

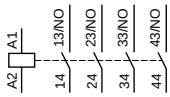


LA4K on Auxiliary Control Relay

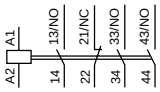


CA2, CA3, CA4K Control Relays

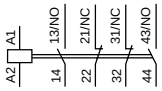
4 N/O



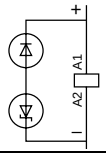
3 N/O + 1 N/C



2 N/O + 2 N/C



CA4K● Coil (suppressor scheme)



LA1K Instantaneous Auxiliary Contact Blocks

For CA2, CA3, CA4K

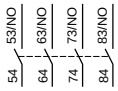
2 N/O

2 N/C

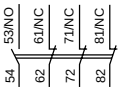
1 N/O + 1 N/C

For CA2, CA3K

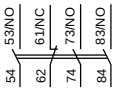
4 N/O



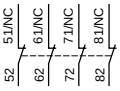
1 N/O + 3 N/C



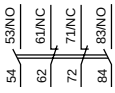
3 N/O + 1 N/O



4 N/C



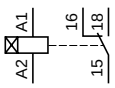
2 N/O + 2 N/C



LA2KT Electronic time Delay Contact Blocks

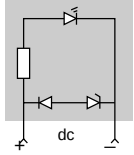
For CA2, CA3, CA4K

1 C/O

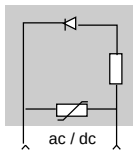


LA4K Suppressor Modules

LA4KC Suppressor Module



LA4KE Suppressor Module



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Environment

Type			CA2	CA3
Conforming to Standards			IEC337-1, 947-1, 947-5, NF C 63-140, VDE0660, BS4794	
Approvals			UL Listed File E164353 CCN NKCR, CSA File LR12721 Class 3211 03, SEMKO, SEV, DEMKO, CE	
Operating Temperature Range		°F (°C)	-4 to 131 (-20 to 55)	
Wire Range	Stranded wire	AWG (mm^2)	Two #20 (0.75) to #16 (1.5)	
	Solid wire	AWG (mm^2)	Two #18 (1) to #14 (2.5)	

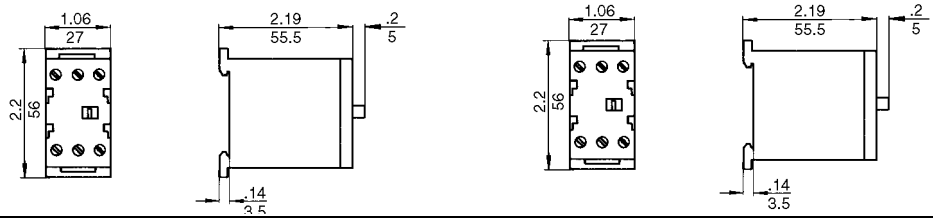
Control circuit characteristics

Type			CA2	CA3
Rated Insulation Voltage	Conforming to UL508 Conforming to VDE 0110 Group C	V V	600 660	600 660
Rated Coil Voltage Uc		V	24 to 600	12 to 220
Permissible Voltage Variation			+10/-20% Uc	
Average Consumption	Inrush		15.5 VA	2.2 W
	Sealed		4.2 VA	2.2 W
Operating Time	Pick-up	ms	8 to 16	10 to 18
	Drop-out	ms	6 to 8	4 to 6
Mechanical Life	In millions of operations		10	10

Contact Ratings

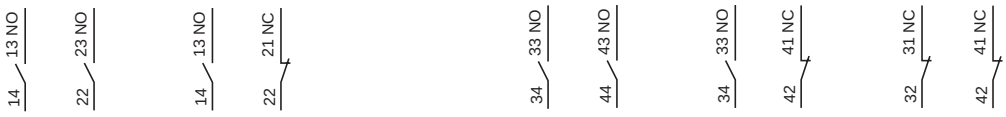
AC								DC	
Volts	Inductive 35% PF						Resistive 75% PF	Volts	Continuous Amps
	UL Rating	Make		Break		Continuous Amps	Make, Break & Cont. Amps		
		Amps	VA	Amps	VA				
120	A600	60	7200	6	720	10	10	24	3
240		30	7200	3	720	10	10	60	2
480		15	7200	1.5	720	10	10	110	0.8
600		12	7200	1.2	720	10	10	240	0.2

Approximate dimensions



Contact Configurations

Relays		Contact adder decks		
2 N/O	1 N/O and 1 N/C	2 N/O	1 N/O and 1 N/O	2 N/C



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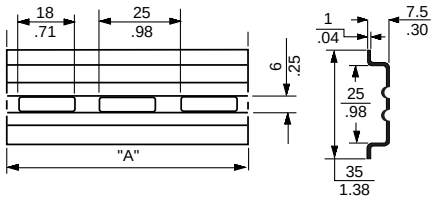
Mounting Track Description		Length	Catalog Number Class 9080 Type MH•••	Std. ● Pack
Symmetrical rail 35 x 7.5mm (1.38 x 0.295") in compliance with EN50022 standard (DIN 46277-3)	Galvanized steel (no mounting holes)	0.08 m / 3"	**9080MH203**	
		0.10 m / 4"	**9080MH204**	
		0.13m / 5"	**9080MH205**	
		0.15 m / 6"	**9080MH206**	
		0.18 m / 7"	**9080MH207**	
		0.20 m / 8"	**9080MH208**	
		0.23 m / 9"	**9080MH209**	
		0.25 m / 10"	**9080MH210**	
		0.28 m / 11"	**9080MH211**	
		0.30 m / 12"	**9080MH212**	10
		0.33 m / 13"	**9080MH213**	
		0.36 m / 14"	**9080MH214**	
		0.38 m / 15"	**9080MH215**	
		0.41 m / 16"	**9080MH216**	
		0.43 m / 17"	**9080MH217**	
		0.46 m / 18"	**9080MH218**	
		0.50 m / 19.68"	**9080MH220**	
		1 m / 39.37"	**9080MH239**	
		2 m / 78.74"	**9080MH279**	
	Galvanized steel, prepunched	0.08 m / 3"	**9080MH303**	
		0.10 m / 4"	**9080MH304**	
		0.13m / 5"	**9080MH305**	
		0.15 m / 6"	**9080MH306**	
		0.18 m / 7"	**9080MH307**	
		0.20 m / 8"	**9080MH308**	
		0.23 m / 9"	**9080MH309**	
		0.25 m / 10"	**9080MH310**	
		0.28 m / 11"	**9080MH311**	
		0.30 m / 12"	**9080MH312**	10
		0.33 m / 13"	**9080MH313**	
		0.36 m / 14"	**9080MH314**	
		0.38 m / 15"	**9080MH315**	
		0.41 m / 16"	**9080MH316**	
		0.43 m / 17"	**9080MH317**	
		0.46 m / 18"	**9080MH318**	
		0.50 m / 19.68"	**9080MH320**	
		1 m / 39.37"	**9080MH339**	
		2 m / 78.74"	**9080MH379**	
High rise track	Aluminum	1 m / 39.37"	**9080MH439**	2

● Orders must specify standard packages or multiples of that quantity

MH3••



mm
inches

Angle bracket kit

For mounting 9080 GH or MH track to a panel at 45° angle. Includes 2 brackets and hardware for mounting the track to the brackets.

9080MH82 1

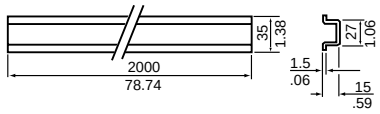
End Clamps

Metal end clamp for 35 mm DIN 3 track, 8 mm (0.31") wide

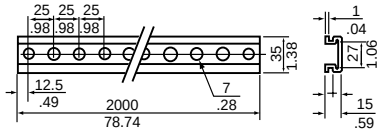
AB1AB8M35 100

Mounting Track Description	Length	Catalog Number	Std. ● Pack	Weight lb (kg)
DIN3				
15 mm depth, 1 mm steel, zinc chromated	2 m / 78.74"	**AM1ED200**	10	2.9 (1.31)
15 mm depth, 1.5 mm steel, zinc chromated	2 m / 78.74"	**AM1DE200**	10	2.0 (0.90)
7.5 mm depth, 1 mm steel, zinc chromated EN50022 & NF C63-015	2 m / 78.74"	**AM1DP200**	10	1.4 (0.65)
DIN1				
Asymmetrical 32 mm track 1.5 mm steel, zinc chromated EN50035 & NF C63-018	2 m / 78.74"	**DZ5MB201**	10	3.3 (1.50)

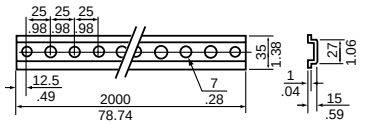
AM1DE200



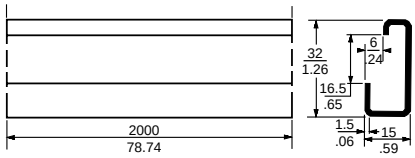
AM1ED200



AM1DP200



DZ5MB201



mm
inches

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Beacons
and indicator banks
Harmony

Looking good!

a brand of Schneider Electric

Telemecanique

Simply Smart!
Leveraging
ingenuity
and intelligence
for **ease of use**

Remote signalling
Harmony
An offer unmatched in content

The Telemecanique brand, worldwide leader in Operator Dialogue components, presents its **Harmony** remote signalling offer.
It enables you to receive, at distances from 5 to 100 m and throughout 360°, any light or audible signalling regarding the status of a machine.

Simple to select from, this offer comprising 3 ranges – Universal, Optimum & Application specific – provides a solution to meet your varying needs. Benefit from quick and simple installation, using either customer assembled variable composition products, comprising units that simply lock together, or complete, pre-assembled and pre-cabled products.

Ingenious, this offer is suitable for all types of environments.
The LED technology, used for all light signalling functions, ensures high performance and, with a view to environmental friendliness, optimises energy consumption.

Aesthetic, in perfect **synergy** with other Telemecanique equipment, Harmony remote signalling differentiates and ensures the efficiency of your dialogue solutions.

Universal range

High performance and wide choice of units

Perfect modularity

- This customer assembled variable composition range is suitable for all indoor and outdoor environments (up to IP66).

Speed and reliability of installation

- Fixing ensured by large locking ring (no tools required). It enables instant access to each unit as well as providing sufficient separation between colours.

Signalling from 35 to 50 m

- Improved performance provided by high luminosity LEDs, “flash” units (5 and 10 Joule) and a powerful, adjustable buzzer.

Optimum range

Excellent price / performance ratio

Economic

- Simple to use, this range, comprising pilot lights, beacons and complete (pre-assembled and pre-cabled) or customer assembled variable composition indicator banks, is for use in protected environments both indoors and outdoors (IP42).

Linear aesthetics

- A design both different and original, the smooth contours of the external surface avoid the accumulation of dust and grime.

Signalling from 5 to 35 m

- Transmission of light and sound signals optimised for short to medium distances.
- Use of LEDs, bulbs and flash.

Application specific range

Ready to use for your specific needs

- Rotating mirror beacons and sirens of pre-defined composition to complement your needs for very long distance signalling (up to 100 metres).
- Ready to use indicator banks: a selection of the most common solutions for repetitive applications.

Improved *performance* and more *innovation* for signalling to meet your needs

With Telemecanique, the inventor of the indicator bank, increase your productivity: remote visual and audible signalling enables the operator to attend to other tasks and, at the same time, be able to intervene quickly in the event of a problem regarding production.

Robustness

- For all indoor and outdoor applications.
- Good resistance to vibration and mechanical shock.
- Degree of protection up to IP66.

Simplicity

- Quick and simple installation using units that easily fit together or by selecting pre-assembled and pre-cabled products.
- Electrical connections between each unit made automatically whilst assembling.
- Units and light sources interchangeable without altering cabling.

Reliability

- "Protected LED" technology: protection assured against short-circuits, voltage spikes and electromagnetic interference.
- 100 000 hours luminosity without maintenance by using LEDs.

Safety

- The combined units are secured by either a screw or locking ring.
- Conformity to international standards and certifications:

Savings in costs

- LED technology for all levels of saving: low power consumption, reduced recycling.

Intuitive messages (conforming to standard IEC 60204-1)

Light signalling

- **Red:** urgent (immediate action required)
- **Yellow / Orange:** anomaly (checking and/or intervention required)
- **Green:** normal condition (optional)
- **Blue:** obligatory action (action required from the operator)
- **White:** monitoring (optional)

Flashing lights

For distinction or specific information:

- Attract more attention.
- Call for immediate action.
- Indicate discordance between the instruction and the actual status.
- Indicate a change in cycle (flashing during transition).

Flash and rotating mirror beacons

- A more powerful signal for top priority information or longer distance signalling (conforming to IEC 60073).

Buzzer and sirens

- Recommended in environments subject to considerable light or sound interference, or when the presence of the operator is of higher importance.

Universal range

High performance and wide choice of units

- **Signalling from 35 to 50 m**
- High degree of protection, up to **IP66**
- Perfect modularity: customer assembled, simple interchangeability of units
- Quick and safe installation: immediate assembly and fixing using locking ring (no tools required)
- Simple maintenance: instant access to each unit
- High luminosity: illuminated units with integral protected LED, base mounted protected LED, flash discharge tube (5 or 10 Joule)

All types of applications

Available in cream for clean environments

Assembly and instant locking of units by ring

Illuminated units with integral protected LED: only 1 ordering reference

Ø 50 XVP

IP 65

- **Entirely modular**
- **Colour: black or cream**
- **Buzzer: multi-tone and multi-directional (IP43)**

Ø 70 XVB

IP 66

- **Entirely modular**
- **Illuminated units with integral protected LED**
- **Interlocking ring (no tools required)**
- **Bottom or side cable entry**

Degree of protection	IP 65	IP66 mounted on base unit / IP65 mounted on support tube
Assembly of units	Customer assembled	Customer assembled
Type of light source	Base mounted protected LED or incandescent bulb (7 W max.) Flash unit, 0.6 J	Illuminated units with integral protected LED, base mounted protected LED or incandescent bulb (7 W max.) Flash unit, 5 J or 10 J
Type of audible signalling	Buzzer, 85 dB (adjustable)	Buzzer, 90 dB (adjustable), IP65
Mounting connection	Assembly and locking by clamping ring	Assembly and locking by clamping ring / connection on AS-Interface
Colour of base unit	black or cream	black
Colour of illuminated units	6 colours	6 colours
Standards and approvals	CE	CE
Supply voltages	24 V AC/DC 120 V AC 230 V AC	24 V AC/DC 120 V AC 230 V AC

Optimum range

Excellent
price / performance ratio

- **Signalling from 5 to 35 m**
- Degree of protection **IP40 / IP42**
- Simple and economical: pre-assembled and pre-cabled or customer assembled products
- The combined units are secured by a screw or rotary interlocking of lens units.
- Linear aesthetics

Simple applications in a protected environment

Pre-assembled and pre-cabled or customer assembled products

The combined units are secured by a screw or rotary interlocking of lens units

	Ø 25 XV1CA	**Ø 45** XVDLS	**Ø 45** XVM	**Ø 70** XVE
	IP 40 ■ **Height of pilot light: 55 mm** ■ **Ø 22/30 hole mounting** ■ **Pre-cabled**	IP 40 ■ **Contrasting aesthetics (dome)** ■ **Colour: black** ■ **Direct mounting on machine**	IP 42 ■ **Complete products or separate units for customer assembly** ■ **Colour: cream** ■ **With or without buzzer integrated in base unit**	IP 42 ■ **New aesthetics** ■ **Illuminated units with integral LED** ■ **Combined units secured by 1 screw per unit**
Degree of protection	IP 40	IP 40	IP 42	IP42 (IP54 using sealing kit)
Assembly of units	Pre-cabled	Pre-assembled	Pre-assembled and pre-cabled or customer assembled	Customer assembled
Type of light source	Incandescent bulb (5 W max.)	Incandescent bulb (5 W max.) Flash unit, 0.5 J	Base mounted LED or incandescent bulb (5 W max.) Flash lamp, 0.8 J	Illuminated units with integral LED, base mounted protected LED or incandescent bulb (5 W max.). Flash unit, 5 J
Type of audible signalling	-	-	Buzzer, 75 dB (adjustable)	Buzzer, 85 dB (non adjustable)
Mounting connection	Ø 22/30 hole mounting	-	Assembly by rotary interlocking of units / connection to colour coded wires	Locking by fixing screw
Colour of base unit	black	black	cream	black
Colour of illuminated units	4 colours	6 colours	5 colours	5 colours
Standards and approvals	CE	CE UL CSA	CE CCC	CE UL CSA CCC
Supply voltages	24 V AC/DC 48 V AC/DC 130 V AC/DC, 220 V AC/DC	24 V AC/DC 120 V AC 230 V AC	24 V AC/DC 120 V AC 230 V AC	24 V AC/DC 120 V AC 230 V AC

Application specific range

Ready to use
for your specific needs

- **Signalling up to 100 m**
- Degree of protection **IP40** to **IP65**
- Simple: complete products
- Quick connection: pre-assembled and pre-cabled indicator banks

All types of applications

Pre-assembled and pre-cabled indicator banks

Rotating mirror beacon: high degree of protection and high luminosity

Ø 70 XVD

IP40

- **Complete products or separate units for customer assembly**
- **Linear aesthetics**
- **Combined units secured by 1 screw throughout height of bank**

Ø 130 XVR

IP65

- **Rotating mirror beacon**
- **Visible from 100 m**
- **5 colours**

Ø 107 XVS

IP40

- **Siren, 106 dB**
- **Audible from 100 m**
- **1 or 2 tone**

Degree of protection	IP40	IP65	IP40
Assembly of units	Pre-assembled and pre-cabled or customer assembled	Pre-defined	Pre-defined
Type of light source	Base mounted protected LED or incandescent bulb (7 W max.) Flash unit, 5 J	Halogen (70 W) or incandescent (25 W) bulb Rotating mirror	-
Type of audible signalling	Buzzer, 90 dB (adjustable)	-	Adjustable, 1 or 2 tones, 106 dB
Mounting connection	Assembly using only 1 screw / connection to colour coded wires	Direct mounting on machine	Direct mounting on machine
Colour of base unit	black	black	black
Colour of illuminated units	6 colours	5 colours	-
Standards and approvals	CE UL CSA PCT	CE PCT	CE PCT
Supply voltages	24 V AC/DC 120 V AC 230 V AC	24 V AC/DC 120 V AC 230 V AC	24 V AC/DC 120 V AC 230 V AC

The efficiency of Telemecanique branded *solutions*

Used in combination, Telemecanique products provide quality solutions, meeting all your Automation & Control applications requirements.

Harmony

is also a complete range of pushbuttons, switches and pilot lights, wall mounting control stations and enclosures, cam switches and foot switches, that are both simple to install and robust.

A worldwide presence

Constantly available worldwide

- More than 5000 points of sale in 130 countries.
- You can be sure to find the range of products that are right for your and which complies fully with the standards in the country where they are used.

Technical assistance wherever you are

- Our technicians are at your disposal to assist you in finding the optimum solution for your particular needs.
- Schneider Electric provides you with all necessary technical assistance, throughout the world.

Simply Smart!

Schneider Electric Industries S.A.

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FRANCE

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http://www.telemecanique.com

Owing to changes in standards and equipment, the characteristics given in the text and images in this document are not binding until they have been confirmed with us.

Design/Production: (Japa)
Photos : Schneider Electric

DIA4ED1041002EN

ART. 804857

02/2005

ZB4BS834

ZB4BT4

ZB4BS64

ZB4BS74

Mushroom Heads for Maintained Push Buttons

Shape of Head	Type of Push	Diameter of Head	Color	Catalog Number	Price
	Trigger action Push-pull■	40 mm	Red	ZB4BT84	**$26.90**
	Trigger action Turn-to-release■	30 mm	Red	ZB4BS834	**56.00**
		40 mm	Red	ZB4BS844	**56.00**
			Red marked “EMO”	ZB4BS84430	**59.00**
	Trigger action Key release (No. 455)▲■	30 mm	Red	ZB4BS934	**56.00**
		40 mm	Red	ZB4BS944▲	**56.00**
		60 mm	Red	ZB4BS964	**56.00**
	Push-pull	40 mm	Black	ZB4BT2	**20.20**
			Red	ZB4BT4	
		60 mm	Black	ZB4BX2	**23.00**
			Red	ZB4BX4	
	Turn-to-release	30 mm	Black	ZB4BS42	**39.00**
			Red	ZB4BS44	
		40 mm	Black	ZB4BS52	**39.00**
			Red	ZB4BS54	
			Red marked “EMO”	ZB4BS5430	**42.40**
			Yellow	ZB4BS55	**39.00**
			Yellow marked “Robot Stop”	ZB4BS5550	**42.40**
		60 mm	Black	ZB4BS62	**44.80**
			Red	ZB4BS64	
	Key release (No. 455) ▲	30 mm	Black	ZB4BS72	**56.00**
			Red	ZB4BS74	
		40 mm	Black	ZB4BS12	**56.00**
			Red	ZB4BS14▲	
		60 mm	Black	ZB4BS22	**56.00**
			Red	ZB4BS24	

▲ Other key numbers:
—key no. 421E: add the suffix 12 to the catalog number.
—key no. 458A: add the suffix 10 to the catalog number.
—key no. 520E: add the suffix 14 to the catalog number.
—key no. 3131A: add the suffix 20 to the catalog number.
Example:
The catalog number for a Ø 40 mm red mushroom head for a trigger action, maintained push button, with release by key no. 421E becomes: ZB4BS94412.

■ Trigger action mushroom heads are tamper proof in that a change of contact state is not possible by teasing or floating the operator.

ZBY9330

Circular Legends for Emergency Stop Mushroom Heads (yellow background)

Diameter	Text	Catalog Number	Price
60 mm	Blank	ZBY9101	**$1.70**
	EMERGENCY STOP	ZBY9330	
90 mm	Blank	ZBY8101	
	EMERGENCY STOP	ZBY8330	

For additional information, reference Catalog #9001CT0001.

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8/1/04

Schneider Electric USA
1415 South Roselle Road
Palatine, IL 60067
Customer Care Center: 1-888-778-2733
Web: www.schneider-electric.us

Item # XVBC4B4, Tower Lights XVBC - Lens Unit

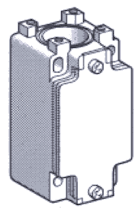
Tower Lights XVBC - Lens Unit

Lens Unit

SPECIFICATIONS

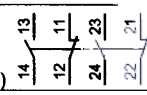
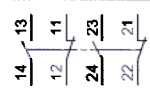
UL File	E164353 CCN NKCR
CSA File	LR44087 Class 3211-03
CE Marked	Yes
RoHS compliant	Yes
NEMA / IP Rating	NEMA 4X/12 - IP65
Housing Color	Black
Lens Color	Red
Bulb Color	not applicable
Supply Voltage	24V AC - 24/48V DC
Signaling Effect	Flashing Light (10W max bulb)
Mounting Type	Integrated Locking Ring
Size	70mm diameter
Terminal Type	Screw Clamp
Comments	must order bulb separately

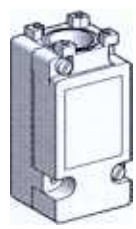
Metal, Fixed or Plug-in Body (2)
Adaptable Sub-Assemblies



ZCKJ●

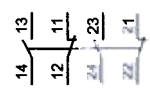
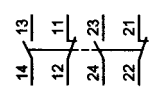
Fixed body/contact assemblies for plunger or rotary head

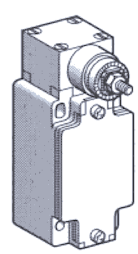
Type	Contact block	Scheme	Positive operation (1)	Catalogue number	Price
1 step	2-pole 1 N/C + 1 N/O snap action (XESP2151)		⊖	ZCKJ1H7	$120.
	Double-pole 2 C/O simultaneous snap action (XESP2021)		–	ZCKJ2H7	160.
	2-pole 1 N/C + 1 N/O break before make slow break (XENP2151)		⊖	ZCKJ5H7	128.
	Double-pole 2 C/O staggered snap action (XESP2031)		–	ZCKJ4H7	176.



ZCKJ●1

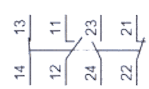
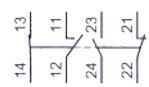
Plug-in body/contact assemblies for plunger or rotary head

Type	Contact block	Scheme	Positive operation (1)	Catalogue number	Price
1 step	Single-pole 1 C/O snap action				$120.
	Double-pole 2 C/O simultaneous snap action			ZCKJ21H7	160.
2 step	Double-pole 2 C/O staggered snap action		–	ZCKJ41H7	176.



ZCKJ404

Body/contact assemblies with spring return rotary head (without operating lever)

Type	Contact block	Scheme	Positive operation (1)	Catalogue number	Price
Fixed body					
2 step 1 from the left and 1 from the right	Double-pole 2 C/O staggered snap action		–	ZCKJ404H7	$280.
Plug-in body					
2 step 1 from the left and 1 from the right	Double-pole 2 C/O staggered snap action		–	ZCKJ4104H7	360.

(1) ⊖ : N/C contact with positive opening operation.
(2) Special versions - 40°C or + 120°C available.

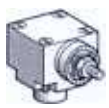
Accessories ..... see pages 5/15 - 5/17
Dimensions ..... see pages 5/19 - 5/20
Wiring ..... see page 5/18

How to Order:

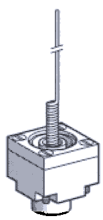
To Order Specify:	Example
● Catalogue Number	ZCKJ1H7

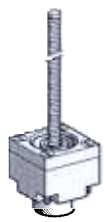
BACK TO MENU

Metal, Fixed or Plug-in Body (4)
Adaptable Sub-Assemblies

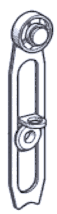

ZCKE05

ZCKE09


ZCKE06

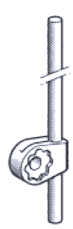

ZCKE08

ZCKY1●


ZCKY4●

ZCKY51

ZCKY5●


ZCKY59

ZCKY81

ZCKY91

ZCKY71

ZCKY61

Rotary heads (without operating lever)

Type	Compatible bodies	Max. actuation speed	Positive operation (1)	Catalogue number	Price
Spring return, actuation from left AND right or from left OR right	ZCKJ●, ZCKJ●●, ZCKJ●D	1.5 m/s by 30° cam	⊖	**ZCKE05**	**$80.**
Stay put, actuation from left AND right	ZCKJ1, J2 ZCKJ11, J21 ZCKJ1D	0.5 m/s	–	**ZCKE09**	**104.**

Multi-directional heads

Type of operator	Compatible bodies	Max. actuation speed	Positive operation (1)	Catalogue number	Price
For actuation by any moving part					
"Cat's whisker"	ZCKJ●, ZCK●● ZCKJ●D except ZCKJ4 and J41	1 m/s in any direction	–	**ZCKE06**	**$80.**
Spring rod lever	ZCKJ●, ZCKJ●● ZCKJ●D except ZCKJ4 and J41	0.5 m/s in any direction	–	**ZCKE08**	**80.**

Operating levers for rotary heads

Description		Positive operation (1)	Catalogue number	Price
For actuation by 30° cam				
Roller lever (2)	thermoplastic	⊖	**ZCKY11**	**$24.**
	steel	⊖	**ZCKY13**	**24.**
	steel, ball bearing mounted	⊖	**ZCKY14**	**56.**
Variable length roller lever (3)	thermoplastic		**ZCKY41**	**24.**
	steel		**ZCKY43**	**24.**
For actuation by any moving part				
Square rod (2)	Ø 3 mm steel, L = 125 mm		**ZCKY51**	**24.**
Round rod (2)	Ø 3 mm steel, L = 125 mm	–	**ZCKY53**	**24.**
	Ø 3 mm glass fibre, L = 125 mm	–	**ZCKY52**	**24.**
	Ø 6 mm en thermoplastic, L = 200 mm		**ZCKY59**	**24.**
Spring lever (3)			**ZCKY81**	**24.**
Spring metal rod lever (3)		–	**ZCKY91**	**24.**
For actuation by specific cam (for operation with ZCKE09 head only)				
Forked arm (2) and rollers ermoplastic	1 track	–	**ZCKY71**	**40.**
	2 track	–	**ZCKY61**	**40.**

(1) ⊖ : operating head or lever able to guarantee positive opening operation .
(2) Adjustable throughout 360° in 5° steps, or in 45° steps by reversing the lever mounting or clamp.
(3) Adjustable throughout 360° in 5° steps.
(4) Special versions - 40°C or + 120°C available.

Metal, Fixed or Plug-in Body
General Characteristics

Environment

Conforming to standards	Products	IEC 947-5-1, IEC 337-1, EN 60 947-5-1, NF C 63-146, VDE 0660-200, UL 508, CSA C22-2 n° 14
	Machine assemblies	IEC 204-1, EN 60 204-1, NF C 79-130
Approvals		CSA A300, UL A300 Listed, NEMKO FI 10 (4) A-400 V, GL, BV, USSR A300=fixed, A600=plug-in
Protective treatment		Standard version : "TC". Special version : "TH"
Ambient air temperature		Operation : - 25...+ 70 °C. Storage : - 40...+ 70 °C Special sub-assemblies available for extreme operating temperatures (- 40°C or + 120 °C)
Vibration resistance		25 gn (10...500 Hz) conforming to IEC 68-2-6
Shock resistance		50 gn (11 ms) conforming to IEC 68-2-27
Electric shock resistance		Class I conforming to IEC 536 and NF C 20-030
Degree of protection		**IP 66 conforming to IEC 529 ; IP 667 conforming to NF C 20-010**
Repeat accuracy		0.01 mm on the tripping points
Cable entry		1/2" NPT

Contact block characteristics

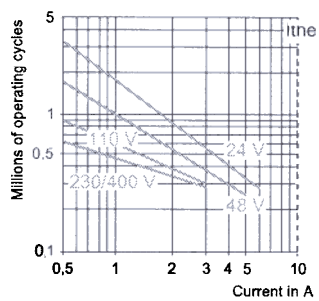
Rated operational characteristics	**~ AC-15 ; A300 (Ue = 240 V, Ie = 3 A)** **⎓ DC-13 ; Q300 (Ue = 250 V, Ie = 0.27 A) conforming to IEC 947-5-1 Appendix A, EN 60 947-5-1**
Rated insulation voltage	Ui = 500 V degree of pollution 3 conforming to IEC 947-1 and VDE 0110, group C conforming to NF C 20-040 Ui = 300 V conforming to UL 508, CSA C22-2 n° 14
Rated impulse withstand voltage	U imp = 6 kV conforming to IEC 947-1, IEC 664
Positive operation (varies by model)	N/C contacts with positive opening operation conforming to IEC 947-5-1 Section 3, EN 60 947-5-1
Resistance across terminals	≤ 25 mΩ conforming to NF C 93-050 method A or IEC 255-7 category 3
Short-circuit protection	10 A cartridge fuse type gG (gl)
Cabling	Screw and captive cable clamp terminals. **XESP2151** and **XESP2141** : Clamping capacity, min. : 1 x 0.34 mm², max. : 2 x 1.5 mm² **XENP21●1** : Clamping capacity, min. : 1 x 0.5 mm², max. : 2 x 2.5 mm² **XCKJ plug-in and XESP20●1:** Clamping capacity, min. : 1 x 0.75 mm², max. : 2 x 1.5 mm²
Minimum actuation speed	**XESP2151, XCKJ plug-in, XESP20●1** : 0.001 m/minute, **XENP21●1** : 0.001 m/second

Electrical durability

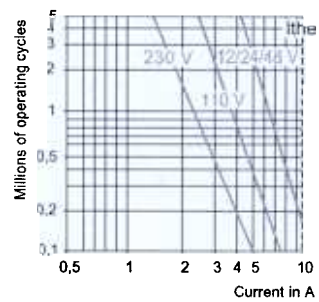
Conforming to IEC 947-5-1 Appendix C.
Utilisation categories AC-15 and DC-13.
Maximum operating rate : 3600 operating cycles per hour.
Load factor : 0.5

a.c. supply ~ 50/60 Hz
mm inductive circuit

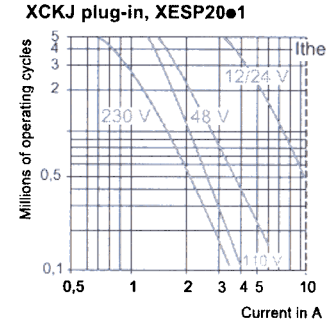
XESP2151, XESP2141



XENP21●1



XCKJ plug-in, XESP20●1



d.c. supply ⎓

Power broken in W for 5 million operating cycles

Voltage	V	24	48	120
mm	W	10	7	4

For XES-P2151 on ⎓ or ~ N/C and N/O contacts simultaneously loaded to the values shown with reverse polarity.

Power broken in W for 5 million operating cycles

Voltage	V	24	48	120
mm	W	13	9	7

Power broken in W for 5 million operating cycles

Voltage	V	24	48	120
mm	W	10	7	4

5 MECHANICAL DETECTION

Wiring

Figure A

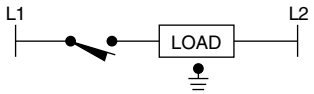
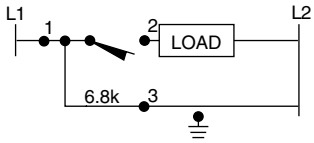


Figure B



Connect terminal 3 (heater) to line (L2) for operation below +32°F.

Specifications

Mechanical			
Temperature range		+32° F to 140° F (0° C to 60° C)	
		+30° F to 85° F (-35° C to 30° C) for SGO8110	
Enclosure ratings	NEMA Type	1, 4, 13	
Vibration resistance		20 G (10 to 2000 Hz)	
Shock resistance		50 G @ 11 ms	
Differential		Max. 50%	
Repeatability		Max. 0.003"	
Electrical		**Reed**	**Triac**
Voltage drop		–	3 V
Minimum load current (mA)		–	15 mA
On delay mS		2 ms	2 ms
Off delay mS		2 ms	2 ms
Cable - screw terminals			#16 AWG
Agency Listings		E 42259 CCN NKCR2	LR 25490 Class 3211 03

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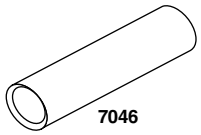

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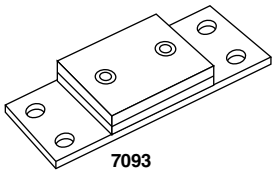

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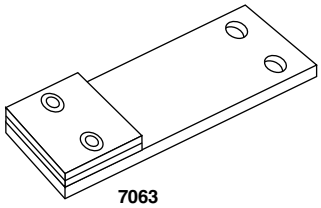

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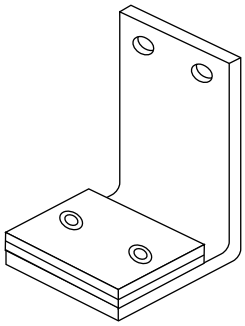

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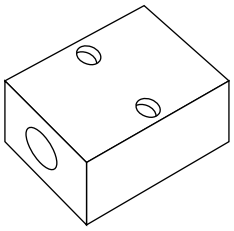

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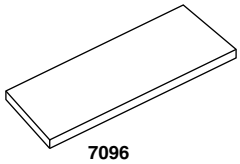

7096

Features:

- Industrial grade magnet recommended for magnet actuated proximity sensors.
- Alnico is used as magnet material for all rigid models.
- Kevlar is used for the flexible magnetic tape.
- The rigid models are already mounted on several types of standard brackets for convenience (except the tubular “high power” version).
- Both South and North Poles are accessible and marked. **The South Pole version is the standard.** North Pole versions may be required in conjunction with the maintained magnetic switch (see page 308).
- For comparison an average magnetic strength rating is listed below. Measurements were made with a Gaussmeter at 0.13" from the sensing surface.

Description		Magnetic Strength	Catalog Number
Tubular		700 Gauss	**7046**
Flat bracket, center	South pole	330 Gauss	**7093**
	North pole	330 Gauss	**7547**
Flat bracket, side	South pole	240 Gauss	**7063**
	North pole	240 Gauss	**70631**
90° bracket	South pole	260 Gauss	**7062**
	North pole	260 Gauss	**70621**
Block type		340 Gauss	**7099**
Flexible tape	1' long	180 Gauss	**7096∗**

∗ For longer tape specify total length in feet. Example: 70966 = 6 feet.

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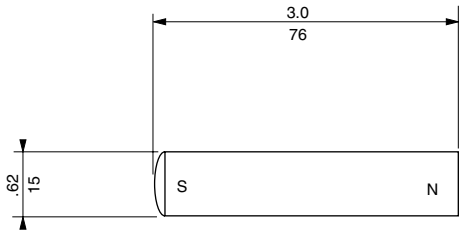
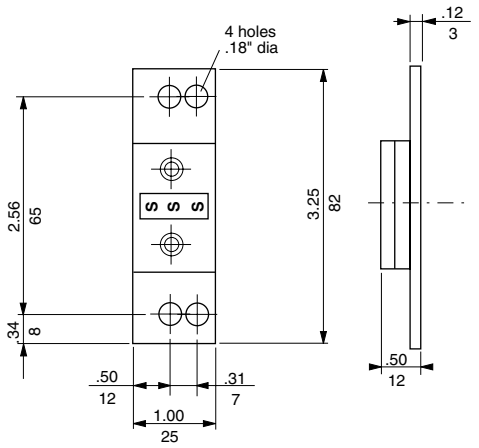
Magnet actuator dimensions

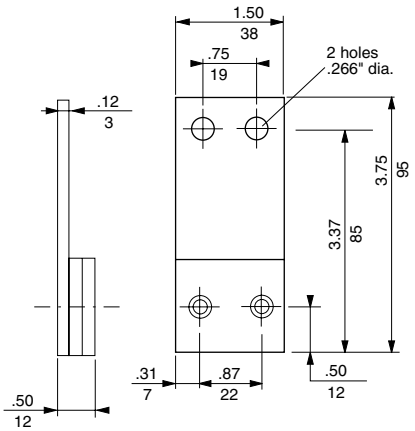
Tubular magnet actuator 7046



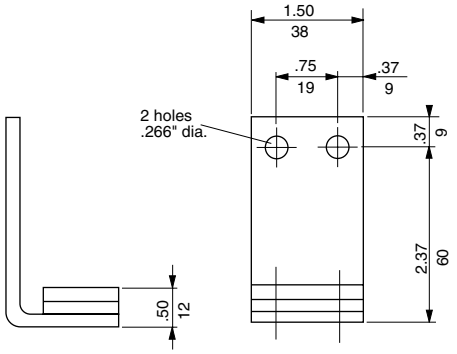
Magnet actuator 7093 (south pole)
Magnet actuator 7597 (north pole)



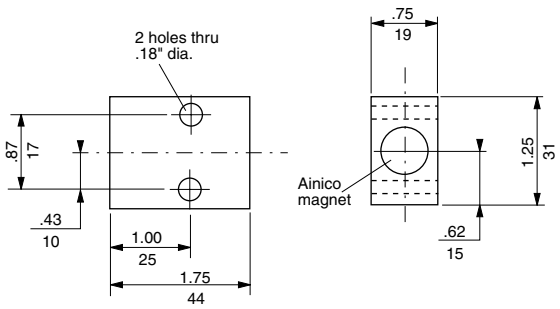
Magnetic actuator 7063 (south pole)
Magnet actuator 70631 (north pole)



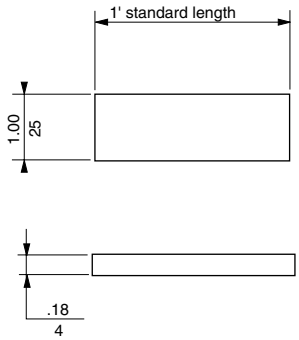
Magnet actuator 7062 (south pole)
Magnet actuator 70621 (north pole)



Block type magnet actuator 7099



Flexible magnetic tape 7096 1 foot



Dual Dimensions $\frac{\text{inches}}{\text{mm}}$

Proximity Sensors

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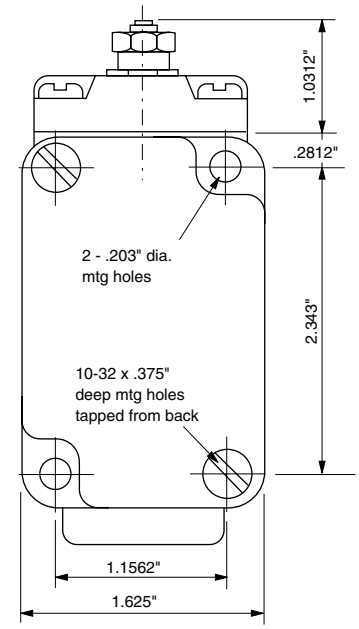

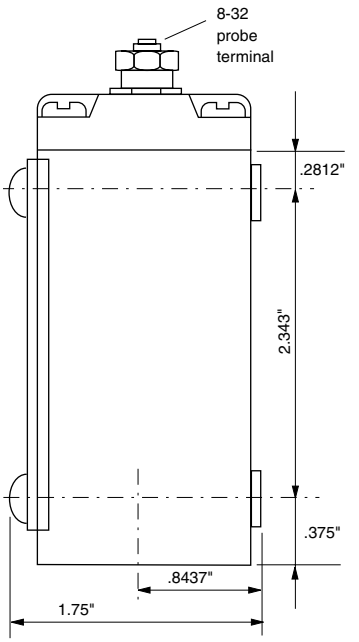

The touch switch is a highly reliable AC solid state presence sensor designed for precise conductivity sensing. Applications include high temperature environment, light conductive, aggressive mechanical and chemical environments that targets positive end-point sensing. All models have a visible neon pilot light to indicate operation of the switch.

Features

- Housings - zinc die cast
- Solid state - no moving parts
- 115 Vac completely self-contained
- Probes up to 10 feet long
- High current output - no relay required for most applications
- Fast response - no warm-up time
- 0.5" NPT conduit entrance
- UL Recognized

Operation

The switch is actuated when a conductive path between probe terminal and ground (1 MΩ or less) is established. The electrical contact to ground operates the switching thyristor. Internal RC snubber and varistor provide effective protection from typical transients. Normal open models have a 10 millisecond (maximum) turn on time. Different off delay times are offered in order that the design engineer may compensate for relay chatter when the probe is subjected to “bounce” from irregular contact with the grounded metal point of contact.

NOTE: For isolated circuits where the ground is not common - the switch ground terminal should be connected to the neutral. The metal target to be detected by the probe should then be wired also to the neutral.

Probe characteristics

The probe terminal is an 8-32 stud protruding from the center of the head. Extensions may be any **electrically conductive wire** or material suitably **insulated from grounded** surface and **limited in length to 10** feet or less.

- Open voltage: 12 Vdc
- Peak current: 1 mA

Switch models

Circuit type	Voltage (nominal)	Current load (max.)	Leakage current (max.)	On delay	Off delay	Catalog Number
Terminal screws						
N.O.	120 Vac	3 Amp	1.7 mA	10 ms	100 ms	**STO8164**
N.C.	120 Vac	3 Amp	1.7 mA	100 ms	30m s	**ST18165**
N.O.	120 Vac	3 Amp	1.7 mA	10 ms	400 ms	**STO8166**
N.O.	120 Vac	3 Amp	1.7 mA	10 ms	20 ms	**STO8167**
Pre wired with 3 feet of cable						
N.O.	120 Vac	3 Amp	1.7 mA	10 ms	100 ms	**STO8001**
N.C.	120 Vac	3 Amp	1.7 mA	100 ms	30 ms	**ST18002**
N.O.	120 Vac	3 Amp	1.7 mA	10 ms	400 ms	**STO8036**
N.O.	120 Vac	3 Amp	1.7 mA	10 ms	20 ms	**STO8042**

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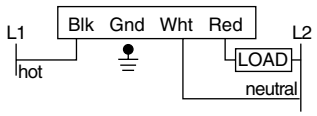
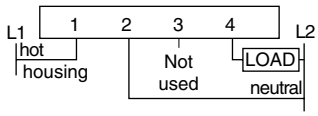
Wiring

Cable wiring



Target connected to ground

Terminal strip wiring



Target connected to ground
Housing must be grounded for proper operation.

Model ST switches may be wired in series or parallel. Connect red lead to black lead of other switch (terminal 4 to terminal 1 of other switch) for series operation. The voltage drop across each switch (in the closed state) does not exceed 2 volts AC.

Specifications

General characteristics		
Temperature range		-40° F to 158° F (-40° C to 70° C)
Enclosure ratings	NEMA Type	1, 4, 13
Voltage drop		2 V
Inrush current maximum		10 Amp
Minimum load current		15 mA
Power supply current (no load)		30 mA
Cable		3' 16-4 SJTO or terminal screws #16 AWG

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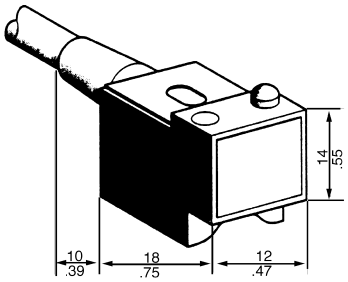
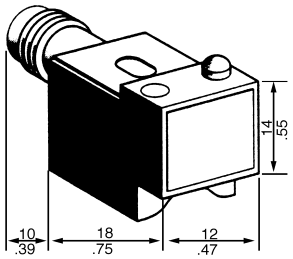


Cable



Nano style connector

Dual Dimensions $\frac{\text{inches}}{\text{mm}}$

Description

Detects the magnet installed on the piston through a non-ferrous cylinder wall. Universal mounting provided by clamp style and strap style mounting. Fast troubleshooting aided by output LED. Trouble-free operation insured by extensive protective circuitry. Connector versions.

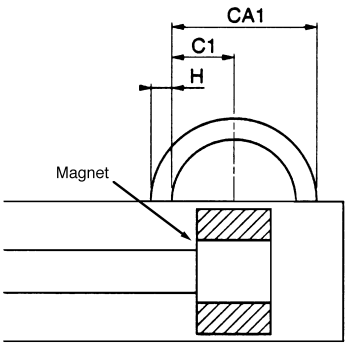
Circuit type	Nominal Sensing Range ∗	Output mode	Load current maximum	Voltage maximum	Mating connector style	Catalog Number
2m Cable						
PNP	3.5 mm	N.O.	100 mA	10-30 Vdc	–	**XS7V12PA332**
NPN	3.5 mm	N.O.	100 mA	10-30 Vdc	–	**XS7V12NA332**
Connector - Nano style						
PNP	3.5 mm	N.O.	100 mA	10-30 Vdc	1 thru 8	**XS7V12PA332S**
NPN	3.5 mm	N.O.	100 mA	10-30 Vdc	1 thru 8	**XS7V12NA332S**

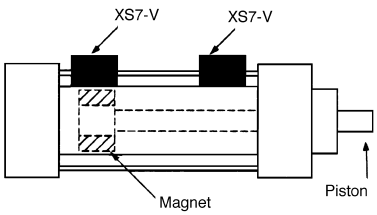
∗ At 11mT.

Application Information

The XS7V sensors detect the magnetic field generated by a magnet. The sensors are mounted in general on the cylinder. The magnets are mounted on the end of the piston and influence the sensor through a non- ferrous cylinder wall (i.e. aluminum). The sensors can be mounted anywhere along the cylinder using mounting accessories such as the ones shown on the next page.

Cylinder Diameter		Active Travel CA1		Travel C1		Hysteresis H	
IN	mm	IN	mm	IN	mm	IN	mm
0.39	10	0.28	7.2	0.13	3.25	0.028	0.70
0.47	12	0.31	7.8	0.14	3.45	0.028	0.70
0.63	16	0.33	8.5	0.15	3.80	0.035	0.90
0.79	20	0.37	9.3	0.17	4.20	0.035	0.90
0.98	25	0.40	10.2	0.18	4.60	0.039	1.00
1.26	32	0.43	11	0.20	5.00	0.039	1.00
1.57	40	0.47	12	0.22	5.50	0.039	1.00
1.97	50	0.47	12	0.22	5.50	0.039	1.00
2.48	63	0.55	14	0.26	6.50	0.039	1.00
3.15	80	0.63	16	0.30	7.50	0.039	1.00
3.94	100	0.71	18	0.33	8.50	0.039	1.00





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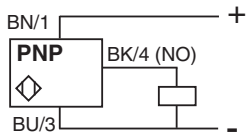
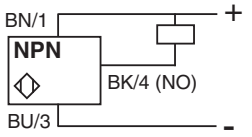
Wiring

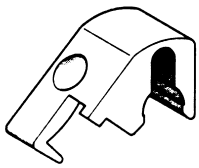
3 wire, PNP



3 wire, NPN



Stainless Steel Mounting Collar



Mounting Bracket for Cylinder Rods

Specifications

Mechanical		
Sensing range @ 11 mT		0 to 3.5mm
Standard Temperature range	Operating	-10° C to 60° C (+ 14° F to + 140° F)
	Storage	-40° C to + 70° C (-40° F to + 158° F)
Enclosure rating	NEMA Type	
	IEC Type	IP67
Enclosure material		Plastic
Repeatability		0.1 mm
Electrical		
Voltage range		12 to 24 Vdc
Voltage limit (including ripple)		10 to 30 Vdc
Voltage drop (across switch), closed state		0.5 V
Maximum load current		100 mA
Current consumption (no load)		30m A
Actuation speed (max.)		10 ms
Response time		3 ms

Options

Description		Suffix
Extended cable length	5 meter cable	L1
	10 meter cable	L2

Accessories

Description	Cylinder Diameter mm/in	Catalog Number	Sold in Lots of
Stainless steel mounting collar	10 / 0.39	**XSZB210**	5
Stainless steel mounting collar	12 / 0.47	**XSZB212**	5
Stainless steel mounting collar	16 / 0.63	**XSZB216**	5
Stainless steel mounting collar	20 / 0.79	**XSZB220**	5
Stainless steel mounting collar	25 / 0.98	**XSZB225**	5
Mounting bracket (for cylinder rods)	32 / 1.26 to 40 / 1.57	**XSZB240**	1
Mounting bracket (for cylinder rods)	50 / 1.97 to 63 / 2.48	**XSZB263**	1
Mounting bracket (for cylinder rods)	80 / 3.15 to 100 / 3.94	**XSZB200**	1

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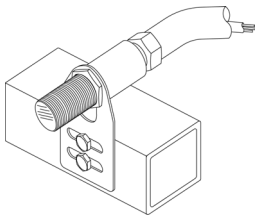
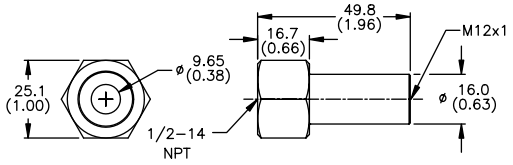
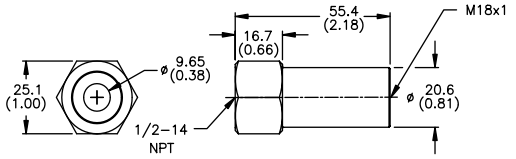
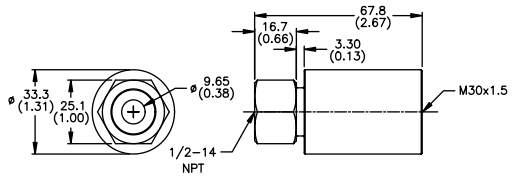
Proximity Sensors
Inductive Sensor Accessories
Conduit Adapters for Tubular Sensors



Features:

- Available for 12, 18 and 30mm tubular sensors
- 1/2" – 14 NPT Inside Thread
- Nickel Plated Brass

Tube Diameter	Tube Thread Size	Dimensions (mm)	Catalog Number
12mm (0.47)	M12 x 1		**XSZCAR12**
18mm (0.71)	M18 x 1		**XSZCAR18**
30mm (1.18)	M30 x 1.5		**XSZCAR30**

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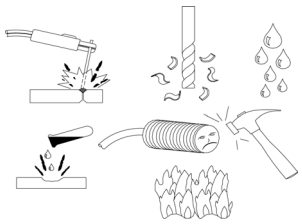
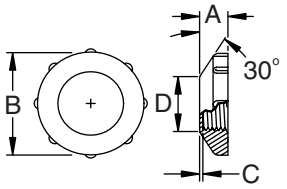


Features:

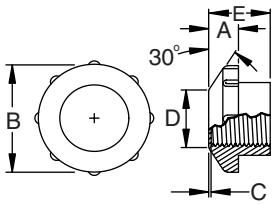
- Shielded and non-shielded caps available
- Different versions available (beveled or non-beveled)
- Provides sensor face protection with no effect in operation

Description

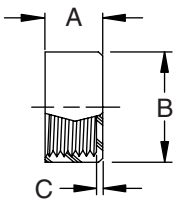
Protection in harsh applications, helps to prevent abrasions, cracks, and other possible damage to the sensors face. Available in many different materials Ceramic, Delrin (Acetal), and Teflon. Provide your sensor with protection and a longer life without the additional charge of a stainless steel face option.



XSZEN••



XSZENN••



XSZSC••••

Beveled caps (30 ° chamfer)

A	B	C	D	E	Catalog Number
8 mm Diameter shielded					
5.1 (0.20)	15.1 (0.59)	0.38 (0.15)	7.00 (0.28)	–	**XSZEN08**
12 mm Diameter shielded					
6.2 (0.26)	24.1 (0.95)	0.76 (0.03)	12.2 (0.48)	–	**XSZEN12**
18 mm Diameter shielded					
8.2 (0.32)	31.2 (1.23)	0.76 (0.03)	17.0 (0.67)	–	**XSZEN18**
30 mm Diameter shielded					
7.6 (0.30)	44.5 (1.75)	1.01 (0.04)	29.0 (1.19)	–	**XSZEN30**
8 mm Diameter non-shielded					
5.1 (0.20)	14.1 (0.56)	0.38 (0.15)	7.00 (2.76)	9.60 (0.37)	**XSZENN08**
12 mm Diameter non-shielded					
6.5 (0.26)	22.9 (0.90)	0.76 (0.03)	12.9 (0.51)	17.3 (0.68)	**XSZENN12**
18 mm Diameter non-shielded					
8.2 (0.32)	34.0 (1.34)	0.76 (0.03)	16.6 (0.65)	17.8 (0.70)	**XSZENN18**
30 mm Diameter non-shielded					
7.5 (0.30)	44.5 (1.75)	1.01 (0.04)	30.0 (1.18)	22.8 (0.90)	**XSZENN30**

Non-beveled caps

A	B	C	Catalog Number
12 mm Diameter shielded			
8.90 (0.35)	16.1 (0.63)	1.26 (0.05)	**XSZSC12C**
8.90 (0.35)	16.1 (0.63)	0.76 (0.03)	**XSZSC12D**
8.90 (0.35)	16.1 (0.63)	0.76 (0.03)	**XSZSC12T**
12 mm Diameter non-shielded			
15.2 (0.60)	16.1 (0.63)	0.76 (0.03)	**XSZSC12ND**
15.2 (0.60)	16.1 (0.63)	0.76 (0.03)	**XSZSC12NT**
18 mm Diameter shielded			
8.80 (0.35)	24.4 (0.96)	1.27 (0.05)	**XSZSC18D**
8.80 (0.35)	24.4 (0.96)	1.27 (0.05)	**XSZSC18T**
18 mm Diameter non-shielded			
18.0 (0.59)	24.4 (0.96)	1.27 (0.05)	**XSZSC18ND**
18.0 (0.59)	24.4 (0.96)	1.27 (0.05)	**XSZSC18NT**

Dual Dimensions $\frac{\text{inches}}{\text{mm}}$

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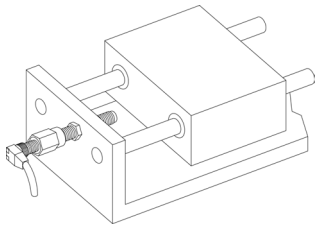
Proximity Sensors
Inductive Sensor Accessories
Plunger Screw Adapters



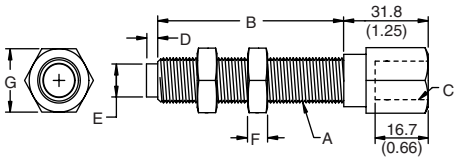
Features

- Accepts 8, 12, or 18mm shielded sensor
- Heat-treated alloy steel construction
- Rugged stop with solid state output

Description

Plunger Screw Adapters provide the ability for a shielded inductive proximity sensor to be used as a mechanical stop switch. Helps to solve many applications that require precise end of travel signals, or a hard stop. Spring requires 252g (9oz) to actuate sensor.

A	B	C	D	E (Dia.)	F	G	Impact Force (Max.)	Catalog Number
8 mm Diameter Shielded Sensors								
M8x1	25.0 (1.00)	M8x1	3.16 (0.12)	5.84 (0.23)	6.26 (0.24)	11.0 (0.43)	2000 N (450 lb-ft)	**XSZB0825**
M8x1	50.0 (2.00)	M8x1	3.16 (0.12)	5.84 (0.23)	6.26 (0.24)	11.0 (0.43)	2000 N (450 lb-ft)	**XSZB0850**
12 mm Diameter Shielded Sensors								
M12x1	25.0 (1.00)	M12x1	4.32 (0.17)	9.40 (0.37)	4.22 (0.17)	15.7 (0.62)	20,500 N (4608 lb-ft)	**XSZB1225**
M12x1	50.0 (2.00)	M12x1	4.32 (0.17)	9.40 (0.37)	4.22 (0.17)	15.7 (0.62)	20,500 N (4608 lb-ft)	**XSZB1250**
M12x1	75.0 (3.00)	M12x1	4.32 (0.17)	9.40 (0.37)	4.22 (0.17)	15.7 (0.62)	20,500 N (4608 lb-ft)	**XSZB1275**
M12x1	100 (4.00)	M12x1	4.32 (0.17)	9.40 (0.37)	4.22 (0.17)	15.7 (0.62)	20,500 N (4608 lb-ft)	**XSZB1210**
18 mm Diameter Shielded Sensors								
M18x1	25.0 (1.00)	M18x1	4.32 (0.17)	14.2 (0.56)	4.22 (0.17)	22.1 (0.87)	45,000 N (10,115lbft)	**XSZB1825**
M18x1	50.0 (2.00)	M18x1	4.32 (0.17)	14.2 (0.56)	4.22 (0.17)	22.1 (0.87)	45,000 N (10,115lbft)	**XSZB1850**
M18x1	75.0 (3.00)	M18x1	4.32 (0.17)	14.2 (0.56)	4.22 (0.17)	22.1 (0.87)	45,000 N (10,115lbft)	**XSZB1875**
M18x1	100 (4.00)	M18x1	4.32 (0.17)	14.2 (0.56)	4.22 (0.17)	22.1 (0.87)	45,000 N (10,115lbft)	**XSZB1810**



XSZB●●●●

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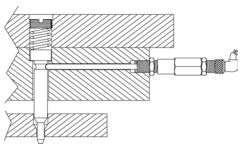


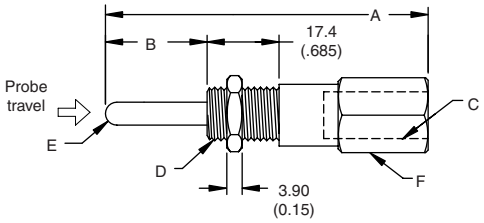
Features:

- Accepts any 8 or 12mm shielded sensor
- Accurate and compact switching in confined areas
- Large variety of stand probe lengths and diameters

Description

Proximity Probe is a spring loaded actuator designed to work with 8mm or 12mm cylindrical inductive proximity sensors. The probe and sensor combination offers increased flexibility in applications that require tight positioning.

A	B	C	D	E (Dia.)	F	Catalog Number
8 mm Diameter Shielded Sensor						
75.6 (2.98)	25.0 (1.00)	M8 x 1 to depth of 21.8 (0.86)	M8 x 1	3.18 (.125)	11.1 (.436)	**XSZPP0825**
99.6 (3.92)	50.0 (2.00)	M8 x 1 to depth of 21.8 (0.86)	M8 x 1	3.18 (.125)	11.1 (.436)	**XSZPP0850**
126 (4.96)	75.0 (3.00)	M8 x 1 to depth of 21.8 (0.86)	M8 x 1	3.18 (.125)	11.1 (.436)	**XSZPP0875**
150 (5.91)	100 (4.00)	M8 x 1 to depth of 21.8 (0.86)	M8 x 1	3.18 (.125)	11.1 (.436)	**XSZPP0810**
12 mm Diameter Shielded Sensor						
75.6 (2.98)	25.0(1.00)	M12 x 1 to depth of 18.0 (0.71)	M12 x 1	6.35 (0.25)	15.8 (.623)	**XSZPP1225**
99.6 (3.92)	50.0 (2.00)	M12 x 1 to depth of 18.0 (0.71)	M12 x 1	6.35 (0.25)	15.8 (.623)	**XSZPP1250**
126 (4.96)	75.0 (3.00)	M12 x 1 to depth of 18.0 (0.71)	M12 x 1	6.35 (0.25)	15.8 (.623)	**XSZPP1275**
150 (5.91)	100 (4.00)	M12 x 1 to depth of 18.0 (0.71)	M12 x 1	6.35 (0.25)	15.8 (.623)	**XSZPP1210**



XSZPP●●●●

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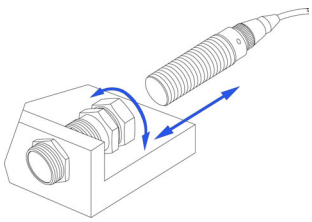
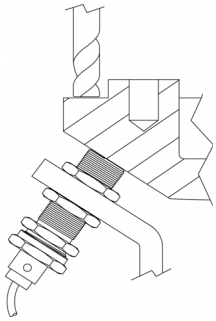




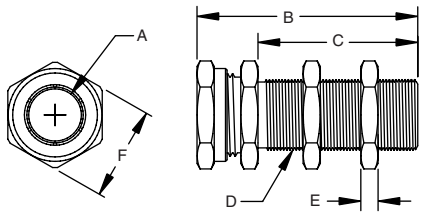
Features:

- Quick change mounting available for 8,12,18 and 30mm sensors
- Short and Long barrel lengths available
- One time adjustment, makes sensor replacement easy and quick
- Provide protection to sensor from impact and damage
- Teflon caps available for quick change mounts (shown below)

Description

Provides time savings in maintenance of sensors, helps prevent downtime. An internal shoulder stop and a collet-style locknut precisely holds the sensor. This helps to maintain a precise sensing distance and reduces the required expertise needed during sensor installation.

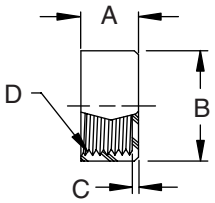
A	B	C	D	E	F	Catalog Number
8 mm Diameter Shielded Sensors						
8.18 (0.32)	32.4 (1.28)	17.5 (0.69)	M12x1	3.85 (0.15)	16.9 (0.67)	**XSZQT08**
8.18 (0.32)	48.0 (1.90)	34.0 (1.34)	M12x1	3.85 (0.15)	16.9 (0.67)	**XSZQTL08**
12 mm Diameter Shielded Sensors						
12.1 (0.48)	33.7 (1.34)	19.5 (0.77)	M16.5x1.5	4.01 (0.16)	21.8 (0.86)	**XSZQT12**
12.1 (0.48)	44.8 (1.76)	30.0 (1.18)	M16.5x1.5	4.01 (0.16)	21.8 (0.86)	**XSZQTL12**
18 mm Diameter Shielded Sensor						
18.1 (0.71)	38.5 (1.52)	20.0 (0.79)	M24 x 1.5	4.95 (0.19)	30.0 (1.18)	**XSZQT18**
18.1 (0.71)	58.0 (2.28)	40.0 (1.57)	M24 x 1.5	4.95 (0.19)	30.0 (1.18)	**XSZQTL18**
30 mm Diameter Shielded Sensors						
30.1 (1.19)	35.0 (1.50)	20.0 (0.79)	M36 x 1.5	6.13 (0.24)	41.0 (1.61)	**XSZQT30**
30.1 (1.19)	58.0 (2.28	40.0 (1.57)	M36 x 1.5	6.13 (0.24)	41.0 (1.61)	**XSZQTL30**



XSZQT●●●

Teflon Caps for Quick change mounting tubes

A	B	C	D	Catalog Number
8.84 (0.35)	14.8 (0.59)	0.76 (0.03)	M12x1	**XSZQTC08**
7.24 (0.29)	19.9 (0.75)	0.76 (0.03	M16x1	**XSZQTC12**
9.00 (0.35)	28.7 (1.13)	0.76 (0.03	M24x1.5	**XSZQTC18**
9.00 (0.35)	41.4 (1.63)	1.26 (0.05)	M36x1.5	**XSZQTC30**



XSZQTC●●

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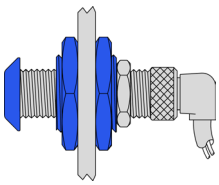


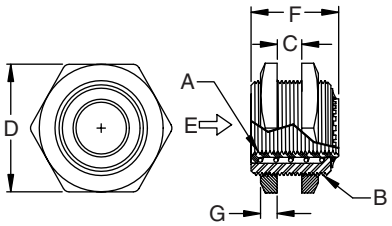
Features:

- Accepts 8, 12, 18 & 30mm shielded or non-shielded sensors
- Sensors become unaffected by accidental impact
- Shielded and Non-shielded caps available, see page 313.

Description

Spring loaded sensor mount for tubular body styles provides impact protection for the sensor in the case of target over travel. The mount is designed to be threaded onto a tubular sensor and held in place by using one of the mounting nuts provided with the sensor. Caps are available to help protect the face of the sensor from lateral and axial impacts, see page 313.

A Inside Thread	B Outside Thread	C Maximum	D Across Flats	E Maximum Over travel	F	G	Catalog Number
8 mm Diameter Sensors							
M8 x 1	M16 x 1.5	12.2 (.481)	22.2 (.875)	9.22 (.363)	22.0 (.867)	3.10 (.155)	**XSZSN08**
12 mm Diameter Sensors							
M12 x 1	M18 x 1	10.0 (.394)	23.9 (.943)	12.1 (.476)	21.3 (.840)	3.94 (.156)	**XSZSN12LP**
M12 x 1	M22 x 1.5	11.5 (.454)	28.4 (1.12)	10.5 (.413)	22.1 (.871)	3.88 (.153)	**XSZSN12**
18 mm Diameter Sensors							
M18 x 1	M30 x 1.5	16.1 (.634)	34.8 (1.37)	13.3 (.523)	29.7 (1.17)	5.08 (0.20)	**XSZSN18**
30 mm Diameter Sensors							
M30 x 1.5	M47 x 1.5	24.6 (.972)	50.8 (2.00)	15.6 (.615)	37.0 (1.37)	4.98 (.196)	**XSZSN30**



XSZSN••

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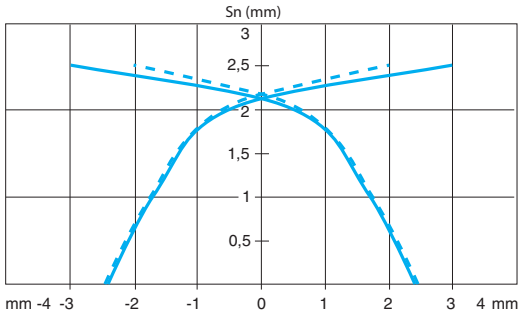
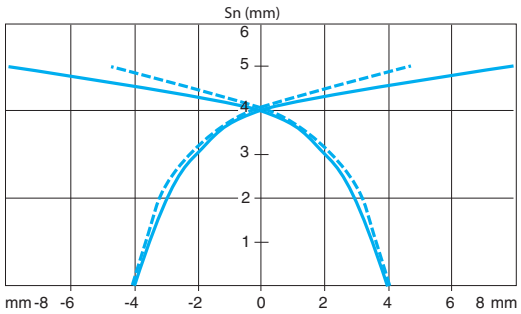
Telemecanique

Shielded



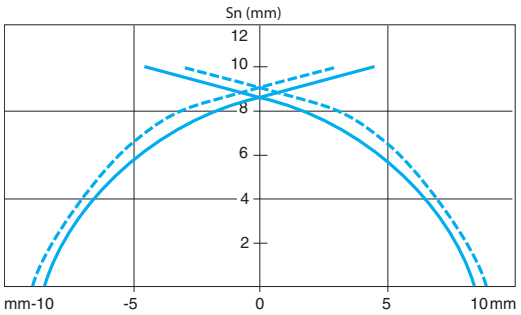
	Target size	Usable range
	mm	mm
XS7J1A1D	5 x 5 x 1	0 . . . 2

_____ pick up points
- - - - - - - - drop out points



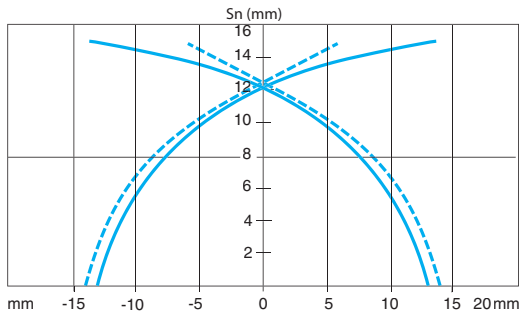
	Target size	Usable range
	mm	mm
XS7F1A1D	5 x 5 x 1	0 . . . 4

_____ pick up points
- - - - - - - - drop out points



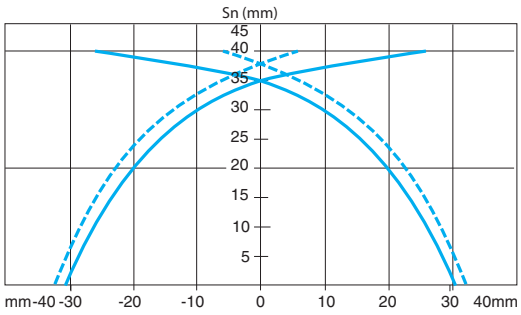
	Target size	Usable range
	mm	mm
XS7E1A1D	8 x 8 x 1	0 . . . 8
XS7E1A1C	8 x 8 x 1	0 . . . 8

_____ pick up points
- - - - - - - - drop out points



	Target size	Usable range
	mm	mm
XS7C1A1D	18 x 18 x 1	0 . . . 12
XS7C1A1C	18 x 18 x 1	0 . . . 12

_____ pick up points
- - - - - - - - drop out points



	Target size	Usable range
	mm	mm
XS7D1A1D	30 x 30 x 1	0 . . . 32
XS7D1A1C	30 x 30 x 1	0 . . . 32

_____ pick up points
- - - - - - - - drop out points

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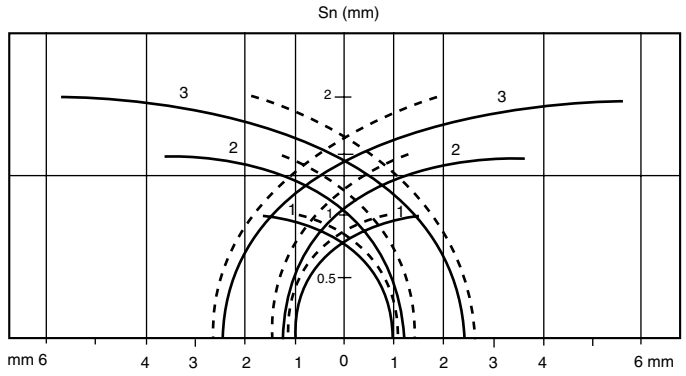
Shielded

1 ø 4 XS1
ø 5 (M5x0.5) XS1

2 ø 6.5 XS1
ø 8 (M8x1) XS1, XS3

3 ø 12 (M12x1)
XS1, XS3

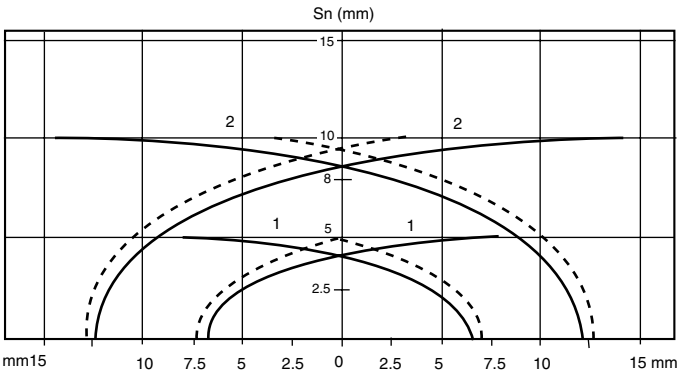


Standard targets	Size	Usable range
	mm	mm
4	5 x 5 x 1	0 . . . 0.8
5	5 x 5 x 1	0 . . . 0.8
6.5	8 x 8 x 1	0 . . . 1.2
8	8 x 8 x 1	0 . . . 1.2
12	12 x 12 x 1	0 . . . 1.6

_____ pick up points
- - - - - - - - drop out points

1 ø 18 (M18x1)
XS1, XS3

2 ø 30 (M30x1.5)
XS1, XS3



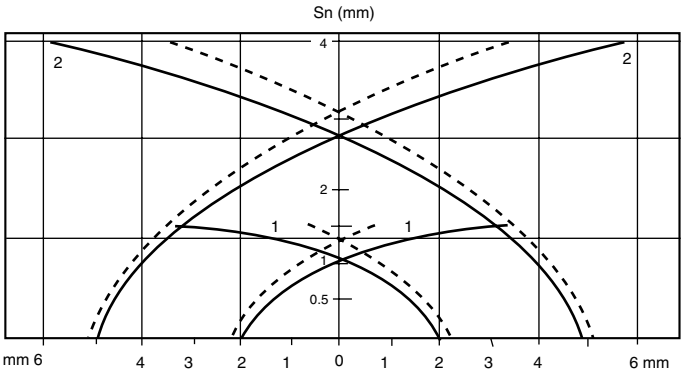
Standard targets	Size	Usable range
	mm	mm
18	18 x 18 x 1	0 . . . 4
30	30 x 30 x 1	0 . . . 8

_____ pick up points
- - - - - - - - drop out points

Non-Shielded and Extended Range

1 ø 8 (M8x1)
XS1, XS2, XS4

2 ø 12 (M12x1)
XS1, XS2, XS4

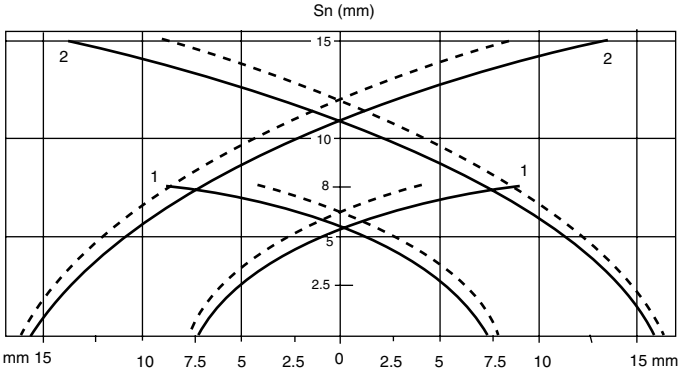


Standard targets	Size	Usable range
	mm	mm
8	8 x 8 x 1	0 . . . 2
12	12 x 12 x 1	0 . . . 3.2

_____ pick up points
- - - - - - - - drop out points

1 ø 18 (M18x1) XS1,
XS2, XS4

2 ø 30 (M30x1.5) XS1,
XS2, XS4



Standard targets	Size	Usable range
	mm	mm
18	24 x 24 x 1	0 . . . 6.4
30	45 x 45 x 1	0 . . . 12

_____ pick up points
- - - - - - - - drop out points

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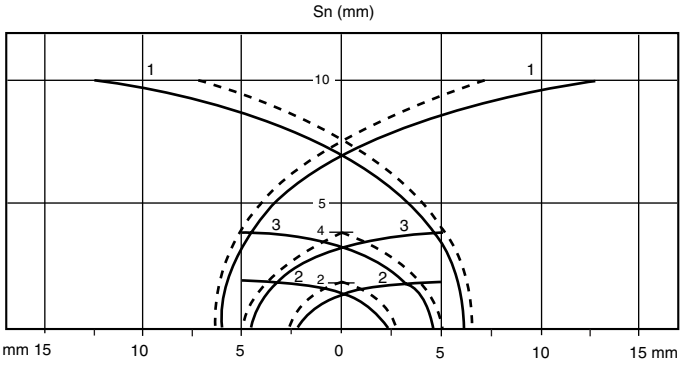
1 shielded, XSEC10

2 shielded, XSG•02

3 non-shielded, XSG•04

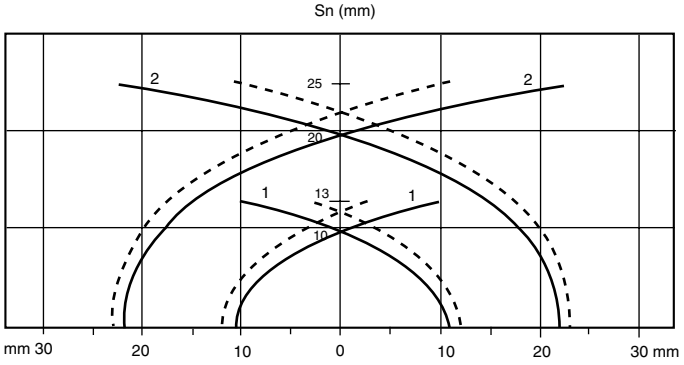


Standard targets	Size	Usable range
	mm	mm
XSEC10	30 x 30 x 1	0 . . . 8
XSG•02	12 x 12 x 1	0 . . . 1.6
XSG•04	12 x 12 x 1	0 . . . 3.2

_____ pick up points
- - - - - - - - drop out points

1 XSB•10

2 XSB•25

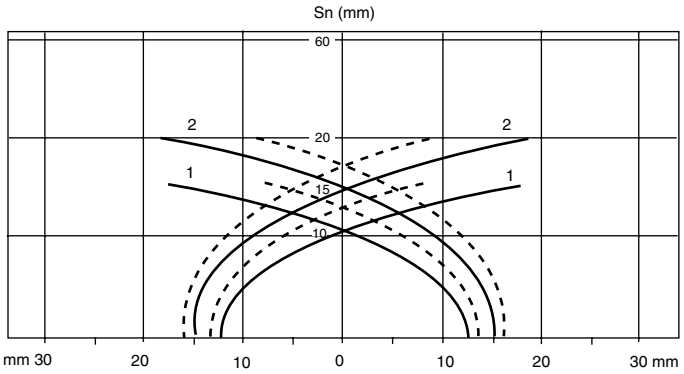


Standard targets	Size	Usable range
	mm	mm
XSB•10	40 x 40 x 1	0 . . . 9
XSB•25	75 x 75 x 1	0 . . . 20

_____ pick up points
- - - - - - - - drop out points

1 shielded, XS7

2 non-shielded, XS8

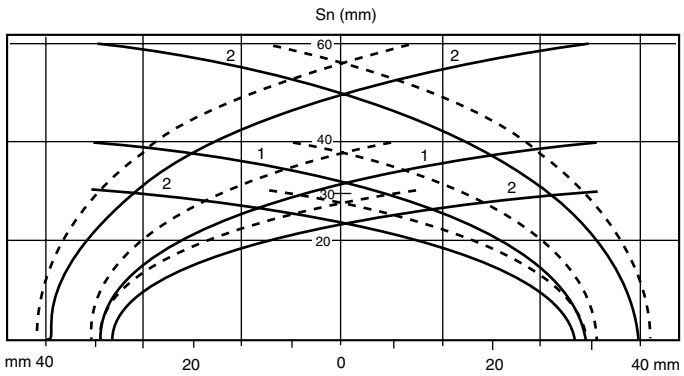


Standard targets	Size	Usable range
	mm	mm
XSC/XS7	45 x 45 x 1	0 . . . 12
XSC/XS8	60 x 60 x 1	0 . . . 16

_____ pick up points
- - - - - - - - drop out points

1 fixed sensing distance, XSD•40

2 adjustable sensing distance, XSD•60



Standard targets	Size	Usable range
	mm	mm
XSD•40	120 x 120 x 1	0 . . . 32
XSD•60	180 x 180 x 1	0 . . . 48

_____ pick up points
- - - - - - - - drop out points

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Old Design	New Design
8 mm Cylindrical ⎓	
XS1M08DA210	**XS508B1DAL2**
XS1M08DA210D	**XS508B1DAM12**
XS1M08DA210L1	**XS508B1DAL5**
XS1M08DA210L2	**XS508B1DAL10**
XS1M08DA210LD	**XS508B1DAL08M12**
XS1M08DB210	**XS508B1DBL2**
XS1M08DB210D	**XS508B1DBM12**
XS1M08DB210L1	**XS508B1DBL5**
XS1M08NA370	**XS608B1NAL2**
XS1M08NA370D	**XS608B1NAM12**
XS1M08NA370L1	**XS608B1NAL5**
XS1M08NB370	**XS608B1NBL2**
XS1M08NB370D	**XS608B1NBM12**
XS1M08NC410	**XS508B1NAL2**
XS1M08NC410	**XS508B1NBL2**
XS1M08NC410D	**XS508B1NAM8**
XS1M08NC410D	**XS508B1NBM8**
XS1M08PA370	**XS608B1PAL2**
XS1M08PA370D	**XS608B1PAM12**
XS1M08PA370L1	**XS608B1PAL5**
XS1M08PA370L2	**XS608B1PAL10**
XS1M08PA370LD	**XS608B1PAL08M12**
XS1M08PA370S	**XS608B1PAM12**
XS1M08PB370	**XS608B1PBL2**
XS1M08PB370D	**XS608B1PBM12**
XS1M08PB370L1	**XS608B1PBL5**
XS1M08PB370L2	**XS608B1PBL10**
XS1M08PC410	**XS508B1PAL2**
XS1M08PC410	**XS508B1PBL2**
XS1M08PC410D	**XS508B1PAM8**
XS1M08PC410D	**XS508B1PBM8**
XS1N08NA340D	**XS508B1NAM8**
XS1N08NA340L1	**XS508B1NAL5**
XS1N08NA340L2	**XS508B1NAL10**
XS1N08NA340S	**XS508B1NAM8**
XS1N08NA349	**XS608B1NAL2**
XS1N08NA349D	**XS608B1NAM12**
XS1N08NA349L1	**XS608B1NAL5**
XS1N08NA349S	**XS608B1NAM12**
XS1N08NB340	**XS508B1NBL2**
XS1N08NB340D	**XS508B1NBM8**
XS1N08NB340S	**XS508B1NBM8**
XS1N08NB349	**XS608B1NBL2**
XS1N08NB349D	**XS608B1NBM12**
XS1N08NB349S	**XS608B1NBM12**
XS1N08PA340	**XS508B1PAL2**
XS1N08PA340D	**XS508B1PAM8**
XS1N08PA340L1	**XS508B1PAL5**
XS1N08PA340L2	**XS508B1PAL10**
XS1N08PA340LD	**XS508B1PAL08M12**
XS1N08PA340S	**XS508B1PAM8**
XS1N08PA349	**XS608B1PAL2**
XS1N08PA349D	**XS608B1PAM12**
XS1N08PA349L1	**XS608B1PAL5**
XS1N08PA349L2	**XS608B1PAL10**
XS1N08PA349S	**XS608B1PAM12**
XS1N08PB340	**XS508B1PBL2**
XS1N08PB340D	**XS508B1PBM8**
XS1N08PB340L1	**XS508B1PBL5**
XS1N08PB340S	**XS508B1PBM8**
XS1N08PB349	**XS608B1PBL2**
XS1N08PB349D	**XS608B1PBM12**
XS1N08PB349L1	**XS608B1PBL5**
XS1N08PB349L2	**XS608B1PBL10**
XS1N08PB349S	**XS608B1PBM12**
XS2M08NA340	**XS608B1NAL2**
XS2M08NC410	**XS608B1NAL2**
XS2M08NC410	**XS608B1NBL2**
XS2M08NC410D	**XS608B1NAM12**
XS2M08NC410D	**XS608B1NBM12**
XS2M08PC410	**XS608B1PAL2**
XS2M08PC410	**XS608B1PBL2**
XS2M08PC410D	**XS608B1PAM12**
XS2M08PC410D	**XS608B1PBM12**
XS2N08NA340	**XS608B1NAL2**
XS2N08NA340D	**XS608B1NAM8**
XS2N08NA340L1	**XS608B1NAL5**
XS2N08NA340S	**XS608B1NAM8**
XS2N08NB340	**XS608B1NBL2**
XS2N08PA340	**XS608B1PAL2**
XS2N08PA340D	**XS608B1PAM8**
XS2N08PA340L1	**XS608B1PAL5**
XS2N08PA340L2	**XS608B1PAL10**
XS2N08PA340S	**XS608B1PAM8**
XS2N08PB340	**XS608B1PBL2**
XS2N08PB340D	**XS608B1PBM8**
XS2N08PB340S	**XS608B1PBM8**
XS3P08NA340	**XS508B1NAL2**
XS3P08NA340D	**XS508B1NAM8**
XS3P08NA370	**XS608B1NAL2**
XS3P08PA340	**XS508B1PAL2**
XS3P08PA340D	**XS508B1PAM12**
XS3P08PA340L1	**XS508B1PAL5**
XS3P08PA370	**XS608B1PAL2**
12 mm Cylindrical ⎓	
XS1M12DA210	**XS512B1DAL2**
XS1M12DA210D	**XS512B1DAM12**
XS1M12DA210L1	**XS512B1DAL5**
XS1M12DA210L2	**XS512B1DAL10**
XS1M12DB210	**XS512B1DBL2**
XS1M12DB210D	**XS512B1DBM12**
XS1M12DB210L1	**XS512B1DBL5**
XS1M12KP340	**XS508B1PAL2**
XS1M12KP340	**XS508B1PBL2**
XS1M12KP340	**XS508B1NAL2**
XS1M12KP340	**XS508B1NBL2**
XS1M12KP340D	**XS508B1PAM8**
XS1M12KP340D	**XS508B1PBM8**
XS1M12KP340D	**XS508B1NAM8**
XS1M12KP340D	**XS508B1NBM8**
XS1M12KP340L1	**XS508B1PAL5**
XS1M12KP340L1	**XS508B1PBL5**
XS1M12KP340L1	**XS508B1NAL5**
XS1M12KP340L1	**XS508B1NBL5**
XS1M12KP340L2	**XS508B1PAL10**
XS1M12KP340L2	**XS508B1PBL10**
XS1M12KP340L2	**XS508B1NAL10**
XS1M12KP340L2	**XS508B1NBL10**
XS1M12NA370	**XS612B1NAL2**
XS1M12NA370D	**XS612B1NAM12**
XS1M12NA370L1	**XS612B1NAL5**
XS1M12NA370L2	**XS612B1NAL10**
XS1M12NA370S	**XS612B1NAM12**
XS1M12NB370	**XS612B1NBL2**
XS1M12NB370D	**XS612B1NBM12**
XS1M12PA370	**XS612B1PAL2**
XS1M12PA370D	**XS612B1PAM12**
XS1M12PA370L1	**XS612B1PAL5**
XS1M12PA370L2	**XS612B1PAL10**
XS1M12PB370	**XS612B1PBL2**
XS1M12PB370D	**XS612B1PBM12**
XS1M12PB370L1	**XS612B1PBL5**
XS1N12NA340	**XS512B1NAL2**
XS1N12NA340D	**XS512B1NAM12**
XS1N12NA340L1	**XS512B1NAL5**
XS1N12NA349	**XS612B1NAL2**
XS1N12NA349D	**XS612B1NAM12**
XS1N12NA349L1	**XS612B1NAL5**
XS1N12NA349L2	**XS612B1NAL10**
XS1N12NB340	**XS512B1NBL2**
XS1N12NB340D	**XS512B1NBM12**
XS1N12NB349	**XS612B1NBL2**
XS1N12NB349D	**XS612B1NBM12**
XS1N12NB349L2	**XS612B1NBL10**
XS1N12NC410	**XS512B1NAL2**
XS1N12NC410	**XS512B1NBL2**
XS1N12NC410D	**XS512B1NBM12**
XS1N12NC410D	**XS512B1NAM12**
XS1N12NC410L1	**XS512B1NAL5**
XS1N12NC410L1	**XS512B1NBL5**
XS1N12PA340	**XS512B1PAL2**
XS1N12PA340D	**XS512B1PAM12**
XS1N12PA340L1	**XS512B1PAL5**
XS1N12PA340L2	**XS512B1PAL10**
XS1N12PA340S	**XS512B1PAM12**
XS1N12PA349	**XS612B1PAL2**
XS1N12PA349D	**XS612B1PAM12**
XS1N12PA349L1	**XS612B1PAL5**
XS1N12PA349L2	**XS612B1PAL10**
XS1N12PA349S	**XS612B1PAM12**
XS1N12PB340	**XS512B1PBL2**
XS1N12PB340D	**XS512B1PBM12**
XS1N12PB349	**XS612B1PBL2**
XS1N12PB349D	**XS612B1PBM12**

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Old Design	New Design	Old Design	New Design	Old Design	New Design
XS1N12PB349L1	**XS612B1PBL5**	XS2N12PA340	**XS612B1PAL2**	XS1M18NA370C	**XS618B1NAM12**
XS1N12PB349L2	**XS612B1PBL10**	XS2N12PA340D	**XS612B1PAM12**	XS1M18NA370D	**XS618B1NAM12**
XS1N12PB349S	**XS612B1PBM12**	XS2N12PA340L1	**XS612B1PAL5**	XS1M18NA370L1	**XS618B1NAL5**
XS1N12PC410	**XS512B1PAL2**	XS2N12PA340L2	**XS612B1PAL10**	XS1M18NA370L2	**XS618B1NAL10**
XS1N12PC410	**XS512B1PBL2**	XS2N12PB340	**XS612B1PBL2**	XS1M18NB370	**XS618B1NBL2**
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XS1N12PC410D	**XS512B1PBM12**	XS2N12PC410	**XS612B1PAL2**	XS1M18NB370D	**XS618B1NBM12**
XS1N12PC410L1	**XS512B1PAL5**	XS2N12PC410	**XS612B1PBL2**	XS1M18NB370L1	**XS618B1NBL5**
XS1N12PC410L1	**XS512B1PBL5**	XS2N12PC410D	**XS612B1PAM12**	XS1M18NB370L2	**XS618B1NBL10**
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XS2M12KP340L1	**XS612B1PAL5**	XS3P12PA370L1	**XS612B1PAL5**	XS1M18PB370B	**XS618B1PBM12**
XS2M12KP340L1	**XS612B1PBL5**	**18 mm Cylindrical ⎓**		XS1M18PB370C	**XS618B1PBM12**
XS2M12KP340L1	**XS612B1NAL5**	XS1M18DA210	**XS518B1DAL2**	XS1M18PB370D	**XS618B1PBM12**
XS2M12KP340L1	**XS612B1NBL5**	XS1M18DA210B	**XS518B1DAM12**	XS1M18PB370G	**XS618B1PBM12**
XS2M12KP340L2	**XS612B1PAL10**	XS1M18DA210C	**XS518B1DAM12**	XS1M18PB370L1	**XS618B1PAL5**
XS2M12KP340L2	**XS612B1PBL10**	XS1M18DA210D	**XS518B1DAM12**	XS1M18PB370L2	**XS618B1PAL10**
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XS2M12KP340L2	**XS612B1NBL10**	XS1M18DA210L1	**XS518B1DAL5**	XS1N18NA340D	**XS518B1NAM12**
XS2M12NA370	**XS612B1NAL2**	XS1M18DA210L2	**XS518B1DAL10**	XS1N18NA340L1	**XS518B1NAL5**
XS2M12NA370D	**XS612B1NAM12**	XS1M18DA210LD	**XS518B1DAL08M12**	XS1N18NA340L2	**XS618B1NAL10**
XS2M12NA370L1	**XS612B1NAL5**	XS1M18DA214D	**XS518B1CAM12**	XS1N18NA349	**XS618B1NAL2**
XS2M12NB370	**XS612B1NBL2**	XS1M18DA214LD	**XS518B1CAL08M12**	XS1N18NA349D	**XS618B1NAM12**
XS2M12NB370D	**XS612B1NBM12**	XS1M18DB210	**XS518B1DBL2**	XS1N18NA349L1	**XS618B1NAL5**
XS2M12PA370	**XS612B1PAL2**	XS1M18DB210B	**XS518B1DBM12**	XS1N18NB340	**XS518B1NBL2**
XS2M12PA370D	**XS612B1PAM12**	XS1M18DB210D	**XS518B1DBM12**	XS1N18NB340D	**XS518B1NBM12**
XS2M12PA370L1	**XS612B1PAL5**	XS1M18KP340	**XS518B1PAL2**	XS1N18NB349	**XS618B1NBL2**
XS2M12PA370L2	**XS612B1PAL10**	XS1M18KP340	**XS518B1PBL2**	XS1N18NB349D	**XS618B1NBM12**
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XS2M12PB370D	**XS612B1PBM12**	XS1M18KP340	**XS518B1NBL2**	XS1N18NC410	**XS518B1NBL2**
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XS2N12NA340	**XS612B1NAL2**	XS1M18KP340D	**XS518B1NBM12**	XS1N18NC410L1	**XS518B1NBL5**
XS2N12NA340D	**XS612B1NAM12**	XS1M18KP340L1	**XS518B1PAL5**	XS1N18PA340	**XS518B1PAL2**
XS2N12NA340L1	**XS612B1NAL5**	XS1M18KP340L1	**XS518B1PBL5**	XS1N18PA340D	**XS518B1PAM12**
XS2N12NA340L2	**XS612B1NAL10**	XS1M18KP340L1	**XS518B1NAL5**	XS1N18PA340L1	**XS518B1PAL5**
XS2N12NB340	**XS612B1NBL2**	XS1M18KP340L1	**XS518B1NBL5**	XS1N18PA340L2	**XS518B1PAL10**
XS2N12NB340D	**XS612B1NBM12**	XS1M18KP340L2	**XS518B1PAL10**	XS1N18PA349	**XS618B1PAL2**
XS2N12NC410	**XS612B1NAL2**	XS1M18KP340L2	**XS518B1PBL10**	XS1N18PA349D	**XS618B1PAM12**
XS2N12NC410	**XS612B1NBL2**	XS1M18KP340L2	**XS518B1NAL10**	XS1N18PA349L1	**XS618B1PAL5**
XS2N12NC410D	**XS612B1NAM12**	XS1M18KP340L2	**XS518B1NBL10**	XS1N18PA349L2	**XS618B1PAL10**
XS2N12NC410D	**XS612B1NBM12**	XS1M18NA370	**XS618B1NAL2**	XS1N18PA349S	**XS618B1PAM12**
XS2N12NC410L1	**XS612B1NAL5**	XS1M18NA370A	**XS618B1NAM12**	XS1N18PB340	**XS518B1PBL2**
XS2N12NC410L1	**XS612B1NBL5**	XS1M18NA370B	**XS618B1NAM12**	XS1N18PB340D	**XS518B1PBM12**

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Old Design	New Design	Old Design	New Design	Old Design	New Design
XS1N18PB340L2	**XS518B1PBL10**	XS2N18NC410	**XS618B1NBL2**	XS1M30NA370	**XS630B1NAL2**
XS1N18PB349	**XS618B1PBL2**	XS2N18NC410D	**XS618B1NAM12**	XS1M30NA370B	**XS630B1NAM12**
XS1N18PB349D	**XS618B1PBM12**	XS2N18NC410D	**XS618B1NBM12**	XS1M30NA370C	**XS630B1NAM12**
XS1N18PB349L1	**XS618B1PBL5**	XS2N18PA340	**XS618B1PAL2**	XS1M30NA370D	**XS630B1NAM12**
XS1N18PB349L2	**XS618B1PBL10**	XS2N18PA340D	**XS618B1PAM12**	XS1M30NA370G	**XS630B1NAM12**
XS1N18PB349S	**XS618B1PBM12**	XS2N18PA340L1	**XS618B1PAL5**	XS1M30NA370L1	**XS630B1NAL5**
XS1N18PC410	**XS518B1PAL2**	XS2N18PA340L2	**XS618B1PAL10**	XS1M30NA370L2	**XS630B1NAL10**
XS1N18PC410	**XS518B1PBL2**	XS2N18PB340	**XS618B1PBL2**	XS1M30NA370T	**XS630B1NAL2T**
XS1N18PC410D	**XS518B1PAM12**	XS2N18PB340D	**XS618B1PBM12**	XS1M30NB370	**XS630B1NBL2**
XS1N18PC410D	**XS518B1PBM12**	XS2N18PC410	**XS618B1PAL2**	XS1M30NB370B	**XS630B1NBM12**
XS1N18PC410L1	**XS518B1PAL5**	XS2N18PC410	**XS618B1PBL2**	XS1M30NB370D	**XS630B1NBM12**
XS1N18PC410L1	**XS518B1PBL5**	XS2N18PC410D	**XS618B1PAM12**	XS1M30PA349C	**XS630B1PAM12**
XS1N18PC410P	**XS518B1PAL10**	XS2N18PC410D	**XS618B1PBM12**	XS1M30PA349D	**XS630B1PAM12**
XS1N18PC410P	**XS518B1PBL10**	XS2N18PC410L1	**XS618B1PAL5**	XS1M30PA370	**XS630B1PAL2**
XS2M18KP340	**XS618B1PAL2**	XS2N18PC410L1	**XS618B1PBL5**	XS1M30PA370A	**XS630B1PAM12**
XS2M18KP340	**XS618B1PBL2**	XS3P18NA340	**XS518B1NAL2**	XS1M30PA370B	**XS630B1PAM12**
XS2M18KP340	**XS618B1NAL2**	XS3P18NA340D	**XS518B1NAM12**	XS1M30PA370C	**XS630B1PAM12**
XS2M18KP340	**XS618B1NBL2**	XS3P18NA370	**XS618B1NAL2**	XS1M30PA370D	**XS630B1PAM12**
XS2M18KP340D	**XS618B1PAM12**	XS3P18PA340	**XS518B1PAL2**	XS1M30PA370G	**XS630B1PAM12**
XS2M18KP340D	**XS618B1PBM12**	XS3P18PA340D	**XS518B1PAM12**	XS1M30PA370L1	**XS630B1PAL5**
XS2M18KP340D	**XS618B1NAM12**	XS3P18PA340L1	**XS518B1PAL5**	XS1M30PA370L2	**XS630B1PAL10**
XS2M18KP340D	**XS618B1NBM12**	XS3P18PA370	**XS618B1PAL2**	XS1M30PA370T	**XS630B1PAL2T**
XS2M18KP340L1	**XS618B1PAL5**	**30 mm Cylindrical ⎓**		XS1M30PB370	**XS630B1PBL2**
XS2M18KP340L1	**XS618B1PBL5**	XS1M30DA210	**XS530B1DAL2**	XS1M30PB370B	**XS630B1PBM12**
XS2M18KP340L1	**XS618B1NAL5**	XS1M30DA210B	**XS530B1DAM12**	XS1M30PB370C	**XS630B1PBM12**
XS2M18KP340L1	**XS618B1NBL5**	XS1M30DA210C	**XS530B1DAM12**	XS1M30PB370D	**XS630B1PBM12**
XS2M18KP340L2	**XS618B1PAL10**	XS1M30DA210D	**XS530B1DAM12**	XS1M30PB370G	**XS630B1PBM12**
XS2M18KP340L2	**XS618B1PBL10**	XS1M30DA210G	**XS530B1DAM12**	XS1M30PB370L1	**XS630B1PBL5**
XS2M18KP340L2	**XS618B1NAL10**	XS1M30DA210L1	**XS530B1DAL5**	XS1M30PB370L2	**XS630B1PBL10**
XS2M18KP340L2	**XS618B1NBL10**	XS1M30DA210L2	**XS530B1DAL10**	XS1N30NA340	**XS530B1NAL2**
XS2M18NA370	**XS618B1NAL2**	XS1M30DA210LA	**XS530B1DAM12**	XS1N30NA340D	**XS530B1NAM12**
XS2M18NA370C	**XS618B1NAM12**	XS1M30DA210LD	**XS530B1DAM12**	XS1N30NA349	**XS630B1NAL2**
XS2M18NA370D	**XS618B1NAM12**	XS1M30DB210	**XS530B1DBL2**	XS1N30NA349D	**XS630B1NAM12**
XS2M18NA370L1	**XS618B1NAL5**	XS1M30DB210B	**XS530B1DBM12**	XS1N30NA349L1	**XS630B1NAL5**
XS2M18NA370L2	**XS618B1NAL10**	XS1M30DB210D	**XS530B1DBM12**	XS1N30NA349L2	**XS630B1NAL10**
XS2M18NA370T	**XS618B1NAM12T**	XS1M30KP340	**XS530B1PAL2**	XS1N30NB340	**XS530B1NBL2**
XS2M18NB370	**XS618B1NBL2**	XS1M30KP340	**XS530B1PBL2**	XS1N30NB349	**XS630B1NBL2**
XS2M18NB370D	**XS618B1NBM12**	XS1M30KP340	**XS530B1NAL2**	XS1N30NB349D	**XS630B1NBM12**
XS2M18PA370	**XS618B1PAL2**	XS1M30KP340	**XS530B1NBL2**	XS1N30NC410	**XS530B1NAL2**
XS2M18PA370C	**XS618B1PAM12**	XS1M30KP340D	**XS530B1PAM12**	XS1N30NC410	**XS530B1NBL2**
XS2M18PA370D	**XS618B1PAM12**	XS1M30KP340D	**XS308B1PBM12**	XS1N30NC410D	**XS530B1NAM12**
XS2M18PA370G	**XS618B1PAM12**	XS1M30KP340D	**XS530B1NAM12**	XS1N30NC410D	**XS530B1NBM12**
XS2M18PA370L1	**XS618B1PAL5**	XS1M30KP340D	**XS530B1NBM12**	XS1N30PA340	**XS530B1PAL2**
XS2M18PA370L2	**XS618B1PAL10**	XS1M30KP340L1	**XS530B1PAL5**	XS1N30PA340D	**XS530B1PAM12**
XS2M18PA370T	**XS618B1PAL2T**	XS1M30KP340L1	**XS530B1PBL5**	XS1N30PA340L1	**XS530B1PAL5**
XS2M18PB370	**XS618B1PBL2**	XS1M30KP340L1	**XS530B1NAL5**	XS1N30PA340L2	**XS530B1PAL10**
XS2M18PB370C	**XS618B1PBM12**	XS1M30KP340L1	**XS530B1NBL6**	XS1N30PA349	**XS630B1PAL2**
XS2M18PB370D	**XS618B1PBM12**	XS1M30KP340L2	**XS530B1PAL10**	XS1N30PA349D	**XS630B1PAM12**
XS2M18PB370G	**XS618B1PBM12**	XS1M30KP340L2	**XS530B1PBL10**	XS1N30PA349L1	**XS630B1PAL5**
XS2M18PB370L1	**XS618B1PBL5**	XS1M30KP340L2	**XS530B1NAL10**	XS1N30PA349L2	**XS630B1PAL10**
XS2M18PB370L2	**XS618B1PBL10**	XS1M30KP340L2	**XS530B1NBL10**	XS1N30PA349S	**XS630B1PAM12**
XS2N18NA340	**XS618B1NAL2**	XS1M30KP370	**XS630B1PAL2**	XS1N30PB340	**XS530B1PBL2**
XS2N18NA340D	**XS618B1NAM12**	XS1M30KP370	**XS630B1PBL2**	XS1N30PB340D	**XS530B1PBM12**
XS2N18NA340L1	**XS618B1NAL5**	XS1M30KP370	**XS630B1NAL2**	XS1N30PB349	**XS630B1PBL2**
XS2N18NC410	**XS618B1NAL2**	XS1M30KP370	**XS630B1NBL2**	XS1N30PB349D	**XS630B1PBM12**

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Old Design	New Design	Old Design	New Design	Old Design	New Design
XS1N30PB349L1	**XS630B1PBL5**	XS2N30PB340D	**XS630B1PBM12**	XS1M18MA230B	**XS618B1MAU20**
XS1N30PB349L2	**XS630B1PBL10**	XS2N30PC410	**XS630B1PAL2**	XS1M18MA230C	**XS618B1MAU20**
XS1N30PC410	**XS530B1PAL2**	XS2N30PC410	**XS630B1PBL2**	XS1M18MA230G	**XS618B1MAU20**
XS1N30PC410	**XS530B1PBL2**	XS2N30PC410D	**XS630B1PAM12**	XS1M18MA230K	**XS618B1MAU20**
XS1N30PC410D	**XS530B1PAM12**	XS2N30PC410D	**XS630B1PBM12**	XS1M18MA230L1	**XS618B1MAL5**
XS1N30PC410D	**XS530B1PBM12**	XS2N30PC410L1	**XS630B1PAL5**	XS1M18MA230L2	**XS618B1MAL10**
XS1N30PC410L1	**XS530B1PAL5**	XS2N30PC410L1	**XS630B1PBL5**	XS1M18MA230T	**XS618B1MAL2T**
XS1N30PC410L1	**XS530B1PBL5**	XS3P30NA340	**XS530B1NAL2**	XS1M18MA239	**XS618B1MAL2**
XS1N30PC410L2	**XS530B1PAL10**	XS3P30NA340D	**XS530B1NAM12**	XS1M18MA239A	**XS618B1MAU20**
XS1N30PC410L2	**XS530B1PBL10**	XS3P30NA370	**XS630B1NAL2**	XS1M18MA239K	**XS618B1MAU20**
XS2M30KP340	**XS630B1PAL2**	XS3P30PA340	**XS530B1PAL2**	XS1M18MA250	**XS618B1MAL2**
XS2M30KP340	**XS630B1PAL2**	XS3P30PA340D	**XS530B1PAM12**	XS1M18MA250A	**XS618B1MAU20**
XS2M30KP340	**XS630B1PAL2**	XS3P30PA340L1	**XS530B1PAL5**	XS1M18MA250H4	**XS618B1MAL2**
XS2M30KP340	**XS630B1PAL2**	XS3P30PA340L2	**XS530B1PAL10**	XS1M18MA250K	**XS618B1MAU20**
XS2M30KP340D	**XS630B1PAM12**	XS3P30PA370	**XS630B1PAL2**	XS1M18MA250KH4	**XS618B1MAU20**
XS2M30KP340D	**XS630B1PAM12**	XS3P30PA370L1	**XS630B1PAL5**	XS1M18MA250L1	**XS618B1MAL5**
XS2M30KP340D	**XS630B1PAM12**	XS3P30PA370L2	**XS630B1PAL10**	XS1M18MA250L2	**XS618B1MAL10**
XS2M30KP340D	**XS630B1PAM12**	**12 mm Cylindrical ∿**		XS1M18MB230	**XS618B1MBL2**
XS2M30KP340L1	**XS630B1PAL5**	XS1M12MA230	**XS612B1MAL2**	XS1M18MB230A	**XS618B1MBU20**
XS2M30KP340L1	**XS630B1PAL5**	XS1M12MA230K	**XS612B1MAU20**	XS1M18MB230B	**XS618B1MBU20**
XS2M30KP340L1	**XS630B1PAL5**	XS1M12MA230L1	**XS612B1MAL5**	XS1M18MB230C	**XS618B1MBU20**
XS2M30KP340L1	**XS630B1PAL5**	XS1M12MA230L2	**XS612B1MAL10**	XS1M18MB230G	**XS618B1MBU20**
XS2M30KP340L2	**XS630B1PAL10**	XS1M12MA239	**XS612B1MAL2**	XS1M18MB230K	**XS618B1MBU20**
XS2M30KP340L2	**XS630B1PAL10**	XS1M12MA239K	**XS612B1MAU20**	XS1M18MB230L1	**XS618B1MBL5**
XS2M30KP340L2	**XS630B1PAL10**	XS1M12MA250	**XS612B1MAL2**	XS1M18MB230L2	**XS618B1MBL10**
XS2M30KP340L2	**XS630B1PAL10**	XS1M12MA250K	**XS612B1MAU20**	XS1M18MB250	**XS618B1MBL2**
XS2M30NA370	**XS630B1NAL2**	XS1M12MA250L1	**XS612B1MAL5**	XS1M18MB250A	**XS618B1MBU20**
XS2M30NA370D	**XS630B1NAM12**	XS1M12MA250L2	**XS612B1MAL10**	XS1M18MB250K	**XS618B1MBU20**
XS2M30NA370L1	**XS630B1NAL5**	XS1M12MB230	**XS612B1MBL2**	XS1M18MB250L1	**XS618B1MBL5**
XS2M30NB370	**XS630B1NBL2**	XS1M12MB230K	**XS612B1MBU20**	XS1M18MB250L2	**XS618B1MBL10**
XS2M30NB370D	**XS630B1NBM12**	XS1M12MB230L1	**XS612B1MBL5**	XS2M18DA210L2	**XS612B1MAL10**
XS2M30PA370	**XS630B1PAL2**	XS1M12MB230L2	**XS612B1MBL10**	XS2M18MA230	**XS618B1MAL2**
XS2M30PA370C	**XS630B1PAM12**	XS1M12MB250	**XS612B1MBL2**	XS2M18MA230A	**XS618B1MAU20**
XS2M30PA370D	**XS630B1PAM12**	XS2M12MA230	**XS612B1MAL2**	XS2M18MA230C	**XS618B1MAU20**
XS2M30PA370G	**XS630B1PAM12**	XS2M12MA230K	**XS612B1MAU20**	XS2M18MA230G	**XS618B1MAU20**
XS2M30PA370L1	**XS630B1PAL5**	XS2M12MA230L1	**XS612B1MAL5**	XS2M18MA230K	**XS618B1MAU20**
XS2M30PA370L2	**XS630B1PAL10**	XS2M12MA230L2	**XS612B1MAL10**	XS2M18MA230L1	**XS618B1MAL5**
XS2M30PA370T	**XS630B1PAL2T**	XS2M12MA250	**XS612B1MAL2**	XS2M18MA230L2	**XS618B1MAL10**
XS2M30PB370	**XS630B1PBL2**	XS2M12MA250K	**XS612B1MAU20**	XS2M18MA230T	**XS618B1MAL2T**
XS2M30PB370C	**XS630B1PBM12**	XS2M12MA250L1	**XS612B1MAL5**	XS2M18MA250	**XS618B1MAL2**
XS2M30PB370D	**XS630B1PBM12**	XS2M12MA250L2	**XS612B1MAL10**	XS2M18MA250A	**XS618B1MAU20**
XS2M30PB370L1	**XS630B1PBL5**	XS2M12MB230	**XS612B1MBL2**	XS2M18MA250K	**XS618B1MAU20**
XS2M30PB370L2	**XS630B1PBL10**	XS2M12MB230K	**XS612B1MBU20**	XS2M18MA250L1	**XS618B1MAL5**
XS2N30NA340	**XS630B1NAL2**	XS2M12MB230L1	**XS612B1MBL5**	XS2M18MA250L2	**XS618B1MAL10**
XS2N30NA340D	**XS630B1NAM12**	XS2M12MB230L2	**XS612B1MBL10**	XS2M18MB230	**XS618B1MBL2**
XS2N30NB340	**XS630B1NBL2**	XS2M12MB250	**XS612B1MBL2**	XS2M18MB230A	**XS618B1MBU20**
XS2N30NC410	**XS630B1NAL2**	XS2M12MB250L1	**XS612B1MBL5**	XS2M18MB230C	**XS618B1MBU20**
XS2N30NC410	**XS630B1NBL2**	XS2M12MB250L2	**XS612B1MBL10**	XS2M18MB230G	**XS618B1MBU20**
XS2N30NC410D	**XS630B1NAM12**	XS3P12MA230	**XS612B1MAL2**	XS2M18MB230K	**XS618B1MBU20**
XS2N30NC410D	**XS630B1NBM12**	XS3P12MA230K	**XS612B1MAU20**	XS2M18MB230L1	**XS618B1MBL5**
XS2N30PA340	**XS630B1PAL2**	XS3P12MA230L1	**XS612B1MAL5**	XS2M18MB230L2	**XS618B1MBL10**
XS2N30PA340D	**XS630B1PAM12**	XS3P12MB230	**XS612B1MBL2**	XS2M18MB250	**XS618B1MBL2**
XS2N30PA340L1	**XS630B1PAL5**	**18 mm Cylindrical ∿**		XS2M18MB250A	**XS618B1MBU20**
XS2N30PA340L2	**XS630B1PAL10**	XS1M18MA230	**XS618B1MAL2**	XS2M18MB250K	**XS618B1MBU20**
XS2N30PB340	**XS630B1PBL2**	XS1M18MA230A	**XS618B1MAU20**	XS2M18MB250L1	**XS618B1MBL5**

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Old Design	New Design
XS2M18MB250L2	**XS618B1MBL10**
XS3P18MA230	**XS618B1MAL2**
XS3P18MA230A	**XS618B1MAU20**
XS3P18MA230K	**XS618B1MAU20**
XS3P18MA230L1	**XS618B1MAL5**
XS3P18MA230L2	**XS618B1MAL10**
XS3P18MB230	**XS618B1MBL2**
XS3P18MB230A	**XS618B1MBU20**
XS3P18MB230K	**XS618B1MBU20**
XS3P18MB230L1	**XS618B1MBL5**
30 mm Cylindrical ∿	
XS1M30MA230	**XS630B1MAL2**
XS1M30MA230A	**XS630B1MAU20**
XS1M30MA230B	**XS630B1MAU20**
XS1M30MA230C	**XS630B1MAU20**
XS1M30MA230G	**XS630B1MAU20**
XS1M30MA230K	**XS630B1MAU20**
XS1M30MA230L1	**XS630B1MAL5**
XS1M30MA230L2	**XS630B1MAL10**
XS1M30MA230T	**XS630B1MAL2T**
XS1M30MA239	**XS630B1MAL2**
XS1M30MA239A	**XS630B1MAU20**
XS1M30MA250	**XS630B1MAL2**
XS1M30MA250A	**XS630B1MAU20**
XS1M30MA250AH4	**XS630B1MAU20**
XS1M30MA250H4	**XS630B1MAL2**
XS1M30MA250K	**XS630B1MAU20**
XS1M30MA250KH4	**XS630B1MAU20**
XS1M30MA250L1	**XS630B1MAL5**
XS1M30MA250L2	**XS630B1MAL10**
XS1M30MB230	**XS630B1MBL2**
XS1M30MB230A	**XS630B1MBU20**
XS1M30MB230B	**XS630B1MBU20**
XS1M30MB230C	**XS630B1MBU20**
XS1M30MB230G	**XS630B1MBU20**
XS1M30MB230K	**XS630B1MBU20**
XS1M30MB230L1	**XS630B1MBL5**
XS1M30MB230L2	**XS630B1MBL10**
XS1M30MB250	**XS630B1MBL2**
XS1M30MB250A	**XS630B1MBU20**
XS1M30MB250K	**XS630B1MBU20**
XS1M30MB250L1	**XS630B1MBL5**
XS1M30MB250L2	**XS630B1MBL10**
XS2M30MA230	**XS630B1MAL2**
XS2M30MA230A	**XS630B1MAU20**
XS2M30MA230C	**XS630B1MAU20**
XS2M30MA230G	**XS630B1MAU20**
XS2M30MA230K	**XS630B1MAU20**
XS2M30MA230L1	**XS630B1MAL5**
XS2M30MA230L2	**XS630B1MAL10**
XS2M30MA230T	**XS630B1MAL2T**
XS2M30MA250	**XS630B1MAL2**
XS2M30MA250K	**XS630B1MAU20**
XS2M30MA250L1	**XS630B1MAL5**
XS2M30MA250L2	**XS630B1MAL10**
XS2M30MB230	**XS630B1MBL2**
XS2M30MB230A	**XS630B1MBU20**
XS2M30MB230C	**XS630B1MBU20**
XS2M30MB230G	**XS630B1MBU20**
XS2M30MB230K	**XS630B1MBU20**
XS2M30MB230L1	**XS630B1MBL5**
XS2M30MB230L2	**XS630B1MBL10**
XS2M30MB250	**XS630B1MBL2**
XS2M30MB250K	**XS630B1MBU20**
XS2M30MB250L1	**XS630B1MBL5**
XS3P30MA230	**XS630B1MAL2**
XS3P30MA230A	**XS630B1MAU20**
XS3P30MA230K	**XS630B1MAU20**
XS3P30MA230L1	**XS630B1MAL5**
XS3P30MA230L2	**XS630B1MAL10**
XS3P30MB230	**XS630B1MBL2**
XS3P30MB230A	**XS630B1MBU20**
XS3P30MB230K	**XS630B1MBU20**
XS3P30MB230L1	**XS630B1MBL5**
XSC Rectangular ∿	
XSCA150549	**XS8C1A1MAL01U20 + XSZBC10**
XSCA150549	**XS8C1A1MBL01U20 + XSZBC10**
XSD Rectangular ∿	
XSDA400519	**XS8D1A1MAU20 + XSZBD10**
XSDA400519	**XS8D1A1MBU20 + XSZBD10**
XSDA400519H7	**XS8D1A1MAU20 + XSZBD10**
XSDA400519H7	**XS8D1A1MBU20 + XSZBD10**
XSDA500519	**XS8D1A1MAU20 + XSZBD10**
XSDA500519	**XS8D1A1MBU20 + XSZBD10**
XSDA500519H7	**XS8D1A1MAU20 + XSZBD10**
XSDA500519H7	**XS8D1A1MBU20 + XSZBD10**
XSDA505539H4	**XS8D1A1MAU20 + XSZBD10**
XSDA505539H4	**XS8D1A1MBU20 + XSZBD10**
XSDA600519	**XS8D1A1MAU20 + XSZBD10**
XSDA600519	**XS8D1A1MBU20 + XSZBD10**
XSDA600519H7	**XS8D1A1MAU20 + XSZBD10**
XSDA600519H7	**XS8D1A1MBU20 + XSZBD10**
XSDM500538	**XS8D1A1MAU20 + XSZBD10**
XSDM500538	**XS8D1A1MBU20 + XSZBD10**
XSDM600539	**XS8D1A1MAU20 + XSZBD10**
XSDM600539	**XS8D1A1MBU20 + XSZBD10**
XSDM600539H7	**XS8D1A1MAU20 + XSZBD10**
XSDM600539H7	**XS8D1A1MBU20 + XSZBD10**
XS7 Rectangular ⎓	
XS7C40DA210	**XS7C1A1DAM8 + XSZBC10**
XS7C40DA210A	**XS7C1A1DAM8 + XSZBC10**
XS7C40DA214D	**XS7C1A1CAL08M12 + XSZBC10**
XS7C40DP210	**XS7C1A1DAM8 + XSZBC10**
XS7C40DP210	**XS7C1A1DBM8 + XSZBC10**
XS7C40DP210H29	**XS7C1A1DAM8 + XSZBC10**
XS7C40DP210H29	**XS7C1A1DBM8 + XSZBC10**
XS7C40DP210H7	**XS7C1A1DAM8 + XSZBC10**
XS7C40DP210H7	**XS7C1A1DBM8 + XSZBC10**
XS7C40DP210TT	**XS7C1A1DAM8 + XSZBC10**
XS7C40DP210TT	**XS7C1A1DBM8 + XSZBC10**
XS7C40DP210TF	**XS7C1A1DAM8 + XSZBC10**
XS7C40DP210TF	**XS7C1A1DBM8 + XSZBC10**
XS7C40KPM40	**XS9C11MPAM8 + XSZBC10**
XS7C40KPM40	**XS9C11MPBM8 + XSZBC10**
XS7C40KPM40	**XS9C11MNAM8 + XSZBC10**
XS7C40KPM40	**XS9C11MPBM8 + XSZBC10**
XS7C40KPM40H29	**XS9C11MPAM8 + XSZBC10**
XS7C40KPM40H29	**XS9C11MPBM8 + XSZBC10**
XS7C40KPM40H29	**XS9C11MNAM8 + XSZBC10**
XS7C40KPM40H29	**XS9C11MPBM8 + XSZBC10**
XS7C40KPM40H7	**XS9C11MPAM8 + XSZBC10**
XS7C40KPM40H7	**XS9C11MPBM8 + XSZBC10**
XS7C40KPM40H7	**XS9C11MNAM8 + XSZBC10**
XS7C40KPM40H7	**XS9C11MPBM8 + XSZBC10**
XS7C40NC440	**XS7C1A1NAM8 + XSZBC10**
XS7C40NC440	**XS7C1A1NBM8 + XSZBC10**
XS7C40NC440D	**XS7C1A1NAM8 + XSZBC10**
XS7C40NC440D	**XS7C1A1NBM8 + XSZBC10**
XS7C40NC440H29	**XS7C1A1NAM8 + XSZBC10**
XS7C40NC440H29	**XS7C1A1NBM8 + XSZBC10**
XS7C40NC449	**XS8C1A1NAM8 + XSZBC10**
XS7C40NC449	**XS8C1A1NBM8 + XSZBC10**
XS7C40NC449H29	**XS8C1A1NAM8 + XSZBC10**
XS7C40NC449H29	**XS8C1A1NBM8 + XSZBC10**
XS7C40PC440	**XS7C1A1PAM8 + XSZBC10**
XS7C40PC440	**XS7C1A1PBM8 + XSZBC10**
XS7C40PC440D	**XS7C1A1PAM8 + XSZBC10**
XS7C40PC440D	**XS7C1A1PBM8 + XSZBC10**
XS7C40PC440H29	**XS7C1A1PAM8 + XSZBC10**
XS7C40PC440H29	**XS7C1A1PBM8 + XSZBC10**
XS7C40PC440H7	**XS7C1A1PAM8 + XSZBC10**
XS7C40PC440H7	**XS7C1A1PBM8 + XSZBC10**
XS7C40PC449	**XS8C1A1PAM8 + XSZBC10**
XS7C40PC449	**XS8C1A1PBM8 + XSZBC10**
XS7C40PC449H29	**XS8C1A1PAM8 + XSZBC10**
XS7C40PC449H29	**XS8C1A1PBM8 + XSZBC10**
XS7C40PC449H7	**XS8C1A1PAM8 + XSZBC10**
XS7C40PC449H7	**XS8C1A1PBM8 + XSZBC10**
XS7T2DA210	**XS7E1A1DAL2 + XSZBE10**
XS7T2DA214LD	**XS7E1A1CAL08M12 + XSZBE10**
XS7T2DA214LD01	**XS7E1A1CAL01M12 + XSZBE10**
XS7T2NC440	**XS7E1A1NAL2 + XSZBE10**
XS7T2NC440	**XS7E1A1NBL2 + XSZBE10**
XS7T2NC440LD	**XS7E1A1NAL01M12 + XSZBE10**
XS7T2NC440LD	**XS7E1A1NBL01M12 + XSZBE10**
XS7T2PC440	**XS7E1A1PAL2 + XSZBE10**
XS7T2PC440	**XS7E1A1PBL2 + XSZBE10**
XS7T2PC440LD	**XS7E1A1PAL08M12 + XSZBE10**
XS7T2PC440LD	**XS7E1A1PBL08M12 + XSZBE10**
XS7T4DA210	**XS7C1A1DAL2 + XSZBC10**
XS7T4DA214LD	**XS7C1A1CAL08M12 + XSZBC10**
XS7T4DA214LD01	**XS7C1A1CAL01M12 + XSZBC10**
XS7T4NC440	**XS7C1A1NAL2 + XSZBC10**
XS7T4NC440	**XS7C1A1NBL2 + XSZBC10**
XS7T4NC440LD	**XS7C1A1NAL01M12 + XSZBC10**

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Old Design	New Design
XS7T4NC440LD	**XS7C1A1NBL01M12 + XSZBC10**
XS7T4PC440	**XS7C1A1PAL2 + XSZBC10**
XS7T4PC440	**XS7C1A1PBL2 + XSZBC10**
XS7T4PC440LD	**XS7C1A1PAL01M12 + XSZBC10**
XS7T4PC440LD	**XS7C1A1PBL01M12 + XSZBC10**
XS8 Rectangular ⎓	
XS8C40DA210	**XS7C1A1DAL01M12 + XSZBC10**
XS8C40DP210	**XS8C1A1DAM8 + XSZBC10**
XS8C40DP210	**XS8C1A1DBM8 + XSZBC10**
XS8C40DP210H29	**XS8C1A1DAM8 + XSZBC10**
XS8C40DP210H29	**XS8C1A1DBM8 + XSZBC10**
XS8C40DP210H7	**XS8C1A1DAM8 + XSZBC10**
XS8C40DP210H7	**XS8C1A1DBM8 + XSZBC10**
XS8C40NC440	**XS8C1A1NAM8 + XSZBC10**
XS8C40NC440	**XS8C1A1NBM8 + XSZBC10**
XS8C40NC440H29	**XS8C1A1NAM8 + XSZBC10**
XS8C40NC440H29	**XS8C1A1NBM8 + XSZBC10**
XS8C40NC449	**XS8C1A1NAM8 + XSZBC10**
XS8C40NC449	**XS8C1A1NBM8 + XSZBC10**
XS8C40NC449H29	**XS8C1A1NAM8 + XSZBC10**
XS8C40NC449H29	**XS8C1A1NBM8 + XSZBC10**
XS8C40NC449H7	**XS8C1A1NAM8 + XSZBC10**
XS8C40NC449H7	**XS8C1A1NBM8 + XSZBC10**
XS8C40PC440	**XS8C1A1PAM8 + XSZBC10**
XS8C40PC440	**XS8C1A1PBM8 + XSZBC10**
XS8C40PC440D	**XS8C1A1PAL01M12 + XSZBC10**
XS8C40PC440D	**XS8C1A1PAL01M12 + XSZBC10**
XS8C40PC440H29	**XS8C1A1PAM8 + XSZBC10**
XS8C40PC440H29	**XS8C1A1PBM8 + XSZBC10**
XS8C40PC440H7	**XS8C1A1PAM8 + XSZBC10**
XS8C40PC440H7	**XS8C1A1PBM8 + XSZBC10**
XS8C40PC449	**XS8C1A1PAM8 + XSZBC10**
XS8C40PC449	**XS8C1A1PBM8 + XSZBC10**
XS8C40PC449D	**XS8C1A1PAL01M12 + XSZBC10**
XS8C40PC449D	**XS8C1A1PAL01M12 + XSZBC10**
XS8C40PC449H29	**XS8C1A1PAM8 + XSZBC10**
XS8C40PC449H29	**XS8C1A1PBM8 + XSZBC10**
XS8C40PC449H7	**XS8C1A1PAM8 + XSZBC10**
XS8C40PC449H7	**XS8C1A1PBM8 + XSZBC10**
XS8T2NC440	**XS8E1A1NAL2 + XSZBE10**
XS8T2NC440	**XS8E1A1NBL2 + XSZBE10**
XS8T2NC440LD	**XS8E1A1NAL01M12 + XSZBE10**
XS8T2NC440LD	**XS8E1A1NBL01M12 + XSZBE10**
XS8T2PC440	**XS8E1A1PAL2 + XSZBE10**
XS8T2PC440	**XS8E1A1PBL2 + XSZBE10**
XS8T2PC440LD	**XS8E1A1PAL01M12 + XSZBE10**
XS8T2PC440LD	**XS8E1A1PBL01M12 + XSZBE10**
XS8T4NC440	**XS8C1A1NAL2 + XSZBC10**
XS8T4NC440	**XS8C1A1NBL2 + XSZBC10**
XS8T4NC440LD	**XS8C1A1NAL01M12 + XSZBC10**
XS8T4NC440LD	**XS8C1A1NBL01M12 + XSZBC10**
XS8T4PC440	**XS8C1A1PAL2 + XSZBC10**
XS8T4PC440	**XS8C1A1PBL2 + XSZBC10**
XS8T4PC440LD	**XS8C1A1PAL01M12 + XSZBC10**
XS8T4PC440LD	**XS8C1A1PBL01M12 + XSZBC10**
XS7 Rectangular ∿	
XS7C40DA210	**XS8C1A1MAL01U20 + XSZBC10**
XS7C40DA210A	**XS8C1A1MAL01U20 + XSZBC10**
XS7C40DP210	**XS8C1A1MAL01U20 + XSZBC10**
XS7C40DP210	**XS8C1A1MBL01U20 + XSZBC10**
XS7C40DP210H29	**XS8C1A1MAL01U20 + XSZBC10**
XS7C40DP210H29	**XS8C1A1MBL01U20 + XSZBC10**
XS7C40DP210H7	**XS8C1A1MAL01U20 + XSZBC10**
XS7C40DP210H7	**XS8C1A1MBL01U20 + XSZBC10**
XS7C40DP210TT	**XS8C1A1MAL01U20 + XSZBC10**
XS7C40DP210TT	**XS8C1A1MBL01U20 + XSZBC10**
XS7C40DP210TF	**XS8C1A1MAL01U20 + XSZBC10**
XS7C40DP210TF	**XS8C1A1MBL01U20 + XSZBC10**
XS7C40FP260	**XS8C1A1MAL01U20 + XSZBC10**
XS7C40FP260	**XS8C1A1MBL01U20 + XSZBC10**
XS7C40FP260A	**XS8C1A1MAL01U20 + XSZBC10**
XS7C40FP260A	**XS8C1A1MBL01U20 + XSZBC10**
XS7C40FP260H29	**XS8C1A1MAL01U20 + XSZBC10**
XS7C40FP260H29	**XS8C1A1MBL01U20 + XSZBC10**
XS7C40FP260H7	**XS8C1A1MAL01U20 + XSZBC10**
XS7C40FP260H7	**XS8C1A1MBL01U20 + XSZBC10**
XS7C40FP260TF	**XS8C1A1MAL01U20 + XSZBC10**
XS7C40FP260TF	**XS8C1A1MBL01U20 + XSZBC10**
XS7C40FP260TT	**XS8C1A1MAL01U20 + XSZBC10**
XS7C40FP260TT	**XS8C1A1MBL01U20 + XSZBC10**
XS7C40MP230	**XS8C1A1MAL01U20 + XSZBC10**
XS7C40MP230	**XS8C1A1MBL01U20 + XSZBC10**
XS7C40MP230A	**XS8C1A1MAL01U20 + XSZBC10**
XS7C40MP230A	**XS8C1A1MBL01U20 + XSZBC10**
XS7C40MP230H29	**XS8C1A1MAL01U20 + XSZBC10**
XS7C40MP230H29	**XS8C1A1MBL01U20 + XSZBC10**
XS7C40MP230H7	**XS8C1A1MAL01U20 + XSZBC10**
XS7C40MP230H7	**XS8C1A1MBL01U20 + XSZBC10**
XS7C40MP230TF	**XS8C1A1MAL01U20 + XSZBC10**
XS7C40MP230TF	**XS8C1A1MBL01U20 + XSZBC10**
XS7C40MP230TT	**XS8C1A1MAL01U20 + XSZBC10**
XS7C40MP230TT	**XS8C1A1MBL01U20 + XSZBC10**
XS8 Rectangular ∿	
XS8C40DA210	**XS8C1A1MAL01U20 + XSZBC10**
XS8C40DP210	**XS8C1A1MAL01U20 + XSZBC10**
XS8C40DP210	**XS8C1A1MBL01U20 + XSZBC10**
XS8C40DP210H29	**XS8C1A1MAL01U20 + XSZBC10**
XS8C40DP210H29	**XS8C1A1MBL01U20 + XSZBC10**
XS8C40DP210H7	**XS8C1A1MAL01U20 + XSZBC10**
XS8C40DP210H7	**XS8C1A1MBL01U20 + XSZBC10**
XS8C40FP260	**XS8C1A1MAL01U20 + XSZBC10**
XS8C40FP260	**XS8C1A1MBL01U20 + XSZBC10**
XS8C40FP260H29	**XS8C1A1MAL01U20 + XSZBC10**
XS8C40FP260H29	**XS8C1A1MBL01U20 + XSZBC10**
XS8C40MP230	**XS8C1A1MAL01U20 + XSZBC10**
XS8C40MP230	**XS8C1A1MBL01U20 + XSZBC10**
XS8C40MP230	**XS8C1A1MAL01U20 + XSZBC10**
XS8C40MP230	**XS8C1A1MBL01U20 + XSZBC10**
XS8C40MP230H29	**XS8C1A1MAL01U20 + XSZBC10**
XS8C40MP230H29	**XS8C1A1MBL01U20 + XSZBC10**
XS8C40MP230H7	**XS8C1A1MAL01U20 + XSZBC10**
XS8C40MP230H7	**XS8C1A1MBL01U20 + XSZBC10**
XSD Rectangular ⎓	
XSDC407138	**XS7D1A1DAM12 + XSZBD10**
XSDC407139	**XS7D1A1DAM12 + XSZBD10**
XSDC407139D4	**XS7D1A1DAM12 + XSZBD10**
XSDC407139H7	**XS7D1A1DAM12 + XSZBD10**
XSDC407139LD	**XS7D1A1DAM12 + XSZBD10**
XSDC407139LD01	**XS7D1A1DAM12 + XSZBD10**
XSDC507139	**XS7D1A1DAM12 + XSZBD10**
XSDC607139	**XS7D1A1DAM12 + XSZBD10**
XSDC607139H7	**XS7D1A1DAM12 + XSZBD10**
XSDC607139LD	**XS7D1A1DAM12 + XSZBD10**
XSDC607139LD01	**XS7D1A1DAM12 + XSZBD10**
XSDC607319	**XS7D1A1DAM12 + XSZBD10**
XSDC607319	**XS7D1A1DBM12 + XSZBD10**
XSDH407339	**XS8D1A1PAM12 + XSZBD10**
XSDH407339	**XS8D1A1PBM12 + XSZBD10**
XSDH407339H7	**XS8D1A1PAM12 + XSZBD10**
XSDH407339H7	**XS8D1A1PBM12 + XSZBD10**
XSDH607339	**XS8D1A1PAM12 + XSZBD10**
XSDH607339	**XS8D1A1PBM12 + XSZBD10**
XSDH607339H7	**XS8D1A1PAM12 + XSZBD10**
XSDH607339H7	**XS8D1A1PBM12 + XSZBD10**
XSDH607339TF	**XS8D1A1PAM12 + XSZBD10**
XSDH607339TF	**XS8D1A1PBM12 + XSZBD10**
XSDJ407339	**XS8D1A1NAM12 + XSZBD10**
XSDJ407339	**XS8D1A1NBM12 + XSZBD10**
XSDJ407339H7	**XS8D1A1NAM12 + XSZBD10**
XSDJ407339H7	**XS8D1A1NBM12 + XSZBD10**
XSDJ607339	**XS8D1A1NAM12 + XSZBD10**
XSDJ607339	**XS8D1A1NBM12 + XSZBD10**
XSDJ607339H7	**XS8D1A1NAM12 + XSZBD10**
XSDJ607339H7	**XS8D1A1NBM12 + XSZBD10**
XSE Rectangular ⎓	
XSEC107130	**XS7E1A1DAL01M12 + XSZBE10**
XSEC1071300	**XS7E1A1DAL2 + XSZBE10**
XSEC1071300L05	**XS7E1A1DAL01M12 + XSZBE10**
XSEC1071301	**XS7E1A1DAL01M12 + XSZBE10**
XSEC1071302	**XS7E1A1DAL01M12 + XSZBE10**
XSEC1071304	**XS7E1A1DAL01M12 + XSZBE10**
XSEC107130D4	**XS7E1A1DAL01M12 + XSZBE10**
XSEC107130H7	**XS7E1A1DAL01M12 + XSZBE10**
XSEC107133	**XS7E1A1DAL01M12 + XSZBE10**
XSEC1071330	**XS7E1A1DAL2 + XSZBE10**
XSEC1071331	**XS7E1A1DAL01M12 + XSZBE10**
XSEC1071332	**XS7E1A1DAL01M12 + XSZBE10**
XSEC1071334	**XS7E1A1DAL01M12 + XSZBE10**
XSEC107133D4	**XS7E1A1DAL01M12 + XSZBE10**
XSEC107230	**XS7E1A1DBM12 + XSZBE10**
XSEC1072301	**XS7E1A1DBL01M12 + XSZBE10**
XSEC107233	**XS7E1A1DBM12 + XSZBE10**
XSEC1072331	**XS7E1A1DBL08M12 + XSZBE10**
XSEC1571300	**XS7E1A1DAL2 + XSZBE10**
XSEC1571330	**XS7E1A1DAL2 + XSZBE10**

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Old Design	New Design	Old Design	New Design	Old Design	New Design
XSC Rectangular ∿					
XSCA150549	**XS8C1A1MAL01U20 + XSZBC10**				
XSCA150549	**XS8C1A1MBL01U20 + XSZBC10**				
XSD Rectangular ∿					
XSDA400519	**XS8D1A1MAU20 + XSZBD10**				
XSDA400519	**XS8D1A1MBU20 + XSZBD10**				
XSDA400519H7	**XS8D1A1MAU20 + XSZBD10**				
XSDA400519H7	**XS8D1A1MBU20 + XSZBD10**				
XSDA500519	**XS8D1A1MAU20 + XSZBD10**				
XSDA500519	**XS8D1A1MBU20 + XSZBD10**				
XSDA500519H7	**XS8D1A1MAU20 + XSZBD10**				
XSDA500519H7	**XS8D1A1MBU20 + XSZBD10**				
XSDA505539H4	**XS8D1A1MAU20 + XSZBD10**				
XSDA505539H4	**XS8D1A1MBU20 + XSZBD10**				
XSDA600519	**XS8D1A1MAU20 + XSZBD10**				
XSDA600519	**XS8D1A1MBU20 + XSZBD10**				
XSDA600519H7	**XS8D1A1MAU20 + XSZBD10**				
XSDA600519H7	**XS8D1A1MBU20 + XSZBD10**				
XSDM500538	**XS8D1A1MAU20 + XSZBD10**				
XSDM500538	**XS8D1A1MBU20 + XSZBD10**				
XSDM600539	**XS8D1A1MAU20 + XSZBD10**				
XSDM600539	**XS8D1A1MBU20 + XSZBD10**				
XSDM600539H7	**XS8D1A1MAU20 + XSZBD10**				
XSDM600539H7	**XS8D1A1MBU20 + XSZBD10**				

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Telemecanique

Obsolete Part Number	Replaced by Part Number
AC	AC/DC
XS1M12FA260	XS1M12MA230
XS1M12FA260K	XS1M12MA230K
XS1M12FB260	XS1M12MB230
XS1M12FB260K	XS1M12MB230K
XS1M18FA260	XS1M18MA230
XS1M18FA260A	XS1M18MA230A
XS1M18FA260K	XS1M18MA230K
XS1M18FB260	XS1M18MB230
XS1M18FB260A	XS1M18MB230A
XS1M18FB260K	XS1M18MB230K
XS1M30FA260	XS1M30MA230
XS1M30FA260A	XS1M30MA230A
XS1M30FA260K	XS1M30MA230K
XS1M30FB260	XS1M30MB230
XS1M30FB260A	XS1M30MB230A
XS1M30FB260K	XS1M30MB230K
XS2M12FA260	XS2M12MA230
XS2M12FA260K	XS2M12MA230K
XS2M12FB260	XS2M12MB230
XS2M12FB260K	XS2M12MB230K
XS2M18FA260	XS2M18MA230
XS2M18FA260A	XS2M18MA230A
XS2M18FA260K	XS2M18MA230K
XS2M18FB260	XS2M18MB230
XS2M18FB260A	XS2M18MB230A
XS2M18FB260K	XS2M18MB230K
XS2M30FA260	XS2M30MA230
XS2M30FA260A	XS2M30MA230A
XS2M30FA260K	XS2M30MA230K
XS2M30FB260	XS2M30MB230
XS2M30FB260A	XS2M30MB230A
XS2M30FB260K	XS2M30MB230K
XS3P12FA260	XS3P12MA230
XS3P12FA260K	XS3P12MA230K
XS3P12FB260	XS3P12MB230
XS3P12FB260K	XS3P12MB230K
XS3P18FA260	XS3P18MA230
XS3P18FA260A	XS3P18MA230A
XS3P18FA260K	XS3P18MA230K
XS3P18FB260	XS3P18MB230
XS3P18FB260A	XS3P18MB230A
XS3P18FB260K	XS3P18MB230K
XS3P30FA260	XS3P30MA230
XS3P30FA260A	XS3P30MA230A
XS3P30FA260K	XS3P30MA230K
XS3P30FB260	XS3P30MB230
XS3P30FB260A	XS3P30MB230A
XS3P30FB260K	XS3P30MB230K
XS4P12FA260	XS4P12MA230
XS4P12FA260K	XS4P12MA230K
XS4P12FB260	XS4P12MB230
XS4P12FB260K	XS4P12MB230K
XS4P18FA260	XS4P18MA230
XS4P18FA260A	XS4P18MA230A
XS4P18FA260K	XS4P18MA230K
XS4P18FB260	XS4P18MB230
XS4P18FB260A	XS4P18MB230A
XS4P18FB260K	XS4P18MB230K
XS4P30FA260	XS4P30MA230
XS4P30FA260A	XS4P30MA230A
XS4P30FA260K	XS4P30MA230K
XS4P30FB260	XS4P30MB230
XS4P30FB260A	XS4P30MB230A
XS4P30FB260K	XS4P30MB230K

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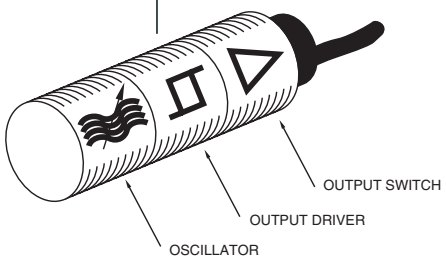
It is an important component in an automation control system.

It transmits information relating to the operating conditions of a machine to the logic processing system:

- Presence, passage, flow of parts
- End of travel
- Rotation and counting.

Essentially, it is a **non-contact part presence** detector.

Composition

Detection stage	Output stage
	
Detection stage • *type of mounting (cylindrical, rectangular)* • *detection characteristics (sensing distance, hysteresis)*	*Output stage* • *type of supply (DC, AC, AC/DC)* • *electrical characteristics (current and voltage)*

Application	Advantages
• *no physical contact with the target*	• *no wear, possibility of detecting fragile or freshly painted objects*
• *high operating rate*	• *perfect compatibility with electronic automated systems*
• *high approach speeds*	• *fast response*
• *rugged, fully encapsulated*	• *excellent resistance to industrial environments*
• *solid state, no moving parts*	• *life of the device is independent of the number of operations*

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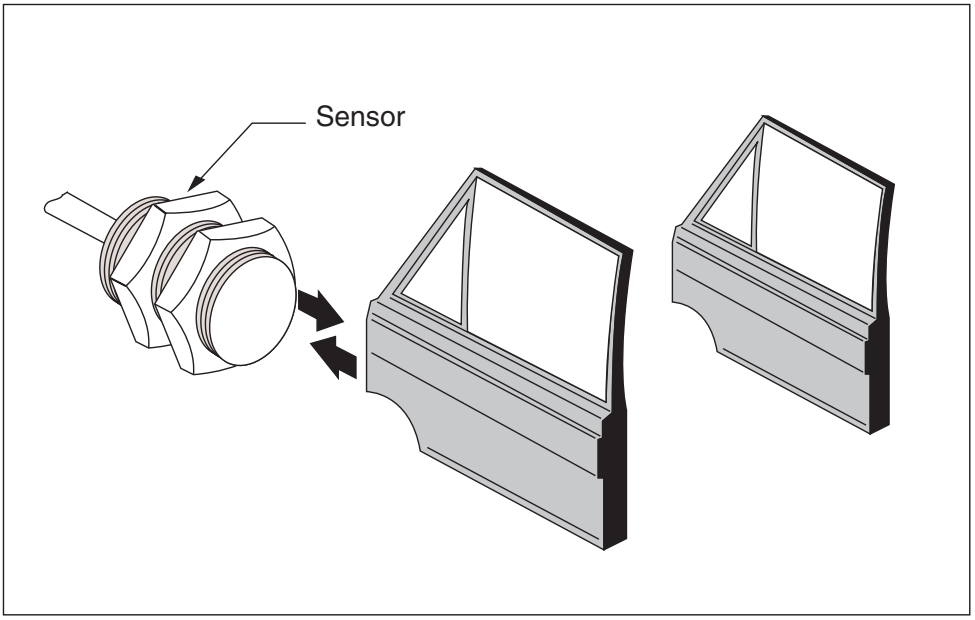
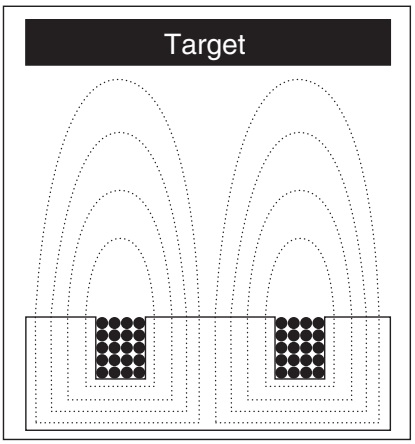
Suitable for the detection of metal objects

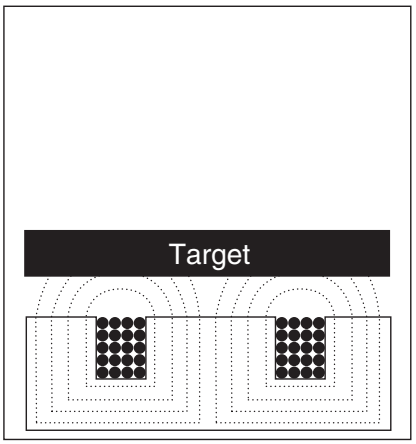
Inductive

- **Identifies** only **metal** targets
- **Predictable** sensing technology—few variables
- **Reliable** industrial technology



Principle of operation





An inductive proximity sensor is essentially comprised of an oscillator whose windings constitute the sensing face. An electromagnetic field is generated in front of these windings.

When a metal object is placed within this field, the resulting currents induced into the target form an additional load, and the oscillations cease.

This causes the output driver to operate, producing an ON or OFF output signal.

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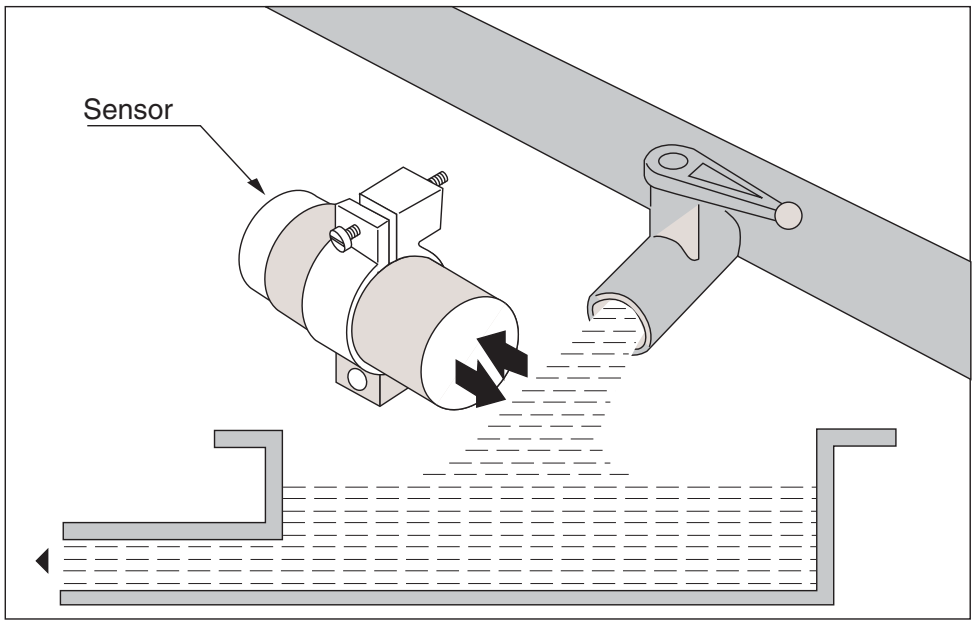
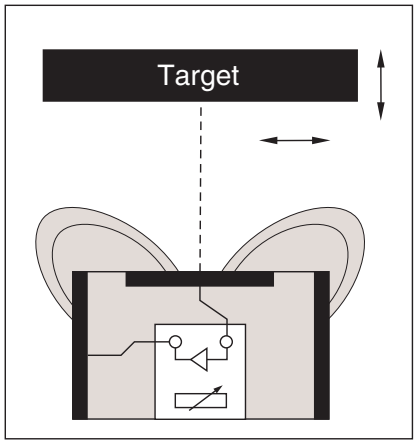
Capacitive

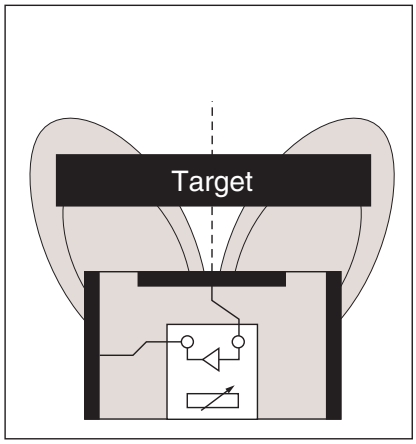
Suitable for the detection of non-conductive targets, liquids and powders



- Detects **any material**
- Affected by environment: humidity, dust, etc.
- Best for:
  - — bulk material
  - — liquids
  - — targets behind a separation wall

Principle of operation





An capacitive proximity sensor is basically comprised of an oscillator whose capacitors constitute the sensing face.

When a conducting or insulating material with a permittivity greater than air is placed within this field, it modifies the coupling capacitance and causes oscillations.

This actuates the output driver, and, depending on the model, an ON or OFF output signal is produced.

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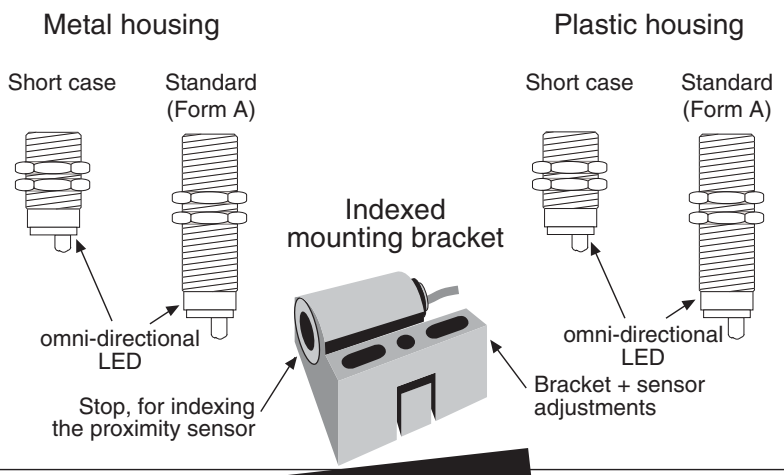
Housing types

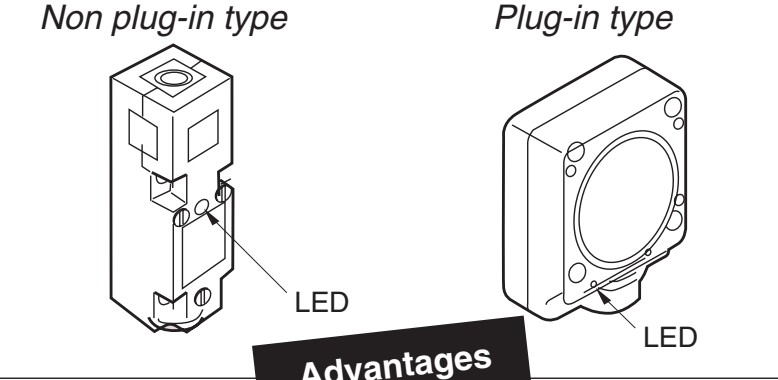
Tubular type



Advantages

- Simple installation and set-up: pre-wired or connector models
- Excellent environmental protection:
  - encapsulated
  - metal housing (plated brass)
  - plastic or stainless steel housing (food, pharmaceuticals)
- Two choices:
  - very short for restricted access areas
  - standard (form A) length for ease of replacement
- No adjustment replacement by using a patented indexing mounting bracket

Block type



Advantages

- Direct interchangeability, no need for readjustment
- Flexibility of connections: screw terminals or connector
- Long sensing distance

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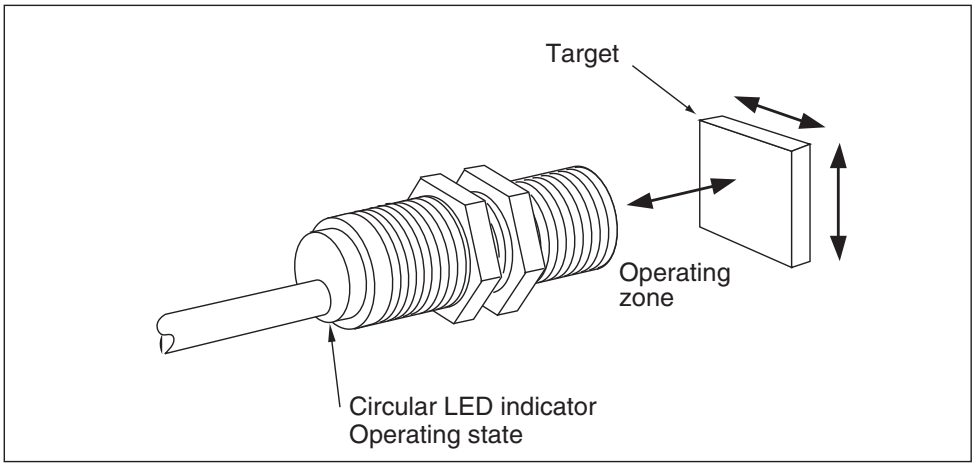
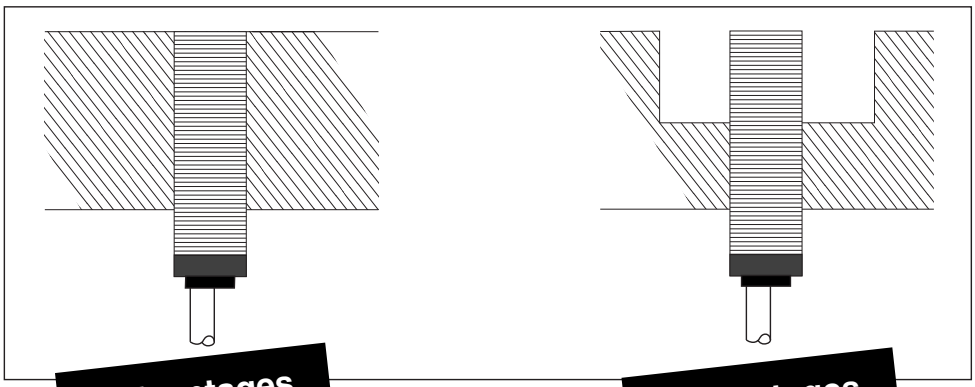
Operating zone



The targets are generally of steel, and of a size equivalent to the sensing face of the sensor. To ensure detection, the target should pass at a distance less than or equal to the usable sensing distance given in the data sheet of the sensor selected.

Suitabiliy for flush mounting in metal



Advantages

- No lateral effect

But

- Reduced sensing distance

Advantages

- Sensing distance + 50 to + 100%

But

- Space required around the device to eliminate the effects of the surrounding metal

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Power supply

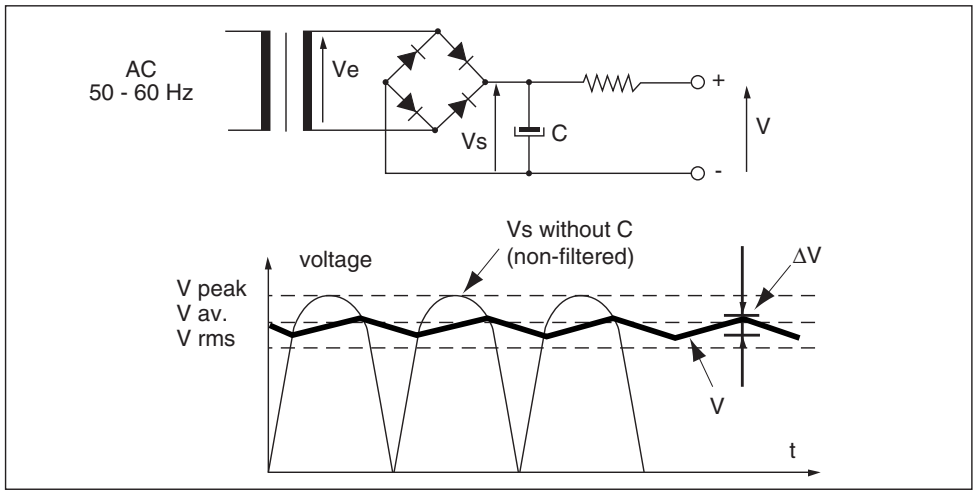
AC or AC/DC sensors for AC circuits

Check that the power supply range limits of the proximity sensor are compatible with the nominal voltage of the AC supply used.

Sensors for DC circuits

Where a DC supply is available, check that the voltage limits of the sensor, including ripple, are compatible with the supply used.

If an AC supply is available, a suitable DC power supply must be selected. A simple one has a transformer, a rectifier, and a smoothing capacitor.



Where voltage is derived from a single phase AC supply, it must be rectified and filtered to ensure that:

- **The peak voltage of the DC supply is lower than the maximum operating voltage of the sensor, peak voltage = rated voltage Ve x √2.**
- **The minimum voltage of the DC supply is greater than the minimum voltage rating of the sensor, given that ΔV = (I x t) ÷ C.**

  ΔV = maximum ripple: 10% (V)
  i = anticipated load current (mA)
  t = period of 1 cycle (8.8 m sec. full wave rectified 60 Hz frequency voltage)
  C = capacitance (μF)

As a general rule, use a transformer with a lower secondary voltage (Ue) than the required DC voltage (U).

Example: 18 Vac to obtain 24 Vdc
35 Vac to obtain 48 Vdc

Mount a filtering capacitor of minimum 400 μF per sensor or 2000 μF for each ampere of load current required.

NOTE: Tubular 3 wire DC universal models (10-58 V), 3 wire DC XSF models, and all AC/DC models can be supplied from full-wave rectified non-filtered (no capacitor C in the diagram above) power supplies.

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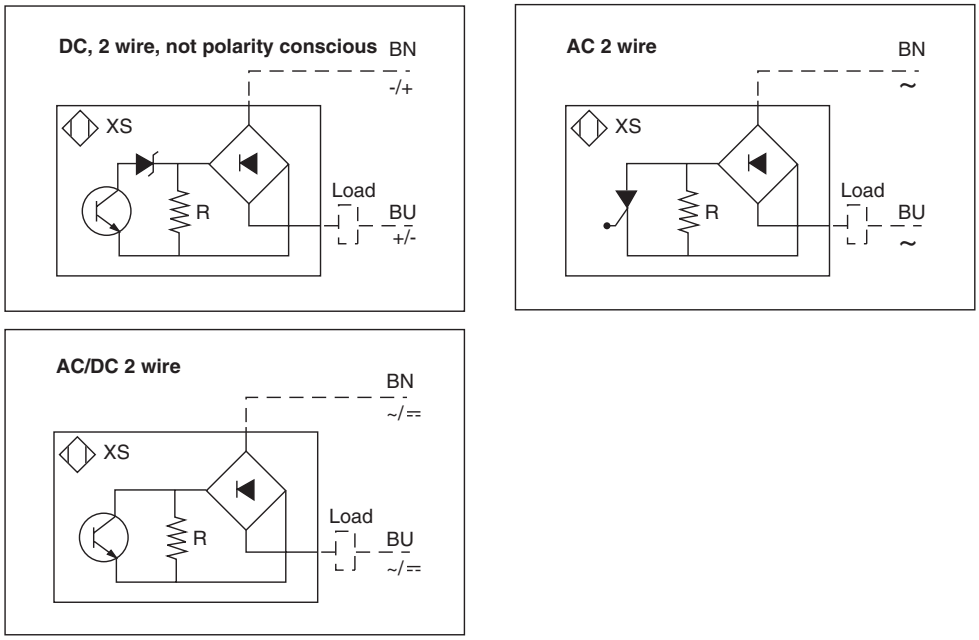
2 Wire type

Output signal



2 wire sensors are wired in series with the load to be switched.

They are subject to:

- a residual current (leakage current) - in the open state
- a voltage drop - in the closed state

For the AC and AC/DC versions, certain models are protected against short-circuits. Refer to the product characteristics.

Advantages

- *They can be wired in the same way as mechanical limit switches.*
- *For the DC and AC/DC versions, they can be connected to either positive (PNP) or negative (NPN) logic inputs.*
- *Polarity insensitive versions, no risk of incorrect connection.*
- *AC/DC versions, reduces stock requirements*

But

Check the possible effects of residual current and voltage drop on the input device controlled (pick-up and drop-out thresholds).

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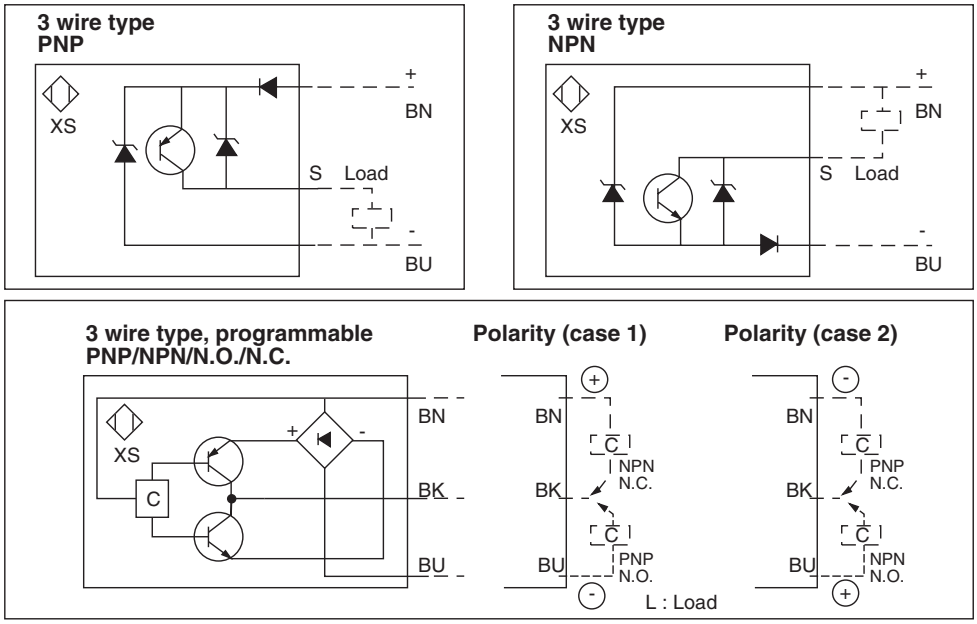
3 Wire type

Output signal



The sensors in this category have:

- 2 wires for the power supply
- 1 wire for the output signal

NOTE: Some models include an additional wire for a complementary output 4 wire type, N.O. + N.C. The technology is still 3 wires.

They are protected against reverse supply polarity and against overloads and short-circuit of the load. For the DC version, there are two types of sensor:

- Basic sensor
  - — PNP model, switching the positive side to the load (sourcing)
  - — NPN model, switching the negative side to the load (sinking)
- Universal DC sensors

A single universal sensor, depending on the wiring connections can perform any of the following 4 functions: PNP/N.O., PNP/N.C., NPN/N.O., NPN/N.C.

Advantages

- *Best switching characteristics: no residual current, low voltage drop, fast*
- *N.O. + N.C. versions*
- *Universal versions, reduces stock requirements*

But

Requires the use of a specialized sensor (PNP or NPN, function of the load connection, to negative or positive, respectively) or a selectable universal type.

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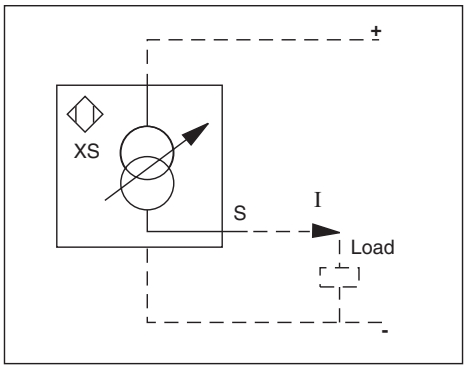
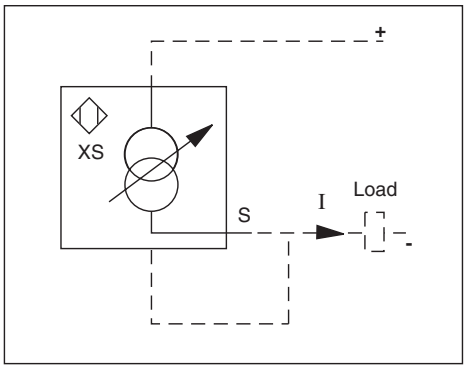
Analog type

Output signal



3 wire type



2 wire type

These proximity sensors convert the approach of a metal target towards the sensing face into a current output signal which is proportional to the distance between the target and the sensing face.

Two models:

dual voltage:	24/48 Vdc
Output:	0 - 10 mA with 3 wire connection
	4 - 14 mA with 2 wire connection
single voltage:	24 Vdc
Output:	0 - 16 mA with 3 wire connection
	4 - 20 mA with 2 wire connection

Advantages

- *Output signal proportional to the distance.*
- *Two or three wire connection using the same device.*

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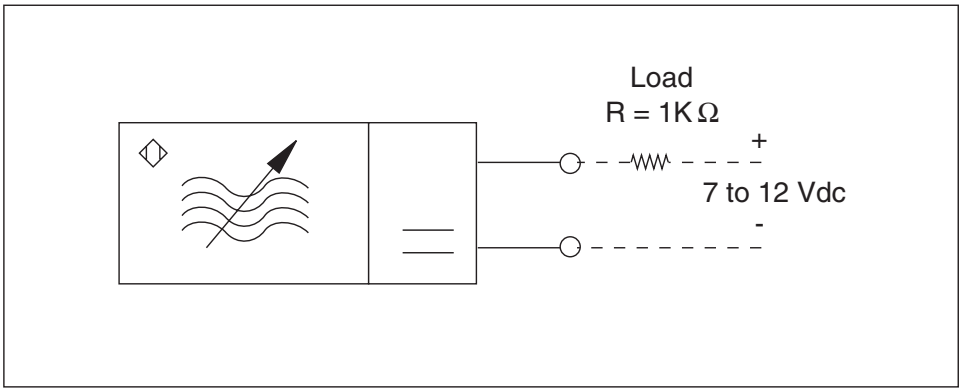
Namur type

Output signal



Namur type proximity sensors (DIN 19234) are electronic sensors in which the current consumption varies when a metal object approaches.

Their operating principle, together with their compact size, enables them to be used in a large number of applications:

- Intrinsically safe (hazardous environments, i.e. explosive). Sensors are used with NY2 intrinsically safe relay/amplifier or equivalent, approved intrinsically safe solid state input.
- Non-intrinsically safe (normal, safe zone). NAMUR sensors associated with a power supply and amplifier unit or equivalent solid state input.

Advantages

- *Can work in hazardous environments.*
- *Basic product, without amplifier.*
- *Compact size.*

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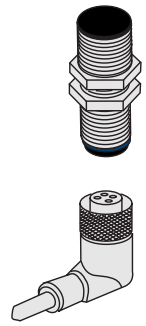
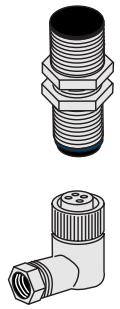
Method of connection

Cable	*Connector*	*Screw Terminals*
		
Features	**Features**	**Features**
Pre-wired sealed cable, excellent resistance to splashing liquid (IP67) or cutting oils (IP68).	*Ease of installation and replacement.*	*Flexibility: user selects type and length of cable.*

Note

In practice, the preceding information enables the selection and installation of a proximity sensor for applications having normal operating conditions. The following pages contain details for applications which need more specific information.

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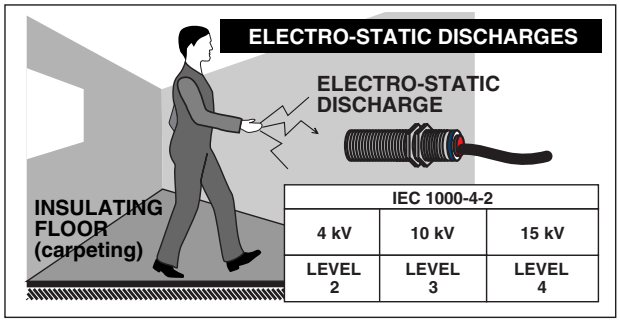
Electromagnetic interference

The XS sensors are tested according to IEC 60947.5.2 standard (similar to the proposed new NEMA ICS 5-4-1999x standard).



DC versions

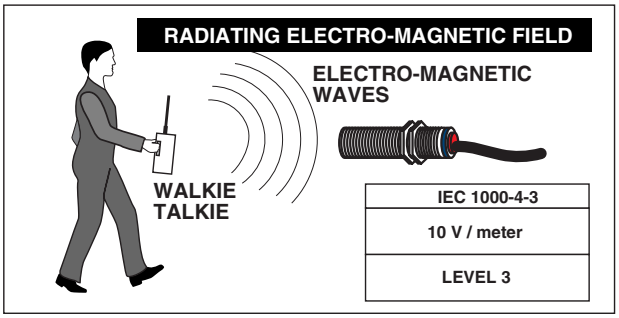
- level 2 immunity (3 wire type)
- level 3 immunity (2 wire type)

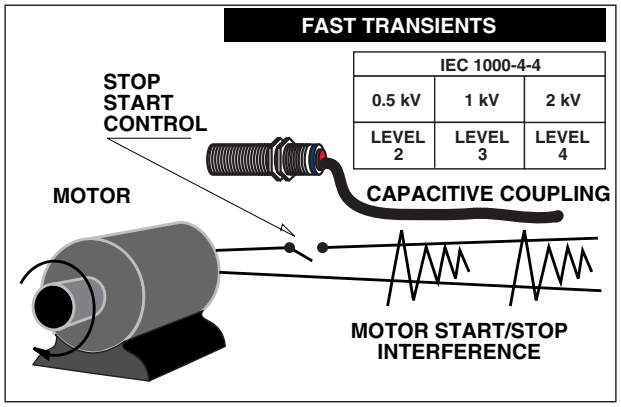
AC/DC versions

- level 4 immunity

DC and AC/DC versions

- level 3 immunity (RFI Radio Frequency Immunity)





DC versions

- level 3 immunity

AC/DC versions

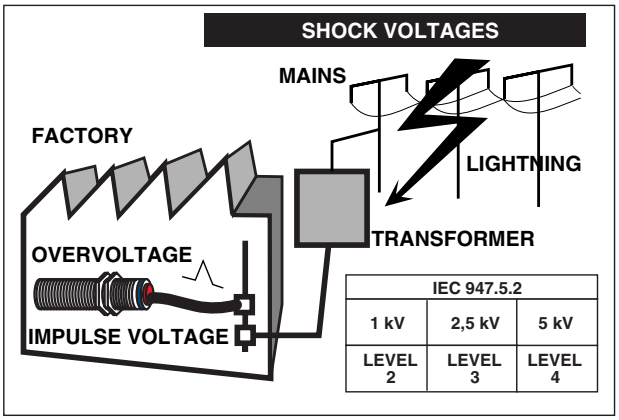
- level 4 immunity

Extended range DC

- level 3 immunity

DC and AC/DC versions

- level 3 immunity (over 8 mm diameter)
- level 2 immunity (tubular 8 mm and smaller)



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Temperature Chemicals

Temperature: where sensors are used outside the ranges shown, reliable operation cannot be assured and permanent damage could result.

Standard length tubular sensors have a very large temperature range: -25° C to 80° C.

NOTE: For extended temperature range, consult factory.

Chemicals: due to the very wide range of chemicals which are found in modern industry, it is very difficult to give general guidelines on sensor applications.

To ensure lasting efficient operation, it is essential that the chemicals coming in contact with the sensors will not affect their housings and, in doing so, prevent their reliable operation.

The XS1/XS2 M series is particularly well adapted to the severe environment, such as machine tool applications.

NOTE: The cables used conform to standard NFC 32 206 and to recommendations CNOMO E03-40-150 N. They are UL Listed and CSA Certified.

The series XS4P plastic cylindrical proximity sensors as well as the stainless steel XS1/ XS2 sensors exhibit excellent overall resistance to:

- **Chemical products,** such as salts, halophytic and aromatic oils, petrols, acids, and diluted bases. For acids, ketones, and phenols, preliminary test should be made according to the nature and concentration of the liquid.
- **Agriculture and food industry products,** such as animal and vegetable based food products (vegetable oils, animal fat, fruit juice, dairy proteins, etc...).

NOTE: For specific details, please consult factory. Have the following information available when making the inquiry:

- *type of substance*
- *concentration*
- *maximum temperature*
- *specific sensor(s) part numbers considered for the application*

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Shocks – Vibrations

Shocks

- The sensors are tested according to IEC 60068.2.27, 50g, duration 11 m sec.

Vibrations

- The sensors are tested according to IEC 60068.2.6, amplitude ± 2 mm, F = 10-55 Hz, 25g to 55 Hz.

Degrees of protection

- IP67 - protection against the effects of immersion, tested according to IEC 60529. Sensor immersed for 30 minutes in 1 meter of water.
- UL Listed: typical NEMA 4X, 6P, 12. No deterioration in either operating or insulation characteristics.
- IP68 - protection against effects of prolonged immersion: the test conditions are subject to agreement between the manufacturer and user.
  Telemecanique selected machine tool applications or other machines frequently drenched in cutting fluids. **IP68 means,** in this case, **cutting oil proof**, a degree of protection requiring a superior encapsulation technology. Extensive testing is performed—1500 hours immersion in fluid at 70° C.

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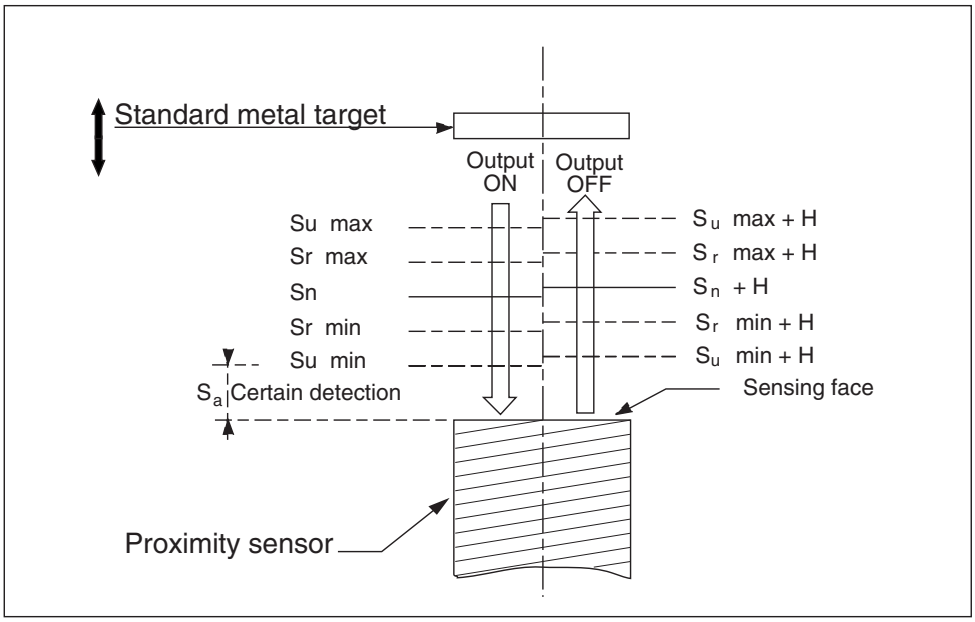
Definition of sensing distances



Nominal (or rated) sensing distance Sn:

The rated operating distance for which the sensor is designed. It does not take into account manufacturing tolerances, or any change in supply voltage, temperature, etc... during operation. Used for selection and base for exact calculations.

Real sensing distance Sr:

The real sensing distance is measured at rated voltage (Un) and at the rated ambient temperature (Tn). It must be between 90% and 110% of the real sensing distance: $0.9Sn \leq Sr \leq 1.1Sn$.

Usable sensing distance Su:

The usable sensing distance is measured at the limits of the permissible variations of the ambient temperature (Ta) and the supply voltage (Ub). It must be between 90% and 110% of the real sensing distance: $0.9Sr \leq Su \leq 1.1Sr$.

Operating zone Sa (usable sensing range):

The operating zone is between **0 and 81%** of the nominal sensing distance Sn:

$0 \leq Sa \leq 0.81Sn$

This is the operating zone of the sensor and corresponds to the area within which detection of the **standard metal target is certain** whatever the variations in voltage or temperature.

This is the **maximum** sensing distance **the designer should consider** for all applications. Correction factors should be considered only when conditions preclude the use of the standard target in the operating temperature and voltage range.

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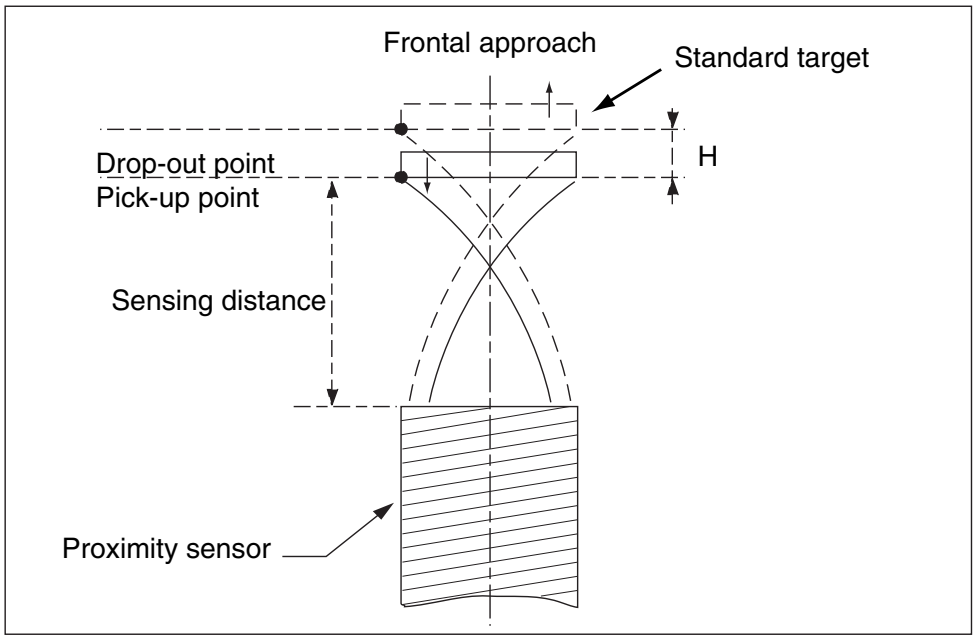
Standard metal target

Standard metal target:

1 mm thick, square mild cold rolled steel, type FE 360. The side of the square is either equal to the diameter of the sensor or of the circle engraved on the active face of the sensing face or is 3 times the nominal sensing distance (Sn). The higher of these values is used.

Differential travel



Differential travel: (hysteresis) H:

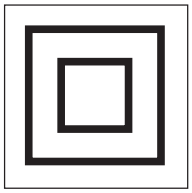
The distance between the pick-up point as the standard metal target frontally approaches the sensor, and the drop-out point as it moves away. Expressed as a percentage of the real sensing distance Sr.

Repeat accuracy (Repeatability

Repeat accuracy (repeatability) R:

The repeatability of the sensing distance, between successive operations. Readings are taken over a period of time while the sensor is subjected to environmental extremes, e.g. 8 hour cycle between 10 and 30° C, with supply voltage variation ± 5% of nominal. Expressed as a percentage of the real sensing distance Sr. Important parameter for positioning applications.

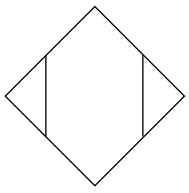
Class 2 material Double Isolation



Class 2 material - Double isolation

The symbol represents electrical insulation conforming to IEC 60536 class 2. It means that all live parts are isolated inside the housing and touching any exterior exposed metal is harmless. No groundings required.

Symbol



International symbol for proximity switches.

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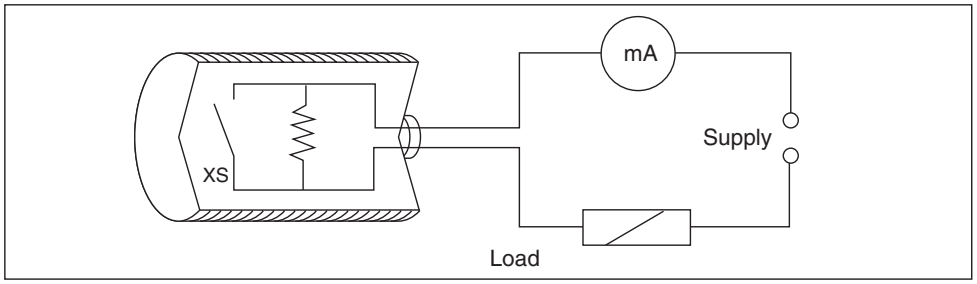
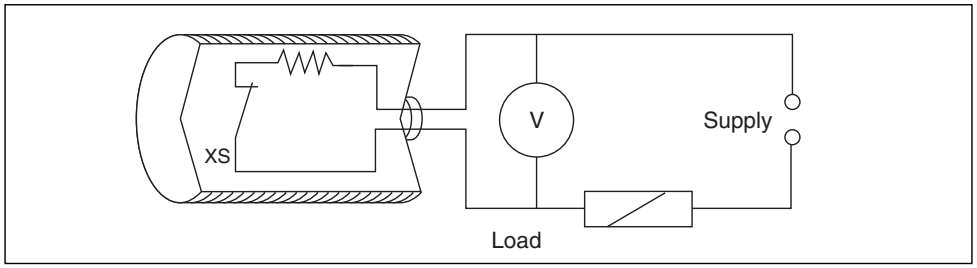
Leakage or Residual current (Ir)



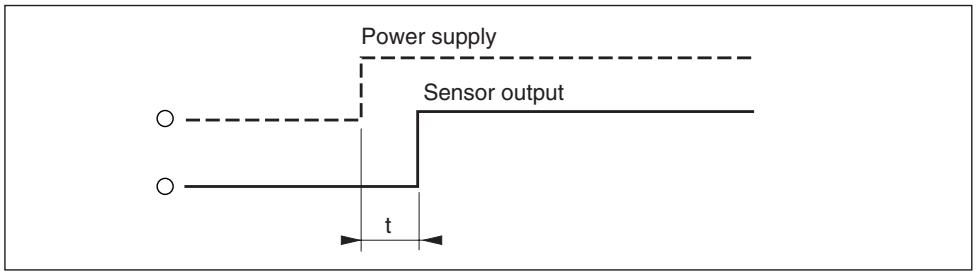
The leakage or residual current corresponds to the current flowing through the sensor in the OFF or “open” state. Important for 2 wire proximity sensors.

Voltage drop (Ud)



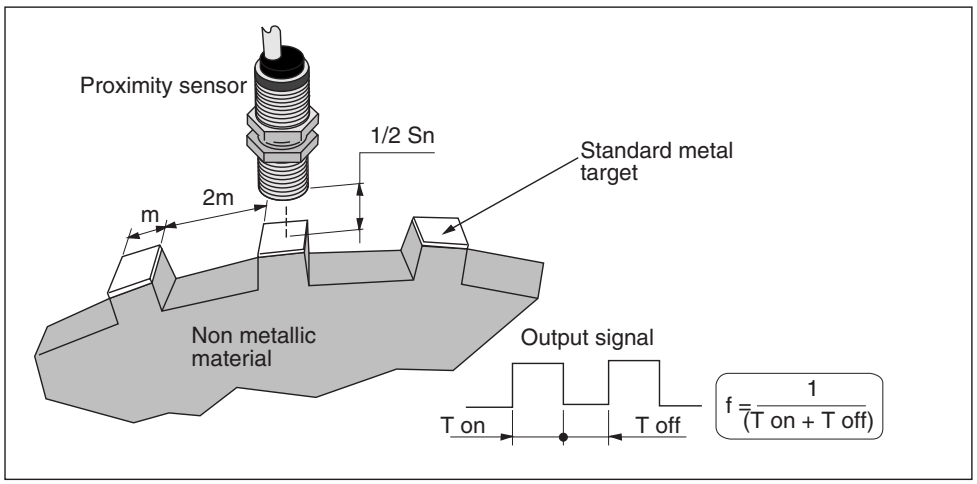
The voltage drop corresponds to the voltage at the proximity sensor’s terminals in the ON or “closed” state.Especially important for 2 wire proximity sensors.

RESPONSE TIME power-up delay



The period of time between energizing the sensor and its fully operational condition. Known also as “warm-up” or “first-up” delay.

Maximum operating frequency



The maximum number of targets a proximity sensor can detect in a second, under standard test conditions (standard EN50018, IEC 60947.5.2). Do not use for selection or design purposes unless the geometry of the application is identical with the one in the picture.

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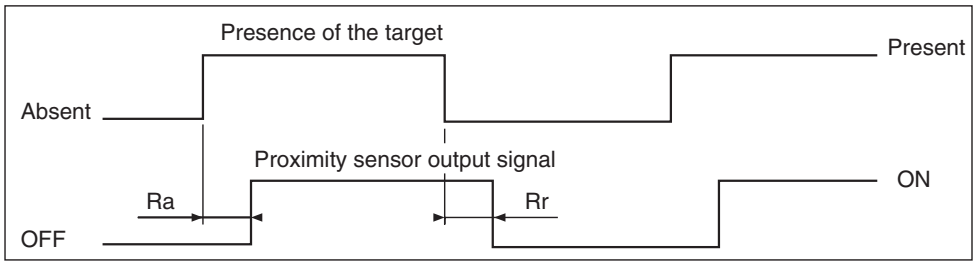
Response time



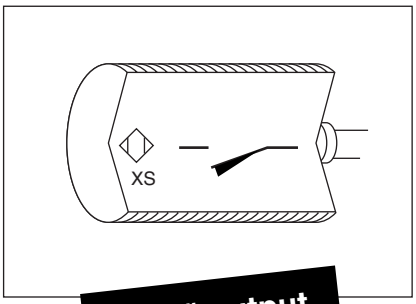
ON delay Ra:

The period between the detection of the target and the subsequent change in its output state. This design parameter determines the relationship between the speed of travel and the size of the target.

OFF delay Rr:

The period between the exit of the target from the sensor's operating zone and the subsequent change in its output state. This design parameter limits the interval between successive targets.

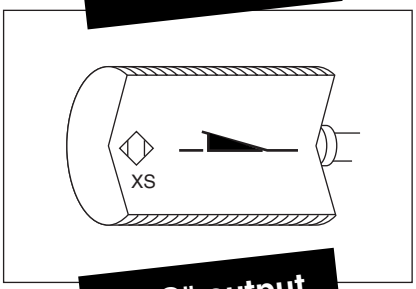
Output signal



"NO" output

N.O. - Normally open

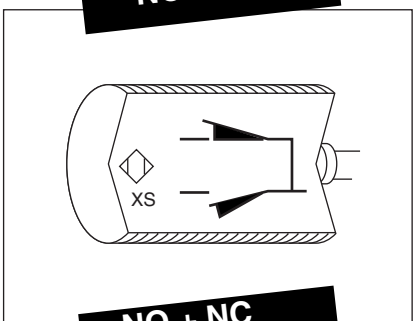
Output circuit turns ON output current when a target is present.



"NC" output

N.C. - Normally closed

Output circuit turns OFF output current when a target is present.



NO + NC output

N.O. + N.C.

Complementary outputs proximity sensor with two outputs, one of which opens, the other closes when a target is present.

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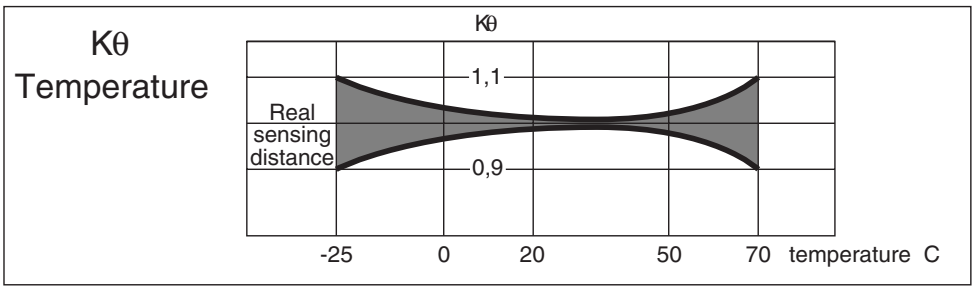
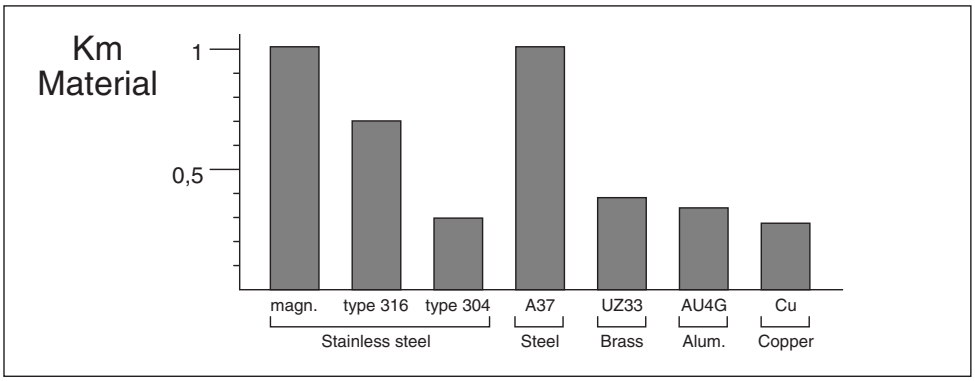
In practice, most targets are generally made of steel and are of a size, equal to or greater than the sensing face of the sensor. Where this is the case, use the sensing distance values given in the characteristics for the particular sensor. To calculate the precise sensing distance for specific applications, the following parameters, which affect the sensing distance, must be taken into account.

Theoretical calculation



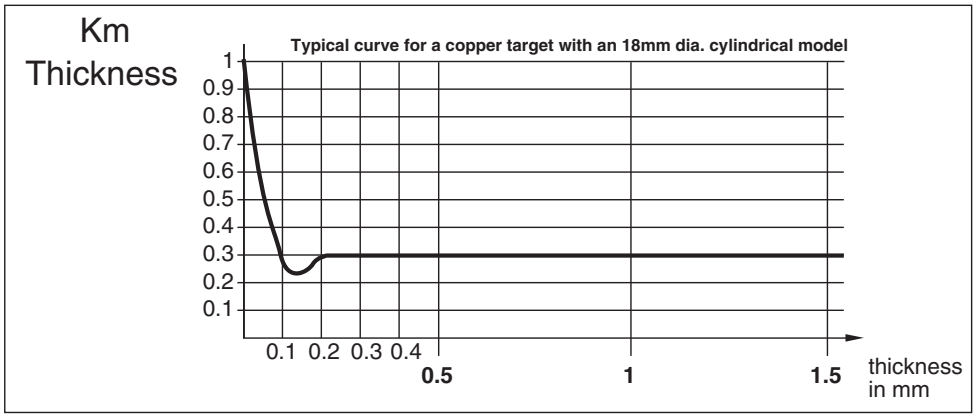
Apply a correction factor Kθ to be determined using the curve above.



Target material correction coefficient Km

Target Material	Stainless Steel			Mild Steel	Brass	Aluminum	Copper
	Magn.	Type 316	Type 304	A37	UZ33	AU4G	CU
Km	1.00	0.70	0.30	1.00	0.37	0.35	0.30

Apply a correction factor Km to be determined using the graph above.



Special case of a very thin target object made of non-ferrous material.

Application tip: Aluminum foil on a nonmetallic surface makes an excellent target.

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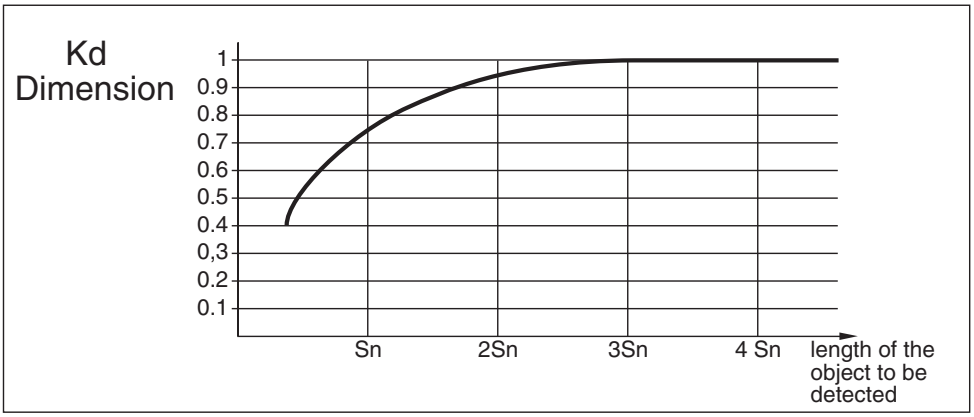

Apply a correction factor Kd to be determined using the curve above.

Usable sensing distance

For all situations, use the general correction factor Kt = 0.9 for power supply variations within the entire voltage range.

Sa = Sn x KΘ x Km x Kd x Kt
Where Sa = usable sensing distance
Sn = nominal sensing distance

Calculation example

Proximity sensor XS7C40MP230 with nominal sensing distance Sn = 15 mm.
Ambient temperature variation 0° C to + 20° C.
Target characteristics:
material: Steel
dimensions: 45 mm x 45 mm x 1 mm

The operating zone, Sa can be found using the formula:
Sa = Sn x KΘ x Km x Kd x Kt
Sa = 15 x 0.98 x 1 x 0.95 x 0.9
Sa = 12.5 mm

Rule of thumb

For standard targets, the rule of thumb is:
Sa = 0.8 Sn

Always test!

Note

The above curves are typical curves only. They are given as a guide to the approximate usable sensing distance of a proximity sensor for a given application

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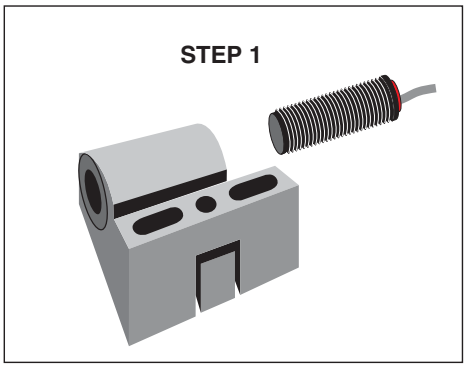
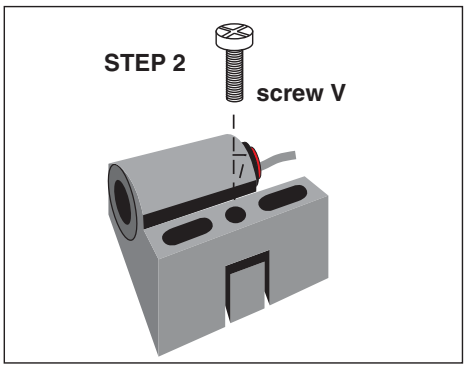
- Patented design
- No adjustment replacement

Mounting

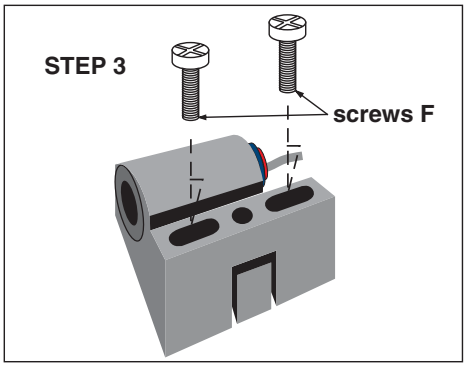
Indexed mounting bracket XSZB



- Insert the sensor in the bracket until it butts against the stop.



- Secure the sensor using V screw.



- Adjust the sensor/bracket combination to assure detection.
- Secure the combination using F screws.

If for any reason adjustment or replacement is necessary:

- Unscrew screw V
- Butt the new sensor against the stop. Once screw V has been tightened, the new sensor will be indexed in the same position as the old one. No adjustment is necessary.

Note: these functions are similar to those of a block type sensor

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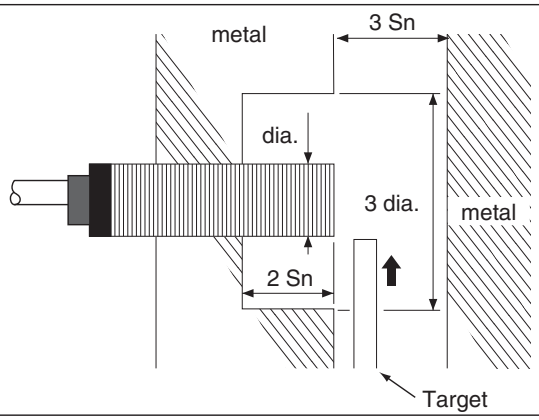
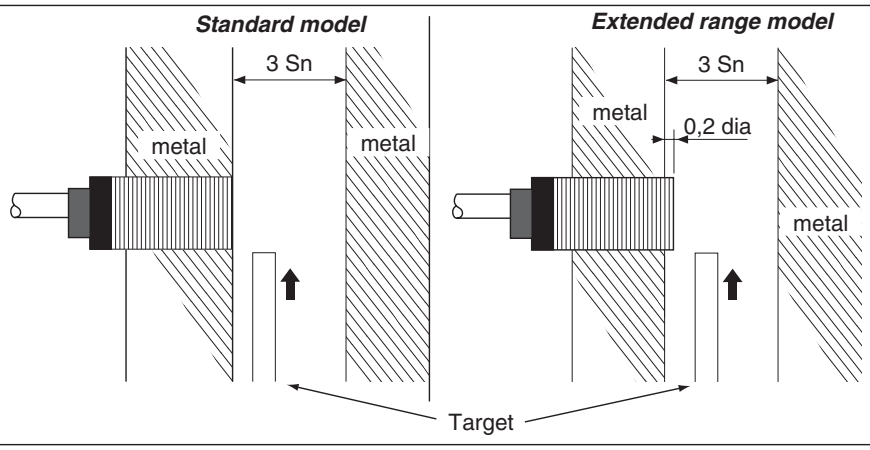
Clearing distances

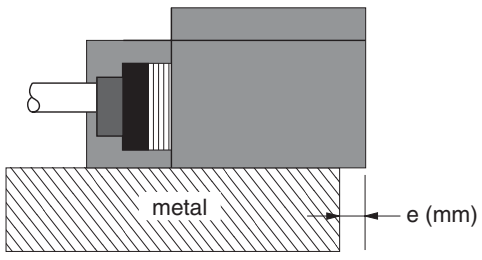
Tubular proximity sensor



Versions not suitable for flush mounting in metal (non-shielded)



Versions suitable for flush mounting in metal (shielded)



- Versions suitable for flush mounting in metal
  e (min): 0
- Versions not suitable for flush mounting in metal
  M8 e (min): 5 mm
  M12 e (min): 8 mm
  M18 e (min): 16 mm
  M30 e (min): 30 mm

Mounting with XSZ B mounting bracket

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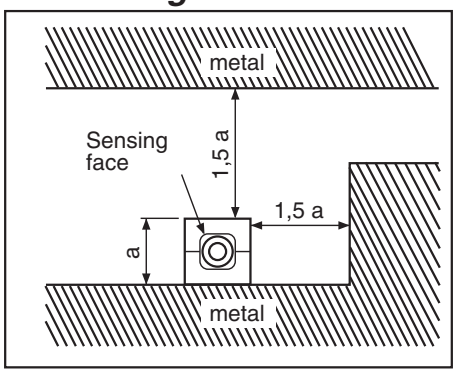
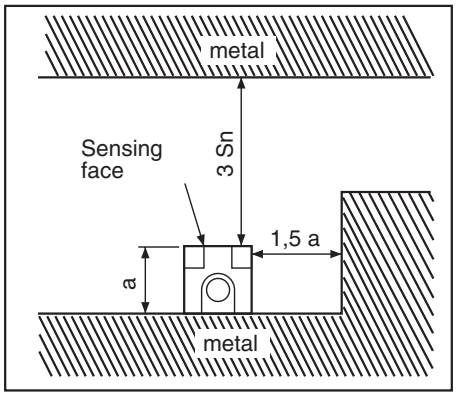
Block type proximity sensors not suitable for mounting in metal

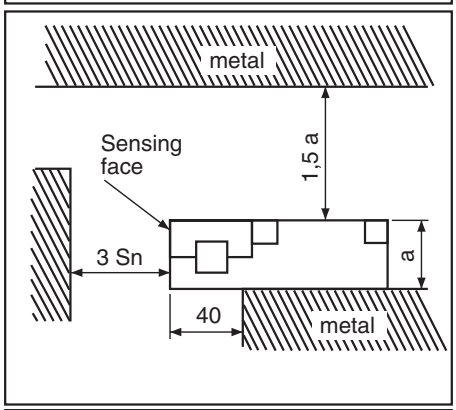
Non-shielded

Clearing distances

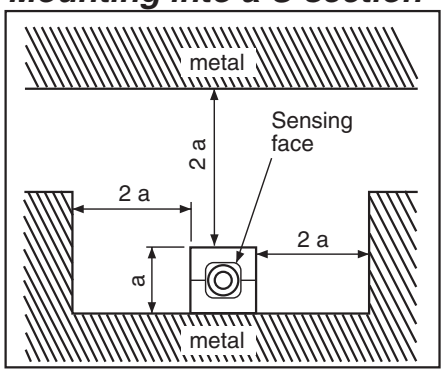
Mounting into a T section

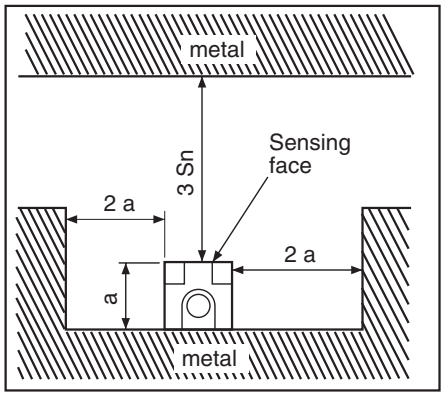


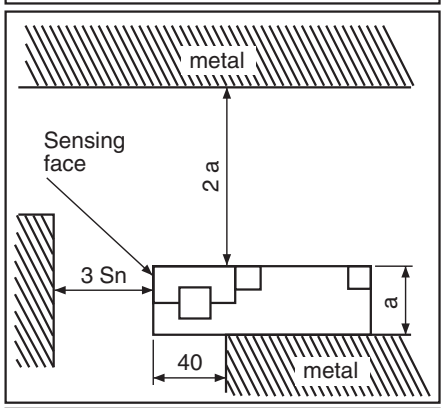




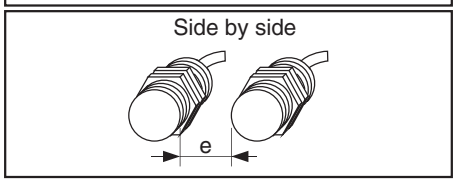
Mounting into a U section

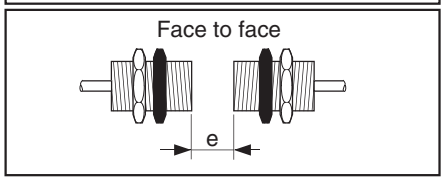






Side by side
Face to face





NOTE: For shorter distances, ***alternate frequency*** *models are required. Call factory for availability.*

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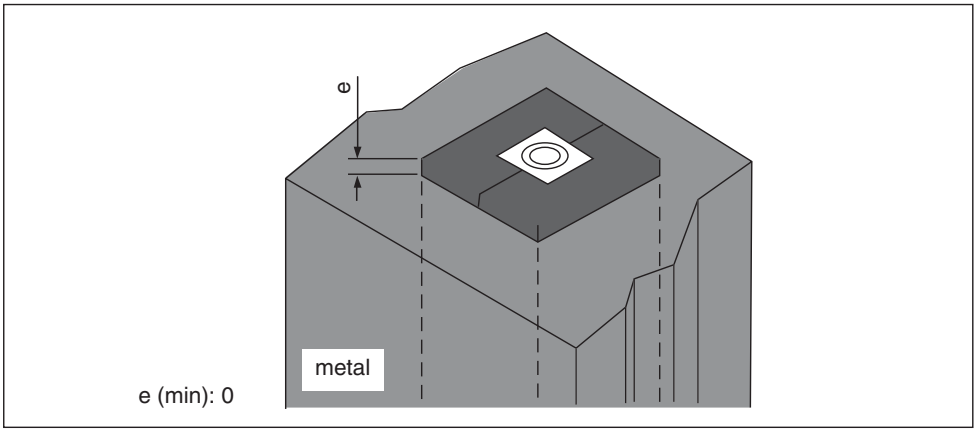
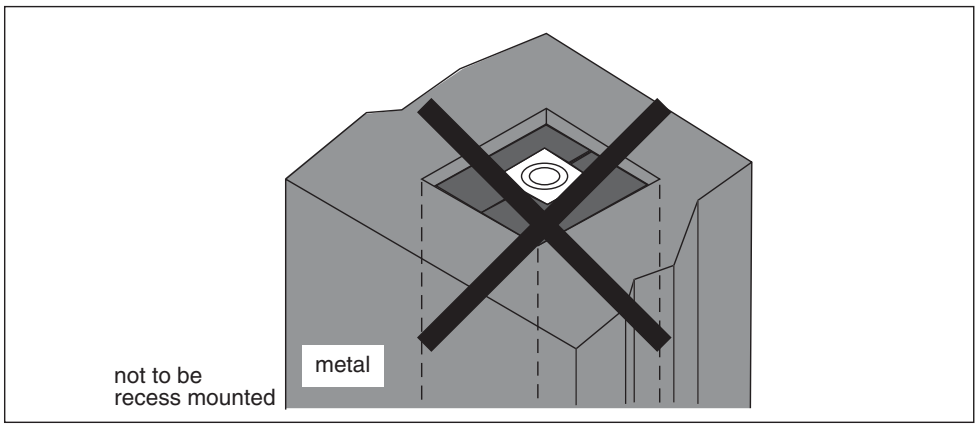
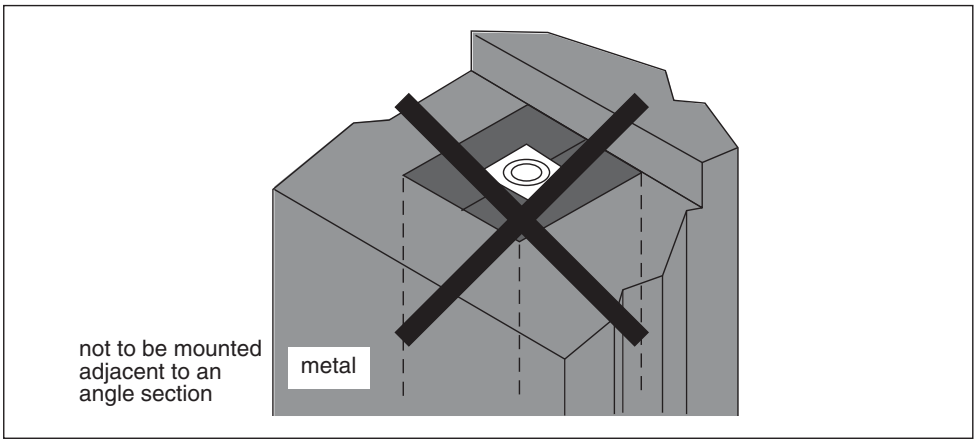
Suitable for flush mounting in metal

Shielded
Mounting with metal on one or more sides simultaneously







Any metal within the immediate vicinity of a proximity sensor distorts the magnetic field around the sensing face. The clearance distances shown above are given for a simplified installation arrangement and would result in the increase of the sensing distance of less than 5%.

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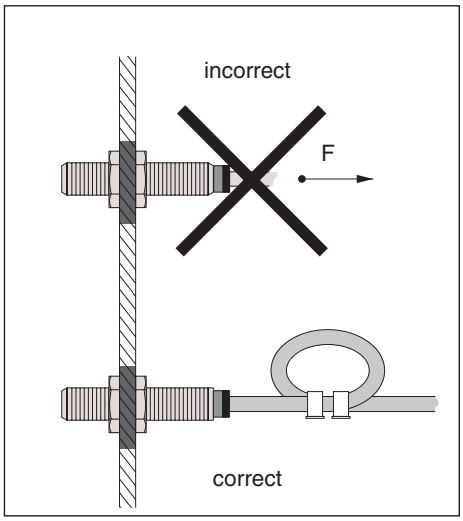
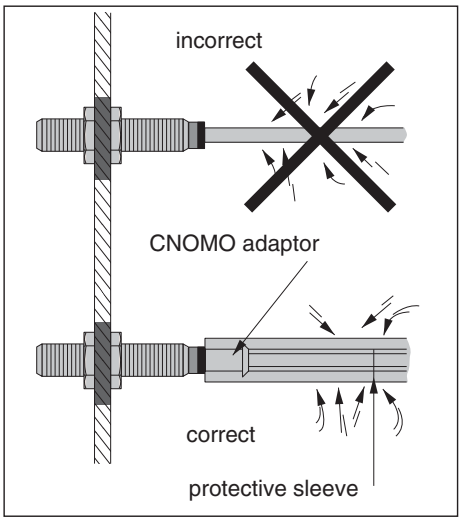
Precautions

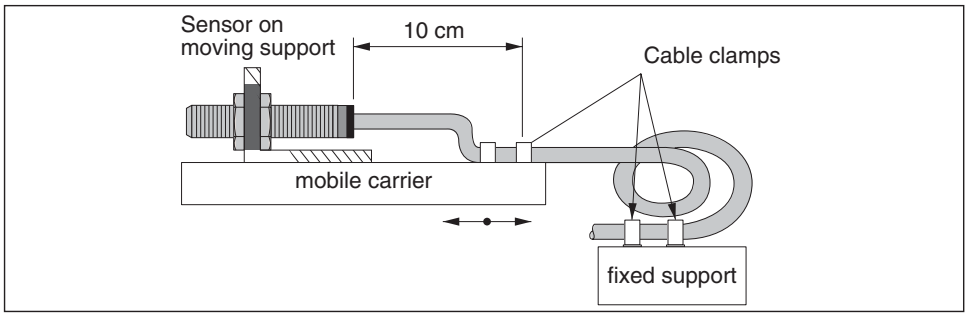
Protection of the cable



Do not exert a pulling force of over 4.4 lb on the sensor cable.

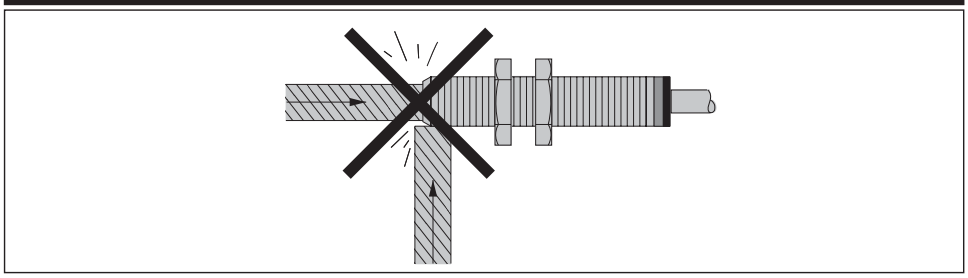


Consider using a protective sleeve or rigid conduit, where necessary.



Avoid repetitive flexing movement between the cable and the sensor.

Protection of the sensing face



The sensor must never be used as a mechanical stop as this may cause irreparable damage.

10/02

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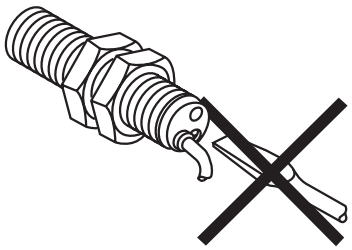
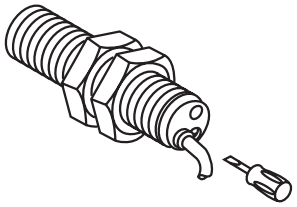
Use of tools for adjustment of the proximity sensor



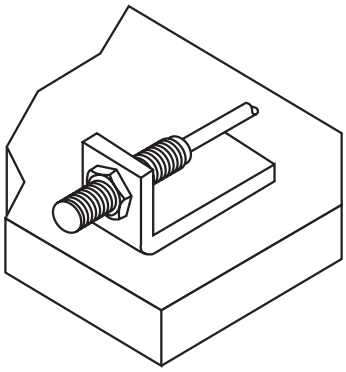
Incorrect



Correct

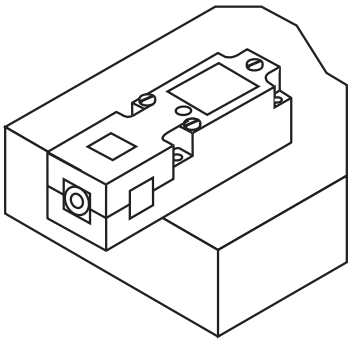
Mounting

Tubular sensor



Ensure a rigid mounting
the mounting must be sufficiently rigid and thick to resist shock and vibrations

Block type sensor



Ensure a rigid mounting
the mounting area must be large enough to support the sensor correctly

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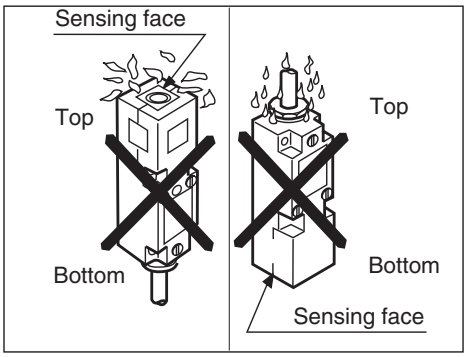
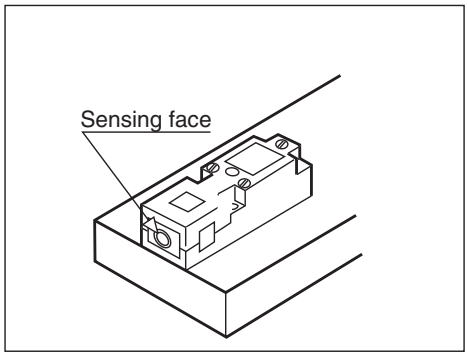
Precautions

Positioning



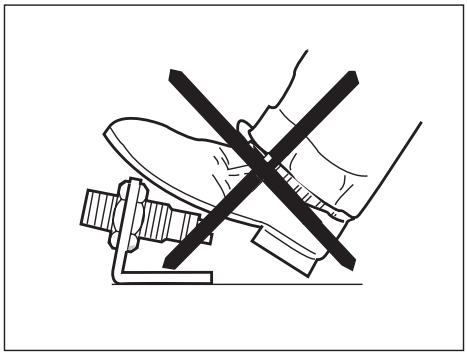
Incorrect

- *danger of debris collecting on the sensor sensing face*
- *danger of liquid entry should the cable gland be mounted improperly*

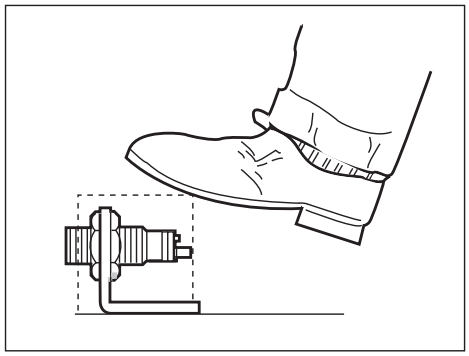


Correct

Mechanical protection



A proximity sensor should never be used as a footrest



Where the possibility of this type of abuse exists, a protective cover should be fitted over the sensor

Remember: For proper installation, the sensor must be mounted solidly to its support.

Depending on the application, the adjustment of the operating distance is carried out:

- either by moving the mounting bracket
- or by adjusting the target

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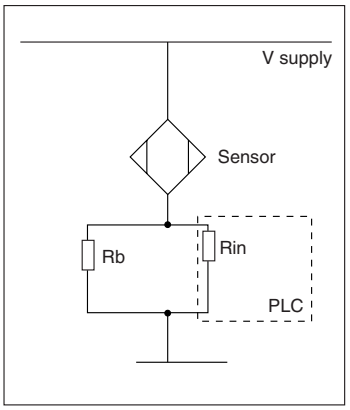

In order for a solid state, 2 wire, AC sensor to be directly compatible with a PLC, two conditions have to be met:

1. Leakage current: (I off) **less than 1.7 mA** (Off state)

2. Load current: greater than the sensor minimum load current (ON state). Typical PLC input currents (load current, I load) are 12-16 mA. Typical values for PLC input resistance (Rin) are: 7.5-10 kΩ.

For sensors which do not meet both of the requirements, a Bleeder Resistor (Rb) has to be wired in parallel with the load.

For each of the two situations, the Bleeder Resistor parameters have to be calculated as shown below. **The smaller value should be selected for the application.**

1. $Rb = \frac{Rin \times Vo\ Max}{I\ off\ (Rin) - Vo\ max}$ ✳ $Pb = \frac{Vs^2}{Rb}$

Where:
- Vo max = PLC input maximum OFF voltage (20-40 Vac)
- Rin = PLC input resistance
- Vs = Line voltage
- Pb = Minimum Bleeder Resistor power rating

Example:

I off = 3.5 mA
Vo max = 20 V
Rin = 6.5 kΩ

Typical examples for Telemecanique TSX DET input modules:

	TSX DET 1604	***TSX DET 0804***
For I off = 3.5 mA	*47 kΩ/0.5 W*	—
For I off = 7 mA	*4.7 kΩ/3 W*	*12 kΩ/1.5 W*

2. $Rb = \frac{Rin \times Vo\ Max}{I\ off\ (Rin) - Vo\ max}$ ✳ $Pb = \frac{Vs^2}{Rb}$

Example:

I min = 30 mA
Vs = 120 V
Rin = 7 kΩ

Typical examples using TSX programmable controllers:

	TSX DET 1604	***TSX DET 0804***
For I min = 20 mA	*64 kΩ/0.5 W*	*24 kΩ/1 W*
For I min = 30 mA	*8.7 kΩ/2 W*	*8.7 kΩ/2 W*

NOTE: All DC 3 wire sensors are PLC compatible.

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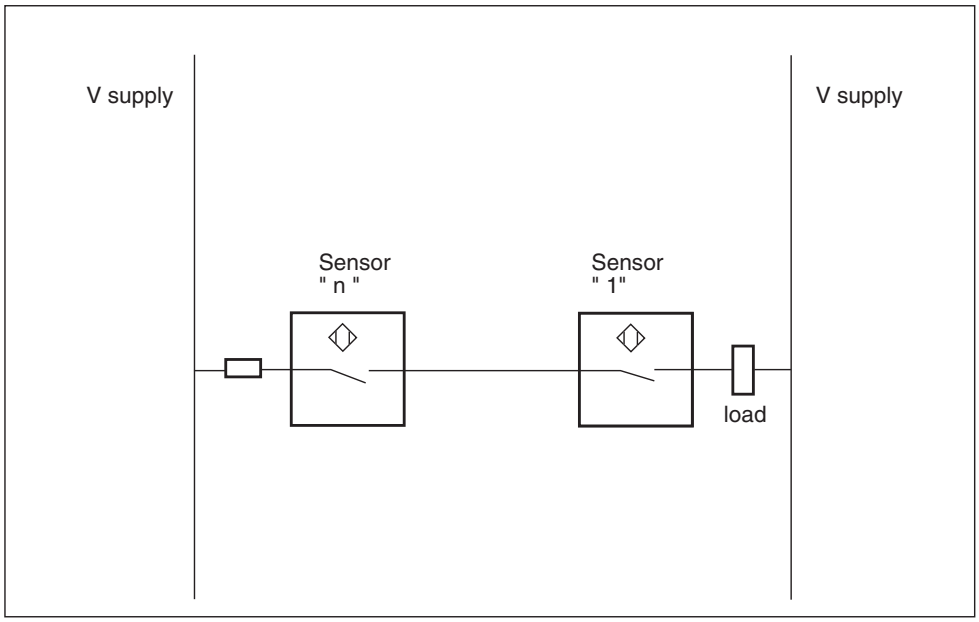
Wiring in series

Wiring two or more sensors in series 2 wire type



The following points should be considered:

1. When in the open state, each sensor will share the supply voltage:

   voltage across the sensor = $\frac{\text{V supply}}{\text{n° proximity sensors}}$

   V sensor and V supply must fall within the sensor's voltage range.

2. If a sensor is OFF, it will be supplied with nearly all the supply voltage.

3. When all sensors are ON, a small voltage drop is present across each sensor; the resultant loss of voltage at the load will be the sum of the individual voltage drops, and the load voltage should be selected accordingly.

4. **Series connection is only possible for sensors with a wide voltage range.**

Example: Four sensors rated at 24-240 Vac can be wired in series at 120 V because even at 90%, V supply = 108 V. When all sensors are OFF, each will see 108/4 = 27 V, which is higher than the minimum voltage rating of the switch (24 V).

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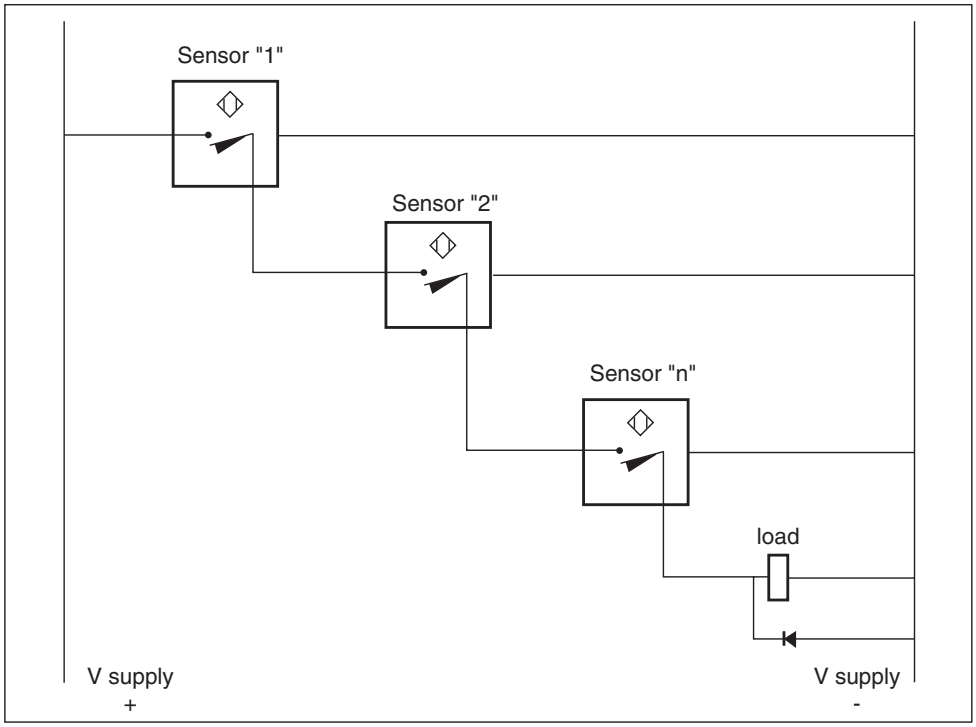
Wiring two or more sensors in series 3 wire type



The following points should be considered:

1. Sensor 1, when conducting its load current, will also carry the leakage currents of all other sensors.
2. Each sensor, when conducting, will produce a voltage drop of 2.6 V, maximum. The load voltage should be selected accordingly.
3. Sensor 2 is powered only when Sensor 1 turns ON. Only after its power-up delay will Sensor 2 be able to function properly. This delay should be taken into consideration when speed is a factor.
4. Use of “flywheel” diodes is recommended where an inductive load is being switched.

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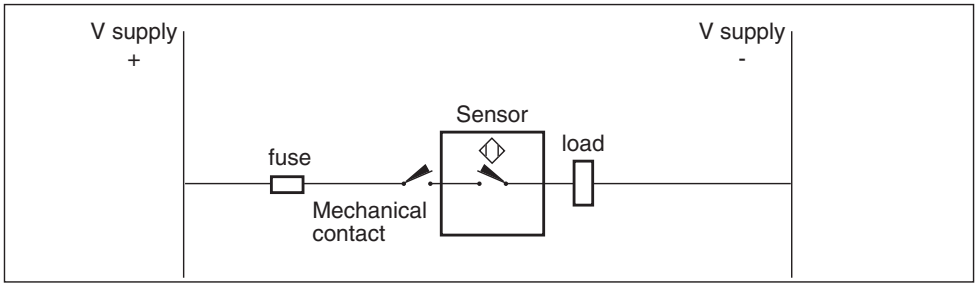
Wiring in series

Wiring proximity sensors in series with mechanical contact devices



The following points should be considered:

1. When the mechanical contact is open, the sensor is not supplied.
2. When the contact closes, the proximity sensor will not operate until a certain time “T” has elapsed, corresponding to the **power-up delay**. Please refer to details of individuals sensor characteristics

Wiring several sensors in parallel 2 wire type

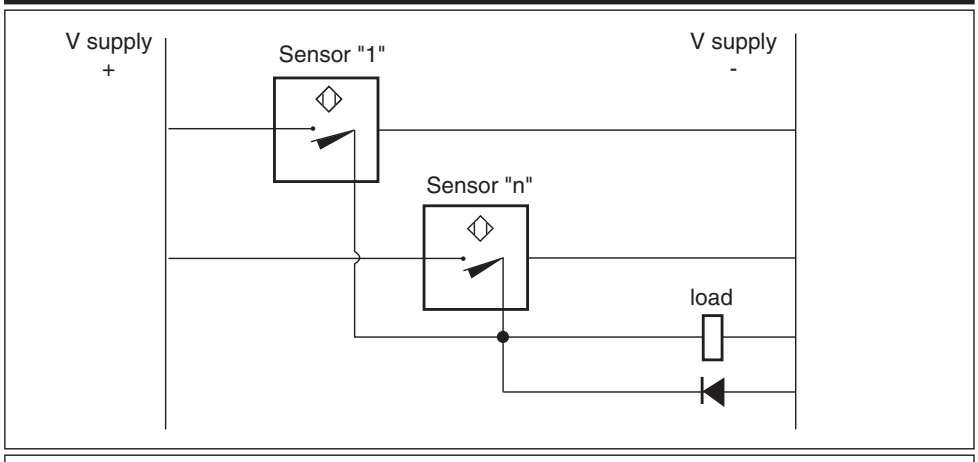
The use of proximity sensors wired in parallel either between themselves or together with mechanical contacts is not recommended.

When one of the sensors is in the ON state, the sensor in parallel is “shorted out” and thus no longer supplied.

As the first unit passes into the OFF state, the second sensor will become energized and will be subject to its power-up delay. This configuration is used where the sensors are working alternately.

When the sensors are OFF, the sum of the leakage currents must be less than the holding current of the load.

3 wire type



No restriction

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Precautions

Length of the cable

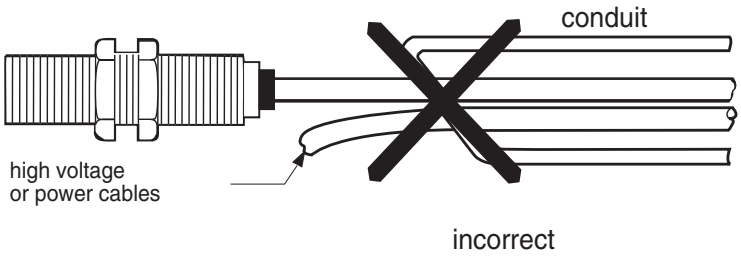
No restrictions up to 660 feet (200 meters) or up to a line capacitance of 0.1 µF. It is important to take into account voltage drop on the line over 660 feet (200 meters).

The XS models are immune to electrical interference encountered in normal industrial conditions.

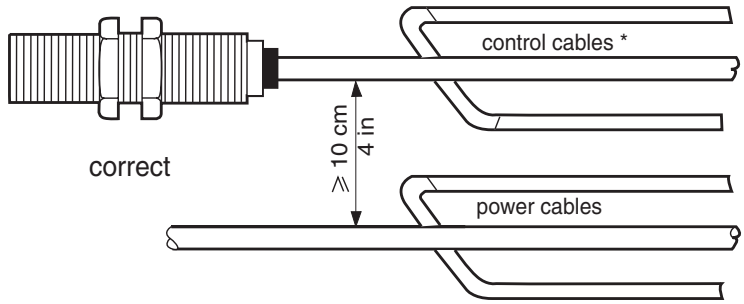
Where extreme electrical noise conditions could occur (large motors, spot welders, etc.) it may be advisable to protect against transients in the following ways:

Suppress interference at source, limit the length of the cables, separate power and control wiring from each other, ensure that the logic systems contain input transient suppression means and use twisted pair and shielded cables.

Separation of power and control wiring



Incorrect



Correct

* Use of individual cables is recommended if long lengths are involved.

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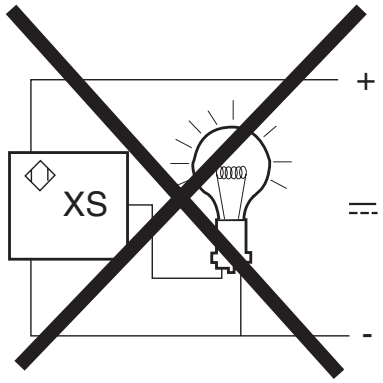
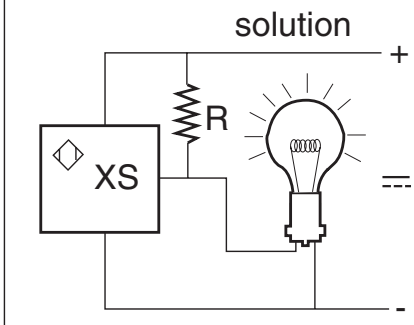
Precautions

Electrical connections to be avoided



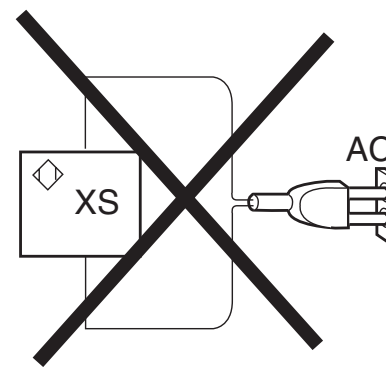
If the load consists of an incandescent lamp, the cold state resistance can be ten times lower than the hot state resistance. This can cause very high current levels on switching



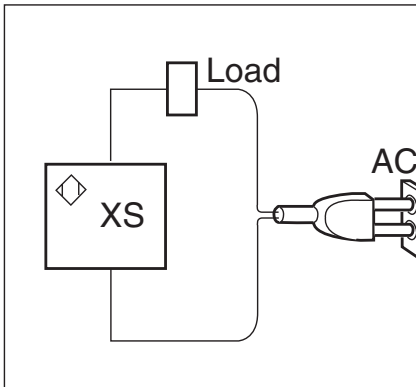
Install a pre-heat resistance in parallel with the proximity sensor.

$$R = \frac{V^2}{P} \times 10$$

V= supply voltage
P= power of lamp



An XS proximity sensor cannot be connected directly to an AC supply source. This would result in immediate destruction of the sensor and considerable danger to the operator (except short circuit protected switches)



A suitable load (see product data) must be connected in series with the proximity sensor.

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Problems	Possible cause	Remedial action
The sensor's output will not change state when a metal target is moved within its operating zone.	*Output failure, or the short circuit protection has operated.*	*• Check that the sensor is the correct one for the supply being used.* *• Check the load current.* *Characteristics:* *- If load current is greater than the max. rated current, a relay should be interposed between the sensor and the load.* *- If load current is lower than the nominal rated current, check for wiring faults which could have caused a short circuit. In any case, a fast-blow fuse should be wired in series with the sensor (AC).* *- For a tubular sensor, if the sensor is brand new, check the mounting torque.*
	Wiring error *Supply problems*	*• Check the wiring.* *• Check voltage range.* *• Check that the supply voltage falls within the operating limits of the sensor in question. Remember that with a rectified supply: Vpeak = Vrms x $\sqrt{2}$*
False or erratic operation with or without the presence of the target object.	*Transients*	*• Install transient suppressors across potential sources (coils, arcing contactors)*
	Influence of surrounding metal	*• Refer to the instruction sheet supplied with the sensor.*
	Effect of interference on the supply lines	*• Ensure that any DC supplies when derived from rectified AC, are correctly filtered ($C \geq 400\ \mu f$)* *• Ensure that AC power cables are run separately from low level DC cables.* *• Where very long distances are involved, use suitable cable:* *- shielded and/or twisted pair* *- suitable wire gage* *• Position the sensor as far away as possible from any source of interference.*
	Response time of the sensor too long for the particular target.	*• Check suitability of the sensor for the target; choose a sensor with a faster response time or use a longer target.*
	Effects of high temperature	*• Eliminate sources of radiated heat, or protect the housing with a heat shield.*

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Cenelec standards

Cylindrical		Block type	
Form A		**Form C**	**Form D**
EN 50008 (NFC 63-076) DC 3 or 4 terminals EN 50040 (NFC 63-071) DC 2 terminals EN 50036 (NFC 63-081) AC terminals		EN 50025 (NFC 63-077) DC 3 or 4 terminals EN 50037 (NFC 63-082) AC 2 terminals	EN 50026 (NFC 63-078) DC 3 or 4 terminals EN 50038 (NFC 63-083) AC 2 terminals

EN 50010 (NFC 63-075)	*Determination of sensing distance and operating frequencies*
EN 50032 (NFC 63-079)	*Definitions, classification, description*
EN 50040 (NFC 63-074)	*Connection identification*

Series XS1/XS2 N, XS1/XS2 M, XS4 P also conform to the requirements of IEC 60947.5.2 standard. (ISO 9000 Self-Certification, NEMA project ICS 5-4-199X)

Approvals

- File LR46094 + LR44087 class 321103
- File E39291 guide NKCR2
- File E39281 guide NKCR
- ● Standard version approved
- ○ pending
- ▲ Special North American version (1/2" NPT cable entry, UL label, etc.)
- FM Intrinsically safe applications

					USSR
XS1 / XS2 L/N	●	—	●	●	—
XS1 / XS2 M	●	—	●	●	—
XS4P	●	—	●	●	—
XSB	▲	—	▲	●	●
XS7 / 8	▲	—	▲	●	—
XSD	▲	—	▲	●	—
XSE	▲	—	▲	●	●
XSG	▲	▲	—	—	—
XS5	▲	—	●	●	—
XS6	▲	—	●	●	—
XS7	▲	—	●	●	—
XS8	▲	—	●	●	—
XS9	▲	—	●	●	—

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Environment

Degree of protection	Conforming to IEC 529	IP65, unless otherwise stated IP66, for booted push button heads
	Conforming to UL 50 and CSA C22.2 No. 94	Type 1, 2, 3, 4, 4X, 12, and 13, unless otherwise stated
Conforming to standards	CE Marked	IEC 947-1, IEC/EN 60947-5-1, IEC 947-5-4, EN 60947-1, JIS C 4520, UL 508, CSA C22.2 No. 14
Product certifications	UL Listed, CSA File E164353 CCN NKCR File LR 44087 Class 3211 03 File E164353 CCN NKCR 2	Standard single contacts with screw clamp terminals: A600; Q600 Double contacts with screw clamp terminals: A600; Q600 Light modules with screw clamp terminals JOYSTICK XD4-PA: A600; R300
	BV, RINA, LROS, DNV, GL (pending)	Standard single contacts and double contacts with screw clamp terminals

Electrical Characteristics of Operators and Contact Blocks

Cabling capacity	Conforming to IEC 947-1	Screw and captive clamp terminals Min: 1 x 24 AWG (0.22 mm^2) without cable end 1 x 22 AWG (0.34 mm^2) for linking Max: 2 x 16 AWG (1.5 mm^2) with cable end 2 x 14 AWG (2.5 mm^2) without cable ends Cross headed screw (POZIDRIV type 1) slotted for flat 4 and 5.5 mm screwdriver	
Maximum Contact Block Usage	XB4/ZB4 Maximum Number of Blocks	Push buttons (Non-Illuminated)	9
		Selector switches (Non-Illuminated)	6
		Push buttons and selectors (Illuminated)	6
		Mushrooms, Push Pull (Non-Illuminated)	6
		Mushrooms, Push Pull (Illuminated)	4
		Mushrooms, Turn-to-Release (Non-Illuminated)	6
		Mushrooms, Trigger Action (Non-Illuminated)	4
		Push-on/Push-off (Non-Illuminated)	3
		Push-on/Push-off (Illuminated)	2
Rated operational characteristics Conforming to IEC/EN 60947-5-1	AC supply: Utilization category AC-15	Standard blocks (single or double) with screw clamp terminals: A600: Ue = 600 Vac and Ie = 1.2 A or Ue = 240 Vac and Ie = 3 A or Ue = 120 Vac and Ie = 6 A Continuous Thermal Current: 10 A	
	DC supply: Utilization category DC-13	Standard single or double blocks with screw clamp terminals: Q600: Ue = 600 Vdc and Ie = 0.1 A or Ue = 250 Vdc and Ie = 0.27 A or Ue = 125 Vdc and Ie = 0.55 A Joystick XD4-PA: R300: Ue = 125 Vdc and Ie = 0.22 A or Ue = 250 Vdc and Ie = 0.1 A	
Electrical durability Conforming to IEC/EN 60947-5-1 Appendix C Operating rate 3600 operating cycles/hour. Load factor: 0.5	AC supply for 1 million operating cycles, utilization category AC-15	Standard blocks for screw clamp terminals:	
		24 Vac	120 Vac / 230 Vac
		4 A	3 A / 2 A
		Standard double blocks with screw clamp terminals:	
		24 Vac	120 Vac / 230 Vac
		3 A	1.5 A / 1 A
	DC supply for 1 million operating cycles, utilization category DC-13	Standard single blocks for screw clamp terminals:	
		24 Vdc	110 Vdc
		0.5 A	0.2 A
		Standard double blocks with screw clamp terminals:	
		24 Vdc	110 Vdc
		0.4 A	0.15 A

Electrical Characteristics of Light Modules

Cabling capacity	Conforming to IEC 947-1	Screw and captive clamp terminals Min: 1 x 24 AWG (0.22 mm^2) without cable end 1 x 22 AWG (0.34 mm^2) for linking Max: 2 x 16 AWG (1.5 mm^2) with cable end

Specific Characteristics of Protected LED® Light Modules Only

Voltage limits	Nominal voltage	24 V: 19.2 to 30 Vdc, 21.6 to 26.4 Vac; 120 V: 102 to 132 Vac; 240 V: 195 to 264 Vac
Current consumption	Applicable to all colors	24 Vac/dc supply blocks: 18 mA 120 Vac supply blocks: 14 mA 240 Vac supply blocks: 14 mA

For additional information, reference Catalog #9001CT0001.

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8/1/04

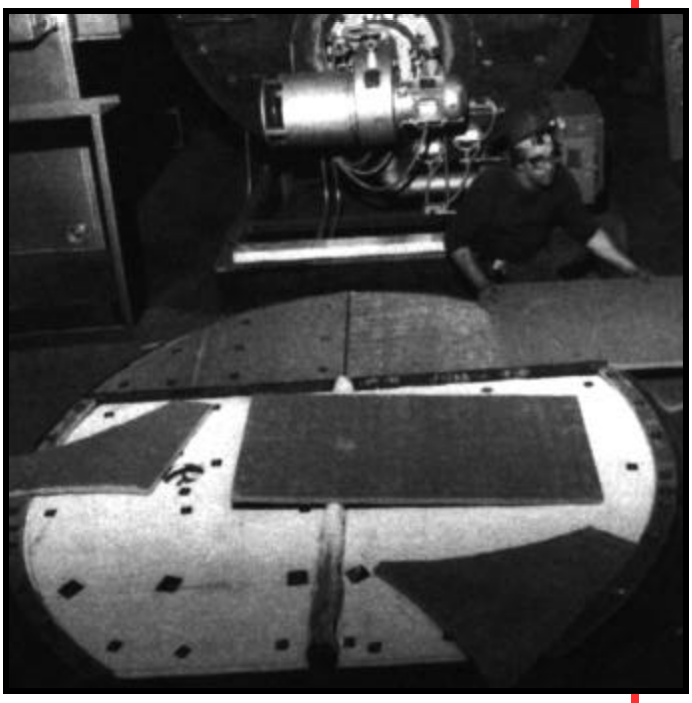
Thermafiber®

K-FAC® 19

HIGH-TEMPERATURE BOARD

STRONG • DURABLE • EASILY APPLIED • NON-ASBESTOS

For insulation of high-temperature ovens, furnaces, kilns, vessels



Low-Cost, Effective Insulation

K-FAC 19 High-Temperature Board provides high strength and excellent workability. It is composed of mineral fiber and selected mineral additives. An organic binder that will dissipate above approximately 475°F is used for low-temperature handling. On initial start-up, heat rise should not exceed 15°F per minute to allow the binder to dissipate without excessive temperature rise. This will occur only on the first startup and will not adversely affect the insulation value. An inorganic binder system allows K-FAC 19 High-Temperature Board to be used at service temperatures to a maximum of 1900°F on the hot surface of the enclosed panel only. Not to be subjected to direct flame impingement as a hot face material. The density allows K-FAC 19 High-Temperature Board to meet a variety of installation requirements.

Versatile Uses

Widely used in applications on precipitators, dryers, ducts and breeching, utility boilers, furnaces, kilns, etc., where high-temperature insulating materials are required.

Rapid Application

Exceptional strength and easy handling allow use of large-size boards to reduce labor costs. Material can be cut quickly by hand with knife or saw for fabrication and application on the job. Attachment is by impaling on pins or studs.

Noncorrosive

K-FAC 19 High-Temperature Board will not cause or sustain corrosion of steel or aluminum finishes as tested per HH-1-558B.

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K-FAC® 19

HIGH-TEMPERATURE BOARD

STRONG • DURABLE • EASILY APPLIED • NON-ASBESTOS

Physical Properties

Physical Data

Nom. density—pcf[1]	Minimum compressive strength—psf at 10% compression	Linear shrinkage, max./24 hr. at 1900°F[2]	Modulus of rupture—psi min.
18.5	4,800	2.50%	95

(1) Density tolerance: ± 1 lb./cu.ft.
(2) Not for use at service temperatures over 1,900°F.

Thermal Conductivity[1] per ASTM C177

K-factor—Btu - in./hr. - ft.^{2} - °F

400°F	500°F	600°F	700°F	800°F	900°F
0.46	0.51	0.56	0.64	0.71	0.80

(1) Degrees represent mean temperature.

Specification Compliance

Meets ASTM C612-93, Type V

Sizes and Availability[1]

Thickness	Sizes Available[2]
1/2”	24” x 36”, 36” x 48”
3/4”	6, 12, 24” x 36”
1-4”[3]	6, 12, 24” x 36”; 24” x 48”

(1) Manufactured in all sizes in Greenville, MS. Available in selected standard sizes from Wabash, IN in combination shipments with Thermafiber Insulation Products.
(2) Thickness tolerance: non-laminated ± 1/64”, laminated ± 1/32”. Width and length tolerance: non-laminated ± 1/32”, laminated ± 1/32” (dimensions subject to no greater than ± 1/8” offset on multiple plies).
(3) Thicknesses from 1” to 4” in 1/2” increments. Thicknesses over 1” are laminated.

Surface Burning Characteristics:

Flame Spread 25
Smoke Developed 5, (Per ASTM E-84)

The information presented herein represents typical or average values obtained by ASTM or other standard methods. The values will vary due to normal manufacturing variations. The person using this product must determine its suitability for a particular application.

Safety First! Follow good safety and industrial hygiene practices during handling and installing of all products and systems. Take necessary precautions and wear the appropriate personal protective equipment as needed. Read material safety data sheets and related literature on products before specification and/or installation.

For further information on these products including non-standard sizes, contact Thermafiber at the sales offices listed below.

NOTICE: We shall not be liable for incidental and consequential damages, directly or indirectly sustained, nor for any loss caused by application of these goods not in accordance with current printed instructions or for other than the intended use. Our liability is expressly limited to replacement of defective goods. Any claim shall be deemed waived unless made in writing to us within thirty (30) days from date it was or reasonably should have been discovered.

Thermafiber® THE MARK IN MINERAL WOOL™

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Low Temperature Insulating Firebrick

Product Information

Thermal Ceramics was first to introduce insulating firebrick (IFB) to the industry in the 1930's. The IFB are manufactured with a unique slurry casting process which creates a network of microporosity which produces low thermal conductivity and good thermal shock characteristics. This process produces brick that are some of the most efficient insulators available in the market. The anorthite mineralogy ($CaO \cdot Al_2O_3 \cdot 2\ SiO_2$) of these low temperature IFB gives them excellent strength at operating temperatures and resistance to corrosive alkali environments.

Features

- Extremely low "K" factors
- Low densities
- Low heat storage
- Excellent strength at room and high temperatures
- Excellent resistance to alkali attack
- Excellent service in applications involving special atmospheres

Applications

- Backup insulation for carbon baking furnaces
- Backup insulation in aluminum electrolytic cells
- Electrical kilns for industrial and hobby use
- Backup insulation for blast furnace stove linings
- Linings for carbonizing furnaces
- Forge furnace linings
- Heat transfer linings

Physical Characteristics

Standard sizes*	9" x 4½" x 2½" and 9" x 4½" x 3" (22.5 cm x 11.25 cm x 6.25 cm and 22.5 cm x 11.25 cm x 7.5 cm)
IFB 23 Tile	9" x 9" x 3" to 24½" x 9" X 3" (22.5 cm x 22.5 cm x 7.5 cm to 61.25 cm x 22.5 cm x 7.5 cm)

* Special sizes available upon request.

Manufacturing Process

TC-23, TC-23 HS, K-23, K-25 IFB	casting
IFB 23 Tile	slinger

Low Temperature Insulating Firebrick

Product Information

Physical Properties	**TC-23**	**TC-23 HS**	**K-23**	**IFB 23 Tile**	**K-25**
Recommended Hot Face use limit,°F *(°C)*	2300 *(1260)*	2300 (1260)	2300 *(1260)*	2300 *(1260)*	2500 *(1371)*
Density, ASTM C 134					
lb/9" straight	2.17-2.52	2.3	1.86	2.2	2.3
(kg)	*(0.99-1.15)*	(1.1)	*(0.84)*	*(1)*	*(1.05)*
pcf	38-44	40	31-33	37	37-40
(kg/m^3)	*(609-705)*	(641)	*(497-529)*	*(593)*	*(593-641)*
Melting temperature,°F	2750 *(1510)*	2750 *(1510)*	2750 *(1510)*	2750 *(1510)*	2800 *(1538)*
Modulus of rupture, ASTM C 133					
psi	110-160	140	120	105	120
(Mpa)	*(0.75-1.03)*	(1.0)	*(0.83)*	*(0.72)*	*(0.83)*
Cold crushing strength, ASTM C 133					
psi	140-220	200	135	125	175
(Mpa)	*(0.97-1.52)*	(1.4)	*(0.93)*	*(0.86)*	*(1.21)*
Permanent linear change, %, per ASTM C 210					
@ 2250°F *(1232°C)*	-0.1 to -0.4	0.0	0	0	-
@ 2450°F *(1343°C)*	-	-	-	-	-0.1
Deformation under hot load, % @ 10 psi, ASTM C 16					
1½ hr @ 2000°F *(1093°C)*	-0.1 to -0.3	0	0	0	-
1½ hr @ 2200°F *(1204°C)*	-	-	-	-	-0.1
Coefficeint of thermal expansion					
in/in°Fx10^{-6}	3	-	3	-	3.1
Chemical Analysis, %					
Alumina, Al_2O_3	39-43	38.8	38.3	38.8	45
Silica, SiO_2	43-45	47.8	44.3	47.8	38
Ferric oxide, Fe_2O_3	0.4-0.6	0.4	0.3	0.4	0.2
Titanium oxide, TiO_2	1.5-1.9	1.6	1.6	1.6	1.6
Calcium oxide, CaO	10-12	10.9	15	10.9	14.5
Magnesium oxide, MgO	0.1-0.2	0.2	0.1	0.2	0.2
Alkalies, as, Na_2O and K_2O	0.4-0.7	0.3	0.4	0.3	0.5
Thermal Conductivity, BTU•in./hr•ft^2•°F *(w/m•k)*, ASTM C 201					
Mean temperature					
@ 500°F	1.1-1.2	*1.2*	0.95	1.0	1.12
(260°C)	*(0.16-0.17)*	*(0.17)*	*(0.13)*	*(0.14)*	*(0.16)*
@ 1000°F	1.3-1.4	1.5	1.18	1.3	1.28
(538°C)	*(0.19-0.20)*	(0.22)	*(0.17)*	*(0.18)*	*(0.18)*
@ 1500°F	1.6-1.7	1.7	1.45	1.6	1.46
(815°C)	*(0.23-0.25)*	(0.25)	*(0.21)*	*(0.23)*	*(0.21)*
@ 2000°F	1.75-1.9	2.0	1.74 *(0.25)*	1.8	1.65
(1093°C)	*(0.25-0.27)*	(0.29)	*(0.25)*	*(0.25)*	*(0.24)*

The values given herein are typical average values obtained in accordance with accepted test methods and are subject to normal manufacturing variations. They are supplied as a technical service and are subject to change without notice. Therefore, the data contained herein should not be used for specification purposes. Check with your Thermal Ceramics office to obtain current information.

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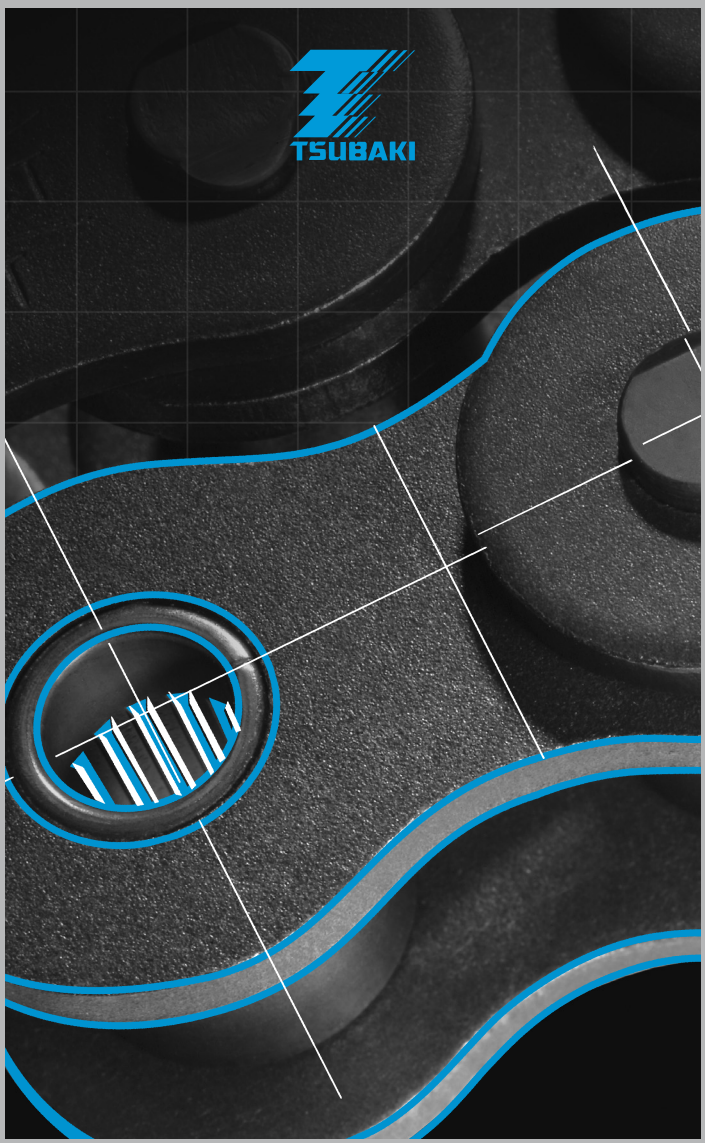
INSTALLATION & MAINTENANCE

For Tsubaki RS Roller Chain & RF Conveyor Chain



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This information is intended to provide general guidelines for roller chain and conveyor chain installation and maintenance. Consult Tsubaki of Canada Limited for specific application problems.

1 Chain Construction

RS Roller Chains and RF Conveyor Chains consist of alternate connections of roller links and pin links. The roller link consists of a roller plate to which two bushings with rotating rollers are press-fit. This roller link is alternately connected to the pin link plate in which two pins have been securely press-fit.

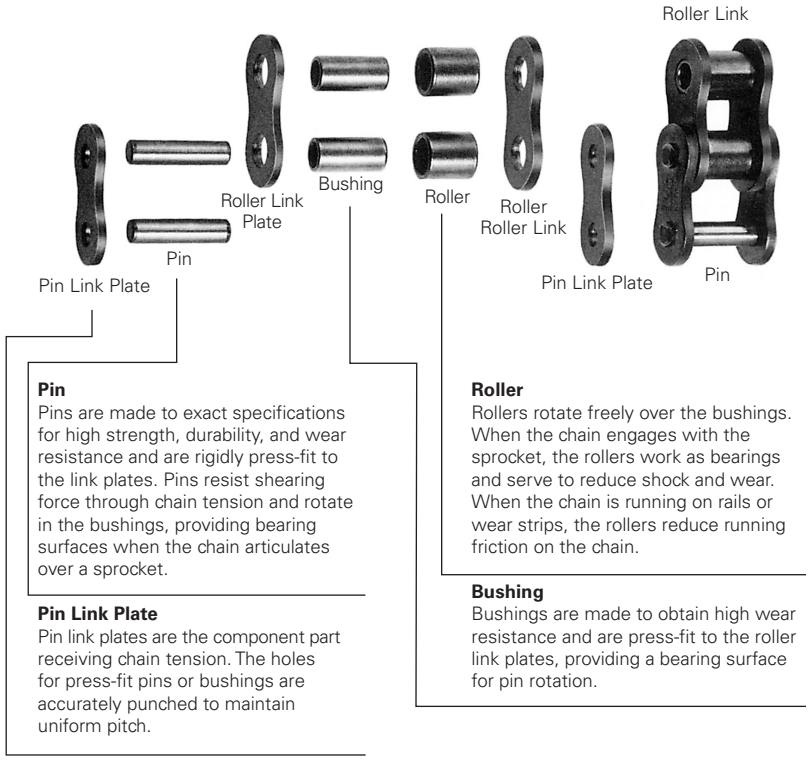


Figure 1-1: RS Roller Chain Construction

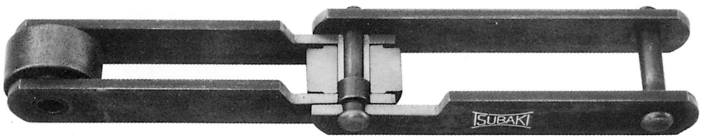


Figure 1-2: RF Conveyor Chain Construction

2 RS Roller Chain Connecting Links

Tsubaki Roller Chain links can be easily connected using one of two types of connecting links. Though an offset type of connecting link is available for the connection of an odd number of links, it is best to use regular links whenever possible.

Connecting Links

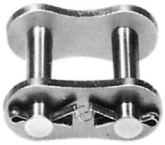
Tsubaki uses two types of connecting links and, generally, two types of fasteners for RS Roller Chain:

1. A regular connecting link with either a spring clip or cotter pin type fastener
2. A special, high-performance, gold-colored connecting link also with a spring clip or cotter pin type fastener

A spring clip is used for links sized RS60 and smaller. For chain sized RS80 and larger, or for three to six strands of RS40 or RS50 chain, a cotter pin is best. A roll pin type is used for chain sized RS240.

The regular connecting link has lower fatigue strength than the gold link but is easy to use and handle. The regular type is suitable for most power transmission applications and has ample strength to withstand relatively high loads over a long period of time. The high-performance gold connecting link is preferred for severe conditions such as high impact or heavy loads and for applications with high-speed drives. The gold connecting link is durable and has fatigue strength almost equal to that of the chain itself. The gold connecting link is easily recognized by its distinctive color.

Spring Clip



Cotter Pin

Figure 2-1: Standard Connecting Link

Spring Clip

Cotter Pin

Figure 2-2: Gold-colored Connecting Link

Offset Links

One-pitch and two-pitch offset links are available for RS Roller Chain. Two-pitch offset links consist of a roller link and an offset link with a riveted pin, as shown in Figure 2-3. The gold type connecting link can be used on both ends of the two-pitch offset link for increased capacity.

The one-pitch offset link is relatively easy to handle but should be confined to lighter loads and medium- to low-speed applications with reduced start-and-stop frequency and low-impact loads.

Two-pitch Offset Link

One-pitch Offset Link

Figure 2-3: Offset Links

Note: Two-pitch offset links for RS41 chain and one-pitch offset links for RS25 chain are not available.

3 How to Connect RS Roller Chain

For easy connection and installation:

1. Wind the chain around one of the sprockets so that the free ends are separated by one sprocket tooth.
2. Insert the connecting link into the two end links of the chain.
3. Install the free connecting link plate and fasten the plate using the spring clip or cotter pin fasteners supplied.

If layout prevents the use of sprocket teeth:

1. Wind the chain around the sprockets so that the free ends come together in the area between the sprockets.
2. Pull the chain ends together and insert the connecting link using a chain puller or by hand.
3. Install the free connecting link plate, then insert and secure the fasteners.

For both methods, be sure to tap the ends of the chain pins after the fasteners have been inserted. By tapping the ends of the pins, the fasteners will rest snugly against the outside of the connecting link plate. This will help the chain to flex freely and smoothly as it goes around the sprocket and allow better penetration of lubricant and greater fastener life.

An offset link must be used when an odd number of pitches is required. However, because the allowable working load is considerably lower than that of the base chain or standard connecting link, the use of offset links should be avoided if possible. Instead, it is better to add one link and take up the extra slack by varying the center distance between the shafts or installing an idler.

Notes:

1. The gold-colored connecting link is made to fit exactly with the pin. Do not make the link plate holes larger or the diameter of the pin smaller, as doing so may damage the chain or reduce its life and performance.
2. For cotter pin type construction, a regular pin link can be used as a substitute for the connecting link. To prevent chain damage or increased wear, the pin link must be carefully driven onto the pin parallel to the connecting link.

Figure 3-1: Connecting RS Roller Chain on a Sprocket

4 How to Disconnect RS Roller Chain

There are two relatively simple methods for disconnecting RS Roller Chain. One way is to use a chain vise and punch. The other is to use a chain breaker.

Using a Chain Vise

1. For riveted type Tsubaki Roller Chain, first grind down one end of the pin to be removed. For cottered type chain, be sure to take out the cotter pin.
2. As shown in Figure 4-1, put the chain into the vise groove and tighten the vise to secure the chain.
3. Hit the head of the pin with a punch or hammer. Be sure to hit the pins alternately for even removal.

Note: For riveted types, be sure to grind off the riveted part of the pin. If the pin is taken out without grinding, it will take more time and may damage the chain. Chain vises and punches are available for RS40 to RS240 chain.

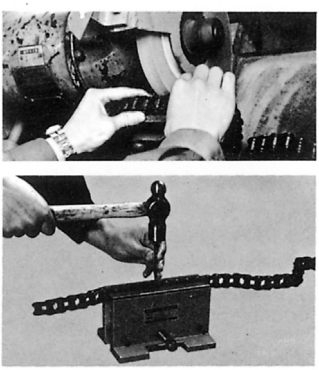


Figure 4-1: Disconnecting RS Roller Chain

Table 4-1: Chain Vise Selection

No. of Strands \ Chain No.	RS40	RS50	RS60	RS80	RS100	RS120	RS140	RS160	RS180	RS200	RS240
1	CV-1										
2		CV-2				CV-3					
3								Not In Stock			

■ Indicates CV-1 ■ Indicates CV-2 □ Indicates CV-3

Notes:

1. For overlapping parts, a smaller chain vise is easier to use.
2. These chain vises can also be used for double-pitch chain other than RS Roller Chain.

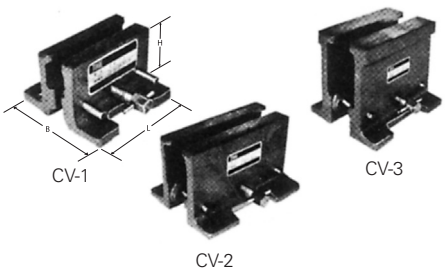


Figure 4-2: Chain Vise Types

Table 4-2: Chain Vise Dimensions mm (in.)

Type	L	H	B
CV-1	100 (3.94)	65 (2.56)	94 ~ 115 (3.70 ~ 4.53)
CV-2	180 (7.09)	110 (4.53)	120 ~ 151 (4.72 ~ 5.94)
CV-3	200 (7.87)	170 (6.69)	180 ~ 220 (7.09 ~ 8.66)

Using a Chain Punch

When using a chain punch, be sure to draw both pins out together. Link plates cannot be used again once the pins have been removed.

Primary Punch

Secondary Punch

Riveting Punch

Figure 4-3: Punch Selection

Table 4-3: Punch Selection

Chain No.	Primary Punch	Secondary Punch	Riveting Punch
RS40 ~ RS60	S-1	D-1	For RS40
RS80 ~ RS120	S-2	D-2	For RS50 For RS60
RS140 ~ RS240	S-3	D-3	For RS80

Using a Chain Breaker

A chain breaker is a tool made for cutting chain. The chain breaker does not require a firm working table and can cut chain already set on a machine. RS25 and RS35 chains require a chain breaker.

Table 4-4: Chain Breaker Selection

Chain No. / No. of Strands	RS25	RS35	RS41	RF06B	RS40	RS50	RS60	RS80	RS100	RS120	RS140	RS160	RS180	RS200	RS240
1	CS-A1	CS-A2	CS-A3	CS-A4	CS-B1			CS-C1		CS-C2		CS-C3			
2															

Notes:

1. A4 type, B type, C type, and two-strand A type are made to order; all others are from stock.
2. This series can also be used with BS Roller Chain and Tsubaki Marine Chain. A specially manufactured breaker for Marine Chain is also available.

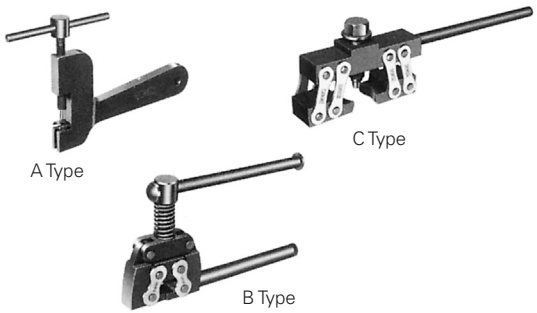


Figure 4-4: Chain Breaker Types

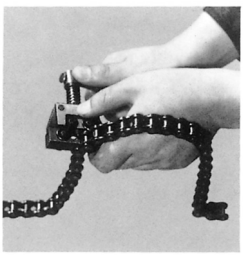


Figure 4-5: Using the Chain Breaker

5 Sprockets for RS Roller Chain

Good quality sprockets are essential for maximum power transmission efficiency. The tooth configurations of Tsubaki Sprockets conform to JIS and ANSI standards. All Tsubaki Sprockets are precision components with finely balanced boss and rim parts that are exactly in accordance with Tsubaki of Canada Limited stated specifications.

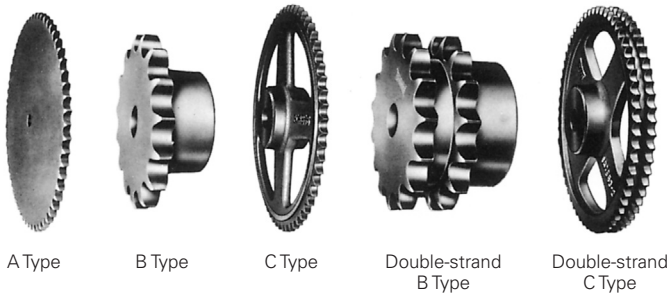


Figure 5-1: Sprocket Types

Sprocket Materials

Suitable sprocket materials should be selected according to the working conditions and requirements of the application. Proper selection will result in higher performance and better cost-effectiveness.

Table 5-1: Sprocket Materials

Sprocket Type	Material
A Type	Low Carbon Steel
B Type	High Carbon Steel
C Type	Ductile Cast Iron (RS40~RS120) Cast Iron (RS140~RS160)

High Frequency Hardening for Tips of Sprocket Teeth

Roller chain is often used for high-speed power transmission. For these applications, use standard sprockets with fewer teeth that have been hardened at the tooth tips by high frequency hardening, such as single-row, B Type Sprockets for RS35~RS100 chain and double-row, B Type Sprockets for RS40~RS100.

Hardening for the tips of sprocket teeth is required in the following cases:

1. For sprockets with up to 24 teeth used at speeds of more than one-eighth of the maximum speed specified for RS Roller Chain
2. For small sprockets and speed ratios of more than 1:4
3. For use with heavy loads at low speeds
4. For use in abrasive conditions

Shaft Hole Processing

If the shaft hole is to be processed by the customer, processing should be based on the tooth bottom. Keyway and shaft hole dimensions are required for processing done by Tsubaki of Canada Limited.

6 Sprocket Installation

Careful and accurate sprocket installation is required for smooth operation and maximum chain and sprocket life.

Sprocket Alignment

1. Level each shaft, checking the adjustment with a level applied directly to the shaft. The incline should be adjusted within the range of ±1/300.

Figure 6-1: Shaft Alignment

2. Align the shaft for parallelism using a scale. Parallelism of the shafts should be adjusted so that the incline is within the range of ±1/300 (A-B/L).

Figure 6-2: Shaft Parallelism

3. Check the axial alignment of the sprocket using a straightedge or scale. The following are the tolerances based on the distance between the shafts.

Up to 1 m (3.3 ft.):	± 1 mm (0.04 in.)
1 m (3.3 ft.) to 10 m (33 ft.):	± Distance between 2 shafts/1,000
More than 10 m (33 ft.):	± 10 mm (0.39 in.)

Figure 6-3: Axial Alignment

4. Attach the sprockets using keys, collars, set bolts, etc., as necessary.

7 RS Roller Chain Lubrication

All Tsubaki Roller Chain is pre-lubricated with a special high-grade lubricant before packing. Tsubaki's lubricant has been specially developed to thoroughly penetrate all parts of the chain, especially the critical areas where the pin and bushing surfaces articulate with each other while the chain is under a full load.

Proper roller chain lubrication is essential for peak performance and maximum chain life. Follow the lubrication schedule and recommendations carefully. Improper lubrication will shorten chain life and decrease operating performance.

Since wear between pins and bushings causes chain elongation, lubrication must be maintained on all contact surfaces. Proper lubrication forms an oil film that:

1. Reduces abrasion and chain wear
2. Reduces chain friction and noise
3. Functions as a coolant when chain is run at high speeds
4. Functions as a cushion against impact

Lubricant for roller rhain must be selected and applied according to the application and working conditions of the chain. Once applied, the lubricant should not be wiped off with a cloth or washed with certain solutions, such as TriClean™.

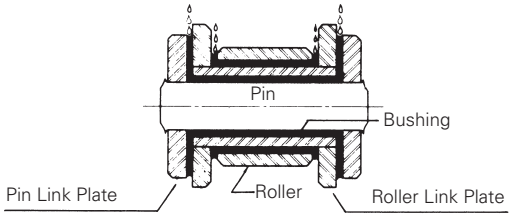


Figure 7-1: Proper Penetration of Lubricant

The lubricant should penetrate the areas shown in Figure 7-1.

Recommended Lubricants

Only high-grade oil of suitable viscosity should be used for RS Roller Chain lubrication. The amount and type of oil depends on the chain specifications, working conditions, and lubricating system.

Oils to avoid:

1. Heavy oil (except under special conditions)
2. Low-grade oil
3. Impure oil or grease
4. Used oil

These types of oil should not be used as they do not lubricate the chain effectively and will reduce service life or cause chain damage or breakage.

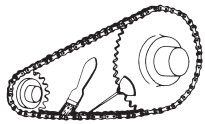
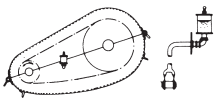
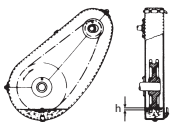
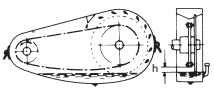
TriClean™ is a trademark of TriSep Corporation, Goleta, CA.

Table 7-1: Lubrication Selection Temperature is in °C (°F)

Lubricating System	A, B				C			
Temp. / Chain No.	-10°~0° (14°~32°)	0°~40° (32°~104°)	40°~50° (104°~122°)	50°~60° (122°~140°)	-10°~0° (14°~32°)	0°~40° (32°~104°)	40°~50° (104°~122°)	50°~60° (122°~140°)
RS50 or smaller	SAE 10	SAE 20	SAE 30	SAE 40	SAE 10	SAE 20	SAE 30	SAE 40
RS60 and RS 80	SAE 20	SAE 30	SAE 40	SAE 50				
RS100					SAE 20	SAE 30	SAE 40	SAE 50
RS120 or larger	SAE 30	SAE 40	SAE 50					

Lubricating System and Quantity of Oil Applied

The following lubricating systems are recommended. Refer to the Tsubaki of Canada Limited Guide to Products and Specifications for system selection.

	Method	Quantity of Oil
System A 	**Manual Application** Oil is applied with an oil filler or brush to the slack side of the chain.	Oil should be applied at a fixed interval, generally about every eight hours, or as often as necessary to prevent the bearing areas from becoming dry.
	**Drip Lubrication** A simple case can be used. Oil from the oil cup is supplied by drip feeding.	Five to 50 drops of oil per minute are necessary for every strand of chain. Actual quantities depend on operating speed.
System B 	**Oil Bath Lubrication** The chain is installed in a leak-free casing.	Depth "h" from oil surface to chain should be 6 mm (.25 in.) to 12 mm (.50 in.). If "h" is too high, the composition of the oil may change due to the heat generated and reduce its effectiveness.
	**Lubrication by Rotating Disc** Oil can be splashed on the chain using a rotating disc installed in a leak-free casing. For this method, speed along the circumference of the disc should be more than 200 m/min. (656 ft./min.). If chain width is more than 124 mm (4.9 in.), use a rotating disc on both sides.	The clearance "h" between the oil surface and the lowest position of the chain should be from 12 mm (.50 in.) to 25 mm (1.0 in.).

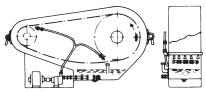
	Method	Quantity of Oil
System C 	**Lubrication by Pump** The chain is contained in a leak-free case and a pump is used to circulate and cool the oil. When the number of chain strands is "n," "n + 1" lubrication supply holes are necessary.	Oil should be supplied according to Table 7-2.

Table 7-2: Quantity of Oil for Lubrication Using a Pump ℓ/min. (gal./min.)

Chain Speed m/min. (ft./min.)	Chain No.			
	RS60 and smaller	RS80 ~ RS100	RS120 ~ RS140	RS160 and larger
500 ~ 800 (1,600 ~ 2,600)	1.0 (0.26)	1.5 (0.40)	2.0 (0.53)	2.5 (0.66)
800 ~ 1,100 (2,600 ~ 3,600)	2.0 (0.53)	2.5 (0.66)	3.0 (0.79)	3.5 (0.92)
1,100 ~ 1,400 (3,600 ~ 4,600)	3.0 (0.79)	3.5 (0.92)	4.0 (1.06)	4.5 (1.19)

Regardless of the lubricating system used, roller chain should be washed periodically with petroleum or gasoline. Examine the pin and bushing to confirm the effectiveness of the lubrication. The appearance of a red or reddish-brown color is usually the result of insufficient lubrication.

8 RS Roller Chain Installation and Layout

Speed Ratio and Chain Lap
The speed ratio of RS Roller Chain can range up to 7:1 under normal conditions. However, a speed ratio of 10:1 is possible if the required speed is very slow. Chain lap on the small sprocket must be at least 120 degrees.

Distance Between Shafts
Optimum distance between sprockets is 30 to 50 times the pitch of the chain, except when there is a pulsating load. In such cases, the distance can be up to 20 times the pitch of the chain.

Layout
When arranging the roller chain drive, the centerline of both sprockets should be as close to horizontal as possible, though the angle of installation can be up to 60 degrees. If installation is close to vertical, slight chain elongation can cause the chain to easily slip off the sprockets. In this case, an idler or guide stopper is recommended.

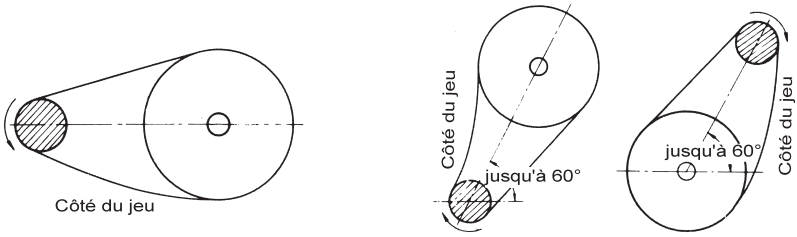


Figure 8-1: General Arrangement

Note: Driving shaft is shown by oblique lines.

It is best to keep the angle of installation within 60 degrees. If the angle must be more than 60 degrees, refer to the instructions for vertical centerlines (No. 3) in the next section.

Layouts Requiring Attention

1. If the slack side is on top, consider the following to eliminate extra chain slack:

   If the driving distance is short, adjust the center distance between the sprockets.

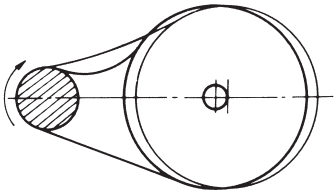


Figure 8-2: Short Driving Distance

If the driving distance is long, adjust chain slack by installing an idler as shown in Figure 8-3.

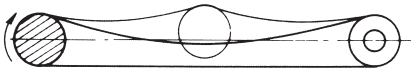
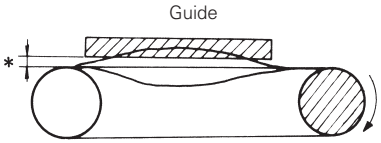


Figure 8-3: Long Driving Distance

2. For pulsating loads caused by high chain speed:

   A stopper will help to prevent vibration. Chain vibration is often caused by the tune of the chain's individual frequency, by the impact period of the driven shaft, or by chordal action of the chain.



*Clearance between the chain and guide stopper should be 2 mm (.781 in.) to 4 mm (.156 in.).

Figure 8-4: Guide Stopper

3. For vertical centerlines:

   Install an idler to eliminate extra chain slack. When the driving shaft is on the lower side (A), an idler is essential.

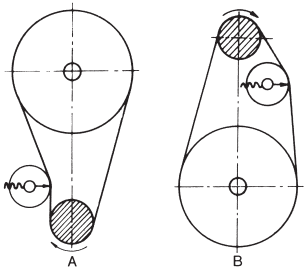


Figure 8-5: Vertical Centerlines

Roller Chain Tension

Initial tension for roller chain power transmission is not as critical as for belt transmission. Generally, roller chain is used with adequate slack. Slack on the lower side is most desirable.

If the chain is excessively tight, chain damage or rapid use of lubricant may result. If the chain is too loose, damage due to vibration or chain winding may result.

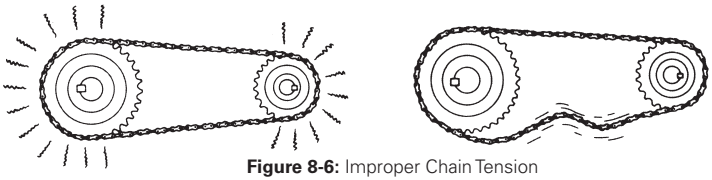


Figure 8-6: Improper Chain Tension

Slack (S S') should be adjusted to four percent of the chain span (AB). For example, if the chain span is 800 mm (31.5 in.), slack should be: 800 mm (31.5 in.) • 0.04 = 32 mm (1.26 in.)

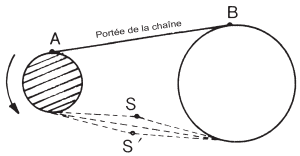


Figure 8-7: Measuring Chain Slack

Slack should be adjusted to approximately two percent in the following situations.

1) Vertical power transmission (idler is required)
2) Distance between the shafts is more than 1 m (3.3 ft.)
3) Heavy loads and frequent starting
4) Sudden backward rotation

The chain will elongate slightly from the beginning of initial operation from 0.05 to 0.1 percent of the full length. As this causes extra slack, adjustment is required. A tensioner can be used to take up the slack or the shaft can be adjusted to minimize chain elongation.

Trial Run

A trial run should be performed before regular operation to check for the following:

1. Proper fit of the connecting link plate (and spring clip or cotter pin)
2. Adequate chain slack
3. Sufficient lubrication
4. No contact between chain and its case
5. No abnormal noise
6. No excessive vibration
7. Chain does not wind around the sprocket
8. No kinks or stiff chain parts

If any problems are discovered, re-install the chain and sprocket, referring to the checkpoints on pages 16 and 17.

9 RS Roller Chain Checkpoints

Chain life is generally considered to have expired when the chain does not engage properly with the sprocket due to elongation or damage of its parts. When this occurs, it is usually necessary to replace the chain.

A long, trouble-free working life can be achieved if chain is properly selected for the conditions of its application. To help prevent damage or premature wear, inspect the chain and sprockets for:

1. Abnormal noise
2. Chain vibration
3. Chain rising on the sprocket
4. Chain winding around the sprocket
5. Kinks or stiff bending of chain
6. Amount and state of lubrication
7. Contact between chain and case
8. Chain appearance. Check for dirt, corrosion, damage on the outside surface of the roller, contact marks, etc. Also check the inside edge and surfaces of the link plates and the surface edges of the pins
9. Damage on the sprocket tooth surfaces and side surface teeth and engaging areas
10. Abrasive stretch of the chain
11. Bending of chain and rotation of roller

Checkpoints

1. Lubrication

While the chain is in operation, check that the lubricating oil moves toward the link plates and that the chain or rotating disc is immersed in the oil bath. When the chain is stopped, check for dirt or abrasive particles produced by improper lubrication. When the chain is removed, the connecting link pin and the inside edge of the bushing should be checked. Damage or a red or reddish-brown color signal improper or insufficient lubrication.

2. Link Plate

Chain exposed to repeated loads over the allowable load can develop fatigue breaks in the link plate. Fatigue breaks are difficult to anticipate until they produce a crack. Cracks usually develop at the edge of a hole or at the side of the link plate as shown in Figures 9-1 and 9-2. Check link plates often for cracks to prevent accidents.

Figure 9-1: Positions where Cracks are Likely to Develop

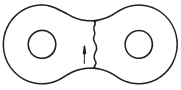


Figure 9-2: Example of an Expanding Crack

3. Roller Link

Care should be taken to avoid repeated impact loads over the allowable load as fatigue breaks may occur. The roller should be checked in the same way as the link plate. If foreign objects interfere with the engagement of the roller and sprocket, the roller may be damaged and a crack may develop. Chains damaged by fatigue breaks must be replaced.

Figure 9-3: Crack Produced on the Roller

4. Sprocket

Chain and sprocket engagement can be checked by observing the roller and sprocket tooth surfaces. A proper margin (A) and improper margin (B) are shown in Figure 9-4. Installation should also be checked. Normal margin position is slightly above the tooth bottom. If tension remains on the slack side, the roller will touch the tooth bottom slightly. If an idler or tightener is used, the margin will be at the center of the tooth bottom.

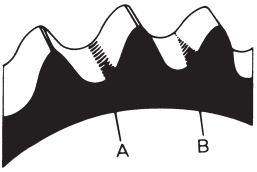


Figure 9-4: Areas to Check for Sprocket Wear

5. Chain Elongation

Chain stretch is calculated as the total amount of elongation caused by wear on the pin and bushing, not including deformation of the link plate. Measuring chain elongation can help estimate the remaining life of the chain.

Measuring Chain Elongation

1. Stretch the chain slightly.
2. To get distance (L), use a vernier to measure the distance of the inside (L_1) and outside (L_2) of the rollers at both ends of the measured links.

$$L = \frac{(L_1 + L_2)}{2}$$

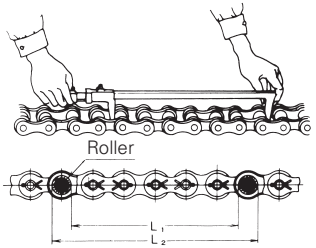


Figure 9-5: Measuring Chain Elongation

3. Use the following equation to calculate chain elongation:

$$\text{Chain Elongation (L)} = \frac{\text{(Measured Length – Standard Length)}}{\text{Standard Length}} \times 100(\%)$$

Where:
Standard Length = Chain Pitch X Number of Links

Note: Measure at least six to ten links to minimize errors. A tape measure can be used if a vernier is not available. Because tape measures are less accurate, the measured length should be as long as possible.

Table 9-1: Maximum Allowable Chain Elongation

No. of Teeth of Driving Sprocket	Chain Elongation (%)
60 or less	1.5
61 ~ 80	1.2
81 ~ 100	1.0
100 or more	0.8

Table 9-2: Standard Length and 1.5% Elongation mm (in.)

No. of Links	Length	RS25	RS35	RS41	RS40	RS50	RS60	RS80
6	Standard	38.10 (1.50)	57.15 (2.25)	76.20 (3.00)	76.20 (3.00)	95.25 (3.75)	114.30 (4.50)	152.40 (6.00)
	1.5% Elongation	38.67 (1.52)	58.01 (2.28)	77.34 (3.05)	77.34 (3.05)	96.68 (3.81)	116.01 (4.57)	154.69 (6.09)
10	Standard	63.50 (2.50)	95.25 (3.75)	127.00 (5.00)	127.00 (5.00)	158.75 (6.25)	190.50 (7.50)	254.00 (10.00)
	1.5% Elongation	64.45 (2.54)	96.68 (3.81)	128.91 (5.08)	128.91 (5.08)	161.13 (6.34)	193.36 (7.61)	257.81 (10.15)
No. of Links	**Length**	**RS100**	**RS120**	**RS140**	**RS160**	**RS180**	**RS200**	**RS240**
6	Standard	190.50 (7.50)	228.60 (9.00)	266.70 (10.50)	304.80 (12.00)	342.90 (13.50)	381.00 (15.00)	457.20 (18.00)
	1.5% Elongation	193.36 (7.61)	232.03 (9.14)	270.70 (10.66)	309.37 (12.18)	348.04 (13.70)	386.72 (15.23)	464.06 (18.27)
10	Standard	317.50 (12.50)	381.00 (15.00)	444.50 (17.50)	508.00 (20.00)	571.50 (22.50)	635.00 (25.00)	762.00 (30.00)
	1.5% Elongation	322.26 (12.69)	386.72 (15.23)	451.17 (17.76)	515.62 (20.30)	580.07 (22.84)	644.53 (25.38)	773.43 (30.45)

Checking Chain Accessories

Check for damage to any metal fittings and make sure fittings are as secure as possible. Loose-fitting attachments may reduce the life of the chain. Generally, a tolerance up to H8 or H9 is permitted for the pin hole diameter.

10 Use Under Special Conditions

Generally, roller chain should be used in relatively clean air and in temperatures of 10°C to 60°C (50°F to 140°F). Refer to the chart below when operating outside this temperature range.

Ambient Temperature	Comments
-50°C ~ -30°C (-60°F ~ -20°F)	Use a special cold-resistant material.
-30°C ~ -10°C (20°F ~ -15°F)	1. Use a lubricating oil for extremely low temperatures. 2. Power transmission efficiency will be reduced.
60°C ~ 150°C (140°F ~ 300°F)	Use a lubricating oil for high temperatures.
150°C ~ 260°C (300°F ~ 480°F)	1. Use a lubricating oil for very high temperatures. 2. Since the wear resistance of the chain is reduced, a larger chain size is recommended.
260+°C (480+°F)	1. Use a lubricating oil for extremely high temperatures. 2. Heat-resistant steel must be used or chain hardness will decrease and chain strength will be significantly reduced.

Use in Wet Conditions

If a chain is splashed with water or runs through heated vapor, such as in a sterilizing machine or water screen, the following problems may occur:

1. An increase in abrasive stretch due to improper or insufficient lubrication.
2. Shortened chain life due to oxidation of the chain material.

In such cases, take the following measures:

1. Decrease bearing pressure by using a larger chain size.
2. Use plated or stainless steel chain.
3. Use a more suitable lubricant.

Use in Acidic or Alkaline Conditions
Exposure to acids will increase chain wear. Brittleness and breakage may occur when standard mechanical abrasion is compounded by chemical corrosion. Acids are more damaging to chain than alkali. Electrochemical corrosion caused by seawater or pit water may also occur. In these cases, chain should be plated or manufactured with corrosion resistant materials.

Use in Abrasive Conditions
Abrasion occurs when sand, coke, metal particles, or dust in the air becomes embedded in the moving or engaging parts of the chain and sprocket. Take the following steps when operating under these conditions:

1. Reduce bearing pressure by using a larger chain size.
2. Increase wear resistance by applying special processing to the parts of the chain where abrasion is a problem.

11 How to Connect RF Conveyor Chain

Unless otherwise specified, new conveyor chains are usually supplied in 3 m (10 ft.) lengths to facilitate handling. The chains are manufactured in even numbers of pitches, with an inner link at one end and an outer link at the other end for easy joining.

To connect the chain:

1. First, fit the pin holes of the outer link plate to the bushing holes to be connected and insert the pins.

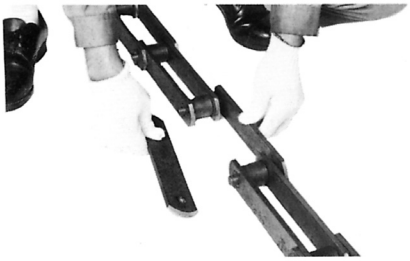


Figure 11-1: Inserting the Pins

2. Hold the counter plate with a hammer (A) and tap the pin heads with another hammer (B) until the pins are completely inserted into the link plate.

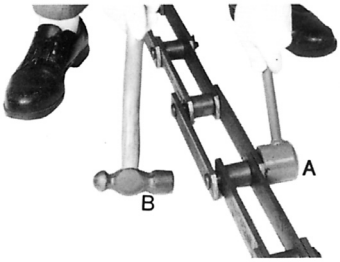


Figure 11-2: Putting on the Link Plate

3. Insert new T-pins or cotter pins into the bearing pins and bend the ends to prevent them from coming loose.

Figure 11-3: Inserting New T-pins or Cotter Pins

4. Check that the chain has smooth flexibility and is free of kinks.

12 How to Disconnect RF Conveyor Chain

Like RS Roller Chain, RF Conveyor Chain from Tsubaki can be easily taken apart, either manually or with a vise or chain breaker.

1. Begin by removing the bent T-pins or cotter pins where the chain is to be cut.

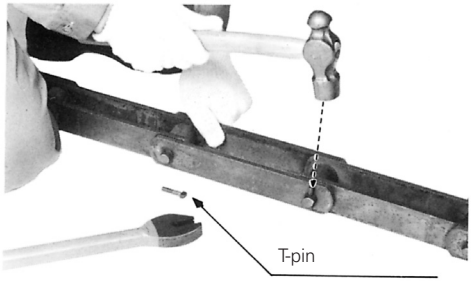


Figure 12-1: Removing the T-pins or Cotter Pins

2. Hold the link plate on the pin head side with a tool and from the opposite side, tap the pin with a hammer until it dislodges.

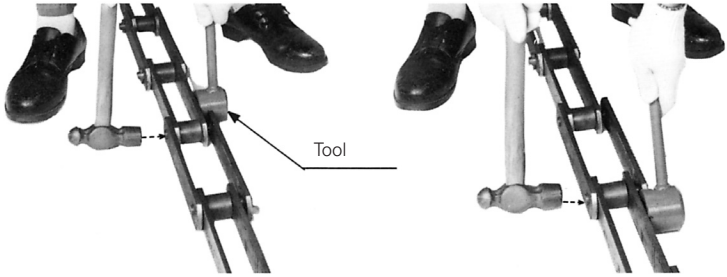


Figure 12-2: Dislodging the Pins

3. Now the chain can be disconnected.

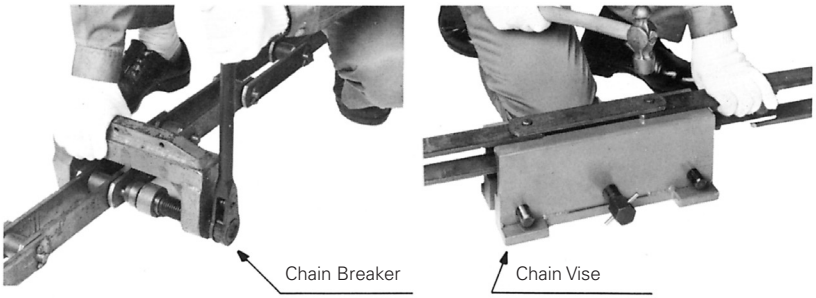


Figure 12-3: Using a Chain Breaker and Chain Vise

13 RF Conveyor Chain Lubrication

As with other power transmission chains, Tsubaki Conveyor Chains require proper lubrication. Good lubrication reduces wear, economizes horsepower, and reduces chain pulsation. Lubrication should be applied once per week by dripping or brushing Turbine Oil #75 - #120 into crevices as shown in Figure 13-1. For conveyor chains with grease pockets, grease should typically be supplied every six months.

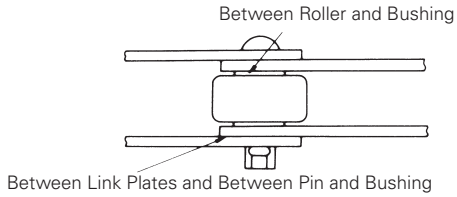


Figure 13-1: Important Conveyor Chain Lubrication Points

Automatic Lubrication System
An automatic lubrication system can be used to save labor or when system configurations prevent manual lubrication.

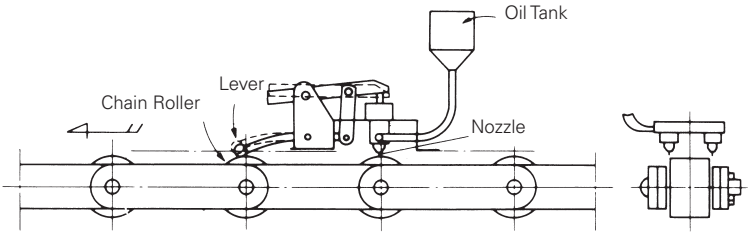


Figure 13-2: Automatic Drip Lubrication

The automatic drip lubrication system pictured in Figure 13-2 utilizes the chain roller as a cam. The roller pushes up a pump lever as it passes by, causing the oil to drip.

This lubricator, however, cannot be used when the conveyor chain functions as an overhead trolley conveyor or when the chain requires many lubrication points. In these cases, a mist type lubricator operated by compressed air is recommended. For coil conveyor chain, an automatic grease feeder is available.

Where Lubrication is Ineffective
In most cases, lubrication is ineffective for bulk conveyors that convey powdery and granular materials. For flow or trough conveyors, the chain buries itself in the material as it moves in the conveying direction. Dust or other particles can become embedded in the chain and reduce or eliminate the lubricant effects of the oil.

14 RF Conveyor Chain Installation and Layout

Adjustment of Chain Tension
The correct amount of chain slack is essential for proper chain operation. When the chain is too tight, working parts such as sprocket wheels, shafts, bearings, etc., carry a much heavier load. However, too much chain slack is also harmful and causes the chain to climb the sprocket teeth.

Frequency of Adjustment
Chain has a tendency to stretch a certain amount at the beginning of operation due to slight distortion of its component parts. After such initial elongation, the chain stretches slightly, but constantly, through normal wear. To maintain proper chain tension, necessary adjustments should be made at regular intervals.

Frequency of adjustment:

First week of operation:	Once per day
Second to fourth week:	Twice per week
Thereafter:	Twice per month

Note: This frequency schedule is based on daily eight-hour operation. If working hours are increased, the frequency of adjustment should be increased accordingly.

Even Adjustment of Take-up on Both Sides
This can be easily obtained with cooperating screw type or counterweight type take-ups. When two parallel chains are adjusted by two independently operated take-ups, care must be taken to ensure an even stroke on both the left and right sides. Uneven adjustment will cause the link plate and the side of the sprocket teeth to interfere with each other and result in an overload position.

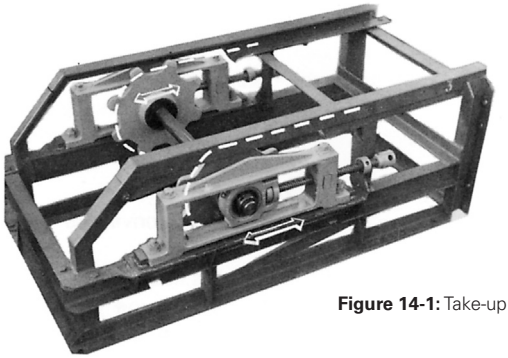


Figure 14-1: Take-up Units

Insufficient Take-up Adjustment
If the chain is still too long after complete take-up adjustment, shorten it by removing two links.

Adjustment of Chain Tension for Flow Conveyor

F Type Flow Conveyor

Proper chain tension for the Tsubaki F Type Flow Conveyor can be determined using the following formulas.

Where:

h = amount of chain slack just behind the head sprocket

L = distance between the sprocket and take-up

1. When material to be conveyed is within a normal temperature range:
   h = 0.1250 X L
2. When material to be conveyed has a high temperature range:
   h = 0.0625 X L

To adjust chain slack, it is best to have two people working as a team: one to observe the chain slack at the head section and the other to adjust take-up at the tail section. Adjustments should be made for normal load conditions.

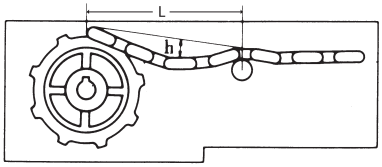


Figure 14-2: Measuring Chain Slack

L Type and S Type Flow Conveyors

Chain tension for Tsubaki L Type and S Type Flow Conveyors is adjusted by inspecting the chain slack through the inspection door located at the side of the curved section of the casing. Chain slack should be adjusted so that it is at the center of the curved section. Too much tension will cause the chain to rub against the casing, and excessive slack can cause the chain to tangle and break. Proper chain slack can be determined using the following formulas.

Where:

a = distance from the centerline of the chain to the casing

L = distance from the casing to the rail

1. When material to be conveyed is within a normal temperature range:
   a = 0.5000 X L
2. When material to be conveyed has a high temperature range:
   a = 0.2500 X L

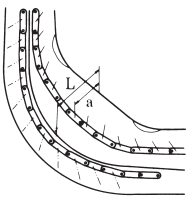


Figure 14-3: Chain Slack for L Type and S Type Flow Conveyors

15 Life of RF Conveyor Chain and Sprockets

After a certain period of time, wear will eventually appear on the chain and sprockets. The life of conveyor chain depends on the wear of each component part and on pitch elongation. Periodic inspection of conveyor chain is required more frequently than for roller chain.

The life of conveyor chain component parts is shown below. Periodic inspection of the wearing parts, proper maintenance, and an established schedule for changing the chains is essential for optimum service life.

Roller Life

When wear between the rail, bushing, and roller causes the under surface of the link plate to contact the rail, the chain has usually reached the end of its usability. As shown in Figure 15-1, when the link plate begins to contact the rail, rolling contact becomes sliding contact between the link plate and rail and results in greater wear, increased chain tension, and reduced horsepower. Such wear generally appears on horizontal or inclined apron conveyors, slat conveyors, etc.

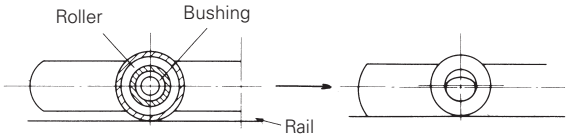


Figure 15-1: Roller Wear

On a curved section of rail, the allowed wear amount is decreased by dimension (S) and requires additional monitoring.

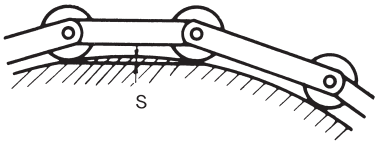


Figure 15-2: Wear on Curved Rail Section

When holes or crevices due to wear appear on the rollers, the chain life has expired.

Bushing Life

Bushings are generally usable until holes appear. Holes may appear as a result of conveying abrasive materials such as iron ore powder, coke, etc.

Link Plate Life

Reciprocal friction between the inner and outer link plates and contact between the side surface of the roller and the inside surface of the link plate causes wear such as (A) and (B) shown in Figure 15-3.

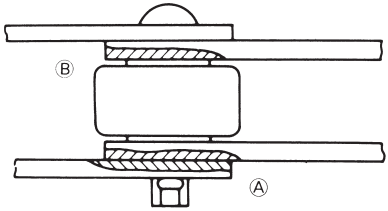


Figure 15-3: Link Plate Wear

Wear that exceeds one-third of the original plate thickness will reduce the tensile strength of the chain. Link plate wear that appears faster than wear on other component parts is usually caused by misalignment of the conveyor during installation. Misalignment can also develop during conveyor operation. Check for the following to ensure maximum working life:

1. Correct alignment of driving and driven sprockets
2. Correct alignment of shafts in horizontal and vertical planes
3. Precision of level gauge and accurate leveling

The link plates on Tsubaki Flow Conveyor Chain move directly on the material to be conveyed or on a steel plate casing. The working life expires when the worn section equals A/2 or H/8, as shown in Figure 15-4.

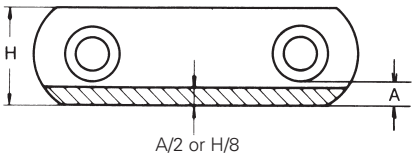


Figure 15-4: Maximum Allowable Link Plate Wear

Pitch Elongation

When the chain engages with the sprocket or runs on a curved rail section, the chain flexes, which causes the chain to stretch. In most cases, this is caused by wear of the bearing parts, such as pins and bushings. As chain pitch elongation increases, the chain tends to climb the top of the sprocket and prevents smooth conveyor operation. The limit of pitch elongation is generally two percent of the chain pitch.

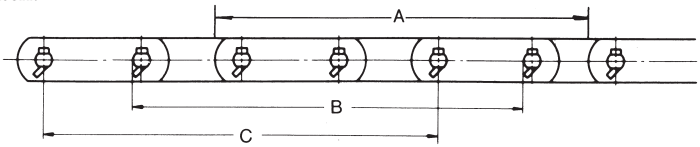


Figure 15-5: Places to Measure Chain Elongation

Figure 15-6 indicates the way to measure chain pitch. Using a steel tape measure, measure as many pitches as possible (at least four are required). Measure length (A), (B), or (C) as shown in Figure 15-5, depending on the wear condition of the chain. The chain pitch elongation per link is determined by comparing the actual pitch to the original chain pitch.

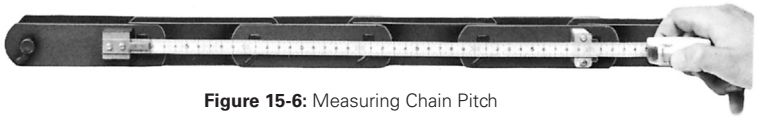


Figure 15-6: Measuring Chain Pitch

Sprocket Life

When the sprocket is worn, chain tends to cling to the sprockets and vibrate. The amount of allowable wear depends on the conveyor type and chain size. Generally, wear to a depth of 3 to 6 mm (0.12 to 0.24 in.) is a sign that the existing sprocket should be repaired or replaced to ensure continued chain life. The following measures can extend sprocket life:

1. Cut section (A) shown in Figure 15-7 with a grinder.
2. Reverse the sprocket to change the engaging area of the teeth.
3. Use a welding rod to obtain the correct tooth profile. However, it is generally more effective to replace the sprocket with a new one.

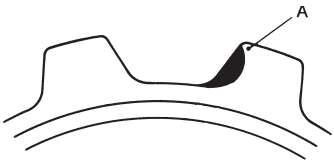


Figure 15-7: Sprocket Wear

If the sprocket teeth are worn as shown in Figure 15-8, sprocket alignment may be incorrect. Proper axial alignment of the sprockets will help reduce or eliminate this type of wear.

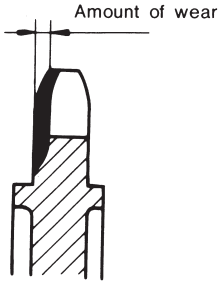


Figure 15-8: Sprocket Tooth Wear

Wear Characteristics of Conveyor Chain

1. Mechanical Wear
When conveyor chain is used under normal operating conditions, mechanical wear causes the bearing surface of the chain to shine brightly. Proper lubrication ensures longer wear life.

2. Wear Caused by Conveyed Material
Materials having excessive wear characteristics tend to stick to the chain and wear its surface due to reciprocal friction between the chain and material. Care should be taken to prevent material from falling on the chain under these conditions. For extra protection, specify chain with higher wear resistance.

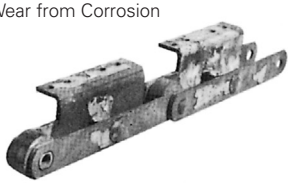
3. Wear Due to Corrosion
Conveyor chain used in applications where acidic or alkaline chemicals are present will be subject to corrosive wear as well as mechanical wear. To protect against chemical corrosion accompanying mechanical wear, use corrosion-resistant chain.

4. Electrochemical Corrosion
When chain is splashed with water and then enters a chemical solution, the surface of the sliding area (i.e., pin/bushing, bushing/roller) is exposed to electrochemical corrosion, one of the most damaging types of corrosion.

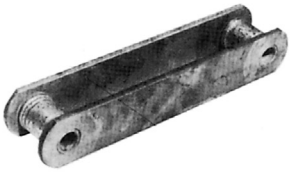
Tsubaki is constantly researching ways to improve the performance of our chains by testing combinations of different materials. Please inquire about our complete line of chains for special environments.

1. Mechanical Wear

3. Wear from Corrosion



2. Wear from Conveyed Materials



4. Electrochemical Corrosion

Figure 15-9: Types of Wear

16 RF Conveyor Chain Checkpoints

Maintenance Checkpoints

Checkpoints	Comments
Centering	A high-precision guide rail is essential to ensure proper centering of the conveyor. If centering is not accurate (with no side guide rail), the conveyor chain will wear and wobble, resulting in shorter chain life.
Sprocket alignment	When two or more sprockets are installed in a row, be sure to align the position of the sprocket teeth. If the sprocket teeth are not properly aligned, the working load will not be equally divided and will cause the chain to twist.
Take-up	If take-up on both sides is uneven, the conveyor chain will not engage smoothly with the sprocket.
Initial chain tension	Maintain adequate chain slack. If chain tension is too high, loss of power will result and can be dangerous. If chain tension is too loose, the chain will climb the sprocket.
Trial run	A trial run after installation should be made under no-load conditions by switching the conveyor on and off several times intermittently. Continuous operation may begin after inspection.
Stopping a conveyor	Stop a conveyor under no-load conditions or remaining material will cause an overload when the system starts again.
Lubrication	Lubricate conveyor chain periodically, except for conveyors that require no lubrication, such as Flow Conveyors. Lubrication is essential for reducer, bearing, and driving roller chain.
Securing conveyor parts	Parts fastened to a conveyor, such as buckets, aprons, slats, etc., are apt to loosen due to vibration. Be sure to fasten nuts and bolts securely and check them periodically.
Amount of chain slack	Regularly check and adjust the amount of chain slack.
Temperature	When differences in temperature, such as summer and winter or between day and night in winter, are severe, conveyor damage may occur. Under these circumstances, operate the conveyor carefully, taking any variations in temperature into account.
Conveyor use and maintenance record	After installing the conveyor, prepare a record of the expected capacity to be conveyed, conveyor speed, r.p.m. of main shaft, electric current, voltage, working hours, actual conveying capacity, inspection date, lubricating date, details of trouble, etc. This will serve as protection against unexpected accidents and is also convenient for maintenance and repairs.

This information is intended to provide general guidelines for roller chain and conveyor chain installation and maintenance. Consult Tsubaki of Canada Limited for specific application problems.

17 Warning Statement

⚠ WARNING

USE CARE TO PREVENT INJURY COMPLY WITH FOLLOWING TO AVOID SERIOUS PERSONAL INJURY:

1. Guards must be provided on all chain and sprocket installations in accordance with provisions of ANSI/ASME B15.1 — 2000 "Safety Standards for Mechanical Power Transmission Apparatus," and ANSI/ASME B20.1 — 2000 "Safety Standards for Conveyors and Related Equipment," or other applicable safety standards. When revisions of these standards are published, the updated edition shall apply.

2. Always lock out the power switch before installing, removing, lubricating or servicing a chain system.

3. When connecting or disconnecting chain:
   a. Eye protection is required. Wear safety glasses, protective clothing, gloves and safety shoes.
   b. Support the chain to prevent uncontrolled movement of chain and parts.
   c. Use of pressing equipment is suggested. Tools must be in good condition and properly used.
   d. Do not attempt to connect or disconnect chain unless you understand chain construction, including the correct direction for pin/rivet removal or insertion.
   e. Do not attempt to rework damaged chains by replacing only the components obviously faulty. The entire chain may be compromised, and it should be discarded.

4. Other cautions:
   a. **Alterations and Repairs** to chains should be made only by qualified personnel with parts and components authorized by Tsubaki of Canada Limited.
   b. **Electroplating of Assembled Chains** is not condoned. Plating of assembled chains could result in failure from hydrogen embrittlement.
   c. **Inspect Chains** for shipment damage before installation. During operation, all chain systems should be inspected on a regular schedule. Visually check for worn, damaged and broken parts caused by improper installation or maintenance, abnormal stress, temperature, humidity, abrasion or corrosion, possible interference with other system components and improper lubrication. (For correct lubrication procedures and systems, consult the Tsubaki of Canada Limited Guide to Products and Specifications.)
   d. **Heating Chain** with a cutting torch is not suggested unless absolutely necessary for removal. If cut in such a manner, it should not be reused.
   e. **Welding** should not be performed on any chain or component.
   f. **Average Ultimate Strength** of a chain means the average load at which it will break when subjected to a destructive tensile test. *It does not mean working load.* For complete information, contact Tsubaki of Canada Limited Technical Support Department.
   g. **Product Dimensions** in this catalog are subject to changes and are intended for general reference only. For exact current dimensions, request certified prints from Tsubaki of Canada Limited.

Driving your business.

Tsubaki of Canada Limited, 1630 Drew Road, Mississauga, ON L5S 1J6
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TCLI&M06

NOTE: In accordance with the policy of Tsubaki of Canada Limited to consistently improve its products, the specifications in this catalogue are subject to change without notice. Please contact Tsubaki for current prices.

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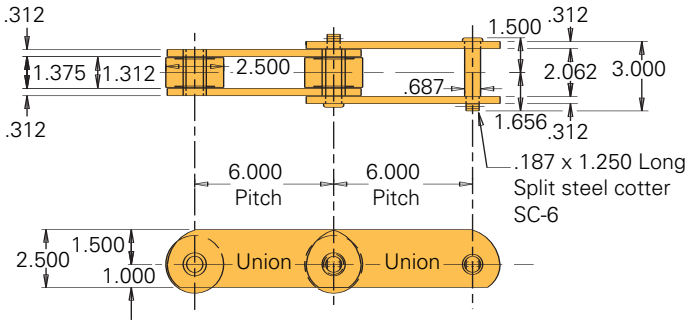
High Sidebar Roller Conveyor Chain/ CC5 Chain

CC5 High Sidebar Roller Conveyor Chain is the most widely used conveyor chain in the auto industry, and no wonder:

- CC5 meets industry quality standards, which means better reliability for your application.
- CC5 rolls on any flat, firm surface, which means "instant conveying" for auto parts.
- CC5 can be customized, including welded-on flat tops, hex holes in sidebars for gravity roll conveyors, top rollers, and custom-specified attachments.



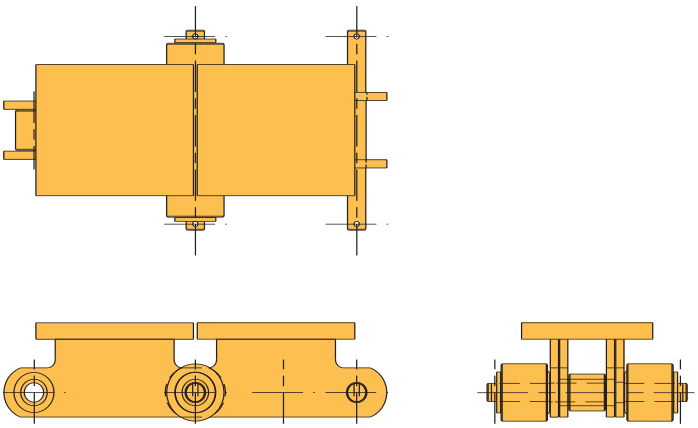
CC5 Specifications

Standard Ultimate Strength	50,000 lbs.
Max. Allowable Working Load	4,800 lbs.
Weight per Foot	11 lbs.

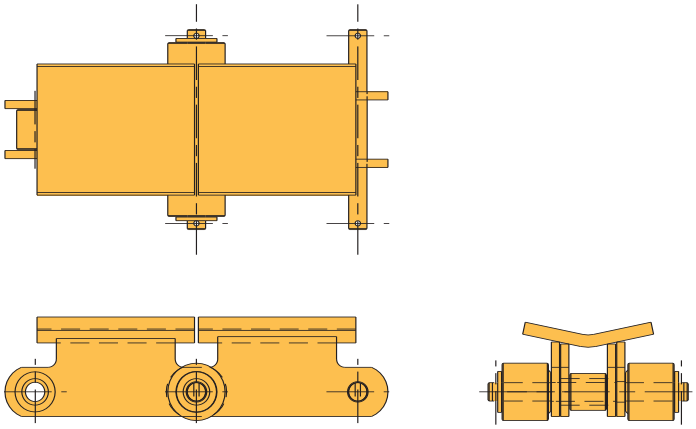
Flat Top and Gull Wing Chains

Double strand Flat Top Chain with outboard carrying rollers moves heavy loads with dependability. Top plate surfaces may be smooth, checkered, or nonskid. Chain pitch ranges from 4" to 24". Gull Wing Chain provides an alternative to Flat Top, keeping the conveyed materials in line during movement. Either style can be made from a variety of materials and heat-treated to stand up to extreme conditions.

Flat Top Chain



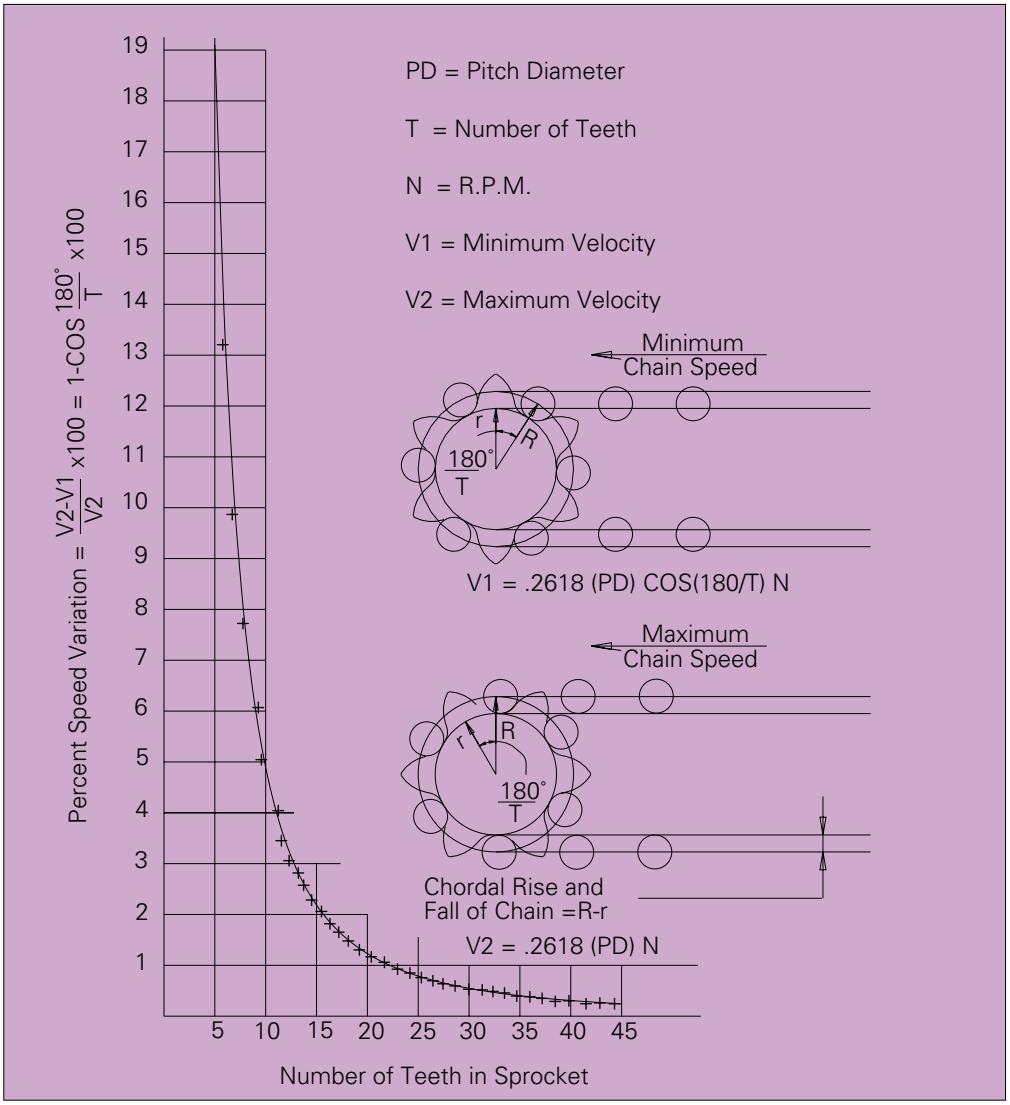
Gull Wing Chain



To locate compatible sprockets for your chain, refer to the Product Cross-Reference in Section D.

Note: Dimensions are subject to change. Contact Union Chain to obtain certified prints for design and construction.

Figure 3 — Variations in Chain Speed Due to Chordal Action



Sprocket Life

When sprockets are worn, the chain tends to cling to the sprockets or vibrate. The amount of allowable wear depends on the conveyor type and chain size. Wear to a depth of 0.12" (3 mm) to 0.24" (6 mm) is usually a sign that the existing sprocket should be replaced, illustrated in Figure 4.

If the sprocket teeth are worn, the alignment may be incorrect. Proper axial alignment of the sprockets will help reduce or even eliminate wear of sprocket teeth, illustrated in Figure 5.

Figure 4 — Sprocket Wear

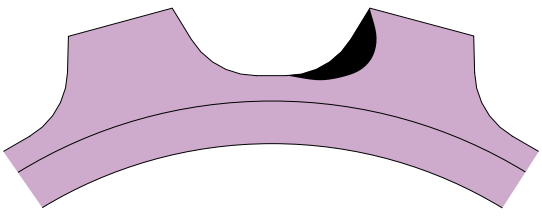
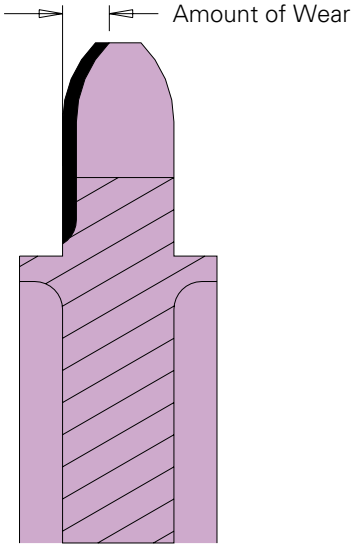


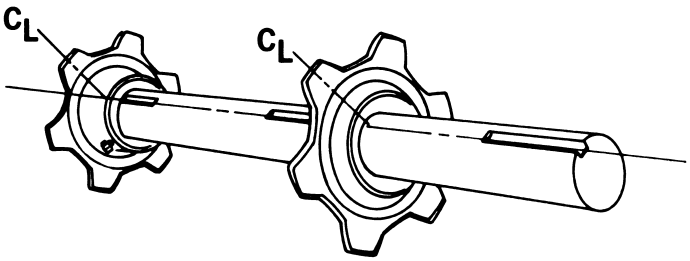
Figure 5 — Sprocket Tooth Wear



Sprockets

Sprockets Keyed In Line
Key driving sprockets on a double-strand chain conveyor or elevator on the head shaft and with the teeth of one sprocket directly in line with teeth of the other. Order "keyed-in-line" and "matched in pairs" to obtain this feature. Key one foot shaft sprocket on its shaft so that the shaft will turn in its bearings. Allow the other sprocket to turn freely, holding it in position by means of set collars. The sprocket can then position itself automatically if uneven wear takes place in the chain strands (Figure 1).

Figure 1



Sprocket Size
Use the largest diameter conveyor sprocket that space and economics permit. This minimizes chain speed variations and pulsations and reduces wear to the chain and sprocket.

Sprocket Terminology

Chain Interaction
Schedule replacement of sprockets and/or chain by assessing the chain-sprocket interaction. If the chain enters and exits smoothly without hanging up or snapping into place, replacement is not necessary. If a chain starts to hang up on the sprocket, reverse or replace the sprocket before damaging chain overload conditions can develop.

Reversible
If the sprockets are symmetrical from side to side they can be reversed. Almost all sprockets are reversible.

New Chain
New or reversed sprockets are required with any new chain. New sprockets will ensure proper chain interaction and will also provide maximum wear performance.

Visual Observation
Carefully observe the wear patterns on chains and sprockets. Wear patterns that are smooth and even indicate good chain-sprocket interaction; unbalanced or severe wear indicates that the system needs maintenance.

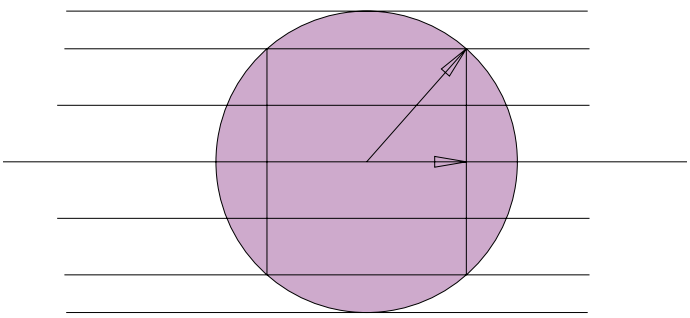
Attachment Clearance
Be sure that any attachment in the area between, above, or below the sidebars will not interfere with the sprocket.

Relief Pocket
In applications where material build-up may occur, the bottom of the tooth pocket is beveled on the side to allow the material to "squeeze" out.

Chordal Action
A sprocket is a collection of chords, or straight segments, that approximate a circle. With more teeth the chords approximate a circle better; with fewer teeth the chords do not approximate a circle as well.

The lineal output from a chordal form is not constant. The square in a circle shown in Figure 2 represents a four-tooth sprocket. Note that the distance from the center to the corner is different than from the center to the middle of the side. The corner would be the equivalent of the chain joint center; the side would be equivalent to the chain centerline at mid-pitch.

Figure 2



The resulting velocity variations are a function of the number of teeth, as shown in Figure 3. Due to these variations, care should be taken in considering sprockets with less than 12 teeth.

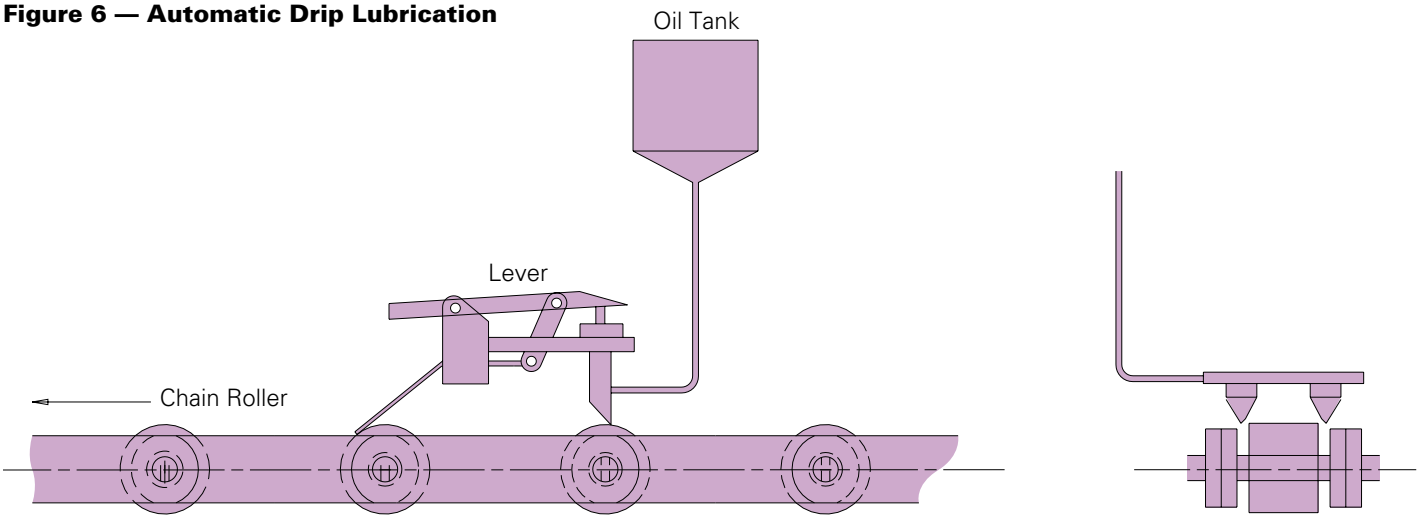
Maintenance Check Points

Check Points	Comments
Centering	A high precision guide rail is essential to ensure proper centering of the conveyor. If centering is not accurate (with no side guide rail), the conveyor chain will wobble and weave resulting in shorter conveyor chain life.
Sprocket alignment	When two or more sprockets are installed in a row, be sure to align the position of the sprocket teeth. If the sprocket teeth are not properly aligned, the working load will not be equally divided and will cause the chain to twist.
Take-up	If take-ups on both sides are uneven, the conveyor chain will not engage smoothly with the sprocket.
Initial chain tension	Maintain adequate chain slack. If chain tension is too high, loss of power will result. This is a dangerous situation and if too loose, the chain will climb the sprocket.
Trial run	Trial run after installation should be made under no load conditions by switching on and off several times intermittently. After inspection, continuous operation may begin.
Stopping conveyor	Stop conveyor under no load conditions, or remaining material will impose an overload when the conveyor starts again.
Lubrication	Lubricate conveyor chain periodically, unless the chain does not require lubrication. Lubrication of reducer, bearing, and driving roller chain is essential.
Securing conveyor parts	Parts fastened to the conveyor such as buckets, aprons, slats, etc., are apt to loosen due to vibration. Pay careful attention to fastening nuts and bolts securely. Be sure to check periodically.
Amount of chain slack	Regularly check and adjust the amount of chain slack.
Temperature and prevention of freezing	When differences in temperatures (summer and winter or between day and night in the winter) are very severe, conveyor damage may occur. Under these circumstances, operate the conveyor carefully, taking any variations in temperature into account.
Conveyor record of use and maintenance	After installing the conveyor, keep a record of the expected capacity to be conveyed, conveyor speed, r.p.m. of main shaft, electric current, voltage, working hours, actual conveying capacity, inspection date, lubricating date, details of trouble, etc. This will serve as protection against unexpected accidents. This record will also be convenient for maintenance and repairs.

Troubleshooting

Problem	Possible Causes	What to Do
Excessive noise	•Misalignment of sprocket •Loose casings or bearings •Too little or too much slack •Chain and/or sprocket wear •Inadequate lubrication or no lubrication •Chain pitch size too large	•Realign sprockets and shafts •Tighten set-bolts •Adjust centers or idler take-up •Replace chain and/or sprocket •Lubricate properly •Replace with correct chain size
Chain vibration	•Resonance to the vibration cycle of machine to be installed •High load fluctuation	•Change vibration cycle of chain or machine •Use torque converter or fluid coupling
Wear on inside of link plate and one side of sprocket teeth	•Misalignment	•Realign sprockets and shafts
Chain climbs sprockets	•Excessive chain slack •Heavy overload	•Adjust centers or idler take-up •Reduce load or install stronger chain
Broken pins, bushings or rollers or heavy wear of pins, bushings or rollers	•Chain speed too high for pitch and sprocket size •Heavy shock or suddenly applied loads •Material build-up in sprocket tooth pockets •Inadequate lubrication •Chain or sprocket corrosion	•Use shorter pitch chain or install larger diameter sprockets •Reduce shock load or install stronger chain •Remove material build-up or install side gashed sprockets •Lubricate properly •Install anti-corrosive chain or sprockets
Chain clings to sprocket	•Center distance too big or high load fluctuation •Excessive chain slack	•Adjust the center distance or install idler take-up •Same as above
Chain gets stiff	•Misalignment •Inadequate lubrication •Corrosion •Excessive load •Material build-up in chain joint •Peening of link plate edges	•Realign sprockets and shafts •Lubricate properly •Replace with anti-corrosive chain •Reduce load or replace with chain of suitable strength •Shield drive from foreign matter •Check for chain interference
Breakage of link plate	•Subjected to shock load •Vibration •Inertia load is too large	•Reduce shock (e.g., install a shock absorber) •Install a device to absorb vibration (e.g., tightener, idler wheel) •Chain section should be checked (increase number of strands or select next larger size chain)
Camber (curved tracking of straight faced roller chains on long conveyors where chain strands are rigidly attached)	•Head shaft sprocket misalignment •Track or rail out of level due to previous chain travel wear •Higher chain tension on one strand than the other strands •Chain strand lengths are different	•Realign head sprockets •Level track or rails •Balance conveyed material load between strands •Specify measured matched and tagged strands

Figure 6 — Automatic Drip Lubrication



Automatic Lubrication

Use automatic lubrication to save labor or when manual lubrication is not possible due to the location of the chain.

The automatic drip system shown in Figure 6 utilizes the chain roller as a cam. The roller pushes a pump as it passes by and causes the oil to drip.

Use a mist-type lubricator when the conveyor chain is used as an overhead trolley conveyor or when the chain requires many points to be lubricated.

For coil conveyor chain, an automatic grease feeder is suggested.

Lubrication is ineffective for bulk conveyors that convey powdery and granular materials. It will not work for flow or trough conveyors where the chain buries itself in the material as it moves and dust or other particles become embedded in the chain clearances.

Inspection

Lubrication

- Manual: Carefully follow lubrication schedule.
- Drip: Inspect the filling of oiler cups and the rate of feed. Check that the feed cups are not clogged and are properly positioned over the chain.
- Bath: Inspect the oil level and check that there is no sludge. Drain, flush and refill the system as the application requires.

If the chains have not been lubricated properly, the joints may have a brownish (rusty) color and the pins of the connecting link of the chain, when removed, may be a discolored brown. The pins may also be roughened, grooved, or galled. Properly lubricated chains will not show the brownish color at the joints; they will be brightly polished with a high luster.

- Check wear on link plates and sides of sprocket teeth indicating misalignment.
- Check shaft and sprocket alignment to prevent wear.
- Check wear on working faces of sprocket teeth. As the system runs these faces should develop a bright, polished appearance. Scratches, galls, grooves, or visible changes in tooth form are probably caused by lubrication failure or overloading.
- Check and adjust chain tension. An elongation of as much as five percent indicates that the chain is riding near its limit of allowable height on the sprocket teeth. A gradual increase in chain length is the result of normal wear. A sudden increase in slack indicates one or more of the following:
  - Lubrication failure
  - Excessive overloading or shock
  - Displacement of shaft bearings
  - Displacement or failure of take-ups
- Check the chain to be sure it is free from dirt, grit or other abrasive material. Clean the chain periodically.
- Check guides, tracks, and the area below the conveyor for buildup of material or dirt which will cause interference or binding of the chain. Exit and entry points of guides and tracks must permit the chain to pass with a minimum amount of impact or interference. Roller chain tracks can be over-lubricated, forcing the rollers to slide rather than roll.
- Exceptionally low chain conveyor speed coupled with high drag friction will occasionally cause surging. A slight increase in speed will correct this problem if the friction can not be reduced.
- Inspect apron and pan bead openings. If the beads have been wedged apart or otherwise distorted, fine material may bleed into moving parts and cause excessive wear.

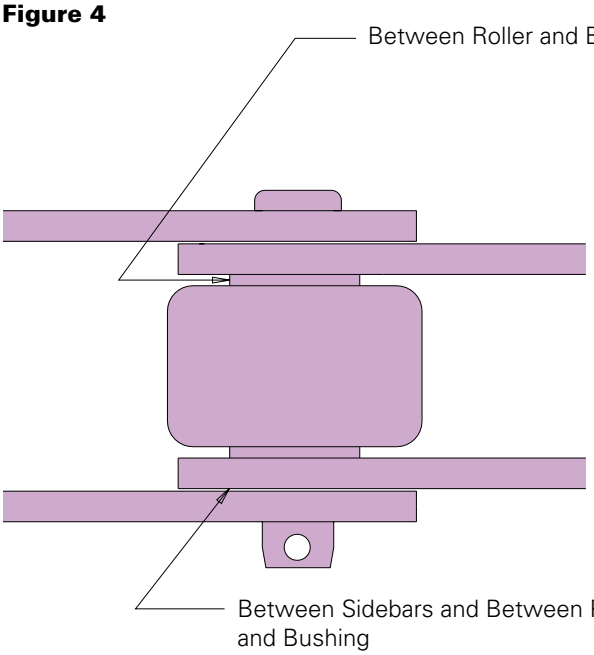
Lubrication

Proper lubrication reduces wear, maximizes horsepower, and helps reduce chain pulsation.

Important points of lubrication are shown in Figure 4.

- Between sidebars (for pin and bushing lubrication).
- Between roller and sidebar (for lubrication of roller and bushing).

Figure 4

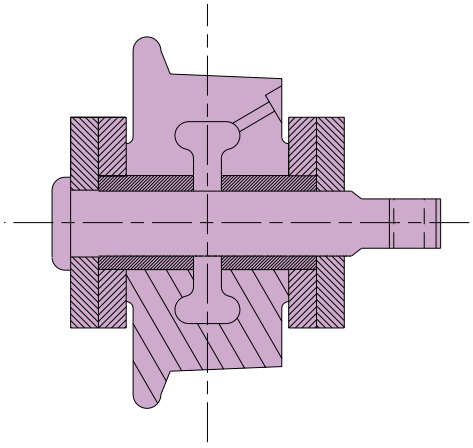


Factors to Consider when Lubricating Roller Conveyor Chain

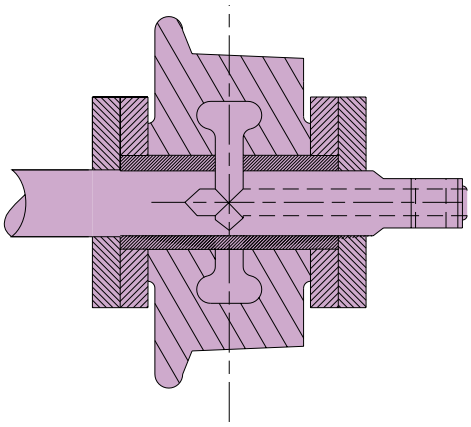
For large diameter rollers or outboard rollers lubricate by self-lubricating sintered metal bushings or by pressure through a grease fitting. Lubrication through pin heads or through rods is suggested only for chains with more than 3/4" pin or rod diameter. When this method is used on through rods, lock collars are provided in place of cotter pins. In severe applications rollers may be equipped with anti-friction bearings that have grease fittings or removable caps for grease packing.

Lubrication with grease requires pressure fittings to port the grease through chain joints. The following examples are methods of porting grease lubrication (Figure 5).

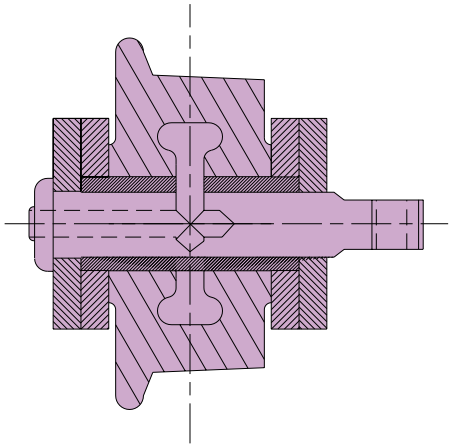
Figure 5



Lubrication through Roller

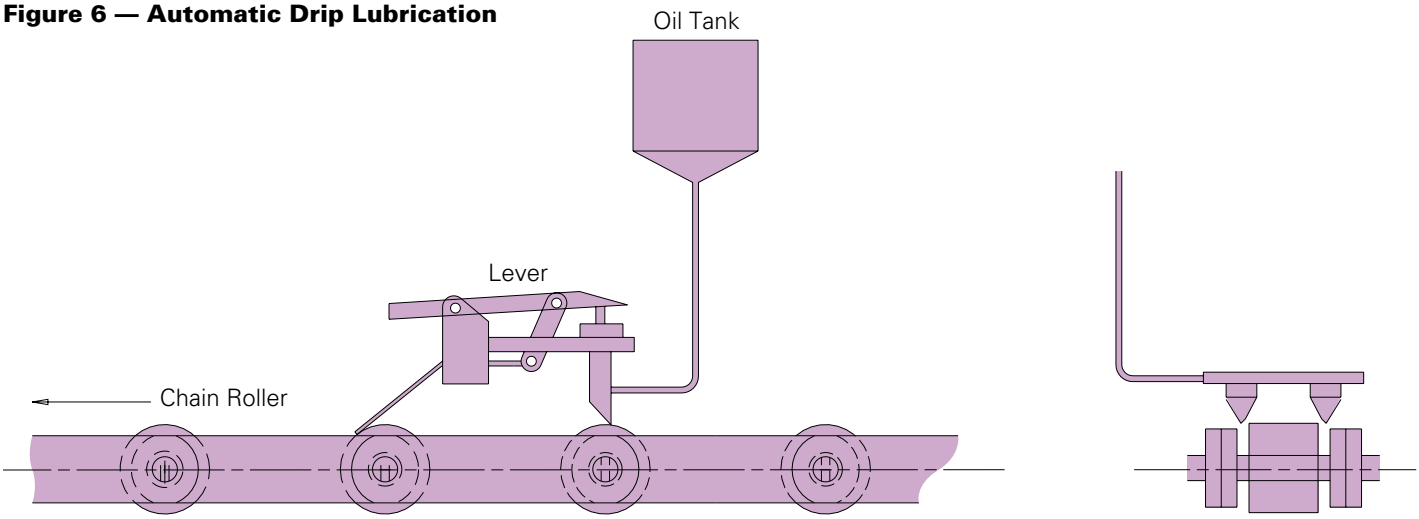


Lubrication through Pin End or Through Rod



Lubrication through Pin Head

Figure 6 — Automatic Drip Lubrication



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Use automatic lubrication to save labor or when manual lubrication is not possible due to the location of the chain.

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Use a mist-type lubricator when the conveyor chain is used as an overhead trolley conveyor or when the chain requires many points to be lubricated.

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  - Displacement or failure of take-ups
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⚠ WARNING

USE CARE TO PREVENT INJURY
COMPLY WITH THE FOLLOWING
TO AVOID SERIOUS PERSONAL INJURY

1. Guards must be provided on all chain and sprocket installations in accordance with provisions of ANSI/ASME B15.1 – 1996 “Safety Standards for Mechanical Power Transmission Apparatus,” and ANSI/ASME B20.1 – 1996 “Safety Standards for Conveyors and Related Equipment,” or other applicable safety standards. When revisions of these standards are published, the updated edition shall apply.

2. Always lock out power switch before installing, removing, lubricating or servicing a chain system.

3. When connecting or disconnecting chain:
   a. Eye protection is required. Wear safety glasses, protective clothing, gloves and safety shoes.
   b. Support the chain to prevent uncontrolled movement of chain and parts.
   c. Use of pressing equipment is recommended. Tools must be in good condition and properly used.
   d. Determine correct direction for pin/rivet removal or insertion.

UST-87 Rev. 6-98

SECTION 7 PARTS LIST, SPARE PARTS LIST, SPECIAL TOOL

7.1 Parts List

RAS AZ ZAWR ALUMINIUM SMELTER PROJECT

Seller/Contractor Parts List
GNA alutech inc.
CATHODE SEALING EQUIPMENT

REVISION NO.	DATE	REASON FOR REVISION	ORIGINATOR	CHECKER	EGS	PEM	CLIENT
MA'ADEN معادن		BECHTEL	Project NO.: **25457**				
			DOCUMENT NO.:				Sheet No.
			25457-				1 of X

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GNA ref	ITEM NO.	COMPONENT TAG NUMBER	SECTION (or assembly)	SUB-SECTION (or sub-assembly)	COMPONENT DESCRIPTION	SECTION / SUB-SECTION PART DESCRIPTION	SELLER / CONTRACTOR PART CODE	MANUFACTURER NAME	MANUFACTURER PART SERIAL NUMBER	LISTING OF PART SUPPLIERS	CLIENT NUMBER	SELLER / CONTRACTOR DRAWING NO.	QTY
A1	1	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	Bearing Fixed		SNL22508/35TLH	SKF of Canada ltd	SNL22508/35TLH			1347-A1-1000	4
A1	2	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	Bearing Free		SNL22508/35TL	SKF of Canada ltd	SNL22508/35TL			1347-A1-1000	4
A1	3	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	Proximity Switch		XS7C40MP230TT	Télémécanique	XS7C40MP230TT			1347-A1-1000	4
A1	4	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	A1-Jonction Box - 4481-MQLK-0001-JB-01		1347-51300	ENVITECH AUTOMATION Inc.	1347-51300			1347-A1-1000	1
A1	5	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	Pneumatic Cylinder		4CSB-2AUV19AC6	Parker	4CSB-2AUV19AC6			1347-A1-1000	4
A1	6	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	Sperical Rod Eye		132291	Parker	132291			1347-A1-1000	4
A1	7	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	Clevis Bracket Parker		83948	Parker	83948			1347-A1-1000	4
A1	8	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	Pivot pin		83963	Parker	83963			1347-A1-1000	4
A1	9	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	Pivot pin		68369	Parker	68369			1347-A1-1000	4
A1	10	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	Filter Regulator Lubrificator (FRL)		P32QA93SEANGLND	Parker	P32QA93SEANGLND			1347-A1-1000	1
A1	11	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	Directionnal Valve		H22VXBG0B9C	Parker	H22VXBG0B9C			1347-A1-1000	1
A1	12	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	Base		PS411117CCP	Parker	PS411117CCP			1347-A1-1000	1
A1	13	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	Flow Control Valve		F600B	Parker	F600B			1347-A1-1000	8
A1	14	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	Muffler		P48	Parker	P48			1347-A1-1000	6
A1	15	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	Check valve		C600B	Parker	C600B			1347-A1-1000	2
C1	16	4481-MHCD-0001	Cathode sealing equipment	Chain conveyor of block oven	Bearing Fixed		SNL22517/75TLH	SKF of Canada ltd	SNL22517/75TLH			1347-C1-1000	2
C1	17	4481-MHCD-0001	Cathode sealing equipment	Chain conveyor of block oven	Bearing Free		SNL22517/75TL	SKF of Canada ltd	SNL22517/75TLH			1347-C1-1000	2
C1	18	4481-MHCD-0001	Cathode sealing equipment	Chain conveyor of block oven	Helical Parallel Brake Motor		R137R77 DRE100LC4BE2HF/DH	SEW-Eurodrive	R137R77 DRE100LC4BE2HF/DH			1347-C1-1000	1
C1	19	4481-MHCD-0001	Cathode sealing equipment	Chain conveyor of block oven	Chain Conveyor CC5		CC5-GSC 6in pitch	TSUBAKI	CC5-GSC 6in pitch			1347-C1-1000	150
C1	20	4481-MHCD-0001	Cathode sealing equipment	Chain conveyor of block oven	Connecting link CC5		CC-5 Link	TSUBAKI	CC-5 Link			1347-C1-1000	2
C1	21	4481-MHCD-0001	Cathode sealing equipment	Chain conveyor of block oven	Sprokets for CC5		CC-5B8F-75mmZ (8teeth,bore 75mm)	TSUBAKI	CC-5B8F-75mmZ (8teeth,bore 75mm)			1347-C1-1000	4
C1	22	4481-MHCD-0001	Cathode sealing equipment	Chain conveyor of block oven	Chain 140 (119143)		140A1 Pitch 1.75in #119143 (ft)	RENOLD	140A1 Pitch 1.75in #119143 (ft)			1347-C1-1000	10
C1	23	4481-MHCD-0001	Cathode sealing equipment	Chain conveyor of block oven	Link 140		link140-1	RENOLD	link140-1			1347-C1-1000	4
C1	24	4481-MHCD-0001	Cathode sealing equipment	Chain conveyor of block oven	Sproket Bore 75		140B28	Martin	140B28			1347-C1-1000	1
C1	25	4481-MHCD-0001	Cathode sealing equipment	Chain conveyor of block oven	Sproket Bore 90		140B14	Martin	140B14			1347-C1-1000	1
C1	26	4481-MHCD-0001	Cathode sealing equipment	Chain conveyor of block oven	Local Disconnect Switch Box		IM 63 III (IP65) 1347-51151 rev 1	CEFEM	IM 63 III (IP65) 1347-51151 rev 1			1347-C1-1000	1
C1	27	4481-MHCD-0001	Cathode sealing equipment	Chain conveyor of block oven	Limit Switch		ZCKJ2H7	Télémécanique	ZCKJ2H7			1347-C1-1000	2
C1	28	4481-MHCD-0001	Cathode sealing equipment	Chain conveyor of block oven	Limit Switch Head		ZCKE055	Télémécanique	ZCKE055			1347-C1-1000	2
C1	29	4481-MHCD-0001	Cathode sealing equipment	Chain conveyor of block oven	Lever 4		ZCKY43 or ZCKY53	Télémécanique	ZCKY43 or ZCKY53			1347-C1-1000	2
C1	30	4481-MHCD-0001	Cathode sealing equipment	Chain conveyor of block oven	Support Tube		XVBZ02	Télémécanique	XVBZ02			1347-C1-1000	1
C1	31	4481-MHCD-0001	Cathode sealing equipment	Chain conveyor of block oven	Cache Tube		XVBC020	Télémécanique	XVBC020			1347-C1-1000	1
C1	32	4481-MHCD-0001	Cathode sealing equipment	Chain conveyor of block oven	Buzzer		XVBC9B	Télémécanique	XVBC9B			1347-C1-1000	1
C1	33	4481-MHCD-0001	Cathode sealing equipment	Chain conveyor of block oven	Base Unit		XVBC21	Télémécanique	XVBC21			1347-C1-1000	1
C1	34	4481-MHCD-0001	Cathode sealing equipment	Chain conveyor of block oven	Flashing Light Red		XVBC4B4	Télémécanique	XVBC4B4			1347-C1-1000	1
C1	35	4481-MHCD-0001	Cathode sealing equipment	Chain conveyor of block oven	Incandescent Bulb		DL1BLB	Télémécanique	DL1BLB			1347-C1-1000	1
C2	36	4481-MHCD-0002	Cathode sealing equipment	Chain conveyor upstream of shot blasting machine (24 bars)	Bearing Fixed		SNL22517/75TLH	SKF of Canada ltd	SNL22517/75TLH			1347-C2-1000	2
C2	37	4481-MHCD-0002	Cathode sealing equipment	Chain conveyor upstream of shot blasting machine (24 bars)	Bearing Free		SNL22517/75TL	SKF of Canada ltd	SNL22517/75TL			1347-C2-1000	2
C2	38	4481-MHCD-0002	Cathode sealing equipment	Chain conveyor upstream of shot blasting machine (24 bars)	Helical Parallel Gear Brake Motor		R97R57 DRE90M4BE2HF/DH	SEW-Eurodrive	R97R57 DRE90M4BE2HF/DH			1347-C2-1000	1
C2	39	4481-MHCD-0002	Cathode sealing equipment	Chain conveyor upstream of shot blasting machine (24 bars)	Chain Conveyor CC5		CC5-GSC 6in pitch	TSUBAKI	CC5-GSC 6in pitch			1347-C2-1000	120
C2	40	4481-MHCD-0002	Cathode sealing equipment	Chain conveyor upstream of shot blasting machine (24 bars)	CC5 Link		CC-5 Link	TSUBAKI	CC-5 Link			1347-C2-1000	2
C2	41	4481-MHCD-0002	Cathode sealing equipment	Chain conveyor upstream of shot blasting machine (24 bars)	Sprockets		CC-5B12F-75mmZ (12teeth,bore 75mm)	TSUBAKI	CC-5B12F-75mmZ (12teeth,bore 75mm)			1347-C2-1000	4
C2	42	4481-MHCD-0002	Cathode sealing equipment	Chain conveyor upstream of shot blasting machine (24 bars)	Chain 140 (119143)		140A1 Pitch 1.75in #119143 (ft)	RENOLD	140A1 Pitch 1.75in #119143 (ft)			1347-C2-1000	10
C2	43	4481-MHCD-0002	Cathode sealing equipment	Chain conveyor upstream of shot blasting machine (24 bars)	Link 140		link140-1	RENOLD	link140-1			1347-C2-1000	3
C2	44	4481-MHCD-0002	Cathode sealing equipment	Chain conveyor upstream of shot blasting machine (24 bars)	Sproket Bore 75		140C40	Martin	140C40			1347-C2-1000	1
C2	45	4481-MHCD-0002	Cathode sealing equipment	Chain conveyor upstream of shot blasting machine (24 bars)	Sproket Bore 60		140B13	Martin	140B13			1347-C2-1000	1
C2	46	4481-MHCD-0002	Cathode sealing equipment	Chain conveyor upstream of shot blasting machine (24 bars)	Local Disconnect Switch Box		IM 63 III (IP65) 1347-51151 rev 1	CEFEM	IM 63 III (IP65) 1347-51151 rev 1			1347-C2-1000	1
C2	47	4481-MHCD-0002	Cathode sealing equipment	Chain conveyor upstream of shot blasting machine (24 bars)	Support Tube		XVBZ02	Télémécanique	XVBZ02			1347-C2-1000	1
C2	48	4481-MHCD-0002	Cathode sealing equipment	Chain conveyor upstream of shot blasting machine (24 bars)	Cache Tube		XVBC020	Télémécanique	XVBC020			1347-C2-1000	1
C2	49	4481-MHCD-0002	Cathode sealing equipment	Chain conveyor upstream of shot blasting machine (24 bars)	Buzzer		XVBC9B	Télémécanique	XVBC9B			1347-C2-1000	1
C2	50	4481-MHCD-0002	Cathode sealing equipment	Chain conveyor upstream of shot blasting machine (24 bars)	Base Unit		XVBC21	Télémécanique	XVBC21			1347-C2-1000	1
C2	51	4481-MHCD-0002	Cathode sealing equipment	Chain conveyor upstream of shot blasting machine (24 bars)	Flashing Light Red		XVBC4B4	Télémécanique	XVBC4B4			1347-C2-1000	1
C2	52	4481-MHCD-0002	Cathode sealing equipment	Chain conveyor upstream of shot blasting machine (24 bars)	Incandescent Bulb		DL1BLB	Télémécanique	DL1BLB			1347-C2-1000	1
C2	53	4481-MHCD-0002	Cathode sealing equipment	Chain conveyor upstream of shot blasting machine (24 bars)	C2 Local Control Panel - 4481-MHCD-0002-CP-02		1347-51090	ENVITECH AUTOMATION Inc.	1347-51090			1347-C2-1000	1
C2	54	4481-MHCD-0002	Cathode sealing equipment	Chain conveyor upstream of shot blasting machine (24 bars)	C2-R9 Local Control Panel - 4481-MHCD-0002-LCS-01		1347-51200	ENVITECH AUTOMATION Inc.	1347-51200			1347-C2-1000	1
C3	55	4481-MHCD-0003	Cathode sealing equipment	Chain conveyor between shot blasting machine and oven	Bearing Fixed		SNL22517/75TLH	SKF of Canada ltd	SNL22517/75TLH			1347-C3-1000	2
C3	56	4481-MHCD-0003	Cathode sealing equipment	Chain conveyor between shot blasting machine and oven	Bearing Free		SNL22517/75TL	SKF of Canada ltd	SNL22517/75TL			1347-C3-1000	2
C3	57	4481-MHCD-0003	Cathode sealing equipment	Chain conveyor between shot blasting machine and oven	Helical Parallel Gear Brake Motor		R77 FRE80M4/DH	SEW-Eurodrive	R77 FRE80M4/DH			1347-C3-1000	1

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C3	58	4481-MHCD-0003	Cathode sealing equipment	Chain conveyor between shot blasting machine and oven	Chain Conveyor CC5		CC5-GSC 6in pitch	TSUBAKI	CC5-GSC 6in pitch			1347-C3-1000	60
C3	59	4481-MHCD-0003	Cathode sealing equipment	Chain conveyor between shot blasting machine and oven	Link CC5		CC-5 Link	TSUBAKI	CC-5 Link			1347-C3-1000	2
C3	60	4481-MHCD-0003	Cathode sealing equipment	Chain conveyor between shot blasting machine and oven	Sprockets		CC-5B8F-75mmZ (8teeth,bore 75mm)	TSUBAKI	CC-5B8F-75mmZ (8teeth,bore 75mm)			1347-C3-1000	4
C3	61	4481-MHCD-0003	Cathode sealing equipment	Chain conveyor between shot blasting machine and oven	Chain 60-2		60A2 Pitch 0.75in #115063 (ft)	RENOLD	60A2 Pitch 0.75in #115063 (ft)			1347-C3-1000	10
C3	62	4481-MHCD-0003	Cathode sealing equipment	Chain conveyor between shot blasting machine and oven	Link 60-2		link60-2	RENOLD	link60-2			1347-C3-1000	3
C3	63	4481-MHCD-0003	Cathode sealing equipment	Chain conveyor between shot blasting machine and oven	Sproket Bore 75		D60C76	Martin	D60C76			1347-C3-1000	1
C3	64	4481-MHCD-0003	Cathode sealing equipment	Chain conveyor between shot blasting machine and oven	Sproket Bore 35		D60B14H	Martin	D60B14H			1347-C3-1000	1
C3	65	4481-MHCD-0003	Cathode sealing equipment	Chain conveyor between shot blasting machine and oven	Local Disconnect Switch Box		IM 63 III (IP65) 1347-51151 rev 1	CEFEM	IM 63 III (IP65) 1347-51151 rev 1			1347-C3-1000	1
C3	66	4481-MHCD-0003	Cathode sealing equipment	Chain conveyor between shot blasting machine and oven	Proximity Switch		XS7C40MP230TT	Télémécanique	XS7C40MP230TT			1347-C3-1000	3
C3	67	4481-MHCD-0003	Cathode sealing equipment	Chain conveyor between shot blasting machine and oven	C3-R7-R8 Local Control Station - 4481-MHCD-0003-LCS-01		1347-51205	ENVITECH AUTOMATION Inc.	1347-51205			1347-C3-1000	1
C4	68	4481-MHCD-0003	Cathode sealing equipment	Chain conveyor for sealed cathode	Bearing Fixed		SNL22517/75TLH	SKF of Canada ltd	SNL22517/75TLH			1347-C3-1000	2
C4	69	4481-MHCD-0003	Cathode sealing equipment	Chain conveyor for sealed cathode	Bearing Free		SNL22517/75TL	SKF of Canada ltd	SNL22517/75TL			1347-C3-1000	2
C4	70	4481-MHCD-0003	Cathode sealing equipment	Chain conveyor for sealed cathode	Helical Parallel Brake Motor		R137R77 DRE100LC4BE2HF/DH	SEW-Eurodrive	R137R77 DRE100LC4BE2HF/DH			1347-C3-1000	1
C4	71	4481-MHCD-0003	Cathode sealing equipment	Chain conveyor for sealed cathode	Chain Conveyor CC5		CC5-GSC 6in pitch	TSUBAKI	CC5-GSC 6in pitch			1347-C3-1000	120
C4	72	4481-MHCD-0003	Cathode sealing equipment	Chain conveyor for sealed cathode	Link cc5		CC-5 Link	TSUBAKI	CC-5 Link			1347-C3-1000	2
C4	73	4481-MHCD-0003	Cathode sealing equipment	Chain conveyor for sealed cathode	Sprokets		CC-5B8F-75mmZ (8teeth,bore 75mm)	TSUBAKI	CC-5B8F-75mmZ (8teeth,bore 75mm)			1347-C3-1000	4
C4	74	4481-MHCD-0003	Cathode sealing equipment	Chain conveyor for sealed cathode	Chain 140 (119143)		140A1 Pitch 1.75in #119143 (ft)	RENOLD	140A1 Pitch 1.75in #119143 (ft)			1347-C3-1000	10
C4	75	4481-MHCD-0003	Cathode sealing equipment	Chain conveyor for sealed cathode	Link 140-1		link140-1	RENOLD	link140-1			1347-C3-1000	3
C4	76	4481-MHCD-0003	Cathode sealing equipment	Chain conveyor for sealed cathode	Sproket Bore 75		140B32	Martin	140B32			1347-C3-1000	1
C4	77	4481-MHCD-0003	Cathode sealing equipment	Chain conveyor for sealed cathode	Sproket Bore 70		140B15	Martin	140B15			1347-C3-1000	1
C4	78	4481-MHCD-0003	Cathode sealing equipment	Chain conveyor for sealed cathode	Local Disconnect Switch Box		IM 63 III (IP65) 1347-51151 rev 1	CEFEM	IM 63 III (IP65) 1347-51151 rev 1			1347-C3-1000	1
C4	79	4481-MHCD-0003	Cathode sealing equipment	Chain conveyor for sealed cathode	Limit Switch		ZCKJ2H7	Télémécanique	ZCKJ2H7			1347-C3-1000	2
C4	80	4481-MHCD-0003	Cathode sealing equipment	Chain conveyor for sealed cathode	Limit Switch head		ZCKE055	Télémécanique	ZCKE055			1347-C3-1000	2
C4	81	4481-MHCD-0003	Cathode sealing equipment	Chain conveyor for sealed cathode	Lever 4		ZCKY43 or ZCKY53	Télémécanique	ZCKY43 or ZCKY53			1347-C3-1000	2
C4	82	4481-MHCD-0003	Cathode sealing equipment	Chain conveyor for sealed cathode	Support Tube		XVBZ02	Télémécanique	XVBZ02			1347-C3-1000	1
C4	83	4481-MHCD-0003	Cathode sealing equipment	Chain conveyor for sealed cathode	Cache Tube		XVBC020	Télémécanique	XVBC020			1347-C3-1000	1
C4	84	4481-MHCD-0003	Cathode sealing equipment	Chain conveyor for sealed cathode	Buzzer		XVBC9B	Télémécanique	XVBC9B			1347-C3-1000	1
C4	85	4481-MHCD-0003	Cathode sealing equipment	Chain conveyor for sealed cathode	Base Unit		XVBC21	Télémécanique	XVBC21			1347-C3-1000	1
C4	86	4481-MHCD-0003	Cathode sealing equipment	Chain conveyor for sealed cathode	Flashing Light Red		XVBC4B4	Télémécanique	XVBC4B4			1347-C3-1000	1
C4	87	4481-MHCD-0003	Cathode sealing equipment	Chain conveyor for sealed cathode	Incandescent Bulb		DL1BLB	Télémécanique	DL1BLB			1347-C3-1000	1
F1	88	4481-MEEP-0001	Cathode sealing equipment	Cathode block oven (capacity of 6 cathode blocks)	Bearing		SY50FM	SKF of Canada ltd	SY50FM			1347-F1-1000	4
F1	89	4481-MEEP-0001	Cathode sealing equipment	Cathode block oven (capacity of 6 cathode blocks)	Bearing		FY35TF	SKF of Canada ltd	FY35TF			1347-F1-1000	4
F1	90	4481-MEEP-0001	Cathode sealing equipment	Cathode block oven (capacity of 6 cathode blocks)	Clockwise Fan		15000cfm, size 338, 5in SP, 1165RPM, 460V/3/60Hz	NEW YORK BLOWER	15000cfm, size 338, 5in SP, 1165RPM, 460V/3/60Hz			1347-F1-1000	2
F1	91	4481-MEEP-0001	Cathode sealing equipment	Cathode block oven (capacity of 6 cathode blocks)	Clounterclockwise Fan		15000cfm, size 338, 5in SP, 1165RPM, 460V/3/60Hz	NEW YORK BLOWER	15000cfm, size 338, 5in SP, 1165RPM, 460V/3/60Hz			1347-F1-1000	1
F1	92	4481-MEEP-0001	Cathode sealing equipment	Cathode block oven (capacity of 6 cathode blocks)	Local Disconnect Switch Box		IM 63 III (IP65) 1347-51151 rev 1	CEFEM	IM 63 III (IP65) 1347-51151 rev 1			1347-F1-1000	3
F1	93	4481-MEEP-0001	Cathode sealing equipment	Cathode block oven (capacity of 6 cathode blocks)	Thermocouple 28"		ARLD00F280UK000 type K 28in	RDC Contrôle	ARLD00F280UK000 type K 28in			1347-F1-1000	6
F1	94	4481-MEEP-0001	Cathode sealing equipment	Cathode block oven (capacity of 6 cathode blocks)	Compressing fitting		SS-600-1-8-BT	RDC Contrôle	SS-600-1-8-BT			1347-F1-1000	6
F1	95	4481-MEEP-0001	Cathode sealing equipment	Cathode block oven (capacity of 6 cathode blocks)	Proximity Switch		XS7C40MP230TT	Télémécanique	XS7C40MP230TT			1347-F1-1000	2
F1	96	4481-MEEP-0001	Cathode sealing equipment	Cathode block oven (capacity of 6 cathode blocks)	Ampli Photoelectrique 24VDC		S142BRNN-924	Carlo Gavazzi	S142BRNN-924			1347-F1-1000	2
F1	97	4481-MEEP-0001	Cathode sealing equipment	Cathode block oven (capacity of 6 cathode blocks)	Transmitter		MOFT20-M12-8	Carlo Gavazzi	MOFT20-M12-8			1347-F1-1000	2
F1	98	4481-MEEP-0001	Cathode sealing equipment	Cathode block oven (capacity of 6 cathode blocks)	Receiver		MOFR-M12-8	Carlo Gavazzi	MOFR-M12-8			1347-F1-1000	2
F1	99	4481-MEEP-0001	Cathode sealing equipment	Cathode block oven (capacity of 6 cathode blocks)	Optic Fibre		OFMS1-10 (1m)	Carlo Gavazzi	OFMS1-10 (1m)			1347-F1-1000	2
F1	100	4481-MEEP-0001	Cathode sealing equipment	Cathode block oven (capacity of 6 cathode blocks)	Base		ZPD11 (11 pins)	Carlo Gavazzi	ZPD11 (11 pins)			1347-F1-1000	2
F1	101	4481-MEEP-0001	Cathode sealing equipment	Cathode block oven (capacity of 6 cathode blocks)	High Temperature Controller		SD6L-LJAE-AARG (24vdc)	Watlow	SD6L-LJAE-AARG (24vdc)			1347-F1-1000	3
F1	102	4481-MEEP-0001	Cathode sealing equipment	Cathode block oven (capacity of 6 cathode blocks)	F1-A,F1-B,F1-C Local Control Station		1347-51204	ENVITECH AUTOMATION Inc.	1347-51204			1347-F1-1000	3
F1	103	4481-MEEP-0001	Cathode sealing equipment	Cathode block oven (capacity of 6 cathode blocks)	Duct Heater		WXL-54 (460V/60Hz)	ASB Heating Elements Ltd	WXL-54 (460V/60Hz)			1347-F1-1000	9
F1	104	4481-MEEP-0001	Cathode sealing equipment	Cathode block oven (capacity of 6 cathode blocks)	Wiring T/C		20AWG 205C Shielded	RDC Contrôle	20AWG 205C Shielded			1347-F1-1000	150
F1	105	4481-MEEP-0001	Cathode sealing equipment	Cathode block oven (capacity of 6 cathode blocks)	Pneumatic Cylinger Parker Vilton		6.00CD-2AUV13A-30.236	Parker	6.00CD-2AUV13A-30.236			1347-F1-1000	2
F1	106	4481-MEEP-0001	Cathode sealing equipment	Cathode block oven (capacity of 6 cathode blocks)	Rod End Clevis Parker		50944	Parker	50944			1347-F1-1000	2
F1	107	4481-MEEP-0001	Cathode sealing equipment	Cathode block oven (capacity of 6 cathode blocks)	Eye Bracket		69197	Parker	69197			1347-F1-1000	2
F1	108	4481-MEEP-0001	Cathode sealing equipment	Cathode block oven (capacity of 6 cathode blocks)	Parker Pivot Pin		68370	Parker	68370			1347-F1-1000	2
F1	109	4481-MEEP-0001	Cathode sealing equipment	Cathode block oven (capacity of 6 cathode blocks)	Filter Regulator Lubrificator (FRL)		P32QA93SEANGLND	Parker	P32QA93SEANGLND			1347-F1-1000	1
F1	110	4481-MEEP-0001	Cathode sealing equipment	Cathode block oven (capacity of 6 cathode blocks)	Directionnal Valve		H22VXBG0B9C	Parker	H22VXBG0B9C			1347-F1-1000	2
F1	111	4481-MEEP-0001	Cathode sealing equipment	Cathode block oven (capacity of 6 cathode blocks)	Base		PS411117CCP	Parker	PS411117CCP			1347-F1-1000	2
F1	112	4481-MEEP-0001	Cathode sealing equipment	Cathode block oven (capacity of 6 cathode blocks)	Flow Control Valve		F600B	Parker	F600B			1347-F1-1000	4
F1	113	4481-MEEP-0001	Cathode sealing equipment	Cathode block oven (capacity of 6 cathode blocks)	Muffler		P48	Parker	P48			1347-F1-1000	4
F1	114	4481-MEEP-0001	Cathode sealing equipment	Cathode block oven (capacity of 6 cathode blocks)	Check valve		C600B	Parker	C600B			1347-F1-1000	1

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GNA ref	ITEM NO.	COMPONENT TAG NUMBER	SECTION (or assembly)	SUB-SECTION (or sub-assembly)	COMPONENT DESCRIPTION	SECTION / SUB-SECTION PART DESCRIPTION	SELLER / CONTRACTOR PART CODE	MANUFACTURER NAME	MANUFACTURER PART SERIAL NUMBER	LISTING OF PART SUPPLIERS	CLIENT NUMBER	SELLER / CONTRACTOR DRAWING NO.	QTY
F2	115	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Rollers		1347-F2-1010	Duraloy Technologies	1347-F2-1010			1347-F2-1000	16
F2	116	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Bearing Adaptor Wellman		985B149P3	Wellman	985B149P3			1347-F2-1000	34
F2	117	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Bearing		FY 40TF open	SKF of Canada ltd	FY 40TF open			1347-F2-1000	16
F2	118	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Bearing		FY 40TF end cover	SKF of Canada ltd	FY 40TF end cover			1347-F2-1000	16
F2	119	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Thrust Washer		TB-1632	SIMCO	TB-1632			1347-F2-1000	8
F2	120	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Helical Bevel Gear Motor		K47 DRE80M4/V/DH	SEW-Eurodrive	K47 DRE80M4/V/DH			1347-F2-1000	2
F2	121	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Helical Bevel Gear Motor		K47 DRE80M4/V/DH	SEW-Eurodrive	K47 DRE80M4/V/DH			1347-F2-1000	2
F2	122	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Chain 40-2		40A2 Pitch 0.5in #115043 (ft)	RENOLD	40A2 Pitch 0.5in #115043 (ft)			1347-F2-1000	30
F2	123	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Link40-2		link40-2	RENOLD	link40-2			1347-F2-1000	6
F2	124	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Chain 80 (119083)		80A1 Pitch 1in #119083 (ft)	RENOLD	80A1 Pitch 1in #119083 (ft)			1347-F2-1000	80
F2	125	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Link80		link80-1	RENOLD	link80-1			1347-F2-1000	5
F2	126	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Sprocket Bore 30		D40B19H	Martin	D40B19H			1347-F2-1000	4
F2	127	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Sprocket Bore 40		D40B52	Martin	D40B52			1347-F2-1000	4
F2	128	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Sprocket Bore 25		HND40B19	Martin	HND40B19			1347-F2-1000	4
F2	129	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Sprocket Bore 40		DS80A18	Martin	DS80A18			1347-F2-1000	8
F2	130	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Idler Bore 19 (3/4in)		80BB12H	Martin	80BB12H			1347-F2-1000	12
F2	131	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Sprocket Bore 40		80B18	Martin	80B18			1347-F2-1000	8
F2	132	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Flange Bushing		FF-1618-1	NORMA BEARING	FF-1618-1			1347-F2-1000	4
F2	133	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Shaft Collar		600104 3/4in	NORMA BEARING	600104 3/4in			1347-F2-1000	12
F2	134	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Shaft Collar		600107 1in	NORMA BEARING	600107 1in			1347-F2-1000	4
F2	135	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Local Disconnect Switch		IM 63 VI (IP65) 1347-51150 rev 1	CEFEM	IM 63 VI (IP65) 1347-51150 rev 1			1347-F2-1000	4
F2	136	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Thermocouple 18"		ARLD00F180UK000 type K 18in	RDC Contrôle	ARLD00F180UK000 type K 18in			1347-F2-1000	8
F2	137	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Compressing fitting		SS-400-1-8-BT	RDC Contrôle	SS-400-1-8-BT			1347-F2-1000	16
F2	138	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Heat Seals		11698	Eclipse Combustion MTL	11698			1347-F2-1000	22
F2	139	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Ampli Photoelectrique 24VDC		S142BRNN-924	Carlo Gavazzi	S142BRNN-924			1347-F2-1000	8
F2	140	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Transmitter		MOFT20-M12-8	Carlo Gavazzi	MOFT20-M12-8			1347-F2-1000	8
F2	141	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Receiver		MOFR-M12-8	Carlo Gavazzi	MOFR-M12-8			1347-F2-1000	8
F2	142	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Optic Fibre		OFMS1-10 (1m)	Carlo Gavazzi	OFMS1-10 (1m)			1347-F2-1000	8
F2	143	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Base		ZPD11 (11 pins)	Carlo Gavazzi	ZPD11 (11 pins)			1347-F2-1000	8
F2	144	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Proximity Switch		XS7C40MP230TT	Télémécanique	XS7C40MP230TT			1347-F2-1000	6
F2	145	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	High Temperature Controller		SD6L-LJAE-AARG (24vdc)	Watlow	SD6L-LJAE-AARG (24vdc)			1347-F2-1000	4
F2	146	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Wiring T/C		20AWG 205C Shielded	RDC Contrôle	20AWG 205C Shielded			1347-F2-1000	150
F2	147	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Electrical Element		RR64x38x1.25 (2.02ohms)	I Squared R Element	RR64x38x1.25 (2.02ohms)			1347-F2-1000	96
F2	148	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Terminal BA312		B312	I Squared R Element	B312			1347-F2-1000	48
F2	149	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Terminal A312		A312	I Squared R Element	A312			1347-F2-1000	96
F2	150	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Clamp		T32	I Squared R Element	T32			1347-F2-1000	200
F2	151	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Gasket		TGA-32-3	I Squared R Element	TGA-32-3			1347-F2-1000	200
F2	152	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Clamp tool		T100	I Squared R Element	T100			1347-F2-1000	1
F2	153	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Pneumatic Cylinder Parker		2.5CBB-2AUV34AC3	Parker	2.5CBB-2AUV34AC3			1347-F2-1000	4
F2	154	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Rod Clevis Parker		50942	Parker	50942			1347-F2-1000	4
F2	155	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Parker Mounting Plate		69195	Parker	69195			1347-F2-1000	4
F2	156	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Parker Pin		68369	Parker	68369			1347-F2-1000	4
F2	157	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Pneumatic Cylinder Parker		3.25CD-2AUV14AC18	Parker	3.25CD-2AUV14AC18			1347-F2-1000	2
F2	158	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Rod Clevis Parker		50942	Parker	50942			1347-F2-1000	2
F2	159	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Parker Mounting Plate		69196	Parker	69196			1347-F2-1000	2
F2	160	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Parker Pin		68369	Parker	68369			1347-F2-1000	2
F2	161	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Filter Regulator Lubrificator (FRL)		P32QA93SEANGLND	Parker	P32QA93SEANGLND			1347-F2-1000	1
F2	162	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Directionnal Valve		H22VXBG0B9C	Parker	H22VXBG0B9C			1347-F2-1000	4
F2	163	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Base		PS411117CCP	Parker	PS411117CCP			1347-F2-1000	4
F2	164	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Flow Control Valve		F600B	Parker	F600B			1347-F2-1000	12
F2	165	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Muffler		P48	Parker	P48			1347-F2-1000	8
F2	166	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Check valve		C600B	Parker	C600B			1347-F2-1000	1
F2	167	4481-MBMB-0001	Cathode sealing equipment	Cathode bar heating furnace (capacity of 16 bars)	Sleeve (Vacuum Formed)		1347-F2-1710 * Soluble ceramic fiber	THERMAL CERAMIC	1347-F2-1710 * Soluble ceramic fiber			1347-F2-1000	32
F3	168	4481-MBAD-0001	Cathode sealing equipment	Ladle Pre-Heating Station	High Temperature Controller		SD6L-LJAE-AARG (24vdc)	Watlow	SD6L-LJAE-AARG (24vdc)			1347-F3-1000	1
F3	169	4481-MBAD-0001	Cathode sealing equipment	Ladle Pre-Heating Station	Thermocouple 28"		ARLD00F280UK000 type K 28in	RDC Contrôle	ARLD00F280UK000 type K 28in			1347-F3-1000	2
F3	170	4481-MBAD-0001	Cathode sealing equipment	Ladle Pre-Heating Station	Compressing fitting		SS-600-1-8-BT	RDC Contrôle	SS-600-1-8-BT			1347-F3-1000	2
F3	171	4481-MBAD-0001	Cathode sealing equipment	Ladle Pre-Heating Station	Wiring T/C		20AWG 205C Shielded	RDC Contrôle	20AWG 205C Shielded			1347-F3-1000	28

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F3	172	4481-MBAD-0001	Cathode sealing equipment	Ladle Pre-Heating Station	Limit Switch		ZCKJ2H7	Télémécanique	ZCKJ2H7			1347-F3-1000	1
F3	173	4481-MBAD-0001	Cathode sealing equipment	Ladle Pre-Heating Station	Limit Switch Head		ZCKE055	Télémécanique	ZCKE055			1347-F3-1000	1
F3	174	4481-MBAD-0001	Cathode sealing equipment	Ladle Pre-Heating Station	Lever 4		ZCKY43 or ZCKY53	Télémécanique	ZCKY43 or ZCKY53			1347-F3-1000	1
F3	175	4481-MBAD-0001	Cathode sealing equipment	Ladle Pre-Heating Station	Local Disconnect Switch Box		IM 63 III (IP65) 1347-51151 rev 1	CEFEM	IM 63 III (IP65) 1347-51151 rev 1			1347-F3-1000	1
F3	176	4481-MBAD-0001	Cathode sealing equipment	Ladle Pre-Heating Station	Appliance valve		Model 58 22571-1	Kitz	Model 58 22571-1			1347-F3-1000	1
F3	177	4481-MBAD-0001	Cathode sealing equipment	Ladle Pre-Heating Station	Gauge 0-60 psi		G14492	Marshalltown	G14492			1347-F3-1000	1
F3	178	4481-MBAD-0001	Cathode sealing equipment	Ladle Pre-Heating Station	Gas pressure regulator		HSR	Fisher	HSR			1347-F3-1000	1
F3	179	4481-MBAD-0001	Cathode sealing equipment	Ladle Pre-Heating Station	Low gas pressure switch		GML-A2-4-4	Dungs	GML-A2-4-4			1347-F3-1000	1
F3	180	4481-MBAD-0001	Cathode sealing equipment	Ladle Pre-Heating Station	Butterfly air adjusting valve		501218	Eclipse	501218			1347-F3-1000	1
F3	181	4481-MBAD-0001	Cathode sealing equipment	Ladle Pre-Heating Station	Modutrol motor		M 7284C 1000, 15273-4	Honeywell	M 7284C 1000, 15273-4			1347-F3-1000	1
F3	182	4481-MBAD-0001	Cathode sealing equipment	Ladle Pre-Heating Station	Burne isolation valve		Model 58 22570-1	Kitz	Model 58 22570-1			1347-F3-1000	2
F3	183	4481-MBAD-0001	Cathode sealing equipment	Ladle Pre-Heating Station	Dual safety shut off gas valve		DMV-DLE 701/6	Dungs	DMV-DLE 701/6			1347-F3-1000	2
F3	184	4481-MBAD-0001	Cathode sealing equipment	Ladle Pre-Heating Station	High gas pressure switch		GMH-A2-4-6	Dungs	GMH-A2-4-6			1347-F3-1000	2
F3	185	4481-MBAD-0001	Cathode sealing equipment	Ladle Pre-Heating Station	Firing valve		Model 58 22570-1	Kitz	Model 58 22570-1			1347-F3-1000	2
F3	186	4481-MBAD-0001	Cathode sealing equipment	Ladle Pre-Heating Station	Butterfly gas valve		100134	Eclipse	100134			1347-F3-1000	2
F3	187	4481-MBAD-0001	Cathode sealing equipment	Ladle Pre-Heating Station	Combustion blower		SMJ10,202759-0-122AA113	Eclipse	SMJ10,202759-0-122AA113			1347-F3-1000	1
F3	188	4481-MBAD-0001	Cathode sealing equipment	Ladle Pre-Heating Station	Combustion air pessure switch		AA-A2-6-5	Dungs	AA-A2-6-5			1347-F3-1000	1
F4	189	4481-MEVD-0001	Cathode sealing equipment	Cast Iron Ingot Drying Station	Limit Switch		ZCKJ2H7	Télémécanique	ZCKJ2H7			1347-F4-1000	1
F4	190	4481-MEVD-0001	Cathode sealing equipment	Cast Iron Ingot Drying Station	Limit Switch Head		ZCKE055	Télémécanique	ZCKE055			1347-F4-1000	1
F4	191	4481-MEVD-0001	Cathode sealing equipment	Cast Iron Ingot Drying Station	Lever 4		ZCKY43 or ZCKY53	Télémécanique	ZCKY43 or ZCKY53			1347-F4-1000	1
F4	192	4481-MEVD-0001	Cathode sealing equipment	Cast Iron Ingot Drying Station	Local Disconnect Switch Box		IM 63 III (IP65) 1347-51151 rev 1	CEFEM	IM 63 III (IP65) 1347-51151 rev 1			1347-F4-1000	1
F4	193	4481-MEVD-0001	Cathode sealing equipment	Cast Iron Ingot Drying Station	Tilting Pneumatic cylinder		8CSB-2AUV19AC18	Parker	8CSB-2AUV19AC18			1347-F4-1000	1
F4	194	4481-MEVD-0001	Cathode sealing equipment	Cast Iron Ingot Drying Station	Spherical rod eye		132292	Parker	132292			1347-F4-1000	1
F4	195	4481-MEVD-0001	Cathode sealing equipment	Cast Iron Ingot Drying Station	Clevis Bracket		83949	Parker	83949			1347-F4-1000	2
F4	196	4481-MEVD-0001	Cathode sealing equipment	Cast Iron Ingot Drying Station	Pin		83964	Parker	83964			1347-F4-1000	2
F4	197	4481-MEVD-0001	Cathode sealing equipment	Cast Iron Ingot Drying Station	Filter Regulator Lubrificator (FRL)		P32QA93SEANGLND	Parker	P32QA93SEANGLND			1347-F4-1000	1
F4	198	4481-MEVD-0001	Cathode sealing equipment	Cast Iron Ingot Drying Station	Manual Valve		PL50	Parker	PL50			1347-F4-1000	1
F4	199	4481-MEVD-0001	Cathode sealing equipment	Cast Iron Ingot Drying Station	Flow Control Valve		F600B	Parker	F600B			1347-F4-1000	1
F4	200	4481-MEVD-0001	Cathode sealing equipment	Cast Iron Ingot Drying Station	Muffler		P48	Parker	P48			1347-F4-1000	1
F4	201	4481-MEVD-0001	Cathode sealing equipment	Cast Iron Ingot Drying Station	Check valve		C600B	Parker	C600B			1347-F4-1000	1
F4	202	4481-MEVD-0001	Cathode sealing equipment	Cast Iron Ingot Drying Station	Manual ball valve		Model 58 22571-1	Kitz	Model 58 22571-1			1347-F4-1000	1
F4	203	4481-MEVD-0001	Cathode sealing equipment	Cast Iron Ingot Drying Station	Gauge 0-60 psi		G14492	Marshalltown	G14492			1347-F4-1000	1
F4	204	4481-MEVD-0001	Cathode sealing equipment	Cast Iron Ingot Drying Station	Gas pressure regulator		HSR	Fisher	HSR			1347-F4-1000	1
F4	205	4481-MEVD-0001	Cathode sealing equipment	Cast Iron Ingot Drying Station	Low gas pressure switch		GML-A2-4-4	Dungs	GML-A2-4-4			1347-F4-1000	1
F4	206	4481-MEVD-0001	Cathode sealing equipment	Cast Iron Ingot Drying Station	Dual safety shut off gas valve		DMV-DLE 701/6	Dungs	DMV-DLE 701/6			1347-F4-1000	1
F4	207	4481-MEVD-0001	Cathode sealing equipment	Cast Iron Ingot Drying Station	High gas pressure switch		GMH-A2-4-4	Dungs	GMH-A2-4-4			1347-F4-1000	1
F4	208	4481-MEVD-0001	Cathode sealing equipment	Cast Iron Ingot Drying Station	Firing valve		Model 58 22570-1	Kitz	Model 58 22570-1			1347-F4-1000	1
F4	209	4481-MEVD-0001	Cathode sealing equipment	Cast Iron Ingot Drying Station	Air gas proportional mixer		LP10,0064-18LPXX	Eclipse	LP10,0064-18LPXX			1347-F4-1000	1
F4	210	4481-MEVD-0001	Cathode sealing equipment	Cast Iron Ingot Drying Station	Zero governor		FRG 705/6	Dungs	FRG 705/6			1347-F4-1000	1
F4	211	4481-MEVD-0001	Cathode sealing equipment	Cast Iron Ingot Drying Station	Combustion blower		SMJ10,202759-0-122AA113	Eclipse	SMJ10,202759-0-122AA113			1347-F4-1000	1
F4	212	4481-MEVD-0001	Cathode sealing equipment	Cast Iron Ingot Drying Station	Combustion air pessure switch		AA-A2-6-5	Dungs	AA-A2-6-5			1347-F4-1000	1
F4	213	4481-MEVD-0001	Cathode sealing equipment	Cast Iron Ingot Drying Station	Butterfly air adjusting valve		501218	Eclipse	501218			1347-F4-1000	1
F4	214	4481-MEVD-0002	Cathode sealing equipment	Cast Iron Ingot Drying Station	Limit Switch		ZCKJ2H7	Télémécanique	ZCKJ2H7			1347-F4-1000	1
F4	215	4481-MEVD-0002	Cathode sealing equipment	Cast Iron Ingot Drying Station	Limit Switch Head		ZCKE055	Télémécanique	ZCKE055			1347-F4-1000	1
F4	216	4481-MEVD-0002	Cathode sealing equipment	Cast Iron Ingot Drying Station	Lever 4		ZCKY43 or ZCKY53	Télémécanique	ZCKY43 or ZCKY53			1347-F4-1000	1
F4	217	4481-MEVD-0002	Cathode sealing equipment	Cast Iron Ingot Drying Station	Local Disconnect Switch Box		IM 63 III (IP65) 1347-51151 rev 1	CEFEM	IM 63 III (IP65) 1347-51151 rev 1			1347-F4-1000	1
F4	218	4481-MEVD-0002	Cathode sealing equipment	Cast Iron Ingot Drying Station	Tilting Pneumatic cylinder		8CSB-2AUV19AC18	Parker	8CSB-2AUV19AC18			1347-F4-1000	1
F4	219	4481-MEVD-0002	Cathode sealing equipment	Cast Iron Ingot Drying Station	Spherical rod eye		132292	Parker	132292			1347-F4-1000	1
F4	220	4481-MEVD-0002	Cathode sealing equipment	Cast Iron Ingot Drying Station	Clevis Bracket		83949	Parker	83949			1347-F4-1000	2
F4	221	4481-MEVD-0002	Cathode sealing equipment	Cast Iron Ingot Drying Station	Pin		83964	Parker	83964			1347-F4-1000	2
F4	222	4481-MEVD-0002	Cathode sealing equipment	Cast Iron Ingot Drying Station	Filter Regulator Lubrificator (FRL)		P32QA93SEANGLND	Parker	P32QA93SEANGLND			1347-F4-1000	1
F4	223	4481-MEVD-0002	Cathode sealing equipment	Cast Iron Ingot Drying Station	Manual Valve		PL50	Parker	PL50			1347-F4-1000	1
F4	224	4481-MEVD-0002	Cathode sealing equipment	Cast Iron Ingot Drying Station	Flow Control Valve		F600B	Parker	F600B			1347-F4-1000	1
F4	225	4481-MEVD-0002	Cathode sealing equipment	Cast Iron Ingot Drying Station	Muffler		P48	Parker	P48			1347-F4-1000	1
F4	226	4481-MEVD-0002	Cathode sealing equipment	Cast Iron Ingot Drying Station	Check valve		C600B	Parker	C600B			1347-F4-1000	1
F4	227	4481-MEVD-0002	Cathode sealing equipment	Cast Iron Ingot Drying Station	Manual ball valve		Model 58 22571-1	Kitz	Model 58 22571-1			1347-F4-1000	1
F4	228	4481-MEVD-0002	Cathode sealing equipment	Cast Iron Ingot Drying Station	Gauge 0-60 psi		G14492	Marshalltown	G14492			1347-F4-1000	1

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GNA ref	ITEM NO.	COMPONENT TAG NUMBER	SECTION (or assembly)	SUB-SECTION (or sub-assembly)	COMPONENT DESCRIPTION	SECTION / SUB-SECTION PART DESCRIPTION	SELLER / CONTRACTOR PART CODE	MANUFACTURER NAME	MANUFACTURER PART SERIAL NUMBER	LISTING OF PART SUPPLIERS	CLIENT NUMBER	SELLER / CONTRACTOR DRAWING NO.	QTY
F4	229	4481-MEVD-0002	Cathode sealing equipment	Cast Iron Ingot Drying Station	Gas pressure regulator		HSR	Fisher	HSR			1347-F4-1000	1
F4	230	4481-MEVD-0002	Cathode sealing equipment	Cast Iron Ingot Drying Station	Low gas pressure switch		GML-A2-4-4	Dungs	GML-A2-4-4			1347-F4-1000	1
F4	231	4481-MEVD-0002	Cathode sealing equipment	Cast Iron Ingot Drying Station	Dual safety shut off gas valve		DMV-DLE 701/6	Dungs	DMV-DLE 701/6			1347-F4-1000	1
F4	232	4481-MEVD-0002	Cathode sealing equipment	Cast Iron Ingot Drying Station	High gas pressure switch		GMH-A2-4-4	Dungs	GMH-A2-4-4			1347-F4-1000	1
F4	233	4481-MEVD-0002	Cathode sealing equipment	Cast Iron Ingot Drying Station	Firing valve		Model 58 22570-1	Kitz	Model 58 22570-1			1347-F4-1000	1
F4	234	4481-MEVD-0002	Cathode sealing equipment	Cast Iron Ingot Drying Station	Air gas proportional mixer		LP10,0064-18LPXX	Eclipse	LP10,0064-18LPXX			1347-F4-1000	1
F4	235	4481-MEVD-0002	Cathode sealing equipment	Cast Iron Ingot Drying Station	Zero governor		FRG 705/6	Dungs	FRG 705/6			1347-F4-1000	1
F4	236	4481-MEVD-0002	Cathode sealing equipment	Cast Iron Ingot Drying Station	Combustion blower		SMJ10,202759-0-122AA113	Eclipse	SMJ10,202759-0-122AA113			1347-F4-1000	1
F4	237	4481-MEVD-0002	Cathode sealing equipment	Cast Iron Ingot Drying Station	Combustion air pessure switch		AA-A2-6-5	Dungs	AA-A2-6-5			1347-F4-1000	1
F4	238	4481-MEVD-0002	Cathode sealing equipment	Cast Iron Ingot Drying Station	Butterfly air adjusting valve		501218	Eclipse	501218			1347-F4-1000	1
G1	239	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	Bearing Fixed		SNL22517/75TLH	SKF of Canada ltd	SNL22517/75TLH			1347-G1-1000	2
G1	240	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	Bearing Free		SNL22517/75TL	SKF of Canada ltd	SNL22517/75TL			1347-G1-1000	2
G1	241	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	Support Roller w/axial guidance		NATV 35	SKF of Canada ltd	NATV 35			1347-G1-1000	2
G1	242	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	Support Roller w/axial guidance		NATV 35 PPA	SKF of Canada ltd	NATV 35 PPA			1347-G1-1000	2
G1	243	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	Bronze Washer		TT-2400-1	NORMA BEARING	TT-2400-1			1347-G1-1000	2
G1	244	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	Bronze Washer		TT-2402	NORMA BEARING	TT-2402			1347-G1-1000	4
G1	245	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	Bronze Washer		TT-2001	NORMA BEARING	TT-2001			1347-G1-1000	4
G1	246	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	Bronze Washer		TT-2400-1	NORMA BEARING	TT-2400-1			1347-G1-1000	2
G1	247	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	Bronze Washer		TT-2402	NORMA BEARING	TT-2402			1347-G1-1000	4
G1	248	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	Bronze Washer		TT-1502	NORMA BEARING	TT-1502			1347-G1-1000	2
G1	249	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	Wheelblock		DRS160A45D65KHA30 Single flange	DEMAG CRANES & Components	DRS160A45D65KHA30 Single flange			1347-G1-1000	2
G1	250	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	Wheelblock		DRS160A45D65KHX Single flange	DEMAG CRANES & Components	DRS160A45D65KHX Single flange			1347-G1-1000	2
G1	251	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	Connection set up		75252044	DEMAG CRANES & Components	75252044			1347-G1-1000	4
G1	252	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	Torque Arm Set		MA160-2 kw	DEMAG CRANES & Components	MA160-2 kw			1347-G1-1000	2
G1	253	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	Guide roller		DRS160	DEMAG CRANES & Components	DRS160			1347-G1-1000	2
G1	254	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	Bumper		DPZ100M12	DEMAG CRANES & Components	DPZ100M12			1347-G1-1000	4
G1	255	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	Gear Motor		AME30DDZBA90A4B020 460/3/60 1.8HP	DEMAG CRANES & Components	AME30DDZBA90A4B020 460/3/60 1.8HP			1347-G1-1000	2
G1	256	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	Local Disconnect Switch Box		IM 63 VI+II (IP65) 1347-51151 rev 1	CEFEM	IM 63 VI+II (IP65) 1347-51151 rev 1			1347-G1-1000	502
G1	257	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	Proximity Switch		XS7C40MP230TT	Télémécanique	XS7C40MP230TT			1347-G1-1000	23
G1	258	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	Rotating Mirror Beacon		ZVR1B94	Télémécanique	ZVR1B94			1347-G1-1000	1
G1	259	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	Mounting tulip		XVR013	Télémécanique	XVR013			1347-G1-1000	1
G1	260	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	R6-G1-R2 Local Control Station - 4481-MQLK-0001-LCS-01		1347-51210	ENVITECH AUTOMATION Inc.	1347-51210			1347-G1-1000	1
G1	261	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	G1-Jonction Box - 4481-MQLK-0001-JB-02		1347-51310	ENVITECH AUTOMATION Inc.	1347-51310			1347-G1-1000	1
G1	262	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	G1-Jonction Box - 4481-MQLK-0001-JB-03		1347-51320	ENVITECH AUTOMATION Inc.	1347-51320			1347-G1-1000	1
G1	263	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	Flexible Tray		SRC-170 (112in lg- 7in w -Overall 124in)	A&A manufacturing Co. Inc	SRC-170 (112in lg- 7in w -Overall 124in)			1347-G1-1000	1
G1	264	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	Hydraulic Cylinder Parker		4CDB-2HKPSV14AC20	Parker	4CDB-2HKPSV14AC20			1347-G1-1000	1
G1	265	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	Female Rod Clevis Parker		50945	Parker	50945			1347-G1-1000	1
G1	266	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	Pivot Pin Parker		68371	Parker	68371			1347-G1-1000	1
G1	267	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	Hydraulic Cylinder Parker		4CBB-2HKPSV24AC19	Parker	4CBB-2HKPSV24AC19			1347-G1-1000	2
G1	268	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	Female Rod Clevis Parker		50948	Parker	50948			1347-G1-1000	2
G1	269	4481-MQLK-0001	Cathode sealing equipment	Positioning gantry for block and bars, including cathode bar alignment station	Pin Parker		68373	Parker	68373			1347-G1-1000	2
H1	270	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	Local Disconnect Switch Box		IM 63 III (IP65) 1347-51151 rev 1	CEFEM	IM 63 III (IP65) 1347-51151 rev 1			1347-H1-1000	2
H1	271	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	Junction Box Flex I/O - 4481 - MPFO-0001-CP-01		1347-51050	ENVITECH AUTOMATION Inc.	1347-51050			1347-H1-1000	1
H1	272	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	H1 Local Control Station - 4481-MPFO-0001-LCS-01		1347-51207	ENVITECH AUTOMATION Inc.	1347-51207			1347-H1-1000	1
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	Water / oil cooler		SAE703-A4-FP	American Industrial	SAE703-A4-FP			1347-H1-1000	1
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	Brass ball valve 3/4" npt		XV500P12	Parker	XV500P12			1347-H1-1000	2
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	Y-strainer 3/4" npt		310-3004	American Industrial	310-3004			1347-H1-1000	2
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	Thermostatic valve 3/4" npt c/w Bulb 310-2001		310-1008	American Industrial	310-1008			1347-H1-1000	1
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	Return filter 10mic. 25 psid		D1LP-1-10Q-VMEME35Y9Y9-1	Parker	D1LP-1-10Q-VMEME35Y9Y9-1			1347-H1-1000	1
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	Limit switches		XCKJ10511H7	TELEMECANIQUE	XCKJ10511H7			1347-H1-1000	10
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	2/2 solenoid valve N.O.		DSH101NRMVD024LDR	Parker	DSH101NRMVD024LDR			1347-H1-1000	1
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	Duplex return filter 10mic		30PD110QHVE2KS1621	Parker	30PD110QHVE2KS1621			1347-H1-1000	1
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	Relief valve		RAH101SV30	Parker	RAH101SV30			1347-H1-1000	2
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	Cable		889D-F4AC-5	ALLEN BRADLEY	889D-F4AC-5			1347-H1-1000	5
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	Dual PNP programmable temperature switch		837E-DA1BN1A1D4	ALLEN BRADLEY	837E-DA1BN1A1D4			1347-H1-1000	2
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	4-1/2" gauge Kpa/Psi 1/2" npt connection		454279SSL04LXGW	DRESSER-ASCHROFT	454279SSL04LXGW			1347-H1-1000	1
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	Partrol needle valve		PN620SV	Parker	PN620SV			1347-H1-1000	5

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H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	Cartridge check valve		CVH103PV	Parker	CVH103PV			1347-H1-1000	3
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	11kW(15hp) 1800rpm,460/3/60, TEFC, 160M metric frame		MA01540416MCLH	WEG	MA01540416MCLH			1347-H1-1000	2
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	Bellhousing		M180ML722B	MAGNALOY	M180ML722B			1347-H1-1000	2
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	Coupling insert		M470N6	MAGNALOY	M470N6			1347-H1-1000	2
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	Half coupling metric bore		M40002806	MAGNALOY	M40002806			1347-H1-1000	2
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	Half coupling metric bore		M400M4212	MAGNALOY	M400M4212			1347-H1-1000	2
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	Vari. Pist. Pump 23cc/rev, 35lpm(9.2gpm)max @ 1800rpm		PVP23362R2V	Parker	PVP23362R2V			1347-H1-1000	2
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	changeover valve assy.		926758	Parker	926758			1347-H1-1000	2
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	Return filter		F3CF2174PE3-F9Y91	Parker	F3CF2174PE3-F9Y91			1347-H1-1000	4
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	1"FLANGE SS BODY c/w SS STEM		1"7150-313636TTT2	METSO-JAMESBURY	1"7150-313636TTT2			1347-H1-1000	1
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	Kleenvent, 10gal., viton xx fiberglass		KV10FOT-28-A2	Parker	KV10FOT-28-A2			1347-H1-1000	1
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	CLS POINTEK LEVEL SWITCH		75ML56300AD000HA0-Zy01=450mm	SIEMENS	75ML56300AD000HA0-Zy01=450mm			1347-H1-1000	1
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	CLS POINTEK LEVEL SWITCH		75ML56300AD000HA0-Zy01=255mm	SIEMENS	75ML56300AD000HA0-Zy01=255mm			1347-H1-1000	1
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	CLS POINTEK LEVEL SWITCH		75ML56300AD000HA0-Zy01=100mm	SIEMENS	75ML56300AD000HA0-Zy01=100mm			1347-H1-1000	1
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	Magnet		SL-11	VESCOR	SL-11			1347-H1-1000	1
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	Breather pressurisable, 5psi, 3/4"npt, 10mic.		PAB.1730.10.5	Parker	PAB.1730.10.5			1347-H1-1000	1
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	4" ss well 1/2"npt inside 3/4"npt outside		TW01-A12-L04	Parker	TW01-A12-L04			1347-H1-1000	1
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	5" thermometer w/ tilt head		50-EL42E-040-XCS	DRESSER-ASCHCROFT	50-EL42E-040-XCS			1347-H1-1000	1
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	Sight glass		BM26A	KROHNE	BM26A			1347-H1-1000	1
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	PROGRAMMABLE DUAL PNP PRESSURE SWITCH 6000psi		836E-DA1EU1D4	ALLEN BRADLEY	836E-DA1EU1D4			1347-H1-1000	1
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	1.5" FLANGE SS BODY c/w SS STEM FULL PORT		1.5"9150313636TTT2	METSO-JAMESBURY	1.5"9150313636TTT2			1347-H1-1000	2
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	400L (105gal.) RESERVOIR OVERHEAD TYPE		Custom	Pneutech-Rousseau	Custom			1347-H1-1000	1
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	CONTROL CABINET 4481-MPF0-0001-CP-01		1347-51050	GNA	1347-51050			1347-H1-1000	1
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	FILLING COUPLER		6610-12-10	PARKER	6610-12-10			1347-H1-1000	1
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	DUST COVER		6657-12M	PARKER	6657-12M			1347-H1-1000	1
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	CHECK VALVE		C1620S65V	PARKER	C1620S65V			1347-H1-1000	1
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	TEST COUPLER		EMA3/7/16-20UNF2A	PARKER	EMA3/7/16-20UNF2A			1347-H1-1000	2
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	FLEXMASTER		NH1600V125B0325	AEROQUIP	NH1600V125B0325			1347-H1-1000	2
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	CHECK VALVE MODIFIED		C620SV*	PARKER	C620SV*			1347-H1-1000	2
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	PROGRAMMABLE DUAL PNP PRESSURE SWITCH 15psi		836E-DA1CC1D4	ALLEN BRADLEY	836E-DA1CC1D4			1347-H1-1000	2
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	PRESSURE TRANSMITTER		3051T-G4A2B21A	ROSEMOUNT	3051T-G4A2B21A			1347-H1-1000	1
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	3WAY BALL VALVE		BV3D16S1SS1VA	PARKER	BV3D16S1SS1VA			1347-H1-1000	1
H1	273	4481-MPF0-0001	Cathode sealing equipment	Hydraulic Power Unit	CHECK VALVE		CV	PARKER	CV			1347-H1-1000	2
P1	274	4481-MZAC-0001	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Proximity Switch		XS7C40MP230TT	Télémécanique	XS7C40MP230TT			1347-P1-1000	4
P1	275	4481-MZAC-0001	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Hydraulic Cylinder		2.5SB-2HKPSV19A1	Parker	2.5SB-2HKPSV19A1			1347-P1-1000	1
P1	276	4481-MZAC-0001	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Clevis Bracket		83948	Parker	83948			1347-P1-1000	1
P1	277	4481-MZAC-0001	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Pin Parker		83963	Parker	83963			1347-P1-1000	2
P1	278	4481-MZAC-0001	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Rod Eye		132291	Parker	132291			1347-P1-1000	1
P1	279	4481-MZAC-0001	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Hydraulic Cylinder		4HH-2HKPSV38A1.75	Parker	4HH-2HKPSV38A1.75			1347-P1-1000	2
P1	280	4481-MZAC-0001	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Pneumatic Cylinder		12CSB-2AUV47AC10	Parker	12CSB-2AUV47AC10			1347-P1-1000	1
P1	281	4481-MZAC-0001	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Clevis Bracket		85951	Parker	85951			1347-P1-1000	3
P1	282	4481-MZAC-0001	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Pivot Pin		83966	Parker	83966			1347-P1-1000	4
P1	283	4481-MZAC-0001	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Rod Eye		132294	Parker	132294			1347-P1-1000	2
P1	284	4481-MZAC-0001	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Filter Regulator Lubrificator (FRL)		P32QA93SEANGLND	Parker	P32QA93SEANGLND			1347-P1-1000	1
P1	285	4481-MZAC-0001	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Directionnal Valve		H22VXBG0B9C	Parker	H22VXBG0B9C			1347-P1-1000	1
P1	286	4481-MZAC-0001	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Base		PS411117CCP	Parker	PS411117CCP			1347-P1-1000	1
P1	287	4481-MZAC-0001	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Flow Control Valve		F600B	Parker	F600B			1347-P1-1000	4
P1	288	4481-MZAC-0001	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Muffler		P48	Parker	P48			1347-P1-1000	3
P1	289	4481-MZAC-0001	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Check valve		C600B	Parker	C600B			1347-P1-1000	1
P1	290	4481-MZAC-0001	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Check valve		C1200B	Parker	C1200B			1347-P1-1000	1
P1	291	4481-MZAC-0001	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Gauge		P1S423 4.5in	Parker	P1S423 4.5in			1347-P1-1000	1
P1	292	4481-MZAC-0002	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Proximity Switch		XS7C40MP230TT	Télémécanique	XS7C40MP230TT			1347-P1-1000	4
P1	293	4481-MZAC-0002	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Hydraulic Cylinder		2.5SB-2HKPSV19A1	Parker	2.5SB-2HKPSV19A1			1347-P1-1000	1
P1	294	4481-MZAC-0002	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Clevis Bracket		83948	Parker	83948			1347-P1-1000	1
P1	295	4481-MZAC-0002	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Pin Parker		83963	Parker	83963			1347-P1-1000	2
P1	296	4481-MZAC-0002	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Rod Eye		132291	Parker	132291			1347-P1-1000	1
P1	297	4481-MZAC-0002	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Hydraulic Cylinder		4HH-2HKPSV38A1.75	Parker	4HH-2HKPSV38A1.75			1347-P1-1000	2

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P1	298	4481-MZAC-0002	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Pneumatic Cylinder		12CSB-2AUV47AC10	Parker	12CSB-2AUV47AC10			1347-P1-1000	1
P1	299	4481-MZAC-0002	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Clevis Bracket		85951	Parker	85951			1347-P1-1000	3
P1	300	4481-MZAC-0002	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Pivot Pin		83966	Parker	83966			1347-P1-1000	4
P1	301	4481-MZAC-0002	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Rod Eye		132294	Parker	132294			1347-P1-1000	2
P1	302	4481-MZAC-0002	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Filter Regulator Lubrificator (FRL)		P32QA93SEANGLND	Parker	P32QA93SEANGLND			1347-P1-1000	1
P1	303	4481-MZAC-0002	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Directionnal Valve		H22VXBG0B9C	Parker	H22VXBG0B9C			1347-P1-1000	1
P1	304	4481-MZAC-0002	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Base		PS411117CCP	Parker	PS411117CCP			1347-P1-1000	1
P1	305	4481-MZAC-0002	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Flow Control Valve		F600B	Parker	F600B			1347-P1-1000	4
P1	306	4481-MZAC-0002	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Muffler		P48	Parker	P48			1347-P1-1000	3
P1	307	4481-MZAC-0002	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Check valve		C600B	Parker	C600B			1347-P1-1000	1
P1	308	4481-MZAC-0002	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Check valve		C1200B	Parker	C1200B			1347-P1-1000	1
P1	309	4481-MZAC-0002	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Gauge		P1S423 4.5in	Parker	P1S423 4.5in			1347-P1-1000	1
R1	310	4481-MJR0-0005	Cathode sealing equipment	Roller conveyor at block oven exit	Rollers		1347-R2-1010	INNOVA	1347-R2-1010			1347-R1-1000	5
R1	311	4481-MJR0-0005	Cathode sealing equipment	Roller conveyor at block oven exit	Bearing Fixed		SNL22513/60TLH	SKF of Canada ltd	SNL22513/60TLH			1347-R1-1000	5
R1	312	4481-MJR0-0005	Cathode sealing equipment	Roller conveyor at block oven exit	Bearing Free		SNL22513/60TLY	SKF of Canada ltd	SNL22513/60TLY			1347-R1-1000	5
R1	313	4481-MJR0-0005	Cathode sealing equipment	Roller conveyor at block oven exit	Helical Bevel Gear Brake Motor		K47 DRE80M4BE1HF/DH	SEW-Eurodrive	K47 DRE80M4BE1HF/DH			1347-R1-1000	1
R1	314	4481-MJR0-0005	Cathode sealing equipment	Roller conveyor at block oven exit	Chain 80 (119083)		80A1 Pitch 1in #119083 (ft)	RENOLD	80A1 Pitch 1in #119083 (ft)			1347-R1-1000	40
R1	315	4481-MJR0-0005	Cathode sealing equipment	Roller conveyor at block oven exit	Link 80		link80-1	RENOLD	link80-1			1347-R1-1000	10
R1	316	4481-MJR0-0005	Cathode sealing equipment	Roller conveyor at block oven exit	Sprocket Bore 60		80B18	Martin	80B18			1347-R1-1000	2
R1	317	4481-MJR0-0005	Cathode sealing equipment	Roller conveyor at block oven exit	Sprocket Bore 60		80B28	Martin	80B28			1347-R1-1000	1
R1	318	4481-MJR0-0005	Cathode sealing equipment	Roller conveyor at block oven exit	Sprocket Bore 60		DS80A18	Martin	DS80A18			1347-R1-1000	3
R1	319	4481-MJR0-0005	Cathode sealing equipment	Roller conveyor at block oven exit	Sprocket Bore 30		80B13	Martin	80B13			1347-R1-1000	1
R1	320	4481-MJR0-0005	Cathode sealing equipment	Roller conveyor at block oven exit	Idler Bore 19 (3/4in)		80BB12H	Martin	80BB12H			1347-R1-1000	7
R1	321	4481-MJR0-0005	Cathode sealing equipment	Roller conveyor at block oven exit	Local Disconnect Switch Box		IM 63 III (IP65) 1347-51151 rev 1	CEFEM	IM 63 III (IP65) 1347-51151 rev 1			1347-R1-1000	1
R1	322	4481-MJR0-0005	Cathode sealing equipment	Roller conveyor at block oven exit	Limit Switch		ZCKJ2H7	Télémécanique	ZCKJ2H7			1347-R1-1000	1
R1	323	4481-MJR0-0005	Cathode sealing equipment	Roller conveyor at block oven exit	Limit Switch Head		ZCKE055	Télémécanique	ZCKE055			1347-R1-1000	1
R1	324	4481-MJR0-0005	Cathode sealing equipment	Roller conveyor at block oven exit	Lever 4		ZCKY43 or ZCKY53	Télémécanique	ZCKY43 or ZCKY53			1347-R1-1000	1
R1	325	4481-MJR0-0005	Cathode sealing equipment	Roller conveyor at block oven exit	Proximity Switch		XS7C40MP230TT	Télémécanique	XS7C40MP230TT			1347-R1-1000	2
R1	326	4481-MJR0-0005	Cathode sealing equipment	Roller conveyor at block oven exit	Hydraulic Cylinder Extension		2.5CD-2HKPSV33AC7.88	Parker	2.5CD-2HKPSV33AC7.88			1347-R1-1000	2
R1	327	4481-MJR0-0005	Cathode sealing equipment	Roller conveyor at block oven exit	Eye Bracket		85361	Parker	85361			1347-R1-1000	2
R1	328	4481-MJR0-0005	Cathode sealing equipment	Roller conveyor at block oven exit	Rod End Clevis parker		50944	Parker	50944			1347-R1-1000	2
R1	329	4481-MJR0-0005	Cathode sealing equipment	Roller conveyor at block oven exit	Parker Pivot Pin		68370	Parker	68370			1347-R1-1000	2
R1	330	4481-MJR0-0005	Cathode sealing equipment	Roller conveyor at block oven exit	Eye Bracket		69198	Parker	69198			1347-R1-1000	2
R1	331	4481-MJR0-0005	Cathode sealing equipment	Roller conveyor at block oven exit	Clevis Bracket		69208	Parker	69208			1347-R1-1000	2
R1	332	4481-MJR0-0005	Cathode sealing equipment	Roller conveyor at block oven exit	Pivot Pin Parker		68371	Parker	68371			1347-R1-1000	2
R2	333	4481-MJR0-0007	Cathode sealing equipment	Roller conveyor for block and bar assembly	Rollers		1347-R2-1010	INNOVA	1347-R2-1010			1347-R2-1000	6
R2	334	4481-MJR0-0007	Cathode sealing equipment	Roller conveyor for block and bar assembly	Bearing Fixed		SNL22513/60TLH	SKF of Canada ltd	SNL22513/60TLH			1347-R2-1000	6
R2	335	4481-MJR0-0007	Cathode sealing equipment	Roller conveyor for block and bar assembly	Bearing Free		SNL22513/60TLY	SKF of Canada ltd	SNL22513/60TLY			1347-R2-1000	6
R2	336	4481-MJR0-0007	Cathode sealing equipment	Roller conveyor for block and bar assembly	Helical Bevel Gear Brake Motor		K57 DRE90M4/DH	SEW-Eurodrive	K57 DRE90M4/DH			1347-R2-1000	1
R2	337	4481-MJR0-0007	Cathode sealing equipment	Roller conveyor for block and bar assembly	Chain 80 (119083)		80A1 Pitch 1in #119083 (ft)	RENOLD	80A1 Pitch 1in #119083 (ft)			1347-R2-1000	50
R2	338	4481-MJR0-0007	Cathode sealing equipment	Roller conveyor for block and bar assembly	Link 80-1		link80-1	RENOLD	link80-1			1347-R2-1000	10
R2	339	4481-MJR0-0007	Cathode sealing equipment	Roller conveyor for block and bar assembly	Sprocket Bore 60		80B28	Martin	80B28			1347-R2-1000	1
R2	340	4481-MJR0-0007	Cathode sealing equipment	Roller conveyor for block and bar assembly	Sprocket Bore 60		DS80A18	Martin	DS80A18			1347-R2-1000	4
R2	341	4481-MJR0-0007	Cathode sealing equipment	Roller conveyor for block and bar assembly	Sprocket Bore 60		80B18	Martin	80B18			1347-R2-1000	2
R2	342	4481-MJR0-0007	Cathode sealing equipment	Roller conveyor for block and bar assembly	Sprocket Bore 35		80B13	Martin	80B13			1347-R2-1000	1
R2	343	4481-MJR0-0007	Cathode sealing equipment	Roller conveyor for block and bar assembly	Idler Bore 19 (3/4in)		80BB12H	Martin	80BB12H			1347-R2-1000	5
R2	344	4481-MJR0-0007	Cathode sealing equipment	Roller conveyor for block and bar assembly	Local Disconnect Switch Box		IM 63 III (IP65) 1347-51151 rev 1	CEFEM	IM 63 III (IP65) 1347-51151 rev 1			1347-R2-1000	1
R2	345	4481-MJR0-0007	Cathode sealing equipment	Roller conveyor for block and bar assembly	Proximity Switch		XS7C40MP230TT	Télémécanique	XS7C40MP230TT			1347-R2-1000	3
R2	346	4481-MJR0-0007	Cathode sealing equipment	Roller conveyor for block and bar assembly	Ampli Photoelectrique 24VDC		S142BRNN-924	Carlo Gavazzi	S142BRNN-924			1347-R2-1000	1
R2	347	4481-MJR0-0007	Cathode sealing equipment	Roller conveyor for block and bar assembly	Transmitter		MOFT20-M12-8	Carlo Gavazzi	MOFT20-M12-8			1347-R2-1000	1
R2	348	4481-MJR0-0007	Cathode sealing equipment	Roller conveyor for block and bar assembly	Receiver		MOFR-M12-8	Carlo Gavazzi	MOFR-M12-8			1347-R2-1000	1
R2	349	4481-MJR0-0007	Cathode sealing equipment	Roller conveyor for block and bar assembly	Optic Fibre		OFMS1-10 (1m)	Carlo Gavazzi	OFMS1-10 (1m)			1347-R2-1000	1
R2	350	4481-MJR0-0007	Cathode sealing equipment	Roller conveyor for block and bar assembly	Base		ZPD11 (11 pins)	Carlo Gavazzi	ZPD11 (11 pins)			1347-R2-1000	1
R2	351	4481-MJR0-0007	Cathode sealing equipment	Roller conveyor for block and bar assembly	R2-Jonction Box - 4481-MJRO-0007-JB-01		1347-51280	ENVITECH AUTOMATION Inc.	1347-51280			1347-R2-1000	1
R2	352	4481-MJR0-0007	Cathode sealing equipment	Roller conveyor for block and bar assembly	Hydraulic Cylinder Extension		2CBB-2HKPSV14AC8.73	Parker	2CBB-2HKPSV14AC8.73			1347-R2-1000	1
R2	353	4481-MJR0-0007	Cathode sealing equipment	Roller conveyor for block and bar assembly	Eye Bracket Parker		69196	Parker	69196			1347-R2-1000	1
R2	354	4481-MJR0-0007	Cathode sealing equipment	Roller conveyor for block and bar assembly	Rod Clevis parker		50942	Parker	50942			1347-R2-1000	5

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R2	355	4481-MJR0-0007	Cathode sealing equipment	Roller conveyor for block and bar assembly	Parker Pin		68369	Parker	68369			1347-R2-1000	6
R2	356	4481-MJR0-0007	Cathode sealing equipment	Roller conveyor for block and bar assembly	Hydraulic Cylinder Parker		2CSD-2HKPSV19AC7	Parker	2CSD-2HKPSV19AC7			1347-R2-1000	2
R2	357	4481-MJR0-0007	Cathode sealing equipment	Roller conveyor for block and bar assembly	Eye Bracket Parker		83948	Parker	83948			1347-R2-1000	4
R2	358	4481-MJR0-0007	Cathode sealing equipment	Roller conveyor for block and bar assembly	Spherical Rod Eye		132291	Parker	132291			1347-R2-1000	2
R2	359	4481-MJR0-0007	Cathode sealing equipment	Roller conveyor for block and bar assembly	Pin Parker		83963	Parker	83963			1347-R2-1000	4
R3	360	4481-MJR0-0006	Cathode sealing equipment	Roller conveyor after sealing station	Rollers		1347-R2-1010	INNOVA	1347-R2-1010			1347-R3-1000	5
R3	361	4481-MJR0-0006	Cathode sealing equipment	Roller conveyor after sealing station	Bearing Fixed		SNL22513/60TLH	SKF of Canada ltd	SNL22513/60TLH			1347-R3-1000	5
R3	362	4481-MJR0-0006	Cathode sealing equipment	Roller conveyor after sealing station	Bearing Free		SNL22513/60TLY	SKF of Canada ltd	SNL22513/60TLY			1347-R3-1000	5
R3	363	4481-MJR0-0006	Cathode sealing equipment	Roller conveyor after sealing station	Helical Bevel Gear Brake Motor		K57 DRE90M4/DH	SEW-Eurodrive	K57 DRE90M4/DH			1347-R3-1000	1
R3	364	4481-MJR0-0006	Cathode sealing equipment	Roller conveyor after sealing station	Chain 80 (119083)		80A1 Pitch 1in #119083 (ft)	RENOLD	80A1 Pitch 1in #119083 (ft)			1347-R3-1000	40
R3	365	4481-MJR0-0006	Cathode sealing equipment	Roller conveyor after sealing station	Link 80		link80-1	RENOLD	link80-1			1347-R3-1000	5
R3	366	4481-MJR0-0006	Cathode sealing equipment	Roller conveyor after sealing station	Sprocket Bore 60		DS80A18	Martin	DS80A18			1347-R3-1000	3
R3	367	4481-MJR0-0006	Cathode sealing equipment	Roller conveyor after sealing station	Sprocket Bore 60		80B28	Martin	80B28			1347-R3-1000	1
R3	368	4481-MJR0-0006	Cathode sealing equipment	Roller conveyor after sealing station	Sprocket Bore 60		80B18	Martin	80B18			1347-R3-1000	2
R3	369	4481-MJR0-0006	Cathode sealing equipment	Roller conveyor after sealing station	Sporcket Bore 35		80B13	Martin	80B13			1347-R3-1000	1
R3	370	4481-MJR0-0006	Cathode sealing equipment	Roller conveyor after sealing station	Idler Bore 19 (3/4in)		80BB12H	Martin	80BB12H			1347-R3-1000	4
R3	371	4481-MJR0-0006	Cathode sealing equipment	Roller conveyor after sealing station	Local Disconnect Switch Box		IM 63 III (IP65) 1347-51151 rev 1	CEFEM	IM 63 III (IP65) 1347-51151 rev 1			1347-R3-1000	1
R3	372	4481-MJR0-0006	Cathode sealing equipment	Roller conveyor after sealing station	Limit Switch		ZCKJ2H7	Télémécanique	ZCKJ2H7			1347-R3-1000	1
R3	373	4481-MJR0-0006	Cathode sealing equipment	Roller conveyor after sealing station	Limit Switch Head		ZCKE055	Télémécanique	ZCKE055			1347-R3-1000	1
R3	374	4481-MJR0-0006	Cathode sealing equipment	Roller conveyor after sealing station	Lever 4		ZCKY43 or ZCKY53	Télémécanique	ZCKY43 or ZCKY53			1347-R3-1000	1
R4	375	4481-MZAC-0001	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Rollers		1347-R2-1010	INNOVA	1347-R2-1010			1347-R4-1000	8
R4	376	4481-MZAC-0001	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Bearing Fixed		SNL22513/60TLH	SKF of Canada ltd	SNL22513/60TLH			1347-R4-1000	8
R4	377	4481-MZAC-0001	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Bearing Free		SNL22513/60TLY	SKF of Canada ltd	SNL22513/60TLY			1347-R4-1000	8
R4	378	4481-MZAC-0001	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Helical Bevel Gear Motor		K57 DRE90M4/DH	SEW-Eurodrive	K57 DRE90M4/DH			1347-R4-1000	1
R4	379	4481-MZAC-0001	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Chain 80 (119083)		80A1 Pitch 1in #119083 (ft)	RENOLD	80A1 Pitch 1in #119083 (ft)			1347-R4-1000	60
R4	380	4481-MZAC-0001	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Offset link 80		link80-1	RENOLD	link80-1			1347-R4-1000	10
R4	381	4481-MZAC-0001	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Sprocket Bore 35		80B13	Martin	80B13			1347-R4-1000	1
R4	382	4481-MZAC-0001	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Sprocket Bore 60		80B18	Martin	80B18			1347-R4-1000	2
R4	383	4481-MZAC-0001	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Sprocket Bore 60		80B28	Martin	80B28			1347-R4-1000	1
R4	384	4481-MZAC-0001	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Sprocket Bore 60		DS80A18	Martin	DS80A18			1347-R4-1000	6
R4	385	4481-MZAC-0001	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Idler Bore 19 (3/4in)		80BB12H	Martin	80BB12H			1347-R4-1000	7
R4	386	4481-MZAC-0001	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Local Disconnect Switch Box		IM 63 III (IP65) 1347-51151 rev 1	CEFEM	IM 63 III (IP65) 1347-51151 rev 1			1347-R4-1000	1
R4	387	4481-MZAC-0001	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Limit Switch		ZCKJ2H7	Télémécanique	ZCKJ2H7			1347-R4-1000	2
R4	388	4481-MZAC-0001	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Limit Switch Head		ZCKE055	Télémécanique	ZCKE055			1347-R4-1000	2
R4	389	4481-MZAC-0001	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Lever 4		ZCKY43 or ZCKY53	Télémécanique	ZCKY43 or ZCKY53			1347-R4-1000	2
R4	390	4481-MZAC-0001	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Proximity Switch		XS7C40MP230TT	Télémécanique	XS7C40MP230TT			1347-R4-1000	5
R4	391	4481-MZAC-0001	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Pneumatic Cylinder		2.5CBB-2AUV34AC3	Parker	2.5CBB-2AUV34AC3			1347-R4-1000	1
R4	392	4481-MZAC-0001	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Clevis Bracket		69208	Parker	69208			1347-R4-1000	2
R4	393	4481-MZAC-0001	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Pivot Pin		68371	Parker	68371			1347-R4-1000	2
R4	394	4481-MZAC-0001	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Eye Bracket		69195	Parker	69195			1347-R4-1000	1
R4	395	4481-MZAC-0001	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Female Rod Clevis		50942	Parker	50942			1347-R4-1000	1
R4	396	4481-MZAC-0001	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Eye Bracket		69196	Parker	69196			1347-R4-1000	1
R4	397	4481-MZAC-0001	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Pivot Pin		68369	Parker	68369			1347-R4-1000	1
R4	398	4481-MZAC-0002	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Rollers		1347-R2-1010	INNOVA	1347-R2-1010			1347-R4-1000	8
R4	399	4481-MZAC-0002	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Bearing Fixed		SNL22513/60TLH	SKF of Canada ltd	SNL22513/60TLH			1347-R4-1000	8
R4	400	4481-MZAC-0002	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Bearing Free		SNL22513/60TLY	SKF of Canada ltd	SNL22513/60TLY			1347-R4-1000	8
R4	401	4481-MZAC-0002	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Helical Bevel Gear Motor		K57 DRE90M4/DH	SEW-Eurodrive	K57 DRE90M4/DH			1347-R4-1000	1
R4	402	4481-MZAC-0002	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Chain 80 (119083)		80A1 Pitch 1in #119083 (ft)	RENOLD	80A1 Pitch 1in #119083 (ft)			1347-R4-1000	60
R4	403	4481-MZAC-0002	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Offset link 80		link80-1	RENOLD	link80-1			1347-R4-1000	10
R4	404	4481-MZAC-0002	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Sprocket Bore 35		80B13	Martin	80B13			1347-R4-1000	1
R4	405	4481-MZAC-0002	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Sprocket Bore 60		80B18	Martin	80B18			1347-R4-1000	2
R4	406	4481-MZAC-0002	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Sprocket Bore 60		80B28	Martin	80B28			1347-R4-1000	1
R4	407	4481-MZAC-0002	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Sprocket Bore 60		DS80A18	Martin	DS80A18			1347-R4-1000	6
R4	408	4481-MZAC-0002	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Idler Bore 19 (3/4in)		80BB12H	Martin	80BB12H			1347-R4-1000	7
R4	409	4481-MZAC-0002	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Local Disconnect Switch Box		IM 63 III (IP65) 1347-51151 rev 1	CEFEM	IM 63 III (IP65) 1347-51151 rev 1			1347-R4-1000	1
R4	410	4481-MZAC-0002	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Limit Switch		ZCKJ2H7	Télémécanique	ZCKJ2H7			1347-R4-1000	2
R4	411	4481-MZAC-0002	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Limit Switch Head		ZCKE055	Télémécanique	ZCKE055			1347-R4-1000	2

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R4	412	4481-MZAC-0002	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Lever 4		ZCKY43 or ZCKY53	Télémécanique	ZCKY43 or ZCKY53			1347-R4-1000	2
R4	413	4481-MZAC-0002	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Proximity Switch		XS7C40MP230TT	Télémécanique	XS7C40MP230TT			1347-R4-1000	5
R4	414	4481-MZAC-0002	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Pneumatic Cylinder		2.5CBB-2AUV34AC3	Parker	2.5CBB-2AUV34AC3			1347-R4-1000	1
R4	415	4481-MZAC-0002	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Clevis Bracket		69208	Parker	69208			1347-R4-1000	2
R4	416	4481-MZAC-0002	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Pivot Pin		68371	Parker	68371			1347-R4-1000	2
R4	417	4481-MZAC-0002	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Eye Bracket		69195	Parker	69195			1347-R4-1000	1
R4	418	4481-MZAC-0002	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Female Rod Clevis		50942	Parker	50942			1347-R4-1000	1
R4	419	4481-MZAC-0002	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Eye Bracket		69196	Parker	69196			1347-R4-1000	1
R4	420	4481-MZAC-0002	Cathode sealing equipment	Prestressing and sealing station c/w conveyor and platforms	Pivot Pin		68369	Parker	68369			1347-R4-1000	1
R5	421	4481-MJR0-0008	Cathode sealing equipment	Roller conveyor at cooling and turning station	Rollers		1347-R2-1010	INNOVA	1347-R2-1010			1347-R5-1000	4
R5	422	4481-MJR0-0008	Cathode sealing equipment	Roller conveyor at cooling and turning station	Local Disconnect Switch Box		IM 63 III (IP65) 1347-51151 rev 1	CEFEM	IM 63 III (IP65) 1347-51151 rev 1			1347-R5-1000	1
R5	423	4481-MJR0-0008	Cathode sealing equipment	Roller conveyor at cooling and turning station	Proximity Switch		XS7C40MP230TT	Télémécanique	XS7C40MP230TT			1347-R5-1000	1
R5	424	4481-MJR0-0008	Cathode sealing equipment	Roller conveyor at cooling and turning station	Limit Switch		ZCKJ2H7	Télémécanique	ZCKJ2H7			1347-R5-1000	2
R5	425	4481-MJR0-0008	Cathode sealing equipment	Roller conveyor at cooling and turning station	Limit Switch Head		ZCKE055	Télémécanique	ZCKE055			1347-R5-1000	2
R5	426	4481-MJR0-0008	Cathode sealing equipment	Roller conveyor at cooling and turning station	Lever 4		ZCKY43 or ZCKY53	Télémécanique	ZCKY43 or ZCKY53			1347-R5-1000	2
R5	427	4481-MJR0-0008	Cathode sealing equipment	Roller conveyor at cooling and turning station	Bearing Fixed		SNL22513/60TLH	SKF of Canada ltd	SNL22513/60TLH			1347-R5-1000	4
R5	428	4481-MJR0-0008	Cathode sealing equipment	Roller conveyor at cooling and turning station	Bearing Free		SNL22513/60TLY	SKF of Canada ltd	SNL22513/60TLY			1347-R5-1000	4
R5	429	4481-MJR0-0008	Cathode sealing equipment	Roller conveyor at cooling and turning station	Helical Bevel Gear Brake Motor		K57 DRE90M4BE2HF/DH	SEW-Eurodrive	K57 DRE90M4BE2HF/DH			1347-R5-1000	1
R5	430	4481-MJR0-0008	Cathode sealing equipment	Roller conveyor at cooling and turning station	Chain (119083)		80A1 Pitch 1in #119083 (ft)	RENOLD	80A1 Pitch 1in #119083 (ft)			1347-R5-1000	40
R5	431	4481-MJR0-0008	Cathode sealing equipment	Roller conveyor at cooling and turning station	Link 80		link80-1	RENOLD	link80-1			1347-R5-1000	10
R5	432	4481-MJR0-0008	Cathode sealing equipment	Roller conveyor at cooling and turning station	Sprocket Bore 60		80B28	Martin	80B28			1347-R5-1000	1
R5	433	4481-MJR0-0008	Cathode sealing equipment	Roller conveyor at cooling and turning station	Sprocket Bore 60		DS80A18	Martin	DS80A18			1347-R5-1000	2
R5	434	4481-MJR0-0008	Cathode sealing equipment	Roller conveyor at cooling and turning station	Sprocket Bore 60		80B18	Martin	80B18			1347-R5-1000	2
R5	435	4481-MJR0-0008	Cathode sealing equipment	Roller conveyor at cooling and turning station	Sprocket Bore 35		80B13	Martin	80B13			1347-R5-1000	1
R5	436	4481-MJR0-0008	Cathode sealing equipment	Roller conveyor at cooling and turning station	Idler Bore 19 (3/4in)		80BB12H	Martin	80BB12H			1347-R5-1000	3
R5	437	4481-MJR0-0008	Cathode sealing equipment	Roller conveyor at cooling and turning station	Hydraulic Cylinder Parker		2.5CJB-2HKPSV34AC11	Parker	2.5CJB-2HKPSV34AC11			1347-R5-1000	1
R6	438	4481-MJR0-0004	Cathode sealing equipment	Roller conveyor at bar furnace exit	Rollers		1347-R6-1010	April Machiniste Enr.	1347-R6-1010			1347-R6-1010	8
R6	439	4481-MJR0-0004	Cathode sealing equipment	Roller conveyor at bar furnace exit	Bearing Fixed		SNL22509/40TLH	SKF of Canada ltd	SNL22509/40TLH			1347-R6-1000	8
R6	440	4481-MJR0-0004	Cathode sealing equipment	Roller conveyor at bar furnace exit	Bearing Free		SNL22509/40TLY	SKF of Canada ltd	SNL22509/40TLY			1347-R6-990	8
R6	441	4481-MJR0-0004	Cathode sealing equipment	Roller conveyor at bar furnace exit	Bearing Fixed		SNL22508/35TLHY	SKF of Canada ltd	SNL22508/35TLHY			1347-R6-980	2
R6	442	4481-MJR0-0004	Cathode sealing equipment	Roller conveyor at bar furnace exit	Bearing Free		SNL22508/35TLY	SKF of Canada ltd	SNL22508/35TLY			1347-R6-970	2
R6	443	4481-MJR0-0004	Cathode sealing equipment	Roller conveyor at bar furnace exit	Helical Bevel Gear Motor		K47 DRE80M4/DH	SEW-Eurodrive	K47 DRE80M4/DH			1347-R6-960	1
R6	444	4481-MJR0-0004	Cathode sealing equipment	Roller conveyor at bar furnace exit	Chain 80 (119083)		80A1 Pitch 1in #119083 (ft)	RENOLD	80A1 Pitch 1in #119083 (ft)			1347-R6-950	50
R6	445	4481-MJR0-0004	Cathode sealing equipment	Roller conveyor at bar furnace exit	Link 80		link80-1	RENOLD	link80-1			1347-R6-940	10
R6	446	4481-MJR0-0004	Cathode sealing equipment	Roller conveyor at bar furnace exit	Sprocket Bore 40		80B35	Martin	80B35			1347-R6-930	1
R6	447	4481-MJR0-0004	Cathode sealing equipment	Roller conveyor at bar furnace exit	Sprocket Bore 30		80B13	Martin	80B13			1347-R6-920	1
R6	448	4481-MJR0-0004	Cathode sealing equipment	Roller conveyor at bar furnace exit	Sprocket Bore 40		80B18	Martin	80B18			1347-R6-910	14
R6	449	4481-MJR0-0004	Cathode sealing equipment	Roller conveyor at bar furnace exit	Idler Bore 19 (3/4in)		80BB12H	Martin	80BB12H			1347-R6-900	10
R6	450	4481-MJR0-0004	Cathode sealing equipment	Roller conveyor at bar furnace exit	Local Disconnect Switch Box		IM 63 III (IP65) 1347-51151 rev 1	CEFEM	IM 63 III (IP65) 1347-51151 rev 1			1347-R6-890	1
R6	451	4481-MJR0-0004	Cathode sealing equipment	Roller conveyor at bar furnace exit	Ampli Photoelectrique 24VDC		S142BRNN-924	Carlo Gavazzi	S142BRNN-924			1347-R6-880	1
R6	452	4481-MJR0-0004	Cathode sealing equipment	Roller conveyor at bar furnace exit	Transmitter		MOFT20-M12-8	Carlo Gavazzi	MOFT20-M12-8			1347-R6-870	1
R6	453	4481-MJR0-0004	Cathode sealing equipment	Roller conveyor at bar furnace exit	Receiver		MOFR-M12-8	Carlo Gavazzi	MOFR-M12-8			1347-R6-860	1
R6	454	4481-MJR0-0004	Cathode sealing equipment	Roller conveyor at bar furnace exit	Optic Fibre		OFMS1-10 (1m)	Carlo Gavazzi	OFMS1-10 (1m)			1347-R6-850	1
R6	455	4481-MJR0-0004	Cathode sealing equipment	Roller conveyor at bar furnace exit	Base		ZPD11 (11 pins)	Carlo Gavazzi	ZPD11 (11 pins)			1347-R6-840	1
R6	456	4481-MJR0-0004	Cathode sealing equipment	Roller conveyor at bar furnace exit	Proximity Switch		XS7C40MP230TT	Télémécanique	XS7C40MP230TT			1347-R6-830	3
R6	457	4481-MJR0-0004	Cathode sealing equipment	Roller conveyor at bar furnace exit	R6-Jonction Box - 4481-MJRO-0004-JB-01		1347-51290	ENVITECH AUTOMATION Inc.	1347-51290			1347-R6-820	1
R6	458	4481-MJR0-0004	Cathode sealing equipment	Roller conveyor at bar furnace exit	Pneumatic Cylinder Parker		6CSB-2AUV19AC4.625	Parker	6CSB-2AUV19AC4.625			1347-R6-810	1
R6	459	4481-MJR0-0004	Cathode sealing equipment	Roller conveyor at bar furnace exit	Spherical Rod Eye parker		132292	Parker	132292			1347-R6-800	1
R6	460	4481-MJR0-0004	Cathode sealing equipment	Roller conveyor at bar furnace exit	Clevis Bracket Parker		83949	Parker	83949			1347-R6-790	2
R6	461	4481-MJR0-0004	Cathode sealing equipment	Roller conveyor at bar furnace exit	Pin Parker		83964	Parker	83964			1347-R6-780	2
R6	462	4481-MJR0-0004	Cathode sealing equipment	Roller conveyor at bar furnace exit	Filter Regulator (FR)		P33QX96SEANGLND	Parker	P33QX96SEANGLND			1347-R6-770	1
R6	463	4481-MJR0-0004	Cathode sealing equipment	Roller conveyor at bar furnace exit	Filter Regulator Lubrificator (FRL)		P32QA93SEANGLND	Parker	P32QA93SEANGLND			1347-R6-760	1
R6	464	4481-MJR0-0004	Cathode sealing equipment	Roller conveyor at bar furnace exit	Directionnal Valve		H22VXBG0B9C	Parker	H22VXBG0B9C			1347-R6-750	1
R6	465	4481-MJR0-0004	Cathode sealing equipment	Roller conveyor at bar furnace exit	Base		PS411117CCP	Parker	PS411117CCP			1347-R6-740	1
R6	466	4481-MJR0-0004	Cathode sealing equipment	Roller conveyor at bar furnace exit	Flow Control Valve		F600B	Parker	F600B			1347-R6-730	2
R6	467	4481-MJR0-0004	Cathode sealing equipment	Roller conveyor at bar furnace exit	Muffler		P48	Parker	P48			1347-R6-720	2
R6	468	4481-MJR0-0004	Cathode sealing equipment	Roller conveyor at bar furnace exit	Check valve		C600B	Parker	C600B			1347-R6-710	1

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R6	469	4481-MJR0-0004	Cathode sealing equipment	Roller conveyor at bar furnace exit	Ball valve		XVVP500P-8 1/2NPT	Parker	XVVP500P-8 1/2NPT			1347-R6-700	1
R6	470	4481-MJR0-0004	Cathode sealing equipment	Roller conveyor at bar furnace exit	Ball Valve		XVVP500P-6 3/8NPT	Parker	XVVP500P-6 3/8NPT			1347-R6-690	3
R6	471	4481-MJR0-0004	Cathode sealing equipment	Roller conveyor at bar furnace exit	Ball Valve		XVVP500P-12 3/4NPT	Parker	XVVP500P-12 3/4NPT			1347-R6-680	1
R7	472	4481-MJR0-0003	Cathode sealing equipment	Roller conveyor at bar furnace entrance	Rollers		1347-R6-1010	April Machiniste Enr.	1347-R6-1010			1347-R7-1000	3
R7	473	4481-MJR0-0003	Cathode sealing equipment	Roller conveyor at bar furnace entrance	Bearing Free		SNL22509/40TLH	SKF of Canada ltd	SNL22509/40TLH			1347-R7-1000	7
R7	474	4481-MJR0-0003	Cathode sealing equipment	Roller conveyor at bar furnace entrance	Bearing Fixed		SNL22509/40TLY	SKF of Canada ltd	SNL22509/40TLY			1347-R7-1000	3
R7	475	4481-MJR0-0003	Cathode sealing equipment	Roller conveyor at bar furnace entrance	Bearing Fixed		SNL22509/40TLH	SKF of Canada ltd	SNL22509/40TLH			1347-R7-1000	4
R7	476	4481-MJR0-0003	Cathode sealing equipment	Roller conveyor at bar furnace entrance	Helical Bevel Gear Brake Motor		K47 DRE80M4BE05HF/DH	SEW-Eurodrive	K47 DRE80M4BE05HF/DH			1347-R7-1000	1
R7	477	4481-MJR0-0003	Cathode sealing equipment	Roller conveyor at bar furnace entrance	Chain 60 (119063)		119063 Chain 0.75in 60A1	RENOLD	119063 Chain 0.75in 60A1			1347-R7-1000	30
R7	478	4481-MJR0-0003	Cathode sealing equipment	Roller conveyor at bar furnace entrance	Link 60-1		link60-1	RENOLD	link60-1			1347-R7-1000	5
R7	479	4481-MJR0-0003	Cathode sealing equipment	Roller conveyor at bar furnace entrance	Sprocket Bore 40		DS60A15	Martin	DS60A15			1347-R7-1000	1
R7	480	4481-MJR0-0003	Cathode sealing equipment	Roller conveyor at bar furnace entrance	Sprocket Bore 40		60B40	Martin	60B40			1347-R7-1000	2
R7	481	4481-MJR0-0003	Cathode sealing equipment	Roller conveyor at bar furnace entrance	Sprocket Bore 30		60B26	Martin	60B26			1347-R7-1000	2
R7	482	4481-MJR0-0003	Cathode sealing equipment	Roller conveyor at bar furnace entrance	Idler Bore 16 (5/8in)		60BB15H	Martin	60BB15H			1347-R7-1000	4
R7	483	4481-MJR0-0003	Cathode sealing equipment	Roller conveyor at bar furnace entrance	Local Disconnect Switch Box		IM 63 III (IP65) 1347-51151 rev 1	CEFEM	IM 63 III (IP65) 1347-51151 rev 1			1347-R7-1000	1
R7	484	4481-MJR0-0003	Cathode sealing equipment	Roller conveyor at bar furnace entrance	Proximity Switch		XS7C40MP230TT	Télémécanique	XS7C40MP230TT			1347-R7-1000	6
R7	485	4481-MJR0-0003	Cathode sealing equipment	Roller conveyor at bar furnace entrance	Hydraulic Cylinder Parker		2.5BB-2HKPSV14A2.125	Parker	2.5BB-2HKPSV14A2.125			1347-R7-1000	1
R7	486	4481-MJR0-0003	Cathode sealing equipment	Roller conveyor at bar furnace entrance	Rod Clevis Parker		50942	Parker	50942			1347-R7-1000	1
R7	487	4481-MJR0-0003	Cathode sealing equipment	Roller conveyor at bar furnace entrance	Mounting Plate		69196	Parker	69196			1347-R7-1000	1
R7	488	4481-MJR0-0003	Cathode sealing equipment	Roller conveyor at bar furnace entrance	Parker Pin		68369	Parker	68369			1347-R7-1000	1
R8	489	4481-MJR0-0002	Cathode sealing equipment	Conical roller conveyor at shot blasting machine exit	Rollers		1347-R8-1010	INNOVA	1347-R8-1010			1347-R8-1000	3
R8	490	4481-MJR0-0002	Cathode sealing equipment	Conical roller conveyor at shot blasting machine exit	Bearing Fixed		SNL22517/75TL	SKF of Canada ltd	SNL22517/75TL			1347-R8-1000	1
R8	491	4481-MJR0-0002	Cathode sealing equipment	Conical roller conveyor at shot blasting machine exit	Bearing Free		SNL22517/75TLHY	SKF of Canada ltd	SNL22517/75TLHY			1347-R8-1000	1
R8	492	4481-MJR0-0002	Cathode sealing equipment	Conical roller conveyor at shot blasting machine exit	Bearing Fixed		SNL22509/40TLH	SKF of Canada ltd	SNL22509/40TLH			1347-R8-1000	3
R8	493	4481-MJR0-0002	Cathode sealing equipment	Conical roller conveyor at shot blasting machine exit	Bearing Free		SNL22509/40TLY	SKF of Canada ltd	SNL22509/40TLY			1347-R8-1000	3
R8	494	4481-MJR0-0002	Cathode sealing equipment	Conical roller conveyor at shot blasting machine exit	Helical Parallel Gear Motor		K47 DT71D4/VS	SEW-Eurodrive	K47 DT71D4/VS			1347-R8-1000	1
R8	495	4481-MJR0-0002	Cathode sealing equipment	Conical roller conveyor at shot blasting machine exit	Chain 40 (119043)		119043 Chain 0.5in 40A1	RENOLD	119043 Chain 0.5in 40A1			1347-R8-1000	30
R8	496	4481-MJR0-0002	Cathode sealing equipment	Conical roller conveyor at shot blasting machine exit	Link 40-1		link40-1	RENOLD	link40-1			1347-R8-1000	5
R8	497	4481-MJR0-0002	Cathode sealing equipment	Conical roller conveyor at shot blasting machine exit	Sproket Bore 30		DS40A17	Martin	DS40A17			1347-R8-1000	1
R8	498	4481-MJR0-0002	Cathode sealing equipment	Conical roller conveyor at shot blasting machine exit	Sproket Bore 40		40B54	Martin	40B54			1347-R8-1000	2
R8	499	4481-MJR0-0002	Cathode sealing equipment	Conical roller conveyor at shot blasting machine exit	Sproket Bore 40		DS40A54	Martin	DS40A54			1347-R8-1000	1
R8	500	4481-MJR0-0002	Cathode sealing equipment	Conical roller conveyor at shot blasting machine exit	Idler Bore 16 (5/8in)		40BB17H	Martin	40BB17H			1347-R8-1000	3
R8	501	4481-MJR0-0002	Cathode sealing equipment	Conical roller conveyor at shot blasting machine exit	Flange Bushing		FF-1618-1	NORMA BEARING	FF-1618-1			1347-R8-1000	2
R8	502	4481-MJR0-0002	Cathode sealing equipment	Conical roller conveyor at shot blasting machine exit	Local Disconnect Switch		IM 63 VI (IP65) 1347-51150 rev 1	CEFEM	IM 63 VI (IP65) 1347-51150 rev 1			1347-R8-1000	1
R8	503	4481-MJR0-0002	Cathode sealing equipment	Conical roller conveyor at shot blasting machine exit	Proximity Switch		XS7C40MP230TT	Télémécanique	XS7C40MP230TT			1347-R8-1000	3
R8	504	4481-MJR0-0002	Cathode sealing equipment	Conical roller conveyor at shot blasting machine exit	Hydraulic Cylinder		2.5CD-2HKPSV13AC6	Parker	2.5CD-2HKPSV13AC6			1347-R8-1000	1
R8	505	4481-MJR0-0002	Cathode sealing equipment	Conical roller conveyor at shot blasting machine exit	Spherical Rod Eye		132291	Parker	132291			1347-R8-1000	1
R8	506	4481-MJR0-0002	Cathode sealing equipment	Conical roller conveyor at shot blasting machine exit	Clevis Bracket Parker		83948	Parker	83948			1347-R8-1000	1
R8	507	4481-MJR0-0002	Cathode sealing equipment	Conical roller conveyor at shot blasting machine exit	Pin Parker		83963	Parker	83963			1347-R8-1000	1
R9	508	4481-MJR0-0001	Cathode sealing equipment	Conical roller conveyor at shot blasting machine entrance	Rollers		1347-R8-1010	INNOVA	1347-R8-1010			1347-R9-1000	3
R9	509	4481-MJR0-0001	Cathode sealing equipment	Conical roller conveyor at shot blasting machine entrance	Bearing Fixed		SNL22517/75TL	SKF of Canada ltd	SNL22517/75TL			1347-R9-1000	1
R9	510	4481-MJR0-0001	Cathode sealing equipment	Conical roller conveyor at shot blasting machine entrance	Bearing Free		SNL22517/75TLHY	SKF of Canada ltd	SNL22517/75TLHY			1347-R9-1000	1
R9	511	4481-MJR0-0001	Cathode sealing equipment	Conical roller conveyor at shot blasting machine entrance	Bearing Fixed		SNL22509/40TLH	SKF of Canada ltd	SNL22509/40TLH			1347-R9-1000	3
R9	512	4481-MJR0-0001	Cathode sealing equipment	Conical roller conveyor at shot blasting machine entrance	Bearing Free		SNL22509/40TLY	SKF of Canada ltd	SNL22509/40TLY			1347-R9-1000	3
R9	513	4481-MJR0-0001	Cathode sealing equipment	Conical roller conveyor at shot blasting machine entrance	Helical Parallel Gear Motor		K47 DT71D4/VS	SEW-Eurodrive	K47 DT71D4/VS			1347-R9-1000	1
R9	514	4481-MJR0-0001	Cathode sealing equipment	Conical roller conveyor at shot blasting machine entrance	Chain 40 (119043)		119043 Chain 0.5in 40A1	RENOLD	119043 Chain 0.5in 40A1			1347-R9-1000	30
R9	515	4481-MJR0-0001	Cathode sealing equipment	Conical roller conveyor at shot blasting machine entrance	Link 40-1		link40-1	RENOLD	link40-1			1347-R9-1000	5
R9	516	4481-MJR0-0001	Cathode sealing equipment	Conical roller conveyor at shot blasting machine entrance	Sprocket Bore 40		DS40A54	Martin	DS40A54			1347-R9-1000	1
R9	517	4481-MJR0-0001	Cathode sealing equipment	Conical roller conveyor at shot blasting machine entrance	Sprocket Bore 40		40B54	Martin	40B54			1347-R9-1000	2
R9	518	4481-MJR0-0001	Cathode sealing equipment	Conical roller conveyor at shot blasting machine entrance	Sprocket Bore 30		DS40A17	Martin	DS40A17			1347-R9-1000	1
R9	519	4481-MJR0-0001	Cathode sealing equipment	Conical roller conveyor at shot blasting machine entrance	Idler Bore 16 (5/8in)		40BB17H	Martin	40BB17H			1347-R9-1000	3
R9	520	4481-MJR0-0001	Cathode sealing equipment	Conical roller conveyor at shot blasting machine entrance	Flange Bushing		FF-1618-1	NORMA BEARING	FF-1618-1			1347-R9-1000	2
R9	521	4481-MJR0-0001	Cathode sealing equipment	Conical roller conveyor at shot blasting machine entrance	Local Disconnect Switch		IM 63 VI (IP65) 1347-51150 rev 1	CEFEM	IM 63 VI (IP65) 1347-51150 rev 1			1347-R9-1000	1
R9	522	4481-MJR0-0001	Cathode sealing equipment	Conical roller conveyor at shot blasting machine entrance	Proximity Switch		XS7C40MP230TT	Télémécanique	XS7C40MP230TT			1347-R9-1000	3
R9	523	4481-MJR0-0001	Cathode sealing equipment	Conical roller conveyor at shot blasting machine entrance	C2-R9 local Control Panel - 4481 - MHCD-0002-CP-01		1347-51080	ENVITECH AUTOMATION Inc.	1347-51080			1347-R9-1000	1
R9	524	4481-MJR0-0001	Cathode sealing equipment	Conical roller conveyor at shot blasting machine entrance	Hydraulic Cylinder		2.5CD-2HKPSV13ACX10.562	Parker	2.5CD-2HKPSV13ACX10.562			1347-R9-1000	1
R9	525	4481-MJR0-0001	Cathode sealing equipment	Conical roller conveyor at shot blasting machine entrance	Spherical Rod Eye		132291	Parker	132291			1347-R9-1000	1

				Purchase Order / Contract Number:				Document Number:					
				Purchase Order / Contract Description:				Document Revision / Date:					
GNA ref	ITEM NO.	COMPONENT TAG NUMBER	SECTION (or assembly)	SUB-SECTION (or sub-assembly)	COMPONENT DESCRIPTION	SECTION / SUB-SECTION PART DESCRIPTION	SELLER / CONTRACTOR PART CODE	MANUFACTURER NAME	MANUFACTURER PART SERIAL NUMBER	LISTING OF PART SUPPLIERS	CLIENT NUMBER	SELLER / CONTRACTOR DRAWING NO.	QTY
R9	526	4481-MJR0-0001	Cathode sealing equipment	Conical roller conveyor at shot blasting machine entrance	Clevis Bracket Parker		83948	Parker	83948			1347-R9-1000	1
R9	527	4481-MJR0-0001	Cathode sealing equipment	Conical roller conveyor at shot blasting machine entrance	Pin Parker		83963	Parker	83963			1347-R9-1000	1
T1	528	4481-MJUT-0001	Cathode sealing equipment	Cooling and turning station	Bearing Fixed		SNL22517/75TLHY	SKF of Canada ltd	SNL22517/75TLHY			1347-T1-1000	1
T1	529	4481-MJUT-0001	Cathode sealing equipment	Cooling and turning station	Bearing Free		SNL22517/75TLY	SKF of Canada ltd	SNL22517/75TLY			1347-T1-1000	1
T1	530	4481-MJUT-0001	Cathode sealing equipment	Cooling and turning station	Bearing Fixed		SNL22517/75TLH	SKF of Canada ltd	SNL22517/75TLH			1347-T1-1000	1
T1	531	4481-MJUT-0001	Cathode sealing equipment	Cooling and turning station	Bearing Free		SNL22517/75TL	SKF of Canada ltd	SNL22517/75TL			1347-T1-1000	1
T1	532	4481-MJUT-0001	Cathode sealing equipment	Cooling and turning station	Proximity Switch		XS7C40MP230TT	Télémécanique	XS7C40MP230TT			1347-T1-1000	4
T1	533	4481-MJUT-0001	Cathode sealing equipment	Cooling and turning station	Limit Switch		ZCKJ2H7	Télémécanique	ZCKJ2H7			1347-T1-1000	2
T1	534	4481-MJUT-0001	Cathode sealing equipment	Cooling and turning station	Limit Switch Head		ZCKE055	Télémécanique	ZCKE055			1347-T1-1000	2
T1	535	4481-MJUT-0001	Cathode sealing equipment	Cooling and turning station	Lever 4		ZCKY43 or ZCKY53	Télémécanique	ZCKY43 or ZCKY53			1347-T1-1000	2
T1	536	4481-MJUT-0001	Cathode sealing equipment	Cooling and turning station	Hydraulic Cylinder		2.5CSB-2HKPSV27AC23	Parker	2.5CSB-2HKPSV27AC23			1347-T1-1000	4
T1	537	4481-MJUT-0001	Cathode sealing equipment	Cooling and turning station	Spherical Rod Eye		132291	Parker	132291			1347-T1-1000	4
T1	538	4481-MJUT-0001	Cathode sealing equipment	Cooling and turning station	Pin Parker		83963	Parker	83963			1347-T1-1000	4
T1	539	4481-MJUT-0001	Cathode sealing equipment	Cooling and turning station	Clevis Bracket parker		83948	Parker	83948			1347-T1-1000	4
ZZE	540	4481-EV-1001	Cathode sealing equipment	SCR Control Panel	SCR F1		WATQ32482300BV0	WATLOW	WATQ32482300BV0			1347-52250	3
ZZE	541	4481-EV-1001	Cathode sealing equipment	SCR Control Panel	Ventilateur		RIT3327107 230V	Rittal	RIT3327107 230V			1347-52250	2
ZZE	542	4481-EV-1001	Cathode sealing equipment	SCR Control Panel	Filtre		RIT3326207	Rittal	RIT3326207			1347-52250	2
ZZE	543	4481-EV-1001	Cathode sealing equipment	SCR Control Panel	Thermostat		RIT3110000	Rittal	RIT3110000			1347-52250	1
ZZE	544	4481-EV-1001	Cathode sealing equipment	SCR Control Panel	Fuse		Fuse 250A	GNA	Fuse 250A			1347-52250	9
ZZE	545	4481-EV-1002	Cathode sealing equipment	SCR Control Panel	SCR F2		WATQ33482300AL0	WATLOW	WATQ33482300AL0			1347-52250	4
ZZE	546	4481-EV-1002	Cathode sealing equipment	SCR Control Panel	Ventilateur		RIT3327107 230V	Rittal	RIT3327107 230V			1347-52250	2
ZZE	547	4481-EV-1002	Cathode sealing equipment	SCR Control Panel	Filtre		RIT3326207	Rittal	RIT3326207			1347-52250	2
ZZE	548	4481-EV-1002	Cathode sealing equipment	SCR Control Panel	Thermostat		RIT3110000	Rittal	RIT3110000			1347-52250	1
ZZE	549	4481-EV-1002	Cathode sealing equipment	SCR Control Panel	Fuse		Fuse 300A	GNA	Fuse 300A			1347-52250	12
PLC	550	4481-CP-1001	Cathode sealing equipment	Central Control Desk	CONTROLLOGIX CHASSIS 10 Slot		1756-A-10	Allen Bradley	1756-A-10			1347-52250	2
PLC	551	4481-CP-1001	Cathode sealing equipment	Central Control Desk	POWER SUPPLY, 13 AMP A 5V / 85-265Vac		1756-PA75	Allen Bradley	1756-PA75			1347-52250	2
PLC	552	4481-CP-1001	Cathode sealing equipment	Central Control Desk	INTERFACE MODULE		1756-EN2F	Allen Bradley	1756-EN2F			1347-52250	1
PLC	553	4481-CP-1001	Cathode sealing equipment	Central Control Desk	PROCESSOR ETHERNET 10-100M / INTERFACE MODULE		1756-L73	Allen Bradley	1756-L73			1347-52250	1
PLC	554	4481-CP-1001	Cathode sealing equipment	Central Control Desk	DIGITAL INPUT CARD 10-31 VDC NPUT 32 PTS		1756-1B32	Allen Bradley	1756-1B32			1347-52250	9
PLC	555	4481-CP-1001	Cathode sealing equipment	Central Control Desk	SLOT FILLER		1756-N2	Allen Bradley	1756-N2			1347-52250	2
PLC	556	4481-CP-1001	Cathode sealing equipment	Central Control Desk	DIGITAL OUTPUT CARD N.O. ISOLATED RELAY OUTPUT 16 PTS		1756-OW 161	Allen Bradley	1756-OW 161			1347-52250	2
PLC	557	4481-CP-1001	Cathode sealing equipment	Central Control Desk	ANALOG OUTPUT CARD, ISOLATED ANALOG OUTPUT-CURRENT 6 PTS		1756-OF6C1	Allen Bradley	1756-OF6C1			1347-52250	2
PLC	558	4481-CP-1001	Cathode sealing equipment	Central Control Desk	IFM MODULE 40-POINT FEED-TOUCH DIGITAL IFM, STANDARD		1492-IFM40D24	Allen Bradley	1492-IFM40D24			1347-52250	9
PLC	559	4481-CP-1001	Cathode sealing equipment	Central Control Desk	CABLE 2.5 METRE PRE-WIRED CABLE FOR 1756-32 PT I/O MODULES		1492-CABLE025Z	Allen Bradley	1492-CABLE025Z			1347-52250	4
PLC	560	4481-CP-1001	Cathode sealing equipment	Central Control Desk	SCREW CLAMP BLOCK 20 POSITIONS NEMA		1756-TBSH	Allen Bradley	1756-TBSH			1347-52250	2
PLC	561	4481-CP-1001	Cathode sealing equipment	Central Control Desk	SCREW CLAMP BLOCK 36 PIN SCREW CLAMP BLOCK WITH STANDARD HOUSING		1756-TBS6H	Allen Bradley	1756-TBS6H			1347-52250	2
PLC	562	4481-CP-1001	Cathode sealing equipment	Central Control Desk	ETHERNET PORT ETHERNET/IP TAP3 COPPER PORTS		1783-ETAP	Allen Bradley	1783-ETAP			1347-52250	8
PLC	563	4481-CP-1001	Cathode sealing equipment	Central Control Desk	ETHERNET MODULE/IP 10/100Mb FLEX I/O ADAPTER MODULE (10 BASE T)		1794-AENT	Allen Bradley	1794-AENT			1347-52250	4
PLC	564	4481-CP-1001	Cathode sealing equipment	Central Control Desk	INPUT MODULE 24 VDC, 16 SINK INPUTS		1794-IB16	Allen Bradley	1794-IB16			1347-52250	11
PLC	565	4481-CP-1001	Cathode sealing equipment	Central Control Desk	OUTPUT MODULE 24 VDC, 16 SOURCE OUTPUTS		1794-OB16	Allen Bradley	1794-OB16			1347-52250	3
PLC	566	4481-CP-1001	Cathode sealing equipment	Central Control Desk	ANALOG INPUT MODULE 8 SINGLE-ENDED INPUTS		1794-IF8IH	Allen Bradley	1794-IF8IH			1347-52250	2
PLC	567	4481-CP-1001	Cathode sealing equipment	Central Control Desk	BASE WITH SPRING TERMINAL BASE 3-WIRE, CAGE CLAMP		1794-TB3S	Allen Bradley	1794-TB3S			1347-52250	25
PLC	568	4481-CP-1001	Cathode sealing equipment	Central Control Desk	INDUSTRIAL INTEGRATED DISPLAY COMPUTER- TOUCHSCREEN- 40GbSATA HDD PERFORMANCE MODEL: CORE DUO 1.2 GHz, 1Gb, DDR2 RAM, CD/DVD-RW, 24VDC		6181P-17TPXPDC	Allen Bradley	6181P-17TPXPDC			1347-52250	1
PLC	569	4481-CP-1001	Cathode sealing equipment	Central Control Desk	PANEL VIEW PLUS PANEL VIEW PLUS 700 TOUCH, STANDARD COMMUNICATIONS (ETHERNET & RS-232) DC POWER, 64 Mb FLASH/64 Mb RAM		2711P-T7C4D1	Allen Bradley	2711P-T7C4D1			1347-52250	1
PLC	570	4481-CP-1001	Cathode sealing equipment	Central Control Desk	TOOLKIT 1 YEAR 8-5 DIRECT TECH-CONNECT		9398-TKIT1B	Allen Bradley	9398-TKIT1B			1347-52250	1
PLC	571	4481-CP-1001	Cathode sealing equipment	Central Control Desk	CABLE 1 METRE PRE-WIRED CABLE FOR 1756 32-PT I/O MODULES		1492-CABLE010Z	Allen Bradley	1492-CABLE010Z			1347-52250	5
PLC	572	4481-CP-1001	Cathode sealing equipment	Central Control Desk	OUTPUT MODULE 24 VDC, 16 OUTPUTS WITH ELECT.FUSING		1794-OB8EP	Allen Bradley	1794-OB8EP			1347-52250	9
PLC	573	4481-CP-1001	Cathode sealing equipment	Central Control Desk	ETHERNET POWERFLEX 70/700 ETHERNET I/P TO DPI COMM.		20-COMM-E COMM.	Allen Bradley	20-COMM-E COMM.			1347-52250	1
PLC	574	4481-CP-1001	Cathode sealing equipment	Central Control Desk	INTERFACE MODULE ETHERNET 10-100M INTERFACE MODULE		1756-EN2T	Allen Bradley	1756-EN2T			1347-52250	3
OPT. EQ	575	4481-MQBL-0001/0002/0003	Cathode sealing equipment	Cast Iron Pouring Ladle with one Tilting Mechanism	Cast iron ladle (1) 380 kg c/w tilting bail		1090-23-0-000	Modern Equipment Co. Inc.	1090-23-0-000			1347-L1-1000	1
OPT. EQ	576	4481-MQBL-0001/0002/0003	Cathode sealing equipment	Cast Iron Pouring Ladle with one Tilting Mechanism	Cast Iron Ladle (2) Shell 380kg capacity		0129-000-0	Modern Equipment Co. Inc.	0129-000-0			1347-L1-1000	2
OPT. EQ	577	4481-MQBL-0001/0002/0003	Cathode sealing equipment	Cast Iron Pouring Ladle with one Tilting Mechanism	Lining		0129-000-0	Modern Equipment Co. Inc.	0129-000-0			1347-L1-1000	1
OPT. EQ	578	4481-MHMS-0001	Cathode sealing equipment	Cast Iron Ingot Scale	Scale		VLC-2256 3ftX3ft	Mettler Toledo	VLC-2256 3ftX3ft			1347-Z1-1000	1
OPT. EQ	579	4481-MHMS-0001	Cathode sealing equipment	Cast Iron Ingot Scale	Anti Splash		1347-AR-0500	Centre de Sciage de la Mauricie	1347-AR-0500			1347-Z1-1000	10
OPT. EQ	580	4481-MJGB-0001	Cathode sealing equipment	Handling Tong Longitudinal Grip	Handling Tong Longitudinal Grip		1347-B2-1000	Hercules SLR inc.	1347-B2-1000			1347-B2-1000/1347-B3-1000/1347-B4-1000	1
OPT. EQ	581	4481-MJGB-0001	Cathode sealing equipment	Handling Tong Longitudinal Grip	Cathode Grab-Transversal B3		1347-B2-1000	Hercules SLR inc.	1347-B2-1000			1347-B2-1000/1347-B3-1000/1347-B4-1000	1

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GNA ref	ITEM NO.	COMPONENT TAG NUMBER	SECTION (or assembly)	SUB-SECTION (or sub-assembly)	COMPONENT DESCRIPTION	SECTION / SUB-SECTION PART DESCRIPTION	SELLER / CONTRACTOR PART CODE	MANUFACTURER NAME	MANUFACTURER PART SERIAL NUMBER	LISTING OF PART SUPPLIERS	CLIENT NUMBER	SELLER / CONTRACTOR DRAWING NO.	QTY
OPT. EQ	582	4481-MJGB-0001	Cathode sealing equipment	Handling Tong Longitudinal Grip	Cathode Grab-Tenon B4		1347-B2-1000	Hercules SLR inc.	1347-B2-1000			1347-B2-1000/1347-B3-1000/1347-B4-1000	1
OPT. EQ	583	4481-MJGB-0001	Cathode sealing equipment	Handling Tong Longitudinal Grip	Bar Handling Shackles B1		1347-B2-1000	Hercules SLR inc.	1347-B2-1000			1347-B2-1000/1347-B3-1000/1347-B4-1000	2
OPT. EQ	584	4481-MJGB-0001	Cathode sealing equipment	Handling Tong Longitudinal Grip	Discount tong		1347-B2-1000	Hercules SLR inc.	1347-B2-1000			1347-B2-1000/1347-B3-1000/1347-B4-1000	1
SAFETY	585		Cathode sealing equipment		Safety light curtain R4		445L-P4S3400YD	Allen Bradley	445L-P4S3400YD				6
SAFETY	586		Cathode sealing equipment		Safety Mat Yellow 750mmx1000mm C2		440F-M1520BYNN	Allen Bradley	440F-M1520BYNN				8
SAFETY	587		Cathode sealing equipment		Safety Mat Yellow 750mmx1000mm C4		440F-M1520BYNN	Allen Bradley	440F-M1520BYNN				14
SAFETY	588		Cathode sealing equipment		Safety Mat Yellow 750mmx1000mm C1		440F-M1520BYNN	Allen Bradley	440F-M1520BYNN				6
SAFETY	589		Cathode sealing equipment		Monitoring safety relay MSR210P		440R-H23176	Allen Bradley	440R-H23176				2
SAFETY	590		Cathode sealing equipment		Monitoring safety relay MSR211P		440R-H23179	Allen Bradley	440R-H23179				4
SAFETY	591		Cathode sealing equipment		Monitoring safety relay MSR121RT		440R-J23102	Allen Bradley	440R-J23102				4
SAFETY	592		Cathode sealing equipment		Standard aluminium perimeter trim 2m		440F-T3210	Allen Bradley	440F-T3210				4
SAFETY	593		Cathode sealing equipment		Active uniting trim 1.5m length		440F-T3020	Allen Bradley	440F-T3020				4
SAFETY	594		Cathode sealing equipment		External corner perimeter trim		440F-T3012	Allen Bradley	440F-T3012				10
SAFETY	595		Cathode sealing equipment		Standard perimeter aluminium trim 3m		440F-T3310	Allen Bradley	440F-T3310				1
SAFETY	596		Cathode sealing equipment		Standard aluminium perimeter trim		440F-T3210	Allen Bradley	440F-T3210				9
SAFETY	597		Cathode sealing equipment		Mat trim 3m length		440F-T3320	Allen Bradley	440F-T3320				3
SAFETY	598		Cathode sealing equipment		Mat trim 2m length		440F-T3220	Allen Bradley	440F-T3220				4
SAFETY	599		Cathode sealing equipment		External corner perimeter trim		440F-T3014	Allen Bradley	440F-T3014				4
SAFETY	600		Cathode sealing equipment		Aluminium perimeter trim 3m length		440F-T3311	Allen Bradley	440F-T3311				2
SAFETY	601		Cathode sealing equipment		Aluminium perimeter trim 4m length		440F-T3411	Allen Bradley	440F-T3411				4
SAFETY	602		Cathode sealing equipment		cable shielded straight female 5m		889D-F5EC-5	Allen Bradley	889D-F5EC-5				4
SAFETY	603		Cathode sealing equipment		Cable shielded straight female 10m		889D-F5EC-10	Allen Bradley	889D-F5EC-10				8
SAFETY	604		Cathode sealing equipment		Stainless steel z-clip 11x5=55		440F-T102935	Allen Bradley	440F-T102935				10
SAFETY	605		Cathode sealing equipment		Limit switch safety switch type 4 R4		802T-ATPD	Allen Bradley	802T-ATPD				2
SAFETY	606		Cathode sealing equipment		Operating levier 3 in. R4		802T-W30A	Allen Bradley	802T-W30A				2

7.2 Recommended Spare Parts List

- *Spare parts List – Start up*
- *Spare parts List – 2 Years of Operation*

RAS AZ ZAWR ALUMINIUM SMELTER PROJECT

Recommended Spare Parts List
GNA alutech inc.
CATHODE SEALING EQUIPMENT

REVISION NO.	DATE	REASON FOR REVISION	ORIGINATOR	CHECKER	EGS	PEM	CLIENT
1	4/21/2011	Spare and Operational	MB				
0		Initial submittal	MB				

ALCOA | MA'ADEN معادن Saudi Arabian Mining Company شركة معادن العربية السعودية

Ma'aden Aluminum Project

BECHTEL

Project NO.: **25457-4480-POA-MXA0-0001**

DOCUMENT NO.: **25457-4480-V1A-MXA0-0188**

Sheet No. 1 of 1

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25457 - RAS AZ ZAWR ALUMINIUM SMELTER PROJECT
Construction / Installation Spare Parts List

Purchase Order / Contract Number: 25457-4480-POA-MXA0-0001 **Document Number:** 1247-SparePartsList-Rev0

Purchase Order / Contract Description: Cathode Sealing Equipment **Document Revision / Date:** Revision 0 / 10 January 2011

GNA Ref.	ITEM NO.	COMPONENT TAG NUMBER (CTN)	SECTION (or assembly)	SUB-SECTION (or sub-assembly)	COMPONENT DESCRIPTION	SECTION / SUB-SECTION PART DESCRIPTION	MANUFACTURER / SELLER NAME	MANUFACTURER / SELLER CODE	CLIENT NUMBER	DRAWING / DOCUMENT NO.	TOTAL QUANTITY INSTALLED FOR THE PACKAGE	QUANTITY RECOMMENDED SPARES FOR CONSTRUCTION / INSTALLATION	SIZE & DIMENSIONS - L x W x H (mm)	GROSS WEIGHT (kg)	UNIT WEIGHT (kg)	PLANNED DELIVERY TIME (days)	UNIT PRICE / CURRENCY	WARRANTY PERIOD (months)
					All the necessary installation parts are supplied with the equipment														

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Ma'aden Aluminum Project

25457 - RAS AZ ZAWR ALUMINIUM SMELTER PROJECT
Pre-Op / Startup and Long Lead Spare Parts List

Purchase Order / Contract Number: 25457-4480-POA-MXA0-0001 **Document Number:** 1247-SparePartsList-Rev1

Purchase Order / Contract Description: Cathode Sealing Equipment **Document Revision / Date:** Revision 1 / 10 January 2011

GNA Ref.	COMPONENT TAG NUMBER (CTN)	SECTION (or assembly)	SUB-SECTION (or sub-assembly)	COMPONENT DESCRIPTION	SECTION / SUB-SECTION PART DESCRIPTION	MANUFACTURER / SELLER NAME	MANUFACTURER / SELLER CODE	CLIENT NUMBER	DRAWING / DOCUMENT NO.	TOTAL QUANTITY INSTALLED FOR THE PACKAGE	QUANTITY RECOMMENDED SPARES FOR PRE-OP / COMMISSIONING	QUANTITY RECOMMENDED SPARES FOR LONG LEAD SPARES	SIZE & DIMENSIONS - L x W x H (mm)	GROSS WEIGHT (kg)	UNIT WEIGHT (kg)	PLANNED DELIVERY TIME (days)	UNIT PRICE / CURRENCY (USD)	WARRANTY PERIOD (months)
F1	4481-MEEP-0001	Cathode Sealing Equipment	Cathode block oven (capacity of 6 cathode blocks)	Thermocouple 28"		RDC Contrôle	ARLD00F280UK000 type K 28in		1347-F1-1000	6	1	0	800X100X100	4	4	20	$ 119.29	12
F2	4481-MBMB-0001	Cathode Sealing Equipment	Cathode bar heating furnace (capacity of 16 bars)	Thermocouple 18"		RDC Contrôle	ARLD00F180UK000 type K 18in		1347-F2-1000	8	1	0	550X100X100	4	4	20	$ 135.39	12
F2	4481-MBMB-0001	Cathode Sealing Equipment	Cathode bar heating furnace (capacity of 16 bars)	Compressing fitting		Swagelok	SS-600-1-8-BT		1347-F2-1000	6	2	0	100X100X100	2	2	20	$ 36.82	12
F1	4481-MEEP-0001	Cathode Sealing Equipment	Cathode block oven (capacity of 6 cathode blocks)	Compressing fitting		Swagelok	SS-400-1-8-BT		1347-F1-1000	8	2	0	100X100X100	2	2	20	$ 34.40	12
F2	4481-MBMB-0001	Cathode Sealing Equipment	Cathode bar heating furnace (capacity of 16 bars)	Temperature Transmitter		Rosemount	28R-A-L1-C1-Q4		1347-F2-1000	7	1	0	100X100X100	2	2	20	$ 1,129.80	12
DSL	4481-MHCD-0002-M1-LDS	Cathode Sealing Equipment	Local Control Panel	Local Disconnect Switch Box		CEFEM	IM 63 III (IP65) 1347-51151 rev 1		1347-52250	23	1	0	800X400X400	5	5	40	$ 840.09	12
DSL	4481-MHCD-0002-M1-LDS	Cathode Sealing Equipment	Local Control Panel	Local Disconnect Switch Box		CEFEM	IM 63 VI (IP65) 1347-51150 rev 1		1347-52250	13	1	0	800X400X400	5	5	40	$ 1,034.63	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	Seal for Bearing TG		SKF	TSN 517L		1347-52000	8	4	0	100X100X100	1	1	15	$ 36.75	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	Seal for Bearing TG		SKF	TSN 509L		1347-52000	20	4	0	100X100X100	1	1	15	$ 36.75	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	Limit Switch		Télémécanique	ZCKJ2H7		1347-52000	20	5	0	100X100X100	2	2	15	$ 82.32	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	Limit Switch Head		Télémécanique	ZCKE055		1347-52000	20	5	0	100X100X100	2	2	15	$ 52.86	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	Lever 4 / 5		Télémécanique	ZCKY43 or ZCKY53		1347-52000	20	5	0	100X100X100	2	2	15	$ 12.35	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	Proximity Switch		Télémécanique	XS7C40MP230TT		1347-52000	81	9	0	100X100X100	2	2	15	$ 169.05	12
F2	4481-MBMB-0001	Cathode Sealing Equipment	Cathode bar heating furnace (capacity of 16 bars)	Electrical Element		I Squared R Element	RR64x38x1.25 (2.02ohms)		1347-F2-1000	96	8	0	2500X150X150	5	5	40	$ 126.16	12
F2	4481-MBMB-0001	Cathode Sealing Equipment	Cathode bar heating furnace (capacity of 16 bars)	Terminal BA312		I Squared R Element	B312		1347-F2-1000	48	2	0	100X100X100	1	1	40	$ 6.62	12
F2	4481-MBMB-0001	Cathode Sealing Equipment	Cathode bar heating furnace (capacity of 16 bars)	Terminal A312		I Squared R Element	A312		1347-F2-1000	96	4	0	100X100X100	1	1	40	$ 6.35	12
F2	4481-MBMB-0001	Cathode Sealing Equipment	Cathode bar heating furnace (capacity of 16 bars)	Clamp		I Squared R Element	T32		1347-F2-1000	200	8	0	100X100X100	1	1	40	$ 5.95	12
F2	4481-MBMB-0001	Cathode Sealing Equipment	Cathode bar heating furnace (capacity of 16 bars)	Gasket		I Squared R Element	TGA-32-3		1347-F2-1000	200	8	0	100X100X100	1	1	40	$ 8.47	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	Ampli Photoelectrique 24VDC		Carlo Gavazzi	S142BRNN-924		1347-52000	8	1	1	100X100X100	1	1	40	$ 316.05	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	Transmitter		Carlo Gavazzi	MOFT20-M12-8		1347-52000	8	1	1	300X50X50	1	1	40	$ 115.40	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	Receiver		Carlo Gavazzi	MOFR-M12-8		1347-52000	8	1	1	300X50X50	1	1	40	$ 115.40	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	Optic Fibre		Carlo Gavazzi	OFMS1-10 (1m)		1347-52000	8	1	1	100X100X100	2	2	40	$ 356.48	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	Base		Carlo Gavazzi	ZPD11 (11 pins)		1347-52000	8	1	1	100X100X100	1	1	40	$ 10.11	12
MCL	4481-ECM-1000	Cathode Sealing Equipment	MCC Panel	DRIVE POWERFLEX 70		Rockwell	20AD5P0A0AYNNNCO		1347-52250	13	1	0	400X400X100	3	3	15	$ 1,466.33	12
MCL	4481-ECM-1000	Cathode Sealing Equipment	MCC Panel	DISPLAY NUM. KEYPAD		Rockwell	20-HIM-A3		1347-52250	13	1	0	200X200X100	2	2	15	$ 230.42	12
PLC	4481-CP-1001	Cathode Sealing Equipment	Central Control Desk	POWER SUPPLY, 13 AMP A 5V / 85-265Vac		Rockwell	1756-PA75		1347-52250	2	1	0	200X200X100	2	2	15	$ 1,297.70	12
PLC	4481-CP-1001	Cathode Sealing Equipment	Central Control Desk	DIGITAL INPUT CARD 10-31 VDC NPUT 32 PTS		Rockwell	1756-1B32		1347-52250	9	1	0	200X200X100	2	2	15	$ 545.68	12
PLC	4481-CP-1001	Cathode Sealing Equipment	Central Control Desk	DIGITAL OUTPUT CARD N.O. ISOLATED RELAY OUTPUT 16 PTS		Rockwell	1756-OW 161		1347-52250	2	1	0	200X200X100	2	2	15	$ 762.49	12
PLC	4481-CP-1001	Cathode Sealing Equipment	Central Control Desk	ANALOG OUTPUT CARD, ISOLATED ANALOG OUTPUT-CURRENT 6 PTS		Rockwell	1756-OF6C1		1347-52250	2	1	0	200X200X100	2	2	15	$ 2,889.71	12
PLC	4481-CP-1001	Cathode Sealing Equipment	Central Control Desk	IFM MODULE 40-POINT FEED-TOUCH DIGITAL IFM, STANDARD		Rockwell	1492-IFM40D24		1347-52250	9	1	0	200X200X100	2	2	15	$ 264.85	12
PLC	4481-CP-1001	Cathode Sealing Equipment	Central Control Desk	CABLE 2.5 METRE PRE-WIRED CABLE FOR 1756-32 PT I/O MODULES		Rockwell	1492-CABLE025Z		1347-52250	4	1	0	200X200X100	2	2	15	$ 296.13	12
PLC	4481-CP-1001	Cathode Sealing Equipment	Central Control Desk	SCREW CLAMP BLOCK 20 POSITIONS NEMA		Rockwell	1756-TBSH		1347-52250	2	1	0	200X200X100	2	2	15	$ 81.70	12
PLC	4481-CP-1001	Cathode Sealing Equipment	Central Control Desk	SCREW CLAMP BLOCK 36 PIN SCREW CLAMP BLOCK WITH STANDARD HOUSING		Rockwell	1756-TBS6H		1347-52250	2	1	0	200X200X100	2	2	15	$ 101.60	12
PLC	4481-CP-1001	Cathode Sealing Equipment	Central Control Desk	ETHERNET PORT ETHERNET/IP TAP3 COPPER PORTS		Rockwell	1783-ETAP		1347-52250	8	1	0	200X200X100	2	2	15	$ 384.39	12

Ma'aden Aluminum Project

25457 - RAS AZ ZAWR ALUMINIUM SMELTER PROJECT
Pre-Op / Startup and Long Lead Spare Parts List

Purchase Order / Contract Number: 25457-4480-POA-MXA0-0001 **Document Number:** 1247-SparePartsList-Rev1

Purchase Order / Contract Description: Cathode Sealing Equipment **Document Revision / Date:** Revision 1 / 10 January 2011

GNA Ref.	COMPONENT TAG NUMBER (CTN)	SECTION (or assembly)	SUB-SECTION (or sub-assembly)	COMPONENT DESCRIPTION	SECTION / SUB-SECTION PART DESCRIPTION	MANUFACTURER / SELLER NAME	MANUFACTURER / SELLER CODE	CLIENT NUMBER	DRAWING / DOCUMENT NO.	TOTAL QUANTITY INSTALLED FOR THE PACKAGE	QUANTITY RECOMMENDED SPARES FOR PRE-OP / COMMISSIONING	QUANTITY RECOMMENDED SPARES FOR LONG LEAD SPARES	SIZE & DIMENSIONS - L x W x H (mm)	GROSS WEIGHT (kg)	UNIT WEIGHT (kg)	PLANNED DELIVERY TIME (days)	UNIT PRICE / CURRENCY (USD)	WARRANTY PERIOD (months)
PLC	4481-CP-1001	Cathode Sealing Equipment	Central Control Desk	ETHERNET MODULE/IP 10/100Mb FLEX I/O ADAPTER MODULE (10 BASE T)		Rockwell	1794-AENT		1347-52250	4	1	0	200X200X100	2	2	15	$ 898.65	12
PLC	4481-CP-1001	Cathode Sealing Equipment	Central Control Desk	INPUT MODULE 24 VDC, 16 SINK INPUTS		Rockwell	1794-IB16		1347-52250	11	1	0	200X200X100	2	2	15	$ 385.43	12
PLC	4481-CP-1001	Cathode Sealing Equipment	Central Control Desk	OUTPUT MODULE 24 VDC, 16 SOURCE OUTPUTS		Rockwell	1794-OB16		1347-52250	3	1	0	200X200X100	2	2	15	$ 564.54	12
PLC	4481-CP-1001	Cathode Sealing Equipment	Central Control Desk	ANALOG INPUT MODULE 8 SINGLE-ENDED INPUTS		Rockwell	1794-IF8IH		1347-52250	2	1	0	200X200X100	2	2	15	$ 1,984.78	12
PLC	4481-CP-1001	Cathode Sealing Equipment	Central Control Desk	BASE WITH SPRING TERMINAL BASE 3-WIRE, CAGE CLAMP		Rockwell	1794-TB3S		1347-52250	25	1	0	200X200X100	2	2	15	$ 242.99	12
PLC	4481-CP-1001	Cathode Sealing Equipment	Central Control Desk	OUTPUT MODULE 24 VDC, 16 OUTPUTS WITH ELECT.FUSING		Rockwell	1794-OB8EP		1347-52250	9	1	0	200X200X100	2	2	15	$ 449.32	12
PLC	4481-CP-1001	Cathode Sealing Equipment	Central Control Desk	INTERFACE MODULE ETHERNET 10-100M INTERFACE MODULE		Rockwell	1756-EN2T		1347-52250	3	1	0	200X200X100	2	2	15	$ 3,496.14	12
PLC	4481-CP-1001	Cathode Sealing Equipment	Central Control Desk	ETHERNET/IP ADAPTER		Rockwell	20-COMM-E-B		1347-52250	14	1	0	100x100x50	1	1	25	$ 661.50	12
PLC	4481-CP-1001	Cathode Sealing Equipment	Central Control Desk	CABLE FLEX I/O EXTENDER 1 FOOT		Rockwell	1794CE1		1347-52250	5	1	0	100x100x100	1	1	30	$ 265.09	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	SAFETY LIGHT CURTAIN		Rockwell	445L-P4S3400YD		1347-52000	6	1	0	300X1500X300	10	10	30	$ 1,786.05	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	SAFETY MAT YELLOW 750mmx1000mm		Rockwell	440F-M1520BYNN		1347-52000	28	2	0	750X1000X300	15	15	30	$ 859.95	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	MAT TRIM 3m LENGHT		Rockwell	440F-T3320		1347-52000	3	1	0	750X750X300	5	5	15	$ 185.22	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	EXTERNAL CORNER PERIMETER TRIM		Rockwell	440F-T3014		1347-52000	4	1	0	750X750X300	5	5	15	$ 137.59	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	ALUMINIUM PERIMETER TRIM 4m LENGHT		Rockwell	440F-T3411		1347-52000	4	1	0	750X750X300	5	5	15	$ 209.18	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	EXTERNAL CORNER PERIMETER TRIM		Rockwell	440F-T3012		1347-52000	3	1	0	750X750X300	5	5	15	$ 50.27	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	STANDARD PERIMETER ALUMINIUM TRIM 3m		Rockwell	440F-T3310		1347-52000	1	1	0	750X750X300	5	5	15	$ 111.13	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	CABLE SHIELDED STRAIGHT FEMALE 10m		Rockwell	889D-F5EC-10		1347-52000	8	1	0	200X200X100	5	5	15	$ 76.07	12
R4	4481-MZAC-0001	Cathode Sealing Equipment	Prestressing and sealing station c/w conveyor and platforms	LIMIT SWITCH SAFETY SWITCH TYPE 4		Rockwell	802T-ATPD		1347-R4-1000	2	1	0	200X200X100	5	5	15	$ 250.27	12
R4	4481-MZAC-0001	Cathode Sealing Equipment	Prestressing and sealing station c/w conveyor and platforms	OPERATING LEVIER 3 IN.		Rockwell	802T-W30A		1347-R4-1000	2	1	0	200X200X100	2	2	15	$ 40.79	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	Safety Relay		Rockwell	MSR121RT		General		1	0	100x100x100	1	1	25	$ 488.22	12
ZZE	4481-EV-1001	Cathode Sealing Equipment	SCR Control Panel	Fuse 250A		GouldShawmut	A4J250		1347-52250	9	3	0	100X500X50	2	2	20	$ 141.75	12
ZZE	4481-EV-1001	Cathode Sealing Equipment	SCR Control Panel	Fuse 300A		GouldShawmut	A4J300		1347-52250	12	3	0	100X500X50	2	2	20	$ 141.75	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	Chain link		Renold	40-2RNCL26		General	-	4	0	50X50X50	1	1	15	$ 6.30	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	Chain mesh		Renold	80-1RNCL11		General	-	6	0	50X50X50	1	1	15	$ 6.30	12
General	4482	Cathode Sealing Equipment	Cathode Sealing equipment	Chain 1" pitch		Renold	119083		General	420 ft	20	0	200X200X100	10	10	25	$ 18.45	12
General	4483	Cathode Sealing Equipment	Cathode Sealing equipment	Chain 0.5" pitch		Renold	119043		General	60 ft	10	0	200X200X100	5	5	25	$ 6.07	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	Ceramic fiber strips		Thermal Ceramic	Superwool HT		1347-F2-1000	-	2	0	400x400x400	1	1	15	$ 21.00	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	Proximity switch mounting plate		GNA	GNA		General	30	2	0	50X50X50	1	1	15	$ 21.00	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	Directional Valve		Parker	H22VXBG0B9C		General		2	0	100X100X100	2	2	20	$ 272.23	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	Base for Valve		Parker	PS411117CCP		General		2	0	100X100X100	1	1	25	$ 74.06	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	Flow control		Parker	F600B		General		3	0	100X100X100	1	1	15	$ 57.05	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	Check valve		Parker	C1200B		General		1	0	100X100X100	1	1	15	$ 70.28	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	Dual rated connector		Thomas and Betts	ADR60-21		1347-F2-1000		1	0	100X100X100	1	1	20	$ 18.74	12
F2	4481-MBMB-0001	Cathode Sealing Equipment	Cathode bar heating furnace (capacity of 16 bars)	Dual rated connector		Thomas and Betts	ADR25-21		1347-F2-1000		4	0	100X100X100	1	1	20	$ 8.61	12

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25457 - RAS AZ ZAWR ALUMINIUM SMELTER PROJECT
Pre-Op / Startup and Long Lead Spare Parts List

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Purchase Order / Contract Number: **25457-4480-POA-MXA0-0001** **Document Number:** **1247-SparePartsList-Rev1**

Purchase Order / Contract Description: **Cathode Sealing Equipment** **Document Revision / Date:** **Revision 1 / 10 January 2011**

GNA Ref.	COMPONENT TAG NUMBER (CTN)	SECTION (or assembly)	SUB-SECTION (or sub-assembly)	COMPONENT DESCRIPTION	SECTION / SUB-SECTION PART DESCRIPTION	MANUFACTURER / SELLER NAME	MANUFACTURER / SELLER CODE	CLIENT NUMBER	DRAWING / DOCUMENT NO.	TOTAL QUANTITY INSTALLED FOR THE PACKAGE	QUANTITY RECOMMENDED SPARES FOR PRE-OP / COMMISSIONING	QUANTITY RECOMMENDED SPARES FOR LONG LEAD SPARES	SIZE & DIMENSIONS - L x W x H (mm)	GROSS WEIGHT (kg)	UNIT WEIGHT (kg)	PLANNED DELIVERY TIME (days)	UNIT PRICE / CURRENCY (USD)	WARRANTY PERIOD (months)
F2	4481-MBMB-0001	Cathode Sealing Equipment	Cathode bar heating furnace (capacity of 16 bars)	Dual rated connector		Thomas and Betts	ADR35		1347-F2-1000		4	0	100X100X100	1	1	20	$ 5.98	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	SKF Grease		SKF	LGEM 2/0.4 High Viscosity		General	-	3	0	200x200X200	3	3	15	$ 15.68	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	TERMINAL BLOCK		Weidmuller	WF10		General		5	0	70 x 70 x 70	1	1	25	$ 29.40	12

25457 - RAS AZ ZAWR ALUMINIUM SMELTER PROJECT
2 Years Operational and Capital / Insurance Spare Parts List

Purchase Order / Contract Number: 25457-4480-POA-MXA0-0001 **Document Number:** 1247-SparePartsList-Rev1

Purchase Order / Contract Description: Cathode Sealing Equipment **Document Revision / Date:** Revision 1 / 14 April 2011

GNA Ref.	COMPONENT TAG NUMBER (CTN)	SECTION (or assembly)	SUB-SECTION (or sub-assembly)	COMPONENT DESCRIPTION	MANUFACTURER / SELLER NAME	MANUFACTURER / SELLER CODE	DRAWING / DOCUMENT NO.	TOTAL QUANTITY INSTALLED FOR THE PACKAGE	QUANTITY RECOMMENDED SPARES FOR 2 YEARS OPERATIONS	QUANTITY RECOMMENDED FOR CAPITAL / INSURANCE SPARES	SIZE & DIMENSIONS - L x W x H (mm)	GROSS WEIGHT (kg)	UNIT WEIGHT (kg)	PLANNED DELIVERY TIME (days)	UNIT PRICE / CURRENCY	WARRANTY PERIOD (months)
		ELECTRICAL														
F1	4481-MEEP-0001	Cathode Sealing Equipment	Cathode block oven (capacity of 6 cathode blocks)	Thermocouple 28"	RDC Contrôle	80UK000 type K 28in	1347-F1-1000	6	3	0	800X100X100	4	4	20	$119.29	12
F1	4481-MEEP-0001	Cathode Sealing Equipment	Cathode block oven (capacity of 6 cathode blocks)	Compressing fitting	RDC Contrôle	SS-400-1-8-BT	1347-F1-1000	8	4	0	100X100X100	2	2	20	$34.40	12
F1	4481-MEEP-0001	Cathode Sealing Equipment	Cathode block oven (capacity of 6 cathode blocks)	Duct Heater	ASB Heating Elements Ltd	WXL-54 (460V/60Hz)	1347-F1-1000	9	1	1	1000X1000X1000	25	25	40	$3,594.15	12
F1	4481-MEEP-0001	Cathode Sealing Equipment	Cathode block oven (capacity of 6 cathode blocks)	High Temperature Controller	Watlow	-LJAE-AARG (24vdc)	1347-F1-1000	3	1	0	300X300X300	2	2	20	$609.17	12
F1	4481-MEEP-0001	Cathode Sealing Equipment	Cathode block oven (capacity of 6 cathode blocks)	Shaft, 2-15/16'', Sq. Key drive 3/4'', SQ Key Wheel 5/8'', 316SS	The New York Blower Co	See description	1347-F1-1000	3	1	1	600X300X300	50	50	20	$4,752.84	12
F1	4481-MEEP-0001	Cathode Sealing Equipment	Cathode block oven (capacity of 6 cathode blocks)	Bearings	The New York Blower Co	Belt PU-300, 2 15/16"	1347-F1-1000	3	1	1	300X300X300	10	10	20	$4,049.07	12
F1	4481-MEEP-0001	Cathode Sealing Equipment	Cathode block oven (capacity of 6 cathode blocks)	Belts	The New York Blower Co	BX55	1347-F1-1000	3	1	1	300X300300	20	20	20	$192.81	12
F2	4481-MBMB-0001	Cathode Sealing Equipment	Cathode bar heating furnace (capacity of 16 bars)	Thermocouple 18"	RDC Contrôle	80UK000 type K 18in	1347-F2-1000	8	4	0	550X100X100	4	4	20	$135.39	12
F2	4481-MBMB-0001	Cathode Sealing Equipment	Cathode bar heating furnace (capacity of 16 bars)	Compressing fitting	RDC Contrôle	SS-600-1-8-BT	1347-F2-1000	6	3	0	100X100X100	2	2	20	$36.82	12
F2	4481-MBMB-0001	Cathode Sealing Equipment	Cathode bar heating furnace (capacity of 16 bars)	Temperature Transmitter	Rosemount	248R-A-L1-C1-Q4	1347-F2-1000	8	2	0	100X100X100	2	2	20	$1,054.83	12
F2	4481-MBMB-0001	Cathode Sealing Equipment	Cathode bar heating furnace (capacity of 16 bars)	Heat Seals	Eclipse	11698	1347-F2-1000	22	4	0	150X150X150	2	2	20	$125.83	12
F2	4481-MBMB-0001	Cathode Sealing Equipment	Cathode bar heating furnace (capacity of 16 bars)	High Temperature Controller	Watlow	-LJAE-AARG (24vdc)	1347-F2-1000	4	1	0	300X300X300	2	2	20	$609.17	12
F2	4481-MBMB-0001	Cathode Sealing Equipment	Cathode bar heating furnace (capacity of 16 bars)	Electrical Element	I Squared R Element	4x38x1.25 (2.02ohms)	1347-F2-1000	96	96	96	2500X150X150	5	5	40	$126.16	12
F2	4481-MBMB-0001	Cathode Sealing Equipment	Cathode bar heating furnace (capacity of 16 bars)	Terminal BA312	I Squared R Element	B312	1347-F2-1000	48	48	48	100X100X100	1	1	40	$6.62	12
F2	4481-MBMB-0001	Cathode Sealing Equipment	Cathode bar heating furnace (capacity of 16 bars)	Terminal A312	I Squared R Element	A312	1347-F2-1000	96	96	96	100X100X100	1	1	40	$6.35	12
F2	4481-MBMB-0001	Cathode Sealing Equipment	Cathode bar heating furnace (capacity of 16 bars)	Clamp	I Squared R Element	T32	1347-F2-1000	200	200	200	100X100X100	1	1	40	$5.95	12
F3	4481-MBAD-0001	Cathode Sealing Equipment	Ladle Pre-Heating Station	Temperature Controller	Honeywell	01-E0-1H00-100-0000	1347-F3-1000	1	1	1	150X150X150	2	2	20	$1,609.65	12
F3	4481-MBAD-0001	Cathode Sealing Equipment	Ladle Pre-Heating Station	Relay Flame Supervisor	Honeywell	RM7895C1012	1347-F3-1000	2	1	1	150X150X150	2	2	20	$837.90	12
F3	4481-MBAD-0001	Cathode Sealing Equipment	Ladle Pre-Heating Station	Purge Card	Honeywell	ST7800A1005	1347-F3-1000	2	1	1	100X100X100	1	1	20	$73.50	12
F4	4481-MEVD-0001	Cathode Sealing Equipment	Cast Iron Ingot Drying Station	Flame Amplifier (Flame Rod)	Honeywell	R7847B1031	1347-F4-1000	2	1	1	100X100X100	1	1	20	$718.83	12
F3	4481-MBAD-0001	Cathode Sealing Equipment	Ladle Pre-Heating Station	Flame Amplifier (UV detector)	Honeywell	R7849A1023	1347-F3-1000	2	1	1	100X100X100	2	2	20	$251.37	12
F3	4481-MBAD-0001	Cathode Sealing Equipment	Ladle Pre-Heating Station	Display Module	Honeywell	S7800A1001	1347-F3-1000	2	1	1	100X100X100	2	2	20	$542.43	12
F3	4481-MBAD-0001	Cathode Sealing Equipment	Ladle Pre-Heating Station	UV detector	Honeywell	C7027A1049	1347-F3-1000	2	1	1	200X200X100	2	2	20	$270.48	12
F2	4481-MBMB-0001	Cathode Sealing Equipment	Cathode bar heating furnace (capacity of 16 bars)	Gasket	I Squared R Element	TGA-32-3	1347-F2-1000	200	200	200	100X100X100	1	1	40	$8.47	12
DSL	4481-MHCD-0002-M1-LDS	Cathode Sealing Equipment	Local Control Panel	Local Disconnect Switch Box	CEFEM	965) 1347-51151 rev 1	1347-52250	23	1	0	800X400X400	5	5	40	$840.09	12
DSL	4481-MHCD-0002-M1-LDS	Cathode Sealing Equipment	Local Control Panel	Local Disconnect Switch Box	CEFEM	965) 1347-51150 rev 1	1347-52250	13	1	0	800X400X400	5	5	40	$1,034.63	12

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ZZE	4481-EV-1001	Cathode Sealing Equipment	SCR Control Panel	Fuse 250A	GouldShawmut	A4J250	1347-52250	9	3	0	100X500X50	2	2	20	$135.24	12
ZZE	4481-EV-1001	Cathode Sealing Equipment	SCR Control Panel	Fuse 300A	GouldShawmut	A4J300	1347-52250	12	3	0	100X500X50	2	2	20	$135.24	12
ZZE	4481-EV-1001	Cathode Sealing Equipment	SCR Control Panel	SCR	WATLOW	WATQ33482300AL0	1347-52250	4	1	0	200X200X100	2	2	15	$5,652.15	12
ZZE	4481-EV-1001	Cathode Sealing Equipment	SCR Control Panel	SCR	WATLOW	WATQ32482300BV0	1347-52250	3	1	0	200X200X100	2	2	15	$4,013.10	12
ZZE	4481-EV-1001	Cathode Sealing Equipment	SCR Control Panel	Fan	Rittal	RIT3327107 230V	1347-52250	4	1	0	500X500X500	10	10	20	$464.52	12
ZZE	4481-EV-1001	Cathode Sealing Equipment	SCR Control Panel	Filtre	Rittal	RIT3326207	1347-52250	4	4	0	200X200X200	5	5	20	$93.05	12
ZZE	4481-EV-1001	Cathode Sealing Equipment	SCR Control Panel	Thermostat	Rittal	RIT3110000	1347-52250	2	1	0	100X100X100	2	2	20	$74.10	12
PLC	4481-CP-1001	Cathode Sealing Equipment	Central Control Desk	A/C system	Rittal	RIT3201200	1347-52250	6	1	0	600X600X200	10	10	20	$2,498.56	12
ZZE	4481-EV-1001	Cathode Sealing Equipment	SCR Control Panel	Fluorescent	Rittal	RITs24139140	1347-52250	16	2	0	1000X200X200	4	4	20	$360.15	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	Ampli Photoelectrique 24VDC	Carlo Gavazzi	S142BRNN-924	1347-52000	8	3	1	100X100X100	1	1	40	$316.05	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	Transmitter	Carlo Gavazzi	MOFT20-M12-8	1347-52000	8	3	1	300X50X50	1	1	40	$115.40	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	Receiver	Carlo Gavazzi	MOFR-M12-8	1347-52000	8	3	1	300X50X50	1	1	40	$115.40	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	Optic Fibre	Carlo Gavazzi	OFMS1-10 (1m)	1347-52000	8	3	1	100X100X100	2	2	40	$356.48	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	Base	Carlo Gavazzi	ZPD11 (11 pins)	1347-52000	8	3	1	100X100X100	1	1	40	$10.11	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	Limit Switch	Télémécanique	ZCKJ2H7	1347-52000	20	5	0	100X100X100	2	2	15	$82.32	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	Limit Switch Head	Télémécanique	ZCKE055	1347-52000	20	5	0	100X100X100	2	2	15	$52.86	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	Lever 4 / 5	Télémécanique	ZCKY43 or ZCKY53	1347-52000	20	5	0	100X100X100	2	2	15	$12.35	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	Proximity Switch	Télémécanique	XS7C40MP230TT	1347-52000	81	9	0	100X100X100	2	2	15	$169.05	12
		MCC													$0.00	
MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	1A Fuse link	NCE Switchgear	123-01	1347-52250		10	0	400X400X100	3	3	15	$2.55	12
MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	Contactor	NCE Switchgear	100-C09-B400	1347-52250		1	0	200X200X100	2	2	15	$49.52	12
MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	Contactor	NCE Switchgear	100-C09-B10	1347-52250	TBA	1	0	200X200X100	2	2	20	$47.08	12
MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	Contactor	NCE Switchgear	100-C16-B10	1347-52250	TBA	1	0	200X200X100	2	2	20	$69.03	12
MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	Contactor	NCE Switchgear	100-C23-B10	1347-52250	TBA	1	0	200X200X100	2	2	20	$96.57	12
MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	Contactor	NCE Switchgear	100-C30-B00	1347-52250	TBA	1	0	200X200X100	2	2	20	$146.81	12
MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	Overload	NCE Switchgear	193-EE-DB	1347-52250	TBA	1	0	200X200X100	2	2	20	$70.49	12
MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	Overload	NCE Switchgear	193-EE-CB	1347-52250	TBA	1	0	200X200X100	2	2	20	$70.49	12
MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	Overload	NCE Switchgear	193-EE-EB	1347-52250	TBA	1	0	200X200X100	2	2	20	$81.22	12
MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	Overload	NCE Switchgear	193-EE-FD	1347-52250	TBA	1	0	200X200X100	2	2	20	$145.60	12
MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	MCB	NCE Switchgear	1492-SP1C100	1347-52250		1	0	200X200X100	2	2	20	$18.02	12
MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	Plug (mains)	NCE Switchgear	15-0113	1347-52250		2	0	200X200X100	2	2	20	$47.85	12
MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	Plug (controls)	NCE Switchgear	O645060000	1347-52250		2	0	200X200X100	2	2	20	$19.46	12
MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	Socket (mains)	NCE Switchgear	15-0114	1347-52250		2	0	200X200X100	2	2	20	$79.11	12
MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	Socket (controls)	NCE Switchgear	O645260000	1347-52250		2	0	200X200X100	2	2	20	$32.28	12
MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	Breaker	NCE Switchgear	140M-D8N-B63	1347-52250		1	0	200X200X100	2	2	20	$104.87	12

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MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	Breaker	NCE Switchgear	140M-D8N-B40	1347-52250		1	0	200X200X100	2	2	20	$104.87	12
MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	Breaker	NCE Switchgear	140M-F8E-C16	1347-52250		1	0	200X200X100	2	2	20	$197.79	12
MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	Breaker	NCE Switchgear	140M-F8N-C32	1347-52250		1	0	200X200X100	2	2	20	$226.57	12
MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	Breaker	NCE Switchgear	140M-D8N-B25	1347-52250		1	0	200X200X100	2	2	20	$104.87	12
MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	Breaker	NCE Switchgear	140M-F8E-C20	1347-52250		1	0	200X200X100	2	2	20	$197.79	12
MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	Breaker	NCE Switchgear	140M-C2E-B25	1347-52250		1	0	200X200X100	2	2	20	$94.39	12
MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	Breaker	NCE Switchgear	140M-C2E-B16	1347-52250		1	0	200X200X100	2	2	20	$88.28	12
MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	Breaker	NCE Switchgear	140M-C2E-B40	1347-52250		1	0	200X200X100	2	2	20	$94.39	12
MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	Breaker	NCE Switchgear	140M-C2E-C10	1347-52250		1	0	200X200X100	2	2	20	$104.87	12
MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	Relay	NCE Switchgear	700-HC24Z24-3	1347-52250		4	0	200X200X100	2	2	20	$17.19	12
MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	Base	NCE Switchgear	700-HN104	1347-52250		2	0	200X200X100	2	2	20	$9.17	12
MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	Indicating light [R]	NCE Switchgear	XB4 BVB1	1347-52250		2	0	200X200X100	2	2	20	$27.29	12
MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	Indicating Lights [Y]	NCE Switchgear	XB4 BVB5	1347-52250		2	0	200X200X100	2	2	20	$27.29	12
MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	Drive	NCE Switchgear	AD1P3AOAYNANCO	1347-52250		1	0	200X200X100	2	2	20	$1,192.54	12
MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	Drive	NCE Switchgear	AD2P1AOAYNANCO	1347-52250		1	0	200X200X100	2	2	20	$1,251.07	12
MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	Drive	NCE Switchgear	AD3P5AOAYNANCO	1347-52250		1	0	200X200X100	2	2	20	$1,316.91	12
MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	Drive	NCE Switchgear	AD8P7AOAYNANCO	1347-52250		1	0	200X200X100	2	2	20	$1,665.65	12
MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	Breaker handle	NCE Switchgear	140M-C-DRY66	1347-52250		4	0	200X200X100	2	2	20	$55.12	12
MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	Contactor	NCE Switchgear	100-C09-DJ10	1347-52250		1	0	200X200X100	2	2	20	$73.39	12
MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	Contactor	NCE Switchgear	100-C09-DJ10	1347-52250		1	0	200X200X100	2	2	20	$73.39	12
MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	Breaker Auxiliary	NCE Switchgear	140M-C-AFA10	1347-52250		2	0	200X200X100	2	2	20	$9.52	12
MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	Contactor Auxiliary	NCE Switchgear	100FA22	1347-52250		2	0	200X200X100	2	2	20	$21.79	12
MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	Reset Push	NCE Switchgear	800FP-R611	1347-52250		2	0	200X200X100	2	2	20	$14.49	12
MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	Reset Rod	NCE Switchgear	800F-ATR08	1347-52250		2	0	200X200X100	2	2	20	$7.32	12
MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	Reset adaptor	NCE Switchgear	193ERA	1347-52250		2	0	200X200X100	2	2	20	$7.32	12
MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	Meter	NCE Switchgear	C13-01	1347-52250		1	0	200X200X100	2	2	20	$126.81	12
MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	TX	NCE Switchgear	100VA 460/230/60HZ	1347-52250		1	0	200X200X100	2	2	20	$67.94	12
MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	Fan	NCE Switchgear	SK3322107	1347-52250		1	0	200X200X100	2	2	20	$186.85	12
MCL	4480-ECM1-0001	Cathode Sealing Equipment	MCC Panel	TX	NCE Switchgear	50VA460/230/60HZ	1347-52250		1	0	200X200X100	2	2	20	$60.39	12
		MECHANICAL													$0.00	
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	Chain 40(119043)	RENOLD	119043	1347-AR-0000	60	10	0	600X500X300	10	10	15	$5.66	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	Chain 40-2	RENOLD	115043	1347-AR-0000	30	10	0	600X500X300	10	10	15	$13.01	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	Chain 80(119083)	RENOLD	119083	1347-AR-0000	420	50	10	600X500X300	25	25	15	$17.27	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	Chain 60-2(115063)	RENOLD	115063	1347-AR-0000	10	10	0	600X500X300	10	10	15	$23.31	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	Chain 60(119063)	RENOLD	119063	1347-AR-0000	30	10	0	600X500X300	10	10	15	$9.42	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	Chain 140(119143)	RENOLD	119143	1347-AR-0000	30	10	0	1000x500X300	25	25	15	$48.66	12

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		PLC													$0.00	
PLC	4481-CP-1001	Cathode Sealing Equipment	Central Control Desk	CONTROLLOGIX CHASSIS 10 Slot	Allen Bradley	1756-A-10	1347-52250	2	0	0	200X200X100	2	2	15	$705.93	12
PLC	4481-CP-1001	Cathode Sealing Equipment	Central Control Desk	POWER SUPPLY, 13 AMP A 5V / 85-265Vac	Allen Bradley	1756-PA75	1347-52250	2	1	0	200X200X100	2	2	15	$1,297.70	12
PLC	4481-CP-1001	Cathode Sealing Equipment	Central Control Desk	INTERFACE MODULE	Allen Bradley	1756-EN2F	1347-52250	1	1	0	200X200X100	2	2	15	$3,835.49	12
PLC	4481-CP-1001	Cathode Sealing Equipment	Central Control Desk	PROCESSOR ETHERNET 10-100M / INTERFACE MODULE	Allen Bradley	1756-L73	1347-52250	1	1	0	200X200X100	2	2	15	$14,191.93	12
PLC	4481-CP-1001	Cathode Sealing Equipment	Central Control Desk	DIGITAL INPUT CARD 10-31 VDC NPUT 32 PTS	Allen Bradley	1756-1B32	1347-52250	9	1	0	200X200X100	2	2	15	$545.68	12
PLC	4481-CP-1001	Cathode Sealing Equipment	Central Control Desk	SLOT FILLER	Allen Bradley	1756-N2	1347-52250	2	1	0	200X200X100	2	2	15	$33.52	12
PLC	4481-CP-1001	Cathode Sealing Equipment	Central Control Desk	DIGITAL OUTPUT CARD N.O. ISOLATED RELAY OUTPUT 16 PTS	Allen Bradley	1756-OW 161	1347-52250	2	1	0	200X200X100	2	2	15	$762.49	12
PLC	4481-CP-1001	Cathode Sealing Equipment	Central Control Desk	ANALOG OUTPUT CARD, ISOLATED ANALOG OUTPUT-CURRENT 6 PTS	Allen Bradley	1756-OF6C1	1347-52250	2	1	0	200X200X100	2	2	15	$2,889.71	12
PLC	4481-CP-1001	Cathode Sealing Equipment	Central Control Desk	IFM MODULE 40-POINT FEED-TOUCH DIGITAL IFM, STANDARD	Allen Bradley	1492-IFM40D24	1347-52250	9	1	0	200X200X100	2	2	15	$264.85	12
PLC	4481-CP-1001	Cathode Sealing Equipment	Central Control Desk	CABLE 2.5 METRE PRE-WIRED CABLE FOR 1756-32 PT I/O MODULES	Allen Bradley	1492-CABLE025Z	1347-52250	4	1	0	200X200X100	2	2	15	$296.13	12
PLC	4481-CP-1001	Cathode Sealing Equipment	Central Control Desk	SCREW CLAMP BLOCK 20 POSITIONS NEMA	Allen Bradley	1756-TBSH	1347-52250	2	1	0	200X200X100	2	2	15	$81.70	12
PLC	4481-CP-1001	Cathode Sealing Equipment	Central Control Desk	SCREW CLAMP BLOCK 36 PIN SCREW CLAMP BLOCK WITH STANDARD HOUSING	Allen Bradley	1756-TBS6H	1347-52250	2	1	0	200X200X100	2	2	15	$101.60	12
PLC	4481-CP-1001	Cathode Sealing Equipment	Central Control Desk	ETHERNET PORT ETHERNET/IP TAP3 COPPER PORTS	Allen Bradley	1783-ETAP	1347-52250	8	1	0	200X200X100	2	2	15	$384.39	12
PLC	4481-CP-1001	Cathode Sealing Equipment	Central Control Desk	ETHERNET MODULE/IP 10/100Mb FLEX I/O ADAPTER MODULE (10 BASE T)	Allen Bradley	1794-AENT	1347-52250	4	1	0	200X200X100	2	2	15	$898.65	12
PLC	4481-CP-1001	Cathode Sealing Equipment	Central Control Desk	INPUT MODULE 24 VDC, 16 SINK INPUTS	Allen Bradley	1794-IB16	1347-52250	11	1	0	200X200X100	2	2	15	$385.43	12
PLC	4481-CP-1001	Cathode Sealing Equipment	Central Control Desk	OUTPUT MODULE 24 VDC, 16 SOURCE OUTPUTS	Allen Bradley	1794-OB16	1347-52250	3	1	0	200X200X100	2	2	15	$564.54	12
PLC	4481-CP-1001	Cathode Sealing Equipment	Central Control Desk	ANALOG INPUT MODULE 8 SINGLE-ENDED INPUTS	Allen Bradley	1794-IF8IH	1347-52250	2	1	0	200X200X100	2	2	15	$1,984.78	12
PLC	4481-CP-1001	Cathode Sealing Equipment	Central Control Desk	BASE WITH SPRING TERMINAL BASE 3-WIRE, CAGE CLAMP	Allen Bradley	1794-TB3S	1347-52250	25	5	0	200X200X100	2	2	15	$242.99	12
PLC	4481-CP-1001	Cathode Sealing Equipment	Central Control Desk	INDUSTRIAL INTEGRATED DISPLAY COMPUTER- TOUCHSCREEN-40GbSATA HDD PERFORMANCE	Allen Bradley	6181P-17TPXPDC	1347-52250	1	0	0	200X200X100	2	2	15	$7,830.18	12
PLC	4481-CP-1001	Cathode Sealing Equipment	Central Control Desk	PANEL VIEW PLUS PANEL VIEW PLUS 700 TOUCH, STANDARD COMMUNICATIONS (ETHERNET & RS-	Allen Bradley	2711P-T7C4D1	1347-52250	1	0	0	200X200X100	2	2	15	$4,730.78	12
PLC	4481-CP-1001	Cathode Sealing Equipment	Central Control Desk	CABLE 1 METRE PRE-WIRED CABLE FOR 1756 32-PT I/O MODULES	Allen Bradley	1492-CABLE010Z	1347-52250	5	1	0	200X200X100	2	2	15	$247.12	12
PLC	4481-CP-1001	Cathode Sealing Equipment	Central Control Desk	OUTPUT MODULE 24 VDC, 16 OUTPUTS WITH ELECT.FUSING	Allen Bradley	1794-OB8EP	1347-52250	9	1	0	200X200X100	2	2	15	$449.32	12
PLC	4481-CP-1001	Cathode Sealing Equipment	Central Control Desk	ETHERNET POWERFLEX 70/700 ETHERNET I/P TO DPI COMM.	Allen Bradley	20-COMM-E COMM.	1347-52250	1	1	0	200X200X100	2	2	15	$617.95	12
PLC	4481-CP-1001	Cathode Sealing Equipment	Central Control Desk	INTERFACE MODULE ETHERNET 10-100M INTERFACE MODULE	Allen Bradley	1756-EN2T	1347-52250	3	1	0	200X200X100	2	2	15	$3,496.14	12
PLC	4481-CP-1001	Cathode Sealing Equipment	Central Control Desk	CPU Battery	Allen Bradley	TBA	1347-52250	1	1	0	100X100X100	1	1	15	$227.85	12
		SAFETY													$0.00	
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	SAFETY LIGHT CURTAIN R4	Allen Bradley	445L-P4S3400YD	1347-52000	1	1	0	300X1500X300	10	10	30	$1,784.73	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	SAFETY LIGHT CURTAIN R4	Allen Bradley	445L-P4S3400YD	1347-52000	5	1	0	300X1500X300	10	10	30	$1,784.73	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	SAFETY MAT YELLOW 750mmx1000mm C2	Allen Bradley	440F-M1520BYNN	1347-52000	8	8	0	750X1000X300	15	15	30	$859.95	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	SAFETY MAT YELLOW 750mmx1000mm C4	Allen Bradley	440F-M1520BYNN	1347-52000	14	0	0	750X1000X300	15	15	30	$859.95	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	SAFETY MAT YELLOW 750mmx1000mm C1	Allen Bradley	440F-M1520BYNN	1347-52000	6	0	0	750X1000X300	15	15	30	$859.95	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	MONITORING SAFETY RELAY MSR210P	Allen Bradley	440R-H23176	1347-52000	2	1	0	300X200X200	2	2	30	$783.22	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	MONITORING SAFETY RELAY MSR211P	Allen Bradley	440R-H23179	1347-52000	4	1	0	300X200X200	2	2	30	$193.16	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	MONITORING SAFETY RELAY MSR121RT	Allen Bradley	440R-J23102	1347-52000	1	1	0	300X200X200	2	2	30	$488.22	12

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General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	MONITORING SAFETY RELAY MSR121RT	Allen Bradley	440R-J23102	1347-52000	1	1	0	300X200X200	2	2	30	$488.22	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	MONITORING SAFETY RELAY MSR121RT	Allen Bradley	440R-J23102	1347-52000	2	1	0	300X200X200	2	2	30	$488.22	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	STANDARD ALUMINIUM PERIMETER TRIM 2m	Allen Bradley	440F-T3210	1347-52000	4	1	0	300X200X200	2	2	30	$62.18	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	ACTIVE UNITING TRIM 1.5m LENGHT	Allen Bradley	440F-T3020	1347-52000	1	1	0	300X200X200	2	2	30	$95.26	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	EXTERNAL CORNER PERIMETER TRIM	Allen Bradley	440F-T3012	1347-52000	7	1	0	300X200X200	2	2	30	$50.27	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	STANDARD PERIMETER ALUMINIUM TRIM 3m	Allen Bradley	440F-T3310	1347-52000	1	1	0	300X200X200	2	2	30	$111.13	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	ACTIVE UNITING TRIM 1.5m LENGHT	Allen Bradley	440F-T3020	1347-52000	3	1	0	300X200X200	2	2	30	$95.26	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	EXTERNAL CORNER PERIMETER TRIM	Allen Bradley	440F-T3012	1347-52000	3	1	0	300X200X200	2	2	30	$50.27	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	STANDARD ALUMINIUM PERIMETER TRIM	Allen Bradley	440F-T3210	1347-52000	9	1	0	300X200X200	2	2	30	$62.18	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	MAT TRIM 3m LENGHT	Allen Bradley	440F-T3320	1347-52000	3	1	0	300X200X200	2	2	30	$185.22	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	MAT TRIM 2m LENGHT	Allen Bradley	440F-T3220	1347-52000	4	1	0	300X200X200	2	2	30	$124.36	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	EXTERNAL CORNER PERIMETER TRIM	Allen Bradley	440F-T3014	1347-52000	4	1	0	300X200X200	2	2	30	$137.59	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	ALUMINIUM PERIMETER TRIM 3m LENGHT	Allen Bradley	440F-T3311	1347-52000	2	1	0	300X200X200	2	2	30	$154.79	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	ALUMINIUM PERIMETER TRIM 4m LENGHT	Allen Bradley	440F-T3411	1347-52000	4	1	0	300X200X200	2	2	30	$209.18	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	CABLE SHIELDED STRAIGHT FEMALE 5m	Allen Bradley	889D-F5EC-5	1347-52000	4	1	0	300X200X200	2	2	30	$50.72	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	CABLE SHIELDED STRAIGHT FEMALE 10m	Allen Bradley	889D-F5EC-10	1347-52000	8	3	0	300X200X200	2	2	30	$76.07	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	STAINLESS STEEL Z-CLIP 11X5=55	Allen Bradley	440F-T102935	1347-52000	10	1	0	300X200X200	2	2	30	$80.70	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	LIMIT SWITCH SAFETY SWITCH TYPE 4 R4	Allen Bradley	802T-ATPD	1347-52000	2	1	0	300X200X200	2	2	30	$250.27	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	OPERATING LEVIER 3 IN. R4	Allen Bradley	802T-W30A	1347-52000	2	1	0	300X200X200	2	2	30	$40.79	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	Unit Exchange Key kit Key A,B,C,D,E,F,G,H,I,J,K,L,M,N,O	Allen Bradley	440T-AIPB33	1347-52000	1	1	0	200X200X100	1	1	30	$831.11	12
		CHILLER													$0.00	
W1	4481-MEHX-0001	Cathode Sealing Equipment	Chiller for Hydraulic Power Unit	COMPRESSOR	FRASCOLD	Q 7 28.1Y	1347-W1-1000	1	1	0	900X600X600	25	25	25	$6,762.00	12
W1	4481-MEHX-0001	Cathode Sealing Equipment	Chiller for Hydraulic Power Unit	EVAPORATOR	HEX	BL26-100H	1347-W1-1000	1	1	0	300X300X200	4	4	25	$2,940.00	12
W1	4481-MEHX-0001	Cathode Sealing Equipment	Chiller for Hydraulic Power Unit	SECONDARY HEAT EXCHANGER SHELL & TUBE	API Basco	AHT-4 Bass	1347-W1-1000	2	1	0	300X300X200	4	4	25	$1,617.00	12
W1	4481-MEHX-0001	Cathode Sealing Equipment	Chiller for Hydraulic Power Unit	RELIEF VALVE	STREAMLINE	AH15503	1347-W1-1000	1	1	0	300X300X200	4	4	25	$470.40	12
W1	4481-MEHX-0001	Cathode Sealing Equipment	Chiller for Hydraulic Power Unit	FILTER DRIER	EMERSON	EKP-41 7 S	1347-W1-1000	1	2	0	300X300X200	4	4	25	$88.20	12
W1	4481-MEHX-0001	Cathode Sealing Equipment	Chiller for Hydraulic Power Unit	LIQUID LINE S.V.	EMERSON	240RA 8 T 5 M	1347-W1-1000	1	1	0	300X300X200	4	4	25	$264.60	12
W1	4481-MEHX-0001	Cathode Sealing Equipment	Chiller for Hydraulic Power Unit	THERMOSTATIC EXPANSION VALVE	SPORLAN	SJE-5-C	1347-W1-1000	1	2	0	300X300X200	4	4	25	$661.50	12
W1	4481-MEHX-0001	Cathode Sealing Equipment	Chiller for Hydraulic Power Unit	BALL VALVE	EMERSON	BVS 058 PCN 806756	1347-W1-1000	1	1	0	300X300X200	4	4	25	$152.88	12
W1	4481-MEHX-0001	Cathode Sealing Equipment	Chiller for Hydraulic Power Unit	COIL FOR SOLENOID VALVE			1347-W1-1000	2	2	0	300X300X200	2	2	25	$88.20	12
W1	4481-MEHX-0001	Cathode Sealing Equipment	Chiller for Hydraulic Power Unit	TEMPERATURE SENSOR	JOHNSON CONTRO	A350P	1347-W1-1000	1	1	0	600X600X600	5	5	25	$88.20	12
W1	4481-MEHX-0001	Cathode Sealing Equipment	Chiller for Hydraulic Power Unit	HIGH PRESS. SWITCH	SAGINOMIYA	HNS2C130YM1Q5	1347-W1-1000	1	1	0	300X300X200	3	3	25	$463.05	12
W1	4481-MEHX-0001	Cathode Sealing Equipment	Chiller for Hydraulic Power Unit	LOW PRESSURE SWITCH	SAGINOMIYA	SNS-2C106YQ11	1347-W1-1000	1	1	0	300X300X200	2	2	25	$463.05	12
W1	4481-MEHX-0001	Cathode Sealing Equipment	Chiller for Hydraulic Power Unit	CONDENSER FAN	KEMAO	30''	1347-W1-1000	1	1	0	300X300X200	5	5	25	$191.10	12
W1	4481-MEHX-0001	Cathode Sealing Equipment	Chiller for Hydraulic Power Unit	CONDENSER FAN MOTOR	KEMAO	1130RPM,460/3/60	1347-W1-1000	1	1	0	300X300X200	5	5	25	$1,073.10	12

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W1	4481-MEHX-0001	Cathode Sealing Equipment	Chiller for Hydraulic Power Unit	SENSOR	DIXELL	XR30	1347-W1-1000	1	1	0	600X600X600	10	10	25	$88.20	12
W1	4481-MEHX-0001	Cathode Sealing Equipment	Chiller for Hydraulic Power Unit	FREEZESTAT	SAGINOMIYA	CNS 2C114YM2Q3	1347-W1-1000	1	1	0	600X600X600	10	10	25	$455.70	12
W1	4481-MEHX-0001	Cathode Sealing Equipment	Chiller for Hydraulic Power Unit	FLOW SWITCH	SAGINOMIYA	FQSU30G	1347-W1-1000	1	1	0	600X600X600	10	10	25	$441.00	
W1	4481-MEHX-0001	Cathode Sealing Equipment	Chiller for Hydraulic Power Unit	CHILLER PUMP	ROTECH	DN 32/16	1347-W1-1000	1	1	0	600X600X600	10	10	25	$2,499.00	
W1	4481-MEHX-0001	Cathode Sealing Equipment	Chiller for Hydraulic Power Unit	3 WAY ELECTRIC VALVE	DANFOSS	ESBE 90 SERIES	1347-W1-1000	1	1	0	600X600X600	10	10	25	$1,102.50	
		SHOTBLASTING MACHINE													$0.00	
S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	13-1/2" BLADE SETS (8)	Wheelabrator Group	C113315	1347-S1-1000	1	4	4	600X600X300	30	30	20	$477.90	12
S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	49 DEG CONTROL CAGE	Wheelabrator Group	737718	1347-S1-1000	1	4	4	300X300X300	15	15	20	$135.83	12
S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	25 EZEFIT 8 BLADE IMPELLER	Wheelabrator Group	737648	1347-S1-1000	1	4	4	600X600X300	15	15	20	$85.63	12
S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	SCREW / SHOULDER IMPELLER (677683)	Wheelabrator Group	682988	1347-S1-1000	1	1	0	600X600X300	15	15	20	$34.03	12
S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	WASHER / HI-COLLAR	Wheelabrator Group	683487	1347-S1-1000	1	1	0	100X100X100	2	2	20	$4.90	12
S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	25EZ140 WHEEL TUNE UP KIT	Wheelabrator Group	739535	1347-S1-1000	1	4	4	200X200X200	5	5	20	$698.62	12
S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	25 EZEFIT BARE WHEEL	Wheelabrator Group	738872	1347-S1-1000	1	4	0	600X600X300	15	15	20	$1,624.72	12
S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	CENTERING PLATE	Wheelabrator Group	731156	1347-S1-1000	1	4	0	200X200X200	5	5	20	$161.33	12
S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	FEED SPOUT LL FOR BD WHEEL ONLY	Wheelabrator Group	471181	1347-S1-1000	1	1	0	200X200X200	5	5	20	$595.72	12
S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	END LINER / 25EZ130-140	Wheelabrator Group	737646	1347-S1-1000	1	8	0	200X200X200	5	5	20	$238.51	12
S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	TOP LINER / 25EZ130-140	Wheelabrator Group	737645	1347-S1-1000	1	4	0	200X200X200	5	5	20	$199.41	12
S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	STEEL FEED SPOUT CLAMP	Wheelabrator Group	737703	1347-S1-1000	1	2	0	100X100X100	2	2	20	$76.88	12
S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	UHMW FEED SPOUT SEAL	Wheelabrator Group	736807	1347-S1-1000	1	1	0	200X200X200	5	5	20	$22.39	12
S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	HUB SEAL	Wheelabrator Group	730988	1347-S1-1000	1	1	0	200X200X200	5	5	20	$12.13	12
S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	ADHESIVE BACK FELT 2"WIDE X 1/8" THICK SOLD IN 50 FOOT LENGTHS	Wheelabrator Group	C015000	1347-S1-1000	1	50	0	200X200X200	5	5	20	$3.19	12
S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	PURE GUM FEED HOSE 3" ID X 4" OD	Wheelabrator Group	C001909	1347-S1-1000	1	20	0	100X100X100	2	2	20	$56.96	12
S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	DOUBLE BOLT CLAMPS	Wheelabrator Group	C100234	1347-S1-1000	1	4	0	100X100X100	5	5	20	$25.70	12
S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	5" ELEVATOR BELT ASSEMBLY	Wheelabrator Group	C214993	1347-S1-1000	1	1	0	200X200X200	5	5	20	$3,124.49	12
S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	STEEL ELEVATOR BELT SPLICE 5" (8X24)	Wheelabrator Group	C103286	1347-S1-1000	1	1	0	200X200X200	5	5	20	$133.06	12
S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	ELEVATOR BELT - PUNCHED ONLY	Wheelabrator Group	C214993PB	1347-S1-1000	1	1	0	300X300X300	5	5	20	$1,296.54	12
S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	ELEVATOR BUCKET 5" 2 - 1/2" CAST (016849)	Wheelabrator Group	C001158	1347-S1-1000	1	10	0	600X600X400	20	20	20	$22.71	12
S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	ELEVATOR BOLT 5 1/16" X 1-1/4" LONG C/W NYLON LOCK NUT	Wheelabrator Group	C001030	1347-S1-1000	1	20	0	100X100X100	2	2	20	$0.72	12
S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	CAP SCREW / FL HD	Wheelabrator Group	500590	1347-S1-1000	1	20	0	100X100X100	2	2	20	$2.87	12
S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	ELEVATOR, LEATHER WASHER (946597) (017402)	Wheelabrator Group	C001029	1347-S1-1000	1	20	0	100X100X100	2	2	20	$0.59	12
S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	2 BOLT PILLOW BLOCK BEARING, 50 MM SKF	Wheelabrator Group	C253627	1347-S1-1000	1	2	0	200X200X200	15	15	20	$238.88	12
S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	SHOT DISC, DWG. A3-38235	Wheelabrator Group	C167321	1347-S1-1000	1	2	0	200X200X200	5	5	20	$36.75	12
S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	FELT SEAL	Wheelabrator Group	C187807	1347-S1-1000	1	2	0	200X200X200	2	2	20	$51.20	12
S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	4 BOLT FLANGE BEARING, 50 MM SKF	Wheelabrator Group	C253628	1347-S1-1000	1	2	0	100X100X100	2	2	20	$210.58	12
S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	LINER	Wheelabrator Group	C215202	1347-S1-1000	1	2	0	200X200X200	5	5	20	$317.37	12

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S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	LINER	Wheelabrator Group	C215206	1347-S1-1000	1	1	0	200X200X200	5	5	20	$437.69	12
S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	LINER	Wheelabrator Group	C215208	1347-S1-1000	1	1	0	200X200X200	5	5	20	$73.12	12
S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	LINER	Wheelabrator Group	C215218	1347-S1-1000	1	1	0	200X200X200	5	5	20	$256.15	12
S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	1/2" CAP NUT CAST LONG-LYFE 13NC	Wheelabrator Group	220040	1347-S1-1000	1	9	0	100X100X100	2	2	20	$16.49	12
S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	OFFSET LINK	Wheelabrator Group	C239113	1347-S1-1000	1	8	0	100X100X100	2	2	20	$12.86	12
S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	CHAIN	Wheelabrator Group	C215426	1347-S1-1000	1	45	0	200X200X200	15	15	20	$15.07	12
S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	2 BOLT PILLOW BLOCK BEARING, 40 MM SKF	Wheelabrator Group	C253629	1347-S1-1000	1	14	0	200X200X200	10	10	20	$217.49	12
S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	FELT SEAL	Wheelabrator Group	C214889	1347-S1-1000	1	14	0	200X200X100	2	2	20	$51.20	12
S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	CABINET RUBBER SEAL	Wheelabrator Group	C236651	1347-S1-1000	1	6	0	300X300X100	5	5	20	$218.30	12
S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	SHOT DISC ASSEMBLY	Wheelabrator Group	C253767	1347-S1-1000	1	2	0	200X200X200	5	5	20	$121.28	12
S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	CHAIN CONNECTING LINK	Wheelabrator Group	C215427	1347-S1-1000	1	1	0	100X100X100	2	2	20	$6.25	12
S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	PAPER CARTRIDGE FILTER 12.75" OD X 8.38" ID X 36" LG	Wheelabrator Group	C057612	1347-S1-1000	1	9	0	600X600X600	15	15	20	$138.18	12
S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	SOLENOID VALVE	Wheelabrator Group	C245660	1347-S1-1000	1	3	0	100X100X100	2	2	20	$124.66	12
S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	MAGNEHELIC GAUGE INLINE FILTER	Wheelabrator Group	C106586	1347-S1-1000	1	1	0	600X600X600	15	15	20	$91.45	12
S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	FILTER / AFTER 24 X 24 X 12	Wheelabrator Group	663949	1347-S1-1000	1	6	0	600X600X600	15	15	20	$229.69	12
S1	4481-MZBP-0001	Cathode Sealing Equipment	Cathode bar Shotblasting Machine	EZFIT 15HP BLAST WHEEL MOTOR, 460V	Wheelabrator Group	C253508	1347-S1-1000	1	1	0	600X600X600	75	75	20	$4,438.81	12
		HYDRAULIC POWER UNIT													$0.00	
H1	4481-MPF0-0001	Cathode Sealing Equipment	Hydraulic Power Unit	5" THERMOMETER W/ TILT HEAD	Dresser -aschroft	50-EL42E-040-XCS	1347-H1-1000	1	1	0	200X200X400	1	1	30	$365.60	12
H1	4481-MPF0-0001	Cathode Sealing Equipment	Hydraulic Power Unit	Breather pressurisable, 5psi, 3/4"npt, 10mic	Parker	PAB.1730.10.5	1347-H1-1000	1	1	0	100X100X100	0.5	0.5	15	$32.42	12
H1	4481-MPF0-0001	Cathode Sealing Equipment	Hydraulic Power Unit	Element 74W single length Viton	Parker	925043	1347-H1-1000	4	4	0	150X150X400	8	2	15	$288.08	12
H1	4481-MPF0-0001	Cathode Sealing Equipment	Hydraulic Power Unit	3 PSID Electrical	Parker	924966	1347-H1-1000	2	1	0	200X200X200	0.5	0.5	15	$205.77	12
H1	4481-MPF0-0001	Cathode Sealing Equipment	Hydraulic Power Unit	Limit switch (installed on item 10)	Schneider Telemecan	XCKJ10511H7	1347-H1-1000	11	2	0	50X50X100	2	1	15	$127.08	12
H1	4481-MPF0-0001	Cathode Sealing Equipment	Hydraulic Power Unit	Pump Seal kit	Parker	SKPVP23/33V20	1347-H1-1000		2	0	200X200X10	1	0.5	30	$303.04	12
H1	4481-MPF0-0001	Cathode Sealing Equipment	Hydraulic Power Unit	var piston pump, 23cc/rev, 35lpm (9.2gpm)r	Parker	PVP23362R2V	1347-H1-1000	2	1	1	400X400X300	20	20	45	$2,157.12	12
H1	4481-MPF0-0001	Cathode Sealing Equipment	Hydraulic Power Unit	Magnaloy insert	Magnaloy	M470N6	1347-H1-1000	2	2	0	100X100X100	1	0.5	15	$7.98	12
H1	4481-MPF0-0001	Cathode Sealing Equipment	Hydraulic Power Unit	Dual scale pressure gauge 0-3000psi	Winters	PPC5073SF	1347-H1-1000	1	1	1	200X200X400	1	1	30	$463.36	12
H1	4481-MPF0-0001	Cathode Sealing Equipment	Hydraulic Power Unit	Visual elecric indicator	Parker	929599	1347-H1-1000	4	1	0	100X200X200	0.5	0.5	15	$206.77	12
H1	4481-MPF0-0001	Cathode Sealing Equipment	Hydraulic Power Unit	10 micron high collapse, single, viton	Parker	932627Q	1347-H1-1000	2	2	0	150X150X400	2	1	15	$183.78	12
H1	4481-MPF0-0001	Cathode Sealing Equipment	Hydraulic Power Unit	Solenoid valve, N.O, overide, viton, 24vdc w	Parker	DSH101NRMV-D024I	1347-H1-1000	1	1	1	100X50X50	0.5	0.5	30	$123.89	12
H1	4481-MPF0-0001	Cathode Sealing Equipment	Hydraulic Power Unit	24 VDC coil	Parker	CAP024D	1347-H1-1000	1	1	0	50X50X50	0.5	0.5	15	$24.17	12
H1	4481-MPF0-0001	Cathode Sealing Equipment	Hydraulic Power Unit	Element 10micron, single, viton	Parker	937403Q	1347-H1-1000	2	2	0	150X150X400	2	1	15	$158.46	12
H1	4481-MPF0-0001	Cathode Sealing Equipment	Hydraulic Power Unit	Electrical indicator	Parker	926643	1347-H1-1000	2	2	0	100X200X200	1	0.5	15	$205.77	12
H1	4481-MPF0-0001	Cathode Sealing Equipment	Hydraulic Power Unit	Visual indicator	Parker	926748	1347-H1-1000	2	2	0	100X200X200	1	0.5	15	$143.27	12
H1	4481-MPF0-0001	Cathode Sealing Equipment	Hydraulic Power Unit	Test coupler, SAE-4 with cover	Parker	EMA3/7/16-20UNF-2A	1347-H1-1000	4	2	0	50X50X50	1	0.5	15	$25.42	12
H1	4481-MPF0-0001	Cathode Sealing Equipment	Hydraulic Power Unit	DVC D03, spring center, 24vdc, to receive d	Parker	D1VW004CVJW	1347-H1-1000	11	1	1	300X100X100	5	5	30	$336.28	12

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H1	4481-MPF0-0001	Cathode Sealing Equipment	Hydraulic Power Unit	Seal kit	Parker	SKD1VW	1347-H1-1000	11	1	1	50X50X50	0.1	0.1	15	$47.58	12
H1	4481-MPF0-0001	Cathode Sealing Equipment	Hydraulic Power Unit	24 VDC Coils	Parker	CK1860414-30-24	1347-H1-1000	33	5	0	50X50X100	2.5	0.5	15	$175.18	12
H1	4481-MPF0-0001	Cathode Sealing Equipment	Hydraulic Power Unit	Connector din 24vdc w. ligth, ISO 1/2"npt cc	Canfield	P5103-3831000	1347-H1-1000	38	5	1	50X50X50	2.5	0.5	15	$13.96	12
H1	4481-MPF0-0001	Cathode Sealing Equipment	Hydraulic Power Unit	Counterbalance valve, ratio 3:1,300-1500 ps	Parker	CB101-AS10V	1347-H1-1000	26	2	0	50X50X100	1	0.5	30	$65.98	12
H1	4481-MPF0-0001	Cathode Sealing Equipment	Hydraulic Power Unit	Body for cb valve, sandwich D03, steel (nee	Parker	BD03-DDX-VS	1347-H1-1000	15	1	0	50X50X100	1	1	45	$185.73	12
H1	4481-MPF0-0001	Cathode Sealing Equipment	Hydraulic Power Unit	DCV D03, spring offset, 24vdc, to receive di	Parker	D1VW20BVJW	1347-H1-1000	2	1	1	300X100X100	5	5	30	$219.68	12
H1	4481-MPF0-0001	Cathode Sealing Equipment	Hydraulic Power Unit	DCV D03, 2 position spring to center, 24vd	Parker	D1VW004KVJW	1347-H1-1000	13	1	1	300X100X100	5	5	30	$219.68	12
H1	4481-MPF0-0001	Cathode Sealing Equipment	Hydraulic Power Unit	Solenoid valve, N.C, overide, viton, 24vdc w	Parker	DSH102CVSP-D024D	1347-H1-1000	3	3	1	100X50X50	1.5	0.5	30	$97.19	12
H1	4481-MPF0-0001	Cathode Sealing Equipment	Hydraulic Power Unit	Parker flow control, SAE8	Parker	F820SV	1347-H1-1000	38	2	2	100X50X50	4	2	30	$53.47	12
H1	4481-MPF0-0001	Cathode Sealing Equipment	Hydraulic Power Unit	Parker flow control, SAE6	Parker	F620SV	1347-H1-1000	6	2	2	100X50X50	2	1	30	$40.47	12
		HYDRAULIC CYLINDERS													$0.00	
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	2 1/2" Gland Kit metalic rod wiper	Parker	RGWAHL0255	1347-4000	4	1		100X100X100	5	5	15	$783.17	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	2 1/2" Rod Kit metalic rod wiper	Parker	RKWAHL0255	1347-4000	4	2	0	100X100X100	10	5	15	$559.47	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	4" Piston kit Hi-load	Parker	PK402HK005	1347-4000	2	2	0	100X100X10	1	0.5	15	$280.81	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	1 3/4" Gland Kit metalic rod wiper	Parker	RGWAHL0175	1347-4000	2	1	0	100X100X100	5	5	15	$374.38	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	1 3/4" Rod Kit metalic rod wiper	Parker	RKWAHL0175	1347-4000	2	2	0	100X100X100	10	5	15	$258.35	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	4" Piston kit Hi-load	Parker	PK402HK005	1347-4000	1	2	0	100X100X10	1	0.5	15	$280.81	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	1 3/8" Gland Kit metalic rod wiper	Parker	RGWAHL0135	1347-4000	1	1	0	100X100X100	5	5	15	$278.21	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	1 3/8" Rod Kit metalic rod wiper	Parker	RKWAHL0135	1347-4000	1	2	0	100X100X100	10	5	15	$189.16	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	2.5" Piston kit Hi-load	Parker	PK252HK005	1347-4000	2	2	0	100X100X10	1	0.5	15	$206.69	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	1 " Gland Kit metalic rod wiper	Parker	RGWAHL0105	1347-4000	2	1	0	100X100X10	0.5	0.5	15	$209.92	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	1 " Rod Kit metalic rod wiper	Parker	RKWAHL0105	1347-4000	2	2	0	100X100X10	1	0.5	15	$116.27	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	2.0" Piston kit Hi-load	Parker	PK202HK005	1347-4000	2	2	0	100X100X10	1	0.5	15	$280.81	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	1 " Gland Kit metalic rod wiper	Parker	RGWAHL0105	1347-4000	2	0	0	100X100X100	0	5	15	$209.92	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	1 " Rod Kit metalic rod wiper	Parker	RKWAHL0105	1347-4000	2	1	0	100X100X10	0.5	0.5	15	$116.27	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	2.0" Piston kit Hi-load	Parker	PK202HK005	1347-4000	1	1	0	100X100X10	0.5	0.5	15	$280.81	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	1 3/8" Gland Kit metalic rod wiper	Parker	RGWAHL0135	1347-4000	1	0	0	100X100X100	0	5	15	$278.21	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	1 3/8" Rod Kit metalic rod wiper	Parker	RKWAHL0135	1347-4000	1	1	0	100X100X10	0.5	0.5	15	$189.16	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	2.5" Piston kit Hi-load	Parker	PK252HK005	1347-4000	1	1	0	100X100X10	0.5	0.5	15	$206.69	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	1 " Gland Kit metalic rod wiper	Parker	RGWAHL0105	1347-4000	1	0	0	100X100X100	0	5	15	$209.92	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	1 " Rod Kit metalic rod wiper	Parker	RKWAHL0105	1347-4000	1	1	0	100X100X10	0.5	0.5	15	$116.27	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	2.5" Piston kit Hi-load	Parker	PK252HK005	1347-4000	1	1	0	100X100X10	0.5	0.5	15	$206.69	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	1 3/8" Gland Kit metalic rod wiper	Parker	RGWAHL0135	1347-4000	1	0	0	100X100X100	0	5	15	$278.21	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	1 3/8" Rod Kit metalic rod wiper	Parker	RKWAHL0135	1347-4000	1	1	0	100X100X10	0.5	0.5	15	$189.16	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	2.5" Piston kit Hi-load	Parker	PK252HK005	1347-4000	1	1	0	100X100X10	0.5	0.5	15	$206.69	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	1 " Gland Kit metalic rod wiper	Parker	RGWAHL0105	1347-4000	1	0	0	100X100X100	0	5	15	$209.92	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	1 " Rod Kit metalic rod wiper	Parker	RKWAHL0105	1347-4000	1	1	0	100X100X10	0.5	0.5	15	$116.27	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	2.5" Piston kit Hi-load	Parker	PK252HK005	1347-4000	1	1	0	100X100X10	0.5	0.5	15	$206.69	12

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General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	1 " Gland Kit metalic rod wiper	Parker	RGWAHL0105	1347-4000	1	0	0	100X100X100	0	5	15	$209.92	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	1 " Rod Kit metalic rod wiper	Parker	RKWAHL0105	1347-4000	1	1	0	100X100X10	0.5	0.5	15	$116.27	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	2.5" Piston kit Hi-load	Parker	PK252HK005	1347-4000	1	1	0	100X100X10	0.5	0.5	15	$206.69	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	2 " Gland Kit metalic rod wiper	Parker	RGWAHL0205	1347-4000	1	1	0	100X100X100	5	5	15	$496.77	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	2 " Rod Kit metalic rod wiper	Parker	RKWAHL0205	1347-4000	1	2	0	100X100X100	10	5	15	$334.15	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	4" Piston kit Hi-load	Parker	PK402HK005	1347-4000	2	2	0	100X100X10	1	0.5	15	$280.81	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	1 " Gland Kit metalic rod wiper	Parker	RGWAHL0105	1347-4000	2	0	0	100X100X100	0	5	15	$209.92	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	1 " Rod Kit metalic rod wiper	Parker	RKWAHL0105	1347-4000	2	1	0	100X100X10	0.5	0.5	15	$116.27	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	2.5" Piston kit Hi-load	Parker	PK252HK005	1347-4000	1	1	0	100X100X10	0.5	0.5	15	$206.69	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	2 " Gland Kit metalic rod wiper	Parker	RGWAHL0205	1347-4000	1	0	0	100X100X10	0	0.5	15	$496.77	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	2 " Rod Kit metalic rod wiper	Parker	RKWAHL0205	1347-4000	1	2	0	100X100X10	1	0.5	15	$334.15	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	4" Piston kit Hi-load	Parker	PK402HK005	1347-4000	2	2	0	100X100X10	1	0.5	15	$280.81	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	1 " Gland Kit metalic rod wiper	Parker	RGWAHL0105	1347-4000	2	0	0	100X100X100	0	5	15	$209.92	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	1 " Rod Kit metalic rod wiper	Parker	RKWAHL0105	1347-4000	2	1	0	100X100X10	0.5	0.5	15	$116.27	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	2.5" Piston kit Hi-load	Parker	PK252HK005	1347-4000	1	1	0	100X100X10	0.5	0.5	15	$206.69	12
		PNEUMATIC CYLINDERS													$0.00	
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	3.25 CD-2AUV14ACx18.00 Rod Gland Kit	Parker	RG2AHL0105	1347-30000	4	2	0	100X200X200	4	2	15	$139.05	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	3.25 CD-2AUV14ACx18.00 Piston Kit	Parker	PK3202A005	1347-30000	4	2	0	100X200X200	2	1	15	$190.57	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	2.50 CBB-2AUV34ACx3.00 Rod Gland Kit	Parker	RG2AHL0105	1347-30000	8	4	0	100X200X200	8	2	15	$139.05	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	2.50 CBB-2AUV34ACx3.00 Piston Kit	Parker	PK2502A005	1347-30000	8	4	0	100X200X200	4	1	15	$170.87	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	6.00 CSB-2AUVS19ACx4.625 Rod Gland K	Parker	RGWAHL0135	1347-30000	2	2	0	100X200X200	4	2	15	$328.18	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	6.00 CSB-2AUVS19ACx4.625 Piston Kit	Parker	PK6002A005	1347-30000	4	2	0	100X200X200	2	1	15	$487.47	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	4.00 CSB-2AUV19ACx6.00 Rod Gland Kit	Parker	RG2AHL0105	1347-30000	8	4	0	100X200X200	8	2	15	$139.05	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	4.00 CSB-2AUV19ACx6.00 Piston kit	Parker	PK4002A005	1347-30000	8	4	0	100X200X200	4	1	15	$209.74	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	6.00 CD-2AUVS13ACx30.236 Rod gland ki	Parker	RGWAHL0135	1347-30000	4	2	0	100X200X200	4	2	15	$328.18	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	6.00 CD-2AUVS13ACx30.236 piston kit	Parker	PK6002A005	1347-30000	4	2	0	100X200X200	2	1	15	$487.47	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	2.50 CBB-2AUV34ACx3.00 Rod gland kit	Parker	RG2AHL0105	1347-30000	4	2	0	100X200X200	4	2	15	$139.05	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	2.50 CBB-2AUV34ACx3.00 piston kit	Parker	PK2502A005	1347-30000	4	2	0	100X200X200	2	1	15	$170.87	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	8.00 CSB-2AUVS19ACx18.00 Rod gland kit	Parker	RGWAHL0135	1347-30000	2	1	0	100X200X200	2	2	15	$328.18	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	8.00 CSB-2AUVS19ACx18.00 piston kit	Parker	PK8002A005	1347-30000	2	1	0	100X200X200	1	1	15	$719.26	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	P32QA93SEANGLND reg element	Parker	P32KA00ESE	1347-30000	7	2	0	100X200X200	2	1	15	$12.41	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	P33QX96SEANGLND reg element	Parker	P33KA00ESE	1347-30000	11	3	0	100X200X200	3	1	15	$13.77	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	H22VXBG0B9C solenoid kit	Parker	PS4041B9P	1347-30000	14	3	0	100X200X200	3	1	15	$47.13	12
General	4481	Cathode Sealing Equipment	Cathode Sealing equipment	H22VXBG0B9C body service kit	Parker	PS4101CP	1347-30000	14	2	0	100X200X200	2	1	15	$28.15	12

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7.3 Special Tools

RAS AZ ZAWR ALUMINIUM SMELTER PROJECT

Special Tools List

REVISION NO.	DATE	REASON FOR REVISION	ORIGINATOR	CHECKER	EGS	PEM	CLIENT

ALCOA | MA'ADEN معادن

Ma'aden Aluminum Project

BECHTEL

Project NO.: **25457-4480-POA-MXA0-0001**

DOCUMENT NO.: **25457-4480-V1A-MXA0-0189**

Sheet No. 1 of 2

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25457 - RAS AZ ZAWR ALUMINIUM SMELTER PROJECT
Special Tools List

ALCOA | MA'ADEN معادن
Ma'aden Aluminum Project

BECHTEL

Purchase Order / Contract Number: 25457-4480-POA-MXA0-0001

Document Number: **1347-Special Tools-Rev1**

Purchase Order / Contract Description: Cathode Sealing Equipment

Document Revision / Date: Rev 1 **23 MR 11**

ITEM NO.	EQUIPMENT TAG NUMBER	SPECIAL TOOL DESCRIPTION	SELLER NAME	SELLER CODE	CLIENT NUMBER	DRAWING / DOCUMENT NO.	QUANTITY RECOMMENDED FOR INSTALLATION	QUANTITY RECOMMENDED FOR OPERATIONS / MAINTENANCE	TOTAL RECOMMENDED QUANTITY FOR PLANT	.	UNIT PRICE / CURRENCY	WARRANTY PERIOD (MONTHS)
1	4481-MJJ0-0001	Bar Handling Beam	GNA alutech inc.	1347-B1-1000	4481-MJJ0-0001	1347-B1-1000	0	1	1	12 weeks	TBA	1 year
2	4481-MJJ0-0002	Bar Handling Beam	GNA alutech inc.	1347-B1-1000	4481-MJJ0-0002	1347-B1-1000	0	1	1	12 weeks	TBA	1 year
3	4481-MJGB-0001	Handling Tong Longitudinal Grip	GNA alutech inc.	1347-B2-1000	4481-MJGB-0001	1347-B2-1000	0	1	1	12 weeks	TBA	1 year
4	4481-MJGB-0002	Handling Tong Transversal	GNA alutech inc.	1347-B3-1000	4481-MJGB-0002	1347-B3-1000	0	1	1	12 weeks	TBA	1 year
5	4481-MJGB-0003	Handling Tong Tenon Grip	GNA alutech inc.	1347-B4-1000	4481-MJGB-0003	1347-B4-1000	0	1	1	12 weeks	TBA	1 year
6	4481-MHCD-0002	Imperial Hex Socket Security Bits for safety guards	GNA alutech inc.	Model 130-097	4481	NA	2	3	5	4 weeks	TBA	1 year
7	4481-MHCD-0002	Metric Hex Socket Security Bits for safety guards	GNA alutech inc.	model 381-266	4481	NA	2	3	5	4 weeks	TBA	1 year

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SECTION 8 TRAINING

8.1 OPERATION & MAINTENANCE Training Manual

See document 25457-4480-V1A-MXA0-0350.

SECTION 9 DRAWINGS

9.1 Drawing List

DRAWING NO.	DESCRIPTION	NAME
MECHANICAL		
1347-AR-0000	Cathode Sealing Equipment Layout	25457-4480-V1A-MXA0-0003
1347-AR-0200	Cathode Sealing Equipment Fence Layout	25457-4480-V1A-MXA0-0103
1347-AR-0100	Cathode Sealing Equipment - Foundation and Load - 1 of 2	25457-4480-V1A-MXA0-0059
1347-AR-0101	Cathode Sealing Equipment - Foundation and Load - 2 of 2	25457-4480-V1A-MXA0-0060
1347-B1-1000	Bar Handling Beam General Arrangement	25457-4480-V1A-MXA0-0161
1347-B2-1000	Handling Tong Longitudinal Grip General Arrangement	25457-4480-V1A-MXA0-0164
1347-B3-1000	Handling Tong Transversal General Arrangement	25457-4480-V1A-MXA0-0163
1347-A1-1000	Cathode Bar Alignment Station General Arrangement	25457-4480-V1A-MXA0-0014
1347-C1-1000	Chain Conveyor of Block Oven General Arrangement	25457-4480-V1A-MXA0-0118
1347-C2-1000	Chain Conveyor - Upstream of Shot Blasting Machine General Arrangement	25457-4480-V1A-MXA0-0025
1347-C3-1000	Chain Conveyor Between Shot Blasting Machine and Oven General Arrangement	25457-4480-V1A-MXA0-0020
1347-C4-1000	Chain Conveyor for Sealed Cathode General Arrangement	25457-4480-V1A-MXA0-0115
1347-F1-1000	Cathode Block Oven General Arrangement	25457-4480-V1A-MXA0-0026
1347-F2-1000	Cathode Bar Heating Furnace General Arrangement	25457-4480-V1A-MXA0-0012
1347-F3-1000	Ladle Preheating Station General Arrangement	25457-4480-V1A-MXA0-0110
1347-F4-1000	Cast Iron Ingot Drying Station General Arrangement	25457-4480-V1A-MXA0-0106
1347-G1-1000	Cathode Bar Positioning Gantry Gantry General Arrangement	25457-4480-V1A-MXA0-0015
1347-H1-1000	Hydraulic Power Unit General Arrangement	25457-4480-V1A-MXA0-0176
1347-L1-1000	Cast Iron Pouring Ladle General Arrangement	25457-4480-V1A-MXA0-0125
1347-P1-1000	Prestressing Station General Arrangement	25457-4480-V1A-MXA0-0069
1347-R1-1000	Carbon Block Oven Exit Conveyor General Arrangement	25457-4480-V1A-MXA0-0119
1347-R2-1000	Roller Conveyor for Block and Bar Assembly General Arrangement	25457-4480-V1A-MXA0-0016
1347-R3-1000	Roller Conveyor after Sealing Station General Arrangement	25457-4480-V1A-MXA0-0027
1347-R4-1000	Pre-Stressing Conveyor General Arrangement	25457-4480-V1A-MXA0-0070
1347-R4-1500	Platforms General Arrangement	25457-4480-V1A-MXA0-0120
1347-R4-1504	Platforms - Stair No 1 - Left-Right	25457-4480-V1A-MXA0-0165
1347-R4-1506	Platforms - Stair No 3 - Left-right	25457-4480-V1A-MXA0-0166
1347-R4-1510	Platforms - Platform No 1 - Right	25457-4480-V1A-MXA0-0167
1347-R4-1511	Platforms - Platform No 2 - Right	25457-4480-V1A-MXA0-0168
1347-R4-1512	Platforms - Platform No 3 - Right	25457-4480-V1A-MXA0-0169
1347-R4-1513	Platforms - Platform No 4 - Right	25457-4480-V1A-MXA0-0170
1347-R4-1514	Platforms - Stair No 1 - Right	25457-4480-V1A-MXA0-0171

DRAWING NO.	DESCRIPTION	NAME
1347-R4-1515	Platforms - Handrail No 1 - Right	25457-4480-V1A-MXA0-0172
1347-R4-1516	Platforms - Handrail No 2 - Right	25457-4480-V1A-MXA0-0173
1347-R4-1517	Platforms - Handrail No 3 - Right	25457-4480-V1A-MXA0-0174
1347-R5-1000	Roller Conveyor at Cooling and Turning Station General Arrangement	25457-4480-V1A-MXA0-0114
1347-R6-1000	Roller Conveyor at Bar Furnace Exit - General Arrangement	25457-4480-V1A-MXA0-0018
1347-R7-1000	Roller Conveyor at Bar Furnace Exit General Arrangement	25457-4480-V1A-MXA0-0021
1347-R8-1000	Conical Roller Conveyor at Shot Blasting Machine Exit General Arrangement	25457-4480-V1A-MXA0-0022
1347-R9-1000	Conical Roller Conveyor at Shot Blasting Machine Entrance General Arrangement	25457-4480-V1A-MXA0-0028
1347-T1-1000	Cooling Turning Station General Arrangement	25457-4480-V1A-MXA0-0116
1347-S1-1000	Cathode Bar Shot Blasting Machine & Dust Collector General Arrangement	25457-4480-V1A-MXA0-0129
HYDRAULIC		
1347-AR-3000	Cathode Sealing Equipment Hydraulic Piping Routing	25457-4480-V1A-MXA0-0404
1347-H1-3001	Hydraulic System Schematic	25457-4480-V1A-MXA0-0156
1347-H1-3002	Hydraulic System Schematic	25457-4480-V1A-MXA0-0157
1347-H1-3003	Hydraulic System Schematic	25457-4480-V1A-MXA0-0158
1347-H1-3004	Hydraulic System Schematic	25457-4480-V1A-MXA0-0159
1347-H1-3005	Bill of Material - Hydraulic	25457-4480-V1A-MXA0-0160
PNEUMATIC		
1347-AR-4000	Cathode Sealing Equipment Pneumatic Piping Routing	25457-4480-V1A-MXA0-0405
ELECTRICAL		
1347-50010	Chain Conveyor Upstream of Shotblasting Machine C2 - P and ID	25457-4480-V1A-MXA0-0029
1347-50020	Conical Roller Conveyor at Shotblasting Machine Entrance R9 - P and ID	25457-4480-V1A-MXA0-0030
1347-50030	Cathode Bar Shotblasting Machine S1 - P and ID	25457-4480-V1A-MXA0-0398
1347-50040	Dust Collector for Shotblasting Machine D1 - P and ID	25457-4480-V1A-MXA0-0399
1347-50050	Conical Roller at Shotblasting Machine Exit R8 - P and ID	25457-4480-V1A-MXA0-0031
1347-50060	Chain Conveyor Between Shotblasting Machine and Oven C3 - P and ID	25457-4480-V1A-MXA0-0032
1347-50070	Roller Conveyor at Bar Furnace Entrance R7 - P and ID	25457-4480-V1A-MXA0-0033
1347-50080	Cathode Bar Heating Furnace F2 - 1 of 3 - P and ID	25457-4480-V1A-MXA0-0034
1347-50081	Cathode Bar Heating Furnace F2 - 2 of 3 - P and ID	25457-4480-V1A-MXA0-0035
1347-50082	Cathode Bar Heating Furnace F2 - 3 of 3 - P and ID	25457-4480-V1A-MXA0-0036
1347-50090	Roller Conveyor at Bar Furnace Exit R6 - P and ID	25457-4480-V1A-MXA0-0037
1347-50100	Positioning Gantry for Block and Bars - G1 - 1 of 2 - P and ID	25457-4480-V1A-MXA0-0038
1347-50101	Positioning Gantry for Block and Bars - G1 - 2 of 2 - P and ID	25457-4480-V1A-MXA0-0039
1347-50110	Chain Conveyor of Block Oven C1 - P and ID	25457-4480-V1A-MXA0-0040
1347-50120	Cathode Block Oven - F1 - 1 of 2 - P and ID	25457-4480-V1A-MXA0-0041
1347-50121	Cathode Block Oven - F1 - 2 of 2 - P and ID	25457-4480-V1A-MXA0-0042

DRAWING NO.	DESCRIPTION	NAME
1347-50130	Roller Conveyor at Block Oven Exit R1 - P and ID	25457-4480-V1A-MXA0-0043
1347-50140	Roller Conveyor for Block and Bar Assembly R2 - P and ID	25457-4480-V1A-MXA0-0044
1347-50150	Prestressing and Sealing Station Conveyor A and Platforms R4A - 1 of 2 - P and ID	25457-4480-V1A-MXA0-0045
1347-50151	Prestressing and Sealing Station Conveyor A and Platforms R4A - 2 of 2 - P and ID	25457-4480-V1A-MXA0-0046
1347-50160	Prestressing and Sealing Station Conveyor B and Platforms R4B - 1 of 2 - P and ID	25457-4480-V1A-MXA0-0047
1347-50161	Prestressing and Sealing Station Conveyor B and Platforms R4B - 2 of 2 - P and ID	25457-4480-V1A-MXA0-0048
1347-50170	Roller Conveyor After Sealing Station R3 - P and ID	25457-4480-V1A-MXA0-0049
1347-50180	Roller Conveyor at Cooling and Turning Station R5 - P and ID	25457-4480-V1A-MXA0-0050
1347-50190	Cooling and Turning Station T1 - P and ID	25457-4480-V1A-MXA0-0051
1347-50200	Chain Conveyor for Sealed Cathode C4 - P and ID	25457-4480-V1A-MXA0-0052
1347-50220	Ladle Pre-Heating Station F3A - P and ID	25457-4480-V1A-MXA0-0386
1347-50221	Ladle Pre-Heating Station F3B - P and ID	25457-4480-V1A-MXA0-0406
1347-50230	Cast Iron Ingot Drying Station A - F4A - P and ID	25457-4480-V1A-MXA0-0387
1347-50240	Cast Iron Ingot Drying Station B - F4B - P and ID	25457-4480-V1A-MXA0-0400
1347-50250	Chain Conveyor C2 and Roller Conveyor R9 - Cable Block Diagram	25457-4480-V1A-MXA0-0130
1347-50260	Cathode Bar Shotblasting Machine S1 - 1 of 2 - Cable Block Diagram	25457-4480-V1A-MXA0-0131
1347-50261	Cathode Bar Shotblasting Machine S1 - 2 of 2 - Cable Block Diagram	25457-4480-V1A-MXA0-0132
1347-50262	Dust collector for Shotblasting Machine D1 - Cable Block Diagram	25457-4480-V1A-MXA0-0133
1347-50270	Conical Roller Conveyor R8, Chain Conveyor C3 and Roller Conveyor R7 - Cable Block Diagram	25457-4480-V1A-MXA0-0134
1347-50280	Cathode Bar Heating Furnace F2 - 1 of 3 - Cable Block Diagram	25457-4480-V1A-MXA0-0135
1347-50281	Cathode Bar Heating Furnace F2 - 2 of 3- Cable Block Diagram	25457-4480-V1A-MXA0-0136
1347-50282	Cathode Bar Heating Furnace F2 - 3 of 3- Cable Block Diagram	25457-4480-V1A-MXA0-0137
1347-50290	Roller Conveyor at Bar Furnace Exit R6 - Cable Block Diagram	25457-4480-V1A-MXA0-0138
1347-50300	Positioning Gantry for Block and Bars G1 - Cable Block Diagram	25457-4480-V1A-MXA0-0139
1347-50310	Chain Conveyor of Block Oven C1 and Cathode Block Oven F1 - 1 of 2 - Cable Block Diagram	25457-4480-V1A-MXA0-0140
1347-50311	Cathode Block Oven F1 -2 of 2 - Cable Block Diagram	25457-4480-V1A-MXA0-0141
1347-50320	Roller Conveyor at Block Oven Exit R1 - Cable Block Diagram	25457-4480-V1A-MXA0-0142
1347-50330	Roller Conveyor for Block and Bar Assembly R2 - Cable Block Diagram	25457-4480-V1A-MXA0-0143
1347-50340	Prestressing and Sealing Station Conveyor at R4A - Cable Block Diagram	25457-4480-V1A-MXA0-0144

DRAWING NO.	DESCRIPTION	NAME
1347-50350	Prestressing and Sealing Station Conveyor B R4B - Cable Block Diagram	25457-4480-V1A-MXA0-0145
1347-50360	Cooling and Turning Station T1 and Roller conveyor R3 and R5 - Cable Block Diagram	25457-4480-V1A-MXA0-0146
1347-50370	Chain Conveyor for Sealed Cathode C4 - Cable Block Diagram	25457-4480-V1A-MXA0-0147
1347-50380	Hydraulic Power Unit H1 - Cable Block Diagram	25457-4480-V1A-MXA0-0148
1347-50390	Chiller for Hydraulic Power Unit W1 - Cable Block Diagram	25457-4480-V1A-MXA0-0149
1347-50400	Ladle Pre-Heating Station F3A - Cable Block Diagram	25457-4480-V1A-MXA0-0150
1347-50410	Cast Iron Ingot Drying Station F4 A- Cable Block Diagram	25457-4480-V1A-MXA0-0151
1347-50420	Cast Iron Ingot Drying Station F4B - Cable Block Diagram	25457-4480-V1A-MXA0-0152
1347-50430	Ladle Pre-Heating Station F3B - Cable Block Diagram	25457-4480-V1A-MXA0-0407
1347-51000	MCC Panel 4481-ECM1-0003 General Arrangement	25457-4480-V1A-MXA0-0071
1347-51010	PLC Panel 4481-CP-1000 General Arrangement	25457-4480-V1A-MXA0-0256
1347-51020	Cathode Sealing Equipment Flex I of 0 Central Control Panel 4481-CP-1001 General Arrangement	25457-4480-V1A-MXA0-0251
1347-51030	Cathode Sealing Equipment Flex I 0f 0 Local Control Panel 4481-MQLK-0001-CP-01 General Arrangement	25457-4480-V1A-MXA0-0268
1347-51040	Cathode Sealing Equipment Flex I of 0 Local Control Panel 4481-MHCD-0003-CP-01 General Arrangement	25457-4480-V1A-MXA0-0194
1347-51060	Cathode Block Oven SCR Panel 4481-MEEP-0001-SCR - General Arrangement	25457-4480-V1A-MXA0-0190
1347-51070	Cathode Bar Heating Furnace SCR Panel 4481-MBMB-0001-SCR - General Arrangement	25457-4480-V1A-MXA0-0193
1347-51080	Local Control Panel 4481-MHCD-0002-CP-01 General Arrangement	25457-4480-V1A-MXA0-0072
1347-51090	Local Control Panel 4481-MHCD-0002-CP-02 General Arrangement	25457-4480-V1A-MXA0-0073
1347-51091	Local Control Panel 4481-MHCD-0002-CP-03	25457-4480-V1A-MXA0-0408
1347-51100	Control Panel 4481-MBMB-0001-CP-01 General Arrangement	25457-4480-V1A-MXA0-0195
1347-51110	Control Panel 4481-MBMB-0001-CP-02 General Arrangement	25457-4480-V1A-MXA0-0196
1347-51120	Local Control Panel 4481-MHCD-0001-CP-01 General Arrangement	25457-4480-V1A-MXA0-0269
1347-51121	Local Control Panel 4481-MHCD-0001-CP-02	25457-4480-V1A-MXA0-0409
1347-51130	Local Control Panel 4481-MZAC-0001-CP-01 General Arrangement	25457-4480-V1A-MXA0-0270
1347-51131	Local Control Panel 4481-MZAC-0001-CP-02-03 General Arrangement	25457-4480-V1A-MXA0-0271
1347-51140	Local Control Panel 4481-MZAC-0002-CP-01 General Arrangement	25457-4480-V1A-MXA0-0272
1347-51141	Local Control Panel 4481-MZAC-0002-CP-02-03 General Arrangement	25457-4480-V1A-MXA0-0273
1347-51150	Local Disconnect Station 2 of 3 General Arrangement	25457-4480-V1A-MXA0-0153
1347-51151	Local Disconnect Station 3 of 3 General Arrangement	25457-4480-V1A-MXA0-0154
1347-51152	Local Disconnect Station 1 of 3 General Arrangement	25457-4480-V1A-MXA0-0155

DRAWING NO.	DESCRIPTION	NAME
1347-51160	Local Control Panel 4481-MJR0-0006-CP-01 General Arrangement	25457-4480-V1A-MXA0-0274
1347-51170	Local Control Panel 4481-MHCD-0004-CP-01 General Arrangement	25457-4480-V1A-MXA0-0275
1347-51171	Local Control Panel 4481-MHCD-0004-CP-02	25457-4480-V1A-MXA0-0410
1347-51200	Local Control Panel 4481-MHCD-0002-LCS-01 General Arrangement	25457-4480-V1A-MXA0-0074
1347-51201	Local Control Station 4481-MZBP-0001-LCS-01 General Arrangement	25457-4480-V1A-MXA0-0086
1347-51202	Local Control Station 4481-MZBP-0001-LCS-02 General Arrangement	25457-4480-V1A-MXA0-0087
1347-51203	Local Control Station 4481-MZBP-0001-LCS-03 General Arrangement	25457-4480-V1A-MXA0-0088
1347-51204	Local Control Station -Equipment Without Drive General Arrangement	25457-4480-V1A-MXA0-0089
1347-51205	Local Control Panel 4481-MHCD-0003-LCS-01 General Arrangement	25457-4480-V1A-MXA0-0075
1347-51206	Local Control Station - Equip with Drive - General Arrangement	25457-4480-V1A-MXA0-0197
1347-51207	Local Control Station 4481-MPF0-0001-LCS-01 General Arrangement	25457-4480-V1A-MXA0-0326
1347-51208	Local Control Station 4481-MJR0-0005-LCS-01 General Arrangement	25457-4480-V1A-MXA0-0276
1347-51209	Local Control Station 4481-MJR0-0006-LCS-01 General Arrangement	25457-4480-V1A-MXA0-0277
1347-51210	Local Control Station 4481-MQlk-0001-LCS-01 General Arrangement	25457-4480-V1A-MXA0-0278
1347-51211	Local Control Station 4481-MHCD-0004-LCS-01 General Arrangement	25457-4480-V1A-MXA0-0279
1347-51212	Local Control Station 4481-MZAC-0001-2-LCS-01 General Arrangement	25457-4480-V1A-MXA0-0280
1347-51220	Ladle Pre-Heating Station Control Panel 4481-MBAD-0001-CP-01 General Arrangement	25457-4480-V1A-MXA0-0327
1347-51221	Ladle Pre-Heating Station B CTRL - Panel 4481-MBAD-0002-CP-01	25457-4480-V1A-MXA0-0411
1347-51230	Cast Iron Drying Station Control Panel 4481-MEVD-0001-CP-01 General Arrangement	25457-4480-V1A-MXA0-0328
1347-51240	Cast Iron Drying Station B Control Panel 4481-MEVD-0002-CP-01 General A	25457-4480-V1A-MXA0-0329
1347-51250	Junction Box 4481-MBMB-0001-JB-01 General Arrangement	25457-4480-V1A-MXA0-0198
1347-51260	Junction Box 4481-MBMB-0001-JB-02 General Arrangement	25457-4480-V1A-MXA0-0199
1347-51270	Junction Box 4481-MJR0-0005-JB-01 General Arrangement	25457-4480-V1A-MXA0-0281
1347-51280	Junction Box 4481-MJR0-0007-JB-01 General Arrangement	25457-4480-V1A-MXA0-0282
1347-51290	Junction Box 4481-MJR0-0004-JB-01 General Arrangement	25457-4480-V1A-MXA0-0283
1347-51300	Junction Box 4481-MQLK-0001-JB-01 General Arrangement	25457-4480-V1A-MXA0-0284
1347-51310	Junction Box 4481-MQLK-0001-JB-02 General Arrangement	25457-4480-V1A-MXA0-0285

DRAWING NO.	DESCRIPTION	NAME
1347-51320	Junction Box 4481-MQLK-0001-JB-03 General Arrangement	25457-4480-V1A-MXA0-0286
1347-51330	Junction Box 4481-MEEP-0001-JB-01 General Arrangement	25457-4480-V1A-MXA0-0257
1347-51350	Junction Box 4481-MEEP-0001-JB-03 General Arrangement	25457-4480-V1A-MXA0-0258
1347-51360	Junction Box 4481-MEEP-0001-JB-11 General Arrangement	25457-4480-V1A-MXA0-0259
1347-51370	Junction Box 4481-MEEP-0001-JB-12 General Arrangement	25457-4480-V1A-MXA0-0260
1347-51380	Junction Box 4481-MEEP-0001-JB-13 General Arrangement	25457-4480-V1A-MXA0-0261
1347-51390	Junction Box 4481-MJR0-0008-JB-01 General Arrangement	25457-4480-V1A-MXA0-0262
1347-51400	Junction Box 4481-MHCD-0002-JB-01 General Arrangement	25457-4480-V1A-MXA0-0200
1347-51410	Junction Box 4481-MHCD-0001-JB-01 General Arrangement	25457-4480-V1A-MXA0-0263
1347-51420	Junction Box 4481-MHCD-0004-JB-01 General Arrangement	25457-4480-V1A-MXA0-0264
1347-51421	Junction Box 4481-MHCD-0004-JB-02 General Arrangement	25457-4480-V1A-MXA0-0265
1347-51422	Junction Box 4481-MHCD-0004-JB-03 General Arrangement	25457-4480-V1A-MXA0-0266
1347-51423	Junction Box 4481-MHCD-0004-JB-04 General Arrangement	25457-4480-V1A-MXA0-0267
1347-52000	Instrument Location - General Arrangement	25457-4480-V1A-MXA0-0053
1347-52250	Control Panel Location - General Arrangement	25457-4480-V1A-MXA0-0054
1347-52500	Earthing Layout Drawing - General Arrangement	25457-4480-V1A-MXA0-0055
1347-55000	Electrical Schematic Sheets	25457-4480-V1A-MXA0-0102
1347-55500	MCC Panel 4480-ECM1-0001 Main Incomer Wiring	25457-4480-V1A-MXA0-0255
1347-55501	MCC Panel 4480-ECM1-0001 230 Vac Distribution	25457-4480-V1A-MXA0-0254
1347-55502	MCC Panel 4480-ECM1-0001 24 Vdc Supply	25457-4480-V1A-MXA0-0253
1347-55510	Motor 4481-MHCD-0002-M1-Electrical Schematic Diagram	25457-4480-V1A-MXA0-0067
1347-55520	Motor 4481-MJR0-0001-M1-Electrical Schematic Diagram	25457-4480-V1A-MXA0-0068
1347-55530	Motor 4481-MZBP-0001-M1-Electrical Schematic Diagram	25457-4480-V1A-MXA0-0217
1347-55531	Motor 4481-MZBP-0001-M7-Electrical Schematic Diagram	25457-4480-V1A-MXA0-0218
1347-55532	Motor 4481-MZBP-0001-M3-Electrical Schematic Diagram	25457-4480-V1A-MXA0-0219
1347-55533	Motor 4481-MZBP-0001-M5-Electrical Schematic Diagram	25457-4480-V1A-MXA0-0220
1347-55534	Motor 4481-MZBP-0001-M2-Electrical Schematic Diagram	25457-4480-V1A-MXA0-0221
1347-55535	Motor 4481-MZBP-0001-M4-Electrical Schematic Diagram	25457-4480-V1A-MXA0-0222
1347-55536	Motor 4481-MZBP-0001-M6-Electrical Schematic Diagram	25457-4480-V1A-MXA0-0223
1347-55537	Motor 4481-MAC0-0001-M1-Electrical Schematic Diagram	25457-4480-V1A-MXA0-0224
1347-55540	Motor 4481-MJR0-0002-M1-Electrical Schematic Diagram	25457-4480-V1A-MXA0-0078
1347-55550	Motor 4481-MHCD-0003-M1-Electrical Schematic Diagram	25457-4480-V1A-MXA0-0079
1347-55560	Motor 4481-MJR0-0003-M1-Electrical Schematic Diagram	25457-4480-V1A-MXA0-0080
1347-55570	Motor 4481-MBMB-0001-M1-Electrical Schematic Diagram	25457-4480-V1A-MXA0-0228
1347-55571	Motor 4481-MBMB-0001-M2-Electrical Schematic Diagram	25457-4480-V1A-MXA0-0229
1347-55572	Motor 4481-MBMB-0001-M1-Electrical Schematic Diagram	25457-4480-V1A-MXA0-0230
1347-55573	Motor 4481-MBMB-0003-M1-Electrical Schematic Diagram	25457-4480-V1A-MXA0-0231
1347-55580	Motor 4481-MJR0-0004-M1-Electrical Schematic Diagram	25457-4480-V1A-MXA0-0306
1347-55590	Motor 4481-MQLK-0001-M1-M2 -Electrical Schematic Diagram	25457-4480-V1A-MXA0-0307
1347-55600	Motor 4481-MHCD-0001-M1-Electrical Schematic Diagram	25457-4480-V1A-MXA0-0308
1347-55610	Motor 4481-MEEP-0001-M1 - Electrical Schematic Diagram	25457-4480-V1A-MXA0-0309

DRAWING NO.	DESCRIPTION	NAME
1347-55611	Motor 4481-MEEP-0001-M2-Electrical Schematic Diagram	25457-4480-V1A-MXA0-0310
1347-55612	Motor 4481-Meep-0001-M3 - Electrical Schematic Diagram	25457-4480-V1A-MXA0-0311
1347-55620	Motor 4481-MJR0-0005-M1 Electrical Schematic Diagram	25457-4480-V1A-MXA0-0312
1347-55630	Motor 4481-MJR0-0007-M1 Electrical Schematic Diagram	25457-4480-V1A-MXA0-0313
1347-55640	Motor 4481-MZAC-0001-M1 Electrical Schematic Diagram	25457-4480-V1A-MXA0-0314
1347-55650	Motor 4481-MZAC-0002-M1 Electrical Schematic Diagram	25457-4480-V1A-MXA0-0315
1347-55660	Motor 4481-MJR0-0006-M1 Electrical Schematic Diagram	25457-4480-V1A-MXA0-0316
1347-55670	Motor 4481-MJR0-0008-M1 Electrical Schematic Diagram	25457-4480-V1A-MXA0-0317
1347-55680	Motor 4481-MHCD-0004-M1 Electrical Schematic Diagram	25457-4480-V1A-MXA0-0318
1347-55690	Motor 4481-MPF0-0001-M1 Electrical Schematic Diagram	25457-4480-V1A-MXA0-0330
1347-55691	Motor 4481-MPF0-0001-M2 Electrical Schematic Diagram	25457-4480-V1A-MXA0-0331
1347-55700	Motor 4481-MEHX-0001-M1-M2-M3-M4 Electrical Schematic Diagram	25457-4480-V1A-MXA0-0332
1347-55710	Motor 4481-MBAD-0001-M1 Electrical Schematic Diagram	25457-4480-V1A-MXA0-0333
1347-55720	Motor 4481-MEVD-0001-M1 Electrical Schematic Diagram	25457-4480-V1A-MXA0-0334
1347-55730	Motor 4481-MEVD-0002-M1 Electrical Schematic Diagram	25457-4480-V1A-MXA0-0335
1347-55740	Motor 481-MBAD-0002-M1 - Electrical Schematic Diagram	25457-4480-V1A-MXA0-0416
1347-56000	Cathode Block Oven Heating Elements - Interconnection Elements - 1 of 2	25457-4480-V1A-MXA0-0371
1347-56001	Cathode Block Oven Heating Elements - Interconnection Elements - 2 of 2	25457-4480-V1A-MXA0-0372
1347-56010	Cathode Bar Heating Elements - Interconnection Diagram - 1 of 2	25457-4480-V1A-MXA0-0373
1347-56011	Cathode Bar Heating Elements - Interconnection Diagram - 2 of 2	25457-4480-V1A-MXA0-0374
1347-56020	Utilities and Control Supply - Interconnection Diagram - 1 of 2	25457-4480-V1A-MXA0-0375
1347-56021	Utilities and Control Supply - Interconnection Diagram - 2 of 2	25457-4480-V1A-MXA0-0376
1347-56030	C4 Matguard Interconnection Diagram	25457-4480-V1A-MXA0-0287
1347-56031	C4 R3 Emergency Stop and HYD Valve Switch Interconnection	25457-4480-V1A-MXA0-0288
1347-56032	C1-G1 Emergency Stop Matguard and HYD-V--SW Interconnection Diagram	25457-4480-V1A-MXA0-0289
1347-56033	Central Control Panel 4481-MHCD-0003-CP-01 Interconnection Diagram	25457-4480-V1A-MXA0-0232
1347-56040	R4A Light Curtain Reset Button Safety Gate SW Interconnection Diagram	25457-4480-V1A-MXA0-0290
1347-56041	R4B Light Curtain Reset Button Safety Gate SW Interconnection Diagram	25457-4480-V1A-MXA0-0291
1347-56050	Central Control Panel 4481-CP-1001 Interconnection Diagram	25457-4480-V1A-MXA0-0233
1347-56060	F3 Burner - Interconnection Diagram - 1 of 2	25457-4480-V1A-MXA0-0377
1347-56061	F3 Burner - Interconnection Diagram - 1 of 2	25457-4480-V1A-MXA0-0378
1347-56070	F4 Burner - Interconnection Diagram - 1 of 2	25457-4480-V1A-MXA0-0379
1347-56080	F4 Burner - Interconnection Diagram - 2 of 2	25457-4480-V1A-MXA0-0380
1347-56090	D1 Collector Fan and W1 Chiller Suppy Interconnection	25457-4480-V1A-MXA0-0104

DRAWING NO.	DESCRIPTION	NAME
	Diagram	
1347-56100	F3B Burner 1-2 Interconnection Diagram	25457-4480-V1A-MXA0-0413
1347-56101	F3B Burner 2-2 Interconnection Diagram	25457-4480-V1A-MXA0-0414
1347-56250	Motor 4481-MHCD-0002 M1 Interconnection Diagram	25457-4480-V1A-MXA0-0234
1347-56260	Motor 4481-MJR0-0001 M1 Interconnection Diagram	25457-4480-V1A-MXA0-0235
1347-56270	Motor 4481-MZBP-0001 M1 Interconnection Diagram	25457-4480-V1A-MXA0-0236
1347-56271	Motor 4481-MHCD-0001 M3 Interconnection Diagram	25457-4480-V1A-MXA0-0237
1347-56272	Motor 4481-MZBP-0001 M7 Interconnection Diagram	25457-4480-V1A-MXA0-0238
1347-56273	Motor 4481-MZBP-0001 M5 Interconnection Diagram	25457-4480-V1A-MXA0-0239
1347-56274	Motor 4481-MZBP-0001 M2 Interconnection Diagram	25457-4480-V1A-MXA0-0240
1347-56275	Motor 4481-MZBP-0001 M4 Interconnection Diagram	25457-4480-V1A-MXA0-0241
1347-56276	Motor 4481-MZBP-0001 M6 Interconnection Diagram	25457-4480-V1A-MXA0-0242
1347-56277	Motor 4481-MAC0-0001 M5 Interconnection Diagram	25457-4480-V1A-MXA0-0243
1347-56280	Motor 4481-MJR0-0002 M1 Interconnection Diagram	25457-4480-V1A-MXA0-0244
1347-56290	Motor 4481-MHCD-0003 M1 Interconnection Diagram	25457-4480-V1A-MXA0-0245
1347-56300	Motor 4481-MBMB-0001 M1 Interconnection Diagram	25457-4480-V1A-MXA0-0247
1347-56310	Motor 4481-MJR0-0003 M1 Interconnection Diagram	25457-4480-V1A-MXA0-0246
1347-56311	Motor 4481-MBMB-0001 M2 Interconnection Diagram	25457-4480-V1A-MXA0-0248
1347-56312	Motor 4481-MBMB-0001 M3 Interconnection Diagram	25457-4480-V1A-MXA0-0249
1347-56313	Motor 4481-MBMB-0001 M4 Interconnection Diagram	25457-4480-V1A-MXA0-0250
1347-56320	Motor 4481-MJR0-0004-M1 Interconnection Diagram	25457-4480-V1A-MXA0-0292
1347-56330	Motor 4481-MQLK- 0001- M1 1 of 2 Interconnection Diagram	25457-4480-V1A-MXA0-0293
1347-56331	Motor 4481-MQLK-0001--M1 2 of 2 Interconnection Diagram	25457-4480-V1A-MXA0-0294
1347-56340	Motor 4481-MHCD-0001--M1 Interconnection Diagram	25457-4480-V1A-MXA0-0295
1347-56350	Motor 4481-MEEP-0001--M1 Interconnection Diagram	25457-4480-V1A-MXA0-0296
1347-56351	Motor 4481-MEEP-0001--M2 Interconnection Diagram	25457-4480-V1A-MXA0-0297
1347-56352	Motor 4481-MEEP-0001--M3 Interconnection Diagram	25457-4480-V1A-MXA0-0298
1347-56360	Motor 4481-MJR0-0005--M1 Interconnection Diagram	25457-4480-V1A-MXA0-0299
1347-56370	Motor 4481-MJR0-0007--M1 Interconnection Diagram	25457-4480-V1A-MXA0-0300
1347-56380	Motor 4481-MZAC-0001-M1 Interconnection Diagram	25457-4480-V1A-MXA0-0301
1347-56390	Motor 4481-MZAC-0002-M1 Interconnection Diagram	25457-4480-V1A-MXA0-0302
1347-56400	Motor 4481-MZAC-0006-M1 Interconnection Diagram	25457-4480-V1A-MXA0-0303
1347-56410	Motor 4481-MJR0--0001-M1 Interconnection Diagram	25457-4480-V1A-MXA0-0304
1347-56420	Motor 4481-MHCD-0004-M1 Interconnection Diagram	25457-4480-V1A-MXA0-0305
1347-56430	Motor 4481-MPF0-0001-M1 Interconnection Diagram	25457-4480-V1A-MXA0-0336
1347-56431	Motor 4481-MPF0-0001-M2 Interconnection Diagram	25457-4480-V1A-MXA0-0337
1347-56450	Motor 4481-MBAD-0001-M1 Interconnection Diagram	25457-4480-V1A-MXA0-0338
1347-56460	Motor 4481-MEVD-0001-M1 Interconnection Diagram	25457-4480-V1A-MXA0-0339
1347-56470	Motor 4481-MEVD-0002-M1 Interconnection Diagram	25457-4480-V1A-MXA0-0403
1347-56480	Motor 481-MBAD-0002-M2 - Electrical Schematic Diagram	25457-4480-V1A-MXA0-0415
1347-56760	PLC Control System Architecture	25457-4480-V1A-MXA0-0122
1347-57000	Motor Control Panel 4481-ECM1-0001 - 1 of 3 - Single Line Diagram	25457-4480-V1A-MXA0-0056
1347-57010	Motor Control Panel 4481-ECM1-0001 - 2 of 3 - Single Line Diagram	25457-4480-V1A-MXA0-0057

DRAWING NO.	DESCRIPTION	NAME
1347-57020	Motor Control Panel 4481-ECM1-0001 - 3 of 3 - Single Line Diagram	25457-4480-V1A-MXA0-0058
1347-PLC I&O	PLC Inputs & Outputs	25457-4480-V1A-MXA0-0320
1347-FLEX 02 I&O	Remote Rack 02 Inputs & Outputs	25457-4480-V1A-MXA0-0321
1347-FLEX 03 I&O	Remote Rack 03 Inputs & Outputs	25457-4480-V1A-MXA0-0322
1347-FLEX 04 I&O	Remote Rack 04 Inputs & Outputs	25457-4480-V1A-MXA0-0323
1347-FLEX 05 I&O	Remote Rack 05 Inputs & Outputs	25457-4480-V1A-MXA0-0324

9.2 Mechanical Drawings – General Assembly

MECHANICAL		NAME
1347-AR-0000	Cathode Sealing Equipment Layout	25457-4480-V1A-MXA0-0003
1347-AR-0200	Cathode Sealing Equipment Fence Layout	25457-4480-V1A-MXA0-0103
1347-B1-1000	Bar Handling Beam General Arrangement	25457-4480-V1A-MXA0-0161
1347-B2-1000	Handling Tong Longitudinal Grip General Arrangement	25457-4480-V1A-MXA0-0164
1347-B3-1000	Handling Tong Transversal General Arrangement	25457-4480-V1A-MXA0-0163
1347-A1-1000	Cathode Bar Alignment Station General Arrangement	25457-4480-V1A-MXA0-0014
1347-C1-1000	Chain Conveyor of Block Oven General Arrangement	25457-4480-V1A-MXA0-0118
1347-C2-1000	Chain Conveyor - Upstream of Shot Blasting Machine General Arrangement	25457-4480-V1A-MXA0-0025
1347-C3-1000	Chain Conveyor Between Shot Blasting Machine and Oven General Arrangement	25457-4480-V1A-MXA0-0020
1347-C4-1000	Chain Conveyor for Sealed Cathode General Arrangement	25457-4480-V1A-MXA0-0115
1347-F1-1000	Cathode Block Oven General Arrangement	25457-4480-V1A-MXA0-0026
1347-F2-1000	Cathode Bar Heating Furnace General Arrangement	25457-4480-V1A-MXA0-0012
1347-F3-1000	Ladle Preheating Station General Arrangement	25457-4480-V1A-MXA0-0110
1347-F4-1000	Cast Iron Ingot Drying Station General Arrangement	25457-4480-V1A-MXA0-0106
1347-G1-1000	Cathode Bar Positioning Gantry Gantry General Arrangement	25457-4480-V1A-MXA0-0015
1347-H1-1000	Hydraulic Power Unit General Arrangement	25457-4480-V1A-MXA0-0176
1347-L1-1000	Cast Iron Pouring Ladle General Arrangement	25457-4480-V1A-MXA0-0125
1347-P1-1000	Prestressing Station General Arrangement	25457-4480-V1A-MXA0-0069
1347-R1-1000	Carbon Block Oven Exit Conveyor General Arrangement	25457-4480-V1A-MXA0-0119
1347-R2-1000	Roller Conveyor for Block and Bar Assembly General Arrangement	25457-4480-V1A-MXA0-0016
1347-R3-1000	Roller Conveyor after Sealing Station General Arrangement	25457-4480-V1A-MXA0-0027
1347-R4-1000	Pre-Stressing Conveyor General Arrangement	25457-4480-V1A-MXA0-0070
1347-R4-1500	Platforms General Arrangement	25457-4480-V1A-MXA0-0120
1347-R4-1504	Platforms - Stair No 1 - Left-Right	25457-4480-V1A-MXA0-0165
1347-R4-1506	Platforms - Stair No 3 - Left-right	25457-4480-V1A-MXA0-0166
1347-R4-1510	Platforms - Platform No 1 - Right	25457-4480-V1A-MXA0-0167
1347-R4-1511	Platforms - Platform No 2 - Right	25457-4480-V1A-MXA0-0168
1347-R4-1512	Platforms - Platform No 3 - Right	25457-4480-V1A-MXA0-0169
1347-R4-1513	Platforms - Platform No 4 - Right	25457-4480-V1A-MXA0-0170
1347-R4-1514	Platforms - Stair No 1 - Right	25457-4480-V1A-MXA0-0171
1347-R4-1515	Platforms - Handrail No 1 - Right	25457-4480-V1A-MXA0-0172
1347-R4-1516	Platforms - Handrail No 2 - Right	25457-4480-V1A-MXA0-0173
1347-R4-1517	Platforms - Handrail No 3 - Right	25457-4480-V1A-MXA0-0174
1347-R5-1000	Roller Conveyor at Cooling and Turning Station General Arrangement	25457-4480-V1A-MXA0-0114
1347-R6-1000	Roller Conveyor at Bar Furnace Exit - General Arrangement	25457-4480-V1A-MXA0-0018
1347-R7-1000	Roller Conveyor at Bar Furnace Exit General Arrangement	25457-4480-V1A-MXA0-0021

1347-R8-1000	Conical Roller Conveyor at Shot Blasting Machine Exit General Arrangement	25457-4480-V1A-MXA0-0022
1347-R9-1000	Conical Roller Conveyor at Shot Blasting Machine Entrance General Arrangement	25457-4480-V1A-MXA0-0028
1347-T1-1000	Cooling Turning Station General Arrangement	25457-4480-V1A-MXA0-0116
1347-S1-1000	Cathode Bar Shot Blasting Machine & Dust Collector General Arrangement	25457-4480-V1A-MXA0-0129

9.3 Foundation and Loads Drawings

DRAWING No.	DESCRIPTION	NAME
1347-AR-0100	Cathode Sealing Equipment - Foundation and Load - 1 of 2	25457-4480-V1A-MXA0-0059
1347-AR-0101	Cathode Sealing Equipment - Foundation and Load - 2 of 2	25457-4480-V1A-MXA0-0060

9.4 Hydraulic Drawings

DRAWING No.	DESCRIPTION	NAME
1347-AR-3000	Cathode Sealing Equipment Hydraulic Piping Routing	25457-4480-V1A-MXA0-0404
1347-H1-3001	Hydraulic System Schematic	25457-4480-V1A-MXA0-0156
1347-H1-3002	Hydraulic System Schematic	25457-4480-V1A-MXA0-0157
1347-H1-3003	Hydraulic System Schematic	25457-4480-V1A-MXA0-0158
1347-H1-3004	Hydraulic System Schematic	25457-4480-V1A-MXA0-0159
1347-H1-3005	Bill of Material - Hydraulic	25457-4480-V1A-MXA0-0160

9.5 Pneumatic Drawings

DRAWING No.	DESCRIPTION	NAME
1347-AR-4000	Cathode Sealing Equipment Pneumatic Piping Routing	25457-4480-V1A-MXA0-0405

9.6 Cable Block Diagrams

DRAWING No.	DESCRIPTION	NAME
1347-50250	Chain Conveyor C2 and Roller Conveyor R9 - Cable Block Diagram	25457-4480-V1A-MXA0-0130
1347-50260	Cathode Bar Shotblasting Machine S1 - 1 of 2 - Cable Block Diagram	25457-4480-V1A-MXA0-0131
1347-50261	Cathode Bar Shotblasting Machine S1 - 2 of 2 - Cable Block Diagram	25457-4480-V1A-MXA0-0132
1347-50262	Dust collector for Shotblasting Machine D1 - Cable Block Diagram	25457-4480-V1A-MXA0-0133
1347-50270	Conical Roller Conveyor R8, Chain Conveyor C3 and Roller Conveyor R7 - Cable Block Diagram	25457-4480-V1A-MXA0-0134
1347-50280	Cathode Bar Heating Furnace F2 - 1 of 3 - Cable Block Diagram	25457-4480-V1A-MXA0-0135
1347-50281	Cathode Bar Heating Furnace F2 - 2 of 3- Cable Block Diagram	25457-4480-V1A-MXA0-0136
1347-50282	Cathode Bar Heating Furnace F2 - 3 of 3- Cable Block Diagram	25457-4480-V1A-MXA0-0137
1347-50290	Roller Conveyor at Bar Furnace Exit R6 - Cable Block Diagram	25457-4480-V1A-MXA0-0138
1347-50300	Positioning Gantry for Block and Bars G1 - Cable Block Diagram	25457-4480-V1A-MXA0-0139
1347-50310	Chain Conveyor of Block Oven C1 and Cathode Block Oven F1 - 1 of 2 - Cable Block Diagram	25457-4480-V1A-MXA0-0140
1347-50311	Cathode Block Oven F1 -2 of 2 - Cable Block Diagram	25457-4480-V1A-MXA0-0141
1347-50320	Roller Conveyor at Block Oven Exit R1 - Cable Block Diagram	25457-4480-V1A-MXA0-0142
1347-50330	Roller Conveyor for Block and Bar Assembly R2 - Cable Block Diagram	25457-4480-V1A-MXA0-0143
1347-50340	Prestressing and Sealing Station Conveyor at R4A - Cable Block Diagram	25457-4480-V1A-MXA0-0144
1347-50350	Prestressing and Sealing Station Conveyor B R4B - Cable Block Diagram	25457-4480-V1A-MXA0-0145
1347-50360	Cooling and Turning Station T1 and Roller conveyor R3 and R5 - Cable Block Diagram	25457-4480-V1A-MXA0-0146
1347-50370	Chain Conveyor for Sealed Cathode C4 - Cable Block Diagram	25457-4480-V1A-MXA0-0147
1347-50380	Hydraulic Power Unit H1 - Cable Block Diagram	25457-4480-V1A-MXA0-0148
1347-50390	Chiller for Hydraulic Power Unit W1 - Cable Block Diagram	25457-4480-V1A-MXA0-0149
1347-50400	Ladle Pre-Heating Station F3A - Cable Block Diagram	25457-4480-V1A-MXA0-0150
1347-50410	Cast Iron Ingot Drying Station F4 A- Cable Block Diagram	25457-4480-V1A-MXA0-0151
1347-50420	Cast Iron Ingot Drying Station F4B - Cable Block Diagram	25457-4480-V1A-MXA0-0152
1347-50430	Ladle Pre-Heating Station F3B - Cable Block Diagram	25457-4480-V1A-MXA0-0407

9.7 Control Panel and Junction Box Drawings

DRAWING No.	DESCRIPTION	NAME
1347-51000	MCC Panel 4481-ECM1-0003 General Arrangement	25457-4480-V1A-MXA0-0071
1347-51010	PLC Panel 4481-CP-1000 General Arrangement	25457-4480-V1A-MXA0-0256
1347-51020	Cathode Sealing Equipment Flex I of 0 Central Control Panel 4481-CP-1001 General Arrangement	25457-4480-V1A-MXA0-0251
1347-51030	Cathode Sealing Equipment Flex I 0f 0 Local Control Panel 4481-MQLK-0001-CP-01 General Arrangement	25457-4480-V1A-MXA0-0268
1347-51040	Cathode Sealing Equipment Flex I of 0 Local Control Panel 4481-MHCD-0003-CP-01 General Arrangement	25457-4480-V1A-MXA0-0194
1347-51060	Cathode Block Oven SCR Panel 4481-MEEP-0001-SCR - General Arrangement	25457-4480-V1A-MXA0-0190
1347-51070	Cathode Bar Heating Furnace SCR Panel 4481-MBMB-0001-SCR - General Arrangement	25457-4480-V1A-MXA0-0193
1347-51080	Local Control Panel 4481-MHCD-0002-CP-01 General Arrangement	25457-4480-V1A-MXA0-0072
1347-51090	Local Control Panel 4481-MHCD-0002-CP-02 General Arrangement	25457-4480-V1A-MXA0-0073
1347-51091	Local Control Panel 4481-MHCD-0002-CP-03	25457-4480-V1A-MXA0-0408
1347-51100	Control Panel 4481-MBMB-0001-CP-01 General Arrangement	25457-4480-V1A-MXA0-0195
1347-51110	Control Panel 4481-MBMB-0001-CP-02 General Arrangement	25457-4480-V1A-MXA0-0196
1347-51120	Local Control Panel 4481-MHCD-0001-CP-01 General Arrangement	25457-4480-V1A-MXA0-0269
1347-51121	Local Control Panel 4481-MHCD-0001-CP-02	25457-4480-V1A-MXA0-0409
1347-51130	Local Control Panel 4481-MZAC-0001-CP-01 General Arrangement	25457-4480-V1A-MXA0-0270
1347-51131	Local Control Panel 4481-MZAC-0001-CP-02-03 General Arrangement	25457-4480-V1A-MXA0-0271
1347-51140	Local Control Panel 4481-MZAC-0002-CP-01 General Arrangement	25457-4480-V1A-MXA0-0272
1347-51141	Local Control Panel 4481-MZAC-0002-CP-02-03 General Arrangement	25457-4480-V1A-MXA0-0273
1347-51150	Local Disconnect Station 2 of 3 General Arrangement	25457-4480-V1A-MXA0-0153
1347-51151	Local Disconnect Station 3 of 3 General Arrangement	25457-4480-V1A-MXA0-0154
1347-51152	Local Disconnect Station 1 of 3 General Arrangement	25457-4480-V1A-MXA0-0155
1347-51160	Local Control Panel 4481-MJR0-0006-CP-01 General Arrangement	25457-4480-V1A-MXA0-0274
1347-51170	Local Control Panel 4481-MHCD-0004-CP-01 General Arrangement	25457-4480-V1A-MXA0-0275
1347-51171	Local Control Panel 4481-MHCD-0004-CP-02	25457-4480-V1A-MXA0-0410
1347-51200	Local Control Panel 4481-MHCD-0002-LCS-01 General Arrangement	25457-4480-V1A-MXA0-0074
1347-51201	Local Control Station 4481-MZBP-0001-LCS-01 General	25457-4480-V1A-MXA0-0086

	Arrangement	
1347-51202	Local Control Station 4481-MZBP-0001-LCS-02 General Arrangement	25457-4480-V1A-MXA0-0087
1347-51203	Local Control Station 4481-MZBP-0001-LCS-03 General Arrangement	25457-4480-V1A-MXA0-0088
1347-51204	Local Control Station -Equipment Without Drive General Arrangement	25457-4480-V1A-MXA0-0089
1347-51205	Local Control Panel 4481-MHCD-0003-LCS-01 General Arrangement	25457-4480-V1A-MXA0-0075
1347-51206	Local Control Station - Equip with Drive - General Arrangement	25457-4480-V1A-MXA0-0197
1347-51207	Local Control Station 4481-MPF0-0001-LCS-01 General Arrangement	25457-4480-V1A-MXA0-0326
1347-51208	Local Control Station 4481-MJR0-0005-LCS-01 General Arrangement	25457-4480-V1A-MXA0-0276
1347-51209	Local Control Station 4481-MJR0-0006-LCS-01 General Arrangement	25457-4480-V1A-MXA0-0277
1347-51210	Local Control Station 4481-MQlk-0001-LCS-01 General Arrangement	25457-4480-V1A-MXA0-0278
1347-51211	Local Control Station 4481-MHCD-0004-LCS-01 General Arrangement	25457-4480-V1A-MXA0-0279
1347-51212	Local Control Station 4481-MZAC-0001-2-LCS-01 General Arrangement	25457-4480-V1A-MXA0-0280
1347-51220	Ladle Pre-Heating Station Control Panel 4481-MBAD-0001-CP-01 General Arrangement	25457-4480-V1A-MXA0-0327
1347-51221	Ladle Pre-Heating Station B CTRL - Panel 4481-MBAD-0002-CP-01	25457-4480-V1A-MXA0-0411
1347-51230	Cast Iron Drying Station Control Panel 4481-MEVD-0001-CP-01 General Arrangement	25457-4480-V1A-MXA0-0328
1347-51240	Cast Iron Drying Station B Control Panel 4481-MEVD-0002-CP-01 General A	25457-4480-V1A-MXA0-0329
1347-51250	Junction Box 4481-MBMB-0001-JB-01 General Arrangement	25457-4480-V1A-MXA0-0198
1347-51260	Junction Box 4481-MBMB-0001-JB-02 General Arrangement	25457-4480-V1A-MXA0-0199
1347-51270	Junction Box 4481-MJR0-0005-JB-01 General Arrangement	25457-4480-V1A-MXA0-0281
1347-51280	Junction Box 4481-MJR0-0007-JB-01 General Arrangement	25457-4480-V1A-MXA0-0282
1347-51290	Junction Box 4481-MJR0-0004-JB-01 General Arrangement	25457-4480-V1A-MXA0-0283
1347-51300	Junction Box 4481-MQLK-0001-JB-01 General Arrangement	25457-4480-V1A-MXA0-0284
1347-51310	Junction Box 4481-MQLK-0001-JB-02 General Arrangement	25457-4480-V1A-MXA0-0285
1347-51320	Junction Box 4481-MQLK-0001-JB-03 General Arrangement	25457-4480-V1A-MXA0-0286
1347-51330	Junction Box 4481-MEEP-0001-JB-01 General Arrangement	25457-4480-V1A-MXA0-0257
1347-51350	Junction Box 4481-MEEP-0001-JB-03 General Arrangement	25457-4480-V1A-MXA0-0258
1347-51360	Junction Box 4481-MEEP-0001-JB-11 General Arrangement	25457-4480-V1A-MXA0-0259
1347-51370	Junction Box 4481-MEEP-0001-JB-12 General Arrangement	25457-4480-V1A-MXA0-0260
1347-51380	Junction Box 4481-MEEP-0001-JB-13 General Arrangement	25457-4480-V1A-MXA0-0261
1347-51390	Junction Box 4481-MJR0-0008-JB-01 General Arrangement	25457-4480-V1A-MXA0-0262
1347-51400	Junction Box 4481-MHCD-0002-JB-01 General Arrangement	25457-4480-V1A-MXA0-0200
1347-51410	Junction Box 4481-MHCD-0001-JB-01 General Arrangement	25457-4480-V1A-MXA0-0263

1347-51420	Junction Box 4481-MHCD-0004-JB-01 General Arrangement	25457-4480-V1A-MXA0-0264
1347-51421	Junction Box 4481-MHCD-0004-JB-02 General Arrangement	25457-4480-V1A-MXA0-0265
1347-51422	Junction Box 4481-MHCD-0004-JB-03 General Arrangement	25457-4480-V1A-MXA0-0266
1347-51423	Junction Box 4481-MHCD-0004-JB-04 General Arrangement	25457-4480-V1A-MXA0-0268
1347-52000	Instrument Location - General Arrangement	25457-4480-V1A-MXA0-0053
1347-52250	Control Panel Location - General Arrangement	25457-4480-V1A-MXA0-0054
1347-52500	Earthing Layout Drawing - General Arrangement	25457-4480-V1A-MXA0-0055

9.8 Electrical Schematics

DRAWING No.	DESCRIPTION	NAME
1347-55000	Electrical Schematic Sheets	25457-4480-V1A-MXA0-0102
1347-55500	MCC Panel 4480-ECM1-0001 Main Incomer Wiring	25457-4480-V1A-MXA0-0255
1347-55501	MCC Panel 4480-ECM1-0001 230 Vac Distribution	25457-4480-V1A-MXA0-0254
1347-55502	MCC Panel 4480-ECM1-0001 24 Vdc Supply	25457-4480-V1A-MXA0-0253
1347-55510	Motor 4481-MHCD-0002-M1-Electrical Schematic Diagram	25457-4480-V1A-MXA0-0067
1347-55520	Motor 4481-MJR0-0001-M1-Electrical Schematic Diagram	25457-4480-V1A-MXA0-0068
1347-55530	Motor 4481-MZBP-0001-M1-Electrical Schematic Diagram	25457-4480-V1A-MXA0-0217
1347-55531	Motor 4481-MZBP-0001-M7-Electrical Schematic Diagram	25457-4480-V1A-MXA0-0218
1347-55532	Motor 4481-MZBP-0001-M3-Electrical Schematic Diagram	25457-4480-V1A-MXA0-0220
1347-55533	Motor 4481-MZBP-0001-M5-Electrical Schematic Diagram	25457-4480-V1A-MXA0-0220
1347-55534	Motor 4481-MZBP-0001-M2-Electrical Schematic Diagram	25457-4480-V1A-MXA0-0221
1347-55535	Motor 4481-MZBP-0001-M4-Electrical Schematic Diagram	25457-4480-V1A-MXA0-0222
1347-55536	Motor 4481-MZBP-0001-M6-Electrical Schematic Diagram	25457-4480-V1A-MXA0-0223
1347-55537	Motor 4481-MAC0-0001-M1-Electrical Schematic Diagram	25457-4480-V1A-MXA0-0224
1347-55540	Motor 4481-MJR0-0002-M1-Electrical Schematic Diagram	25457-4480-V1A-MXA0-0225
1347-55550	Motor 4481-MHCD-0003-M1-Electrical Schematic Diagram	25457-4480-V1A-MXA0-0226
1347-55560	Motor 4481-MJR0-0003-M1-Electrical Schematic Diagram	25457-4480-V1A-MXA0-0227
1347-55570	Motor 4481-MBMB-0001-M1-Electrical Schematic Diagram	25457-4480-V1A-MXA0-0228
1347-55571	Motor 4481-MBMB-0001-M2-Electrical Schematic Diagram	25457-4480-V1A-MXA0-0229
1347-55572	Motor 4481-MBMB-0001-M1-Electrical Schematic Diagram	25457-4480-V1A-MXA0-0230
1347-55573	Motor 4481-MBMB-0003-M1-Electrical Schematic Diagram	25457-4480-V1A-MXA0-0231
1347-55580	Motor 4481-MJR0-0004-M1-Electrical Schematic Diagram	25457-4480-V1A-MXA0-0306
1347-55590	Motor 4481-MQLK-0001-M1-M2 -Electrical Schematic Diagram	25457-4480-V1A-MXA0-0307
1347-55600	Motor 4481-MHCD-0001-M1-Electrical Schematic Diagram	25457-4480-V1A-MXA0-0308
1347-55610	Motor 4481-MEEP-0001-M1 - Electrical Schematic Diagram	25457-4480-V1A-MXA0-0309
1347-55611	Motor 4481-MEEP-0001-M2-Electrical Schematic Diagram	25457-4480-V1A-MXA0-0310
1347-55612	Motor 4481-Meep-0001-M3 - Electrical Schematic Diagram	25457-4480-V1A-MXA0-0311
1347-55620	Motor 4481-MJR0-0005-M1 Electrical Schematic Diagram	25457-4480-V1A-MXA0-0312
1347-55630	Motor 4481-MJR0-0007-M1 Electrical Schematic Diagram	25457-4480-V1A-MXA0-0313
1347-55640	Motor 4481-MZAC-0001-M1 Electrical Schematic Diagram	25457-4480-V1A-MXA0-0314
1347-55650	Motor 4481-MZAC-0002-M1 Electrical Schematic Diagram	25457-4480-V1A-MXA0-0315
1347-55660	Motor 4481-MJR0-0006-M1 Electrical Schematic Diagram	25457-4480-V1A-MXA0-0316
1347-55670	Motor 4481-MJR0-0008-M1 Electrical Schematic Diagram	25457-4480-V1A-MXA0-0317
1347-55680	Motor 4481-MHCD-0004-M1 Electrical Schematic Diagram	25457-4480-V1A-MXA0-0318

DRAWING No.	DESCRIPTION	NAME
1347-55690	Motor 4481-MPF0-0001-M1 Electrical Schematic Diagram	25457-4480-V1A-MXA0-0330
1347-55691	Motor 4481-MPF0-0001-M2 Electrical Schematic Diagram	25457-4480-V1A-MXA0-0331
1347-55700	Motor 4481-MEHX-0001-M1-M2-M3-M4 Electrical Schematic Diagram	25457-4480-V1A-MXA0-0332
1347-55710	Motor 4481-MBAD-0001-M1 Electrical Schematic Diagram	25457-4480-V1A-MXA0-0333
1347-55720	Motor 4481-MEVD-0001-M1 Electrical Schematic Diagram	25457-4480-V1A-MXA0-0334
1347-55730	Motor 4481-MEVD-0002-M1 Electrical Schematic Diagram	25457-4480-V1A-MXA0-0335
1347-55740	Motor 481-MBAD-0002-M1 - Electrical Schematic Diagram	25457-4480-V1A-MXA0-0416

9.9 Interconnections

DRAWING No.	DESCRIPTION	NAME
1347-56000	Cathode Block Oven Heating Elements - Interconnection Elements - 1 of 2	25457-4480-V1A-MXA0-0371
1347-56001	Cathode Block Oven Heating Elements - Interconnection Elements - 2 of 2	25457-4480-V1A-MXA0-0372
1347-56010	Cathode Bar Heating Elements - Interconnection Diagram - 1 of 2	25457-4480-V1A-MXA0-0373
1347-56011	Cathode Bar Heating Elements - Interconnection Diagram - 2 of 2	25457-4480-V1A-MXA0-0374
1347-56020	Utilities and Control Supply - Interconnection Diagram - 1 of 2	25457-4480-V1A-MXA0-0375
1347-56021	Utilities and Control Supply - Interconnection Diagram - 2 of 2	25457-4480-V1A-MXA0-0376
1347-56030	C4 Matguard Interconnection Diagram	25457-4480-V1A-MXA0-0287
1347-56031	C4 R3 Emergency Stop and HYD Valve Switch Interconnection	25457-4480-V1A-MXA0-0288
1347-56032	C1-G1 Emergency Stop Matguard and HYD-V--SW Interconnection Diagram	25457-4480-V1A-MXA0-0289
1347-56033	Central Control Panel 4481-MHCD-0003-CP-01 Interconnection Diagram	25457-4480-V1A-MXA0-0232
1347-56040	R4A Light Curtain Reset Button Safety Gate SW Interconnection Diagram	25457-4480-V1A-MXA0-0290
1347-56041	R4B Light Curtain Reset Button Safety Gate SW Interconnection Diagram	25457-4480-V1A-MXA0-0291
1347-56050	Central Control Panel 4481-CP-1001 Interconnection Diagram	25457-4480-V1A-MXA0-0233
1347-56060	F3 Burner - Interconnection Diagram - 1 of 2	25457-4480-V1A-MXA0-0377
1347-56061	F3 Burner - Interconnection Diagram - 1 of 2	25457-4480-V1A-MXA0-0378
1347-56070	F4 Burner - Interconnection Diagram - 1 of 2	25457-4480-V1A-MXA0-0379
1347-56080	F4 Burner - Interconnection Diagram - 2 of 2	25457-4480-V1A-MXA0-0380
1347-56090	D1 Collector Fan and W1 Chiller Suppy Interconnection Diagram	25457-4480-V1A-MXA0-0104
1347-56100	F3B Burner 1-2 Interconnection Diagram	25457-4480-V1A-MXA0-0413
1347-56101	F3B Burner 2-2 Interconnection Diagram	25457-4480-V1A-MXA0-0414
1347-56250	Motor 4481-MHCD-0002 M1 Interconnection Diagram	25457-4480-V1A-MXA0-0234
1347-56260	Motor 4481-MJR0-0001 M1 Interconnection Diagram	25457-4480-V1A-MXA0-0235
1347-56270	Motor 4481-MZBP-0001 M1 Interconnection Diagram	25457-4480-V1A-MXA0-0236
1347-56271	Motor 4481-MHCD-0001 M3 Interconnection Diagram	25457-4480-V1A-MXA0-0237
1347-56272	Motor 4481-MZBP-0001 M7 Interconnection Diagram	25457-4480-V1A-MXA0-0238
1347-56273	Motor 4481-MZBP-0001 M5 Interconnection Diagram	25457-4480-V1A-MXA0-0239
1347-56274	Motor 4481-MZBP-0001 M2 Interconnection Diagram	25457-4480-V1A-MXA0-0240
1347-56275	Motor 4481-MZBP-0001 M4 Interconnection Diagram	25457-4480-V1A-MXA0-0241

DRAWING No.	DESCRIPTION	NAME
1347-56276	Motor 4481-MZBP-0001 M6 Interconnection Diagram	25457-4480-V1A-MXA0-0242
1347-56277	Motor 4481-MAC0-0001 M5 Interconnection Diagram	25457-4480-V1A-MXA0-0243
1347-56280	Motor 4481-MJR0-0002 M1 Interconnection Diagram	25457-4480-V1A-MXA0-0244
1347-56290	Motor 4481-MHCD-0003 M1 Interconnection Diagram	25457-4480-V1A-MXA0-0245
1347-56300	Motor 4481-MBMB-0001 M1 Interconnection Diagram	25457-4480-V1A-MXA0-0247
1347-56310	Motor 4481-MJR0-0003 M1 Interconnection Diagram	25457-4480-V1A-MXA0-0246
1347-56311	Motor 4481-MBMB-0001 M2 Interconnection Diagram	25457-4480-V1A-MXA0-0248
1347-56312	Motor 4481-MBMB-0001 M3 Interconnection Diagram	25457-4480-V1A-MXA0-0249
1347-56313	Motor 4481-MBMB-0001 M4 Interconnection Diagram	25457-4480-V1A-MXA0-0250
1347-56320	Motor 4481-MJR0-0004-M1 Interconnection Diagram	25457-4480-V1A-MXA0-0292
1347-56330	Motor 4481-MQLK- 0001- M1 1 of 2 Interconnection Diagram	25457-4480-V1A-MXA0-0292
1347-56331	Motor 4481-MQLK-0001--M1 2 of 2 Interconnection Diagram	25457-4480-V1A-MXA0-0294
1347-56340	Motor 4481-MHCD-0001--M1 Interconnection Diagram	25457-4480-V1A-MXA0-0295
1347-56350	Motor 4481-MEEP-0001--M1 Interconnection Diagram	25457-4480-V1A-MXA0-0296
1347-56351	Motor 4481-MEEP-0001--M2 Interconnection Diagram	25457-4480-V1A-MXA0-0297
1347-56352	Motor 4481-MEEP-0001--M3 Interconnection Diagram	25457-4480-V1A-MXA0-0298
1347-56360	Motor 4481-MJR0-0005--M1 Interconnection Diagram	25457-4480-V1A-MXA0-0299
1347-56370	Motor 4481-MJR0-0007--M1 Interconnection Diagram	25457-4480-V1A-MXA0-0300
1347-56380	Motor 4481-MZAC-0001-M1 Interconnection Diagram	25457-4480-V1A-MXA0-0301
1347-56390	Motor 4481-MZAC-0002-M1 Interconnection Diagram	25457-4480-V1A-MXA0-0302
1347-56400	Motor 4481-MZAC-0006-M1 Interconnection Diagram	25457-4480-V1A-MXA0-0303
1347-56410	Motor 4481-MJR0--0001-M1 Interconnection Diagram	25457-4480-V1A-MXA0-0304
1347-56420	Motor 4481-MHCD-0004-M1 Interconnection Diagram	25457-4480-V1A-MXA0-0305
1347-56430	Motor 4481-MPF0-0001-M1 Interconnection Diagram	25457-4480-V1A-MXA0-0336
1347-56431	Motor 4481-MPF0-0001-M2 Interconnection Diagram	25457-4480-V1A-MXA0-0337
1347-56450	Motor 4481-MBAD-0001-M1 Interconnection Diagram	25457-4480-V1A-MXA0-0338
1347-56460	Motor 4481-MEVD-0001-M1 Interconnection Diagram	25457-4480-V1A-MXA0-0339
1347-56470	Motor 4481-MEVD-0002-M1 Interconnection Diagram	25457-4480-V1A-MXA0-0403
1347-56480	Motor 481-MBAD-0002-M2 - Electrical Schematic Diagram	25457-4480-V1A-MXA0-0415
1347-57000	Motor Control Panel 4481-ECM1-0001 - 1 of 3 - Single Line Diagram	25457-4480-V1A-MXA0-0056
1347-57010	Motor Control Panel 4481-ECM1-0001 - 2 of 3 - Single Line Diagram	25457-4480-V1A-MXA0-0057
1347-57020	Motor Control Panel 4481-ECM1-0001 - 3 of 3 - Single Line Diagram	25457-4480-V1A-MXA0-0059

9.10 Inputs & Outputs

DRAWING No.	DESCRIPTION	NAME
1347-56760	PLC Control System Architecture	25457-4480-V1A-MXA0-0122
1347-PLC I&O	PLC Inputs & Outputs	25457-4480-V1A-MXA0-0320
1347-FLEX 02 I&O	Remote Rack 02 Inputs & Outputs	25457-4480-V1A-MXA0-0321
1347-FLEX 03 I&O	Remote Rack 03 Inputs & Outputs	25457-4480-V1A-MXA0-0322
1347-FLEX 04 I&O	Remote Rack 04 Inputs & Outputs	25457-4480-V1A-MXA0-0323
1347-FLEX 05 I&O	Remote Rack 05 Inputs & Outputs	25457-4480-V1A-MXA0-0324

9.11 P&ID's

DRAWING No.	DESCRIPTION	NAME
1347-50010	Chain Conveyor Upstream of Shotblasting Machine C2 - P and ID	25457-4480-V1A-MXA0-0029
1347-50020	Conical Roller Conveyor at Shotblasting Machine Entrance R9 - P and ID	25457-4480-V1A-MXA0-0030
1347-50030	Cathode Bar Shotblasting Machine S1 - P and ID	25457-4480-V1A-MXA0-0398
1347-50040	Dust Collector for Shotblasting Machine D1 - P and ID	25457-4480-V1A-MXA0-0399
1347-50050	Conical Roller at Shotblasting Machine Exit R8 - P and ID	25457-4480-V1A-MXA0-0031
1347-50060	Chain Conveyor Between Shotblasting Machine and Oven C3 - P and ID	25457-4480-V1A-MXA0-0032
1347-50070	Roller Conveyor at Bar Furnace Entrance R7 - P and ID	25457-4480-V1A-MXA0-0033
1347-50080	Cathode Bar Heating Furnace F2 - 1 of 3 - P and ID	25457-4480-V1A-MXA0-0034
1347-50081	Cathode Bar Heating Furnace F2 - 2 of 3 - P and ID	25457-4480-V1A-MXA0-0035
1347-50082	Cathode Bar Heating Furnace F2 - 3 of 3 - P and ID	25457-4480-V1A-MXA0-0036
1347-50090	Roller Conveyor at Bar Furnace Exit R6 - P and ID	25457-4480-V1A-MXA0-0037
1347-50100	Positioning Gantry for Block and Bars - G1 - 1 of 2 - P and ID	25457-4480-V1A-MXA0-0038
1347-50101	Positioning Gantry for Block and Bars - G1 - 2 of 2 - P and ID	25457-4480-V1A-MXA0-0039
1347-50110	Chain Conveyor of Block Oven C1 - P and ID	25457-4480-V1A-MXA0-0040
1347-50120	Cathode Block Oven - F1 - 1 of 2 - P and ID	25457-4480-V1A-MXA0-0041
1347-50121	Cathode Block Oven - F1 - 2 of 2 - P and ID	25457-4480-V1A-MXA0-0042
1347-50130	Roller Conveyor at Block Oven Exit R1 - P and ID	25457-4480-V1A-MXA0-0043
1347-50140	Roller Conveyor for Block and Bar Assembly R2 - P and ID	25457-4480-V1A-MXA0-0044
1347-50150	Prestressing and Sealing Station Conveyor A and Platforms R4A - 1 of 2 - P and ID	25457-4480-V1A-MXA0-0045
1347-50151	Prestressing and Sealing Station Conveyor A and Platforms R4A - 2 of 2 - P and ID	25457-4480-V1A-MXA0-0046
1347-50160	Prestressing and Sealing Station Conveyor B and Platforms R4B - 1 of 2 - P and ID	25457-4480-V1A-MXA0-0047
1347-50161	Prestressing and Sealing Station Conveyor B and Platforms R4B - 2 of 2 - P and ID	25457-4480-V1A-MXA0-0048
1347-50170	Roller Conveyor After Sealing Station R3 - P and ID	25457-4480-V1A-MXA0-0049
1347-50180	Roller Conveyor at Cooling and Turning Station R5 - P and ID	25457-4480-V1A-MXA0-0050
1347-50190	Cooling and Turning Station T1 - P and ID	25457-4480-V1A-MXA0-0051
1347-50200	Chain Conveyor for Sealed Cathode C4 - P and ID	25457-4480-V1A-MXA0-0052
1347-50220	Ladle Pre-Heating Station F3A - P and ID	25457-4480-V1A-MXA0-0386
1347-50221	Ladle Pre-Heating Station F3B - P and ID	25457-4480-V1A-MXA0-0406
1347-50230	Cast Iron Ingot Drying Station A - F4A - P and ID	25457-4480-V1A-MXA0-0387

1347-50240	Cast Iron Ingot Drying Station B - F4B - P and ID	25457-4480-V1A-MXA0-0400

9.12 Cable List

DRAWING No.	DESCRIPTION	NAME
1347-Cable List	Cable List	25457-4480-V1A-MXA0-0319

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DATE:
FILE:

LISTE DE MATERIELS/BILL OF MATERIALS

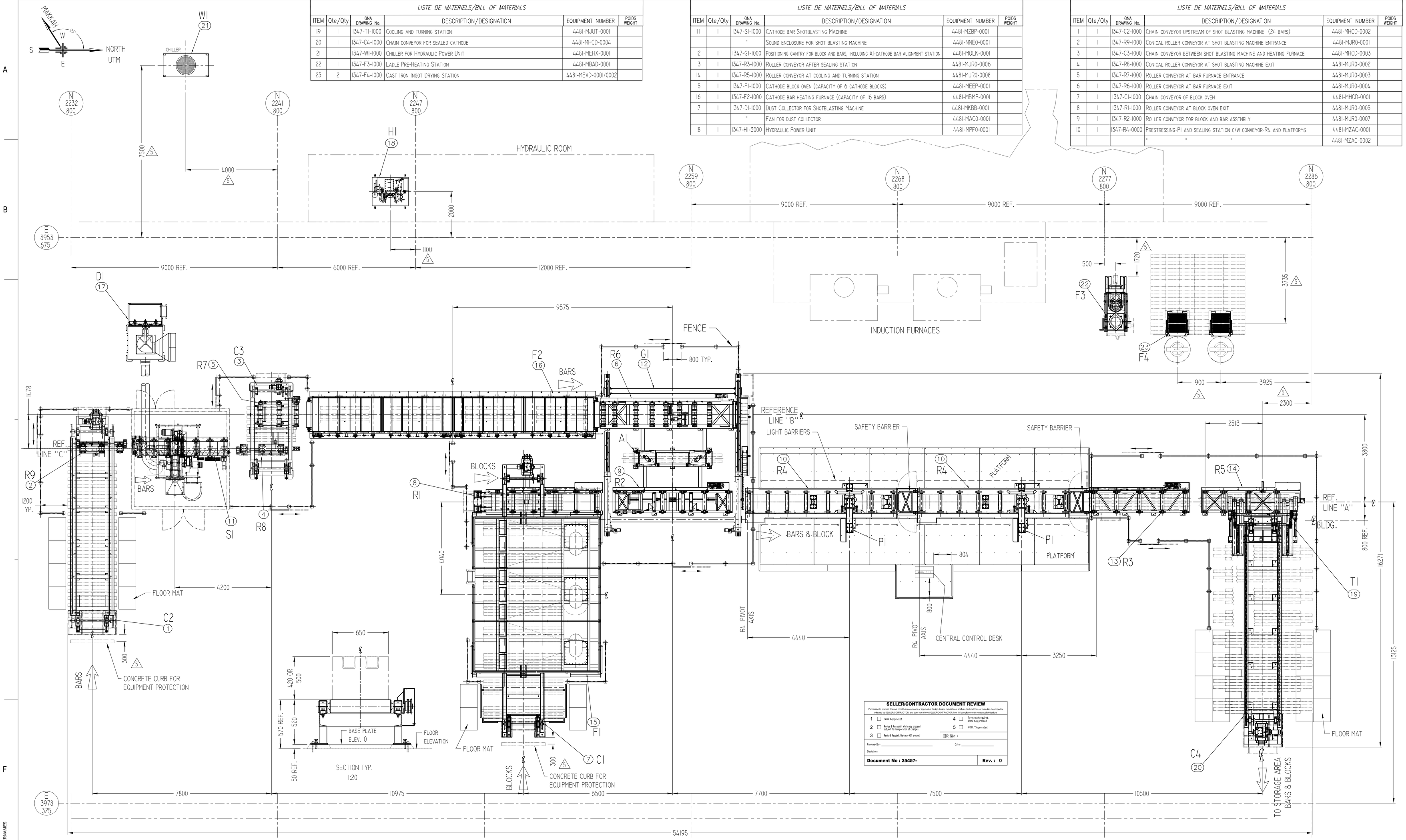
ITEM	Qte/Qty	GNA DRAWING No.	DESCRIPTION/DESIGNATION	EQUIPMENT NUMBER	POIDS WEIGHT
19	1	1347-TI-1000	COOLING AND TURNING STATION	4481-MJUT-0001	
20	1	1347-C4-1000	CHAIN CONVEYOR FOR SEALED CATHODE	4481-MHCD-0004	
21	1	1347-WI-1000	CHILLER FOR HYDRAULIC POWER UNIT	4481-MEHX-0001	
22	1	1347-F3-1000	LADLE PRE-HEATING STATION	4481-MBAD-0001	
23	2	1347-F4-1000	CAST IRON INGOT DRYING STATION	4481-MEVD-0001/0002	

LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/Qty	GNA DRAWING No.	DESCRIPTION/DESIGNATION	EQUIPMENT NUMBER	POIDS WEIGHT
11	1	1347-SI-1000	CATHODE BAR SHOTBLASTING MACHINE	4481-MZBP-0001	
		"	SOUND ENCLOSURE FOR SHOT BLASTING MACHINE	4481-MNE0-0001	
12	1	1347-GI-1000	POSITIONING GANTRY FOR BLOCK AND BARS, INCLUDING AI-CATHODE BAR ALIGNMENT STATION	4481-MQLK-0001	
13	1	1347-R3-1000	ROLLER CONVEYOR AFTER SEALING STATION	4481-MJR0-0006	
14	1	1347-R5-1000	ROLLER CONVEYOR AT COOLING AND TURNING STATION	4481-MJR0-0008	
15	1	1347-FI-1000	CATHODE BLOCK OVEN (CAPACITY OF 6 CATHODE BLOCKS)	4481-MEEP-0001	
16	1	1347-F2-1000	CATHODE BAR HEATING FURNACE (CAPACITY OF 16 BARS)	4481-MBMP-0001	
17	1	1347-DI-1000	DUST COLLECTOR FOR SHOTBLASTING MACHINE	4481-MKBB-0001	
		"	FAN FOR DUST COLLECTOR	4481-MAC0-0001	
18	1	1347-HI-3000	HYDRAULIC POWER UNIT	4481-MPF0-0001	

LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/Qty	GNA DRAWING No.	DESCRIPTION/DESIGNATION	EQUIPMENT NUMBER	POIDS WEIGHT
1	1	1347-C2-1000	CHAIN CONVEYOR UPSTREAM OF SHOT BLASTING MACHINE (24 BARS)	4481-MHCD-0002	
2	1	1347-R9-1000	CONICAL ROLLER CONVEYOR AT SHOT BLASTING MACHINE ENTRANCE	4481-MJR0-0001	
3	1	1347-C3-1000	CHAIN CONVEYOR BETWEEN SHOT BLASTING MACHINE AND HEATING FURNACE	4481-MHCD-0003	
4	1	1347-R8-1000	CONICAL ROLLER CONVEYOR AT SHOT BLASTING MACHINE EXIT	4481-MJR0-0002	
5	1	1347-R7-1000	ROLLER CONVEYOR AT BAR FURNACE ENTRANCE	4481-MJR0-0003	
6	1	1347-R6-1000	ROLLER CONVEYOR AT BAR FURNACE EXIT	4481-MJR0-0004	
7	1	1347-C1-1000	CHAIN CONVEYOR OF BLOCK OVEN	4481-MHCD-0001	
8	1	1347-RI-1000	ROLLER CONVEYOR AT BLOCK OVEN EXIT	4481-MJR0-0005	
9	1	1347-R2-1000	ROLLER CONVEYOR FOR BLOCK AND BAR ASSEMBLY	4481-MJR0-0007	
10	1	1347-R4-0000	PRESTRESSING-PI AND SEALING STATION C/W CONVEYOR-R4 AND PLATFORMS	4481-MZAC-0001	
			" "	4481-MZAC-0002	



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NUMBER	REV.	TITLE
REFERENCE DRAWINGS		

REV.	DESCRIPTION	DATE	DRN.	CHK.	R.E.	A.E. / S.	E.G.S.	P.E.M.
5	GEN. UPDATE (EQUIPMENT LOCATION)	FE 17 '11	LG	M.B.	C.C.			
4	F3, F4, H1, S1, W1 AND FENCE RELOCATED; FLOOR MAT ADDED	DE 14 '10	E.I.	M.B.	C.C.			
2	GEN. REV.	AU 20 10	E.I.	M.B.	C.C.			
1	OVERALL DIM. 51900 CHANGED FOR 54000	JL 20 10	E.I.	M.B.	C.C.			
0	PRELIMINARY	JL 08 10	E.I.	M.B.	C.C.			

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SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CATHODE SEALING EQUIPMENT
EQUIPMENT LAYOUT

CLIENT DRG. No. REV.

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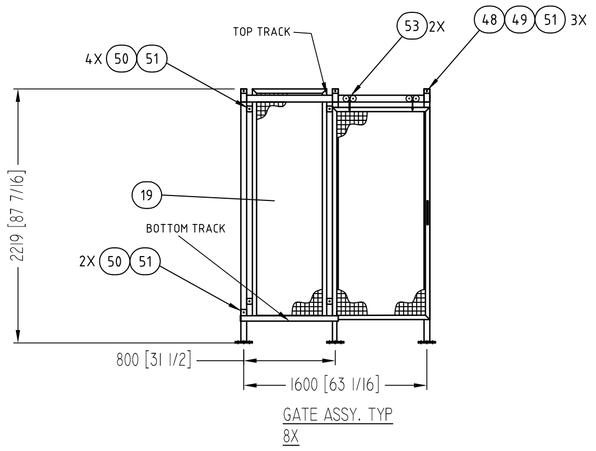

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LISTE DE MATERIELS/BILL OF MATERIALS

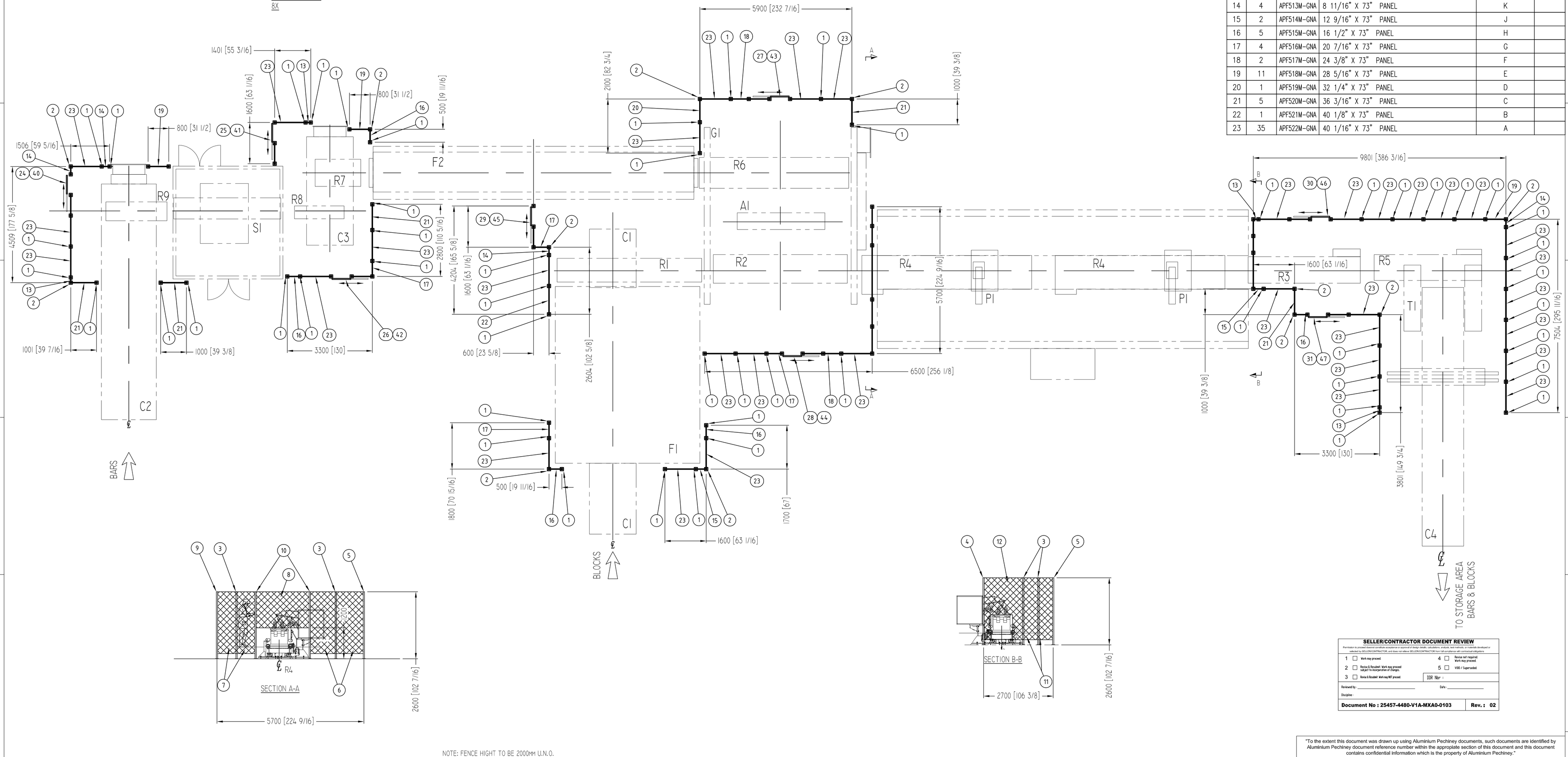
ITEM	Qte/Qty	No. PIECE-MAT. MAT.-PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
44	1		DUAL KEY CHAINE LOCK L-N		
45	1		DUAL KEY CHAINE LOCK L-O		
46	1		DUAL KEY CHAINE LOCK H-I		
47	1		DUAL KEY CHAINE LOCK H-J		
48	25		ALLEN CAP SCREW M8 X 75LG		
49	25		HEX. NUT M8		
50	375		ALLEN CAP SCREW M8 X 20LG		
51	600		WASHER M8		
52	215		LOCK WASHER M8		
53	16		BOX RAIL HANGER C/W 4-1/2" BOLT		

LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/Qty	No. PIECE-MAT. MAT.-PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
24	1		GATE ASSY A-B		
25	1		GATE ASSY D-E		
26	1		GATE ASSY D-F		
27	1		GATE ASSY L-M		
28	1		GATE ASSY L-N		
29	1		GATE ASSY L-O		
30	1		GATE ASSY H-I		
31	1		GATE ASSY H-J		
40	1		DUAL KEY CHAINE LOCK A-B		
41	1		DUAL KEY CHAINE LOCK D-E		
42	1		DUAL KEY CHAINE LOCK D-F		
43	1		DUAL KEY CHAINE LOCK L-M		

LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/Qty	No. PIECE-MAT. MAT.-PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
1	54	APF601M-GNA	81" STD. POST	X	
2	13	APF601M-GNA-C	81" STD. CORNER POST	Z	
3	4	CONV-S	102 3/8" STD. CONVEYOR POST	CONV-S	
4	1	CONV-C	102 3/8" CONVEYOR CORNER POST (RIGHT)	CONV-C	
5	2	CONV-C	102 3/8" CONVEYOR CORNER POST (LEFT)	CONV-C	
6	2	A-A-001	38 3/16" X 94 3/8" CONVEYOR PANEL	AA 001	
7	2	A-A-002	26 3/8" X 94 3/8" CONVEYOR PANEL	AA 002	
8	1	A-A-003	79 1/2" X 55 1/8" CONVEYOR PANEL	AA 003	
9	1	A-A-004	102 3/8" TRANSITIONAL CONVEYOR POST	AA 004	
10	2	A-A-005	102 3/8" OVER CONVEYOR POST	AA 005	
11	2	B-B-001	22 7/16" X 94 3/8" CONVEYOR PANEL	BB 001	
12	1	B-B-002	51 15/16" X 94 3/8" CONVEYOR PANEL	BB 002	
13	4	APF512M-GNA	4 3/4" X 73" PANEL	L	
14	4	APF513M-GNA	8 11/16" X 73" PANEL	K	
15	2	APF514M-GNA	12 9/16" X 73" PANEL	J	
16	5	APF515M-GNA	16 1/2" X 73" PANEL	H	
17	4	APF516M-GNA	20 7/16" X 73" PANEL	G	
18	2	APF517M-GNA	24 3/8" X 73" PANEL	F	
19	11	APF518M-GNA	28 5/16" X 73" PANEL	E	
20	1	APF519M-GNA	32 1/4" X 73" PANEL	D	
21	5	APF520M-GNA	36 3/16" X 73" PANEL	C	
22	1	APF521M-GNA	40 1/8" X 73" PANEL	B	
23	35	APF522M-GNA	41 1/16" X 73" PANEL	A	



NOTE: FENCE HIGHT TO BE 2000mm U.N.O.

SELLER/CONTRACTOR DOCUMENT REVIEW

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2 ☐ Revise & Resubmit. Work may proceed subject to incorporation of changes.
3 ☐ Revise & Resubmit. Work may NOT proceed.
4 ☐ Revise not required. Work may proceed.
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DDR Nbr :

Reviewed by : _____ Date : _____

Discipline :

Document No : 25457-4480-V1A-MXA0-0103 | **Rev. : 02**

NUMBER	REV.	TITLE
REFERENCE DRAWINGS		

REV.	DESCRIPTION	DATE	DRN.	CHK.	R.E.	A.E. / S.	E.G.S.	P.E.M.
3	GEN. REV.	AL.14.'11	E.I./A.L.	M.B.	C.C.			
2	FENCE MODIFIED	FE.03.'11	H.K.	M.B.	C.C.			
1	SECTION B-B ADDED	JA.25.'11	H.K.	M.B.	C.C.			
0	FIRST ISSUE	DE.17.2010	C.C.	M.B.	C.C.			

REVISIONS

STAMP

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ALCOA | Ma'aden

Ma'aden Aluminum Project

Bechtel

GNA alutech inc. — Departement Ingenierie Engineering Department, 9495 Trans-Canada, Saint-Laurent, Quebec, H4S 1V3, Canada

		DATE
DRAWN	E. Iancu	JL 08 10
CHK.	M. Blanchet	
R.E.	C. Coupal	
A.E. / S.		
E.G.S.		
P.E.M.		
CLIENT		

SELLER DRAWING No. 1347-AR-0200 — REV. 3

Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CATHODE SEALING EQUIPMENT
FENCE LAYOUT

SCALE: 1:75 — FORMAT A1

BECHTEL DRG. No. — — — — — — REV.

CLIENT DRG. No. — REV.

USER: $USERNAME$
TIME: $TIME$
$DATE$
$FILE$
DATE:
FILE:

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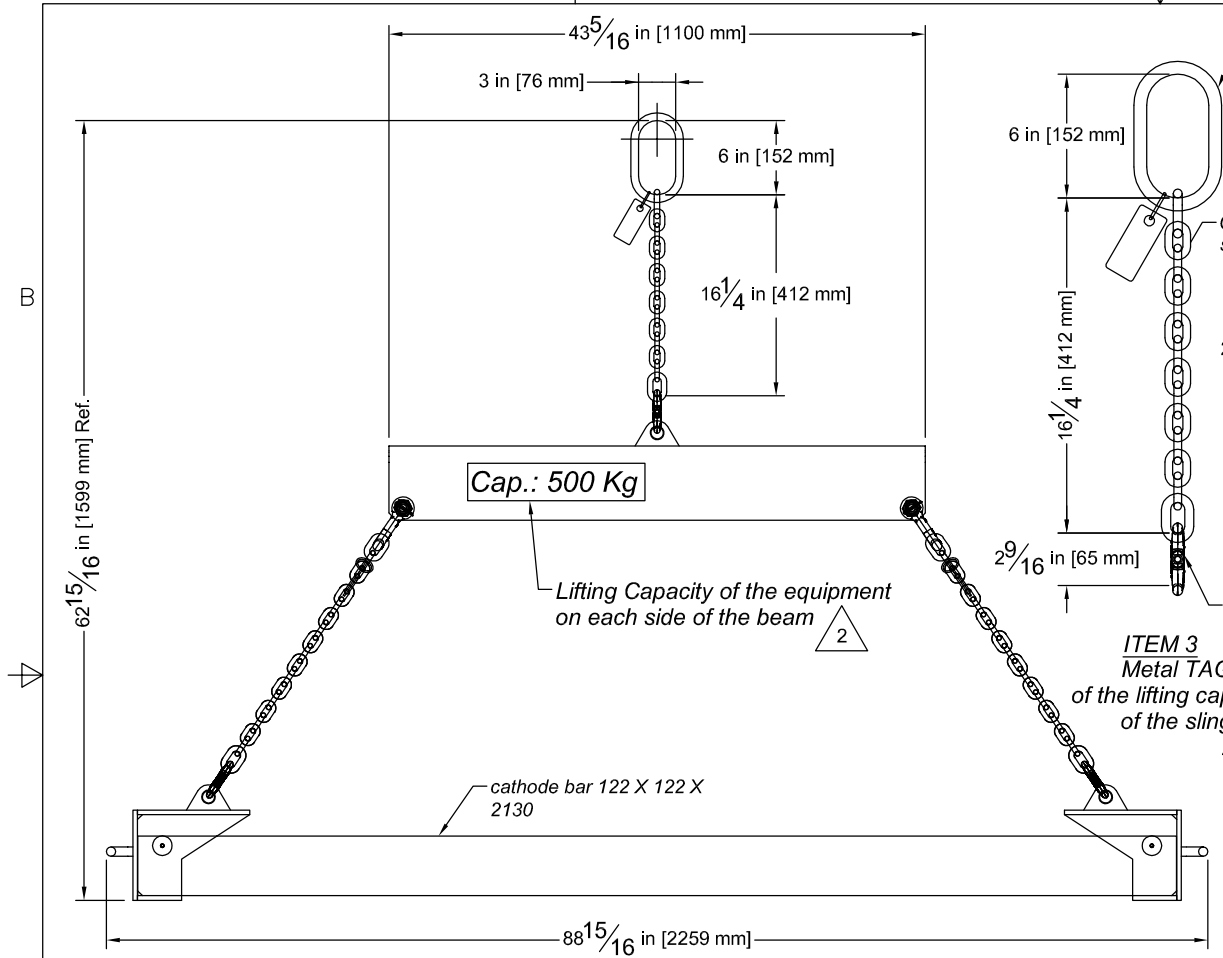
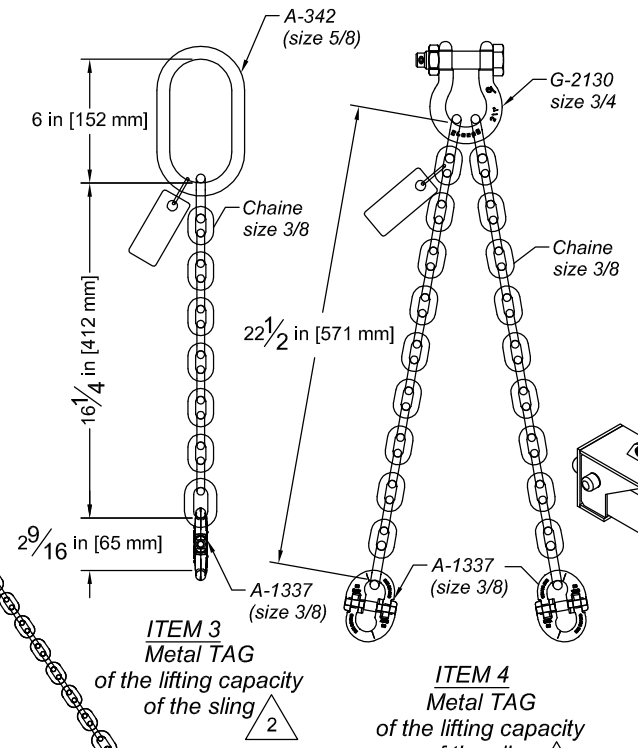
LISTE DE MATERIELS/BILL OF MATERIALS

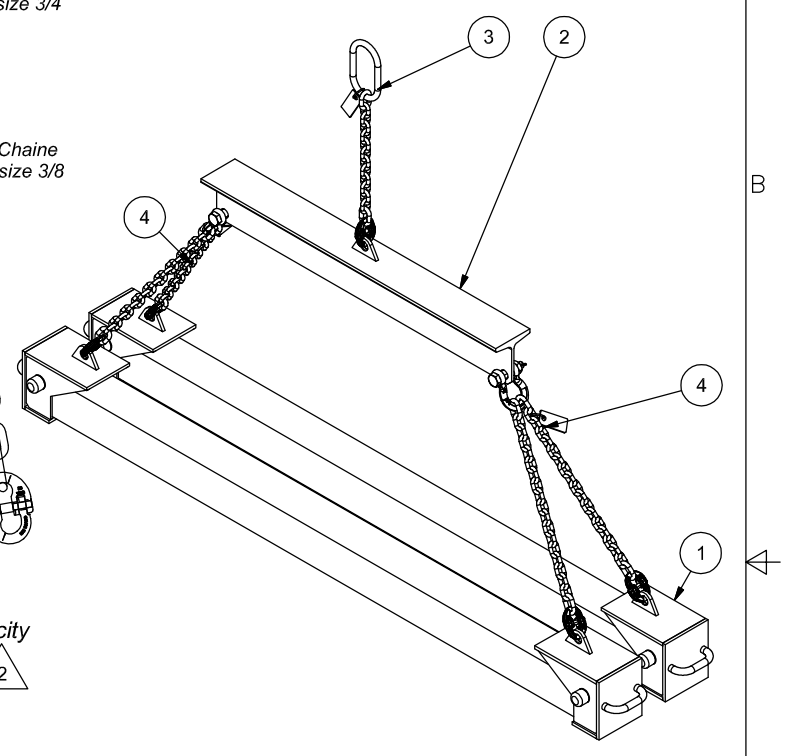
ITEM	Qte/Qty	No. PIECE–MAT. MAT.–PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
1	4	1347-B1-1100	BAR SUPPORT		26 kg
2	1	1347-B1-1200	SUPPORT		27 kg

REVISION HISTORY

REV	DESCRIPTION	DATE	APPROVED
1	Revision by the customer's request	16/11/2010	
2	Revision as client notes	02/12/2010	







NOTES:
1. BREAK SHARP CORNERS, DEBURR AFTER DRILLING AND CUTTING.
2. ALL STRUCTURAL SHAPES AND PLATES MUST BE WITHOUT DISTORTION.
3. ALL WELDS MUST CONFORM CSA W-47, W-59.
4. STEEL PLATES SHALL BE CUT OUT OF ONE PLATE ONLY,IF NOT, JOINING PLATES SHALL BE WELDED BUTT JOINT FULL PENETRATION. THE WELDING SEAM SHALL BE BEHIND A STRUCTURAL SHAPE.
   IF NOT OTHERWISE SPECIFIED, ALL WELDS ARE CONTINUOUS.
5. CLEAN ALL WELDED SURFACES OF BURRS AND ASPERITIES.
6. HANDLE PAINTED WITH CARE (TO AVOID RUST AFTER INSTALLATION).
7. PROVIDE AND INSTALL LIFTING LUG(S) APPROPRIATE FOR TOTAL WEIGHT OF PART(S) (IF APPLICABLE).
8. PRE-ASSEMBLE PARTS IN SHOP FOR DIMENSIONAL AND FUNCTIONAL VERIFICATION.
9. ALL MACHINED SURFACES TO BE COATED WITH TEMPORARY CORROSION PROTECTION.
10. PIECES SHALL BE MATCH MARKED FOR SUBSEQUENT DISASSEMLY.
11. LENGTHS ON BILL OF MATERIAL ARE NOMINAL DIMENSIONS, REFER TO DRAWING FOR EXACT DIMENSIONS.

PAINT NOTES:
1. PAINT PROCEDURE AND MANUFACTURER AS PER BECHTEL SPECIFICATION 25457-0000-3PS-G000-0002 REV.001

ITEM	QTY	DESCRIPTION	MATERIAL	STOCK NUMBER
1	4	Bar support: #1347-B4-1100 (see sheet 2)		
2	1	Support: # 1347-B4-1200 (see sheet 3)		
3	1	Single leg sling, chain size 3/8		
4	2	Double leg sling, chain size 3/8		

COMMANDE / ORDER No 3863-D
QUANTITÉ / QUANTITY 2
CAPACITÉ / CAPACITY 2 x 250 Kg =500 Kg
ÉPREUVE / TEST 125%
FACTEUR DE SÉCURITÉ / SAFETY FACTOR 5:1
POIDS / WEIGHT 104 Kg
PEINTURE / PAINT Traffic yellow "RAL 1023"

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3800 Transcanadienne, Pointe-Claire Québec H9R 1B1
Tel: (514) 428-5511 Fax: (514) 428-5555

	Date (jj-mm-aa) (dd-mm-yy)	Nom/Name
Dessiné par: Drawing by:	09/11/2010	G.Avetisian
Verifié par: Checked by:		R.Bellehumeur
Approuvé par: Approuved by:		

Tolérances géométrique: ASME Y14.5-1994
Fraction ± 1/8" Decimale x.x ± .06" x.xx ± .015" x.xxx ± .005" x.xxxx ± .001"
Angle ± 1/2°

Unité de mesure: Po.
Unit of measure:

Projection américaine
Third angle projection

Sceau ingénieur

Client/Customer: GNA ALUTECHINC.

Titre/Title: BAR HANDLING BEAM # 1347-B4-1000 Cap.: 500 Kg

N° Item

Format	No dessin	Modèle Série	Revision
B		47-9695	2

Echelle Scale: N/A | Logiciel Software: Inventor 11 | Page Sheet: 1 / 3

EQUIPMENT TAG # 4481-MJJ0-0001
EQUIPMENT TAG # 4481-MJJ0-0002

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
		1		NOTES ADDED	JA.10."11	EI	M.B.	C.C.
		0		INITIAL DESIGN	AU.16."10	A.V.	M.B.	C.C.
REFERENCES		REVISIONS						

NOTES

STATUS: —

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RESPONSIBLE ENG. -- DATE: ---	CLIENT: DATE:
ENG. GROUP SUP. DATE:	DRAWING SCALE: NTS

Vendor or Subcontractor Logo: GNA alutech inc. Département Ingénierie Engineering Department 1649 Tunucanada Montmagny, Quebec G5V 1J2 Canada

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SELLER DRAWING No. 1347–B1–1000 | REV. 1

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
Bar Handling Beam
GENERAL ARRANGEMENT

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx –	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3–		–AZ	

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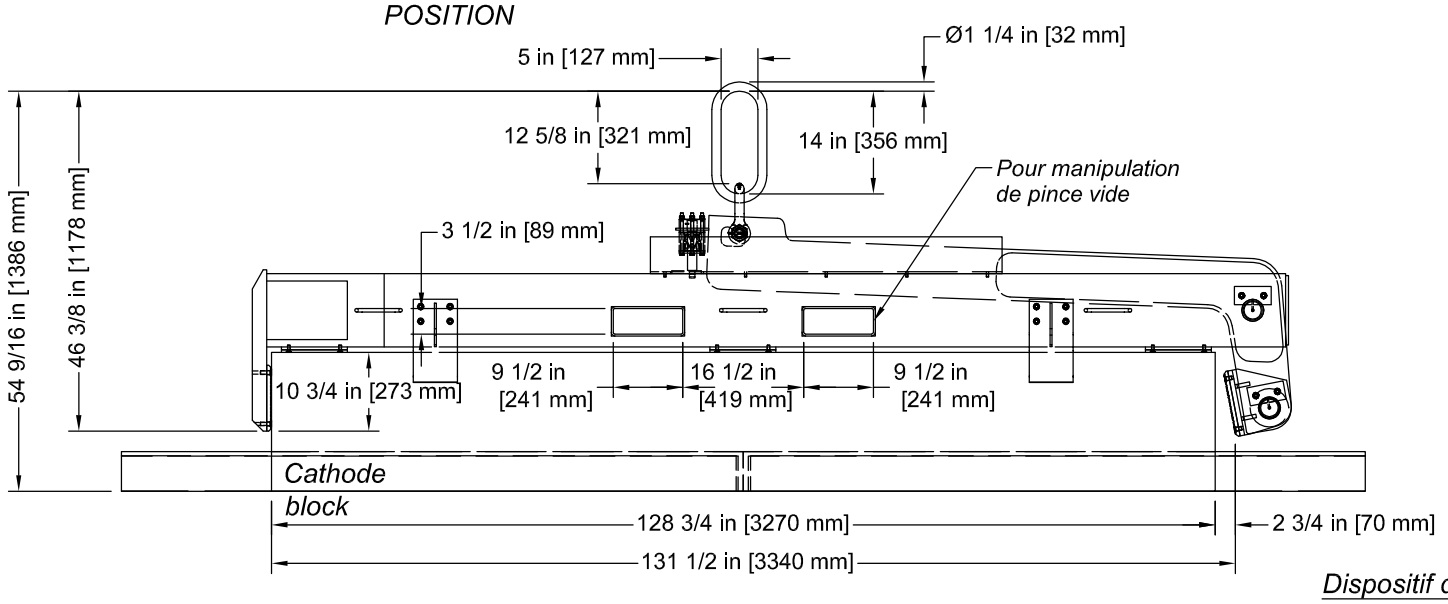
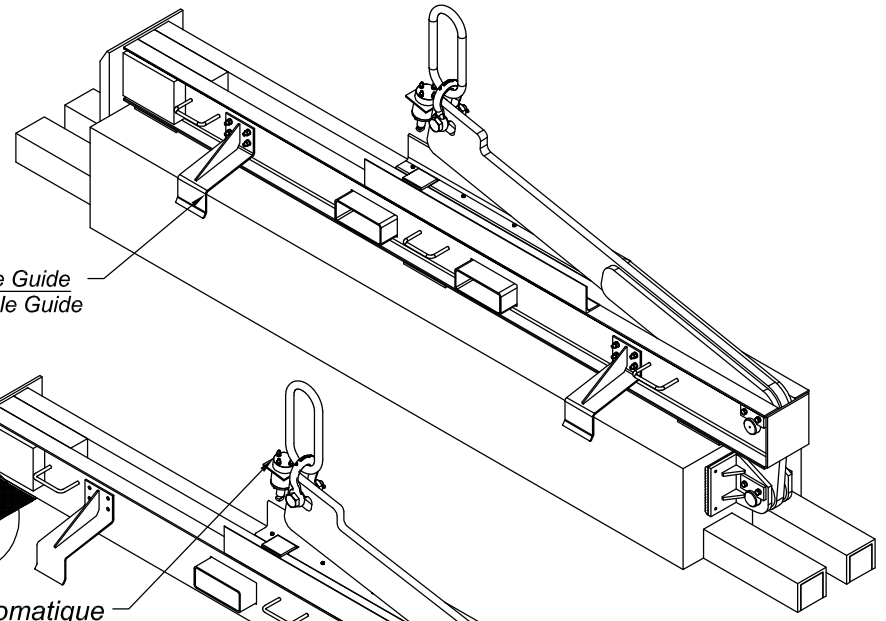
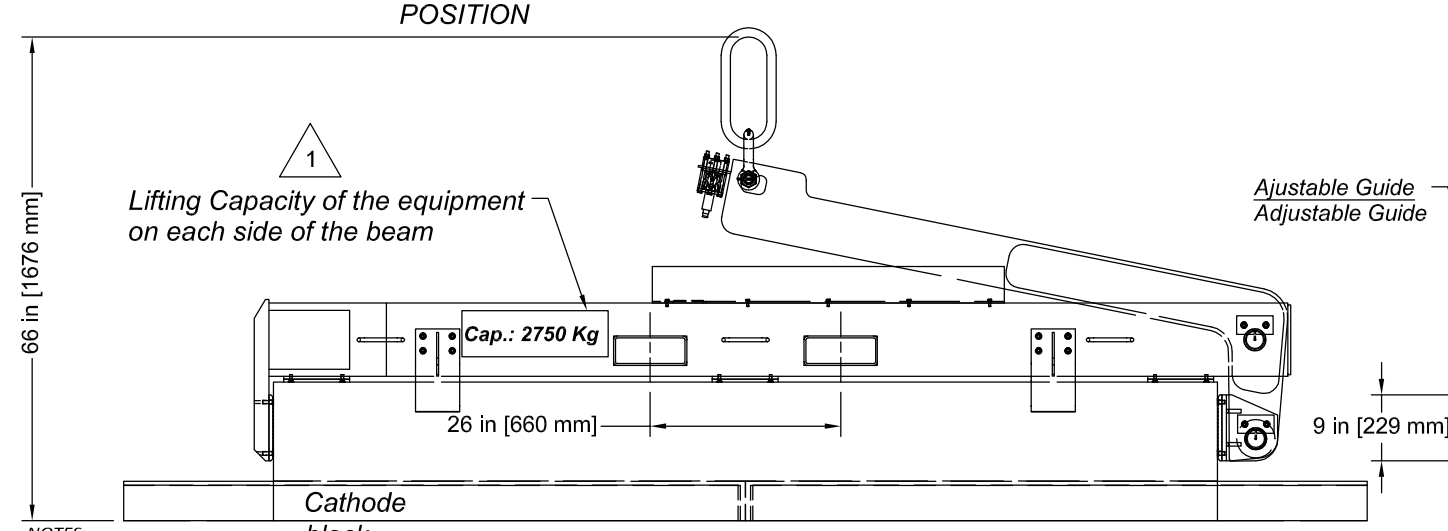
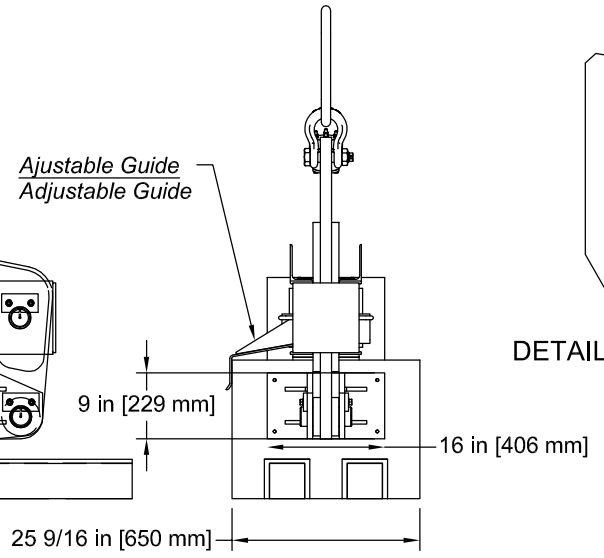
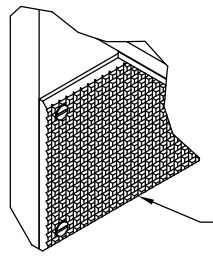




POSITION PINCE FERMER / CLOSED TONGS POSITION







1
PLATE "GRIPPES"
STYLE IS DIAMOND
GRIP 1/4" x 1/4" (6.35mm x 6 35mm)
MATERIAL IS QT-100(CSA G40.21-92-100QT)
FASTENED WITH BOLTS
OPERATION TEMPERATURE: BLOCK 300°C

DETAIL A

REVISION HISTORY			
REV	DESCRIPTION	DATE	APPROVED
1	Plate "Gripperes" Lifting Capacity Ajustable Guide	29/12/2010	

NOTES:
1. BREAK SHARP CORNERS, DEBURR AFTER DRILLING AND CUTTING.
2. ALL STRUCTURAL SHAPES AND PLATES MUST BE WITHOUT DISTORTION.
3. ALL WELDS MUST CONFORM CSA W-47, W-59.
4. STEEL PLATES SHALL BE CUT OUT OF ONE PLATE ONLY,IF NOT, JOINING PLATES SHALL BE WELDED BUTT JOINT FULL PENETRATION. THE WELDING SEAM SHALL BE BEHIND A STRUCTURAL SHAPE. IF NOT OTHERWISE SPECIFIED, ALL WELDS ARE CONTINUOUS.
5. CLEAN ALL WELDED SURFACES OF BURRS AND ASPERITIES.
6. HANDLE PAINTED WITH CARE (TO AVOID RUST AFTER INSTALLATION).
7. PROVIDE AND INSTALL LIFTING LUG(S) APPROPRIATE FOR TOTAL WEIGHT OF PART(S) (IF APPLICABLE).
8. PRE-ASSEMBLE PARTS IN SHOP FOR DIMENSIONAL AND FUNCTIONAL VERIFICATION.
9. ALL MACHINED SURFACES TO BE COATED WITH TEMPORARY CORROSION PROTECTION.
10. PIECES SHALL BE MATCH MARKED FOR SUBSEQUENT DISASSEMLY.
11. LENGTHS ON BILL OF MATERIAL ARE NOMINAL DIMENSIONS, REFER TO DRAWING FOR EXACT DIMENSIONS.

PAINT NOTES:
1. PAINT PROCEDURE AND MANUFACTURER AS PER BECHTEL SPECIFICATION 25457-0000-3PS-G000-0002 REV.001

COMMANDE / ORDER No 3863-A
QUANTITÉ / QUANTITY 1
CAPACITÉ / CAPACITY 2750 Kg
ÉPREUVE / TEST 3438 Kg + Certificat de test de levage / LIFTING TEST CERTIFICATION
FACTEUR DE SÉCURITÉ / SAFETY FACTOR 3.5:1
POIDS / WEIGHT 870 Kg
PEINTURE / PAINT Traffic yellow "RAL 1-23"

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Y:\InventorDrawings\Workgroup\Projets\62\62-9692\62-9692-A00.bmp
Tel: (514) 428-5511 Fax: (514) 428-5555
3800 Transcanadienne, Pointe-Claire, Québec H9R 1B1

	Date (mm-jj-aa) (mm-dd-yy)	Nom/Name
Dessiné par: Drawing by:	18/11/2010	G.Avetisian
Verifié par: Checked by:		R.Bellehumeur
Approuvé par: Approved by:		

Tolerances géometrique: ASME Y14.5-1994
Fraction ±1/8" Décimale x.x ±.06" x.xx ±.015" x.xxx ±.005" x.xxxx ±.001"
Angle ±1/2'

Unité de mesure: Po. Unit of measure:

Sceau ingénieur

Projection américaine — Third angle projection

Client/Customer: GNA ALUTECH INC.

Titre/Title: Longitudinal Grip Handling Tongs
GNA project #APT-E D.341.81.13.001
Cap.: 2750 Kg

N° Item

Format	No dessin	Modèle Série	Revision
B		62-9692	1
Echelle Scale N/A	Logiciel Software Inventor 11	Page Sheet 1 / 1	

EQUIPMENT TAG # 4481-MJGB-0001

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
		2		NOTES ADDED	FE.08.'11	LG	M.B.	C.C.
		1		NOTES ADDED	JA.10.'11	EI	M.B.	C.C.
		0		INITIAL DESIGN	NO.16.'10	A.V.	M.B.	C.C.
REFERENCES		REVISIONS						

NOTES

STATUS: —

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DATE:	---	DATE:	
ENG. GROUP SUP. DATE:		DRAWING SCALE:	NTS

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SELLER DRAWING No. 1347-B2-1000 REV. 2

Vendor or Subcontractor Logo: GNA alutech inc. — Département Ingénierie Engineering Department 3800 Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
Handling Tong Longitudinal Grip
GENERAL ARRANGEMENT

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-	00AZ-	XX -	XXXX -	XXXX -	XXX — XXX

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3—		—AZ	

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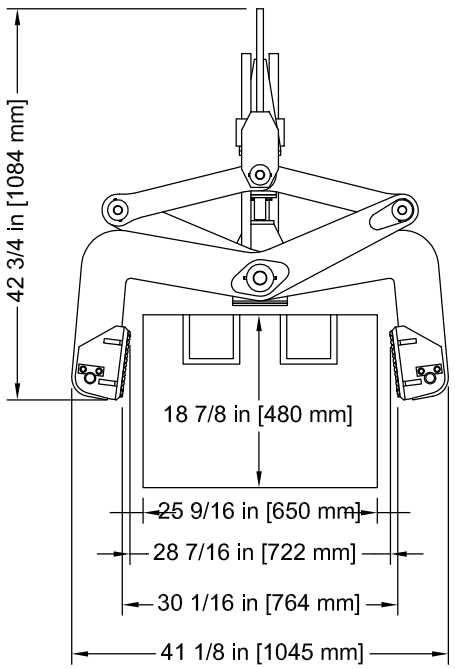
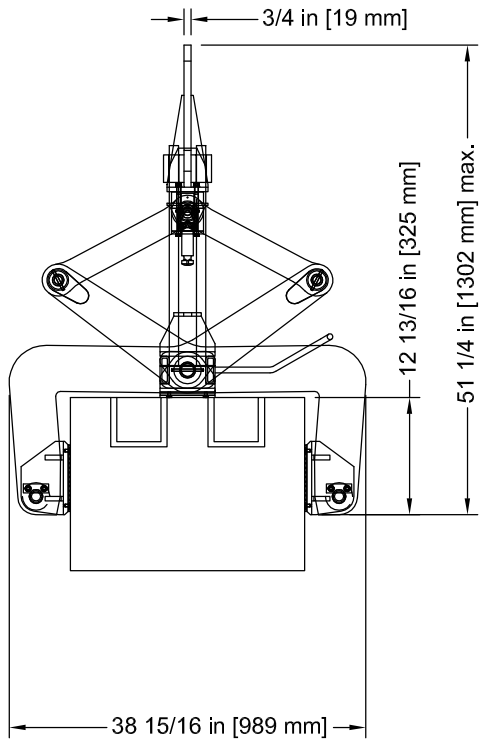
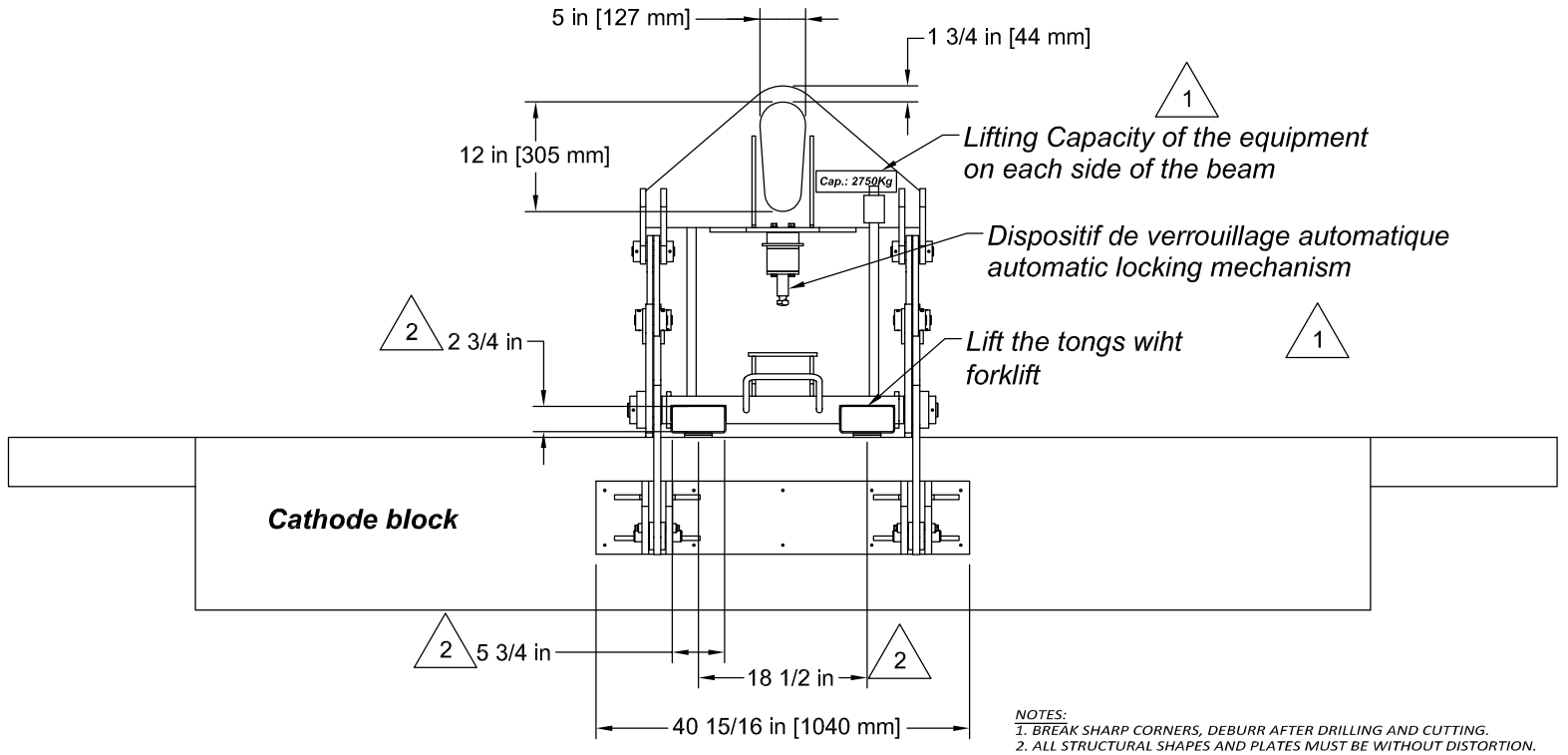
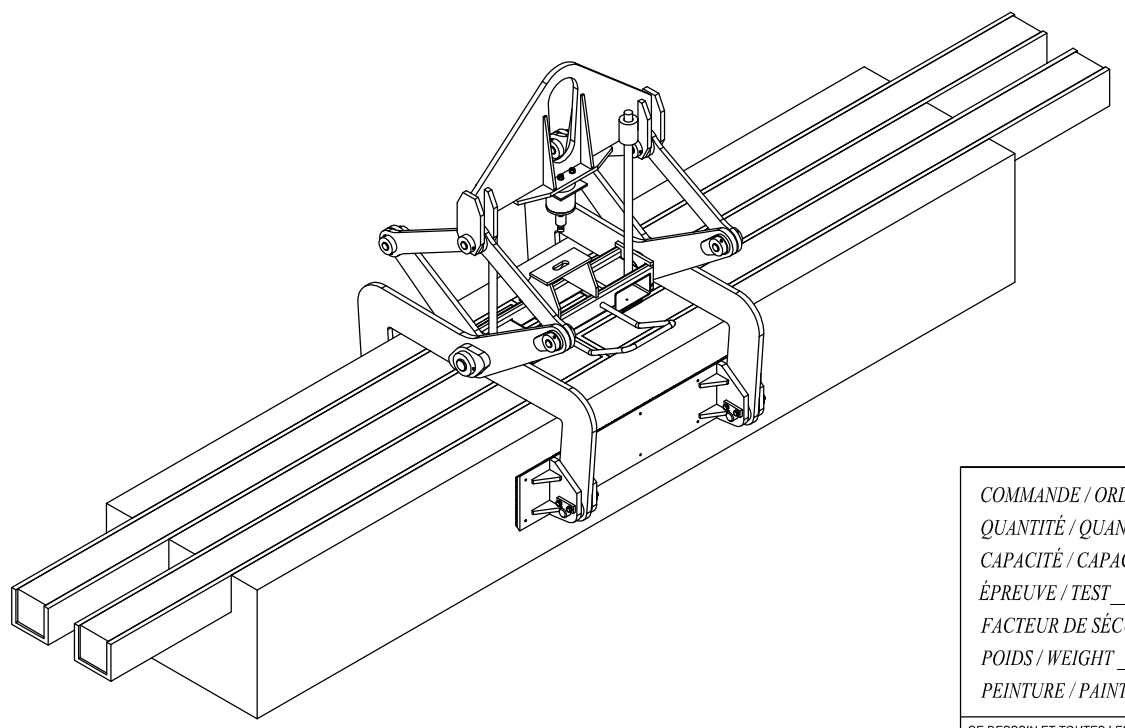
POSITION PINCE OUVERTE
OPENED TONGS POSITION



POSITION PINCE FERMER
CLOSED TONGS POSITION







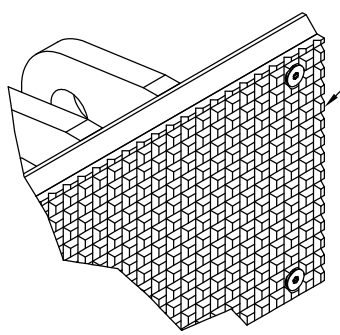


PLATE "GRIPPES" (1)
STYLE IS DIAMOND
GRIP 1/4" x 1/4" (6.35mm x 6.35mm)
MATERIAL IS QT-100(G40.21-92-100QT)
FASTENED WITH BOLTS

NOTES:
1. BREAK SHARP CORNERS, DEBURR AFTER DRILLING AND CUTTING.
2. ALL STRUCTURAL SHAPES AND PLATES MUST BE WITHOUT DISTORTION.
3. ALL WELDS MUST CONFORM CSA W-47, W-59.
4. STEEL PLATES SHALL BE CUT OUT OF ONE PLATE ONLY,IF NOT, JOINING PLATES SHALL BE WELDED BUTT JOINT FULL PENETRATION. THE WELDING SEAM SHALL BE BEHIND A STRUCTURAL SHAPE. IF NOT OTHERWISE SPECIFIED, ALL WELDS ARE CONTINUOUS.
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8. PRE-ASSEMBLE PARTS IN SHOP FOR DIMENSIONAL AND FUNCTIONAL VERIFICATION.
9. ALL MACHINED SURFACES TO BE COATED WITH TEMPORARY CORROSION PROTECTION.
10. PIECES SHALL BE MATCH MARKED FOR SUBSEQUENT DISASSEMLY.
11. LENGTHS ON BILL OF MATERIAL ARE NOMINAL DIMENSIONS, REFER TO DRAWING FOR EXACT DIMENSIONS.

PAINT NOTES:
1. PAINT PROCEDURE AND MANUFACTURER
AS PER BECHTEL SPECIFICATION 25457-0000-3PS-G000-0002 REV.001

MAXIMUM BLOCK TEMPERATURE: 300°C

REVISION HISTORY			
REV	DESCRIPTION	DATE	APPROVED
1	Plate "GRIPPERS" Lifting Capacity Lift the tongs wiht forklift	29/12/2010	
2	Tel que noté/As noted	11/01/2011	

COMMANDE / ORDER No 3863-B
QUANTITÉ / QUANTITY 1
CAPACITÉ / CAPACITY 2750 Kg
ÉPREUVE / TEST 3438 Kg + Certificat de test de levage / LIFTING TEST CERTIFICATION
FACTEUR DE SÉCURITÉ / SAFETY FACTOR 3.5:1
POIDS / WEIGHT 300 Kg
PEINTURE / PAINT Traffic yellow ' RAL 1023'

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Y:\InventorDrawings\Workgroup\Projets\62\62-9693\62-9693-A11.bmp
Tel: (514) 428-5511 Fax: (514) 428-5555
3800 Transcanadienne, Pointe-Claire, Québec H9R 1B1

	Date (jj-mm-aa) (dd-mm-yy)	Nom/Name
Dessiné par: Drawing by:	18/11/2010	G.Avetisian
Verifié par: Checked by:		R.Bellehumeur
Approuvé par: Approuved by:		

Tolerances géometrique: ASME Y14.5-1994
Fraction ±1/8" Décimale x.x ±.06" x.xx ±.015" x.xxx ±.005" x.xxxx ±.001"
Angle ±1/2'

Unité de mesure: Po. *Unit of measure:*

Sceau ingénieur

Projection américaine — *Third angle projection*

Client/Customer
GNA ALUTECH INC.

Titre/Title
Transversal Grip Handling Tongs
GNA project #APT-E D.341.81.13.0002
Cap.: 2750 Kg

N° Item

Format	No dessin	Modèle	Série	Revision
B			62-9693	2
Echelle Scale N/A	Logiciel Software Inventor 2008		Page Sheet	1 / 1

EQUIPMENT TAG # 4481-MJGB-0002

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
		2		NOTES ADDED	FE.08.'11	LG	M.B.	C.C.
		1		NOTES ADDED	JA.10.'11	EI	M.B.	C.C.
		0		INITIAL DESIGN	NO.19.'10	A.V.	M.B.	C.C.
REFERENCES		REVISIONS						

NOTES

STATUS —

DRAWN/DEST'D:	--	AREA ENG.:	
DATE:	NO.19.10	DATE:	
CHECKED:	--	PRJ ENG MGR:	
DATE:	---	DATE:	
RESPONSIBLE ENG.	--	CLIENT:	
DATE:	---	DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NTS
DATE:			

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Vendor or Subcontractor Logo:
GNA alutech inc. — Département Ingénierie / Engineering Department, 3800 Trans-Canada, Pointe-Claire, Québec H9R 1B1, Canada

BECHTEL

Project Title:
Ras Az Zawr
Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-	00AZ-	xx -	xxxx -	xxxx - xxx -	xxx

SELLER DRAWING No. 1347-B3-1000 — REV. 2

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
Handling Tong Transversal
GENERAL ARRANGEMENT

MA'ADEN

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—		—	—	A3-		-AZ	

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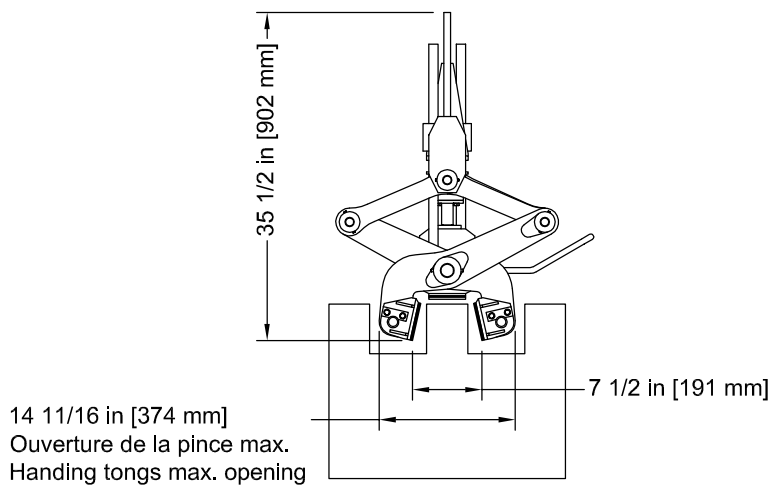
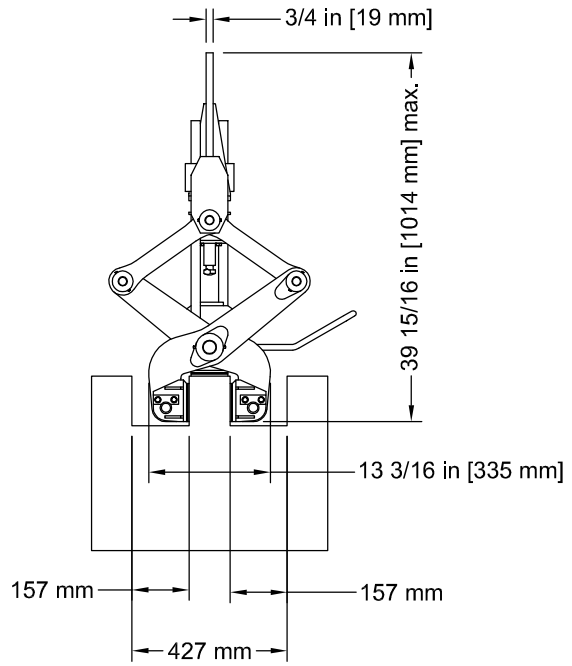
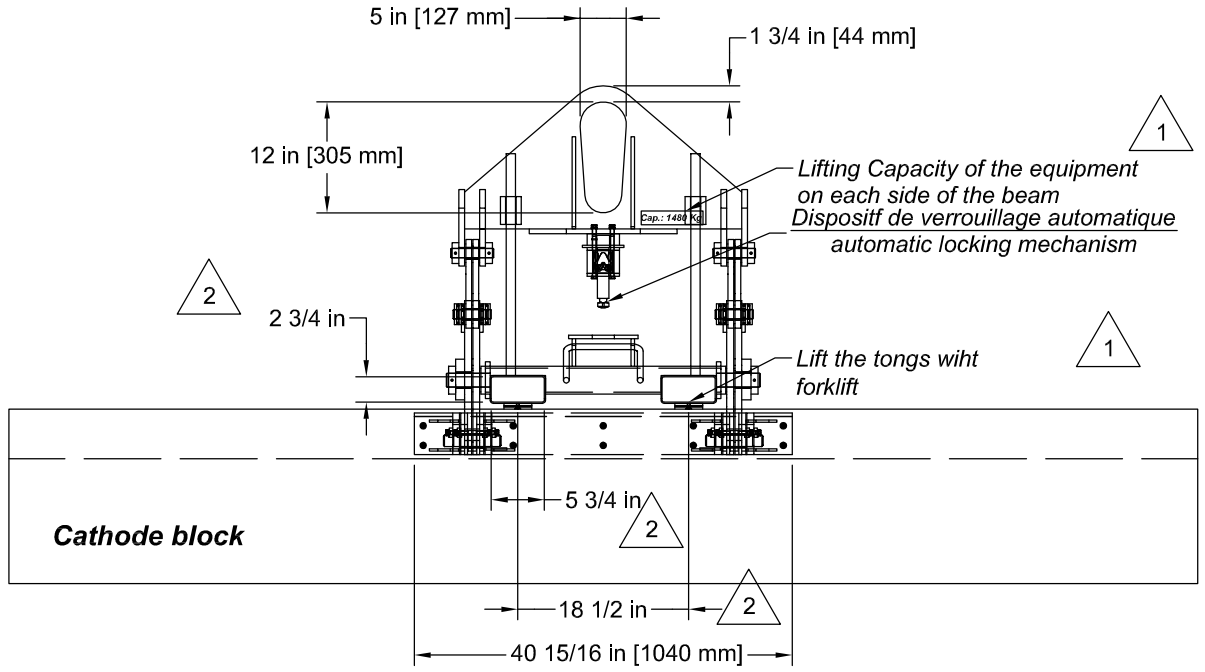
REVISION HISTORY			
REV	DESCRIPTION	DATE	APPROVED
1	PLATE FMK RUBBER WAS PLATE "GRIPPERS"	10/03/2008	G.Avetisian

POSITION PINCE OUVERTE
OPENED TONGS POSITION



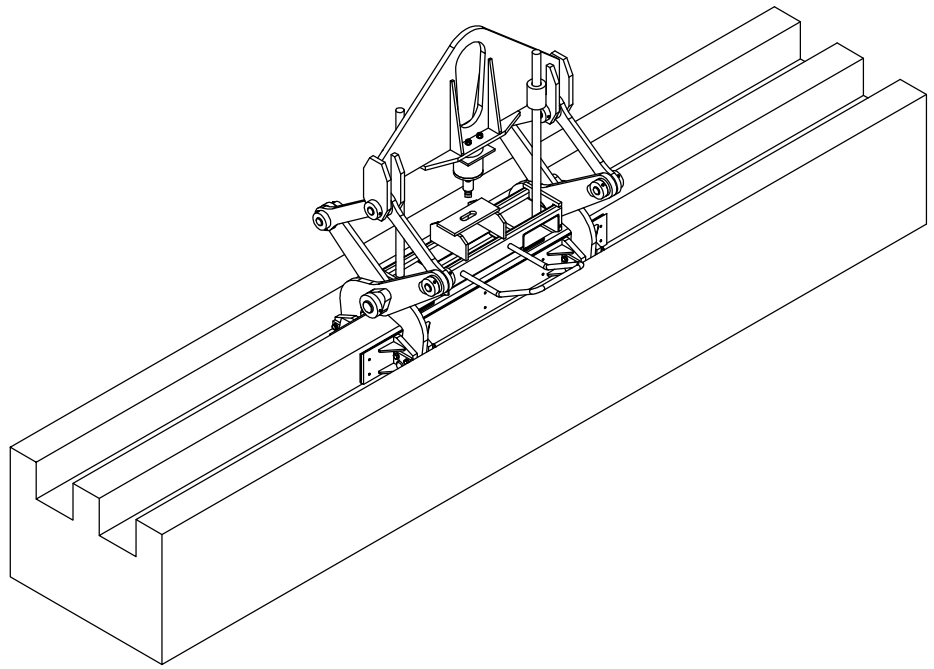
POSITION PINCE FERMER
CLOSED TONGS POSITION





NOTES:
1. *BREAK SHARP CORNERS, DEBURR AFTER DRILLING AND CUTTING.*
2. *ALL STRUCTURAL SHAPES AND PLATES MUST BE WITHOUT DISTORTION.*
3. *ALL WELDS MUST CONFORM CSA W-47, W-59.*
4. *STEEL PLATES SHALL BE CUT OUT OF ONE PLATE ONLY,IF NOT, JOINING PLATES SHALL BE WELDED BUTT JOINT FULL PENETRATION. THE WELDING SEAM SHALL BE BEHIND A STRUCTURAL SHAPE.*
   IF NOT OTHERWISE SPECIFIED, ALL WELDS ARE CONTINUOUS.
5. *CLEAN ALL WELDED SURFACES OF BURRS AND ASPERITIES.*
6. *HANDLE PAINTED WITH CARE (TO AVOID RUST AFTER INSTALLATION).*
7. *PROVIDE AND INSTALL LIFTING LUG(S) APPROPRIATE FOR TOTAL WEIGHT OF PART(S) (IF APPLICABLE).*
8. *PRE-ASSEMBLE PARTS IN SHOP FOR DIMENSIONAL AND FUNCTIONAL VERIFICATION.*
9. *ALL MACHINED SURFACES TO BE COATED WITH TEMPORARY CORROSION PROTECTION.*
10. *PIECES SHALL BE MATCH MARKED FOR SUBSEQUENT DISASSEMLY.*
11. *LENGTHS ON BILL OF MATERIAL ARE NOMINAL DIMENSIONS, REFER TO DRAWING FOR EXACT DIMENSIONS.*

PAINT NOTES:
1. ***PAINT PROCEDURE AND MANUFACTURER AS PER BECHTEL SPECIFICATION 25457-0000-3PS-G000-0002 REV.001***



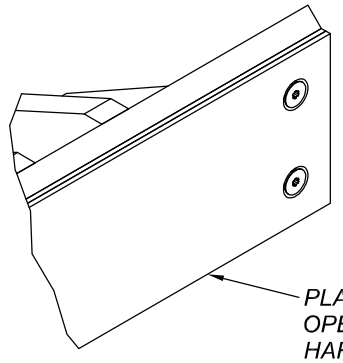


PLATE VOLTA FEZ
OPERATING TEMPERATURE: -22° to +140°F (-30° to +60°C)
HARDNESS: 95 A / 46 D SHORE
FASTENED WITH BOLTS

REVISION HISTORY			
REV	DESCRIPTION	DATE	APPROVED
1	Lifting capacity Lift the tongs wiht forklift	29/12/2010	
2	Tel que noté / As noted	11/01/2011	

COMMANDE / ORDER No 3863-C
QUANTITÉ / QUANTITY 1
CAPACITÉ / CAPACITY 1480 Kg
ÉPREUVE / TEST 1850 Kg + Certificat de test de levage / LIFTING TEST CERTIFICATION
FACTEUR DE SÉCURITÉ / SAFETY FACTOR 3.5:1
POIDS / WEIGHT 275 Kg
PEINTURE / PAINT Traffic yellow ' RAL 1023'

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Québec H9R 1B1
Tel: (514) 428-5511 Fax: (514) 428-5555

	Date (mm-jj-aa) (mm-dd-yy)	Nom/Name
Dessiné par: Drawing by:	17/11/2010	G.Avetisian
Verifié par: Checked by:		R.Bellehumeur
Approuvé par: Approved by:		

Tolerances géometrique: ASME Y14.5-1994
Fraction ±1/8" *Décimale* x.x ±.06" x.xx ±.015" x.xxx ±.005" x.xxxx ±.001"
Angle ±1/2'

Unité de mesure: Po. *Unit of measure:*

Projection américaine *Third angle projection*

Sceau ingénieur

Client/Customer
GNA ALUTECH INC.

Titre/Title
Tenon Grip Handling Tongs
GNA project #APT-E D.341.81.13.0003
Cap.: 1480 Kg

N° Item

Format	No dessin	Modèle Série	Revision
B		62-9694	1
Echelle Scale N/A	Logiciel Software Inventor 2008		Page Sheet 1 / 1

EQUIPMENT TAG # 4481-MJGB-0003

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
		2		NOTE UPDATED (LIFTING TEST CERTIFICATION)	FE.08.'11	LG	M.B.	C.C.
		1		INITIAL DESIGN	JA.10.'11	E.I.	M.B.	C.C.
		0		INITIAL DESIGN	NO.17.'10	A.V.	M.B.	C.C.
REFERENCES		REVISIONS						

NOTES

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SELLER DRAWING No. 1347-B4-1000 REV. 2

STATUS —

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DATE:	NO.17.2010	DATE:	
CHECKED:	--	PRJ ENG MGR:	
DATE:	---	DATE:	
RESPONSIBLE ENG.	--	CLIENT:	
DATE:	---	DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NTS
DATE:			

Vendor or Subcontractor Logo:
GNA alutech Inc. Département Ingénierie Engineering Department 3400 Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
Handling Tong Tenon Grip
GENERAL ARRANGEMENT

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-	00AZ-	xx -	xxxx -	xxxx -	xxx — xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—		—	—	A3—		—AZ	

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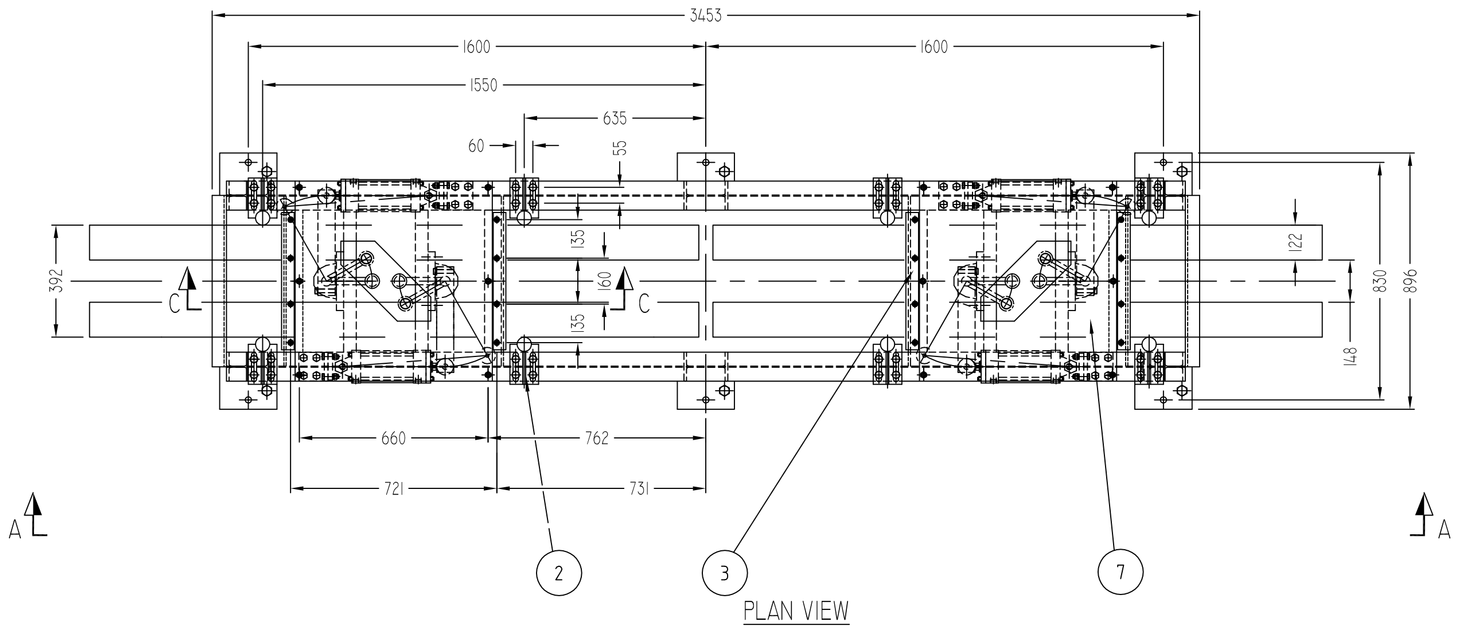
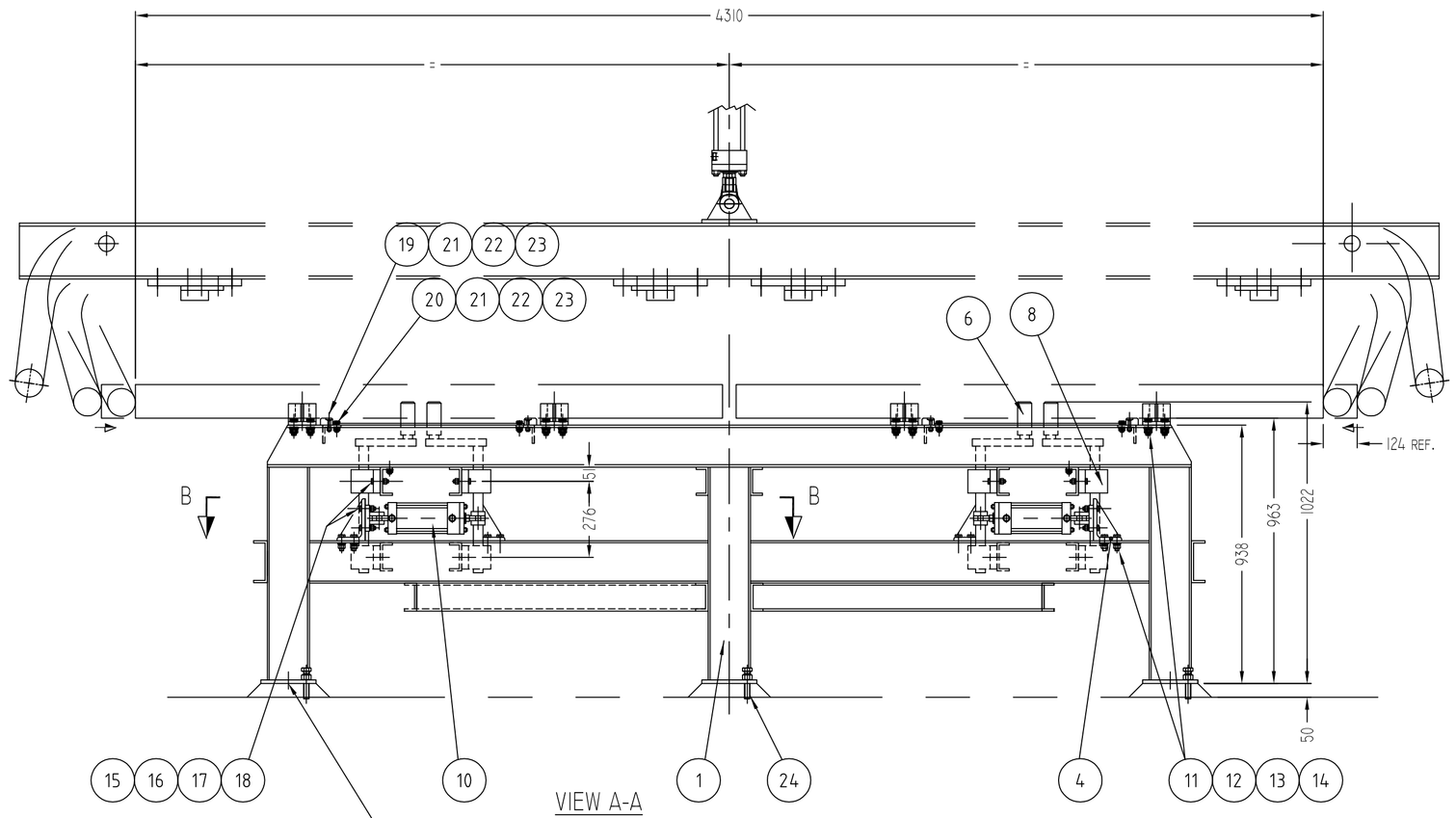
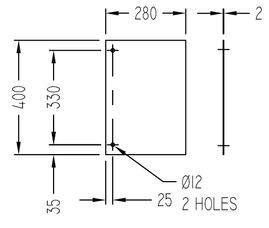


PLAN VIEW

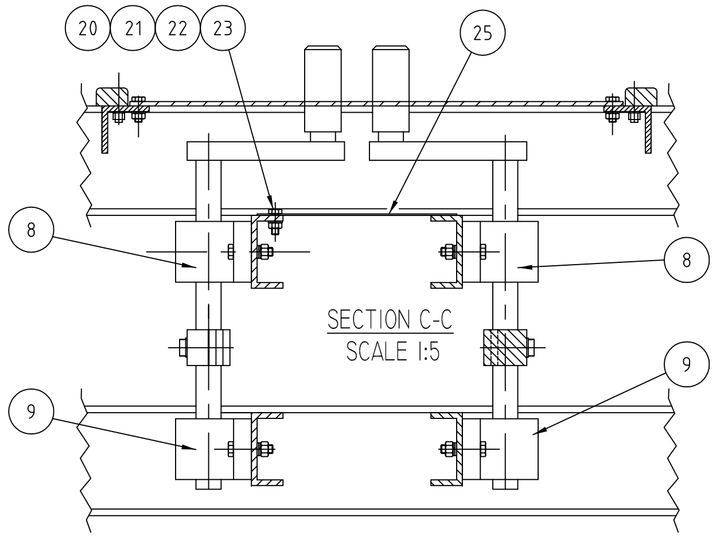


VIEW A-A

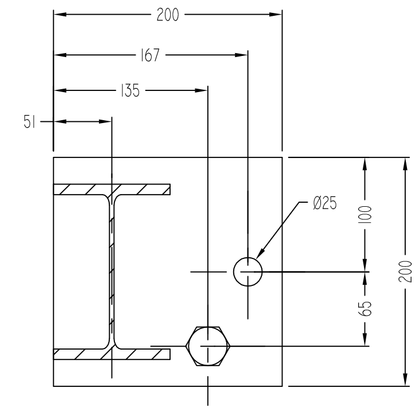
ANCHOR BOLT DETAIL,
SEE DWG. 1347-AR-0100



DETAIL ITEM #25



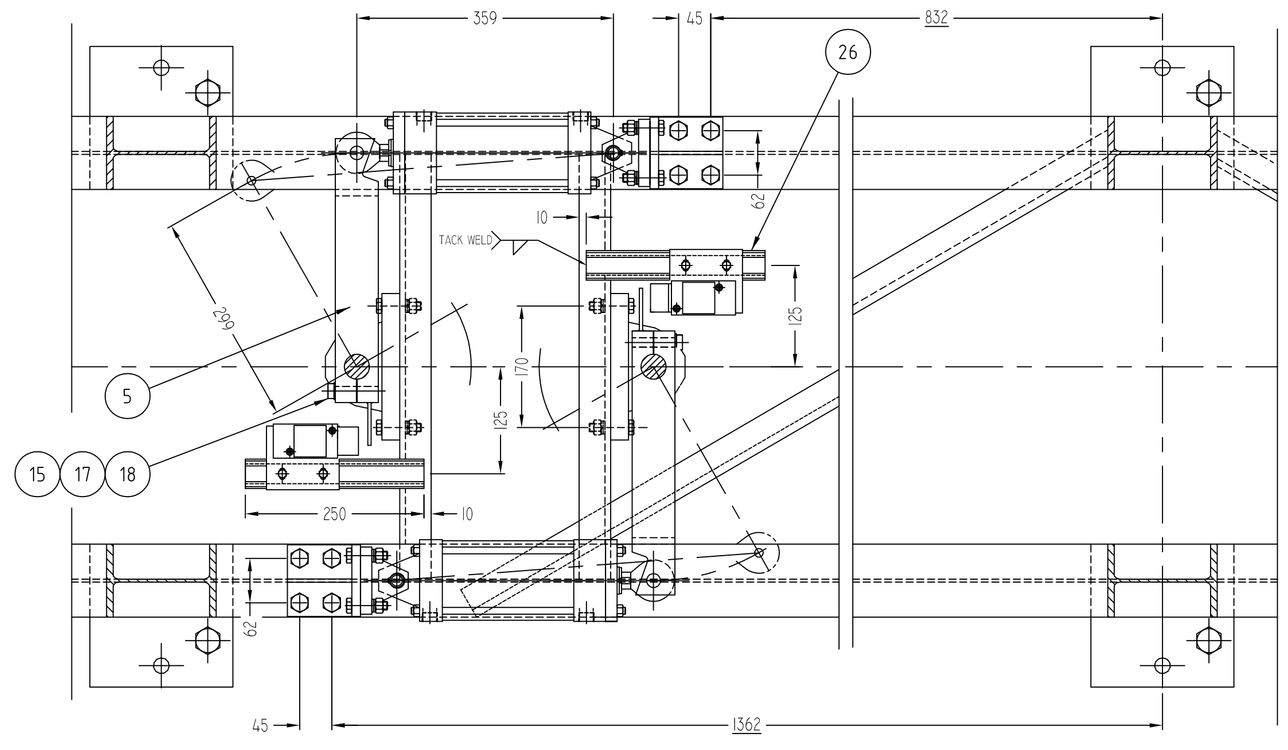
SECTION C-C
SCALE 1:5



TYPICAL BASE PLATE DETAIL

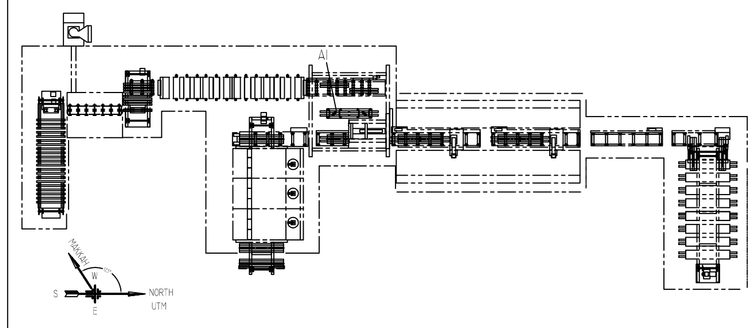
△2 NOTES:

1. FOR FOUNDATION DETAILS SEE DRAWING 1347-AR-0100 AND 1347-AR-0101.
2. ALL MECHANICAL PARTS WILL HAVE AN ACCES FOR MAINTENANCE.
3. THERE IS A GREASE POINT FOR ALL BEARINGS.



SECTION B-B
SCALE 1:5

△2 EQUIPMENT TAG # 4481-MQLK-0001



LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/Qty	No. PIECE-MAT. MAT.-PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
1	1	1347-A1-1100	FRAME		470 KG
2	8	1347-A1-1210	STOPPER		20 KG
3	4	1347-A1-1220	BAR GUIDE		16 KG
4	4	1347-A1-1230	CYLINDER SUPPORT		12 KG
5	4	1347-A1-1240	CYLINDER ARM		10 KG
6	4	1347-A1-1250	CENTERING ARM		36 KG
7	2	1347-A1-1300	HEAT SHIELDS		20 KG
8	4	SNL22508/35 TG	"SKF" PILLOW BLOCK (FIXED)	BY GNA	
9	4	SNL22508/35 TG	"SKF" PILLOW BLOCK (FREE)	BY GNA	
10	4		PNEUM. CYL. 4-CSB2AUV19AC-6"	PARKER	
		#83963	PIVOT PIN	PARKER	
		#83948	CLEVIS BRACKET	PARKER	
		#132291	SPHERICAL ROD EYE	PARKER	
11	48		HEX. BOLT M16 x 50 LG		
12	48		HEX. NUT M16		
13	48		WASHER 17		
14	48		LOCK WASHER A 16		
15	36		HEX. BOLT M12 x 60 LG		
16	32		HEX. NUT M12		
17	36		WASHER 13		
18	36		LOCK WASHER A 12		
19	16		HEX. CSK CAP SCREW M10 x 45 LG		
20	16		HEX. BOLT M10 x 25 LG		
21	32		HEX. NUT M10		
22	32		WASHER 11		
23	32		LOCK WASHER A 10		
24	10	STD	HEX. BOLT M20 x 100 LG	FOR ADJUSTMENT	
25	2	SS	SHEET #14 ga. x 280 x 400 mm LG		
26	4	STEEL	CANTRUST 1-3/4" X 250 LG		

APPROX. TOTAL WEIGHT: 700 Kg

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4 ☐ Revise not required. Work may proceed.
5 ☐ VOID / Superseded.

DDR Nbr :

Reviewed by : _____ Date : _____

Discipline :

Document No : 25457- **Rev. : 0**

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SELLER DRAWING No. 1347-A1-1000 REV. 3

NUMBER	REV.	TITLE
REFERENCE DRAWINGS		

REV.	DESCRIPTION	DATE	DRN.	CHK.	R.E.	A.E. / S.	E.G.S.	P.E.M.
3	FOR APPROVAL	OC.29 2010	LG	M.B.	C.C.			
2	GUARD DETAIL, NOTES AND EQUIPMENT TAG NUMBER ADDED	SE.24.'10	C.C	M.B.	C.C.			
1	LINE WEIGHT MODIFIED	SE.01.'10	E.I.	M.B.	C.C.			
0	INITIAL DESIGN	AU.02.'10	E.I.	M.B.	C.C.			
REVISIONS								

STAMP

ALCOA | Ma'aden Aluminum Project

Bechtel

GNA alutech inc. — Departement Ingenierie Engineering Department, 9495 Trans-Canada, Saint-Laurent, Quebec, H4S 1V3, Canada

		DATE
DRAWN	E. Iancu	AU.02.'10
CHK.	M. Blanchet	
R.E.	C. Coupal	
A.E. / S.		
E.G.S.		
P.E.M.		
CLIENT		

SCALE: 1:15 FORMAT A1

BECHTEL DRG. No. - - - - - REV.

CLIENT DRG. No. REV.

Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CATHODE BAR ALIGNEMENT STATION
GENERAL ARRANGEMENT

USER: $USERNAMES
TIME: $TIME$
$DATE$
$FILE$
DATE:
FILE:

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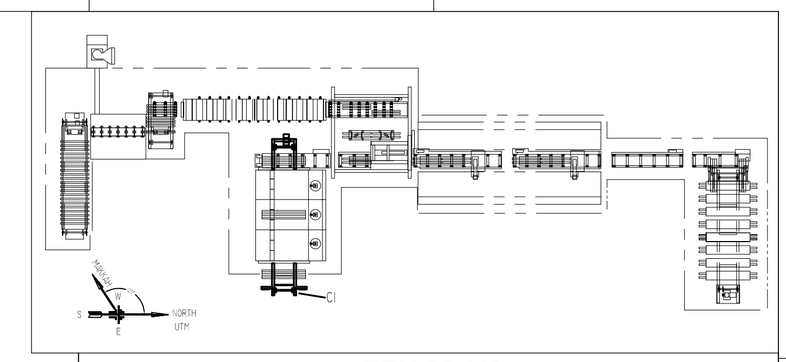
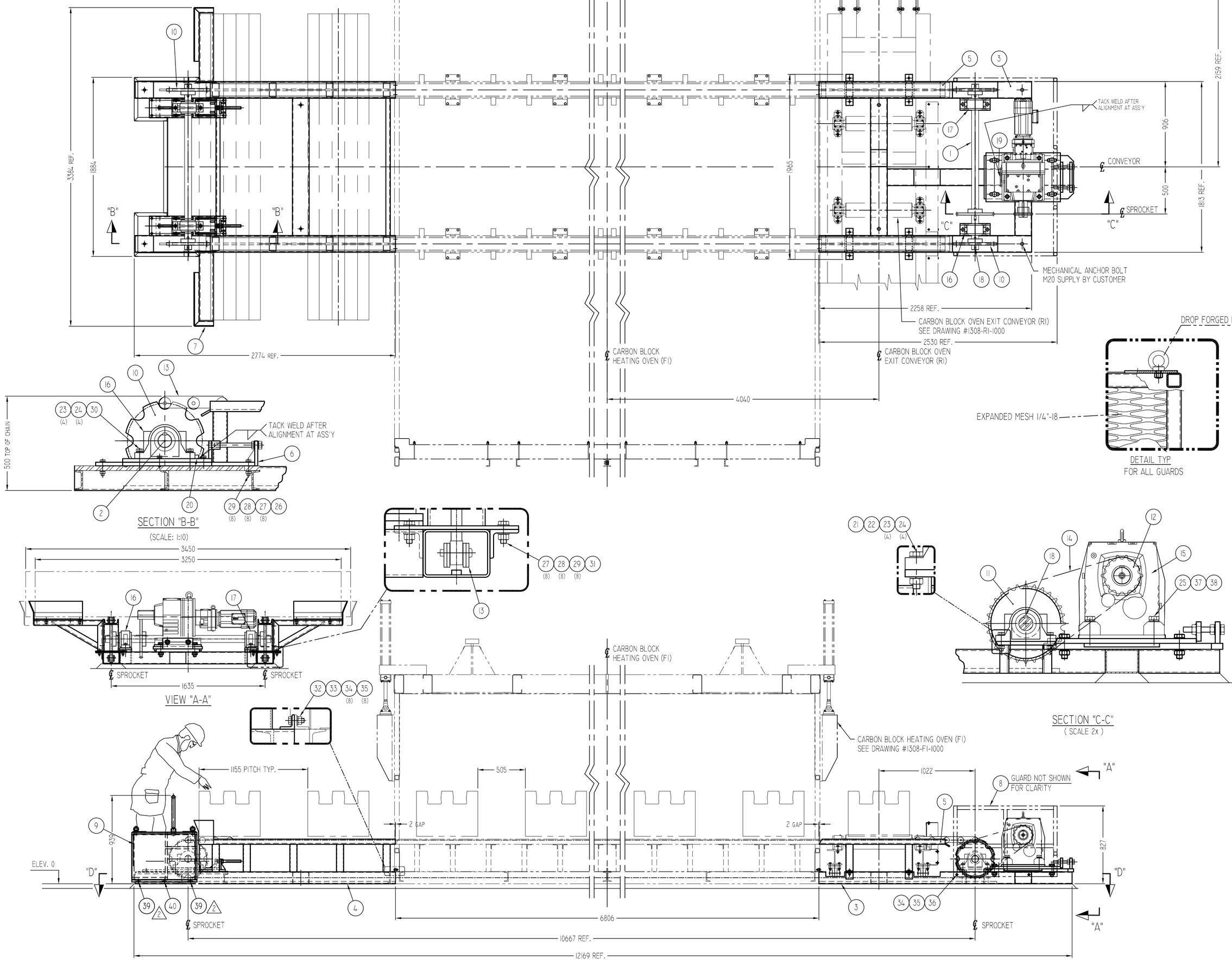


KEY PLAN

LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/Qty	No. PIECE–MAT. MAT.–PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
1	1	1347-C1-1010	SHAFT (DRIVE)		60 Kg
2	1	1347-C1-1020	SHAFT		60 Kg
3	1	1347-C1-1100	CHAIN DRIVE FRAME		477 Kg
4	1	1347-C1-1200	TAKE-UP FRAME		410 Kg
5	2	1347-C1-1300	CHAIN GUIDE		80 Kg
6	2	1347-C1-1400	TAKE-UP ASSEMBLY		76 Kg
7	1	1347-C1-1500	BLOCK GUIDE		104 Kg
8	1	1347-C1-1600	GUARD (DRIVE SIDE)		120 Kg
9	1	1347-C1-1700	GUARD (TAKE-UP SIDE)		100 Kg
10	4	#CC5 B8	SPROCKET 6" PITCH, BORE ø75, 8 T.	BY "GNA"	143 Kg
11	1	#140B28	SPROCKET #140, BORE ø75, 28 TEETH	BY "GNA"	25 Kg
12	1	#140B14	SPROCKET #140, BORE ø90, 14 TEETH	BY "GNA"	8 Kg
13	1	#CC5	CONVEYOR CHAIN 6" PITCH X 45200 mm LENGHT	BY "GNA"	1560 Kg
14	1		ROLLER CHAIN #140 X 83 '' LG "RENOLD"	BY "GNA"	11 Kg
15	1	R137R770RE100LO4BE2HK	REDUCER 2.2 Kw, 6.9 RPM, SHAFT ø90	BY "GNA"	
16	2	SNL22517/75TG	PILLOW BLOCK (FIXED) BORE ø75 "SKF"	BY "GNA"	20 Kg
17	2	SNL22517/75TG	PILLOW BLOCK (FREE) BORE ø75 "SKF"	BY "GNA"	20 Kg
18	5	C-1045	BAR 20 X 12 X 110 LG	KEY	1 Kg
19	1	STEEL	RECT. BAR 19.05 (3/4") X 200 LG	STOP BLOCK	–
20	2	STEEL	RECT. BAR 19.05 (3/4") X 60 LG	STOP BLOCK	–
21	4	STD	HEX. CAPSCREW M20 X 90 LG, DIN 931		
22	4	STD	HEX. NUT M20, DIN 934		
23	8	STD	FLAT WASHER FOR BOLT M20, DIN 125A		
24	8	STD	LOCKWASHER FOR BOLT M20, DIN 127A		
3	25	4	STD	HEX. CAPSCREW M30 X 120 LG, DIN 931		
26	8	STD	HEX. CAPSCREW M16 X 75 LG, DIN 931		
27	16	STD	HEX. NUT M16, DIN 934		
28	16	STD	FLAT WASHER FOR BOLT M16, DIN 125A		
29	16	STD	LOCKWASHER FOR BOLT M16, DIN 127A		
30	4	STD	HEX. CAPSCREW M20 X 70 LG, DIN 931		
31	8	STD	HEX. CAPSCREW M16 X 50 LG, DIN 931		
32	8	STD	HEX. CAPSCREW M12 X 35 LG, DIN 933		
33	8	STD	HEX. NUT M12, DIN 934		
34	16	STD	FLAT WASHER FOR BOLT M12, DIN 125A		
35	16	STD	LOCKWASHER FOR BOLT M12, DIN 127A		
36	8	STD	HEX. CAPSCREW M12 X 20 LG, DIN 933		
37	4	STD	FLAT WASHER FOR BOLT M30, DIN 125A		
38	4	STD	LOCKWASHER FOR BOLT M30, DIN 127A		
2	39	4	STD	HEX. CAPSCREW M12 X 50 LG, DIN 933		
2	40	2	STD	SECURITY HEX. SOCKET BUTTON HEAD CAP SCREW 3/8-16 UNC X 2"	SPAENAUR 381-266	BY "GNA"

APPROX. WEIGHT: 2821 Kg

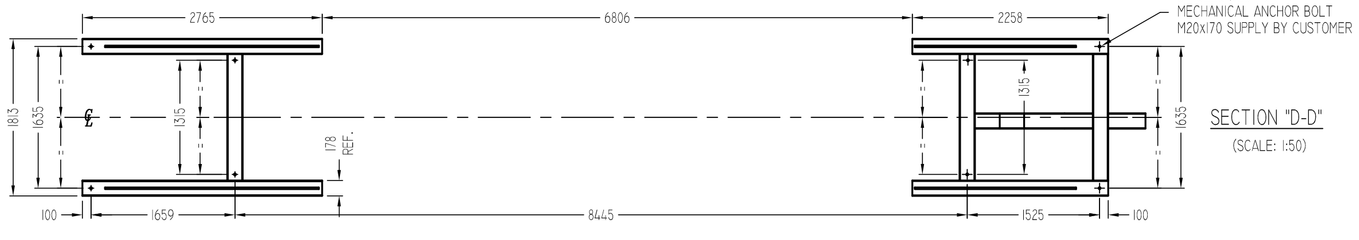


SECTION "B-B"
(SCALE: 1:10)

DETAIL TYP
FOR ALL GUARDS

VIEW "A-A"

SECTION "C-C"
(SCALE 2x)



SECTION "D-D"
(SCALE: 1:50)

NOTES:

1. FOR FOUNDATION DETAILS SEE DRAWING 1347-AR-0100 AND 1347-AR-0101.
2. ALL MECHANICAL PARTS WILL HAVE AN ACCES FOR MAINTENANCE.
3. THERE IS A GREASE POINT FOR ALL BEARINGS.

EQUIPMENT TAG # 4481-MHCD-0001

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1 ☐ Work may proceed. 4 ☐ Revise not required. Work may proceed.
2 ☐ Revise & Resubmit. Work may proceed subject to incorporation of changes. 5 ☐ VOID / Superseded.
3 ☐ Revise & Resubmit. Work may NOT proceed. DDR Nbr :

Reviewed by : _____ Date : _____
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Document No : 25457- **Rev. : 0**

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SELLER DRAWING No.	REV.
1347–C1–1000	3

NUMBER	REV.	TITLE
REFERENCE DRAWINGS		

REV.	DESCRIPTION	DATE	DRN.	CHK.	R.E.	A.E. / S.	E.G.S.	P.E.M.
3	ITEM #25 CHANGED FOR 120mm (INSTEAD OF 100)	DE.02 2010	C.C.	M.B.	C.C.			
2	ITEM #39 AND #40 ADDED	NO.25.2010	C.C.	M.B.	C.C.			
1	ITEM #11 AND #12 REVISED.	OC.12.'10	C.C.	M.B.	C.C.			
0								
REVISIONS								

STAMP

ALCOA | Ma'aden Aluminum Project

Bechtel

GNA alutech inc. Departement Ingenierie Engineering Department 9495 Trans-Canada Saint-Laurent, Quebec H4S 1V3 Canada

		DATE
DRAWN	C.C.	SE.20.'10
CHK.	M. Blanchet	
R.E.	C. Coupal	
A.E. / S.		
E.G.S.		
P.E.M.		
CLIENT		

Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CHAIN CONVEYOR OF BLOCK OVEN
GENERAL ASSEMBLY – DDR. NO. 121

SCALE: 1:25 FORMAT A1

BECHTEL DRG. No. — — — — — REV.

CLIENT DRG. No. REV.

USER: $USERNAME$ TIME: $TIME$ $DATE$ $FILE$ DATE: FILE:

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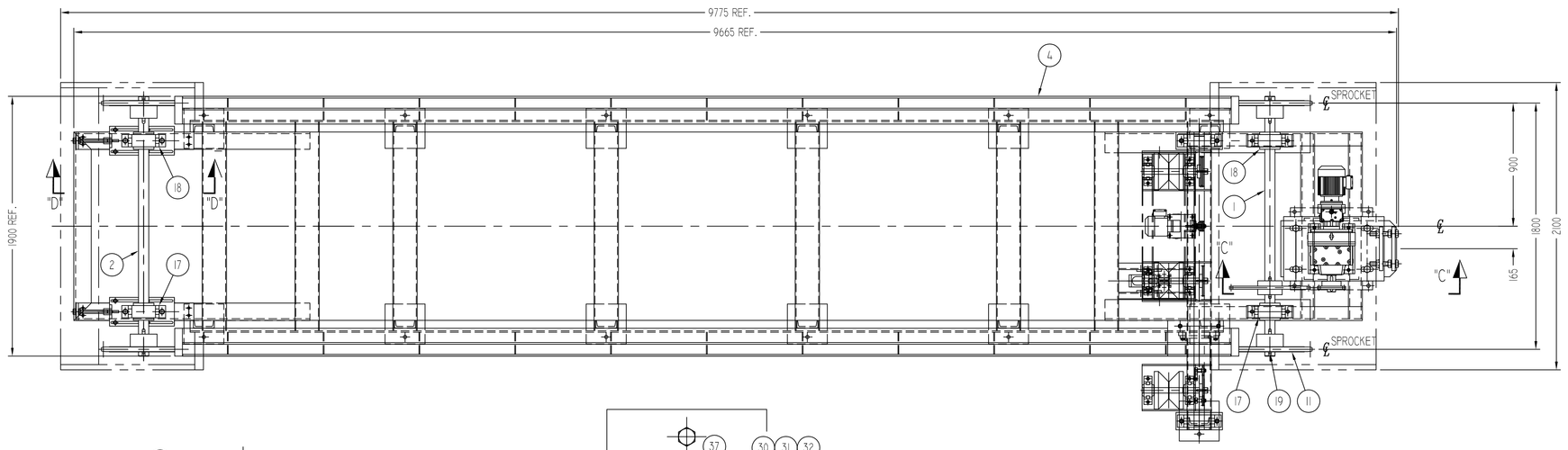

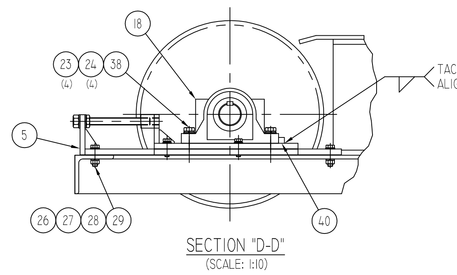

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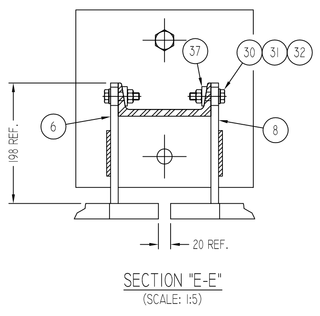
(SCALE: 1:10)



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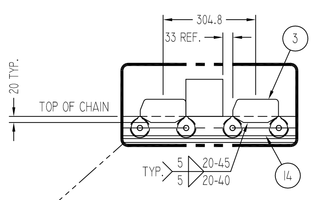
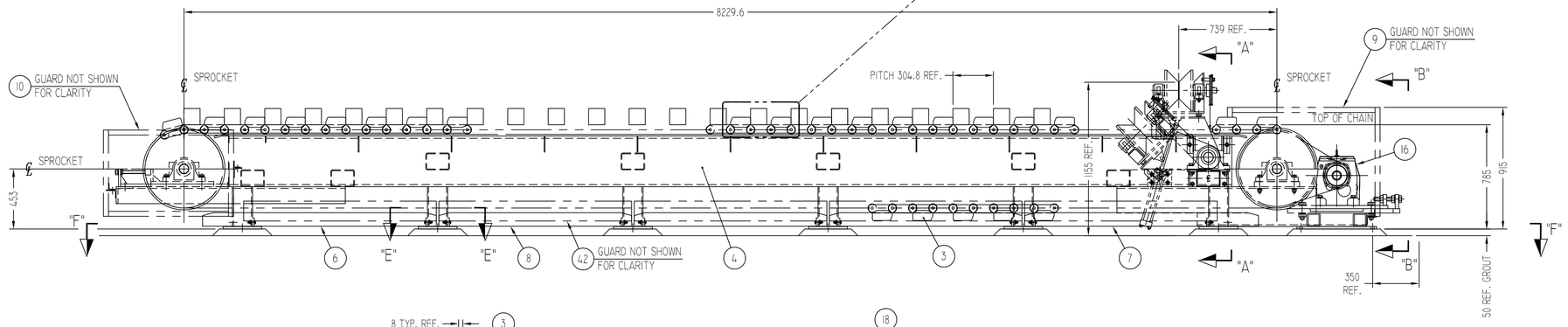
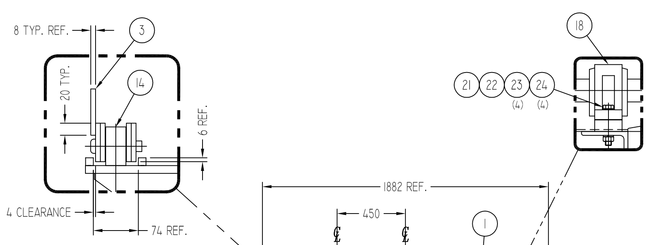
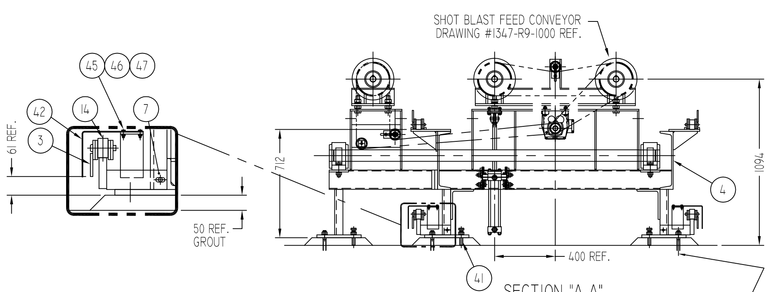




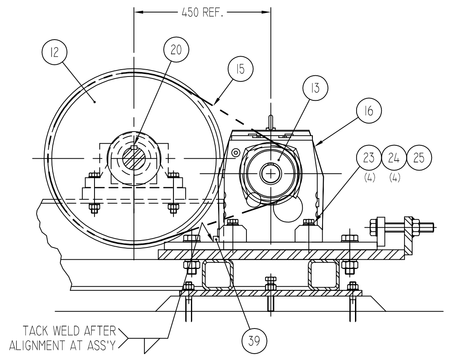


VIEW "B-B"



SECTION "A-A"

17 HOLES Ø24 FOR MECHANICAL ANCHOR BOLT M24X470 SUPPLY BY CUSTOMER



SECTION "C-C"
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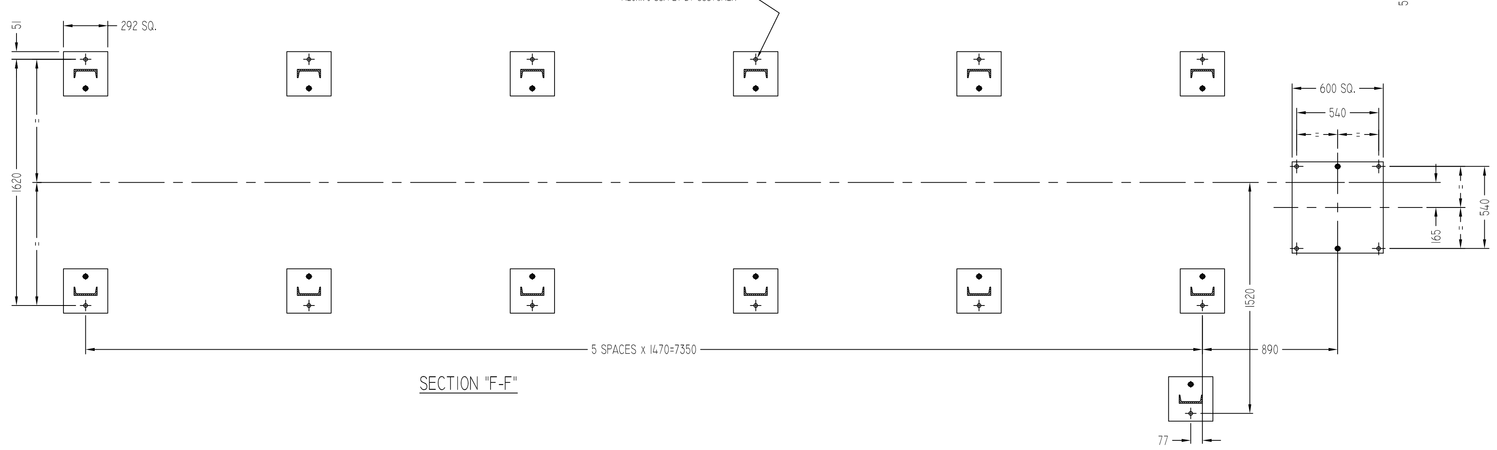
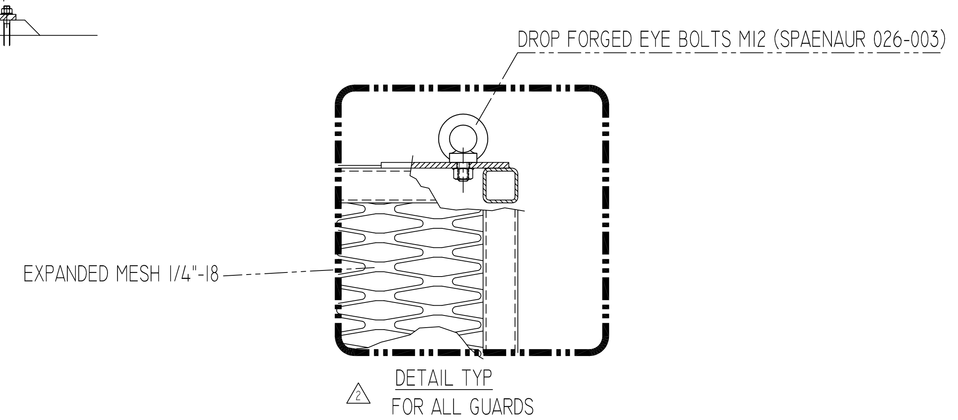
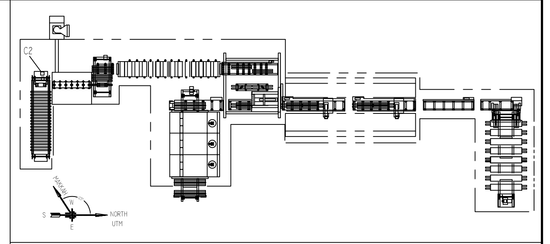


SECTION "F-F"



⚠ DETAIL TYP
FOR ALL GUARDS



KEY PLAN

LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/Qty	No. PIECE–MAT. MAT.–PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
1	1	1347-C2-1010	SHAFT (DRIVE)		65 Kg
2	1	1347-C2-1020	SHAFT		65 Kg
3	120	1347-C2-1030	SPACER		120 Kg
⚠4	1	1347-C2-1100	CONVEYOR FRAME		2285 Kg
5	2	1347-C2-1200	TAKE-UP ASSEMBLY		76 Kg
6	2	1347-C2-1300	END GUIDE		76 Kg
7	2	1347-C2-1400	END GUIDE		76 Kg
8	6	1347-C2-1500	MIDDLE GUIDE		192 Kg
9	1	1347-C2-1600	GUARD (DRIVE SIDE)		160 Kg
10	1	1347-C2-1700	GUARD		76 Kg
11	4	CC5B12F	SPROCKET 6" PITCH, BORE Ø75, 12 T. WITH KEYWAY	"BY GNA"	
12	1	#140C40	SPROCKET #140, BORE Ø75, 40 TEETH	BY "GNA"	42 Kg
13	1	#140B13	SPROCKET #140, BORE Ø60, 13 TEETH	BY "GNA"	4 Kg
14	2	#CC5	CONVEYOR CHAIN 6" PITCH X 18309 LG C/W	BY "GNA"	600 Kg
–			#K2 ATTACHMENT		
15	1	#119143	ROLLER CHAIN #140 X 2170 LG "RENOLD"	BY "GNA"	17 Kg
16	1	R97R57DRE90KM4	REDUCER 1.5 Kw, OUTPUT 5.7 RPM, SHAFT Ø60	BY "GNA"	
–					
17	2	SNL22517/75TG	PILLOW BLOCK (FIXED) BORE Ø75 "SKF"	BY "GNA"	20 Kg
18	2	SNL22517/75TG	PILLOW BLOCK (FREE) BORE Ø75 "SKF"	BY "GNA"	20 Kg
19	4	C-1045	BAR 20 X 12 X 160 LG	KEY	
20	1	C-1045	BAR 20 X 12 X 130 LG	KEY	
21	4	STD	HEX. CAPSCREW M20 X 120 LG, DIN 931		
22	4	STD	HEX. NUT M20, DIN 934		
23	12	STD	FLAT WASHER FOR BOLT M20, DIN 125A		
24	12	STD	LOCKWASHER FOR BOLT M20, DIN 127A		
25	4	STD	HEX. CAPSCREW M20 X 80 LG, DIN 931		
26	8	STD	HEX. CAPSCREW M16 X 60 LG, DIN 931		
27	8	STD	HEX. NUT M16, DIN 934		
28	8	STD	FLAT WASHER FOR BOLT M16, DIN 125A		
29	8	STD	LOCKWASHER FOR BOLT M16, DIN 127A		
30	20	STD	HEX. CAPSCREW M12 X 50 LG, DIN 931		
31	20	STD	HEX. NUT M12, DIN 934		
32	20	STD	FLAT WASHER FOR BOLT M12, DIN 125A		
37	20	STD	SQUARE BEVELED WASHER FOR BOLT 1/2" DIA.		
38	4	STD	HEX. CAPSCREW M20 X 70 LG, DIN 931		
39	1	STEEL	RECT. BAR 19.05 X 200 LG	STOP BLOCK	
40	2	STEEL	RECT. BAR 19.05 X 60 LG	STOP BLOCK	
41	14	STD	HEX. CAPSCREW M20 X 100 LG		
42	10	1347-C2-1800	GUARD		
⚠43					
44					
45	40	STD	HEX. CAPSCREW M6 X 25 LG, DIN 933		
46	40	STD	HEX. NUT M6, DIN 934		
47	40	STD	FLAT WASHER FOR BOLT M6, DIN 125A		

APPROX. TOTAL WEIGHT: 3912 Kg

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5 ☐ VOID / Superseded.

DDR Nbr :

Reviewed by : _____ Date : _____

Discipline :

Document No : 25457- **Rev. : 0**

⚠ NOTES:
1. FOR FOUNDATION DETAILS SEE DRAWING 1347-AR-0100 AND 1347-AR-0101.
2. ALL MECHANICAL PARTS WILL HAVE AN ACCES FOR MAINTENANCE.
3. THERE IS A GREASE POINT FOR ALL BEARINGS.

⚠ EQUIPMENT TAG # 4481-MHCD-0002

WELDING SPECIFICATION, unless otherwise noted:

z=0,4 X t | z=0,5 X t | z=0,5 X t

z= FILLET SIZE | t= THICK. OF THINNER PLATE

TOLERANCES // WE SPECIFIED METRIC (mm)

ASSEMBLY WELDED CONSTRUCTION

NOM. Length	NOM. Length
to 100	to 1000 ± 3.0
to 400	to 2000 ± 4.0
to 1000	to 4000 ± 5.0
over 1000	over 4000 ± 6.0

MACHINING
0.- ± 0.5 — HOLES —
1.- ± 0.25 CNC: ± .25
0.05 ± 0.05 CNC: ± .25
ANG. ± 1° MAN: ± .35

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SELLER DRAWING No. 1347-C2-1000 REV. 4

			4	ITEM 4 UPDATED	NO.18.2010	CD	M.B.	C.C.		
			3	FOR APPROVAL	OC.29 2010	LG	M.B.	C.C.		
			2	GUARD DETAIL, NOTES AND EQUIPMENT TAG NUMBER ADDED	SE.24.'10	C.C.	M.B.	C.C.		
			1	REMOVE ITEM #43	SE.14.'10	C.D.	M.B.	C.C.		
			0	FIRST DESIGN	AU.31.'10	C.D.	M.B.	C.C.		
NUMBER	REV.	TITLE	REV.	DESCRIPTION	DATE	DRN.	CHK.	R.E.	A.E./S.	E.G.S.	P.E.M.
REFERENCE DRAWINGS			REVISIONS							

STAMP

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Ma'aden Aluminum Project

SCALE: 1:20 FORMAT A0

Bechtel

GNA alutech inc. Departement Ingenierie Engineering Department 9466 Trans-Canada Saint-Laurent, Quebec H4S 1V3 Canada

		DATE
DRAWN	C. Duplantie	AU.31.'10
CHK.	M. Blanchet	
R.E.	C. Coupal	
A.E. / S.		
E.G.S.		
P.E.M.		
CLIENT		

BECHTEL DRG. No. — — — — — REV.

CLIENT DRG. No. REV.

Ras Az Zawr
Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CHAIN CONVEYOR UPSTREAM OF SHOT BLASTING MACHINE (24 BARS)
GENERAL ASSEMBLY

DATE: $DATE$ FILE: $FILE$ TIME:$TIME$ USER:$USERNAME$

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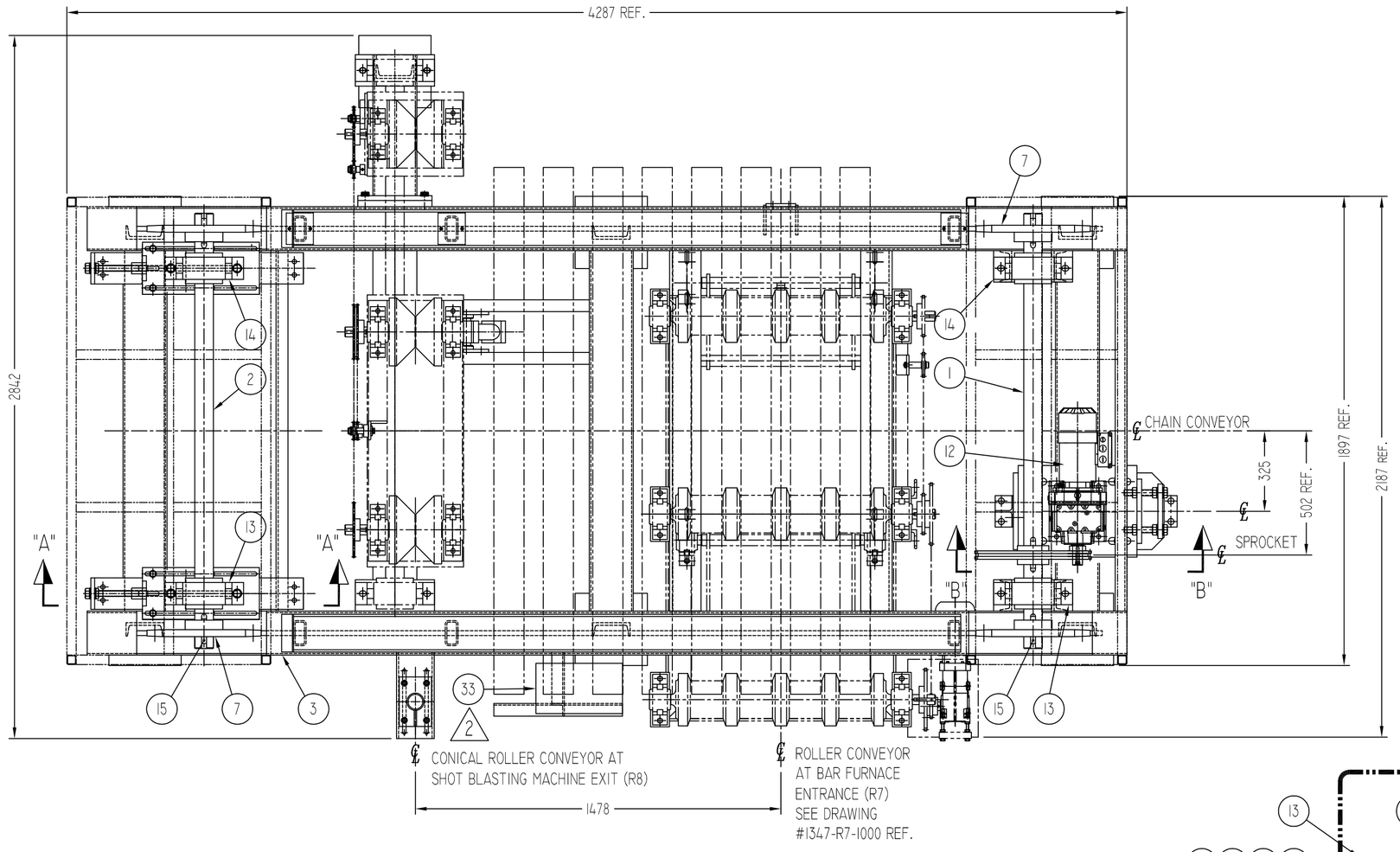

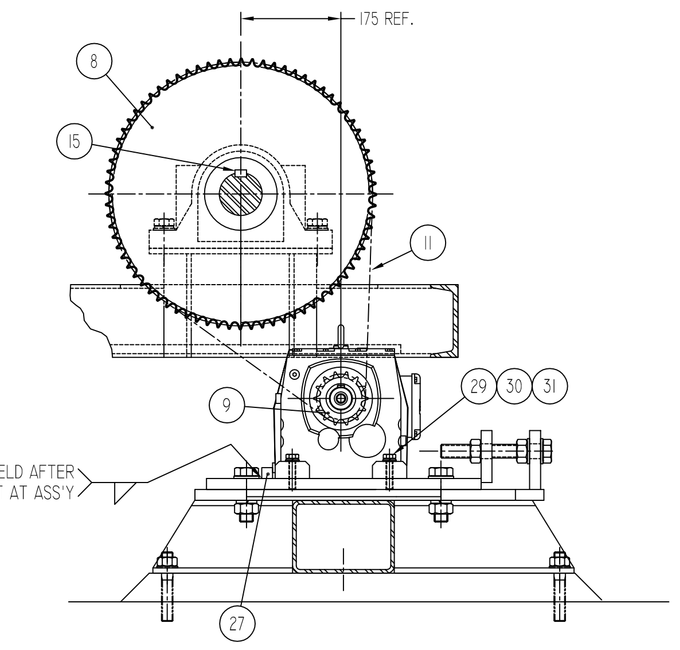

SECTION "B-B"
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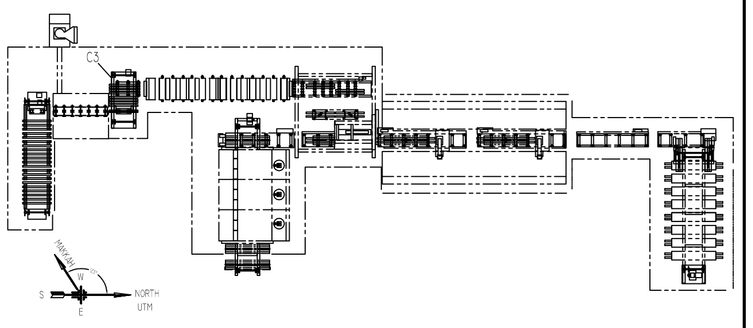
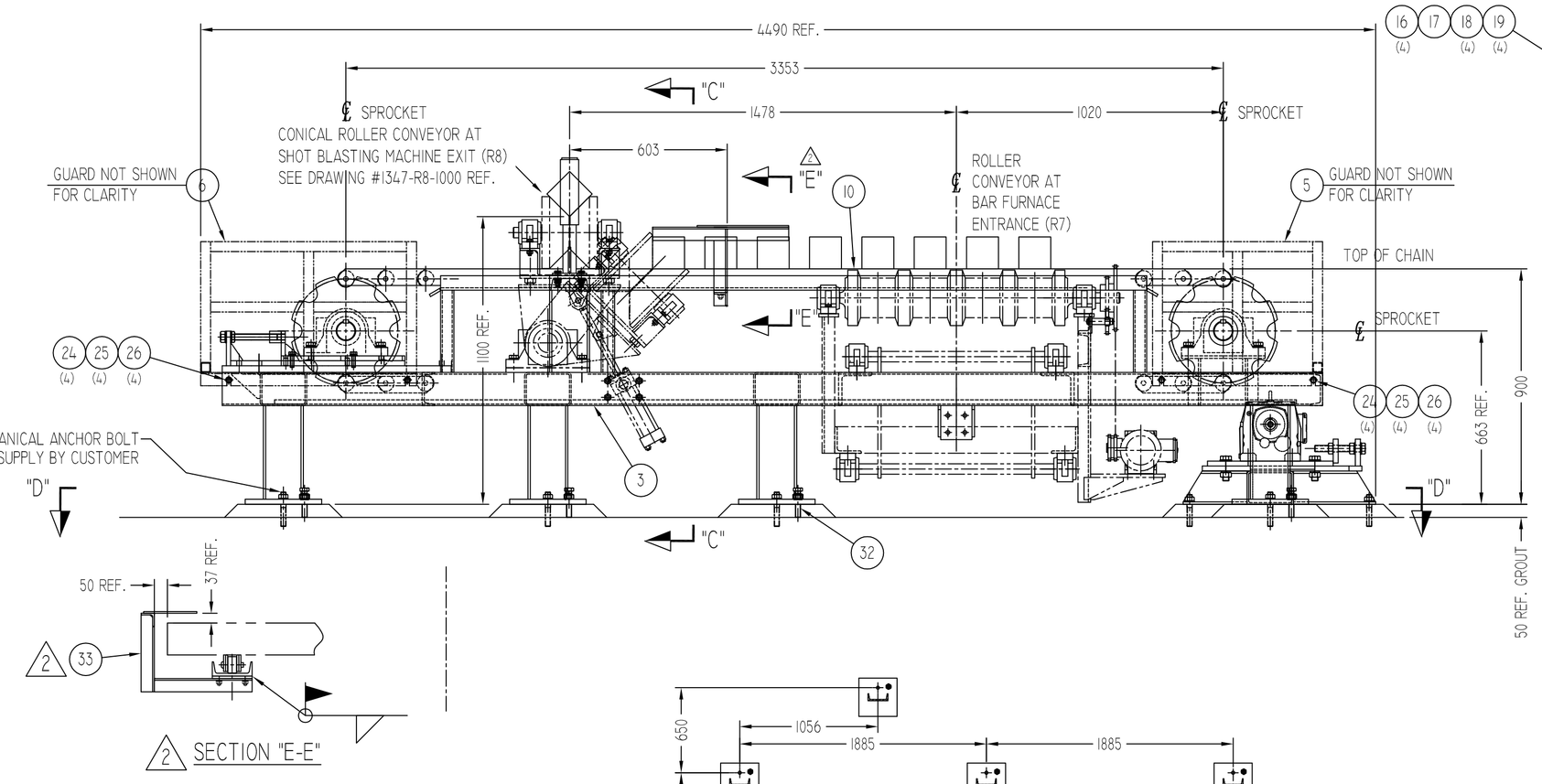


LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/Qty	No. PIECE-MAT. MAT.-PART. No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
1	1	1347-C3-1010	SHAFT (DRIVE)		60 Kg
2	1	1347-C3-1020	SHAFT		60 Kg
3	1	1347-C3-1100	MAIN FRAME		966 Kg
4	2	1347-C3-1200	TAKE-UP ASSEMBLY		86 Kg
5	1	1347-C3-1300	GUARD (DRIVE SIDE)		92 Kg
6	1	1347-C3-1400	GUARD (TAKE-UP SIDE)		103 Kg
7	4	#CC5 B8	SPROCKET 6" PITCH, BORE ø75, 8 T.	"BY GNA"	40 Kg
8	1	#D60C76	SPROCKET #60, BORE ø75, 76 TEETH	BY "GNA"	27 Kg
9	1	#D60B14H	SPROCKET #60, BORE ø40, 14 TEETH	BY "GNA"	2 Kg
10	2	#CC5	CONVEYOR CHAIN 6" PITCH X 7957 LG	BY "GNA"	261 Kg
11	1	#115063	ROLLER CHAIN #60 X 1746 LG	BY "GNA"	3 Kg
12	1	R77DRE80M4/DH	REDUCER 0.75 Kw, OUTPUT 13 RPM, SHAFT ø40	BY "GNA"	48 Kg
13	2	SNL22517/75TG	PILLOW BLOCK (FIXED) BORE ø75 "SKF"	BY "GNA"	20 Kg
14	2	SNL22517/75TG	PILLOW BLOCK (FREE) BORE ø75 "SKF"	BY "GNA"	20 Kg
15	5	C-1045	BAR 20 X 12 X 110 LG	KEY	
16	8	STD	HEX. CAPSCREW M20 X 70 LG, DIN 931		
17	4	STD	HEX. NUT M20, DIN 934		
18	8	STD	FLAT WASHER FOR BOLT M20, DIN 125A		
19	8	STD	LOCKWASHER FOR BOLT M20, DIN 127A		
20	8	STD	HEX. CAPSCREW M16 X 70 LG, DIN 931		
21	8	STD	HEX. NUT M16, DIN 934		
22	8	STD	FLAT WASHER FOR BOLT M16, DIN 125A		
23	8	STD	LOCKWASHER FOR BOLT M16, DIN 127A		
24	8	STD	HEX. CAPSCREW M12 X 20 LG, DIN 933		
25	8	STD	FLAT WASHER FOR BOLT M12, DIN 125A		
26	8	STD	LOCKWASHER FOR BOLT M12, DIN 127A		
27	1	STEEL	RECT. BAR 19.05 (3/4") X 180 LG	STOP BLOCK	
28	2	STEEL	RECT. BAR 19.05 (3/4") X 60 LG	STOP BLOCK	
29	4	STD	HEX. CAPSCREW M12 X 45 LG, DIN 931		
30	4	STD	FLAT WASHER FOR BOLT M14, DIN 125A		
31	4	STD	LOCKWASHER FOR BOLT M114, DIN 127A		
32	6	STD	HEX. CAPSCREW M20 X 100 LG		
33	1	1347-C3-1500	BAR GUARD		9 Kg

APPROX. TOTAL WEIGHT: 1797 Kg



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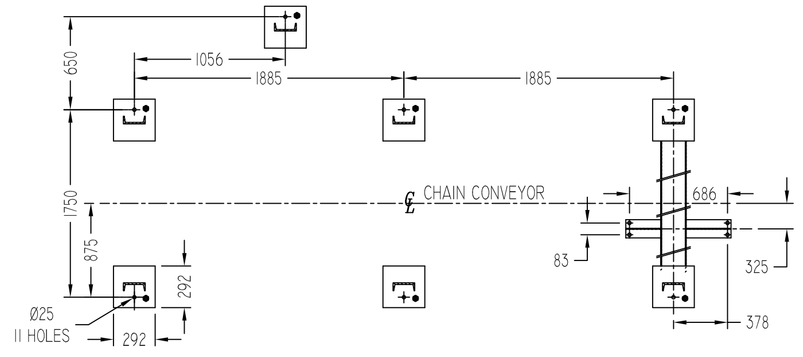

SECTION "D-D"
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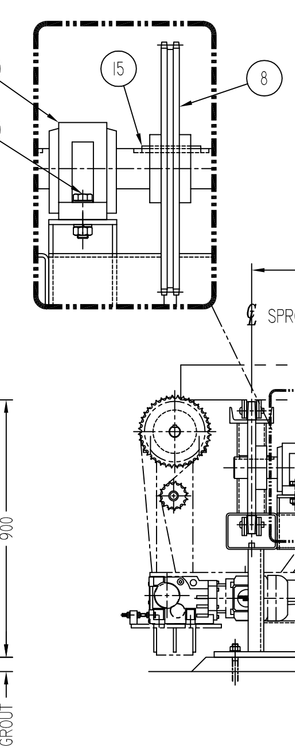

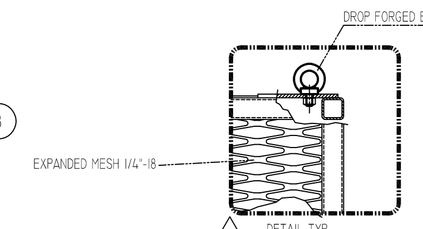

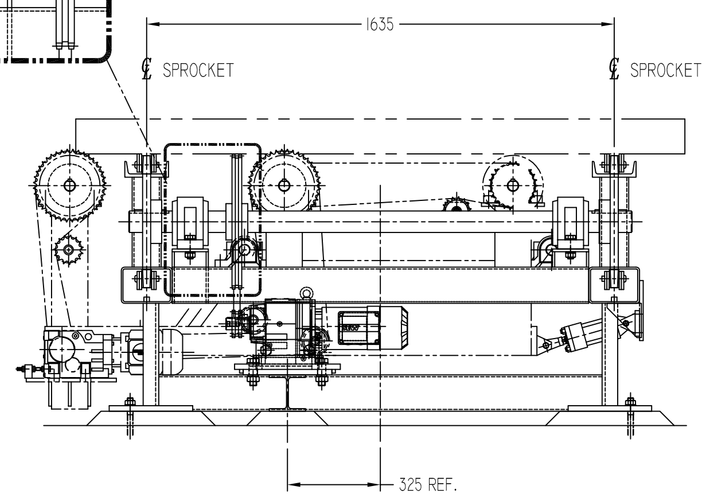

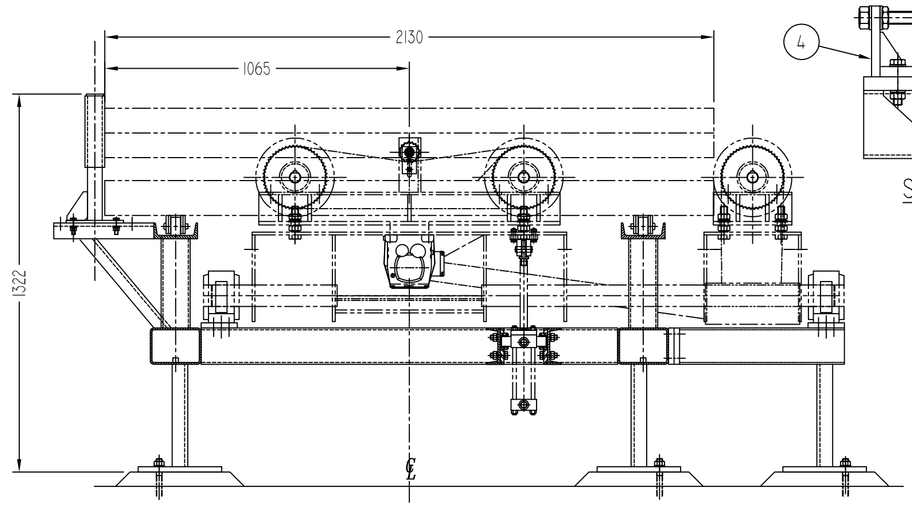

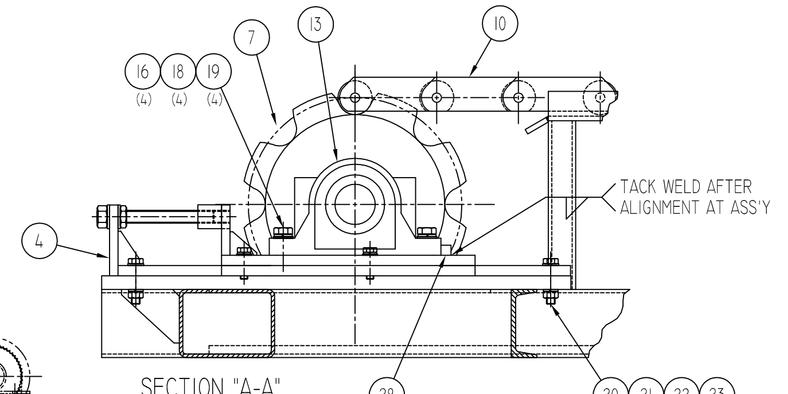

SECTION "A-A"
(SCALE: 1 : 8)

NOTES:
1. FOR FOUNDATION DETAILS SEE DRAWING 1347-AR-0100 AND 1347-AR-0101.
2. ALL MECHANICAL PARTS WILL HAVE AN ACCES FOR MAINTENANCE.
3. THERE IS A GREASE POINT FOR ALL BEARINGS.

EQUIPMENT TAG # 4481-MHCD-0003

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5 ☐ VOID / Superseded.

DIR Nbr :

Reviewed by : _____ Date : _____

Discipline :

Document No : 25457- **Rev. : 0**

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SELLER DRAWING No. 1347-C3-1000 REV. 3

NUMBER	REV.	TITLE
REFERENCE DRAWINGS		

REV.	DESCRIPTION	DATE	DRN.	CHK.	R.E.	A.E. / S.	E.G.S.	P.E.M.
3	FOR APPROVAL	OC.29 2010	LG	M.B.	C.C.			
2	ITEM #33 AND SECTION E-E ADDED, MOTOR NUMBER REVISED	SE.30.'10	C.C.	M.B.	C.C.			
1	GUARD DETAIL, NOTES, ITEM 33, 34, 35 AND EQUIPMENT TAG NUMBER ADDED	SE.24.'10	C.C.	M.B.	C.C.			
0	INITIAL DESIGN	AU.05.'10	A.V.	M.B.	C.C.			

REVISIONS

STAMP

ALCOA | Ma'aden

Ma'aden Aluminum Project

SCALE: 1=15 FORMAT A1

Bechtel

GNA alutech inc. Departement Ingenierie Engineering Department 9490 Trans-Canada Saint-Laurent, Quebec H4S 1V3 Canada

		DATE
DRAWN	A.V.	AU.05.'10
CHK.	M. Blanchet	
R.E.	C. Coupal	
A.E. / S.		
E.G.S.		
P.E.M.		
CLIENT		

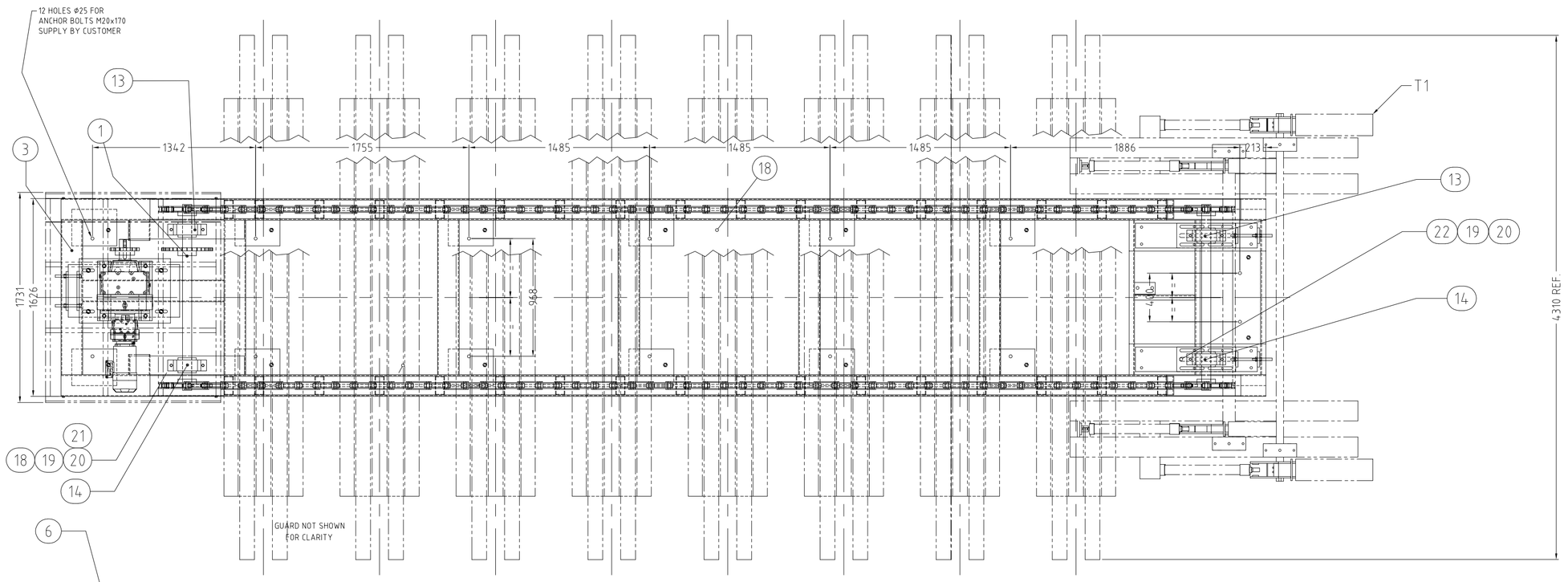
BECHTEL DRG. No. - - - - - REV.

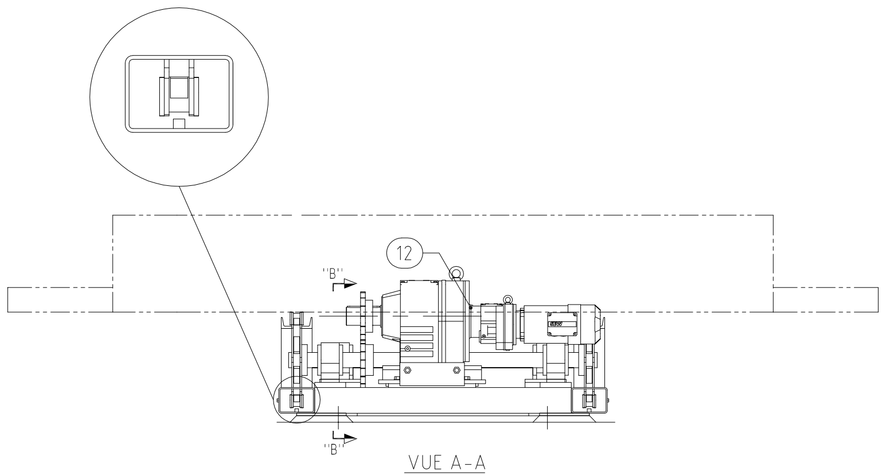
CLIENT DRG. No. REV.

Ras Az Zawr Aluminium Smelter

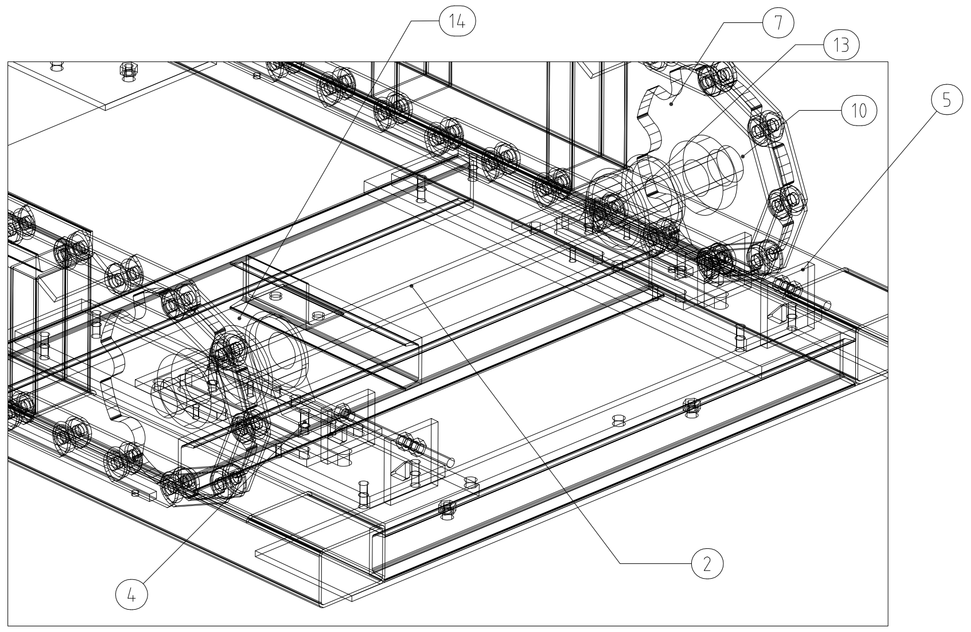
SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CHAIN CONVEYOR BETWEEN SHOT BLASTING MACHINE AND OVEN
GENERAL ARRANGEMENT

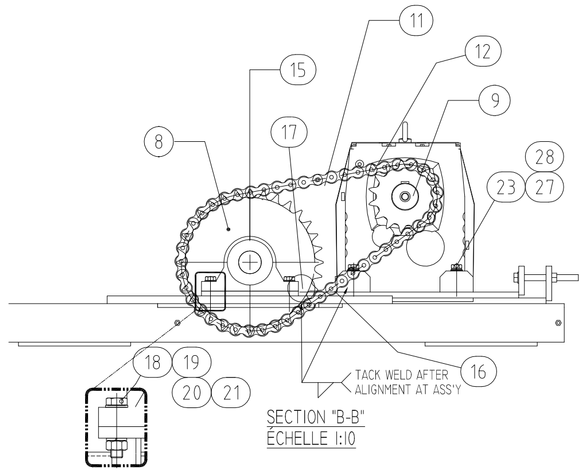
USER: $USERNAME$
TIME: $TIME$
$DATE$
$FILE$



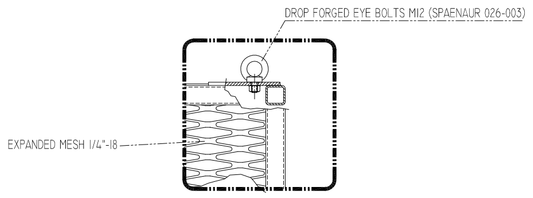


VUE A-A
SCALE 1:15

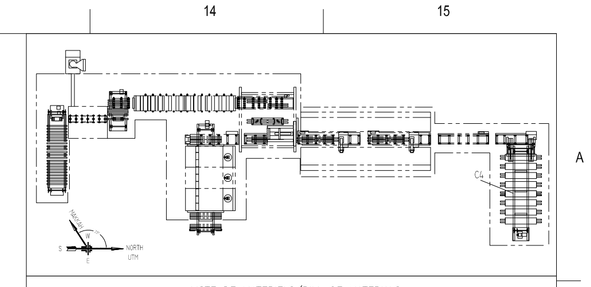




SECTION "B-B"
ÉCHELLE 1:10



DETAIL TYP
FOR ALL GUARDS



ITEM	Qte/Qty	No. PIECE-MAT. MAT.-PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
1	1	1347-C4-1010	SHAFT (DRIVE)		52 Kg
2	1	1347-C4-1020	SHAFT		52 Kg
3	1	1347-C4-1100	MAIN FRAME (DETAIL)		1906 Kg
4	2	1347-C4-1310	ADJUSTING PLATE		25 Kg
5	2	1347-C4-1320	BASE PLATE		80 Kg
6	1	1347-C4-1200	GUARD DRIVE SIDE		130 Kg
7	4	ØCC5B8F-75mmZ	SPROCKET 6" PITCH, BORE Ø75, 8 T. "TSUBAKI"	"BY GNA"	143 Kg
8	1	Ø140B32	SPROCKET Ø140, BORE Ø75, 32 TEETH	BY "GNA"	35 KG
9	1	Ø140B15	SPROCKET Ø140, BORE Ø90, 15TEETH	BY "GNA"	11.5 Kg
10	2	ØCC5	CONVEYOR CHAIN 6" PITCH X 17983 mm LG	BY "GNA"	600 Kg
11	1	Ø140	ROLLER CHAIN Ø140 X 2185mm LG	BY "GNA"	11 Kg
12	1	R13787TDR100	REDUCER 2.2 Kw, 6 RPM, SHAFT Ø90	BY "GNA"	304 kg
13	2	SNL22517/751G	PILLOW BLOCK (FIXED) BORE Ø75 "SKF"	BY "GNA"	28 Kg
14	2	SNL22517/751G	PILLOW BLOCK (FREE) BORE Ø75 "SKF"	BY "GNA"	28 Kg
15	5	C-1045	BAR 20 X 12 X 110 LG	KEY	0.5 Kg
16	1	STEEL	RECT. BAR 19.05 (3/4") X 200 LG	STOP BLOCK	0.25 Kg
17	2	STEEL	RECT. BAR 19.05 (3/4") X 60 LG	STOP BLOCK	0.25 Kg
18	16	STD	HEX. CAPSCREW M20 X 100 LG, DIN 931		
19	12	STD	FLAT WASHER FOR BOLT M20, DIN 125A		
20	12	STD	LOCKWASHER FOR BOLT M20, DIN 127A		
21	4	STD	HEX, NUT M20 DIN 934		
22	4	STD	HEX. CAPSCREW M20 X 60 LG, DIN 933		
23	4	STD	HEX. CAPSCREW M24 X 90 LG, DIN 933		
24	4	STD	HEX, CAPSCREW M12 X 20 LG, DIN 933		
25	8	STD	FLAT WASHER FOR BOLT M12 DIN 125A		
26	8	STD	LOCKWASHER FOR BOLT M12, 127A		
27	4	STD	FLAT WASHER FOR BOLT M24 DIN 125A		
28	4	STD	LOCKWASHER FOR BOLT M24, 127A		

LISTE DE MATERIELS/BILL OF MATERIALS

APPROX. TOTAL WEIGHT: 3406 kg

NOTES:
1. FOR FOUNDATION DETAILS SEE DRAWING 1347-AR-0100 AND 1347-AR-0101.
2. ALL MECHANICAL PARTS WILL HAVE AN ACCES FOR MAINTENANCE.
3. THERE IS A GREASE POINT FOR ALL BEARINGS.

EQUIPMENT TAG # 4481-MHCD-0004

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4 ☐ Revise not required. Work may proceed.
5 ☐ VOID / Superseded.

DDR Nbr :

Reviewed by : _____ Date : _____

Discipline :

Document No : 25457- **Rev. : 0**

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NUMBER	REV.	TITLE

REFERENCE DRAWINGS

REV.	DESCRIPTION	DATE	DRN.	CHK.	R.E.	A.E./S.	E.G.S.	P.E.M.
2	FOR APPROVAL	OC.29 2010	LG	M.B.	C.C.			
1	GUARD DETAIL, NOTES AND EQUIPMENT TAG NUMBER ADDED	SE.29.'10	A.V.	M.B.	C.C.			
0	FIRST DESIGN	SE.14.'10	C.D.	M.B.	C.C.			

REVISIONS

STAMP

ALCOA | MA'ADEN Saudi Arabian Mining Company

Ma'aden Aluminum Project

SCALE: 1:20 | FORMAT A0

Bechtel

GNA alutech inc.
Departement Ingenierie
Engineering Department
9495 Trans-Canada
Saint-Laurent, Quebec
H4S 1V3
Canada

		DATE
DRAWN	C. Duplantie	SE.14.'10
CHK.	M. Blanchet	
R.E.	C. Coupal	
A.E. / S.		
E.G.S.		
P.E.M.		
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BECHTEL DRG. No. - - - - - REV.

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SELLER DRAWING No. 1347-C4-1000 REV. 2

Ras Az Zawr
Aluminium Smelter

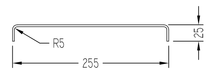
SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CHAIN CONVEYOR FOR SEALED CATHODE
GENERAL ASSEMBLY

CLIENT DRG. No. REV.

USER&USERNAMES
TIME-STIMES
$DATES
$FILES
DATE:
FILE:

NOTES:

1. FOR FOUNDATION DETAILS SEE DRAWING 1347-AR-0100 AND 1347-AR-0101.
2. ALL MECHANICAL PARTS WILL HAVE AN ACCES FOR MAINTENANCE.
3. THERE IS A GREASE POINT FOR ALL BEARINGS.
4. MOVING PARTS WILL BE PROTECTED TO AVOID ANY PINCH POINTS.



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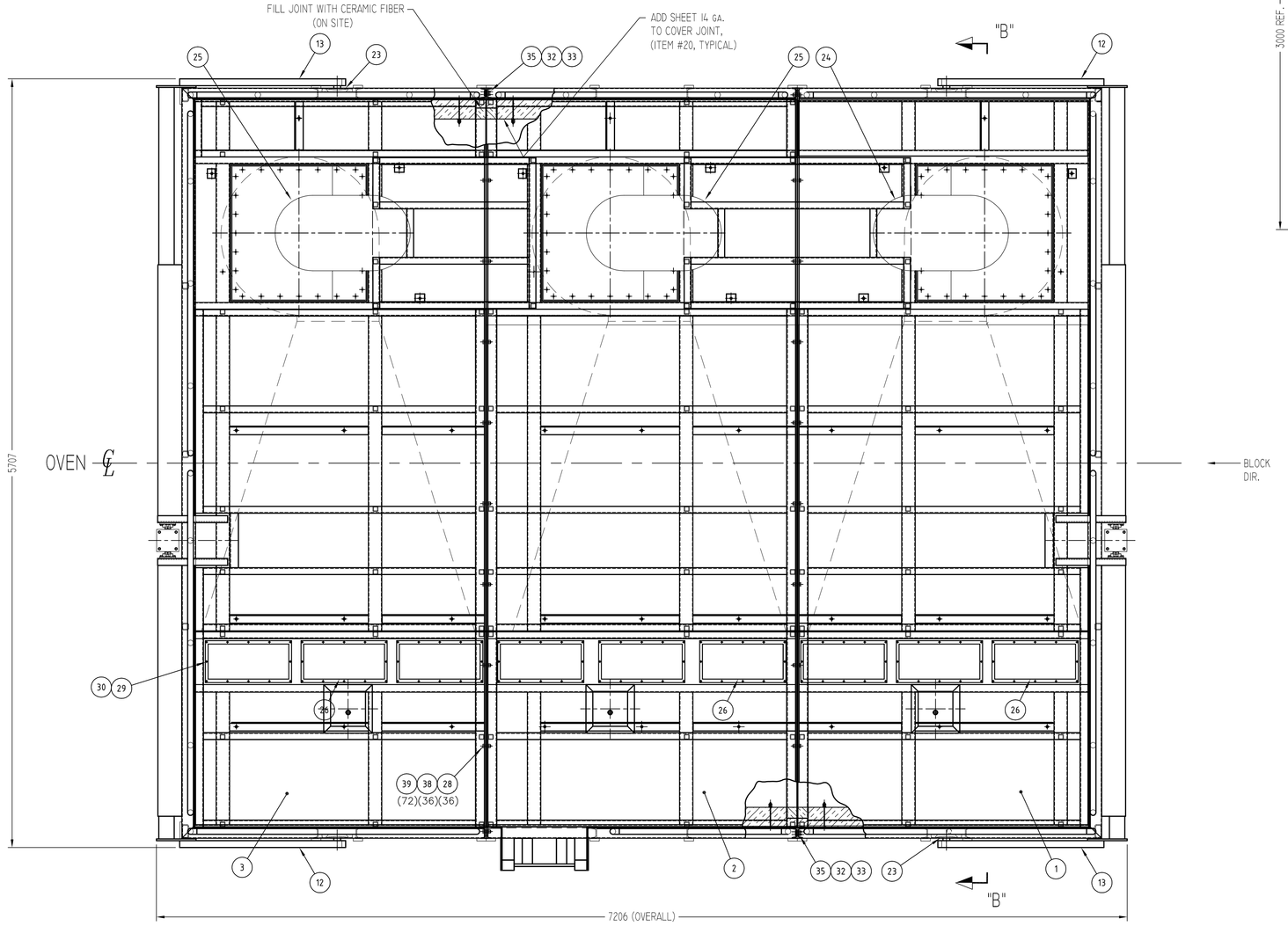
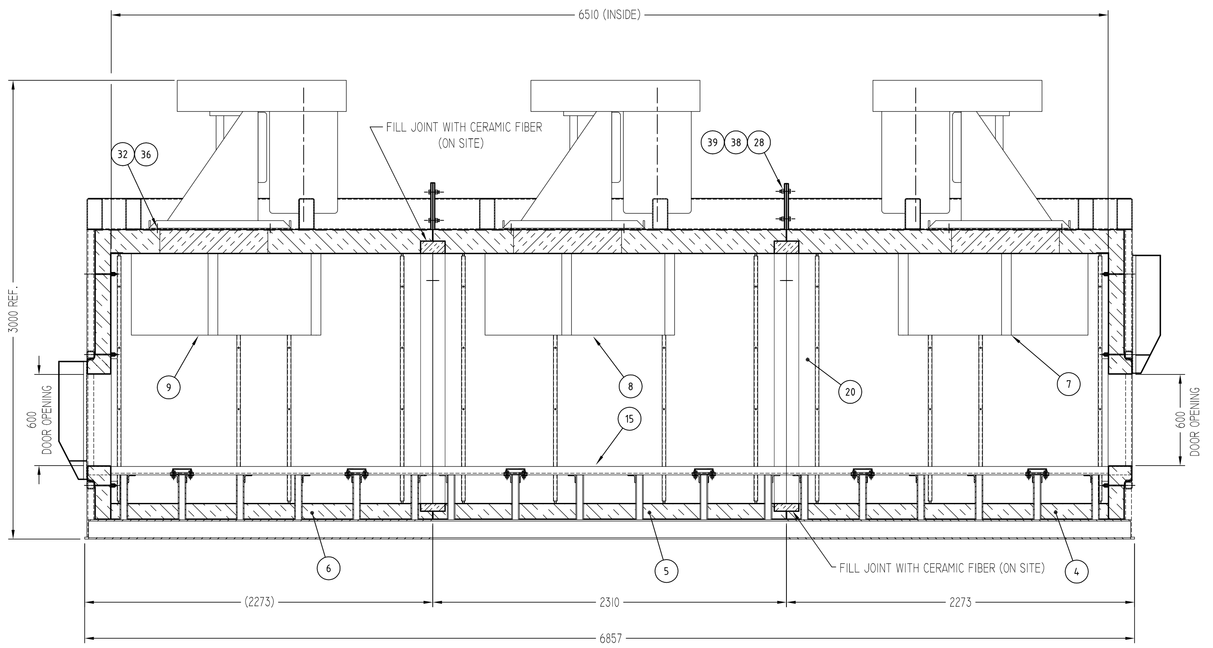


TOP VIEW



A-A
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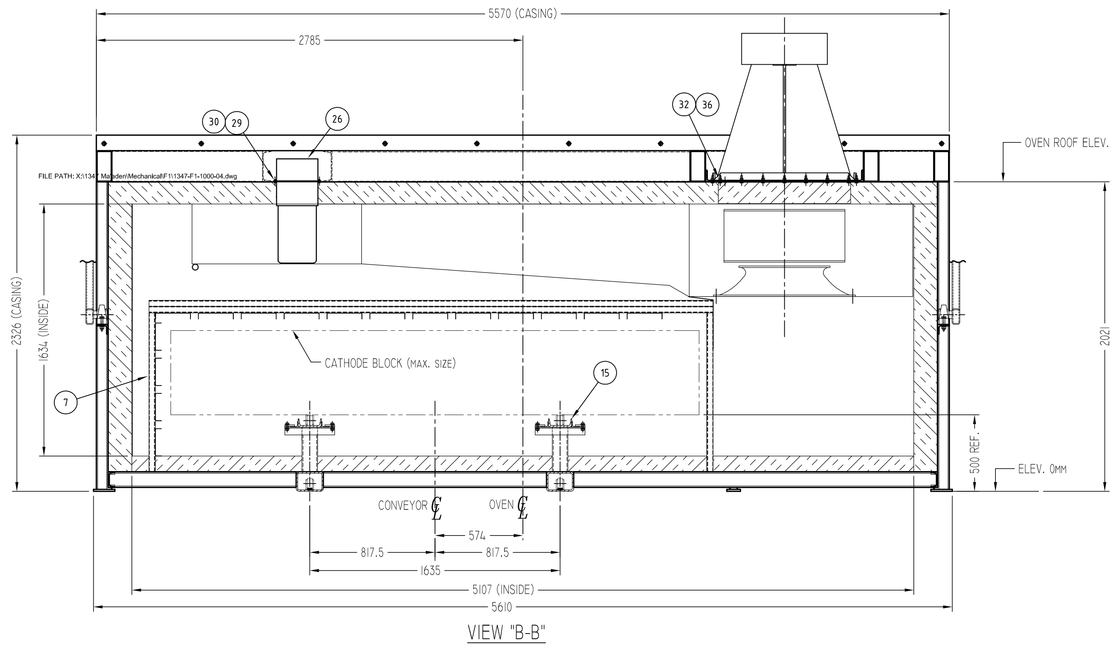

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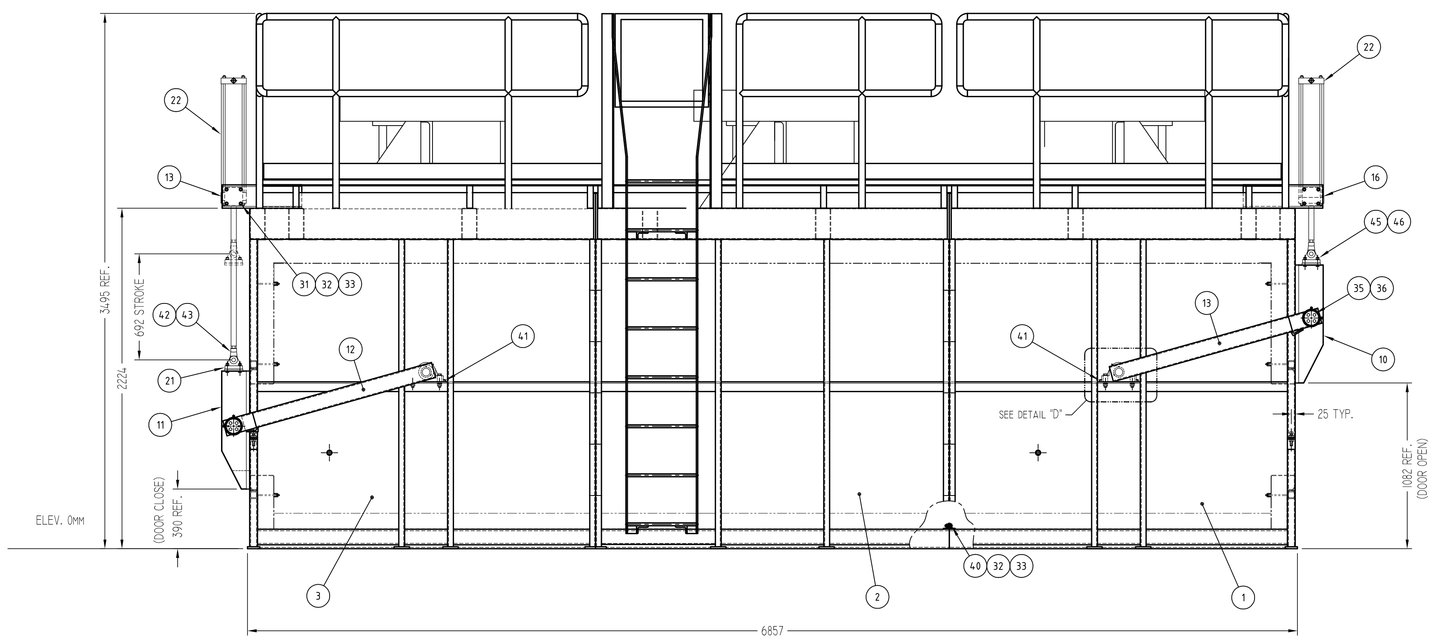
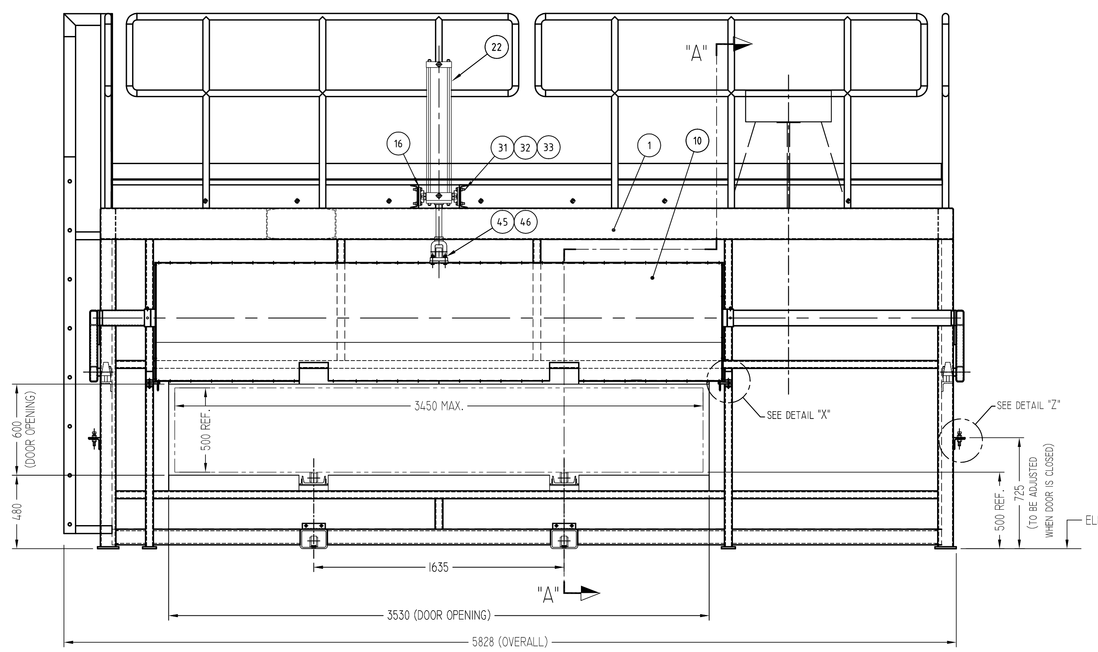
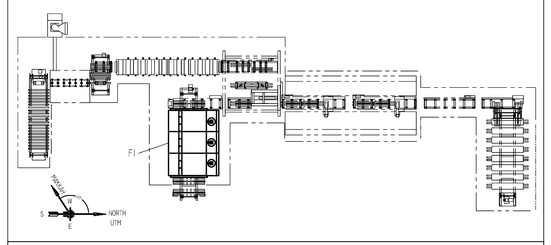


SIDE VIEW

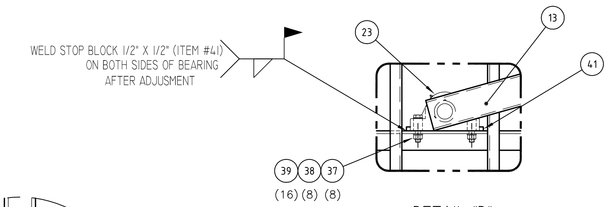


FRONT VIEW (ENTRY SIDE)



ITEM	Qte/Qty	No. PIECE-MAT. MAT.-PART. No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS/ WEIGHT
1	1	1347-F1-1010	OUTER CASING, ENTRY SIDE	C/W F1-1011	2619 Kg
2	1	1347-F1-1020	OUTER CASING, MIDDLE SECTION		2115 Kg
3	1	1347-F1-1030	OUTER CASING, EXIT SIDE	C/W F1-1031	2619 Kg
4	1	1347-F1-1110	INNER CASING AND INSULATION, ENTRY SIDE		840 Kg
5	1	1347-F1-1120	INNER CASING AND INSULATION, MIDDLE SECTION		700 Kg
6	1	1347-F1-1130	INNER CASING AND INSULATION, EXIT SIDE		840 Kg
7	1	1347-F1-1210	BAFFLES AND DEFLECTORS, ENTRY SIDE		657 Kg
8	1	1347-F1-1220	BAFFLES AND DEFLECTORS, MIDDLE SECTION		683 Kg
9	1	1347-F1-1230	BAFFLES AND DEFLECTORS, EXIT SIDE		657 Kg
10	1	1347-F1-1410	DOOR ASSY., ENTRY SIDE	C/W F1-1411	388 Kg
11	1	1347-F1-1430	DOOR ASSY., EXIT SIDE	C/W F1-1411	388 Kg
12	2	1347-F1-1450	DOOR ARM #1		42 Kg
13	2	1347-F1-1455	DOOR ARM #2		42 Kg
14	4	1347-F1-1470	DOOR SAFETY STOPPER		–
15	1	1347-F1-1500	CHAIN RAIL GUIDE ASSEMBLY		272 Kg
16	4	FY 35 TF	FLANGED BEARING 35mm		11 Kg
17	1	1347-F1-1400	HANDRAIL AND LADDER ASSEMBLY		493 Kg
18					
19					
20	4	44W	SHEET 14 ga. 296 mm x 1630 mm		44 Kg
21	2	69197	EYE BRACKET	BY GNA	–
22	2	–	PNEUM. CYL. BORE 150, STRK. 692 + EXT. ROD	BY GNA	–
23	4	SY 50 FM	PILLOW BLOCK BEARING, BORE 50 MM	BY GNA	15 kg
24	1	SIZE 338	PLUG FAN WITH HOUSING, ROTATION CCW	BY GNA	227 kg
25	2	SIZE 338	PLUG FAN WITH HOUSING, ROTATION CW	BY GNA	227 kg
26	9	WXL-54	HEATING ELEMENT, 54 kW	BY GNA	234 kg
27					
28	36	GRADE 8.8	HEX. BOLT M16 X 50	DIN 931	
29	108	STD.	HEX. NUT M6	DIN 934	
30	108	STD.	FLAT WASHER FOR BOLT M6	DIN 125 A	
31	16	GRADE 8.8	HEX. BOLT M12 X 50	DIN 933	
32	164	STD.	HEX. NUT M12	DIN 934	
33	84	STD.	FLAT WASHER FOR BOLT M12	DIN 125 A	
34					
35	60	GRADE 8.8	HEX. BOLT M12 X 40	DIN 931	
36	112	STD.	LOCK WASHER FOR BOLT M12	DIN 127 A	
37	12	GRADE 8.8	HEX. BOLT M16 X 80, FULLY THREADED	DIN 933	
38	52	STD.	HEX. NUT M16	DIN 934	
39	88	STD.	FLAT WASHER FOR BOLT M16	DIN 125 A	
40	8	GRADE 8.8	HEX. BOLT M12 X 30	DIN 933	
41	8	44W	SQUARE BAR 1/2" x 1/2" x 60 lg.	STOP BLOCK	
42	2	50944	FEMALE ROD END CLEVIS	BY GNA	–
43	2	68370	PIVOT PIN	BY GNA	–
44	4	44W	ANGLE 3" x 3" x 3/8" X 50mm		–
45	4	STD.	HEX. NUT M14	DIN 934	
46	4	STD.	LOCK WASHER FOR M14 BOLT	DIN 127 A	

APPROX. TOTAL WEIGHT: 14113 Kg



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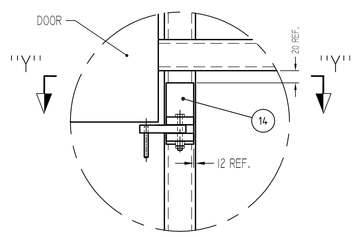

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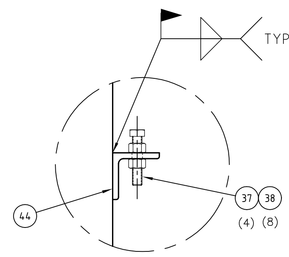

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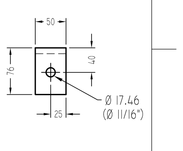

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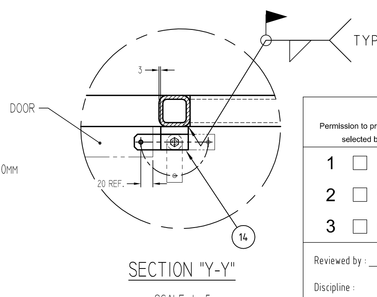

SECTION "Y-Y"
SCALE: 1 : 5

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4 ☐ Revise not required. Work may proceed.
5 ☐ VOID / Superseded.

DIR Nbr° :

Reviewed by : _____ Date : _____

Discipline :

Document No : 25457- **Rev. : 0**

EQUIPMENT TAG # 4481-MEEP-0001

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SELLER DRAWING No. 1347-F1-1000 REV. 4

NUMBER	REV.	TITLE
REFERENCE DRAWINGS		

REV.	DESCRIPTION	DATE	DRN.	CHK.	R.E.	A.E. / I.G.S.	P.E.M.
4	ITEM #17 UPDATED	NO.18.10	C.C.				
3	GENERAL REVISION	OC.25.10	C.C.				
2	NOTES AND EQUIPMENT TAG NUMBER ADDED	SE.28.10	C.C.				
1	GENERAL REVISION	SE.24.10	LG				
0	FIRST ISSUE	AU.31.10	LG				

REVISIONS

STAMP

ALCOA | Ma'aden Aluminum Project

SCALE: 1: 20 FORMAT A0

Bechtel

GNA alutech inc.

Departement Ingenierie Engineering Department
9495 Trans-Canada
Saint-Laurent, Quebec
H4S 1V3
Canada

		DATE
DRAWN	L.G	AU.31.'10
CHK.	M. Blachet	
R.E.	C. Coupal	
A.E. / S.		
E.G.S.		
P.E.M.		
CLIENT		

BECHTEL DRG. No. — — — — — REV.

Ras Az Zawr
Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CATHODE BLOCK OVEN (capacity of 6 cathode blocks)
GENERAL ARRANGEMENT

CLIENT DRG. No. REV.

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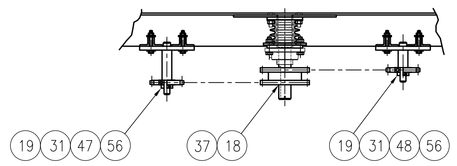
USER:$USERNAME$ TIME:$TIME$ DATE:$DATE$ FILE:$FILE$

TOTAL APPROX. WEIGHT (STEEL ONLY) : 15500 Kg
TOTAL APPROX. WEIGHT REFRACTORY : 10000 Kg



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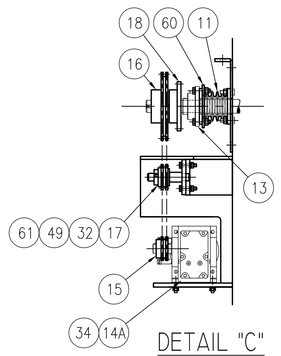

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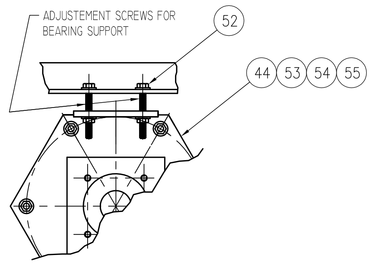

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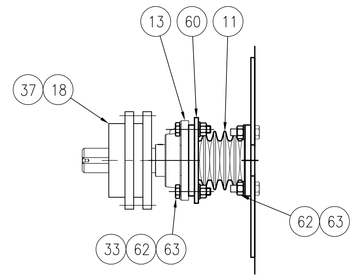

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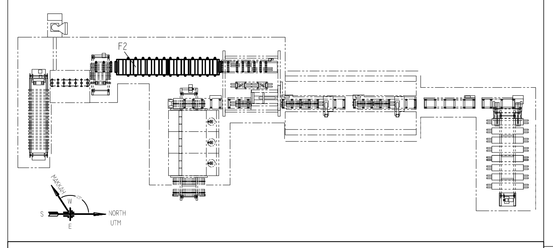
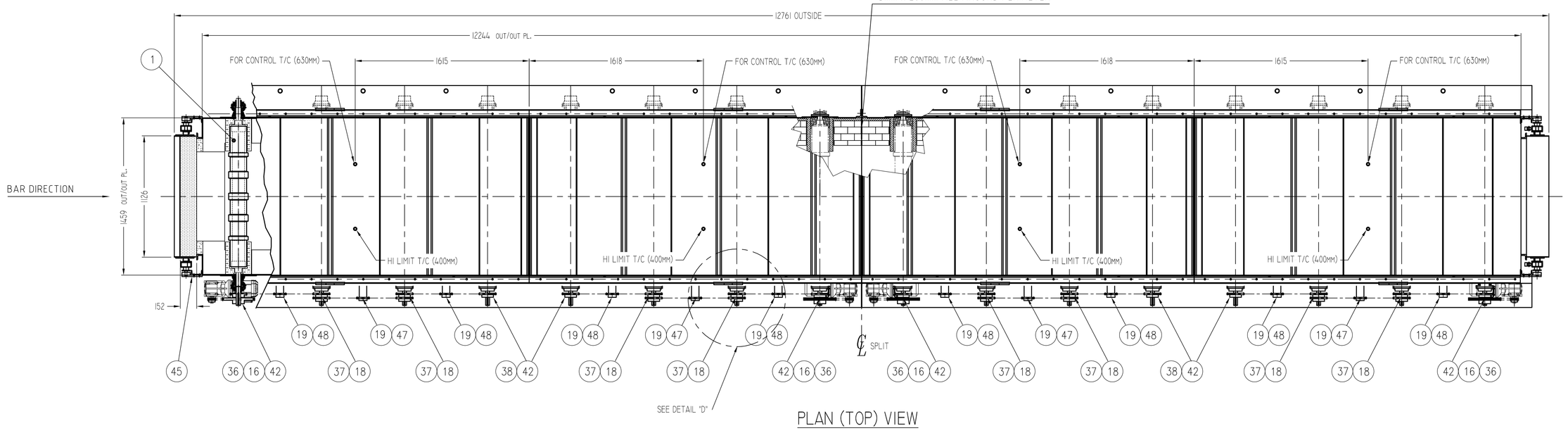
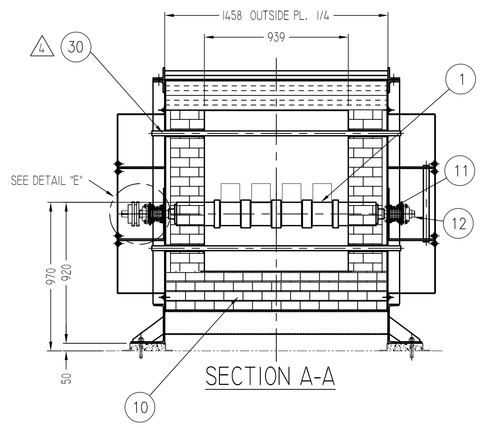
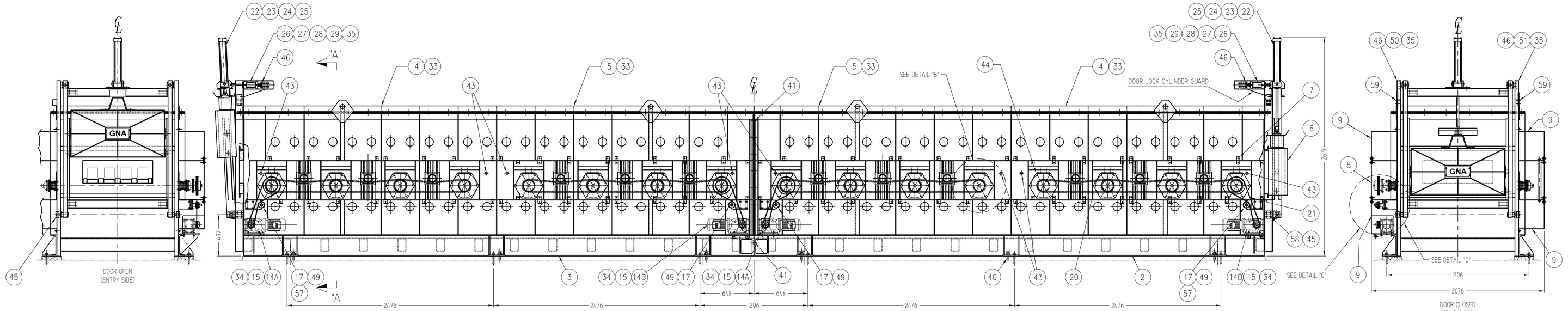


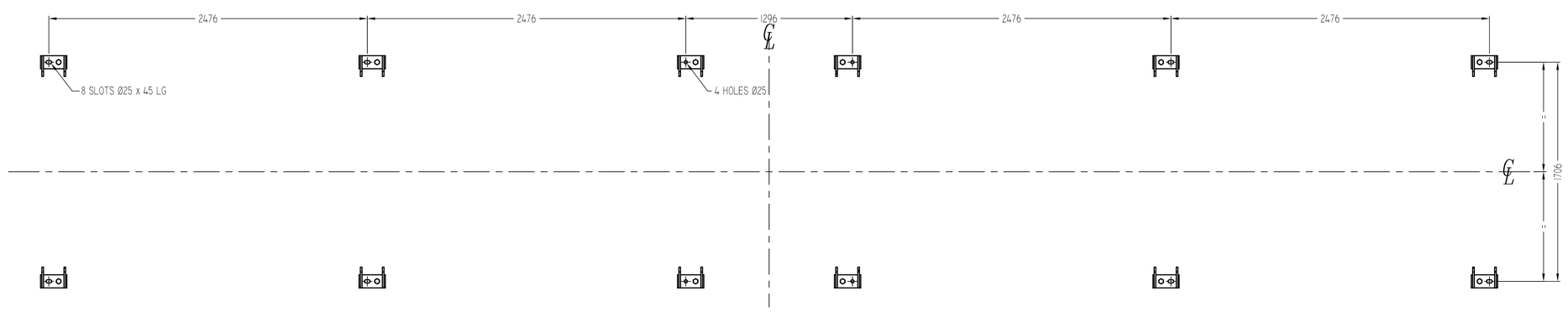


PLAN (TOP) VIEW



SECTION A-A





FOOTPRINT

LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/Qty	No. PIECE–MAT. MAT.–PART. No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
1	16	1347–F2–1010	SUPPORT ROLL	BY GNA	1872Kg
⚠1 ⚠2	1	1347–F2–1110	FURNACE CASING, EXIT SIDE		3955Kg
⚠1 ⚠2	1	1347–F2–1111	FURNACE CASING, ENTRY SIDE		
4	2	1347–F2–1200	FURNACE TOP COVER END		788Kg
5	2	1347–F2–1210	FURNACE TOP COVER CENTER		804Kg
6	2	1347–F2–1300	DOOR FRAME ASS'Y		375Kg
⚠5	4	1347–F2–1400	GUARDS ATTACHMENT PLATE ASS'Y		20Kg
8	2	1347–F2–1500	CHAIN GUARD		140Kg
9	2	1347–F2–1600	HEATING ELEMENT TERMINAL GUARD		508Kg
10	2	1347–F2–1700	REFRACTORY	BY GNA	10000Kg
11	32	985B149P3	HEAT SLING ADAPTER , SHAFT 1 7/16ø	BY GNA	
⚠3 12	16	FY 40 TF	"SKF" FLG BREARING FREE, SHAFT ø40mm	BY GNA	
⚠3 13	16	FY 40 TF	"SKF" FLG BREARING FIXED, SHAFT ø40mm	BY GNA	
⚠3 14A	2	K47–DRE80M4	MOTOR–REDUCER	BY GNA	
			SHAFT ø30mm, MOTOR 0.75 kW, OUTPUT 49 rpm		
⚠3 14B	2	K47–DRE80M4	MOTOR–REDUCER	BY GNA	
			SHAFT ø30mm, MOTOR 0.75 kW, OUTPUT 49 rpm		
15	4	D40B19H	SPROCKET #40, 19 TEETH,	BY GNA	
			DOUBLE–TYPE 'B', SHAFT ø30mm, KEY 8X7		
16	4	D40B52	SPROCKET #40, 52 TEETH,	BY GNA	
			DOUBLE–TYPE 'B', SHAFT 40ømm, KEY 12x8		
17	4	HND40B19	IDLER SPROCKET, #40, 19 TEETH,	BY GNA	
			DOUBLE, SPROCKET C/W BEARING		
18	8	DS80A18	SPROCKET #80, 18 TEETH, SHAFT ø40mm, KEY 12x8	BY GNA	
19	12	80BB12H	IDLER SPROCKET C/W BEARING, 12 TEETH, BORE 0.75"	BY GNA	
⚠5 20	12		#80 CHAIN C/W (12) ROLLER LINK, 6'–8"	BY GNA	
⚠5 21	4		#40–2 CHAIN C/W (4) ROLLER LINK, 5'–1"	BY GNA	
22	2	325C0–2AUV	"PARKER" DOOR LIFT, HEAVY DUTY AIR CYLINDER	BY GNA	
			BORE 3 1/4ø, 1ø ROD, 18" STROKE		
23	2	50942	"PARKER" FEMALE ROD CLEVIS	BY GNA	
24	2	69196	"PARKER" EYE BRACKET	BY GNA	
25	2	68369	"PARKER" PIVOT PIN, 3/4ø	BY GNA	
26	4	2.5CB0–2AUV0AC3	"PARKER" DOOR LOCK, HEAVY DUTY AIR CYLINDER	BY GNA	
			BORE 2 1/2ø, 1ø ROD, 3" STROKE		
⚠5 27	4	50942	"PARKER" FEMALE ROD CLEVIS	BY GNA	
28	4	69195	"PARKER" MOUNTING PALTE	BY GNA	
⚠5 29	4	68369	"PARKER" PIVOT PIN, ø1/2	BY GNA	
⚠4 30	96	RR64x38x1.25	ELECTRIC ELEMENT, SILICON CARBIDE	BY GNA	
			ø1.25 , HEATING SECTION 38" (965mm), 64" LG.		
			2.02 ohms, col. 133V		
⚠5 31	12	600–104	"SPAENAUR" CLAMPING COLLAR	BY GNA	
			C/W SET SCREW, SHAFT ø0.75"		
⚠5 32	4	600–107	"SPAENAUR" CLAMPING COLLAR	BY GNA	
			C/W SET SCREW, SHAFT ø1"		
⚠5 33	262		HEX BOLT M12 x 50 LG		
34	16		HEX BOLT M10 x 60 LG		
			C/W HEX NUT, FLAT WASHER & LOCK WASHER		
⚠5 35	32		HEX BOLT M10 x 40 LG		
			C/W HEX NUT & (2) LOCK WASHER		
36	4	1045	BAR 12 x 8 x 100	KEY	
37	8	1045	BAR 12 x 8 x 80	KEY	
38	4	1045	BAR 12 x 8 x 40	KEY	
⚠3 39					
40	12		HEX BOLT M24 x 100 LG		
⚠5 41	28		HEX BOLT M14 x 50 LG		
			C/W HEX NUT, (2) WASHER & (1) LOCK WASHER		
42	8	80B18	SPROCKET #80, 18 TEETH, TYPE 'B	BY GNA	
			SHAFT 40ømm, KEY 12x8		
43	16	11698	"ECLIPSE" HEAT SEAL ASSEMBLY	BY GNA	
44	32	1347–F2–1130	BEARING SUPPORT		224Kg
45	4	1347–F2–1140	DOOR MECHANISME SUPPORT		16Kg
46	4	1347–F2–1150	DOOR CLAMPING CYLINDER SUPPORT		2Kg
47	4	1347–F2–1160	DRIVEN CHAIN TENSIONER ALIGNMENT		16Kg
48	8	1347–F2–1165	DRIVEN CHAIN TENSIONER ALIGNMENT		32Kg
49	4	1347–F2–1170	DRIVE CHAIN TENSIONER ALIGNMENT		28Kg
50	2	1347–F2–1180	FRAME EXTENSION		14Kg
51	2	1347–F2–1190	FRAME EXTENSION		14Kg
52	64		HEX. BOLT M10 x 80mm		
			C/W (2) HEX NUT & (2) FLAT WASHER		
53	192		HEX. NUT M10		
54	192		LOCK WASHER M10		
55	192		WASHER M10		
56	48		HEX. BOLT M10 x 70mm		
			C/W (1) HEX NUT & (2) FLAT WASHER		
57	8		HEX. BOLT M10 x 50mm		
			C/W (1) HEX NUT, (2) FLAT WASHERS & (1) LOCK WASHER		
⚠5 58	16		HEX. BOLT M10 x 40mm		
			C/W (1) HEX NUT, (2) FLAT WASHERS & (1) LOCK WASHER		
⚠5 59	16		HEX. BOLT M10 x 60mm		
			C/W (1) HEX NUT, (2) FLAT WASHERS & (1) LOCK WASHER		
⚠5 60	32	1347–F2–1800	FLANGE ADAPTOR		
			C/W (1) HEX NUT & (1) LOCK WASHER		
⚠5 61	8	BRONZE	TRUST WASHER I.D. ø1" O.D. ø2"		
			BOSTON BRONZE #TB1632		
⚠5 62	390		M12 HEX NUT		
⚠5 63	390		M12 FLAT WASHER		

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5 ☐ VOID / Superseded

DRR Nbr :

Reviewed by : Date :

Discipline :

Document No : 25457- **Rev. : 0**

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SELLER DRAWING No. 1347–F2–1000 REV. 4

WELDING SPECIFICATION, unless otherwise noted:

z=0,4 X t | z=0,5 X t | z=0,5 X t

z= FILLET SIZE t= THICK. OF THINNER PLATE

TOLERANCES,# not stipulated
METRIC (mm)

WELDED CONSTRUCTION			
NOM. Length	TOL. +/-	NOM. Length	TOL. +/-
to 25	± 1.0	to 1000	± 3.0
to 315	± 1.5	to 2000	± 4.0
to 800	± 2.0	to 4000	± 6.0
to 1250	± 2.5	over 4000	± 9.0

MACHINING	
D.	± 0.5
L.D.	± 0.5
L@D	± 0.05
ANG.	± 0°
[— HOLES —	
ORC.	± .20
OSC.	± .25

NUMBER	REV.	TITLE
REFERENCE DRAWINGS		

REV.	DESCRIPTION	DATE	DRN.	CHK.	R.E.	A.E. / S.	E.G.S.	P.E.M.
4	ITEM 30 NEW DESCRIPTION	NO.19.'10	C.D.	M.B.				
3	FOR CONSTRUCTION	OC.29.'10	C.C.	L.G.				
2	ITEM #2 ARE 1347–F2–1110 AND ITEM #3 MIRROR OF 1347–F2–1110	SE.03.'10	C.D.					
1	GENERAL REVISION	AU.25.'10	C.D.					
0	FIRST DESIGN	AU.10.'10	C.D.	E.I.	C.C.			

REVISIONS

STAMP

ALCOA | Ma'aden Aluminum Project

Bechtel

GNA alutech inc.
Departement Ingenierie
Engineering Department
9495 Trans-Canada
Saint-Laurent, Quebec
H4S 1V3
Canada

		DATE
DRAWN	C.Duplantie	AU.03.'10
CHK.	M. Blanchet	
R.E.	C. Coupal	
A.E. / S.		
E.G.S.		
P.E.M.		
CLIENT		

SCALE: 1:20 FORMAT A0

BECHTEL DRG. No. — — — — — REV.

Ras Az Zawr
Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CATHODE BAR HEATING FURNACE (CAP. 16 BARS)
GENERAL ASSEMBLY

CLIENT DRG. No. REV.

EQUIPMENT TAG # 4481-MBMB-0001

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USER:$USERNAME$
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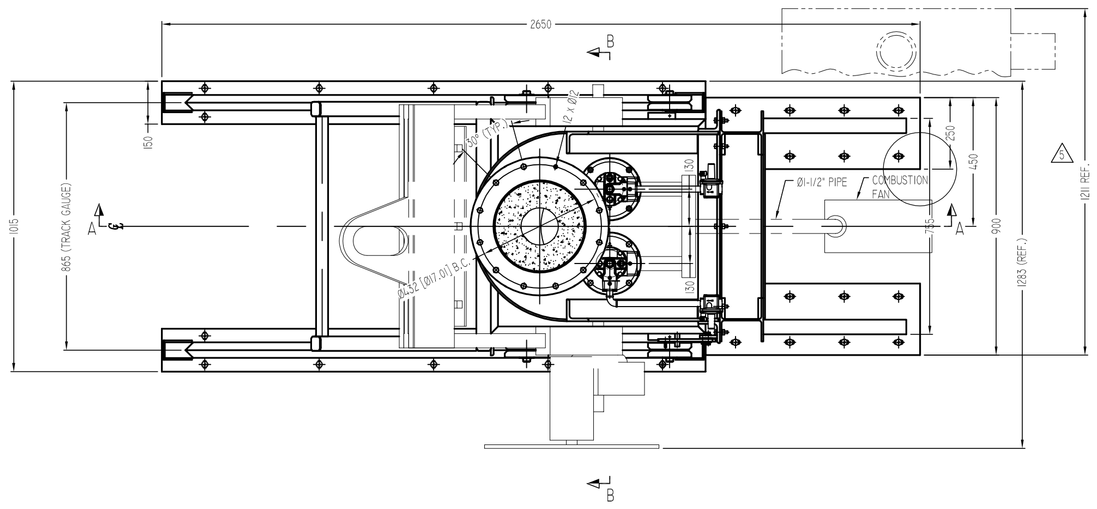

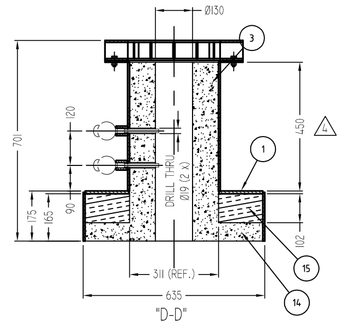

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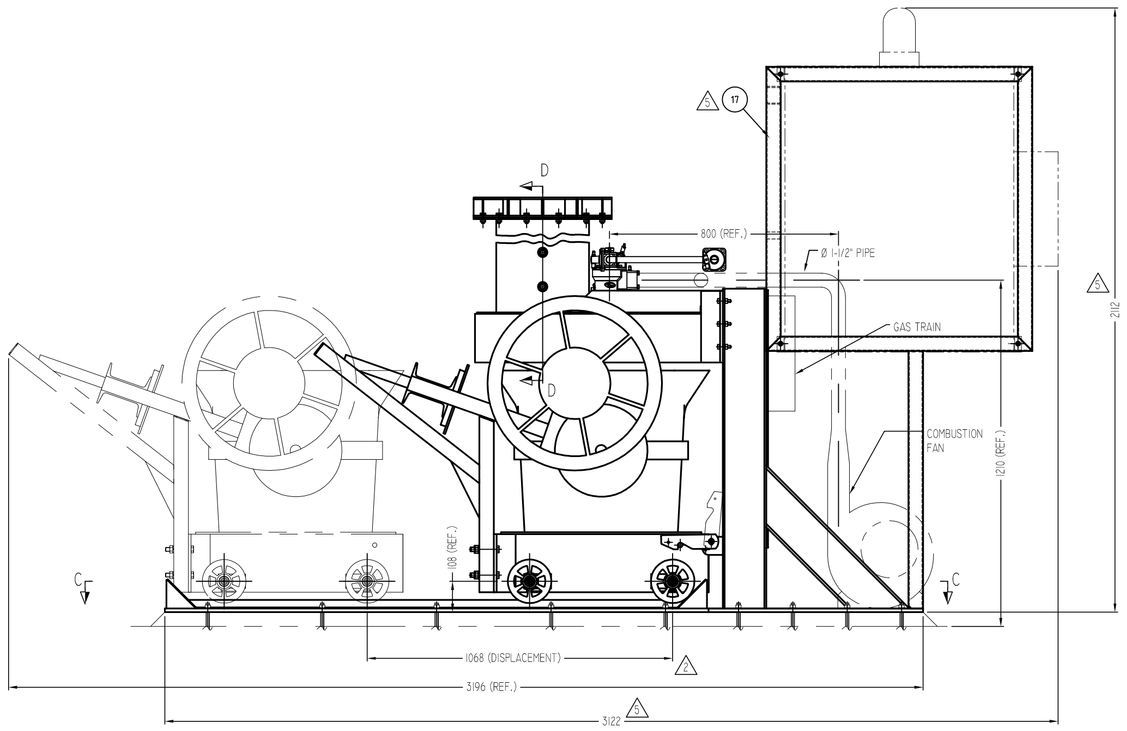

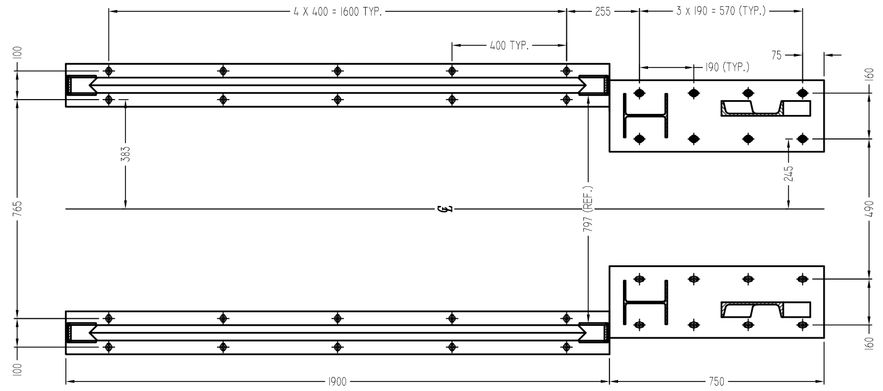

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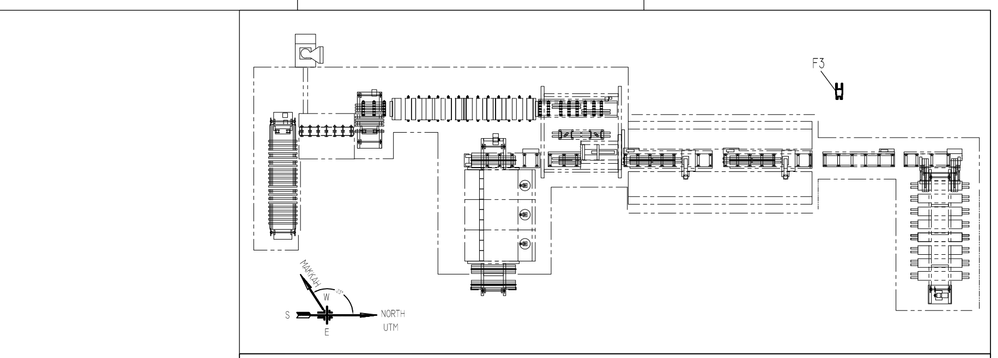
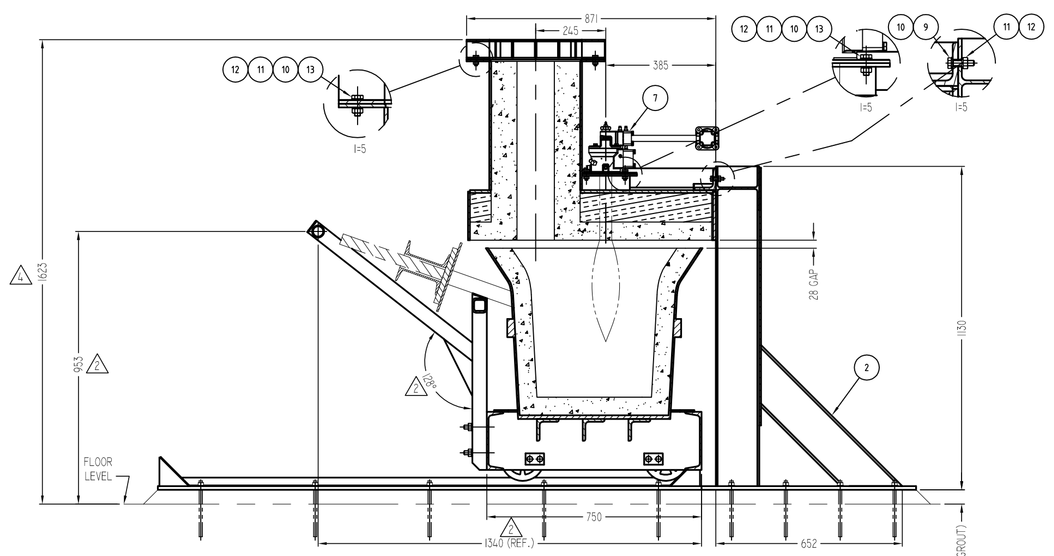


LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/Qty	No. PIECE–MAT. MAT.–PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
1	1	1347-F3-0200	COVER		110 KG
2	1	1347-F3-0300	SUPPORT		1146 KG
3	1	1347-F3-0400	DILUTION SECTION		13 KG
4	1	1347-LI -1000	CAST IRON POURING LADLE WITH ONE TILTING MECHANISM	EMPTY WEIGHT	415 KG
5	1	1347-F3-0600	CARRIAGE		148 KG
6	2	1347-F3-0700	TRACK		73 KG
7	2	TJ0025	BURNER C/W REFRACTORY BLOCK		29 KG
8					
9	9	STD	HEX BOLT M 10 x 40 MM LG	DIN 933	
10	29	STD	PLAIN WASHER M 10	DIN 125-1 A	
11	29	STD	HEX NUT M 10	DIN 934	
12	29	STD	LOCK WASHER M 10	DIN 128	
13	20	STD	HEX BOLT M 10 x 30 MM LG	DIN 933	
14		REFRAC.	80-GWM (FP0 PLASTIC		
15		REFRAC.	CERAMIC FIBER 10 LB/PC		
16	2		CERAMIC PAPER GASKET, Ø220mm X 6mm THICK		
17	1	1347-F3-1900	CONTROL PANEL SUPPORT		26

STEEL APPROX. WEIGHT: 926 KG



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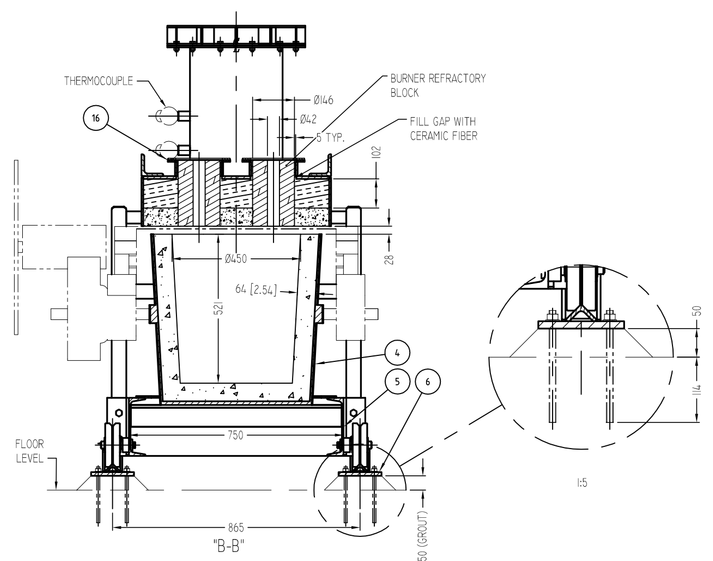

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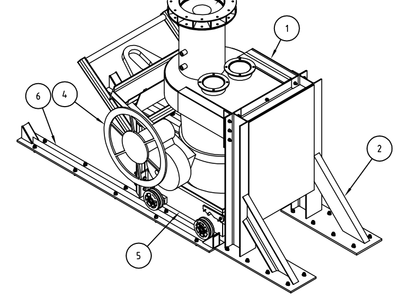

EQUIPMENT TAG # 4481-MBAD-0001

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Discipline :

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SELLER DRAWING No. 1347–F3–1000 REV. 5

NUMBER	REV.	TITLE

REFERENCE DRAWINGS

REV.	DESCRIPTION	DATE	DRN.	CHK.	R.E.	A.E. / S.	C.G.S.	P.E.M.
5	ITEM #17 ADDED	MR.22.'11	E.I.		C.C.			
4	CHIMNEY STRETCHED 150 mm	FE.02.'11	A.V.		C.C.			
3	FOR CONSTRUCTION	DE.20.'10	C.C.	L.G.	C.C.			
2	ITEM #2, #4 & #5 REVISED	NO.03.'10	A.V.	M.B.	C.C.			
1	GENERAL REVISION	OC.18.'10	A.V.	M.B.	C.C.			
0	INITIAL DESIGN	SE.20.'10	A.V.	M.B.	C.C.			

REVISIONS

STAMP

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Ma'aden Aluminum Project

SCALE: 1:15 FORMAT A1

Bechtel

GNA alutech inc. Departement Ingenierie Engineering Department 9495 Trans-Canada Saint-Laurent, Quebec H4S 1V3 Canada

		DATE
DRAWN	A.V.	SE.20.'10
CHK.	M. Blanchet	
R.E.	C. Coupal	
A.E. / S.		
E.G.S.		
P.E.M.		
CLIENT		

BECHTEL DRG. No. — — — — — REV.

Ras Az Zawr
Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
LADLE PREHEATING STATION
GENERAL ARRANGEMENT

CLIENT DRG. No. REV.

USER: $USERNAME$ TIME: $TIME$ $DATE$ $FILE$ DATE: FILE:

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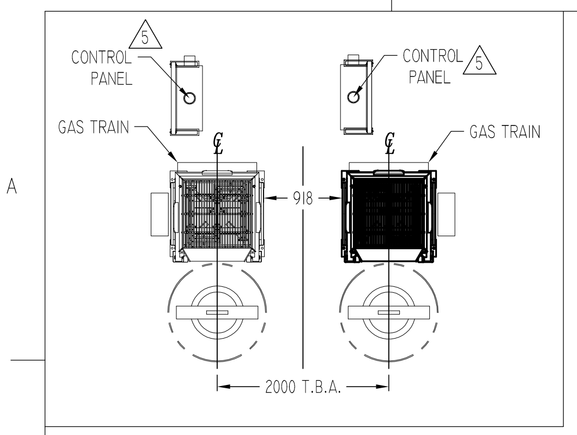
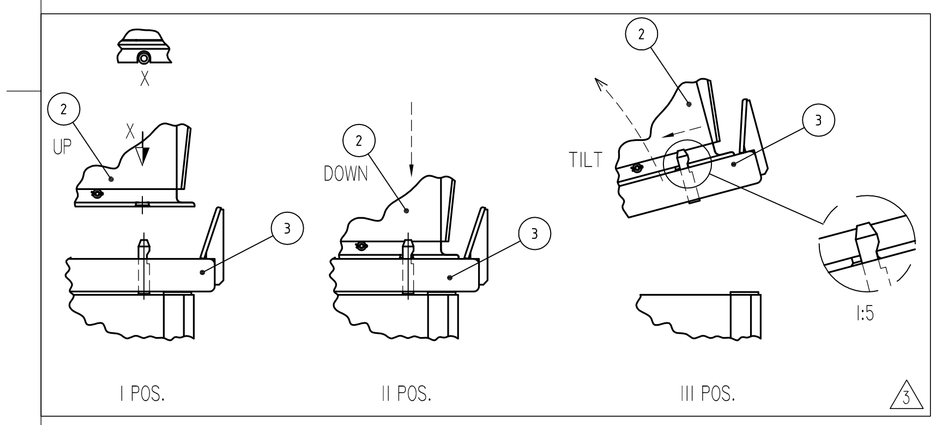
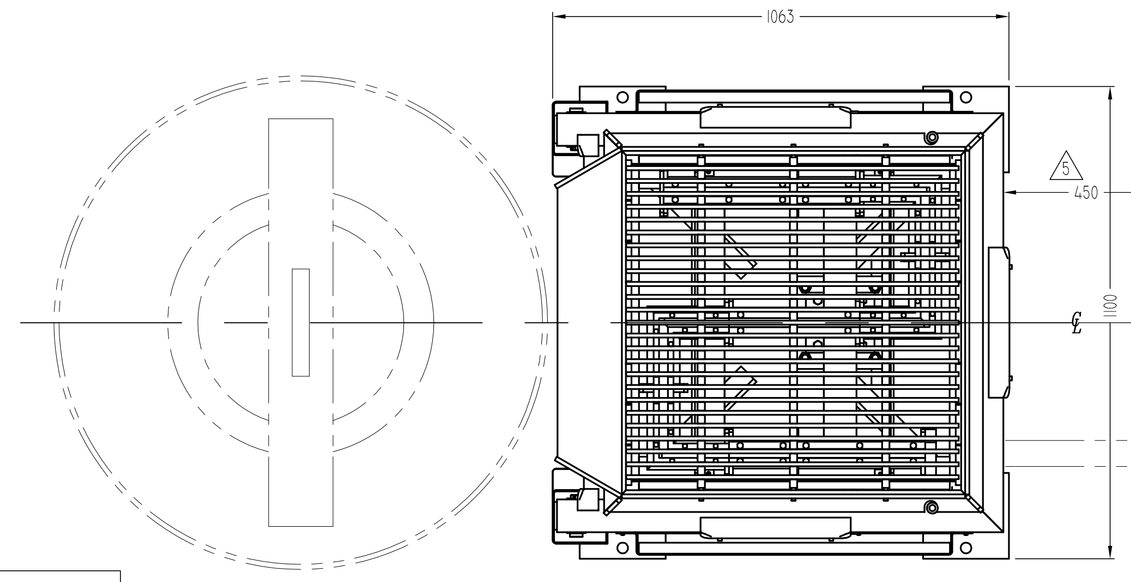
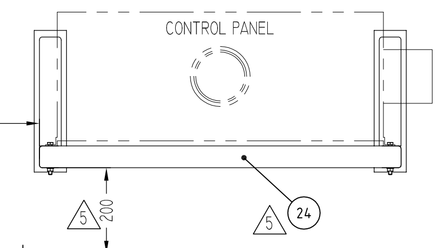


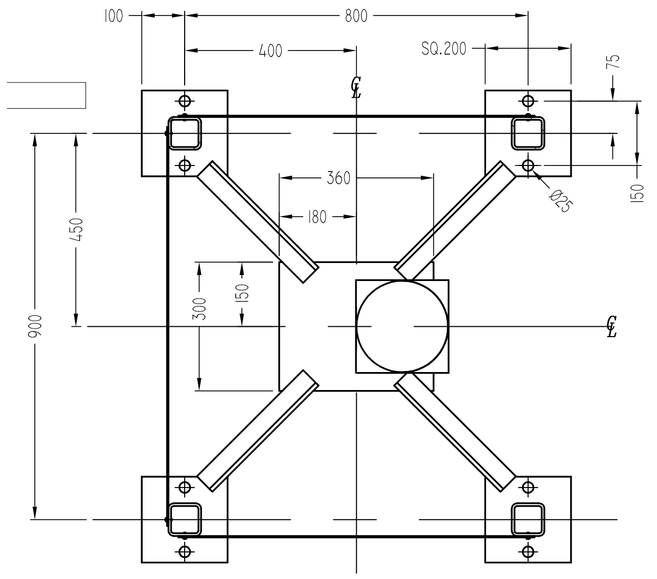
EQUIPMENT TAG # 4481-MEVD-0001

EQUIPMENT TAG # 4481-MEVD-0002

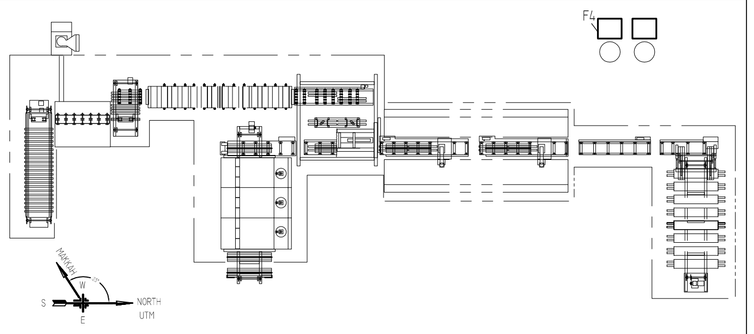








B-B

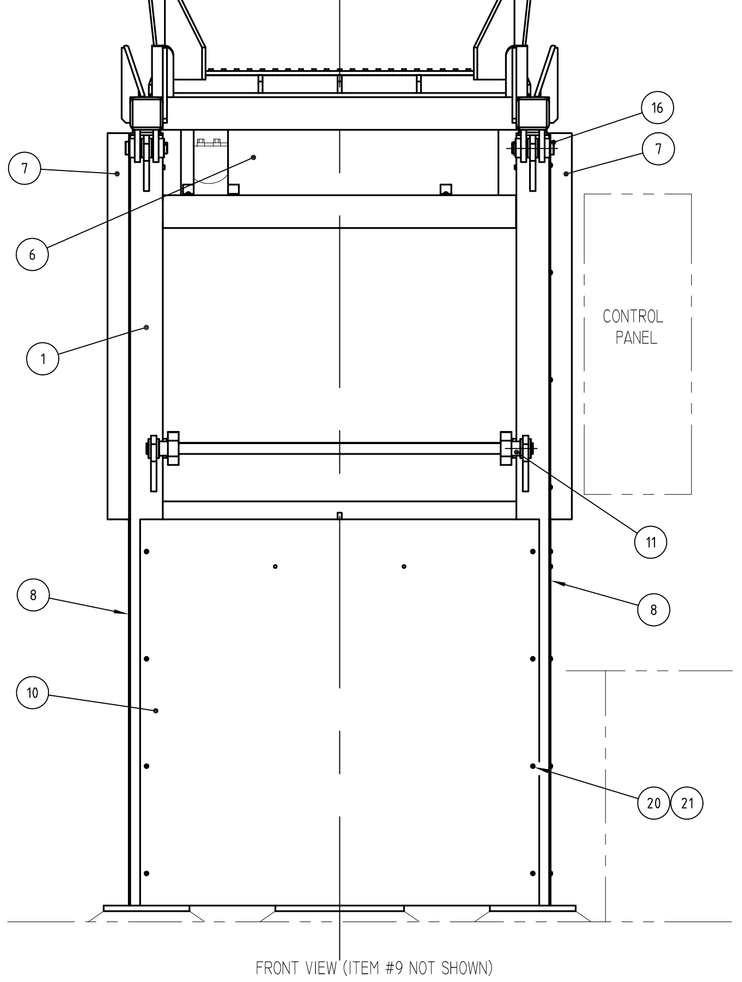


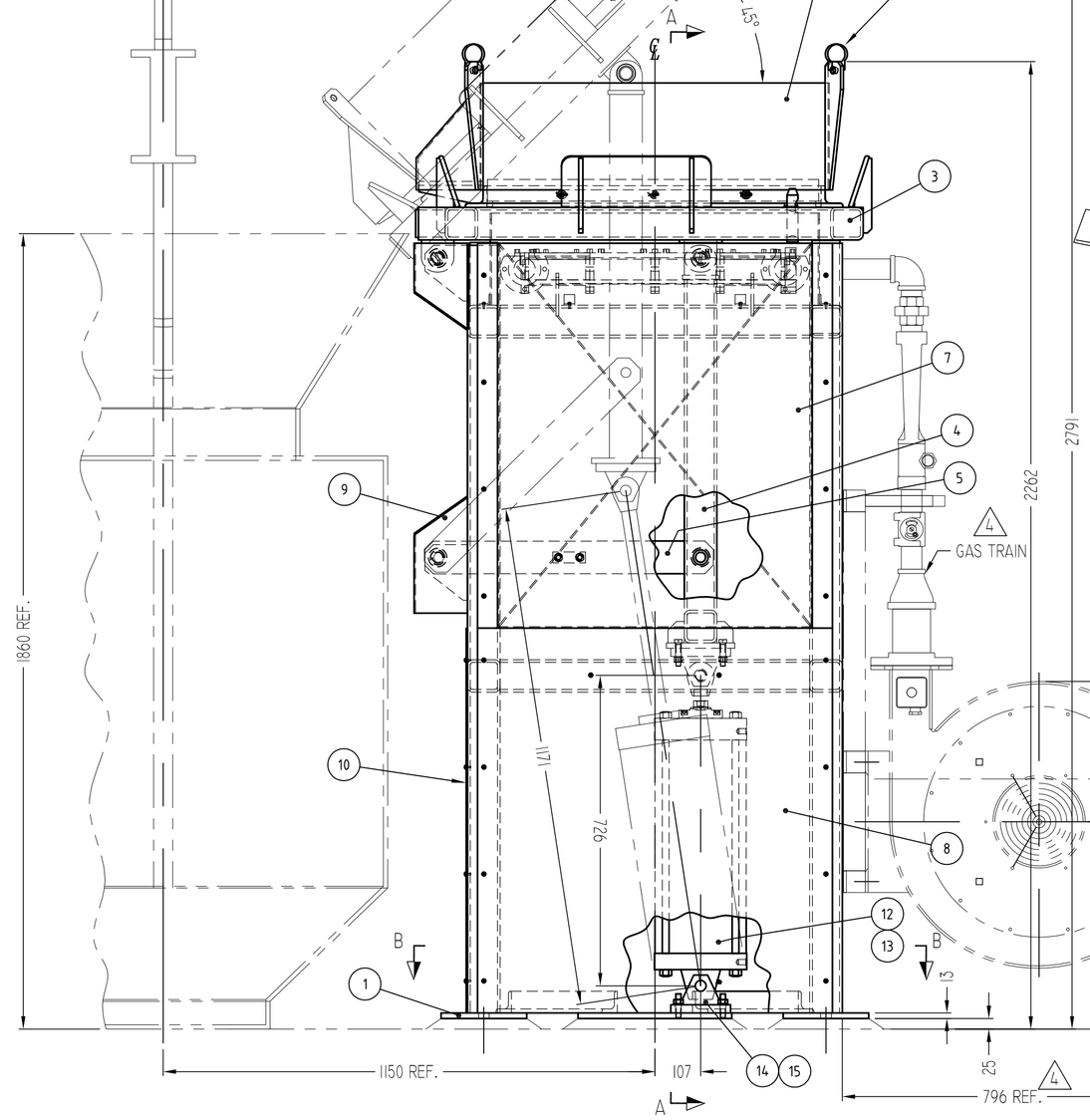
LISTE DE MATERIELS/BILL OF MATERIALS

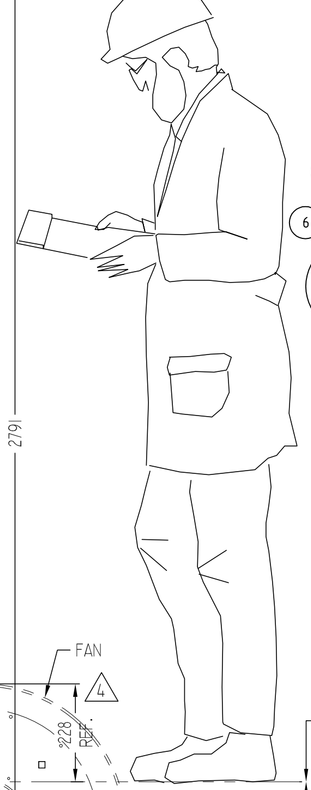
ITEM	Qte/Qty	No. PIECE-MAT. MAT.-PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
5	24	1	1347-F4-1800	CONTROL PANEL SUPPORT		28

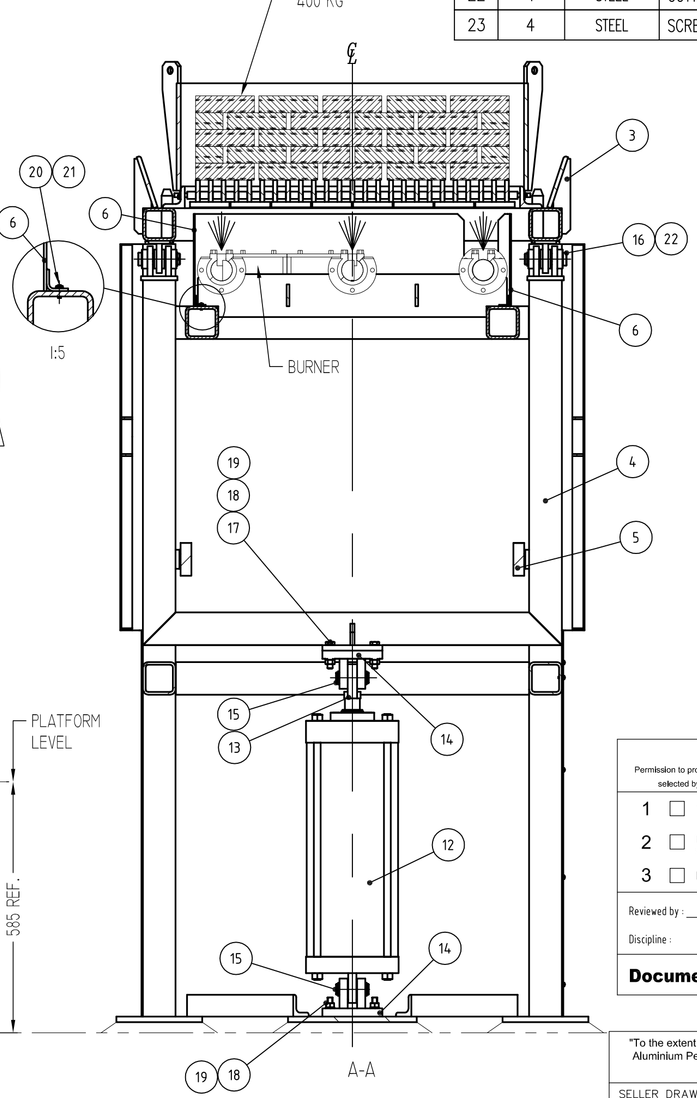
LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/Qty	No. PIECE-MAT. MAT.-PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
1	1	1347-F4-1100	MAIN FRAME		
2	1	1347-F4-1200	BUCKET		
3	1	1347-F4-1300	TILTING SUPPORT		
4	1	1347-F4-1400	ARM #1		
5	1	1347-F4-1500	ARM #2		
6	2	1347-F4-1600	HEAT SHEILD		
7	2	1347-F4-1710	GUARD #1		
8	2	1347-F4-1720	GUARD #2		
9	1	1347-F4-1730	GUARD #3		
10	1	1347-F4-1740	GUARD #4		
11	2	44W	PIPE 1" x SCH. 40 x 20mm LG "SPACER"		
12	1		AIR CYL. BORE 8", ROD 1-3/8", STROKE 18"	BY GNA	
13	1		SPHERICAL ROD EYE - 132292	BY GNA	
14	2		CLEVIS BRACKET - 83949	BY GNA	
15	2		PIN - 83964	BY GNA	
16	4	STEEL	PIN ø1"x3.5" LG McMASTER #98306A688 or EQ.		
17	4	STD	HEX BOLT M12x55 DIN 933		
18	8	STD	HEX NUT M12 DIN 934		
19	8	STD	LOCK WASHER 12 DIN 125		
20	62	STD	BOLT M4x12 DIN 7985		
21	62	STD	FLAT WASHER 4 DIN 125		
22	4	STEEL	COTTER PIN ø3/16" x 1-1/2" LG		
23	4	STEEL	SCREW PIN SHACKLE CROSBY G-209A No.1017472		









APPROX. TOTAL WEIGHT: 900 Kg

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Document No : 25457- **Rev. : 0**

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NUMBER	REV.	TITLE
REFERENCE DRAWINGS		

REV.	DESCRIPTION	DATE	DRN.	CHK.	R.E.	A.E. / S.	E.G.S.	P.E.M.
5	ITEM #24 ADDED	MR.23.11	E.I.	M.B.	C.C.			
4	FAN AND GAS TRAIN ADDED	FE.21.11	E.I.	M.B.	C.C.			
3	DET. ADDED	NO.29.10	E.I.	M.B.	C.C.			
2	GEN. REV.	NO.03.10	E.I.	M.B.	C.C.			
1	LOADING BIN HEIGHT REV. & LIFTING LUGS ADDED ON BUCKET	OC.19.10	E.I.	M.B.	C.C.			
0	PRELIMINARY	SE.20.10	E.I.	M.B.	C.C.			

REVISIONS

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Ma'aden Aluminum Project

SCALE: 1:10 FORMAT A1

Bechtel

GNA alutech inc. Departement Ingenierie Engineering Department 9495 Trans-Canada Saint-Laurent, Quebec H4S 1V3 Canada

		DATE
DRAWN	E.I.	SE.20.'10
CHK.	M. Blanchet	
R.E.	C. Coupal	
A.E. / S.		
E.G.S.		
P.E.M.		
CLIENT		

BECHTEL DRG. No. — — — — — REV.

SELLER DRAWING No. 1347-F4-1000 REV. 5

Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CAST IRON INGOT DRYING STATION
GEN. ARR.

CLIENT DRG. No. REV.

USER: $USERNAME$ TIME: $TIME$ $DATE$ $FILE$ DATE: FILE:

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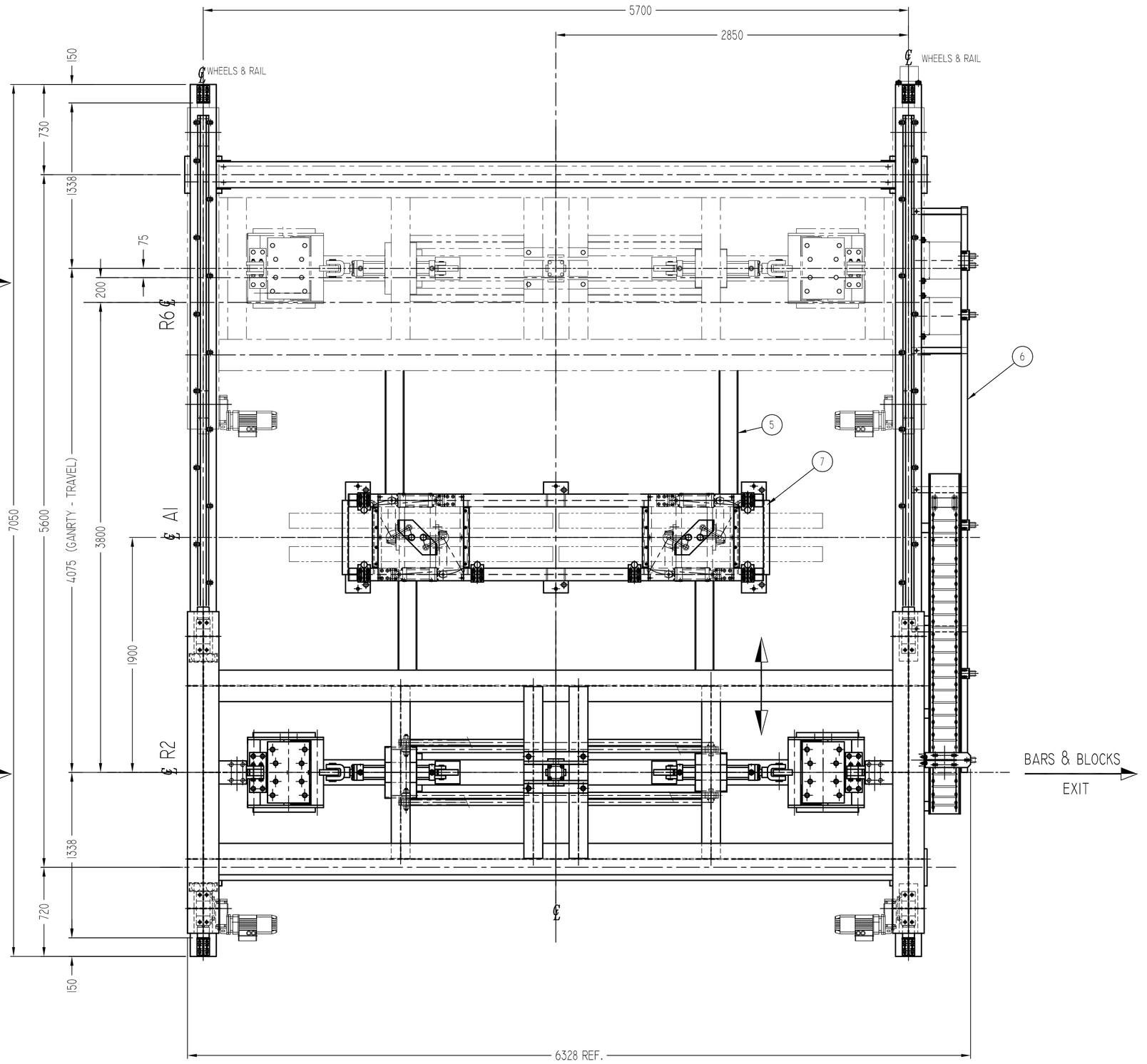

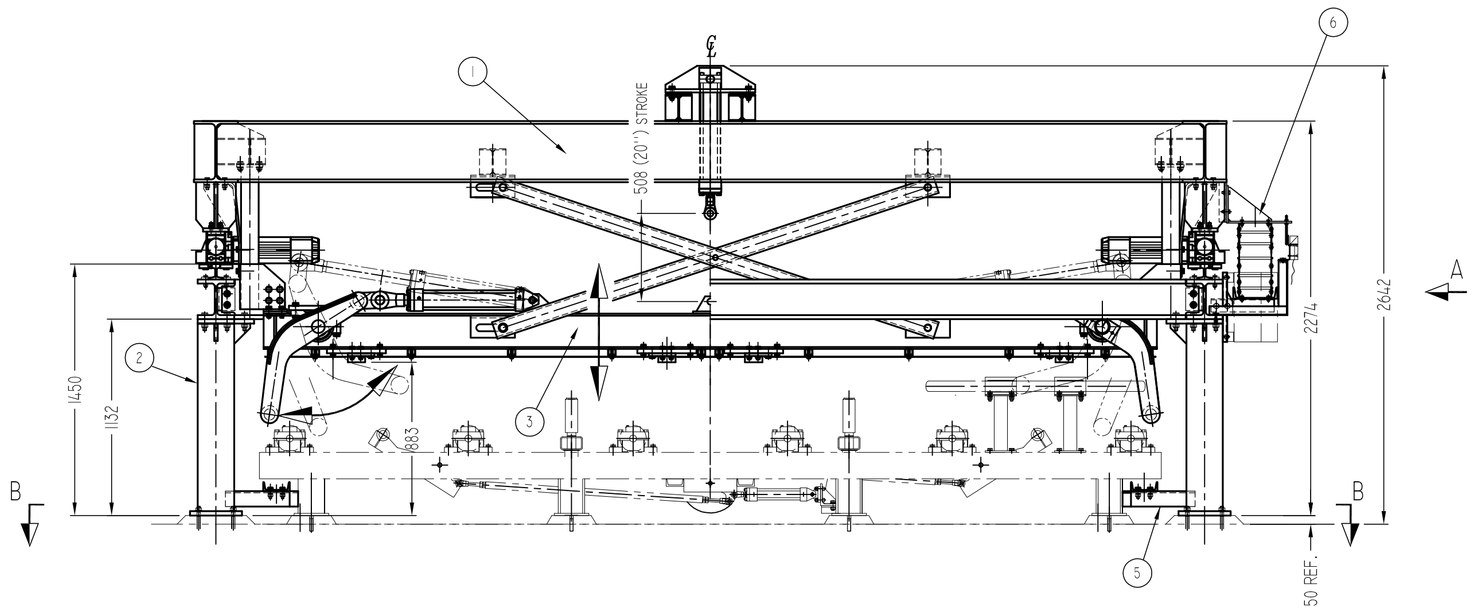

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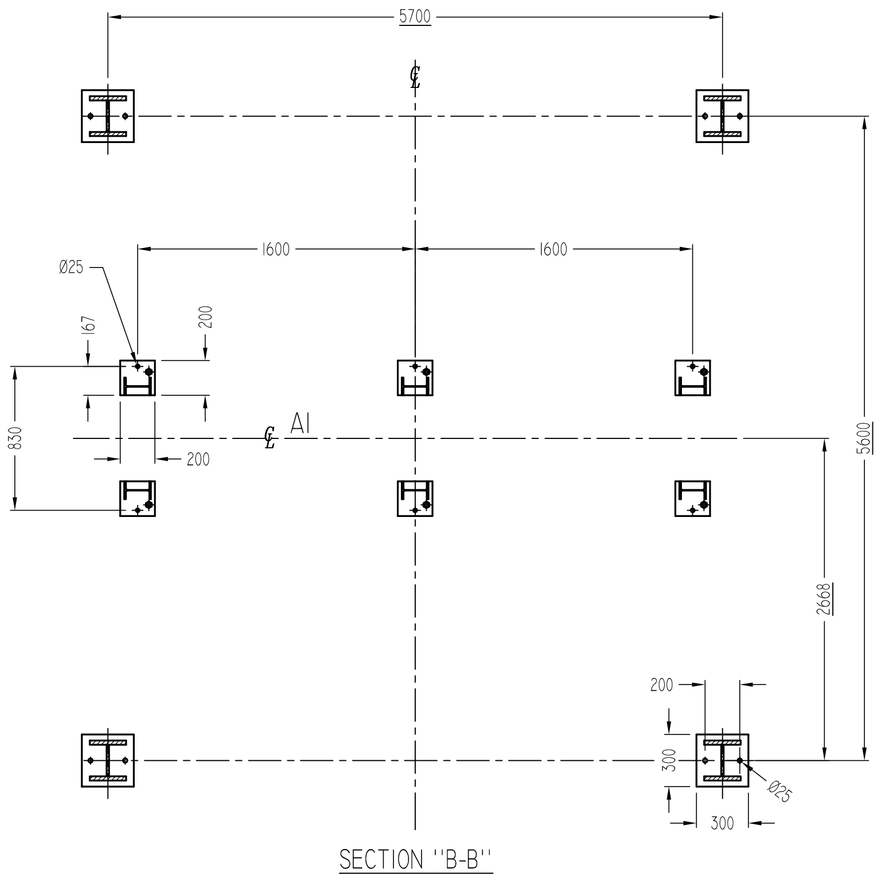
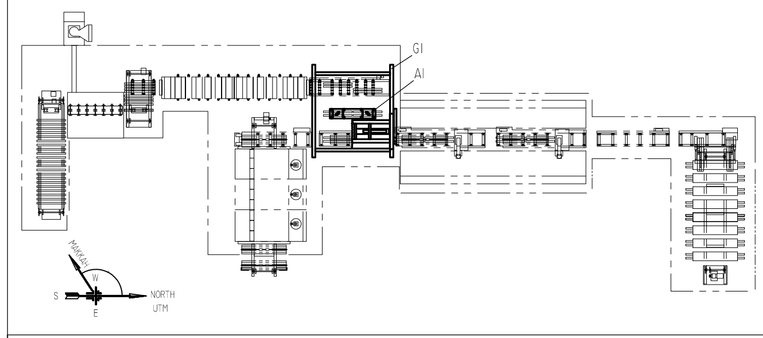


SECTION ''B-B''

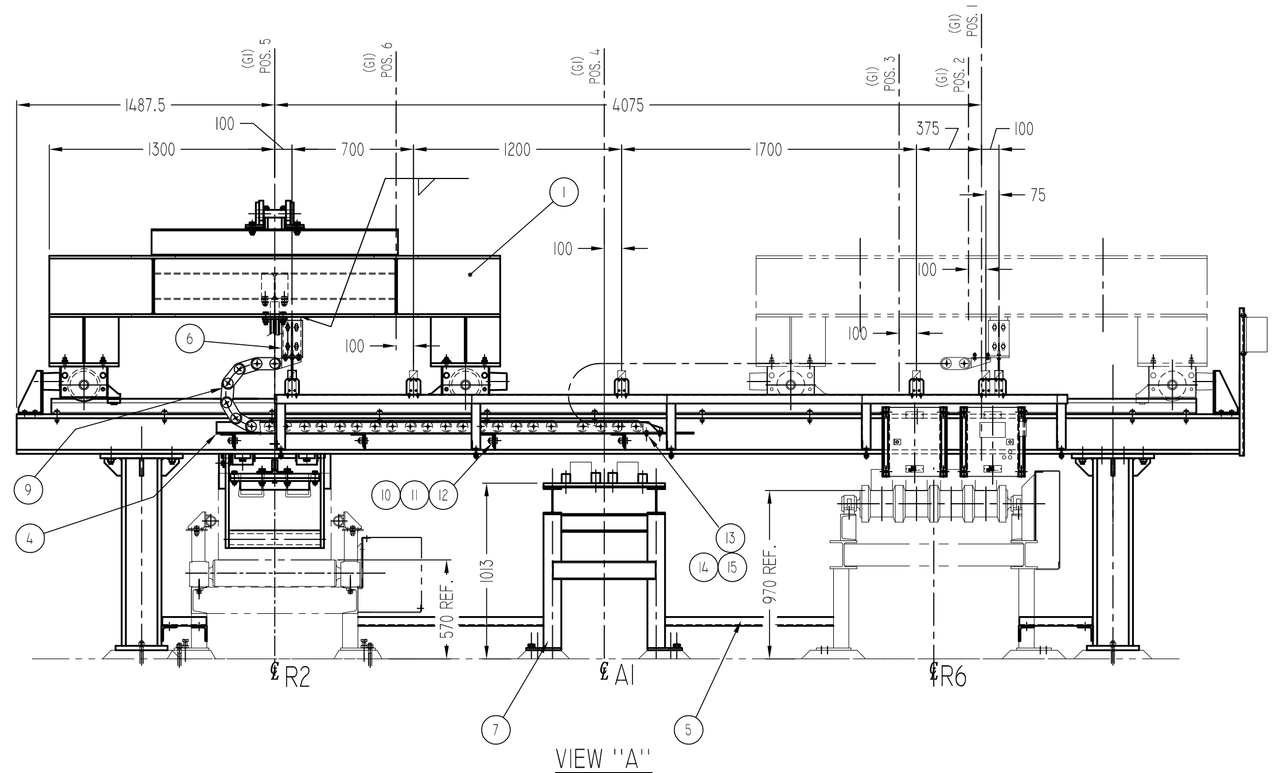


KEY PLAN

LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/Qty	No. PIECE-MAT. MAT-PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
1	1	1347-G1-1100	BAR LIFTING MECHANISM ASSEMBLY		1860Kg
2	1	1347-G1-1200	GANTRY - GIRDER & COLUMN ASSEMBLY		2400Kg
3	1	1347-G1-1300	BAR CLAMPING MECHANISM ASSEMBLY		1090Kg
4	1	1347-G1-1004	FLEXIBLE TRAY SUPPORT		70 Kg
5	1	1347-G1-1005	CONECTION BRACKET FOR A1, G1, R2 & R6		170 Kg
6	1	1347-G1-1400	PROXIMITY SENSORS & JUNCTION BOXES SUPPORTS		17 Kg
7	1	1347-A1-1000	CATHODE BAR ALIGNEMENT STATION		700 Kg
8					
9	1	SRC-170	"GORTRAC" FLEXIBLE TRAY CARRIER x112" LG x 1	BY GNA	
10	8		HEX. BOLT M20 x 50 LG.		
11	8		HEX. NUT M20		
12	8		LOCK WASHER M20		
13	8		HEX. BOLT M10 x 25 LG.		
14	8		HEX. NUT M10		
15	8		LOCK WASHER M10		

TOTAL APPROX. WEIGHT : 5425 Kg



VIEW ''A''

EQUIPMENT TAG # 4481-MQLK-0001

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NUMBER	REV.	TITLE	REV.	DESCRIPTION	DATE	DRN.	CHK.	R.E.	A.E. / S.	E.G.S.	P.E.M.
REFERENCE DRAWINGS			REVISIONS								
			0	ISSUED FOR APPROVAL	JL.23.'10	E.I.	M.B.	C.C.			

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GNA alutech inc.

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BECHTEL DRG. No. — — — — — REV.

		DATE
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CHK.	M. Blachet	
R.E.	C. Coupal	
A.E. / S.		
E.G.S.		
P.E.M.		
CLIENT		

Ras Az Zawr
Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CATHODE BAR POSITIONING GANTRY
GENERAL ASSEMBLY

CLIENT DRG. No. REV.

USER: $USERNAME$ TIME: $TIME$ $DATE$ $FILE$ DATE: FILE:

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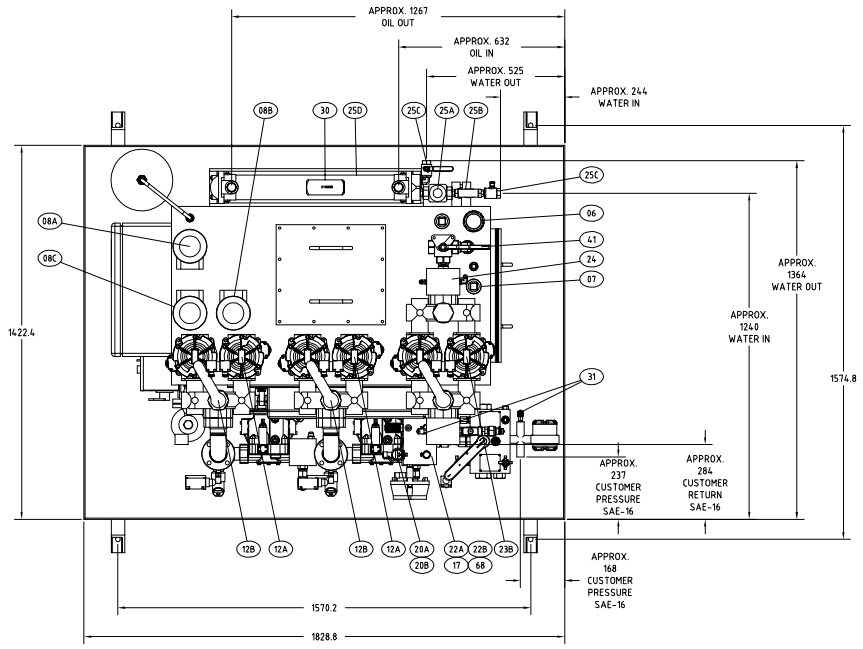
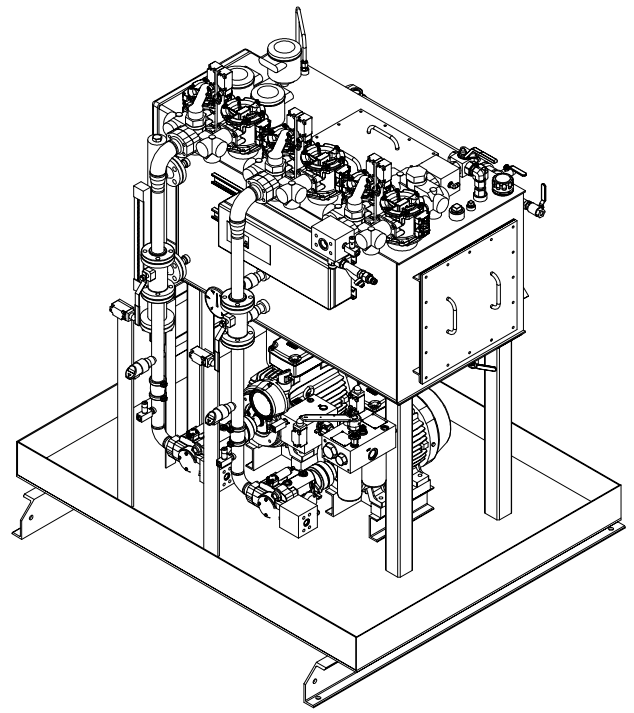
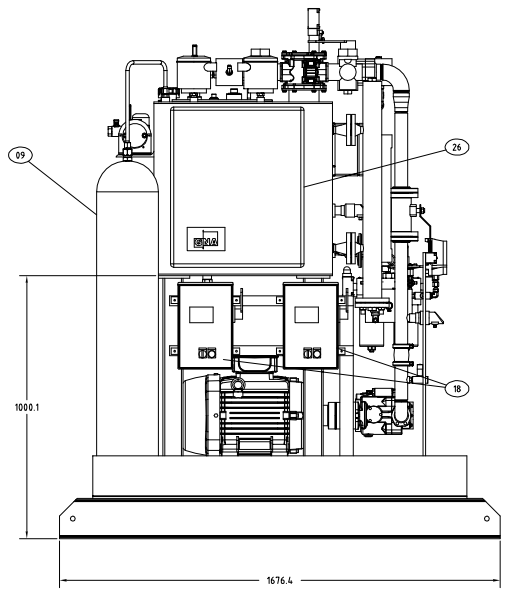
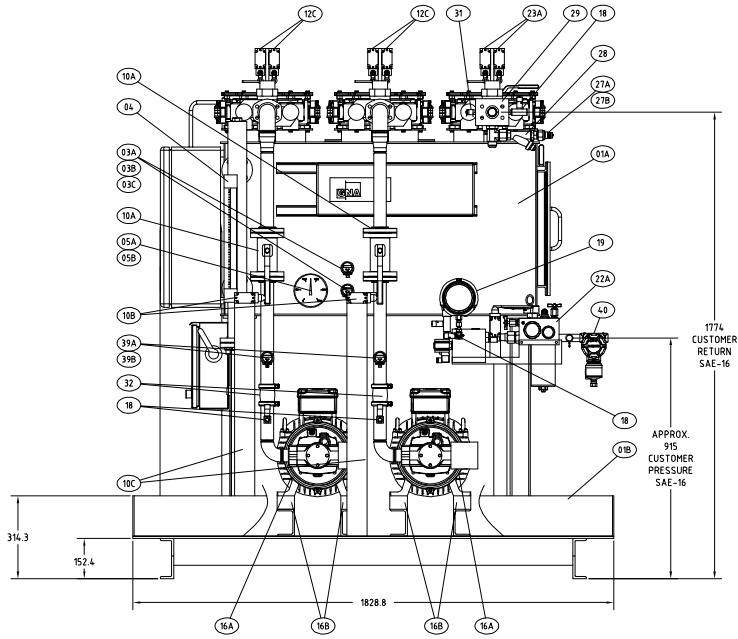
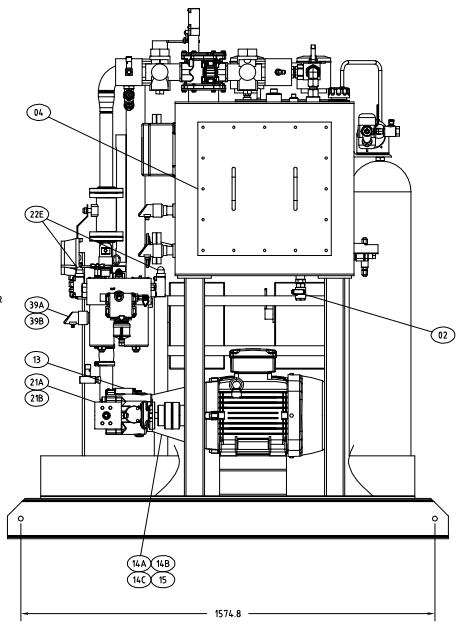


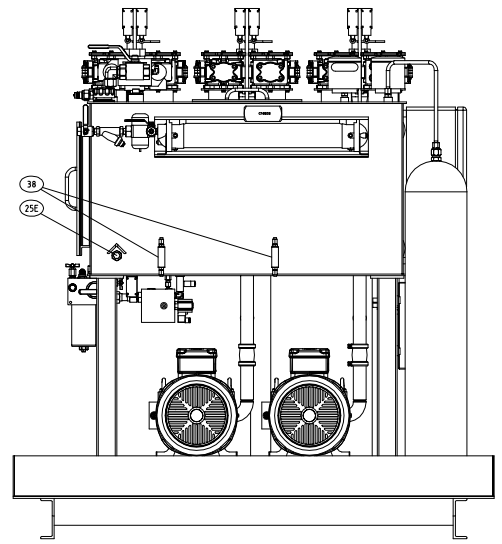


NOTE: ITEM 50-113 NOT PART OF HPU ASSEMBLY, SHIPPED LOOSE









NOTE : REFER TO BILL OF MATERIAL ON DWG. 1347-H1-3005
AND HYDRAULIC SYSTEM SCHEMATIC DWG. 1347-H1-3001

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Document No : 25457-4480-V1A-MXAO-xxxx **Rev. : 000**

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		REVISIONS						

NOTES

STATUS: FOR DESIGN

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DATE:	SE.27.'10	DATE:	
CHECKED:	M.B.	PRJ ENG MGR:	
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BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

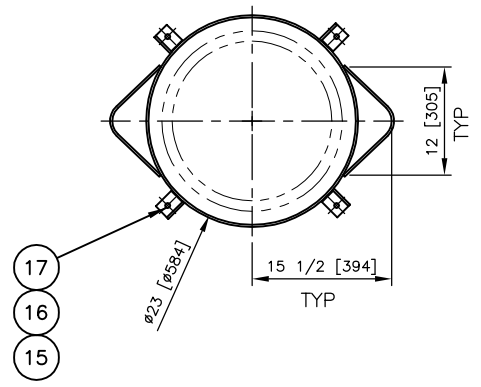
SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
HYDRAULIC POWER UNIT
ASSEMBLY DRAWING

MA'ADEN Wala

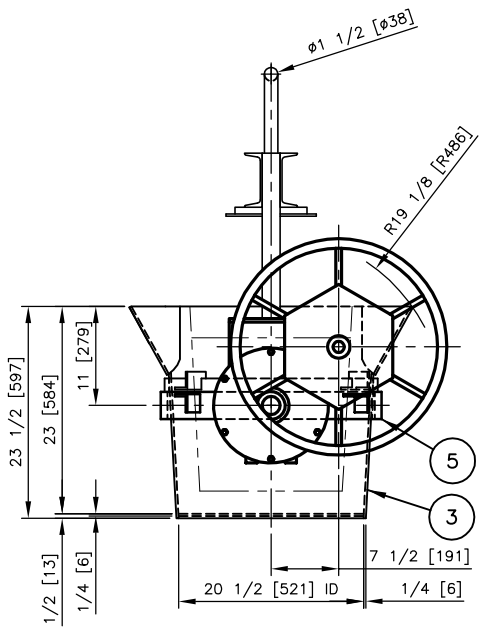
PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

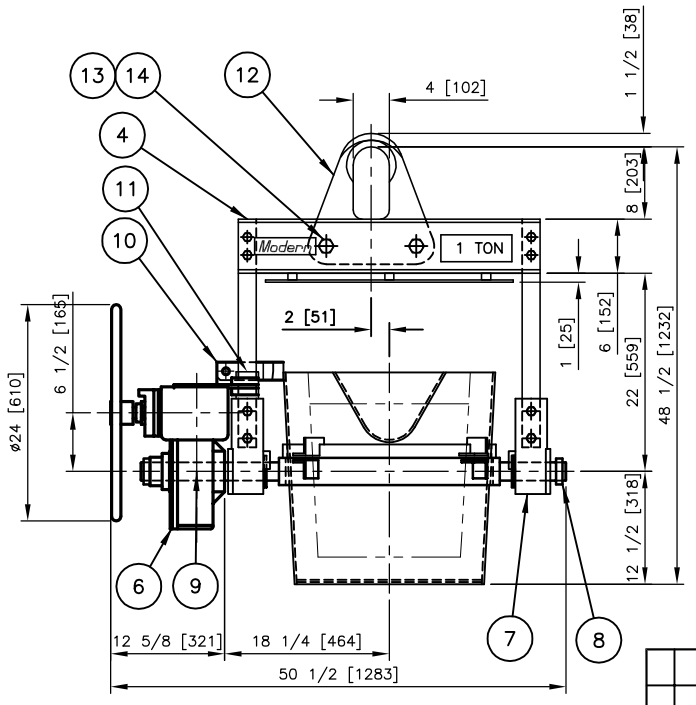
Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3—		—AZ	

1090-2300-2-047



LADLE CAPACITY = 840#(380KG) IRON BASED ON .23# PER CUBIC INCH DENSITY, 2 1/2" SIDE LINING 2 1/2" BOTTOM LINING AND 3 1/2" FREE TOP SPACE.
ALL REFRACTORY IS SUPPLIED AND INSTALLED BY OTHERS.
REFRACTORY DENSITY OF .09# PER CUBIC INCH USED FOR BALANCE CALCULATIONS.
NOTE: THE RATED CAPACITY OF THIS LADLE IS BASED ON THE VOLUME OF THE LADLE, LINING THICKNESS AND INDICATED NOMINAL FREE TOP SPACE.
CAUTION: LADLE FILL LEVEL MUST COMPLY WITH ANSI SPEC. Z 241.2 SECTION 6.3.5.1 "LADLES SHALL NOT BE FILLED WITH MOLTEN MATERIAL ABOVE A LEVEL WHERE SPILLAGE MAY OCCUR WHEN NORMALLY TRANSPORTED".





MATERIAL LIST

NO.	REQD	PART NUMBER	DESCRIPTION	WT.
1	1	1090-2300-2-047	ø23" TAPERED OPEN LADLE	.
2	.	.	.	.
3	1	0129-0578-2	SHELL	.
4	1	0189-0863-2	BAIL	.
5	1	0190-0456-2	SHANK RING	.
6	1	5230-5215-3	"C" GEAR ASSEMBLY	.
7	2	2200-1035-2	TRUNNION ASSEMBLY	.
8	2	0030-0021-5	SET COLLAR	.
9	1	0171-0046-2-047	KEY	.
10	1	0028-0145-3	BRACKET TORQUE	.
11	1	0179-0004-1	BLOCK	.
12	1	0189-0422-2	CRANE HOOK EYE	.
13	2	9903-1309	HSSB 1-8NC X 4	.
14	2	9903-1078	HSSB HEX NUT 1-8NC	.
15	4	9903-1196	SCR CAP 1/2-123NC X 2 1/2	.
16	4	9903-1081	NUT HEX FULL 1/2-13NC	.
17	4	9903-1476	LOCK WASHER 1/2	.
18	15	0156-0028-5	GREASE	.

ESTIMATED WEIGHTS
LADLE ASS'Y - 555#
REFRACTORY @ .09#/CU.IN. - 360#
EMPTY WEIGHT - 915#
BRASS @ .31#/CU.IN. - 840#
WEIGHT @ RATED CAPACITY - 1,755#
BRIMFULL METAL - 210#
GROSS WEIGHT - 1,965#

MATERIAL SPECIFICATION NOTES

1) ALL STEEL SHALL CONFORM TO ASTM A36 STANDARDS FOR MINIMUM MECHANICAL PROPERTIES, AND SHALL BE FABRICATED IN ACCORDANCE WITH THE RECOMMENDED PRACTICE OF THE AMERICAN INSTITUTE OF STEEL CONSTRUCTION.
2) ALL STEEL SHALL CONFORM TO ANSI/ASTM A6-78 (OR LATEST EDITION) STANDARDS FOR DIMENSIONAL TOLERANCE.
3) ALL BOLTS SHALL CONFORM TO ASTM A325 STANDARDS FOR MINIMUM MECHANICAL PROPERTIES UNLESS OTHERWISE SPECIFIED.
4) WELDING PROCEDURES TO CONFORM TO AISC FOR DESIGN, FABRICATION AND ERECTION OF STRUCTURAL STEEL FOR BUILDINGS.
5) AISC STANDARD WELDING SYMBOLS WILL BE USED FOR THE DESIGNATION OF WELDS.
6) ALL SHOP AND FIELD WELDED CONNECTIONS SHALL BE MADE WITH E70 SERIES ELECTRODES UNLESS OTHERWISE SPECIFIED.

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OPEN HOLES . UNLESS OTHERWISE NOTED

DIMENSIONAL TOLERANCES
- UNLESS OTHERWISE SPECIFIED -

SIZE	MACHINED	FRACTIONAL
UNDER 12"	.010	± 1/32"
12" TO 24"	.020	± 1/16"
24" TO 48"	.032	± 3/32"
48" TO 72"	AS SPECIFIED	± 1/8"
72" TO 240"	AS SPECIFIED	± 1/4"
OVER 240"	AS SPECIFIED	± 3/8"

ALL MACHINED SURFACES 125√
CHAMFER AND WELD PREP'S ±2 1/2"
CORNER RADII .06" MAX.
BREAK ALL CORNERS AND REMOVE ALL BURRS

REVISIONS

FILE NO. P:\ACAD\1090\23002047.dwg
PLOT DATE 10/18/10
REFERENCES: .

Modern Equipment Company
planning . . . engineering . . . manufacturing . . . erection
BOX 993, PORT WASHINGTON, WISCONSIN 53074-0993
TELEPHONE: 262-284-9431 FAX: 262-284-9433
AN ALCO INDUSTRIES INC. CO.

FOR GNA ALUTEC
LOCATION QUEBEC, CANADA
DESCRIPTION ø23" TAPERED OPEN LADLE

DRAWN BY	DATE	CHECKED BY	DATE	SHEET NO.
GDA	10/19/10	.	.	.

DWG. NO. 1090-2300-2-047
SCALE 3/4" = 12"
CONTRACT 101067

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Discipline :
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Rev.: 0

Document No : 25457-

EQUIPMENT TAG # 4481-MBQL-0001
EQUIPMENT TAG # 4481-MBQL-0002
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0		DESIN INITIAL	OC.20.'10	E.I.	M.B.	C.C.

DRAWING NUMBER | TITLE | REFERENCES | REVISIONS | NOTES

STATUS -

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Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SELLER DRAWING No. 1347-L1-1000 REV. 1

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
LADLE PREHEATING STATION
Cast Iron Pouring Ladle with one Tilting Mechanism

MA'ADEN

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
	-	-	-	A3-		-AZ	

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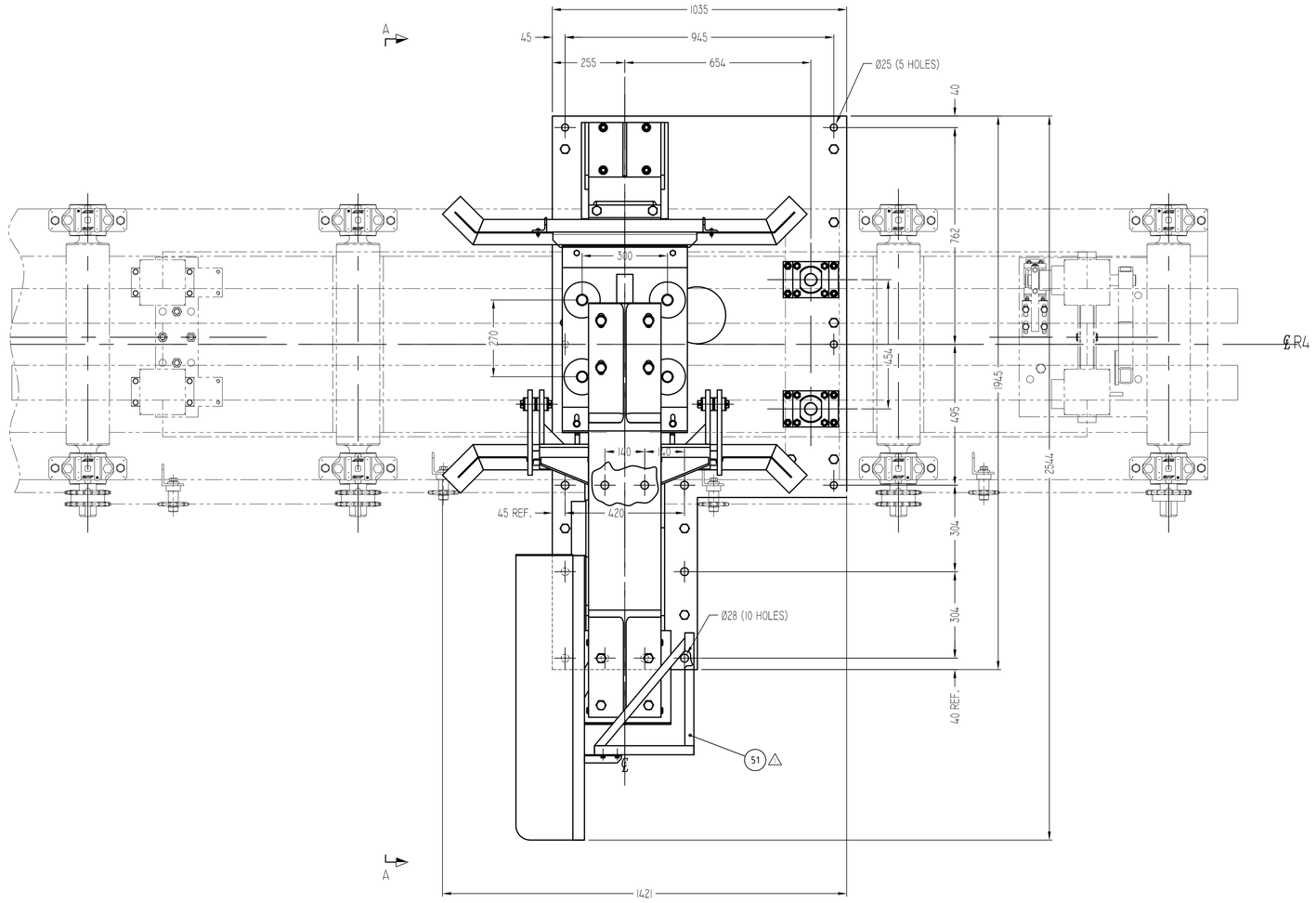
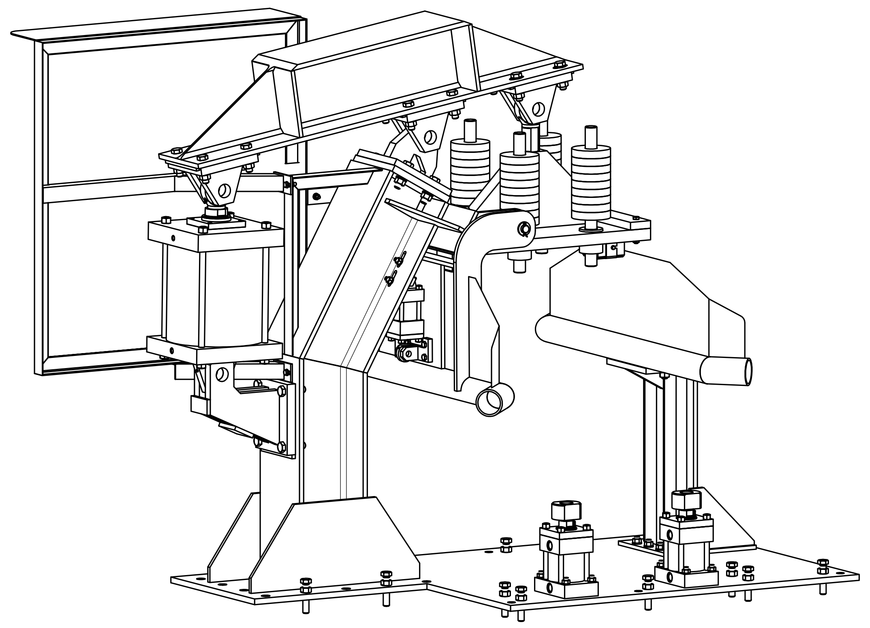
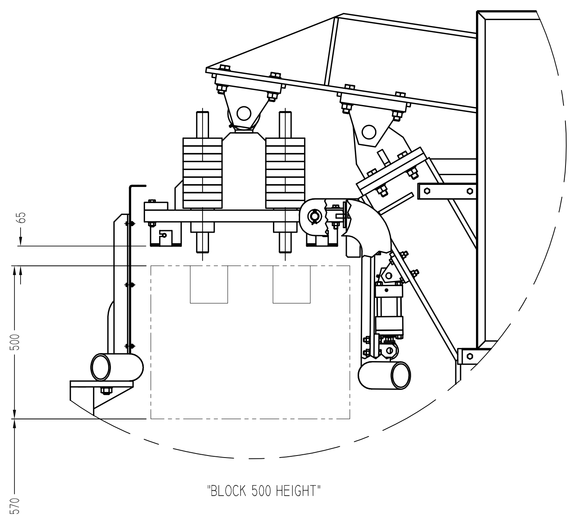
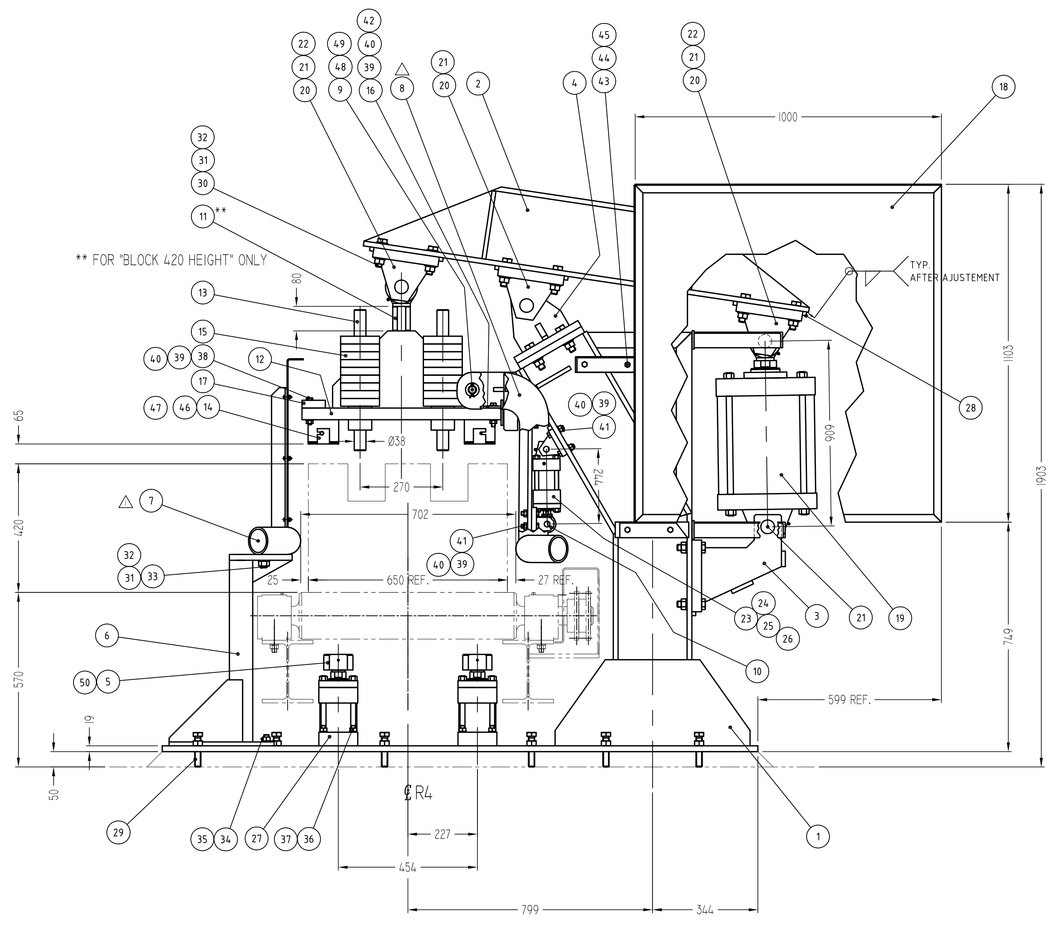




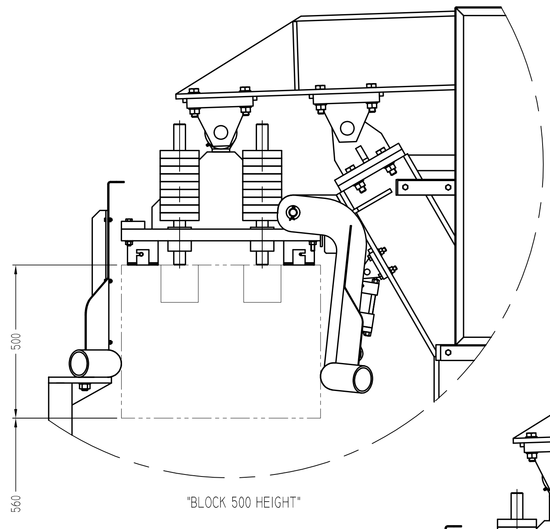
ITEM #51 NOT SHOWN FOR CLARITY △



"BLOCK 500 HEIGHT"



A-A
UPPER POSITION
"BLOCK 420 HEIGHT"



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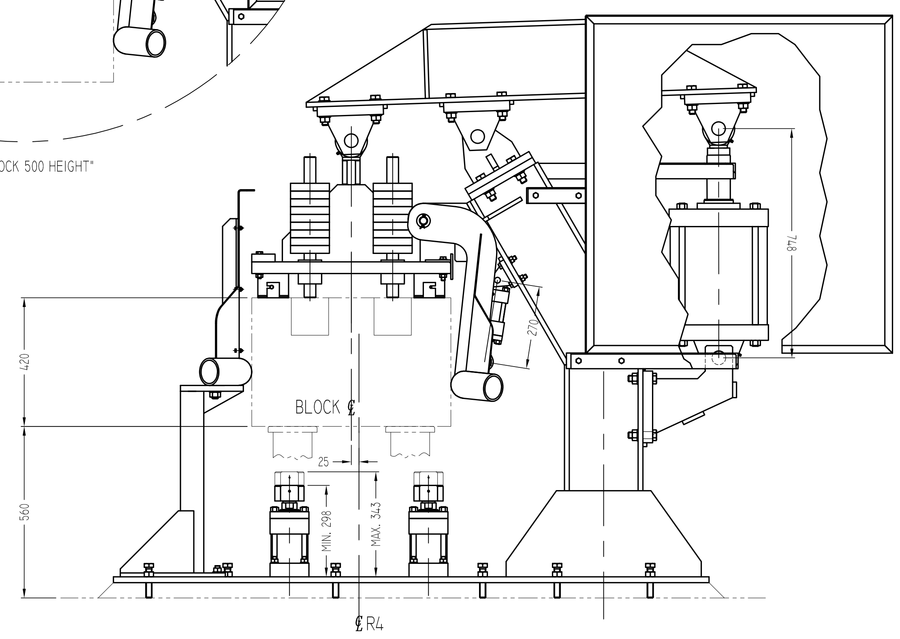
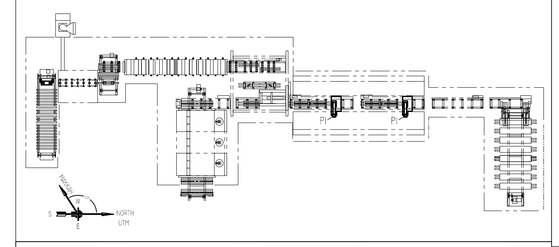


A-A
LOWER POSITION
"BLOCK 420 HEIGHT"



LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/Qty	No. PIECE-MAT. MAT.-PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
1	1	1347-P1-1100	MAIN FRAME		450
2	1	1347-P1-1110	PRE-STRESSING STRUCTURE		96
3	1	1347-P1-1120	PNEUMATIC CYLINDER BRACKET		33
4	1	1347-P1-1130	PRE-STRESSING STRUCTURE BRACKET		18
5	2	1347-P1-1140	R4 AJUSTMENT SYSTEM		4
6	1	1347-P1-1150	WIDTH CENTERING SYSTEM SUPPORT		65
△ 7	1	1347-P1-1160	WIDTH CENTERING STOPPER		18
△ 8	1	1347-P1-1170	WIDTH CENTERING PUSHER		49
9	2	1347-P1-1180	WIDTH CENTERING PIN		1
10	1	1347-P1-1190	WIDTH CENTERING BRACKET		2
11	1	1347-P1-1195	SPACER		1
12	1	1347-P1-1210	PRE-STRESSING HEAD STRUCTURE		135
13	4	1347-P1-1220	SLIDING ROD		24
14	2	1347-P1-1230	SUPPORT PLATE		1
15	32	1347-P1-1240	WEIGHT RING		64
16	1	1347-P1-1250	PRE-STRESSING HEAD ADJUSTING PLATE		3.5
17	1	1347-P1-1260	WEIGHT PLATE		7 KG
18	1	1347-P1-1300	SUPPORT		52
△ 19	1		"PARKER" PNEUMATIC CYLINDER SPHERICAL BEARING MOUNTING BORE 12" DIA, ROD 3", STROKE 10"	"BY GNA"	
20	3	#83951	CLEVIS BRACKET "PARKER"	"BY GNA"	
21	4	#83966	PIVOT PIN "PARKER"	"BY GNA"	
22	2	#132294	SPHERICAL ROD EYE "PARKER"	"BY GNA"	
23	1		"PARKER" HYDRAULIC CYLINDER SPHERICAL BEARING MOUNTING BORE 2-1/2", ROD #1, STROKE 1"	"BY GNA"	
24	1	#83948	CLEVIS BRACKET "PARKER"	"BY GNA"	
25	2	#83963	PIVOT PIN "PARKER"	"BY GNA"	
26	1	#132291	SPHERICAL ROD EYE "PARKER"	"BY GNA"	
27	2		"PARKER" HYDRAULIC CYLINDER CAP RECTANGULAR MOUNTING BORE 4", ROD #3, STROKE 1.75"	"BY GNA"	
28	9	STEEL	SQ. BAR 12.7 (1/2") X 12.7 (1/2") X 200mm LG		
29	13	STD	HEX BOLT M20 X 100 LG, DIN 933 (FOR HEIGHT AJUSTMENT)		
30	20	STD	HEX. BOLT M20 X 80 LG, DIN 933		
31	22	STD	HEX. NUT M20, DIN 934		
32	26	STD	FLAT WASHER FOR BOLT M20 DIN 125A		
33	20	STD	HEX. BOLT M20 X 50 LG, DIN 933		
34	7	STD	HEX NUT M16 DIN 934		
35	7	STD	FLAT WASHER FOR BOLT M16, DIN 125A		
36	8	STD	HEX NUT M14, DIN 934		
37	8	STD	FLAT WASHER FOR BOLT M14, DIN 125A		
38	2	STD	HEX BOLT M12 X 80 LG DIN 931		
39	12	STD	HEX NUT M12, DIN 934		
40	22	STD	FLAT WASHER FOR BOLT M12, DIN 125A		
41	8	STD	HEX BOLT M12 X 50 LG DIN 933		
42	2	STD	HEX BOLT M12 X 70 LG DIN 931		
43	6	STD	HEX BOLT M10 X 35 LG DIN 933		
44	6	STD	HEX NUT M10, DIN 934		
45	8	STD	FLAT WASHER FOR BOLT M10, DIN 125A		
46	4	STD	HEX BOLT M6 X 20 LG DIN 933		
47	4	STD	FLAT WASHER FOR BOLT M6, DIN 125A		
48	6	STD	FLAT WASHER STYLE "CC" FOR BOLT 1"		
49	4	STD	CUTTER PIN ø 3/16" x 1 3/4" LG		
50	2	STD	HEX SOCKET SET SCREWS M8x15 LG DIN 916		
△ 51	1	1347-P1-1400	GUARD		13

TOTAL APPROX. WEIGHT : 1328 kg

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4 ☐ Revise not required. Work may proceed.
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DDR Nbr :

Reviewed by : _____ Date : _____

Discipline :

Document No : 25457- **Rev. : 0**

EQUIPMENT TAG # 4481-MZAC-0001

EQUIPMENT TAG # 4481-MZAC-0002

NUMBER	REV.	TITLE
REFERENCE DRAWINGS		

REV.	DESCRIPTION	DATE	DRN.	CHK.	R.E.	A.E. / S.	E.G.S.	P.E.M.
1	ITEMS #7 AND #8 UPDATED, ITEM #51 ADDED	DE.01.'10	C.C.	M.B.	C.C.			
0	INITIAL DESIGN	AU.23.'10	E.I.	M.B.	C.C.			

REVISIONS

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ALCOA | Ma'aden Saudi Arabian Mining Company

Ma'aden Aluminum Project

SCALE: 1:10 FORMAT A0

Bechtel

Departement Ingenierie
Engineering Department
9450 Trans-Canada
Saint-Laurent, Quebec
H4S 1V3
Canada

		DATE
DRAWN	E. Iancu	AU.23.'10
CHK.	M. Blanchet	
R.E.	C. Coupal	
A.E. / S.		
E.G.S.		
P.E.M.		
CLIENT		

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SELLER DRAWING No. 1347-P1-1000 REV. 1

Ras Az Zawr
Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
PRESTRESSING STATION
GENERAL ASSEMBLY

CLIENT DRG. No. REV.

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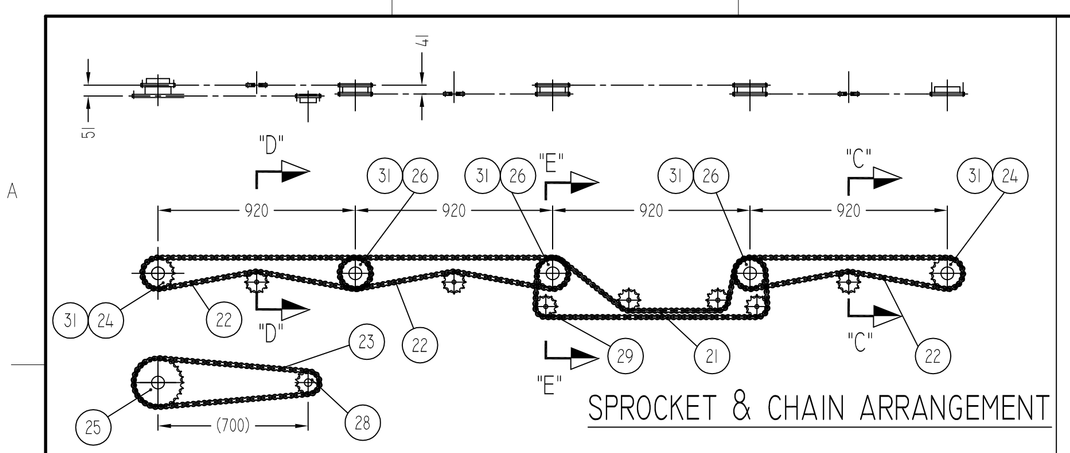
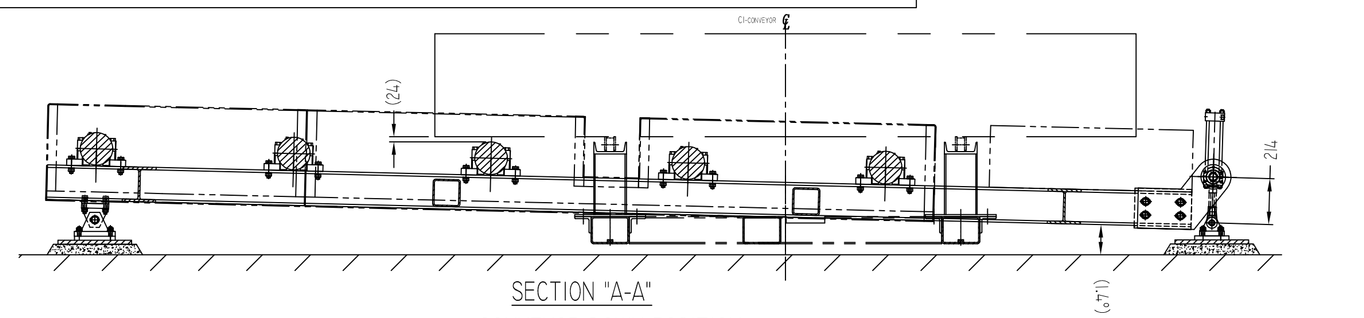


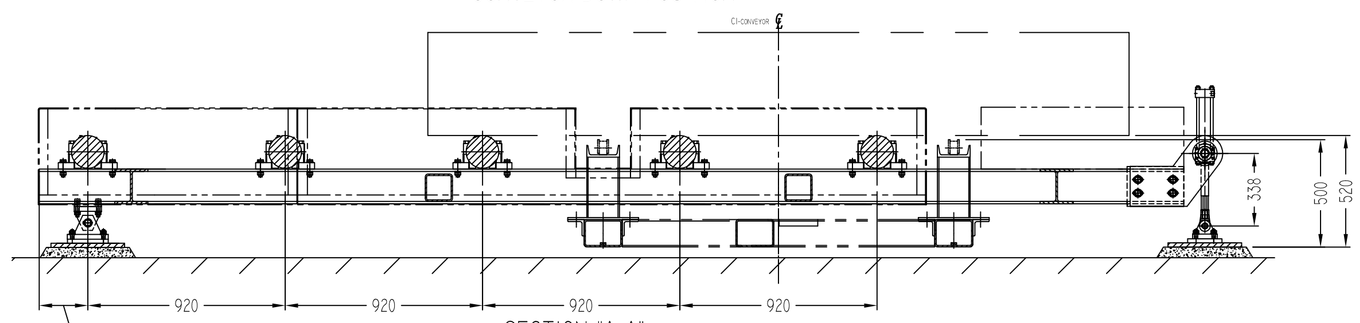
SPROCKET & CHAIN ARRANGEMENT

64	10	S.A.E	WASHER 5/8"			32	5	SNL22513/60TG	PILLOW BLOCK (FIXED) BORE ø60 "SKF"	BY "GNA"	50 kg
65	49	DIN 125-B	WASHER 10			33	5	SNL22513/60TGY	PILLOW BLOCK (FREE) BORE ø60 "SKF"	BY "GNA"	50 kg
66	4	DIN 9021-A	WASHER 10			34					
67	16	DIN 125-B	WASHER 20			35	2	1347-R1-1005	HYDR. CYLINDER, BORE ø 2.5",ROD ø 1.375",	BY "GNA"	24 kg
68	16	DIN 125-B	WASHER 14						STROKE 7.88" #2.50CD-2HKTSV33AC7.88" "PARKER"		
69	16	DIN 127	SPRING WASHER A 20			36	2	#85361	EYE BRACKET	BY "GNA"	3 kg
70	20	DIN 127	SPRING WASHER A 16			37	2	#50944	FEMALE ROD CLEVIS	BY "GNA"	2 kg
71	40	DIN 127	SPRING WASHER A 14			38	2	#68370	PIVOT PIN	BY "GNA"	1 kg
72	11	ANSI B18.21.1	SPRING WASHER 5/8"			39	2	#69198	EYE BRACKET	BY "GNA"	3 kg
73	4	DIN 127	SPRING WASHER A 10			40	2	#69208	CLEVIS BRACKET	BY "GNA"	2 kg
74	24	DIN 7980	SPRING WASHER A 6			41	2	#68371	PIVOT PIN	BY "GNA"	1 kg
						42	16	DIN 933	HEX-HEAD BOLT M14 X 45		
						43	1	K47-DRE80M4BE11F/DH	GEARMOTOR 0.75 kW, OUTPUT 44 rpm	BY "GNA"	
									OUTPUTSHAFT ø30 (M1A), TERMINALBOX-POSITION 270		
						45	8	DIN 933	HEX. HEAD BOLT M20 x 100		1 kg
						46	16	DIN 933	HEX. HEAD BOLT M20 x 60		1 kg
						47	20	DIN 933	HEX. HEAD BOLT M16 x 70		2 kg
						48	8	DIN 933	HEX-HEAD BOLT M14 X 75		
						49	4	DIN 933	HEX. HEAD BOLT M10 X 50		
						50	2	DIN 933	HEX. HEAD BOLT M10 X 110		
						51	2	ANSI B18.3	HEX. SOCK. HEAD SHOULDER SCREW 0.750 X 3.25"		
						52	1	ANSI B18.3	HEX. SOCK. HEAD SHOULDER SCREW 0.750 X 2.75"		
						53	1	ANSI B18.3	HEX. SOCK. HEAD SHOULDER SCREW 0.750 X 1.5"		
						54	31	ANSI B18.3.4M	HEX. SOCKET CAP SCREW M10 X 25		
						55	24	DIN 912	CYLINDER HEAD CAP SCREW M6 X 20		
						57	16	DIN 934	HEX. NUT M20		
						58	20	DIN 934	HEX. NUT M16		
						59	40	DIN 934	HEX. NUT M14		
						60	10	ANSI B18.2.2	HEX. NUT 5/8-11		
						61	14	DIN 934	HEX. NUT M10		
						62	20	DIN 125-B	WASHER 16		
						63	12	DIN 125-A	WASHER M20		

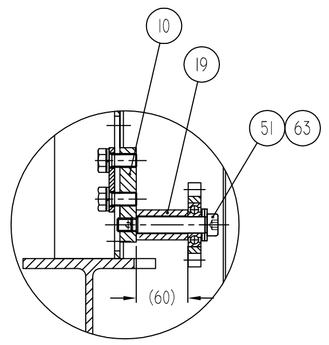
TOTAL WEIGHT APPROX. = 1980 KG



SECTION "A-A"
CONVEYOR DOWN POSITION



SECTION "A-A"
CONVEYOR UP POSITION



SECTION "C-C"
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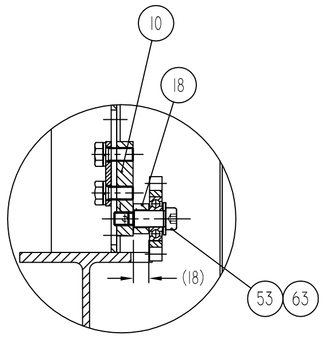

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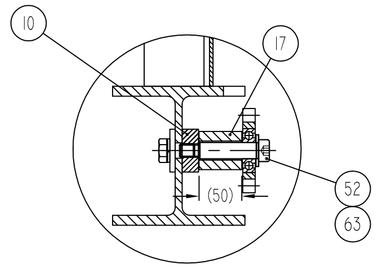

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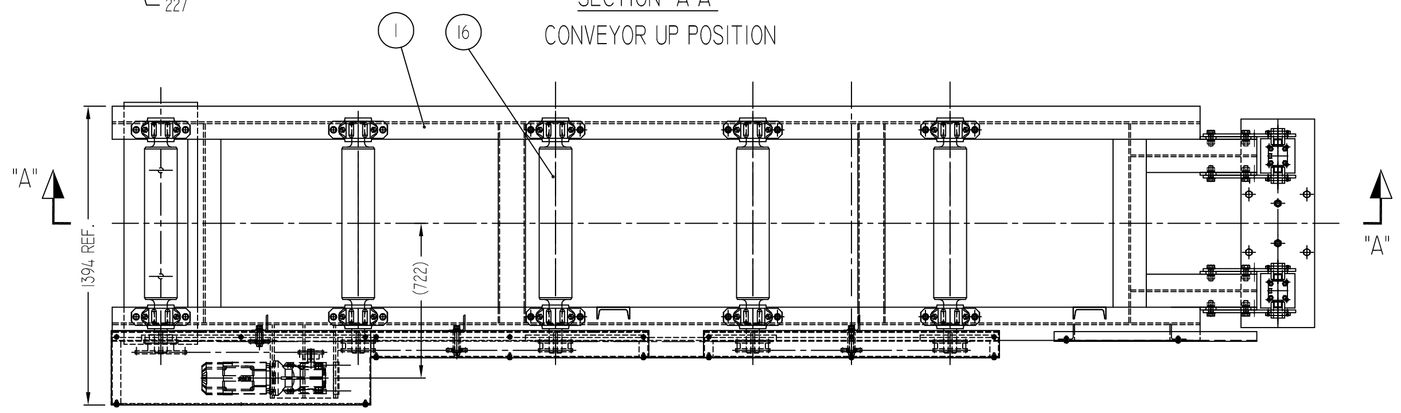

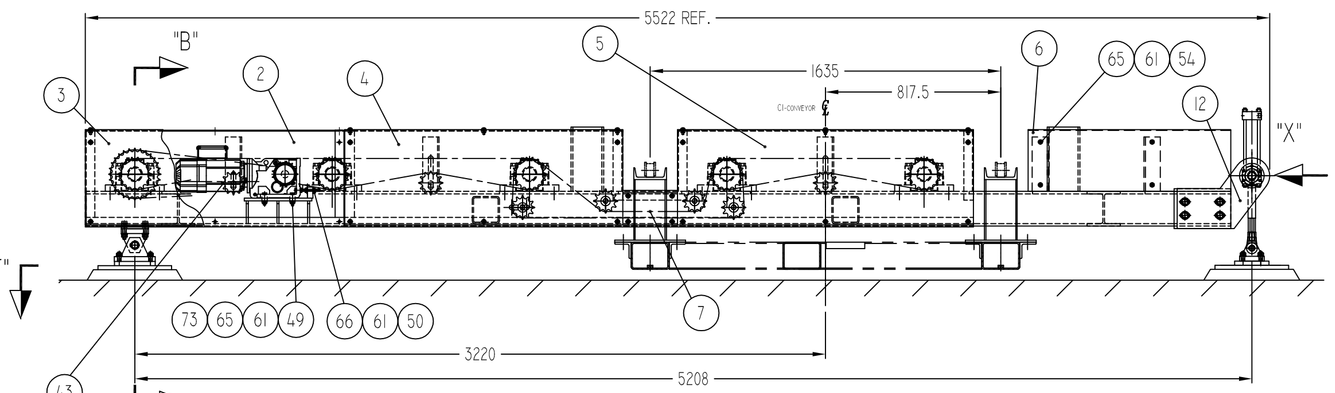

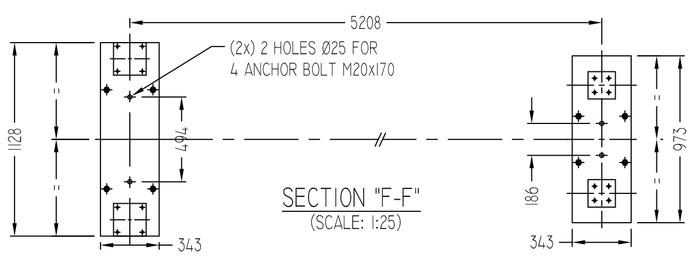

SECTION "F-F"
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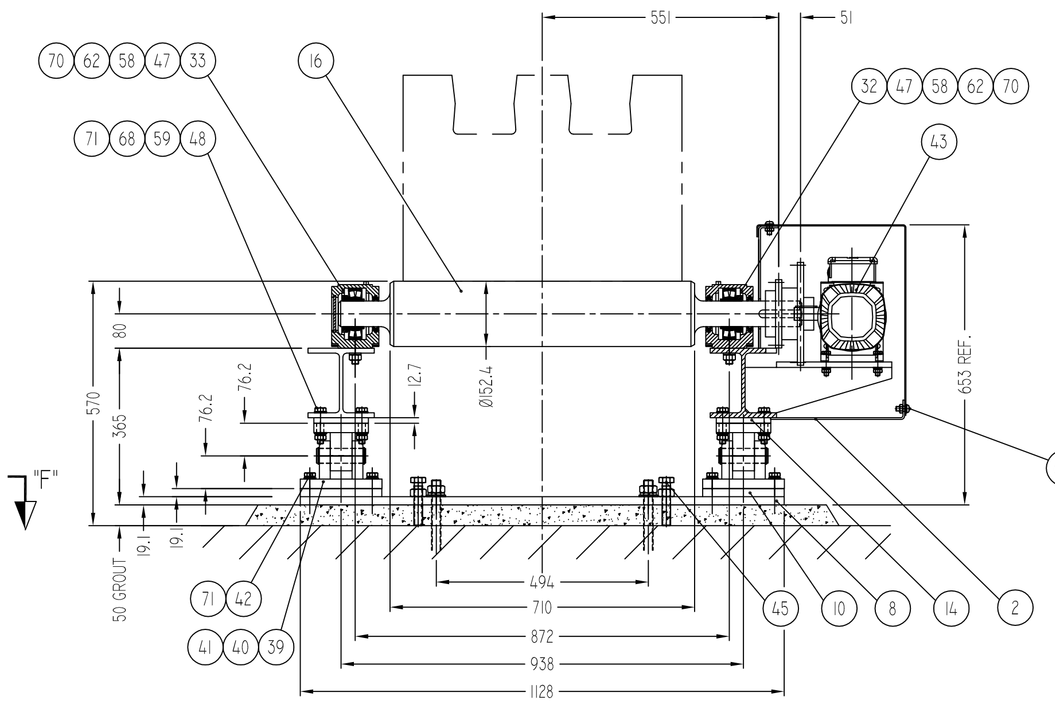

SECTION "B-B"
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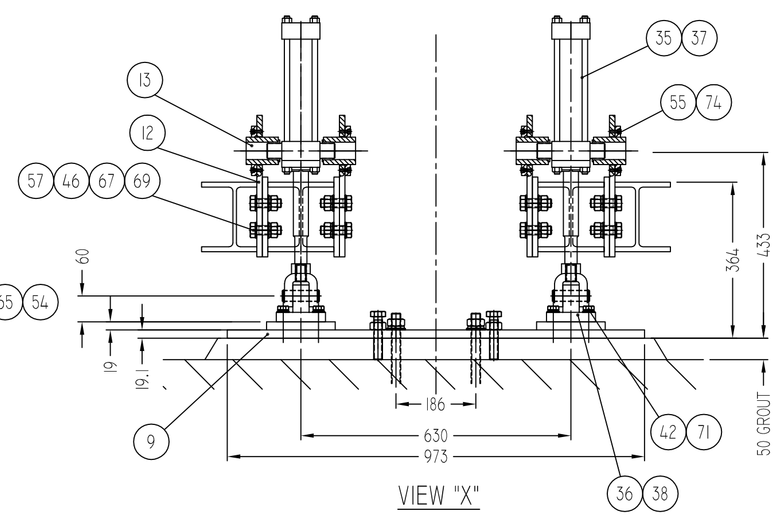
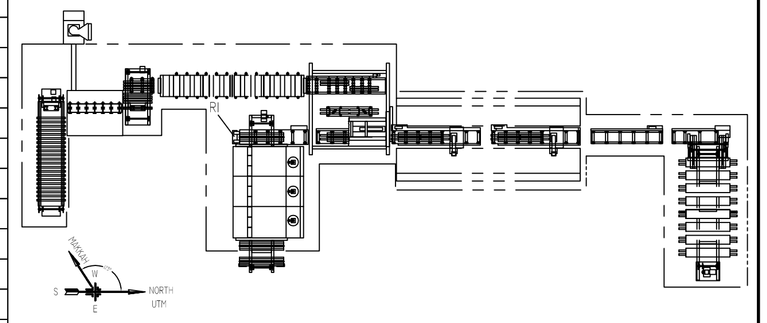


VIEW "X"

NOTES:
1. FOR FOUNDATION DETAILS SEE DRAWING 1347-AR-0100 AND 1347-AR-0101.
2. ALL MECHANICAL PARTS WILL HAVE AN ACCES FOR MAINTENANCE.
3. THERE IS A GREASE POINT FOR ALL BEARINGS.



LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/Qty	No. PIECE-MAT. MAT.-PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
1	1	1347-R1-1100	MAIN FRAME		575 kg
2	1	1347-R1-1110	GUARD		100 kg
3	1	1347-R1-1120	COVER		20 kg
4	1	1347-R1-1130	COVER		16 kg
5	1	1347-R1-1140	COVER		17 kg
6	1	1347-R1-1150	GUARD		
7	1	1347-R1-1160	COVER		2 kg
8	1	1347-R1-1210	BASE PLATE		64 kg
9	1	1347-R1-1220	BASE PLATE		50 kg
10	4	1347-R1-1800	FIXING PLATE		1 kg
11					
12	4	1347-R1-1250	PLATE		72 kg
13	4	1347-R1-1260	HUB		14 kg
14	2	1347-R1-1270	PLATE		3 kg
15					
16	5	1347-R1-1010	ROLLER		550 kg
17	2	1347-R1-1030	SPACER		1.5 kg
18	1	1347-R1-1040	SPACER SHORT		0.4 kg
19	2	1347-R1-1050	SPACER LONG		1.5 kg
20	3	ANSI B18.3	HEX. SOCK. HEAD SHOULDER SCREW 0.750 X 2.75"		
21	1	#119083	ROLLER CHAIN #80 X 2844 LG	BY "GNA"	16 kg
22	3	#119083	ROLLER CHAIN #80 X 2311 LG	BY "GNA"	19 kg
23	1	#119083	ROLLER CHAIN #80 X 1930 LG	BY "GNA"	5 kg
24	2	#80B18	SPROCKET ,PITCH 1",BORE ø60, 18 TEETH	BY "GNA"	7 kg
			INCL. KEYWAY FOR KEY 11 x 18		
25	1	#80B28	SPROCKET ,PITCH 1", 28 TEETH	BY "GNA"	7 kg
			BORE ø60, INCL. KEYWAY FOR KEY 11 x 18		
26	3	#DS80A18	SPROCKET ,PITCH 1",BORE ø60, 18 TEETH	BY "GNA"	21 kg
			INCL. KEYWAY FOR KEY 11 x 18		
28	1	#80B13	SPROCKET ,PITCH 1",BORE ø30, 13 TEETH	BY "GNA"	2 kg
			INCL. KEYWAY FOR KEY 10 x 8		
29	7	#80BB12H	IDLER SPR.,PITCH 1",BORE ø3/4", 12 TEETH	BY "GNA"	7 kg
31	5	C-1045	KEY 11 x 18 x 90 LG		

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EQUIPMENT TAG # 4481-MJRO-0005

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SELLER DRAWING No. 1347-R1-1000 REV. 1

NUMBER	REV.	TITLE
REFERENCE DRAWINGS		

REV.	DESCRIPTION	DATE	DRN.	CHK.	R.E.	A.E. / S.	E.G.S.	P.E.M.
1	REVISION, ITEM #27 REMOVED.	06.14.'10	C.C.					
0	FIRST ISSUE	SE.09.'10	C.C.					

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Bechtel | GNA alutech inc. Departement Ingenierie Engineering Department 9495 Trans-Canada Saint-Laurent, Quebec H4S 1V3 Canada

		DATE
DRAWN	X.X.	SE.09.'10
CHK.	M. Blanchet	
R.E.	C. Coupal	
A.E. / S.		
E.G.S.		
P.E.M.		
CLIENT		

Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CARBON BLOCK OVEN EXIT CONVEYOR
GENERAL ARRANGEMENT – DDR. NO. 121

SCALE: 1:20 FORMAT A1

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CLIENT DRG. No. REV.

USER: $USERNAME$ TIME: $TIME$ $DATE$ $FILE$ DATE: FILE:

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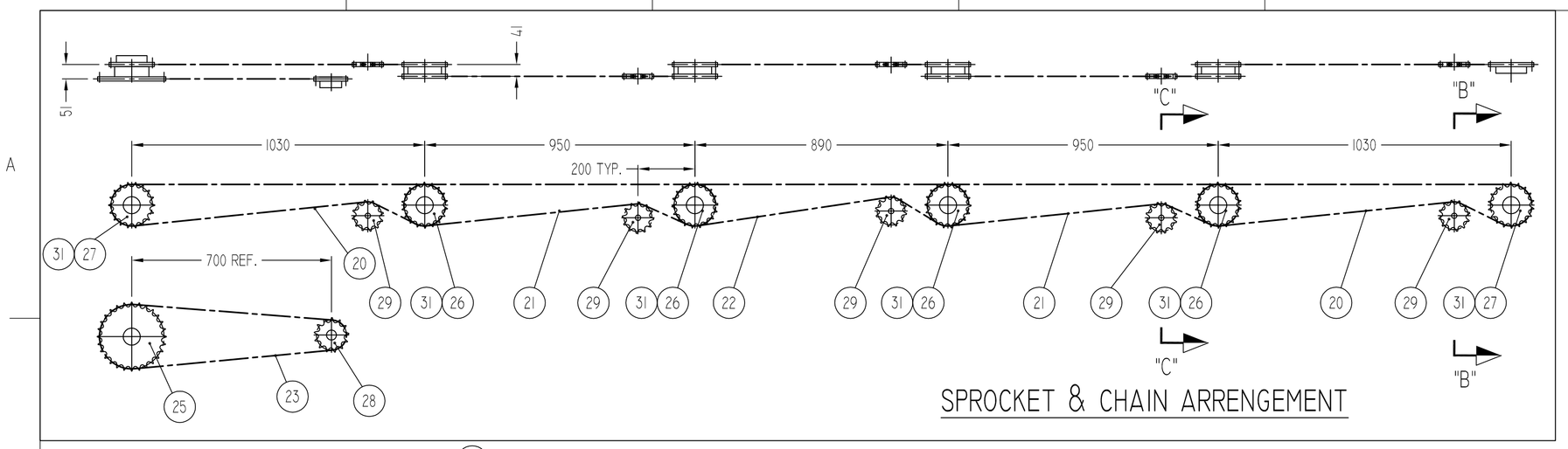
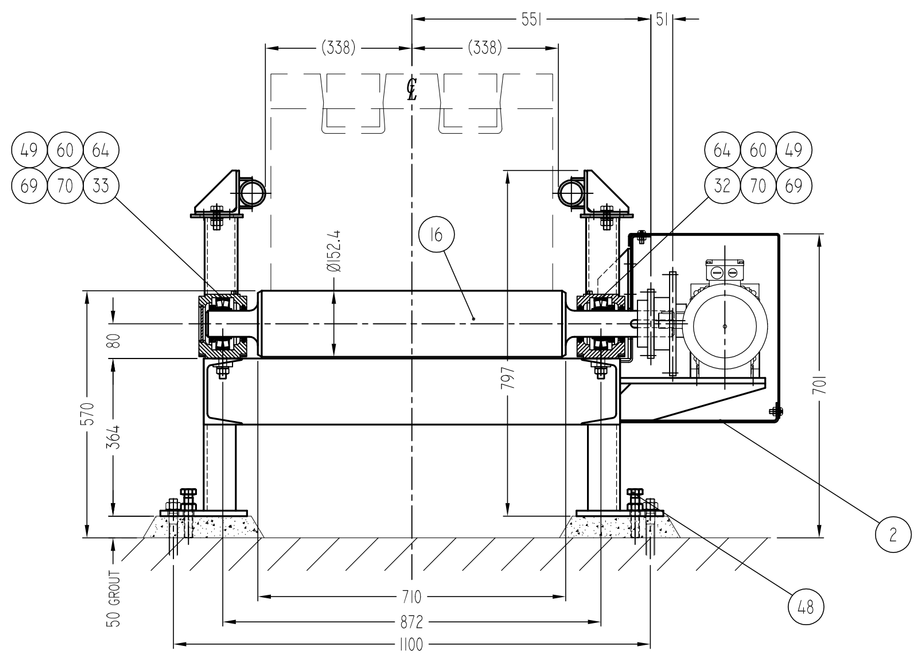


SPROCKET & CHAIN ARRENGEMENT



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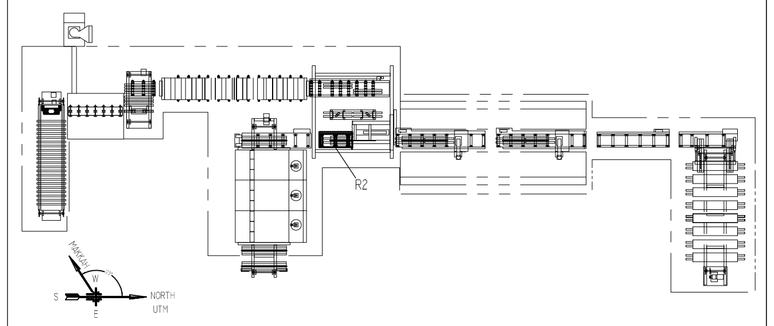
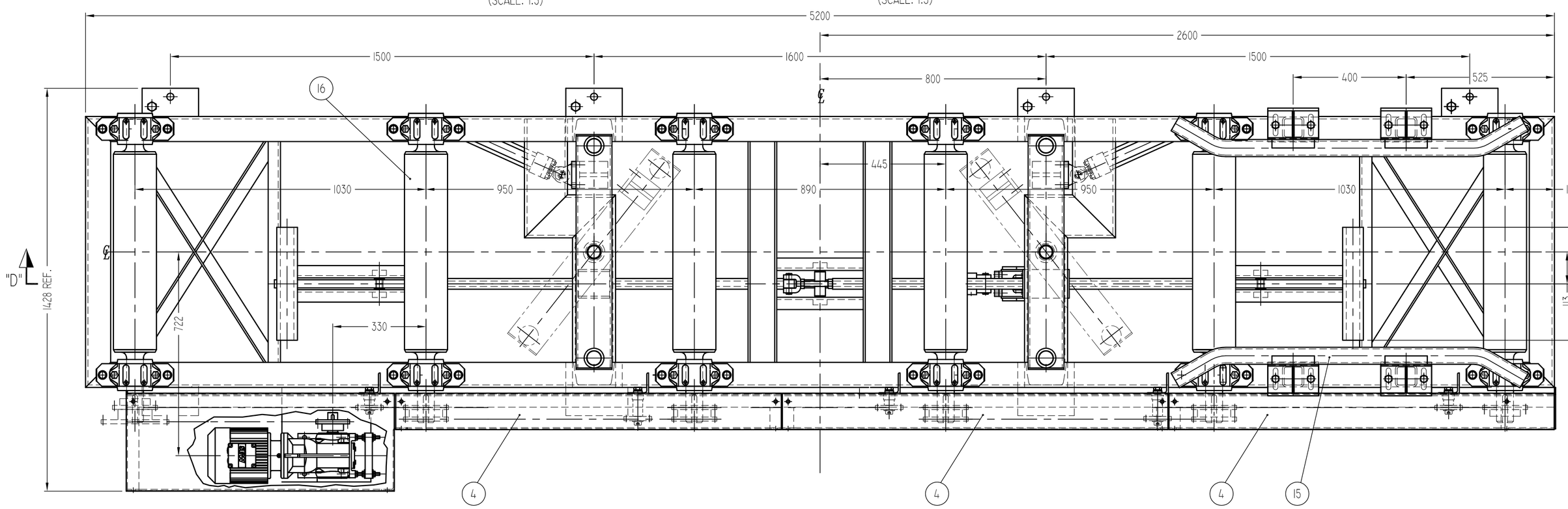
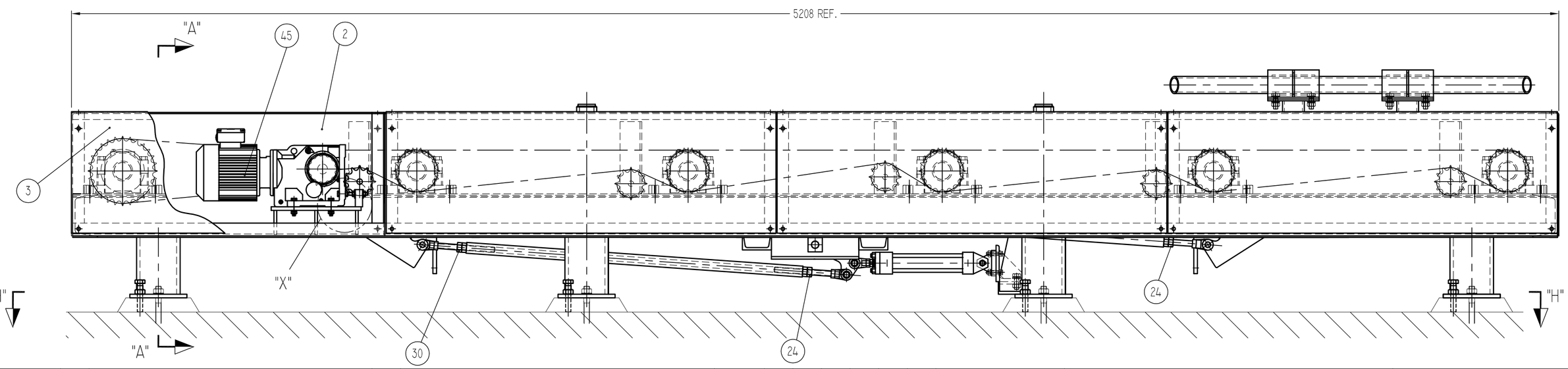


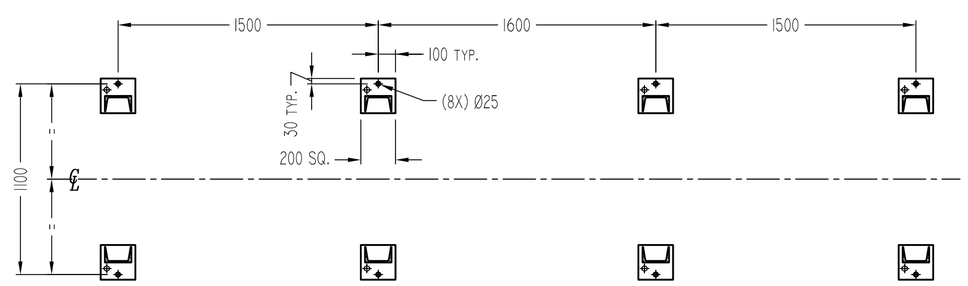
LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/Qty	No. PIECE–MAT. MAT.–PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
1	1	1347–R2–1100	MAIN FRAME		560 kg
2	1	1347–R2–1110	GUARD		53 kg
3	1	1347–R2–1120	COVER		17 kg
4	3	1347–R2–1130	COVER		45 kg
5	2	1347–R2–1210	LEVER		80 kg
6	1	1347–R2–1220	LEVER		3.5 kg
7	2	1347–R2–1230	JAW (RIGHT HAND THREAD)	*	2 kg
8	2	1347–R2–1240	JAW (LEFT HAND THREAD)	*	2 kg
9	2	1347–R2–1250	TURNBUCKLE BODY		14 kg
10	1	1347–R2–1260	BRACKET		2 kg
11	1	1347–R2–1310	CENTERING UNIT (WIDTH)		53 kg
12	1	1347–R2–1320	CENTERING UNIT (WIDTH)		53 kg
13	4	1347–R2–1330	CAP		4 kg
14	2	1347–R2–1340	ANGLE (SUPPORT)		2 kg
15	1	1347–R2–1400	GUIDE		125 kg
16	6	1347–R2–1010	ROLLER		660 kg
17	5	1347–R2–1800	FIXING PLATE		1 kg
18	2	STEEL	TUBE MEC. OD 1–3/8" x ID 13/16" x 60	SPACER	2 kg
19	3	STEEL	TUBE MEC. OD 1–3/8" x ID 13/16" x 19	SPACER	1 kg
20	2	#119083	ROLLER CHAIN #80 X 2540 LG	BY "GNA"	14 kg
21	2	#119083	ROLLER CHAIN #80 X 2388 LG	BY "GNA"	13 kg
22	1	#119083	ROLLER CHAIN #80 X 2286 LG	BY "GNA"	5 kg
23	1	#119083	ROLLER CHAIN #80 X 1930 LG	BY "GNA"	5 kg
24	2		HEX. NUT 3/4"–16 (RIGHT HAND THREADED)		
25	1	#80B28	SPROCKET ,PITCH 1", 28 TEETH	BY "GNA"	7 kg
			BORE ø60, INCL. KEYWAY FOR KEY 11 x 18		
26	4	#DS80A18	SPROCKET ,PITCH 1",BORE ø60, 18 TEETH	BY "GNA"	21 kg
			BORE ø60, INCL. KEYWAY FOR KEY 11 x 18		
27	2	#80B18	SPROCKET ,PITCH 1",BORE ø60, 18 TEETH	BY "GNA"	7 kg
			BORE ø60, INCL. KEYWAY FOR KEY 11 x 18		
28	1	#80B13	SPROCKET ,PITCH 1",BORE ø35, 13 TEETH	BY "GNA"	2 kg
			BORE ø35, INCL. KEYWAY FOR KEY 10 x 8		
29	5	#80BB12H	IDLER SPR.,PITCH 1",BORE ø19, 12 TEETH	BY "GNA"	3 kg
30	2		HEX. NUT 3/4"–16 (LEFT HAND THREADED)		
31	6	C–1045	KEY 11 x 18 x 90 LG		

CONTINUED ON DRAWING-NO. 1347-R2-1001







SECTION "H-H"
(SCALE: 1:25)

THIS DRAWING MUST BE READ WITH 1347-R2-1001

EQUIPMENT TAG # 4481-MJR0-0007

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NUMBER	REV.	TITLE
REFERENCE DRAWINGS		

REV.	DESCRIPTION	DATE	DRN.	CHK.	R.E.	A.E. / S.	E.G.S.	P.E.M.
0								
REVISIONS								

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Ma'aden Aluminum Project

SCALE: 1:10 FORMAT A1

Bechtel

GNA alutech inc.

Departement Ingenierie Engineering Department
9495 Trans-Canada
Saint-Laurent, Quebec
H4S 1V3
Canada

		DATE
DRAWN	E.Iancu	JL.26.'10
CHK.	M. Blanchet	
R.E.	C. Coupal	
A.E. / S.		
E.G.S.		
P.E.M.		
CLIENT		

BECHTEL DRG. No. — — — — — REV.

SELLER DRAWING No. 1347–R2–1000 REV. 0

Ras Az Zawr
Aluminium Smelter

SMELTER PLANT FACILITY
PLOTTED BY: 1347-Datalink-Engineering\DWG\REV\1347-R2-1000-00.dwg
ROLLER CONVEYOR FOR BLOCK & BAR ASSEMBLY
GENERAL ARRANGEMENT

CLIENT DRG. No. REV.

TIME: $TIME$
$DATE$
$FILE$
DATE:
FILE:
USER: $USERNAME$

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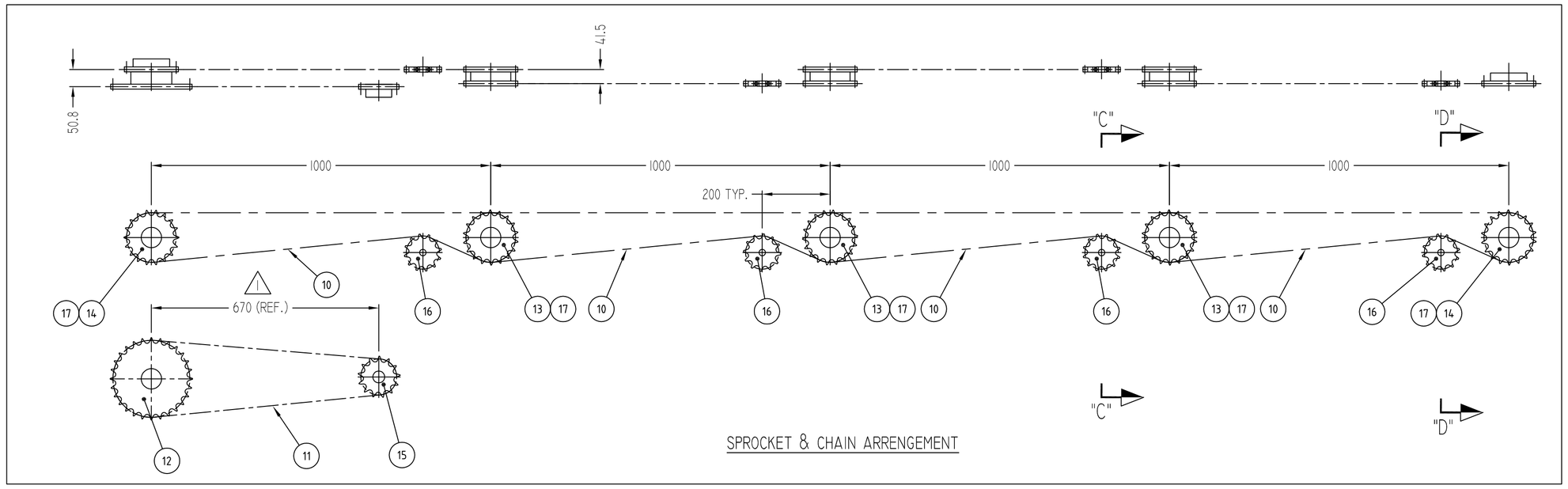
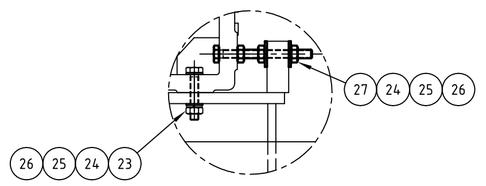
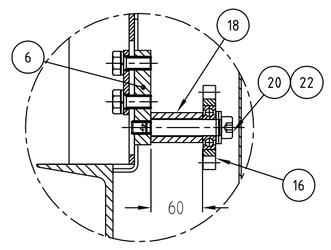
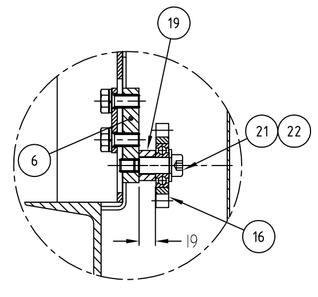
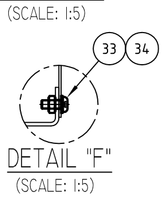
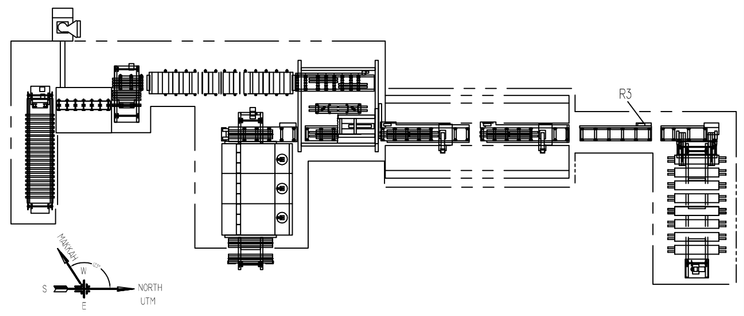








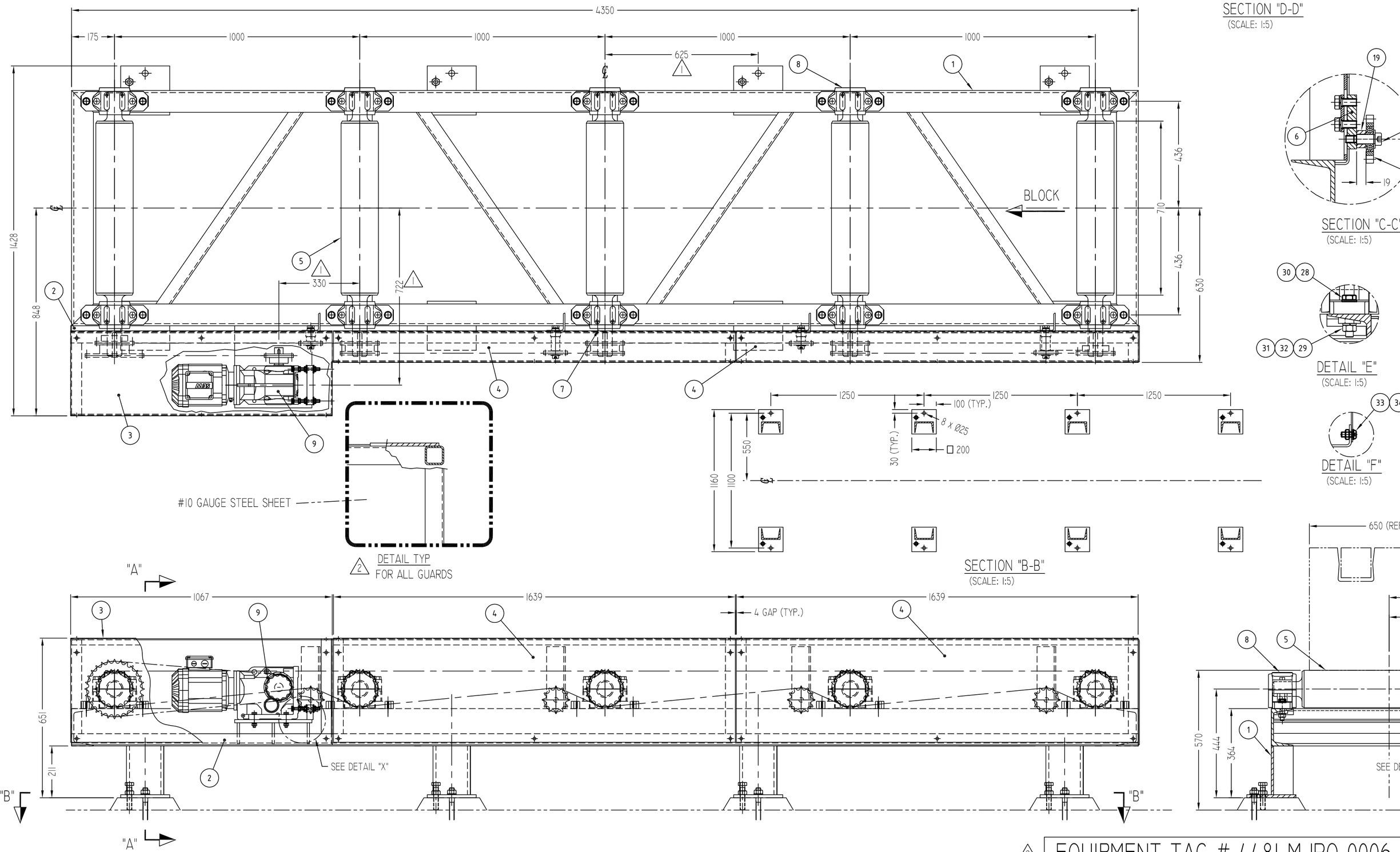




LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/Qty	No. PIECE-MAT. MAT.-PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
1	1	1347-R3-1100	MAIN FRAME		377 kg
2	1	1347-R3-1110	GUARDS		134 kg
3	1	1347-R3-1120	COVER #1		23 kg
4	2	1347-R3-1130	COVER #2		52 kg
5	5	1347-R3-1010	ROLLER	BY "GNA"	550 kg
6	4	1347-R3-1800	FIXING PLATE		4 kg
7	5	SNL22513/60TG	PILLOW BLOCK (FIXED) BORE ø60 "SKF"	BY "GNA"	42 kg
8	5	SNL22513/60TGY	PILLOW BLOCK (FREE) BORE ø60 "SKF"	BY "GNA"	42 kg
9	1	K57DRE90M4/DH	GEARMOTOR 1.1 kW, OUTPUT 39 rpm	BY "GNA"	41 Kg
			OUTPUTSHAFT ø35 (A-side)		
10	4	#119083	ROLLER CHAIN #80 X 2480 LG	BY "GNA"	28 kg
11	1	#119083	ROLLER CHAIN #80 X 1870 LG	BY "GNA"	5 kg
12	1	#80B28	SPROCKET, PITCH 1", 28 TEETH	BY "GNA"	7 kg
			BORE ø60, INCL. KEYWAY FOR KEY 11 x 18		
13	3	#DS80A18	SPROCKET, PITCH 1", BORE ø60, 18 TEETH	BY "GNA"	16 kg
			BORE ø60, INCL. KEYWAY FOR KEY 11 x 18		
14	2	#80B18	SPROCKET, PITCH 1", BORE ø60, 18 TEETH	BY "GNA"	7 kg
			BORE ø60, INCL. KEYWAY FOR KEY 11 x 18		
15	1	#80B13	SPROCKET, PITCH 1", BORE ø35, 13 TEETH	BY "GNA"	2 kg
			BORE ø35, INCL. KEYWAY FOR KEY 10 x 8		
16	4	#80BB12H	IDLER SPR.,PITCH 1", BORE ø19, 12 TEETH	BY "GNA"	3 kg
17	5	C-1045	KEY 11 x 18 x 90 LG		
18	2	STEEL	TUBE MEC. OD 1-3/8" x ID 13/16" x 60	SPACER	2 kg
19	2	STEEL	TUBE MEC. OD 1-3/8" x ID 13/16" x 19	SPACER	1 kg
20	2	ANSI B18.3	HEX. SOCK. HEAD SHOULDER SCREW 0.750X3.25"		
21	2	ANSI B18.3	HEX. SOCK. HEAD SHOULDER SCREW 0.750X1.5"		
22	4	DIN125_2A	WASHER 21		
23	4	DIN 933	HEX. HEAD BOLT M12 X 50		
24	10	DIN 934	HEX. NUT M12		
25	12	DIN 9021-A	WASHER 12		
26	6	DIN 127	SPRING WASHER A 12		
27	2	DIN 933	HEX. HEAD BOLT M12 X 110		
28	20	DIN 933	HEX. HEAD BOLT M16 x 80		
29	20	DIN 934	HEX. NUT M16		
30	20	DIN 125-B	WASHER 16		
31	20	ASTM F436	SQUARE BEVELED WASHER 0.625		
32	20	DIN 127	SPRING WASHER A 16		
33	24	ANSI B18.3.4M	HEX. SOCKET CAP SCREW M10 X 25		
34	24	DIN 125-B	WASHER 10		

TOTAL WEIGHT APPROX. = 1336 KG



NOTES:

1. FOR FOUNDATION DETAILS SEE DRAWING 1347-AR-0100 AND 1347-AR-0101.
2. ALL MECHANICAL PARTS WILL HAVE AN ACCES FOR MAINTENANCE.
3. THERE IS A GREASE POINT FOR ALL BEARINGS.

EQUIPMENT TAG # 4481-MJRO-0006

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NUMBER	REV.	TITLE
REFERENCE DRAWINGS		

REV.	DESCRIPTION	DATE	DRN.	CHK.	R.E.	A.E. / S.	E.G.S.	P.E.M.
3	FOR APPROVAL	OC.29 2010	LG	M.B.	C.C.			
2	GUARD DETAIL, NOTES AND EQUIPMENT TAG NUMBER ADDED	SE.27.'10	C.C.	M.B.	C.C.			
1	GENERAL REVISION	SE.23.'10	A.V.	M.B.	C.C.			
0	INITIAL DESIGN	AU.30.'10	A.V.	M.B.	C.C.			

REVISIONS

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Ma'aden Aluminum Project

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Bechtel

GNA alutech inc. Departement Ingenierie Engineering Department 9495 Trans-Canada Saint-Laurent, Quebec H4S 1V3 Canada

		DATE
DRAWN	A.V.	AU.30.'10
CHK.	M. Blanchet	
R.E.	C. Coupal	
A.E. / S.		
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P.E.M.		
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CLIENT DRG. No. REV.

Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
ROLLER CONVEYOR AFTER SEALING STATION
GENERAL ARRANGEMENT

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TIME: $TIMES
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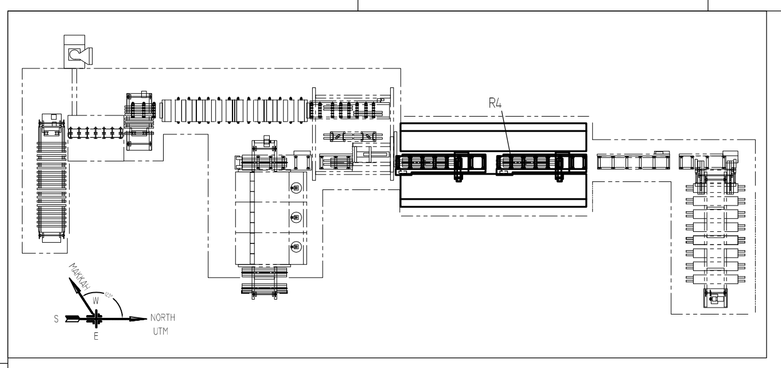
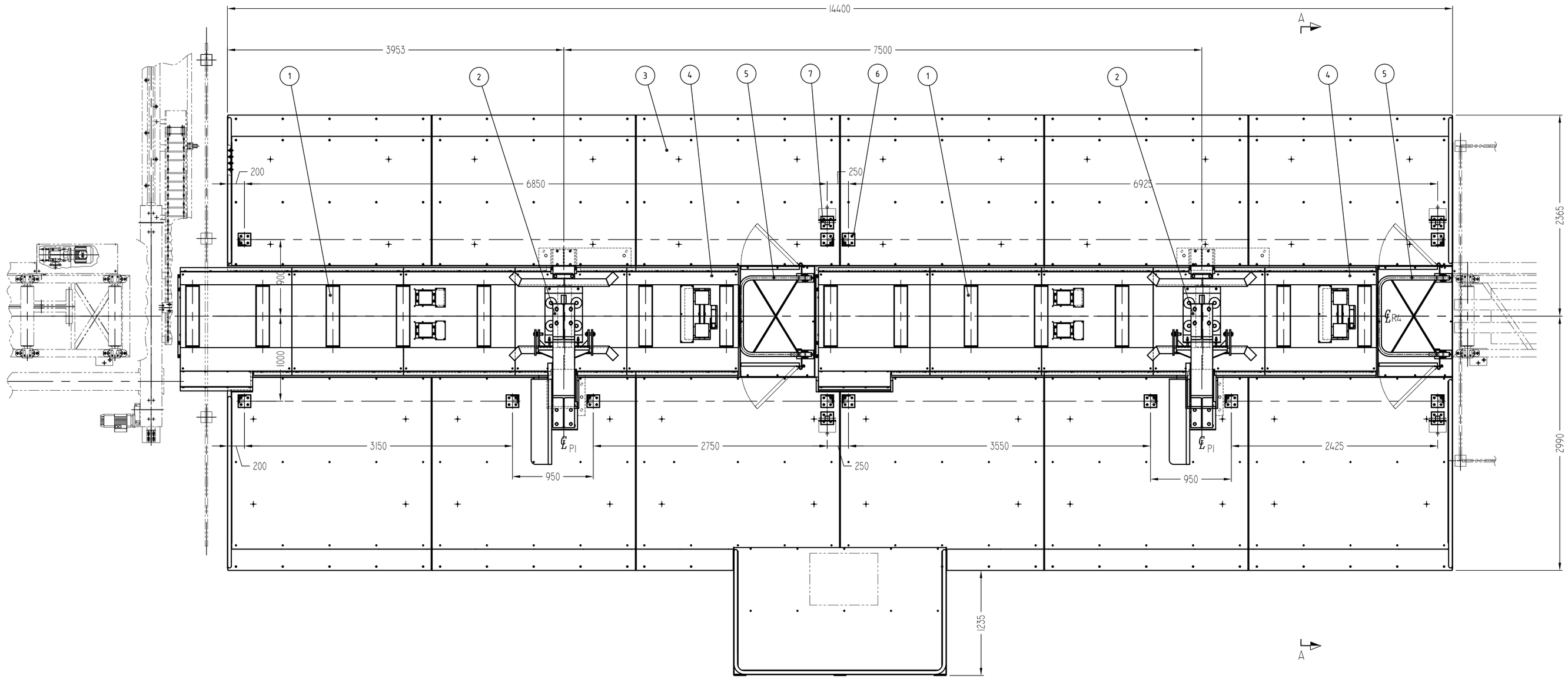
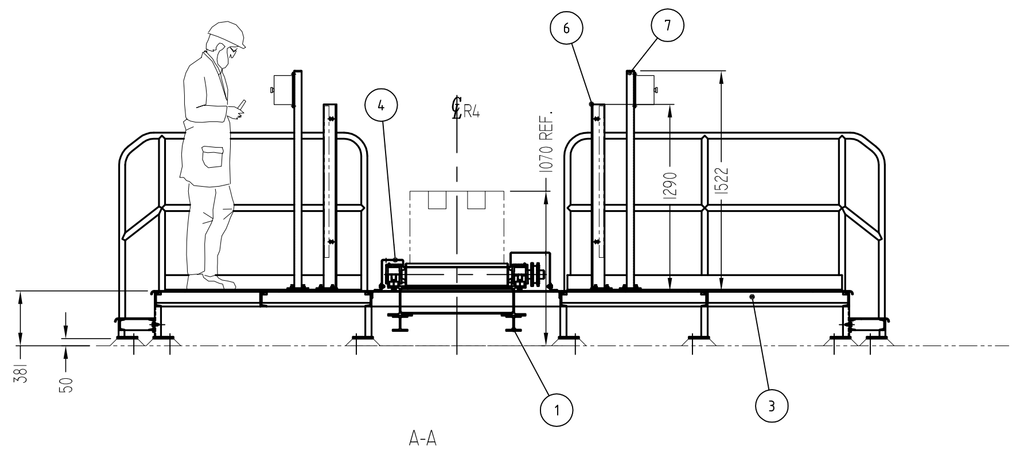
DATE:
FILE:



LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/Qty	No. PIECE-MAT. MAT.-PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
1	2	1347-R4-1000	SEALING STATION CONVEYOR – GEN. ARR.		4400 KG
2	2	1347-P1-1000	PRESTRESSING STATION – GEN. ARR.		4400 KG
3	1	1347-R4-1500	PLATFORM – GEN. ARR.		
4	2	1347-R4-1600	GUARD – GEN. ARR.		
5	2	1347-R4-1700	SAFETY BARRIER		
6	12	1347-R4-1900	SUPPORT FOR SAFETY LIGHT CURTAIN		
7	4	1347-R4-1910	SUPPORT FOR RESET BOX		





A-A

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EQUIPMENT TAG # 4481-MZAC-0002

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FILE:

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REV.	DESCRIPTION	DATE	DRN.	CHK.	R.E.	A.E. / S.	E.G.S.	P.E.M.
0	INITIAL DESIGN	DE.22.10	E.I.	M.B.	C.C.			

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Ma'aden Aluminum Project

SCALE: 1:30

FORMAT A1

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GNA alutech inc.

Departement Ingenierie
Engineering Department
9495 Trans-Canada
Saint-Laurent, Quebec
H4S 1V3
Canada

		DATE
DRAWN	E.I.	DE.22.'10
CHK.	M. Blanchet	
R.E.	C. Coupal	
A.E. / S.		
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SELLER DRAWING No. 1347-R4-0000 REV. 0

Ras Az Zawr
Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
Prestressing-P1 and sealing station c/w conveyor-R4 and platforms
GENERAL ARRANGEMENT

CLIENT DRG. No. REV.

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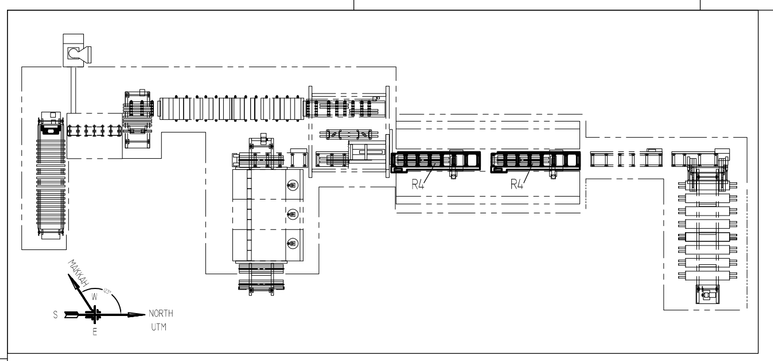

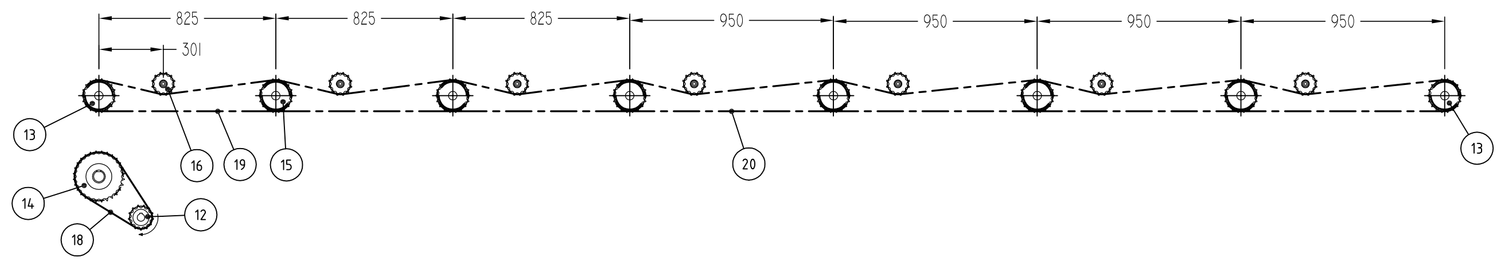

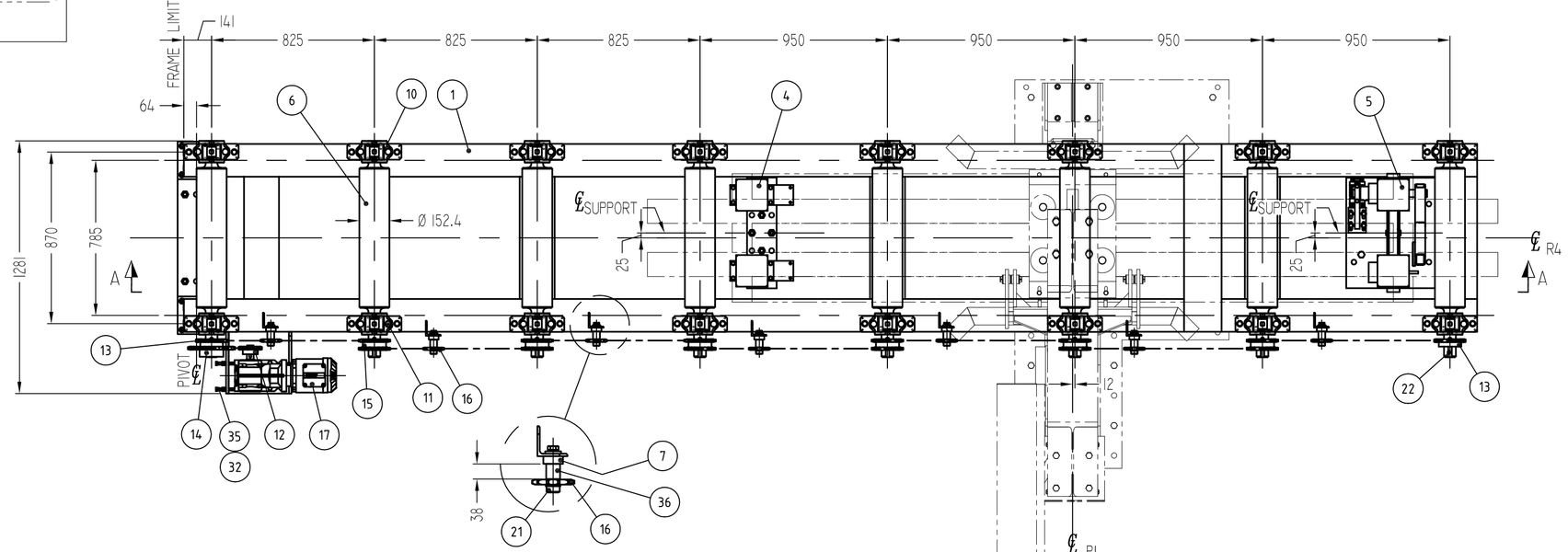

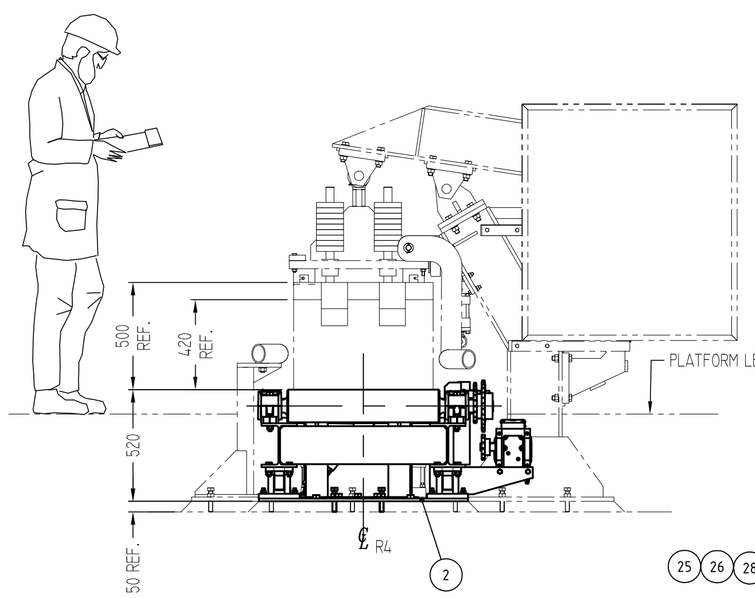

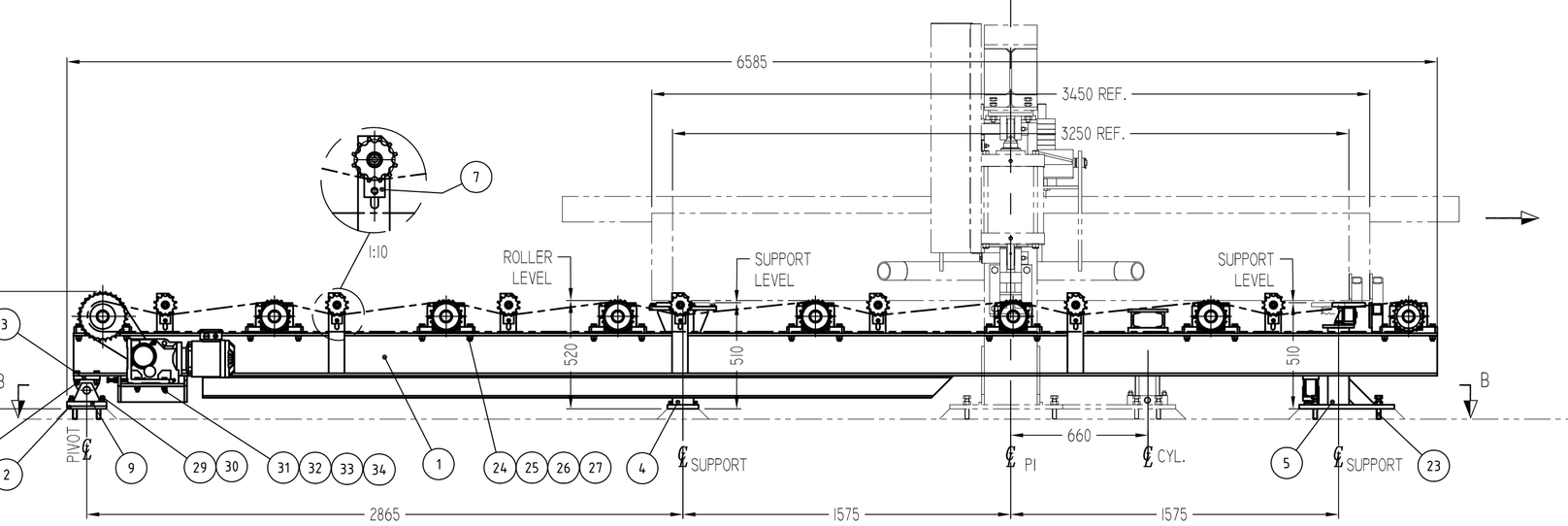

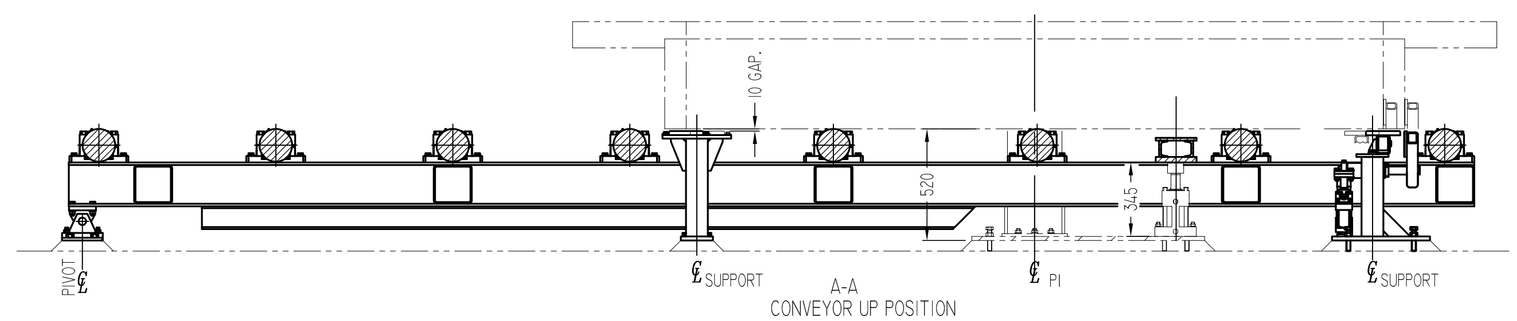

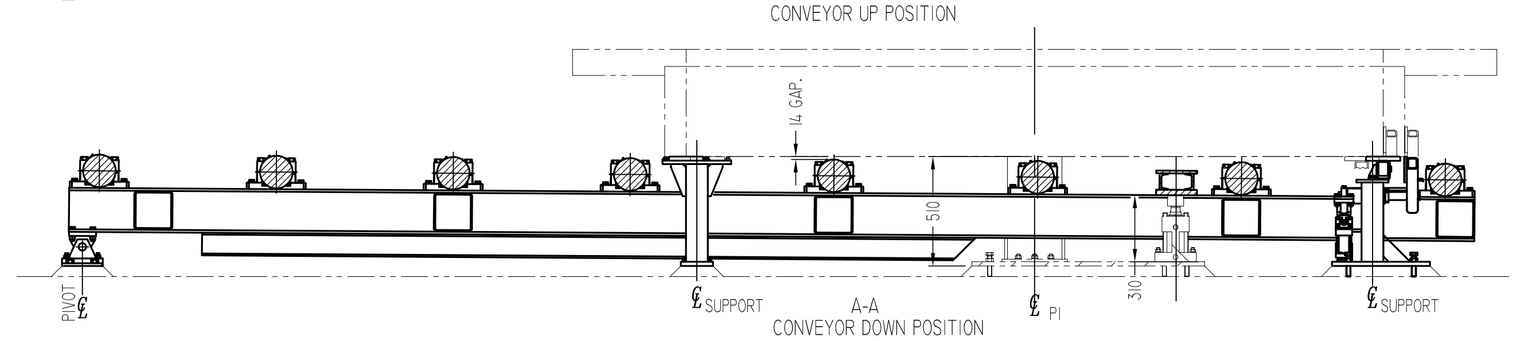

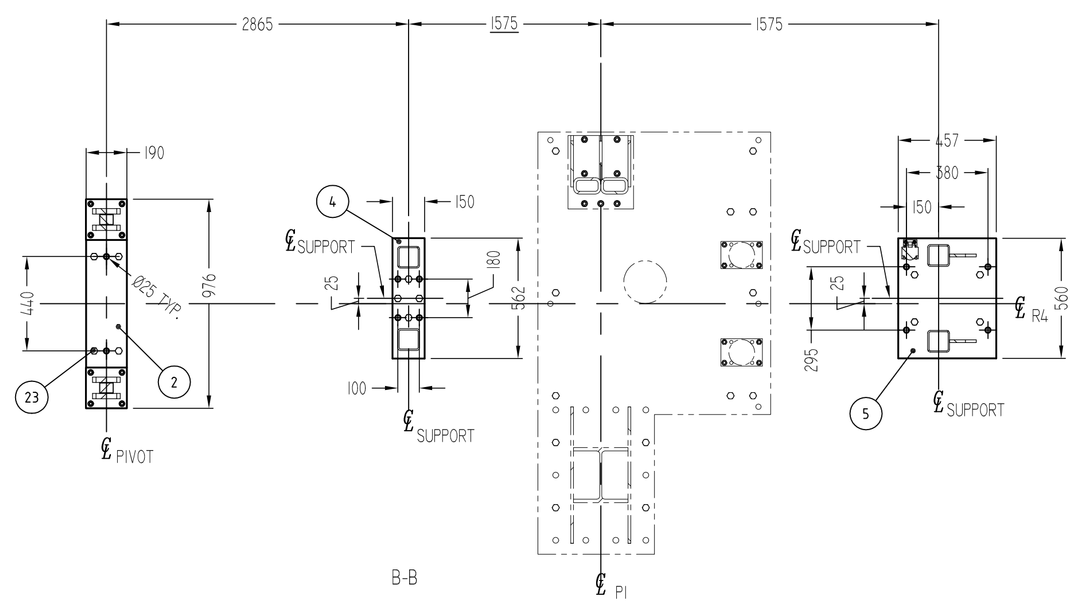

LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/Qty	No. PIECE-MAT. MAT.-PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
1	1	1347-R4-1110	MAIN FRAME		925
2	1	1347-R4-1120	BASE PLATE		20 KG
3	2	1347-R4-1130	CLEVIS		8 KG
4	1	1347-R4-1200	FIX SUPPORT		48 KG
5	1	1347-R4-1300	AJUSTABLE SUPPORT		110 KG
6	8	1347-R4-1010	ROLLER		880 KG
7	7	1347-R4-1800	FIXING PLATE		7 KG
8					
9	2	STD	CLEVIS BRACKET – #69208 ; PIVOT PIN – # 68371	BY "GNA"	
10	8	SNL22513/60 TGY	PILLOW BLOCKS (FREE) BORE 60ø "SKF"	BY "GNA"	
11	8	SNL22513/60 TG	PILLOW BLOCKS (FIXED) BORE 60ø "SKF"	BY "GNA"	
12	1	#80B13	SPROCKET FOR MOTOR, 1" PITCH, BORE 35ø, 13 TEETH,	BY "GNA"	
			WITH REGULAR KEYWAY		
13	2	#80B18	SINGLE SPROCKET, 1" PITCH, BORE 60ø, 18 TEETH,	BY "GNA"	
			WITH REGULAR KEYWAY		
14	1	#80B28	SINGLE SPROCKET, 1" PITCH, BORE 60ø, 28 TEETH,	BY "GNA"	
			WITH REGULAR KEYWAY		
15	6	#DS80A18	DOUBLE SPROCKET, 1" PITCH, BORE 60ø, 18 TEETH,	BY "GNA"	
			WITH REGULAR KEYWAY		
16	7	#80B12H	BALL BEARING IDLER SPROCKET (HARDENED TEETH)	BY "GNA"	
17	1	K57DRE90M4/DH	GEARMOTOR 1.12 kW, OUTPUT 39 rpm,	BY "GNA"	
18	1	# 80	ROLLER CHAIN #80 X 43" LG	BY "GNA"	
19	3	# 80	ROLLER CHAIN #80 X 84" LG	BY "GNA"	
20	4	# 80	ROLLER CHAIN #80 X 94" LG	BY "GNA"	
21	7	STD	HEX. SOCKET SHOULDER SCREWS (3/4") 5/8-11-UNC, 2-1/4" LONG.		
22	8	STD	KEY 18 X 11 X 80		
23	12	STD	HEX. CAP. SCREW M20 X 100 DIN 933		
24	32	STD	HEX. CAP. SCREW M16 X 70 DIN 933		
25	40	STD	HEX. NUT M16		
26	72	STD	FLAT WASHER FOR BOLT M16		
27	32	STD	LOCK WASHER FOR BOLT M16–DIN–127A		
28	8	STD	HEX. CAP. SCREW M16 X 55 DIN 933		
29	8	STD	HEX NUT M14 DIN 934		
30	8	STD	FLAT WASHER FOR BOLT M14 (DIN 125A)		
31	4	STD	HEX. CAP. SCREW M12 X 60 DIN 933		
32	6	STD	HEX. NUT M12 DIN 934		
33	8	STD	FLAT WASHER FOR BOLT M12		
34	4	STD	LOCK WASHER FOR BOLT M12		
35	2	STD	HEX. CAP. SCREW M12 X 90 DIN 933		
36	7	STEEL	TUBE MEC. OD 1–3/8" x ID 13/16" x 38 mm LG		

TOTAL APPROX. WEIGHT : 2200 Kg

SELLER/CONTRACTOR DOCUMENT REVIEW

Permission to proceed is limited to review of major design assumptions, analyses, test methods, or interfaces developed or selected by SELLER/CONTRACTOR, and does not relieve SELLER/CONTRACTOR from full compliance with contractual obligations.

1 ☐	Work may proceed.	4 ☐	Revise not required. Work may proceed.
2 ☐	Revise & Resubmit. Work may proceed subject to incorporation of changes.	5 ☐	VOID / Superseded.
3 ☐	Revise & Resubmit. Work may NOT proceed.	DDR Nbr :	

Reviewed by : _____ Date : _____

Discipline :

Document No : 25457- **Rev. : 0**

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SELLER DRAWING No. 1347-R4-1000 REV. 1

NUMBER	REV.	TITLE
REFERENCE DRAWINGS		

REV.	DESCRIPTION	DATE	DRN.	CHK.	R.E.	A.E. / S.	E.G.S.	P.E.M.
1	GEN. REVISION FOR APPROVAL	OC.29 2010	LG	M.B.	C.C.			
0	INITIAL DESIGN	SE.03.10	E.I.	M.B.	C.C.			

REVISIONS

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Ma'aden Aluminum Project

SCALE: 1:20 FORMAT A1

Bechtel

GNA alutech inc.
Departement Ingenierie
Engineering Department
9495 Trans-Canada
Saint-Laurent, Quebec
H4S 1V3
Canada

		DATE
DRAWN	E.I.	SE.03.'10
CHK.	M. Blanchet	
R.E.	C. Coupal	
A.E. / S.		
E.G.S.		
P.E.M.		
CLIENT		

BECHTEL DRG. No. - - - - - REV.

RAS AZ ZAWR ALUMINIUM SMELTER

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
SEALING STATION CONVEYOR
GENERAL ARRANGEMENT

CLIENT DRG. No. REV.

USER: $USERNAMES TIME: $TIMES $DATES $FILES DATE: FILE:

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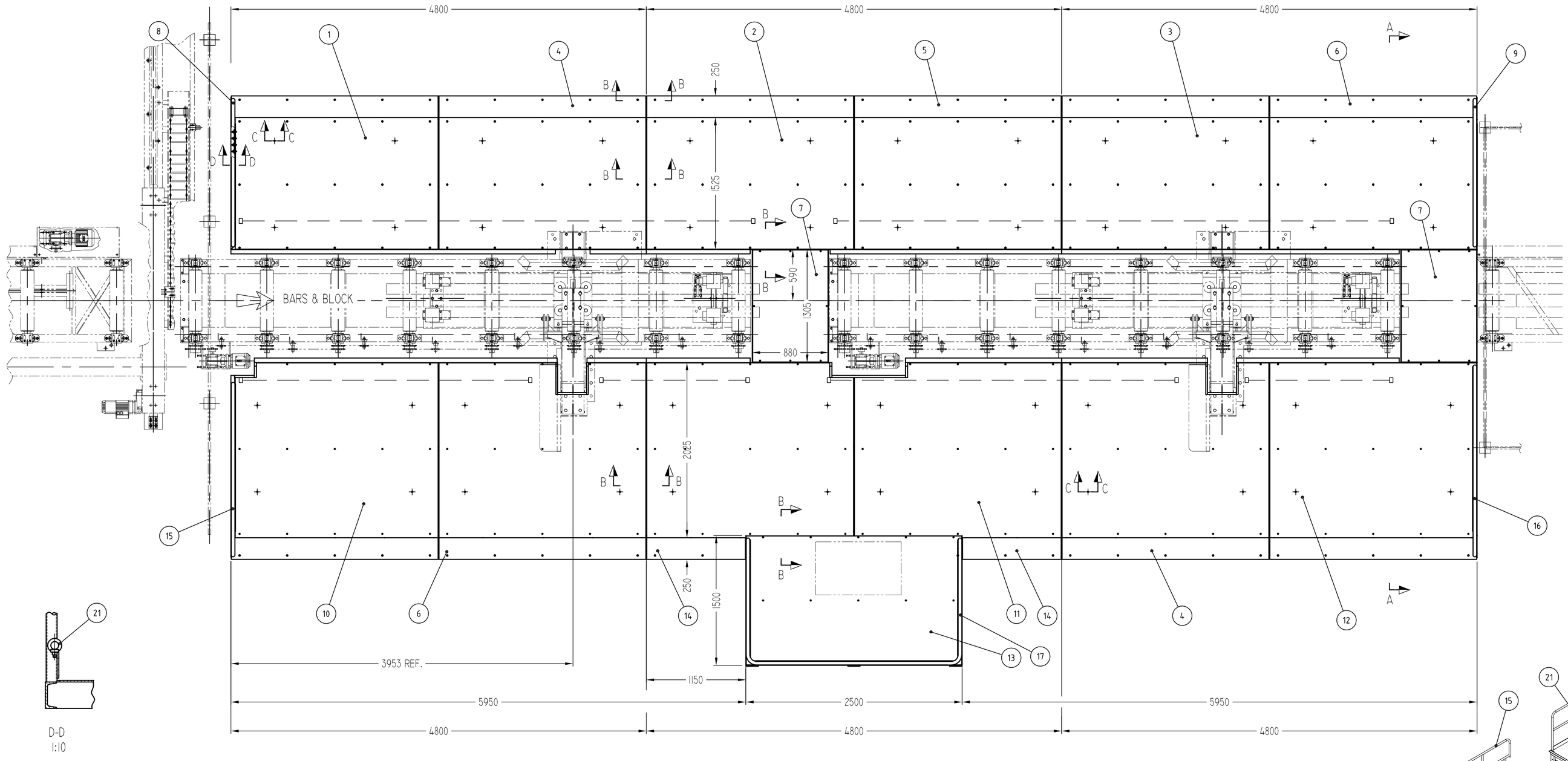

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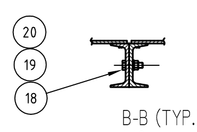

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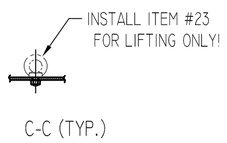

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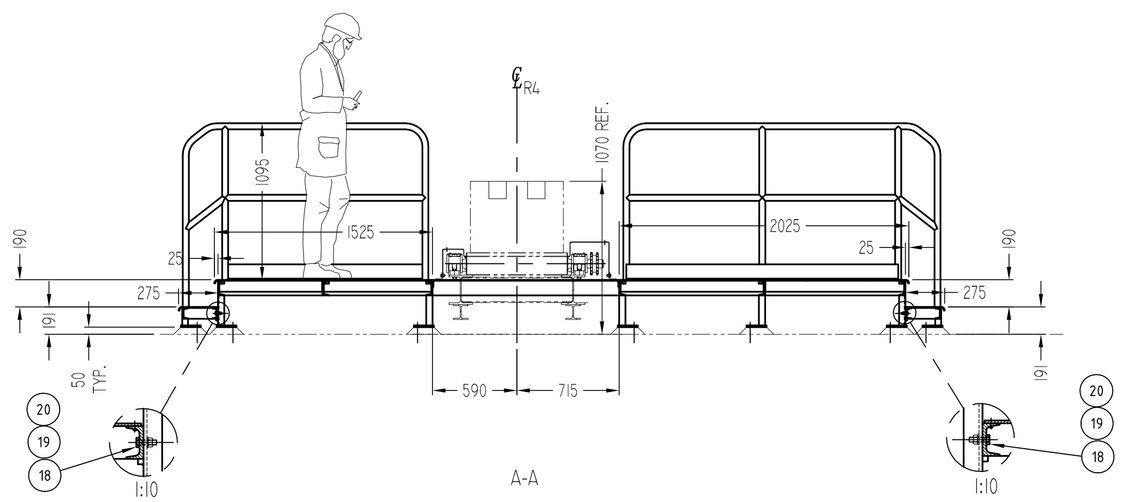

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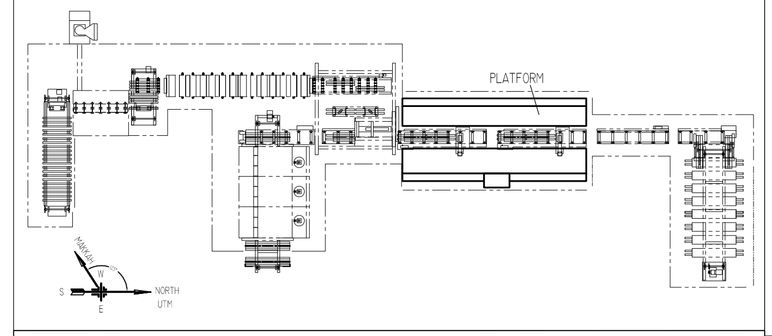
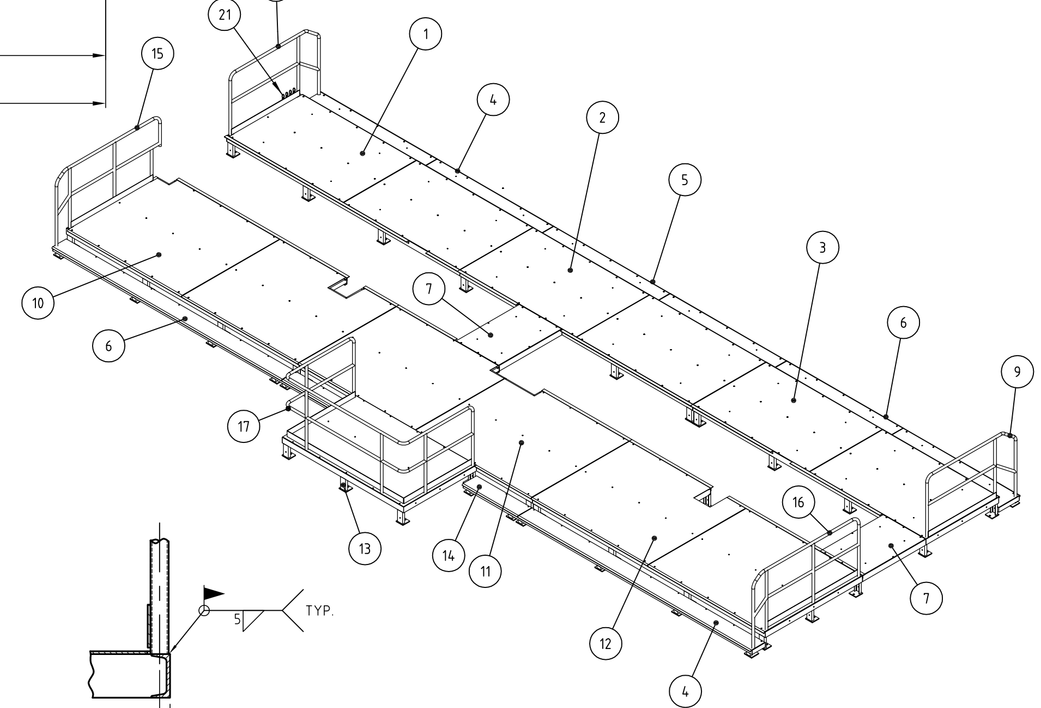


LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/Qty	No. PIECE–MAT. MAT.–PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
1	1	1347–R4–1501	PLATFORM #1 (LEFT)	BY GNA	660
2	1	1347–R4–1502	PLATFORM #2 (LEFT)	BY GNA	660
3	1	1347–R4–1503	PLATFORM #3 (LEFT)	BY GNA	660
4	2	1347–R4–1504	STAIR #1 (LEFT–RIGHT)	1X BY GNA / 1X BY CLIENT	560
5	1	1347–R4–1505	STAIR #2 (LEFT)	BY GNA	280
6	2	1347–R4–1506	STAIR #3 (LEFT–RIGHT)	1X BY GNA / 1X BY CLIENT	560
7	2	1347–R4–1507	PLATFORM #4 (LEFT)	BY GNA	216
8	1	1347–R4–1508	HANDRAIL #1 (LEFT)	BY GNA	32
9	1	1347–R4–1509	HANDRAIL #2 (LEFT)	BY GNA	32
10	1	1347–R4–1510	PLATFORM #1 (RIGHT)	BY CLIENT	835
11	1	1347–R4–1511	PLATFORM #2 (RIGHT)	BY CLIENT	820
12	1	1347–R4–1512	PLATFORM #3 (RIGHT)	BY CLIENT	835
13	1	1347–R4–1513	PLATFORM #4 (RIGHT)	BY CLIENT	330
14	2	1347–R4–1514	STAIR #1 (RIGHT)	BY CLIENT	96
15	1	1347–R4–1515	HANDRAIL #1 (RIGHT)	BY CLIENT	36
16	1	1347–R4–1516	HANDRAIL #2 (RIGHT)	BY CLIENT	40
17	1	1347–R4–1517	HANDRAIL #3 (RIGHT)	BY CLIENT	82
18	64	STD	HEX. BOLT M12x40 DIN 933	28 BY CLIENT	
19	64	STD	HEX. NUT M12 DIN 934	28 BY CLIENT	
20	64	STD	FLAT WASHER 12 DIN 125	28 BY CLIENT	
21	4	DIN 580	DROP FORGED EYE BOLTS M12 (SPAENAUR 026–003)		

BY GNA : 3085 Kg
BY CLIENT : 3400 Kg
TOTAL APPROX. WEIGHT : 6485 Kg



DETAIL TYP.
1:10

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2	☐ Revise & Resubmit. Work may proceed subject to incorporation of changes.	5	☐ VOID / Superseded.
3	☐ Revise & Resubmit. Work may NOT proceed.	DDR Nbr :	

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Discipline :

Document No : 25457- **Rev. : 0**

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SELLER DRAWING No. 1347–R4–1500 REV. 1

NUMBER	REV.	TITLE

REFERENCE DRAWINGS

REV.	DESCRIPTION	DATE	DRN.	CHK.	R.E.	A.E. / S.	E.G.S.	P.E.M.
1	GEN. REV.	NO.16.10	E.I.	M.B.	C.C.			
0	INITIAL DESIGN	OC.04.10	E.I.	M.B.	C.C.			

REVISIONS

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Ma'aden Aluminum Project

SCALE: 1:30 FORMAT A1

Bechtel

GNA alutech inc.
Departement Ingenierie
Engineering Department
9495 Trans-Canada
Saint-Laurent, Quebec
H4S 1V3
Canada

		DATE
DRAWN	E.I.	OC.04.'10
CHK.	M. Blanchet	
R.E.	C. Coupal	
A.E. / S.		
E.G.S.		
P.E.M.		
CLIENT		

BECHTEL DRG. No. — — — — — REV.

Ras Az Zawr
Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
PLATFORMS
GENERAL ARRANGEMENT

CLIENT DRG. No. REV.

USER: $USERNAME$
TIME: $TIME$
$DATE$
$FILE$
DATE:
FILE:

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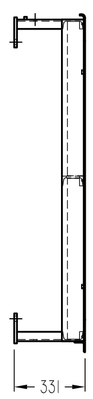
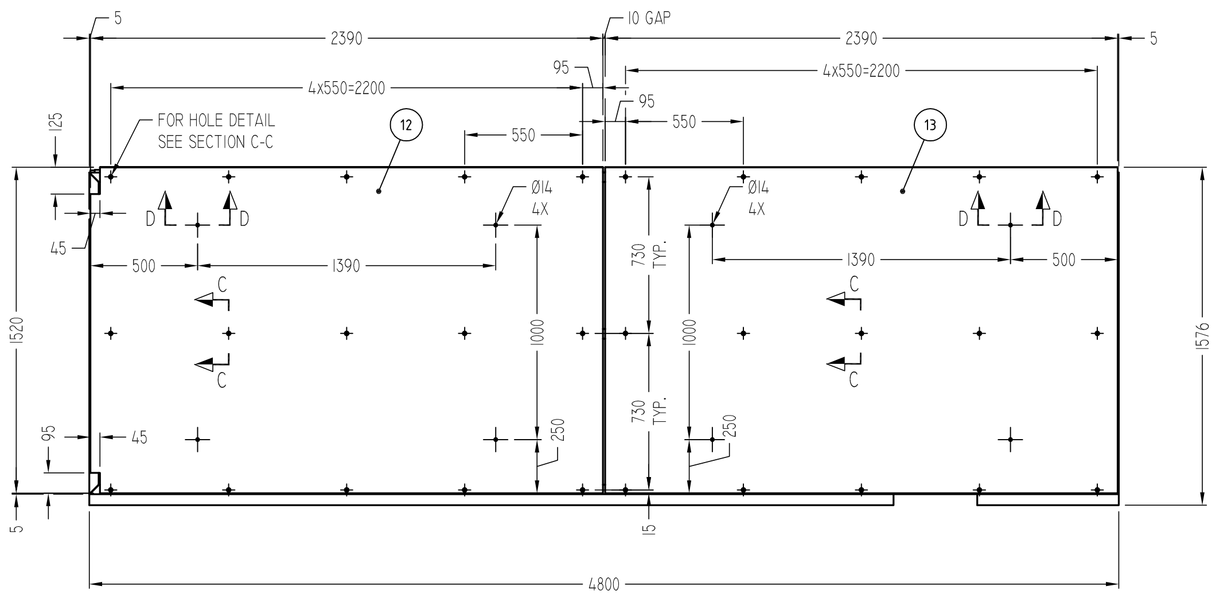
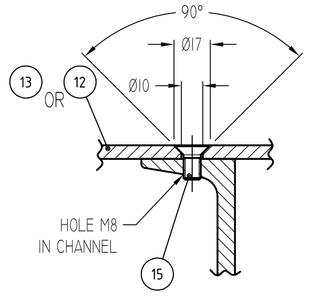
LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/Qty	No. PIECE-MAT. MAT.-PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
1	2	44W	C 4 x 7.25 x 4800		
2	1	44W	C 4 x 7.25 x 1500		
3	1	44W	C 4 x 7.25 x 1500		
4	1	44W	C 4 x 7.25 x 4783		
5	4	44W	C 4 x 7.25 x 210		
6	3	44W	C 4 x 7.25 x 210		
7	5	44W	C 3 x 6 x 720		
8	5	44W	C 3 x 6 x 750		
9	1	44W	L 2 x 2 x 1/4 x 3750		
10	1	44W	L 2 x 2 x 1/4 x 660		
11	7	44W	PL. 1/2 x 140 x 140		
12	1	44W	CHECKERED PLATE 1/4" x 1535 x 2390		
13	1	44W	CHECKERED PLATE 1/4" x 1535 x 2390		
14	4	STD	SQ. BAR 1/2" x 100		
15	30	STD	HEX SOCKET CAP SCREW M8x16 DIN 7991		
16	8	STD	HEX. NUT M12 DIN 934		

TOTAL WEIGHT APPROX. = 660 KG

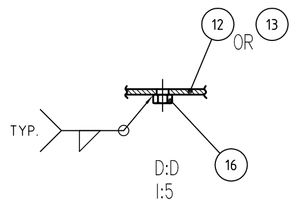


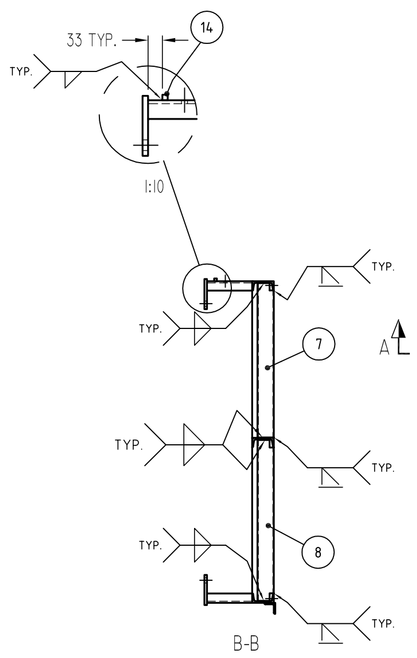


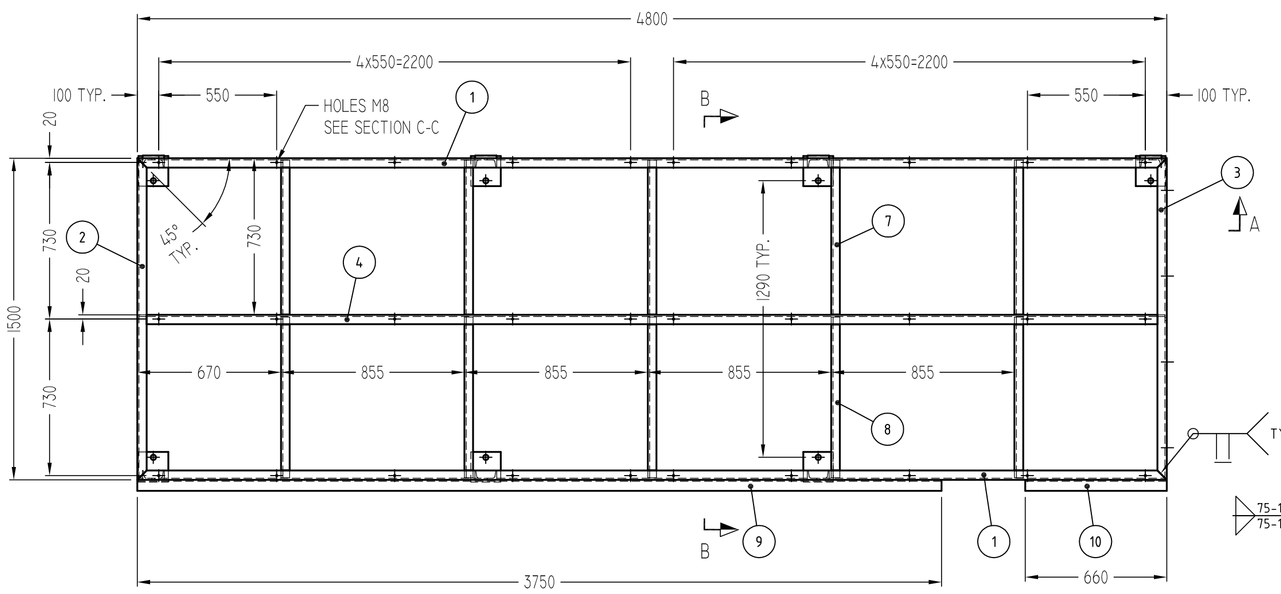


DRILL NOTE:
DRILL PILOT HOLES
THROUGH ITEM #12 AND #13
TOGETHER WITH ITEMS #1 AND #4

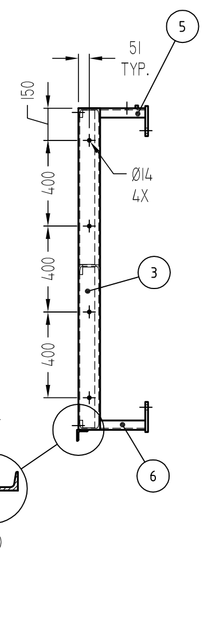
C-C
1:2

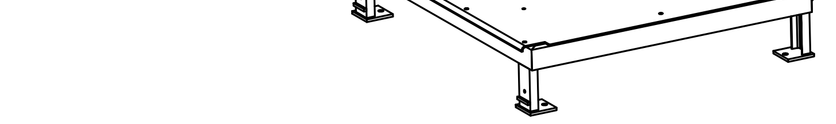


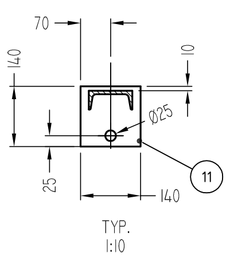


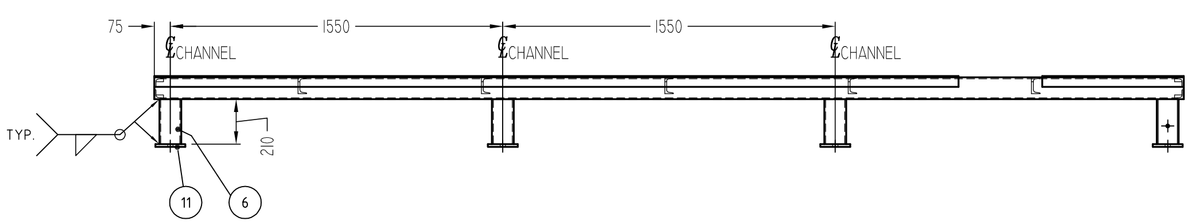


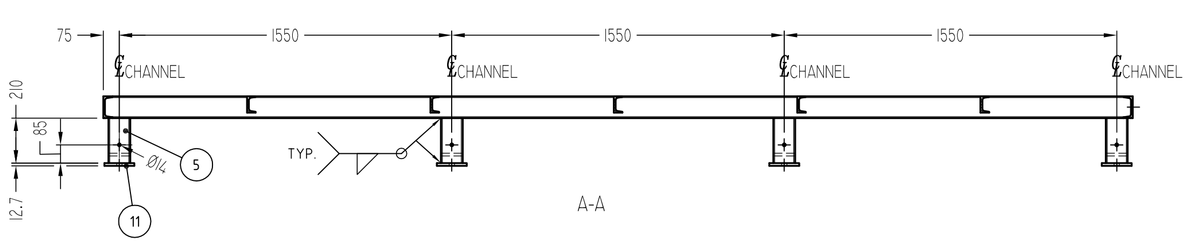
ITEMS #12 AND #13 NOT SHOWN



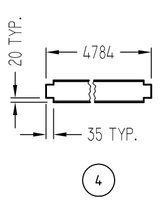


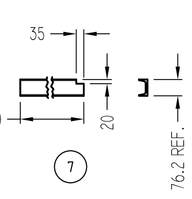


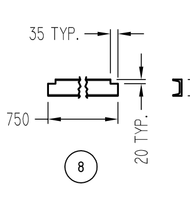


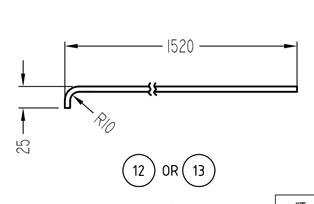


A-A



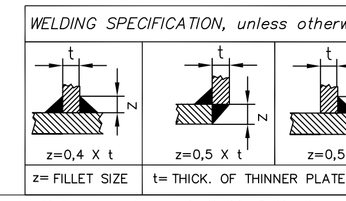






1:5

WELDING SPECIFICATION, unless otherwise noted



z= FILLET SIZE t= THICK. OF THINNER PLATE

TOLERANCES, IF NOT SPECIFIED
METRIC (mm)

ASSEMBLY WELDED CONSTRUCTION			
NOM. Length		NOM. Length	
from 30 to 120	± 1.0	from 1000 to 2000	± 3.0
from 120 to 315	± 1.0	from 2000 to 4000	± 4.0
from 315 to 1000	± 2.0	over 4000	± 5.0

MACHINING			
O:	± 0,4	--- HOLES ---	
O.D.:	± 0,1		
O.ID:	± 0,05	CBC:	± .20
ANG.:	± 1°	LOC.:	± .35

NOTES:
1. BREAK SHARP CORNERS, DEBURR AFTER DRILLING AND CUTTING.
2. ALL STRUCTURAL SHAPES AND PLATES MUST BE WITHOUT DISTORTION.
3. ALL WELDS MUST CONFORM CSA W-47, W-59.
4. STEEL PLATES SHALL BE CUT OUT OF ONE PLATE ONLY, IF NOT, JOINING PLATES SHALL BE WELDED BUTT JOINT FULL PENETRATION. THE WELDING SEAM SHALL BE BEHIND A STRUCTURAL SHAPE.
   IF NOT OTHERWISE SPECIFIED, ALL WELDS ARE CONTINUOUS.
5. CLEAN ALL WELDED SURFACES OF BURRS AND ASPERITIES.
6. HANDLE PAINTED PIECES WITH CARE (TO AVOID RUST AFTER INSTALLATION)
7. PROVIDE AND INSTALL LIFTING LUG(S) APPROPRIATE FOR TOTAL WEIGHT OF PART(S). (IF APPLICABLE)
8. PRE-ASSEMBLE PARTS IN SHOP FOR DIMENSIONAL AND FUNCTIONAL VERIFICATION.
9. ALL MACHINED SURFACES TO BE COATED WITH TEMPORARY CORROSION PROTECTION.
10. PIECES SHALL BE MATCH MARKED FOR SUBSEQUENT DISASSEMBLY.
11. LENGTHS ON BILL OF MATERIAL ARE NOMINAL DIMENSIONS, REFER TO DRAWING FOR EXACT DIMENSIONS.

PAINT NOTES:

1. PAINT PROCEDURE AND MANUFACTURER AS PER BECHTEL SPECIFICATION 25457-0000-3PS-G000-0002 REV. 001

"To the extent this document was drawn up using Aluminium Pechiney documents, such documents are identified by Aluminium Pechiney document reference number within the appropiate section of this document and this document contains confidential information which is the property of Aluminium Pechiney."

SELLER DRAWING No. 1347-R4-1501 REV. 0

NUMBER	REV.	TITLE
REFERENCE DRAWINGS		

REV.	DESCRIPTION	DATE	DRN.	CHK.	R.E.	A.E. / S.	E.G.S.	P.E.M.
0	INITIAL DESIGN	NO.16.10	E.I.	M.B.	C.C.			
REVISIONS								

STAMP

ALCOA | Ma'aden Aluminum Project

Bechtel

GNA alutech inc. — Departement Ingenierie / Engineering Department, 9495 Trans-Canada, Saint-Laurent, Quebec, H4S 1V3, Canada

		DATE
DRAWN	E.I.	NO.16.'10
CHK.	M. Blanchet	
R.E.	C. Coupal	
A.E. / S.		
E.G.S.		
P.E.M.		
CLIENT		

SCALE: 1:20 FORMAT A1

BECHTEL DRG. No. — — — — — REV.

Ras Az Zawr
Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
PLATFORMS
PLATFORM #1 (LEFT)

CLIENT DRG. No. REV.

USER: $USERNAME$
TIME: $TIME$
$DATE$
$FILE$
DATE:
FILE:

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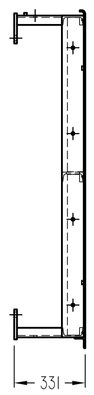
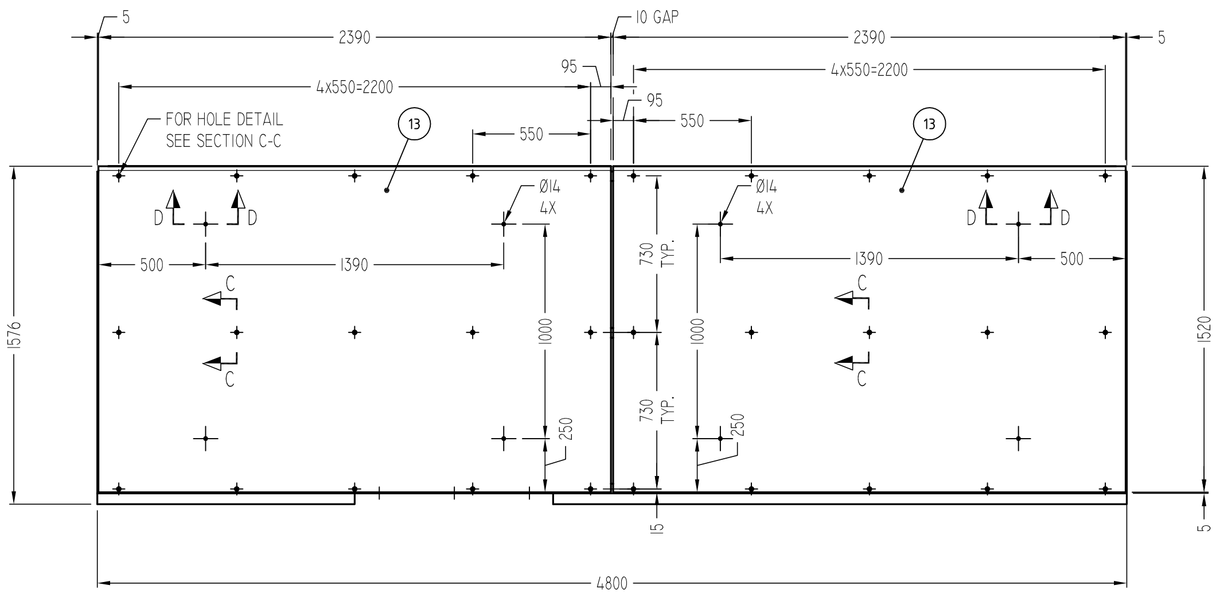
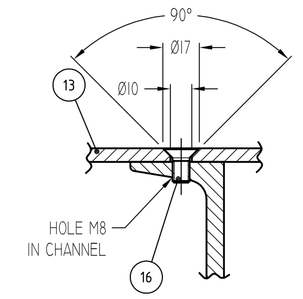
LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/Qty	No. PIECE-MAT. MAT.-PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
1	1	44W	C 4 x 7.25 x 4800		
2	1	44W	C 4 x 7.25 x 4800		
3	2	44W	C 4 x 7.25 x 1500		
4					
5	1	44W	C 4 x 7.25 x 4783		
6	4	44W	C 4 x 7.25 x 210		
7	4	44W	C 4 x 7.25 x 210		
8	5	44W	C 3 x 6 x 720		
9	5	44W	C 3 x 6 x 750		
10	1	44W	L 2 x 2 x 1/4 x 1200		
11	1	44W	L 2 x 2 x 1/4 x 2675		
12	8	44W	PL. 1/2 x 140 x 140		
13	2	44W	CHECKERED PLATE 1/4" x 1535 x 2390		
14					
15	4	STD	SQ. BAR 1/2" x 100		
16	30	STD	HEX SOCKET CAP SCREW M8x16 DIN 7991		
17	8	STD	HEX. NUT M12 DIN 934		

TOTAL WEIGHT APPROX. = 660 KG

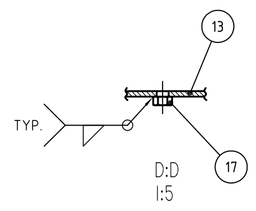


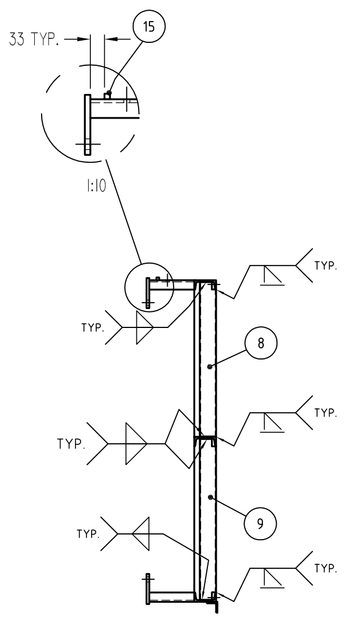




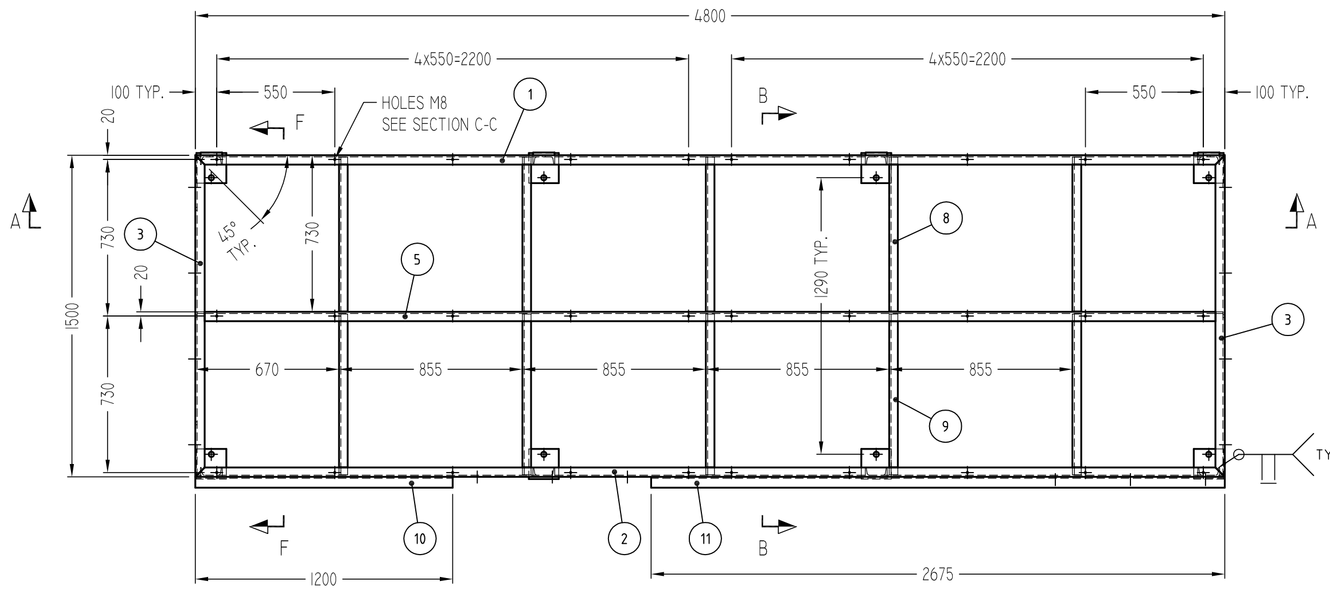
DRILL NOTE:
DRILL PILOT HOLES
THROUGH ITEM #13 AND #14
TOGETHER WITH ITEMS #1, #2 AND #4

C-C
1:2

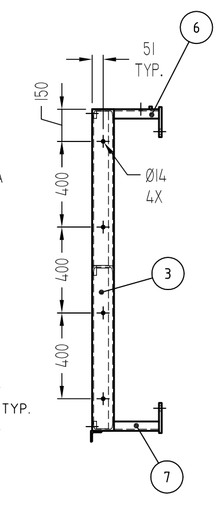


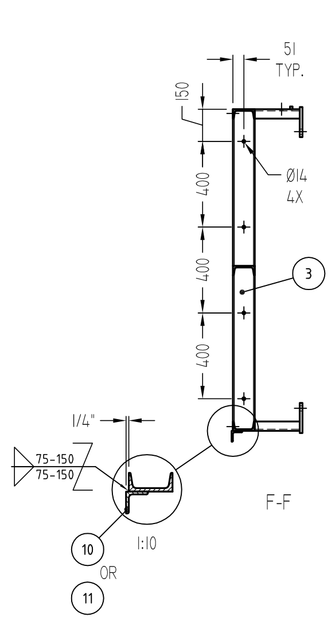


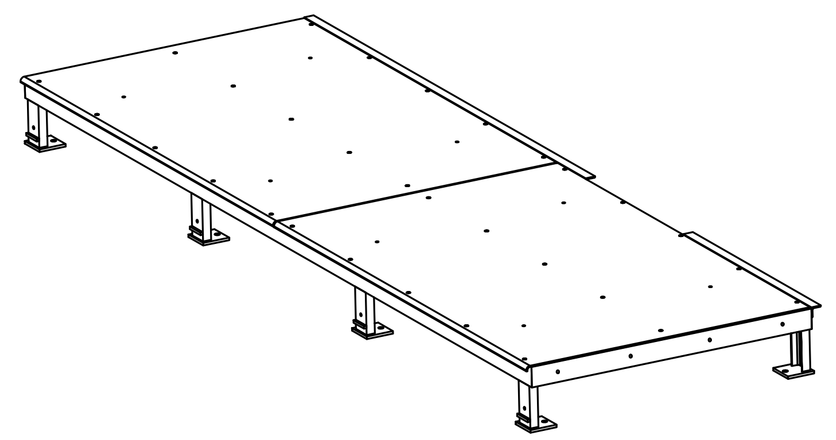
B-B

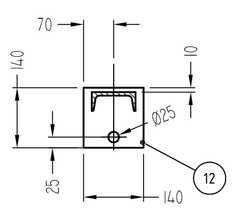


ITEM #13 NOT SHOWN

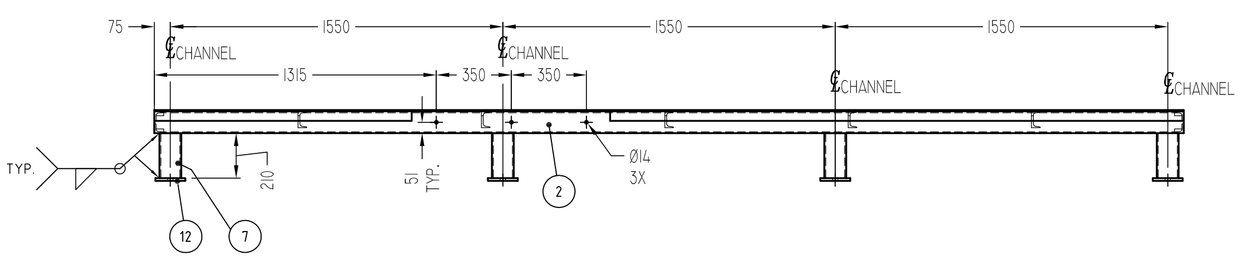


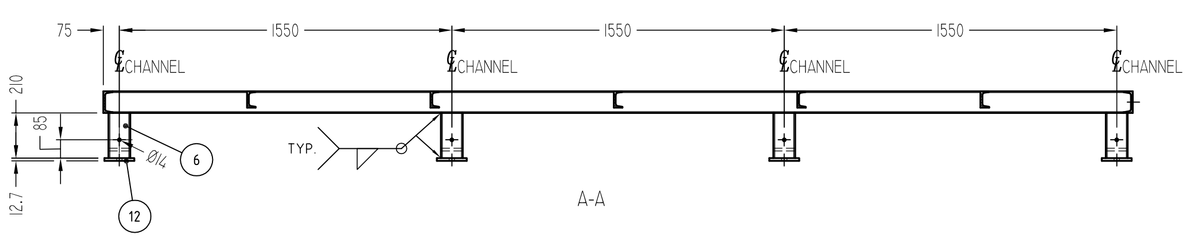




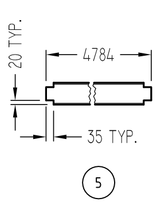


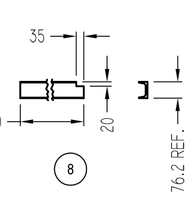
TYP.
1:10

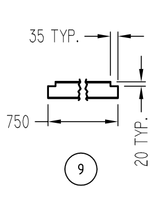


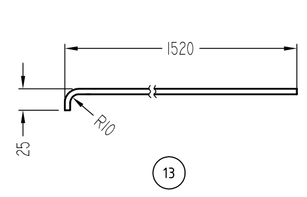


A-A









1:5

NOTES:
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4. STEEL PLATES SHALL BE CUT OUT OF ONE PLATE ONLY, IF NOT, JOINING PLATES SHALL BE WELDED BUTT JOINT FULL PENETRATION. THE WELDING SEAM SHALL BE BEHIND A STRUCTURAL SHAPE.
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11. LENGTHS ON BILL OF MATERIAL ARE NOMINAL DIMENSIONS, REFER TO DRAWING FOR EXACT DIMENSIONS.

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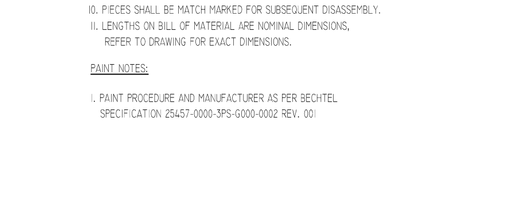
WELDING SPECIFICATION, unless otherwise noted



TOLERANCES, IF NOT SPECIFIED
LINEAR (mm)

ASSEMBLY WELDED CONSTRUCTION			
NOM. Length		NOM. Length	
from 0 to 120	± 1.0	from 1000 to 2000	± 3.0
from 315 to 1000	± 2.0	from 2000 to 4000	± 4.0
		over 4000	± 5.0

MACHINING		
0:	± 0.5	-- HOLES --
0.0:	± 0.1	
0.00:	± 0.05	DIA.: ± .20
ANG.:	± 1°	LOC.: ± .35

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SELLER DRAWING No. 1347-R4-1502 REV. 0

NUMBER	REV.	TITLE
REFERENCE DRAWINGS		

REV.	DESCRIPTION	DATE	DRN.	CHK.	R.E.	A.E. / S.	E.G.S.	P.E.M.
0	INITIAL DESIGN	NO.16.'10	E.I.	M.B.	C.C.			
REVISIONS								

STAMP

ALCOA | Ma'aden

Ma'aden Aluminum Project

Bechtel

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Departement Ingenierie
Engineering Department
9495 Trans-Canada
Saint-Laurent, Quebec
H4S 1V3
Canada

		DATE
DRAWN	E.I.	NO.16.'10
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R.E.	C. Coupal	
A.E. / S.		
E.G.S.		
P.E.M.		
CLIENT		

SCALE: 1:20 FORMAT A1

BECHTEL DRG. No. — — — — — REV.

CLIENT DRG. No. REV.

Ras Az Zawr
Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
PLATFORMS
PLATFORM #2 (LEFT)

USER: $USERNAME$
TIME: $TIME$
$DATE$
$FILE$
DATE:
FILE:

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4	1	44W	C 4 x 7.25 x 1500		
5	1	44W	C 4 x 7.25 x 4783		
6	4	44W	C 4 x 7.25 x 210		
7	4	44W	C 4 x 7.25 x 210		
8	5	44W	C 3 x 6 x 720		
9	5	44W	C 3 x 6 x 750		
10	1	44W	L 2 x 2 x 1/4 x 1650		
11	1	44W	L 2 x 2 x 1/4 x 1850		
12	8	44W	PL. 1/2 x 140 x 140		
13	1	44W	CHECKERED PLATE 1/4" x 1535 x 2390		
14	1	44W	CHECKERED PLATE 1/4" x 1535 x 2390		
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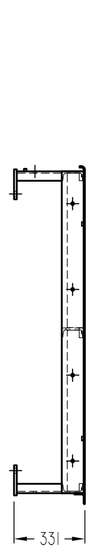
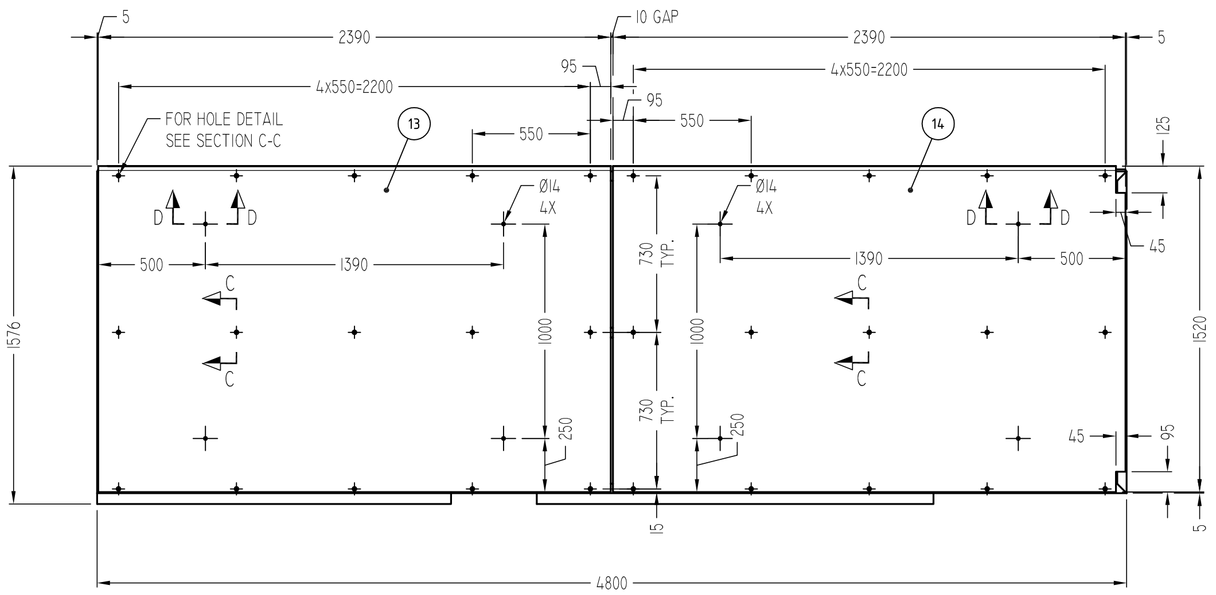
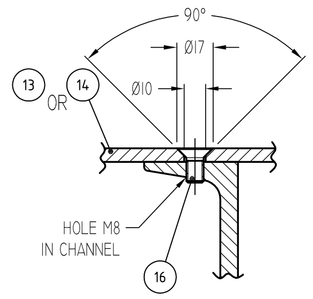
17	8	STD	HEX. NUT M12 DIN 934		

TOTAL WEIGHT APPROX. = 660 KG







DRILL NOTE:
DRILL PILOT HOLES
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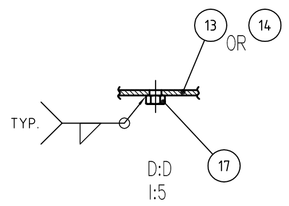
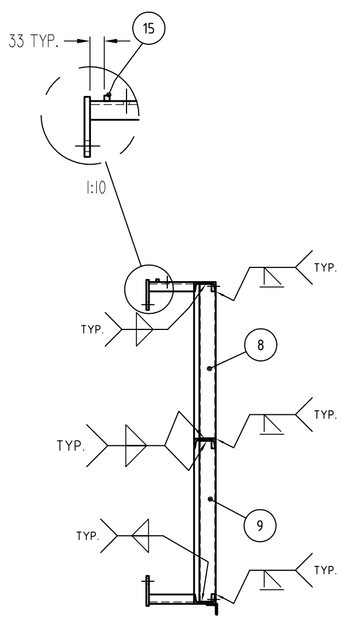
C-C
1:2





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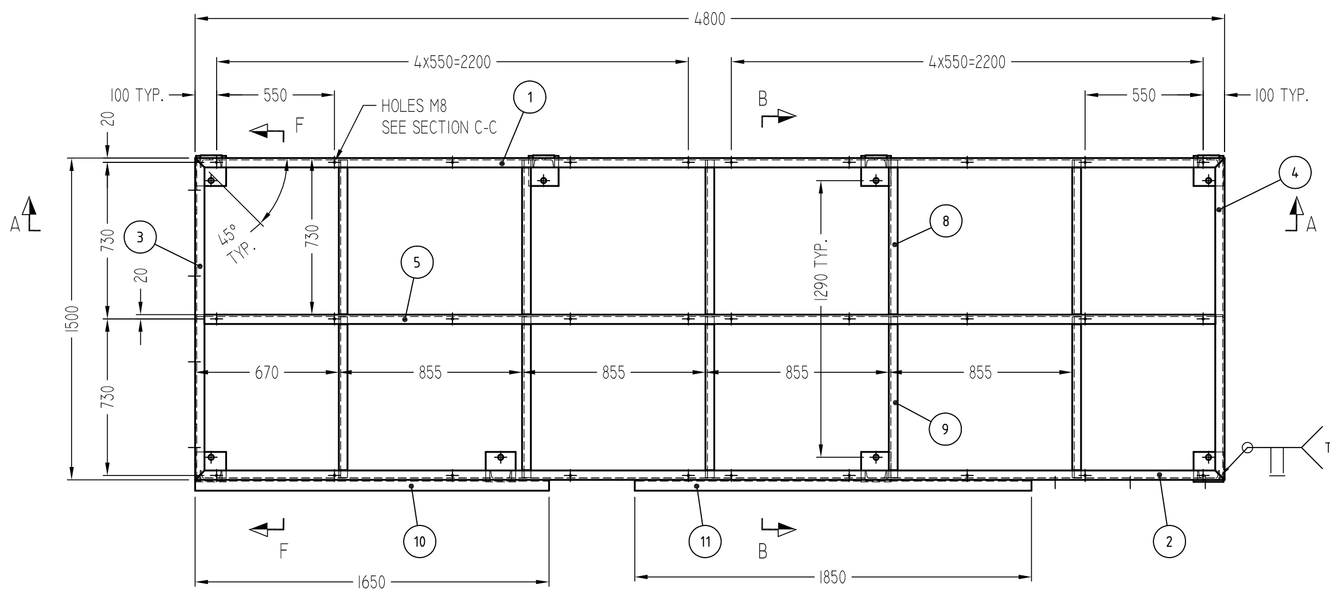

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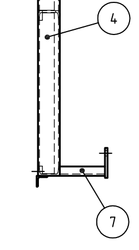

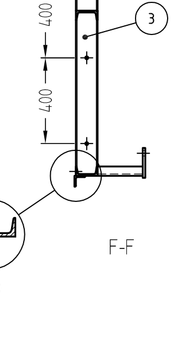

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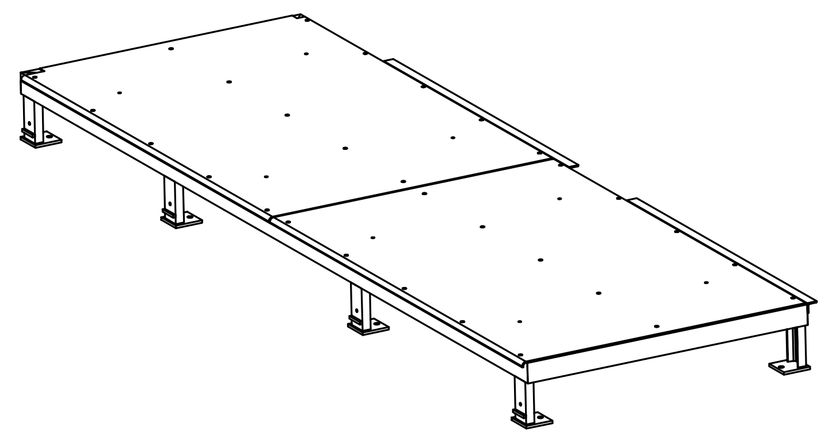

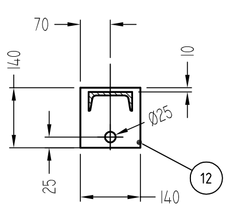

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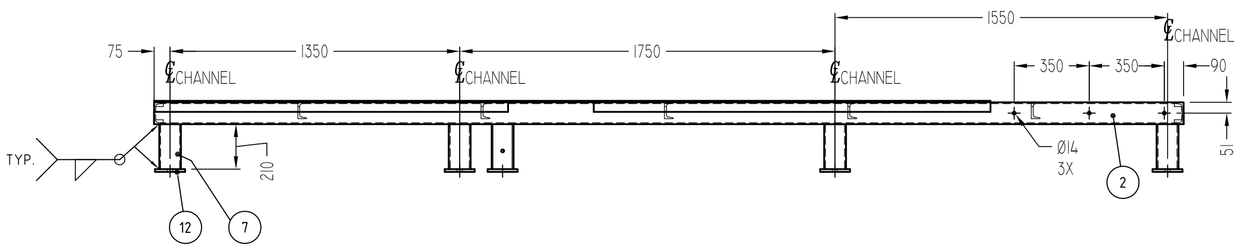

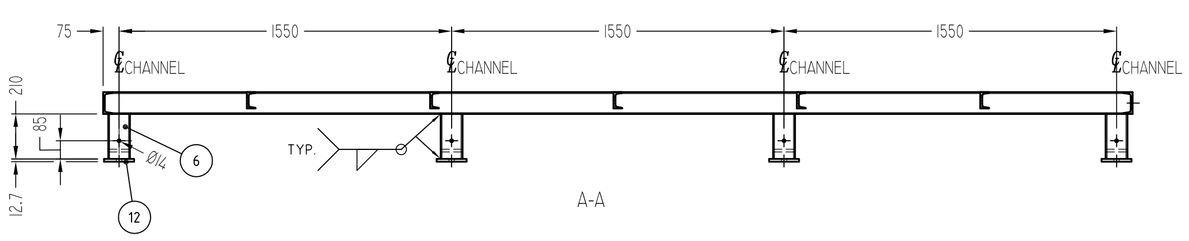

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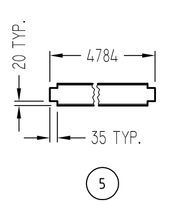

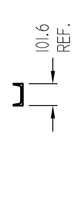

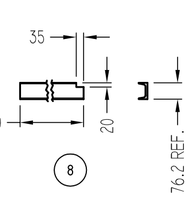

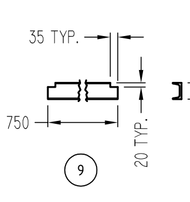

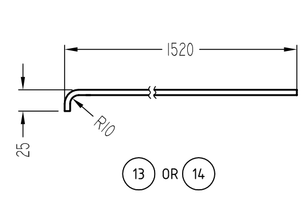

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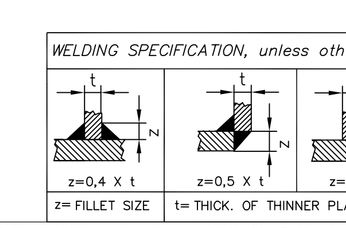

z=0,4 X t | z=0,5 X t | z=0,5 X t

z= FILLET SIZE | t= THICK. OF THINNER PLATE

TOLERANCES, IF NOT SPECIFIED
METRIC (mm)

ASSEMBLY WELDED CONSTRUCTION

NOM. Length	±	NOM. Length	±
from 30 to 120	1.0	from 1000 to 2000	3.0
from 120 to 315	1.0	from 2000 to 4000	4.0
from 315 to 1000	2.0	over 4000	5.0

MACHINING

0.	± 0.5	-- HOLES --
0.0:	± 0.1	--
0.00:	± 0.05	CBC.: ± .20
ANG.:	± 1°	LOC.: ± .35

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SELLER DRAWING No. 1347-R4-1503 | REV. 0

NUMBER	REV.	TITLE
REFERENCE DRAWINGS		

REV.	DESCRIPTION	DATE	DRN.	CHK.	R.E.	A.E. / S.G.S.	P.E.M.
0	INITIAL DESIGN	NO.16.10	E.I.	M.B.	C.C.		
REVISIONS							

STAMP

Ma'aden Aluminum Project

SCALE: 1:20 | FORMAT A1

Bechtel

Departement Ingenierie
Engineering Department
9495 Trans-Canada
Saint-Laurent, Quebec
H4S 1V3
Canada

		DATE
DRAWN	E.I.	NO.16.'10
CHK.	M. Blanchet	
R.E.	C. Coupal	
A.E. / S.		
E.G.S.		
P.E.M.		
CLIENT		

BECHTEL DRG. No. — — — — — | REV.

CLIENT DRG. No. | REV.

Ras Az Zawr
Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
PLATFORMS
PLATFORM #3 (LEFT)

USER: $USERNAME$
TIME: $TIME$
$DATE$
$FILE$
DATE:
FILE:

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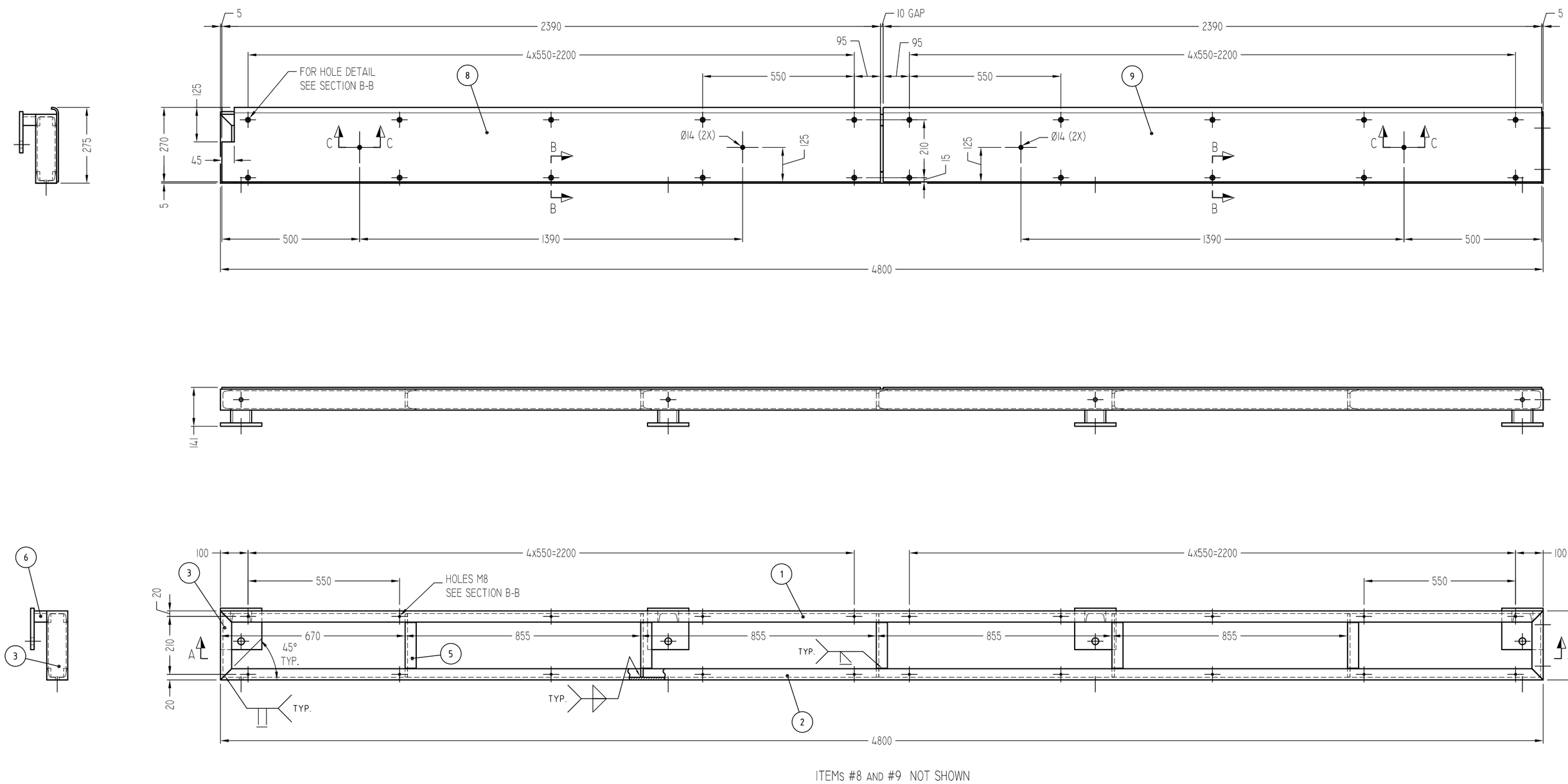
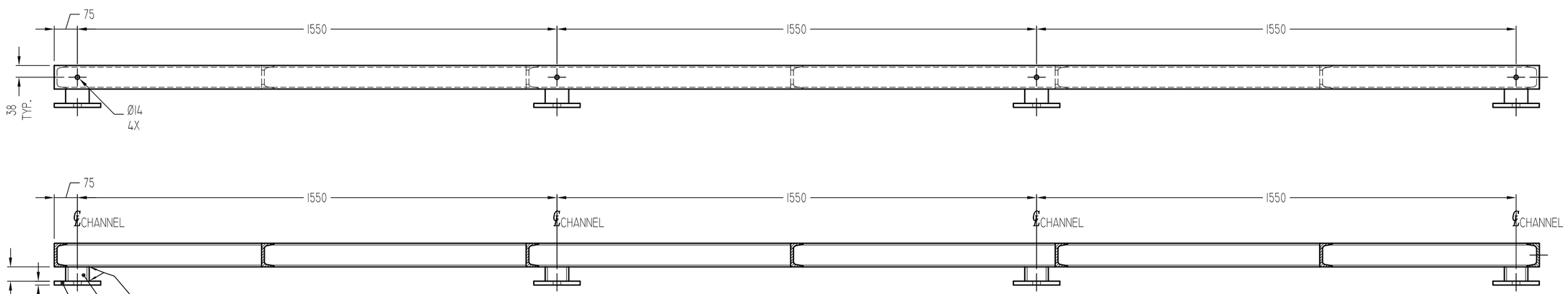
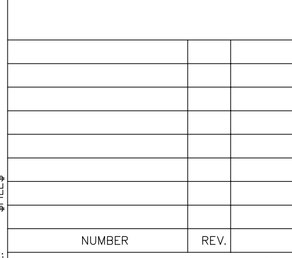
LISTE DE MATERIELS/BILL OF MATERIALS

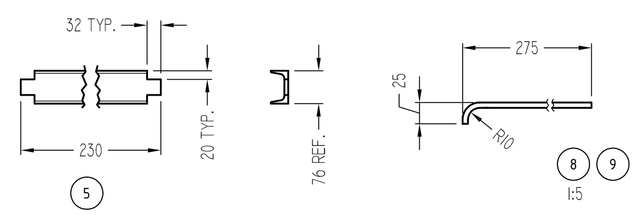
ITEM	Qte/Qty	No. PIECE-MAT. MAT.-PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
1	1	44W	C 3 x 6 x 4800		
2	1	44W	C 3 x 6 x 4800		
3	1	44W	C 3 x 6 x 250		
4	1	44W	C 3 x 6 x 250		
5	5	44W	C 3 x 6 x 230		
6	4	44W	C 3 x 6 x 46		
7	4	44W	PL. 1/2 x 140 x 140		
8	1	44W	CHECKERED PLATE 1/4" x 285 x 2390		
9	1	44W	CHECKERED PLATE 1/4" x 285 x 2390		
10	20	STD	HEX SOCKET CAP SCREW M8x16 DIN 7991		
11	4	STD	HEX. NUT M12 DIN 934		

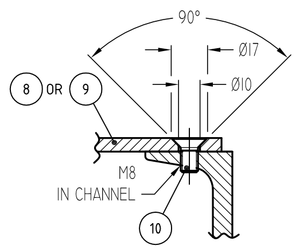
TOTAL WEIGHT APPROX. = 280 KG





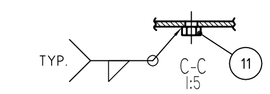


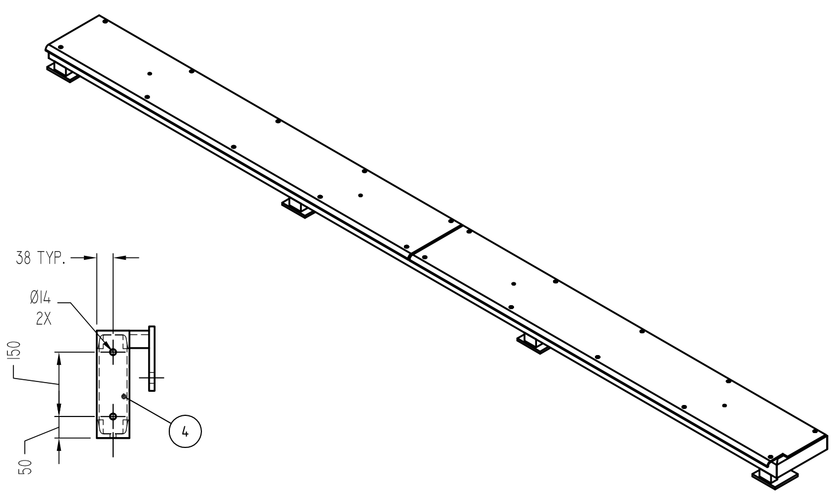




DRILL NOTE:
DRILL PILOT HOLES THROUGH ITEMS #8 AND #9 TOGETHER WITH ITEMS #1 AND #2

B-B 1:2



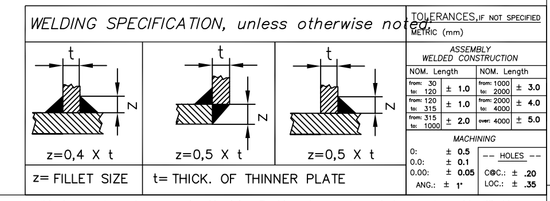


NOTES:
1. BREAK SHARP CORNERS, DEBURR AFTER DRILLING AND CUTTING.
2. ALL STRUCTURAL SHAPES AND PLATES MUST BE WITHOUT DISTORTION.
3. ALL WELDS MUST CONFORM CSA W-47, W-59.
4. STEEL PLATES SHALL BE CUT OUT OF ONE PLATE ONLY, IF NOT, JOINING PLATES SHALL BE WELDED BUTT JOINT FULL PENETRATION. THE WELDING SEAM SHALL BE BEHIND A STRUCTURAL SHAPE.
   IF NOT OTHERWISE SPECIFIED, ALL WELDS ARE CONTINUOUS.
5. CLEAN ALL WELDED SURFACES OF BURRS AND ASPERITIES.
6. HANDLE PAINTED PIECES WITH CARE (TO AVOID RUST AFTER INSTALLATION)
7. PROVIDE AND INSTALL LIFTING LUG(S) APPROPRIATE FOR TOTAL WEIGHT OF PART(S). (IF APPLICABLE)
8. PRE-ASSEMBLE PARTS IN SHOP FOR DIMENSIONAL AND FUNCTIONAL VERIFICATION.
9. ALL MACHINED SURFACES TO BE COATED WITH TEMPORARY CORROSION PROTECTION.
10. PIECES SHALL BE MATCH MARKED FOR SUBSEQUENT DISASSEMBLY.
11. LENGTHS ON BILL OF MATERIAL ARE NOMINAL DIMENSIONS, REFER TO DRAWING FOR EXACT DIMENSIONS.

PAINT NOTES:

1. PAINT PROCEDURE AND MANUFACTURER AS PER BECHTEL SPECIFICATION 25457-0000-3PS-G000-0002 REV. 001

WELDING SPECIFICATION, unless otherwise noted



TOLERANCES, IF NOT SPECIFIED
DIMS: (mm)

ASSEMBLY WELDED CONSTRUCTION

NOM. Length		NOM. Length	
from 30 to 120	± 1.0	from 1000 to 2000	± 3.0
from 120 to 315	± 1.0	from 2000 to 4000	± 4.0
from 315 to 1000	± 2.0	over 4000	± 5.0

MACHINING

		-- HOLES --	
0:	± 0.5		
0.0:	± 0.1		
0.00:	± 0.05	CBC:	± .20
ANG.:	± 1°	LOC.:	± .35

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SELLER DRAWING No. 1347-R4-1504 REV. 0

NUMBER	REV.	TITLE
REFERENCE DRAWINGS		

REV.	DESCRIPTION	DATE	DRN.	CHK.	R.E.	A.E. / S.	E.G.S.	P.E.M.
0	INITIAL DESIGN	NO.16.10	E.I.	M.B.	C.C.			
REVISIONS								

STAMP

ALCOA | MAADEN ALCOA

Ma'aden Aluminum Project

SCALE: 1:10 FORMAT A1

BECHTEL Bechtel

GNA alutech inc. Departement Ingenierie Engineering Department 9495 Trans-Canada Saint-Laurent, Quebec H4S 1V3 Canada

		DATE
DRAWN	E.I.	NO.16.'10
CHK.	M. Blanchet	
R.E.	C. Coupal	
A.E. / S.		
E.G.S.		
P.E.M.		
CLIENT		

BECHTEL DRG. No. — — — — — REV.

CLIENT DRG. No. REV.

Ras Az Zawr
Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
PLATFORMS
STAIR #1 (LEFT-RIGHT)

USER: $USERNAME$ TIME: $TIME$ $DATE$ $FILE$ DATE: FILE:

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USER: $USERNAME$
TIME: $TIME$
$DATE$
$FILE$
DATE:
FILE:

LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/Qty	No. PIECE-MAT. MAT.-PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
1	1	44W	C 3 x 6 x 4800		
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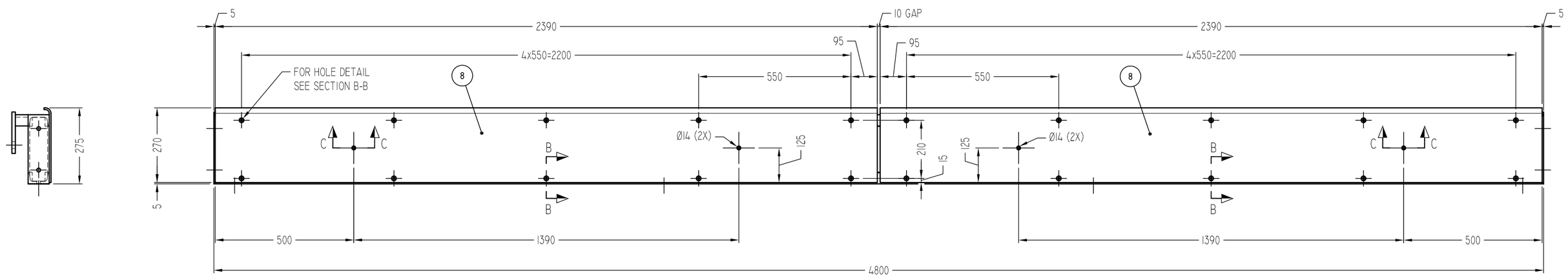
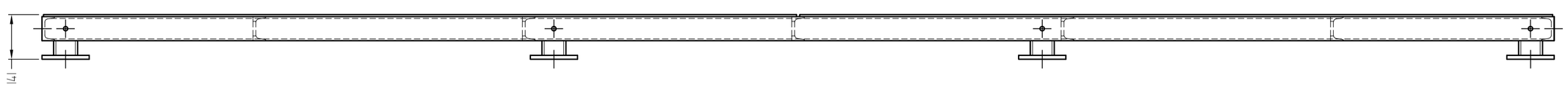
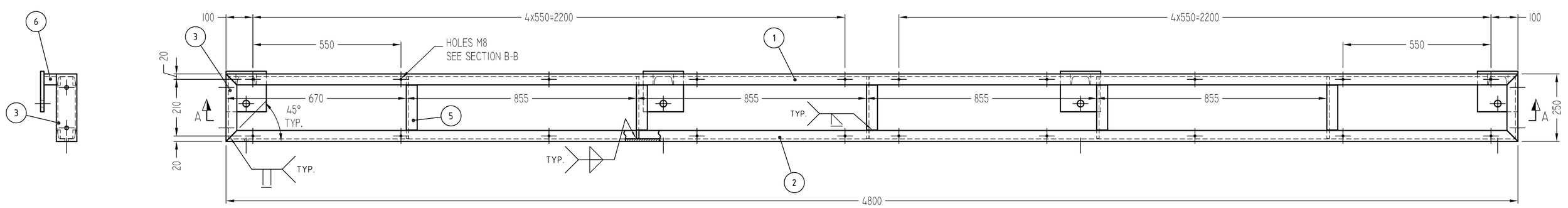
6	4	44W	C 3 x 6 x 46		
7	4	44W	PL. 1/2 x 140 x 140		
8	2	44W	CHECKERED PLATE 1/4" x 285 x 2390		
9					
10	20	STD	HEX SOCKET CAP SCREW M8x16 DIN 7991		
11	4	STD	HEX. NUT M12 DIN 934		

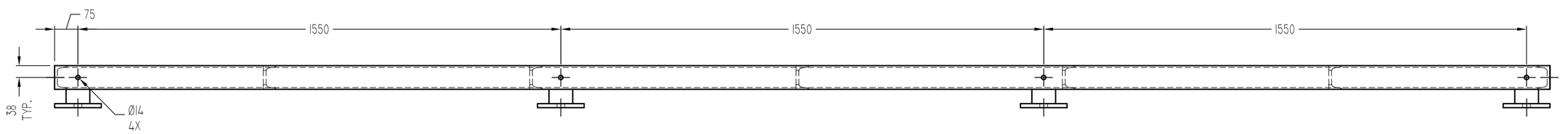
TOTAL WEIGHT APPROX. = 280 KG

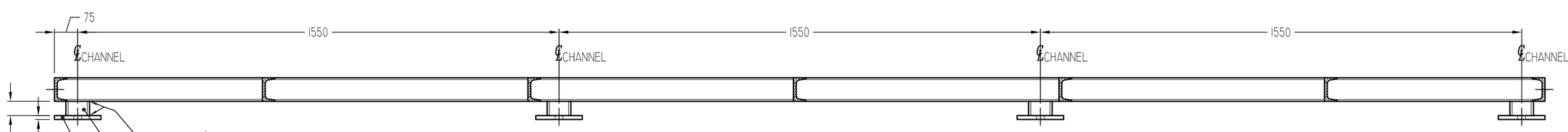






ITEMS #8 AND #9 NOT SHOWN





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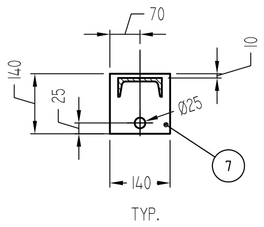
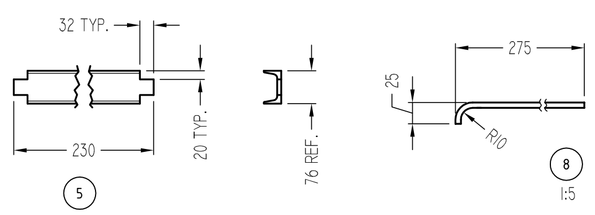
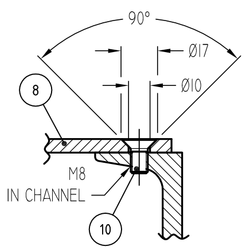
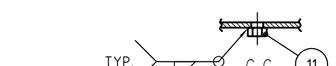


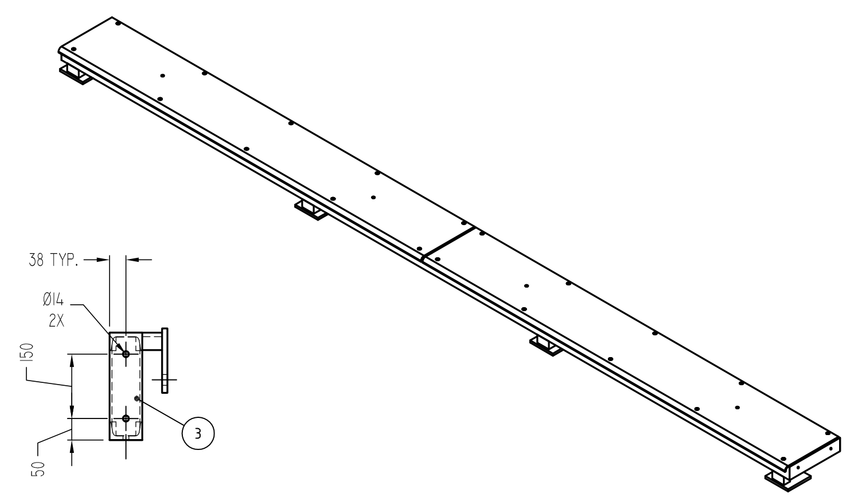




B-B
1:2

DRILL NOTE:
DRILL PILOT HOLES
THROUGH ITEMS #8
TOGETHER WITH ITEMS #1 AND #2





NOTES:
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PAINT NOTES:

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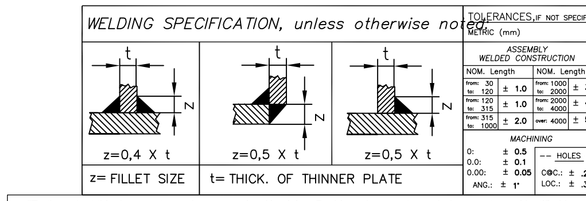
WELDING SPECIFICATION, unless otherwise noted



TOLERANCES, IF NOT SPECIFIED
DIMS: (mm)

ASSEMBLY
WELDED CONSTRUCTION

NOM. Length		NOM. Length	
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from 120 to 315	± 1.0	from 2000 to 4000	± 4.0
from 315 to 1000	± 2.0	over 4000	± 5.0

MACHINING

		-- HOLES --	
0:	± 0.5		
0.0:	± 0.1	CBC:	± .20
0.00:	± 0.05	LOC.:	± .35
ANG.:	± 1°		

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SELLER DRAWING No. 1347-R4-1505 REV. 0

NUMBER	REV.	TITLE
REFERENCE DRAWINGS		

REV.	DESCRIPTION	DATE	DRN.	CHK.	R.E.	A.E. / S.	E.G.S.	P.E.M.
0	INITIAL DESIGN	NO.16.10	E.I.	M.B.	C.C.			
REVISIONS								

STAMP

ALCOA | Ma'aden Aluminum Project

SCALE: 1:10 FORMAT A1

Bechtel

GNA alutech inc. — Departement Ingenierie Engineering Department, 9495 Trans-Canada, Saint-Laurent, Quebec, H4S 1V3, Canada

		DATE
DRAWN	E.I.	NO.16.'10
CHK.	M. Blanchet	
R.E.	C. Coupal	
A.E. / S.		
E.G.S.		
P.E.M.		
CLIENT		

BECHTEL DRG. No. — — — — — REV.

CLIENT DRG. No. REV.

Ras Az Zawr
Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
PLATFORMS
STAIR #2 (LEFT)

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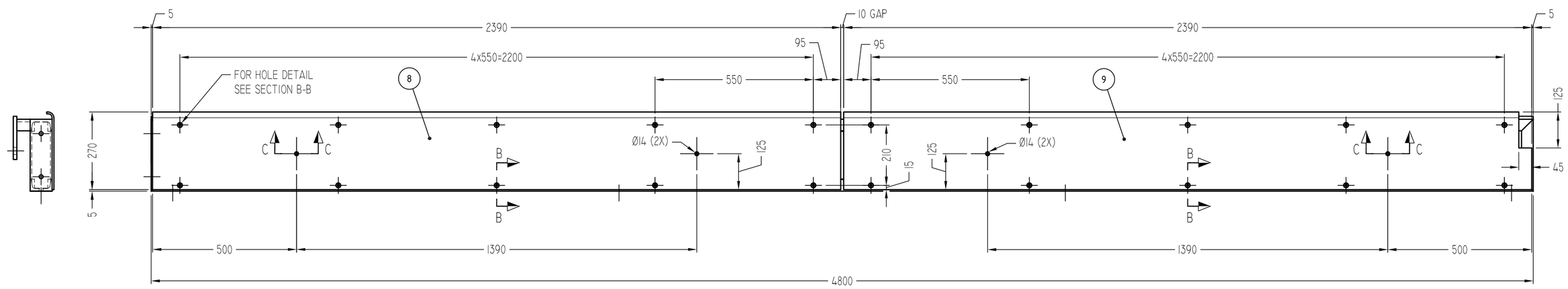
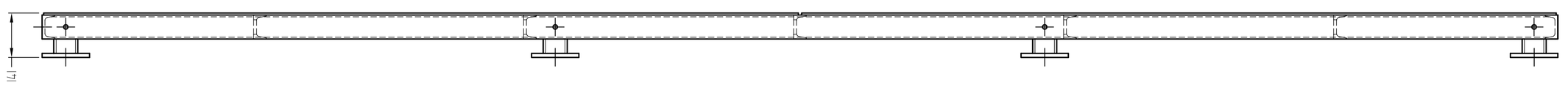
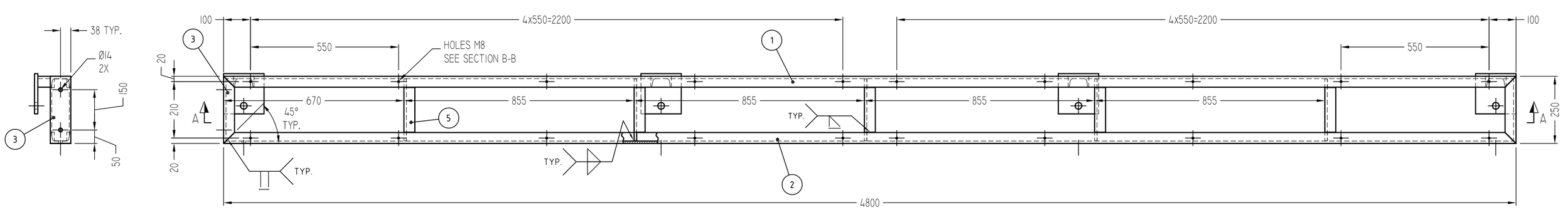
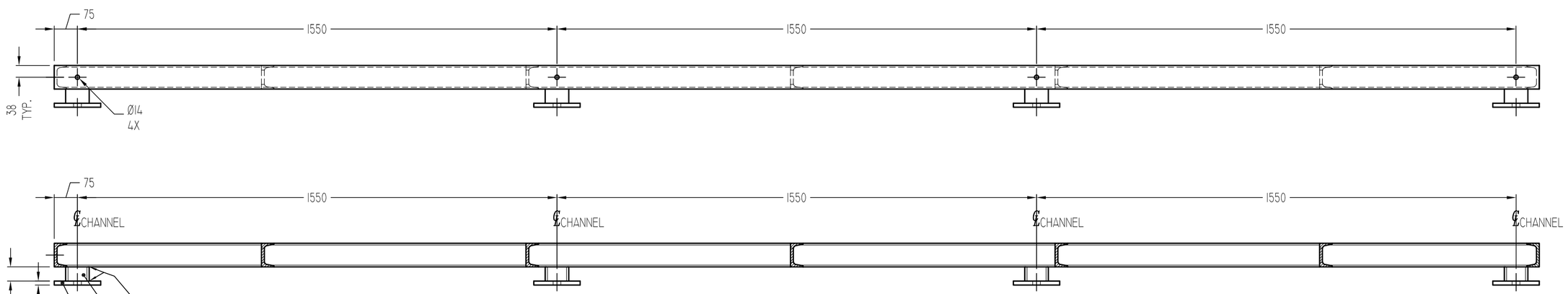


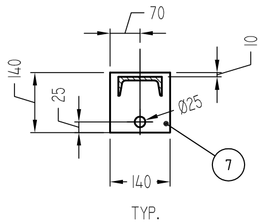


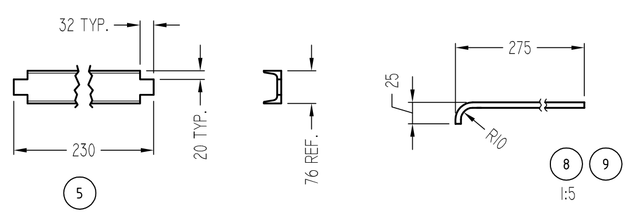


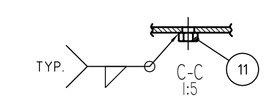
ITEMS #8 AND #9 NOT SHOWN

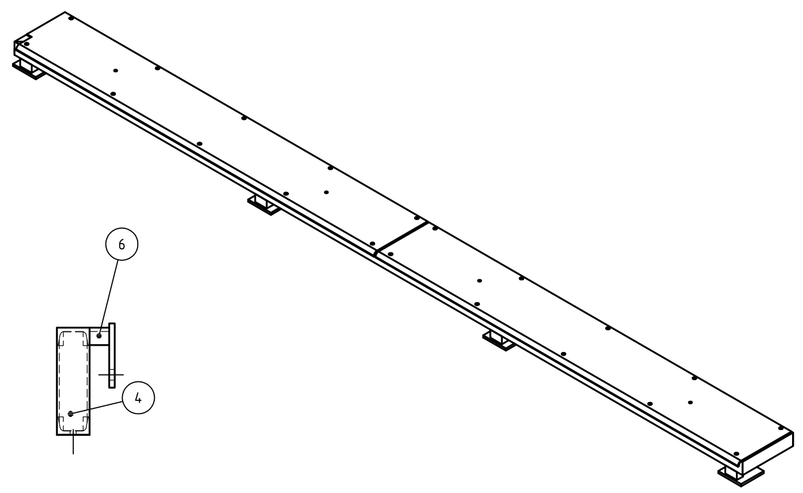


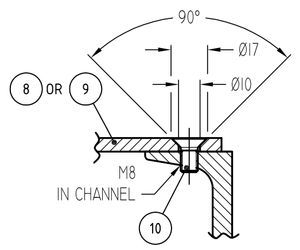
A-A











DRILL NOTE:
DRILL PILOT HOLES
THROUGH ITEMS #8 AND #9
TOGETHER WITH ITEMS #1 AND #2

B-B
1:2

NOTES:
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3. ALL WELDS MUST CONFORM CSA W-47, W-59.
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   IF NOT OTHERWISE SPECIFIED, ALL WELDS ARE CONTINUOUS.
5. CLEAN ALL WELDED SURFACES OF BURRS AND ASPERITIES.
6. HANDLE PAINTED PIECES WITH CARE (TO AVOID RUST AFTER INSTALLATION)
7. PROVIDE AND INSTALL LIFTING LUG(S) APPROPRIATE FOR TOTAL WEIGHT OF PART(S). (IF APPLICABLE)
8. PRE-ASSEMBLE PARTS IN SHOP FOR DIMENSIONAL AND FUNCTIONAL VERIFICATION.
9. ALL MACHINED SURFACES TO BE COATED WITH TEMPORARY CORROSION PROTECTION.
10. PIECES SHALL BE MATCH MARKED FOR SUBSEQUENT DISASSEMBLY.
11. LENGTHS ON BILL OF MATERIAL ARE NOMINAL DIMENSIONS, REFER TO DRAWING FOR EXACT DIMENSIONS.

PAINT NOTES:

1. PAINT PROCEDURE AND MANUFACTURER AS PER BECHTEL SPECIFICATION 25457-0000-3PS-G000-0002 REV. 001

WELDING SPECIFICATION, unless otherwise noted

TOLERANCES, IF NOT SPECIFIED
DIMENSIONS (mm)

ASSEMBLY WELDED CONSTRUCTION

NOM. Length		NOM. Length	
from 30 to 120	± 1.0	from 1000 to 2000	± 3.0
from 120 to 315	± 1.0	from 2000 to 4000	± 4.0
from 315 to 1000	± 2.0	over 4000	± 5.0

MACHINING

		-- HOLES --	
O.	± 0.5		
O.O.	± 0.1		
O.OO.	± 0.05	CBC.:	± .20
ANG.:	± 1°	LOC.:	± .35

z=0,4 X t | z=0,5 X t | z=0,5 X t

z= FILLET SIZE | t= THICK. OF THINNER PLATE

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SELLER DRAWING No. 1347-R4-1506 REV. 0

NUMBER	REV.	TITLE
REFERENCE DRAWINGS		

REV.	DESCRIPTION	DATE	DRN.	CHK.	R.E.	A.E. / S.	E.G.S.	P.E.M.
0	INITIAL DESIGN	NO.16.10	E.I.	M.B.	C.C.			

REVISIONS

STAMP

ALCOA | Ma'aden Aluminum Project

Bechtel

GNA alutech inc. — Departement Ingenierie Engineering Department, 9495 Trans-Canada, Saint-Laurent, Quebec, H4S 1V3, Canada

		DATE
DRAWN	E.I.	NO.16.'10
CHK.	M. Blanchet	
R.E.	C. Coupal	
A.E. / S.		
E.G.S.		
P.E.M.		
CLIENT		

SCALE: 1:10 | FORMAT A1

BECHTEL DRG. No. — — — — — REV.

CLIENT DRG. No. REV.

Ras Az Zawr
Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
PLATFORMS
STAIR #3 (LEFT-RIGHT)

USER: $USERNAME$ TIME: $TIME$ $DATE$ $FILE$ DATE: FILE:

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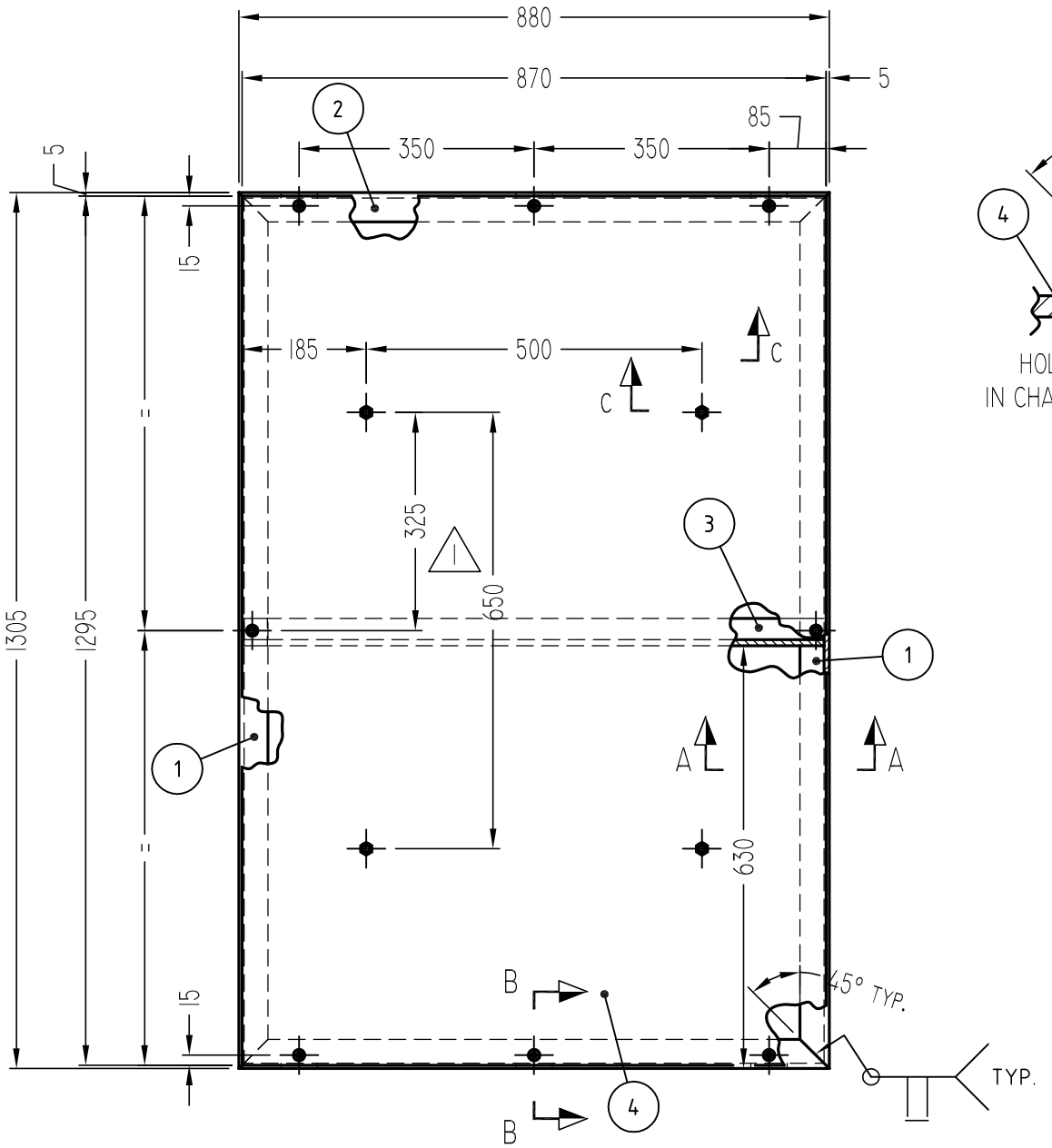
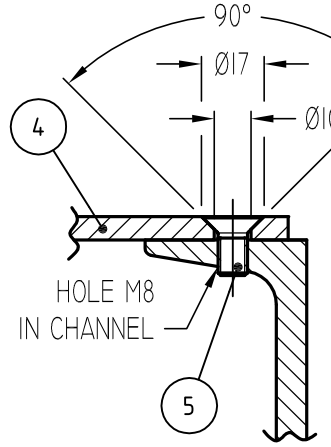




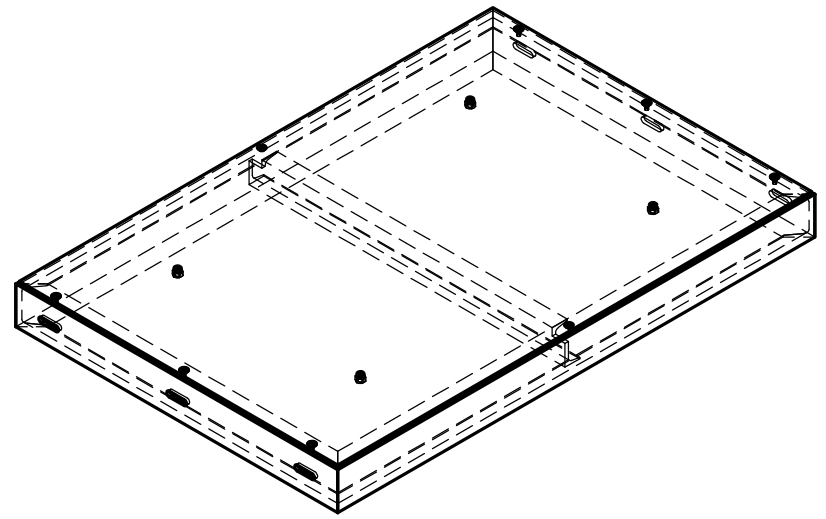
B-B
1:2

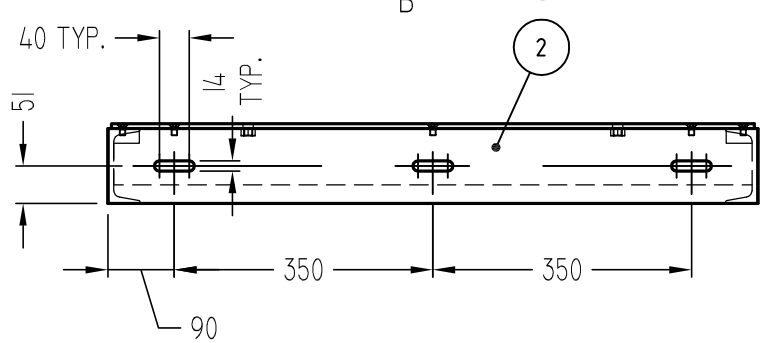
DRILL NOTE:
DRILL PILOT HOLES
THROUGH ITEM #4
TOGETHER WITH ITEMS #1, #2

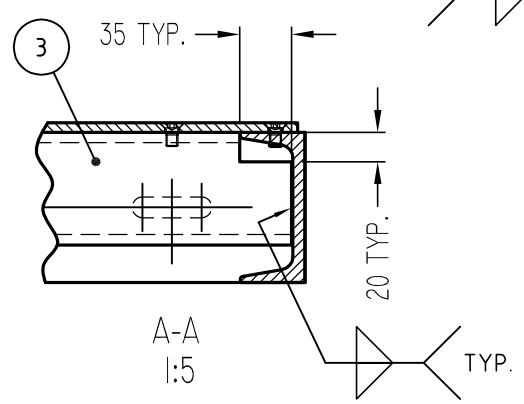
LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/Qty	No. PIECE–MAT. MAT.–PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
1	2	44W	C 4 x 7.25 x 1305		
2	2	44W	C 4 x 7.25 x 880		
3	1	44W	C 3 x 6 x 863		
4	1	44W	CHECKERED PLATE 1/4" x 870 x 1295		
5	8	STD	HEX SOCKET CAP SCREW M8x16 DIN 7991		
6	4	STD	HEX. NUT M12 DIN 934		

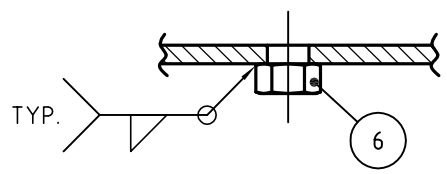
TOTAL APPROX. WEIGHT : 108 KG







A-A
1:5



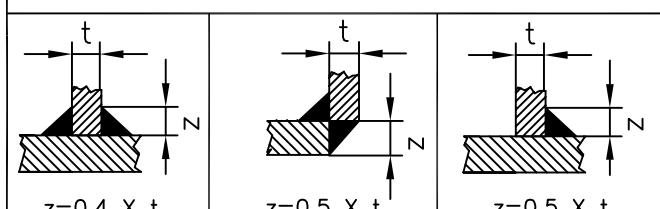
C-C
1:2

NOTES:
1. BREAK SHARP CORNERS, DEBURR AFTER DRILLING AND CUTTING.
2. ALL STRUCTURAL SHAPES AND PLATES MUST BE WITHOUT DISTORTION.
3. ALL WELDS MUST CONFORM CSA W-47, W-59.
4. STEEL PLATES SHALL BE CUT OUT OF ONE PLATE ONLY, IF NOT, JOINING PLATES SHALL BE WELDED BUTT JOINT FULL PENETRATION. THE WELDING SEAM SHALL BE BEHIND A STRUCTURAL SHAPE.
   IF NOT OTHERWISE SPECIFIED, ALL WELDS ARE CONTINUOUS.
5. CLEAN ALL WELDED SURFACES OF BURRS AND ASPERITIES.
6. HANDLE PAINTED PIECES WITH CARE (TO AVOID RUST AFTER INSTALLATION)
7. PROVIDE AND INSTALL LIFTING LUG(S) APPROPRIATE FOR TOTAL WEIGHT OF PART(S). (IF APPLICABLE)
8. PRE-ASSEMBLE PARTS IN SHOP FOR DIMENSIONAL AND FUNCTIONAL VERIFICATION.
9. ALL MACHINED SURFACES TO BE COATED WITH TEMPORARY CORROSION PROTECTION.
10. PIECES SHALL BE MATCH MARKED FOR SUBSEQUENT DISASSEMBLY.
11. LENGTHS ON BILL OF MATERIAL ARE NOMINAL DIMENSIONS, REFER TO DRAWING FOR EXACT DIMENSIONS.

PAINT NOTES:

1. PAINT PROCEDURE AND MANUFACTURER AS PER BECHTEL SPECIFICATION 25457-0000-3PS-G000-0002 REV. 001

WELDING SPECIFICATION, unless otherwise noted.



z=0,4 X t | z=0,5 X t | z=0,5 X t

z= FILLET SIZE | t= THICK. OF THINNER PLATE

TOLERANCES, IF NOT SPECIFIED METRIC (mm)

ASSEMBLY WELDED CONSTRUCTION

NOM. Length		NOM. Length	
from: 30 to: 120	± 1.0	from: 1000 to: 2000	± 3.0
from: 120 to: 315	± 1.0	from: 2000 to: 4000	± 4.0
from: 315 to: 1000	± 2.0	over: 4000	± 5.0

MACHINING

0:	± 0.5
0.0:	± 0.1
0.00:	± 0.05
ANG.:	± 1°

-- HOLES --
C©C.: ± .20
LOC.: ± .35

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SELLER DRAWING No. 1347–R4–1507 REV. 1

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		REVISIONS						
		1		DIM. UPDATED	DE.20.'10	C.C.	M.B.	C.C.
		0		INITIAL DESIGN	NO.17.'10	E.I.	M.B.	C.C.

NOTES

STATUS —

DRAWN/DES'D:	E.I.	AREA ENG.:	
DATE:	NO.17.'10	DATE:	
CHECKED:	M.B.	PRJ ENG MGR:	
DATE:		DATE:	
RESPONSIBLE ENG.	C.C.	CLIENT:	
DATE:	---	DATE:	
ENG. GROUP SUP. DATE:		DRAWING SCALE:	1:10

Vendor or Subcontractor Logo: GNA alutech Inc. Département Ingénierie / Engineering Department 1600 Transcanada Baie-d'Urfé, Québec H9X 1W3 Canada

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
PLATFORMS
PLATFORM #4 (LEFT)

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	XX -	XXXX -	XXXX -	XXX –	XXX

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3–		–AZ	

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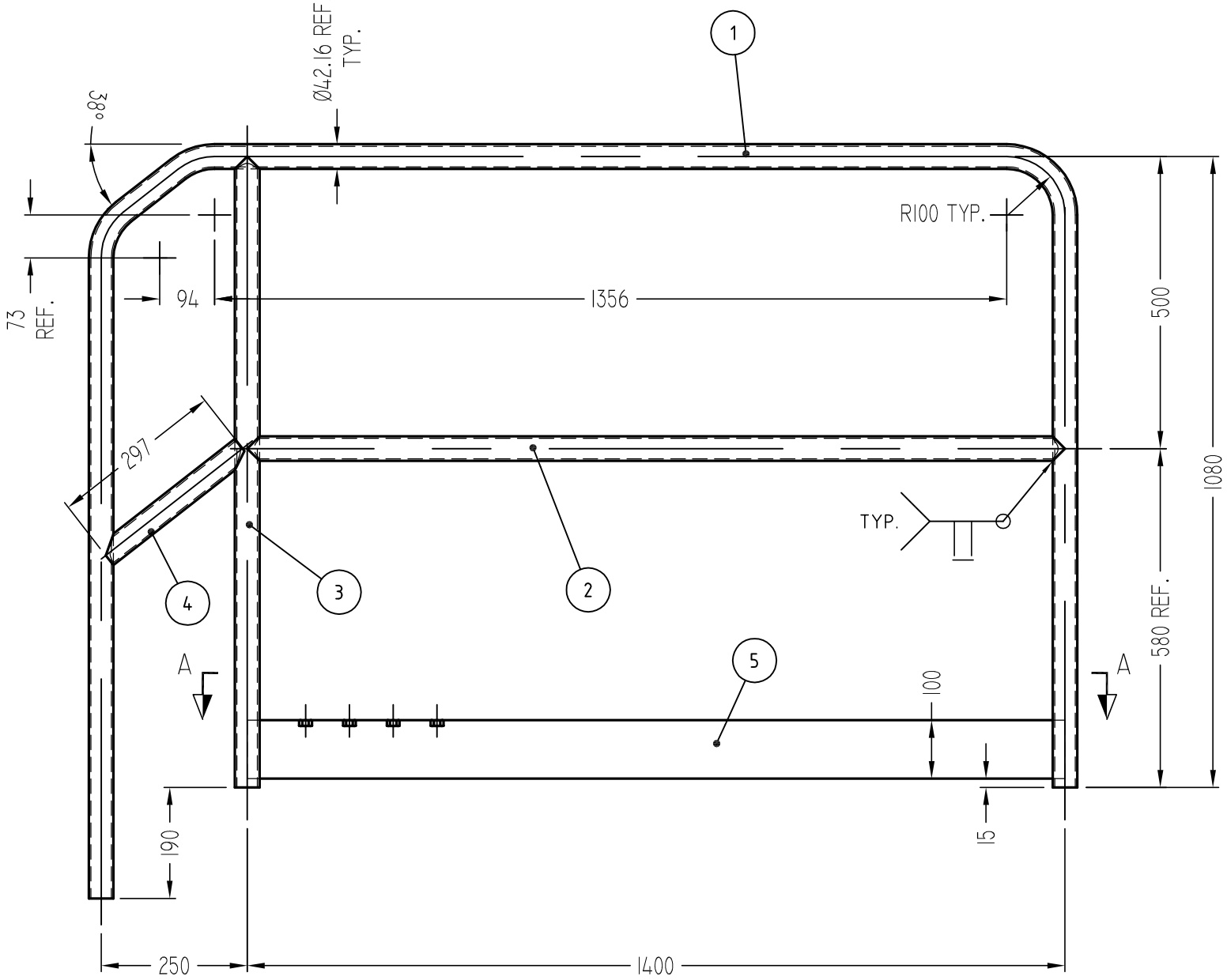
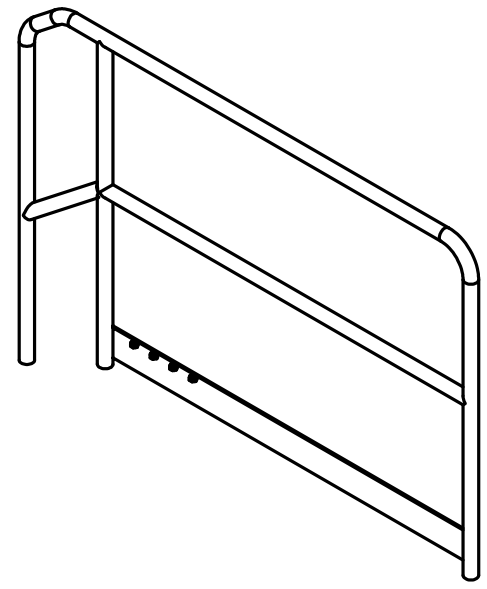
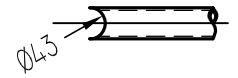






DETAIL TYP.

LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/Qty	No. PIECE–MAT. MAT.–PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
1	1	44W	PIPE 1–1/4" SCH. #40 x 4870 LG		
2	1	44W	PIPE 1–1/4" SCH. #40 x 1400 LG		
3	1	44W	PIPE 1–1/4" SCH. #40 x 1080 LG		
4	1	44W	PIPE 1–1/4" SCH. #40 x 297 LG		
5	1	44W	PL. 1/4" x 100 x 1400 LG		
6	4	STD	HEX. NUT M12 DIN 934		

TOTAL APPROX. WEIGHT : 32 KG

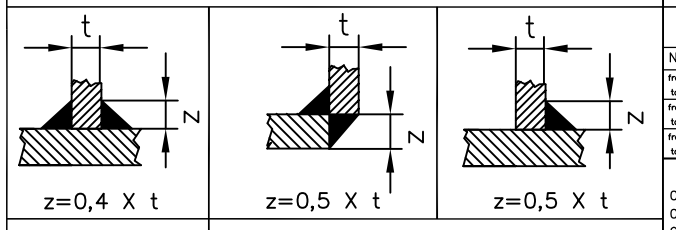
NOTES:

1. BREAK SHARP CORNERS, DEBURR AFTER DRILLING AND CUTTING.
2. ALL STRUCTURAL SHAPES AND PLATES MUST BE WITHOUT DISTORTION.
3. ALL WELDS MUST CONFORM CSA W-47, W-59.
4. STEEL PLATES SHALL BE CUT OUT OF ONE PLATE ONLY, IF NOT, JOINING PLATES SHALL BE WELDED BUTT JOINT FULL PENETRATION. THE WELDING SEAM SHALL BE BEHIND A STRUCTURAL SHAPE.
   IF NOT OTHERWISE SPECIFIED, ALL WELDS ARE CONTINUOUS.
5. CLEAN ALL WELDED SURFACES OF BURRS AND ASPERITIES.
6. HANDLE PAINTED PIECES WITH CARE (TO AVOID RUST AFTER INSTALLATION)
7. PROVIDE AND INSTALL LIFTING LUG(S) APPROPRIATE FOR TOTAL WEIGHT OF PART(S). (IF APPLICABLE)
8. PRE-ASSEMBLE PARTS IN SHOP FOR DIMENSIONAL AND FUNCTIONAL VERIFICATION.
9. ALL MACHINED SURFACES TO BE COATED WITH TEMPORARY CORROSION PROTECTION.
10. PIECES SHALL BE MATCH MARKED FOR SUBSEQUENT DISASSEMBLY.
11. LENGTHS ON BILL OF MATERIAL ARE NOMINAL DIMENSIONS, REFER TO DRAWING FOR EXACT DIMENSIONS.

PAINT NOTES:

1. PAINT PROCEDURE AND MANUFACTURER AS PER BECHTEL SPECIFICATION 25457-0000-3PS-G000-0002 REV. 001

WELDING SPECIFICATION, unless otherwise noted



z= FILLET SIZE t= THICK. OF THINNER PLATE

TOLERANCES, IF NOT SPECIFIED
METRIC (mm)

ASSEMBLY WELDED CONSTRUCTION

NOM. Length		NOM. Length	
from: 30 to: 120	± 1.0	from: 1000 to: 2000	± 3.0
from: 120 to: 315	± 1.0	from: 2000 to: 4000	± 4.0
from: 315 to: 1000	± 2.0	over: 4000	± 5.0

MACHINING

		HOLES
0:	± 0.5	C@C.: ± .20
0.0:	± 0.1	LOC.: ± .35
0.00:	± 0.05	
ANG.:	± 1°	

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SELLER DRAWING No. 1347–R4–1508 REV. 0

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		0		INITIAL DESIGN	NO.17.'10	E.I.	M.B.	C.C.
		REVISIONS						

NOTES

STATUS —

DRAWN/DES'D: E.I. DATE: NO.17.'10
CHECKED: M.B. DATE: ---
RESPONSIBLE ENG. C.C. DATE: ---
ENG. GROUP SUP. DATE:
AREA ENG.: DATE:
PRJ ENG MGR.: DATE:
CLIENT: DATE:
DRAWING SCALE: 1:10

Vendor or Subcontractor Logo: GNA alutech Inc. Département Ingénierie Engineering Department 9690 Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
PLATFORMS
HANDRAIL #1 (LEFT)

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx –	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—	—	A3–		–AZ	

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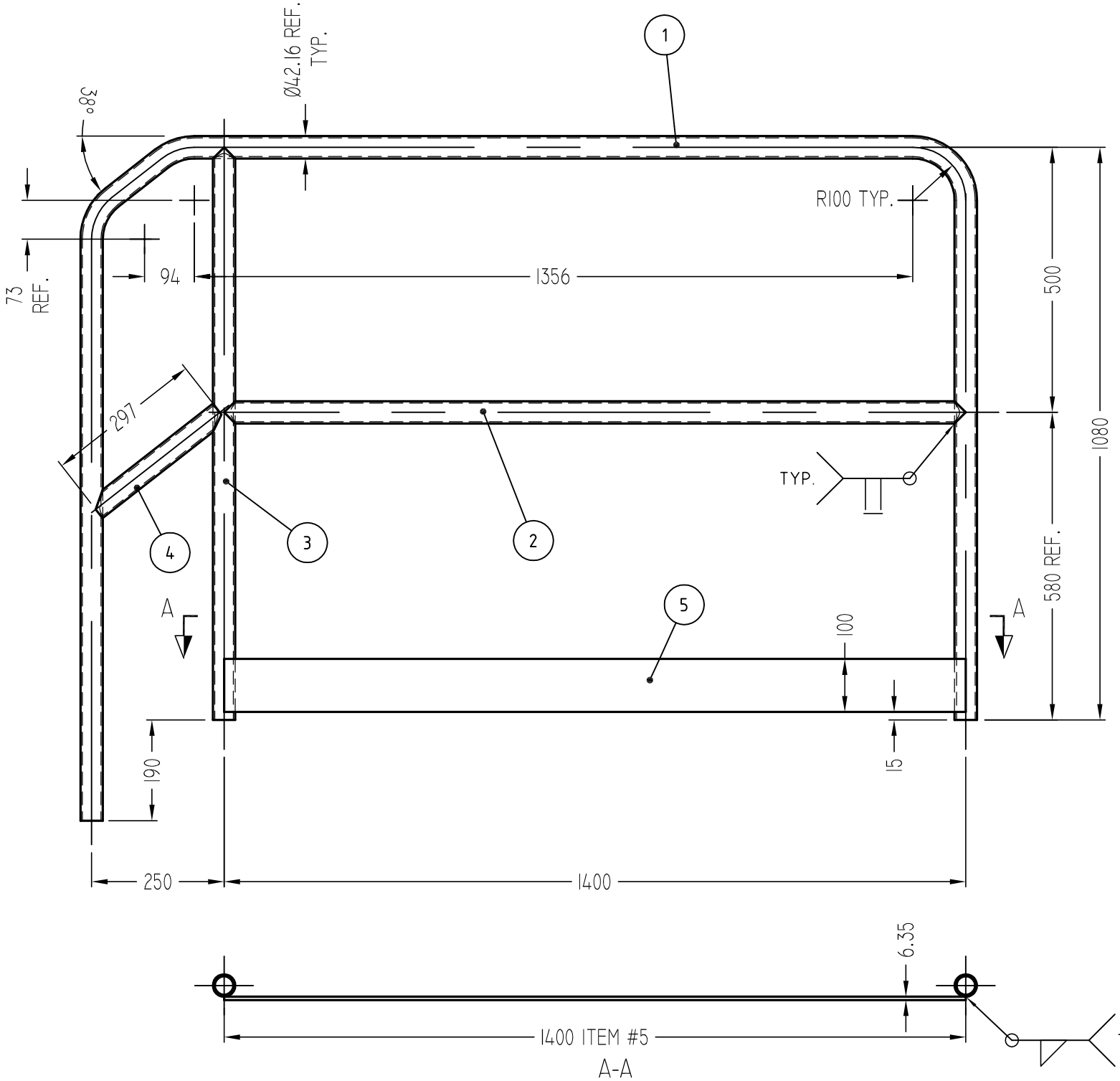
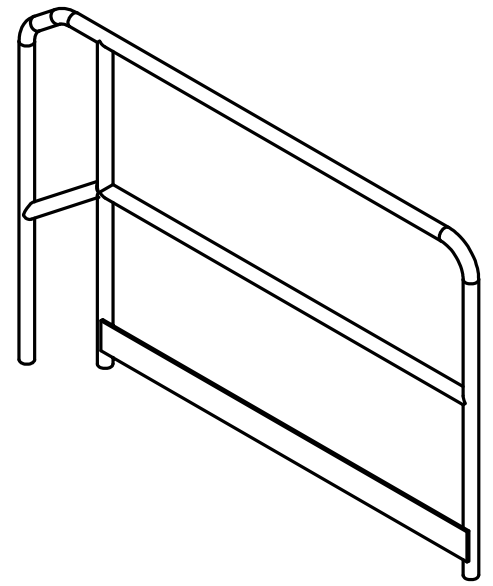


LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/Qty	No. PIECE–MAT. MAT.–PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
1	1	44W	PIPE 1–1/4" SCH. #40 x 4870 LG		
2	1	44W	PIPE 1–1/4" SCH. #40 x 1400 LG		
3	1	44W	PIPE 1–1/4" SCH. #40 x 1080 LG		
4	1	44W	PIPE 1–1/4" SCH. #40 x 297 LG		
5	1	44W	PL. 1/4" x 100 x 1400 LG		

TOTAL APPROX. WEIGHT : 32 KG



NOTES:

1. BREAK SHARP CORNERS, DEBURR AFTER DRILLING AND CUTTING.
2. ALL STRUCTURAL SHAPES AND PLATES MUST BE WITHOUT DISTORTION.
3. ALL WELDS MUST CONFORM CSA W-47, W-59.
4. STEEL PLATES SHALL BE CUT OUT OF ONE PLATE ONLY, IF NOT, JOINING PLATES SHALL BE WELDED BUTT JOINT FULL PENETRATION. THE WELDING SEAM SHALL BE BEHIND A STRUCTURAL SHAPE.
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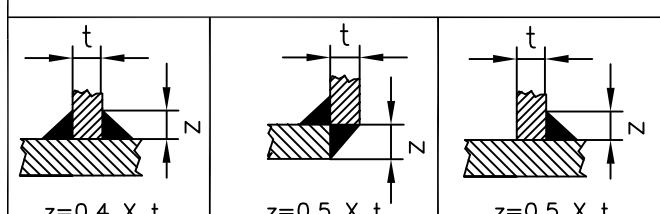
11. LENGTHS ON BILL OF MATERIAL ARE NOMINAL DIMENSIONS, REFER TO DRAWING FOR EXACT DIMENSIONS.

PAINT NOTES:

1. PAINT PROCEDURE AND MANUFACTURER AS PER BECHTEL SPECIFICATION 25457-0000-3PS-G000-0002 REV. 001

WELDING SPECIFICATION, unless otherwise noted



z= FILLET SIZE

t= THICK. OF THINNER PLATE

TOLERANCES, IF NOT SPECIFIED
METRIC (mm)

ASSEMBLY WELDED CONSTRUCTION

NOM. Length		NOM. Length	
from: 30 to: 120	± 1.0	from: 1000 to: 2000	± 3.0
from: 120 to: 315	± 1.0	from: 2000 to: 4000	± 4.0
from: 315 to: 1000	± 2.0	over: 4000	± 5.0

MACHINING

		HOLES
0:	± 0.5	C@C.: ± .20
0.0:	± 0.1	LOC.: ± .35
0.00:	± 0.05	
ANG.:	± 1°	

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SELLER DRAWING No. 1347–R4–1509 REV. 0

REFERENCES		REVISIONS						
DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
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NOTES

STATUS —

DRAWN/DES'D:	E.I.	AREA ENG.:	
DATE:	NO.17.'10	DATE:	
CHECKED:	M.B.	PRJ ENG MGR.:	
DATE:	---	DATE:	
RESPONSIBLE ENG.	C.C.	CLIENT:	
DATE:	---	DATE:	
ENG. GROUP SUP. DATE:		DRAWING SCALE:	1:10

Vendor or Subcontractor Logo: GNA eLytech Inc. — Département Ingénierie Engineering Department 9690 Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
PLATFORMS
HANDRAIL #2 (LEFT)

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-	00AZ-	xx -	xxxx -	xxxx - xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3–		–AZ	

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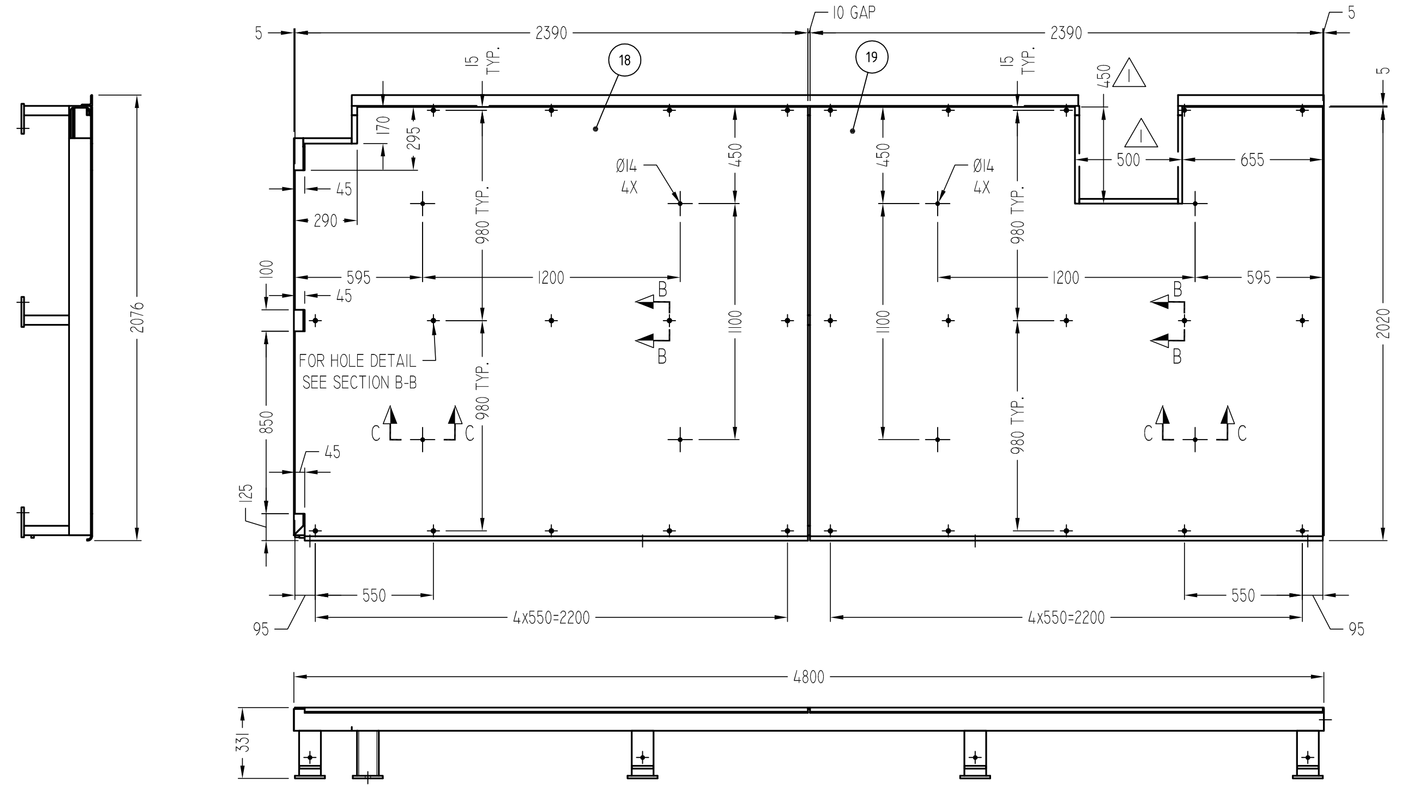
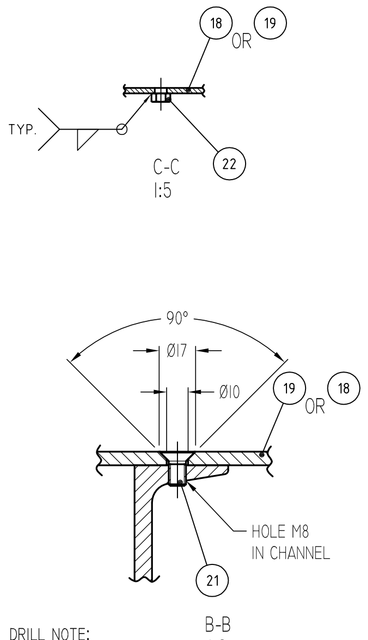




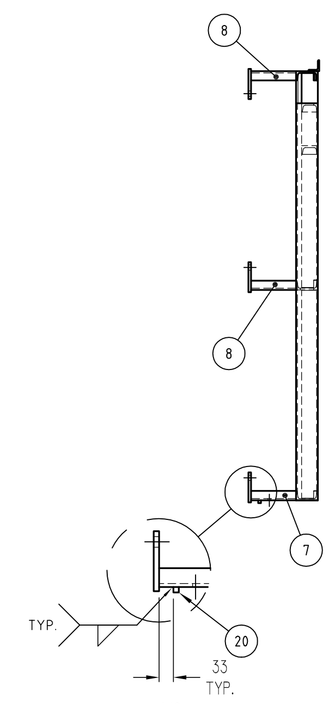
DRILL NOTE:
DRILL PILOT HOLES
THROUGH ITEM #18 AND #19
TOGETHER WITH ITEMS #1, #3, #4 AND #6

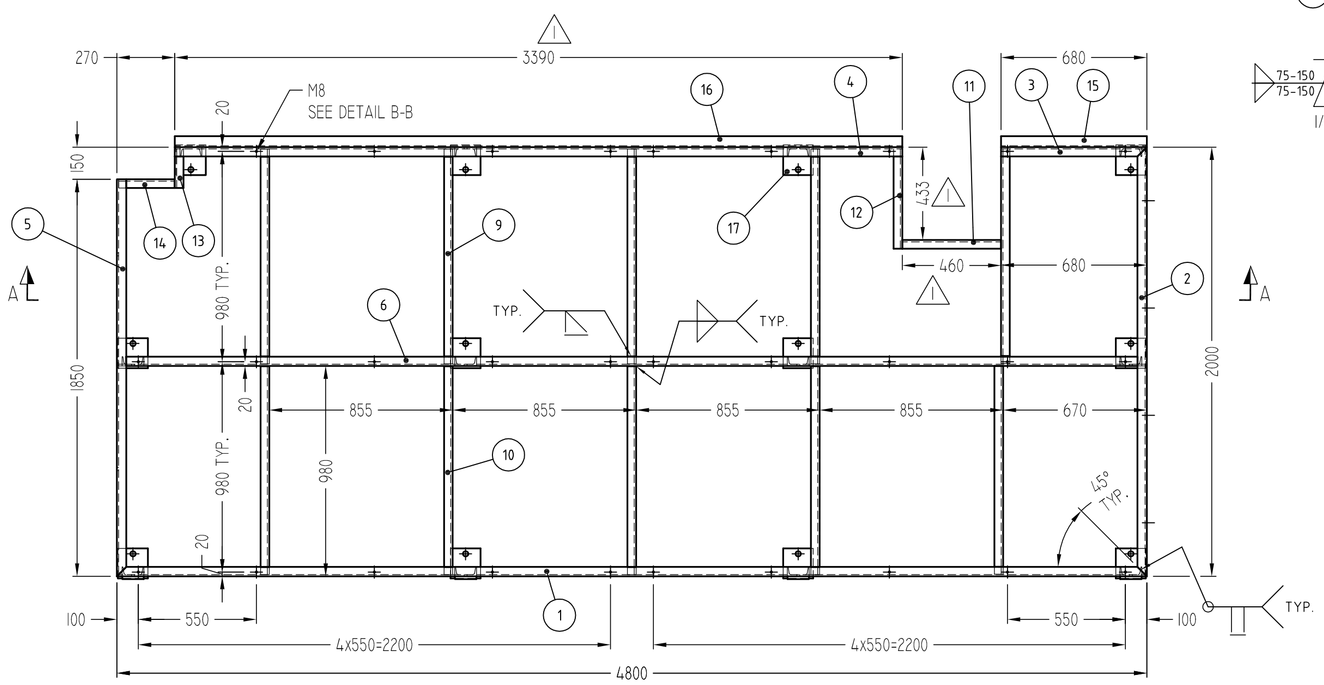
ITEM	Qte/Qty	No. PIECE-MAT. MAT.-PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
1	1	44W	C 4 x 7.25 x 4800		
2	1	44W	C 4 x 7.25 x 2000		
3	1	44W	C 4 x 7.25 x 680		
4	1	44W	C 4 x 7.25 x 3390		
5	1	44W	C 4 x 7.25 x 1850		
6	1	44W	C 4 x 7.25 x 4783		
7	4	44W	C 4 x 7.25 x 210		
8	8	44W	C 4 x 7.25 x 210		
9	5	44W	C 3 x 6 x 1000		
10	5	44W	C 3 x 6 x 970		
11	1	44W	C 3 x 6 x 460		
12	1	44W	C 3 x 6 x 465		
13	1	44W	C 3 x 6 x 182		
14	1	44W	C 3 x 6 x 260		
15	1	44W	L 2 x 2 x 1/4 x 680		
16	1	44W	L 2 x 2 x 1/4 x 3390		
17	12	44W	PL. 1/2 x 140 x 140		
18	1	44W	CHECKERED PLATE 1/4" x 2060 x 2390		
19	1	44W	CHECKERED PLATE 1/4" x 2060 x 2390		
20	4	44W	SQ. BAR 1/2" x 100		
21	29	STD	HEX SOCKET CAP SCREW M8x16 DIN 7991		
22	8	STD	HEX. NUT M12 DIN 934		

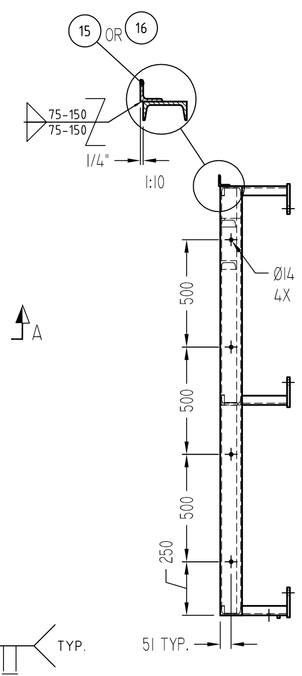
TOTAL WEIGHT APPROX. = 835 KG

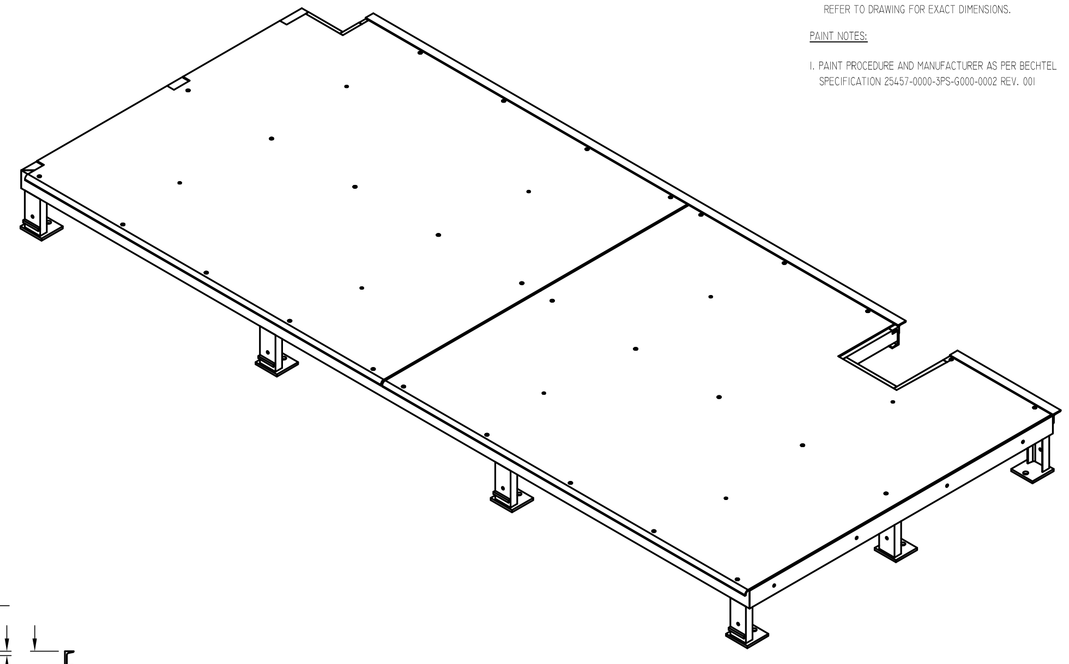
NOTES:
1. BREAK SHARP CORNERS, DEBURR AFTER DRILLING AND CUTTING.
2. ALL STRUCTURAL SHAPES AND PLATES MUST BE WITHOUT DISTORTION.
3. ALL WELDS MUST CONFORM CSA W-47, W-59.
4. STEEL PLATES SHALL BE CUT OUT OF ONE PLATE ONLY, IF NOT, JOINING PLATES SHALL BE WELDED BUTT JOINT FULL PENETRATION. THE WELDING SEAM SHALL BE BEHIND A STRUCTURAL SHAPE.
   IF NOT OTHERWISE SPECIFIED, ALL WELDS ARE CONTINUOUS.
5. CLEAN ALL WELDED SURFACES OF BURRS AND ASPERITIES.
6. HANDLE PAINTED PIECES WITH CARE (TO AVOID RUST AFTER INSTALLATION)
7. PROVIDE AND INSTALL LIFTING LUG(S) APPROPRIATE FOR TOTAL WEIGHT OF PART(S). (IF APPLICABLE)
8. PRE-ASSEMBLE PARTS IN SHOP FOR DIMENSIONAL AND FUNCTIONAL VERIFICATION.
9. ALL MACHINED SURFACES TO BE COATED WITH TEMPORARY CORROSION PROTECTION.
10. PIECES SHALL BE MATCH MARKED FOR SUBSEQUENT DISASSEMBLY.
11. LENGTHS ON BILL OF MATERIAL ARE NOMINAL DIMENSIONS, REFER TO DRAWING FOR EXACT DIMENSIONS.

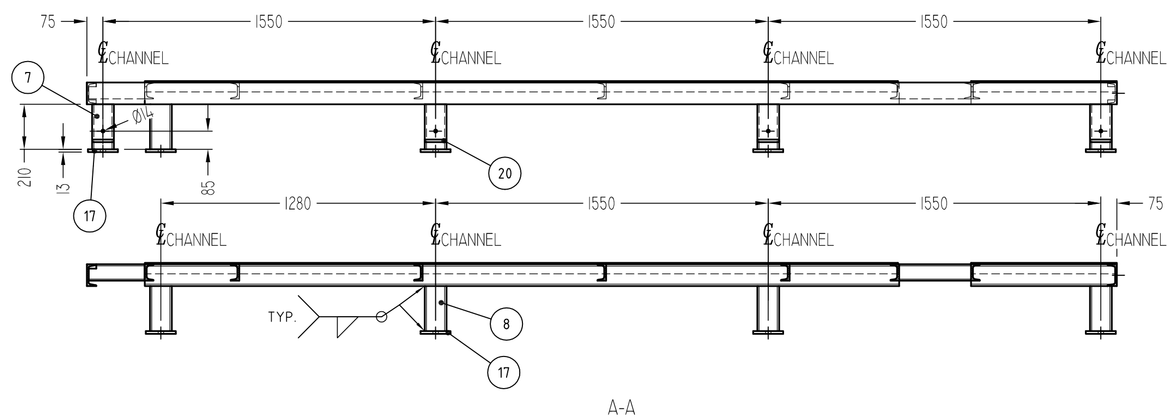
PAINT NOTES:
1. PAINT PROCEDURE AND MANUFACTURER AS PER BECHTEL SPECIFICATION 25457-0000-3PS-G000-0002 REV. 001

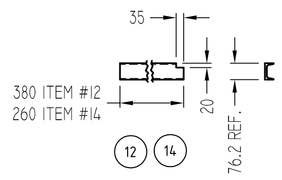


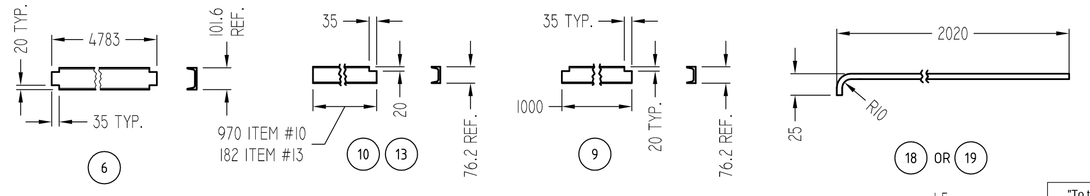


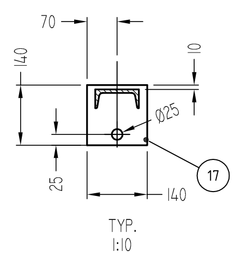












WELDING SPECIFICATION, unless otherwise noted			TOLERANCES, if NOT SPECIFIED Metric (mm)
			ASSEMBLY WELDED CONSTRUCTION
z=0,4 X t	z=0,5 X t	z=0,5 X t	NOM. Length / NOM. Length from 30 to 120 ± 1.0 / from 1000 to 2000 ± 3.0 from 121 to 315 ± 1.0 / from 2001 to 4000 ± 4.0 from 315 to 1000 ± 2.0 / over 4000 ± 5.0
z= FILLET SIZE	t= THICK. OF THINNER PLATE		MACHINING 0: ± 0.5 / 0.0: ± 0.1 / 0.00: ± 0.05 / ANG.: ± 1° / <-> HOLES / ⌀C: ± .20 / LOC.: ± .35

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NUMBER	REV.	TITLE
REFERENCE DRAWINGS		

REV.	DESCRIPTION	DATE	DRN.	CHK.	R.E.	A.E. / S.	E.G.S.	P.E.M.
1	ITEMS 4, 11, 12, 16 AND 18 REVISED	MR.25.11	E.I.	M.B.	C.C.			
0	INITIAL DESIGN	NO.16.10	E.I.	M.B.	C.C.			
REVISIONS								

STAMP

ALCOA | Ma'aden

Ma'aden Aluminum Project

SCALE: 1:20 | FORMAT A1

Bechtel

GNA alutech inc. — Département Ingénierie Engineering Department, 9495 Trans-Canada, Saint-Laurent, Quebec, H4S 1V3, Canada

		DATE
DRAWN	E.I.	NO.16.'10
CHK.	M. Blanchet	
R.E.	C. Coupal	
A.E. / S.		
E.G.S.		
P.E.M.		
CLIENT		

BECHTEL DRG. No. — — — — — REV.

SELLER DRAWING No. 1347-R4-1510 REV. 1

CLIENT DRG. No. REV.

Ras Az Zawr
Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
PLATFORMS
PLATFORM #1 (RIGHT)

DATE: $DATE$ FILE: $FILE$ TIME: $TIME$ USER: $USERNAME$

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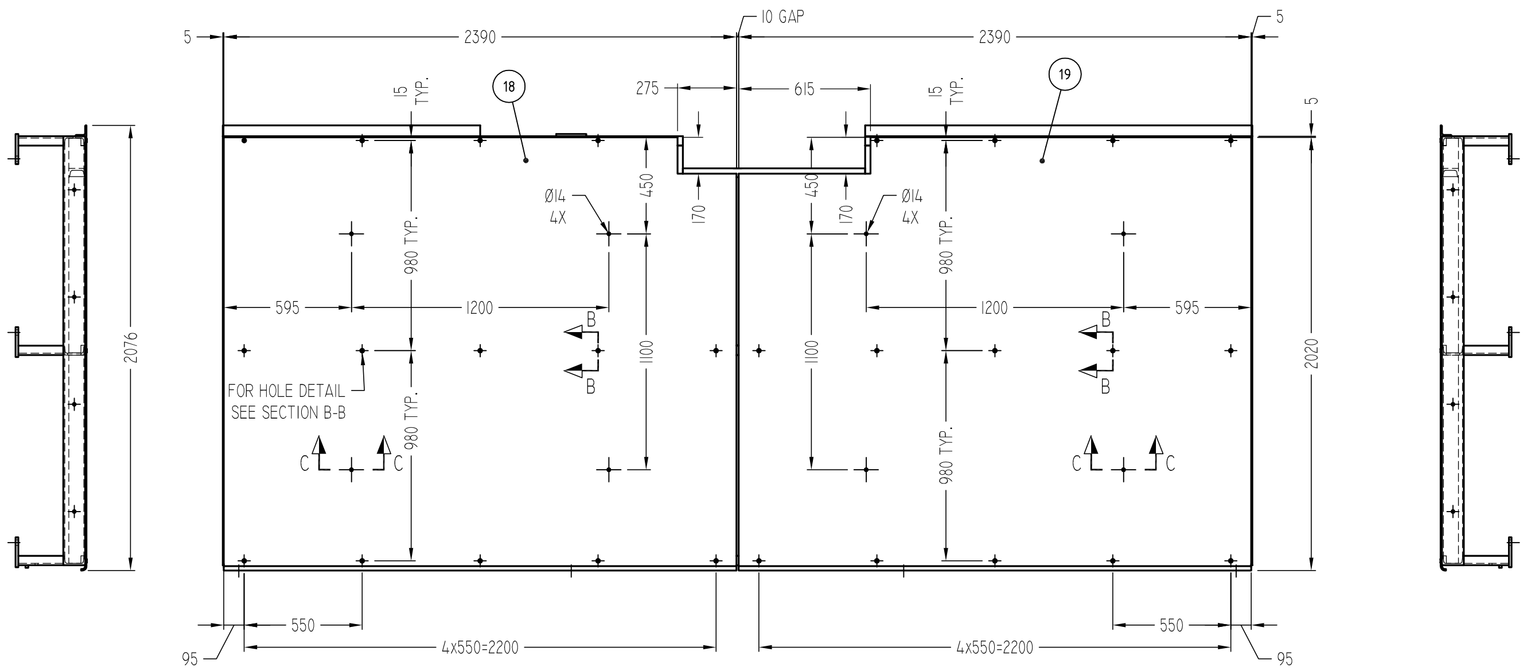
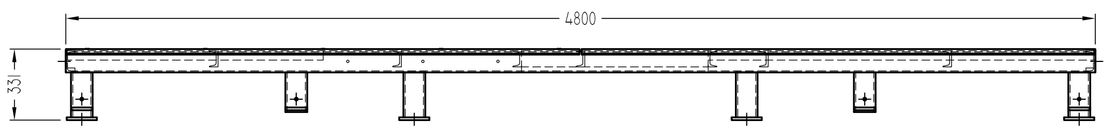
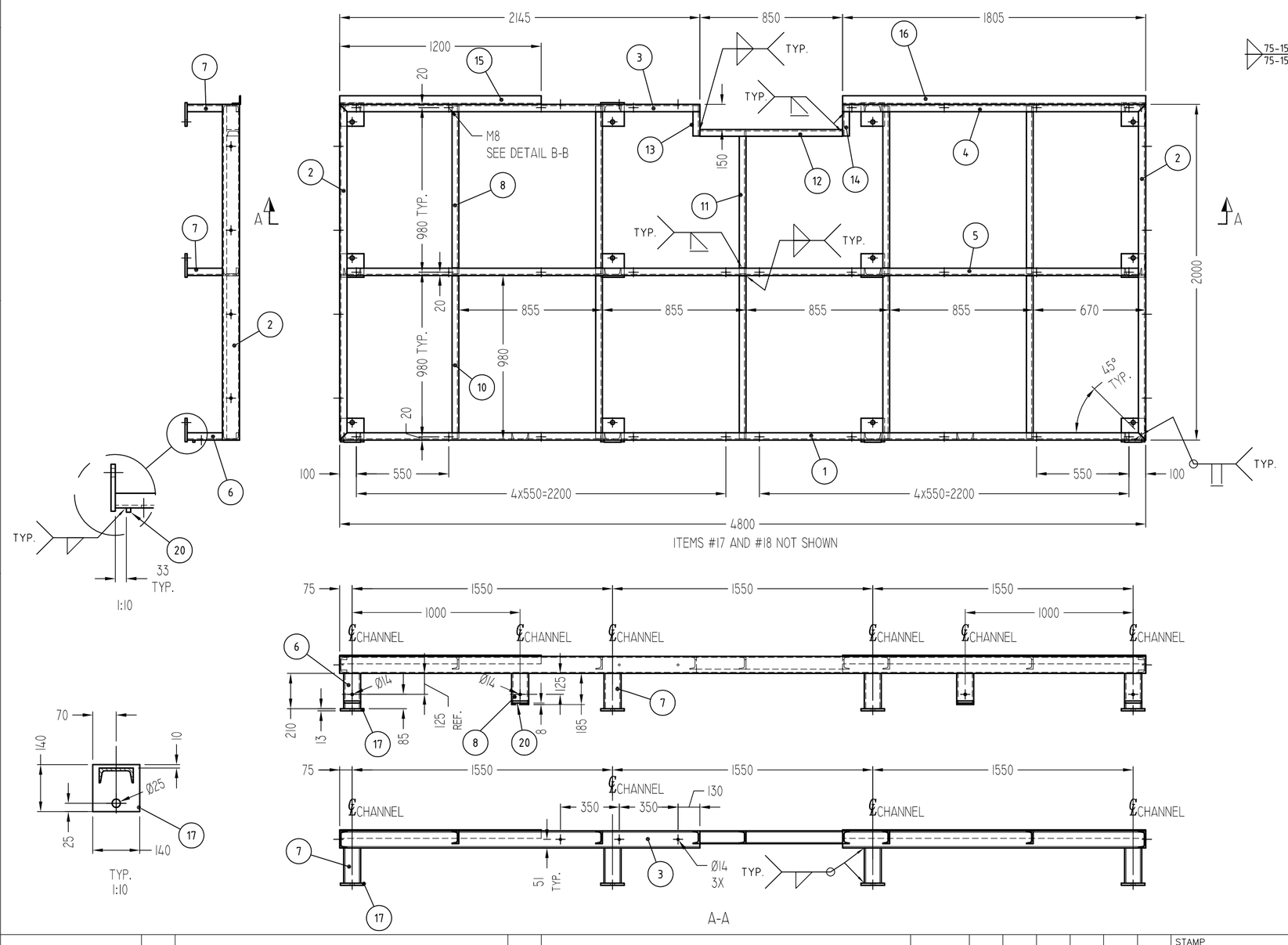
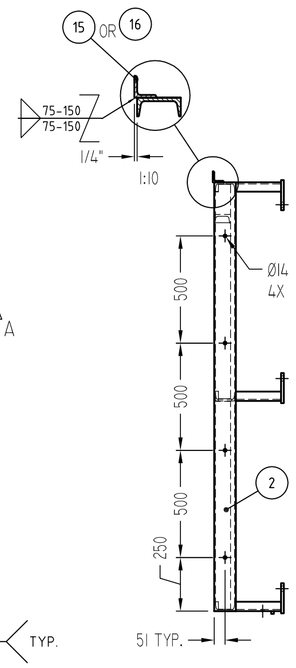
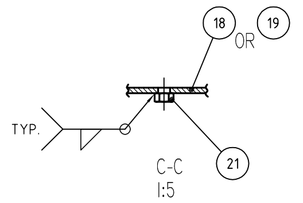
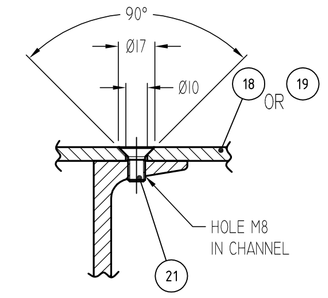












DRILL NOTE:
DRILL PILOT HOLES
THROUGH ITEM #17 AND #18
TOGETHER WITH ITEMS #1, #3, AND #4

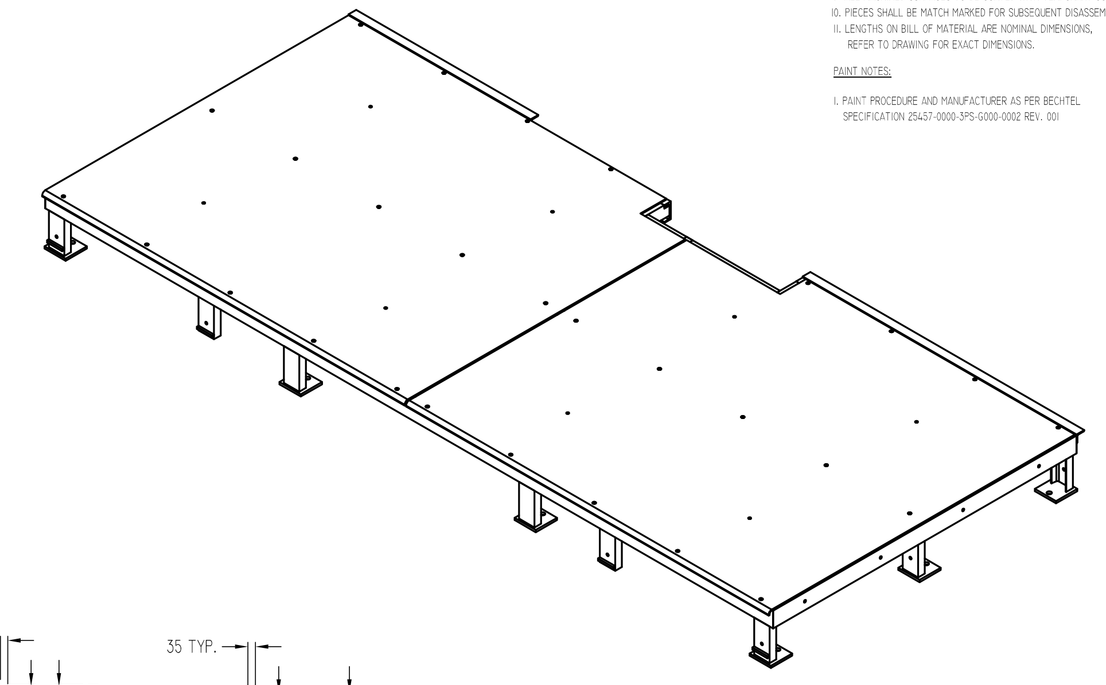
LISTE DE MATERIELS/BILL OF MATERIALS

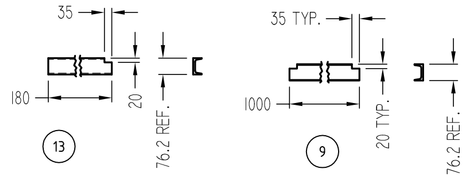
ITEM	Qte/Qty	No. PIECE-MAT. MAT.-PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
1	1	44W	C 4 x 7.25 x 4800		
2	2	44W	C 4 x 7.25 x 2000		
3	1	44W	C 4 x 7.25 x 2145		
4	1	44W	C 4 x 7.25 x 1805		
5	1	44W	C 4 x 7.25 x 4783		
6	2	44W	C 4 x 7.25 x 210		
7	10	44W	C 4 x 7.25 x 210		
8	2	44W	C 4 x 7.25 x 185		
9	4	44W	C 3 x 6 x 1000		
10	5	44W	C 3 x 6 x 970		
11	1	44W	C 3 x 6 x 850		
12	1	44W	C 3 x 6 x 850		
13	1	44W	C 3 x 6 x 180		
14	1	44W	C 3 x 6 x 180		
15	1	44W	L 2 x 2 x 1/4 x 1200		
16	1	44W	L 2 x 2 x 1/4 x 1805		
17	12	44W	PL. 1/2 x 140 x 140		
18	1	44W	CHECKERED PLATE 1/4" x 2060 x 2390		
19	1	44W	CHECKERED PLATE 1/4" x 2060 x 2390		
20	4	44W	SQ. BAR 1/2" x 100		
21	29	STD	HEX SOCKET CAP SCREW M8x16 DIN 7991		
22	8	STD	HEX. NUT M12 DIN 934		

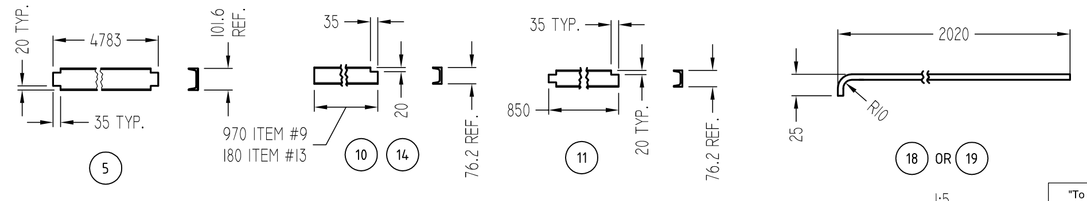
TOTAL WEIGHT APPROX. = 820 KG

NOTES:
1. BREAK SHARP CORNERS, DEBURR AFTER DRILLING AND CUTTING.
2. ALL STRUCTURAL SHAPES AND PLATES MUST BE WITHOUT DISTORTION.
3. ALL WELDS MUST CONFORM CSA W-47, W-59.
4. STEEL PLATES SHALL BE CUT OUT OF ONE PLATE ONLY, IF NOT, JOINING PLATES SHALL BE WELDED BUTT JOINT FULL PENETRATION. THE WELDING SEAM SHALL BE BEHIND A STRUCTURAL SHAPE.
   IF NOT OTHERWISE SPECIFIED, ALL WELDS ARE CONTINUOUS.
5. CLEAN ALL WELDED SURFACES OF BURRS AND ASPERITIES.
6. HANDLE PAINTED PIECES WITH CARE (TO AVOID RUST AFTER INSTALLATION)
7. PROVIDE AND INSTALL LIFTING LUG(S) APPROPRIATE FOR TOTAL WEIGHT OF PART(S). (IF APPLICABLE)
8. PRE-ASSEMBLE PARTS IN SHOP FOR DIMENSIONAL AND FUNCTIONAL VERIFICATION.
9. ALL MACHINED SURFACES TO BE COATED WITH TEMPORARY CORROSION PROTECTION.
10. PIECES SHALL BE MATCH MARKED FOR SUBSEQUENT DISASSEMBLY.
11. LENGTHS ON BILL OF MATERIAL ARE NOMINAL DIMENSIONS, REFER TO DRAWING FOR EXACT DIMENSIONS.

PAINT NOTES:
1. PAINT PROCEDURE AND MANUFACTURER AS PER BECHTEL SPECIFICATION 25457-0000-3PS-G000-0002 REV. 001







WELDING SPECIFICATION, unless otherwise noted

z=0,4 X t	z=0,5 X t	z=0,5 X t
z= FILLET SIZE	t= THICK. OF THINNER PLATE	

TOLERANCES, IF NOT SPECIFIED	
Metric (mm)	
ASSEMBLY WELDED CONSTRUCTION	
NOM. Length	NOM. Length
from 30 to 120 ± 1.0	from 1000 to 2000 ± 3.0
from 120 to 315 ± 1.0	from 2000 to 4000 ± 4.0
from 315 to 1000 ± 2.0	over 4000 ± 5.0
MACHINING	
0: ± 0.5	--- HOLES ---
0.0: ± 0.1	
0.00: ± 0.05	CBC: ± .20
ANG.: ± 1°	LOC.: ± .35

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SELLER DRAWING No. 1347-R4-1511 REV. 0

NUMBER	REV.	TITLE
REFERENCE DRAWINGS		

REV.	DESCRIPTION	DATE	DRN.	CHK.	R.E.	A.E. / S.G.S.	P.E.M.
0	INITIAL DESIGN	NO.16.'10	E.I.	M.B.	C.C.		
REVISIONS							

STAMP

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Bechtel

GNA alutech inc.
Departement Ingenierie
Engineering Department
9495 Trans-Canada
Saint-Laurent, Quebec
H4S 1V3
Canada

		DATE
DRAWN	E.I.	NO.16.'10
CHK.	M. Blanchet	
R.E.	C. Coupal	
A.E. / S.		
E.G.S.		
P.E.M.		
CLIENT		

Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
PLATFORMS
PLATFORM #2 (RIGHT)

SCALE: 1:20 FORMAT A1

BECHTEL DRG. No. — — — — — REV.

CLIENT DRG. No. REV.

DATE: $DATE$ TIME: $TIME$ USER: $USERNAME$ FILE: $FILE$

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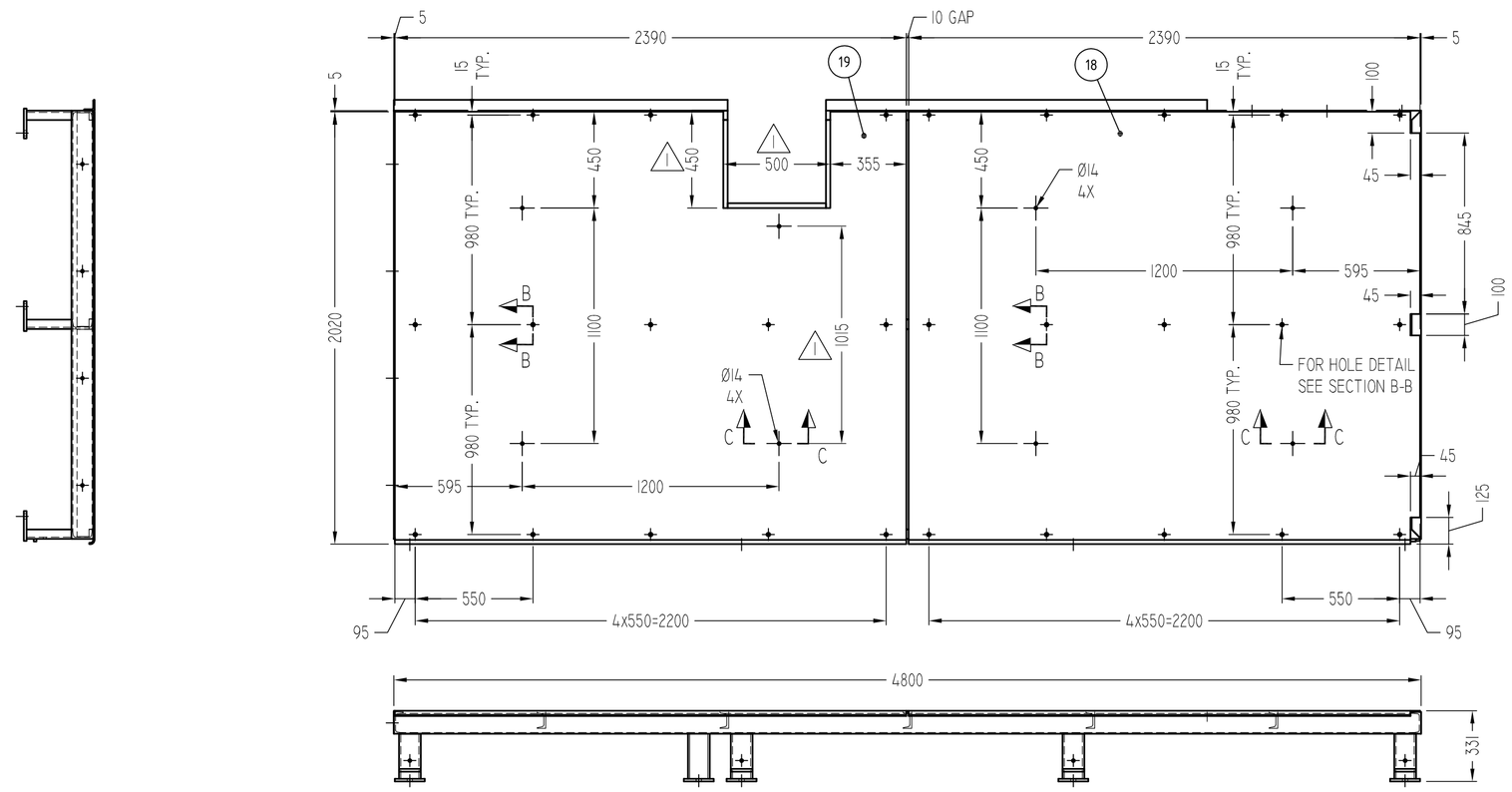
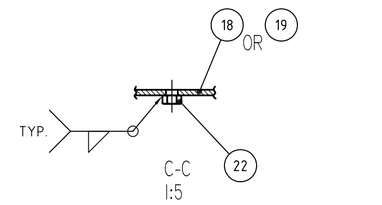
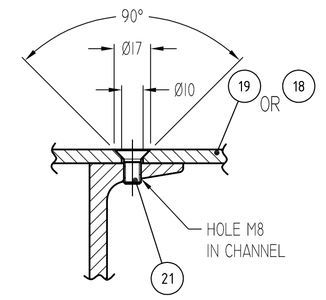


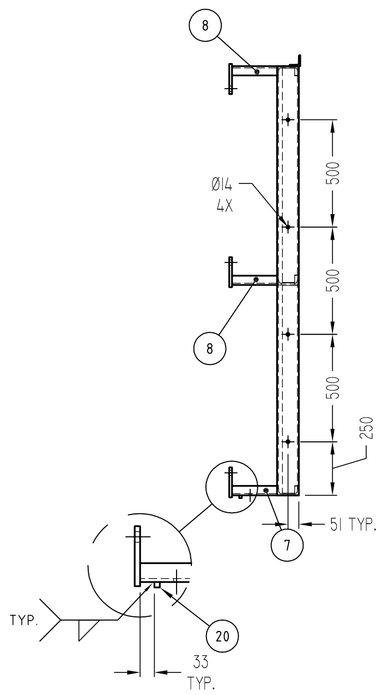


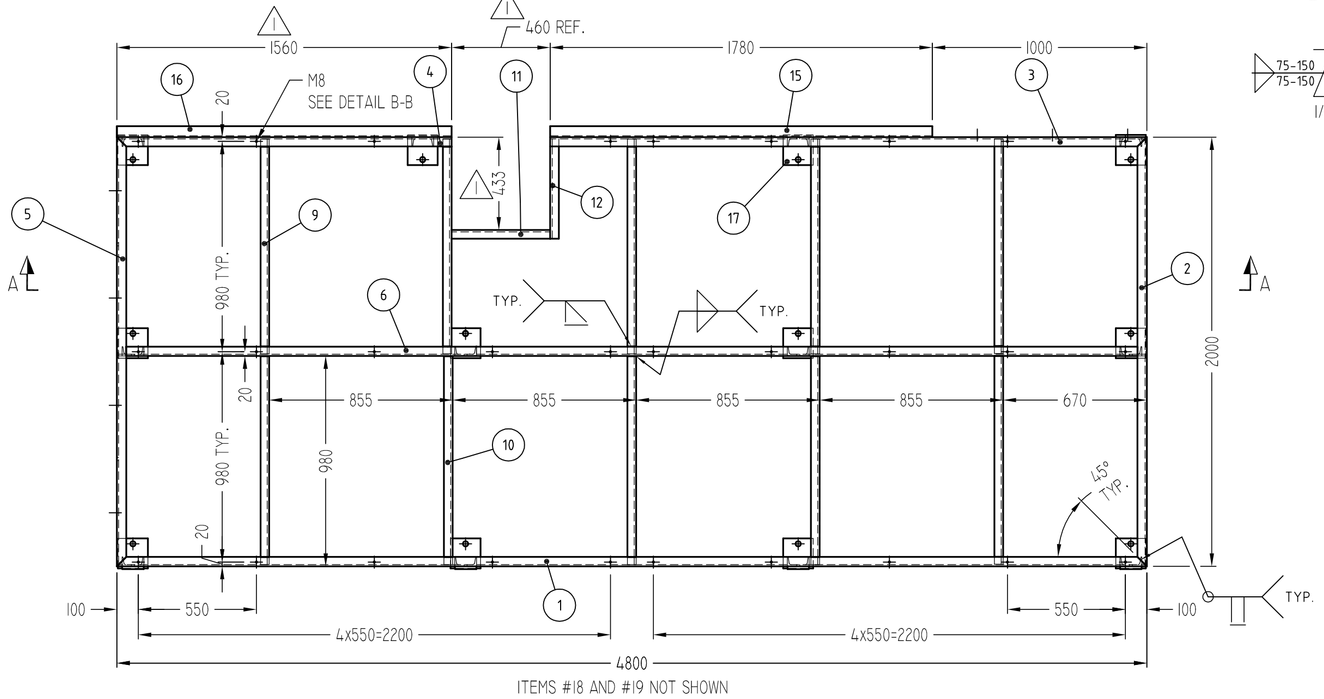


DRILL NOTE:
DRILL PILOT HOLES
THROUGH ITEM #18 AND #19
TOGETHER WITH ITEMS #1, #3, #4 AND #6

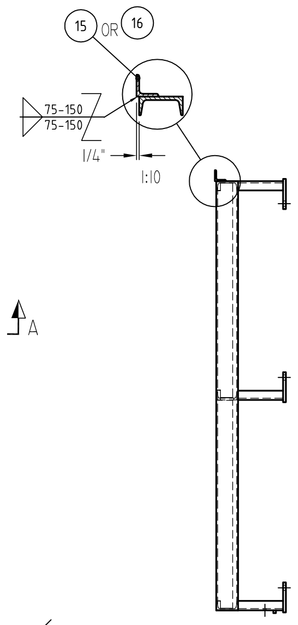
ITEM	Qte/Qty	No. PIECE-MAT. MAT.-PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
			LISTE DE MATERIELS/BILL OF MATERIALS		
1	1	44W	C 4 x 7.25 x 4800		
2	1	44W	C 4 x 7.25 x 2000		
3	1	44W	C 4 x 7.25 x 2780		
4	1	44W	C 4 x 7.25 x 1560		
5	1	44W	C 4 x 7.25 x 2000		
6	1	44W	C 4 x 7.25 x 4783		
7	4	44W	C 4 x 7.25 x 210		
8	8	44W	C 4 x 7.25 x 210		
9	5	44W	C 3 x 6 x 1000		
10	5	44W	C 3 x 6 x 970		
11	1	44W	C 3 x 6 x 460		
12	1	44W	C 3 x 6 x 465		
13					
14					
15	1	44W	L 2 x 2 x 1/4 x 1780		
16	1	44W	L 2 x 2 x 1/4 x 1560		
17	12	44W	PL. 1/2 x 140 x 140		
18	1	44W	CHECKERED PLATE 1/4" x 2060 x 2390		
19	1	44W	CHECKERED PLATE 1/4" x 2060 x 2390		
20	4	44W	SQ. BAR 1/2" x 100		
21	29	STD	HEX SOCKET CAP SCREW M8x16 DIN 7991		
22	8	STD	HEX. NUT M12 DIN 934		

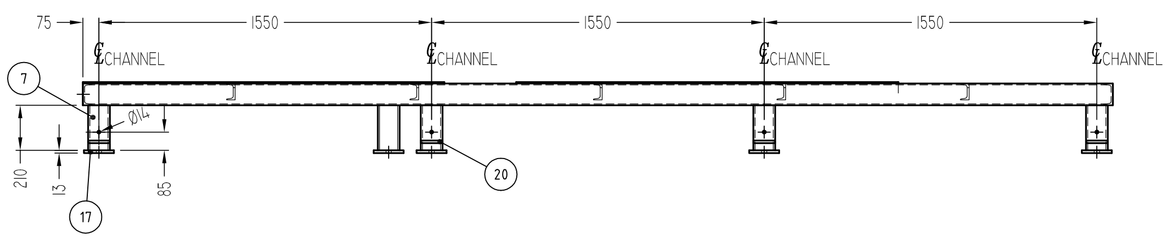
TOTAL WEIGHT APPROX. = 835 KG

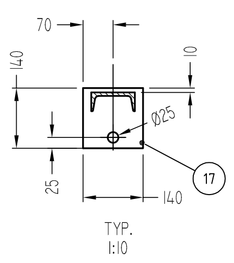


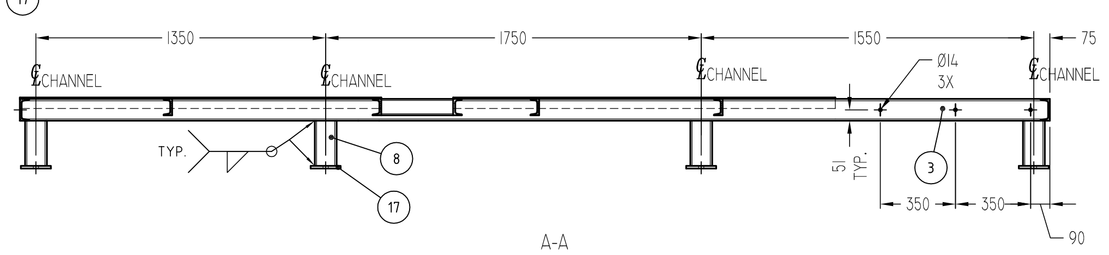


ITEMS #18 AND #19 NOT SHOWN









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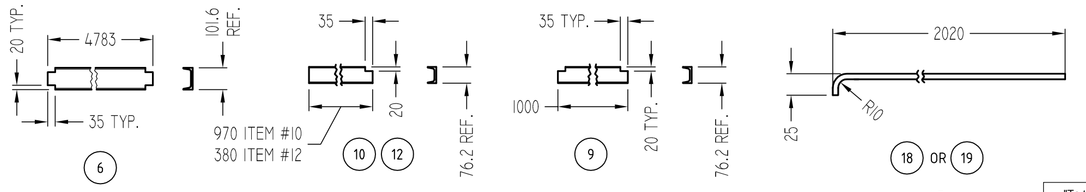

NOTES:
1. BREAK SHARP CORNERS, DEBURR AFTER DRILLING AND CUTTING.
2. ALL STRUCTURAL SHAPES AND PLATES MUST BE WITHOUT DISTORTION.
3. ALL WELDS MUST CONFORM CSA W-47, W-59.
4. STEEL PLATES SHALL BE CUT OUT OF ONE PLATE ONLY, IF NOT, JOINING PLATES SHALL BE WELDED BUTT JOINT FULL PENETRATION. THE WELDING BEAM SHALL BE BEHIND A STRUCTURAL SHAPE.
   IF NOT OTHERWISE SPECIFIED, ALL WELDS ARE CONTINUOUS.
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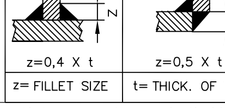
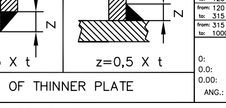
10. PIECES SHALL BE MATCH MARKED FOR SUBSEQUENT DISASSEMBLY.
11. LENGTHS ON BILL OF MATERIAL ARE NOMINAL DIMENSIONS, REFER TO DRAWING FOR EXACT DIMENSIONS.

PAINT NOTES:

1. PAINT PROCEDURE AND MANUFACTURER AS PER BECHTEL SPECIFICATION 25457-0000-3PS-G000-0002 REV. 001

WELDING SPECIFICATION, unless otherwise noted





z= FILLET SIZE t= THICK. OF THINNER PLATE

TOLERANCES,IF NOT SPECIFIED

METRIC (mm)

ASSEMBLY WELDED CONSTRUCTION			
NOM. Length		NOM. Length	
from 30 to 120	± 1.0	from 1000 to 2000	± 3.0
from 120 to 315	± 1.0	to 2000 to 4000	± 4.0
to 315 to 1000	± 2.0	over 4000	± 5.0

MACHINING

0:	± 0.5	HOLES
0.0:	± 0.1	
0.00:	± 0.05	DIA.: ± .20
ANG.:	± 1°	LOC.: ± .35

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SELLER DRAWING No.	REV.
1347-R4-1512	1

NUMBER	REV.	TITLE (REFERENCE DRAWINGS)	REV.	DESCRIPTION (REVISIONS)	DATE	DRN.	CHK.	R.E.	A.E. / S.	E.G.S.	P.E.M.
			1	ITEMS 4, 11, 12, 16 AND 18 REVISED	NO.16.'10	E.I.	M.B.	C.C.			
			0	INITIAL DESIGN	NO.16.'10	E.I.	M.B.	C.C.			

STAMP

ALCOA | Ma'aden Aluminum Project

Bechtel

GNA alutech inc. — Departement Ingenierie Engineering Department, 9495 Trans-Canada, Saint-Laurent, Quebec, H4S 1V3, Canada

		DATE
DRAWN	E.I.	NO.16.'10
CHK.	M. Blanchet	
R.E.	C. Coupal	
A.E. / S.		
E.G.S.		
P.E.M.		
CLIENT		

Ras Az Zawr
Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
PLATFORMS
PLATFORM #3 (RIGHT)

SCALE: 1:20 | FORMAT A1

BECHTEL DRG. No. — — — — — REV.

CLIENT DRG. No. REV.

USER: $USERNAME$
TIME: $TIME$
$DATE$
$FILE$
DATE:
FILE:

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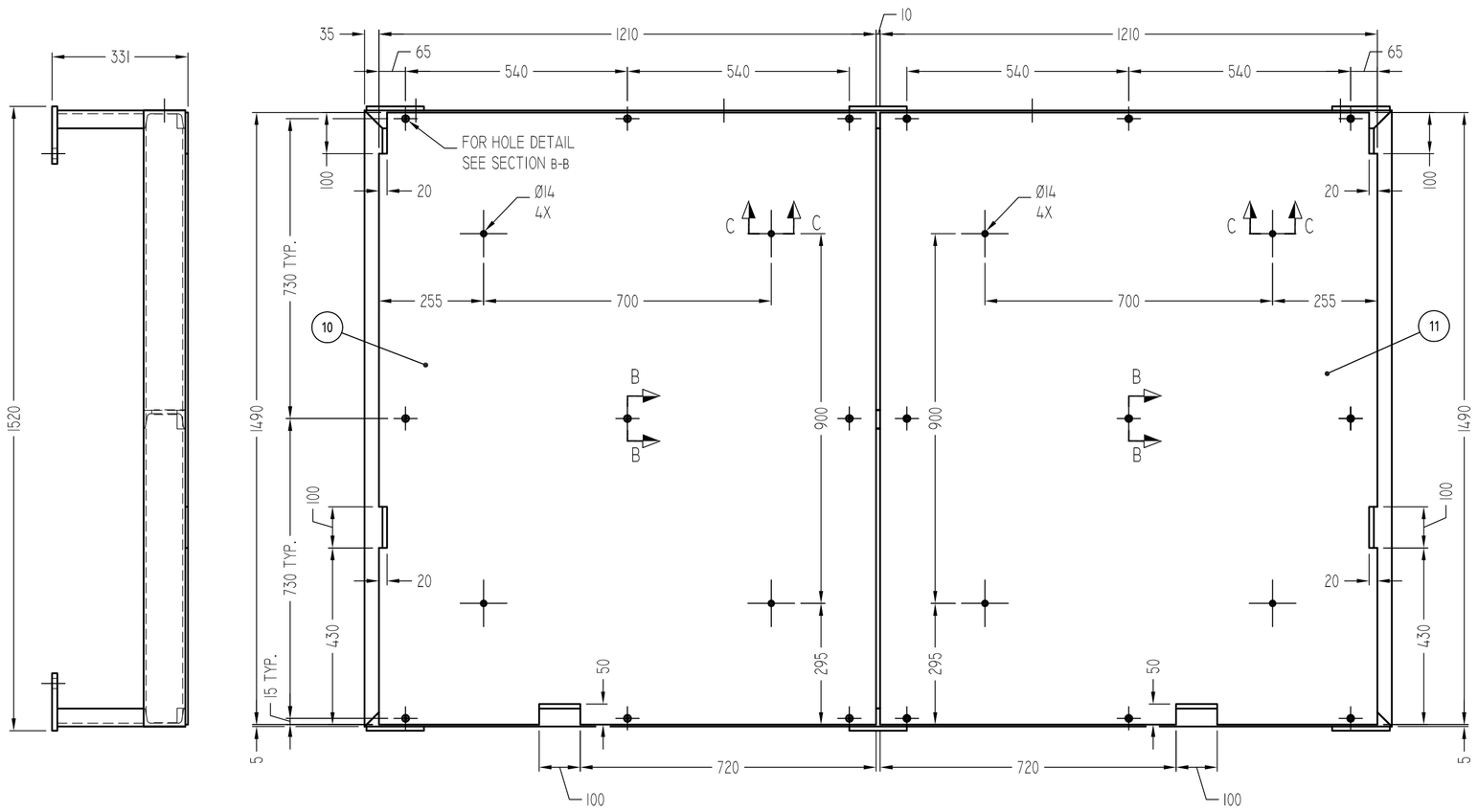
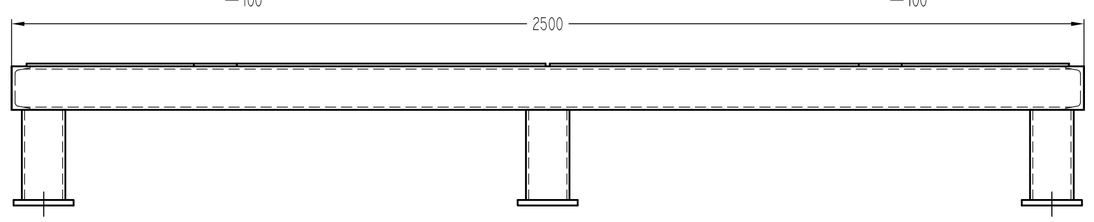
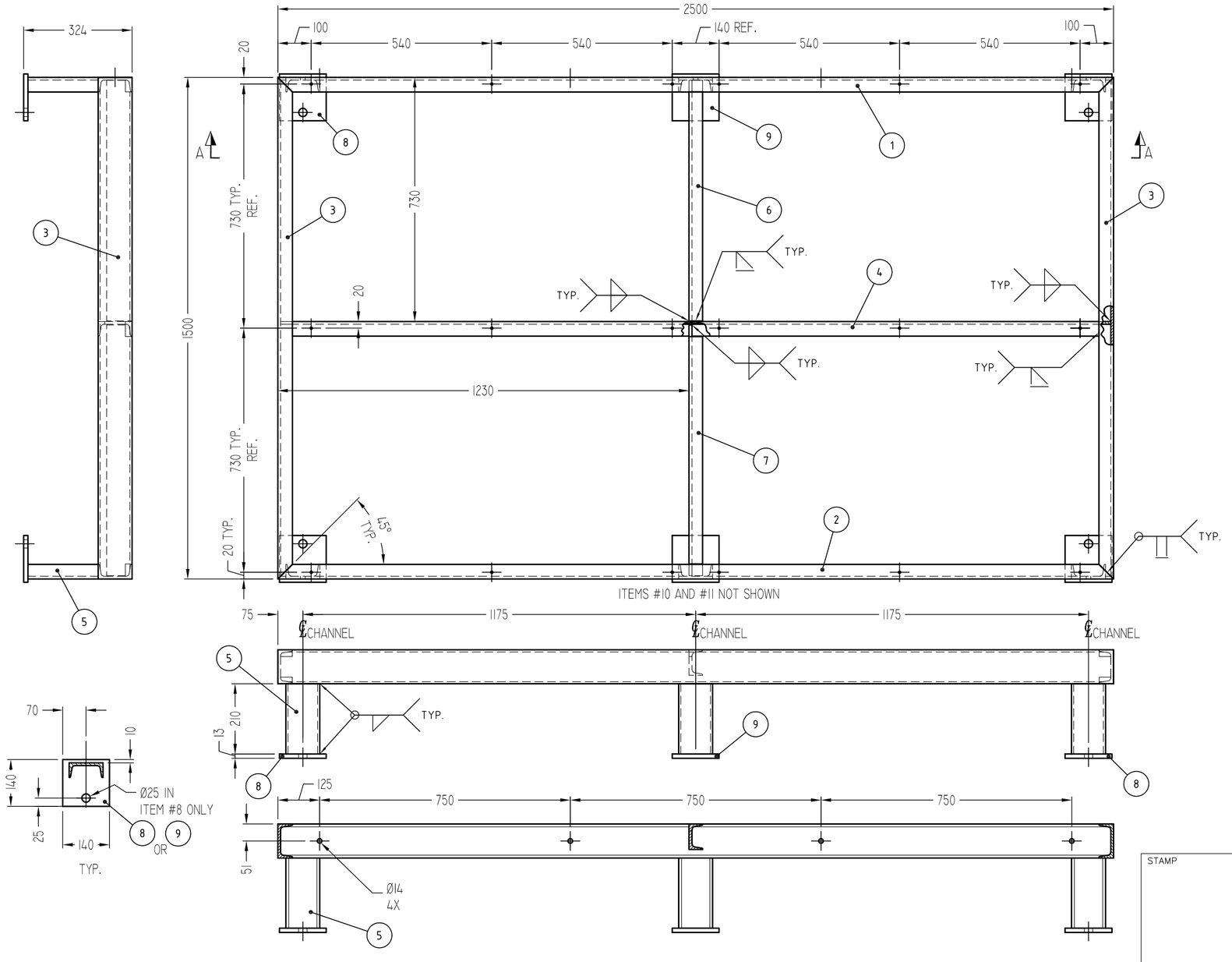
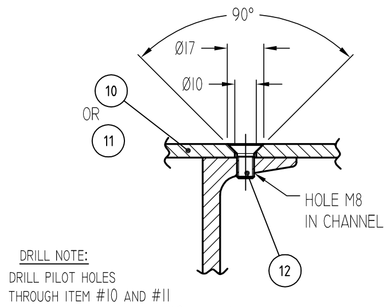


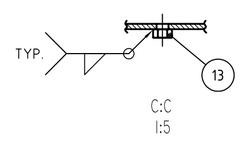






DRILL NOTE:
DRILL PILOT HOLES
THROUGH ITEM #10 AND #11
TOGETHER WITH ITEMS #1, #2 AND #4

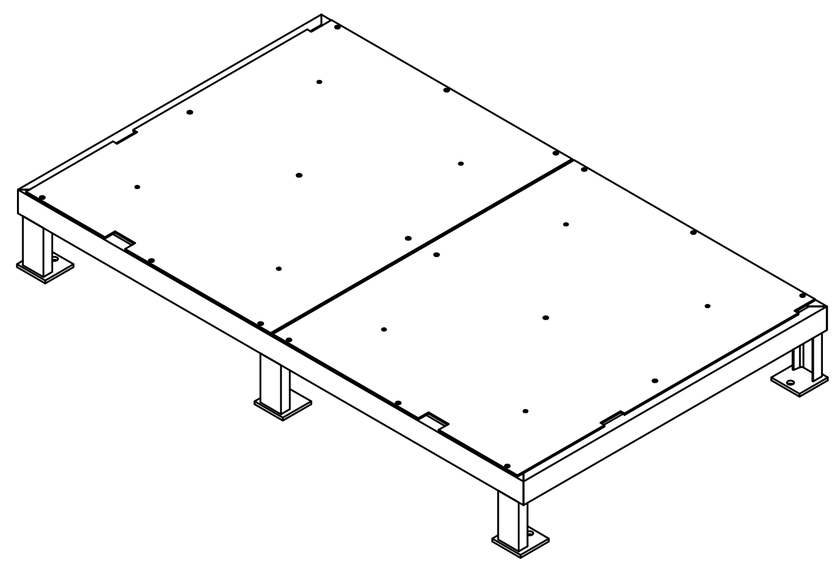
B-B
1:2

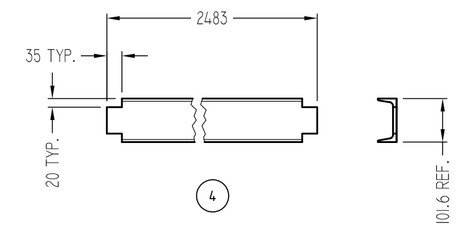


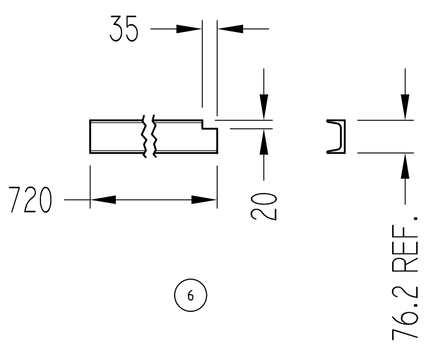
C:C
1:5

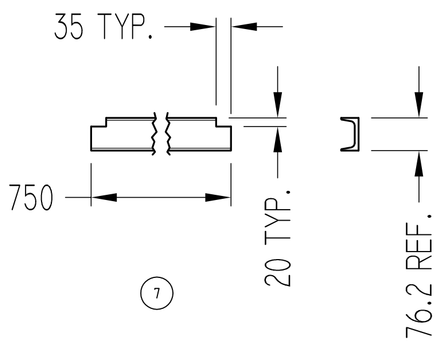
LISTE DE MATERIELS/BILL OF MATERIALS					
ITEM	Qte/Qty	No. PIECE-MAT. MAT.-PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
1	1	44W	C 4 x 7.25 x 2500		
2	1	44W	C 4 x 7.25 x 2500		
3	2	44W	C 4 x 7.25 x 1500		
4	1	44W	C 4 x 7.25 x 2483		
5	6	44W	C 4 x 7.25 x 210		
6	1	44W	C 3 x 6 x 720		
7	1	44W	C 3 x 6 x 750		
8	4	44W	PL. 1/2 x 140 x 140		
9	2	44W	PL. 1/2 x 140 x 140		
10	1	44W	CHECKERED PLATE 1/4" x 1210 x 1490		
11	1	44W	CHECKERED PLATE 1/4" x 1210 x 1490		
12	18	STD	HEX SOCKET CAP SCREW M8x16 DIN 7991		
13	8	STD	HEX. NUT M12 DIN 934		

TOTAL WEIGHT APPROX. = 330 KG







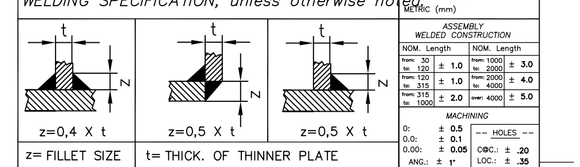


NOTES:
1. BREAK SHARP CORNERS, DEBURR AFTER DRILLING AND CUTTING.
2. ALL STRUCTURAL SHAPES AND PLATES MUST BE WITHOUT DISTORTION.
3. ALL WELDS MUST CONFORM CSA W-47, W-59.
4. STEEL PLATES SHALL BE CUT OUT OF ONE PLATE ONLY, IF NOT, JOINING PLATES SHALL BE WELDED BUTT JOINT FULL PENETRATION. THE WELDING SEAM SHALL BE BEHIND A STRUCTURAL SHAPE.
   IF NOT OTHERWISE SPECIFIED, ALL WELDS ARE CONTINUOUS.
5. CLEAN ALL WELDED SURFACES OF BURRS AND ASPERITIES.
6. HANDLE PAINTED PIECES WITH CARE (TO AVOID RUST AFTER INSTALLATION)
7. PROVIDE AND INSTALL LIFTING LUG(S) APPROPRIATE FOR TOTAL WEIGHT OF PART(S). (IF APPLICABLE)
8. PRE-ASSEMBLE PARTS IN SHOP FOR DIMENSIONAL AND FUNCTIONAL VERIFICATION.
9. ALL MACHINED SURFACES TO BE COATED WITH TEMPORARY CORROSION PROTECTION.
10. PIECES SHALL BE MATCH MARKED FOR SUBSEQUENT DISASSEMBLY.
11. LENGTHS ON BILL OF MATERIAL ARE NOMINAL DIMENSIONS, REFER TO DRAWING FOR EXACT DIMENSIONS.

PAINT NOTES:

1. PAINT PROCEDURE AND MANUFACTURER AS PER BECHTEL SPECIFICATION 25457-0000-3PS-G000-0002 REV. 00

WELDING SPECIFICATION, unless otherwise noted



TOLERANCES, if NOT SPECIFIED METRIC (mm)

ASSEMBLY WELDED CONSTRUCTION

NOM. Length		NOM. Length	
from 30 to 120	± 1.0	from 1000 to 2000	± 3.0
from 120 to 315	± 1.0	from 2000 to 4000	± 4.0
from 315 to 1000	± 2.0	over 4000	± 5.0

MACHINING

		HOLES
O:	± 0.5	
O.O:	± 0.1	
O.OO:	± 0.05	CIRC.: ± .20
ANG.:	± 1°	LOC.: ± .35

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SELLER DRAWING No. 1347-R4-1513 REV. 0

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ALCOA | Ma'aden

Ma'aden Aluminum Project

SCALE: 1:10 FORMAT A1

Bechtel

GNA alutech inc.
Departement Ingenierie
Engineering Department
9495 Trans-Canada
Saint-Laurent, Quebec
H4S 1V3
Canada

		DATE
DRAWN	E.I.	NO.16.'10
CHK.	M. Blanchet	
R.E.	C. Coupal	
A.E. / S.		
E.G.S.		
P.E.M.		
CLIENT		

BECHTEL DRG. No. — — — — — REV.

Ras Az Zawr
Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
PLATFORMS
PLATFORM #4 (RIGHT)

CLIENT DRG. No. REV.

NUMBER	REV.	TITLE	REV.	DESCRIPTION	DATE	DRN.	CHK.	R.E.	A.E. / S.	E.G.S.	P.E.M.
REFERENCE DRAWINGS			REVISIONS								
			0	INITIAL DESIGN	NO.16.10	E.I.	M.B.	C.C.			

DATE: $DATE$
FILE: $FILE$
TIME: $TIME$
USER: $USERNAME$

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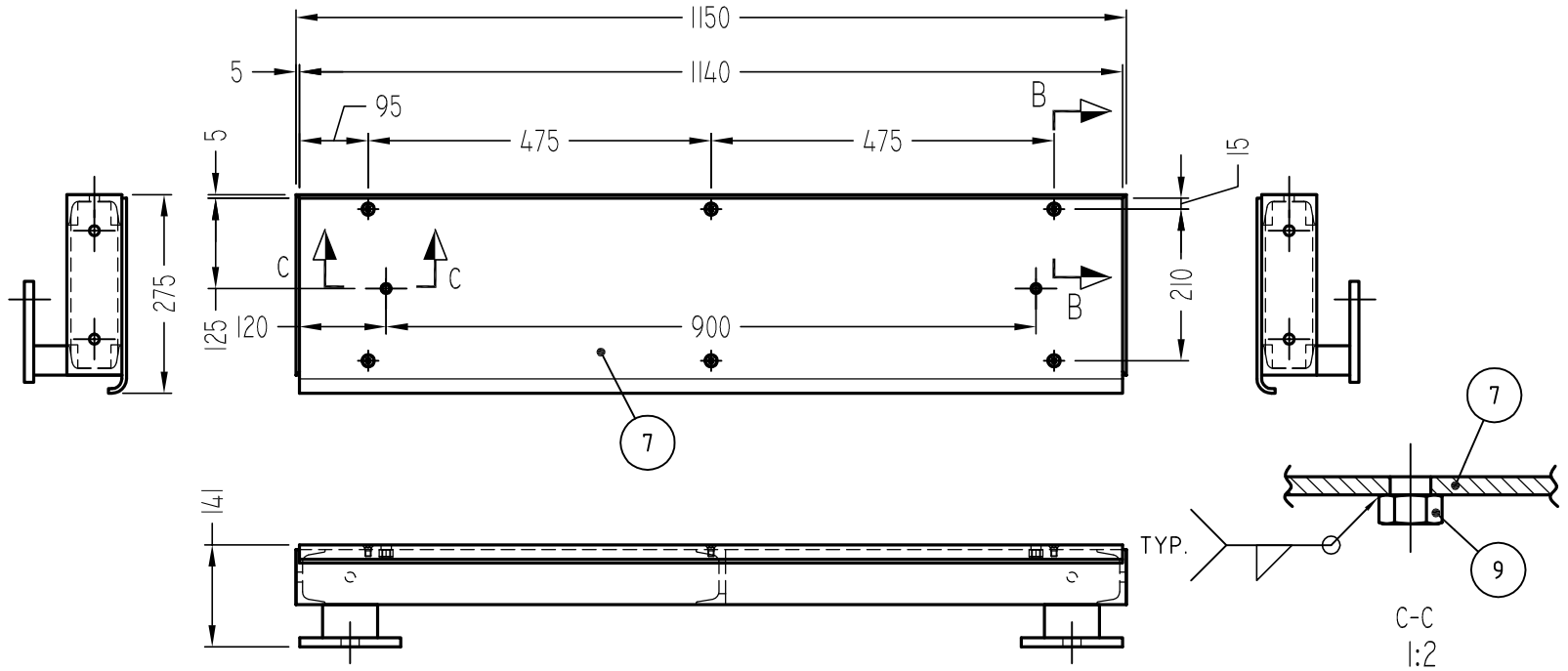

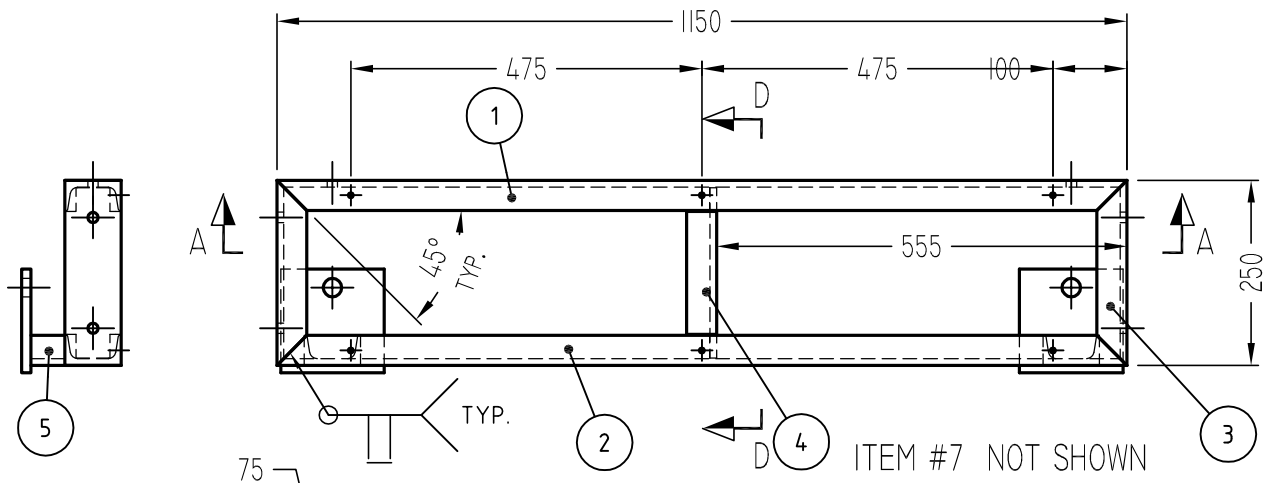

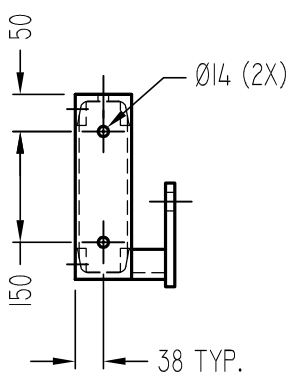

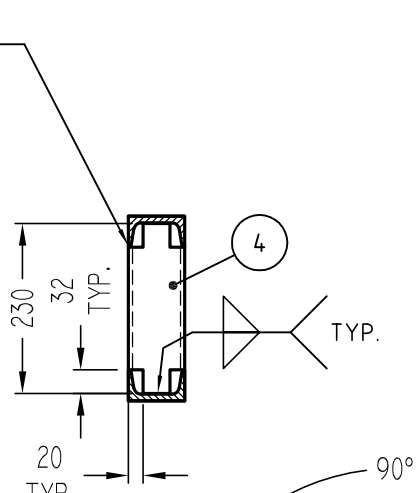

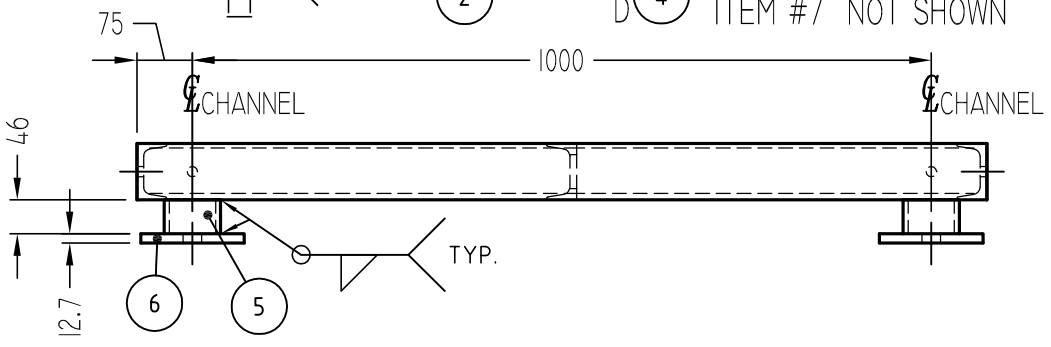

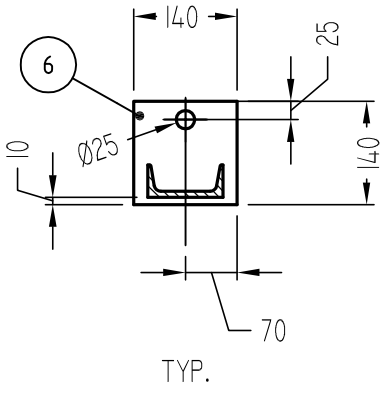

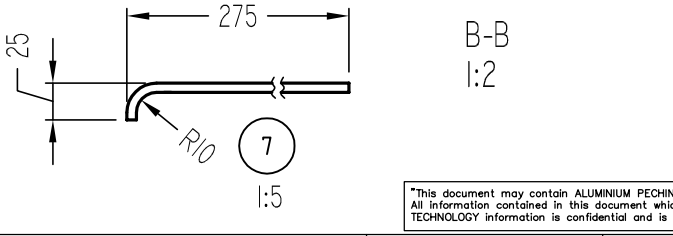

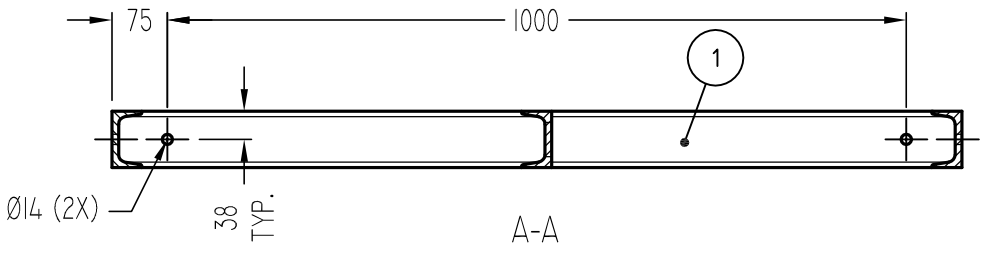

LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/Qty	No. PIECE–MAT. MAT.–PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
1	1	44W	C 3 x 6 x 1150		
2	1	44W	C 3 x 6 x 1150		
3	2	44W	C 3 x 6 x 250		
4	1	44W	C 3 x 6 x 230		
5	2	44W	C 3 x 6 x 46		
6	2	44W	PL. 1/2 x 140 x 140		
7	1	44W	CHECKERED PLATE 1/4" x 285 x 1150		
8	6	STD	HEX SOCKET CAP SCREW M8x16 DIN 7991		
9	2	STD	HEX. NUT M12 DIN 934		

TOTAL APPROX. WEIGHT : 48 KG

NOTES:
1. BREAK SHARP CORNERS, DEBURR AFTER DRILLING AND CUTTING.
2. ALL STRUCTURAL SHAPES AND PLATES MUST BE WITHOUT DISTORTION.
3. ALL WELDS MUST CONFORM CSA W-47, W-59.
4. STEEL PLATES SHALL BE CUT OUT OF ONE PLATE ONLY, IF NOT, JOINING PLATES SHALL BE WELDED BUTT JOINT FULL PENETRATION. THE WELDING SEAM SHALL BE BEHIND A STRUCTURAL SHAPE.
   IF NOT OTHERWISE SPECIFIED, ALL WELDS ARE CONTINUOUS.
5. CLEAN ALL WELDED SURFACES OF BURRS AND ASPERITIES.
6. HANDLE PAINTED PIECES WITH CARE (TO AVOID RUST AFTER INSTALLATION)
7. PROVIDE AND INSTALL LIFTING LUG(S) APPROPRIATE FOR TOTAL WEIGHT OF PART(S). (IF APPLICABLE)
8. PRE-ASSEMBLE PARTS IN SHOP FOR DIMENSIONAL AND FUNCTIONAL VERIFICATION.
9. ALL MACHINED SURFACES TO BE COATED WITH TEMPORARY CORROSION PROTECTION.
10. PIECES SHALL BE MATCH MARKED FOR SUBSEQUENT DISASSEMBLY.
11. LENGTHS ON BILL OF MATERIAL ARE NOMINAL DIMENSIONS, REFER TO DRAWING FOR EXACT DIMENSIONS.

PAINT NOTES:

1. PAINT PROCEDURE AND MANUFACTURER AS PER BECHTEL SPECIFICATION 25457-0000-3PS-G000-0002 REV. 001

TOLERANCES, IF NOT SPECIFIED
METRIC (mm)

ASSEMBLY WELDED CONSTRUCTION

NOM. Length		NOM. Length	
from: 30 to: 120	± 1.0	from: 1000 to: 2000	± 3.0
from: 120 to: 315	± 1.0	from: 2000 to: 4000	± 4.0
from: 315 to: 1000	± 2.0	over: 4000	± 5.0

MACHINING

		HOLES
0:	± 0.5	C©C.: ± .20
0.0:	± 0.1	LOC.: ± .35
0.00:	± 0.05	
ANG.:	± 1°	

WELDING SPECIFICATION, unless otherwise noted:

z=0,4 X t	z=0,5 X t	z=0,5 X t
z= FILLET SIZE	t= THICK. OF THINNER PLATE	

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SELLER DRAWING No. 1347–R4–1514 REV. 0

REV.	DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
			0		INITIAL DESIGN	NO.17.'10	E.I.	M.B.	C.C.

REFERENCES | REVISIONS | NOTES

STATUS —

DRAWN/DEST'D:	E.I.	AREA ENG.:	
DATE:	NO.17.'10	DATE:	
CHECKED:	M.B.	PRJ ENG MGR:	
DATE:	---	DATE:	
RESPONSIBLE ENG.	C.C.	CLIENT:	
DATE:	---	DATE:	
ENG. GROUP SUP. DATE:		DRAWING SCALE:	1:10

Vendor or Subcontractor Logo: GNA alTech Inc. — Département Ingénierie / Engineering Department, 9600 TransCanada, Saint-Laurent, Québec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
PLATFORMS
STAIR #1 (RIGHT)

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx –	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—		—	—	A3–		–AZ	

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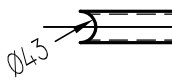
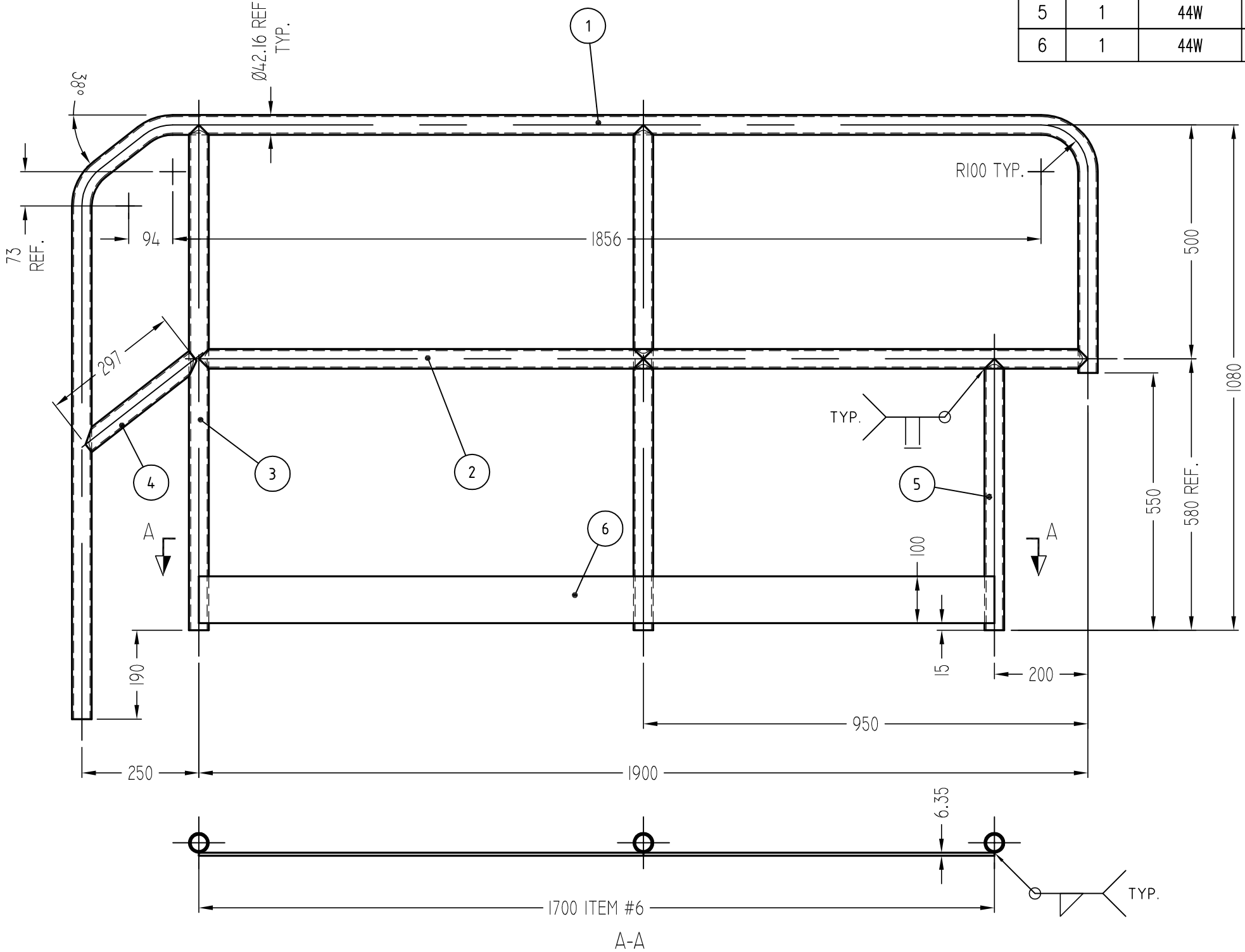
LISTE DE MATERIELS/BILL OF MATERIALS					
ITEM	Qte/Qty	No. PIECE–MAT. MAT.–PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
1	1	44W	PIPE 1–1/4" SCH. #40 x 3820 LG		
2	2	44W	PIPE 1–1/4" SCH. #40 x 950 LG		
3	2	44W	PIPE 1–1/4" SCH. #40 x 1080 LG		
4	1	44W	PIPE 1–1/4" SCH. #40 x 297 LG		
5	1	44W	PIPE 1–1/4" SCH. #40 x 550 LG		
6	1	44W	PL. 1/4" x 100 x 1700LG		

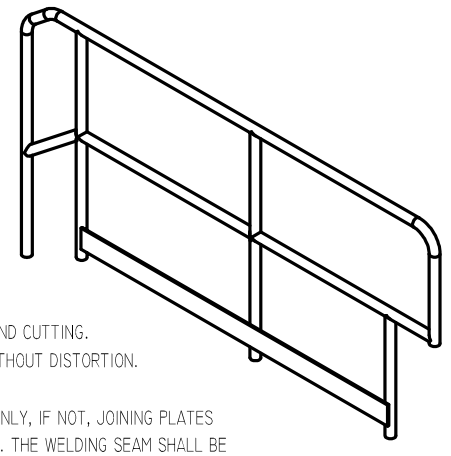
TOTAL APPROX. WEIGHT : 36 KG



DETAIL TYP.



A-A



NOTES:

1. BREAK SHARP CORNERS, DEBURR AFTER DRILLING AND CUTTING.
2. ALL STRUCTURAL SHAPES AND PLATES MUST BE WITHOUT DISTORTION.
3. ALL WELDS MUST CONFORM CSA W-47, W-59.
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10. PIECES SHALL BE MATCH MARKED FOR SUBSEQUENT DISASSEMBLY.
11. LENGTHS ON BILL OF MATERIAL ARE NOMINAL DIMENSIONS, REFER TO DRAWING FOR EXACT DIMENSIONS.

PAINT NOTES:

1. PAINT PROCEDURE AND MANUFACTURER AS PER BECHTEL SPECIFICATION 25457-0000-3PS-G000-0002 REV. 001

TOLERANCES, IF NOT SPECIFIED
METRIC (mm)

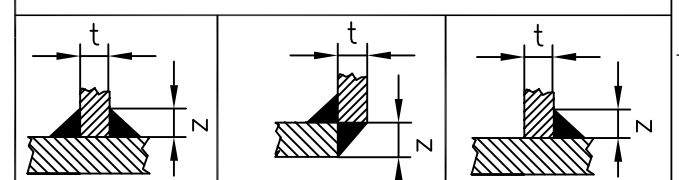
ASSEMBLY WELDED CONSTRUCTION

NOM. Length		NOM. Length	
from: 30 to: 120	± 1.0	from: 1000 to: 2000	± 3.0
from: 120 to: 315	± 1.0	from: 2000 to: 4000	± 4.0
from: 315 to: 1000	± 2.0	over: 4000	± 5.0

MACHINING

		HOLES	
0:	± 0.5	C@C.:	± .20
0.0:	± 0.1	LOC.:	± .35
0.00:	± 0.05		
ANG.:	± 1°		

WELDING SPECIFICATION, unless otherwise noted:



z= FILLET SIZE
t= THICK. OF THINNER PLATE

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SELLER DRAWING No. 1347–R4–1515 REV. 0

REFERENCES		REVISIONS						NOTES
DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
		0		INITIAL DESIGN	NO.17.'10	E.I.	M.B.	C.C.

STATUS: —

DRAWN/DES'D:	E.I.	AREA ENG.:	
DATE:	NO.17.'10	DATE:	
CHECKED:	M.B.	PRJ ENG MGR:	
DATE:	---	DATE:	
RESPONSIBLE ENG.	C.C.	CLIENT:	
DATE:	---	DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	1:10
DATE:			

Vendor or Subcontractor Logo: GNA Multitech Inc. — Département Ingénierie / Engineering Department — Saint-Hyacinthe, Québec, Canada

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457	00AZ	xx	xxxx	xxxx – xxx	xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
PLATFORMS
HANDRAIL #1 (RIGHT)

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3–		–AZ	

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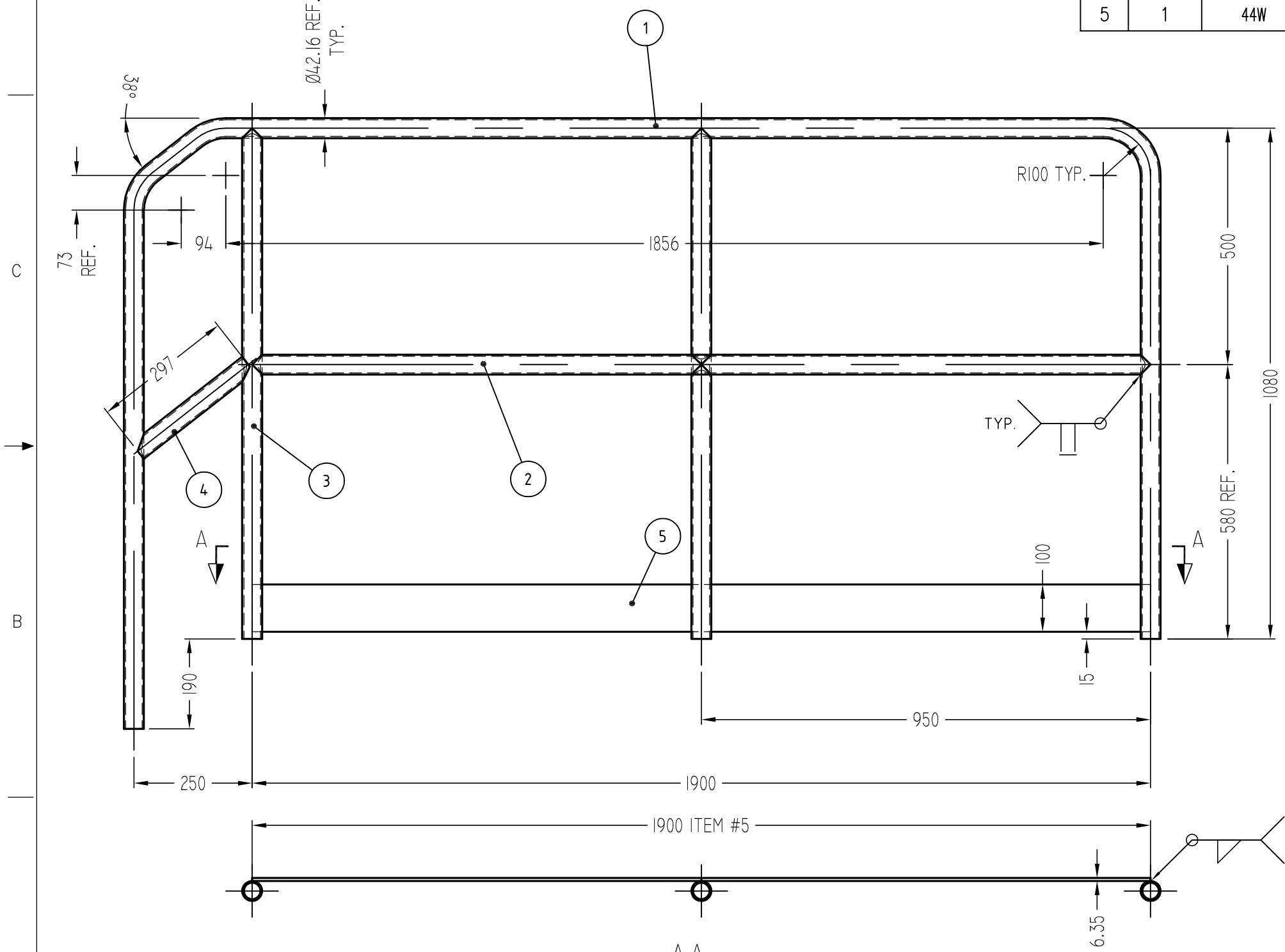
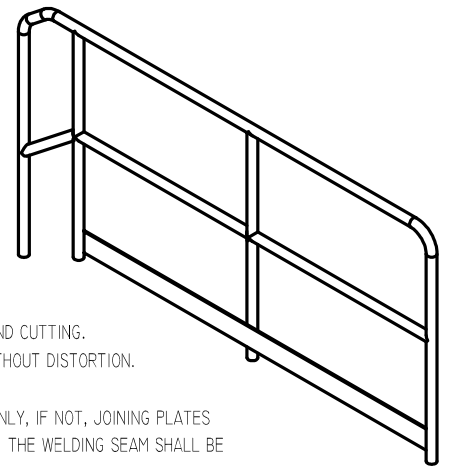
LISTE DE MATERIELS/BILL OF MATERIALS					
ITEM	Qte/Qty	No. PIECE–MAT. MAT.–PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
1	1	44W	PIPE 1–1/4" SCH. #40 x 4370 LG		
2	2	44W	PIPE 1–1/4" SCH. #40 x 950 LG		
3	2	44W	PIPE 1–1/4" SCH. #40 x 1080 LG		
4	1	44W	PIPE 1–1/4" SCH. #40 x 297 LG		
5	1	44W	PL. 1/4" x 100 x 1900 LG		

TOTAL APPROX. WEIGHT : 40 KG





NOTES:

1. BREAK SHARP CORNERS, DEBURR AFTER DRILLING AND CUTTING.
2. ALL STRUCTURAL SHAPES AND PLATES MUST BE WITHOUT DISTORTION.
3. ALL WELDS MUST CONFORM CSA W-47, W-59.
4. STEEL PLATES SHALL BE CUT OUT OF ONE PLATE ONLY, IF NOT, JOINING PLATES SHALL BE WELDED BUTT JOINT FULL PENETRATION. THE WELDING SEAM SHALL BE BEHIND A STRUCTURAL SHAPE.
   IF NOT OTHERWISE SPECIFIED, ALL WELDS ARE CONTINUOUS.
5. CLEAN ALL WELDED SURFACES OF BURRS AND ASPERITIES.
6. HANDLE PAINTED PIECES WITH CARE (TO AVOID RUST AFTER INSTALLATION)
7. PROVIDE AND INSTALL LIFTING LUG(S) APPROPRIATE FOR TOTAL WEIGHT OF PART(S). (IF APPLICABLE)
8. PRE-ASSEMBLE PARTS IN SHOP FOR DIMENSIONAL AND FUNCTIONAL VERIFICATION.
9. ALL MACHINED SURFACES TO BE COATED WITH TEMPORARY CORROSION PROTECTION.
10. PIECES SHALL BE MATCH MARKED FOR SUBSEQUENT DISASSEMBLY.
11. LENGTHS ON BILL OF MATERIAL ARE NOMINAL DIMENSIONS, REFER TO DRAWING FOR EXACT DIMENSIONS.

PAINT NOTES:

1. PAINT PROCEDURE AND MANUFACTURER AS PER BECHTEL SPECIFICATION 25457-0000-3PS-G000-0002 REV. 001

TOLERANCES, IF NOT SPECIFIED
METRIC (mm)

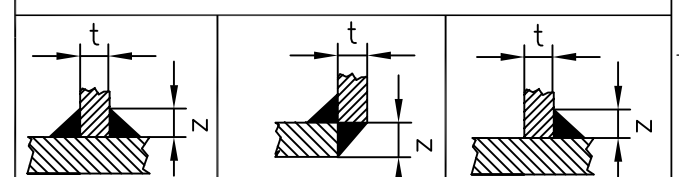
ASSEMBLY WELDED CONSTRUCTION

NOM. Length		NOM. Length	
from: 30 to: 120	± 1.0	from: 1000 to: 2000	± 3.0
from: 120 to: 315	± 1.0	from: 2000 to: 4000	± 4.0
from: 315 to: 1000	± 2.0	over: 4000	± 5.0

MACHINING

		-- HOLES --	
0:	± 0.5	C@C.:	± .20
0.0:	± 0.1	LOC.:	± .35
0.00:	± 0.05		
ANG.:	± 1°		

WELDING SPECIFICATION, unless otherwise noted:



z= FILLET SIZE
t= THICK. OF THINNER PLATE

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SELLER DRAWING No. 1347–R4–1516 | REV. 0

REVISIONS								
No	STATUS	DESCRIPTION	DATE	BY	CHK	APP	NOTES
0		INITIAL DESIGN	NO.17.'10	E.I.	M.B.	C.C.	

REFERENCES	
DRAWING NUMBER	TITLE

STATUS: —

DRAWN/DES'D:	E.I.	AREA ENG.:	
DATE:	NO.17.'10	DATE:	
CHECKED:	M.B.	PRJ ENG MGR:	
DATE:	---	DATE:	
RESPONSIBLE ENG.	C.C.	CLIENT:	
DATE:	---	DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	1:10
DATE:			

Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie / Engineering Department — 1400 Trans-Canada, Jonquière, Québec, G8B 1J9, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
PLATFORMS
HANDRAIL #2 (RIGHT)

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457	00AZ	xx	xxxx	xxxx - xxx	— xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3–		–AZ	

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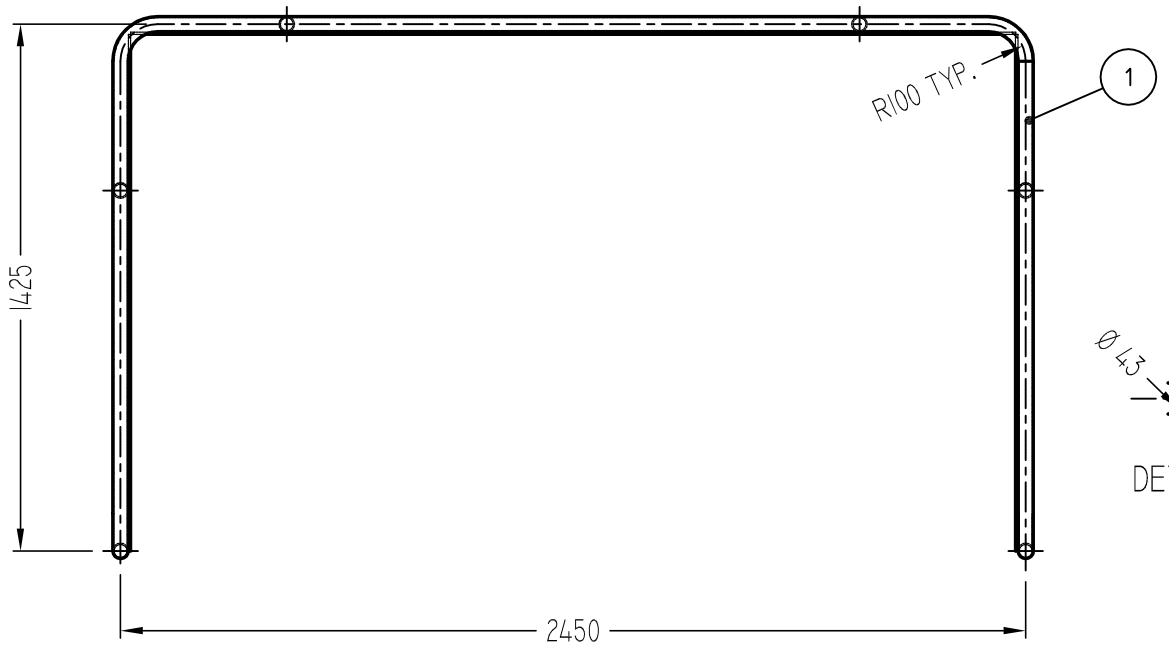

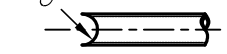

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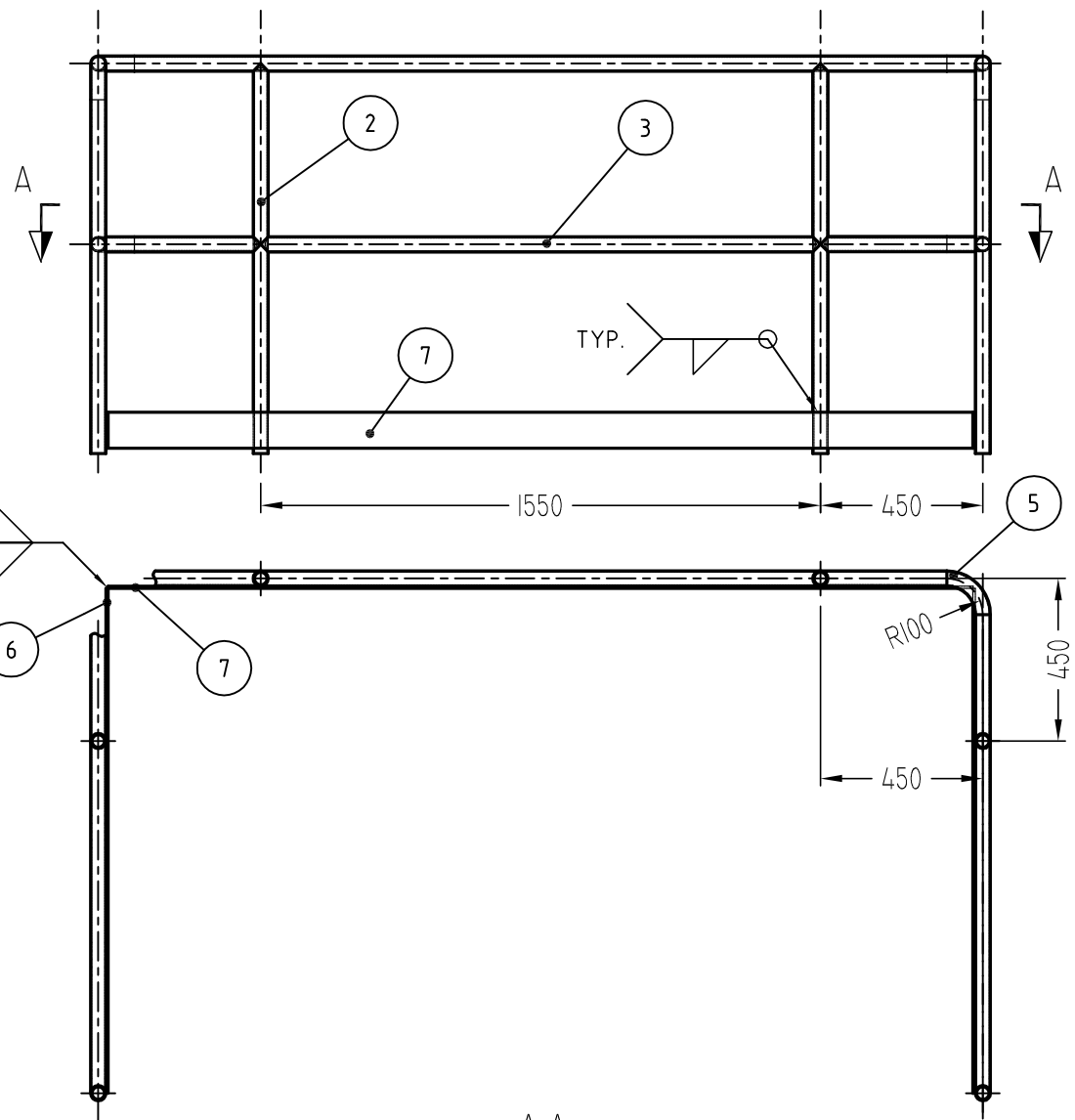

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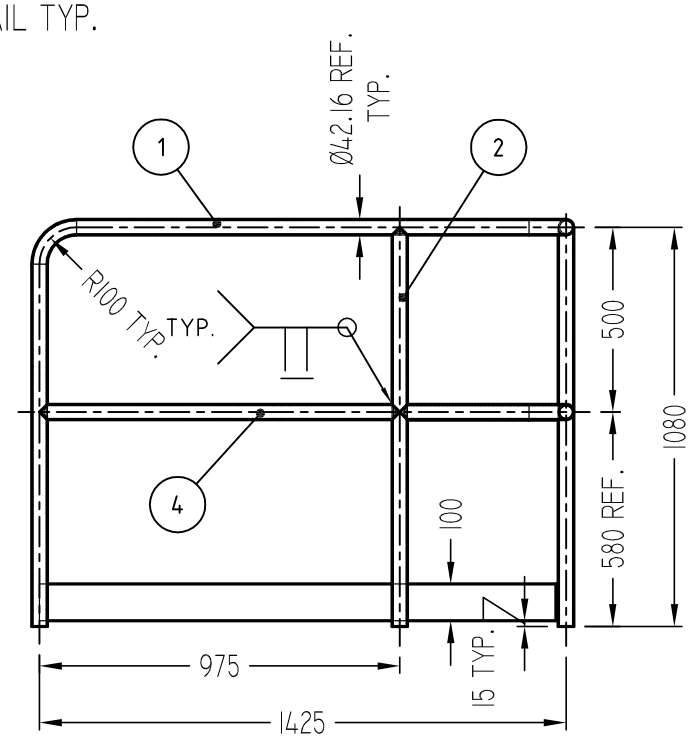

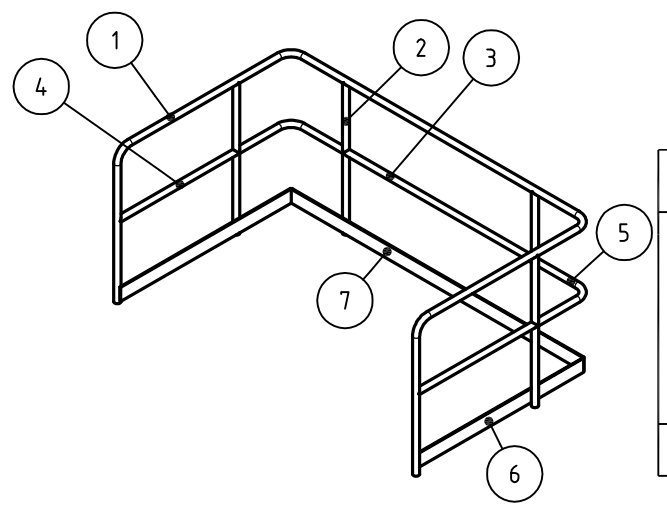

LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/Qty	No. PIECE–MAT. MAT.–PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
1	1	44W	PIPE 1–1/4" SCH. #40 x 7300 LG		
2	4	44W	PIPE 1–1/4" SCH. #40 x 1080 LG		
3	1	44W	PIPE 1–1/4" SCH. #40 x 1050 LG		
4	2	44W	PIPE 1–1/4" SCH. #40 x 975 LG		
5	2	44W	PIPE 1–1/4" SCH. #40 x 860 LG		
6	2	44W	PL. 1/4" x 100 x 1398 LG		
7	1	44W	PL. 1/4" x 100 x 2396 LG		

TOTAL APPROX. WEIGHT : 82 Kg

NOTES:

1. BREAK SHARP CORNERS, DEBURR AFTER DRILLING AND CUTTING.
2. ALL STRUCTURAL SHAPES AND PLATES MUST BE WITHOUT DISTORTION.
3. ALL WELDS MUST CONFORM CSA W-47, W-59.
4. STEEL PLATES SHALL BE CUT OUT OF ONE PLATE ONLY, IF NOT, JOINING PLATES SHALL BE WELDED BUTT JOINT FULL PENETRATION. THE WELDING SEAM SHALL BE BEHIND A STRUCTURAL SHAPE.
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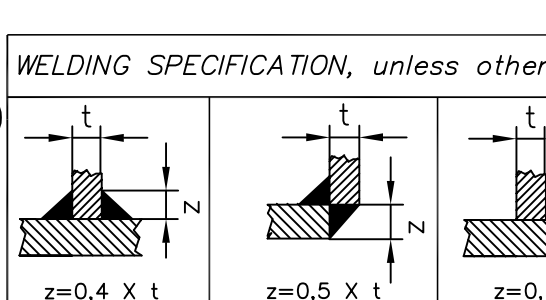
11. LENGTHS ON BILL OF MATERIAL ARE NOMINAL DIMENSIONS, REFER TO DRAWING FOR EXACT DIMENSIONS.

PAINT NOTES:

1. PAINT PROCEDURE AND MANUFACTURER AS PER BECHTEL SPECIFICATION 25457-0000-3PS-G000-0002 REV. 001

WELDING SPECIFICATION, unless otherwise noted



z= FILLET SIZE

t= THICK. OF THINNER PLATE

TOLERANCES, IF NOT SPECIFIED
METRIC (mm)

ASSEMBLY WELDED CONSTRUCTION

NOM. Length		NOM. Length	
from: 30 to: 120	± 1.0	from: 1000 to: 2000	± 3.0
from: 120 to: 315	± 1.0	from: 2000 to: 4000	± 4.0
from: 315 to: 1000	± 2.0	over: 4000	± 5.0

MACHINING

		HOLES
0:	± 0.5	
0.0:	± 0.1	C@C.: ± .20
0.00:	± 0.05	LOC.: ± .35
ANG.:	± 1°	

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SELLER DRAWING No. 1347-R4-1517

REV. 0

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
		0		INITIAL DESIGN	NO.17.2010	E.I.	M.B.	C.C.
REFERENCES		REVISIONS						

NOTES

STATUS —

DRAWN/DES'D:	E.I.	AREA ENG.:	
DATE:	NO.17.'10	DATE:	
CHECKED:	M.B.	PRJ ENG MGR:	
DATE:	---	DATE:	
RESPONSIBLE ENG.	C.C.	CLIENT:	
DATE:	---	DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	1:20
DATE:			

Vendor or Subcontractor Logo: GNA aLtech Inc. Département Ingénierie Engineering Department Saint-Hyacinthe, Québec Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
PLATFORMS
HANDRAIL #3 (RIGHT)

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx –	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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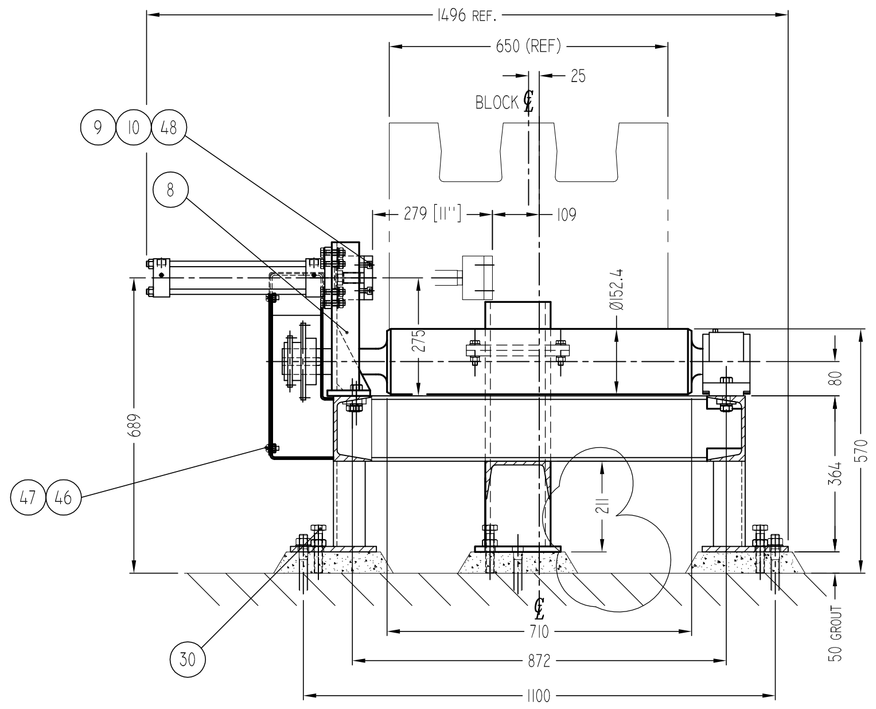

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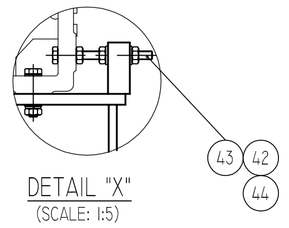

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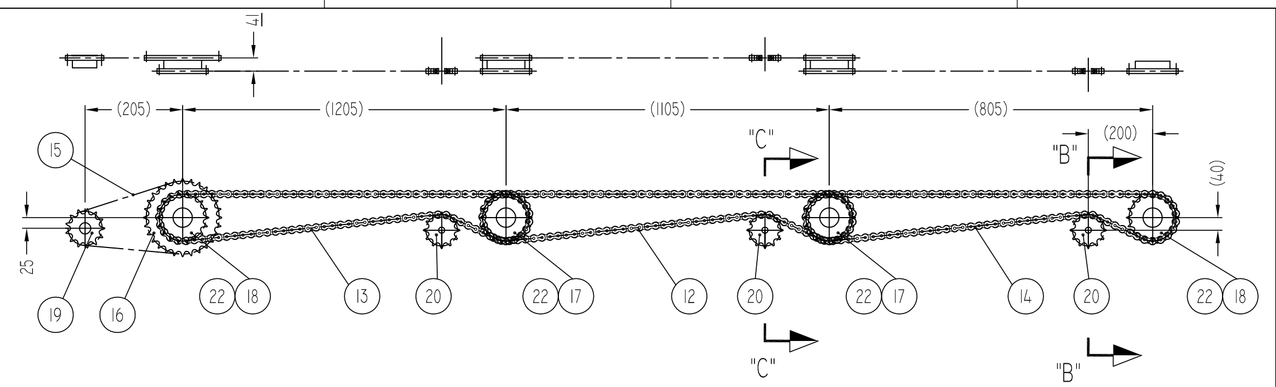
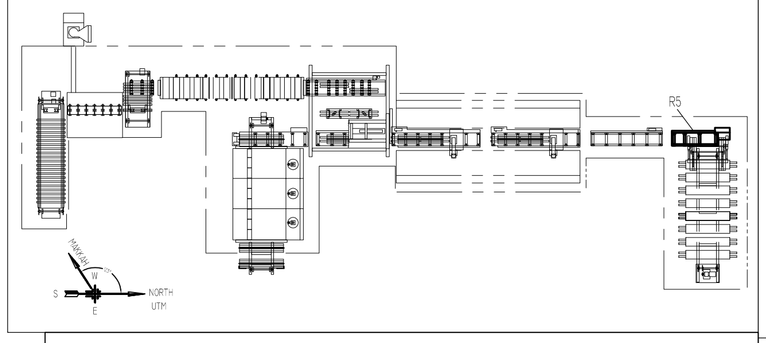


SPROCKET & CHAIN ARRENGEMENT



SELLER/CONTRACTOR DOCUMENT REVIEW

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1 ☐ Work may proceed.
2 ☐ Revise & Resubmit. Work may proceed subject to incorporation of Changes.
3 ☐ Revise & Resubmit. Work may NOT proceed.
4 ☐ Revise not required. Work may proceed.
5 ☐ VOID / Superseded.

DDR Nbr :

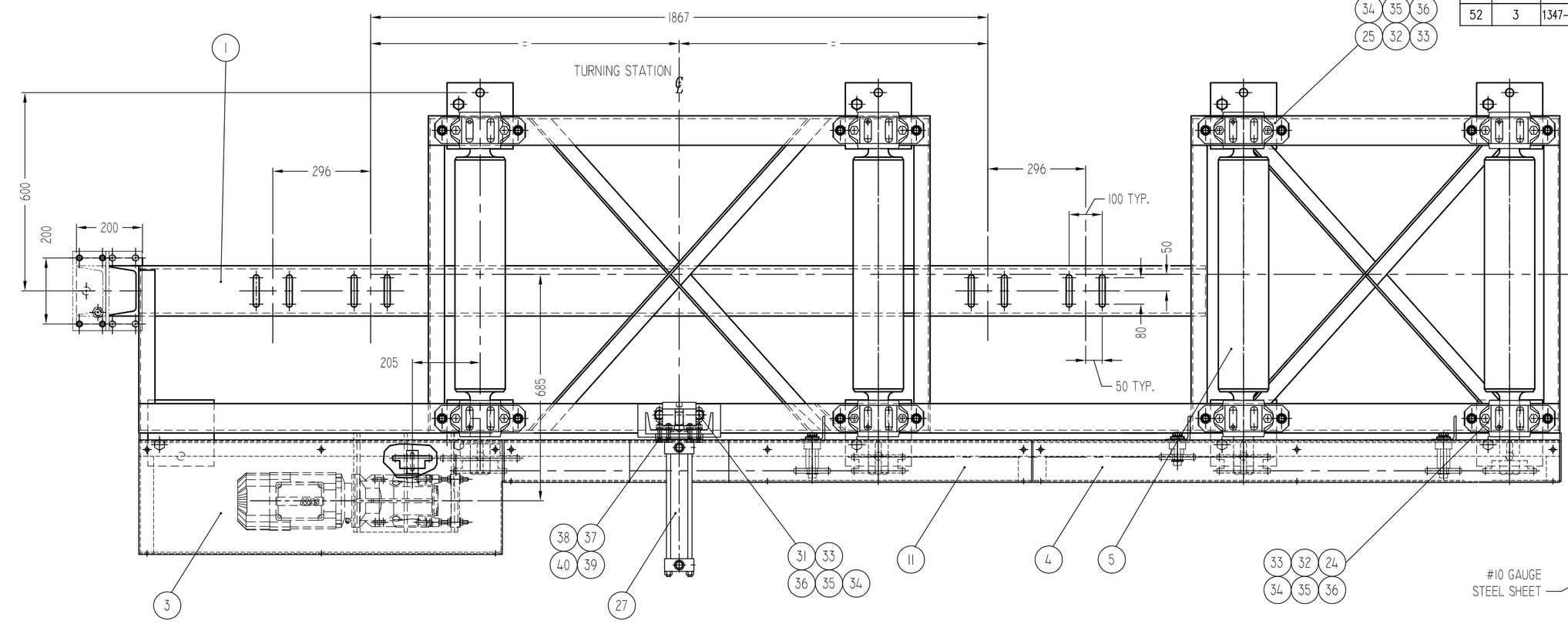
Reviewed by : _____ Date : _____

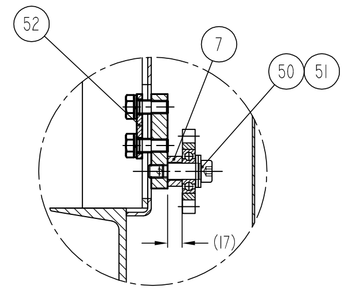
Discipline :

Document No : 25457- **Rev. : 0**

LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/Qty	No. PIECE-MAT. MAT.-PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
41	4	DIN 933	HEX. HEAD BOLT M10 X 50		
42	2	DIN 933	HEX. HEAD BOLT M10 X 110		
43	10	DIN 934	HEX. NUT M10		
44	4	DIN 9021-A	WASHER 10		
45	4	DIN 127	SPRING WASHER A 10		
46	28	DIN 125-B	WASHER 10		
47	24	ANSI B18.3.4M	HEX. SOCKET CAP SCREW M10 X 25		
48	2	DIN 912	CYLINDER HEAD CAP SCREW M10 X 20		
49	2	ANSI B18.3	HEX. SOCK. HEAD SHOULDER SCREW 0.750 X 3		
50	1	ANSI B18.3	HEX. SOCK. HEAD SHOULDER SCREW 0.750 X 1.5		
51	4	S.A.E	WASHER 3/4"		
52	3	1347-R5-1800	FIXING PLATE		3 kg





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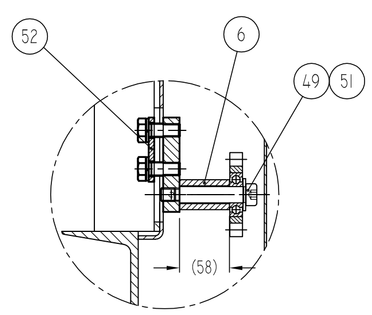

SECTION "C-C"
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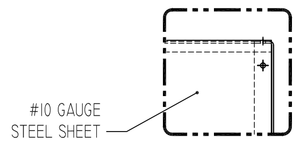
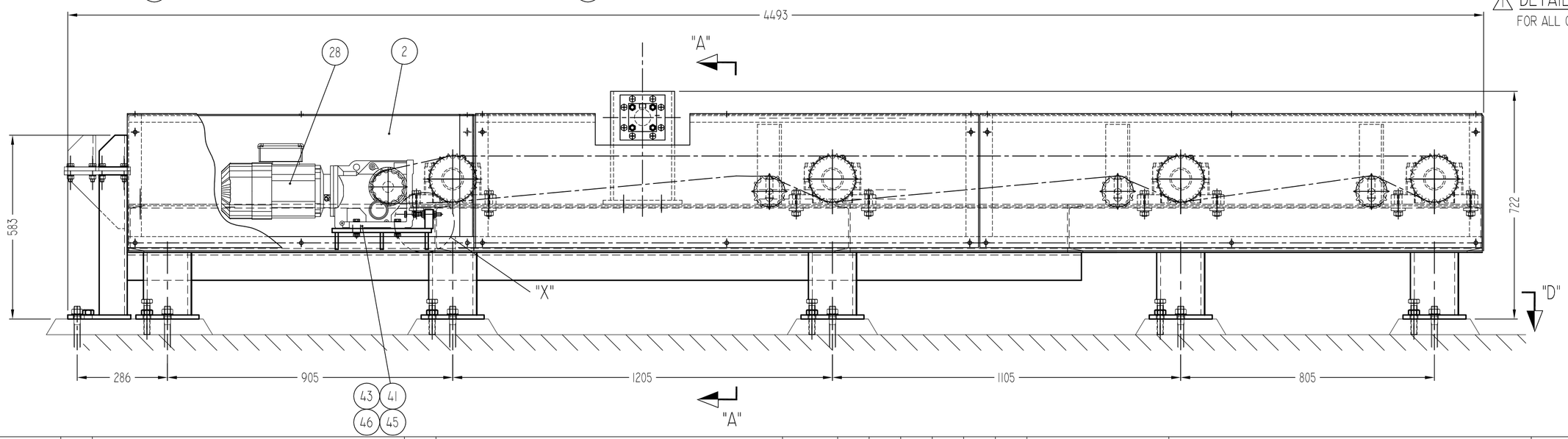
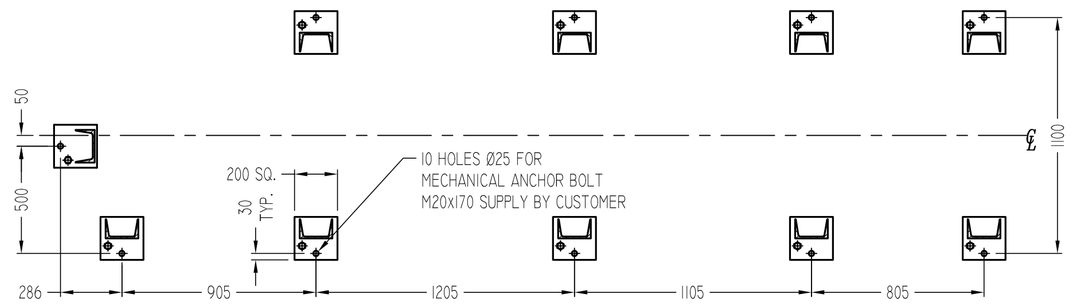


△ DETAIL TYP
FOR ALL GUARDS





SECTION "D-D"
(SCALE: 1:20)

NOTES:
1. FOR FOUNDATION DETAILS SEE DRAWING 1347-AR-0100 AND 1347-AR-0101.
2. ALL MECHANICAL PARTS WILL HAVE AN ACCES FOR MAINTENANCE.
3. THERE IS A GREASE POINT FOR ALL BEARINGS.

△ EQUIPMENT TAG # 4481-MJRO-0008

LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/Qty	No. PIECE-MAT. MAT.-PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
1	1	1347-R5-1100	MAIN FRAME		415 kg
2	1	1347-R5-1110	GUARD		104 kg
3	1	1347-R5-1120	COVER		18 kg
4	1	1347-R5-1130	COVER		19 kg
5	4	1347-R5-1010	ROLL DETAILS	BY "GNA"	550 kg
6	2	1347-R5-1020	SPACER		2 kg
7	1	1347-R5-1030	SPACER (SHORT)		1 kg
8	1	1347-R5-1040	CYLINDER SUPPORT		12 kg
9	1	1347-R5-1050	PUSHER		1 kg
10	1	1347-R5-1060	PUSHER WEAR PLATE		0.2 kg
11	1	1347-R5-1140	COVER		19 kg
12	1	#119083	ROLLER CHAIN #80 X 2692 (106") LG "RENOLD"	BY "GNA"	10 kg
13	1	#119083	ROLLER CHAIN #80 X 2895 (114") LG "RENOLD"	BY "GNA"	11 kg
14	1	#119083	ROLLER CHAIN #80 X 2083 (82") LG "RENOLD"	BY "GNA"	9 kg
15	1	#119083	ROLLER CHAIN #80 X 813 (32") LG "RENOLD"	BY "GNA"	2.1 kg
16	1	#80B28	SPROCKET ,PITCH 1", 28 TEETH	BY "GNA"	4.3 kg
			BORE Ø60, INCL. KEYWAY FOR KEY 11 x 18		
17	2	#DS80A18	SPROCKET, PITCH 1", BORE Ø60, 18 TEETH	BY "GNA"	11 kg
			BORE Ø60, INCL. KEYWAY FOR KEY 11 x 18		
18	2	#80B18	SPROCKET ,PITCH 1",BORE Ø60, 18 TEETH	BY "GNA"	3.4 kg
			BORE Ø60, INCL. KEYWAY FOR KEY 11 x 18		
19	1	#80B13	SPROCKET ,PITCH 1",BORE Ø35, 13 TEETH	BY "GNA"	0.9 kg
			BORE Ø35, INCL. KEYWAY FOR KEY 10 x 8		
20	3	#80BB12H	IDLER SPR.,PITCH 1",BORE Ø19, 12 TEETH	BY "GNA"	2.1 kg
22	4	C-1045	KEY 11 x 18 x 90 LG		
24	4	SNL22513/60TA	PILLOW BLOCK (FIXED) BORE Ø60 "SKF"	BY "GNA"	42 kg
25	4	SNL22513/60TA	PILLOW BLOCK (FREE) BORE Ø60 "SKF"	BY "GNA"	42 kg
27	1		HYDR. CYL. BORE Ø 2.5",ROD Ø 1.375", STROKE 11"	BY "GNA"	15 kg
			#2.50CJB-2HKR34AC11" - "PARKER"		
28	1	K57-DRE90M4	GEARMOTOR 1.1 kW, OUTPUT 40 rpm	BY "GNA"	
			OUTPUTSHAFT Ø35 (M1A), JBOX-POSITION 270		
30	10	DIN 933	HEX. HEAD BOLT M20 x 100		1 kg
31	2	DIN 933	HEX. HEAD BOLT M16 x 65		
32	16	DIN 933	HEX. HEAD BOLT M16 x 80		2 kg
33	18	DIN 934	HEX. NUT M16		
34	18	ASTM F436	SQUARE BEVELED WASHER 0.625		
35	18	DIN 127	SPRING WASHER A 16		
36	18	DIN 125-B	WASHER 16		
37	8	DIN 933	HEX. HEAD BOLT M12 X 50		
38	8	DIN 934	HEX. NUT M12		
39	16	DIN 125-B	WASHER 12		
40	8	DIN 127	SPRING WASHER A 12		

TOTAL WEIGHT APPROX. = 1330 KG

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NUMBER	REV.	TITLE
REFERENCE DRAWINGS		

REV.	DESCRIPTION	DATE	DRN.	CHK.	R.E.	A.E./S.	E.G.S.	P.E.M.
2	FOR APPROVAL	OC.29 2010	LG	M.B.	C.C.			
1	GUARD DETAIL, NOTES AND EQUIPMENT TAG NUMBER ADDED	SE.29.'10	A.V.	M.B.	C.C.			
0	FIRST DESIGN	SE.03.'10	C.D.	M.B.	C.C.			

REVISIONS

STAMP

ALCOA | Ma'aden Aluminum Project

SCALE: 1:10 FORMAT A1

Bechtel

GNA alutech inc. — Département Ingénierie / Engineering Department, 9690 Trans-Canada, Saint-Laurent, Quebec, H4S 1V3, Canada

		DATE
DRAWN	C. Duplantie	SE.03.'10
CHK.	M. Blanchet	
R.E.	C. Coupal	
A.E. / S.		
E.G.S.		
P.E.M.		
CLIENT		

BECHTEL DRG. No. - - - - - REV.

SELLER DRAWING No. 1347-R5-1000 REV. 2

RAS AZ ZAWR ALUMINIUM SMELTER

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
ROLLER CONVEYOR AT COOLING AND TURNING STATION
GENERAL ASSEMBLY

CLIENT DRG. No. REV.

DATE: FILE: TIME: $TIME $DATES $FILES USER: $USERNAMES

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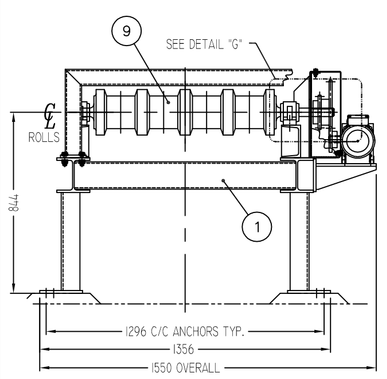

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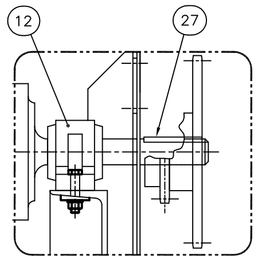

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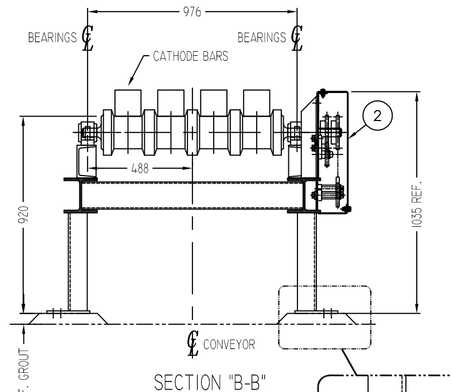

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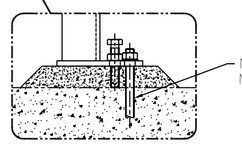

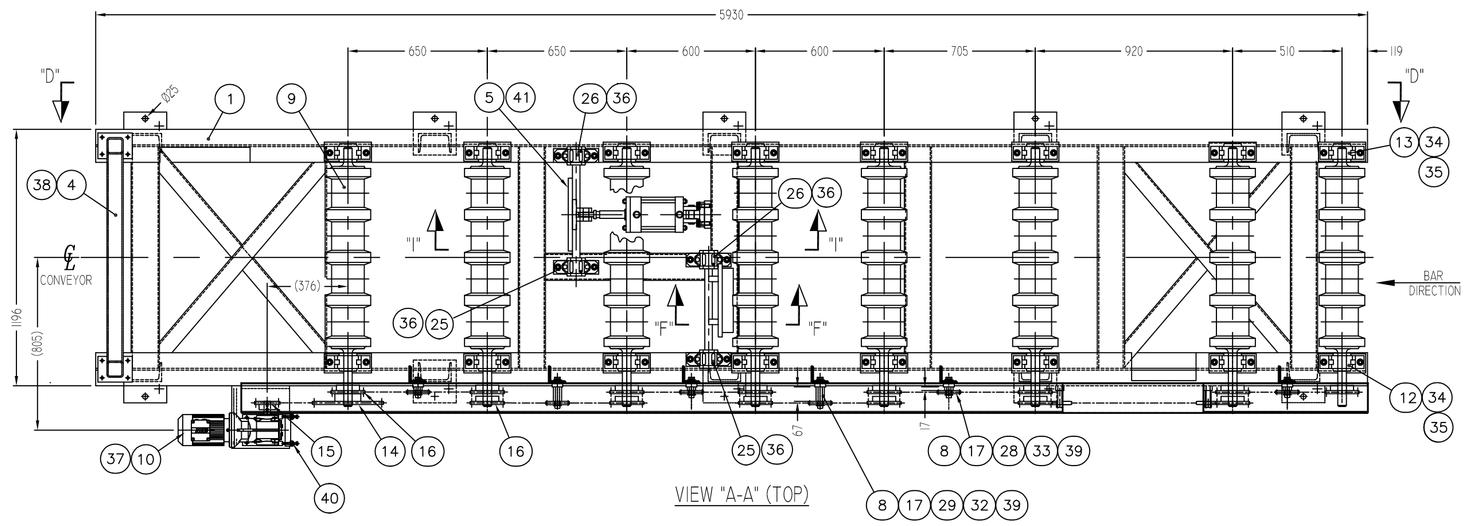

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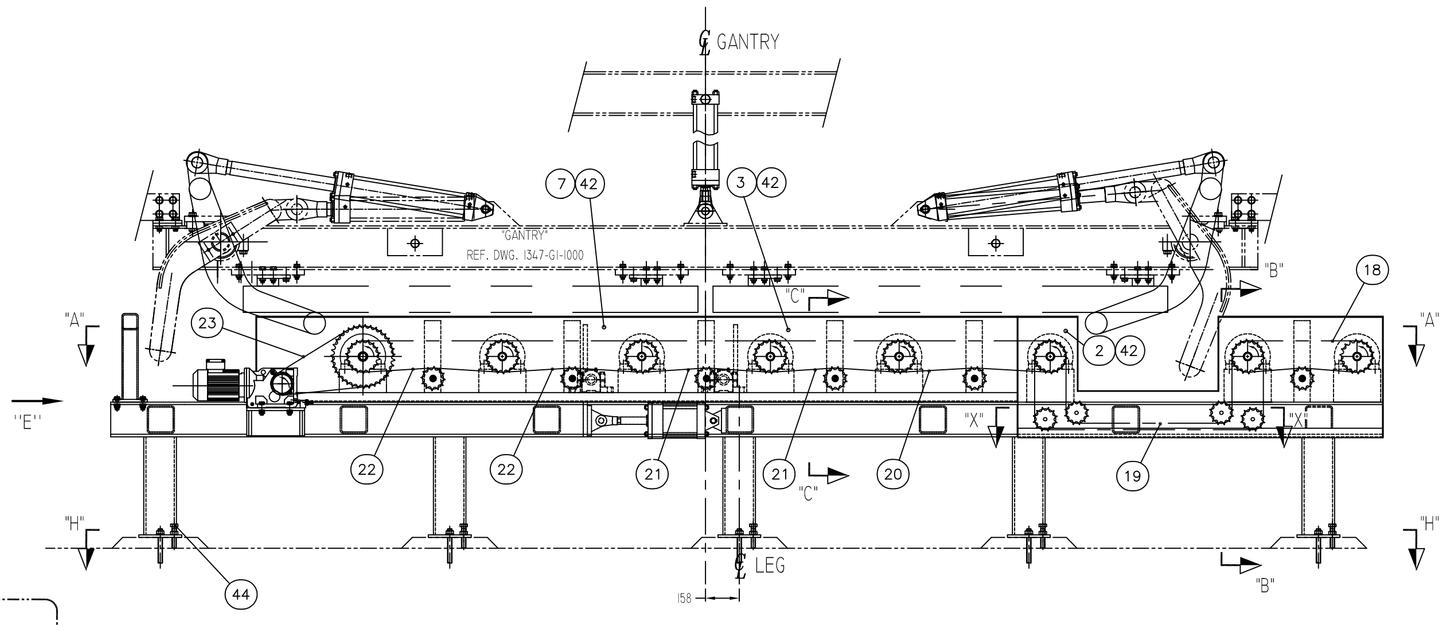
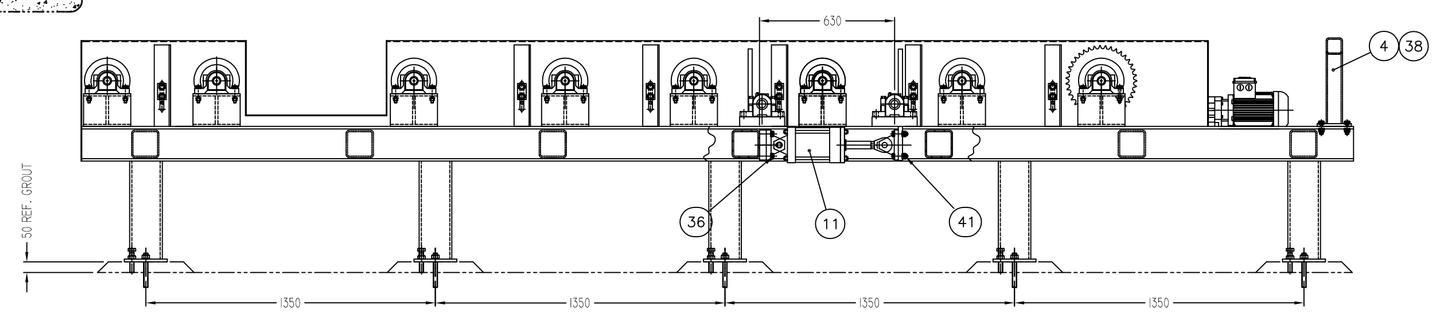


ELEVATION VIEW (GARD COVER OMITTED FOR CLARITY)



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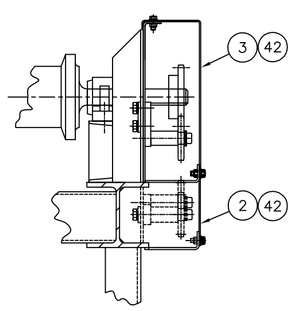

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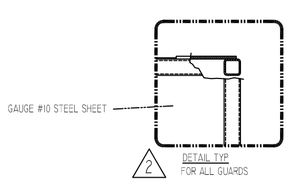

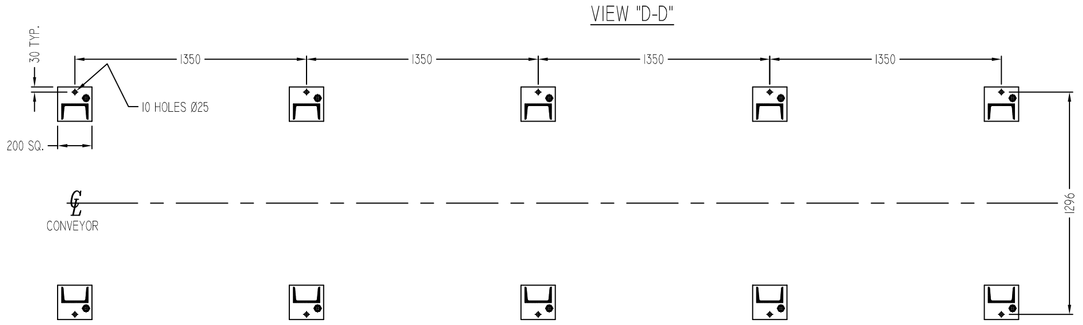

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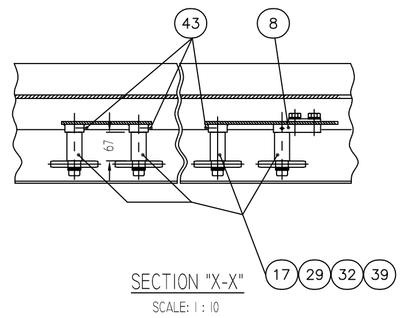

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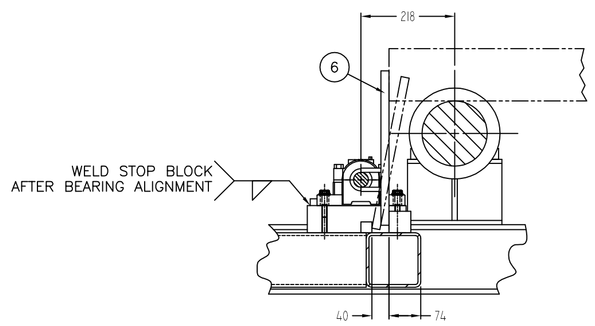

SECTION "F-F"
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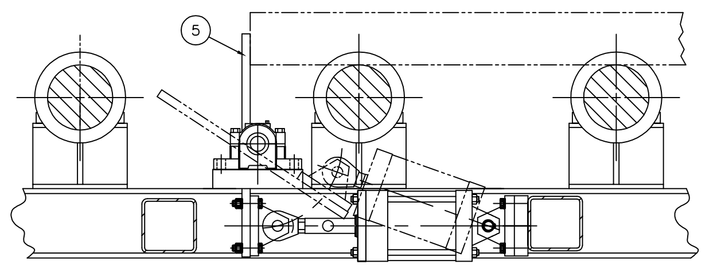


SECTION "I-I"
SCALE: 1 : 10

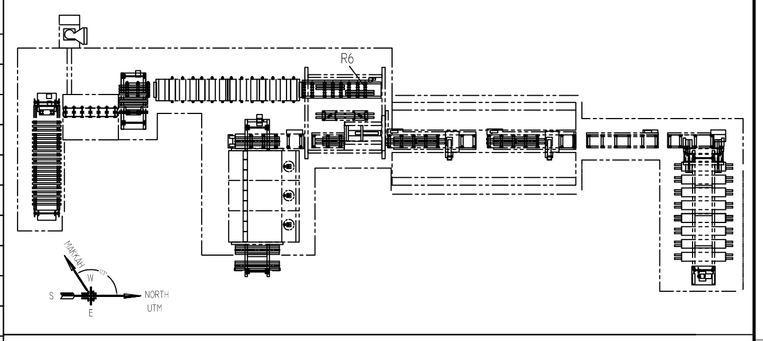
LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/Qty	No. PIECE-MAT. MAT.-PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
37	4	DIN 933	HEX. BOLT M10 x 50 LG.		
	4	DIN 934	HEX. NUT M10		
	4	DIN 125	FLAT WASHER M10		
	4	DIN 128	LOCK WASHER M10		
38	8	DIN 933	HEX. BOLT M12 x 45 LG.		
	8	DIN 934	HEX. NUT M12		
	8	DIN 128	LOCK WASHER M12		
39	20	DIN 125_2A	FLAT WASHER 21		
40	2	DIN 933	HEX. BOLT M10 x 65 LG.		
	2	DIN 934	HEX. NUT M10		
	2	DIN 128	LOCK WASHER M10		
41	4	DIN 933	HEX. BOLT M12 x 60 LG.		
	4	DIN 934	HEX. NUT M12		
	4	DIN 128	LOCK WASHER M12		
42	30	DIN 933	HEX. BOLT M10 x 20 LG.		
	30	DIN 125	FLAT WASHER M10		
43	3	DIN916	HEX SOCKET SET SCREW M6 x 16		
44	10	DIN 933	HEX. BOLT M20 x 100 LG.		

APPROX. TOTAL WEIGHT: 1210 Kg

NOTES:

1. FOR FOUNDATION DETAILS SEE DRAWING 1347-AR-0100 AND 1347-AR-0101.
2. ALL MECHANICAL PARTS WILL HAVE AN ACCES FOR MAINTENANCE.
3. THERE IS A GREASE POINT FOR ALL BEARINGS.
4. FENCE AROUND EQUIPEMENT, NO PROTECTION GUARDING REQUIRED.



KEY PLAN

LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/Qty	No. PIECE-MAT. MAT.-PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
1	1	1347-R6-1100	CONVEYOR FRAME		1083 KG
2	1	1347-R6-1200	WIDE CHAIN GARD		30 KG
3	1	1347-R6-1300	SMALL CHAIN GARD		22 KG
4	1	1347-R6-1400	BAR SAFETY BUMPER		18 KG
5	1	1347-R6-1500	MECHANICAL STOPPER		32 KG
6	1	1347-R6-1600	FIXED STOPPER		22 KG
7	1	1347-R6-1700	SMALL CHAIN GARD (DRIVE SIDE)		
8	7	1347-R6-1800	FIXING PLATE		
9	8	1347-R6-1010	ROLL		
10	1	K47-DRE80M4/DH	GEARMOTOR, 1 hp, 0.75 kW, 44 rpm,1443 lb*in	BY GNA	
11	1	6SB2AUV19A4.625	AIR CYL., 6" BORE , ROD 1 3/8", 4-5/8" STROKE	BY GNA	
	1	#132292	SPHERICAL ROD EYE "PARKER"	BY GNA	
	2	#83949	CLEVIS BRACKET "PARKER"	BY GNA	
	2	#83964	PIN "PARKER"	BY GNA	
12	8	SNL22509/40TG	"SKF" PILLOW BLOCK UNIT (FIXED), BORE 40mm	BY GNA	
13	8	SNL22509/40TGY	"SKF" PILLOW BLOCK UNIT (FREE), BORE 40mm	BY GNA	
14	1	80B35	SPROCKET, #80, 35 TEETHS, BORE 40mm	BY GNA	
15	1	80B13	SPROCKET, #80, 13 TEETHS, BORE 30mm	BY GNA	
16	14	80B18	SPROCKET, #80, 18 TEETHS, BORE 40mm	BY GNA	
17	10	80BB12H	IDLER SPROCKET, #80, 12 TEETHS, ø3/4"	BY GNA	
18	1	STEEL	ROLLER CHAIN 1" PITCH #80, 59" LG.	BY GNA	
19	1	STEEL	ROLLER CHAIN 1" PITCH #80, 139" LG.	BY GNA	
20	1	STEEL	ROLLER CHAIN 1" PITCH #80, 74" LG.	BY GNA	
21	2	STEEL	ROLLER CHAIN 1" PITCH #80, 66" LG.	BY GNA	
22	2	STEEL	ROLLER CHAIN 1" PITCH #80, 70" LG.	BY GNA	
23	1	STEEL	ROLLER CHAIN 1" PITCH #80, 56" LG.	BY GNA	
24					
25	2	SNL22508/35TG	"SKF" PILLOW BLOCK UNIT (FIXED), BORE 35mm	BY GNA	
26	2	SNL22508/35TGY	"SKF" PILLOW BLOCK UNIT (FREE), BORE 35mm	BY GNA	
27	8	C-1045	BAR 8 X 12 X 90 LG	KEY	
28	4	STEEL	MECHANICAL TUBE O.D. 1.5", I.D. 0.75", 17mm LG		
29	6	STEEL	MECHANICAL TUBE O.D. 1.5", I.D. 0.75", 67mm LG		
30					
31					
32	6	364-073	"SPAENAUR" HEX.SOCKET SHOULDER SCREW		
			SHOULDER: ø 3/4x 3.5" LG.		
33	4	364-072	"SPAENAUR" HEX.SOCKET SHOULDER SCREW		
			SHOULDER: ø 3/4 x 1.5" LG.		
34	32	W-290	"SPAENAUR" SQUARE BEVEL WASHER ø 1/2"		
35	32	DIN 931	HEX. BOLT M12 x 70 LG.		
	32	DIN 934	HEX. NUT M12		
	32	DIN 125	FLAT WASHER M12		
	32	DIN 128	LOCK WASHER M12		
36	12	DIN 933	HEX. BOLT M12 x 50 LG.		
	12	DIN 128	LOCK WASHER M12		

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4 ☐ Revise not required. Work may proceed.
5 ☐ VOID / Superseded.

DDR Nbr :

Reviewed by : Date :

Discipline :

Document No : 25457- **Rev. : 0**

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EQUIPMENT TAG # 4481-MJRO-0004

NUMBER	REV.	TITLE
REFERENCE DRAWINGS		

REV.	DESCRIPTION	DATE	DRN.	CHK.	R.E.	A.E. / S.	E.G.S.	P.E.M.
3	FOR APPROVAL	OC.29 2010	LG	M.B.	C.C.			
2	DETAIL GUARD, NOTES AND EQUIPMENT TAG NUMBER ADDED, ITEM #11 REV.	SE.24.'10	C.C.	M.B.	C.C.			
1	LINE WEIGHT MODIFIED	SE.01.'10	E.I.	M.B.	C.C.			
0	INITIAL DESIGN	AU.02.'10	E.I.	M.B.	C.C.			

REVISIONS

STAMP

Ma'aden Aluminum Project

SCALE: 1:20 FORMAT A1

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GNA alutech inc.
Departement Ingenierie
Engineering Department
9450 Trans-Canada
Saint-Laurent, Quebec
H4S 1V3
Canada

		DATE
DRAWN	E. Iancu	AU.02.'10
CHK.	M. Blanchet	
R.E.	C. Coupal	
A.E. / S.		
E.G.S.		
P.E.M.		
CLIENT		

BECHTEL DRG. No. - - - - - REV.

CLIENT DRG. No. REV.

SELLER DRAWING No. 1347-R6-1000 REV. 3

Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
ROLLER CONVEYOR AT BAR FURNACE EXIT
GENERAL ASSEMBLY

USER: $USERNAME$ TIME: $TIME$ $DATES $FILES DATE: FILE:

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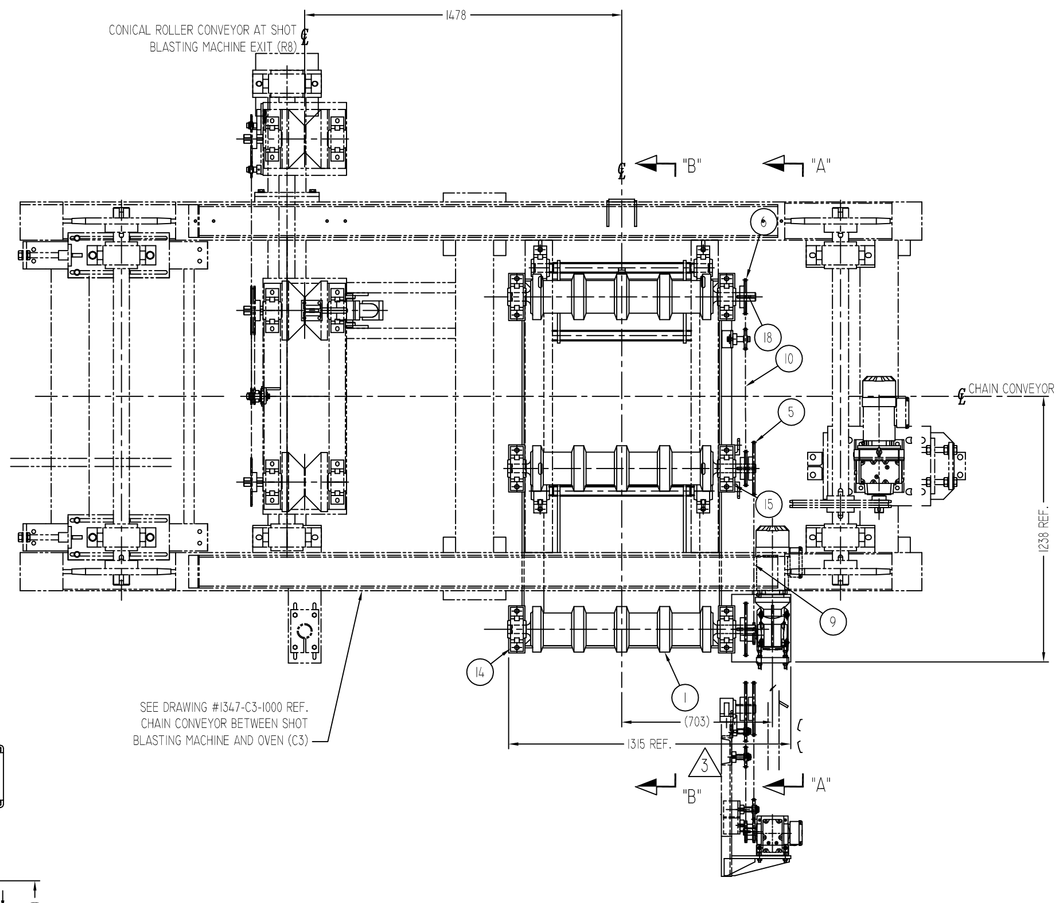

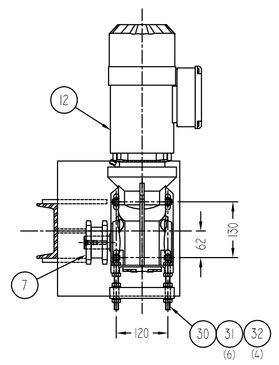

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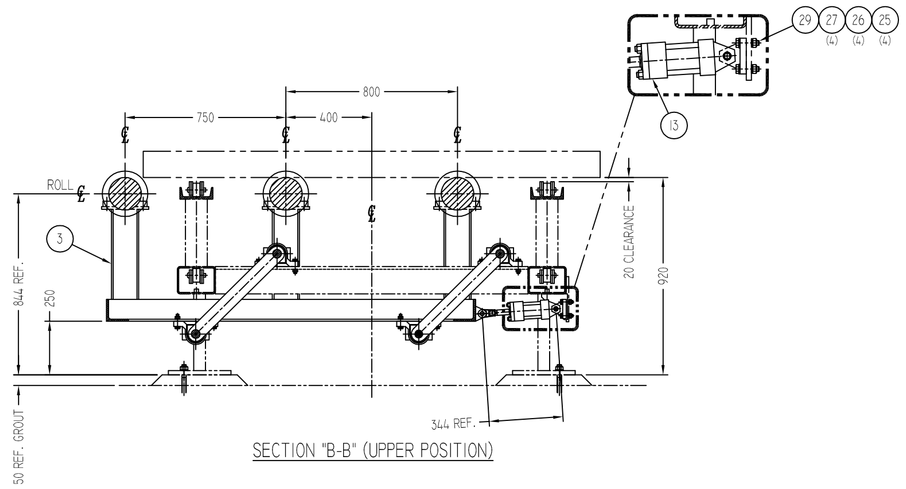

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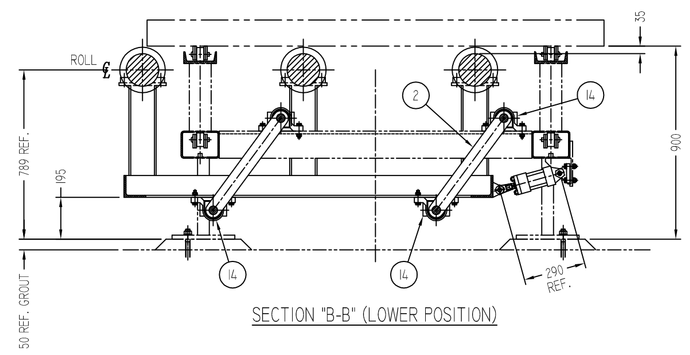

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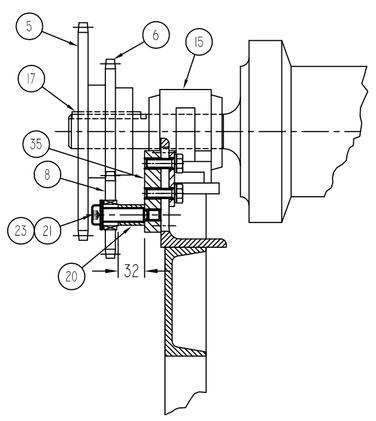

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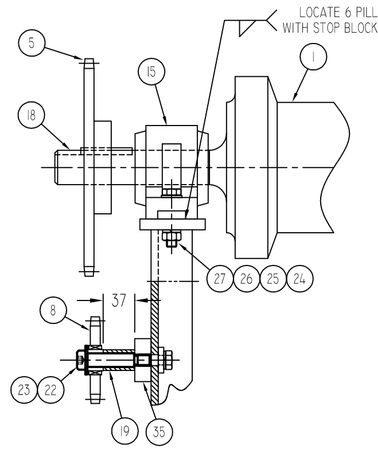

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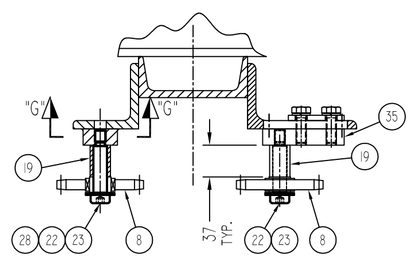

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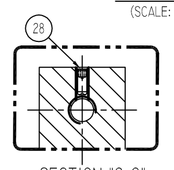

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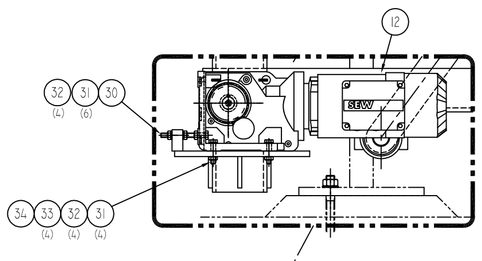

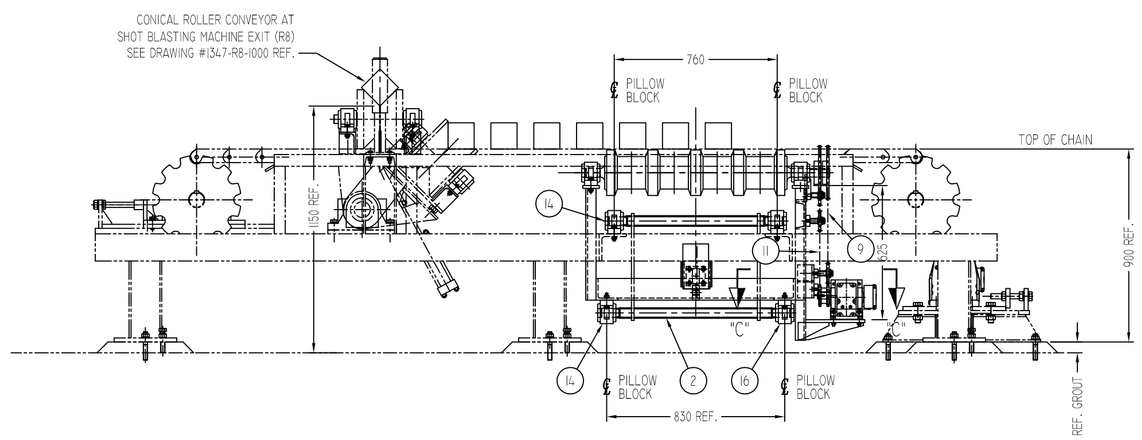

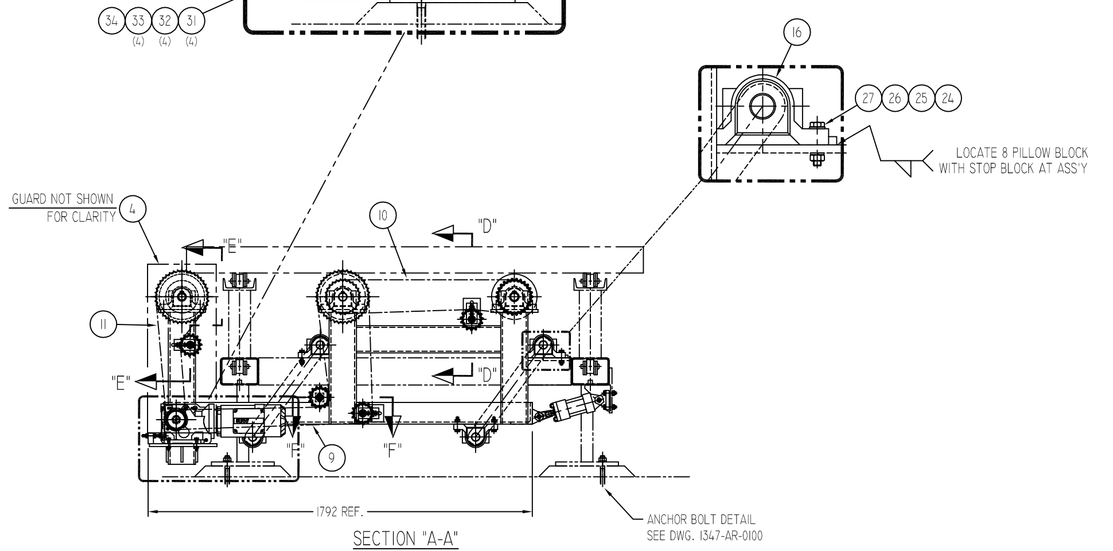

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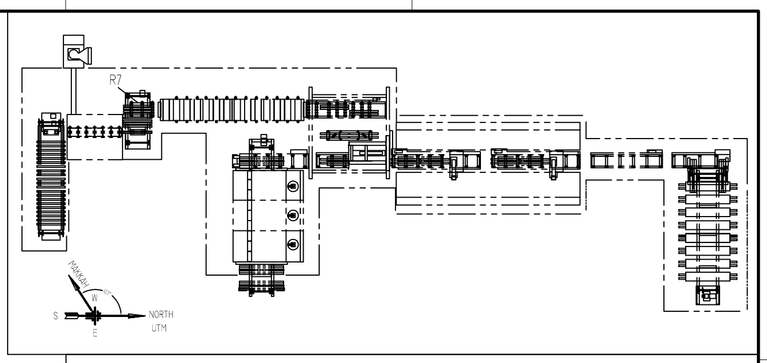

LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/Qty	No. PIECE–MAT. MAT.–PART. No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
1	3	1347–R7–1010	ROLL		471 Kg
2	2	1347–R7–1020	PIVOT ARM		58 Kg
3	1	1347–R7–1100	MAIN FRAME		170 Kg
4	1	1347–R7–1200	GUARD ASSEMBLY		23 Kg
5	2	#60B40	SPROCKET #60, BORE ø40, 40 TEETH	BY "GNA"	10 Kg
6	2	#60B26	SPROCKET #60, BORE ø40, 26 TEETH	BY "GNA"	6 Kg
3 7	1	#DS60A15	SPROCKET #60, BORE ø30, 15 TEETH	BY "GNA"	1.8 Kg
8	4	#60BB15H	BALL BEARING IDLER #60, 15 TEETH	BY "GNA"	2 Kg
9	1	#119063	ROLLER CHAIN #60 X 3225 LG "RENOLD"	BY "GNA"	5 Kg
10	1	#119063	ROLLER CHAIN #60 X 2100 LG "RENOLD"	BY "GNA"	3.3 Kg
11	1	#119063	ROLLER CHAIN #60 X 1715 LG "RENOLD"	BY "GNA"	2.7 Kg
12	1	KA7-DRE80M4BE2SHF/BK	REDUCER 0.75 Kw, OUTPUT 44 RPM, SHAFT ø30	BY "GNA"	34 Kg
13	1	2.5038-2IKTSH14CZ.12	HYDRAULIC CYLINDER CLEVIS MOUNT, BORE 2–1/2"	BY "GNA"	
–			ROD 1" DIA., STROKE 54mm C/W FEMALE ROD		
–			CLEVIS, CLEVIS BRACKET & PIVOT PIN "PARKER"		
14	7	SNL22509/40TGY	PILLOW BLOCK (FREE) BORE ø40 "SKF"	BY "GNA"	26 Kg
15	3	SNL22509/40TG	PILLOW BLOCK (FIXED) BORE ø40 "SKF"	BY "GNA"	11 Kg
16	4	SNL22509/40TGY	PILLOW BLOCK (FIXED) BORE ø40 "SKF"	BY "GNA"	15 Kg
17	1	C–1045	BAR 8 X 12 X 80 LG	KEY	
18	2	C–1045	BAR 8 X 12 X 60 LG	KEY	
3 19	3	STEEL	MECH. TUBING ø23.8 X 3.4 WALL X 37 LG		
3 20	1	STEEL	MECH. TUBING ø23.8 X 3.4 WALL X 32 LG		
3 21	1	STD	HEX. SOCKET SHOULDER SCREW 5/8" X 2"LG		
3 22	3	STD	HEX. SOCKET SHOULDER SCREW 5/8" X 2–1/4"LG		
23	4	STD	FLAT WASHER FOR BOLT M16, DIN 125_2A		
24	28	STD	HEX. BOLT M12 X 60 LG, DIN 931		
25	32	STD	HEX. NUT M12, DIN 934		
26	32	STD	FLAT WASHER FOR BOLT M12, DIN 125A		
27	32	STD	LOCKWASHER FOR BOLT M12, DIN 127A		
28	1	DIN 916	HEX SOCKET SET SCREW M6 x 12		
29	4	STD	HEX. BOLT M12 X 50 LG, DIN 931		
30	2	STD	HEX. BOLT M10 X 110 LG, DIN 933		
31	10	STD	HEX. NUT M10, DIN 934		
32	8	STD	FLAT WASHER FOR BOLT M10, DIN 125A		
33	4	STD	LOCKWASHER FOR BOLT M10, DIN 127A		
34	4	STD	HEX. BOLT M10 X 50 LG, DIN 931		
35	3	1347–R7–1800	FIXING PLATE		3 Kg

APPROX. TOTAL WEIGHT: 862 Kg

⚠ NOTES:

1. FOR FOUNDATION DETAILS SEE DRAWING 1347-AR-0100 AND 1347-AR-0101.
2. ALL MECHANICAL PARTS WILL HAVE AN ACCES FOR MAINTENANCE.
3. THERE IS A GREASE POINT FOR ALL BEARINGS.

⚠ EQUIPMENT TAG # 4481-MJRO-0003

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Discipline :

Document No : 25457- **Rev. : 0**

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SELLER DRAWING No. 1347-R7-1000 REV. 3

NUMBER	REV.	TITLE
REFERENCE DRAWINGS		

REV.	DESCRIPTION	DATE	DRN.	CHK.	R.E.	A.E. / S.	E.G.S.	P.E.M.
3	ITEMS # 7, 19 to 22 UPDATED / VIEWS D-D, E-E, F-F UPDATED, GUARD REMOVED	NO.25 2010	C.C.	LG	LG			
2	FOR APPROVAL	OC.29 2010	LG	M.B.	C.C.			
1	GUARD DETAIL, NOTES AND EQUIPMENT TAG NUMBER ADDED	SE.24.'10	C.C.	M.B.	C.C.			
0	INITIAL DESIGN	AU.10.'10	A.V.	M.B.	C.C.			

REVISIONS

STAMP

ALCOA | Ma'aden Aluminum Project

SCALE: 1=20 FORMAT A1

Bechtel

Departement Ingenierie
Engineering Department
9496 Trans-Canada
Saint-Laurent, Quebec
H4S 1V3
Canada

		DATE
DRAWN	A.V.	AU.10.'10
CHK.	M. Blanchet	
R.E.	C. Coupal	
A.E. / S.		
E.G.S.		
P.E.M.		
CLIENT		

BECHTEL DRG. No. - - - - - REV.

CLIENT DRG. No. REV.

Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
ROLLER CONVEYOR AT BAR FURNACE ENTRANCE
GENERAL ARRANGEMENT

USER: $USERNAMES
TIME: $TIMES
$DATES
$FILES
DATE:
FILE:

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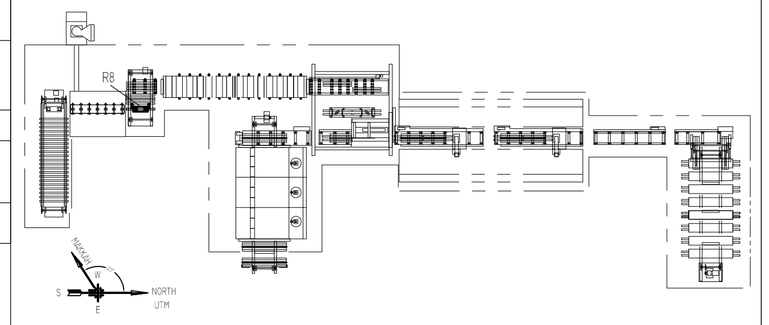
1 ☐ Work may proceed.
2 ☐ Revise & Resubmit. Work may proceed subject to incorporation of changes.
3 ☐ Revise & Resubmit. Work may NOT proceed.
4 ☐ Revise not required. Work may proceed.
5 ☐ VOID / Superseded.

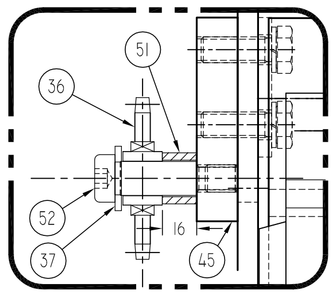
DDR Nbr :

Reviewed by : Date :

Discipline :

Document No : 25457- **Rev. :**





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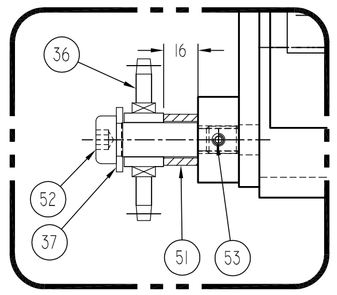

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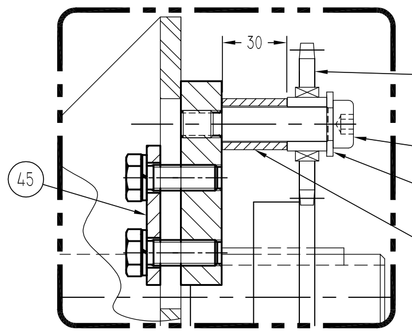

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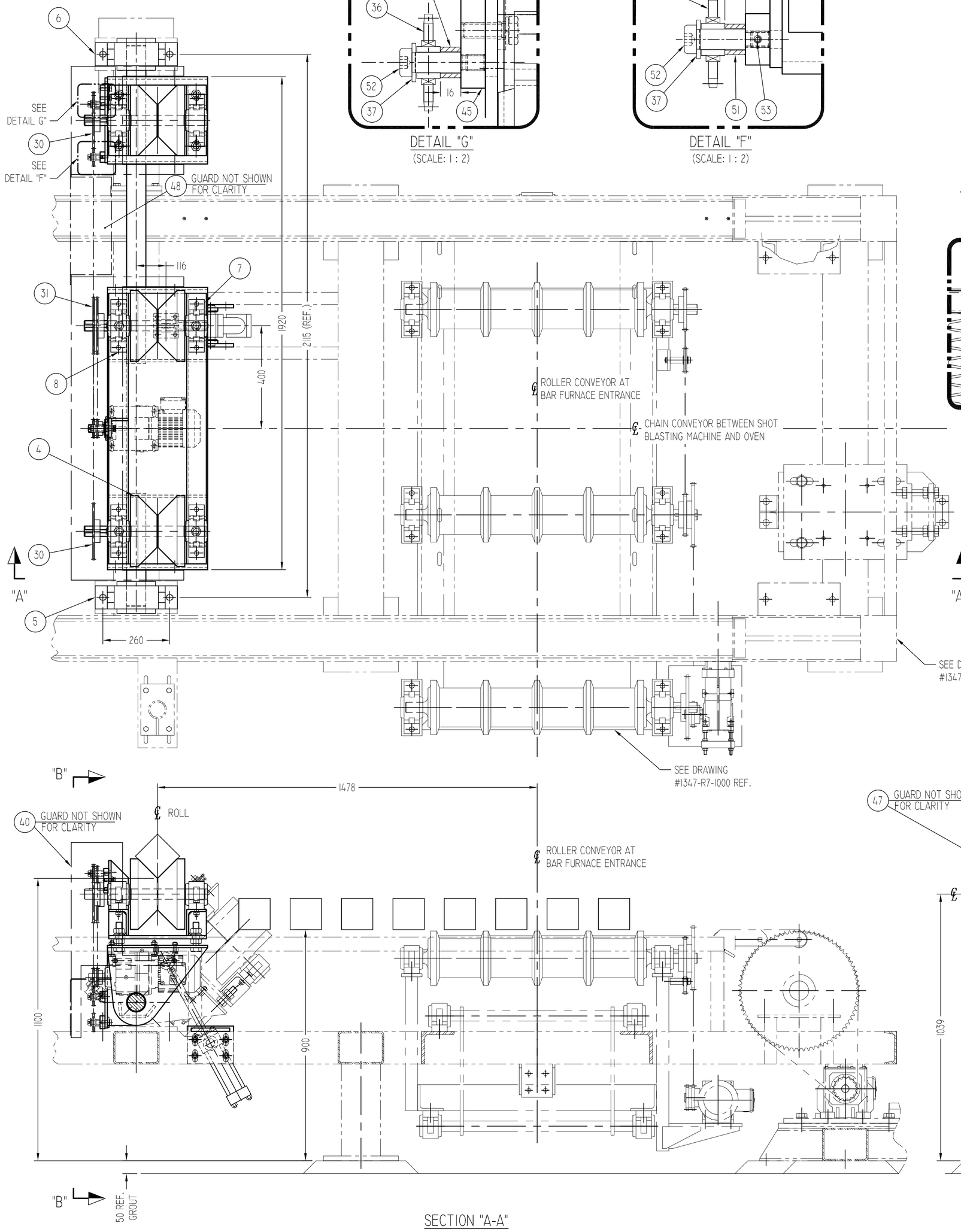
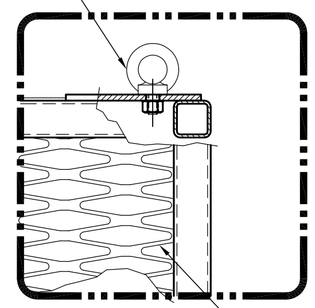
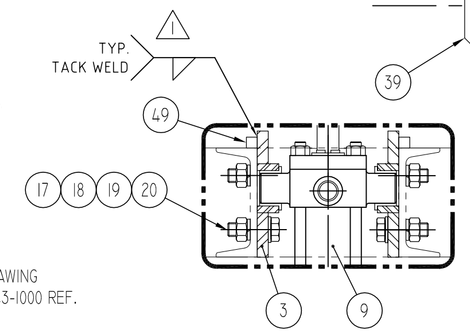




DETAIL TYP
FOR ALL GUARDS 1



DETAIL "D"
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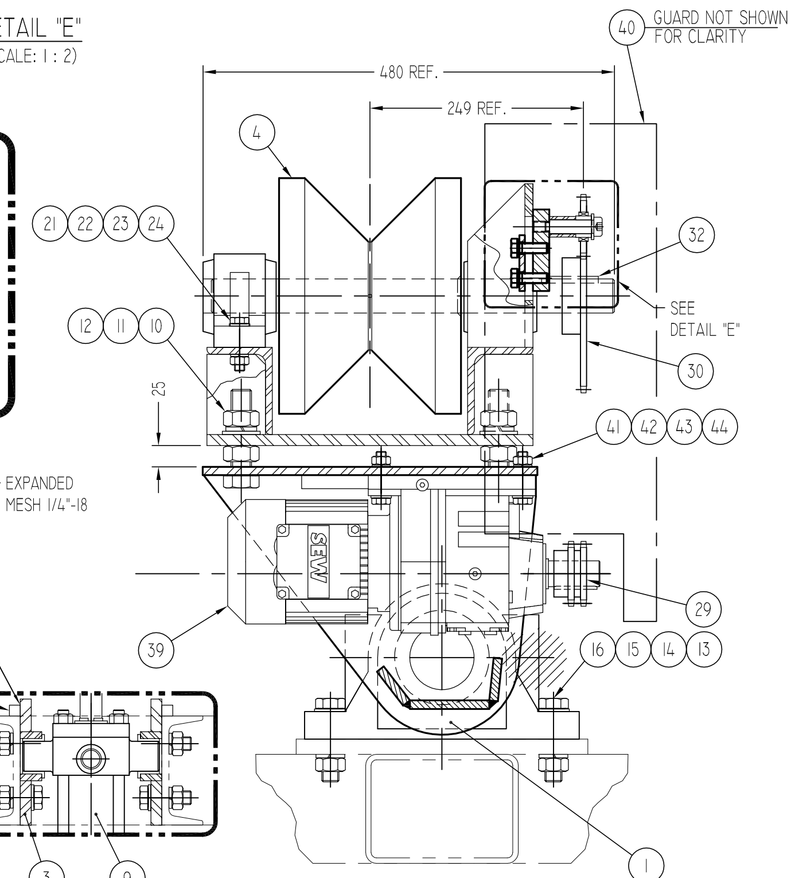
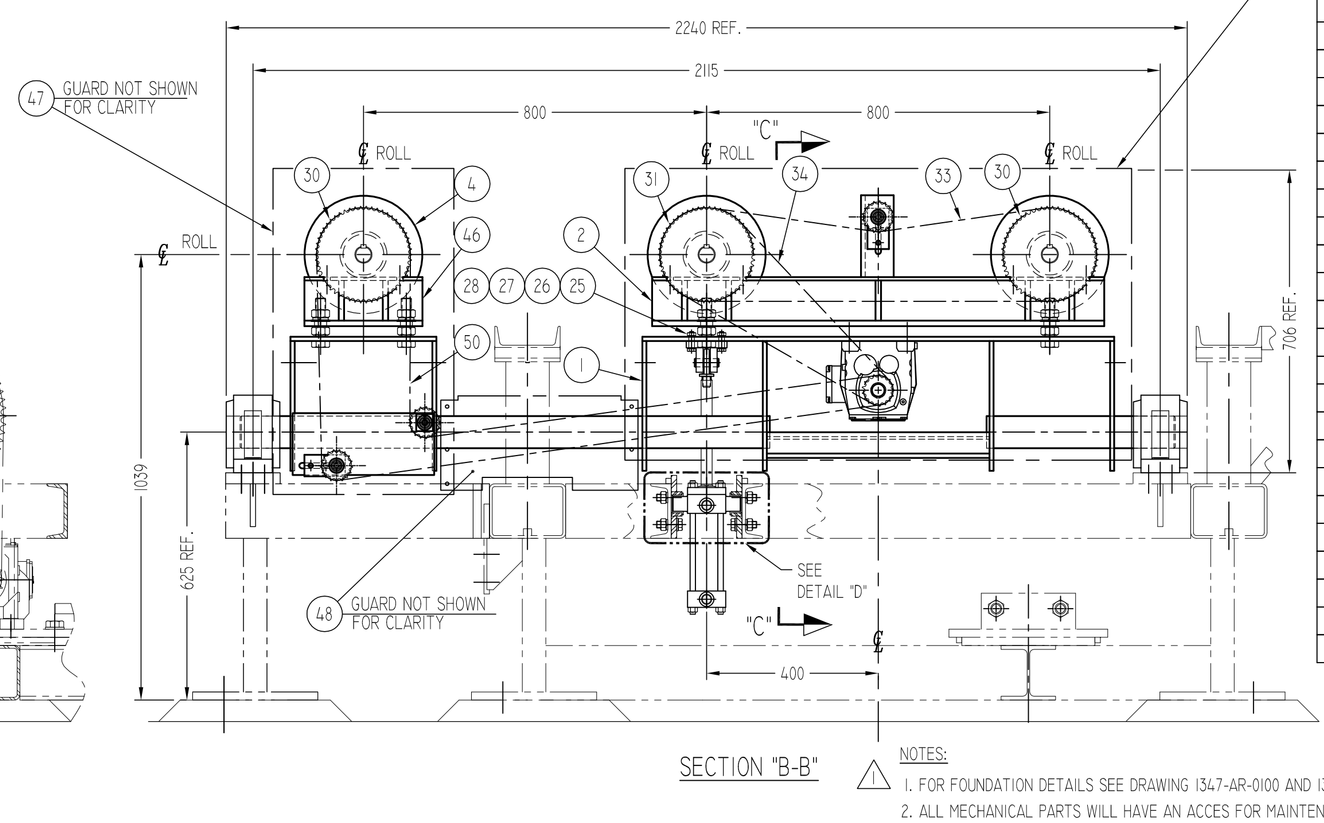


SECTION "C-C"
(SCALE: 1 : 5)

SECTION "A-A"



SECTION "B-B"

NOTES:
1. FOR FOUNDATION DETAILS SEE DRAWING 1347-AR-0100 AND 1347-AR-0101.
2. ALL MECHANICAL PARTS WILL HAVE AN ACCES FOR MAINTENANCE.
3. THERE IS A GREASE POINT FOR ALL BEARINGS.

LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/Qty	No. PIECE-MAT. MAT.-PART. No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
1	1	1347-R8-1100	ROLLER SUPPORT (PIVOT)		171 Kg
2	1	1347-R8-1200	ROLLER SUPPORT #1		72 Kg
3	2	1347-R8-1300	CYLINDER SUPPORT		6 Kg
4	3	1347-R8-1010	ROLLER ASSEMBLY		210 Kg
5	1	SNL22517/75TGY	PILLOW BLOCK (FREE) BORE ø75 "SKF"	BY "GNA"	20 Kg
6	1	SNL22517/75TGY	PILLOW BLOCK (FIXED) BORE ø75 "SKF"	BY "GNA"	20 Kg
7	3	SNL22509/40TGY	PILLOW BLOCK (FREE) BORE ø40 "SKF"	BY "GNA"	5 Kg
8	3	SNL22509/40TG	PILLOW BLOCK (FIXED) BORE ø40 "SKF"	BY "GNA"	5 Kg
9	1		HYDRAULIC CYLINDER , HEAD TRUNNION, BORE	BY "GNA"	
–			2-1/2", ROD ø1", NET STROKE 6" WITH		
–			EXTENSION ROD C/W SPERICAL ROD		
–			EYE MALE (#132291), CLEVIS BRACKET (#83948) &		
–			PIVOT PIN (#83963) "PARKER"		
10	16	STD	HEX. NUT M24, DIN 934		
11	8	STD	FLAT WASHER FOR BOLT M24, DIN 125A		
12	8	STD	LOCKWASHER FOR BOLT M24, DIN 127A		
13	4	STD	HEX. CAPSCREW M20 X 80 LG, DIN 933		
14	4	STD	HEX. NUT M20, DIN 934		
15	4	STD	FLAT WASHER FOR BOLT M20, DIN 125A		
16	4	STD	LOCKWASHER FOR BOLT M20, DIN 127A		
17	8	STD	HEX. CAP SCREW M16 X 50 LG, DIN 933		
18	8	STD	HEX. NUT M16, DIN 934		
19	8	STD	FLAT WASHER FOR BOLT M16, DIN 125A		
20	8	STD	LOCKWASHER FOR BOLT M16, DIN 127A		
21	12	STD	HEX. CAP SCREW M12 X 55 LG, DIN 933		
22	12	STD	HEX. NUT M12, DIN 934		
23	12	STD	FLAT WASHER FOR BOLT M12, DIN 125A		
24	12	STD	LOCKWASHER FOR BOLT M12, DIN 127A		
25	4	STD	HEX. CAP SCREW M10 X 45 LG, DIN 933		
26	4	STD	HEX. NUT M10, DIN 934		
27	4	STD	FLAT WASHER FOR BOLT M10, DIN 125A		
28	4	STD	LOCKWASHER FOR BOLT M10, DIN 127A		
29	1	#D40B17H	SPROCKET #40, BORE ø30, 17 TEETH	BY "GNA"	0.7 Kg
30	2	#40B54	SPROCKET #40, BORE ø40, 54 TEETH	BY "GNA"	6Kg
31	1	#D40B54	SPROCKET #40, BORE ø40, 54 TEETH	BY "GNA"	7 Kg
32	3	C-1045	FLAT BAT 12 X 8 X 60 LG	KEY	
33	1	#119043	ROLLER CHAIN #40 X 2295 LG	BY "GNA"	2 Kg
34	1	#119043	ROLLER CHAIN #40 X 1483 LG	BY "GNA"	1 Kg
35	1	STEEL	MECH. TUBING ø 23.8 X 3.4 WALL X 30 LG		
36	3	#40BB17H	IDLER #40, BORE #16, 17 TEETH	BY "GNA"	1 Kg
37	3	DIN 125_2A	FLAT WASHER FOR BOLT M16		
38	1	STD	HEX. SHOULDER SCREW 5/8"x 2" LG		
39	1	R47-DT71D4/VS	REDUCER 0.37 Kw, OUTPUT 12 RPM, SHAFT ø 30	BY "GNA"	
40	1	1347-R8-1400	GUARD #1		26 Kg
41	4	STD	HEX. CAP SCREW M12 X 55 LG, DIN 933		
42	4	STD	HEX. NUT M12, DIN 934		
43	4	STD	FLAT WASHER FOR BOLT M12, DIN 125A		
44	4	STD	LOCKWASHER FOR BOLT M12, DIN 127A		
45	2	1347-R8-1800	FIXING PLATE		2 Kg
46	1	1347-R8-1250	ROLLER SUPPORT #2		20 Kg
47	1	1347-R8-1450	GUARD #2		18 Kg
48	1	1347-R8-1470	GUARD #3		4 Kg
49	2	STEEL	SQ. BAR 12.7 mm x 150 mm Lg		
50	1	#119043	ROLLER CHAIN #40 X 3785 LG	BY "GNA"	2.5 Kg
51	2	STEEL	MECH. TUBING ø 23.8 X 3.4 WALL X 16 LG		
52	2	STD	HEX. SHOULDER SCREW 5/8" x 1-1/2" LG		
53	1	DIN 916	HEX SOCKET SET SCREW M6 x 12		

APPROX. WEIGHT: 600 Kg

⚠ EQUIPMENT TAG # 4481-MJRO-0002

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NUMBER	REV.	TITLE
REFERENCE DRAWINGS		

REV.	DESCRIPTION	DATE	DRN.	CHK.	R.E.	A.E. / S.	E.G.S.	P.E.M.
2	FOR APPROVAL	OC.29 2010	LG	M.B.	C.C.			
1	GUARD DETAIL, NOTES AND EQUIPMENT TAG NUMBER ADDED. WELD REVISED	SE.28.'10	A.V.	M.B.	C.C.			
0	INITIAL DESIGN		A.V.	M.B.	C.C.			

REVISIONS

STAMP

ALCOA | Ma'aden Aluminum Project

SCALE: 1=10 FORMAT A1

Bechtel

GNA alutech inc. — Departement Ingenierie Engineering Department, 9495 Trans-Canada, Saint-Laurent, Quebec, H4S 1V3, Canada

		DATE
DRAWN	A.V.	AU.22.'10
CHK.	M. Blanchet	
R.E.	C. Coupal	
A.E. / S.		
E.G.S.		
P.E.M.		
CLIENT		

BECHTEL DRG. No. - - - - - REV.

SELLER DRAWING No. 1347-R8-1000 REV. 2

Ras Az Zaur Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CONICAL ROLLER CONVEYOR AT SHOT BLASTING MACHINE EXIT
GENERAL ARRANGEMENT

CLIENT DRG. No. REV.

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TIME: STIMES
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DATE:
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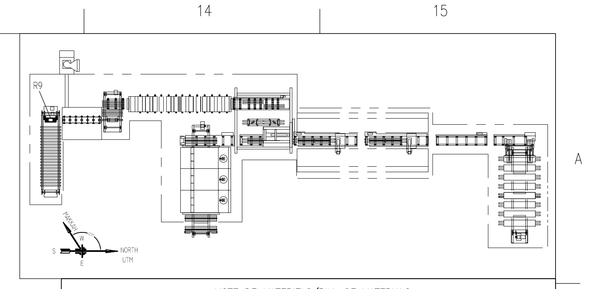

ITEM	Qte/Qty	No. PIECE-MAT. MAT.-PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS/ WEIGHT
1	1	1347-R9-1100	ROLLER SUPPORT (PIVOT)		167 Kg
2	1	1347-R9-1200	ROLLER SUPPORT		73 Kg
3	1	1347-R9-1210	ROLLER SUPPORT		20 Kg
4	2	1347-R9-1300	CYLINDER SUPPORT		5 Kg
5	3	1347-R9-1010	ROLLER ASSEMBLY	BY "GNA"	210 Kg
6	1	SNL22517/75TDI	PILLOW BLOCK (FREE) BORE #75 "SKF"	BY "GNA"	14 Kg
7	1	SNL22517/75TDI	PILLOW BLOCK (FIXED) BORE #75 "SKF"	BY "GNA"	14 Kg
8	3	SNL22509/401DI	PILLOW BLOCK (FREE) BORE #40 "SKF"	BY "GNA"	11.1 Kg
9	3	SNL22509/401G	PILLOW BLOCK (FIXED) BORE #40 "SKF"	BY "GNA"	11.1 Kg
10	1	#0540A54	SPROCKET #40, BORE #40, 54 TEETH	BY "GNA"	7 Kg
11	2	#40B54	SPROCKET #40, BORE #40, 54 TEETH	BY "GNA"	6 Kg
12	1	#040B17H	SPROCKET #40, BORE #30, 17 TEETH	BY "GNA"	0.8 Kg
13	3	#40BB17H	IDLER #40, BORE #16, 17 TEETH	BY "GNA"	0.7 Kg
14	1	#119043	ROLLER CHAIN #40 X 2296 LG "RENOLD"	BY "GNA"	1.5 Kg
15	1	#119043	ROLLER CHAIN #40 X 1491 LG "RENOLD"	BY "GNA"	0.8 Kg
16	1	#119043	ROLLER CHAIN #40 X 3690 LG "RENOLD"	BY "GNA"	2.2 Kg
17	1	R47-07T1D4/VS	REDUCER 0,37 Kw, OUTPUT 12 RPM, SHAFT #30	BY "GNA"	22 Kg
18	1		HYDRAULIC CYLINDER , HEAD TRUNNION, BORE	BY "GNA"	
–			2-1/2", ROD #1", NET STROKE 10-9/16" WITH		
–			EXTENSION ROD C/W SPERICAL ROD		
–			EYE MALE (#132291), CLEVIS BRACKET (#83948) &		
–			PIVOT PIN (#83963)		
19	3	C-1045	FLAT BAR 12 X 8 X 60 LG	KEY	
20	3	STEEL	MECH. TUBING #23.8 X 3.4 WALL X 37 LG		
21	3	STD	HEX. SOCKET SHOULDER SCREW 5/8"x 2-1/4" LG		
22	16	STD	HEX. NUT M24, DIN 934		
23	8	STD	FLAT WASHER FOR BOLT M24, DIN 125A		
24	8	STD	LOCKWASHER FOR BOLT M24, DIN 127A		
25	4	STD	HEX. CAPSCREW M20 X 80 LG, DIN 933		
26	4	STD	HEX. NUT M20, DIN 934		
27	4	STD	FLAT WASHER FOR BOLT M20, DIN 125A		
28	4	STD	LOCKWASHER FOR BOLT M20, DIN 127A		
29	8	STD	HEX. CAP SCREW M16 X 50 LG, DIN 933		
30	8	STD	HEX. NUT M16, DIN 934		
31	8	STD	FLAT WASHER FOR BOLT M16, DIN 125A		
32	8	STD	LOCKWASHER FOR BOLT M16, DIN 127A		
33	8	STD	HEX. CAP SCREW M12 X 55 LG, DIN 933		
34	8	STD	HEX. NUT M12, DIN 934		
35	8	STD	FLAT WASHER FOR BOLT M12, DIN 125A		
36	8	STD	LOCKWASHER FOR BOLT M12, DIN 127A		
37	4	STD	HEX. CAP SCREW M10 X 45 LG, DIN 933		
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42	4	STD	HEX. NUT M12, DIN 934		
43	4	STD	FLAT WASHER FOR BOLT M12, DIN 125A		
44	4	STD	LOCKWASHER FOR BOLT M12, DIN 127A		
45	1	1347-R9-1400	GUARD		
46	3	DIN 125_2A	FLAT WASHER FOR BOLT M16		
47	2	1347-R9-1800	FIXING PLATE		2 Kg
48	2	STEEL	SQ. BAR 12.7 mm x 150 mm Lg		
49	1	1347-R9-1410	GUARD		
50	1	1347-R9-1420	GUARD		
51	1	DIN 916	HEX SOCKET SET SCREW M6 x 12		

APPROX. TOTAL WEIGHT: 586 Kg

NOTES:
1. FOR FOUNDATION DETAILS SEE DRAWING 1347-AR-0100 AND 1347-AR-0101.
2. ALL MECHANICAL PARTS WILL HAVE AN ACCES FOR MAINTENANCE.
3. THERE IS A GREASE POINT FOR ALL BEARINGS.

DETAIL "G" (SCALE: 1 : 2)

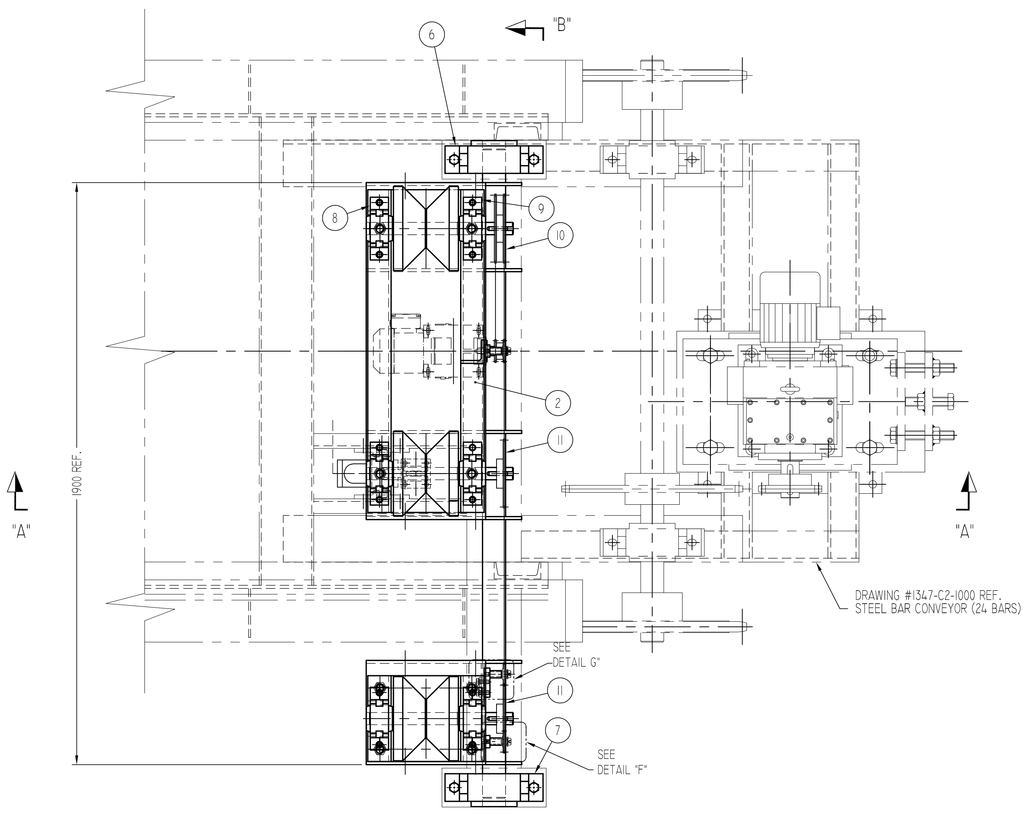
DETAIL "F" (SCALE: 1 : 2)

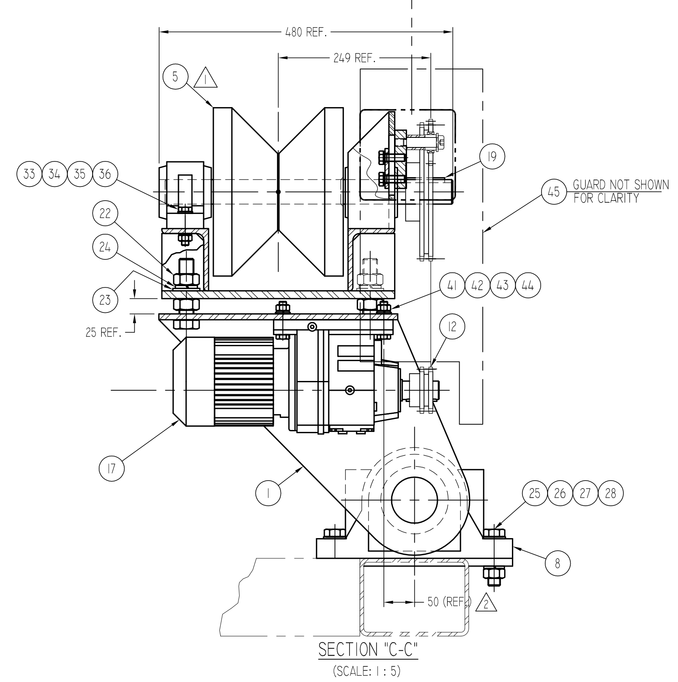
DETAIL "E" (SCALE: 1 : 2)

DROP FORGED EYE BOLTS M12 (SPAENAUR 026-003)

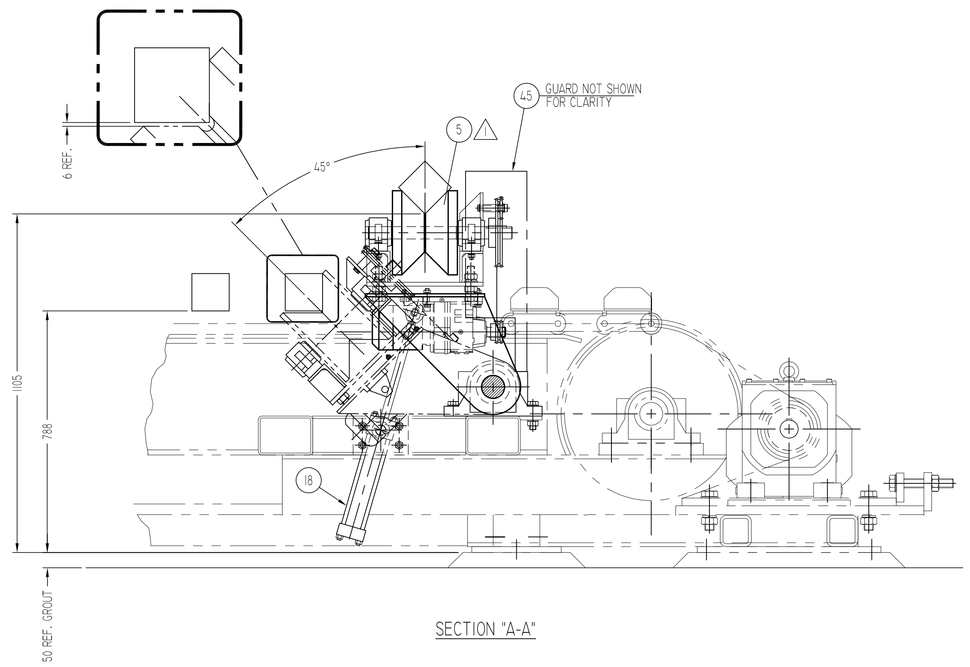
EXPANDED MESH 1/4"-18

DETAIL TYP FOR ALL GUARDS

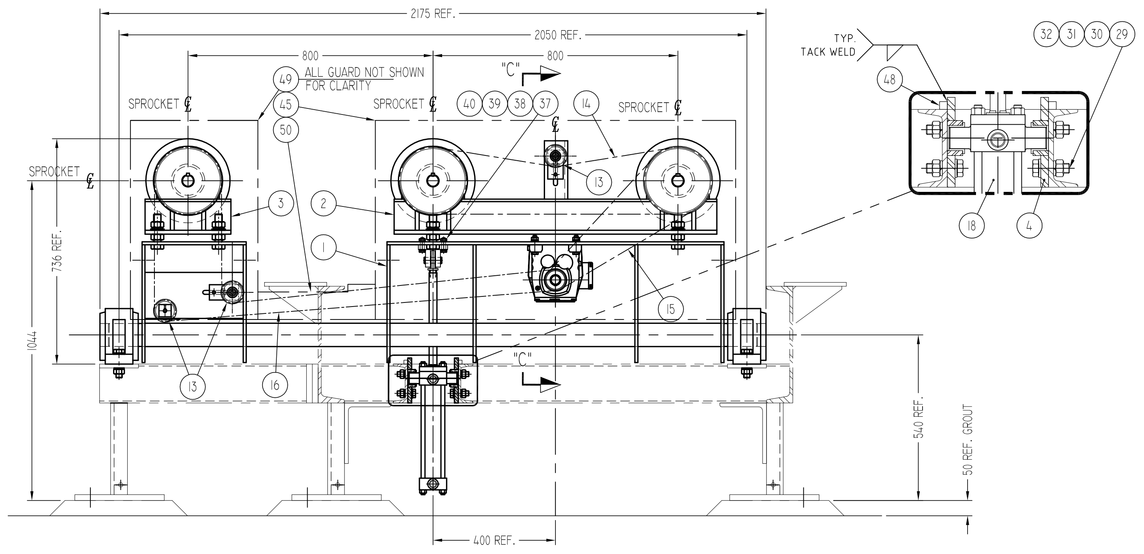




SECTION "C-C" (SCALE: 1 : 5)



SECTION "A-A"



SECTION "B-B"

EQUIPMENT TAG # 4481-MJR0-0001

SELLER/CONTRACTOR DOCUMENT REVIEW

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1 ☐ Work may proceed.
2 ☐ Revise & Resubmit. Work may proceed subject to incorporation of changes.
3 ☐ Revise & Resubmit. Work may NOT proceed.
4 ☐ Revise not required. Work may proceed.
5 ☐ VOID / Superseded.

DDR Nbr :

Reviewed by : _____ Date : _____

Discipline :

Document No : 25457- **Rev. : 0**

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SELLER DRAWING No. 1347-R9-1000 REV. 4

Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CONICAL ROLLER CONVEYOR AT SHOT BLASTING MACHINE ENTRANCE
GENERAL ASSEMBLY

CLIENT DRG. No. REV.

	DRAWN	C. Duplantie	DATE AU.26.'10
	CHK.	M. Blanchet	
	R.E.	C. Coupal	
	A.E. / S.		
	E.G.S.		
	P.E.M.		
	CLIENT		

BECHTEL DRG. No. — — — — — REV.

Bechtel

GNA alutech inc. Departement Ingenierie Engineering Department 9495 Trans-Canada Saint-Laurent, Quebec H4S 1V3 Canada

ALCOA | MA'ADEN Saudi Arabian Mining Company

Ma'aden Aluminum Project

SCALE: 1:10 FORMAT A0

STAMP

NUMBER	REV.	TITLE	REV.	DESCRIPTION	DATE	DRN.	CHK.	R.E.	A.E./S.	E.G.S.	P.E.M.
			4	ITEMS 20-21 UPDATED (7mm LONGER), ITEM #10 CHANGED FOR DS40AS4	no.24 2010	LG	M.B.	C.C.			
			3	FOR APPROVAL	OC.29 2010	LG	M.B.	C.C.			
			2	GUARD DETAIL, NOTES AND EQUIPMENT TAG NUMBER ADDED	SE.24.'10	C.C.	M.B.	C.C.			
			1	ITEM 5 "BY GNA"	SE.23.'10	C.D.	M.B.	C.C.			
			0	FIRST DESIGN	AU.26.'10	C.D.	M.B.	C.C.			

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DATE: $DATE$ DATE: $DATE$ TIME:$TIME$ USER:$USERNAME$

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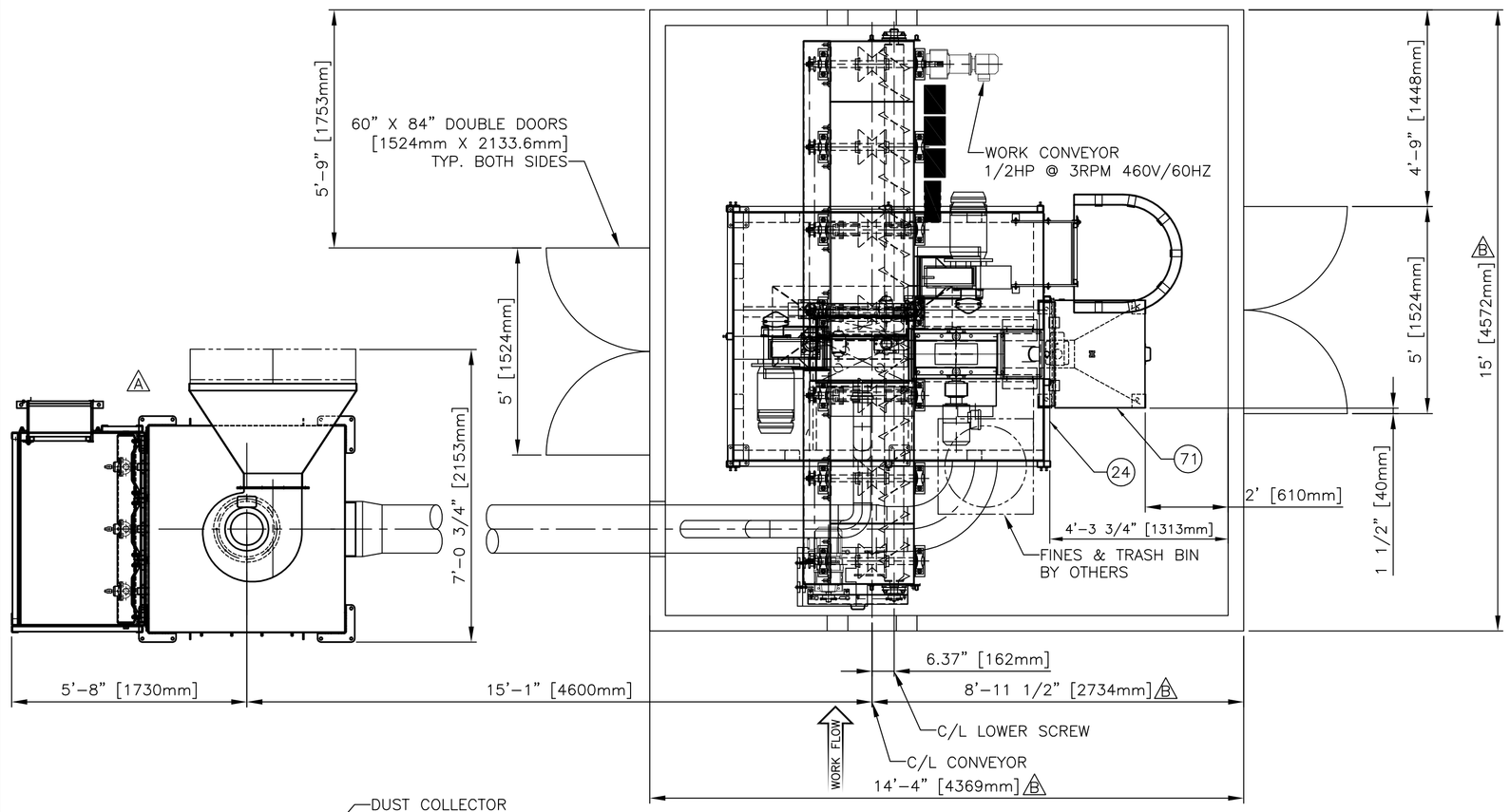

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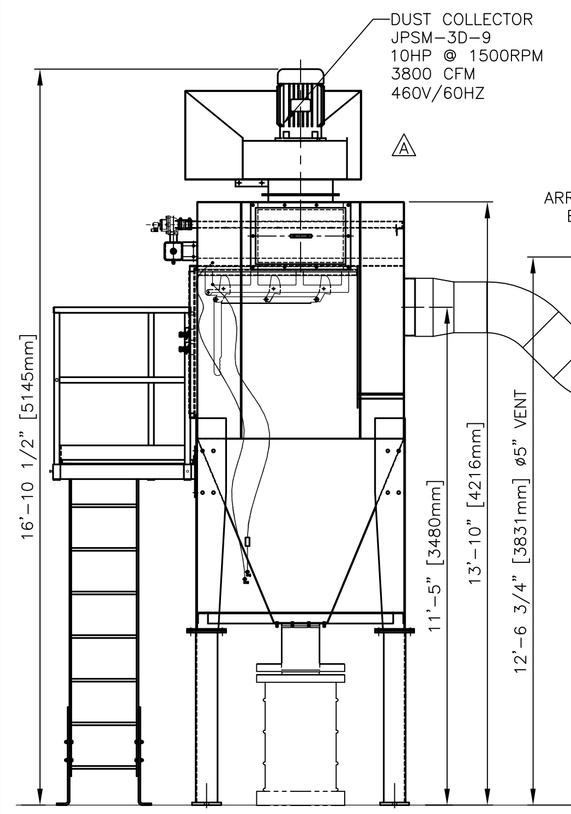
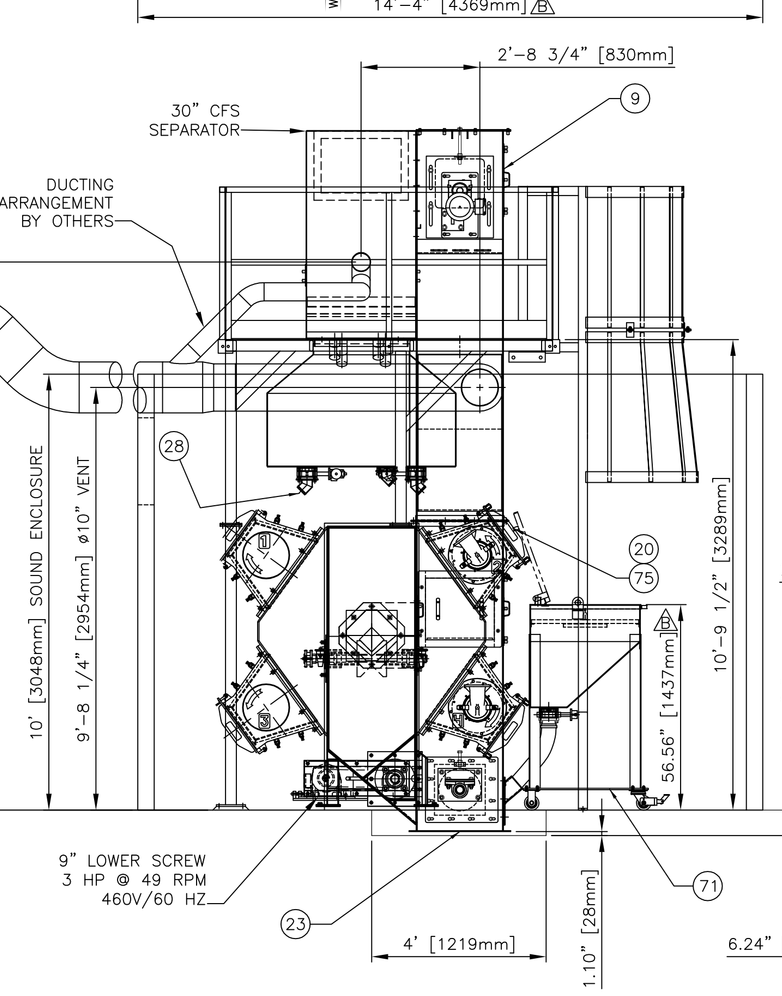
FOR APPROVAL

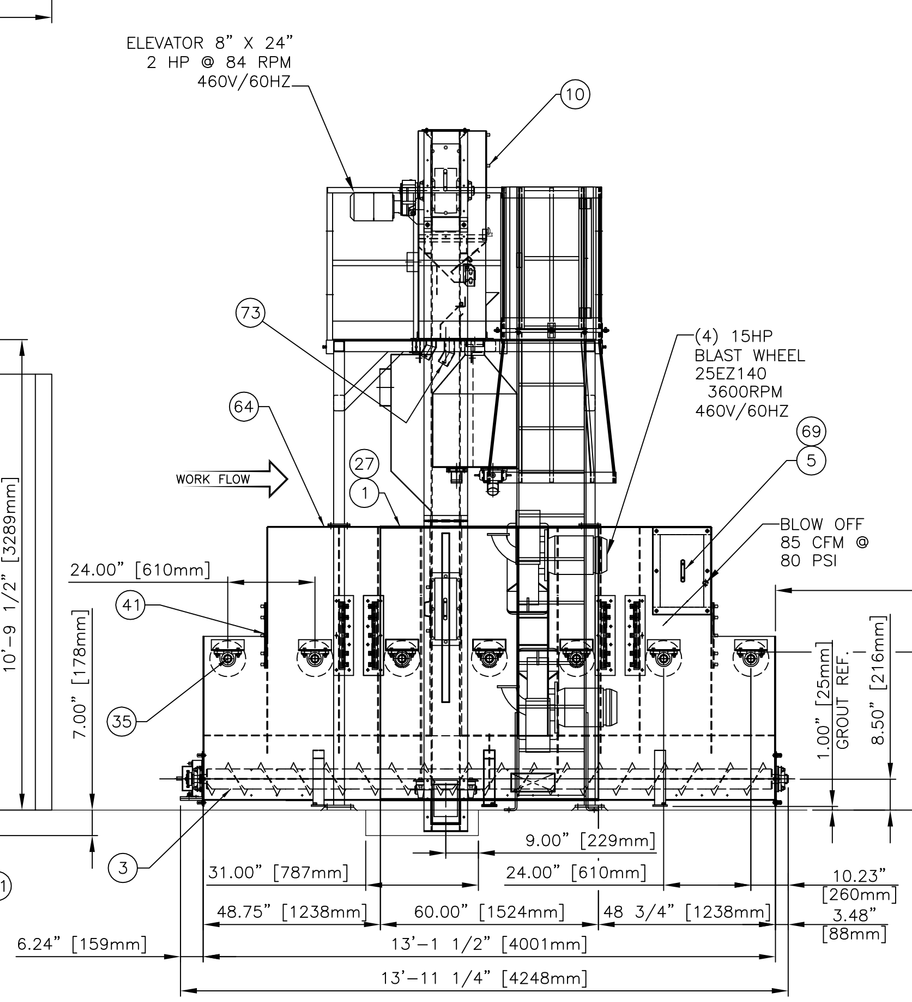
CUSTOMER: GNA ALUTECH
JOB No: 3783 DATE: 01-FEB-11
CUSTOMER APPROVAL SIGNATURE: _____ DATE: _____

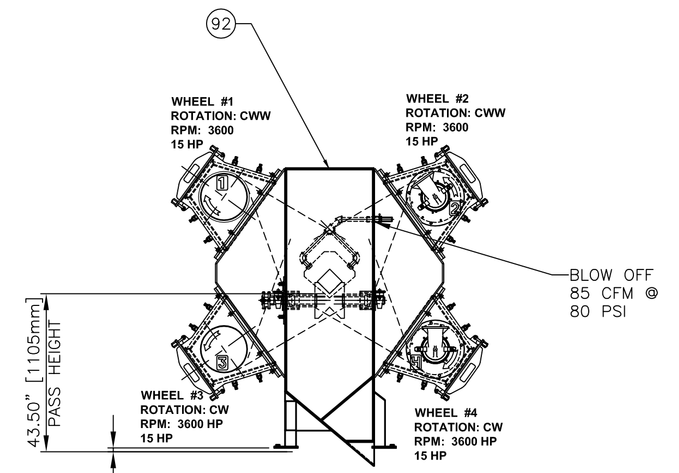
ITEM	QTY	PART NO	DWG NO	DESCRIPTION	WT
1	1	C236632	A1-100643	CABINET WELDMENT	1392
3	1	C253632	A1-109616	SCREW CONVEYOR ARR'T	409
5	1	C215267	A1-89175	INSPECTION DOORS ARR'T	293
9	1	C253639	A1-109620	ELEVATOR ASSEMBLY, 8" X 24"	1103
10	1	C215053	A1-89052	SEPARATOR ASSEMBLY	406
20	1	C253640	A1-109621	BLAST WHEEL ARRANGEMENT	–
23	–	C253595	A1-109593	FOOT PRINT	–
24	1	C253700	A1-109677	PLATFORM ARRANGEMENT	1855
27	1	C215193	A1-89131	LINERS IN LINE ARRANGEMENT	174
28	1	C236869	A1-100804	FEED PIPES ARRANGEMENT	305
29	1	C253718	A1-109690	FIELD MATERIALS	–
A 30	1	C253698	A1-109676	DUST COLLECTOR	3274
35	1	C253721	A1-109681	CONVEYOR ARRANGEMENT	680
41	1	C236650	A1-100653	SEALS ARRANGEMENT	226
64	1	C236864	A1-100800	VESTIBULES ARRANGEMENT	2370
69	1	C253733	A2-56586	BLOW-OFF ARR'T	2
71	1	C253754	A1-109699	ABRASIVE ADDER ARR'T	495
73	1	C216531	A1-89776	TRASH & OVERFLOW PIPE ARR'T	23
B 74	1	C254534	A1-110166	SOUND ENCLOSURE	–
75	1	C215184	A1-89126	WHEEL POD ARRANGEMENT	582

COMPRESSED AIR REQUIREMENT
100CFM @ 80PSI









BLAST PATTERN
ENTRANCE END

REV	DATE	DESCRIPTION	BY
B	01 FEB 2011	UPDATED SOUND ENCLOSURE & ABRASIVE ADDER	KRH
A	23 DEC 2010	REVISED DUST COLLECTOR TO DIRECT DRIVE	LPB

UNLESS OTHERWISE SPECIFIED:
ANGLES ± 1°
FRACTIONS ± 1/16
2 PL DEC ± .06
3 PL DEC ± .005
ALL WELDS TO BE MADE IN ACCORDANCE WITH AMERICAN WELDING SOCIETY AWS A2.4:2007
DO NOT SCALE DRAWING

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wheelabrator GROUP

GA, BILLET DESCALING MACHINE
(4) 25EZ140 @ 15HP
GNA ALLUTECH

GROUP	WEIGHT:	CREATED BY	SHEET 1 OF 1	SIZE
22	SCALE: 1/2" = 1'	HACKAK	DATE: 08 DEC 2010	A1-109567

PROJECT 3783
COPY OF A1-109567
PNC C253520

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Document No : 25457- **Rev. : 0**

EQUIPMENT TAG # 4481-MZBP-0001
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SELLER DRAWING No. 1347-S1-1000 REV. 2

REV.	NUMBER	TITLE	DESCRIPTION	DATE	DRN.	CHK.	R.E.	A.E. / S.	E.G.S.	P.E.M.
2			GEN REV.	JA.28.'11	A.V.	M.B.	C.C.			
1			GEN REV.	DE.14.'10	A.V.	M.B.	C.C.			
0			INITIAL DESIGN	OC.26.'10	A.V.	M.B.	C.C.			

REFERENCE DRAWINGS | REVISIONS

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		DATE
DRAWN	A.V.	OC.26.'10
CHK.	M. Blanchet	
R.E.	C. Coupal	
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E.G.S.		
P.E.M.		
CLIENT		

GNA alutech inc.
Departement Ingenierie
Engineering Department
9495 Trans-Canada
Saint-Laurent, Quebec
H4S 1V3
Canada

SCALE: N.A. FORMAT A1

BECHTEL DRG. No. — — — — — REV.

CLIENT DRG. No. REV.

Ras Az Zawr
Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CATHODE BAR SHOTBLASTING MACHINE
DUST COLLECTOR FOR SHOTBLASTING MACHINE

USER: $USERNAME$
TIME: $TIME$
$DATE$
$FILE$
DATE:
FILE:

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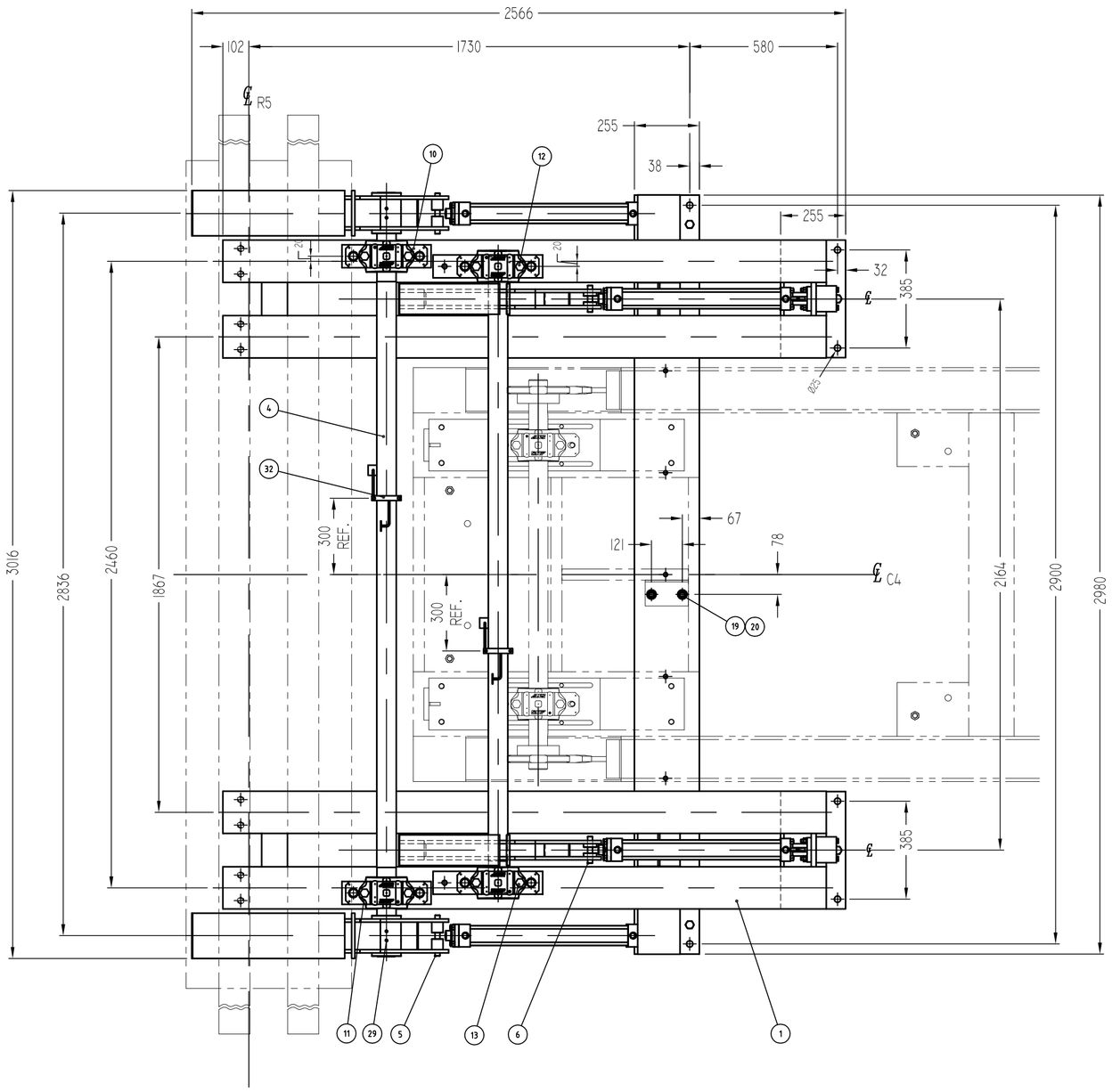
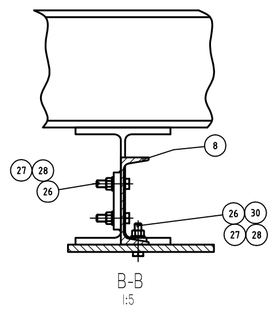
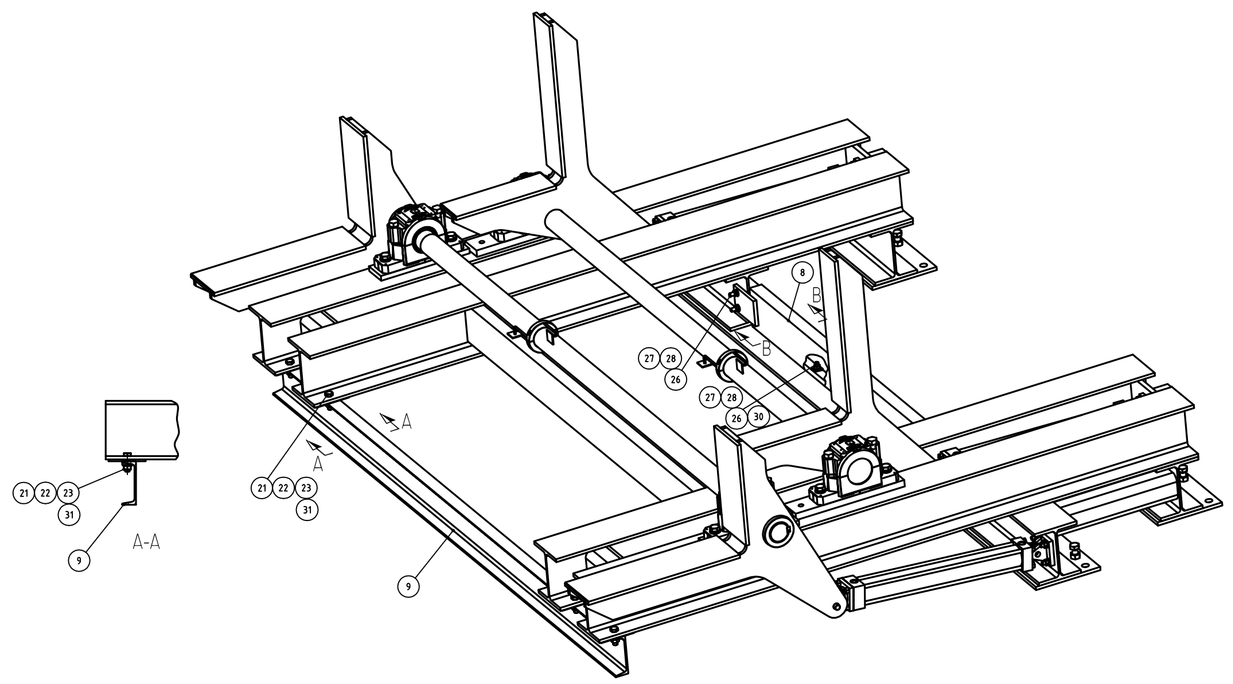
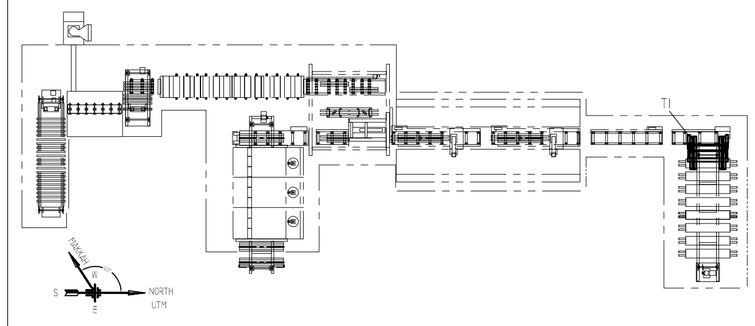




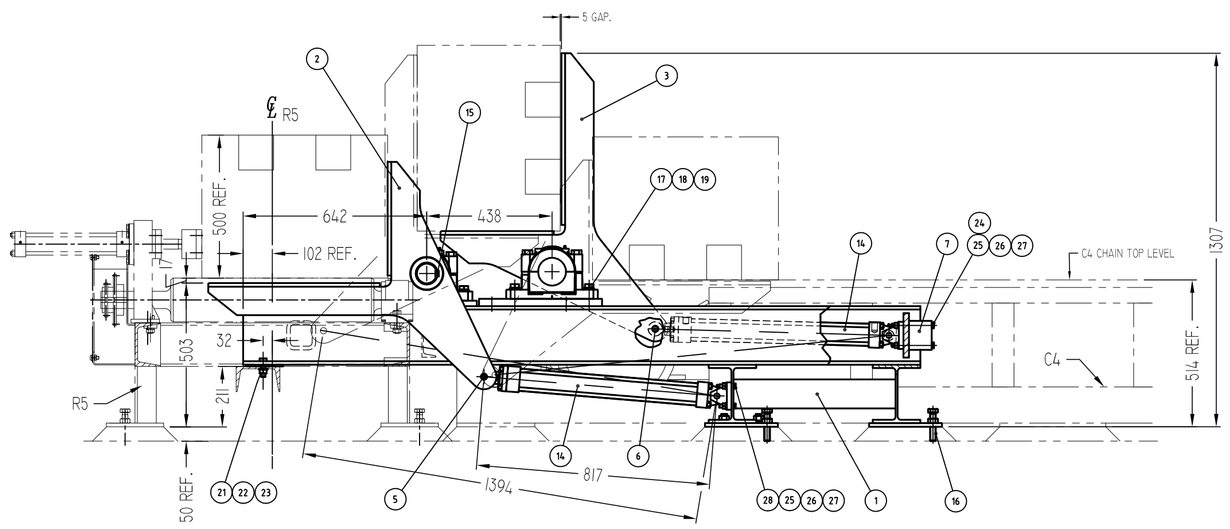




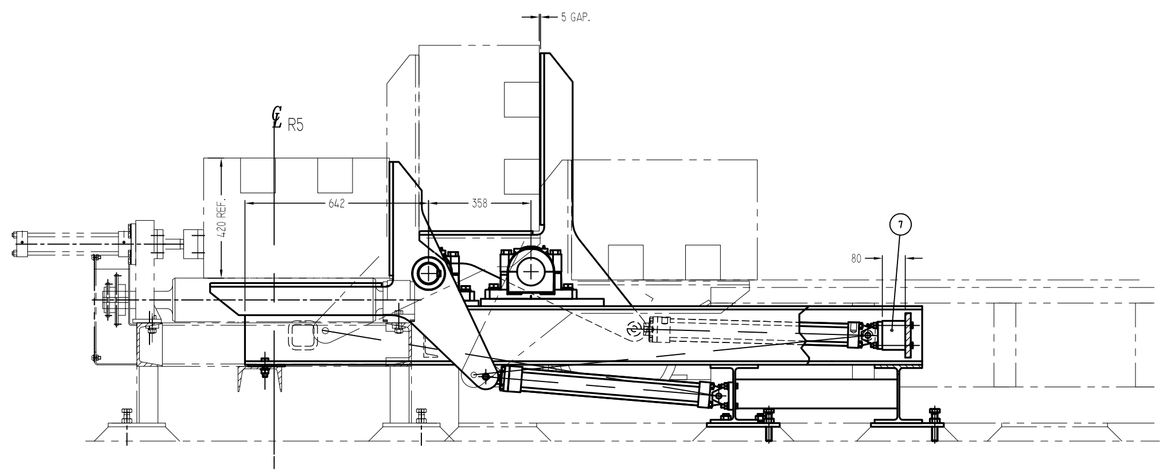
LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/Qty	No. PIECE–MAT. MAT.–PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS/ WEIGHT
1	1	1347-T1-1100	MAIN FRAME		705
2	2	1347-T1-1200	SWING ARM 1		126
3	1	1347-T1-1300	SWING ARM 2		190
4	1	1347-T1-1400	SWING ARM 1 SHAFT		106
5	2	1347-T1-1450	PIN #1		1
6	2	1347-T1-1460	PIN #2		1
7	2	1347-T1-1470	SPACER		13
8	1	1347-T1-1500	TRANSPORT BRACE #1		22
9	1	1347-T1-1600	TRANSPORT BRACE #2		31
10	1	SNL22517/75TG	PILLOW BLOCK (FIXED) BORE ø75 "SKF"	BY GNA	
11	1	SNL22517/75TG	PILLOW BLOCK (FREE) BORE ø75 "SKF"	BY GNA	
12	1	SNL22517/75TGY	PILLOW BLOCK (FIXED) BORE ø75 "SKF"	BY GNA	
13	1	SNL22517/75TGY	PILLOW BLOCK (FREE) BORE ø75 "SKF"	BY GNA	
14	4	CSB2HLR27MC	"PARKER" HYDRAULIC CYLINDER, BORE 2.5"	BY GNA	
			SPHERICAL, ROD #2 1.75" DIA, STROKE 23"		
	4	132291	"PARKER" SPHERICAL ROD EYE	BY GNA	
	4	83963	"PARKER" PIVOT PIN	BY GNA	
	4	83948	"PARKER" CLEVIS BRACKET	BY GNA	
15	2	STD	KEY 20 X 12 X 100		
16	4	STD	HEX BOLT DIN933 M20 X 100 mm		
17	8	STD	HEX BOLT DIN933 M20 X 60 mm		
18	8	STD	LOCK WASHERS DIN 127B (20)		
19	10	STD	FLAT WASHERS DIN 125A (20)		
20	2	STD	NUT M20 DIN 934		
21	8	STD	HEX BOLT M16 x 55 LG		
22	8	STD	HEX NUT M16 (DIN 934)		
23	8	STD	FLAT WASHER FOR BOLT M16 (DIN 125 A)		
24	8	STD	HEX BOLT DIN 933 M12 X 140 mm		
25	16	STD	LOCK WASHERS DIN 127B (12)		
26	25	STD	FLAT WASHERS DIN 125A (12)		
27	25	STD	NUT M12 DIN 934		
28	17	STD	HEX BOLT M12 x 50 LG		
29	8	STD	SET SCREW DIN 916 (M10 x 25mm)		
30	5	STD	BEVELED WASHER 12 DIN 435		
31	8	STD	BEVELED WASHER 16 DIN 435		
32	2	1347-T1-1700	POSITION INDICATEUR		
				TOTAL WEIGHT:	1500 KG

NOTES:
1. FOR FOUNDATION DETAILS SEE DRAWING 1347-AR-0100 AND 1347-AR-0101.
2. ALL MECHANICAL PARTS WILL HAVE AN ACCES FOR MAINTENANCE.
3. THERE IS A GREASE POINT FOR ALL BEARINGS.



SIDE VIEW
"BLOCK 420 HEIGHT"



SIDE VIEW
"BLOCK 420 HEIGHT"

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NUMBER	REV.	TITLE

REFERENCE DRAWINGS

REV.	DESCRIPTION	DATE	DRN.	CHK.	R.E.	A.E. / S.	E.G.S.	P.E.M.
1	FOR APPROVAL	OC.29 2010	LG	M.B.	C.C.			
0	INITIAL DESIGN	SE.28.10	E.I.	M.B.	C.C.			

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BECHTEL DRG. No. - - - - - REV.

SELLER DRAWING No. 1347-T1-1000 REV. 1

CLIENT DRG. No. REV.

Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
COOLING AND TURNING STATION
GENERAL ARRANGEMENT

USER: $USERNAME$
TIME: $TIME$
$DATE$
$FILE$
DATE:
FILE:

9.3 Foundation and Loads Drawings

DRAWING No.	DESCRIPTION
1347-AR-0100	Cathode Sealing Equipment - Foundation and Load - 1 of 2
1347-AR-0101	Cathode Sealing Equipment - Foundation and Load - 2 of 2

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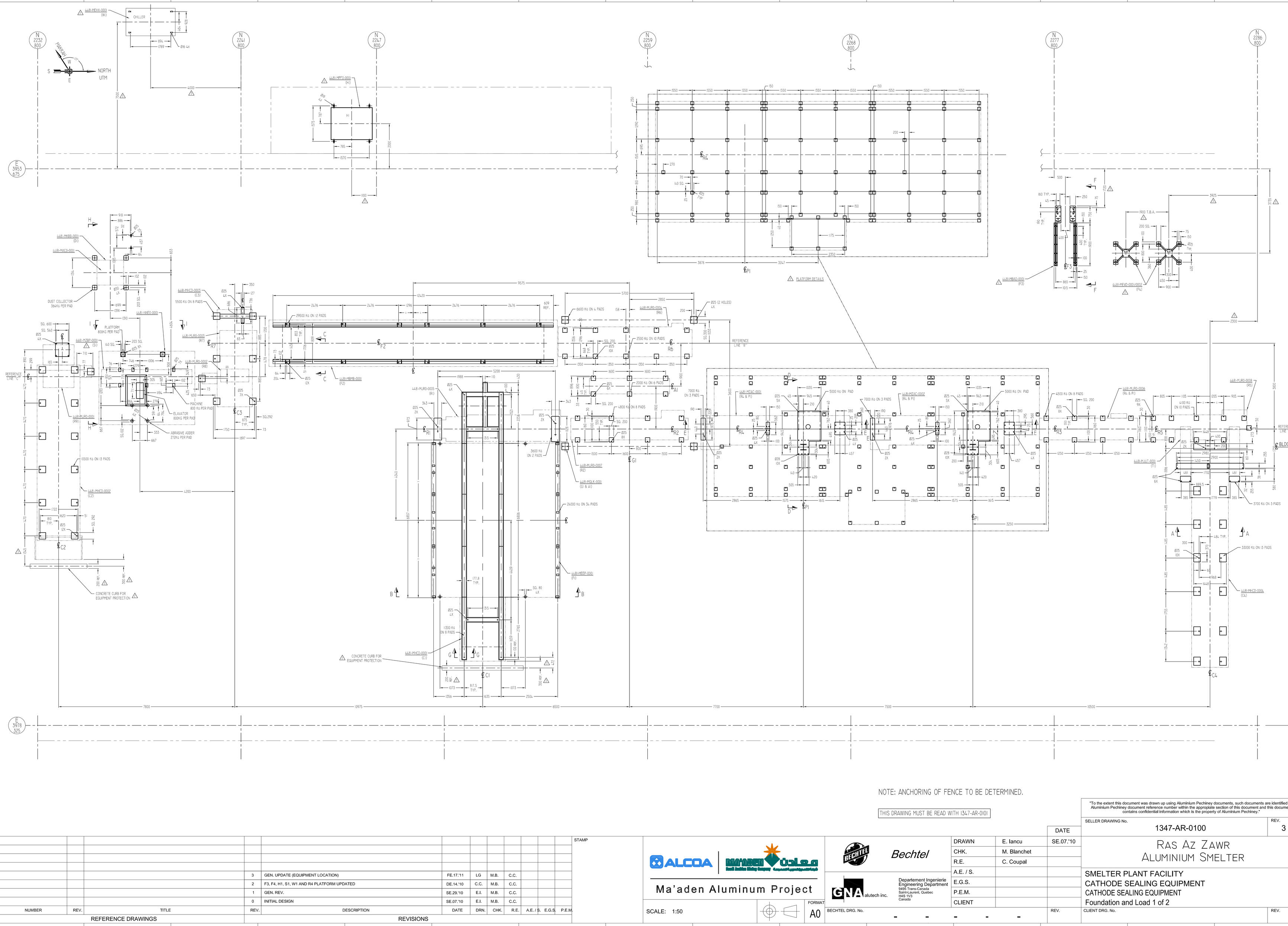

NOTE: ANCHORING OF FENCE TO BE DETERMINED.

THIS DRAWING MUST BE READ WITH 1347-AR-0101

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REFERENCE DRAWINGS		

REV.	DESCRIPTION	DATE	DRN.	CHK.	R.E.	A.E. / S.	E.G.S.	P.E.M.
3	GEN. UPDATE (EQUIPMENT LOCATION)	FE.17.'11	LG	M.B.	C.C.			
2	F3, F4, H1, S1, W1 AND R4 PLATFORM UPDATED	DE.14.'10	C.C.	M.B.	C.C.			
1	GEN. REV.	SE.29.'10	E.I.	M.B.	C.C.			
0	INITIAL DESIGN	SE.07.'10	E.I.	M.B.	C.C.			
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BECHTEL DRG. No. - - - - - REV.

SELLER DRAWING No. 1347-AR-0100 REV. 3

RAS AZ ZAWR
ALUMINIUM SMELTER

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CATHODE SEALING EQUIPMENT
Foundation and Load 1 of 2

CLIENT DRG. No. REV.

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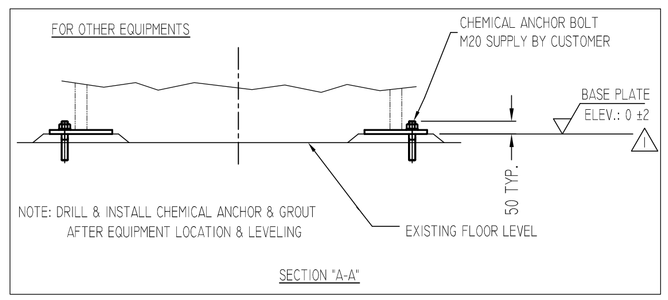
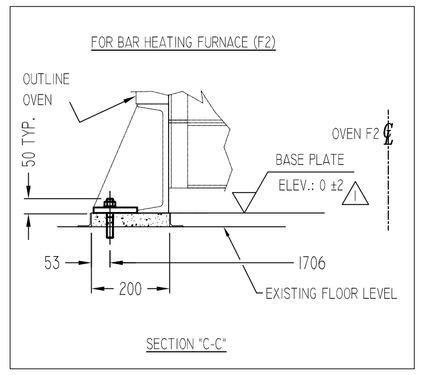


SECTION "A-A"



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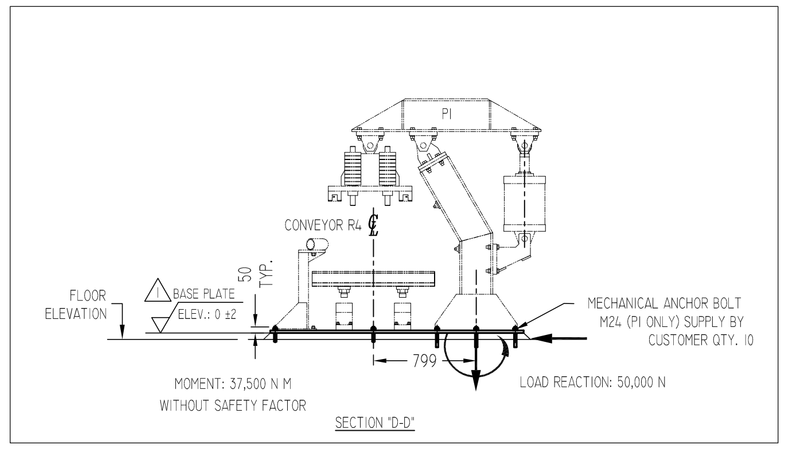

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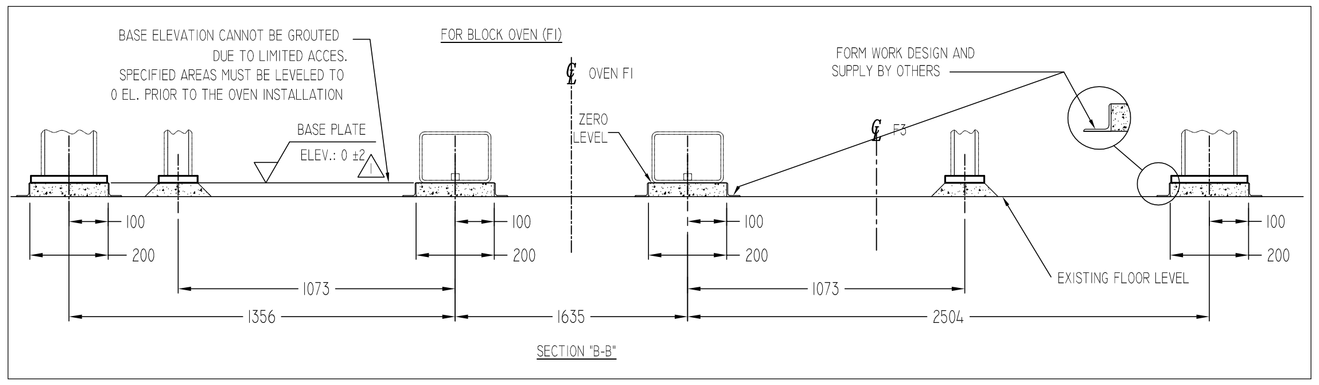
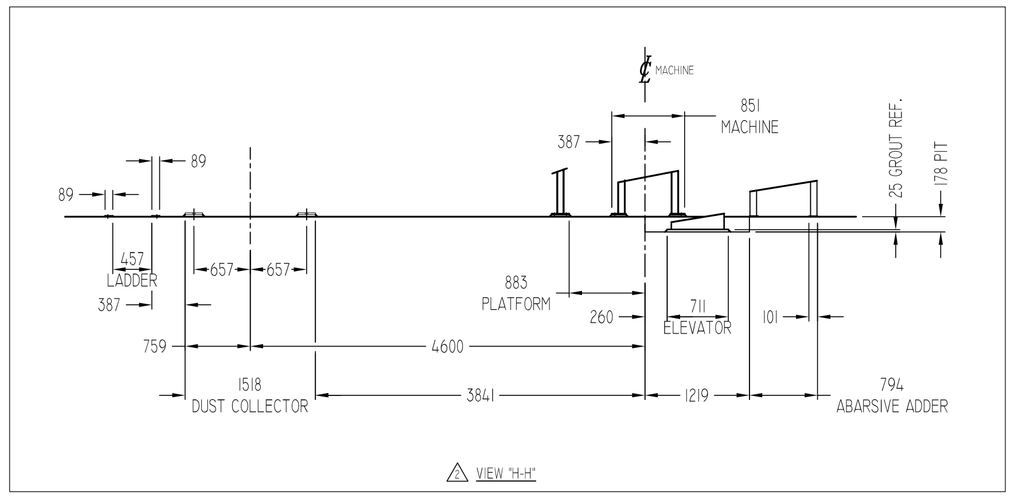
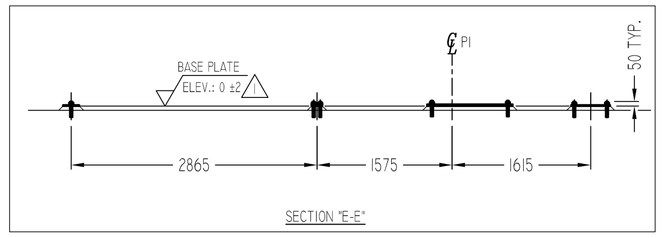


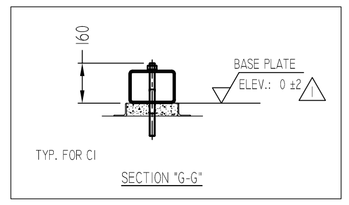
SECTION "B-B"



⚠ VIEW "H-H"

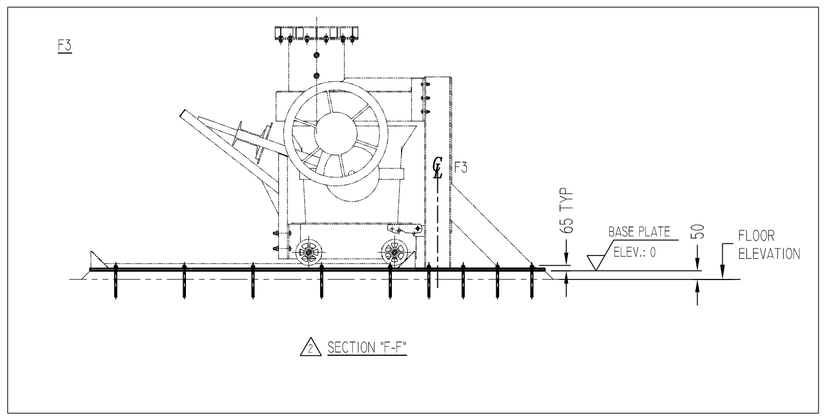


SECTION "E-E"

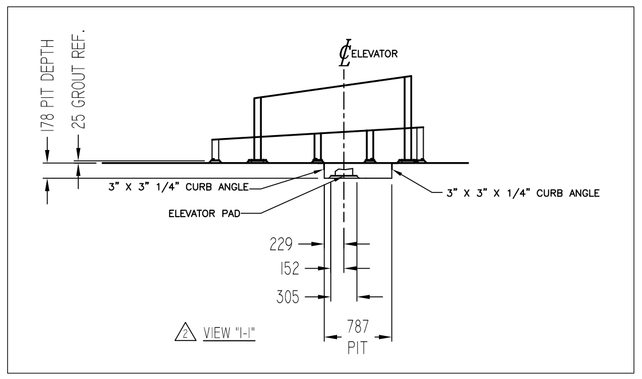


SECTION "G-G"

ANCHOR BOLTS	Qte/Qty	GNA DRAWING No.	DESCRIPTION/DESIGNATION	EQUIPMENT NUMBER	LOAD KG
M20x170	16	1347-C2-1000	CHAIN CONVEYOR UPSTREAM OF SHOT BLASTING MACHINE (24 BARS)	4481-MHCD-0002	10500
-	-	1347-R9-1000	CONICAL ROLLER CONVEYOR AT SHOT BLASTING MACHINE ENTRANCE	4481-MJR0-0001	600
M20x170	10	1347-C3-1000	CHAIN CONVEYOR BETWEEN SHOT BLASTING MACHINE AND HEATING FURNACE	4481-MHCD-0003	5500
-	-	1347-R8-1000	CONICAL ROLLER CONVEYOR AT SHOT BLASTING MACHINE EXIT	4481-MJR0-0002	600
-	-	1347-R7-1000	ROLLER CONVEYOR AT BAR FURNACE ENTRANCE	4481-MJR0-0003	900
M20x170	10	1347-R6-1000	ROLLER CONVEYOR AT BAR FURNACE EXIT	4481-MJR0-0004	2500
M20x300	8	1347-C1-1000	CHAIN CONVEYOR OF BLOCK OVEN	4481-MHCD-0001	11300
M20x170	4	1347-R1-1000	ROLLER CONVEYOR AT BLOCK OVEN EXIT	4481-MJR0-0005	3600
M20x170	8	1347-R2-1000	ROLLER CONVEYOR FOR BLOCK AND BAR ASSEMBLY	4481-MJR0-0007	4800
M20x170 M20x170 M24x210	10 FOR C4, 5 FOR PI 10 FOR PI	1347-RL-0000	PRESTRESSING-PI AND SEALING STATION-R4 C/W CONVEYOR AND PLATFORMS	4481-MZAC-0001	7000 FOR R4, 5000 FOR PI
M20x170 M20x170 M24x210	10 FOR C4, 5 FOR PI 10 FOR PI	1347-RA-0000	PRESTRESSING-PI AND SEALING STATION-R4 C/N CONVEYOR AND PLATFORMS	4481-MZAC-0002	7000 FOR R4, 5000 FOR PI
⚠ M20x170	90	1347-RL-1500	PLATFORMS		
		1347-SI-1000	CATHODE BAR SHOTBLASTING MACHINE	4481-MZBP-0001	
		"	SOUND ENCLOSURE FOR SHOT BLASTING MACHINE	4481-NNE0-0001	
M20x170	8 FOR C1 10 FOR A1	1347-G1-1000	POSITIONING GANTRY FOR BLOCK AND BARS, INCLUDING AI-CATHODE BAR ALIGNMENT STATION	4481-MOLK-0001	6600 FOR C1 2000 FOR A1
M20x170	8	1347-R3-1000	ROLLER CONVEYOR AFTER SEALING STATION	4481-MJR0-0006	4500
M20x170	10	1347-R5-1000	ROLLER CONVEYOR AT COOLING AND TURNING STATION	4481-MJR0-0008	4100
-	-	1347-F1-1000	CATHODE BLOCK OVEN (CAPACITY OF 6 CATHODE BLOCKS)	4481-MEEP-0001	24000
M20x170	12	1347-F2-1000	CATHODE BAR HEATING FURNACE (CAPACITY OF 16 BARS)	4481-MBMB-0001	29500
		1347-DI-1000	DUST COLLECTOR FOR SHOTBLASTING MACHINE	4481-MKBB-0001	
		"	FAN FOR DUST COLLECTOR	4481-MAC0-0001	
		1347-HI-1000	HYDRAULIC POWER UNIT	4481-MPF0-0001	
M20x170	6	1347-TI-1000	COOLING AND TURNING STATION	4481-MJUT-0001	3700
M20x170	14	1347-CA-1000	CHAIN CONVEYOR FOR SEALED CATHODE	4481-MHCD-0004	33000
		1347-WI-1000	CHILLER FOR HYDRAULIC POWER UNIT	4481-MEHX-0001	
⚠ M12x200	36	1347-F3-1000	LADLE PRE-HEATING STATION	4481-MBAD-0001	675
M20x170	16	1347-F4-1000	CAST IRON INGOT DRYING STATION	4481-MEVD-0001	



⚠ SECTION "F-F"



⚠ VIEW "I-I"

NOTE:

1. BLOCK AND BAR WEIGHTS ARE INCLUDED IN EQUIPMENT LOADS.
2. DYNAMIC LOADS ARE NEGLIGEABLE
⚠ 3. SEE BILL OF MATERIAL FOR ANCHOR BOLTS LENGHT
⚠ 4. CHEMICAL ANCHOR BOLTS SUPPLIED BY CLIENT

THIS DRAWING MUST BE READ WITH 1347-AR-0100

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Discipline :

Document No : 25457- | Rev. : 0

NUMBER	REV.	TITLE	REV.	DESCRIPTION	DATE	DRN.	CHK.	R.E.	A.E. / S.	E.G.S.	P.E.M.
REFERENCE DRAWINGS			REVISIONS								
			2	S1, F3 AND F4 UPDATED	DE.14.2010	C.C.	M.B.	C.C.			
			1	TOLERANCE ADDED AND NOTE MODIF.	SE.29.'10	E.I.	M.B.	C.C.			
			0	INITIAL DESIGN	SE.07.'10	E.I.	M.B.	C.C.			

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ALCOA | Ma'aden Aluminum Project

SCALE: –

FORMAT A1

Bechtel

GNA alutech inc. — Departement Ingenierie Engineering Department, 9495 Trans-Canada, Saint-Laurent, Quebec, H4S 1V3, Canada

		DATE
DRAWN	E. Iancu	SE.07.'10
CHK.	M. Blanchet	
R.E.	C. Coupal	
A.E. / S.		
E.G.S.		
P.E.M.		
CLIENT		

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SELLER DRAWING No. 1347-AR-0101 REV. 2

CLIENT DRG. No. REV.

Ras Az Zawr
Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CATHODE SEALING EQUIPMENT
Foundation and Load 2 of 2

USER: $USERNAME$ TIME: $TIME$ $DATE$ $FILE$ DATE: FILE:

9.4 Hydraulic Drawings

DRAWING No.	DESCRIPTION
1347-AR-3000	Cathode Sealing Equipment Hydraulic Piping Routing
1347-H1-3001	Hydraulic System Schematic
1347-H1-3002	Hydraulic System Schematic
1347-H1-3003	Hydraulic System Schematic
1347-H1-3004	Hydraulic System Schematic
1347-H1-3005	Bill of Material - Hydraulic

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Discipline :

Document No : 25457-4480-V1A-MXAO-XXXX **Rev. : 000**

LISTE DE MATERIELS/BILL OF MATERIALS

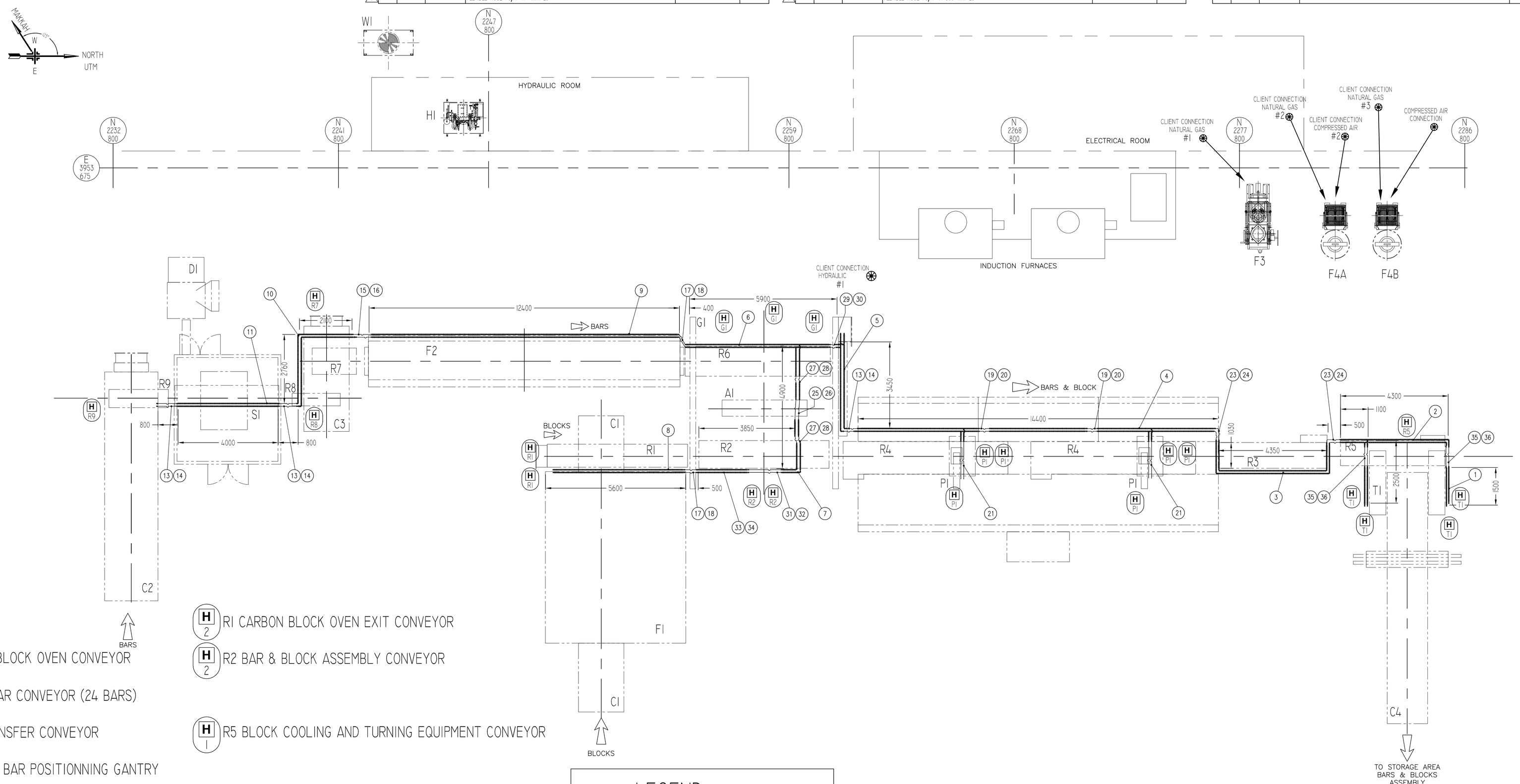
ITEM	Qte/Qty	No. PIECE-MAT. MAT.-PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
25	1		FLEXIBLE HOSE ø1" X mm LG		
26	1		FLEXIBLE HOSE ø3/4" X mm LG		
27	2		FLEXIBLE HOSE ø1" X mm LG		
28	2		FLEXIBLE HOSE ø3/4" X mm LG		
29	1		FLEXIBLE HOSE ø1" X mm LG		
30	1		FLEXIBLE HOSE ø3/4" X mm LG		
31	1		FLEXIBLE HOSE ø1" X mm LG		
32	1		FLEXIBLE HOSE ø3/4" X mm LG		
33	1		PIPE ø 1" X 2000 mm LG		
34	1		PIPE ø 3/4" X 2000 mm LG		
35	2		FLEXIBLE HOSE ø1" X mm LG		
36	2		FLEXIBLE HOSE ø3/4" X mm LG		

LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/Qty	No. PIECE-MAT. MAT.-PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
13	3		FLEXIBLE HOSE ø1" X 1500 mm LG		
14	3		FLEXIBLE HOSE ø3/4" X 1500 mm LG		
15	1		FLEXIBLE HOSE ø1" X 1200 mm LG		
16	1		FLEXIBLE HOSE ø3/4" X 1200 mm LG		
17	2		FLEXIBLE HOSE ø1" X 1000 mm LG		
18	2		FLEXIBLE HOSE ø3/4" X 1000 mm LG		
19	2		FLEXIBLE HOSE ø1" X 600 mm LG		
20	2		FLEXIBLE HOSE ø3/4" X 600 mm LG		
21	4		FLEXIBLE HOSE ø1/2" X 2800 mm LG		
22					
23	2		FLEXIBLE HOSE ø1" X 800 mm LG		
24	2		FLEXIBLE HOSE ø3/4" X 800 mm LG		

LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/Qty	No. PIECE-MAT. MAT.-PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
1	1		PIPE ø1" AND PIPE ø3/4" X 3000 mm	T1	
2	1		PIPE ø1" AND PIPE ø3/4" X 4300 mm	R5	
3	1		PIPE ø1" AND PIPE ø3/4" X 6300 mm	R3	
4	1		PIPE ø1" AND PIPE ø3/4" X 14400 mm	PLATFORM	
5	1		PIPE ø1" AND PIPE ø3/4" X 6300 mm	G1	
6	1		PIPE ø1" AND PIPE ø3/4" X 5800 mm	R6	
7	1		PIPE ø1" AND PIPE ø3/4" X 2000 mm	R2	
8	1		PIPE ø1" AND PIPE ø3/4" X 5400 mm	R1	
9	1		PIPE ø1" AND PIPE ø3/4" X 12400 mm	F2	
10	1		PIPE ø1" AND PIPE ø3/4" X 4800 mm	C3	
11	1		PIPE ø1" AND PIPE ø3/4" X 6000 mm	S1	
12					



R1 CARBON BLOCK OVEN EXIT CONVEYOR
R2 BAR & BLOCK ASSEMBLY CONVEYOR
R5 BLOCK COOLING AND TURNING EQUIPMENT CONVEYOR
R7 FURNACE FEED CONVEYOR
R8 SHOT BLASTER EXIT CONVEYOR
R9 SHOT BLAST FEED CONVEYOR

C1 CARBON BLOCK OVEN CONVEYOR
C2 STEEL BAR CONVEYOR (24 BARS)
C3 BAR TRANSFER CONVEYOR
G1 CATHODE BAR POSITIONNING GANTRY
HI HYDRAULIC POWER UNIT
PIA CARBON BLOCK PRE-STRESSING UNIT
PIB CARBON BLOCK PRE-STRESSING UNIT
T1 BLOCK COOLING & TURNING STATION

LEGEND
H XX HYDRAULIC CYLINDERS TOTAL QTY. 21

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NUMBER	REV.	TITLE	REV.	DESCRIPTION	DATE	DRN.	CHK.	R.E.	A.E. / ESG.S.	P.E.M.
			1	FLEXIBLE HOSE AND PIPE UPDATED.	MR.30.'11	E.I.	M.B.	C.C.		
			0	FIRST ISSUE	DE.08.2010	C.C.	M.B.	C.C.		

REFERENCE DRAWINGS | REVISIONS

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SCALE: NTS | FORMAT A1

Bechtel

GNA alutech inc. Département Ingenierie Engineering Department 9495 Trans-Canada Saint-Laurent, Quebec H4S 1V3 Canada

		DATE
DRAWN	C.C.	DE.08.'10
CHK.	M. Blanchet	
R.E.	C. Coupal	
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SELLER DRAWING No. 1347-AR-3000 REV. 1

Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
HYDRAULIC
HYDRAULIC PIPING ROUTING

CLIENT DRG. No. REV.

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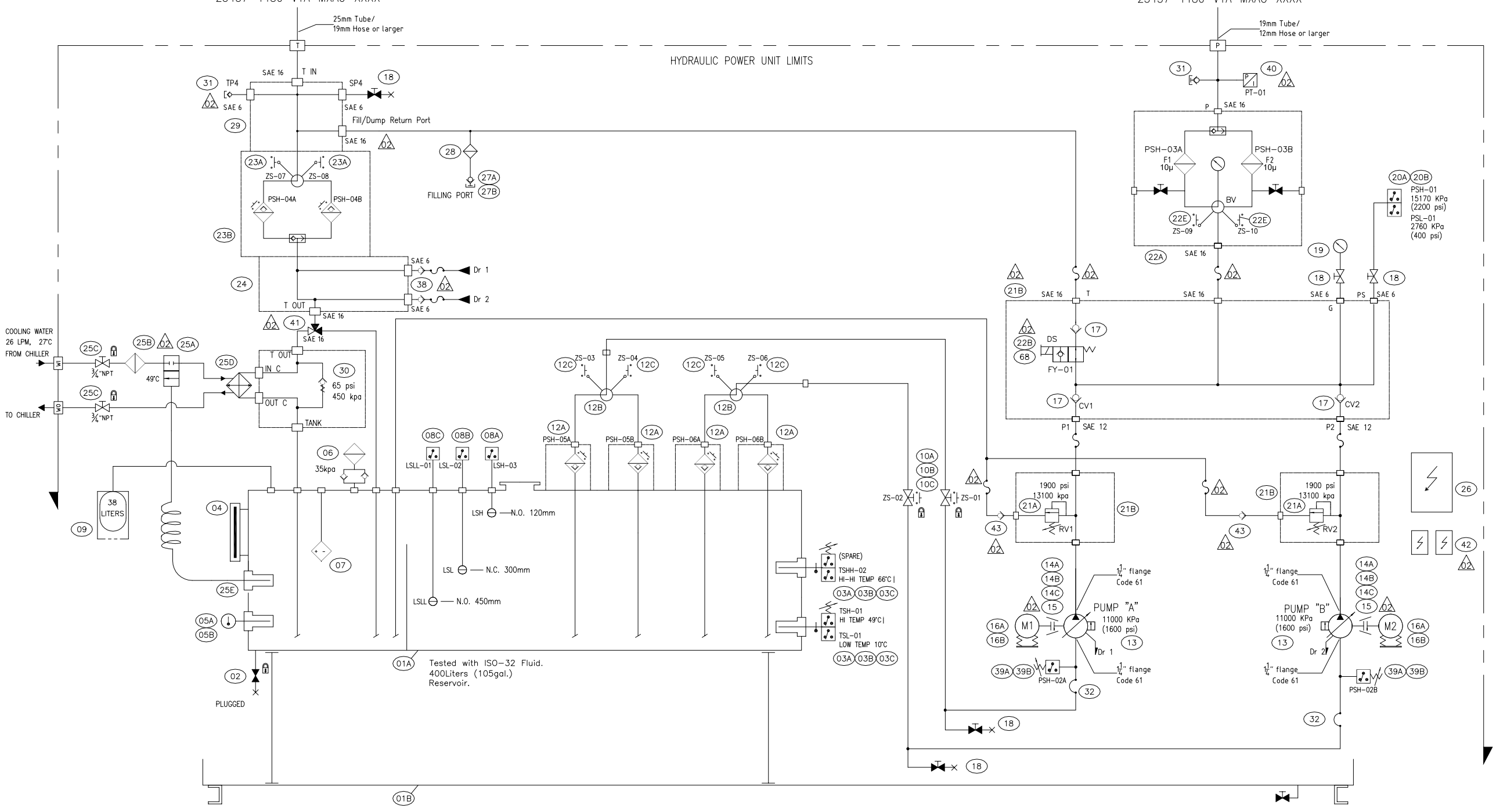
H1
HYDRAULIC POWER UNIT
4481-MPF0-0001



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Discipline :

Document No : 25457-4480-V1A-MXA0-xxxx **Rev. : 000**

NOTE:

1) DESIGNED TO OPERATED IN HIGHLY ABRASIVE, DUST LADEN ATM AND SUITABLE FOR HIGH PRESSURE WASH DOWN WITH DETERGENTS

△02 2) SPECIFICATION : 1347-H1-3001-00
2547-4480-P0A-MXA0-0001

3) NOISE LEVEL 85 dB(A)

4) ALL INTERCONNECTION HOSES BY OTHERS

5) G1 CYLINDER #102 LOWERS ONLY BY GRAVITY

△02 6) ITEMS #42 x 2 MOTOR STATION BOX, AND #26 JUNCTION BOX FREE ISSUE BY GNA

NOTE : EQUIPMENT NUMBER IS INSTRUMENT NUMBER PREFIX

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
		2		UPDATE	NO.19.'10	T.Pa.	M.B.	C.C.
		1		GENERAL UPDATE BY PNEUTECH	NO.06.'10	T.Pa.	M.B.	C.C.
REFERENCES		REVISIONS						

NOTES

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DATE:		DATE:	
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DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NTS
DATE:			

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Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
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SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
HYDRAULIC SYSTEM
SCHEMATIC (1/4)

MA'ADEN Wabag

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—		—	—	A3-		-AZ	

T1

COOLING & TURNING STATION
4481-MJUT-0001

TILT
2.5"BORE X 1 3/4"ROD X 23"STROKE (2.5CSB-2HKTSV27AC23.00")
Q MAX=25 LPM Q MAX=25 LPM

G1

POSITIONING GANTRY
4481-MQLK-0001

CLAMPING
4"BORE X 2.5"ROD X 19"STROKE
(4CBB-2HKPSV24AC19.00")
Q MAX=25 LPM Q MAX=25 LPM

LOWER/RAISE
4"BORE X 1 3/4"ROD X 20"STROKE
(4CDB-2HKPSV14AC20.00")
Q MAX=25 LPM

R1

BLOCK OVEN EXIT CONVEYOR
4481-MJRO-0005

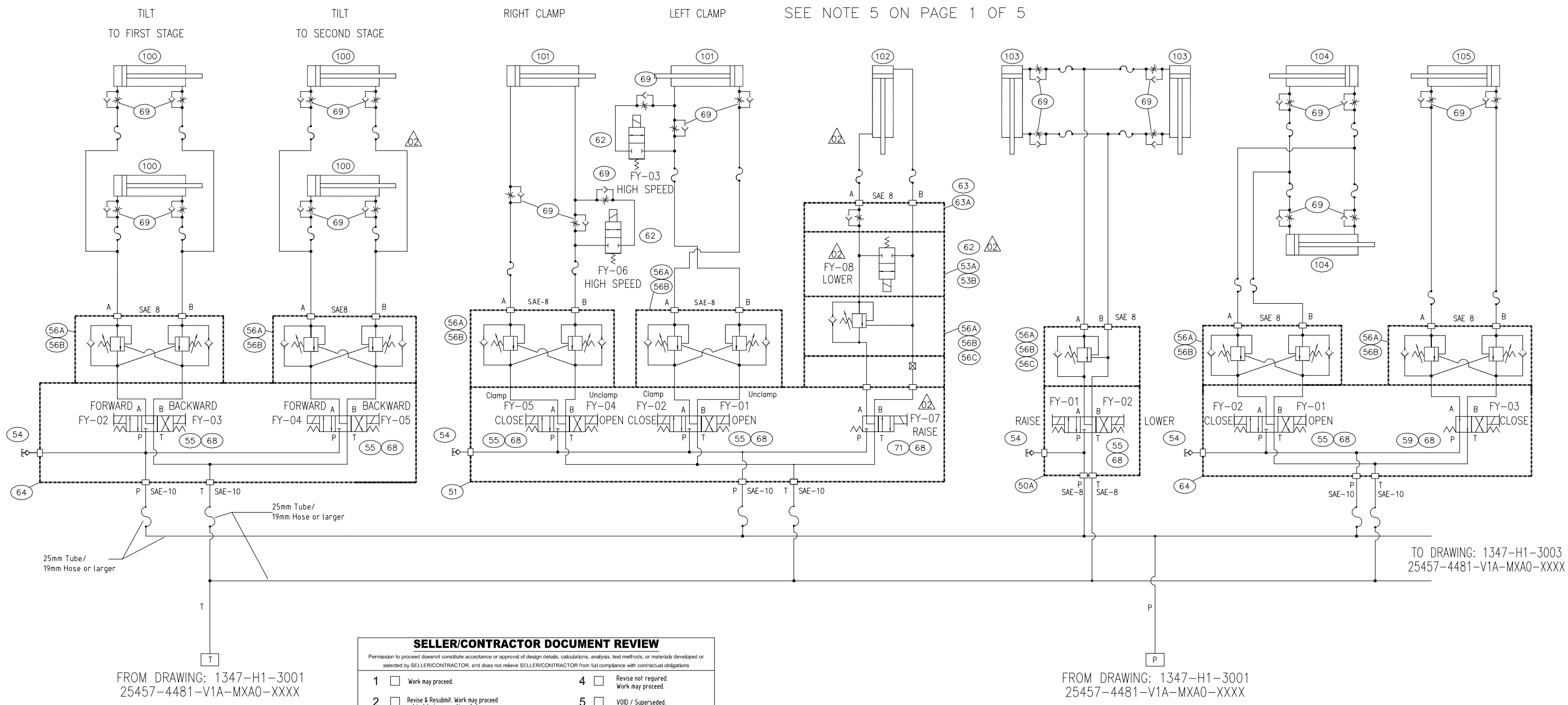
RAISE/LOWER
2.5"BORE X 1 3/8"ROD X 7 7/8"STROKE
(2.5CD-2HKPSV33AC7.875")
Q MAX=23 LPM

R2

BLOCK & BAR ASSEMBLY CONVEYOR
4481-MJRO-0007

WIDTH CENTERING
2"BORE X 1"ROD X 7"STROKE
(2CSB-2HKTSV19AC7.00")
Q MAX=23 LPM

LENGTH CENTERING
2"BORE X 1"ROD X 8 3/4"STROKE
(2CBB-2HKTSV14AC8.75")
Q MAX=23 LPM



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REFERENCES		2		UPDATE	NO.19.'10	T.Pa.	M.B.	C.C.
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Project Title: Ras Az Zawr Aluminium Smelter

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25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SELLER DRAWING No. 1347-H1-3002 REV. 2

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
HYDRAULIC SYSTEM
SCHEMATIC (2/4)

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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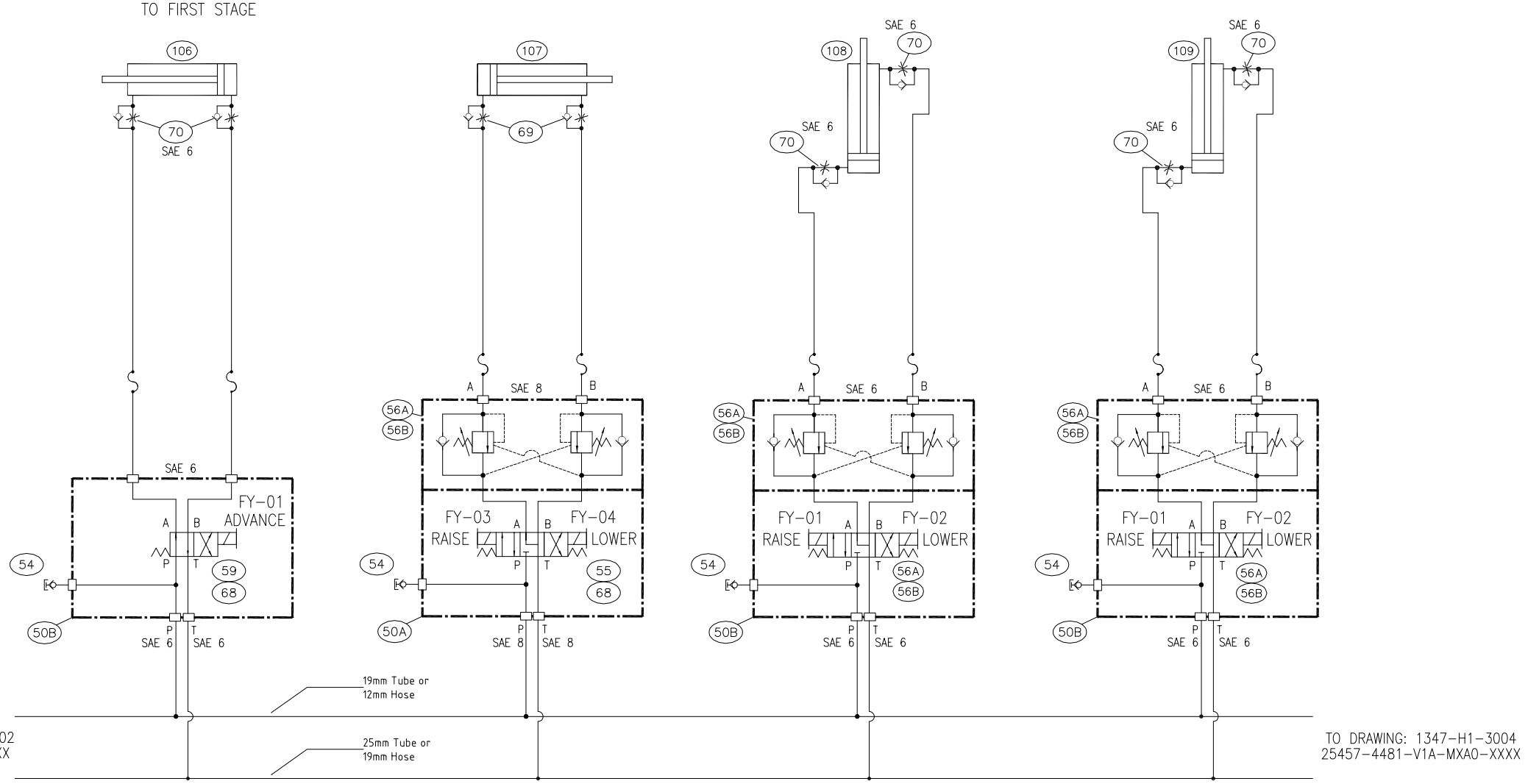
R5	R7	R8	R9
BLOCK COOLING AND TURNING CONVEYOR	BAR FURNACE FEED CONVEYOR	SHOT BLAST EXIT CONVEYOR	SHOT BLAST FEED CONVEYOR
4481–MJRO–0008	4481–MJRO–0003	4481–MJRO–0002	4481–MJRO–0001
PUSHER 2.5"BORE X 1 3/8"ROD X 11"STROKE (2.5CJB–2HKPSV34AC11.00") Q MAX=12 LPM	RAISE/LOWER 2.5"BORE X 1"ROD X 2 1/8"STROKE (2.5BB–2HKPSV14A2,125") Q MAX=23 LPM	TILT BAR 2.5"BORE X 1"ROD X 6"STROKE (2.5CD–2HKPSV13AC6.00") Q MAX=12 LPM	RAISE/LOWER 2.5"BORE X 1"ROD X 10 9/16"STROKE (2.5CD–2HKPSV13AC10.5625") Q MAX=12 LPM



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Document No : 25457-4480-V1A-MXAO-xxxx **Rev. : 000**

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		2		UPDATE	NO.19.'10	T.Pa.	M.B.	C.C.
		1		GENERAL UPDATE BY PNEUTECH	NO.06.'10	T.Pa.	M.B.	C.C.
REFERENCES		REVISIONS						

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DATE:			

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BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

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SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
HYDRAULIC SYSTEM
SCHEMATIC (3/4)

MA'ADEN معادن

Type | Building | Discipline | Phase | Format | Sequential | Location | Rev. No.
— — — — A3– –AZ

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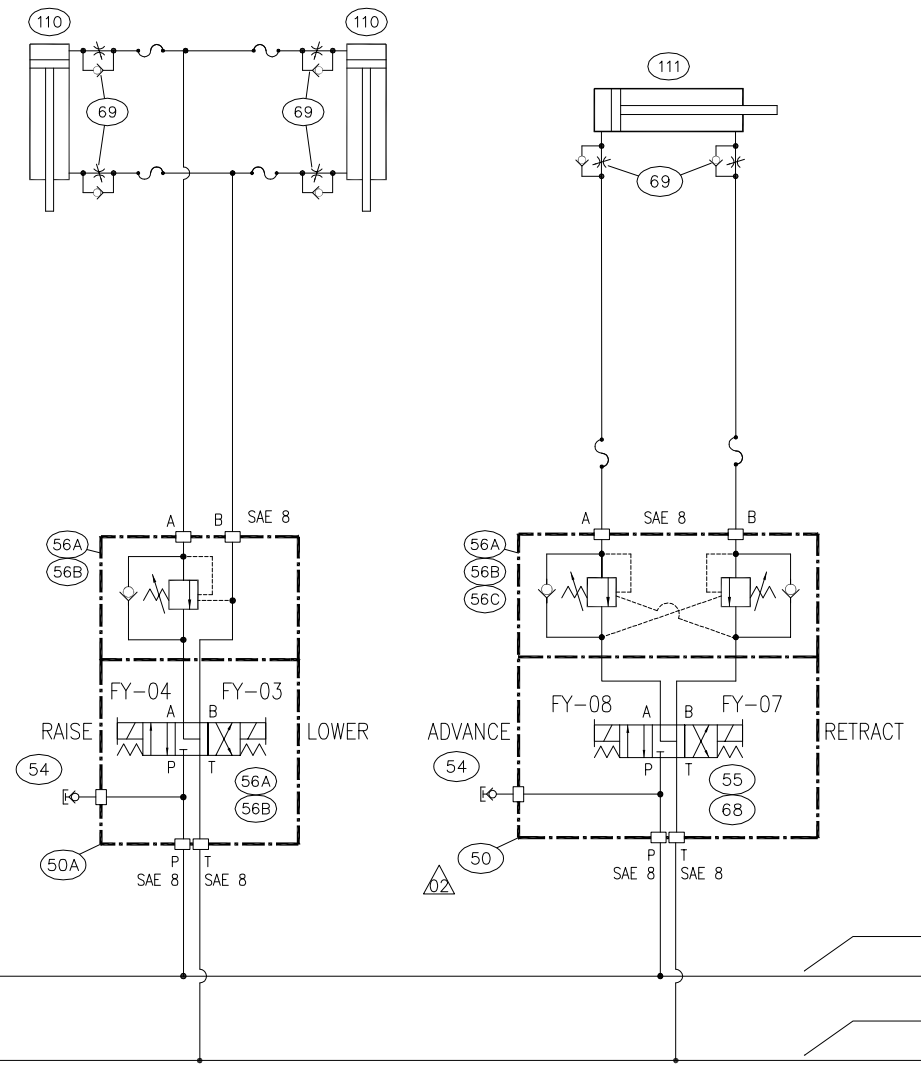
P1+R4A

CARBON BLOCK PRE-STRESSING & PRE-STRESSING CONVEYOR

4481-MZAC-0001

RAISE/LOWER
4"BORE X 1 3/4"ROD X 1 3/4"STROKE
(4HH-2HKPSV38A1.75")
Q MAX=23 LPM

WIDTH CENTERING
2-1/2" BORE X 1" ROD X 1" STROKE
(2.5SB-2HKPSV19A1.00")
Q MAX=23 LPM



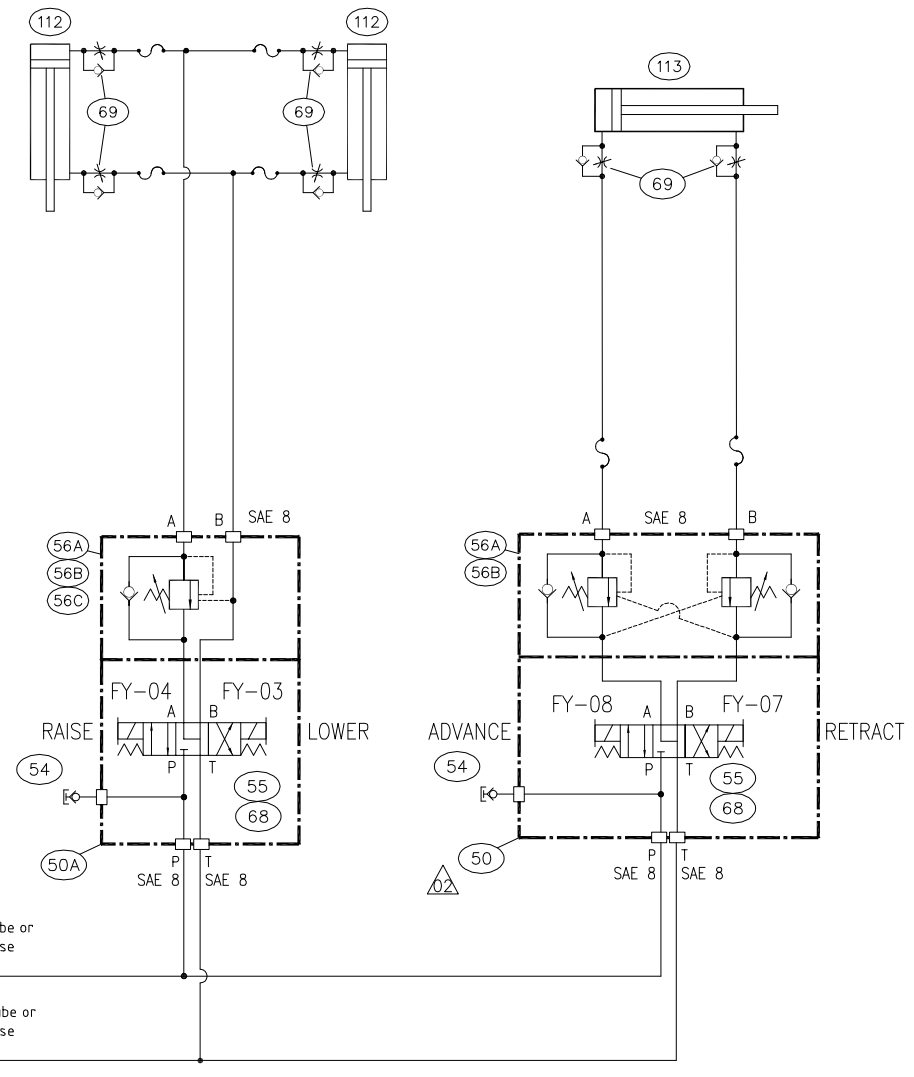
P1+R4B

CARBON BLOCK PRE-STRESSING & PRE-STRESSING CONVEYOR

481-MZAC-0002

RAISE/LOWER
4"BORE X 1 3/4"ROD X 1 3/4"STROKE
(4HH-2HKPSV38A1.75")
Q MAX=23 LPM

WIDTH CENTERING
2-1/2" BORE X 1" ROD X 1" STROKE
(2.5SB-2HKPSV19A1.00")
Q MAX=23 LPM



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REFERENCES		REVISIONS						
		2		UPDATE	NO.19.'10	T.Pa.	M.B.	C.C.
		1		GENERAL UPDATE BY PNEUTECH	NO.06.'10	T.Pa.	M.B.	C.C.

NOTES

STATUS: FOR DESIGN

DRAWN/DES'D:	PNEUTECH	AREA ENG.:	
DATE:	SE.27.'10	DATE:	
CHECKED:	M.B.	PRJ ENG MGR:	
DATE:		DATE:	
RESPONSIBLE ENG.	C.C.	CLIENT:	
DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NTS
DATE:			

Vendor or Subcontractor Logo: GNA alutech inc. — Departement Ingenierie Engineering Department 5600 Trans-Canada Saint-Laurent, Quebec Canada H4T 1V3

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
HYDRAULIC SYSTEM
SCHEMATIC (4/4)

MA'ADEN Wala

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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5 ☐ VOID / Superseded.

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Reviewed by : _____ Date : _____

Discipline :

Document No : 25457-4480-V1A-MXAO-xxxx **Rev. : 000**

ITEM	QTY	PART No.	DESCRIPTION	MANUFACTURE
26	1	--	GNA CONTROL CABINET	GNA
25E	1	--	WELL	--
25D	1	SAE703-A4-FP	WATER/OIL COOLER	American Industrial
25C	2	VP500P12	BRASS BALL VALVES 3/4"npt	PARKER
25B	1	310-3004	Y-STRAINER 3/4"npt	American Industrial
25A	1	310-1008	THERMOSTATIC VALVE 3/4"npt c/w BULB 310-2001	American Industrial
24	1	--	Drain Line Return Manifold	Pneutech-Rousseau
23B	1	---------->	D1LP-1-10Q-VMEME35Y9Y9-1	
			RETURN FILTER 10mic. 25psid	PARKER
23A	2	XCKJ10511H7	LIMIT SWITCHES	TELEMECANIQUE
22E	2	XCKJ10511H7	LIMIT SWITCHES	TELEMECANIQUE
22B	1	DSH101NRMVD024LDR	2/2 SOLENOID VALVE N.O.	PARKER
22A	1	30PD110QHVE2KS1621	DUPLEX RETURN FILTER 10mic.	PARKER
21B	2	B10-2-x8T	CARTRDIGE BODY	PARKER
21A	2	RAH101SV30	RELIEF VALVE	PARKER
20B	2	889D-F4AC-5	CABLE	ALLEN BRADLEY
20A	2	836E-DA1CC1D4	DUAL PNP PROGRAMMABLE TEMERATURE SWITCH	ALLEN BRADLEY
19	1	451279SSL04LXGW	4 1/2" GAUGE Kpa/PSI 1/2" NPT CONNECTION	DRESSER-ASCHROFT
18	5	PN620SV	PARTROL NEEDLE VALVE	PARKER
17	3	CVH103PV	CARTRIDGE CHECK VALVE	PARKER
16B	4	--	VIBRATION PAD	PNEUTECH
16A	2	MA01540416MCLH	11kW(15hp) 1800rpm,460/3/60, TEFC, 160M metric frame	WEG
15	2	M230ML602B	BELLHOUSING	MAGNALOY
14C	2	M470N6	COUPLING INSERT	MAGNALOY
14B	2	M40002806	HALF COUPLING METRIC BORE	MAGNALOY
14A	2	M400M4212	HALF COUPLING METRIC BORE	MAGNALOY
13	2	PVP23362R2V	VARI. PIST. PUMP 23cc/rev, 35lpm(9.2gpm)max @ 1800rpm	PARKER
12C	4	XCKJ10511H7	LIMIT SWITCH	TELELMECANIQUE
12B	2	926758	CHANGEOVER VALVE ASSY.	PARKER
12A	4	F3CF2174PE3-F9Y91	RETURN FILTRE	PARKER
11		NOT USED		
10C	2	--	BRACKET	Pneutech-Rousseau
10B	2	XCKJ10511H7	LIMIT SWITCH	TELEMECANIQUE
10A	2	1.5"9150313636TTT2	1" FLANGE SS BODY c/w SS STEM FULL PORT	METSO-JAMESBURY
09	1	KV10FOT-28-A2	KLEENVENT, 10gal, viton xx Fiberglass	PARKER
08C	1	---------->	75ML56300AD000HA0-Zy01=100mm	
			SURE SITE LEVEL SWITCH	SIEMENS
08B	1	---------->	75ML56300AD000HA0-Zy01=255mm	
			SURE SITE LEVEL SWITCH	SIEMENS
08A	1	---------->	75ML56300AD000HA0-Zy01=450mm	
			SURE SITE LEVEL SWITCH	SIEMENS
07	1	SL-11	MAGNET	VESCOR
06	1	PAB.1730.10.5	BREATHER PRESSURISABLE, 5psi, 3/4"npt, 10mic.	PARKER
05B	1	TW01-A12-L04	4 " SS WELL 1/2" npt INSIDE 3/4" npt OUTSIDE	--
05A	1	50-EL42E-040-XCS	5" THERMOMETER W/ TITLE HEAD	DRESSER-ASCHCROFT
04	1	BM26A	SIGHT GLASS	KROHNE
03C	2	889D-F4AC-5	CABLE	ALLEN-BRADLEY
03B	2	--	THERMO WELL	--
03A	2	837E-DA1BN1A1D4	DUAL PNP PROGRAMMABLE TEMERATURE SWITCH	ALLEN BRADLEY
02	1	1"7150-313636TTT2	1"FLANGE SS BODY c/w SS STEM	METSO-JAMESBURY
01	1		400L (105gal.) RESERVOIR c/w 110% DRIP TRAY	Pneutech-Rousseau

GENERAL UPDATE BY PNEUTECH

ITEM	QTY	PART No.	DESCRIPTION	MANUFACTURE
102	1	---------->	4.00CDB2HKPVS14ACx20.00"	
			2H HYD. CYL. 4.00"bore, 20.0" stroke, METALIC ROD WIPER	
			c/w 50945 ROD CLEVIS, 68371 PIVOT PIN	PARKER
101	2	---------->	4.00CBB2HKPVS24ACx19.00"	
			2H HYD. CYL. 4.00"bore, 19.0" stroke, METALIC ROD WIPER	
			c/w 50948 ROD CLEVIS, 68373 PIVOT PIN	PARKER
100	4	---------->	2.50CSB2HKTVS27ACx23.00"	
			2H HYD. CYL. 2.50"bore, 11.0" stroke, METALIC ROD WIPER	
			c/w 132291 ROD EYE, 83963 PIVOT PIN	
			83948 CLEVIS BRACKET	PARKER
		72-99 Not Used		
71	1	D1VW004KVJW	Description Eng.	Manufacture
70	6	F620SV	FLOW CONTROL VALVE SAE-6	PARKER
69	35	F820SV	FLOW CONTROL VALVE SAE-8	PARKER
68	38	P5103-3831000	DIN CONNECTOR 24vdc	CANFIELD
		65-67 Not Used		
64	2	DD03P022S	MANIFOLD, D03, SAE-8, DUCTILE IRON	DAMAN
63	1	FM2AAKV	FLOW CONTROL VALVE	PARKER
62	1	---------->	DSH101CREV-D024LDR	
			2/2 SOLENOID VALVE N.C. VITON 24vdc	PARKER
		60-61 Not Used		
59	2	D1VW020BVJW	DIRECTIONAL VALVE D03	PARKER
		57 TO 58 Not Used		
56C	3	P10-3A-V	PLUG VITON	PARKER
56B	15	BD03-DDX-VS	BODY FOR CB VALVE SANDWICH	PARKER
56A	26	CB101-AS10V	COUNTERBALANCE VALVE	PARKER
55	13	D1VW004CVJG5	DIRECTIONAL VALVE D03 24vdc	PARKER
54	11	EMA3/7/16-20UNF2A	TEST COUPLER	PARKER
53B	1	P10-2-V	PLUG VITON	PARKER
53A	1	BD03-ABX-VS	CARTPAK BODY, SANDWICH D03, STEEL	PARKER
52B	1	--	MANIFOLD PLUG TO B PORT	--
52A	1	DD03TP-AB-4S	TAPPING PLATE, SAE-4	DAMAN
51	1	DD03P032S	MANIFOLD 3 STATIONS, D03, SAE-8 DUCTILE IRON	DAMAN
50B	3	DD3SPSB6S	SUBPLATE D03, 1 STATION, SAE-6, DUCTILE IRON	DAMAN
50A	6	DD3SPSB8S	SUBPLATE D03, 1 STATION, SAE-8, DUCTILE IRON	DAMAN
		42-49 Not Used		
41	1	2"AM150FD3600MT	3WAY BALL VALVE	METSO-JAMESBURY
40	1	3051T-G4A2B21A	PRESSURE TRANSMITTER	ROSEMOUNT
39B	2	889D-F4AC-5	CABLE	ALLEN BRADLEY
39A	2	836E-DA1EU1D4	PROGRAMMABLE DUAL PNP PRESSURE SWITCH 6000psi	ALLEN BRADLEY
38	2	C620SV	CHECK VALVE	PARKER
		33 to 37 Not Used		
32	2	NH1600V125B0325	FLEXMASTER	AEROQUIP
31	4	EMA3/7/16-20UNF2A	TEST COUPLER	PARKER
30	1	C1620S65V	CHECK VALVE	PARKER
29	1	--	RETURN MANIFOLD	Pneutech-Rousseau
28	1	310-3004	Y-STRAINER 3/4"npt	American Industrial
27B	1	6657-12M	DUST COVER	PARKER
27A	1	6610-12-10	FILLING COUPLER	PARKER

ITEM	QTY	PART No.	DESCRIPTION	MANUFACTURE
113	1	---------->	2.50CSB2HKPVS19ACx1.00"	
			2H HYD. CYL. 2.50"bore, 1.00" stroke, METALIC ROD WIPER	
			c/w 132291 ROD EYE, 83963 PIVOT PIN	
			83948 CLEVIS BRACKET	PARKER
112	2	---------->	4.00CHH2HKPVS38ACx1.75"	
			2H HYD. CYL. 4.00"bore, 1.75" stroke, METALIC ROD WIPER	
111	1	---------->	2.50CSB2HKPVS19ACx1.00"	
			2H HYD. CYL. 2.50"bore, 1.00" stroke, METALIC ROD WIPER	
			c/w 132291 ROD EYE, 83963 PIVOT PIN	
			83948 CLEVIS BRACKET	PARKER
110	2	---------->	4.00CHH2HKPVS38ACx1.75"	
			2H HYD. CYL. 4.00"bore, 1.75" stroke, METALIC ROD WIPER	
109	1	---------->	2.50CD2HKPVS13ACx10.562"	
			2H HYD. CYL. 2.50"bore, 10.562" stroke, METALIC ROD WIPER	
			c/w 132291 ROD EYE, 83963 PIVOT PIN	
			83948 CLEVIS BRACKET	PARKER
108	1	---------->	2.50CD2HKPVS13ACx6.00"	
			2H HYD. CYL. 2.50"bore, 6.00" stroke, METALIC ROD WIPER	
			c/w 132291 ROD EYE, 83963 PIVOT PIN	
			83948 CLEVIS BRACKET	PARKER
107	1	---------->	2.50CBB2HKPVS14ACx2.125"	
			2H HYD. CYL. 2.50"bore, 2.125" stroke, METALIC ROD WIPER	
			c/w 50942 ROD CLEVIS, 68369 PIVOT PIN	
			69196 MOUNTING PLATE	PARKER
106	1	---------->	2.50CJB2HKPVS34ACx11.00"	
			2H HYD. CYL. 2.50"bore, 11.00" stroke, METALIC ROD WIPER	
105	1	---------->	2.00CBB2HKTVS14ACx8.73"	
			2H HYD. CYL. 2.00"bore, 8.73" stroke, METALIC ROD WIPER	
			c/w 50942 ROD CLEVIS, 68369 PIVOT PIN	
			69196 EYE BRACKET	PARKER
104	2	---------->	2.00CSB2HKTVS19ACx7.00"	
			2H HYD. CYL. 2.00"bore, 7.0" stroke, METALIC ROD WIPER	
			c/w 132291 ROD EYE, 83963 PIVOT PIN	
			83948 CLEVIS BRACKET	PARKER
103	2	---------->	2.50CD2HKPVS33ACx7.88"	
			2H HYD. CYL. 2.50"bore, 7.88" stroke, METALIC ROD WIPER	
			STOP TUBE 3" NET STROKE 4.88"	
			c/w 85361 EYE BRACKET, 50994 ROD CLEVIS	
			68370 PIVOT PIN, 69198 EYE BRACKET, 68371 PIVOT PIN	

Refer to dwg. 1347-H1-3001 to 1347-H1-3004

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		1		GENERAL UPDATE BY PNEUTECH	NO.06.'10	T.Po.	M.B.	C.C.

REVISIONS

NOTES

STATUS: FOR DESIGN

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DATE:	SE.27.'10	DATE:	
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BECHTEL

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
HYDRAULIC SYSTEM
BILL OF MATERIAL

Project Title: Ras Az Zawr Aluminium Smelter

MA'ADEN WMSA

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx	xxxx	xxxx	xxx	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
	—	—	—	A3—		—AZ	

9.5 Pneumatic Drawings

DRAWING No.	DESCRIPTION
1347-AR-4000	Cathode Sealing Equipment Pneumatic Piping Routing
1347-AR-4001	Pneumatic Diagram F2
1347-AR-4002	Pneumatic Diagram F1
1347-AR-4003	Pneumatic Diagram R4A
1347-AR-4004	Pneumatic Diagram R4B
1347-AR-4005	Pneumatic Diagram R6
1347-AR-4006	Pneumatic Diagram A1
1347-AR-4007	Pneumatic Diagram F4A
1347-AR-4008	Pneumatic Diagram F4B

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3 ☐	Revise & Resubmit. Work may NOT proceed.	DDR Nbr :	

Reviewed by : _____ Date : _____

Discipline :

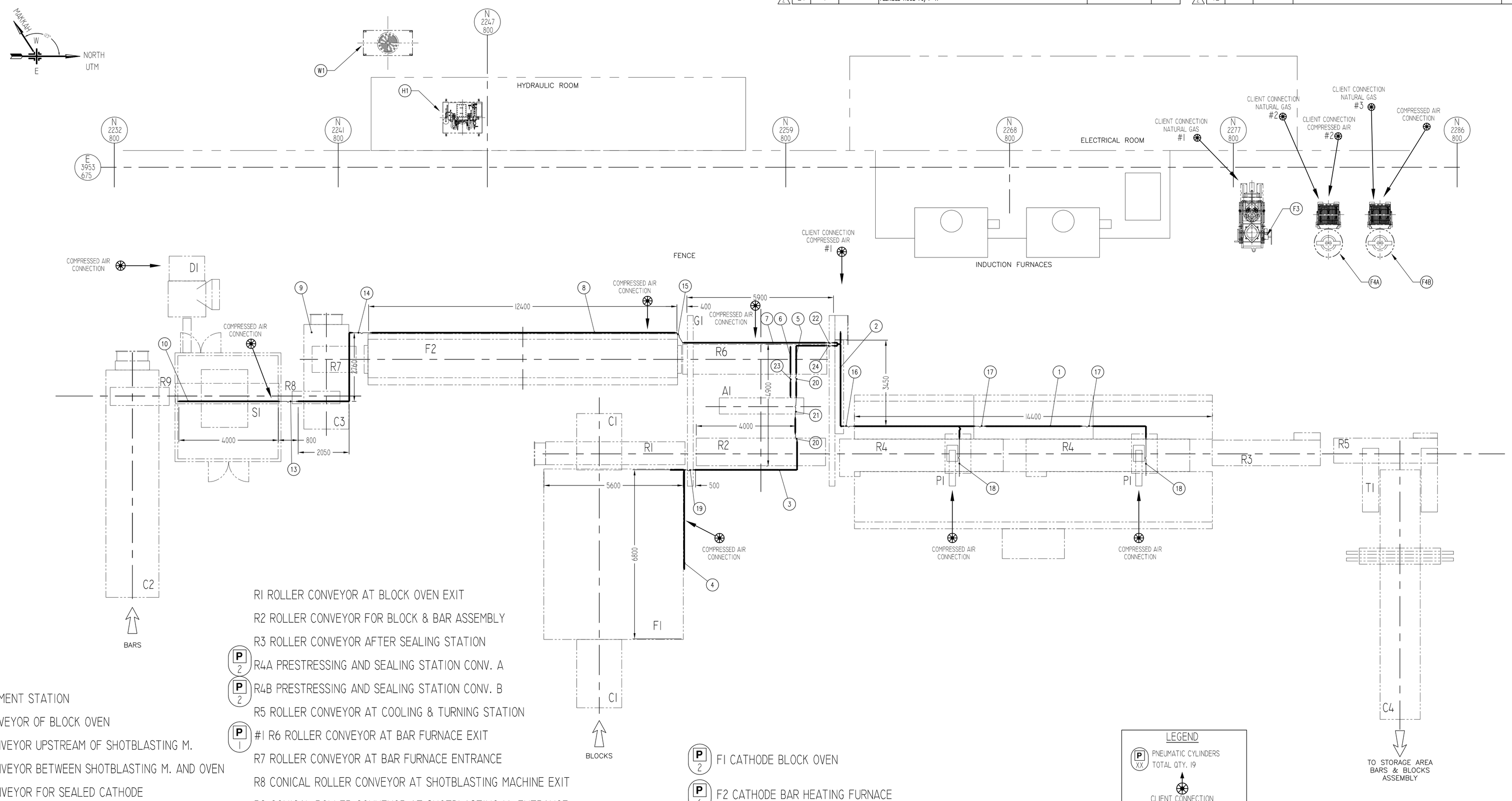
Document No : 25457-4480-V1A-MXAO-XXXX **Rev. : 000**

LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/Qty	No. PIECE-MAT. MAT.-PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
13	1		FLEXIBLE HOSE ø1-1/4" X 1500		
14	1		FLEXIBLE HOSE ø1-1/4" X 1200		
15	1		FLEXIBLE HOSE ø1-1/4" X 1000		
16	1		FLEXIBLE HOSE ø3/4" X 1500		
17	2		FLEXIBLE HOSE ø3/4" X 600		
18	2		FLEXIBLE HOSE ø3/4" X 3200		
19	1		FLEXIBLE HOSE ø3/4" X 1000		
20	2		FLEXIBLE HOSE ø3/4" X		
21	1		FLEXIBLE HOSE ø3/4" X		
22	1		FLEXIBLE HOSE ø1-1/4" X		
23	1		FLEXIBLE HOSE ø3/8" X		
24	1		FLEXIBLE HOSE ø3/4" X		

LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/Qty	No. PIECE-MAT. MAT.-PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
1	1		PIPE ø3/4" X 11800 mm LG	PLATFORM	
2	1		PIPE ø3/4" X 4900 mm LG	G1	
3	1		PIPE ø3/4" X 5200 mm LG	R2	
4	1		PIPE ø3/4" X 13000 mm LG	F1	
5	1		PIPE ø3/4" X 2400 mm LG	R6	
6	1		PIPE ø3/8" X 1600 mm LG	R6	
7	1		PIPE ø1 1/4" X 5800 mm LG	R6	
8	1		PIPE ø1 1/4" X 12400 mm LG	F2	
9	1		PIPE ø1 1/4" X 4700 mm LG	C3	
10	1		PIPE ø1 1/4" X 6000 mm LG	S1	
11					
12					



(P 4) A1 BAR ALIGNMENT STATION
C1 CHAIN CONVEYOR OF BLOCK OVEN
C2 CHAIN CONVEYOR UPSTREAM OF SHOTBLASTING M.
C3 CHAIN CONVEYOR BETWEEN SHOTBLASTING M. AND OVEN
C4 CHAIN CONVEYOR FOR SEALED CATHODE
G1 POSITIONNING GANTRY FOR BLOCK & BARS
H1 HYDRAULIC POWER UNIT
T1 COOLING & TURNING STATION

R1 ROLLER CONVEYOR AT BLOCK OVEN EXIT
R2 ROLLER CONVEYOR FOR BLOCK & BAR ASSEMBLY
R3 ROLLER CONVEYOR AFTER SEALING STATION
(P 2) R4A PRESTRESSING AND SEALING STATION CONV. A
(P 2) R4B PRESTRESSING AND SEALING STATION CONV. B
R5 ROLLER CONVEYOR AT COOLING & TURNING STATION
(P 1) #1 R6 ROLLER CONVEYOR AT BAR FURNACE EXIT
R7 ROLLER CONVEYOR AT BAR FURNACE ENTRANCE
R8 CONICAL ROLLER CONVEYOR AT SHOTBLASTING MACHINE EXIT
R9 CONICAL ROLLER CONVEYOR AT SHOTBLASTING M. ENTRANCE
(P 1) S1 CATHODE BAR SHOTBLASTING MACHINE IN
S1 CATHODE BAR SHOTBLASTING MACHINE OUT
(P 1) D1 DUST COLLECTOR

(P 2) F1 CATHODE BLOCK OVEN
(P 6) F2 CATHODE BAR HEATING FURNACE
F3 LADLE PRE-HEATING STATION
(P 1) #2 F4A CAST IRON INGOT DRYING STATION
(P 1) F4B CAST IRON INGOT DRYING STATION

LEGEND
(P XX) PNEUMATIC CYLINDERS TOTAL QTY. 19
CLIENT CONNECTION COMPRESSED AIR TOTAL QTY. 1

NOTE:
1. - MATERIALS & INSTALLATION BY BECHTEL
2. - ROUTING FOR INFORMATION ONLY AND MAY BE MODIFIED AS REQUIRED

NUMBER	REV.	TITLE
REFERENCE DRAWINGS		

REV.	DESCRIPTION	DATE	DRN.	CHK.	R.E.	A.E. /ESG.S	P.E.M.
2	FLEXIBLE HOSE AND PIPE UPDATED.	MR.30.'11	E.I.	M.B.	C.C.		
1	ITEMS #17 AND #18 REMOVED, ITEMS #5, #6, #7 AND #8 UPDATED.	DE.22.2010	C.C.	M.B.	C.C.		
0	FIRST ISSUE	DE.06.2010	C.C.	M.B.	C.C.		
REVISIONS							

STAMP

ALCOA | Ma'aden Aluminum Project

SCALE: NTS FORMAT A1

Bechtel

		DATE
DRAWN	C.C.	DE.06.'10
CHK.	M. Blanchet	
R.E.	C. Coupal	
A.E. / S.		
E.G.S.		
P.E.M.		
CLIENT		

GNA alutech inc. Departement Ingenierie Engineering Department 9486 Trans-Canada Saint-Laurent, Quebec H4S 1V3 Canada

BECHTEL DRG. No. — — — — — REV.

CLIENT DRG. No. REV.

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SELLER DRAWING No. 1347-AR-4000 REV. 2

Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
PNEUMATIC
PNEUMATIC PIPING ROUTING

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LISTE DE MATERIELS/BILL OF MATERIALS

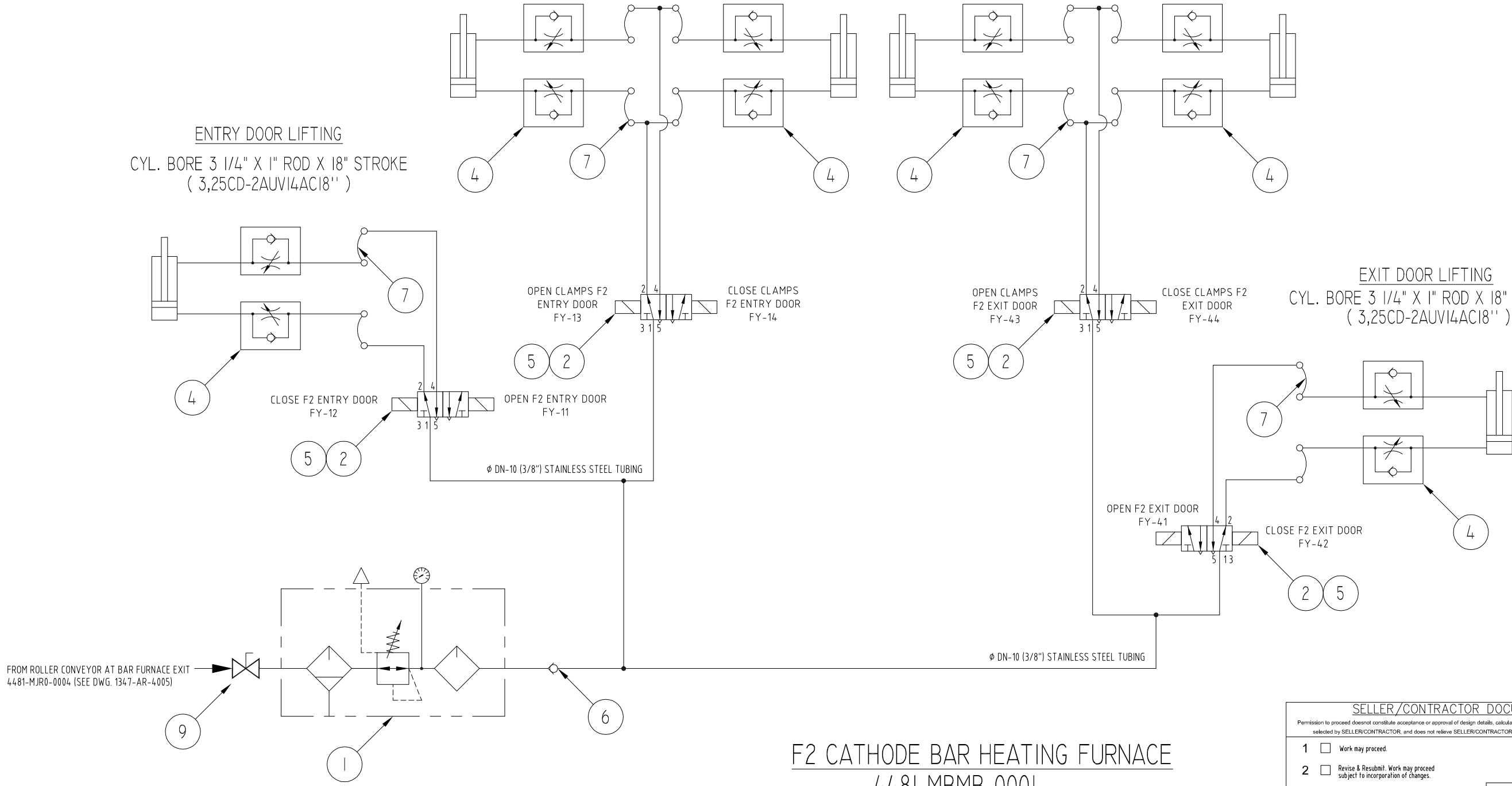
ITEM	Qte/QTY	No. PIECE-MAT. / MAT.-PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
1	1		F.R.L. UNIT # 16A-2-6-A-18-A-2-B PARKER DN 10 (3/8") NPT	"BY GNA"	
2	4		CONTROL VALVE # AL-4-1-533-BKN-53-00-A PARKER DN10 (3/8")	"BY GNA"	
			4/2, 5 PORTS, DOUBLE SOLENOID		
4	12		FLOW CONTROL VALVE # F600B PARKER DN10 (3/8")	"BY GNA"	
5	8		EXHAUST PORT MUFFLER # EM37 PARKER DN10 (3/8")	"BY GNA"	
6	1		CHECK VALVE # C600B PARKER DN 10 (3/8")	"BY GNA"	
7	12		HI TEMP. PNEUMATIC HOSE (350°F), Ø11/2" X 460 mm LG (18")	"BY GNA"	
			3/8" NPT EACH ENDS	"BY GNA"	
8					
9	1		BALL VALVE DN 10 (3/8") # B-6400SE-3/8 WATTS	"BY GNA"	

ENTRY DOOR CLAMPING
CYL. BORE 2 1/2" X 1" ROD X 3" STROKE
(2,5CBB-2AUV34AC3'')

EXIT DOOR CLAMPING
CYL. BORE 2 1/2" X 1" ROD X 3" STROKE
(2,5CBB-2AUV34AC3'')

ENTRY DOOR LIFTING
CYL. BORE 3 1/4" X 1" ROD X 18" STROKE
(3,25CD-2AUV14AC18'')

EXIT DOOR LIFTING
CYL. BORE 3 1/4" X 1" ROD X 18" STROKE
(3,25CD-2AUV14AC18'')



F2 CATHODE BAR HEATING FURNACE
4481-MBMB-0001
(DOOR LIFTING)

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Discipline :

Document No : 25457-4480-V1A-MXA0-XXXX | Rev. : 000

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SELLER DRAWING No. 1347-AR-4001 | REV. 0

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		0		FIRST ISSUE	SE.28.2010	C.C.	M.B.	C.C.
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NOTES

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RESPONSIBLE ENG.	---	CLIENT:	
DATE:	---	DATE:	
ENG. GROUP SUP. DATE:		DRAWING SCALE:	NTS

Vendor or Subcontractor Logo: GNA ulutech Inc. — Département Ingénierie Engineering Department, 9455 Trans-Canada, Saint-Laurent, Quebec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
F2 CATHODE BAR HEATING FURNACE
PNEUMATIC DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-	00AZ-	xx -	xxxx -	xxxx - xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
—		—	—	A3-		-AZ	

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LISTE DE MATERIELS/BILL OF MATERIALS

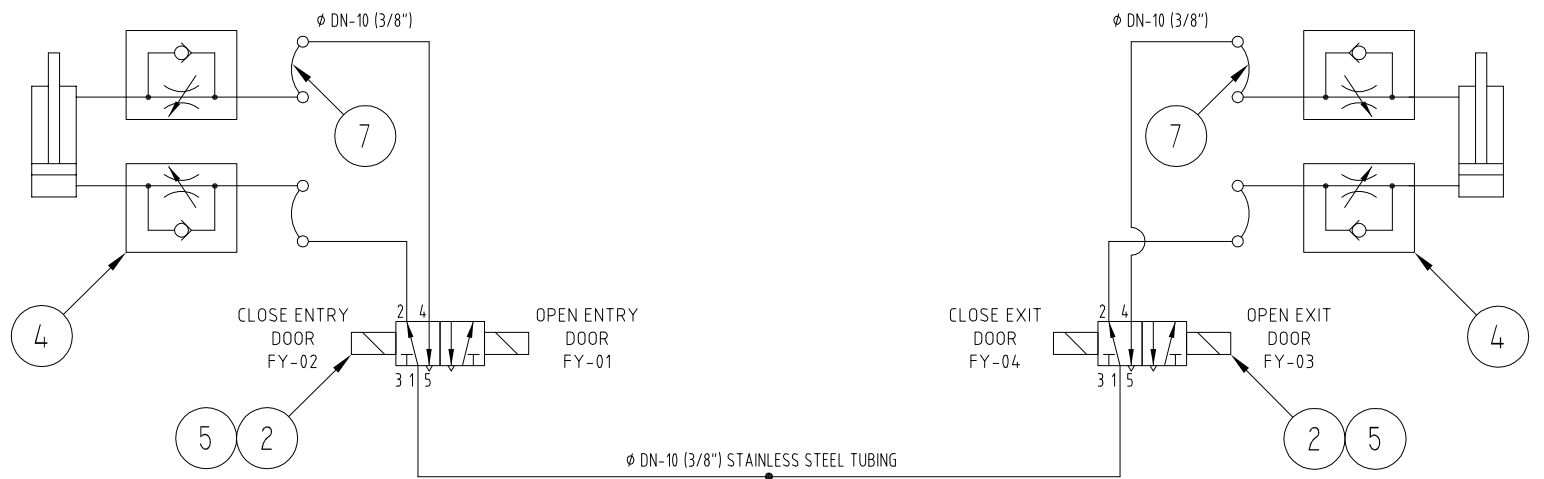
ITEM	Qte/QTY	No. PIECE-MAT. MAT.-PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
1	1		F.R.L. UNIT # 16A-2-6-A-18-A-2-B PARKER DN 10 (3/8") NPT	"BY GNA"	
2	2		CONTROL VALVE # AL-4-1-533-BKN-53-00-A PARKER DN10 (3/8")	"BY GNA"	
			5/2, 5 PORTS, DOUBLE SOLENOID		
4	4		FLOW CONTROL VALVE # F600B PARKER DN10 (3/8")	"BY GNA"	
5	4		EXHAUST PORT MUFFLER # EM37 PARKER DN10 (3/8")	"BY GNA"	
6	1		CHECK VALVE # C600B PARKER DN 10 (3/8")	"BY GNA"	
7	4		HI TEMP. PNEUMATIC HOSE (350°F), Ø1/2" X 460 mm LG (18")	"BY GNA"	
			3/8" NPT EACH ENDS	"BY GNA"	
8					
9	1		BALL VALVE DN 10 (3/8") # B-6400SE-3/8 WATTS	"BY GNA"	

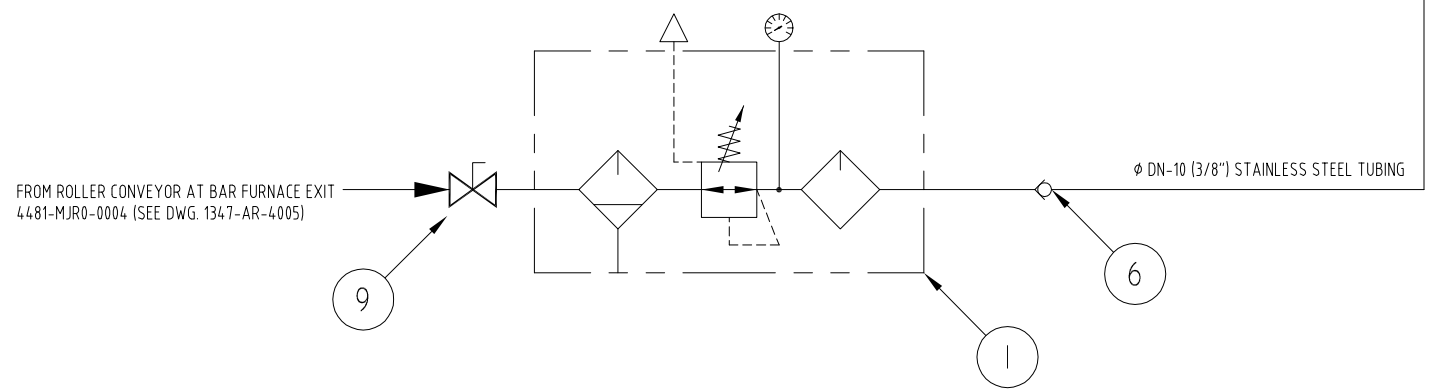
ENTRY DOOR LIFTING

CYL. BORE 5" x ROD 1-3/8" x STROKE 27-11/16"
(5.00D-2AUV34A27.687)

EXIT DOOR LIFTING

CYL. BORE 5" x ROD 1-3/8" x STROKE 27-11/16"
(5.00D-2AUV34A27.687)





FI
CATHODE BLOCK OVEN
4481-MEEP-0001
(DOOR LIFTING)

SELLER/CONTRACTOR DOCUMENT REVIEW

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3 ☐ Revise & Resubmit. Work may NOT proceed.
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5 ☐ VOID / Superseded.

DDR Nbr :

Reviewed by : _____ Date : _____

Discipline :

Document No : 25457-4480-V1A-MXAO-XXXX | Rev. : 000

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DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		REVISIONS						
		0		FIST ISSUE	SE.28.2010	C.C.	M.B.	C.C.

NOTES

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DATE:	SE.28.'10	DATE:	
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DATE:	---	DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NTS
DATE:			

Vendor or Subcontractor Logo: GNA ab.tech Inc. — Département Ingenierie / Engineering Department, 9690 Trans-Canada, Saint-Laurent, Quebec (H4S 1V7), Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
F1 CATHODE BLOCK OVEN
PNEUMATIC DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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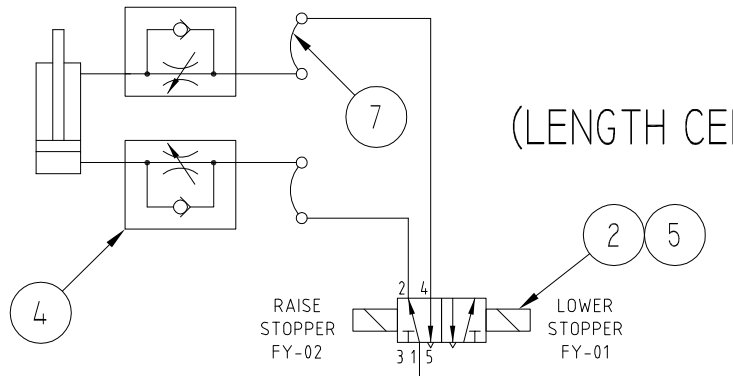
R4A PRESTRESSING AND SEALING STATION
CONVEYOR A
4481-MZAC-0001

LISTE DE MATERIELS/BILL OF MATERIALS

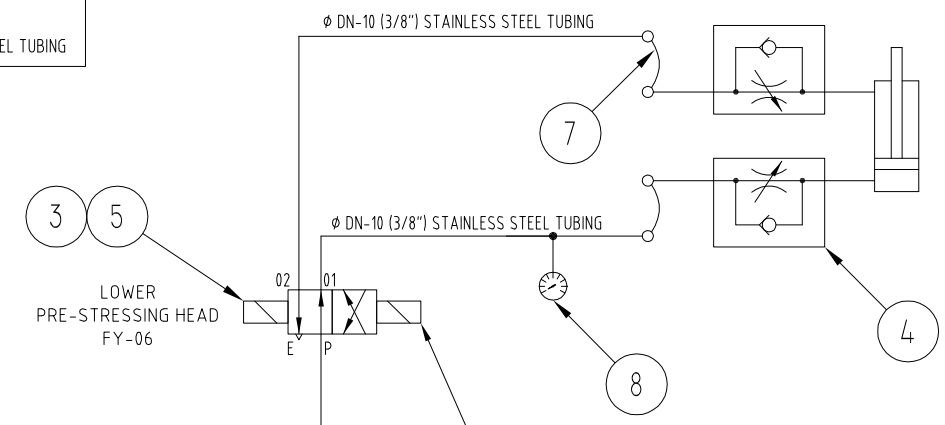
ITEM	Qte/Qty	No. PIECE-MAT. MAT.-PART NO.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
1	1		F.R.L. UNIT # 16A-2-6-A-18-A-2-B PARKER DN 10 (3/8") NPT	"BY GNA"	
2	1		CONTROL VALVE # AL-4-1-533-BKN-53-00-A PARKER DN10 (3/8")	"BY GNA"	
			4/2, 5 PORTS, DOUBLE SOLENOID		
3	1		CONTROL VALVE # HHB-40-0-37-01-BL PARKER DN10 (3/8")	"BY GNA"	
			4/2, 4 PORTS, DOUBLE SOLENOID		
4	4		FLOW CONTROL VALVE # F600B PARKER DN10 (3/8")	"BY GNA"	
5	3		EXHAUST PORT MUFFLER # EM37 PARKER DN10 (3/8")	"BY GNA"	
6	1		CHECK VALVE # C600B PARKER DN 10 (3/8")	"BY GNA"	
7	4		HI TEMP. PNEUMATIC HOSE (350°F), Ø1/2" X 460 mm LG (18")	"BY GNA"	
			3/8" NPT EACH ENDS	"BY GNA"	
8	1		GAUGE 0 - 600 KPA (WIDE WINDOW)	"BY GNA"	
9	1		BALL VALVE DN 10 (3/8") # B-6400SE-3/8 WATTS	"BY GNA"	

LENGTH STOPPER
CYL. BORE 2-1/2" x ROD 1" x STROKE 3"
(2.5BB2AU34AC3)

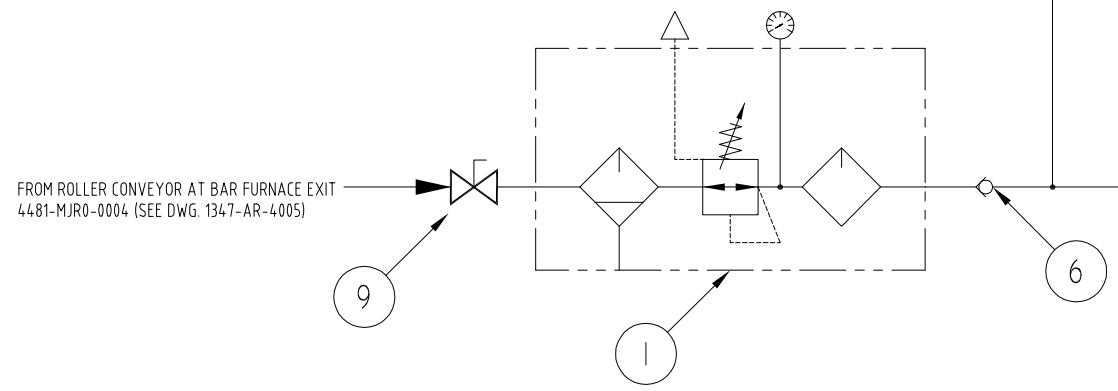


(LENGTH CENTERING)

PRE-STRESSING
CYL. BORE 12" x ROD 2-1/2" x STROKE 10"
(12.00SB-2AUV47AC10.00)



(PRE-STRESSING)



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Discipline :

Document No : 25457-4480-V1A-MXA0-XXXX | Rev. : 000

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DATE:	---	DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NTS
DATE:			

Vendor or Subcontractor Logo: GNA a.i.tech Inc. — Département Ingénierie Engineering Department 9490 Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

BECHTEL

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
R4A PRESTRESSING AND SEALING STATION CONVEYOR A
PNEUMATIC DIAGRAM

Project Title: Ras Az Zawr Aluminium Smelter

MA'ADEN

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
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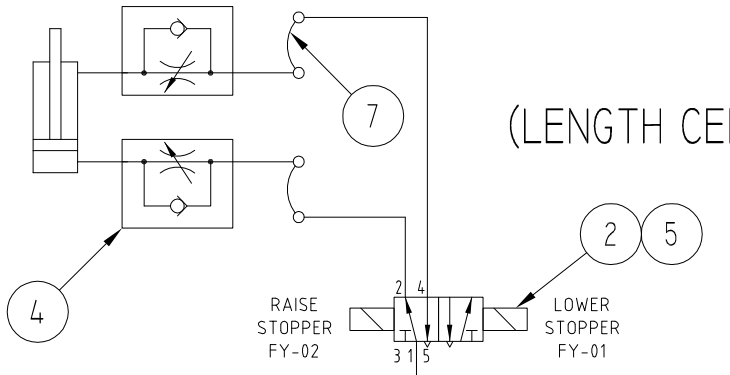
R4B PRESTRESSING AND SEALING STATION
CONVEYOR B
4481-MZAC-0002

LISTE DE MATERIELS/BILL OF MATERIALS

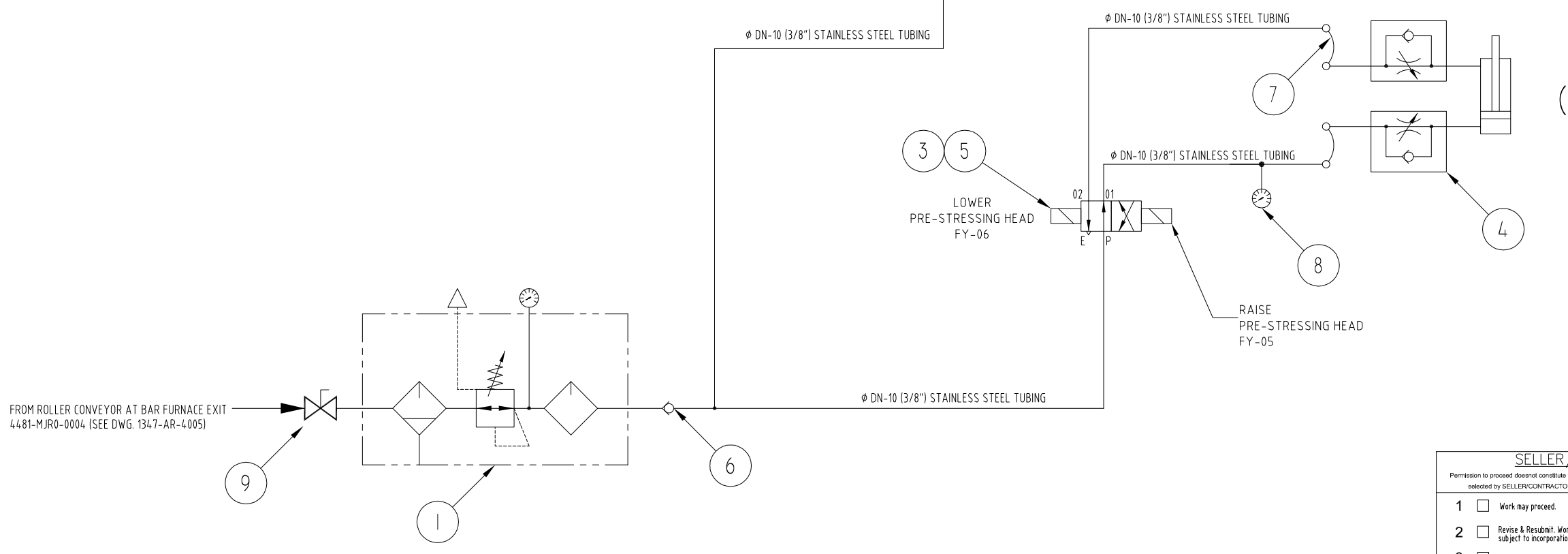
ITEM	Qte/QTY	No. PIECE-MAT. MAT.-PART NO.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
1	1		F.R.L. UNIT # 16A-2-6-A-18-A-2-B PARKER DN10 (3/8") NPT	"BY GNA"	
2	1		CONTROL VALVE # AL-4-1-533-BKN-53-00-A PARKER DN10 (3/8")	"BY GNA"	
			4/2, 5 PORTS, DOUBLE SOLENOID		
3	1		CONTROL VALVE # HHB-40-0-37-01-BL PARKER DN10 (3/8")	"BY GNA"	
			4/2, 4 PORTS, DOUBLE SOLENOID		
4	4		FLOW CONTROL VALVE # F600B PARKER DN10 (3/8")	"BY GNA"	
5	3		EXHAUST PORT MUFFLER # EM37 PARKER DN10 (3/8")	"BY GNA"	
6	1		CHECK VALVE # C600B PARKER DN 10 (3/8")	"BY GNA"	
7	4		HI TEMP. PNEUMATIC HOSE (350°F), Ø1/2" X 460 MM LG (18")	"BY GNA"	
			3/8" NPT EACH ENDS	"BY GNA"	
8	1		GAUGE 0 - 600 KPA (WIDE WINDOW)	"BY GNA"	
9	1		BALL VALVE DN 10 (3/8") # B-6400SE-3/8 WATTS	"BY GNA"	

LENGTH STOPPER
CYL. BORE 2-1/2" x ROD 1" x STROKE 3"
(2.5BB2AU34AC3)



(LENGTH CENTERING)

PRE-STRESSING
CYL. BORE 12" x ROD 2-1/2" x STROKE 10"
(12.00SB-2AUV47AC10.00)



(PRE-STRESSING)

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3 ☐	Revise & Resubmit. Work may NOT proceed.	DDR Nbr :	

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Discipline :

Document No : 25457-4480-V1A-MXA0-XXXX | Rev. : 000

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		REVISIONS						

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ENG. GROUP SUP.		DRAWING SCALE:	NTS
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Vendor or Subcontractor Logo: GNA a.j.tech Inc. — Département Ingénierie / Engineering Department, 9495 Trans-Canada, Saint-Laurent, Quebec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
R4B PRESTRESSING AND SEALING STATION CONVEYOR B
PNEUMATIC DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
—	—	—		A3—		—AZ	

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LISTE DE MATERIELS/BILL OF MATERIALS

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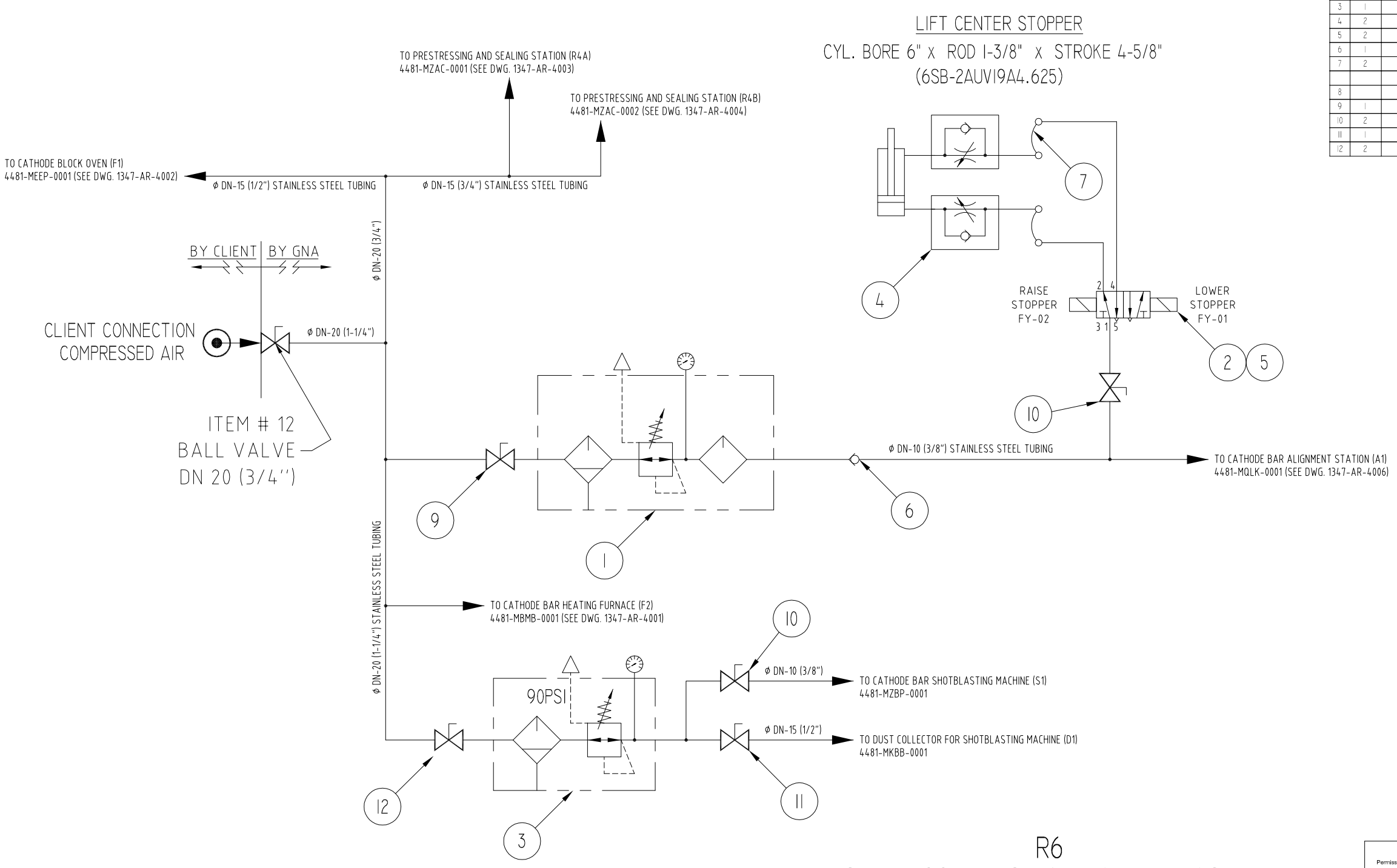
1	1		F.R.L. UNIT # 16A-2-6-A-18-A-2-B PARKER DN 10 (3/8") NPT	"BY GNA"	
2	1		CONTROL VALVE # AL-4-1-533-BKN-53-00-A PARKER DN10 (3/8")	"BY GNA"	
			4/2, 5 PORTS, DOUBLE SOLENOID		
3	1		F.R. UNIT # XXXX PARKER DN 20 (3/4") NPT	"BY GNA"	
4	2		FLOW CONTROL VALVE # F6008 PARKER DN10 (3/8")	"BY GNA"	
5	2		EXHAUST PORT MUFFLER # EM37 PARKER DN10 (3/8")	"BY GNA"	
6	1		CHECK VALVE # C6008 PARKER DN 10 (3/8")	"BY GNA"	
7	2		HI TEMP. PNEUMATIC HOSE (350°F), Ø1/2" X 460 mm LG (18")	"BY GNA"	
			3/8" NPT EACH ENDS	"BY GNA"	
8					
9	1		BALL VALVE DN 10 (3/8") # B-6400SE-3/8 PARKER	"BY GNA"	
10	2		BALL VALVE DN 10 (3/8") # B-XXXXSE-3/8 WATTS	"BY GNA"	
11	1		BALL VALVE DN 15 (1/2") # B-6400SE-1/2 WATTS	"BY GNA"	
12	2		BALL VALVE DN 20 (3/4") # B-6400SE-3/4 WATTS	"BY GNA"	



R6
ROLLER CONVEYOR AT BAR FURNACE EXIT
4481-MJR0-0004
(LIFT CENTER STOPPER)

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Discipline :

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		0		FIRST ISSUE	SE.28.2010	C.C.	M.B.	C.C.
REFERENCES		REVISIONS						

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ENG. GROUP SUP.		DRAWING SCALE:	NTS
DATE:			

Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie / Engineering Department — 1600 Lionel-Boulet, Varennes, Québec, Canada, J3X 1P7 — (450) 652-1972 — Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
R6 ROLLER CONVEYOR AT BAR FURNACE EXIT
PNEUMATIC DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3—		—AZ	

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LISTE DE MATERIELS/BILL OF MATERIALS

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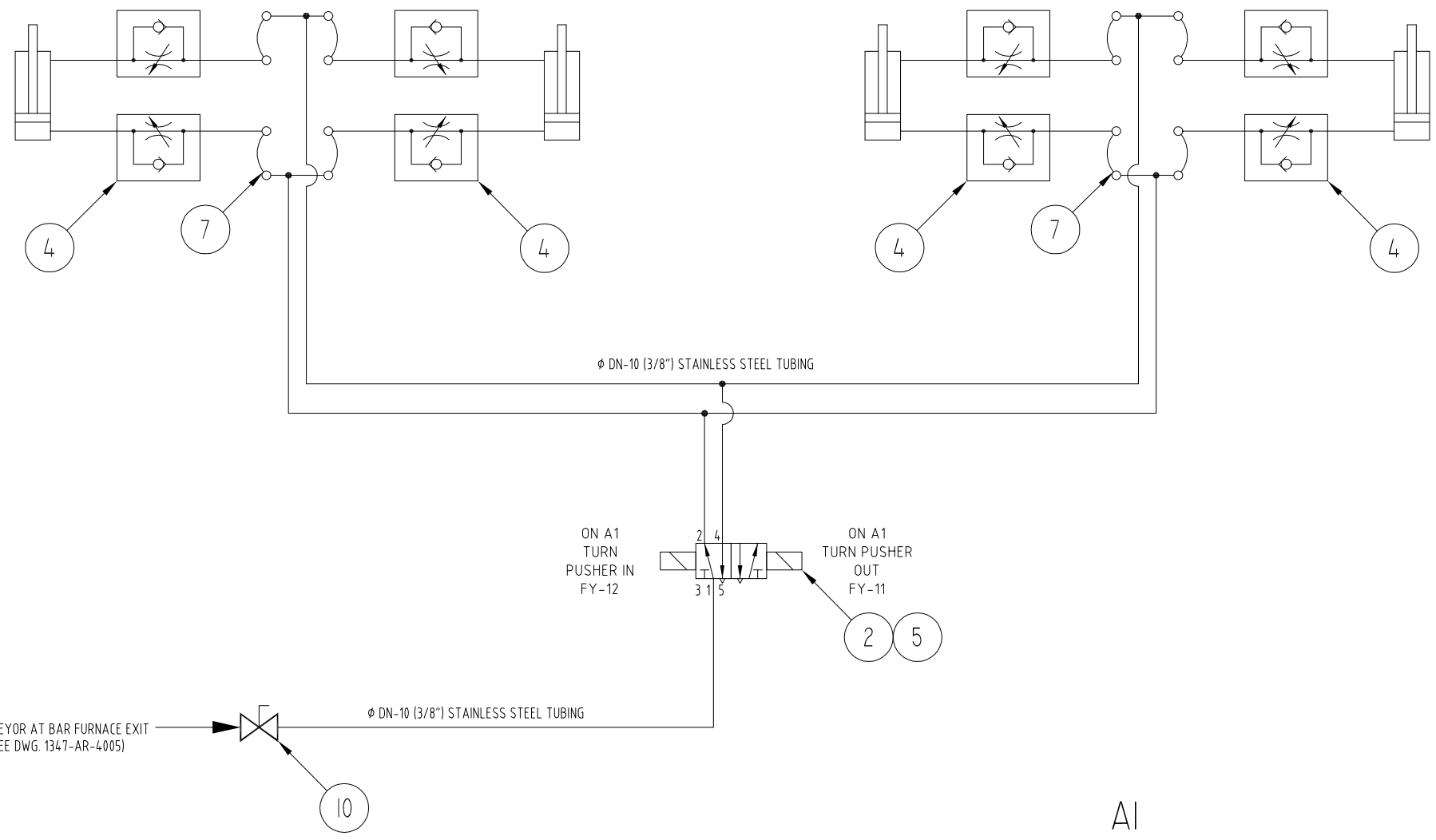
2	1		CONTROL VALVE # AL-4-1-533-BKN-53-00-A PARKER DN10 (3/8")	"BY GNA"	
			4/2, 5 PORTS, DOUBLE SOLENOID		
4	8		FLOW CONTROL VALVE # F600B PARKER DN10 (3/8")	"BY GNA"	
5	2		EXHAUST PORT MUFFLER # EM37 PARKER DN10 (3/8")	"BY GNA"	
6					
7	8		HI TEMP. PNEUMATIC HOSE (350°F), Ø1/2" X 460 mm LG (18")	"BY GNA"	
			3/8" NPT EACH ENDS	"BY GNA"	
8					
9					
10	1		BALL VALVE DN 10 (3/8") # B-XXXXSE-3/8 WATTS	"BY GNA"	

LEFT SIDE - STOPPER - BAR
CYL. BORE 4 " X ROD Ø1" STROKE 6"
(4CSB-2AUV19AC6)

RIGHT SIDE - STOPPER - BAR
CYL. BORE 4 " X ROD Ø1" STROKE 6"
(4CSB-2AUV19AC6)



AI
CATHODE BAR ALIGNMENT STATION
4481-MQLK-0001

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SELLER DRAWING No. 1347-AR-4006 | REV. 0

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REFERENCES | REVISIONS

NOTES

STATUS: FOR DESIGN

DRAWN/DES'D:	C.C.	AREA ENG.:	
DATE:	SE.29.'10	DATE:	
CHECKED:	--	PRJ ENG MGR:	
DATE:	---	DATE:	
RESPONSIBLE ENG.	--	CLIENT:	
DATE:	---	DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NTS
DATE:			

Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie / Engineering Department — 1600, rue Nicholas-Appert, Québec (Québec) G1N 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No | SUBD. | DISC. | SECTOR | SEQUENCE | REV.
25457-00AZ- xx - xxxx - xxxx - xxx - xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
A1 CATHODE BAR ALIGNMENT STATION
PNEUMATIC DIAGRAM

MA'ADEN معادن

Type | Building | Discipline | Phase | Format | Sequential | Location | Rev. No.
— — — — A3— —AZ

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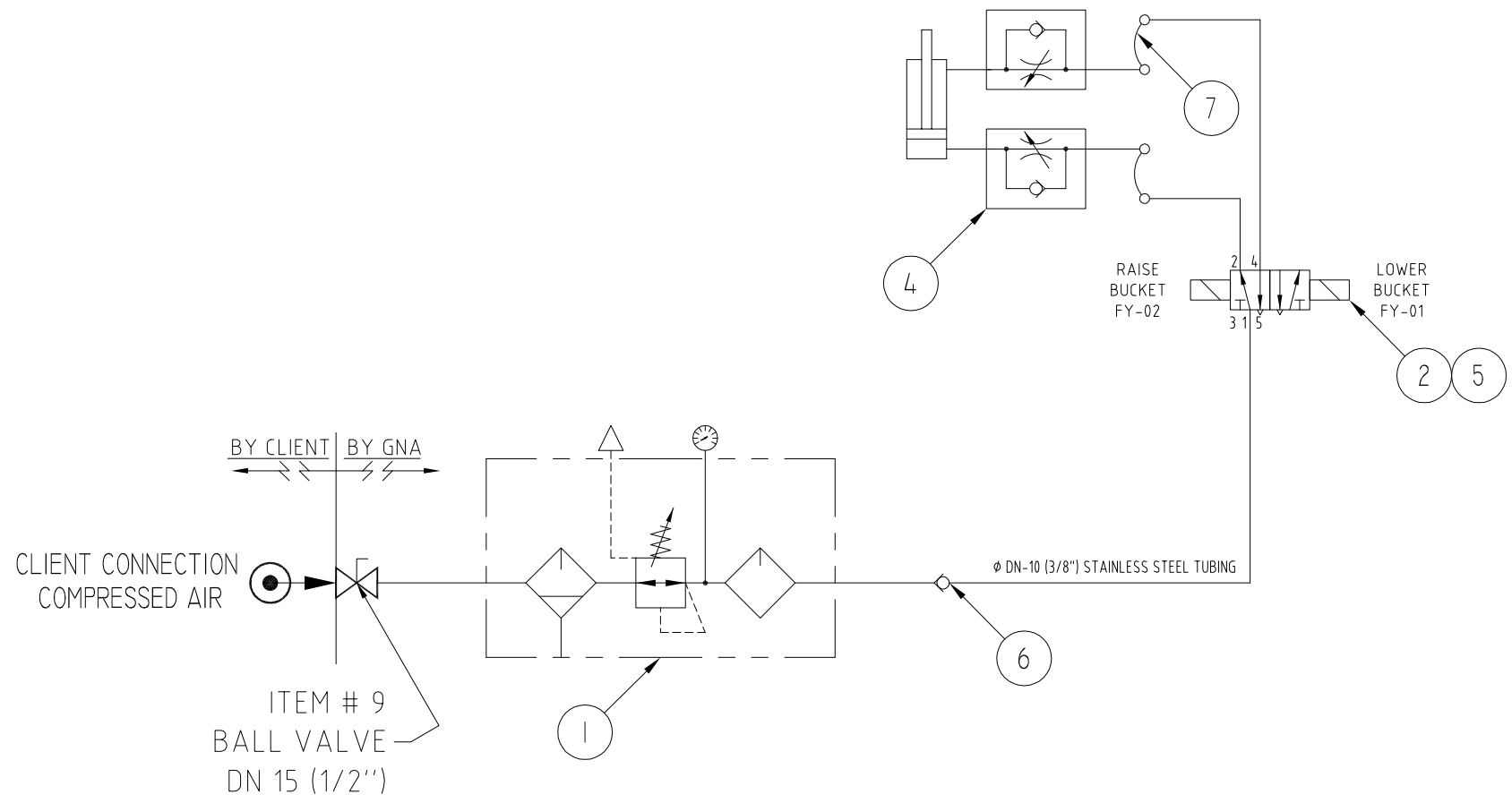
LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/QTY	No. PIECE-MAT. MAT.-PART NO.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
1	1		F.R.L. UNIT # 16A-2-6-A-18-A-2-B PARKER DN 10 (3/8") NPT	"BY GNA"	
2	1		CONTROL VALVE # AL-4-1-533-BKN-53-00-A PARKER DN10 (3/8")	"BY GNA"	
			4/2, 5 PORTS, DOUBLE SOLENOID		
4	2		FLOW CONTROL VALVE # F600B PARKER DN10 (3/8")	"BY GNA"	
5	2		EXHAUST PORT MUFFLER # EM37 PARKER DN10 (3/8")	"BY GNA"	
6	1		CHECK VALVE # C600B PARKER DN 10 (3/8")	"BY GNA"	
7	2		HI TEMP. PNEUMATIC HOSE (350°F), Ø1/2" X 460 mm LG (18")	"BY GNA"	
			3/8" NPT EACH ENDS	"BY GNA"	
8					
9	1		BALL VALVE DN 10 (3/8") # B-6400SE-3/8 WATTS	"BY GNA"	

TILT BUCKET SUPPORT

CYL. BORE 8" x ROD 1-3/8" x STROKE 18"
(8CSB-2AUVS19AC18)



F4A
CAST IRON INGOT DRYING STATION A
4481-MEVD-0001
(TILT BUCKET SUPPORT)

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3 ☐ Revise & Resubmit. Work may NOT proceed.
4 ☐ Revise not required. Work may proceed.
5 ☐ VOID / Superseded.

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Discipline :

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DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		REVISIONS						
		0		FIRST ISSUE	SE.28.2010	C.C.	M.B.	C.C.

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DATE:			

Vendor or Subcontractor Logo: GNA a&i tech Inc. — Département Ingénierie Engineering Department 9695 Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
F4A CAST IRON INGOT DRYING STATION A
PNEUMATIC DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
—	—	—		A3-		-AZ	

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LISTE DE MATERIELS/BILL OF MATERIALS

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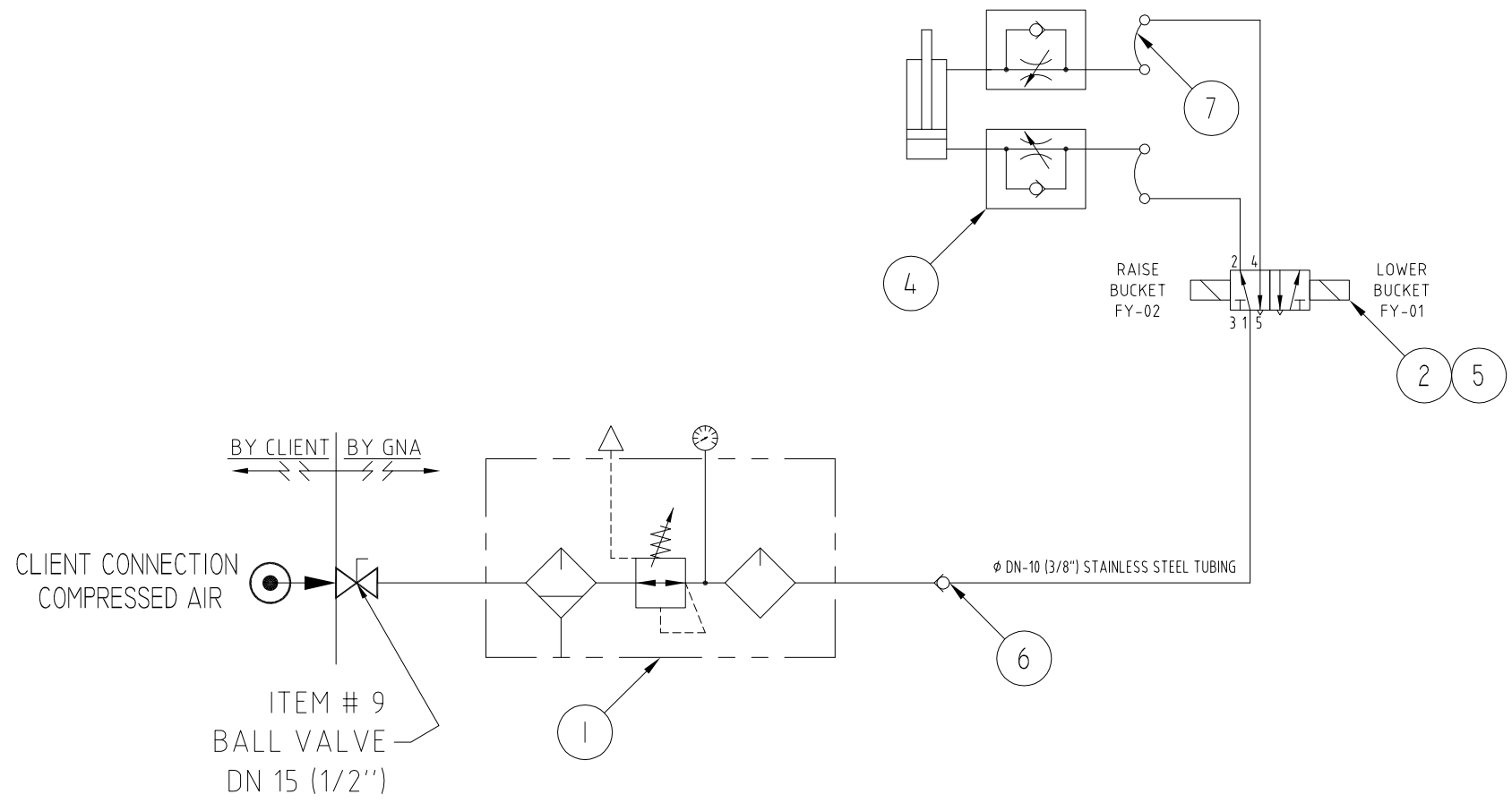
2	1		CONTROL VALVE # AL-4-1-533-BKN-53-00-A PARKER DN10 (3/8")	"BY GNA"	
			4/2, 5 PORTS, DOUBLE SOLENOID		
4	2		FLOW CONTROL VALVE # F600B PARKER DN10 (3/8")	"BY GNA"	
5	2		EXHAUST PORT MUFFLER # EM37 PARKER DN10 (3/8")	"BY GNA"	
6	1		CHECK VALVE # C600B PARKER DN 10 (3/8")	"BY GNA"	
7	2		HI TEMP. PNEUMATIC HOSE (350°F), Ø11/2" X 460 mm LG (18")	"BY GNA"	
			3/8" NPT EACH ENDS	"BY GNA"	
8					
9	1		BALL VALVE DN 10 (3/8") # B-6400SE-3/8 WATTS	"BY GNA"	

TILT BUCKET SUPPORT

CYL. BORE 8" x ROD 1-3/8" x STROKE 18"
(8CSB-2AUVS19AC18)



F4B
CAST IRON INGOT DRYING STATION B
4481-MEVD-0002
(TILT BUCKET SUPPORT)

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Discipline :

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DATE:			

Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie / Engineering Department, 9692 Trans-Canada, Saint-Laurent, Québec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
F4B CAST IRON INGOT DRYING STATION B
PNEUMATIC DIAGRAM

MA'ADEN

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
—	—	—		A3-		-AZ	

9.6 Cable Block Diagrams

DRAWING No.	DESCRIPTION
1347-50250	Chain Conveyor C2 and Roller Conveyor R9 - Cable Block Diagram
1347-50260	Cathode Bar Shotblasting Machine S1 - 1 of 2 - Cable Block Diagram
1347-50261	Cathode Bar Shotblasting Machine S1 - 2 of 2 - Cable Block Diagram
1347-50262	Dust collector for Shotblasting Machine D1 - Cable Block Diagram
1347-50270	Conical Roller Conveyor R8, Chain Conveyor C3 and Roller Conveyor R7 - Cable Block Diagram
1347-50280	Cathode Bar Heating Furnace F2 - 1 of 3 - Cable Block Diagram
1347-50281	Cathode Bar Heating Furnace F2 - 2 of 3- Cable Block Diagram
1347-50282	Cathode Bar Heating Furnace F2 - 3 of 3- Cable Block Diagram
1347-50290	Roller Conveyor at Bar Furnace Exit R6 - Cable Block Diagram
1347-50300	Positioning Gantry for Block and Bars G1 - Cable Block Diagram
1347-50310	Chain Conveyor of Block Oven C1 and Cathode Block Oven F1 - 1 of 2 - Cable Block Diagram
1347-50311	Cathode Block Oven F1 -2 of 2 - Cable Block Diagram
1347-50320	Roller Conveyor at Block Oven Exit R1 - Cable Block Diagram
1347-50330	Roller Conveyor for Block and Bar Assembly R2 - Cable Block Diagram
1347-50340	Prestressing and Sealing Station Conveyor at R4A - Cable Block Diagram
1347-50350	Prestressing and Sealing Station Conveyor B R4B - Cable Block Diagram
1347-50360	Cooling and Turning Station T1 and Roller conveyor R3 and R5 - Cable Block Diagram
1347-50370	Chain Conveyor for Sealed Cathode C4 - Cable Block Diagram
1347-50380	Hydraulic Power Unit H1 - Cable Block Diagram
1347-50390	Chiller for Hydraulic Power Unit W1 - Cable Block Diagram
1347-50400	Ladle Pre-Heating Station F3A - Cable Block Diagram
1347-50410	Cast Iron Ingot Drying Station F4 A- Cable Block Diagram
1347-50420	Cast Iron Ingot Drying Station F4B - Cable Block Diagram
1347-50430	Ladle Pre-Heating Station F3B - Cable Block Diagram

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CATHODE SEALING EQUIPEMENT (1347)
C2 CHAIN CONVEYOR UPSTREAM OF SHOTBLASTING MACHINE (24 BARS) 4481-MHCD-0002
R9 CONICAL ROLLER CONVEYOR AT SHOTBLASTING MACHINE ENTRANCE 4481-MJR0-0001

4481-MHCD-0003 CP-01
FLEX I/O
LOCAL CONTROL PANEL

4481-MHCD-0002-CP-01-J1 (26C x 1,5mm2) +G — 24Vdc

4481-CP-1000
PLC PANEL
PROGRAMMABLE CONTROLLER AND INPUT/OUTPUT

4481-MJR0-0001-M1-J1 (12C x 1,5mm2) — 24Vdc

4481-MHCD-0002-M1-J1 (12C x 1,5mm2) — 24Vdc

4480-ECM1-0001
MOTOR CONTROL CENTER PANEL

STARTER 4481-MJR0-0001 M1-ST

STARTER 4481-MHCD-0002 M1-ST

4481-MJR0-0001-M1-J2 (1P x 1,5mm2) — THERMISTOR
4481-MJR0-0001-M1-P1 (3C x 2,5mm2) +G — 460V/3Ø/60Hz
4481-MJR0-0001-M1-P3 (3C x 2,5mm2) +G — 230V/1Ø/60Hz
4481-MHCD-0002-LCS-01-J1 (7C x 1,5mm2) +G — 24Vdc
4481-MHCD-0002-M1-P1 (3C x 2,5mm2) +G — 460V/3Ø/60Hz
4481-MHCD-0002-LCS-01-J2 (8C x 1,5mm2) — 24Vdc

4481-MJR0-0001 M1-LDS
R9
CONICAL ROLLER CONVEYOR AT SHOTBLASTING MACHINE ENTRANCE
LOCAL DISCONNECT SWITCH

4481-MHCD-0002 M1-LDS
C2
CHAIN CONVEYOR UPSTREAM OF SHOTBLASTING MACHINE (24 BARS)
LOCAL DISCONNECT SWITCH

4481-MJR0-0001-M1-P2 (3C x 2,5mm2) +G — 460V/3Ø/60Hz
4481-MJR0-0001-M1-P4 (2C x 2,5mm2) +G — 230V/1Ø/60Hz
4481-MJR0-0001-M1-LDS-J1 (4C x 1,5mm2) — 24Vdc
4481-MHCD-0002-M1-P2 (3C x 2,5mm2) +G — 460V/3Ø/60Hz
4481-MHCD-0002-M1-LDS-J1 (4C x 1,5mm2) — 24Vdc

THERM.
M
R9
CONICAL ROLLER CONVEYOR AT SHOTBLASTING MACHINE ENTRANCE
MOTOR
4481-MJR0-0001-M1
0,37 KW
FAN
44 W

C2
CHAIN CONVEYOR UPSTREAM OF SHOTBLASTING MACHINE (24 BARS)
MOTOR
4481-MHCD-0002-M1
1,1 KW

4481-MHCD-0002 LCS-01
C2
STOP PUSH BUTTON REMOTE / OFF / JOG SELECTOR
R9
STOP PUSH BUTTON REMOTE / OFF / JOG SELECTOR
LOCAL CONTROL STATION

3

4481-MHCD-0002 CP-03
ACCESS REQUEST
ACCESS REQUEST RESET
LOCAL CONTROL PANEL

4481-MHCD-0002-CP-03-J1 (7C x 1,5mm2) +G — 24Vdc

4481-MHCD-0002 CP-01
EMERGENCY STOP
ACCESS / LIGHT (GREEN) RESET
SOLENOID RELEASE UNIT WITH MAIN SAFETY KEY
C2
CHAIN CONVEYOR UPSTREAM OF SHOTBLASTING MACHINE (24 BARS)
R9
CONICAL ROLLER CONVEYOR AT SHOTBLASTING MACHINE ENTRANCE
LOCAL CONTROL PANEL

4481-MHCD-0002-JB01-J1 (4C x 1,5mm2) — 24Vdc

4481-MHCD-0002 JB-01
C2 CONVEYOR PRESENCE SENSING ON C2 MATGUARD
JUNCTION BOX

4481-MHCD-0002-HSS-03
MATGUARD #1
MATGUARD #2
MATGUARD #3
MATGUARD #4
MATGUARD #5
MATGUARD #6
MATGUARD #7
MATGUARD #8

4481-MHCD-0002-HA01-J1 (3C x 1,5mm2) +G — 24Vdc

4481-MHCD-0002-HA-01
C2 CONVEYOR MOTION WARNING HORN

4481-MHCD-0002-HL-01
C2 CONVEYOR MOTION WARNING LIGHT

4481-MJR0-0001-ZS01-J1 (2C x 1,5mm2) — 24Vdc
4481-MJR0-0001-ZS02-J1 (2C x 1,5mm2) — 24Vdc
4481-MJR0-0001-ZS03-J1 (2C x 1,5mm2) — 24Vdc
4481-MJR0-0001-ZS04-J1 (2C x 1,5mm2) +G — 24Vdc

4481-MJR0-0001-ZS-01
R9 CONVEYOR BAR ON R9 CONVEYOR PROXIMITY SWITCH

4481-MJR0-0001-ZS-02
R9 CONVEYOR CONVEYOR UP PROXIMITY SWITCH

4481-MJR0-0001-ZS-03
R9 CONVEYOR CONVEYOR DOWN PROXIMITY SWITCH

4481-MJR0-0001-ZS-04
R9 CONVEYOR VALVE HYD OFF LIMIT SWITCH

4481-MJR0-0001-FY01-J1 (2C x 1,5mm2) +G — 24Vdc
4481-MJR0-0001-FY02-J1 (2C x 1,5mm2) +G — 24Vdc

4481-MJR0-0001-FY-01
R9 CONVEYOR RAISE SOLENOID VALVE (HYD.)

4481-MJR0-0001-FY-02
R9 CONVEYOR LOWER SOLENOID VALVE (HYD.)

4481-MHCD-0002-CP02-J1 (2C x 1,5mm2) +G — 24Vdc

4481-MHCD-0002 CP-02
EMERGENCY STOP LOCATED ON C2 INLET
LOCAL CONTROL PANEL

4481-MHCD-0002-CP01-J2 (9C x 1,5mm2) — 24Vdc

NOTE:
4481-XXXX-XXX-XXX-XX (XXC x XXmm2) +G — CABLE NUMBER
* WIRING BY GNA

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SELLER DRAWING No. 1347-50250 — REV. 3

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REFERENCES		3		ADD LOCAL CONTROL PANEL	15/08/2011	F.P.	T.Pa.	M.B.
		2		UPDATE	06/05/2011	E.B.	T.Pa.	M.B.
		1		UPDATE	22/11/2010	F.P.	T.Pa.	M.B.
		REVISIONS						

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DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA altech Inc. Département Ingénierie Engineering Department 9600, Trans-Canada Saint-Laurent, Quebec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CHAIN CONV. UPSTREAM C2 & C. ROLLER CONV. AT SHOTB. M. ENTRANCE R9
CABLE BLOCK DIAGRAM

MA'ADEN ALCOA

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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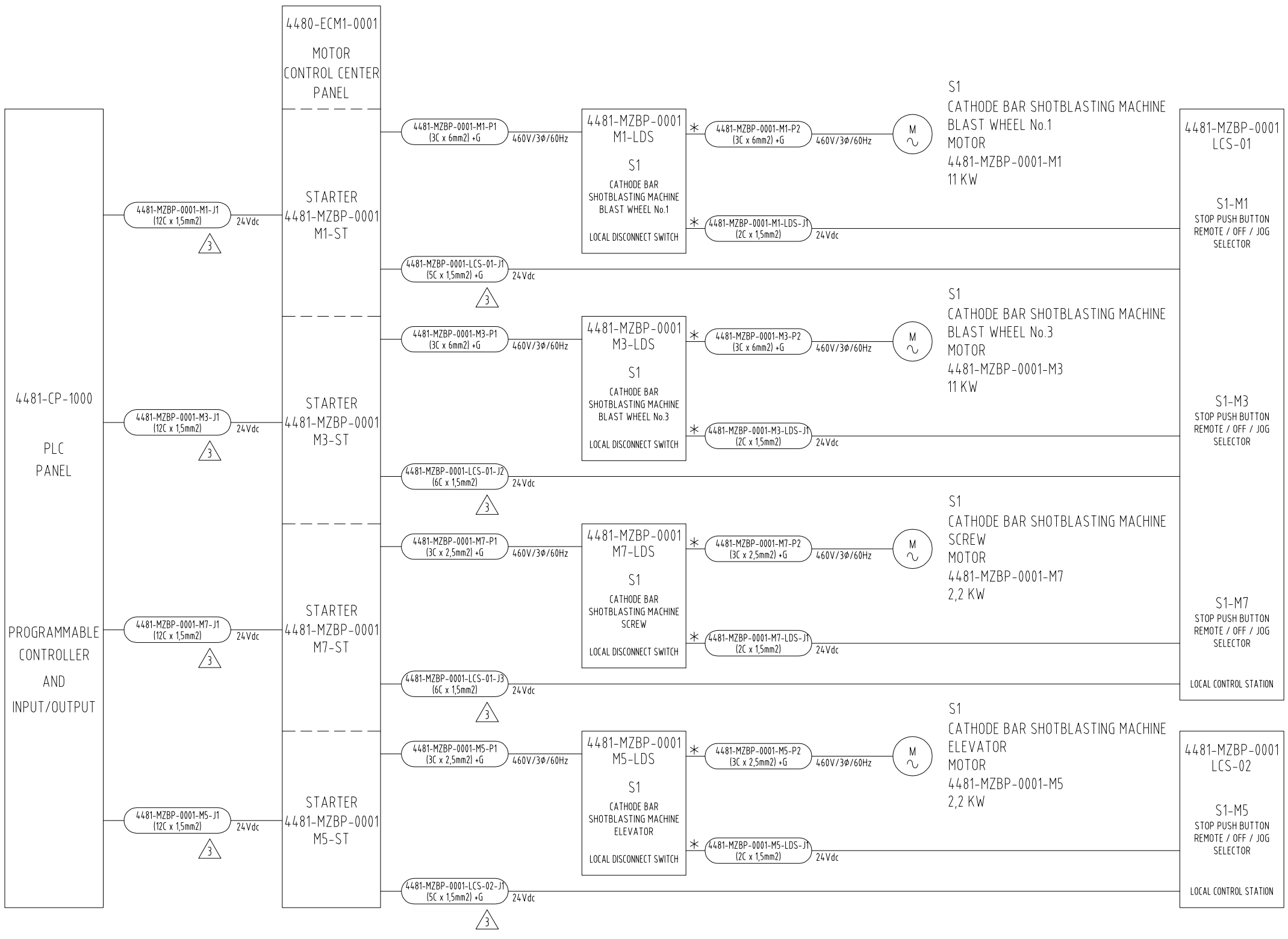
CATHODE SEALING EQUIPEMENT (1347)
S1 CATHODE BAR SHOTBLASTING MACHINE (1/2) 4481-MZBP-0001



NOTE:

4481-XXXX-XXX-XXX-XX (XXC x XXmm2) +G — CABLE NUMBER WIRING BY GNA

*

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Discipline :

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REFERENCES		3		UPDATE	09/05/2011	E.B.	T.Pa.	M.B.
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		1		UPDATE	22/11/2010	F.P.	T.Pa.	M.B.
		REVISIONS						

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DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA s&j-tech Inc. — Département Ingénierie / Engineering Department, 9450 Trans-Canada, Saint-Laurent, Québec, H4S 1V3, Canada

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CATHODE BAR SHOTBLASTING MACHINE S1 (1/2)
CABLE BLOCK DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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CATHODE SEALING EQUIPEMENT (1347)

S1 CATHODE BAR SHOTBLASTING MACHINE (2/2) 4481-MZBP-0001

4481-MHCD-0003
CP-01
FLEX I/O
LOCAL CONTROL PANEL

4481-MZBP-0001-JB-01-J1
(19C x 1,5mm2) +G
24Vdc
3

4481-MZBP-0001
JB-01
S1
CATHODE BAR
SHOTBLASTING MACHINE
JUNCTION BOX

4481-MZBP-0001-JB02-J1
(2C x 1,5mm2) +G
24Vdc

4481-MZBP-0001-ZS01-J1
(2C x 1,5mm2)
24Vdc
4481-MZBP-0001-ZS-01
PART DETECT
AT ENTRANCE
PROXIMITY SWITCH

4481-MZBP-0001-ZS02-J1
(2C x 1,5mm2) +G
24Vdc
4481-MZBP-0001-ZS-02
DOOR 1
CLOSED
LIMIT SWITCH

4481-MZBP-0001-ZS03-J1
(2C x 1,5mm2) +G
24Vdc
4481-MZBP-0001-ZS-03
DOOR 2
CLOSED
LIMIT SWITCH

4481-MZBP-0001-FY01-J1
(5C x 1,5mm2) +G
24Vdc

4481-MZBP-0001-FY06-J1
(2C x 1,5mm2) +G
24Vdc
4481-MZBP-0001-FY-06
BLOW-OFF NOZZLE
CONTROL
SOLENOID VALVE (PN)

4481-MZBP-0001
JB-02
S1
CATHODE BAR
SHOTBLASTING MACHINE
HOPPER LEVEL
JUNCTION BOX

4481-MZBP-0001-ZS04-J1
(3C x 1,5mm2)
24Vdc
4481-MZBP-0001-ZS-04
HOPPER
LEVEL
PROBE

4481-MZBP-0001-FY-01
BLAST WHEEL 1 ABRASIVE
4481-MZBP-0001-FY-02
BLAST WHEEL 2 ABRASIVE
4481-MZBP-0001-FY-03
BLAST WHEEL 3 ABRASIVE
4481-MZBP-0001-FY-04
BLAST WHEEL 4 ABRASIVE
4481-MZBP-0001-FY-05
ABRASIVE ADDER
CONTROL
SOLENOID VALVE (PN)
3

4481-CP-1000
PLC
PANEL
PROGRAMMABLE
CONTROLLER
AND
INPUT/OUTPUT

4480-ECM1-0001
MOTOR
CONTROL CENTER
PANEL

STARTER
4481-MZBP-0001
M2-ST

4481-MZBP-0001-M2-J1
(12C x 1,5mm2)
24Vdc
3

4481-MZBP-0001-M2-P1
(3C x 6mm2) +G
460V/3Ø/60Hz

4481-MZBP-0001
M2-LDS
S1
CATHODE BAR
SHOTBLASTING MACHINE
BLAST WHEEL No.2
LOCAL DISCONNECT SWITCH

4481-MZBP-0001-M2-P2
(3C x 6mm2) +G
460V/3Ø/60Hz
M

S1
CATHODE BAR SHOTBLASTING MACHINE
BLAST WHEEL No.2
MOTOR
4481-MZBP-0001-M2
11 KW

4481-MZBP-0001-M2-LDS-J1
(2C x 1,5mm2)
24Vdc

4481-MZBP-0001
LCS-03
S1-M2
STOP PUSH BUTTON
JOG / OFF / REMOTE
SELECTOR

4481-MZBP-0001-LCS-03-J1
(5C x 1,5mm2) +G
24Vdc
3

STARTER
4481-MZBP-0001
M4-ST

4481-MZBP-0001-M4-J1
(12C x 1,5mm2)
24Vdc
3

4481-MZBP-0001-M4-P1
(3C x 6mm2) +G
460V/3Ø/60Hz

4481-MZBP-0001
M4-LDS
S1
CATHODE BAR
SHOTBLASTING MACHINE
BLAST WHEEL No.4
LOCAL DISCONNECT SWITCH

4481-MZBP-0001-M4-P2
(3C x 6mm2) +G
460V/3Ø/60Hz
M

S1
CATHODE BAR SHOTBLASTING MACHINE
BLAST WHEEL No.4
MOTOR
4481-MZBP-0001-M4
11 KW

4481-MZBP-0001-M4-LDS-J1
(2C x 1,5mm2)
24Vdc

S1-M4
STOP PUSH BUTTON
JOG / OFF / REMOTE
SELECTOR

4481-MZBP-0001-LCS-03-J2
(6C x 1,5mm2)
24Vdc

STARTER
4481-MZBP-0001
M6-ST

4481-MZBP-0001-M6-J1
(12C x 1,5mm2)
24Vdc
3

4481-MZBP-0001-M6-J2
(1P x 1,5mm2)
THERMISTOR

4481-MZBP-0001-M6-P1
(3C x 2,5mm2) +G
460V/3Ø/60Hz

4481-MZBP-0001
M6-LDS
S1
CATHODE BAR
SHOTBLASTING MACHINE
WORK CONVEYOR
LOCAL DISCONNECT SWITCH

THERM.
4481-MZBP-0001-M6-P2
(3C x 2,5mm2) +G
460V/3Ø/60Hz
M

S1
CATHODE BAR SHOTBLASTING MACHINE
WORK CONVEYOR
MOTOR
4481-MZBP-0001-M6
0,37 KW

4481-MZBP-0001-M6-LDS-J1
(2C x 1,5mm2)
24Vdc

S1-M6
STOP PUSH BUTTON
JOG / OFF / REMOTE
SELECTOR

4481-MZBP-0001-LCS-03-J3
(6C x 1,5mm2)
24Vdc
3

LOCAL CONTROL STATION

NOTE:
4481-XXXX-XXX-XXX-XX
(XXC x XXmm2) +G
CABLE NUMBER
WIRING BY GNA

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Discipline :

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SELLER DRAWING No. 1347-50261 | REV. 3

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		2		UPDATE	09/05/2011	E.B.	T.Pa.	M.B.
		2		UPDATE	14/02/2011	E.B.	T.Pa.	M.B.
		1		UPDATE	22/11/2010	F.P.	T.Pa.	M.B.
		REVISIONS						

NOTES

STATUS: FOR DESIGN

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DATE:	28/07/2010	DATE:	
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DATE:		DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA a&i tech Inc. — Département Ingénierie / Engineering Department, 9650 TransCanada, Bâtiment, Québec, H8S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CATHODE BAR SHOTBLASTING MACHINE S1 (2/2)
CABLE BLOCK DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
—	—	—		A3-		-AZ	

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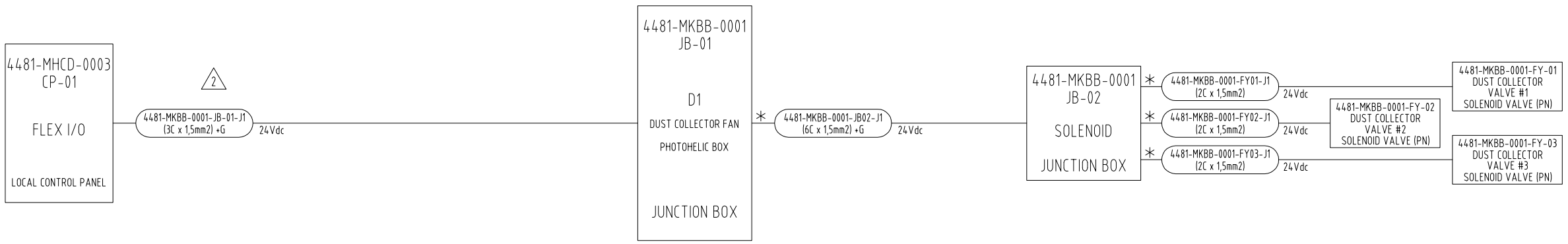
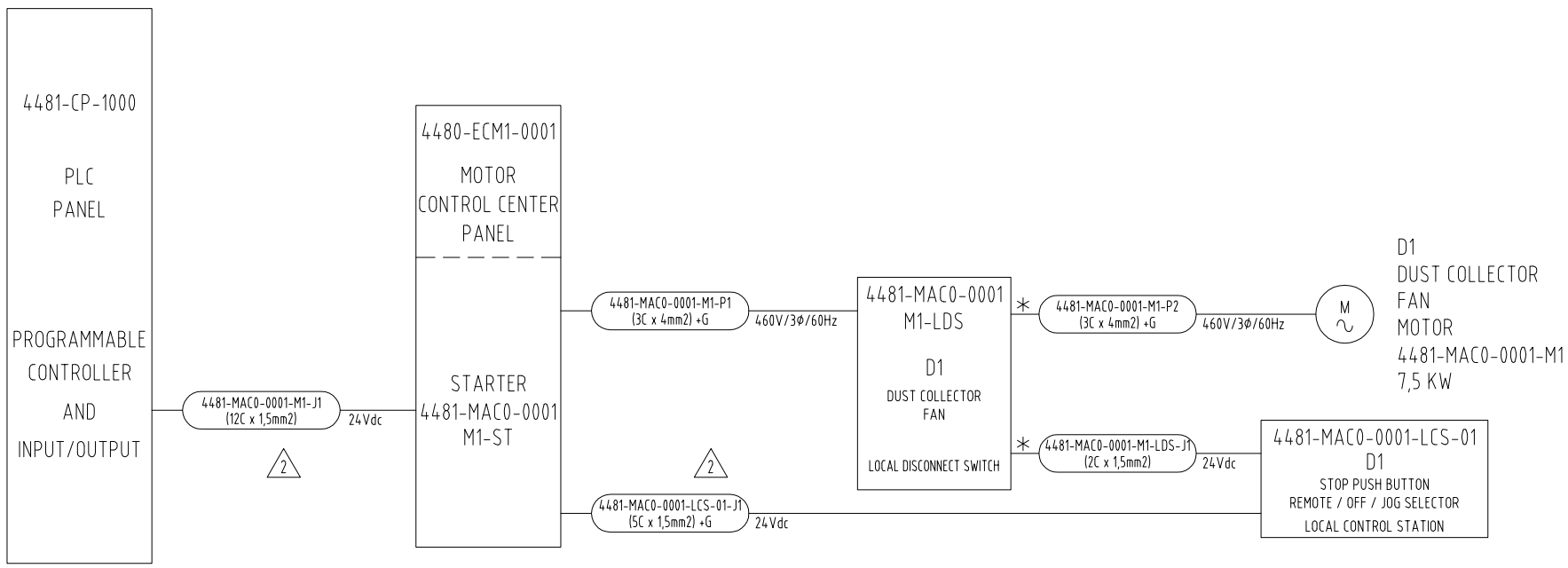
CATHODE SEALING EQUIPEMENT (1347)
D1 DUST COLLECTOR FOR SHOTBLASTING MACHINE 4481-MKBB-0001





NOTE:

4481-XXXX-XXX-XXX-XX (XXC x XXmm2) +G — CABLE NUMBER

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Discipline :

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SELLER DRAWING No. 1347-50262 | REV. 2

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		2		UPDATE	09/05/2011	E.B.	T.Pa.	M.B.
		1		UPDATE	22/11/2010	F.P.	T.Pa.	M.B.
		REVISIONS						

NOTES

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DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie / Engineering Department, 9600 Trans-Canada, Baie-d'Urfé, Québec, H9X 3T4, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DUST COLLECTOR FOR SHOTBLASTING MACHINE D1
CABLE BLOCK DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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CATHODE SEALING EQUIPEMENT (1347)
R8 CONICAL ROLLER CONVEYOR AT SHOTBLASTING MACHINE EXIT 4481-MJR0-0002
C3 CHAIN CONVEYOR BETWEEN SHOTBLASTING MACHINE AND OVEN 4481-MHCD-0003
R7 ROLLER CONVEYOR AT BAR FURNACE ENTRANCE 4481-MJR0-0003

4481-CP-1000
PLC PANEL
PROGRAMMABLE CONTROLLER AND INPUT/OUTPUT

4480-ECM1-0001
MOTOR CONTROL CENTER PANEL
DUISTRIBUTION PANEL BREAKER MCB9

STARTER 4481-MJR0-0002 M1-ST
STARTER 4481-MHCD-0003 M1-ST
STARTER 4481-MJR0-0003 M1-ST

4481-MHCD-0003-CP-01-J2 (6C x 1,5mm2) 24Vdc
4481-MJR0-0002-M1-J1 (12C x 1,5mm2) 24Vdc
4481-MHCD-0003-M1-J1 (12C x 1,5mm2) 24Vdc
4481-MJR0-0003-M1-J1 (12C x 1,5mm2) 24Vdc

4481-MQLK-0001 CP-01
FLEX I/O
LOCAL CONTROL PANEL

4481-MHCD-0003-CP-01-J1 ETHERNET COOPER — ETHERNET

4481-MHCD-0003-CP-01-P1 (3C x 2.5mm2) +G 230V/1Ø/60Hz

4481-MJR0-0002-M1-J2 (1P x 1,5mm2) THERMISTOR
4481-MJR0-0002-M1-P1 (3C x 2,5mm2) +G 460V/3Ø/60Hz
4481-MJR0-0002-M1-P3 (3C x 2,5mm2) +G 230V/1Ø/60Hz

4481-MJR0-0002 M1-LDS
R8 CONICAL ROLLER CONVEYOR AT SHOTBLASTING MACHINE EXIT
LOCAL DISCONNECT SWITCH

4481-MJR0-0002-M1-P2 (3C x 2,5mm2) +G 460V/3Ø/60Hz
4481-MJR0-0002-M1-P4 (2C x 2,5mm2) +G 230V/1Ø/60Hz
4481-MJR0-0002-M1-LDS-J1 (4C x 1,5mm2) 24Vdc

THERM.
M
R8
CONICAL ROLLER CONVEYOR AT SHOTBLASTING MACHINE EXIT
MOTOR
4481-MJR0-0002-M1
0,37 KW
FAN

4481-MHCD-0003-LCS-01-J1 (7C x 1,5mm2) +G 24Vdc
4481-MHCD-0003-M1-J2 (1P x 1,5mm2) THERMISTOR
4481-MHCD-0003-M1-P1 (3C x 2,5mm2) +G 460V/3Ø/60Hz

4481-MHCD-0003 M1-LDS
C3
CHAIN CONVEYOR BETWEEN SHOTBLASTING MACHINE AND OVEN
LOCAL DISCONNECT SWITCH

4481-MHCD-0003-M1-P2 (3C x 2,5mm2) +G 460V/3Ø/60Hz
4481-MHCD-0003-M1-LDS-J1 (4C x 1,5mm2) 24Vdc

THERM.
M
C3
CONV. BETWEEN SHOT BLASTING M. AND OVEN
MOTOR
4481-MHCD-0003-M1
0,75 KW

4481-MHCD-0003-LCS-01-J2 (8C x 1,5mm2) 24Vdc
4481-MJR0-0003-M1-P1 (3C x 2,5mm2) +G 460V/3Ø/60Hz

4481-MJR0-0003 M1-LDS
R7
ROLLER CONVEYOR AT BAR FURNACE ENTRANCE
LOCAL DISCONNECT SWITCH

4481-MJR0-0003-M1-P2 (3C x 2,5mm2) +G 460V/3Ø/60Hz
4481-MJR0-0003-M1-LDS-J1 (4C x 1,5mm2) 24Vdc

M
R7
ROLLER CONVEYAT BAR FURNACE ENTRANCE
MOTOR
4481-MJR0-0003-M1
0,75 KW

4481-MHCD-0003-LCS-01-J3 (8C x 1,5mm2) 24Vdc

4481-MHCD-0003 LCS-01

R8
STOP PUSH BUTTON REMOTE / OFF / JOG SELECTOR

C3
STOP PUSH BUTTON REMOTE / OFF / JOG SELECTOR

R7
STOP PUSH BUTTON REMOTE / OFF / JOG SELECTOR

LOCAL CONTROL STATION

4481-MHCD-0003 CP-01
EMERGENCY STOP ACCESS / LIGHT (GREEN) RESET
1
SOLENOID RELEASE UNIT WITH MAIN KEY
FLEX I/O
R8
CONICAL ROLLER CONVEYOR AT SHOTBLASTING MACHINE EXIT
C3
CHAIN CONVEYOR BETWEEN SHOTBLASTING CONVEYOR AND OVEN
R7
ROLLER CONVEYOR AT BAR FURNACE ENTRANCE
LOCAL CONTROL PANEL

4481-MJR0-0002-ZS01-J1 (2C x 1,5mm2) 24Vdc — 4481-MJR0-0002-ZS-01 R8 CONVEYOR BAR ON R8 CONVEYOR PROXIMITY SWITCH
4481-MJR0-0002-ZS02-J1 (2C x 1,5mm2) 24Vdc — 4481-MJR0-0002-ZS-02 R8 CONVEYOR CONVEYOR UP PROXIMITY SWITCH
4481-MJR0-0002-ZS03-J1 (2C x 1,5mm2) 24Vdc — 4481-MJR0-0002-ZS-03 R8 CONVEYOR CONVEYOR DOWN PROXIMITY SWITCH
4481-MHCD-0003-ZS04-J1 (2C x 1,5mm2) 24Vdc — 4481-MHCD-0003-ZS-04 C3 CONVEYOR BAR IN SECOND POSITION PROXIMITY SWITCH
4481-MHCD-0003-ZS05-J1 (2C x 1,5mm2) 24Vdc — 4481-MHCD-0003-ZS-05 C3 CONVEYOR BAR IN FOURTH POSITION PROXIMITY SWITCH
4481-MHCD-0003-ZS06-J1 (2C x 1,5mm2) 24Vdc — 4481-MHCD-0003-ZS-06 C3 CONVEYOR BAR IN LAST POSITION PROXIMITY SWITCH
4481-MJR0-0003-ZS07-J1 (2C x 1,5mm2) 24Vdc — 4481-MJR0-0003-ZS-07 R7 CONVEYOR CONVEYOR UP PROXIMITY SWITCH
4481-MJR0-0003-ZS08-J1 (2C x 1,5mm2) 24Vdc — 4481-MJR0-0003-ZS-08 R7 CONVEYOR CONVEYOR DOWN PROXIMITY SWITCH
4481-MJR0-0003-ZS09-J1 (2C x 1,5mm2) 24Vdc — 4481-MJR0-0003-ZS-09 R7 CONVEYOR BAR No.1 DETECTED PROXIMITY SWITCH
4481-MJR0-0003-ZS10-J1 (2C x 1,5mm2) 24Vdc — 4481-MJR0-0003-ZS-10 R7 CONVEYOR BAR No.2 DETECTED PROXIMITY SWITCH
4481-MJR0-0003-ZS11-J1 (2C x 1,5mm2) 24Vdc — 4481-MJR0-0003-ZS-11 R7 CONVEYOR BAR No.3 DETECTED PROXIMITY SWITCH
4481-MJR0-0003-ZS12-J1 (2C x 1,5mm2) 24Vdc — 4481-MJR0-0003-ZS-12 R7 CONVEYOR BAR No.4 DETECTED PROXIMITY SWITCH
4481-MJR0-0003-ZS13-J1 (2C x 1,5mm2) +G 24Vdc — 4481-MJR0-0003-ZS-13 R7, R8 CONVEYOR VALVE HYD OFF LIMIT SWITCH 1
4481-MJR0-0002-FY01-J1 (2C x 1,5mm2) +G 24Vdc — 4481-MJR0-0002-FY-01 R8 CONVEYOR RAISE SOLENOID VALVE (HYD.)
4481-MJR0-0002-FY02-J1 (2C x 1,5mm2) +G 24Vdc — 4481-MJR0-0002-FY-02 R8 CONVEYOR LOWER SOLENOID VALVE (HYD.)
4481-MJR0-0003-FY03-J1 (2C x 1,5mm2) +G 24Vdc — 4481-MJR0-0003-FY-03 R7 CONVEYOR RAISE SOLENOID VALVE (HYD.)
4481-MJR0-0003-FY04-J1 (2C x 1,5mm2) +G 24Vdc — 4481-MJR0-0003-FY-04 R7 CONVEYOR LOWER SOLENOID VALVE (HYD.)

4481-MHCD-0003-CP01-J3 (13C x 1.5mm2) 24Vdc

NOTE:
4481-XXXX-XXX-XXX-XX (XXC x XXmm2) +G — CABLE NUMBER
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DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		2		UPDATE	10/05/2011	E.B.	T.Pa.	M.B.
		1		UPDATE	22/11/2010	F.P.	T.Pa.	M.B.
		REVISIONS						

NOTES

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DATE:		DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie / Engineering Department, 1650 TransCanada, Saint-Laurent, Québec, H4S 1V3, Canada — BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CONICAL ROLLER CONV. R8 & CHAIN CONV. C3 & ROLLER CONV. R7
CABLE BLOCK DIAGRAM

MA'ADEN

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx –	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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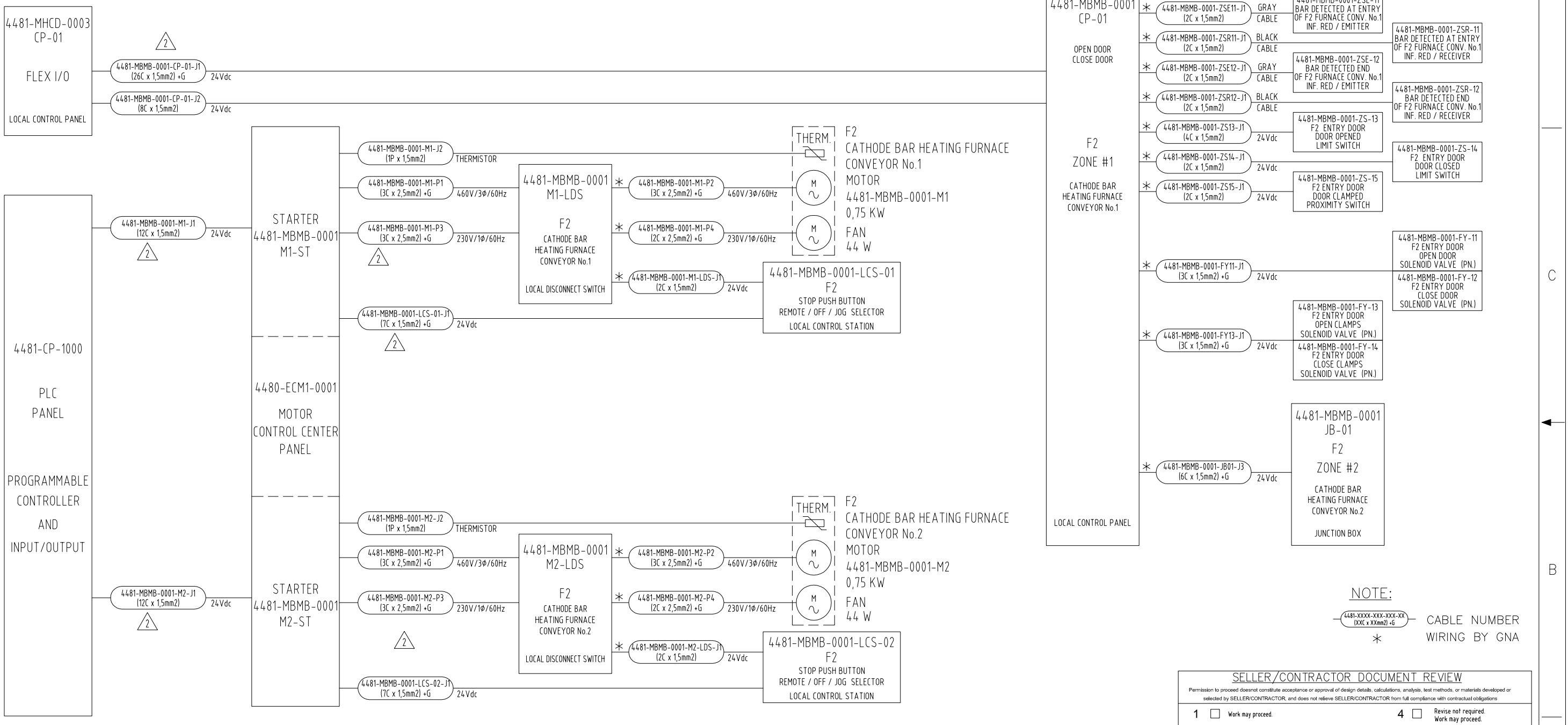
CATHODE SEALING EQUIPEMENT (1347)
F2 CATHODE BAR HEATING FURNACE (1/3) 4481-MBMB-0001



NOTE:

4481-XXXX-XXX-XXX-XX (XXC x XXmm2) +G — CABLE NUMBER

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SELLER DRAWING No. 1347-50280 | REV. 2

No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
2		UPDATE	10/05/2011	E.B.	T.Pa.	M.B.
1		CHANGE MBMP TO MBMB	22/11/2010	F.P.	T.Pa.	M.B.

DRAWING NUMBER | TITLE | REFERENCES | REVISIONS

NOTES

STATUS: FOR DESIGN

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DATE:		DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:		DATE:	
ENG. GROUP SUP. DATE:		DRAWING SCALE:	NONE

Vendor or Subcontractor Logo: GNA a.j.tech Inc. — Département Ingénierie / Engineering Department, 9690 TransCanada, Saint-Laurent, Québec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CATHODE BAR HEATING FURNACE F2 (1/3)
CABLE BLOCK DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
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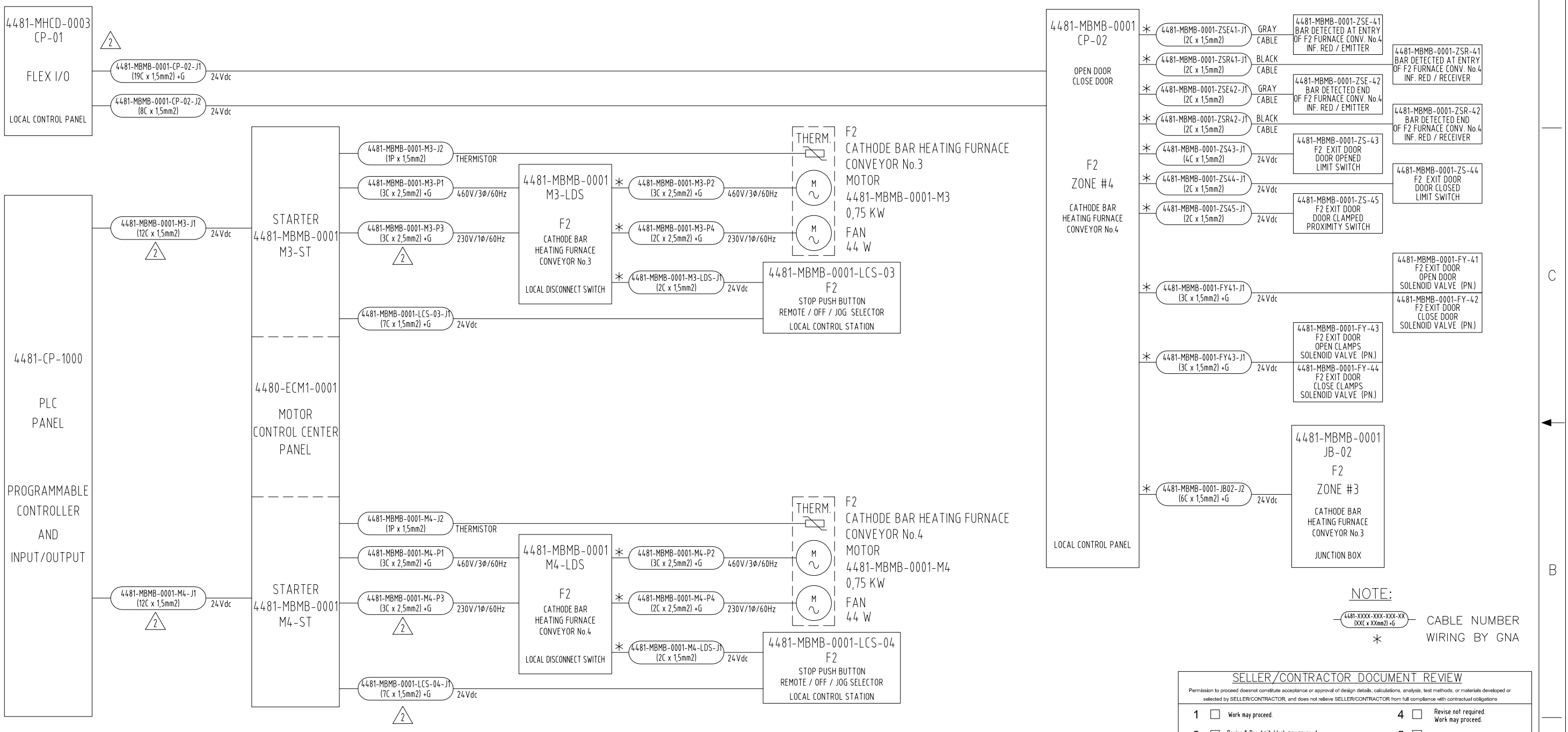
CATHODE SEALING EQUIPEMENT (1347)
F2 CATHODE BAR HEATING FURNACE (2/3) 4481-MBMB-0001



NOTE:

4481-XXXX-XXX-XXX-XX (XXC x XXmm2) +G — CABLE NUMBER

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SELLER DRAWING No. 1347-50281 | REV. 2

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		2		UPDATE	10/05/2011	E.B.	T.Pa.	M.B.
		1		CHANGE MBMP TO MBMB	22/11/2010	F.P.	T.Pa.	M.B.
		REVISIONS						

NOTES

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DATE:	28/07/2010	DATE:	
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DATE:		DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie / Engineering Department 1010, rue Nobel, Boîte postale / Box 1210 Saint-Laurent, Québec (H4S 1V3) Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CATHODE BAR HEATING FURNACE F2 (2/3)
CABLE BLOCK DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—	—	A3—		—AZ	

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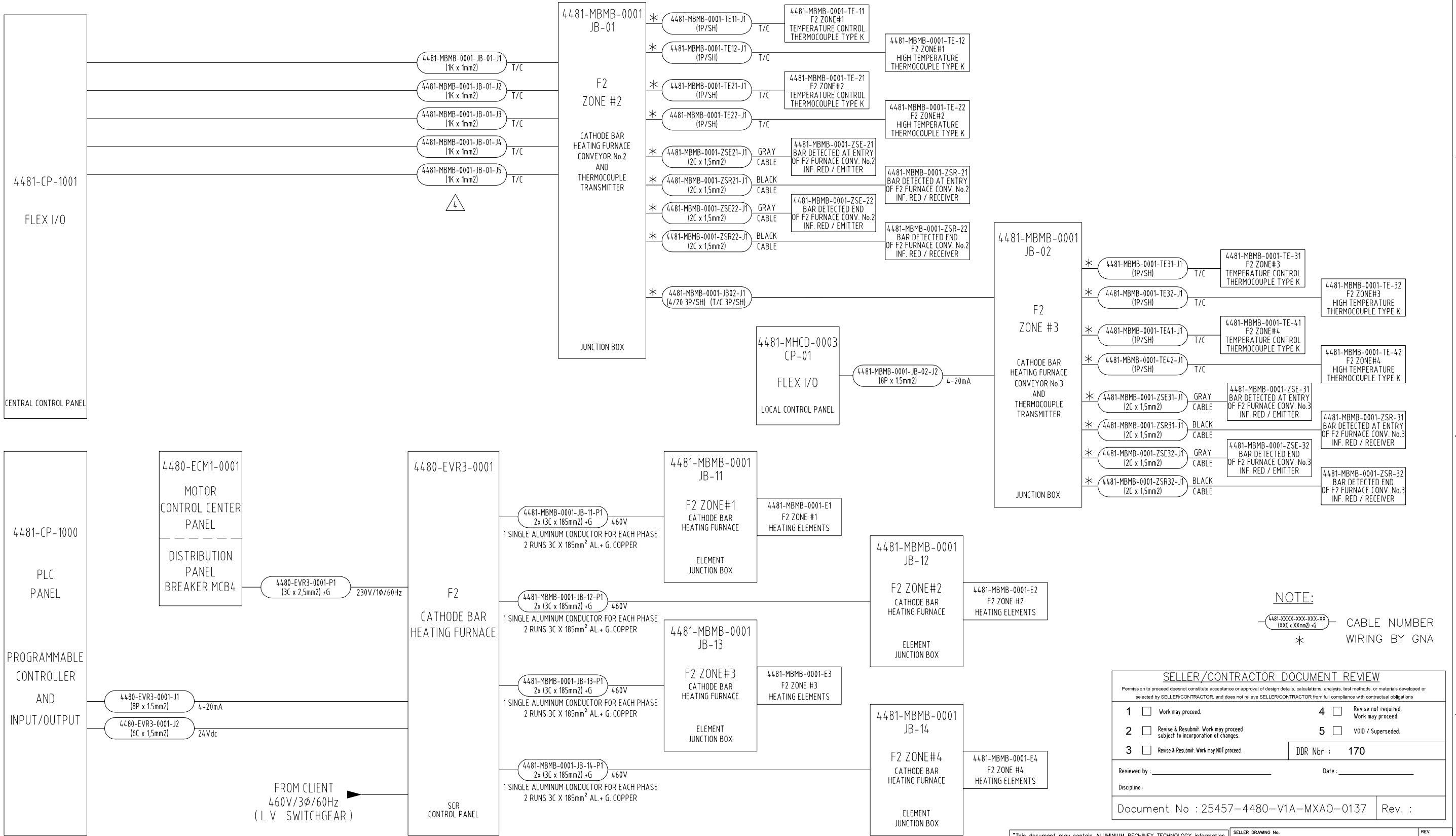
CATHODE SEALING EQUIPEMENT (1347)
F2 CATHODE BAR HEATING FURNACE (3/3) 4481-MBMB-0001



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2 ☐ Revise & Resubmit. Work may proceed subject to incorporation of changes.
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4 ☐ Revise not required. Work may proceed.
5 ☐ VOID / Superseded.

DDR Nbr : 170

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SELLER DRAWING No. 1347-50282 | REV. 4

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
		4		UPDATE	08/07/2011	F.P.	T.Pa.	M.B.
		3		UPDATE	10/05/2011	E.B.	T.Pa.	M.B.
		2		CHANGE MBMB-0001 TO EVR3-0001	12/02/2011	F.P.	T.Pa.	M.B.
		1		UPDATE & CHANGE MBMP TO MBMB	22/11/2010	F.P.	T.Pa.	M.B.

REFERENCES — REVISIONS

NOTES

STATUS: FOR DESIGN

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DATE:	28/07/2010	DATE:	
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DATE:		DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA a.i.tech Inc. — Département Ingénierie Engineering Department 1600 Trans-Canada Dorval (Québec) Québec H4S 1J7 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CATHODE BAR HEATING FURNACE F2 (3/3)
CABLE BLOCK DIAGRAM

MA'ADEN وعاد

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
—	—	—		A3-		-AZ	

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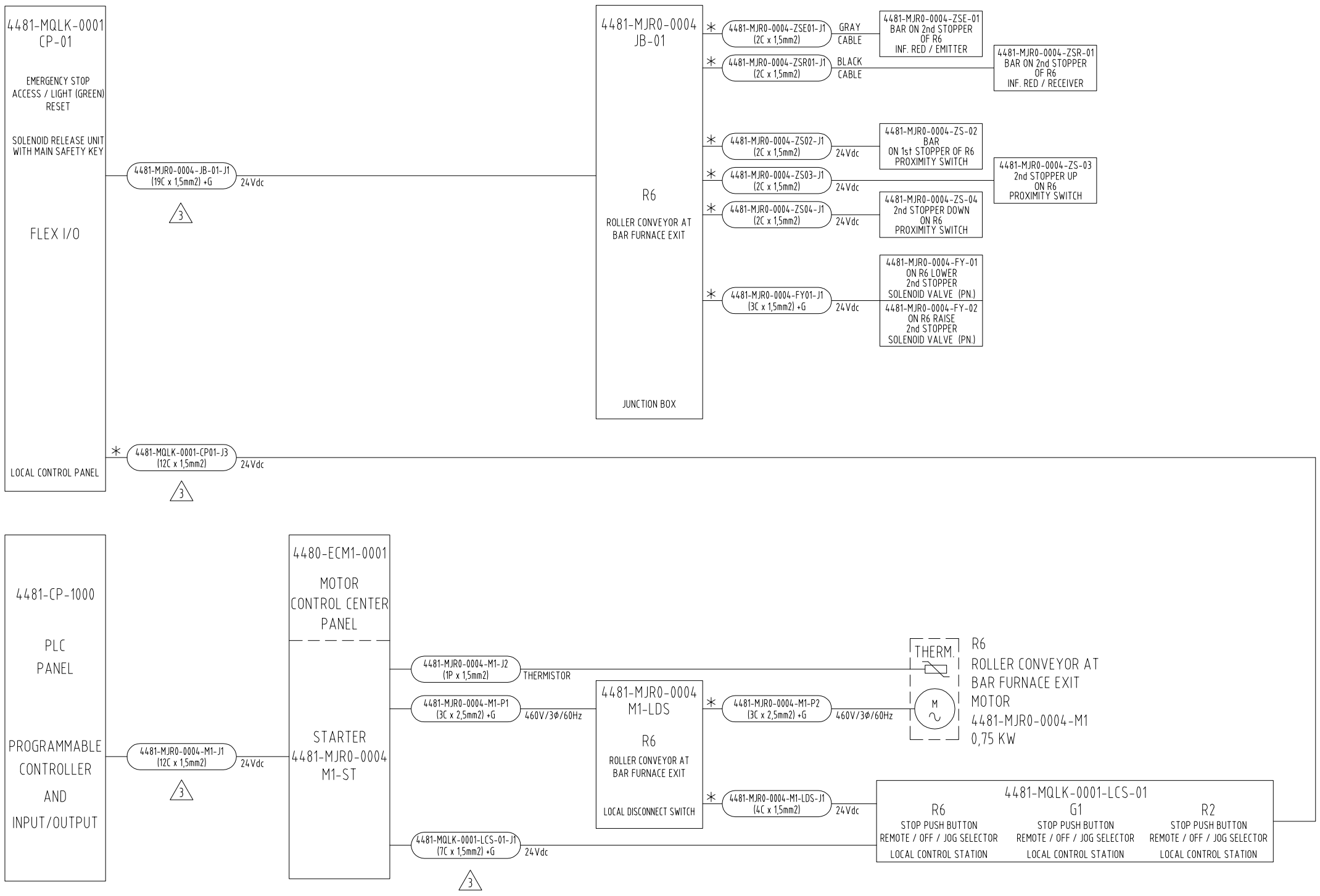
CATHODE SEALING EQUIPEMENT (1347)
R6 ROLLER CONVEYOR AT BAR FURNACE EXIT 4481-MJR0-0004



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2 ☐	Revise & Resubmit. Work may proceed subject to incorporation of changes.	5 ☐	VOID / Superseded.
3 ☐	Revise & Resubmit. Work may NOT proceed.	DDR Nbr :	170

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Discipline :

Document No : 25457-4480-V1A-MXA0-0138 | Rev. :

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SELLER DRAWING No. 1347-50290 | REV. 3

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
		3		UPDATE	09/05/2011	F.P.	T.Pa.	M.B.
		2		REMOVE FY-11 & FY-12	01/03/2011	F.P.	T.Pa.	M.B.
		1		UPDATE	22/11/2010	F.P.	T.Pa.	M.B.
REFERENCES		REVISIONS						

NOTES

STATUS: FOR DESIGN

DRAWN/DES'D:	F.P.	AREA ENG.:	
DATE:	28/07/10	DATE:	
CHECKED:	E.B.	PRJ ENG MGR:	
DATE:		DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie / Engineering Department — 1400, rue Jean-Baptiste-Deschamps, Saint-Laurent, Québec, Canada H4S 1V3

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

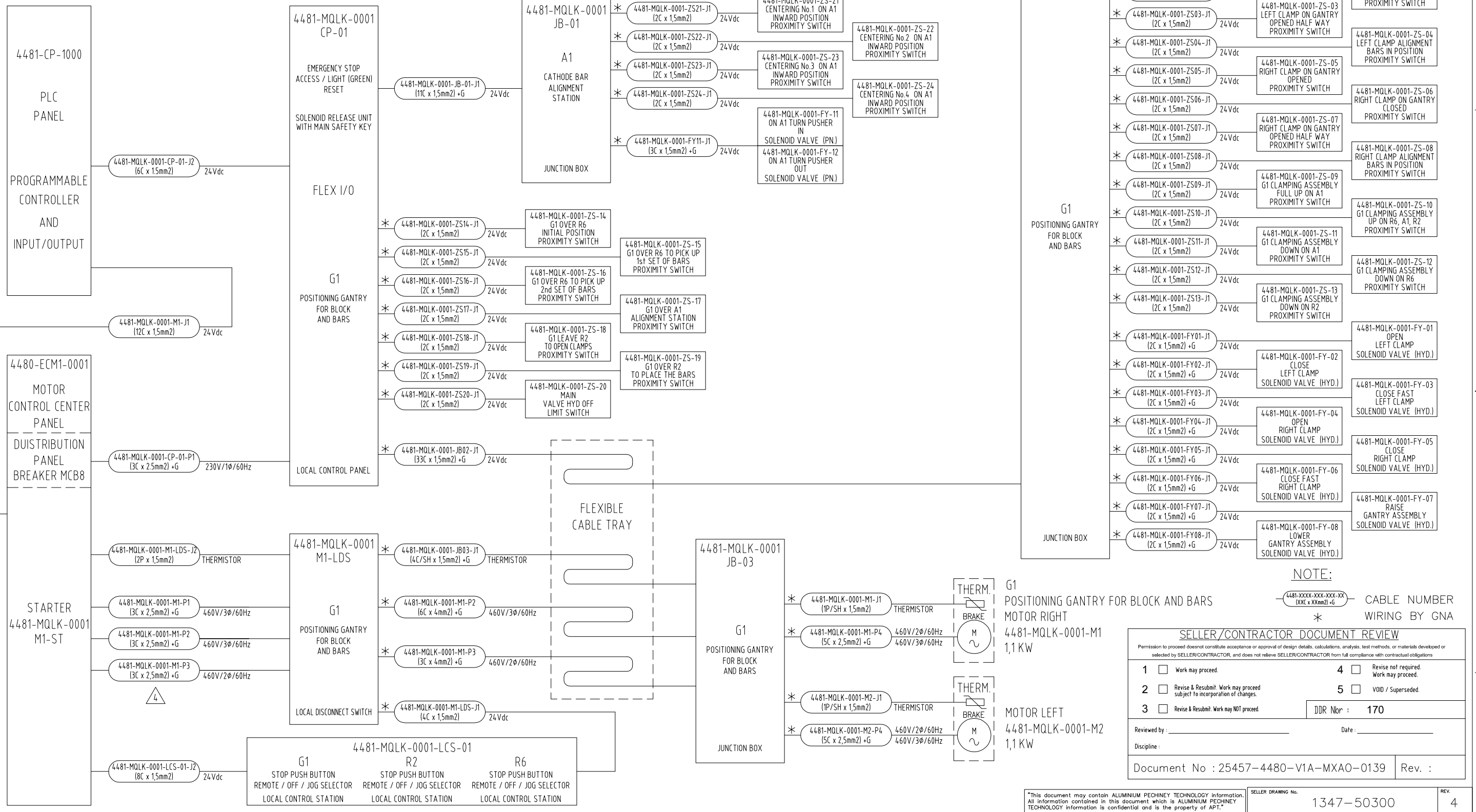
PROJ. No | SUBD. | DISC. | SECTOR | SEQUENCE | REV.
25457-00AZ- xx - xxxx - xxxx - xxx - xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
ROLLER CONVEYOR AT BAR FURNACE EXIT R6
CABLE BLOCK DIAGRAM

MA'ADEN معادن

Type | Building | Discipline | Phase | Format | Sequential | Location | Rev. No.
— | — — | — | A3- | -AZ

CATHODE SEALING EQUIPEMENT (1347)
G1 POSITIONING GANTRY FOR BLOCK AND BARS
INCLUDING CATHODE BAR ALIGNMENT STATION 4481-MQLK-0001



NOTE:

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2 ☐	Revise & Resubmit. Work may proceed subject to incorporation of changes.	5 ☐	VOID / Superseded.
3 ☐	Revise & Resubmit. Work may NOT proceed.	DDR Nbr :	170

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Discipline :

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No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
4		UPDATE	08/07/2011	F.P.	T.Pa.	M.B.
3		UPDATE	09/05/2011	F.P.	T.Pa.	M.B.
2		ADD FY-11 & FY-12	01/03/2011	F.P.	T.Pa.	M.B.
1		UPDATE	22/11/2010	F.P.	T.Pa.	M.B.

DRAWING NUMBER | TITLE | REFERENCES | REVISIONS

NOTES

STATUS: FOR DESIGN

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DATE:	28/07/10	DATE:	
CHECKED:	E.B.	PRJ ENG MGR:	
DATE:		DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA ais/tech Inc. — Département Ingénierie Engineering Department 9450 Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SELLER DRAWING No. 1347-50300 | REV. 4

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
POSITIONING GANTRY FOR BLOCK & BARS INCL. CATH. BAR ALIGN. STATION G1
CABLE BLOCK DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—		—	—	A3-		-AZ	

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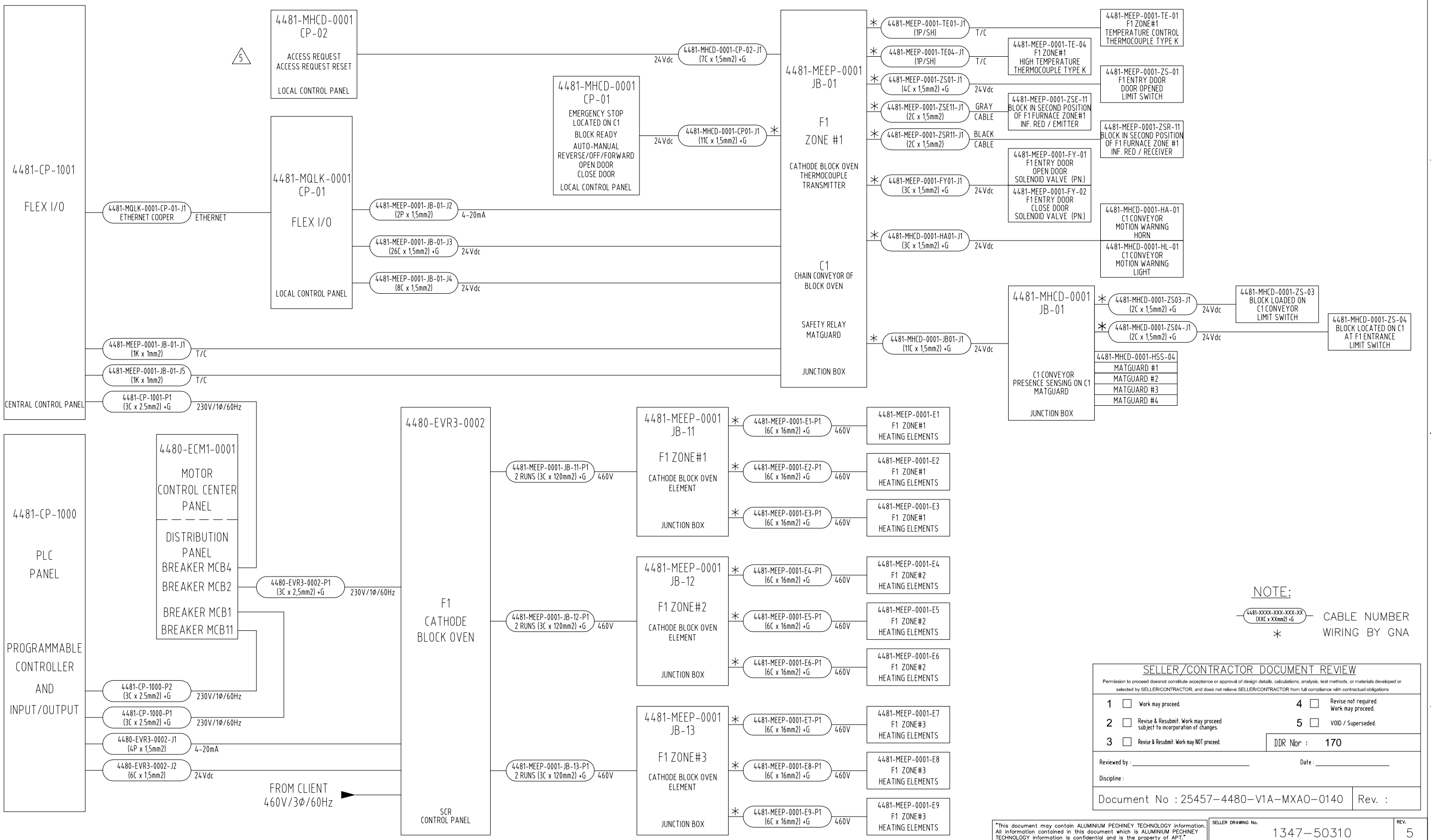
CATHODE SEALING EQUIPEMENT (1347)
C1 CHAIN CONVEYOR OF BLOCK OVEN (1/2) 4481-MHCD-0001
F1 CATHODE BLOCK OVEN (1/2) 4481-MEEP-0001



NOTE:

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SELLER/CONTRACTOR DOCUMENT REVIEW

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Discipline :

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SELLER DRAWING No. 1347-50310 | REV. 5

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
		5		ADD LOCAL CONTROL PANEL	15/08/2011	F.P.	T.Po.	M.B.
		4		UPDATE	08/07/2011	F.P.	T.Po.	M.B.
		3		UPDATE	09/05/2011	F.P.	T.Po.	M.B.
		2		CHANGE NAME OF F1 SCR CONTROL PANEL	01/03/2011	F.P.	T.Po.	M.B.
		1		UPDATE	22/11/2010	F.P.	T.Po.	M.B.
REFERENCES		REVISIONS						

NOTES

STATUS: FOR DESIGN

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DATE:	28/07/2010	DATE:	
CHECKED:	E.B.	PRJ ENG MGR:	
DATE:		DATE:	
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DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA ellutech Inc. — Département Ingénierie, Engineering Department, 9450 Trans-Canada, Saint-Laurent, Quebec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

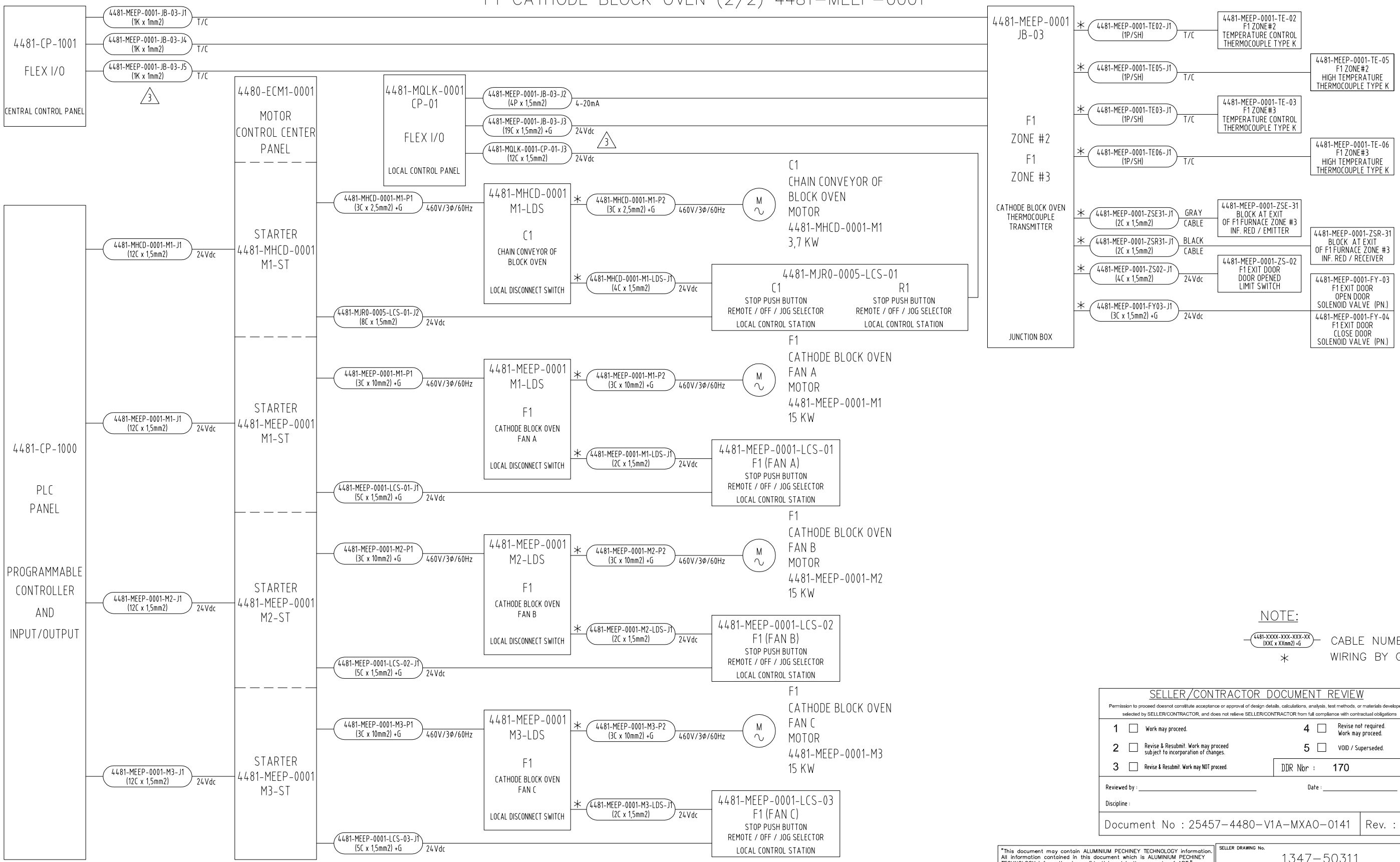
SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CHAIN CONV. OF BLOCK OVEN C1 & CATHODE BLOCK OVEN F1 (1/2)
CABLE BLOCK DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
—	—	—		A3-		-AZ	

CATHODE SEALING EQUIPEMENT (1347)
C1 CHAIN CONVEYOR OF BLOCK OVEN (2/2) 4481-MHCD-0001
F1 CATHODE BLOCK OVEN (2/2) 4481-MEEP-0001



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		3		UPDATE	08/07/2011	F.P.	T.Pa.	M.B.
		2		UPDATE	09/05/2011	F.P.	T.Pa.	M.B.
		1		UPDATE	22/11/2010	F.P.	T.Pa.	M.B.
REFERENCES		REVISIONS						

NOTES

STATUS: FOR DESIGN

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SELLER DRAWING No. 1347-50311 REV. 3

Vendor or Subcontractor Logo: GNA a&i tech Inc. — Département Ingénierie Engineering Department 9600 Trans-Canada Baie-d'Urfé, Québec Canada

BECHTEL

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CATHODE BLOCK OVEN F1 (2/2)
CABLE BLOCK DIAGRAM

Project Title: Ras Az Zawr Aluminium Smelter

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
—	—	—		A3-		-AZ	

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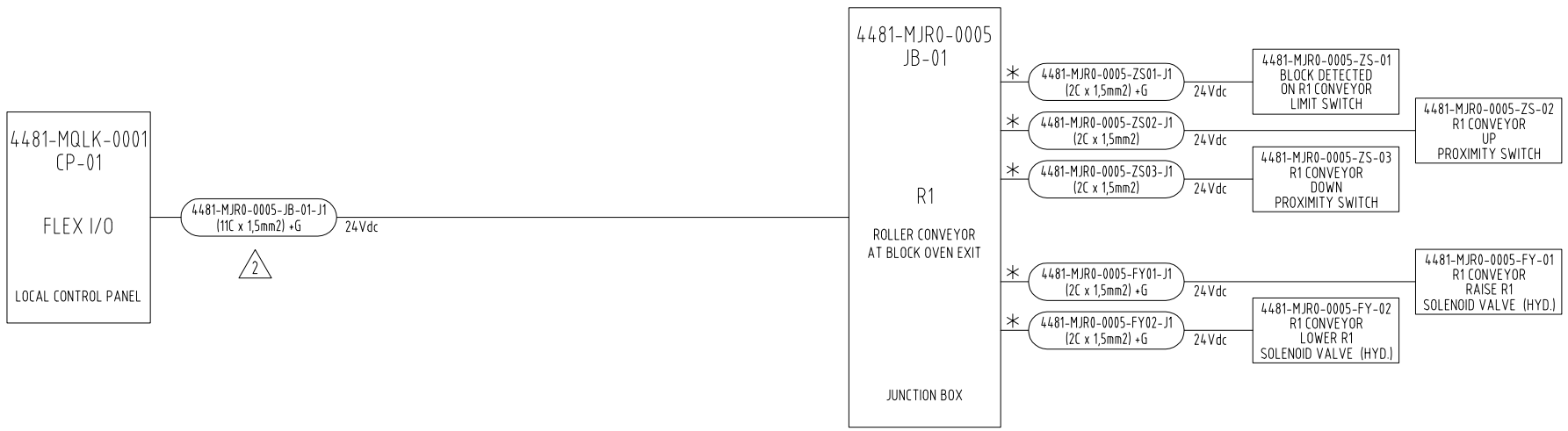
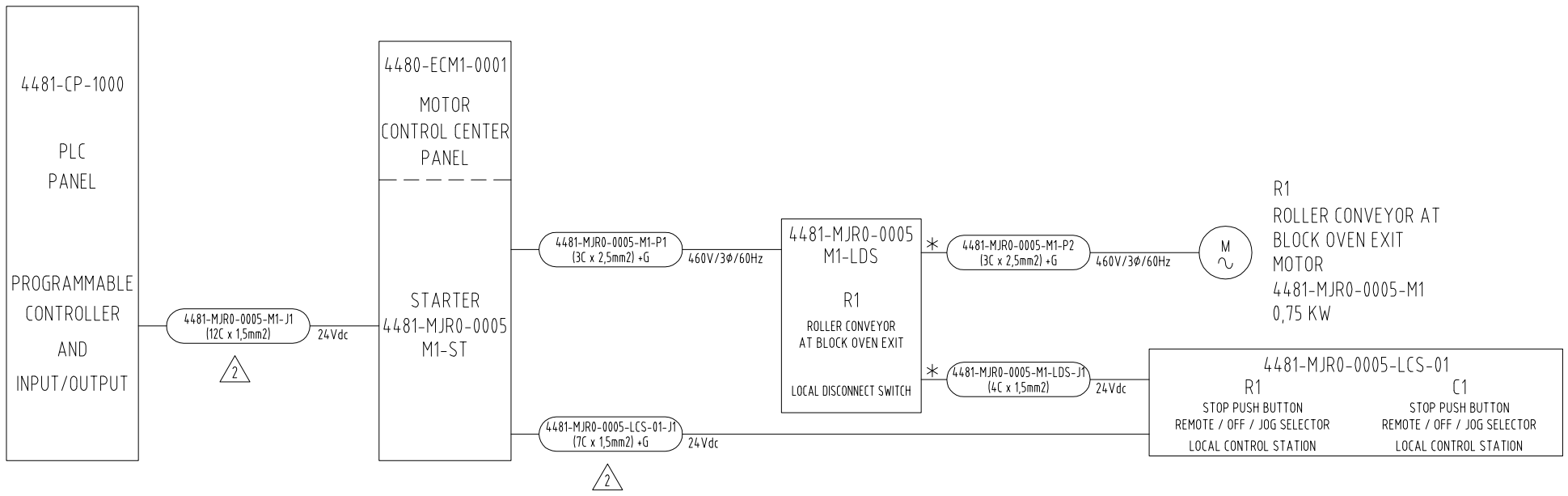
CATHODE SEALING EQUIPEMENT (1347)
R1 ROLLER CONVEYOR AT BLOCK OVEN EXIT 4481-MJR0-0005





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SELLER DRAWING No. 1347-50320 | REV. 2

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
		2		UPDATE	09/05/2011	F.P.	T.Pa.	M.B.
		1		UPDATE	22/11/2010	F.P.	T.Pa.	M.B.
REFERENCES		REVISIONS						

NOTES

STATUS: FOR DESIGN

DRAWN/DES'D: F.P.	AREA ENG.:
DATE: 28/07/2010	DATE:
CHECKED: E.B.	PRJ ENG MGR:
DATE:	DATE:
RESPONSIBLE ENG. M.B.	CLIENT:
DATE:	DATE:
ENG. GROUP SUP.	DRAWING SCALE: NONE
DATE:	

Vendor or Subcontractor Logo: GNA a&i tech Inc. — Département Ingénierie Engineering Department 9695 Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
ROLLER CONVEYOR AT BLOCK OVEN EXIT R1
CABLE BLOCK DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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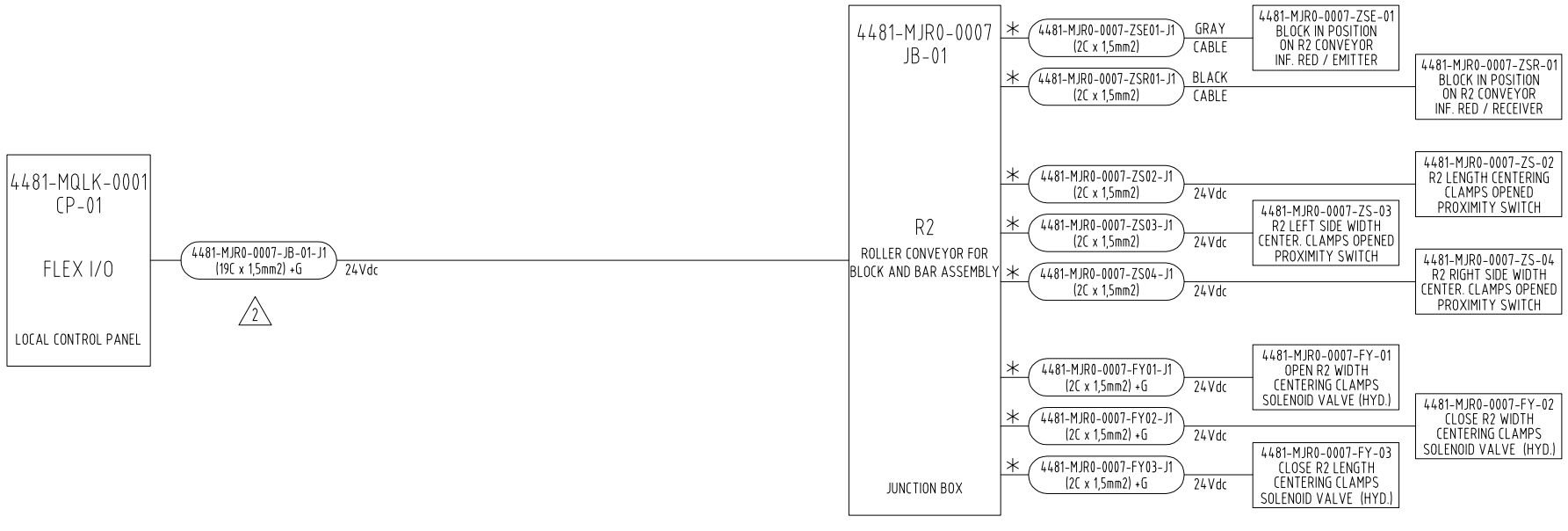
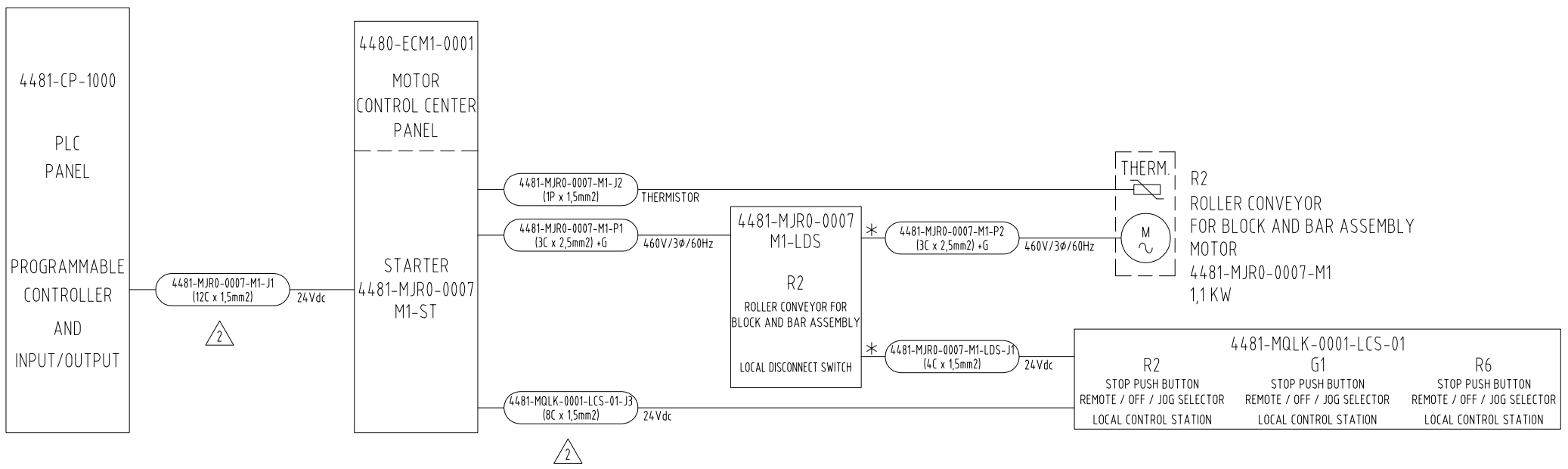
CATHODE SEALING EQUIPEMENT (1347)
R2 ROLLER CONVEYOR FOR BLOCK AND BAR ASSEMBLY 4481-MJR0-0007





NOTE:

4481-XXXX-XXX-XXX-XX (XXC x XXmm2) +G — CABLE NUMBER

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2 ☐	Revise & Resubmit. Work may proceed subject to incorporation of changes.	5 ☐	VOID / Superseded.
3 ☐	Revise & Resubmit. Work may NOT proceed.	DDR Nor :	170

Reviewed by : _____ Date : _____

Discipline :

Document No : 25457-4480-V1A-MXA0-0143 | Rev. :

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REFERENCES		REVISIONS						
		2		UPDATE	09/05/2011	F.P.	T.Po.	M.B.
		1		UPDATE	22/11/2010	F.P.	T.Po.	M.B.

NOTES

STATUS: FOR DESIGN

DRAWN/DES'D: F.P.	AREA ENG.:
DATE: 28/07/2010	DATE:
CHECKED: E.B.	PRJ ENG MGR:
DATE:	DATE:
RESPONSIBLE ENG. M.B.	CLIENT:
DATE:	DATE:
ENG. GROUP SUP.	DRAWING SCALE: NONE
DATE:	

Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie, Engineering Department, 9495 Trans-Canada, Saint-Laurent, Quebec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SELLER DRAWING No. 1347-50330 — REV. 2

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
ROLLER CONVEYOR FOR BLOCK AND BAR ASSEMBLY R2
CABLE BLOCK DIAGRAM

MA'ADEN

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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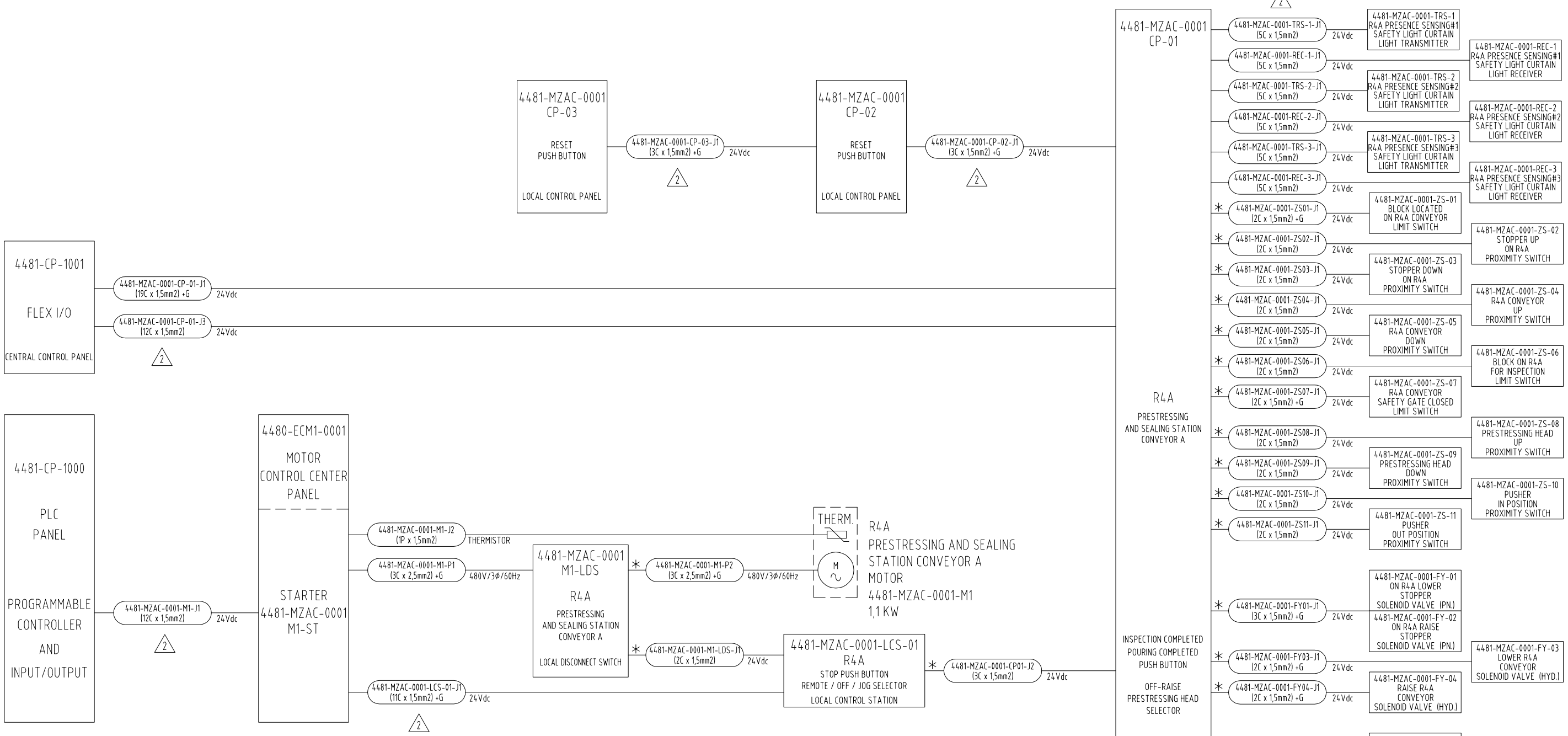
CATHODE SEALING EQUIPEMENT (1347)
R4A PRESTRESSING AND SEALING STATION CONVEYOR A 4481-MZAC-0001



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Document No : 25457-4480-V1A-MXA0-0144 | Rev. :

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		2		UPDATE	10/05/2011	E.B.	T.Pa.	M.B.
		1		UPDATE	22/11/2010	F.P.	T.Pa.	M.B.
REFERENCES		REVISIONS						

NOTES

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DATE:			

Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie Engineering Department 9695 Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457	00AZ	xx	xxxx	xxxx	xxx – xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
PRESTRESSING AND SEALING STATION CONVEYOR A R4A
CABLE BLOCK DIAGRAM

MA'ADEN

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3–		–AZ	

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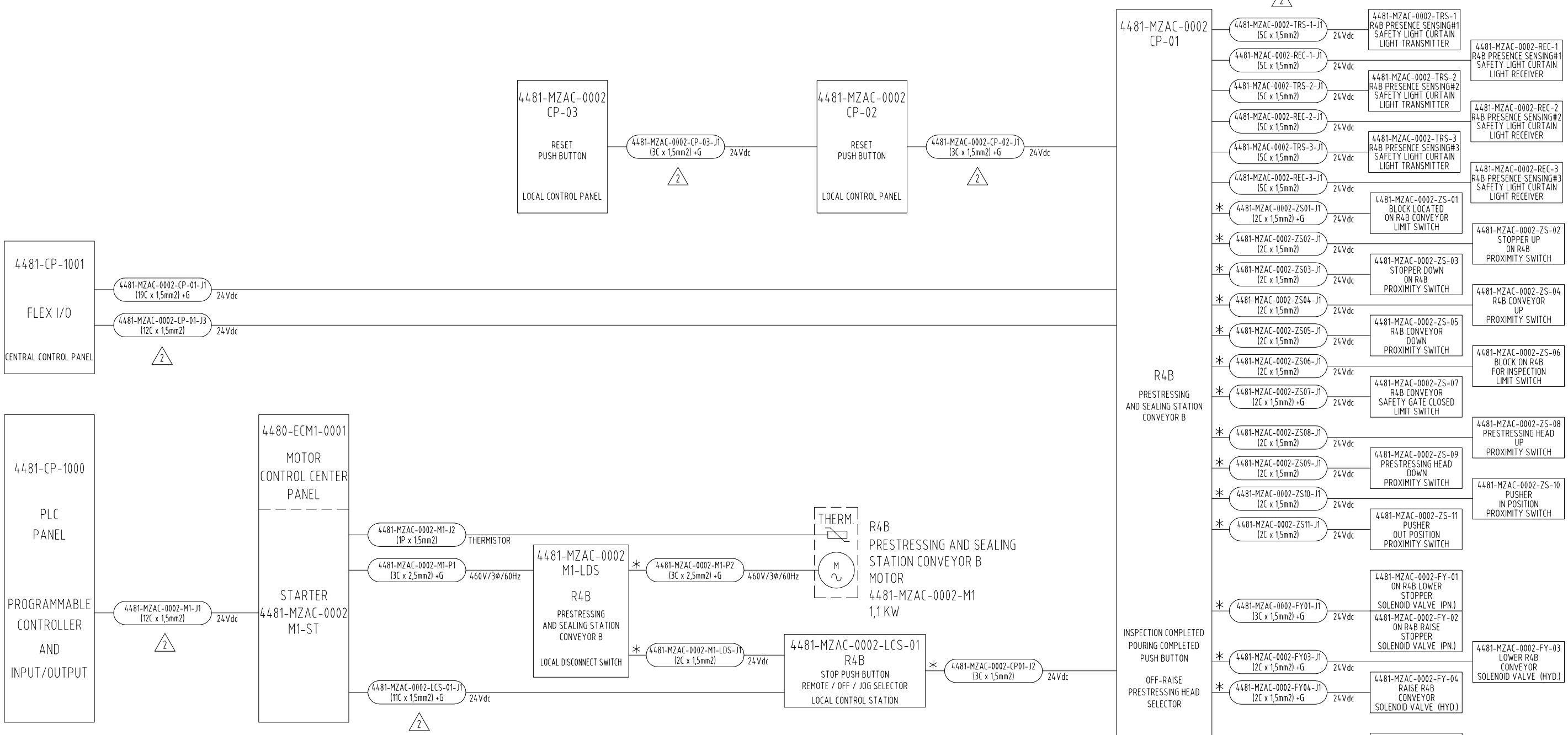
CATHODE SEALING EQUIPEMENT (1347)
R4B PRESTRESSING AND SEALING STATION CONVEYOR B 4481-MZAC-0002



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Document No : 25457-4480-V1A-MXAO-0145 | Rev. :

NOTE:

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		2		UPDATE	10/05/2011	E.B.	T.Po.	M.B.
		1		UPDATE	22/11/2010	F.P.	T.Po.	M.B.
REFERENCES		REVISIONS						

NOTES

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DATE:			

Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie Engineering Department 9695 Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
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SELLER DRAWING No. 1347-50350 — REV. 2

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
PRESTRESSING AND SEALING STATION CONVEYOR B R4B
CABLE BLOCK DIAGRAM

MA'ADEN

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
	—	—	—	A3-		-AZ	

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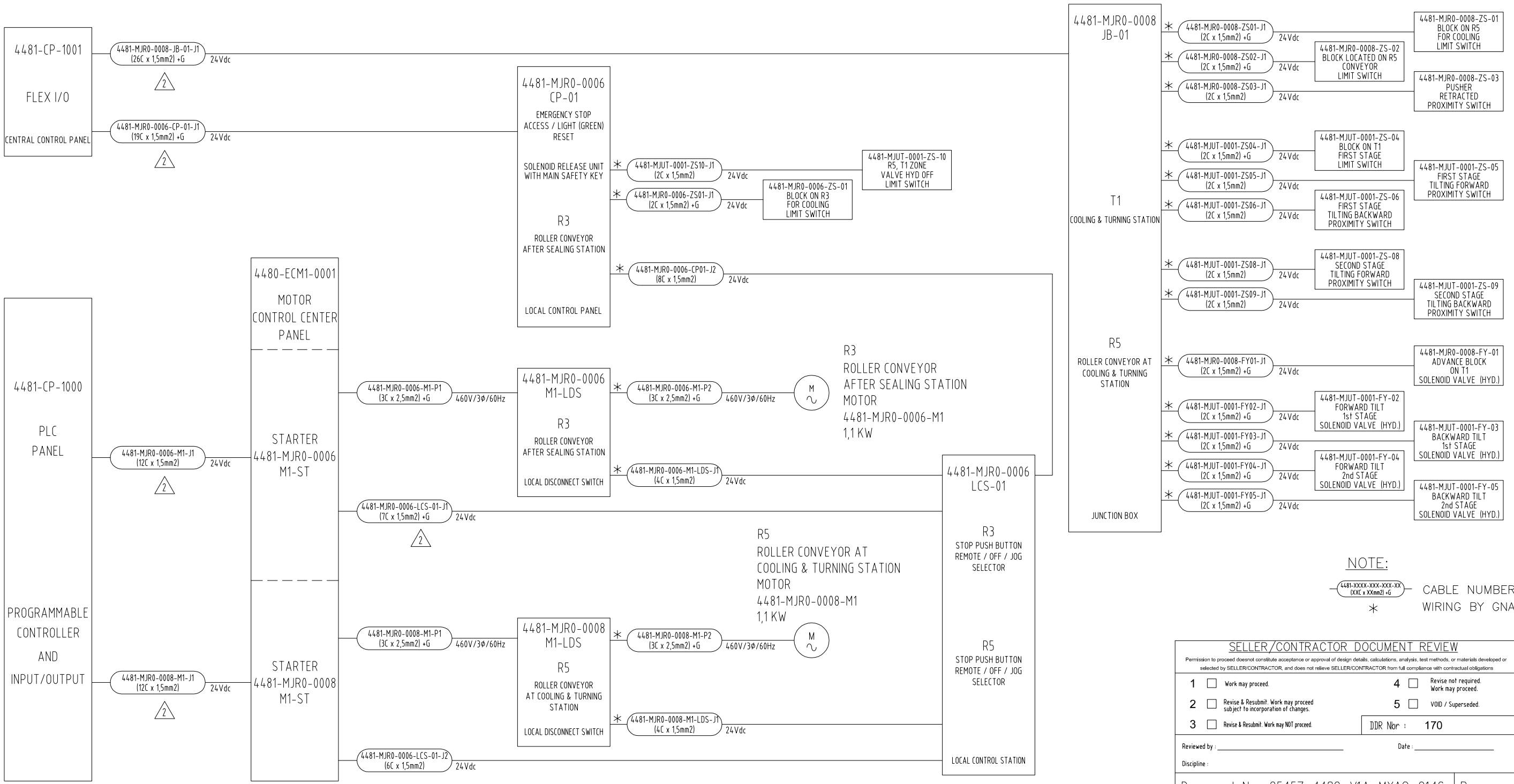
CATHODE SEALING EQUIPEMENT (1347)
T1 COOLING & TURNING STATION 4481-MJUT-0001
R3 ROLLER CONVEYOR AFTER SEALING STATION 4481-MJR0-0006
R5 ROLLER CONVEYOR AT COOLING & TURNING STATION 4481-MJR0-0008



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REFERENCES		2		UPDATE	10/05/2011	E.B.	T.Po.	M.B.
		1		UPDATE	22/11/2010	F.P.	T.Po.	M.B.
		REVISIONS						

NOTES

STATUS: FOR DESIGN

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ENG. GROUP SUP.	DRAWING SCALE: NONE
DATE:	

Vendor or Subcontractor Logo: GNA a&i tech Inc. — Département Ingénierie Engineering Department 9455 Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
COOLING & TURNING STATION T1 & ROLLER CONVEYOR R3 & R5
CABLE BLOCK DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
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Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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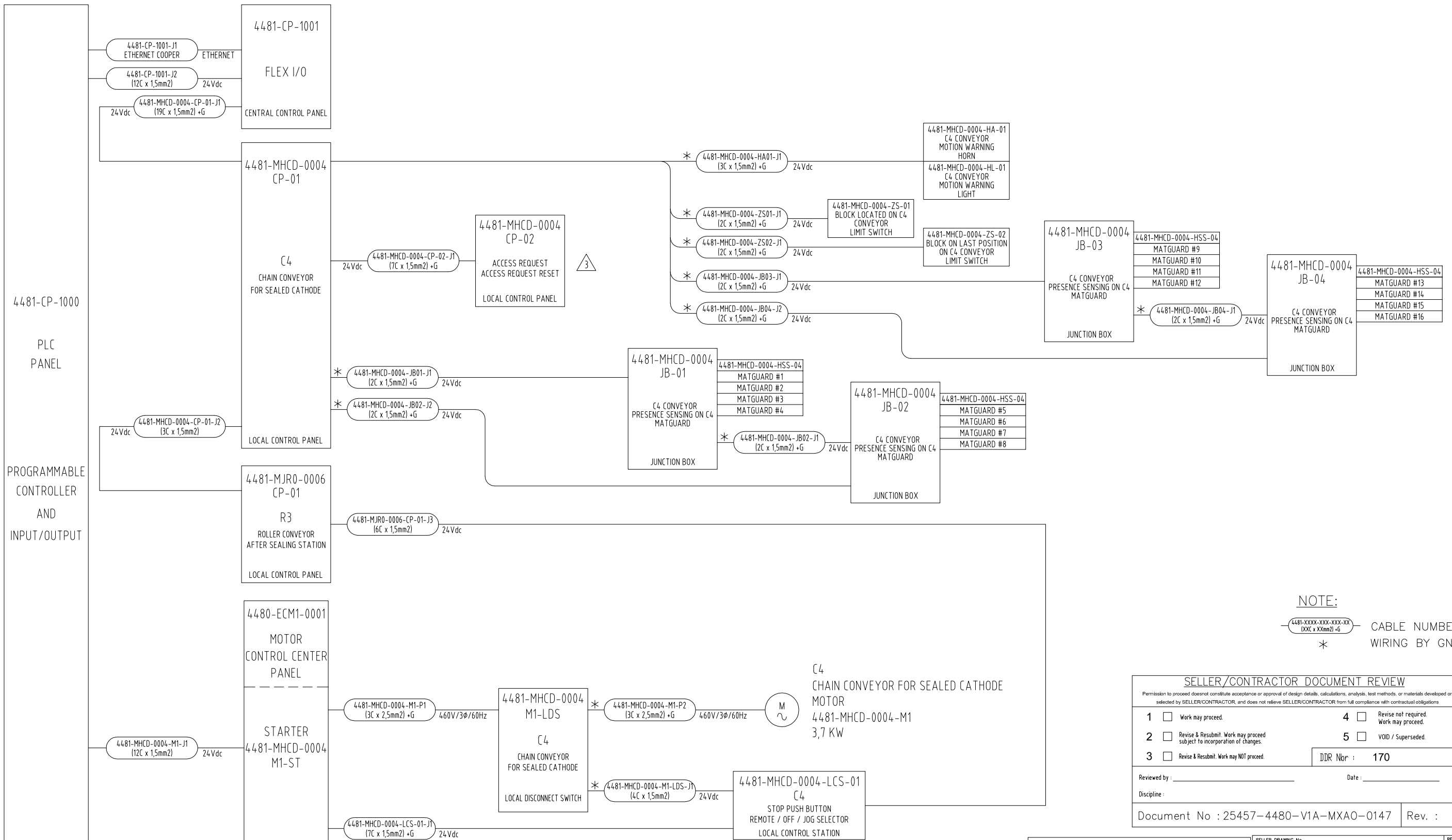
CATHODE SEALING EQUIPEMENT (1347)
C4 CHAIN CONVEYOR FOR SEALED CATHODE 4481-MHCD-0004



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DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
		3		ADD LOCAL CONTROL PANEL	15/08/2011	F.P.	T.Pa.	M.B.
		2		UPDATE	10/05/2011	F.P.	T.Pa.	M.B.
		1		UPDATE	22/11/2010	F.P.	T.Pa.	M.B.
REFERENCES		REVISIONS						

NOTES

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RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA a&i tech Inc. — Département Ingénierie / Engineering Department, 9690 Trans-Canada, Saint-Laurent, Québec H4S 1J9, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CHAIN CONVEYOR FOR SEALED CATHODE C4
CABLE BLOCK DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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CATHODE SEALING EQUIPEMENT (1347)
H1 HYDRAULIC POWER UNIT 4481-MPF0-0001

4481-CP-1000
PLC PANEL
PROGRAMMABLE CONTROLLER AND INPUT/OUTPUT

4481-MPF0-0001-CP-01-J1 ETHERNET COOPER — ETHERNET
4481-MPF0-0001-CP-01-P1 (3C x 2,5mm2)+G — 230V/1Ø/60Hz
2

4481-MPF0-0001-M1-J1 (8C x 1,5mm2) — 24Vdc
2

4480-ECM1-0001
MOTOR CONTROL CENTER PANEL
STARTER 4481-MPF0-0001 M1-ST

4481-MPF0-0001-M2-J1 (8C x 1,5mm2) — 24Vdc
2

STARTER 4481-MPF0-0001 M2-ST

4481-MHCD-0003 CP-01
FLEX I/O
LOCAL CONTROL PANEL

4481-MPF0-0001-CP-01-J2 ETHERNET COOPER — ETHERNET

4481-MPF0-0001-M1-P1 (3C x 6mm2) +G — 460V/3Ø/60Hz
4481-MPF0-0001 M1-LDS
H1 HUDRAULIC POWER UNIT PUMP A
LOCAL DISCONNECT SWITCH
4481-MPF0-0001-M1-P2 (3C x 6mm2) +G — 460V/3Ø/60Hz
M ~
H1 HYDRAULIC POWER UNIT PUMP A MOTOR 4481-MPF0-0001-M1 11 KW

4481-MPF0-0001-M1-LDS-J1 (2C x 1,5mm2) — 24Vdc

4481-MPF0-0001-LCS-01-J1 (5C x 1,5mm2) +G — 24Vdc
2

4481-MPF0-0001-M2-P1 (3C x 6mm2) +G — 460V/3Ø/60Hz
4481-MPF0-0001 M2-LDS
H1 HUDRAULIC POWER UNIT PUMP B
LOCAL DISCONNECT SWITCH
4481-MPF0-0001-M2-P2 (3C x 6mm2) +G — 460V/3Ø/60Hz
M ~
H1 HYDRAULIC POWER UNIT PUMP B MOTOR 4481-MPF0-0001-M2 11 KW

4481-MPF0-0001-M2-LDS-J1 (2C x 1,5mm2) — 24Vdc

4481-MPF0-0001-LCS-01-J2 (6C x 1,5mm2) — 24Vdc
2

4481-MPF0-0001 LCS-01
H1 (PUMP A)
STOP PUSH BUTTON REMOTE / OFF / JOG SELECTOR
H1 (PUMP B)
STOP PUSH BUTTON REMOTE / OFF / JOG SELECTOR
LOCAL CONTROL STATION

4481-MPF0-0001 CP-01
FLEX I/O
LOCAL CONTROL PANEL

H1 HYDRAULIC POWER UNIT

4481-MPF0-0001-TS01-J1 (4C x 1,5mm2) +G	24Vdc	4481-MPF0-0001-TSL-01 LOW OIL TEMPERATURE TEMPERATURE SWITCH	
		4481-MPF0-0001-TSH-01 HIGH OIL TEMPERATURE TEMPERATURE SWITCH	4481-MPF0-0001-TSHH-02 HIGH HIGH OIL TEMP. TEMPERATURE SWITCH
4481-MPF0-0001-TSHH02-J1 (4C x 1,5mm2) +G	24Vdc		SPARE TEMPERATURE SWITCH
4481-MPF0-0001-LSLL01-J1 (3C x 1,5mm2) +G	24Vdc	4481-MPF0-0001-LSLL-01 LOW LOW OIL LEVEL LEVEL SWITCH	
4481-MPF0-0001-LSL02-J1 (3C x 1,5mm2) +G	24Vdc		4481-MPF0-0001-LSL-02 LOW OIL LEVEL LEVEL SWITCH
4481-MPF0-0001-LSH03-J1 (3C x 1,5mm2) +G	24Vdc	4481-MPF0-0001-LSH-03 HIGH OIL LEVEL LEVEL SWITCH	
4481-MPF0-0001-PS01-J1 (4C x 1,5mm2) +G	24Vdc		4481-MPF0-0001-PSL-01 LOW SYSTEM PRESSURE PRESSURE SWITCH
			4481-MPF0-0001-PSH-01 HIGH SYSTEM PRESSURE PRESSURE SWITCH
4481-MPF0-0001-PSH02A-J1 (2C x 1,5mm2) +G	24Vdc	4481-MPF0-0001-PSH-02A SUCTION HIGH PUMP A PRESSURE SWITCH	
4481-MPF0-0001-PSH02B-J1 (2C x 1,5mm2) +G	24Vdc		4481-MPF0-0001-PSH-02B SUCTION HIGH PUMP B PRESSURE SWITCH
4481-MPF0-0001-PSH03A-J1 (2C x 1,5mm2) +G	24Vdc	4481-MPF0-0001-PSH-03A PRESSURE FILTER 1 BLOCKED PRESSURE SWITCH	
4481-MPF0-0001-PSH03B-J1 (2C x 1,5mm2) +G	24Vdc		4481-MPF0-0001-PSH-03B PRESSURE FILTER 2 BLOCKED PRESSURE SWITCH
4481-MPF0-0001-PSH04A-J1 (2C x 1,5mm2) +G	24Vdc	4481-MPF0-0001-PSH-04A RETURN FILTER 1 BLOCKED PRESSURE SWITCH	
4481-MPF0-0001-PSH04B-J1 (2C x 1,5mm2) +G	24Vdc		4481-MPF0-0001-PSH-04B RETURN FILTER 2 BLOCKED PRESSURE SWITCH
4481-MPF0-0001-PSH05A-J1 (2C x 1,5mm2) +G	24Vdc	4481-MPF0-0001-PSH-05A SUCTION FILTER 1 PUMP A BLOCKED PRESSURE SWITCH	
4481-MPF0-0001-PSH05B-J1 (2C x 1,5mm2) +G	24Vdc		4481-MPF0-0001-PSH-05B SUCTION FILTER 2 PUMP A BLOCKED PRESSURE SWITCH
4481-MPF0-0001-PSH06A-J1 (2C x 1,5mm2) +G	24Vdc	4481-MPF0-0001-PSH-06A SUCTION FILTER 1 PUMP B BLOCKED PRESSURE SWITCH	
4481-MPF0-0001-PSH06B-J1 (2C x 1,5mm2) +G	24Vdc		4481-MPF0-0001-PSH-06B SUCTION FILTER 2 PUMP B BLOCKED PRESSURE SWITCH
4481-MPF0-0001-ZS01-J1 (2C x 1,5mm2) +G	24Vdc	4481-MPF0-0001-ZS-01 VALVE PUMP A OPEN LIMIT SWITCH	
4481-MPF0-0001-ZS02-J1 (2C x 1,5mm2) +G	24Vdc		4481-MPF0-0001-ZS-02 VALVE PUMP B OPEN LIMIT SWITCH
4481-MPF0-0001-ZS03-J1 (2C x 1,5mm2) +G	24Vdc	4481-MPF0-0001-ZS-03 VALVE SUCTION FILTER1 PUMP A OPEN LIMIT SWITCH	
4481-MPF0-0001-ZS04-J1 (2C x 1,5mm2) +G	24Vdc		4481-MPF0-0001-ZS-04 VALVE SUCTION FILTER2 PUMP A OPEN LIMIT SWITCH
4481-MPF0-0001-ZS05-J1 (2C x 1,5mm2) +G	24Vdc	4481-MPF0-0001-ZS-05 VALVE SUCTION FILTER1 PUMP B OPEN LIMIT SWITCH	
4481-MPF0-0001-ZS06-J1 (2C x 1,5mm2) +G	24Vdc		4481-MPF0-0001-ZS-06 VALVE SUCTION FILTER2 PUMP B OPEN LIMIT SWITCH
4481-MPF0-0001-ZS07-J1 (2C x 1,5mm2) +G	24Vdc	4481-MPF0-0001-ZS-07 VALVE RETURN FILTER1 OPEN LIMIT SWITCH	
4481-MPF0-0001-ZS08-J1 (2C x 1,5mm2) +G	24Vdc		4481-MPF0-0001-ZS-08 VALVE RETURN FILTER2 OPEN LIMIT SWITCH
4481-MPF0-0001-ZS09-J1 (2C x 1,5mm2) +G	24Vdc	4481-MPF0-0001-ZS-09 VALVE PRESSION FILTER1 OPEN LIMIT SWITCH	
4481-MPF0-0001-ZS10-J1 (2C x 1,5mm2) +G	24Vdc		4481-MPF0-0001-ZS-10 VALVE PRESSION FILTER2 OPEN LIMIT SWITCH
4481-MPF0-0001-FY01-J1 (2C x 1,5mm2) +G	24Vdc	4481-MPF0-0001-FY-01 DUMPING VALVE SOLENOID VALVE (HYD)	
4481-MPF0-0001-PT01-J1 (1P/SH x 1,5mm2)	4-20mA		4481-MPF0-0001-PT-01 HPU PRESSURE TRANSMITTER

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Discipline :

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NOTE:

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		2		UPDATE	MA/12/2011	E.B.	T.Pa.	M.B.
		1		UPDATE	22/11/2010	F.P.	T.Pa.	M.B.

REFERENCES — REVISIONS

NOTES

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DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA a.b.tech Inc. — Département Ingénierie / Engineering Department, 9690 Trans-Canada, Saint-Laurent, Québec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

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SELLER DRAWING No. 1347-50380 | REV. 2

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
HYDRAULIC POWER UNIT H1
CABLE BLOCK DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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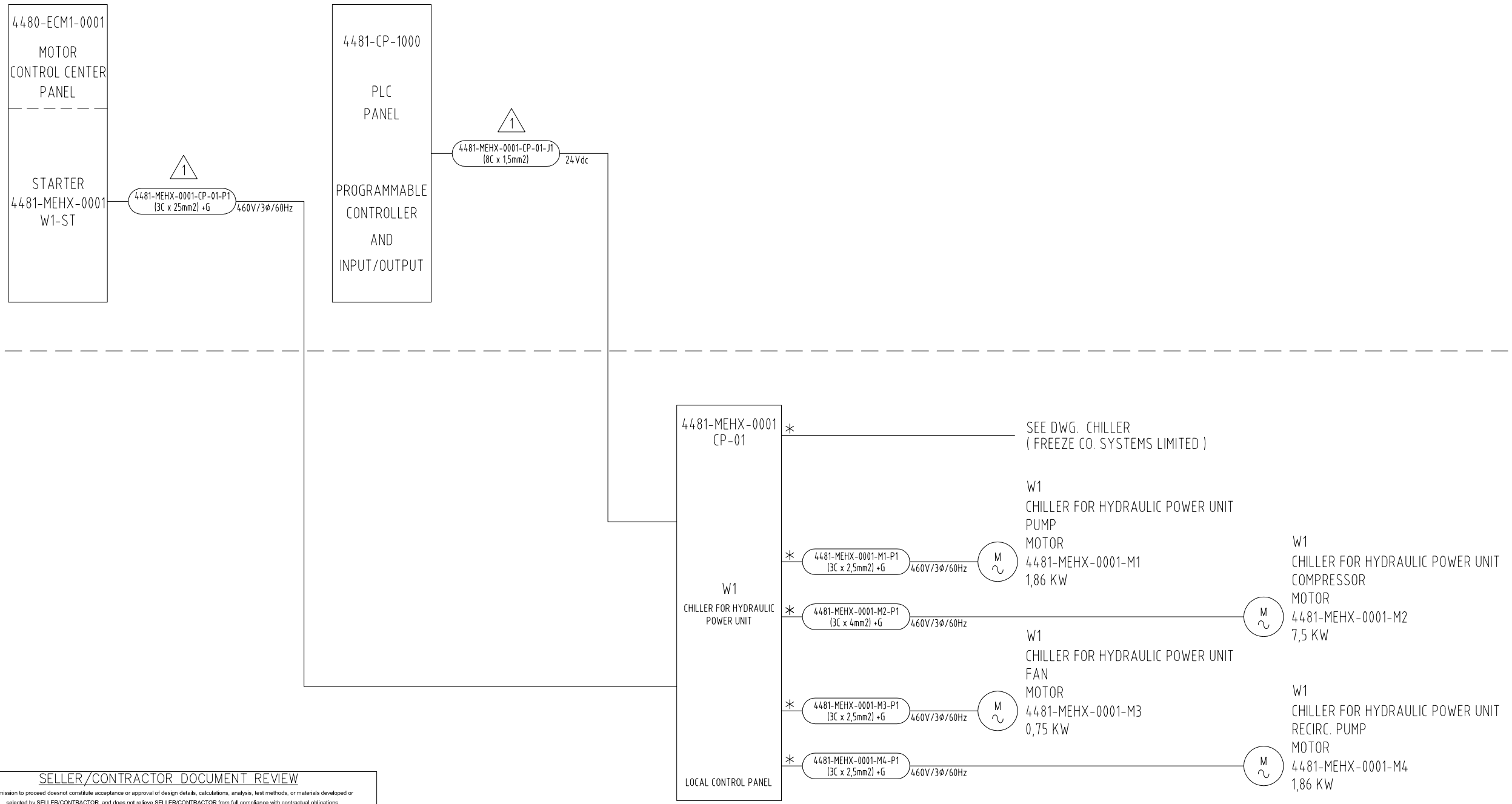
CATHODE SEALING EQUIPEMENT (1347)
W1 CHILLER FOR HYDRAULIC POWER UNIT 4481-MEHX-0001



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Discipline :

Document No : 25457-4480-V1A-MXA0-0149 | Rev. :

NOTE:

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DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
		1		UPDATE	22/11/2010	F.P.	T.Pa.	M.B.
REFERENCES		REVISIONS						

NOTES

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SELLER DRAWING No. 1347-50390 — REV. 1

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CHILLER FOR HYDRAULIC POWER UNIT W1
CABLE BLOCK DIAGRAM

Project Title: Ras Az Zawr Aluminium Smelter

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
—	—	—		A3-		-AZ	

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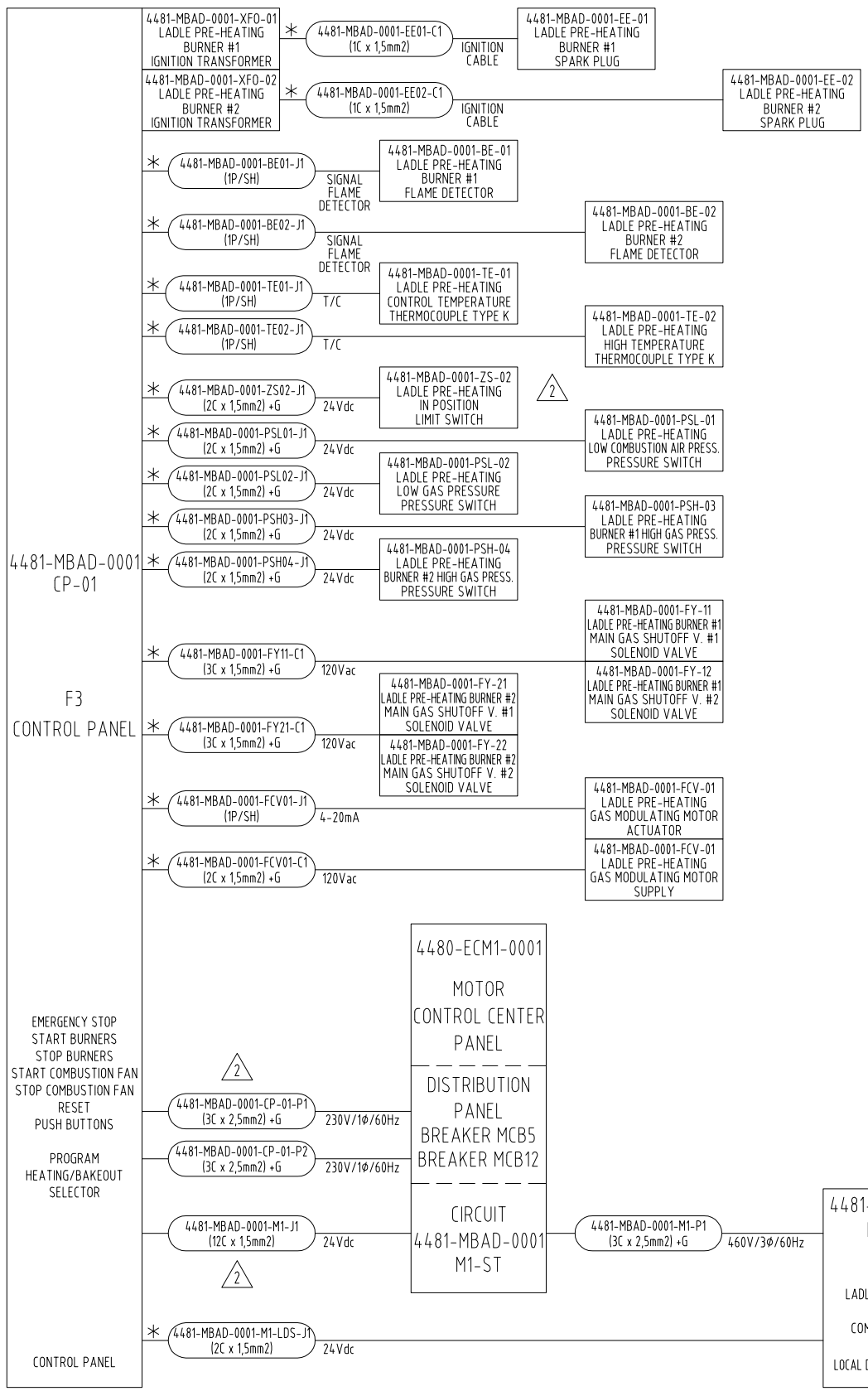
CATHODE SEALING EQUIPEMENT (1347)
F3 LADLE PRE-HEATING STATION 4481-MBAD-0001



NOTE:

4481-XXXX-XXX-XXX-XX (XXC x XXmm2) +G — CABLE NUMBER

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Reviewed by : _____ Date : _____

Discipline :

Document No : 25457-4480-V1A-MXA0-0150 | Rev. :

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DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		2		CHANGE ZS-01 INTO ZS-02	05/05/2011	F.P.	T.Po.	M.B.
		1		UPDATE	22/11/2010	F.P.	T.Po.	M.B.
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NOTES

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DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

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BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
LADLE PRE-HEATING STATION F3
CABLE BLOCK DIAGRAM

MA'ADEN

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—	—	A3-		-AZ	

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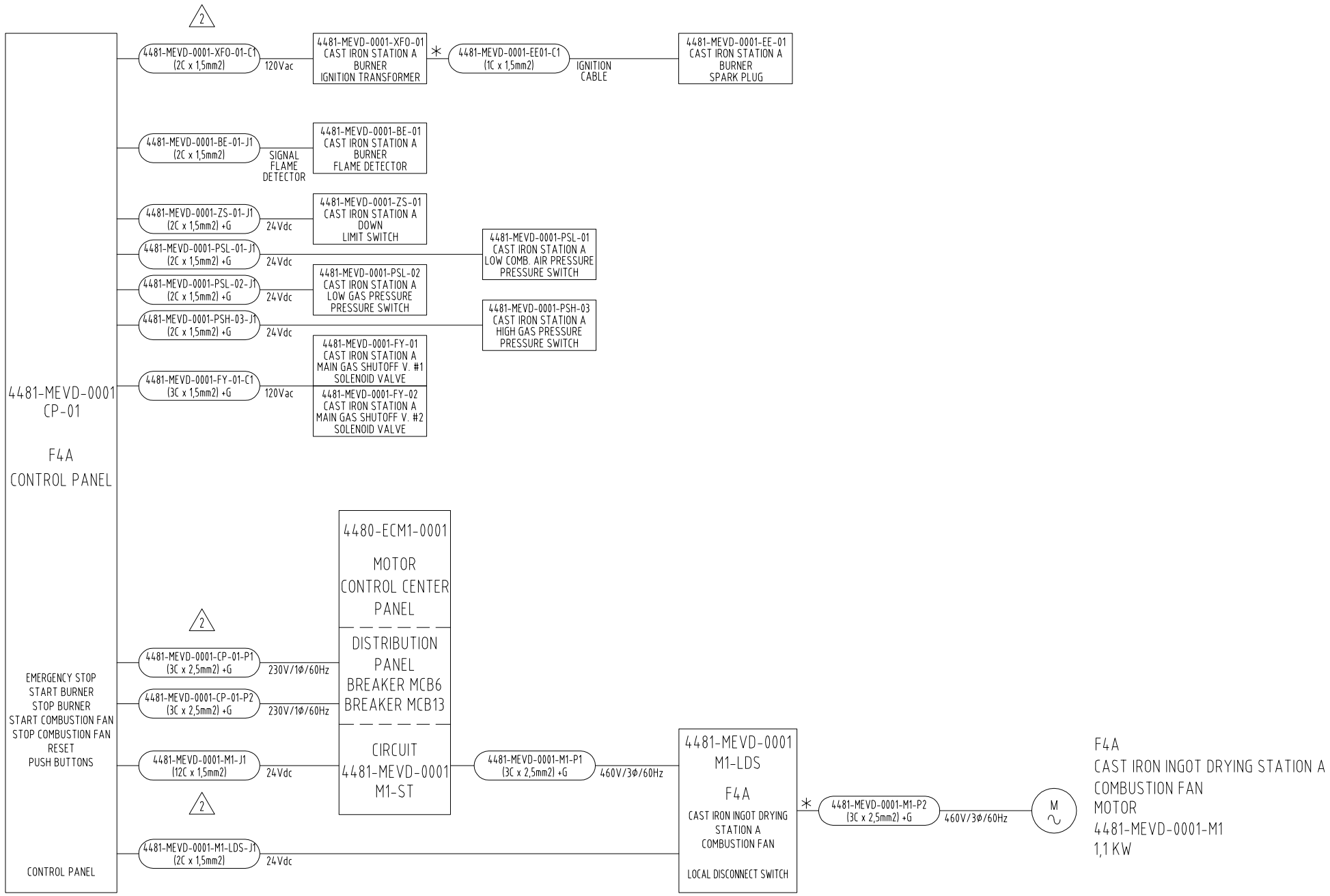
CATHODE SEALING EQUIPEMENT (1347)
F4A CAST IRON INGOT DRYING STATION A 4481-MEVD-0001



NOTE:

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DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
		2		UPDATE	10/05/2011	F.P.	T.Po.	M.B.
		1		UPDATE	22/11/2010	F.P.	T.Po.	M.B.

REFERENCES — REVISIONS

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DATE:			

Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie / Engineering Department, 5600, Trans-Canada, Saint-Laurent, Quebec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CAST IRON INGOT DRYING STATION A F4A
CABLE BLOCK DIAGRAM

MA'ADEN Alcoa

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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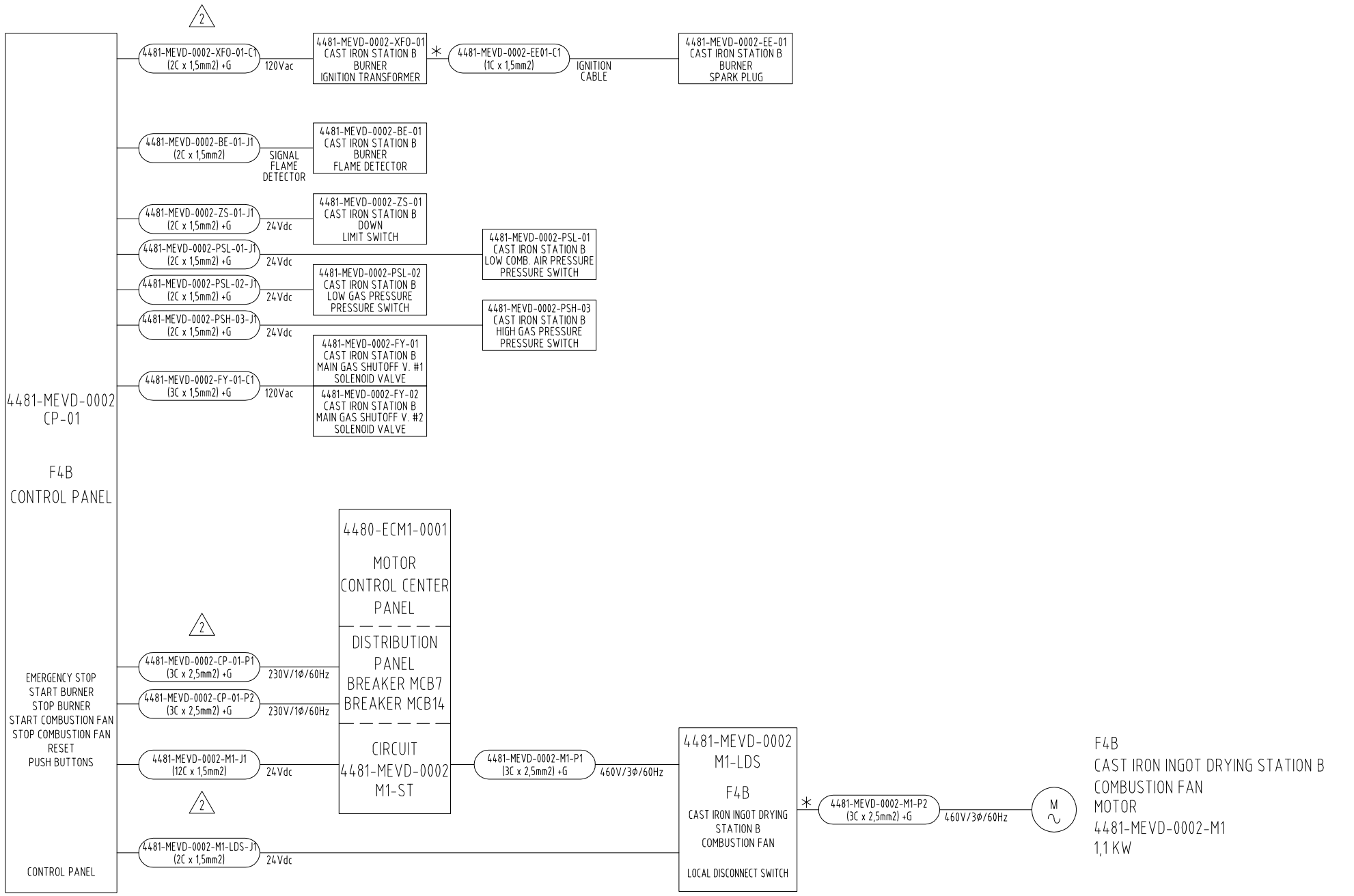
CATHODE SEALING EQUIPEMENT (1347)
F4B CAST IRON INGOT DRYING STATION B 4481-MEVD-0002



NOTE:

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SELLER DRAWING No. 1347-50420 | REV. 2

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		2		UPDATE	10/05/2011	F.P.	T.Pa.	M.B.
		1		UPDATE	22/11/2010	F.P.	T.Pa.	M.B.
		REVISIONS						

NOTES

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BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No | SUBD. | DISC. | SECTOR | SEQUENCE | REV.
25457-00AZ- xx - xxxx - xxxx - xxx - xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CAST IRON INGOT DRYING STATION B F4B
CABLE BLOCK DIAGRAM

MA'ADEN معادن

Type | Building | Discipline | Phase | Format | Sequential | Location | Rev. No.
— | — | — | A3- | -AZ

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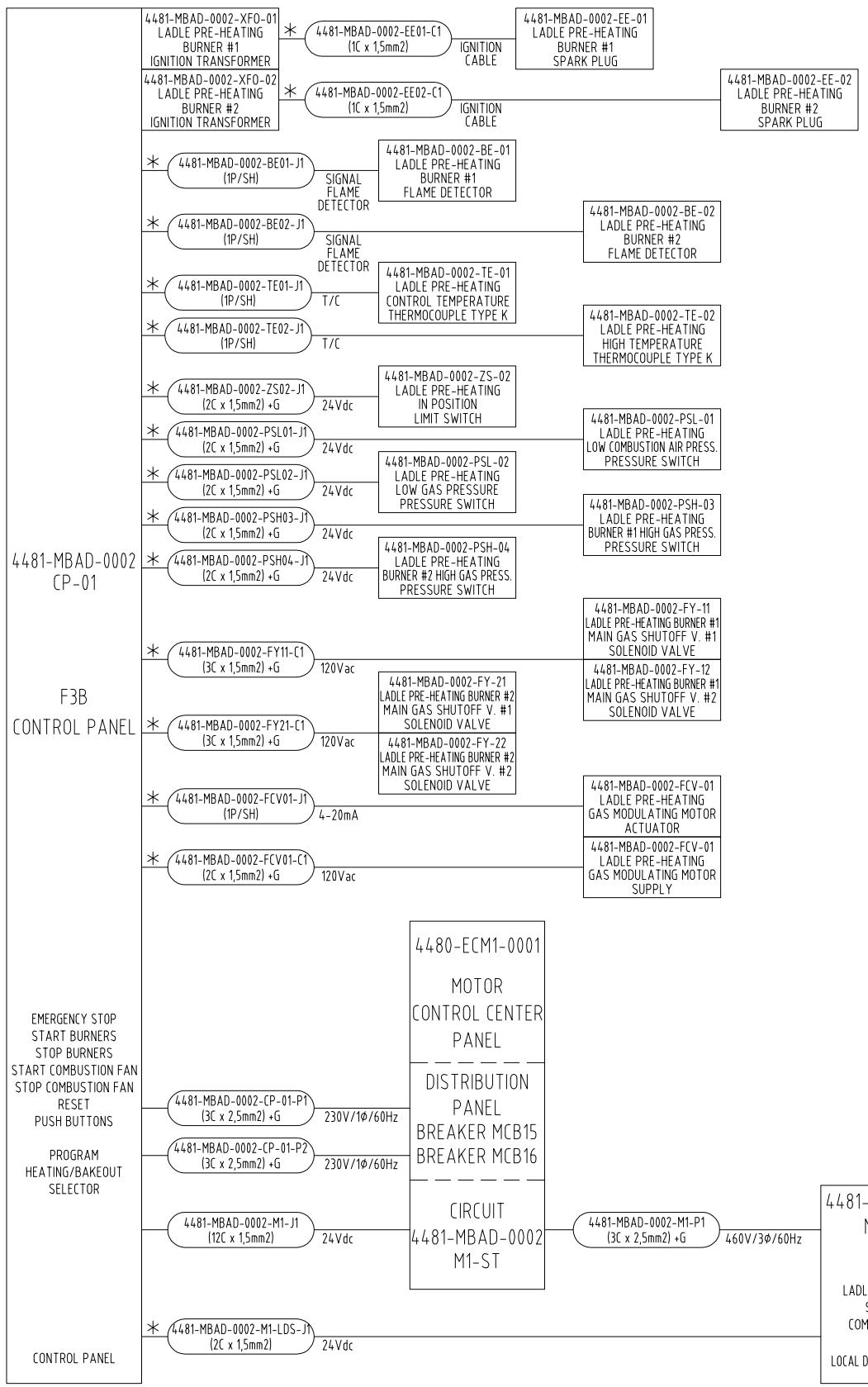
CATHODE SEALING EQUIPEMENT (1347)
F3B LADLE PRE-HEATING STATION B 4481-MBAD-0002



NOTE:

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Discipline :

Document No : 25457-4480-V1A-MXA0- Rev. :

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SELLER DRAWING No. 1347-50430 REV. 0

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		0		REVISIONS				

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DATE:	15/08/2011	DATE:	
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DATE:			

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BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
LADLE PRE-HEATING STATION F3B
CABLE BLOCK DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

9.7 Control Panel and Junction Box Drawings

DRAWING No.	DESCRIPTION
1347-51000	MCC Panel 4481-ECM1-0003 General Arrangement
1347-51010	PLC Panel 4481-CP-1000 General Arrangement
1347-51020	Cathode Sealing Equipment Flex I of 0 Central Control Panel 4481-CP-1001 General Arrangement
1347-51030	Cathode Sealing Equipment Flex I 0f 0 Local Control Panel 4481-MQLK-0001-CP-01 General Arrangement
1347-51040	Cathode Sealing Equipment Flex I of 0 Local Control Panel 4481-MHCD-0003-CP-01 General Arrangement
1347-51060	Cathode Block Oven SCR Panel 4481-MEEP-0001-SCR - General Arrangement
1347-51070	Cathode Bar Heating Furnace SCR Panel 4481-MBMB-0001-SCR - General Arrangement
1347-51080	Local Control Panel 4481-MHCD-0002-CP-01 General Arrangement
1347-51090	Local Control Panel 4481-MHCD-0002-CP-02 General Arrangement
1347-51091	Local Control Panel 4481-MHCD-0002-CP-03
1347-51100	Control Panel 4481-MBMB-0001-CP-01 General Arrangement
1347-51110	Control Panel 4481-MBMB-0001-CP-02 General Arrangement
1347-51120	Local Control Panel 4481-MHCD-0001-CP-01 General Arrangement
1347-51121	Local Control Panel 4481-MHCD-0001-CP-02
1347-51130	Local Control Panel 4481-MZAC-0001-CP-01 General Arrangement
1347-51131	Local Control Panel 4481-MZAC-0001-CP-02-03 General Arrangement
1347-51140	Local Control Panel 4481-MZAC-0002-CP-01 General Arrangement
1347-51141	Local Control Panel 4481-MZAC-0002-CP-02-03 General Arrangement
1347-51150	Local Disconnect Station 2 of 3 General Arrangement
1347-51151	Local Disconnect Station 3 of 3 General Arrangement
1347-51152	Local Disconnect Station 1 of 3 General Arrangement
1347-51160	Local Control Panel 4481-MJR0-0006-CP-01 General Arrangement
1347-51170	Local Control Panel 4481-MHCD-0004-CP-01 General Arrangement
1347-51171	Local Control Panel 4481-MHCD-0004-CP-02
1347-51200	Local Control Panel 4481-MHCD-0002-LCS-01 General Arrangement
1347-51201	Local Control Station 4481-MZBP-0001-LCS-01 General Arrangement
1347-51202	Local Control Station 4481-MZBP-0001-LCS-02 General Arrangement
1347-51203	Local Control Station 4481-MZBP-0001-LCS-03 General Arrangement
1347-51204	Local Control Station -Equipment Without Drive General Arrangement
1347-51205	Local Control Panel 4481-MHCD-0003-LCS-01 General Arrangement
1347-51206	Local Control Station - Equip with Drive - General Arrangement
1347-51207	Local Control Station 4481-MPF0-0001-LCS-01 General Arrangement
1347-51208	Local Control Station 4481-MJR0-0005-LCS-01 General Arrangement
1347-51209	Local Control Station 4481-MJR0-0006-LCS-01 General Arrangement
1347-51210	Local Control Station 4481-MQlk-0001-LCS-01 General Arrangement

1347-51211	Local Control Station 4481-MHCD-0004-LCS-01 General Arrangement
1347-51212	Local Control Station 4481-MZAC-0001-2-LCS-01 General Arrangement
1347-51220	Ladle Pre-Heating Station Control Panel 4481-MBAD-0001-CP-01 General Arrangement
1347-51221	Ladle Pre-Heating Station B CTRL - Panel 4481-MBAD-0002-CP-01
1347-51230	Cast Iron Drying Station Control Panel 4481-MEVD-0001-CP-01 General Arrangement
1347-51240	Cast Iron Drying Station B Control Panel 4481-MEVD-0002-CP-01 General A
1347-51250	Junction Box 4481-MBMB-0001-JB-01 General Arrangement
1347-51260	Junction Box 4481-MBMB-0001-JB-02 General Arrangement
1347-51270	Junction Box 4481-MJR0-0005-JB-01 General Arrangement
1347-51280	Junction Box 4481-MJR0-0007-JB-01 General Arrangement
1347-51290	Junction Box 4481-MJR0-0004-JB-01 General Arrangement
1347-51300	Junction Box 4481-MQLK-0001-JB-01 General Arrangement
1347-51310	Junction Box 4481-MQLK-0001-JB-02 General Arrangement
1347-51320	Junction Box 4481-MQLK-0001-JB-03 General Arrangement
1347-51330	Junction Box 4481-MEEP-0001-JB-01 General Arrangement
1347-51350	Junction Box 4481-MEEP-0001-JB-03 General Arrangement
1347-51360	Junction Box 4481-MEEP-0001-JB-11 General Arrangement
1347-51370	Junction Box 4481-MEEP-0001-JB-12 General Arrangement
1347-51380	Junction Box 4481-MEEP-0001-JB-13 General Arrangement
1347-51390	Junction Box 4481-MJR0-0008-JB-01 General Arrangement
1347-51400	Junction Box 4481-MHCD-0002-JB-01 General Arrangement
1347-51410	Junction Box 4481-MHCD-0001-JB-01 General Arrangement
1347-51420	Junction Box 4481-MHCD-0004-JB-01 General Arrangement
1347-51420	Junction Box 4481-MHCD-0004-JB-02 General Arrangement
1347-51422	Junction Box 4481-MHCD-0004-JB-03 General Arrangement
1347-51423	Junction Box 4481-MHCD-0004-JB-04 General Arrangement
1347-52000	Instrument Location - General Arrangement
1347-52250	Control Panel Location - General Arrangement
1347-52500	Earthing Layout Drawing - General Arrangement

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SWITCHBOARD SPECIFICATION - 25457-0000-3PS-ECM1-0001

1. FORM - FORM 4B
2. I.P RATING - 42
3. FAULT LEVEL - 80KA FOR 1 SECOND
4. CONSTRUCTION - 2MM ZINTEC
5. PAINT COLOUR - RAL 7032 - EXTERNAL
   WHITE - BACKPANS AND PLATES
6. FRONT ACCESS/CABLE ENTRY FRONT/BOTTOM

F - FAN
HIM - HUMAN INTERFACE MODULE
V - VENT
M - MULTI-FUNCTION METER

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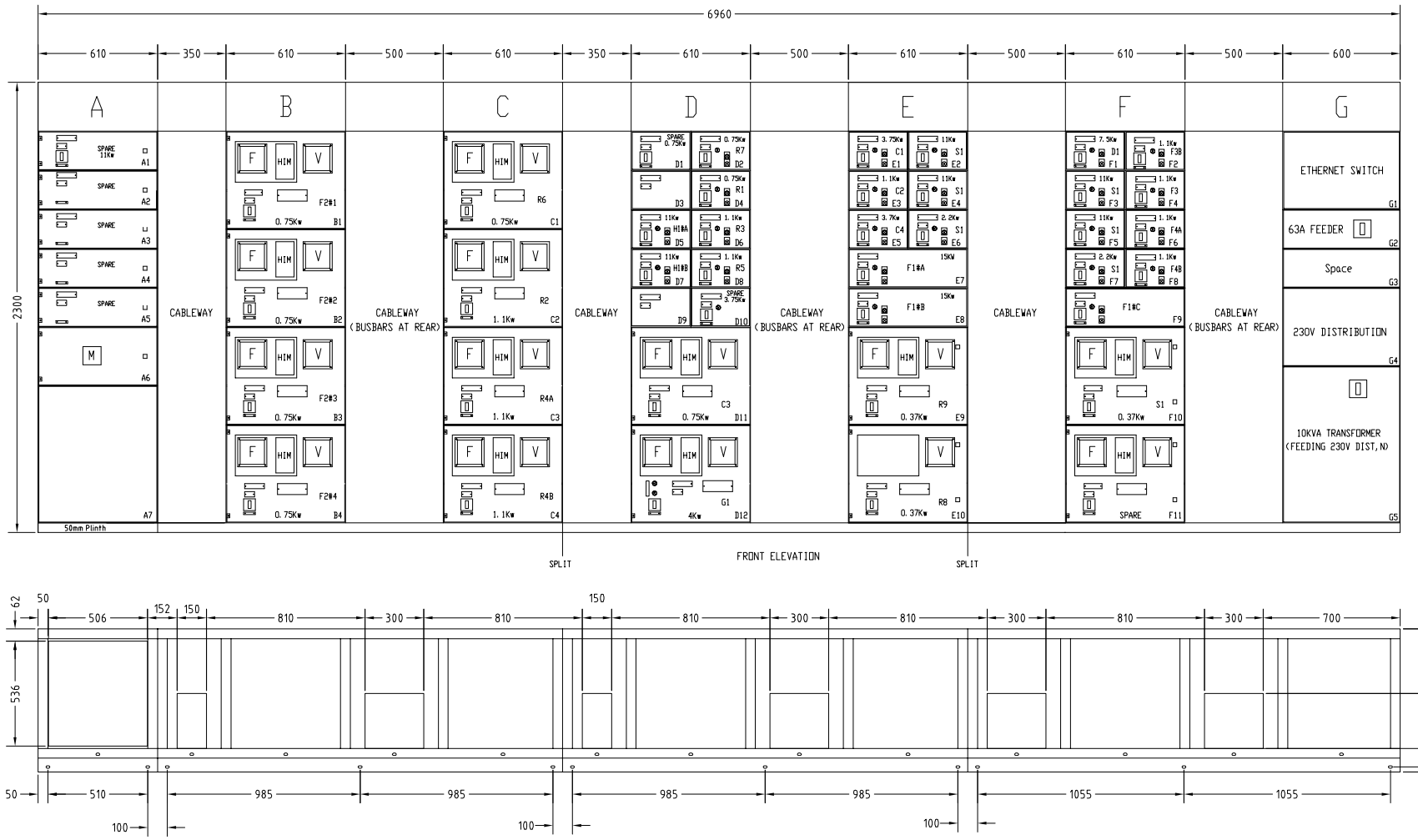
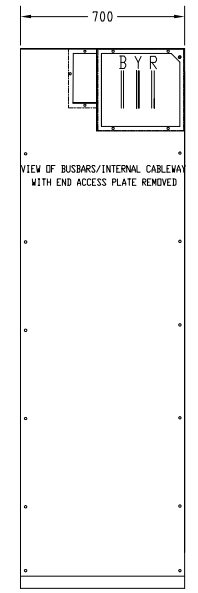
Discipline :

Document No : 25457-4480-V1A-MXA0-0071 | Rev. : 004

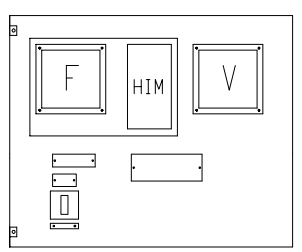
NOTE: 20% SPARE EQUIPPED FEEDER, THE REMAINING SPARES ARE EMPTY TRAYS

Comp Ref	Circuit Reference	KW Rating	Description
A1	Spare (with breaker only type 140M-F8N-C32)	11Kw DOL	
A2	Spare (empty tray)		
A3	Spare (empty tray)		
A4	Spare (empty tray)		
A5	Spare (empty tray)		
A6	Incoming Supply Metering		
A7	Incoming Cable connections		
B1	4481-MBMB-0001-M1	0.75kW VSD	F2 Cathode Bar Heating Furnace Conveyor No 1
B2	4481-MBMB-0001-M2	0.75kW VSD	F2 Cathode Bar Heating Furnace Conveyor No 2
B3	4481-MBMB-0001-M3	0.75kW VSD	F2 Cathode Bar Heating Furnace Conveyor No 3
B4	4481-MBMB-0001-M4	0.75kW VSD	F2 Cathode Bar Heating Furnace Conveyor No 4
C1	4481-MJRO-0004-M1	0.75kW VSD	R6 Roller Conveyor At Bar F Exit
C2	4481-MJRO-0007-M1	1.1kW VSD	R2 Roller Conveyor For Block And Bar Assembly
C3	4481-MZAC-0001-M1	1.1kW VSD	R4A Prestressing and Sealing Station Conveyor A
C4	4481-MZAC-0002-M1	1.1kW VSD	R4B Prestressing and Sealing Station Conveyor B
D1	Spare (with breaker only type 140M-F8N-B25)	0.75Kw DOL	
D2	4481-MJRO-0003-M1	0.75Kw Rv DOL	R7 Roller Conveyor At Bar Furnace Entrance
D3	Spare (empty tray)		
D4	4481-MJRO-0005-M1	0.75Kw DOL	R1 Roller Conveyor At Block Oven Exit
D5	4481-MPFO-0001-M1	11Kw DOL	H1 Hydraulic Power Unit Pump A
D6	4481-MJRO-0006-M1	1.1Kw DOL	R3 Roller Conveyor After Sealing Station
D7	4481-MPFO-0001-M2	11Kw DOL	H1 Hydraulic Power Unit Pump B
D8	4481-MJRO-0008-M1	1.1Kw DOL	R5 Roller Conveyor At Cooling And Turning Station
D9	Spare (empty tray)		
D10	Spare (with breaker only type 140M-F8N-C16)	3.7Kw DOL	
D11	4481-MHCD-0003-M1	0.75kW VSD	C3 Chain Conveyor Between Shot Blasting Machine & Oven
D12	4481-MQLK-0001-M1 & M2 Twin Drive 1.1Kw	4.0kW VSD	G1 Positioning Gantry For Block & Bars No1 & 2
E1	4481-MHCD-0001-M1	3.7Kw Rv DOL	C1 Chain Conveyor Of Block Oven
E2	4481-MZBP-0001-M1	11Kw DOL	S1 Cathode Bar Shot Blasting Machine Blast Wheel No 1
E3	4481-MHCD-0002-M1	1.1Kw DOL	C2 Chain Conveyor Upstream Of Shot Blasting Machine
E4	4481-MZBP-0001-M2	11Kw DOL	S1 Cathode Bar Shot Blasting Machine Blast Wheel No 2
E5	4481-MHCD-0004-M1	3.7Kw DOL	C4 Chain Conveyor For Sealed Cathode
E6	4481-MZBP-0001-M7	2.2Kw DOL	S1 Cathode Bar Shotblasting Machine Screw
E7	4481-MEEP-0001-M1	15Kw DOL	F1 Cathode Block Oven Fan A
E8	4481-MEEP-0001-M2	15Kw DOL	F1 Cathode Block Oven Fan B
E9	4481-MJRO-0001-M1	0.37kW VSD	R9 Conical Roller Conveyor at Shotblasting Machine Entrance
E10	4481-MJRO-0002-M1	0.37kW VSD	R8 Conical Roller Conveyor at Shotblasting Machine Entrance
F1	4481-MACO-0001-M1	7.5Kw DOL	D1 Dust Collector Fan
F2	4481-MBAD-0002-M1	1.1Kw DOL	F3B Ladle Pre-Heating ST. B Combustion Fan
F3	4481-MZBP-0001-M3	11Kw DOL	S1 Cathode Bar Shotblasting Machine Blast Wheel No 3
F4	4481-MBAD-0001-M1	1.1Kw DOL	F3 Ladle Pre-Heating ST. Combustion Fan
F5	4481-MZBP-0001-M4	11Kw DOL	S1 Cathode Bar Shotblasting Machine Blast Wheel No 4
F6	4481-MEVD-0001-M1	1.1Kw DOL	F4A Cast Iron ST. A Combustion Fan
F7	4481-MZBP-0001-M5	2.2Kw DOL	S1 Cathode Bar Shotblasting Machine Elevator
F8	4481-MEVD-0002-M1	1.1Kw DOL	F4B Cast Iron ST. B Combustion Fan
F9	4481-MEEP-0001-M3	15Kw DOL	F1 Cathode Block Oven Fan C
F10	4481-MZBP-0001-M6	0.37kW VSD	S1 Cathode Bar Shotblasting Machine Work Conveyor
F11	Spare (empty tray)		
G1	Cisco IE3000-BTC Ethernet Sw		
G2	4481-MEHX-M1,M2,M3,M4	63A MCCB	W1 Chiller For Hydraulic Power Unit Local Control Panel
G3	SPACE		
G4	230V Distribution		16 Way MCB 230V Section Control & Utilities
G5	460/230V 10KVA Transformer		

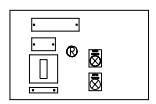




TYPICAL VSD DOOR



TYPICAL DOL DOOR



EQUIPMENT TAG # 4480-ECM1-0001

	CLIENT GNA ALUTECH PROJECT AZ ZABIRAH SMELTER PROJECT CATHODE SEALING EQUIPMENT MCC		
DRAWN BY	CHECKED	APPROVED	
RC	GH		
DATE	DATE	DATE	
22/12/10	22/12/10		

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TITLE	SCALE	DRAWING No	REV No
CATHODE SEALING SHOP MCC GENERAL ARRANGEMENT	NTS	D6608-1	3

STANDARDS AND APPROVALS — ASTA CERTIFICATION — BSEN ISO 9001 CERTIFICATE FM45190 — IEC 439-1 BSEN 60439-1

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DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		5		UPDATE	SE.21.2011	F.P.	E.B.	M.B.
		4		UPDATE	AU.18.2011	F.P.	E.B.	M.B.
		3		UPDATE	FE.08.2011	F.P.	E.B.	M.B.
		2		UPDATE	JA.12.2011	F.P.	E.B.	M.B.
		1		UPDATE	DE.15.2010	F.P.	E.B.	M.B.
		REVISIONS						

NOTES

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DATE:		DATE:	
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Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie / Engineering Department, 9650 Trans-Canada, Ste-Anne-de-Bellevue, Québec, H9X 3Y2, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MCC PANEL 4480-ECM1-0001
GENERAL ARRANGEMENT

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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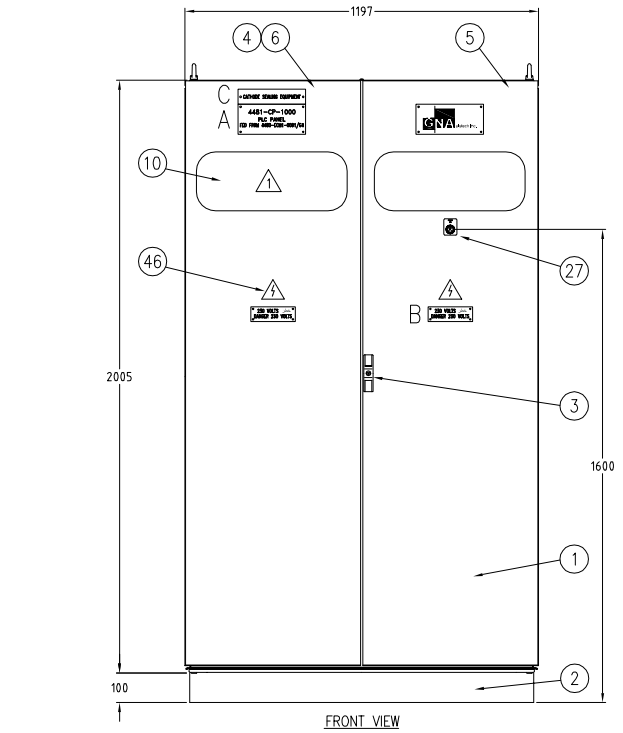

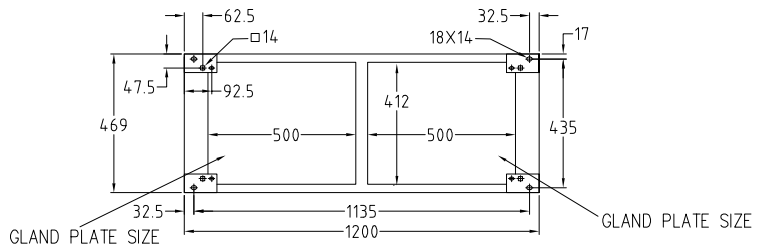

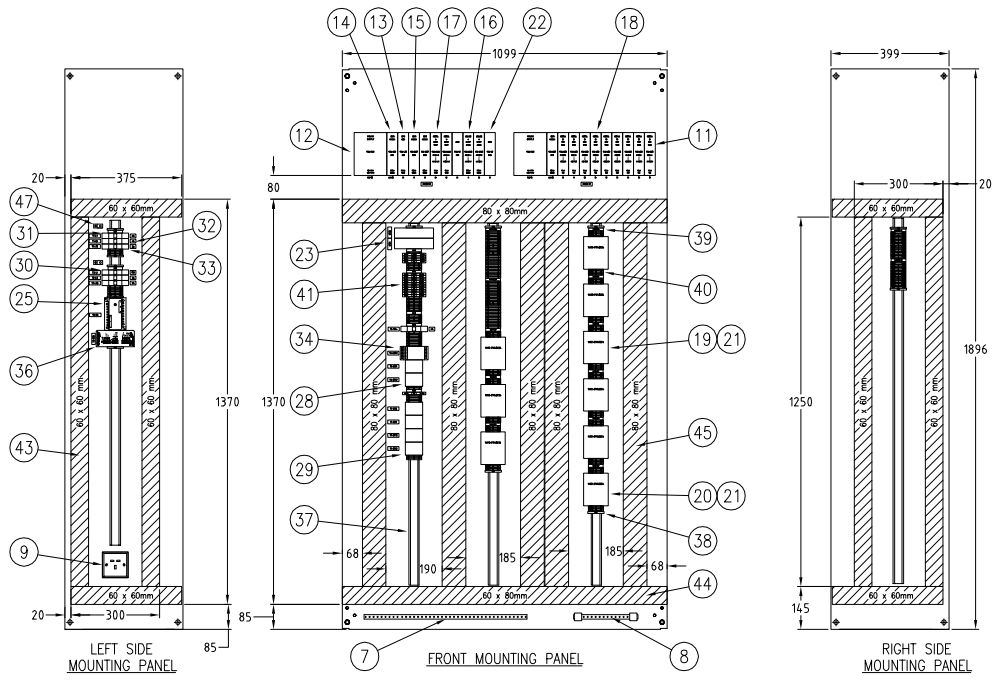

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA	101,6mm x 228,6mm
A	1	4481-CP-1000 PLC PANEL FED FROM 4480-ECM1-0001/G4	100mm x 230mm FIRST ROW : 14mm 2nd AND 3rd ROW : 12mm
B	1	230 VOLTS DANGER 230 VOLTS	50mm x 150mm LETTER DIM. : 12mm
27	1	POWER ON	50mm x 45mm LETTER DIM. : 4mm
C	1	CATHODE SEALING EQUIPMENT	50mm x 230mm LETTER DIM. : 12mm

MATERIAL LIST (5341-COF-102)

ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL TS8, 2000mm x 1200mm x 500mm IP55	RITTAL	TS 8205.500
	1	SIDE WALLS	RITTAL	TS 8105.235
	2	SIDE MOUNTING PLATE 2000 x 500mm	RITTAL	TS 8609.050
2	1	FRONT & REAR CABLE BASE 100mm HIGH	RITTAL	TS 8601.200
	1	SIDE CABLE BASE 100mm HIGH	RITTAL	TS 8601.050
3	1	COMFORT HANDLE FOR SEMICYLINDER	RITTAL	TS 8611.070
	1	LOCK AND PUSHBUTTON INSERT	RITTAL	SZ 2469.000
4	1	FLUORESCENT LIGHT & RECEPTACLE 230V/60Hz	RITTAL	SZ 4139.140
5	1	DOOR-OPERATED SWITCH WITH POWER CORD 1m	RITTAL	SZ 4315.300
6	1	CONNECTION CABLE WITH SOCKET, WITHOUT PLUG 3m	RITTAL	SZ 4315.100
7	1	NON INSULATED GROUND BAR (35 mm^2)	RITTAL	SZ 2364.000
	2	MOUNTING BRACKET	RITTAL	SZ 2365.000
8	1	INSULATED GROUND BAR	ENVITECH	
9	1	RECEPTACLE 13A, 230Vac, CONFORME BS 1363A	MK ELECTRIC	2958 WHI
10	1	VIEWING WINDOW	ENVITECH	
11	2	10-SLOT CONTROLLOGIX CHASSIS	ALLEN-BRADLEY	1756-A10
12	2	POWER SUPPLY 5V @ 13A	ALLEN-BRADLEY	1756-PA75
13	1	LOGIX 5673 PROCESSOR 8 MBYTE USER MEMORY	ALLEN-BRADLEY	1756-L73
14	1	ETHERNET FIBER INTERFACE MODULE	ALLEN-BRADLEY	1756-EN2F
15	3	ETHERNET INTERFACE MODULE	ALLEN-BRADLEY	1756-EN2T
16	2	ANALOG OUTPUT-CURRENT 6 CHANNEL	ALLEN-BRADLEY	1756-OF6CI
17	2	DIGITAL RELAY OUTPUT 16 CHANNEL	ALLEN-BRADLEY	1756-OW16I
18	9	DIGITAL DC INPUT 32 CHANNEL	ALLEN-BRADLEY	1756-IB32
19	5	PRE-WIRED CABLE 1m	ALLEN-BRADLEY	1492-CABLE010Z
20	4	PRE-WIRED CABLE 2.5m	ALLEN-BRADLEY	1492-CABLE025Z
21	9	IFM MODULE (1756-IB32)	ALLEN-BRADLEY	1492-IFM40D24
22	2	SLOT FILLER	ALLEN-BRADLEY	1756-N2
23	2	ETHERNET/IP TAP3 COOPER PORTS	ALLEN-BRADLEY	1783-ETAP
24				
25	1	POWER FILTER	ERICO	TDF20A240V
26				
27	1	PILOT LIGHT HEAD (GREEN)	TELEMECANIQUE	XB4BV033
	1	LIGHT MODULE WITH PROTECTED LED (GREEN)	TELEMECANIQUE	ZBVM3
	1	BODY / MOUNTING COLLAR	TELEMECANIQUE	ZB4BZ009
28	4	CONTROL RELAY 24Vdc, 4NO	TELEMECANIQUE	CA3-KN40BD
	2	AUXILIARY CONTACT 4NO	TELEMECANIQUE	LA1-KN40
29	2	CONTROL RELAY 24Vdc, 2NO, 2NC	TELEMECANIQUE	CA3-KN22BD
30	1	CIRCUIT BREAKER 10A	TELEMECANIQUE	MG24432
31	1	CIRCUIT BREAKER 6A	TELEMECANIQUE	MG24430
32	3	CIRCUIT BREAKER 4A	TELEMECANIQUE	MG24428
33	2	CIRCUIT BREAKER 2A	TELEMECANIQUE	MG24426
34	1	EMERGENCY STOP RELAY 24Vdc	PILZ	PNOZ X3P
35				
36	1	POWER SUPPLY 24Vdc; 6,5A	WEIDMULLER	CP SNT (9925340024)
37	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
38	BATCH	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
39	BATCH	TERMINAL MARKERS (20)	WEIDMULLER	SchT 5s (163193)
	BATCH	PROTECTIVE STRIPS CLEAR (20)	WEIDMULLER	STR 5s (163194)
40	BATCH	TERMINAL BLOCKS 2,5mm^2	WEIDMULLER	ZDU2.5-2/3AN (170601)
41	BATCH	FUSIBLE TERMINAL BLOCK 2.5mm^2	WEIDMULLER	ZSI2.5 (161640)
42				
43	BATCH	DUCT 60 X 60mm	IBOCO	T1-2222G
44	BATCH	DUCT 60 X 80mm	IBOCO	T1-2230G
45	BATCH	DUCT 80 X 80mm	IBOCO	T1-3030G
46	2	LABEL 76 x 76mm (ELECTRICAL)	BRADY	89153
47	2	CONNECTORS	THOMAS & BETTS	ADR2

PLC CONTROL PANEL (4481-CP-1000)

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DDR Nbr : 179

Reviewed by : _____ Date : _____

Discipline :

Document No : 25457-4480-V1A-MXA0-0256 | Rev. :

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

REFERENCES		REVISIONS							
DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
		1		ADD VIEWING WINDOW	14/03/2011	T.Pa.		

NOTES

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Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx	xxxx	xxxx	xxx	xxx

SELLER DRAWING No. 1347-51010 | REV. 1

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
PLC CONTROL PANEL 4481-CP-1000
GENERAL ARRANGEMENT

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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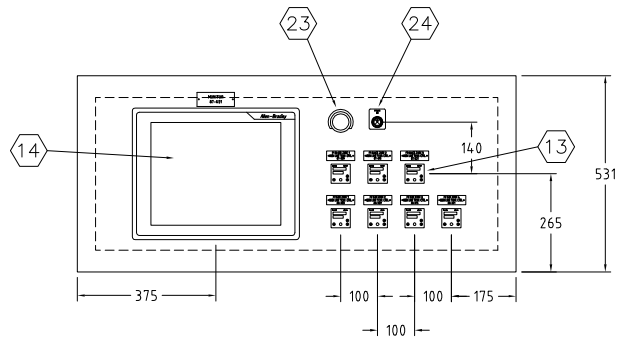
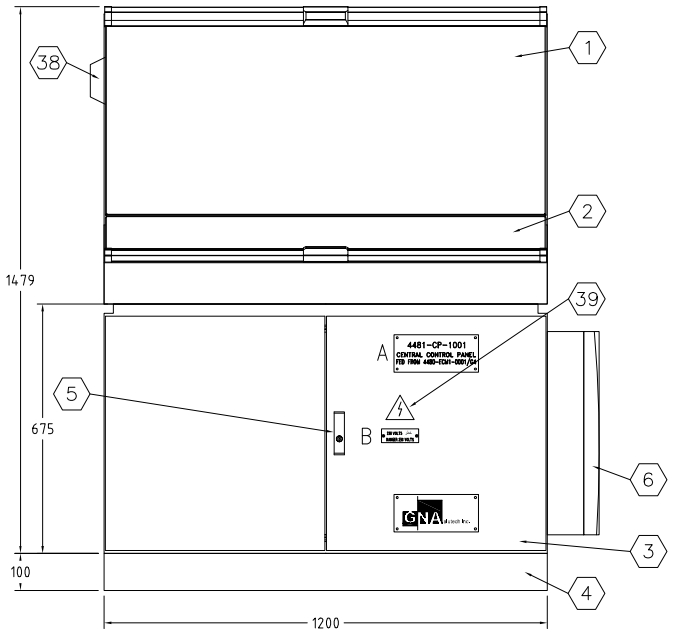
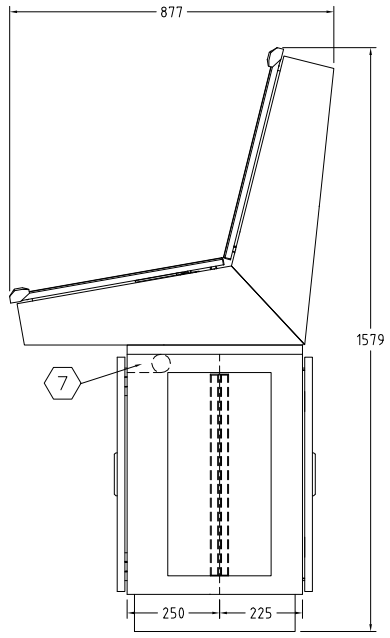


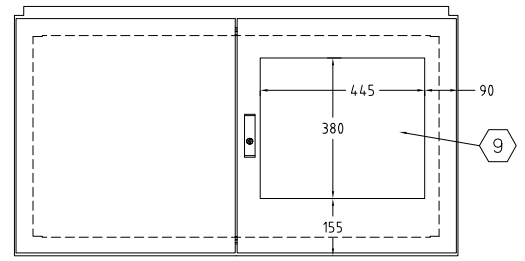


FRONT VIEW

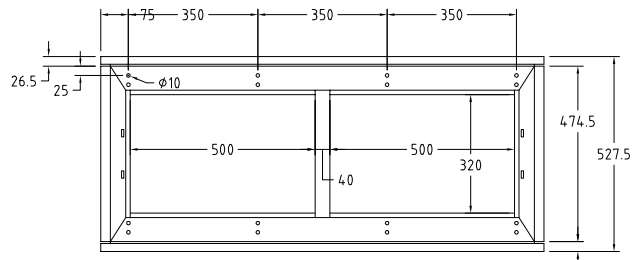


RIGHT SIDE VIEW

ITEM	QTY	NAME PLATE LIST	DIMENSIONS
	1	GNA	101,6mm X 228,6mm
A	1	4481–CP–1001 CENTRAL CONTROL DESK FED FROM 4480–ECM1–0001/G4	100mm X 230mm FIRST ROW : 14mm 2nd and 3th ROW: 12mm
B	1	230 VOLTS خطر DANGER 230 VOLTS	37mm X 100mm LETTER DIM. : 6mm
13	1	F1 BLOCK ZONE 1 HIGH LIMIT TEMP. CTRL. 87–U09	25mm X 75mm LETTER DIM. : 6mm
	1	F1 BLOCK ZONE 2 HIGH LIMIT TEMP. CTRL. 87–U15	25mm X 75mm LETTER DIM. : 6mm
	1	F1 BLOCK ZONE 3 HIGH LIMIT TEMP. CTRL. 87–U21	25mm X 75mm LETTER DIM. : 6mm
	1	F2 BAR ZONE 1 HIGH LIMIT TEMP. CTRL. 88–U03	25mm X 75mm LETTER DIM. : 6mm
	1	F2 BAR ZONE 2 HIGH LIMIT TEMP. CTRL. 88–U09	25mm X 75mm LETTER DIM. : 6mm
	1	F2 BAR ZONE 3 HIGH LIMIT TEMP. CTRL. 88–U15	25mm X 75mm LETTER DIM. : 6mm
	1	F2 BAR ZONE 4 HIGH LIMIT TEMP. CTRL. 88–U21	25mm X 75mm LETTER DIM. : 6mm
14	1	MONITOR 87–U01	25mm X 75mm LETTER DIM. : 6mm
24	1	POWER ON	25mm X 75mm LETTER DIM. : 6mm

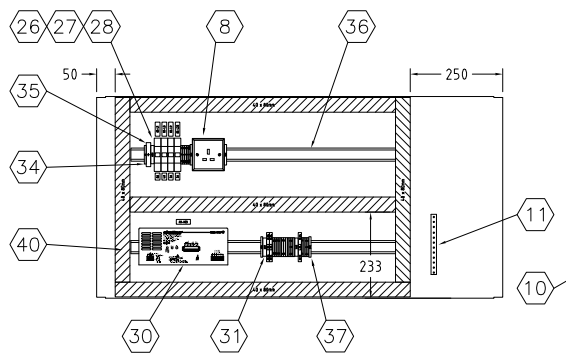


REAR VIEW

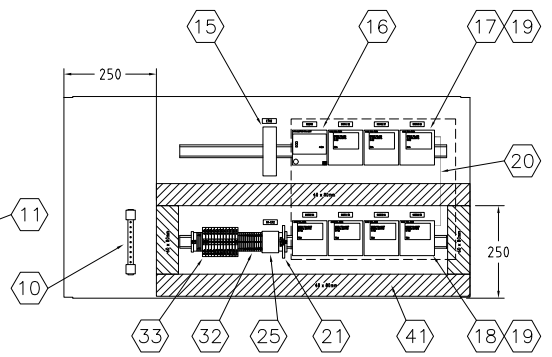


⚠1 BOTTOM VIEW (GLAND PLATE SIZE)

MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	CONSOLE TOP SECTION 750mm x 1200mm x 240mm IP55	RITTAL	TP 6722.500
2	1	CONSOLE CENTER SECTION 235mm x 1200mm x 750mm IP55	RITTAL	TP 6716.500
3	1	CONSOLE BOTTOM SECTION 675mm x 1200mm x 500mm IP55	RITTAL	TP 6706.500
	2	GLAND PLATE	RITTAL	5001.217
	2	GLAND PLATE	RITTAL	5001.225
4	1	BASE FRONT AND REAR 100 mm HIGH	RITTAL	SO 8601.200
	1	BASE SIDE TRIM PANELS 100 mm HIGH	RITTAL	SO 8601.050
5	1	HANDLE SYSTEM	RITTAL	SZ 2435.000
	1	LOCK AND PUSHBUTTON INSERT	RITTAL	SZ 2469.000
⚠2 6	1	AIR CONDITIONER 230Vdc, 60Hz, 300W	RITTAL	SK 3302.100
7	1	FLUORESCENT	RITTAL	SZ 4139.140
8	1	RECEPTACLE 13A, 230Vac, CONFORME BS 1363A	MK ELECTRIC	2958 WHI
9	1	VIEWING COVER	ENVITECH	
10	1	INSULATED GROUND BAR	ENVITECH	
11	1	NON INSULATED GROUND BAR (35mm²)	ENVITECH	
12				
13	7	HIGH TEMPERATURE CONTROLLER	WATLOW	SD6L–LJAE–AARG
14	1	VERSAVIEW 1700P	ALLEN–BRADLEY	6181P–17TPXPDC
15	1	ETHERNET TAP	ALLEN–BRADLEY	1783–ETAP
16	1	FLEX I/O ETHERNET ADAPTER	ALLEN–BRADLEY	1794–AENT
17	3	FLEX I/O DIGITAL DC INPUT MODULE (16)	ALLEN–BRADLEY	1794–IB16
18	4	FLEX I/O DIGITAL DC OUTPUT MODULE (8)	ALLEN–BRADLEY	1794–OB8EP
19	7	TERMINAL BASE	ALLEN–BRADLEY	1794–TB3S
20	1	EXTENDER CABLE	ALLEN–BRADLEY	1794–CE1
21	1	ISOLATION RELAY 24Vdc	ALLEN–BRADLEY	700–HLT2Z24
22				
23	1	EMERGENCY STOP TURN TO RELEASE OPERATOR RED	TELEMECANIQUE	ZB4BS64
	1	CONTACT BLOCK 1NC	TELEMECANIQUE	ZB4BZ102
	1	GUARD RING	EATON	M22–XGPV
	1	EMERGENCY STOP LABEL	ENVITECH	
24	1	PILOT LIGHT HEAD (GREEN)	TELEMECANIQUE	XB4BV033
	1	LIGHT MODULE WITH PROTECTED LED (GREEN)	TELEMECANIQUE	ZBVM3
	1	BODY / MOUNTING COLLAR	TELEMECANIQUE	ZB4BZ009
25	1	CONTROL RELAIS 24Vdc, 4NO	TELEMECANIQUE	CA3–KN40BD
26	1	CIRCUIT BREAKER 8A	TELEMECANIQUE	MG24431
27	1	CIRCUIT BREAKER 4A	TELEMECANIQUE	MG24428
28	2	CIRCUIT BREAKER 2A	TELEMECANIQUE	MG24426
29				
⚠2 30	BATCH	POWER SUPPLY 24Vdc; 12,5A	WEIDMULLER	CP SNT (9916250024)
31	BATCH	TERMINAL MARKERS	WEIDMULLER	SchT 5s (163193)
	BATCH	PROTECTIVE STRIPS CLEAR	WEIDMULLER	STR 5s (163194)
32	BATCH	TERMINAL BLOCK 2.5mm²	WEIDMULLER	ZDU2.5–2/3AN (170601)
33	BATCH	FUSIBLE TERMINAL BLOCK 2.5mm	WEIDMULLER	ZSI2.5 (161640)
34	BATCH	GROUND TERMINAL BLOCK 2.5mm²	WEIDMULLER	ZPE2.5–2/3AN (170609)
35	BATCH	GROUND TERMINAL BLOCK 16mm²	WEIDMULLER	ZPE16–2/1AN (177296)
36	BATCH	RAIL	WEIDMULLER	TS–35 (51450)
37	BATCH	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
38	1	HORN	EDWARDS	875–G1
39	1	LABEL 76 x 76mm (ELECTRICAL)	BRADY	89153
40	BATCH	DUCT 40 mm X 80 mm	IBOCO	T1–1530G
41	BATCH	DUCT 60 mm X 80 mm	IBOCO	T1–2230G



FRONT MOUNTING PLATE



REAR MOUNTING PLATE

DESK FLEX I/O
(CENTRAL CONTROL PANEL 4481–CP–1001)

NOTES:

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DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		2		AIR CONDITIONER POWER	MR.28.11	T.Pa.	E.B.	M.B.
		1		GLAND PLATE SIZE ADDED	MR.16.11	E.I.	T.Pa.	M.B.
		REVISIONS						

NOTES

STATUS: FOR DESIGN

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ENG. GROUP SUP.	DATE:	DRAWING SCALE:	1: 20

Vendor or Subcontractor Logo: GNA silutech Inc. Département Ingénierie Engineering Department 8405 Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
FLEX I/O CENTRAL CONTROL PANEL 4481-CP-1001
GENERAL ARRANGEMENT

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
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Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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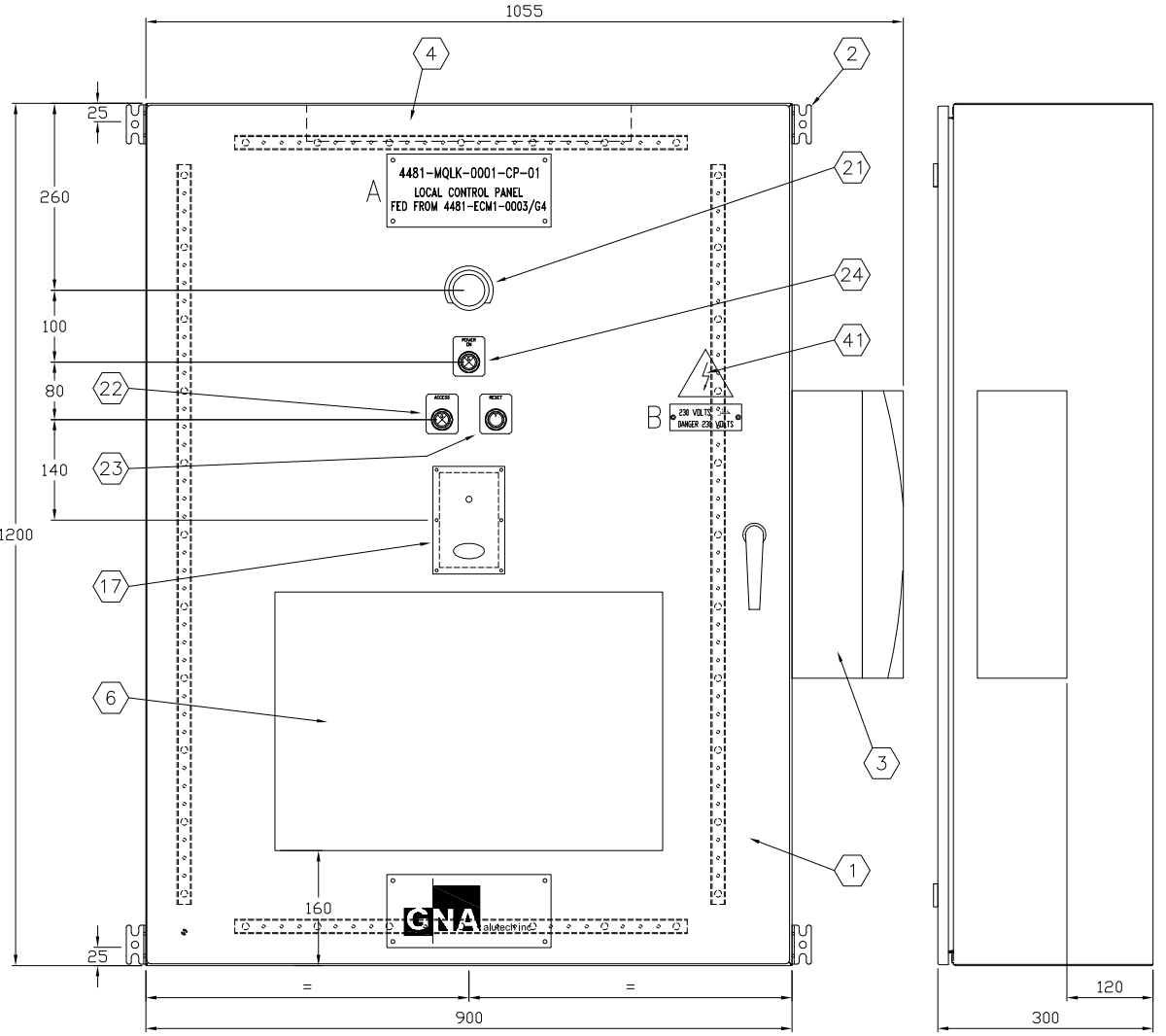

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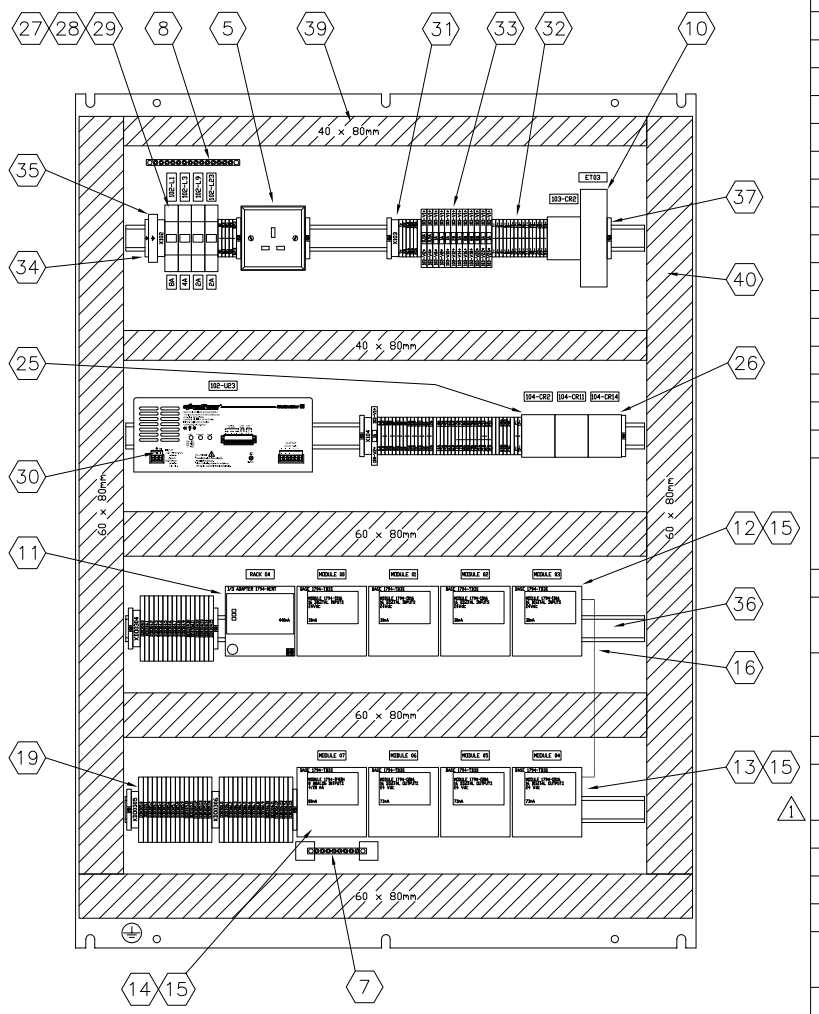

MOUNTING PANEL

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA alutech inc.	101.6mm x 228.6mm
A	1	4481-MQLK-0001-CP-01 LOCAL CONTROL PANEL FED FROM 4481-ECM1-0003/G4	100mm x 230mm FIRST ROW : 14mm 2nd and 3rd ROW : 12mm
B	1	230 VOLTS DANGER 230 VOLTS	37mm x 100mm LETTER DIM. : 8mm
22	1	ACCESS	50mm x 45mm LETTER DIM. : 4mm
23	1	RESET	50mm x 45mm LETTER DIM. : 4mm
24	1	POWER ON	50mm x 45mm LETTER DIM. : 4mm

MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 1200mmX900mmX300mm IP66	RITTAL	WM483612NC
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	KL 1590.000
3	1	AIR CONDITIONER 230Vdc, 60Hz, 100W	RITTAL	3201.200
4	1	FLUORESCENT	RITTAL	SZ 4139.140
5	1	RECEPTACLE 13A, 230Vac, CONFORME BS 1363A	MK ELECTRIC	2958 WHI
6	1	VIEWING COVER	ENVITECH	
7	1	INSULATED GROUND BAR	XXXX	XXXXX
8	1	GROUND BAR	XXXX	XXXXX
9				
10	1	ETHERNET TAP	ALLEN-BRADLEY	1783-ETAP
11	1	FLEX I/O ETHERNET ADAPTER	ALLEN-BRADLEY	1794-AENT
12	4	FLEX I/O DIGITAL DC INPUT MODULE (16)	ALLEN-BRADLEY	1794-IB16
13	3	FLEX I/O DIGITAL DC OUTPUT MODULE (16)	ALLEN-BRADLEY	1794-OB16
14	1	FLEX I/O ANALOG INPUT MODULE (8)	ALLEN-BRADLEY	1794-IF8IH
15	8	TERMINAL BASE	ALLEN-BRADLEY	1794-TB3S
16	1	EXTENDER CABLE	ALLEN-BRADLEY	1794-CE1
17	1	SOLENOID RELEASE UNIT WITH MAIN SAFETY KEY	ALLEN-BRADLEY	MSRUE13
18				
19	48	ISOLATION RELAY 24Vdc	ALLEN-BRADLEY	700-HLT2Z24
20				
21	1	EMERGENCY STOP TURN TO RELEASE OPERATOR RED	TELEMECANIQUE	ZB4BS64
	1	CONTACT BLOCK 1NC	TELEMECANIQUE	ZB4BZ102
	1	GUARD RING	EATON	M22-XGPV
	1	EMERGENCY STOP LABEL	ENVITECH	
22	1	PUSH BUTTON LIGHT WITH PROTECTED LED (GREEN) 1NO	TELEMECANIQUE	XB4BW33B5
23	1	RESET PUSH BUTTON (YELOW)	TELEMECANIQUE	ZB4BA5
	1	CONTACT BLOCK 1NC	TELEMECANIQUE	ZB4BZ102
24	1	PILOT LIGHT HEAD (GREEN)	TELEMECANIQUE	ZB4BV033
	1	LIGHT MODULE WITH PROTECTED LED (GREEN)	TELEMECANIQUE	ZBVM3
	1	BODY / MOUNTING COLLAR	TELEMECANIQUE	ZB4BZ009
25	2	CONTROL RELAIS 24Vdc, 4NO	TELEMECANIQUE	CA3-KN40BD
26	2	CONTROL RELAIS 24Vdc, 2NO+2NC	TELEMECANIQUE	CA3-KN22BD
	1	AUXILIARY CONTACT 4NC	TELEMECANIQUE	LA1-KN04
27	1	CIRCUIT BREAKER 8A	TELEMECANIQUE	MG24431
28	1	CIRCUIT BREAKER 4A	TELEMECANIQUE	MG24428
29	2	CIRCUIT BREAKER 2A	TELEMECANIQUE	MG24426
30	1	POWER SUPPLY 24Vdc; 12,5A	WEIDMULLER	CP SNT (9916250024)
31	BATCH	TERMINAL MARKERS	WEIDMULLER	SchT 5s (163193)
	BATCH	PROTECTIVE STRIPS CLEAR	WEIDMULLER	STR 5s (163194)
32	BATCH	TERMINAL BLOCK 2.5mm ^{2}	WEIDMULLER	ZDU2.5-2/3AN (170601)
33	BATCH	FUSIBLE TERMINAL BLOCK 2.5mm	WEIDMULLER	ZSI2.5 (161640)
34	1	GROUND TERMINAL BLOCK 2.5mm ^{2}	WEIDMULLER	ZPE2.5-2/3AN (170609)
35	1	GROUND TERMINAL BLOCK 16mm ^{2}	WEIDMULLER	ZPE16-2/1AN (177296)
36	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
37	BATCH	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
38				
39	BATCH	DUCT 40mm X 80mm	IBOCO	T1-1530G
40	BATCH	DUCT 60mm X 80mm	IBOCO	T1-2230G
41	1	LABEL 76 x 76mm (ELECTRICAL)	BRADY	89153

G1 FLEX I/O
(CONTROL PANEL 4481-MQLK-0001-CP-01)

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

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		1		UPDATE	31/01/2011	T.Pa	E.B.	M.B.

NOTES

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DATE:			

Vendor or Subcontractor Logo: GNA alutech inc. — Département Ingénierie / Engineering Department, 5450 Trans-Canada, Saint-Laurent, Québec, H4S 1Y9, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-	00AZ-	xx -	xxxx -	xxxx -	xxx - xxx

SELLER DRAWING No. 1347-51030 | REV. 1

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
FLEX I/O LOCAL CONTROL PANEL 4481-MQLK-0001-CP-01
GENERAL ARRANGEMENT

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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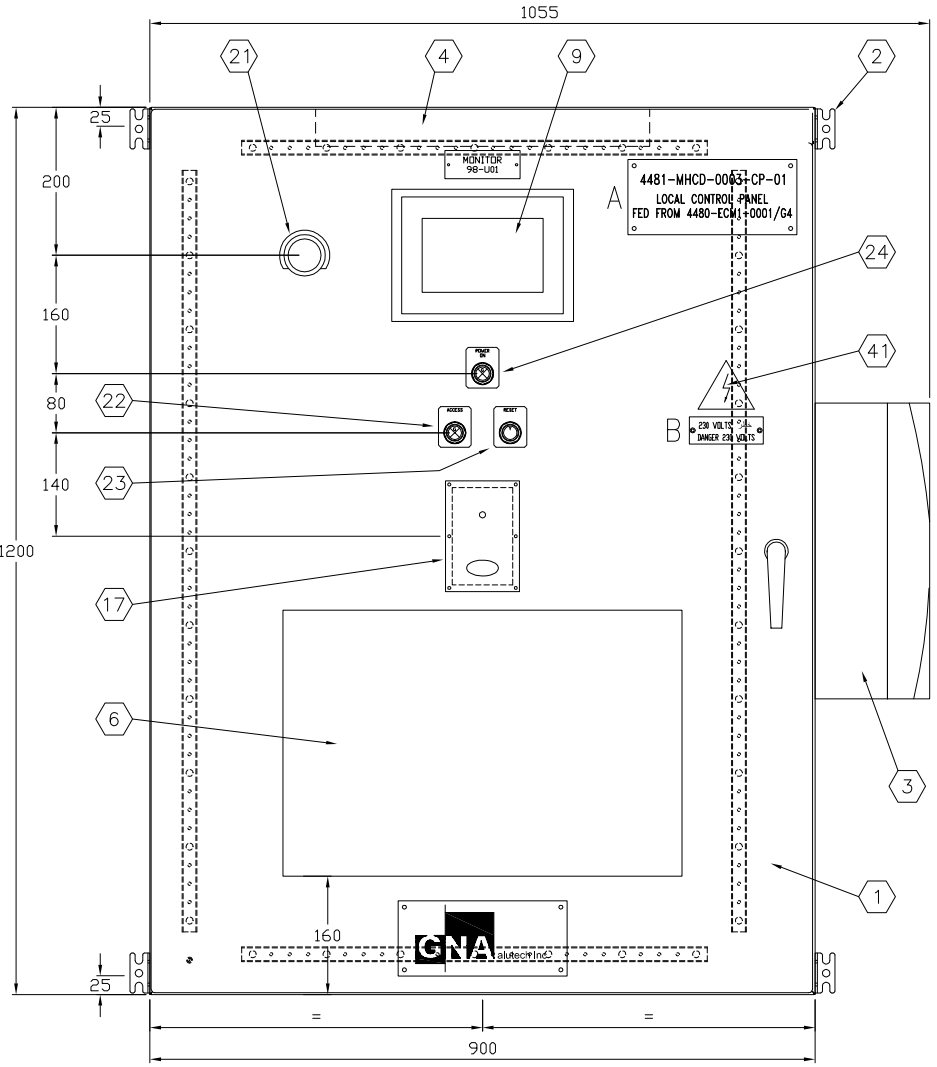

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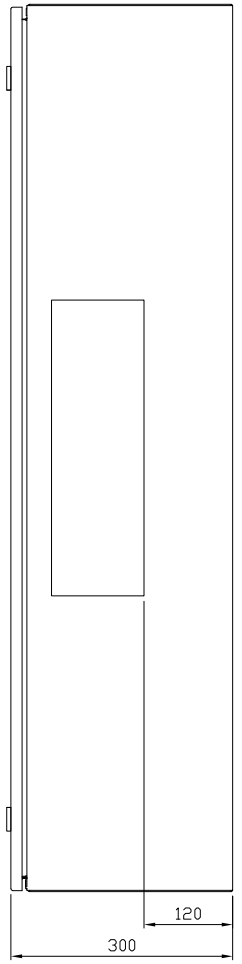

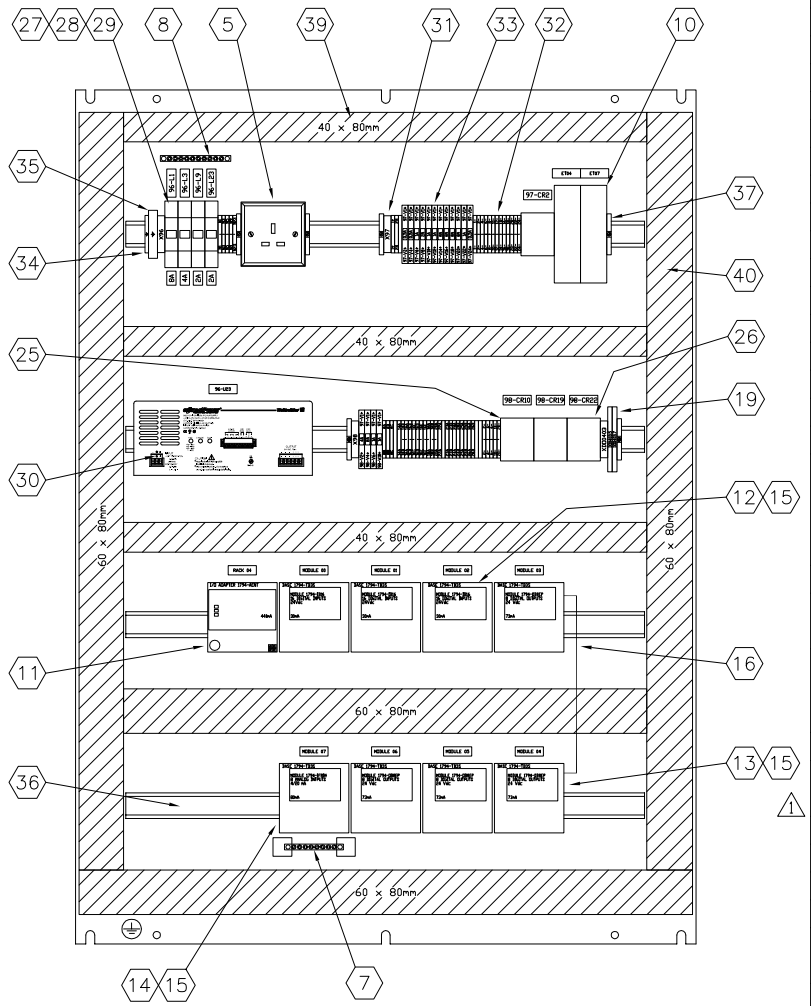

MOUNTING PANEL

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA slutech inc.	101.6mm x 228.6mm
A	1	4481-MHCD-0003-CP-01 LOCAL CONTROL PANEL FED FROM 4480-ECM1-0001/G4	100mm x 230mm FIRST ROW : 14mm 2nd and 3rd ROW : 12mm
B	1	230 VOLTS DANGER 230 VOLTS	37mm x 100mm LETTER DIM. : 8mm
9	1	MONITOR 98-U01	37mm x 100mm LETTER DIM. : 8mm
22	1	ACCESS	50mm x 45mm LETTER DIM. : 4mm
23	1	RESET	50mm x 45mm LETTER DIM. : 4mm
24	1	POWER ON	50mm x 45mm LETTER DIM. : 4mm

MATERIAL LIST

ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 1200mmX900mmX300mm IP66	RITTAL	WM483612NC
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	KL 1590.000
3	1	AIR CONDITIONER 230Vdc, 60Hz, 100W	RITTAL	3201.200
4	1	FLUORESCENT	RITTAL	SZ 4139.140
5	1	RECEPTACLE 13A, 230Vac, CONFORME BS 1363A	MK ELECTRIC	2958 WHI
6	1	VIEWING COVER	ENVITECH	
7	1	INSULATED GROUND BAR	XXXX	XXXXX
8	1	GROUND BAR	XXXX	XXXXX
9	1	PANELVIEW PLUS 700	ALLEN-BRADLEY	2711P-T7C4D1
10	2	ETHERNET TAP	ALLEN-BRADLEY	1783-ETAP
11	1	FLEX I/O ETHERNET ADAPTER	ALLEN-BRADLEY	1794-AENT
12	3	FLEX I/O DIGITAL DC INPUT MODULE (16)	ALLEN-BRADLEY	1794-IB16
13	4	FLEX I/O DIGITAL DC OUTPUT MODULE (8)	ALLEN-BRADLEY	1794-OB8EP
14	1	FLEX I/O ANALOG INPUT MODULE (8)	ALLEN-BRADLEY	1794-IF8IH
15	8	TERMINAL BASE	ALLEN-BRADLEY	1794-TB3S
16	1	EXTENDER CABLE	ALLEN-BRADLEY	1794-CE1
17	1	SOLENOID RELEASE UNIT WITH MAIN SAFETY KEY	ALLEN-BRADLEY	MSRUE13
18				
19	2	ISOLATION RELAY 24Vdc	ALLEN-BRADLEY	700-HLT2Z24
20				
21	1	EMERGENCY STOP TURN TO RELEASE OPERATOR RED	TELEMECANIQUE	ZB4BS64
	1	CONTACT BLOCK 1NC	TELEMECANIQUE	ZB4BZ102
	1	GUARD RING	EATON	M22-XGPV
	1	EMERGENCY STOP LABEL	ENVITECH	
22	1	PUSH BUTTON LIGHT WITH PROTECTED LED (GREEN) 1NO	TELEMECANIQUE	XB4BW33B5
23	1	RESET PUSH BUTTON (YELOW)	TELEMECANIQUE	ZB4BA5
	1	CONTACT BLOCK 1NC	TELEMECANIQUE	ZB4BZ102
24	1	PILOT LIGHT HEAD (GREEN)	TELEMECANIQUE	ZB4BV033
	1	LIGHT MODULE WITH PROTECTED LED (GREEN)	TELEMECANIQUE	ZBVM3
	1	BODY / MOUNTING COLLAR	TELEMECANIQUE	ZB4BZ009
25	2	CONTROL RELAIS 24Vdc, 4NO	TELEMECANIQUE	CA3-KN40BD
26	2	CONTROL RELAIS 24Vdc, 2NO+2NC	TELEMECANIQUE	CA3-KN22BD
	1	AUXILIARY CONTACT 4NC	TELEMECANIQUE	LA1-KN04
27	1	CIRCUIT BREAKER 8A	TELEMECANIQUE	MG24431
28	1	CIRCUIT BREAKER 4A	TELEMECANIQUE	MG24428
29	2	CIRCUIT BREAKER 2A	TELEMECANIQUE	MG24426
30	1	POWER SUPPLY 24Vdc; 12,5A	WEIDMULLER	CP SNT (9916250024)
31	BATCH	TERMINAL MARKERS	WEIDMULLER	SchT 5s (163193)
	BATCH	PROTECTIVE STRIPS CLEAR	WEIDMULLER	STR 5s (163194)
32	BATCH	TERMINAL BLOCK 2.5mm ^{2}	WEIDMULLER	ZDU2.5-2/3AN (170601)
33	BATCH	FUSIBLE TERMINAL BLOCK 2.5mm	WEIDMULLER	ZSI2.5 (161640)
34	1	GROUND TERMINAL BLOCK 2.5mm ^{2}	WEIDMULLER	ZPE2.5-2/3AN (170609)
35	1	GROUND TERMINAL BLOCK 16mm ^{2}	WEIDMULLER	ZPE16-2/1AN (177296)
36	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
37	BATCH	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
38				
39	BATCH	DUCT 40mm X 80mm	IBOCO	T1-1530G
40	BATCH	DUCT 60mm X 80mm	IBOCO	T1-2230G
41	1	LABEL 76 x 76mm (ELECTRICAL)	BRADY	89153

C3 FLEX I/O
(CONTROL PANEL 4481-MHCD-0003-CP-01)

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

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DATE:			

Vendor or Subcontractor Logo: GNA slutech inc. — Département Ingénierie Engineering Department 9405 Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SELLER DRAWING No. 1347-51040 | REV. 1

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
FLEX I/O LOCAL CONTROL PANEL 4481-MHCD-0003-CP-01
GENERAL ARRANGEMENT

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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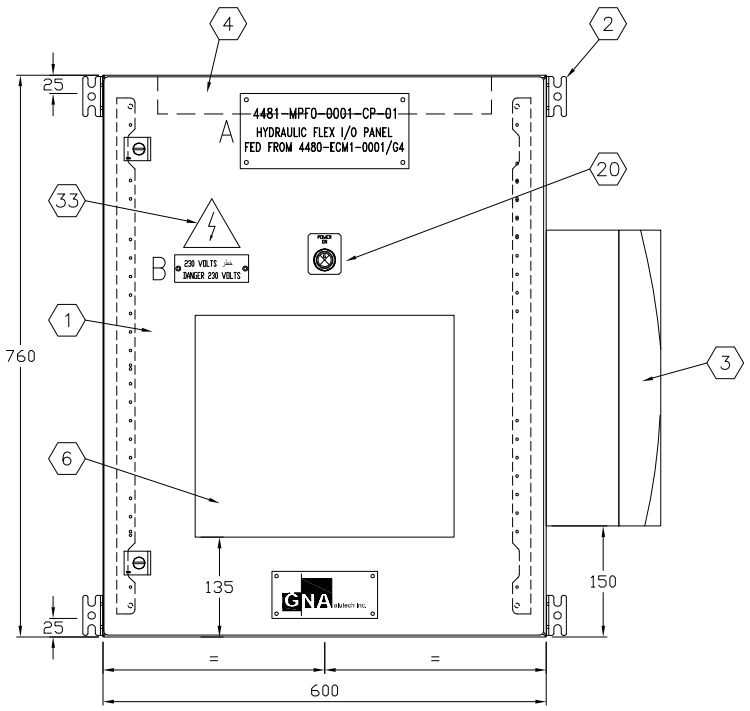
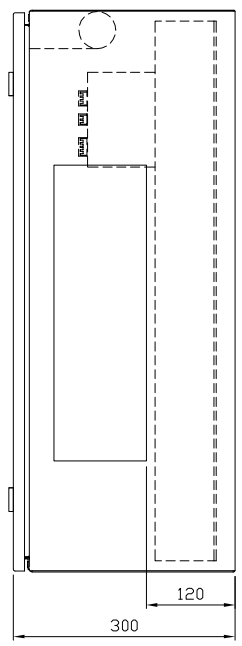
ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA aluTech Inc.	63,5mm x 142,8mm
1	1	4481-MPF0-0001-CP-01 HYDRAULIC FLEX I/O PANEL FED FROM 4480-ECM1-0001/G4	100mm x 230mm FIRST ROW : 14mm 2nd and 3rd ROW : 12mm
1	1	230 VOLTS DANGER 230 VOLTS	37mm x 100mm LETTER DIM. : 8mm
20	1	POWER ON	50mm x 45mm LETTER DIM. : 4mm





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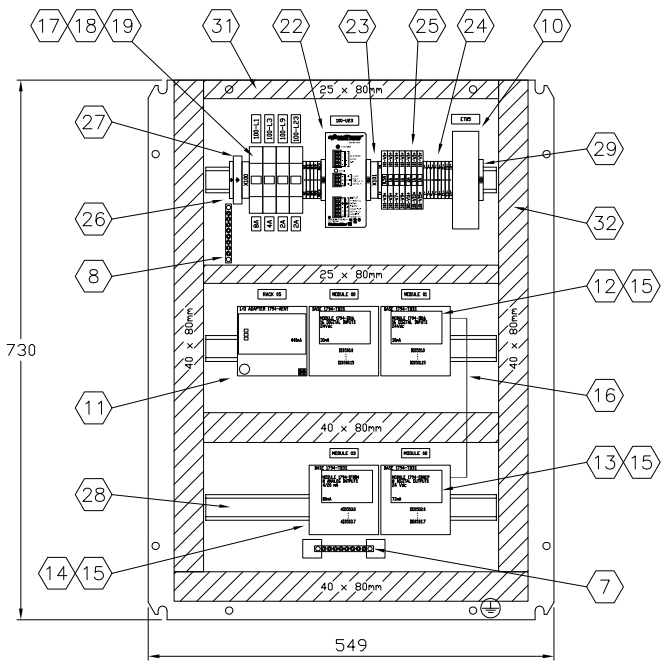

MOUNTING PANEL

MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 760mmX600mmX300mm IP66	RITTAL	WM302412NC
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	KL 1590.000
3	1	AIR CONDITIONER 230Vdc, 60Hz, 100W	RITTAL	3201.200
4	1	FLUORESCENT 24Vdc	XXXX	XXXXX
5				
6	1	VIEWING COVER	XXXX	XXXXX
7	1	INSULATED GROUND BAR	XXXX	XXXXX
8	1	GROUND BAR	XXXX	XXXXX
9				
10	1	ETHERNET TAP	ALLEN-BRADLEY	1783-ETAP
11	1	FLEX I/O ETHERNET ADAPTER	ALLEN-BRADLEY	1794-AENT
12	2	FLEX I/O DIGITAL DC INPUT MODULE (16)	ALLEN-BRADLEY	1794-IB16
13	1	FLEX I/O DIGITAL DC OUTPUT MODULE (8)	ALLEN-BRADLEY	1794-OB8EP
14	1	FLEX I/O ANALOG INPUT MODULE (8)	ALLEN-BRADLEY	1794-IF8IH
15	4	TERMINAL BASE	ALLEN-BRADLEY	1794-TB3S
16	1	EXTENDER CABLE	ALLEN-BRADLEY	1794-CE1
17	1	CIRCUIT BREAKER 8A	TELEMECANIQUE	MG24431
18	1	CIRCUIT BREAKER 4A	TELEMECANIQUE	MG24428
19	2	CIRCUIT BREAKER 2A	TELEMECANIQUE	MG24426
20	1	PILOT LIGHT HEAD (GREEN)	TELEMECANIQUE	ZB4BV033
	1	LIGHT MODULE WITH PROTECTED LED (GREEN)	TELEMECANIQUE	ZBVM3
	1	BODY / MOUNTING COLLAR	TELEMECANIQUE	ZB4BZ009
21				
22	1	POWER SUPPLY 24Vdc; 6,5A	WEIDMULLER	CP SNT (9925340024)
23	BATCH	TERMINAL MARKERS	WEIDMULLER	SchT 5s (163193)
	BATCH	PROTECTIVE STRIPS CLEAR	WEIDMULLER	STR 5s (163194)
24	BATCH	TERMINAL BLOCK 2.5mm ^{2}	WEIDMULLER	ZDU2.5-2/3AN (170601)
25	BATCH	FUSIBLE TERMINAL BLOCK 2.5mm	WEIDMULLER	ZSI2.5 (161640)
26	1	GROUND TERMINAL BLOCK 2.5mm ^{2}	WEIDMULLER	ZPE2.5-2/3AN (170609)
27	1	GROUND TERMINAL BLOCK 16mm ^{2}	WEIDMULLER	ZPE16-2/1AN (177296)
28	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
29	3	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
30				
31	BATCH	DUCT 25mm X 80mm	IBOCO	T1-1030G
32	BATCH	DUCT 40mm X 80mm	IBOCO	T1-1530G
33	1	LABEL 76 x 76mm (ELECTRICAL)	BRADY	89153

NOTES:

1 -PAINT:
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H1 HYDRAULIC
(CONTROL PANEL 4481-MPF0-0001-CP-01)

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		REVISIONS						

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DATE:			

Vendor or Subcontractor Logo: GNA aluTech inc. — Département Ingénierie / Engineering Department, 8495 Trans-Canada, Saint-Laurent, Québec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SELLER DRAWING No. 1347-51050 REV. 1

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
FLEX I/O LOCAL CONTROL PANEL 4481-MPF0-0001-CP-01
GENERAL ARRANGEMENT

MA'ADEN

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

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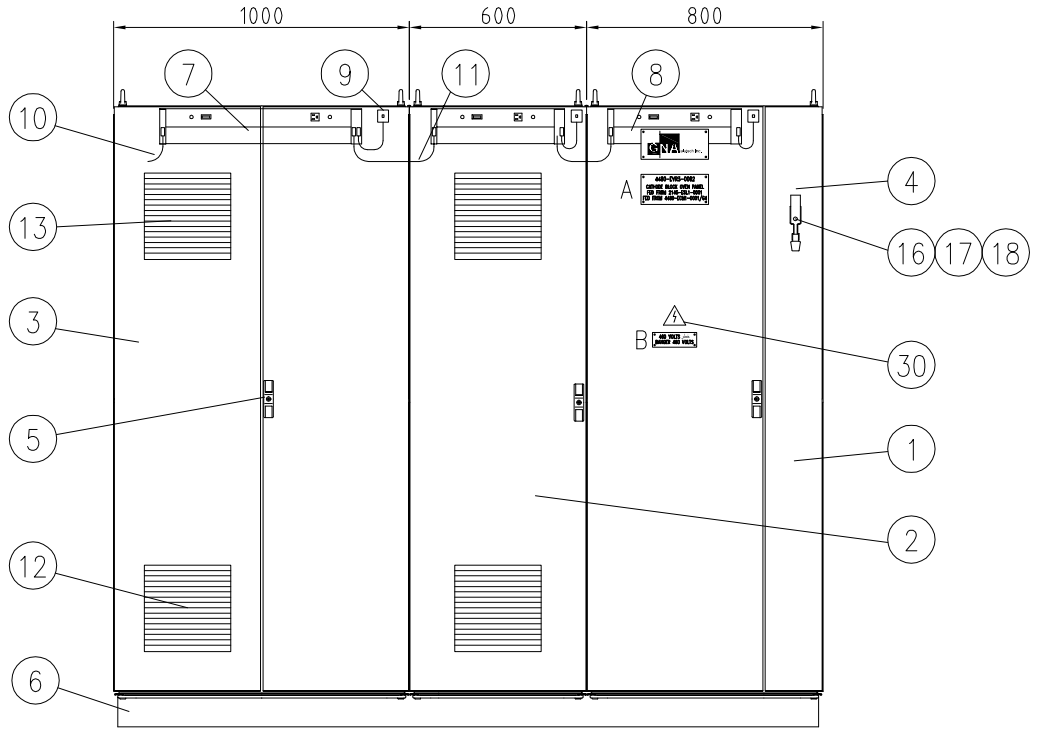

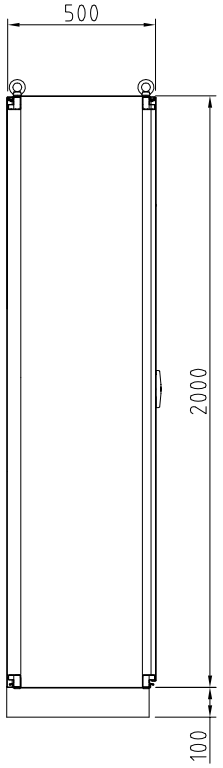

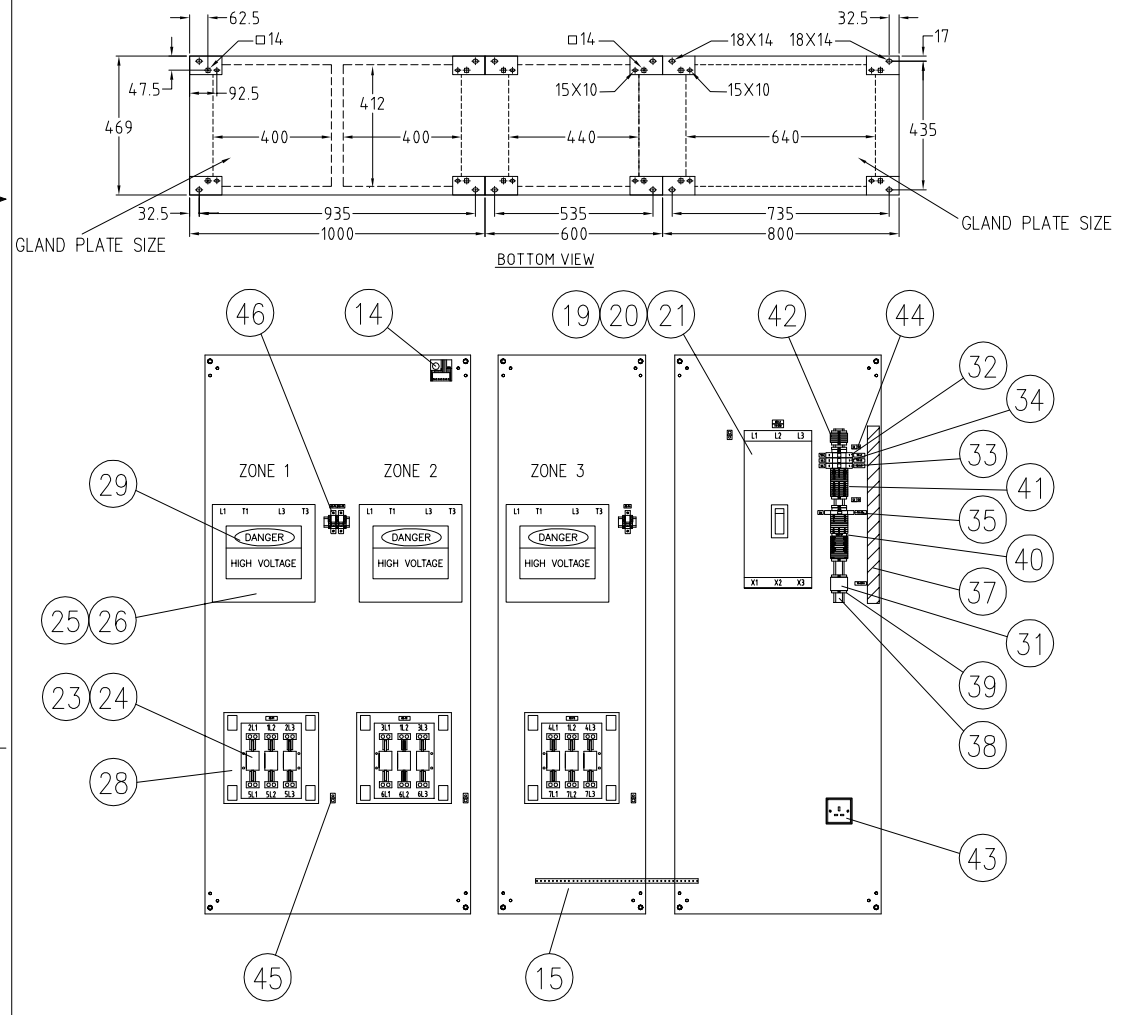

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA ultech inc.	101,6mm x 228,6mm
A	1	4480-EVR3-0002 CATHODE BLOCK OVEN PANEL FED FROM 2145-ESL1-0001 FED FROM 4480-ECM1-0001/G4	100mm x 230mm FIRST ROW : 14mm 2nd, 3rd and 4th ROW : 12mm
B	1	460 VOLTS DANGER 460 VOLTS	50mm x 150mm LETTER DIM. : 12mm

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

F1 SCR CONTROL PANEL (CATHODE BLOCK OVEN)

SELLER/CONTRACTOR DOCUMENT REVIEW

Permission to proceed doesnot constitute acceptance or approval of design details, calculations, analysis, test methods, or materials developed or selected by SELLER/CONTRACTOR, and does not relieve SELLER/CONTRACTOR from full compliance with contractual obligations

1 ☐	Work may proceed.	4 ☐	Revise not required. Work may proceed.
2 ☐	Revise & Resubmit. Work may proceed subject to incorporation of changes.	5 ☐	VOID / Superseded.
3 ☐	Revise & Resubmit. Work may NOT proceed.	DDR Nor :	179

Reviewed by : _____ Date : _____

Discipline :

Document No : 25457-4480-V1A-MXA0-0190 | Rev. :

MATERIAL LIST

ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	DISCONNECT PANEL 2000 mm X 800 mm X 500 mm	RITTAL	TS 8905.500
	1	SIDEWALL SCREW-FASTENED, FOR TS	RITTAL	TS 8105.235
	2	COVER FOR BAYING (TOP)	RITTAL	TS 8800.850
	2	BAYING CLAMP, VERTICAL TS	RITTAL	TS 8800.410
	2	ANGULAR BAYING BRACKET TS	RITTAL	TS 8800.430
2	1	PANEL 2000 mm X 600 mm X 500 mm (1 DOOR)	RITTAL	TS 8605.500
3	1	PANEL 2000 mm X 1000 mm X 500 mm (2 DOORS)	RITTAL	TS 8005.500
4	1	INTERLOCK ACTIVATOR	RITTAL	TS 4912.000
	2	SLAVE DOOR DEFEATER KIT	RITTAL	TS 4911.000
	1	INTERLOCKING ROD	RITTAL	TS 4920.000
	1	FLANGE MOUNT DISCONNECT LOCK	RITTAL	TS 8611.310
5	3	COMFORT HANDLE FOR SEMICYLINDER	RITTAL	TS 8611.280
	3	LOCK AND PUSHBUTTON INSERT	RITTAL	SZ 2469.000
6	1	BASE/PLINTH COMPONENT FRONT AND REAR FOR TS(100mm)	RITTAL	TS 8601.800
	1	BASE/PLINTH COMPONENT FRONT AND REAR FOR TS (100mm)	RITTAL	TS 8601.600
	1	BASE/PLINTH COMPONENT FRONT AND REAR FOR TS (100mm)	RITTAL	TS 8601.000
	2	BASE/PLINTH SIDE TRIM PANELS FOR TS (100mm)	RITTAL	TS 8601.050
7	1	FLUORESCENT LIGHT & RECEPTACLE 230V/60Hz	RITTAL	SZ 4139.180
8	2	FLUORESCENT LIGHT & RECEPTACLE 230V/60Hz	RITTAL	SZ 4139.140
9	3	DOOR-OPERATED SWITCH WITH POWER CORD 1m	RITTAL	SZ 4315.300
10	1	CONNECTION CABLE WITH SOCKET, WITHOUT PLUG 3m	RITTAL	SZ 4315.100
11	2	CONNECTION CABLE WITH SOCKET AND PLUG 1m	RITTAL	SZ 4315.200
12	2	FAN 230V/60Hz	RITTAL	SK 3327.107
13	2	FAN FILTER	RITTAL	SK 3326.207
14	1	THERMOSTAT (FAN)	RITTAL	SK 3110.000
1 15	1	NON INSULATED GROUND BAR (35 mm²)	RITTAL	SZ 2364.000
	1	MOUNTING BRACKET	RITTAL	SZ 2365.000
16	1	DISCONNECT HANDLE	SIEMENS	FH0HN
17	1	BREAKER OPERATOR	SIEMENS	FH0NBO
18	1	CABLE	SIEMENS	FH0NC060
19	1	CIRCUIT BREAKER	SIEMENS	ND63B800-L
20	1	UNDERVOLTAGE TRIP 24Vdc, 2 AUX. SWITCHES	SIEMENS	U07MN64AA
21	1	LUG	SIEMENS	3TA4N8500
22				
23	3	FUSE BLOCK 400A, 600V, 3POLE	GOULD SHAWMUT	64033J
24	9	FAST ACTING FUSE 250A	GOULD SHAWMUT	A4J250
25	3	SCR POWER CONTROLLER 300A, 480V, 2 LEGS	WATLOW	Q32-482-300-BV0
26	3	LUG KIT		
27				
28	3	CLEAR PROTECTIVE COVER	CONTROLES RL	
29	3	LABEL 178 x 254mm (HIGH VOLTAGE)	CONTROLES RL	
30	1	LABEL 76 x 76mm (ELECTRICAL)	BRADY	89153
1 31	1	CONTROL RELAY 24Vdc, 3NO, 1NC	TELEMECANIQUE	CA3-KN31BD
32	1	CIRCUIT BREAKER 10A	TELEMECANIQUE	MG24432
33	1	CIRCUIT BREAKER 6A	TELEMECANIQUE	MG24430
34	1	CIRCUIT BREAKER 4A	TELEMECANIQUE	MG24428
35	1	CIRCUIT BREAKER 2A	TELEMECANIQUE	MG24426
36				
37	BATCH	DUCT 40mm X 80mm	IBOCO	T1-1530G
38	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
39	BATCH	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
40	BATCH	TERMINAL MARKERS	WEIDMULLER	SchT 5s (163193)
	BATCH	PROTECTIVE STRIPS CLEAR	WEIDMULLER	STR 5s (163194)
41	BATCH	TERMINAL BLOCKS 2,5mm²	WEIDMULLER	ZDU2.5-2/3AN (170601)
42	BATCH	GROUND TERMINAL BLOCKS 2,5mm²	WEIDMULLER	ZPE2.5-2/3AN (170609)
43	1	RECEPTACLE 13A, 250Vac, 2P3W CONFORME BS1363A	INTERNATIONAL	72215
	1	PCV BOX FOR RECEPTACLE	INTERNATIONAL	72360
44	2	CONNECTOR	THOMAS & BETTS	ADR2
45	4	CONNECTOR	THOMAS & BETTS	ADR11
46	3	FUSE HOLDER 1 POLE, 50A, 750V	FERRAZ	US141
	3	FUSE 1A, 690V	FERRAZ	17011-G

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SELLER DRAWING No. 1347-51060 | REV. 1

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REFERENCES		1		UPDATE	14/02/2011	T.Pa.	E.B.	M.B.
		REVISIONS						

NOTES

STATUS: FOR DESIGN

DRAWN/DES'D:	F.P.	AREA ENG.:	
DATE:	28/07/2010	DATE:	
CHECKED:	E.B.	PRJ ENG MGR:	
DATE:		DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	1:25
DATE:			

Vendor or Subcontractor Logo: GNA ultech inc. Département Ingénierie Engineering Department 9405 Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CATHODE BLOCK OVEN SCR PANEL 4480-EVR3-0002
GENERAL ARRANGEMENT

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
—	—	—		A3-		-AZ	

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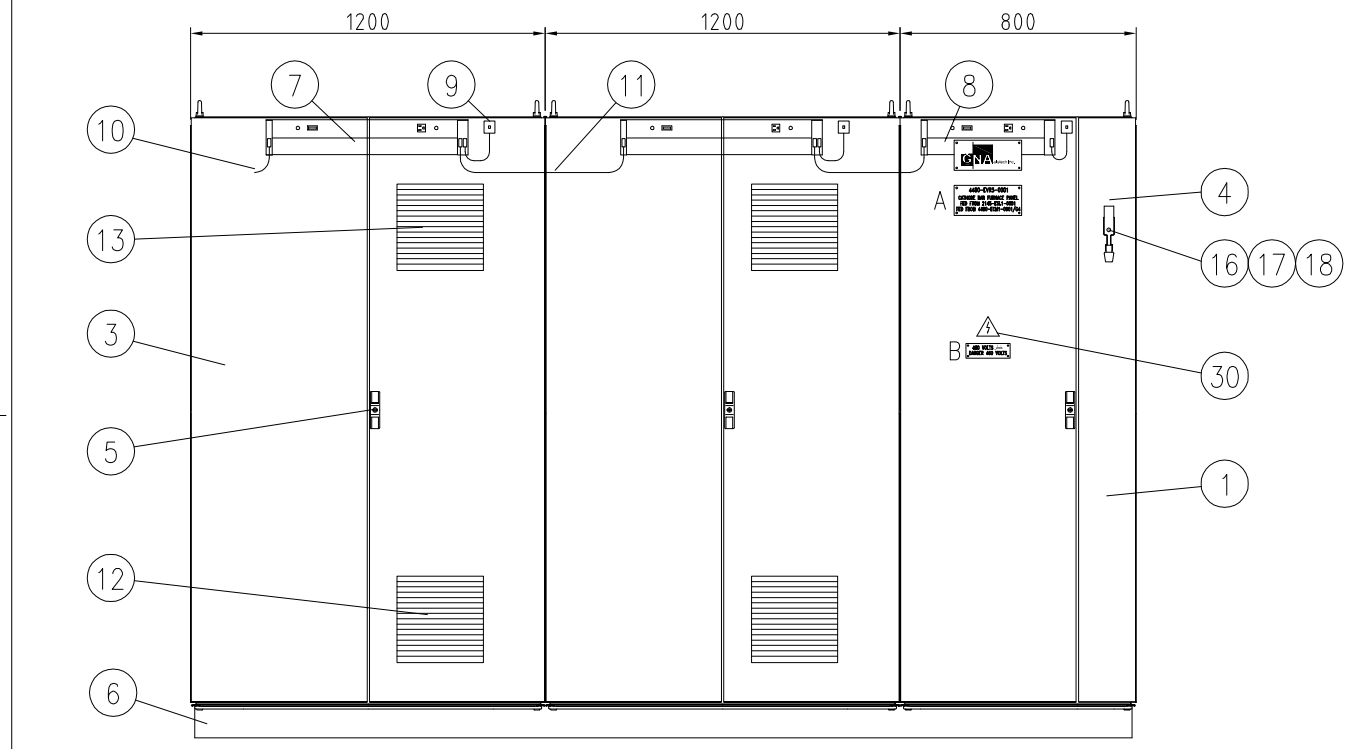
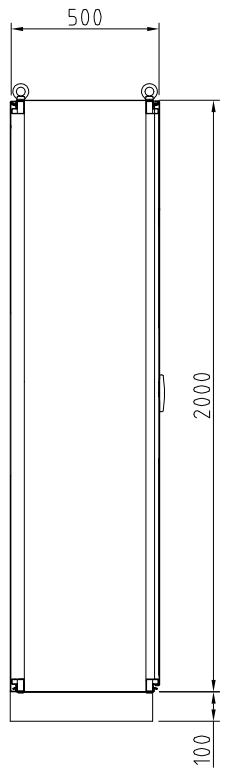
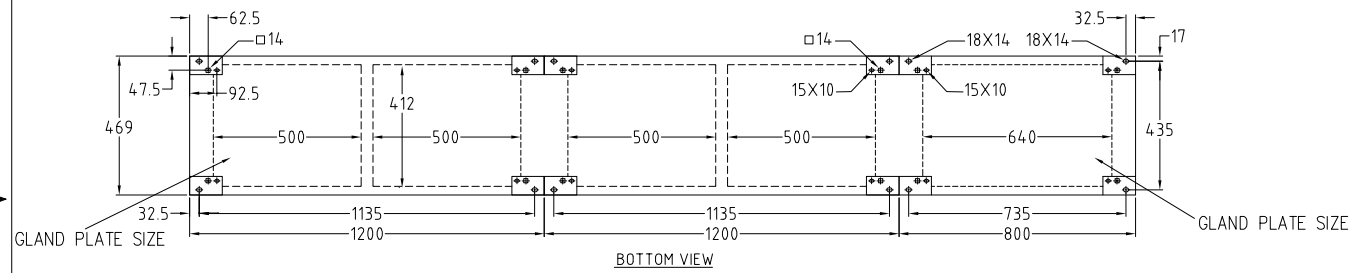
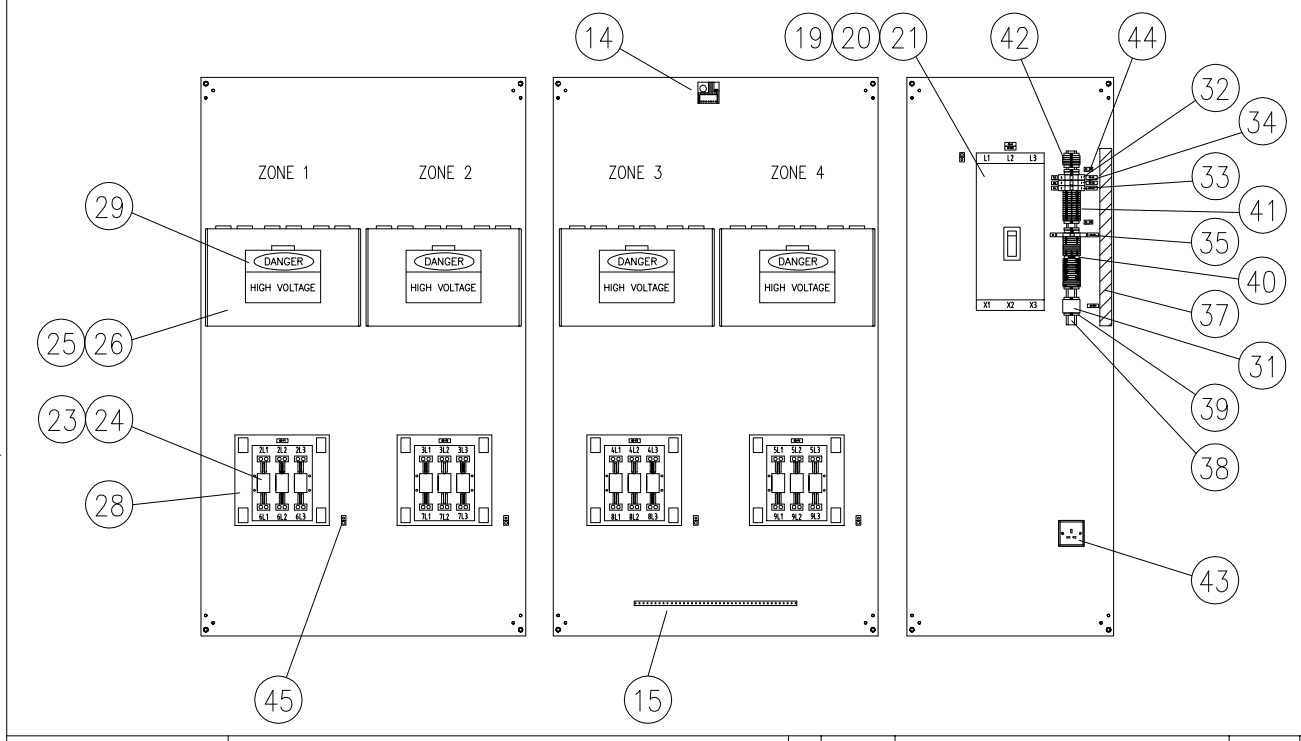






BOTTOM VIEW



ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA eLutech Inc.	101,6mm x 228,6mm
A	1	4480-EVR3-0001 CATHODE BAR FURNACE PANEL FED FROM 2145-ESL1-0001 FED FROM 4480-ECM1-0001/G4	100mm x 230mm FIRST ROW : 14mm 2nd, 3rd and 4th ROW : 12mm
B	1	460 VOLTS DANGER 460 VOLTS	50mm x 150mm LETTER DIM. : 12mm

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

F2 SCR CONTROL PANEL (CATHODE BAR FURNACE)

SELLER/CONTRACTOR DOCUMENT REVIEW

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5 ☐ VOID / Superseded.

DDR Nbr : 179

Reviewed by : _____ Date : _____

Discipline :

Document No : 25457-4480-V1A-MXA0-0193 Rev. :

ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
		MATERIAL LIST		
1	1	DISCONNECT PANEL 2000 mm X 800 mm X 500 mm	RITTAL	TS 8905.500
	1	SIDEWALL SCREW-FASTENED, FOR TS	RITTAL	TS 8105.235
	2	COVER FOR BAYING (TOP)	RITTAL	TS 8800.850
	2	BAYING CLAMP, VERTICAL TS	RITTAL	TS 8800.410
	2	ANGULAR BAYING BRACKET TS	RITTAL	TS 8800.430
2	2	PANEL 2000 mm X 1200 mm X 500 mm (2 DOORS)	RITTAL	TS 8205.500
3				
4	1	INTERLOCK ACTIVATOR	RITTAL	TS 4912.000
	2	SLAVE DOOR DEFEATER KIT	RITTAL	TS 4911.000
	1	INTERLOCKING ROD	RITTAL	TS 4920.000
	1	FLANGE MOUNT DISCONNECT LOCK	RITTAL	TS 8611.310
5	3	COMFORT HANDLE FOR SEMICYLINDER	RITTAL	TS 8611.280
	3	LOCK AND PUSHBUTTON INSERT	RITTAL	SZ 2469.000
6	1	BASE/PLINTH COMPONENT FRONT AND REAR FOR TS(100mm)	RITTAL	TS 8601.800
	1	BASE/PLINTH COMPONENT FRONT AND REAR FOR TS (100mm)	RITTAL	TS 8601.600
	1	BASE/PLINTH COMPONENT FRONT AND REAR FOR TS (100mm)	RITTAL	TS 8601.000
	2	BASE/PLINTH SIDE TRIM PANELS FOR TS (100mm)	RITTAL	TS 8601.050
7	2	FLUORESCENT LIGHT & RECEPTACLE 230V/60Hz	RITTAL	SZ 4139.180
8	1	FLUORESCENT LIGHT & RECEPTACLE 230V/60Hz	RITTAL	SZ 4139.140
9	3	DOOR-OPERATED SWITCH WITH POWER CORD 1m	RITTAL	SZ 4315.300
10	1	CONNECTION CABLE WITH SOCKET, WITHOUT PLUG 3m	RITTAL	SZ 4315.100
11	2	CONNECTION CABLE WITH SOCKET AND PLUG 1m	RITTAL	SZ 4315.200
12	2	FAN 230V/60Hz	RITTAL	SK 3327.107
13	2	FAN FILTER	RITTAL	SK 3326.207
14	1	THERMOSTAT (FAN)	RITTAL	SK 3110.000
1 15	1	NON INSULATED GROUND BAR (35 mm²)	RITTAL	SZ 2364.000
	1	MOUNTING BRACKET	RITTAL	SZ 2365.000
16	1	DISCONNECT HANDLE	SIEMENS	FHOHN
17	1	BREAKER OPERATOR	SIEMENS	FHONBO
18	1	CABLE	SIEMENS	FHONC060
19	1	CIRCUIT BREAKER	SIEMENS	ND63B120-L
20	1	UNDERVOLTAGE TRIP 24Vdc, 2 AUX. SWITCHES	SIEMENS	U07MN64AA
21	1	LUG	SIEMENS	3TA4N8500
22				
23	4	FUSE BLOCK 400A, 600V, 3POLE	GOULD SHAWMUT	64033J
24	12	FAST ACTING FUSE 300A	GOULD SHAWMUT	A4J300
25	3	SCR POWER CONTROLLER 300A, 480V, 3 LEGS	WATLOW	Q33-482-300-AL0
26	3	LUG KIT		
27				
28	4	CLEAR PROTECTIVE COVER	CONTROLES RL	
29	4	LABEL 178 x 254mm (HIGH VOLTAGE)	CONTROLES RL	
30	1	LABEL 76 x 76mm (ELECTRICAL)	BRADY	89153
1 31	1	CONTROL RELAY 24Vdc, 3NO, 1NC	TELEMECANIQUE	CA3-KN31BD
	1	AUXILIARY CONTACT 4NO	TELEMECANIQUE	LA1-KN40
32	1	CIRCUIT BREAKER 10A	TELEMECANIQUE	MG24432
33	1	CIRCUIT BREAKER 6A	TELEMECANIQUE	MG24430
34	1	CIRCUIT BREAKER 4A	TELEMECANIQUE	MG24428
35	1	CIRCUIT BREAKER 2A	TELEMECANIQUE	MG24426
36				
37	BATCH	DUCT 40mm X 80mm	IBOCO	T1-1530G
38	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
39	BATCH	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
40	BATCH	TERMINAL MARKERS	WEIDMULLER	SchT 5s (163193)
	BATCH	PROTECTIVE STRIPS CLEAR	WEIDMULLER	STR 5s (163194)
41	BATCH	TERMINAL BLOCKS 2,5mm²	WEIDMULLER	ZDU2.5-2/3AN (170601)
42	BATCH	GROUND TERMINAL BLOCKS 2,5mm²	WEIDMULLER	ZPE2.5-2/3AN (170609)
43	1	RECEPTACLE 13A, 250Vac, 2P3W CONFORME BS1363A	INTERNATIONAL	72215
	1	PCV BOX FOR RECEPTACLE	INTERNATIONAL	72360
44	2	CONNECTOR	THOMAS & BETTS	ADR2
45	5	CONNECTOR	THOMAS & BETTS	ADR11

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1347-51070	1

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		1		UPDATE	14/02/2011	T.Pa.	E.B.	M.B.
		REVISIONS						

NOTES

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DATE:			

Vendor or Subcontractor Logo: GNA eLutech Inc. — Département Ingénierie / Engineering Department, 9405 Trans-Canada, Saint-Laurent, Québec H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CATHODE BAR HEATING FURNACE SCR PANEL 4480-EVR3-0001
GENERAL ARRANGEMENT

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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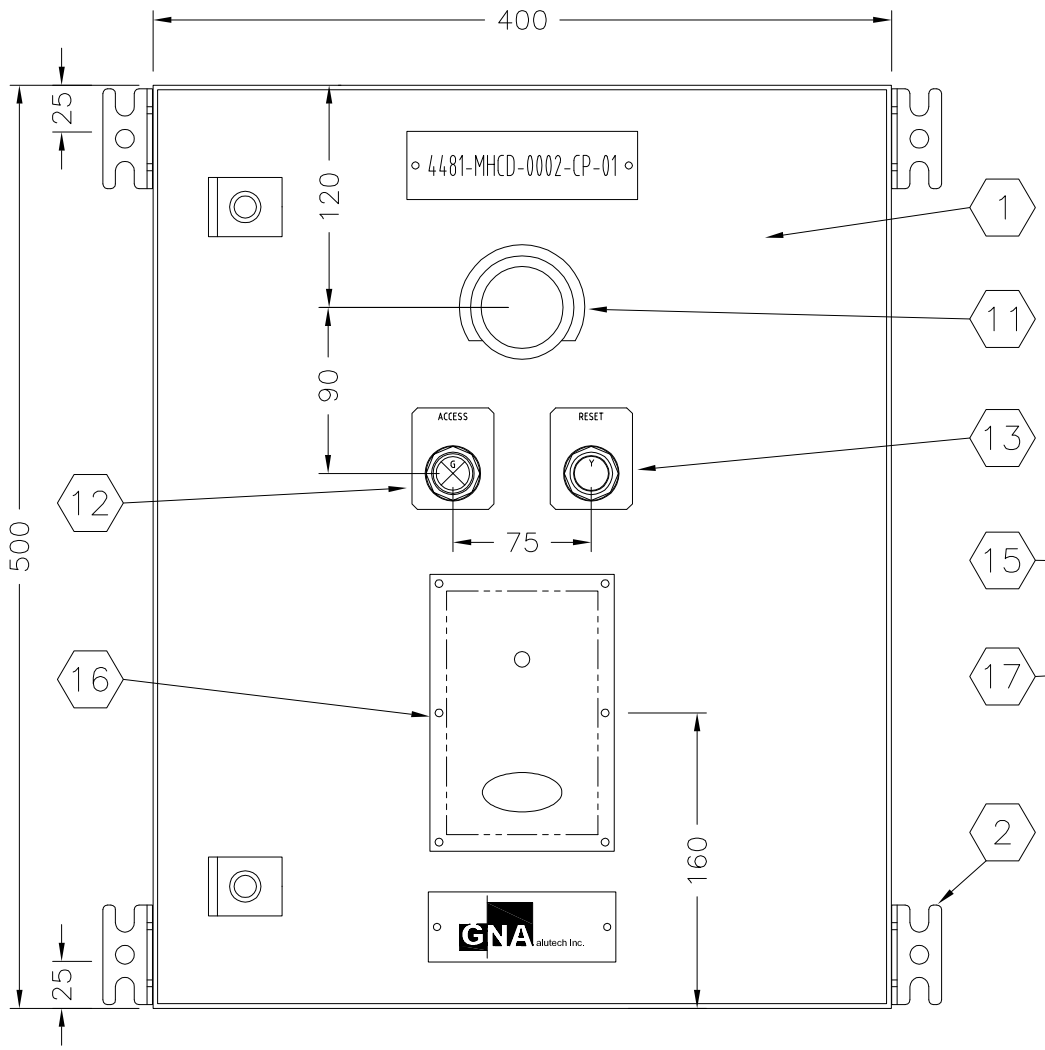
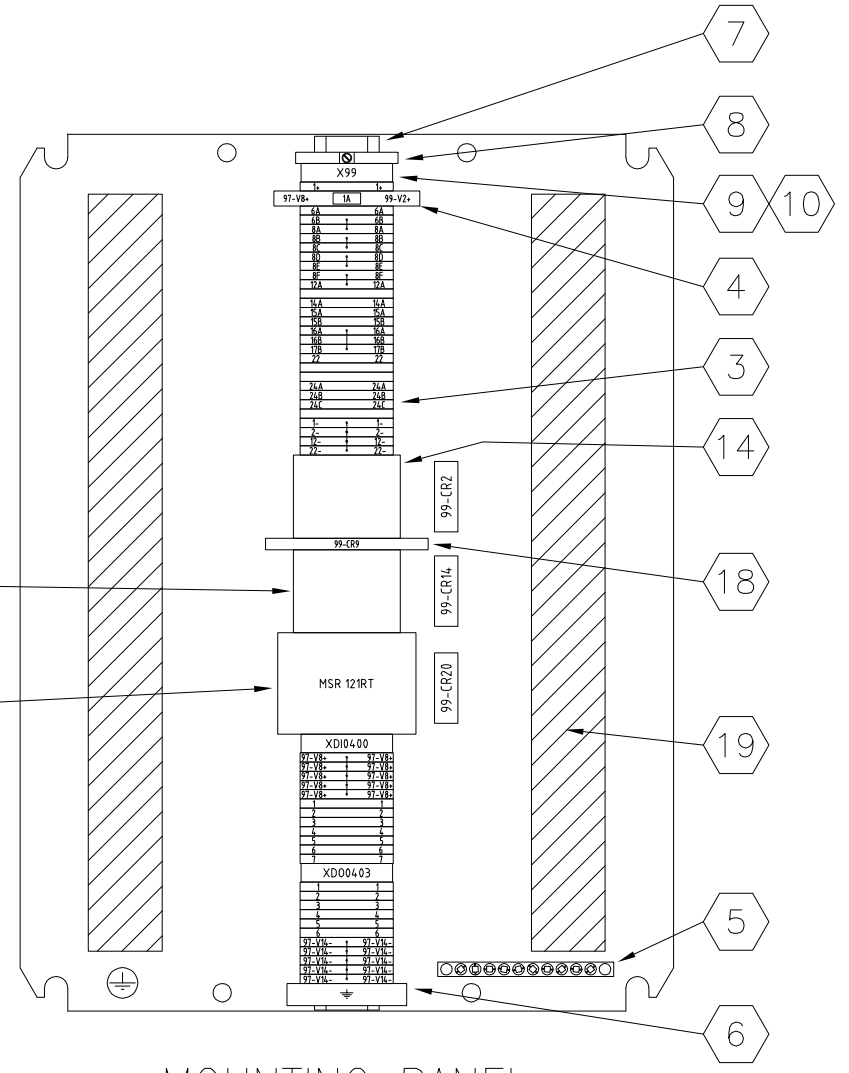


500mm X 400mm X 210mm



MOUNTING PANEL

MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 500mmX400mmX210mm IP66	RITTAL	AE 1045.500
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	SZ 2503.010
3	BATCH	TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZDU2.5-2/3AN (170601)
4	1	FUSIBLE TERMINAL BLOCK 2.5mm	WEIDMULLER	ZSI2.5 (161640)
5	1	GROUND BAR	ENVITECH	XXXXX
6	1	GROUND TERMINAL BLOCK 16mm^2	WEIDMULLER	ZPE16-2/1AN (177296)
7	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
8	BATCH	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
9	BATCH	TERMINAL MARKERS (20)	WEIDMULLER	SchT 5s (163193)
10	BATCH	PROTECTIVE STRIPS CLEAR (20)	WEIDMULLER	STR 5s (163194)
11	1	EMERGENCY STOP TURN TO RELEASE OPERATOR RED	TELEMECANIQUE	ZB4BS64
	1	CONTACT BLOCK 1NC	TELEMECANIQUE	ZB4BZ102
	1	GUARD RING	EATON	M22-XGPV
	1	EMERGENCY STOP LABEL	ENVITECH	
12	1	PUSH BUTTON LIGHT WITH PROTECTED LED (GREEN) 1NO	TELEMECANIQUE	XB4BW33B5
13	1	RESET PUSH BUTTON (YELOW)	TELEMECANIQUE	ZB4BA5
	1	CONTACT BLOCK 1NC	TELEMECANIQUE	ZB4BZ102
14	1	CONTROL RELAIS 24Vdc, 4NO	TELEMECANIQUE	CA3-KN40BD
15	1	CONTROL RELAIS 24Vdc, 2NO+2NC	TELEMECANIQUE	CA3-KN22BD
16	1	SOLENOID RELEASE UNIT WITH MAIN SAFETY KEY	ALLEN-BRADLEY	MSRUE13
17	1	SAFETY RELAY MSR 121RT	ALLEN-BRADLEY	440R-J23102
18	1	ISOLATION RELAIS 24Vdc	ALLEN-BRADLEY	700-HLT2Z24
19	BATCH	DUCT 40mm X 80mm	IBOCO	T1-1530G

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA alutech inc.	38,1mm x 101,6mm
1	1	4481-MHCD-0002-CP-01	37mm x 125mm LETTER DIM. : 12mm
12	1	ACCESS	50mm x 45mm LETTER DIM. : 4mm
13	1	RESET	50mm x 45mm LETTER DIM. : 4mm

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

C2 CHAIN CONVEYOR UPSTREAM OF SHOTBLASTING MACHINE
R9 CONICAL ROLLER CONVEYOR AT SHOTB. M. ENTRANCE
EMERGENCY STOP, ACCESS LIGHT / RESET
(LOCAL CONTROL PANEL 4481-MHCD-0002-CP-01)

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Reviewed by : _____ Date : _____

Discipline :

Document No : 25457-4480-V1A-MXA0-0072 | Rev. :

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
		1		UPDATE	31/01/2011	T.Pa	E.B.	M.B.
REFERENCES		REVISIONS						

NOTES

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DATE:	26/10/2010	DATE:	
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BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No | SUBD. | DISC. | SECTOR | SEQUENCE | REV.
25457-00AZ- xx - xxxx - xxxx - xxx - xxx

SELLER DRAWING No. 1347-51080 | REV. 1

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
LOCAL CONTROL PANEL 4481-MHCD-0002-CP-01
GENERAL ARRANGEMENT

MA'ADEN

Type | Building | Discipline | Phase | Format | Sequential | Location | Rev. No.
— | — | — | — | A3- | | -AZ |

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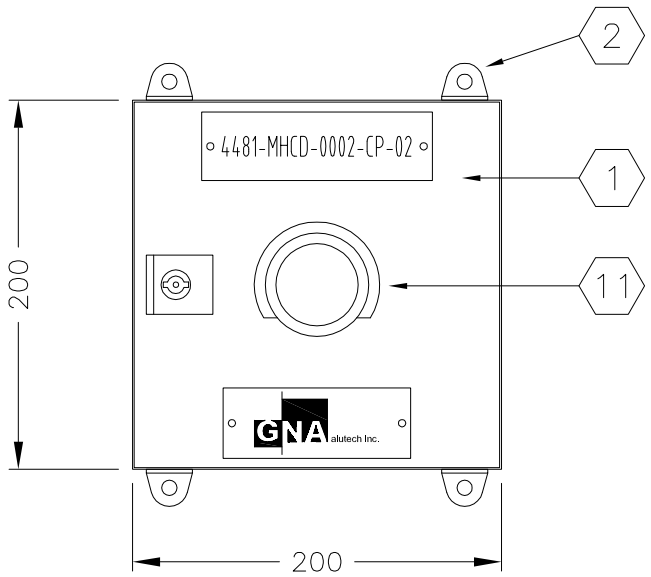
MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 200mmX200mmX120mm IP66	RITTAL	EB 1549.500
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	KL 1590.000
3	3	TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZDU2.5-2/3AN (170601)
4	1	GROUND TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZPE2.5-2/3AN (170609)
5	1	GROUND TERMINAL BLOCKS 16mm^2	WEIDMULLER	ZPE16-2/1AN (177296)
6				
7	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
8	1	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
9	BATCH	TERMINAL MARKERS (20)	WEIDMULLER	SchT 5s (163193)
10	BATCH	PROTECTIVE STRIPS CLEAR (20)	WEIDMULLER	STR 5s (163194)
11	1	EMERGENCY STOP TURN TO RELEASE OPERATOR	TELEMECANIQUE	ZB4BS64
	1	CONTACT BLOCK	TELEMECANIQUE	ZB4BZ102
	1	GUARD RING	EATON	M22-XGPV
	1	EMERGENCY STOP LABEL	ENVITECH	



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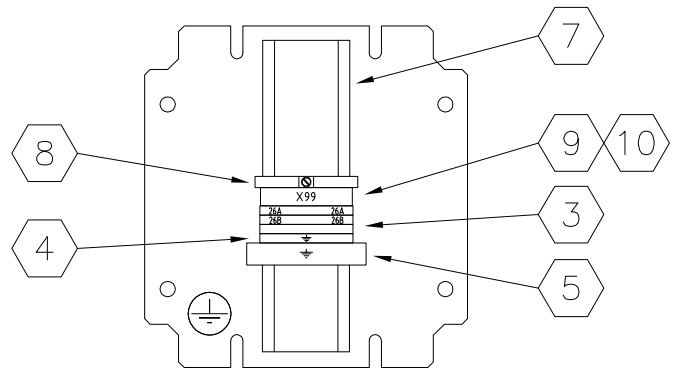

MOUNTING PANEL

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA alutech inc.	38,1mm x 101,6mm
1	1	4481-MHCD-0002-CP-02	37mm x 125mm LETTER DIM. : 12mm

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

C2 CHAIN CONVEYOR UPSTREAM OF SHOTBLASTING MACHINE EMERGENCY STOP (LOCAL CONTROL PANEL 4481-MHCD-0002-CP-02)

SELLER/CONTRACTOR DOCUMENT REVIEW

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3 ☐ Revise & Resubmit. Work may NOT proceed.
4 ☐ Revise not required. Work may proceed.
5 ☐ VOID / Superseded.

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Discipline :

Document No : 25457-4480-V1A-MXA0-0073 | Rev. :

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ENG. GROUP SUP.		DRAWING SCALE:	1: 4
DATE:			

Vendor or Subcontractor Logo: GNA alutech inc. Département Ingénierie / Engineering Department 5692 Trans-Canada Saint-Laurent, Québec H4S 1Y3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SELLER DRAWING No. 1347-51090 | REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
LOCAL CONTROL PANEL 4481-MHCD-0002-CP-02
GENERAL ARRANGEMENT

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
	—	—	—	A3-		-AZ	

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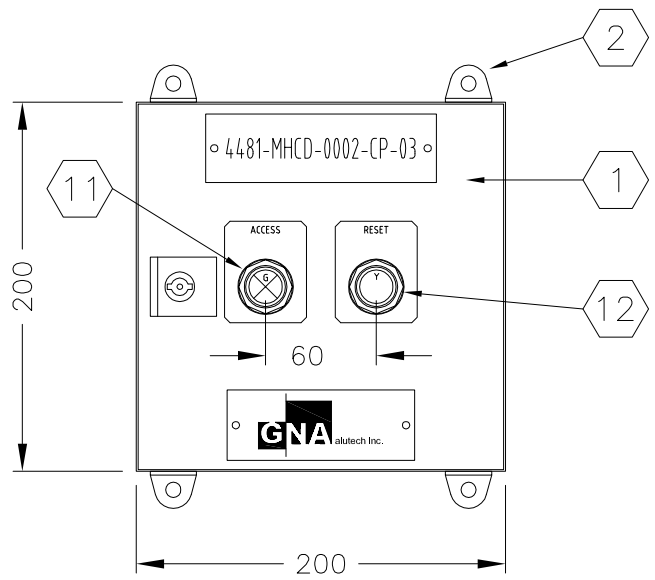
MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 200mmX200mmX120mm IP66	RITTAL	EB 1549.500
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	KL 1590.000
3	3	TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZDU2.5-2/3AN (170601)
4	1	GROUND TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZPE2.5-2/3AN (170609)
5	1	GROUND TERMINAL BLOCKS 16mm	WEIDMULLER	ZPE16-2/1AN (177296)
6				
7	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
8	1	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
9	BATCH	TERMINAL MARKERS (20)	WEIDMULLER	SchT 5s (163193)
10	BATCH	PROTECTIVE STRIPS CLEAR (20)	WEIDMULLER	STR 5s (163194)
11	1	PUSH BUTTON LIGHT WITH PROTECTED LED (GREEN) 1NO	TELEMECANIQUE	ZB4BW0B31
	1	HEAD FOR ILLUMINATED PUSH BUTTON (GREEN)	TELEMECANIQUE	ZB4BW333
12	1	RESET PUSH BUTTON (YELOW)	TELEMECANIQUE	ZB4BA5
	1	CONTACT BLOCK 1NO	TELEMECANIQUE	ZB4BZ101



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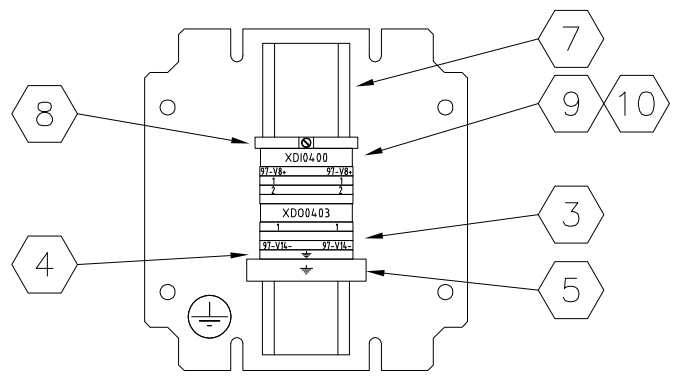

MOUNTING PANEL

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA alutech Inc.	38,1mm x 101,6mm
1	1	4481-MHCD-0002-CP-03	37mm x 125mm LETTER DIM. : 12mm
11	1	ACCESS	50mm x 45mm LETTER DIM. : 4mm
12	1	RESET	50mm x 45mm LETTER DIM. : 4mm

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

C2 CHAIN CONVEYOR UPSTREAM OF SHOTBLASTING MACHINE
SAFETY MAT RESET
(LOCAL CONTROL PANEL 4481-MHCD-0002-CP-03)

SELLER/CONTRACTOR DOCUMENT REVIEW

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Vendor or Subcontractor Logo: GNA alutech Inc. Département Ingénierie / Engineering Department, 5450 Trans-Canada, Saint-Laurent, Québec, H4S 1Y3, Canada

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SELLER DRAWING No. 1347-51091 | REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
LOCAL CONTROL PANEL 4481-MHCD-0002-CP-03
GENERAL ARRANGEMENT

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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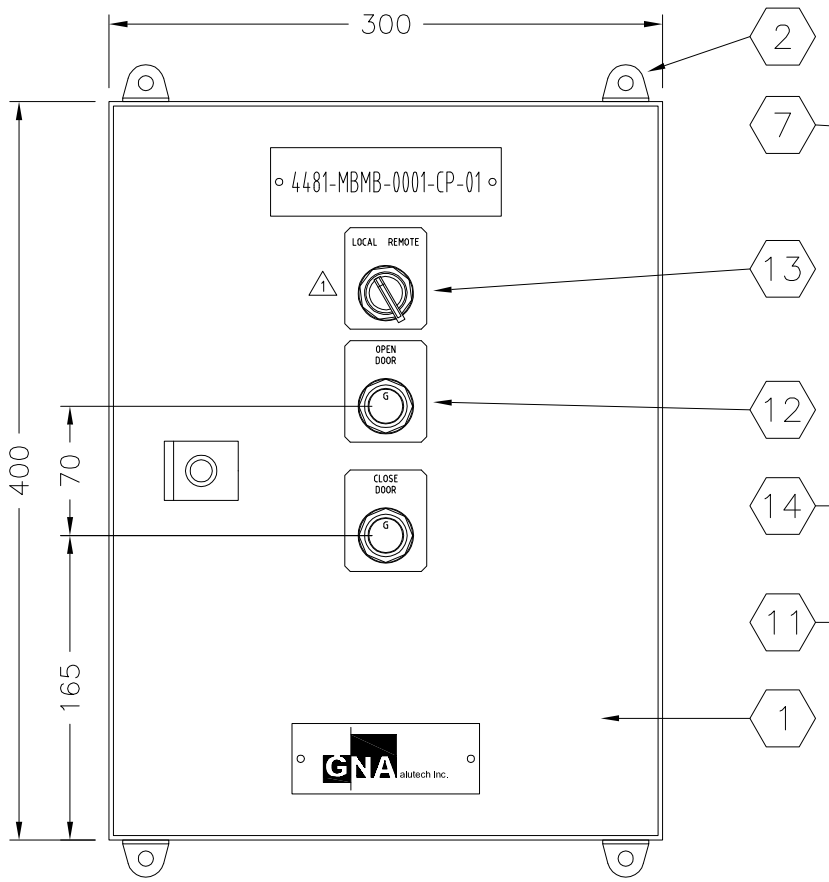
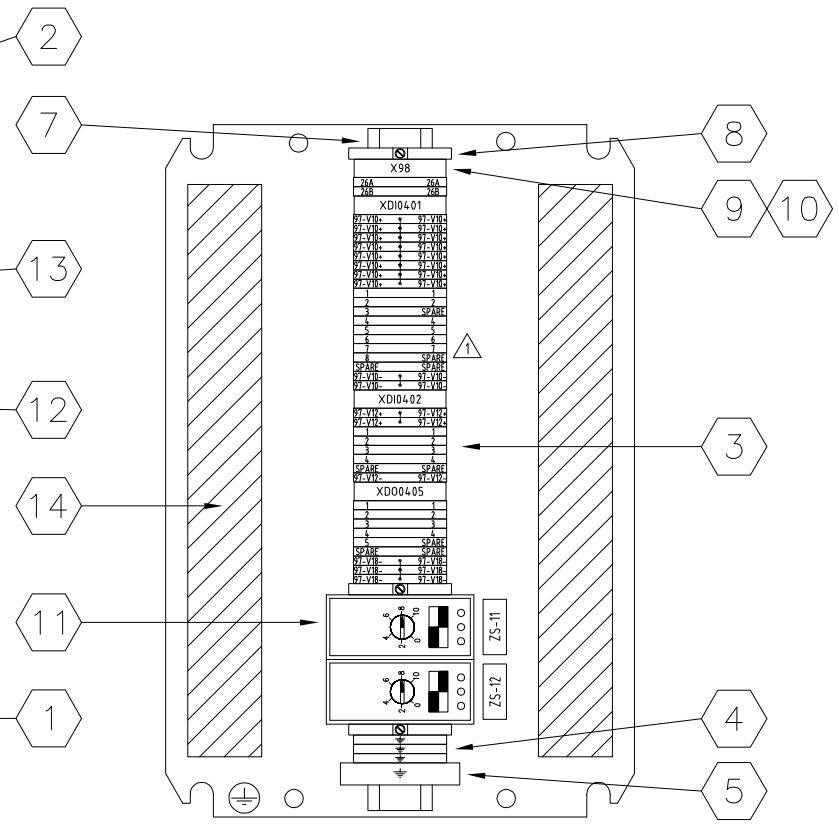


400mm X 300mm X 155mm



MOUNTING PANEL

MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 400mmX300mmX155mm IP66	RITTAL	EB 1577.500
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	KL 1590.000
3	BATCH	TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZDU2.5-2/3AN (170601)
4	3	GROUND TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZPE2.5-2/3AN (170609)
5	1	GROUND TERMINAL BLOCKS 16mm^2	WEIDMULLER	ZPE16-2/1AN (177296)
6				
7	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
8	3	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
9	BATCH	TERMINAL MARKERS (20)	WEIDMULLER	SchT 5s (163193)
10	BATCH	PROTECTIVE STRIPS CLEAR (20)	WEIDMULLER	STR 5s (163194)
11	2	PHOTOELECTRIC SWITCH 24 Vdc	CARLO GAVAZZI	S142BRNN-924
	2	EMITTER	CARLO GAVAZZI	MOFT20-M12-8
	2	RECEIVER	CARLO GAVAZZI	MOFR-M12-8
	2	FIBER OPTICS 1m	CARLO GAVAZZI	OFMS1-10
	2	BASE	CARLO GAVAZZI	ZPD11
12	2	PUSH BUTTON 1NO (GREEN)	TELEMECANIQUE	XB4BA31
13	1	SELECTOR SWITCH 2 POSITION	TELEMECANIQUE	ZB4BD2
	1	CONTACT BLOCK 1NO	TELEMECANIQUE	ZB4BZ101
14	BATCH	DUCT 40mm X 80mm	IBOCO	T1-1530G

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA alutech inc.	38,1mm x 101,6mm
1	1	4481-MBMB-0001-CP-01	37mm x 125mm LETTER DIM. : 12mm
12	1	OPEN DOOR	50mm x 45mm LETTER DIM. : 4mm
12	1	CLOSE DOOR	50mm x 45mm LETTER DIM. : 4mm
13	1	LOCAL REMOTE	50mm x 45mm LETTER DIM. : 4mm

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

F2 ZONE#1 CATHODE BAR
HEATING FURNACE CONVEYOR No.1
(CONTROL PANEL 4481-MBMB-0001-CP-01)

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Discipline :

Document No : 25457-4480-V1A-MXA0-0195 | Rev. :

REFERENCES		REVISIONS						
DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
		1		ADD SELECTOR	JA 27 2011	F.P.	E.B.	M.B.

NOTES

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Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie / Engineering Department, 5650 Trans-Canada, Sainte-Anne-de-Bellevue, Québec, H9X 3Y2, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SELLER DRAWING No. 1347-51100 | REV. 1

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CONTROL PANEL 4481-MBMB-0001-CP-01
GENERAL ARRANGEMENT

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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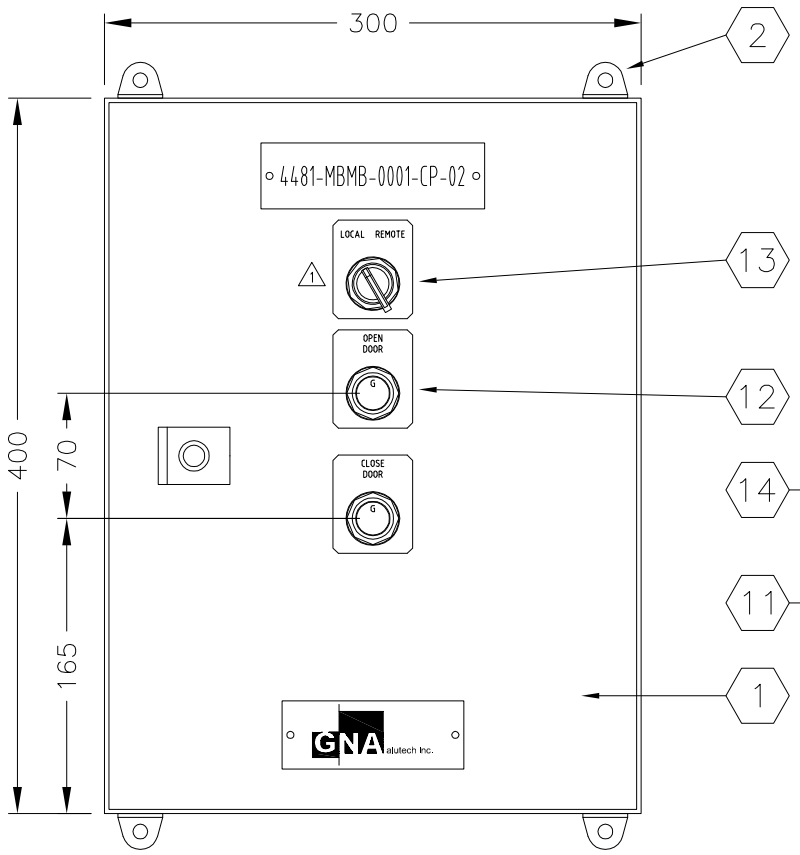

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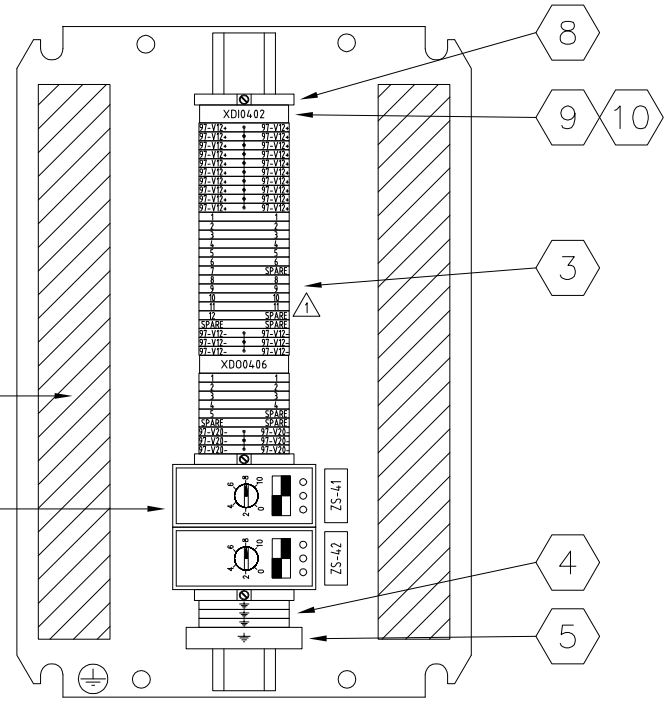

MOUNTING PANEL

MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 400mmX300mmX155mm IP66	RITTAL	EB 1577.500
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	KL 1590.000
3	BATCH	TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZDU2.5-2/3AN (170601)
4	4	GROUND TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZPE2.5-2/3AN (170609)
5	1	GROUND TERMINAL BLOCKS 16mm^2	WEIDMULLER	ZPE16-2/1AN (177296)
6				
7	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
8	3	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
9	BATCH	TERMINAL MARKERS (20)	WEIDMULLER	SchT 5s (163193)
10	BATCH	PROTECTIVE STRIPS CLEAR (20)	WEIDMULLER	STR 5s (163194)
11	2	PHOTOELECTRIC SWITCH 24 Vdc	CARLO GAVAZZI	S142BRNN-924
	2	EMITTER	CARLO GAVAZZI	MOFT20-M12-8
	2	RECEIVER	CARLO GAVAZZI	MOFR-M12-8
	2	FIBER OPTICS 1m	CARLO GAVAZZI	OFMS1-10
	2	BASE	CARLO GAVAZZI	ZPD11
12	2	PUSH BUTTON 1NO (GREEN)	TELEMECANIQUE	XB4BA31
13	1	SELECTOR SWITCH 2 POSITION	TELEMECANIQUE	ZB4BD2
	1	CONTACT BLOCK 1NO	TELEMECANIQUE	ZB4BZ101
14	BATCH	DUCT 40mm X 80mm	IBOCO	T1-1530G

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA alutech Inc.	38,1mm x 101,6mm
1	1	4481-MBMB-0001-CP-02	37mm x 125mm LETTER DIM. : 12mm
12	1	OPEN DOOR	50mm x 45mm LETTER DIM. : 4mm
12	1	CLOSE DOOR	50mm x 45mm LETTER DIM. : 4mm
13	1	LOCAL REMOTE	50mm x 45mm LETTER DIM. : 4mm

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

F2 ZONE#4 CATHODE BAR HEATING FURNACE CONVEYOR No.4 (CONTROL PANEL 4481-MBMB-0001-CP-02)

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Discipline :

Document No : 25457-4480-V1A-MXA0-0196 | Rev. :

REFERENCES		REVISIONS							
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		1		ADD SELECTOR	JA 01 2011	F.P.	E.B.	M.B.	

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BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CONTROL PANEL 4481-MBMB-0001-CP-02
GENERAL ARRANGEMENT

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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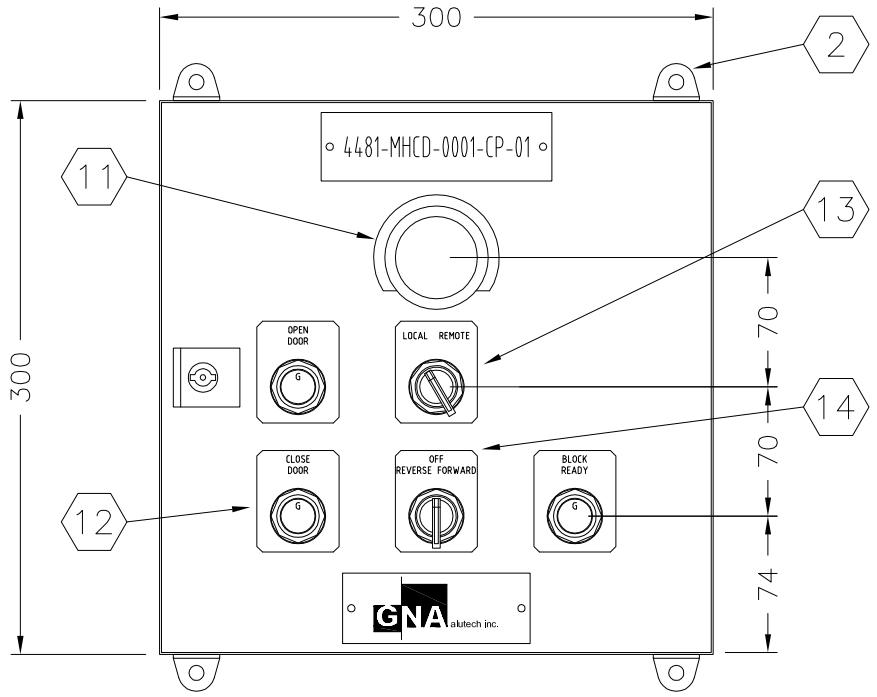

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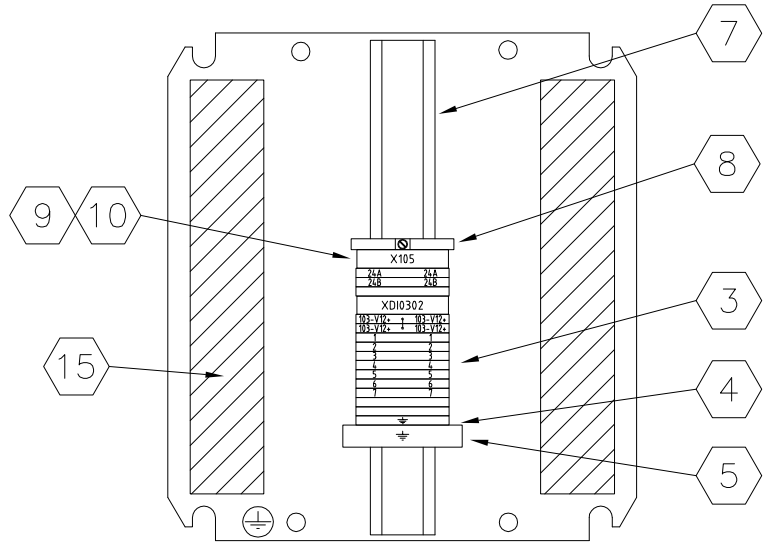

MOUNTING PANEL

MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 300mmX300mmX120mm IP66	RITTAL	EB 1555.500
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	KL 1590.000
3	BATCH	TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZDU2.5-2/3AN (170601)
4	1	GROUND TERMINAL BLOCK 2.5mm^2	WEIDMULLER	ZPE2.5-2/3AN (170609)
5	1	GROUND TERMINAL BLOCK 16mm^2	WEIDMULLER	ZPE16-2/1AN (177296)
6				
7	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
8	1	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
9	BATCH	TERMINAL MARKERS (20)	WEIDMULLER	SchT 5s (163193)
10	BATCH	PROTECTIVE STRIPS CLEAR (20)	WEIDMULLER	STR 5s (163194)
11	1	EMERGENCY STOP TURN TO RELEASE OPERATOR	TELEMECANIQUE	ZB4BS64
	1	CONTACT BLOCK	TELEMECANIQUE	ZB4BZ102
	1	GUARD RING	EATON	M22-XGPV
	1	EMERGENCY STOP LABEL	ENVITECH	
12	3	PUSH BUTTON (GREEN)	TELEMECANIQUE	XB4BA3
	3	CONTACT BLOCK 1NO	TELEMECANIQUE	ZB4BZ101
13	1	SELECTOR SWITCH 2 POSITION	TELEMECANIQUE	ZB4BD2
	1	CONTACT BLOCK 1NO	TELEMECANIQUE	ZB4BZ101
14	1	SELECTOR SWITCH 3 POSITION	TELEMECANIQUE	ZB4BD3
	2	CONTACT BLOCK 1NO	TELEMECANIQUE	ZB4BZ101
15	BATCH	DUCT 40mm X 60mm	IBOCO	T1-1522G

ITEM	QTY	NAME PLATE LIST	DIMENSION	FOR EQUIP.
1	1	GNA alutech inc.	38,1mm x 101,6mm	–
1	1	4481-MHCD-0001-CP-01	37mm x 125mm LETTER DIM. : 12mm	–
1	1	OPEN DOOR	50mm x 45mm LETTER DIM. : 4mm	F1
1	1	CLOSE DOOR	50mm x 45mm LETTER DIM. : 4mm	F1
1	1	BLOCK READY	50mm x 45mm LETTER DIM. : 4mm	C1
1	1	LOCAL REMOTE	50mm x 45mm LETTER DIM. : 4mm	C1
1	1	OFF REVERSE FORWARD	50mm x 45mm LETTER DIM. : 4mm	C1

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

F1 CATHODE BLOCK OVEN
C1 CHAIN CONVEYOR FOR BLOCK OVEN
EMERGENCY STOP, BLOCK READY, AUTO-MANUAL
(LOCAL CONTROL PANEL 4481-MHCD-0001-CP-01)

SELLER/CONTRACTOR DOCUMENT REVIEW

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4 ☐ Revise not required. Work may proceed.
5 ☐ VOID / Superseded.

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Discipline :

Document No : 25457-4480-V1A-MXA0-0269 | Rev. :

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REFERENCES | REVISIONS

NOTES

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Vendor or Subcontractor Logo: GNA alutech inc. Département Ingénierie / Engineering Department, 9480 Trans-Canada, Saint-Laurent, Quebec, CANADA, H4S 1V3, Canada

BECHTEL

SELLER DRAWING No. 1347-51120 | REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
LOCAL CONTROL PANEL 4481-MHCD-0001-CP-01
GENERAL ARRANGEMENT

Project Title: Ras Az Zawr Aluminium Smelter

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
–	–	–		A3-		-AZ	

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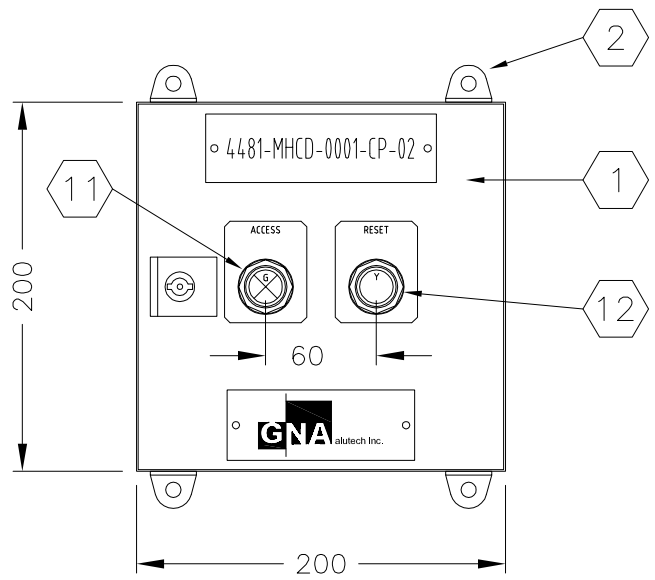
MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 200mmX200mmX120mm IP66	RITTAL	EB 1549.500
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	KL 1590.000
3	3	TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZDU2.5-2/3AN (170601)
4	1	GROUND TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZPE2.5-2/3AN (170609)
5	1	GROUND TERMINAL BLOCKS 16mm	WEIDMULLER	ZPE16-2/1AN (177296)
6				
7	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
8	1	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
9	BATCH	TERMINAL MARKERS (20)	WEIDMULLER	SchT 5s (163193)
10	BATCH	PROTECTIVE STRIPS CLEAR (20)	WEIDMULLER	STR 5s (163194)
11	1	PUSH BUTTON LIGHT WITH PROTECTED LED (GREEN) 1NO	TELEMECANIQUE	ZB4BW0B31
	1	HEAD FOR ILLUMINATED PUSH BUTTON (GREEN)	TELEMECANIQUE	ZB4BW333
12	1	RESET PUSH BUTTON (YELOW)	TELEMECANIQUE	ZB4BA5
	1	CONTACT BLOCK 1NO	TELEMECANIQUE	ZB4BZ101



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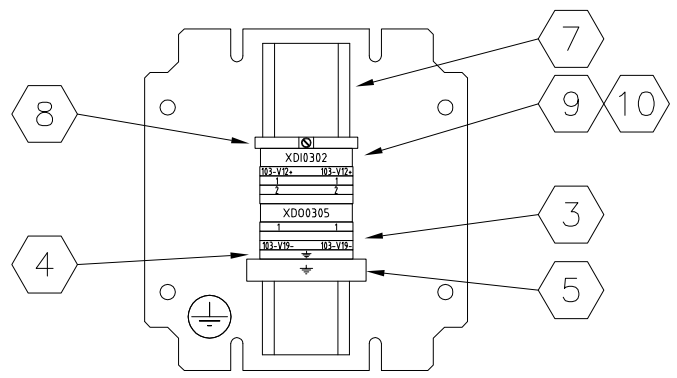

MOUNTING PANEL

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA alutech inc.	38,1mm x 101,6mm
1	1	4481-MHCD-0001-CP-02	37mm x 125mm LETTER DIM. : 12mm
11	1	ACCESS	50mm x 45mm LETTER DIM. : 4mm
12	1	RESET	50mm x 45mm LETTER DIM. : 4mm

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

C1 CHAIN CONVEYOR UPSTREAM OF SHOTBLASTING MACHINE
SAFETY MAT RESET
(LOCAL CONTROL PANEL 4481-MHCD-0001-CP-02)

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5 ☐ VOID / Superseded.

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Discipline :

Document No : 25457-4480-V1A-MXAO-0XXX | Rev. :

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1347-51121	0

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		0						

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DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	1: 4
DATE:			

Vendor or Subcontractor Logo: GNA alutech inc. Département Ingénierie / Engineering Department 5692 Trans-Canada Saint-Laurent, Québec H4S 1Y3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
LOCAL CONTROL PANEL 4481-MHCD-0001-CP-02
GENERAL ARRANGEMENT

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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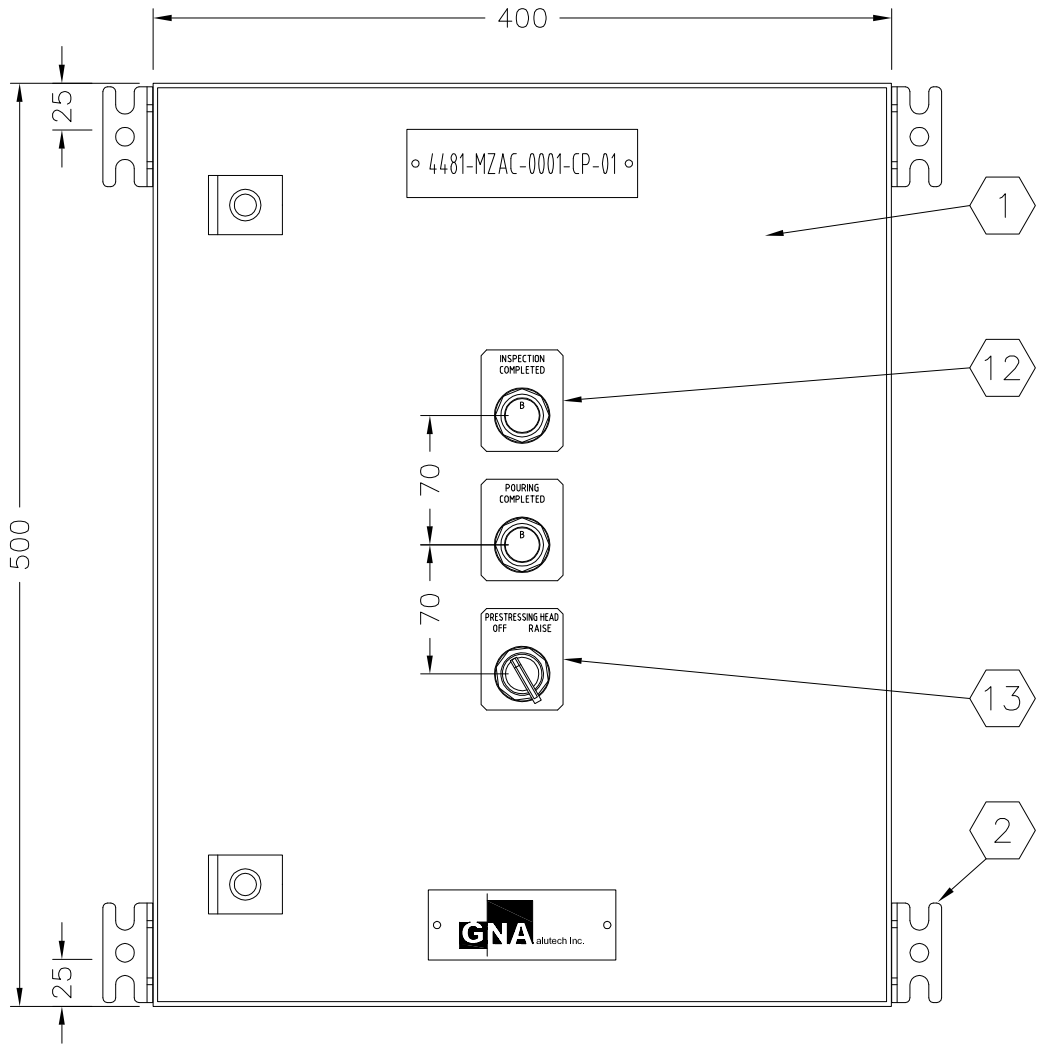
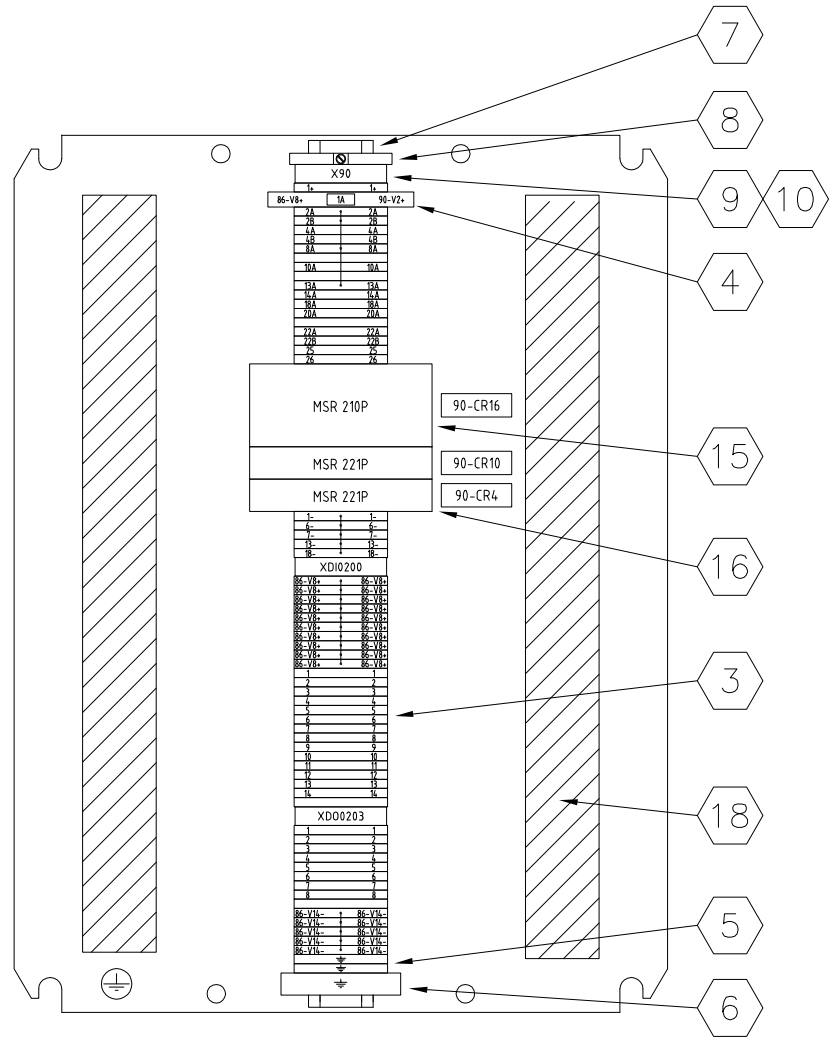


500mm X 400mm X 210mm



MOUNTING PANEL

MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 500mmX400mmX210mm IP66	RITTAL	AE 1045.500
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	SZ 2503.010
3	BATCH	TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZDU2.5-2/3AN (170601)
4	1	FUSIBLE TERMINAL BLOCK 2.5mm	WEIDMULLER	ZSI2.5 (161640)
5	2	GROUND TERMINAL BLOCK 2.5mm^2	WEIDMULLER	ZPE2.5-2/3AN (170609)
6	1	GROUND TERMINAL BLOCK 16mm^2	WEIDMULLER	ZPE16-2/1AN (177296)
7	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
8	BATCH	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
9	BATCH	TERMINAL MARKERS (20)	WEIDMULLER	SchT 5s (163193)
10	BATCH	PROTECTIVE STRIPS CLEAR (20)	WEIDMULLER	STR 5s (163194)
11				
12	2	PUSH BUTTON (BLACK)	TELEMECANIQUE	XB4BA21
	2	CONTACT BLOCK 1NO	TELEMECANIQUE	ZB4BZ101
13	1	SELECTOR SWITCH 2 POSITION	TELEMECANIQUE	ZB4BD2
	1	CONTACT BLOCK 1NO	TELEMECANIQUE	ZB4BZ101
	2	ADD-ON CONTACT BLOCK 1NC	TELEMECANIQUE	ZBE102
14				
15	1	MONITORING SAFETY RELAY MSR 210P	ALLEN-BRADLEY	440R-H23176
16	2	MONITORING SAFETY RELAY MSR 221P	ALLEN-BRADLEY	440R-H23179
17				
18	BATCH	DUCT 40mm X 80mm	IBOCO	T1-1530G

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA alutech Inc.	38,1mm x 101,6mm
1	1	4481-MZAC-0001-CP-01	37mm x 125mm LETTER DIM. : 12mm
12	1	INSPECTION COMPLETED	50mm x 45mm LETTER DIM. : 4mm
12	1	POURING COMPLETED	50mm x 45mm LETTER DIM. : 4mm
13	1	PRESTRESSING HEAD OFF RAISE	50mm x 45mm LETTER DIM. : 4mm

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

R4A PRESTRESING AND SEALING STATION CONVEYOR A
INSPECTION, POURING COMPLETED
(LOCAL CONTROL PANEL 4481-MZAC-0001-CP-01)

SELLER/CONTRACTOR DOCUMENT REVIEW

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Discipline :

Document No : 25457-4480-V1A-MXAO-0270 | Rev. :

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DATE:			

Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie, Engineering Department, 8400 Trans-Canada, Saint-Laurent, Québec, H4S 1V3, Canada

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SELLER DRAWING No.	REV.
1347-51130	0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
LOCAL CONTROL PANEL 4481-MZAC-0001-CP-01
GENERAL ARRANGEMENT

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
-	-	-		A3-		-AZ	

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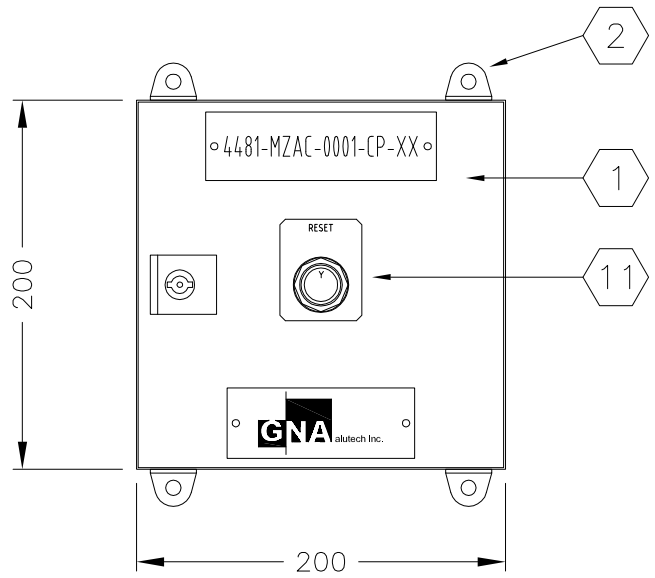
MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 200mmX200mmX120mm IP66	RITTAL	EB 1549.500
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	KL 1590.000
3	3	TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZDU2.5-2/3AN (170601)
4	1	GROUND TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZPE2.5-2/3AN (170609)
5	1	GROUND TERMINAL BLOCKS 16mm^2	WEIDMULLER	ZPE16-2/1AN (177296)
6				
7	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
8	1	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
9	BATCH	TERMINAL MARKERS (20)	WEIDMULLER	SchT 5s (163193)
10	BATCH	PROTECTIVE STRIPS CLEAR (20)	WEIDMULLER	STR 5s (163194)
11	1	RESET PUSH BUTTON (YELOW)	TELEMECANIQUE	XB4BA5
	1	CONTACT BLOCK 1NO	TELEMECANIQUE	ZB4BZ101



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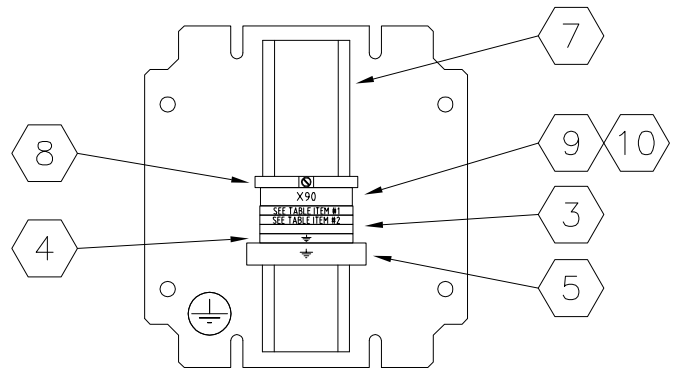

MOUNTING PANEL

ITEM	QTY	NAME PLATE LIST	DIMENSION	ITEM #1	ITEM #2
1	1	GNA alutech inc.	38,1mm x 101,6mm	–	–
1	1	4481-MZAC-0001-CP-02	37mm x 125mm LETTER DIM. : 12mm	18B	18C
1	1	4481-MZAC-0001-CP-03	37mm x 125mm LETTER DIM. : 12mm	19B	19C
1	1	RESET	50mm x 45mm LETTER DIM. : 4mm	EACH	EACH

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

R4A PRESTRESSING AND SEALING STATION CONVEYOR A RESET (LOCAL CONTROL PANEL 4481-MZAC-0001-CP-02/03)

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5 ☐ VOID / Superseded.

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Discipline :

Document No : 25457-4480-V1A-MXA0-0271 Rev. :

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Vendor or Subcontractor Logo: GNA alutech Inc. Département Ingénierie / Engineering Department 5650 Trans-Canada Saint-Laurent, Québec H4S 1Y3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

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SELLER DRAWING No. 1347-51131 REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
LOCAL CONTROL PANEL 4481-MZAC-0001-CP-02/03
GENERAL ARRANGEMENT

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
	–	–	–	A3-		-AZ	

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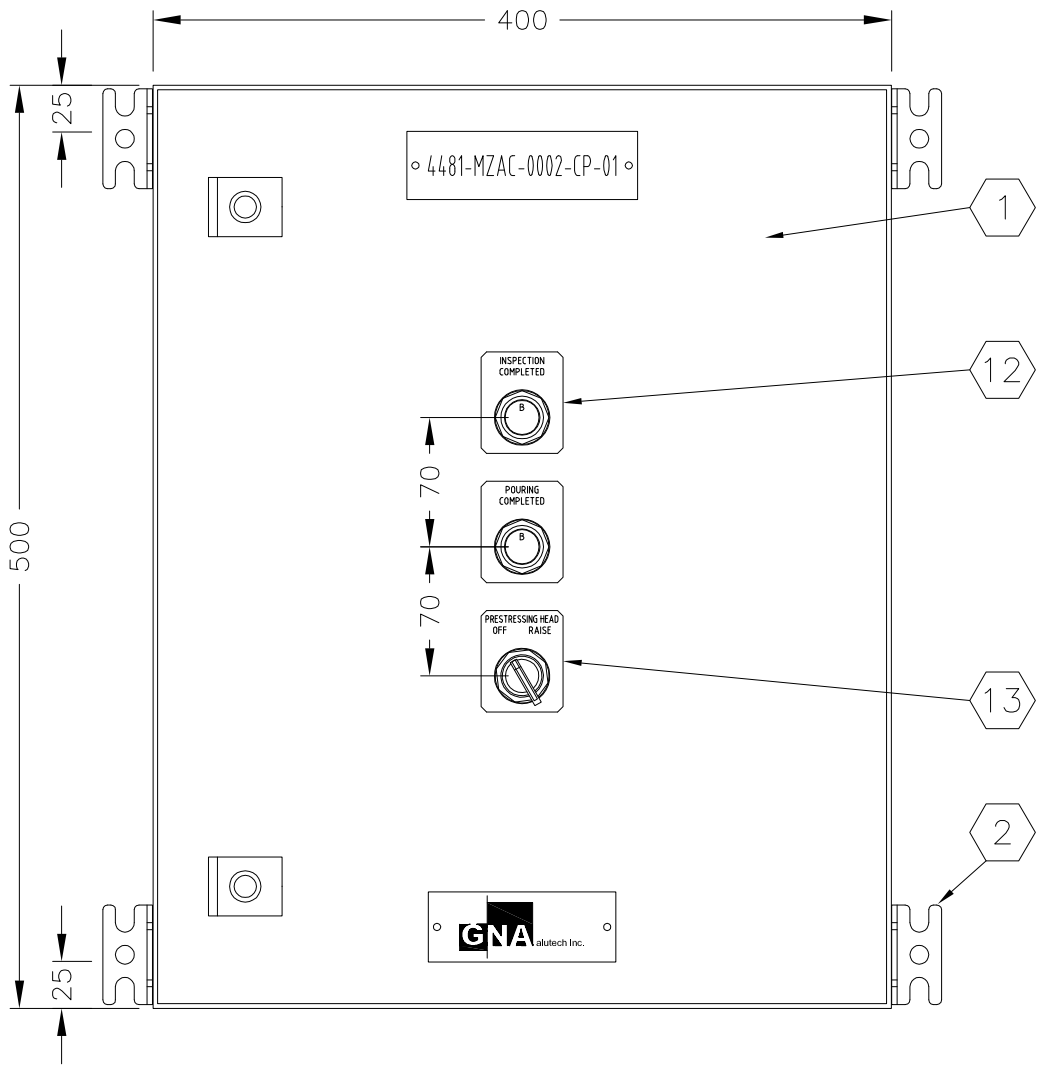
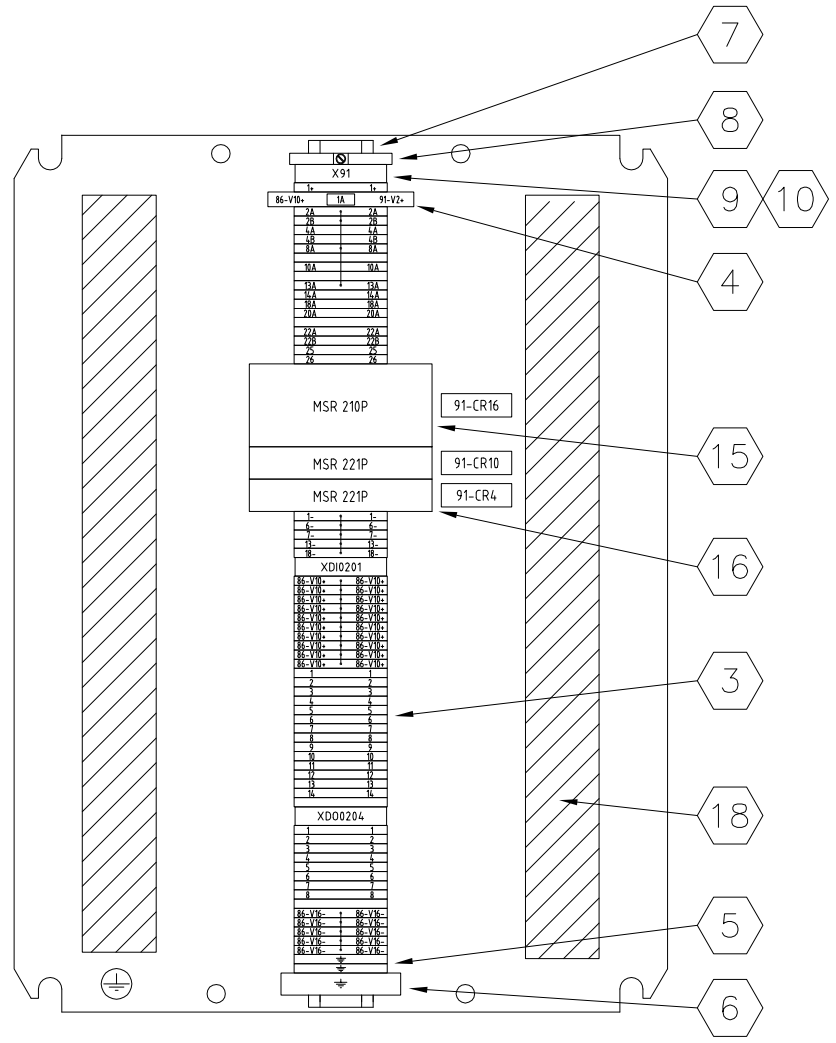


500mm X 400mm X 210mm



MOUNTING PANEL

MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 500mmX400mmX210mm IP66	RITTAL	AE 1045.500
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	SZ 2503.010
3	BATCH	TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZDU2.5-2/3AN (170601)
4	1	FUSIBLE TERMINAL BLOCK 2.5mm	WEIDMULLER	ZSI2.5 (161640)
5	2	GROUND TERMINAL BLOCK 2.5mm^2	WEIDMULLER	ZPE2.5-2/3AN (170609)
6	1	GROUND TERMINAL BLOCK 16mm^2	WEIDMULLER	ZPE16-2/1AN (177296)
7	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
8	BATCH	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
9	BATCH	TERMINAL MARKERS (20)	WEIDMULLER	SchT 5s (163193)
10	BATCH	PROTECTIVE STRIPS CLEAR (20)	WEIDMULLER	STR 5s (163194)
11				
12	2	PUSH BUTTON (BLACK)	TELEMECANIQUE	XB4BA21
	2	CONTACT BLOCK 1NO	TELEMECANIQUE	ZB4BZ101
13	1	SELECTOR SWITCH 2 POSITION	TELEMECANIQUE	ZB4BD2
	1	CONTACT BLOCK 1NO	TELEMECANIQUE	ZB4BZ101
	2	ADD-ON CONTACT BLOCK 1NC	TELEMECANIQUE	ZBE102
14				
15	1	MONITORING SAFETY RELAY MSR 210P	ALLEN-BRADLEY	440R-H23176
16	2	MONITORING SAFETY RELAY MSR 221P	ALLEN-BRADLEY	440R-H23179
17				
18	BATCH	DUCT 40mm X 80mm	IBOCO	T1-1530G

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA alutech inc.	38,1mm x 101,6mm
1	1	4481-MZAC-0002-CP-01	37mm x 125mm LETTER DIM. : 12mm
12	1	INSPECTION COMPLETED	50mm x 45mm LETTER DIM. : 4mm
12	1	POURING COMPLETED	50mm x 45mm LETTER DIM. : 4mm
13	1	PRESTRESSING HEAD OFF RAISE	50mm x 45mm LETTER DIM. : 4mm

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

R4B PRESTRESING AND SEALING STATION CONVEYOR B
INSPECTION, POURING COMPLETED
(LOCAL CONTROL PANEL 4481-MZAC-0002-CP-01)

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Discipline :	
Document No : 25457-4480-V1A-MXA0-0272	Rev. :

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REFERENCES		REVISIONS						

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DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	1: 4
DATE:			

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Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie, Engineering Department, 8410 Trans-Canada, Saint-Laurent, Québec H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SELLER DRAWING No.: 1347-51140 — REV.: 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
LOCAL CONTROL PANEL 4481-MZAC-0002-CP-01
GENERAL ARRANGEMENT

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—		—	—	A3-		-AZ	

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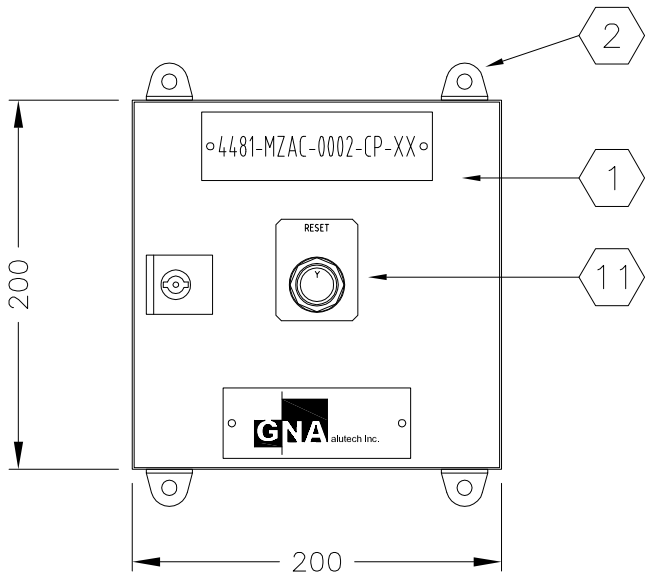
3	3	TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZDU2.5-2/3AN (170601)
4	1	GROUND TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZPE2.5-2/3AN (170609)
5	1	GROUND TERMINAL BLOCKS 16mm^2	WEIDMULLER	ZPE16-2/1AN (177296)
6				
7	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
8	1	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
9	BATCH	TERMINAL MARKERS (20)	WEIDMULLER	SchT 5s (163193)
10	BATCH	PROTECTIVE STRIPS CLEAR (20)	WEIDMULLER	STR 5s (163194)
11	1	RESET PUSH BUTTON (YELOW)	TELEMECANIQUE	XB4BA5
	1	CONTACT BLOCK 1NO	TELEMECANIQUE	ZB4BZ101



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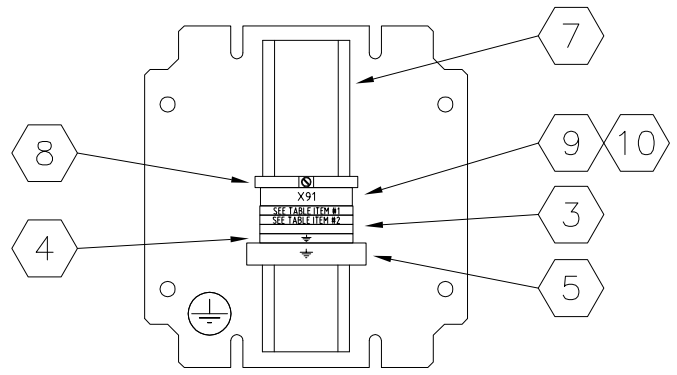

MOUNTING PANEL

ITEM	QTY	NAME PLATE LIST	DIMENSION	ITEM #1	ITEM #2
1	1	GNA alutech inc.	38,1mm x 101,6mm	–	–
1	1	4481-MZAC-0002-CP-02	37mm x 125mm LETTER DIM. : 12mm	18B	18C
1	1	4481-MZAC-0002-CP-03	37mm x 125mm LETTER DIM. : 12mm	19B	19C
1	1	RESET	50mm x 45mm LETTER DIM. : 4mm	EACH	EACH

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

R4B PRESTRESSING AND SEALING STATION CONVEYOR B RESET (LOCAL CONTROL PANEL 4481-MZAC-0002-CP-02/03)

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Vendor or Subcontractor Logo: GNA alutech Inc. Département Ingénierie / Engineering Department, 9450 Trans-Canada, Montréal, Québec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SELLER DRAWING No. 1347-51141 | REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
LOCAL CONTROL PANEL 4481-MZAC-0002-CP-02/03
GENERAL ARRANGEMENT

MA'ADEN

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
	–	–	–	A3–		–AZ	

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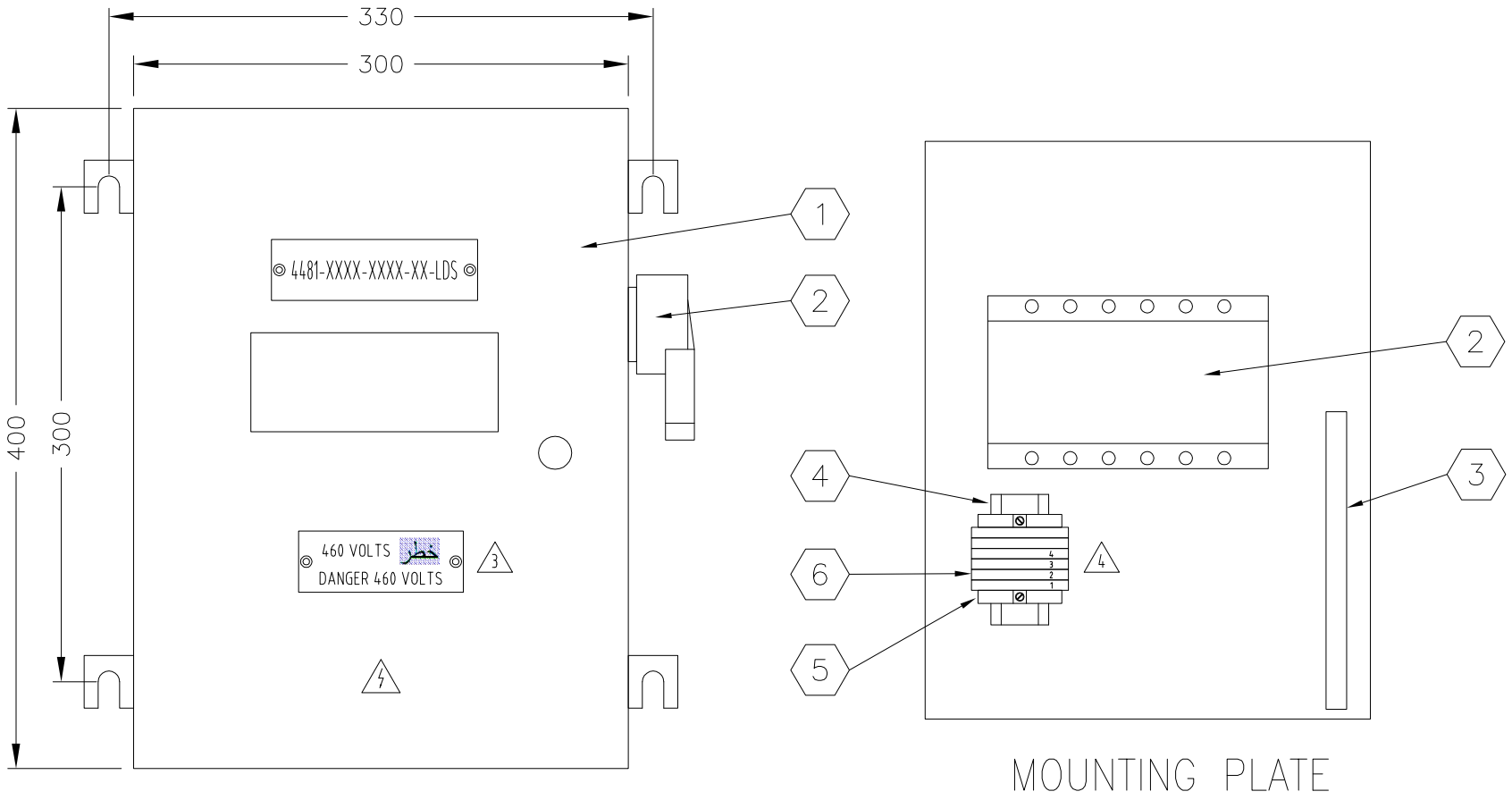
MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 330mmX210mmX155mm IP65	CEFEM	IM 63 VI C
2	1	CIRCUIT DISCONNECT 63A, 6P	CEFEM	
3	1	NON INSULATED GROUND BAR	CEFEM	
4	BATCH	RAIL	WEIDMULLER	TS 35 (51450)
5	2	END BRACKET	WEIDMULLER	ZEW TS35 (954000)
6	4	TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZDU 2.5-2 (177206)



400mm X 300mm X 250mm

MOUNTING PLATE

ITEM	QTY	NAME PLATE LIST	DIMENSION	FOR EQUIP.
1	1	4481-MJR0-0001-M1-LDS	37mm x 125mm LETTER DIM. : 12mm	R9
1	1	4481-MJR0-0002-M1-LDS	37mm x 125mm LETTER DIM. : 12mm	R8
1	1	4481-MBMB-0001-M1-LDS	37mm x 125mm LETTER DIM. : 12mm	F2Z1
1	1	4481-MBMB-0001-M2-LDS	37mm x 125mm LETTER DIM. : 12mm	F2Z2
1	1	4481-MBMB-0001-M3-LDS	37mm x 125mm LETTER DIM. : 12mm	F2Z3
1	1	4481-MBMB-0001-M4-LDS	37mm x 125mm LETTER DIM. : 12mm	F2Z4
1	1	460 VOLTS خطر DANGER 460 VOLTS	37mm x 100mm LETTER DIM. : 8mm	EACH EQUIP.

NOTES:

1 -PAINT:
INTERNAL: GLOSS WHITE - STANDARD RAL 9010
EXTERNAL: PEBBLE GREY SEMI-GLOSS - STANDARD RAL 7032

1

LOCAL DISCONNECT SWITCH (ISOLATOR)

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2 ☐	Revise & Resubmit. Work may proceed subject to incorporation of changes.	5 ☐	VOID / Superseded.
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DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		REVISIONS						
		4		UPDATE	05/01/11	F.P.	E.B.	C.C.
		3		CHANGE NAMEPLATE DESCRIPTION	06/12/10	F.P.	E.B.	C.C.
		2		CHANGE THE WORD "STATION" INTO "SWITCH"	17/11/10	F.P.	E.B.	C.C.
		1		UPDATE	05/11/10	F.P.	E.B.	C.C.

NOTES

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Vendor or Subcontractor Logo: GNA altech inc. Département Ingénierie Engineering Department 9650 Trans-Canada Saint-Laurent, Quebec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
LOCAL DISCONNECT SWITCH (1/3)
GENERAL ARRANGEMENT

MA'ADEN

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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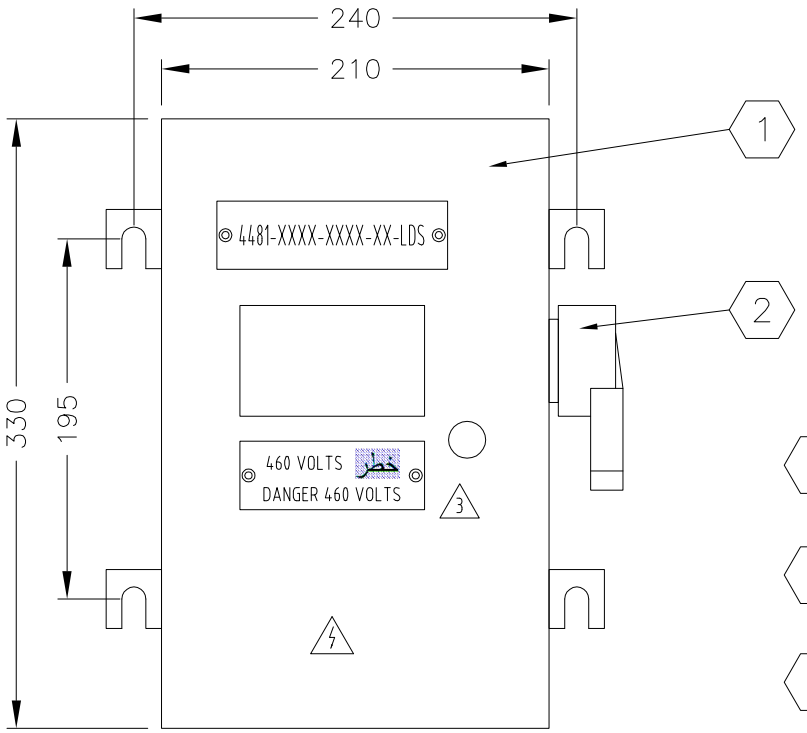
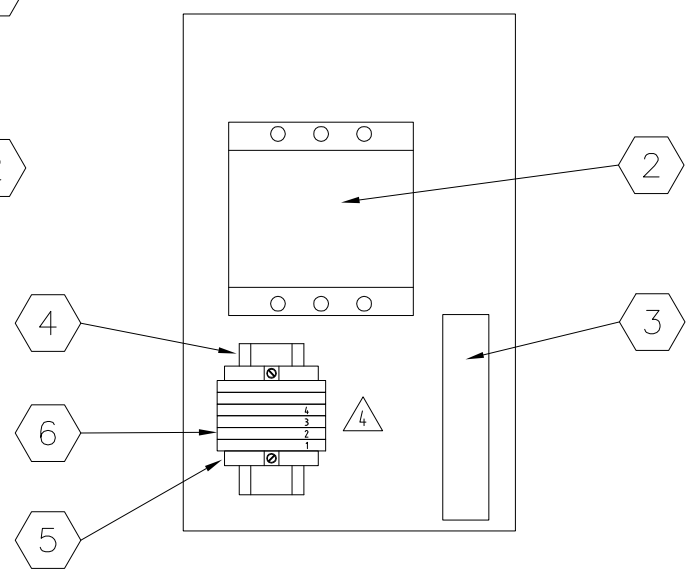
MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 400mmX300mmX250mm IP65	CEFEM	IM 63 III C
2	1	CIRCUIT DISCONNECT 63A, 3P	CEFEM	
3	1	NON INSULATED GROUND BAR	CEFEM	
4	BATCH	RAIL	WEIDMULLER	TS 35 (51450)
5	2	END BRACKET	WEIDMULLER	ZEW TS35 (954000)
6	4	TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZDU 2.5-2 (177206)

NOTES:

1 -PAINT:
INTERNAL: GLOSS WHITE - STANDARD RAL 9010
EXTERNAL: PEBBLE GREY SEMI-GLOSS - STANDARD RAL 7032 (1)



330mm X 210mm X 155mm



MOUNTING PLATE

LOCAL DISCONNECT SWITCH (ISOLATOR)

ITEM	QTY	NAME PLATE LIST	DIMENSION	FOR EQUIP.
1	1	4481-MZBP-0001-M1-LDS	37mm x 125mm LETTER DIM. : 12mm	S1
1	1	4481-MZBP-0001-M2-LDS	37mm x 125mm LETTER DIM. : 12mm	S1
1	1	4481-MZBP-0001-M3-LDS	37mm x 125mm LETTER DIM. : 12mm	S1
1	1	4481-MZBP-0001-M4-LDS	37mm x 125mm LETTER DIM. : 12mm	S1
1	1	4481-MZBP-0001-M5-LDS	37mm x 125mm LETTER DIM. : 12mm	S1
1	1	4481-MZBP-0001-M6-LDS	37mm x 125mm LETTER DIM. : 12mm	S1
1	1	4481-MZBP-0001-M7-LDS	37mm x 125mm LETTER DIM. : 12mm	S1
1	1	4481-MHCD-0001-M1-LDS	37mm x 125mm LETTER DIM. : 12mm	C1
1	1	4481-MHCD-0002-M1-LDS	37mm x 125mm LETTER DIM. : 12mm	C2
1	1	4481-MHCD-0003-M1-LDS	37mm x 125mm LETTER DIM. : 12mm	C3
1	1	4481-MHCD-0004-M1-LDS	37mm x 125mm LETTER DIM. : 12mm	C4
1	1	4481-MEEP-0001-M1-LDS	37mm x 125mm LETTER DIM. : 12mm	F1-A
1	1	4481-MEEP-0001-M2-LDS	37mm x 125mm LETTER DIM. : 12mm	F1-B
1	1	4481-MEEP-0001-M3-LDS	37mm x 125mm LETTER DIM. : 12mm	F1-C
1	1	4481-MJR0-0003-M1-LDS	37mm x 125mm LETTER DIM. : 12mm	R7
1	1	4481-MJR0-0004-M1-LDS	37mm x 125mm LETTER DIM. : 12mm	R6
1	1	4481-MJR0-0005-M1-LDS	37mm x 125mm LETTER DIM. : 12mm	R1
1	1	4481-MJR0-0006-M1-LDS	37mm x 125mm LETTER DIM. : 12mm	R3
1	1	4481-MJR0-0007-M1-LDS	37mm x 125mm LETTER DIM. : 12mm	R2
1	1	4481-MJR0-0008-M1-LDS	37mm x 125mm LETTER DIM. : 12mm	R5
1	1	4481-MPF0-0001-M1-LDS	37mm x 125mm LETTER DIM. : 12mm	H1-A
1	1	4481-MPF0-0001-M2-LDS	37mm x 125mm LETTER DIM. : 12mm	H1-B
1	1	4481-MZAC-0001-M1-LDS	37mm x 125mm LETTER DIM. : 12mm	R4A
1	1	4481-MZAC-0002-M1-LDS	37mm x 125mm LETTER DIM. : 12mm	R4B
1	1	4481-MAC0-0001-M1-LDS	37mm x 125mm LETTER DIM. : 12mm	D1
1	1	4481-MBAD-0001-M1-LDS	37mm x 125mm LETTER DIM. : 12mm	F3A
1	1	4481-MBAD-0002-M1-LDS	37mm x 125mm LETTER DIM. : 12mm	F3B
1	1	4481-MEVD-0001-M1-LDS	37mm x 125mm LETTER DIM. : 12mm	F4A
1	1	4481-MEVD-0002-M1-LDS	37mm x 125mm LETTER DIM. : 12mm	F4B
1	1	460 VOLTS خطر DANGER 460 VOLTS	37mm x 100mm LETTER DIM. : 8mm	EACH EQUIP.

(5) (1) (1) (1)

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REFERENCES		REVISIONS							
DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
		5		ADD 4481-MBAD-0002-M1-LDS DISCONNECT SWITCH	10/08/11	F.P.	E.B.	C.C.
		4		UPDATE	05/01/11	F.P.	E.B.	C.C.
		3		CHANGE NAMEPLATE DESCRIPTION	06/12/10	F.P.	E.B.	C.C.
		2		CHANGE THE WORD "STATION" INTO "SWITCH"	17/11/10	F.P.	E.B.	C.C.
		1		UPDATE	05/11/10	F.P.	E.B.	C.C.

NOTES

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DATE:			

Vendor or Subcontractor Logo: GNA alutech inc. — Département Ingénierie Engineering Department 6650 Trans-Canada Saint-Laurent, Quebec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SELLER DRAWING No. 1347-51151 | REV. 5

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
LOCAL DISCONNECT SWITCH (2/3)
GENERAL ARRANGEMENT

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—		—	—	A3-		-AZ	

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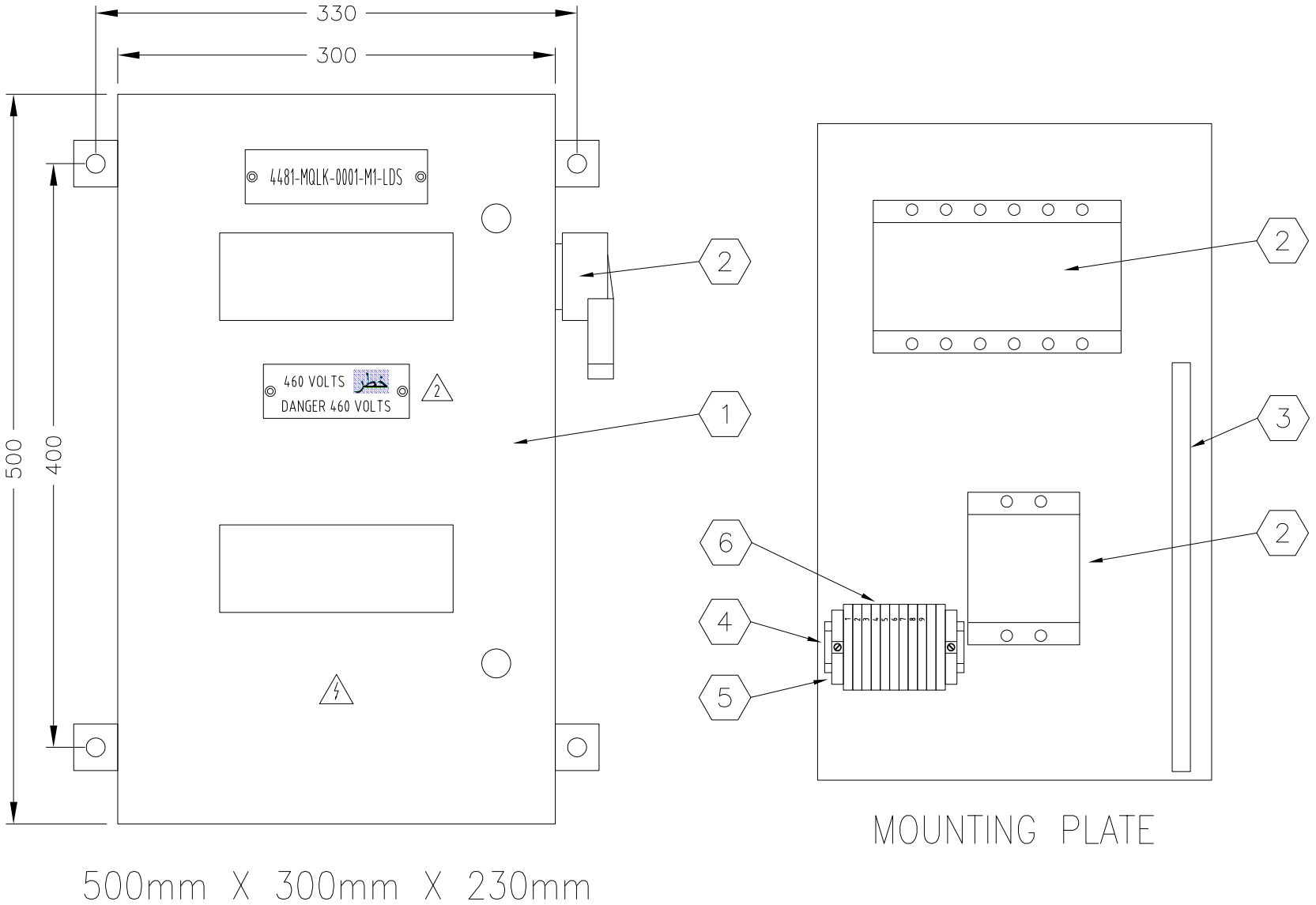
MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 500mmX300mmX230mm IP65	CEFEM	IM 63 (VI + II) C
2	1	CIRCUIT DISCONNECT 63A, 8P (6P + 2P)	CEFEM	
3	1	NON INSULATED GROUND BAR	CEFEM	
4	BATCH	RAIL	WEIDMULLER	TS 35 (51450)
5	2	END BRACKET	WEIDMULLER	ZEW TS35 (954000)
6	4	TERMINAL BLOCKS 2.5mm²	WEIDMULLER	ZDU 2.5-2 (177206)



500mm X 300mm X 230mm

MOUNTING PLATE

NAME PLATE LIST				
ITEM	QTY	NAME PLATE LIST	DIMENSION	FOR EQUIP.
1	1	4481-MQLK-0001-M1-LDS	37mm x 125mm LETTER DIM. : 12mm	G1
1	1	460 VOLTS خطر DANGER 460 VOLTS	37mm x 100mm LETTER DIM. : 8mm	

NOTES:

1 -PAINT:
INTERNAL: GLOSS WHITE - STANDARD RAL 9010
EXTERNAL: PEBBLE GREY SEMI-GLOSS - STANDARD RAL 7032

LOCAL DISCONNECT SWITCH
(ISOLATOR 4481-MQLK-0001-M1-LDS)

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3 ☐ Revise & Resubmit. Work may NOT proceed.
4 ☐ Revise not required. Work may proceed.
5 ☐ VOID / Superseded.

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Discipline :

Document No : 25457-4480-V1A-MXA0-0155 | Rev. :

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		3		UPDATE	05/01/11	F.P.	E.B.	C.C.
		2		CHANGE NAMEPLATE DESCRIPTION	06/12/10	F.P.	E.B.	C.C.
		1		CHANGE IN DEFINITION THE WORD "STATION" INTO "SWITCH"	17/11/10	F.P.	E.B.	C.C.
REFERENCES		REVISIONS						

NOTES

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SELLER DRAWING No. 1347-51152 REV. 3

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
LOCAL DISCONNECT SWITCH (3/3)
GENERAL ARRANGEMENT

Project Title: Ras Az Zawr Aluminium Smelter

MA'ADEN

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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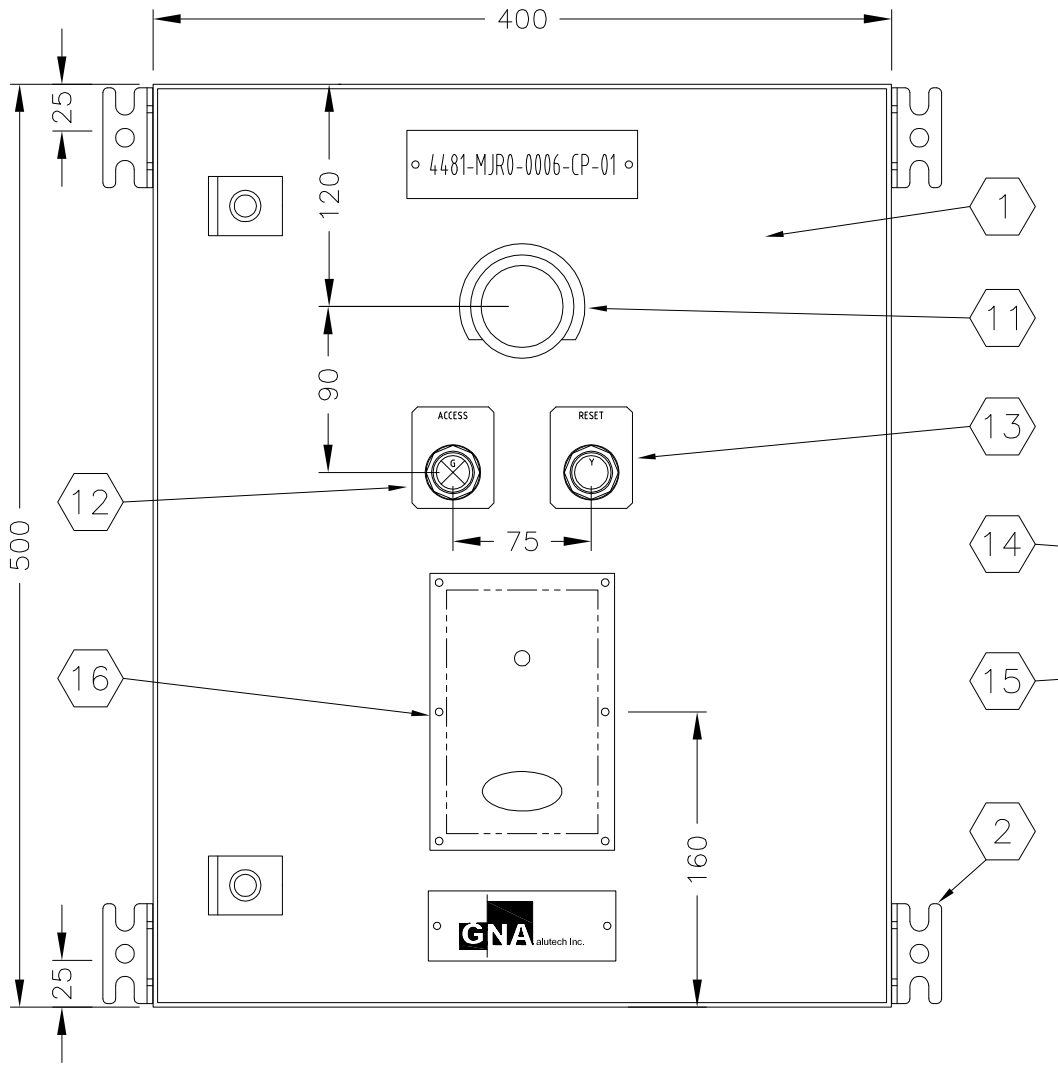
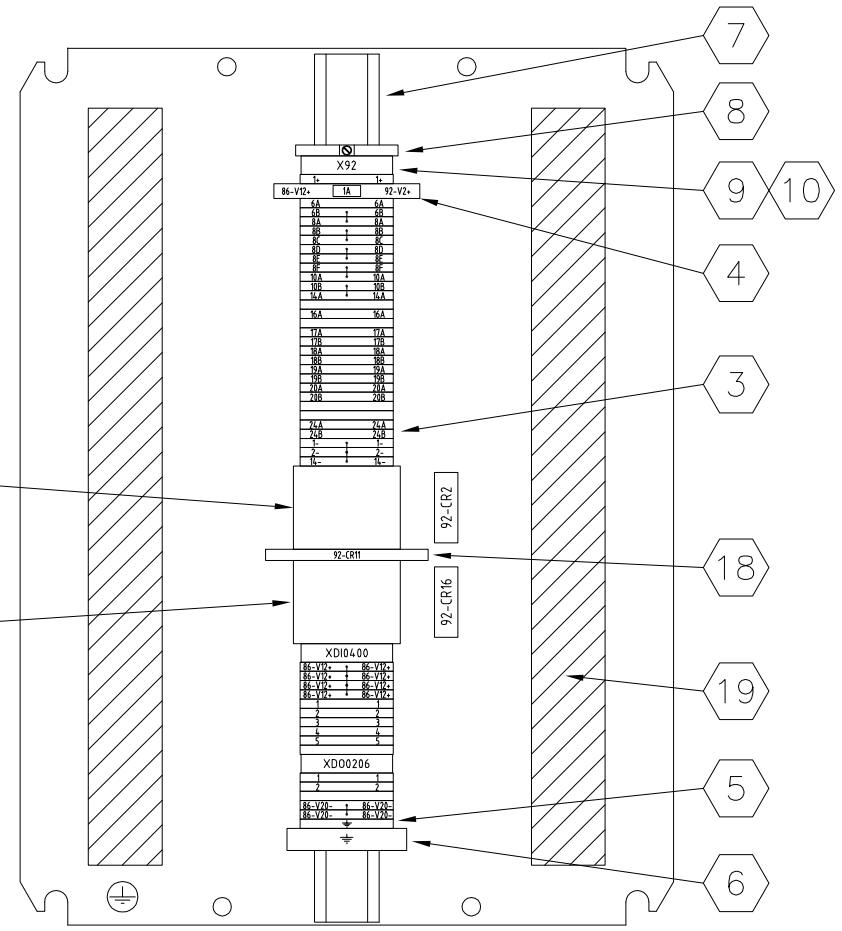


500mm X 400mm X 210mm



MOUNTING PANEL

MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 500mmX400mmX210mm IP66	RITTAL	AE 1045.500
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	SZ 2503.010
3	BATCH	TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZDU2.5-2/3AN (170601)
4	1	FUSIBLE TERMINAL BLOCK 2.5mm	WEIDMULLER	ZSI2.5 (161640)
5	1	GROUND TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZPE2.5-2/3AN (170609)
6	1	GROUND TERMINAL BLOCK 16mm^2	WEIDMULLER	ZPE16-2/1AN (177296)
7	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
8	BATCH	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
9	BATCH	TERMINAL MARKERS (20)	WEIDMULLER	SchT 5s (163193)
10	BATCH	PROTECTIVE STRIPS CLEAR (20)	WEIDMULLER	STR 5s (163194)
11	1	EMERGENCY STOP TURN TO RELEASE OPERATOR RED	TELEMECANIQUE	ZB4BS64
	1	CONTACT BLOCK 1NC	TELEMECANIQUE	ZB4BZ102
	1	GUARD RING	EATON	M22-XGPV
	1	EMERGENCY STOP LABEL	ENVITECH	
12	1	PUSH BUTTON LIGHT WITH PROTECTED LED (GREEN) 1NO	TELEMECANIQUE	XB4BW33B5
13	1	RESET PUSH BUTTON (YELOW)	TELEMECANIQUE	XB4BA5
	1	CONTACT BLOCK 1NC	TELEMECANIQUE	ZB4BZ102
14	1	CONTROL RELAIS 24Vdc, 4NO	TELEMECANIQUE	CA3-KN40BD
15	1	CONTROL RELAIS 24Vdc, 2NO+2NC	TELEMECANIQUE	CA3-KN22BD
	1	AUXILIARY CONTACT 4NC	TELEMECANIQUE	LA1-KN04
16	1	SOLENOID RELEASE UNIT WITH MAIN SAFETY KEY	ALLEN-BRADLEY	MSRUE13
17				
18	1	ISOLATION RELAIS 24Vdc	ALLEN-BRADLEY	700-HLT2Z24
19	BATCH	DUCT 40mm X 80mm	IBOCO	T1-1530G

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA alutech inc.	38,1mm x 101,6mm
1	1	4481-MJR0-0006-CP-01	37mm x 125mm LETTER DIM. : 12mm
1	1	ACCESS	50mm x 45mm LETTER DIM. : 4mm
1	1	RESET	50mm x 45mm LETTER DIM. : 4mm

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

R3 ROLLER CONVEYOR AFTER SEALING STATION
EMERGENCY STOP, ACCESS LIGHT / RESET
(LOCAL CONTROL PANEL 4481-MJR0-0006-CP-01)

SELLER/CONTRACTOR DOCUMENT REVIEW

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4 ☐ Revise not required. Work may proceed.
5 ☐ VOID / Superseded.

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Discipline :

Document No : 25457-4480-V1A-MXA0-0274 | Rev. :

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		0						

REFERENCES | REVISIONS

NOTES

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BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SELLER DRAWING No. 1347-51160 | REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
LOCAL CONTROL PANEL 4481-MJR0-0006-CP-01
GENERAL ARRANGEMENT

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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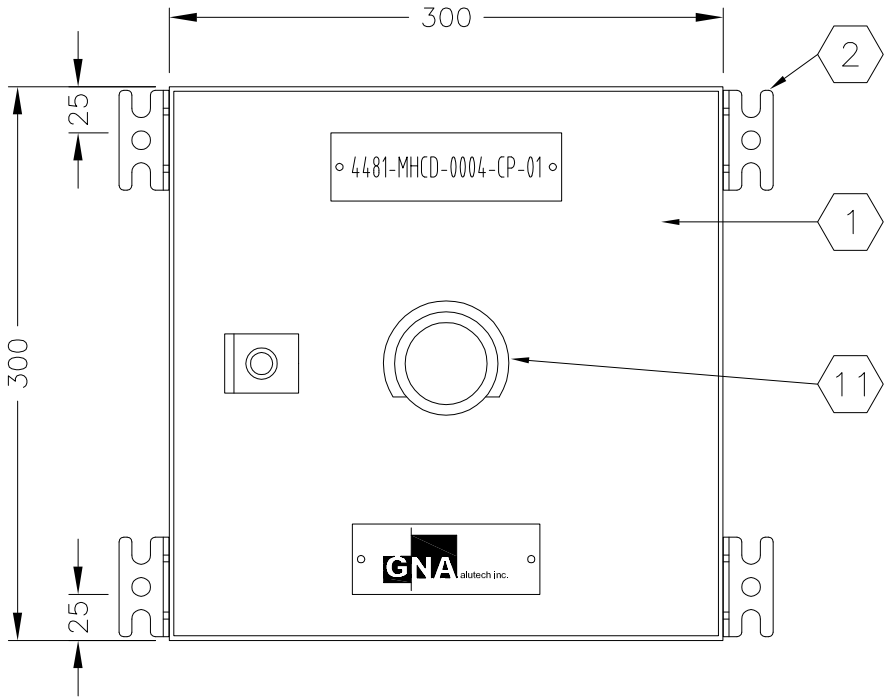
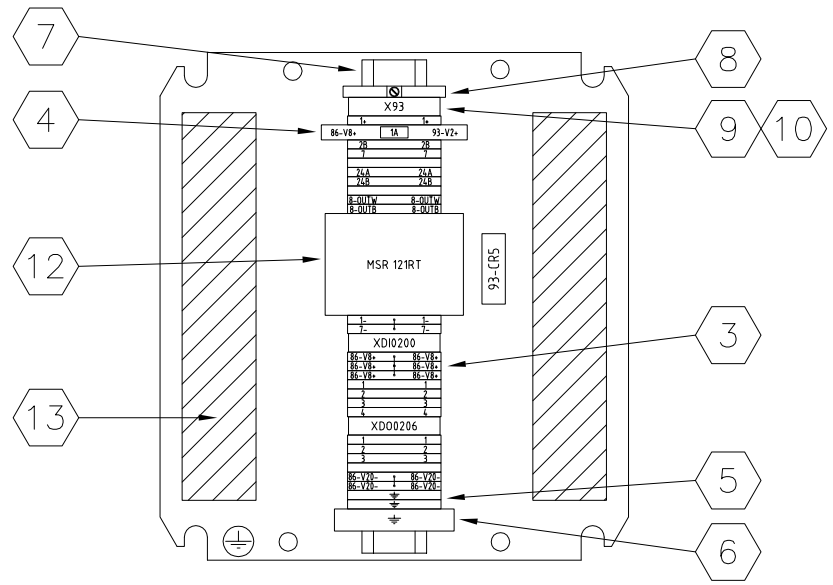


300mm X 300mm X 210mm



MOUNTING PANEL

MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 300mmX300mmX210mm IP66	RITTAL	AE 1033.500
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	SZ 2503.010
3	BATCH	TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZDU2.5-2/3AN (170601)
4	1	FUSIBLE TERMINAL BLOCK 2.5mm	WEIDMULLER	ZSI2.5 (161640)
5	2	GROUND TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZPE2.5-2/3AN (170609)
6	1	GROUND TERMINAL BLOCKS 16mm^2	WEIDMULLER	ZPE16-2/1AN (177296)
7	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
8	1	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
9	BATCH	TERMINAL MARKERS (20)	WEIDMULLER	SchT 5s (163193)
10	BATCH	PROTECTIVE STRIPS CLEAR (20)	WEIDMULLER	STR 5s (163194)
11	1	EMERGENCY STOP TURN TO RELEASE OPERATOR	TELEMECANIQUE	ZB4BS64
	1	CONTACT BLOCK	TELEMECANIQUE	ZB4BZ102
	1	GUARD RING	EATON	M22-XGPV
	1	EMERGENCY STOP LABEL	ENVITECH	
12	1	SAFETY RELAY MSR 121RT	ALLEN-BRADLEY	440R-J23102
13	BATCH	DUCT 40mm X 80mm	IBOCO	T1-1530G

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA alutech inc.	38,1mm x 101,6mm
1	1	4481-MHCD-0004-CP-01	37mm x 125mm LETTER DIM. : 12mm

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

C4 CHAIN CONVEYOR FOR SEALED CATHODE
EMERGENCY STOP
(LOCAL CONTROL PANEL 4481-MHCD-0004-CP-01)

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Discipline :

Document No : 25457-4480-V1A-MXA0-0275 | Rev. :

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Vendor or Subcontractor Logo: GNA alutech inc. — Département Ingénierie, Engineering Department, 8485 Trans-Canada, Saint-Laurent, Québec, H4S 1V3, Canada

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No | SUBD. | DISC. | SECTOR | SEQUENCE | REV.
25457-00AZ- xx - xxxx - xxxx - xxx - xxx

SELLER DRAWING No. 1347-51170 | REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
LOCAL CONTROL PANEL 4481-MHCD-0004-CP-01
GENERAL ARRANGEMENT

MA'ADEN

Type | Building | Discipline | Phase | Format | Sequentiel | Location | Rev. No.
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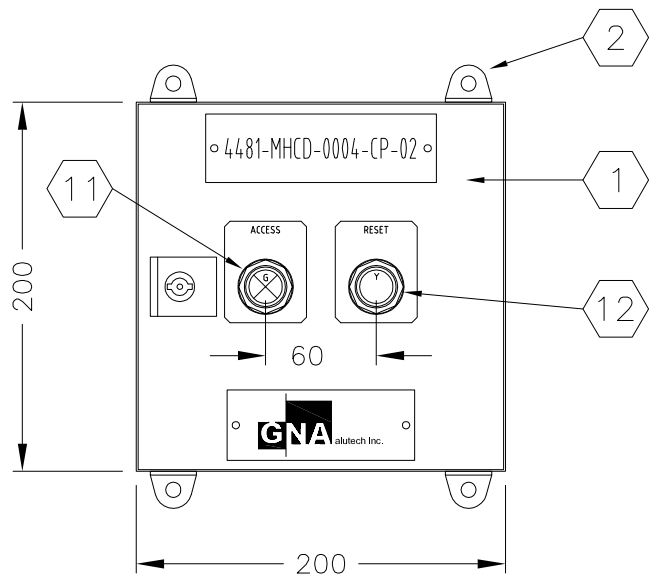
MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 200mmX200mmX120mm IP66	RITTAL	EB 1549.500
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	KL 1590.000
3	3	TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZDU2.5-2/3AN (170601)
4	1	GROUND TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZPE2.5-2/3AN (170609)
5	1	GROUND TERMINAL BLOCKS 16mm	WEIDMULLER	ZPE16-2/1AN (177296)
6				
7	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
8	1	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
9	BATCH	TERMINAL MARKERS (20)	WEIDMULLER	SchT 5s (163193)
10	BATCH	PROTECTIVE STRIPS CLEAR (20)	WEIDMULLER	STR 5s (163194)
11	1	PUSH BUTTON LIGHT WITH PROTECTED LED (GREEN) 1NO	TELEMECANIQUE	ZB4BW0B31
	1	HEAD FOR ILLUMINATED PUSH BUTTON (GREEN)	TELEMECANIQUE	ZB4BW333
12	1	RESET PUSH BUTTON (YELOW)	TELEMECANIQUE	ZB4BA5
	1	CONTACT BLOCK 1NO	TELEMECANIQUE	ZB4BZ101



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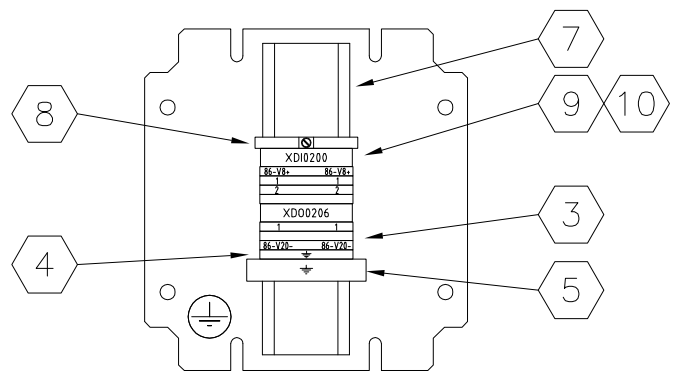

MOUNTING PANEL

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA alutech Inc.	38,1mm x 101,6mm
1	1	4481-MHCD-0004-CP-02	37mm x 125mm LETTER DIM. : 12mm
11	1	ACCESS	50mm x 45mm LETTER DIM. : 4mm
12	1	RESET	50mm x 45mm LETTER DIM. : 4mm

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

C4 CHAIN CONVEYOR UPSTREAM OF SHOTBLASTING MACHINE SAFETY MAT RESET (LOCAL CONTROL PANEL 4481-MHCD-0004-CP-02)

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ENG. GROUP SUP.		DRAWING SCALE:	1: 4
DATE:			

Vendor or Subcontractor Logo: GNA alutech Inc. Département Ingénierie / Engineering Department, 9450 Trans-Canada, Saint-Laurent, Québec, H4S 1V3, Canada

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SELLER DRAWING No. 1347-51171 | REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
LOCAL CONTROL PANEL 4481-MHCD-0004-CP-02
GENERAL ARRANGEMENT

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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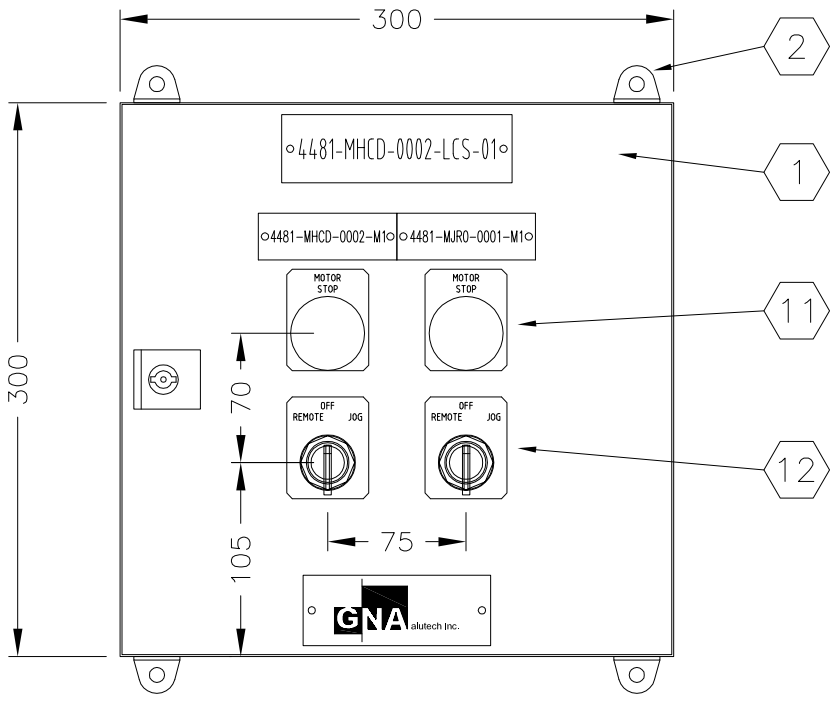
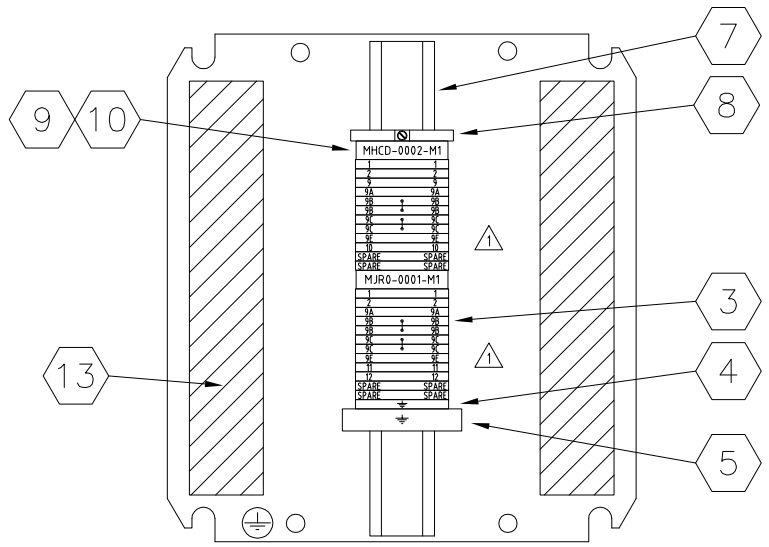


300mm X 300mm X 120mm



MOUNTING PANEL

MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 300mmX300mmX120mm IP66	RITTAL	EB 1555.500
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	KL 1590.000
3	BATCH	TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZDU2.5-2/3AN (170601)
4	1	GROUND TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZPE2.5-2/3AN (170609)
5	1	GROUND TERMINAL BLOCKS 16mm^2	WEIDMULLER	ZPE16-2/1AN (177296)
6				
7	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
8	1	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
9	BATCH	TERMINAL MARKERS (20)	WEIDMULLER	SchT 5s (163193)
10	BATCH	PROTECTIVE STRIPS CLEAR (20)	WEIDMULLER	STR 5s (163194)
11	2	STOP BUTTON PUSH/PULL TO RELEASE OPERATOR RED	TELEMECANIQUE	ZB4BT84
	2	CONTACT BLOCK 1NC	TELEMECANIQUE	ZB4BZ102
	2	PROTECTION	TELEMECANIQUE	ZBZ1604
12	2	SELECTOR SWITCH 3 POSITION RIGHT SPRING RETURN	TELEMECANIQUE	ZB4BD8
	4	CONTACT BLOCK 1NO	TELEMECANIQUE	ZB4BZ101
13	BATCH	DUCT 40mm X 60mm	IBOCO	T1-1522G

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA alutech Inc.	38,1mm x 101,6mm
1	1	4481-MHCD-0002-LCS-01	37mm x 125mm LETTER DIM. : 12mm
1	1	4481-MHCD-0002-M1	25mm x 75mm LETTER DIM. : 6mm
1	1	4481-MJR0-0001-M1	25mm x 75mm LETTER DIM. : 6mm
1	2	MOTOR STOP	50mm x 45mm LETTER DIM. : 4mm
1	2	OFF REMOTE JOG	50mm x 45mm LETTER DIM. : 4mm

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

C2 CHAIN CONV. UPSTREAM OF SHOTBLASTING M.
R9 CONICAL ROLLER CONVEYOR AT SHOTB. M. ENTRANCE
(LOCAL CONTROL STATION 4481-MHCD-0002-LCS-01)

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Discipline :

Document No : 25457-4480-V1A-MXA0-0074 | Rev. :

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NOTES

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SELLER DRAWING No. 1347-51200 | REV. 1

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
LOCAL CONTROL STATION 4481-MHCD-0002-LCS-01
GENERAL ARRANGEMENT

Project Title: Ras Az Zawr Aluminium Smelter

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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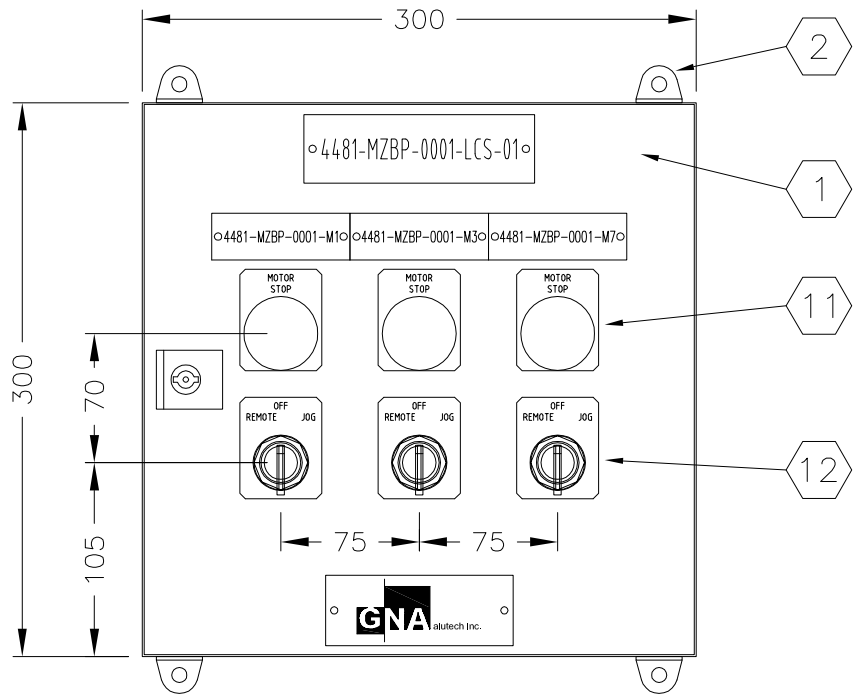

300mm X 300mm X 120mm

MOUNTING PANEL

MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 300mmX300mmX120mm IP66	RITTAL	EB 1555.500
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	KL 1590.000
3	BATCH	TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZDU2.5-2/3AN (170601)
4	1	GROUND TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZPE2.5-2/3AN (170609)
5	1	GROUND TERMINAL BLOCKS 16mm^2	WEIDMULLER	ZPE16-2/1AN (177296)
6				
7	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
8	1	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
9	BATCH	TERMINAL MARKERS (20)	WEIDMULLER	SchT 5s (163193)
10	BATCH	PROTECTIVE STRIPS CLEAR (20)	WEIDMULLER	STR 5s (163194)
11	3	STOP BUTTON PUSH/PULL TO RELEASE OPERATOR	TELEMECANIQUE	ZB4BT84
	3	CONTACT BLOCK 1NC	TELEMECANIQUE	ZB4BZ102
	3	PROTECTION	TELEMECANIQUE	ZBZ1604
12	3	SELECTOR SWITCH 3 POSITION RIGHT SPRING RETURN	TELEMECANIQUE	ZB4BD8
	6	CONTACT BLOCK 1NO	TELEMECANIQUE	ZB4BZ101
13	BATCH	DUCT 40mm X 60mm	IBOCO	T1-1522G

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA alutech Inc.	38,1mm x 101,6mm
1	1	4481-MZBP-0001-LCS-01	37mm x 125mm LETTER DIM. : 12mm
1	1	4481-MZBP-0001-M1	25mm x 75mm LETTER DIM. : 6mm
1	1	4481-MZBP-0001-M3	25mm x 75mm LETTER DIM. : 6mm
1	1	4481-MZBP-0001-M7	25mm x 75mm LETTER DIM. : 6mm
1	3	MOTOR STOP	50mm x 45mm LETTER DIM. : 4mm
1	3	OFF REMOTE JOG	50mm x 45mm LETTER DIM. : 4mm

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

S1 CATHODE BAR SHOTBLASTING MACHINE
(LOCAL CONTROL STATION 4481-MZBP-0001-LCS-01)

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Discipline :

Document No : 25457-4480-V1A-MXA0-0086 | Rev. :

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SELLER DRAWING No. 1347-51201 | REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
LOCAL CONTROL STATION 4481-MZBP-0001-LCS-01
GENERAL ARRANGEMENT

Project Title: Ras Az Zawr Aluminium Smelter

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
-	-	-	-	A3-		-AZ	

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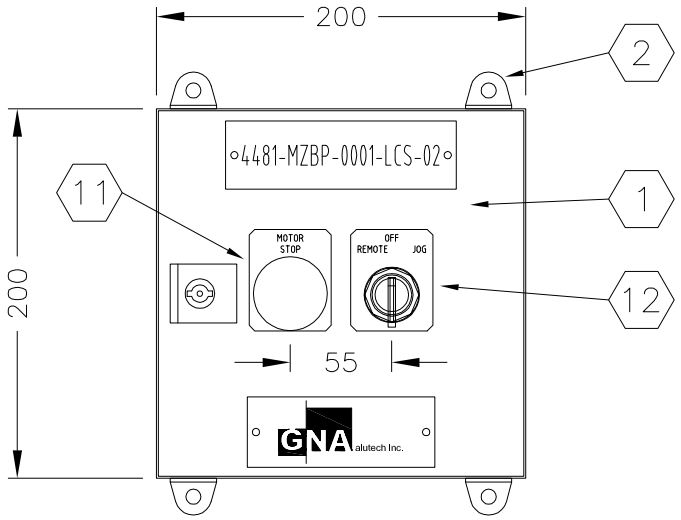

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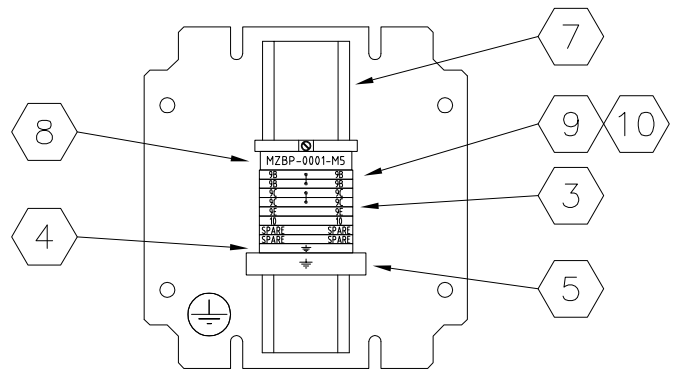

MOUNTING PANEL

MATERIAL LIST				
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1	1	PANEL 200mmX200mmX120mm IP66	RITTAL	EB 1549.500
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6				
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8	1	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
9	BATCH	TERMINAL MARKERS (20)	WEIDMULLER	SchT 5s (163193)
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11	1	STOP BUTTON PUSH/PULL TO RELEASE OPERATOR	TELEMECANIQUE	ZB4BT84
	1	CONTACT BLOCK 1NC	TELEMECANIQUE	ZB4BZ102
	1	PROTECTION	TELEMECANIQUE	ZBZ1604
12	1	SELECTOR SWITCH 3 POSITION RIGHT SPRING RETURN	TELEMECANIQUE	ZB4BD8
	2	CONTACT BLOCK 1NO	TELEMECANIQUE	ZB4BZ101

ITEM	QTY	NAME PLATE LIST	DIMENSION
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1	1	MOTOR STOP	50mm x 45mm LETTER DIM. : 4mm
1	1	OFF REMOTE JOG	50mm x 45mm LETTER DIM. : 4mm

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

S1 CATHODE BAR SHOTBLASTING MACHINE
(LOCAL CONTROL STATION 4481-MZBP-0001-LCS-02)

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Discipline :

Document No : 25457-4480-V1A-MXA0-0087 | Rev. :

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GNA alutech Inc. Département Ingénierie Engineering Department 9400 Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No | SUBD. | DISC. | SECTOR | SEQUENCE | REV.
25457-00AZ- xx - xxxx - xxxx - xxx - xxx

SELLER DRAWING No. 1347-51202 | REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
LOCAL CONTROL STATION 4481-MZBP-0001-LCS-02
GENERAL ARRANGEMENT

MA'ADEN معادن

Type | Building | Discipline | Phase | Format | Sequentiel | Location | Rev. No.
- | - | - | - | A3- | -AZ

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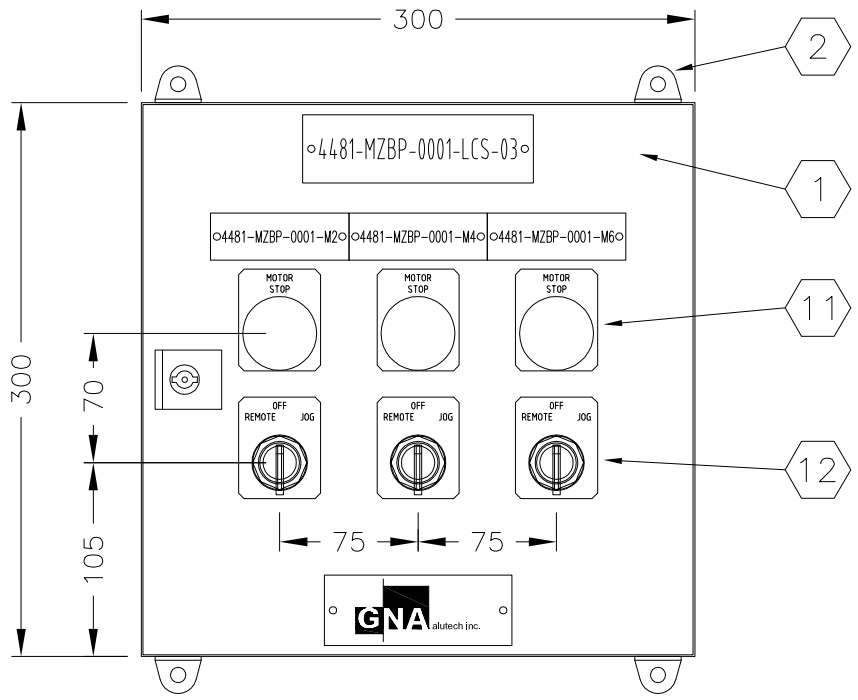

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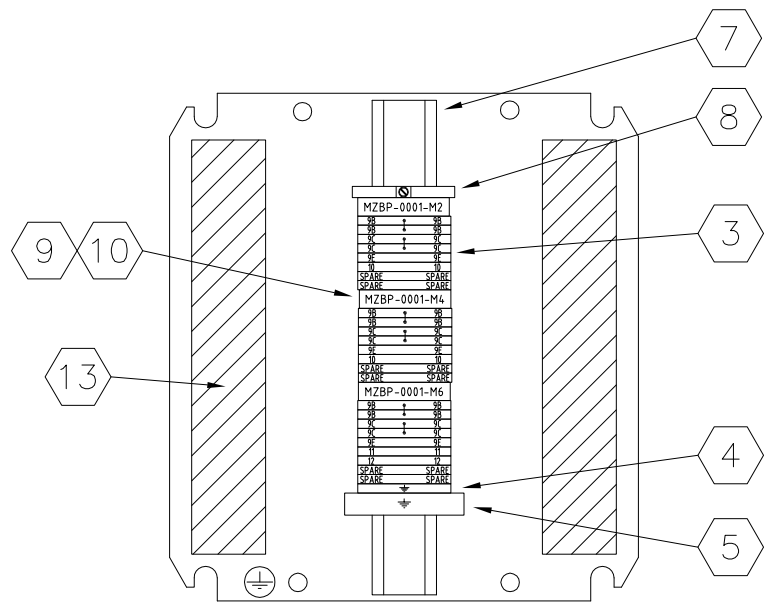

MOUNTING PANEL

MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 300mmX300mmX120mm IP66	RITTAL	EB 1555.500
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	KL 1590.000
3	BATCH	TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZDU2.5-2/3AN (170601)
4	1	GROUND TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZPE2.5-2/3AN (170609)
5	1	GROUND TERMINAL BLOCKS 16mm^2	WEIDMULLER	ZPE16-2/1AN (177296)
6				
7	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
8	1	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
9	BATCH	TERMINAL MARKERS (20)	WEIDMULLER	SchT 5s (163193)
10	BATCH	PROTECTIVE STRIPS CLEAR (20)	WEIDMULLER	STR 5s (163194)
11	3	STOP BUTTON PUSH/PULL TO RELEASE OPERATOR	TELEMECANIQUE	ZB4BT84
	3	CONTACT BLOCK 1NC	TELEMECANIQUE	ZB4BZ102
	3	PROTECTION	TELEMECANIQUE	ZBZ1604
12	3	SELECTOR SWITCH 3 POSITION RIGHT SPRING RETURN	TELEMECANIQUE	ZB4BD8
	6	CONTACT BLOCK 1NO	TELEMECANIQUE	ZB4BZ101
13	BATCH	DUCT 40mm X 60mm	IBOCO	T1-1522G

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA alutech inc.	38,1mm x 101,6mm
1	1	4481-MZBP-0001-LCS-03	37mm x 125mm LETTER DIM. : 12mm
1	1	4481-MZBP-0001-M2	25mm x 75mm LETTER DIM. : 6mm
1	1	4481-MZBP-0001-M4	25mm x 75mm LETTER DIM. : 6mm
1	1	4481-MZBP-0001-M6	25mm x 75mm LETTER DIM. : 6mm
1	3	MOTOR STOP	50mm x 45mm LETTER DIM. : 4mm
1	3	OFF REMOTE JOG	50mm x 45mm LETTER DIM. : 4mm

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

S1 CATHODE BAR SHOTBLASTING MACHINE
(LOCAL CONTROL STATION 4481-MZBP-0001-LCS-03)

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Discipline :

Document No : 25457-4480-V1A-MXA0-0088 | Rev. :

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Vendor or Subcontractor Logo: GNA alutech inc. — Département Ingénierie / Engineering Department, 5450 Trans-Canada, Saint-Laurent, Québec, H4S 1Y3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SELLER DRAWING No. 1347-51203 | REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
LOCAL CONTROL STATION 4481-MZBP-0001-LCS-03
GENERAL ARRANGEMENT

MA'ADEN

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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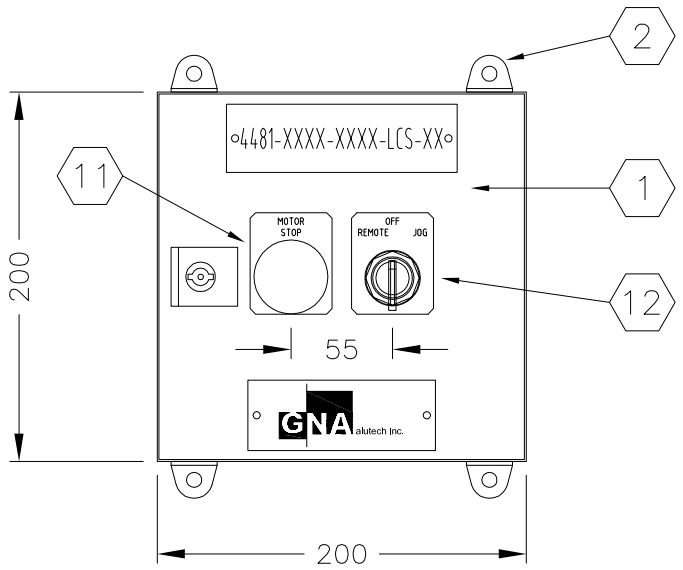
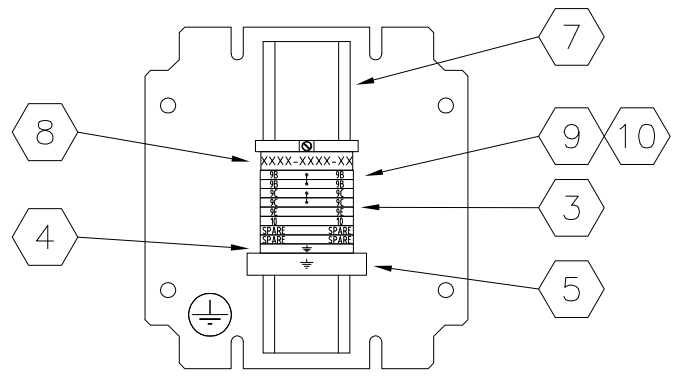


200mm X 200mm X 120mm



MOUNTING PANEL

MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 200mmX200mmX120mm IP66	RITTAL	EB 1549.500
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	KL 1590.000
3	BATCH	TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZDU2.5-2/3AN (170601)
4	1	GROUND TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZPE2.5-2/3AN (170609)
5	1	GROUND TERMINAL BLOCKS 16mm^2	WEIDMULLER	ZPE16-2/1AN (177296)
6				
7	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
8	1	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
9	BATCH	TERMINAL MARKERS (20)	WEIDMULLER	SchT 5s (163193)
10	BATCH	PROTECTIVE STRIPS CLEAR (20)	WEIDMULLER	STR 5s (163194)
11	1	STOP BUTTON PUSH/PULL TO RELEASE OPERATOR	TELEMECANIQUE	ZB4BT84
	1	CONTACT BLOCK 1NC	TELEMECANIQUE	ZB4BZ102
	1	PROTECTION	TELEMECANIQUE	ZBZ1604
12	1	SELECTOR SWITCH 3 POSITION RIGHT SPRING RETURN	TELEMECANIQUE	ZB4BD8
	2	CONTACT BLOCK 1NO	TELEMECANIQUE	ZB4BZ101

ITEM	QTY	NAME PLATE LIST	DIMENSION	FOR EQUIP.	MARKER
1	1	GNA alutech inc.	38,1mm x 101,6mm	–	–
1	1	4481-MAC0-0001-LCS-01	37mm x 125mm LETTER DIM. : 12mm	D1	MAC0-0001-M1
1	1	4481-MEEP-0001-LCS-01	37mm x 125mm LETTER DIM. : 12mm	F1-A	MEEP-0001-M1
1	1	4481-MEEP-0001-LCS-02	37mm x 125mm LETTER DIM. : 12mm	F1-B	MEEP-0001-M2
1	1	4481-MEEP-0001-LCS-03	37mm x 125mm LETTER DIM. : 12mm	F1-C	MEEP-0001-M3
1	1	MOTOR STOP	50mm x 45mm LETTER DIM. : 4mm	EACH EQUIP.	–
1	1	OFF REMOTE JOG	50mm x 45mm LETTER DIM. : 4mm	EACH EQUIP.	–

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

LOCAL CONTROL STATION (EQUIP. WITHOUT DRIVE)

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Discipline :

Document No : 25457-4480-V1A-MXA0-0089 | Rev. :

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BECHTEL

SELLER DRAWING No. 1347-51204 | REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
LOCAL CONTROL STATION (EQUIP. WITHOUT DRIVE)
GENERAL ARRANGEMENT

Project Title: Ras Az Zawr Aluminium Smelter

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
–	–	–		A3-		-AZ	

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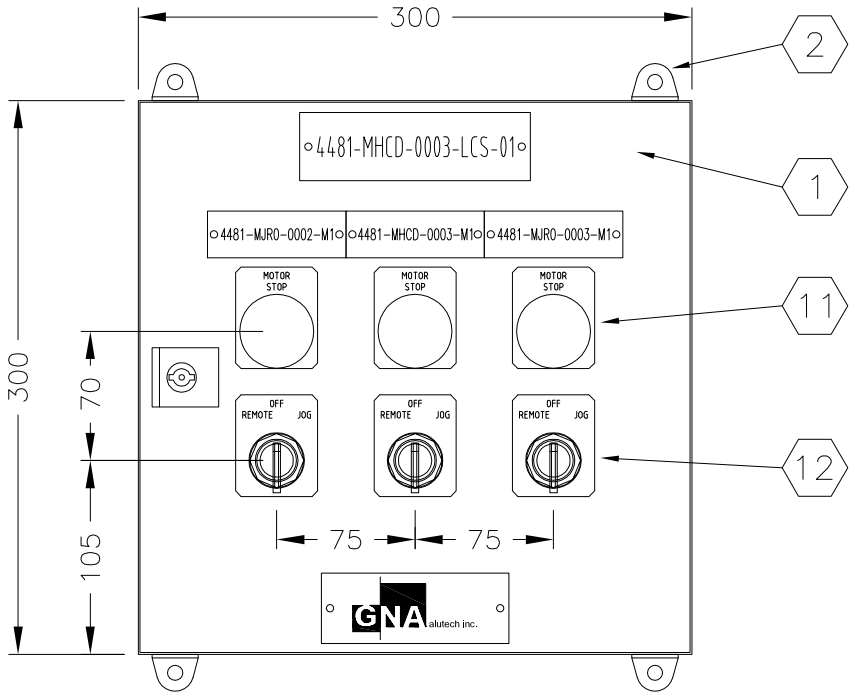
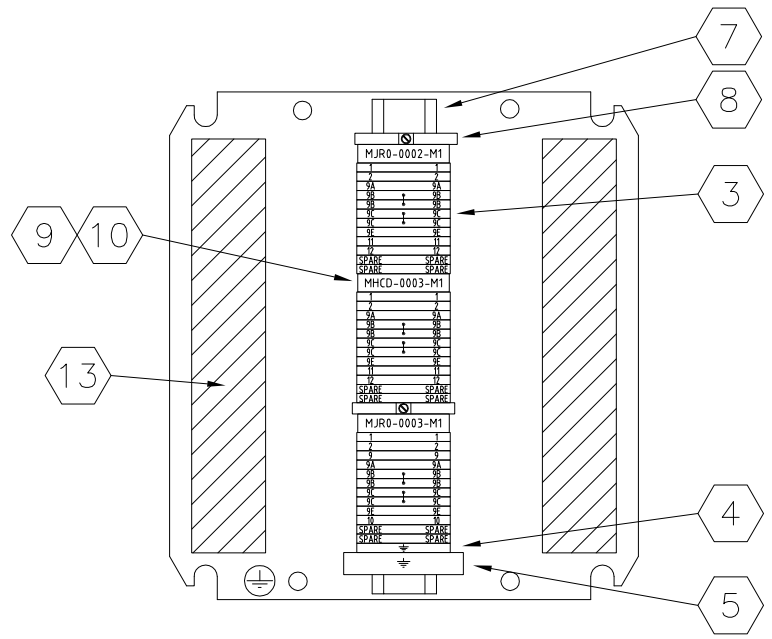


300mm X 300mm X 120mm



MOUNTING PANEL

MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 300mmX300mmX120mm IP66	RITTAL	EB 1555.500
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	KL 1590.000
3	BATCH	TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZDU2.5-2/3AN (170601)
4	1	GROUND TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZPE2.5-2/3AN (170609)
5	1	GROUND TERMINAL BLOCKS 16mm^2	WEIDMULLER	ZPE16-2/1AN (177296)
6				
7	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
8	1	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
9	BATCH	TERMINAL MARKERS (20)	WEIDMULLER	SchT 5s (163193)
10	BATCH	PROTECTIVE STRIPS CLEAR (20)	WEIDMULLER	STR 5s (163194)
11	3	STOP BUTTON PUSH/PULL TO RELEASE OPERATOR RED	TELEMECANIQUE	ZB4BT84
	3	CONTACT BLOCK 1NC	TELEMECANIQUE	ZB4BZ102
	3	PROTECTION	TELEMECANIQUE	ZBZ1604
12	3	SELECTOR SWITCH 3 POSITION RIGHT SPRING RETURN	TELEMECANIQUE	ZB4BD8
	6	CONTACT BLOCK 1NO	TELEMECANIQUE	ZB4BZ101
13	BATCH	DUCT 40mm X 60mm	IBOCO	T1-1522G

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA alutech inc.	38,1mm x 101,6mm
1	1	4481-MHCD-0003-LCS-01	37mm x 125mm LETTER DIM. : 12mm
1	1	4481-MJR0-0002-M1	25mm x 75mm LETTER DIM. : 6mm
1	1	4481-MHCD-0003-M1	25mm x 75mm LETTER DIM. : 6mm
1	1	4481-MJR0-0003-M1	25mm x 75mm LETTER DIM. : 6mm
1	3	MOTOR STOP	50mm x 45mm LETTER DIM. : 4mm
1	3	OFF REMOTE JOG	50mm x 45mm LETTER DIM. : 4mm

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

C3 CHAIN CONV. BETWWEN SHOTB. M. AND OVEN
R7 ROLLER CONVEYOR AT BAR FURNACE ENTRANCE
R8 CONICAL ROLLER CONVEYOR AT SHOTB. M. EXIT
(LOCAL CONTROL STATION 4481-MHCD-0003-LCS-01)

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SELLER DRAWING No. 1347-51205 | REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
LOCAL CONTROL STATION 4481-MHCD-0003-LCS-01
GENERAL ARRANGEMENT

Project Title: Ras Az Zawr Aluminium Smelter

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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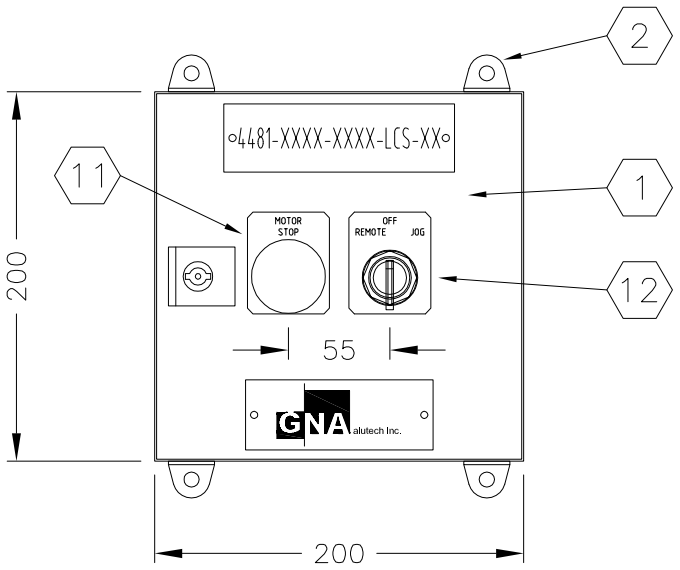

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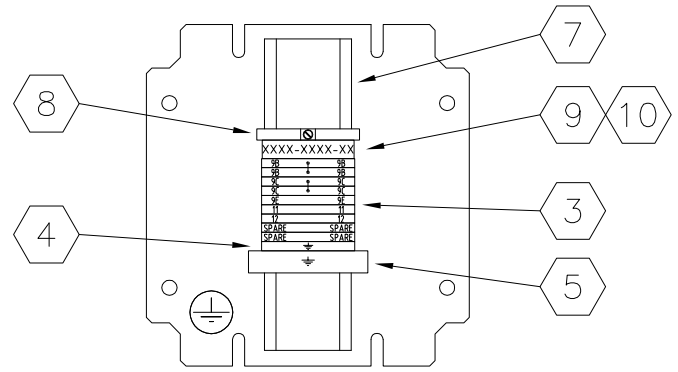

MOUNTING PANEL

MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 200mmX200mmX120mm IP66	RITTAL	EB 1549.500
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	KL 1590.000
3	BATCH	TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZDU2.5-2/3AN (170601)
4	1	GROUND TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZPE2.5-2/3AN (170609)
5	1	GROUND TERMINAL BLOCKS 16mm^2	WEIDMULLER	ZPE16-2/1AN (177296)
6				
7	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
8	1	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
9	BATCH	TERMINAL MARKERS (20)	WEIDMULLER	SchT 5s (163193)
10	BATCH	PROTECTIVE STRIPS CLEAR (20)	WEIDMULLER	STR 5s (163194)
11	1	STOP BUTTON PUSH/PULL TO RELEASE OPERATOR	TELEMECANIQUE	ZB4BT84
	1	CONTACT BLOCK 1NC	TELEMECANIQUE	ZB4BZ102
	1	PROTECTION	TELEMECANIQUE	ZBZ1604
12	1	SELECTOR SWITCH 3 POSITION RIGHT SPRING RETURN	TELEMECANIQUE	ZB4BD8
	2	CONTACT BLOCK 1NO	TELEMECANIQUE	ZB4BZ101

ITEM	QTY	NAME PLATE LIST	DIMENSION	FOR EQUIP.	MARKER
1	1	GNA alutech inc.	38,1mm x 101,6mm	–	–
1	1	4481-MBMB-0001-LCS-01	37mm x 125mm LETTER DIM. : 12mm	F2M1	MBMB-0001-M1
1	1	4481-MBMB-0001-LCS-02	37mm x 125mm LETTER DIM. : 12mm	F2M2	MBMB-0001-M2
1	1	4481-MBMB-0001-LCS-03	37mm x 125mm LETTER DIM. : 12mm	F2M3	MBMB-0001-M3
1	1	4481-MBMB-0001-LCS-04	37mm x 125mm LETTER DIM. : 12mm	F2M4	MBMB-0001-M4
1	1	MOTOR STOP	50mm x 45mm LETTER DIM. : 4mm	EACH EQUIP.	–
1	1	OFF REMOTE JOG	50mm x 45mm LETTER DIM. : 4mm	EACH EQUIP.	–

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

LOCAL CONTROL STATION (EQUIP. WITH DRIVE)

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Discipline :

Document No : 25457-4480-V1A-MXA0-0197 | Rev. :

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Vendor or Subcontractor Logo: GNA alutech inc. Département Ingenierie Engineering Department 5660 Trans-Canada Saint-Laurent, Quebec H4S 1Y2 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SELLER DRAWING No. 1347-51206 | REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
LOCAL CONTROL STATION (EQUIP. WITH DRIVE)
GENERAL ARRANGEMENT

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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MATERIAL LIST				
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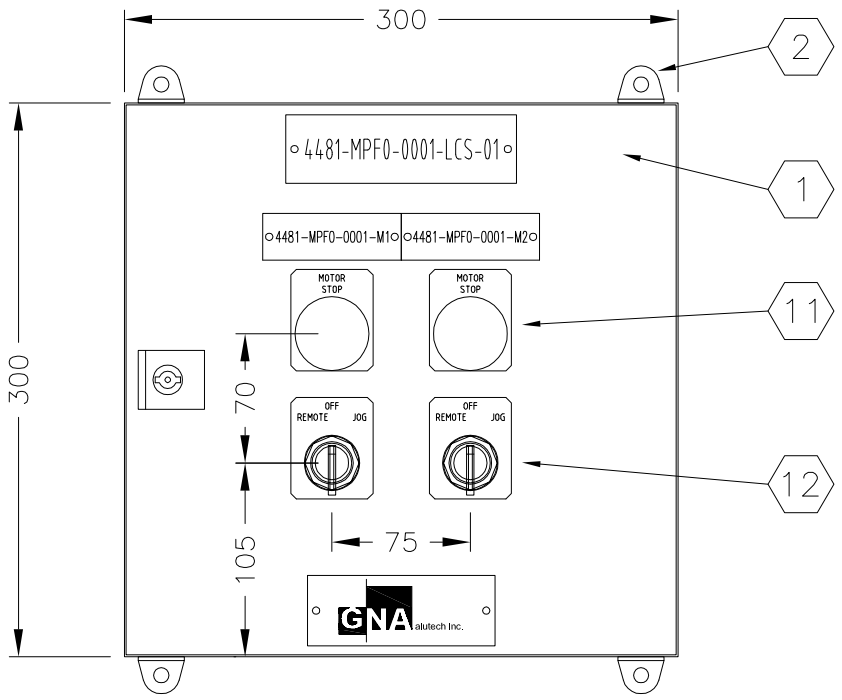
4	1	GROUND TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZPE2.5-2/3AN (170609)
5	1	GROUND TERMINAL BLOCKS 16mm^2	WEIDMULLER	ZPE16-2/1AN (177296)
6				
7	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
8	1	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
9	BATCH	TERMINAL MARKERS (20)	WEIDMULLER	SchT 5s (163193)
10	BATCH	PROTECTIVE STRIPS CLEAR (20)	WEIDMULLER	STR 5s (163194)
11	2	STOP BUTTON PUSH/PULL TO RELEASE OPERATOR	TELEMECANIQUE	ZB4BT84
	2	CONTACT BLOCK 1NC	TELEMECANIQUE	ZB4BZ102
	2	PROTECTION	TELEMECANIQUE	ZBZ1604
12	2	SELECTOR SWITCH 3 POSITION RIGHT SPRING RETURN	TELEMECANIQUE	ZB4BD8
	4	CONTACT BLOCK 1NO	TELEMECANIQUE	ZB4BZ101
13	BATCH	DUCT 40mm X 60mm	IBOCO	T1-1522G



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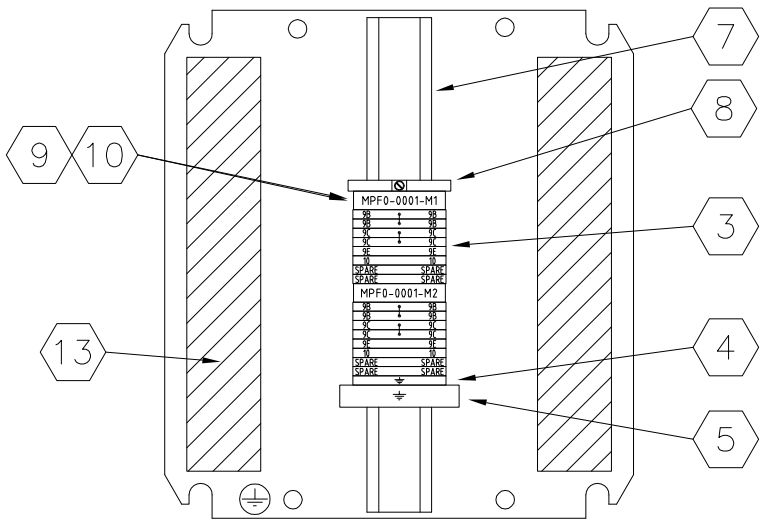

MOUNTING PANEL

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA alutech inc.	38,1mm x 101,6mm
1	1	4481-MPF0-0001-LCS-01	37mm x 125mm LETTER DIM. : 12mm
1	1	4481-MPF0-0001-M1	25mm x 75mm LETTER DIM. : 6mm
1	1	4481-MPF0-0001-M2	25mm x 75mm LETTER DIM. : 6mm
1	2	MOTOR STOP	50mm x 45mm LETTER DIM. : 4mm
1	2	OFF REMOTE JOG	50mm x 45mm LETTER DIM. : 4mm

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

H1 HYDRAULIC POWER UNIT
(LOCAL CONTROL STATION 4481-MPF0-0001-LCS-01)

SELLER/CONTRACTOR DOCUMENT REVIEW

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4 ☐ Revise not required. Work may proceed.
5 ☐ VOID / Superseded.

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Reviewed by : _____ Date : _____

Discipline :

Document No : 25457-4480-V1A-MXA0-0326 | Rev. :

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NOTES

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Vendor or Subcontractor Logo: GNA alutech inc. — Département Ingénierie / Engineering Department, 5695 Trans-Canada, Montréal, Québec, H4S 1V5, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SELLER DRAWING No. 1347-51207 | REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
LOCAL CONTROL STATION 4481-MPF0-0001-LCS-01
GENERAL ARRANGEMENT

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
—	—	—		A3-		-AZ	

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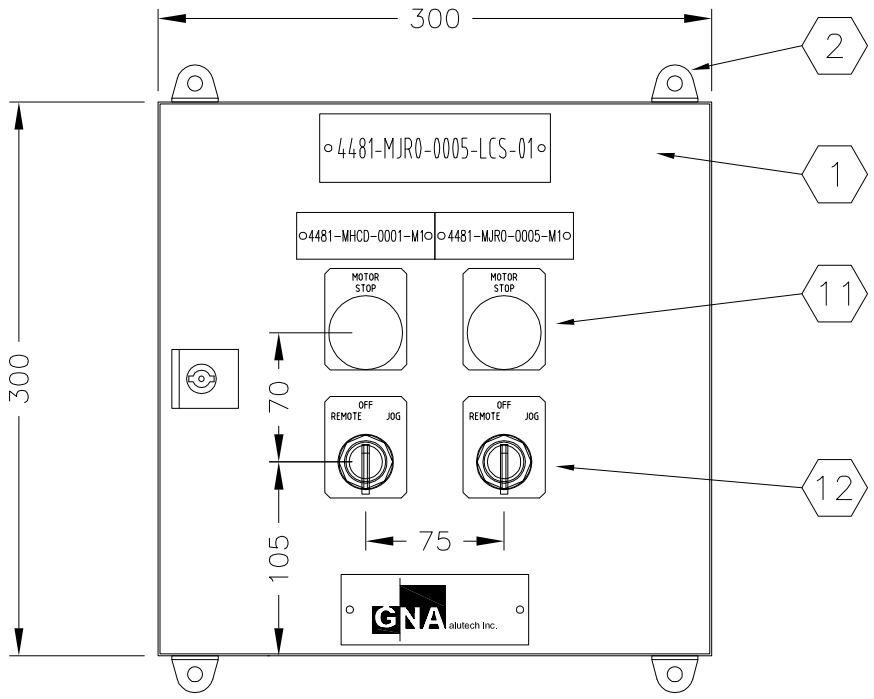
MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 300mmX300mmX120mm IP66	RITTAL	EB 1555.500
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	KL 1590.000
3	BATCH	TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZDU2.5-2/3AN (170601)
4	1	GROUND TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZPE2.5-2/3AN (170609)
5	1	GROUND TERMINAL BLOCKS 16mm^2	WEIDMULLER	ZPE16-2/1AN (177296)
6				
7	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
8	1	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
9	BATCH	TERMINAL MARKERS (20)	WEIDMULLER	SchT 5s (163193)
10	BATCH	PROTECTIVE STRIPS CLEAR (20)	WEIDMULLER	STR 5s (163194)
11	2	STOP BUTTON PUSH/PULL TO RELEASE OPERATOR	TELEMECANIQUE	ZB4BT84
	2	CONTACT BLOCK 1NC	TELEMECANIQUE	ZB4BZ102
	2	PROTECTION	TELEMECANIQUE	ZBZ1604
12	2	SELECTOR SWITCH 3 POSITION RIGHT SPRING RETURN	TELEMECANIQUE	ZB4BD8
	4	CONTACT BLOCK 1NO	TELEMECANIQUE	ZB4BZ101
13	BATCH	DUCT 40mm X 60mm	IBOCO	T1-1522G



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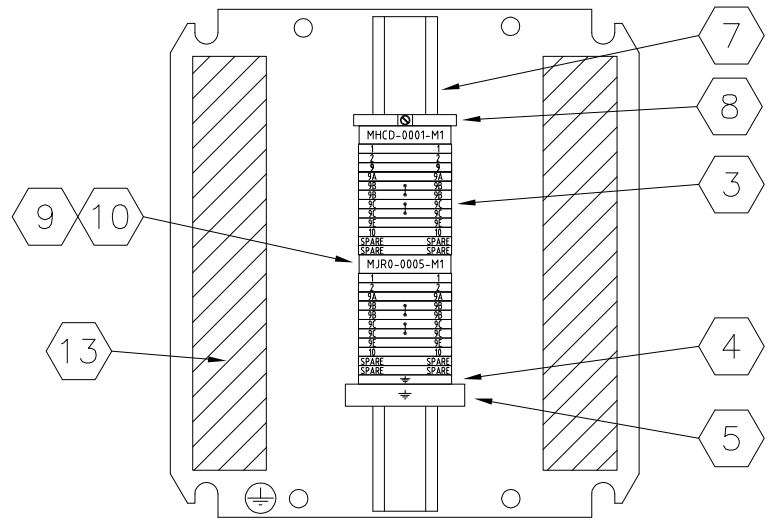

MOUNTING PANEL

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA alutech Inc.	38,1mm x 101,6mm
1	1	4481-MJR0-0005-LCS-01	37mm x 125mm LETTER DIM. : 12mm
1	1	4481-MHCD-0001-M1	25mm x 75mm LETTER DIM. : 6mm
1	1	4481-MJR0-0005-M1	25mm x 75mm LETTER DIM. : 6mm
1	2	MOTOR STOP	50mm x 45mm LETTER DIM. : 4mm
1	2	OFF REMOTE JOG	50mm x 45mm LETTER DIM. : 4mm

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

C1 CHAIN CONVEYOR OF BLOCK OVEN
R1 ROLLER CONVEYOR AT BLOCK OVEN EXIT
(LOCAL CONTROL STATION 4481-MJR0-0005-LCS-01)

SELLER/CONTRACTOR DOCUMENT REVIEW

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Discipline :

Document No : 25457-4480-V1A-MXA0-0276 | Rev. :

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Vendor or Subcontractor Logo: GNA alutech inc. — Département Ingénierie / Engineering Department, 8690 Trans-Canada, Montréal, Québec, H4S 1V9, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No | SUBD. | DISC. | SECTOR | SEQUENCE | REV.
25457-00AZ- xx - xxxx - xxxx - xxx - xxx

SELLER DRAWING No. 1347-51208 | REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
LOCAL CONTROL STATION 4481-MJR0-0005-LCS-01
GENERAL ARRANGEMENT

MA'ADEN

Type | Building | Discipline | Phase | Format | Sequentiel | Location | Rev. No.
— — — — A3- -AZ

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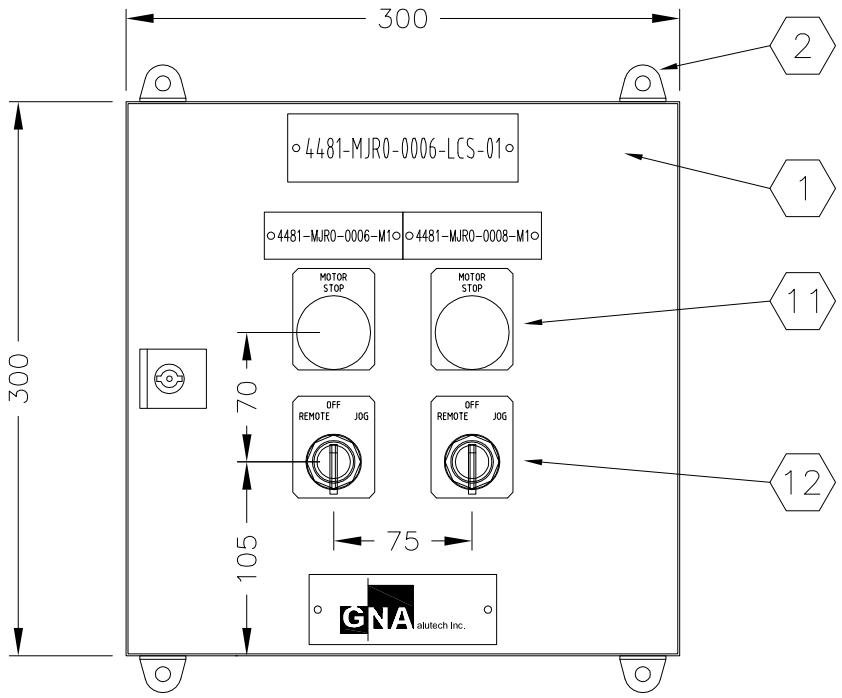
MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 300mmX300mmX120mm IP66	RITTAL	EB 1555.500
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	KL 1590.000
3	BATCH	TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZDU2.5-2/3AN (170601)
4	1	GROUND TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZPE2.5-2/3AN (170609)
5	1	GROUND TERMINAL BLOCKS 16mm^2	WEIDMULLER	ZPE16-2/1AN (177296)
6				
7	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
8	1	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
9	BATCH	TERMINAL MARKERS (20)	WEIDMULLER	SchT 5s (163193)
10	BATCH	PROTECTIVE STRIPS CLEAR (20)	WEIDMULLER	STR 5s (163194)
11	2	STOP BUTTON PUSH/PULL TO RELEASE OPERATOR	TELEMECANIQUE	ZB4BT84
	2	CONTACT BLOCK 1NC	TELEMECANIQUE	ZB4BZ102
	2	PROTECTION	TELEMECANIQUE	ZBZ1604
12	2	SELECTOR SWITCH 3 POSITION RIGHT SPRING RETURN	TELEMECANIQUE	ZB4BD8
	4	CONTACT BLOCK 1NO	TELEMECANIQUE	ZB4BZ101
13	BATCH	DUCT 40mm X 60mm	IBOCO	T1-1522G



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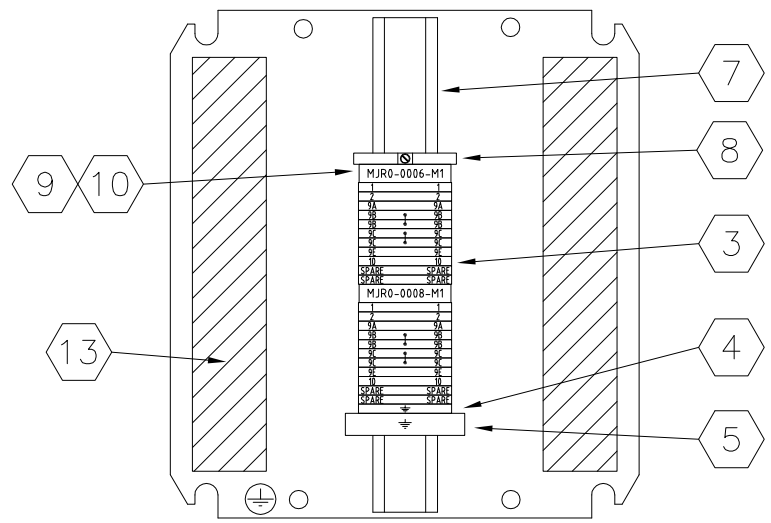

MOUNTING PANEL

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA alutech Inc.	38,1mm x 101,6mm
1	1	4481-MJR0-0006-LCS-01	37mm x 125mm LETTER DIM. : 12mm
1	1	4481-MJR0-0006-M1	25mm x 75mm LETTER DIM. : 6mm
1	1	4481-MJR0-0008-M1	25mm x 75mm LETTER DIM. : 6mm
1	2	MOTOR STOP	50mm x 45mm LETTER DIM. : 4mm
1	2	OFF REMOTE JOG	50mm x 45mm LETTER DIM. : 4mm

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

R3 ROLLER CONVEYOR AFTER SEALING STATION
R5 ROLLER CONVEYOR AT COOLING & TURNING STATION
(LOCAL CONTROL STATION 4481-MJR0-0006-LCS-01)

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4 ☐ Revise not required. Work may proceed.
5 ☐ VOID / Superseded.

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Reviewed by : _____ Date : _____

Discipline :

Document No : 25457-4480-V1A-MXA0-0277 | Rev. :

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REFERENCES | REVISIONS

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Vendor or Subcontractor Logo: GNA alutech Inc. Département Ingénierie Engineering Department 9405 Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No | SUBD. | DISC. | SECTOR | SEQUENCE | REV.
25457-00AZ- xx - xxxx - xxxx - xxx - xxx

SELLER DRAWING No. 1347-51209 | REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
LOCAL CONTROL STATION 4481-MJR0-0006-LCS-01
GENERAL ARRANGEMENT

MA'ADEN معادن

Type | Building | Discipline | Phase | Format | Sequentiel | Location | Rev. No.
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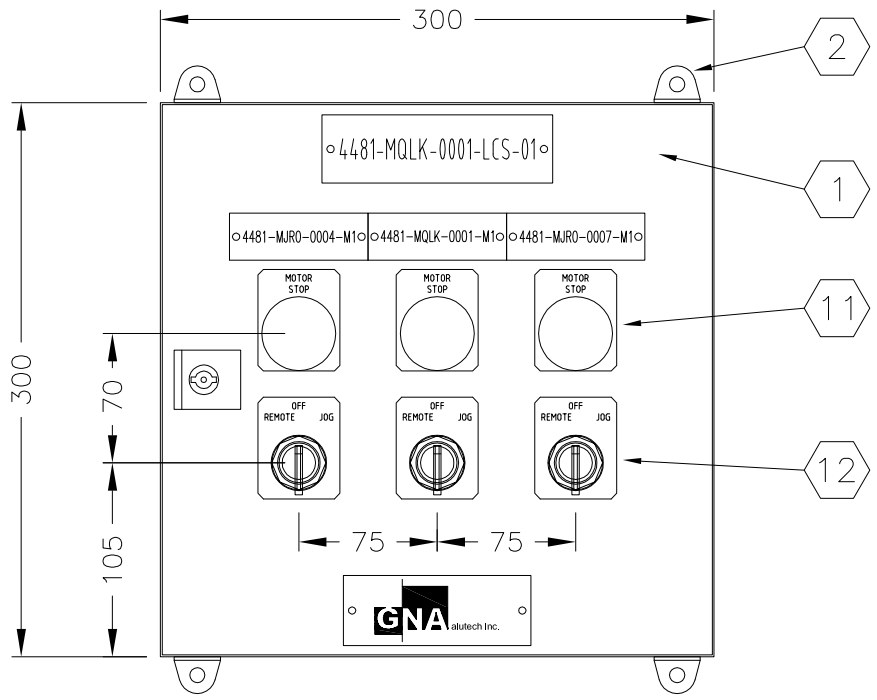

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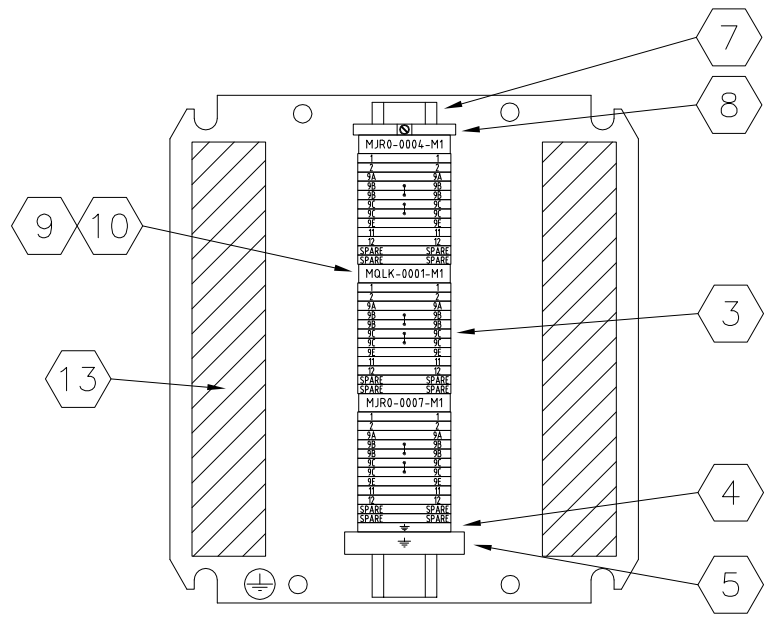

MOUNTING PANEL

MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 300mmX300mmX120mm IP66	RITTAL	EB 1555.500
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	KL 1590.000
3	BATCH	TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZDU2.5-2/3AN (170601)
4	1	GROUND TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZPE2.5-2/3AN (170609)
5	1	GROUND TERMINAL BLOCKS 16mm^2	WEIDMULLER	ZPE16-2/1AN (177296)
6				
7	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
8	1	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
9	BATCH	TERMINAL MARKERS (20)	WEIDMULLER	SchT 5s (163193)
10	BATCH	PROTECTIVE STRIPS CLEAR (20)	WEIDMULLER	STR 5s (163194)
11	3	STOP BUTTON PUSH/PULL TO RELEASE OPERATOR	TELEMECANIQUE	ZB4BT84
	3	CONTACT BLOCK 1NC	TELEMECANIQUE	ZB4BZ102
	3	PROTECTION	TELEMECANIQUE	ZBZ1604
12	3	SELECTOR SWITCH 3 POSITION RIGHT SPRING RETURN	TELEMECANIQUE	ZB4BD8
	6	CONTACT BLOCK 1NO	TELEMECANIQUE	ZB4BZ101
13	BATCH	DUCT 40mm X 60mm	IBOCO	T1-1522G

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA alutech inc.	38,1mm x 101,6mm
1	1	4481-MQLK-0001-LCS-01	37mm x 125mm LETTER DIM. : 12mm
1	1	4481-MJR0-0004-M1	25mm x 75mm LETTER DIM. : 6mm
1	1	4481-MQLK-0001-M1	25mm x 75mm LETTER DIM. : 6mm
1	1	4481-MJR0-0007-M1	25mm x 75mm LETTER DIM. : 6mm
1	3	MOTOR STOP	50mm x 45mm LETTER DIM. : 4mm
1	3	OFF REMOTE JOG	50mm x 45mm LETTER DIM. : 4mm

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

R6 ROLLER CONVEYOR AT BAR FURNACE EXIT
G1 POSITIONING GANTRY FOR BLOCK AND BARS
R2 ROLLER CONVEYOR FOR BLOCK AND BAR ASSEMBLY
(LOCAL CONTROL STATION 4481-MQLK-0001-LCS-01)

SELLER/CONTRACTOR DOCUMENT REVIEW

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5 ☐ VOID / Superseded.

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Discipline :

Document No : 25457-4480-V1A-MXA0-0278 | Rev. :

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REFERENCES | REVISIONS

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SELLER DRAWING No. 1347-51210 | REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
LOCAL CONTROL STATION 4481-MQLK-0001-LCS-01
GENERAL ARRANGEMENT

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 200mmX200mmX120mm IP66	RITTAL	EB 1549.500
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	KL 1590.000
3	BATCH	TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZDU2.5-2/3AN (170601)
4	1	GROUND TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZPE2.5-2/3AN (170609)
5	1	GROUND TERMINAL BLOCKS 16mm^2	WEIDMULLER	ZPE16-2/1AN (177296)
6				
7	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
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9	BATCH	TERMINAL MARKERS (20)	WEIDMULLER	SchT 5s (163193)
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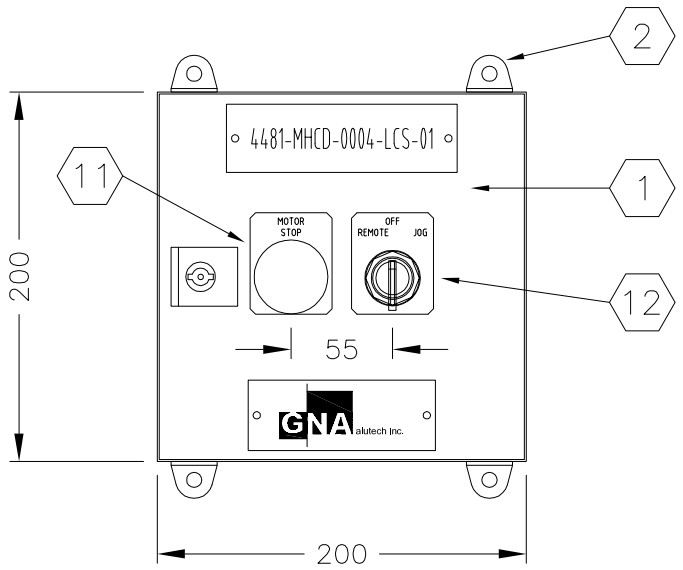
11	1	STOP BUTTON PUSH/PULL TO RELEASE OPERATOR	TELEMECANIQUE	ZB4BT84
	1	CONTACT BLOCK 1NC	TELEMECANIQUE	ZB4BZ102
	1	PROTECTION	TELEMECANIQUE	ZBZ1604
12	1	SELECTOR SWITCH 3 POSITION RIGHT SPRING RETURN	TELEMECANIQUE	ZB4BD8
	2	CONTACT BLOCK 1NO	TELEMECANIQUE	ZB4BZ101



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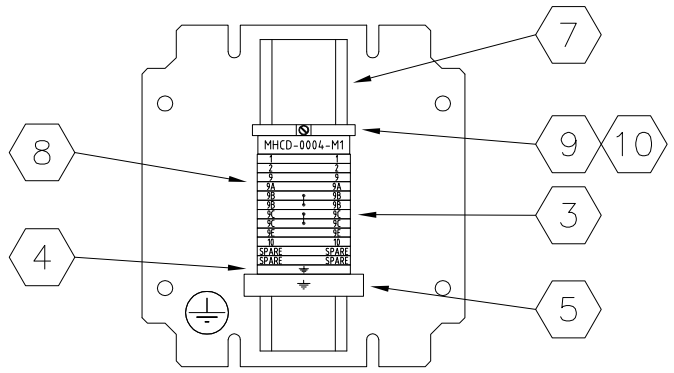

MOUNTING PANEL

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA alutech inc.	38,1mm x 101,6mm
1	1	4481-MHCD-0004-LCS-01	37mm x 125mm LETTER DIM. : 12mm
1	1	MOTOR STOP	50mm x 45mm LETTER DIM. : 4mm
1	1	OFF REMOTE JOG	50mm x 45mm LETTER DIM. : 4mm

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

C4 CHAIN CONVEYOR FOR SEALED CATHODE (LOCAL CONTROL STATION 4481-MHCD-0004-LCS-01)

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Discipline :

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1347-51211	0

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REFERENCES | REVISIONS

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Vendor or Subcontractor Logo: GNA alutech inc. — Département Ingénierie / Engineering Department, 5692 Trans-Canada, Saint-Laurent, Québec, H4S 1Y3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
LOCAL CONTROL STATION 4481-MHCD-0004-LCS-01
GENERAL ARRANGEMENT

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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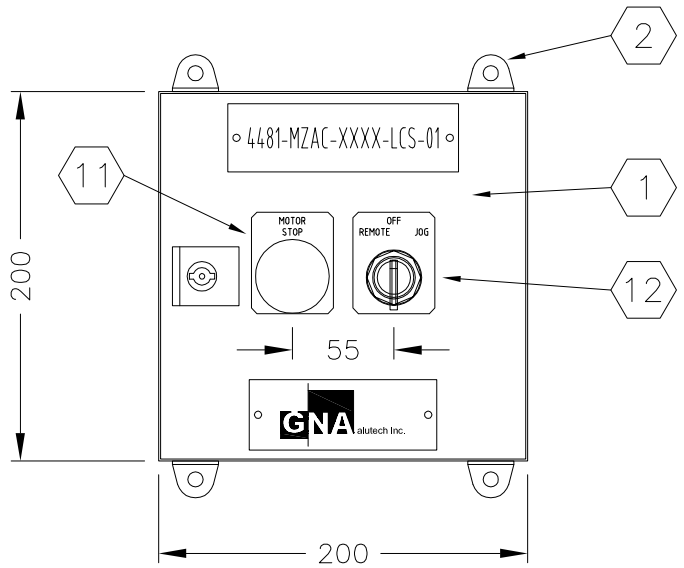
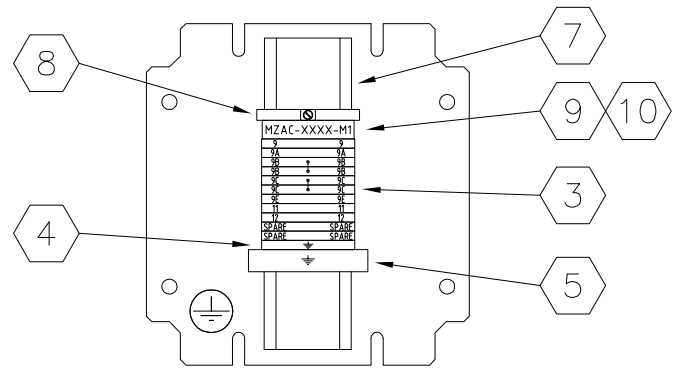


200mm X 200mm X 120mm



MOUNTING PANEL

MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 200mmX200mmX120mm IP66	RITTAL	EB 1549.500
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	KL 1590.000
3	BATCH	TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZDU2.5-2/3AN (170601)
4	1	GROUND TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZPE2.5-2/3AN (170609)
5	1	GROUND TERMINAL BLOCKS 16mm^2	WEIDMULLER	ZPE16-2/1AN (177296)
6				
7	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
8	1	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
9	BATCH	TERMINAL MARKERS (20)	WEIDMULLER	SchT 5s (163193)
10	BATCH	PROTECTIVE STRIPS CLEAR (20)	WEIDMULLER	STR 5s (163194)
11	1	STOP BUTTON PUSH/PULL TO RELEASE OPERATOR	TELEMECANIQUE	ZB4BT84
	1	CONTACT BLOCK 1NC	TELEMECANIQUE	ZB4BZ102
	1	PROTECTION	TELEMECANIQUE	ZBZ1604
12	1	SELECTOR SWITCH 3 POSITION RIGHT SPRING RETURN	TELEMECANIQUE	ZB4BD8
	2	CONTACT BLOCK 1NO	TELEMECANIQUE	ZB4BZ101

ITEM	QTY	NAME PLATE LIST	DIMENSION	FOR EQUIP.	MARKER
1	1	GNA alutech inc.	38,1mm x 101,6mm	–	–
1	1	4481-MZAC-0001-LCS-01	37mm x 125mm LETTER DIM. : 12mm	R4A	MZAC-0001-M1
1	1	4481-MZAC-0002-LCS-01	37mm x 125mm LETTER DIM. : 12mm	R4B	MZAC-0002-M1
1	1	MOTOR STOP	50mm x 45mm LETTER DIM. : 4mm	EACH EQUIP.	–
1	1	OFF REMOTE JOG	50mm x 45mm LETTER DIM. : 4mm	EACH EQUIP.	–

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

R4A PRESTRESSING AND SEALING STATION CONVEYOR A
R4B PRESTRESSING AND SEALING STATION CONVEYOR B
(LOCAL CONTROL STATION 4481-MZAC-0001/2-LCS-01)

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1 ☐ Work may proceed.
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3 ☐ Revise & Resubmit. Work may NOT proceed.
4 ☐ Revise not required. Work may proceed.
5 ☐ VOID / Superseded.

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Discipline :

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REFERENCES | REVISIONS

NOTES

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DATE:	26/10/2010	DATE:	
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DATE:		DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:		DATE:	
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DATE:			

Vendor or Subcontractor Logo: GNA alutech Inc. Département Ingénierie / Engineering Department, 5692 Trans-Canada, Saint-Laurent, Quebec H4S 1Y3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SELLER DRAWING No. 1347-51212 | REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
LOCAL CONTROL STATION 4481-MZAC-0001/2-LCS-01
GENERAL ARRANGEMENT

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
	–	–	–	A3-		-AZ	

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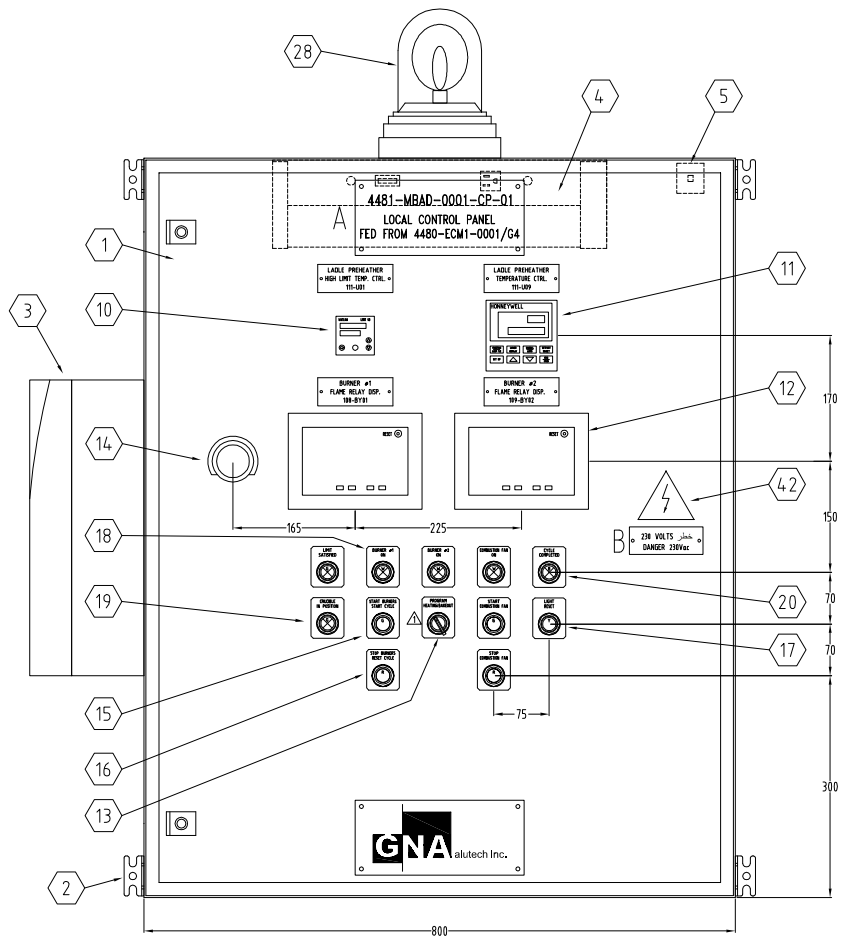

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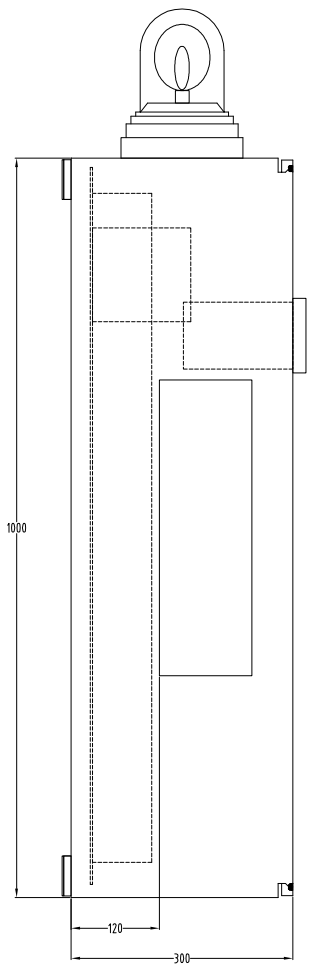

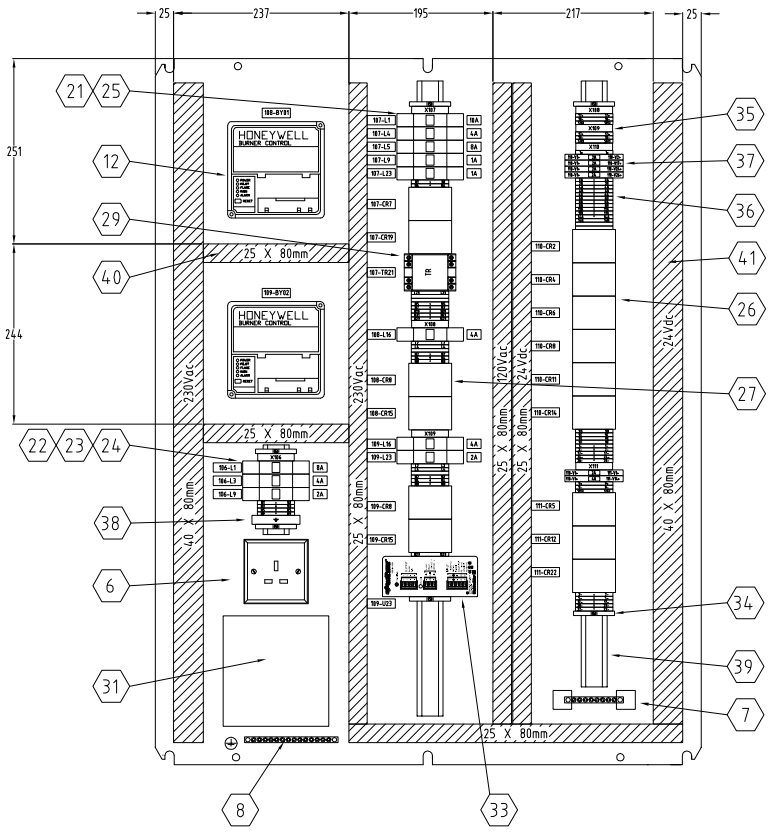

MOUNTING PANEL

MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 1000mm x 800mm x 300mm IP66	RITTAL	AE 1180.500
2	1	WALL MOUNTING BRACKETS (4)	RITTAL	SZ 2503.200
3	1	AIR CONDITIONER 230Vac, 60Hz, 100W	RITTAL	3201.200
4	1	FLUORESCENT 24Vdc	ENVITECH	XXXX
5	1	DOOR LIMIT SWITCH	ENVITECH	XXXX
6	1	RECEPTACLE 13A, 230Vac, CONFORME BS 1363A	MK ELECTRIC	2958 WHI
7	1	INSULATED GROUND BAR	ENVITECH	
8	1	GROUND BAR	ENVITECH	
9				
10	1	HIGH TEMPERATURE CONTROLLER	WATLOW	SD6L-LJAE-AARG
11	1	TEMPERATURE CONTROLLER	HONEYWELL	UDC3501-EE-10H00-100-0000-00-0
12	2	RELAY FLAME SUPERVISOR	HONEYWELL	RM7890B1030
	2	FLAME AMPLIFIER (FOR UV DET. C7027)	HONEYWELL	R7849A1023
	2	KEYBOARD DISPLAY MODULE	HONEYWELL	S7800A1001
	2	WIRING BASE	HONEYWELL	Q7800A1005
	2	DATA CONTROLBUS MODULE	HONEYWELL	S7810A1009
	2	COVER ASSEMBLY WITH REMOTE RESET	HONEYWELL	204718C
	2	UV DETECTOR	HONEYWELL	C7027A1049
13	1	SELECTOR SWITCH 2 POSITION	TELEMECANIQUE	ZB4BD2
	1	CONTACT BLOCK 1NO	TELEMECANIQUE	ZB4BZ101
14	1	EMERGENCY STOP TURN TO RELEASE OPERATOR RED	TELEMECANIQUE	ZB4BS64
	1	CONTACT BLOCK 1NC	TELEMECANIQUE	ZB4BZ102
	1	GUARD RING	EATON	M22-XGPV
	1	EMERGENCY STOP LABEL	ENVITECH	
15	2	PUSH BUTTON (GREEN)	TELEMECANIQUE	ZB4BA3
	2	CONTACT BLOCK 1N/O	TELEMECANIQUE	ZB4BZ101
	1	CONTACT BLOCK 1N/C	TELEMECANIQUE	ZB4BZ102
16	2	PUSH BUTTON (RED)	TELEMECANIQUE	ZB4BA4
	2	CONTACT BLOCK 1N/C	TELEMECANIQUE	ZB4BZ102
	1	CONTACT BLOCK 1N/O	TELEMECANIQUE	ZB4BZ101
17	1	RESET PUSH BUTTON (YELOW)	TELEMECANIQUE	XB4BA5
	1	CONTACT BLOCK 1N/O	TELEMECANIQUE	ZB4BZ101
18	3	PILOT LIGHT WITH PROTECTED LED (WHITE)	TELEMECANIQUE	XB4BVB1
19	2	PILOT LIGHT WITH PROTECTED LED (GREEN)	TELEMECANIQUE	XB4BVB3
20	1	PILOT LIGHT WITH PROTECTED LED (BLUE)	TELEMECANIQUE	XB4BVB6
21	1	CIRCUIT BREAKER 10A	TELEMECANIQUE	MG24432
22	2	CIRCUIT BREAKER 8A	TELEMECANIQUE	MG24431
23	4	CIRCUIT BREAKER 4A	TELEMECANIQUE	MG24428
24	2	CIRCUIT BREAKER 2A	TELEMECANIQUE	MG24426
25	2	CIRCUIT BREAKER 1A	TELEMECANIQUE	MG24425
26	9	CONTROL RELAY 24Vdc, 2NO 2NC	TELEMECANIQUE	CA3-KN22BD
27	6	CONTROL RELAY 120Vac, 2NO 2NC	TELEMECANIQUE	CA2-KN22G7
28	1	ROTATING MIRROR BEACON 24Vdc (RED)	TELEMECANIQUE	XVR1B94
29	1	PURGE TIMER	PANASONIC	PM4HS-H-AC240V
	1	BASE RELAY (8 PINS)	PANASONIC	ATC180031
	1	LOCK KNOB	PANASONIC	ATC18001
30				
31	1	TRANSFORMER 750VA, 230Vac/120Vac, 60Hz	HAMMOND	SP750MQMJ
32				
33	1	POWER SUPPLY 230Vac/24Vdc, 6,5A	WEIDMULLER	CP SNT (9925340024)
34	BATCH	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
35	BATCH	TERMINAL MARKERS	WEIDMULLER	SchT 5s (163193)
	BATCH	PROTECTIVE STRIPS CLEAR	WEIDMULLER	STR 5s (163194)
36	BATCH	TERMINAL BLOCKS 2.5mm²	WEIDMULLER	ZDU2.5-2/3AN (170601)
37	BATCH	FUSIBLE TERMINAL BLOCKS 2.5mm²	WEIDMULLER	ZSI2.5 (161640)
38	BATCH	GROUND TERMINAL BLOCK 16mm²	WEIDMULLER	ZPE16-2/1AN (177296)
39	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
40	BATCH	DUCT 25 X 80mm	IBOCO	T1-1030G
41	BATCH	DUCT 40 X 80mm	IBOCO	T1-1530G
42	1	LABEL 76 x 76mm (ELECTRICAL)	BRADY	89153

F3 LADLE PRE-HEATING STATION
(CONTROL PANEL 4481-MBAD-0001-CP-01)

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA alutech Inc.	101.6mm x 228.6mm
A	1	4481-MBAD-0001-CP-01 LOCAL CONTROL PANEL FED FROM 4480-ECM1-0001/G4	100mm x 230mm FIRST ROW : 14mm 2nd and 3rd ROW : 12mm
B	1	230 VOLTS DANGER 230 VOLTS	38.1mm X 101.6mm LETTER DIM. : 8mm
10	1	LADLE PREHEATHER HIGH LIMIT TEMP. CTRL. 111-U01	38.1mm X 101.6mm LETTER DIM. : 6mm
11	1	LADLE PREHEATHER TEMPERATURE CTRL. 111-U09	38.1mm X 101.6mm LETTER DIM. : 6mm
12	2	BURNER #1 FLAME RELAY DISP. 108-BY01	38.1mm X 101.6mm LETTER DIM. : 6mm
12	2	BURNER #2 FLAME RELAY DISP. 109-BY02	38.1mm X 101.6mm LETTER DIM. : 6mm
13	1	PROGRAM HEATING/BAKEOUT ⚠	50mm x 45mm LETTER DIM. : 4mm

15	1	START BURNERS START CYCLE	50mm x 45mm LETTER DIM. : 4mm
15	1	START COMBUSTION FAN	50mm x 45mm LETTER DIM. : 4mm
16	1	STOP BURNERS RESET CYCLE	50mm x 45mm LETTER DIM. : 4mm
16	1	STOP COMBUSTION FAN	50mm x 45mm LETTER DIM. : 4mm
17	1	LIGHT RESET	50mm x 45mm LETTER DIM. : 4mm
18	1	COMBUSTION FAN ON	50mm x 45mm LETTER DIM. : 4mm
18	1	BURNER #1 ON	50mm x 45mm LETTER DIM. : 4mm
18	1	BURNER #2 ON	50mm x 45mm LETTER DIM. : 4mm
19	1	LIMIT SATISFIED	50mm x 45mm LETTER DIM. : 4mm
19	1	CRUCIBLE IN POSITION	50mm x 45mm LETTER DIM. : 4mm
20	1	CYCLE COMPLETED	50mm x 45mm LETTER DIM. : 4mm

NOTES:
1 –PAINT:
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Document No : 25457-4480-V1A-MXA0-0327 Rev. :

			1		UPDATE	15/04/2011	T.Pa.	E.B.	M.B.
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REFERENCES			REVISIONS						

NOTES

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DATE:			

Vendor or Subcontractor Logo:
GNA alutech Inc.
Département Ingénierie
Engineering Department
6565 Pierre-Canada
Saint-Laurent, Quebec
H4S 1V3
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SELLER DRAWING No. 1347-51220 REV. 1

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
LADLE PRE-HEATING STATION CONTROL PANEL 4481-MBAD-0001-CP-01
GENERAL ARRANGEMENT

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx –	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—		—	—	A3–		–AZ	

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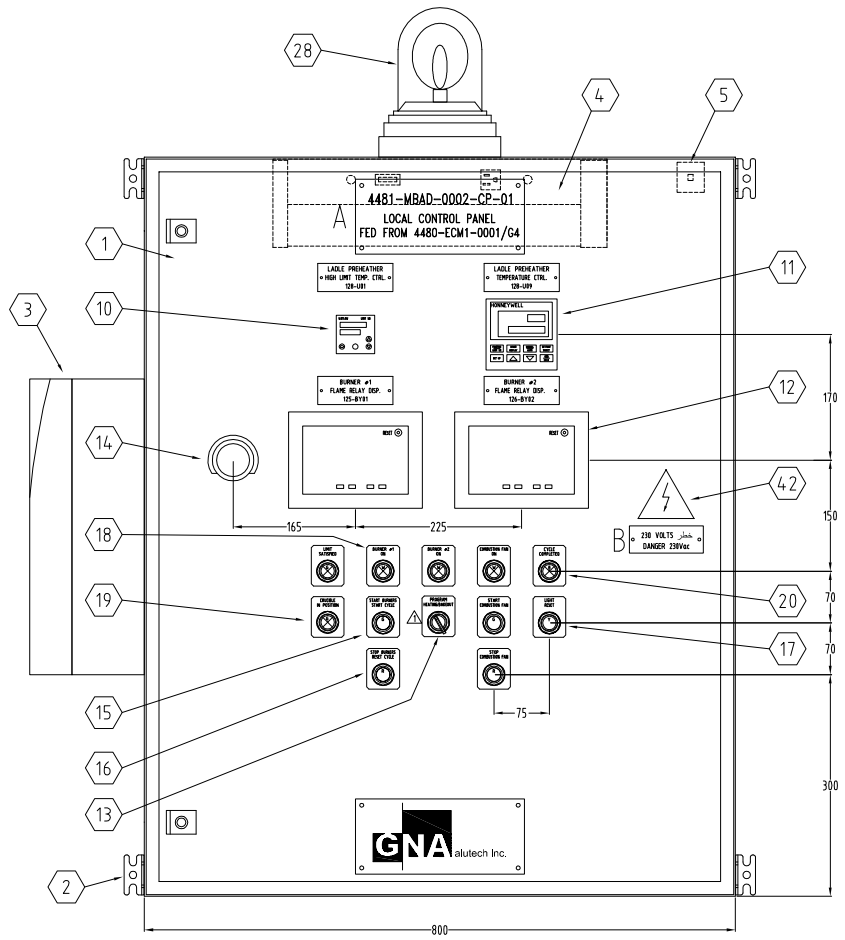

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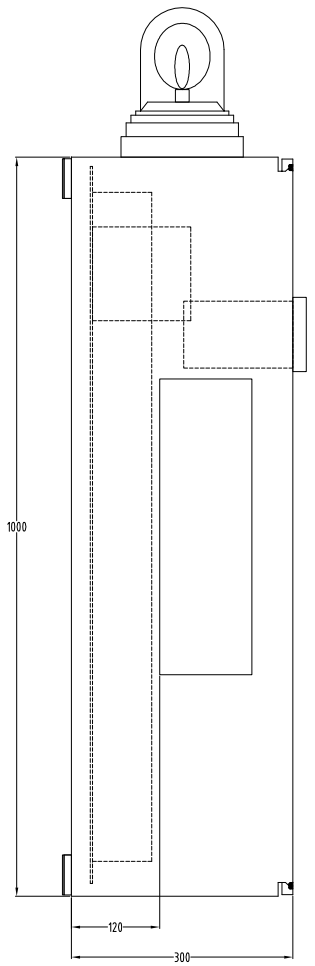

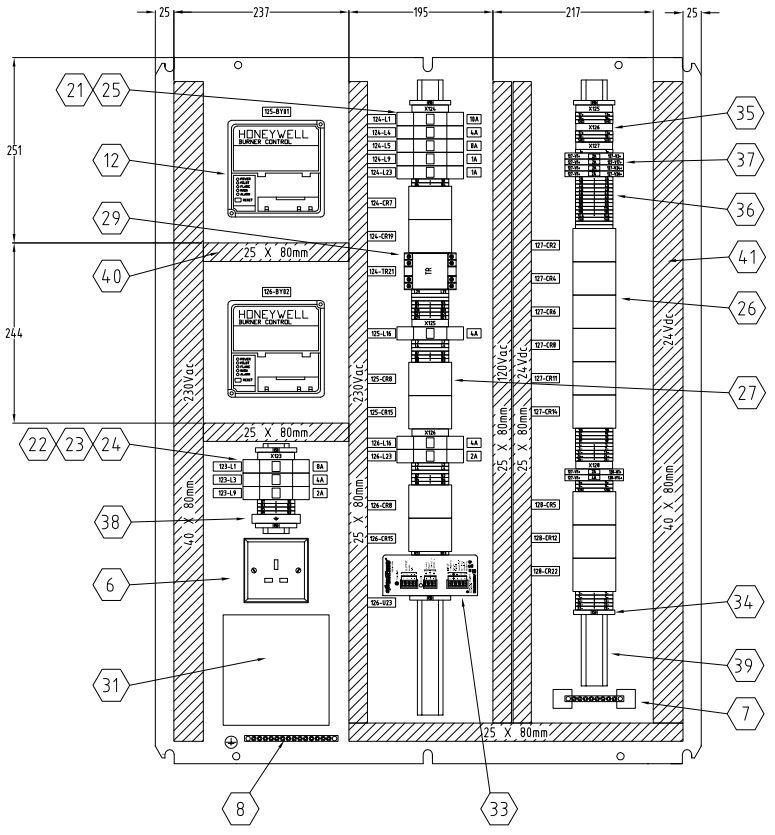

MOUNTING PANEL

F3B LADLE PRE-HEATING STATION
(CONTROL PANEL 4481-MBAD-0002-CP-01)

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA alutech Inc.	101.6mm x 228.6mm
A	1	4481-MBAD-0002-CP-01 LOCAL CONTROL PANEL FED FROM 4480-ECM1-0001/G4	100mm x 230mm FIRST ROW : 14mm 2nd and 3rd ROW : 12mm
B	1	230 VOLTS DANGER 230 VOLTS	38.1mm X 101.6mm LETTER DIM. : 8mm
10	1	LADLE PREHEATHER HIGH LIMIT TEMP. CTRL. 128-U01	38.1mm X 101.6mm LETTER DIM. : 6mm
11	1	LADLE PREHEATHER TEMPERATURE CTRL. 128-U09	38.1mm X 101.6mm LETTER DIM. : 6mm
12	2	BURNER #1 FLAME RELAY DISP. 125-BY01	38.1mm X 101.6mm LETTER DIM. : 6mm
12	2	BURNER #2 FLAME RELAY DISP. 126-BY02	38.1mm X 101.6mm LETTER DIM. : 6mm
13	1	PROGRAM HEATING/BAKEOUT	50mm x 45mm LETTER DIM. : 4mm
15	1	START BURNERS START CYCLE	50mm x 45mm LETTER DIM. : 4mm
15	1	START COMBUSTION FAN	50mm x 45mm LETTER DIM. : 4mm
16	1	STOP BURNERS RESET CYCLE	50mm x 45mm LETTER DIM. : 4mm
16	1	STOP COMBUSTION FAN	50mm x 45mm LETTER DIM. : 4mm
17	1	LIGHT RESET	50mm x 45mm LETTER DIM. : 4mm
18	1	COMBUSTION FAN ON	50mm x 45mm LETTER DIM. : 4mm
18	1	BURNER #1 ON	50mm x 45mm LETTER DIM. : 4mm
18	1	BURNER #2 ON	50mm x 45mm LETTER DIM. : 4mm
19	1	LIMIT SATISFIED	50mm x 45mm LETTER DIM. : 4mm
19	1	CRUCIBLE IN POSITION	50mm x 45mm LETTER DIM. : 4mm
20	1	CYCLE COMPLETED	50mm x 45mm LETTER DIM. : 4mm

ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 1000mm x 800mm x 300mm IP66	RITTAL	AE 1180.500
2	1	WALL MOUNTING BRACKETS (4)	RITTAL	SZ 2503.200
3	1	AIR CONDITIONER 230Vac, 60Hz, 100W	RITTAL	3201.200
4	1	FLUORESCENT 24Vdc	ENVITECH	XXXX
5	1	DOOR LIMIT SWITCH	ENVITECH	XXXX
6	1	RECEPTACLE 13A, 230Vac, CONFORME BS 1363A	MK ELECTRIC	2958 WHI
7	1	INSULATED GROUND BAR	ENVITECH	
8	1	GROUND BAR	ENVITECH	
9				
10	1	HIGH TEMPERATURE CONTROLLER	WATLOW	SD6L-LJAE-AARG
11	1	TEMPERATURE CONTROLLER	HONEYWELL	UDC3501-EE-10H00-100-0000-00-0
12	2	RELAY FLAME SUPERVISOR	HONEYWELL	RM7890B1030
	2	FLAME AMPLIFIER (FOR UV DET. C7027)	HONEYWELL	R7849A1023
	2	KEYBOARD DISPLAY MODULE	HONEYWELL	S7800A1001
	2	WIRING BASE	HONEYWELL	Q7800A1005
	2	DATA CONTROLBUS MODULE	HONEYWELL	S7810A1009
	2	COVER ASSEMBLY WITH REMOTE RESET	HONEYWELL	204718C
	2	UV DETECTOR	HONEYWELL	C7027A1049
13	1	SELECTOR SWITCH 2 POSITION	TELEMECANIQUE	ZB4BD2
	1	CONTACT BLOCK 1NO	TELEMECANIQUE	ZB4BZ101
14	1	EMERGENCY STOP TURN TO RELEASE OPERATOR RED	TELEMECANIQUE	ZB4BS64
	1	CONTACT BLOCK 1NC	TELEMECANIQUE	ZB4BZ102
	1	GUARD RING	EATON	M22-XGPV
	1	EMERGENCY STOP LABEL	ENVITECH	
15	2	PUSH BUTTON (GREEN)	TELEMECANIQUE	ZB4BA3
	2	CONTACT BLOCK 1N/O	TELEMECANIQUE	ZB4BZ101
	1	CONTACT BLOCK 1N/C	TELEMECANIQUE	ZB4BZ102
16	2	PUSH BUTTON (RED)	TELEMECANIQUE	ZB4BA4
	2	CONTACT BLOCK 1N/C	TELEMECANIQUE	ZB4BZ102
	1	CONTACT BLOCK 1N/O	TELEMECANIQUE	ZB4BZ101
17	1	RESET PUSH BUTTON (YELOW)	TELEMECANIQUE	XB4BA5
	1	CONTACT BLOCK 1N/O	TELEMECANIQUE	ZB4BZ101
18	3	PILOT LIGHT WITH PROTECTED LED (WHITE)	TELEMECANIQUE	XB4BVB1
19	2	PILOT LIGHT WITH PROTECTED LED (GREEN)	TELEMECANIQUE	XB4BVB3
20	1	PILOT LIGHT WITH PROTECTED LED (BLUE)	TELEMECANIQUE	XB4BVB6
21	1	CIRCUIT BREAKER 10A	TELEMECANIQUE	MG24432
22	2	CIRCUIT BREAKER 8A	TELEMECANIQUE	MG24431
23	4	CIRCUIT BREAKER 4A	TELEMECANIQUE	MG24428
24	2	CIRCUIT BREAKER 2A	TELEMECANIQUE	MG24426
25	2	CIRCUIT BREAKER 1A	TELEMECANIQUE	MG24425
26	9	CONTROL RELAY 24Vdc, 2NO 2NC	TELEMECANIQUE	CA3-KN22BD
27	6	CONTROL RELAY 120Vac, 2NO 2NC	TELEMECANIQUE	CA2-KN22G7
28	1	ROTATING MIRROR BEACON 24Vdc (RED)	TELEMECANIQUE	XVR1B94
29	1	PURGE TIMER	PANASONIC	PM4HS-H-AC240V
	1	BASE RELAY (8 PINS)	PANASONIC	ATC180031
	1	LOCK KNOB	PANASONIC	ATC18001
30				
31	1	TRANSFORMER 750VA, 230Vac/120Vac, 60Hz	HAMMOND	SP750MQMJ
32				
33	1	POWER SUPPLY 230Vac/24Vdc, 6,5A	WEIDMULLER	CP SNT (9925340024)
34	BATCH	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
35	BATCH	TERMINAL MARKERS	WEIDMULLER	SchT 5s (163193)
	BATCH	PROTECTIVE STRIPS CLEAR	WEIDMULLER	STR 5s (163194)
36	BATCH	TERMINAL BLOCKS 2.5mm²	WEIDMULLER	ZDU2.5-2/3AN (170601)
37	BATCH	FUSIBLE TERMINAL BLOCKS 2.5mm²	WEIDMULLER	ZSI2.5 (161640)
38	BATCH	GROUND TERMINAL BLOCK 16mm²	WEIDMULLER	ZPE16-2/1AN (177296)
39	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
40	BATCH	DUCT 25 X 80mm	IBOCO	T1-1030G
41	BATCH	DUCT 40 X 80mm	IBOCO	T1-1530G
42	1	LABEL 76 x 76mm (ELECTRICAL)	BRADY	89153

NOTES:

1 –PAINT:
RAL 7035 GRAY - STANDARD RITTAL

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4 ☐ Revise not required. Work may proceed.
5 ☐ VOID / Superseded.

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Discipline :

Document No : 25457-4480-V1A-MXAO- Rev. :

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NOTES

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DATE:	19/08/2011	DATE:	
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DATE:			

Vendor or Subcontractor Logo: GNA alutech inc. — Département Ingénierie Engineering Department 9495 Trans-Canada Saint-Laurent, Quebec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
LADLE PRE-HEATING STATION B CTRL. PANEL 4481-MBAD-0002-CP-01
GENERAL ARRANGEMENT

MA'ADEN

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx –	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
–	–	–		A3–		–AZ	

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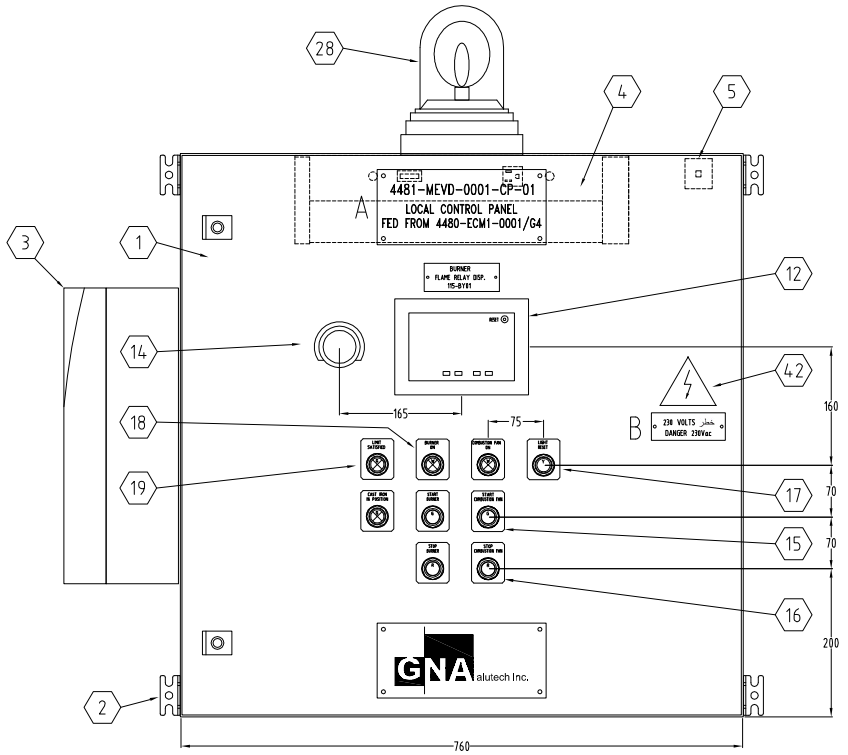

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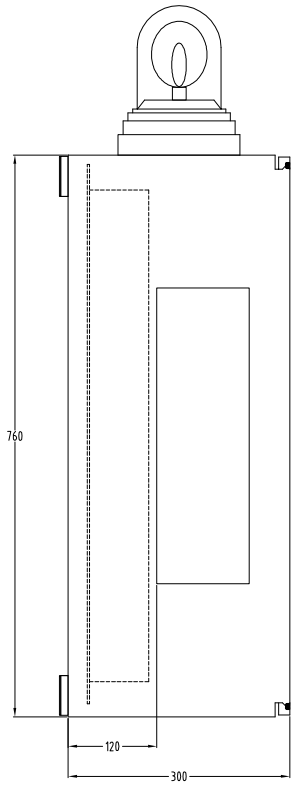

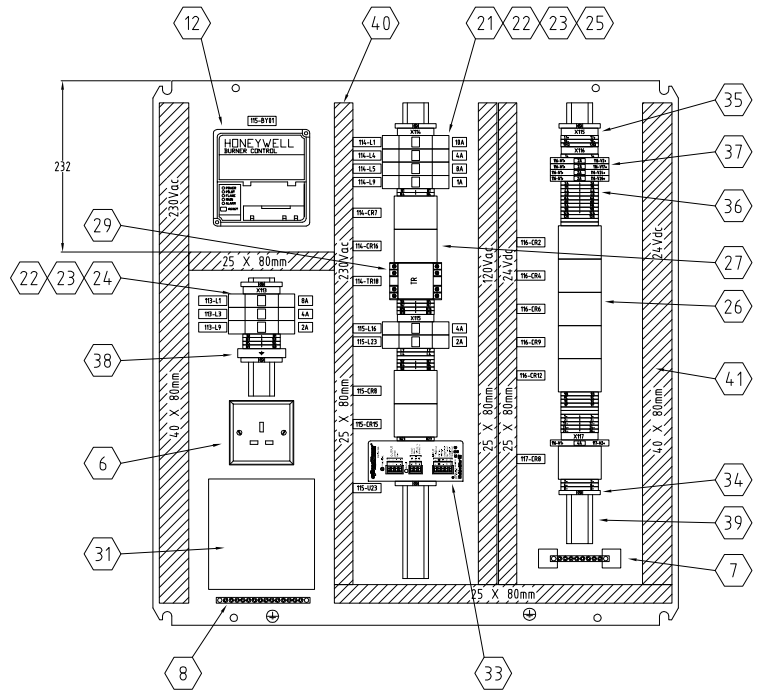

MOUNTING PANEL

F4A CAST IRON INGOT DRYING STATION A
(CONTROL PANEL 4481-MEVD-0001-CP-01)

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA alutech inc.	101.6mm x 228.6mm
A	1	4481-MEVD-0001-CP-01 LOCAL CONTROL PANEL FED FROM 4480-ECM1-0001/G4	100mm x 230mm FIRST ROW : 14mm 2nd and 3rd ROW : 12mm
B	1	230 VOLTS خطر DANGER 230 VOLTS	38.1mm X 101.6mm LETTER DIM. : 8mm
10	1	BURNER FLAME RELAY DISP. 115-BY01	38.1mm X 101.6mm LETTER DIM. : 6mm
15	1	START BURNER	50mm x 45mm LETTER DIM. : 4mm
15	1	START COMBUSTION FAN	50mm x 45mm LETTER DIM. : 4mm
16	1	STOP BURNER	50mm x 45mm LETTER DIM. : 4mm
16	1	STOP COMBUSTION FAN	50mm x 45mm LETTER DIM. : 4mm
17	1	LIGHT RESET	50mm x 45mm LETTER DIM. : 4mm
18	1	COMBUSTION FAN ON	50mm x 45mm LETTER DIM. : 4mm
18	1	BURNER ON	50mm x 45mm LETTER DIM. : 4mm
19	1	LIMIT SATISFIED	50mm x 45mm LETTER DIM. : 4mm
19	1	CAST IRON IN POSITION	50mm x 45mm LETTER DIM. : 4mm

MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 760mm x 760mm x 300mm IP66	RITTAL	AE 1073.500
2	1	WALL MOUNTING BRACKETS (4)	RITTAL	SZ 2503.200
3	1	AIR CONDITIONER 230Vdc, 60Hz, 100W	RITTAL	3201.200
4	1	FLUORESCENT	ENVITECH	XXXX
5	1	DOOR LIMIT SWITCH	ENVITECH	XXXX
6	1	RECEPTACLE 13A, 230Vac, CONFORME BS 1363A	MK ELECTRIC	2958 WHI
7	1	INSULATED GROUND BAR	ENVITECH	
8	1	GROUND BAR	ENVITECH	
9				
10				
11				
12	1	RELAY FLAME SUPERVISOR	HONEYWELL	RM7890B1030
	1	FLAME AMPLIFIER (FOR FLAME ROD)	HONEYWELL	R7847B1031
	1	KEYBOARD DISPLAY MODULE	HONEYWELL	S7800A1001
	1	WIRING BASE	HONEYWELL	Q7800A1005
	1	DATA CONTROLBUS MODULE	HONEYWELL	S7810A1009
	1	COVER ASSEMBLY WITH REMOTE RESET	HONEYWELL	204718C
13				
14	1	EMERGENCY STOP TURN TO RELEASE OPERATOR RED	TELEMECANIQUE	ZB4BS64
	1	CONTACT BLOCK 1NC	TELEMECANIQUE	ZB4BZ102
	1	GUARD RING	EATON	M22-XGPV
	1	EMERGENCY STOP LABEL	ENVITECH	
15	2	PUSH BUTTON (GREEN)	TELEMECANIQUE	ZB4BA3
	2	CONTACT BLOCK 1N/O	TELEMECANIQUE	ZB4BZ101
16	2	PUSH BUTTON (RED)	TELEMECANIQUE	ZB4BA4
	2	CONTACT BLOCK 1N/C	TELEMECANIQUE	ZB4BZ102
17	1	RESET PUSH BUTTON (YELOW)	TELEMECANIQUE	XB4BA5
	1	CONTACT BLOCK 1N/O	TELEMECANIQUE	ZB4BZ101
18	2	PILOT LIGHT WITH PROTECTED LED (WHITE)	TELEMECANIQUE	XB4BVB1
19	2	PILOT LIGHT WITH PROTECTED LED (GREEN)	TELEMECANIQUE	XB4BVB3
20				
21	1	CIRCUIT BREAKER 10A	TELEMECANIQUE	MG24432
22	2	CIRCUIT BREAKER 8A	TELEMECANIQUE	MG24431
23	3	CIRCUIT BREAKER 4A	TELEMECANIQUE	MG24428
24	2	CIRCUIT BREAKER 2A	TELEMECANIQUE	MG24426
25	1	CIRCUIT BREAKER 1A	TELEMECANIQUE	MG24425
26	6	CONTROL RELAY 24Vdc, 2NO 2NC	TELEMECANIQUE	CA3-KN22BD
27	4	CONTROL RELAY 120Vac, 2NO 2NC	TELEMECANIQUE	CA2-KN22G7
28	1	ROTATING MIRROR BEACON 24Vdc (RED)	TELEMECANIQUE	XVR1B94
29	1	PURGE TIMER	PANASONIC	PM4HS-H-AC240V
	1	BASE RELAY (8 PINS)	PANASONIC	ATC180031
	1	LOCK KNOB	PANASONIC	ATC18001
30				
31	1	TRANSFORMER 750VA, 230Vac/120Vac, 60Hz	HAMMOND	SP750MQMJ
32				
33	1	POWER SUPPLY 230Vac/24Vdc, 6,5A	WEIDMULLER	CP SNT (9925340024)
34	BATCH	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
35	BATCH	TERMINAL MARKERS	WEIDMULLER	SchT 5s (163193)
	BATCH	PROTECTIVE STRIPS CLEAR	WEIDMULLER	STR 5s (163194)
36	BATCH	TERMINAL BLOCKS 2.5mm²	WEIDMULLER	ZDU2.5-2/3AN (170601)
37	BATCH	FUSIBLE TERMINAL BLOCKS 2.5mm²	WEIDMULLER	ZSI2.5 (161640)
38	BATCH	GROUND TERMINAL BLOCK 16mm²	WEIDMULLER	ZPE16-2/1AN (177296)
39	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
40	BATCH	DUCT 25 X 80mm	IBOCO	T1-1030G
41	BATCH	DUCT 40 X 80mm	IBOCO	T1-1530G
42	1	LABEL 76 x 76mm (ELECTRICAL)	BRADY	89153

NOTES:

1 –PAINT:
RAL 7035 GRAY - STANDARD RITTAL

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Vendor or Subcontractor Logo: GNA alutech inc. — Departement Ingenierie, Engineering Department, 9680 Trans-Canada, Mont-Saint-Hilaire, Quebec, J3G 1Y7, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CAST IRON DRYING STATION A CONTROL PANEL 4481-MEVD-0001-CP-01
GENERAL ARRANGEMENT

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx –	xxx

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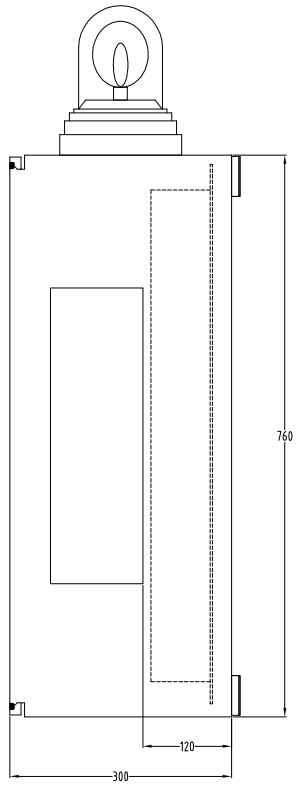

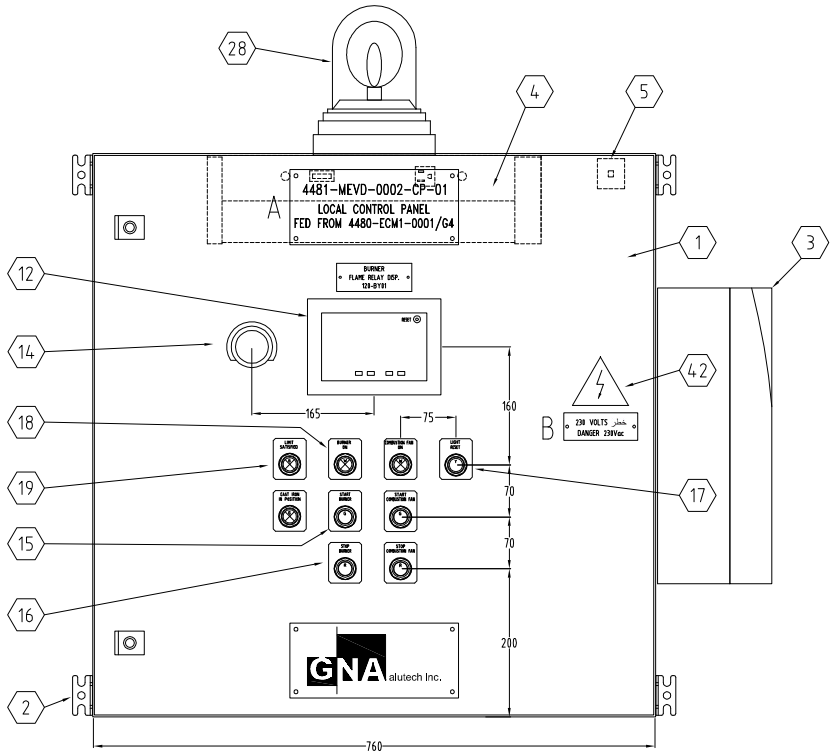

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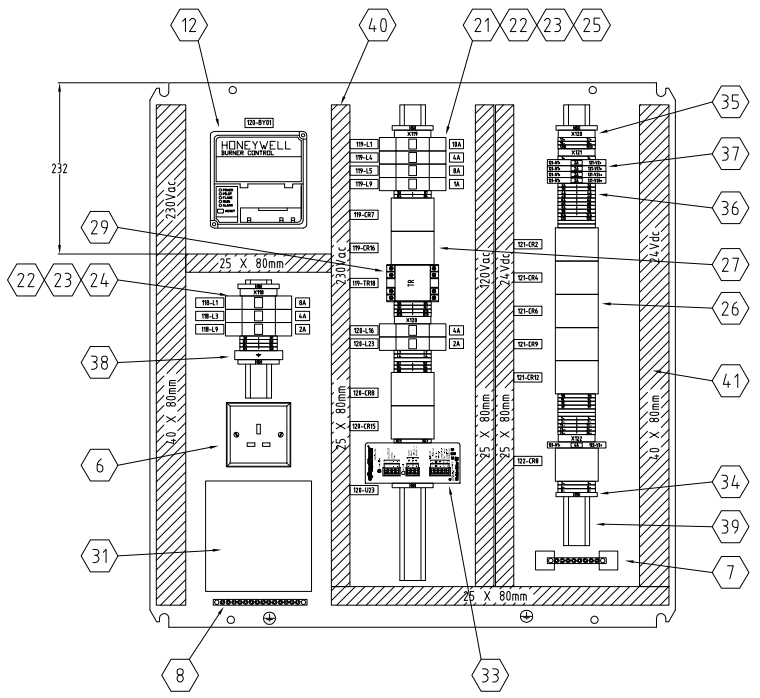

MOUNTING PANEL

F4B CAST IRON INGOT DRYING STATION B
(CONTROL PANEL 4481-MEVD-0002-CP-01)

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA alutech inc.	101.6mm x 228.6mm
A	1	4481-MEVD-0002-CP-01 LOCAL CONTROL PANEL FED FROM 4480-ECM1-0001/G4	100mm x 230mm FIRST ROW : 14mm 2nd and 3rd ROW : 12mm
B	1	230 VOLTS خطر DANGER 230 VOLTS	38.1mm X 101.6mm LETTER DIM. : 8mm
10	1	BURNER FLAME RELAY DISP. 120-BY01	38.1mm X 101.6mm LETTER DIM. : 6mm
15	1	START BURNER	50mm x 45mm LETTER DIM. : 4mm
15	1	START COMBUSTION FAN	50mm x 45mm LETTER DIM. : 4mm
16	1	STOP BURNER	50mm x 45mm LETTER DIM. : 4mm
16	1	STOP COMBUSTION FAN	50mm x 45mm LETTER DIM. : 4mm
17	1	LIGHT RESET	50mm x 45mm LETTER DIM. : 4mm
18	1	COMBUSTION FAN ON	50mm x 45mm LETTER DIM. : 4mm
18	1	BURNER ON	50mm x 45mm LETTER DIM. : 4mm
19	1	LIMIT SATISFIED	50mm x 45mm LETTER DIM. : 4mm
19	1	CAST IRON IN POSITION	50mm x 45mm LETTER DIM. : 4mm

MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 760mm x 760mm x 300mm IP66	RITTAL	AE 1073.500
2	1	WALL MOUNTING BRACKETS (4)	RITTAL	SZ 2503.200
3	1	AIR CONDITIONER 230Vdc, 60Hz, 100W	RITTAL	3201.200
4	1	FLUORESCENT	ENVITECH	XXXX
5	1	DOOR LIMIT SWITCH	ENVITECH	XXXX
6	1	RECEPTACLE 13A, 230Vac, CONFORME BS 1363A	MK ELECTRIC	2958 WHI
7	1	INSULATED GROUND BAR	ENVITECH	
8	1	GROUND BAR	ENVITECH	
9				
10				
11				
12	1	RELAY FLAME SUPERVISOR	HONEYWELL	RM7890B1030
	1	FLAME AMPLIFIER (FOR FLAME ROD)	HONEYWELL	R7847B1031
	1	KEYBOARD DISPLAY MODULE	HONEYWELL	S7800A1001
	1	WIRING BASE	HONEYWELL	Q7800A1005
	1	DATA CONTROLBUS MODULE	HONEYWELL	S7810A1009
	1	COVER ASSEMBLY WITH REMOTE RESET	HONEYWELL	204718C
13				
14	1	EMERGENCY STOP TURN TO RELEASE OPERATOR RED	TELEMECANIQUE	ZB4BS64
	1	CONTACT BLOCK 1NC	TELEMECANIQUE	ZB4BZ102
	1	GUARD RING	EATON	M22-XGPV
	1	EMERGENCY STOP LABEL	ENVITECH	
15	2	PUSH BUTTON (GREEN)	TELEMECANIQUE	ZB4BA3
	2	CONTACT BLOCK 1N/O	TELEMECANIQUE	ZB4BZ101
16	2	PUSH BUTTON (RED)	TELEMECANIQUE	ZB4BA4
	2	CONTACT BLOCK 1N/C	TELEMECANIQUE	ZB4BZ102
17	1	RESET PUSH BUTTON (YELOW)	TELEMECANIQUE	XB4BA5
	1	CONTACT BLOCK 1N/O	TELEMECANIQUE	ZB4BZ101
18	2	PILOT LIGHT WITH PROTECTED LED (WHITE)	TELEMECANIQUE	XB4BVB1
19	2	PILOT LIGHT WITH PROTECTED LED (GREEN)	TELEMECANIQUE	XB4BVB3
20				
21	1	CIRCUIT BREAKER 10A	TELEMECANIQUE	MG24432
22	2	CIRCUIT BREAKER 8A	TELEMECANIQUE	MG24431
23	3	CIRCUIT BREAKER 4A	TELEMECANIQUE	MG24428
24	2	CIRCUIT BREAKER 2A	TELEMECANIQUE	MG24426
25	1	CIRCUIT BREAKER 1A	TELEMECANIQUE	MG24425
26	6	CONTROL RELAY 24Vdc, 2NO 2NC	TELEMECANIQUE	CA3-KN22BD
27	4	CONTROL RELAY 120Vac, 2NO 2NC	TELEMECANIQUE	CA2-KN22G7
28	1	ROTATING MIRROR BEACON 24Vdc (RED)	TELEMECANIQUE	XVR1B94
29	1	PURGE TIMER	PANASONIC	PM4HS-H-AC240V
	1	BASE RELAY (8 PINS)	PANASONIC	ATC180031
	1	LOCK KNOB	PANASONIC	ATC18001
30				
31	1	TRANSFORMER 750VA, 230Vac/120Vac, 60Hz	HAMMOND	SP750MQMJ
32				
33	1	POWER SUPPLY 230Vac/24Vdc, 6,5A	WEIDMULLER	CP SNT (9925340024)
34	BATCH	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
35	BATCH	TERMINAL MARKERS	WEIDMULLER	SchT 5s (163193)
	BATCH	PROTECTIVE STRIPS CLEAR	WEIDMULLER	STR 5s (163194)
36	BATCH	TERMINAL BLOCKS 2.5mm²	WEIDMULLER	ZDU2.5-2/3AN (170601)
37	BATCH	FUSIBLE TERMINAL BLOCKS 2.5mm²	WEIDMULLER	ZSI2.5 (161640)
38	BATCH	GROUND TERMINAL BLOCK 16mm²	WEIDMULLER	ZPE16-2/1AN (177296)
39	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
40	BATCH	DUCT 25 X 80mm	IBOCO	T1-1030G
41	BATCH	DUCT 40 X 80mm	IBOCO	T1-1530G
42	1	LABEL 76 x 76mm (ELECTRICAL)	BRADY	89153

NOTES:

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DATE:			

Vendor or Subcontractor Logo: GNA alutech inc. — Departement Ingenierie Engineering Department 9680 Trans-Canada H4S 1V7 Lorraine, Quebec Canada

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CAST IRON DRYING STATION B CONTROL PANEL 4481-MEVD-0002-CP-01
GENERAL ARRANGEMENT

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
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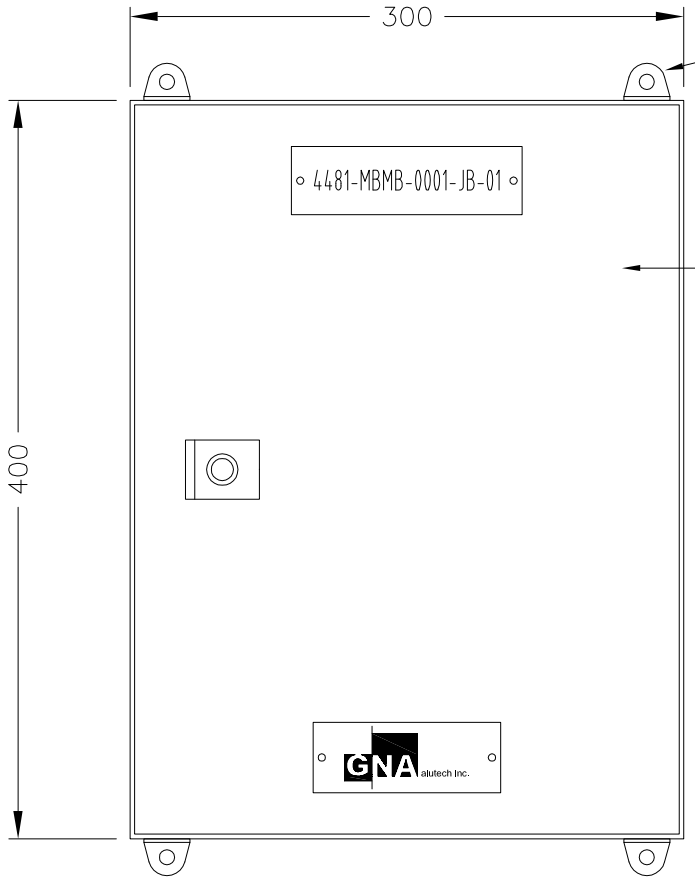

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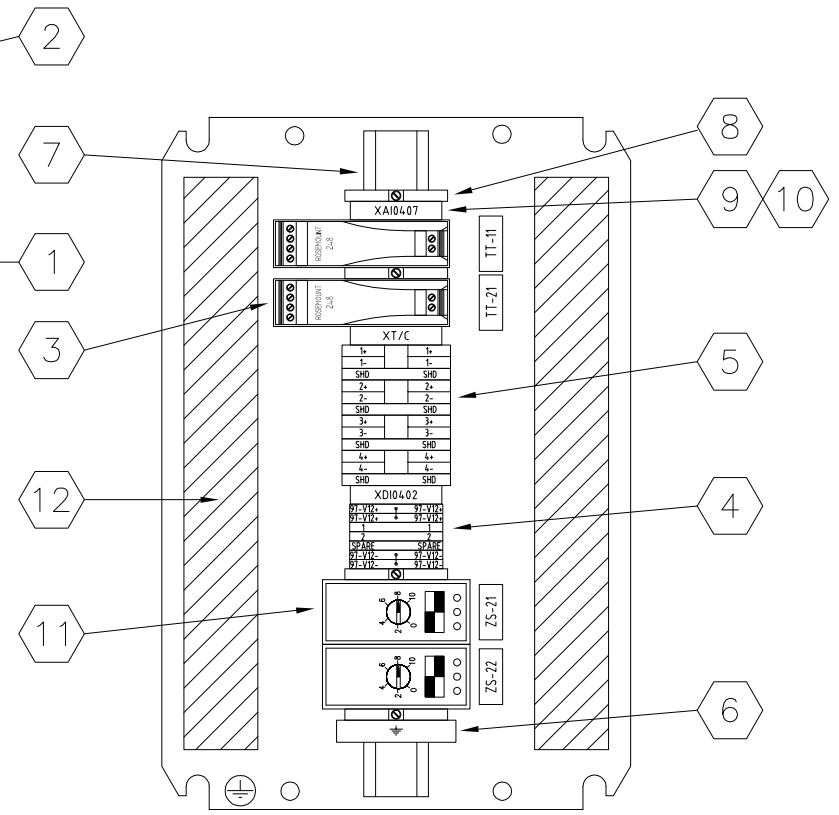

MOUNTING PANEL

MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 400mmX300mmX155mm IP66	RITTAL	EB 1577.500
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	KL 1590.000
3	2	TEMPERATURE TRANSMITTER	ROSEMOUNT	248R
4	BATCH	TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZDU2.5-2/3AN (170601)
5	4	THERMOCOUPLE TERMINAL BLOCKS	WEIDMULLER	WDU 2.5/TC (102410)
6	1	GROUND TERMINAL BLOCK 16mm ^{2}	WEIDMULLER	ZPE16-2/1AN (177296)
7	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
8	3	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
9	BATCH	TERMINAL MARKERS (20)	WEIDMULLER	SchT 5s (163193)
10	BATCH	PROTECTIVE STRIPS CLEAR (20)	WEIDMULLER	STR 5s (163194)
11	2	PHOTOELECTRIC SWITCH 24 Vdc	CARLO GAVAZZI	S142BRNN-924
	2	EMITTER	CARLO GAVAZZI	MOFT20-M12-8
	2	RECEIVER	CARLO GAVAZZI	MOFR-M12-8
	2	FIBER OPTICS 1m	CARLO GAVAZZI	OFMS1-10
	2	BASE	CARLO GAVAZZI	ZPD11
12	BATCH	DUCT 40mm X 80mm	IBOCO	T1-1530G

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA alutech inc.	38,1mm x 101,6mm
1	1	4481-MBMB-0001-JB-01	37mm x 125mm LETTER DIM. : 12mm

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

F2 ZONE#2 CATHODE BAR
HEATING FURNACE CONVEYOR No.2
(JUNCTION BOX 4481-MBMB-0001-JB-01)

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Discipline :

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DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	1: 4
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Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie / Engineering Department, 9450 Trans-Canada, Saint-Laurent, Québec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
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SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
JUNCTION BOX 4481-MBMB-0001-JB-01
GENERAL ARRANGEMENT

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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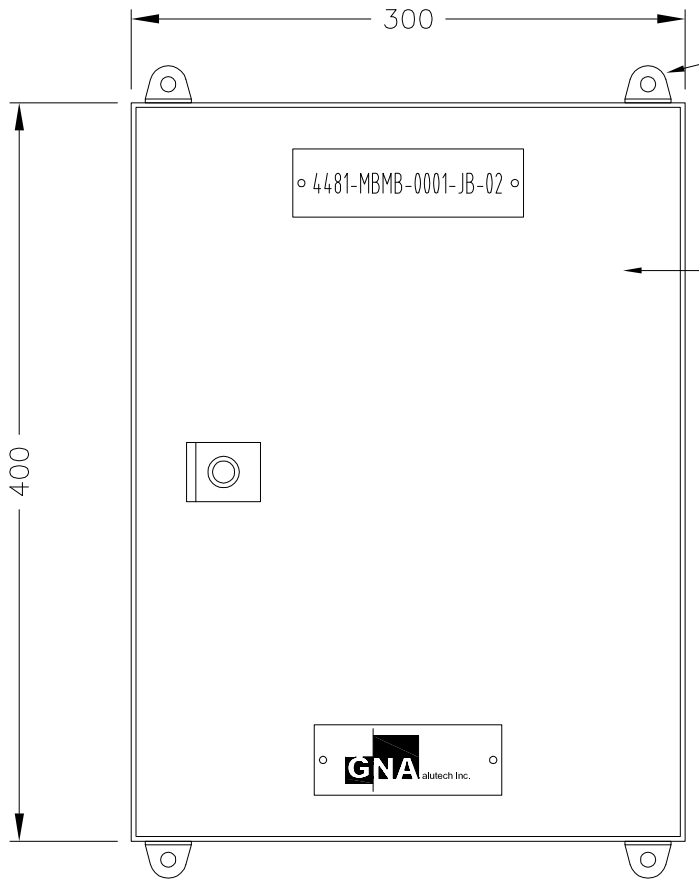
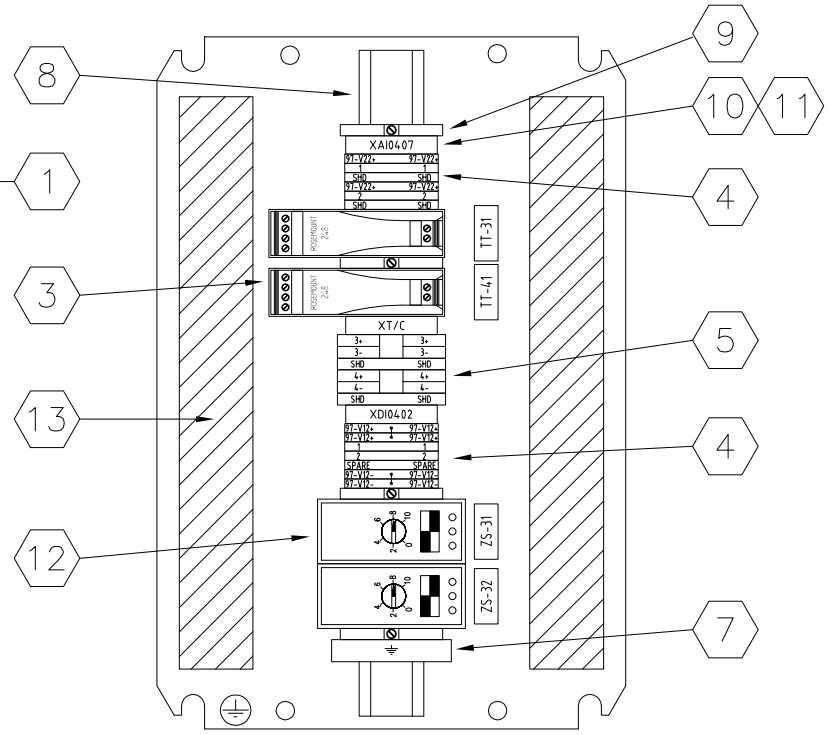


400mm X 300mm X 155mm



MOUNTING PANEL

MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 400mmX300mmX155mm IP66	RITTAL	EB 1577.500
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	KL 1590.000
3	2	TEMPERATURE TRANSMITTER	ROSEMOUNT	248R
4	BATCH	TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZDU2.5-2/3AN (170601)
5	2	THERMOCOUPLE TERMINAL BLOCKS	WEIDMULLER	WDU 2.5/TC (102410)
6				
7	1	GROUND TERMINAL BLOCKS 16mm^2	WEIDMULLER	ZPE16-2/1AN (177296)
8	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
9	3	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
10	BATCH	TERMINAL MARKERS (20)	WEIDMULLER	SchT 5s (163193)
11	BATCH	PROTECTIVE STRIPS CLEAR (20)	WEIDMULLER	STR 5s (163194)
12	2	PHOTOELECTRIC SWITCH 24 Vdc	CARLO GAVAZZI	S142BRNN-924
	2	EMITTER	CARLO GAVAZZI	MOFT20-M12-8
	2	RECEIVER	CARLO GAVAZZI	MOFR-M12-8
	2	FIBER OPTICS 1m	CARLO GAVAZZI	OFMS1-10
	2	BASE	CARLO GAVAZZI	ZPD11
13	BATCH	DUCT 40mm X 80mm	IBOCO	T1-1530G

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA alutech Inc.	38,1mm x 101,6mm
1	1	4481-MBMB-0001-JB-02	37mm x 125mm LETTER DIM. : 12mm

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

F2 ZONE#3 CATHODE BAR
HEATING FURNACE CONVEYOR No.3
(JUNCTION BOX 4481-MBMB-0001-JB-02)

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Document No : 25457-4480-V1A-MXA0-0199 | Rev. :

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BECHTEL

SELLER DRAWING No. 1347-51260 | REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
JUNCTION BOX 4481-MBMB-0001-JB-02
GENERAL ARRANGEMENT

Project Title: Ras Az Zawr Aluminium Smelter

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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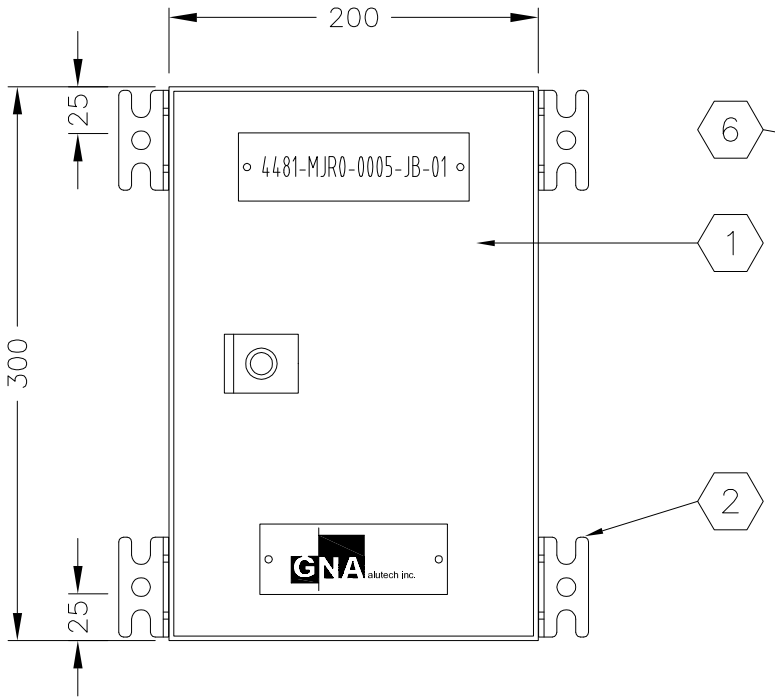
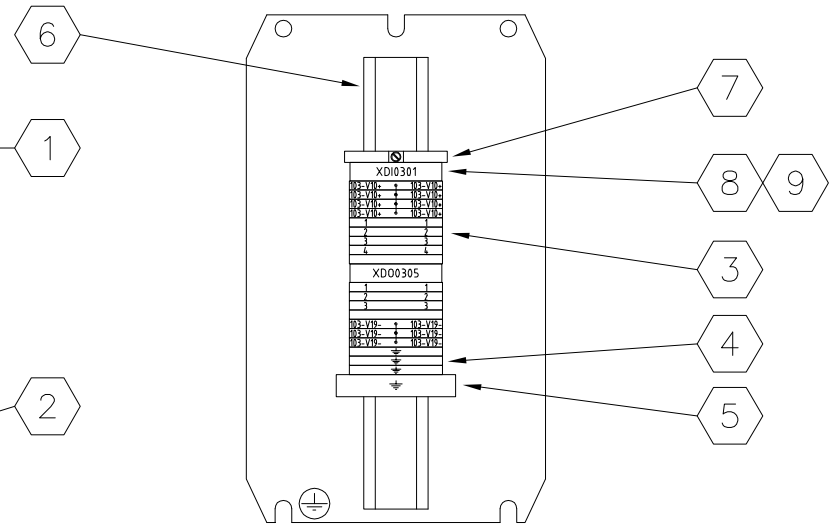
MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 300mmX200mmX155mm IP66	RITTAL	AE 1035.500
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	SZ 2503.010
3	BATCH	TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZDU2.5-2/3AN (170601)
4	3	GROUND TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZPE2.5-2/3AN (170609)
5	1	GROUND TERMINAL BLOCKS 16mm^2	WEIDMULLER	ZPE16-2/1AN (177296)
6	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
7	1	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
8	BATCH	TERMINAL MARKERS (20)	WEIDMULLER	SchT 5s (163193)
9	BATCH	PROTECTIVE STRIPS CLEAR (20)	WEIDMULLER	STR 5s (163194)



300mm X 200mm X 155mm



MOUNTING PANEL

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA alutech inc.	38,1mm x 101,6mm
1	1	4481-MJR0-0005-JB-01	37mm x 125mm LETTER DIM. : 12mm

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

R1 ROLLER CONVEYOR AT BLOCK OVEN EXIT (JUNCTION BOX 4481-MJR0-0005-JB-01)

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Discipline :

Document No : 25457-4480-V1A-MXA0-0281 | Rev. :

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BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SELLER DRAWING No.: 1347-51270 | REV.: 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
JUNCTION BOX 4481-MJR0-0005-JB-01
GENERAL ARRANGEMENT

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—		—	—	A3-		-AZ	

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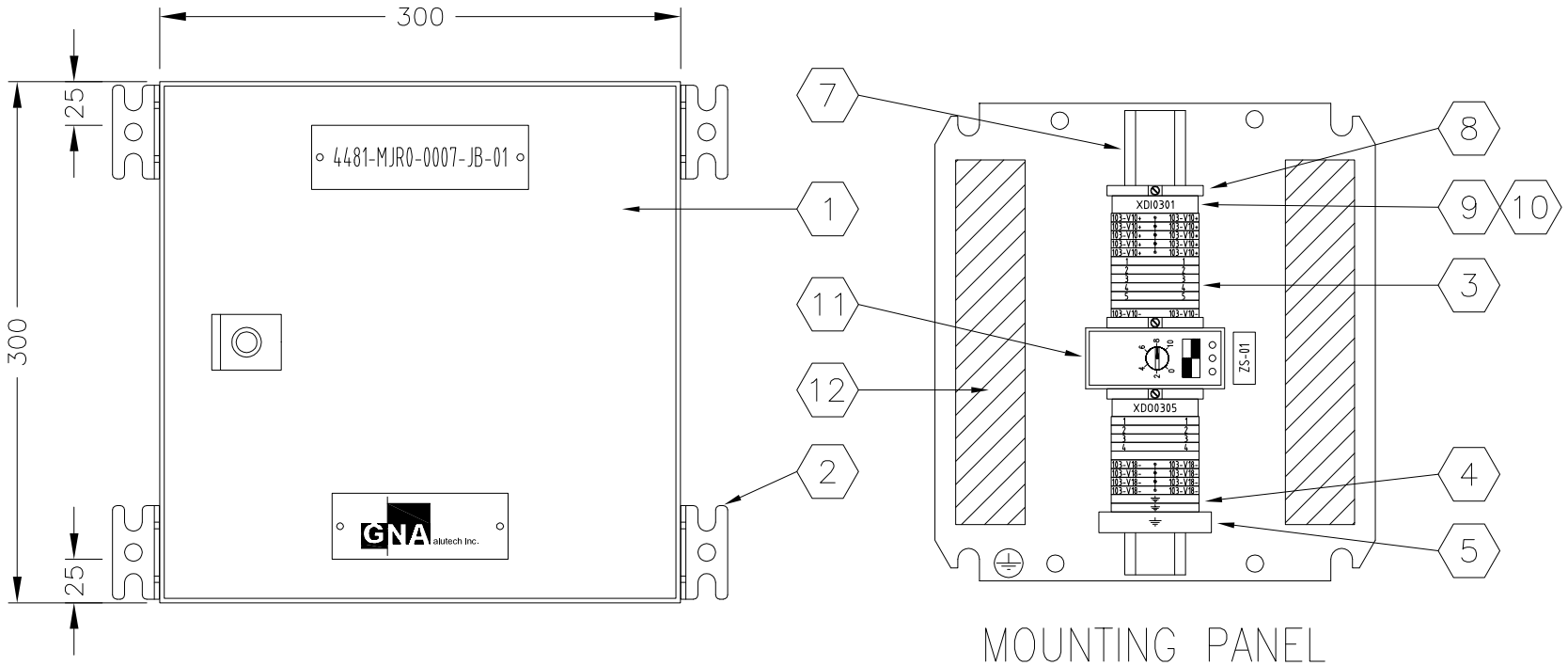

300mm X 300mm X 210mm

MOUNTING PANEL

MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 300mmX300mmX210mm IP66	RITTAL	AE 1033.500
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	SZ 2503.010
3	BATCH	TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZDU2.5-2/3AN (170601)
4	2	GROUND TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZPE2.5-2/3AN (170609)
5	1	GROUND TERMINAL BLOCKS 16mm^2	WEIDMULLER	ZPE16-2/1AN (177296)
6				
7	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
8	3	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
9	BATCH	TERMINAL MARKERS (20)	WEIDMULLER	SchT 5s (163193)
10	BATCH	PROTECTIVE STRIPS CLEAR (20)	WEIDMULLER	STR 5s (163194)
11	1	PHOTOELECTRIC SWITCH 24 Vdc	CARLO GAVAZZI	S142BRNN-924
	1	EMITTER	CARLO GAVAZZI	MOFT20-M12-8
	1	RECEIVER	CARLO GAVAZZI	MOFR-M12-8
	1	FIBER OPTICS 1m	CARLO GAVAZZI	OFMS1-10
	1	BASE	CARLO GAVAZZI	ZPD11
12	BATCH	DUCT 40mm X 80mm	IBOCO	T1-1530G

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA alutech inc.	38,1mm x 101,6mm
1	1	4481-MJR0-0007-JB-01	37mm x 125mm LETTER DIM. : 12mm

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

R2 ROLLER CONVEYOR FOR BLOCK & BAR ASSEMBLY
(JUNCTION BOX 4481-MJR0-0007-JB-01)

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Discipline :

Document No : 25457-4480-V1A-MXA0-0282 | Rev. :

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Vendor or Subcontractor Logo:
GNA alutech inc. Département Ingénierie Engineering Department 9495 Trans-Canada Saint-Laurent, Quebec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

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SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
JUNCTION BOX 4481-MJR0-0007-JB-01
GENERAL ARRANGEMENT

MA'ADEN

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
—	—	—		A3-		-AZ	

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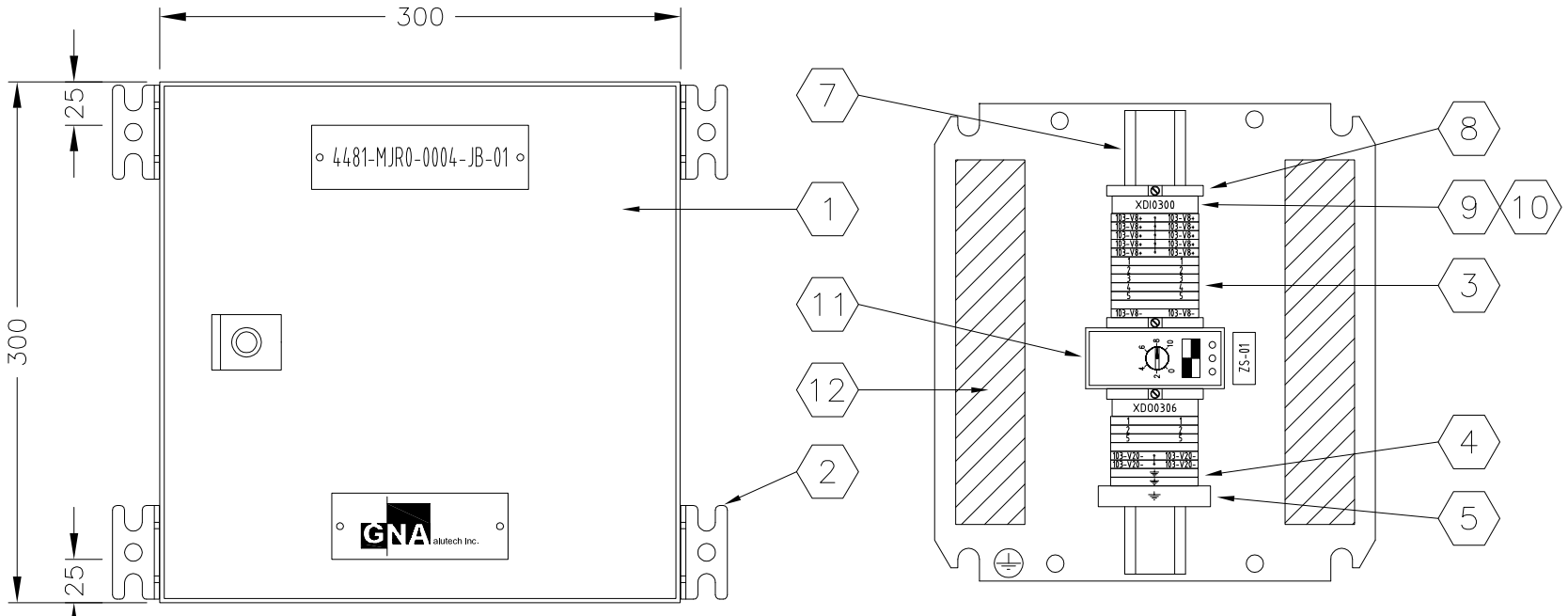

300mm X 300mm X 210mm

MOUNTING PANEL

MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 300mmX300mmX210mm IP66	RITTAL	AE 1033.500
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	SZ 2503.010
3	BATCH	TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZDU2.5-2/3AN (170601)
4	2	GROUND TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZPE2.5-2/3AN (170609)
5	1	GROUND TERMINAL BLOCKS 16mm^2	WEIDMULLER	ZPE16-2/1AN (177296)
6				
7	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
8	3	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
9	BATCH	TERMINAL MARKERS (20)	WEIDMULLER	SchT 5s (163193)
10	BATCH	PROTECTIVE STRIPS CLEAR (20)	WEIDMULLER	STR 5s (163194)
11	1	PHOTOELECTRIC SWITCH 24 Vdc	CARLO GAVAZZI	S142BRNN-924
	1	EMITTER	CARLO GAVAZZI	MOFT20-M12-8
	1	RECEIVER	CARLO GAVAZZI	MOFR-M12-8
	1	FIBER OPTICS 1m	CARLO GAVAZZI	OFMS1-10
	1	BASE	CARLO GAVAZZI	ZPD11
12	BATCH	DUCT 40mm X 80mm	IBOCO	T1-1530G

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA alutech inc.	38,1mm x 101,6mm
1	1	4481-MJR0-0004-JB-01	37mm x 125mm LETTER DIM. : 12mm

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

R6 ROLLER CONVEYOR AT BAR FURNACE EXIT
(JUNCTION BOX 4481-MJR0-0004-JB-01)

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BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457	00AZ	xx	xxxx	xxxx - xxx	xxx

SELLER DRAWING No. 1347-51290 | REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
JUNCTION BOX 4481-MJR0-0004-JB-01
GENERAL ARRANGEMENT

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
	—	—	—	A3		AZ	

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MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 300mmX200mmX155mm IP66	RITTAL	AE 1035.500
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	SZ 2503.010
3	BATCH	TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZDU2.5-2/3AN (170601)
4	1	GROUND TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZPE2.5-2/3AN (170609)
5	1	GROUND TERMINAL BLOCKS 16mm^2	WEIDMULLER	ZPE16-2/1AN (177296)
6	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
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8	BATCH	TERMINAL MARKERS (20)	WEIDMULLER	SchT 5s (163193)
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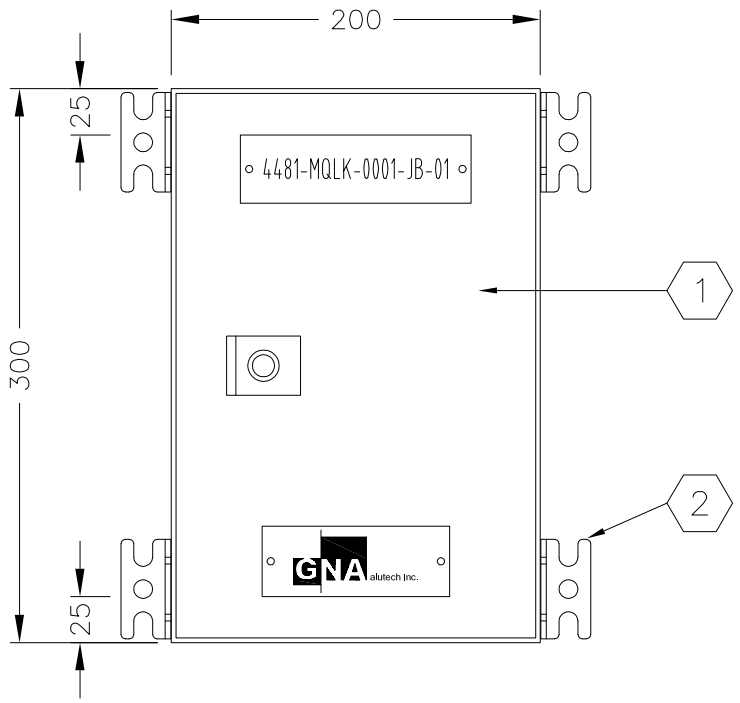

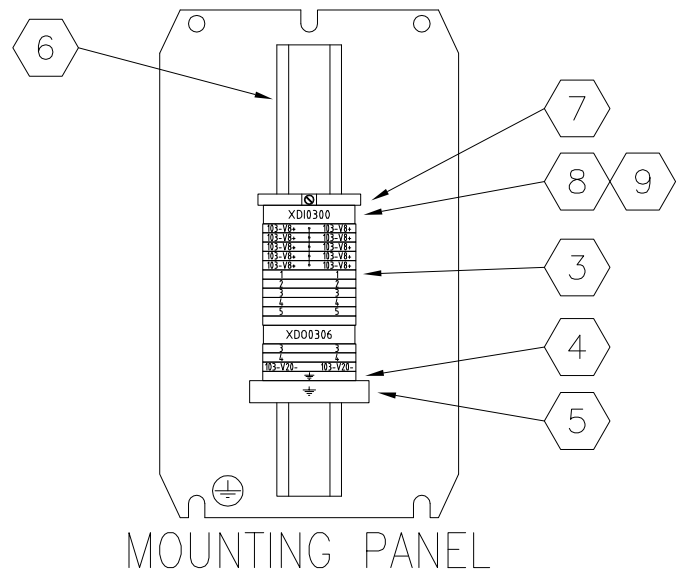

MOUNTING PANEL

300mm X 200mm X 155mm

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA alutech inc.	38,1mm x 101,6mm
1	1	4481-MQLK-0001-JB-01	37mm x 125mm LETTER DIM. : 12mm

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

A1 CATHODE BAR ALIGNMENT STATION
(JUNCTION BOX 4481-MQLK-0001-JB-01)

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Discipline :

Document No : 25457-4480-V1A-MXA0-0284 | Rev. :

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BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SELLER DRAWING No. 1347-51300 | REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
JUNCTION BOX 4481-MQLK-0001-JB-01
GENERAL ARRANGEMENT

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
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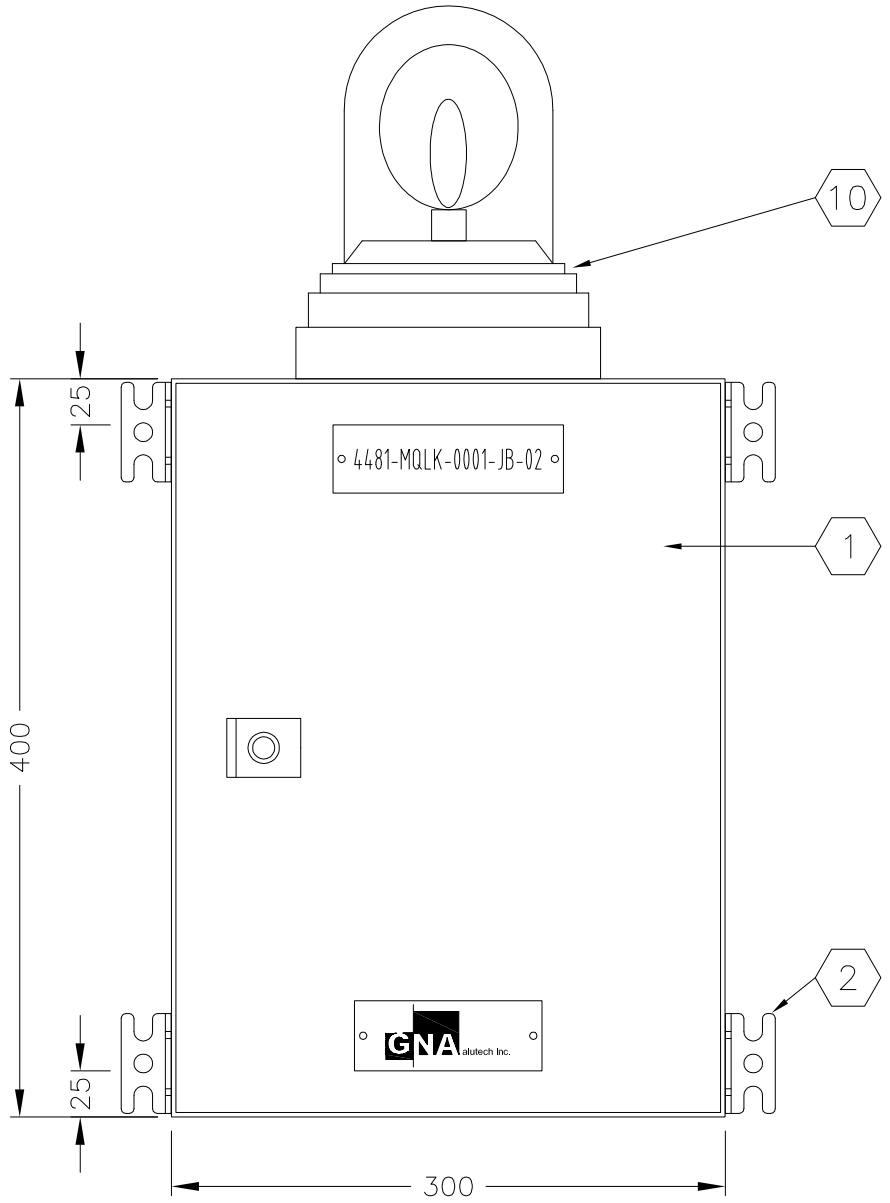
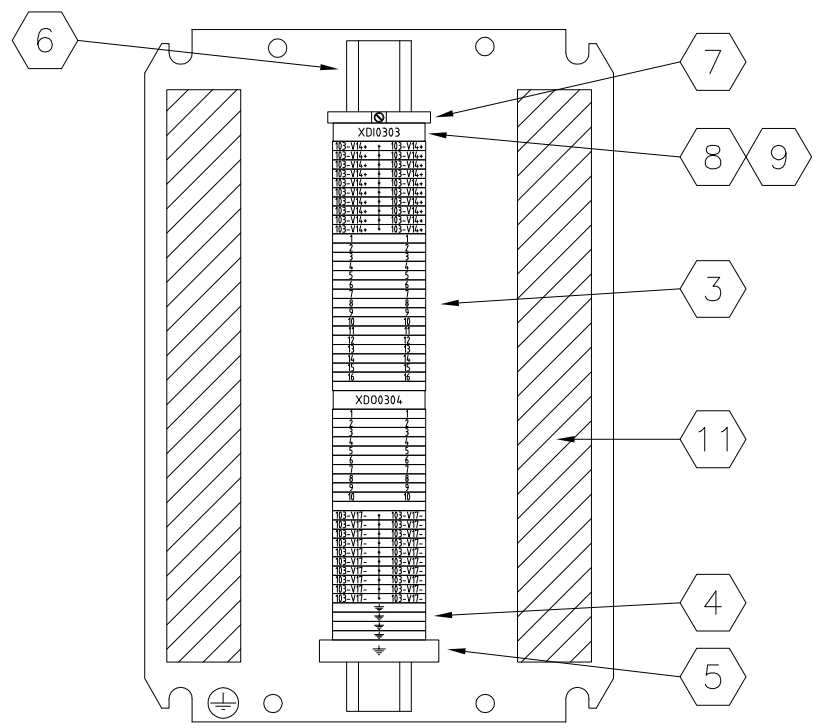


400mm X 300mm X 210mm



MOUNTING PANEL

MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 400mmX300mmX210mm IP66	RITTAL	AE 1034.500
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	SZ 2503.010
3	BATCH	TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZDU2.5-2/3AN (170601)
4	BATCH	GROUND TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZPE2.5-2/3AN (170609)
5	1	GROUND TERMINAL BLOCKS 16mm^2	WEIDMULLER	ZPE16-2/1AN (177296)
6	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
7	1	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
8	BATCH	TERMINAL MARKERS (20)	WEIDMULLER	SchT 5s (163193)
9	BATCH	PROTECTIVE STRIPS CLEAR (20)	WEIDMULLER	STR 5s (163194)
10	1	ROTATING MIRROR BEACON 24Vdc (RED)	TELEMECANIQUE	XVR1B94
	1	MOUNTING TULIP	TELEMECANIQUE	XVR013
11	BATCH	DUCT 40mm X 80mm	IBOCO	T1-1530G

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA alutech inc.	38,1mm x 101,6mm
1	1	4481-MQLK-0001-JB-02	37mm x 125mm LETTER DIM. : 12mm

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

G1 POSITIONING GANTRY FOR BLOCK AND BARS (JUNCTION BOX 4481-MQLK-0001-JB-02)

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Reviewed by : _____	Date : _____
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Document No : 25457-4480-V1A-MXAO-0285	Rev. :

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		0		REVISIONS				

NOTES

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Vendor or Subcontractor Logo: GNA alutech inc. Département Ingénierie Engineering Department 9495 Trans-Canada Saint-Laurent, Quebec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SELLER DRAWING No. 1347-51310 REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
JUNCTION BOX 4481-MQLK-0001-JB-02
GENERAL ARRANGEMENT

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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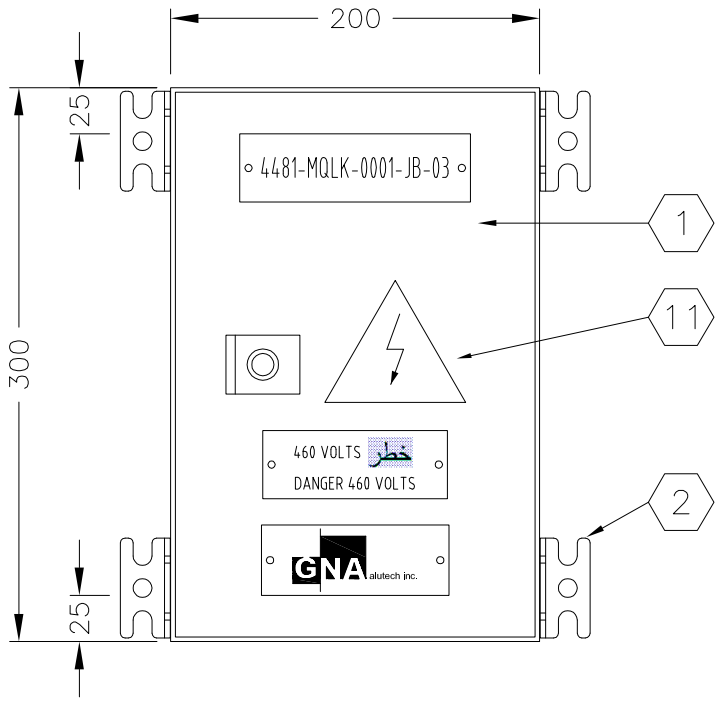
MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 300mmX200mmX155mm IP66	RITTAL	AE 1035.500
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	SZ 2503.010
3	BATCH	TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZDU2.5-2/3AN (170601)
4	BATCH	TERMINAL BLOCKS 4mm^2	WEIDMULLER	ZDU4-2 (177037)
5	3	GROUND TERMINAL BLOCKS 4mm^2	WEIDMULLER	ZPE4-2 (177038)
6	3	GROUND TERMINAL BLOCKS 16mm^2	WEIDMULLER	ZPE16-2/1AN (177296)
7	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
8	2	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
9	BATCH	TERMINAL MARKERS (20)	WEIDMULLER	SchT 5s (163193)
10	BATCH	PROTECTIVE STRIPS CLEAR (20)	WEIDMULLER	STR 5s (163194)
11	1	LABEL 76 x 76 (ELECTRICAL)	BRADY	89153



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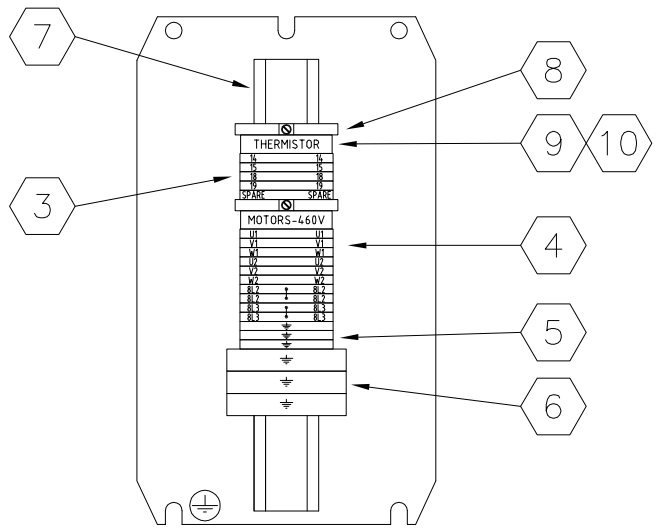

MOUNTING PANEL

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA alutech inc.	38,1mm x 101,6mm
1	1	4481-MQLK-0001-JB-03	37mm x 125mm LETTER DIM. : 12mm
10	1	460 VOLTS خطر DANGER 460 VOLTS	37mm x 100mm LETTER DIM. : 7mm

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

G1 POSITIONING GANTRY FOR BLOCK AND BARS (JUNCTION BOX 4481-MQLK-0001-JB-03)

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Discipline :

Document No : 25457-4480-V1A-MXA0-0286 | Rev. :

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Vendor or Subcontractor Logo: GNA alutech inc. — Département Ingénierie Engineering Department 8400 Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

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SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
JUNCTION BOX 4481-MQLK-0001-JB-03
GENERAL ARRANGEMENT

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
—	—	—		A3-		-AZ	

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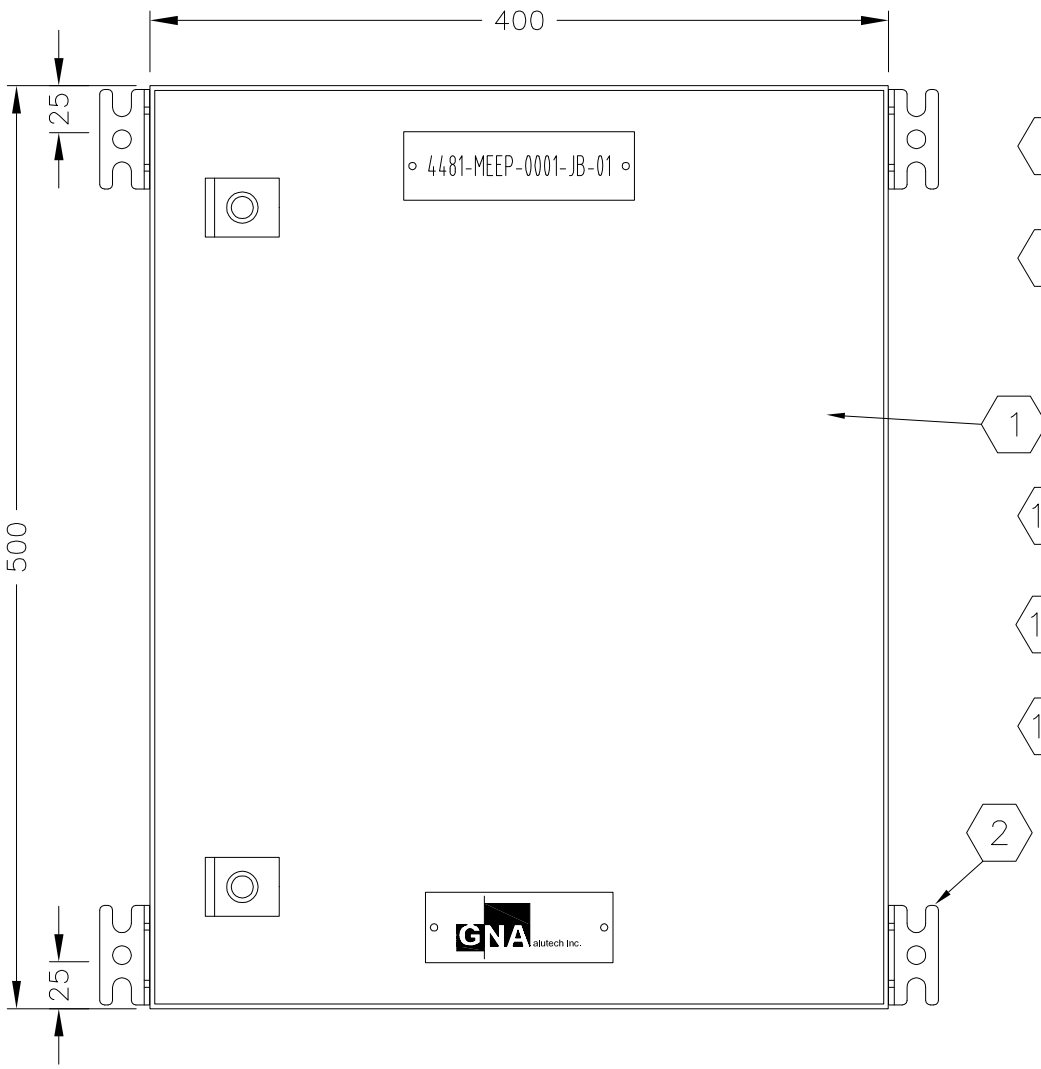
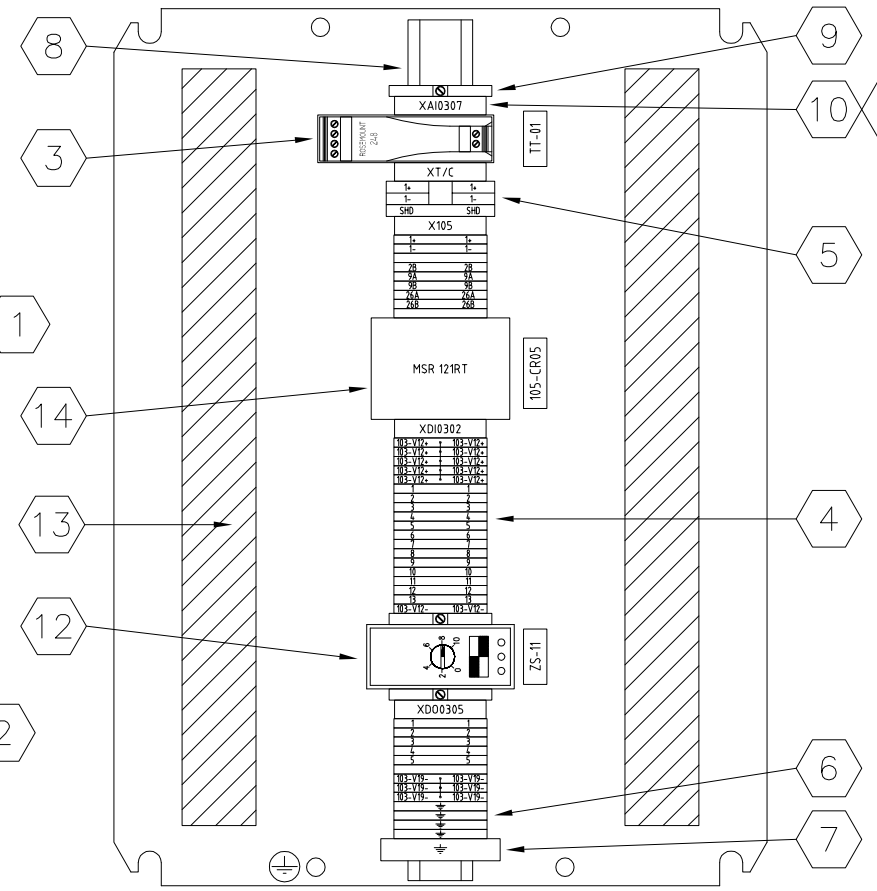


500mm X 400mm X 210mm



MOUNTING PANEL

MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 500mmX400mmX210mm IP66	RITTAL	AE 1045.500
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	SZ 2503.010
3	1	TEMPERATURE TRANSMITTER	ROSEMOUNT	248R
4	BATCH	TERMINAL BLOCKS 2.5mm	WEIDMULLER	ZDU2.5-2/3AN (170601)
5	1	THERMOCOUPLE TERMINAL BLOCKS	WEIDMULLER	WDU 2.5/TC (102410)
6	4	GROUND TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZPE2.5-2/3AN (170609)
7	1	GROUND TERMINAL BLOCKS 16mm^2	WEIDMULLER	ZPE16-2/1AN (177296)
8	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
9	3	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
10	BATCH	TERMINAL MARKERS (20)	WEIDMULLER	SchT 5s (163193)
11	BATCH	PROTECTIVE STRIPS CLEAR (20)	WEIDMULLER	STR 5s (163194)
12	1	PHOTOELECTRIC SWITCH 24 Vdc	CARLO GAVAZZI	S142BRNN-924
	1	EMITTER	CARLO GAVAZZI	MOFT20-M12-8
	1	RECEIVER	CARLO GAVAZZI	MOFR-M12-8
	1	FIBER OPTICS 1m	CARLO GAVAZZI	OFMS1-10
	1	BASE	CARLO GAVAZZI	ZPD11
13	BATCH	DUCT 40mm X 80mm	IBOCO	T1-1530G
14	1	SAFETY RELAY MSR 121RT	ALLEN-BRADLEY	440R-J23102

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA alutech inc.	38,1mm x 101,6mm
1	1	4481-MEEP-0001-JB-01	37mm x 125mm LETTER DIM. : 12mm

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

F1 ZONE#1 CATHODE BLOCK OVEN
C1 CHAIN CONVEYOR OF BLOCK OVEN
(JUNCTION BOX 4481-MEEP-0001-JB-01)

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Discipline :

Document No : 25457-4480-V1A-MXA0-0257 | Rev. :

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Vendor or Subcontractor Logo: GNA alutech inc. — Departement Ingenierie Engineering Department 9680 Trans-Canada Mont-Saint-Hilaire, Quebec J3G 1V7 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SELLER DRAWING No. 1347-51330 | REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
JUNCTION BOX 4481-MEEP-0001-JB-01
GENERAL ARRANGEMENT

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
—		—	—	A3-		-AZ	

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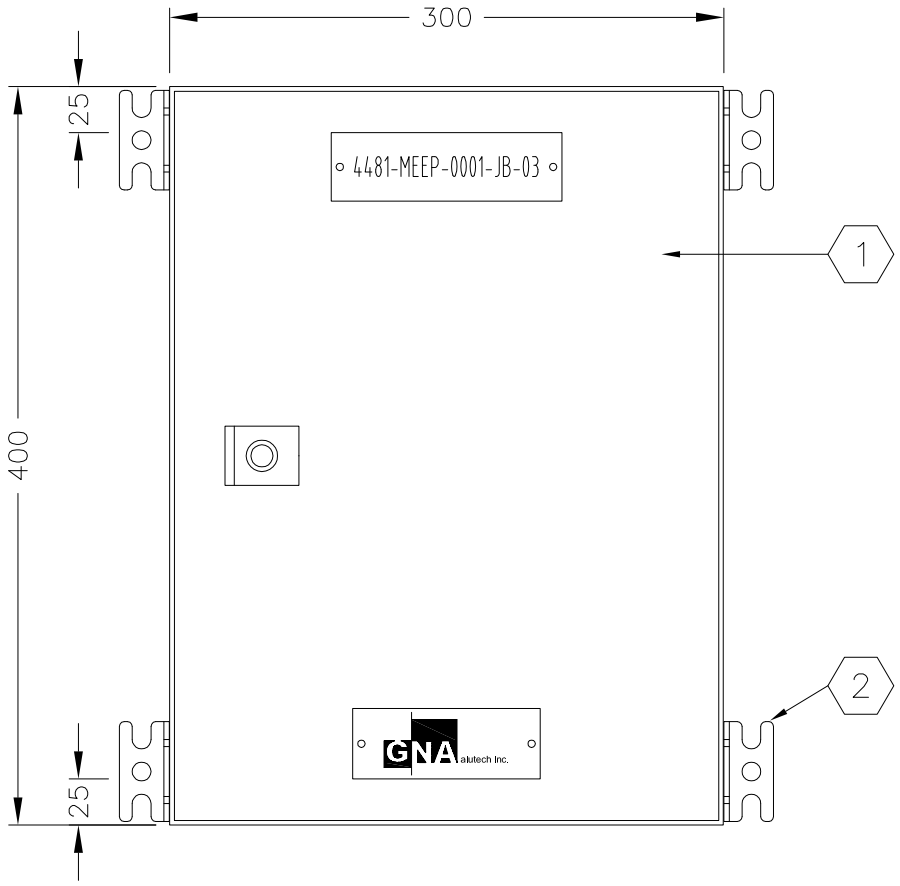
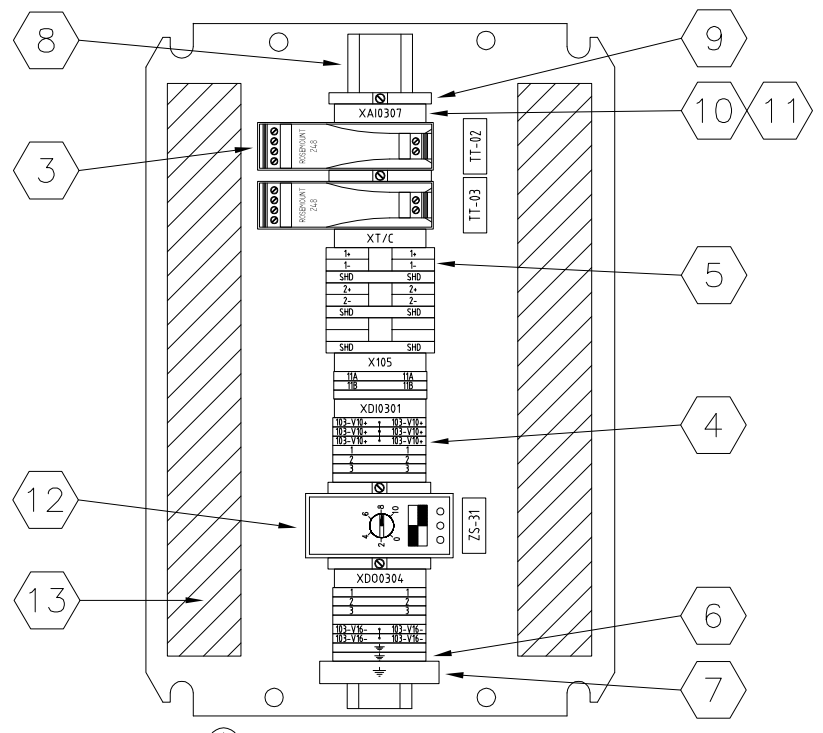


400mm X 300mm X 210mm



MOUNTING PANEL

MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 400mmX300mmX210mm IP66	RITTAL	AE 1034.500
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	SZ 2503.010
3	2	TEMPERATURE TRANSMITTER	ROSEMOUNT	248R
4	BATCH	TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZDU2.5-2/3AN (170601)
5	3	THERMOCOUPLE TERMINAL BLOCKS	WEIDMULLER	WDU 2.5/TC (102410)
6	2	GROUND TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZPE2.5-2/3AN (170609)
7	1	GROUND TERMINAL BLOCKS 16mm^2	WEIDMULLER	ZPE16-2/1AN (177296)
8	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
9	4	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
10	BATCH	TERMINAL MARKERS (20)	WEIDMULLER	SchT 5s (163193)
11	BATCH	PROTECTIVE STRIPS CLEAR (20)	WEIDMULLER	STR 5s (163194)
12	1	PHOTOELECTRIC SWITCH 24 Vdc	CARLO GAVAZZI	S142BRNN-924
	1	EMITTER	CARLO GAVAZZI	MOFT20-M12-8
	1	RECEIVER	CARLO GAVAZZI	MOFR-M12-8
	1	FIBER OPTICS 1m	CARLO GAVAZZI	OFMS1-10
	1	BASE	CARLO GAVAZZI	ZPD11
13	BATCH	DUCT 40mm X 80mm	IBOCO	T1-1530G

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA alutech Inc.	38,1mm x 101,6mm
1	1	4481-MEEP-0001-JB-03	37mm x 125mm LETTER DIM. : 12mm

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

F1 ZONE#2 & #3 CATHODE BLOCK OVEN
(JUNCTION BOX 4481-MEEP-0001-JB-03)

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Discipline :

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Vendor or Subcontractor Logo: GNA alutech Inc. Département Ingénierie Engineering Department 8400 Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SELLER DRAWING No. 1347-51350 | REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
JUNCTION BOX 4481-MEEP-0001-JB-03
GENERAL ARRANGEMENT

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
-		-	-	A3-		-AZ	

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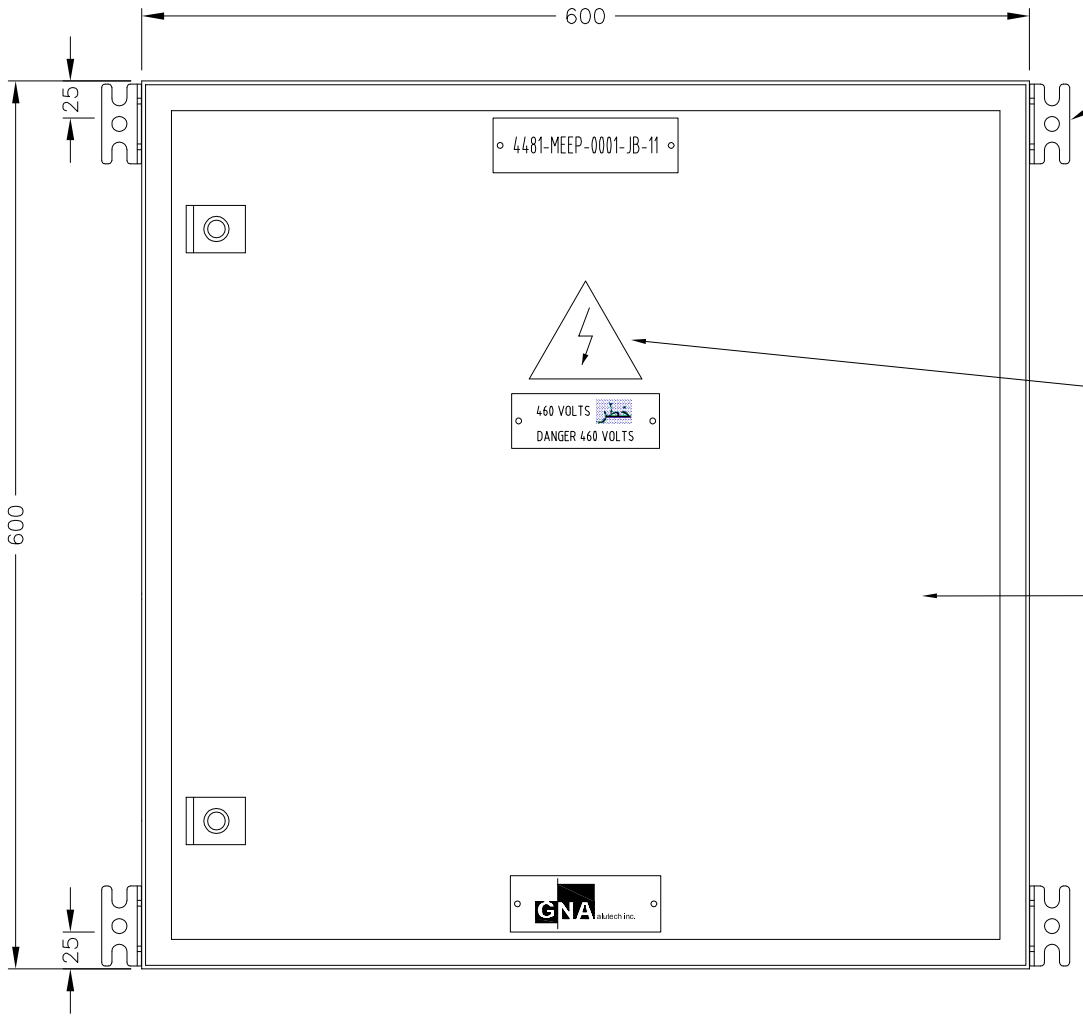
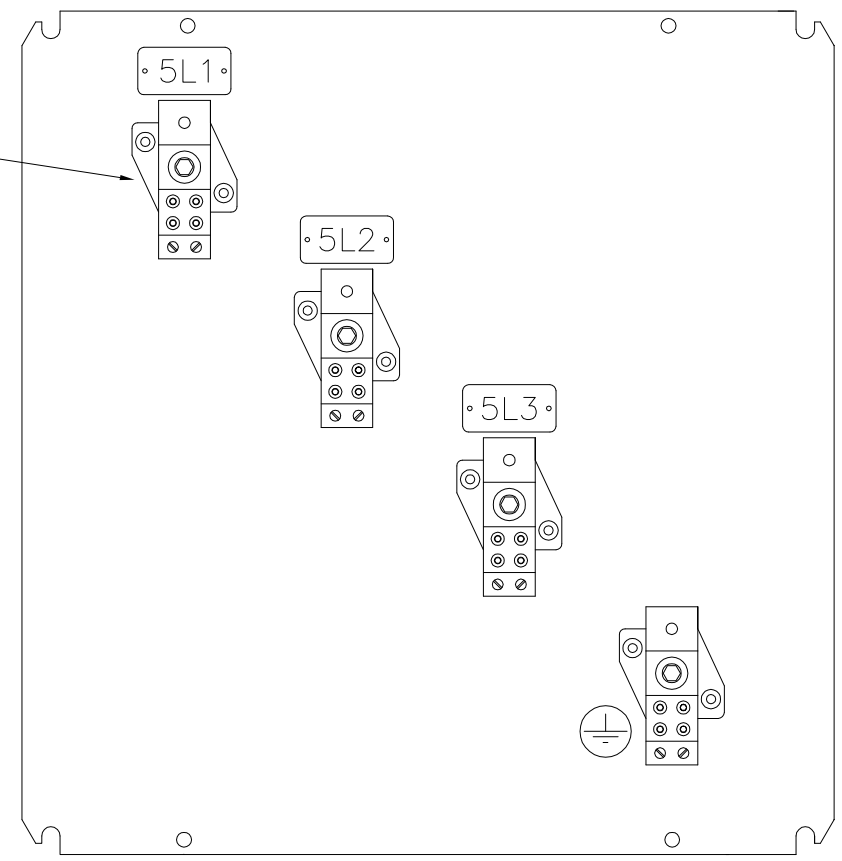
MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 600mmX600mmX210mm IP66	RITTAL	AE 1060.500
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	SZ 2503.010
3	4	SPLITER BLOCKS	BEL	SBT400
4	1	LABEL 76 X 76 (ELECTRICAL)	BRADY	89153



600mm X 600mm X 210mm



MOUNTING PANEL

F1 ZONE#1 CATHODE BLOCK OVEN
(JUNCTION BOX 4481-MEEP-0001-JB-11)

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA	38,1mm x 101,6mm
1	1	4481-MEEP-0001-JB-11	37mm x 125mm LETTER DIM. : 12mm
1	1	5L1	32mm x 63mm LETTER DIM. : 15mm
1	1	5L2	32mm x 63mm LETTER DIM. : 15mm
1	1	5L3	32mm x 63mm LETTER DIM. : 15mm
4	1	460 VOLTS DANGER 460 VOLTS	37mm x 100mm LETTER DIM. : 7mm

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

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Vendor or Subcontractor Logo: GNA allutech inc. Departement Ingenierie Engineering Department 5600, Trans-Canada Saint-Laurent, Quebec H4S 1Y3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

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SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
JUNCTION BOX 4481-MEEP-0001-JB-11
GENERAL ARRANGEMENT

MA'ADEN

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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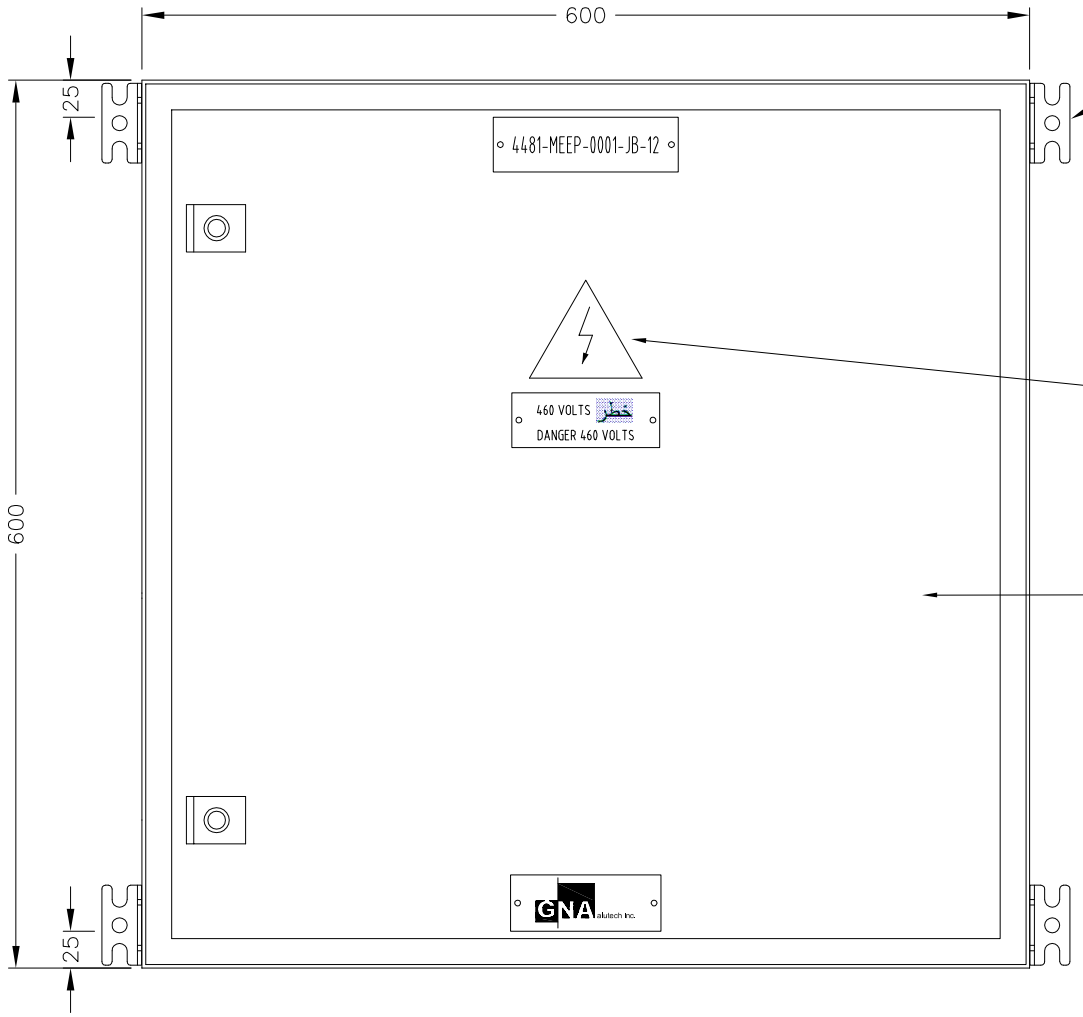
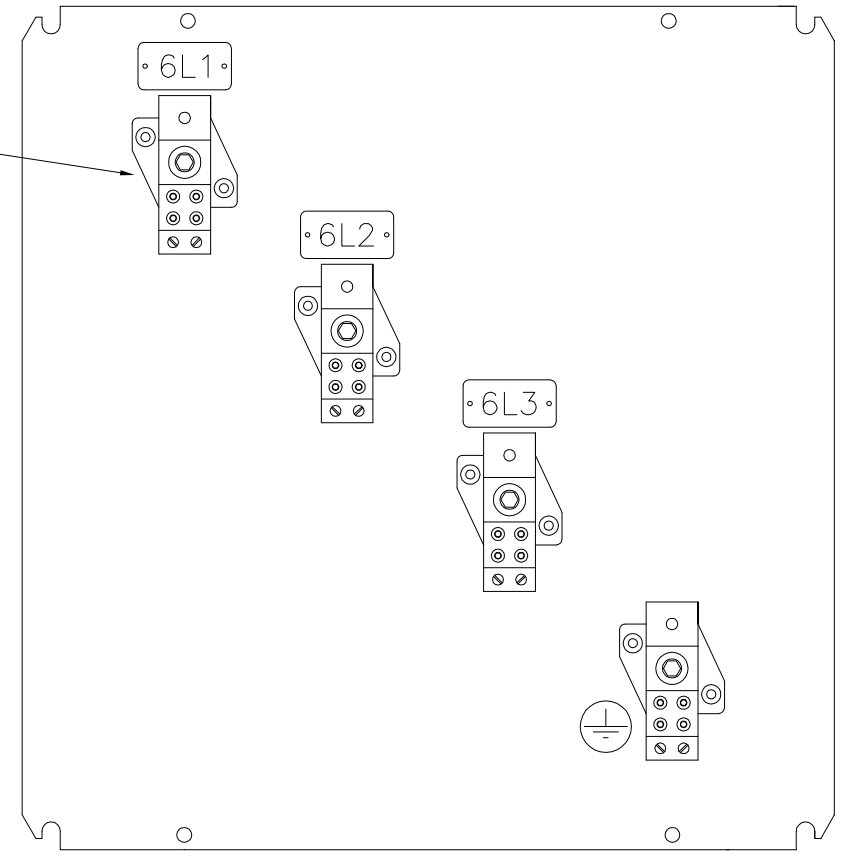
MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 600mmX600mmX210mm IP66	RITTAL	AE 1060.500
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	SZ 2503.010
3	4	SPLITER BLOCKS	BEL	SBT400
4	1	LABEL 76 X 76 (ELECTRICAL)	BRADY	89153



600mm X 600mm X 210mm



MOUNTING PANEL

F1 ZONE#2 CATHODE BLOCK OVEN
(JUNCTION BOX 4481-MEEP-0001-JB-12)

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA alutech inc.	38,1mm x 101,6mm
1	1	4481-MEEP-0001-JB-12	37mm x 125mm LETTER DIM. : 12mm
1	1	6L1	32mm x 63mm LETTER DIM. : 15mm
1	1	6L2	32mm x 63mm LETTER DIM. : 15mm
1	1	6L3	32mm x 63mm LETTER DIM. : 15mm
4	1	460 VOLTS خطر DANGER 460 VOLTS	37mm x 100mm LETTER DIM. : 7mm

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

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3 ☐ Revise & Resubmit. Work may NOT proceed.
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Reviewed by : _____ Date : _____

Discipline :

Document No : 25457-4480-V1A-MXA0-0260 | Rev. :

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REFERENCES | REVISIONS

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Vendor or Subcontractor Logo: GNA alutech inc. — Departement Ingenierie Engineering Department 9400 Trans-Canada Route Transport, Quebec H4S 1J4 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SELLER DRAWING No. 1347-51370 | REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
JUNCTION BOX 4481-MEEP-0001-JB-12
GENERAL ARRANGEMENT

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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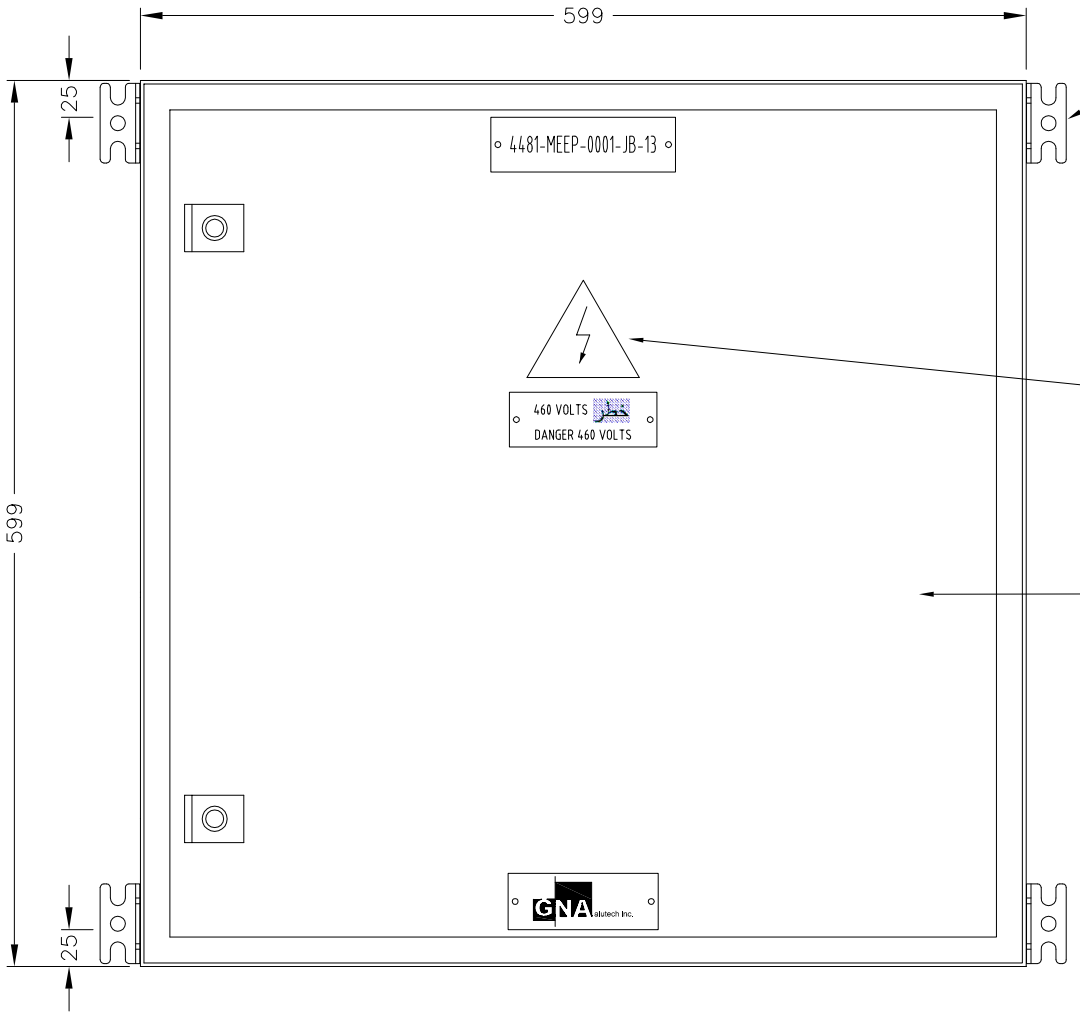
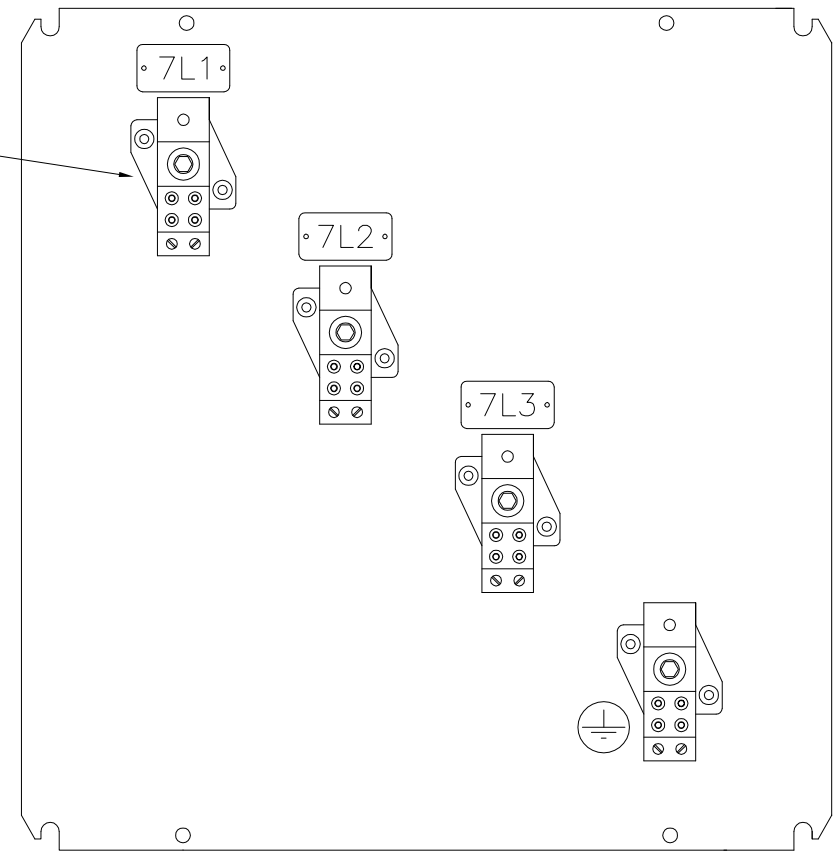
MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 600mmX600mmX210mm IP66	RITTAL	AE 1060.500
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	SZ 2503.010
3	4	SPLITER BLOCKS	BEL	SBT400
4	1	LABEL 76 X 76 (ELECTRICAL)	BRADY	89153



600mm X 600mm X 210mm



MOUNTING PANEL

F1 ZONE#3 CATHODE BLOCK OVEN
(JUNCTION BOX 4481-MEEP-0001-JB-13)

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA alutech Inc.	38,1mm x 101,6mm
1	1	4481-MEEP-0001-JB-13	37mm x 125mm LETTER DIM. : 12mm
1	1	7L1	32mm x 63mm LETTER DIM. : 15mm
1	1	7L2	32mm x 63mm LETTER DIM. : 15mm
1	1	7L3	32mm x 63mm LETTER DIM. : 15mm
4	1	460 VOLTS خطر DANGER 460 VOLTS	37mm x 100mm LETTER DIM. : 7mm

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

SELLER/CONTRACTOR DOCUMENT REVIEW

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4 ☐ Revise not required. Work may proceed.
5 ☐ VOID / Superseded.

DDR Nbr :

Reviewed by : _____ Date : _____

Discipline :

Document No : 25457-4480-V1A-MXAO-0261 | Rev. :

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
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NOTES

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Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie / Engineering Department, 9490 Trans-Canada, Saint-Laurent, Quebec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457	00AZ	xx	xxxx	xxxx - xxx	- xxx

SELLER DRAWING No. 1347-51380 | REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
JUNCTION BOX 4481-MEEP-0001-JB-13
GENERAL ARRANGEMENT

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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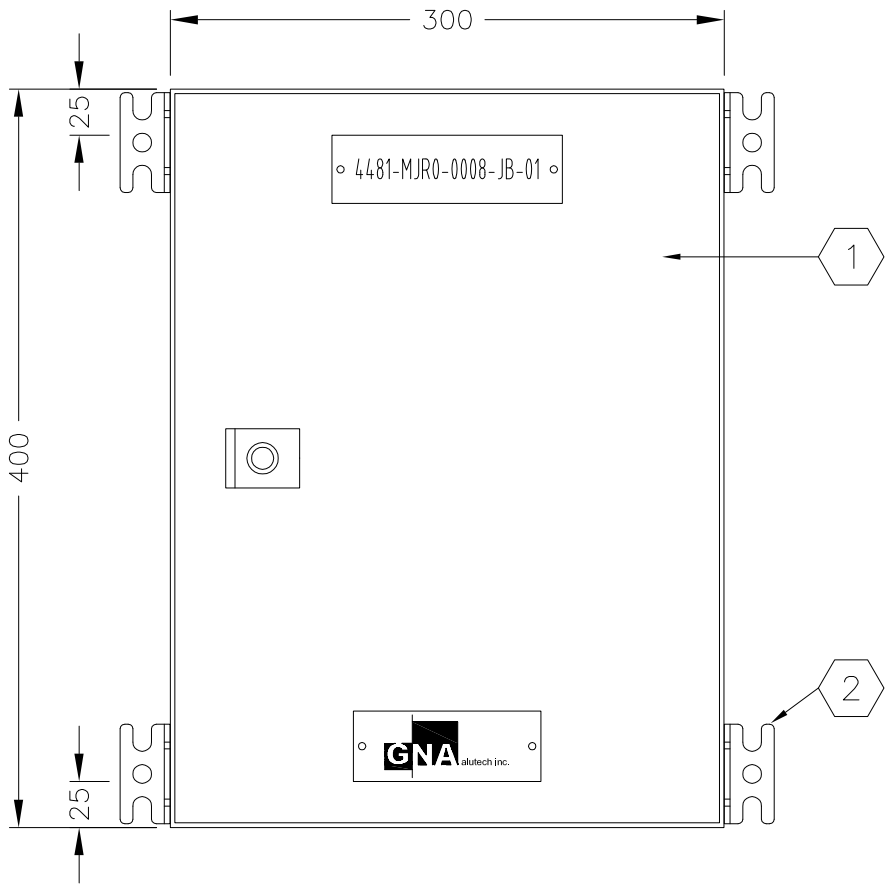
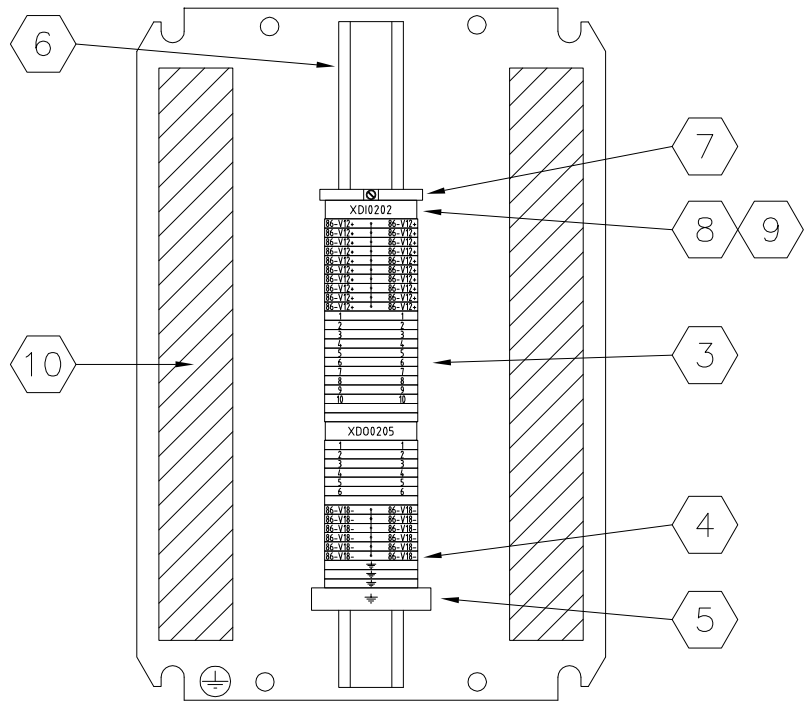
MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 400mmX300mmX210mm IP66	RITTAL	AE 1034.500
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	SZ 2503.010
3	BATCH	TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZDU2.5-2/3AN (170601)
4	3	GROUND TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZPE2.5-2/3AN (170609)
5	1	GROUND TERMINAL BLOCKS 16mm^2	WEIDMULLER	ZPE16-2/1AN (177296)
6	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
7	1	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
8	BATCH	TERMINAL MARKERS (20)	WEIDMULLER	SchT 5s (163193)
9	BATCH	PROTECTIVE STRIPS CLEAR (20)	WEIDMULLER	STR 5s (163194)
10	BATCH	DUCT 40mm X 80mm	IBOCO	T1-1530G



400mm X 300mm X 210mm



MOUNTING PANEL

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA alutech inc.	38,1mm x 101,6mm
1	1	4481-MJR0-0008-JB-01	37mm x 125mm LETTER DIM. : 12mm

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

T1 COOLING & TURNING STATION
R5 ROLLER CONVEYOR AT COOLING & TURNING STATION
(JUNCTION BOX 4481-MJR0-0008-JB-01)

SELLER/CONTRACTOR DOCUMENT REVIEW

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5 ☐ VOID / Superseded.

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Discipline :

Document No : 25457-4480-V1A-MXA0-0262 | Rev. :

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Vendor or Subcontractor Logo: GNA alutech inc. — Département Ingénierie / Engineering Department, 9495 Trans-Canada, Saint-Laurent, Québec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

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SELLER DRAWING No. 1347-51390 | REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
JUNCTION BOX 4481-MJR0-0008-JB-01
GENERAL ARRANGEMENT

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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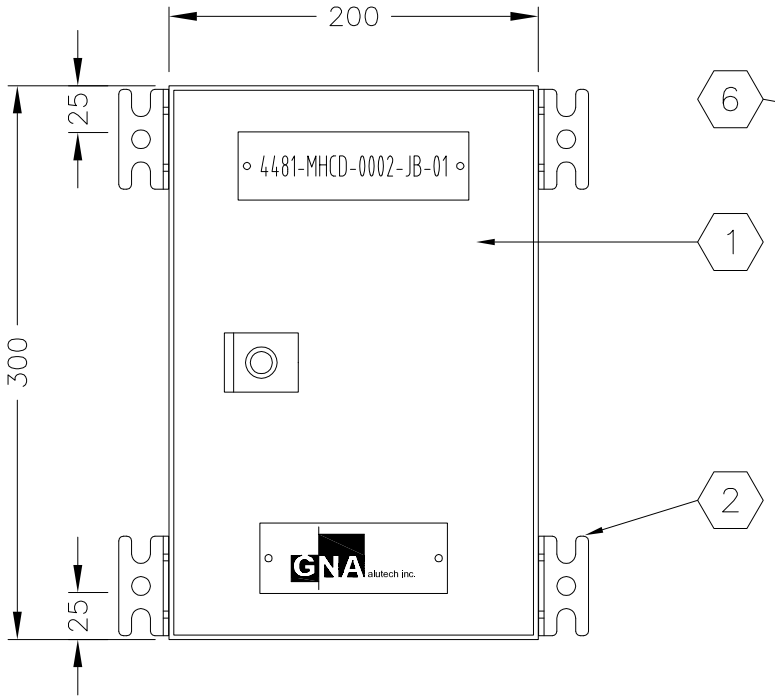
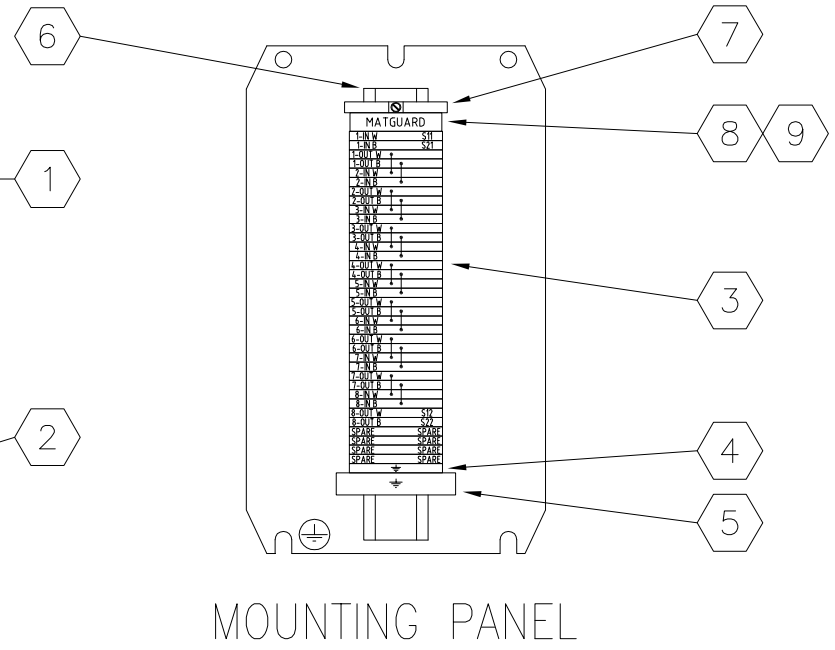
MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 300mmX200mmX155mm IP66	RITTAL	AE 1035.500
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	SZ 2503.010
3	BATCH	TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZDU2.5-2/3AN (170601)
4	1	GROUND TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZPE2.5-2/3AN (170609)
5	1	GROUND TERMINAL BLOCKS 16mm^2	WEIDMULLER	ZPE16-2/1AN (177296)
6	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
7	1	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
8	BATCH	TERMINAL MARKERS (20)	WEIDMULLER	SchT 5s (163193)
9	BATCH	PROTECTIVE STRIPS CLEAR (20)	WEIDMULLER	STR 5s (163194)



300mm X 200mm X 155mm



MOUNTING PANEL

C2 CONVEYOR
PRESENCE SENSING ON C2
MATGUARD

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA aiutech inc.	38,1mm x 101,6mm
1	1	4481-MHCD-0002-JB-01	37mm x 125mm LETTER DIM. : 12mm

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

C2 CONVEYOR PRESENCE SENSING ON C2 MATGUARD (JUNCTION BOX 4481-MHCD-0002-JB-01)

SELLER/CONTRACTOR DOCUMENT REVIEW

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4 ☐ Revise not required. Work may proceed.
5 ☐ VOID / Superseded.

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Discipline :

Document No : 25457-4480-V1A-MXA0-0200 | Rev. :

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Vendor or Subcontractor Logo: GNA aiutech inc. — Département Ingénierie / Engineering Department, 9650 Trans-Canada, Saint-Laurent, Québec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457	00AZ	xx	xxxx	xxxx - xxx	xxx

SELLER DRAWING No. 1347-51400 | REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
JUNCTION BOX 4481-MHCD-0002-JB-01
GENERAL ARRANGEMENT

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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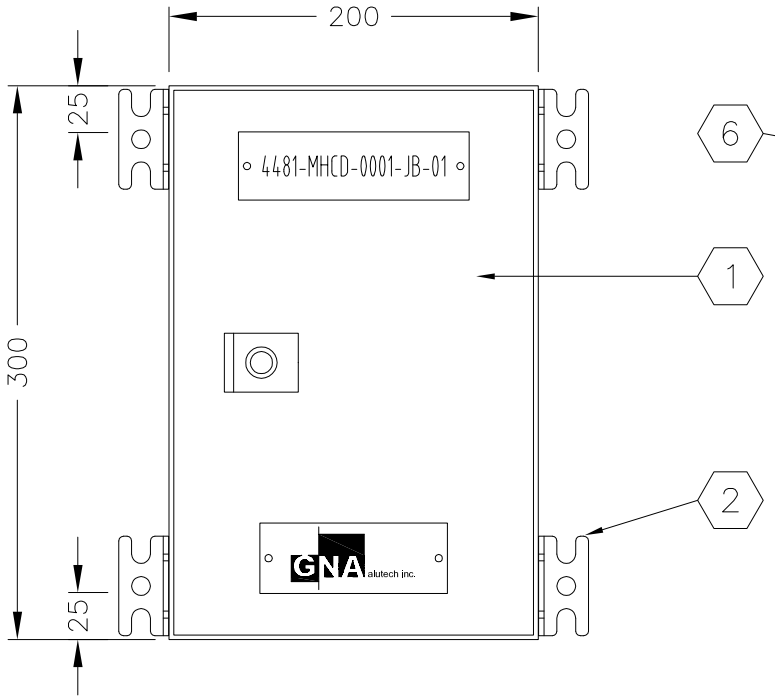
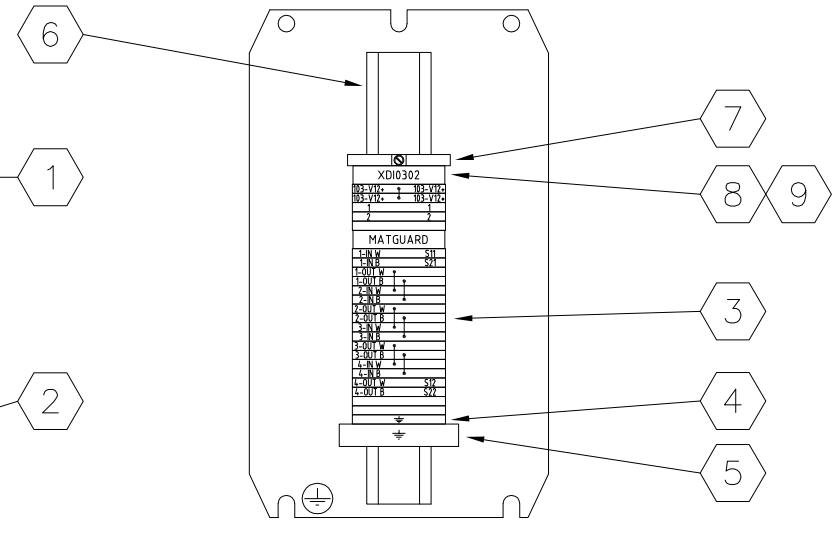
MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 300mmX200mmX155mm IP66	RITTAL	AE 1035.500
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	SZ 2503.010
3	BATCH	TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZDU2.5-2/3AN (170601)
4	1	GROUND TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZPE2.5-2/3AN (170609)
5	1	GROUND TERMINAL BLOCKS 16mm^2	WEIDMULLER	ZPE16-2/1AN (177296)
6	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
7	1	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
8	BATCH	TERMINAL MARKERS (20)	WEIDMULLER	SchT 5s (163193)
9	BATCH	PROTECTIVE STRIPS CLEAR (20)	WEIDMULLER	STR 5s (163194)



300mm X 200mm X 155mm



MOUNTING PANEL

C1 CONVEYOR
PRESENCE SENSING ON C1
MATGUARD

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA alutech inc.	38,1mm x 101,6mm
1	1	4481-MHCD-0001-JB-01	37mm x 125mm LETTER DIM. : 12mm

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

C1 CONVEYOR PRESENCE SENSING ON C1 MATGUARD (JUNCTION BOX 4481-MHCD-0001-JB-01)

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Discipline :

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Vendor or Subcontractor Logo: GNA alutech inc. — Département Ingénierie / Engineering Department, 9690 TransCanada, Saint-Laurent, Québec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No | SUBD. | DISC. | SECTOR | SEQUENCE | REV.
25457-00AZ- xx - xxxx - xxxx - xxx - xxx

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SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
JUNCTION BOX 4481-MHCD-0001-JB-01
GENERAL ARRANGEMENT

MA'ADEN معادن

Type | Building | Discipline | Phase | Format | Sequential | Location | Rev. No.
— | — | — | | A3- | | -AZ |

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MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 300mmX200mmX155mm IP66	RITTAL	AE 1035.500
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	SZ 2503.010
3	BATCH	TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZDU2.5-2/3AN (170601)
4	1	GROUND TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZPE2.5-2/3AN (170609)
5	1	GROUND TERMINAL BLOCKS 16mm^2	WEIDMULLER	ZPE16-2/1AN (177296)
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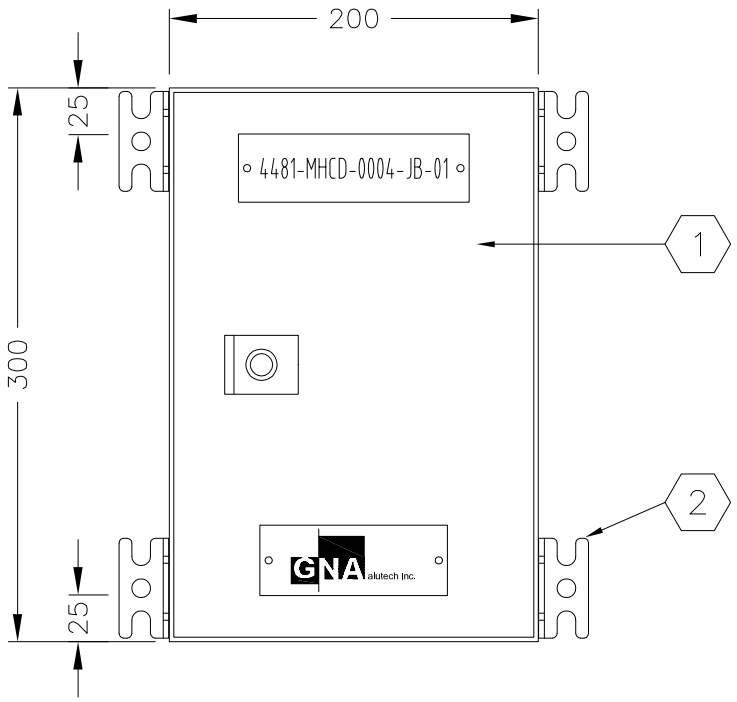
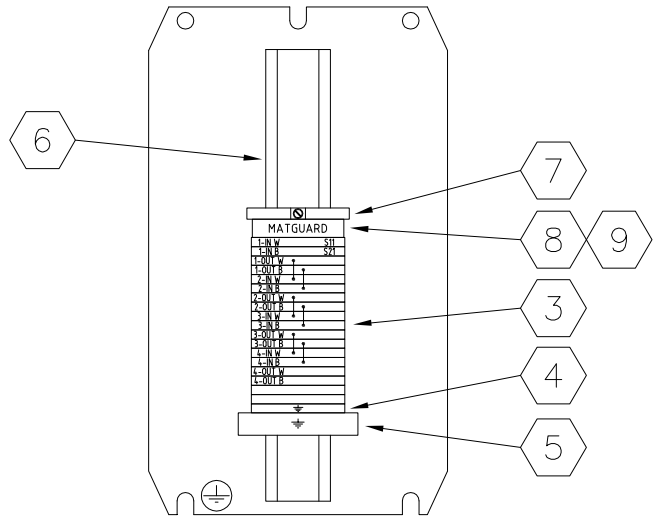


300mm X 200mm X 155mm



MOUNTING PANEL

C4 CONVEYOR
PRESENCE SENSING ON C4
MATGUARD

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA alutech inc.	38,1mm x 101,6mm
1	1	4481-MHCD-0004-JB-01	37mm x 125mm LETTER DIM. : 12mm

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

C4 CONVEYOR PRESENCE SENSING ON C4 MATGUARD (JUNCTION BOX 4481-MHCD-0004-JB-01)

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5 ☐ VOID / Superseded.

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Discipline :

Document No : 25457-4480-V1A-MXA0-0264 | Rev. :

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REFERENCES | REVISIONS

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Vendor or Subcontractor Logo: GNA alutech inc. — Département Ingénierie / Engineering Department, 9480 Trans-Canada, Saint-Laurent, Quebec, CANADA, H4S 1V3

BECHTEL

SELLER DRAWING No. 1347-51420 | REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
JUNCTION BOX 4481-MHCD-0004-JB-01
GENERAL ARRANGEMENT

Project Title: Ras Az Zawr Aluminium Smelter

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
-	-	-		A3-		-AZ	

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MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
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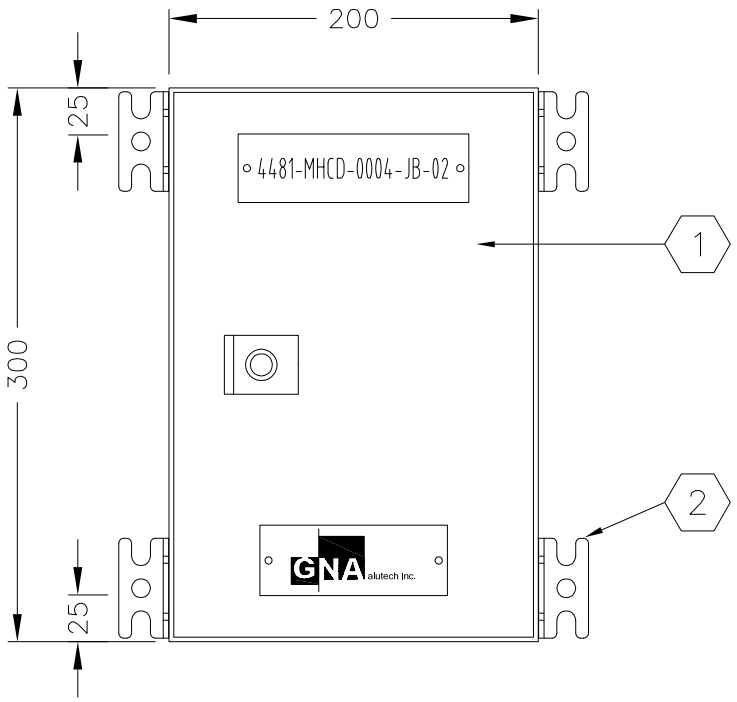
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	SZ 2503.010
3	BATCH	TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZDU2.5-2/3AN (170601)
4	1	GROUND TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZPE2.5-2/3AN (170609)
5	1	GROUND TERMINAL BLOCKS 16mm^2	WEIDMULLER	ZPE16-2/1AN (177296)
6	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
7	1	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
8	BATCH	TERMINAL MARKERS (20)	WEIDMULLER	SchT 5s (163193)
9	BATCH	PROTECTIVE STRIPS CLEAR (20)	WEIDMULLER	STR 5s (163194)



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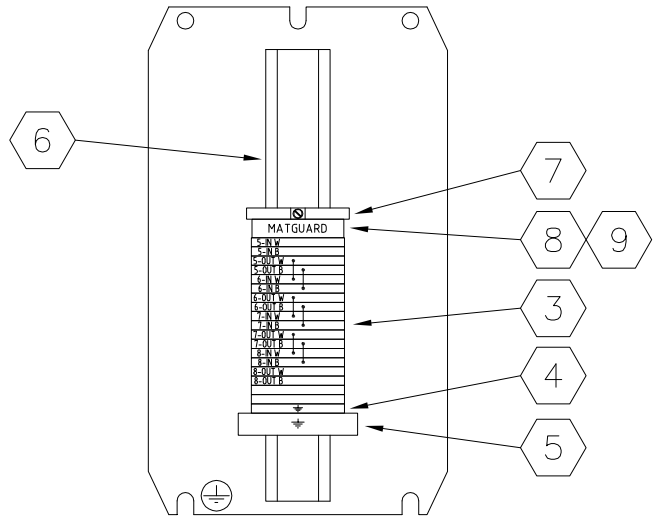

MOUNTING PANEL

C4 CONVEYOR
PRESENCE SENSING ON C4
MATGUARD

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA alutech inc.	38,1mm x 101,6mm
1	1	4481-MHCD-0004-JB-02	37mm x 125mm LETTER DIM. : 12mm

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

C4 CONVEYOR PRESENCE SENSING ON C4 MATGUARD (JUNCTION BOX 4481-MHCD-0004-JB-02)

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4 ☐ Revise not required. Work may proceed.
5 ☐ VOID / Superseded.

DDR Nbr :

Reviewed by : _____ Date : _____

Discipline :

Document No : 25457-4480-V1A-MXA0-0265 | Rev. :

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
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REFERENCES | REVISIONS

STATUS: FOR DESIGN

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Vendor or Subcontractor Logo: GNA alutech inc. — Département Ingénierie / Engineering Department, 9450 Trans-Canada, Saint-Laurent, Quebec H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SELLER DRAWING No. 1347-51421 | REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
JUNCTION BOX 4481-MHCD-0004-JB-02
GENERAL ARRANGEMENT

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
—	—	—		A3-		-AZ	

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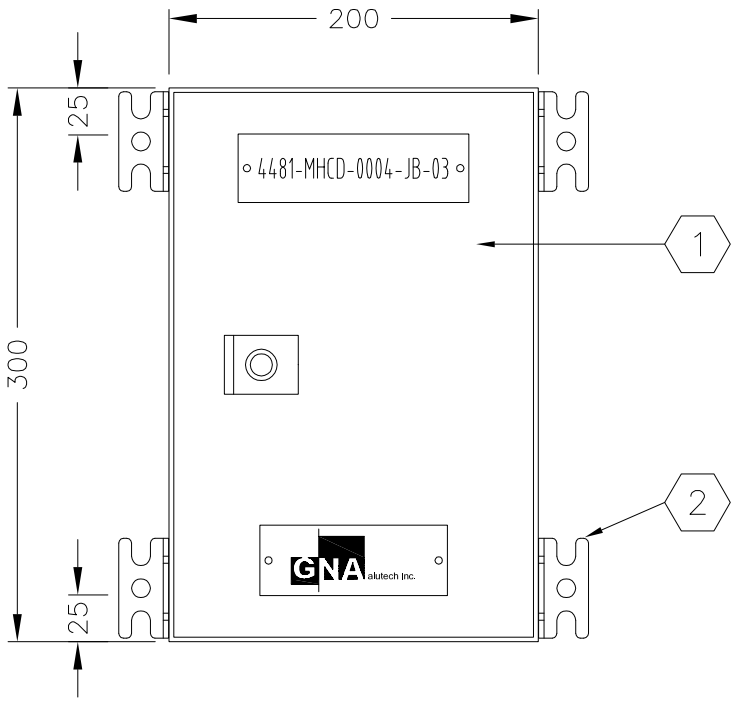
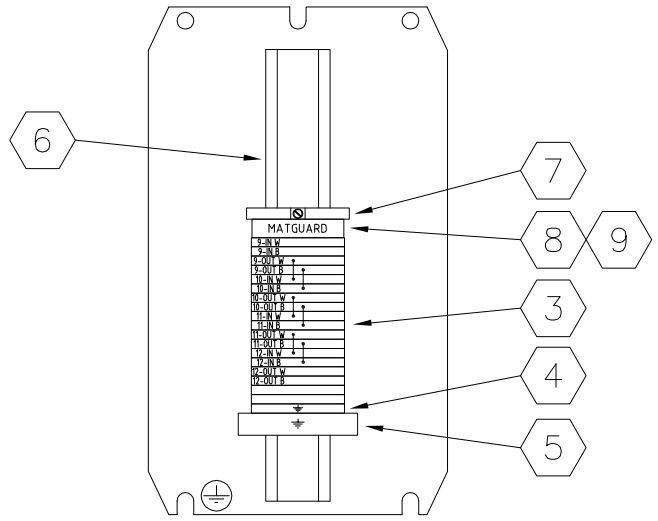
MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 300mmX200mmX155mm IP66	RITTAL	AE 1035.500
2	1	WALL-MOUNTING BRACKETS (4)	RITTAL	SZ 2503.010
3	BATCH	TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZDU2.5-2/3AN (170601)
4	1	GROUND TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZPE2.5-2/3AN (170609)
5	1	GROUND TERMINAL BLOCKS 16mm^2	WEIDMULLER	ZPE16-2/1AN (177296)
6	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
7	1	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
8	BATCH	TERMINAL MARKERS (20)	WEIDMULLER	SchT 5s (163193)
9	BATCH	PROTECTIVE STRIPS CLEAR (20)	WEIDMULLER	STR 5s (163194)



300mm X 200mm X 155mm



MOUNTING PANEL

C4 CONVEYOR
PRESENCE SENSING ON C4
MATGUARD

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA alutech inc.	38,1mm x 101,6mm
1	1	4481-MHCD-0004-JB-03	37mm x 125mm LETTER DIM. : 12mm

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

C4 CONVEYOR PRESENCE SENSING ON C4 MATGUARD (JUNCTION BOX 4481-MHCD-0004-JB-03)

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4 ☐ Revise not required. Work may proceed.
5 ☐ VOID / Superseded.

DDR Nbr :

Reviewed by : _____ Date : _____

Discipline :

Document No : 25457-4480-V1A-MXA0-0266 | Rev. :

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
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REFERENCES | REVISIONS

NOTES

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Vendor or Subcontractor Logo:
GNA alutech inc. Département Ingénierie / Engineering Department, 9450 Trans-Canada, Saint-Laurent, Quebec H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SELLER DRAWING No. 1347-51422 | REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
JUNCTION BOX 4481-MHCD-0004-JB-03
GENERAL ARRANGEMENT

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
—	—	—		A3-		-AZ	

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MATERIAL LIST				
ITEM	QUANTITY	DESCRIPTION	MANUFACTURER	MODEL
1	1	PANEL 300mmX200mmX155mm IP66	RITTAL	AE 1035.500
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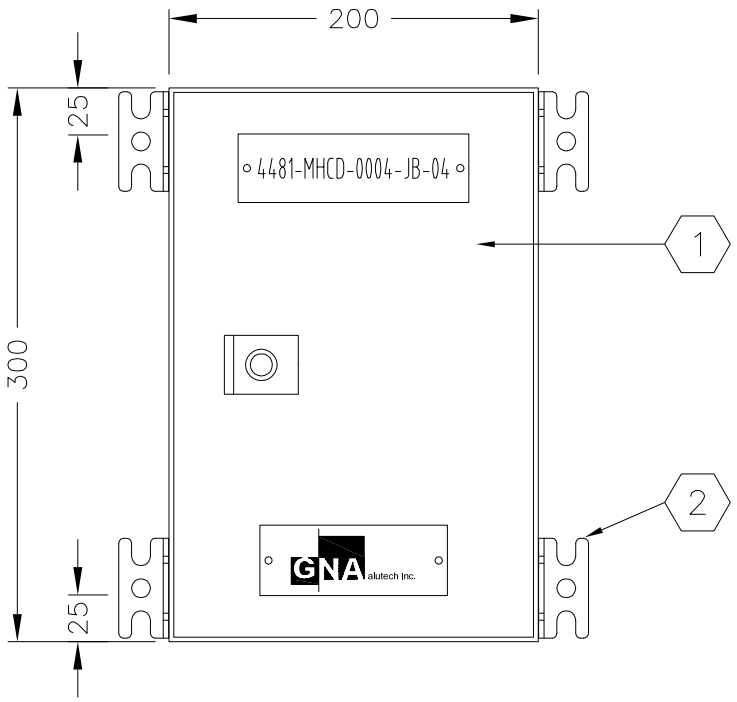
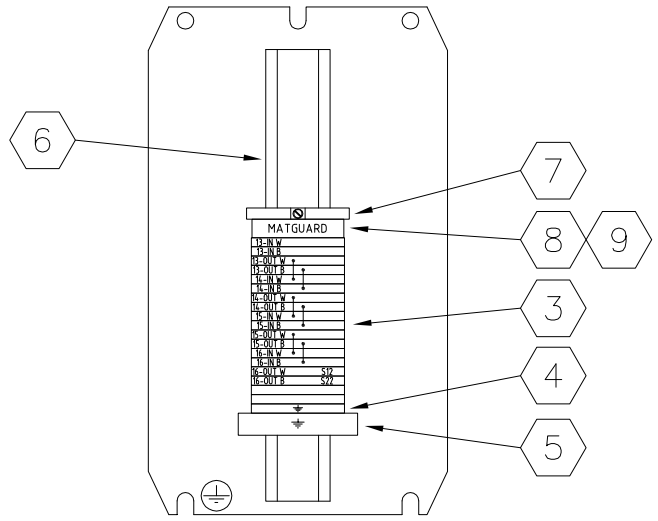
3	BATCH	TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZDU2.5-2/3AN (170601)
4	1	GROUND TERMINAL BLOCKS 2.5mm^2	WEIDMULLER	ZPE2.5-2/3AN (170609)
5	1	GROUND TERMINAL BLOCKS 16mm^2	WEIDMULLER	ZPE16-2/1AN (177296)
6	BATCH	RAIL	WEIDMULLER	TS-35 (51450)
7	1	END BRACKET	WEIDMULLER	ZEW TS 35 (954000)
8	BATCH	TERMINAL MARKERS (20)	WEIDMULLER	SchT 5s (163193)
9	BATCH	PROTECTIVE STRIPS CLEAR (20)	WEIDMULLER	STR 5s (163194)



300mm X 200mm X 155mm



MOUNTING PANEL

C4 CONVEYOR
PRESENCE SENSING ON C4
MATGUARD

ITEM	QTY	NAME PLATE LIST	DIMENSION
1	1	GNA alutech inc.	38,1mm x 101,6mm
1	1	4481-MHCD-0004-JB-04	37mm x 125mm LETTER DIM. : 12mm

NOTES:

1 -PAINT:
RAL 7035 GRAY -STANDARD RITTAL

C4 CONVEYOR PRESENCE SENSING ON C4 MATGUARD (JUNCTION BOX 4481-MHCD-0004-JB-04)

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DDR Nbr :

Reviewed by : _____ Date : _____

Discipline :

Document No : 25457-4480-V1A-MXA0-0267 | Rev. :

REFERENCES		REVISIONS						
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NOTES

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Vendor or Subcontractor Logo: GNA alutech inc. — Département Ingénierie / Engineering Department, 9450 Trans-Canada, Saint-Laurent, Québec, H4S 1V3, Canada

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SELLER DRAWING No. 1347-51423 | REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
JUNCTION BOX 4481-MHCD-0004-JB-04
GENERAL ARRANGEMENT

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
—	—	—		A3-		-AZ	

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DDR Nbr : 110

Reviewed by : _____ Date : _____

Discipline :

Document No : 25457-4480-V1A-MXAO-0055 | Rev. :

LISTE DE MATERIELS/BILL OF MATERIALS

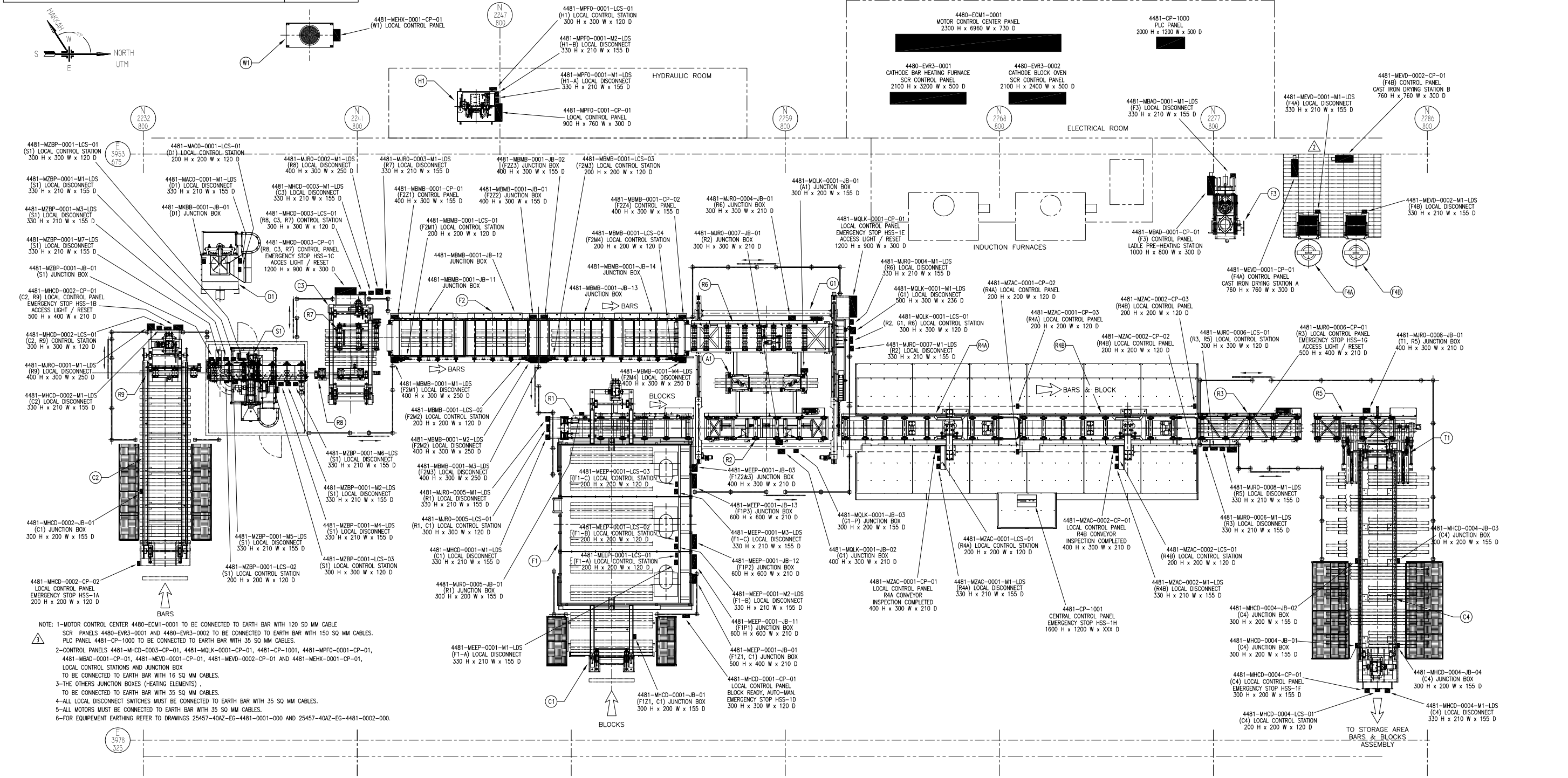
ITEM	Qte/Qty	No. PIECE-MAT. MAT.-PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
D1		4481-MKBB-0001	DUST COLLECTOR FOR SHOTBLASTING MACHINE		
H1		4481-MPF0-0001	HYDRAULIC POWER UNIT		
T1		4481-MJUT-0001	COOLING AND TURNING STATION		
C4		4481-MHCD-0004	CHAIN CONVEYOR FOR SEALED CATHODE		
W1		4481-MEHX-0001	CHILLER FOR HYDRAULIC POWER UNIT		
F3		4481-MBAD-0001	LADLE PRE-HEATING STATION		
F4A		4481-MEVD-0001	CAST IRON INGOT DRYING STATION A		
F4B		4481-MEVD-0002	CAST IRON INGOT DRYING STATION B		

LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/Qty	No. PIECE-MAT. MAT.-PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
R4A		4481-MZAC-0001	PRESTRESSING AND SEALING STATION C/W CONVEYOR A AND PLATFORMS		
R4B		4481-MZAC-0002	PRESTRESSING AND SEALING STATION C/W CONVEYOR B AND PLATFORMS		
S1		4481-MZBP-0001	CATHODE BAR SHOTBLASTING MACHINE		
G1		4481-MQLK-0001	POSITIONING GANTRY FOR BLOCK & BARS		
R3		4481-MJRO-0006	ROLLER CONVEYOR AFTER SEALING STATION		
R5		4481-MJRO-0008	ROLLER CONVEYOR AT CODLING & TURNING STATION		
F1		4481-MEEP-0001	CATHODE BLOCK OVEN (CAPACITY OF 6 CATHODE BLOCKS)		
F2		4481-MBMB-0001	CATHODE BAR HEATING FURNACE (CAPACITY OF 16 BARS)		

LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/Qty	No. PIECE-MAT. MAT.-PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
C2		4481-MHCD-0002	CHAIN CONVEYOR UPSTREAM OF SHOTBLASTING MACHINE (24 BARS)		
R9		4481-MJRO-0001	CONICAL ROLLER CONVEYOR AT SHOTBLASTING MACHINE ENTRANCE		
R8		4481-MJRO-0002	CONICAL ROLLER CONVEYOR AT SHOTBLASTING MACHINE EXIT		
C3		4481-MHCD-0003	CHAIN CONVEYOR BETWEEN SHOTBLASTING MACHINE AND OVEN		
R7		4481-MJRO-0003	ROLLER CONVEYOR AT BAR FURNACE ENTRANCE		
R6		4481-MJRO-0004	ROLLER CONVEYOR AT BAR FURNACE EXIT		
C1		4481-MHCD-0001	CHAIN CONVEYOR OF BLOCK OVEN		
R1		4481-MJRO-0005	ROLLER CONVEYOR AT BLOCK OVEN EXIT		
R2		4481-MJRO-0007	ROLLER CONVEYOR FOR BLOCK AND BAR ASSEMBLY		



NOTE: 1-MOTOR CONTROL CENTER 4480-ECM1-0001 TO BE CONNECTED TO EARTH BAR WITH 120 SD MM CABLE
SCR PANELS 4480-EVR3-0001 AND 4480-EVR3-0002 TO BE CONNECTED TO EARTH BAR WITH 150 SQ MM CABLES.
PLC PANEL 4481-CP-1000 TO BE CONNECTED TO EARTH BAR WITH 35 SQ MM CABLES.
2-CONTROL PANELS 4481-MHCD-0003-CP-01, 4481-MQLK-0001-CP-01, 4481-CP-1001, 4481-MPF0-0001-CP-01, 4481-MBAD-0001-CP-01, 4481-MEVD-0001-CP-01, 4481-MEVD-0002-CP-01 AND 4481-MEHX-0001-CP-01, LOCAL CONTROL STATIONS AND JUNCTION BOX TO BE CONNECTED TO EARTH BAR WITH 16 SQ MM CABLES.
3-THE OTHERS JUNCTION BOXES (HEATING ELEMENTS) , TO BE CONNECTED TO EARTH BAR WITH 35 SQ MM CABLES.
4-ALL LOCAL DISCONNECT SWITCHES MUST BE CONNECTED TO EARTH BAR WITH 35 SQ MM CABLES.
5-ALL MOTORS MUST BE CONNECTED TO EARTH BAR WITH 35 SQ MM CABLES.
6-FOR EQUIPEMENT EARTHING REFER TO DRAWINGS 25457-40AZ-EG-4481-0001-000 AND 25457-40AZ-EG-4481-0002-000.

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
		3		UPDATE	SE/21/11	F.P.	E.B.	M.B.
		2		UPDATE	AU/17/11	F.P.	E.B.	M.B.
		1		UPDATE	30/05/11	F.P.	E.B.	M.B.
REFERENCES		REVISIONS						

NOTES

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SELLER DRAWING No. 1347-52500 | REV. 3

Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie Engineering Department 9490 Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
EARTHING LAYOUT DRAWING
GENERAL ASSEMBLY

MA'ADEN

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
	—	—	—	A3-		-AZ	

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DDR Nbr : 173

Reviewed by : _____ Date : _____

Discipline :

Document No : 25457-4480-V1A-MXAO-0054 Rev. : 001

LISTE DE MATERIELS/BILL OF MATERIALS

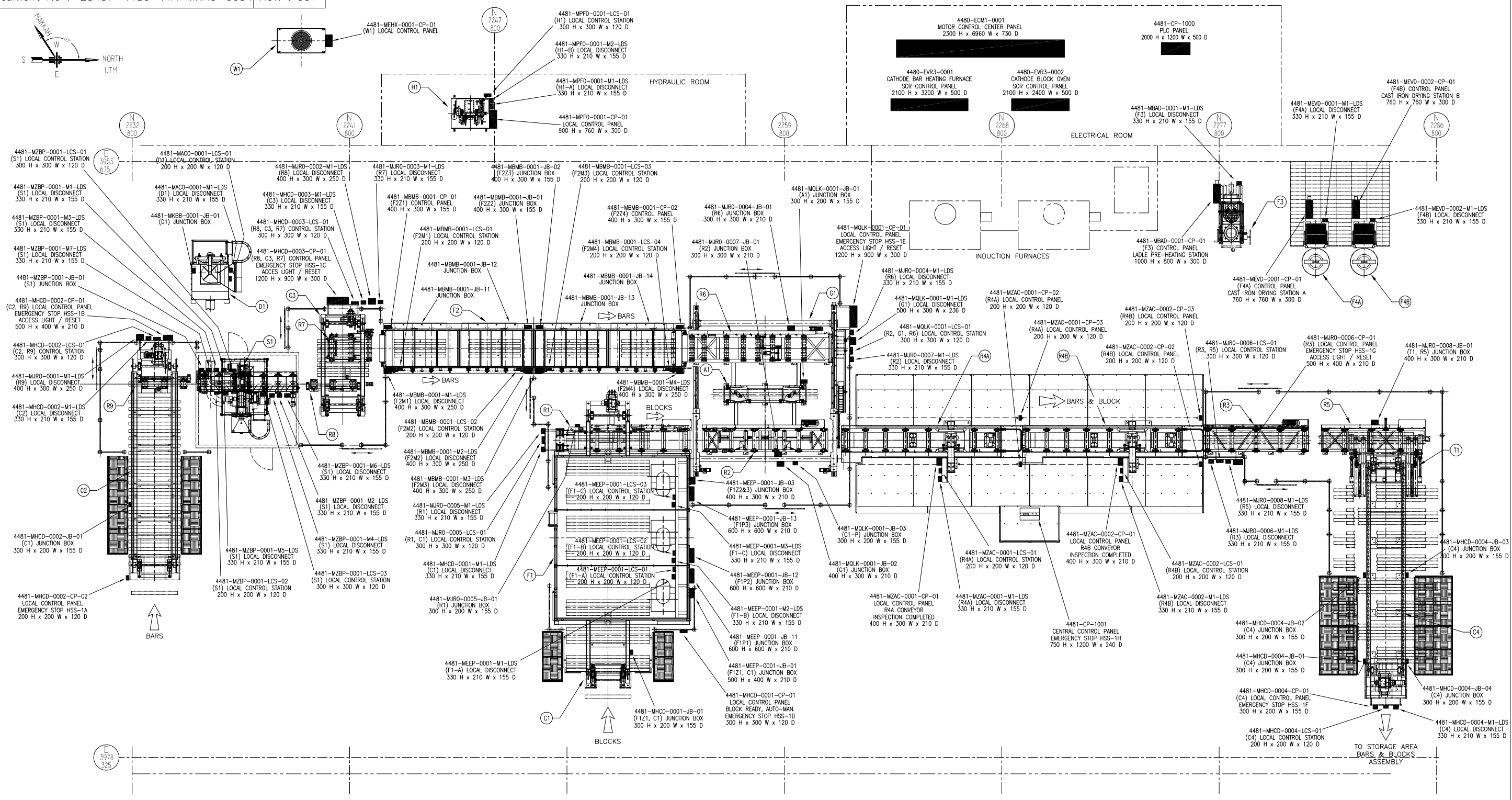
ITEM	Qte/Qty	No. PIECE-MAT. MAT.-PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
D1		4481-MKBB-0001	DUST COLLECTOR FOR SHOTBLASTING MACHINE		
H1		4481-MPF0-0001	HYDRAULIC POWER UNIT		
T1		4481-MJUT-0001	COOLING AND TURNING STATION		
C4		4481-MHCD-0004	CHAIN CONVEYOR FOR SEALED CATHODE		
W1		4481-MEHX-0001	CHILLER FOR HYDRAULIC POWER UNIT		
F3		4481-MBAD-0001	LADLE PRE-HEATING STATION		
F4A		4481-MEVD-0001	CAST IRON INGOT DRYING STATION A		
F4B		4481-MEVD-0002	CAST IRON INGOT DRYING STATION B		

LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/Qty	No. PIECE-MAT. MAT.-PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
R4A		4481-MZAC-0001	PRESTRESSING AND SEALING STATION C/W CONVEYOR A AND PLATFORMS		
R4B		4481-MZAC-0002	PRESTRESSING AND SEALING STATION C/W CONVEYOR B AND PLATFORMS		
S1		4481-MZBP-0001	CATHODE BAR SHOTBLASTING MACHINE		
G1		4481-MQLK-0001	POSITIONING GANTRY FOR BLOCK & BARS		
R3		4481-MJRO-0006	ROLLER CONVEYOR AFTER SEALING STATION		
R5		4481-MJRO-0008	ROLLER CONVEYOR AT COOLING & TURNING STATION		
F1		4481-MEIP-0001	CATHODE BLOCK OVEN (CAPACITY OF 6 CATHODE BLOCKS)		
F2		4481-MBMB-0001	CATHODE BAR HEATING FURNACE (CAPACITY OF 16 BARS)		

LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/Qty	No. PIECE-MAT. MAT.-PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
C2		4481-MHCD-0002	CHAIN CONVEYOR UPSTREAM OF SHOTBLASTING MACHINE (24 BARS)		
R9		4481-MJRO-0001	CONICAL ROLLER CONVEYOR AT SHOTBLASTING MACHINE ENTRANCE		
R8		4481-MJRO-0002	CONICAL ROLLER CONVEYOR AT SHOTBLASTING MACHINE EXIT		
C3		4481-MHCD-0003	CHAIN CONVEYOR BETWEEN SHOTBLASTING MACHINE AND OVEN		
R7		4481-MJRO-0003	ROLLER CONVEYOR AT BAR FURNACE ENTRANCE		
R6		4481-MJRO-0004	ROLLER CONVEYOR AT BAR FURNACE EXIT		
C1		4481-MHCD-0001	CHAIN CONVEYOR OF BLOCK OVEN		
R1		4481-MJRO-0005	ROLLER CONVEYOR AT BLOCK OVEN EXIT		
R2		4481-MJRO-0007	ROLLER CONVEYOR FOR BLOCK AND BAR ASSEMBLY		



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DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		3		UPDATE	MA-10-11	T.Pa.	E.B.	F.P.
		2		UPDATE	NO-19-10	T.Pa.	E.B.	M.B.
		1		UPDATE	SE-30-10	F.P.	E.B.	M.B.
		REVISIONS						

NOTES

STATUS: FOR DESIGN

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DATE:	11/08/10	DATE:	
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DATE:		DATE:	
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DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA alutech inc. — Département Ingénierie / Engineering Department, 6400 Trans-Canada, Saint-Laurent, Quebec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CONTROL PANEL & JUNCTION BOX LOCATION
GENERAL ASSEMBLY

MA'ADEN

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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DDR Nbr : 110

Reviewed by : _____ Date : _____

Discipline :

Document No : 25457-4480-V1A-MXAO-0055 | Rev. :

LISTE DE MATERIELS/BILL OF MATERIALS

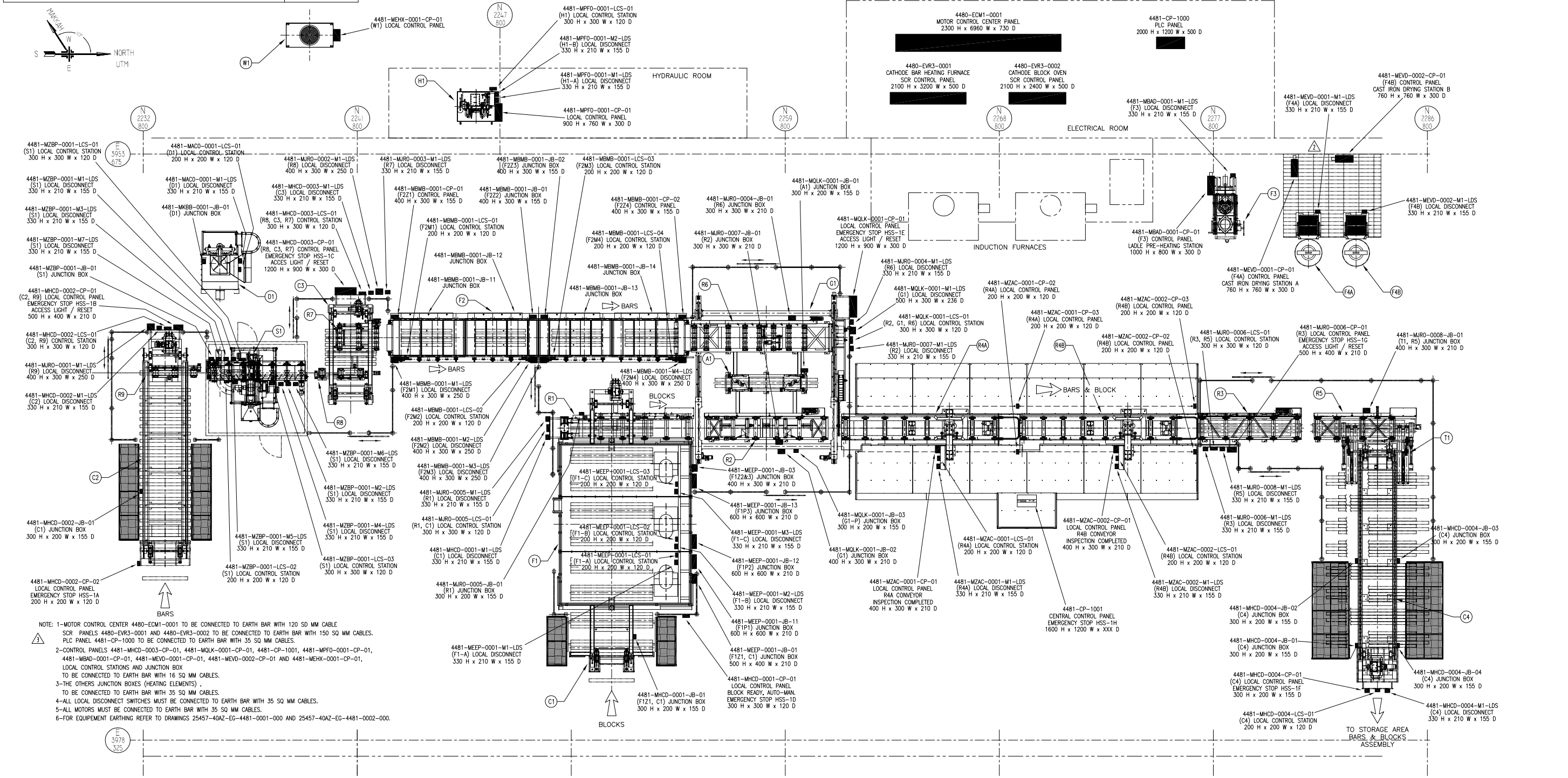
ITEM	Qte/Qty	No. PIECE-MAT. MAT.-PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
D1		4481-MKBB-0001	DUST COLLECTOR FOR SHOTBLASTING MACHINE		
H1		4481-MPF0-0001	HYDRAULIC POWER UNIT		
T1		4481-MJUT-0001	COOLING AND TURNING STATION		
C4		4481-MHCD-0004	CHAIN CONVEYOR FOR SEALED CATHODE		
W1		4481-MEHX-0001	CHILLER FOR HYDRAULIC POWER UNIT		
F3		4481-MBAD-0001	LADLE PRE-HEATING STATION		
F4A		4481-MEVD-0001	CAST IRON INGOT DRYING STATION A		
F4B		4481-MEVD-0002	CAST IRON INGOT DRYING STATION B		

LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/Qty	No. PIECE-MAT. MAT.-PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
R4A		4481-MZAC-0001	PRESTRESSING AND SEALING STATION C/W CONVEYOR A AND PLATFORMS		
R4B		4481-MZAC-0002	PRESTRESSING AND SEALING STATION C/W CONVEYOR B AND PLATFORMS		
S1		4481-MZBP-0001	CATHODE BAR SHOTBLASTING MACHINE		
G1		4481-MQLK-0001	POSITIONING GANTRY FOR BLOCK & BARS		
R3		4481-MJRO-0006	ROLLER CONVEYOR AFTER SEALING STATION		
R5		4481-MJRO-0008	ROLLER CONVEYOR AT CODLING & TURNING STATION		
F1		4481-MEEP-0001	CATHODE BLOCK OVEN (CAPACITY OF 6 CATHODE BLOCKS)		
F2		4481-MBMB-0001	CATHODE BAR HEATING FURNACE (CAPACITY OF 16 BARS)		

LISTE DE MATERIELS/BILL OF MATERIALS

ITEM	Qte/Qty	No. PIECE-MAT. MAT.-PART No.	DESCRIPTION/DESIGNATION	REMARQUE/REMARK	POIDS WEIGHT
C2		4481-MHCD-0002	CHAIN CONVEYOR UPSTREAM OF SHOTBLASTING MACHINE (24 BARS)		
R9		4481-MJRO-0001	CONICAL ROLLER CONVEYOR AT SHOTBLASTING MACHINE ENTRANCE		
R8		4481-MJRO-0002	CONICAL ROLLER CONVEYOR AT SHOTBLASTING MACHINE EXIT		
C3		4481-MHCD-0003	CHAIN CONVEYOR BETWEEN SHOTBLASTING MACHINE AND OVEN		
R7		4481-MJRO-0003	ROLLER CONVEYOR AT BAR FURNACE ENTRANCE		
R6		4481-MJRO-0004	ROLLER CONVEYOR AT BAR FURNACE EXIT		
C1		4481-MHCD-0001	CHAIN CONVEYOR OF BLOCK OVEN		
R1		4481-MJRO-0005	ROLLER CONVEYOR AT BLOCK OVEN EXIT		
R2		4481-MJRO-0007	ROLLER CONVEYOR FOR BLOCK AND BAR ASSEMBLY		



NOTE: 1-MOTOR CONTROL CENTER 4480-ECM1-0001 TO BE CONNECTED TO EARTH BAR WITH 120 SD MM CABLE
SCR PANELS 4480-EVR3-0001 AND 4480-EVR3-0002 TO BE CONNECTED TO EARTH BAR WITH 150 SQ MM CABLES.
PLC PANEL 4481-CP-1000 TO BE CONNECTED TO EARTH BAR WITH 35 SQ MM CABLES.
2-CONTROL PANELS 4481-MHCD-0003-CP-01, 4481-MQLK-0001-CP-01, 4481-CP-1001, 4481-MPF0-0001-CP-01, 4481-MBAD-0001-CP-01, 4481-MEVD-0001-CP-01, 4481-MEVD-0002-CP-01 AND 4481-MEHX-0001-CP-01, LOCAL CONTROL STATIONS AND JUNCTION BOX TO BE CONNECTED TO EARTH BAR WITH 16 SQ MM CABLES.
3-THE OTHERS JUNCTION BOXES (HEATING ELEMENTS) , TO BE CONNECTED TO EARTH BAR WITH 35 SQ MM CABLES.
4-ALL LOCAL DISCONNECT SWITCHES MUST BE CONNECTED TO EARTH BAR WITH 35 SQ MM CABLES.
5-ALL MOTORS MUST BE CONNECTED TO EARTH BAR WITH 35 SQ MM CABLES.
6-FOR EQUIPEMENT EARTHING REFER TO DRAWINGS 25457-40AZ-EG-4481-0001-000 AND 25457-40AZ-EG-4481-0002-000.

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
		3		UPDATE	SE/21/11	F.P.	E.B.	M.B.
		2		UPDATE	AU/17/11	F.P.	E.B.	M.B.
		1		UPDATE	30/05/11	F.P.	E.B.	M.B.
REFERENCES		REVISIONS						

NOTES

STATUS: FOR DESIGN

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SELLER DRAWING No. 1347-52500 | REV. 3

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BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
EARTHING LAYOUT DRAWING
GENERAL ASSEMBLY

MA'ADEN

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
	—	—	—	A3-		-AZ	

9.8 Electrical Schematics

DRAWING No.	DESCRIPTION
1347-55000	Electrical Schematic Sheets
1347-55500	MCC Panel 4480-ECM1-0001 Main Incomer Wiring
1347-55501	MCC Panel 4480-ECM1-0001 230 Vac Distribution
1347-55502	MCC Panel 4480-ECM1-0001 24 Vdc Supply
1347-55510	Motor 4481-MHCD-0002-M1-Electrical Schematic Diagram
1347-55520	Motor 4481-MJR0-0001-M1-Electrical Schematic Diagram
1347-55530	Motor 4481-MZBP-0001-M1-Electrical Schematic Diagram
1347-55531	Motor 4481-MZBP-0001-M7-Electrical Schematic Diagram
1347-55532	Motor 4481-MZBP-0001-M3-Electrical Schematic Diagram
1347-55533	Motor 4481-MZBP-0001-M5-Electrical Schematic Diagram
1347-55534	Motor 4481-MZBP-0001-M2-Electrical Schematic Diagram
1347-55535	Motor 4481-MZBP-0001-M4-Electrical Schematic Diagram
1347-55536	Motor 4481-MZBP-0001-M6-Electrical Schematic Diagram
1347-55537	Motor 4481-MAC0-0001-M1-Electrical Schematic Diagram
1347-55540	Motor 4481-MJR0-0002-M1-Electrical Schematic Diagram
1347-55550	Motor 4481-MHCD-0003-M1-Electrical Schematic Diagram
1347-55560	Motor 4481-MJR0-0003-M1-Electrical Schematic Diagram
1347-55570	Motor 4481-MBMB-0001-M1-Electrical Schematic Diagram
1347-55571	Motor 4481-MBMB-0001-M2-Electrical Schematic Diagram
1347-55572	Motor 4481-MBMB-0001-M1-Electrical Schematic Diagram
1347-55573	Motor 4481-MBMB-0003-M1-Electrical Schematic Diagram
1347-55580	Motor 4481-MJR0-0004-M1-Electrical Schematic Diagram
1347-55590	Motor 4481-MQLK-0001-M1-M2 -Electrical Schematic Diagram
1347-55600	Motor 4481-MHCD-0001-M1-Electrical Schematic Diagram
1347-55610	Motor 4481-MEEP-0001-M1 - Electrical Schematic Diagram
1347-55611	Motor 4481-MEEP-0001-M2-Electrical Schematic Diagram
1347-55612	Motor 4481-Meep-0001-M3 - Electrical Schematic Diagram
1347-55620	Motor 4481-MJR0-0005-M1 Electrical Schematic Diagram
1347-55630	Motor 4481-MJR0-0007-M1 Electrical Schematic Diagram
1347-55640	Motor 4481-MZAC-0001-M1 Electrical Schematic Diagram
1347-55650	Motor 4481-MZAC-0002-M1 Electrical Schematic Diagram
1347-55660	Motor 4481-MJR0-0006-M1 Electrical Schematic Diagram
1347-55670	Motor 4481-MJR0-0008-M1 Electrical Schematic Diagram
1347-55680	Motor 4481-MHCD-0004-M1 Electrical Schematic Diagram
1347-55690	Motor 4481-MPF0-0001-M1 Electrical Schematic Diagram

DRAWING No.	DESCRIPTION
1347-55691	Motor 4481-MPF0-0001-M2 Electrical Schematic Diagram
1347-55700	Motor 4481-MEHX-0001-M1-M2-M3-M4 Electrical Schematic Diagram
1347-55710	Motor 4481-MBAD-0001-M1 Electrical Schematic Diagram
1347-55720	Motor 4481-MEVD-0001-M1 Electrical Schematic Diagram
1347-55730	Motor 4481-MEVD-0002-M1 Electrical Schematic Diagram
1347-55740	Motor 481-MBAD-0002-M1 - Electrical Schematic Diagram

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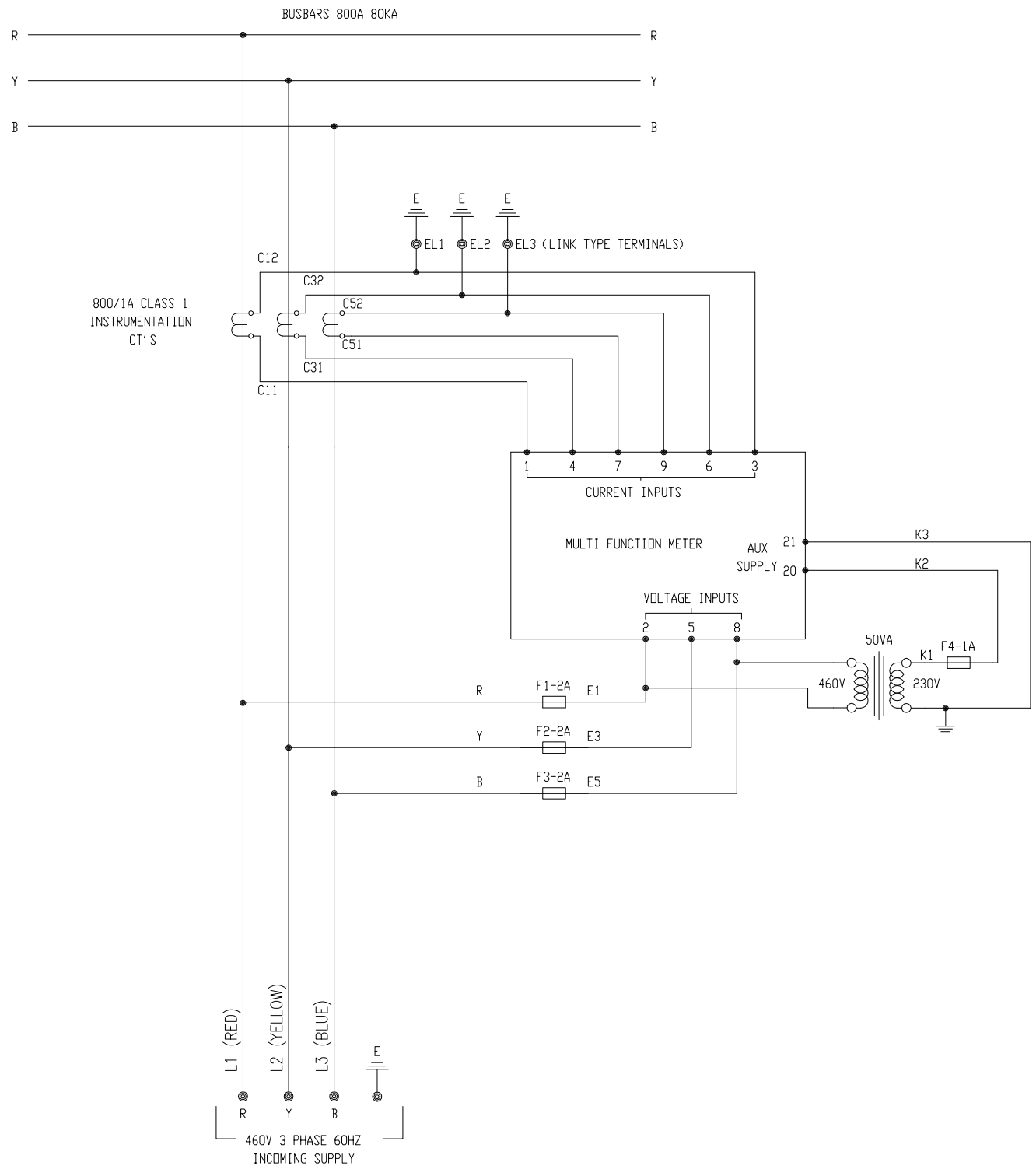

CLIENT GNA ALUTECH
PROJECT AZ ZABIRAH SMELTER PROJECT
CATHODE SEALING EQUIPMENT MCC

DRAWN BY	CHECKED	APPROVED
RC	GH	
DATE	DATE	DATE
25/02/11	25/02/11	

NCE Switchgear
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tel:0141 945 4646
fax:0141 945 6710
e-mail:contracts@nce-uk.com
website:www.nce-swgr.com

TITLE	SCALE	DRAWING No	REV No
MAIN INCOMER WIRING	NTS	D6608-2	1

STANDARDS AND APPROVALS — ASTA CERTIFICATION; BSEN ISO 9001 CERTIFICATE FM45190; IEC 439-1 BSEN 60439-1

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		2		UPDATE	25/11/10	F.P.	T.Pa.	E.B.
		1		UPDATE	04/11/10	F.P.	T.Pa.	E.B.
REFERENCES		REVISIONS						

NOTES

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DATE:	

Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie, Engineering Department, 9495 Trans-Canada, Saint-Laurent, Québec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR CONTROL CENTER PANEL 4480-ECM1-0001
MAIN INCOMER WIRING

MA'ADEN

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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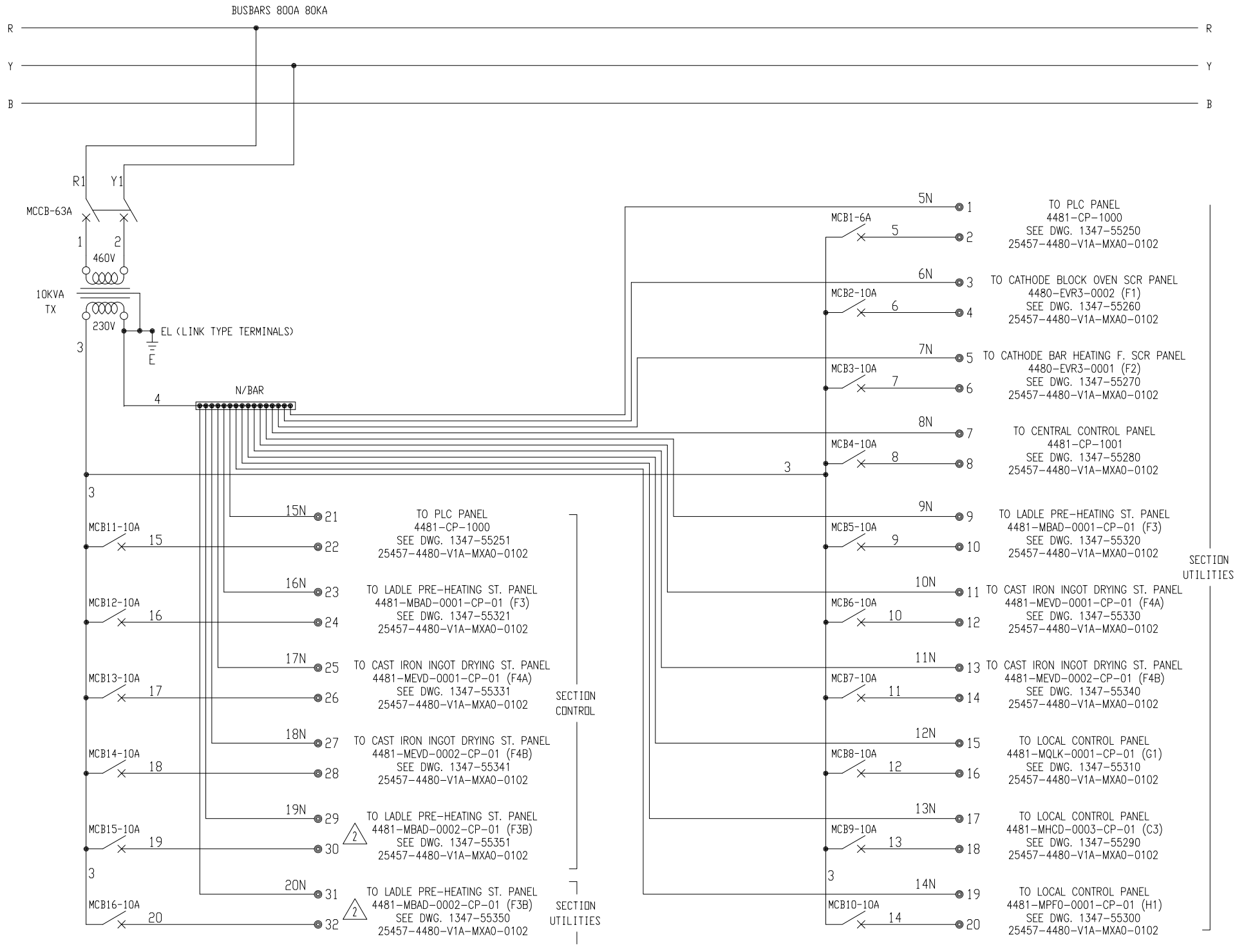
Discipline :

Document No : 25457-4480-V1A-MXA0-0254 | Rev. : 002



		2		UPDATE	AU-18-11	F.P.	E.B.	C.C.
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DATE:			

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BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-	00AZ-	xx -	xxxx -	xxxx -	xxx — xxx

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—		—	—	A3—		—AZ	

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MCC PANEL 4480-ECM1-0001
230 Vac DISTRIBUTION

CLIENT GNA ALUTECH
PROJECT AZ ZABIRAH SMELTER PROJECT
CATHODE SEALING EQUIPMENT MCC

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DATE	DATE	DATE
25/02/11	25/02/11	

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website: www.nce-swgr.com

TITLE	SCALE	DRAWING No	REV No
230V AC DISTRIBUTION	NTS	D6608-3	1

STANDARDS AND APPROVALS — ASTA CERTIFICATION — BSEN ISO 9001 CERTIFICATE FM53190 — IEC 439-1 BSEN 60439-1

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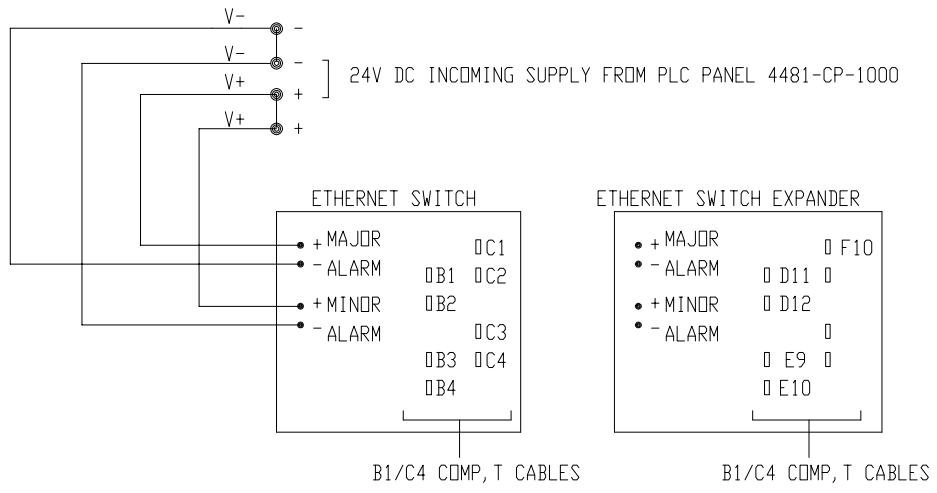
Discipline :

Document No : 25457-4480-V1A-MXA0-0253 | Rev. : 001



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PROJECT AZ ZABIRAH SMELTER PROJECT
CATHODE SEALING EQUIPMENT MCC

DRAWN BY	CHECKED	APPROVED
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DATE	DATE	DATE
25/02/11	25/02/11	

NCE Switchgear
117 Ruchill Street
Glasgow G20 9QN
tel:0141 945 4646
fax:0141 945 6700
e-mail: contracts@nce-uk.com
website: www.nce-swgr.com

TITLE	SCALE	DRAWING No	REV No
24V DC SUPPLY	NTS	D6608-4	2

STANDARDS AND APPROVALS — ASTA CERTIFICATION; BSEN ISO 9001 CERTIFICATE FM53190; IEC 439-1 BSEN 60439-1

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REFERENCES — REVISIONS

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DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie / Engineering Department, 1010 Sherbrooke West, Suite 1610, Montréal, Québec, H3A 2R7, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MCC PANEL 4480-ECM1-0001
24 Vdc SUPPLY

MA'ADEN

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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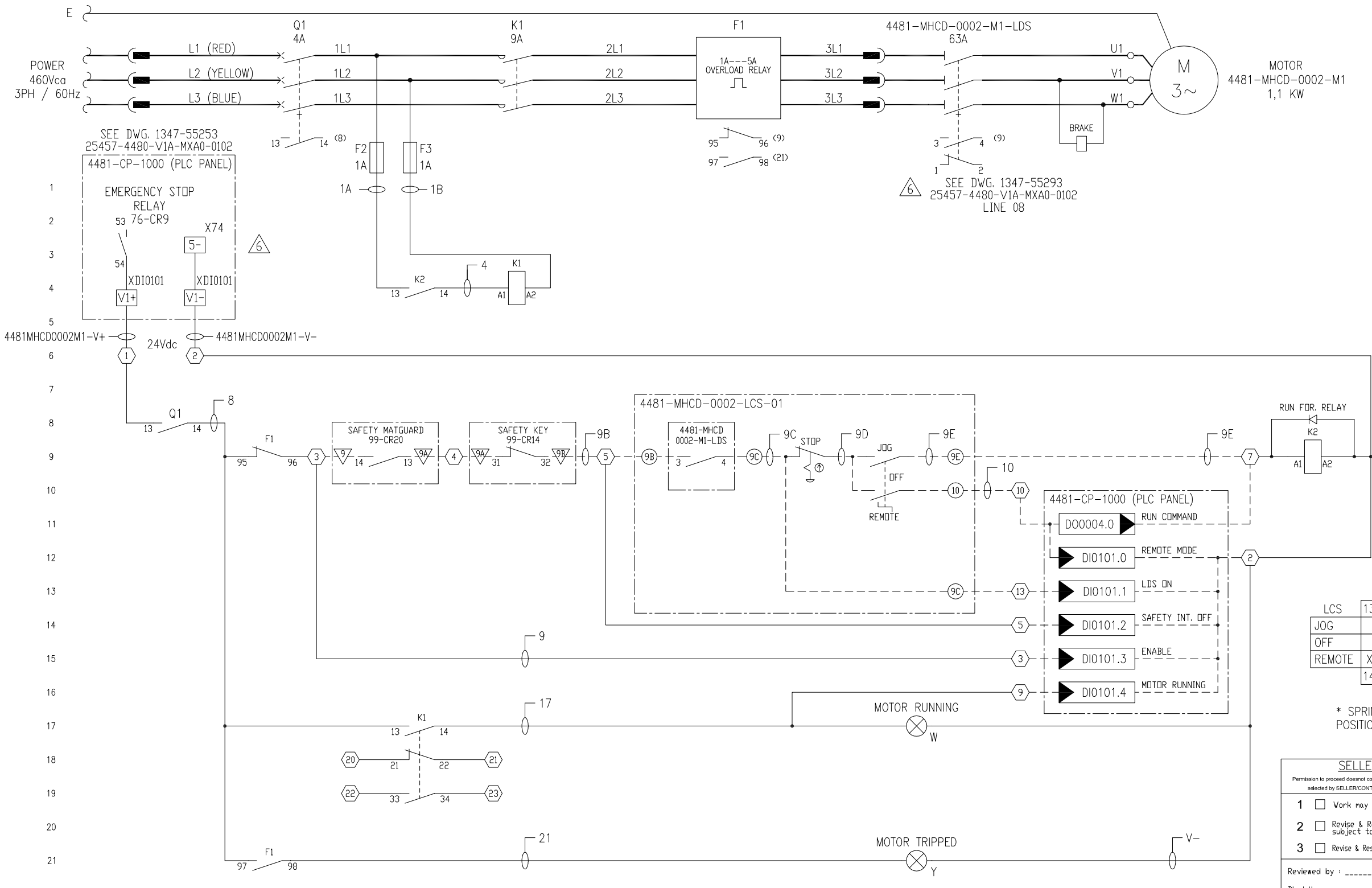
C2 CONVEYOR UPSTREAM OF SHOTBLASTING MACHINE STARTER 4481-MHCD-0002-M1-ST

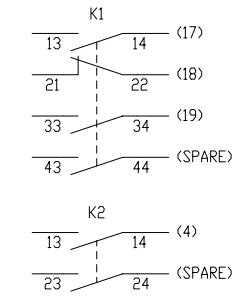


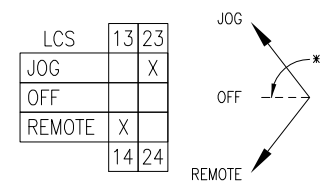
LEGEND:

LDS	LOCAL DISCONNECT SWITCH
LCS	LOCAL CONTROL STATION
———	MCC WIRING
- - - -	WIRING EXTERNAL TO MCC

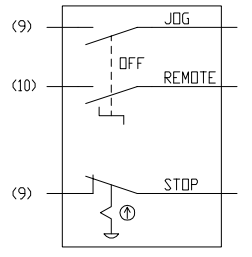
TERMINALS:

- (X) MCC STARTER
- ▽ SAFETY RELAY PANEL OR E-STOP
- (X) LOCAL CONTROL STATION
- [X] MOTOR





* SPRING RETURN TO OFF POSITION WHEN RELEASED.



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Discipline :

Document No : 25457-4480-V1A-MXA0-0067 | Rev. :

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SELLER DRAWING No. 1347-55510 | REV. 6

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		6		ADD EMERGENCY STOP CONTACT	AL-12-11	F.P.	E.B.	C.C.
		5		CHANGE SAFETY CONTACT	FE-01-11	F.P.	E.B.	C.C.
		4		ADD FUSE & CHANGE SEC. CONTACT OF LDS FROM NO INTO NC	DE-02-10	F.P.	E.B.	C.C.
		3		ADD NORMAL CLOSED CONTACT	NO-25-10	T.Pa.	E.B.	C.C.
		2		UPDATE	NO-10-10	E.B.	T.Pa.	C.C.
		1		UPDATE	OC-04-10	E.B.	T.Pa.	C.C.
		REVISIONS						

NOTES

STATUS: FOR DESIGN

DRAWN/DES'D: F.P. DATE: 26/07/2010	AREA ENG.: DATE:
CHECKED: E.B. DATE:	PRJ ENG MGR: DATE:
RESPONSIBLE ENG. M.B. DATE:	CLIENT: DATE:
ENG. GROUP SUP. DATE:	DRAWING SCALE: NONE

Vendor or Subcontractor Logo: GNA a|e|tech Inc. Département Ingénierie Engineering Department 9495 Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MHCD-0002-M1
ELECTRICAL SCHEMATIC DIAGRAM

MA'ADEN Wire

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
—	—	—		A3-		-AZ	

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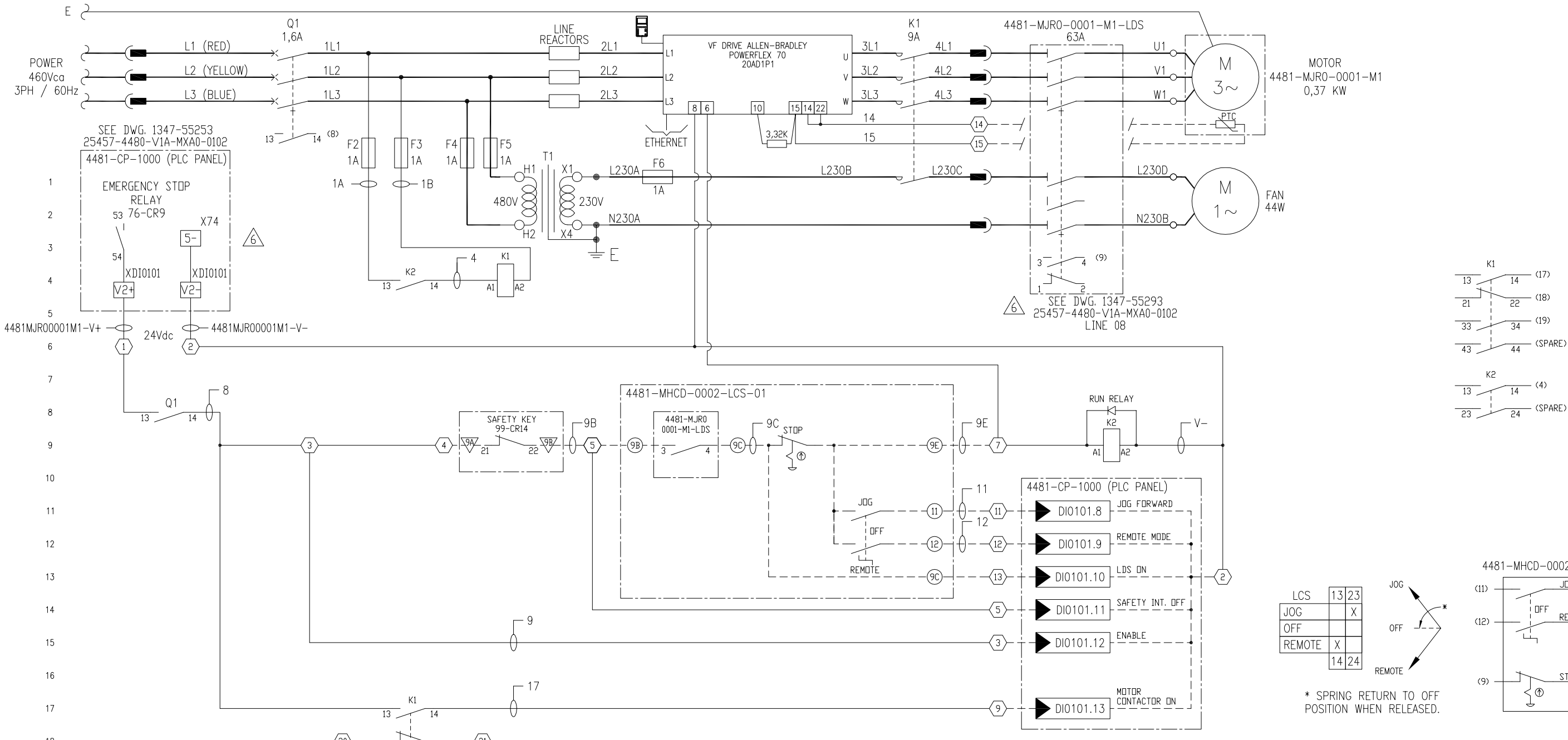
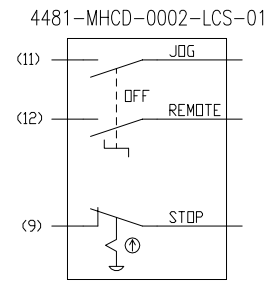
R9 ROLLER CONVEYOR AT SHOTBLASTING MACHINE ENTRANCE STARTER 4481-MJR0-0001-M1-ST



LCS	13	23
JOG		X
OFF		
REMOTE	X	
	14	24

* SPRING RETURN TO OFF POSITION WHEN RELEASED.



LEGEND:

LDS LOCAL DISCONNECT SWITCH
LCS LOCAL CONTROL STATION
——— MCC WIRING
– – – – WIRING EXTERNAL TO MCC

TERMINALS:

(X) MCC STARTER
▽ SAFETY RELAY PANEL OR E-STOP
(X) LOCAL CONTROL STATION
[X] MOTOR

SELLER/CONTRACTOR DOCUMENT REVIEW

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5 ☐ VOID / Superseded.

DDR Nbr :

Reviewed by : _____ Date : _____

Discipline :

Document No : 25457-4480-V1A-MXAO-0068 Rev. :

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No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
6		UPDATE	MA-11-2011	E.B.	T.Pa.	C.C.
5		CHANGE SAFETY CONTACT	FE-01-11	F.P.	E.B.	C.C.
4		ADD FUSE & CHANGE SEC. CONTACT OF LDS FROM NO INTO NC	DE-02-10	F.P.	E.B.	C.C.
3		ADD NORMAL CLOSED CONTACT	NO-25-10	T.Pa.	E.B.	C.C.
2		UPDATE	NO-10-10	E.B.	T.Pa.	C.C.
1		UPDATE	OC-04-10	E.B.	T.Pa.	C.C.

DRAWING NUMBER | TITLE | REFERENCES | REVISIONS

NOTES

STATUS: FOR DESIGN

DRAWN/DEST:	F.P.	AREA ENG.:	
DATE:	26/07/2010	DATE:	
CHECKED:	E.B.	PRJ ENG MGR:	
DATE:		DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA a|i|tech Inc. Département Ingénierie Engineering Department 9690 TransCanada Baie-Lavaltrie, Québec J4Z 1V3 Canada

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SELLER DRAWING No. 1347-55520 REV. 6

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MJR0-0001-M1
ELECTRICAL SCHEMATIC DIAGRAM

MA'ADEN Wa'ad al Zawr

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—	—	A3–		–AZ	

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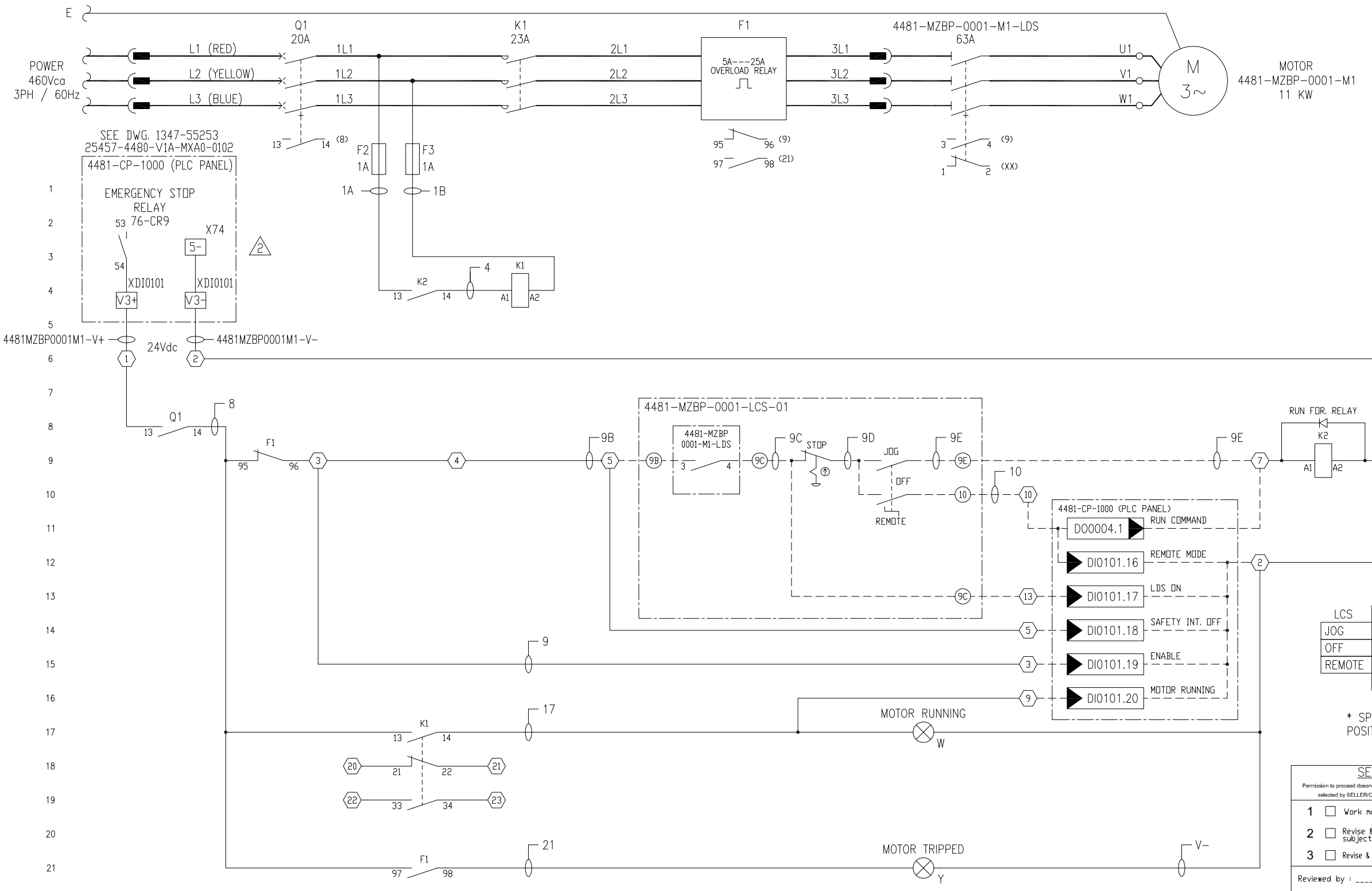
S1 CATHODE BAR SHOTBLASTING MACHINE BLAST WHELL No. 1 STARTER 4481-MZBP-0001-M1-ST

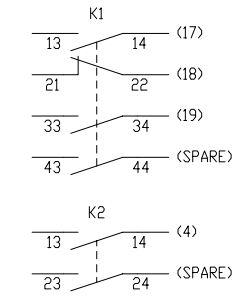


LEGEND:

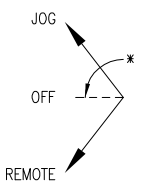
LDS	LOCAL DISCONNECT SWITCH
LCS	LOCAL CONTROL STATION
———	MCC WIRING
- - - -	WIRING EXTERNAL TO MCC

TERMINALS:

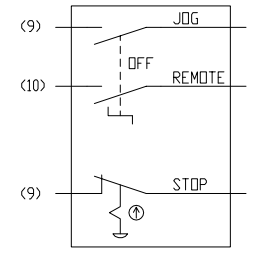
- (X) MCC STARTER
- ▽ SAFETY RELAY PANEL OR E-STOP
- (X) LOCAL CONTROL STATION
- [X] MOTOR



LCS	13	23
JOG		X
OFF		
REMOTE	X	
	14	24



* SPRING RETURN TO OFF POSITION WHEN RELEASED.



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Discipline :

Document No : 25457-4480-V1A-MXA0-0217 | Rev. :

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SELLER DRAWING No. 1347-55530 | REV. 2

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		2		UPDATE	MA-11-2011	F.P.	E.B.	C.C.
		1		ADD FUSE & CHANGE SEC. CONTACT OF LDS FROM NO INTO NC	DE-02-10	F.P.	E.B.	C.C.
		REVISIONS						

NOTES

STATUS: FOR DESIGN

DRAWN/DES'D: F.P. DATE: 10/11/2010	AREA ENG.: DATE:
CHECKED: E.B. DATE:	PRJ ENG MGR: DATE:
RESPONSIBLE ENG. M.B. DATE:	CLIENT: DATE:
ENG. GROUP SUP. DATE:	DRAWING SCALE: NONE

Vendor or Subcontractor Logo: GNA a.b.tech Inc. Département Ingénierie Engineering Department 9455 Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MZBP-0001-M1
ELECTRICAL SCHEMATIC DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
—	—	—		A3-		-AZ	

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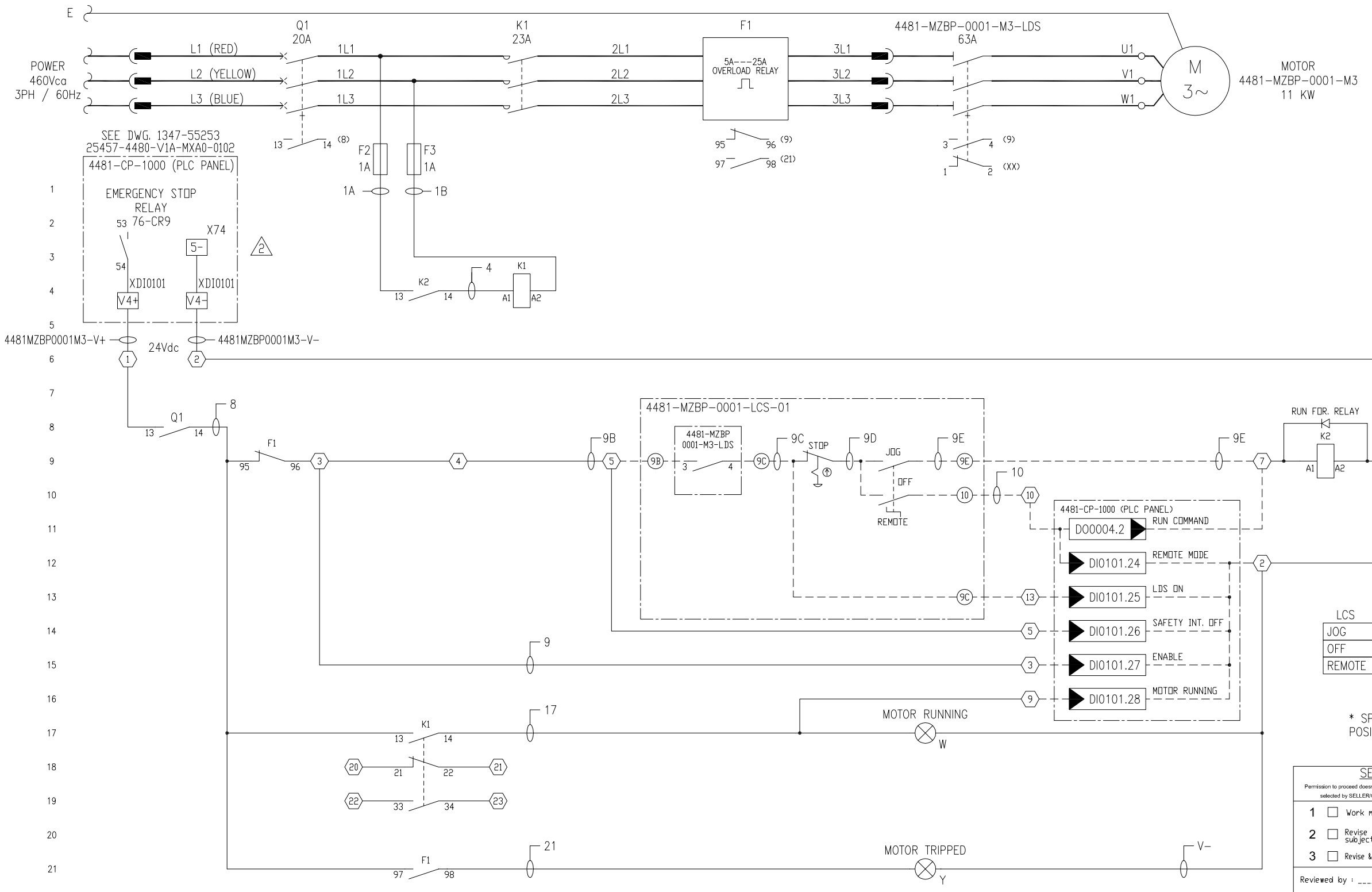
S1 CATHODE BAR SHOTBLASTING MACHINE BLAST WHELL No. 3 STARTER 4481-MZBP-0001-M3-ST

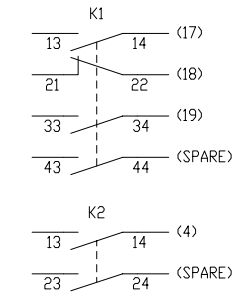


LEGEND:

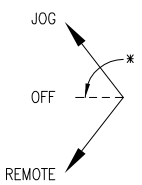
LDS	LOCAL DISCONNECT SWITCH
LCS	LOCAL CONTROL STATION
———	MCC WIRING
- - - -	WIRING EXTERNAL TO MCC

TERMINALS:

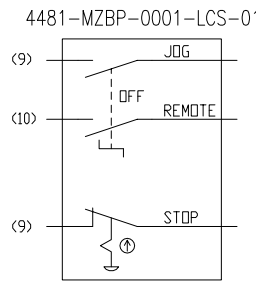
- (X) MCC STARTER
- ▽ SAFETY RELAY PANEL OR E-STOP
- (X) LOCAL CONTROL STATION
- [X] MOTOR



LCS	13	23
JOG		X
OFF		
REMOTE	X	
	14	24



* SPRING RETURN TO OFF POSITION WHEN RELEASED.



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Discipline :

Document No : 25457-4480-V1A-MXA0-0218 | Rev. :

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DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		REVISIONS						
		2		UPDATE	MA-11-11	E.B.	T.Po.	C.C.
		1		ADD FUSE & CHANGE SEC. CONTACT OF LDS FROM NO INTO NC	DE-02-10	F.P.	E.B.	C.C.

NOTES

STATUS: FOR DESIGN

DRAWN/DES'D: F.P.	AREA ENG.:
DATE: 10/11/2010	DATE:
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DATE:	DATE:
RESPONSIBLE ENG. M.B.	CLIENT:
DATE:	DATE:
ENG. GROUP SUP.	DRAWING SCALE: NONE
DATE:	

Vendor or Subcontractor Logo: GNA a.b.tech Inc. — Département Ingénierie Engineering Department 9455 Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada — BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

SELLER DRAWING No. 1347-55531 — REV. 2

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MZBP-0001-M3
ELECTRICAL SCHEMATIC DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—		—	—	A3-		-AZ	

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S1 CATHODE BAR SHOTBLASTING MACHINE SCREW STARTER 4481-MZBP-0001-M7-ST

POWER 460Vca 3PH / 60Hz
L1 (RED)
L2 (YELLOW)
L3 (BLUE)
Q1 6,3A
K1 12A
F1 1A---5A OVERLOAD RELAY
4481-MZBP-0001-M7-LDS 63A
MOTOR 4481-MZBP-0001-M7 2,2 KW
SEE DWG. 1347-55253 25457-4480-V1A-MXA0-0102
4481-CP-1000 (PLC PANEL)
EMERGENCY STOP RELAY 76-CR9
F2 1A
F3 1A
4481MZBP0001M7-V+
24Vdc
4481MZBP0001M7-V-
4481-MZBP-0001-LCS-01
RUN FOR. RELAY
STOP
JOG
OFF
REMOTE
DO0004.3 RUN COMMAND
DI0102.0 REMOTE MODE
DI0102.1 LDS ON
DI0102.2 SAFETY INT. OFF
DI0102.3 ENABLE
DI0102.4 MOTOR RUNNING
MOTOR RUNNING W
MOTOR TRIPPED Y

LEGEND:
LDS LOCAL DISCONNECT SWITCH
LCS LOCAL CONTROL STATION
MCC WIRING
WIRING EXTERNAL TO MCC

TERMINALS:
MCC STARTER
SAFETY RELAY PANEL OR E-STOP
LOCAL CONTROL STATION
MOTOR

K1: 13-14 (17); 21-22 (18); 33-34 (19); 43-44 (SPARE)
K2: 13-14 (4); 23-24 (SPARE)

LCS	13	23
JOG		X
OFF		
REMOTE	X	
	14	24

* SPRING RETURN TO OFF POSITION WHEN RELEASED.

4481-MZBP-0001-LCS-01: (9) JOG; (10) OFF; REMOTE; (9) STOP

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4 ☐ Revise not required. Work may proceed.
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SELLER DRAWING No. 1347-55532 REV. 2

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		2		UPDATE	MA-11-11	E.B.	T.Po.	C.C.
		1		ADD FUSE & CHANGE SEC. CONTACT OF LDS FROM NO INTO NC	DE-02-10	F.P.	E.B.	C.C.
		REVISIONS						

NOTES

STATUS: FOR DESIGN

DRAWN/DES'D: F.P. DATE: 10/11/2010	AREA ENG.: DATE:
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RESPONSIBLE ENG. M.B. DATE:	CLIENT: DATE:
ENG. GROUP SUP. DATE:	DRAWING SCALE: NONE

Vendor or Subcontractor Logo: GNA a|a tech Inc. Département Ingénierie Engineering Department 9455 Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MZBP-0001-M7
ELECTRICAL SCHEMATIC DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
—	—	—		A3-		-AZ	

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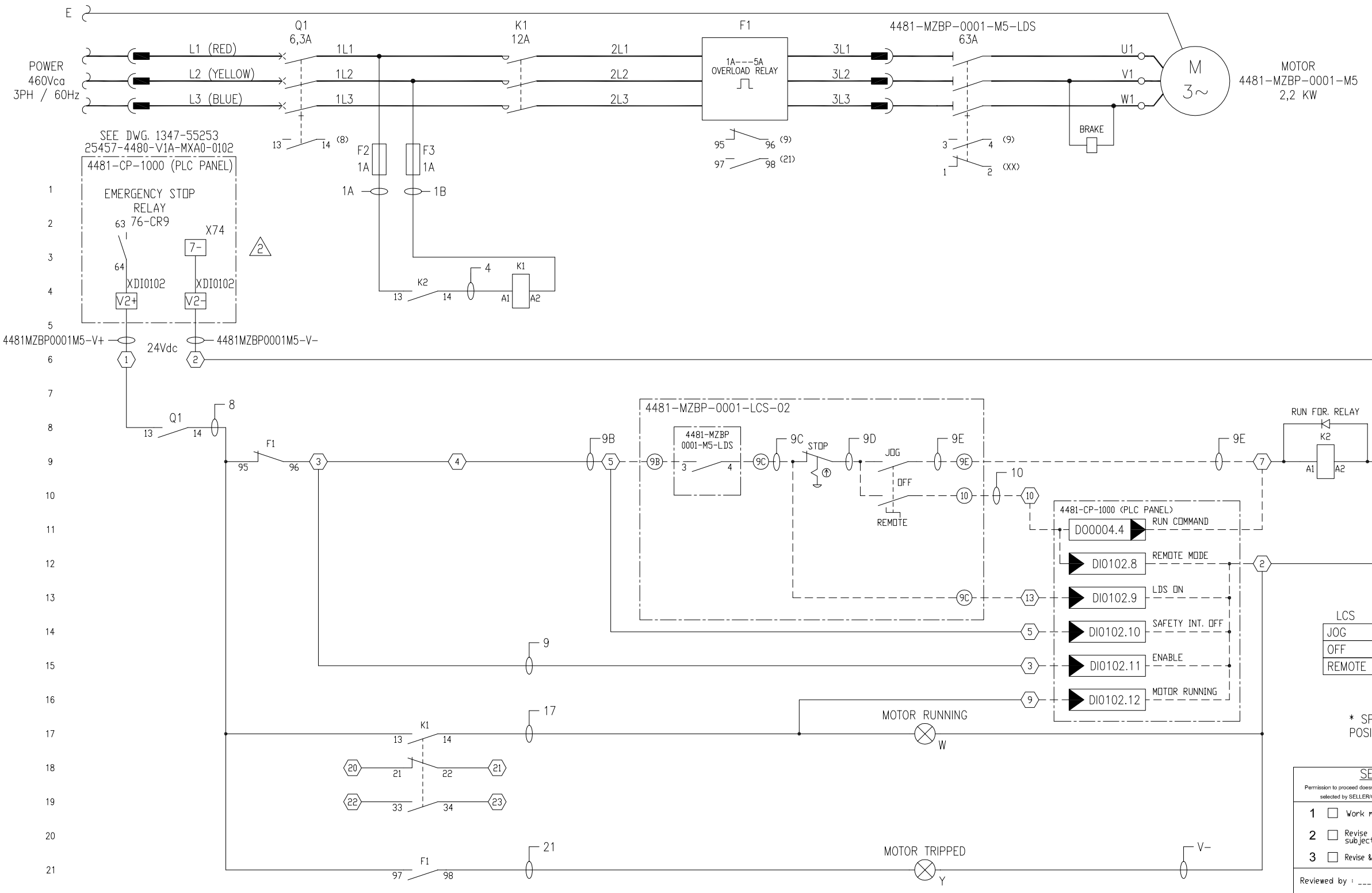
S1 CATHODE BAR SHOTBLASTING MACHINE ELEVATOR STARTER 4481-MZBP-0001-M5-ST

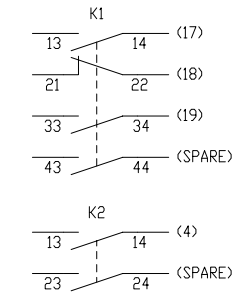


LEGEND:

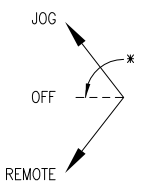
LDS	LOCAL DISCONNECT SWITCH
LCS	LOCAL CONTROL STATION
———	MCC WIRING
- - - -	WIRING EXTERNAL TO MCC

TERMINALS:

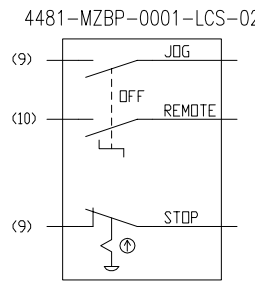
- (X) MCC STARTER
- ▽ SAFETY RELAY PANEL OR E-STOP
- (X) LOCAL CONTROL STATION
- [X] MOTOR



LCS	13	23
JOG		X
OFF		
REMOTE	X	
	14	24



* SPRING RETURN TO OFF POSITION WHEN RELEASED.



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Discipline :

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SELLER DRAWING No. 1347-55533 | REV. 2

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		2		UPDATE	MA-11-11	E.B.	T.Pa.	C.C.
		1		ADD FUSE & CHANGE SEC. CONTACT OF LDS FROM NO INTO NC	DE-02-10	F.P.	E.B.	C.C.
		REVISIONS						

NOTES

STATUS: FOR DESIGN

DRAWN/DES'D: F.P.	AREA ENG.:
DATE: 10/11/2010	DATE:
CHECKED: E.B.	PRJ ENG MGR:
DATE:	DATE:
RESPONSIBLE ENG. M.B.	CLIENT:
DATE:	DATE:
ENG. GROUP SUP.	DRAWING SCALE: NONE
DATE:	

Vendor or Subcontractor Logo: GNA a.b.tech Inc. — Département Ingénierie / Engineering Department, 9490 Trans-Canada, Saint-Laurent, Québec (H4S 1V3), Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MZBP-0001-M5
ELECTRICAL SCHEMATIC DIAGRAM

MA'ADEN

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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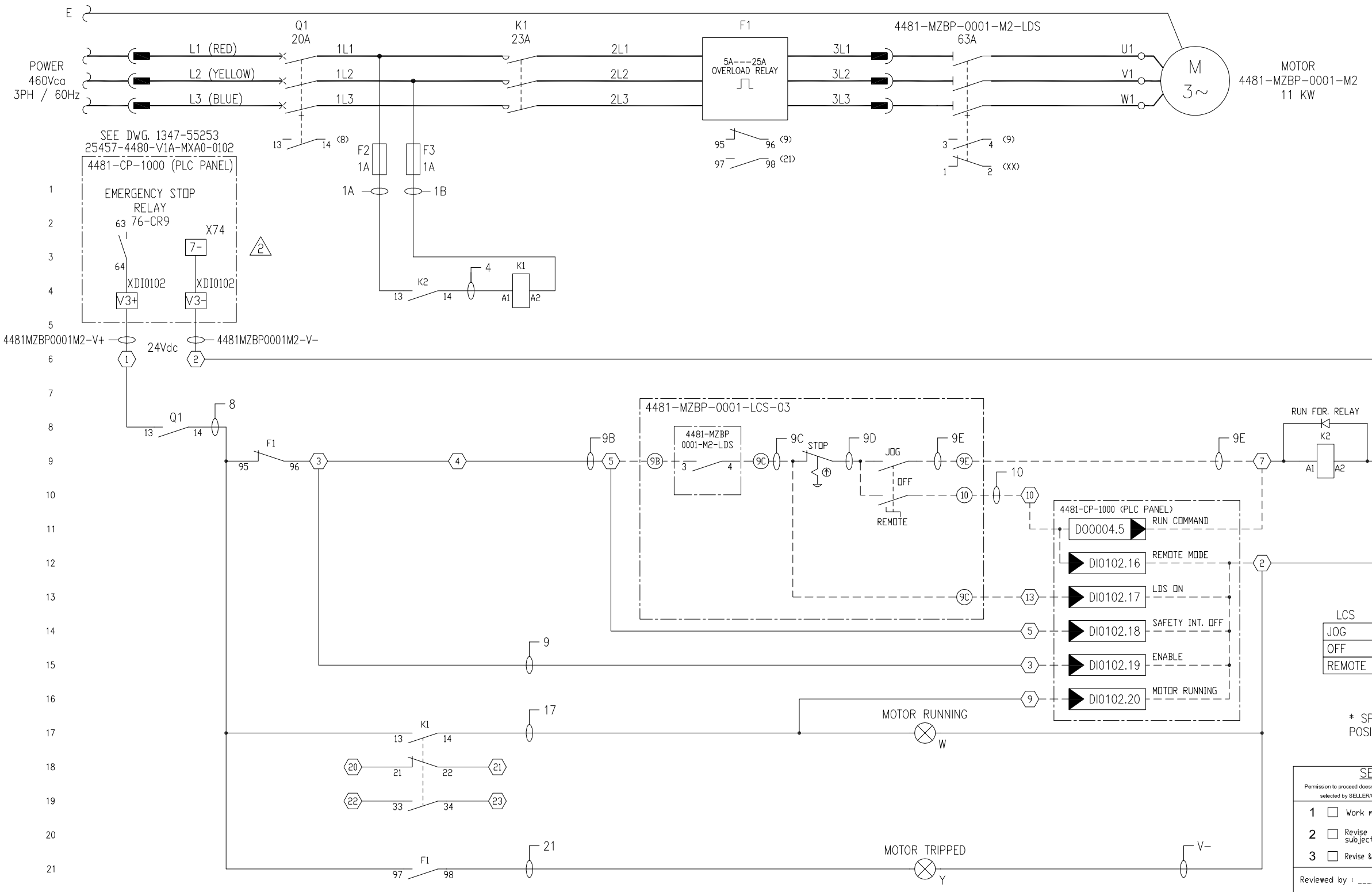
S1 CATHODE BAR SHOTBLASTING MACHINE BLAST WHEEL No. 2 STARTER 4481-MZBP-0001-M2-ST

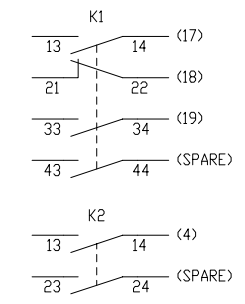


LEGEND:

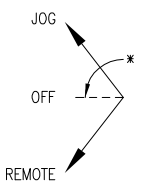
LDS	LOCAL DISCONNECT SWITCH
LCS	LOCAL CONTROL STATION
———	MCC WIRING
- - - -	WIRING EXTERNAL TO MCC

TERMINALS:

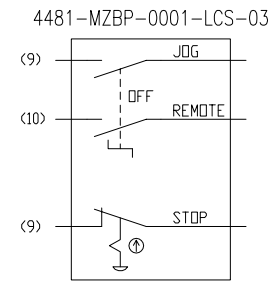
- (X) MCC STARTER
- ▽ SAFETY RELAY PANEL OR E-STOP
- (X) LOCAL CONTROL STATION
- [X] MOTOR



LCS	13	23
JOG		X
OFF		
REMOTE	X	
	14	24



* SPRING RETURN TO OFF POSITION WHEN RELEASED.



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Reviewed by : _____ Date : _____

Discipline :

Document No : 25457-4480-V1A-MXA0-0221 | Rev. :

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REFERENCES		2		UPDATE	MA-11-11	E.B.	T.Po.	C.C.
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		REVISIONS						

NOTES

STATUS: FOR DESIGN

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CHECKED: E.B. DATE:	PRJ ENG MGR: DATE:
RESPONSIBLE ENG. M.B. DATE:	CLIENT: DATE:
ENG. GROUP SUP. DATE:	DRAWING SCALE: NONE

Vendor or Subcontractor Logo: GNA a.b.tech Inc. Département Ingénierie Engineering Department 9455 Trans-Canada Saint-Laurent, Quebec H4S 1V3 Canada

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No | SUBD. | DISC. | SECTOR | SEQUENCE | REV.
25457-00AZ- xx - xxxx - xxxx - xxx - xxx

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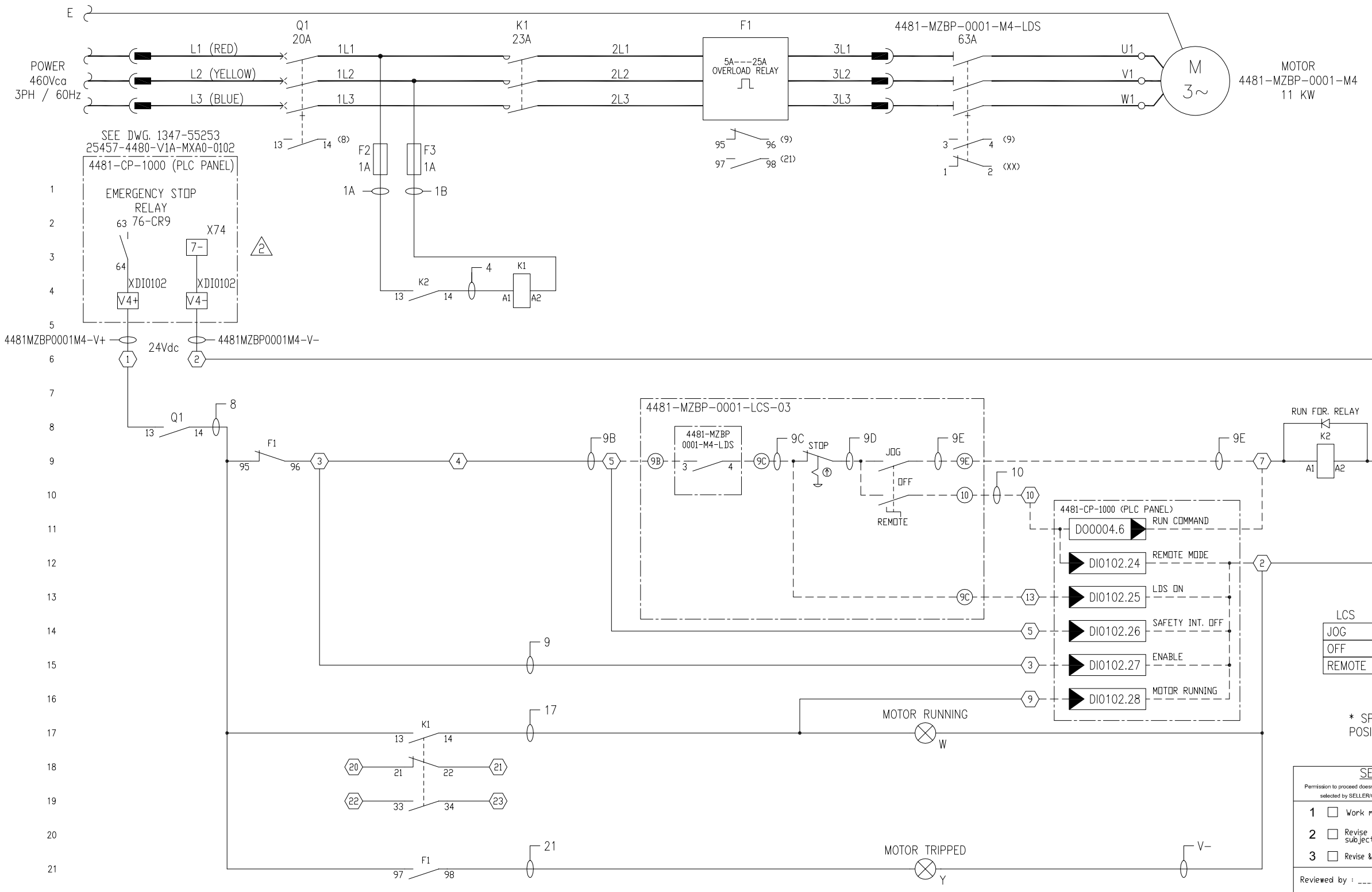
SELLER DRAWING No. 1347-55534 | REV. 2

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MZBP-0001-M2
ELECTRICAL SCHEMATIC DIAGRAM

MA'ADEN

Type | Building | Discipline | Phase | Format | Sequentiel | Location | Rev. No.
— | — | — | | A3- | | -AZ |

S1 CATHODE BAR SHOTBLASTING MACHINE BLAST WHEEL No. 4 STARTER 4481-MZBP-0001-M4-ST

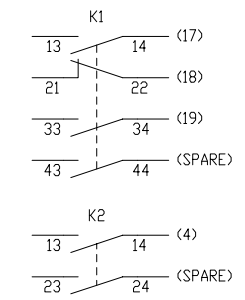


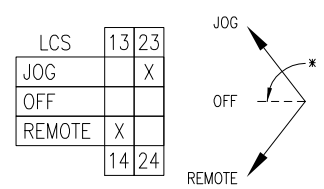
LEGEND:

LDS LOCAL DISCONNECT SWITCH
LCS LOCAL CONTROL STATION
MCC WIRING
WIRING EXTERNAL TO MCC

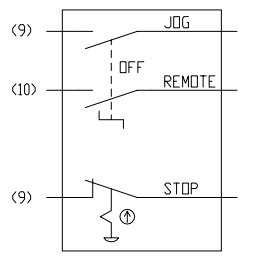
TERMINALS:

(X) MCC STARTER
▽ SAFETY RELAY PANEL OR E-STOP
(X) LOCAL CONTROL STATION
[X] MOTOR





* SPRING RETURN TO OFF POSITION WHEN RELEASED.



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Document No : 25457-4480-V1A-MXAO-0222 Rev. :

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		REVISIONS						

NOTES

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RESPONSIBLE ENG. M.B. DATE:	CLIENT: DATE:
ENG. GROUP SUP. DATE:	DRAWING SCALE: NONE

Vendor or Subcontractor Logo: GNA a.b.tech Inc. Département Ingénierie Engineering Department 9455 Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No | SUBD. | DISC. | SECTOR | SEQUENCE | REV.
25457-00AZ- xx - xxxx - xxxx - xxx - xxx

SELLER DRAWING No. 1347-55535 REV. 2

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MZBP-0001-M4
ELECTRICAL SCHEMATIC DIAGRAM

MA'ADEN

Type | Building | Discipline | Phase | Format | Sequentiel | Location | Rev. No.
— | — | — | A3- | -AZ

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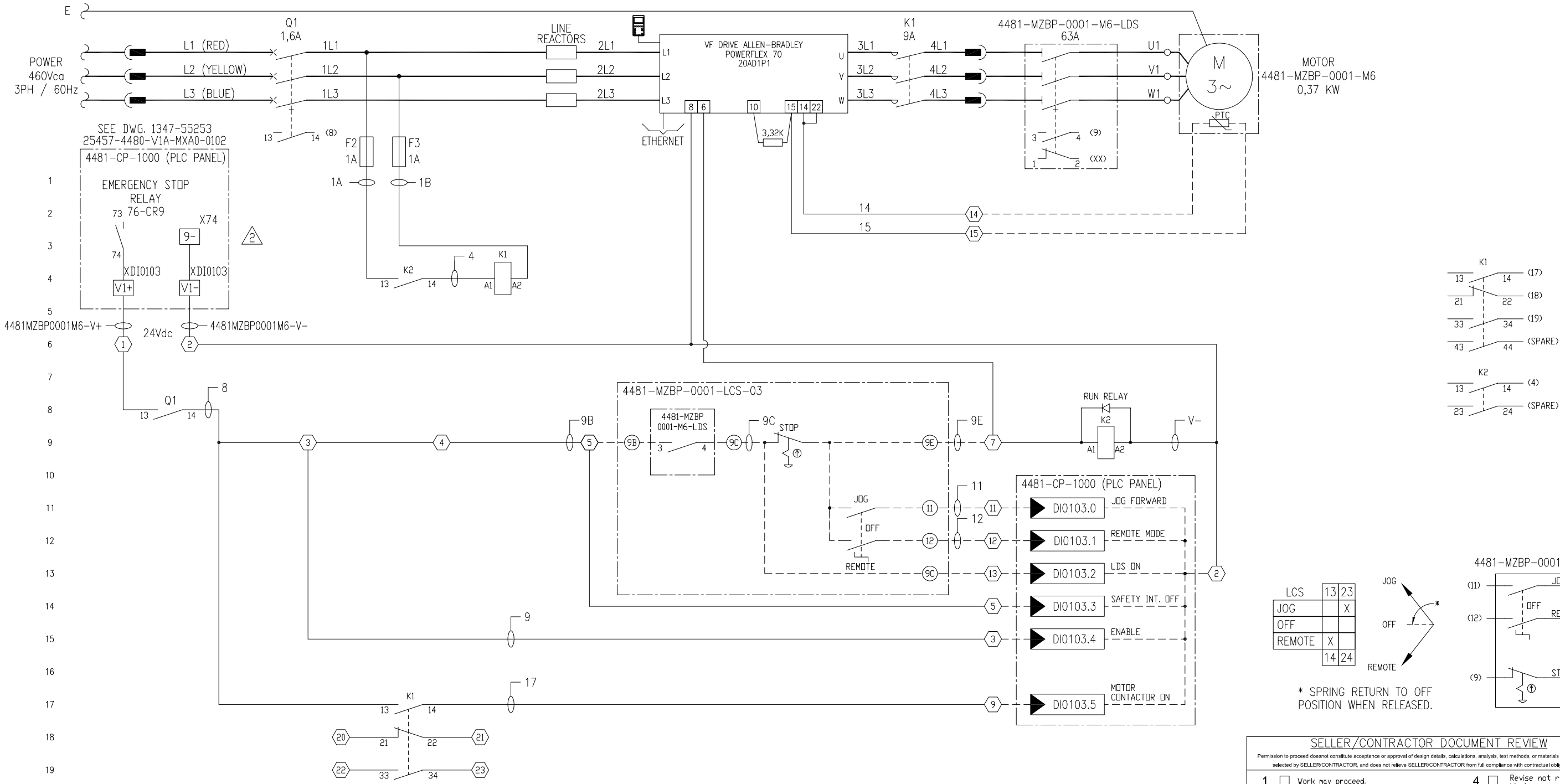
S1 CATHODE BAR SHOTBLASTING MACHINE WORK CONVEYOR STARTER 4481-MZBP-0001-M6-ST



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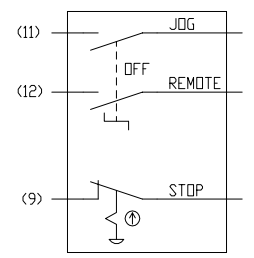
JOG		X
OFF		
REMOTE	X	
	14	24

* SPRING RETURN TO OFF POSITION WHEN RELEASED.



LEGEND:

LDS LOCAL DISCONNECT SWITCH
LCS LOCAL CONTROL STATION
MCC WIRING
WIRING EXTERNAL TO MCC

TERMINALS:

(X) MCC STARTER
SAFETY RELAY PANEL OR E-STOP
(X) LOCAL CONTROL STATION
[X] MOTOR

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		1		ADD FUSE & CHANGE SEC. CONTACT OF LDS FROM NO INTO NC	DE-02-10	F.P.	E.B.	C.C.

REFERENCES — REVISIONS — NOTES

STATUS: FOR DESIGN

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DATE:	10/11/2010	DATE:	
CHECKED:	E.B.	PRJ ENG MGR:	
DATE:		DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA Altech Inc. — Département Ingénierie / Engineering Department, 9600 Transcanada, Pointe-aux-Trembles, Québec, H1E 2B2, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No 25457 | SUBD. 00AZ | DISC. xx | SECTOR xxxx | SEQUENCE xxxx-xxx | REV. xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MZBP-0001-M6
ELECTRICAL SCHEMATIC DIAGRAM

MA'ADEN معادن

Type — | Building — | Discipline — | Phase — | Format A3– | Sequential –AZ | Location | Rev. No.

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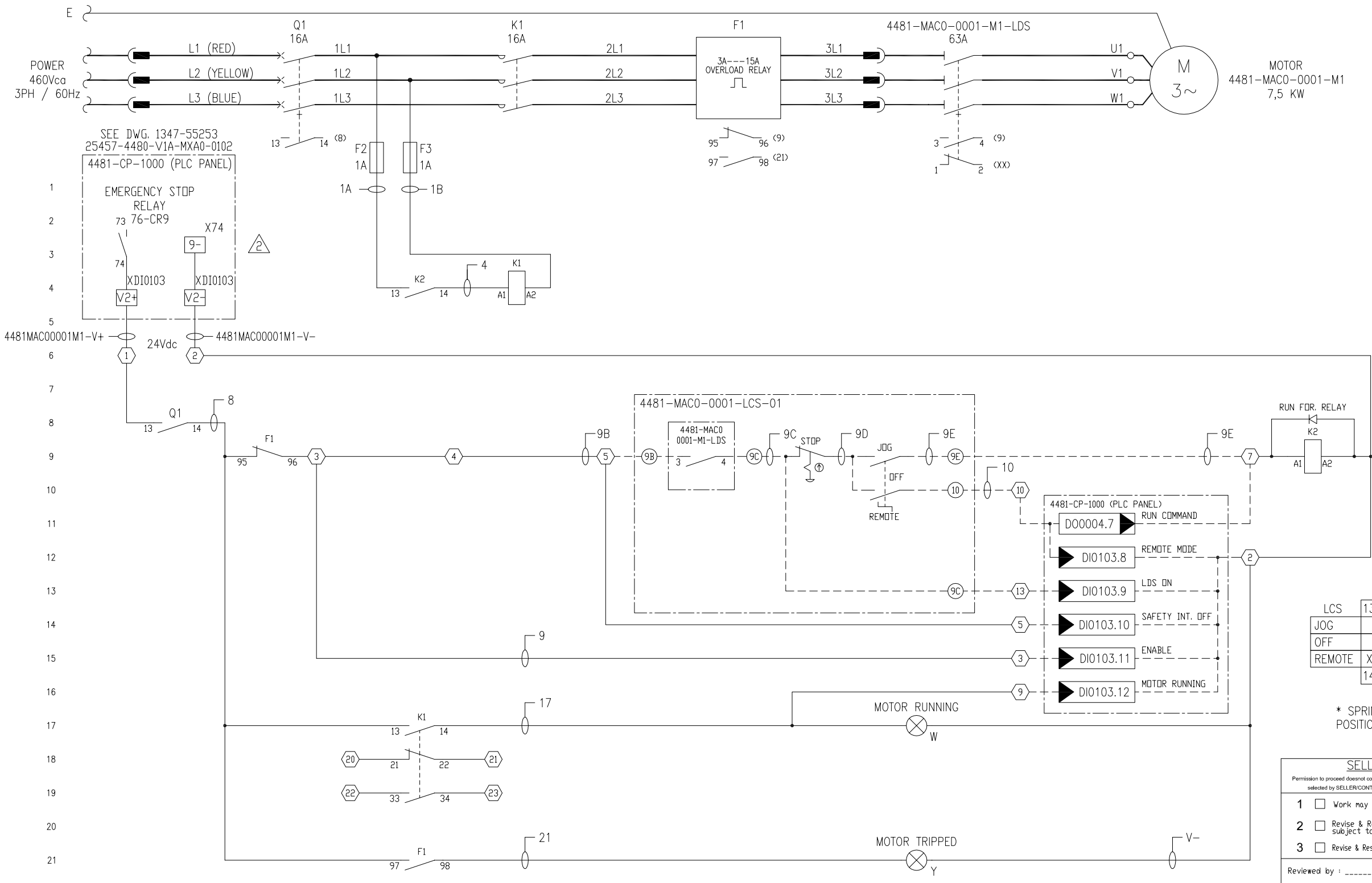
D1 DUST COLLECTOR FOR SHOTBLASTING MACHINE FAN STARTER 4481-MAC0-0001-M1-ST

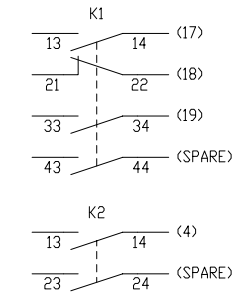


LEGEND:

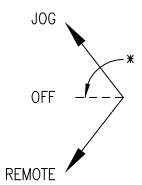
LDS	LOCAL DISCONNECT SWITCH
LCS	LOCAL CONTROL STATION
———	MCC WIRING
- - - -	WIRING EXTERNAL TO MCC

TERMINALS:

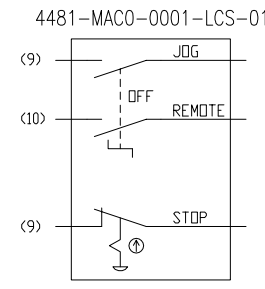
- (X) MCC STARTER
- ▽ SAFETY RELAY PANEL OR E-STOP
- (X) LOCAL CONTROL STATION
- [X] MOTOR



LCS	13	23
JOG		X
OFF		
REMOTE	X	
	14	24



* SPRING RETURN TO OFF POSITION WHEN RELEASED.



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		REVISIONS						

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ENG. GROUP SUP. DATE:	DRAWING SCALE: NONE

Vendor or Subcontractor Logo: GNA a.b.tech Inc. — Département Ingénierie Engineering Department 9455 Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MAC0-0001-M1
ELECTRICAL SCHEMATIC DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
—	—	—		A3-		-AZ	

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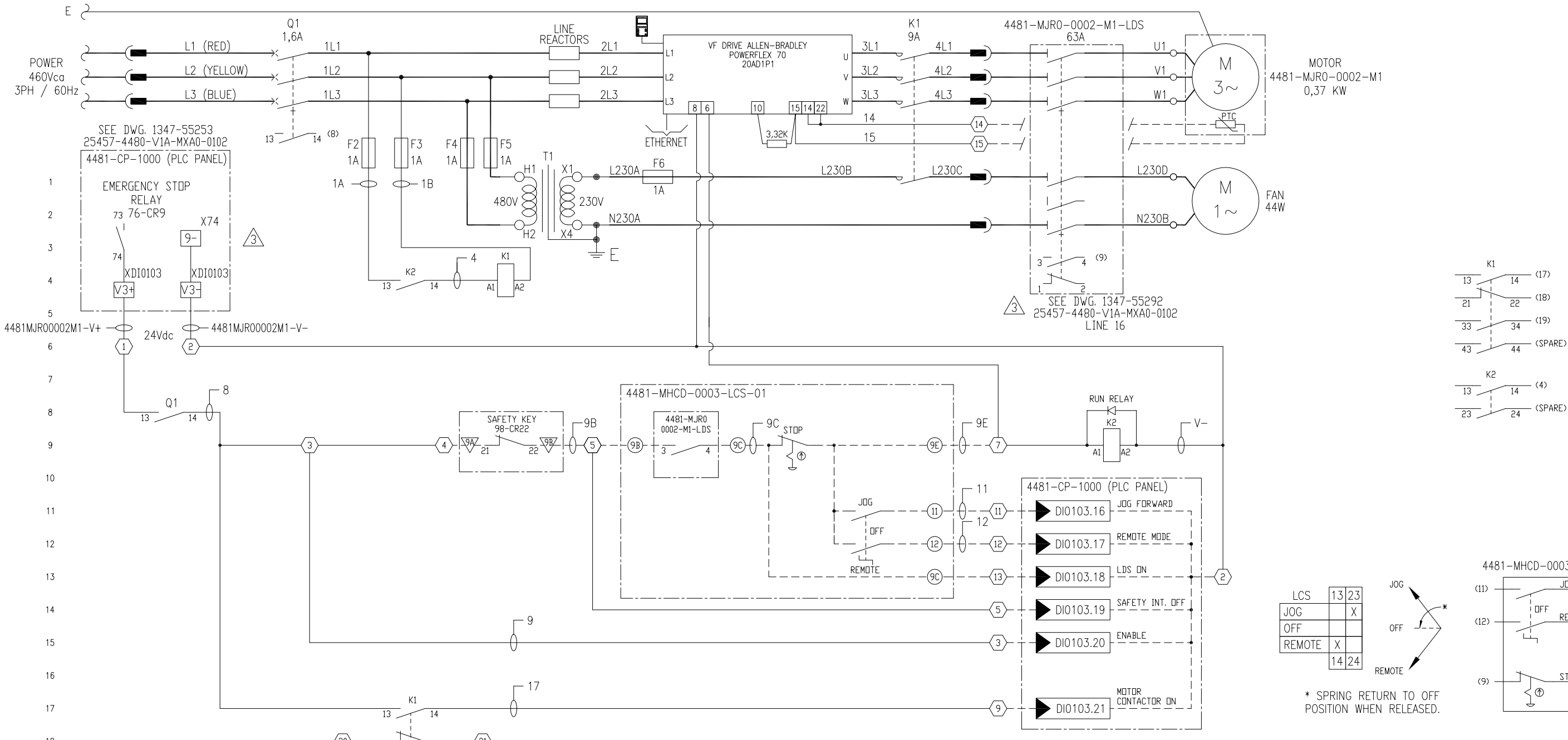
R8 ROLLER CONVEYOR AT SHOTBLASTING MACHINE EXIT STARTER 4481-MJR0-0002-M1-ST



LCS	13	23
JOG		X
OFF		
REMOTE	X	
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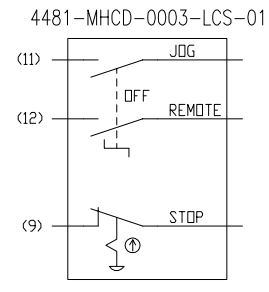
* SPRING RETURN TO OFF POSITION WHEN RELEASED.



LEGEND:

- LDS LOCAL DISCONNECT SWITCH
- LCS LOCAL CONTROL STATION
- MCC WIRING
- WIRING EXTERNAL TO MCC

TERMINALS:

- (X) MCC STARTER
- ▽ SAFETY RELAY PANEL OR E-STOP
- (X) LOCAL CONTROL STATION
- [X] MOTOR

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DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		3		UPDATE	MA-11-11	E.B.	T.Pa.	C.C.
		2		CHANGE SAFETY CONTACT	FE-01-11	F.P.	E.B.	C.C.
		1		ADD FUSE & CHANGE SEC. CONTACT OF LDS FROM NO INTO NC	DE-02-10	F.P.	E.B.	C.C.
		REVISIONS						

NOTES

STATUS: FOR DESIGN

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DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA a|i|tech Inc. Département Ingénierie Engineering Department 9690 Trans-Canada Saint-Laurent, Quebec H4S 1V3 Canada

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SELLER DRAWING No. 1347-55540 REV. 3

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MJR0-0002-M1
ELECTRICAL SCHEMATIC DIAGRAM

MA'ADEN Ma'aden Wa'ad Al Shamal Phosphate Company

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—	—	A3—	—	AZ	

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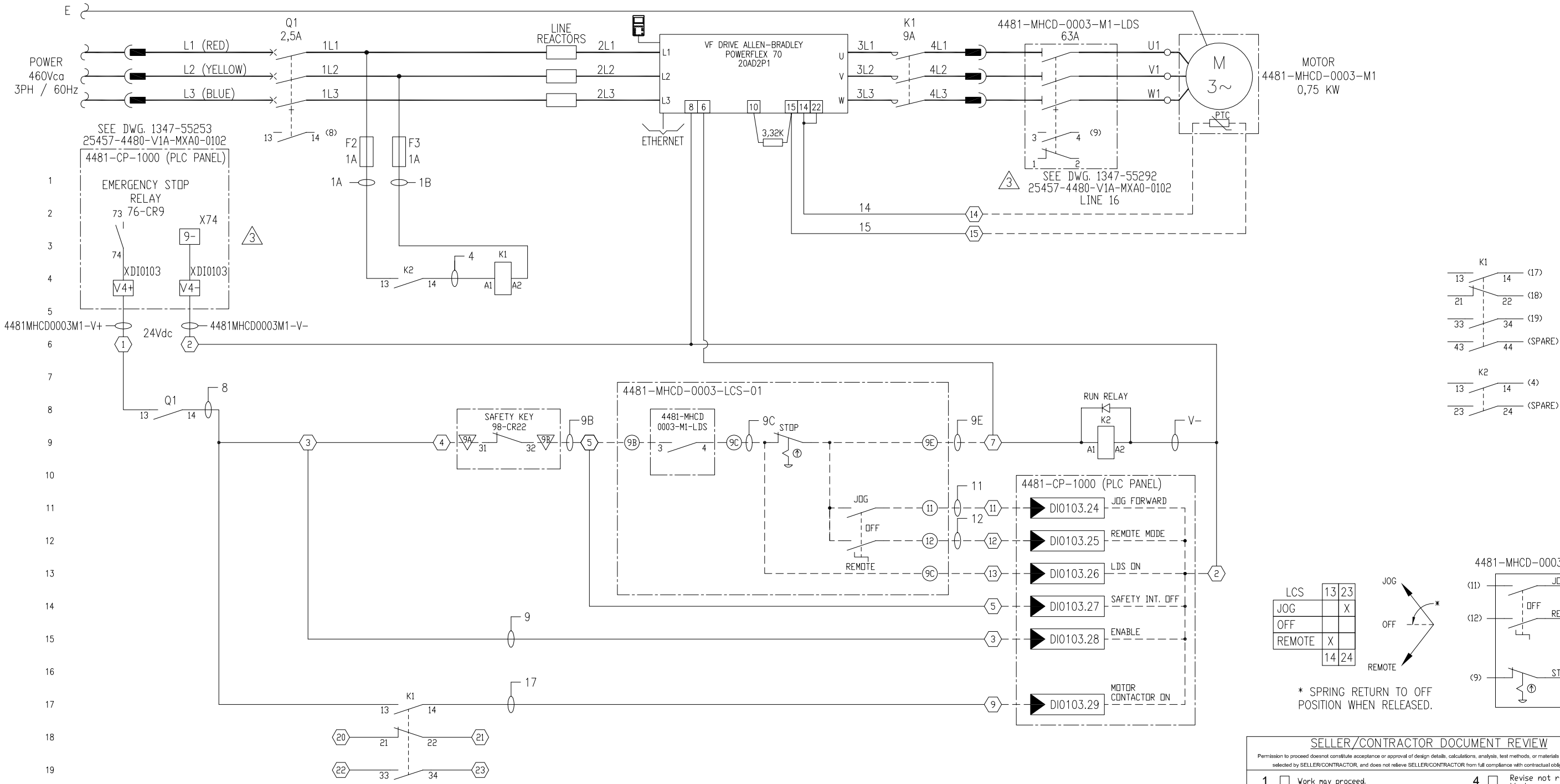
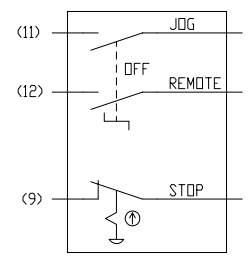
C3 CONVEYOR BETWEEN SHOTBLASTING MACHINE AND OVEN STARTER 4481-MHCD-0003-M1-ST



LCS	13	23
JOG		X
OFF		
REMOTE	X	
	14	24

* SPRING RETURN TO OFF POSITION WHEN RELEASED.

4481-MHCD-0003-LCS-01



LEGEND:

- LDS LOCAL DISCONNECT SWITCH
- LCS LOCAL CONTROL STATION
- MCC WIRING
- WIRING EXTERNAL TO MCC

TERMINALS:

- (X) MCC STARTER
- ▽ SAFETY RELAY PANEL OR E-STOP
- (X) LOCAL CONTROL STATION
- [X] MOTOR

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5 ☐ VOID / Superseded.

DDR Nbr :

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Discipline :

Document No : 25457-4480-V1A-MXA0-0226 Rev. :

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SELLER DRAWING No. 1347-55550 REV. 3

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		3		UPDATE	MA-11-11	E.B.	T.Pa.	C.C.
		2		CHANGE SAFETY CONTACT	FE-01-11	F.P.	E.B.	C.C.
		1		ADD FUSE & CHANGE SEC. CONTACT OF LDS FROM NO INTO NC	DE-02-10	F.P.	E.B.	C.C.
		REVISIONS						

NOTES

STATUS: FOR DESIGN

DRAWN/DES'D:	F.P.	AREA ENG.:	
DATE:	10/11/2010	DATE:	
CHECKED:	E.B.	PRJ ENG MGR:	
DATE:		DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA alTech Inc. — Département Ingénierie / Engineering Department — 9450 TransCanada, Bâtiscan, Québec, G0A 4S0, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

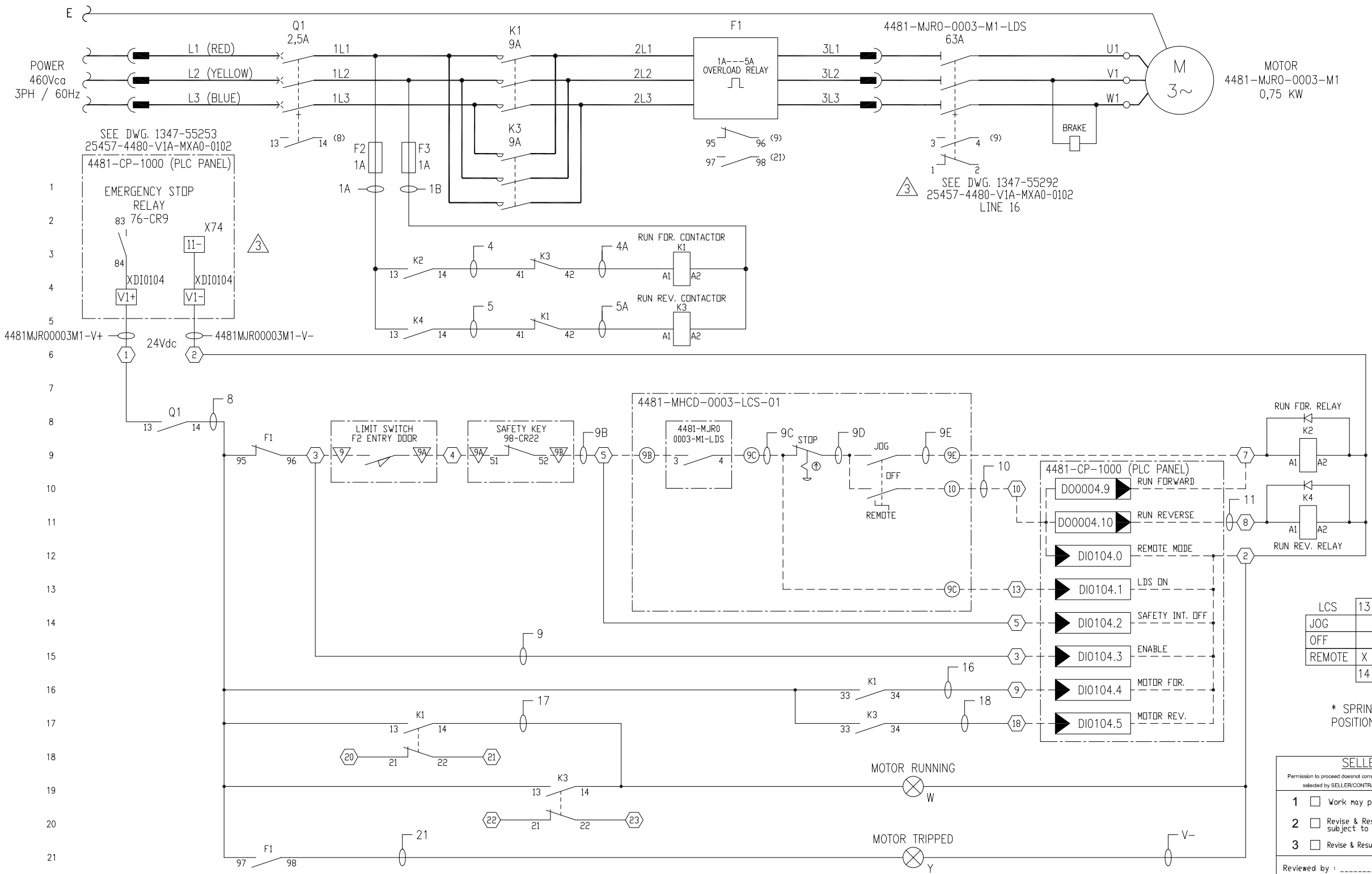
PROJ. No | SUBD. | DISC. | SECTOR | SEQUENCE | REV.
25457-00AZ- xx - xxxx - xxxx - xxx - xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MHCD-0003-M1
ELECTRICAL SCHEMATIC DIAGRAM

MA'ADEN معادن

Type | Building | Discipline | Phase | Format | Sequential | Location | Rev. No.
— | — | — | — | A3– | –AZ

R7 ROLLER CONVEYOR AT BAR FURNACE ENTRANCE STARTER 4481-MJR0-0003-M1-ST

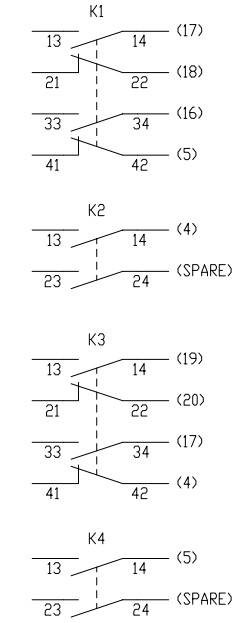


LEGEND:

LDS LOCAL DISCONNECT SWITCH
LCS LOCAL CONTROL STATION
MCC WIRING
WIRING EXTERNAL TO MCC

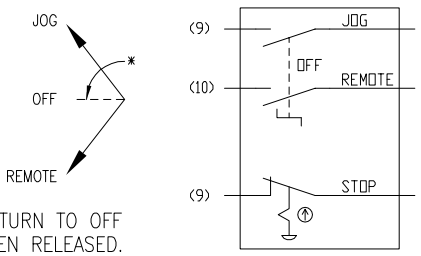
TERMINALS:

- (X) MCC STARTER
- ▽ SAFETY RELAY PANEL OR E-STOP
- (X) LOCAL CONTROL STATION
- [X] MOTOR



4481-MHCD-0003-LCS-01

LCS	13	23
JOG		X
OFF		
REMOTE	X	
	14	24



* SPRING RETURN TO OFF POSITION WHEN RELEASED.

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2 ☐ Revise & Resubmit. Work may proceed subject to incorporation of Changes.	5 ☐ VOID / Superseded.
3 ☐ Revise & Resubmit. Work may NOT proceed.	DDR Nbr :

Reviewed by : _____ Date : _____

Discipline :

Document No : 25457-4480-V1A-MXA0-0227 Rev. :

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DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
		3		UPDATE	MA-12-11	E.B.	T.Pa.	C.C.
		2		CHANGE SAFETY CONTACT	FE-01-11	F.P.	E.B.	C.C.
		1		ADD FUSE & CHANGE SEC. CONTACT OF LDS FROM NO INTO NC	DE-02-10	F.P.	E.B.	C.C.
REFERENCES		REVISIONS						

NOTES

STATUS: FOR DESIGN

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DATE:	10/11/2010	DATE:	
CHECKED:	E.B.	PRJ ENG MGR:	
DATE:		DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie / Engineering Department, 6400 Trans-Canada, Saint-Laurent, Québec, H4S 1V3, Canada

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SELLER DRAWING No. 1347-55560 REV. 3

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MJR0-0003-M1
ELECTRICAL SCHEMATIC DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—		—	—	A3–		–AZ	

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F2 CATHODE BAR HEATING FURNACE CONVEYOR No. 1 STARTER 4481-MBMB-0001-M1-ST

POWER 460Vca 3PH / 60Hz
L1 (RED)
L2 (YELLOW)
L3 (BLUE)
Q1 2,5A
1L1
1L2
1L3
LINE REACTORS
2L1
2L2
2L3
VF DRIVE ALLEN-BRADLEY POWERFLEX 70 20AD2P1
L1
L2
L3
U
V
W
3L1
3L2
3L3
K1 9A
4L1
4L2
4L3
4481-MBMB-0001-M1-LDS 63A
U1
V1
W1
M 3~
MOTOR 4481-MBMB-0001-M1 0,75 KW
PTC
ETHERNET
3,32K
14
15
SEE DWG. 1347-55253 25457-4480-V1A-MXA0-0102
4481-CP-1000 (PLC PANEL)
EMERGENCY STOP RELAY 76-CR9
83
84
X74
11-
XDI0104
V2+
V2-
24Vdc
4481MBMB0001M1-V+
4481MBMB0001M1-V-
F2 1A
F3 1A
F4 1A
F5 1A
1A
1B
T1
H1
H2
480V
X1
X4
230V
L230A
F6 1A
L230B
L230C
L230D
N230A
N230B
FAN 44W
M 1~
K2
K1
A1
A2
4481-MBMB-0001-LCS-01
4481-MBMB 0001-M1-LDS
9B
9C
9E
STOP
RUN RELAY
V-
JOG
OFF
REMOTE
JOG FORWARD
REMOTE MODE
LDS ON
SAFETY INT. OFF
ENABLE
MOTOR CONTACTOR ON
DI0104.8
DI0104.9
DI0104.10
DI0104.11
DI0104.12
DI0104.13

K1
13 14 (17)
21 22 (18)
33 34 (19)
43 44 (SPARE)

K2
13 14 (4)
23 24 (SPARE)

LCS	13	23
JOG		X
OFF		
REMOTE	X	
	14	24

* SPRING RETURN TO OFF POSITION WHEN RELEASED.

4481-MBMB-0001-LCS-01
(11) JOG
OFF
(12) REMOTE
(9) STOP

LEGEND:
LDS LOCAL DISCONNECT SWITCH
LCS LOCAL CONTROL STATION
MCC WIRING
WIRING EXTERNAL TO MCC

TERMINALS:
MCC STARTER
SAFETY RELAY PANEL OR E-STOP
LOCAL CONTROL STATION
MOTOR

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Discipline :
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DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		2		UPDATE	MA-12-11	E.B.	T.Pa.	C.C.
		1		ADD FUSE & CHANGE SEC. CONTACT OF LDS FROM NO INTO NC	DE-02-10	F.P.	E.B.	C.C.

NOTES

STATUS: FOR DESIGN

DRAWN/DESD:	F.P.	AREA ENG.:	
DATE:	10/11/2010	DATE:	
CHECKED:	E.B.	PRJ ENG MGR:	
DATE:		DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA ab.tech Inc. Département Ingénierie Engineering Department 9450 Transcanada Pointe-aux-Trembles, Québec Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MBMB-0001-M1
ELECTRICAL SCHEMATIC DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx –	xxx

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
	–	–	–	A3–		–AZ	

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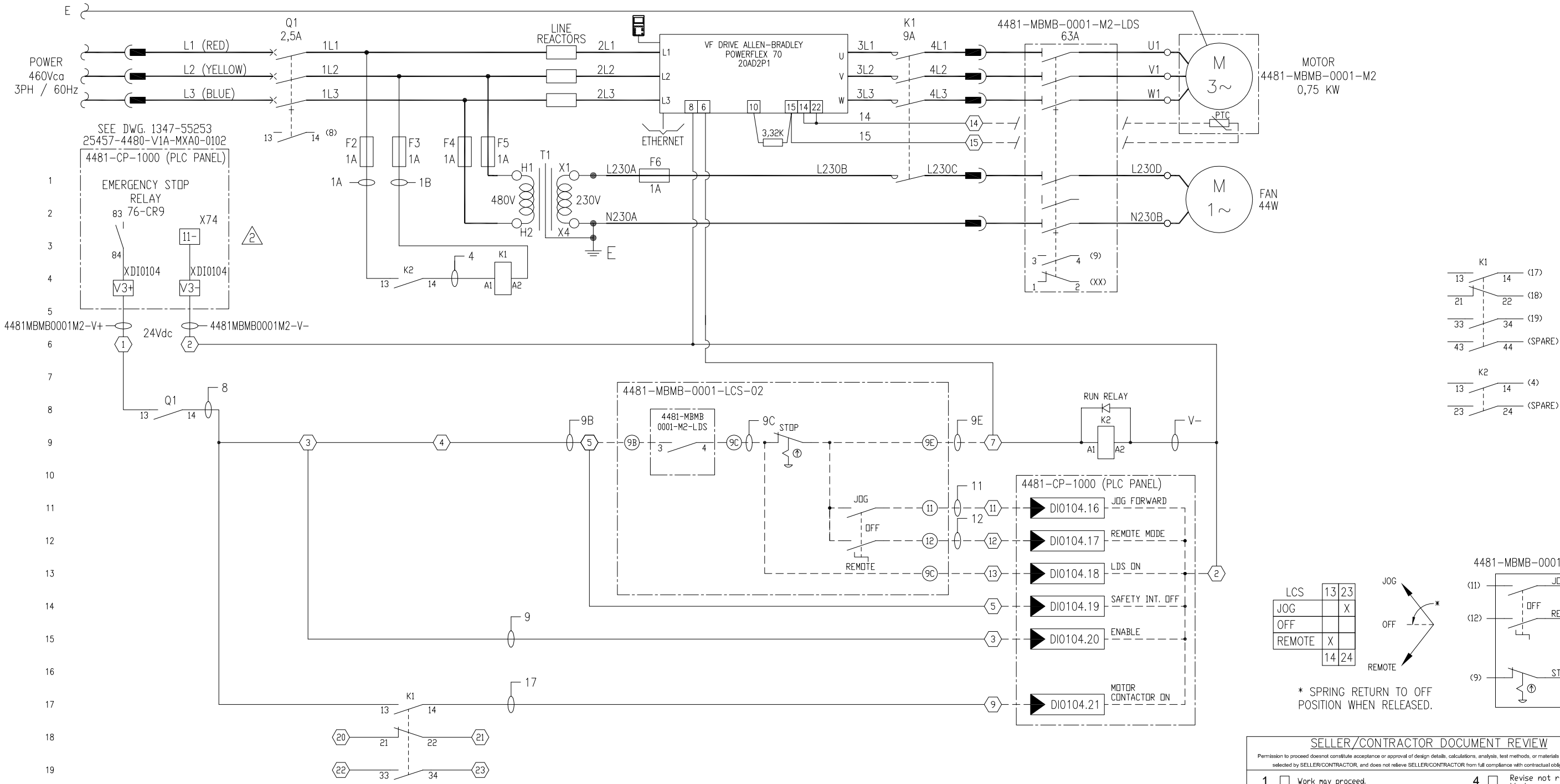
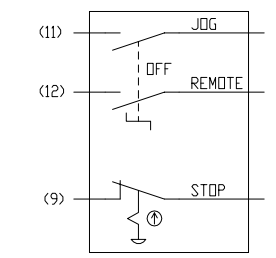
F2 CATHODE BAR HEATING FURNACE CONVEYOR No. 2 STARTER 4481-MBMB-0001-M2-ST



LCS	13	23
JOG		X
OFF		
REMOTE	X	
	14	24

* SPRING RETURN TO OFF POSITION WHEN RELEASED.



LEGEND:

- LDS LOCAL DISCONNECT SWITCH
- LCS LOCAL CONTROL STATION
- MCC WIRING
- WIRING EXTERNAL TO MCC

TERMINALS:

- (X) MCC STARTER
- ▽ SAFETY RELAY PANEL OR E-STOP
- (X) LOCAL CONTROL STATION
- [X] MOTOR

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DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
		2		UPDATE	MA-12-11	E.B.	T.Pa.	C.C.
		1		ADD FUSE & CHANGE SEC. CONTACT OF LDS FROM NO INTO NC	DE-02-10	F.P.	E.B.	C.C.

REFERENCES — REVISIONS — NOTES

STATUS: FOR DESIGN

DRAWN/DES'D:	F.P.	AREA ENG.:	
DATE:	10/11/2010	DATE:	
CHECKED:	E.B.	PRJ ENG MGR:	
DATE:		DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA ab.tech Inc. — Département Ingénierie / Engineering Department, 9450 Trans-Canada, Pointe-aux-Trembles, Québec, H1E 1A1, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MBMB-0001-M2
ELECTRICAL SCHEMATIC DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
—		—	—	A3—		—AZ	

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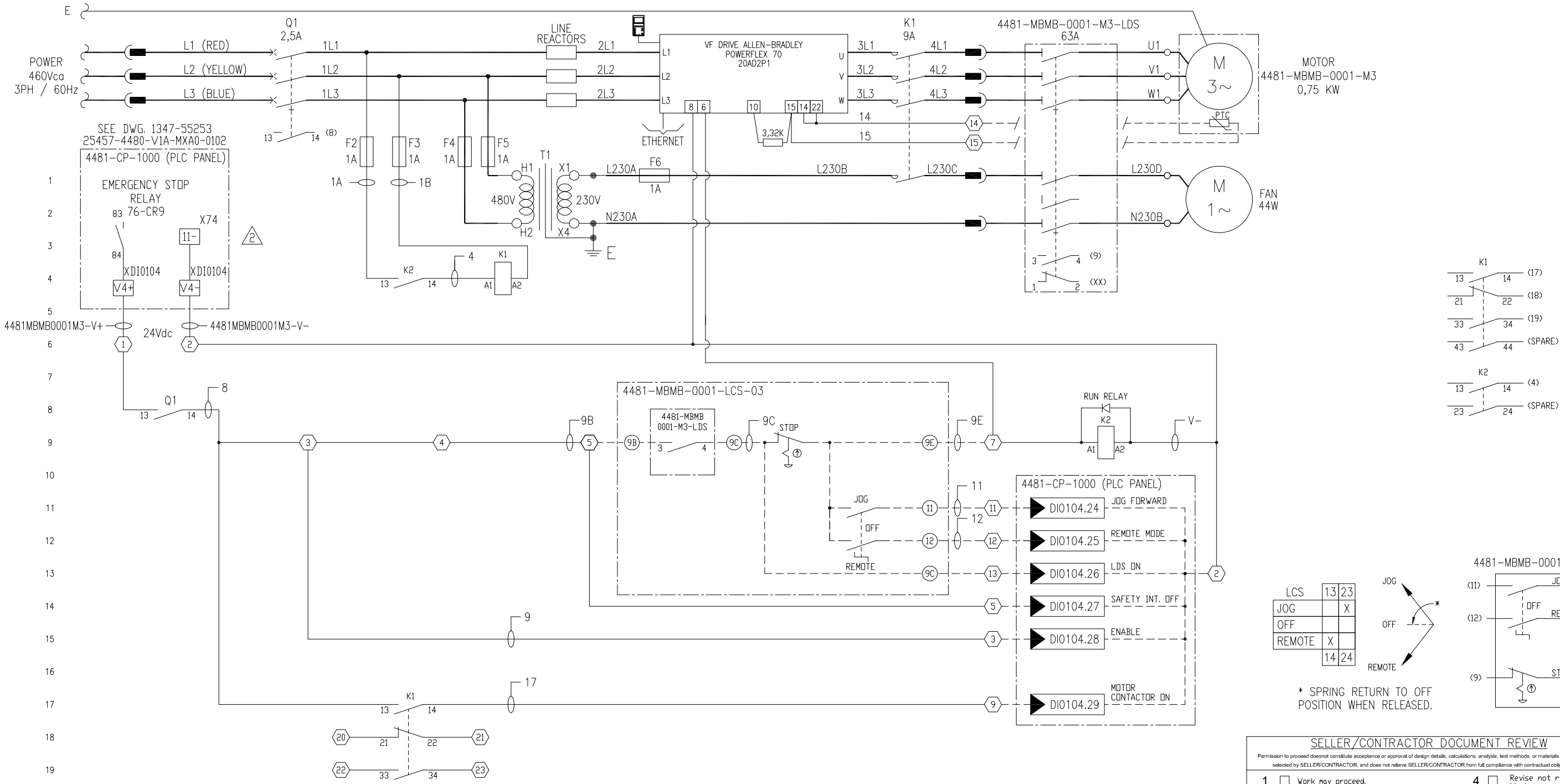
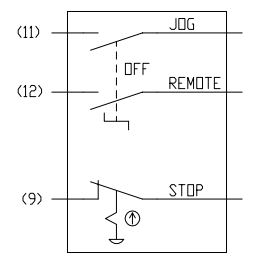
F2 CATHODE BAR HEATING FURNACE CONVEYOR No. 3 STARTER 4481-MBMB-0001-M3-ST



LCS	13	23
JOG		X
OFF		
REMOTE	X	
	14	24

* SPRING RETURN TO OFF POSITION WHEN RELEASED.



LEGEND:

- LDS LOCAL DISCONNECT SWITCH
- LCS LOCAL CONTROL STATION
- MCC WIRING
- WIRING EXTERNAL TO MCC

TERMINALS:

- (X) MCC STARTER
- ▽ SAFETY RELAY PANEL OR E-STOP
- (X) LOCAL CONTROL STATION
- [X] MOTOR

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		2		UPDATE	MA-12-11	E.B.	T.Pa.	C.C.
		1		ADD FUSE & CHANGE SEC. CONTACT OF LDS FROM NO INTO NC	DE-02-10	F.P.	E.B.	C.C.
REFERENCES		REVISIONS						

NOTES

STATUS: FOR DESIGN

DRAWN/DES'D:	F.P.	AREA ENG.:	
DATE:	10/11/2010	DATE:	
CHECKED:	E.B.	PRJ ENG MGR:	
DATE:		DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA alstech Inc. Département Ingénierie Engineering Department 9600 Trans-Canada Baie-d'Urfé, Québec H9X 3T5 Canada

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No 25457 | SUBD. 00AZ | DISC. - | SECTOR xx | SEQUENCE xxxx - xxxx | REV. xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MBMB-0001-M3
ELECTRICAL SCHEMATIC DIAGRAM

MA'ADEN

Type — | Building — | Discipline — | Phase — | Format A3– | Sequential – | Location AZ | Rev. No.

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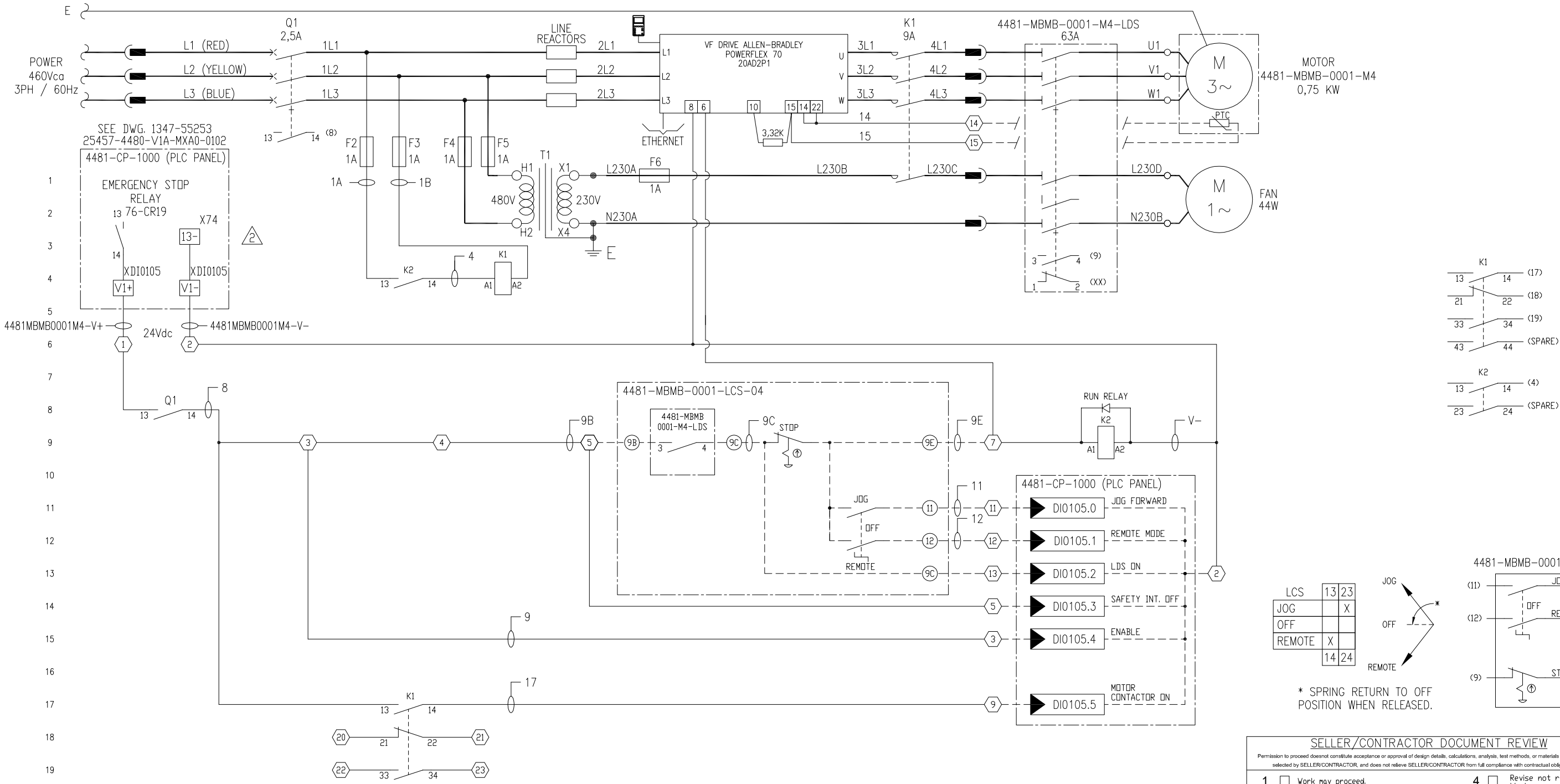
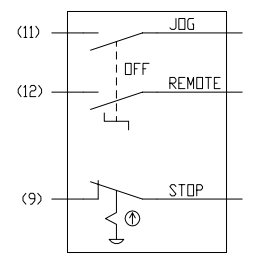
F2 CATHODE BAR HEATING FURNACE CONVEYOR No. 4 STARTER 4481-MBMB-0001-M4-ST



LCS	13	23
JOG		X
OFF		
REMOTE	X	
	14	24

* SPRING RETURN TO OFF POSITION WHEN RELEASED.



LEGEND:

- LDS LOCAL DISCONNECT SWITCH
- LCS LOCAL CONTROL STATION
- MCC WIRING
- WIRING EXTERNAL TO MCC

TERMINALS:

- (X) MCC STARTER
- ▽ SAFETY RELAY PANEL OR E-STOP
- (X) LOCAL CONTROL STATION
- [X] MOTOR

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Discipline :

Document No : 25457-4480-V1A-MXA0-0231 | Rev. :

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SELLER DRAWING No. 1347-55573 | REV. 2

No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
2		UPDATE	MA-12-11	E.B.	T.Pa.	C.C.
1		ADD FUSE & CHANGE SEC. CONTACT OF LDS FROM NO INTO NC	DE-02-10	F.P.	E.B.	C.C.

DRAWING NUMBER | TITLE | REFERENCES | REVISIONS | NOTES

STATUS: FOR DESIGN

DRAWN/DES'D:	F.P.	AREA ENG.:	
DATE:	10/11/2010	DATE:	
CHECKED:	E.B.	PRJ ENG MGR:	
DATE:		DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA aLtech Inc. Département Ingénierie Engineering Department 9650 Transcanada Pointe-aux-Trembles, Québec Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MBMB-0001-M4
ELECTRICAL SCHEMATIC DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx –	xxx

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
–		–	–	A3–		–AZ	

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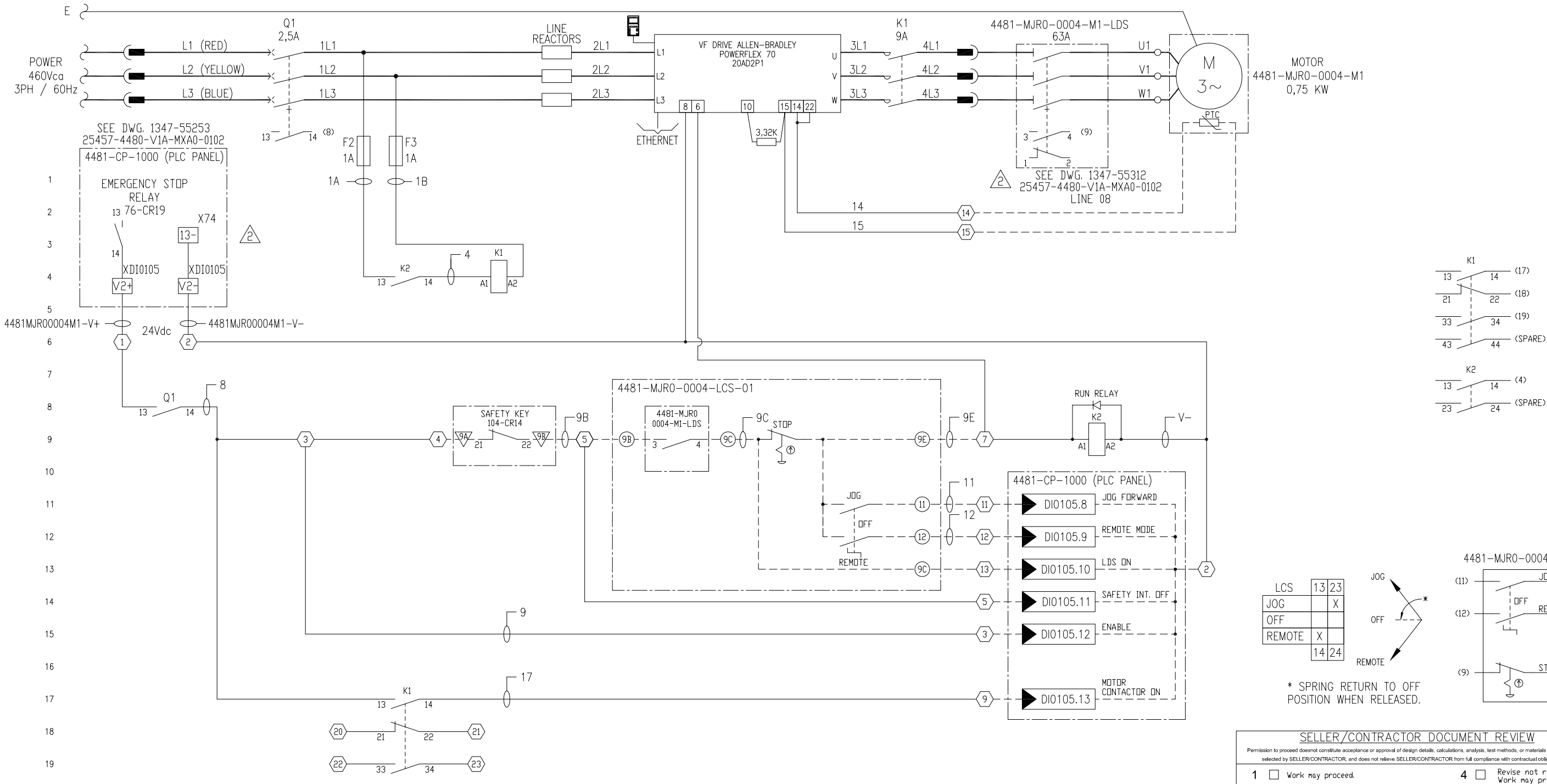
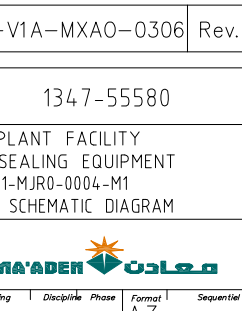
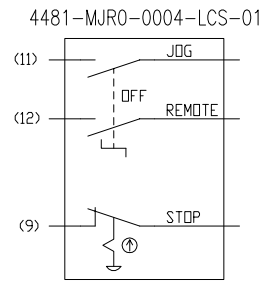
R6 ROLLER CONVEYOR AT BAR FURNACE EXIT STARTER 4481-MJR0-0004-M1-ST





LCS	13	23
JOG		X
OFF		
REMOTE	X	
	14	24

* SPRING RETURN TO OFF POSITION WHEN RELEASED.



LEGEND:

LDS LOCAL DISCONNECT SWITCH
LCS LOCAL CONTROL STATION
MCC WIRING
WIRING EXTERNAL TO MCC

TERMINALS:

(X) MCC STARTER
▽ SAFETY RELAY PANEL OR E-STOP
(X) LOCAL CONTROL STATION
[X] MOTOR

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4 ☐ Revise not required. Work may proceed.
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Discipline :

Document No : 25457-4480-V1A-MXA0-0306 Rev. :

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SELLER DRAWING No. 1347-55580 REV. 2

REFERENCES		REVISIONS							
DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
		2		UPDATE	MA-12-11	E.B.	T.Pa.	C.C.
		1		ADD FUSE & CHANGE SEC. CONTACT OF LDS FROM NO INTO NC	DE-02-10	F.P.	E.B.	C.C.

NOTES

STATUS: FOR DESIGN

DRAWN/DEST:	F.P.	AREA ENG.:	
DATE:	10/11/2010	DATE:	
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DATE:		DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA a|tech Inc. Département Ingénierie / Engineering Department, 9690 Trans-Canada, Saint-Laurent, Quebec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MJR0-0004-M1
ELECTRICAL SCHEMATIC DIAGRAM

MA'ADEN ALUMINA

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—	—	A3-		-AZ	

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G1 POSITIONING GANTRY FOR BLOCK AND BARS STARTER 4481-MQLK-0001-M1-ST

POWER 460Vca 3PH / 60Hz
L1 (RED)
L2 (YELLOW)
L3 (BLUE)
Q1 6,3A
LINE REACTORS
VF DRIVE ALLEN-BRADLEY POWERFLEX 70 20AD5P0
ENABLE
ETHERNET
K1 12A
F1A(1A--5A)
F1B(1A--5A)
4481-MQLK-0001-M1-LDS 63A
MOTOR 4481-MQLK-0001-M1 1,1 KW
MOTOR 4481-MQLK-0001-M2 1,1 KW
BRAKE
PTC
SEE DWG. 1347-55253 25457-4480-V1A-MXA0-0102
4481-CP-1000 (PLC PANEL)
EMERGENCY STOP RELAY 76-CR19
XDI0105 V3+
XDI0105 V3-
F2 1A
F3 1A
817S-PTC-48 THERMISTOR RELAY
3,32K
4481MQLK0001M1-V+
24Vdc
4481MQLK0001M1-V-
4481-MQLK-0001 JB-03
SEE DWG. 1347-55312 25457-4480-V1A-MXA0-0102 LINE 08
4481-MQLK-0001-LCS-01
SAFETY HEY 104-CR14
4481-MQLK 0001-M1-LDS
STOP
RUN RELAY K2
V-
JOG
OFF
REMOTE
4481-CP-1000 (PLC PANEL)
DI0105.16 JOG FORWARD
DI0105.17 REMOTE MODE
DI0105.18 LDS ON
DI0105.19 SAFETY INT. OFF
DI0105.20 ENABLE
DI0105.21 MOTOR CONTACTOR ON
DO0004.12 BRAKE
K3 BRAKE CONTACTOR

K1 (17) (18) (19) (SPARE)
K2 (4) (SPARE)

4481-MQLK-0001-LCS-01

LCS	13	23
JOG		X
OFF		
REMOTE	X	
	14	24

* SPRING RETURN TO OFF POSITION WHEN RELEASED.

LEGEND:
LDS LOCAL DISCONNECT SWITCH
LCS LOCAL CONTROL STATION
MCC WIRING
WIRING EXTERNAL TO MCC

TERMINALS:
(X) MCC STARTER
SAFETY RELAY PANEL OR E-STOP
(X) LOCAL CONTROL STATION
[X] MOTOR

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REFERENCES		2		UPDATE	MA-12-11	E.B.	T.Po.	C.C.
		1		ADD RELAY THERMISTOR & CHANGE SEC. CONTACT OF LDS	DE-02-10	F.P.	E.B.	C.C.

NOTES

STATUS: FOR DESIGN

DRAWN/DES'D: F.P.	AREA ENG.:
DATE: 26/07/2010	DATE:
CHECKED: E.B.	PRJ ENG MGR:
DATE:	DATE:
RESPONSIBLE ENG. M.B.	CLIENT:
DATE:	DATE:
ENG. GROUP SUP.	DRAWING SCALE: NONE
DATE:	

Vendor or Subcontractor Logo: GNA a.b.tech Inc. Département Ingénierie Engineering Department 9495 Trans-Canada Saint-Laurent, Quebec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SELLER DRAWING No. 1347-55590 REV. 2

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MQLK-0001-M1/M2
ELECTRICAL SCHEMATIC DIAGRAM

MA'ADEN

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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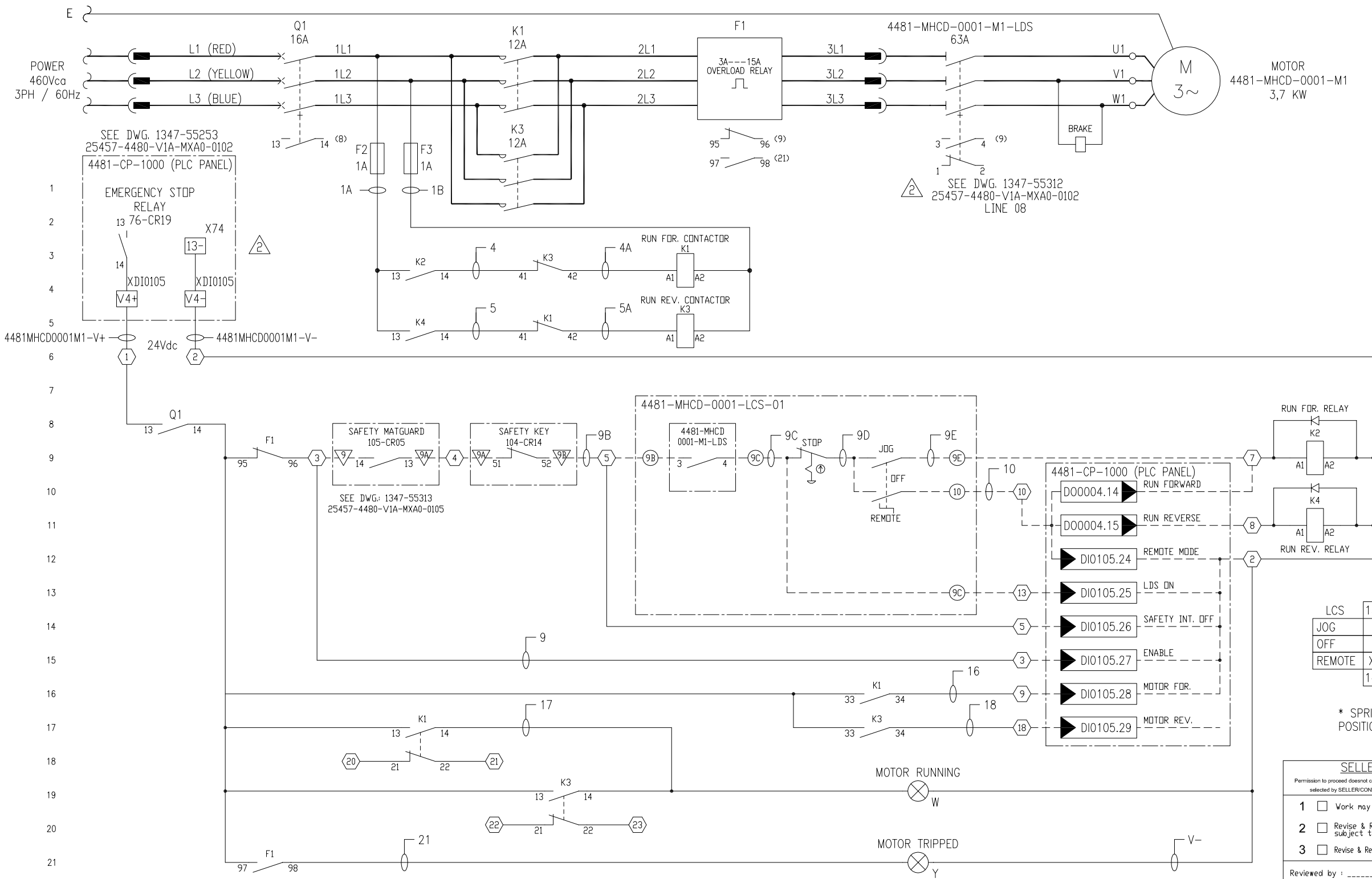
C1 CHAIN CONVEYOR OF BLOCK OVEN STARTER 4481-MHCD-0001-M1-ST

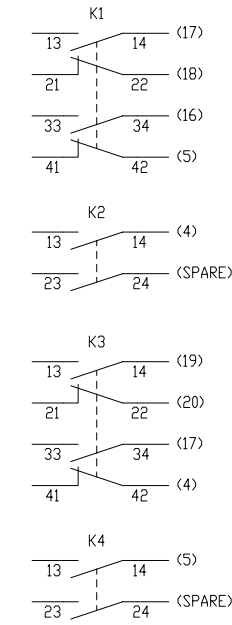


LEGEND:

LDS LOCAL DISCONNECT SWITCH
LCS LOCAL CONTROL STATION
——— MCC WIRING
– – – – WIRING EXTERNAL TO MCC

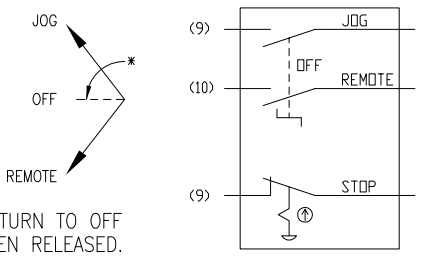
TERMINALS:

(X) MCC STARTER
▽ SAFETY RELAY PANEL OR E-STOP
(X) LOCAL CONTROL STATION
[X] MOTOR



4481-MHCD-0001-LCS-01

LCS	13	23
JOG		X
OFF		
REMOTE	X	
	14	24



* SPRING RETURN TO OFF POSITION WHEN RELEASED.

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		2		UPDATE	MA-12-11	E.B.	T.Pa.	C.C.
		1		ADD FUSE & CHANGE SEC. CONTACT OF LDS FROM NO INTO NC	DE-02-10	F.P.	E.B.	C.C.
REFERENCES		REVISIONS						

NOTES

STATUS: FOR DESIGN

DRAWN/DES'D:	F.P.	AREA ENG.:	
DATE:	10/11/2010	DATE:	
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DATE:		DATE:	
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ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA silutech Inc. — Département Ingénierie / Engineering Department, 9450 Trans-Canada, Saint-Laurent, Québec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SELLER DRAWING No. 1347-55600 REV. 2

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MHCD-0001-M1
ELECTRICAL SCHEMATIC DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—		—	—	A3–		–AZ	

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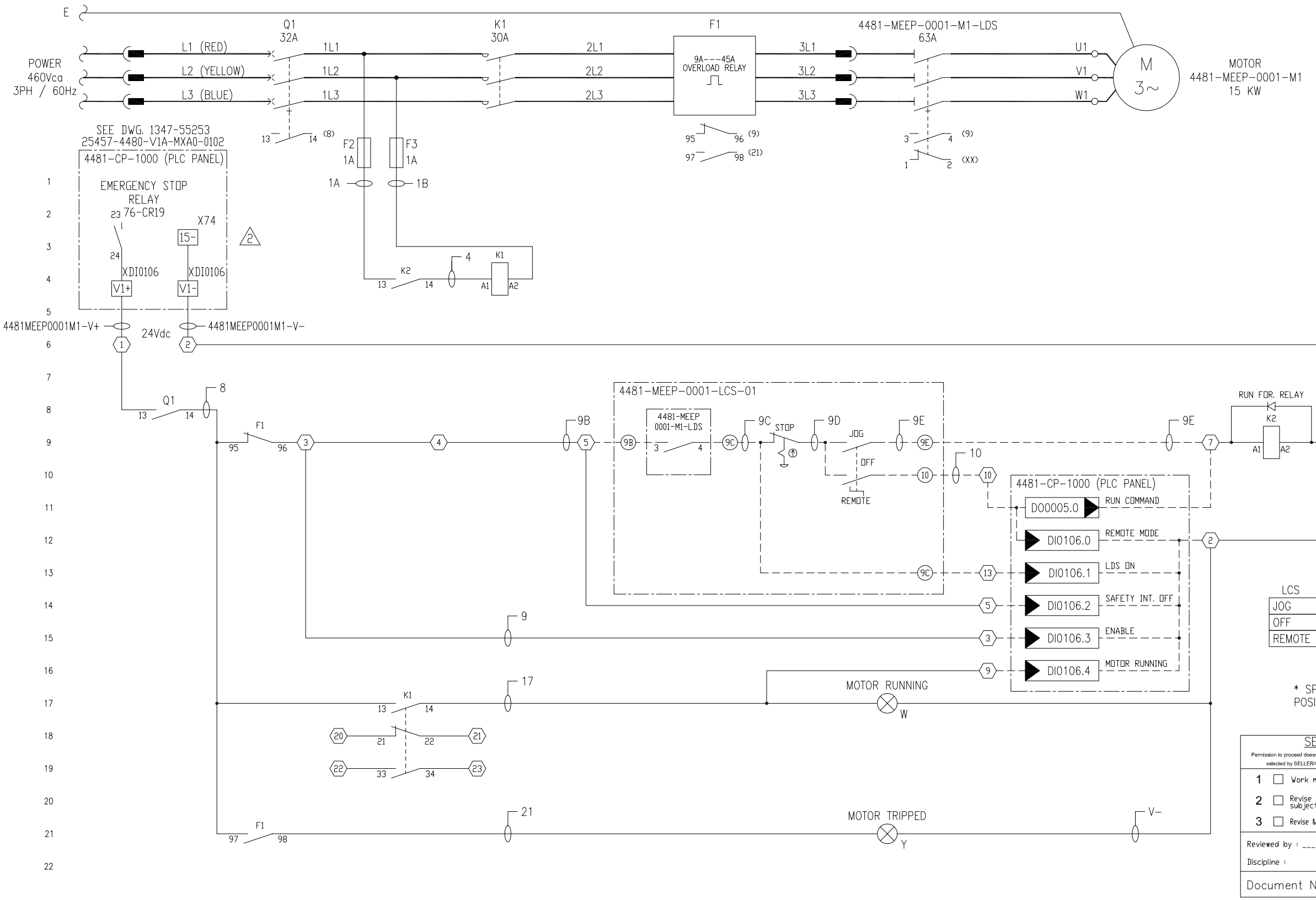
F1 CATHODE BLOCK OVEN FAN A STARTER 4481-MEEP-0001-M1-ST

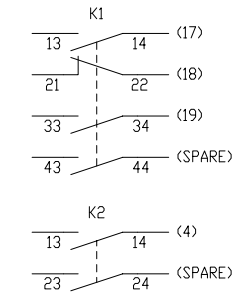


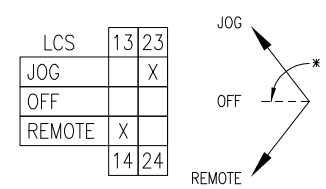
LEGEND:

LDS	LOCAL DISCONNECT SWITCH
LCS	LOCAL CONTROL STATION
———	MCC WIRING
- - - -	WIRING EXTERNAL TO MCC

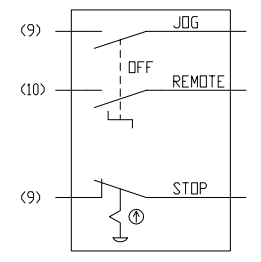
TERMINALS:

- (X) MCC STARTER
- ▽ SAFETY RELAY PANEL OR E-STOP
- (X) LOCAL CONTROL STATION
- [X] MOTOR





* SPRING RETURN TO OFF POSITION WHEN RELEASED.



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REFERENCES		2		UPDATE	MA-12-11	E.B.	T.Po.	C.C.
		1		ADD FUSE & CHANGE SEC. CONTACT OF LDS FROM NO INTO NC	DE-02-10	F.P.	E.B.	C.C.

NOTES

STATUS: FOR DESIGN

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Vendor or Subcontractor Logo: GNA a.b.tech Inc. — Département Ingénierie / Engineering Department, 9495 Trans-Canada, Saint-Laurent, Québec, H4S 1V3, Canada — BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MEEP-0001-M1
ELECTRICAL SCHEMATIC DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
—	—	—		A3-		-AZ	

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F1 CATHODE BLOCK OVEN FAN B STARTER 4481-MEEP-0001-M2-ST

POWER 460Vca 3PH / 60Hz
L1 (RED)
L2 (YELLOW)
L3 (BLUE)
Q1 32A
K1 30A
F1 9A---45A OVERLOAD RELAY
4481-MEEP-0001-M2-LDS 63A
U1
V1
W1
M 3~
MOTOR 4481-MEEP-0001-M2 15 KW

SEE DWG. 1347-55253 25457-4480-V1A-MXA0-0102
4481-CP-1000 (PLC PANEL)
EMERGENCY STOP RELAY 76-CR19
X74
XDI0106 V2+
XDI0106 V2-
F2 1A
F3 1A
4481MEEP0001M2-V+
24Vdc
4481MEEP0001M2-V-

4481-MEEP-0001-LCS-02
4481-MEEP 0001-M2-LDS
STOP
JOG
OFF
REMOTE
RUN FOR. RELAY K2
4481-CP-1000 (PLC PANEL)
D00005.1 RUN COMMAND
DI0106.8 REMOTE MODE
DI0106.9 LDS ON
DI0106.10 SAFETY INT. OFF
DI0106.11 ENABLE
DI0106.12 MOTOR RUNNING
MOTOR RUNNING W
MOTOR TRIPPED Y
V-

LEGEND:
LDS LOCAL DISCONNECT SWITCH
LCS LOCAL CONTROL STATION
MCC WIRING
WIRING EXTERNAL TO MCC

TERMINALS:
MCC STARTER
SAFETY RELAY PANEL OR E-STOP
LOCAL CONTROL STATION
MOTOR

K1: 13-14 (17); 21-22 (18); 33-34 (19); 43-44 (SPARE)
K2: 13-14 (4); 23-24 (SPARE)

LCS	13	23
JOG		X
OFF		
REMOTE	X	
	14	24

JOG / OFF / REMOTE *

* SPRING RETURN TO OFF POSITION WHEN RELEASED.

4481-MEEP-0001-LCS-02: (9) JOG; OFF; (10) REMOTE; (9) STOP

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NOTES

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DATE:	DATE:
RESPONSIBLE ENG. M.B.	CLIENT:
DATE:	DATE:
ENG. GROUP SUP.	DRAWING SCALE: NONE
DATE:	

Vendor or Subcontractor Logo: GNA a.b.tech Inc. Département Ingénierie Engineering Department 9455 Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No 25457-00AZ- | SUBD. | DISC. | SECTOR xx - | SEQUENCE xxxx - xxx | REV. - xxx

SELLER DRAWING No. 1347-55611 | REV. 2

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MEEP-0001-M2
ELECTRICAL SCHEMATIC DIAGRAM

MA'ADEN معادن

Type — | Building — | Discipline Phase — | Format A3- | Sequentiel | Location -AZ | Rev. No.

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F1 CATHODE BLOCK OVEN FAN C STARTER 4481-MEEP-0001-M3-ST

POWER 460Vca 3PH / 60Hz
L1 (RED)
L2 (YELLOW)
L3 (BLUE)
Q1 32A
K1 30A
F1 9A---45A OVERLOAD RELAY
4481-MEEP-0001-M3-LDS 63A
U1 V1 W1
M 3~
MOTOR 4481-MEEP-0001-M3 15 KW

SEE DWG. 1347-55253
25457-4480-V1A-MXA0-0102
4481-CP-1000 (PLC PANEL)
EMERGENCY STOP RELAY 76-CR19
X74
XDI0106 V3+
XDI0106 V3-
F2 1A
F3 1A
4481MEEP0001M3-V+
24Vdc
4481MEEP0001M3-V-

4481-MEEP-0001-LCS-03
4481-MEEP 0001-M3-LDS
STOP
JOG
OFF
REMOTE
RUN FOR. RELAY K2
4481-CP-1000 (PLC PANEL)
DO0005.2 RUN COMMAND
DI0106.16 REMOTE MODE
DI0106.17 LDS ON
DI0106.18 SAFETY INT. OFF
DI0106.19 ENABLE
DI0106.20 MOTOR RUNNING

MOTOR RUNNING W
MOTOR TRIPPED Y
V-

LEGEND:
LDS LOCAL DISCONNECT SWITCH
LCS LOCAL CONTROL STATION
MCC WIRING
WIRING EXTERNAL TO MCC

TERMINALS:
MCC STARTER
SAFETY RELAY PANEL OR E-STOP
LOCAL CONTROL STATION
MOTOR

K1: 13-14 (17); 21-22 (18); 33-34 (19); 43-44 (SPARE)
K2: 13-14 (4); 23-24 (SPARE)

LCS	13	23
JOG		X
OFF		
REMOTE	X	
	14	24

JOG / OFF / REMOTE *

* SPRING RETURN TO OFF POSITION WHEN RELEASED.

4481-MEEP-0001-LCS-03: (9) JOG; OFF; (10) REMOTE; (9) STOP

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Discipline :
Document No : 25457-4480-V1A-MXA0-0311 | Rev. :

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DRAWING NUMBER | TITLE | REFERENCES | REVISIONS | NOTES

STATUS: FOR DESIGN

DRAWN/DES'D: F.P. DATE: 10/11/2010	AREA ENG.: DATE:
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ENG. GROUP SUP. DATE:	DRAWING SCALE: NONE

Vendor or Subcontractor Logo: GNA a.b.tech Inc. Département Ingénierie Engineering Department 9455 Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No | SUBD. | DISC. | SECTOR | SEQUENCE | REV.
25457-00AZ- xx - xxxx - xxxx - xxx - xxx

SELLER DRAWING No. 1347-55612 | REV. 2

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MEEP-0001-M3
ELECTRICAL SCHEMATIC DIAGRAM

MA'ADEN معادن

Type | Building | Discipline | Phase | Format | Sequentiel | Location | Rev. No.
— | — | — | | A3- | | -AZ |

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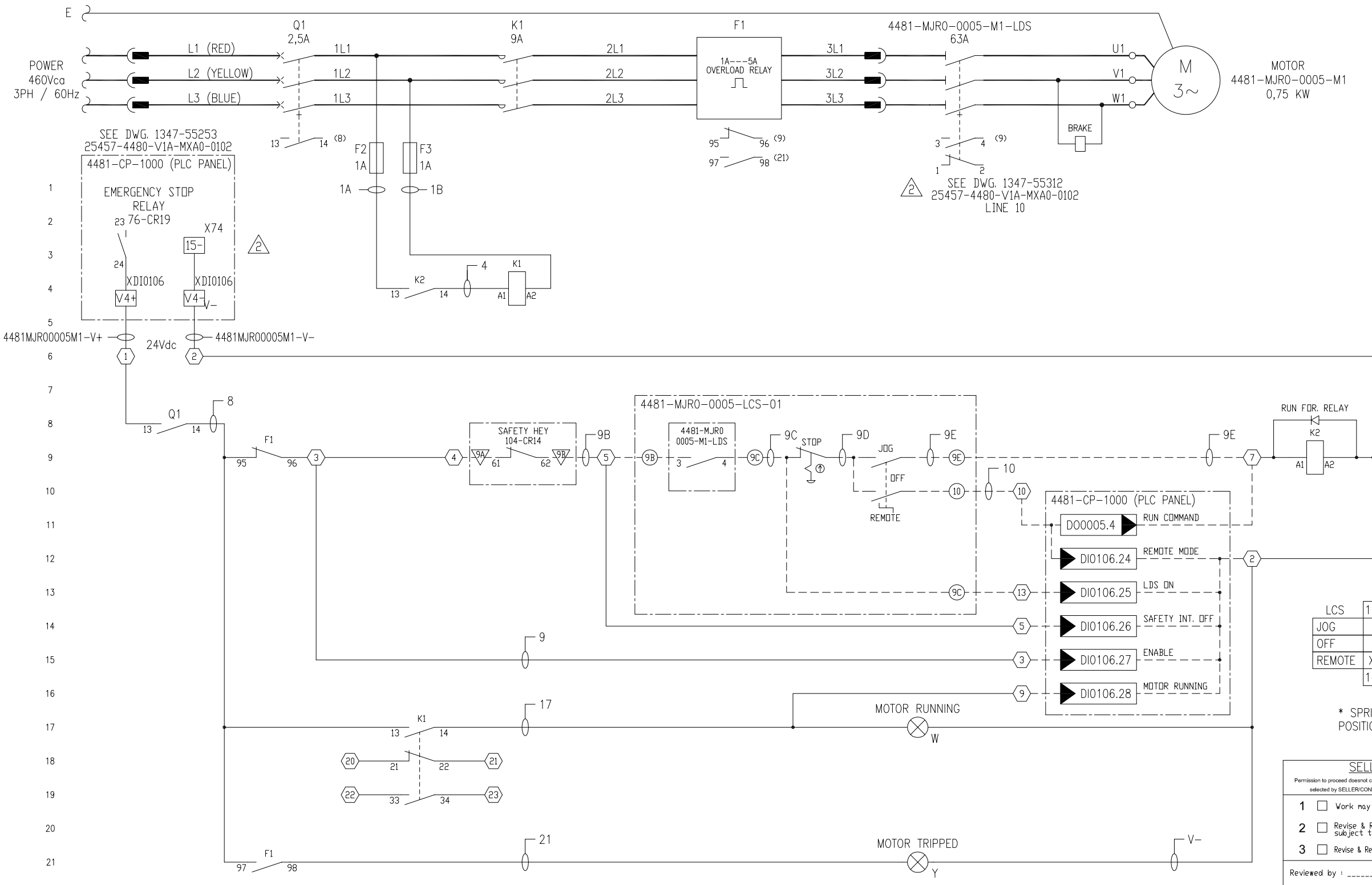
R1 ROLLER CONVEYOR AT BLOCK OVEN EXIT STARTER 4481-MJR0-0005-M1-ST

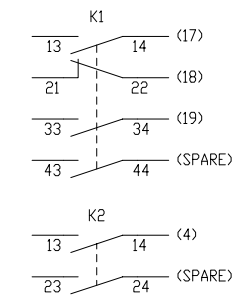


LEGEND:

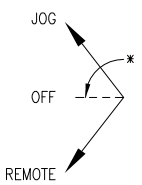
LDS	LOCAL DISCONNECT SWITCH
LCS	LOCAL CONTROL STATION
———	MCC WIRING
- - - -	WIRING EXTERNAL TO MCC

TERMINALS:

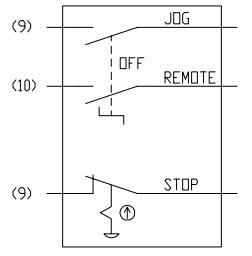
- (X) MCC STARTER
- ▽ SAFETY RELAY PANEL OR E-STOP
- (X) LOCAL CONTROL STATION
- [X] MOTOR



LCS	13	23
JOG		X
OFF		
REMOTE	X	
	14	24



* SPRING RETURN TO OFF POSITION WHEN RELEASED.



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Reviewed by : _____ Date : _____

Discipline :

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REFERENCES		2		UPDATE	MA-12-11	E.B.	T.Pa.	C.C.
		REVISIONS						

NOTES

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DATE:	DATE:
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DATE:	DATE:
ENG. GROUP SUP.	DRAWING SCALE: NONE
DATE:	

Vendor or Subcontractor Logo: GNA a.i. tech Inc. — Département Ingénierie / Engineering Department, 9695 Trans-Canada, Sainte-Julienne, Québec, J0K0 1V0, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

SELLER DRAWING No. 1347-55620 — REV. 2

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MJR0-0005-M1
ELECTRICAL SCHEMATIC DIAGRAM

MA'ADEN

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
—	—	—		A3-		-AZ	

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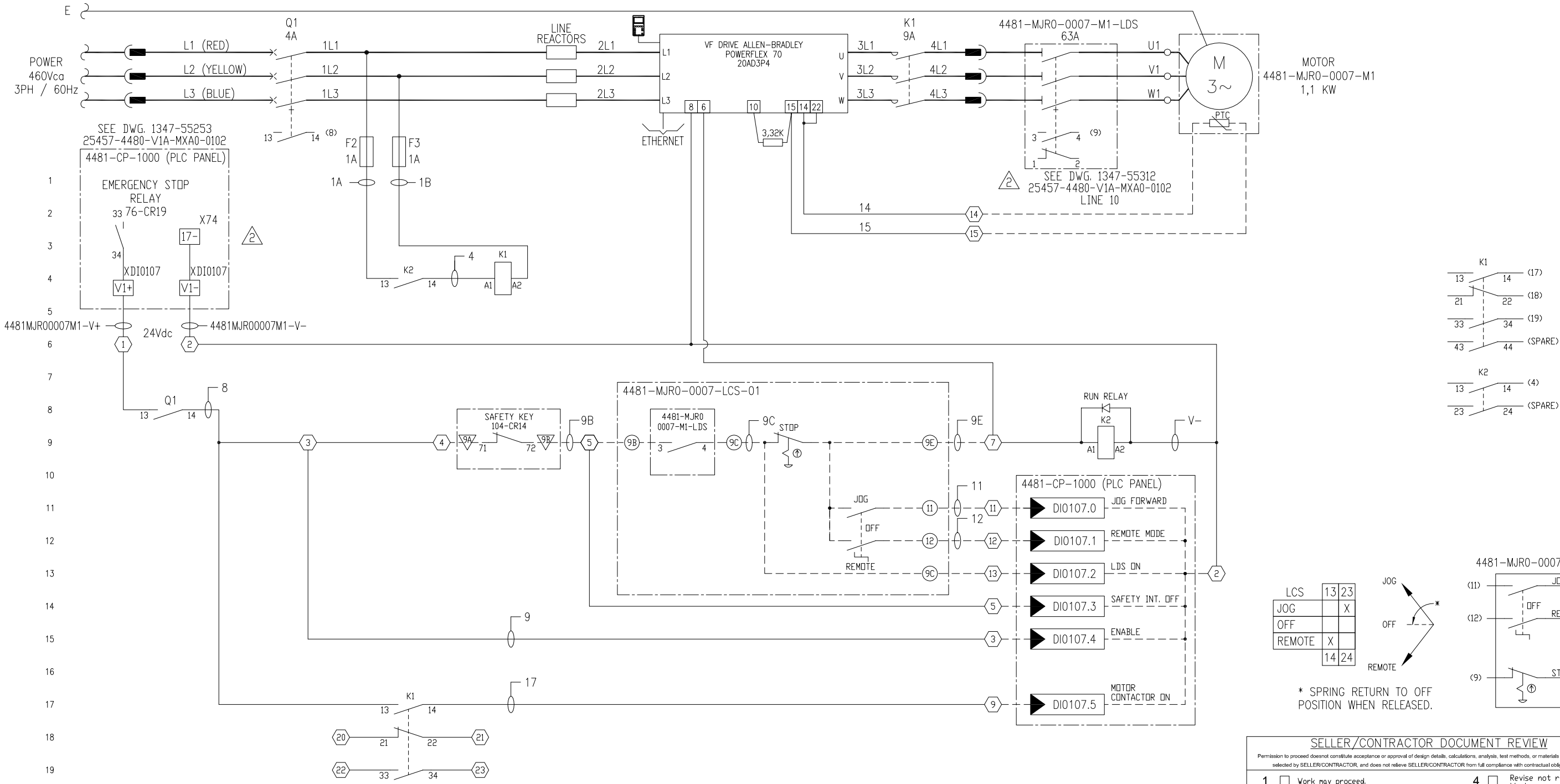
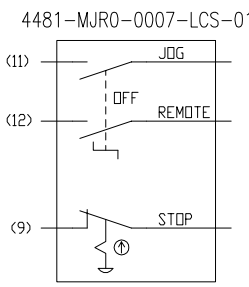
R2 ROLLER CONVEYOR FOR BLOCK & BAR ASSEMBLY STARTER 4481-MJR0-0007-M1-ST



LCS	13	23
JOG		X
OFF		
REMOTE	X	
	14	24

* SPRING RETURN TO OFF POSITION WHEN RELEASED.



LEGEND:

LDS LOCAL DISCONNECT SWITCH
LCS LOCAL CONTROL STATION
MCC WIRING
WIRING EXTERNAL TO MCC

TERMINALS:

(X) MCC STARTER
SAFETY RELAY PANEL OR E-STOP
(X) LOCAL CONTROL STATION
[X] MOTOR

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Discipline :

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REFERENCES		2		UPDATE	MA-12-11	E.B.	T.Pa.	C.C.
		1		ADD FUSE & CHANGE SEC. CONTACT OF LDS FROM NO INTO NC	DE-02-10	F.P.	E.B.	C.C.
		REVISIONS						

NOTES

STATUS: FOR DESIGN

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DATE:	10/11/2010	DATE:	
CHECKED:	E.B.	PRJ ENG MGR:	
DATE:		DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA ab.tech Inc. — Département Ingénierie / Engineering Department — 9460 Trans-Canada, Saint-Laurent, Québec, H4S 1V9, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MJR0-0007-M1
ELECTRICAL SCHEMATIC DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—		—	—	A3-		-AZ	

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R4A PRESTRESSING & SEALING STATION CONVEYOR A STARTER 4481-MZAC-0001-M1-ST

POWER 460Vca 3PH / 60Hz
L1 (RED)
L2 (YELLOW)
L3 (BLUE)
Q1 4A
1L1
1L2
1L3
LINE REACTORS
2L1
2L2
2L3
VF DRIVE ALLEN-BRADLEY POWERFLEX 70 20AD3P4
L1
L2
L3
U
V
W
3L1
3L2
3L3
K1 9A
4L1
4L2
4L3
4481-MZAC-0001-M1-LDS 63A
U1
V1
W1
M 3~
MOTOR 4481-MZAC-0001-M1 1,1 KW
PTC
ETHERNET
3,32K
SEE DWG. 1347-55253 25457-4480-V1A-MXA0-0102
4481-CP-1000 (PLC PANEL)
EMERGENCY STOP RELAY 76-CR19
X74
XDI0107
V2+
V2-
F2 1A
F3 1A
1A
1B
K2
K1
A1
A2
4481MZAC0001M1-V+
24Vdc
4481MZAC0001M1-V-
Q1
SAFETY GATE CLOSED
SAFETY LIGHT CURTAIN 90-CR16
4481-MZAC-0001-LCS-01
4481-MZAC 0001-M1-LDS
STOP
RUN RELAY
V-
JOG
OFF
REMOTE
DI0107.8 JOG FORWARD
DI0107.9 REMOTE MODE
DI0107.10 LDS ON
DI0107.11 SAFETY INT. OFF
DI0107.12 ENABLE
DI0107.13 MOTOR CONTACTOR ON

K1
13 14 (17)
21 22 (18)
33 34 (19)
43 44 (SPARE)

K2
13 14 (4)
23 24 (SPARE)

LCS	13	23
JOG		X
OFF		
REMOTE	X	
	14	24

* SPRING RETURN TO OFF POSITION WHEN RELEASED.

4481-MZAC-0001-LCS-01
(11) JOG
OFF
(12) REMOTE
(9) STOP

LEGEND:
LDS LOCAL DISCONNECT SWITCH
LCS LOCAL CONTROL STATION
MCC WIRING
WIRING EXTERNAL TO MCC

TERMINALS:
MCC STARTER
SAFETY RELAY PANEL OR E-STOP
LOCAL CONTROL STATION
MOTOR

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DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
		2		UPDATE	MA-12-11	E.B.	T.Pa.	C.C.
		1		ADD FUSE & CHANGE SEC. CONTACT OF LDS FROM NO INTO NC	DE-02-10	F.P.	E.B.	C.C.
REFERENCES		REVISIONS						

NOTES

STATUS: FOR DESIGN

DRAWN/DES'D:	F.P.	AREA ENG.:	
DATE:	10/11/2010	DATE:	
CHECKED:	E.B.	PRJ ENG MGR:	
DATE:		DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA a|j|tech Inc. Département Ingénierie / Engineering Department, 9690 TransCanada, Baie-Lavaren, Québec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MZAC-0001-M1
ELECTRICAL SCHEMATIC DIAGRAM

MA'ADEN

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—	—	A3-		-AZ	

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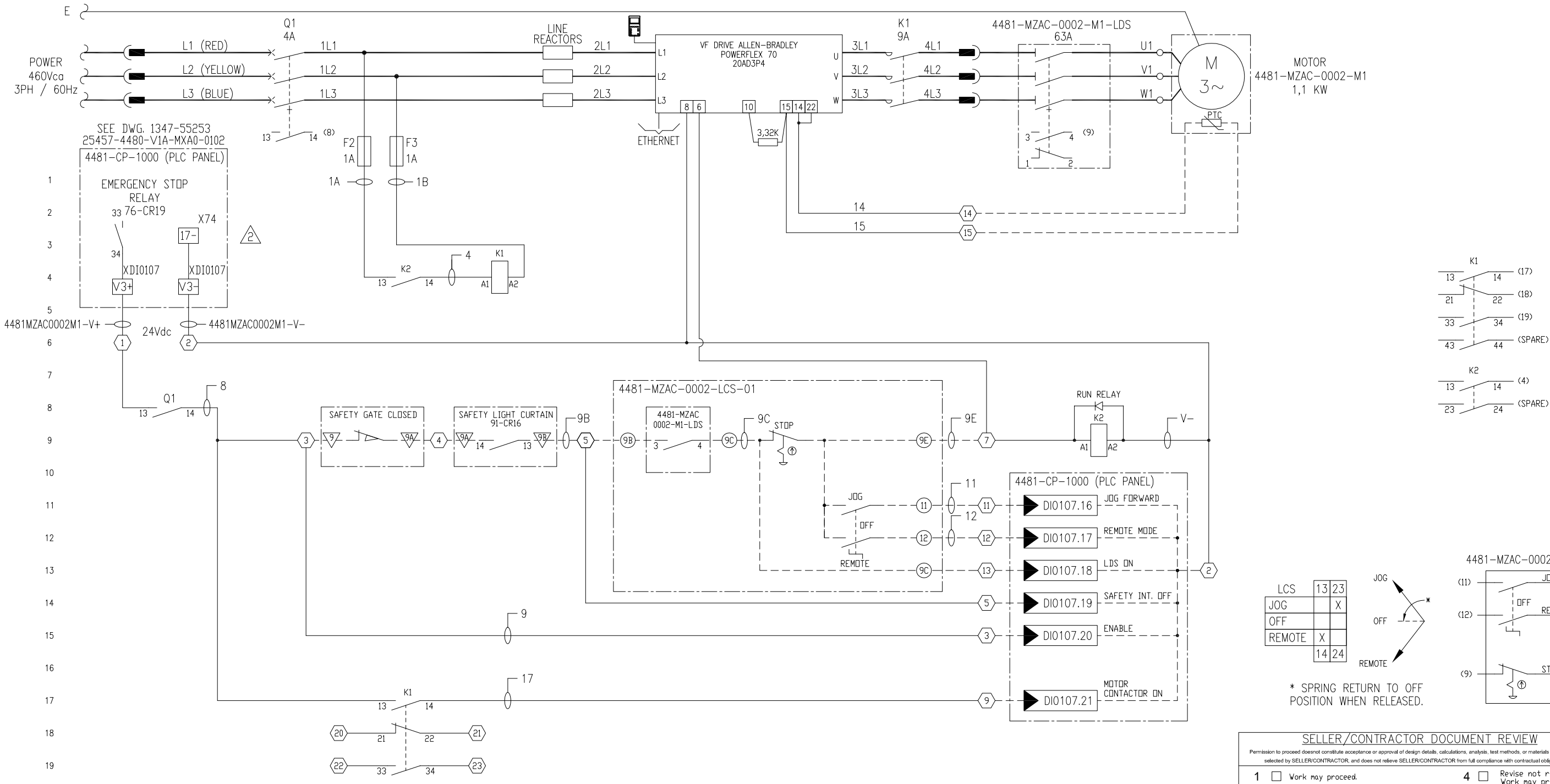
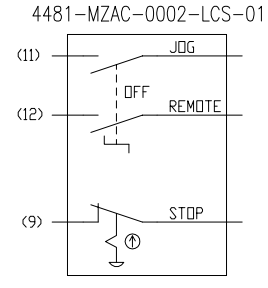
R4B PRESTRESSING & SEALING STATION CONVEYOR B STARTER 4481-MZAC-0002-M1-ST



LCS	13	23
JOG		X
OFF		
REMOTE	X	
	14	24

* SPRING RETURN TO OFF POSITION WHEN RELEASED.



LEGEND:

LDS LOCAL DISCONNECT SWITCH
LCS LOCAL CONTROL STATION
——— MCC WIRING
– – – – WIRING EXTERNAL TO MCC

TERMINALS:

(X) MCC STARTER
▽ SAFETY RELAY PANEL OR E-STOP
(X) LOCAL CONTROL STATION
[X] MOTOR

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2		UPDATE	MA-12-11	E.B.	T.Pa.	C.C.
1		ADD FUSE & CHANGE SEC. CONTACT OF LDS FROM NO INTO NC	DE-02-10	F.P.	E.B.	C.C.

DRAWING NUMBER | TITLE | REFERENCES | REVISIONS

NOTES

STATUS: FOR DESIGN

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DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA a|i|tech Inc. Département Ingénierie / Engineering Department, 5600 TransCanada, Baie-Lavaltrie, Québec, J5Z 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MZAC-0002-M1
ELECTRICAL SCHEMATIC DIAGRAM

MA'ADEN

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—	—	A3-		-AZ	

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R3 ROLLER CONVEYOR AFTER SEALING STATION STARTER 4481-MJR0-0006-M1-ST

POWER 460Vca 3PH / 60Hz
L1 (RED)
L2 (YELLOW)
L3 (BLUE)
Q1 4A
K1 9A
F1 1A---5A OVERLOAD RELAY
4481-MJR0-0006-M1-LDS 63A
MOTOR 4481-MJR0-0006-M1 1,1 KW
BRAKE
SEE DWG. 1347-55253 25457-4480-V1A-MXA0-0102
4481-CP-1000 (PLC PANEL)
EMERGENCY STOP RELAY 76-CR19
F2 1A
F3 1A
SEE DWG. 1347-55287 25457-4480-V1A-MXA0-0102 LINE 08
4481MJR00006M1-V+
24Vdc
4481MJR00006M1-V-
4481-MJR0-0006-LCS-01
SAFETY KEY 92-CR16
STOP
JOG
OFF
REMOTE
RUN FOR. RELAY
RUN COMMAND
REMOTE MODE
LDS ON
SAFETY INT. OFF
ENABLE
MOTOR RUNNING
MOTOR TRIPPED

LEGEND:
LDS LOCAL DISCONNECT SWITCH
LCS LOCAL CONTROL STATION
MCC WIRING
WIRING EXTERNAL TO MCC

TERMINALS:
MCC STARTER
SAFETY RELAY PANEL OR E-STOP
LOCAL CONTROL STATION
MOTOR

K1: 13-14 (17); 21-22 (18); 33-34 (19); 43-44 (SPARE)
K2: 13-14 (4); 23-24 (SPARE)

LCS	13	23
JOG		X
OFF		
REMOTE	X	
	14	24

* SPRING RETURN TO OFF POSITION WHEN RELEASED.

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4 ☐ Revise not required. Work may proceed.
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		2		UPDATE	MA-12-11	E.B.	T.Po.	C.C.
		1		ADD FUSE & CHANGE SEC. CONTACT OF LDS FROM NO INTO NC	DE-02-10	F.P.	E.B.	C.C.

NOTES

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ENG. GROUP SUP. DATE:	DRAWING SCALE: NONE

Vendor or Subcontractor Logo: GNA a|j tech Inc. Département Ingénierie Engineering Department 9495 Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No | SUBD. | DISC. | SECTOR | SEQUENCE | REV.
25457-00AZ- xx - xxxx - xxxx - xxx - xxx

SELLER DRAWING No. 1347-55660 REV. 2

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MJR0-0006-M1
ELECTRICAL SCHEMATIC DIAGRAM

MA'ADEN

Type | Building | Discipline | Phase | Format | Sequential | Location | Rev. No.
— | — | — | — | A3- | -AZ

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R5 ROLLER CONVEYOR AT COOLING & TURNING STATION STARTER 4481-MJR0-0008-M1-ST

POWER 460Vca 3PH / 60Hz
L1 (RED)
L2 (YELLOW)
L3 (BLUE)
Q1 4A
K1 9A
F1 1A---5A OVERLOAD RELAY
4481-MJR0-0008-M1-LDS 63A
1L1 1L2 1L3
2L1 2L2 2L3
3L1 3L2 3L3
U1 V1 W1
M 3~
MOTOR 4481-MJR0-0008-M1 1,1 KW
BRAKE
F2 1A
F3 1A
1A 1B
SEE DWG. 1347-55253 25457-4480-V1A-MXA0-0102
4481-CP-1000 (PLC PANEL)
EMERGENCY STOP RELAY 76-CR19
X74
XDI0108 V1+
XDI0108 V1-
4481MJR00008M1-V+
24Vdc
4481MJR00008M1-V-
SEE DWG. 1347-55287 25457-4480-V1A-MXA0-0102 LINE 08

LEGEND:
LDS LOCAL DISCONNECT SWITCH
LCS LOCAL CONTROL STATION
MCC WIRING
WIRING EXTERNAL TO MCC

TERMINALS:
MCC STARTER
SAFETY RELAY PANEL OR E-STOP
LOCAL CONTROL STATION
MOTOR

K1: 13-14 (17); 21-22 (18); 33-34 (19); 43-44 (SPARE)
K2: 13-14 (4); 23-24 (SPARE)

4481-MJR0-0008-LCS-01
SAFETY INTERLOCK 92-CR16
4481-MJR0 0008-M1-LDS
STOP
JOG
OFF
REMOTE
RUN FOR. RELAY K2
4481-CP-1000 (PLC PANEL)
DO0005.7 RUN COMMAND
DI0108.0 REMOTE MODE
DI0108.1 LDS ON
DI0108.2 SAFETY INT. OFF
DI0108.3 ENABLE
DI0108.4 MOTOR RUNNING
MOTOR RUNNING W
MOTOR TRIPPED Y
V-

LCS	13	23
JOG		X
OFF		
REMOTE	X	
	14	24

* SPRING RETURN TO OFF POSITION WHEN RELEASED.

4481-MJR0-0008-LCS-01: (9) JOG; (10) OFF; REMOTE; (9) STOP

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Discipline :
Document No : 25457-4480-V1A-MXA0-0317 Rev. :

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SELLER DRAWING No. 1347-55670 REV. 2

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		2		UPDATE	MA-12-11	E.B.	T.Po.	C.C.
		1		ADD FUSE & CHANGE SEC. CONTACT OF LDS FROM NO INTO NC	DE-02-10	F.P.	E.B.	C.C.
		REVISIONS						

NOTES

STATUS: FOR DESIGN

DRAWN/DES'D: F.P. DATE: 10/11/2010	AREA ENG.: DATE:
CHECKED: E.B. DATE:	PRJ ENG MGR: DATE:
RESPONSIBLE ENG. M.B. DATE:	CLIENT: DATE:
ENG. GROUP SUP. DATE:	DRAWING SCALE: NONE

Vendor or Subcontractor Logo: GNA a.b.tech Inc. Département Ingénierie Engineering Department 9495 Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No | SUBD. | DISC. | SECTOR | SEQUENCE | REV.
25457-00AZ- xx - xxxx - xxxx - xxx - xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MJR0-0008-M1
ELECTRICAL SCHEMATIC DIAGRAM

MA'ADEN معادن

Type — | Building — | Discipline — | Phase — | Format A3- | Sequential — | Location -AZ | Rev. No.

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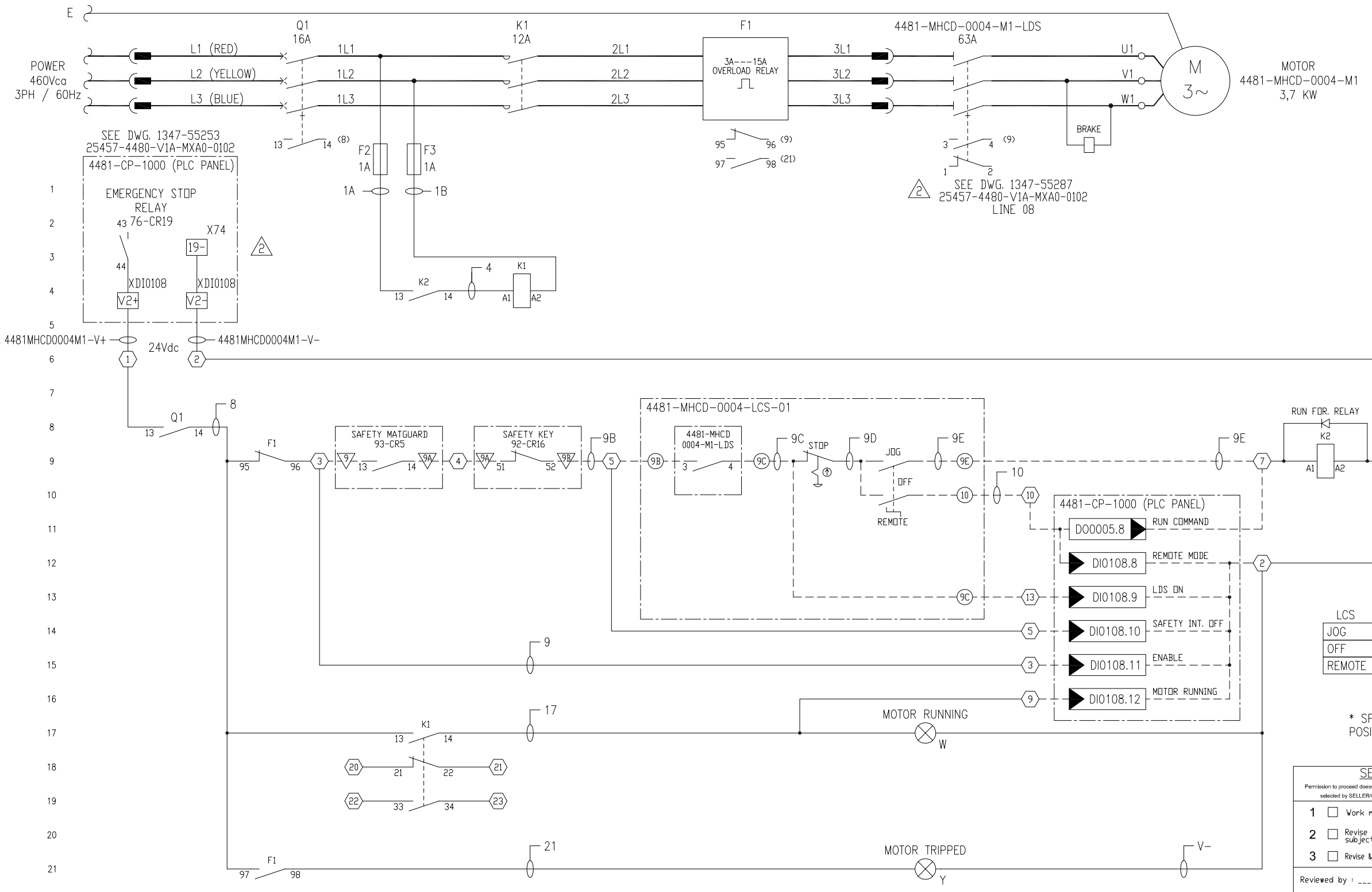
C4 CHAIN CONVEYOR FOR SEALED CATHODE STARTER 4481-MHCD-0004-M1-ST

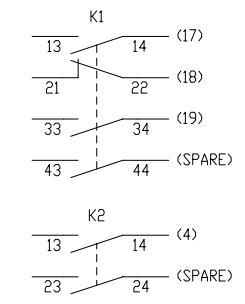


LEGEND:

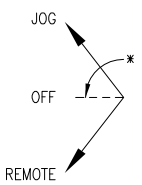
LDS	LOCAL DISCONNECT SWITCH
LCS	LOCAL CONTROL STATION
———	MCC WIRING
- - - -	WIRING EXTERNAL TO MCC

TERMINALS:

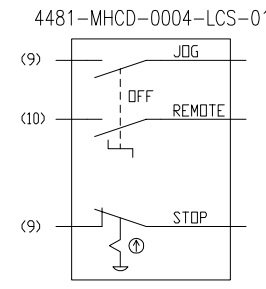
- (X) MCC STARTER
- ▽ SAFETY RELAY PANEL OR E-STOP
- (X) LOCAL CONTROL STATION
- [X] MOTOR



LCS	13	23
JOG		X
OFF		
REMOTE	X	
	14	24



* SPRING RETURN TO OFF POSITION WHEN RELEASED.



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Discipline :

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DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		2		UPDATE	MA-12-11	E.B.	T.Pa.	C.C.
		1		ADD FUSE & CHANGE SEC. CONTACT OF LDS FROM NO INTO NC	DE-02-10	F.P.	E.B.	C.C.
		REVISIONS						

NOTES

STATUS: FOR DESIGN

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ENG. GROUP SUP. DATE:	DRAWING SCALE: NONE

Vendor or Subcontractor Logo: GNA a|e|tech Inc. Département Ingénierie Engineering Department 9495 Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MHCD-0004-M1
ELECTRICAL SCHEMATIC DIAGRAM

MA'ADEN

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
—	—	—		A3-	—AZ		

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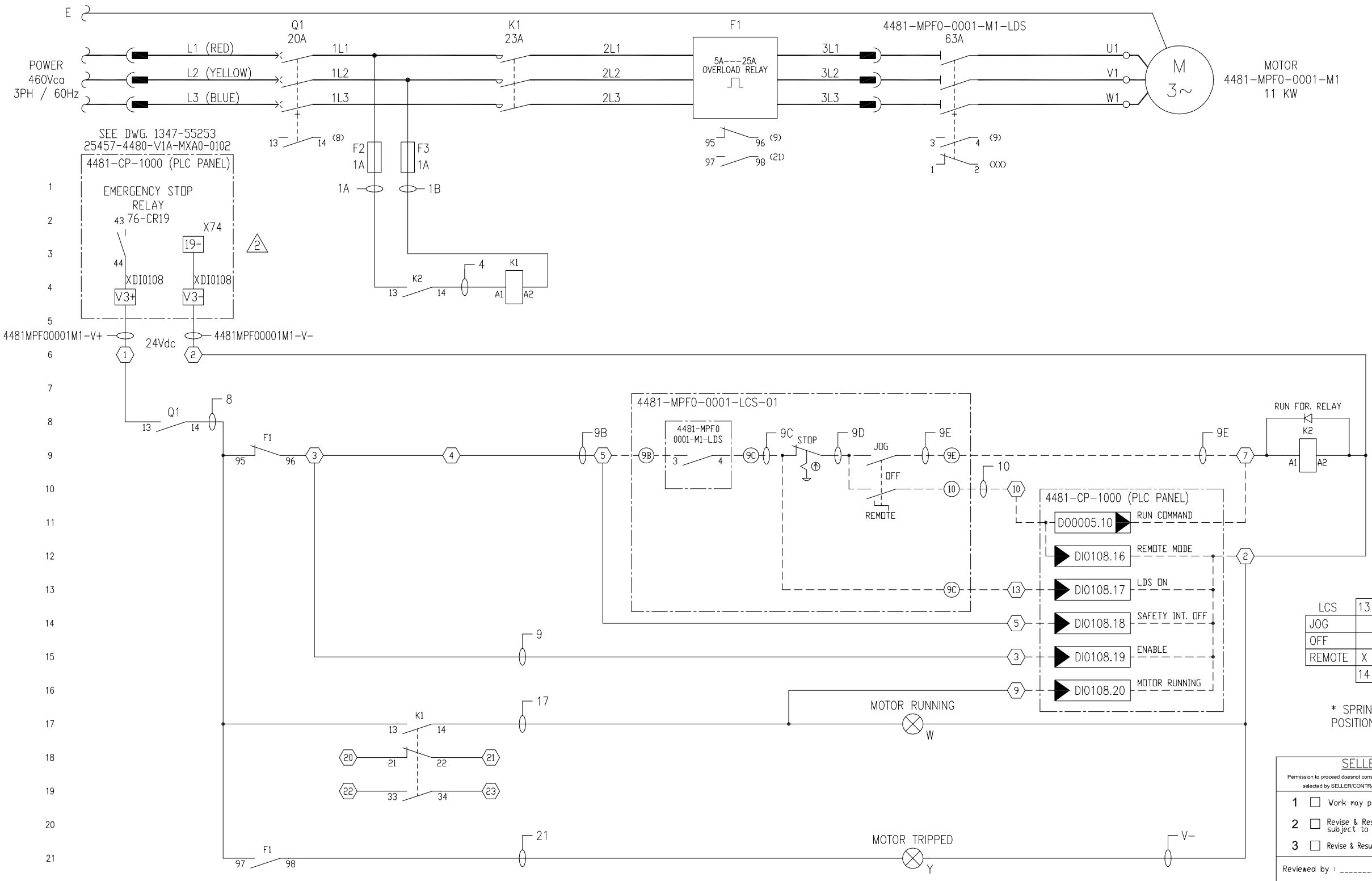
H1 HYDRAULIC POWER UNIT
PUMP A
STARTER
4481-MPF0-0001-M1-ST

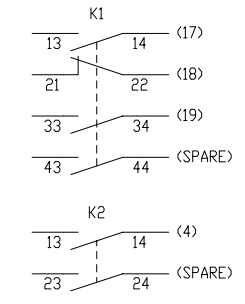


LEGEND:

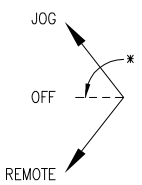
LDS	LOCAL DISCONNECT SWITCH
LCS	LOCAL CONTROL STATION
———	MCC WIRING
– – – –	WIRING EXTERNAL TO MCC

TERMINALS:

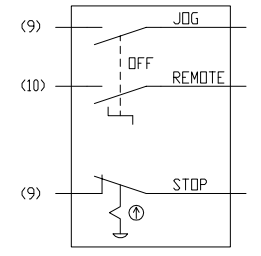
- (X) MCC STARTER
- ▽ SAFETY RELAY PANEL OR E-STOP
- (X) LOCAL CONTROL STATION
- [X] MOTOR



LCS	13	23
JOG		X
OFF		
REMOTE	X	
	14	24



* SPRING RETURN TO OFF POSITION WHEN RELEASED.



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REFERENCES		2		UPDATE	MA-12-11	E.B.	T.Po.	C.C.
		1		ADD FUSE & CHANGE SEC. CONTACT OF LDS FROM NO INTO NC	DE-02-10	F.P.	E.B.	C.C.
		REVISIONS						

NOTES

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RESPONSIBLE ENG. M.B. DATE:	CLIENT: DATE:
ENG. GROUP SUP. DATE:	DRAWING SCALE: NONE

Vendor or Subcontractor Logo: GNA a.b.tech Inc. — Département Ingénierie Engineering Department 9495 Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MPF0-0001-M1
ELECTRICAL SCHEMATIC DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx –	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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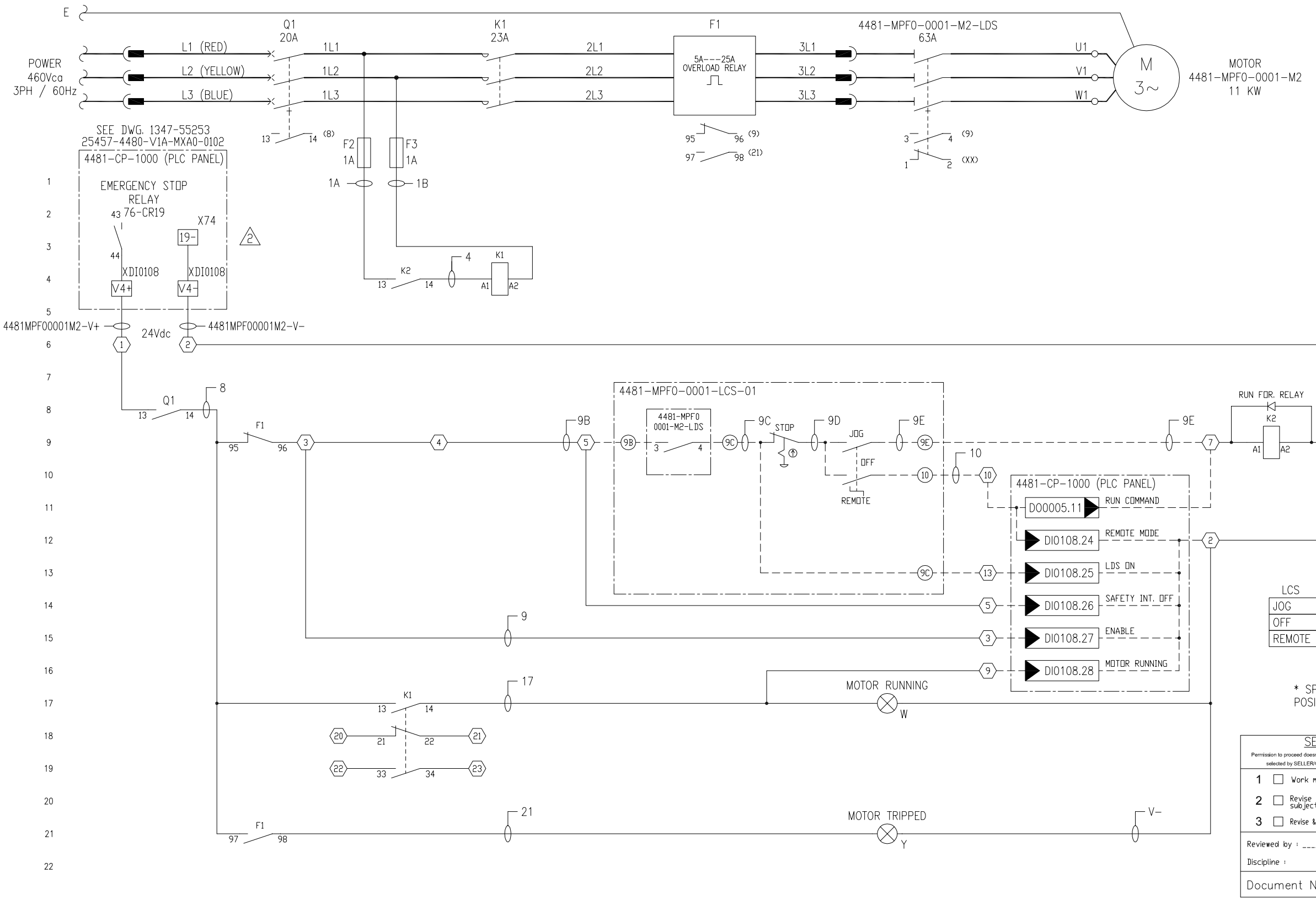
H1 HYDRAULIC POWER UNIT
PUMP B
STARTER
4481-MPF0-0001-M2-ST

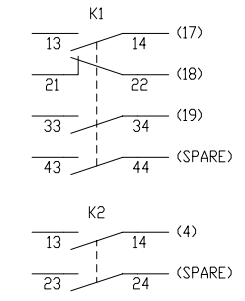


LEGEND:

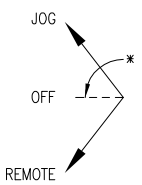
LDS	LOCAL DISCONNECT SWITCH
LCS	LOCAL CONTROL STATION
———	MCC WIRING
- - - -	WIRING EXTERNAL TO MCC

TERMINALS:

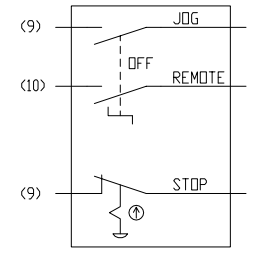
- (X) MCC STARTER
- ▽ SAFETY RELAY PANEL OR E-STOP
- (X) LOCAL CONTROL STATION
- [X] MOTOR



LCS	13	23
JOG		X
OFF		
REMOTE	X	
	14	24



* SPRING RETURN TO OFF POSITION WHEN RELEASED.



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REFERENCES		REVISIONS						
DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
		2		UPDATE	MA-12-11	E.B.	T.Po.	C.C.
		1		ADD FUSE & CHANGE SEC. CONTACT OF LDS FROM NO INTO NC	DE-02-10	F.P.	E.B.	C.C.

NOTES

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DATE:	DATE:
ENG. GROUP SUP.	DRAWING SCALE: NONE
DATE:	

Vendor or Subcontractor Logo: GNA a.b.tech Inc. — Département Ingénierie / Engineering Department, 9495 Trans-Canada, Saint-Laurent, Québec, H4S 1V3, Canada — BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SELLER DRAWING No. 1347-55691 | REV. 2

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MPF0-0001-M2
ELECTRICAL SCHEMATIC DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-	00AZ-	xx -	xxxx -	xxxx -	xxx — xxx

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
—	—	—		A3-		-AZ	

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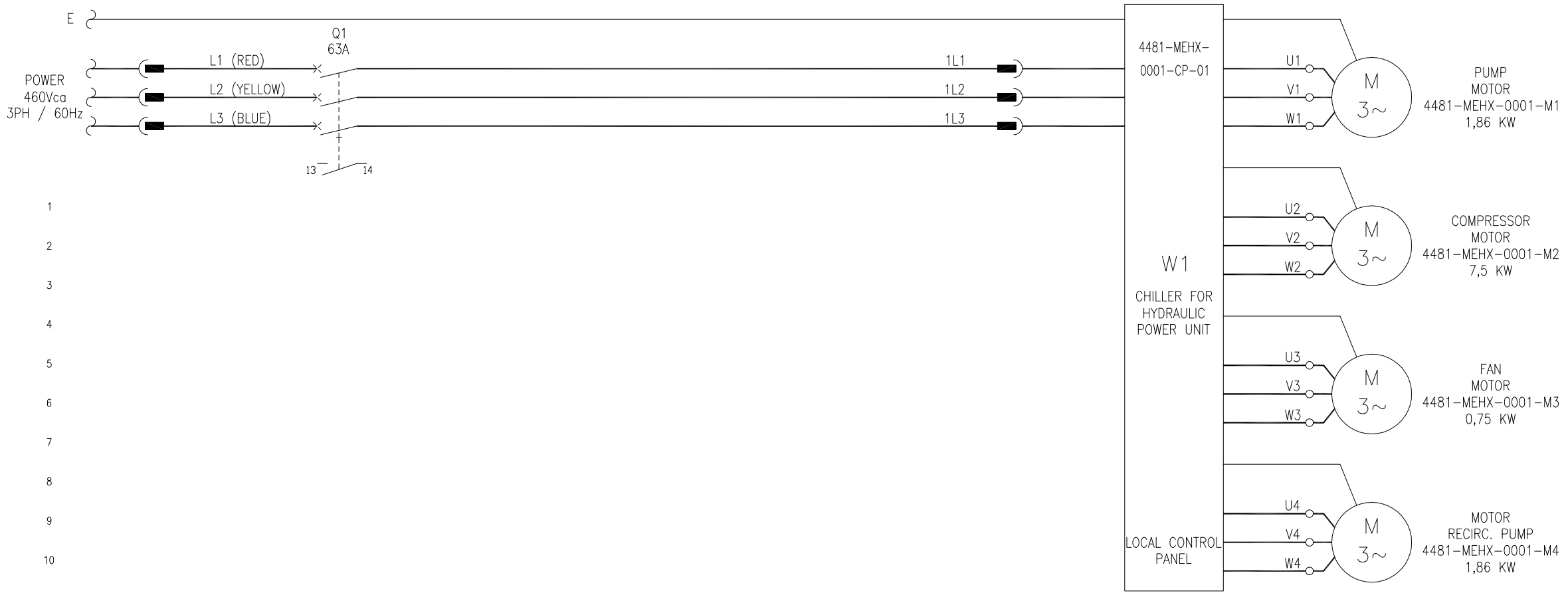
W1 CHILLER FOR HYDRAULIC POWER UNIT STARTER 4481-MEHX-0001-W1-ST



LEGEND:

LDS	LOCAL DISCONNECT SWITCH
LCS	LOCAL CONTROL STATION
———	MCC WIRING
– – – –	WIRING EXTERNAL TO MCC

TERMINALS:

- (X) MCC STARTER
- ▽ SAFETY RELAY PANEL OR E-STOP
- (X) LOCAL CONTROL STATION
- [X] MOTOR

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DATE:	DATE:
ENG. GROUP SUP.	DRAWING SCALE: NONE
DATE:	

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BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx –	xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTORS 4481-MEHX-0001-M1/M2/M3/M4
ELECTRICAL SCHEMATIC DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
–		–	–	A3–		–AZ	

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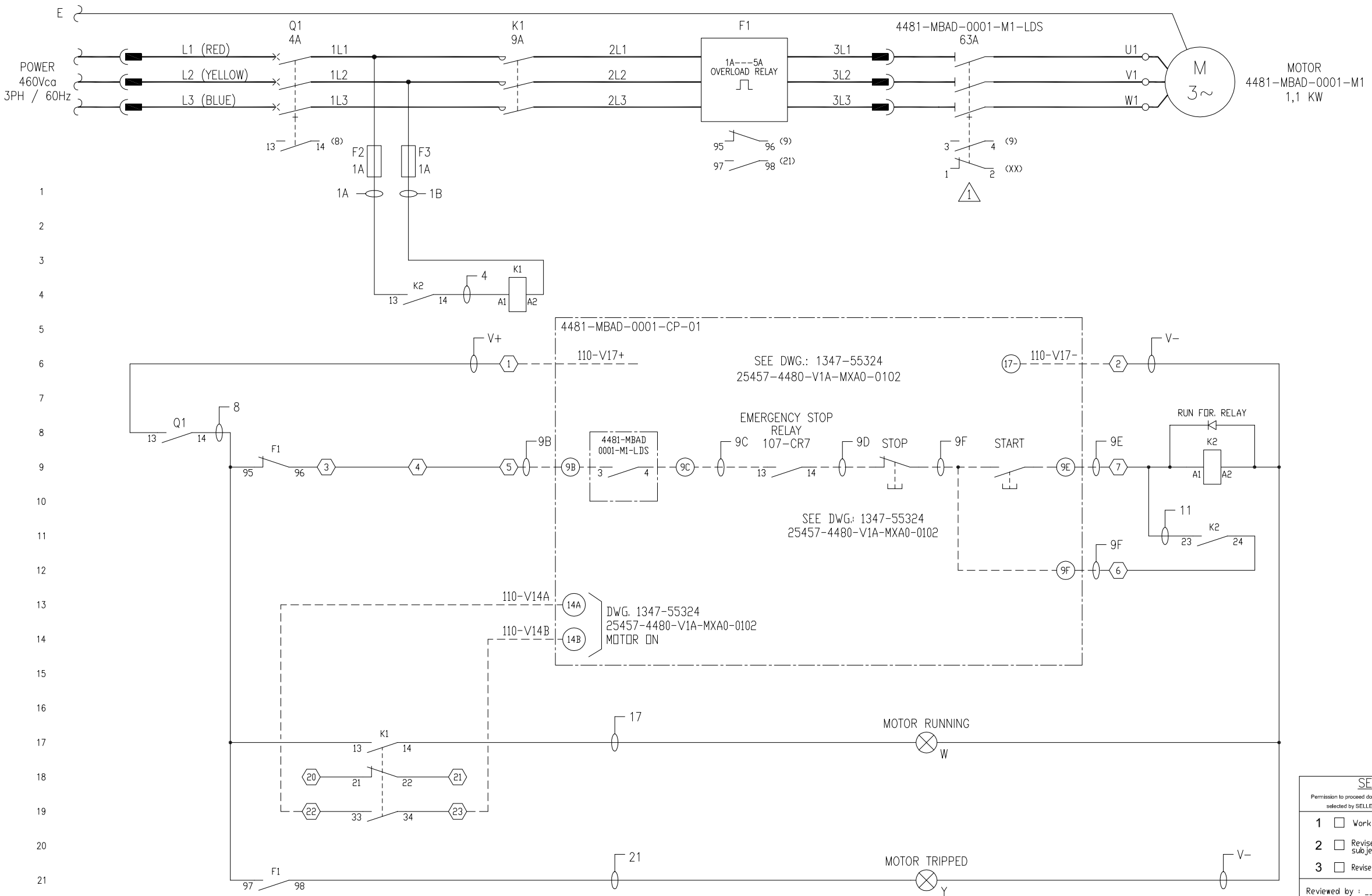
F3 LADLE PRE-HEATING COMBUSTION FAN STARTER 4481-MBAD-0001-M1-ST

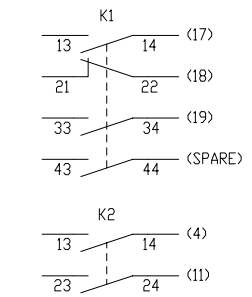


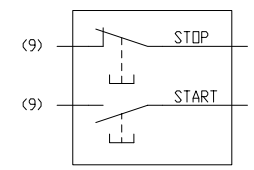
LEGEND:

LDS	LOCAL DISCONNECT SWITCH
CP	CONTROL PANEL
———	MCC WIRING
- - - -	WIRING EXTERNAL TO MCC

TERMINALS:

- (X) MCC STARTER
- ▽ SAFETY RELAY PANEL OR E-STOP
- (X) CONTROL PANEL
- [X] MOTOR





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SELLER DRAWING No.	REV.
1347-55710	1

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REFERENCES — REVISIONS

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DATE:		DATE:	
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DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA eLtech Inc. — Département Ingénierie / Engineering Department, 9690 Trans-Canada, Saint-Laurent, Québec, H4S 1J9, Canada

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MBAD-0001-M1
ELECTRICAL SCHEMATIC DIAGRAM

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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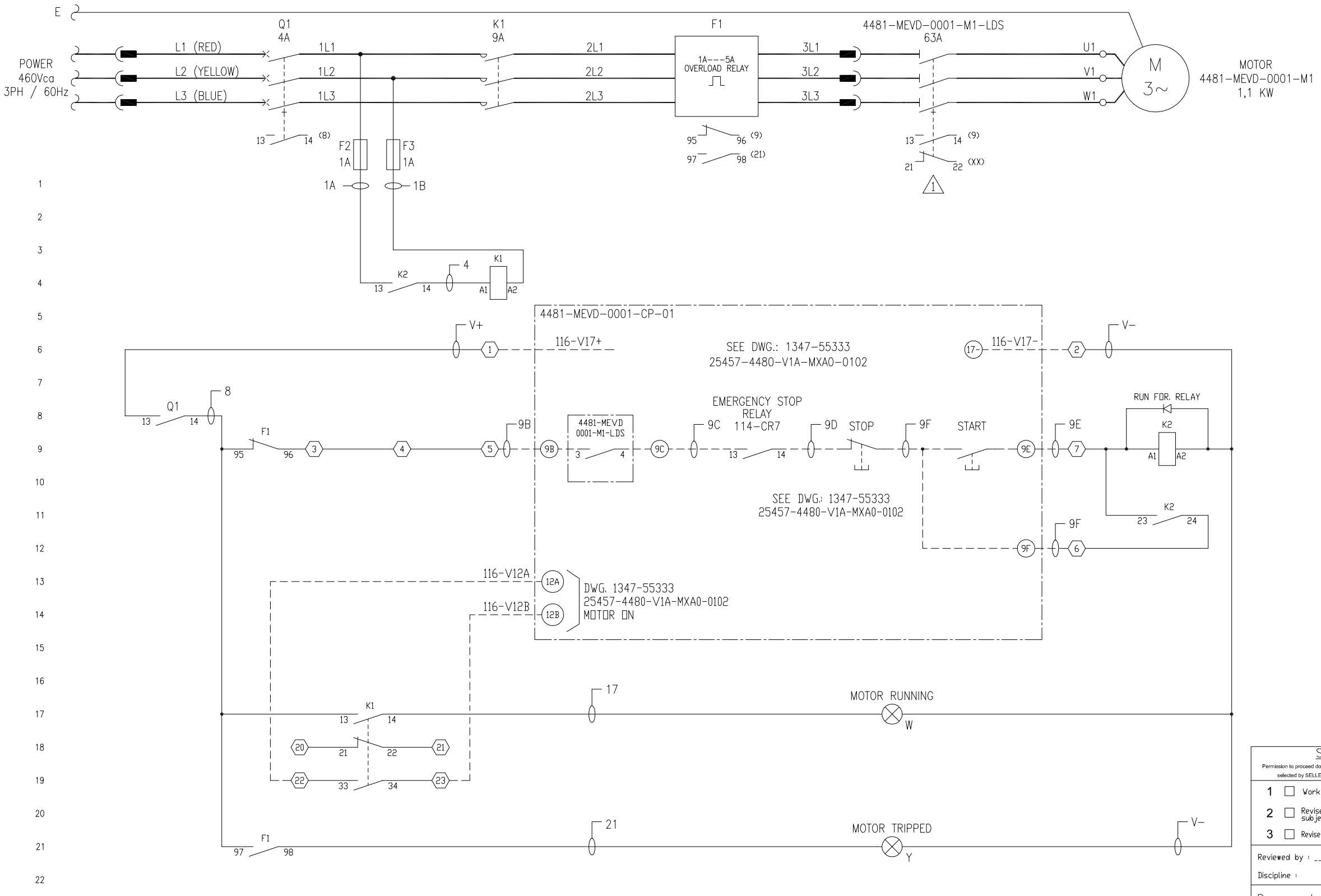
F4A CAST IRON INGOT DRYING STATION A COMBUSTION FAN STARTER 4481-MEVD-0001-M1-ST

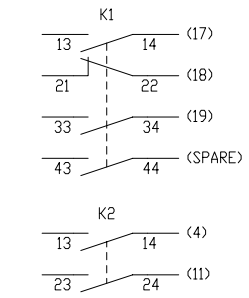


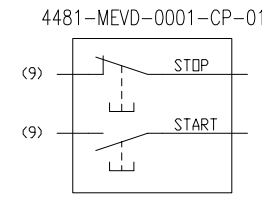
LEGEND:

LDS	LOCAL DISCONNECT SWITCH
CP	CONTROL PANEL
———	MCC WIRING
- - - -	WIRING EXTERNAL TO MCC

TERMINALS:

- (X) MCC STARTER
- ▽ SAFETY RELAY PANEL OR E-STOP
- (X) CONTROL PANEL
- [X] MOTOR





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Discipline :

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SELLER DRAWING No.	REV.
1347-55720	1

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MEVD-0001-M1
ELECTRICAL SCHEMATIC DIAGRAM

No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
1		ADD FUSE & CHANGE SEC. CONTACT OF LDS FROM NO INTO NC	DE-02-10	F.P.	E.B.	C.C.

DRAWING NUMBER | TITLE | REFERENCES | REVISIONS

NOTES

STATUS: FOR DESIGN

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CHECKED:	E.B.	PRJ ENG MGR:	
DATE:		DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA a.j.tech Inc. — Département Ingénierie / Engineering Department — 9690 TransCanada, Bâtiment/Building 1, Saint-Laurent, Québec, Canada H4S 1V3

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

MA'ADEN ALCOA

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-	00AZ-	xx -	xxxx -	xxxx -	xxx — xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—		—	—	A3—		—AZ	

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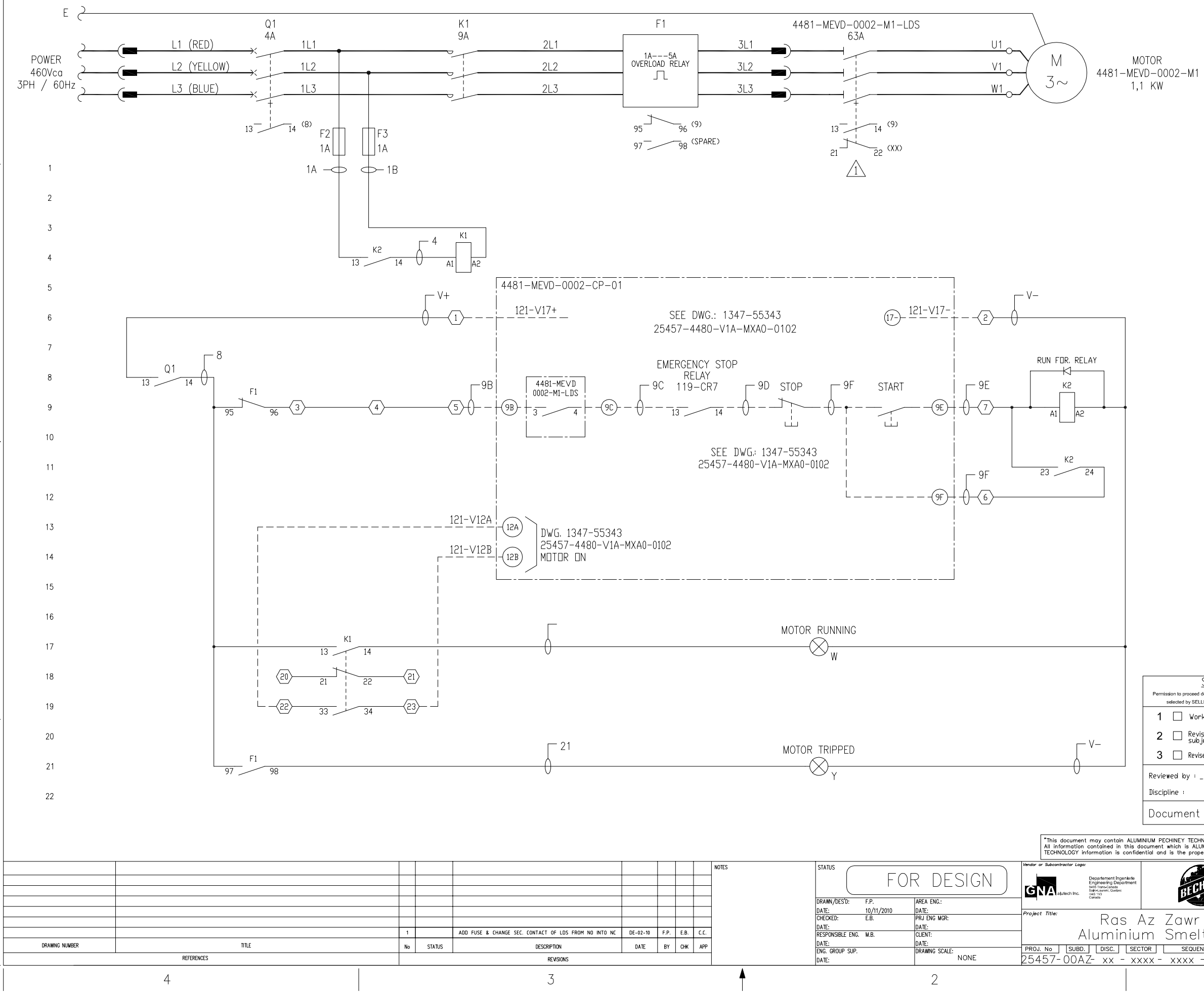
F4B CAST IRON INGOT DRYING STATION B COMBUSTION FAN STARTER 4481-MEVD-0002-M1-ST

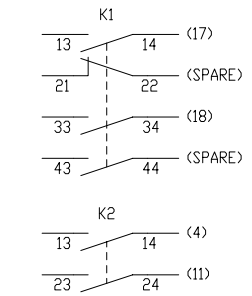


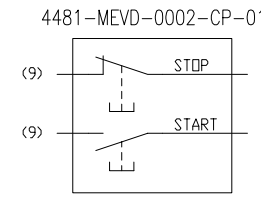
LEGEND:

LDS	LOCAL DISCONNECT SWITCH
CP	CONTROL PANEL
———	MCC WIRING
– – – –	WIRING EXTERNAL TO MCC

TERMINALS:

- (X) MCC STARTER
- ▽ SAFETY RELAY PANEL OR E-STOP
- (X) CONTROL PANEL
- [X] MOTOR





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Discipline :

Document No : 25457-4480-V1A-MXA0-0335 | Rev. : 0

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1347-55730	1

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1		ADD FUSE & CHANGE SEC. CONTACT OF LDS FROM NO INTO NC	DE-02-10	F.P.	E.B.	C.C.

DRAWING NUMBER | TITLE | REFERENCES | REVISIONS

NOTES

STATUS: FOR DESIGN

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DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA alutech Inc. Département Ingénierie / Engineering Department, 9690 TransCanada, Baie-Lavaltrie, Québec, J5Z 1V2, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MEVD-0002-M1
ELECTRICAL SCHEMATIC DIAGRAM

MA'ADEN

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx –	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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F3B LADLE PRE-HEATING COMBUSTION FAN STARTER 4481-MBAD-0002-M1-ST

POWER 460Vca 3PH / 60Hz

L1 (RED)
L2 (YELLOW)
L3 (BLUE)

Q1 4A — 1L1, 1L2, 1L3
K1 9A — 2L1, 2L2, 2L3
F1 1A---5A OVERLOAD RELAY — 3L1, 3L2, 3L3
4481-MBAD-0002-M1-LDS 63A — U1, V1, W1

MOTOR 4481-MBAD-0002-M1 1,1 KW

13 14 (8)
95 96 (9)
97 98 (21)
3 4 (9)
1 2 (XX)

F2 1A
F3 1A
1A — 1B

K2 13 14
4
K1 A1 A2

4481-MBAD-0002-CP-01

V+ 1
127-V17+
SEE DWG.: 1347-55354
25457-4480-V1A-MXA0-0102
17 127-V17-
V- 2

Q1 13 14 8
F1 95 96 3
4 5 9B
9B 4481-MBAD 0002-M1-LDS 3 4 9C
9C 13 14 9D
EMERGENCY STOP RELAY 124-CR7
9D STOP 9F
START 9E
9E 7
RUN FDR. RELAY K2 A1 A2

SEE DWG.: 1347-55354
25457-4480-V1A-MXA0-0102

11 K2 23 24
9F 6

127-V14A 14A
127-V14B 14B
DWG. 1347-55354
25457-4480-V1A-MXA0-0102
MOTOR ON

K1 13 14
20 21 22
22 33 34 23

17
MOTOR RUNNING
W

21
MOTOR TRIPPED
Y

F1 97 98
V-

LEGEND:

LDS LOCAL DISCONNECT SWITCH
CP CONTROL PANEL
MCC WIRING
WIRING EXTERNAL TO MCC

TERMINALS:

- (X) MCC STARTER
- ▽ SAFETY RELAY PANEL OR E-STOP
- (X) CONTROL PANEL
- [X] MOTOR

K1
13 14 (17)
21 22 (18)
33 34 (19)
43 44 (SPARE)

K2
13 14 (4)
23 24 (11)

4481-MBAD-0002-CP-01
(9) STOP
(9) START

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Discipline :
Document No : 25457-4480-V1A-MXA0- Rev. :

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DATE:	15/08/2011	DATE:	
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DATE:			

Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie Engineering Department 9650 Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SELLER DRAWING No. 1347-55740 REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MBAD-0002-M1
ELECTRICAL SCHEMATIC DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

9.9 Interconnections

DRAWING No.	DESCRIPTION
1347-56000	Cathode Block Oven Heating Elements - Interconnection Elements - 1 of 2
1347-56001	Cathode Block Oven Heating Elements - Interconnection Elements - 2 of 2
1347-56010	Cathode Bar Heating Elements - Interconnection Diagram - 1 of 2
1347-56011	Cathode Bar Heating Elements - Interconnection Diagram - 2 of 2
1347-56020	Utilities and Control Supply - Interconnection Diagram - 1 of 2
1347-56021	Utilities and Control Supply - Interconnection Diagram - 2 of 2
1347-56030	C4 Matguard Interconnection Diagram
1347-56031	C4 R3 Emergency Stop and HYD Valve Switch Interconnection
1347-56032	C1-G1 Emergency Stop Matguard and HYD-V--SW Interconnection Diagram
1347-56033	Central Control Panel 4481-MHCD-0003-CP-01 Interconnection Diagram
1347-56040	R4A Light Curtain Reset Button Safety Gate SW Interconnection Diagram
1347-56041	R4B Light Curtain Reset Button Safety Gate SW Interconnection Diagram
1347-56050	Central Control Panel 4481-CP-1001 Interconnection Diagram
1347-56060	F3 Burner - Interconnection Diagram - 1 of 2
1347-56061	F3 Burner - Interconnection Diagram - 1 of 2
1347-56070	F4 Burner - Interconnection Diagram - 1 of 2
1347-56080	F4 Burner - Interconnection Diagram - 2 of 2
1347-56090	D1 Collector Fan and W1 Chiller Suppy Interconnection Diagram
1347-56100	F3B Burner 1-2 Interconnection Diagram
1347-56101	F3B Burner 2-2 Interconnection Diagram
1347-56250	Motor 4481-MHCD-0002 M1 Interconnection Diagram
1347-56260	Motor 4481-MJR0-0001 M1 Interconnection Diagram
1347-56270	Motor 4481-MZBP-0001 M1 Interconnection Diagram
1347-56271	Motor 4481-MHCD-0001 M3 Interconnection Diagram
1347-56272	Motor 4481-MZBP-0001 M7 Interconnection Diagram
1347-56273	Motor 4481-MZBP-0001 M5 Interconnection Diagram
1347-56273	Motor 4481-MJR0-0003 M1 Interconnection Diagram
1347-56274	Motor 4481-MZBP-0001 M2 Interconnection Diagram
1347-56275	Motor 4481-MZBP-0001 M4 Interconnection Diagram
1347-56276	Motor 4481-MZBP-0001 M6 Interconnection Diagram
1347-56277	Motor 4481-MAC0-0001 M5 Interconnection Diagram
1347-56280	Motor 4481-MJR0-0002 M1 Interconnection Diagram
1347-56290	Motor 4481-MHCD-0003 M1 Interconnection Diagram
1347-56300	Motor 4481-MBMB-0001 M1 Interconnection Diagram
1347-56311	Motor 4481-MBMB-0001 M2 Interconnection Diagram

DRAWING No.	DESCRIPTION
1347-56312	Motor 4481-MBMB-0001 M3 Interconnection Diagram
1347-56313	Motor 4481-MBMB-0001 M4 Interconnection Diagram
1347-56320	Motor 4481-MJR0-0004-M1 Interconnection Diagram
1347-56330	Motor 4481-MQLK- 0001- M1 1 of 2 Interconnection Diagram
1347-56331	Motor 4481-MQLK-0001--M1 2 of 2 Interconnection Diagram
1347-56340	Motor 4481-MHCD-0001--M1 Interconnection Diagram
1347-56350	Motor 4481-MEEP-0001--M1 Interconnection Diagram
1347-56351	Motor 4481-MEEP-0001--M2 Interconnection Diagram
1347-56352	Motor 4481-MEEP-0001--M3 Interconnection Diagram
1347-56360	Motor 4481-MJR0-0005--M1 Interconnection Diagram
1347-56370	Motor 4481-MJR0-0007--M1 Interconnection Diagram
1347-56380	Motor 4481-MZAC-0001-M1 Interconnection Diagram
1347-56390	Motor 4481-MZAC-0002-M1 Interconnection Diagram
1347-56400	Motor 4481-MZAC-0006-M1 Interconnection Diagram
1347-56410	Motor 4481-MJR0--0001-M1 Interconnection Diagram
1347-56420	Motor 4481-MHCD-0004-M1 Interconnection Diagram
1347-56430	Motor 4481-MPF0-0001-M1 Interconnection Diagram
1347-56431	Motor 4481-MPF0-0001-M2 Interconnection Diagram
1347-56450	Motor 4481-MBAD-0001-M1 Interconnection Diagram
1347-56460	Motor 4481-MEVD-0001-M1 Interconnection Diagram
1347-56470	Motor 4481-MEVD-0002-M1 Interconnection Diagram
1347-56480	Motor 481-MBAD-0002-M2 - Electrical Schematic Diagram
1347-57000	Motor Control Panel 4481-ECM1-0001 - 1 of 3 - Single Line Diagram
1347-57010	Motor Control Panel 4481-ECM1-0001 - 2 of 3 - Single Line Diagram
1347-57020	Motor Control Panel 4481-ECM1-0001 - 3 of 3 - Single Line Diagram

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ELECTRICAL ROOM

CATHODE BLOCK OVEN SCR CONTROL PANEL
4480-EVR3-0002

SEE DWG.: 1347-55262
25457-4480-V1A-MXA0-0102

SCR#1
F1 ZONE #1

LIGNE L1 400A — CHARGE T1 — 2L1 — 80-F1 250A — 5L1
1L2 — 250A — 5L2
L3 400A — T3 — 2L3 — 250A — 5L3
L2

COOLING FAN: L1 — (M) — 1, 2, 4(+), 5(-) — L2

SEE DWG.: 1347-55262
25457-4480-V1A-MXA0-0102

SCR#2
F1 ZONE #2

LIGNE L1 400A — CHARGE T1 — 3L1 — 80-F2 250A — 6L1
1L2 — 250A — 6L2
L3 400A — T3 — 3L3 — 250A — 6L3
L2

COOLING FAN: L1 — (M) — 1, 2, 4(+), 5(-) — L2

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Discipline :

Document No : 25457-4480-V1A-MXA0-0371 | Rev. :

JUNCTION BOX
4481-MEEP-0001-JB-11

4481-MEEP-0001-JB-11-P1
2 RUNS (3C x 120mm2) +G
1

5L1 → 1: 5L1-1, 5L1-2, 5L1-1, 5L1-2, 5L1-1, 5L1-2
5L2 → 2: 5L2-1, 5L2-2, 5L2-1, 5L2-2, 5L2-1, 5L2-2
5L3 → 3: 5L3-1, 5L3-2, 5L3-1, 5L3-2, 5L3-1, 5L3-2

JUNCTION BOX
4481-MEEP-0001-JB-12

4481-MEEP-0001-JB-12-P1
2 RUNS (3C x 120mm2) +G
1

6L1 → 1: 6L1-1, 6L1-2, 6L1-1, 6L1-2, 6L1-1, 6L1-2
6L2 → 2: 6L2-1, 6L2-2, 6L2-1, 6L2-2, 6L2-1, 6L2-2
6L3 → 3: 6L3-1, 6L3-2, 6L3-1, 6L3-2, 6L3-1, 6L3-2

FIELD

4481-MEEP-0001-E1-P1 (6C x 16mm2) +G — 5L1-1, 5L2-1, 5L3-1 / 5L1-2, 5L2-2, 5L3-2
F1 ZONE#1
4481-MEEP-0001-E1
CATHODE BLOCK OVEN
HEATING ELEMENTS
54 KW

4481-MEEP-0001-E2-P1 (6C x 16mm2) +G — 5L1-1, 5L2-1, 5L3-1 / 5L1-2, 5L2-2, 5L3-2
F1 ZONE#1
4481-MEEP-0001-E2
CATHODE BLOCK OVEN
HEATING ELEMENTS
54 KW

4481-MEEP-0001-E3-P1 (6C x 16mm2) +G — 5L1-1, 5L2-1, 5L3-1 / 5L1-2, 5L2-2, 5L3-2
F1 ZONE#1
4481-MEEP-0001-E3
CATHODE BLOCK OVEN
HEATING ELEMENTS
54 KW

4481-MEEP-0001-E4-P1 (6C x 16mm2) +G — 6L1-1, 6L2-1, 6L3-1 / 6L1-2, 6L2-2, 6L3-2
F1 ZONE#2
4481-MEEP-0001-E4
CATHODE BLOCK OVEN
HEATING ELEMENTS
54 KW

4481-MEEP-0001-E5-P1 (6C x 16mm2) +G — 6L1-1, 6L2-1, 6L3-1 / 6L1-2, 6L2-2, 6L3-2
F1 ZONE#2
4481-MEEP-0001-E5
CATHODE BLOCK OVEN
HEATING ELEMENTS
54 KW

4481-MEEP-0001-E6-P1 (6C x 16mm2) +G — 6L1-1, 6L2-1, 6L3-1 / 6L1-2, 6L2-2, 6L3-2
F1 ZONE#2
4481-MEEP-0001-E6
CATHODE BLOCK OVEN
HEATING ELEMENTS
54 KW

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REFERENCES — REVISIONS

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DATE:		DATE:	
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DATE:			

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Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No | SUBD. | DISC. | SECTOR | SEQUENCE | REV.
25457-00AZ- xx - xxxx - xxxx - xxx – xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CATHODE BLOCK OVEN HEATING ELEMENTS (1/2)
INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type | Building | Discipline | Phase | Format | Sequentiel | Location | Rev. No.
– | – | – | – | A3– | –AZ

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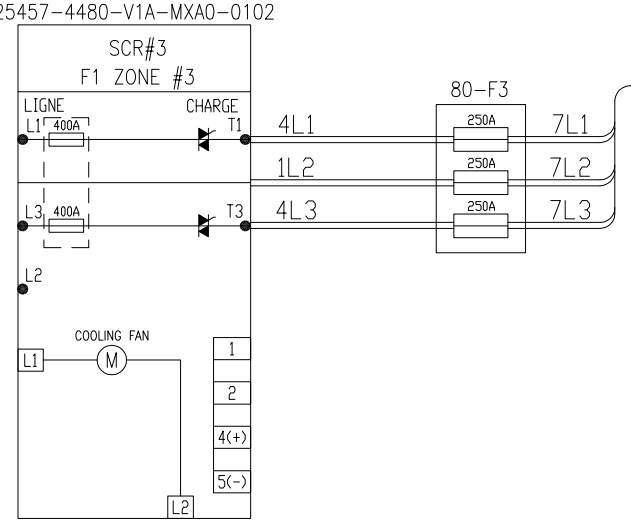
ELECTRICAL ROOM

CATHODE BLOCK OVEN SCR CONTROL PANEL
4480-EVR3-0002

SEE DWG.: 1347-55262
25457-4480-V1A-MXA0-0102



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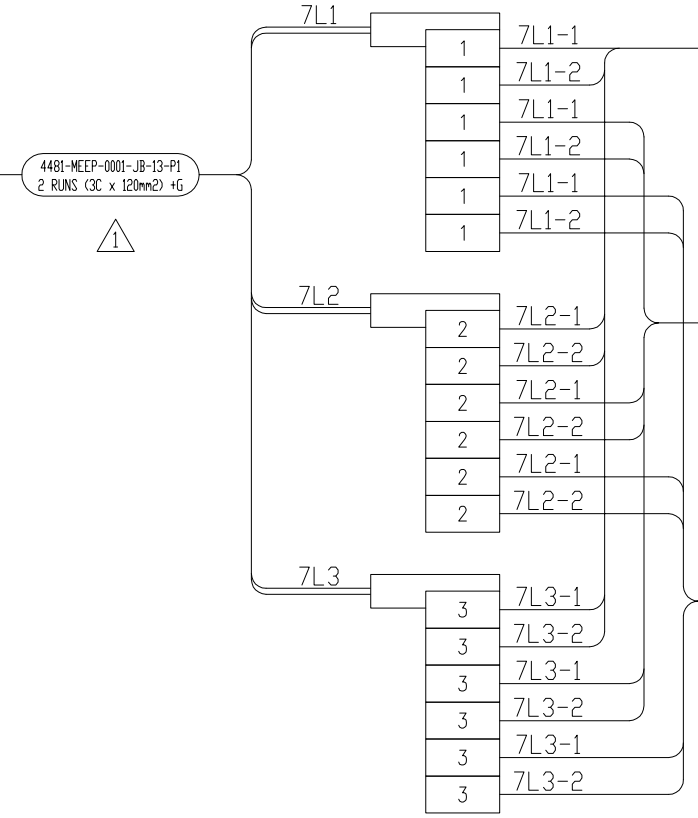

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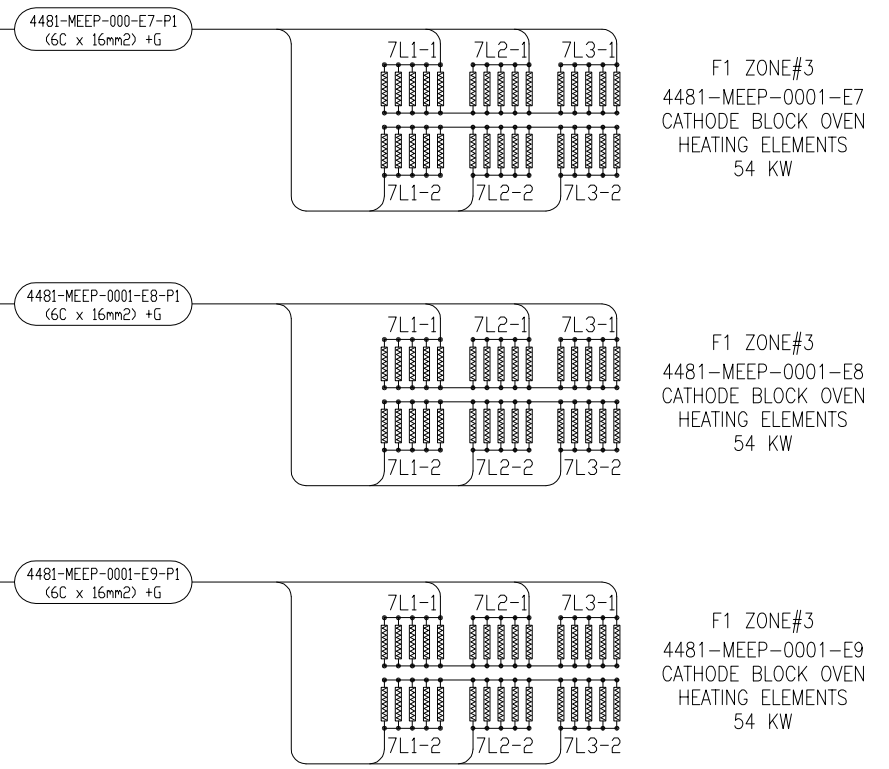

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Discipline :

Document No : 25457-4480-V1A-MXA0-0372 | Rev. :

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DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie / Engineering Department, 1000 rue Nicholas, Saint-Laurent, Québec H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No | SUBD. | DISC. | SECTOR | SEQUENCE | REV.
25457-00AZ- xx - xxxx - xxxx - xxx — xxx

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SELLER DRAWING No. 1347-56001 | REV. 1

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CATHODE BLOCK OVEN HEATING ELEMENTS (2/2)
INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type | Building | Discipline | Phase | Format | Sequential | Location | Rev. No.
— — — — A3— —AZ

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ELECTRICAL ROOM

CATHODE BAR HEATING F. SCR CONTROL PANEL
4480-EVR3-0001

SEE DWG.: 1347-55272
25457-4480-V1A-MXA0-0102

SCR #1
F2 ZONE#1

LIGNE / CHARGE
L1 400A T1 — 2L1 — 83-CT11 (Bk / Wh) — 83-F1 300A — 6L1
L2 400A T2 — 2L2 — 300A — 6L2
L3 400A T3 — 2L3 — 83-CT13 (Bk / Wh) — 300A — 6L3

TB-3: C1, C2
T1: 1, 2, 3, 4, 5
Red, Bk

COOLING FAN: L1, M, L2
1, 2, 4(+), 5(-)

4481-MBMB-0001-JB-11-P1
2 RUNS (3C x 185mm2) +G
⚠1

SEE DWG.: 1347-55272
25457-4480-V1A-MXA0-0102

SCR #2
F2 ZONE#2

LIGNE / CHARGE
L1 400A T1 — 3L1 — 83-CT21 (Bk / Wh) — 83-F2 300A — 7L1
L2 400A T2 — 3L2 — 300A — 7L2
L3 400A T3 — 3L3 — 83-CT23 (Bk / Wh) — 300A — 7L3

TB-3: C1, C2
T1: 1, 2, 3, 4, 5
Red, Bk

COOLING FAN: L1, M, L2
1, 2, 4(+), 5(-)

4481-MBMB-0001-JB-12-P1
2 RUNS (3C x 185mm2) +G
⚠1

JUNCTION BOX
4481-MBMB-0001-JB-11

6L1 — 4481-MBMB-0001-E1A-P1 (2C x 70mm2) 200°C
6L2 — 4481-MBMB-0001-E1B-P1 (2C x 70mm2) 200°C
6L3 — 4481-MBMB-0001-E1C-P1 (2C x 70mm2) 200°C

JUNCTION BOX
4481-MBMB-0001-JB-12

7L1 — 4481-MBMB-0001-E2A-P1 (2C x 70mm2) 200°C
7L2 — 4481-MBMB-0001-E2B-P1 (2C x 70mm2) 200°C
7L3 — 4481-MBMB-0001-E2C-P1 (2C x 70mm2) 200°C

FIELD

ZONE#1 (240KW)
TOP: COM, 6L1, 6L2, 6L3
BOTTOM: COM, 6L1, 6L2, 6L3
SIDE 1 / SIDE 2

ZONE#2 (240KW)
TOP: COM, 7L1, 7L2, 7L3
BOTTOM: COM, 7L1, 7L2, 7L3
SIDE 1 / SIDE 2

SELLER/CONTRACTOR DOCUMENT REVIEW

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DDR Nbr : 172

Reviewed by : _____ Date : _____

Discipline :

Document No : 25457-4480-V1A-MXA0-0373 | Rev. :

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No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
1		UPDATE	10-MA-2011	F.P.	E.B.	C.C.

DRAWING NUMBER | TITLE | REFERENCES | REVISIONS

NOTES

STATUS: FOR DESIGN

DRAWN/DES'D:	F.P.	AREA ENG.:	
DATE:	25/08/2010	DATE:	
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DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA a.j.tech Inc. — Departement Ingenierie / Engineering Department, 9690 TransCanada, Saint-Laurent, Quebec, H4S 1V3, Canada

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No | SUBD. | DISC. | SECTOR | SEQUENCE | REV.
25457-00AZ- xx - xxxx - xxxx - xxx — xxx

SELLER DRAWING No.: 1347-56010 | REV.: 1

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CATHODE BAR HEATING ELEMENTS (1/2)
INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type | Building | Discipline | Phase | Format | Sequentiel | Location | Rev. No.
— | — — | — | A3— | —AZ

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ELECTRICAL ROOM

CATHODE BAR HEATING F. SCR CONTROL PANEL
4480-EVR3-0001

SEE DWG.: 1347-55273
25457-4480-V1A-MXA0-0102

SCR #3
F2 ZONE#3

LIGNE / CHARGE
L1 400A T1 — 4L1 — 83-CT31 (Bk / Wh) — 83-F3 300A — 8L1
L2 400A T2 — 4L2 — 300A — 8L2
L3 400A T3 — 4L3 — 83-CT33 (Bk / Wh) — 300A — 8L3

TB-3: C1, C2
T1: 1, 2, 3, 4, 5 (Red, Bk)
COOLING FAN: L1, M, L2 — 1, 2, 4(+), 5(-)

4481-MBMB-0001-JB-13-P1
2 RUNS (3C x 185mm2) +G
1

SEE DWG.: 1347-55273
25457-4480-V1A-MXA0-0102

SCR #4
F2 ZONE#4

LIGNE / CHARGE
L1 400A T1 — 5L1 — 83-CT41 (Bk / Wh) — 83-F4 300A — 9L1
L2 400A T2 — 5L2 — 300A — 9L2
L3 400A T3 — 5L3 — 83-CT43 (Bk / Wh) — 300A — 9L3

TB-3: C1, C2
T1: 1, 2, 3, 4, 5 (Red, Bk)
COOLING FAN: L1, M, L2 — 1, 2, 4(+), 5(-)

4481-MBMB-0001-JB-14-P1
2 RUNS (3C x 185mm2) +G
1

JUNCTION BOX
4481-MBMB-0001-JB-13

8L1 — 4481-MBMB-0001-E3A-P1 (2C x XXmm2) +G
8L2 — 4481-MBMB-0001-E3B-P1 (2C x XXmm2) +G
8L3 — 4481-MBMB-0001-E3C-P1 (2C x XXmm2) +G

JUNCTION BOX
4481-MBMB-0001-JB-14

9L1 — 4481-MBMB-0001-E4A-P1 (2C x XXmm2) +G
9L2 — 4481-MBMB-0001-E4B-P1 (2C x XXmm2) +G
9L3 — 4481-MBMB-0001-E4C-P1 (2C x XXmm2) +G

FIELD

ZONE#3 (240KW)
TOP: COM — 8L1 / 8L2 / 8L3 — SIDE 1 / SIDE 2
BOTTOM: COM — 8L1 / 8L2 / 8L3 — SIDE 1 / SIDE 2

ZONE#4 (240KW)
TOP: COM — 9L1 / 9L2 / 9L3 — SIDE 1 / SIDE 2
BOTTOM: COM — 9L1 / 9L2 / 9L3 — SIDE 1 / SIDE 2

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DATE:			

Vendor or Subcontractor Logo: GNA a.j.t.e.c. Inc. — Departement Ingenierie / Engineering Department, 9680 TransCanada, Baie-Louvain, Quebec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457	00AZ	xx	xxxx	xxxx	xxx – xxx

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SELLER DRAWING No. 1347-56011 | REV. 1

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CATHODE BAR HEATING ELEMENTS (2/2)
INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
–	–	–	–	A3–		–AZ	

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ELECTRICAL ROOM

FIELD

MOTOR CONTROL CENTER PANEL 4480-ECM1-0001

BREAKER MCB1
SEE DWG. 1347-55501
25457-4480-V1A-MXA0-0254

2 — 4480-ECM1-0001-G4-5 (1) → 4481-CP-1000-P1 (3C x 2,5mm2) +G
1 — 4480-ECM1-0001-G4-5N (2)
⏚ — (1SP-1G)
1

BREAKER MCB11
SEE DWG. 1347-55501
25457-4480-V1A-MXA0-0254

22 — 4480-ECM1-0001-G4-15 (1) → 4481-CP-1000-P2 (3C x 2,5mm2) +G
21 — 4480-ECM1-0001-G4-15N (2)
⏚ — (1SP-1G)
1

BREAKER MCB2
SEE DWG. 1347-55501
25457-4480-V1A-MXA0-0254

4 — 4480-ECM1-0001-G4-6 (1) → 4480-EVR3-0002-P1 (3C x 2,5mm2) +G
3 — 4480-ECM1-0001-G4-6N (2)
⏚ — (1SP-1G)
1

BREAKER MCB3
SEE DWG. 1347-55501
25457-4480-V1A-MXA0-0254

6 — 4480-ECM1-0001-G4-7 (1) → 4480-EVR3-0001-P1 (3C x 2,5mm2) +G
5 — 4480-ECM1-0001-G4-7N (2)
⏚ — (1SP-1G)
1

BREAKER MCB4
SEE DWG. 1347-55501
25457-4480-V1A-MXA0-0254

8 — 4480-ECM1-0001-G4-8 (1) → 4481-CP-1001-P1 (3C x 2,5mm2) +G
7 — 4480-ECM1-0001-G4-8N (2)
⏚ — (1SP-1G)
1

BREAKER MCB5
SEE DWG. 1347-55501
25457-4480-V1A-MXA0-0254

10 — 4480-ECM1-0001-G4-9 (1) → 4481-MBAD-0001-CP-01-P1 (3C x 2,5mm2) +G
9 — 4480-ECM1-0001-G4-9N (2)
⏚ — (1SP-1G)
1

BREAKER MCB12
SEE DWG. 1347-55501
25457-4480-V1A-MXA0-0254

24 — 4480-ECM1-0001-G4-16 (1) → 4481-MBAD-0001-CP-01-P2 (3C x 2,5mm2) +G
23 — 4480-ECM1-0001-G4-16N (2)
⏚ — (1SP-1G)
1

PLC PANEL 4481-CP-1000

X71 G — 4480-ECM1-0001-G4-5 (1) → 71-L1 × 6A → X71 N1 — 4480-ECM1-0001-G4-5N (2) — (1SP-1G)
SEE DWG. 1347-55250
25457-4480-V1A-MXA0-0102

X72 G — 4480-ECM1-0001-G4-15 (1) → 72-L1 × 10A → X72 N1 — 4480-ECM1-0001-G4-15N (2) — (1SP-1G)
SEE DWG. 1347-55251
25457-4480-V1A-MXA0-0102

CATHODE BLOCK OVEN SCR CONTROL PANEL 4480-EVR3-0002

X78 G — 4480-ECM1-0001-G4-6 (1) → 78-L1 × 10A → X78 N1 — 4480-ECM1-0001-G4-6N (2) — (1SP-1G)
SEE DWG. 1347-55260
25457-4480-V1A-MXA0-0102

CATHODE BAR HEATING F. SCR CONTROL PANEL 4480-EVR3-0001

X81 G — 4480-ECM1-0001-G4-7 (1) → 81-L1 × 10A → X81 N1 — 4480-ECM1-0001-G4-7N (2) — (1SP-1G)
SEE DWG. 1347-55270
25457-4480-V1A-MXA0-0102

CENTRAL CONTROL PANEL 4481-CP-1001

X85 G — 4480-ECM1-0001-G4-8 (1) → 85-L1 × 8A → X85 N1 — 4480-ECM1-0001-G4-8N (2) — (1SP-1G)
SEE DWG. 1347-55280
25457-4480-V1A-MXA0-0102

LADLE PRE-HEATING STATION 4481-MBAD-0001-CP-01 F3

X106 G — 4480-ECM1-0001-G4-9 (1) → 106-L1 × 8A → X106 N1 — 4480-ECM1-0001-G4-9N (2) — (1SP-1G)
SEE DWG. 1347-55320
25457-4480-V1A-MXA0-0102

X107 G — 4480-ECM1-0001-G4-16 (1) → 107-L1 × 10A → X107 N1 — 4480-ECM1-0001-G4-16N (2) — (1SP-1G)
SEE DWG. 1347-55321
25457-4480-V1A-MXA0-0102

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DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		1		UPDATE	10-MA-2011	F.P.	E.B.	C.C.
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ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie, Engineering Department, Baie-Comeau, Québec, Canada, (418) 589-1701

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No | SUBD. | DISC. | SECTOR | SEQUENCE | REV.
25457-00AZ- xx - xxxx - xxxx - xxx — xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
UTILITIES & CONTROL SUPPLY (1/2)
INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type | Building | Discipline | Phase | Format | Sequential | Location | Rev. No.
— — — — A3— —AZ

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ELECTRICAL ROOM

MOTOR CONTROL CENTER PANEL
4480-ECM1-0001

BREAKER MCB6 SEE DWG. 1347-55501 25457-4480-V1A-MXA0-0254	12	4480-ECM1-0001-G4-10 (1)	4481-MEVD-0001-CP-01-P1 (3C x 2,5mm2) +G	
	11	4480-ECM1-0001-G4-10N (2)		
		(1SP-1G)		
BREAKER MCB13 SEE DWG. 1347-55501 25457-4480-V1A-MXA0-0254	26	4480-ECM1-0001-G4-17 (1)	4481-MEVD-0001-CP-01-P2 (3C x 2,5mm2) +G	
	25	4480-ECM1-0001-G4-17N (2)		
		(1SP-1G)		
BREAKER MCB7 SEE DWG. 1347-55501 25457-4480-V1A-MXA0-0254	14	4480-ECM1-0001-G4-11 (1)	4481-MEVD-0002-CP-01-P1 (3C x 2,5mm2) +G	
	13	4480-ECM1-0001-G4-11N (2)		
		(1SP-1G)		
BREAKER MCB14 SEE DWG. 1347-55501 25457-4480-V1A-MXA0-0254	28	4480-ECM1-0001-G4-18 (1)	4481-MEVD-0002-CP-01-P2 (3C x 2,5mm2) +G	
	27	4480-ECM1-0001-G4-18N (2)		
		(1SP-1G)		
BREAKER MCB8 SEE DWG. 1347-55501 25457-4480-V1A-MXA0-0254	16	4480-ECM1-0001-G4-12 (1)	4481-MQLK-0001-CP-01-P1 (3C x 2,5mm2) +G	
	15	4480-ECM1-0001-G4-12N (2)		
		(1SP-1G)		
BREAKER MCB9 SEE DWG. 1347-55501 25457-4480-V1A-MXA0-0254	18	4480-ECM1-0001-G4-13	4481-MHCD-0003-CP-01-P1 (3C x 2,5mm2) +G	
	17	4480-ECM1-0001-G4-13N		
		(1SP-1G)		
BREAKER MCB10 SEE DWG. 1347-55501 25457-4480-V1A-MXA0-0254	20	4480-ECM1-0001-G4-14	4481-MPF0-0001-CP-01-P1 (3C x 2,5mm2) +G	
	19	4480-ECM1-0001-G4-14N		
		(1SP-1G)		

2

FIELD

CAST IRON INGOT DRYING STATION A
4481-MEVD-0001-CP-01 — F4A

X113 G	(1SP-1G)	4480-ECM1-0001-G4-10 (1)	113-L1 × 8A	SEE DWG. 1347-55330 25457-4480-V1A-MXA0-0102
		4480-ECM1-0001-G4-10N (2)	X113 N1	
X114 G	(1SP-1G)	4480-ECM1-0001-G4-17 (1)	114-L1 × 10A	SEE DWG. 1347-55331 25457-4480-V1A-MXA0-0102
		4480-ECM1-0001-G4-17N (2)	X114 N1	

CAST IRON INGOT DRYING STATION B
4481-MEVD-0002-CP-01 — F4B

X118 G	(1SP-1G)	4480-ECM1-0001-G4-11 (1)	118-L1 × 8A	SEE DWG. 1347-55340 25457-4480-V1A-MXA0-0102
		4480-ECM1-0001-G4-11N (2)	X118 N1	
X119 G	(1SP-1G)	4480-ECM1-0001-G4-18 (1)	119-L1 × 10A	SEE DWG. 1347-55341 25457-4480-V1A-MXA0-0102
		4480-ECM1-0001-G4-18N (2)	X119 N1	

LOCAL CONTROL PANEL
4481-MQLK-0001-CP-01 — G1

X102 G	(1SP-1G)	4480-ECM1-0001-G4-12 (1)	102-L1 × 8A	SEE DWG. 1347-55310 25457-4480-V1A-MXA0-0102
		4480-ECM1-0001-G4-12N (2)	X102 N1	

LOCAL CONTROL PANEL
4481-MHCD-0003-CP-01 — C3

X96 G	(1SP-1G)	4480-ECM1-0001-G4-13 (1)	96-L1 × 8A	SEE DWG. 1347-55290 25457-4480-V1A-MXA0-0102
		4480-ECM1-0001-G4-13N (2)	X96 N1	

LOCAL CONTROL PANEL
4481-MPF0-0001-CP-01 — H1

X100 G	(1SP-1G)	4480-ECM1-0001-G4-14 (1)	100-L1 × 8A	SEE DWG. 1347-55300 25457-4480-V1A-MXA0-0102
		4480-ECM1-0001-G4-14N (2)	X100 N1	

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DATE:			

Vendor or Subcontractor Logo: GNA a.i.tech Inc. — Département Ingénierie / Engineering Department, 1600 Tremblay, Boisbriand, Québec, J4G 1V9, Canada — BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
UTILITIES & CONTROL SUPPLY (2/2)
INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—	—	A3–		–AZ	

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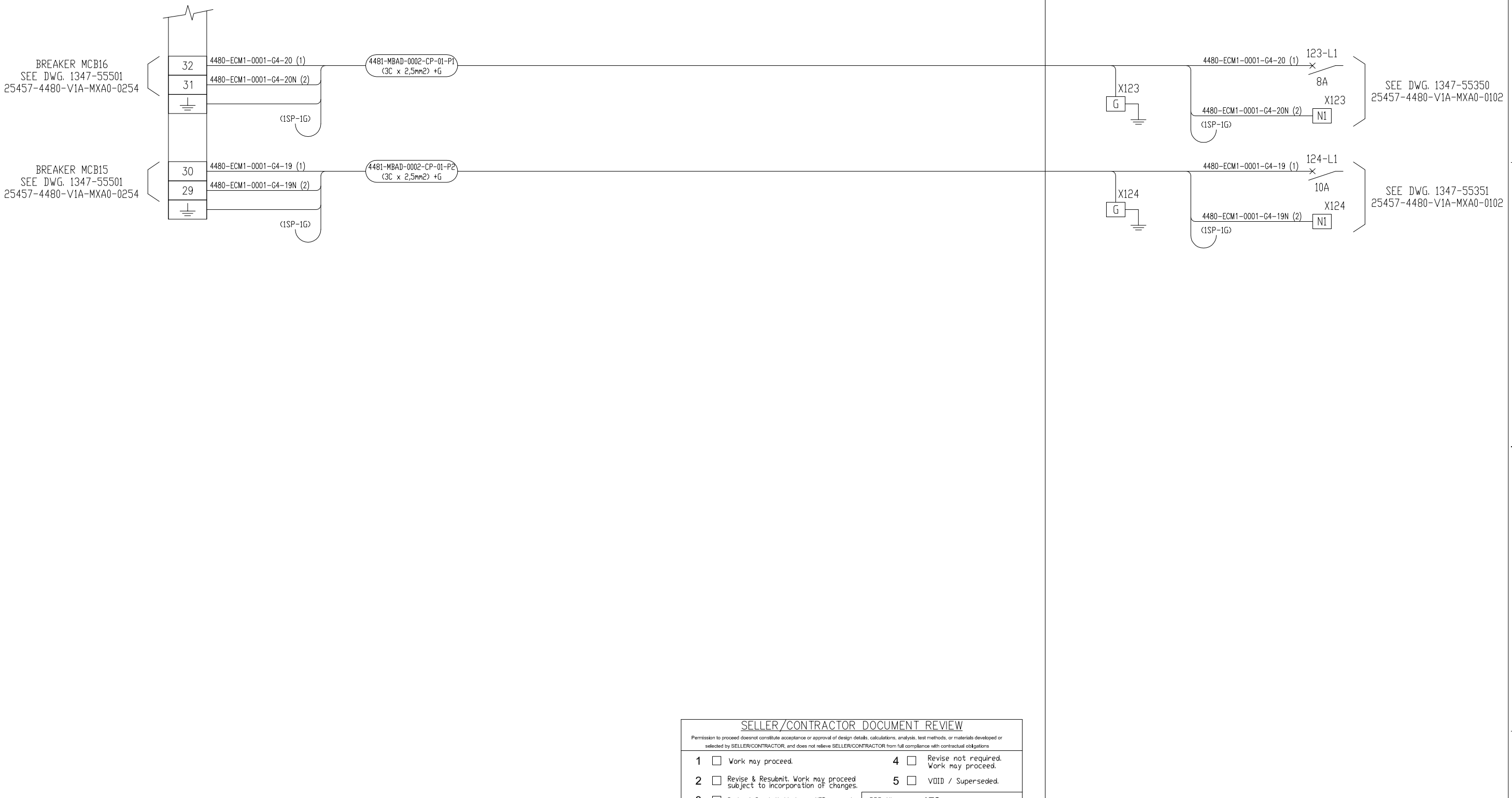
ELECTRICAL ROOM

MOTOR CONTROL CENTER PANEL
4480-ECM1-0001

FIELD

LADLE PRE-HEATING STATION B
4481-MBAD-0002-CP-01

F3B



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DATE:			

Vendor or Subcontractor Logo:
GNA alutech Inc. Département Ingénierie Engineering Department 9690 TransCanada Saint-Laurent, Québec H4S 1V3 Canada

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

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SELLER DRAWING No.: 1347-56022 REV.: 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
UTILITIES & CONTROL SUPPLY FOR F3B
INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3—		—AZ	

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4 | 3 | 2 | 1

LOCAL CONTROL PANEL
4481-MJR0-0006-CP-01 R3

LOCAL CONTROL PANEL
4481-MHCD-0004-CP-01 C4

JUNCTION BOX
4481-MHCD-0004-JB-01 C4

FIELD

SEE DWG. 1347-55287
25457-4480-V1A-MXA0-0102

X92
20A 93-V2B
20B 93-V7

4481-MHCD-0004-CP-01-J2
(3C x 1,5mm2)

(1SP)

1

93-V2B
93-V7

X93
2B
7

(1SP)

SEE DWG. 1347-55288
25457-4480-V1A-MXA0-0102

S12 S12 93-CR5 S11 S11
S22 S22 C4 S21 S21
MATGUARD RELAY

4481-MHCD-0004-JB01-J1
(2C x 1,5mm2) +G

S11
S21

MATGUARD
S11 1-IN W
S21 1-IN B
1-OUT W
1-OUT B
2-IN W
2-IN B
2-OUT W
2-OUT B
3-IN W
3-IN B
3-OUT W
3-OUT B
4-IN W
4-IN B
4-OUT W
4-OUT B

4481-MHCD-0004-HSS-04
MATGUARD #1
MATGUARD #2
MATGUARD #3
MATGUARD #4

4481-MHCD-0004-JB02-J1
(2C x 1,5mm2) +G

4-OUT W
4-OUT B

4481-MHCD-0004-JB03-J1
(2C x 1,5mm2) +G

8-OUT W 8-OUT W
8-OUT B 8-OUT B

JUNCTION BOX
4481-MHCD-0004-JB-03 C4

FIELD

MATGUARD
8-OUT W 9-IN W
8-OUT B 9-IN B
9-OUT W
9-OUT B
10-IN W
10-IN B
10-OUT W
10-OUT B
11-IN W
11-IN B
11-OUT W
11-OUT B
12-IN W
12-IN B
12-OUT W
12-OUT B

4481-MHCD-0004-HSS-04
MATGUARD #9
MATGUARD #10
MATGUARD #11
MATGUARD #12

JUNCTION BOX
4481-MHCD-0004-JB-02 C4

MATGUARD
4-OUT W 5-IN W
4-OUT B 5-IN B
5-OUT W
5-OUT B
6-IN W
6-IN B
6-OUT W
6-OUT B
7-IN W
7-IN B
7-OUT W
7-OUT B
8-IN W
8-IN B
8-OUT W
8-OUT B

4481-MHCD-0004-HSS-04
MATGUARD #5
MATGUARD #6
MATGUARD #7
MATGUARD #8

4481-MHCD-0004-JB02-J2
(2C x 1,5mm2) +G

8-OUT W
8-OUT B

4481-MHCD-0004-JB04-J1
(2C x 1,5mm2) +G

12-OUT W
12-OUT B

JUNCTION BOX
4481-MHCD-0004-JB-04 C4

MATGUARD
12-OUT W 13-IN W
12-OUT B 13-IN B
13-OUT W
13-OUT B
14-IN W
14-IN B
14-OUT W
14-OUT B
15-IN W
15-IN B
15-OUT W
15-OUT B
16-IN W
16-IN B
S12 16-OUT W
S22 16-OUT B

4481-MHCD-0004-HSS-04
MATGUARD #13
MATGUARD #14
MATGUARD #15
MATGUARD #16

4481-MHCD-0004-JB04-J2
(2C x 1,5mm2)

S12
S22

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Discipline :

Document No : 25457-4480-V1A-MXA0-0287 | Rev. :

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1		UPDATE	10-MA-2011	F.P.	E.B.	C.C.

DRAWING NUMBER | TITLE | REFERENCES | REVISIONS

NOTES

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ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA aLi-tech Inc. Département Ingénierie Engineering Department 9400 Trans-Canada Ste-Anne-de-Bellevue, Québec H9X 1L9 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
C4 MATGUARD
INTERCONNECTION DIAGRAM

MA'ADEN

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

4 | 3 | 2 | 1

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LOCAL CONTROL PANEL
4481-MHCD-0004-CP-01

C4

CENTRAL CONTROL PANEL
4481-CP-1001

PLC CONTROL PANEL
4481-CP-1000

X86
86-V2+
86-V2+ (3)
2B
86-V2B (4)
SEE DWG. 1347-55281
25457-4480-V1A-MXA0-0102

X93
93-V24B
24B
87-V4D (9)
EMERGENCY STOP
HSS-1F
93-V24A
24A
87-V4C (10)
(7SP-1G)
2
SEE DWG. 1347-55288
25457-4480-V1A-MXA0-0102

4481-MHCD-0004-CP-01-J1
(19C x 1,5mm2) +G

X87
87-V4D (9)
4D
75-V24B (1)
87-V4C (10)
4C
87-V4C (11)
87-V4B (12)
4B
87-V4B
EMERGENCY STOP
HSS-1H
87-V4A
4A
75-V24A (2)
10
77-V10A (5)
25
77-V10D (6)
SEE DWG. 1347-55282
25457-4480-V1A-MXA0-0102

4481-CP-1001-J2
(12C x 1,5mm2)

X75
75-V24B (1)
24B
75-V24A (2)
24A
SEE DWG. 1347-55254
25457-4480-V1A-MXA0-0102

X76
86-V2+ (3)
10A
86-V2B (4)
10B
SEE DWG. 1347-55255
25457-4480-V1A-MXA0-0102

X77
77-V10A (5)
10A
77-V10D (6)
10D
77-V12E (7)
12E
(5SP)
SEE DWG. 1347-55256
25457-4480-V1A-MXA0-0102

X88
25
77-V12E (7)
(5SP)
SEE DWG. 1347-55283
25457-4480-V1A-MXA0-0102

FIELD

LOCAL CONTROL PANEL
4481-MJR0-0006-CP-01

R3

X92
92-V24B
24B
87-V4C (11)
EMERGENCY STOP
HSS-1G
92-V24A
24A
87-V4B (12)
(7SP-1G)
SEE DWG. 1347-55287
25457-4480-V1A-MXA0-0102

4481-MJR0-0006-CP-01-J1
(19C x 1,5mm2) +G

R5, T1 ZONE
HYD. VALVE SW.
4481-MJUT-0001-ZS-10
C
NO
92-V10A
92-V10B

4481-MJUT-0001-ZS10-J1
(2C x 1,5mm2) +G

92-V10A
92-V10B
10A
10B
SEE DWG. 1347-55287
25457-4480-V1A-MXA0-0102

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		2		UPDATE	AU-15-11	F.P.	E.B.	C.C.
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REFERENCES | REVISIONS

NOTES

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DATE:			

Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie / Engineering Department, 5199 Rue Cochrane, Saint-Laurent, Québec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
C4, R3 EMERGENCY STOP & HYD. VALVE SWITCH INTERCONNECTION DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3—		—AZ	

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FIELD

4481-MHCD-0001-HSS-04

MATGUARD #1
MATGUARD #2
MATGUARD #3
MATGUARD #4

JUNCTION BOX
4481-MHCD-0001-JB-01 C1

MATGUARD

1-IN W	S11	S11 (4)
1-IN B	S21	S21 (6)
1-OUT W		
1-OUT B		
2-IN W		
2-IN B		
2-OUT W		
2-OUT B		
3-IN W		
3-IN B		
3-OUT W		
3-OUT B		
4-IN W		
4-IN B		
4-OUT W	S12	S12 (5)
4-OUT B	S22	S22 (7)

(4SP-1G)

JUNCTION BOX
4481-MEEP-0001-JB-01 C1/F1

4481-MHCD-0001-JB01-J1
(11C x 1,5mm2) +G

S11 (4)
S12 (5)
S21 (6)
S22 (7)
(4SP-1G)

105-CR05
C1
MATGUARD RELAY

SEE DWG. 1347-55313
25457-4480-V1A-MXAO-0102

PLC CONTROL PANEL
4481-CP-1000

LOCAL CONTROL PANEL
4481-MHCD-0001-CP-01 C1

LOCAL CONTROL PANEL
4481-MQLK-0001-CP-01 R1/R2/R6
A1/C1/F1/G1

X103

SEE DWG. 1347-55311
25457-4480-V1A-MXAO-0102

103-V2+
103-V2+ (3)
2B
103-V2B (4)

X105

105-V24B
105-V26B (8)
24B
24A
105-V24A
105-V26A (9)

EMERGENCY STOP
HSS-1D

SEE DWG. 1347-55313
25457-4480-V1A-MXAO-0102

(2SP-1G)

4481-MHCD-0001-CP01-J1
(11C x 1,5mm2) +G

X105

105-V26B (8)
26B
26A
105-V26A (9)
104-V24C (17)
104-V24B (18)

(2SP-1G)
(7SP-1G)

4481-MEEP-0001-JB-01-J3
(26C x 1,5mm2) +G

3

X104

104-V24C (17)
24C
24B
24A
104-V24B
104-V24A

EMERGENCY STOP
HSS-1E

SEE DWG. 1347-55312
25457-4480-V1A-MXAO-0102

(7SP-1G)

4481-MQLK-0001-CP-01-J2
(6C x 1,5mm2)

75-V15B (1)
75-V15A (2)

(2SP)

X75

75-V15B (1)
15B
15A
75-V15A (2)

SEE DWG. 1347-55254
25457-4480-V1A-MXAO-0102

X76

103-V2+ (3)
12A
12B
103-V2B (4)

(2SP)

SEE DWG. 1347-55255
25457-4480-V1A-MXAO-0102

FIELD

MAIN HYDRAULIC
VALVE SW.
4481-MQLK-0001-ZS-20

104-V10E
C
NO
104-V10F

SEE DWG. 1347-55312
25457-4480-V1A-MXAO-0102

10E
10F

4481-MQLK-0001-ZS20-J1
(2C x 1,5mm2)

104-V10E
104-V10F

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DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
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		2		UPDATE	MR-29-11	F.P.	E.B.	C.C.
		1		UPDATE	JA-27-11	F.P.	E.B.	C.C.
REFERENCES		REVISIONS						

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DATE:			

Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie / Engineering Department, 9690 TransCanada, Baie-Lavaltrie, Québec, J4Z 1V2, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No 25457 | SUBD. 00AZ | DISC. - | SECTOR xx | SEQUENCE xxxx - xxxx - xxx | REV. xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
C1, G1 EMERGENCY STOP, MATGUARD & HYD. V. SW.
INTERCONNECTION DIAGRAM

MA'ADEN Alcoa

Type — | Building — | Discipline — | Phase — | Format A3– | Sequential – | Location AZ | Rev. No.

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FIELD

4481-MHCD-0002-HSS-03

MATGUARD #1
MATGUARD #2
MATGUARD #3
MATGUARD #4
MATGUARD #5
MATGUARD #6
MATGUARD #7
MATGUARD #8

MATGUARD

1-IN W	S11	S11 (1)
1-IN B	S21	S21 (3)
1-OUT W		
1-OUT B		
2-IN W		
2-IN B		
2-OUT W		
2-OUT B		
3-IN W		
3-IN B		
3-OUT W		
3-OUT B		
4-IN W		
4-IN B		
4-OUT W		
4-OUT B		
5-IN W		
5-IN B		
5-OUT W		
5-OUT B		
6-IN W		
6-IN B		
6-OUT W		
6-OUT B		
7-IN W		
7-IN B		
7-OUT W		
7-OUT B		
8-IN W		
8-IN B		
8-OUT W	S12	S12 (2)
8-OUT B	S22	S22 (4)

JUNCTION BOX
4481-MHCD-0002-JB-01

LOCAL CONTROL PANEL
4481-MHCD-0002-CP-01 C2/R9

4481-MHCD-0002-JB01-J1
(4C x 1,5mm2)

S11 (1)
S12 (2)
S21 (3)
S22 (4)

99-CR20

C2
MATGUARD RELAY

X99

8F	99-V8F
8E	99-V8E

SEE DWG. 1347-55293
25457-4480-V1A-MXAO-0102

4481-MJR0-0001-ZS04-J1
(2C x 1,5mm2)

R9 CONVEYOR
HYD. VALVE SW.
4481-MJR0-0001-ZS-04

99-V8F — C
99-V8E — NO

LOCAL CONTROL PANEL
4481-MHCD-0003-CP-01 C2/R9/S1
C3/R8/R7

X97

97-V2+	97-V2+ (3)
2B	97-V2B (4)

SEE DWG. 1347-55291
25457-4480-V1A-MXAO-0102

LOCAL CONTROL PANEL
4481-MHCD-0002-CP-02 C2

X99

99-V26B	26B
99-V26A	26A

99-V24C

EMERGENCY STOP
HSS-1A

99-V24B

SEE DWG. 1347-55293
25457-4480-V1A-MXAO-0102

4481-MHCD-0002-CP02-J1
(2C x 1,5mm2) +G

99-V24C	24C
99-V24B	
99-V24B	24B
99-V24A	24A

EMERGENCY STOP
HSS-1B

SEE DWG. 1347-55293
25457-4480-V1A-MXAO-0102

98-V8C (16)
98-V8B (17)
(6SP-1G)

4481-MHCD-0002-CP-01-J1
(26C x 1,5mm2) +G

3
(6SP-1G)

98-V8C (16)
98-V8B (17)
98-V8B
98-V8A

EMERGENCY STOP
HSS-1C

SEE DWG. 1347-55292
25457-4480-V1A-MXAO-0102

X98

8C	75-V8B (1)
8B	
8A	75-V8A (2)
18A	98-V18A
18B	98-V18B

SEE DWG. 1347-55292
25457-4480-V1A-MXAO-0102

4481-MHCD-0003-CP-01-J2
(6C x 1,5mm2)

(2SP)

4481-MJR0-0003-ZS13-J1
(2C x 1,5mm2)

SEE DWG. 1347-55254
25457-4480-V1A-MXAO-0102

X75

75-V8B (1)	8B
75-V8A (2)	8A

X76

97-V2+ (3)	11A
97-V2B (4)	11B

(2SP)

SEE DWG. 1347-55255
25457-4480-V1A-MXAO-0102

PLC CONTROL PANEL
4481-CP-1000

FIELD

R7, R8 CONVEYOR
HYD. VALVE SW.
4481-MJR0-0003-ZS-13

98-V18A — C
98-V18B — NO

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Discipline :

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		1		UPDATE	JA-27-11	F.P.	E.B.	C.C.
REFERENCES		REVISIONS						

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DATE:	10/10/2010	DATE:	
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DATE:		DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
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Vendor or Subcontractor Logo: GNA a.j.tech Inc. — Département Ingénierie / Engineering Department — 9690 TransCanada, Suite/suite#, Quebec (QC) H1Y 2V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

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SELLER DRAWING No.: 1347-56033 | REV.: 3

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
C2, C3 EMERGENCY STOP, MATGUARD & HYD. V. SW.
INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—		—	—	A3-		-AZ	

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FIELD

LOCAL CONTROL PANEL
4481-MZAC-0001-CP-01

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DDR Nbr : 172

Reviewed by : _____ Date : _____

Discipline :

Document No : 25457-4480-V1A-MXA0-0290 | Rev. :

R4A PRESENCE SENSING#1 SAFETY LIGHT CURTAIN

4481-MZAC-0001-TRS-1 (TRANSMITTER #1): BROWN 1, WHITE 2, BLACK 4, GRAY 5, BLUE 3

4481-MZAC-0001-REC-1 (RECEIVER #1): BROWN 1, WHITE 2, BLACK 4, GRAY 5, BLUE 3

4481-MZAC-0001-TRS-1-J1 (5C x 1,5mm2) ① 4481-MZAC-0001-REC-1-J1 (5C x 1,5mm2)

X90: WHITE 4A; BLACK, BROWN 2A; BROWN, GRAY, BLUE, GRAY, BLUE 7- ①

WHITE, BLACK → S12 S20 S32 / 90-CR4 MSR221P / S42 S50 S62

R4A PRESENCE SENSING#2 SAFETY LIGHT CURTAIN

4481-MZAC-0001-TRS-2 (TRANSMITTER #2): BROWN 1, WHITE 2, BLACK 4, GRAY 5, BLUE 3

4481-MZAC-0001-REC-2 (RECEIVER #2): BROWN 1, WHITE 2, BLACK 4, GRAY 5, BLUE 3

4481-MZAC-0001-TRS-2-J1 (5C x 1,5mm2) ① 4481-MZAC-0001-REC-2-J1 (5C x 1,5mm2)

X90: WHITE 4B; BLACK, BROWN 2B; BROWN, GRAY, BLUE, GRAY, BLUE 6- ①

WHITE, BLACK → S12 S20 S32 / 90-CR4 MSR221P / S42 S50 S62

R4A PRESENCE SENSING#3 SAFETY LIGHT CURTAIN

4481-MZAC-0001-TRS-3 (TRANSMITTER #3): BROWN 1, WHITE 2, BLACK 4, GRAY 5, BLUE 3

4481-MZAC-0001-REC-3 (RECEIVER #3): BROWN 1, WHITE 2, BLACK 4, GRAY 5, BLUE 3

4481-MZAC-0001-TRS-3-J1 (5C x 1,5mm2) ① 4481-MZAC-0001-REC-3-J1 (5C x 1,5mm2)

X90: WHITE 10A; BLACK, BROWN 8A; BROWN, GRAY, BLUE, GRAY, BLUE 13-

WHITE, BLACK → S12 S20 S32 / 90-CR10 MSR221P / S42 S50 S62

SEE DWG. 1347-55285
25457-4480-V1A-MXA0-0102

R4A SAFETY GATE CLOSED LIMIT SWITCH

4481-MZAC-0001-ZS07: C, NO, C, NO

90-V22A, 90-V22B → 4481-MZAC-0001-ZS07-J1 (2C x 1,5mm2) +G → X90 22A, 22B

LOCAL CONTROL PANEL 4481-MZAC-0001-CP-03 R4A

90-HS19, 90-V19B, 90-V19C → X90 19B, 19C → 90-V18B, 90-V18C → 4481-MZAC-0001-CP-03-J1 (3C x 1,5mm2) +G ① (1SP)

SEE DWG. 1347-55285
25457-4480-V1A-MXA0-0102

LOCAL CONTROL PANEL 4481-MZAC-0001-CP-02 R4A

X90 18B, 18C → 90-V18A, 90-V20A → 4481-MZAC-0001-CP-02-J1 (3C x 1,5mm2) +G ① → 18A, 20A (1SP)

90-HS18, 90-V18B, 90-V18C (1SP)

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No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
1		UPDATE	MR-29-11	F.P.	E.B.	C.C.

REFERENCES | REVISIONS | NOTES

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ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA s&i-tech Inc. — Département Ingénierie Engineering Department 9490 Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No | SUBD. | DISC. | SECTOR | SEQUENCE | REV.
25457-00AZ- xx - xxxx - xxxx - xxx - xxx

SELLER DRAWING No. 1347-56040 | REV. 1

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
R4A LIGHT CURTAIN, RESET BUTTON, SAFETY GATE SW.
INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type | Building | Discipline | Phase | Format | Sequential | Location | Rev. No.
— | — | — | — | A3— | —AZ

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FIELD

LOCAL CONTROL PANEL
4481-MZAC-0002-CP-01

R4B PRESENCE SENSING#1
SAFETY LIGHT CURTAIN

4481-MZAC-0002-TRS-1 — TRANSMITTER #1
BROWN 1
WHITE 2
BLACK 4
GRAY 5
BLUE 3

4481-MZAC-0002-TRS-1-J1 (5C x 1,5mm2)

4481-MZAC-0002-REC-1 — RECEIVER #1
BROWN 1
WHITE 2
BLACK 4
GRAY 5
BLUE 3

4481-MZAC-0002-REC-1-J1 (5C x 1,5mm2)

1

X91
4A: WHITE, BLACK
2A: BROWN, BROWN
7-: GRAY, BLUE, GRAY, BLUE

1

WHITE
BLACK

S12 S20 S32
91-CR4
MSR221P
S42 S50 S62

R4B PRESENCE SENSING#2
SAFETY LIGHT CURTAIN

4481-MZAC-0002-TRS-2 — TRANSMITTER #2
BROWN 1
WHITE 2
BLACK 4
GRAY 5
BLUE 3

4481-MZAC-0002-TRS-2-J1 (5C x 1,5mm2)

4481-MZAC-0002-REC-2 — RECEIVER #2
BROWN 1
WHITE 2
BLACK 4
GRAY 5
BLUE 3

4481-MZAC-0002-REC-2-J1 (5C x 1,5mm2)

1

X91
4B: WHITE, BLACK
2B: BROWN, BROWN
6-: GRAY, BLUE, GRAY, BLUE

1

BLACK
WHITE

R4B PRESENCE SENSING#3
SAFETY LIGHT CURTAIN

4481-MZAC-0002-TRS-3 — TRANSMITTER #3
BROWN 1
WHITE 2
BLACK 4
GRAY 5
BLUE 3

4481-MZAC-0002-TRS-3-J1 (5C x 1,5mm2)

4481-MZAC-0002-REC-3 — RECEIVER #3
BROWN 1
WHITE 2
BLACK 4
GRAY 5
BLUE 3

4481-MZAC-0002-REC-3-J1 (5C x 1,5mm2)

1

X91
10A: WHITE, BLACK
8A: BROWN, BROWN
13-: GRAY, BLUE, GRAY, BLUE

WHITE
BLACK

S12 S20 S32
91-CR10
MSR221P
S42 S50 S62

R4B SAFETY GATE
CLOSED LIMIT SWITCH
4481-MZAC-0002-ZS07

C — 91-V22A
NO
C
NO — 91-V22B

4481-MZAC-0002-ZS07-J1 (2C x 1,5mm2) +G

91-V22A — 22A
91-V22B — 22B

LOCAL CONTROL PANEL
4481-MZAC-0002-CP-03 R4B

91-HS19
91-V19B — 19B
91-V19C — 19C
91-V18B
91-V18C

4481-MZAC-0002-CP-03-J1 (3C x 1,5mm2) +G

1

(1SP)

SEE DWG. 1347-55286
25457-4480-V1A-MXA0-0102

LOCAL CONTROL PANEL
4481-MZAC-0002-CP-02 R4B

X91
91-V18B — 18B
91-HS18
91-V18B
91-V18C
91-V18C — 18C
91-V18A
91-V20A

(1SP)

4481-MZAC-0002-CP-02-J1 (3C x 1,5mm2) +G

1

91-V18A — 18A
91-V20A — 20A

(1SP)

SEE DWG. 1347-55286
25457-4480-V1A-MXA0-0102

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		REVISIONS						

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DATE:			

Vendor or Subcontractor Logo: GNA alitech Inc. — Département Ingénierie / Engineering Department, 9690 Trans-Canada, Saint-Laurent, Québec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SELLER DRAWING No. 1347-56041 | REV. 1

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
R4B LIGHT CURTAIN, RESET BUTTON, SAFETY GATE SW.
INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—	—	A3-		-AZ	

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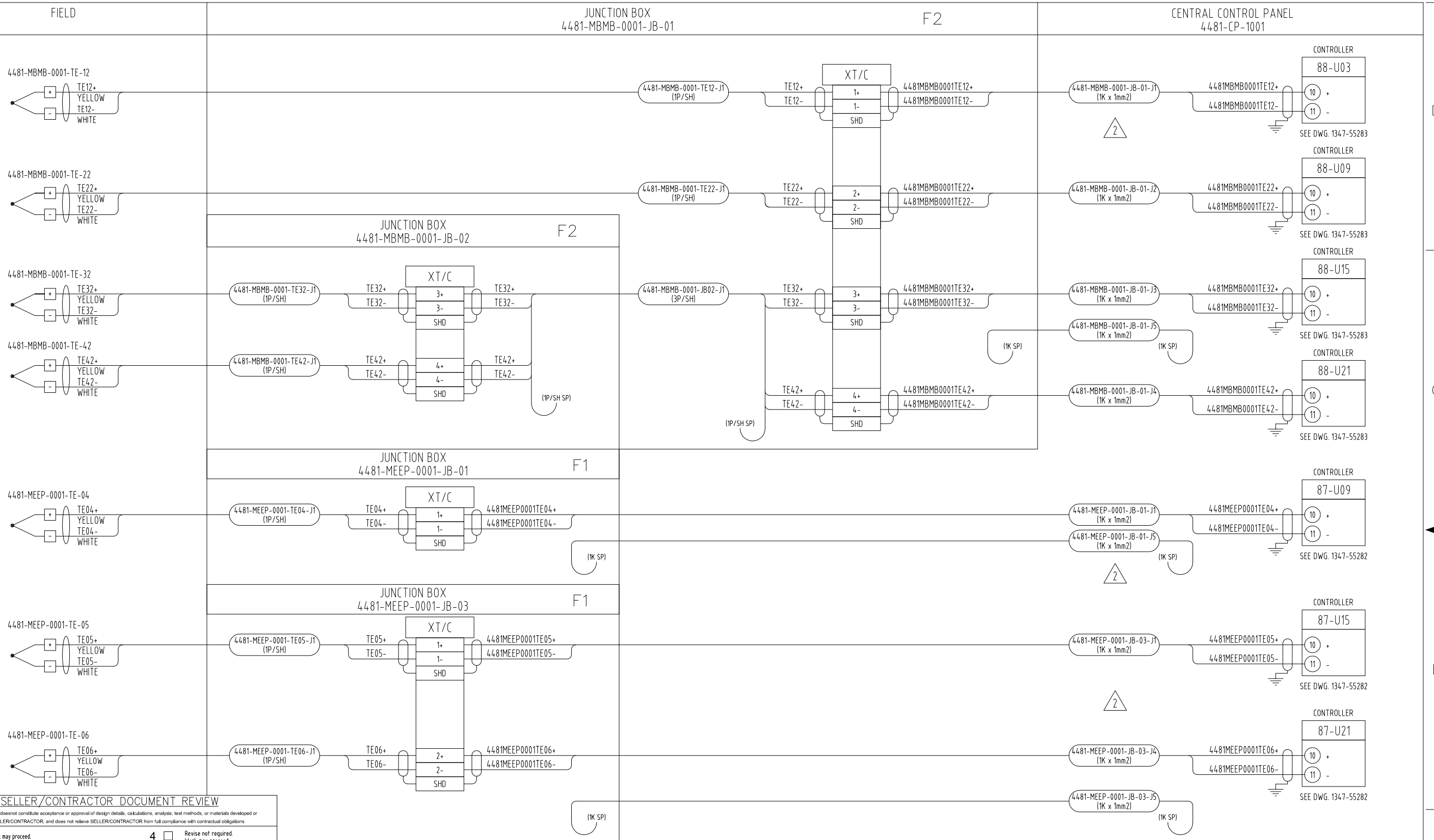

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Discipline :

Document No : 25457-4480-V1A-MXA0-0233 | Rev. :

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REFERENCES		2		UPDATE	08/07/2011	F.P.	T.Pa.	M.B.
		1		UPDATE	MR-22-11	F.P.	T.Pa.	C.C.
		REVISIONS						

NOTES

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ENG. GROUP SUP.	DRAWING SCALE: NONE
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BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

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SELLER DRAWING No. 1347-56050 | REV. 2

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CENTRAL CONTROL PANEL 4481-CP-1001
INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—		—	—	A3—		—AZ	

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CONTROL PANEL
4481-MBAD-0001-CP-01

F3

FIELD

X107
- L23 — 107-L23
- N23 — 107-N23

SEE DWG. 1347-55321
25457-4480-V1A-MXA0-0102

X111
- 9+ — FCV01+
- 9- — FCV01-
- SHD

4481-MBAD-0001-FCV01-C1 (2C x 1,5mm2) +G

4481-MBAD-0001-FCV01-J1 (1P/SH)

4481-MBAD-0001-FCV-01
107-L23 BLACK — 120Vac — 107-N23 WHITE
G
T1 — 24Vac — T2
FCV01+ → +8
FCV01- → -3
4/20mA
GAS MODULATING MOTOR ACTUATOR

X108
- L2 — 108-L2B
- N2 — 108-N2
- L4 — 108-L4, 108-L4
- N4 — 108-N4
- 17+ — 108-V17
- 18- — 108-V18
- SHD

1

4481-MBAD-0001-XFO-01
IGNITION TRANSFO.
120Vac

4481-MBAD-0001-EE01-C1 (1C x 1,5mm2)

4481-MBAD-0001-EE-01
BURNER #1 SPARK PLUG

4481-MBAD-0001-FY11-C1 (3C x 1,5mm2) +G

4481-MBAD-0001-FY-11
108-L4 — BURNER #1 MAIN GAS SSOV #1 SOLENOID VALVE

4481-MBAD-0001-FY-12
108-L4, 108-N4 — BURNER #1 MAIN GAS SSOV #2 SOLENOID VALVE

4481-MBAD-0001-BE01-J1 (1P/SH)

4481-MBAD-0001-BE-01
108-V17 BLUE — S1
108-V18 WHITE — S2
1
BURNER #1 FLAME DETECTOR

SEE DWG. 1347-55322
25457-4480-V1A-MXA0-0102

X109
- L2 — 109-L2B
- N2 — 109-N2
- L4 — 109-L4, 109-L4
- N4 — 109-N4
- 17+ — 109-V17
- 18- — 109-V18
- SHD

1

4481-MBAD-0001-XFO-02
IGNITION TRANSFO.
120Vac

4481-MBAD-0001-EE02-C1 (1C x 1,5mm2)

4481-MBAD-0001-EE-02
BURNER #2 SPARK PLUG

4481-MBAD-0001-FY21-C1 (3C x 1,5mm2) +G

4481-MBAD-0001-FY-21
109-L4 — BURNER #2 MAIN GAS SSOV #1 SOLENOID VALVE

4481-MBAD-0001-FY-22
109-L4, 109-N4 — BURNER #2 MAIN GAS SSOV #2 SOLENOID VALVE

4481-MBAD-0001-BE02-J1 (1P/SH)

4481-MBAD-0001-BE-02
109-V17 BLUE — S1
109-V18 WHITE — S2
1
BURNER #2 FLAME DETECTOR

SEE DWG. 1347-55323
25457-4480-V1A-MXA0-0102

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Document No : 25457-4480-V1A-MXA0-0377 | Rev. :

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		1		CHANGE FLAME DETECTOR WIRE COLOR & ADD BORNERS	21/04/2011	T.Po.	E.B.	M.B.
REFERENCES		REVISIONS						

NOTES

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Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie / Engineering Department — 1600, rue Cyrille-Duquet, Suite/Local 101, Québec (Québec) G1N 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

SELLER DRAWING No. 1347-56060 — REV. 1

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
F3 BURNER (1/2)
INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—	—	A3—		—AZ	

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CONTROL PANEL
4481-MBAD-0001-CP-01

F3

FIELD

X110

SEE DWG. 1347-55324
25457-4480-V1A-MXA0-0102

2A	110-V2A	4481-MBAD-0001-PSL01-J1 (2C x 1,5mm2) +G	4481-MBAD-0001-PSL-01: 110-V2A / 110-V2B — LADLE PRE-HEATING LOW COMB. AIR PRESSURE PRESSURE SWITCH
2B	110-V2B		
4A	110-V4A	4481-MBAD-0001-PSL02-J1 (2C x 1,5mm2) +G	4481-MBAD-0001-PSL-02: 110-V4A / 110-V4B — LADLE PRE-HEATING LOW GAS PRESSURE PRESSURE SWITCH
4B	110-V4B		
6A	110-V6A	4481-MBAD-0001-PSH03-J1 (2C x 1,5mm2) +G	4481-MBAD-0001-PSH-03: 110-V6A / 110-V6B — LADLE PRE-HEATING BURNER #1 HIGH GAS PRESSURE PRESSURE SWITCH
6B	110-V6B		
8A	110-V8A	4481-MBAD-0001-PSH04-J1 (2C x 1,5mm2) +G	4481-MBAD-0001-PSH-04: 110-V8A / 110-V8B — LADLE PRE-HEATING BURNER #2 HIGH GAS PRESSURE PRESSURE SWITCH (1)
8B	110-V8B		
11A	110-V11A	4481-MBAD-0001-ZS02-J1 (2C x 1,5mm2) +G	4481-MBAD-0001-ZS-02 (1): 110-V11A / 110-V11B — LADLE PRE-HEATING IN POSITION LIMIT SWITCH
11B	110-V11B		

SEE DWG. 1347-55324

CONTROLLER
111-U09

SEE DWG. 1347-55325
25457-4480-V1A-MXA0-0102

+ 35	4481MBAD0001TE01+	4481-MBAD-0001-TE01-J1 (1P/SH)	4481-MBAD-0001-TE-01: TE01+ YELLOW / TE01- WHITE — LADLE PRE-HEATING CONTROL TEMPERATURE TERMOCOUPLE
- 36	4481MBAD0001TE01-		

SEE DWG. 1347-55325

CONTROLLER
111-U01

SEE DWG. 1347-55325
25457-4480-V1A-MXA0-0102

+ 10	4481MBAD0001TE02+	4481-MBAD-0001-TE02-J1 (1P/SH)	4481-MBAD-0001-TE-02: TE02+ YELLOW / TE02- WHITE — LADLE PRE-HEATING HIGH TEMPERATURE TERMOCOUPLE
- 11	4481MBAD0001TE02-		

SEE DWG. 1347-55325

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DDR Nbr : 172

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Discipline :

Document No : 25457-4480-V1A-MXA0-0378 | Rev. :

No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
1		CHANGE NO INTO NC FOR PSH-04 & ZS-01 INTO ZS-02	05/05/2011	F.P.	E.B.	M.B.

DRAWING NUMBER | TITLE | REFERENCES | REVISIONS

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BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No | SUBD. | DISC. | SECTOR | SEQUENCE | REV.
25457-00AZ- xx - xxxx - xxxx - xxx - xxx

SELLER DRAWING No. 1347-56061 | REV. 1

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
F3 BURNER (2/2)
INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type | Building | Discipline | Phase | Format | Sequential | Location | Rev. No.
— | — | — | A3— | —AZ

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CONTROL PANEL
4481-MEVD-0001-CP-01

F4A

FIELD

SEE DWG. 1347-55332
25457-4480-V1A-MXAO-0102

X115

L2	115-L2B	4481-MEVD-0001-XFO-01-C1 (2C x 1,5mm2)
N2	115-N2	
L4	115-L4	4481-MEVD-0001-FY-01-C1 (3C x 1,5mm2) +G
	115-L4	
N4	115-N4	
17+	115-V17	4481-MEVD-0001-BE-01-J1 (2C x 1,5mm2)
18-	115-V18	
SHD		

1

4481-MEVD-0001-XFO-01
IGNITION TRANSFO.
115-L2B
115-N2
120Vac

4481-MEVD-0001-EE01-C1 (1C x 1,5mm2)

4481-MEVD-0001-EE-01
BURNER
SPARK PLUG

4481-MEVD-0001-FY-01
115-L4
BURNER
MAIN GAS SSOV #1
SOLENOID VALVE

4481-MEVD-0001-FY-02
115-L4
115-N4
BURNER
MAIN GAS SSOV #2
SOLENOID VALVE

4481-MEVD-0001-BE-01
115-V17
115-V18
ON BURNER
BURNER
FLAME ROD
FLAME DETECTOR

SEE DWG. 1347-55333
25457-4480-V1A-MXAO-0102

X116

2A	116-V2A	4481-MEVD-0001-PSL-01-J1 (2C x 1,5mm2) +G
2B	116-V2B	
4A	116-V4A	4481-MEVD-0001-PSL-02-J1 (2C x 1,5mm2) +G
4B	116-V4B	
6A	116-V6A	4481-MEVD-0001-PSH-03-J1 (2C x 1,5mm2) +G
6B	116-V6B	
9A	116-V9A	4481-MEVD-0001-ZS-01-J1 (2C x 1,5mm2) +G
9B	116-V9B	

4481-MEVD-0001-PSL-01
116-V2A
116-V2B
CAST IRON STATION A
LOW COMB. AIR PRESSURE
PRESSURE SWITCH

4481-MEVD-0001-PSL-02
116-V4A
116-V4B
CAST IRON STATION A
LOW GAS PRESSURE
PRESSURE SWITCH

4481-MEVD-0001-PSH-03
116-V6A
116-V6B
CAST IRON STATION A
HIGH GAS PRESSURE
PRESSURE SWITCH

4481-MEVD-0001-ZS-01
116-V9A
116-V9B
CAST IRON STATION A
DOWN
LIMIT SWITCH

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Discipline :

Document No : 25457-4480-V1A-MXAO-0379 | Rev. :

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DATE:			

Vendor or Subcontractor Logo: GNA a.i.tech Inc. — Département Ingénierie / Engineering Department, 1600, Trans-Canada, Baie-d'Urfé, Québec, H9X 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
F4A BURNER
INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—	—	A3-		-AZ	

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CONTROL PANEL
4481-MEVD-0002-CP-01

F4B

FIELD

SEE DWG. 1347-55342
25457-4480-V1A-MXAO-0102

X120

L2	120-L2B	4481-MEVD-0002-XFO-01-C1 (2C x 1,5mm2)
N2	120-N2	
L4	120-L4	4481-MEVD-0002-FY-01-C1 (3C x 1,5mm2) +G
	120-L4	
N4	120-N4	
17+	120-V17	4481-MEVD-0002-BE-01-J1 (2C x 1,5mm2)
18-	120-V18	
SHD		

1

4481-MEVD-0002-XFO-01
IGNITION TRANSFO.
120-L2B
120-N2
120Vac

4481-MEVD-0002-EE01-C1
(1C x 1,5mm2)

4481-MEVD-0002-EE-01
BURNER
SPARK PLUG

4481-MEVD-0002-FY-01
120-L4
BURNER
MAIN GAS SSOV #1
SOLENOID VALVE

4481-MEVD-0002-FY-02
120-L4
120-N4
BURNER
MAIN GAS SSOV #2
SOLENOID VALVE

4481-MEVD-0002-BE-01
120-V17
120-V18
ON BURNER
BURNER
FLAME ROD
FLAME DETECTOR

SEE DWG. 1347-55343
25457-4480-V1A-MXAO-0102

X121

2A	121-V2A	4481-MEVD-0002-PSL-01-J1 (2C x 1,5mm2) +G
2B	121-V2B	
4A	121-V4A	4481-MEVD-0002-PSL-02-J1 (2C x 1,5mm2) +G
4B	121-V4B	
6A	121-V6A	4481-MEVD-0002-PSH-03-J1 (2C x 1,5mm2) +G
6B	121-V6B	
9A	121-V9A	4481-MEVD-0002-ZS-01-J1 (2C x 1,5mm2) +G
9B	121-V9B	

4481-MEVD-0002-PSL-01
121-V2A
121-V2B
CAST IRON STATION B
LOW COMB. AIR PRESSURE
PRESSURE SWITCH

4481-MEVD-0002-PSL-02
121-V4A
121-V4B
CAST IRON STATION B
LOW GAS PRESSURE
PRESSURE SWITCH

4481-MEVD-0002-PSH-03
121-V6A
121-V6B
CAST IRON STATION B
HIGH GAS PRESSURE
PRESSURE SWITCH

4481-MEVD-0002-ZS-01
121-V9A
121-V9B
CAST IRON STATION B
DOWN
LIMIT SWITCH

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Discipline :

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DATE:			

Vendor or Subcontractor Logo:
GNA a.i.tech Inc. — Département Ingénierie / Engineering Department, 1660 Transcanada, Bâtiment, Quebec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
F4B BURNER
INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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LOCAL CONTROL PANEL
4481-MHCD-0003-CP-01

JUNCTION BOX
4481-MKBB-0001-JB-01

D1

X98

98-V4+

98-V4+

4-

98-V4-

(1SP-1G)

4481-MKBB-0001-JB-01-J1
(3C x 1,5mm2) +G

98-V4+

98-V4-

(1SP-1G)

24Vdc FEED

98-V4+

98-V4-

MOTOR CONTROL CENTER PANEL
4480-ECM1-0001

(COMP-G2)
(MOTORS-W1)

LOCAL CONTROL PANEL
4481-MEHX-0001-CP-01

W1

1L1

1L2

1L3

1L1

1L2

1L3

4481-MEHX-0001-CP-01-P1
(3C x 25mm2) +G

1L1

1L2

1L3

1L1

1L2

1L3

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Discipline :

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ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie / Engineering Department — 9600 Trans-Canada, Baie-d'Urfé, Québec H9X 3T7, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

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SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
D1 COLLECTOR FAN & W1 CHILLER SUPPLY
INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
—	—	—		A3—		—AZ	

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CONTROL PANEL
4481-MBAD-0002-CP-01

F3B

FIELD

X124
- L23 — 124-L23
- N23 — 124-N23

SEE DWG. 1347-55351
25457-4480-V1A-MXA0-0102

X128
- 9+ — FCV01+
- 9- — FCV01-
- SHD

4481-MBAD-0002-FCV01-C1
(2C x 1,5mm2) +G

4481-MBAD-0002-FCV01-J1
(1P/SH)

4481-MBAD-0002-FCV-01
124-L23 BLACK — 120Vac — 124-N23 WHITE
T1 — 24Vac — T2
G

FCV01+ — +8
FCV01- — -3
4/20mA

GAS MODULATING MOTOR ACTUATOR

X125
- L2 — 125-L2B
- N2 — 125-N2
- L4 — 125-L4, 125-L4
- N4 — 125-N4
- 17+ — 125-V17
- 18- — 125-V18
- SHD

SEE DWG. 1347-55352
25457-4480-V1A-MXA0-0102

125-L2B, 125-N2 → L2, N2

4481-MBAD-0002-XFO-01
IGNITION TRANSFO.
120Vac

4481-MBAD-0002-EE01-C1
(1C x 1,5mm2)

4481-MBAD-0002-EE-01
BURNER #1
SPARK PLUG

4481-MBAD-0002-FY11-C1
(3C x 1,5mm2) +G

4481-MBAD-0002-FY-11
125-L4
BURNER #1
MAIN GAS SSOV #1
SOLENOID VALVE

4481-MBAD-0002-FY-12
125-L4, 125-N4
BURNER #1
MAIN GAS SSOV #2
SOLENOID VALVE

4481-MBAD-0002-BE01-J1
(1P/SH)

4481-MBAD-0002-BE-01
125-V17 BLUE — S1
125-V18 WHITE — S2
BURNER #1
FLAME DETECTOR

X126
- L2 — 126-L2B
- N2 — 126-N2
- L4 — 126-L4, 126-L4
- N4 — 126-N4
- 17+ — 126-V17
- 18- — 126-V18
- SHD

SEE DWG. 1347-55353
25457-4480-V1A-MXA0-0102

126-L2B, 126-N2 → L2, N2

4481-MBAD-0002-XFO-02
IGNITION TRANSFO.
120Vac

4481-MBAD-0002-EE02-C1
(1C x 1,5mm2)

4481-MBAD-0002-EE-02
BURNER #2
SPARK PLUG

4481-MBAD-0002-FY21-C1
(3C x 1,5mm2) +G

4481-MBAD-0002-FY-21
126-L4
BURNER #2
MAIN GAS SSOV #1
SOLENOID VALVE

4481-MBAD-0002-FY-22
126-L4, 126-N4
BURNER #2
MAIN GAS SSOV #2
SOLENOID VALVE

4481-MBAD-0002-BE02-J1
(1P/SH)

4481-MBAD-0002-BE-02
126-V17 BLUE — S1
126-V18 WHITE — S2
BURNER #2
FLAME DETECTOR

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Vendor or Subcontractor Logo:
GNA alutech Inc. — Département Ingénierie Engineering Department 1600, rue Cyrille-Duquet, Québec (Québec) G7K 1Y3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

SELLER DRAWING No. 1347-56100 — REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
F3B BURNER (1/2)
INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—	—	A3—		—AZ	

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CONTROL PANEL
4481-MBAD-0002-CP-01

F3B

FIELD

X127

SEE DWG. 1347-55354
25457-4480-V1A-MXA0-0102

2A	127-V2A	4481-MBAD-0002-PSL01-J1 (2C x 1,5mm2) +G	127-V2A / 127-V2B	4481-MBAD-0002-PSL-01 — LADLE PRE-HEATING LOW COMB. AIR PRESSURE PRESSURE SWITCH
2B	127-V2B			
4A	127-V4A	4481-MBAD-0002-PSL02-J1 (2C x 1,5mm2) +G	127-V4A / 127-V4B	4481-MBAD-0002-PSL-02 — LADLE PRE-HEATING LOW GAS PRESSURE PRESSURE SWITCH
4B	127-V4B			
6A	127-V6A	4481-MBAD-0002-PSH03-J1 (2C x 1,5mm2) +G	127-V6A / 127-V6B	4481-MBAD-0002-PSH-03 — LADLE PRE-HEATING BURNER #1 HIGH GAS PRESSURE PRESSURE SWITCH
6B	127-V6B			
8A	127-V8A	4481-MBAD-0002-PSH04-J1 (2C x 1,5mm2) +G	127-V8A / 127-V8B	4481-MBAD-0002-PSH-04 — LADLE PRE-HEATING BURNER #2 HIGH GAS PRESSURE PRESSURE SWITCH
8B	127-V8B			
11A	127-V11A	4481-MBAD-0002-ZS02-J1 (2C x 1,5mm2) +G	127-V11A / 127-V11B	4481-MBAD-0002-ZS-02 — LADLE PRE-HEATING IN POSITION LIMIT SWITCH
11B	127-V11B			

SEE DWG. 1347-55324

CONTROLLER
128-U09

SEE DWG. 1347-55355
25457-4480-V1A-MXA0-0102

+ 35	4481MBAD0002TE01+	4481-MBAD-0002-TE01-J1 (1P/SH)	TE01+ YELLOW TE01- WHITE — 4481-MBAD-0002-TE-01 — LADLE PRE-HEATING CONTROL TEMPERATURE TERMOCOUPLE
- 36	4481MBAD0002TE01-		

SEE DWG. 1347-55355

CONTROLLER
128-U01

SEE DWG. 1347-55355
25457-4480-V1A-MXA0-0102

+ 10	4481MBAD0002TE02+	4481-MBAD-0002-TE02-J1 (1P/SH)	TE02+ YELLOW TE02- WHITE — 4481-MBAD-0002-TE-02 — LADLE PRE-HEATING HIGH TEMPERATURE TERMOCOUPLE
- 11	4481MBAD0002TE02-		

SEE DWG. 1347-55355

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Discipline :

Document No : 25457-4480-V1A-MXA0- | Rev. :

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Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie / Engineering Department, 9600 Trans-Canada, Baie-Comeau, Québec, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
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SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
F3B BURNER (2/2)
INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3—		—AZ	

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FIELD

ELECTRICAL ROOM

LOCAL CONTROL PANEL
4481-MHCD-0002-CP-01 (C2/R9)

X99

DISCONNECT SWITCH (C2)	8A	99-V8A
	8B	99-V8B
SEE DWG. 1347-55293	8C	
	16B	4481MHCD0002M1-9B
SAFETY KEY RELAY	16A	4481MHCD0002M1-9A
	17B	
SAFETY MATGUARD RELAY	22	4481MHCD0002M1-9

4481-MHCD-0002-CP01-J2 (9C x 1,5mm2)

M 3~ — U1, V1, W1

4481-MHCD-0002-M1 (1,1 KW)

4481-MHCD-0002-LCS-01

MHCD-0002-M1

99-V8A	1	99-V8A
99-V8B	2	99-V8B
4481MHCD0002M1-9	9	4481MHCD0002M1-9 (1)
4481MHCD0002M1-9A	9A	4481MHCD0002M1-9A (2)
4481MHCD0002M1-9B	9B	4481MHCD0002M1-9B
	9B	4481MHCD0002M1-9B (3)
	9C	4481MHCD0002M1-9C
	9C	4481MHCD0002M1-9C (6)
	9E	4481MHCD0002M1-9E (4)
	10	4481MHCD0002M1-10 (5)

4481MHCD0002M1-9D

STOP / JOG / OFF / REMOTE

(1SP-1G)

4481-MHCD-0002-LCS-01-J2 (7C x 1,5mm2) +G

⚠1

4481-MHCD-0002-M1-P2 (3C x 2,5mm2) +G

4481-MHCD-0002-M1-LDS-J1 (4C x 1,5mm2)

4481-MHCD-0002-M1-LDS

U1		3L1
V1		3L2
W1		3L3
4481MHCD0002M1-9C	4	
4481MHCD0002M1-9B	3	
99-V8B	2	
99-V8A	1	

4481-MHCD-0002-M1-P1 (3C x 2,5mm2) +G

3L1	3L1
3L2	3L2
3L3	3L3

MOTOR CONTROL CENTER PANEL (COMP-E3) (MOTOR-C2)
4480-ECM1-0001

4481-MHCD-0002-M1-ST

	1	4481MHCD0002M1-V+ (1)
	2	4481MHCD0002M1-V- (2)
	3	4481MHCD0002M1-9 (3)
4481MHCD0002M1-9 (1)	3	
4481MHCD0002M1-9A (2)	4	
	4	
	5	4481MHCD0002M1-9B (4)
4481MHCD0002M1-9B (3)	5	
	7	4481MHCD0002M1-9E (5)
4481MHCD0002M1-9E (4)	7	
	9	4481MHCD0002M1-17 (6)
	10	4481MHCD0002M1-10 (7)
4481MHCD0002M1-10 (5)	10	
	13	4481MHCD0002M1-9C (8)
4481MHCD0002M1-9C (6)	13	
	20	
	21	
	22	
	23	
	24	
	25	

(1SP-1G)

(4SP)

⚠1

PLC PANEL
4481-CP-1000

4481-MHCD-0002-M1-J1 (12C x 1,5mm2)

INPUT CARD
XDI0101

4481MHCD0002M1-V+ (1)	V1+
	V2+
	V3+
	V4+
	IN0
4481MHCD0002M1-9C (8)	IN1
4481MHCD0002M1-9B (4)	IN2
4481MHCD0002M1-9 (3)	IN3
4481MHCD0002M1-17 (6)	IN4
	IN5
	IN6
	IN7
4481MHCD0002M1-V- (2)	V1-
	V2-

4481MHCD0002M1-10

OUTPUT CARD
XD□0004

4481MHCD0002M1-9E (5)	0
4481MHCD0002M1-10 (7)	VO+

(4SP)

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Discipline :

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REFERENCES		1		UPDATE CONNECTORS FOR MCC	MR-14-2011	F.P.	E.B.	C.C.
		REVISIONS						

NOTES

STATUS: FOR DESIGN

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DATE:	DATE:
ENG. GROUP SUP.	DRAWING SCALE: NONE
DATE:	

Vendor or Subcontractor Logo: GNA alstech Inc. — Département Ingénierie Engineering Department, 9495 Trans-Canada, Saint-Laurent, Quebec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MHCD-0002-M1
INTERCONNECTION DIAGRAM

MA'ADEN

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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FIELD

ELECTRICAL ROOM

LOCAL CONTROL PANEL
4481-MHCD-0002-CP-01 (C2/R9)

X99 ⚠1

SEE DWG. 1347-55293
DISCONNECT SWITCH (R9)
SAFETY KEY RELAY

8B		
8C	99-V8C	4481-MHCD-0002-CP01-J2 (9C x 1,5mm2)
8D	99-V8D	
15A	4481MJR00001M1-9A	
15B	4481MJR00001M1-9B	

THERMISTORS
4481MJR00001M1-14
4481MJR00001M1-15

M 3~ U1 V1 W1
4481-MJR0-0001-M1
(0,37 KW)

M 1~ L230D N230B
FAN
(44 W)

4481-MHCD-0002-LCS-01

MJR0-0001-M1

1	99-V8C	99-V8C
2	99-V8D	99-V8D
9A	4481MJR00001M1-9A	4481MJR00001M1-9A (1)
9B	4481MJR00001M1-9B	4481MJR00001M1-9B
9B		4481MJR00001M1-9B (2)
9C	4481MJR00001M1-9C	4481MJR00001M1-9C
9C	4481MJR00001M1-9C (6)	4481-MHCD-0002-LCS-01-J1 (8C x 1,5mm2)
9E	4481MJR00001M1-9E	4481MJR00001M1-9E (3)
11	4481MJR00001M1-11 (4)	
12	4481MJR00001M1-12 (5)	

STOP
JOG
OFF
REMOTE
(2SP)

4481-MJR0-0001-M1-J2 (1P x 1,5mm2) ⚠1

4481-MJR0-0001-M1-P2 (3C x 2,5mm2) +G

4481-MJR0-0001-M1-P4 (3C x 2,5mm2) +G

4481-MJR0-0001-M1-LDS-J1 (4C x 1,5mm2)

4481-MJR0-0001-M1-LDS

U1		4L1
V1		4L2
W1		4L3
L230D		L230C
N230B		N230A
4481MJR00001M1-9C	4	
4481MJR00001M1-9B	3	
99-V8D	2	
99-V8C	1	

(1SP)

MOTOR CONTROL CENTER PANEL (COMP-E9) (MOTOR-R9)
4480-ECM1-0001

4481-MJR0-0001-M1-ST

1	4481MJR00001M1-V+ (1)	4481-MJR0-0001-M1-J1 (12C x 1,5mm2)
2	4481MJR00001M1-V- (2)	
3	4481MJR00001M1-9 (3)	
3		
4		
4	4481MJR00001M1-9A (1)	
5	4481MJR00001M1-9B (4)	
5	4481MJR00001M1-9B (2)	
7	4481MJR00001M1-9E (3)	
9	4481MJR00001M1-17 (5)	
11	4481MJR00001M1-11 (6)	
11	4481MJR00001M1-11 (4)	
12	4481MJR00001M1-12 (7)	
12	4481MJR00001M1-12 (5)	
13	4481MJR00001M1-9C (8)	
13	4481MJR00001M1-9C (6)	
20		
21		
22		
23		
24		
25		
14	4481MJR00001M1-14	
15	4481MJR00001M1-15	

(2SP) (4SP) ⚠1

4481-MJR0-0001-M1-P1 (3C x 2,5mm2) +G

4L1	4L1
4L2	4L2
4L3	4L3

4481-MJR0-0001-M1-P3 (3C x 2,5mm2) +G ⚠1 (1SP)

L230C	L230C
N230A	N230A

PLC PANEL
4481-CP-1000

INPUT CARD
XDI0101

V1+	4481MJR00001M1-V+ (1)
V2+	
V3+	
V4+	
IN8	4481MJR00001M1-11 (6)
IN9	4481MJR00001M1-12 (7)
IN10	4481MJR00001M1-9C (8)
IN11	4481MJR00001M1-9B (4)
IN12	4481MJR00001M1-9 (3)
IN13	4481MJR00001M1-17 (5)
IN14	
IN15	
V1-	4481MJR00001M1-V- (2)
V2-	

(4SP)

No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
1		UPDATE CONNECTORS FOR MCC	MR-14-2011	F.P.	E.B.	C.C.

DRAWING NUMBER | TITLE
REFERENCES
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NOTES

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DATE:			

Vendor or Subcontractor Logo: GNA a&i tech Inc. — Département Ingénierie / Engineering Department — 9690 TransCanada, Bâtiment, Québec (QC) H1J 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

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SELLER DRAWING No.: 1347-56260 | REV.: 1

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MJR0-0001-M1
INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—		—	—	A3-		-AZ	

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FIELD

ELECTRICAL ROOM

MOTOR CONTROL CENTER PANEL (COMP-E2) (MOTOR-S1)
4480-ECM1-0001

PLC PANEL
4481-CP-1000

4481-MZBP-0001-LCS-01

MZBP-0001-M1
9B 4481MZBP0001M1-9B
9B 4481MZBP0001M1-9B (1)
9C 4481MZBP0001M1-9C
9C 4481MZBP0001M1-9C (4)
9E 4481MZBP0001M1-9E (2)
10 4481MZBP0001M1-10 (3)
4481MZBP0001M1-9D
STOP
JOG
OFF
REMOTE
(1SP-1G)

4481-MZBP-0001-LCS-01-J1
(5C x 1,5mm2) +G

2

4481-MZBP-0001-M1-ST
1 4481MZBP0001M1-V+ (1)
2 4481MZBP0001M1-V- (2)
3 4481MZBP0001M1-9 (3)
3
4
4
5 4481MZBP0001M1-9B (4)
5 4481MZBP0001M1-9B (1)
7 4481MZBP0001M1-9E (5)
7 4481MZBP0001M1-9E (2)
9 4481MZBP0001M1-17 (6)
10 4481MZBP0001M1-10 (7)
10 4481MZBP0001M1-10 (3)
13 4481MZBP0001M1-9C (8)
13 4481MZBP0001M1-9C (4)
20
21
22
23
24
25
(1SP-1G)
(4SP)

2

4481-MZBP-0001-M1-J1
(12C x 1,5mm2)

INPUT CARD
XDI0101
V1+
V2+
V3+
V4+
IN16
IN17
IN18
IN19
IN20
IN21
IN22
IN23
V3-
V4-
4481MZBP0001M1-V+ (1)
4481MZBP0001M1-9C (8)
4481MZBP0001M1-9B (4)
4481MZBP0001M1-9 (3)
4481MZBP0001M1-17 (6)
4481MZBP0001M1-V- (2)
4481MZBP0001M1-10

OUTPUT CARD
XD□0004
4481MZBP0001M1-9E (5) 1
4481MZBP0001M1-10 (7) V1+
(4SP)

M
3~
U1
V1
W1
4481-MZBP-0001-M1
(11 KW)

4481-MZBP-0001-M1-P2
(3C x 6mm2) +G

4481-MZBP-0001-M1-LDS

U1 3L1
V1 3L2
W1 3L3

4481-MZBP-0001-M1-LDS-J1
(2C x 1,5mm2)
4481MZBP0001M1-9C 4
4481MZBP0001M1-9B 3
2
1

4481-MZBP-0001-M1-P1
(3C x 6mm2) +G
3L1 3L1
3L2 3L2
3L3 3L3

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SELLER DRAWING No. 1347-56270 | REV. 2

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REFERENCES		2		UPDATE CONNECTORS FOR MCC	MR-14-2011	F.P.	E.B.	C.C.
		1		CHANGE CABLE MOTOR FOR 6mm2	JA-13-2011	E.B.	T.Pa.	M.B.
		REVISIONS						

NOTES

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DATE: 15/11/2010	DATE:
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DATE:	DATE:
RESPONSIBLE ENG. M.B.	CLIENT:
DATE:	DATE:
ENG. GROUP SUP.	DRAWING SCALE: NONE
DATE:	

Vendor or Subcontractor Logo: GNA a.j.tech Inc. Département Ingénierie Engineering Department 9495 Trans-Canada Saint-Laurent, Quebec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MZBP-0001-M1
INTERCONNECTION DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx –	xxx

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
–	–	–		A3–		–AZ	

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FIELD

ELECTRICAL ROOM

MOTOR CONTROL CENTER PANEL (COMP-F3) (MOTOR-S1)
4480-ECM1-0001

PLC PANEL
4481-CP-1000

4481-MZBP-0001-LCS-01

MZBP-0001-M3
9B 4481MZBP0001M3-9B
9B 4481MZBP0001M3-9B (1)
9C 4481MZBP0001M3-9C
9C 4481MZBP0001M3-9C (4)
9E 4481MZBP0001M3-9E (2)
10 4481MZBP0001M3-10 (3)
4481MZBP0001M3-9B
STOP
JOG
OFF
REMOTE
(2SP)

4481-MZBP-0003-LCS-01-J2
(6C x 1,5mm2)
2

4481-MZBP-0001-M3-ST
1 4481MZBP0001M3-V+ (1)
2 4481MZBP0001M3-V- (2)
3 4481MZBP0001M3-9 (3)
3
4
4
5 4481MZBP0001M3-9B (4)
5 4481MZBP0001M3-9B (1)
7 4481MZBP0001M3-9E (5)
7 4481MZBP0001M3-9E (2)
9 4481MZBP0001M3-17 (6)
10 4481MZBP0001M3-10 (7)
10 4481MZBP0001M3-10 (3)
13 4481MZBP0001M3-9C (8)
13 4481MZBP0001M3-9C (4)
20
21
22
23
24
25
(2SP)
(4SP)
2

4481-MZBP-0001-M3-J1
(12C x 1,5mm2)

INPUT CARD
XDI0101
V1+
V2+
V3+
V4+
IN24
IN25
IN26
IN27
IN28
IN29
IN30
IN31
V3-
V4-
4481MZBP0001M3-V+ (1)
4481MZBP0001M3-9C (8)
4481MZBP0001M3-9B (4)
4481MZBP0001M3-9 (3)
4481MZBP0001M3-17 (6)
4481MZBP0001M3-V- (2)
4481MZBP0001M3-10

OUTPUT CARD
XD□0004
2
V2+
4481MZBP0001M3-9E (5)
4481MZBP0001M3-10 (7)
(4SP)

M
3~
U1
V1
W1
4481-MZBP-0001-M3
(11 KW)

4481-MZBP-0001-M3-P2
(3C x 6mm2) +G

4481-MZBP-0001-M3-P1
(3C x 6mm2) +G
3L1
3L2
3L3

4481-MZBP-0001-M3-LDS

4481-MZBP-0001-M3-LDS-J1
(2C x 1,5mm2)
4481MZBP0001M3-9C 4
4481MZBP0001M3-9B 3
2
1

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REFERENCES		2		UPDATE CONNECTORS FOR MCC	MR-14-2011	F.P.	E.B.	C.C.
		1		CHANGE CABLE MOTOR FOR 6mm2	JA-13-2011	E.B.	T.Pa.	M.B.
		REVISIONS						

NOTES

STATUS: FOR DESIGN

DRAWN/DES'D: F.P. DATE: 15/11/2010	AREA ENG.: DATE:
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RESPONSIBLE ENG. M.B. DATE:	CLIENT: DATE:
ENG. GROUP SUP. DATE:	DRAWING SCALE: NONE

Vendor or Subcontractor Logo:
GNA alutech Inc. Département Ingénierie Engineering Department 8495 Trans-Canada Saint-Laurent, Quebec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MZBP-0001-M3
INTERCONNECTION DIAGRAM

MA'ADEN

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx –	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
–	–	–		A3–		–AZ	

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FIELD

ELECTRICAL ROOM

MOTOR CONTROL CENTER PANEL (COMP-E6) (MOTOR-S1)
4480-ECM1-0001

PLC PANEL
4481-CP-1000

4481-MZBP-0001-LCS-01

MZBP-0001-M7
9B 4481MZBP0001M7-9B
9B 4481MZBP0001M7-9B (1)
9C 4481MZBP0001M7-9C
9C 4481MZBP0001M7-9C (4)
9E 4481MZBP0001M7-9E (2)
10 4481MZBP0001M7-10 (3)
4481MZBP0001M7-9D
STOP
JOG
OFF
REMOTE
(2SP)

4481-MZBP-0001-LCS-01-J3 (6C x 1,5mm2)

4481-MZBP-0001-M7-ST
1 4481MZBP0001M7-V+ (1)
2 4481MZBP0001M7-V- (2)
3 4481MZBP0001M7-9 (3)
3
4
4
5 4481MZBP0001M7-9B (4)
5 4481MZBP0001M7-9B (1)
7 4481MZBP0001M7-9E (5)
7 4481MZBP0001M7-9E (2)
9 4481MZBP0001M7-17 (6)
10 4481MZBP0001M7-10 (7)
10 4481MZBP0001M7-10 (3)
13 4481MZBP0001M7-9C (8)
13 4481MZBP0001M7-9C (4)
20
21
22
23
24
25
(2SP)
(4SP)

4481-MZBP-0001-M7-J1 (12C x 1,5mm2)

INPUT CARD
XDI0102
4481MZBP0001M7-V+ (1) V1+
V2+
V3+
V4+
IN0
4481MZBP0001M7-9C (8) IN1
4481MZBP0001M7-9B (4) IN2
4481MZBP0001M7-9 (3) IN3
4481MZBP0001M7-17 (6) IN4
IN5
IN6
IN7
4481MZBP0001M7-V- (2) V1-
V2-
4481MZBP0001M7-10

OUTPUT CARD
XDO0004
4481MZBP0001M7-9E (5) 3
4481MZBP0001M7-10 (7) V3+
(4SP)

M
3~
U1
V1
W1
4481-MZBP-0001-M7
(2,2 KW)

4481-MZBP-0001-M7-P2 (3C x 2,5mm2) +G

4481-MZBP-0001-M7-LDS-J1 (2C x 1,5mm2)

4481-MZBP-0001-M7-LDS
U1 3L1
V1 3L2
W1 3L3
4481MZBP0001M7-9C 4
4481MZBP0001M7-9B 3
2
1

4481-MZBP-0001-M7-P1 (3C x 2,5mm2) +G
3L1 3L1
3L2 3L2
3L3 3L3

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3 ☐ Revise & Resubmit. Work may NOT proceed.
4 ☐ Revise not required. Work may proceed.
5 ☐ VOID / Superseded.

DDR Nbr : 172

Reviewed by : _____ Date : _____

Discipline :

Document No : 25457-4480-V1A-MXA0-0238 | Rev. :

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SELLER DRAWING No. 1347-56272 | REV. 1

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		1		UPDATE CONNECTORS FOR MCC	MR-14-2011	F.P.	E.B.	C.C.
		REVISIONS						

NOTES

STATUS: FOR DESIGN

DRAWN/DES'D: F.P.	AREA ENG.:
DATE: 15/11/2010	DATE:
CHECKED: E.B.	PRJ ENG MGR:
DATE:	DATE:
RESPONSIBLE ENG. M.B.	CLIENT:
DATE:	DATE:
ENG. GROUP SUP.	DRAWING SCALE: NONE
DATE:	

Vendor or Subcontractor Logo: GNA a.i.tech Inc. Département Ingénierie Engineering Department 9695 Trans-Canada Boulevard, Dorval (H9S 1V3) Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MZBP-0001-M7
INTERCONNECTION DIAGRAM

MA'ADEN

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx –	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3–		–AZ	

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FIELD

ELECTRICAL ROOM

MOTOR CONTROL CENTER PANEL (COMP-F7) (MOTOR-S1)
4480-ECM1-0001

PLC PANEL
4481-CP-1000

4481-MZBP-0001-LCS-02

MZBP-0001-M5

9B — 4481MZBP0001M5-9B
9B — 4481MZBP0001M5-9B (1)
9C — 4481MZBP0001M5-9C
9C — 4481MZBP0001M5-9C (4)
4481MZBP0001M5-9D
STOP
JOG
OFF
REMOTE
9E — 4481MZBP0001M5-9E (2)
10 — 4481MZBP0001M5-10 (3)
(1SP-1G)

4481-MZBP-0001-LCS-02-J1
(5C x 1,5mm2) +G

4481-MZBP-0001-M5-ST

1 — 4481MZBP0001M5-V+ (1)
2 — 4481MZBP0001M5-V- (2)
3 — 4481MZBP0001M5-9 (3)
3
4 — 4481MZBP0001M5-9B (4)
4
5 — 4481MZBP0001M5-9B (1)
5
7 — 4481MZBP0001M5-9E (5)
7 — 4481MZBP0001M5-9E (2)
9 — 4481MZBP0001M5-17 (6)
10 — 4481MZBP0001M5-10 (7)
10 — 4481MZBP0001M5-10 (3)
13 — 4481MZBP0001M5-9C (8)
13 — 4481MZBP0001M5-9C (4)
20
21
22
23
24
25
(1SP-1G)
(4SP)

1

4481-MZBP-0001-M5-J1
(12C x 1,5mm2)

INPUT CARD
XDI0102

V1+ — 4481MZBP0001M5-V+ (1)
V2+
V3+
V4+
IN8 — 4481MZBP0001M5-9C (8)
IN9 — 4481MZBP0001M5-9B (4)
IN10 — 4481MZBP0001M5-9 (3)
IN11 — 4481MZBP0001M5-17 (6)
IN12
IN13
IN14
IN15
V1- — 4481MZBP0001M5-V- (2)
V2-

4481MZBP0001M5-10

OUTPUT CARD
XD□0004

4481MZBP0001M5-9E (5) — 4
4481MZBP0001M5-10 (7) — V4+
(4SP)

M
3~
U1
V1
W1
4481-MZBP-0001-M5
(2,2 KW)

4481-MZBP-0001-M5-P2
(3C x 2,5mm2) +G

4481-MZBP-0001-M5-LDS-J1
(2C x 1,5mm2)

4481-MZBP-0001-M5-LDS

U1 — 3L1
V1 — 3L2
W1 — 3L3
4481MZBP0001M5-9C — 4
4481MZBP0001M5-9B — 3
2
1

4481-MZBP-0001-M5-P1
(3C x 2,5mm2) +G

3L1 — 3L1
3L2 — 3L2
3L3 — 3L3

SELLER/CONTRACTOR DOCUMENT REVIEW

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Discipline :

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SELLER DRAWING No. 1347-56273 | REV. 1

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		1		UPDATE CONNECTORS FOR MCC	MR-14-2011	F.P.	E.B.	C.C.
		REVISIONS						

NOTES

STATUS: FOR DESIGN

DRAWN/DES'D: F.P.	AREA ENG.:
DATE: 15/11/2010	DATE:
CHECKED: E.B.	PRJ ENG MGR:
DATE:	DATE:
RESPONSIBLE ENG. M.B.	CLIENT:
DATE:	DATE:
ENG. GROUP SUP.	DRAWING SCALE: NONE
DATE:	

Vendor or Subcontractor Logo: GNA a.i.tech Inc. — Département Ingénierie / Engineering Department, 9690 Trans-Canada, Saint-Laurent, Québec (H4S 1V3), Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MZBP-0001-M5
INTERCONNECTION DIAGRAM

MA'ADEN

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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FIELD

ELECTRICAL ROOM

MOTOR CONTROL CENTER PANEL (COMP-E4) (MOTOR-S1)
4480-ECM1-0001

PLC PANEL
4481-CP-1000

4481-MZBP-0001-LCS-03

MZBP-0001-M2

9B 4481MZBP0001M2-9B
9B 4481MZBP0001M2-9B (1)
9C 4481MZBP0001M2-9C
9C 4481MZBP0001M2-9C (4)
4481MZBP0001M2-9D
STOP
JOG
9E 4481MZBP0001M2-9E (2)
OFF
10 4481MZBP0001M2-10 (3)
REMOTE
(1SP-1G)

4481-MZBP-0001-LCS-03-J1
(5C x 1,5mm2) +G

2

4481-MZBP-0001-M2-ST

1	4481MZBP0001M2-V+ (1)
2	4481MZBP0001M2-V- (2)
3	4481MZBP0001M2-9 (3)
3	
4	
4	
5	4481MZBP0001M2-9B (4)
5	4481MZBP0001M2-9B (1)
7	4481MZBP0001M2-9E (5)
7	4481MZBP0001M2-9E (2)
9	4481MZBP0001M2-17 (6)
10	4481MZBP0001M2-10 (7)
10	4481MZBP0001M2-10 (3)
13	4481MZBP0001M2-9C (8)
13	4481MZBP0001M2-9C (4)
20	
21	
22	
23	
24	
25	

(1SP-1G)
(4SP)

2

4481-MZBP-0001-M2-J1
(12C x 1,5mm2)

INPUT CARD
XDI0102

V1+	4481MZBP0001M2-V+ (1)
V2+	
V3+	
V4+	
IN16	4481MZBP0001M2-9C (8)
IN17	4481MZBP0001M2-9B (4)
IN18	4481MZBP0001M2-9 (3)
IN19	4481MZBP0001M2-17 (6)
IN20	
IN21	
IN22	
IN23	
V3-	4481MZBP0001M2-V- (2)
V4-	

4481MZBP0001M2-10

OUTPUT CARD
XD□0004

5	4481MZBP0001M2-9E (5)
V5+	4481MZBP0001M2-10 (7)

(4SP)

M
3~
U1
V1
W1
4481-MZBP-0001-M2
(11 KW)

4481-MZBP-0001-M2-P2
(3C x 6mm2) +G

4481-MZBP-0001-M2-LDS-J1
(2C x 1,5mm2)

4481-MZBP-0001-M2-LDS

U1 3L1
V1 3L2
W1 3L3
4481MZBP0001M2-9C 4
4481MZBP0001M2-9B 3
2
1

4481-MZBP-0001-M2-P1
(3C x 6mm2) +G

3L1 3L1
3L2 3L2
3L3 3L3

SELLER/CONTRACTOR DOCUMENT REVIEW

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Discipline :

Document No : 25457-4480-V1A-MXA0-0240 | Rev. :

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SELLER DRAWING No. 1347-56274 | REV. 2

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		2		UPDATE CONNECTORS FOR MCC	MR-14-2011	F.P.	E.B.	C.C.
		1		CHANGE CABLE MOTOR FOR 6mm2	JA-13-2011	E.B.	T.Pa.	M.B.
		REVISIONS						

NOTES

STATUS: FOR DESIGN

DRAWN/DES'D: F.P.	AREA ENG.:
DATE: 15/11/2010	DATE:
CHECKED: E.B.	PRJ ENG MGR:
DATE:	DATE:
RESPONSIBLE ENG. M.B.	CLIENT:
DATE:	DATE:
ENG. GROUP SUP.	DRAWING SCALE: NONE
DATE:	

Vendor or Subcontractor Logo: GNA a.j.tech Inc. — Département Ingénierie Engineering Department 9495 Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MZBP-0001-M2
INTERCONNECTION DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
—	—	—		A3-		-AZ	

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FIELD

ELECTRICAL ROOM

MOTOR CONTROL CENTER PANEL (COMP-F5) (MOTOR-S1)
4480-ECM1-0001

PLC PANEL
4481-CP-1000

4481-MZBP-0001-LCS-03

MZBP-0001-M4
9B 4481MZBP0001M4-9B
9B 4481MZBP0001M4-9B (1)
9C 4481MZBP0001M4-9C
9C 4481MZBP0001M4-9C (4)
9E 4481MZBP0001M4-9E (2)
10 4481MZBP0001M4-10 (3)
4481MZBP0001M4-9D
STOP
JOG
OFF
REMOTE
(2SP)

4481-MZBP-0001-LCS-03-J2 (6C x 1,5mm2)

4481-MZBP-0001-M4-ST
1 4481MZBP0001M4-V+ (1)
2 4481MZBP0001M4-V- (2)
3 4481MZBP0001M4-9 (3)
3
4
4
5 4481MZBP0001M4-9B (1)
5 4481MZBP0001M4-9B (4)
7 4481MZBP0001M4-9E (5)
7 4481MZBP0001M4-9E (2)
9 4481MZBP0001M4-17 (6)
10 4481MZBP0001M4-10 (7)
10 4481MZBP0001M4-10 (3)
13 4481MZBP0001M4-9C (8)
13 4481MZBP0001M4-9C (4)
20
21
22
23
24
25
(2SP)
(4SP)
2

4481-MZBP-0001-M4-J1 (12C x 1,5mm2)

INPUT CARD
XDI0102
V1+ 4481MZBP0001M4-V+ (1)
V2+
V3+
V4+
IN24 4481MZBP0001M4-9C (8)
IN25 4481MZBP0001M4-9B (4)
IN26 4481MZBP0001M4-9 (3)
IN27 4481MZBP0001M4-17 (6)
IN28
IN29
IN30
IN31
V3- 4481MZBP0001M4-V- (2)
V4-
4481MZBP0001M4-10

OUTPUT CARD
XD□0004
4481MZBP0001M4-9E (5) 6
4481MZBP0001M4-10 (7) V6+
(4SP)

M
3~
U1
V1
W1
4481-MZBP-0001-M4
(11 KW)

4481-MZBP-0001-M4-P2 (3C x 6mm2) +G

4481-MZBP-0001-M4-LDS

4481-MZBP-0001-M4-LDS-J1 (2C x 1,5mm2)

U1 3L1
V1 3L2
W1 3L3
4481MZBP0001M4-9C 4
4481MZBP0001M4-9B 3
2
1

4481-MZBP-0001-M4-P1 (3C x 6mm2) +G

3L1 3L1
3L2 3L2
3L3 3L3

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Discipline :

Document No : 25457-4480-V1A-MXA0-0241 | Rev. :

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SELLER DRAWING No. 1347-56275 | REV. 2

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		2		UPDATE CONNECTORS FOR MCC	MR-14-2011	F.P.	E.B.	C.C.
		1		CHANGE CABLE MOTOR FOR 6mm2	JA-13-2011	E.B.	T.Pa.	M.B.
		REVISIONS						

NOTES

STATUS: FOR DESIGN

DRAWN/DES'D: F.P.	AREA ENG.:
DATE: 15/11/2010	DATE:
CHECKED: E.B.	PRJ ENG MGR:
DATE:	DATE:
RESPONSIBLE ENG. M.B.	CLIENT:
DATE:	DATE:
ENG. GROUP SUP.	DRAWING SCALE: NONE
DATE:	

Vendor or Subcontractor Logo: GNA a.j.tech Inc. Département Ingénierie Engineering Department 9495 Trans-Canada Saint-Laurent, Quebec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MZBP-0001-M4
INTERCONNECTION DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx –	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
–	–	–		A3–		–AZ	

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FIELD

ELECTRICAL ROOM

MOTOR CONTROL CENTER PANEL (COMP-F10) (MOTOR-S1)
4480-ECM1-0001

PLC PANEL
4481-CP-1000

4481-MZBP-0001-LCS-03

MZBP-0001-M6

9B — 4481MZBP0001M6-9B
9B — 4481MZBP0001M6-9B (1)
9C — 4481MZBP0001M6-9C
9C — 4481MZBP0001M6-9C (5)
STOP
4481MZBP0001M6-9E — 9E — 4481MZBP0001M6-9E (2)
JOG
11 — 4481MZBP0001M6-11 (3)
OFF
12 — 4481MZBP0001M6-12 (4)
REMOTE
(2SP)

4481-MZBP-0001-LCS-03-J3
(6C x 1,5mm2)
1

4481-MZBP-0001-ST

1	4481MZBP0001M6-V+ (1)
2	4481MZBP0001M6-V+ (2)
3	4481MZBP0001M6-9 (3)
3	
4	
4	
5	4481MZBP0001M6-9B (4)
5	4481MZBP0001M6-9B (1)
7	4481MZBP0001M6-9E (2)
9	4481MZBP0001M6-17 (5)
11	4481MZBP0001M6-11 (6)
11	4481MZBP0001M6-11 (3)
12	4481MZBP0001M6-12 (7)
12	4481MZBP0001M6-12 (4)
13	4481MZBP0001M6-9C (8)
13	4481MZBP0001M6-9C (5)
20	
21	
22	
23	
24	
25	
14	4481MZBP0001M6-14
15	4481MZBP0001M6-15

(2SP)
(4SP)

4481-MZBP-0001-M6-J1
(12C x 1,5mm2)

INPUT CARD
XDI0103

4481MZBP0001M6-V+ (1)	V1+
	V2+
	V3+
	V4+
4481MZBP0001M6-11 (6)	IN0
4481MZBP0001M6-12 (7)	IN1
4481MZBP0001M6-9C (8)	IN2
4481MZBP0001M6-9B (4)	IN3
4481MZBP0001M6-9 (3)	IN4
4481MZBP0001M6-17 (5)	IN5
	IN6
	IN7
4481MZBP0001M6-V- (2)	V1-
	V2-

(4SP)

THERMISTORS
4481MZBP0001M6-14
4481MZBP0001M6-15

4481-MZBP-0001-M6-J2
(1P x 1,5mm2)

4481MZBP0001M6-14
4481MZBP0001M6-15

M
3~
U1
V1
W1
4481-MZBP-0001-M6
(0,37 KW)

4481-MZBP-0001-M6-P2
(3C x 2,5mm2) +G

4481-MZBP-0001-M6-LDS

U1 — 4L1
V1 — 4L2
W1 — 4L3

4481-MZBP-0001-M6-P1
(3C x 2,5mm2) +G

4L1	4L1
4L2	4L2
4L3	4L3

4481-MZBP-0001-M6-LDS-J1
(2C x 1,5mm2)

4481MZBP0001M6-9C — 4
4481MZBP0001M6-9B — 3
2
1

1

SELLER/CONTRACTOR DOCUMENT REVIEW

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DDR Nbr : 172

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Discipline :

Document No : 25457-4480-V1A-MXA0-0242 | Rev. :

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SELLER DRAWING No. 1347-56276 | REV. 1

No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
1		UPDATE CONNECTORS FOR MCC	MR-14-2011	F.P.	E.B.	C.C.

DRAWING NUMBER | TITLE
REFERENCES | REVISIONS

NOTES

STATUS: FOR DESIGN

DRAWN/DES'D:	F.P.	AREA ENG.:	
DATE:	15/11/2010	DATE:	
CHECKED:	E.B.	PRJ ENG MGR:	
DATE:		DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA alutech Inc. Département Ingénierie / Engineering Department, 9650 Trans-Canada, Saint-Laurent, Québec, H4S 1V3, Canada

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No | SUBD. | DISC. | SECTOR | SEQUENCE | REV.
25457-00AZ- xx - xxxx - xxxx - xxx - xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MZBP-0000-M6
INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type | Building | Discipline | Phase | Format | Sequential | Location | Rev. No.
— | — | — | | A3— | | —AZ |

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FIELD

ELECTRICAL ROOM

MOTOR CONTROL CENTER PANEL (COMP-F1) (MOTOR-D1)
4480-ECM1-0001

PLC PANEL
4481-CP-1000

4481-MAC0-0001-LCS-01

MAC0-0001-M1

9B — 4481MAC00001M1-9B
9B — 4481MAC00001M1-9B (1)
9C — 4481MAC00001M1-9C
9C — 4481MAC00001M1-9C (4)
9E — 4481MAC00001M1-9E (2)
10 — 4481MAC00001M1-10 (3)

4481MAC00001M1-9D

STOP
JOG
OFF
REMOTE

(1SP-1G)

4481-MAC0-0001-LCS-01-J1
(5C x 1,5mm2) +G

2

4481-MAC0-0001-M1-ST

1	4481MAC00001M1-V+ (1)
2	4481MAC00001M1-V- (2)
3	4481MAC00001M1-9 (3)
3	
4	
4	
5	4481MAC00001M1-9B (4)
5	4481MAC00001M1-9B (1)
7	4481MAC00001M1-9E (5)
7	4481MAC00001M1-9E (2)
9	4481MAC00001M1-17 (6)
10	4481MAC00001M1-10 (7)
10	4481MAC00001M1-10 (3)
13	4481MAC00001M1-9C (8)
13	4481MAC00001M1-9C (4)
20	
21	
22	
23	
24	
25	

(1SP-1G)

(4SP)

2

4481-MAC0-0001-M1-J1
(12C x 1,5mm2)

INPUT CARD
XDI0103

V1+	4481MAC00001M1-V+ (1)
V2+	
V3+	
V4+	
IN8	4481MAC00001M1-9C (8)
IN9	4481MAC00001M1-9B (4)
IN10	4481MAC00001M1-9 (3)
IN11	4481MAC00001M1-17 (6)
IN12	
IN13	
IN14	
IN15	
V1-	4481MAC00001M1-V- (2)
V2-	

4481MAC00001M1-10

OUTPUT CARD
XD□0004

7	4481MAC00001M1-9E (5)
V7+	4481MAC00001M1-10 (7)

(4SP)

U1
V1
W1
M
3~
4481-MAC0-0001-M1
(7,5 KW)

4481-MAC0-0001-M1-P2
(3C x 4mm2) +G

4481-MAC0-0001-M1-LDS-J1
(2C x 1,5mm2)

4481-MAC0-0001-M1-LDS

U1 — 3L1
V1 — 3L2
W1 — 3L3

4481MAC00001M1-9C — 4
4481MAC00001M1-9B — 3
2
1

4481-MAC0-0001-M1-P1
(3C x 4mm2) +G

3L1	3L1
3L2	3L2
3L3	3L3

2

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Document No : 25457-4480-V1A-MXA0-0243 | Rev. :

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SELLER DRAWING No. 1347-56277 | REV. 2

No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
2		UPDATE CONNECTORS FOR MCC	MR-14-2011	F.P.	E.B.	C.C.
1		CHANGE CABLE MOTOR FOR 4mm2	JA-13-2011	E.B.	T.Pa.	M.B.

DRAWING NUMBER | TITLE
REFERENCES | REVISIONS

NOTES

STATUS: FOR DESIGN

DRAWN/DES'D: F.P. DATE: 15/11/2010	AREA ENG.: DATE:
CHECKED: E.B. DATE:	PRJ ENG MGR: DATE:
RESPONSIBLE ENG. M.B. DATE:	CLIENT: DATE:
ENG. GROUP SUP. DATE:	DRAWING SCALE: NONE

Vendor or Subcontractor Logo: GNA a.b.tech Inc. — Département Ingénierie Engineering Department 9695 Trans-Canada Saint-Laurent, Quebec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MAC0-0001-M1
INTERCONNECTION DIAGRAM

MA'ADEN

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
—	—	—		A3-		-AZ	

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FIELD

ELECTRICAL ROOM

LOCAL CONTROL PANEL
4481-MHCD-0003-CP-01 (R8/C3/R7)

X98 ⚠1

SEE DWG. 1347-55292 — 14B
16A — 98-V16A
DISCONNECT SWITCH (R8) — 16B — 98-V16B
SEE DWG. 1347-56290 — 16C
23A — 4481MJR00002M1-9A
SAFETY KEY RELAY — 23B — 4481MJR00002M1-9B

4481-MHCD-0003-CP01-J3 (13C x 1,5mm2)

4481-MHCD-0003-LCS-01

MJR0-0002-M1

98-V16A	1	98-V16A
98-V16B	2	98-V16B
4481MJR00002M1-9A	9A	4481MJR00002M1-9A (1)
4481MJR00002M1-9B	9B	4481MJR00002M1-9B
	9B	4481MJR00002M1-9B (2)
	9C	4481MJR00002M1-9C
	9C	4481MJR00002M1-9C (6)
4481MJR00002M1-9E	9E	4481MJR00002M1-9E (3)
	11	4481MJR00002M1-11 (4)
	12	4481MJR00002M1-12 (5)

STOP
JOG
OFF
REMOTE
(1SP-1G)

4481-MHCD-0003-LCS-01-J1 (7C x 1,5mm2) +G ⚠1

MOTOR CONTROL CENTER PANEL (COMP-E10) (MOTOR-R8)
4480-ECM1-0001

4481-MJR0-0002-M1-ST

4481MJR00002M1-9A (1)	1	4481MJR00002M1-V+ (1)
	2	4481MJR00002M1-V- (2)
	3	4481MJR00002M1-9 (3)
	3	
	4	
4481MJR00002M1-9B (2)	4	4481MJR00002M1-9B (4)
4481MJR00002M1-9E (3)	5	
	7	
	9	4481MJR00002M1-17 (5)
4481MJR00002M1-11 (4)	11	4481MJR00002M1-11 (6)
	11	
4481MJR00002M1-12 (5)	12	4481MJR00002M1-12 (7)
	12	
4481MJR00002M1-9C (6)	13	4481MJR00002M1-9C (8)
	13	
	20	
	21	
	22	
	23	
	24	
	25	
4481MJR00002M1-14	14	
4481MJR00002M1-15	15	

(1SP-1G)
(4SP)
⚠1

PLC PANEL
4481-CP-1000

4481-MJR0-0002-M1-J1 (12C x 1,5mm2)

INPUT CARD
XDI0103

4481MJR00002M1-V+ (1)	V1+
	V2+
	V3+
	V4+
4481MJR00002M1-11 (6)	IN16
4481MJR00002M1-12 (7)	IN17
4481MJR00002M1-9C (8)	IN18
4481MJR00002M1-9B (4)	IN19
4481MJR00002M1-9 (3)	IN20
4481MJR00002M1-17 (5)	IN21
	IN22
	IN23
4481MJR00002M1-V- (2)	V3-
	V4-

(4SP)

THERMISTORS
4481MJR00002M1-14
4481MJR00002M1-15

4481-MJR0-0002-M1-J2 (1P x 1,5mm2)

M 3~ — U1, V1, W1
4481-MJR0-0002-M1 (0,37 KW)

4481-MJR0-0002-M1-P2 (3C x 2,5mm2) +G

4481-MJR0-0002-M1-LDS

U1	4L1
V1	4L2
W1	4L3

4481-MJR0-0002-M1-P1 (3C x 2,5mm2) +G

4L1	4L1
4L2	4L2
4L3	4L3

M 1~ — L230D, N230B
FAN (44 W)

4481-MJR0-0002-M1-P4 (2C x 2,5mm2) +G

L230D	L230C
N230B	N230A

(1SP)

4481-MJR0-0002-M1-P3 (3C x 2,5mm2) +G ⚠1 (1SP)

L230C	L230C
N230A	N230A

4481-MJR0-0002-M1-LDS-J1 (4C x 1,5mm2)

4481MJR00002M1-9C	4
4481MJR00002M1-9B	3
98-V16B	2
98-V16A	1

No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
1		UPDATE CONNECTORS FOR MCC	MR-14-2011	F.P.	E.B.	C.C.

DRAWING NUMBER | TITLE | REFERENCES | REVISIONS | NOTES

STATUS: FOR DESIGN

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SELLER DRAWING No. 1347-56280 | REV. 1

Vendor or Subcontractor Logo: GNA ab.tech Inc. — Département Ingénierie / Engineering Department, Ivaltech Transcanada, Baie-Comeau, Québec, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MJR0-0002-M1
INTERCONNECTION DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—		—	—	A3—		—AZ	

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FIELD

ELECTRICAL ROOM

LOCAL CONTROL PANEL
4481-MHCD-0003-CP-01 (R8/C3/R7)

X98 ⚠1

SEE DWG. 1347-56280	16B		
	16C	98-V16C	4481-MHCD-0003-CP01-J3 (13C x 1,5mm2)
DISCONNECT SWITCH (C3)	16D	98-V16D	
SEE DWG. 1347-56300	16E		
	24A	4481MHCD0003M1-9A	
SAFETY KEY RELAY	24B	4481MHCD0003M1-9B	

THERMISTORS
- 4481MHCD0003M1-14
- 4481MHCD0003M1-15

M 3~ U1 V1 W1
4481-MHCD-0003-M1 (0,75 KW)

4481-MHCD-0003-LCS-01

MHCD-0003-M1

98-V16C	1	98-V16C
98-V16D	2	98-V16D
4481MHCD0003M1-9A	9A	4481MHCD0003M1-9A (1)
4481MHCD0003M1-9B	9B	4481MHCD0003M1-9B
	9B	4481MHCD0003M1-9B (2)
	9C	4481MHCD0003M1-9C
	9C	4481MHCD0003M1-9C (6)
4481MHCD0003M1-9E	9E	4481MHCD0003M1-9E (3)
	11	4481MHCD0003M1-11 (4)
	12	4481MHCD0003M1-12 (5)

STOP, JOG, OFF, REMOTE, (2SP)

4481-MHCD-0003-LCS-01-J2 (8C x 1,5mm2) ⚠1

4481-MHCD-0003-M1-J2 (1P x 1,5mm2)

4481-MHCD-0003-M1-P2 (3C x 2,5mm2) +G

4481-MHCD-0003-M1-LDS-J1 (4C x 1,5mm2)

4481-MHCD-0003-M1-LDS

U1	4L1	
V1	4L2	
W1	4L3	
4481MHCD0003M1-9C	4	
4481MHCD0003M1-9B	3	
98-V16D	2	
98-V16C	1	

MOTOR CONTROL CENTER PANEL (COMP-D11) (MOTOR-C3)
4480-ECM1-0001

4481-MHCD-0003-M1-P1 (3C x 2,5mm2) +G

4L1	4L1	
4L2	4L2	
4L3	4L3	

4481-MHCD-0003-M1-ST

	1	4481MHCD0003M1-V+ (1)
	2	4481MHCD0003M1-V+ (2)
	3	4481MHCD0003M1-9 (3)
	3	
	4	
4481MHCD0003M1-9A (1)	4	
	5	4481MHCD0003M1-9B (4)
4481MHCD0003M1-9B (2)	5	
4481MHCD0003M1-9E (3)	7	
	9	4481MHCD0003M1-17 (5)
	11	4481MHCD0003M1-11 (6)
4481MHCD0003M1-11 (4)	11	
	12	4481MHCD0003M1-12 (7)
4481MHCD0003M1-12 (5)	12	
	13	4481MHCD0003M1-9C (8)
4481MHCD0003M1-9C (6)	13	
	20	
	21	
	22	
	23	
	24	
	25	
4481MHCD0003M1-14	14	
4481MHCD0003M1-15	15	

⚠1

(2SP) (4SP)

PLC PANEL
4481-CP-1000

4481-MHCD-0003-M1-J1 (12C x 1,5mm2)

INPUT CARD
XDI0103

	V1+
	V2+
	V3+
4481MHCD0003M1-V+ (1)	V4+
4481MHCD0003M1-11 (6)	IN24
4481MHCD0003M1-12 (7)	IN25
4481MHCD0003M1-9C (8)	IN26
4481MHCD0003M1-9B (4)	IN27
4481MHCD0003M1-9 (3)	IN28
4481MHCD0003M1-17 (5)	IN29
	IN30
	IN31
	V3–
4481MHCD0003M1-V– (2)	V4–

(4SP)

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SELLER DRAWING No. 1347-56290 | REV. 1

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		1		UPDATE CONNECTORS FOR MCC	MR-14-2011	F.P.	E.B.	C.C.
		REVISIONS						

NOTES

STATUS: FOR DESIGN

DRAWN/DES'D:	F.P.	AREA ENG.:	
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DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA ab.tech Inc. — Département Ingénierie Engineering Department 9650 Transcanada Pointe-aux-Trembles, Québec Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MHCD-0003-M1
INTERCONNECTION DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx –	xxx

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
–		–	–	A3–		–AZ	

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FIELD

ELECTRICAL ROOM

LOCAL CONTROL PANEL
4481-MHCD-0003-CP-01 (R8/C3/R7)

X98

SEE DWG. 1347-56290 — 16D
16E — 98-V16E
DISCONNECT SWITCH (R7) — 16F — 98-V16F
SEE DWG. 1347-55292 — 18A
25B — 4481MJR00003M1-9B
SAFETY KEY RELAY
25A — 4481MJR00003M1-9A
26B
SEE DWG. 1347-55292 — 26A — 4481MJR00003M1-9

4481-MHCD-0003-CP01-J3 (13C x 1,5mm2)

4481-MHCD-0003-LCS-01

MJR0-0003-M1

98-V16E	1	98-V16E
98-V16F	2	98-V16F
4481MJR00003M1-9	9	4481MJR00003M1-9 (1)
4481MJR00003M1-9A	9A	4481MJR00003M1-9A (2)
4481MJR00003M1-9B	9B	4481MJR00003M1-9B
	9B	4481MJR00003M1-9B (3)
	9C	4481MJR00003M1-9C
	9C	4481MJR00003M1-9C (6)
	9E	4481MJR00003M1-9E (4)
	10	4481MJR00003M1-10 (5)

4481MJR00003M1-9D
STOP
JOG
OFF
REMOTE
(2SP)

4481-MHCD-0003-LCS-01-J3 (8C x 1,5mm2) +G

MOTOR CONTROL CENTER PANEL (COMP-D2) (MOTOR-R7)
4480-ECM1-0001

4481-MJR0-0003-M1-ST

4481MJR00003M1-9 (1)	1	4481MJR00003M1-V+ (1)
4481MJR00003M1-9A (2)	2	4481MJR00003M1-V- (2)
4481MJR00003M1-9B (3)	3	4481MJR00003M1-9 (3)
	3	
	4	
	4	
	5	4481MJR00003M1-9B (4)
	5	
	7	4481MJR00003M1-9E (5)
4481MJR00003M1-9E (4)	7	
	8	4481MJR00003M1-11 (9)
	9	4481MJR00003M1-16 (6)
	10	4481MJR00003M1-10 (7)
4481MJR00003M1-10 (5)	10	
	13	4481MJR00003M1-9C (8)
4481MJR00003M1-9C (6)	13	
	18	4481MJR00003M1-18 (10)
	20	
	21	
	22	
	23	
	24	
	25	

(2SP)
(2SP)

4481-MJR0-0003-M1-P1 (3C x 2,5mm2) +G

3L1	3L1
3L2	3L2
3L3	3L3

PLC PANEL
4481-CP-1000

4481-MJR0-0003-M1-J1 (12C x 1,5mm2)

INPUT CARD
XDI0104

4481MJR00003M1-V+ (1)	V1+
	V2+
	V3+
	V4+
	IN0
4481MJR00003M1-9C (8)	IN1
4481MJR00003M1-9B (4)	IN2
4481MJR00003M1-9 (3)	IN3
4481MHCD002M1-16 (6)	IN4
4481MJR00003M1-18 (10)	IN5
	IN6
	IN7
4481MJR00003M1-V- (2)	V1-
	V2-

4481MJR00003M1-10

OUTPUT CARD
XD□0004

4481MJR00003M1-9E (5)	9
4481MJR00003M1-10 (7)	V9+
4481MJR00003M1-11 (9)	10
	V10+

(2SP)

4481-MJR0-0003-M1-LDS

4481-MJR0-0003-M1-P2 (3C x 2,5mm2) +G

U1	3L1
V1	3L2
W1	3L3

4481-MJR0-0003-M1-LDS-J1 (4C x 1,5mm2)

4481MJR00003M1-9C	4
4481MJR00003M1-9B	3
98-V16F	2
98-V16E	1

M 3~
U1 V1 W1
4481-MJR0-0003-M1
(0,75 KW)

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Discipline :

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SELLER DRAWING No. 1347-56300 | REV. 2

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		REVISIONS						
		2		UPDATE CONNECTORS FOR MCC	MR-14-2011	F.P.	E.B.	C.C.
		1		UPDATE	FE-07-2011	F.P.	T.Pa.	C.C.

NOTES

STATUS: FOR DESIGN

DRAWN/DES'D: F.P.	AREA ENG.:
DATE: 15/11/2010	DATE:
CHECKED: E.B.	PRJ ENG MGR:
DATE:	DATE:
RESPONSIBLE ENG. M.B.	CLIENT:
DATE:	DATE:
ENG. GROUP SUP.	DRAWING SCALE: NONE
DATE:	

Vendor or Subcontractor Logo: GNA a.i.tech Inc. — Département Ingénierie Engineering Department 9490 Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MJR0-0003-M1
INTERCONNECTION DIAGRAM

MA'ADEN

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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FIELD

ELECTRICAL ROOM

MOTOR CONTROL CENTER PANEL (COMP-B1) (MOTOR-F2)
4480-ECM1-0001

PLC PANEL
4481-CP-1000

4481-MBMB-0001-LCS-01

MBMB-0001-M1

9B — 4481MBMB0001M1-9B
9B — 4481MBMB0001M1-9B (1)
9C — 4481MBMB0001M1-9C
9C — 4481MBMB0001M1-9C (5)
STOP
4481MBMB0001M1-9E — 9E — 4481MBMB0001M1-9E (2)
JOG
11 — 4481MBMB0001M1-11 (3)
OFF
12 — 4481MBMB0001M1-12 (4)
REMOTE
(2SP-1G)

4481-MBMB-0001-LCS-01-J1
(7C x 1,5mm2) +G
1

4481-MBMB-0001-M1-ST

1 — 4481MBMB0001M1-V+ (1)
2 — 4481MBMB0001M1-V- (2)
3 — 4481MBMB0001M1-9 (3)
3
4
4
5 — 4481MBMB0001M1-9B (4)
4481MBMB0001M1-9B (1) — 5
4481MBMB0001M1-9E (2) — 7
9 — 4481MBMB0001M1-17 (5)
11 — 4481MBMB0001M1-11 (6)
4481MBMB0001M1-11 (3) — 11
12 — 4481MBMB0001M1-12 (7)
4481MBMB0001M1-12 (4) — 12
13 — 4481MBMB0001M1-9C (8)
4481MBMB0001M1-9C (5) — 13
(2SP-1G)
(4SP)
20
21
22
23
24
25
4481MBMB0001M1-14 — 14
4481MBMB0001M1-15 — 15
1

4481-MBMB-0001-M1-J1
(12C x 1,5mm2)

INPUT CARD
XDI0104

4481MBMB0001M1-V+ (1) — V1+
V2+
V3+
V4+
4481MBMB0001M1-11 (6) — IN8
4481MBMB0001M1-12 (7) — IN9
4481MBMB0001M1-9C (8) — IN10
4481MBMB0001M1-9B (4) — IN11
4481MBMB0001M1-9 (3) — IN12
4481MBMB0001M1-17 (5) — IN13
IN14
IN15
V1-
4481MBMB0001M1-V- (2) — V2-
(4SP)

THERMISTORS
4481MBMB0001M1-14
4481MBMB0001M1-15

4481-MBMB-0001-M1-J2
(1P x 1,5mm2)

M 3~ — U1, V1, W1
4481-MBMB-0001-M1
(0,75 KW)

4481-MBMB-0001-M1-P2
(3C x 2,5mm2) +G

4481-MBMB-0001-M1-LDS

U1 — 4L1
V1 — 4L2
W1 — 4L3

4481-MBMB-0001-M1-P1
(3C x 2,5mm2) +G

4L1 — 4L1
4L2 — 4L2
4L3 — 4L3

M 1~ — L230D, N230B
FAN
(44 W)

4481-MBMB-0001-M1-P4
(2C x 2,5mm2) +G

L230D — L230C
N230B — N230A
(1SP)

4481-MBMB-0001-M1-P3
(3C x 2,5mm2) +G
1
(1SP)

L230C — L230C
N230A — N230A

4481-MBMB-0001-M1-LDS-J1
(2C x 1,5mm2)

4481MBMB0001M1-9C — 4
4481MBMB0001M1-9B — 3
2
1

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Discipline :

Document No : 25457-4480-V1A-MXA0-0247 | Rev. :

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1		UPDATE CONNECTORS FOR MCC	MR-14-2011	F.P.	E.B.	C.C.

DRAWING NUMBER | TITLE | REFERENCES | REVISIONS

NOTES

STATUS: FOR DESIGN

DRAWN/DESD:	F.P.	AREA ENG.:	
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DATE:		DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA aLutech Inc. — Département Ingénierie / Engineering Department, 9650 Trans-Canada, Saint-Laurent, Québec (H4S 1V3), Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MBMB-0001-M1
INTERCONNECTION DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—		—	—	A3-		-AZ	

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FIELD

ELECTRICAL ROOM

MOTOR CONTROL CENTER PANEL (COMP-B2) (MOTOR-F2)
4480-ECM1-0001

PLC PANEL
4481-CP-1000

4481-MBMB-0001-LCS-02

MBMB-0001-M2

9B — 4481MBMB0001M2-9B
9B — 4481MBMB0001M2-9B (1)
9C — 4481MBMB0001M2-9C
9C — 4481MBMB0001M2-9C (5)
STOP
4481MBMB0001M2-9E
9E — 4481MBMB0001M2-9E (2)
JOG
11 — 4481MBMB0001M2-11 (3)
OFF
12 — 4481MBMB0001M2-12 (4)
REMOTE
(2SP-1G)

4481-MBMB-0001-LCS-02-J1
(7C x 1,5mm2) +G

4481-MBMB-0001-M2-ST

1 — 4481MBMB0001M2-V+ (1)
2 — 4481MBMB0001M2-V- (2)
3 — 4481MBMB0001M2-9 (3)
3
4
4
5 — 4481MBMB0001M2-9B (4)
5
7
9 — 4481MBMB0001M2-17 (5)
11 — 4481MBMB0001M2-11 (6)
11
12 — 4481MBMB0001M2-12 (7)
12
13 — 4481MBMB0001M2-9C (8)
13
20
21
22
23
24
25
14 — 4481MBMB0001M2-14
15 — 4481MBMB0001M2-15

4481MBMB0001M2-9B (1)
4481MBMB0001M2-9E (2)
4481MBMB0001M2-11 (3)
4481MBMB0001M2-12 (4)
4481MBMB0001M2-9C (5)
(2SP-1G)
(4SP)

4481-MBMB-0001-M2-J1
(12C x 1,5mm2)

INPUT CARD
XDI0104

V1+ — 4481MBMB0001M2-V+ (1)
V2+
V3+
V4+
IN16 — 4481MBMB0001M2-11 (6)
IN17 — 4481MBMB0001M2-12 (7)
IN18 — 4481MBMB0001M2-9C (8)
IN19 — 4481MBMB0001M2-9B (4)
IN20 — 4481MBMB0001M2-9 (3)
IN21 — 4481MBMB0001M2-17 (5)
IN22
IN23
V3- — 4481MBMB0001M2-V- (2)
V4-
(4SP)

THERMISTORS
4481MBMB0001M2-14
4481MBMB0001M2-15

4481-MBMB-0001-M2-J2
(1P x 1,5mm2)

M 3~
U1
V1
W1
4481-MBMB-0001-M2
(0,75 KW)

4481-MBMB-0001-M2-P2
(3C x 2,5mm2) +G

4481-MBMB-0001-M2-LDS

U1 — 4L1
V1 — 4L2
W1 — 4L3

4481-MBMB-0001-M2-P1
(3C x 2,5mm2) +G

4L1
4L2
4L3

M 1~
L230D
N230B
FAN
(44 W)

4481-MBMB-0001-M2-P4
(2C x 2,5mm2) +G

L230D — L230C
N230B — N230A
(1SP)

4481-MBMB-0001-M2-P3
(3C x 2,5mm2) +G

L230C
N230A
(1SP)

4481-MBMB-0001-M2-LDS-J1
(2C x 1,5mm2)

4481MBMB0001M2-9C — 4
4481MBMB0001M2-9B — 3
2
1

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Discipline :

Document No : 25457-4480-V1A-MXA0-0248 | Rev. :

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No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
1		UPDATE CONNECTORS FOR MCC	MR-14-2011	F.P.	E.B.	C.C.

DRAWING NUMBER | TITLE
REFERENCES
REVISIONS

NOTES

STATUS: FOR DESIGN

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DATE:		DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA eLutech Inc. — Département Ingénierie / Engineering Department, 9650 Trans-Canada, Saint-Laurent, Québec (H4S 1V3), Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MBMB-0001-M2
INTERCONNECTION DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—		—	—	A3—		—AZ	

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FIELD

ELECTRICAL ROOM

MOTOR CONTROL CENTER PANEL (COMP-B3) (MOTOR-F2)
4480-ECM1-0001

PLC PANEL
4481-CP-1000

4481-MBMB-0001-LCS-03

MBMB-0001-M3

9B — 4481MBMB0001M3-9B
9B — 4481MBMB0001M3-9B (1)
9C — 4481MBMB0001M3-9C
9C — 4481MBMB0001M3-9C (5)
STOP
4481MBMB0001M3-9E
9E — 4481MBMB0001M3-9E (2)
JOG
11 — 4481MBMB0001M3-11 (3)
OFF
12 — 4481MBMB0001M3-12 (4)
REMOTE
(2SP-1G)

4481-MBMB-0001-LCS-03-J1
(7C x 1,5mm2) +G
1

4481-MBMB-0001-M3-ST

1 — 4481MBMB0001M3-V+ (1)
2 — 4481MBMB0001M3-V- (2)
3 — 4481MBMB0001M3-9 (3)
3
4
4
5 — 4481MBMB0001M3-9B (4)
5
4481MBMB0001M3-9B (1)
4481MBMB0001M3-9E (2)
7
9 — 4481MBMB0001M3-17 (5)
11 — 4481MBMB0001M3-11 (6)
11
4481MBMB0001M3-11 (3)
12 — 4481MBMB0001M3-12 (7)
12
4481MBMB0001M3-12 (4)
13 — 4481MBMB0001M3-9C (8)
13
4481MBMB0001M3-9C (5)
20
21
22
23
24
25
14 — 4481MBMB0001M3-14
15 — 4481MBMB0001M3-15
(2SP-1G)
(4SP)
1

4481-MBMB-0001-M3-J1
(12C x 1,5mm2)

INPUT CARD
XDI0104

V1+ — 4481MBMB0001M3-V+ (1)
V2+
V3+
V4+
IN24 — 4481MBMB0001M3-11 (6)
IN25 — 4481MBMB0001M3-12 (7)
IN26 — 4481MBMB0001M3-9C (8)
IN27 — 4481MBMB0001M3-9B (4)
IN28 — 4481MBMB0001M3-9 (3)
IN29 — 4481MBMB0001M3-17 (5)
IN30
IN31
V3- — 4481MBMB0001M3-V- (2)
V4-
(4SP)

THERMISTORS
4481MBMB0001M3-14
4481MBMB0001M3-15

4481-MBMB-0001-M3-J2
(1P x 1,5mm2)

M
3~
U1
V1
W1
4481-MBMB-0001-M3
(0,75 KW)

4481-MBMB-0001-M3-P2
(3C x 2,5mm2) +G

4481-MBMB-0001-M3-P1
(3C x 2,5mm2) +G

4481-MBMB-0001-M3-LDS

U1 — 4L1
V1 — 4L2
W1 — 4L3

4L1
4L2
4L3

M
1~
L230D
N230B
FAN
(44 W)

4481-MBMB-0001-M3-P4
(2C x 2,5mm2) +G

4481-MBMB-0001-M3-P3
(3C x 2,5mm2) +G

L230D — L230C
N230B — N230A
(1SP)

L230C
N230A

4481-MBMB-0001-M3-LDS-J1
(2C x 1,5mm2)

4481MBMB0001M3-9C — 4
4481MBMB0001M3-9B — 3
2
1

1
(1SP)

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		1		UPDATE CONNECTORS FOR MCC	MR-14-2011	F.P.	E.B.	C.C.
		REVISIONS						

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RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie / Engineering Department, 9650 Trans-Canada, Baie-d'Urfé, Québec, H9X 3Y5, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MBMB-0001-M3
INTERCONNECTION DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—		—	—	A3-		-AZ	

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FIELD

ELECTRICAL ROOM

MOTOR CONTROL CENTER PANEL (COMP-B4) (MOTOR-F2)
4480-ECM1-0001

PLC PANEL
4481-CP-1000

4481-MBMB-0001-LCS-04

MBMB-0001-M4

9B — 4481MBMB0001M4-9B
9B — 4481MBMB0001M4-9B (1)
9C — 4481MBMB0001M4-9C
9C — 4481MBMB0001M4-9C (5)
STOP
4481MBMB0001M4-9E
9E — 4481MBMB0001M4-9E (2)
JOG
11 — 4481MBMB0001M4-11 (3)
OFF
12 — 4481MBMB0001M4-12 (4)
REMOTE
(2SP-1G)

4481-MBMB-0001-LCS-04-J1
(7C x 1,5mm2) +G
1

4481-MBMB-0001-M4-ST

1 — 4481MBMB0001M4-V+ (1)
2 — 4481MBMB0001M4-V- (2)
3 — 4481MBMB0001M4-9 (3)
3
4
4
5 — 4481MBMB0001M4-9B (4)
5
7
9 — 4481MBMB0001M4-17 (5)
11 — 4481MBMB0001M4-11 (6)
11
12 — 4481MBMB0001M4-12 (7)
12
13 — 4481MBMB0001M4-9C (8)
13
20
21
22
23
24
25
14 — 4481MBMB0001M4-14
15 — 4481MBMB0001M4-15
1

4481MBMB0001M4-9B (1)
4481MBMB0001M4-9E (2)
4481MBMB0001M4-11 (3)
4481MBMB0001M4-12 (4)
4481MBMB0001M4-9C (5)
(2SP-1G)
4481MBMB0001M4-17 (5)
4481MBMB0001M4-11 (6)
4481MBMB0001M4-12 (7)
4481MBMB0001M4-9C (8)
(4SP)

4481-MBMB-0001-M4-J1
(12C x 1,5mm2)

INPUT CARD
XDI0105

4481MBMB0001M4-V+ (1) — V1+
V2+
V3+
V4+
4481MBMB0001M4-11 (6) — IN0
4481MBMB0001M4-12 (7) — IN1
4481MBMB0001M4-9C (8) — IN2
4481MBMB0001M4-9B (4) — IN3
4481MBMB0001M4-9 (3) — IN4
4481MBMB0001M4-17 (5) — IN5
IN6
IN7
4481MBMB0001M4-V- (2) — V1-
V2-
(4SP)

THERMISTORS
4481MBMB0001M4-14
4481MBMB0001M4-15

4481-MBMB-0001-M4-J2
(1P x 1,5mm2)

M
3~
U1
V1
W1
4481-MBMB-0001-M4
(0,75 KW)

4481-MBMB-0001-M4-P2
(3C x 2,5mm2) +G

4481-MBMB-0001-M4-LDS

U1 — 4L1
V1 — 4L2
W1 — 4L3

4481-MBMB-0001-M4-P1
(3C x 2,5mm2) +G

4L1
4L2
4L3

M
1~
L230D
N230B
FAN
(44 W)

4481-MBMB-0001-M4-P4
(2C x 2,5mm2) +G

L230D — L230C
N230B — N230A
(1SP)

4481-MBMB-0001-M4-P3
(3C x 2,5mm2) +G
1
(1SP)

L230C
N230A

4481-MBMB-0001-M4-LDS-J1
(2C x 1,5mm2)

4481MBMB0001M4-9C — 4
4481MBMB0001M4-9B — 3
2
1

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Discipline :

Document No : 25457-4480-V1A-MXA0-0250 | Rev. :

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SELLER DRAWING No. 1347-56313 | REV. 1

No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
1		UPDATE CONNECTORS FOR MCC	MR-14-2011	F.P.	E.B.	C.C.

DRAWING NUMBER | TITLE | REFERENCES | REVISIONS

NOTES

STATUS: FOR DESIGN

DRAWN/DES'D:	F.P.	AREA ENG.:	
DATE:	15/11/2010	DATE:	
CHECKED:	E.B.	PRJ ENG MGR:	
DATE:		DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA alTech Inc. — Département Ingénierie / Engineering Department — 1600 Transcanada, Rabeauville, Québec (Québec) Canada

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No 25457 | SUBD. 00AZ | DISC. - | SECTOR xx | SEQUENCE xxxx - xxxx - xxx | REV. xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MBMB-0001-M4
INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type — | Building — | Discipline — | Phase — | Format A3 | Sequential — | Location AZ | Rev. No.

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FIELD

ELECTRICAL ROOM

LOCAL CONTROL PANEL
4481-MQLK-0001-CP-01 (G1)

X104

SEE DWG. 1347-55312 — 6B
8A — 104-V8A
DISCONNECT SWITCH (R6) — 8B — 104-V8B
SEE DWG. 1347-56330 — 8C
15A — 4481MJR00004M1-9A
SAFETY KEY RELAY — 15B — 4481MJR00004M1-9B

4481-MQLK-0001-CP01-J3 (12C x 1,5mm2) ⚠1

4481-MQLK-0001-LCS-01

MJR0-0004-M1

104-V8A	1	104-V8A
104-V8B	2	104-V8B
4481MJR00004M1-9A	9A	4481MJR00004M1-9A (1)
4481MJR00004M1-9B	9B	4481MJR00004M1-9B
	9B	4481MJR00004M1-9B (2)
	9C	4481MJR00004M1-9C
	9C	4481MJR00004M1-9C (6)
4481MJR00004M1-9E	9E	4481MJR00004M1-9E (3)
	11	4481MJR00004M1-11 (4)
	12	4481MJR00004M1-12 (5)

STOP
JOG
OFF
REMOTE
(1SP-1G)

4481-MQLK-0001-LCS-01-J1 (7C x 1,5mm2) +G ⚠1

THERMISTORS
4481MJR00004M1-14
4481MJR00004M1-15

4481-MJR0-0004-M1-J2 (1P x 1,5mm2)

M 3~
U1
V1
W1
4481-MJR0-0004-M1 (0,75 KW)

4481-MJR0-0004-M1-P2 (3C x 2,5mm2) +G

4481-MJR0-0004-M1-LDS

U1 — 4L1
V1 — 4L2
W1 — 4L3

4481-MJR0-0004-M1-LDS-J1 (4C x 1,5mm2)

4481MJR00004M1-9C — 4
4481MJR00004M1-9B — 3
104-V8B — 2
104-V8A — 1

MOTOR CONTROL CENTER PANEL (COMP-C1) (MOTOR-R6)
4480-ECM1-0001

4481-MJR0-0004-M1-P1 (3C x 2,5mm2) +G

4L1	4L1
4L2	4L2
4L3	4L3

4481-MJR0-0004-M1-ST

4481MJR00004M1-9A (1)	1	4481MJR00004M1-V+ (1)
	2	4481MJR00004M1-V+ (2)
	3	4481MJR00004M1-9 (3)
	3	
	4	
4481MJR00004M1-9B (2)	5	4481MJR00004M1-9B (4)
4481MJR00004M1-9E (3)	5	
	7	
	9	4481MJR00004M1-17 (5)
4481MJR00004M1-11 (4)	11	4481MJR00004M1-11 (6)
	11	
4481MJR00004M1-12 (5)	12	4481MJR00004M1-12 (7)
	12	
4481MJR00004M1-9C (6)	13	4481MJR00004M1-9C (8)
	13	
(1SP-1G)	20	(4SP)
	21	
	22	
	23	
	24	
	25	
4481MJR00004M1-14	14	
4481MJR00004M1-15	15	

⚠1

PLC PANEL
4481-CP-1000

4481-MJR0-0004-M1-J1 (12C x 1,5mm2)

INPUT CARD
XDI0105

4481MJR00004M1-V+ (1)	V1+
	V2+
	V3+
	V4+
4481MJR00004M1-11 (6)	IN8
4481MJR00004M1-12 (7)	IN9
4481MJR00004M1-9C (8)	IN10
4481MJR00004M1-9B (4)	IN11
4481MJR00004M1-9 (3)	IN12
4481MJR00004M1-17 (5)	IN13
	IN14
	IN15
	V1−
4481MJR00004M1-V− (2)	V2−

(4SP)

NOTES

No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
1		UPDATE CONNECTORS FOR MCC	MR-14-2011	F.P.	E.B.	C.C.

DRAWING NUMBER | TITLE
REFERENCES

STATUS: FOR DESIGN

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DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA Biotech Inc. — Département Ingénierie / Engineering Department, 9690 Trans-Canada, Saint-Laurent, Quebec (QC) H4S 1V0, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No | SUBD. | DISC. | SECTOR | SEQUENCE | REV.
25457-00AZ- xx - xxxx - xxxx - xxx — xxx

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SELLER DRAWING No.: 1347-56320 | REV.: 1

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MJR0-0004-M1
INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type | Building | Discipline | Phase | Format | Sequential | Location | Rev. No.
— | — | — | — | A3− | | −AZ |

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FIELD

ELECTRICAL ROOM

LOCAL CONTROL PANEL 4481-MQLK-0001-CP-01 (G1)

X104

SEE DWG. 1347-56320 — 8B
8C — 104-V8C
DISCONNECT SWITCH (G1) — 8D — 104-V8D
SEE DWG. 1347-56340 — 8E
16A — 4481MQLK0001M1-9A
SAFETY KEY RELAY — 16B — 4481MQLK0001M1-9B

4481-MQLK-0001-CP01-J3 (12C x 1,5mm2)

4481-MQLK-0001-LCS-01

MQLK-0001-M1

104-V8C	1	104-V8C
104-V8D	2	104-V8D
4481MQLK0001M1-9A	9A	4481MQLK0001M1-9A (1)
4481MQLK0001M1-9B	9B	4481MQLK0001M1-9B
	9B	4481MQLK0001M1-9B (2)
	9C	4481MQLK0001M1-9C
	9C	4481MQLK0001M1-9C (6)
4481MQLK0001M1-9E	9E	4481MQLK0001M1-9E (3)
JOG	11	4481MQLK0001M1-11 (4)
OFF		
REMOTE	12	4481MQLK0001M1-12 (5)

(2SP)

4481-MQLK-0001-LCS-01-J2 (8C x 1,5mm2)

MOTOR CONTROL CENTER PANEL (COMP-D12) (MOTOR-G1) 4480-ECM1-0001

4481-MQLK-0001-M1-ST

	1	4481MQLK0001M1-V+ (1)
	2	4481MQLK0001M1-V+ (2)
	3	4481MQLK0001M1-9 (3)
	3	
	4	
4481MQLK0001M1-9A (1)	4	
	5	4481MQLK0001M1-9B (4)
4481MQLK0001M1-9B (2)	5	
4481MQLK0001M1-9E (3)	7	
	8	4481MQLK0001M1-8 (9)
	9	4481MQLK0001M1-17 (5)
	11	4481MQLK0001M1-11 (6)
4481MQLK0001M1-11 (4)	11	
	12	4481MQLK0001M1-12 (7)
4481MQLK0001M1-12 (5)	12	
	13	4481MQLK0001M1-9C (8)
4481MQLK0001M1-9C (6)	13	
(2SP)	20	
	21	
	22	
	23	
	24	
	25	

(3SP)

4481-MQLK-0001-M1-J1 (12C x 1,5mm2)

PLC PANEL 4481-CP-1000

INPUT CARD
XDI0105

	V1+
4481MQLK0001M1-V+ (1)	V2+
	V3+
	V4+
4481MQLK0001M1-11 (6)	IN16
4481MQLK0001M1-12 (7)	IN17
4481MQLK0001M1-9C (8)	IN18
4481MQLK0001M1-9B (4)	IN19
	IN20
4481MQLK0001M1-17 (5)	IN21
	IN22
	IN23
4481MQLK0001M1-V- (2)	V3-
	V4-

OUTPUT CARD
XD□□0004

4481MQLK0001M1-8 (9)	12
4481MQLK0001M1-9 (3)	V12+

(3SP)

4481MQLK0001M1-9

SEE DWG. 1347-56331

4481-MQLK-0001-M1-LDS

4481-MQLK-0001-JB03-J1 (4C/SH x 1,5mm2)

4481MQLK0001M1-14	14	4481MQLK0001M1-14
4481MQLK0001M1-15	15	4481MQLK0001M1-15
4481MQLK0001M2-18	18	4481MQLK0001M2-18
4481MQLK0001M2-19	19	4481MQLK0001M2-19

4481-MQLK-0001-M1-LDS-J2 (2P x 1,5mm2)

4481MQLK0001M1-14	14
4481MQLK0001M1-15	15
4481MQLK0001M2-18	18
4481MQLK0001M2-19	19

2

4481-MQLK-0001-M1-P2 (6C x 4mm2) +G

U1	5L1	5L1
V1	5L2	5L2
W1	5L3	5L3
U2	6L1	6L1
V2	6L2	6L2
W2	6L3	6L3

4481-MQLK-0001-M1-P1 (3C x 2,5mm2) +G

5L1	5L1
5L2	5L2
5L3	5L3

2

4481-MQLK-0001-M1-P2 (3C x 2,5mm2) +G

6L1	6L1
6L2	6L2
6L3	6L3

2

4481-MQLK-0001-M1-P3 (3C x 4mm2) +G

8L2	7L2	7L2
8L3	7L3	7L3

(1SP)

4481-MQLK-0001-M1-P3 (3C x 2,5mm2) +G

7L2	7L2
7L3	7L3

2 (1SP)

4481-MQLK-0001-M1-LDS-J1 (4C x 1,5mm2)

4481MQLK0001M1-9C	4
4481MQLK0001M1-9B	3
104-V8D	2
104-V8C	1

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SELLER DRAWING No. 1347-56330 | REV. 2

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		2		UPDATE	08/07/2011	F.P.	T.Pa.	M.B.
		1		UPDATE CONNECTORS FOR MCC	MR-14-2011	F.P.	E.B.	C.C.
		REVISIONS						

NOTES

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RESPONSIBLE ENG. M.B.	CLIENT:
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ENG. GROUP SUP.	DRAWING SCALE: NONE
DATE:	

Vendor or Subcontractor Logo: GNA altech Inc. — Département Ingénierie Engineering Department 9495 Trans-Canada Saint-Laurent, Quebec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MQLK-0001-M1 (1/2)
INTERCONNECTION DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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FIELD

JUNCTION BOX
4481-MQLK-0001-JB-03 (G1)

FLEXIBLE
CABLE TRAY

1

THERMISTORS
4481MQLK0001M1-14
4481MQLK0001M1-15

M
3~
U1
V1
W1
8L2
BRAKE
8L3

4481-MQLK-0001-M1
(1,1 KW)

4481-MQLK-0001-M1-J1
(1P/SH x 1,5mm2)

4481-MQLK-0001-M1-P4
(5C x 2,5mm2) +G

THERMISTORS
4481MQLK0001M1-14 — 14 — 4481MQLK0001M1-14
4481MQLK0001M1-15 — 15 — 4481MQLK0001M1-15
4481MQLK0001M2-18 — 18 — 4481MQLK0001M2-18
4481MQLK0001M2-19 — 19 — 4481MQLK0001M2-19

MOTORS
U1 — U1 — U1
V1 — V1 — V1
W1 — W1 — W1

8L2 — 8L2
8L3 — 8L3
8L2 — 8L2 — 8L2
8L3 — 8L3 — 8L3

4481-MQLK-0001-JB03-J1
(4C/SH x 1,5mm2)

4481-MQLK-0001-M1-P2
(6C x 4mm2) +G

4481-MQLK-0001-M1-P3
(3C x 4mm2) +G

SEE DWG. 1347-56331

1

THERMISTORS
4481MQLK0001M2-18
4481MQLK0001M2-19

M
3~
U2
V2
W2
8L2
BRAKE
8L3

4481-MQLK-0001-M2
(1,1 KW)

4481-MQLK-0001-M2-J1
(1P/SH x 1,5mm2)

4481-MQLK-0001-M2-P4
(5C x 2,5mm2) +G

U2 — U2 — U2
V2 — V2 — V2
W2 — W2 — W2

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REFERENCES — REVISIONS

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DATE:			

Vendor or Subcontractor Logo: GNA eLitech Inc. — Département Ingénierie / Engineering Department, 9690 Trans-Canada, Saint-Laurent, Québec H4S 1J9, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MQLK-0001-M1 (2/2)
INTERCONNECTION DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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FIELD

ELECTRICAL ROOM

LOCAL CONTROL PANEL
4481-MQLK-0001-CP-01 (G1)

X104

SEE DWG. 1347-56330	8D	104-V8E (1)
	8E	
DISCONNECT SWITCH (C1)	8F	104-V8F (2)
SEE DWG. 1347-56360	10A	
	17B	4481MHCD0001M1-9B (5)
SAFETY KEY RELAY	17A	4481MHCD0001M1-9A (4)
SAFETY MATGUARD RELAY LIMIT SWITCH ENTRY DOOR	21D	
	21C	
LIMIT SWITCH EXIT DOOR	21B	
	21A	4481MHCD0001M1-9 (3)

4481-MQLK-0001-CP-01-J3 (12C x 1,5mm2)

△3

M
3~
U1
V1
W1

4481-MHCD-0001-M1
(3,7 KW)

4481-MJR0-0005-LCS-01

MHCD-0001-M1

104-V8E (1)	1	104-V8E
104-V8F (2)	2	104-V8F
4481MHCD0001M1-9 (3)	9	4481MHCD0001M1-9 (1)
4481MHCD0001M1-9A (4)	9A	4481MHCD0001M1-9A (2)
4481MHCD0001M1-9B (5)	9B	4481MHCD0001M1-9B
	9B	4481MHCD0001M1-9B (3)
	9C	4481MHCD0001M1-9C
	9C	4481MHCD0001M1-9C (6)
	9E	4481MHCD0001M1-9E (4)
	10	4481MHCD0001M1-10 (5)

4481MHCD0001M1-9B

STOP
JOG
OFF
REMOTE

(2SP)

4481-MJR0-0005-LCS-01-J2 (8C x 1,5mm2)

4481-MHCD-0001-M1-LDS

U1	3L1	
V1	3L2	
W1	3L3	
4481MHCD0001M1-9C	4	
4481MHCD0001M1-9B	3	
104-V8F	2	
104-V8E	1	

4481-MHCD-0001-M1-P2 (3C x 2,5mm2) +G

4481-MHCD-0001-M1-LDS-J1 (4C x 1,5mm2)

4481-MHCD-0001-M1-P1 (3C x 2,5mm2) +G

3L1	3L1
3L2	3L2
3L3	3L3

MOTOR CONTROL CENTER PANEL (COMP-E1) (MOTOR-C1)
4480-ECM1-0001

4481-MHCD-0001-M1-ST

4481MHCD0001M1-9 (1)	1	4481MHCD0001M1-V+ (1)
	2	4481MHCD0001M1-V- (2)
	3	4481MHCD0001M1-9 (3)
	3	
4481MHCD0001M1-9A (2)	4	
	4	
4481MHCD0001M1-9B (3)	5	4481MHCD0001M1-9B (4)
	5	
4481MHCD0001M1-9E (4)	7	4481MHCD0001M1-9E (5)
	7	
	8	4481MHCD0001M1-11 (9)
	9	4481MHCD0001M1-16 (6)
	10	4481MHCD0001M1-10 (7)
4481MHCD0001M1-10 (5)	10	
	13	4481MHCD0001M1-9C (8)
4481MHCD0001M1-9C (6)	13	
	18	4481MHCD0001M1-18 (10)
	20	
	21	
	22	
	23	
	24	
	25	

(2SP)

(2SP)

4481-MHCD-0001-M1-J1 (12C x 1,5mm2)

PLC PANEL
4481-CP-1000

INPUT CARD
XDI0105

4481MHCD0001M1-V+ (1)	V1+
	V2+
	V3+
	V4+
	IN24
4481MHCD0001M1-9C (8)	IN25
4481MHCD0001M1-9B (4)	IN26
4481MHCD0001M1-9 (3)	IN27
4481MHCD0001M1-16 (6)	IN28
4481MHCD0001M1-18 (10)	IN29
	IN30
	IN31
	V3-
4481MHCD0001M1-V- (2)	V4-

4481MHCD0001M1-10

OUTPUT CARD
XD□0004

4481MHCD0001M1-9E (5)	14
4481MHCD0001M1-10 (7)	V14+
4481MHCD0001M1-11 (9)	15
	V15+

(2SP)

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Discipline :

Document No : 25457-4480-V1A-MXA0-0295 | Rev. :

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		3		UPDATE	08/07/2011	F.P.	T.Pa.	M.B.
		2		UPDATE CONNECTORS FOR MCC	MR-14-2011	F.P.	E.B.	C.C.
		1		UPDATE	FE-07-2011	F.P.	T.Pa.	C.C.
REFERENCES		REVISIONS						

NOTES

STATUS: FOR DESIGN

DRAWN/DES'D: F.P.	AREA ENG.:
DATE: 15/11/2010	DATE:
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DATE:	DATE:
RESPONSIBLE ENG. M.B.	CLIENT:
DATE:	DATE:
ENG. GROUP SUP.	DRAWING SCALE: NONE
DATE:	

Vendor or Subcontractor Logo: GNA a.i.tech Inc. — Département Ingénierie Engineering Department 9695 Trans-Canada Saint-Laurent, Quebec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MHCD-0001-M1
INTERCONNECTION DIAGRAM

MA'ADEN

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
—	—	—		A3-		-AZ	

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FIELD

ELECTRICAL ROOM

MOTOR CONTROL CENTER PANEL (COMP-E7) (MOTOR-F1)
4480-ECM1-0001

PLC PANEL
4481-CP-1000

4481-MEEP-0001-LCS-01

MEEP-0001-M1
9B 4481MEEP0001M1-9B
9B 4481MEEP0001M1-9B (1)
9C 4481MEEP0001M1-9C
9C 4481MEEP0001M1-9C (4)
9E 4481MEEP0001M1-9E (2)
10 4481MEEP0001M1-10 (3)
4481MEEP0001M1-9D
STOP
JOG
OFF
REMOTE
(1SP-1G)

4481-MEEP-0001-LCS-01-J1
(5C x 1,5mm2) +G

4481-MEEP-0001-M1-ST
1 4481MEEP0001M1-V+ (1)
2 4481MEEP0001M1-V- (2)
3 4481MEEP0001M1-9 (3)
3
4
4
5 4481MEEP0001M1-9B (4)
5 4481MEEP0001M1-9B (1)
7 4481MEEP0001M1-9E (5)
7 4481MEEP0001M1-9E (2)
9 4481MEEP0001M1-17 (6)
10 4481MEEP0001M1-10 (7)
10 4481MEEP0001M1-10 (3)
13 4481MEEP0001M1-9C (8)
13 4481MEEP0001M1-9C (4)
20
21
22
23
24
25
(1SP-1G)
(4SP)

1

4481-MEEP-0001-M1-J1
(12C x 1,5mm2)

INPUT CARD
XDI0106
4481MEEP0001M1-V+ (1) V1+
V2+
V3+
V4+
IN0
4481MEEP0001M1-9C (8) IN1
4481MEEP0001M1-9B (4) IN2
4481MEEP0001M1-9 (3) IN3
4481MEEP0001M1-17 (6) IN4
IN5
IN6
IN7
4481MEEP0001M1-V- (2) V1-
V2-
4481MEEP0001M1-10

OUTPUT CARD
XD□0005
4481MEEP0001M1-9E (5) 0
4481MEEP0001M1-10 (7) V0+
(4SP)

M
3~
U1
V1
W1
4481-MEEP-0001-M1
(15 KW)

4481-MEEP-0001-M1-P2
(3C x 10mm2) +G

4481-MEEP-0001-M1-LDS-J1
(2C x 1,5mm2)

4481-MEEP-0001-M1-LDS
U1 3L1
V1 3L2
W1 3L3
4481MEEP0001M1-9C 4
4481MEEP0001M1-9B 3
2
1

4481-MEEP-0001-M1-P1
(3C x 10mm2) +G

3L1 3L1
3L2 3L2
3L3 3L3

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No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
1		UPDATE CONNECTORS FOR MCC	MR-14-2011	F.P.	E.B.	C.C.

DRAWING NUMBER | TITLE | REFERENCES | REVISIONS | NOTES

STATUS: FOR DESIGN

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DATE:	

Vendor or Subcontractor Logo:
GNA alztech Inc. Département Ingénierie Engineering Department 9695 Trans-Canada Saint-Laurent, Quebec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MEEP-0001-M1
INTERCONNECTION DIAGRAM

MA'ADEN معادن

PROJ. No | SUBD. | DISC. | SECTOR | SEQUENCE | REV.
25457-00AZ- xx - xxxx - xxxx - xxx – xxx

Type | Building | Discipline | Phase | Format | Sequential | Location | Rev. No.
— — — — A3– –AZ

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FIELD

ELECTRICAL ROOM

MOTOR CONTROL CENTER PANEL (COMP-E8) (MOTOR-F1)
4480-ECM1-0001

PLC PANEL
4481-CP-1000

4481-MEEP-0001-LCS-02

MEEP-0001-M2

9B 4481MEEP0001M2-9B
9B 4481MEEP0001M2-9B (1)
9C 4481MEEP0001M2-9C
9C 4481MEEP0001M2-9C (4)
9E 4481MEEP0001M2-9E (2)
10 4481MEEP0001M2-10 (3)

4481MEEP0001M2-9D

STOP
JOG
OFF
REMOTE

(1SP-1G)

4481-MEEP-0001-LCS-02-J1
(5C x 1,5mm2) +G

4481-MEEP-0001-M2-ST

1 4481MEEP0001M2-V+ (1)
2 4481MEEP0001M2-V- (2)
3 4481MEEP0001M2-9 (3)
3
4
4
5 4481MEEP0001M2-9B (4)
5 4481MEEP0001M2-9B (1)
7 4481MEEP0001M2-9E (5)
7 4481MEEP0001M2-9E (2)
9 4481MEEP0001M2-17 (6)
10 4481MEEP0001M2-10 (7)
10 4481MEEP0001M2-10 (3)
13 4481MEEP0001M2-9C (8)
13 4481MEEP0001M2-9C (4)
20
21
22
23
24
25

(1SP-1G)

(4SP)

1

4481-MEEP-0001-M2-J1
(12C x 1,5mm2)

INPUT CARD
XDI0106

V1+ 4481MEEP0001M2-V+ (1)
V2+
V3+
V4+
IN8 4481MEEP0001M2-9C (8)
IN9 4481MEEP0001M2-9B (4)
IN10 4481MEEP0001M2-9 (3)
IN11 4481MEEP0001M2-17 (6)
IN12
IN13
IN14
IN15
V1- 4481MEEP0001M2-V- (2)
V2-

4481MEEP0001M2-10

OUTPUT CARD
XD□0005

4481MEEP0001M2-9E (5) 1
4481MEEP0001M2-10 (7) V1+

(4SP)

M
3~
U1
V1
W1

4481-MEEP-0001-M2
(15 KW)

4481-MEEP-0001-M2-P2
(3C x 10mm2) +G

4481-MEEP-0001-M2-LDS-J1
(2C x 1,5mm2)

4481-MEEP-0001-M2-LDS

U1 3L1
V1 3L2
W1 3L3

4481MEEP0001M2-9C 4
4481MEEP0001M2-9B 3
2
1

4481-MEEP-0001-M2-P1
(3C x 10mm2) +G

3L1 3L1
3L2 3L2
3L3 3L3

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Discipline :

Document No : 25457-4480-V1A-MXA0-0297 | Rev. :

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SELLER DRAWING No. 1347-56351 | REV. 1

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		1		UPDATE CONNECTORS FOR MCC	MR-14-2011	F.P.	E.B.	C.C.
		REVISIONS						

NOTES

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ENG. GROUP SUP.	DRAWING SCALE: NONE
DATE:	

Vendor or Subcontractor Logo: GNA a.i.tech Inc. Département Ingénierie Engineering Department 9495 Trans-Canada Saint-Laurent, Quebec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MEEP-0001-M2
INTERCONNECTION DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx –	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3–		–AZ	

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FIELD

ELECTRICAL ROOM

MOTOR CONTROL CENTER PANEL (COMP-F9) (MOTOR-F1)
4480-ECM1-0001

PLC PANEL
4481-CP-1000

4481-MEEP-0001-LCS-03

MEEP-0001-M3

9B 4481MEEP0001M3-9B
9B 4481MEEP0001M3-9B (1)
9C 4481MEEP0001M3-9C
9C 4481MEEP0001M3-9C (4)
9E 4481MEEP0001M3-9E (2)
10 4481MEEP0001M3-10 (3)

4481MEEP0001M3-9D

STOP
JOG
OFF
REMOTE

(1SP-1G)

4481-MEEP-0001-LCS-03-J1
(5C x 1,5mm2) +G

4481-MEEP-0001-M3-ST

1 4481MEEP0001M3-V+ (1)
2 4481MEEP0001M3-V- (2)
3 4481MEEP0001M3-9 (3)
3
4
4
5 4481MEEP0001M3-9B (4)
5 4481MEEP0001M3-9B (1)
7 4481MEEP0001M3-9E (5)
7 4481MEEP0001M3-9E (2)
9 4481MEEP0001M3-17 (6)
10 4481MEEP0001M3-10 (7)
10 4481MEEP0001M3-10 (3)
13 4481MEEP0001M3-9C (8)
13 4481MEEP0001M3-9C (4)
20
21
22
23
24
25

(1SP-1G)
(4SP)

1

4481-MEEP-0001-M3-J1
(12C x 1,5mm2)

INPUT CARD
XDI0106

V1+
V2+
V3+
V4+
IN16
IN17
IN18
IN19
IN20
IN21
IN22
IN23
V3-
V4-

4481MEEP0001M3-V+ (1)
4481MEEP0001M3-9C (8)
4481MEEP0001M3-9B (4)
4481MEEP0001M3-9 (3)
4481MEEP0001M3-17 (6)
4481MEEP0001M3-V- (2)

4481MEEP0001M3-10

OUTPUT CARD
XD□0005

2 4481MEEP0001M3-9E (5)
V2+ 4481MEEP0001M3-10 (7)

(4SP)

M
3~
U1
V1
W1

4481-MEEP-0001-M3
(15 KW)

4481-MEEP-0001-M3-P2
(3C x 10mm2) +G

4481-MEEP-0001-M3-LDS-J1
(2C x 1,5mm2)

4481-MEEP-0001-M3-LDS

U1 3L1
V1 3L2
W1 3L3

4481MEEP0001M3-9C 4
4481MEEP0001M3-9B 3
2
1

4481-MEEP-0001-M3-P1
(3C x 10mm2) +G

3L1 3L1
3L2 3L2
3L3 3L3

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DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
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		REVISIONS						

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RESPONSIBLE ENG. M.B.	CLIENT:
DATE:	DATE:
ENG. GROUP SUP.	DRAWING SCALE: NONE
DATE:	

Vendor or Subcontractor Logo: GNA a.i. tech Inc. — Département Ingénierie Engineering Department 9495 Trans-Canada Saint-Laurent, Quebec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MEEP-0001-M3
INTERCONNECTION DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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FIELD

ELECTRICAL ROOM

LOCAL CONTROL PANEL
4481-MQLK-0001-CP-01 (G1)

X104

SEE DWG. 1347-56340 — 8F
10A — 104-V10A (6)
DISCONNECT SWITCH (R1) — 10B — 104-V10B (7)
SEE DWG. 1347-56370 — 10C
18A — 4481MJR00005M1-9A (8)
SAFETY KEY RELAY — 18B — 4481MJR00005M1-9B (9)
(3SP)

4481-MQLK-0001-CP-01-J3 (12C x 1,5mm2)

2

M 3~
U1
V1
W1
4481-MJR0-0005-M1
(0,75 KW)

4481-MJR0-0005-LCS-01

MJR0-0005-M1

104-V10A (6)	1	104-V10A
104-V10B (7)	2	104-V10B
4481MJR00005M1-9A (8)	9A	4481MJR00005M1-9A (1)
4481MJR00005M1-9B (9)	9B	4481MJR00005M1-9B
	9B	4481MJR00005M1-9B (2)
	9C	4481MJR00005M1-9C
	9C	4481MJR00005M1-9C (5)
	9E	4481MJR00005M1-9E (3)
	10	4481MJR00005M1-10 (4)

(3SP)
(2SP-1G)
4481MJR00005M1-9D
STOP
JOG
OFF
REMOTE

4481-MJR0-0005-LCS-01-J1 (7C x 1,5mm2) +G

4481-MJR0-0005-M1-P2 (3C x 2,5mm2) +G
4481-MJR0-0005-M1-LDS-J1 (4C x 1,5mm2)

4481-MJR0-0005-M1-LDS

U1 — 3L1
V1 — 3L2
W1 — 3L3
4481MJR00005M1-9C — 4
4481MJR00005M1-9B — 3
104-V10B — 2
104-V10A — 1

MOTOR CONTROL CENTER PANEL (COMP-D4) (MOTOR-R1)
4480-ECM1-0001

4481-MJR0-0005-M1-P1 (3C x 2,5mm2) +G

3L1 — 3L1
3L2 — 3L2
3L3 — 3L3

4481-MJR0-0005-M1-ST

4481MJR00005M1-9A (1)	1 — 4481MJR00005M1-V+ (1)
4481MJR00005M1-V- (2)	2
4481MJR00005M1-9 (3)	3
	3
	4
4481MJR00005M1-9A (1)	4
4481MJR00005M1-9B (4)	5
4481MJR00005M1-9B (2)	5
4481MJR00005M1-9E (5)	7
4481MJR00005M1-9E (3)	7
4481MJR00005M1-17 (6)	9
4481MJR00005M1-10 (7)	10
4481MJR00005M1-10 (4)	10
4481MJR00005M1-9C (8)	13
4481MJR00005M1-9C (5)	13
	20
	21
	22
	23
	24
	25

(2SP-1G)
(4SP)

4481-MJR0-0005-M1-J1 (12C x 1,5mm2)

PLC PANEL
4481-CP-1000

INPUT CARD
XDI0106

4481MJR00005M1-V+ (1)	V1+
	V2+
	V3+
	V4+
4481MJR00005M1-9C (8)	IN24
4481MJR00005M1-9B (4)	IN25
4481MJR00005M1-9 (3)	IN26
4481MJR00005M1-17 (6)	IN27
	IN28
	IN29
	IN30
	IN31
4481MJR00005M1-V- (2)	V3-
	V4-

4481MJR00005M1-10

OUTPUT CARD
XD□0005

4481MJR00005M1-9E (5)	4
4481MJR00005M1-10 (7)	V4+

(4SP)

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Discipline :

Document No : 25457-4480-V1A-MXA0-0299 | Rev. :

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SELLER DRAWING No. 1347-56360 | REV. 2

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		2		UPDATE	08/07/2011	F.P.	T.Pa.	M.B.
		1		UPDATE CONNECTORS FOR MCC	MR-14-2011	F.P.	E.B.	C.C.
		REVISIONS						

NOTES

STATUS: FOR DESIGN

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ENG. GROUP SUP. DATE:	DRAWING SCALE: NONE

Vendor or Subcontractor Logo: GNA a.i.tech Inc. — Département Ingénierie Engineering Department 8495 Trans-Canada Saint-Laurent, Quebec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MJR0-0005-M1
INTERCONNECTION DIAGRAM

MA'ADEN

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
—	—	—		A3-		-AZ	

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FIELD

ELECTRICAL ROOM

LOCAL CONTROL PANEL
4481-MQLK-0001-CP-01 (G1)

X104

SEE DWG. 1347-56360 — 10B
10C — 104-V10C
DISCONNECT SWITCH (R6) — 10D — 104-V10D
SEE DWG. 1347-55312 — 10E
19A — 4481MJR00007M1-9A
SAFETY KEY RELAY — 19B — 4481MJR00007M1-9B

4481-MQLK-0001-CP01-J3 (12C x 1,5mm2) ⚠1

4481-MQLK-0001-LCS-01

MJR0-0007-M1

104-V10C	1	104-V10C
104-V10D	2	104-V10D
4481MJR00007M1-9A	9A	4481MJR00007M1-9A (1)
4481MJR00007M1-9B	9B	4481MJR00007M1-9B
	9B	4481MJR00007M1-9B (2)
	9C	4481MJR00007M1-9C
	9C	4481MJR00007M1-9C (6)
4481MJR00007M1-9E	9E	4481MJR00007M1-9E (3)
	11	4481MJR00007M1-11 (4)
	12	4481MJR00007M1-12 (5)

STOP
JOG
OFF
REMOTE
(2SP)

4481-MQLK-0001-LCS-01-J3 (8C x 1,5mm2) ⚠1

MOTOR CONTROL CENTER PANEL (COMP-C2) (MOTOR-R2)
4480-ECM1-0001

4481-MJR0-0007-M1-ST

	1	4481MJR00007M1-V+ (1)
	2	4481MJR00007M1-V+ (2)
	3	4481MJR00007M1-9 (3)
	3	
	4	
4481MJR00007M1-9A (1)	4	
	5	4481MJR00007M1-9B (4)
4481MJR00007M1-9B (2)	5	
4481MJR00007M1-9E (3)	7	
	9	4481MJR00007M1-17 (5)
	11	4481MJR00007M1-11 (6)
4481MJR00007M1-11 (4)	11	
	12	4481MJR00007M1-12 (7)
4481MJR00007M1-12 (5)	12	
	13	4481MJR00007M1-9C (8)
4481MJR00007M1-9C (6)	13	
	20	
	21	
	22	
	23	
	24	
	25	
4481MJR00007M1-14	14	
4481MJR00007M1-15	15	

(2SP)
(4SP)
⚠1

PLC PANEL
4481-CP-1000

4481-MJR0-0007-M1-J1 (12C x 1,5mm2)

INPUT CARD
XDI0107

4481MJR00007M1-V+ (1)	V1+
	V2+
	V3+
	V4+
4481MJR00007M1-11 (6)	IN0
4481MJR00007M1-12 (7)	IN1
4481MJR00007M1-9C (8)	IN2
4481MJR00007M1-9B (4)	IN3
4481MJR00007M1-9 (3)	IN4
4481MJR00007M1-17 (5)	IN5
	IN6
	IN7
4481MJR00007M1-V- (2)	V1-
	V2-

(4SP)

THERMISTORS
4481MJR00007M1-14
4481MJR00007M1-15

4481-MJR0-0007-M1-J2 (1P x 1,5mm2)

M 3~ — U1, V1, W1
4481-MJR0-0007-M1 (1,1 KW)

4481-MJR0-0007-M1-P2 (3C x 2,5mm2) +G

4481-MJR0-0007-M1-LDS

U1	4L1
V1	4L2
W1	4L3

4481-MJR0-0007-M1-P1 (3C x 2,5mm2) +G

4L1	4L1
4L2	4L2
4L3	4L3

4481-MJR0-0007-M1-LDS-J1 (4C x 1,5mm2)

4481MJR00007M1-9C	4
4481MJR00007M1-9B	3
104-V10D	2
104-V10C	1

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Discipline :

Document No : 25457-4480-V1A-MXA0-0300 | Rev. :

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DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		1		UPDATE CONNECTORS FOR MCC	MR-14-2011	F.P.	E.B.	C.C.
		REVISIONS						

NOTES

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DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA Altech Inc. — Département Ingénierie Engineering Department 9600 Trans-Canada Pointe-aux-Trembles, Québec Canada

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No | SUBD. | DISC. | SECTOR | SEQUENCE | REV.
25457-00AZ- xx - xxxx - xxxx - xxx — xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MJR0-0007-M1
INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type | Building | Discipline | Phase | Format | Sequential | Location | Rev. No.
— | — | — | A3— | —AZ

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FIELD

ELECTRICAL ROOM

LOCAL CONTROL PANEL
4481-MZAC-0001-CP-01 (R4A)

X90

SEE DWG. 1347-55285
SAFETY GATE CLOSED — 22A — 4481MZAC0001M1-9
22B — 4481MZAC0001M1-9A
SAFETY LIGHT CURTAIN RELAY — 14A — 4481MZAC0001M1-9B

4481-MZAC-0001-CP01-J2 (3C x 1,5mm2)

THERMISTORS
4481MZAC0001M1-14
4481MZAC0001M1-15

M 3~
U1
V1
W1
4481-MZAC-0001-M1
(1,1 KW)

4481-MZAC-0001-LCS-01

MZAC-0001-M1

4481MZAC0001M1-9	9	4481MZAC0001M1-9 (1)
4481MZAC0001M1-9A	9A	4481MZAC0001M1-9A (2)
4481MZAC0001M1-9B	9B	4481MZAC0001M1-9B
	9B	4481MZAC0001M1-9B (3)
	9C	4481MZAC0001M1-9C
	9C	4481MZAC0001M1-9C (7)
4481MZAC0001M1-9E	9E	4481MZAC0001M1-9E (4)
JOG	11	4481MZAC0001M1-11 (5)
OFF		
	12	4481MZAC0001M1-12 (6)
REMOTE		

STOP

(4SP-1G)

4481-MZAC-0001-LCS-01-J1 (11C x 1,5mm2) +G

1

4481-MZAC-0001-M1-J2 (1P x 1,5mm2)

4481-MZAC-0001-M1-P2 (3C x 2,5mm2) +G

4481-MZAC-0001-M1-LDS

U1 — 4L1
V1 — 4L2
W1 — 4L3

4481-MZAC-0001-M1-LDS-J1 (2C x 1,5mm2)

4481MZAC0001M1-9C — 4
4481MZAC0001M1-9B — 3
2
1

4481-MZAC-0001-M1-PI (3C x 2,5mm2) +G

4L1
4L2
4L3

MOTOR CONTROL CENTER PANEL (COMP-C3) (MOTOR-R4A)
4480-ECM1-0001

4481-MZAC-0001-M1-ST

4481MZAC0001M1-9 (1)	1	4481MZAC0001M1-V+ (1)
	2	4481MZAC0001M1-V+ (2)
	3	4481MZAC0001M1-9 (3)
4481MZAC0001M1-9 (1)	3	
	4	
4481MZAC0001M1-9A (2)	4	
	5	4481MZAC0001M1-9B (4)
4481MZAC0001M1-9B (3)	5	
4481MZAC0001M1-9E (4)	7	
	9	4481MZAC0001M1-17 (5)
	11	4481MZAC0001M1-11 (6)
4481MZAC0001M1-11 (5)	11	
	12	4481MZAC0001M1-12 (7)
4481MZAC0001M1-12 (6)	12	
	13	4481MZAC0001M1-9C (8)
4481MZAC0001M1-9C (7)	13	
	20	
	21	
	22	
	23	
	24	
	25	
4481MZAC0001M1-14	14	
4481MZAC0001M1-15	15	

(4SP-1G)

(4SP)

1

4481-MZAC-0001-M1-P1 (3C x 2,5mm2) +G

4L1	4L1
4L2	4L2
4L3	4L3

PLC PANEL
4481-CP-1000

4481-MZAC-0001-M1-J1 (12C x 1,5mm2)

INPUT CARD
XDI0107

4481MZAC0001M1-V+ (1)	V1+
	V2+
	V3+
	V4+
4481MZAC0001M1-11 (6)	IN8
4481MZAC0001M1-12 (7)	IN9
4481MZAC0001M1-9C (8)	IN10
4481MZAC0001M1-9B (4)	IN11
4481MZAC0001M1-9 (3)	IN12
4481MZAC0001M1-17 (5)	IN13
	IN14
	IN15
4481MZAC0001M1-V- (2)	V1-
	V2-

(4SP)

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DRAWING NUMBER | TITLE | REFERENCES | REVISIONS | NOTES

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ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie / Engineering Department, 9690 TransCanada, Baie-Saurel, Québec, J4G 1V3, Canada

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No | SUBD. | DISC. | SECTOR | SEQUENCE | REV.
25457-00AZ- xx - xxxx - xxxx - xxx - xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MZAC-0001-M1
INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type | Building | Discipline | Phase | Format | Sequential | Location | Rev. No.
— | — | — | | A3— | | —AZ |

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FIELD

ELECTRICAL ROOM

LOCAL CONTROL PANEL 4481-MZAC-0002-CP-01 (R4B)

X91

SEE DWG. 1347-55286 SAFETY GATE CLOSED — 22A — 4481MZAC0002M1-9
22B — 4481MZAC0002M1-9A
SAFETY LIGHT CURTAIN RELAY — 14A — 4481MZAC0002M1-9B

4481-MZAC-0002-CP01-J2 (3C x 1,5mm2)

THERMISTORS
4481MZAC0002M1-14
4481MZAC0002M1-15

M 3~ U1 V1 W1
4481-MZAC-0002-M1 (1,1 KW)

4481-MZAC-0002-LCS-01

MZAC-0002-M1

4481MZAC0002M1-9	9	4481MZAC0002M1-9 (1)
4481MZAC0002M1-9A	9A	4481MZAC0002M1-9A (2)
4481MZAC0002M1-9B	9B	4481MZAC0002M1-9B
	9B	4481MZAC0002M1-9B (3)
	9C	4481MZAC0002M1-9C
	9C	4481MZAC0002M1-9C (7)
4481MZAC0002M1-9E	9E	4481MZAC0002M1-9E (4)
	11	4481MZAC0002M1-11 (5)
	12	4481MZAC0002M1-12 (6)

STOP
JOG
OFF
REMOTE
(4SP-1G)

4481-MZAC-0002-LCS-01-J1 (11C x 1,5mm2) +G
1

4481-MZAC-0002-M1-J2 (1P x 1,5mm2)
4481-MZAC-0002-M1-P2 (3C x 2,5mm2) +G
4481-MZAC-0002-M1-LDS-J1 (2C x 1,5mm2)

4481-MZAC-0002-M1-LDS

U1 V1 W1 — 4L1 4L2 4L3
4481MZAC0002M1-9C — 4
4481MZAC0002M1-9B — 3
2
1

MOTOR CONTROL CENTER PANEL (COMP-C3) 4480-ECM1-0001 (MOTOR-R4B)

4481-MZAC-0002-M1-ST

4481MZAC0002M1-9 (1)	1	4481MZAC0002M1-V+ (1)
	2	4481MZAC0002M1-V+ (2)
	3	4481MZAC0002M1-9 (3)
	3	4481MZAC0002M1-9 (1)
	4	4481MZAC0002M1-9A (2)
	4	
	5	4481MZAC0002M1-9B (4)
	5	4481MZAC0002M1-9B (3)
	7	4481MZAC0002M1-9E (4)
	9	4481MZAC0002M1-17 (5)
	11	4481MZAC0002M1-11 (6)
	11	4481MZAC0002M1-11 (5)
	12	4481MZAC0002M1-12 (7)
	12	4481MZAC0002M1-12 (6)
	13	4481MZAC0002M1-9C (8)
	13	4481MZAC0002M1-9C (7)
	20	
	21	
	22	
	23	
	24	
	25	
4481MZAC0002M1-14	14	
4481MZAC0002M1-15	15	

(4SP-1G)
(4SP)

1

4481-MZAC-0002-M1-P1 (3C x 2,5mm2) +G

4L1	4L1
4L2	4L2
4L3	4L3

PLC PANEL 4481-CP-1000

4481-MZAC-0002-M1-J1 (12C x 1,5mm2)

INPUT CARD
XDI0107

4481MZAC0002M1-V+ (1)	V1+
	V2+
	V3+
	V4+
4481MZAC0002M1-11 (6)	IN16
4481MZAC0002M1-12 (7)	IN17
4481MZAC0002M1-9C (8)	IN18
4481MZAC0002M1-9B (4)	IN19
4481MZAC0002M1-9 (3)	IN20
4481MZAC0002M1-17 (5)	IN21
	IN22
	IN23
4481MZAC0002M1-V- (2)	V3-
	V4-

(4SP)

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DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA aluTech Inc. — Département Ingénierie / Engineering Department, 9690 Trans-Canada, Saint-Laurent, Quebec (QC) H4S 1V0, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No 25457 | SUBD. 00AZ | DISC. - | SECTOR xx | SEQUENCE xxxx - xxxx | REV. xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MZAC-0002-M1
INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type — | Building — | Discipline — | Phase — | Format A3 | Sequential — | Location AZ | Rev. No.

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FIELD

ELECTRICAL ROOM

LOCAL CONTROL PANEL
4481-MJR0-0006-CP-01 (R3-R5)

X92

SEE DWG. 1347-55287 — 6B — 92-V8A
DISCONNECT SWITCH (R3) — 8A — 92-V8B
8B
SEE DWG. 1347-56410 — 8C
17A — 4481MJR00006M1-9A
SAFETY KEY RELAY — 17B — 4481MJR00006M1-9B

1

4481-MJR0-0006-CP01-J2
(8C x 1,5mm2)

4481-MJR0-0006-LCS-01

MJR0-0006-M1

92-V8A	1	92-V8A
92-V8B	2	92-V8B
4481MJR00006M1-9A	9A	4481MJR00006M1-9A (1)
4481MJR00006M1-9B	9B	4481MJR00006M1-9B
	9B	4481MJR00006M1-9B (2)
	9C	4481MJR00006M1-9C
	9C	4481MJR00006M1-9C (5)
	9E	4481MJR00006M1-9E (3)
	10	4481MJR00006M1-10 (4)

4481MJR00006M1-9D

STOP
JOG
OFF
REMOTE

(2SP-1G)

4481-MJR0-0006-LCS-01-J1
(7C x 1,5mm2) +G

1

MOTOR CONTROL CENTER PANEL (COMP-D6) (MOTOR-R3)
4480-ECM1-0001

4481-MJR0-0006-M1-ST

4481MJR00006M1-9A (1)	1	4481MJR00006M1-V+ (1)
4481MJR00006M1-9B (2)	2	4481MJR00006M1-V- (2)
	3	4481MJR00006M1-9 (3)
	3	
	4	
4481MJR00006M1-9A (1)	4	
	5	4481MJR00006M1-9B (4)
4481MJR00006M1-9B (2)	5	
	7	4481MJR00006M1-9E (5)
4481MJR00006M1-9E (3)	7	
	9	4481MJR00006M1-17 (6)
	10	4481MJR00006M1-10 (7)
4481MJR00006M1-10 (4)	10	
	13	4481MJR00006M1-9C (8)
4481MJR00006M1-9C (5)	13	
	20	
	21	
	22	
	23	
	24	
	25	

(2SP-1G)

(4SP)

1

4481-MJR0-0006-M1-J1
(12C x 1,5mm2)

PLC PANEL
4481-CP-1000

INPUT CARD
XDI0107

4481MJR00006M1-V+ (1)	V1+
	V2+
	V3+
	V4+
	IN24
4481MJR00006M1-9C (8)	IN25
4481MJR00006M1-9B (4)	IN26
4481MJR00006M1-9 (3)	IN27
4481MJR00006M1-17 (6)	IN28
	IN29
	IN30
	IN31
4481MJR00006M1-V- (2)	V3-
	V4-

4481MJR00006M1-10

OUTPUT CARD
XD□0005

4481MJR00006M1-9E (5)	6
4481MJR00006M1-10 (7)	V6+

(4SP)

M
3~
U1
V1
W1
4481-MJR0-0006-M1
(1,1 KW)

4481-MJR0-0006-M1-P2
(3C x 2,5mm2) +G

4481-MJR0-0006-M1-LDS

U1		3L1
V1		3L2
W1		3L3
4481MJR00006M1-9C	4	
4481MJR00006M1-9B	3	
92-V8B	2	
92-V8A	1	

4481-MJR0-0006-M1-LDS-J1
(4C x 1,5mm2)

4481-MJR0-0006-M1-P1
(3C x 2,5mm2) +G

3L1	3L1
3L2	3L2
3L3	3L3

1

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Discipline :

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REFERENCES		1		UPDATE CONNECTORS FOR MCC	MR-14-2011	F.P.	E.B.	C.C.
		REVISIONS						

NOTES

STATUS: FOR DESIGN

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DATE: 15/11/2010	DATE:
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DATE:	DATE:
RESPONSIBLE ENG. M.B.	CLIENT:
DATE:	DATE:
ENG. GROUP SUP.	DRAWING SCALE: NONE
DATE:	

Vendor or Subcontractor Logo: GNA a.b.tech Inc. — Département Ingénierie Engineering Department 9495 Trans-Canada Saint-Laurent, Quebec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MJR0-0006-M1
INTERCONNECTION DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-	-AZ		

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FIELD

ELECTRICAL ROOM

LOCAL CONTROL PANEL
4481-MJR0-0006-CP-01 (R3-R5)

X92

SEE DWG. 1347-56400 — 8B — 92-V8C
DISCONNECT SWITCH (R5) — 8C — 92-V8C
SEE DWG. 1347-56420 — 8D — 92-V8D
SAFETY KEY RELAY — 8E — 4481MJR00008M1-9A
18A — 4481MJR00008M1-9A
18B — 4481MJR00008M1-9B

1

4481-MJR0-0006-CP01-J2 (8C x 1,5mm2)

M 3~ — U1, V1, W1

4481-MJR0-0008-M1 (1,1 KW)

4481-MJR0-0008-M1-P2 (3C x 2,5mm2) +G

4481-MJR0-0008-M1-LDS-J1 (4C x 1,5mm2)

4481-MJR0-0006-LCS-01

MJR0-0008-M1

92-V8C	1	92-V8C
92-V8D	2	92-V8D
4481MJR00008M1-9A	9A	4481MJR00008M1-9A (1)
4481MJR00008M1-9B	9B	4481MJR00008M1-9B
	9B	4481MJR00008M1-9B (2)
	9C	4481MJR00008M1-9C
	9C	4481MJR00008M1-9C (5)
	9E	4481MJR00008M1-9E (3)
	10	4481MJR00008M1-10 (4)

4481MJR00008M1-9D

STOP
JOG
OFF
REMOTE

(1SP)

4481-MJR0-0006-LCS-01-J2 (6C x 1,5mm2)

1

4481-MJR0-0008-M1-LDS

U1	3L1	
V1	3L2	
W1	3L3	
4481MJR00008M1-9C	4	
4481MJR00008M1-9B	3	
92-V8D	2	
92-V8C	1	

MOTOR CONTROL CENTER PANEL (COMP-D8) (MOTOR-R5)
4480-ECM1-0001

4481-MJR0-0008-M1-P1 (3C x 2,5mm2) +G

4481-MJR0-0008-M1-ST

	1	4481MJR00008M1-V+ (1)
	2	4481MJR00008M1-V- (2)
	3	4481MJR00008M1-9 (3)
	3	
	4	
4481MJR00008M1-9A (1)	4	
	5	4481MJR00008M1-9B (4)
4481MJR00008M1-9B (2)	5	
	7	4481MJR00008M1-9E (5)
4481MJR00008M1-9E (3)	7	
	9	4481MJR00008M1-17 (6)
	10	4481MJR00008M1-10 (7)
4481MJR00008M1-10 (4)	10	
	13	4481MJR00008M1-9C (8)
4481MJR00008M1-9C (5)	13	
	20	
	21	
	22	
	23	
	24	
	25	

(1SP)

(4SP)

1

3L1	3L1	
3L2	3L2	
3L3	3L3	

PLC PANEL
4481-CP-1000

4481-MJR0-0008-M1-J1 (12C x 1,5mm2)

INPUT CARD
XDI0108

4481MJR00008M1-V+ (1)	V1+
	V2+
	V3+
	V4+
	IN0
4481MJR00008M1-9C (8)	IN1
4481MJR00008M1-9B (4)	IN2
4481MJR00008M1-9 (3)	IN3
4481MJR00008M1-17 (6)	IN4
	IN5
	IN6
	IN7
4481MJR00008M1-V- (2)	V1-
	V2-

4481MJR00008M1-10

OUTPUT CARD
XD□0005

4481MJR00008M1-9E (5)	7
4481MJR00008M1-10 (7)	V7+

(4SP)

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Discipline :

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SELLER DRAWING No. 1347-56410 | REV. 1

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		1		UPDATE CONNECTORS FOR MCC	MR-14-2011	F.P.	E.B.	C.C.
		REVISIONS						

NOTES

STATUS: FOR DESIGN

DRAWN/DES'D: F.P.	AREA ENG.:
DATE: 15/11/2010	DATE:
CHECKED: E.B.	PRJ ENG MGR:
DATE:	DATE:
RESPONSIBLE ENG. M.B.	CLIENT:
DATE:	DATE:
ENG. GROUP SUP.	DRAWING SCALE: NONE
DATE:	

Vendor or Subcontractor Logo: GNA a.b.tech Inc. — Département Ingénierie Engineering Department 8495 Trans-Canada Saint-Laurent, Quebec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MJR0-0008-M1
INTERCONNECTION DIAGRAM

MA'ADEN

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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FIELD

ELECTRICAL ROOM

LOCAL CONTROL PANEL
4481-MJR0-0006-CP-01 (R3)

X92

SEE DWG. 1347-56410 — 8D — 92-V8E (1)
DISCONNECT SWITCH (C2) — 8E — 92-V8F (2)
SEE DWG. 1347-55287 — 8F — 10A — 19B — 4481MHCD0004M1-9B (5)
SAFETY KEY RELAY — 19A — 4481MHCD0004M1-9A (4)
SAFETY MATGUARD RELAY — 20B — 20A — 4481MHCD0004M1-9 (3)

(1SP)

4481-MJR0-0006-CP-01-J3
(6C x 1,5mm2)

1

M
3~
U1
V1
W1
4481-MHCD-0004-M1
(3,7 KW)

4481-MHCD-0004-LCS-01

MHCD-0004-M1

92-V8E (1) — 1 — 92-V8E
92-V8F (2) — 2 — 92-V8F
4481MHCD0004M1-9 (3) — 9 — 4481MHCD0004M1-9 (1)
4481MHCD0004M1-9A (4) — 9A — 4481MHCD0004M1-9A (2)
4481MHCD0004M1-9B (5) — 9B — 4481MHCD0004M1-9B
9B — 4481MHCD0004M1-9B (3)
9C — 4481MHCD0004M1-9C
9C — 4481MHCD0004M1-9C (6)

(1SP)

4481MHCD0004M1-9B
STOP
JOG
OFF
REMOTE

9E — 4481MHCD0004M1-9E (4)
10 — 4481MHCD0004M1-10 (5)

(1SP-1G)

4481-MHCD-0004-LCS-01-J1
(7C x 1,5mm2) +G

1

4481-MHCD-0004-M1-P2
(3C x 2,5mm2) +G

4481-MHCD-0004-M1-LDS-J1
(4C x 1,5mm2)

4481-MHCD-0004-M1-LDS

U1 — 3L1
V1 — 3L2
W1 — 3L3

4481MHCD0004M1-9C — 4
4481MHCD0004M1-9B — 3
92-V8F — 2
92-V8E — 1

MOTOR CONTROL CENTER PANEL (COMP-E5) (MOTOR-C4)
4480-ECM1-0001

4481-MHCD-0004-M1-P1
(3C x 2,5mm2) +G

3L1 — 3L1
3L2 — 3L2
3L3 — 3L3

4481-MHCD-0004-M1-ST

1 — 4481MHCD0004M1-V+ (1)
2 — 4481MHCD0004M1-V- (2)
3 — 3 — 4481MHCD0004M1-9 (3)
4481MHCD0004M1-9 (1) — 4
4481MHCD0004M1-9A (2) — 4
5 — 5 — 4481MHCD0004M1-9B (4)
4481MHCD0004M1-9B (3) — 5
7 — 7 — 4481MHCD0004M1-9E (5)
4481MHCD0004M1-9E (4) — 9
10 — 10 — 4481MHCD0004M1-17 (6)
4481MHCD0004M1-10 (5) — 13 — 13 — 4481MHCD0004M1-10 (7)
4481MHCD0004M1-9C (6) — 20 — 4481MHCD0004M1-9C (8)
21
22
23
24
25

(1SP-1G)

(4SP)

1

4481-MHCD-0004-M1-J1
(12C x 1,5mm2)

PLC PANEL
4481-CP-1000

INPUT CARD
XDI0108

4481MHCD0004M1-V+ (1) — V1+
V2+
V3+
V4+
4481MHCD0004M1-9C (8) — IN8
4481MHCD0004M1-9B (4) — IN9
4481MHCD0004M1-9 (3) — IN10
4481MHCD0004M1-17 (6) — IN11
IN12
IN13
IN14
IN15
4481MHCD0004M1-V- (2) — V1-
V2-

4481MHCD0004M1-10

OUTPUT CARD
XD□0005

4481MHCD0004M1-9E (5) — 8
4481MHCD0004M1-10 (7) — V8+

(4SP)

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Discipline :

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SELLER DRAWING No. 1347-56420 | REV. 1

No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
1		UPDATE CONNECTORS FOR MCC	MR-14-2011	F.P.	E.B.	C.C.

DRAWING NUMBER | TITLE | REFERENCES | REVISIONS

NOTES

STATUS: FOR DESIGN

DRAWN/DES'D: F.P.	AREA ENG.:
DATE: 15/11/2010	DATE:
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DATE:	DATE:
RESPONSIBLE ENG. M.B.	CLIENT:
DATE:	DATE:
ENG. GROUP SUP.	DRAWING SCALE: NONE
DATE:	

Vendor or Subcontractor Logo: GNA a.b.tech Inc. — Département Ingénierie / Engineering Department, 9495 Trans-Canada, Saint-Laurent, Québec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MHCD-0004-M1
INTERCONNECTION DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
—	—	—		A3-		-AZ	

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FIELD

ELECTRICAL ROOM

MOTOR CONTROL CENTER PANEL (COMP-D5) (MOTOR-H1)
4480-ECM1-0001

PLC PANEL
4481-CP-1000

4481-MPF0-0001-LCS-01

MPF0-0001-M1
9B — 4481MPF00001M1-9B
9B — 4481MPF00001M1-9B (1)
9C — 4481MPF00001M1-9C
9C — 4481MPF00001M1-9C (4)
9E — 4481MPF00001M1-9E (2)
10 — 4481MPF00001M1-10 (3)
4481MPF00001M1-9D
STOP
JOG
OFF
REMOTE
(1SP-1G)

4481-MPF0-0001-LCS-01-J1
(5C x 1,5mm2) +G

1

4481-MPF0-0001-M1-ST

1	4481MPF00001M1-V+ (1)
2	4481MPF00001M1-V- (2)
3	4481MPF00001M1-9 (3)
3	
4	
4	
5	4481MPF00001M1-9B (4)
5	4481MPF00001M1-9B (1)
7	4481MPF00001M1-9E (5)
7	4481MPF00001M1-9E (2)
9	4481MPF00001M1-17 (6)
10	4481MPF00001M1-10 (7)
10	4481MPF00001M1-10 (3)
13	4481MPF00001M1-9C (8)
13	4481MPF00001M1-9C (4)
20	
21	
22	
23	
24	
25	

(1SP-1G)
(4SP)

1

4481-MPF0-0001-M1-J1
(12C x 1,5mm2)

INPUT CARD
XDI0108

4481MPF00001M1-V+ (1)	V1+
	V2+
	V3+
	V4+
4481MPF00001M1-9C (8)	IN16
4481MPF00001M1-9B (4)	IN17
4481MPF00001M1-9 (3)	IN18
4481MPF00001M1-17 (6)	IN19
	IN20
	IN21
	IN22
	IN23
4481MPF00001M1-V- (2)	V3-
	V4-

4481MPF00001M1-10

OUTPUT CARD
XD□0005

4481MPF00001M1-9E (5)	10
4481MPF00001M1-10 (7)	V10+

(4SP)

M
3~
U1
V1
W1
4481-MPF0-0001-M1
(11 KW)

4481-MPF0-0001-M1-P2
(3C x 6mm2) +G

4481-MPF0-0001-M1-P1
(3C x 2,5mm2) +G

3L1	3L1
3L2	3L2
3L3	3L3

4481-MPF0-0001-M1-LDS

U1	3L1
V1	3L2
W1	3L3

4481-MPF0-0001-M1-LDS-J1
(2C x 1,5mm2)

4481MPF00001M1-9C	4
4481MPF00001M1-9B	3
	2
	1

SELLER/CONTRACTOR DOCUMENT REVIEW

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Discipline :

Document No : 25457-4480-V1A-MXA0-0336 | Rev. :

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SELLER DRAWING No. 1347-56430 | REV. 1

No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
1		UPDATE CONNECTORS FOR MCC	MR-14-2011	F.P.	E.B.	C.C.

REFERENCES | REVISIONS

NOTES

STATUS: FOR DESIGN

DRAWN/DES'D: F.P.	AREA ENG.:
DATE: 15/11/2010	DATE:
CHECKED: E.B.	PRJ ENG MGR:
DATE:	DATE:
RESPONSIBLE ENG. M.B.	CLIENT:
DATE:	DATE:
ENG. GROUP SUP.	DRAWING SCALE: NONE
DATE:	

Vendor or Subcontractor Logo: GNA a.j.tech Inc. — Département Ingénierie / Engineering Department, 9690 Trans-Canada, Saint-Laurent, Québec (H4S 1V3), Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MPF0-0001-M1
INTERCONNECTION DIAGRAM

MA'ADEN

PROJ. No 25457 | SUBD. 00AZ | DISC. - | SECTOR xx | SEQUENCE xxxx-xxx | REV. -xxx

Type — | Building — | Discipline — | Phase — | Format A3- | Sequential — | Location -AZ | Rev. No.

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FIELD

ELECTRICAL ROOM

MOTOR CONTROL CENTER PANEL (COMP-D7) (MOTOR-H1)
4480-ECM1-0001

PLC PANEL
4481-CP-1000

4481-MPF0-0001-LCS-01

MPF0-0001-M2

9B — 4481MPF00001M2-9B
9B — 4481MPF00001M2-9B (1)
9C — 4481MPF00001M2-9C
9C — 4481MPF00001M2-9C (4)
9E — 4481MPF00001M2-9E (2)
10 — 4481MPF00001M2-10 (3)

4481MPF00001M2-9D

STOP
JOG
OFF
REMOTE

(2SP)

4481-MPF0-0001-LCS-01-J2
(6C x 1,5mm2)

1

4481-MPF0-0001-M2-ST

1	4481MPF00001M2-V+ (1)
2	4481MPF00001M2-V- (2)
3	4481MPF00001M2-9 (3)
3	
4	
4	
5	4481MPF00001M2-9B (4)
5	4481MPF00001M2-9B (1)
7	4481MPF00001M2-9E (5)
7	4481MPF00001M2-9E (2)
9	4481MPF00001M2-17 (6)
10	4481MPF00001M2-10 (7)
10	4481MPF00001M2-10 (3)
13	4481MPF00001M2-9C (8)
13	4481MPF00001M2-9C (4)
20	
21	
22	
23	
24	
25	

(2SP)

(4SP)

1

4481-MPF0-0001-M2-J1
(12C x 1,5mm2)

INPUT CARD
XDI0108

V1+	4481MPF00001M2-V+ (1)
V2+	
V3+	
V4+	
IN24	4481MPF00001M2-9C (8)
IN25	4481MPF00001M2-9B (4)
IN26	4481MPF00001M2-9 (3)
IN27	4481MPF00001M2-17 (6)
IN28	
IN29	
IN30	
IN31	
V3-	4481MPF00001M2-V- (2)
V4-	

4481MPF00001M2-10

OUTPUT CARD
XD□0005

11	4481MPF00001M2-9E (5)
V11+	4481MPF00001M2-10 (7)

(4SP)

M
3~
U1
V1
W1

4481-MPF0-0001-M2
(11 KW)

4481-MPF0-0001-M2-P2
(3C x 6mm2) +G

4481-MPF0-0001-M2-LDS-J1
(2C x 1,5mm2)

4481-MPF0-0001-M2-LDS

U1 — 3L1
V1 — 3L2
W1 — 3L3

4481MPF00001M2-9C — 4
4481MPF00001M2-9B — 3
2
1

4481-MPF0-0001-M2-P1
(3C x 2,5mm2) +G

3L1	3L1
3L2	3L2
3L3	3L3

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Discipline :

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SELLER DRAWING No. 1347-56431 REV. 1

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
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		REVISIONS						

NOTES

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RESPONSIBLE ENG. M.B. DATE:	CLIENT: DATE:
ENG. GROUP SUP. DATE:	DRAWING SCALE: NONE

Vendor or Subcontractor Logo: GNA alstech Inc. — Département Ingénierie Engineering Department 9695 Trans-Canada Saint-Laurent, Quebec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MPF0-0001-M2
INTERCONNECTION DIAGRAM

MA'ADEN

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
—	—	—		A3-		-AZ	

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FIELD

ELECTRICAL ROOM

MOTOR CONTROL CENTER PANEL (COMP-F4) (MOTOR-F3)
4480-ECM1-0001

PLC PANEL
4481-CP-1000

4481-MBAD-0001-CP-01

X110

110-V17+

110-V17+ (1)

17-

110-V17- (2)

4481MBAD0001M1-9B

9B

4481MBAD0001M1-9B (3)

4481MBAD0001M1-9C

9C

4481MBAD0001M1-9C

4481MBAD0001M1-9D

EMERGENCY STOP

STOP

4481MBAD0001M1-9F

START

9E

4481MBAD0001M1-9E (4)

9F

4481MBAD0001M1-9F (5)

14A

110-V14A (6)

14B

110-V14B (7)

(5SP)

4481-MBAD-0001-M1-J1
(12C x 1,5mm2)

1

4481-MBAD-0001-M1-ST

110-V17+ (1) 1

110-V17- (2) 2

3

4

4481MBAD0001M1-9B (3) 5

4481MBAD0001M1-9F (5) 6

4481MBAD0001M1-9E (4) 7

20

21

110-V14A (6) 22

110-V14B (7) 23

(5SP) 24

25

M
3~

U1

V1

W1

4481-MBAD-0001-M1
(1,1 KW)

4481-MBAD-0001-M1-P2
(3C x 2,5mm2) +G

4481-MBAD-0001-M1-LDS

U1 3L1

V1 3L2

W1 3L3

4481-MBAD-0001-M1-LDS-J1
(2C x 1,5mm2)

4481MBAD0001M1-9C 4

4481MBAD0001M1-9B 3

2

1

4481-MBAD-0001-M1-P1
(3C x 2,5mm2) +G

3L1 3L1

3L2 3L2

3L3 3L3

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Discipline :

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SELLER DRAWING No. 1347-56450 REV. 1

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		REVISIONS						
		1		UPDATE	11-05-2011	E.B.	T.P.A.	C.C.

NOTES

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DATE:	15/11/2010	DATE:	
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DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA a&i tech Inc. — Département Ingénierie / Engineering Department, 9490 Trans-Canada, Saint-Laurent, Québec, H4S 1J9, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MBAD-0001-M1
INTERCONNECTION DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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FIELD

ELECTRICAL ROOM

MOTOR CONTROL CENTER PANEL (COMP-F6) (MOTOR-F4A)
4480-ECM1-0001

PLC PANEL
4481-CP-1000

4481-MEVD-0001-CP-01

X116

116-V17+

116-V17+ (1)

17-

116-V17- (2)

4481MEVD0001M1-9B

9B

4481MEVD0001M1-9B (3)

4481MEVD0001M1-9C

9C

4481MEVD0001M1-9C

4481MEVD0001M1-9D

EMERGENCY STOP

STOP

4481MEVD0001M1-9F

START

9E

4481MEVD0001M1-9E (4)

9F

4481MEVD0001M1-9F (5)

12A

116-V12A (6)

12B

116-V12B (7)

(5SP)

4481-MEVD-0001-M1-J1
(12C x 1,5mm2)

1

4481-MEVD-0001-M1-ST

116-V17+ (1) 1

116-V17- (2) 2

3

4

4481MEVD0001M1-9B (3) 5

4481MEVD0001M1-9F (5) 6

4481MEVD0001M1-9E (4) 7

20

21

116-V12A (6) 22

116-V12B (7) 23

(5SP) 24

25

M
3~

U1

V1

W1

4481-MEVD-0001-M1
(1,1 KW)

4481-MEVD-0001-M1-P2
(3C x 2,5mm2) +G

4481-MEVD-0001-M1-LDS

U1 3L1

V1 3L2

W1 3L3

4481-MEVD-0001-M1-LDS-J1
(2C x 1,5mm2)

4481MEVD0001M1-9C 4

4481MEVD0001M1-9B 3

2

1

4481-MEVD-0001-M1-P1
(3C x 2,5mm2) +G

3L1 3L1

3L2 3L2

3L3 3L3

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Discipline :

Document No : 25457-4480-V1A-MXA0-0339 Rev. :

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DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
		1		UPDATE	10-05-2011	E.B.	T.P.A.	C.C.

REFERENCES

REVISIONS

NOTES

STATUS: FOR DESIGN

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DATE:		DATE:	
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DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA a&i tech Inc. — Département Ingénierie / Engineering Department, 9490 Trans-Canada, Saint-Laurent, Québec, H4S 1J9, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MEVD-0001-M1
INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—	—	A3-		-AZ	

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FIELD

ELECTRICAL ROOM

MOTOR CONTROL CENTER PANEL (COMP-F8) (MOTOR-F4B)
4480-ECM1-0001

PLC PANEL
4481-CP-1000

4481-MEVD-0002-CP-01

X121

121-V17+ — 121-V17+ (1)

17- — 121-V17- (2)

4481MEVD0002M1-9B — 9B — 4481MEVD0002M1-9B (3)

4481MEVD0002M1-9C — 9C — 4481MEVD0002M1-9C

4481MEVD0002M1-9D — EMERGENCY STOP

STOP

4481MEVD0002M1-9F — START — 9E — 4481MEVD0002M1-9E (4)

9F — 4481MEVD0002M1-9F (5)

12A — 121-V12A (6)

12B — 121-V12B (7)

(5SP)

4481-MEVD-0002-M1-J1
(12C x 1,5mm2)

1

4481-MEVD-0002-M1-ST

121-V17+ (1)	1
121-V17- (2)	2
	3
	4
4481MEVD0002M1-9B (3)	5
4481MEVD0002M1-9F (5)	6
4481MEVD0002M1-9E (4)	7
	20
	21
121-V12A (6)	22
121-V12B (7)	23
(5SP)	24
	25

M
3~

U1
V1
W1

4481-MEVD-0002-M1
(1,1 KW)

4481-MEVD-0002-M1-P2
(3C x 2,5mm2) +G

4481-MEVD-0002-M1-LDS-J1
(2C x 1,5mm2)

4481-MEVD-0002-M1-LDS

U1 — 3L1
V1 — 3L2
W1 — 3L3

4481MEVD0002M1-9C — 4
4481MEVD0002M1-9B — 3
2
1

4481-MEVD-0002-M1-P1
(3C x 2,5mm2) +G

3L1	3L1
3L2	3L2
3L3	3L3

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Discipline :

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DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
		1		UPDATE	10-05-2011	E.B.	T.P.A.	F.P.

REFERENCES — REVISIONS

NOTES

STATUS: FOR DESIGN

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DATE:		DATE:	
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DATE:			

Vendor or Subcontractor Logo: GNA a&i tech Inc. — Département Ingénierie / Engineering Department, 9490 Trans-Canada, Saint-Laurent, Québec, H4S 1J9, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MEVD-0002-M1
INTERCONNECTION DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
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Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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FIELD

ELECTRICAL ROOM

MOTOR CONTROL CENTER PANEL (COMP-F2)
4480-ECM1-0001 (MOTOR-F3B)

PLC PANEL
4481-CP-1000

4481-MBAD-0002-CP-01

X127

127-V17+

127-V17+ (1)

17-

127-V17- (2)

4481MBAD0002M1-9B

9B

4481MBAD0002M1-9B (3)

4481MBAD0002M1-9C

9C

4481MBAD0002M1-9C

4481MBAD0002M1-9D

EMERGENCY STOP

STOP

4481MBAD0002M1-9F

START

9E

4481MBAD0002M1-9E (4)

9F

4481MBAD0002M1-9F (5)

14A

127-V14A (6)

14B

127-V14B (7)

(5SP)

4481-MBAD-0002-M1-J1
(12C x 1,5mm2)

4481-MBAD-0002-M1-ST

127-V17+ (1) 1

127-V17- (2) 2

3

4

4481MBAD0002M1-9B (3) 5

4481MBAD0002M1-9F (5) 6

4481MBAD0002M1-9E (4) 7

20

21

127-V14A (6) 22

127-V14B (7) 23

(5SP) 24

25

M
3~

U1

V1

W1

4481-MBAD-0002-M1
(1,1 KW)

4481-MBAD-0002-M1-P2
(3C x 2,5mm2) +G

4481-MBAD-0002-M1-LDS

U1 3L1

V1 3L2

W1 3L3

4481-MBAD-0002-M1-P1
(3C x 2,5mm2) +G

3L1 3L1

3L2 3L2

3L3 3L3

4481-MBAD-0002-M1-LDS-J1
(2C x 1,5mm2)

4481MBAD0002M1-9C 4

4481MBAD0002M1-9B 3

2

1

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ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo:

GNA a.i.tech Inc. Département Ingénierie Engineering Department 9495 Trans-Canada Saint-Laurent, Quebec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR 4481-MBAD-0002-M1
INTERCONNECTION DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx –	xxx

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
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DDR Nbr : 171

Reviewed by : _____ Date : _____

Discipline :

Document No : 25457-4480-V1A-MXA0-0056 | Rev. : 003

460Vac, 3ø, 60Hz, 800A — BUS BAR 80KA/1SEC.

A1: 25A | I >> — SPARE
A2: SPARE
A3: SPARE
A4: SPARE
A5: SPARE
A6: INCOMING SUPPLY METERING
A7: INCOMING LINE FROM CLIENT 460Vac, ø3, 60HZ

B1: 2,5A | I >> — TRANSFO 460V/230V — ETHERNET — LINE REACTOR — AC VARIABLE SPEED DRIVE — PLC — CC — 63A — FAN 44W CATHODE BAR HEATING FURNACE CONVEYOR No.1 0,75 KW 4481-MBMB-0001-M1 — F2
B2: 2,5A | I >> — TRANSFO 460V/230V — ETHERNET — LINE REACTOR — AC VARIABLE SPEED DRIVE — PLC — CC — 63A — FAN 44W CATHODE BAR HEATING FURNACE CONVEYOR No.2 0,75 KW 4481-MBMB-0001-M2 — F2
B3: 2,5A | I >> — TRANSFO 460V/230V — ETHERNET — LINE REACTOR — AC VARIABLE SPEED DRIVE — PLC — CC — 63A — FAN 44W CATHODE BAR HEATING FURNACE CONVEYOR No.3 0,75 KW 4481-MBMB-0001-M3 — F2
B4: 2,5A | I >> — TRANSFO 460V/230V — ETHERNET — LINE REACTOR — AC VARIABLE SPEED DRIVE — PLC — CC — 63A — FAN 44W CATHODE BAR HEATING FURNACE CONVEYOR No.4 0,75 KW 4481-MBMB-0001-M4 — F2
C1: 2,5A | I >> — ETHERNET — LINE REACTOR — AC VARIABLE SPEED DRIVE — PLC — CC — 63A — R6 ROLLER CONVEYOR AT BAR F. EXIT 0,75 KW 4481-MJRO-0004-M1
C2: 4A | I >> — ETHERNET — LINE REACTOR — AC VARIABLE SPEED DRIVE — PLC — CC — 63A — R2 ROLLER CONVEYOR FOR BLOCK AND BAR ASSEMBLY 1,1 KW 4481-MJRO-0007-M1
C3: 4A | I >> — ETHERNET — LINE REACTOR — AC VARIABLE SPEED DRIVE — PLC — CC — 63A — R4A PRESTRESSING AND SEALING STATION CONVEYOR A 1,1 KW 4481-MZAC-0001-M1
C4: 4A | I >> — ETHERNET — LINE REACTOR — AC VARIABLE SPEED DRIVE — PLC — CC — 63A — R4B PRESTRESSING AND SEALING STATION CONVEYOR B 1,1 KW 4481-MZAC-0002-M1
D1: 2,5A | I >> — SPARE

M.C.C. / FIELD

TO DWG. 1347-57010 (25457-4480-V1A-MXA0-0057)

460Vac, 3ø, 60Hz, 800A — BUS BAR 80KA/1SEC.

E2: 25A | I >> — CC — PLC — 21A — 63A — S1 CATHODE BAR SHOTBLASTING MACHINE BLAST WHEEL No.1 11 KW 4481-MZBP-0001-M1
E1: 10A | I >> — F R — CC — PLC — 7,6A — 63A — BRAKE — C1 CHAIN CONVEYOR OF BLOCK OVEN 3,7 KW 4481-MHCD-0001-M1
D12: 6,3A | I >> — ETHERNET — LINE REACTOR — AC VARIABLE SPEED DRIVE — PLC — CC — 2,6A — 2,6A — FLEXIBLE CABLE TRAY — JUNCTION BOX 4481-MQLK-0001-JB-03 — 63A — BRAKE — G1 POSITIONING GANTRY FOR BLOCK & BARS No.1 1,1 KW 4481-MQLK-0001-M1
D11: 2,5A | I >> — ETHERNET — LINE REACTOR — AC VARIABLE SPEED DRIVE — PLC — CC — 63A — BRAKE — G1 POSITIONING GANTRY FOR BLOCK & BARS No.2 1,1 KW 4481-MQLK-0001-M2
D10: 4A | I >> — SPARE
D9: SPARE
D8: 4A | I >> — CC — PLC — 2,6A — 63A — BRAKE — R5 ROLLER CONVEYOR AT COOLING & TURNING STATION 1,1 KW 4481-MJRO-0008-M1
D7: 25A | I >> — CC — PLC — 21A — 63A — H1 HYDRAULIC POWER UNIT PUMP B 11 KW 4481-MPFO-0001-M2
D6: 4A | I >> — CC — PLC — 2,25A — 63A — BRAKE — R3 ROLLER CONVEYOR AFTER SEALING STATION 1,1 KW 4481-MJRO-0006-M1
D5: 25A | I >> — CC — PLC — 21 — 63A — H1 HYDRAULIC POWER UNIT PUMP A 11 KW 4481-MPFO-0001-M1
D4: 2,5A | I >> — CC — PLC — 1,8A — 63A — BRAKE — R1 ROLLER CONVEYOR AT BLOCK OVEN EXIT 0,75 KW 4481-MJRO-0005-M1
D3: SPARE
D2: 2,5A | I >> — F R — CC — PLC — 1,8A — 63A — BRAKE — R7 ROLLER CONVEYOR AT BAR FURNACE ENTRANCE 0,75 KW 4481-MJRO-0003-M1

C3: CHAIN CONV. BETWEEN SHOT BLASTING MACHINE AND OVEN 0,75 KW 4481-MHCD-0003-M1

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SELLER DRAWING No. 1347-57000 — REV. 5

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		5		UPDATE	FE-04-11	F.P.	E.B.	M.B.
		4		ADD GANTRY LINE REACTOR AND UPDATE	NO-19-10	T.Pa.	E.B.	M.B.
		3		UPDATE	NO-11-10	F.P.	E.B.	M.B.
		2		UPDATE	NO-04-10	F.P.	E.B.	M.B.
		1		UPDATE	SE-28-10	F.P.	E.B.	M.B.
		REVISIONS						

NOTES

STATUS: FOR DESIGN

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DATE:			

Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie Engineering Department 9695 Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR CONTROL PANEL 4481-ECM1-0001 (1/3)
SINGLE LINE DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
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DDR Nbr : 171

Reviewed by : _____ Date : _____

Discipline :

Document No : 25457-4480-V1A-MXAO-0057 | Rev. : 003

460Vac, 3ø, 60Hz, 800A BUS BAR 80KA/1SEC.

FROM DWG. 1347-57000 (25457-4480-V1A-MXAO-0056)

E3 4A | CC | PLC | 2,6A | 63A | BRAKE | M
C2 CHAIN CONVEYOR UPSTREAM OF SHOTBLASTING MACHINE 1,1 KW 4481-MHCD-0002-M1

E4 25A | CC | PLC | 21A | 63A | M
S1 CATHODE BAR SHOTBLASTING MACHINE BLAST WHEEL No.2 11 KW 4481-MZBP-0001-M2

E5 10A | CC | PLC | 7,6A | 63A | BRAKE | M
C4 CHAIN CONVEYOR FOR SEALED CATHODE 3,7 KW 4481-MHCD-0004-M1

E6 6,3A | CC | PLC | 4,8A | 63A | M
S1 CATHODE BAR SHOTBLASTING MACHINE SCREW 2,2 KW 4481-MZBP-0001-M7

E7 50A | CC | PLC | 27A | 63A | M
F1 CATHODE BLOCK OVEN FAN A 15 KW 4481-MEEP-0001-M1

E8 50A | CC | PLC | 27A | 63A | M
F1 CATHODE BLOCK OVEN FAN B 15 KW 4481-MEEP-0001-M2

E9 1,6A | TRANSFO 460V/230V | ETHERNET | LINE REACTOR | AC VARIABLE SPEED DRIVE | CC | PLC | 63A | M M
FAN 44W R9 CONICAL ROLLER CONVEYOR AT SHOTBLASTING MACHINE ENTRANCE 0,37 KW 4481-MJRO-0001-M1

E10 1,6A | TRANSFO 460V/230V | ETHERNET | LINE REACTOR | AC VARIABLE SPEED DRIVE | CC | PLC | 63A | M M
FAN 44W R8 CONICAL ROLLER CONVEYOR AT SHOTBLASTING MACHINE EXIT 0,37 KW 4481-MJRO-0002-M1

F1 25A | CC | PLC | 14A | 63A | M
D1 DUST COLLECTOR FAN 7,5 KW 4481-MACO-0001-M1

F2 10A
SPARE

F3 25A | CC | PLC | 21A | 63A | M
S1 CATHODE BAR SHOTBLASTING MACHINE BLAST WHEEL No.3 11 KW 4481-MZBP-0001-M3

F4 4A | CC | PLC | 2,6A | 63A | M
F3 LADLE PRE-HEATING ST. COMBUSTION FAN 1,1 KW 4481-MBAD-0001-M1

F5 25A | CC | PLC | 21A | 63A | M
S1 CATHODE BAR SHOTBLASTING MACHINE BLAST WHEEL No.4 11 KW 4481-MZBP-0001-M4

M.C.C. / FIELD

460Vac, 3ø, 60Hz, 800A BUS BAR 80KA/1SEC.

G5 MCCB 63A | ISOLATION TRANSFORMER 10KVA/460V/230V

G4 230V DISTRIBUTION

SECTION CONTROL
1 CIRCUIT 10 AMP. 230V
1 CIRCUIT 10 AMP. 230V
1 CIRCUIT 10 AMP. 230V
1 CIRCUIT 10 AMP. 230V
1 CIRCUIT 10 AMP. 230V
1 CIRCUIT 10 AMP. 230V
1 CIRCUIT 6 AMP. 230V
1 CIRCUIT 10 AMP. 230V
1 CIRCUIT 10 AMP. 230V
1 CIRCUIT 10 AMP. 230V
1 CIRCUIT 10 AMP. 230V
1 CIRCUIT 10 AMP. 230V
1 CIRCUIT 10 AMP. 230V
BREAKER MCB15 (10A) 4481-MBAD-0002-CP-01
5 BREAKER MCB16 (10A) 4481-MBAD-0002-CP-01

SECTION UTILITIES
1 CIRCUIT 10 AMP. 230V
1 CIRCUIT 10 AMP. 230V
1 CIRCUIT 10 AMP. 230V
1 CIRCUIT 10 AMP. 230V

PLC PANEL BREAKER MCB11 (10A) 4481-CP-1000
CAST IRON ST. A PANEL BREAKER MCB13 (10A) 4481-MEVD-0001-CP-01
PLC PANEL BREAKER MCB1 (6A) 4481-CP-1000
CAST IRON ST. A PANEL BREAKER MCB6 (10A) 4481-MEVD-0001-CP-01
CAST IRON ST. B PANEL BREAKER MCB7 (10A) 4481-MEVD-0002-CP-01
LADLE PRE-HEATING ST. PANEL BREAKER MCB12 (10A) 4481-MBAD-0001-CP-01
CAST IRON ST. B PANEL BREAKER MCB14 (10A) 4481-MEVD-0002-CP-01
CATHODE BLOCK OVEN SCR CONTROL PANEL BREAKER MCB2 (10A) 4480-EVR3-0002
LADLE PRE-HEATING ST. PANEL BREAKER MCB5 (10A) 4481-MBAD-0001-CP-01
LOCAL CONTROL PANEL BREAKER MCB8 (10A) 4481-MQLK-0001-CP-01
LOCAL CONTROL PANEL BREAKER MCB10 (10A) 4481-MPFO-0001-CP-01
CATHODE BAR HEATING F. SCR CONTROL PANEL BREAKER MCB3 (10A) 4480-EVR3-0001
CENTRAL CONTROL PANEL BREAKER MCB4 (10A) 4481-CP-1001
LOCAL CONTROL PANEL BREAKER MCB9 (10A) 4481-MHCD-0003-CP-01

M.C.C. / FIELD

G3 SPARE 5

G2 63A | CC | PLC
CHILLER FOR HYDRAULIC POWER UNIT LOCAL CONTROL PANEL
W1 CHILLER PUMP 1,86 KW 4481-MEHX-0001-M1
W1 CHILLER COMPRESSOR 7,5 KW 4481-MEHX-0001-M2
W1 CHILLER FAN 0,75 KW 4481-MEHX-0001-M3
W1 CHILLER RECIRCULATION PUMP 1,86 KW 4481-MEHX-0001-M4

G1 CISCO IE3000-BTC ETHERNET SWITCH

F11 SPARE

F10 1,6A | ETHERNET | LINE REACTOR | AC VARIABLE SPEED DRIVE | CC | PLC | 63A | M
S1 CATHODE BAR SHOTBLASTING MACHINE WORK CONVEYOR 0,37 KW 4481-MZBP-0001-M6

F9 50A | CC | PLC | 27A | 63A | M
F1 CATHODE BLOCK OVEN FAN C 15 KW 4481-MEEP-0001-M3

F8 4A | CC | PLC | 2,6A | 63A | M
F4B CAST IRON ST. B COMBUSTION FAN 1,1 KW 4481-MEVD-0002-M1

F7 6,3A | CC | PLC | 4,8A | 63A | BRAKE | M
S1 CATHODE BAR SHOTBLASTING MACHINE ELEVATOR 2,2 KW 4481-MZBP-0001-M5

F6 4A | CC | PLC | 2,6A | 63A | M
F4A CAST IRON ST. A COMBUSTION FAN 1,1 KW 4481-MEVD-0001-M1

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5		UPDATE	SE-01-11	F.P.	E.B.	M.B.
4		UPDATE	FE-04-10	F.P.	E.B.	M.B.
3		UPDATE	NO-11-10	F.P.	E.B.	M.B.
2		UPDATE	NO-04-10	F.P.	E.B.	M.B.
1		UPDATE	SE-28-10	F.P.	E.B.	M.B.

DRAWING NUMBER | TITLE | REFERENCES | REVISIONS

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ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA a&i tech Inc. Département Ingénierie Engineering Department 9650 Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR CONTROL PANEL 4481-ECM1-0001 (2/3)
SINGLE LINE DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
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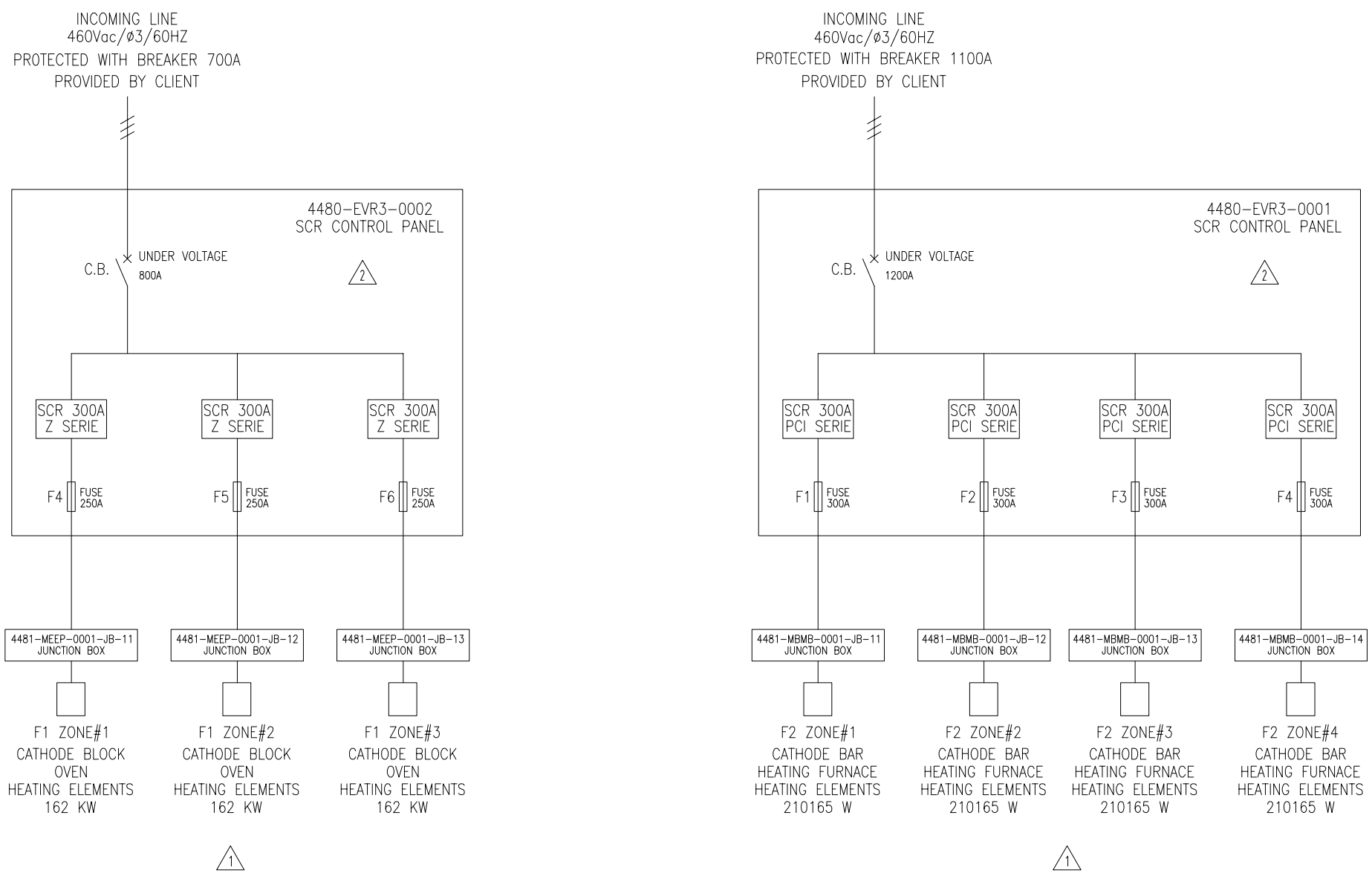
Reviewed by : _____ Date : _____

Discipline :

Document No : 25457-4480-V1A-MXA0-0058 | Rev. : 001



DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		2		UPDATE	FE-04-10	F.P.	E.B.	M.B.
		1		UPDATE	OC-10-10	F.P.	E.B.	M.B.
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BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SELLER DRAWING No. 1347-57020 | REV. 2

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR CONTROL PANEL 4481-ECM1-0001 (3/3)
SINGLE LINE DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

9.10 Inputs & Outputs

DRAWING No.	DESCRIPTION
1347-56760	PLC Control System Architecture
1347-PLC I&O	PLC Inputs & Outputs
1347-FLEX 02 I&O	Remote Rack 02 Inputs & Outputs
1347-FLEX 03 I&O	Remote Rack 03 Inputs & Outputs
1347-FLEX 04 I&O	Remote Rack 04 Inputs & Outputs
1347-FLEX 05 I&O	Remote Rack 05 Inputs & Outputs

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Discipline :

Document No : 25457-4480-V1A-MXAO-0122 | Rev. :

LEGEND
ETHERNET COOPER CABLE
ETHERNET FIBER-OPTIC CABLE

LEVEL 2
(BY OTHERS)

LEVEL 1
ELECTRICAL ROOM

ETHERNET FIBER-OPTIC CABLE

4481-ECM1-1000
MCC PANEL

CISCO IE3000-8TC BASE SWITCH SW00 — RJ45 RJ45 RJ45 RJ45 RJ45 RJ45 RJ45 RJ45
CISCO IE3000-8TC EXPANSION SWITCH SW01 — RJ45 RJ45 RJ45 RJ45 RJ45 RJ45 RJ45 RJ45
FROM MOTORS DRIVES

4481-CP-1000
PLC PANEL

MAIN RACK 00 (1756-A10)
4481-PLC-0001

1756-PA75	1756 EN2F 00	1756 L73 01	1756 EN2T 02	1756 EN2T 03	TBS6H 1756 OW16I 04	TBS6H 1756 OW16I 05	1756 N2 06	TBSH 1756 OF6CI 07	TBSH 1756 OF6CI 08	1756 N2 09

RJ45 1783-ETAP ET00 RJ45 RJ45

MAIN RACK 01 (1756-A10)
4481-PLC-0001

1756-PA75	1756 EN2T 00	1756 IB32 01	1756 IB32 02	1756 IB32 03	1756 IB32 04	1756 IB32 05	1756 IB32 06	1756 IB32 07	1756 IB32 08	1756 IB32 09

△2

RJ45 1783-ETAP ET01 RJ45 RJ45

1492-CABLE025Z — IFM40D24

ETHERNET COOPER CABLE

FIELD

RJ45 RJ45 1783-ETAP ET02 RJ45

VERSAVIEW 1700P
6181P-17TPXPDC
WITH RSVIEW SOFTWARE

REMOTE RACK 02
4481-PLC-0001

1794 AENT A	TB3S 1794 IB16 00	TB3S 1794 IB16 01	TB3S 1794 IB16 02	TB3S 1794 OB8EP 03	TB3S 1794 OB8EP 04	TB3S 1794 OB8EP 05	TB3S 1794 OB8EP 06

4481-CP-1001 (SEALING STATION PLATFORM)
CENTRAL CONTROL PANEL

RJ45 RJ45 1783-ETAP ET03 RJ45

REMOTE RACK 03
4481-PLC-0001

1794 AENT A	TB3S 1794 IB16 00	TB3S 1794 IB16 01	TB3S 1794 IB16 02	TB3S 1794 IB16 03	TB3S 1794 OB16 04	TB3S 1794 OB16 05	TB3S 1794 OB16 06	TB3S 1794 IF8IH 07

4481-MQLK-0001-CP-01 (G1)
LOCAL CONTROL PANEL

RJ45 RJ45 1783-ETAP ET04 RJ45

△4

REMOTE RACK 04
4481-PLC-0001

1794 AENT A	TB3S 1794 IB32 00	TB3S 1794 IB16 01	TB3S 1794 IB16 02	TB3S 1794 OB8EP 03	TB3S 1794 OB8EP 04	TB3S 1794 OB8EP 05	TB3S 1794 OB8EP 06	TB3S 1794 IF8IH 07

RJ45 RJ45 1783-ETAP ET07 RJ45

PANELVIEW PLUS 700
2711P-T7C4D1

4481-MHCD-0003-CP-01 (C3)
LOCAL CONTROL PANEL

RJ45 RJ45 1783-ETAP ET05 RJ45

REMOTE RACK 05
4481-PLC-0001

1794 AENT A	TB3S 1794 IB16 00	TB3S 1794 IB16 01	TB3S 1794 OB8EP 02	TB3S 1794 IF8IH 03

4481-MPF0-0001-CP-01 (H1)
LOCAL CONTROL PANEL

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
		4		REPLACE 1794-IB16 WITH 1794-IB32	31/08/2011	F.P.	E.B.	C.C.
		3		REMOVE ETHERNET TAP FOR VERSAVIEW 1700P	01/02/2011	T.Pa.	E.B.	C.C.
		2		UPDATE	04/12/2010	T.Pa.	E.B.	C.C.
		1		UPDATE	11/11/2010	T.Pa.	E.B.	C.C.
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SELLER DRAWING No. 1347-56760 | REV. 4

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
PLC
CONTROL SYSTEM ARCHITECTURE

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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3	1347-53002-00	DIGITAL INPUT (24 VDC) RACK: 01 SLOT: 01 (3/4) I/O INTERCONNECTION DIAGRAM
4	1347-53003-00	DIGITAL INPUT (24 VDC) RACK: 01 SLOT: 01 (3/4) I/O INTERCONNECTION DIAGRAM
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37	1347-54000-00	DIGITAL OUTPUT (24 VDC) RACK: 00 SLOT: 04 (1/2) I/O INTERCONNECTION DIAGRAM
38	1347-54001-00	DIGITAL OUTPUT (24 VDC) RACK: 00 SLOT: 04 (2/2) I/O INTERCONNECTION DIAGRAM
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1 41	1347-54050-01	ANALOG OUTPUT (4-20MA VDC) RACK: 00 SLOT: 07 I/O INTERCONNECTION DIAGRAM
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Département Ingénierie
Engineering Department
1645 1re Avenue
Québec, Québec
Canada

Project Title:

Ras Az Zawr
Aluminium Smelter

SELLER DRAWING No.

1347–PLC I&O

REV. 1

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
I/O INTERCONNECTION DIAGRAMS
PLC

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
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MOTOR CONTROL CENTER PANEL
4480-ECM1-0001

C2
CHAIN CONVEYOR UPSTREAM
OF SHOTBLASTING MACHINE
STARTER 4481-MHCD-0002-M1-ST

SEE DWG. 1347-56250
25457-4480-V1A-MXA0-0234

PLC PANEL
4481-CP-1000

0 1 2 3 4 5 6 7 8 9

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1756-IB32
VOLTAGE	24Vdc
SLOT	01
RACK	01
PANEL	4481-CP-1000
IFM MODULE	1492-IFM40D24
PRE-WIRED CABLE	1492-CABLE025Z

SEE DWG. 1347-55253
25457-4480-V1A-MXA0-0102
FROM LINE 05

XDI0101
74-V5A
4481MHCD0002M1-V+ (1)
V1+

XDO0004
4481MHCD0002M1-10 (7)
V0+
SEE DWG. 1347-54000
4481MHCD0002M1-10

TEST
TEST

PRE-WIRED CABLE

4481MHCD0002M1-9C (8)	IN1	7	2	DI0101.1	4481-MHCD-0002-M1 LDS ON CHAIN CONVEYOR UPSTREAM OF SHOTBLASTING MACHINE
4481MHCD0002M1-9B (4)	IN2	9	3	DI0101.2	4481-MHCD-0002-M1 SAFETY INT. OFF CHAIN CONVEYOR UPSTREAM OF SHOTBLASTING MACHINE
4481MHCD0002M1-9 (3)	IN3	11	4	DI0101.3	4481-MHCD-0002-M1 ENABLE CHAIN CONVEYOR UPSTREAM OF SHOTBLASTING MACHINE
4481MHCD0002M1-17 (6)	IN4	13	5	DI0101.4	4481-MHCD-0002-M1 MOTOR RUNNING CHAIN CONVEYOR UPSTREAM OF SHOTBLASTING MACHINE
4481MHCD0002M1-V- (2)	V1-				
IN5		15	6	DI0101.5	SPARE
IN6		17	7	DI0101.6	SPARE
IN7		19	8	DI0101.7	SPARE

4481-MHCD-0002-M1
REMOTE MODE
CHAIN CONVEYOR UPSTREAM
OF SHOTBLASTING MACHINE

SEE DWG. 1347-53001

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DATE:	

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BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT (24 Vdc) RACK: 01 SLOT: 01 (1/4)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

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MOTOR CONTROL CENTER PANEL
4480-ECM1-0001

R9
CONICAL ROLLER CONVEYOR
AT SHOTBLASTING MACHINE ENTRANCE
STARTER 4481-MJR0-0001-M1-ST

SEE DWG. 1347-56260
25457-4480-V1A-MXA0-0235

PLC PANEL
4481-CP-1000

0 1 2 3 4 5 6 7 8 9

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1756-IB32
VOLTAGE	24Vdc
SLOT	01
RACK	01
PANEL	4481-CP-1000
IFM MODULE	1492-IFM40D24
PRE-WIRED CABLE	1492-CABLE025Z

FROM DWG. 1347-53000

4481MJR00001M1-V+ (1)	V2+				
4481MJR00001M1-11 (6)	IN8	21	9	DI0101.8	4481-MJR0-0001-M1 JOG FORWARD CONICAL ROLLER CONVEYOR AT SHOTBLASTING MACHINE ENTRANCE
4481MJR00001M1-12 (7)	IN9	23	10	DI0101.9	4481-MJR0-0001-M1 REMOTE MODE CONICAL ROLLER CONVEYOR AT SHOTBLASTING MACHINE ENTRANCE
4481MJR00001M1-9C (8)	IN10	25	11	DI0101.10	4481-MJR0-0001-M1 LDS ON CONICAL ROLLER CONVEYOR AT SHOTBLASTING MACHINE ENTRANCE
4481MJR00001M1-9B (4)	IN11	27	12	DI0101.11	4481-MJR0-0001-M1 SAFETY INT. OFF CONICAL ROLLER CONVEYOR AT SHOTBLASTING MACHINE ENTRANCE
4481MJR00001M1-9 (3)	IN12	29	13	DI0101.12	4481-MJR0-0001-M1 ENABLE CONICAL ROLLER CONVEYOR AT SHOTBLASTING MACHINE ENTRANCE
4481MJR00001M1-17 (5)	IN13	31	14	DI0101.13	4481-MJR0-0001-M1 MOTOR CONTACTOR ON CONICAL ROLLER CONVEYOR AT SHOTBLASTING MACHINE ENTRANCE
4481MJR00001M1-V- (2)	V2-				
	IN14	33	15	DI0101.14	SPARE
	IN15	35	16	DI0101.15	SPARE
	COM0	39	17	COM 0	
	COM0	1	18	COM 0	

TO DWG. 1347-53002

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SELLER DRAWING No. 1347-53001 | REV. 0

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT (24 Vdc) RACK: 01 SLOT: 01 (2/4)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—	—	A3-		-AZ	

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MOTOR CONTROL CENTER PANEL
4480-ECM1-0001

S1
CATHODE BAR SHOTBLASTING MACHINE
BLAST WHEEL No. 1
STARTER 4481-MZBP-0001-M1-ST

SEE DWG. 1347-56270
25457-4480-V1A-MXA0-0236

PLC PANEL
4481-CP-1000

0 1 2 3 4 5 6 7 8 9

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1756-IB32
VOLTAGE	24Vdc
SLOT	01
RACK	01
PANEL	4481-CP-1000
IFM MODULE	1492-IFM40D24
PRE-WIRED CABLE	1492-CABLE025Z

SEE DWG. 1347-53001

4481MZBP0001M1-V+ (1) — V3+

4481MZBP0001M1-10 (7) — XDO0004 V1+ — 4481MZBP0001M1-10
SEE DWG. 1347-54000

4481MZBP0001M1-10	IN16	6	19	DI0101.16	4481-MZBP-0001-M1 REMOTE MODE SHOTBLASTING MACHINE BLAST WHEEL No. 1
4481MZBP0001M1-9C (8)	IN17	8	20	DI0101.17	4481-MZBP-0001-M1 LDS ON SHOTBLASTING MACHINE BLAST WHEEL No. 1
4481MZBP0001M1-9B (4)	IN18	10	21	DI0101.18	4481-MZBP-0001-M1 SAFETY INT. OFF SHOTBLASTING MACHINE BLAST WHEEL No. 1
4481MZBP0001M1-9 (3)	IN19	12	22	DI0101.19	4481-MZBP-0001-M1 ENABLE SHOTBLASTING MACHINE BLAST WHEEL No. 1
4481MZBP0001M1-17 (6)	IN20	14	23	DI0101.20	4481-MZBP-0001-M1 MOTOR RUNNING SHOTBLASTING MACHINE BLAST WHEEL No. 1
4481MZBP0001M1-V- (2)	V3-				
	IN21	16	24	DI0101.21	SPARE
	IN22	18	25	DI0101.22	SPARE
	IN23	20	26	DI0101.23	SPARE

SEE DWG. 1347-53003

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Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No: 25457-00AZ- | SUBD.: xx - | DISC.: xxxx - | SECTOR: xxxx - | SEQUENCE: xxx - | REV.: xxx

SELLER DRAWING No.: 1347-53002 | REV.: 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT (24 Vdc) RACK: 01 SLOT: 01 (3/4)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type: — | Building: — | Discipline: — | Phase: — | Format: A3- | Sequential: | Location: -AZ | Rev. No.

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MOTOR CONTROL CENTER PANEL
4480-ECM1-0001

S1
CATHODE BAR SHOTBLASTING MACHINE
BLAST WHEEL No. 3
STARTER 4481-MZBP-0001-M3-ST

SEE DWG. 1347-56271
25457-4480-V1A-MXA0-0237

PLC PANEL
4481-CP-1000

0 1 2 3 4 5 6 7 8 9

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1756-IB32
VOLTAGE	24Vdc
SLOT	01
RACK	01
PANEL	4481-CP-1000
IFM MODULE	1492-IFM40D24
PRE-WIRED CABLE	1492-CABLE025Z

FROM DWG. 1347-53002

4481MZBP0001M3-V+ (1) — V4+

4481MZBP0001M3-10 (7) — XD00004 V2+ — 4481MZBP0001M3-10 — IN24 — 22 — 27 — DI0101.24 — 4481-MZBP-0001-M3 REMOTE MODE SHOTBLASTING MACHINE BLAST WHEEL No.3
SEE DWG. 1347-54000

4481MZBP0001M3-9C (8) — IN25 — 24 — 28 — DI0101.25 — 4481-MZBP-0001-M3 LDS ON SHOTBLASTING MACHINE BLAST WHEEL No.3

4481MZBP0001M3-9B (4) — IN26 — 26 — 29 — DI0101.26 — 4481-MZBP-0001-M3 SAFETY INT. OFF SHOTBLASTING MACHINE BLAST WHEEL No.3

4481MZBP0001M3-9 (3) — IN27 — 28 — 30 — DI0101.27 — 4481-MZBP-0001-M3 ENABLE SHOTBLASTING MACHINE BLAST WHEEL No.3

4481MZBP0001M3-17 (6) — IN28 — 30 — 31 — DI0101.28 — 4481-MZBP-0001-M3 MOTOR RUNNING SHOTBLASTING MACHINE BLAST WHEEL No.3

4481MZBP0001M3-V- (2) — V4-

IN29 — 32 — 32 — DI0101.29 — SPARE

IN30 — 34 — 33 — DI0101.30 — SPARE

IN31 — 36 — 34 — DI0101.31 — SPARE

74-V5- — 74-V5-

FROM LINE 05
SEE DWG. 1347-55253
25457-4480-V1A-MXA0-0102

COM1 — 40 — 35 — COM 1

COM1 — 2 — 36 — COM 1

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SELLER DRAWING No. 1347-53003 — REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT (24 Vdc) RACK: 01 SLOT: 01 (4/4)
I/O INTERCONNECTION DIAGRAM

Project Title: Ras Az Zawr Aluminium Smelter

MA'ADEN

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

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MOTOR CONTROL CENTER PANEL
4480-ECM1-0001

S1
CATHODE BAR SHOTBLASTING MACHINE
SCREW
STARTER 4481-MZBP-0001-M7-ST

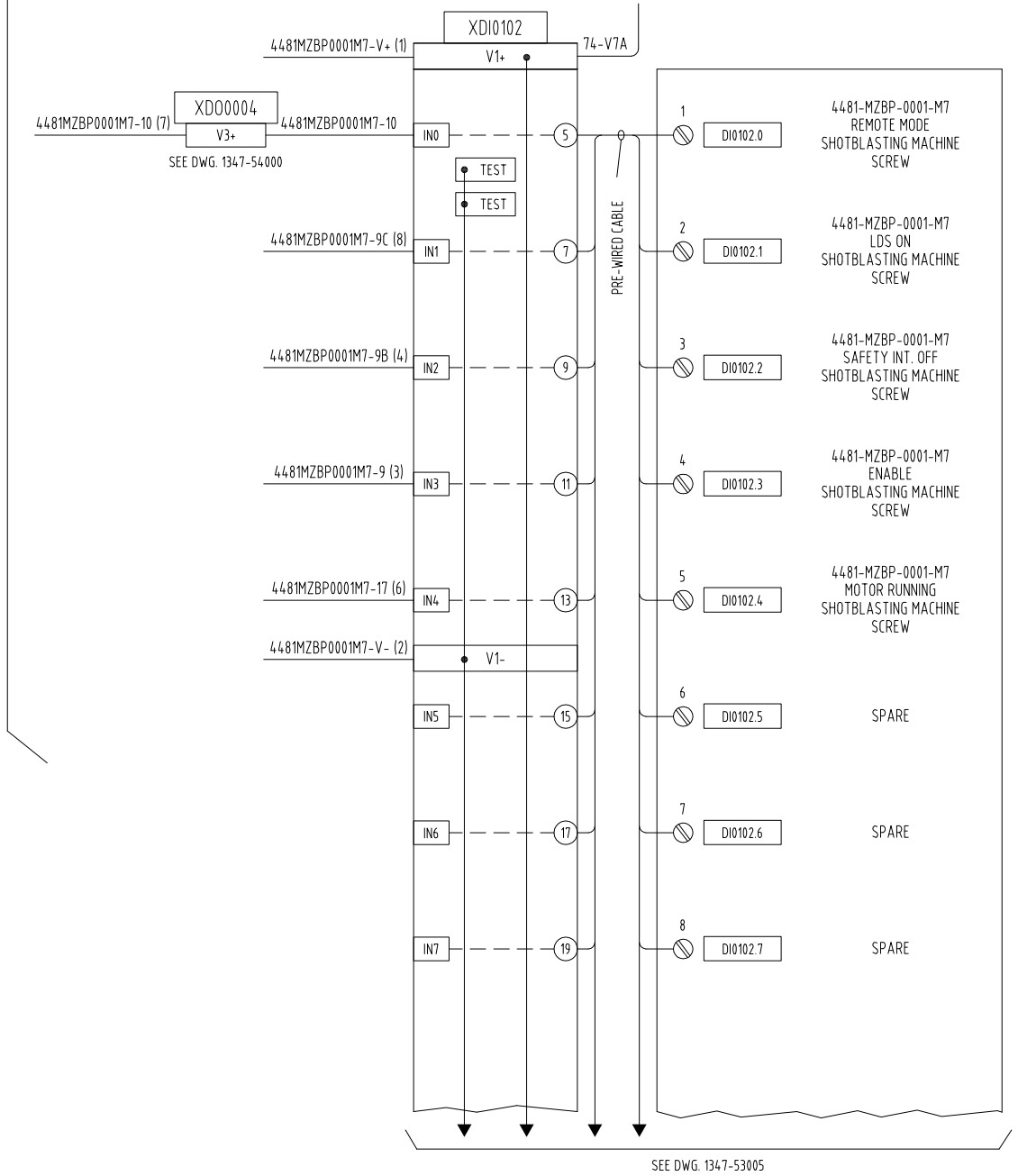
SEE DWG. 1347-56272
25457-4480-V1A-MXA0-0238

PLC PANEL
4481-CP-1000

0 1 2 3 4 5 6 7 8 9

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1756-IB32
VOLTAGE	24Vdc
SLOT	02
RACK	01
PANEL	4481-CP-1000
IFM MODULE	1492-IFM40D24
PRE-WIRED CABLE	1492-CABLE025Z

SEE DWG. 1347-55253
25457-4480-V1A-MXA0-0102
FROM LINE 07



SEE DWG. 1347-53005

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Vendor or Subcontractor Logo: GNA Automation Inc. — Département Ingénierie Engineering Department, 6410, Trans-Canadien, Saint-Laurent, Québec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT (24 Vdc) RACK: 01 SLOT: 02 (1/4)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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MOTOR CONTROL CENTER PANEL
4480-ECM1-0001

S1
CATHODE BAR SHOTBLASTING MACHINE
ELEVATOR
STARTER 4481-MZBP-0001-M5-ST

SEE DWG. 1347-56273
25457-4480-V1A-MXA0-0239

PLC PANEL
4481-CP-1000

0 1 2 3 4 5 6 7 8 9

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1756-IB32
VOLTAGE	24Vdc
SLOT	02
RACK	01
PANEL	4481-CP-1000
IFM MODULE	1492-IFM40D24
PRE-WIRED CABLE	1492-CABLE025Z

FROM DWG. 1347-53004

4481MZBP0001M5-V+ (1)	V2+				
4481MZBP0001M5-10 (7) XDO0004 V4+ (SEE DWG. 1347-54000)	4481MZBP0001M5-10	IN8	21	9 DI0102.8	4481-MZBP-0001-M5 REMOTE MODE SHOTBLASTING MACHINE ELEVATOR
4481MZBP0001M5-9C (8)		IN9	23	10 DI0102.9	4481-MZBP-0001-M5 LDS ON SHOTBLASTING MACHINE ELEVATOR
4481MZBP0001M5-9B (4)		IN10	25	11 DI0102.10	4481-MZBP-0001-M5 SAFETY INT. OFF SHOTBLASTING MACHINE ELEVATOR
4481MZBP0001M5-9 (3)		IN11	27	12 DI0102.11	4481-MZBP-0001-M5 ENABLE SHOTBLASTING MACHINE ELEVATOR
4481MZBP0001M5-17 (6)		IN12	29	13 DI0102.12	4481-MZBP-0001-M5 MOTOR RUNING SHOTBLASTING MACHINE ELEVATOR
4481MZBP0001M5-V- (2)	V2-				
		IN13	31	14 DI0102.13	SPARE
		IN14	33	15 DI0102.14	SPARE
		IN15	35	16 DI0102.15	SPARE
		COM0	39	17 COM 0	
		COM0	1	18 COM 0	

TO DWG. 1347-53006

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SELLER DRAWING No.: 1347-53005 — REV.: 0

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT (24 Vdc) RACK: 01 SLOT: 02 (2/4)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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MOTOR CONTROL CENTER PANEL
4480-ECM1-0001

S1
CATHODE BAR SHOTBLASTING MACHINE
BLAST WHEEL No. 2
STARTER 4481-MZBP-0001-M2-ST

SEE DWG. 1347-56274
25457-4480-V1A-MXA0-0240

PLC PANEL
4481-CP-1000

0 1 2 3 4 5 6 7 8 9

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1756-IB32
VOLTAGE	24Vdc
SLOT	02
RACK	01
PANEL	4481-CP-1000
IFM MODULE	1492-IFM40D24
PRE-WIRED CABLE	1492-CABLE025Z

SEE DWG. 1347-53005

4481MZBP0001M2-V+ (1) — V3+

4481MZBP0001M2-10 (7) — XD00004 V5+ — 4481MZBP0001M2-10
SEE DWG. 1347-54000

4481MZBP0001M2-10	IN16	6	19	DI0102.16	4481-MZBP-0001-M2 REMOTE MODE SHOTBLASTING MACHINE BLAST WHEEL No. 2
4481MZBP0001M2-9C (8)	IN17	8	20	DI0102.17	4481-MZBP-0001-M2 LDS ON SHOTBLASTING MACHINE BLAST WHEEL No. 2
4481MZBP0001M2-9B (4)	IN18	10	21	DI0102.18	4481-MZBP-0001-M2 SAFETY INT. OFF SHOTBLASTING MACHINE BLAST WHEEL No. 2
4481MZBP0001M2-9 (3)	IN19	12	22	DI0102.19	4481-MZBP-0001-M2 ENABLE SHOTBLASTING MACHINE BLAST WHEEL No. 2
4481MZBP0001M2-17 (6)	IN20	14	23	DI0102.20	4481-MZBP-0001-M2 MOTOR RUNNING SHOTBLASTING MACHINE BLAST WHEEL No. 2
4481MZBP0001M2-V- (2) — V3-					
	IN21	16	24	DI0102.21	SPARE
	IN22	18	25	DI0102.22	SPARE
	IN23	20	26	DI0102.23	SPARE

SEE DWG. 1347-53007

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
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Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-	00AZ-	xx -	xxxx -	xxxx - xxx	– xxx

SELLER DRAWING No.: 1347–53006 — REV.: 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT (24 Vdc) RACK: 01 SLOT: 02 (3/4)
I/O INTERCONNECTION DIAGRAM

MA'ADEN

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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MOTOR CONTROL CENTER PANEL
4480-ECM1-0001

S1
CATHODE BAR SHOTBLASTING MACHINE
BLAST WHEEL No. 4
STARTER 4481-MZBP-0001-M4-ST

SEE DWG. 1347-56275
25457-4480-V1A-MXA0-0241

PLC PANEL
4481-CP-1000

0 1 2 3 4 5 6 7 8 9

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1756-IB32
VOLTAGE	24Vdc
SLOT	02
RACK	01
PANEL	4481-CP-1000
IFM MODULE	1492-IFM40D24
PRE-WIRED CABLE	1492-CABLE025Z

FROM DWG. 1347-53006

4481MZBP0001M4-V+ (1) — V4+

4481MZBP0001M4-10 (7) — XD00004 V6+ — SEE DWG. 1347-54000 — 4481MZBP0001M4-10 — IN24 — 22 — 27 DI0102.24 — 4481-MZBP-0001-M4 REMOTE MODE SHOTBLASTING MACHINE BLAST WHEEL No.4

4481MZBP0001M4-9C (8) — IN25 — 24 — 28 DI0102.25 — 4481-MZBP-0001-M4 LDS ON SHOTBLASTING MACHINE BLAST WHEEL No.4

4481MZBP0001M4-9B (4) — IN26 — 26 — 29 DI0102.26 — 4481-MZBP-0001-M4 SAFETY INT. OFF SHOTBLASTING MACHINE BLAST WHEEL No.4

4481MZBP0001M4-9 (3) — IN27 — 28 — 30 DI0102.27 — 4481-MZBP-0001-M4 ENABLE SHOTBLASTING MACHINE BLAST WHEEL No.4

4481MZBP0001M4-17 (6) — IN28 — 30 — 31 DI0102.28 — 4481-MZBP-0001-M4 MOTOR RUNNING SHOTBLASTING MACHINE BLAST WHEEL No.4

4481MZBP0001M4-V- (2) — V4-

IN29 — 32 — 32 DI0102.29 — SPARE

IN30 — 34 — 33 DI0102.30 — SPARE

IN31 — 36 — 34 DI0102.31 — SPARE

74-V7- — 74-V7-

FROM LINE 07
SEE DWG. 1347-55253
25457-4480-V1A-MXA0-0102

COM1 — 40 — 35 COM 1

COM1 — 2 — 36 COM 1

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SELLER DRAWING No. 1347-53007 — REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT (24 Vdc) RACK: 01 SLOT: 02 (4/4)
I/O INTERCONNECTION DIAGRAM

Project Title: Ras Az Zawr Aluminium Smelter

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—		—	—	A3-		-AZ	

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MOTOR CONTROL CENTER PANEL
4480-ECM1-0001

S1
CATHODE BAR SHOTBLASTING MACHINE
WORK CONVEYOR
STARTER 4481-MZBP-0001-M6-ST

SEE DWG. 1347-56276
25457-4480-V1A-MXA0-0242

PLC PANEL
4481-CP-1000

0 1 2 3 4 5 6 7 8 9

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1756-IB32
VOLTAGE	24Vdc
SLOT	03
RACK	01
PANEL	4481-CP-1000
IFM MODULE	1492-IFM40D24
PRE-WIRED CABLE	1492-CABLE025Z

SEE DWG. 1347-55253
25457-4480-V1A-MXA0-0102
FROM LINE 09

XDI0103

4481MZBP0001M6-V+ (1)	V1+	74-V9A			
4481MZBP0001M6-11 (6)	IN0	5	0	1 DI0103.0	4481-MZBP-0001-M6 JOG FORWARD SHOTBLASTING MACHINE WORK CONVEYOR
	TEST				
	TEST				
4481MZBP0001M6-12 (7)	IN1	7	PRE-WIRED CABLE	2 DI0103.1	4481-MZBP-0001-M6 REMOTE MODE SHOTBLASTING MACHINE WORK CONVEYOR
4481MZBP0001M6-9C (8)	IN2	9		3 DI0103.2	4481-MZBP-0001-M6 LDS ON SHOTBLASTING MACHINE WORK CONVEYOR
4481MZBP0001M6-9B (4)	IN3	11		4 DI0103.3	4481-MZBP-0001-M6 SAFETY INT. OFF SHOTBLASTING MACHINE WORK CONVEYOR
4481MZBP0001M6-9 (3)	IN4	13		5 DI0103.4	4481-MZBP-0001-M6 ENABLE SHOTBLASTING MACHINE WORK CONVEYOR
4481MZBP0001M6-17 (5)	IN5	15		6 DI0103.5	4481-MZBP-0001-M6 MOTOR CONTACTOR ON SHOTBLASTING MACHINE WORK CONVEYOR
4481MZBP0001M6-V- (2)	V1-				
	IN6	17		7 DI0103.6	SPARE
	IN7	19		8 DI0103.7	SPARE

SEE DWG. 1347-53009

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ENG. GROUP SUP.	DRAWING SCALE: NONE
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Vendor or Subcontractor Logo: GNA Automation Inc. — Département Ingénierie Engineering Department, 6410, Trans-Canada, Saint-Laurent, Québec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT (24 Vdc) RACK: 01 SLOT: 03 (1/4)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—	—	A3-		-AZ	

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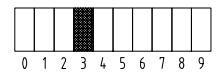
MOTOR CONTROL CENTER PANEL
4480-ECM1-0001

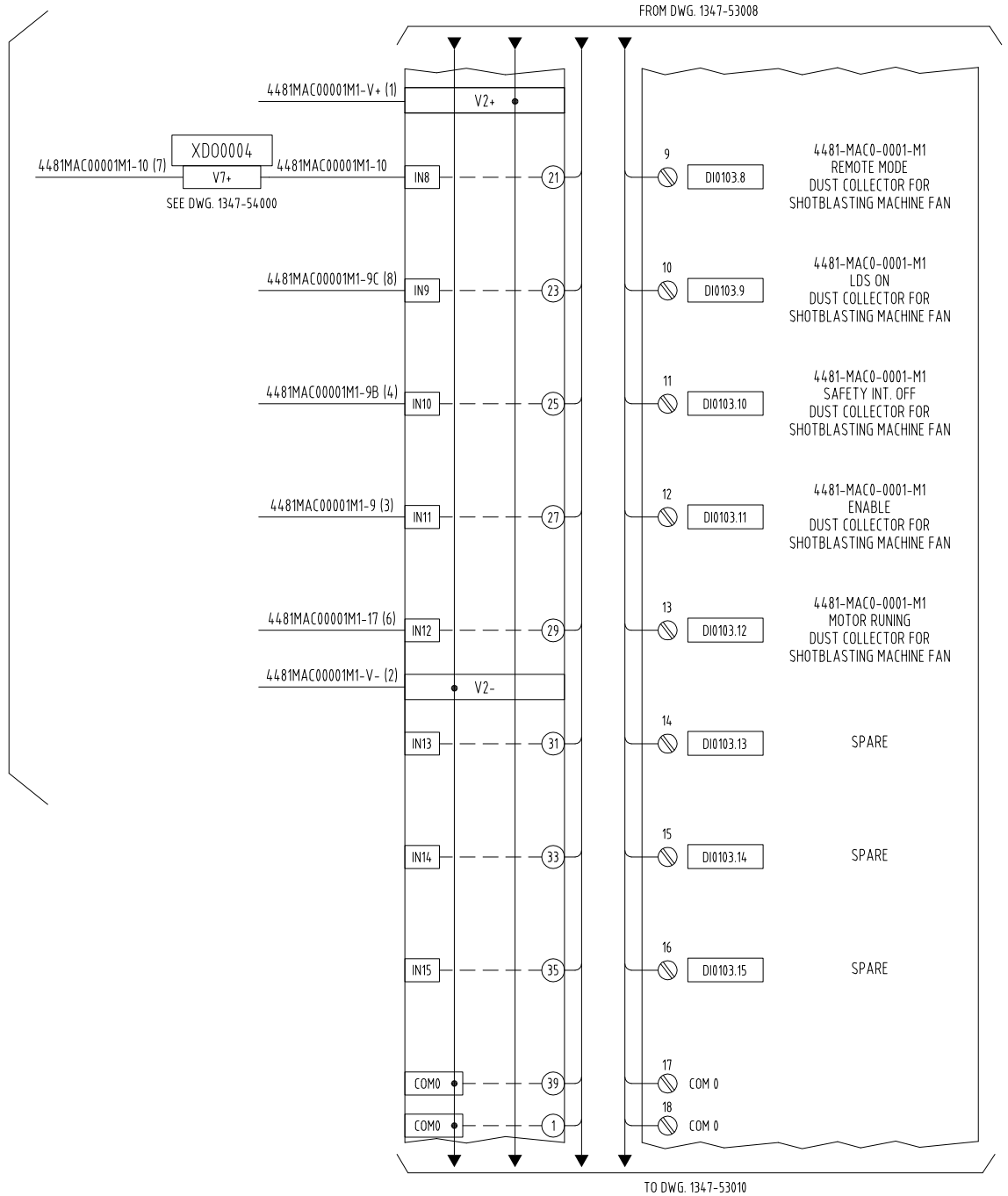
D1
DUST COLLECTOR FOR SHOTBLASTING MACHINE
FAN
STARTER 4481-MAC0-0001-M1-ST

SEE DWG. 1347-56277
25457-4480-V1A-MXA0-0243

PLC PANEL
4481-CP-1000



MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1756-IB32
VOLTAGE	24Vdc
SLOT	03
RACK	01
PANEL	4481-CP-1000
IFM MODULE	1492-IFM40D24
PRE-WIRED CABLE	1492-CABLE025Z



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Vendor or Subcontractor Logo:
GNA ellutech inc. — Département Ingénierie Engineering Department, 6400 Trans-Canada, Baie-Comeau, Québec, H4S 1V3, Canada

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Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SELLER DRAWING No.: 1347-53009 — REV.: 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT (24 Vdc) RACK: 01 SLOT: 03 (2/4)
I/O INTERCONNECTION DIAGRAM

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—		—	—	A3-		-AZ	

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MOTOR CONTROL CENTER PANEL
4480-ECM1-0001

R8
ROLLER CONVEYOR AT
SHOTBLASTING MACHINE EXIT
STARTER 4481-MJR0-0002-M1-ST

PLC PANEL
4481-CP-1000

0 1 2 3 4 5 6 7 8 9

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1756-IB32
VOLTAGE	24Vdc
SLOT	03
RACK	01
PANEL	4481-CP-1000
IFM MODULE	1492-IFM40D24
PRE-WIRED CABLE	1492-CABLE025Z

SEE DWG. 1347-56280
25457-4480-V1A-MXA0-0244

SEE DWG. 1347-53009

4481MJR00002M1-V+ (1)	V3+				
4481MJR00002M1-11 (6)	IN16	6	19	DI0103.16	4481-MJR0-0002-M1 JOG FORWARD ROLLER CONVEYOR AT SHOTBLASTING MACHINE EXIT
4481MJR00002M1-12 (7)	IN17	8	20	DI0103.17	4481-MJR0-0002-M1 REMOTE MODE ROLLER CONVEYOR AT SHOTBLASTING MACHINE EXIT
4481MJR00002M1-9C (8)	IN18	10	21	DI0103.18	4481-MJR0-0002-M1 LDS ON ROLLER CONVEYOR AT SHOTBLASTING MACHINE EXIT
4481MJR00002M1-9B (4)	IN19	12	22	DI0103.19	4481-MJR0-0002-M1 SAFETY INT. OFF ROLLER CONVEYOR AT SHOTBLASTING MACHINE EXIT
4481MJR00002M1-9 (3)	IN20	14	23	DI0103.20	4481-MJR0-0002-M1 ENABLE ROLLER CONVEYOR AT SHOTBLASTING MACHINE EXIT
4481MJR00002M1-17 (5)	IN21	16	24	DI0103.21	4481-MJR0-0002-M1 MOTOR CONTACTOR ON ROLLER CONVEYOR AT SHOTBLASTING MACHINE EXIT
4481MJR00002M1-V- (2)	V3-				
	IN22	18	25	DI0103.22	SPARE
	IN23	20	26	DI0103.23	SPARE

SEE DWG. 1347-53011

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Vendor or Subcontractor Logo: GNA ellutech inc. — Département Ingénierie Engineering Department, 6400 Trans-Canada, Baie-d'Urfé, Québec, H9X 1V3, Canada

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-	00AZ-	xx -	xxxx -	xxxx - xxx -	xxx

SELLER DRAWING No.: 1347-53010 — REV.: 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT (24 Vdc) RACK: 01 SLOT: 03 (3/4)
I/O INTERCONNECTION DIAGRAM

MA'ADEN

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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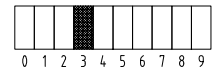
MOTOR CONTROL CENTER PANEL
4480-ECM1-0001

C3
CHAIN CONVEYOR BETWEEN
BETWEEN SHOTBLASTING
MACHINE AND OVEN
STARTER 4481-MHCD-0003-M1-ST

PLC PANEL
4481-CP-1000



MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1756-IB32
VOLTAGE	24Vdc
SLOT	03
RACK	01
PANEL	4481-CP-1000
IFM MODULE	1492-IFM40D24
PRE-WIRED CABLE	1492-CABLE025Z

SEE DWG. 1347-56290
25457-4480-V1A-MXA0-0245

FROM DWG. 1347-53010

4481MHCD0003M1-V+ (1)	V4+			
4481MHCD0003M1-11 (6)	IN24	22	27 DI0103.24	4481-MHCD-0003-M1 JOG FORWARD CHAIN CONVEYOR BETWEEN SHOTBLASTING MACHINE AND OVEN
4481MHCD0003M1-12 (7)	IN25	24	28 DI0103.25	4481-MHCD-0003-M1 REMOTE MODE CHAIN CONVEYOR BETWEEN SHOTBLASTING MACHINE AND OVEN
4481MHCD0003M1-9C (8)	IN26	26	29 DI0103.26	4481-MHCD-0003-M1 LDS ON CHAIN CONVEYOR BETWEEN SHOTBLASTING MACHINE AND OVEN
4481MHCD0003M1-9B (4)	IN27	28	30 DI0103.27	4481-MHCD-0003-M1 SAFETY INT. OFF CHAIN CONVEYOR BETWEEN SHOTBLASTING MACHINE AND OVEN
4481MHCD0003M1-9 (3)	IN28	30	31 DI0103.28	4481-MHCD-0003-M1 ENABLE CHAIN CONVEYOR BETWEEN SHOTBLASTING MACHINE AND OVEN
4481MHCD0003M1-17 (5)	IN29	32	32 DI0103.29	4481-MHCD-0003-M1 MOTOR CONTACTOR ON CHAIN CONVEYOR BETWEEN SHOTBLASTING MACHINE AND OVEN
4481MHCD0003M1-V- (2)	V4-			
	IN30	34	33 DI0103.30	SPARE
	IN31	36	34 DI0103.31	SPARE
74-V9-	74-V9-			
FROM LINE 09 SEE DWG. 1347-55253 25457-4480-V1A-MXA0-0102	COM1	40	35 COM 1	
	COM1	2	36 COM 1	

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Vendor or Subcontractor Logo: GNA ellutech inc. — Département Ingénierie, Engineering Department, 5686 Trans-Canada, Pointe-aux-Trembles, Québec, H1A 1E9, Canada

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SELLER DRAWING No. 1347-53011 — REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT (24 Vdc) RACK: 01 SLOT: 03 (4/4)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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MOTOR CONTROL CENTER PANEL
4480-ECM1-0001

R7
ROLLER CONVEYOR AT
BAR FURNACE ENTRANCE
STARTER 4481-MJR0-0003-M1-ST

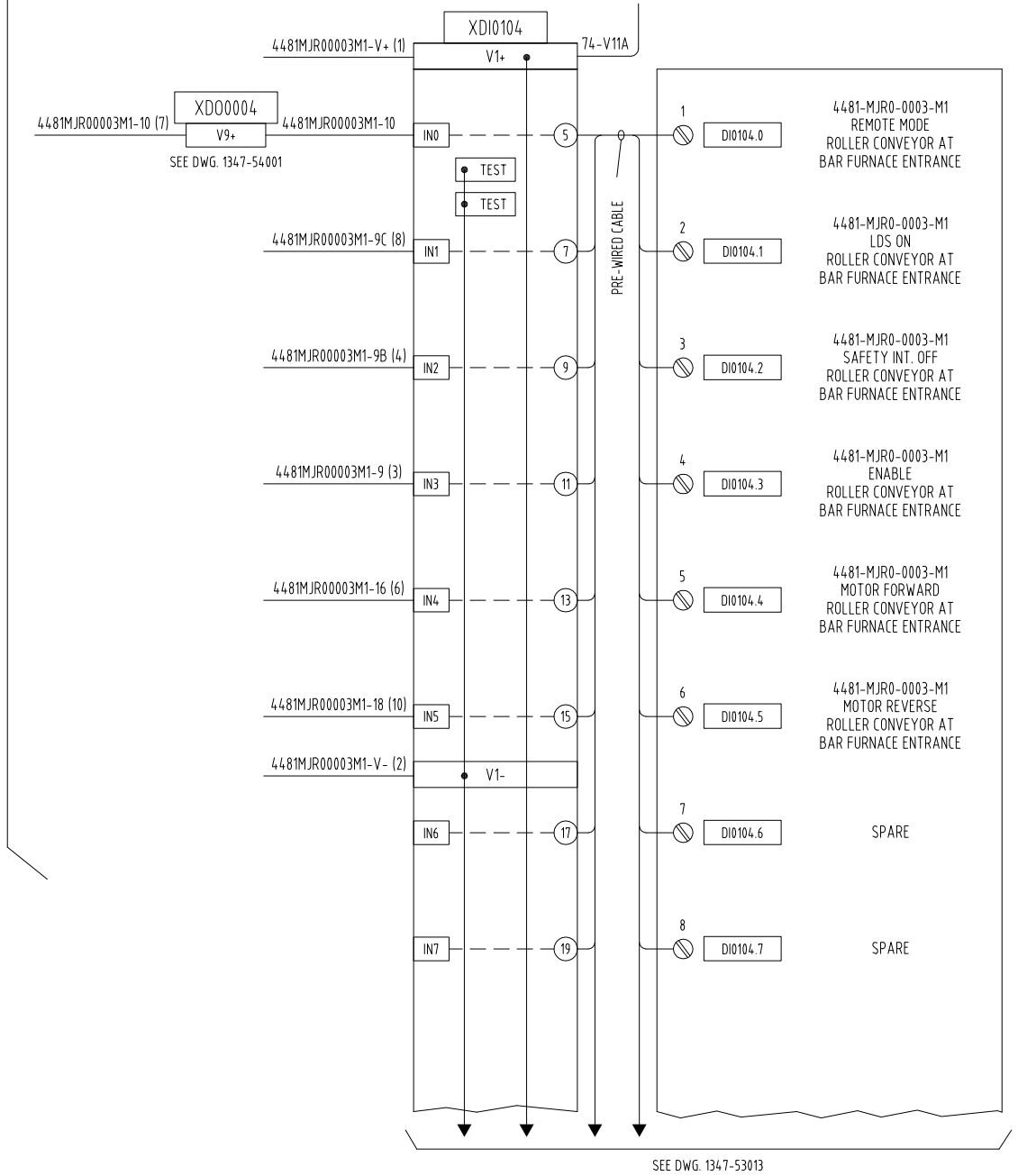
SEE DWG. 1347-56300
25457-4480-V1A-MXA0-0246

PLC PANEL
4481-CP-1000

0 1 2 3 4 5 6 7 8 9

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1756-IB32
VOLTAGE	24Vdc
SLOT	04
RACK	01
PANEL	4481-CP-1000
IFM MODULE	1492-IFM40D24
PRE-WIRED CABLE	1492-CABLE025Z

SEE DWG. 1347-55253
25457-4480-V1A-MXA0-0102
FROM LINE 11



SEE DWG. 1347-53013

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Vendor or Subcontractor Logo: GNA ultech inc. — Département Ingénierie, Engineering Department, 6410, Trans-Canadien, Saint-Laurent, Québec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT (24 Vdc) RACK: 01 SLOT: 04 (1/4)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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MOTOR CONTROL CENTER PANEL
4480-ECM1-0001

F2
CATHODE BAR HEATING
FURNACE CONVEYOR No. 1
STARTER 4481-MBMB-0001-M1-ST

SEE DWG. 1347-56310
25457-4480-V1A-MXA0-0247

PLC PANEL
4481-CP-1000

0 1 2 3 4 5 6 7 8 9

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1756-IB32
VOLTAGE	24Vdc
SLOT	04
RACK	01
PANEL	4481-CP-1000
IFM MODULE	1492-IFM40D24
PRE-WIRED CABLE	1492-CABLE025Z

FROM DWG. 1347-53012

4481MBMB0001M1-V+ (1)	V2+				
4481MBMB0001M1-11 (6)	IN8	21	9	DI0104.8	4481-MBMB-0001-M1 JOG FORWARD CATHODE BAR HEATING FURNACE CONVEYOR No. 1
4481MBMB0001M1-12 (7)	IN9	23	10	DI0104.9	4481-MBMB-0001-M1 REMOTE MODE CATHODE BAR HEATING FURNACE CONVEYOR No. 1
4481MBMB0001M1-9C (8)	IN10	25	11	DI0104.10	4481-MBMB-0001-M1 LDS ON CATHODE BAR HEATING FURNACE CONVEYOR No. 1
4481MBMB0001M1-9B (4)	IN11	27	12	DI0104.11	4481-MBMB-0001-M1 SAFETY INT. OFF CATHODE BAR HEATING FURNACE CONVEYOR No. 1
4481MBMB0001M1-9 (3)	IN12	29	13	DI0104.12	4481-MBMB-0001-M1 ENABLE CATHODE BAR HEATING FURNACE CONVEYOR No. 1
4481MBMB0001M1-17 (5)	IN13	31	14	DI0104.13	4481-MBMB-0001-M1 MOTOR CONTACTOR ON CATHODE BAR HEATING FURNACE CONVEYOR No. 1
4481MBMB0001M1-V- (2)	V2-				
	IN14	33	15	DI0104.14	SPARE
	IN15	35	16	DI0104.15	SPARE
	COM0	39	17	COM 0	
	COM0	1	18	COM 0	

TO DWG. 1347-53014

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Vendor or Subcontractor Logo: GNA ellutech inc. Département Ingénierie Engineering Department 6400 Trans-Canada Baie-d'Urfé, Québec H9X 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457	00AZ	xx	xxxx	xxxx - xxx	xxx

SELLER DRAWING No. 1347-53013 REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT (24 Vdc) RACK: 01 SLOT: 04 (2/4)
I/O INTERCONNECTION DIAGRAM

MA'ADEN

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—	—	A3	—	AZ	

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MOTOR CONTROL CENTER PANEL
4480-ECM1-0001

F2
CATHODE BAR HEATING
FURNACE CONVEYOR No. 2
STARTER 4481-MBMB-0001-M2-ST

SEE DWG. 1347-56311
25457-4480-V1A-MXA0-0248

PLC PANEL
4481-CP-1000

0 1 2 3 4 5 6 7 8 9

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1756-IB32
VOLTAGE	24Vdc
SLOT	04
RACK	01
PANEL	4481-CP-1000
IFM MODULE	1492-IFM40D24
PRE-WIRED CABLE	1492-CABLE025Z

SEE DWG. 1347-53013

4481MBMB0001M2-V+ (1)	V3+				
4481MBMB0001M2-11 (6)	IN16	6	19	DI0104.16	4481-MBMB-0001-M2 JOG FORWARD CATHODE BAR HEATING FURNACE CONVEYOR No. 2
4481MBMB0001M2-12 (7)	IN17	8	20	DI0104.17	4481-MBMB-0001-M2 REMOTE MODE CATHODE BAR HEATING FURNACE CONVEYOR No. 2
4481MBMB0001M2-9C (8)	IN18	10	21	DI0104.18	4481-MBMB-0001-M2 LDS ON CATHODE BAR HEATING FURNACE CONVEYOR No. 2
4481MBMB0001M2-9B (4)	IN19	12	22	DI0104.19	4481-MBMB-0001-M2 SAFETY INT. OFF CATHODE BAR HEATING FURNACE CONVEYOR No. 2
4481MBMB0001M2-9 (3)	IN20	14	23	DI0104.20	4481-MBMB-0001-M2 ENABLE CATHODE BAR HEATING FURNACE CONVEYOR No. 2
4481MBMB0001M2-17 (5)	IN21	16	24	DI0104.21	4481-MBMB-0001-M2 MOTOR CONTACTOR ON CATHODE BAR HEATING FURNACE CONVEYOR No. 2
4481MBMB0001M2-V- (2)	V3-				
	IN22	18	25	DI0104.22	SPARE
	IN23	20	26	DI0104.23	SPARE

SEE DWG. 1347-53015

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ENG. GROUP SUP.		DRAWING SCALE:	NONE
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Vendor or Subcontractor Logo: GNA ellutech inc. — Département Ingénierie, Engineering Department, 6400 Trans-Canada, Baie-d'Urfé, Québec, H9X 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

SELLER DRAWING No.: 1347—53014 — REV.: 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT (24 Vdc) RACK: 01 SLOT: 04 (3/4)
I/O INTERCONNECTION DIAGRAM

MA'ADEN

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—	—	A3—		—AZ	

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MOTOR CONTROL CENTER PANEL
4480-ECM1-0001

F2
CATHODE BAR HEATING
FURNACE CONVEYOR No. 3
STARTER 4481-MBMB-0001-M3-ST

SEE DWG. 1347-56312
25457-4480-V1A-MXA0-0249

PLC PANEL
4481-CP-1000

0 1 2 3 4 5 6 7 8 9

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1756-IB32
VOLTAGE	24Vdc
SLOT	04
RACK	01
PANEL	4481-CP-1000
IFM MODULE	1492-IFM40D24
PRE-WIRED CABLE	1492-CABLE025Z

FROM DWG. 1347-53014

4481MBMB0001M3-V+ (1)	V4+				
4481MBMB0001M3-11 (6)	IN24	22	27	DI0104.24	4481-MBMB-0001-M3 JOG FORWARD CATHODE BAR HEATING FURNACE CONVEYOR No. 3
4481MBMB0001M3-12 (7)	IN25	24	28	DI0104.25	4481-MBMB-0001-M3 REMOTE MODE CATHODE BAR HEATING FURNACE CONVEYOR No. 3
4481MBMB0001M3-9C (8)	IN26	26	29	DI0104.26	4481-MBMB-0001-M3 LDS ON CATHODE BAR HEATING FURNACE CONVEYOR No. 3
4481MBMB0001M3-9B (4)	IN27	28	30	DI0104.27	4481-MBMB-0001-M3 SAFETY INT. OFF CATHODE BAR HEATING FURNACE CONVEYOR No. 3
4481MBMB0001M3-9 (3)	IN28	30	31	DI0104.28	4481-MBMB-0001-M3 ENABLE CATHODE BAR HEATING FURNACE CONVEYOR No. 3
4481MBMB0001M3-17 (5)	IN29	32	32	DI0104.29	4481-MBMB-0001-M3 MOTOR CONTACTOR ON CATHODE BAR HEATING FURNACE CONVEYOR No. 3
4481MBMB0001M3-V- (2)	V4-				
	IN30	34	33	DI0104.30	SPARE
	IN31	36	34	DI0104.31	SPARE
74-V11-	74-V11-				
FROM LINE 11 SEE DWG. 1347-55253 25457-4480-V1A-MXA0-0102	COM1	40	35	COM 1	
	COM1	2	36	COM 1	

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		0		REVISIONS				

NOTES

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Vendor or Subcontractor Logo: GNA ellutech inc. — Département Ingénierie, Engineering Department, 5686 Trans-Canada, Pointe-aux-Trembles, Québec, H1A 1E9, Canada

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx	xxxx	xxxx	xxx	xxx

SELLER DRAWING No. 1347-53015 — REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT (24 Vdc) RACK: 01 SLOT: 04 (4/4)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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MOTOR CONTROL CENTER PANEL
4480-ECM1-0001

F2
CATHODE BAR HEATING
FURNACE CONVEYOR No. 4
STARTER 4481-MBMB-0001-M4-ST

SEE DWG. 1347-56313
25457-4480-V1A-MXA0-0250

PLC PANEL
4481-CP-1000

0 1 2 3 4 5 6 7 8 9

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1756-IB32
VOLTAGE	24Vdc
SLOT	05
RACK	01
PANEL	4481-CP-1000
IFM MODULE	1492-IFM40D24
PRE-WIRED CABLE	1492-CABLE025Z

SEE DWG. 1347-55253
25457-4480-V1A-MXA0-0102
FROM LINE 13

XDI0105

4481MBMB0001M4-V+ (1)	V1+	74-V13A			
4481MBMB0001M4-11 (6)	IN0	5	0	1 DI0105.0	4481-MBMB-0001-M4 JOG FORWARD CATHODE BAR HEATING FURNACE CONVEYOR No. 4
	TEST				
	TEST				
4481MBMB0001M4-12 (7)	IN1	7	PRE-WIRED CABLE	2 DI0105.1	4481-MBMB-0001-M4 REMOTE MODE CATHODE BAR HEATING FURNACE CONVEYOR No. 4
4481MBMB0001M4-9C (8)	IN2	9		3 DI0105.2	4481-MBMB-0001-M4 LDS ON CATHODE BAR HEATING FURNACE CONVEYOR No. 4
4481MBMB0001M4-9B (4)	IN3	11		4 DI0105.3	4481-MBMB-0001-M4 SAFETY INT. OFF CATHODE BAR HEATING FURNACE CONVEYOR No. 4
4481MBMB0001M4-9 (3)	IN4	13		5 DI0105.4	4481-MBMB-0001-M4 ENABLE CATHODE BAR HEATING FURNACE CONVEYOR No. 4
4481MBMB0001M4-17 (5)	IN5	15		6 DI0105.5	4481-MBMB-0001-M4 MOTOR CONTACTOR ON CATHODE BAR HEATING FURNACE CONVEYOR No. 4
4481MBMB0001M4-V- (2)	V1-				
	IN6	17		7 DI0105.6	SPARE
	IN7	19		8 DI0105.7	SPARE

SEE DWG. 1347-53017

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SELLER DRAWING No. 1347-53016 | REV. 0

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RESPONSIBLE ENG. M.B.	CLIENT:
DATE:	DATE:
ENG. GROUP SUP.	DRAWING SCALE: NONE
DATE:	

Vendor or Subcontractor Logo: GNA Automation inc. — Département Ingénierie / Engineering Department, 6490, Trans-Canada, Suite 4, Laurent, Québec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT (24 Vdc) RACK: 01 SLOT: 05 (1/4)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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MOTOR CONTROL CENTER PANEL
4480-ECM1-0001

R6
ROLLER CONVEYOR AT
BAR FURNACE EXIT
STARTER 4481-MJR0-0004-M1-ST

PLC PANEL
4481-CP-1000

0 1 2 3 4 5 6 7 8 9

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1756-IB32
VOLTAGE	24Vdc
SLOT	05
RACK	01
PANEL	4481-CP-1000
IFM MODULE	1492-IFM40D24
PRE-WIRED CABLE	1492-CABLE025Z

SEE DWG. 1347-56320
25457-4480-V1A-MXA0-0292

FROM DWG. 1347-53016

4481MJR00004M1-V+ (1)	V2+			
4481MJR00004M1-11 (6)	IN8	21	9 DI0105.8	4481-MJR0-0004-M1 JOG FORWARD ROLLER CONVEYOR AT BAR FURNACE EXIT
4481MJR00004M1-12 (7)	IN9	23	10 DI0105.9	4481-MJR0-0004-M1 REMOTE MODE ROLLER CONVEYOR AT BAR FURNACE EXIT
4481MJR00004M1-9C (8)	IN10	25	11 DI0105.10	4481-MJR0-0004-M1 LDS ON ROLLER CONVEYOR AT BAR FURNACE EXIT
4481MJR00004M1-9B (4)	IN11	27	12 DI0105.11	4481-MJR0-0004-M1 SAFETY INT. OFF ROLLER CONVEYOR AT BAR FURNACE EXIT
4481MJR00004M1-9 (3)	IN12	29	13 DI0105.12	4481-MJR0-0004-M1 ENABLE ROLLER CONVEYOR AT BAR FURNACE EXIT
4481MJR00004M1-17 (5)	IN13	31	14 DI0105.13	4481-MJR0-0004-M1 MOTOR CONTACTOR ON ROLLER CONVEYOR AT BAR FURNACE EXIT
4481MJR00004M1-V- (2)	V2-			
	IN14	33	15 DI0105.14	SPARE
	IN15	35	16 DI0105.15	SPARE
	COM0	39	17 COM 0	
	COM0	1	18 COM 0	

TO DWG. 1347-53018

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Vendor or Subcontractor Logo:
GNA ellutech inc. — Département Ingénierie, Engineering Department, 6490 Trans-Canada, Saint-Laurent, Quebec, H4S 1V3, Canada

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No | SUBD. | DISC. | SECTOR | SEQUENCE | REV.
25457-00AZ- xx - xxxx - xxxx - xxx – xxx

SELLER DRAWING No.: 1347–53017 | REV.: 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT (24 Vdc) RACK: 01 SLOT: 05 (2/4)
I/O INTERCONNECTION DIAGRAM

MA'ADEN

Type | Building | Discipline | Phase | Format | Sequential | Location | Rev. No.
– | – – | | A3– | –AZ

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MOTOR CONTROL CENTER PANEL
4480-ECM1-0001

G1
POSITIONING GANTRY
FOR BLOCK AND BARS
STARTER 4481-MQLK-0001-M1-ST

PLC PANEL
4481-CP-1000

0 1 2 3 4 5 6 7 8 9

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1756-IB32
VOLTAGE	24Vdc
SLOT	05
RACK	01
PANEL	4481-CP-1000
IFM MODULE	1492-IFM40D24
PRE-WIRED CABLE	1492-CABLE025Z

SEE DWG. 1347-56330
25457-4480-V1A-MXA0-0293

SEE DWG. 1347-53017

4481MQLK0001M1-V+ (1) — V3+

4481MQLK0001M1-11 (6)	IN16	6	19	DI0105.16	4481-MQLK-0001-M1 JOG FORWARD POSITIONING GANTRY FOR BLOCK AND BARS
4481MQLK0001M1-12 (7)	IN17	8	20	DI0105.17	4481-MQLK-0001-M1 REMOTE MODE POSITIONING GANTRY FOR BLOCK AND BARS
4481MQLK0001M1-9C (8)	IN18	10	21	DI0105.18	4481-MQLK-0001-M1 LDS ON POSITIONING GANTRY FOR BLOCK AND BARS
4481MQLK0001M1-9B (4)	IN19	12	22	DI0105.19	4481-MQLK-0001-M1 SAFETY INT. OFF POSITIONING GANTRY FOR BLOCK AND BARS
4481MQLK0001M1-9 (3) — XD00004 — V12+	IN20	14	23	DI0105.20	4481-MQLK-0001-M1 ENABLE POSITIONING GANTRY FOR BLOCK AND BARS
4481MQLK0001M1-17 (5)	IN21	16	24	DI0105.21	4481-MQLK-0001-M1 MOTOR CONTACTOR ON POSITIONING GANTRY FOR BLOCK AND BARS
4481MQLK0001M1-V- (2) — V3-					
	IN22	18	25	DI0105.22	SPARE
	IN23	20	26	DI0105.23	SPARE

SEE DWG. 1347-54001

SEE DWG. 1347-53019

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
		0						
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SELLER DRAWING No.: 1347-53018 — REV.: 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT (24 Vdc) RACK: 01 SLOT: 05 (3/4)
I/O INTERCONNECTION DIAGRAM

Project Title: Ras Az Zawr Aluminium Smelter

MA'ADEN

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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MOTOR CONTROL CENTER PANEL
4480-ECM1-0001

C1
CHAIN CONVEYOR
OF BLOCK OVEN
STARTER 4481-MHCD-0001-M1-ST

SEE DWG. 1347-56340
25457-4480-V1A-MXA0-0295

PLC PANEL
4481-CP-1000

0 1 2 3 4 5 6 7 8 9

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1756-IB32
VOLTAGE	24Vdc
SLOT	05
RACK	01
PANEL	4481-CP-1000
IFM MODULE	1492-IFM40D24
PRE-WIRED CABLE	1492-CABLE025Z

FROM DWG. 1347-53018

4481MHCD0001M1-V+ (1)	V4+				
4481MHCD0001M1-10 (7) → XD00004 V14+ (SEE DWG. 1347-54001)	4481MHCD0001M1-10	IN24	22	27 DI0105.24	4481-MHCD-0001-M1 REMOTE MODE CHAIN CONVEYOR OF BLOCK OVEN
4481MHCD0001M1-9C (8)		IN25	24	28 DI0105.25	4481-MHCD-0001-M1 LDS ON CHAIN CONVEYOR OF BLOCK OVEN
4481MHCD0001M1-9B (4)		IN26	26	29 DI0105.26	4481-MHCD-0001-M1 SAFETY INT. OFF CHAIN CONVEYOR OF BLOCK OVEN
4481MHCD0001M1-9 (3)		IN27	28	30 DI0105.27	4481-MHCD-0001-M1 ENABLE CHAIN CONVEYOR OF BLOCK OVEN
4481MHCD0001M1-16 (6)		IN28	30	31 DI0105.28	4481-MHCD-0001-M1 MOTOR FORWARD CHAIN CONVEYOR OF BLOCK OVEN
4481MHCD0001M1-18 (10)		IN29	32	32 DI0105.29	4481-MHCD-0001-M1 MOTOR REVERSE CHAIN CONVEYOR OF BLOCK OVEN
4481MHCD0001M1-V- (2)	V4-				
		IN30	34	33 DI0105.30	SPARE
		IN31	36	34 DI0105.31	SPARE
74-V13- (FROM LINE 13 SEE DWG. 1347-55253 25457-4480-V1A-MXA0-0102)	74-V13-				
		COM1	40	35 COM 1	
		COM1	2	36 COM 1	

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Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

SELLER DRAWING No. 1347—53019 REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT (24 Vdc) RACK: 01 SLOT: 05 (4/4)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—		—	—	A3—		—AZ	

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MOTOR CONTROL CENTER PANEL
4480-ECM1-0001

F1
CATHODE BLOCK OVEN
FAN A
STARTER 4481-MEEP-0001-M1-ST

PLC PANEL
4481-CP-1000

0 1 2 3 4 5 6 7 8 9

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1756-IB32
VOLTAGE	24Vdc
SLOT	06
RACK	01
PANEL	4481-CP-1000
IFM MODULE	1492-IFM40D24
PRE-WIRED CABLE	1492-CABLE025Z

SEE DWG. 1347-55253
25457-4480-V1A-MXA0-0102
FROM LINE 15

SEE DWG. 1347-56350
25457-4480-V1A-MXA0-0296

XDI0106

4481MEEP0001M1-V+ (1) — V1+ — 74-V15A

XDO0005

4481MEEP0001M1-10 (7) — V0+ — 4481MEEP0001M1-10

SEE DWG. 1347-54002

4481MEEP0001M1-10	IN0	5	0	DI0106.0	4481-MEEP-0001-M1 REMOTE MODE CATHODE BLOCK OVEN FAN A
4481MEEP0001M1-9C (8)	IN1	7		DI0106.1	4481-MEEP-0001-M1 LDS ON CATHODE BLOCK OVEN FAN A
4481MEEP0001M1-9B (4)	IN2	9		DI0106.2	4481-MEEP-0001-M1 SAFETY INT. OFF CATHODE BLOCK OVEN FAN A
4481MEEP0001M1-9 (3)	IN3	11		DI0106.3	4481-MEEP-0001-M1 ENABLE CATHODE BLOCK OVEN FAN A
4481MEEP0001M1-17 (6)	IN4	13		DI0106.4	4481-MEEP-0001-M1 MOTOR RUNNING CATHODE BLOCK OVEN FAN A
4481MEEP0001M1-V- (2)	V1-				
	IN5	15		DI0106.5	SPARE
	IN6	17		DI0106.6	SPARE
	IN7	19		DI0106.7	SPARE

TEST
TEST

PRE-WIRED CABLE

SEE DWG. 1347-53021

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		0		REVISIONS				

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DATE:		DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo:
GNA ellutech inc. — Département Ingénierie, Engineering Department, 5686 Trans-Canada, Pointe-aux-Trembles, Québec, H1A 1E9, Canada

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Project Title:
Ras Az Zawr
Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

SELLER DRAWING No.: 1347—53020 — REV.: 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT (24 Vdc) RACK: 01 SLOT: 06 (1/4)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—		—	—	A3—		—AZ	

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MOTOR CONTROL CENTER PANEL
4480-ECM1-0001

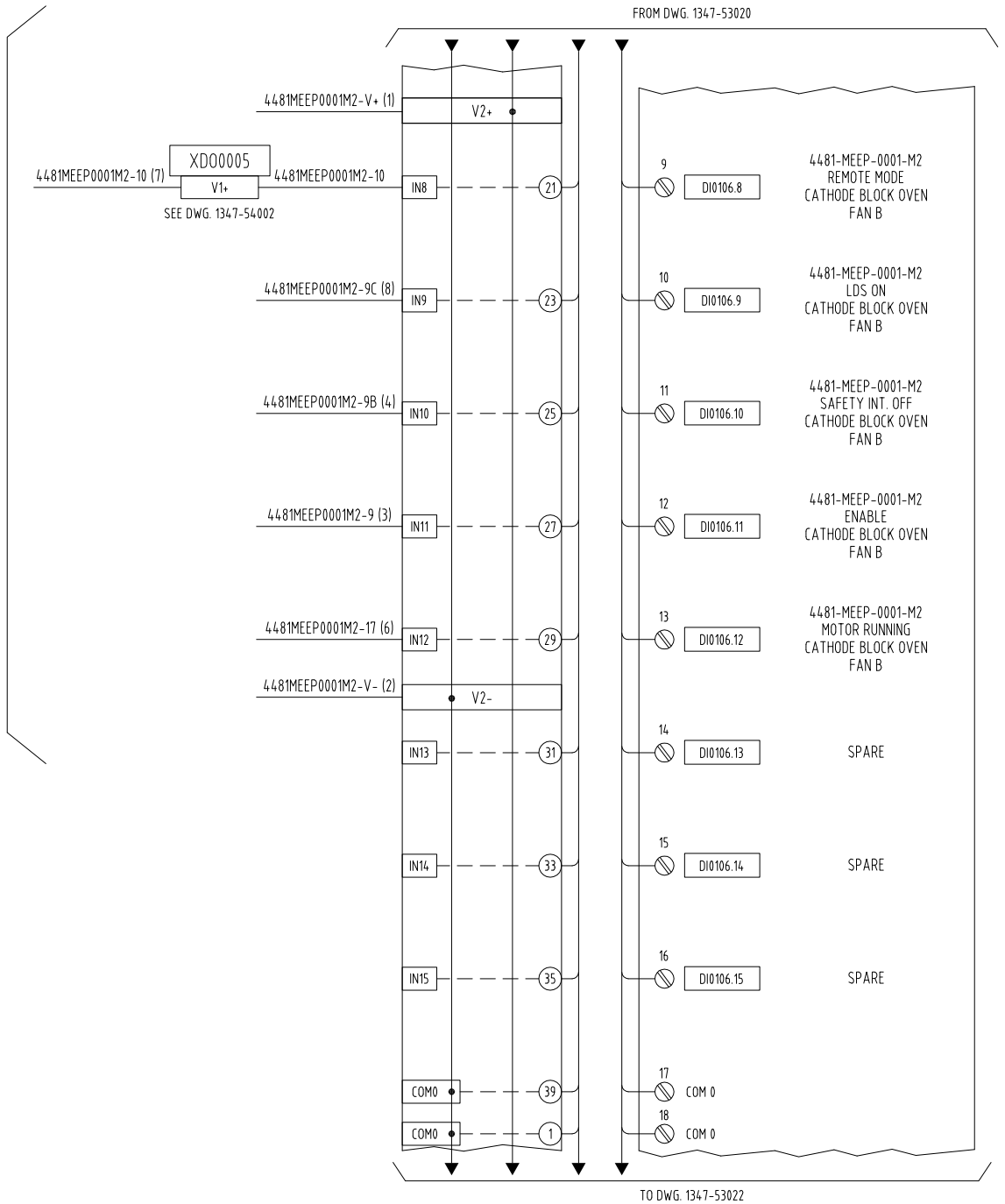
F1
CATHODE BLOCK OVEN
FAN B
STARTER 4481-MEEP-0001-M2-ST

PLC PANEL
4481-CP-1000

0 1 2 3 4 5 6 7 8 9

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1756-IB32
VOLTAGE	24Vdc
SLOT	06
RACK	01
PANEL	4481-CP-1000
IFM MODULE	1492-IFM40D24
PRE-WIRED CABLE	1492-CABLE025Z

SEE DWG. 1347-56351
25457-4480-V1A-MXA0-0297



DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
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NOTES

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Vendor or Subcontractor Logo:
GNA ellutech inc. — Département Ingénierie, Engineering Department, 6400 Trans-Canada, Baie-d'Urfé, Québec, H9X 1V3, Canada

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SELLER DRAWING No.: 1347-53021 — REV.: 0

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT (24 Vdc) RACK: 01 SLOT: 06 (2/4)
I/O INTERCONNECTION DIAGRAM

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
	—	—	—	A3-		-AZ	

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MOTOR CONTROL CENTER PANEL
4480-ECM1-0001

F1
CATHODE BLOCK OVEN
FAN C
STARTER 4481-MEEP-0001-M3-ST

SEE DWG. 1347-56352
25457-4480-V1A-MXA0-0298

PLC PANEL
4481-CP-1000

0 1 2 3 4 5 6 7 8 9

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1756-IB32
VOLTAGE	24Vdc
SLOT	06
RACK	01
PANEL	4481-CP-1000
IFM MODULE	1492-IFM40D24
PRE-WIRED CABLE	1492-CABLE025Z

SEE DWG. 1347-53021

4481MEEP0001M3-V+ (1) — V3+

4481MEEP0001M3-10 (7) — XD00005 V2+ — 4481MEEP0001M3-10
SEE DWG. 1347-54002

4481MEEP0001M3-10	IN16	6	19	DI0106.16	4481-MEEP-0001-M3 REMOTE MODE CATHODE BLOCK OVEN FAN C
4481MEEP0001M3-9C (8)	IN17	8	20	DI0106.17	4481-MEEP-0001-M3 LDS ON CATHODE BLOCK OVEN FAN C
4481MEEP0001M3-9B (4)	IN18	10	21	DI0106.18	4481-MEEP-0001-M3 SAFETY INT. OFF CATHODE BLOCK OVEN FAN C
4481MEEP0001M3-9 (3)	IN19	12	22	DI0106.19	4481-MEEP-0001-M3 ENABLE CATHODE BLOCK OVEN FAN C
4481MEEP0001M3-17 (6)	IN20	14	23	DI0106.20	4481-MEEP-0001-M3 MOTOR RUNNING CATHODE BLOCK OVEN FAN C
4481MEEP0001M3-V- (2)	V3-				
	IN21	16	24	DI0106.21	SPARE
	IN22	18	25	DI0106.22	SPARE
	IN23	20	26	DI0106.23	SPARE

SEE DWG. 1347-53023

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
		0						

REFERENCES — REVISIONS

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Vendor or Subcontractor Logo: GNA ellutech inc. — Département Ingénierie Engineering Department, 6400 Trans-Canada, Baie-d'Urfé, Québec, H9X 1V3, Canada

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No | SUBD. | DISC. | SECTOR | SEQUENCE | REV.
25457-00AZ- xx - xxxx - xxxx - xxx — xxx

SELLER DRAWING No.: 1347—53022 — REV.: 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT (24 Vdc) RACK: 01 SLOT: 06 (3/4)
I/O INTERCONNECTION DIAGRAM

MA'ADEN

Type | Building | Discipline | Phase | Format | Sequential | Location | Rev. No.
— | — | — | — | A3— | —AZ

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MOTOR CONTROL CENTER PANEL
4480-ECM1-0001

R1
ROLLER CONVEYOR AT
BLOCK OVEN EXIT
STARTER 4481-MJR0-0005-M1-ST

PLC PANEL
4481-CP-1000

0 1 2 3 4 5 6 7 8 9

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1756-IB32
VOLTAGE	24Vdc
SLOT	06
RACK	01
PANEL	4481-CP-1000
IFM MODULE	1492-IFM40D24
PRE-WIRED CABLE	1492-CABLE025Z

SEE DWG. 1347-56360
25457-4480-V1A-MXA0-0299

FROM DWG. 1347-53022

4481MJR00005M1-V+ (1) — V4+

4481MJR00005M1-10 (7) — XD00005 V4+ — 4481MJR00005M1-10 — IN24 — 22
SEE DWG. 1347-54002

4481MJR00005M1-9C (8) — IN25 — 24

4481MJR00005M1-9B (4) — IN26 — 26

4481MJR00005M1-9 (3) — IN27 — 28

4481MJR00005M1-17 (6) — IN28 — 30

4481MJR00005M1-V- (2) — V4-

IN29 — 32

IN30 — 34

IN31 — 36

74-V15- — 74-V15-

FROM LINE 15
SEE DWG. 1347-55253
25457-4480-V1A-MXA0-0102

COM1 — 40

COM1 — 2

27	DI0106.24	4481-MJR0-0005-M1 REMOTE MODE ROLLER CONVEYOR AT BLOCK OVEN EXIT
28	DI0106.25	4481-MJR0-0005-M1 LDS ON ROLLER CONVEYOR AT BLOCK OVEN EXIT
29	DI0106.26	4481-MJR0-0005-M1 SAFETY INT. OFF ROLLER CONVEYOR AT BLOCK OVEN EXIT
30	DI0106.27	4481-MJR0-0005-M1 ENABLE ROLLER CONVEYOR AT BLOCK OVEN EXIT
31	DI0106.28	4481-MJR0-0005-M1 MOTOR RUNNING ROLLER CONVEYOR AT BLOCK OVEN EXIT
32	DI0106.29	SPARE
33	DI0106.30	SPARE
34	DI0106.31	SPARE
35	COM 1	
36	COM 1	

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
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Vendor or Subcontractor Logo: GNA ellutech inc. — Département Ingénierie / Engineering Department, 6400 Trans-Canada, Baie-d'Urfé, Québec, H9X 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SELLER DRAWING No. 1347-53023 — REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT (24 Vdc) RACK: 01 SLOT: 06 (4/4)
I/O INTERCONNECTION DIAGRAM

MA'ADEN

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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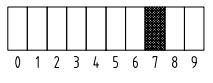
MOTOR CONTROL CENTER PANEL
4480-ECM1-0001

R2
ROLLER CONVEYOR FOR
BLOCK & BAR ASSEMBLY
STARTER 4481-MJR0-0007-M1-ST

SEE DWG. 1347-56370
25457-4480-V1A-MXA0-0300

PLC PANEL
4481-CP-1000



MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1756-IB32
VOLTAGE	24Vdc
SLOT	07
RACK	01
PANEL	4481-CP-1000
IFM MODULE	1492-IFM40D24
PRE-WIRED CABLE	1492-CABLE025Z

SEE DWG. 1347-55253
25457-4480-V1A-MXA0-0102
FROM LINE 17

XDI0107

4481MJR00007M1-V+ (1)	V1+	74-V17A			
4481MJR00007M1-11 (6)	IN0	5	0	1 DI0107.0	4481-MJR0-0007-M1 JOG FORWARD ROLLER CONVEYOR FOR BLOCK & BAR ASSEMBLY
	TEST				
	TEST				
4481MJR00007M1-12 (7)	IN1	7	PRE-WIRED CABLE	2 DI0107.1	4481-MJR0-0007-M1 REMOTE MODE ROLLER CONVEYOR FOR BLOCK & BAR ASSEMBLY
4481MJR00007M1-9C (8)	IN2	9		3 DI0107.2	4481-MJR0-0007-M1 LDS ON ROLLER CONVEYOR FOR BLOCK & BAR ASSEMBLY
4481MJR00007M1-9B (4)	IN3	11		4 DI0107.3	4481-MJR0-0007-M1 SAFETY INT. OFF ROLLER CONVEYOR FOR BLOCK & BAR ASSEMBLY
4481MJR00007M1-9 (3)	IN4	13		5 DI0107.4	4481-MJR0-0007-M1 ENABLE ROLLER CONVEYOR FOR BLOCK & BAR ASSEMBLY
4481MJR00007M1-17 (5)	IN5	15		6 DI0107.5	4481-MJR0-0007-M1 MOTOR CONTACTOR ON ROLLER CONVEYOR FOR BLOCK & BAR ASSEMBLY
4481MJR00007M1-V- (2)	V1-				
	IN6	17		7 DI0107.6	SPARE
	IN7	19		8 DI0107.7	SPARE

SEE DWG. 1347-53025

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Vendor or Subcontractor Logo: GNA Automation inc. — Département Ingénierie, Engineering Department, 6410, Trans-Canada, Suite/Local, Quebec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT (24 Vdc) RACK: 01 SLOT: 07 (1/4)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—	—	A3-		-AZ	

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MOTOR CONTROL CENTER PANEL
4480-ECM1-0001

R4A
PRESTRESSING & SEALING
STATION CONVEYOR A
STARTER 4481-MZAC-0001-M1-ST

SEE DWG. 1347-56380
25457-4480-V1A-MXA0-0301

PLC PANEL
4481-CP-1000

0 1 2 3 4 5 6 7 8 9

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1756-IB32
VOLTAGE	24Vdc
SLOT	07
RACK	01
PANEL	4481-CP-1000
IFM MODULE	1492-IFM40D24
PRE-WIRED CABLE	1492-CABLE025Z

FROM DWG. 1347-53024

4481MZAC0001M1-V+ (1)	V2+				
4481MZAC0001M1-11 (6)	IN8	21	9	DI0107.8	4481-MZAC-0001-M1 JOG FORWARD ROLLER CONVEYOR AT BAR FURNACE EXIT
4481MZAC0001M1-12 (7)	IN9	23	10	DI0107.9	4481-MZAC-0001-M1 REMOTE MODE ROLLER CONVEYOR AT BAR FURNACE EXIT
4481MZAC0001M1-9C (8)	IN10	25	11	DI0107.10	4481-MZAC-0001-M1 LDS ON ROLLER CONVEYOR AT BAR FURNACE EXIT
4481MZAC0001M1-9B (4)	IN11	27	12	DI0107.11	4481-MZAC-0001-M1 SAFETY INT. OFF ROLLER CONVEYOR AT BAR FURNACE EXIT
4481MZAC0001M1-9 (3)	IN12	29	13	DI0107.12	4481-MZAC-0001-M1 ENABLE ROLLER CONVEYOR AT BAR FURNACE EXIT
4481MZAC0001M1-17 (5)	IN13	31	14	DI0107.13	4481-MZAC-0001-M1 MOTOR CONTACTOR ON ROLLER CONVEYOR AT BAR FURNACE EXIT
4481MZAC0001M1-V- (2)	V2-				
	IN14	33	15	DI0107.14	SPARE
	IN15	35	16	DI0107.15	SPARE
	COM0	39	17	COM 0	
	COM0	1	18	COM 0	

TO DWG. 1347-53026

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
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GNA ellutech inc. — Département Ingénierie, Engineering Department, 6490 Trans-Canada, Saint-Laurent, Québec, H4S 1V3, Canada

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No: 25457 | SUBD.: 00 | DISC.: AZ | SECTOR: xx | SEQUENCE: xxxx - xxxx - xxx | REV.: xxx

SELLER DRAWING No.: 1347-53025 | REV.: 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT (24 Vdc) RACK: 01 SLOT: 07 (2/4)
I/O INTERCONNECTION DIAGRAM

MA'ADEN

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—	—	A3	—	AZ	

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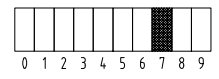
MOTOR CONTROL CENTER PANEL
4480-ECM1-0001

R4B
PRESTRESSING & SEALING
STATION CONVEYOR B
STARTER 4481-MZAC-0002-M1-ST

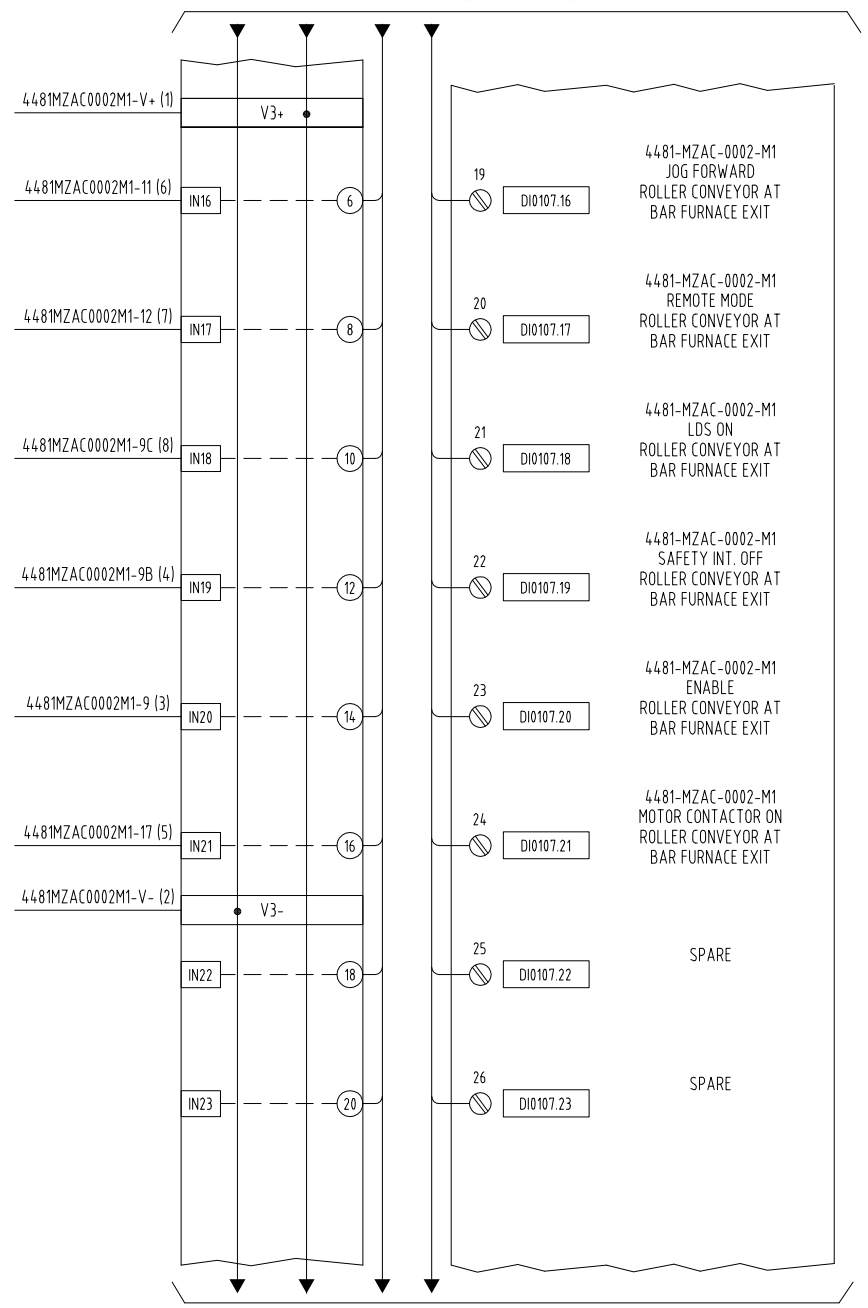
SEE DWG. 1347-56390
25457-4480-V1A-MXA0-0302

PLC PANEL
4481-CP-1000



MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1756-IB32
VOLTAGE	24Vdc
SLOT	07
RACK	01
PANEL	4481-CP-1000
IFM MODULE	1492-IFM40D24
PRE-WIRED CABLE	1492-CABLE025Z

SEE DWG. 1347-53025



SEE DWG. 1347-53027

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Vendor or Subcontractor Logo:
GNA ellutech inc. — Département Ingénierie Engineering Department, 6400 Trans-Canada, Baie-d'Urfé, Québec, H9X 1V3, Canada

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Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

SELLER DRAWING No.: 1347—53026 — REV.: 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT (24 Vdc) RACK: 01 SLOT: 07 (3/4)
I/O INTERCONNECTION DIAGRAM

MA'ADEN

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—		—	—	A3—		—AZ	

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MOTOR CONTROL CENTER PANEL
4480-ECM1-0001

R3
ROLLER CONVEYOR
AFTER SEALING STATION
STARTER 4481-MJR0-0006-M1-ST

SEE DWG. 1347-56400
25457-4480-V1A-MXA0-0303

PLC PANEL
4481-CP-1000

0 1 2 3 4 5 6 7 8 9

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1756-IB32
VOLTAGE	24Vdc
SLOT	07
RACK	01
PANEL	4481-CP-1000
IFM MODULE	1492-IFM40D24
PRE-WIRED CABLE	1492-CABLE025Z

FROM DWG. 1347-53026

4481MJR00006M1-V+ (1) — V4+

4481MJR00006M1-10 (7) — XD00005 V6+ — 4481MJR00006M1-10 — IN24 — 22 — 27 — DI0107.24 — 4481-MJR0-0006-M1 REMOTE MODE ROLLER CONVEYOR AFTER SEALING STATION
SEE DWG. 1347-54002

4481MJR00006M1-9C (8) — IN25 — 24 — 28 — DI0107.25 — 4481-MJR0-0006-M1 LDS ON ROLLER CONVEYOR AFTER SEALING STATION

4481MJR00006M1-9B (4) — IN26 — 26 — 29 — DI0107.26 — 4481-MJR0-0006-M1 SAFETY INT. OFF ROLLER CONVEYOR AFTER SEALING STATION

4481MJR00006M1-9 (3) — IN27 — 28 — 30 — DI0107.27 — 4481-MJR0-0006-M1 ENABLE ROLLER CONVEYOR AFTER SEALING STATION

4481MJR00006M1-17 (6) — IN28 — 30 — 31 — DI0107.28 — 4481-MJR0-0006-M1 MOTOR RUNNING ROLLER CONVEYOR AFTER SEALING STATION

4481MJR00006M1-V- (2) — V4-

IN29 — 32 — 32 — DI0107.29 — SPARE

IN30 — 34 — 33 — DI0107.30 — SPARE

IN31 — 36 — 34 — DI0107.31 — SPARE

74-V17- — 74-V17-

FROM LINE 17
SEE DWG. 1347-55253
25457-4480-V1A-MXA0-0102

COM1 — 40 — 35 — COM 1

COM1 — 2 — 36 — COM 1

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
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ENG. GROUP SUP.		DRAWING SCALE:	NONE
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Vendor or Subcontractor Logo: GNA altutech inc. Département Ingénierie Engineering Department 9490 Trans-Canada Saint-Laurent, Quebec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT (24 Vdc) RACK: 01 SLOT: 07 (4/4)
I/O INTERCONNECTION DIAGRAM

MA'ADEN

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—		—	—	A3-		-AZ	

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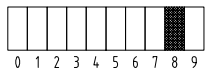
MOTOR CONTROL CENTER PANEL
4480-ECM1-0001

R5
ROLLER CONVEYOR AT
COOLING & TURNING STATION
STARTER 4481-MJR0-0008-M1-ST

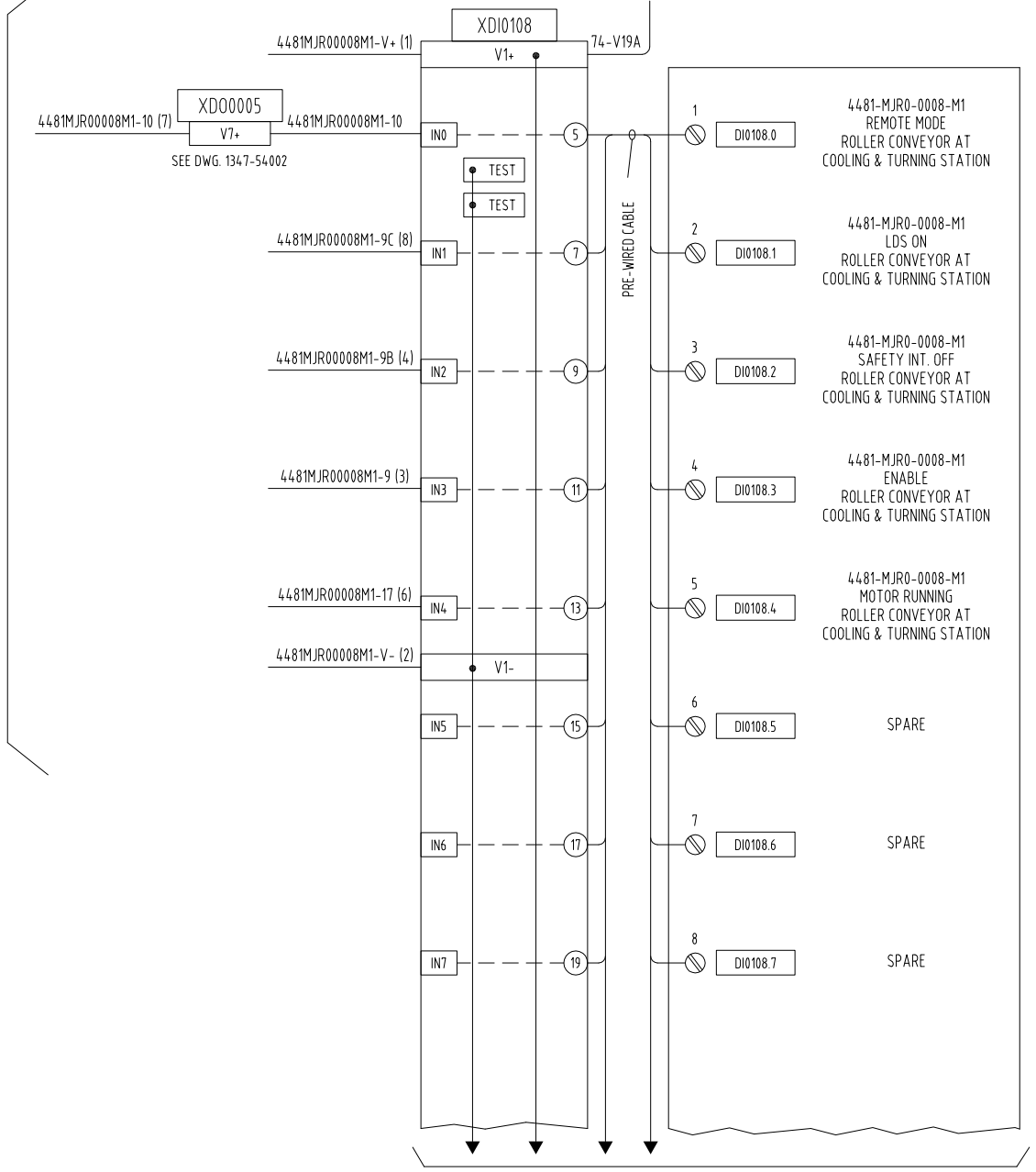
PLC PANEL
4481-CP-1000



MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1756-IB32
VOLTAGE	24Vdc
SLOT	08
RACK	01
PANEL	4481-CP-1000
IFM MODULE	1492-IFM40D24
PRE-WIRED CABLE	1492-CABLE025Z

SEE DWG. 1347-56410
25457-4480-V1A-MXA0-0304

SEE DWG. 1347-55253
25457-4480-V1A-MXA0-0102
FROM LINE 19



SEE DWG. 1347-53029

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Vendor or Subcontractor Logo: GNA Automation Inc. — Département Ingénierie Engineering Department, 6490, Trans-Canada, Saint-Laurent, Québec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT (24 Vdc) RACK: 01 SLOT: 08 (1/4)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—		—	—	A3—		—AZ	

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MOTOR CONTROL CENTER PANEL
4480-ECM1-0001

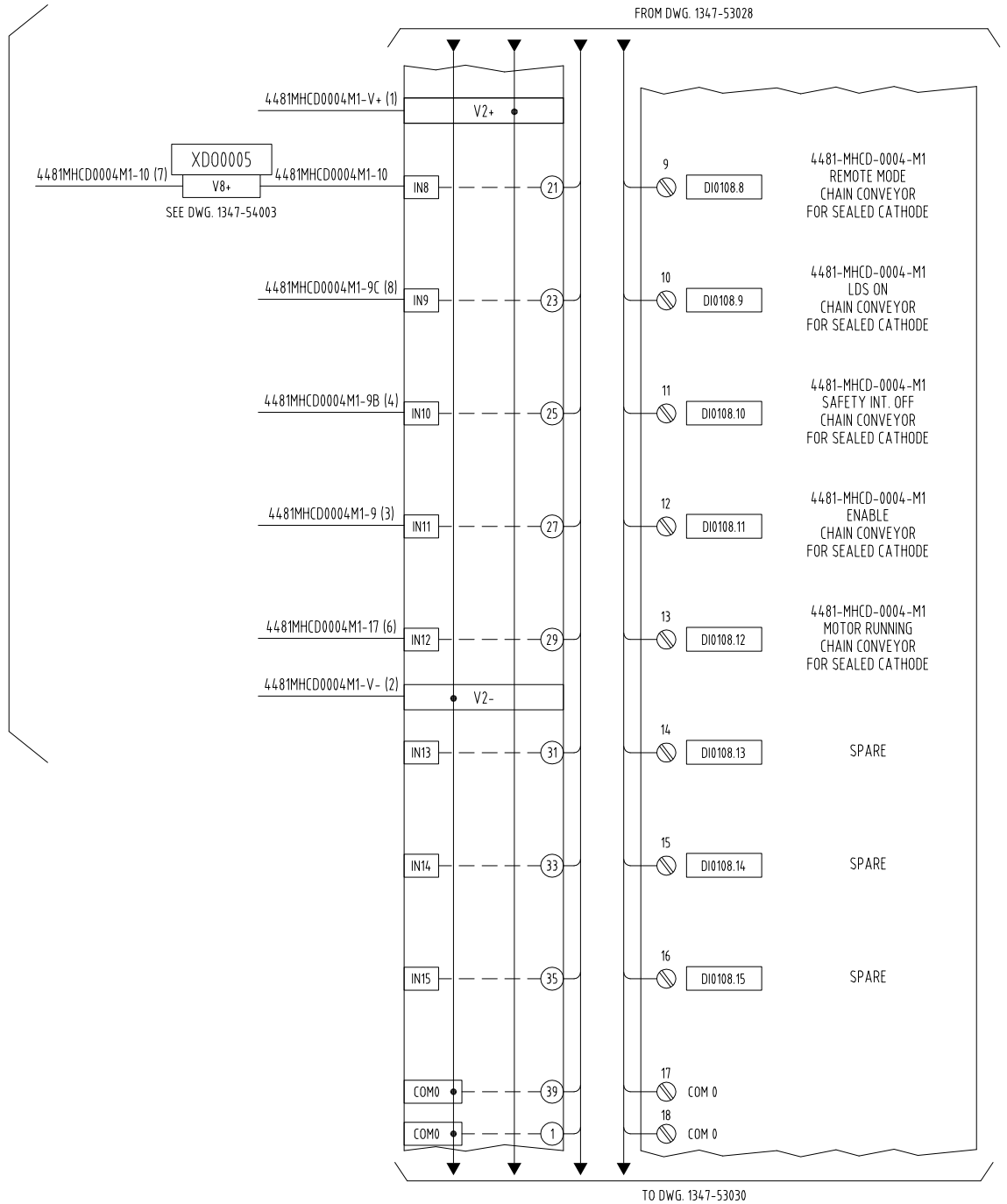
C4
CHAIN CONVEYOR
FOR SEALED CATHODE
STARTER 4481-MHCD-0004-M1-ST

SEE DWG. 1347-56420
25457-4480-V1A-MXA0-0305

PLC PANEL
4481-CP-1000

0 1 2 3 4 5 6 7 8 9

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1756-IB32
VOLTAGE	24Vdc
SLOT	08
RACK	01
PANEL	4481-CP-1000
IFM MODULE	1492-IFM40D24
PRE-WIRED CABLE	1492-CABLE025Z



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GNA ellutech inc. — Département Ingénierie, Engineering Department, 6490 Trans-Canada, Saint-Laurent, Québec, H4S 1V3, Canada

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SELLER DRAWING No.: 1347-53029 — REV.: 0

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT (24 Vdc) RACK: 01 SLOT: 08 (2/4)
I/O INTERCONNECTION DIAGRAM

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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MOTOR CONTROL CENTER PANEL
4480-ECM1-0001

H1
HYDRAULIC POWER UNIT
PUMP A
STARTER 4481-MPF0-0001-M1-ST

SEE DWG. 1347-56430
25457-4480-V1A-MXA0-0336

PLC PANEL
4481-CP-1000

0 1 2 3 4 5 6 7 8 9

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1756-IB32
VOLTAGE	24Vdc
SLOT	08
RACK	01
PANEL	4481-CP-1000
IFM MODULE	1492-IFM40D24
PRE-WIRED CABLE	1492-CABLE025Z

SEE DWG. 1347-53029

4481MPF00001M1-V+ (1) — V3+

4481MPF00001M1-10 (7) — XD00005 V10+ — 4481MPF00001M1-10
SEE DWG. 1347-54003

4481MPF00001M1-9C (8)	IN17	8	20	DI0108.17	4481-MPF0-0001-M1 LDS ON HYDRAULIC POWER UNIT PUMP A
4481MPF00001M1-9B (4)	IN18	10	21	DI0108.18	4481-MPF0-0001-M1 SAFETY INT. OFF HYDRAULIC POWER UNIT PUMP A
4481MPF00001M1-9 (3)	IN19	12	22	DI0108.19	4481-MPF0-0001-M1 ENABLE HYDRAULIC POWER UNIT PUMP A
4481MPF00001M1-17 (6)	IN20	14	23	DI0108.20	4481-MPF0-0001-M1 MOTOR RUNNING HYDRAULIC POWER UNIT PUMP A
4481MPF00001M1-V- (2) — V3-					
	IN21	16	24	DI0108.21	SPARE
	IN22	18	25	DI0108.22	SPARE
	IN23	20	26	DI0108.23	SPARE

SEE DWG. 1347-53031

No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
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Vendor or Subcontractor Logo: GNA ellutech inc. — Département Ingénierie Engineering Department, 6400 Trans-Canada, Baie-d'Urfé, Québec, H9X 1V3, Canada

Project Title: Ras Az Zawr Aluminium Smelter

SELLER DRAWING No. 1347-53030 | REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT (24 Vdc) RACK: 01 SLOT: 08 (3/4)
I/O INTERCONNECTION DIAGRAM

MA'ADEN

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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MOTOR CONTROL CENTER PANEL
4480-ECM1-0001

H2
HYDRAULIC POWER UNIT
PUMP B
STARTER 4481-MPF0-0001-M2-ST

SEE DWG. 1347-56431
25457-4480-V1A-MXA0-0337

PLC PANEL
4481-CP-1000

0 1 2 3 4 5 6 7 8 9

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1756-IB32
VOLTAGE	24Vdc
SLOT	08
RACK	01
PANEL	4481-CP-1000
IFM MODULE	1492-IFM40D24
PRE-WIRED CABLE	1492-CABLE025Z

FROM DWG. 1347-53030

4481MPF00001M2-V+ (1)	V4+				
4481MPF00001M2-10 (7) → XD00005 V11+ (SEE DWG. 1347-54003)	4481MPF00001M2-10	IN24	22	27 DI0108.24	4481-MPF0-0001-M2 REMOTE MODE HYDRAULIC POWER UNIT PUMP B
4481MPF00001M2-9C (8)		IN25	24	28 DI0108.25	4481-MPF0-0001-M2 LDS ON HYDRAULIC POWER UNIT PUMP B
4481MPF00001M2-9B (4)		IN26	26	29 DI0108.26	4481-MPF0-0001-M2 SAFETY INT. OFF HYDRAULIC POWER UNIT PUMP B
4481MPF00001M2-9 (3)		IN27	28	30 DI0108.27	4481-MPF0-0001-M2 ENABLE HYDRAULIC POWER UNIT PUMP B
4481MPF00001M2-17 (6)		IN28	30	31 DI0108.28	4481-MPF0-0001-M2 MOTOR RUNNING HYDRAULIC POWER UNIT PUMP B
4481MPF00001M2-V- (2)	V4-				
		IN29	32	32 DI0108.29	SPARE
		IN30	34	33 DI0108.30	SPARE
		IN31	36	34 DI0108.31	SPARE
74-V19- (FROM LINE 19 SEE DWG. 1347-55253 25457-4480-V1A-MXA0-0102)	74-V19-				
		COM1	40	35 COM 1	
		COM1	2	36 COM 1	

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Vendor or Subcontractor Logo: GNA ellutech inc. — Département Ingénierie / Engineering Department, 6490 Trans-Canada, Sainte-Julienne, Québec, J4B 5V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No | SUBD. | DISC. | SECTOR | SEQUENCE | REV.
25457-00AZ- xx - xxxx - xxxx - xxx - xxx

SELLER DRAWING No. 1347-53031 | REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT (24 Vdc) RACK: 01 SLOT: 08 (4/4)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type | Building | Discipline | Phase | Format | Sequential | Location | Rev. No.
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SCR CONTROL PANEL
4480-EVR3-0002

SCR CONTROL PANEL
4480-EVR3-0001

PLC PANEL
4481-CP-1000

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1756-IB32
VOLTAGE	24Vdc
SLOT	09
RACK	01
PANEL	4481-CP-1000
IFM MODULE	1492-IFM40D24
PRE-WIRED CABLE	1492-CABLE025Z

0 1 2 3 4 5 6 7 8 9

SEE DWG. 1347-55261
25457-4480-V1A-MXA0-0102

F1 UNDERVOLTAGE COIL
79-CR8

X79
1-
4B
4A

79-V1+
77-V1B
77-V1-
DI0109.0
74-V21A
(2SP)

SEE DWG. 1347-55271
25457-4480-V1A-MXA0-0102

F2 UNDERVOLTAGE COIL
82-CR8

X82
4B
4A
1-

82-V1+
77-V3B
77-V3-
DI0109.2
74-V21A
(2SP)

4480-EVR3-0002-J2
(6C x 1,5mm2)

4480-EVR3-0001-J2
(6C x 1,5mm2)

X77
1B
1-
3B
3-

77-V1B
77-V1-
77-V3B
77-V3-

SEE DWG. 1347-55253
25457-4480-V1A-MXA0-0102
FROM LINE 21

XDI0109
V1+
V2+
V3+
IN0
IN1
IN2
IN3
IN4
IN5
IN6
IN7
TEST
TEST
74-V21A
DI0109.0
DI0109.2
74-V21A
74-V21A
77-CR10
43
44
DI0109.4
77-CR12
43
44
DI0109.5
76-ESR5
41
42
DI0109.6
74-V21A
5
7
9
11
13
15
17
19
PRE-WIRED CABLE

1	DI0109.0	4481-EVR3-0002 POWER ON F1 CATHODE BLOCK OVEN
2	DI0109.1	SPARE
3	DI0109.2	4481-EVR3-0001 POWER ON F2 CATHODE BAR HEATING FURNACE
4	DI0109.3	SPARE
5	DI0109.4	77-CR10 F1 CATHODE BLOCK OVEN HIGH TEMPERATURE
6	DI0109.5	77-CR12 F2 CATHODE BAR HEATING FURNACE HIGH TEMPERATURE
7	DI0109.6	76-ESR5 MAIN EMERGENCY STOP
8	DI0109.7	SPARE

SEE DWG. 1347-53033

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
		1		UPDATE	10-MA-2011	F.P.	E.B.	C.C.
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Vendor or Subcontractor Logo: GNA ultech inc. — Département Ingénierie / Engineering Department, 6490, Trans-Canada, Saint-Laurent, Québec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-	00AZ-	xx -	xxxx -	xxxx -	xxx – xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT (24 Vdc) RACK: 01 SLOT: 09 (1/4)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—	—	A3–		–AZ	

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LOCAL CONTROL PANEL
4481-MEHX-0001-CP-01

W1
CHILLER FOR HYDRAULIC
POWER UNIT
LOCAL CONTROL PANEL

2541 — 2541 — 74-V21A (1)
CR242 — 2542 — 2542 — DI0109.8 (2)
2543 — 2543
CR249 — 2544 — 2544 — DI0109.9 (3)
(SSP)

4481-MEHX-0001-CP-01-J1
(8C x 1,5mm2)
1

PLC PANEL
4481-CP-1000

0 1 2 3 4 5 6 7 8 9

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1756-IB32
VOLTAGE	24Vdc
SLOT	09
RACK	01
PANEL	4481-CP-1000
IFM MODULE	1492-IFM40D24
PRE-WIRED CABLE	1492-CABLE025Z

FROM DWG. 1347-53032

74-V21A (1) — V4+
DI0109.8 (2) — IN8 — 21 — 9 — DI0109.8 — 4481-MEHX-0001-W1 SYSTEM FAULT CHILLER FOR HYDRAULIC POWER UNIT
DI0109.9 (3) — IN9 — 23 — 10 — DI0109.9 — 4481-MEHX-0001-W1 SYSTEM ON CHILLER FOR HYDRAULIC POWER UNIT
(SSP)
IN10 — 25 — 11 — DI0109.10 — SPARE
IN11 — 27 — 12 — DI0109.11 — SPARE
IN12 — 29 — 13 — DI0109.12 — SPARE
IN13 — 31 — 14 — DI0109.13 — SPARE
IN14 — 33 — 15 — DI0109.14 — SPARE
IN15 — 35 — 16 — DI0109.15 — SPARE
COM0 — 39 — 17 — COM 0
COM0 — 1 — 18 — COM 0

TO DWG. 1347-53034

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SELLER DRAWING No. 1347-53033 — REV. 1

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REFERENCES — REVISIONS

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Vendor or Subcontractor Logo: GNA ellutech inc. — Département Ingénierie, Engineering Department, 6400 Trans-Canada, Baie-d'Urfé, Québec, H9X 1V3, Canada

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No | SUBD. | DISC. | SECTOR | SEQUENCE | REV.
25457-00AZ- xx - xxxx - xxxx - xxx - xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT (24 Vdc) RACK: 01 SLOT: 09 (2/4)
I/O INTERCONNECTION DIAGRAM

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Type | Building | Discipline | Phase | Format | Sequential | Location | Rev. No.
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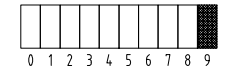
PLC PANEL
4481-CP-1000



MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1756-IB32
VOLTAGE	24Vdc
SLOT	09
RACK	01
PANEL	4481-CP-1000
IFM MODULE	1492-IFM40D24
PRE-WIRED CABLE	1492-CABLE025Z

SEE DWG. 1347-53033

IN16	6	19	DI0109.16	SPARE
IN17	8	20	DI0109.17	SPARE
IN18	10	21	DI0109.18	SPARE
IN19	12	22	DI0109.19	SPARE
IN20	14	23	DI0109.20	SPARE
IN21	16	24	DI0109.21	SPARE
IN22	18	25	DI0109.22	SPARE
IN23	20	26	DI0109.23	SPARE

SEE DWG. 1347-53035

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
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SELLER DRAWING No.: 1347-53034 — REV.: 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT (24 Vdc) RACK: 01 SLOT: 09 (3/4)
I/O INTERCONNECTION DIAGRAM

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
	—	—	—	A3-		-AZ	

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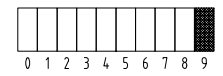
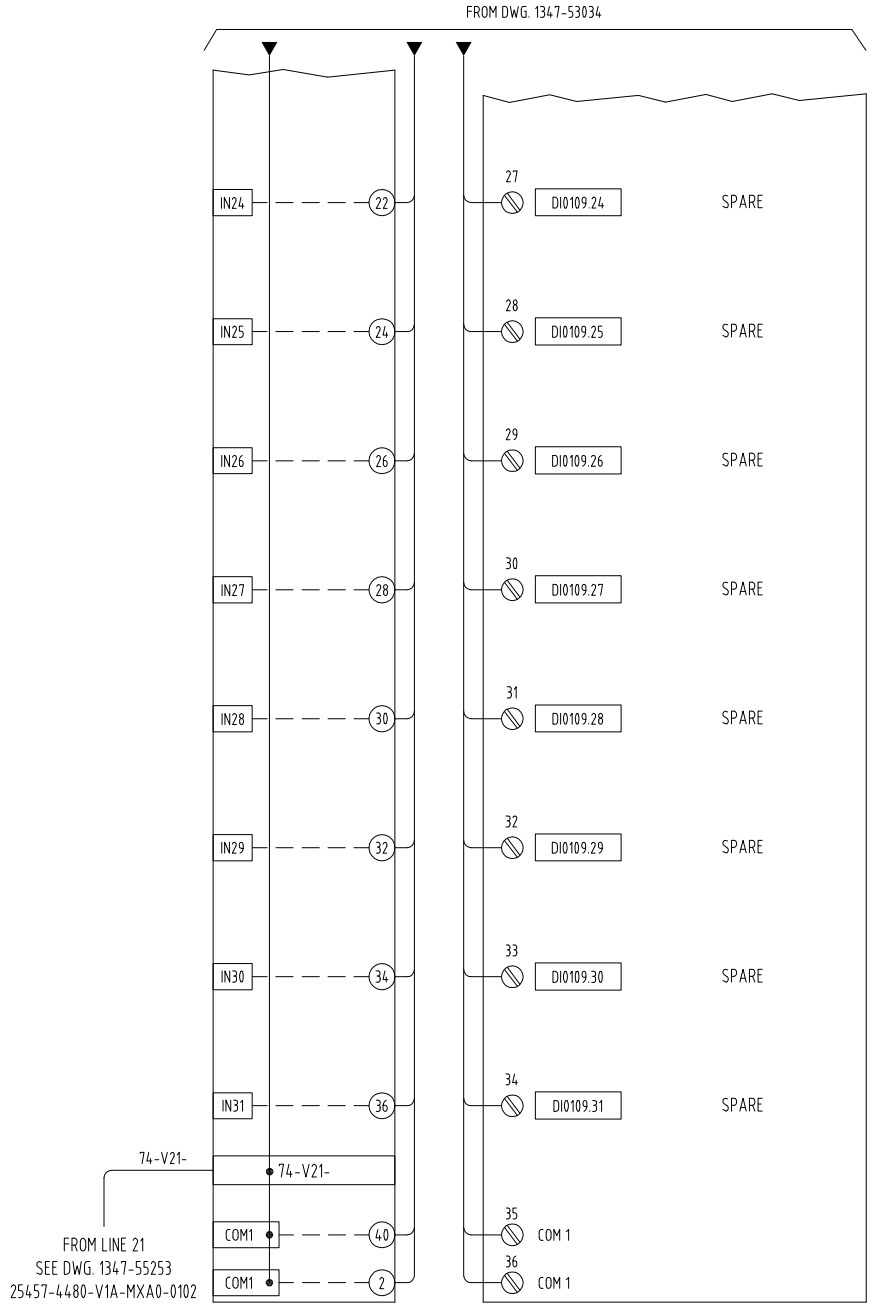
PLC PANEL
4481-CP-1000



MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1756-IB32
VOLTAGE	24Vdc
SLOT	09
RACK	01
PANEL	4481-CP-1000
IFM MODULE	1492-IFM40D24
PRE-WIRED CABLE	1492-CABLE025Z



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SELLER DRAWING No. 1347-53035 | REV. 0

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Vendor or Subcontractor Logo: GNA ultratech inc. — Département Ingénierie, Engineering Department, 6400 Trans-Canada, Baie-d'Urfé, Québec, H9X 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx	xxxx	xxxx	xxx	xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT (24 Vdc) RACK: 01 SLOT: 09 (4/4)
I/O INTERCONNECTION DIAGRAM

MA'ADEN

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—	—	A3-		-AZ	

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PLC PANEL 4481-CP-1000	
MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL OUTPUT
MODEL	1756-OW16I
VOLTAGE	24Vdc
SLOT	04
RACK	00
PANEL	4481-CP-1000
TERMINAL BASE	1756-TBS6H

0 1 2 3 4 5 6 7 8 9

DO0004

XDO0004

4481-MHCD-0002-M1 RUN COMMAND CHAIN CONVEYOR UPSTREAM OF SHOTBLASTING MACHINE	DO0004.0	1	BLACK	0	4481MHCD0002M1-9E (5)	4481-MHCD-0002-M1-J1 (8C x 1,5mm2)	4481MHCD0002M1-9E (5)	7	C2 STARTER 4481-MHCD-0002-M1-ST CHAIN CONVEYOR UPSTREAM OF SHOTBLASTING MACHINE
	L1-0	2	WHITE	V0+	4481MHCD0002M1-10 (7) 4481MHCD0002M1-10 ▶ SEE DWG. 1347-53000		4481MHCD0002M1-10 (7)	10	
4481-MZBP-0001-M1 RUN COMMAND CATHODE BAR SHOTBLASTING MACHINE BLAST WHEEL No. 1	DO0004.1	3	RED	1	4481MZBP0001M1-9E (5)	4481-MZBP-0001-M1-J1 (8C x 1,5mm2)	4481MZBP0001M1-9E (5)	7	S1 STARTER 4481-MZBP-0001-M1-ST CATHODE BAR SHOTBLASTING MACHINE BLAST WHEEL No. 1
	L1-1	4	GREEN	V1+	4481MZBP0001M1-10 (7) 4481MZBP0001M1-10 ▶ SEE DWG. 1347-53002		4481MZBP0001M1-10 (7)	10	
4481-MZBP-0001-M3 RUN COMMAND CATHODE BAR SHOTBLASTING MACHINE BLAST WHEEL No. 3	DO0004.2	5	ORANGE	2	4481MZBP0001M3-9E (5)	4481-MZBP-0001-M3-J1 (8C x 1,5mm2)	4481MZBP0001M3-9E (5)	7	S1 STARTER 4481-MZBP-0001-M3-ST CATHODE BAR SHOTBLASTING MACHINE BLAST WHEEL No. 3
	L1-2	6	BLUE	V2+	4481MZBP0001M3-10 (7) 4481MZBP0001M3-10 ▶ SEE DWG. 1347-53003		4481MZBP0001M3-10 (7)	10	
4481-MZBP-0001-M7 RUN COMMAND CATHODE BAR SHOTBLASTING MACHINE SCREW	DO0004.3	7	WHITE/BLACK	3	4481MZBP0001M7-9E (5)	4481-MZBP-0001-M7-J1 (8C x 1,5mm2)	4481MZBP0001M7-9E (5)	7	S1 STARTER 4481-MZBP-0001-M7-ST CATHODE BAR SHOTBLASTING MACHINE SCREW
	L1-3	8	RED/BLACK	V3+	4481MZBP0001M7-10 (7) 4481MZBP0001M7-10 ▶ SEE DWG. 1347-53004		4481MZBP0001M7-10 (7)	10	
4481-MZBP-0001-M5 RUN COMMAND CATHODE BAR SHOTBLASTING MACHINE ELEVATOR	DO0004.4	9	GREEN/BLACK	4	4481MZBP0001M5-9E (5)	4481-MZBP-0001-M5-J1 (8C x 1,5mm2)	4481MZBP0001M5-9E (5)	7	S1 STARTER 4481-MZBP-0001-M5-ST CATHODE BAR SHOTBLASTING MACHINE ELEVATOR
	L1-4	10	ORANGE/BLACK	V4+	4481MZBP0001M5-10 (7) 4481MZBP0001M5-10 ▶ SEE DWG. 1347-53005		4481MZBP0001M5-10 (7)	10	
4481-MZBP-0001-M2 RUN COMMAND CATHODE BAR SHOTBLASTING MACHINE BLAST WHEEL No. 2	DO0004.5	11	BLUE/BLACK	5	4481MZBP0001M2-9E (5)	4481-MZBP-0001-M2-J1 (8C x 1,5mm2)	4481MZBP0001M2-9E (5)	7	S1 STARTER 4481-MZBP-0001-M2-ST CATHODE BAR SHOTBLASTING MACHINE BLAST WHEEL No. 2
	L1-5	12	BLACK/WHITE	V5+	4481MZBP0001M2-10 (7) 4481MZBP0001M2-10 ▶ SEE DWG. 1347-53006		4481MZBP0001M2-10 (7)	10	
4481-MZBP-0001-M4 RUN COMMAND CATHODE BAR SHOTBLASTING MACHINE BLAST WHEEL No. 4	DO0004.6	13	RED/WHITE	6	4481MZBP0001M4-9E (5)	4481-MZBP-0001-M4-J1 (8C x 1,5mm2)	4481MZBP0001M4-9E (5)	7	S1 STARTER 4481-MZBP-0001-M4-ST CATHODE BAR SHOTBLASTING MACHINE BLAST WHEEL No. 4
	L1-6	14	GREEN/WHITE	V6+	4481MZBP0001M4-10 (7) 4481MZBP0001M4-10 ▶ SEE DWG. 1347-53007		4481MZBP0001M4-10 (7)	10	
4481-MAC0-0001-M1 RUN COMMAND DUST COLLECTOR FOR SHOTBLASTING MACHINE FAN	DO0004.7	15	BLUE/WHITE	7	4481MAC00001M1-9E (5)	4481-MAC0-0001-M1-J1 (8C x 1,5mm2)	4481MAC00001M1-9E (5)	7	D1 STARTER 4481-MAC0-0001-M1-ST DUST COLLECTOR FOR SHOTBLASTING MACHINE FAN
	L1-7	16	BLACK/RED	V7+	4481MAC00001M1-10 (7) 4481MAC00001M1-10 ▶ SEE DWG. 1347-53009		4481MAC00001M1-10 (7)	10	

TO DWG. 1347-54001

MOTOR CONTROL CENTER PANEL
4480-ECM1-0001

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Vendor or Subcontractor Logo: GNA eluotech inc. Département Ingénierie Engineering Department 5600, Trans-Canada Salaberry-de-Valleyfield, Québec J6S 1Y3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx –	xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL OUTPUT (24 Vdc) RACK: 00 SLOT: 04 (1/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
–	–	–		A3–		–AZ	

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PLC PANEL 4481-CP-1000	
MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL OUTPUT
MODEL	1756-OW16I
VOLTAGE	24Vdc
SLOT	04
RACK	00
PANEL	4481-CP-1000
TERMINAL BASE	1756-TBS6H

0 1 2 3 4 5 6 7 8 9

FROM DWG. 1347-54000

SPARE	DO0004.8	17	WHITE/RED	8		
	L1-8	18	ORANGE/RED	V8+		
4481-MJR0-0003-M1 RUN FORWARD ROLLER CONVEYOR AT BAR FURNACE ENTRANCE	DO0004.9	19	BLUE/RED	9	4481MJR00003M1-9E (5)	4481-MJR0-0003-M1-J1 (10C x 1,5mm2)
	L1-9	20	RED/GREEN	V9+	4481MJR00003M1-10 (7) / 4481MJR00003M1-10 → SEE DWG. 1347-53012	
4481-MJR0-0003-M1 RUN REVERSE ROLLER CONVEYOR AT BAR FURNACE ENTRANCE	DO0004.10	21	ORANGE/GREEN	10	4481MJR00003M1-11 (9)	
	L1-10	22	BLACK/WHITE/RED	V10+		
SPARE	DO0004.11	23	WHITE/BLACK/RED	11		
	L1-11	24	RED/BLACK/WHITE	V11+		
4481-MQLK-0001-M1 BRAKE POSITIONING GANTRY FOR BLOCK AND BARS	DO0004.12	25	GRREN/BLACK/WHITE	12	4481MQLK0001M1-8 (9)	4481-MQLK-0001-M1-J1 (9C x 1,5mm2)
	L1-12	26	ORANGE/BLACK/WHITE	V12+	4481MQLK0001M1-9 (3) / 4481MQLK0001M1-9 → SEE DWG. 1347-53018	
SPARE	DO0004.13	27	BLUE/BLACK/WHITE	13		
	L1-13	28	BLACK/RED/GREEN	V13+		
4481-MHCD-0001-M1 RUN FORWARD CHAIN CONVEYOR OF BLOCK OVEN	DO0004.14	29	WHITE/RED/GREEN	14	4481MHCD0001M1-9E (5)	4481-MHCD-0001-M1-J1 (10C x 1,5mm2)
	L1-14	30	RED/BLACK/GREEN	V14+	4481MHCD0001M1-10 (7) / 4481MHCD0001M1-10 → SEE DWG. 1347-53019	
4481-MHCD-0001-M1 RUN REVERSE CHAIN CONVEYOR OF BLOCK OVEN	DO0004.15	31	GREEN/BLACK/ORANGE	15	4481MHCD0001M1-11 (9)	
	L1-15	32	ORANGE/BLACK/GREEN	V15+		
	NOT USED	33				
	L1-15	34				

MOTOR CONTROL CENTER PANEL 4480-ECM1-0001

4481MJR00003M1-9E (5)	7	R7 STARTER 4481-MJR0-0003-M1-ST ROLLER CONVEYOR AT BAR FURNACE ENTRANCE
4481MJR00003M1-10 (7)	10	
4481MJR00003M1-11 (9)	8	
4481MQLK0001M1-8 (9)	8	G1 STARTER 4481-MQLK-0001-M1-ST POSITIONING GANTRY FOR BLOCK AND BARS
4481MQLK0001M1-9 (3)	3	
4481MHCD0001M1-9E (5)	7	C1 STARTER 4481-MHCD-0001-M1-ST CHAIN CONVEYOR OF BLOCK OVEN
4481MHCD0001M1-10 (7)	10	
4481MHCD0001M1-11 (9)	8	

REVISIONS								
No	STATUS	DESCRIPTION	DATE	BY	CHK	APP		
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Vendor or Subcontractor Logo: GNA ellutech inc. — Département Ingénierie, Engineering Department, 5686 Trans-Canada, Pointe-aux-Trembles, Québec, H1A 1E9, Canada — BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

SELLER DRAWING No.: 1347—54001 — REV.: 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL OUTPUT (24 Vdc) RACK: 00 SLOT: 04 (2/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—		—	—	A3—		—AZ	

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PLC PANEL 4481-CP-1000	
MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL OUTPUT
MODEL	1756-OW16I
VOLTAGE	24Vdc
SLOT	05
RACK	00
PANEL	4481-CP-1000
TERMINAL BASE	1756-TBS6H

0 1 2 3 4 5 6 7 8 9

DO0005

XDO0005

4481-MEEP-0001-M1 RUN COMMAND CATHODE BLOCK OVEN FAN A	DO0005.0	1	BLACK	0	4481MEEP0001M1-9E (5)	4481-MEEP-0001-M1-J1 (8C x 1,5mm2)	4481MEEP0001M1-9E (5) → 7
	L1-0	2	WHITE	V0+	4481MEEP0001M1-10 (7) → 4481MEEP0001M1-10 → SEE DWG. 1347-53020		4481MEEP0001M1-10 (7) → 10
4481-MEEP-0001-M2 RUN COMMAND CATHODE BLOCK OVEN FAN B	DO0005.1	3	RED	1	4481MEEP0001M2-9E (5)	4481-MEEP-0001-M2-J1 (8C x 1,5mm2)	4481MEEP0001M2-9E (5) → 7
	L1-1	4	GREEN	V1+	4481MEEP0001M2-10 (7) → 4481MEEP0001M2-10 → SEE DWG. 1347-53021		4481MEEP0001M2-10 (7) → 10
4481-MEEP-0001-M3 RUN COMMAND CATHODE BLOCK OVEN FAN C	DO0005.2	5	ORANGE	2	4481MEEP0001M3-9E (5)	4481-MEEP-0001-M3-J1 (8C x 1,5mm2)	4481MEEP0001M3-9E (5) → 7
	L1-2	6	BLUE	V2+	4481MEEP0001M3-10 (7) → 4481MEEP0001M3-10 → SEE DWG. 1347-53022		4481MEEP0001M3-10 (7) → 10
SPARE	DO0005.3	7	WHITE/BLACK	3			
	L1-3	8	RED/BLACK	V3+			
4481-MJR0-0005-M1 RUN COMMAND ROLLER CONVEYOR AT BLOCK OVEN EXIT	DO0005.4	9	GREEN/BLACK	4	4481MJR00005M1-9E (5)	4481-MJR0-0005-M1-J1 (8C x 1,5mm2)	4481MJR00005M1-9E (5) → 7
	L1-4	10	ORANGE/BLACK	V4+	4481MJR00005M1-10 (7) → 4481MJR00005M1-10 → SEE DWG. 1347-53023		4481MJR00005M1-10 (7) → 10
SPARE	DO0005.5	11	BLUE/BLACK	5			
	L1-5	12	BLACK/WHITE	V5+			
4481-MJR0-0006-M1 RUN COMMAND ROLLER CONVEYOR AFTER SEALING STATION	DO0005.6	13	RED/WHITE	6	4481MJR00006M1-9E (5)	4481-MJR0-0006-M1-J1 (8C x 1,5mm2)	4481MJR00006M1-9E (5) → 7
	L1-6	14	GREEN/WHITE	V6+	4481MJR00006M1-10 (7) → 4481MJR00006M1-10 → SEE DWG. 1347-53027		4481MJR00006M1-10 (7) → 10
4481-MJR0-0008-M1 RUN COMMAND ROLLER CONVEYOR AT COOLING & TURNING STATION	DO0005.7	15	BLUE/WHITE	7	4481MJR00008M1-9E (5)	4481-MJR0-0008-M1-J1 (8C x 1,5mm2)	4481MJR00008M1-9E (5) → 7
	L1-7	16	BLACK/RED	V7+	4481MJR00008M1-10 (7) → 4481MJR00008M1-10 → SEE DWG. 1347-53028		4481MJR00008M1-10 (7) → 10

TO DWG. 1347-54003

MOTOR CONTROL CENTER PANEL
4480-ECM1-0001

F1	STARTER 4481-MEEP-0001-M1-ST CATHODE BLOCK OVEN FAN A
F1	STARTER 4481-MEEP-0001-M2-ST CATHODE BLOCK OVEN FAN A
F1	STARTER 4481-MEEP-0001-M3-ST CATHODE BLOCK OVEN FAN A
R1	STARTER 4481-MJR0-0005-M1-ST CATHODE BLOCK OVEN FAN A
R3	STARTER 4481-MJR0-0006-M1-ST ROLLER CONVEYOR AFTER SEALING STATION
R5	STARTER 4481-MJR0-0008-M1-ST ROLLER CONVEYOR AT COOLING & TURNING STATION

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Vendor or Subcontractor Logo: GNA alutech inc. Département Ingénierie / Engineering Department, 9400, Trans-Canada, Suite 04, Lavaltrie, Québec, J5T 3S3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SELLER DRAWING No.: 1347-54002 REV.: 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL OUTPUT (24 Vdc) RACK: 00 SLOT: 05 (1/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—	—	A3–		–AZ	

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PLC PANEL
4481-CP-1000

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL OUTPUT
MODEL	1756-OW16I
VOLTAGE	24Vdc
SLOT	05
RACK	00
PANEL	4481-CP-1000
TERMINAL BASE	1756-TBS6H

0 1 2 3 4 5 6 7 8 9

FROM DWG. 1347-54002

4481-MHCD-0004-M1 RUN COMMAND CHAIN CONVEYOR FOR SEALED CATHODE	DO0005.8	17	WHITE/RED	8	4481MHCD0004M1-9E (5)	4481-MHCD-0004-M1-J1 (8C x 1,5mm2)
	L1-8	18	ORANGE/RED	V8+	4481MHCD0004M1-10 (7)	
SPARE	DO0005.9	19	BLUE/RED	9	4481MHCD0004M1-10	SEE DWG. 1347-53029
	L1-9	20	RED/GREEN	V9+		
4481-MPF0-0001-M1 RUN COMMAND HYDRAULIC POWER UNIT PUMP A	DO0005.10	21	ORANGE/GREEN	10	4481MPF00001M1-9E (5)	4481-MPF0-0001-M1-J1 (8C x 1,5mm2)
	L1-10	22	BLACK/WHITE/RED	V10+	4481MPF00001M1-10 (7)	
4481-MPF0-0001-M2 RUN COMMAND HYDRAULIC POWER UNIT PUMP B	DO0005.11	23	WHITE/BLACK/RED	11	4481MPF00001M1-10	SEE DWG. 1347-53030
	L1-11	24	RED/BLACK/WHITE	V11+	4481MPF00001M2-9E (5)	4481-MPF0-0001-M2-J1 (8C x 1,5mm2)
SPARE	DO0005.12	25	GRREN/BLACK/WHITE	12	4481MPF00001M2-10 (7)	
	L1-12	26	ORANGE/BLACK/WHITE	V12+	4481MPF00001M2-10	SEE DWG. 1347-53031
SPARE	DO0005.13	27	BLUE/BLACK/WHITE	13		
	L1-13	28	BLACK/RED/GREEN	V13+		
4481-MEEP-0001 F1 CATHODE BLOCK OVEN ZONE #1, #2, #3 HEATER ENABLE	DO0005.14	29	WHITE/RED/GREEN	14	DO0005.14	LINE 05
	L1-14	30	RED/BLACK/GREEN	V14+	76-V9A	SEE DWG. 1347-55256 25457-4480-V1A-MXA0-0077
4481-MBMB-0001 F2 CATHODE BAR HEATING F. ZONE #1, #2, #3, #4 HEATER ENABLE	DO0005.15	31	GREEN/BLACK/ORANGE	15	DO0005.15	LINE 07
	L1-15	32	ORANGE/BLACK/GREEN	V15+		
	NOT USED	33				
	L1-15	34				

MOTOR CONTROL CENTER PANEL
4480-ECM1-0001

4481MHCD0004M1-9E (5)	7	C4 STARTER 4481-MHCD-0004-M1-ST CHAIN CONVEYOR FOR SEALED CATHODE
4481MHCD0004M1-10 (7)	10	
4481MPF00001M1-9E (5)	7	H1 STARTER 4481-MPF0-0001-M1-ST HYDRAULIC POWER UNIT PUMP A
4481MPF00001M1-10 (7)	10	
4481MPF00001M2-9E (5)	7	H1 STARTER 4481-MPF0-0001-M2-ST HYDRAULIC POWER UNIT PUMP B
4481MPF00001M2-10 (7)	10	

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ENG. GROUP SUP.	DRAWING SCALE: NONE
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Vendor or Subcontractor Logo: GNA aluminech inc. — Département Ingénierie Engineering Department 6490, Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

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SELLER DRAWING No. 1347-54003 — REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL OUTPUT (24 Vdc) RACK: 00 SLOT: 05 (2/2)
I/O INTERCONNECTION DIAGRAM

Project Title: Ras Az Zawr Aluminium Smelter

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—	—	A3—		—AZ	

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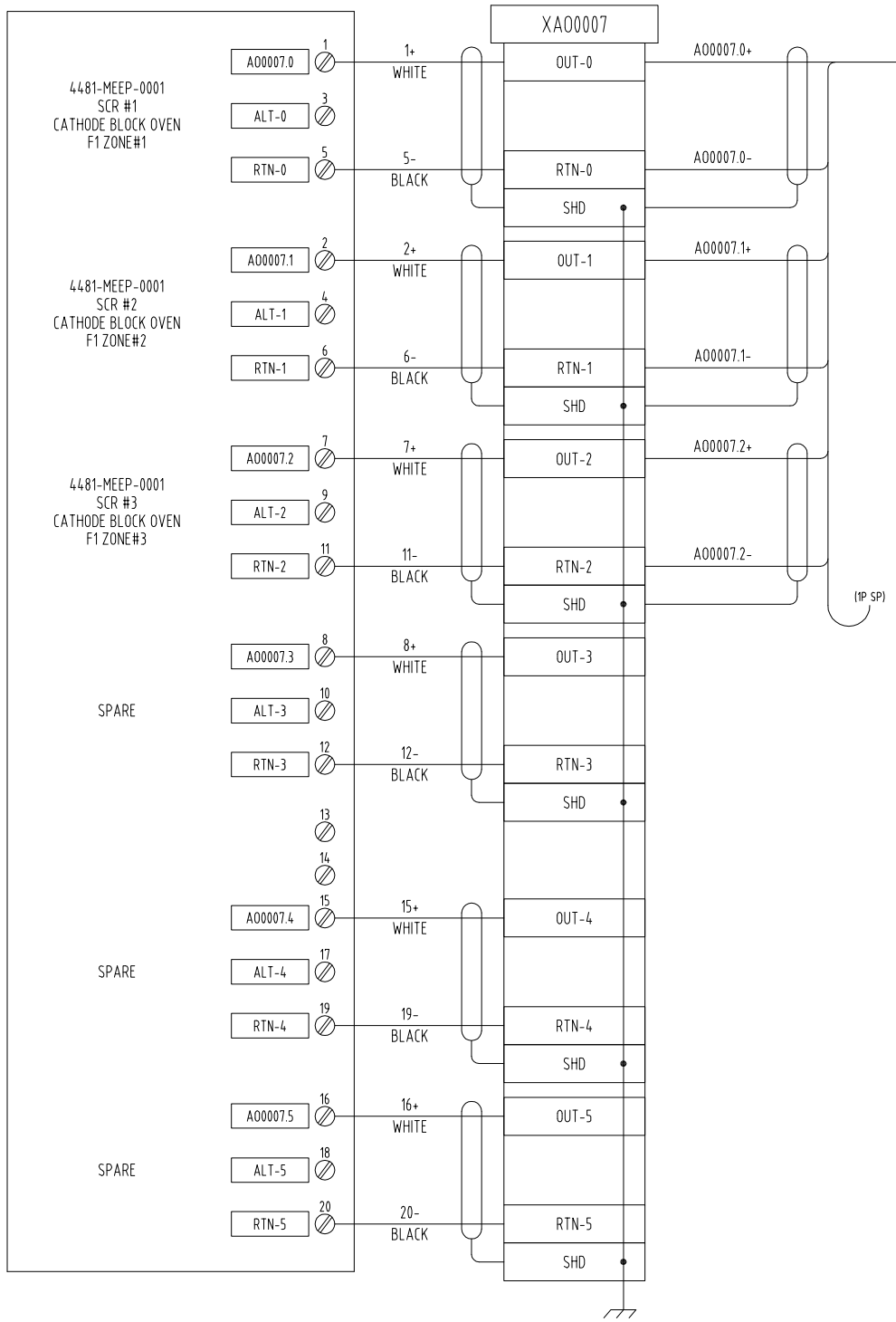
PLC PANEL 4481-CP-1000	
MANUFACTURER	ALLEN-BRADLEY
TYPE	ANALOG OUTPUT
MODEL	1756-OF6CI
VOLTAGE	4-20mA
SLOT	07
RACK	00
PANEL	4481-CP-1000
TERMINAL BASE	1756-TBSH

0 1 2 3 4 5 6 7 8 9



4480-EVR3-0002-J1
(4P x 15mm2)
1

CATHODE BLOCK OVEN SCR CONTROL PANEL
4480-EVR3-0002

AO00007.0+ SCR1+
AO00007.0- SCR1-
SHD
SEE DWG. 1347-55262
25457-4480-V1A-MXAO-0102

AO00007.1+ SCR2+
AO00007.1- SCR2-
SHD
SEE DWG. 1347-55262
25457-4480-V1A-MXAO-0102

AO00007.2+ SCR3+
AO00007.2- SCR3-
SHD
SEE DWG. 1347-55262
25457-4480-V1A-MXAO-0102
(1P SP)

No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
1		UPDATE	10-MA-2011	F.P.	E.B.	C.C.

DRAWING NUMBER | TITLE | REFERENCES | REVISIONS

NOTES

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Vendor or Subcontractor Logo: GNA ellutech inc. — Département Ingénierie, Engineering Department, 5686 Trans-Canada, Lachenaie, Québec, J6W 4K2, Canada — BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SELLER DRAWING No. 1347-54050 — REV. 1

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
ANALOG OUTPUT (4-20mA) RACK: 00 SLOT: 07
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—		—	—	A3-		-AZ	

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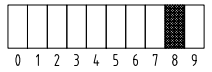
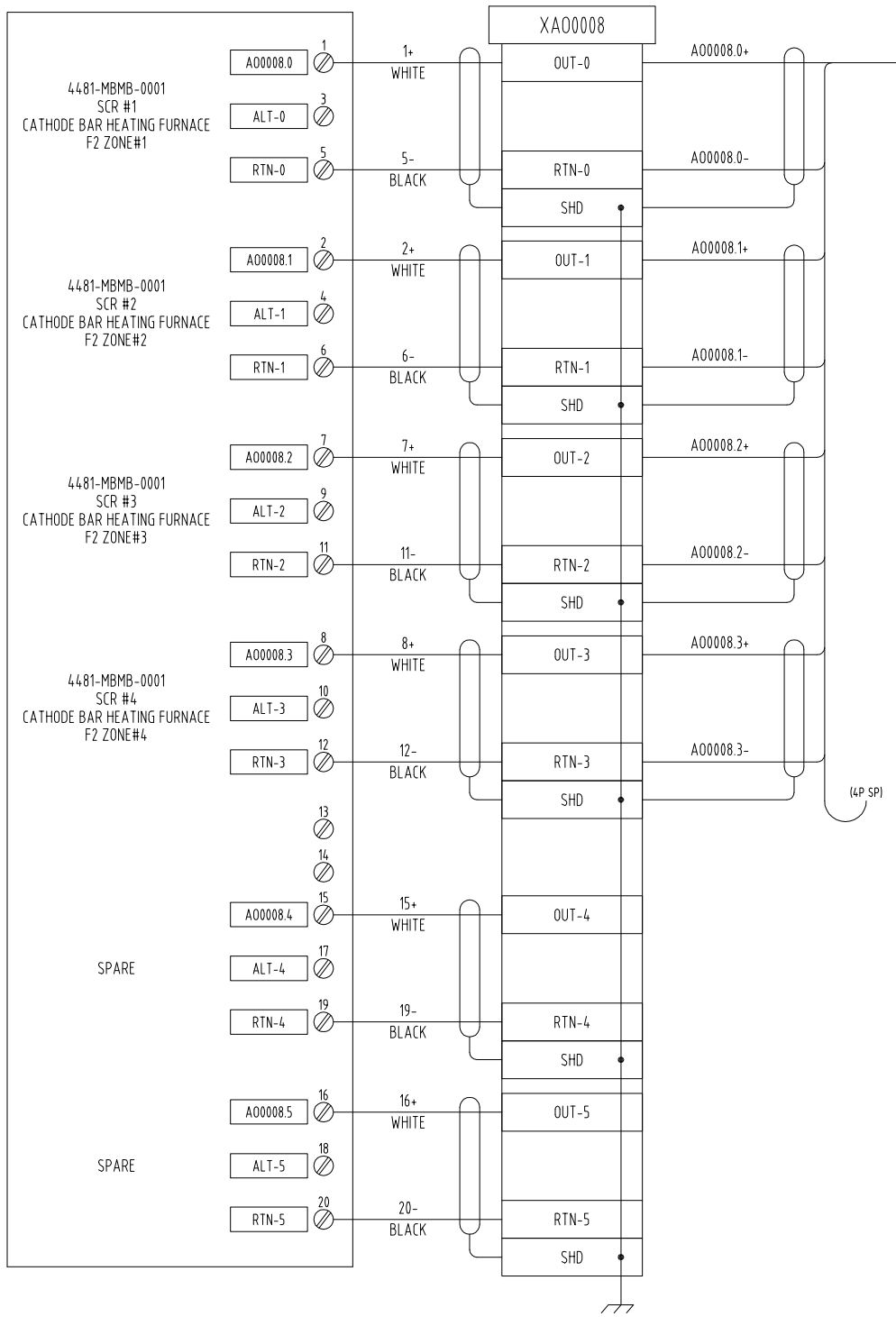
PLC PANEL
4481-CP-1000

MANUFACTURER	ALLEN-BRADLEY
TYPE	ANALOG OUTPUT
MODEL	1756-OF6CI
VOLTAGE	4-20mA
SLOT	08
RACK	00
PANEL	4481-CP-1000
TERMINAL BASE	1756-TBSH





CATHODE BAR HEATING FURNACE SCR CONTROL PANEL
4480-EVR3-0001

4480-EVR3-0001-J1
(8P x 1.5mm2)
△1

AO00008.0+ → SCR1+
AO00008.0- → SCR1-
SHD
SEE DWG. 1347-55272
25457-4480-V1A-MXAO-0102

AO00008.1+ → SCR2+
AO00008.1- → SCR2-
SHD
SEE DWG. 1347-55272
25457-4480-V1A-MXAO-0102

AO00008.2+ → SCR3+
AO00008.2- → SCR3-
SHD
SEE DWG. 1347-55273
25457-4480-V1A-MXAO-0102

△1 (4P SP)
AO00008.3+ → SCR4+
AO00008.3- → SCR4-
SHD
SEE DWG. 1347-55273
25457-4480-V1A-MXAO-0102

No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
1		UPDATE	10-MA-2011	F.P.	E.B.	C.C.

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BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
ANALOG OUTPUT (4-20mA) RACK: 00 SLOT: 08
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—		—	—	A3-		-AZ	

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2	1347-53101-02	DIGITAL INPUT FLEX I/O (24 VDC) RACK: 02 MODULE: 00 (2/2) I/O INTERCONNECTION DIAGRAM
3	1347-53102-01	DIGITAL INPUT FLEX I/O (24 VDC) RACK: 02 MODULE: 01 (1/2) I/O INTERCONNECTION DIAGRAM
4	1347-53103-01	DIGITAL INPUT FLEX I/O (24 VDC) RACK: 02 MODULE: 01 (2/2) I/O INTERCONNECTION DIAGRAM
5	1347-53104-01	DIGITAL INPUT FLEX I/O (24 VDC) RACK: 02 MODULE: 02 (1/2) I/O INTERCONNECTION DIAGRAM
6	1347-53105-01	DIGITAL INPUT FLEX I/O (24 VDC) RACK: 02 MODULE: 02 (2/2) I/O INTERCONNECTION DIAGRAM
7	1347-54100-01	DIGITAL OUTPUT FLEX I/O (24 VDC) RACK: 02 MODULE: 03 (1/2) I/O INTERCONNECTION DIAGRAM
8	1347-54101-01	DIGITAL OUTPUT FLEX I/O (24 VDC) RACK: 02 MODULE: 03 (2/2) I/O INTERCONNECTION DIAGRAM
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12	1347-54105-01	DIGITAL OUTPUT FLEX I/O (24 VDC) RACK: 02 MODULE: 05 (2/2) I/O INTERCONNECTION DIAGRAM
13	1347-54106-02	DIGITAL OUTPUT FLEX I/O (24 VDC) RACK: 02 MODULE: 06 (1/2) I/O INTERCONNECTION DIAGRAM
14	1347-54107-01	DIGITAL OUTPUT FLEX I/O (24 VDC) RACK: 02 MODULE: 06 (2/2) I/O INTERCONNECTION DIAGRAM

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2 ☐ Revise & Resubmit. Work may proceed subject to incorporation of changes.

3 ☐ Revise & Resubmit. Work may NOT proceed.

4 ☐ Revise not required. Work may proceed.

5 ☐ VOID / Superseded.

DDR Nbr : 230

Reviewed by : _____ Date : _____

Discipline :

Document No : 25457-4480-V1A-MXA0-0321 Rev. :

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SELLER DRAWING No. 1347-FLEX 02 I&O REV. 3

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
		3		UPDATE	15-AU-2011	F.P.	E.B.	C.C.
		2		UPDATE	11-JL-2011	F.P.	E.B.	C.C.
		1		UPDATE	10-MA-2011	F.P.	E.B.	C.C.

REFERENCES REVISIONS

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ENG. GROUP SUP. DATE:	DRAWING SCALE: NONE

Vendor or Subcontractor Logo: GNA aLtech inc. Département Ingénierie Engineering Department 5450, Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
I/O INTERCONNECTION DIAGRAMS
REMOTE RACK 02

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
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Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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FIELD

LOCAL CONTROL PANEL
4481-MZAC-0001-CP-01
R4A

CENTRAL CONTROL PANEL
4481-CP-1001
R4A

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1794-IB16
VOLTAGE	24Vdc
MODULE	00
RACK	02
PANEL	4481-CP-1001
TERMINAL BASE	1794-TB3S

A 0 1 2 3 4 5 6

SEE DWG. 1347-55285
25457-4480-V1A-MXAO-0102

X90
1+ 86-V8+ (3)
1- 86-V8- (2)

XDI0200

4481-MZAC-0001-ZS-01
C DI0200.0
NO 86-V8+
4481-MZAC-0001-ZS01-J1 (2C x 1,5mm2) +G
DI0200.0 1 DI0200.0 (1)
86-V8+

4481-MZAC-0001-ZS-02
C DI0200.1
NO 86-V8+
4481-MZAC-0001-ZS02-J1 (2C x 1,5mm2)
DI0200.1 2 DI0200.1 (4)
86-V8+

4481-MZAC-0001-ZS-03
C DI0200.2
NO 86-V8+
4481-MZAC-0001-ZS03-J1 (2C x 1,5mm2)
DI0200.2 3 DI0200.2 (5)
86-V8+

4481-MZAC-0001-ZS-04
C DI0200.3
NO 86-V8+
4481-MZAC-0001-ZS04-J1 (2C x 1,5mm2)
DI0200.3 4 DI0200.3 (6)
86-V8+

4481-MZAC-0001-ZS-05
C DI0200.4
NO 86-V8+
4481-MZAC-0001-ZS05-J1 (2C x 1,5mm2)
DI0200.4 5 DI0200.4 (7)
86-V8+

4481-MZAC-0001-ZS-06
C DI0200.5
NO 86-V8+
4481-MZAC-0001-ZS06-J1 (2C x 1,5mm2) +G
DI0200.5 6 DI0200.5 (8)
86-V8+

4481-MZAC-0001-HS-04
DI0200.6 7 DI0200.6 (9)
86-V8+

4481-MZAC-0001-HS-05
DI0200.7 8 DI0200.7 (10)
86-V8+

SEE DWG. 1347-53101

25457-4480-V1A-MXAO-0102
SEE DWG. 1347-55281
FROM LINE 08

4481-MZAC-0001-CP-01-J1 (19C x 1,5mm2) +G
1

86-V8+ 34 +24Vdc

DI0200.0 (1)	0	DI0200.0	4481-MZAC-0001-ZS-01 BLOCK LOCATED ON R4A CONVEYOR LIMIT SWITCH
86-V8- (2)	17		
86-V8+ (3)	35		
DI0200.1 (4)	1	DI0200.1	4481-MZAC-0001-ZS-02 STOPPER UP ON R4A PROXIMITY SWITCH
	36		
DI0200.2 (5)	2	DI0200.2	4481-MZAC-0001-ZS-03 STOPPER DOWN ON R4A PROXIMITY SWITCH
	37		
DI0200.3 (6)	3	DI0200.3	4481-MZAC-0001-ZS-04 R4A CONVEYOR UP PROXIMITY SWITCH
	38		
DI0200.4 (7)	4	DI0200.4	4481-MZAC-0001-ZS-05 R4A CONVEYOR DOWN PROXIMITY SWITCH
	39		
DI0200.5 (8)	5	DI0200.5	4481-MZAC-0001-ZS-06 BLOCK ON R4A FOR INSPECTION LIMIT SWITCH
	40		
DI0200.6 (9)	6	DI0200.6	4481-MZAC-0001-HS-04 INSPECTION COMPLETED PUSH BUTTON
	41		
DI0200.7 (10)	7	DI0200.7	4481-MZAC-0001-HS-05 POURING COMPLETED PUSH BUTTON
	42		

SEE DWG. 1347-53101

DRAWING NUMBER	TITLE
REFERENCES	

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GNA alutech inc. — Département Ingénierie, Engineering Department, 6405 Trans-Canada, Montmagny, Québec, G5V 1V1, Canada
BECHTEL

Project Title:
Ras Az Zawr
Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SELLER DRAWING No.: 1347-53100
REV.: 1

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT FLEX I/O (24 Vdc) RACK: 02 MODULE: 00 (1/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—		—	—	A3-		-AZ	

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FIELD

LOCAL CONTROL PANEL
4481-MZAC-0001-CP-01 R4A

CENTRAL CONTROL PANEL
4481-CP-1001 C4/R4A

A 0 1 2 3 4 5 6

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1794-IB16
VOLTAGE	24Vdc
MODULE	00
RACK	02
PANEL	4481-CP-1001
TERMINAL BASE	1794-TB3S

SEE DWG. 1347-53100

4481-MZAC-0001-ZS-09
C
DI0200.8
NO
86-V8+
4481-MZAC-0001-ZS08-J1
(2C x 1,5mm2) +G
DI0200.8
86-V8+
9
DI0200.8 (11)
86-V8+

4481-MZAC-0001-ZS-08
C
DI0200.9
NO
86-V8+
4481-MZAC-0001-ZS09-J1
(2C x 1,5mm2)
DI0200.9
86-V8+
10
DI0200.9 (12)
86-V8+

4481-MZAC-0001-ZS-11
C
DI0200.10
NO
86-V8+
4481-MZAC-0001-ZS10-J1
(2C x 1,5mm2)
DI0200.10
86-V8+
11
DI0200.10 (13)
86-V8+

4481-MZAC-0001-ZS-10
C
DI0200.11
NO
86-V8+
4481-MZAC-0001-ZS11-J1
(2C x 1,5mm2)
DI0200.11
86-V8+
12
DI0200.11 (14)
86-V8+
(5SP-1G)
2
13
86-V8+

SEE DWG. 1347-53100

DI0200.8 (11)
8
DI0200.8
43
4481-MZAC-0001-ZS-09
PRESTRESSING HEAD
DOWN
PROXIMITY SWITCH

DI0200.9 (12)
9
DI0200.9
44
4481-MZAC-0001-ZS-08
PRESTRESSING HEAD
UP
PROXIMITY SWITCH

DI0200.10 (13)
10
DI0200.10
45
4481-MZAC-0001-ZS-11
PUSHER
OUT POSITION
PROXIMITY SWITCH

DI0200.11 (14)
11
DI0200.11
46
4481-MZAC-0001-ZS-10
PUSHER
IN POSITION
PROXIMITY SWITCH
(5SP-1G)
2

DI0200.12 (11)
12
DI0200.12
47
2
4481-MHCD-0004-HS-03
C4 ZONE
ACCESS REQUEST
PUSH BUTTON
4481-MHCD-0004-HS-04
C4 ZONE
ACCESS REQUEST RESET
PUSH BUTTON

DI0200.13 (12)
13
DI0200.13
48
2

DI0200.14 (1)
14
DI0200.14
31
86-V8- (2)
86-V8+ (3)
49
DI0200.15 (4)
15
DI0200.15
50
4481-MHCD-0004-ZS-01
BLOCK LOCATED ON C4
CONVEYOR
LIMIT SWITCH
4481-MHCD-0004-ZS-02
BLOCK ON LAST POSITION
ON C4 CONVEYOR
LIMIT SWITCH

86-V8-
16
COMMON

4481-MHCD-0004-CP-01-J1
(19C x 1,5mm2) +G

FROM LINE 08
SEE DWG. 1347-55281
25457-4480-V1A-MXAO-0102

LOCAL CONTROL PANEL
4481-MHCD-0004-CP-02 C4

2
4481-MHCD-0004-HS-03
XDI0200
DI0200.12
1
DI0200.12 (1)
4481-MHCD-0004-HS-04
DI0200.13
2
DI0200.13 (2)
86-V8+
86-V8+
86-V8+ (3)

FIELD

4481-MHCD-0004-ZS-01
C
DI0200.14
NO
86-V8+
4481-MHCD-0004-CP-02-J1
(7C x 1,5mm2) +G
DI0200.12 (1)
DI0200.13 (2)
86-V8+ (3)
DI0200.14
86-V8+

4481-MHCD-0004-ZS-02
C
DI0200.15
NO
86-V8+
4481-MHCD-0004-ZS02-J1
(2C x 1,5mm2) +G
DI0200.15
86-V8+

LOCAL CONTROL PANEL
4481-MHCD-0004-CP-01 C4

SEE DWG. 1347-55288
25457-4480-V1A-MXAO-0102
X93
1+
1-
86-V8+ (3)
86-V8- (2)
XDI0200
3
DI0200.12 (11)
4
DI0200.13 (12)
86-V8+
2
1
DI0200.14 (1)
86-V8+
2
DI0200.15 (4)
86-V8+

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SELLER DRAWING No. 1347-53101 REV. 2

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2		UPDATE	15-AU-2011	F.P.	E.B.	C.C.
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DRAWING NUMBER | TITLE | REFERENCES | REVISIONS | NOTES

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ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA altech inc. Département Ingénierie / Engineering Department 5660 Trans-Canada, Saint-Laurent, Québec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No | SUBD. | DISC. | SECTOR | SEQUENCE | REV.
25457-00AZ- xx - xxxx - xxxx - xxx - xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT FLEX I/O (24 Vdc) RACK: 02 MODULE: 00 (2/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—	—	A3—		—AZ	

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FIELD

LOCAL CONTROL PANEL
4481-MZAC-0002-CP-01
R4B

CENTRAL CONTROL PANEL
4481-CP-1001
R4B

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1794-IB16
VOLTAGE	24Vdc
MODULE	01
RACK	02
PANEL	4481-CP-1001
TERMINAL BASE	1794-TB3S

A 0 1 2 3 4 5 6

SEE DWG. 1347-55286
25457-4480-V1A-MXAO-0102

X91
1+ 86-V10+ (3)
1- 86-V10- (2)

XDI0201

4481-MZAC-0002-ZS-01 — C — DI0201.0 — NO — 86-V10+
4481-MZAC-0002-ZS01-J1 (2C x 1,5mm2) +G
DI0201.0 — 1 — DI0201.0 (1)
86-V10+ — 86-V10+

4481-MZAC-0002-ZS-02 — C — DI0201.1 — NO — 86-V10+
4481-MZAC-0002-ZS02-J1 (2C x 1,5mm2)
DI0201.1 — 2 — DI0201.1 (4)
86-V10+ — 86-V10+

4481-MZAC-0002-ZS-03 — C — DI0201.2 — NO — 86-V10+
4481-MZAC-0002-ZS03-J1 (2C x 1,5mm2)
DI0201.2 — 3 — DI0201.2 (5)
86-V10+ — 86-V10+

4481-MZAC-0002-ZS-04 — C — DI0201.3 — NO — 86-V10+
4481-MZAC-0002-ZS04-J1 (2C x 1,5mm2)
DI0201.3 — 4 — DI0201.3 (6)
86-V10+ — 86-V10+

4481-MZAC-0002-ZS-05 — C — DI0201.4 — NO — 86-V10+
4481-MZAC-0002-ZS05-J1 (2C x 1,5mm2)
DI0201.4 — 5 — DI0201.4 (7)
86-V10+ — 86-V10+

4481-MZAC-0002-ZS-06 — C — DI0201.5 — NO — 86-V10+
4481-MZAC-0002-ZS06-J1 (2C x 1,5mm2) +G
DI0201.5 — 6 — DI0201.5 (8)
86-V10+ — 86-V10+

4481-MZAC-0002-HS-04
DI0201.6 — 7 — DI0201.6 (9)
86-V10+ — 86-V10+

4481-MZAC-0002-HS-05
DI0201.7 — 8 — DI0201.7 (10)
86-V10+ — 86-V10+

SEE DWG. 1347-53103

25457-4480-V1A-MXAO-0102
SEE DWG. 1347-55281
FROM LINE 10

4481-MZAC-0002-CP-01-J1 (19C x 1,5mm2) +G
1

86-V10+ — 34 — +24Vdc

DI0201.0 (1)	0	DI0201.0	4481-MZAC-0002-ZS-01 BLOCK LOCATED ON R4B CONVEYOR LIMIT SWITCH
86-V10- (2)	17		
86-V10+ (3)	35		
DI0201.1 (4)	1	DI0201.1	4481-MZAC-0002-ZS-02 STOPPER UP ON R4B PROXIMITY SWITCH
	36		
DI0201.2 (5)	2	DI0201.2	4481-MZAC-0002-ZS-03 STOPPER DOWN ON R4B PROXIMITY SWITCH
	37		
DI0201.3 (6)	3	DI0201.3	4481-MZAC-0002-ZS-04 R4B CONVEYOR UP PROXIMITY SWITCH
	38		
DI0201.4 (7)	4	DI0201.4	4481-MZAC-0002-ZS-05 R4B CONVEYOR DOWN PROXIMITY SWITCH
	39		
DI0201.5 (8)	5	DI0201.5	4481-MZAC-0002-ZS-06 BLOCK ON R4B FOR INSPECTION LIMIT SWITCH
	40		
DI0201.6 (9)	6	DI0201.6	4481-MZAC-0002-HS-04 INSPECTION COMPLETED PUSH BUTTON
	41		
DI0201.7 (10)	7	DI0201.7	4481-MZAC-0002-HS-05 POURING COMPLETED PUSH BUTTON
	42		

SEE DWG. 1347-53103

DRAWING NUMBER	TITLE
REFERENCES	

No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
1		UPDATE	10-MA-2011	F.P.	E.B.	C.C.

REVISIONS

NOTES

STATUS: FOR DESIGN

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Vendor or Subcontractor Logo:
GNA alutech inc. — Département Ingénierie, Engineering Department, 6400 Trans-Canada, Montréal (Québec), H4S 1A9, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SELLER DRAWING No.: 1347-53102 — REV.: 1

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT FLEX I/O (24 Vdc) RACK: 02 MODULE: 01 (1/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—		—	—	A3-		-AZ	

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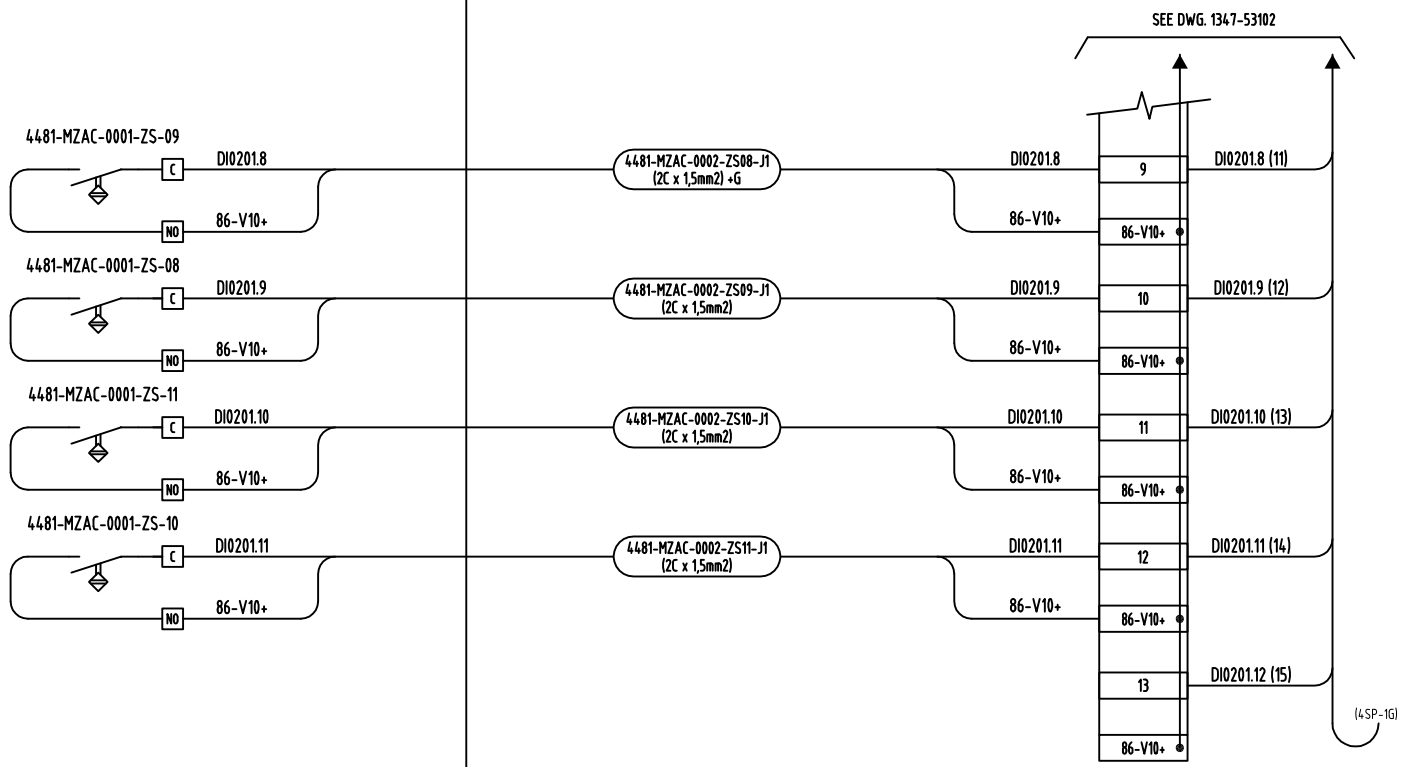
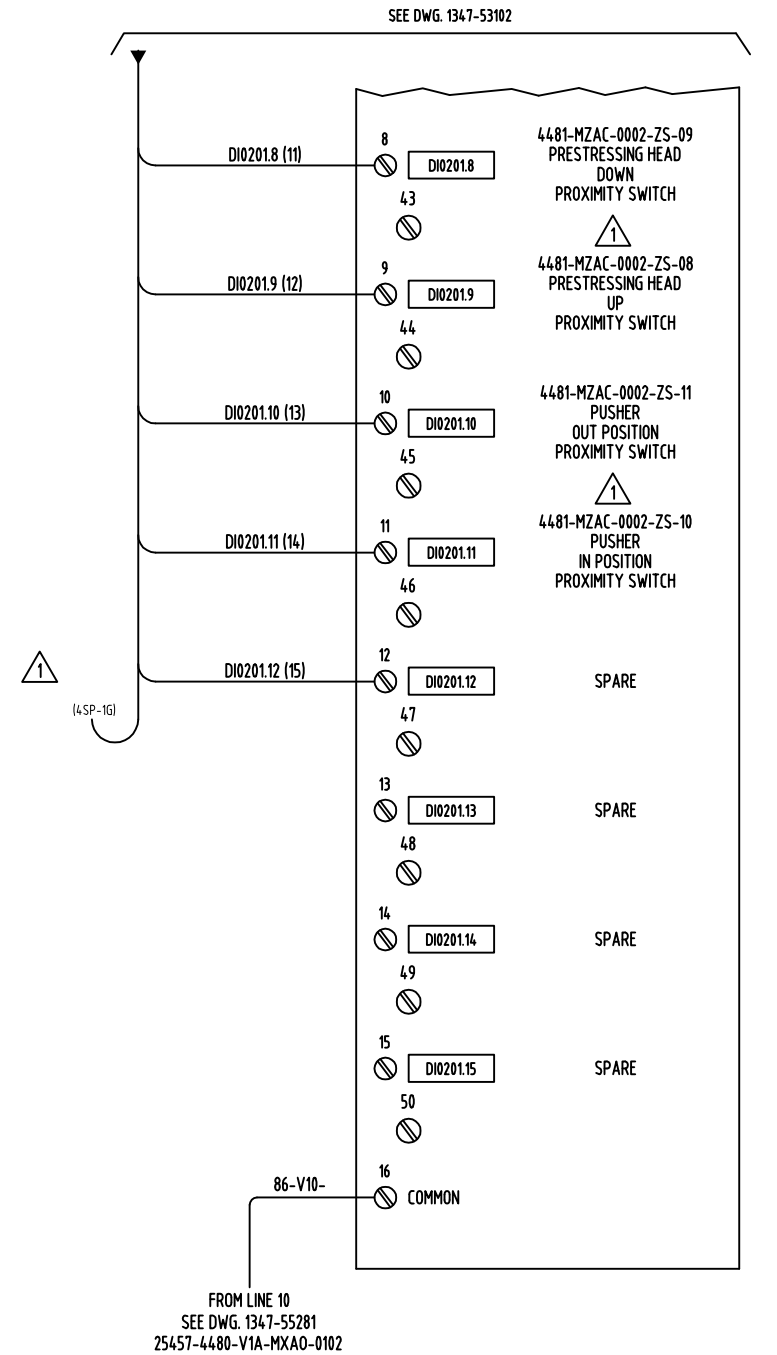
FIELD	LOCAL CONTROL PANEL 4481-MZAC-0002-CP-01 R4B	CENTRAL CONTROL PANEL 4481-CP-1001 R4B

A 0 1 2 3 4 5 6

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1794-IB16
VOLTAGE	24Vdc
MODULE	01
RACK	02
PANEL	4481-CP-1001
TERMINAL BASE	1794-TB3S





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REFERENCES		REVISIONS						
DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
		1		UPDATE	MR-16-11	F.P.	E.B.	M.B.

NOTES

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DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA inc. — Département Ingénierie / Engineering Department, 1111 Jacques-Cartier, Saint-Laurent, Québec, H4S 1V5, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SELLER DRAWING No. 1347-53103 REV. 1

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT FLEX I/O (24 Vdc) RACK: 02 MODULE: 01 (2/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—	—	A3-		-AZ	

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FIELD	JUNCTION BOX 4481-MJR0-0008-JB-01 R5/T1	CENTRAL CONTROL PANEL 4481-CP-1001 R5/T1

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1794-IB16
VOLTAGE	24Vdc
MODULE	02
RACK	02
PANEL	4481-CP-1001
TERMINAL BASE	1794-TB3S

A 0 1 2 3 4 5 6

25457-4480-V1A-MXA0-0102
SEE DWG. 1347-55281
FROM LINE 12

86-V12+ — 34 — +24Vdc

4481-MJR0-0008-ZS-01 — C / NO — DI0202.0 — 86-V12+
4481-MJR0-0008-ZS-02 — C / NO — DI0202.1 — 86-V12+
4481-MJR0-0008-ZS-03 — C / NO — DI0202.2 — 86-V12+
4481-MJUT-0001-ZS-04 — C / NO — DI0202.4 — 86-V12+
4481-MJUT-0001-ZS-05 — C / NO — DI0202.5 — 86-V12+
4481-MJUT-0001-ZS-06 — C / NO — DI0202.6 — 86-V12+

4481-MJR0-0008-ZS01-J1 (2C x 1,5mm2) +G
4481-MJR0-0008-ZS02-J1 (2C x 1,5mm2) +G
4481-MJR0-0008-ZS03-J1 (2C x 1,5mm2)
4481-MJUT-0001-ZS04-J1 (2C x 1,5mm2) +G
4481-MJUT-0001-ZS05-J1 (2C x 1,5mm2)
4481-MJUT-0001-ZS06-J1 (2C x 1,5mm2)

XDI0202

DI0202.0	1	DI0202.0 (1)
86-V12+	86-V12+	86-V12+ (2)
DI0202.1	2	DI0202.1 (3)
86-V12+	86-V12+	
DI0202.2	3	DI0202.2 (4)
86-V12+	86-V12+	
	4	DI0202.3 (5)
	86-V12+	
DI0202.4	5	DI0202.4 (6)
86-V12+	86-V12+	
DI0202.5	6	DI0202.5 (7)
86-V12+	86-V12+	
DI0202.6	7	DI0202.6 (8)
86-V12+	86-V12+	
	8	DI0202.7 (9)
	86-V12+	

SEE DWG. 1347-53105

4481-MJR0-0008-JB-01-J1 (26C x 1,5mm2) +G — 1

DI0202.0 (1)	0	DI0202.0	4481-MJR0-0008-ZS-01 BLOCK ON R5 FOR COOLING LIMIT SWITCH
86-V12+ (2)	35		
DI0202.1 (3)	1	DI0202.1	4481-MJR0-0008-ZS-02 BLOCK LOCATED ON R5 CONVEYOR LIMIT SWITCH
	36		
DI0202.2 (4)	2	DI0202.2	4481-MJR0-0008-ZS-03 PUSHER RETRACTED PROXIMITY SWITCH
	37		
DI0202.3 (5)	3	DI0202.3	SPARE
	38		
DI0202.4 (6)	4	DI0202.4	4481-MJUT-0001-ZS-04 BLOCK ON T1 FIRST STAGE LIMIT SWITCH
	39		
DI0202.5 (7)	5	DI0202.5	4481-MJUT-0001-ZS-05 FIRST STAGE TILTING FORWARD PROXIMITY SWITCH
	40		
DI0202.6 (8)	6	DI0202.6	4481-MJUT-0001-ZS-06 FIRST STAGE TILTING BACKWARD PROXIMITY SWITCH
	41		
DI0202.7 (9)	7	DI0202.7	SPARE
	42		

SEE DWG. 1347-53105

REFERENCES		REVISIONS					
DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
		1		UPDATE	10-MA-2011	F.P.	E.B.	C.C.

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Vendor or Subcontractor Logo: GNA ekatech inc. — Département Ingénierie, Engineering Department, 6405 Trans-Canada, Montmorency, Québec, G4X 1V7, Canada

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	XX -	XXXX -	XXXX -	XXX -	XXX

SELLER DRAWING No.: 1347-53104 REV.: 1

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT FLEX I/O (24 Vdc) RACK: 02 MODULE: 02 (1/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—		—	—	A3-		-AZ	

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FIELD

JUNCTION BOX
4481-MJR0-0008-JB-01 R5/T1

CENTRAL CONTROL PANEL
4481-CP-1001 R3/T1

A 0 1 2 3 4 5 6

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1794-IB16
VOLTAGE	24Vdc
MODULE	02
RACK	02
PANEL	4481-CP-1001
TERMINAL BASE	1794-TB3S

SEE DWG. 1347-53104

4481-MJUT-0001-ZS-08
C
NO
DI0202.8
86-V12+
4481-MJUT-0001-ZS08-J1
(2C x 1,5mm2)
DI0202.8
86-V12+
9
86-V12+
DI0202.8 (10)

4481-MJUT-0001-ZS-09
C
NO
DI0202.9
86-V12+
4481-MJUT-0001-ZS09-J1
(2C x 1,5mm2)
DI0202.9
86-V12+
10
86-V12+
DI0202.9 (11)

LOCAL CONTROL PANEL
4481-MJR0-0006-CP-01 R3

4481-MJR0-0006-ZS-01
C
NO
DI0202.12
86-V12+
4481-MJR0-0006-ZS01-J1
(2C x 1,5mm2) +G
XDI0202
DI0202.12
86-V12+
1
86-V12+
DI0202.12 (1)
2
86-V12+
DI0202.13 (4)

92-CR2
43
44
DI0202.14
86-V12+
3
86-V12+
DI0202.14 (5)

92-CR11
11
14
DI0202.15
86-V12+
4
86-V12+
DI0202.15 (6)

SEE DWG. 1347-55287
25457-4480-V1A-MXA0-0102

X92
1+
86-V12+ (3)
1-
86-V12- (2)

4481-MJR0-0006-CP-01-J1
(19C x 1,5mm2) +G
1

SEE DWG. 1347-53104

DI0202.8 (10)	8	DI0202.8	4481-MJUT-0001-ZS-08 SECOND STAGE TILTING FORWARD PROXIMITY SWITCH
	43		
DI0202.9 (11)	9	DI0202.9	4481-MJUT-0001-ZS-09 SECOND STAGE TILTING BACKWARD PROXIMITY SWITCH
	44		
	10	DI0202.10	SPARE
	45		
	11	DI0202.11	SPARE
	46		
DI0202.12 (1)	12	DI0202.12	4481-MJR0-0006-ZS-01 BLOCK ON R3 FOR COOLING LIMIT SWITCH
86-V12- (2)	29		
86-V12+ (3)	47		
DI0202.13 (4)	13	DI0202.13	SPARE
	48		
DI0202.14 (5)	14	DI0202.14	92-CR2 R3, R5, T1, C4 ZONE ACCESS REQUEST RELAY
	49		
DI0202.15 (6)	15	DI0202.15	92-CR11 R3, R5, T1, C4 ZONE KEY SOLENOID ON RELAY
	50		
86-V12-	16	COMMON	

FROM LINE 12
SEE DWG. 1347-55281
25457-4480-V1A-MXA0-0102

No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
1		UPDATE	10-MA-2011	F.P.	E.B.	C.C.

REVISIONS

DRAWING NUMBER | TITLE | REFERENCES

NOTES

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DATE:		DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA ststech inc. — Département Ingénierie / Engineering Department, 1600 Trans-Canada, Dorval, Québec, H4S 1Y9, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No | SUBD. | DISC. | SECTOR | SEQUENCE | REV.
25457-00AZ- xx - xxxx - xxxx - xxx - xxx

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SELLER DRAWING No. 1347-53105 REV. 1

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT FLEX I/O (24 Vdc) RACK: 02 MODULE: 02 (2/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type | Building | Discipline | Phase | Format | Sequential | Location | Rev. No.
– – – A3– –AZ

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R4A	CENTRAL CONTROL PANEL 4481-CP-1001	LOCAL CONTROL PANEL 4481-MZAC-0001-CP-01	R4A	FIELD

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL OUTPUT
MODEL	1794-OB8EP
VOLTAGE	24Vdc
MODULE	03
RACK	02
PANEL	4481-CP-1001
TERMINAL BASE	1794-TB3S

A 0 1 2 3 4 5 6

FROM LINE 14
SEE DWG: 1347-55281
25457-4480-V1A-MXAO-0102

34 +24Vdc — 86-V14A

4481-MZAC-0001-FY-01
LOWER STOPPER ON R4A
SOLENOID VALVE (PN.)
DO0203.0 — 0 — DO0203.0 (1) — 4481-MZAC-0001-CP-01-J3 (12C x 1,5mm2) — 2
17
1 — 86-V14- (2)
18

4481-MZAC-0001-FY-02
RAISE STOPPER ON R4A
SOLENOID VALVE (PN.)
DO0203.1 — 2 — DO0203.1 (3)
19
3
20

4481-MZAC-0001-FY-03
LOWER
R4A CONVEYOR
SOLENOID VALVE (HYD.)
DO0203.2 — 4 — DO0203.2 (4)
21
5
22

4481-MZAC-0001-FY-04
RAISE
R4A CONVEYOR
SOLENOID VALVE (HYD.)
DO0203.3 — 6 — DO0203.3 (5)
23
7
24

SEE DWG. 1347-54101

XDO0203

DO0203.0 (1) — 1 — DO0203.0 — 4481-MZAC-0001-FY01-J1 (3C x 1,5mm2) +G
86-V14- (2) — 86-V14- — 86-V14-

DO0203.1 (3) — 2 — DO0203.1

DO0203.2 (4) — 3 — DO0203.2 — 4481-MZAC-0001-FY03-J1 (2C x 1,5mm2) +G
86-V14- — 86-V14-

DO0203.3 (5) — 4 — DO0203.3 — 4481-MZAC-0001-FY04-J1 (2C x 1,5mm2) +G
86-V14- — 86-V14-

SEE DWG. 1347-54101

4481-MZAC-0001-FY-01
DO0203.0 — 1 — 2
4481-MZAC-0001-FY-02
DO0203.1 — 4 — 3
86-V14-

4481-MZAC-0001-FY-03
DO0203.2 — + —
86-V14- — -

4481-MZAC-0001-FY-04
DO0203.3 — + —
86-V14- — -

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2		UPDATE	11-JL-2011	F.P.	E.B.	C.C.
1		UPDATE	10-MA-2011	F.P.	E.B.	C.C.

DRAWING NUMBER | TITLE
REFERENCES | REVISIONS

NOTES

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DATE:		DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA Automation inc. — Département Ingénierie / Engineering Department, 1600 Trans-Canada, Dorval, Québec, H4S 1A9, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx	xxxx	xxxx	xxx	xxx

SELLER DRAWING No.: 1347-54100 — REV.: 2

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL OUTPUT FLEX I/O (24 Vdc) RACK: 02 MODULE: 03 (1/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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R4A	CENTRAL CONTROL PANEL 4481-CP-1001	LOCAL CONTROL PANEL 4481-MZAC-0001-CP-01	R4A	FIELD

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL OUTPUT
MODEL	1794-OB8EP
VOLTAGE	24Vdc
MODULE	03
RACK	02
PANEL	4481-CP-1001
TERMINAL BASE	1794-TB3S

A 0 1 2 3 4 5 6

SEE DWG. 1347-54100

4481-MZAC-0001-FY-05
RAISE PRESTRESSING HEAD
SOLENOID VALVE (PN.)
DO0203.4 — 8 — DO0203.4 (6)
25
9
26

4481-MZAC-0001-FY-06
LOWER PRESTRESSING HEAD
SOLENOID VALVE (PN.)
DO0203.5 — 10 — DO0203.5 (7)
27
11
28

4481-MZAC-0001-FY-07
RETRACT PUSHER
ON R4A
SOLENOID VALVE (HYD.)
DO0203.6 — 12 — DO0203.6 (8)
29
13
30

4481-MZAC-0001-FY-08
ADVANCE PUSHER
ON R4A
SOLENOID VALVE (HYD.)
DO0203.7 — 14 — DO0203.7 (9)
31
15
32

16 COMMON — 86-V14-

FROM LINE 14
SEE DWG. 1347-55281
25457-4480-V1A-MXA0-0102

SEE DWG. 1347-54100

XDI0200
86-V8+ — 86-V8+

OFF-RAISE
PRESTRESSING HEAD
90-HS25
86-V8+ — DO0203.4A

X90

DO0203.4 (6) — 5 — DO0203.4 — DO0203.4A — 25 — DO0203.4A — 4481-MZAC-0001-FY05-J1 (3C x 1,5mm2) +G — DO0203.4A — 1 — 2 — 4481-MZAC-0001-FY-05

DO0203.5 (7) — 6 — DO0203.5 — DO0203.5A — 26 — DO0203.5A — DO0203.5A — 4 — 3 — 4481-MZAC-0001-FY-06

86-V14- — 86-V14-

DO0203.6 (8) — 7 — DO0203.6 — 4481-MZAC-0001-FY07-J1 (2C x 1,5mm2) +G — DO0203.6 — + — 4481-MZAC-0001-FY-07
86-V14- — 86-V14- — -

DO0203.7 (9) — 8 — DO0203.7 — 4481-MZAC-0001-FY08-J1 (2C x 1,5mm2) +G — DO0203.7 — + — 4481-MZAC-0001-FY-08
86-V14- — 86-V14- — -

(3SP) — (3SP)

No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
1		UPDATE	10-MA-2011	F.P.	E.B.	C.C.

DRAWING NUMBER | TITLE | REFERENCES | REVISIONS

NOTES

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DATE:		DATE:	
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DATE:			

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Vendor or Subcontractor Logo: GNA alutech inc. — Département Ingénierie Engineering Department 5695 Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No | SUBD. | DISC. | SECTOR | SEQUENCE | REV.
25457-00AZ- xx - xxxx - xxxx - xxx — xxx

SELLER DRAWING No. 1347-54101 | REV. 1

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL OUTPUT FLEX I/O (24 Vdc) RACK: 02 MODULE: 03 (2/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN

Type | Building | Discipline | Phase | Format | Sequential | Location | Rev. No.
— | — | — | — | A3 | — | AZ |

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R4B	CENTRAL CONTROL PANEL 4481-CP-1001	LOCAL CONTROL PANEL 4481-MZAC-0002-CP-01	R4B	FIELD

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL OUTPUT
MODEL	1794-OB8EP
VOLTAGE	24Vdc
MODULE	04
RACK	02
PANEL	4481-CP-1001
TERMINAL BASE	1794-TB3S

A 0 1 2 3 4 5 6

FROM LINE 16
SEE DWG: 1347-55281
25457-4480-V1A-MXAO-0102

34 +24Vdc — 86-V16A

4481-MZAC-0002-FY-01
LOWER STOPPER ON R4B
SOLENOID VALVE (PN.)
DO0204.0 — 0 — DO0204.0 (1) — 4481-MZAC-0002-CP-01-J3 (12C x 1,5mm2) — 2
17
1 — 86-V16- (2)
18

4481-MZAC-0002-FY-02
RAISE STOPPER ON R4B
SOLENOID VALVE (PN.)
DO0204.1 — 2 — DO0204.1 (3)
19
3
20

4481-MZAC-0002-FY-03
LOWER
R4B CONVEYOR
SOLENOID VALVE (HYD.)
DO0204.2 — 4 — DO0204.2 (4)
21
5
22

4481-MZAC-0002-FY-04
RAISE
R4B CONVEYOR
SOLENOID VALVE (HYD.)
DO0204.3 — 6 — DO0204.3 (5)
23
7
24

SEE DWG. 1347-54103

XDO0204

DO0204.0 (1) — 1 — DO0204.0 — 4481-MZAC-0002-FY01-J1 (3C x 1,5mm2) +G
86-V16- (2) — 86-V16- — 86-V16-

DO0204.1 (3) — 2 — DO0204.1

DO0204.2 (4) — 3 — DO0204.2 — 4481-MZAC-0002-FY03-J1 (2C x 1,5mm2) +G
86-V16- — 86-V16-

DO0204.3 (5) — 4 — DO0204.3 — 4481-MZAC-0002-FY04-J1 (2C x 1,5mm2) +G
86-V16- — 86-V16-

SEE DWG. 1347-54103

4481-MZAC-0002-FY-01
DO0204.0 — 1 — 2
4481-MZAC-0002-FY-02
DO0204.1 — 4 — 3
86-V16-

4481-MZAC-0002-FY-03
DO0204.2 — + —
86-V16- — -

4481-MZAC-0002-FY-04
DO0204.3 — + —
86-V16- — -

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SELLER DRAWING No. 1347-54102 — REV. 2

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2		UPDATE	11-JL-2011	F.P.	E.B.	C.C.
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DRAWING NUMBER | TITLE | REFERENCES | REVISIONS

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DATE:		DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA Automation inc. — Département Ingénierie / Engineering Department, 1600 Trans-Canada, Dorval, Québec, H4S 1A9, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL OUTPUT FLEX I/O (24 Vdc) RACK: 02 MODULE: 04 (1/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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R4B	CENTRAL CONTROL PANEL 4481-CP-1001	LOCAL CONTROL PANEL 4481-MZAC-0002-CP-01	R4B	FIELD

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL OUTPUT
MODEL	1794-OB8EP
VOLTAGE	24Vdc
MODULE	04
RACK	02
PANEL	4481-CP-1001
TERMINAL BASE	1794-TB3S

A 0 1 2 3 4 5 6

SEE DWG. 1347-54102

4481-MZAC-0002-FY-05
RAISE PRESTRESSING HEAD
SOLENOID VALVE (PN.)
DO0204.4 — 8 — DO0204.4 (6)
25
9
26

4481-MZAC-0002-FY-06
LOWER PRESTRESSING HEAD
SOLENOID VALVE (PN.)
DO0204.5 — 10 — DO0204.5 (7)
27
11
28

4481-MZAC-0002-FY-07
RETRACT PUSHER
ON R4B
SOLENOID VALVE (HYD.)
DO0204.6 — 12 — DO0204.6 (8)
29
13
30

4481-MZAC-0002-FY-08
ADVANCE PUSHER
ON R4B
SOLENOID VALVE (HYD.)
DO0204.7 — 14 — DO0204.7 (9) — 1 — (3SP)
31
15
32

COMMON — 16 — 86-V16-

FROM LINE 16
SEE DWG. 1347-55281
25457-4480-V1A-MXA0-0102

SEE DWG. 1347-54102

XDI0201
86-V10+ — 86-V10+

OFF-RAISE
PRESTRESSING HEAD
91-HS25
86-V10+ — DO0204.4A

X91

DO0204.4 (6) — 5 — DO0204.4 — DO0204.4A — 25 — DO0204.4A — 4481-MZAC-0002-FY05-J1 (3C x 1,5mm2) +G
DO0204.5 (7) — 6 — DO0204.5 — DO0204.5A — 26 — DO0204.5A
86-V16-

DO0204.6 (8) — 7 — DO0204.6 — 4481-MZAC-0002-FY07-J1 (2C x 1,5mm2) +G
86-V16-

DO0204.7 (9) — 8 — DO0204.7 — 4481-MZAC-0002-FY08-J1 (2C x 1,5mm2) +G
86-V16-
(3SP)

4481-MZAC-0002-FY-05
DO0204.4A — 1 — 2
4481-MZAC-0002-FY-06
DO0204.5A — 4 — 3
86-V16-

4481-MZAC-0002-FY-07
DO0204.6 — + — -
86-V16-

4481-MZAC-0002-FY-08
DO0204.7 — + — -
86-V16-

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DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA Automation inc. — Département Ingénierie / Engineering Department, 1600 Trans-Canada, Dorval (Québec) H9P 2V4, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx	xxxx	xxxx	xxx	xxx

SELLER DRAWING No.: 1347-54103 — REV.: 1

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL OUTPUT FLEX I/O (24 Vdc) RACK: 02 MODULE: 04 (2/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—	—	A3–		–AZ	

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R5/T1	CENTRAL CONTROL PANEL 4481-CP-1001	JUNCTION BOX 4481-MJR0-0008-JB-01	R5/T1	FIELD

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL OUTPUT
MODEL	1794-OB8EP
VOLTAGE	24Vdc
MODULE	05
RACK	02
PANEL	4481-CP-1001
TERMINAL BASE	1794-TB3S

A 0 1 2 3 4 5 6

FROM LINE 18
SEE DWG. 1347-55281
25457-4480-V1A-MXA0-0102

34 +24Vdc — 86-V18A

4481-MJR0-0008-FY-01
ADVANCE BLOCK ON T1
SOLENOID VALVE (HYD.)
DO0205.0 — 0 — DO0205.0 (12) — 4481-MJR0-0008-JB-01-J1 (26C x 1,5mm2) +G — 1
17
1 — 86-V18- (13)

4481-MJUT-0001-FY-02
FORWARD TILT
1st STAGE
SOLENOID VALVE (HYD.)
DO0205.1 — 2 — DO0205.1 (14)
18
19
3
20

4481-MJUT-0001-FY-03
BACKWARD TILT
1st STAGE
SOLENOID VALVE (HYD.)
DO0205.2 — 4 — DO0205.2 (15)
21
5
22

4481-MJUT-0001-FY-04
FORWARD TILT
2nd STAGE
SOLENOID VALVE (HYD.)
DO0205.3 — 6 — DO0205.3 (16)
23
7
24

SEE DWG. 1347-54105

XDO0205

DO0205.0 (12)	1	86-V18-	DO0205.0	4481-MJR0-0008-FY01-J1 (2C x 1,5mm2) +G
86-V18- (13)			86-V18-	
DO0205.1 (14)	2	86-V18-	DO0205.1	4481-MJUT-0001-FY02-J1 (2C x 1,5mm2) +G
DO0205.2 (15)	3	86-V18-	DO0205.2	4481-MJUT-0001-FY03-J1 (2C x 1,5mm2) +G
DO0205.3 (16)	4	86-V18-	DO0205.3	4481-MJUT-0001-FY04-J1 (2C x 1,5mm2) +G

SEE DWG. 1347-54105

4481-MJR0-0008-FY-01: DO0205.0 (+), 86-V18- (-)
4481-MJUT-0001-FY-02: DO0205.1 (+), 86-V18- (-)
4481-MJUT-0001-FY-03: DO0205.2 (+), 86-V18- (-)
4481-MJUT-0001-FY-04: DO0205.3 (+), 86-V18- (-)

DRAWING NUMBER	TITLE
REFERENCES	

No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
1		UPDATE	10-MA-2011	F.P.	E.B.	C.C.

REVISIONS

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DATE:		DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA alutech inc. — Département Ingénierie, Engineering Department, 1496 Trans-Canada, Dorval (Québec), H9P 2N4, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

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SELLER DRAWING No.: 1347-54104 — REV.: 1

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL OUTPUT FLEX I/O (24 Vdc) RACK: 02 MODULE: 05 (1/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—		—	—	A3-		-AZ	

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T1	CENTRAL CONTROL PANEL 4481-CP-1001	JUNCTION BOX 4481-MJR0-0008-JB-01 R5/T1	FIELD

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL OUTPUT
MODEL	1794-OB8EP
VOLTAGE	24Vdc
MODULE	05
RACK	02
PANEL	4481-CP-1001
TERMINAL BASE	1794-TB3S

A 0 1 2 3 4 5 6

SEE DWG. 1347-54104

4481-MJUT-0001-FY-05
BACKWARD TILT
2nd STAGE
SOLENOID VALVE (HYD.)

	DO0205.4	8	DO0205.4 (17)
		25	
		9	
		26	
SPARE	DO0205.5	10	DO0205.5 (18)
		27	
		11	
		28	
SPARE	DO0205.6	12	
		29	
		13	
		30	
SPARE	DO0205.7	14	
		31	
		15	
		32	
COMMON		16	86-V18-

1 (8SP-1G)

FROM LINE 18
SEE DWG. 1347-55281
25457-4480-V1A-MXA0-0102

SEE DWG. 1347-54104

DO0205.4 (17) → 5 → DO0205.4 → 4481-MJUT-0001-FY05-J1 (2C x 1,5mm2) +G → 4481-MJUT-0001-FY-05: DO0205.4 (+), 86-V18- (-)

86-V18- → 86-V18-

DO0205.5 (18) → 6 → 86-V18-

(8SP-1G)

DRAWING NUMBER	TITLE	1		UPDATE	10-MA-2011	F.P.	E.B.	C.C.
		No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		REVISIONS						

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DATE:		DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA allutech inc. — Département Ingénierie / Engineering Department, 5490 Trans-Canada, Salaberry-de-Valleyfield, Québec, J6S 5V3, Canada

BECHTEL

Project Title: **Ras Az Zawr Aluminium Smelter**

PROJ. No | SUBD. | DISC. | SECTOR | SEQUENCE | REV.
25457-00AZ- xx - xxxx - xxxx - xxx — xxx

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SELLER DRAWING No. 1347-54105 | REV. 1

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL OUTPUT FLEX I/O (24 Vdc) RACK: 02 MODULE: 05 (2/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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C4	CENTRAL CONTROL PANEL 4481-CP-1001	LOCAL CONTROL PANEL 4481-MHCD-0004-CP-01 C4	FIELD

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL OUTPUT
MODEL	1794-OB8EP
VOLTAGE	24Vdc
MODULE	06
RACK	02
PANEL	4481-CP-1001
TERMINAL BASE	1794-TB3S

A 0 1 2 3 4 5 6

FROM LINE 20
SEE DWG. 1347-55281
25457-4480-V1A-MXA0-0102

34 +24Vdc — 86-V20A

4481-MHCD-0004-HA-01
C4 CONVEYOR
MOTION WARNING
HORN

DO0206.0 — 0 — DO0206.0 (5) — 4481-MHCD-0004-CP-01-J1 (19C x 1,5mm2) +G

17 — 1 — 86-V20- (6) — 18

4481-MHCD-0004-HL-01
C4 CONVEYOR
MOTION WARNING
LIGHT

DO0206.1 — 2 — DO0206.1 (7) — 19 — 3 — 20

4481-MHCD-0004-YL-01
C4 ZONE
ACCESS REQUEST
LIGHT

DO0206.2 — 4 — DO0206.2 (8) — 21 — 5 — 22

SPARE

DO0206.3 — 6 — 23 — 7 — 24

SEE DWG. 1347-54107

XDO0206

DO0206.0 (5) — 1 — DO0206.0 — 4481-MHCD-0004-HA01-J1 (3C x 1,5mm2) +G

DO0206.1 (7) — 2 — DO0206.1

86-V20- (6) — 86-V20- — 86-V20-

DO0206.2 (8) — 3 — DO0206.2 (4) — 4481-MHCD-0004-CP-02-J1 (7C x 1,5mm2) +G

86-V20- — 86-V20- (5)

(2SP-1G) — 2

4481-MHCD-0004-HA-01
DO0206.0 — + —

4481-MHCD-0004-HL-01
DO0206.1 — +

86-V20- — -

LOCAL CONTROL PANEL
4481-MHCD-0004-CP-02 C4

XDO0206

4481-MHCD-0004-YL-01
DO0206.2 (4) — 1 — DO0206.2

86-V20- (5) — 86-V20- — 86-V20-

(2SP-1G) — 2

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SELLER DRAWING No. 1347-54106 REV. 2

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
		2		UPDATE	15-AU-2011	F.P.	E.B.	C.C.
		1		UPDATE	10-MA-2011	F.P.	E.B.	C.C.

REFERENCES — REVISIONS

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DATE:	DATE:
RESPONSIBLE ENG. M.B.	CLIENT:
DATE:	DATE:
ENG. GROUP SUP.	DRAWING SCALE: NONE
DATE:	

Vendor or Subcontractor Logo: GNA a.i.Tech inc. Département Ingénierie Engineering Department 9490 Trans-Canada Saint-Laurent, Quebec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No | SUBD. | DISC. | SECTOR | SEQUENCE | REV.
25457-00AZ- xx - xxxx - xxxx - xxx - xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL OUTPUT FLEX I/O (24 Vdc) RACK: 02 MODULE: 06 (1/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN

Type | Building | Discipline | Phase | Format | Sequential | Location | Rev. No.
— | — | — | A3- | -AZ

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R3	CENTRAL CONTROL PANEL 4481-CP-1001	LOCAL CONTROL PANEL 4481-MJR0-0006-CP-01	R3	FIELD

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL OUTPUT
MODEL	1794-OB8EP
VOLTAGE	24Vdc
MODULE	06
RACK	02
PANEL	4481-CP-1001
TERMINAL BASE	1794-TB3S

A 0 1 2 3 4 5 6

SEE DWG. 1347-54106

92-YL5
R3, R5, T1, C4 ZONE
ACCESS REQUEST
LIGHT

DO0206.4 — 8 — DO0206.4 (7) — 4481-MJR0-0006-CP-01-J1 (19C x 1,5mm2) +G — 1 — XD00206 1 — DO0206.4 — 92-YL5

25

9 — 86-V20- (8) — 86-V20- (8) — 86-V20- — 86-V20-

26

CR-0206.5
R3, R5, T1, C4 ZONE
ACCESS AUTHORIZED
RELAY

DO0206.5 — 10 — DO0206.5 — A1 — DO0206.5 — A2

R3, R5, T1, C4 ZONE
ACCESS AUTHORIZED
92-V6B (10) — DO0206.5 — 14 — 11 — 92-V6A (9)

SEE DWG. 1347-55287
25457-4480-V1A-MXA0-0102

27

11 — 86-V20- — X92 — 92-V6A (9) — 6A — 92-V6B (10) — 6B

28

SPARE

DO0206.6 — 12

29

13

30

87-UA6
AUDIO
ALARM

DO0206.7 — 14 — DO0206.7 — 87-UA6

31

15 — 86-V20-

32

COMMON — 16 — 86-V20-

FROM LINE 20
SEE DWG. 1347-55281
25457-4480-V1A-MXA0-0102

No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
1		UPDATE	10-MA-2011	F.P.	E.B.	C.C.

REVISIONS

DRAWING NUMBER | TITLE

REFERENCES

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DATE:			

Vendor or Subcontractor Logo: GNA alutech inc. — Département Ingénierie / Engineering Department, 5690 Trans-Canada, Dorval, Québec, H4S 1V9, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No | SUBD. | DISC. | SECTOR | SEQUENCE | REV.
25457-00AZ- xx - xxxx - xxxx - xxx — xxx

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SELLER DRAWING No. 1347-54107 | REV. 1

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL OUTPUT FLEX I/O (24 Vdc) RACK: 02 MODULE: 06 (2/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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1	14	1347-54203-01	DIGITAL OUTPUT FLEX I/O (24 VDC) RACK: 03 MODULE: 05 (2/2) I/O INTERCONNECTION DIAGRAM
	15	1347-54204-00	DIGITAL OUTPUT FLEX I/O (24 VDC) RACK: 03 MODULE: 06 (1/2) I/O INTERCONNECTION DIAGRAM
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Discipline :

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Vendor or Subcontractor Logo: GNA alTech inc. — Département Ingénierie / Engineering Department, 9400 Trans-Canada, Saint-Laurent, Québec H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

SELLER DRAWING No.: 1347-FLEX 03 I&O — REV.: 2

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
I/O INTERCONNECTION DIAGRAMS
REMOTE RACK 03 (G1)

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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FIELD

JUNCTION BOX
4481-MJR0-0004-JB-01

R6

LOCAL CONTROL PANEL
4481-MQLK-0001-CP-01

R6/G1

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1794-IB16
VOLTAGE	24Vdc
MODULE	00
RACK	03
PANEL	4481-MQLK-0001-CP-01
TERMINAL BASE	1794-TB3S

A 0 1 2 3 4 5 6 7

FROM LINE 08
SEE DWG. 1347-55311
25457-4480-V1A-MXA0-0103

EMITTER — 4481-MJR0-0004-ZSE-01 — GRAY CABLE — 4481-MJR0-0004-ZSE01-J1 (2C x 1,5mm2) — GRAY CABLE

RECEIVER — 4481-MJR0-0004-ZSR-01 — BLACK CABLE — 4481-MJR0-0004-ZSR01-J1 (2C x 1,5mm2) — BLACK CABLE

ZS-01: WHITE 5 → 2; BLACK 7 → 3; WHITE 6 → 1; BLACK 8 → 4; 10

XDI0300

4481-MJR0-0004-ZS-02: C — DI0300.1; NO — 103-V8+ — 4481-MJR0-0004-ZS02-J1 (2C x 1,5mm2)

4481-MJR0-0004-ZS-03: C — DI0300.2; NO — 103-V8+ — 4481-MJR0-0004-ZS03-J1 (2C x 1,5mm2)

4481-MJR0-0004-ZS-04: C — DI0300.3; NO — 103-V8+ — 4481-MJR0-0004-ZS04-J1 (2C x 1,5mm2)

4481-MQLK-0001-ZS-19: C — DI0300.5; NO — 103-V8+ — 4481-MQLK-0001-ZS19-J1 (2C x 1,5mm2)

4481-MQLK-0001-ZS-18: C — DI0300.6; NO — 103-V8+ — 4481-MQLK-0001-ZS18-J1 (2C x 1,5mm2)

4481-MQLK-0001-ZS-17: C — DI0300.7; NO — 103-V8+ — 4481-MQLK-0001-ZS17-J1 (2C x 1,5mm2)

XDI0300			
103-V8+	103-V8+	103-V8+ (3)	4481-MJR0-0004-JB01-J1 (18C x 1,5mm2) +G
DI0300.0	1	DI0300.0 (1)	
103-V8-	103-V8-	103-V8- (2)	
DI0300.1	2	DI0300.1 (4)	
103-V8+	103-V8+		
DI0300.2	3	DI0300.2 (5)	
103-V8+	103-V8+		
DI0300.3	4	DI0300.3 (6)	
103-V8+	103-V8+		
	5	DI0300.4 (7)	
	103-V8+		

103-V8+	34	+24Vdc	
DI0300.0 (1)	0	DI0300.0	4481-MJR0-0004-ZS-01 BAR ON 2nd STOPPER OF R6 INF.RED EMITTER/RECEIVER
103-V8- (2)	17		
103-V8+ (3)	35		
DI0300.1 (4)	1	DI0300.1	4481-MJR0-0004-ZS-02 BAR ON 1st STOPPER OF R6 PROXIMITY SWITCH
	36		
DI0300.2 (5)	2	DI0300.2	4481-MJR0-0004-ZS-03 2nd STOPPER UP ON R6 PROXIMITY SWITCH
	37		
DI0300.3 (6)	3	DI0300.3	4481-MJR0-0004-ZS-04 2nd STOPPER DOWN ON R6 PROXIMITY SWITCH
	38		
DI0300.4 (7)	4	DI0300.4	SPARE
	39		
DI0300.5	5	DI0300.5	4481-MQLK-0001-ZS-19 G1 OVER R2 TO PLACE THE BARS PROXIMITY SWITCH
103-V8+	40		
DI0300.6	6	DI0300.6	4481-MQLK-0001-ZS-18 G1 LEAVE R2 TO OPEN CLAMPS PROXIMITY SWITCH
103-V8+	41		
DI0300.7	7	DI0300.7	4481-MQLK-0001-ZS-17 G1 OVER A1 ALIGNMENT STATION PROXIMITY SWITCH
103-V8+	42		

SEE DWG. 1347-53201

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Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

SELLER DRAWING No. 1347-53200 — REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT FLEX I/O (24 Vdc) RACK: 03 MODULE: 00 (1/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—		—	—	A3—		—AZ	

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FIELD

LOCAL CONTROL PANEL
4481-MQLK-0001-CP-01

A1/G1

A 0 1 2 3 4 5 6 7

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1794-IB16
VOLTAGE	24Vdc
MODULE	00
RACK	03
PANEL	4481-MQLK-0001-CP-01
TERMINAL BASE	1794-TB3S

SEE DWG. 1347-53200

4481-MQLK-0001-ZS-16 — C / NO — DI0300.8 — 103-V8+
4481-MQLK-0001-ZS-15 — C / NO — DI0300.9 — 103-V8+
4481-MQLK-0001-ZS-14 — C / NO — DI0300.10 — 103-V8+
4481-MQLK-0001-ZS-21 — C / NO — DI0300.0 — 103-V8+
4481-MQLK-0001-ZS-22 — C / NO — DI0300.1 — 103-V8+
4481-MQLK-0001-ZS-23 — C / NO — DI0300.2 — 103-V8+
4481-MQLK-0001-ZS-24 — C / NO — DI0300.3 — 103-V8+

JUNCTION BOX
4481-MQLK-0001-JB-01

A1

XDI0300

4481-MQLK-0001-ZS21-J1 (2C x 1,5mm2)	DI0300.11	1	DI0300.11 (1)
	103-V8+	103-V8+	103-V8+ (2)
4481-MQLK-0001-ZS22-J1 (2C x 1,5mm2)	DI0300.12	2	DI0300.12 (3)
	103-V8+	103-V8+	
4481-MQLK-0001-ZS23-J1 (2C x 1,5mm2)	DI0300.13	3	DI0300.13 (4)
	103-V8+	103-V8+	
4481-MQLK-0001-ZS24-J1 (2C x 1,5mm2)	DI0300.14	4	DI0300.14 (5)
	103-V8+	103-V8+	
		5	DI0300.15 (6)
		103-V8+	

4481-MQLK-0001-ZS16-J1 (2C x 1,5mm2)	DI0300.8	8	DI0300.8 — 4481-MQLK-0001-ZS-16 G1 OVER R6 TO PICK UP 2nd SET OF BARS PROXIMITY SWITCH
	103-V8+	43	
4481-MQLK-0001-ZS15-J1 (2C x 1,5mm2)	DI0300.9	9	DI0300.9 — 4481-MQLK-0001-ZS-15 G1 OVER R6 TO PICK UP 1st SET OF BARS PROXIMITY SWITCH
	103-V8+	44	
4481-MQLK-0001-ZS14-J1 (2C x 1,5mm2)	DI0300.10	10	DI0300.10 — 4481-MQLK-0001-ZS-14 G1 OVER R6 INITIAL POSITION PROXIMITY SWITCH
	103-V8+	45	
4481-MQLK-0001-JB01-J1 (11C x 1,5mm2) +G	DI0300.11 (1)	11	DI0300.11 — 4481-MQLK-0001-ZS-21 CENTERING No.1 ON A1 INWARD POSITION PROXIMITY SWITCH
	103-V8+ (2)	46	
	DI0300.12 (3)	12	DI0300.12 — 4481-MQLK-0001-ZS-22 CENTERING No.2 ON A1 INWARD POSITION PROXIMITY SWITCH
		47	
	DI0300.13 (4)	13	DI0300.13 — 4481-MQLK-0001-ZS-23 CENTERING No.3 ON A1 INWARD POSITION PROXIMITY SWITCH
		48	
	DI0300.14 (5)	14	DI0300.14 — 4481-MQLK-0001-ZS-24 CENTERING No.4 ON A1 INWARD POSITION PROXIMITY SWITCH
		49	
	DI0300.15 (6)	15	DI0300.15 — SPARE
		50	
	103-V8-	16	COMMON

FROM LINE 08
SEE DWG. 1347-55311
25457-4480-V1A-MXA0-0103

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BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

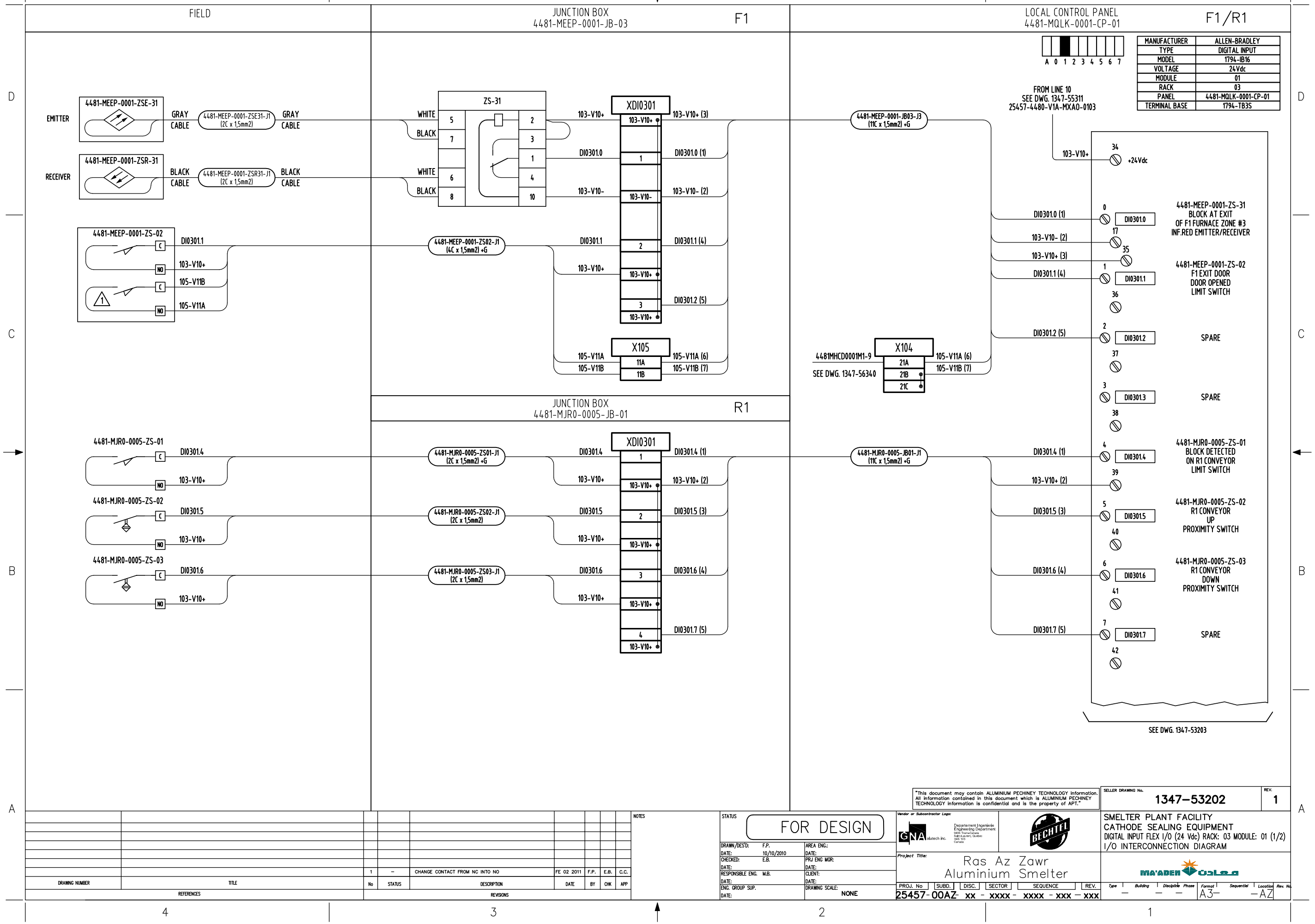
PROJ. No | SUBD. | DISC. | SECTOR | SEQUENCE | REV.
25457-00AZ- XX - XXXX - XXXX - XXX - XXX

SELLER DRAWING No. 1347-53201 | REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT FLEX I/O (24 Vdc) RACK: 03 MODULE: 00 (2/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type | Building | Discipline | Phase | Format | Sequential | Location | Rev. No.
— — — — A3- -AZ



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Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-	00AZ-	xx -	xxxx -	xxxx - xxx -	xxx

SELLER DRAWING No. 1347–53202 — REV. 1

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT FLEX I/O (24 Vdc) RACK: 03 MODULE: 01 (1/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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FIELD

JUNCTION BOX
4481-MJR0-0007-JB-01

R2

LOCAL CONTROL PANEL
4481-MQLK-0001-CP-01

R2

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1794-IB16
VOLTAGE	24Vdc
MODULE	01
RACK	03
PANEL	4481-MQLK-0001-CP-01
TERMINAL BASE	1794-TB3S

A 0 1 2 3 4 5 6 7

EMITTER — 4481-MJR0-0007-ZSE-01 — GRAY CABLE — 4481-MJR0-0007-ZSE01-J1 (2C x 1,5mm2) — GRAY CABLE — WHITE 5 / BLACK 7 — ZS-01 — 2 / 3 — 103-V10+ — XDI0301 103-V10+ — 103-V10+ (3)

RECEIVER — 4481-MJR0-0007-ZSR-01 — BLACK CABLE — 4481-MJR0-0007-ZSR01-J1 (2C x 1,5mm2) — BLACK CABLE — WHITE 6 / BLACK 8 — 1 / 4 — DI0301.9 — 1 — DI0301.9 (1)

103-V10- — 10 — 103-V10- — 103-V10- (2)

4481-MJR0-0007-ZS-02 — C / NO — DI0301.10 — 103-V10+ — 4481-MJR0-0007-ZS02-J1 (2C x 1,5mm2) — DI0301.10 — 2 — DI0301.10 (4) — 103-V10+ — 103-V10+

4481-MJR0-0007-ZS-03 — C / NO — DI0301.11 — 103-V10+ — 4481-MJR0-0007-ZS03-J1 (2C x 1,5mm2) — DI0301.11 — 3 — DI0301.11 (5) — 103-V10+ — 103-V10+

4481-MJR0-0007-ZS-04 — C / NO — DI0301.12 — 103-V10+ — 4481-MJR0-0007-ZS04-J1 (2C x 1,5mm2) — DI0301.12 — 4 — DI0301.12 (6) — 103-V10+ — 103-V10+

5 — DI0301.13 (7) — 103-V10+

4481-MJR0-0007-JB01-J1 (18C x 1,5mm2) +G

SEE DWG. 1347-53202

8	DI0301.8	SPARE
43		
9	DI0301.9	4481-MJR0-0007-ZS-01 BLOCK IN POSITION ON R2 CONVEYOR INF.RED EMITTER/RECEIVER
26		
44		
10	DI0301.10	4481-MJR0-0007-ZS-02 R2 LENGTH CENTERING CLAMPS OPENED PROXIMITY SWITCH
45		
11	DI0301.11	4481-MJR0-0007-ZS-03 R2 LEFT SIDE WIDTH CENTER. CLAMPS OPENED PROXIMITY SWITCH
46		
12	DI0301.12	4481-MJR0-0007-ZS-04 R2 RIGHT SIDE WIDTH CENTER. CLAMPS OPENED PROXIMITY SWITCH
47		
13	DI0301.13	SPARE
48		
14	DI0301.14	SPARE
49		
15	DI0301.15	SPARE
50		
16	COMMON	

DI0301.9 (1) — 103-V10- (2) — 103-V10+ (3) — DI0301.10 (4) — DI0301.11 (5) — DI0301.12 (6) — DI0301.13 (7) — 103-V10-

FROM LINE 10
SEE DWG. 1347-55311
25457-4480-V1A-MXA0-0103

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DATE:		DATE:	
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DATE:		DATE:	
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DATE:			

Vendor or Subcontractor Logo: GNA Automatech inc. — Département Ingénierie / Engineering Department, 1600 Tremblay, Saint-Laurent, Québec, H4S 1V3, Canada — BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT FLEX I/O (24 Vdc) RACK: 03 MODULE: 01 (2/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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FIELD

JUNCTION BOX
4481-MEEP-0001-JB-01 C1/F1

LOCAL CONTROL PANEL
4481-MQLK-0001-CP-01 C1/F1

A 0 1 2 3 4 5 6 7

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1794-IB16
VOLTAGE	24Vdc
MODULE	02
RACK	03
PANEL	4481-MQLK-0001-CP-01
TERMINAL BASE	1794-TB3S

FROM LINE 12
SEE DWG. 1347-55311
25457-4480-V1A-MXAO-0102

4481-MEEP-0001-ZSE-11
EMITTER
GRAY CABLE
4481-MEEP-0001-ZSE11-J1 (2C x 1,5mm2)
WHITE 5
BLACK 7
ZS-11
2 3 1 4 10
103-V12+
DI0302.0
103-V12-
XDI0302
103-V12+ 1
DI0302.0 (1)
4481-MEEP-0001-JB-01-J3 (26C x 1,5mm2) +G
103-V12+ 34 +24Vdc
DI0302.0 (1) 0 DI0302.0
4481-MEEP-0001-ZS-11
BLOCK IN SECOND POSITION
OF F1 FURNACE ZONE #1
INF.RED EMITTER/RECEIVER
103-V12- (2) 17
103-V12+ (3) 35
DI0302.1 (4) 1 DI0302.1 SPARE
36

4481-MEEP-0001-ZSR-11
RECEIVER
BLACK CABLE
4481-MEEP-0001-ZSR11-J1 (2C x 1,5mm2)
WHITE 6
BLACK 8
103-V12-
2
103-V12+
DI0302.1 (4)

4481-MEEP-0001-ZS-01
C
NO
C
NO
DI0302.2
103-V12+
105-V9B
105-V9A
4481-MEEP-0001-ZS01-J1 (4C x 1,5mm2) +G
DI0302.2
103-V12+
3
103-V12+
DI0302.2 (5)
DI0302.2 (5) 2 DI0302.2
4481-MEEP-0001-ZS-01
F1 ENTRY DOOR
DOOR OPENED
LIMIT SWITCH
37
3 DI0302.3 SPARE
38

X105
1+
1-
2B
9A
9B
103-V12+ (3)
103-V12- (2)
105-V2B (10)
105-V9A (9)
105-V9A
105-V9B
DI0302.4 (19) 4 DI0302.4
△3
4481-MHCD-0001-HS-06
C1 ZONE
ACCESS REQUEST
PUSH BUTTON
39

JUNCTION BOX
4481-MHCD-0001-JB-01 C1

4481-MHCD-0001-ZS-03
C
NO
DI0302.5
103-V12+
4481-MHCD-0001-ZS03-J1 (2C x 1,5mm2) +G
XDI0302
1
2
DI0302.5
103-V12+
103-V12+
DI0302.5 (1)
103-V12+ (2)
4481-MHCD-0001-JB01-J1 (11C x 1,5mm2) +G
DI0302.5 (1)
103-V12+ (2)
4
103-V12+
DI0302.5 (6)
DI0302.5 (6) 5 DI0302.5
4481-MHCD-0001-ZS-03
BLOCK LOADED ON
C1 CONVEYOR
LIMIT SWITCH
40

4481-MHCD-0001-ZS-04
C
NO
DI0302.6
103-V12+
4481-MHCD-0001-ZS04-J1 (2C x 1,5mm2) +G
DI0302.6
103-V12+
2
103-V12+
DI0302.6 (3)
DI0302.6 (3)
5
DI0302.6 (7)
DI0302.6 (7) 6 DI0302.6
4481-MHCD-0001-ZS-04
BLOCK LOCATED ON C1
AT F1 ENTRANCE
LIMIT SWITCH
41

JUNCTION BOX
4481-MHCD-0001-CP-02 C1

4481-MHCD-0001-HS-06
DI0302.4
4481-MHCD-0001-HS-07
DI0302.7
103-V12+
XDI0302
1
2
DI0302.4 (1)
DI0302.7 (2)
103-V12+ (3)
△3
4481-MHCD-0001-CP-02-J1 (7C x 1,5mm2) +G
DI0302.7 (2)
103-V12+ (3)
6
103-V12+
△3
DI0302.4 (1)
DI0302.4 (1)
13
DI0302.7 (8)
DI0302.7 (8) 7 DI0302.7
△3
4481-MHCD-0001-HS-07
C1 ZONE
ACCESS REQUEST RESET
PUSH BUTTON
42

X104
21C
21D
105-V9A (9)
105-V2B (10)

SEE DWG. 1347-53205

SEE DWG. 1347-53205

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SELLER DRAWING No. 1347-53204 REV. 3

No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
3		UPDATE	15-AU-2011	F.P.	E.B.	C.C.
2		UPDATE	10-MA-2011	F.P.	E.B.	C.C.
1	–	CHANGE CONTACT FROM NC INTO NO	FE-02-2011	F.P.	E.B.	C.C.

DRAWING NUMBER | TITLE | REFERENCES | REVISIONS

NOTES

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ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA aTech inc. Département Ingénierie Engineering Department 5000, Rue Rideau, Québec (Québec) G2E 5G2 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT FLEX I/O (24 Vdc) RACK: 03 MODULE: 02 (1/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx –	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
	–	–	–	A3–		–AZ	

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LOCAL CONTROL PANEL 4481-MHCD-0001-CP-01 — C1

XDI0302

103-V12+	103-V12+	103-V12+ (2)	
4481-MEEP-0001-HS-07 (2)	DI0302.8	1	DI0302.8 (1)
4481-MEEP-0001-HS-08 (2)	DI0302.9	2	DI0302.9 (3)
4481-MHCD-0001-HS-03	DI0302.10	3	DI0302.10 (4)
4481-MHCD-0001-HUS-04	DI0302.11	4	DI0302.11 (5)
4481-MHCD-0001-HUS-05	DI0302.12	5	DI0302.12 (6)
	DI0302.13	6	DI0302.13 (7)

4481-MHCD-0001-CP01-J1 (11C x 1,5mm2) +G

JUNCTION BOX 4481-MEEP-0001-JB-01 — C1/F1

SEE DWG. 1347-53204

DI0302.8 (1)	7	DI0302.8 (11)	
103-V12+ (2)	103-V12+		
DI0302.9 (3)	8	DI0302.9 (12)	
DI0302.10 (4)	9	DI0302.10 (13)	
DI0302.11 (5)	10	DI0302.11 (14)	
DI0302.12 (6)	11	DI0302.12 (15)	
DI0302.13 (7)	12	DI0302.13 (16)	

LOCAL CONTROL PANEL 4481-MQLK-0001-CP-01 — C1/F1

A 0 1 2 3 4 5 6 7

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1794-IB16
VOLTAGE	24Vdc
MODULE	02
RACK	03
PANEL	4481-MQLK-0001-CP-01
TERMINAL BASE	1794-TB3S

SEE DWG. 1347-53204

DI0302.8 (11)	8	DI0302.8	43	4481-MEEP-0001-HS-07 (2) OPEN DOORS PUSH BUTTON
DI0302.9 (12)	9	DI0302.9	44	4481-MEEP-0001-HS-08 (2) CLOSE DOORS PUSH BUTTON
DI0302.10 (13)	10	DI0302.10	45	4481-MHCD-0001-HS-03 BLOCK READY ON C1 CONVEYOR PUSH BUTTON
DI0302.11 (14)	11	DI0302.11	46	4481-MHCD-0001-HUS-04 REMOTE MODE C1 CONVEYOR SELECTOR
DI0302.12 (15)	12	DI0302.12	47	4481-MHCD-0001-HUS-05 REVERSE C1 CONVEYOR SELECTOR
DI0302.13 (16)	13	DI0302.13	48	4481-MHCD-0001-HUS-05 FORWARD C1 CONVEYOR SELECTOR
104-CR2 43	14	DI0302.14	44 / 49 (103-V12+)	104-CR2 R1, R2, R6, G1, A1 ZONE ACCESS REQUEST RELAY
SEE DWG. 1347-55312 25457-4480-V1A-MXA0-0102				
104-CR11 43	15	DI0302.15	44 / 50 (103-V12+)	104-CR11 R1, R2, R6, G1, A1 ZONE KEY SOLENOID ON RELAY
103-V12-	16	COMMON		

FROM LINE 12
SEE DWG. 1347-55311
25457-4480-V1A-MXA0-0102

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REFERENCES		2		CHANGE HS-01 TO HS-07 AND HS-02 TO HS-08	15-AU-2011	F.P.	E.B.	C.C.
		1		UPDATE	10-MA-2011	F.P.	E.B.	C.C.
		REVISIONS						

NOTES

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DATE:			

Vendor or Subcontractor Logo: GNA a.i.Tech inc. — Département Ingénierie, Engineering Department, 8450 Trans-Canada, Saint-Laurent, Quebec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

SELLER DRAWING No.: 1347—53205 — REV.: 2

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT FLEX I/O (24 Vdc) RACK: 03 MODULE: 02 (2/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3—		—AZ	

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FIELD

JUNCTION BOX
4481-MQLK-0001-JB-02

G1

LOCAL CONTROL PANEL
4481-MQLK-0001-CP-01

G1

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1794-IB16
VOLTAGE	24Vdc
MODULE	03
RACK	03
PANEL	4481-MQLK-0001-CP-01
TERMINAL BASE	1794-TB3S

A 0 1 2 3 4 5 6 7

FROM LINE 14
SEE DWG. 1347-55311
25457-4480-V1A-MXA0-0103

103-V14+ → 34 +24Vdc

4481-MQLK-0001-ZS-01
C — DI0303.0
NO — 103-V14+
→ 4481-MQLK-0001-ZS01-J1 (2C x 1,5mm2)
DI0303.0 → XDI0303 1 → DI0303.0 (1)
103-V14+ → 103-V14+ → 103-V14+ (2)
4481-MQLK-0001-JB02-J1 (33C x 1,5mm2) +G
FLEXIBLE CABLE TRAY
DI0303.0 (1) → 0 DI0303.0
4481-MQLK-0001-ZS-01 LEFT CLAMP ON GANTRY OPENED PROXIMITY SWITCH
103-V14+ (2) → 35

4481-MQLK-0001-ZS-02
C — DI0303.1
NO — 103-V14+
→ 4481-MQLK-0001-ZS02-J1 (2C x 1,5mm2)
DI0303.1 → 2 → DI0303.1 (3)
103-V14+ → 103-V14+
DI0303.1 (3) → 1 DI0303.1
4481-MQLK-0001-ZS-02 LEFT CLAMP ON GANTRY CLOSED PROXIMITY SWITCH
36

4481-MQLK-0001-ZS-03
C — DI0303.2
NO — 103-V14+
→ 4481-MQLK-0001-ZS03-J1 (2C x 1,5mm2)
DI0303.2 → 3 → DI0303.2 (4)
103-V14+ → 103-V14+
DI0303.2 (4) → 2 DI0303.2
4481-MQLK-0001-ZS-03 LEFT CLAMP ON GANTRY OPENED HALF WAY PROXIMITY SWITCH
37

4481-MQLK-0001-ZS-04
C — DI0303.3
NO — 103-V14+
→ 4481-MQLK-0001-ZS04-J1 (2C x 1,5mm2)
DI0303.3 → 4 → DI0303.3 (5)
103-V14+ → 103-V14+
DI0303.3 (5) → 3 DI0303.3
4481-MQLK-0001-ZS-04 LEFT CLAMP ALIGNMENT BARS IN POSITION PROXIMITY SWITCH
38

4481-MQLK-0001-ZS-05
C — DI0303.4
NO — 103-V14+
→ 4481-MQLK-0001-ZS05-J1 (2C x 1,5mm2)
DI0303.4 → 5 → DI0303.4 (6)
103-V14+ → 103-V14+
DI0303.4 (6) → 4 DI0303.4
4481-MQLK-0001-ZS-05 RIGHT CLAMP ON GANTRY OPENED PROXIMITY SWITCH
39

4481-MQLK-0001-ZS-06
C — DI0303.5
NO — 103-V14+
→ 4481-MQLK-0001-ZS06-J1 (2C x 1,5mm2)
DI0303.5 → 6 → DI0303.5 (7)
103-V14+ → 103-V14+
DI0303.5 (7) → 5 DI0303.5
4481-MQLK-0001-ZS-06 RIGHT CLAMP ON GANTRY CLOSED PROXIMITY SWITCH
40

4481-MQLK-0001-ZS-07
C — DI0303.6
NO — 103-V14+
→ 4481-MQLK-0001-ZS07-J1 (2C x 1,5mm2)
DI0303.6 → 7 → DI0303.6 (8)
103-V14+ → 103-V14+
DI0303.6 (8) → 6 DI0303.6
4481-MQLK-0001-ZS-07 RIGHT CLAMP ON GANTRY OPENED HALF WAY PROXIMITY SWITCH
41

4481-MQLK-0001-ZS-08
C — DI0303.7
NO — 103-V14+
→ 4481-MQLK-0001-ZS08-J1 (2C x 1,5mm2)
DI0303.7 → 8 → DI0303.7 (9)
103-V14+ → 103-V14+
DI0303.7 (9) → 7 DI0303.7
4481-MQLK-0001-ZS-08 RIGHT CLAMP ALIGNMENT BARS IN POSITION PROXIMITY SWITCH
42

SEE DWG. 1347-53207

SEE DWG. 1347-53207

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
		0						

REFERENCES

REVISIONS

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SELLER DRAWING No. 1347-53206 REV. 0

Vendor or Subcontractor Logo: GNA akitech Inc. Département Ingénierie Engineering Department 9600 TransCanada Montréal, Québec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT FLEX I/O (24 Vdc) RACK: 03 MODULE: 03 (1/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457	00AZ	xx	xxxx	xxxx	xxx – xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
	–	–	–	A3	–	AZ	

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FIELD

JUNCTION BOX
4481-MQLK-0001-JB-02
G1

LOCAL CONTROL PANEL
4481-MQLK-0001-CP-01
G1

A 0 1 2 3 4 5 6 7

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1794-IB16
VOLTAGE	24Vdc
MODULE	03
RACK	03
PANEL	4481-MQLK-0001-CP-01
TERMINAL BASE	1794-TB3S

SEE DWG. 1347-53206

4481-MQLK-0001-ZS-09
C
NO
DI0303.8
103-V14+
4481-MQLK-0001-ZS09-J1
(2C x 1,5mm2)
DI0303.8
103-V14+
9
103-V14+
DI0303.8 (10)
DI0303.8 (10)
8
DI0303.8
43
4481-MQLK-0001-ZS-09
G1 CLAMPING ASSEMBLY
FULL UP ON A1
PROXIMITY SWITCH

4481-MQLK-0001-ZS-10
C
NO
DI0303.9
103-V14+
4481-MQLK-0001-ZS10-J1
(2C x 1,5mm2)
DI0303.9
103-V14+
10
103-V14+
DI0303.9 (11)
DI0303.9 (11)
9
DI0303.9
44
4481-MQLK-0001-ZS-10
G1 CLAMPING ASSEMBLY
UP ON R6, A1, R2
PROXIMITY SWITCH

4481-MQLK-0001-ZS-11
C
NO
DI0303.10
103-V14+
4481-MQLK-0001-ZS11-J1
(2C x 1,5mm2)
DI0303.10
103-V14+
11
103-V14+
DI0303.10 (12)
DI0303.10 (12)
10
DI0303.10
45
4481-MQLK-0001-ZS-11
G1 CLAMPING ASSEMBLY
DOWN ON A1
PROXIMITY SWITCH

4481-MQLK-0001-ZS-12
C
NO
DI0303.11
103-V14+
4481-MQLK-0001-ZS12-J1
(2C x 1,5mm2)
DI0303.11
103-V14+
12
103-V14+
DI0303.11 (13)
DI0303.11 (13)
11
DI0303.11
46
4481-MQLK-0001-ZS-12
G1 CLAMPING ASSEMBLY
DOWN ON R6
PROXIMITY SWITCH

4481-MQLK-0001-ZS-13
C
NO
DI0303.12
103-V14+
4481-MQLK-0001-ZS13-J1
(2C x 1,5mm2)
DI0303.12
103-V14+
13
103-V14+
DI0303.12 (14)
DI0303.12 (14)
12
DI0303.12
47
4481-MQLK-0001-ZS-13
G1 CLAMPING ASSEMBLY
DOWN ON R2
PROXIMITY SWITCH

14
103-V14+
DI0303.13 (15)
DI0303.13 (15)
13
DI0303.13
48
SPARE

15
103-V14+
DI0303.14 (16)
DI0303.14 (16)
14
DI0303.14
49
SPARE

16
103-V14+
DI0303.15 (17)
DI0303.15 (17)
15
DI0303.15
50
SPARE

103-V14-
16
COMMON

FROM LINE 14
SEE DWG. 1347-55311
25457-4480-V1A-MXA0-0103

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		0		REVISIONS				

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RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA Automatech Inc. — Département Ingénierie, Engineering Department, 1600 Transcanada, Saint-Laurent, Quebec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No: 25457 | SUBD.: 00AZ | DISC.: xx | SECTOR: xxxx | SEQUENCE: xxxx - xxx | REV.: xxx

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SELLER DRAWING No.: 1347-53207

REV.: 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT FLEX I/O (24 Vdc) RACK: 03 MODULE: 03 (2/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN ALUMINA

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3		AZ	

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	4	3	2	1
	FIELD	JUNCTION BOX 4481-MEEP-0001-JB-01 F1Z1	LOCAL CONTROL PANEL 4481-MQLK-0001-CP-01 F1	

MANUFACTURER	ALLEN-BRADLEY
TYPE	ANALOG INPUT
MODEL	1794-IF8IH
CURRENT	4-20mA
MODULE	07
RACK	03
PANEL	4481-MQLK-0001-CP-01
TERMINAL BASE	1794-TB3S

A 0 1 2 3 4 5 6 7

FROM LINE 22
SEE DWG. 1347-55311
25457-4480-V1A-MXA0-0103

4481-MEEP-0001-TE-01
TE01+ YELLOW
TE01- WHITE
4481-MEEP-0001-TE01-J1 (1P/SH)

XAI0307
4481-MEEP-0001 TT-01
TE01+ ② + ⊕
TE01- ③ - ⊕
103-V22+ AI0307.0
(1P/SH SP)

4481-MEEP-0001-JB01-J2 (2P/SH)
(1P/SH SP)

103-V22+ 34 +24Vdc
103-V22+ 35
AI0307.0 0 AI0307.0
1 I0 Ret
17

4481-MEEP-0001-TE-01 TEMPERATURE CONTROL CATHODE BLOCK OVEN F1 ZONE #1

JUNCTION BOX 4481-MEEP-0001-JB-03 F1Z2/F1Z3

4481-MEEP-0001-TE-02
TE02+ YELLOW
TE02- WHITE
4481-MEEP-0001-TE02-J1 (1P/SH)

XAI0307
4481-MEEP-0001 TT-02
TE02+ ② + ⊕
TE02- ③ - ⊕
103-V22+ AI0307.1
(1P/SH SP)

4481-MEEP-0001-JB03-J2 (3P/SH)
(1P/SH SP)

103-V22+ 36
AI0307.1 2 AI0307.1
3 I1 Ret
18

4481-MEEP-0001-TE-02 TEMPERATURE CONTROL CATHODE BLOCK OVEN F1 ZONE #2

4481-MEEP-0001-TE-03
TE03+ YELLOW
TE03- WHITE
4481-MEEP-0001-TE03-J1 (1P/SH)

4481-MEEP-0001 TT-03
TE03+ ② + ⊕
TE03- ③ - ⊕
103-V22+ AI0307.2
(1P/SH SP)

103-V22+ 37
AI0307.2 4 AI0307.2
5 I2 Ret
19

4481-MEEP-0001-TE-03 TEMPERATURE CONTROL CATHODE BLOCK OVEN F1 ZONE #3

38
6 AI0307.3
7 I3 Ret
20

SPARE

SEE DWG. 1347-53251

									NOTES
		0							
DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP	
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ENG. GROUP SUP.		DRAWING SCALE:	NONE
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Vendor or Subcontractor Logo: GNA Automatech Inc. — Département Ingénierie Engineering Department, 9690 Trans-Canada, Saint-Laurent, Québec, H4S 1V3, Canada

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SELLER DRAWING No. 1347-53250 REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
ANALOG INPUT FLEX I/O (4-20mA) RACK: 03 MODULE: 07 (1/2)
I/O INTERCONNECTION DIAGRAM

Project Title: Ras Az Zawr Aluminium Smelter

MA'ADEN

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-	00AZ-	XX -	XXXX -	XXXX - XXX -	XXX

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3—		—AZ	

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FIELD

LOCAL CONTROL PANEL
4481-MQLK-0001-CP-01

F1

A 0 1 2 3 4 5 6 7

MANUFACTURER	ALLEN-BRADLEY
TYPE	ANALOG INPUT
MODEL	1794-IF8IH
CURRENT	4-20mA
MODULE	07
RACK	03
PANEL	4481-MQLK-0001-CP-01
TERMINAL BASE	1794-TB3S

FROM DWG. 1347-53250

39		
8	AI0307.4	SPARE
9	I4 Ret	
21		
40		
10	AI0307.5	SPARE
11	I5 Ret	
22		
41		
12	AI0307.6	SPARE
13	I6 Ret	
23		
42		
14	AI0307.7	SPARE
15	I7 Ret	
24		
16	COMMON	

103-V22-

FROM LINE 22
SEE DWG. 1347-55311
25457-4480-V1A-MXAO-0103

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SELLER DRAWING No. 1347-53251 | REV. 0

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DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA alutech inc. — Département Ingénierie, Engineering Department, 5685, Trans-Canada, Suite 100, Saint-Laurent, Québec, H4S 1V5, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
ANALOG INPUT FLEX I/O (4-20mA) RACK: 03 MODULE: 07 (2/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457	00AZ	xx	xxxx	xxxx	xxx – xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
–	–	–		A3	–	AZ	

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MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL OUTPUT
MODEL	1794-OB16
VOLTAGE	24Vdc
MODULE	04
RACK	03
PANEL	4481-MQLK-0001-CP-01
TERMINAL BASE	1794-TB3S

A 0 1 2 3 4 5 6 7

G1 — LOCAL CONTROL PANEL 4481-MQLK-0001-CP-01

SEE DWG. 1347-55311
25457-4480-V1A-MXA0-0103
FROM LINE 16

+24Vdc 34 — 103-V16A — X103 16A — 103-V16A

4481-MQLK-0001-FY-01 OPEN LEFT CLAMP SOLENOID VALVE (HYD.)	DO0304.0	0	17	DO0304.0	0 A1 A2	103-V16A 14 DO0304.0 11 DO0304.0 (18)
4481-MQLK-0001-FY-02 CLOSE LEFT CLAMP SOLENOID VALVE (HYD.)	DO0304.1	1	18	DO0304.1	1 A1 A2	103-V16A 14 DO0304.1 11 DO0304.1 (20)
4481-MQLK-0001-FY-03 CLOSE FAST LEFT CLAMP SOLENOID VALVE (HYD.)	DO0304.2	2	19	DO0304.2	2 A1 A2	103-V16A 14 DO0304.2 11 DO0304.2 (21)
4481-MQLK-0001-FY-04 OPEN RIGHT CLAMP SOLENOID VALVE (HYD.)	DO0304.3	3	20	DO0304.3	3 A1 A2	103-V16A 14 DO0304.3 11 DO0304.3 (22)
4481-MQLK-0001-FY-05 CLOSE RIGHT CLAMP SOLENOID VALVE (HYD.)	DO0304.4	4	21	DO0304.4	4 A1 A2	103-V16A 14 DO0304.4 11 DO0304.4 (23)
4481-MQLK-0001-FY-06 CLOSE FAST RIGHT CLAMP SOLENOID VALVE (HYD.)	DO0304.5	5	22	DO0304.5	5 A1 A2	103-V16A 14 DO0304.5 11 DO0304.5 (24)
4481-MQLK-0001-FY-08 LOWER GANTRY ASSEMBLY SOLENOID VALVE (HYD.)	DO0304.6	6	23	DO0304.6	6 A1 A2	103-V16A 14 DO0304.6 11 DO0304.6 (25)
4481-MQLK-0001-FY-07 RAISE GANTRY ASSEMBLY SOLENOID VALVE (HYD.)	DO0304.7	7	24	DO0304.7	7 A1 A2	103-V16A 14 DO0304.7 11 DO0304.7 (26)

SEE DWG. 1347-54201

4481-MQLK-0001-JB02-J1 (33C x 1,5mm2) +G — FLEXIBLE CABLE TRAY

JUNCTION BOX 4481-MQLK-0001-JB-02 — G1

XD00304

DO0304.0 (18)	1	103-V17- (19)	DO0304.0	4481-MQLK-0001-FY01-J1 (2C x 1,5mm2) +G
DO0304.1 (20)	2	103-V17-	DO0304.1	4481-MQLK-0001-FY02-J1 (2C x 1,5mm2) +G
DO0304.2 (21)	3	103-V17-	DO0304.2	4481-MQLK-0001-FY03-J1 (2C x 1,5mm2) +G
DO0304.3 (22)	4	103-V17-	DO0304.3	4481-MQLK-0001-FY04-J1 (2C x 1,5mm2) +G
DO0304.4 (23)	5	103-V17-	DO0304.4	4481-MQLK-0001-FY05-J1 (2C x 1,5mm2) +G
DO0304.5 (24)	6	103-V17-	DO0304.5	4481-MQLK-0001-FY06-J1 (2C x 1,5mm2) +G
DO0304.6 (25)	7	103-V17-	DO0304.6	4481-MQLK-0001-FY08-J1 (2C x 1,5mm2) +G
DO0304.7 (26)	8	103-V17-	DO0304.7	4481-MQLK-0001-FY07-J1 (2C x 1,5mm2) +G

SEE DWG. 1347-54201

FIELD

4481-MQLK-0001-FY-01	DO0304.0	103-V17-
4481-MQLK-0001-FY-02	DO0304.1	103-V17-
4481-MQLK-0001-FY-03	DO0304.2	103-V17-
4481-MQLK-0001-FY-04	DO0304.3	103-V17-
4481-MQLK-0001-FY-05	DO0304.4	103-V17-
4481-MQLK-0001-FY-06	DO0304.5	103-V17-
4481-MQLK-0001-FY-08	DO0304.6	103-V17-
4481-MQLK-0001-FY-07	DO0304.7	103-V17-

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
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SELLER DRAWING No. 1347-54200 — REV. 0

Vendor or Subcontractor Logo: GNA Alutech Inc. — Département Ingénierie / Engineering Department, 5600 Trans-Canada, Suite Laurent, Québec H4S 1V9, Canada — BECHTEL

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL OUTPUT FLEX I/O (24 Vdc) RACK: 03 MODULE: 04 (1/2)
I/O INTERCONNECTION DIAGRAM

Project Title: Ras Az Zawr Aluminium Smelter — MA'ADEN

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	XX -	XXXX -	XXXX -	XXX -	XXX

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3—		—AZ	

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F1/G1	LOCAL CONTROL PANEL 4481-MQLK-0001-CP-01	JUNCTION BOX 4481-MQLK-0001-JB-02 G1	FIELD

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL OUTPUT
MODEL	1794-OB16
VOLTAGE	24Vdc
MODULE	04
RACK	03
PANEL	4481-MQLK-0001-CP-01
TERMINAL BASE	1794-TB3S

A 0 1 2 3 4 5 6 7

SEE DWG. 1347-54200

4481-MQLK-0001-HL-01
HOT
ZONE
ALARM LIGHT
DO0304.8 — 8 — 8 A1 A2 — DO0304.8
25

SPARE
DO0304.9 — 9 — 9 A1 A2 — DO0304.9
26

SPARE
DO0304.10 — 10 — 10 A1 A2 — DO0304.10
27

SPARE
DO0304.11 — 11 — 11 A1 A2 — DO0304.11
28

4481-MEEP-0001-FY-03
OPEN F1 EXIT DOOR
SOLENOID VALVE (PN.)
DO0304.12 — 12 — 12 A1 A2 — DO0304.12
29

4481-MEEP-0001-FY-04
CLOSE F1 EXIT DOOR
SOLENOID VALVE (PN.)
DO0304.13 — 13 — 13 A1 A2 — DO0304.13
30

SPARE
DO0304.14 — 14 — 14 A1 A2 — DO0304.14
31

SPARE
DO0304.15 — 15 — 15 A1 A2 — DO0304.15
32 — 103-V16-

COMMON
16 — 103-V16-

103-V16A DO0304.8 14 — 11 DO0304.8 (27)
103-V16A DO0304.9 14 — 11 DO0304.9 (28)
X103 17- — 103-V17- (19) (5SP-1G)
SEE DWG. 1347-55311
25457-4480-V1A-MXA0-0103

103-V16A DO0304.12 14 — 11 DO0304.12 (8)
103-V16A DO0304.13 14 — 11 DO0304.13 (10)
103-V16A DO0304.14 14 — 11 DO0304.14 (11)
X103 16- — 103-V16- (9) (0SP-1G)
SEE DWG. 1347-55311
25457-4480-V1A-MXA0-0103

4481-MEEP-0001-JB03-J3
(11C x 1,5mm2) +G

SEE DWG. 1347-54200

DO0304.8 (27) — 9 — DO0304.8 (+) 4481-MQLK-0001-HL-01
103-V17- — 103-V17- (-)
DO0304.9 (28) — 10
(5SP-1G) — 103-V17-

JUNCTION BOX
4481-MEEP-0001-JB-03 F1

XD00304
DO0304.12 (8) — 1 — DO0304.12
103-V16- (9) — 103-V16- — 103-V16-
DO0304.13 (10) — 2 — DO0304.13
DO0304.14 (11) — 3
(0SP-1G) — 103-V16-

4481-MEEP-0001-FY03-J1
(3C x 1,5mm2) +G

DO0304.12 — 1 — 2 — 4481-MEEP-0001-FY-03
DO0304.13 — 4 — 3 — 4481-MEEP-0001-FY-04
103-V16-

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
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Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie / Engineering Department, 5605 Trans-Canada, Saint-Laurent, Quebec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SELLER DRAWING No. 1347-54201 — REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL OUTPUT FLEX I/O (24 Vdc) RACK: 03 MODULE: 04 (2/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—	—	A3		-AZ	

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	4	3	2	1
	C1/F1	LOCAL CONTROL PANEL 4481-MQLK-0001-CP-01	JUNCTION BOX 4481-MEEP-0001-JB-01 C1/F1	FIELD

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL OUTPUT
MODEL	1794-OB16
VOLTAGE	24Vdc
MODULE	05
RACK	03
PANEL	4481-MQLK-0001-CP-01
TERMINAL BASE	1794-TB3S

A 0 1 2 3 4 5 6 7

SEE DWG. 1347-55311
25457-4480-V1A-MXAO-0102
FROM LINE 18

+24Vdc 34 — 103-V18A — X103 18A — 103-V18A

4481-MEEP-0001-FY-01 OPEN F1 ENTRY DOOR SOLENOID VALVE (PN.)	DO0305.0	0	0	A1	A2	17	DO0305.0
4481-MEEP-0001-FY-02 CLOSE F1 ENTRY DOOR SOLENOID VALVE (PN.)	DO0305.1	1	1	A1	A2	18	DO0305.1
4481-MHCD-0001-HA-01 C1 CONVEYOR MOTION WARNING HORN	DO0305.2	2	2	A1	A2	19	DO0305.2
4481-MHCD-0001-HL-01 C1 CONVEYOR MOTION WARNING LIGHT	DO0305.3	3	3	A1	A2	20	DO0305.3
2 4481-MHCD-0001-YL-01 C1 ZONE ACCESS REQUEST LIGHT	DO0305.4	4	4	A1	A2	21	DO0305.4
SPARE	DO0305.5	5	5	A1	A2	22	DO0305.5
SPARE	DO0305.6	6	6	A1	A2	23	DO0305.6
SPARE	DO0305.7	7	7	A1	A2	24	DO0305.7

SEE DWG. 1347-54203

103-V18A	DO0305.0	14	DO0305.0 (1) 11
103-V18A	DO0305.1	14	DO0305.1 (3) 11
103-V18A	DO0305.2	14	DO0305.2 (4) 11
103-V18A	DO0305.3	14	DO0305.3 (5) 11
103-V18A	DO0305.4	14	DO0305.4 (6) 11

X103 19- — 103-V19- (2) (2SP)

SEE DWG. 1347-55311
25457-4480-V1A-MXAO-0102

4481-MEEP-0001-JB-01-J4 (8C x 1,5mm2)

XD00305

DO0305.0 (1)	1	DO0305.0	4481-MEEP-0001-FY01-J1 (3C x 1,5mm2) +G
103-V19- (2)	103-V19-	103-V19-	
DO0305.1 (3)	2	DO0305.1	
DO0305.2 (4)	3	DO0305.2	4481-MHCD-0001-HA01-J1 (3C x 1,5mm2) +G
DO0305.3 (5)	4	DO0305.3	
	103-V19-	103-V19-	
DO0305.4 (6) (2SP)	5	DO0305.4 (4)	
	103-V19-	103-V19- (5)	

2 (2SP-1G)

4481-MEEP-0001-FY-01: DO00305.0 — 1 — 2
4481-MEEP-0001-FY-02: DO00305.1 — 4 — 3; 103-V19-

4481-MHCD-0001-HA-01: DO00305.2 — +
4481-MHCD-0001-HL-01: DO00305.3 — +; 103-V19- —

LOCAL CONTROL PANEL
4481-MHCD-0001-CP-02 C1

4481-MHCD-0001-CP-02-J1 (7C x 1,5mm2) +G

XD00305

DO0305.4 (4)	1	DO0305.4 — 4481-MHCD-0001-YL-01
103-V19- (5)	103-V19-	103-V19-

(2SP-1G)

2

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REFERENCES		2		UPDATE	15-AU-2011	F.P.	E.B.	C.C.
		1		UPDATE	10-MA-2011	F.P.	E.B.	C.C.
		REVISIONS						

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RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA altech inc. Département Ingénierie / Engineering Department, 5655 TransCanada, Saint-Laurent, Québec H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SELLER DRAWING No. 1347-54202 REV. 2

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL OUTPUT FLEX I/O (24 Vdc) RACK: 03 MODULE: 05 (1/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—		—	—	A3—		—AZ	

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R1/R2	4481-MQLK-0001-CP-01 LOCAL CONTROL PANEL	JUNCTION BOX 4481-MJR0-0005-JB-01 R1	FIELD

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL OUTPUT
MODEL	1794-OB16
VOLTAGE	24Vdc
MODULE	05
RACK	03
PANEL	4481-MQLK-0001-CP-01
TERMINAL BASE	1794-TB3S

A 0 1 2 3 4 5 6 7

SEE DWG. 1347-54202

4481-MJR0-0005-FY-01 RAISE R1 CONVEYOR SOLENOID VALVE (HYD.) — DO0305.8 — 8 — 25
4481-MJR0-0005-FY-02 LOWER R1 CONVEYOR SOLENOID VALVE (HYD.) — DO0305.9 — 9 — 26
SPARE — DO0305.10 — 10 — 27
SPARE — DO0305.11 — 11 — 28
4481-MJR0-0007-FY-01 OPEN R2 WIDTH CENTERING CLAMPS SOLENOID VALVE (HYD.) — DO0305.12 — 12 — 29
4481-MJR0-0007-FY-02 CLOSE R2 WIDTH CENTERING CLAMPS SOLENOID VALVE (HYD.) — DO0305.13 — 13 — 30
4481-MJR0-0007-FY-03 CLOSE R2 LENGTH CENTERING CLAMPS SOLENOID VALVE (HYD.) — DO0305.14 — 14 — 31
SPARE — DO0305.15 — 15 — 32
COMMON — 16 — 103-V18-

DO0305.8	8	A1	A2	
DO0305.9	9	A1	A2	
DO0305.10	10	A1	A2	
DO0305.11	11	A1	A2	
DO0305.12	12	A1	A2	
DO0305.13	13	A1	A2	
DO0305.14	14	A1	A2	
DO0305.15	15	A1	A2	103-V18-

103-V18A	DO0305.8	14	11 — DO0305.8 (6)
103-V18A	DO0305.9	14	11 — DO0305.9 (8)
103-V18A	DO0305.10	14	11 — DO0305.10 (9)
103-V18A	DO0305.12	14	11 — DO0305.12 (8)
103-V18A	DO0305.13	14	11 — DO0305.13 (10)
103-V18A	DO0305.14	14	11 — DO0305.14 (11)
103-V18A	DO0305.15	14	11 — DO0305.15 (12)

X103 — 19- — 103-V19- (7) (2SP-1G)
SEE DWG. 1347-55311 25457-4480-V1A-MXA0-0103

X103 — 18- — 103-V18- (9) (6SP-1G)
SEE DWG. 1347-55311 25457-4480-V1A-MXA0-0103

4481-MJR0-0005-JB01-J1 (11C x 1,5mm2) +G
4481-MJR0-0007-JB01-J1 (18C x 1,5mm2) +G

JUNCTION BOX 4481-MJR0-0005-JB-01 R1

XD00305

DO0305.8 (6)	1	103-V19-	103-V19-
103-V19- (7)			
DO0305.9 (8)	2	103-V19-	103-V19-
DO0305.10 (9) (2SP-1G)	3	103-V19-	

4481-MJR0-0005-FY01-J1 (2C x 1,5mm2) +G
4481-MJR0-0005-FY02-J1 (2C x 1,5mm2) +G

4481-MJR0-0005-FY-01: DO0305.8 (+), 103-V19- (-)
4481-MJR0-0005-FY-02: DO0305.9 (+), 103-V19- (-)

JUNCTION BOX 4481-MJR0-0007-JB-01 R2

XD00305

DO0305.12 (8)	1	103-V18-	103-V18-
103-V18- (9)			
DO0305.13 (10)	2	103-V18-	103-V18-
DO0305.14 (11)	3	103-V18-	103-V18-
DO0305.15 (12) (6SP-1G)	4	103-V18-	

4481-MJR0-0007-FY01-J1 (2C x 1,5mm2) +G
4481-MJR0-0007-FY02-J1 (2C x 1,5mm2) +G
4481-MJR0-0007-FY03-J1 (2C x 1,5mm2) +G

4481-MJR0-0007-FY-01: DO0305.12 (+), 103-V18- (-)
4481-MJR0-0007-FY-02: DO0305.13 (+), 103-V18- (-)
4481-MJR0-0007-FY-03: DO0305.14 (+), 103-V18- (-)

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ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA Automation inc. — Département Ingénierie / Engineering Department — 1690, Trans-Canada, Salaberry-de-Valleyfield, Québec, Canada, J6S 5V3

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL OUTPUT FLEX I/O (24 Vdc) RACK: 03 MODULE: 05 (2/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3—		—AZ	

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	4	3	2	1
	G1	LOCAL CONTROL PANEL 4481-MQLK-0001-CP-01	FIELD	

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL OUTPUT
MODEL	1794-OB16
VOLTAGE	24Vdc
MODULE	06
RACK	03
PANEL	4481-MQLK-0001-CP-01
TERMINAL BASE	1794-TB3S

A 0 1 2 3 4 5 6 7

SEE DWG. 1347-55311
25457-4480-V1A-MXAO-0103
FROM LINE 20

X103
20A
20-

34 +24Vdc — 103-V20A — 103-V20A

104-YL5 R1, R2, R6, G1, A1 ZONE ACCESS REQUEST LIGHT	DO0306.0	0	0	DO0306.0 A1 A2
CR-0306.1 R1, R2, R6, G1, A1 ZONE ACCESS AUTHORIZED RELAY	DO0306.1	1	1	DO0306.1 A1 A2
SPARE	DO0306.2	2	2	DO0306.2 A1 A2
SPARE	DO0306.3	3	3	DO0306.3 A1 A2
SPARE	DO0306.4	4	4	DO0306.4 A1 A2
SPARE	DO0306.5	5	5	DO0306.5 A1 A2
SPARE	DO0306.6	6	6	DO0306.6 A1 A2
SPARE	DO0306.7	7	7	DO0306.7 A1 A2

17 18 19 20 21 22 23 24

103-V20A — DO0306.0 (14 / 11) — DO0306.0 — 104-YL5 — 103-V20-

R1, R2, R6, G1, A1 ZONE ACCESS AUTHORIZED
104-V6B — DO0306.1 (14 / 11) — 104-V6A

SEE DWG. 1347-55312
25457-4480-V1A-MXAO-0104

SEE DWG. 1347-54205

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
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Vendor or Subcontractor Logo: GNA Solutech Inc. — Département Ingénierie / Engineering Department, 9695 Transcanada, Saint-Laurent, Québec, H4S 1V5, Canada

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SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL OUTPUT FLEX I/O (24 Vdc) RACK: 03 MODULE: 06 (1/2)
I/O INTERCONNECTION DIAGRAM

Project Title: Ras Az Zawr Aluminium Smelter

MA'ADEN

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3—		—AZ	

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R6/A1 — LOCAL CONTROL PANEL
4481-MQLK-0001-CP-01

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL OUTPUT
MODEL	1794-OB16
VOLTAGE	24Vdc
MODULE	06
RACK	03
PANEL	4481-MQLK-0001-CP-01
TERMINAL BASE	1794-TB3S

A 0 1 2 3 4 5 6 7

SEE DWG. 1347-54204

4481-MJR0-0004-FY-01
ON R6 LOWER
2nd STOPPER
SOLENOID VALVE (PN.)
DO0306.8 — 8 — 25

4481-MJR0-0004-FY-02
ON R6 RAISE
2nd STOPPER
SOLENOID VALVE (PN.)
DO0306.9 — 9 — 26

4481-MQLK-0001-FY-11
ON A1 TURN PUSHER
IN
SOLENOID VALVE (PN.)
DO0306.10 — 10 — 27

4481-MQLK-0001-FY-12
ON A1 TURN PUSHER
OUT
SOLENOID VALVE (PN.)
DO0306.11 — 11 — 28

SPARE — DO0306.12 — 12 — 29

SPARE — DO0306.13 — 13 — 30

SPARE — DO0306.14 — 14 — 31

SPARE — DO0306.15 — 15 — 32

COMMON — 16 — 103-V20-

DO0306.8 — 8 — A1 — A2 — 103-V20A 14 — DO0306.8 11 — DO0306.8 (8)
DO0306.9 — 9 — A1 — A2 — 103-V20A 14 — DO0306.9 11 — DO0306.9 (10)
DO0306.10 — 10 — A1 — A2 — 103-V20A 14 — DO0306.10 11 — DO0306.10 (7)
DO0306.11 — 11 — A1 — A2 — 103-V20A 14 — DO0306.11 11 — DO0306.11 (9)
DO0306.12 — 12 — A1 — A2 — 103-V20A 14 — DO0306.12 11 — DO0306.12 (11)
DO0306.13 — 13 — A1 — A2
DO0306.14 — 14 — A1 — A2
DO0306.15 — 15 — A1 — A2

X103
20- — 103-V20- (8) (2SP-1G)
20- — 103-V20- (9) (7SP-1G)

SEE DWG. 1347-55311
25457-4480-V1A-MXA0-0103

4481-MJR0-0004-JB01-J1 (18C x 1,5mm2) +G

JUNCTION BOX
4481-MJR0-0004-JB-01
R6

XD00306
DO0306.8 (8) — 1 — DO0306.8 — 103-V20-
103-V20- (9) — 103-V20- — 103-V20-
DO0306.9 (10) — 2 — DO0306.9
DO0306.12 (11) — 5 — (7SP-1G)
103-V20-

4481-MJR0-0004-FY01-J1 (3C x 1,5mm2) +G

FIELD

4481-MJR0-0004-FY-01
DO0306.8 — 1 — 2
4481-MJR0-0004-FY-02
DO0306.9 — 4 — 3
103-V20-

4481-MQLK-0001-JB01-J1 (11C x 1,5mm2) +G

JUNCTION BOX
4481-MQLK-0001-JB-01
A1

XD00306
DO0306.10 (7) — 3 — DO0306.10 — 103-V20-
103-V20- (8) — 103-V20- — 103-V20-
DO0306.11 (9) — 4 — DO0306.11 (2SP-1G)

4481-MQLK-0001-FY11-J1 (3C x 1,5mm2) +G

4481-MQLK-0001-FY-11
DO0306.10 — 1 — 2
4481-MQLK-0001-FY-12
DO0306.11 — 4 — 3
103-V20-

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Vendor or Subcontractor Logo: GNA Multech Inc. — Département Ingénierie / Engineering Department, 1400 Jean-Paroutis, Saint-Laurent, Québec, H4S 1V3, Canada

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx	xxxx	xxxx	xxx	xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL OUTPUT FLEX I/O (24 Vdc) RACK: 03 MODULE: 06 (2/2)
I/O INTERCONNECTION DIAGRAM

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—	—	A3—		—AZ	

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1	1347-53300-02	DIGITAL INPUT FLEX I/O (24 VDC) RACK: 04 MODULE: 00 (1/4) I/O INTERCONNECTION DIAGRAM
2	1347-53301-01	DIGITAL INPUT FLEX I/O (24 VDC) RACK: 04 MODULE: 00 (2/4) I/O INTERCONNECTION DIAGRAM
3	1347-53306-00	DIGITAL INPUT FLEX I/O (24 VDC) RACK: 04 MODULE: 00 (3/4) I/O INTERCONNECTION DIAGRAM
4	1347-53307-00	DIGITAL INPUT FLEX I/O (24 VDC) RACK: 04 MODULE: 00 (4/4) I/O INTERCONNECTION DIAGRAM
5	1347-53302-00	DIGITAL INPUT FLEX I/O (24 VDC) RACK: 04 MODULE: 01 (1/2) I/O INTERCONNECTION DIAGRAM
6	1347-53303-03	DIGITAL INPUT FLEX I/O (24 VDC) RACK: 04 MODULE: 01 (2/2) I/O INTERCONNECTION DIAGRAM
7	1347-53304-01	DIGITAL INPUT FLEX I/O (24 VDC) RACK: 04 MODULE: 02 (1/2) I/O INTERCONNECTION DIAGRAM
8	1347-53305-03	DIGITAL INPUT FLEX I/O (24 VDC) RACK: 04 MODULE: 02 (2/2) I/O INTERCONNECTION DIAGRAM
9	1347-53350-01	ANALOG INPUT FLEX I/O (4-20MA) RACK: 04 MODULE: 07 (1/2) I/O INTERCONNECTION DIAGRAM
10	1347-53351-00	ANALOG INPUT FLEX I/O (4-20MA) RACK: 04 MODULE: 07 (2/2) I/O INTERCONNECTION DIAGRAM
11	1347-54300-01	DIGITAL OUTPUT FLEX I/O (24 VDC) RACK: 04 MODULE: 03 (1/2) I/O INTERCONNECTION DIAGRAM
12	1347-54301-01	DIGITAL OUTPUT FLEX I/O (24 VDC) RACK: 04 MODULE: 03 (2/2) I/O INTERCONNECTION DIAGRAM
13	1347-54302-02	DIGITAL OUTPUT FLEX I/O (24 VDC) RACK: 04 MODULE: 04 (1/2) I/O INTERCONNECTION DIAGRAM
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15	1347-54304-01	DIGITAL OUTPUT FLEX I/O (24 VDC) RACK: 04 MODULE: 05 (1/2) I/O INTERCONNECTION DIAGRAM
16	1347-54305-01	DIGITAL OUTPUT FLEX I/O (24 VDC) RACK: 04 MODULE: 05 (2/2) I/O INTERCONNECTION DIAGRAM
17	1347-54306-01	DIGITAL OUTPUT FLEX I/O (24 VDC) RACK: 04 MODULE: 06 (1/2) I/O INTERCONNECTION DIAGRAM
18	1347-54307-01	DIGITAL OUTPUT FLEX I/O (24 VDC) RACK: 04 MODULE: 06 (2/2) I/O INTERCONNECTION DIAGRAM

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		1		UPDATE	10-MA-2011	F.P.	E.B.	C.C.
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Vendor or Subcontractor Logo: GNA Altech inc. — Département Ingénierie / Engineering Department, 9650 TransCanada, Saint-Laurent, Québec H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457	00AZ	xx	xxxx	xxxx - xxx	xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
I/O INTERCONNECTION DIAGRAMS
REMOTE RACK 04 (C3)

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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4	FIELD
3	LOCAL CONTROL PANEL 4481-MHCD-0002-CP-01 C2/R9
2	JUNCTION BOX 4481-MZBP-0001-JB-01 S1
1	LOCAL CONTROL PANEL 4481-MHCD-0003-CP-01 C2/R9/S1

4481-MJR0-0001-ZS-01 — C / NO — DI0400.0 — 4481-MJR0-0001-ZS01-J1 (2C x 1,5mm2) — 97-V8+

4481-MJR0-0001-ZS-02 — C / NO — DI0400.1 — 4481-MJR0-0001-ZS02-J1 (2C x 1,5mm2) — 97-V8+

4481-MJR0-0001-ZS-03 — C / NO — DI0400.2 — 4481-MJR0-0001-ZS03-J1 (2C x 1,5mm2) — 97-V8+

4481-MZBP-0001-ZS-01 — C / NO — DI0400.5 — 4481-MZBP-0001-ZS01-J1 (2C x 1,5mm2) — 97-V8+

4481-MZBP-0001-ZS-02 — C / NO — DI0400.6 — 4481-MZBP-0001-ZS02-J1 (2C x 1,5mm2) — 97-V8+

4481-MZBP-0001-ZS-03 — C / NO — DI0400.7 — 4481-MZBP-0001-ZS03-J1 (2C x 1,5mm2) — 97-V8+

XDI0400

1	DI0400.0	DI0400.0 (1)
	97-V8+	
2	DI0400.1	DI0400.1 (4)
	97-V8+	
3	DI0400.2	DI0400.2 (5)
	97-V8+	
4	DI0400.3	DI0400.3 (6)
	97-V8+	
5	DI0400.4	DI0400.4 (7)
	97-V8+	

99-CR2: 43 / 44 — 99-CR9: 11 / 14

SEE DWG. 1347-55293 25457-4480-V1A-MXA0-0102

X99: 1+ 97-V8+ (3); 1- 97-V8- (2)

SEE DWG. 1347-53306

XDI0400

1	DI0400.5	DI0400.5 (1)
	97-V8+	97-V8+ (2)
2	DI0400.6 (1)	DI0400.6 (3)
	97-V8+ (2)	
3	DI0400.7 (3)	DI0400.7 (4)
	97-V8+	

SEE DWG. 1347-53301

4481-MHCD-0002-CP-01-J1 (26C x 1,5mm2) +G

4481-MZBP-0001-JB-01-J1 (19C x 1,5mm2) +G

A 0 1 2 3 4 5 6 7

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1794-IB32
VOLTAGE	24Vdc
MODULE	00
RACK	04
PANEL	4481-MHCD-0003-CP-01
TERMINAL BASE	1794-TB32S

FROM LINE 08 SEE DWG. 1347-55291 25457-4480-V1A-MXA0-0102

97-V8+ — 35 +24Vdc

DI0400.0 (1)	0	DI0400.0	4481-MJR0-0001-ZS-01 R9 CONVEYOR BAR ON R9 CONVEYOR PROXIMITY SWITCH
27-V8- (2)	36		
97-V8+ (3)	37		
DI0400.1 (4)	1	DI0400.1	4481-MJR0-0001-ZS-02 R9 CONVEYOR CONVEYOR UP PROXIMITY SWITCH
DI0400.2 (5)	2	DI0400.2	4481-MJR0-0001-ZS-03 R9 CONVEYOR CONVEYOR DOWN PROXIMITY SWITCH
DI0400.3 (6)	3	DI0400.3	99-CR2 C2, R9 ZONE ACCESS REQUEST RELAY
DI0400.4 (7)	4	DI0400.4	99-CR9 C2, R9 ZONE KEY SOLENOID ON RELAY
DI0400.5 (1)	5	DI0400.5	4481-MZBP-0001-ZS-01 PART DETECT AT ENTRANCE PROXIMITY SWITCH
97-V8+ (2)	39		
DI0400.6 (3)	6	DI0400.6	4481-MZBP-0001-ZS-02 DOOR 1 CLOSED LIMIT SWITCH
DI0400.7 (4)	7	DI0400.7	4481-MZBP-0001-ZS-03 DOOR 2 CLOSED LIMIT SWITCH

SEE DWG. 1347-53301

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RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA a/Tech inc. — Département Ingénierie / Engineering Department, 5650 TransCanada, Saint-Laurent, Québec H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

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SELLER DRAWING No. 1347-53300 REV. 2

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT FLEX I/O (24 Vdc) RACK: 04 MODULE: 00 (1/4)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3—		—AZ	

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FIELD	JUNCTION BOX 4481-MZBP-0001-JB-02 S1	JUNCTION BOX 4481-MZBP-0001-JB-01 S1	LOCAL CONTROL PANEL 4481-MHCD-0003-CP-01 C3/R8/S1

A 0 1 2 3 4 5 6 7

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1794-IB32
VOLTAGE	24Vdc
MODULE	00
RACK	04
PANEL	4481-MHCD-0003-CP-01
TERMINAL BASE	1794-TB32S

4481-MZBP-0001-ZS-04 (S, V+, V-) DI0400.8, 97-V8+, 97-V8- → 4481-MZBP-0001-ZS04-J1 (3C x 1,5mm2) → XDI0400 (1) DI0400.8, 97-V8+, 97-V8- → 4481-MZBP-0001-JB02-J1 (3C x 1,5mm2) +G → SEE DWG. 1347-53300 (4) DI0400.8, 97-V8+, 97-V8- → DI0400.8 (5), 97-V8- (6), DI0400.9 (7), 97-V8+ (5)

SEE DWG. 1347-53300

DI0400.8 (5)	8	DI0400.8	4481-MZBP-0001-ZS-04 HOPPER LEVEL PROBE
97-V8- (6)	40		
DI0400.9 (7)	9	DI0400.9	SPARE

4481-MJR0-0002-ZS-01 (C, NO)	DI0400.10, 97-V8+	4481-MJR0-0002-ZS01-J1 (2C x 1,5mm2)	97-V8+ → 97-V8+	DI0400.10	10 DI0400.10 / 45 97-V8+	4481-MJR0-0002-ZS-01 R8 CONVEYOR BAR ON R8 CONVEYOR PROXIMITY SWITCH
4481-MJR0-0002-ZS-02 (C, NO)	DI0400.11, 97-V8+	4481-MJR0-0002-ZS02-J1 (2C x 1,5mm2)	97-V8+ → 97-V8+	DI0400.11	11 DI0400.11	4481-MJR0-0002-ZS-02 R8 CONVEYOR CONVEYOR UP PROXIMITY SWITCH
4481-MJR0-0002-ZS-03 (C, NO)	DI0400.12, 97-V8+	4481-MJR0-0002-ZS03-J1 (2C x 1,5mm2)	97-V8+ → 97-V8+	DI0400.12	12 DI0400.12 / 47	4481-MJR0-0002-ZS-03 R8 CONVEYOR CONVEYOR DOWN PROXIMITY SWITCH
4481-MHCD-0003-ZS-04 (C, NO)	DI0400.13, 97-V8+	4481-MHCD-0003-ZS04-J1 (2C x 1,5mm2)	97-V8+ → 97-V8+	DI0400.13	13 DI0400.13	4481-MHCD-0003-ZS-04 C3 CONVEYOR BAR IN SECOND POSITION PROXIMITY SWITCH
4481-MHCD-0003-ZS-05 (C, NO)	DI0400.14, 97-V8+	4481-MHCD-0003-ZS05-J1 (2C x 1,5mm2)	97-V8+ → 97-V8+	DI0400.14	14 DI0400.14 / 49	4481-MHCD-0003-ZS-05 C3 CONVEYOR BAR IN FOURTH POSITION PROXIMITY SWITCH
4481-MHCD-0003-ZS-06 (C, NO)	DI0400.15, 97-V8+	4481-MHCD-0003-ZS06-J1 (2C x 1,5mm2)	97-V8+ → 97-V8+	DI0400.15	15 DI0400.15	4481-MHCD-0003-ZS-06 C3 CONVEYOR BAR IN LAST POSITION PROXIMITY SWITCH

42 COM1

41 +24Vdc

SEE DWG. 1347-53306

1

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DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		1		UPDATE	15-AU-2011	F.P.	E.B.	C.C.
		REVISIONS						

NOTES

STATUS: FOR DESIGN

DRAWN/DES'D:	F.P.	AREA ENG.:	
DATE:	10/10/2010	DATE:	
CHECKED:	E.B.	PRJ ENG MGR:	
DATE:		DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA aiTech inc. — Département Ingénierie / Engineering Department, 8480 J.Talon Canada, Montréal, Québec, H4S 1V3, Canada

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

SELLER DRAWING No. 1347-53301 REV. 1

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT FLEX I/O (24 Vdc) RACK: 04 MODULE: 00 (2/4)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—	—	A3—		—AZ	

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FIELD

LOCAL CONTROL PANEL
4481-MHCD-0003-CP-01

R7

A 0 1 2 3 4 5 6 7

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1794-IB16
VOLTAGE	24Vdc
MODULE	01
RACK	04
PANEL	4481-MHCD-0003-CP-01
TERMINAL BASE	1794-TB3S

FROM LINE 10
SEE DWG. 1347-55291
25457-4480-V1A-MXA0-0097

97-V10+ — 34 — +24Vdc

4481-MJR0-0003-ZS-07 — C / NO — DI0401.0 — 4481-MJR0-0003-ZS07-J1 (2C x 1,5mm2) — 97-V10+
DI0401.0 — 0 — DI0401.0 — 35 — 97-V10+
4481-MJR0-0003-ZS-07 R7 CONVEYOR CONVEYOR UP PROXIMITY SWITCH

4481-MJR0-0003-ZS-08 — C / NO — DI0401.1 — 4481-MJR0-0003-ZS08-J1 (2C x 1,5mm2) — 97-V10+
DI0401.1 — 1 — DI0401.1 — 36 — 97-V10+
4481-MJR0-0003-ZS-08 R7 CONVEYOR CONVEYOR DOWN PROXIMITY SWITCH

4481-MJR0-0003-ZS-09 — C / NO — DI0401.2 — 4481-MJR0-0003-ZS09-J1 (2C x 1,5mm2) — 97-V10+
DI0401.2 — 2 — DI0401.2 — 37 — 97-V10+
4481-MJR0-0003-ZS-09 R7 CONVEYOR BAR No.1 DETECTED PROXIMITY SWITCH

4481-MJR0-0003-ZS-10 — C / NO — DI0401.3 — 4481-MJR0-0003-ZS10-J1 (2C x 1,5mm2) — 97-V10+
DI0401.3 — 3 — DI0401.3 — 38 — 97-V10+
4481-MJR0-0003-ZS-10 R7 CONVEYOR BAR No.2 DETECTED PROXIMITY SWITCH

4481-MJR0-0003-ZS-11 — C / NO — DI0401.4 — 4481-MJR0-0003-ZS11-J1 (2C x 1,5mm2) — 97-V10+
DI0401.4 — 4 — DI0401.4 — 39 — 97-V10+
4481-MJR0-0003-ZS-11 R7 CONVEYOR BAR No.3 DETECTED PROXIMITY SWITCH

4481-MJR0-0003-ZS-12 — C / NO — DI0401.5 — 4481-MJR0-0003-ZS12-J1 (2C x 1,5mm2) — 97-V10+
DI0401.5 — 5 — DI0401.5 — 40 — 97-V10+
4481-MJR0-0003-ZS-12 R7 CONVEYOR BAR No.4 DETECTED PROXIMITY SWITCH

SEE DWG. 1347-55292
25457-4480-V1A-MXA0-0098

98-CR10 (43 / 44) — DI0401.6 — 6 — DI0401.6 — 41 — 97-V10+
98-CR10 R8, C3, R7 ZONE ACCESS REQUEST RELAY

98-CR19 (43 / 44) — DI0401.7 — 7 — DI0401.7 — 42 — 97-V10+
98-CR19 R8, C3, R7 ZONE ACCESS REQUEST RELAY

SEE DWG. 1347-53303

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
		0						

REFERENCES — REVISIONS

NOTES

STATUS: FOR DESIGN

DRAWN/DESD:	F.P.	AREA ENG.:	
DATE:	10/10/2010	DATE:	
CHECKED:	E.B.	PRJ ENG MGR:	
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RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

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Vendor or Subcontractor Logo: GNA Alutech Inc. — Département Ingénierie / Engineering Department, 9695 Trans-Canada, Ste-Anne-de-Bellevue, Québec, H9X 3V1, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SELLER DRAWING No. 1347–53302 — REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT FLEX I/O (24 Vdc) RACK: 04 MODULE: 01 (1/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx –	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
–		–	–	A3–		–AZ	

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FIELD

LOCAL CONTROL PANEL
4481-MBMB-0001-CP-01 F2Z1

LOCAL CONTROL PANEL
4481-MHCD-0003-CP-01 F2

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1794-IB16
VOLTAGE	24Vdc
MODULE	01
RACK	04
PANEL	4481-MHCD-0003-CP-01
TERMINAL BASE	1794-TB3S

A 0 1 2 3 4 5 6 7

4481-MBMB-0001-ZSE-11 — EMITTER — GRAY CABLE — 4481-MBMB-0001-ZSE11-J1 (2C x 1,5mm2) — GRAY CABLE
4481-MBMB-0001-ZSR-11 — RECEIVER — BLACK CABLE — 4481-MBMB-0001-ZSR11-J1 (2C x 1,5mm2) — BLACK CABLE
4481-MBMB-0001-ZSE-12 — EMITTER — GRAY CABLE — 4481-MBMB-0001-ZSE12-J1 (2C x 1,5mm2) — GRAY CABLE
4481-MBMB-0001-ZSR-12 — RECEIVER — BLACK CABLE — 4481-MBMB-0001-ZSR12-J1 (2C x 1,5mm2) — BLACK CABLE

ZS-11: WHITE 5 → 2; BLACK 7 → 3; WHITE 6 → 1; BLACK 8 → 4; 10
ZS-12: WHITE 5 → 2; BLACK 7 → 3; WHITE 6 → 1; BLACK 8 → 4; 10

XDI0401
97-V10+ → 97-V10+ → 97-V10+ (5)
DI0401.8 → 1 → DI0401.8 (1)
97-V10- → 97-V10- → 97-V10- (4)
97-V10+ → 97-V10+
DI0401.9 → 2 → DI0401.9 (2)
97-V10- → 97-V10-
3 → DI0401.10 (3)
97-V10+
DI0401.11 → 4 → DI0401.11 (6)
97-V10+ → 97-V10+
5
97-V10+
DI0401.12 → 6 → DI0401.12 (7)
97-V10+
7
97-V10+
DI0401.13 → 8 → DI0401.13 (8)
97-V10+
DI0401.14 → 7 → DI0401.14 (9)
97-V10+
8 → DI0401.15 (10)
97-V10+

4481-MBMB-0001-ZS-13: C — DI0401.11; NO — 97-V10+; C — 98-V26B; NO — 98-V26A; (2)
4481-MBMB-0001-ZS13-J1 (4C x 1,5mm2)

X98: 26A — 4481MJR00003M1-9 (11); 26B — 4481MJR00003M1-9A (12)

4481-MBMB-0001-ZS-14: C — DI0401.12; NO — 97-V10+
4481-MBMB-0001-ZS14-J1 (2C x 1,5mm2)

4481-MBMB-0001-ZS-15: C — DI0401.13; NO — 97-V10+
4481-MBMB-0001-ZS15-J1 (2C x 1,5mm2)

HUS-13: DI0401.14; (1)

4481-MBMB-0001-CP01-J1 (26C x 1,5mm2) +G

SEE DWG. 1347-53302

DI0401.8 (1)	8 DI0401.8	4481-MBMB-0001-ZS-11 BAR DETECTED AT ENTRY OF F2 FURNACE CONV. No.1 INF.RED EMITTER/RECEIVER
	43	
DI0401.9 (2)	9 DI0401.9	4481-MBMB-0001-ZS-12 BAR DETECTED AT END OF F2 FURNACE CONV. No.1 INF.RED EMITTER/RECEIVER
	44	
DI0401.10 (3)	10 DI0401.10	SPARE
97-V10- (4)	27	
97-V10+ (5)	45	
DI0401.11 (6)	11 DI0401.11	4481-MBMB-0001-ZS-13 F2 ENTRY DOOR DOOR OPENED LIMIT SWITCH
	46	
DI0401.12 (7)	12 DI0401.12	4481-MBMB-0001-ZS-14 F2 ENTRY DOOR DOOR CLOSED LIMIT SWITCH
	47	
DI0401.13 (8)	13 DI0401.13	4481-MBMB-0001-ZS-15 F2 ENTRY DOOR DOOR CLAMPED PROXIMITY SWITCH
	48	
DI0401.14 (9)	14 DI0401.14	4481-MBMB-0001-HUS-13 F2 ENTRY DOOR REMOTE MODE SELECTOR (1)
	49	
DI0401.15 (10)	15 DI0401.15	SPARE
	50	
97-V10-	16 COMMON	

X98: 26A — 4481MJR00003M1-9 (11); 26B — 4481MJR00003M1-9A (12)

FROM LINE 10
SEE DWG. 1347-55291
25457-4480-V1A-MXA0-0097

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		2	–	CHANGE CONTACT FROM NC INTO NO	FE 02 2011	F.P.	E.B.	C.C.
		1	–	ADD. REMOTE MODE INPUT DI0401.14	JA 27 2011	F.P.	E.B.	M.B.
		REVISIONS						

NOTES

STATUS: FOR DESIGN

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DATE:		DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA Automatisation inc. — Département Ingénierie / Engineering Department — 5455 Louis-Pasteur, Salaberry-de-Valleyfield, Québec, J6S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

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SELLER DRAWING No. 1347-53303 REV. 2

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT FLEX I/O (24 Vdc) RACK: 04 MODULE: 01 (2/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3–		–AZ	

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FIELD

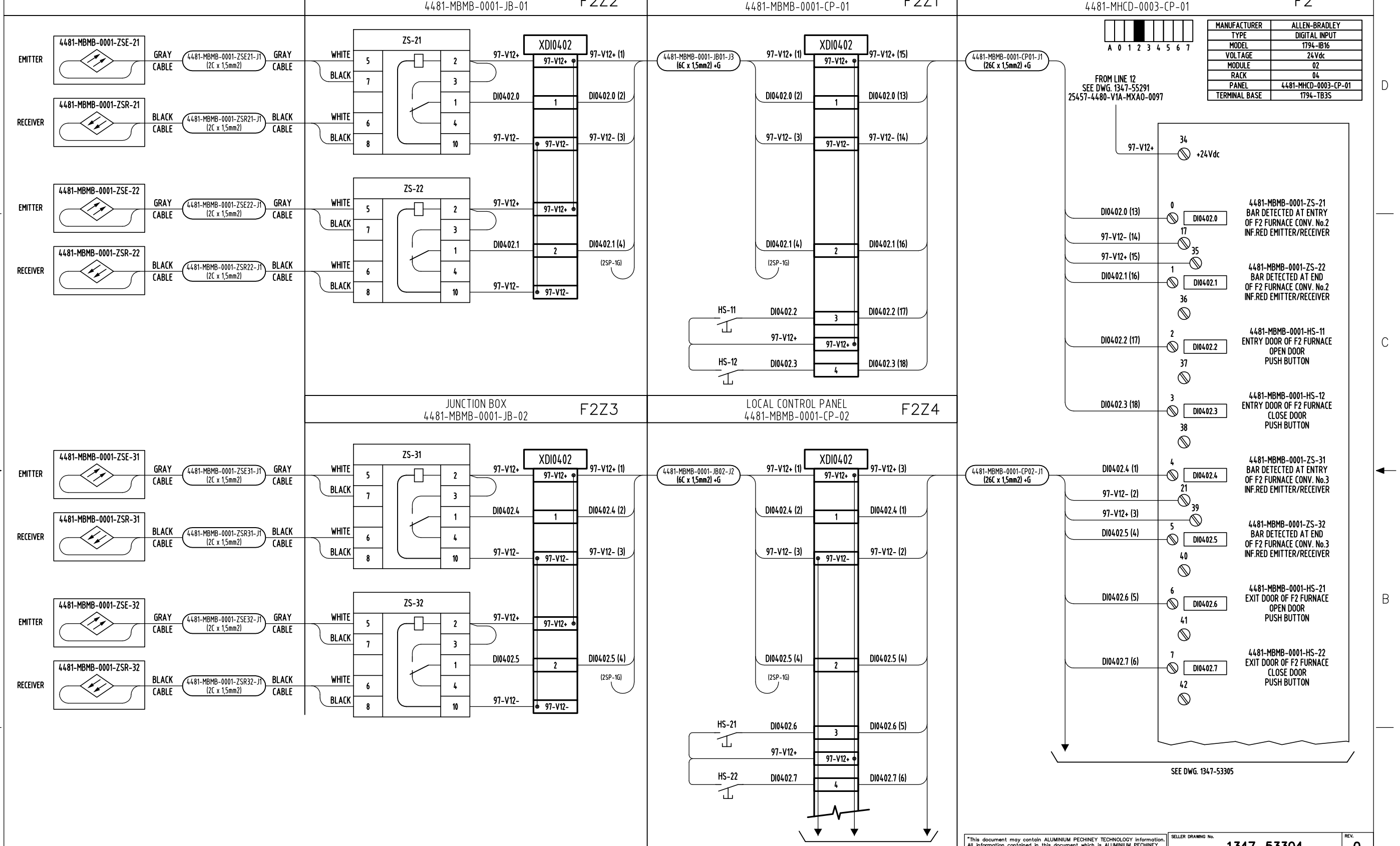
JUNCTION BOX 4481-MBMB-0001-JB-01 F2Z2

LOCAL CONTROL PANEL 4481-MBMB-0001-CP-01 F2Z1

LOCAL CONTROL PANEL 4481-MHCD-0003-CP-01 F2

JUNCTION BOX 4481-MBMB-0001-JB-02 F2Z3

LOCAL CONTROL PANEL 4481-MBMB-0001-CP-02 F2Z4



MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1794-IB16
VOLTAGE	24Vdc
MODULE	02
RACK	04
PANEL	4481-MHCD-0003-CP-01
TERMINAL BASE	1794-TB3S

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		0		REVISIONS				

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STATUS: FOR DESIGN

DRAWN/DES'D:	F.P.	AREA ENG.:	
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CHECKED:	E.B.	PRJ ENG MGR:	
DATE:		DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

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Vendor or Subcontractor Logo: GNA Automatech Inc. — Département Ingénierie / Engineering Department, 1695 Transcanada, Saint-Laurent, Québec, H4S 1V3, Canada

SELLER DRAWING No. 1347-53304 REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT FLEX I/O (24 Vdc) RACK: 04 MODULE: 02 (1/2)
I/O INTERCONNECTION DIAGRAM

Project Title: Ras Az Zawr Aluminium Smelter

MA'ADEN

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3—		—AZ	

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FIELD

LOCAL CONTROL PANEL
4481-MBMB-0001-CP-02
F2Z4

LOCAL CONTROL PANEL
4481-MHCD-0003-CP-01
F2

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1794-IB16
VOLTAGE	24Vdc
MODULE	02
RACK	04
PANEL	4481-MHCD-0003-CP-01
TERMINAL BASE	1794-TB3S

A 0 1 2 3 4 5 6 7

SEE DWG. 1347-53304

4481-MBMB-0001-ZSE-41 — EMITTER — GRAY CABLE — 4481-MBMB-0001-ZSE41-J1 (2C x 1,5mm2) — GRAY CABLE
4481-MBMB-0001-ZSR-41 — RECEIVER — BLACK CABLE — 4481-MBMB-0001-ZSR41-J1 (2C x 1,5mm2) — BLACK CABLE
4481-MBMB-0001-ZSE-42 — EMITTER — GRAY CABLE — 4481-MBMB-0001-ZSE42-J1 (2C x 1,5mm2) — GRAY CABLE
4481-MBMB-0001-ZSR-42 — RECEIVER — BLACK CABLE — 4481-MBMB-0001-ZSR42-J1 (2C x 1,5mm2) — BLACK CABLE

ZS-41: WHITE 5 / BLACK 7 / WHITE 6 / BLACK 8 — 2, 3, 1, 4, 10
ZS-42: WHITE 5 / BLACK 7 / WHITE 6 / BLACK 8 — 2, 3, 1, 4, 10

4481-MBMB-0001-ZS-43: C / DI0402.11 / NO / 97-V12+ / C / SPARE / NO / SPARE — 4481-MBMB-0001-ZS43-J1 (4C x 1,5mm2)
4481-MBMB-0001-ZS-44: C / DI0402.12 / NO / 97-V12+ — 4481-MBMB-0001-ZS44-J1 (2C x 1,5mm2)
4481-MBMB-0001-ZS-45: C / DI0402.13 / NO / 97-V12+ — 4481-MBMB-0001-ZS45-J1 (2C x 1,5mm2)
HUS-23: DI0402.14 / 97-V12+ (2SP)

97-V12+	97-V12+
DI0402.8	5 — DI0402.8 (7)
97-V12-	97-V12-
97-V12+	97-V12+
DI0402.9	6 — DI0402.9 (8)
97-V12-	97-V12-
	7 — DI0402.10 (9)
97-V12+	97-V12+
DI0402.11	8 — DI0402.11 (10)
97-V12+	97-V12+
DI0402.12	9 — DI0402.12 (11)
97-V12+	97-V12+
DI0402.13	10 — DI0402.13 (12)
97-V12+	97-V12+
DI0402.14	11 — DI0402.14 (13)
97-V12+	97-V12+
	12 — DI0402.15 (14)
	97-V12+

SEE DWG. 1347-53304

DI0402.8 (7)	8 — DI0402.8 — 43	4481-MBMB-0001-ZS-41 BAR DETECTED AT ENTRY OF F2 FURNACE CONV. No.4 INF.RED EMITTER/RECEIVER
DI0402.9 (8)	9 — DI0402.9 — 44	4481-MBMB-0001-ZS-42 BAR DETECTED AT END OF F2 FURNACE CONV. No.4 INF.RED EMITTER/RECEIVER
DI0402.10 (9)	10 — DI0402.10 — 45	SPARE
DI0402.11 (10)	11 — DI0402.11 — 46	4481-MBMB-0001-ZS-43 F2 EXIT DOOR DOOR OPENED LIMIT SWITCH
DI0402.12 (11)	12 — DI0402.12 — 47	4481-MBMB-0001-ZS-44 F2 EXIT DOOR DOOR CLOSED LIMIT SWITCH
DI0402.13 (12)	13 — DI0402.13 — 48	4481-MBMB-0001-ZS-45 F2 EXIT DOOR DOOR CLAMPED PROXIMITY SWITCH
DI0402.14 (13)	14 — DI0402.14 — 49	4481-MBMB-0001-HUS-23 F2 EXIT DOOR REMOTE MODE SELECTOR (1)
DI0402.15 (14)	15 — DI0402.15 — 50	SPARE
97-V12-	16 — COMMON	

FROM LINE 12
SEE DWG. 1347-55291
25457-4480-V1A-MXA0-0097

REVISIONS							
2	–	CHANGE CONTACT FROM NC INTO NO	FE 02 2011	F.P.	E.B.	C.C.
1	–	ADD. REMOTE MODE INPUT DI0402.14	JA 27 2011	F.P.	E.B.	M.B.
No	STATUS	DESCRIPTION	DATE	BY	CHK	APP

DRAWING NUMBER | TITLE
REFERENCES

NOTES

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DATE:		DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA automation inc. — Département Ingénierie, Engineering Department, 5600 Trans-Canada, Saint-Laurent, Quebec, H4S 1V5, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-	00AZ-	xx -	xxxx -	xxx -	xxx

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SELLER DRAWING No. 1347-53305 — REV. 2

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT FLEX I/O (24 Vdc) RACK: 04 MODULE: 02 (2/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
–	–	–	–	A3–		–AZ	

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LOCAL CONTROL PANEL
4481-MHCD-0002-CP-03 C2

4481-MHCD-0002-HS-05
4481-MHCD-0002-HS-06
DI0400.16
DI0400.17
97-V8+
XDI0400
1
2
97-V8+
DI0400.16 (1)
DI0400.17 (2)
97-V8+ (3)

4481-MHCD-0002-CP-03-J1
(7C x 1,5mm2) +G

LOCAL CONTROL PANEL
4481-MHCD-0002-CP-01 C2/R9

SEE DWG. 1347-53300
DI0400.16 (1)
DI0400.17 (2)
97-V8+ (3)
6
7
97-V8+
DI0400.16 (18)
DI0400.17 (19)

4481-MHCD-0002-CP-01-J1
(26C x 1,5mm2) +G

LOCAL CONTROL PANEL
4481-MHCD-0003-CP-01 C3/R8/S1

A 0 1 2 3 4 5 6 7

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1794-IB32
VOLTAGE	24Vdc
MODULE	00
RACK	04
PANEL	4481-MHCD-0003-CP-01
TERMINAL BASE	1794-TB32S

SEE DWG. 1347-53301
43 +24Vdc
44 COM2
DI0400.16 (18)
DI0400.17 (19)

17	DI0400.16	4481-MHCD-0002-HS-05 C2 ZONE ACCESS REQUEST PUSH BUTTON
18	DI0400.17	4481-MHCD-0002-HS-06 C2 ZONE ACCESS REQUEST RESET PUSH BUTTON
19	DI0400.18	SPARE
20	DI0400.19	SPARE
21	DI0400.20	SPARE
22	DI0400.21	SPARE
23	DI0400.22	SPARE
24	DI0400.23	SPARE

SEE DWG. 1347-53307

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SELLER DRAWING No. 1347-53306 REV. 0

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		0		REVISIONS				

NOTES

STATUS: FOR DESIGN

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DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA aLtech inc. Département Ingénierie Engineering Department 9450 TransCanada Saint-Laurent, Québec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT FLEX I/O (24 Vdc) RACK: 04 MODULE: 00 (3/4)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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FIELD

LOCAL CONTROL PANEL
4481-MHCD-0003-CP-01

C3/R8/S1

A 0 1 2 3 4 5 6 7

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1794-IB32
VOLTAGE	24Vdc
MODULE	00
RACK	04
PANEL	4481-MHCD-0003-CP-01
TERMINAL BASE	1794-TB32S

SEE DWG. 1347-53306

25	DI0400.24	SPARE
26	DI0400.25	SPARE
27	DI0400.26	SPARE
28	DI0400.27	SPARE
29	DI0400.28	SPARE
30	DI0400.29	SPARE
31	DI0400.30	SPARE
32	DI0400.31	SPARE
50	COM2	97-V8-

FROM LINE 08
SEE DWG. 1347-55291
25457-4480-V1A-MXA0-0102

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SELLER DRAWING No. 1347-53307 | REV. 0

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DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA aLtech inc. — Département Ingénierie, Engineering Department, 9650 Trans-Canada, Saint-Laurent, Quebec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT FLEX I/O (24 Vdc) RACK: 04 MODULE: 00 (4/4)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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4	FIELD
3	JUNCTION BOX 4481-MBMB-0001-JB-01 F2
2	JUNCTION BOX 4481-MBMB-0001-JB-02 F2
1	LOCAL CONTROL PANEL 4481-MHCD-0003-CP-01 F2

MANUFACTURER	ALLEN-BRADLEY
TYPE	ANALOG INPUT
MODEL	1794-IF8IH
CURRENT	4-20mA
MODULE	07
RACK	04
PANEL	4481-MHCD-0003-CP-01
TERMINAL BASE	1794-TB3S

A 0 1 2 3 4 5 6 7

FROM LINE 22
SEE DWG. 1347-55291
25457-4480-V1A-MXA0-0097

4481-MBMB-0001-TE-11
TE11+ YELLOW
TE11- WHITE
4481-MBMB-0001-TE11-J1 (1P/SH)
4481-MBMB-0001-JB02-J1 (3P/SH)
4481-MBMB-0001-JB02-J2 (5P/SH)

XAI0407
4481-MBMB-0001 TT-11
TE11+ TE11-
97-V22+ AI0407.0
(1P/SH SP)

4481-MBMB-0001-TE-21
TE21+ YELLOW
TE21- WHITE
4481-MBMB-0001-TE21-J1 (1P/SH)
4481-MBMB-0001 TT-21
TE21+ TE21-
97-V22+ AI0407.1
(1P/SH SP)

4481-MBMB-0001-TE-31
TE31+ YELLOW
TE31- WHITE
4481-MBMB-0001-TE31-J1 (1P/SH)
4481-MBMB-0001 TT-31
TE31+ TE31-
97-V22+ AI0407.2

4481-MBMB-0001-TE-41
TE41+ YELLOW
TE41- WHITE
4481-MBMB-0001-TE41-J1 (1P/SH)
4481-MBMB-0001 TT-41
TE41+ TE41-
97-V22+ AI0407.3
(1P/SH SP)

XAI0407
97-V22+ AI0407.0
97-V22+ AI0407.1
1
2
SHD
(1P/SH SP)

97-V22+ 34 +24Vdc
97-V22+ 35
AI0407.0 0 AI0407.0 — 4481-MBMB-0001-TE-11 TEMPERATURE CONTROL CATHODE BAR HEATING FURNACE ZONE #1
1 I0 Ret
17
97-V22+ 36
AI0407.1 2 AI0407.1 — 4481-MBMB-0001-TE-21 TEMPERATURE CONTROL CATHODE BAR HEATING FURNACE ZONE #2
3 I1 Ret
18
97-V22+ 37
AI0407.2 4 AI0407.2 — 4481-MBMB-0001-TE-31 TEMPERATURE CONTROL CATHODE BAR HEATING FURNACE ZONE #3
5 I2 Ret
19
97-V22+ 38
AI0407.3 6 AI0407.3 — 4481-MBMB-0001-TE-41 TEMPERATURE CONTROL CATHODE BAR HEATING FURNACE ZONE #4
(1P/SH SP)
7 I3 Ret
20

SEE DWG. 1347-53351

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
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NOTES

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ENG. GROUP SUP. DATE:		DRAWING SCALE:	NONE

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SELLER DRAWING No. 1347-53350 REV. 0

Vendor or Subcontractor Logo: GNA Mutech Inc. Département Ingénierie Engineering Department 1600, Transcanada Saint-Laurent, Québec H4T 1A1 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
ANALOG INPUT FLEX I/O (4-20mA) RACK: 04 MODULE: 07 (1/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—		—	—	A3-		—AZ	

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FIELD

LOCAL CONTROL PANEL
4481-MHCD-0003-CP-01

F2

A 0 1 2 3 4 5 6 7

MANUFACTURER	ALLEN-BRADLEY
TYPE	ANALOG INPUT
MODEL	1794-IF8IH
CURRENT	4-20mA
MODULE	07
RACK	04
PANEL	4481-MHCD-0003-CP-01
TERMINAL BASE	1794-TB3S

FROM DWG. 1347-53350

39		
8	AI0407.4	SPARE
9	I4 Ret	
21		
40		
10	AI0407.5	SPARE
11	I5 Ret	
22		
41		
12	AI0407.6	SPARE
13	I6 Ret	
23		
42		
14	AI0407.7	SPARE
15	I7 Ret	
24		
16	COMMON	

97-V22-

FROM LINE 22
SEE DWG. 1347-55291
25457-4480-V1A-MXA0-0097

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ENG. GROUP SUP.		DRAWING SCALE:	NONE
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Vendor or Subcontractor Logo: GNA Robotech Inc. — Département Ingénierie / Engineering Department — Boul. Industriel-Ouest, Sainte-Julienne, Québec, J0K 1V0, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
ANALOG INPUT FLEX I/O (4-20mA) RACK: 04 MODULE: 07 (2/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3—		—AZ	

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C2/R9

LOCAL CONTROL PANEL
4481-MHCD-0003-CP-01

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL OUTPUT
MODEL	1794-OB8EP
VOLTAGE	24Vdc
MODULE	03
RACK	04
PANEL	4481-MHCD-0003-CP-01
TERMINAL BASE	1794-TB3S

A 0 1 2 3 4 5 6 7

SEE DWG. 1347-54300

99-YL5
C2, R9 ZONE
ACCESS REQUEST
LIGHT
DO0403.4 — 8 — DO0403.4 (13)
25
9
26

CR-0403.5
C2, R9 ZONE
ACCESS AUTHORIZED
RELAY
DO0403.5 — 10 — DO0403.5 A1 — DO0403.5 — A2
27
11 — 97-V14-
28

98-YL13
R8,C3, R7 ZONE
ACCESS REQUEST
LIGHT
DO0403.6 — 12 — DO0403.6 — 98-YL13
29
13 — 97-V14-
30

CR-0403.6
R8,C3, R7 ZONE
ACCESS AUTHORIZED
RELAY
DO0403.7 — 14 — DO0403.7 A1 — DO0403.7 — A2
31
15 — 97-V14-
32
16 — COMMON — 97-V14-

FROM LINE 14
SEE DWG. 1347-55291
25457-4480-V1A-MXAO-0102

PLC
C2, R9 ZONE
ACCESS AUTHORIZED
DO0403.5
99-V6B (15) — 14 — 11 — 99-V6A (14)

SEE DWG. 1347-55293
25457-4480-V1A-MXAO-0102

PLC
R8,C3,R7 ZONE
ACCESS AUTHORIZED
DO0403.7
98-V14B — 14 — 11 — 98-V14A

SEE DWG. 1347-55292
25457-4480-V1A-MXAO-0102

LOCAL CONTROL PANEL
4481-MHCD-0002-CP-01

C2/R9

FIELD

SEE DWG. 1347-54300

DO0403.4 (13) — 5 — DO0403.4 — 99-YL5
97-V14- — 97-V14-

SEE DWG. 1347-55293
25457-4480-V1A-MXAO-0102

SEE DWG. 1347-54303

1

X99
99-V6A (14) — 6A
99-V6B (15) — 6B

No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
1		UPDATE	15-AU-2011	F.P.	E.B.	C.C.

REFERENCES — REVISIONS

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RESPONSIBLE ENG. M.B.	CLIENT:
DATE:	DATE:
ENG. GROUP SUP.	DRAWING SCALE: NONE
DATE:	

Vendor or Subcontractor Logo: GNA eLitech Inc. — Département Ingénierie, Engineering Department, 9490 Trans-Canada, Saint-Laurent, Quebec, H4S 1V3, Canada

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No 25457-00AZ- | SUBD. xx | DISC. - | SECTOR xxxx | SEQUENCE - xxxx - xxx | REV. - xxx

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SELLER DRAWING No. 1347-54301 | REV. 1

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL OUTPUT FLEX I/O (24 Vdc) RACK: 04 MODULE: 03 (2/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN

Type — | Building — | Discipline — | Phase — | Format A3- | Sequential | Location -AZ | Rev. No.

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MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL OUTPUT
MODEL	1794-OB8EP
VOLTAGE	24Vdc
MODULE	04
RACK	04
PANEL	4481-MHCD-0003-CP-01
TERMINAL BASE	1794-TB3S

A 0 1 2 3 4 5 6 7

S1 — LOCAL CONTROL PANEL 4481-MHCD-0003-CP-01

FROM LINE 16
SEE DWG. 1347-55291
25457-4480-V1A-MXAO-0097

34 +24Vdc — 97-V16A

4481-MZBP-0001-FY-01 BLAST WHEEL #1 ABRASIVE CONTROL SOLENOID VALVE
DO0404.0 — 0 — DO0404.0 (8) — 4481-MZBP-0001-JB01-J1 (18C x 1,5mm2) +G
17
1 — 97-V16- (9)
18

4481-MZBP-0001-FY-02 BLAST WHEEL #2 ABRASIVE CONTROL SOLENOID VALVE
DO0404.1 — 2 — DO0404.1 (10)
19
3
20

4481-MZBP-0001-FY-03 BLAST WHEEL #3 ABRASIVE CONTROL SOLENOID VALVE
DO0404.2 — 4 — DO0404.2 (11)
21
5
22

4481-MZBP-0001-FY-04 BLAST WHEEL #4 ABRASIVE CONTROL SOLENOID VALVE
DO0404.3 — 6 — DO0404.3 (12)
23
7
24

SEE DWG. 1347-54303

S1 — JUNCTION BOX 4481-MZBP-0001-JB-01

XD00404

DO0404.0 (8)	1	DO0404.0
97-V16- (9)	97-V16-	97-V16-
DO0404.1 (10)	2	DO0404.1
DO0404.2 (11)	3	DO0404.2
DO0404.3 (12)	4	DO0404.3

SEE DWG. 1347-54303

FIELD

4481-MZBP-0001-FY01-J1 (5C x 1,5mm2) +G

4481-MZBP-0001-FY-01: DO0404.0 (+), 97-V16- (-)
4481-MZBP-0001-FY-02: DO0404.1 (+), (-)
4481-MZBP-0001-FY-03: DO0404.2 (+), (-)
4481-MZBP-0001-FY-04: DO0404.3 (+), (-)

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No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
1		UPDATE	JA-21-11	F.P.	E.B.	C.C.

DRAWING NUMBER / TITLE — REFERENCES — REVISIONS

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DATE:		DATE:	
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DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA Glutech Inc. — Département Ingénierie Engineering Department 1640 Trans-Canada Dorval (Québec) H4S 1V5 Canada

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No 25457 | SUBD. 00AZ | DISC. xx | SECTOR xxxx | SEQUENCE xxx | REV. xxx

SELLER DRAWING No. 1347-54302 — REV. 1

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL OUTPUT FLEX I/O (24 Vdc) RACK: 04 MODULE: 04 (1/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type — | Building — | Discipline — | Phase — | Format A3 | Sequential — | Location AZ | Rev. No.

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S1	LOCAL CONTROL PANEL 4481-MHCD-0003-CP-01	JUNCTION BOX 4481-MZBP-0001-JB-01 S1	FIELD

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL OUTPUT
MODEL	1794-OB8EP
VOLTAGE	24Vdc
MODULE	04
RACK	04
PANEL	4481-MHCD-0003-CP-01
TERMINAL BASE	1794-TB3S

A 0 1 2 3 4 5 6 7

SEE DWG. 1347-54302

4481-MZBP-0001-FY-05 ABRASIVE ADDER CONTROL SOLENOID VALVE — DO0404.4 — 8 — DO0404.4 (13)
25
9
26
4481-MZBP-0001-FY-06 BLOW-OFF NOZZLE CONTROL SOLENOID VALVE — DO0404.5 — 10 — DO0404.5 (14)
27
11
28
SPARE — DO0404.6 — 12 — DO0404.6 (15) (4SP-1G)
29
13
30
4481-MHCD-0002-YL-01 C2 ZONE ACCESS REQUEST LIGHT — DO0404.7 — 14 — DO0404.7 (20) — 4481-MHCD-0002-CP-01-J1 (26C x 1,5mm2) +G
31
15
32
COMMON — 16 — 97-V16-

FROM LINE 16
SEE DWG. 1347-55291
25457-4480-V1A-MXA0-0102

SEE DWG. 1347-54302

DO0404.4 (13) — 5 — DO0404.4 — 97-V16-
97-V16-
DO0404.5 (14) — 6 — DO0404.5 — 97-V16-
97-V16-
DO0404.5 (15) — 7
(4SP-1G)
97-V16-

4481-MZBP-0001-FY05-J1 (2C x 1,5mm2) +G — DO0404.4 — 4481-MZBP-0001-FY-05 — 97-V16-
4481-MZBP-0001-FY06-J1 (2C x 1,5mm2) +G — DO0404.5 — 4481-MZBP-0001-FY-06 — 97-V16-

LOCAL CONTROL PANEL 4481-MHCD-0002-CP-01 C2	LOCAL CONTROL PANEL 4481-MHCD-0002-CP-03 C2

SEE DWG. 1347-54301

DO0404.7 (20) — 6 — DO0404.7 (4) — 97-V14- (5) (2SP-1G)
97-V14-
2

4481-MZBP-0001-CP-03-J1 (7C x 1,5mm2) +G — DO0404.7 (4) — XD00403 1 — DO0404.7 — 4481-MHCD-0002-YL-01
97-V14- (5) — 97-V14- — 97-V14-
(2SP-1G)
2

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SELLER DRAWING No.	REV.
1347-54303	2

No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
2		UPDATE	15-AU-2011	F.P.	E.B.	C.C.
1		UPDATE	10-MA-2011	F.P.	E.B.	C.C.

DRAWING NUMBER | TITLE | REFERENCES | REVISIONS

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DATE:		DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA ulutech inc. — Département Ingénierie / Engineering Department, 1600 Trans-Canada, H8S 4J4 Pte-Claire, Québec, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL OUTPUT FLEX I/O (24 Vdc) RACK: 04 MODULE: 04 (2/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx	- xxxx -	xxxx	- xxx	- xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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F2	LOCAL CONTROL PANEL 4481-MHCD-0003-CP-01	LOCAL CONTROL PANEL 4481-MBMB-0001-CP-01	F2Z1	FIELD

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL OUTPUT
MODEL	1794-OB8EP
VOLTAGE	24Vdc
MODULE	05
RACK	04
PANEL	4481-MHCD-0003-CP-01
TERMINAL BASE	1794-TB3S

A 0 1 2 3 4 5 6 7

FROM LINE 18
SEE DWG. 1347-55291
25457-4480-V1A-MXA0-0097

34 +24Vdc — 97-V18A

4481-MBMB-0001-FY-11
F2 ENTRY DOOR
OPEN DOOR
SOLENOID VALVE (PN.)
DO0405.0 — 0 — DO0405.0 (19) — 4481-MBMB-0001-CP01-J1 (26C x 1,5mm2) +G
17
1 — 97-V18- (20)
18

4481-MBMB-0001-FY-12
F2 ENTRY DOOR
CLOSE DOOR
SOLENOID VALVE (PN.)
DO0405.1 — 2 — DO0405.1 (21)
19
3
20

4481-MBMB-0001-FY-13
F2 ENTRY DOOR
OPEN CLAMPS
SOLENOID VALVE (PN.)
DO0405.2 — 4 — DO0405.2 (22)
21
5
22

4481-MBMB-0001-FY-14
F2 ENTRY DOOR
CLOSE CLAMPS
SOLENOID VALVE (PN.)
DO0405.3 — 6 — DO0405.3 (23)
23
7
24

SEE DWG. 1347-54305

XDO0405

DO0405.0 (19) — 1 — DO0405.0 — 4481-MBMB-0001-FY11-J1 (3C x 1,5mm2) +G
97-V18- (20) — 97-V18- — 97-V18-
DO0405.1 (21) — 2 — DO0405.1
DO0405.2 (22) — 3 — DO0405.2 — 4481-MBMB-0001-FY13-J1 (3C x 1,5mm2) +G
97-V18- — 97-V18-
DO0405.3 (23) — 4 — DO0405.3

SEE DWG. 1347-54305

4481-MBMB-0001-FY-11
DO0405.0 — 4 — 3
4481-MBMB-0001-FY-12
DO0405.1 — 1 — 2
97-V18-

4481-MBMB-0001-FY-13
DO0405.2 — 4 — 3
4481-MBMB-0001-FY-14
DO0405.3 — 1 — 2
97-V18-

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DATE:			

Vendor or Subcontractor Logo: GNA eltutech Inc. — Département Ingénierie, Engineering Department, 6490 Trans-Canada, Saint-Laurent, Québec, H4S 1V9, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL OUTPUT FLEX I/O (24 Vdc) RACK: 04 MODULE: 05 (1/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457	00AZ	XX	XXXX	XXXX	XXX – XXX

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
–		–	–	A3–		–AZ	

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R8	LOCAL CONTROL PANEL 4481-MHCD-0003-CP-01	LOCAL CONTROL PANEL 4481-MBMB-0001-CP-01 F2Z1	FIELD

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL OUTPUT
MODEL	1794-OB8EP
VOLTAGE	24Vdc
MODULE	05
RACK	04
PANEL	4481-MHCD-0003-CP-01
TERMINAL BASE	1794-TB3S

A 0 1 2 3 4 5 6 7

SEE DWG. 1347-54304

SPARE — D00405.4 — 8 — D00405.4 (24) (2SP-1G)
25
9
26
SPARE — D00405.5 — 10
27
11
28
4481-MJR0-0002-FY-01 R8 CONVEYOR RAISE SOLENOID VALVE (HYD.) — D00405.6 — 12 — D00405.6 — 4481-MJR0-0002-FY01-J1 (2C x 1,5mm2) +G
29
13 — 97-V18-
30
4481-MJR0-0002-FY-02 R8 CONVEYOR LOWER SOLENOID VALVE (HYD.) — D00405.7 — 14 — D00405.7 — 4481-MJR0-0002-FY02-J1 (2C x 1,5mm2) +G
31
15 — 97-V18-
32
COMMON — 16 — 97-V18-

FROM LINE 18
SEE DWG. 1347-55291
25457-4480-V1A-MXA0-0097

SEE DWG. 1347-54304

D00405.4 (24) (2SP-1G) — 5 — 97-V18-

4481-MJR0-0002-FY-01
D00405.6 — + — 97-V18- —

4481-MJR0-0002-FY-02
D00405.7 — + — 97-V18- —

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Vendor or Subcontractor Logo: GNA alutech inc. — Département Ingénierie / Engineering Department, 6405 Trans-Canada, Saint-Laurent, Québec H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No 25457 | SUBD. 00AZ | DISC. xx | SECTOR xxxx | SEQUENCE xxx - xxx | REV. xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL OUTPUT FLEX I/O (24 Vdc) RACK: 04 MODULE: 05 (2/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN

Type — | Building — | Discipline — | Phase — | Format A3 | Sequential — | Location AZ | Rev. No.

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F2	LOCAL CONTROL PANEL 4481-MHCD-0003-CP-01	LOCAL CONTROL PANEL 4481-MBMB-0001-CP-02	F2Z4	FIELD

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL OUTPUT
MODEL	1994-OB8EP
VOLTAGE	24Vdc
MODULE	06
RACK	04
PANEL	4481-MHCD-0003-CP-01
TERMINAL BASE	1994-TB3S

A 0 1 2 3 4 5 6 7

FROM LINE 20
SEE DWG. 1347-55291
25457-4480-V1A-MXA0-0097

34 +24Vdc — 97-V20A

4481-MBMB-0001-FY-41
F2 EXIT DOOR
OPEN DOOR
SOLENOID VALVE (PN.)
DO0406.0 — 0 — DO0406.0 (15) — 4481-MBMB-0001-CP02-J1 (18C x 1,5mm2) +G
19
1 — 97-V20- (16)
18

4481-MBMB-0001-FY-42
F2 EXIT DOOR
CLOSE DOOR
SOLENOID VALVE (PN.)
DO0406.1 — 2 — DO0406.1 (17)
19
3
20

4481-MBMB-0001-FY-43
F2 EXIT DOOR
OPEN CLAMPS
SOLENOID VALVE (PN.)
DO0406.2 — 4 — DO0406.2 (18)
21
5
22

4481-MBMB-0001-FY-44
F2 EXIT DOOR
CLOSE CLAMPS
SOLENOID VALVE (PN.)
DO0406.3 — 6 — DO0406.3 (19)
23
7
24

SEE DWG. 1347-54307

XD00406

DO0406.0 (15) — 1 — DO0406.0 — 4481-MBMB-0001-FY41-J1 (3C x 1,5mm2) +G
97-V20- (16) — 97-V20- — 97-V20-
DO0406.1 (17) — 2 — DO0406.1
DO0406.2 (18) — 3 — DO0406.2 — 4481-MBMB-0001-FY43-J1 (3C x 1,5mm2) +G
97-V20- — 97-V20-
DO0406.3 (19) — 4 — DO0406.3

SEE DWG. 1347-54307

4481-MBMB-0001-FY-41
DO0406.0 — 4 — 3
4481-MBMB-0001-FY-42
DO0406.1 — 1 — 2
97-V20-

4481-MBMB-0001-FY-43
DO0406.2 — 4 — 3
4481-MBMB-0001-FY-44
DO0406.3 — 1 — 2
97-V20-

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DATE:			

Vendor or Subcontractor Logo: GNA alutech inc. — Département Ingénierie / Engineering Department, 1600 Trans-Canada, Saint-Laurent, Québec, H4S 1V3, Canada

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No | SUBD. | DISC. | SECTOR | SEQUENCE | REV.
25457-00AZ- xx - xxxx - xxxx - xxx — xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL OUTPUT FLEX I/O (24 Vdc) RACK: 04 MODULE: 06 (1/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—		—	—	A3–		–AZ	

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R7	LOCAL CONTROL PANEL 4481-MHCD-0003-CP-01	LOCAL CONTROL PANEL 4481-MBMB-0001-CP-02 F2Z4	FIELD

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL OUTPUT
MODEL	1794-OB8EP
VOLTAGE	24Vdc
MODULE	06
RACK	04
PANEL	4481-MHCD-0003-CP-01
TERMINAL BASE	1794-TB3S

A 0 1 2 3 4 5 6 7

SEE DWG. 1347-54306

SPARE — DO0406.4 — 8 — DO0406.4 (20) — (6SP-1G)
25
9
26
SPARE — DO0406.5 — 10
27
11
28
4481-MJR0-0003-FY-03 R7 CONVEYOR RAISE SOLENOID VALVE (HYD.) — DO0406.6 — 12 — DO0406.6
29
13 — 97-V16-
30
4481-MJR0-0003-FY-04 R7 CONVEYOR LOWER SOLENOID VALVE (HYD.) — DO0406.7 — 14 — DO0406.7
31
15 — 97-V16-
32
COMMON — 16 — 97-V20-

FROM LINE 20
SEE DWG. 1347-55291
25457-4480-V1A-MXAO-0097

SEE DWG. 1347-54306

DO0406.4 (20) — (6SP-1G) — 5 — 97-V20-

4481-MJR0-0003-FY03-J1 (2C x 1,5mm2) +G

4481-MJR0-0003-FY-03
DO0406.6 — + — 97-V16- —

4481-MJR0-0003-FY04-J1 (2C x 1,5mm2) +G

4481-MJR0-0003-FY-04
DO0406.7 — + — 97-V16- —

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Vendor or Subcontractor Logo: GNA Automation Inc. — Département Ingénierie, Engineering Department, 9691 Trans-Canada, Montréal (Québec) H4S 1V5, Canada — BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

SELLER DRAWING No. 1347-54307 — REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL OUTPUT FLEX I/O (24 Vdc) RACK: 04 MODULE: 06 (2/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3—		—AZ	

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1	1347-53400-01	DIGITAL INPUT FLEX I/O (24 VDC) RACK: 05 MODULE: 00 (1/2) I/O INTERCONNECTION DIAGRAM
2	1347-53401-01	DIGITAL INPUT FLEX I/O (24 VDC) RACK: 05 MODULE: 00 (2/2) I/O INTERCONNECTION DIAGRAM
3	1347-53402-01	DIGITAL INPUT FLEX I/O (24 VDC) RACK: 05 MODULE: 01 (1/2) I/O INTERCONNECTION DIAGRAM
4	1347-53403-00	DIGITAL INPUT FLEX I/O (24 VDC) RACK: 05 MODULE: 01 (2/2) I/O INTERCONNECTION DIAGRAM
5	1347-53460-00	ANALOG INPUT FLEX I/O (4-20MA) RACK: 05 MODULE: 03 (1/2) I/O INTERCONNECTION DIAGRAM
6	1347-53461-00	ANALOG INPUT FLEX I/O (4-20MA) RACK: 05 MODULE: 03 (2/2) I/O INTERCONNECTION DIAGRAM
7	1347-54400-00	DIGITAL OUTPUT FLEX I/O (24 VDC) RACK: 05 MODULE: 02 (1/2) I/O INTERCONNECTION DIAGRAM
8	1347-54401-00	DIGITAL OUTPUT FLEX I/O (24 VDC) RACK: 05 MODULE: 02 (2/2) I/O INTERCONNECTION DIAGRAM

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Discipline :

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Vendor or Subcontractor Logo: GNA alutech inc. Département Ingénierie Engineering Department 8490 Trans-Canada Saint-Laurent, Quebec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SELLER DRAWING No. 1347-FLEX 05 I&O | REV. 1

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
I/O INTERCONNECTION DIAGRAMS
REMOTE RACK 05 (H1)

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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FIELD

LOCAL CONTROL PANEL
4481-MPF0-0001-CP-01

H1

A 0 1 2 3

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1794-IB16
VOLTAGE	24Vdc
MODULE	00
RACK	05
PANEL	4481-MPF0-0001-CP-01
TERMINAL BASE	1794-TB3S

FROM LINE 07
SEE DWG. 1347-55301
25457-4480-V1A-MXAO-0102

101-V7+ → 34 +24Vdc

4481-MPF0-0001-TSH-01
TEMPERATURE SWITCH
(NC CONTACT)
1 101-V7+
2 DI0500.0
3 101-V7-
4 DI0500.1

4481-MPF0-0001-TSL-01
TEMPERATURE SWITCH
(NC CONTACT)

4481-MPF0-0001-TS01-J1
(4C x 1,5mm2) +G

DI0500.0 → 0 DI0500.0 — 4481-MPF0-0001-TSH-01 HIGH OIL TEMPERATURE TEMPERATURE SWITCH
101-V7- → 17
101-V7+ → 35
DI0500.1 → 1 DI0500.1 — 4481-MPF0-0001-TSL-01 LOW OIL TEMPERATURE TEMPERATURE SWITCH
36

4481-MPF0-0001-TSHH-02
TEMPERATURE SWITCH
(NC CONTACT)
1 101-V7+
2 DI0500.2
3 101-V7-
4 DI0500.3

SPARE
TEMPERATURE SWITCH

4481-MPF0-0001-TSHH02-J1
(4C x 1,5mm2) +G

DI0500.2 → 2 DI0500.2 — 4481-MPF0-0001-TSHH-02 HIGH HIGH OIL TEMPERATURE TEMPERATURE SWITCH
101-V7- → 19
101-V7+ → 37
DI0500.3 → 3 DI0500.3 — SPARE
38

4481-MPF0-0001-LSLL-01
LEVEL SWITCH
DI0500.4
101-V7-
101-V7+
NC NO
3 2 1
1 2 3
GND N L

4481-MPF0-0001-LSLL01-J1
(3C x 1,5mm2) +G

DI0500.4 → 4 DI0500.4 — 4481-MPF0-0001-LSLL-01 LOW LOW OIL LEVEL LEVEL SWITCH
101-V7- → 21
101-V7+ → 39

4481-MPF0-0001-LSL-02
LEVEL SWITCH
DI0500.5
101-V7-
101-V7+
NC NO
3 2 1
1 2 3
GND N L

4481-MPF0-0001-LSL02-J1
(3C x 1,5mm2) +G

DI0500.5 → 5 DI0500.5 — 4481-MPF0-0001-LSL-02 LOW OIL LEVEL LEVEL SWITCH
101-V7- → 22
101-V7+ → 40

1

4481-MPF0-0001-LSH-03
LEVEL SWITCH
DI0500.6
101-V7-
101-V7+
NC NO
3 2 1
1 2 3
GND N L

4481-MPF0-0001-LSH03-J1
(3C x 1,5mm2) +G

DI0500.6 → 6 DI0500.6 — 4481-MPF0-0001-LSH-03 HIGH OIL LEVEL LEVEL SWITCH
101-V7- → 23
101-V7+ → 41
7 DI0500.7 — SPARE
42

1

SEE DWG. 1347-53401

No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
1		CHANGE CONTACTS FROM NO INTO NC	27-MA-11	F.P.	T.Pa.	M.B.

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Vendor or Subcontractor Logo: GNA altech inc. — Département Ingénierie / Engineering Department — 9690 Transcanada, Saint-Laurent, Québec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT FLEX I/O (24 Vdc) RACK: 05 MODULE: 00 (1/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3—		—AZ	

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FIELD

LOCAL CONTROL PANEL
4481-MPF0-0001-CP-01

H1

A 0 1 2 3

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1794-IB16
VOLTAGE	24Vdc
MODULE	00
RACK	05
PANEL	4481-MPF0-0001-CP-01
TERMINAL BASE	1794-TB3S

SEE DWG. 1347-53400

4481-MPF0-0001-PSL-01
PRESSURE SWITCH
(NC CONTACT)
1 101-V7+
2 DI0500.8
3 101-V7-
4 DI0500.9

1

4481-MPF0-0001-PSH-01
PRESSURE SWITCH
(NC CONTACT)

4481-MPF0-0001-PS01-J1
(4C x 1,5mm2) +G

DI0500.8 → 8 DI0500.8 — 4481-MPF0-0001-PSL-01 LOW SYSTEM PRESSURE PRESSURE SWITCH
101-V7- → 25
101-V7+ → 43
DI0500.9 → 9 DI0500.9 — 4481-MPF0-0001-PSH-01 HIGH SYSTEM PRESSURE PRESSURE SWITCH
44

4481-MPF0-0001-PSH-02A
C DI0500.10
1 P
NO 101-V7+

4481-MPF0-0001-PSH02A-J1
(2C x 1,5mm2) +G

DI0500.10 → 10 DI0500.10 — 4481-MPF0-0001-PSH-02A SUCTION HIGH PUMP A PRESSURE SWITCH
101-V7+ → 45

4481-MPF0-0001-PSH-02B
C DI0500.11
1 P
NO 101-V7+

4481-MPF0-0001-PSH02B-J1
(2C x 1,5mm2) +G

DI0500.11 → 11 DI0500.11 — 4481-MPF0-0001-PSH-02B SUCTION HIGH PUMP B PRESSURE SWITCH
101-V7+ → 46

4481-MPF0-0001-PSH-03A
C DI0500.12
1 P
NO 101-V7+

4481-MPF0-0001-PSH03A-J1
(2C x 1,5mm2) +G

DI0500.12 → 12 DI0500.12 — 4481-MPF0-0001-PSH-03A PRESSURE FILTER 1 BLOCKED PRESSURE SWITCH
101-V7+ → 47

4481-MPF0-0001-PSH-03B
C DI0500.13
1 P
NO 101-V7+

4481-MPF0-0001-PSH03B-J1
(2C x 1,5mm2) +G

DI0500.13 → 13 DI0500.13 — 4481-MPF0-0001-PSH-03B PRESSURE FILTER 2 BLOCKED PRESSURE SWITCH
101-V7+ → 48

4481-MPF0-0001-PSH-04A
C DI0500.14
1 P
NO 101-V7+

4481-MPF0-0001-PSH04A-J1
(2C x 1,5mm2) +G

DI0500.14 → 14 DI0500.14 — 4481-MPF0-0001-PSH-04A RETURN FILTER 1 BLOCKED PRESSURE SWITCH
101-V7+ → 49

4481-MPF0-0001-PSH-04B
C DI0500.15
1 P
NO 101-V7+

4481-MPF0-0001-PSH04B-J1
(2C x 1,5mm2) +G

DI0500.15 → 15 DI0500.15 — 4481-MPF0-0001-PSH-04B RETURN FILTER 2 BLOCKED PRESSURE SWITCH
101-V7+ → 50

101-V7- → 16 COMMON

FROM LINE 07
SEE DWG. 1347-55301
25457-4480-V1A-MXA0-0102

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Vendor or Subcontractor Logo: GNA aLtech inc. — Département Ingénierie / Engineering Department, Baie-D'Urfé/Canada, Montréal, Québec, H9X 1J2, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

SELLER DRAWING No. 1347-53401 — REV. 1

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT FLEX I/O (24 Vdc) RACK: 05 MODULE: 00 (2/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3—		—AZ	

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FIELD

LOCAL CONTROL PANEL
4481-MPF0-0001-CP-01

H1

A 0 1 2 3

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1794-IB16
VOLTAGE	24Vdc
MODULE	01
RACK	05
PANEL	4481-MPF0-0001-CP-01
TERMINAL BASE	1794-TB3S

FROM LINE 09
SEE DWG. 1347-55301
25457-4480-V1A-MXAO-0102

101-V9+ → 34 +24Vdc

4481-MPF0-0001-PSH-05A
C, P, NO
DI0501.0 → 4481-MPF0-0001-PSH05A-J1 (2C x 1,5mm2) +G → DI0501.0 → 0 DI0501.0
101-V9+ → 35
4481-MPF0-0001-PSH-05A SUCTION FILTER 1 PUMP A BLOCKED PRESSURE SWITCH

4481-MPF0-0001-PSH-05B
C, P, NO
DI0501.1 → 4481-MPF0-0001-PSH05B-J1 (2C x 1,5mm2) +G → DI0501.1 → 1 DI0501.1
101-V9+ → 36
4481-MPF0-0001-PSH-05B SUCTION FILTER 2 PUMP A BLOCKED PRESSURE SWITCH

4481-MPF0-0001-PSH-06A
C, P, NO
DI0501.2 → 4481-MPF0-0001-PSH06A-J1 (2C x 1,5mm2) +G → DI0501.2 → 2 DI0501.2
101-V9+ → 37
4481-MPF0-0001-PSH-06A SUCTION FILTER 1 PUMP B BLOCKED PRESSURE SWITCH

4481-MPF0-0001-PSH-06B
C, P, NO
DI0501.3 → 4481-MPF0-0001-PSH06B-J1 (2C x 1,5mm2) +G → DI0501.3 → 3 DI0501.3
101-V9+ → 38
4481-MPF0-0001-PSH-06B SUCTION FILTER 2 PUMP B BLOCKED PRESSURE SWITCH

4 DI0501.4 SPARE
39

5 DI0501.5 SPARE
40

4481-MPF0-0001-ZS-01
C, NO
DI0501.6 → 4481-MPF0-0001-ZS01-J1 (2C x 1,5mm2) +G → DI0501.6 → 6 DI0501.6
101-V9+ → 41
4481-MPF0-0001-ZS-01 VALVE PUMP A OPEN LIMIT SWITCH

4481-MPF0-0001-ZS-02
C, NO
DI0501.7 → 4481-MPF0-0001-ZS02-J1 (2C x 1,5mm2) +G → DI0501.7 → 7 DI0501.7
101-V9+ → 42
4481-MPF0-0001-ZS-02 VALVE PUMP B OPEN LIMIT SWITCH

SEE DWG. 1347-53403

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Vendor or Subcontractor Logo: GNA altech inc. Département Ingénierie Engineering Department Baie-Comeau, Québec Canada

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

SELLER DRAWING No. 1347-53402 REV. 1

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT FLEX I/O (24 Vdc) RACK: 05 MODULE: 01 (1/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3—		—AZ	

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FIELD

LOCAL CONTROL PANEL
4481-MPF0-0001-CP-01

H1

A 0 1 2 3

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL INPUT
MODEL	1794-IB16
VOLTAGE	24Vdc
MODULE	01
RACK	05
PANEL	4481-MPF0-0001-CP-01
TERMINAL BASE	1794-TB3S

SEE DWG. 1347-53402

4481-MPF0-0001-ZS-03	C	DI0501.8	4481-MPF0-0001-ZS03-J1 (2C x 1,5mm2) +G	DI0501.8	8	DI0501.8	4481-MPF0-0001-ZS-03 VALVE SUCTION FILTER 1 PUMP A OPEN LIMIT SWITCH
	NO	101-V9+		101-V9+	43		
4481-MPF0-0001-ZS-04	C	DI0501.9	4481-MPF0-0001-ZS04-J1 (2C x 1,5mm2) +G	DI0501.9	9	DI0501.9	4481-MPF0-0001-ZS-04 VALVE SUCTION FILTER 2 PUMP A OPEN LIMIT SWITCH
	NO	101-V9+		101-V9+	44		
4481-MPF0-0001-ZS-05	C	DI0501.10	4481-MPF0-0001-ZS05-J1 (2C x 1,5mm2) +G	DI0501.10	10	DI0501.10	4481-MPF0-0001-ZS-05 VALVE SUCTION FILTER 1 PUMP B OPEN LIMIT SWITCH
	NO	101-V9+		101-V9+	45		
4481-MPF0-0001-ZS-06	C	DI0501.11	4481-MPF0-0001-ZS06-J1 (2C x 1,5mm2) +G	DI0501.11	11	DI0501.11	4481-MPF0-0001-ZS-06 VALVE SUCTION FILTER 2 PUMP B OPEN LIMIT SWITCH
	NO	101-V9+		101-V9+	46		
4481-MPF0-0001-ZS-07	C	DI0501.12	4481-MPF0-0001-ZS07-J1 (2C x 1,5mm2) +G	DI0501.12	12	DI0501.12	4481-MPF0-0001-ZS-07 VALVE RETURN FILTER 1 OPEN LIMIT SWITCH
	NO	101-V9+		101-V9+	47		
4481-MPF0-0001-ZS-08	C	DI0501.13	4481-MPF0-0001-ZS08-J1 (2C x 1,5mm2) +G	DI0501.13	13	DI0501.13	4481-MPF0-0001-ZS-08 VALVE RETURN FILTER 2 OPEN LIMIT SWITCH
	NO	101-V9+		101-V9+	48		
4481-MPF0-0001-ZS-09	C	DI0501.14	4481-MPF0-0001-ZS09-J1 (2C x 1,5mm2) +G	DI0501.14	14	DI0501.14	4481-MPF0-0001-ZS-09 VALVE PRESSION FILTER 1 OPEN LIMIT SWITCH
	NO	101-V9+		101-V9+	49		
4481-MPF0-0001-ZS-10	C	DI0501.15	4481-MPF0-0001-ZS10-J1 (2C x 1,5mm2) +G	DI0501.15	15	DI0501.15	4481-MPF0-0001-ZS-10 VALVE PRESSION FILTER 2 OPEN LIMIT SWITCH
	NO	101-V9+		101-V9+	50		
				101-V9-	16	COMMON	

FROM LINE 09
SEE DWG. 1347-55301
25457-4480-V1A-MXA0-0102

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SELLER DRAWING No. 1347-53403 | REV. 0

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
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Vendor or Subcontractor Logo: GNA altech inc. Département Ingénierie Engineering Department 5080 Rue Cypihot Saint-Laurent, Québec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL INPUT FLEX I/O (24 Vdc) RACK: 05 MODULE: 01 (2/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—	—	A3–		–AZ	

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FIELD

LOCAL CONTROL PANEL
4481-MPF0-0001-CP-01

H1

MANUFACTURER	ALLEN-BRADLEY
TYPE	ANALOG INPUT
MODEL	1794-IF8IH
CURRENT	4-20mA
MODULE	03
RACK	05
PANEL	4481-MPF0-0001-CP-01
TERMINAL BASE	1794-TB3S

A 0 1 2 3

4481-MPF0-0001-PT-01
HPU PRESSURE TRANSMITTER
\+ 101-V13+
\- AI0503.0

4481-MPF0-0001-PT01-J1
(1P/SH)

FROM LINE 13
SEE DWG. 1347-55301
25457-4480-V1A-MXAO-0102

101-V13+ → 34 +24Vdc
101-V13+ → 35
AI0503.0 → 0 AI0503.0 — 4481-MPF0-0001-PT-01 HPU PRESSURE TRANSMITTER
1 I0 Ret
17 COM
36
2 AI0503.1 — SPARE
3 I1 Ret
18
37
4 AI0503.2 — SPARE
5 I2 Ret
19
38
6 AI0503.3 — SPARE
7 I3 Ret
20

SEE DWG. 1347-53461

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BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457	00AZ	xx	xxxx	xxxx	xxx – xxx

SELLER DRAWING No. 1347–53460 — REV. 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
ANALOG INPUT FLEX I/O (4–20mA) RACK: 05 MODULE: 03 (1/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
–		–	–	A3–		–AZ	

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FIELD

LOCAL CONTROL PANEL
4481-MPF0-0001-CP-01

H1

A 0 1 2 3

MANUFACTURER	ALLEN-BRADLEY
TYPE	ANALOG INPUT
MODEL	1794-IF8IH
CURRENT	4-20mA
MODULE	03
RACK	05
PANEL	4481-MPF0-0001-CP-01
TERMINAL BASE	1794-TB3S

FROM DWG. 1347-53460

39		
8	AI0503.4	SPARE
9	I4 Ret	
21		
40		
10	AI0503.5	SPARE
11	I5 Ret	
22		
41		
12	AI0503.6	SPARE
13	I6 Ret	
23		
42		
14	AI0503.7	SPARE
15	I7 Ret	
24		
16	COMMON	

101-V13-

FROM LINE 13
SEE DWG. 1347-55301
25457-4480-V1A-MXA0-0102

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Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SELLER DRAWING No.: 1347-53461 REV.: 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
ANALOG INPUT FLEX I/O (4-20mA) RACK: 05 MODULE: 03 (2/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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H1

LOCAL CONTROL PANEL
4481-MPF0-0001-CP-01

FIELD

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL OUTPUT
MODEL	1794-OB8EP
VOLTAGE	24Vdc
MODULE	02
RACK	05
PANEL	4481-MPF0-0001-CP-01
TERMINAL BASE	1794-TB3S

A 0 1 2 3

FROM LINE 11
SEE DWG. 1347-55301
25457-4480-V1A-MXAO-0102

34 +24Vdc — 101-V11+

4481-MPF0-0001-FY-01
DUMPING
VALVE
SOLENOID VALVE (HYD.)

DO0502.0 — 0 — DO0502.0 — 4481-MPF0-0001-FY01-J1 (2C x 1,5mm2) +G

17

1 — 101-V11-

18

SPARE — DO0502.1 — 2

19

3

20

SPARE — DO0502.2 — 4

21

5

22

SPARE — DO0502.3 — 6

23

7

24

SEE DWG. 1347-54401

4481-MPF0-0001-FY-01
DO0502.0 — +
101-V11- — -

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BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL OUTPUT FLEX I/O (24 Vdc) RACK: 05 MODULE: 02 (1/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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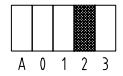
H1

LOCAL CONTROL PANEL
4481-MPF0-0001-CP-01

FIELD

MANUFACTURER	ALLEN-BRADLEY
TYPE	DIGITAL OUTPUT
MODEL	1794-OB8EP
VOLTAGE	24Vdc
MODULE	02
RACK	05
PANEL	4481-MPF0-0001-CP-01
TERMINAL BASE	1794-TB3S



SEE DWG. 1347-54400

SPARE	D00502.4	8
		25
		9
		26
SPARE	D00502.5	10
		27
		11
		28
SPARE	D00502.6	12
		29
		13
		30
SPARE	D00502.7	14
		31
		15
		32
COMMON		16

101-V11-

FROM LINE 11
SEE DWG. 1347-55301
25457-4480-V1A-MXA0-0102

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Vendor or Subcontractor Logo:

GNA eLitech inc. — Département Ingénierie Engineering Department, 8450 Trans-Canada, Saint-Laurent, Quebec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SELLER DRAWING No.: 1347-54401 — REV.: 0

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DIGITAL OUTPUT FLEX I/O (24 Vdc) RACK: 05 MODULE: 02 (2/2)
I/O INTERCONNECTION DIAGRAM

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

9.11 P&ID's

DRAWING No.	DESCRIPTION
1347-50010	Chain Conveyor Upstream of Shotblasting Machine C2 - P and ID
1347-50020	Conical Roller Conveyor at Shotblasting Machine Entrance R9 - P and ID
1347-50030	Cathode Bar Shotblasting Machine S1 - P and ID
1347-50040	Dust Collector for Shotblasting Machine D1 - P and ID
1347-50050	Conical Roller at Shotblasting Machine Exit R8 - P and ID
1347-50060	Chain Conveyor Between Shotblasting Machine and Oven C3 - P and ID
1347-50070	Roller Conveyor at Bar Furnace Entrance R7 - P and ID
1347-50080	Cathode Bar Heating Furnace F2 - 1 of 3 - P and ID
1347-50081	Cathode Bar Heating Furnace F2 - 2 of 3 - P and ID
1347-50082	Cathode Bar Heating Furnace F2 - 3 of 3 - P and ID
1347-50090	Roller Conveyor at Bar Furnace Exit R6 - P and ID
1347-50100	Positioning Gantry for Block and Bars - G1 - 1 of 2 - P and ID
1347-50101	Positioning Gantry for Block and Bars - G1 - 2 of 2 - P and ID
1347-50110	Chain Conveyor of Block Oven C1 - P and ID
1347-50120	Cathode Block Oven - F1 - 1 of 2 - P and ID
1347-50121	Cathode Block Oven - F1 - 2 of 2 - P and ID
1347-50130	Roller Conveyor at Block Oven Exit R1 - P and ID
1347-50140	Roller Conveyor for Block and Bar Assembly R2 - P and ID
1347-50150	Prestressing and Sealing Station Conveyor A and Platforms R4A - 1 of 2 - P and ID
1347-50151	Prestressing and Sealing Station Conveyor A and Platforms R4A - 2 of 2 - P and ID
1347-50160	Prestressing and Sealing Station Conveyor B and Platforms R4B - 1 of 2 - P and ID
1347-50161	Prestressing and Sealing Station Conveyor B and Platforms R4B - 2 of 2 - P and ID
1347-50170	Roller Conveyor After Sealing Station R3 - P and ID
1347-50180	Roller Conveyor at Cooling and Turning Station R5 - P and ID
1347-50190	Cooling and Turning Station T1 - P and ID
1347-50200	Chain Conveyor for Sealed Cathode C4 - P and ID
1347-50220	Ladle Pre-Heating Station F3A - P and ID
1347-50221	Ladle Pre-Heating Station F3B - P and ID
1347-50230	Cast Iron Ingot Drying Station A - F4A - P and ID
1347-50240	Cast Iron Ingot Drying Station B - F4B - P and ID

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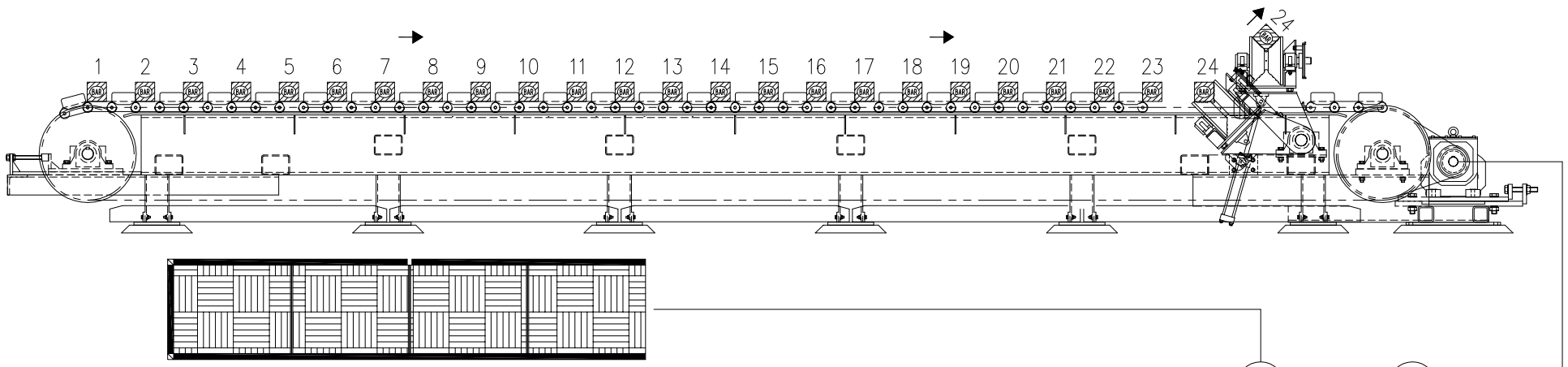
C2 CHAIN CONVEYOR UPSTREAM OF SHOTBLASTING MACHINE (24 BARS)
EQUIPMENT NUMBER : 4481-MHCD-0002

SIDE VIEW C2
CHAIN CONVEYOR UPSTREAM OF SHOTBLASTING MACHINE
4481-MHCD-0002

FRONT VIEW R9
CONICAL ROLLER CONVEYOR AT SHOTBLASTING MACHINE ENTRENCE
4481-MJR0-0001



PRESENCE SENSING ON C2
MATGUARD
(ON BOTH SIDES OF C2)

SAFETY STOP LIMIT SWITCH — HSS 03

8 EMERGENCY STOP PUSH BUTTONS — HSS 1A TO 1H

MOTOR BRAKE

FLEX I/O PANEL
4481-MHCD-0003-CP-01
RACK 04
I/O

2

- HS 05 — 13 — ACCESS REQUEST PUSH BUTTON
- HS 06 — 13 — ACCESS REQUEST RESET PUSH BUTTON
- YL 01 — 13 — C2 ZONE ACCESS REQUEST LIGHT
- HA 01 — MOTION WARNING HORN
- HL 01 — MOTION WARNING LIGHT

NR — 1 — M
C2
4481-MHCD-0002-M1
CHAIN CONVEYOR UPSTREAM OF SHOTBLASTING MACHINE
MOTOR
1,1 KW

- HUS 01 — 14 — REMOTE-OFF-JOG SELECTOR
- HS 02 — 14 — STOP PUSH BUTTON

PLC — PLC I/O PANEL 4481-CP-1000

PANELVIEW
FORWARD C2 CONVEYOR
AUTO / MANUAL
HMI

PANELS

INSTRUMENT LOCATION		PANEL DESCRIPTION
2	13	LOCAL CONTROL PANEL 4481-MHCD-0002-CP-03
	14	LOCAL CONTROL STATION 4481-MHCD-0002-LCS-01

EXAMPLE
HUS 01 — 14 — LOCATED ON LOCAL CONTROL STATION

LEGEND

A/S	AIR SUPPLY
H/S	HYDRAULIC SUPPLY
ES/AC	ELECTRICAL SUPPLY 115Vac/480Vac
ES/DC	ELECTRICAL SUPPLY 24Vdc
1	INTERLOCK
I/O	PLC I/O
	ELECTRICAL SIGNAL
	NUMERIC SIGNAL
	HYDRAULIC SIGNAL
	PNEUMATIC SIGNAL

NOTE : EQUIPMENT NUMBER IS INSTRUMENT NUMBER PREFIX

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Discipline :

Document No : 25457-4480-V1A-MXA0-0029 | Rev. :

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REFERENCES		2		UPDATE	AU-15-11	F.P.	E.B.	C.C.
		1		UPDATE	MR-30-11	F.P.	E.B.	C.C.
		REVISIONS						

NOTES

STATUS: FOR DESIGN

DRAWN/DES'D:	F.P.	AREA ENG.:	
DATE:	26/07/10	DATE:	
CHECKED:	E.B.	PRJ ENG MGR:	
DATE:	26/07/10	DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:	26/07/10	DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA Automation Technologies Inc. — Département Ingénierie / Engineering Department, 9650 Trans-Canada, Saint-Laurent, Québec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CHAIN CONVEYOR UPSTREAM OF SHOTBLASTING MACHINE C2
P & ID

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—		—	—	A3-		-AZ	

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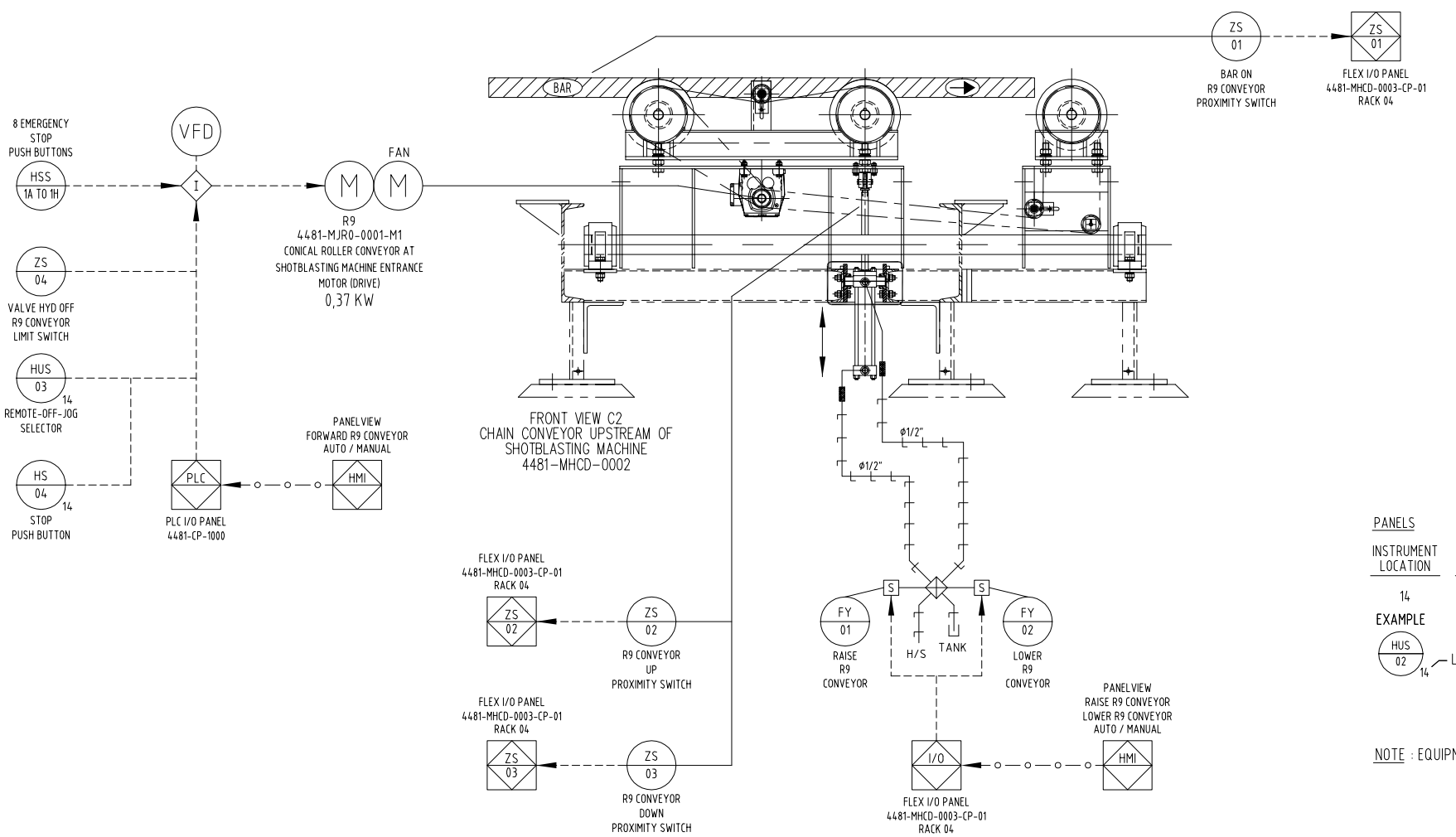
R9 CONICAL ROLLER CONVEYOR AT SHOTBLASTING MACHINE ENTRANCE
EQUIPMENT NUMBER : 4481-MJR0-0001

SIDE VIEW R9
CONICAL ROLLER CONVEYOR AT SHOTBLASTING MACHINE ENTRANCE
4481-MJR0-0001



LEGEND

A/S	AIR SUPPLY
H/S	HYDRAULIC SUPPLY
ES/AC	ELECTRICAL SUPPLY 115Vac/480Vac
ES/DC	ELECTRICAL SUPPLY 24Vdc
I	INTERLOCK
I/O	PLC I/O
----------	ELECTRICAL SIGNAL
—o—o—o—o—	NUMERIC SIGNAL
⊥⊥⊥⊥⊥⊥	HYDRAULIC SIGNAL
//////////	PNEUMATIC SIGNAL

PANELS

INSTRUMENT LOCATION	PANEL DESCRIPTION
14	LOCAL CONTROL STATION 4481-MHCD-0002-LCS-01

EXAMPLE

HUS 02 14 — LOCATED ON LOCAL CONTROL STATION

NOTE : EQUIPMENT NUMBER IS INSTRUMENT NUMBER PREFIX

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3 ☐	Revise & Resubmit. Work may NOT proceed.	DDR Nbr :	110

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DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		REVISIONS						
		1		UPDATE	MR-30-11	F.P.	E.B.	C.C.

NOTES

STATUS: FOR DESIGN

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RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:	26/07/10	DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie / Engineering Department — 1600 Transcanada, Dolbeau-Mistassini, Québec, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CONICAL ROLLER CONVEYOR AT SHOTBLASTING MACHINE ENTRANCE R9
P & ID

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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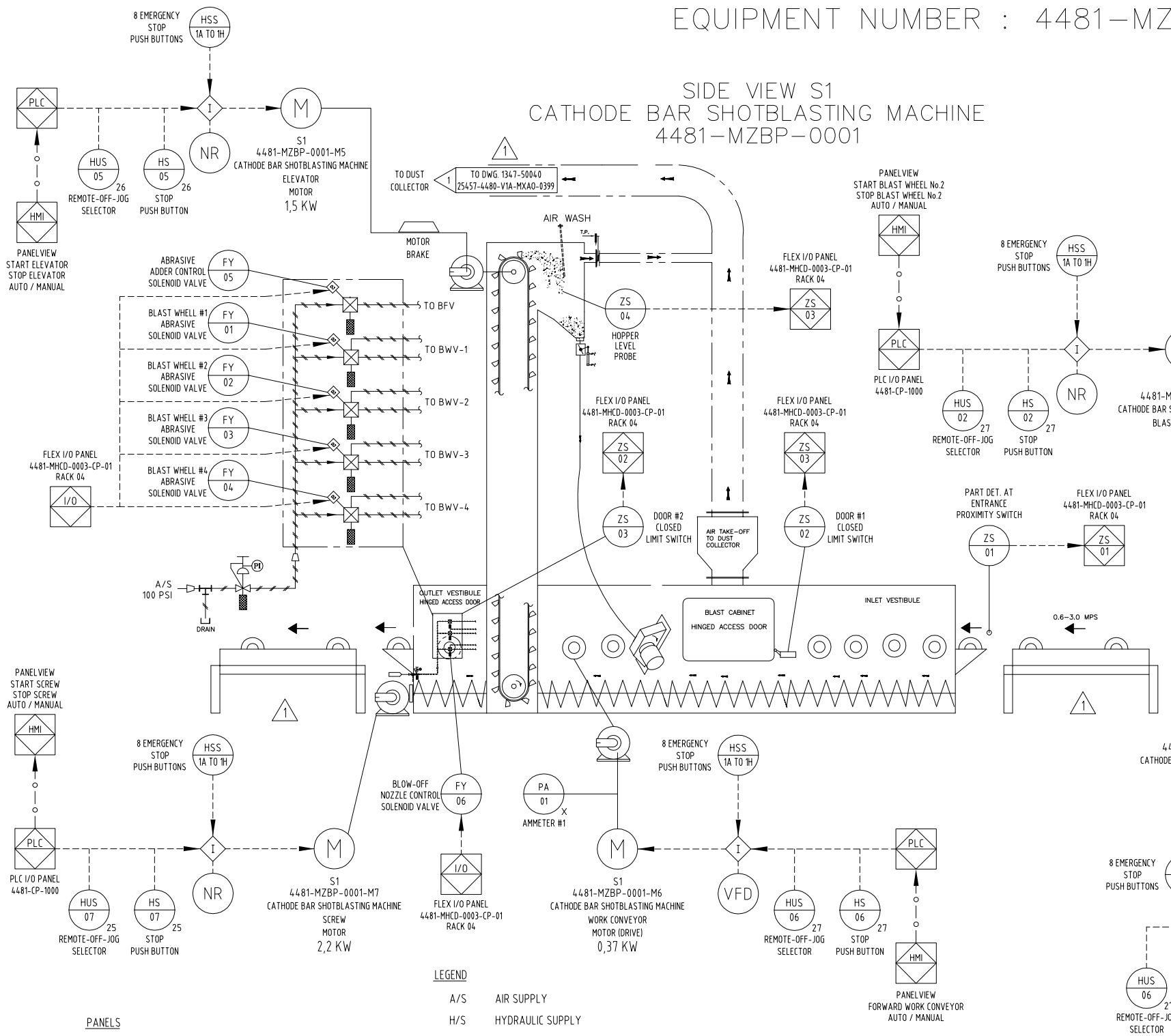
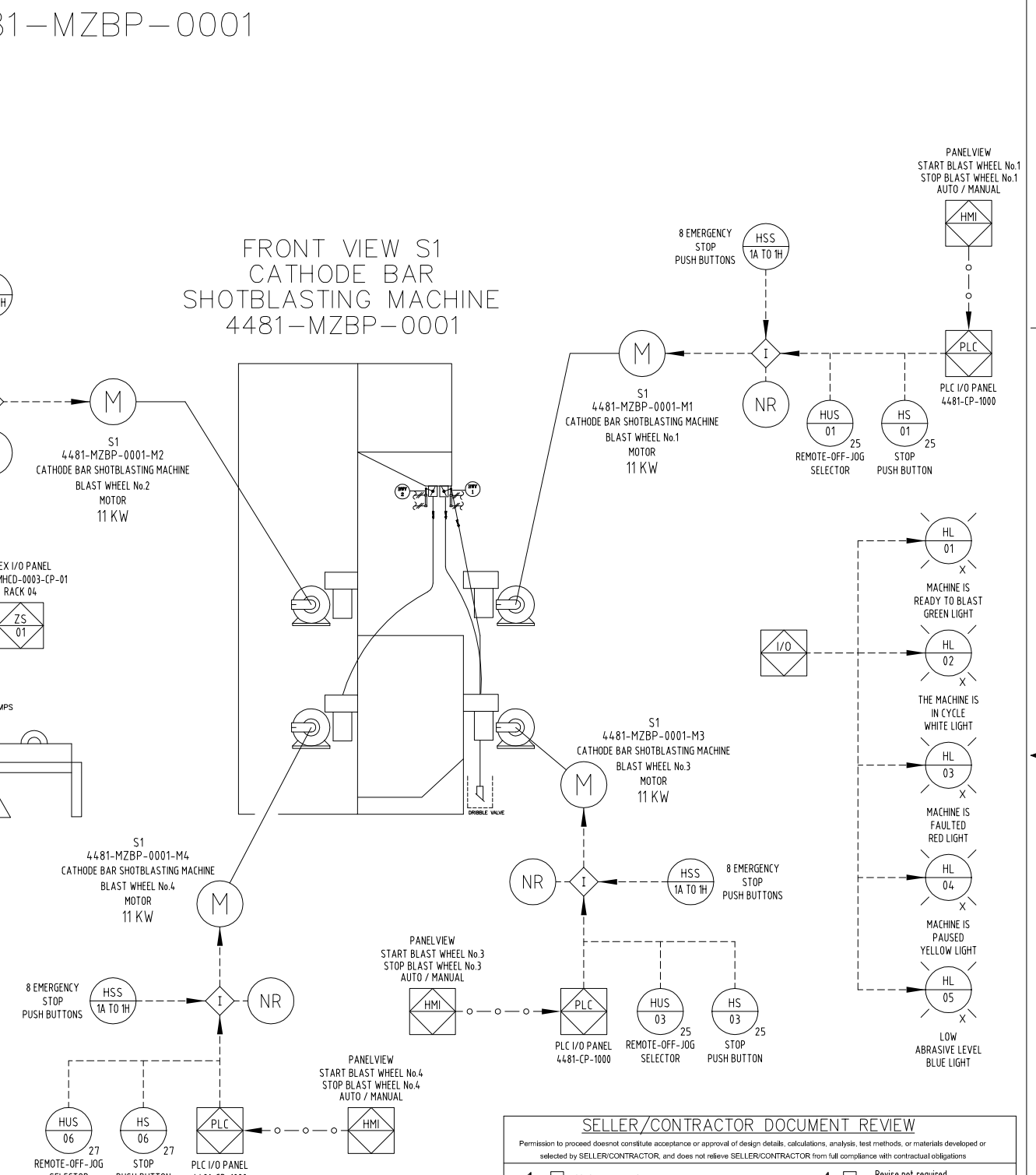
S1 CATHODE BAR SHOTBLASTING MACHINE
EQUIPMENT NUMBER : 4481-MZBP-0001

SIDE VIEW S1
CATHODE BAR SHOTBLASTING MACHINE
4481-MZBP-0001



FRONT VIEW S1
CATHODE BAR
SHOTBLASTING MACHINE
4481-MZBP-0001



PANELS

INSTRUMENT LOCATION	PANEL DESCRIPTION
25	MOTOR STATION 4481-MZBP-0001-LCS-01
26	MOTOR STATION 4481-MZBP-0001-LCS-02
27	MOTOR STATION 4481-MZBP-0001-LCS-03

EXAMPLE

HUS 02 / 25 — LOCATED ON MOTOR STATION

NOTE : EQUIPMENT NUMBER IS INSTRUMENT NUMBER PREFIX

LEGEND

A/S	AIR SUPPLY
H/S	HYDRAULIC SUPPLY
ES/AC	ELECTRICAL SUPPLY 115Vac/480Vac
ES/DC	ELECTRICAL SUPPLY 24Vdc
1	INTERLOCK
I/O	PLC I/O
----------	ELECTRICAL SIGNAL
—o—o—o—o—	NUMERIC SIGNAL
L L L L L L	HYDRAULIC SIGNAL
//////////	PNEUMATIC SIGNAL

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4 ☐ Revise not required. Work may proceed.
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DDR Nbr : 110

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Discipline :

Document No : 25457-4480-V1A-MXA0-0398 | Rev. :

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DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		1		UPDATE	24-MA-11	F.P.	E.B.	M.B.
		REVISIONS						

NOTES

STATUS: FOR DESIGN

DRAWN/DES'D:	F.P.	AREA ENG.:	
DATE:	26/07/10	DATE:	
CHECKED:	E.B.	PRJ ENG MGR:	
DATE:	26/07/10	DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:	26/07/10	DATE:	
ENG. GROUP SUP. DATE:		DRAWING SCALE:	NONE

Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie Engineering Department 9450 Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CATHODE BAR SHOTBLASTING MACHINE S1
P & ID

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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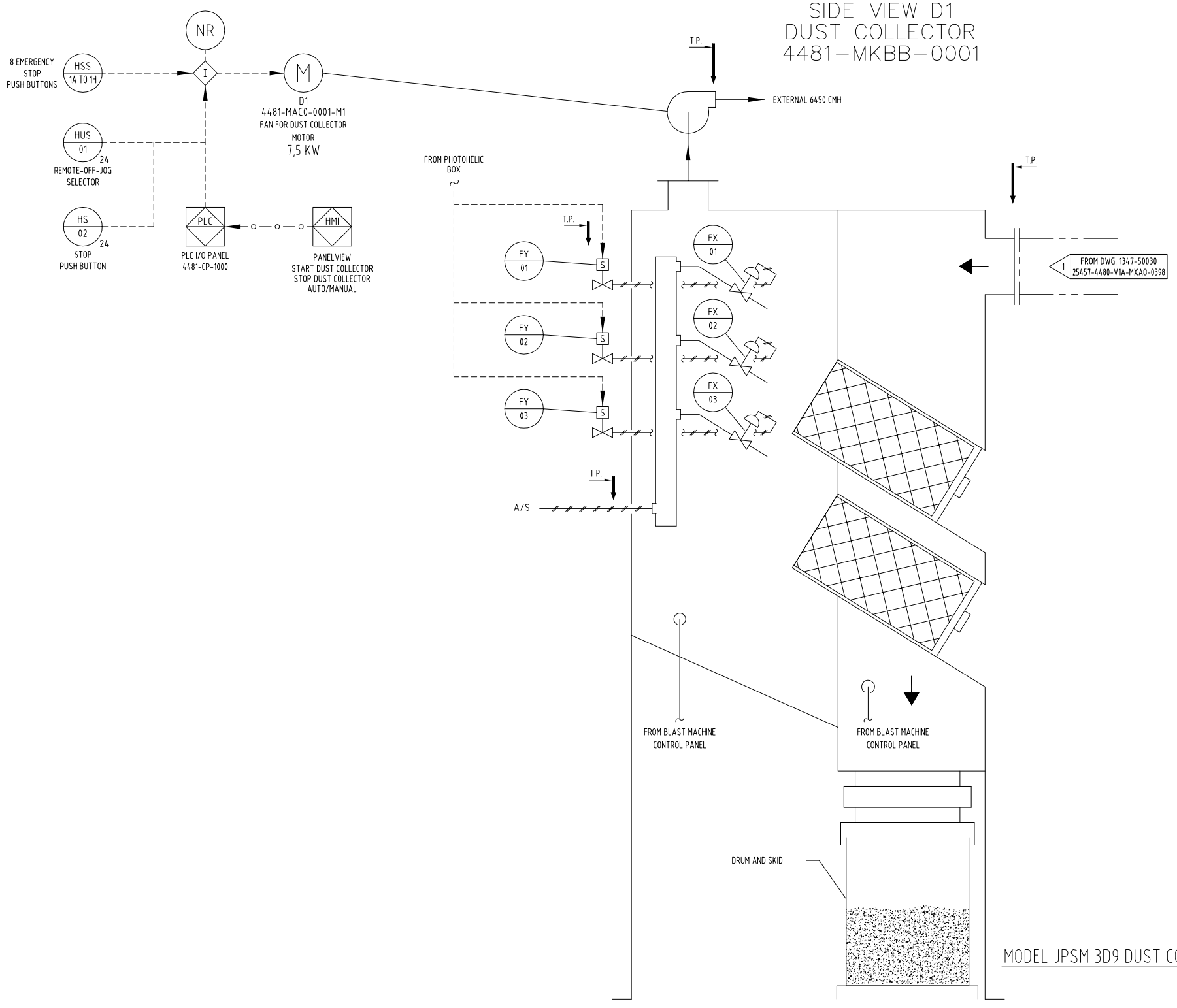
D1 DUST COLLECTOR FOR SHOTBLASTING MACHINE
EQUIPMENT NUMBER : 4481-MKBB-0001



MODEL JPSM 3D9 DUST COLLECTOR

LEGEND

A/S	AIR SUPPLY
H/S	HYDRAULIC SUPPLY
ES/AC	ELECTRICAL SUPPLY 115Vac/480Vac
ES/DC	ELECTRICAL SUPPLY 24Vdc
I	INTERLOCK
I/O	PLC I/O
----------	ELECTRICAL SIGNAL
—o—o—o—o—	NUMERIC SIGNAL
L L L L L L	HYDRAULIC SIGNAL
/ / / / / / /	PNEUMATIC SIGNAL

PANELS

INSTRUMENT LOCATION	PANEL DESCRIPTION
24	MOTOR STATION 4481-MAC0-0001-M1-LDS

EXAMPLE

HUS 01 — 24 — LOCATED ON MOTOR STATION

NOTE : EQUIPMENT NUMBER IS INSTRUMENT NUMBER PREFIX

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Document No : 25457-4480-V1A-MXA0-0399 | Rev. :

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		0						

REFERENCES | REVISIONS

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RESPONSIBLE ENG.	M.B.	CLIENT:	
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ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie / Engineering Department, 8690 Transcanadienne, Saint-Laurent, Québec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-	00AZ-	xx -	xxxx -	xxxx -	xxx — xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
DUST COLLECTOR FOR SHOTBLASTING MACHINE D1
P & ID

MA'ADEN معادن

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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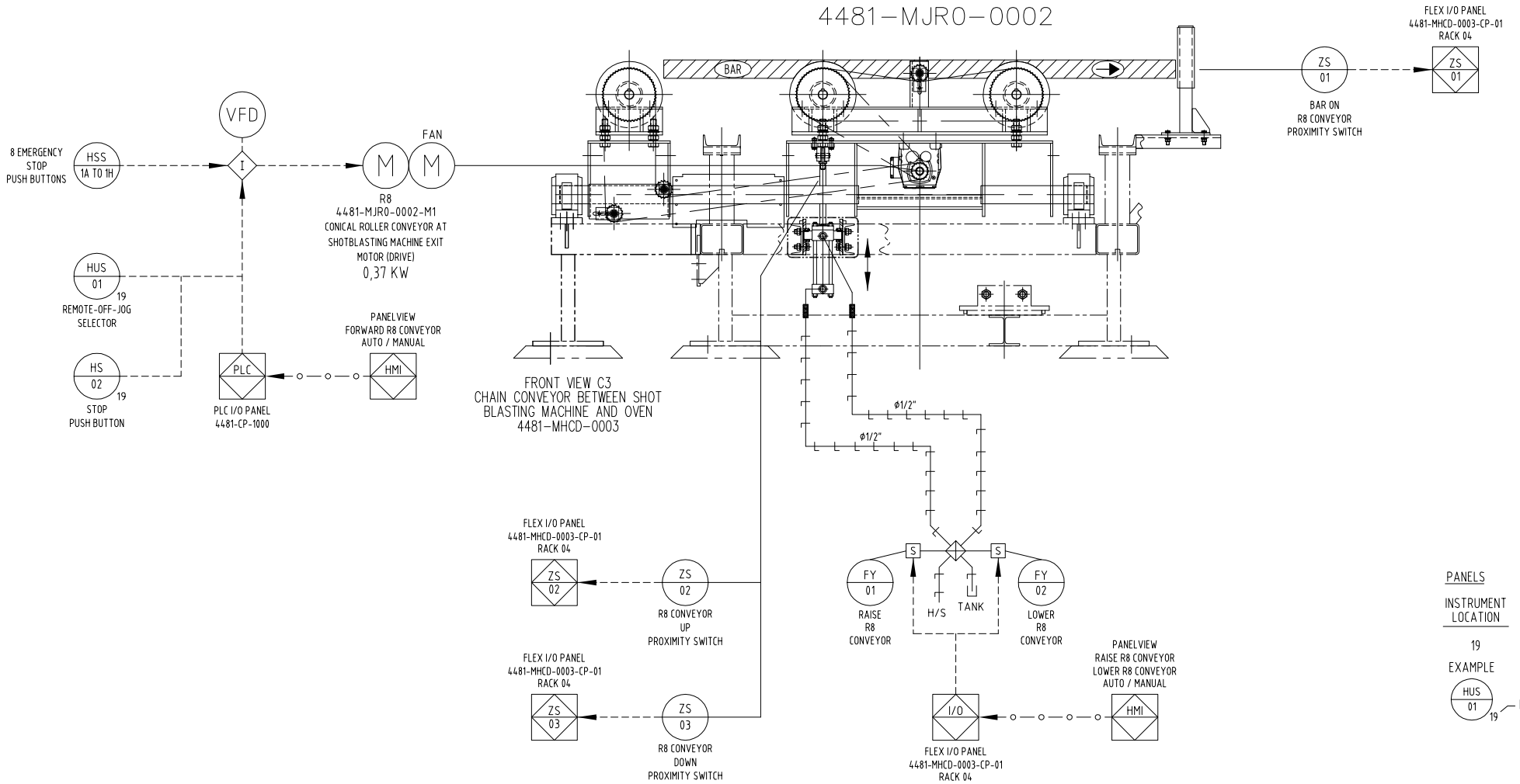
R8 CONICAL ROLLER CONVEYOR AT SHOTBLASTING MACHINE EXIT
EQUIPMENT NUMBER : 4481-MJR0-0002

SIDE VIEW R8
CONICAL ROLLER CONVEYOR AT SHOTBLASTING MACHINE EXIT
4481-MJR0-0002



LEGEND

A/S	AIR SUPPLY
H/S	HYDRAULIC SUPPLY
ES/AC	ELECTRICAL SUPPLY 115Vac/480Vac
ES/DC	ELECTRICAL SUPPLY 24Vdc
I	INTERLOCK
I/O	PLC I/O
	ELECTRICAL SIGNAL
	NUMERIC SIGNAL
	HYDRAULIC SIGNAL
	PNEUMATIC SIGNAL

PANELS

INSTRUMENT LOCATION	PANEL DESCRIPTION
19	LOCAL CONTROL STATION 4481-MHCD-0003-LCS-01

EXAMPLE

HUS 01 19 — LOCATED ON LOCAL CONTROL STATION

NOTE : EQUIPMENT NUMBER IS INSTRUMENT NUMBER PREFIX

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Discipline :

Document No : 25457-4480-V1A-MXA0-0031 | Rev. : 001

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		1		UPDATE	MR-30-11	F.P.	E.B.	C.C.

NOTES

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CHECKED:	E.B.	PRJ ENG MGR:	
DATE:	26/07/10	DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:	26/07/10	DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA a.i.tech Inc. — Département Ingénierie / Engineering Department, 1600 Transcanadienne, Baie-Louvain, Québec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CONICAL ROLLER CONVEYOR AT SHOTBLASTING MACHINE EXIT R8
P & ID

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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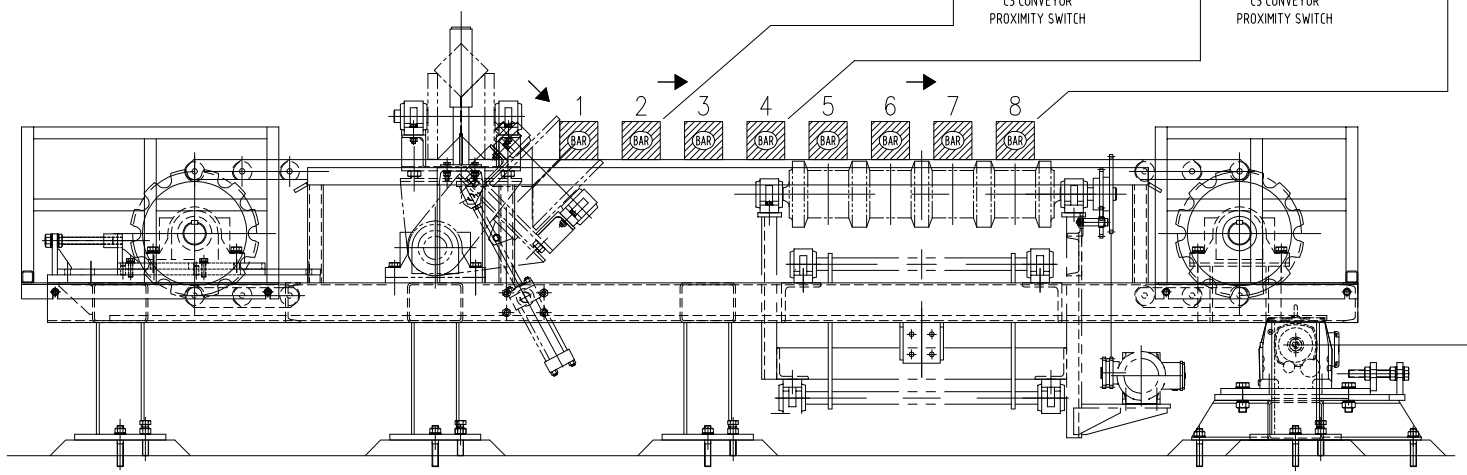
C3 CHAIN CONVEYOR BETWEEN SHOT BLASTING MACHINE AND OVEN
EQUIPMENT NUMBER : 4481-MHCD-0003

SIDE VIEW C3
CHAIN CONVEYOR BETWEEN
SHOT BLASTING MACHINE AND OVEN
4481-MHCD-0003

FRONT VIEW R8
CONICAL ROLLER CONVEYOR AT SHOTBLASTING MACHINE EXIT
4481-MJR0-0002



FRONT VIEW R7
ROLLER CONVEYOR AT BAR FURNACE ENTRANCE
4481-MJR0-0003

FLEX I/O PANEL
4481-MHCD-0003-CP-01
RACK 04

ZS 04 — BAR IN SECOND POS. OF C3 CONVEYOR PROXIMITY SWITCH

FLEX I/O PANEL
4481-MHCD-0003-CP-01
RACK 04

ZS 05 — BAR IN FOURTH POS. OF C3 CONVEYOR PROXIMITY SWITCH

FLEX I/O PANEL
4481-MHCD-0003-CP-01
RACK 04

ZS 06 — BAR IN LAST POS. OF C3 CONVEYOR PROXIMITY SWITCH

M — C3
4480-MHCD-0003-M1
CHAIN CONVEYOR BETWEEN
SHOT BLASTING MACHINE AND OVEN
MOTOR (DRIVE)
0,75 KW

VFD

I — HSS 1A TO 1H — 8 EMERGENCY STOP PUSH BUTTONS

HUS 03 19 — REMOTE-OFF-JOG SELECTOR

HS 04 19 — STOP PUSH BUTTON

PANEL VIEW
FORWARD C3 CONVEYOR
AUTO / MANUAL
HMI

PLC I/O PANEL
4481-CP-1000
PLC

LEGEND

A/S	AIR SUPPLY
H/S	HYDRAULIC SUPPLY
ES/AC	ELECTRICAL SUPPLY 115Vac/480Vac
ES/DC	ELECTRICAL SUPPLY 24Vdc
I	INTERLOCK
I/O	PLC I/O
----------	ELECTRICAL SIGNAL
—o—o—o—	NUMERIC SIGNAL
L L L L L	HYDRAULIC SIGNAL
//////	PNEUMATIC SIGNAL

PANELS

INSTRUMENT LOCATION	PANEL DESCRIPTION
19	LOCAL CONTROL STATION 4481-MHCD-0003-LCS-01

EXAMPLE
HUS 03 19 — LOCATED ON LOCAL CONTROL STATION

NOTE : EQUIPMENT NUMBER IS INSTRUMENT NUMBER PREFIX

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3 ☐	Revise & Resubmit. Work may NOT proceed.	DDR Nbr :	110

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Discipline :

Document No : 25457-4480-V1A-MXA0-0032 | Rev. : 001

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DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
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		1		UPDATE	MR-30-11	F.P.	E.B.	C.C.

NOTES

STATUS: FOR DESIGN

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DATE:	26/07/10	DATE:	
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DATE:	26/07/10	DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:	26/07/10	DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA eLtech Inc. — Département Ingénierie / Engineering Department, Saint-Hyacinthe, Québec, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CHAIN CONVEYOR BETWEEN SHOTBLASTING MACHINE AND OVEN C3
P & ID

MA'ADEN

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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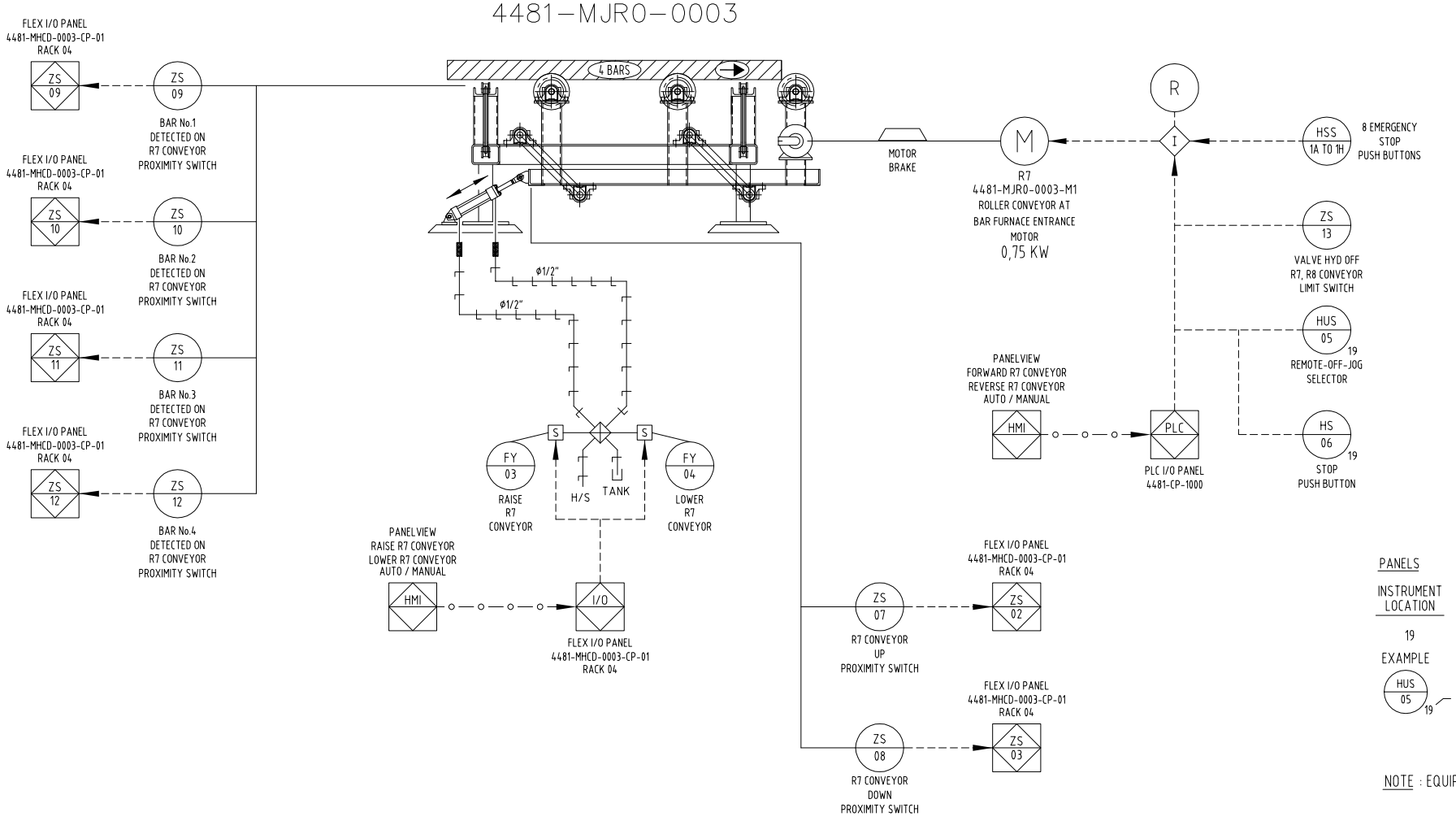
R7 ROLLER CONVEYOR AT BAR FURNACE ENTRANCE
EQUIPMENT NUMBER : 4481-MJR0-0003

SIDE VIEW R7
ROLLER CONVEYOR AT BAR FURNACE ENTRANCE
4481-MJR0-0003



LEGEND

A/S	AIR SUPPLY
H/S	HYDRAULIC SUPPLY
ES/AC	ELECTRICAL SUPPLY 115Vac/480Vac
ES/DC	ELECTRICAL SUPPLY 24Vdc
◇ I	INTERLOCK
I/O	PLC I/O
----------	ELECTRICAL SIGNAL
—o—o—o—o—	NUMERIC SIGNAL
L L L L L L	HYDRAULIC SIGNAL
//////////	PNEUMATIC SIGNAL

PANELS

INSTRUMENT LOCATION	PANEL DESCRIPTION
19	LOCAL CONTROL STATION 4481-MHCD-0003-LCS-01

EXAMPLE

HUS 05 / 19 — LOCATED ON LOCAL CONTROL STATION

NOTE : EQUIPMENT NUMBER IS INSTRUMENT NUMBER PREFIX

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4 ☐ Revise not required. Work may proceed.
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NOTES

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DATE:	26/07/10	DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA a|a tech Inc. — Département Ingénierie / Engineering Department, 9495 Trans-Canada, Saint-Laurent, Québec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
ROLLER CONVEYOR AT BAR FURNACE ENTRANCE R7
P & ID

MA'ADEN

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
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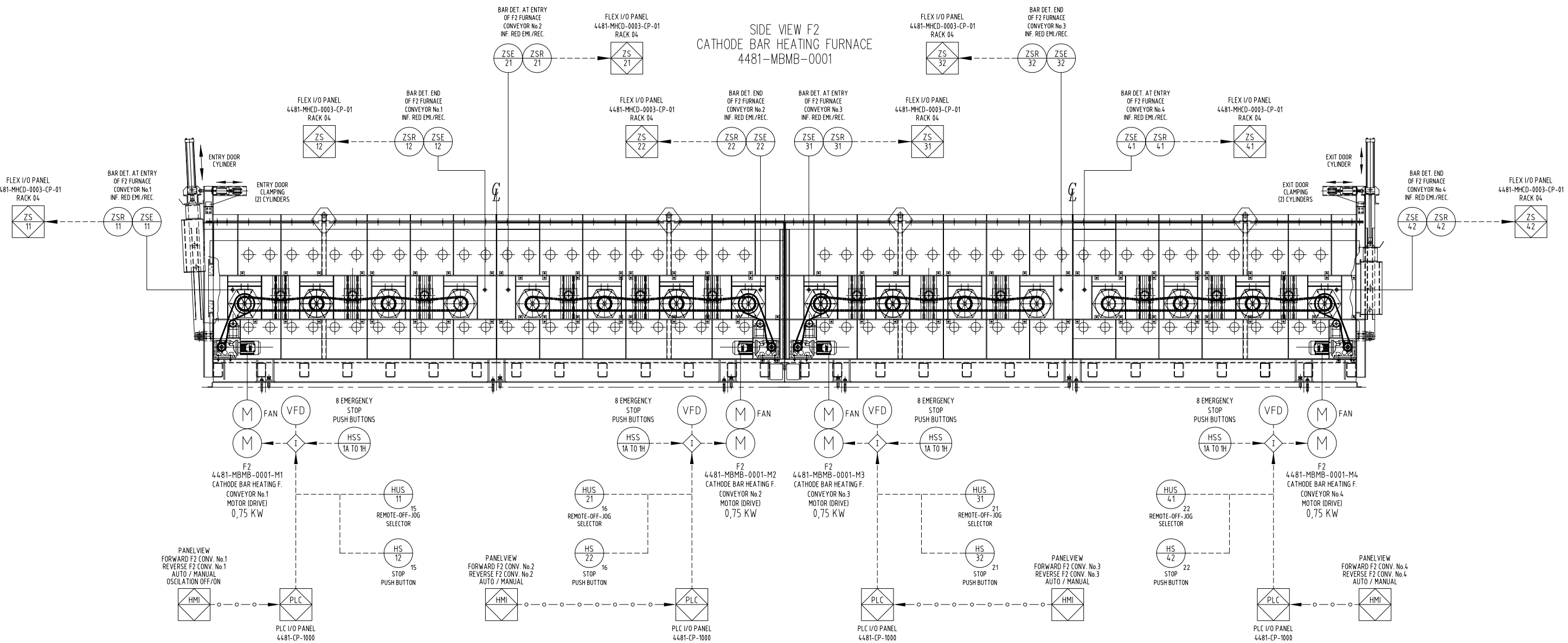
F2 CATHODE BAR HEATING FURNACE (1/3)
EQUIPMENT NUMBER : 4481-MBMB-0001



PANELS

INSTRUMENT LOCATION	DESCRIPTION
15	LOCAL CONTROL STATION 4481-MBMB-0001-LCS-01
16	LOCAL CONTROL STATION 4481-MBMB-0001-LCS-02
21	LOCAL CONTROL STATION 4481-MBMB-0001-LCS-03
22	LOCAL CONTROL STATION 4481-MBMB-0001-LCS-04

EXAMPLE

HUS 11 / 15 — LOCATED ON LOCAL CONTROL STATION

NOTE 1 : EQUIPMENT NUMBER IS INSTRUMENT NUMBER PREFIX

NOTE 2 : 70 MIN. CYCLE TIME IS COMPLETED IN HMI

LEGEND

A/S	AIR SUPPLY
H/S	HYDRAULIC SUPPLY
ES/AC	ELECTRICAL SUPPLY 115Vac/480Vac
ES/DC	ELECTRICAL SUPPLY 24Vdc
	INTERLOCK
I/O	PLC I/O
	ELECTRICAL SIGNAL
	NUMERIC SIGNAL
	HYDRAULIC SIGNAL
	PNEUMATIC SIGNAL

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REFERENCES — REVISIONS

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DATE:	26/07/10	DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:	26/07/10	DATE:	
ENG. GROUP SUP. DATE:		DRAWING SCALE:	NONE

Vendor or Subcontractor Logo: GNA altech Inc. — Département Ingénierie Engineering Department 9455 Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CATHODE BAR HEATING FURNACE F2 (1/3)
P & ID

MA'ADEN

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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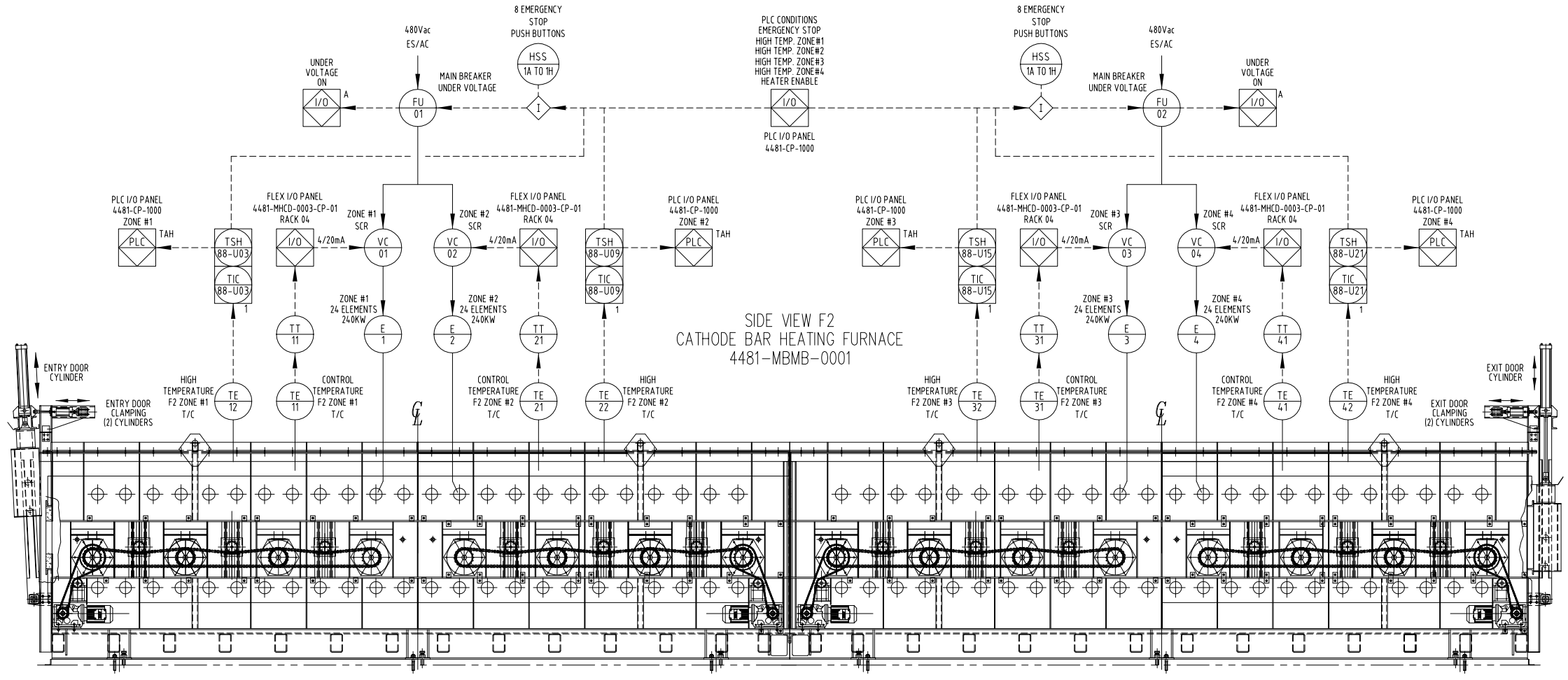
F2 CATHODE BAR HEATING FURNACE (2/3)
EQUIPMENT NUMBER : 4481-MBMB-0001



SIDE VIEW F2
CATHODE BAR HEATING FURNACE
4481-MBMB-0001

PANELS

INSTRUMENT LOCATION	DESCRIPTION
1	CENTRAL CONTROL PANEL 4481-CP-1001

EXAMPLE

TIC 88-U03 / 1 — LOCATED ON CENTRAL CONTROL PANEL

NOTE 1 : EQUIPMENT NUMBER IS INSTRUMENT NUMBER PREFIX

NOTE 2 : 70 MIN. CYCLE TIME IS COMPLETED IN HMI

LEGEND

A/S	AIR SUPPLY
H/S	HYDRAULIC SUPPLY
ES/AC	ELECTRICAL SUPPLY 115Vac/480Vac
ES/DC	ELECTRICAL SUPPLY 24Vdc
1	INTERLOCK
I/O	PLC I/O
----------	ELECTRICAL SIGNAL
—o—o—o—o—	NUMERIC SIGNAL
L L L L L L	HYDRAULIC SIGNAL
//////////	PNEUMATIC SIGNAL

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REFERENCES | REVISIONS | NOTES

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ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

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BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CATHODE BAR HEATING FURNACE F2 (2/3)
P & ID

MA'ADEN Alcoa

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25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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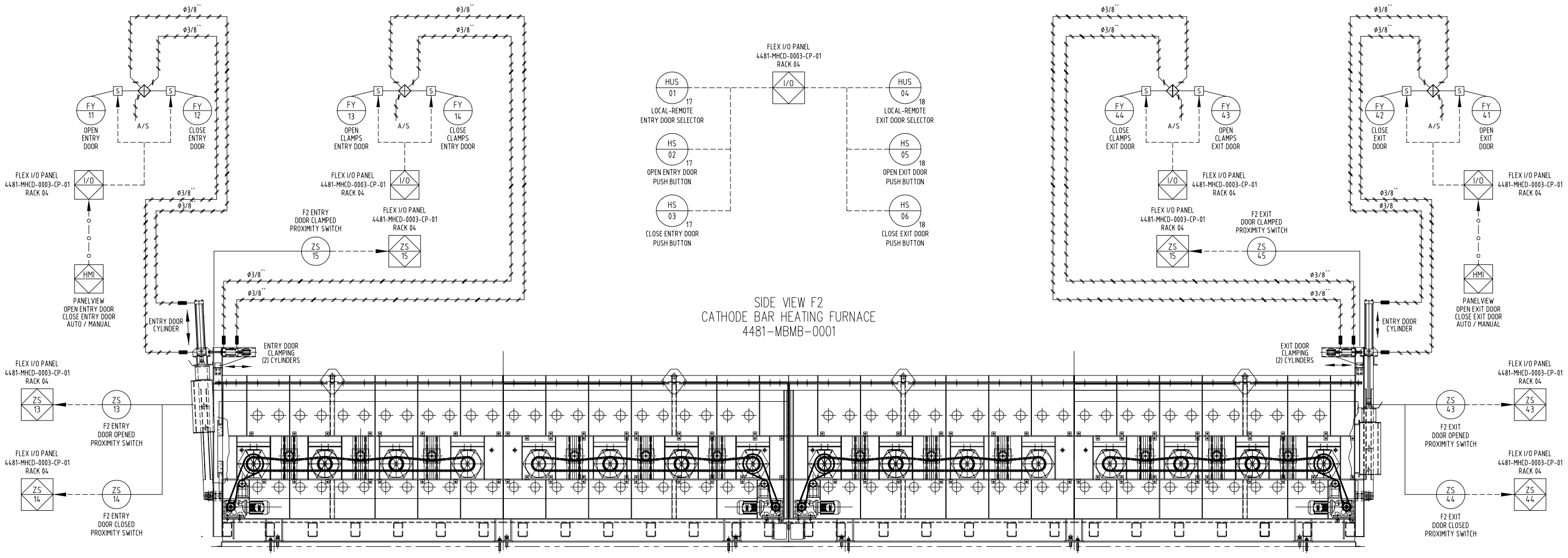
F2 CATHODE BAR HEATING FURNACE (3/3)
EQUIPMENT NUMBER : 4481-MBMB-0001



SIDE VIEW F2
CATHODE BAR HEATING FURNACE
4481-MBMB-0001

PANELS

INSTRUMENT LOCATION	PANEL DESCRIPTION
17	CONTROL PANEL 4481-MBMB-0001-CP-01
18	CONTROL PANEL 4481-MBMB-0001-CP-02

EXAMPLE

HUS 01 / 17 — LOCATED ON CONTROL PANEL

NOTE 1 : EQUIPMENT NUMBER IS INSTRUMENT NUMBER PREFIX

NOTE 2 : 70 MIN. CYCLE TIME IS COMPLETED IN HMI

LEGEND

A/S	AIR SUPPLY
H/S	HYDRAULIC SUPPLY
ES/AC	ELECTRICAL SUPPLY 115Vac/480Vac
ES/DC	ELECTRICAL SUPPLY 24Vdc
	INTERLOCK
I/O	PLC I/O
	ELECTRICAL SIGNAL
	NUMERIC SIGNAL
	HYDRAULIC SIGNAL
	PNEUMATIC SIGNAL

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BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CATHODE BAR HEATING FURNACE F2 (3/3)
P. & ID

MA'ADEN Wasa

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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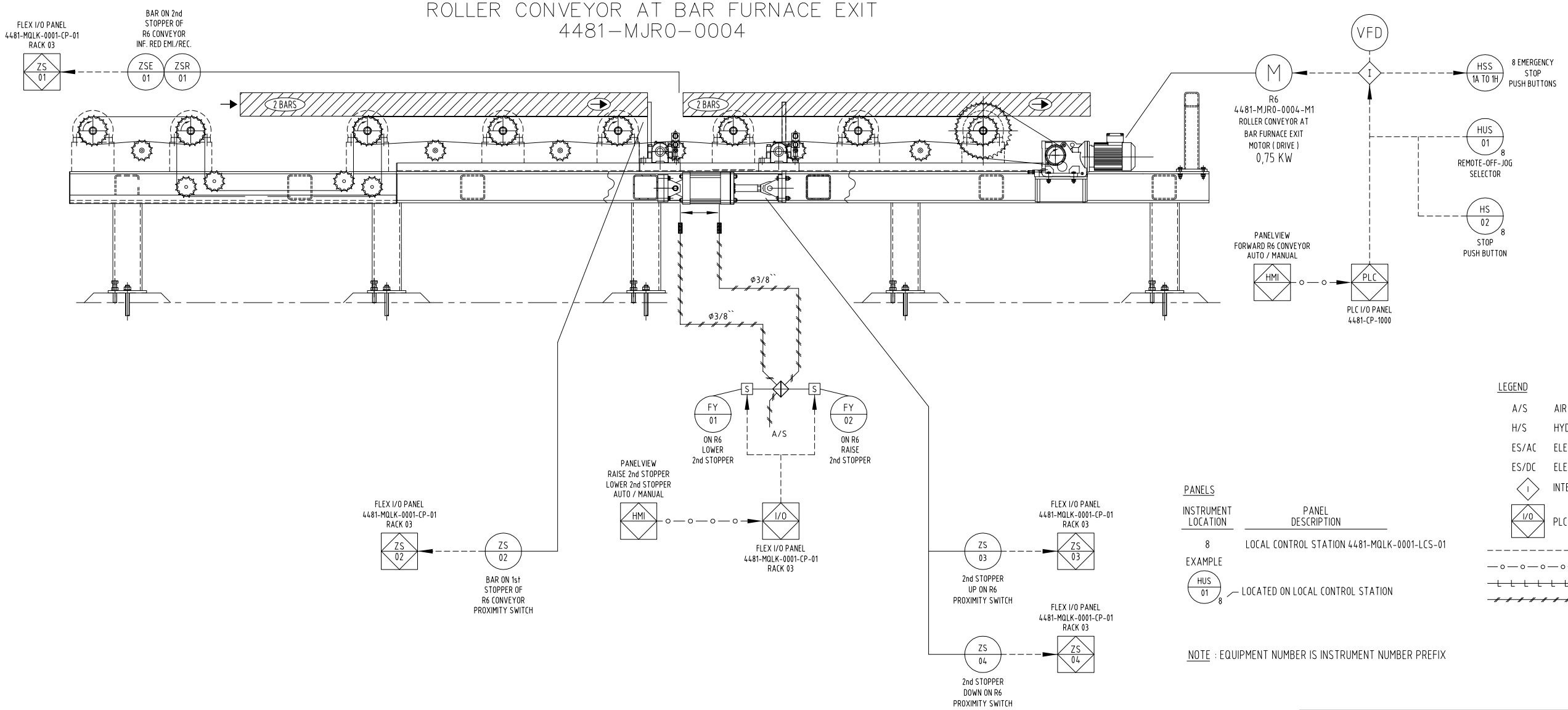
R6 ROLLER CONVEYOR AT BAR FURNACE EXIT
EQUIPMENT NUMBER : 4481-MJR0-0004

SIDE VIEW R6
ROLLER CONVEYOR AT BAR FURNACE EXIT
4481-MJR0-0004



LEGEND

A/S	AIR SUPPLY
H/S	HYDRAULIC SUPPLY
ES/AC	ELECTRICAL SUPPLY 115Vac/480Vac
ES/DC	ELECTRICAL SUPPLY 24Vdc
I	INTERLOCK
I/O	PLC I/O
	ELECTRICAL SIGNAL
	NUMERIC SIGNAL
	HYDRAULIC SIGNAL
	PNEUMATIC SIGNAL

PANELS

INSTRUMENT LOCATION	PANEL DESCRIPTION
8	LOCAL CONTROL STATION 4481-MQLK-0001-LCS-01

EXAMPLE

HUS 01 8 — LOCATED ON LOCAL CONTROL STATION

NOTE : EQUIPMENT NUMBER IS INSTRUMENT NUMBER PREFIX

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DATE:	26/07/10	DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA s&i-tech Inc. — Département Ingénierie Engineering Department 9490 Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
ROLLER CONVEYOR AT BAR FURNACE EXIT R6
P & ID

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
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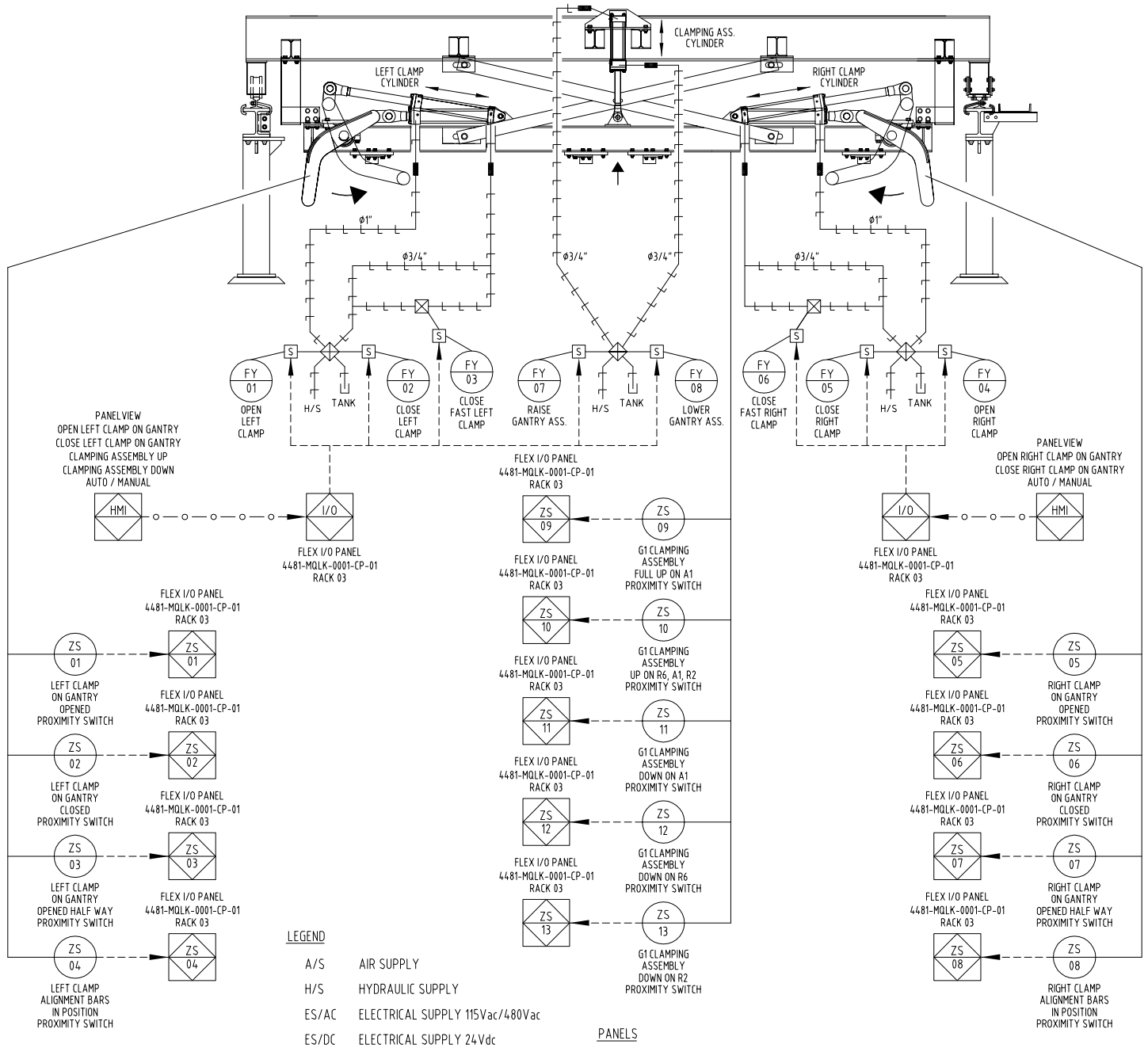
G1 POSITIONING GANTRY FOR BLOCK & BARS (1/2) INCLUDING CATHODE BAR ALIGNMENT STATION EQUIPMENT NUMBER : 4481-MQLK-0001

SIDE VIEW G1 POSITIONING GANTRY FOR BLOCK & BARS 4481-MQLK-0001



LEGEND

A/S	AIR SUPPLY
H/S	HYDRAULIC SUPPLY
ES/AC	ELECTRICAL SUPPLY 115Vac/480Vac
ES/DC	ELECTRICAL SUPPLY 24Vdc
I	INTERLOCK
I/O	PLC I/O

ELECTRICAL SIGNAL
NUMERIC SIGNAL
HYDRAULIC SIGNAL
PNEUMATIC SIGNAL

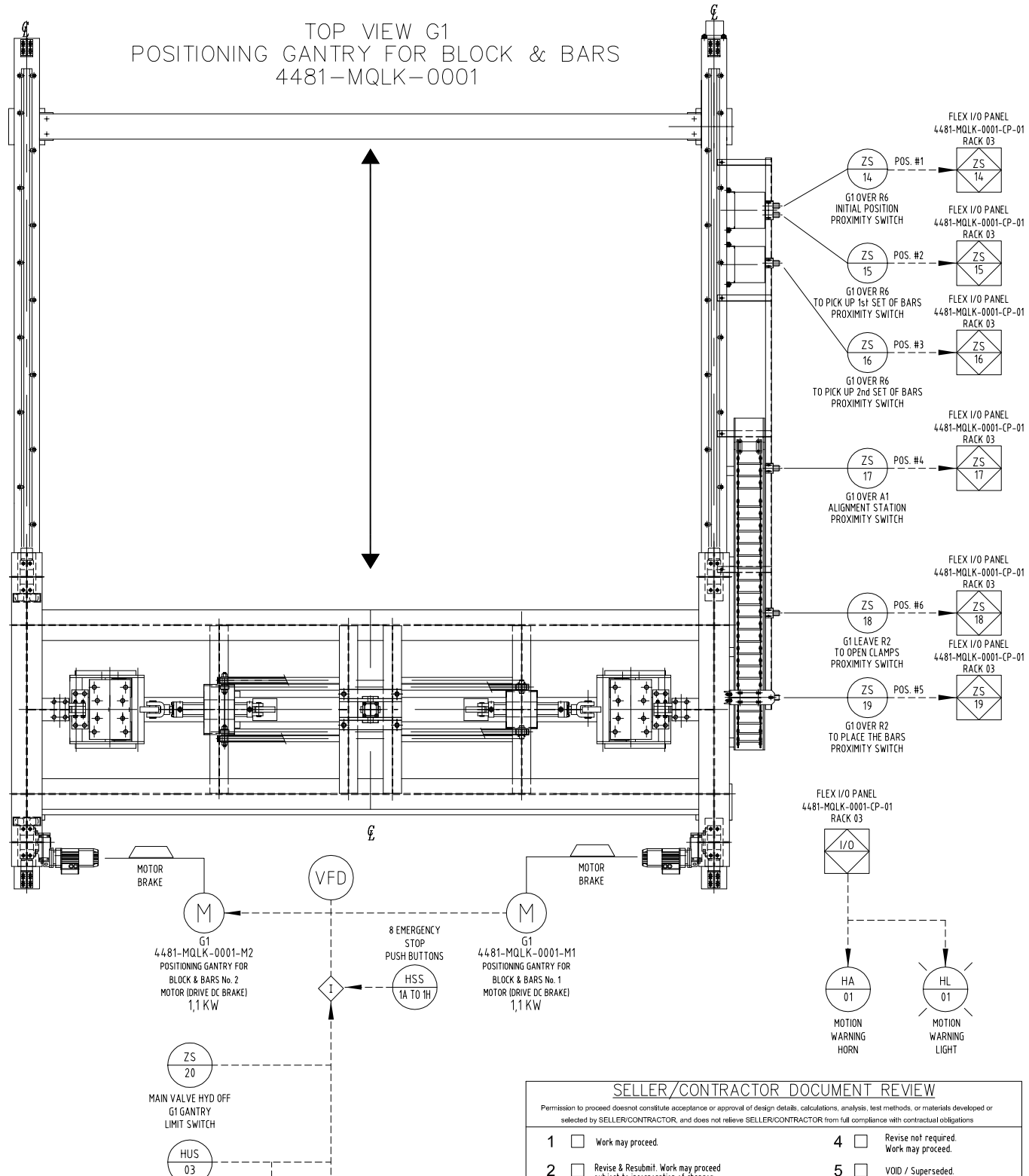
PANELS

INSTRUMENT LOCATION	PANEL DESCRIPTION
9	LOCAL CONTROL STATION 4481-MQLK-0001-LCS-01

EXAMPLE: HUS 01 / 9 — LOCATED ON LOCAL CONTROL STATION

NOTE : EQUIPMENT NUMBER IS INSTRUMENT NUMBER PREFIX

TOP VIEW G1 POSITIONING GANTRY FOR BLOCK & BARS 4481-MQLK-0001



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REFERENCES		REVISIONS						

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RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:	26/07/10	DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA Technologies Inc. — Département Ingénierie / Engineering Department, 9690 Trans-Canada, Saint-Laurent, Québec, H4S 1V3, Canada

BECHTEL

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
POSITIONING GANTRY FOR BLOCK & BARS G1 (1/2)
P & ID

Project Title: Ras Az Zawr Aluminium Smelter

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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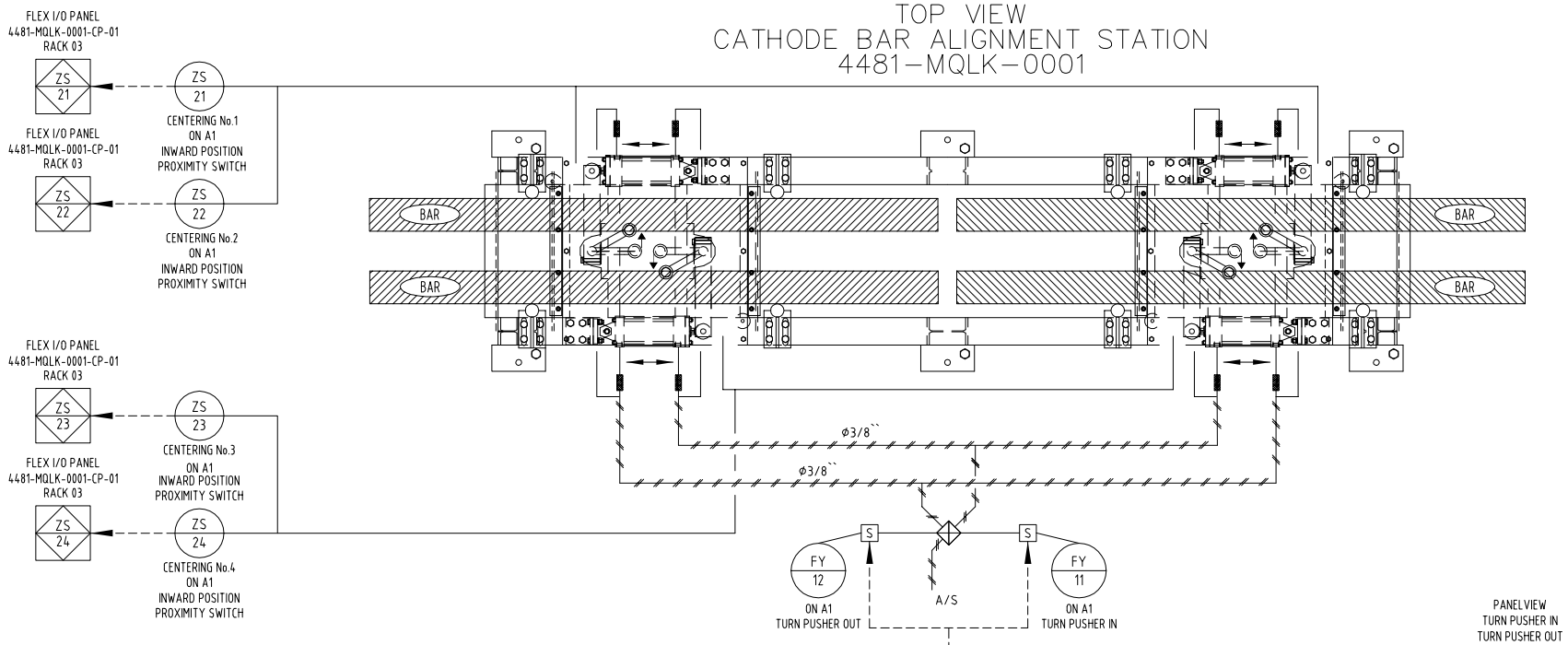
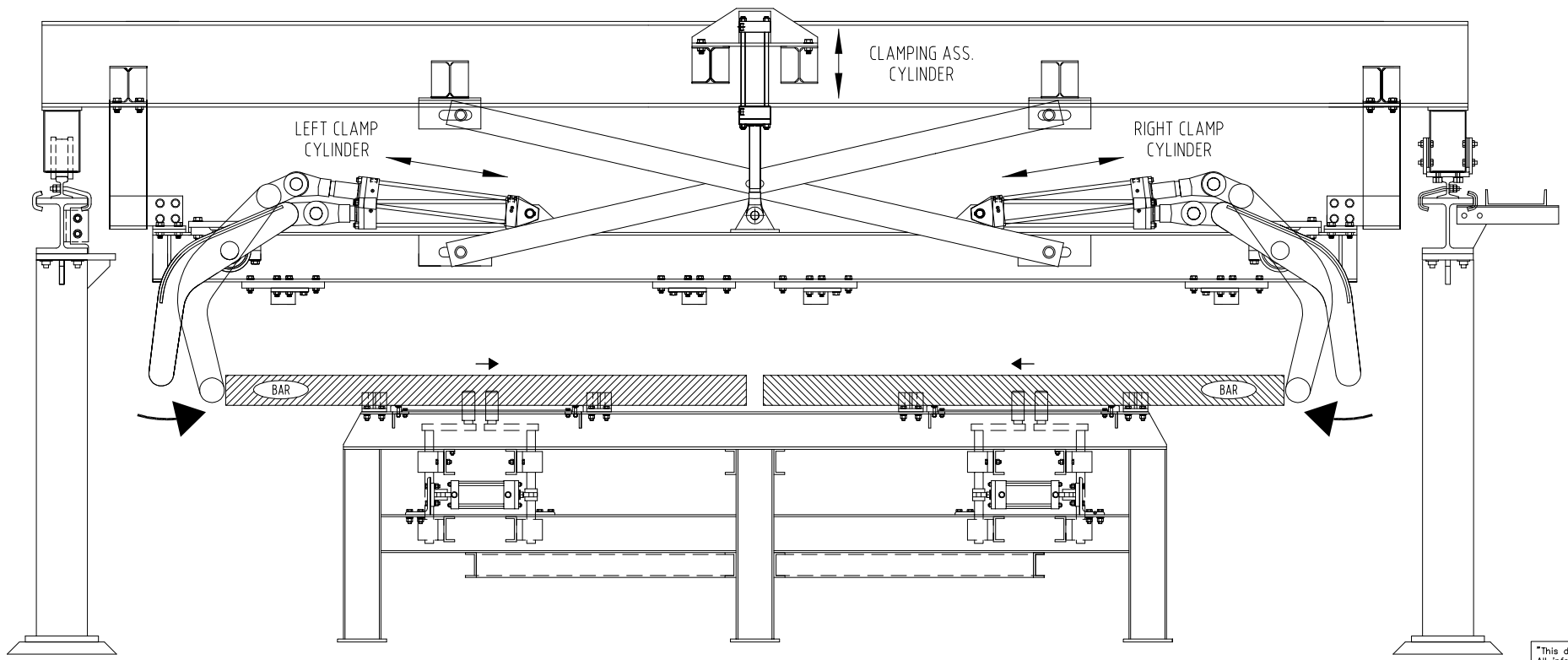
G1 POSITIONING GANTRY FOR BLOCK & BARS (2/2)
INCLUDING CATHODE BAR ALIGNMENT STATION
EQUIPMENT NUMBER : 4481-MQLK-0001

TOP VIEW
CATHODE BAR ALIGNMENT STATION
4481-MQLK-0001



SIDE VIEW
CATHODE BAR ALIGNMENT STATION
4481-MQLK-0001



LEGEND

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H/S	HYDRAULIC SUPPLY
ES/AC	ELECTRICAL SUPPLY 115Vac/480Vac
ES/DC	ELECTRICAL SUPPLY 24Vdc
I	INTERLOCK
I/O	PLC I/O
----------	ELECTRICAL SIGNAL
—o—o—o—o—	NUMERIC SIGNAL
⊥⊥⊥⊥⊥⊥	HYDRAULIC SIGNAL
//////////	PNEUMATIC SIGNAL

NOTE : EQUIPMENT NUMBER IS INSTRUMENT NUMBER PREFIX

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Discipline :

Document No : 25457-4480-V1A-MXA0-0039 | Rev. : 001

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NOTES

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RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:	26/07/10	DATE:	
ENG. GROUP SUP. DATE:		DRAWING SCALE:	NONE

Vendor or Subcontractor Logo: GNA s&j-tech Inc. — Département Ingénierie Engineering Department 9450 Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SELLER DRAWING No. 1347-50101 | REV. 1

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
POSITIONING GANTRY FOR BLOCK & BARS G1 (2/2)
P & ID

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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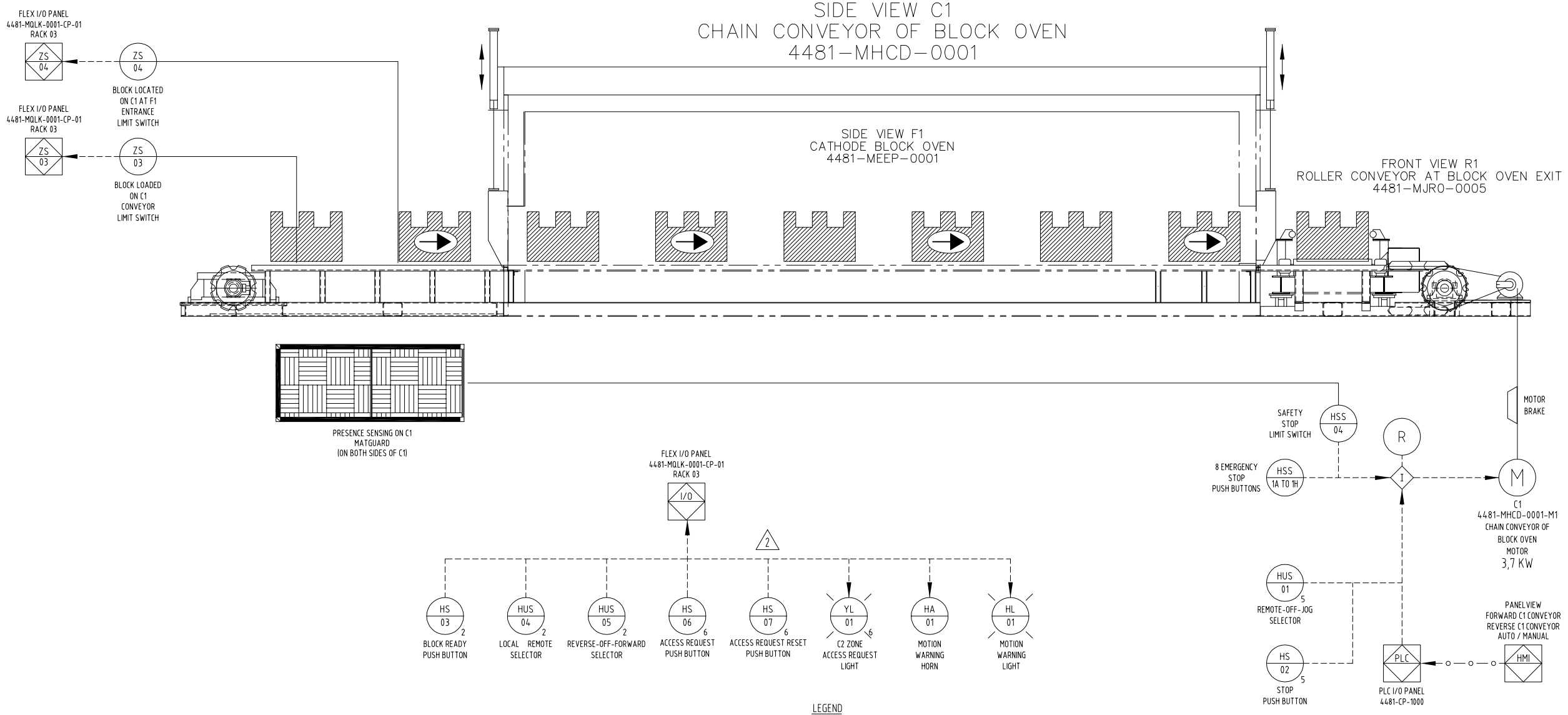
C1 CHAIN CONVEYOR OF BLOCK OVEN
EQUIPMENT NUMBER : 4481-MHCD-0001



PANELS

INSTRUMENT LOCATION	PANEL DESCRIPTION
2	LOCAL CONTROL PANEL 4481-MHCD-0001-CP-01
5	LOCAL CONTROL STATION 4481-MJR0-0005-LCS-01
2 / 6	LOCAL CONTROL PANEL 4481-MHCD-0001-CP-02

EXAMPLE

HUS 01 / 5 — LOCATED ON LOCAL CONTROL STATION

NOTE : EQUIPMENT NUMBER IS INSTRUMENT NUMBER PREFIX

LEGEND

A/S	AIR SUPPLY
H/S	HYDRAULIC SUPPLY
ES/AC	ELECTRICAL SUPPLY 115Vac/480Vac
ES/DC	ELECTRICAL SUPPLY 24Vdc
1	INTERLOCK
I/O	PLC I/O
----------	ELECTRICAL SIGNAL
—o—o—o—o—	NUMERIC SIGNAL
L L L L L L	HYDRAULIC SIGNAL
/ / / / / / /	PNEUMATIC SIGNAL

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SELLER DRAWING No. 1347-50110 | REV. 2

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		2		UPDATE	AU-15-11	F.P.	E.B.	C.C.
		1		UPDATE	MR-30-11	F.P.	E.B.	C.C.

REVISIONS

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RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:	26/07/10	DATE:	
ENG. GROUP SUP. DATE:		DRAWING SCALE:	NONE

Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie / Engineering Department, 1600 TransCanada, Baie-Lavaltrie, Québec, J4Z 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

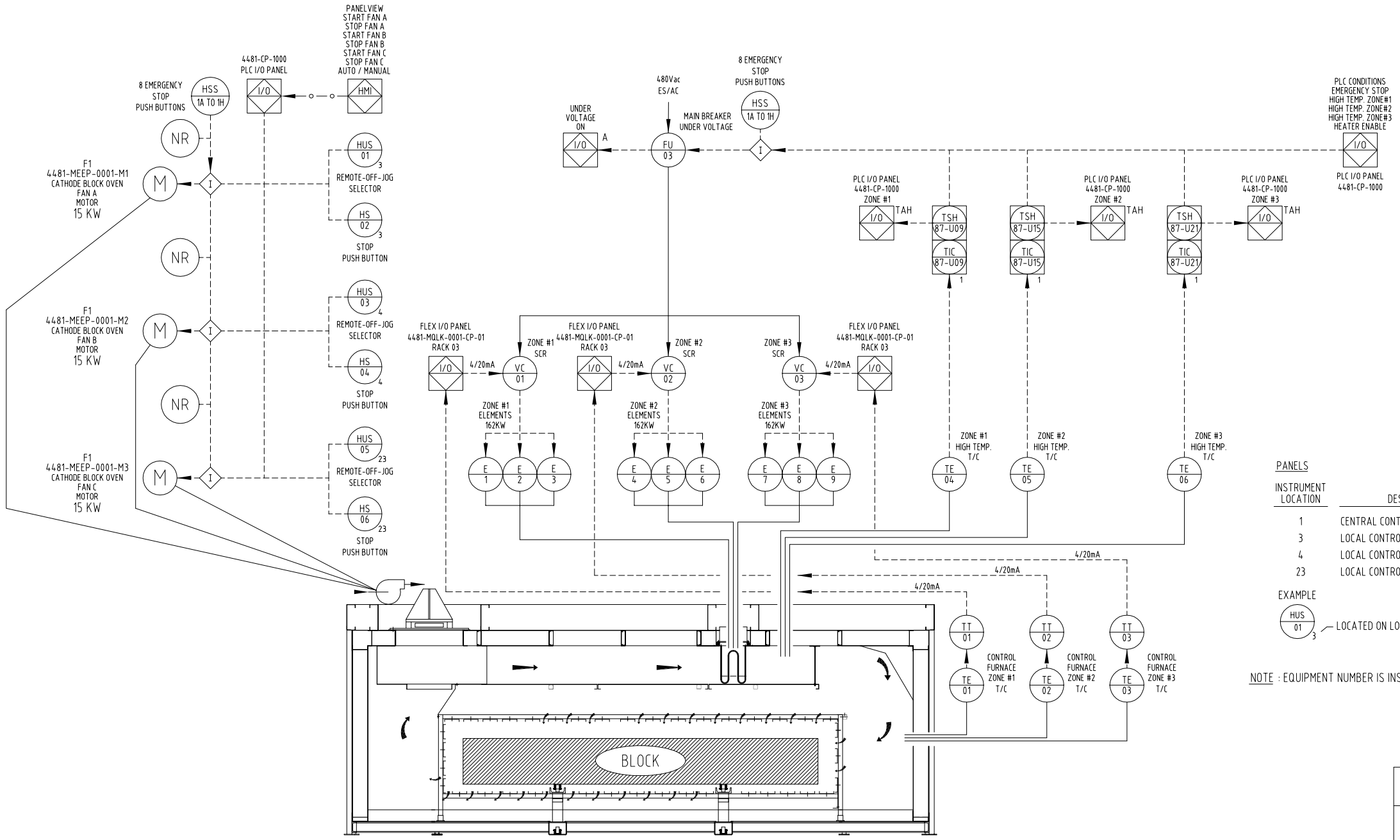
SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CHAIN CONVEYOR OF BLOCK OVEN C1
P & ID

MA'ADEN Wa'ad

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

F1 CATHODE BLOCK OVEN (1/2)
EQUIPMENT NUMBER : 4481-MEEP-0001



FRONT VIEW F1
CATHODE BLOCK OVEN
4481-MEEP-0001

PANELS

INSTRUMENT LOCATION	PANEL DESCRIPTION
1	CENTRAL CONTROL PANEL 4481-CP-1001
3	LOCAL CONTROL STATION 4481-MEEP-0001-LCS-01
4	LOCAL CONTROL STATION 4481-MEEP-0001-LCS-02
23	LOCAL CONTROL STATION 4481-MEEP-0001-LCS-03

EXAMPLE

HUS 01 / 3 — LOCATED ON LOCAL CONTROL STATION

LEGEND

A/S	AIR SUPPLY
H/S	HYDRAULIC SUPPLY
ES/AC	ELECTRICAL SUPPLY 115Vac/480Vac
ES/DC	ELECTRICAL SUPPLY 24Vdc
I	INTERLOCK
I/O	PLC I/O
	ELECTRICAL SIGNAL
	NUMERIC SIGNAL
	HYDRAULIC SIGNAL
	PNEUMATIC SIGNAL

NOTE : EQUIPMENT NUMBER IS INSTRUMENT NUMBER PREFIX

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REFERENCES — REVISIONS

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Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie / Engineering Department, 5650 Trans-Canada, Saint-Laurent, Quebec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SELLER DRAWING No. 1347-50120 | REV. 1

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CATHODE BLOCK OVEN F1 (1/2)
P & ID

MA'ADEN

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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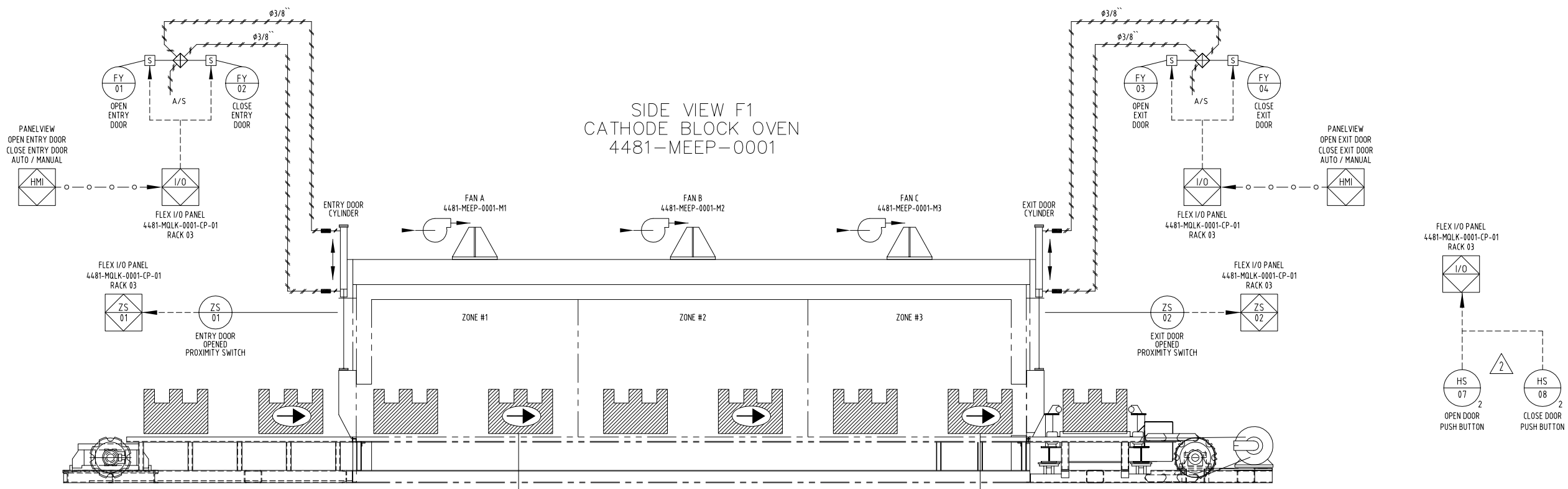
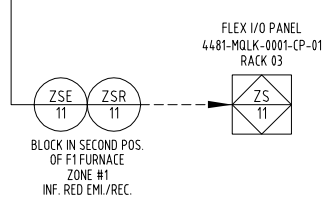
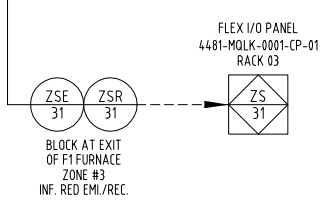
F1 CATHODE BLOCK OVEN (2/2)
EQUIPMENT NUMBER : 4481–MEEP–0001



SIDE VIEW C1
CHAIN CONVEYOR OF BLOCK OVEN
4481–MHCD–0001

SIDE VIEW R1
ROLLER CONVEYOR AT BLOCK OVEN EXIT
4481–MJRO–0005





PANELS

INSTRUMENT LOCATION	PANEL DESCRIPTION
2	LOCAL CONTROL PANEL 4481-MHCD-0001-CP-01

EXAMPLE

HUS 01 / S — LOCATED ON LOCAL CONTROL STATION

NOTE : EQUIPMENT NUMBER IS INSTRUMENT NUMBER PREFIX

LEGEND

A/S	AIR SUPPLY
H/S	HYDRAULIC SUPPLY
ES/AC	ELECTRICAL SUPPLY 115Vac/480Vac
ES/DC	ELECTRICAL SUPPLY 24Vdc
I	INTERLOCK
I/O	PLC I/O
----------	ELECTRICAL SIGNAL
—o—o—o—o—	NUMERIC SIGNAL
L L L L L L	HYDRAULIC SIGNAL
//////////	PNEUMATIC SIGNAL

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4 ☐ Revise not required. Work may proceed.
5 ☐ VOID / Superseded.

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		2		CHANGE HS–06 TO HS–07 AND HS–07 TO HS–08	AU–15–11	F.P.	E.B.	C.C.
		1		UPDATE	MR–30–11	F.P.	E.B.	C.C.
REFERENCES		REVISIONS						

NOTES

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RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:	26/07/10	DATE:	
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DATE:			

Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie Engineering Department 6550, rue Yvon-Trudeau Trois-Rivières, Québec (Québec) G9A 5G4 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CATHODE BLOCK OVEN F1 (2/2)
P & ID

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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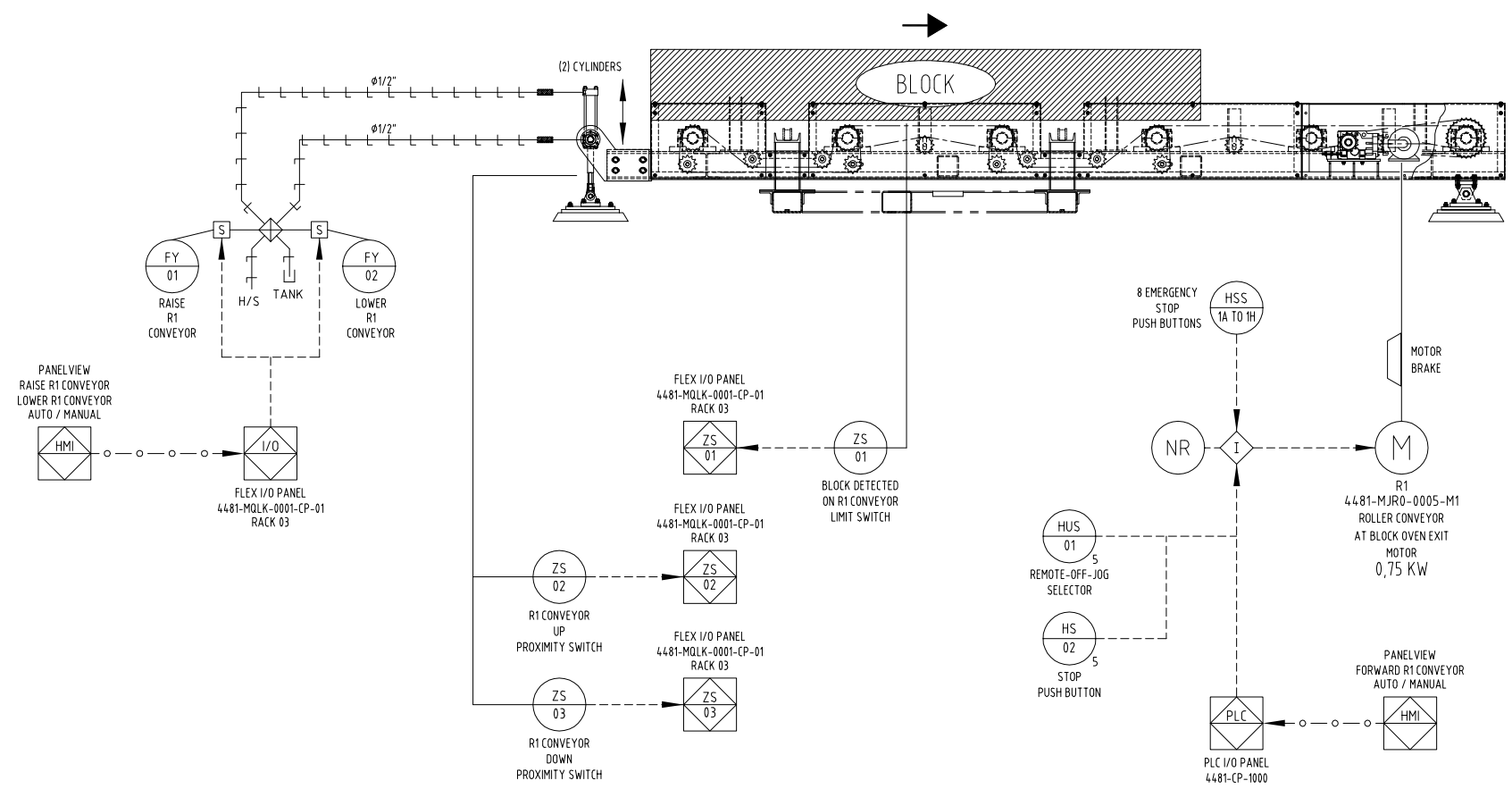
R1 ROLLER CONVEYOR AT BLOCK OVEN EXIT
EQUIPMENT NUMBER : 4481-MJR0-0005

SIDE VIEW R1
ROLLER CONVEYOR AT BLOCK OVEN EXIT
4481-MJR0-0005



PANELS

INSTRUMENT LOCATION	PANEL DESCRIPTION
5	LOCAL CONTROL STATION 4481-MJR0-0005-LCS-01

EXAMPLE

HUS 01 / 5 — LOCATED ON LOCAL CONTROL STATION

NOTE : EQUIPMENT NUMBER IS INSTRUMENT NUMBER PREFIX

LEGEND

A/S	AIR SUPPLY
H/S	HYDRAULIC SUPPLY
ES/AC	ELECTRICAL SUPPLY 115Vac/480Vac
ES/DC	ELECTRICAL SUPPLY 24Vdc
I	INTERLOCK
I/O	PLC I/O
- - - - - - - - - - - -	ELECTRICAL SIGNAL
—o—o—o—o—	NUMERIC SIGNAL
—L—L—L—L—	HYDRAULIC SIGNAL
—/—/—/—/—	PNEUMATIC SIGNAL

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RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:	26/07/10	DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie / Engineering Department, 9495 Trans-Canada, Saint-Laurent, Québec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
ROLLER CONVEYOR AT BLOCK OVEN EXIT R1
P & ID

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
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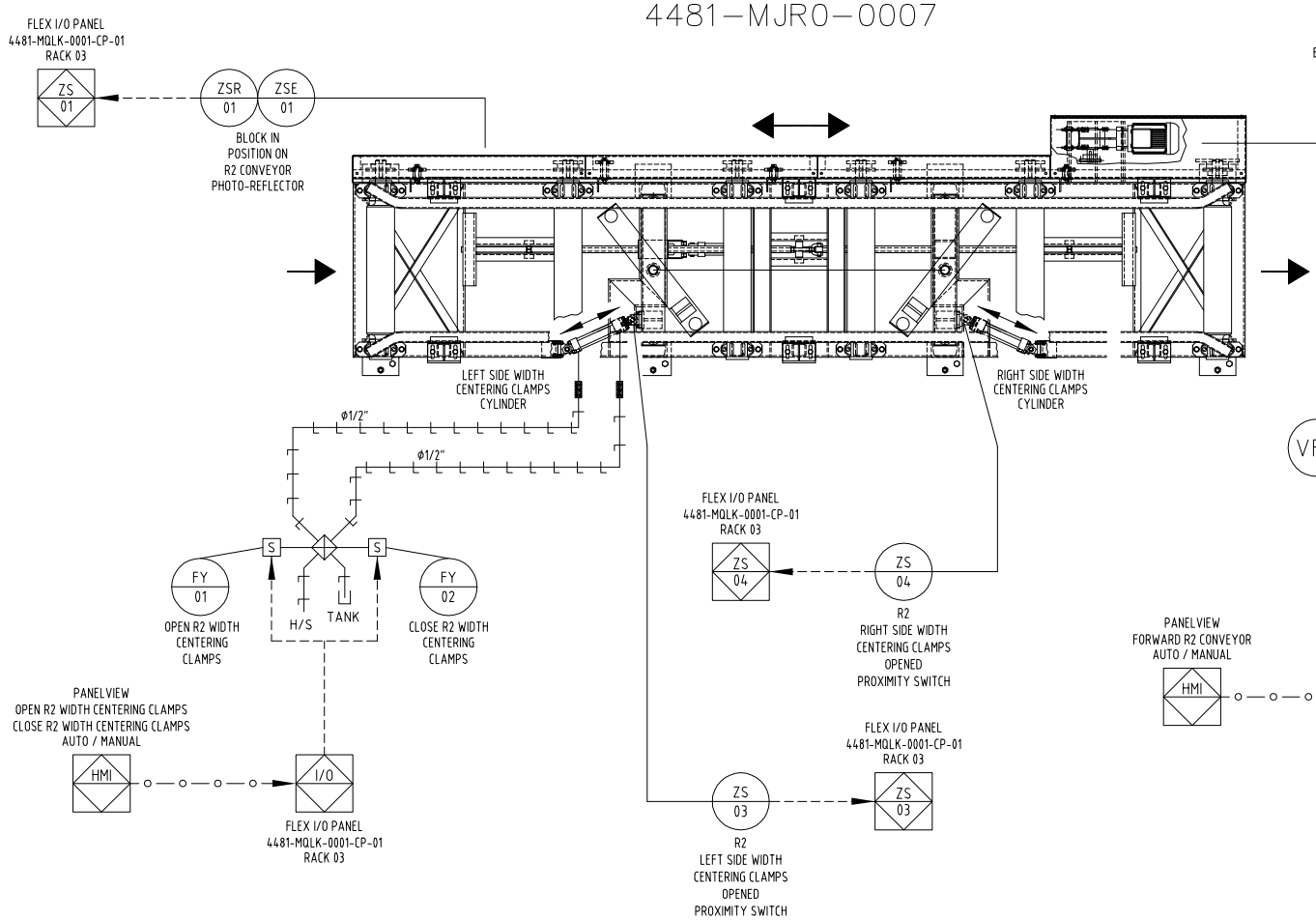
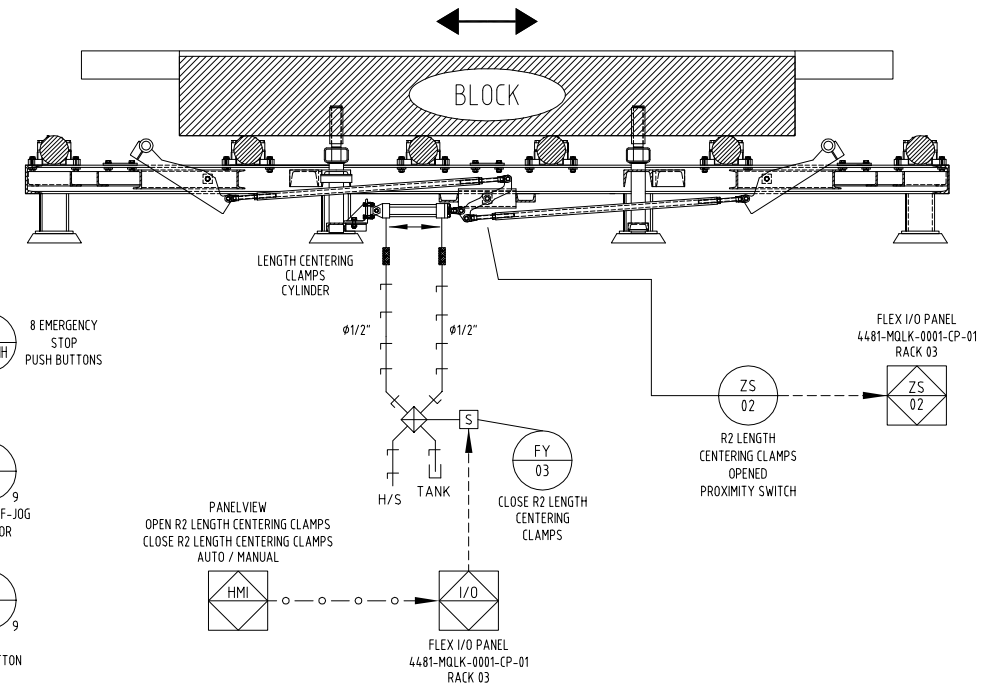
R2 ROLLER CONVEYOR FOR BLOCK AND BAR ASSEMBLY
EQUIPMENT NUMBER : 4481-MJR0-0007

TOP VIEW R2
ROLLER CONVEYOR FOR BLOCK AND BAR ASSEMBLY
4481-MJR0-0007



SIDE VIEW R2
ROLLER CONVEYOR FOR BLOCK AND BAR ASSEMBLY
4481-MJR0-0007



LEGEND

A/S	AIR SUPPLY
H/S	HYDRAULIC SUPPLY
ES/AC	ELECTRICAL SUPPLY 115Vac/480Vac
ES/DC	ELECTRICAL SUPPLY 24Vdc
I	INTERLOCK
I/O	PLC I/O
----------	ELECTRICAL SIGNAL
—o—o—o—o—	NUMERIC SIGNAL
⊥⊥⊥⊥⊥⊥	HYDRAULIC SIGNAL
//////////	PNEUMATIC SIGNAL

PANELS

INSTRUMENT LOCATION	PANEL DESCRIPTION
9	LOCAL CONTROL STATION 4481-MQLK-0001-LCS-01

EXAMPLE

HUS 01 9 — LOCATED ON LOCAL CONTROL STATION

NOTE : EQUIPMENT NUMBER IS INSTRUMENT NUMBER PREFIX

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REFERENCES		REVISIONS						

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RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:	26/07/10	DATE:	
ENG. GROUP SUP. DATE:		DRAWING SCALE:	NONE

Vendor or Subcontractor Logo: GNA a.i.tech Inc. — Département Ingénierie / Engineering Department, 9690 Trans-Canada, Montréal, Québec, H4S 1V9, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
ROLLER CONVEYOR FOR BLOCK AND BAR ASSEMBLY R2
P & ID

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
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Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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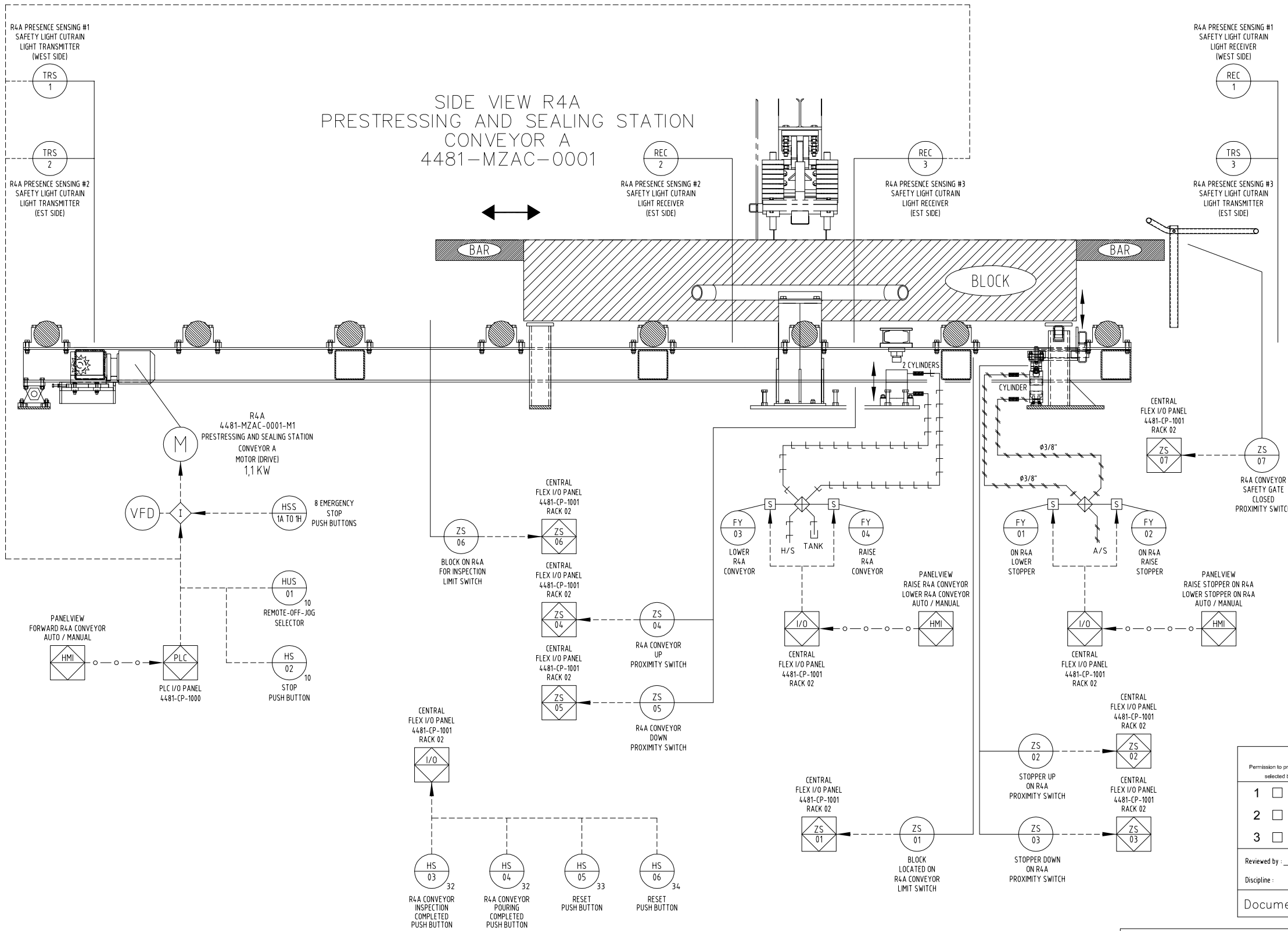
R4A PRESTRESSING AND SEALING STATION CONVEYOR A (1/2)
EQUIPMENT NUMBER : 4481-MZAC-0001



PANELS

INSTRUMENT LOCATION	PANEL DESCRIPTION
10	LOCAL CONTROL STATION 4481-MZAC-0001-LCS-01
32	LOCAL CONTROL PANEL 4481-MZAC-0001-CP-01
33	LOCAL CONTROL PANEL 4481-MZAC-0001-CP-02
34	LOCAL CONTROL PANEL 4481-MZAC-0001-CP-03

EXAMPLE

HUS 01 / 10 — LOCATED ON LOCAL CONTROL STATION

NOTE : EQUIPMENT NUMBER IS INSTRUMENT NUMBER PREFIX

LEGEND

A/S	AIR SUPPLY
H/S	HYDRAULIC SUPPLY
ES/AC	ELECTRICAL SUPPLY 115Vac/480Vac
ES/DC	ELECTRICAL SUPPLY 24Vdc
I	INTERLOCK
I/O	PLC I/O
----------	ELECTRICAL SIGNAL
—o—o—o—o—	NUMERIC SIGNAL
L L L L L L	HYDRAULIC SIGNAL
//////////	PNEUMATIC SIGNAL

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3 ☐	Revise & Resubmit. Work may NOT proceed.	DDR Nbr :	110

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DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
		1		UPDATE	MR-30-11	F.P.	E.B.	C.C.
REFERENCES		REVISIONS						

NOTES

STATUS: FOR DESIGN

DRAWN/DES'D:	F.P.	AREA ENG.:	
DATE:	26/07/10	DATE:	
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DATE:	26/07/10	DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:	26/07/10	DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie / Engineering Department, 9600 Trans-Canada, Baie-d'Urfé, Québec, H9X 3T4, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No 25457-00AZ- | SUBD. xx - | DISC. xxxx - | SECTOR xxxx - | SEQUENCE xxx - | REV. xxx

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
PRESTRESSING AND SEALING STATION CONVEYOR A R4A (1/2)
P & ID

MA'ADEN

Type — | Building — | Discipline — | Phase — | Format A3- | Sequential | Location -AZ | Rev. No.

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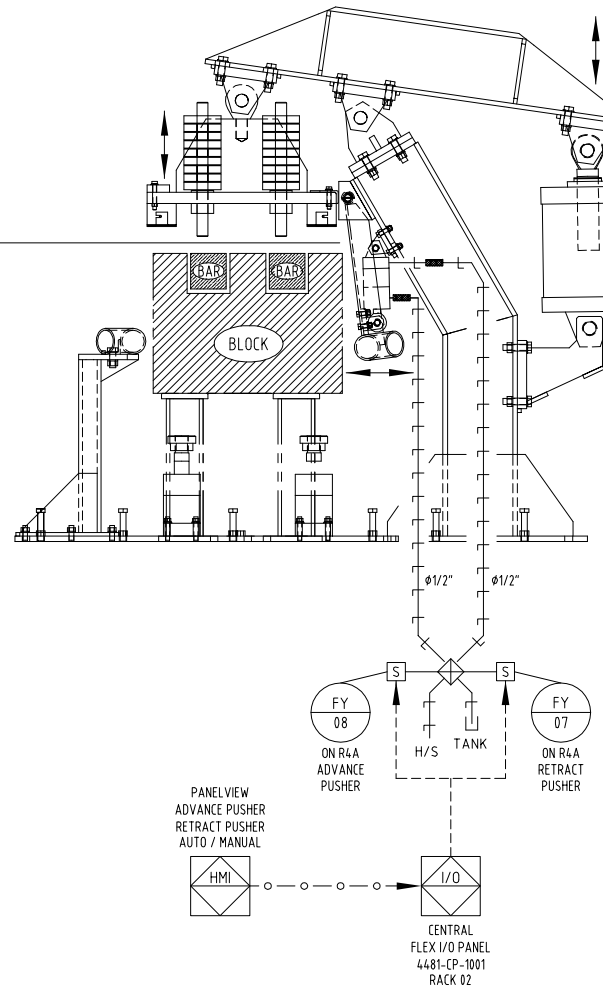
R4A PRESTRESSING AND SEALING STATION CONVEYOR A (2/2)
EQUIPMENT NUMBER : 4481-MZAC-0001

FRONT VIEW R4A
PRESTRESSING AND SEALING STATION
CONVEYOR A
4481-MZAC-0001



CENTRAL FLEX I/O PANEL 4481-CP-1001 RACK 02 — I/O
HUS 01 — 32 — OFF-RAISE SELECTOR

CENTRAL FLEX I/O PANEL 4481-CP-1001 RACK 02 — ZS 10 — CENTRAL FLEX I/O PANEL 4481-CP-1001 RACK 02 — ZS 10 — PUSHER IN POSITION PROXIMITY SWITCH

CENTRAL FLEX I/O PANEL 4481-CP-1001 RACK 02 — ZS 11 — PUSHER OUT POSITION PROXIMITY SWITCH

PANELVIEW
RAISE PRESTRESSING HEAD
LOWER PRESTRESSING HEAD
AUTO / MANUAL
HMI — I/O — CENTRAL FLEX I/O PANEL 4481-CP-1001 RACK 02

ZS 08 — PRESTRESSING HEAD UP PROXIMITY SWITCH — CENTRAL FLEX I/O PANEL 4481-CP-1001 RACK 02 — ZS 08

ZS 09 — PRESTRESSING HEAD DOWN PROXIMITY SWITCH — CENTRAL FLEX I/O PANEL 4481-CP-1001 RACK 02 — ZS 09

PANELVIEW
ADVANCE PUSHER
RETRACT PUSHER
AUTO / MANUAL
HMI — I/O — CENTRAL FLEX I/O PANEL 4481-CP-1001 RACK 02

PANELS

INSTRUMENT LOCATION	PANEL DESCRIPTION
32	LOCAL CONTROL PANEL 4481-MZAC-0001-CP-01

EXAMPLE: HUS 01 — 10 — LOCATED ON LOCAL CONTROL STATION

NOTE : EQUIPMENT NUMBER IS INSTRUMENT NUMBER PREFIX

LEGEND

A/S	AIR SUPPLY
H/S	HYDRAULIC SUPPLY
ES/AC	ELECTRICAL SUPPLY 115Vac/480Vac
ES/DC	ELECTRICAL SUPPLY 24Vdc
I	INTERLOCK
I/O	PLC I/O
----------	ELECTRICAL SIGNAL
—o—o—o—o—	NUMERIC SIGNAL
L L L L L L L	HYDRAULIC SIGNAL
/ / / / / / /	PNEUMATIC SIGNAL

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Discipline :

Document No : 25457-4480-V1A-MXA0-0046 | Rev. : 001

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1			UPDATE	MR-30-11	F.P.	E.B.	C.C.	

DRAWING NUMBER | TITLE | No | STATUS | DESCRIPTION | DATE | BY | CHK | APP
REFERENCES | REVISIONS | NOTES

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CHECKED:	E.B.	PRJ ENG MGR:	
DATE:	26/07/10	DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:	26/07/10	DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA s&i-tech Inc. Département Ingénierie Engineering Department 9450 Trans-Canada Saint-Laurent, Quebec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
PRESTRESSING AND SEALING STATION CONVEYOR A R4A (2/2)
P & ID

MA'ADEN معادن

SELLER DRAWING No. 1347-50151 | REV. 1

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
—	—	—		A3—		—AZ	

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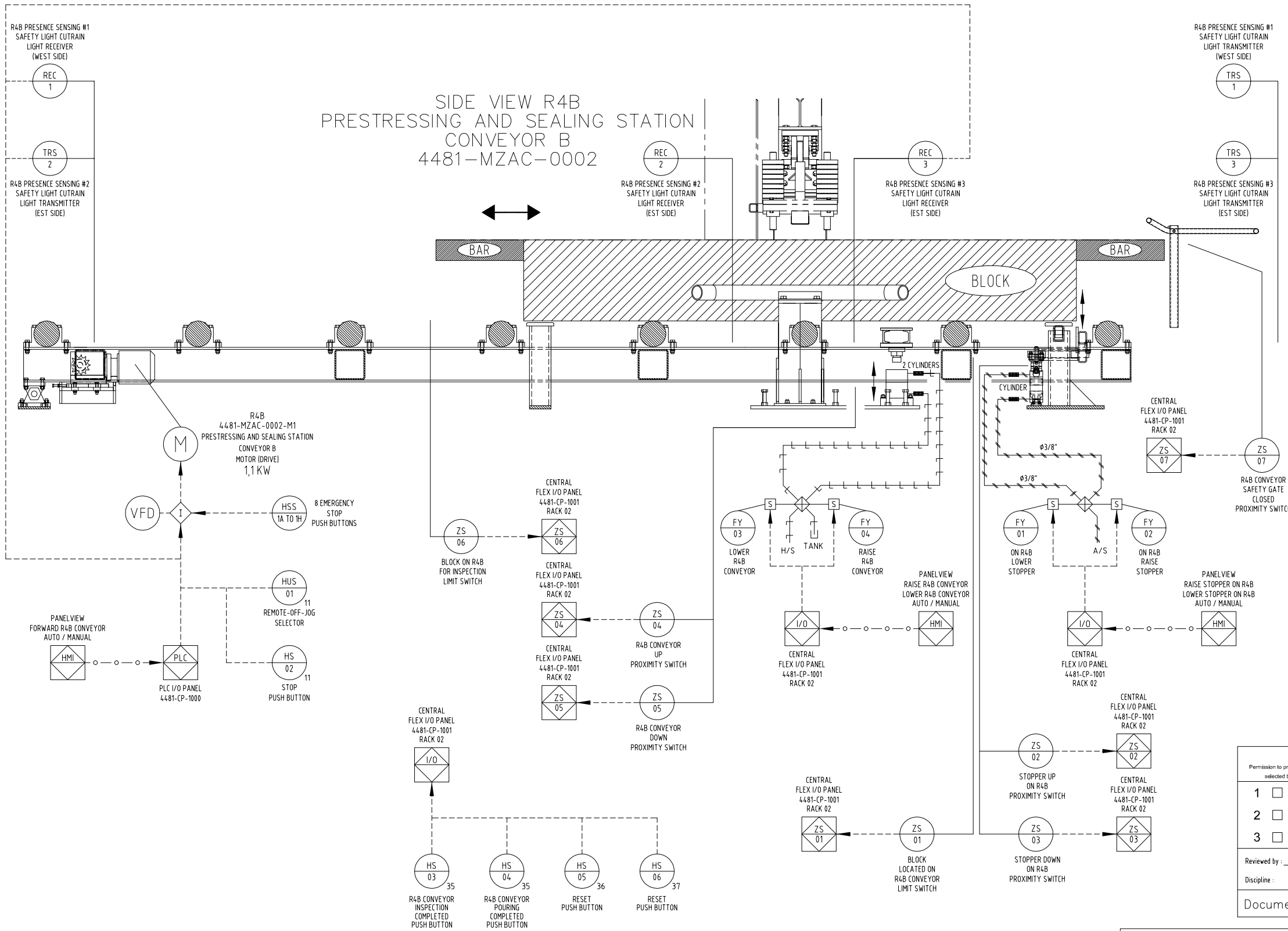
R4B PRESTRESSING AND SEALING STATION CONVEYOR B (1/2)
EQUIPMENT NUMBER : 4481-MZAC-0002



PANELS

INSTRUMENT LOCATION	PANEL DESCRIPTION
11	LOCAL CONTROL STATION 4481-MZAC-0002-LCS-01
35	LOCAL CONTROL PANEL 4481-MZAC-0002-CP-01
36	LOCAL CONTROL PANEL 4481-MZAC-0002-CP-02
37	LOCAL CONTROL PANEL 4481-MZAC-0002-CP-03

EXAMPLE

HUS 01 / 11 — LOCATED ON LOCAL CONTROL STATION

NOTE : EQUIPMENT NUMBER IS INSTRUMENT NUMBER PREFIX

LEGEND

A/S	AIR SUPPLY
H/S	HYDRAULIC SUPPLY
ES/AC	ELECTRICAL SUPPLY 115Vac/480Vac
ES/DC	ELECTRICAL SUPPLY 24Vdc
I	INTERLOCK
I/O	PLC I/O
----------	ELECTRICAL SIGNAL
—o—o—o—o—	NUMERIC SIGNAL
L L L L L L	HYDRAULIC SIGNAL
//////////	PNEUMATIC SIGNAL

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Document No : 25457-4480-V1A-MXA0-0047 | Rev. : 001

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DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		1		UPDATE	MR-30-11	F.P.	E.B.	C.C.

REVISIONS

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RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:	26/07/10	DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie / Engineering Department, 9690 Trans-Canada, Saint-Laurent, Québec, H4S 1V0, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
PRESTRESSING AND SEALING STATION CONVEYOR B R4B (1/2)
P & ID

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
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Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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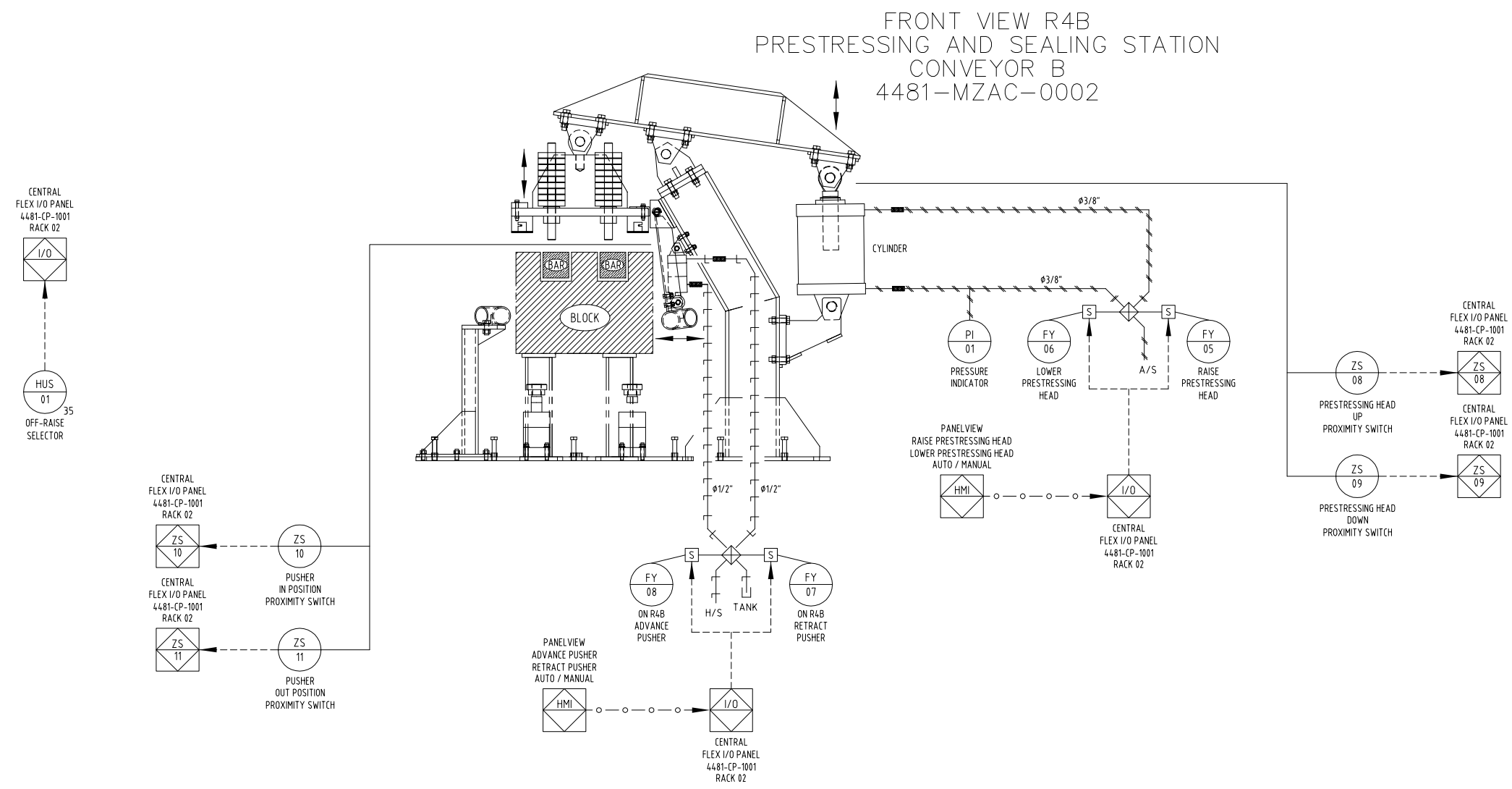
R4B PRESTRESSING AND SEALING STATION CONVEYOR B (2/2)
EQUIPMENT NUMBER : 4481-MZAC-0002



PANELS

INSTRUMENT LOCATION	PANEL DESCRIPTION
35	LOCAL CONTROL PANEL 4481-MZAC-0001-CP-01

EXAMPLE

HUS 01 / 10 — LOCATED ON LOCAL CONTROL STATION

NOTE : EQUIPMENT NUMBER IS INSTRUMENT NUMBER PREFIX

LEGEND

A/S	AIR SUPPLY
H/S	HYDRAULIC SUPPLY
ES/AC	ELECTRICAL SUPPLY 115Vac/480Vac
ES/DC	ELECTRICAL SUPPLY 24Vdc
I	INTERLOCK
I/O	PLC I/O
----------	ELECTRICAL SIGNAL
—o—o—o—o—	NUMERIC SIGNAL
L L L L L L	HYDRAULIC SIGNAL
/ / / / / /	PNEUMATIC SIGNAL

NOTE : EQUIPMENT NUMBER IS INSTRUMENT NUMBER PREFIX

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1347-50161	1

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RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:	26/07/10	DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA s&i-tech Inc. Département Ingénierie Engineering Department 9450 Trans-Canada Saint-Laurent, Quebec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
PRESTRESSING AND SEALING STATION CONVEYOR B R4B (2/2)
P & ID

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
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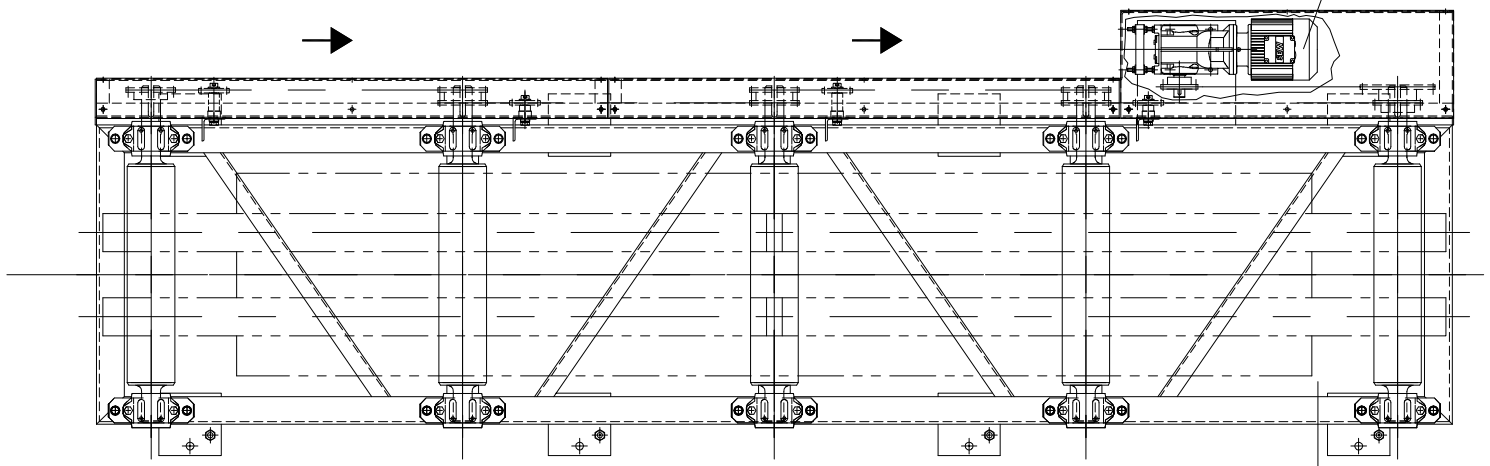
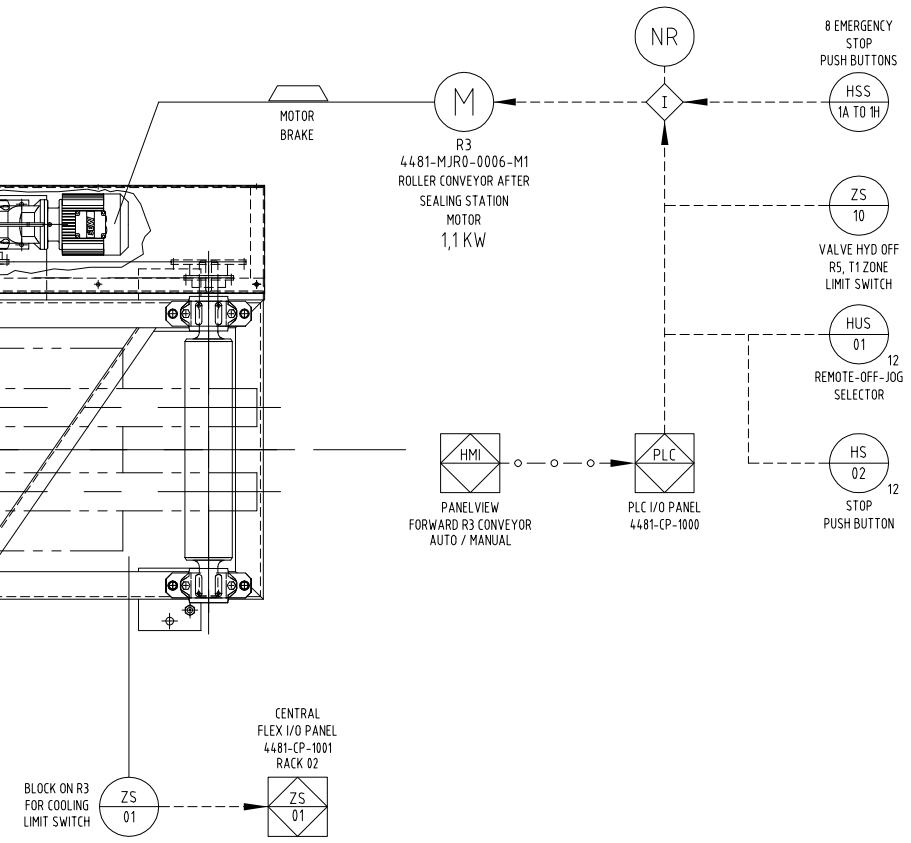
R3 ROLLER CONVEYOR AFTER SEALING STATION
EQUIPMENT NUMBER : 4481-MJR0-0006

SIDE VIEW R3
ROLLER CONVEYOR AFTER SEALING STATION
4481-MJR0-0006





LEGEND

A/S	AIR SUPPLY
H/S	HYDRAULIC SUPPLY
ES/AC	ELECTRICAL SUPPLY 115Vac/480Vac
ES/DC	ELECTRICAL SUPPLY 24Vdc
I	INTERLOCK
I/O	PLC I/O
----------	ELECTRICAL SIGNAL
—o—o—o—o—	NUMERIC SIGNAL
LLLLLLL	HYDRAULIC SIGNAL
//////////	PNEUMATIC SIGNAL

PANELS

INSTRUMENT LOCATION	PANEL DESCRIPTION
12	CONTROL STATION STATION 4481-MJR0-0006-LCS-01

EXAMPLE

HUS 01 / 12 — LOCATED ON CONTROL STATION STATION

NOTE : EQUIPMENT NUMBER IS INSTRUMENT NUMBER PREFIX

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4 ☐ Revise not required. Work may proceed.
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Discipline :

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REFERENCES		REVISIONS						

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RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:	26/07/10	DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie / Engineering Department — 5199 Rue Cochrane, Saint-Laurent, Québec (H4S 1V3) Canada

BECHTEL

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
ROLLER CONVEYOR AFTER SEALING STATION R3
P & ID

Project Title: Ras Az Zawr Aluminium Smelter

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
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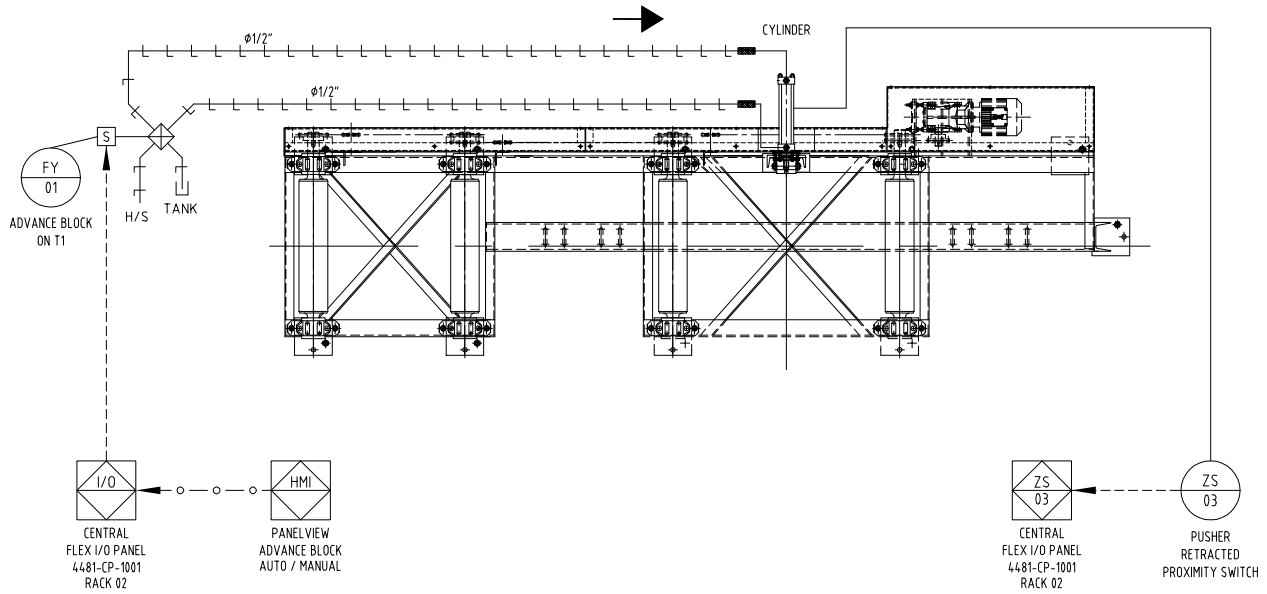
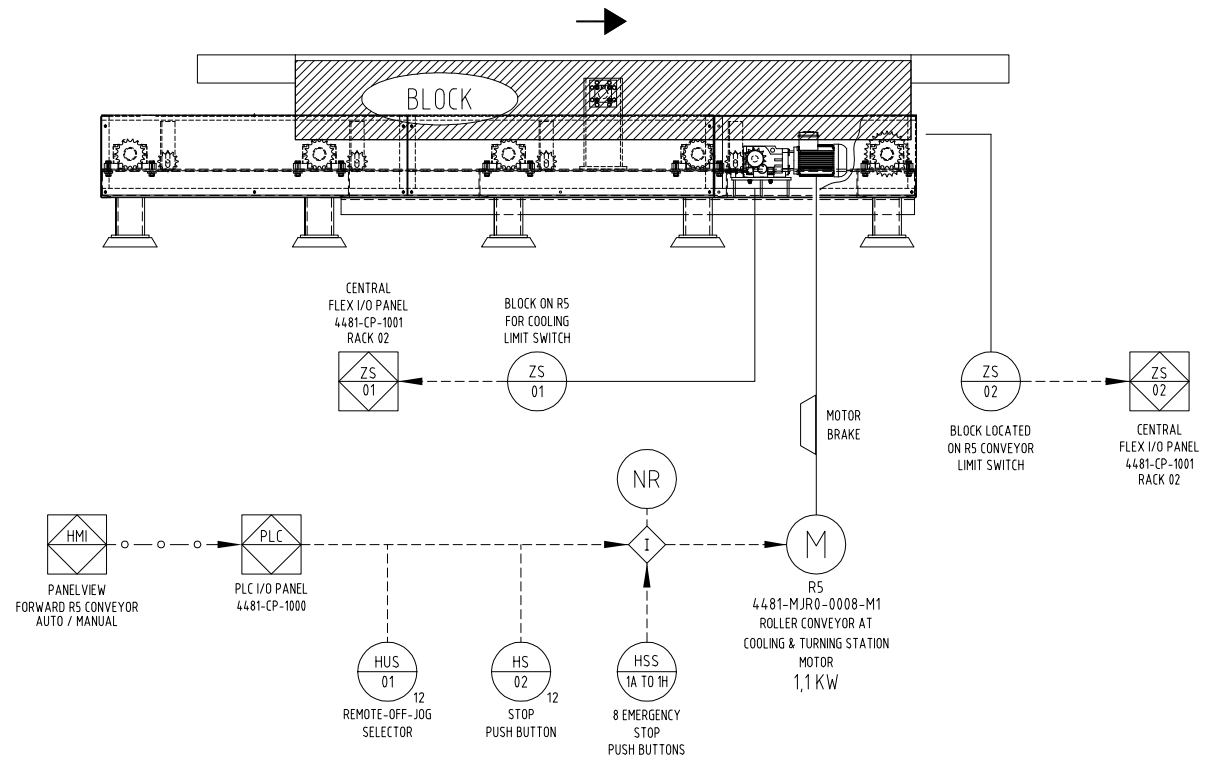
R5 ROLLER CONVEYOR AT COOLING & TURNING STATION
EQUIPMENT NUMBER : 4481-MJR0-0008

TOP VIEW R5
ROLLER CONVEYOR AT COOLING & TURNING STATION
4481-MJR0-0008



SIDE VIEW R5
ROLLER CONVEYOR AT COOLING & TURNING STATION
4481-MJR0-0008



LEGEND

A/S	AIR SUPPLY
H/S	HYDRAULIC SUPPLY
ES/AC	ELECTRICAL SUPPLY 115Vac/480Vac
ES/DC	ELECTRICAL SUPPLY 24Vdc
I	INTERLOCK
I/O	PLC I/O
----------	ELECTRICAL SIGNAL
—o—o—o—o—	NUMERIC SIGNAL
L L L L L L	HYDRAULIC SIGNAL
//////////	PNEUMATIC SIGNAL

PANELS

INSTRUMENT LOCATION	PANEL DESCRIPTION
12	CONTROL STATION STATION 4481-MJR0-0006-LCS-01

EXAMPLE

HUS 01 / 12 — LOCATED ON CONTROL STATION STATION

NOTE : EQUIPMENT NUMBER IS INSTRUMENT NUMBER PREFIX

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Discipline :

Document No : 25457-4480-V1A-MXA0-0050 | Rev. : 001

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1347-50180	1

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		REVISIONS						

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DATE:	26/07/10	DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA aluTech Inc. — Département Ingénierie / Engineering Department, 9690 TransCanada, Saint-Laurent, Quebec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
ROLLER CONVEYOR AT COOLING & TURNING STATION R5
P & ID

MA'ADEN

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3—		—AZ	

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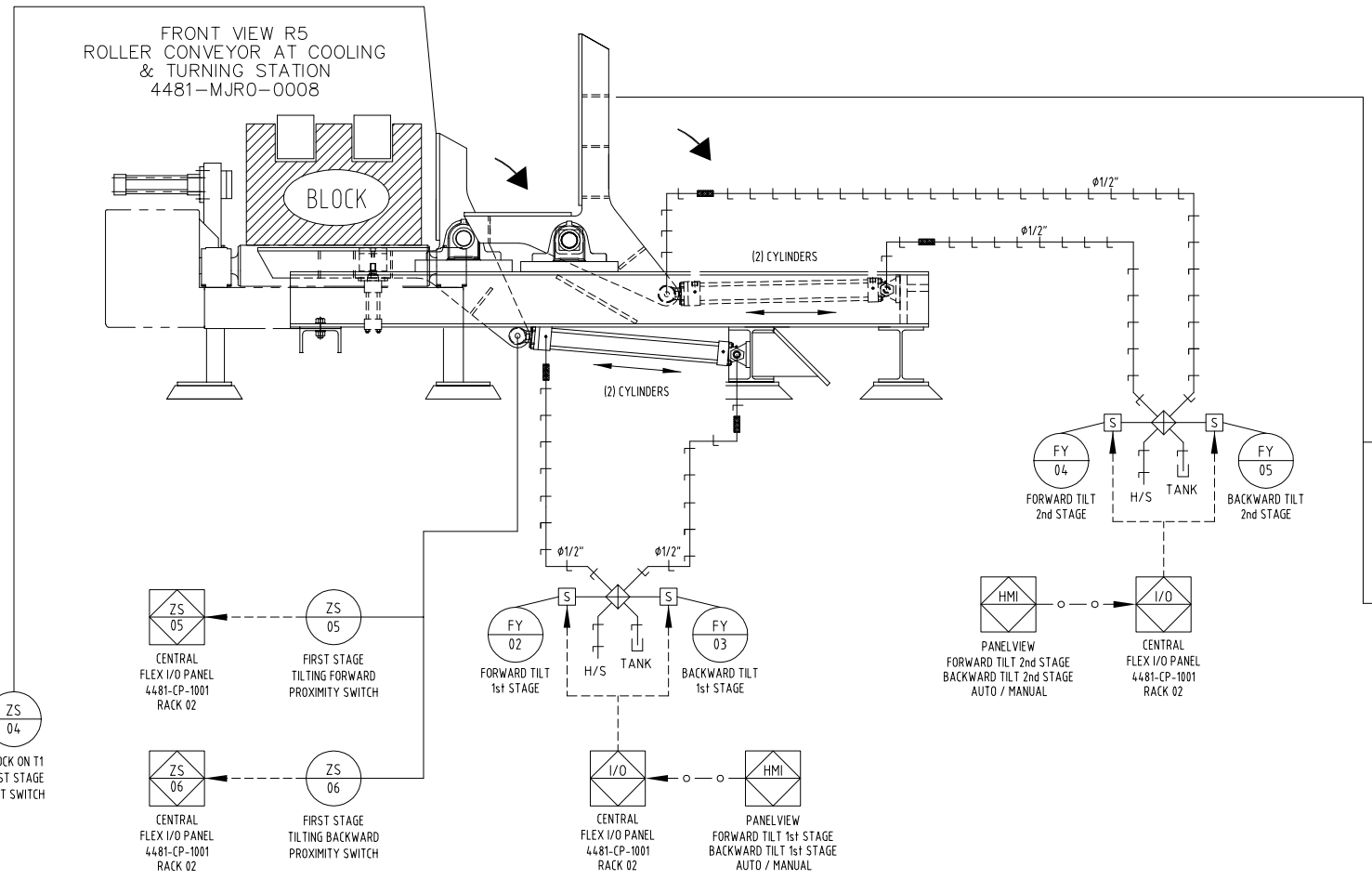
T1 COOLING & TURNING STATION
EQUIPMENT NUMBER : 4481-MJUT-0001

SIDE VIEW T1
COOLING & TURNING STATION
4481-MJUT-0001



LEGEND

A/S	AIR SUPPLY
H/S	HYDRAULIC SUPPLY
ES/AC	ELECTRICAL SUPPLY 115Vac/480Vac
ES/DC	ELECTRICAL SUPPLY 24Vdc
I	INTERLOCK
I/O	PLC I/O
----------	ELECTRICAL SIGNAL
—o—o—o—o—	NUMERIC SIGNAL
L L L L L L	HYDRAULIC SIGNAL
//////////	PNEUMATIC SIGNAL

NOTE : EQUIPMENT NUMBER IS INSTRUMENT NUMBER PREFIX

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3 ☐	Revise & Resubmit. Work may NOT proceed.	DDR Nbr :	110

Reviewed by : _____ Date : _____

Discipline :

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REFERENCES | REVISIONS | NOTES

STATUS: FOR DESIGN

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CHECKED:	E.B.	PRJ ENG MGR:	
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RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:	26/07/10	DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA a&i-tech Inc. — Département Ingénierie Engineering Department 9490 Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

BECHTEL

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
COOLING & TURNING STATION T1
P & ID

Project Title: Ras Az Zawr Aluminium Smelter

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
—	—	—		A3—		—AZ	

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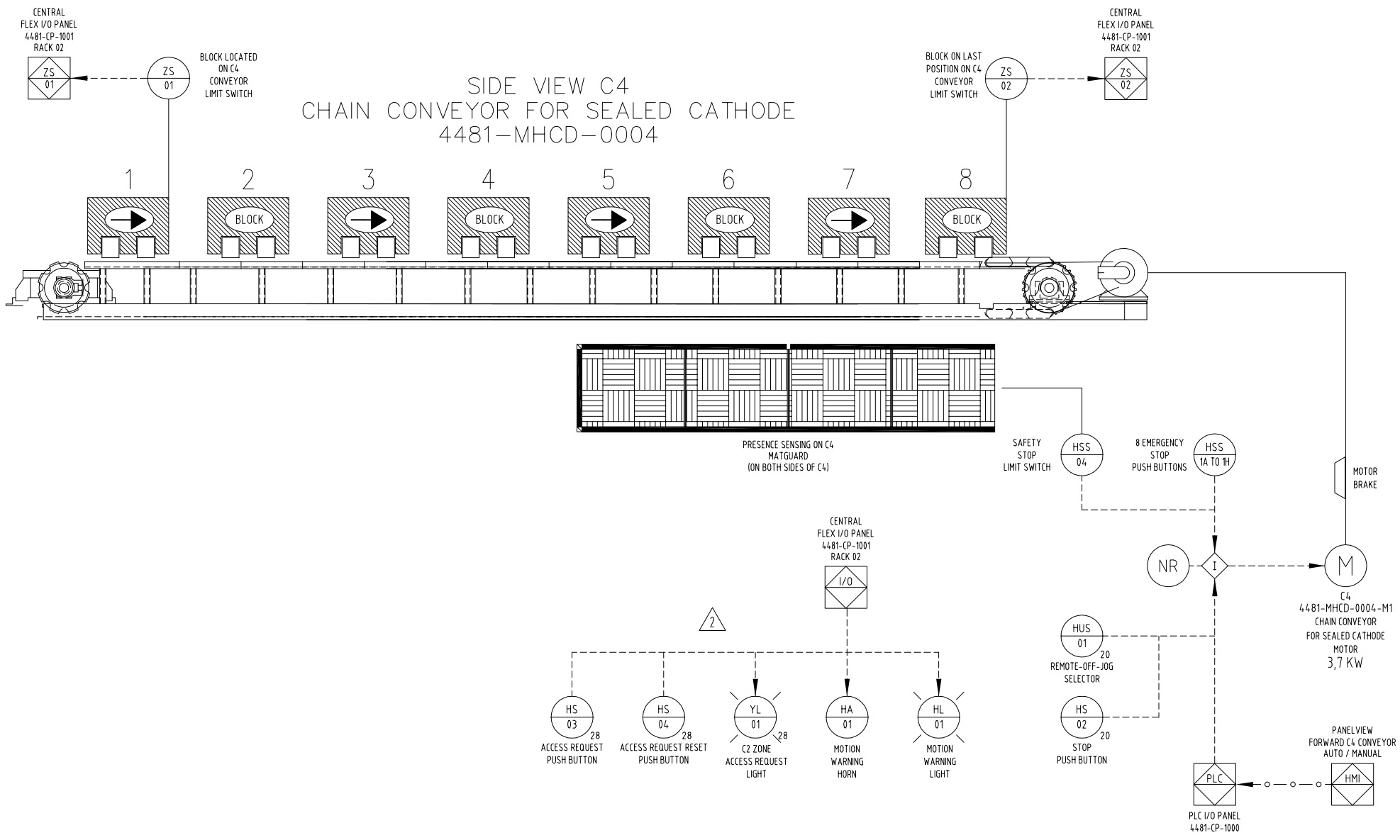
C4 CHAIN CONVEYOR FOR SEALED CATHODE
EQUIPMENT NUMBER : 4481-MHCD-0004



PANELS

INSTRUMENT LOCATION	PANEL DESCRIPTION
20	LOCAL CONTROL STATION 4481-MHCD-0004-LCS-01
2 28	LOCAL CONTROL PANEL 4481-MHCD-0004-CP-02

EXAMPLE

HUS 01 — 20 — LOCATED ON LOCAL CONTROL STATION

NOTE : EQUIPMENT NUMBER IS INSTRUMENT NUMBER PREFIX

LEGEND

A/S	AIR SUPPLY
H/S	HYDRAULIC SUPPLY
ES/AC	ELECTRICAL SUPPLY 115Vac/480Vac
ES/DC	ELECTRICAL SUPPLY 24Vdc
I	INTERLOCK
I/O	PLC I/O
----------	ELECTRICAL SIGNAL
—o—o—o—o—	NUMERIC SIGNAL
L L L L L L L	HYDRAULIC SIGNAL
/ / / / / / /	PNEUMATIC SIGNAL

SELLER/CONTRACTOR DOCUMENT REVIEW

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Document No : 25457-4480-V1A-MXA0-0052 | Rev. :

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		2		UPDATE	AU-15-11	F.P.	E.B.	C.C.
		1		UPDATE	MR-30-11	F.P.	E.B.	C.C.
REFERENCES		REVISIONS						

NOTES

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DATE:	26/07/10	DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA altech Inc. — Département Ingénierie / Engineering Department, 1000 rue Cathala, Baie-Comeau, Québec, G4Z 1V3, Canada

BECHTEL

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CHAIN CONVEYOR FOR SEALED CATHODE C4
P & ID

Project Title: Ras Az Zawr Aluminium Smelter

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx —	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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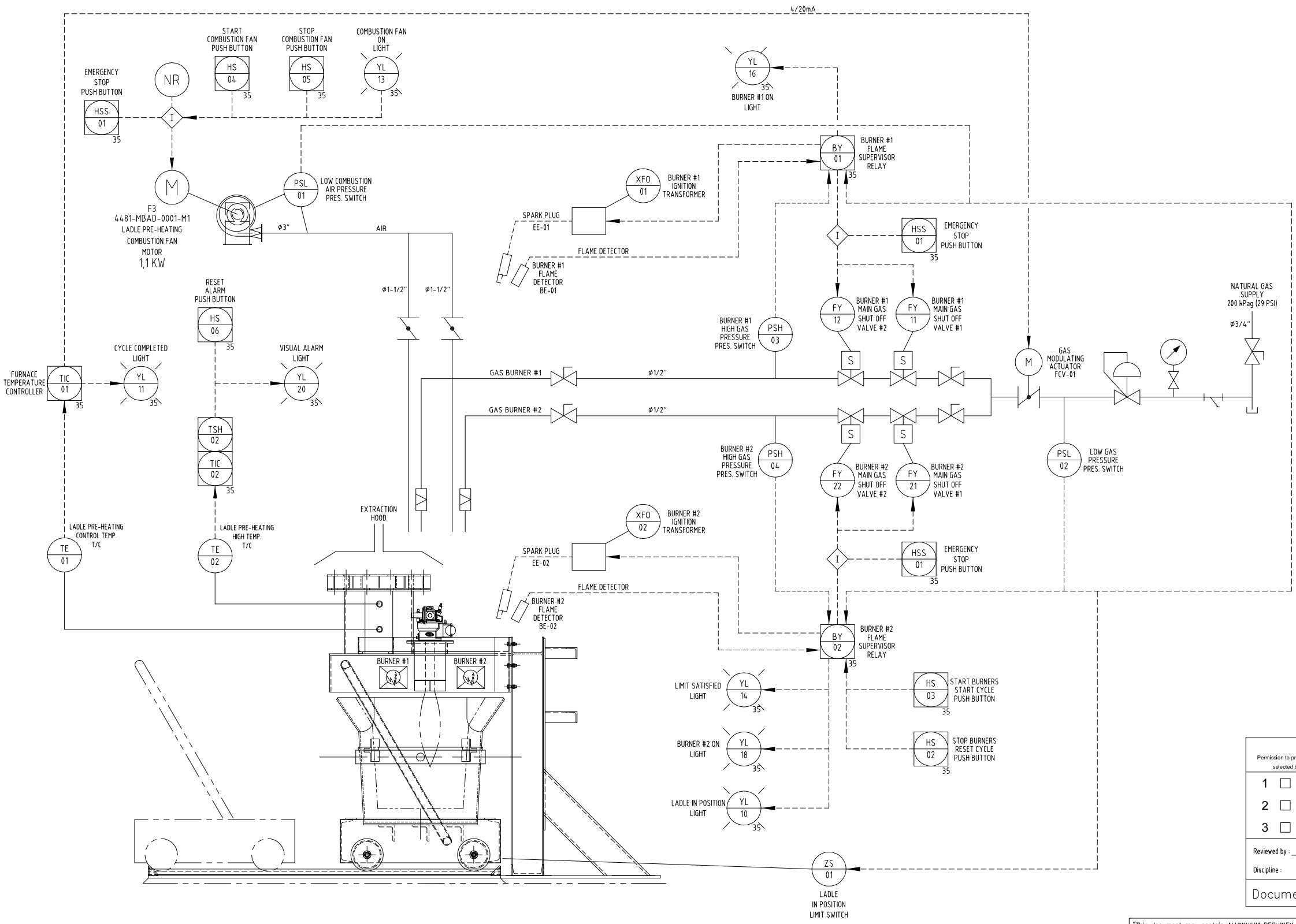
F3 LADLE PRE-HEATING STATION
EQUIPMENT NUMBER : 4481-MBAD-0001



LEGEND

A/S	AIR SUPPLY
H/S	HYDRAULIC SUPPLY
ES/AC	ELECTRICAL SUPPLY 115Vac/480Vac
ES/DC	ELECTRICAL SUPPLY 24Vdc
I	INTERLOCK
I/O	PLC I/O
----------	ELECTRICAL SIGNAL
—o—o—o—o—	NUMERIC SIGNAL
L L L L L L	HYDRAULIC SIGNAL
//////////	PNEUMATIC SIGNAL

PANELS

INSTRUMENT LOCATION	PANEL DESCRIPTION
35	LADLE PRE-HEATING CONTROL PANEL 4481-MBAD-0001-CP-01

EXAMPLE

HS 02 — 35 — LOCATED ON CONTROL PANEL

NOTE : EQUIPMENT NUMBER IS INSTRUMENT NUMBER PREFIX

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Discipline :

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DATE:	26/07/10	DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

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BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
LADLE PRE-HEATING STATION F3
P & ID

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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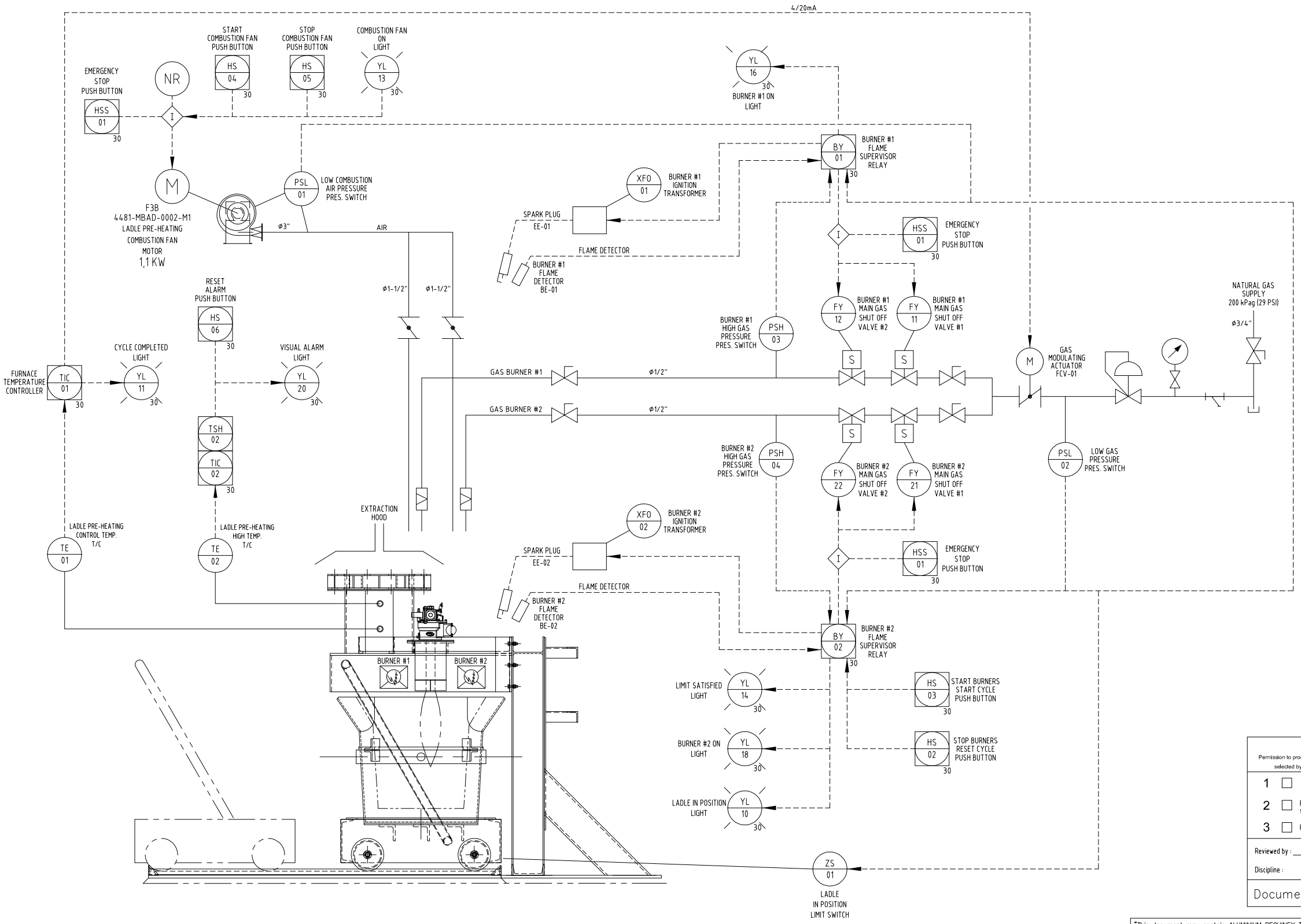
F3B LADLE PRE-HEATING STATION B
EQUIPMENT NUMBER : 4481-MBAD-0002



LEGEND

A/S	AIR SUPPLY
H/S	HYDRAULIC SUPPLY
ES/AC	ELECTRICAL SUPPLY 115Vac/480Vac
ES/DC	ELECTRICAL SUPPLY 24Vdc
I	INTERLOCK
I/O	PLC I/O
	ELECTRICAL SIGNAL
	NUMERIC SIGNAL
	HYDRAULIC SIGNAL
	PNEUMATIC SIGNAL

PANELS

INSTRUMENT LOCATION	PANEL DESCRIPTION
30	LADLE PRE-HEATING CONTROL PANEL 4481-MBAD-0002-CP-01

EXAMPLE

HS 02 / 30 — LOCATED ON CONTROL PANEL

NOTE : EQUIPMENT NUMBER IS INSTRUMENT NUMBER PREFIX

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Document No : 25457-4480-V1A-MXA0- Rev. :

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REFERENCES — REVISIONS

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RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:		DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie Engineering Department 9695 Trans-Canada Saint-Laurent, Québec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
LADLE PRE-HEATING STATION F3B
P & ID

MA'ADEN

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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F4A CAST IRON INGOT DRYING STATION A
EQUIPMENT NUMBER : 4481-MEVD-0001

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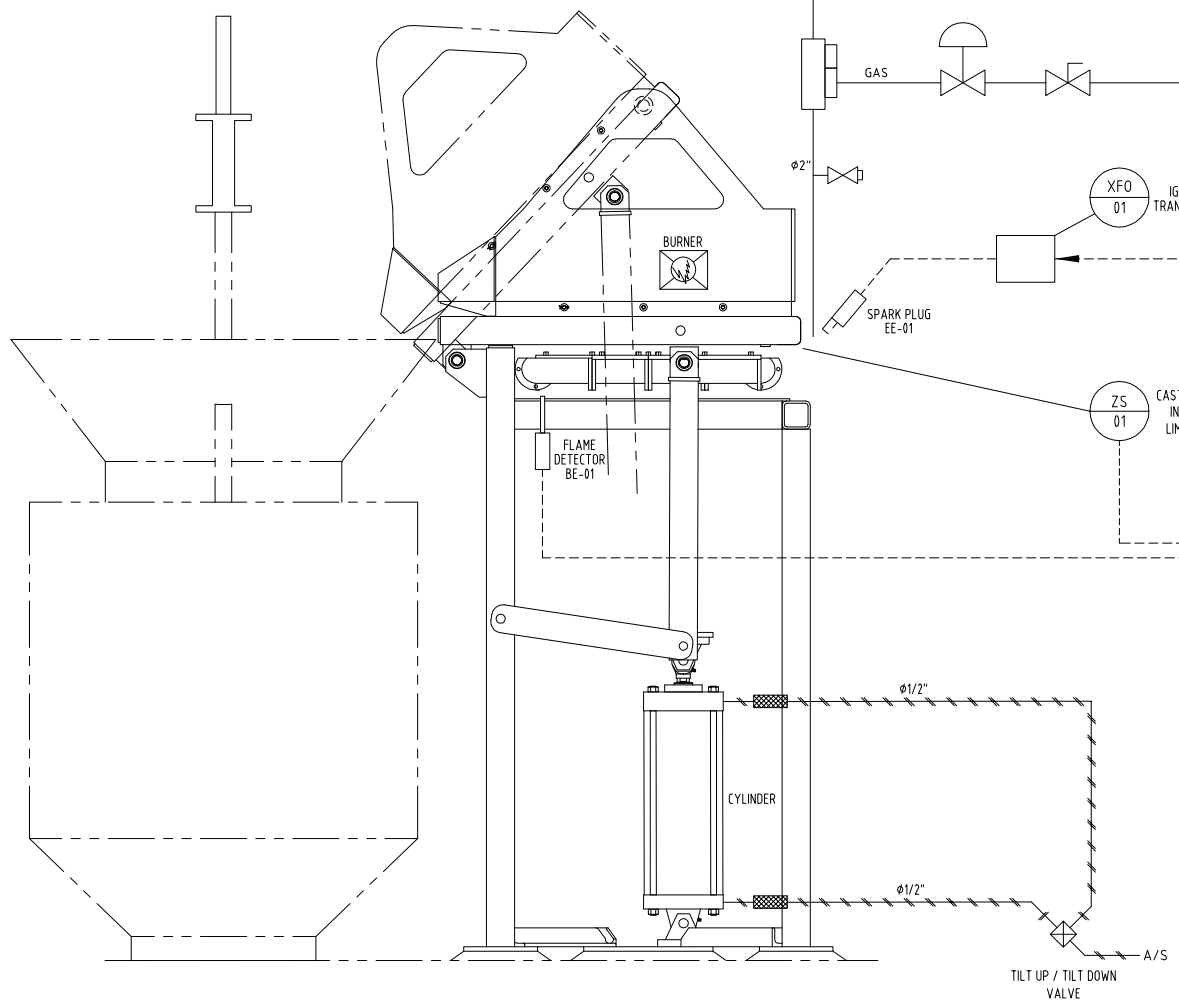
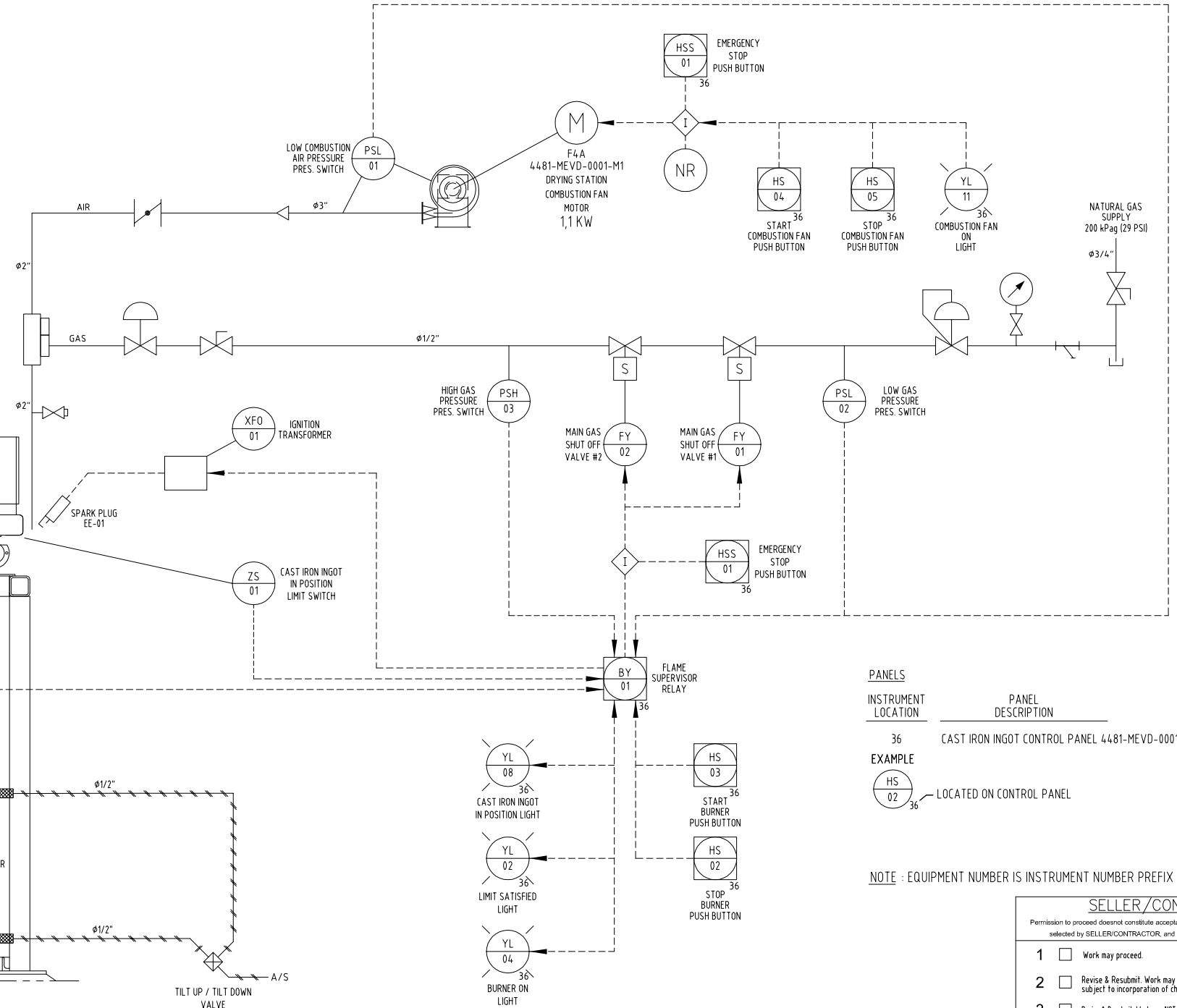
SIDE VIEW F4A
CAST IRON INGOT DRYING STATION
4481-MEVD-0001





PANELS

INSTRUMENT LOCATION	PANEL DESCRIPTION
36	CAST IRON INGOT CONTROL PANEL 4481-MEVD-0001-CP-01

EXAMPLE

HS 02 (36) — LOCATED ON CONTROL PANEL

NOTE : EQUIPMENT NUMBER IS INSTRUMENT NUMBER PREFIX

LEGEND

A/S	AIR SUPPLY
H/S	HYDRAULIC SUPPLY
ES/AC	ELECTRICAL SUPPLY 115Vac/480Vac
ES/DC	ELECTRICAL SUPPLY 24Vdc
I	INTERLOCK
I/O	PLC I/O
	ELECTRICAL SIGNAL
	NUMERIC SIGNAL
	HYDRAULIC SIGNAL
	PNEUMATIC SIGNAL

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DATE:	26/07/10	DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
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Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie / Engineering Department, 6400 Trans-Canada, Saint-Laurent, Québec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CAST IRON INGOT DRYING STATION A F4A
P & ID

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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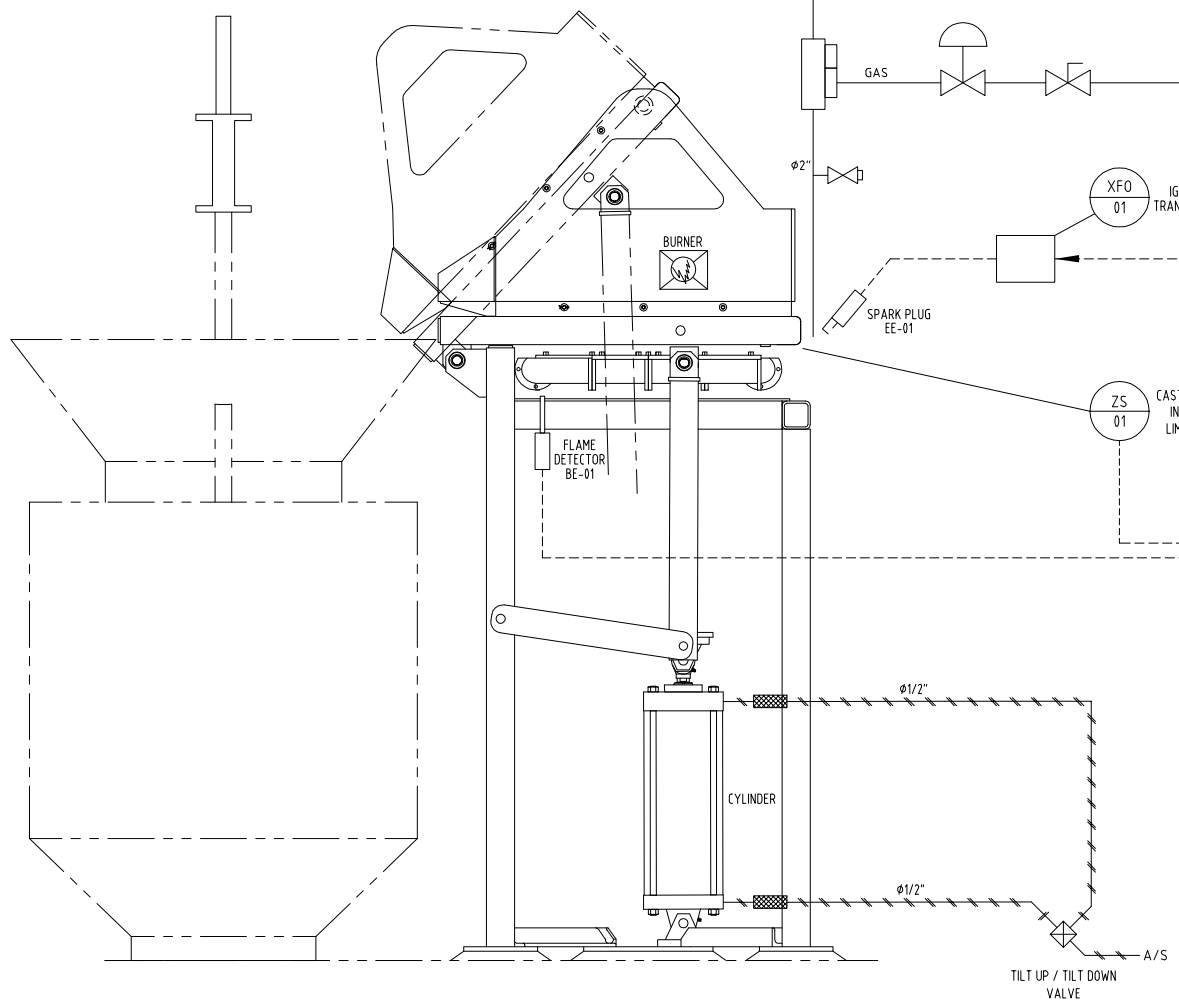
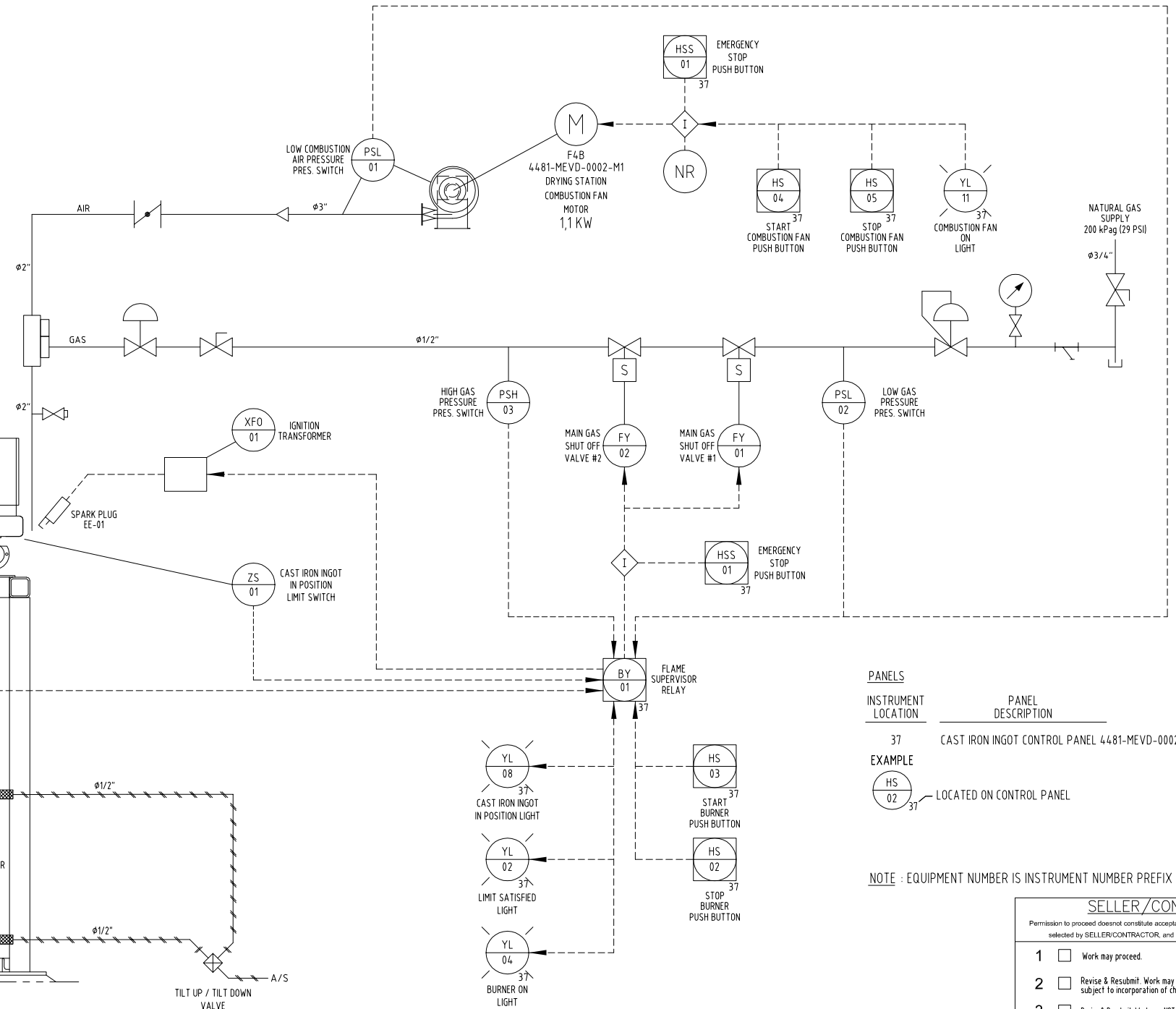
F4B CAST IRON INGOT DRYING STATION B
EQUIPMENT NUMBER : 4481-MEVD-0002

SIDE VIEW F4B
CAST IRON INGOT DRYING STATION
4481-MEVD-0002





PANELS

INSTRUMENT LOCATION	PANEL DESCRIPTION
37	CAST IRON INGOT CONTROL PANEL 4481-MEVD-0002-CP-01

EXAMPLE

HS 02 37 — LOCATED ON CONTROL PANEL

NOTE : EQUIPMENT NUMBER IS INSTRUMENT NUMBER PREFIX

LEGEND

A/S	AIR SUPPLY
H/S	HYDRAULIC SUPPLY
ES/AC	ELECTRICAL SUPPLY 115Vac/480Vac
ES/DC	ELECTRICAL SUPPLY 24Vdc
I	INTERLOCK
I/O	PLC I/O

ELECTRICAL SIGNAL
NUMERIC SIGNAL
HYDRAULIC SIGNAL
PNEUMATIC SIGNAL

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4 ☐ Revise not required. Work may proceed.
5 ☐ VOID / Superseded.

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BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
CAST IRON INGOT DRYING STATION B F4B
P & ID

MA'ADEN معادن

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx -	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—		—	—	A3-		-AZ	

9.12 Cable List

DRAWING No.	DESCRIPTION
1347-Cable List	Cable List

Ma'aden Aluminum Project

25457 RAS AZ ZAWR ALUMINIUM SMELTER PROJECT

Title:	**Cathode Sealing Equipment**	**Date (YY-MM-DD):**	**11-03-08**
Vendor Name:	GNA alutech	**System:**	
Revision No. :	**4**	**Document No.:**	25457-4481-V1A-MXA0-0319
MR No:	25457-4480-POA-MXA0-0001		

Cable List

Rev	Status	Facility	Cable Number	Equipment Number: Origin	Equipment Number: Destination	Service Level	Cable Code	Termination Drawing No.	Cable Supplied by	Installed by	Terminated by	Vendor Doc. No.	Construction Workpack Number	Cost Code	Estimated Total Length (meter)	Notes/Remarks
								C2 CHAIN CONVEYOR R9 CONICAL ROLLER	**UPSTREAM OF SHOTBLAST. CONVEYOR AT SHOTB.**	**MACHINE MACHINE ENTRANCE**	**4481-MHCD-0002 4481-MJR0-0001**					
0	C		4481-MHCD-0002-CP-01-J1	4481-MHCD-0003-CP-01	4481-MHCD-0002-CP-01	J	27CX1.5MM2	25457-4480-V1A-MXA0-0130	Bechtel	Bechtel	Bechtel					0232 , (0323 - PAGE 1,9,10)
4	C		4481-MHCD-0002-CP-03-J1	4481-MHCD-0002-CP-01	4481-MHCD-0002-CP-03	J	8CX1.5MM2	25457-4480-V1A-MXA0-0130	Bechtel	Bechtel	Bechtel					0323 - PAGE 7,14
0	C		4481-MJR0-0001-M1-J1	4481-CP-1000	4480-ECM1-0001	J	12CX1.5MM2	25457-4480-V1A-MXA0-0130	Bechtel	Bechtel	Bechtel					0235
0	C		4481-MHCD-0002-M1-J1	4481-CP-1000	4480-ECM1-0001	J	12CX1.5MM2	25457-4480-V1A-MXA0-0130	Bechtel	Bechtel	Bechtel					0234
0	C		4481-MJR0-0001-M1-J2	4480-ECM1-0001	4481-MJR0-0001-M1	J	1PX1.5MM2	25457-4480-V1A-MXA0-0130	Bechtel	Bechtel	Bechtel					0235
0	C		4481-MHCD-0002-LCS-01-J1	4480-ECM1-0001	4481-MHCD-0002-LCS-01	J	8CX1.5MM2	25457-4480-V1A-MXA0-0130	Bechtel	Bechtel	Bechtel					0235
0	C		4481-MHCD-0002-LCS-01-J2	4480-ECM1-0001	4481-MHCD-0002-LCS-01	J	8CX1.5MM2	25457-4480-V1A-MXA0-0130	Bechtel	Bechtel	Bechtel					0234
0	C		4481-MJR0-0001-M1-P1	4480-ECM1-0001	4481-MJR0-0001-M1-LDS	P	3C002CUGPC	25457-4480-V1A-MXA0-0130	Bechtel	Bechtel	Bechtel					0235
0	C		4481-MJR0-0001-M1-P3	4480-ECM1-0001	4481-MJR0-0001-M1-LDS	P	3C002CUGPC	25457-4480-V1A-MXA0-0130	Bechtel	Bechtel	Bechtel					0235
0	C		4481-MHCD-0002-M1-P1	4480-ECM1-0001	4481-MHCD-0002-M1-LDS	P	3C002CUGPA	25457-4480-V1A-MXA0-0130	Bechtel	Bechtel	Bechtel					0234
								S1 CATHODE BAR	**SHTBLASTING**	**MACHINE**	**4481-MZBP-0001**					
0	C		4481-MZBP-0001-M1-J1	4481-CP-1000	4480-ECM1-0001	J	12CX1.5MM2	25457-4480-V1A-MXA0-0131	Bechtel	Bechtel	Bechtel					0236
0	C		4481-MZBP-0001-M3-J1	4481-CP-1000	4480-ECM1-0001	J	12CX1.5MM2	25457-4480-V1A-MXA0-0131	Bechtel	Bechtel	Bechtel					0237
0	C		4481-MZBP-0001-M5-J1	4481-CP-1000	4480-ECM1-0001	J	12CX1.5MM2	25457-4480-V1A-MXA0-0131	Bechtel	Bechtel	Bechtel					0239
0	C		4481-MZBP-0001-M7-J1	4481-CP-1000	4480-ECM1-0001	J	12CX1.5MM2	25457-4480-V1A-MXA0-0131	Bechtel	Bechtel	Bechtel					0238
0	C		4481-MZBP-0001-LCS-01-J1	4480-ECM1-0001	4481-MZBP-0001-LCS-01	J	6CX1.5MM2	25457-4480-V1A-MXA0-0131	Bechtel	Bechtel	Bechtel					0236
0	C		4481-MZBP-0001-LCS-01-J2	4480-ECM1-0001	4481-MZBP-0001-LCS-01	J	6CX1.5MM2	25457-4480-V1A-MXA0-0131	Bechtel	Bechtel	Bechtel					0237
0	C		4481-MZBP-0001-LCS-01-J3	4480-ECM1-0001	4481-MZBP-0001-LCS-01	J	6CX1.5MM2	25457-4480-V1A-MXA0-0131	Bechtel	Bechtel	Bechtel					0238
0	C		4481-MZBP-0001-LCS-02-J1	4480-ECM1-0001	4481-MZBP-0001-LCS-02	J	6CX1.5MM2	25457-4480-V1A-MXA0-0131	Bechtel	Bechtel	Bechtel					0239
0	C		4481-MZBP-0001-M1-P1	4480-ECM1-0001	4481-MZBP-0001-M1-LDS	P	3C006CUGPA	25457-4480-V1A-MXA0-0131	Bechtel	Bechtel	Bechtel					0236
0	C		4481-MZBP-0001-M3-P1	4480-ECM1-0001	4481-MZBP-0001-M3-LDS	P	3C006CUGPA	25457-4480-V1A-MXA0-0131	Bechtel	Bechtel	Bechtel					0237
0	C		4481-MZBP-0001-M7-P1	4480-ECM1-0001	4481-MZBP-0001-M7-LDS	P	3C002CUGPA	25457-4480-V1A-MXA0-0131	Bechtel	Bechtel	Bechtel					0238
0	C		4481-MZBP-0001-M5-P1	4480-ECM1-0001	4481-MZBP-0001-M5-LDS	P	3C002CUGPA	25457-4480-V1A-MXA0-0131	Bechtel	Bechtel	Bechtel					0239
								S1 CATHODE BAR	**SHTBLASTING**	**MACHINE**	**4481-MZBP-0001**					
0	C		4481-MZBP-0001-JB-01-J1	4481-MHCD-0003-CP-01	4481-MZBP-0001-JB-01	J	20CX1.5MM2	25457-4480-V1A-MXA0-0132	Bechtel	Bechtel	Bechtel					0323 - PAGE 1,2,11,12
0	C		4481-MZBP-0001-M2-J1	4481-CP-1000	4480-ECM1-0001	J	12CX1.5MM2	25457-4480-V1A-MXA0-0132	Bechtel	Bechtel	Bechtel					0240
0	C		4481-MZBP-0001-M4-J1	4481-CP-1000	4480-ECM1-0001	J	12CX1.5MM2	25457-4480-V1A-MXA0-0132	Bechtel	Bechtel	Bechtel					0241
0	C		4481-MZBP-0001-M6-J1	4481-CP-1000	4480-ECM1-0001	J	12CX1.5MM2	25457-4480-V1A-MXA0-0132	Bechtel	Bechtel	Bechtel					0242
0	C		4481-MZBP-0001-M6-J2	4480-ECM1-0001	4481-MZBP-0001-M6	J	1PX1.5MM2	25457-4480-V1A-MXA0-0132	Bechtel	Bechtel	Bechtel					0242
0	C		4481-MZBP-0001-LCS-03-J1	4480-ECM1-0001	4481-MZBP-0001-LCS-03	J	6CX1.5MM2	25457-4480-V1A-MXA0-0132	Bechtel	Bechtel	Bechtel					0240
0	C		4481-MZBP-0001-LCS-03-J2	4480-ECM1-0001	4481-MZBP-0001-LCS-03	J	6CX1.5MM2	25457-4480-V1A-MXA0-0132	Bechtel	Bechtel	Bechtel					0241
0	C		4481-MZBP-0001-LCS-03-J3	4480-ECM1-0001	4481-MZBP-0001-LCS-03	J	6CX1.5MM2	25457-4480-V1A-MXA0-0132	Bechtel	Bechtel	Bechtel					0242
0	C		4481-MZBP-0001-M2-P1	4480-ECM1-0001	4481-MZBP-0001-M2-LDS	P	3C006CUGPA	25457-4480-V1A-MXA0-0132	Bechtel	Bechtel	Bechtel					0240
0	C		4481-MZBP-0001-M4-P1	4480-ECM1-0001	4481-MZBP-0001-M4-LDS	P	3C006CUGPA	25457-4480-V1A-MXA0-0132	Bechtel	Bechtel	Bechtel					0241
0	C		4481-MZBP-0001-M6-P1	4480-ECM1-0001	4481-MZBP-0001-M6-LDS	P	3C002CUGPC	25457-4480-V1A-MXA0-0132	Bechtel	Bechtel	Bechtel					0242
								D1 DUST COLLECTOR	**FOR SHOTBLASTING**	**MACHINE**	**4481-MKBB-0001**					
2	C		4481-MKBB-0001-JB-01-J1	4481-MHCD-0003-CP-01	4481-MKBB-0001-JB-01	J	4CX1.5MM2	25457-4480-V1A-MXA0-0133	Bechtel	Bechtel	Bechtel					0104
0	C		4481-MACO-0001-M1-J1	4481-CP-1000	4480-ECM1-0001	J	12CX1.5MM2	25457-4480-V1A-MXA0-0133	Bechtel	Bechtel	Bechtel					0243
0	C		4481-MACO-0001-LCS-01-J1	4480-ECM1-0001	4481-MACO-0001-LCS-01	J	6CX1.5MM2	25457-4480-V1A-MXA0-0133	Bechtel	Bechtel	Bechtel					0243
0	C		4481-MACO-0001-M1-P1	4480-ECM1-0001	4481-MACO-0001-M1-LDS	P	3C004CUGPA	25457-4480-V1A-MXA0-0133	Bechtel	Bechtel	Bechtel					0243
								R8 CONICAL ROLLER C3 CHAIN CONVEYOR R7 ROLLER CONVEYOR	**CONV. AT SHOTBLAST. BETWEEN SHOTBLAST. AT BAR FURNACE**	**MACHINE EXIT MACHINE & OVEN ENTRANCE**	**4481-MJR0-0002 4481-MHCD-0003 4481-MJRO-0003**					
0	C		4481-MHCD-0003-CP-01-J1	4481-MHCD-0003-CP-01	4481-MQLK-0001-CP-01	J	1ETH	25457-4480-V1A-MXA0-0134	Bechtel	Bechtel	Bechtel					0122
0	C		4481-MHCD-0003-CP-01-J2	4481-MHCD-0003-CP-01	4481-CP-1000	J	6CX1.5MM2	25457-4480-V1A-MXA0-0134	Bechtel	Bechtel	Bechtel					0232
0	C		4481-MHCD-0003-CP-01-P1	4480-ECM1-0001	4481-MHCD-0003-CP-01	P	3C002CUGPA	25457-4480-V1A-MXA0-0134	Bechtel	Bechtel	Bechtel					0376
0	C		4481-MJR0-0002-M1-J1	4481-CP-1000	4480-ECM1-0001	J	12CX1.5MM2	25457-4480-V1A-MXA0-0134	Bechtel	Bechtel	Bechtel					0244
0	C		4481-MJR0-0002-M1-J2	4480-ECM1-0001	4481-MJR0-0002-M1	J	1PX1.5MM2	25457-4480-V1A-MXA0-0134	Bechtel	Bechtel	Bechtel					0244
0	C		4481-MHCD-0003-M1-J1	4481-CP-1000	4480-ECM1-0001	J	12CX1.5MM2	25457-4480-V1A-MXA0-0134	Bechtel	Bechtel	Bechtel					0245
0	C		4481-MHCD-0003-M1-J2	4480-ECM1-0001	4481-MHCD-0003-M1	J	1PX1.5MM2	25457-4480-V1A-MXA0-0134	Bechtel	Bechtel	Bechtel					0245
0	C		4481-MJR0-0003-M1-J1	4481-CP-1000	4480-ECM1-0001	J	12CX1.5MM2	25457-4480-V1A-MXA0-0134	Bechtel	Bechtel	Bechtel					0246
0	C		4481-MHCD-0003-LCS-01-J1	4480-ECM1-0001	4481-MHCD-0003-LCS-01	J	8CX1.5MM2	25457-4480-V1A-MXA0-0134	Bechtel	Bechtel	Bechtel					0244
0	C		4481-MHCD-0003-LCS-01-J2	4480-ECM1-0001	4481-MHCD-0003-LCS-01	J	8CX1.5MM2	25457-4480-V1A-MXA0-0134	Bechtel	Bechtel	Bechtel					0245
0	C		4481-MHCD-0003-LCS-01-J3	4480-ECM1-0001	4481-MHCD-0003-LCS-01	J	8CX1.5MM2	25457-4480-V1A-MXA0-0134	Bechtel	Bechtel	Bechtel					0246
0	C		4481-MJR0-0002-M1-P1	4480-ECM1-0001	4481-MJR0-0002-M1-LDS	P	3C002CUGPC	25457-4480-V1A-MXA0-0134	Bechtel	Bechtel	Bechtel					0244
0	C		4481-MJR0-0002-M1-P3	4480-ECM1-0001	4481-MJR0-0002-M1-LDS	P	3C002CUGPC	25457-4480-V1A-MXA0-0134	Bechtel	Bechtel	Bechtel					0244
0	C		4481-MHCD-0003-M1-P1	4480-ECM1-0001	4481-MHCD-0003-M1-LDS	P	3C002CUGPC	25457-4480-V1A-MXA0-0134	Bechtel	Bechtel	Bechtel					0245
0	C		4481-MJR0-0003-M1-P1	4480-ECM1-0001	4481-MJR0-0003-M1-LDS	P	3C002CUGPA	25457-4480-V1A-MXA0-0134	Bechtel	Bechtel	Bechtel					0246
								F2 CATHODE BAR	**HEATING**	**FURNACE**	**4481-MBMB-0001**					
0	C		4481-MBMB-0001-CP-01-J1	4481-MHCD-0003-CP-01	4481-MBMB-0001-CP-01	J	27CX1.5MM2	25457-4480-V1A-MXA0-0135	Bechtel	Bechtel	Bechtel				0323 - PAGE 4,5	
0	C		4481-MBMB-0001-CP-01-J2	4481-MHCD-0003-CP-01	4481-MBMB-0001-CP-01	J	8CX1.5MM2	25457-4480-V1A-MXA0-0135	Bechtel	Bechtel	Bechtel				0323 - PAGE 13,14	
0	C		4481-MBMB-0001-M1-J1	4481-CP-1000	4480-ECM1-0001	J	12CX1.5MM2	25457-4480-V1A-MXA0-0135	Bechtel	Bechtel	Bechtel				0247	
0	C		4481-MBMB-0001-M1-J2	4480-ECM1-0001	4481-MBMB-0001-M1	J	1PX1.5MM2	25457-4480-V1A-MXA0-0135	Bechtel	Bechtel	Bechtel				0247	
0	C		4481-MBMB-0001-M2-J1	4481-CP-1000	4480-ECM1-0001	J	12CX1.5MM2	25457-4480-V1A-MXA0-0135	Bechtel	Bechtel	Bechtel				0248	
0	C		4481-MBMB-0001-M2-J2	4480-ECM1-0001	4481-MBMB-0001-M2	J	1PX1.5MM2	25457-4480-V1A-MXA0-0135	Bechtel	Bechtel	Bechtel				0248	
0	C		4481-MBMB-0001-LCS-01-J1	4480-ECM1-0001	4481-MBMB-0001-LCS-01	J	8CX1.5MM2	25457-4480-V1A-MXA0-0135	Bechtel	Bechtel	Bechtel				0247	
0	C		4481-MBMB-0001-LCS-02-J1	4480-ECM1-0001	4481-MBMB-0001-LCS-02	J	8CX1.5MM2	25457-4480-V1A-MXA0-0135	Bechtel	Bechtel	Bechtel				0248	
0	C		4481-MBMB-0001-M1-P1	4480-ECM1-0001	4481-MBMB-0001-M1-LDS	P	3C002CUGPC	25457-4480-V1A-MXA0-0135	Bechtel	Bechtel	Bechtel				0247	
0	C		4481-MBMB-0001-M1-P3	4480-ECM1-0001	4481-MBMB-0001-M1-LDS	P	3C002CUGPC	25457-4480-V1A-MXA0-0135	Bechtel	Bechtel	Bechtel				0247	
0	C		4481-MBMB-0001-M2-P1	4480-ECM1-0001	4481-MBMB-0001-M2-LDS	P	3C002CUGPC	25457-4480-V1A-MXA0-0135	Bechtel	Bechtel	Bechtel				0248	
0	C		4481-MBMB-0001-M2-P3	4480-ECM1-0001	4481-MBMB-0001-M2-LDS	P	3C002CUGPC	25457-4480-V1A-MXA0-0135	Bechtel	Bechtel	Bechtel				0248	
								F2 CATHODE BAR	**HEATING**	**FURNACE**	**4481-MBMB-0001**					
0	C		4481-MBMB-0001-CP-02-J1	4481-MHCD-0003-CP-01	4481-MBMB-0001-CP-02	J	20CX1.5MM2	25457-4480-V1A-MXA0-0136	Bechtel	Bechtel	Bechtel				0323 - PAGE 5,6	
0	C		4481-MBMB-0001-CP-02-J2	4481-MHCD-0003-CP-01	4481-MBMB-0001-CP-02	J	8CX1.5MM2	25457-4480-V1A-MXA0-0136	Bechtel	Bechtel	Bechtel				0323 - PAGE 15,16	
0	C		4481-MBMB-0001-M3-J1	4481-CP-1000	4480-ECM1-0001	J	12CX1.5MM2	25457-4480-V1A-MXA0-0136	Bechtel	Bechtel	Bechtel				0249	
0	C		4481-MBMB-0001-M3-J2	4480-ECM1-0001	4481-MBMB-0001-M3	J	1PX1.5MM2	25457-4480-V1A-MXA0-0136	Bechtel	Bechtel	Bechtel				0249	
0	C		4481-MBMB-0001-M4-J1	4481-CP-1000	4480-ECM1-0001	J	12CX1.5MM2	25457-4480-V1A-MXA0-0136	Bechtel	Bechtel	Bechtel				0250	
0	C		4481-MBMB-0001-M4-J2	4480-ECM1-0001	4481-MBMB-0001-M4	J	1PX1.5MM2	25457-4480-V1A-MXA0-0136	Bechtel	Bechtel	Bechtel				0250	
0	C		4481-MBMB-0001-LCS-03-J1	4480-ECM1-0001	4481-MBMB-0001-LCS-03	J	8CX1.5MM2	25457-4480-V1A-MXA0-0136	Bechtel	Bechtel	Bechtel				0249	
0	C		4481-MBMB-0001-LCS-04-J1	4480-ECM1-0001	4481-MBMB-0001-LCS-04	J	8CX1.5MM2	25457-4480-V1A-MXA0-0136	Bechtel	Bechtel	Bechtel				0250	
0	C		4481-MBMB-0001-M3-P1	4480-ECM1-0001	4481-MBMB-0001-M3-LDS	P	3C002CUGPC	25457-4480-V1A-MXA0-0136	Bechtel	Bechtel	Bechtel				0249	
0	C		4481-MBMB-0001-M3-P3	4480-ECM1-0001	4481-MBMB-0001-M3-LDS	P	3C002CUGPC	25457-4480-V1A-MXA0-0136	Bechtel	Bechtel	Bechtel				0249	
0	C		4481-MBMB-0001-M4-P1	4480-ECM1-0001	4481-MBMB-0001-M4-LDS	P	3C002CUGPC	25457-4480-V1A-MXA0-0136	Bechtel	Bechtel	Bechtel				0250	
0	C		4481-MBMB-0001-M4-P3	4480-ECM1-0001	4481-MBMB-0001-M4-LDS	P	3C002CUGPC	25457-4480-V1A-MXA0-0136	Bechtel	Bechtel	Bechtel				0250	
								F2 CATHODE BAR	**HEATING**	**FURNACE**	**4481-MBMB-0001**					
3	C		4481-MBMB-0001-JB-01-J1	4481-CP-1001	4481-MBMB-0001-JB-01	J	1KX1MM2	25457-4480-V1A-MXA0-0137	Bechtel	Bechtel	Bechtel				0233	
3	C		4481-MBMB-0001-JB-01-J2	4481-CP-1001	4481-MBMB-0001-JB-01	J	1KX1MM2	25457-4480-V1A-MXA0-0137	Bechtel	Bechtel	Bechtel				0233	
3	C		4481-MBMB-0001-JB-01-J3	4481-CP-1001	4481-MBMB-0001-JB-01	J	1KX1MM2	25457-4480-V1A-MXA0-0137	Bechtel	Bechtel	Bechtel				0233	
3	C		4481-MBMB-0001-JB-01-J4	4481-CP-1001	4481-MBMB-0001-JB-01	J	1KX1MM2	25457-4480-V1A-MXA0-0137	Bechtel	Bechtel	Bechtel				0233	
3	C		4481-MBMB-0001-JB-01-J5	4481-CP-1001	4481-MBMB-0001-JB-01	J	1KX1MM2	25457-4480-V1A-MXA0-0137	Bechtel	Bechtel	Bechtel				0233	
0	C		4481-MBMB-0001-JB-02-J2	4481-MBMB-0001-JB-02	4481-MHCD-0003-CP-01	J	8PX1.5MM2	25457-4480-V1A-MXA0-0137	Bechtel	Bechtel	Bechtel				0323 - PAGE 7	
0	C		4480-EVR3-0001-P1	4480-ECM1-0001	4480-EVR3-0001	P	3C002CUGPA	25457-4480-V1A-MXA0-0137	Bechtel	Bechtel	Bechtel				0375	
0	C		4480-EVR3-0001-J1	4481-CP-1000	4480-EVR3-0001	J	8PX1.5MM2	25457-4480-V1A-MXA0-0137	Bechtel	Bechtel	Bechtel				0320 - PAGE 42	
3	C		4480-EVR3-0001-J2	4481-CP-1000	4480-EVR3-0001	J	6CX1.5MM2	25457-4480-V1A-MXA0-0137	Bechtel	Bechtel	Bechtel				0320 - PAGE 33	
0	C		4481-MBMB-0001-JB-11-P1	4480-EVR3-0001	4481-MBMB-0001-JB-11	P	3C185ALGPA	25457-4480-V1A-MXA0-0137	Bechtel	Bechtel	Bechtel				0373 / 2 RUNS 3x185mm2 AL. + G. COPPER	
0	C		4481-MBMB-0001-JB-12-P1	4480-EVR3-0001	4481-MBMB-0001-JB-12	P	3C185ALGPA	25457-4480-V1A-MXA0-0137	Bechtel	Bechtel	Bechtel				0373 / 2 RUNS 3x185mm2 AL. + G. COPPER	
0	C		4481-MBMB-0001-JB-13-P1	4480-EVR3-0001	4481-MBMB-0001-JB-13	P	3C185ALGPA	25457-4480-V1A-MXA0-0137	Bechtel	Bechtel	Bechtel				0374 / 2 RUNS 3x185mm2 AL. + G. COPPER	
0	C		4481-MBMB-0001-JB-14-P1	4480-EVR3-0001	4481-MBMB-0001-JB-14	P	3C185ALGPA	25457-4480-V1A-MXA0-0137	Bechtel	Bechtel	Bechtel				0374 / 2 RUNS 3x185mm2 AL. + G. COPPER	
								R6 ROLLER CONVEYOR	**AT BAR FURNACE**	**EXIT**	**4481-MJR0-0004**					
0	C		4481-MJR0-0004-JB-01-J1	4481-MQLK-0001-CP-01	4481-MJR0-0004-JB-01	J	20CX1.5MM2	25457-4480-V1A-MXA0-0138	Bechtel	Bechtel	Bechtel				0322 - PAGE 1,16	
0	C		4481-MJR0-0004-M1-J1	4481-CP-1000	4480-ECM1-0001	J	12CX1.5MM2	25457-4480-V1A-MXA0-0138	Bechtel	Bechtel	Bechtel				0292	
0	C		4481-MJR0-0004-M1-J2	4480-ECM1-0001	4481-MJR0-0004-M1	J	1PX1.5MM2	25457-4480-V1A-MXA0-0138	Bechtel	Bechtel	Bechtel				0292	
0	C		4481-MQLK-0001-LCS-01-J1	4480-ECM1-0001	4481-MQLK-0001-LCS-01	J	8CX1.5MM2	25457-4480-V1A-MXA0-0138	Bechtel	Bechtel	Bechtel				0292	
0	C		4481-MJR0-0004-M1-P1	4480-ECM1-0001	4481-MJR0-0004-M1-LDS	P	3C002CUGPC	25457-4480-V1A-MXA0-0138	Bechtel	Bechtel	Bechtel				0292	
								G1 POSITIONING GANTRY	**FOR BLOCK AND**	**BARS**	**4481-MQLK-0001**					
0	C		4481-MQLK-0001-JB-01-J1	4481-MQLK-0001-CP-01	4481-MQLK-0001-JB-01	J	12CX1.5MM2	25457-4480-V1A-MXA0-0139	Bechtel	Bechtel	Bechtel				0322 - PAGE 2,16	
0	C		4481-MQLK-0001-M1-J1	4481-CP-1000	4480-ECM1-0001	J	12CX1.5MM2	25457-4480-V1A-MXA0-0139	Bechtel	Bechtel	Bechtel				0293	
0	C		4481-MQLK-0001-LCS-01-J2	4480-ECM1-0001	4481-MQLK-0001-LCS-01	J	8CX1.5MM2	25457-4480-V1A-MXA0-0139	Bechtel	Bechtel	Bechtel				0293	
0	C		4481-MQLK-0001-M1-LDS-J2	4480-ECM1-0001	4481-MQLK-0001-M1-LDS	J	2PX1.5MM2	25457-4480-V1A-MXA0-0139	Bechtel	Bechtel	Bechtel				0293	
0	C		4481-MQLK-0001-CP-01-P1	4480-ECM1-0001	4481-MQLK-0001-CP-01	P	3C002CUGPA	25457-4480-V1A-MXA0-0139	Bechtel	Bechtel	Bechtel				0376	
0	C		4481-MQLK-0001-CP-01-J2	4481-CP-1000	4481-MQLK-0001-CP-01	J	6CX1.5MM2	25457-4480-V1A-MXA0-0139	Bechtel	Bechtel	Bechtel				0289	
1	C		4481-MQLK-0001-M1-P1	4480-ECM1-0001	4481-MQLK-0001-M1-LDS	P	3C002CUGPC	25457-4480-V1A-MXA0-0139	Bechtel	Bechtel	Bechtel				0293	
1	C		4481-MQLK-0001-M1-P2	4480-ECM1-0001	4481-MQLK-0001-M1-LDS	P	3C002CUGPC	25457-4480-V1A-MXA0-0139	Bechtel	Bechtel	Bechtel				0293	
1	C		4481-MQLK-0001-M1-P3	4480-ECM1-0001	4481-MQLK-0001-M1-LDS	P	3C002CUGPC	25457-4480-V1A-MXA0-0139	Bechtel	Bechtel	Bechtel				0293	
								C1 CHAIN CONVEYOR F1 CATHODE	**OF BLOCK**	**BLOCK**	**OVEN OVEN**	**4481-MHCD-0001 4481-MEEP-0001**				
3	C		4481-MEEP-0001-JB-01-J1	4481-CP-1001	4481-MEEP-0001-JB-01	J	1KX1MM2	25457-4480-V1A-MXA0-0140	Bechtel		Bechtel				0233	
0	C		4481-MEEP-0001-JB-01-J2	4481-MQLK-0001-CP-01	4481-MEEP-0001-JB-01	J	2PX1.5MM2	25457-4480-V1A-MXA0-0140	Bechtel		Bechtel				0322 - PAGE 9	
0	C		4481-MEEP-0001-JB-01-J3	4481-MQLK-0001-CP-01	4481-MEEP-0001-JB-01	J	27CX1.5MM2	25457-4480-V1A-MXA0-0140	Bechtel		Bechtel				0289 , (0322 - PAGE 5,6)	
0	C		4481-MEEP-0001-JB-01-J4	4481-MQLK-0001-CP-01	4481-MEEP-0001-JB-01	J	8CX1.5MM2	25457-4480-V1A-MXA0-0140	Bechtel		Bechtel				0322 - PAGE 13	
3	C		4481-MEEP-0001-JB-01-J5	4481-CP-1001	4481-MEEP-0001-JB-01	J	1KX1MM2	25457-4480-V1A-MXA0-0140	Bechtel		Bechtel				0233	
4	C		4481-MHCD-0001-CP-02-J1	4481-MEEP-0001-JB-01	4481-MHCD-0002-CP-02	J	8CX1.5MM2	25457-4480-V1A-MXA0-0140	Bechtel		Bechtel				0322 - PAGE 5,13	
0	C		4481-MQLK-0001-CP-01-J1	4481-CP-1001	4481-MQLK-0001-CP-01	J	1ETH	25457-4480-V1A-MXA0-0140	Bechtel		Bechtel				0122	
0	C		4480-EVR3-0002-J1	4481-CP-1000	4480-EVR3-0002	J	4PX1.5MM2	25457-4480-V1A-MXA0-0140	Bechtel		Bechtel				0320 - PAGE 41	
0	C		4480-EVR3-0002-J2	4481-CP-1000	4480-EVR3-0002	J	6CX1.5MM2	25457-4480-V1A-MXA0-0140	Bechtel		Bechtel				0320 - PAGE 33	
0	C		4481-CP-1001-P1	4480-ECM1-0001	4481-CP-1001	P	3C002CUGPA	25457-4480-V1A-MXA0-0140	Bechtel		Bechtel				0375	
0	C		4481-CP-1000-P1	4480-ECM1-0001	4481-CP-1000	P	3C002CUGPA	25457-4480-V1A-MXA0-0140	Bechtel		Bechtel				0375	
0	C		4481-CP1000-P2	4480-ECM1-0001	4481-CP-1000	P	3C002CUGPA	25457-4480-V1A-MXA0-0140	Bechtel		Bechtel				0375	
0	C		4480-EVR3-0002-P1	4480-ECM1-0001	4480-EVR3-0002	P	3C002CUGPA	25457-4480-V1A-MXA0-0140	Bechtel		Bechtel				0375	
0	C		4481-MEEP-0001-JB-11-P1	4480-EVR3-0002	4481-MEEP-0001-JB-11	P	3C120ALGPA	25457-4480-V1A-MXA0-0140	Bechtel		Bechtel				0371 / 2 RUNS 3x120mm2 AL. + G. COPPER	
0	C		4481-MEEP-0001-JB-12-P1	4480-EVR3-0002	4481-MEEP-0001-JB-12	P	3C120ALGPA	25457-4480-V1A-MXA0-0140	Bechtel		Bechtel				0371 / 2 RUNS 3x120mm2 AL. + G. COPPER	
0	C		4481-MEEP-0001-JB-13-P1	4480-EVR3-0002	4481-MEEP-0001-JB-13	P	3C120ALGPA	25457-4480-V1A-MXA0-0140	Bechtel		Bechtel				0372 / 2 RUNS 3x120mm2 AL. + G. COPPER	
								C1 CHAIN CONVEYOR F1 CATHODE	**OF BLOCK**	**BLOCK**	**OVEN OVEN**	**4481-MHCD-0001 4481-MEEP-0001**				
3	C		4481-MEEP-0001-JB-03-J1	4481-CP-1001	4481-MEEP-0001-JB-03	J	1KX1MM2	25457-4480-V1A-MXA0-0141	Bechtel		Bechtel				0233	
0	C		4481-MEEP-0001-JB-03-J2	4481-MQLK-0001-CP-01	4481-MEEP-0001-JB-03	J	4PX1.5MM2	25457

								R2 ROLLER CONVEYOR	**FOR BLOCK AND**	**BAR ASSEMBLY**	**4481-MJR0-0007**							
0	C		4481-MJR0-0007-JB-01-J1	4481-MQLK-0001-CP-01	4481-MJR0-0007-JB-01	J	20CX1.5MM2	25457-4480-V1A-MXAO-0143	Bechtel	Bechtel	Bechtel							0322 - PAGE 4,14
0	C		4481-MJR0-0007-M1-J1	4481-CP-1000	4480-ECM1-0001	J	12CX1.5MM2	25457-4480-V1A-MXAO-0143	Bechtel	Bechtel	Bechtel							0300
0	C		4481-MJR0-0007-M1-J2	4480-ECM1-0001	4481-MJR0-0007-M1	J	1PX1.5MM2	25457-4480-V1A-MXAO-0143	Bechtel	Bechtel	Bechtel							0300
0	C		4481-MQLK-0001-LCS-01-J3	4480-ECM1-0001	4481-MQLK-0001-LCS-01	J	8CX1.5MM2	25457-4480-V1A-MXAO-0143	Bechtel	Bechtel	Bechtel							0300
0	C		4481-MJR0-0007-M1-P1	4480-ECM1-0001	4481-MJR0-0007-M1-LDS	P	3C002CUGPC	25457-4480-V1A-MXAO-0143	Bechtel	Bechtel	Bechtel							0300
								R4A PRESTRESSING &	**SEALING STATION**	**CONVEYOR A**	**4481-MZAC-0001**							
0	C		4481-MZAC-0001-CP-01-J1	4481-CP-1001	4481-MZAC-0001-CP-01	J	20CX1.5MM2	25457-4480-V1A-MXAO-0144	Bechtel	Bechtel	Bechtel							0321 - PAGE 1,2
0	C		4481-MZAC-0001-CP-01-J3	4481-CP-1001	4481-MZAC-0001-CP-01	J	12CX1.5MM2	25457-4480-V1A-MXAO-0144	Bechtel	Bechtel	Bechtel							0321 - PAGE 7,8
0	C		4481-MZAC-0001-CP-02-J1	4481-MZAC-0001-CP-01	4481-MZAC-0001-CP-02	J	3CX1.5MM2	25457-4480-V1A-MXAO-0144	Bechtel	Bechtel	Bechtel							0290
0	C		4481-MZAC-0001-CP-03-J1	4481-MZAC-0001-CP-02	4481-MZAC-0001-CP-03	J	3CX1.5MM2	25457-4480-V1A-MXAO-0144	Bechtel	Bechtel	Bechtel							0290
0	C		4481-MZAC-0001-M1-J1	4481-CP-1000	4480-ECM1-0001	J	12CX1.5MM2	25457-4480-V1A-MXAO-0144	Bechtel	Bechtel	Bechtel							0301
0	C		4481-MZAC-0001-M1-J2	4480-ECM1-0001	4481-MZAC-0001-M1	J	1PX1.5MM2	25457-4480-V1A-MXAO-0144	Bechtel	Bechtel	Bechtel							0301
0	C		4481-MZAC-0001-LCS-01-J1	4480-ECM1-0001	4481-MZAC-0001-LCS-01	J	12CX1.5MM2	25457-4480-V1A-MXAO-0144	Bechtel	Bechtel	Bechtel							0301
0	C		4481-MZAC-0001-M1-P1	4480-ECM1-0001	4481-MZAC-0001-M1-LDS	P	3C002CUGPC	25457-4480-V1A-MXAO-0144	Bechtel	Bechtel	Bechtel							0301
0	C		4481-MZAC-0001-TRS-1-J1	4481-MZAC-0001-CP-01	4481-MZAC-0001-TRS-1	J	5CX1.5MM2	25457-4480-V1A-MXAO-0144	GNA	GNA	Bechtel							0290
0	C		4481-MZAC-0001-REC-1-J1	4481-MZAC-0001-CP-01	4481-MZAC-0001-REC-1	J	5CX1.5MM2	25457-4480-V1A-MXAO-0144	GNA	GNA	Bechtel							0290
0	C		4481-MZAC-0001-TRS-2-J1	4481-MZAC-0001-CP-01	4481-MZAC-0001-TRS-2	J	5CX1.5MM2	25457-4480-V1A-MXAO-0144	GNA	GNA	Bechtel							0290
0	C		4481-MZAC-0001-REC-2-J1	4481-MZAC-0001-CP-01	4481-MZAC-0001-REC-2	J	5CX1.5MM2	25457-4480-V1A-MXAO-0144	GNA	GNA	Bechtel							0290
0	C		4481-MZAC-0001-TRS-3-J1	4481-MZAC-0001-CP-01	4481-MZAC-0001-TRS-3	J	5CX1.5MM2	25457-4480-V1A-MXAO-0144	GNA	GNA	Bechtel							0290
0	C		4481-MZAC-0001-REC-3-J1	4481-MZAC-0001-CP-01	4481-MZAC-0001-REC-3	J	5CX1.5MM2	25457-4480-V1A-MXAO-0144	GNA	GNA	Bechtel							0290
								R4B PRESTRESSING &	**SEALING STATION**	**CONVEYOR B**	**4481-MZAC-0002**							
0	C		4481-MZAC-0002-CP-01-J1	4481-CP-1001	4481-MZAC-0002-CP-01	J	20CX1.5MM2	25457-4480-V1A-MXAO-0145	Bechtel	Bechtel	Bechtel							0321 - PAGE 3,4
0	C		4481-MZAC-0002-CP-01-J3	4481-CP-1001	4481-MZAC-0002-CP-01	J	12CX1.5MM2	25457-4480-V1A-MXAO-0145	Bechtel	Bechtel	Bechtel							0321 - PAGE 9,10
0	C		4481-MZAC-0002-CP-02-J1	4481-MZAC-0002-CP-01	4481-MZAC-0002-CP-02	J	3CX1.5MM2	25457-4480-V1A-MXAO-0145	Bechtel	Bechtel	Bechtel							0291
0	C		4481-MZAC-0002-CP-03-J1	4481-MZAC-0002-CP-02	4481-MZAC-0002-CP-03	J	3CX1.5MM2	25457-4480-V1A-MXAO-0145	Bechtel	Bechtel	Bechtel							0291
0	C		4481-MZAC-0002-M1-J1	4481-CP-1000	4480-ECM1-0001	J	12CX1.5MM2	25457-4480-V1A-MXAO-0145	Bechtel	Bechtel	Bechtel							0302
0	C		4481-MZAC-0002-M1-J2	4480-ECM1-0001	4481-MZAC-0002-M1	J	1PX1.5MM2	25457-4480-V1A-MXAO-0145	Bechtel	Bechtel	Bechtel							0302
0	C		4481-MZAC-0002-LCS-01-J1	4480-ECM1-0001	4481-MZAC-0002-LCS-01	J	12CX1.5MM2	25457-4480-V1A-MXAO-0145	Bechtel	Bechtel	Bechtel							0302
0	C		4481-MZAC-0002-M1-P1	4480-ECM1-0001	4481-MZAC-0002-M1-LDS	P	3C002CUGPC	25457-4480-V1A-MXAO-0145	Bechtel	Bechtel	Bechtel							0302
0	C		4481-MZAC-0002-TRS-1-J1	4481-MZAC-0002-CP-01	4481-MZAC-0002-TRS-1	J	5CX1.5MM2	25457-4480-V1A-MXAO-0144	GNA	GNA	Bechtel							0291
0	C		4481-MZAC-0002-REC-1-J1	4481-MZAC-0002-CP-01	4481-MZAC-0002-REC-1	J	5CX1.5MM2	25457-4480-V1A-MXAO-0144	GNA	GNA	Bechtel							0291
0	C		4481-MZAC-0002-TRS-2-J1	4481-MZAC-0002-CP-01	4481-MZAC-0002-TRS-2	J	5CX1.5MM2	25457-4480-V1A-MXAO-0144	GNA	GNA	Bechtel							0291
0	C		4481-MZAC-0002-REC-2-J1	4481-MZAC-0002-CP-01	4481-MZAC-0002-REC-2	J	5CX1.5MM2	25457-4480-V1A-MXAO-0144	GNA	GNA	Bechtel							0291
0	C		4481-MZAC-0002-TRS-3-J1	4481-MZAC-0002-CP-01	4481-MZAC-0002-TRS-3	J	5CX1.5MM2	25457-4480-V1A-MXAO-0144	GNA	GNA	Bechtel							0291
0	C		4481-MZAC-0002-REC-3-J1	4481-MZAC-0002-CP-01	4481-MZAC-0002-REC-3	J	5CX1.5MM2	25457-4480-V1A-MXAO-0144	GNA	GNA	Bechtel							0291
								T1 COOLING &	**TURNING**	**AFTER**	**STATION**	**4481-MJUT-0001**						
0	C		4481-MJR0-0006-CP-01-J1	4481-CP-1001	4481-MJR0-0006-CP-01	J	20CX1.5MM2	25457-4480-V1A-MXAO-0146	Bechtel	Bechtel	Bechtel							0288 (0321 - PAGE 6,14)
0	C		4481-MJR0-0008-JB-01-J1	4481-CP-1001	4481-MJR0-0008-JB-01	J	27CX1.5MM2	25457-4480-V1A-MXAO-0146	Bechtel	Bechtel	Bechtel							0321 - PAGE 5,6,11,12
0	C		4481-MJR0-0006-M1-J1	4481-CP-1000	4480-ECM1-0001	J	12CX1.5MM2	25457-4480-V1A-MXAO-0146	Bechtel	Bechtel	Bechtel							0303
0	C		4481-MJR0-0008-M1-J1	4481-CP-1000	4480-ECM1-0001	J	12CX1.5MM2	25457-4480-V1A-MXAO-0146	Bechtel	Bechtel	Bechtel							0304
0	C		4481-MJR0-0006-LCS-01-J1	4480-ECM1-0001	4481-MJR0-0006-LCS-01	J	8CX1.5MM2	25457-4480-V1A-MXAO-0146	Bechtel	Bechtel	Bechtel							0303
0	C		4481-MJR0-0006-LCS-01-J2	4480-ECM1-0001	4481-MJR0-0006-LCS-01	J	6CX1.5MM2	25457-4480-V1A-MXAO-0146	Bechtel	Bechtel	Bechtel							0304
0	C		4481-MJR0-0006-M1-P1	4480-ECM1-0001	4481-MJR0-0006-M1-LDS	P	3C002CUGPA	25457-4480-V1A-MXAO-0146	Bechtel	Bechtel	Bechtel							0303
0	C		4481-MJR0-0008-M1-P1	4480-ECM1-0001	4481-MJR0-0008-M1-LDS	P	3C002CUGPA	25457-4480-V1A-MXAO-0146	Bechtel	Bechtel	Bechtel							0304
								C4 CHAIN CONV. FOR	**SEALED CATHODE**	**4481-MHCD-0004**								
0	C		4481-CP-1001-J1	4481-CP-1000	4481-CP-1001	J	1ETH	25457-4480-V1A-MXAO-0147	Bechtel	Bechtel	Bechtel							0122
0	C		4481-CP-1001-J2	4481-CP-1000	4481-CP-1001	J	12CX1.5MM2	25457-4480-V1A-MXAO-0147	Bechtel	Bechtel	Bechtel							0288
0	C		4481-MHCD-0004-CP-01-J1	4481-CP-1001	4481-MHCD-0004-CP-01	J	20CX1.5MM2	25457-4480-V1A-MXAO-0147	Bechtel	Bechtel	Bechtel							0288 (0321 - PAGE 2,13)
0	C		4481-MHCD-0004-CP-01-J2	4481-MJR0-0006-CP-01	4481-MHCD-0004-CP-01	J	3CX1.5MM2	25457-4480-V1A-MXAO-0147	Bechtel	Bechtel	Bechtel							0287
4	C		4481-MHCD-0004-CP-02-J1	4481-MHCD-0004-CP-01	4481-MHCD-0004-CP-02	J	8CX1.5MM2	25457-4480-V1A-MXAO-0147	Bechtel	Bechtel	Bechtel							0321 - PAGE 2,13
0	C		4481-MJR0-0006-CP-01-J3	4481-MJR0-0006-CP-01	4481-MHCD-0004-LCS-01	J	6CX1.5MM2	25457-4480-V1A-MXAO-0147	Bechtel	Bechtel	Bechtel							0305
0	C		4481-MHCD-0004-M1-J1	4481-CP-1000	4480-ECM1-0001	J	12CX1.5MM2	25457-4480-V1A-MXAO-0147	Bechtel	Bechtel	Bechtel							0305
0	C		4481-MHCD-0004-LCS-01-J1	4480-ECM1-0001	4481-MHCD-0004-LCS-01	J	8CX1.5MM2	25457-4480-V1A-MXAO-0147	Bechtel	Bechtel	Bechtel							0305
0	C		4481-MHCD-0004-M1-P1	4480-ECM1-0001	4481-MHCD-0004-M1-LDS	P	3C002CUGPA	25457-4480-V1A-MXAO-0147	Bechtel	Bechtel	Bechtel							0305
								H1 HYDRAULIC	**POWER UNIT**	**4481-MPF0-0001**								
0	C		4481-MPF0-0001-CP-01-J1	4481-CP-1000	4481-MPF0-0001-CP-01	J	1ETH	25457-4480-V1A-MXAO-0148	Bechtel	Bechtel	Bechtel							0122
0	C		4481-MPF0-0001-CP-01-J2	4481-MHCD-0003-CP-01	4481-MPF0-0001-CP-01	J	1ETH	25457-4480-V1A-MXAO-0148	Bechtel	Bechtel	Bechtel							0122
0	C		4481-MPF0-0001-CP-01-P1	4481-CP-1000	4481-MPF0-0001-CP-01	P	3C002CUGPA	25457-4480-V1A-MXAO-0148	Bechtel	Bechtel	Bechtel							0376
0	C		4481-MPF0-0001-M1-J1	4481-CP-1000	4480-ECM1-0001	J	12CX1.5MM2	25457-4480-V1A-MXAO-0148	Bechtel	Bechtel	Bechtel							0336
0	C		4481-MPF0-0001-M2-J1	4481-CP-1000	4480-ECM1-0001	J	12CX1.5MM2	25457-4480-V1A-MXAO-0148	Bechtel	Bechtel	Bechtel							0337
0	C		4481-MPF0-0001-LCS-01-J1	4480-ECM1-0001	4481-MPF0-0001-LCS-01	J	6CX1.5MM2	25457-4480-V1A-MXAO-0148	Bechtel	Bechtel	Bechtel							0336
0	C		4481-MPF0-0001-LCS-01-J2	4480-ECM1-0001	4481-MPF0-0001-LCS-01	J	6CX1.5MM2	25457-4480-V1A-MXAO-0148	Bechtel	Bechtel	Bechtel							0337
0	C		4481-MPF0-0001-M1-P1	4480-ECM1-0001	4481-MPF0-0001-M1-LDS	P	3C006CUGPA	25457-4480-V1A-MXAO-0148	Bechtel	Bechtel	Bechtel							0336
0	C		4481-MPF0-0001-M2-P1	4480-ECM1-0001	4481-MPF0-0001-M2-LDS	P	3C006CUGPA	25457-4480-V1A-MXAO-0148	Bechtel	Bechtel	Bechtel							0337
								W1 CHILLER FOR HYD.	**POWER UNIT**	**4481-MEHX-0001**								
0	C		4481-MEHX-0001-CP-01-J1	4481-CP-1000	4481-MEHX-0001-CP-01	J	8CX1.5MM2	25457-4480-V1A-MXAO-0149	Bechtel	Bechtel	Bechtel							0320 - PAGE 34
0	C		4481-MEHX-0001-CP-01-P1	4480-ECM1-0001	4481-MEHX-0001-CP-01	P	3C025CUGPA	25457-4480-V1A-MXAO-0149	Bechtel	Bechtel	Bechtel							0104
								F3 LADLE PREHEATING	**STATION**	**4481-MBAD-0001**								
0	C		4481-MBAD-0001-M1-J1	4481-MBAD-0001-CP-01	4480-ECM1-0001	J	12CX1.5MM2	25457-4480-V1A-MXAO-0150	Bechtel	Bechtel	Bechtel							0338
0	C		4481-MBAD-0001-CP-01-P1	4480-ECM1-0001	4481-MBAD-0001-CP-01	P	3C002CUGPA	25457-4480-V1A-MXAO-0150	Bechtel	Bechtel	Bechtel							0375
0	C		4481-MBAD-0001-CP-01-P2	4480-ECM1-0001	4481-MBAD-0001-CP-01	P	3C002CUGPA	25457-4480-V1A-MXAO-0150	Bechtel	Bechtel	Bechtel							0375
0	C		4481-MBAD-0001-M1-P1	4480-ECM1-0001	4481-MBAD-0001-M1-LDS	P	3C002CUGPA	25457-4480-V1A-MXAO-0150	Bechtel	Bechtel	Bechtel							0338
								F4A CAST IRON INGOT	**DRYING STATION A**	**4481-MEVD-0001**								
0	C		4481-MEVD-0001-M1-J1	4481-MEVD-0001-CP-01	4480-ECM1-0001	J	12CX1.5MM2	25457-4480-V1A-MXAO-0151	Bechtel	Bechtel	Bechtel							0339
0	C		4481-MEVD-0001-CP-01-P1	4480-ECM1-0001	4481-MEVD-0001-CP-01	P	3C002CUGPA	25457-4480-V1A-MXAO-0151	Bechtel	Bechtel	Bechtel							0376
0	C		4481-MEVD-0001-CP-01-P2	4480-ECM1-0001	4481-MEVD-0001-CP-01	P	3C002CUGPA	25457-4480-V1A-MXAO-0151	Bechtel	Bechtel	Bechtel							0376
3	C		4481-MEVD-0001-XFO-01-C1	4481-MEVD-0001-CP-01	4481-MEVD-0001-XFO-01	C	2CX1.5MM2	25457-4480-V1A-MXAO-0151	Bechtel	Bechtel	Bechtel							0379
3	C		4481-MEVD-0001-BE-01-J1	4481-MEVD-0001-CP-01	4481-MEVD-0001-BE-01	J	2CX1.5MM2	25457-4480-V1A-MXAO-0151	Bechtel	Bechtel	Bechtel							0379
3	C		4481-MEVD-0001-ZS-01-J1	4481-MEVD-0001-CP-01	4481-MEVD-0001-ZS-01	J	2CX1.5MM2	25457-4480-V1A-MXAO-0151	Bechtel	Bechtel	Bechtel							0379
3	C		4481-MEVD-0001-PSL-01-J1	4481-MEVD-0001-CP-01	4481-MEVD-0001-PSL-01	J	2CX1.5MM2	25457-4480-V1A-MXAO-0151	Bechtel	Bechtel	Bechtel							0379
3	C		4481-MEVD-0001-PSL-02-J1	4481-MEVD-0001-CP-01	4481-MEVD-0001-PSL-02	J	2CX1.5MM2	25457-4480-V1A-MXAO-0151	Bechtel	Bechtel	Bechtel							0379
3	C		4481-MEVD-0001-PSH-03-J1	4481-MEVD-0001-CP-01	4481-MEVD-0001-PSH-03	J	2CX1.5MM2	25457-4480-V1A-MXAO-0151	Bechtel	Bechtel	Bechtel							0379
3	C		4481-MEVD-0001-FY-01-C1	4481-MEVD-0001-CP-01	4481-MEVD-0001-FY-01/02	C	3CX1.5MM2	25457-4480-V1A-MXAO-0151	Bechtel	Bechtel	Bechtel							0379
3	C		4481-MEVD-0001-M1-LDS-J1	4481-MEVD-0001-CP-01	4481-MEVD-0001-M1-LDS	J	2CX1.5MM2	25457-4480-V1A-MXAO-0151	Bechtel	Bechtel	Bechtel							0339
0	C		4481-MEVD-0001-M1-P1	4480-ECM1-0001	4481-MEVD-0001-M1-LDS	P	3C002CUGPA	25457-4480-V1A-MXAO-0151	Bechtel	Bechtel	Bechtel							0339
								F4B CAST IRON INGOT	**DRYING STATION B**	**4481-MEVD-0002**								
0	C		4481-MEVD-0002-M1-J1	4481-MEVD-0002-CP-01	4480-ECM1-0001	J	12CX1.5MM2	25457-4480-V1A-MXAO-0152	Bechtel	Bechtel	Bechtel							0105
0	C		4481-MEVD-0002-CP-01-P1	4480-ECM1-0001	4481-MEVD-0002-CP-01	P	3C002CUGPA	25457-4480-V1A-MXAO-0152	Bechtel	Bechtel	Bechtel							0376
0	C		4481-MEVD-0002-CP-01-P2	4480-ECM1-0001	4481-MEVD-0002-CP-01	P	3C002CUGPA	25457-4480-V1A-MXAO-0152	Bechtel	Bechtel	Bechtel							0376
3	C		4481-MEVD-0002-XFO-01-C1	4481-MEVD-0002-CP-01	4481-MEVD-0002-XFO-01	C	2CX1.5MM2	25457-4480-V1A-MXAO-0252	Bechtel	Bechtel	Bechtel							0380
3	C		4481-MEVD-0002-BE-01-J1	4481-MEVD-0002-CP-01	4481-MEVD-0002-BE-01	J	2CX1.5MM2	25457-4480-V1A-MXAO-0252	Bechtel	Bechtel	Bechtel							0380
3	C		4481-MEVD-0002-ZS-01-J1	4481-MEVD-0002-CP-01	4481-MEVD-0002-ZS-01	J	2CX1.5MM2	25457-4480-V1A-MXAO-0252	Bechtel	Bechtel	Bechtel							0380
3	C		4481-MEVD-0002-PSL-01-J1	4481-MEVD-0002-CP-01	4481-MEVD-0002-PSL-01	J	2CX1.5MM2	25457-4480-V1A-MXAO-0252	Bechtel	Bechtel	Bechtel							0380
3	C		4481-MEVD-0002-PSL-02-J1	4481-MEVD-0002-CP-01	4481-MEVD-0002-PSL-02	J	2CX1.5MM2	25457-4480-V1A-MXAO-0252	Bechtel	Bechtel	Bechtel							0380
3	C		4481-MEVD-0002-PSH-03-J1	4481-MEVD-0002-CP-01	4481-MEVD-0002-PSH-03	J	2CX1.5MM2	25457-4480-V1A-MXAO-0252	Bechtel	Bechtel	Bechtel							0380
3	C		4481-MEVD-0002-FY-01-C1	4481-MEVD-0002-CP-01	4481-MEVD-0002-FY-01/02	C	3CX1.5MM2	25457-4480-V1A-MXAO-0252	Bechtel	Bechtel	Bechtel							0380
3	C		4481-MEVD-0002-M1-LDS-J1	4481-MEVD-0002-CP-01	4481-MEVD-0002-M1-LDS	J	2CX1.5MM2	25457-4480-V1A-MXAO-0252	Bechtel	Bechtel	Bechtel							0105
0	C		4481-MEVD-0002-M1-P1	4480-ECM1-0001	4481-MEVD-0002-M1-LDS	P	3C002CUGPA	25457-4480-V1A-MXAO-0152	Bechtel	Bechtel	Bechtel							0105
			END OF LIST															

SECTION 10 SOFTWARE

10.1 Program Listing

Final version will be provided directly at site.

APPENDICE 1
Hydraulic Power Unit
Pneutech - Parker

Hydraulic Unit
Service Manual

for

GNA

Purchase Order # 00006518

Project # 1394757-00 (100579-00)

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Appendix

A. Hydraulic Schematic

B. Hydraulic Assembly Drawing

C. Recommended Spare Parts

System Settings

Client: **GNA**

Project: **1394757-00 (100579-00)**

P.O.#: **00006518**

Delivery Date: **Feb. 07 2011**

Fittings:	Parker Triple-lok (37° Flare) Hamlet Tube Fitting
Paint:	Pneutech Standard Gray (Interlac 665 Alkyd Finish)
Motor:	ABB Motors 11kw(15hp) 1772rpm 460/3/60 Frame : 160M Model# : M3AA160MLA Full Load Amperage :18.2A Service Factor Full Load :20.0A
Pressure Setting:	131 Bars
Compensator Setting:	110 Bars
Flow Setting:	45.5 LPM
Recommended Oil Grade:	ISO 32
Maximum Operating Temp:	60 °C
Filter Element:	Suction Filter = F3CF274W = 924456 Pressure Filter = 30PD110Q = 932624Q Return Filter = DILP110Q = 937403Q

System Characteristics:

HINTS ON MAINTENANCE OF HYDRAULIC FLUID IN THE SYSTEM

HYDRAULIC FLUID CHANGES

Good maintenance procedures make it mandatory to keep the hydraulic fluid clean. A daily / weekly or monthly log should be kept on the hydraulic fluid condition.

No hard and fast rule can be established for changing the fluid because of the great variety of operating conditions. However, we do know that when filter elements are replaced frequently, service life of a system increases. Periodic testing of the fluid by the supplier is recommended to confirm suitability of the continued use and to establish the correct fluid and filter element replacement interval.

Some of the considerations affecting hydraulic fluid life are: operating temperature, type of service, contamination levels, filtration, and the chemical composition of the fluid.

FLUID RECOMMENDATIONS

Premium quality hydraulic oil with viscosity range between 150-250 SSU (30-50cst.) at 100°F (38°C).
Normal operating viscosity range between 80-1000 SSU (17-180cst.)
Maximum start-up viscosity is 4000 SSU (1000cst.)
NOTE: Consult Pneutech when exceeding 160°F operation. Oil should have maximum anti-wear properties, rust and oxidation treatment.

DRAINING THE SYSTEM

The system should be started and the fluid heated before draining. This will lower the time it takes to drain the system and allow impurities suspended in the fluid to be removed. It is desirable to remove all fluid from the system. Bleeding of the fluid at the lowest point in the system will help in most cases.

Systems that have accumulated deposits that were not removed during draining, must be flushed with a light viscosity fluid. The fluid should contain a rust inhibitor to protect metal surfaces against rust formation after draining.

When hydraulic fluid is added to replenish the system, it should be pumped through a 25-micron filter. If such a filter is not available, a funnel with a fine wire screen (200 mesh or finer) can be used. It is important that fluid can be clean and free of all substances, which will cause improper operation.

FLUID CONTAMINTAION / AERATION – CAUSES AND EFFECTS

CONTAMINATION

A contamination system can be the result of several factures: system design inadequate, poor maintenance of the system, poor housekeeping of the system and adverse operating conditions.

A. System inadequate

1. Reservoirs that cannot be cleaned.
2. Breather that permit abrasives, inherent in the atmosphere to enter the system.
3. Poor cylinder packing design (no wiper to clean dirt from the piston rod).
4. Improper piston rod design (piston rods with poor wear characteristics).
5. Improper valving (anti-cavitation checks omitted from cylinder circuits with rapid drop characteristics).
6. Failure to provide adequate filtration

B. Poor maintenance of the system

1. Improper and unclean practices when adding fluid to the system.
2. Failure to clean breathers
3. Failure to change pitted cylinder rods and worn cylinder packings.
4. Failure to use good cleanliness practices when changing system components.
5. Failure to change filter cartridges and/or fluid at proper intervals.
6. Failure to purge debris from the system after a pump failure.

C. Poor housekeeping of the system

Surgical cleanliness is not required, however, ordinary clean practices during assembly will pay off in increased service life of the equipment.

Excessive and improper use of pipe thread sealer on lines and gaskets in the system can cause pump failures. This is especially true when a type of sealer is used that hardens.

Another source of contamination is fittings, hoses and lines that are received from a vendor uncapped. The use of brazed or welded fittings and unpickled steel plating can also contribute to contamination.

D. Adverse Operating Conditions

From experience, we have found that machines used in a very dusty atmosphere and in windy areas require special components. For example, heavy-duty breather, chrome-plated piston rods, plus frequent changes of the filter cartridges are also required.

Effects of Contamination

Contamination affects all types of hydraulic equipment adversely. Precision high tolerance parts are very susceptible to the effects of contamination. Dirty fluid causes wear which accelerates leakage and the development of heat in a system. Heat lowers the lubricity of a hydraulic fluid and causes additional wear.

If a hydraulic pump or motor should fail, the system becomes contaminated: Remove the unit for repair. The reservoir must be drained flushed and cleaned. All hoses, lines, cylinders and valves should be inspected for wear and particles of the unit that failed. Flush all components of the complete system to remove metallic particles.

Replace filter elements. Dispose of the fluid removed from the system and fill the reservoir with clean hydraulic fluid. Install a new or rebuilt unit and start-up the system. Allow the system to run for a period of time to verify normal operation. Filter elements should be changed after 40 or 50 hours of operation. This guaranties that the system is essentially clean and free of any residue of the failed unit.

AERATION (air bubbles in the fluid)

Causes

The following are candidates for the formation of the air in a system.

A. Leaking inlet lines
B. Control valve "O" rings leaking.
C. Shaft seal leakage.
D. Leaking cylinder packings caused by cavitating cylinders.
E. Turbulence or sloshing in the reservoir.
F. Vortexing fluid in the reservoir
G. Release of air suspended within the fluid.

Effects

Aeration can be in many forms: large bubbles, foam or in various degrees of suspension. It usually causes pump noise (cavitation). Small bubbles causes extreme and rapid ring wear, with corresponding vane tip wear. Larger bubbles cause vanes to collapse and pound. This pounding effect develops rippling in the ring and the ring will have a dull appearance. This is more apparent on the straight vane rings that are hardened cast iron. With extreme aeration cases, the wear is so rapid that a ring contour at the pressure quadrant. When the step reaches a depth where the vane extends and locks, the vane and/or ring will break. Also, the shaft can break where it enters the rotor if the torque is great enough.

Cures

A. Leaking inlet lines

1. Pipe Threaded fittings can be porous. Use an approved type of pipe thread sealer on all pipe threads.
2. If the pump inlet flange surface is rough, scored or mutilated, air leakage past the "O" ring seal can result.

With any of the above defects, air can be pulled into the system.

B. Control valve “O” ring leaking

“O” rings are used to seal against port leakage in many control valves. These seals can be checked, by applying heavy grease around the part to be checked. If the noise stops, the trouble has been located and repair can be initiated.

On the systems that have been operating at excessive high temperatures, the “O” rings can harden and take a set. If this occurs, air leakage can result. This is true not only in a pump, but also in the rest of the components of the system. Another factor enhancing air leakage is the actual fluid composition. Fluids which have a high sulphur content tend to accelerate “O” ring hardness. This is one of the principle reasons for keeping system operating temperatures down. Normal operating temperature of a system is 90° above ambient. When operating temperatures are in excess of this value, trouble may result. Maximum operating temperatures should be checked at the pump outlet port.

C. Shaft seal leakage

Most vane pumps are internally drained. The shaft seal cavity is connected to the pump inlet. Excessively high inlet vacuums can cause air leakage at the shaft seal. The maximum vacuum measured at the pump inlet should not exceed five inches of mercury.

Shaft misalignment can increase the probability of air leakage past the shaft seal. Universal jointed couplings or splined couplings can cause seal leakage if not properly aligned. Straight (direct) coupling

The use of the wrong type of tools can cause distortion or mutilation of a shaft seal at installation. The outer diameter of the shaft should be lightly polished before installation to remove any burrs or roughness in the area of the shaft seal.

Shaft seals must be made of the correct material for a given application. A material that is not compatible with fluid can deteriorate and the result in a leakage problem.

D. Leaking cylinder packings caused by cavitating cylinders

On applications where a rapid raise and a lower cycle is experienced, air can enter the system through a cylinder rod seal. Vacuums, in excess of 20 inches of mercury, have been recorded in systems without anti-cavitation check valves. This is enough to force dirt particles past the shaft seal into the system with the air. An anti-cavitation check will allow flow from the reservoir to enter the rod area of the cylinder during a vacuum condition. Anti-cavitation checks should always be used to prevent a high vacuum condition from developing. This will lower the possibility of fluid contamination through the rod seal of a working cylinder.

E. Turbulence or sloshing in the reservoir

Return lines if improperly located, can cause turbulence and aeration. A plexiglass window should be placed in the prototype reservoir to study flow conditions. Return lines emptying above the fluid level cause bubbles to form in the system. Return lines should always be terminated below the fluid level. Vehicle movement can cause sloshing within the reservoir. The reservoir must be deep enough to prevent aeration.

F. Vortexing fluid in the reservoir

If the fluid level in the reservoir is low and the inlet demand is great, a vortex condition can develop that pulls air into the pump inlet. In a hydraulic system, vortexing is normally the result of low fluid or poor reservoir design.

One of the best ways of curing a vortex problem is to place an anti-cavitation plate over the outlet of the reservoir. This is a common piece of sheet metal at least 1/8 inch thick set over and above the outlet opening. This plate will allow flow into the outlet from a horizontal direction and effectively extends and enlarges the reservoir opening. This prevents the vortex condition from developing.

F. Release of air suspended within the fluid

There is considerable air suspended in cold hydraulic fluid. As the fluid warms, air is released into the system. A reduction of fluid pressure will also release air out of suspension. A simple relief valve poppet can create an orifice that increases velocity of the fluid and lowers its pressure. The reduced pressure condition releases air out of suspension into the system. Relief valves should be returned below the fluid level of the reservoir as far from the reservoir outlet as possible. This allows time for the air released by the relief valve to me removed before leaving the reservoir and entering the inlet area of the pump.

In some cases, special return line configurations are needed, or air bleed valves used, to remove air from the system.

A special baffle made of 60 meshes can be installed into the reservoir. This baffle should be positioned at a 30°angle in the reservoir, so that the inlet oil is above the screen and the outlet oil is below the screen. The top of the screen should be below the reservoir fluid level far enough to prevent surfaces foam from coming in contact with the screen. Surface foam can penetrate through the screen into the outlet area. The screen baffle will eliminate all bubbles except the very small ones from the fluid if designed properly.

TECHNICAL INFORMATION

Trouble-Shooting Guide and Maintenance Hints

Introduction

General

The trouble shooting charts and maintenance hints the follow are of a general system nature but should provide an intuitive feeling for a specific system. The more general information is covered in the immediately following paragraphs. Effect and probable cause charts appear on the following pages.

System design

There is of course, little point in discussing the design of a system that has been operating satisfactorily for a period of time. However, a seemingly uncomplicated procedure such as relocating a system or changing a component part can cause problems. Because of this, the following points should be considered:

A. Each component in the system must be compatible with and form and integral part of the system. For example, an inadequate size filter on the inlet of a pomp can cause cavitation and and subsequent damage to the pump.

B. All lines must be of proper size and free of restrictive bends. An undersized or restricted line results in a pressure drop in the line itself.

C. Some components must be mounted in a specific position with respect to other components or the lines. The housing of an in-line pump, for example, must remain filled with fluid to provide lubrication.

D. The inclusion of adequate test points for pressure readings, although not essential for operation, will expedite trouble-shooting.

Knowing the System

Probably the greatest aid to trouble-shooting is the confidence of knowing the system. The construction and operating characteristics of each one should be understood. For example, knowing that a solenoid controlled directional valve can be manually actuated will save considerable time in isolating a defective solenoid. Some additional practices that will increase your ability and also the useful life of the system follow:

A. Know the capabilities of the system. Each component in the system has a maximum rated speed, torque, or pressure. Loading the system beyond the specifications simply increases the possibility of failure.

B. Know the correct operating pressures. Always set and check pressures with a gauge. How else can you know if the operating pressure is above the maximum rating of the components? The question may arise as to what the correct operating pressure is. If it isn't correctly specified on the hydraulic schematic, the following rule should be applied: The correct operating pressure is the lowest pressure that will allow adequate performance of the system function and still remain below the maximum rating of the components and machine.

Once the correct pressures have been established, note them on the hydraulic schematic for future reference.

C. Know the proper signal levels, feedback levels, and dither and gain settings in servo control systems. If they aren't specified, check them when the system is functioning correctly and mark them on the schematic for future reference.

Developing systematic procedures

Analyze the system and develop a logical sequence for setting valves, mechanical stops, interlocks, and electrical controls. Tracing of flow paths can often be accomplished by listening for flow in the lines or feeling them for warmth. Develop a cause and effect trouble-shooting guide similar to the charts appearing on the following pages. The initial time spent on such a project could save hours of system, downtime.

Recognizing trouble indications

The ability to recognize trouble indications in a specific system is usually acquired with experience. However, a few general trouble indications can be discussed.

A. Excessive heat means trouble. A misaligned coupling places an excessive load on bearings and can be readily identified by the heat generated. A warmer than normal tank return line on a relief valve indicates operation at relief valve setting. Hydraulic fluids that have a low viscosity will increase the internal leakage of components resulting in a heat rise. Cavitation and slippage in a pump will also generate heat.

B. Excessive noise means wear, misalignment, cavitation or air in the fluid. Contaminated Fluid can cause a relief valve to stick and chatter. These noises may be the result of dirty filters, or fluid, high fluid viscosity, excessive drive speed, low reservoir level, loose intake lines, or worn couplings.

Maintenance

Three simple maintenance procedures have the greatest effect on hydraulic system performance, efficiency, and life. Yet, the very simplicity of them may be the reason they are so often overlooked. What are they?

Simply these:

A. Maintaining a clean sufficient quantity of hydraulic fluid of the proper type and viscosity.

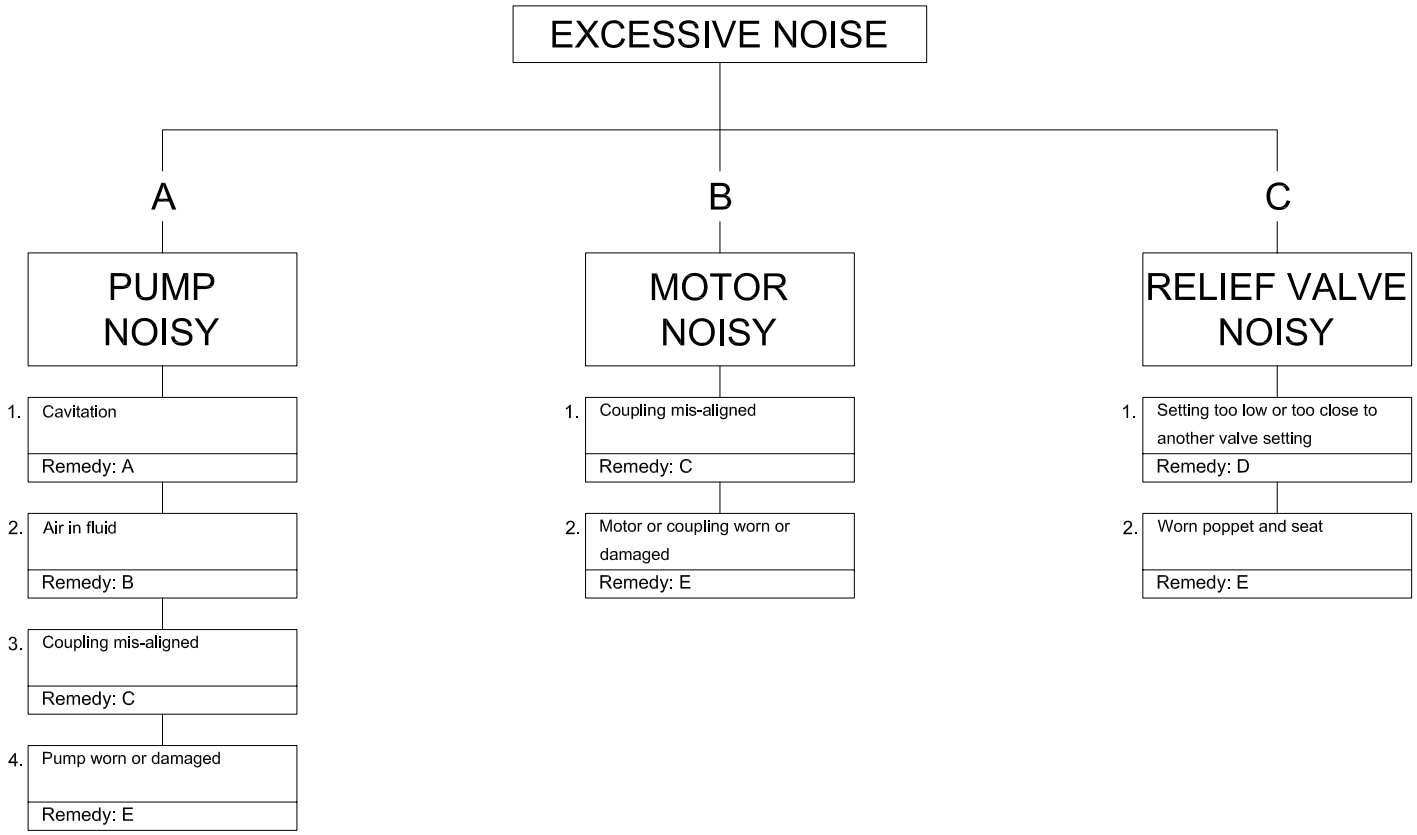
B. Changing filters and cleaning strainers.

C. Keeping all connections tight, but not to the point of distortion, so that air is excluded from the system

Trouble-shooting guides

The following charts are arranged in five main categories. The heading of each one is an effect that indicates a malfunction in the system. For example: if a pump is exceptionally noisy, refer to the chart 1 titled EXCESSIVE NOISE. The noisy pump appears in Column A under main heading. In column A there are four probable causes for a noisy pump. The causes are sequenced according to the ease of checking it. The first cause is cavitation and the remedy is "a". If the first cause does not exist, check for the cause number 2, etc.

CHART 1



REMEDIES:

- A - Any or all of the following:
  - Replace dirty filters.
  - Wash strainers in solvent compatible with system fluid.
  - Clean clogged inlet line.
  - Clean or replace reservoir breather vent.
  - Change system fluid.
  - Change to proper pump drive motor speed.
  - Overhaul or replace supercharge pump.
  - Fluid may be to cold.

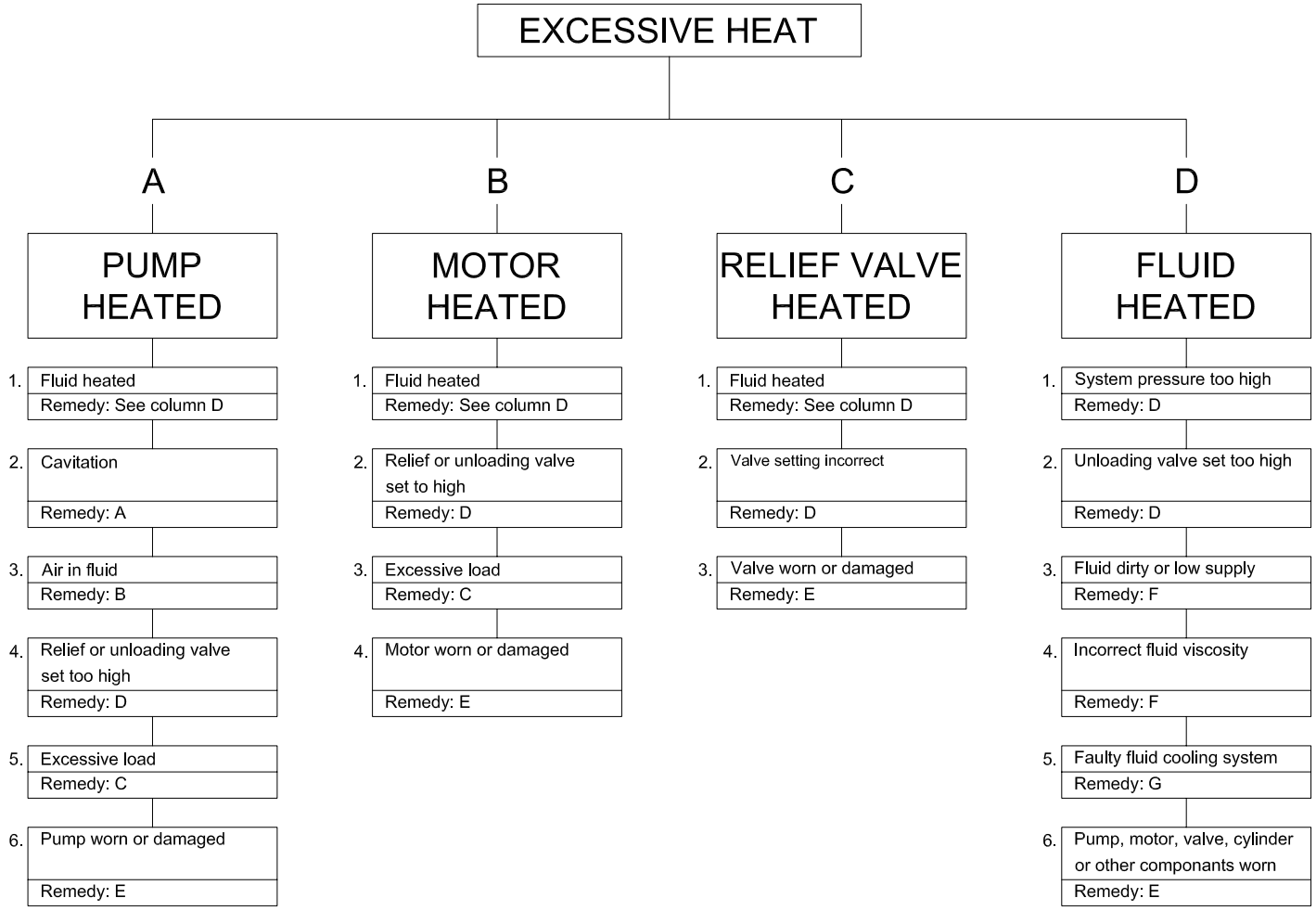
- B - Any or all of the following:
  - Tighten leaking connections.
  - Fill reservoir to proper level (with rare exeption all return lines should be below fluid level in reservoir).
  - Bleed air from system.
  - Replace pump shaft seal (and shaft if worn at seal journal).

- C - Align unit and check condition of seals, bearings and coupling.

- D - Install pressure gauge and adjust to correct pressure.

- E - Overhaul or replace.

CHART 2



REMEDIES:

- A - Any or all of the following:
  - Replace dirty filters.
  - Clean clogged inlet line.
  - Clean or replace reservoir breather vent.
  - Change system fluid.
  - Change to proper pump drive motor speed.
  - Overhaul or replace supercharge pump.

- B - Any or all of the following:
  - Tighten leaking connections.
  - Fill reservoir to proper level (with rare exeption all return lines should be below fluid level in reservoir).
  - Bleed air from system.
  - Replace pump shaft seal (and shaft if worn at seal journal).

- C - Any or all of the following:
  - Align unit and check condition of seals and bearings.
  - Locate and correct mechanical binding.
  - Check for work load in excess of circuit design.

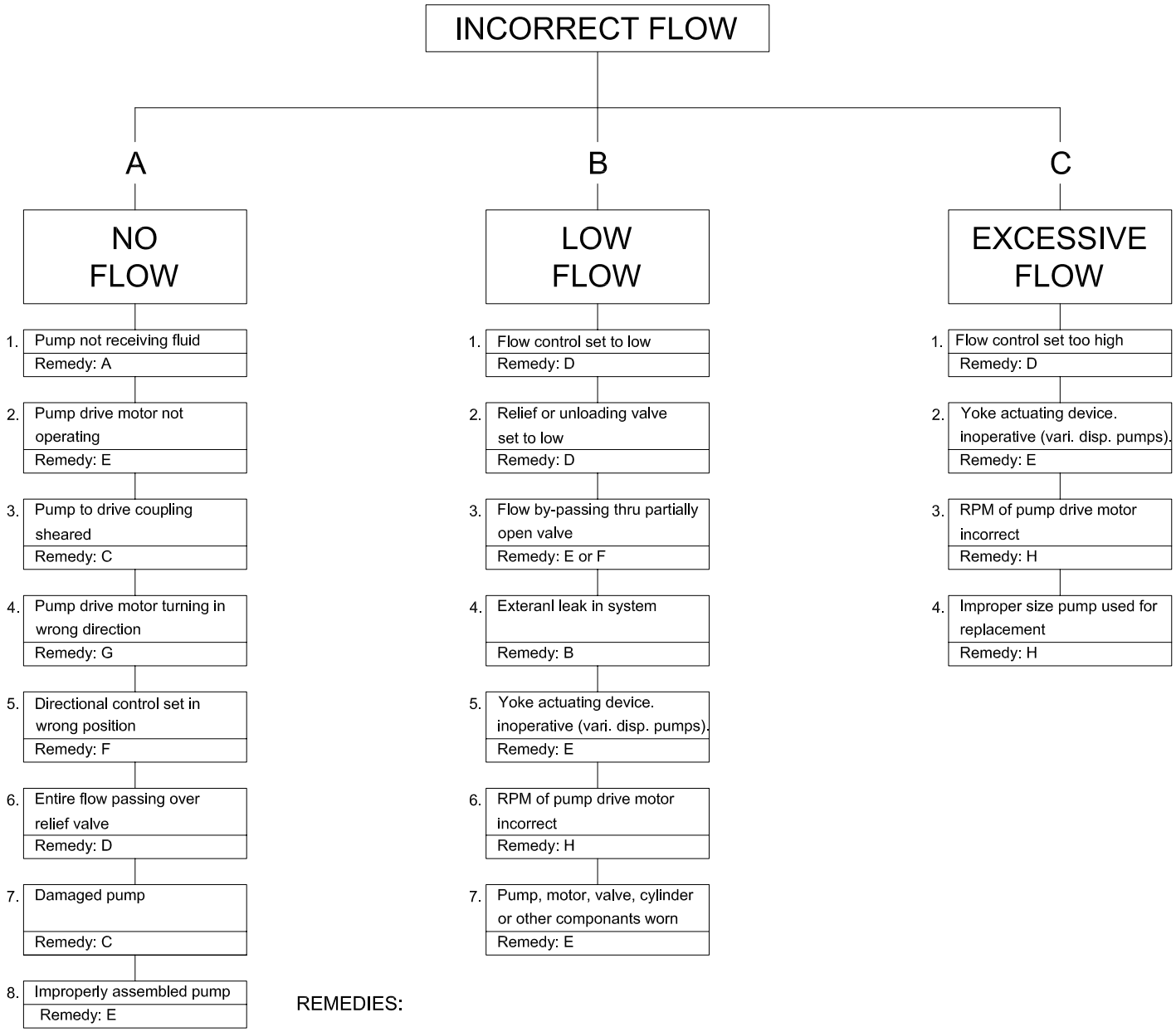
- D - Install pressure gauge and adjust to correct pressure. (Keep at least 125psi difference between valve settings).

- E - Overhaul or replace.

- F - Any or all of the following:
  - Change filters and also system fluid if of improper viscosity.
  - Fill reservoir to proper level.

- G - Any or all of the following:
  - Clean cooler and/or cooler strainer.
  - Replace cooler control valve.
  - Repair or replace cooler.

CHART 3



REMEDIES:

- A - Any or all of the following:
  - Replace dirty filters.
  - Clean clogged inlet line.
  - Clean or replace reservoir breather vent.
  - Fill reservoir to proper level.
  - Overhaul or replace supercharge pump.

- B - Tighten leaking connections.

- C - Any or all of the following:
  - Check for damaged pump or pump drive.
  - Replace and align coupling

- D - Adjust.

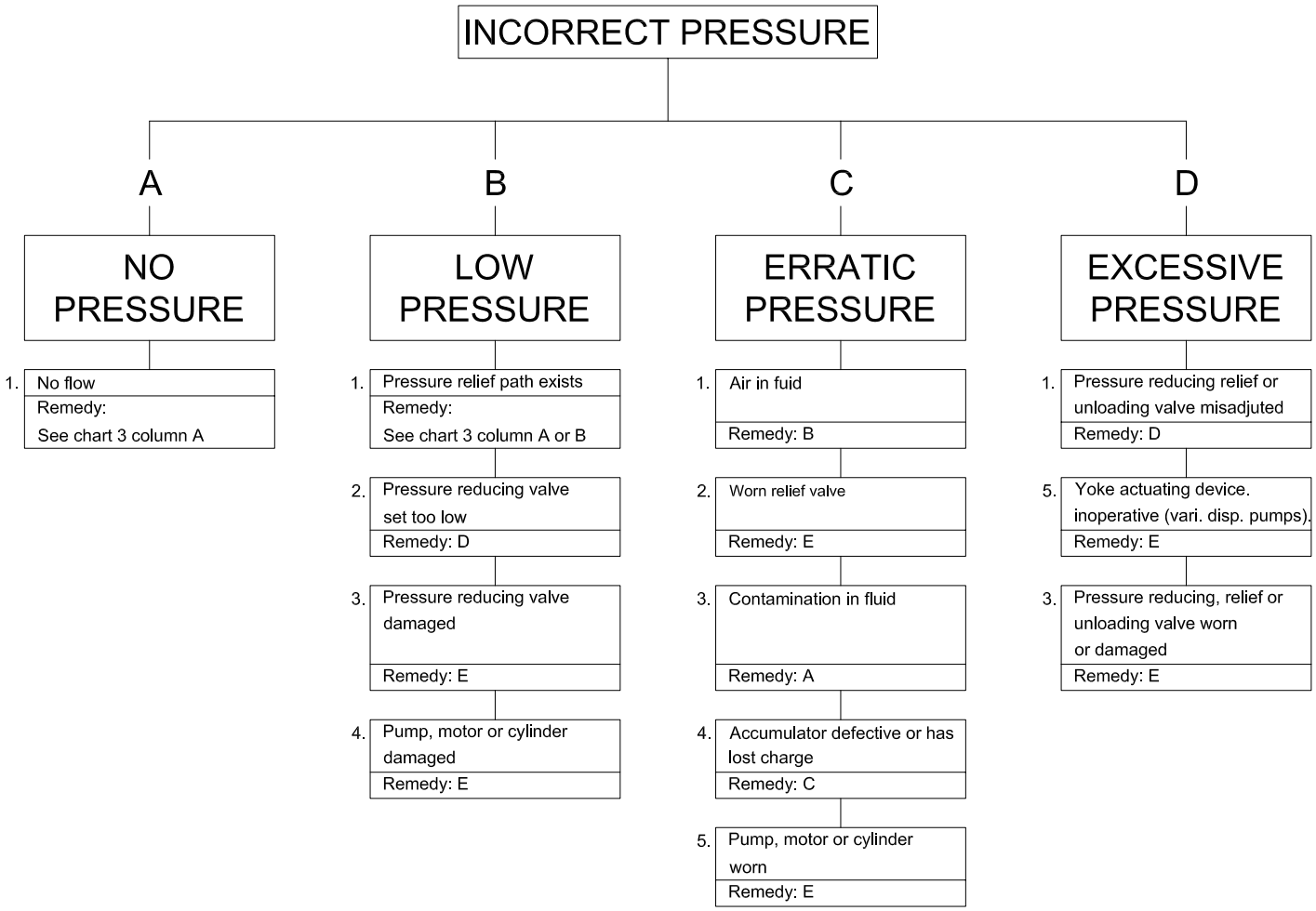
- E - Overhaul or replace.

- F - Any or all of the following:
  - Check position of manually operated controls
  - Check electrical circuit on solenoid operated controls
  - Repair or replace pilot pressure pump

- G - Reverse rotation

- H - Replace with correct unit

CHART 4



REMEDIES:

- A - Replace dirty filters and system fluid.

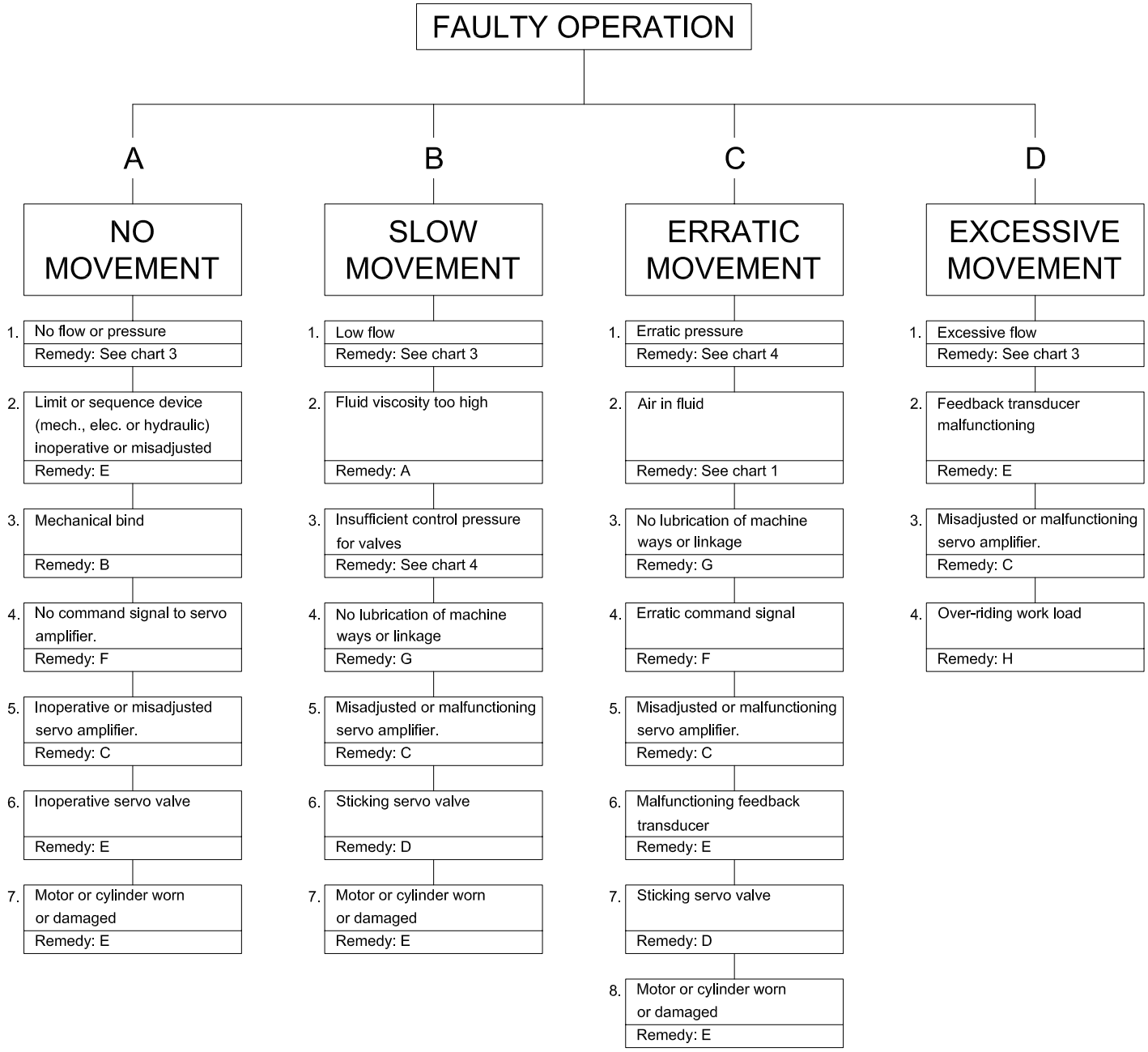
- B - Tighten leaking connections (fill reservoir to proper level and bleed air from system).

- C - Any or all of the following:
  - Check gas valve for leakage.
  - Charge to correct pressure.
  - Overhaul if defective

- D - Adjust.

- E - Overhaul or replace.

CHART 5



REMEDIES:

- A - Fluid may be to cold or should be changed to clean fluid of correct viscosity.

- B - Locate bind and repair.

- C - Adjust, repair or replace.

- D - Any or all of the following:
  - Clean and adjust or replace.
  - Check condition of system fluid and filters.

- E - Overhaul or replace.

- F - Repair command console or interconnecting wires.

- G - Lubricate.

- H - Adjust, repair or replace counterbalance valve.

FLANGED BALL VALVES ANSI CLASS 150 & 300

STANDARD BORE:

1/2" – 10" (DN 15 – 250) SERIES 7000
12" – 20" (DN 300 – 500) AND LARGER SERIES 5000

The JAMESBURY® polymeric-seated flanged ball valves offer a patented flexible-lip seat design that provides positive bi-directional shut-off for a variety of applications in industries ranging from chemical and petrochemical to refining, pulp and paper, and power.

Polymeric-seated flanged ball valves are available in sizes 1/2" – 24" (DN 15 – 600) in both full-bore and standard-bore designs that fully conform to ASME B16.34 requirements.

A choice of body, trim, and seat materials is available to suit an extensive range of applications. As an option, valves can be prepared for special services, such as chlorine, oxygen, high-vacuum, hydrogen peroxide or NACE.

FIRE-TITE® Valves

Standard body and trim materials for FIRE-TITE valves are carbon steel with 316 stainless steel trim and all 316 stainless steel. Seat material options are PTFE (T) and XTREME® (X) for applications involving chemicals, petrochemicals, acids, caustics, and steam. PFA (B) seats are available to resist the effects of polymerizing monomers such as butadiene and styrene.

Non FIRE-TITE Valves

Non FIRE-TITE valves are available with UHMW (U) polyethylene and Peek® (L) seats.

CE Marked

CE marked and documented valves 7180, 7380, 5180 and 5380 which meet the European Pressure Equipment Directive (PED) 97/23/EC are available in ANSI Class 150/300. CE marked products also meet the requirements of BS 5351. Operating torques, construction options and valve dimensions are exactly the same as the standard ANSI 150/300 offering. (See page 18) for ordering instructions.

FEATURES AND BENEFITS

- XTREME seat provides longer life, industry leading expanded performance boundaries, and greater value.
- Polymeric flexible lip-seat design offers tight shut-off in either direction and extended cycle life with minimum maintenance.
- FIRE-TITE version with non-metallic seats meets API 607, Edition 4, and BS6755-Part 2 requirements.
- Superior control characteristics, coupled with tight shut-off capabilities, make these valves ideal for a variety of on-off and control applications.
- API 608 compliance to serve refineries and related chemical and petrochemical industries.
- NACE MR0103 compliance available.
- Meets 23 standard and 7 optional industry standards and specifications. For details (see page 19).

NEW FEATURES AND BENEFITS
For 1/2" – 2" (DN 15 – 50) Series 7000

- New stem seal system is live loaded and engineered to assure long sealing life - patent pending.
- ISO 5211 Bonnet for global conformity.
- New stainless steel linkage for VPVL, ERV, ER and EU actuators has a guided coupling to align topworks during assembly and eliminate side load stress on stem seals for long life, clean environment and reduced maintenance.

Single-Source Responsibility

- Valves, actuators and accessories may be purchased completely mounted from one source.

metso
Expect results

SPECIFICATIONS

Flow Data

The table at right provides flow coefficients for JAMESBURY valves covered in this bulletin. C_v values represent the flow of water at +60˚F through the valve in U.S. gallons per minute at a pressure drop of 1 psi. The metric equivalent, K_v, is the flow of water at 16˚C through the valve in cubic meters per hour at a pressure drop of 1 kg/cm^2. To convert C_v to K_v, multiply by 0.8569.

Valve Body Ratings

These are the maximum working pressure ratings of the valve body only. The seat ratings, shown on the next page, determine the practical temperature and pressure limitations according to actual service conditions. Test pressures are recommended pressures for hydrostatic test with ball half open.

Valve Size		Cv
Inches	DN	Standard Bore
1/2	15	9
3/4	20	19
1	25	45
1-1/2	40	125
2	50	165
3	80	350
4	100	550
6	150	765
8	200	1890
10	250	3900
12	300	6700
14	350	5100/5400*
16	400	8100/8500*
18	450	11,000/9800*
20	500	16,000/13,000*

* Class 300 long pattern

Maximum Working Pressure, psi						
Temp ˚F	Class 150				Class 300	
	Carbon steel*	316 Stainless steel*	Alloy 20*	Monel®	Carbon steel*	316 Stainless steel*
-20 to 100	285	275	230	230	740	720
200	260	235	200	200	675	620
300	230	215	190	190	655	560
400	200	195	190	185	635	515
500	170	170	170	170	600	480
Test Pressure	450	425	350	350	1125	1100

Maximum Working Pressure, bar						
Temp ˚C	Class 150				Class 300	
	Carbon steel*	316 Stainless steel*	Alloy 20*	Monel	Carbon steel*	316 Stainless steel*
-29 to 38	19.6	19.0	15.9	15.9	51.1	49.6
100	17.7	16.2	13.5	13.5	46.6	42.2
150	15.8	14.8	13.1	13.1	45.1	38.5
200	13.8	13.7	13.1	13.1	43.8	35.7
250	11.7	11.7	11.7	11.7	41.9	33.4
Test Pressure	30	29	24	24	77	75

* In accordance with ASME B16-34-2004

Valve Seat Ratings

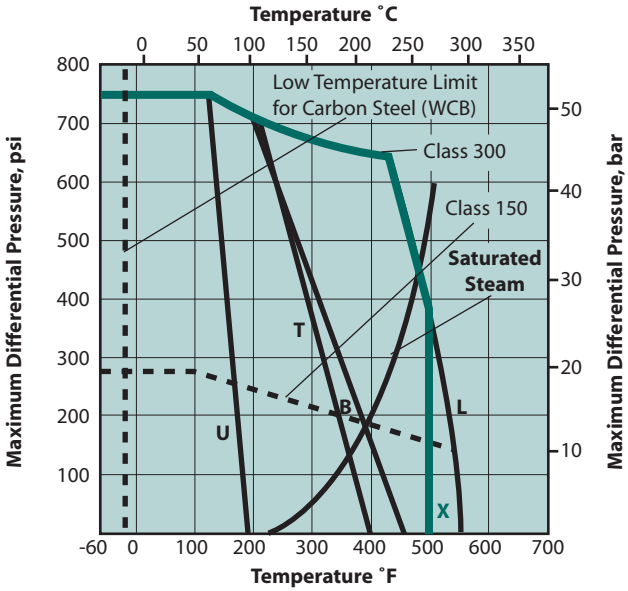
Seat ratings, indicated by solid lines in the charts on the next page, are based on differential pressure with the valve ball in the fully closed position and refer to seats only. The dotted lines indicate maximum working pressures for *WCB carbon steel* valve bodies. (Maximum working pressures of other body materials are shown in the tables above.) The combination of dotted and solid lines indicates the maximum valve rating at specific pressure and temperature conditions. Valves with PTFE, XTREME, PEEK®, PFA, and UHMW polyethylene seats can be used in service to -60˚F (-51˚C) provided that the valve body material is suitable for such a temperature. Carbon steel valves are rated to -20˚F (-29˚C).

On saturated steam service, stainless steel trim is recommended at all pressures and is required above 200 psi (14 bar). See Bulletin B150-1. Peek seats require 17-4 PH stainless steel stems. For more application information on seat materials, refer to Bulletin T140-1.

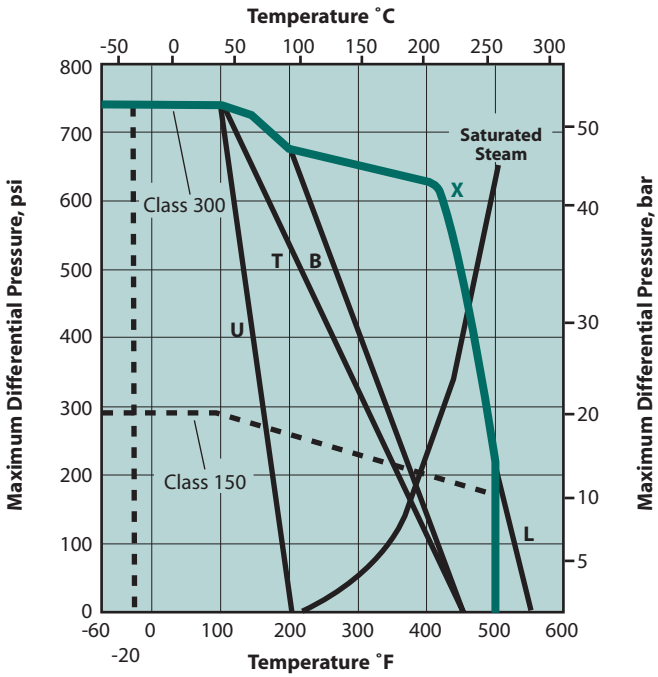
XTREME Performance and Value

XTREME seats provide longer life, expanded performance boundaries, and the greatest possible value. XTREME is a unique material that resulted from a technological breakthrough in our polymer research lab. The material is a fluoropolymer-based blend proprietary to JAMESBURY that provides superior quarter-turn performance.

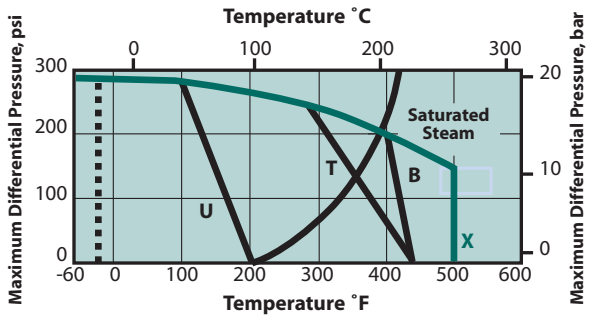
1/2" – 2" (DN 15 – 50) Standard Bore



3" – 6" (DN 80 – 150) Standard Bore

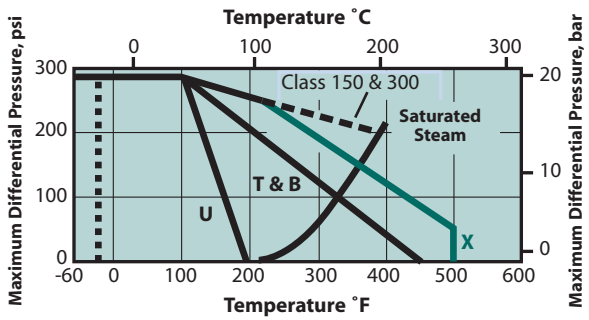


8" (DN 200) Standard Bore Non-Trunnion



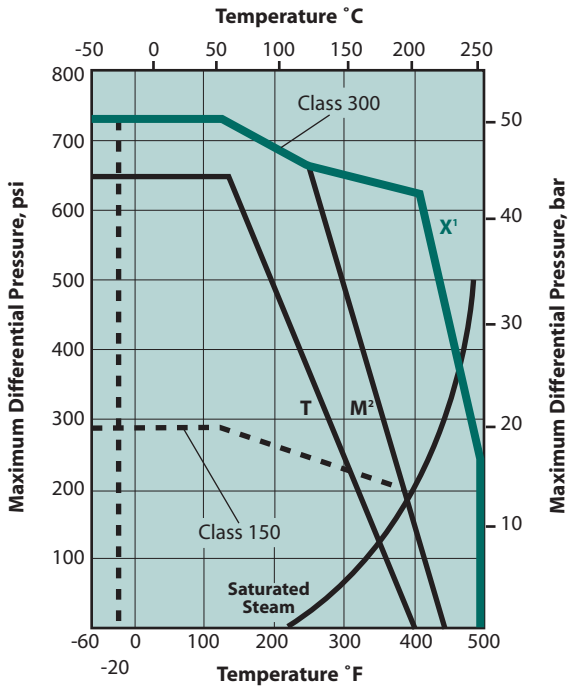
*** ANSI Class 300 Non-Trunnion is 275 psi (19 bar) max.**

10" (DN 250) Standard Bore Non-Trunnion



*** ANSI Class 300 Non-Trunnion is 275 psi (19 bar) max.**

Trunnion Valves
8" – 20" (DN 200 – 500) Standard Bore



X¹ 6" – 12" (DN 150 – 300) Only
M² 6" – 24" (DN 150 – 600)

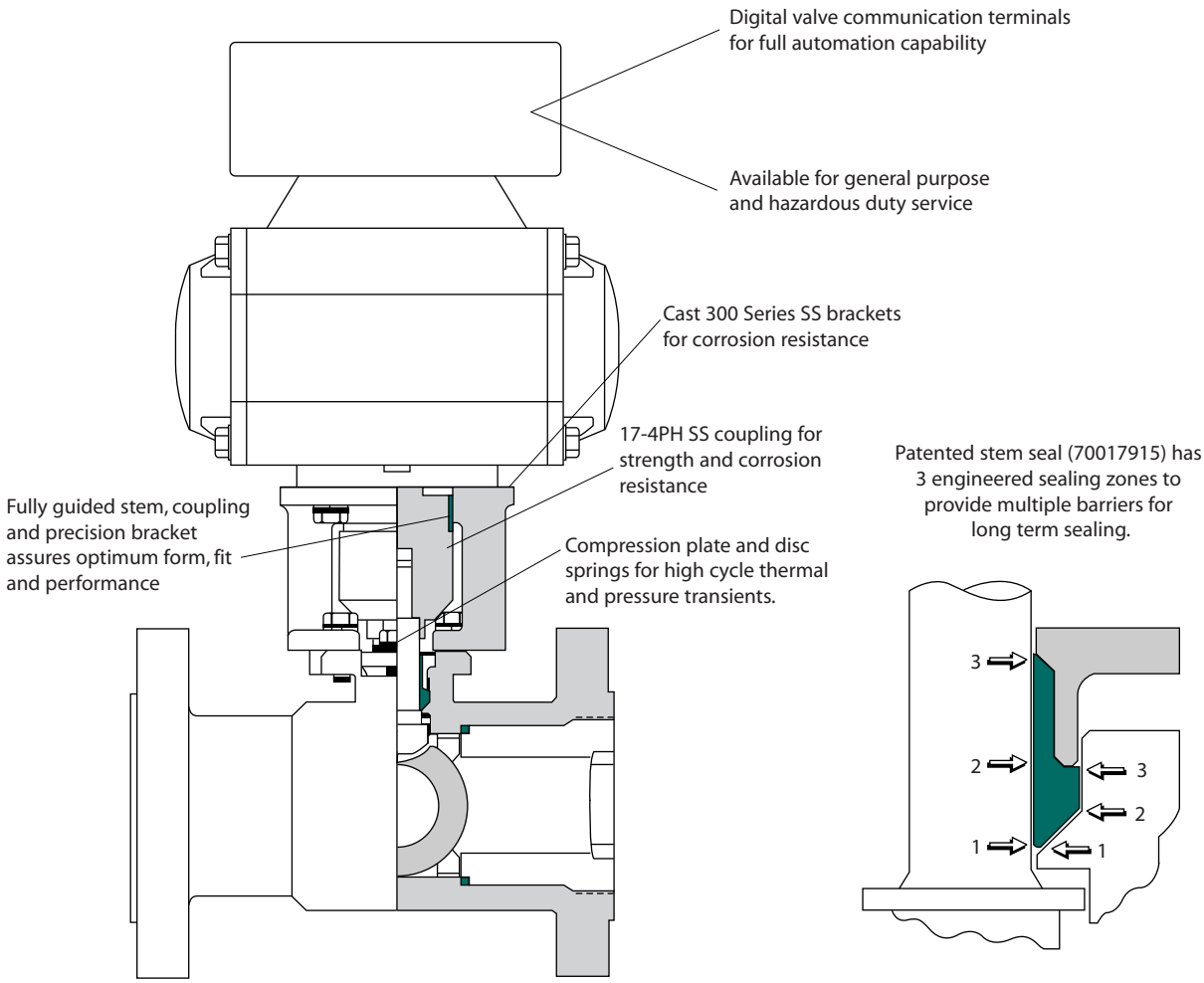
NOTE 1: For series 7000 **NOTE 2:** For series 5000

LEGEND:

T = PTFE	M = Filled PTFE	B = PFA
L = Peek	U = UHMW	X = XTREME

JAMESBURY 'The Ultimate Process Automation Package'
for VPVL Pneumatic Actuators, V-Series and ADC-Series Electric Actuators

For 1/2" – 2" (DN 15 – 50) Standard Port Series 7000

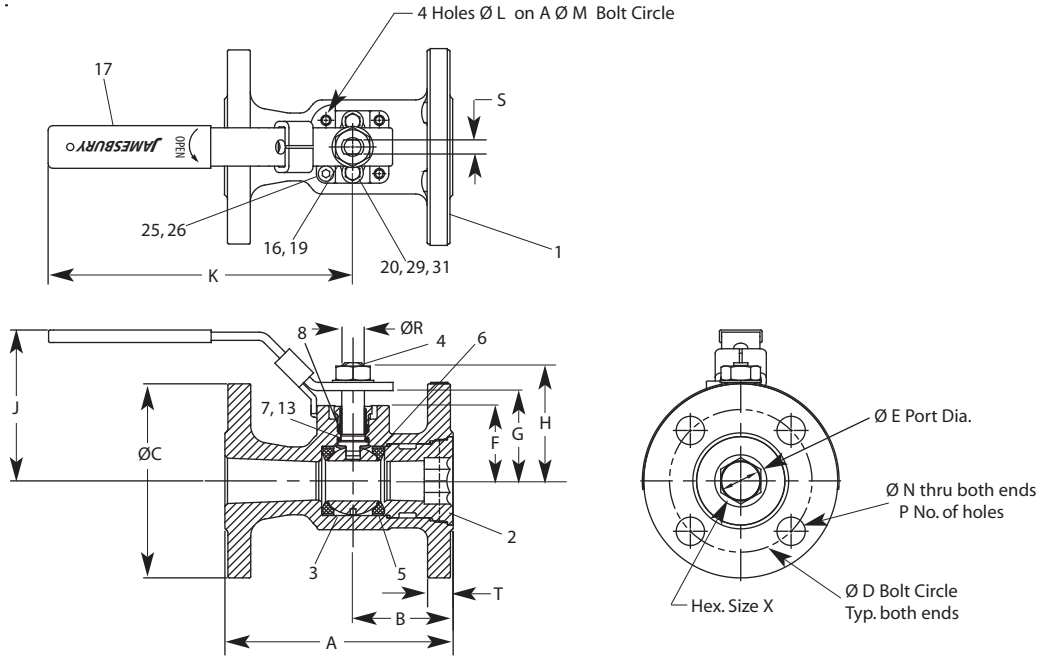


Automation Performance and Value

Valves combined with JAMESBURY actuators, network capable valve monitors and communication devices offer a total value and performance package. Available with pneumatic VALV-POWR VPVL actuators, V-Series and ADC-Series electric actuators and with STONEL® QUARTZ®, ECLIPSE®, and HAWKEYE® digital monitors or VCTs, the packages have a wide range of applications. Visit our website at **www.metso.com/automation**.

DIMENSIONS

Series 7150 ANSI Class 150 and Series 7300 & 730S ANSI Class 300 Flanged Valves



Valve Size inches	Series 7150 ANSI Class 150 Approximate Dimensions - inches																		ISO Bonnet	Approx Weight lb
	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	X		
1/2	4.25	1.94	3.50	2.38	0.50	1.06	1.33	1.63	3.38	5.00	M5	1.42	0.62	4	0.31	0.18	0.50	0.50	F03	3.5
3/4	4.63	2.00	3.88	2.75	0.69	1.22	1.49	1.79	3.50	5.00	M5	1.42	0.62	4	0.31	0.18	0.50	0.69	F03	4.5
1	5.00	2.19	4.25	3.12	0.88	1.65	2.04	2.58	3.69	6.50	M5	1.65	0.62	4	0.50	0.31	0.56	0.88	F04	7.5
1-1/2	6.50	2.65	5.00	3.88	1.25	2.08	2.59	3.30	4.27	8.00	M6	1.97	0.62	4	0.62	0.37	0.69	1.25	F05	11.5
2	7.00	2.64	6.00	4.75	1.50	2.26	2.78	3.49	4.46	8.00	M6	1.97	0.75	4	0.62	0.37	0.75	1.50	F05	16.0

Valve Size DN	Series 7150 ANSI Class 150 Approximate Dimensions - mm																		ISO Bonnet	Approx Weight kg
	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	X		
15	108	49	89	60	13	27	34	41	86	127	M5	36	16	4	8	5	13	13	F03	1.6
20	118	51	99	70	18	31	38	45	89	127	M5	36	16	4	8	5	13	18	F03	2.0
25	127	56	108	79	22	42	52	66	94	165	M5	42	16	4	13	8	14	22	F04	3.4
40	165	67	127	99	32	53	66	84	108	203	M6	50	16	4	16	9	18	32	F05	5.2
50	178	67	152	121	38	57	71	89	113	203	M6	50	19	4	16	9	19	38	F05	7.3

Valve Size inches	Series 7300 & 730S ANSI Class 300 Approximate Dimensions - inches																			ISO Bonnet	Approx Weight lb	
	7300 A	730s A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	X		730S	7300
1/2	5.50	4.25	1.94	3.75	2.62	0.50	1.06	1.33	1.63	3.38	5.00	M5	1.42	0.62	4	0.31	0.18	0.56	0.50	F03	5.0	6.0
3/4	6.00	4.63	2.00	4.62	3.25	0.69	1.22	1.49	1.79	3.50	5.00	M5	1.42	0.75	4	0.31	0.18	0.62	0.69	F03	8.0	8.0
1	6.50	5.00	2.19	4.88	3.50	0.88	1.65	2.04	2.58	3.69	6.50	M5	1.65	0.75	4	0.50	0.31	0.69	0.88	F04	9.5	9.5
1-1/2	7.50	6.50	2.65	6.12	4.50	1.25	2.08	2.59	3.30	4.27	8.00	M6	1.97	0.88	4	0.62	0.37	0.81	1.25	F05	17.5	16.0
2	8.50	7.00	2.64	6.50	5.00	1.50	2.26	2.78	3.49	4.46	8.00	M6	1.97	0.75	8	0.62	0.37	0.88	1.50	F05	21.0	22.0

Valve Size DN	Series 7300 & 730S ANSI Class 300 Approximate Dimensions - mm																			ISO Bonnet	Approx Weight kg	
	730S A	730S A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	X		730S	7300
15	140	108	49	95	67	13	27	34	41	86	127	M5	36	16	4	8	5	14	13	F03	2.3	2.7
20	152	118	51	117	83	18	31	38	45	89	127	M5	36	19	4	8	5	16	18	F03	3.6	3.6
25	165	127	56	124	89	22	42	52	66	94	165	M5	42	19	4	12	8	18	22	F04	4.3	4.3
40	191	165	67	155	114	32	53	66	84	108	203	M6	50	22	4	16	9	21	32	F05	7.9	7.3
50	216	178	67	165	127	38	57	71	89	113	203	M6	50	19	8	16	9	22	38	F05	9.5	10.0

BILLS OF MATERIALS AND PARTS LIST

FIRE-TITE 1/2" – 2" (DN 15 – 50) Standard Port Series 7000 Valves

Part No.	Part Name	Body Material			
		Carbon Steel (22)	316 Stainless Steel (36)	Alloy 20 (35)	Monel (71)
1	Body	Carbon steel ASTM A216 Type WCB	316 Stainless steel ASTM A351 Type CF8M	Alloy 20 ASTM A351 Type CN7M	Monel ASTM A494 Type M35-1
2	Insert	Carbon steel ASTM A216 Type WCB	316L Stainless steel ASTM A351 Type CF8M	Alloy 20 ASTM A351 Type CN7M	Monel ASTM A494 Type M35-1
3	Ball	316 Stainless steel +, Monel, Hastelloy C		Alloy 20	Monel, Hastelloy C as specified
4	Stem	316 Stainless steel +, Monel, Hastelloy C		Alloy 20	Monel, Hastelloy C as specified
5	Seat	PTFE, XTREME, PFA			
6	Body Seal	TFM			
7	Secondary Stem Seal	Graphite			
8	Primary Stem Seal	PTFE, TFM® (XTREME-Seated Valves)			
13	Stem Bearing	Filled PTFE			
16	Hex Nut	Carbon steel (zinc plated)	300 Series Stainless steel		
17	Handle	Carbon steel (zinc plated)	300 Series Stainless steel		
19	Lock Washer	Carbon steel (zinc plated)	300 Series Stainless steel		
20	Compression Plate	316 Stainless steel			Monel
25	Socket Cap Screw	300 Series Stainless steel			
26	Handle Stop Spacer	300 Series Stainless steel			
29	Hex Cap Screw	300 Series Stainless steel (Monel if Chlorine or NACE)			Monel
31	Disc Springs	Inconel			

Non FIRE-TITE 1/2" – 2" (DN 15 – 50) Standard Port Series 7000 Valves

Part No.	Part Name	Body Material			
		Carbon Steel (22)	316 Stainless Steel (36)	Alloy 20 (35)	Monel (71)
1	Body	Carbon steel ASTM A216 Type WCB	316 Stainless steel ASTM A351 Type CF8M	Alloy 20 ASTM A351 Type CN7M	Monel ASTM A494 Type M35-1
2	Insert	Carbon steel ASTM A216 Type WCB	316L Stainless steel ASTM A351 Type CF8M	Alloy 20 ASTM A351 Type CN7M	Monel ASTM A494 Type M35-1
3	Ball	316 Stainless steel +, Monel, Hastelloy C		Alloy 20	Monel, Hastelloy C as specified
4	Stem	316 Stainless steel +, 17-4 PH Stainless steel 2, Monel, Hastelloy C		Alloy 20	Monel, Hastelloy C as specified
5	Seat	PTFE, Peek # & UHMWPE			
6	Body Seal	UHMWPE (w/UHMWPE seats), Graphite (w/Peek seats)			
8	Primary Stem Seal	Graphite (w/Peek seats), UHMWPE (w/UHMWPE seats)			
10	Stem Guide	Peek (Peek seated valves)			
16	Hex Nut	Carbon steel (zinc plated)	300 Series Stainless steel		
17	Handle	Carbon steel (zinc plated)	300 Series Stainless steel		
19	Lock Washer	Carbon steel (zinc plated)	300 Series Stainless steel		
20	Compression Plate	316 Stainless steel (Monel if Chlorine)			Monel
24	Stem Bearing	Filled PTFE (Peek when Peek-seated), (UHMWPE when UHMWPE-seated)			
25	Socket Cap Screw	300 Series Stainless steel			
26	Handle Stop Spacer	300 Series Stainless steel			
29	Hex Cap Screw	300 Series Stainless steel (Monel if Chlorine)			Monel
31	Disc Springs	Inconel			

Requires 17-4 PH stem

Note 1: When investment castings are used, chemical and physical properties are determined from a master heat in accordance with ASME/ANSI B16.34-1996 Sect. 5.1.2.

Note 2: 17-4 PH stems required with Peek seats

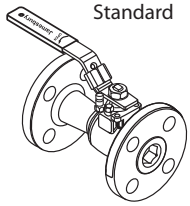
\+ Furnished with valves for NACE MR0103 service.

ACCESSORIES

Locking Devices

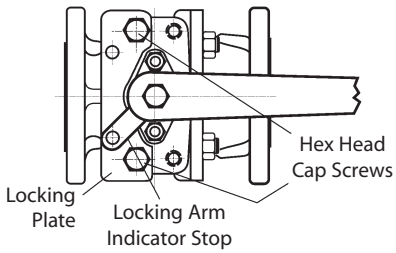
When safety measures are necessary, a reliable locking plate is available to allow the valve to be padlocked in either the open or closed position. Proper figure numbers are shown in the Accessory Table below.

Slide Lock
Standard



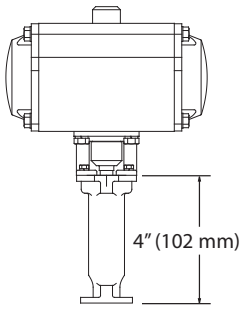
1/2" – 2" (DN 15 – 50)
Series 7000

3" – 8" (DN 80 – 200) Series 7150
3" – 6" (DN 80 – 150) Series 730S & 7300
LD56, 57 & 58



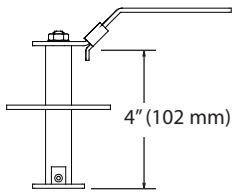
Bonnet/Stem Extensions SE-096, 097 & 098

4" (102 mm) bonnet/stem extensions are available for applications that require insulated pipe, particularly useful for automated products, extension can also be used to prevent interference between actuators and companion pipelines and equipment. They are ideal as extension that require locking lever or locking oval handle capability. Stainless steel construction offers the option of using the extension to complement the carbon steel stem extension (SE-093, 094 & 095) offerings.



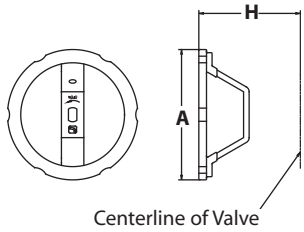
Stem Extensions SE-093, 094 & 095

A standard 4" (102 mm) stem extension is offered for Series 7000 valves (1/2 – 2") for improved accessibility, particularly when used in insulated pipelines. Stem extension kits can be ordered factory-mounted or shipped separately for field mounting



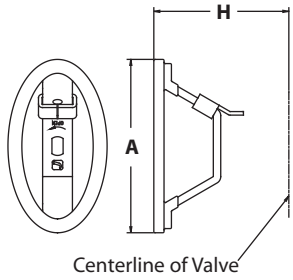
Round Handles

Series 7000 ball valves have optional round handles available. To order handles separately, specify the part number shown in the accessories table below.



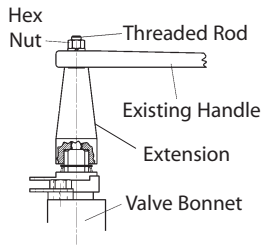
Oval handles with slide-lock

Optional oval handle saves space and may be padlocked to retain the valve in the open or closed position.



Stem Extensions SE-60, 61 & 62

A standard 4" (102 mm) stem extension is offered for Series 7000 valves (3 – 8") for improved accessibility, particularly when used in insulated pipelines. Stem extension kits can be ordered factory-mounted or shipped separately for field mounting



3" – 8" (DN 80 – 200) Series 7150
3" – 6" (DN 80 – 150) Series 730S & 7300

Accessory Table – inches (DN)									
Valve Size Standard Bore	Locking Device	Stem Ext.	*Bonnet Ext.	Locking Oval	Round	Round/Oval Handle		Allowable Max. Torque FT•LBS (N•m)	
						Dimension A	Dimension H	Round	Oval
1/2 (15)	Standard Equipment	SE-093	SE-096	112-0108-30	112-0105-30	4.00 (101.6)	2.96 (75.2)	9 (12)	9 (12)
3/4 (20)		SE-093	SE-096	112-0108-30	112-0105-30	4.00 (101.6)	3.11 (79.0)	9 (12)	9 (12)
1 (25)		SE-094	SE-097	112-0109-30	112-0106-30	4.50 (114.3)	3.70 (94.0)	18 (24)	18 (24)
1-1/2 (40)		SE-095	SE-098	112-0110-30	112-0107-30	5.75 (146.0)	4.75 (120.7)	25 (34)	25 (34)
2 (50)		SE-095	SE-098	112-0110-30	112-0107-30	5.75 (146.0)	4.94 (125.5)	25 (34)	25 (34)
3 (80)	LD56	SE-60	NA						
4 (100) 7150	LD56	SE-60							
4 (100) 730S & 7300	LD57	SE-61							
6 (150) 7150	LD57	SE-61							
6 (150) 730S & 7300	LD58	SE-62							
8 (200) 7150	LD58	SE-62							

* For valves with PEEK(L) seats use bonnet extension SE-096, 097 or 098.

VALVE TORQUE DATA

Use these torque charts as a guide for actuator selection. Additional requirements may be imposed by media characteristics, trim, and frequency of valve operation. For clean lubricating fluid service, required torque for PTFE (T), XTREME (X) and filled PTFE (M) seated valves only may be reduced 20% when the valve is equipped with corrosion resistant trim. For difficult services such as slurries and semi-solids, and for oxygen, increase values by 50%. If in doubt, err on the side of safety by using a larger actuator than would normally be selected.

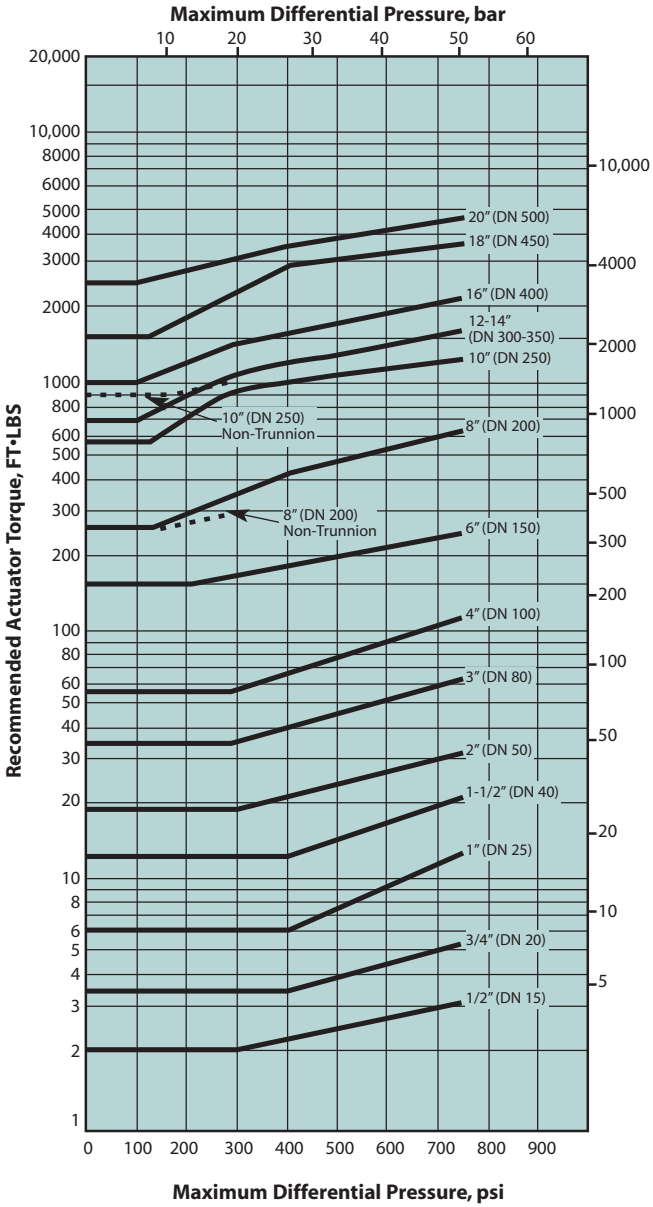
Valves with E-PAK® require an increase in operating torque. Refer to Bulletin B115-4 for additional information.

Torque output values and actuator selection tables for the different types of JAMESBURY actuators are contained in the bulletins listed below.

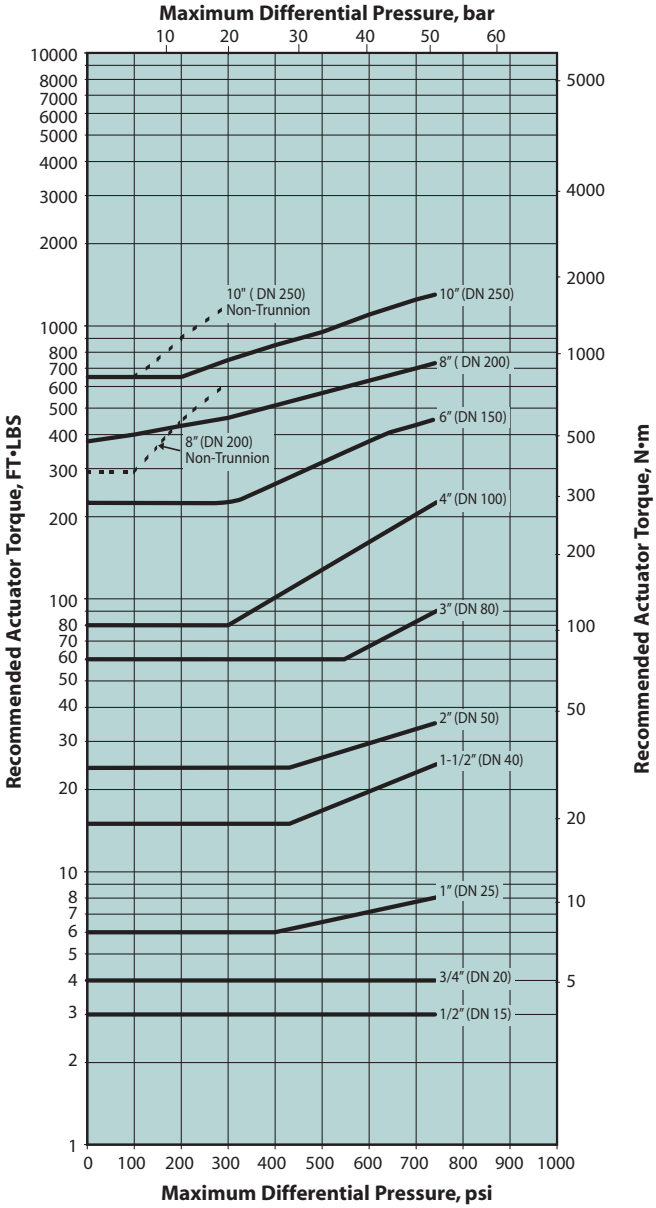
Manual Gear Actuators	A100-1
B-Series Piston Actuators	6B20
QUADRA-POWR® X Spring Diaphragm Rotary Actuators	A110-4
VALV-POWR® Series VPVL	A111-3
VPVL Stainless Steel	A111-4
V-Series Electric Actuators	A200-1
ADC Electric Actuators	A201-1

ANSI Class 150 and 300 Valve Torque Data

PTFE (T) Seated Valves



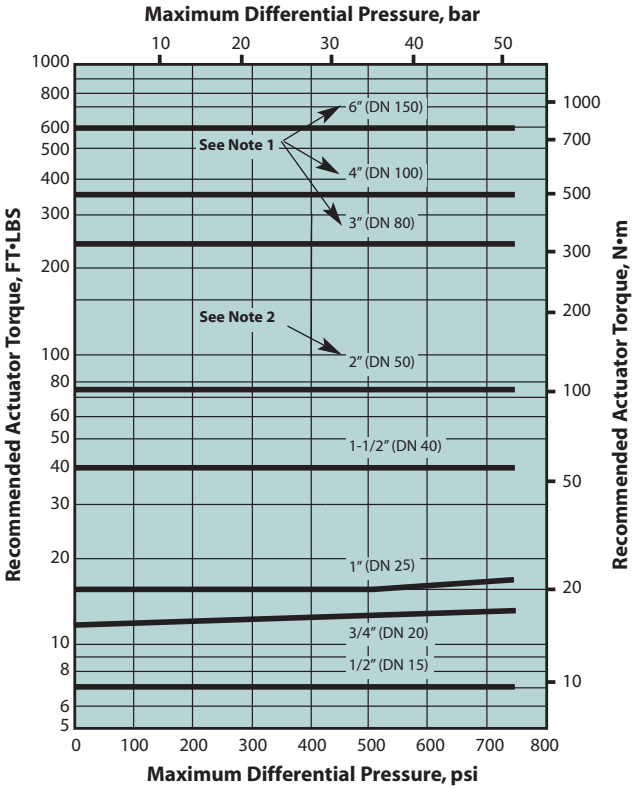
XTREME (X) Seated Valves 1/2" – 10" (DN 15 – 250)



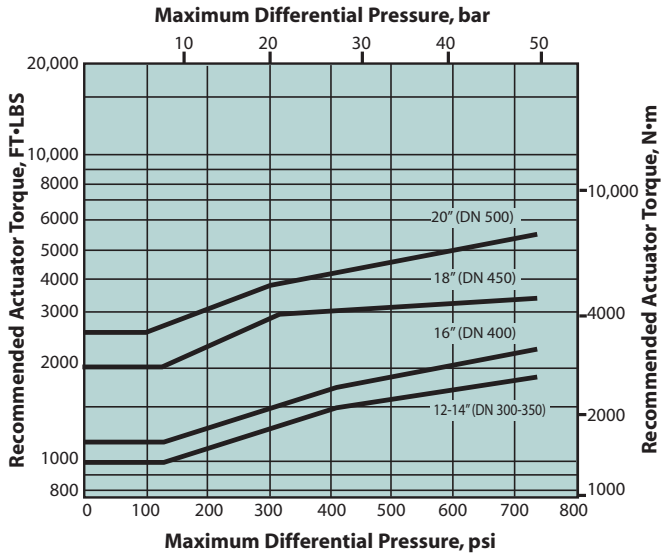
VALVE TORQUE DATA

ANSI Class 150 and 300 Valves

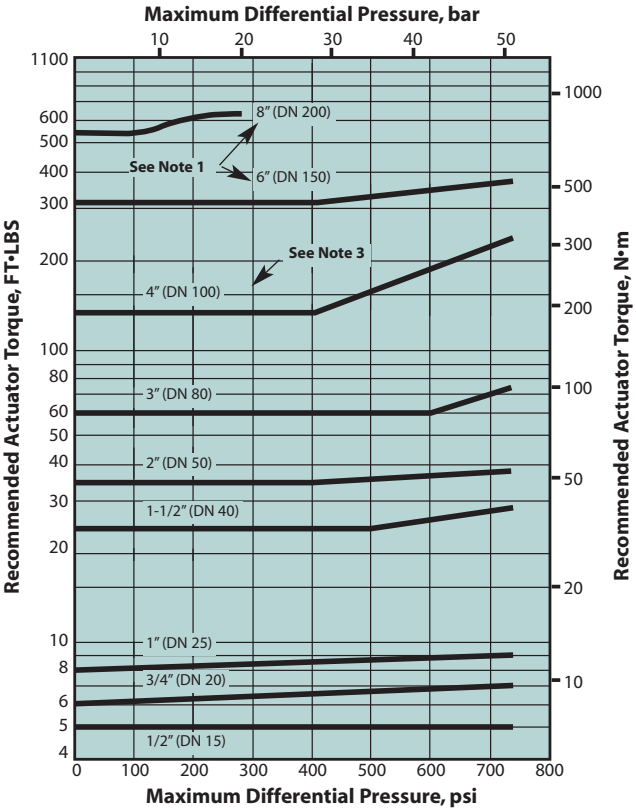
Peek (L) Seated Valves 1/2" – 6" (DN 15 – 150)



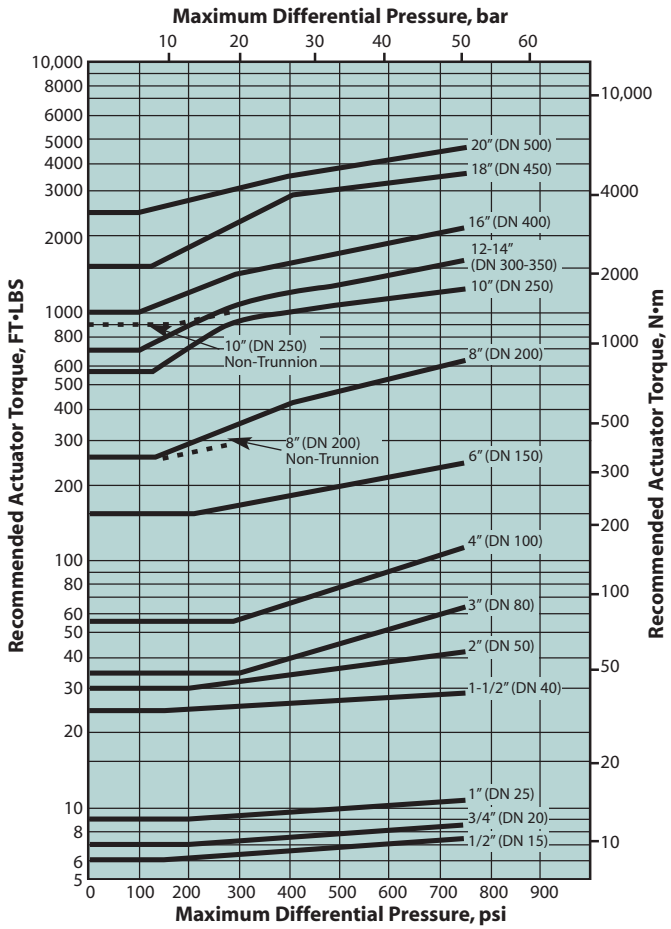
Filled PTFE (M) Seated Valves



PFA (B) Seated Valves 1/2" – 8" (DN 15 – 200)



UHMW Polyethylene (U) Seated Valves



Note 1: Actuator is required;
Note 2: Actuator is required for difficult service;
Note 3: Actuator is required for difficult service and pressure greater than 500 psi.

HOW TO ORDER

EXAMPLE: A 2" ANSI Class 300 short design valve (730S) in FIRE-TITE design with raised-face flanges (31), carbon steel body (22), and 316 stainless steel trim (36), with XTREME seats (XTZ) and molecularly enhanced PTFE stem seals is written: 2" 730S-31-2236XTZ1.

1	2	3	—	4	—	5	6	7	8
2"	730S	–		31		22	36	XTZ	1

1	Size		
1/2" to 20"	1/2" (DN 15)	3" (DN 80)	12" (DN 300)
	3/4" (DN 20)	4" (DN 100)	14" (DN 350)
	1" (DN 25)	6" (DN 150)	16" (DN 400)
	1-1/2" (DN 40)	8" (DN 200)	18" (DN 450)
	2" (DN 50)	10" (DN 250)	20" (DN 500)

2	Valve Series & Style	Size Range
7150	Standard Bore Class 150	1/2 – 10" (DN 15 – 250)
7180	Standard Bore Class 150*	1/2 – 10" (DN 15 – 250)
730S	Standard Bore Class 300 (Short)	1/2 – 10" (DN 15 – 250)
7300	Standard Bore Class 300	1/2 – 10" (DN 15 – 250)
7380	Standard Bore Class 300*	1/2 – 10" (DN 15 – 250)
5150	Standard Bore Class 150	12 – 20" (DN 300 – 500)
5180	Standard Bore Class 150*	12 – 20" (DN 300 – 500)
530S	Standard Bore Class 300 (Short)	12" (DN 300)
5300**	Standard Bore Class 300	12 – 20" (DN 300 – 500)
5380	Standard Bore Class 300*	12 – 20" (DN 300 – 500)

* Metric units on nameplate. Valves larger than 1" (DN 25) are CE marked. Includes static grounding per BS 5351.
** 18" Only available as 53LO.

3	Special Construction
—	Standard (no entry)
C	Chlorine
N	NACE MR0103
O	Oxygen
TG	Top Grounded (1/2" – 2" 7000)
STG	Grounded 7000 Series
STGR	Grounded 5000 Series
V	High Vacuum
VC	High Vacuum Certified
DT	125 RMS Flange Finish
DBB	Double Block and Bleed (See Bulletin B151-1)

4	End Connection Construction	Size Range
11	Raised Face Non-FIRE-TITE Non-Trunnion	1/2 – 10" (DN 15 – 250) Standard Bore
31	Raised Face FIRE-TITE Non-Trunnion	1/2 – 10" (DN 15 – 250) Standard Bore
71	Raised Face FIRE-TITE Trunnion	10 – 20" (DN 250 – 500) Class 150 Std Bore 8 – 20" (DN 200 – 500) Class 300 Std Bore

5	Body Material*	Size Range
22	Carbon Steel (WCB)	All
35	Alloy 20 (CN7M)	1/2 – 10" (DN 15 – 250) Std Bore Class 150
36	Stainless Steel (CF8M)	All
71	Monel	Optional in all sizes
28	Carbon Steel (LCC)	Optional in all sizes

* Other materials available on application

6	Ball & Stem Materials*	Size Range
35	Alloy 20	1/2 – 10" (DN 15 – 250) Std Bore,
36	316 Stainless Steel	All
71	Monel	1/2 – 8" (DN 15 – 200) Std Bore, optional in all others
73	Hastelloy	Optional in all sizes
HB	316 SS, 17-4 PH	Req'd for seat & seal code LGG
00	Same as body	All (Carbon steel not available)

* Other materials available on application

7	Seat / Body Seal / Stem Seal Material*	Size Range
XTZ	XTREME/PTFE[2]/TFM	1/2 – 10" (DN 20 – 250) Std Bore
TTT	PTFE/PTFE[2]/PTFE[2]	All
MTT	Filled PTFE/PTFE/PTFE	12 – 20" (DN 300 – 500) Std Bore
BTT	PFA/PTFE[2]/PTFE[2]	1/2 – 8" (DN 15 – 200) Std Bore
LGG †[13]	Peek/Graphite/Graphite	1/2 – 6" (DN 15 – 150) Std Bore
UUU [1]	UHMW/UHMW/UHMW	1/2 – 10" (DN 15 – 250) Std Bore
MBT [1]	Barrier-filled PTFE	4 – 12" (DN 100 – 300) Std Bore
ZTT	TFM/PTFE[2]/PTFE[2]	1/2" – 10" (DN 15 – 250) Full Bore

* Use first two letters only for Series 5000 valves
† Requires 17-4PH Stem
1 Non-FIRE-TITE only
2 TFM on sizes 1-1/2" (DN 40) and smaller
3 Not a self relieving seat design

8	Bolts	Nuts	Application
1*	ASTM A193 Gr B7	ASTM A194 Gr 2H	Carbon Steel Monel
2	ASTM A193 Gr B8, B8C, B8M or B8T (Class 2)	ASTM A194 Gr 8B, 8CB, 8MB, 8TB, or 8FB	316 St. Stl. Alloy 20
5**[4]	ASTM A193 Gr B7M	ASTM A194 Gr 2HM	All NACE
4**	Monel		Monel All NACE All Cl_2

Bolts and nuts for 2" and smaller valves apply to bonnet hardware only. For 3" and larger, bolts and nuts pertain to bonnet hardware and body and cap fasteners.

* Not available on 2" Standard Bore and smaller
** Required for compliance to NACE MR0103-2003 3" and larger.
4 2" (DN 50) and smaller use Monel bonnet hardware for NACE MR0103-2003 compatibility.

Hastelloy is a registered trademark of Haynes International, Inc. Monel is a registered trademark of Inco. Delrin is a registered trademark of Dupont Co.

STANDARDS AND SPECIFICATIONS

The Company

ISO 9001 – 2000 ANSI/150/ASQ Q9001 – 2000
Pressure Equipment Directive 97/23/EC

The Product - Standard

API 598	American Petroleum Institute - Valve Inspection and testing
API 607 Edition 4	American Petroleum Institute - Fire Test for Soft Seated Valves (Division of refining)
API 608	Metal Ball Valves Used in On-Off Service that have Buttwelded or Flanged Ends for Size 1/2 – 2" (DN 15 – 50) NPS
ANSI/ASME B16.10	American National Standard - Face-to-Face and End-to-End Dimensions of Ferrous Valves
ANSI/ASME B16.5	American National Standard - Steel Pipe Flanges and Flanged Fittings
ANSI/ASME B16.34	American National Standard - Steel Valves - Flanged and Buttwelded End
ANSI/ASME B31.1	American National Standard - Power Piping
ANSI/ASME B31.3	American National Standard - Chemical Plant and Petroleum Refinery Piping
ANSI/FCI 70-2-1991	American National Standard - For Control Valve Seat Leakage
BS2080:1989	British Standards Institute - Specification for Face-to-Face Dimensions of Flanged and Buttwelded Steel Valves
BS 6755-2: 1987	Testing of Valves. Specification for Fire Type-Testing Requirements
ISO 15848-1	Industrial Valves - Fugitive Emissions - Measurement, Test & Qualification Procedures
ISO 5752:1982	International Standard for Organization Metal Valves for use in Flanged Piping Systems
ISA 75.02	Valve Sizing Coefficient Cv, Piping Geometry Factor Fp and Pressure Drop Limitation XT
ISA S75.19	Hydrostatic Testing of Control Valves
ISO 5211	Dimensions for Attachment of Actuators/Gear Boxes to Valves (ISO Mounting)
MSS SP-25	Manufacturers Standardization Society - Standard Marking System for Valves
MSS-SP-55	Manufacturers Standardization Society - Quality Standards for Steel Castings
MSS-SP-6-1996	Standard Finishes for Contact Faces of Pipe Flanges and Connecting-End Flanges of Valves and Fittings
MSS-SP-44-1996	Steel Pipe Line Flanges
MSS-SP-61-1992	Pressure Testing of Steel Valves
MSS SP-72-1992	Flanged or Butt and Weld End Ball Valves Having Full or Reduced Bores for General Liquid and Gas Service
MSS SP-96-1996	Terminology for Valves and Fittings

The Product - Optional

BS 5351	Steel Ball Valves for the Petroleum, Petrochemical and Allied Industries
97 / 23 / EC	European Pressure Equipment Directive
MSS SP-53-1995 (R-1990)	Quality Standard For Steel Castings and Forgings for Valves, Flanges and Fittings and Other Piping Components-Magnetic Particle Examination Method
MSS SP-93-1987 (R-1992)	Quality Standard For Steel Castings and Forgings for Valves, Flanges and Fittings and Other Piping Components-Liquid Penetrant Method
NACE Standard MR0103	National Association of Corrosion Engineers-Engineers - Materials Resistant to Sulfide Stress Cracking in Corrosive Petroleum Refining Environments
Factory Mutual (FM)	Figure 1052 Gas and Oil Shutoff Valves.
Underwriter Laboratory (UL)	Categories MHKZ, YQAR, YRBX, YRPV, YSDT.

837E Temperature Switches	**837E Nondisplay Temperature Switches**	**839E Flow Switches**
• Microprocessor based with no moving parts for longer life and reduced downtime • Rugged, corrosion-resistant 316L stainless steel housing features an IP66 enclosure rating to withstand harsh industrial conditions • Media temperature range from -50…150°C (-58…302°F) • Industry-leading four-digit 14-segment digital display • Independently programmable dual PNP N.O./N.C. outputs or 4…20 mA analog output • 316L stainless steel probe	• Microprocessor based with no moving parts for longer life and reduced downtime • Rugged, corrosion-resistant 316L stainless steel housing features an IP66 enclosure rating to withstand harsh industrial conditions • Media temperature range from -50…150°C (-58…302°F) • 4…20 mA analog output PC programmable via the M12 connector • 316L stainless steel probe	• Microprocessor based with no moving parts for longer life and reduced downtime • Rugged, corrosion-resistant 316 stainless steel housing features an IP66 enclosure rating to withstand harsh industrial conditions • Flow range from 0.03…3 m/s (0.1…9.84 ft/s) • Industry-leading four-digit 14-segment digital display • Independently programmable dual PNP N.O./N.C. outputs or 4…20 mA analog output • 316L stainless steel probe
• Automotive industry • Machine tool • Hydraulics • Batch temperature control	• Automotive industry • Machine tool • Hydraulics • Batch temperature control	• Food and beverage • Pharmaceuticals • Water/wastewater • Hydraulics
• 12…30V DC	• 10…35V DC	• 18…30V DC
• Dual PNP N.O./N.C. or 4…20 mA analog with single PNP N.O./N.C. programmable outputs	• 4…20 mA analog	• Dual PNP N.O./N.C. or 4…20 mA analog with single PNP N.O./N.C. programmable outputs
• <60 mA	• <23 mA	• <100 mA
• 250 mA (each output)	• 250 mA (each output)	• 250 mA (each output)
• cULus • CE Marked for all applicable directives	• cULus • CE Marked for all applicable directives	• cULus • CE Marked for all applicable directives
• See page 7-10	• See page 7-13	• See page 7-15

837E Temperature Switches

Features

- Microprocessor based with no moving parts for longer life and reduced downtime
- Rugged, corrosion-resistant 316L stainless steel housing features an IP66 enclosure rating to withstand harsh industrial conditions
- Media temperature range from –50…150°C (–58…302°F)
- Operating temperatures from –40…85°C (–40…185°F)
- Industry-leading four-digit 14-segment digital display
- Independently programmable dual PNP N.O./N.C. outputs or 4…20 mA analog output with single PNP N.O./N.C. output
- Stainless steel probe

Specifications

Certifications	cULus, CE Marked for all applicable directives, and 3 A authorized only with sanitary adaptor
Supply Voltage	12…30V DC
Output	Dual PNP N.O./N.C. or 4…20 mA analog output with single PNP N.O./N.C.
Supply Current	<60 mA (no load)
Load Current, Max.	250 mA (per PNP output)
Analog Output Impedance	Max. (V_{supply} - 6.5V)/0.22 A
Accuracy	<0.2°C
Repeatability	<0.1°C
Temperature Drift	<0.1°C per year
Media Temperature [C (F)]	-50…150° (-58…302°)
Operating Temperature [C (F)]	-40…85° (-40…185°)
Housing Material	316 stainless steel
Wetted Parts	316L stainless steel
Enclosure Type Rating	IP66
Switch Cycles, Min.	>10,000,000
Response Time	Switch Output: ≤20 ms Analog Output: Rise Time: T_{90} ≤200 ms Analog Output: Settling Time: T_{99} ≤500 ms

Applications

- Automotive industry
- Machine tool
- Hydraulics
- Batch temperature control
- Food and beverage
- Pharmaceuticals

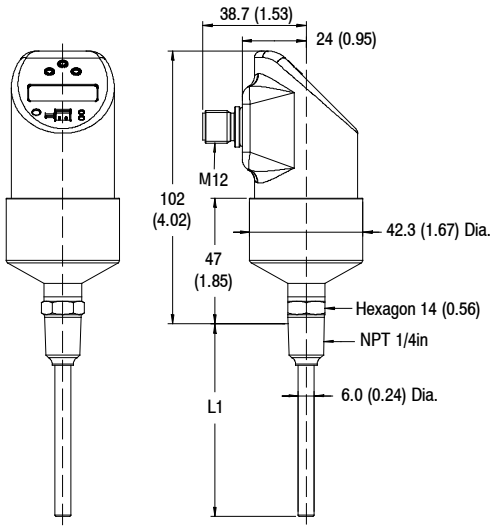
Product Selection

Process Connection	Set Point Range [C (F)]	Reset Point Range [C (F)]	Probe Length	Cat. No.	
				Dual PNP Output	4…20 mA Analog Output w/Single PNP Output❶
1/4 inch NPT (Male)	-49…150° (-57…302°)	-50…149.5° (-58…301°)	50 (1.96 in.)	837E-DA1BN1A1D4	837E-DC1BN1A1D4
	-49…150° (-57…302°)	-50…149.5° (-58…301°)	100 (3.93 in.)	837E-DA1BN1A2D4	837E-DC1BN1A2D4
	-49…150° (-57…302°)	-50…149.5° (-58…301°)	200 (7.87 in.)	837E-DA1BN1A4D4	837E-DC1BN1A4D4
1/2 inch NPT (Male)	-49…150° (-56.2…302°)	-50…149.5° (-58…301.1°)	50 (1.96 in.)	837E-DA1BN2A1D4	837E-DC1BN2A1D4
	-49…150° (-57…302°)	-50…149.5° (-58…301.1°)	100 (3.93 in.)	837E-DA1BN2A2D4	837E-DC1BN2A2D4
	-49…150° (-57…302°)	-50…149.5° (-58…301°)	200 (7.87 in.)	837E-DA1BN2A4D4	837E-DC1BN2A4D4
G1/4 BSPP	-49…150° (-57…302°)	-50…149.5° (-58…301°)	50 (1.96 in.)	837E-DA1BN3A1D4	837E-DC1BN3A1D4
	-49…150° (-57…302°)	-50…149.5° (-58…301°)	100 (3.93 in.)	837E-DA1BN3A2D4	837E-DC1BN3A2D4
	-49…150° (-57…302°)	-50…149.5° (-58…301°)	200 (7.87 in.)	837E-DA1BN3A4D4	837E-DC1BN3A4D4
G1/2 BSPP	-49…150° (-57…302°)	-50…149.5° (-58…301°)	50 (1.96 in.)	837E-DA1BN4A1D4	837E-DC1BN4A1D4
	-49…150° (-57…302°)	-50…149.5° (-58…301°)	100 (3.93 in.)	837E-DA1BN4A2D4	837E-DC1BN4A2D4
	-49…150° (-57…302°)	-50…149.5° (-58…301°)	200 (7.87 in.)	837E-DA1BN4A4D4	837E-DC1BN4A4D4
Sanitary Connection					
1…1.5 inch Clamp	-49…150° (-57…302°)	-50…149.5° (-58…301°)	50 mm (1.96 in.)	837E-DA1BNBA1D4	837E-DC1BNBA1D4
	-49…150° (-57…302°)	-50…149.5° (-58…301°)	100 mm (3.93 in.)	837E-DA1BNBA2D4	837E-DC1BNBA2D4
	-49…150° (-57…302°)	-50…149.5° (-58…301°)	200 mm (7.87 in.)	837E-DA1BNBA4D4	837E-DC1BNBA4D4
2 inch Clamp	-49…150° (-57…302°)	-50…149.5° (-58…301°)	50 mm (1.96 in.)	837E-DA1BNCA1D4	837E-DC1BNCA1D4
	-49…150° (-57…302°)	-50…149.5° (-58…301°)	100 mm (3.93 in.)	837E-DA1BNCA2D4	837E-DC1BNCA2D4
	-49…150° (-57…302°)	-50…149.5° (-58…301°)	200 mm (7.87 in.)	837E-DA1BNCA4D4	837E-DC1BNCA4D4
Base Switch	-49…150° (-57…302°)	-50…149.5° (-58…301°)	50 mm (1.96 in.)	837E-DA1BN7A1D4	837E-DC1BN7A1D4
	-49…150° (-57…302°)	-50…149.5° (-58…301°)	100 mm (3.93 in.)	837E-DA1BN7A2D4	837E-DC1BN7A2D4
	-49…150° (-57…302°)	-50…149.5° (-58…301°)	200 mm (7.87 in.)	837E-DA1BN7A4D4	837E-DC1BN7A4D4
Recommended cordset: 2 m (6.5 ft) 4-pin DC micro (straight) ❷					889D-F4AC-2
Recommended cordset: 2 m (6.5 ft) 4-pin DC micro (right angle) ❷					889D-R4AC-2

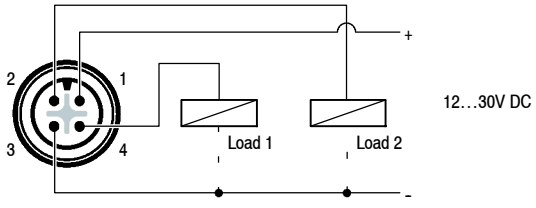
❶ Analog output version may be set up to output dual PNP N.O./N.C.

❷ Additional cable lengths are available. Shielded cables may be used to protect analog signal quality in an electrically noisy environment—refer to the *On-Machine ™ Connectivity* catalog for options.

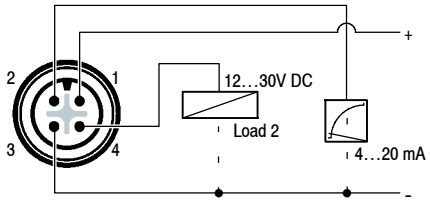
Approximate Dimensions [mm (in.)]



Wiring Diagram



Dual PNP



4…20 mA Analog with Single PNP

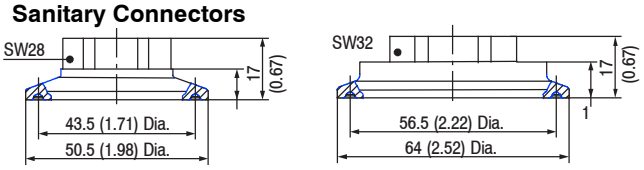
Note: Output 2 operates as diagnostic/break contact in DESINA mode.

837E Temperature Switches

Accessories

Description	Cat. No.
Configuration kit (includes converter cable and ReadWin 2000 software)	836E-NSR
1…1.5 inch sanitary clamp	836E-NH7B
2 inch sanitary clamp	836E-NH7C

Sanitary Connectors



837E Nondisplay Temperature Switches

Features

- Microprocessor based with no moving parts for longer life and reduced downtime
- Rugged, corrosion-resistant 316L stainless steel housing features an IP67 enclosure rating to withstand harsh industrial conditions
- Media temperature range from –50…150°C (–58…302°F)
- Operating temperatures from –40…85°C (–40…185°F)
- 4…20 mA analog output PC programmable via the M12 connector
- Stainless steel probe

Applications

- Automotive industry
- Machine tool
- Hydraulics
- Batch temperature control
- Food and beverage
- Pharmaceuticals

Specifications

Certifications	cULus, CE Marked for all applicable directives, and 3 A authorized only with sanitary adaptor
Supply Voltage	10…35V DC
Output	4…20 mA analog
Supply Current	<23 mA (no load)
Analog Output Impedance	Max. (V_{supply} - 10V)/0.23 A
Accuracy	<0.2°C
Repeatability	<0.1°C
Temperature Drift	<0.1°C per year
Media Temperature [C (F)]	-50…150° (-58…302°)
Operating Temperature [C (F)]	-40…85° (-40…185°)
Housing Material	316 stainless steel
Wetted Parts	316L stainless steel
Enclosure Type Rating	IP67
Switch Cycles, Min.	>10,000,000
Response Time	< 3 s

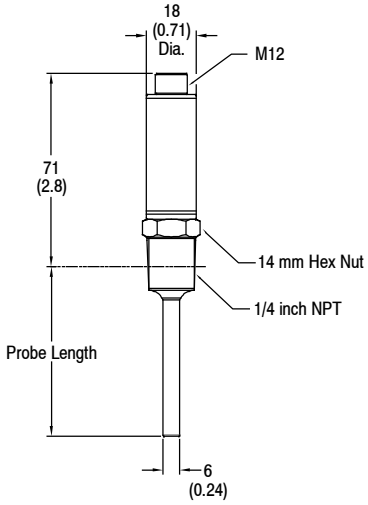
837E Nondisplay Temperature Switches

Product Selection

Process Connection	Media Temperature [C (F)]	Probe Length	Cat. No. 4…20 mA Analog Output
1/4 inch NPT (Male)	-50…150° (-58…302°)	50 mm (1.96 in.)	837E-TD1BN1A1-D4
	-50…150° (-58…302°)	100 mm (3.93 in.)	837E-TD1BN1A2-D4
	-50…150° (-58…302°)	200 mm (7.87 in.)	837E-TD1BN1A4-D4
1/2 inch NPT (Male)	-50…150° (-58…302°)	50 mm (1.96 in.)	837E-TD1BN2A1-D4
	-50…150° (-58…302°)	100 mm (3.93 in.)	837E-TD1BN2A2-D4
	-50…150° (-58…302°)	200 mm (7.87 in.)	837E-TD1BN2A4-D4
G1/4 BSPP	-50…150° (-58…302°)	50 mm (1.96 in.)	837E-TD1BN3A1-D4
	-50…150° (-58…302°)	100 mm (3.93 in.)	837E-TD1BN3A2-D4
	-50…150° (-58…302°)	200 mm (7.87 in.)	837E-TD1BN3A4-D4
Sanitary Connection			
1…1.5 inch Clamp	-50…150° (-58…302°)	50 mm (1.96 in.)	837E-TD1BNBA1-D4
	-50…150° (-58…302°)	100 mm (3.93 in.)	837E-TD1BNBA2-D4
	-50…150° (-58…302°)	200 mm (7.87 in.)	837E-TD1BNBA4-D4
2 inch Clamp	-50…150° (-58…302°)	50 mm (1.96 in.)	837E-TD1BNCA1-D4
	-50…150° (-58…302°)	100 mm (3.93 in.)	837E-TD1BNCA2-D4
	-50…150° (-58…302°)	200 mm (7.87 in.)	837E-TD1BNCA4-D4
Recommended cordset: 2 m (6.5 ft) 4-pin DC Micro (straight) ❶			889D-F4AC-2
Recommended cordset: 2 m (6.5 ft) 4-pin DC Micro (right angle) ❶			889D-R4AC-2

❶ Additional cable lengths are available. Shielded cables may be used to protect analog signal quality in an electrically noisy environment—refer to the *On-Machine Connectivity* catalog for options.

Approximate Dimensions [mm (in.)]



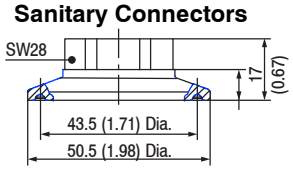
Wiring Diagram

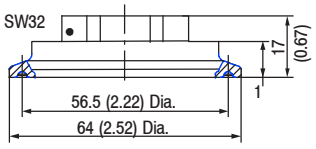
Pin No.	Description	Wire Color
1	Power supply 10…35V DC, current output 4…20 mA	Brown
2	Connection of PC configuration cable, shortened pin	White
3	Power supply 0V DC, current output 4…20 mA	Blue
4	Connection of PC configuration cable, shortened pin	Black

Accessories

Description	Cat. No.
Configuration kit (includes converter cable and ReadWin 2000 software)	836E-NSR
Cable adaptor, PC programming	836E-NSRT
1…1.5 inch sanitary clamp	836E-NH7B
2 inch sanitary clamp	836E-NH7C

Sanitary Connectors





TBR Bi-Metal Threaded Thermowell

RoHS compliant

Description & Features:

- Available in a wide range of materials for use on most applications
- Standard “stepped construction” offering is complemented by an array of custom thermowells including: straight, tapered, sanitary and flanged configurations
- CRN registered
- 1 year warranty

Applications:

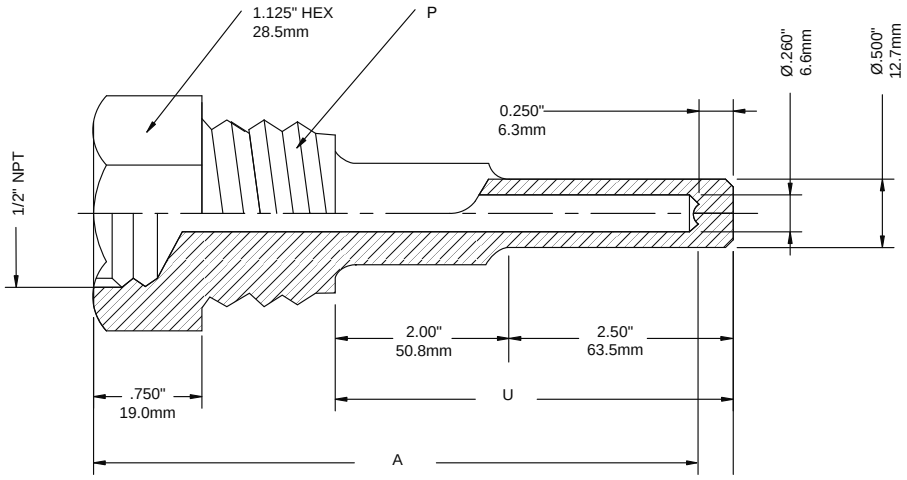
- Allows for the creation of a “sealed system”, whereby the thermometer can be removed from the application without the need for shutting down or draining the system
- To protect the thermometer from possible exposure to the process media

Specifications	
Thermometer Connection	½” NPT female connection standard Other thread sizes are available upon request
Process Connection	¾”, ½” or 1” NPT connection standard Other thread sizes are available upon request
Bore	0.260” (6.5mm) bore standard
Construction	Stepped construction standard Tapered construction available upon request
Material	Brass, AISI 304 SS, AISI 316 SS standard Other materials available upon request

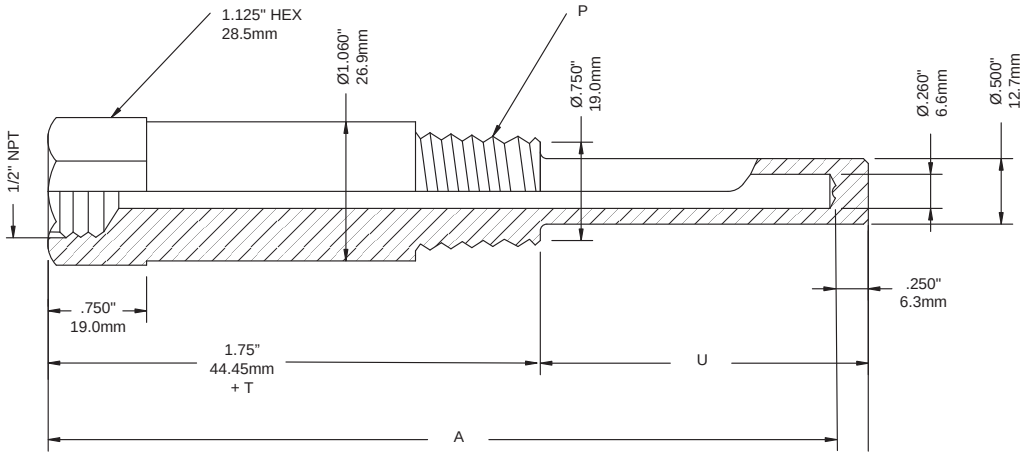
Order Codes (Thermowells without lag. Products in bold are normally in stock)

Stem Length A	NPT Connection P	Material	Code	Standard Insertion Length U	Shank Diameter
2.5" (63mm)	¾"	Brass	**TBR25**	1⅜" (35mm)	½" (12.5mm)
		304 SS	**TBR25-1**		
		316 SS	**TBR25-2**		
	½"	Brass	**TBR2550**	1⅜" (35mm)	½" (12.5mm)
		304 SS	TBR2550-1		
		316 SS	TBR2550-2		
4" (100mm)	¾"	Brass	**TBR35**	2.5" (63mm)	½" (12.5mm)
		304 SS	**TBR35-1**		
		316 SS	**TBR35-2**		
	½"	Brass	**TBR3550**	2.5" (63mm)	½" (12.5mm)
		304 SS	TBR3550-1		
		316 SS	TBR3550-2		
	1"	Brass	TBR35100	2.5" (63mm)	½" (12.5mm)
		304 SS	TBR35100-1		
		316 SS	TBR35100-2		
6" (150mm)	¾"	Brass	**TBR6**	4.5" (115mm)	¾" (19mm)
		304 SS	**TBR6-1**		
		316 SS	**TBR6-2**		
	½"	Brass	**TBR650**	4.5" (115mm)	⅝" (16mm)
		304 SS	TBR650-1		
		316 SS	TBR650-2		
	1"	Brass	TBR6100	4.5" (115mm)	⅞" (22mm)
		304 SS	TBR6100-1		
		316 SS	TBR6100-2		
9" (229mm)	¾"	Brass	**TBR9**	7.5" (190mm)	¾" (19mm)
		304 SS	**TBR9-1**		
		316 SS	**TBR9-2**		
	½"	Brass	**TBR950**	7.5" (190mm)	⅝" (16mm)
		304 SS	TBR950-1		
		316 SS	TBR950-2		
	1"	Brass	TBR9100	7.5" (190mm)	⅞" (22mm)
		304 SS	TBR9100-1		
		316 SS	TBR9100-2		
12" (305mm)	¾"	Brass	**TBR12**	10.5" (266mm)	¾" (19mm)
		304 SS	**TBR12-1**		
		316 SS	**TBR12-2**		
	½"	Brass	TBR1250	10.5" (266mm)	⅝" (16mm)
		304 SS	TBR1250-1		
		316 SS	TBR1250-2		
	1"	Brass	TBR12100	10.5" (266mm)	⅞" (22mm)
		304 SS	TBR12100-1		
		316 SS	TBR12100-2		

Standard Thermowell without lag



Standard Thermowell with lag



Cordsets & Patchcords, DC Micro Style

18 and 22 AWG, Yellow, Black, or Blue PVC

DC Micro Style

4-Pin DC Micro Cordset

Features

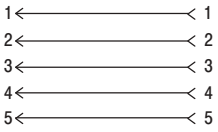
- Ratcheting coupling nut
- Subtle black or highly visible yellow PVC jacket offers good oil and chemical resistance
- Blue jacket models for intrinsically safe applications
- "–Q" models specifically wired for Quadroplex applications.
- "–V" models allow wiring of devices using pin 2 for output into standard single-point distribution boxes and IP 67 I/O

Specifications

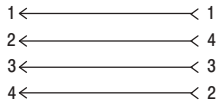
Certifications	UL recognized and CSA certified
Mechanical	
Coupling Nut	Epoxy-Coated Zinc
Material	Molded oil-resistant PUR
Contacts	Gold over nickel-plated brass
Cable	Oil-resistant PVC jacket, 18AWG or 22AWG conductors, 300V, UL recognized and CSA certified
Bend Radius	10x diameter
Cable Diameter	2/c = 5 mm (0.21 in) 3/c = 5 mm (0.21 in) 4/c = 5 mm (0.21 in) 5/c = 6.5 mm (0.25 in) 4/c (18AWG) = 6.5 mm (0.25 in)
Electrical	
Cable Rating	UL AWM style 2661 VW–1 105C 300V, CSA AWM A/B I/II 80C 300V FT1, UV oil and water resistant
Assembly Rating	250V, 4 A
Environmental	
Enclosure Type Rating	IP 67, NEMA 6P, 1200 psi (8270 kPa) washdown
Operating Temperature—C (F)	–20…+105° (–4…+221°)

Wiring Diagrams

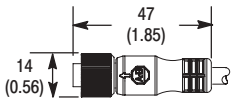
Standard Models



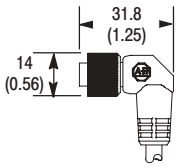
889D–*4ACD*–V* Models



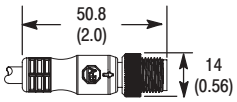
Dimensions—mm (in)



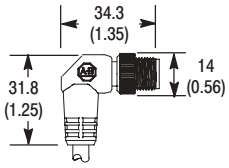
Straight Female



Right Angle Female

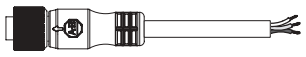


Straight Male

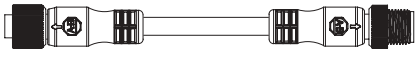


Right Angle Male

Dimensions are approximate. Illustrations are not drawn to scale.

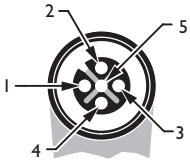
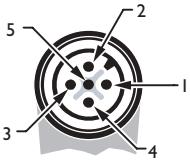


Example of Cordset



Example of Patchcord

Pinout and Color Code

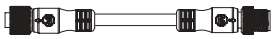
Color Code	Face View Pinout							
	2–Pin		3–Pin		4–Pin		5–Pin	
			 Female		 Male			
A	1 NA 2 NA 3 Brown	4 Blue 5 NA	1 Brown 2 NA 3 Blue	4 Black 5 NA	1 Brown 2 White 3 Blue	4 Black 5 NA	1 Brown 2 White 3 Blue	4 Black 5 Grey
B	1 Brown 2 NA 3 NA	4 Blue 5 NA	—		—		—	

Product Selection

Cordsets

Pin Count	Color Code	Jacket Color	Wire Gauge	Cat. No.			
				Straight Female	Right Angle Female	Straight Male	Right Angle Male
2-Pin	A	Yellow	22 AWG	889D–F2AC–*	889D–R2AC–*	889D–M2AC–*	889D–E2AC–*
	B	Black		889D–F2BC–Q*	889D–R2BC–Q*	—	—
3-Pin	A	Yellow		889D–F3AC–*	889D–R3AC–*	889D–M3AC–*	889D–E3AC–*
4-Pin	A	Yellow		889D–F4AC–*	889D–R4AC–*	889D–M4AC–*	889D–E4AC–*
	A	Yellow	18 AWG	889D–F4AE–*	889D–R4AE–*	889D–M4AE–*	889D–E4AE–*
	A	Black	22 AWG	889D–F4BC–*	889D–R4BC–*	889D–M4BC–*	889D–E4BC–*
	A	Blue		889D–F4LC–*	889D–R4LC–*	889D–M4LC–*	889D–E4LC–*
5-Pin	A	Yellow	22 AWG	889D–F5AC–*	889D–R5AC–*	889D–M5AC–*	889D–E5AC–*
	A	Black		889D–F5BC–*	889D–R5BC–*	889D–M5BC–*	889D–E5BC–*

Patchcords

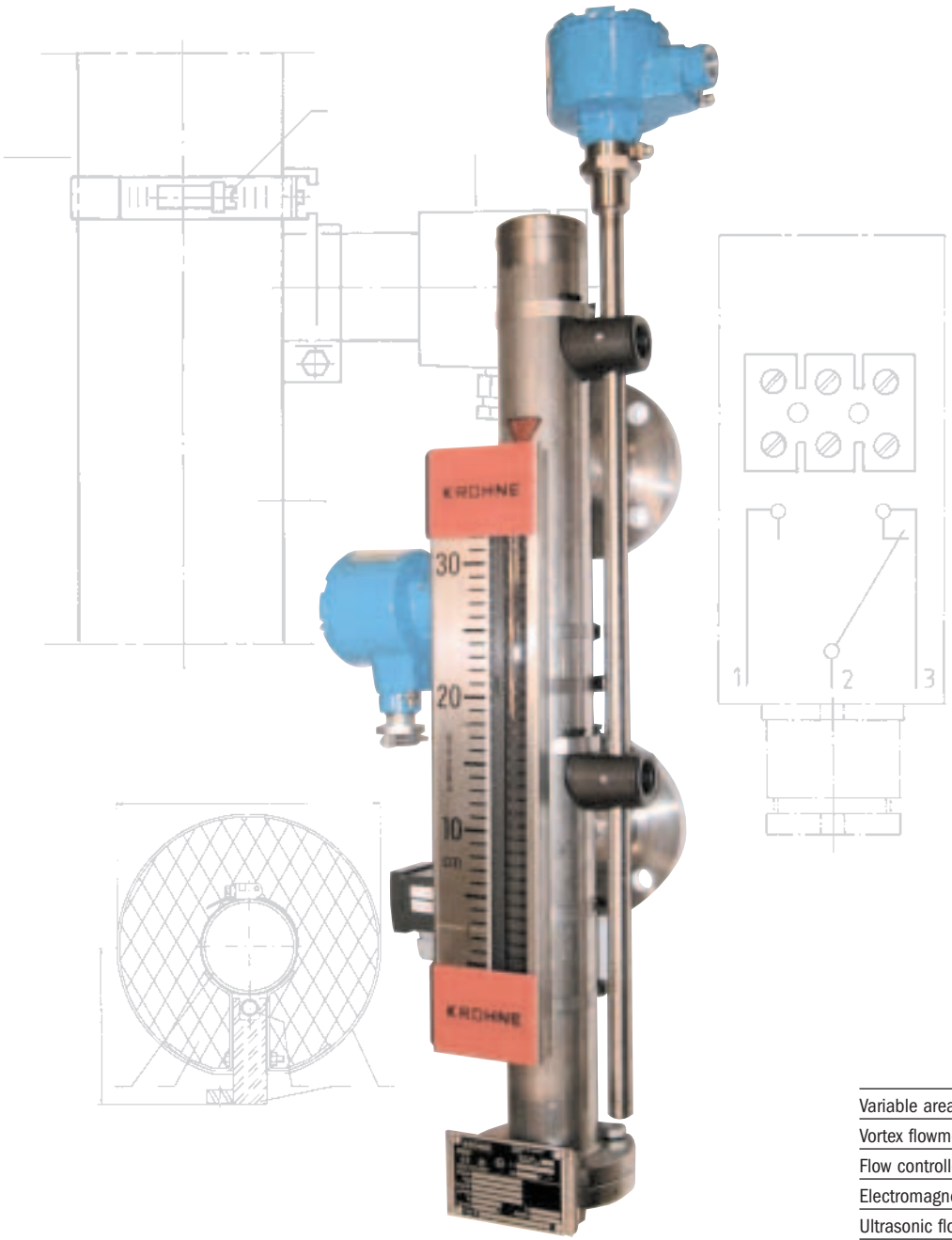


Pin Count	Color Code	Jacket Color	Wire Gauge	Cat. No.			
				Straight Female Straight Male	Straight Female Right Angle Male	Right Angle Female Straight Male	Right Angle Female Right Angle Male
2-Pin	A	Yellow	22 AWG	889D–F2ACDM–‡	889D–F2ACDE–‡	889D–R2ACDM–‡	889D–R2ACDE–‡
	B	Black	22 AWG	889D–F2BCDM–Q‡	889D–F2BCDE–Q‡	889D–R2BCDM–Q‡	889D–R2BCDE–Q‡
3-Pin	A	Yellow	22 AWG	889D–F3ACDM–‡	889D–F3ACDE–‡	889D–R3ACDM–‡	889D–R3ACDE–‡
4-Pin	A	Yellow	22 AWG	889D–F4ACDM–‡	889D–F4ACDE–‡	889D–R4ACDM–‡	889D–R4ACDE–‡
	A★	Yellow	22 AWG	889D–F4ACDM–V‡	889D–F4ACDE–V‡	889D–R4ACDM–V‡	889D–R4ACDE–V‡
	A	Yellow	18 AWG	889D–F4AEDM–‡	889D–F4AEDE–‡	889D–R4AEDM–‡	889D–R4AEDE–‡
	A	Black	22 AWG	889D–F4BCDM–‡	889D–F4BCDE–‡	889D–R4BCDM–‡	889D–R4BCDE–‡
	A	Blue	22 AWG	889D–F4LCDM–‡	889D–F4LCDE–‡	889D–R4LCDM–‡	889D–R4LCDE–‡
5-Pin	A	Yellow	22 AWG	889D–F5ACDM–‡	889D–F5ACDE–‡	889D–R5ACDM–‡	889D–R5ACDE–‡
	A	Yellow	22 AWG	889D–F5BCDM–‡	889D–F5BCDE–‡	889D–R5BCDM–‡	889D–R5BCDE–‡

* Replace symbol with 2 (2 m), 5 (5 m) or 10 (10 m) for standard cable lengths.
‡ Replace symbol with 0M3 (1 ft), 1 (1 m), 2 (2 m), 5 (5 m) or 10 (10 m) for standard lengths.
★ See Wiring Diagrams.

Note: Stainless steel connectors may be ordered by adding an "S" to the bulletin number (e.g. **889DS–F4AC–***).

Bypass Level Indicator
BM 26 A



Variable area flowmeters
Vortex flowmeters
Flow controllers
Electromagnetic flowmeters
Ultrasonic flowmeters
Mass flowmeters
Level measuring instruments
Communications technology
Engineering systems & solutions
Switches, counters, displays and recorders
Heat metering
Pressure and temperature

Bypass-level indicator BM 26 A

- **Simple, rugged design**
- **Particularly suitable for use with highly corosive, noxious or flammable substances and ideal for severe operating conditions**
- **For Level or Interface measurement**

Operating principle

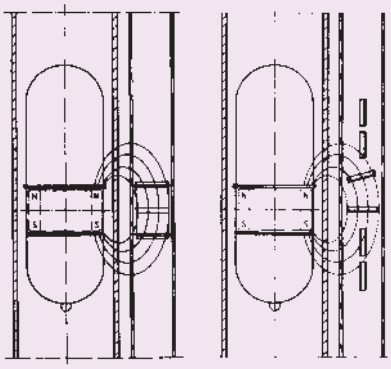
The BM 26 operates on the principle of communicating vessels. The measuring chamber is connected adjacent to the tank so that the same conditions are obtained in the chamber as those in the tank.

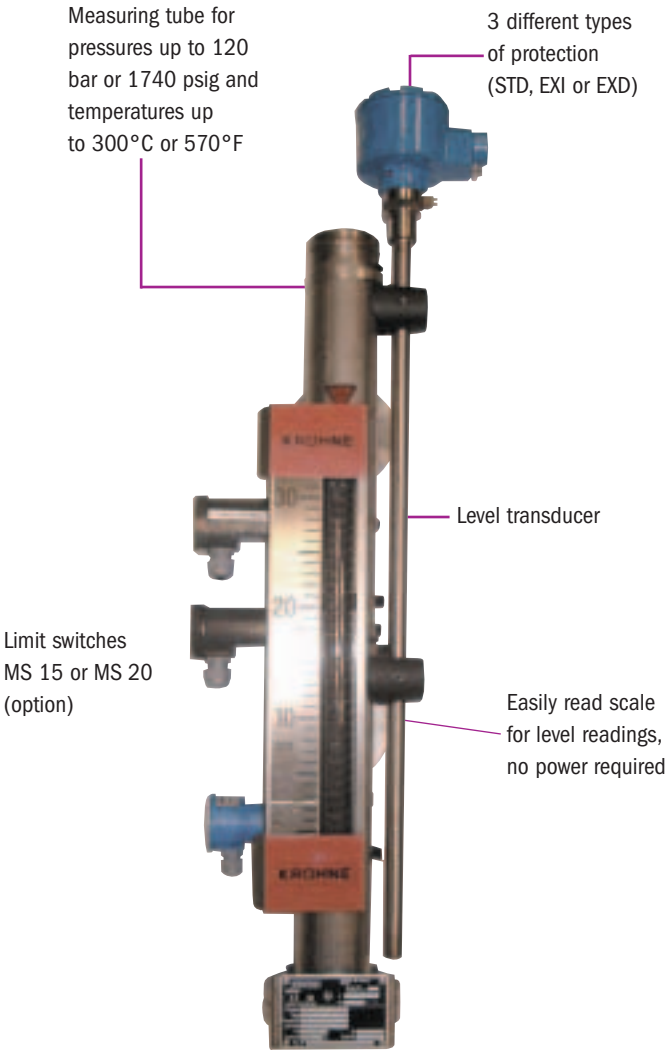
The float is equipped with a system of permanent magnets to transmit measured values to the local indicator.

The magnet system of the float activates either the magnetic flaps according to the liquid level, or a movable follower magnet in the indicating section of the indicator depending on the method of indication chosen.

The column of reversed yellow magnetic flaps, or the vertical position of the follower magnet, indicates the liquid level.

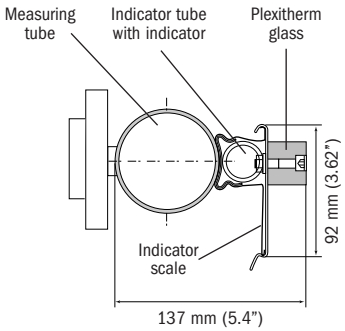
Standard indicator **Flap indicator**





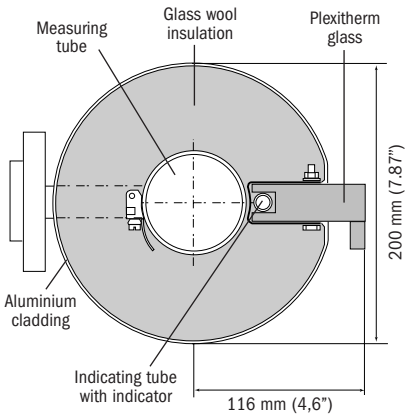
Special versions

BM 26 A/AG
down to –40°C or –40°F



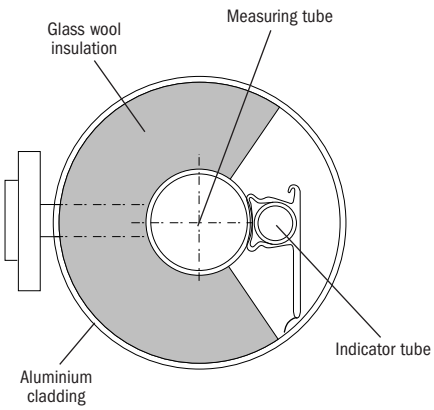
BM 26 A/TR, BM 26 A/IC/TR
down to –200°C or –330°F

BM 26 A/IC/TR is insulated.
BM 26 A/TR is ready for insulation by customer, please specify length of socket up to the connection flange.



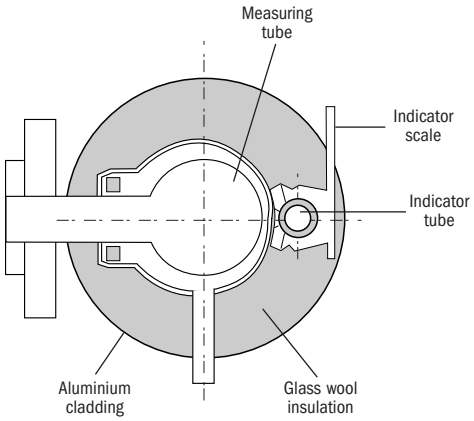
BM 26 A/HR, BM 26 A/IC/HR
for temperatures from -200 ... +300°C or -390 ... +570°F.

BM 26 A/IC/HR is insulated.
BM 26 A/HR is ready for insulation by customer, please specify length of socket up to the connection flange.



Heating system for measuring tube BM 26 A/B
For extreme operating conditions, the measuring tube is fitted with a heating jacket, standard connection Ermeto 12 for hot-water or steam heating.
Max. allowable operating pressure of the heating medium is 6 bar or 87 psig. Insulation of the measuring tube is recommended.

Section through measuring tube with heating jacket



The responsibility as to the suitability, intended use and corrosion-resistance of the materials used in their construction rests solely with the purchaser.

Technical data

Instrument type	**BM 26 A**
Measuring range (standard)	0.3 ... 6 m or 0.98 ... 19.68 ft
Accuracy	± 10 mm or ± 0.4" of measured value
Min. product density	0.5 kg/l ... 3.0 kg/l or 31.2 ... 187 lbs/ft^3
Viscosity	≤ 5000 mPa s or ≤ 3.360 lb/ft s
Max. allowable operating pressure at 20°C or 70°F (dependent on material, flange pressure rating and float pressure resistance)	40 bar or 580 psig; Information on higher pressure levels available on request
Indicator	
Standard	Linear indicator with cm/m graduation
Option	Linear scale with inch/feet, % or volume Graduation, as required; flap indicator without scale; flap indicator with scale in cm/m, inch/feet, % or volume graduation, as required
Mounting position	Vertical
Protection (indicator) to EN 60529	IP 68 (equivalent to NEMA 6)
Pressure vessel approvals	Pressure equipment directive 97/23/EC
Electromagnetic compatibility (EMC)	EN 50081-1, EN 50082-2 and EN 61326 (1 + 2)
Ambient temperature	
Standard, with flap or bar indicator	-20°C ... +200°C or –5 ... +390°F
Optional, non- Ex	-200°C ... +300°C or -325 ... +570°F

BM 26 A Bypass Level Indicator for all options, except those shown in tables below

Temperature class	Process temperature	Ambient temperature range for:
T6	T(fluid) ≤70°C or ≤160°F	-20...+60°C or –4...+140°F
T5	T(fluid) ≤95°C or ≤205°F	-20...+50°C or -4...+120°F
T4	T(fluid) ≤130°C or ≤265°F	-20...+50°C or -4...+120°F
T3	T(fluid) ≤195°C or ≤380°F	-20...+40°C or -4...+105°F

BM 26 A Bypass Level Indicator with level transducer PRETOP 5343B transmitter and / or all EXI – approved level switches

Temperature class	Process temperature	Ambient temperature range for:
T6	T(fluid) ≤70°C or ≤160°F	-40...+60°C or –40...+140°F
T5	T(fluid) ≤95°C or ≤205°F	-40...+50°C or -40...+120°F
T4	T(fluid) ≤130°C or ≤265°F	-40...+50°C or -40...+120°F
T3	T(fluid) ≤195°C or ≤380°F	-40...+40°C or -40...+105°F

BM 26 A Bypass Level Indicator without level transducer or level switch

Temperature class	Process temperature	Ambient temperature
T6	T(fluid) ≤70°C or 160°F	-20...+60°C or -4...+140°F
T5	T(fluid) ≤95°C or 205°F	-20...+50°C or -4...+120°F
T4	T(fluid) ≤130°C or 265°F	-20...+50°C or -4...+120°F
T3	T(fluid) ≤195°C or 380°F	-20...+40°C or -4...+105°F

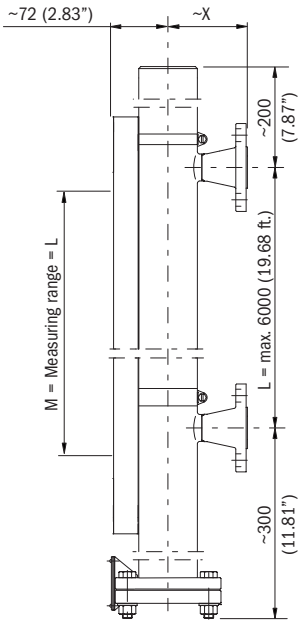
Connecting flanges	
Standard	DN 25, PN 40 Form C (to DIN 2656)
Option	DN 15...DN 50, PN 16 or PN 40 or $^1/_2$"... 2", 150 lbs/RF or 300 lbs/RF
Connecting flanges for the heating jacket	
Screw joint (standard)	Ermeto 12; DN 15, PN 40 or $^1/_2$", 150 lbs/RF or 300 lbs/RF
Pipe	12 x 1 mm or 0.47" x 0.04"
Information on other standards and pressure ratings supplied on request	
Materials	See "Instrument versions"
Level transducer	
ER (reed chain)	Current output 4...20 mA
Limit switches MS 15; MS 20	Min. and max. contact

Instrument versions

BM 26 A measuring tube class	Description
BM 26 A/C	Equipped with two lateral connections
BM 26 A/D	Equipped with two axial connections
BM 26 A/E	Equipped with one axial entry and one bottom lateral exit connection
BM 26 A/F	Equipped with one lateral entry and one top axial exit connection

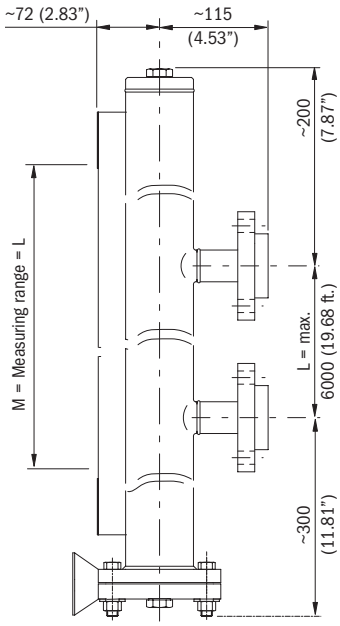
Dimensions

BM 26 A/C/RR
Welding neck flange

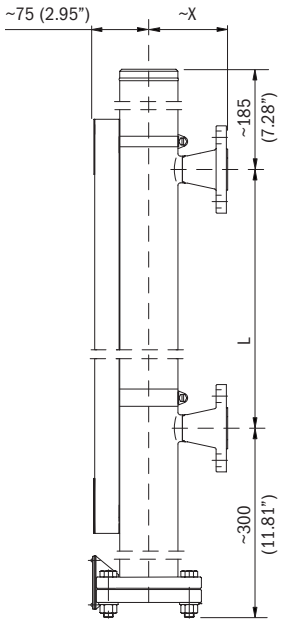


"X" is not defined

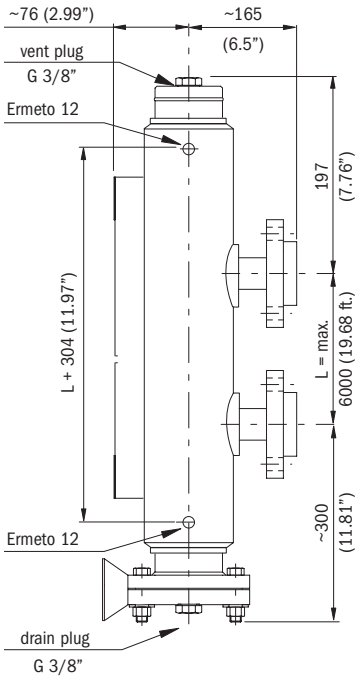
BM 26 A/C/RR
Loose (EN-DIN) flange



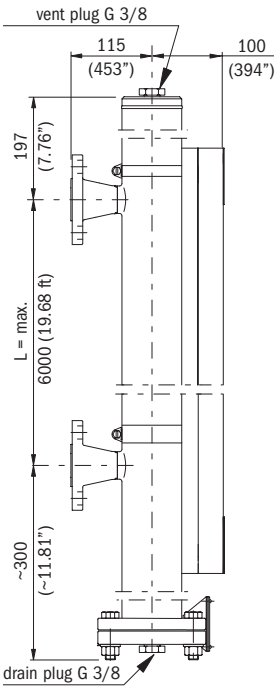
BM 26 A/C/ATEX
Welding neck flange



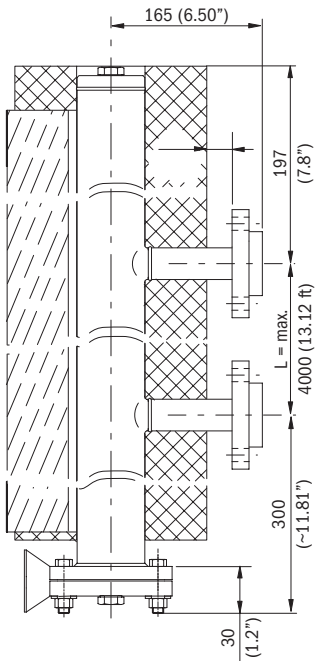
BM 26 A/C/B
(reheater sub-type C)
Loose (EN-DIN) flange



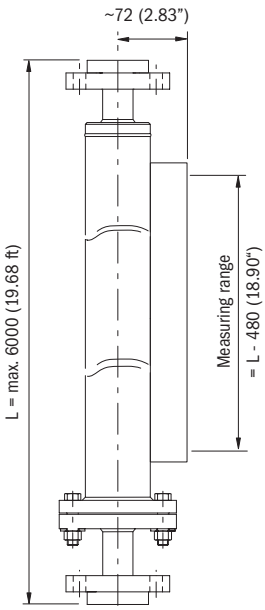
BM 26 A/C/AG
(anti-freeze sub-type C)
Welding neck flange



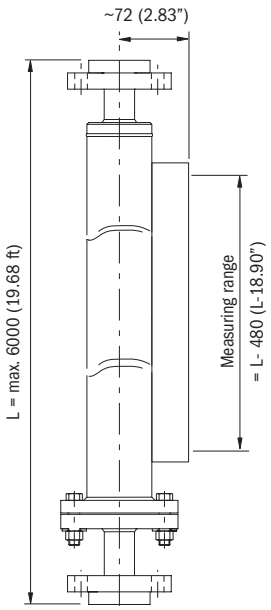
BM 26 A/C/IC/TR or /HR
TR low, HR high temperature
Loose (EN-DIN) flange



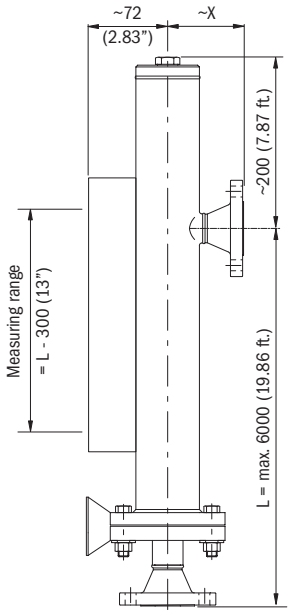
BM 26 A/D/RR
Loose (EN-DIN) flange



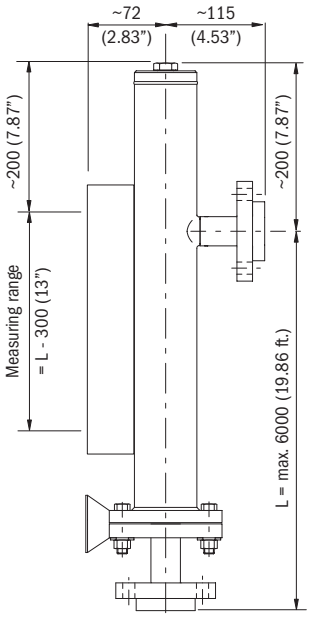
BM 26 A/D/RR
Loose (EN-DIN) flange



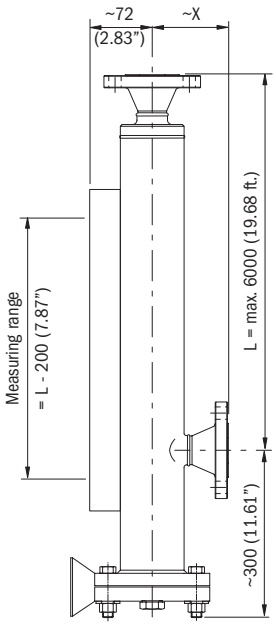
BM 26 A/E/RR
Welding neck flange



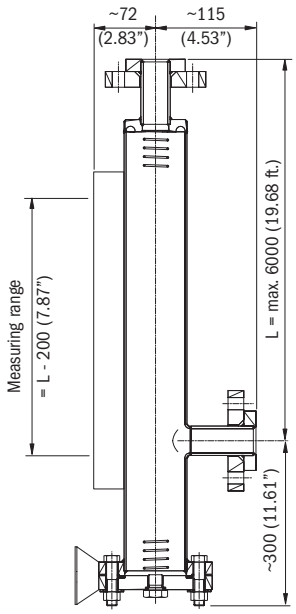
BM 26 A/E/RR
Loose (EN-DIN) flange



BM 26 A/F/RR
Welding neck flange



BM 26 A/F/RR
Loose (EN-DIN) flange



Dimensions in mm (inches)

"X" is not defined

Weights

Version	Weight in kg (for 1 m or 3.28 ft)		Weight in lbs (for 1 m or 3.28 ft)	
BM 26 A/STD	14.5	0.51*	31.96	1.12*
BM 26 A/EXD	20.6	0.82*	45.50	1.81*

* weight for every additional 100 mm or 3.94" flange spacing

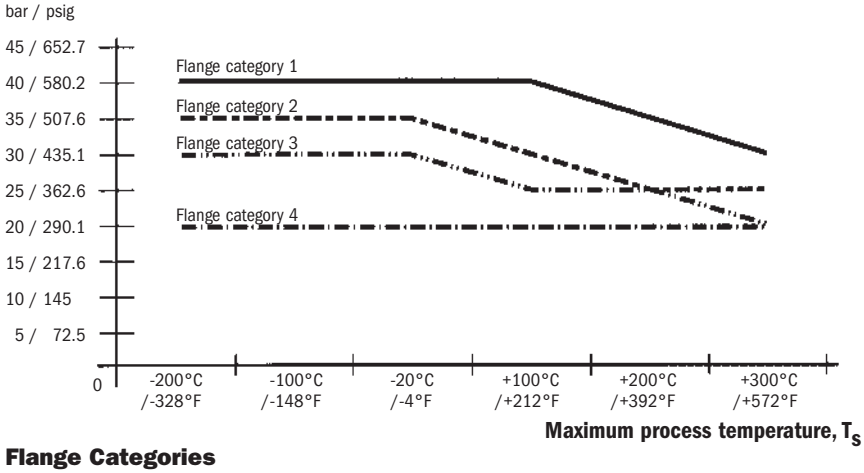
Guide tube assembly materials

Version	Flange	Gaskets	Measuring tube		
			Material	Diameter	
				mm	inches
BM 26 A	Stainless steel 316Ti (1.4571) or 316L (1.4404)	Aramide (PTFE optional)	Stainless steel 316Ti (1.4571) or 316L (1.4404)	72 x 2.3	2.83 x 0.091

Maximum operating conditions (according to Pressure Equipment Directive 97 / 23 / EC)

BM 26 A with 316 Ti steel measuring tube

Maximum allowable operating pressure, P_S

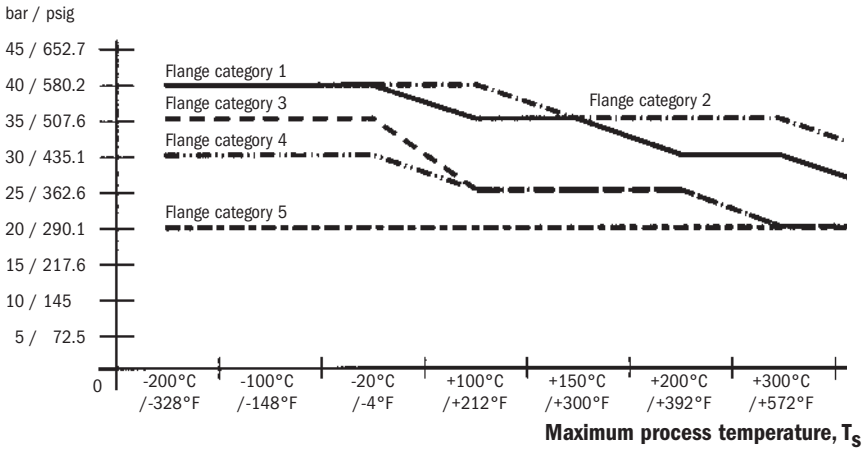


Flange Categories

1	2	3	4
DN15 PN40	DN50 PN40	DN40 PN40	1/2" ASA 150 lbs
DN20 PN40	DN50 PN40 WN	DN40 PN40 WN	3/4" ASA 150 lbs
DN25 PN40	2" ASA 300 lbs		1" ASA 150 lbs
DN15 PN40 WN			1"1/2 ASA 150 lbs
DN20 PN40 WN			2" ASA 150 lbs
DN25 PN40 WN			
1/2" ASA 300 lbs			
3/4" ASA 300 lbs			
1" ASA 300 lbs			
1"1/2 ASA 300 lbs			

BM 26 A with 316 L steel measuring tube

Maximum allowable operating pressure, P_S



Flange Categories

1	2	3	4	5
DN15 PN40	DN25 PN40	DN40 PN40	DN50 PN40	1/2" ASA 150 lbs
DN20 PN40	DN25 PN40 WN	DN40 PN40 WN	DN50 PN40 WN	3/4" ASA 150 lbs
DN15 PN40 WN	1" ANSI 300 lbs	1"1/2 ASA 300 lbs	2" ASA 300 lbs	1" ANSI 150 lbs
DN20 PN40 WN				1"1/2 ASA 150 lbs
1/2" ASA 300 lbs				2" ASA 300 lbs
3/4" ASA 300 lbs				

Level transducer

A choice of three transmitters are available for the BM 26 A. The transmitter is defined by the type of communication used, electronics housing protection, housing material and transmitter module.

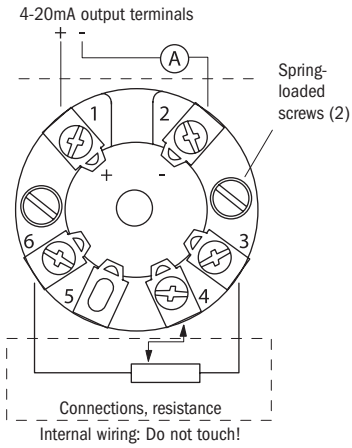
Version designation	Housing protection	Housing material	Transmitter module
ER/STD/AL/D	Without (non Ex)	AL (Aluminium)	PRelevel
ER/EXI/AL/D	EExia	AL (Aluminium)	PRelevel
ER/EXD/AL/D	EExd	AL (Aluminium)	PRelevel

Technical data

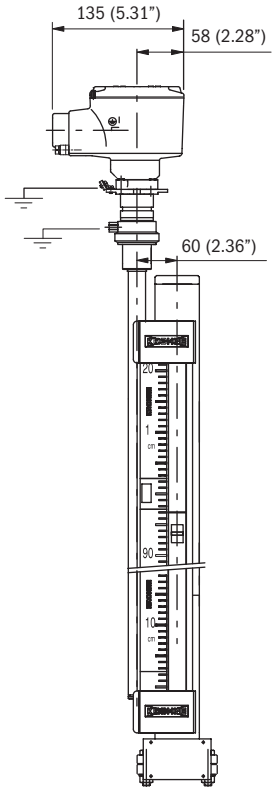
Module	**PRelevel** (PRETOP 5343B)
Description	4...20 mA intrinsically-safe transmitter; Conversion of change in resistance to analogue current signals.
Output	4...20 mA (limits: 3.8; 23 mA); Scale inversion possible. Max. load $R_L = \frac{(U - 8)}{0.023}$ [Ω]
Measuring error	≤ ± 0.1% of range
Updating time	100 ms
Power supply	8 ...35 V DC
Ambient temperature °C	-40...+60°C (T6) -40...+85°C (T4)
Ambient temperature °F	-40...+140°F (T6) -40...+185°F (T4)
Human interface	PC with communications interface Loop Link 5905 and configuration software provided on a CD-ROM; Sensor error detection is programmable for different output values; NAMUR NE43 values can be selected directly.; Response time is programmable.
Certificates and Approvals Standards Ex	 EN 50014 and EN 50020; EN 50081-1 and 2; EN 50082-1 and 2 EEx ia IIC T4/T6; ATEX 127088
Maximum power dissipated by the Exd housing	5 W
Maximum safety values for Exi applications At 4...20 mA terminal block	 U_i: 28 V I_i: 120 mA P_i: 0.84 W C_i: 1 nF L_i: 10 µH

Electrical connections

PRelevel (top view)



Dimensions



Floats

Select float as a function of the pressure, temperature, and density of the liquid. In addition, the required degree of corrosion resistance and use of the correct magnet system must be considered when selecting materials.

Code VF06...	Float No.	Float options	Dimension diameter in		Material options
			mm	inches	
Standard versions without approvals or for use in Ex hazardous zones					
1	2	Cylinder	64 x 200 x 0.5	2.52 x 7.87 x 0.02	316Ti (1.4571) or 316L (1.4404)
2	1	Cylinder	64 x 200 x 1.0	2.52 x 7.87 x 0.04	316Ti (1.4571) or 316L (1.4404)
3	3	Cylinder	64 x 208 x 0.6	2.52 x 8.19 x 0.024	titanium
4	4	Cylinder	64 x 208 x 1.0	2.52 x 8.19 x 0.04	titanium
5	2	Cylinder, pressure balanced	64 x 200 x 0.5	2.52 x 7.87 x 0.02	316Ti (1.4571) or 316L (1.4404)
6	3	Cylinder, pressure balanced	64 x 208 x 0.6	2.52 x 8.19 x 0.024	titanium
7	2	Cylinder, adjusted density	64 x 200 x 0.5	2.52 x 7.87 x 0.02	316Ti (1.4571) or 316L (1.4404)
8	1	Cylinder, adjusted density	64 x 200 x 1.0	2.52 x 7.87 x 0.04	316Ti (1.4571) or 316L (1.4404)
A	2	Cylinder, low density	64 x 200 x 0.5	2.52 x 7.87 x 0.02	316Ti (1.4571) or 316L (1.4404)
B	1	Cylinder, low density	64 x 200 x 1.0	2.52 x 7.87 x 0.04	316Ti (1.4571) or 316L (1.4404)
C	3	Cylinder, low density	64 x 208 x 0.6	2.52 x 8.19 x 0.024	titanium
D	3	Cylinder, low density	64 x 208 x 1.0	2.52 x 8.19 x 0.04	titanium
F	2	Cylinder, density adjusted, low density	64 x 200 x 0.5	2.52 x 7.87 x 0.02	316Ti (1.4571) or 316L (1.4404)
G	1	Cylinder, density adjusted, low density	64 x 200 x 1.0	2.52 x 7.87 x 0.04	316Ti (1.4571) or 316L (1.4404)
H	2	Cylinder, guided for v. low density	64 x 200 x 0.5	2.52 x 7.87 x 0.02	316Ti (1.4571) or 316L (1.4404)
K	1	Cylinder, guided for v. low density	64 x 200 x 1.0	2.52 x 7.87 x 0.04	316Ti (1.4571) or 316L (1.4404)
L	3	Cylinder, guided for v. low density	64 x 208 x 0.6	2.52 x 8.19 x 0.024	titanium
M	4	Cylinder, guided for v. low density	64 x 208 x 1.0	2.52 x 8.19 x 0.04	titanium
R	1	Cylinder, ballasted for interface	64 x 200 x 1.0	2.52 x 7.87 x 0.04	316Ti (1.4571) or 316L (1.4404)
S	4	Cylinder, ballasted for interface	64 x 208 x 1.0	2.52 x 8.19 x 0.04	titanium

Application limits

Density and temperature limits

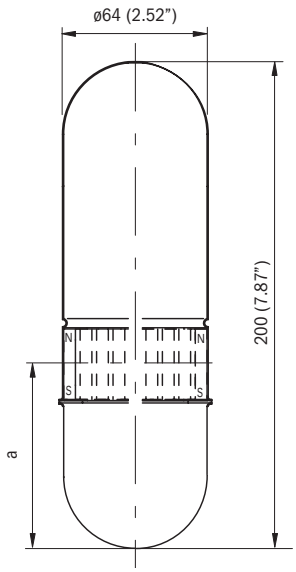
Float BM 26 A No.	Density and temperature limits					
	Min. density of product		Product temperature			
			min.		max.	
	kg/l	lbs/ft³	°C	°F	°C	°F
BM 26 A/Standard versions without approvals						
1	0.82	51.19	-200	-330	+300	+570
2	0.55	34.34	-200	-330	+300	+570
3	0.50	31.21	-200	-330	+300	+570
4	0.60	37.46	-200	-330	+300	+570
Instruments or approved for use in Ex hazardous zones						
BM 26 A/ATEX (local indicator with electrical equipment)						
1	0.82	51.19	-20	-4	+100	+210
2	0.55	34.34	-20	-4	+100	+210
3	0.50	31.21	-20	-4	+100	+210
4	0.60	37.46	-20	-4	+100	+210

Operating pressure limits

Float BM 26 A No.	Application limits							
	Max. allowable operating pressure							
	20°C or 70°F		100°C or 210°F		200°C or 390°F		300°C or 570°F	
	bar	psig	bar	psig	bar	psig	bar	psig
Standard versions without approvals								
1	55	800	41	600	37	535	32	464
2	23	335	12	175	10	145	9	131
3	23	335	13	188	10	145	8	115
4	55	800	31	450	24	350	19	276
BM 26 A/Ex (local indicator with electrical equipment)								
1	55	800	41	600	-	-	-	-
2	23	335	12	175	-	-	-	-
3	23	335	13	188	-	-	-	-
4	55	800	31	450	-	-	-	-

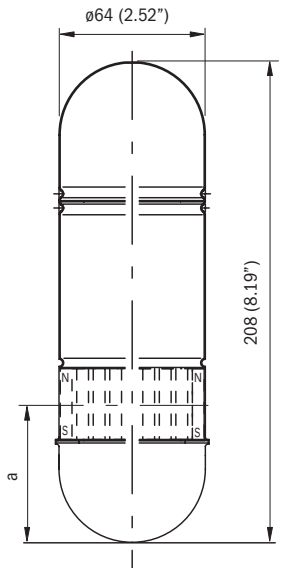
Dimensions

Floats-No. 1, 2 (316 L or 316 TL)



where a = 47 mm or 1.85"
Dimensions in mm (inches)

Floats-No. 3, 4 (Titanium)



where a = 48 mm or 1.89"

Wall thickness

Float	Wall thickness
1	1 mm or 0.04”
2	0.5 mm or 0.02”
3	0.6 mm or 0.024”
4	1 mm or 0.04”

The responsibility as to the suitability, intended use and corrosion-resistance of the materials used in their construction rests solely with the purchaser.

Subject to change without notice.

Type code

BM 26 A bypass liquid level indicator

Code Level indicator

VF06 **0**

Connection type and material

A	C / RR / 316 TI	lateral / lateral	**C**	E / RR /316 TI	bottom axial / top lateral	**G**	C / RR / 316 L	lateral / lateral *	**K**	E / RR /316 L	bottom axial / top lateral
B	D / RR / 316 TI	axial / axial	**D**	F / RR / 316 TI	bottom lateral / top axial	**H**	D / RR / 316 L	axial / axial	**L**	F / RR / 316 L	bottom lateral / top axial

Connection DN PN

1	DN 15 PN 40 flange	lap joint	**L**	DN 25 PN 40 WN flange		**U**	3/4" ANSI 150 lb WN flange	
2	DN 20 PN 40 flange	lap joint	**M**	DN 40 PN 40 WN flange		**V**	1/2" ANSI 300 lb WN flange	
3	DN 25 PN 40 flange *	lap joint	**N**	DN 50 PN 40 flange		**W**	3/4" ANSI 300 lb WN flange	
4	DN 40 PN 40 flange	lap joint	**P**	1/2" ASA ANSI 150 lb WN flange		**X**	1" ANSI 300 lb WN flange	
5	DN 50 PN 40 flange	lap joint	**R**	1" ASA AINSI 150 lb WN flange		**Y**	1"1/2 ANSI 300 lb WN flange	
6	DN 15 PN 40 WN flange		**S**	1"1/2 ANSI 150 lb WN flange		**Z**	2" ANSI 300 lb flange	
D	DN 20 PN 40 WN flange		**T**	2" ANSI 150 lb WN flange				

C - C Lenght > 1 m

0	0 m (standard)	**4**	4 m
1	1 m *	**5**	5 m
2	2 m	**6**	6 m
3	3 m		

C - C Lenght in "mm"

0	0 mm *	**4**	400 mm	**7**	700 mm
1	100 mm	**5**	500 mm	**8**	800 mm
2	200 mm	**6**	600 mm	**A**	900 mm
3	300 mm				

Float Stainles steel floats are according to the material of the device

1	0,5 mm *316 TI / 316 L* 15*	**C**	0,6 mm *Titanium*10* low density
2	1 mm *316 TI / 316 L* 15* (standard) *	**D**	1 mm *Titanium*10* low density
3	0,6 mm *Titanium*15*	**F**	0,5 mm *316 TI / 316 L* 15* d.adjusted low density
4	1 mm *Titanium*15*	**G**	1 mm *316 TI / 316 L* 15* d.adjusted low density
5	0,5 mm *316 TI / 316 L* 10* p. balanced	**H**	0,5 mm *316 TI / 316 L* 3* guided float for very low density
6	0,6 mm *Titanium* 15* p. balanced	**K**	1 mm *316 TI / 316 L* 3* guided float for very low density
7	0,5 mm *316 TI / 316 L* 15* d.adjusted	**L**	0,6 mm *Titanium*3* guided float for very low density
8	1 mm *316 TI / 316 L* 15* d.adjusted	**M**	1 mm *Titanium*3* guided float for very low density
A	0,5 mm *316 TI / 316 L* 10* low density	**R**	1 mm *316 TI / 316 L* 15* LEST IF
B	1 mm *316 TI / 316 L* 10* low density	**S**	1 mm *Titanium*15* LEST IF

Flange types

0	standard flanges *	**5**	large male	**8**	small female	**C**	V13 DIN 2513		
1	large tongue	**3**	small tongue	**6**	small male	**A**	Feder DIN 2512	**D**	R13 DIN 2513
2	large groove	**4**	small groove	**7**	large female	**B**	Nut DIN 2512		

Gaskets type

0	standard gasket (Klingerit) *
1	PTFE gasket

Indication / Scale

0	st. Steel scale (m+cm) (index) *
1	feet + inches st.Steel scale (index)
2	without scale (index)
3	% st.Steel scale (index)
4	volume st. Steel scale (index)
5	without scale (flap)
6	st. Steel scale (m+cm) (flap)
7	feet + inches st.Steel scale (flap)
8	% st. Steel scale (flap)
A	volume st. Steel scale (flap)
D	without indication

Drain

0	without drain	**7**	DN 15 PN 40 WN flange	**F**	3/4" ANSI 300 WN flange
1	G 3/8" drain *	**A**	DN 25 PN 40 WN flange	**G**	1" ANSI 300 WN flange
2	1/2" GAZ	**B**	1/2" ANSI 150 WN flange		
4	3/8 " NPT	**C**	3/4" ANSI 150 WN flange		
5	1/2" NPT	**D**	1" ANSI 150 WN flange		
6	3/4" NPT	**E**	1/2" ANSI 300 WN flange		

Vent

0	without event	**7**	DN 15 PN 40 WN flange	**F**	3/4" ANSI 300 WN flange
1	G 3/8" event *	**A**	DN 25 PN 40 WN flange	**G**	1" ANSI 300 WN flange
2	1/2" GAZ	**B**	1/2" ANSI 150 WN flange		
4	3/8 " NPT	**C**	3/4" ANSI 150 WN flange		
5	1/2" NPT	**D**	1" ANSI 150 WN flange		
6	3/4" NPT	**E**	1/2" ANSI 300 WN flange		

Design (low, high temperature, heating) TR, AG, HR, B

0	standard *
3	TR.ANTI-FREEZE LONG CONNECTION (DBG)
4	AG.ANTI-FREEZE (FR)
6	HR H; TEMP INDICATOR ONLY
7	HR H TEMP INDICATOR & LONG CONNECTION
K	B FLANGE DN15 & LONG CONNECTION
N	B/HR FLANGE-DN15 LONG CONNECTION

Insulation

0	without insulation jacket *
5	with insulation jacket (long neck)

Admissible maximum temperature

1	-200¡C	**5**	+100¡C
2	-100¡C	**6**	+195¡C
3	-20¡C	**7**	+300¡C
4	+20¡C *		

Approval

0	Non Ex *	**3**	EEx ia IIC (1G) T3 T6
1	EEx d IIC (1/2G) T3 T6		
2	EEx d IIC (2G) T3 T6		

Contact type

0	without *	**5**	MS 15 /RE/ STD / HC/ PC / NN / BT	**B**	MS 15 /RE/ Exl / LC/ AL / NO / HT
1	MS 20/ STD / LC/ PC / NN / BT	**6**	MS 15 /RE/ STD / HC/ AL / NN / HT	**C**	MS 15 /RE/ EXD / LC/ AL / NN / HT
2	MS 15/RE/ STD / LC/ PC / NO / BT	**7**	MS 20/ Exl / LC/ PC / NN / BT	**D**	MS 15 /RE/ EXD / LC/ AL / NO / HT
3	MS 15 /RE/ STD / LC/ AL / NN / HT	**8**	MS 15 /RE/ Exl / LC/ PC / NO / BT	**E**	MS 15 /RE/ EXD / LC/ AL / NN / HT
4	MS 15 /RE/ STD / LC/ AL / NO / HT	**A**	MS 15 /RE/ Exl / LC/ AL / NN / HT		

Contact number

0	without *	**2**	2 switches
1	1 switch	**3**	3 switches

ER Transmitter

0	without ER transmitter *	**4**	ER/EXI/AL/D (Pr level PRETOP 5343B)
2	ER/STD/AL/D (Pr level PRETOP 5343B)	**6**	ER/EXD/AL/D (Pr level PRETOP 5343B)

Material Certificate

0	Without *
2	3.1.b Certificate for pieces under pressure
5	Material conformity certificate

Hydraulics Control Certificate

0	Without *
1	2.3. Hydraulics test certificate
2	3.1.B Hydraulics test certificate

Certificate for Calibration

0	Without *
1	Adjustment certificate

Certificates (miscellaneous)

0	Without *
1	2.1. Certificate of compliance with order
2	Overall dimensions (layout)
3	Tag on Stainless steel plate 20x40
4	2.1. Certificate + overall dimensions (layout)
5	2.1. + Tag on Stainless Steel plate
6	Overall dimensions + Tag on Stainless Steel plate
7	2.1. + Overall dimensions + Tag on SS plate

VF06 | | | | | | | | | | |

EL Series Bimetal Thermometers

FEATURES

- *Silicone liquid fill*
- *1% full span accuracy (ASME B40.3 Grade A)*
- *Maximum ambient temp. is 150°F (65°C)*
- *Hermetically sealed case to prevent entry of moisture, interior corrosion and coil freeze-up.*
- *External adjustment permits zero reset from outside the case.*
- *Maxivison® dial allows readability from any angle without parallax error.*
- *Silicone coil dampening (up to 400°F) provides vibration dampening and improves response time.*
- *All-welded stainless steel construction*
- *Durable polycarbonate window*
- *Protection IP 65*
- *Five year limited warranty*

MADE IN THE USA

SPECIFICATIONS

Ashcroft® Series:	EL
Dial Sizes:	3,″ 5″
Stem Length:	2½″–24″ (1)
Case & Stem:	304 stainless steel, hermetically sealed
Stem Dia:	.250″
Window:	Durable polycarbonate window
Dial:	Maxivision®, black figures on white background
Pointer:	Black
Connection:	½ NPT and ½ NPT union
Connection Location:	Everyangle, Rear
Ranges:	-40/160°F — 50/550°F -20/120°C — 0/300°C

Options:

Code	Description
C4	Individual calibration cert.
XCS	Dual scale
XDM	Dial marking
XNH	Stainless steel tag
XNN	Paper tag
X3B	⅜″ stem dia. with ½ NPT
X02	¼ NPT when ½ NPT is standard (2)
XS1	Silicone free

(1) Special or longer length available, consult factory
(2) Only available on rear connection

Thermowells must be used on all pressure or velocity applications, to protect the stem of thermometer from corrosion and physical damage, and to facilitate removal of the thermometer without disturbing the process. Maximum ambient temperature is 150°F (65°C).

HOW TO ORDER

30 EL 60 R 040 0/250°F XNH

Dial Size: 3″ Code 30
Case Style: EL
Stem Connection: ½ NPT Code 60
Stem Location: Rear Code R
Stem Length: 4″ Code 040
Range: Code 0/250°F
Options: Stainless steel tag

All specifications are subject to change without notice.
All sales subject to standard terms and conditions.
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Ashcroft Inc., 250 East Main Street, Stratford, CT 06614 USA
Tel: 203-378-8281 • Fax: 203-385-0408
email: info@ashcroft.com • www.ashcroft.com

EL Series Bimetal Thermometers

EL Series selection table

Case Dial	Size Code	Style Code	Stem Conn.	Stem Code	Stem Location	Stem Lengths Available Code	"S" Length (inches)	Code	Temperature Range °F* Fahrenheit	°/Div.	Fig. Inter.	°C Celsius	°/Div.	Fig. Inter.
3″	30	EL	½ NPT Union	42	Everyangle	E	2½	025	–40/160	2	20	–10/110	2	10
									–20/120††			–20/120	2	20
							4	040	30/130††	1	10	0/50††	1	5
							6	060	0/200	2	20	0/100	1	10
			½ NPT	60	Rear	R	9	090	0/250			10/150	2	20
							12	120	50/300					
5″	50		½ NPT Union	42	Everyangle	E	15	150	50/550	5	50		5	50
							18	180						
			½ NPT	60	Rear	R	24	240						

EL Dimensions

Case Series	Dial Size	Connection Location	A	B	C	G	H	S	NPT	Hex	Weight in ounces[3] S – 2½″
EL	2″	Rear (Plain)	2 3/32 (53)	3/8 (10)	3/8 (8)	–	–	–[2]	–	1 1/16	4½
EL	2″	Rear (Plain, pointed stem)	2 3/32 (53)	3/8 (10)	5/16 (8)	–	–	–[2]	–	1 1/16	4½
EL	2″	Rear (Threaded)	2 3/32 (53)	3/8 (10)	3/8 (8)	–	–	–[2]	¼	1 1/16	4½
EL	3″	Rear	3 5/32 (80)	19/32 (15)	3/8 (8)	–	–	–[2]	½	⅞	7
EL	3″	Everyangle	3 5/32 (80)	19/32 (15)	–	1 21/32 (42)	3 1/32 (89)	–[2]	½	⅞	10
EL	5″	Rear	5 1/32 (128)	23/32 (18)	3/8 (8)	–	–	–[2]	½	⅞	16
EL	5″	Everyangle	5 1/16 (128)	23/32 (18)	–	1⅛ (48)	3 21/32 (93)	–[2]	½	⅞	25

NOTES:
1. Figures in parenthesis ( ) are in millimeters. All other dimensions are in inches.
2. Standard "S" dimensions are 2½, 4, 6, 9, 12, 15, 18 and 24 inches. Standard stem diameter is ¼ inch.
3. Add 1 oz. for every 2 inches of stem length.

EL Series dual scale ranges

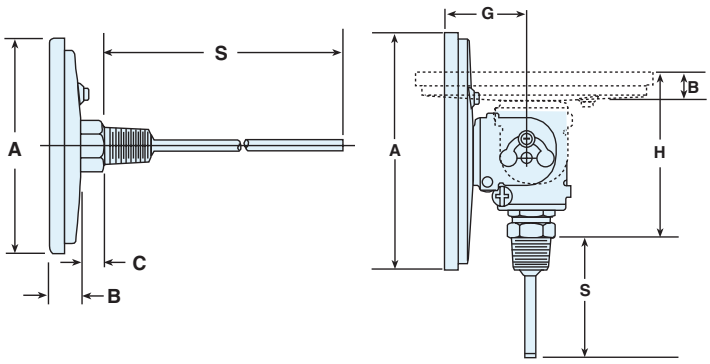
Inner		Outer
–40/160°F	and	–40/70°C
–20/120°F	and	–30/50°C†
0/200°F	and	–20/94°C
0/250°F	and	–20/120°C
30/130°F	and	0/55°C†
50/300°F	and	10/150°C
50/550°F	and	10/290°C

Overtemperature limits

Top of Range °F	Maximum Overpressure
up to 160	100% of span
160/300	300°F
300/550	550°F

*Dual scale ranges available for all standard °F ranges Use Ashcroft Duratemp® thermometers for ranges above and below those listed above.
††Minimum stem length for Everyangle is 4″.

DIMENSIONS



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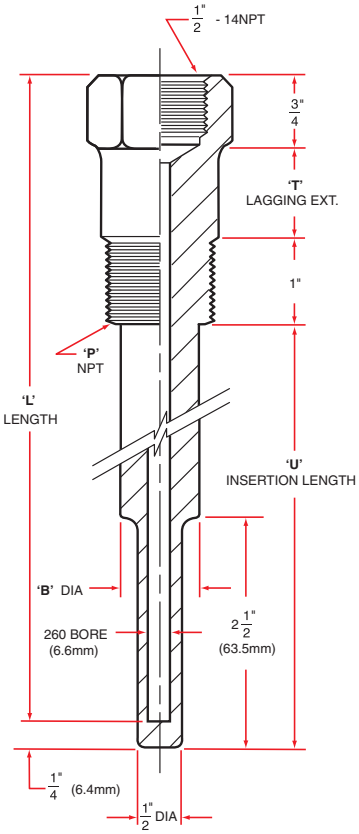
Thermowells *Threaded Stepped*



Style	Bore	Stem Length	Options
Stepped **TW01** *Stepped Lag* **TW11**	**A** *0.260* **B** *0.385*	**Please insert in Decimal Units**	**See Chart**

Process Size	Stem Material
1/2" NPT **08**	**See Chart**
3/4" NPT **12**	
1" NPT **16**	
1 1/4" NPT **20**	
1 1/2" NPT **24**	

'B' Diameter:

1/2" NPT- 5/8"
3/4" NPT- 3/4"
1" NPT- 7/8"

Example:

TW11 *Lagged Stepped*
A *0.260*
12 *3/4" NPT*
L *316SS*
06 *6" Stem*
B *SS Plug & Chain*

***Note for lag (T)**

if (L) is over 6", the industry std. for (T) is 3"

if (L) is under 6", the industry std. for (T) is 2"

Material Chart:

A *Brass*
D *Carbon Steel*
E *A105*
F *F11*
G *F22*
H *304*
J *304/L*
L *316*
M *316/L*
R *Monel*
T *Titanium*
U *Hast. C*

See full chart for more material codes.

MAC-WELD MACHINING & MANUFACTURING LTD.

1-877-MAC-WELD (622-9353)

Tel: (519) 332-1388 Fax: (519) 332-3280

Mac-Weld.com

Reservoir Equipment

Filler Breather Filters (Metal)

Filter flange type

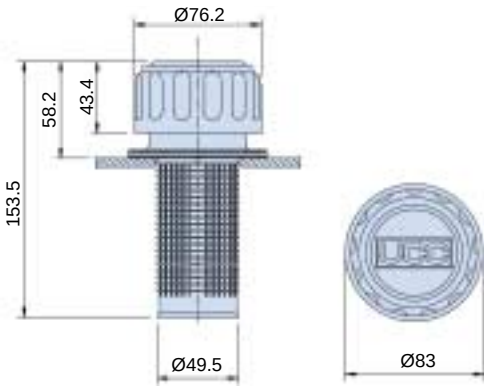
Displacement:
720 l/min.

Micron rating:
10µ/40µ.

Air flow:
0.75m³/min.

Weight:
0.27 Kg. (PAB.1730.*.**)
0.24 Kg. (AB.1163.**)

Valve Crack Pressure:
0.35 and 0.7 bar.



Locking lug option (5515 & 5561)

For added security, certain Parker Filtration Metal Filler Breather Filters can be specified with a locking lug option.

ORDERING INFORMATION

Air Breather – Threaded and push-on type
Note: Zinc and yellow passivated caps available. Consult Parker Filtration.

Part Number	Supersedes		Displacement l/min	Rating Micron	Air Flow	Thread	Weight
SAB.1562.40	**MBI.B2A2A1P**	**H00602-003**	720	40	0.75m³/min	G¾	0.20 Kg
SAB.1562.10	**MBI.B1A2A1P**	**H00602-001**	430	10	0.45m³/min	G¾	0.20 Kg
SAB.1563.40	**MBI.C2A2A1P**	**–**	270	40	0.30m³/min	G¼	0.06 Kg
SAB.1563.10	**MBI.C1A2A1P**	**–**	135	10	0.15m³/min	G¼	0.06 Kg
AB.1381.40	**MBI.E2A1A1P**	**–**	720	40	0.75m³/min	–	0.13 Kg

Filler Breather – Filter flange type

Part Number Total Assembly	Supersedes		Part Number Cap Assembly	Supersedes	Displacement l/min	Rating Micron	Air Flow	Thread	Weight
AB.1163.40	**MBI.D2A1B1P**	**H00153-003**	**CAP.1163.40**	**CPI.D2A1A1P**	720	40	0.75m³/min	– –	0.24 Kg
AB.1163.10	**MBI.D1A1B1P**	**H00153-001**	**CAP.1163.10**	**CPI.D1A1A1P**	430	10	0.45m³/min	– –	0.24 Kg
AB.1380.40	**MBI.A2A1B1P**	**–**	**CAP.1380.40**	**CPI.A2A1A1P**	270	40	0.30m³/min	– –	0.07 Kg
AB.1380.10	**MBI.A1A1B1P**	**–**	**CAP.1380.10**	**CPI.A1A1A1P**	135	10	0.15m³/min	– –	0.08 Kg
5561	**MBI.D1A1B2P**	**–**	**–**	**–**	–	–	–	–	–
5515	**MBI.D2A1B2P**	**–**	**–**	**–**	–	–	–	–	–

Filler Breather – Filter type (Pressurised)

Part Number Total Assembly	Supersedes		Part Number Cap Assembly	Supersedes	Displacement l/min	Rating Micron	Air Flow	Thread	Weight
***PAB.1730.40.5**	**MBI.D2C1B1P**	**H00153-004**	***CAP.1730.40.5**	**CPI.D2C1A1P**	720	40	0.75m³/min	– –	0.27 Kg
****PAB.1730.40.10**	**MBI.D2D1B1P**	**–**	****CAP.1730.40.10**	**CPI.D2D1A1P**	720	40	0.75m³/min	– –	0.27 Kg
***PAB.1730.10.5**	**MBI.D1C1B1P**	**H00153-002**	****CAP.1730.40.5**	**CPI.D1C1A1P**	430	10	0.45m³/min	– –	0.27 Kg
****PAB.1730.10.10**	**MBI.D1D1B1P**	**–**	****CAP.1730.10.10**	**CPI.D1D1A1P**	430	10	0.45m³/min	– –	0.27 Kg

Air Breather – Threaded type (Pressurised)

Part Number	Supersedes		Displacement l/min	Rating Micron	Air Flow	Thread	Weight
***SPA.1731.40.5**	**MBI.B2C2A1P**	**H00602-004**	720	40	0.75m³/min	G¾	0.20 Kg
****SPA.1731.40.10**	**MBI.B2D2A1P**	**–**	720	40	0.75m³/min	G¾	0.20 Kg
***SPA.1731.10.5**	**MBI.B1C2A1P**	**H00602-002**	430	10	0.45m³/min	G¾	0.20 Kg
****SPA.1731.10.10**	**MBI.B1D2A1P**	**–**	430	10	0.45m³/min	G¾	0.20 Kg

* Valve Crack Pressure 0.35 bar. **Valve Crack Pressure 0.70 bar. For dipstick and locking lug options consult Parker Filtration.

Threaded type (Pressurised)

Displacement:
720 l/min.

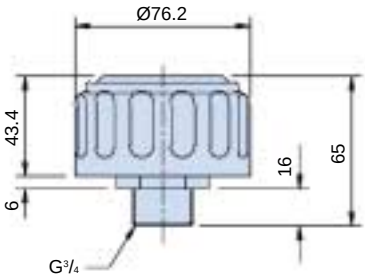
Thread:
G3/4.

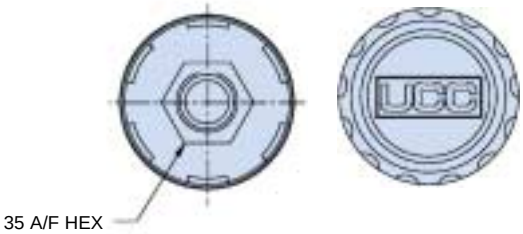
Micron Rating:
10µ/40µ.

Valve Crack-Pressure:
0.35 and 0.7 bar.

Air Flow:
0.75m³/min.

Weight:
0.2 Kg.





Threaded type

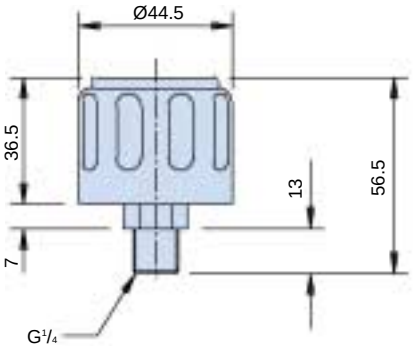
Displacement:
270 l/min.

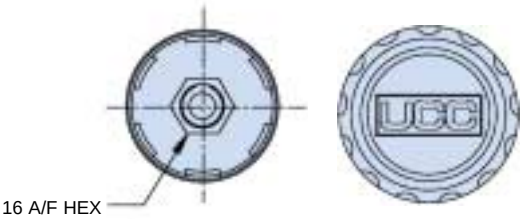
Micron rating:
10µ/40µ.

Air flow:
0.3m³/min.

Weight:
0.06 Kg.

Thread:
G1/4.





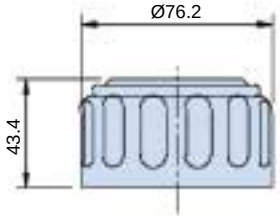
Push on type

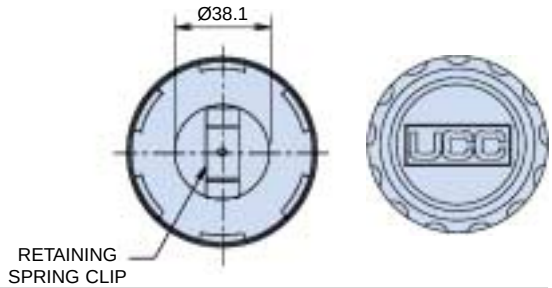
Displacement:
720 l/min.

Micron rating:
40µ.

Air flow:
0.75m³/min.

Weight:
0.13 Kg.





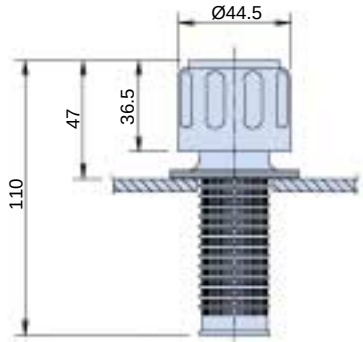
Filter flange type

Displacement:
270 l/min.

Micron rating:
10µ/40µ.

Air flow:
0.3m³/min.

Weight:
0.07 Kg.



TANK INSTALLATION NOTES

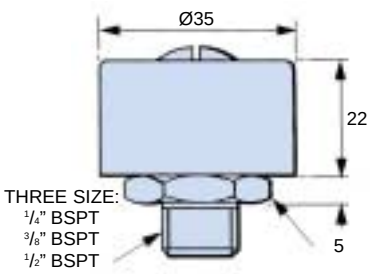
1. Un-pressurised 6 hole fixing
Form off tank mounting holes between Ø4.0 and Ø4.4 (dependant on the material and thickness, consult Parker Filtration) equispaced on 70.0-73.0 P.C.D. to suit No. 10 thread forming screws supplied.

2. Pressurised 6 hole fixing
Form 6 off mounting holes between Ø4.0 and Ø4.4 equispaced on 73.0 P.C.D. to suit
No. 10 thread forming screws supplied.

3. Un-pressurised 3 hole fixing
Form 3 off tank mounting holes between Ø4.0 and Ø4.4 equispaced on 41.3 P.C.D. to suit
No. 10 thread forming screws supplied.

BREATHER UNITS

Small Breather Specification



ORDERING INFORMATION

Part Number	Description
H00279-001	Small breather 1/4" BSPT thread
H00279-002	Small breather 3/8" BSPT thread
H00279-003	Small breather 1/2" BSPT thread

TANK MAGNETS

Vescor Tank Magnets Pay Off For You because they pick-up material that ordinary filters miss. Tank Magnets help maintain clean oil. The cleaner the oil can be kept in your reservoirs, the less your troubles will be and the greater your savings will be.

REGULAR TANK MAGNETS – This Heavy Duty model uses 5/8" solid steel rod, furnished with a 5" support rod. However, these support rods can be ordered any length desired, either shorter or longer than 5" to suit the reservoir. Heavy Duty comes with the end threaded 5/8"-18 NF. The support rod can also be furnished with special threads or with special means of attachment brazed on. Pipe plugs are optional and are furnished in 2 1/2" NPT size. When a Tank-Magnet is ordered with a pipe plug, the unit is shipped assembled so all that is required is to unwrap it and screw it into position. The recommended opening that will accommodate the unit is a 2 1/2" pipe flange or a hole approximately 2 1/4" in diameter. If desired, it can be installed in the cover of any opening larger than this.

Construction – The magnetic unit of the Vescor® Tank Magnet is exceptionally efficient. Each section is composed of a larger doughnut shaped ceramic magnet and two disc shaped pole pieces. This unique design adds the area of the discs to the area of the magnets to give the greatest amount of magnetic surface possible. This design also permits the hydraulic fluid to flow in and around the magnets and discs, thus allowing the oil to come in intimate contact with the magnets and discs to facilitate the removal of ferrous particles.

SLIM LINE TANK MAGNETS consists of Alnico V Magnets encased in a non-magnetic tube with the major difference between it and regular tank magnet being that it is only 5/8" in diameter. This means that it can be put through a hole tapped for 3/4" pipe plug and can be used where mounting space is a premium. Slim Line Tank Magnets come in two types, the **Slim Line** and **Extra Sturdy Slim Line**, with standard aluminum or optional stainless steel housings. The aluminum housing series are numbered SL-11, etc. for the Slim Lines and SLX-11, etc. for the Extra Sturdy lines. To designate the stainless steel housing units, SS is added after the appropriate catalog number, i.e., SLX-13 SS.

Construction – **Magnetic units** - Basically the same for all types of Slim Lines, the magnetic units vary only in length. Support rods - All Slim Lines are normally furnished with a 5" long support rod, but can be furnished with any length, either longer or shorter than the standard 5" length. **Housing** - Slim Lines come with aluminum housing for use with ordinary hydraulic fluids. For use where conditions might cause problems such as water glycols or phosphate esters, a stainless steel housing is provided. **Mounting** - Pipe plugs for mounting in the reservoir top are optional and are furnished in any size from 3/4" NPT to 3" NPT, with a 1 1/4" NPT or larger being recommended. Units come completely assembled and ready for installation.

Application – For greatest protection - Use a size such, that the magnetic unit extends from 1" off the floor of the reservoir to the top of the oil level.

For lowest cost - Use a standard unit of any series for all sizes of reservoirs. Position it 1" from the bottom of the reservoir with proper length support rod.

No maintenance is needed except for periodic cleaning, with cleaning once a month recommended. To clean, remove from the reservoir, wipe with a clean cloth and reinstall.

WHICH ONE SHOULD I USE?

STANDARD

When . . .

- The support rod is short
- The magnetic unit is small
- Normal use can be expected
- Cost is important

HEAVY DUTY

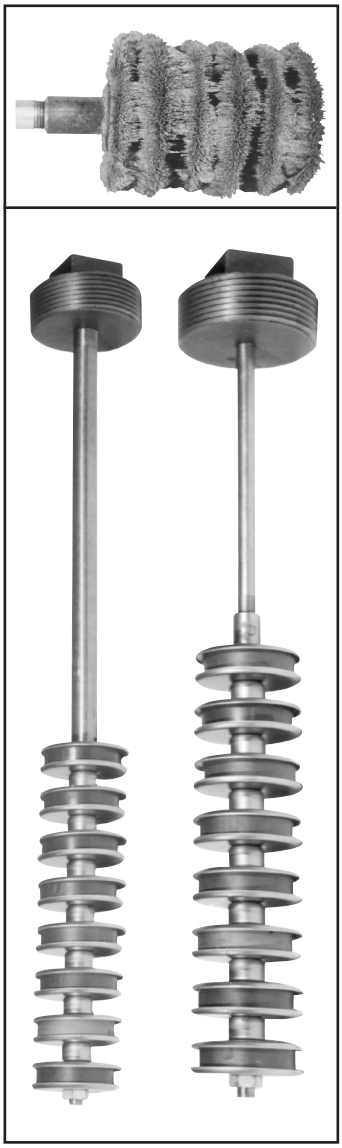
When . . .

- The support rod is long
- The magnetic unit is large
- Abuse in shipping or operation is expected
- A little more can be spent

CLEANING

Cleaning a Tank Magnet couldn't be easier. An ordinary air hose using shop compressed air does the job in seconds.

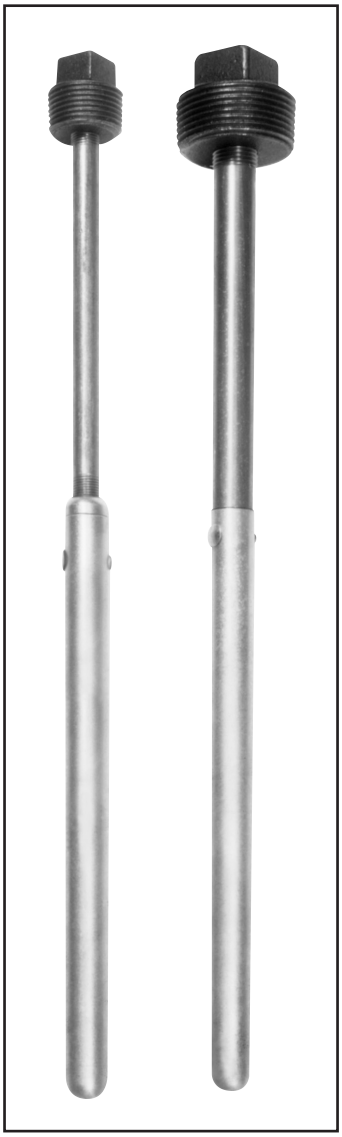
STANDARD MAGNETS



Cat. No. HDM-13 with 9" support rod and 2 1/2" pipe plug HEAVY DUTY

Cat. No. TM-14 with 5" support rod and 2 1/2" pipe plug STANDARD

SLIM LINE MAGNETS



Cat. No. SL-18-5 With 5"support rod and 1 1/4" pipe plug STANDARD

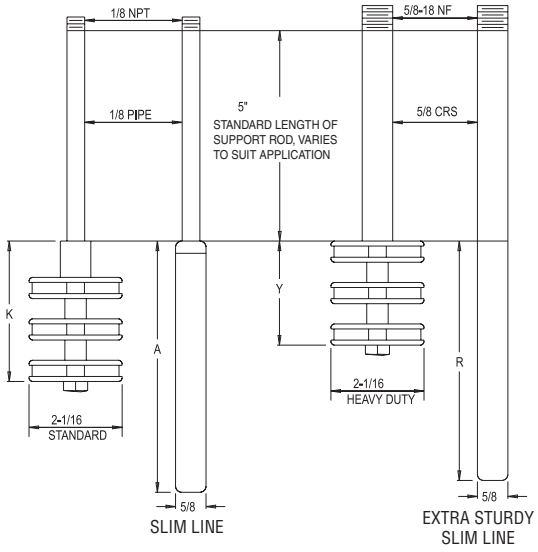
Cat. No. SLX-18 With 5" support rod and 1 1/4" pipe plug HEAVY DUTY

NOTE: WITH VESCORS' POLICY OF CONSTANTLY IMPROVING ITS PRODUCTS, SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

TANK MAGNETS

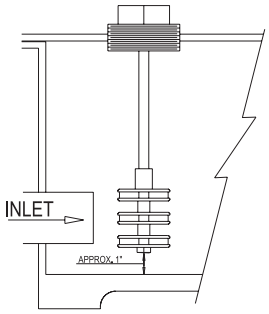
STANDARD / HEAVY DUTY

Reservoir Capacity (gallons)	Standard Part No.	Standard K Dimension	Heavy Duty Part No.	Heavy Duty Y Dimension	No. of Magnets
0-10	**TM- 6**	1⅝"	**HDM- 6**	⅞"	1
10-30	**TM- 7**	2 11/16"	**HDM- 7**	1 15/16"	2
30-60	**TM- 9**	3¾"	**HDM- 8**	3"	3
60-100	**TM-10**	4 13/16"	**HDM- 9**	4 1/16"	4
100-150	**TM-11**	5⅞"	**HDM-10**	5⅛"	5
150-210	**TM-12**	6 15/16"	**HDM-11**	6 3/16"	6
210-280	**TM-13**	8"	**HDM-12**	7¼"	7
280-350	**TM-14**	9 1/16"	**HDM-13**	8 5/16"	8



SLIM LINE / EXTRA STURDY SLIM LINE

Slim Line Part No.	Slim Line A Dimension	Extra Sturdy Slim Line Catalog No.	Extra Sturdy Slim Line R Dimension
SL-11	6"	**SLX-11**	5¾"
SL-13.5	8½"	**SLX-13**	8¼"
SL-16	11"	**SLX-16**	10¾"
SL-18.5	13½"	**SLX-18**	13¼"
SL-21	16"	**SLX-21**	15¾"
SL-23.5	18½"	**SLX-23**	18¼"
SL-26	21"	**SLX-26**	20¾"
SL-28.5	23½"	**SLX-28**	23¼"
SL-31	26"	**SLX-31**	25¾"

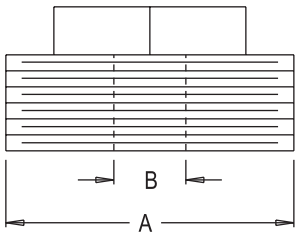


WHEN ORDERING BE SURE TO:

- List number of the magnetic unit
- Give part number of plug (if plug is desired)
- Give length of support rod (if other than standard 5")
- Add SS to unit number if stainless steel housings are desired

Our experienced design engineers are available to give you quick and efficient help on any problems you may have with magnetic applications or with special designs.

Pipe Plugs for Tank Magnets

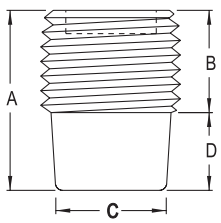


Vescor Part Number	Dimensions A NPT	Dimensions B Thread	Use with Magnet
PM-125	1¼" NPT	⅛" NPT	SL Series
PM-125X	1¼" NPT	⅝-18NF	SLX Series
PM-250	2½" NPT	⅛" NPT	TM Series
PM-250HD	2½" NPT	⅝"-18NF	HDM Series

Square Head Magnetic Plugs

Vescor Magnetic Drain Plugs attract and hold abrasive, ferrous metal particles preventing their circulation through hydraulic system. By holding these particles Vescor Magnetic Plugs prevent excessive wear to a hydraulic systems components.

Vescor Part Number	Nominal Pipe Size	Dimensions A	B	C	D	Body Material
4044041	½" NPTF	.96	.57	.56	.38	Steel
4054121	¾" NPTF	1.11	.62	.62	.45	Steel



Specifications:

- Steel Body Material
- Permanent magnet fastened to plug body
- Ceramic magnet
- Readily available from stock

NOTE: WITH VESCORS' POLICY OF CONSTANTLY IMPROVING ITS PRODUCTS, SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

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Overview

Pointek CLS200 (standard version) is a versatile inverse frequency shift capacitance level switch with optional rod/cable choices and configurable output, ideal for detection of liquids, solids, slurries, foam and interfaces.

Benefits

- Potted construction protects signal circuit from shock, vibration, humidity and/or condensation
- High chemical resistance
- Level detection independent of tank or pipe earth reference
- Insensitive to product buildup due to high frequency oscillation
- 3 LED indicators for sensor status, output status, and power
- SIL/IEC61508 compliant for use in safety integrated level applications for overfill protection (SIL-2)

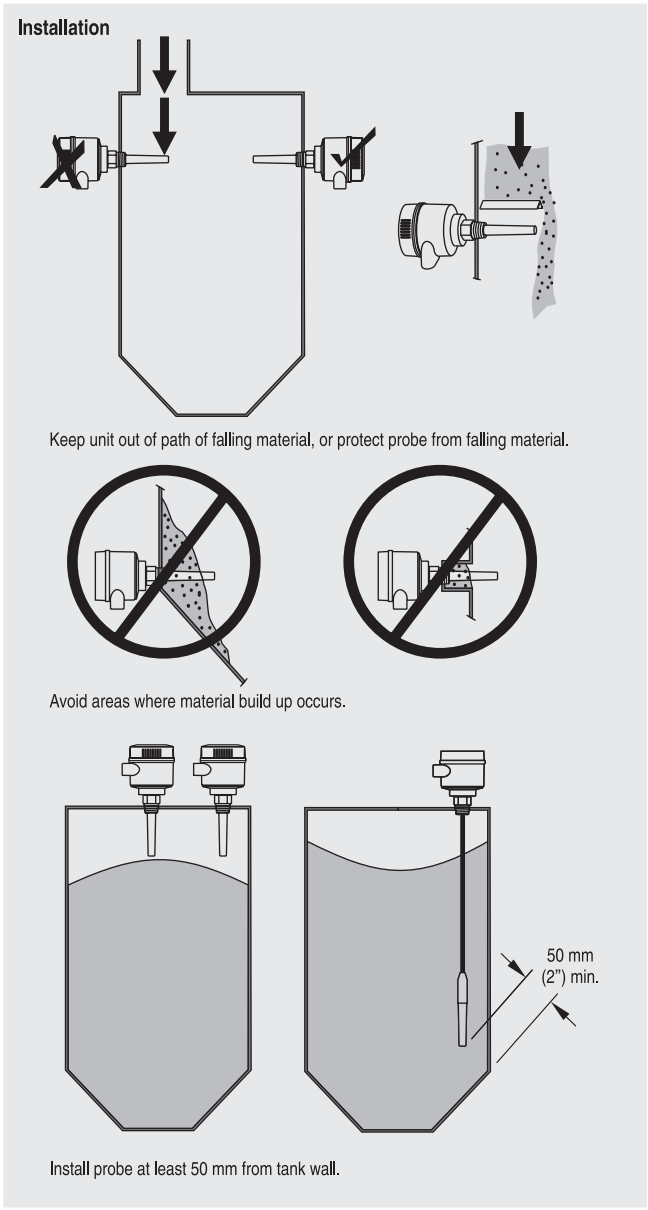
Application

Pointek CLS200 standard version has 3 LED indicators with basic relay and solid-state switch alarms.

The power supply is galvanically isolated and accepts a wide range of voltages (12 to 250 V AC/DC). When used with thermal isolator, the stainless steel and PPS (PVDF optional) materials used in the probe construction provide a temperature rating up to +125 °C (+257 °F) on the process wetted portion of the probe. The switch responds to any material with a dielectric constant of 1.5 or more by detecting a change in oscillating frequency, and it can be set to detect before contact or on contact with the probe. The CLS200 operates independently of the tank wall or pipe so it does not require an external reference electrode for level detection in a non-conductive vessel such as concrete or plastic.

- Key Applications: liquids, slurries, powders, granules, pressurized applications, hazardous areas

Configuration



Pointek CLS200 installation

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Pointek CLS200 - Standard

Technical specifications

Mode of operation	
Measuring principle	Inverse frequency shift capacitive level detection
Input	
Measured variable	Change in picoFarad (pF)
Output	
Output signal	
• Relay output	1 SPDT Form C relay
- Max. contact voltage	• 30 V DC • 250 V AC
- Max. contact current	• 5 A (DC) • 8 A (AC)
- Max. switching capacity	150 W (DC) 2000 VA (AC)
- Time delay (ON and/or OFF)	1 to 60 s
• Solid-state output	
- Output	Galvanically isolated
- Protection	Against reversed polarity (bipolar)
- Max. switching voltage	• 30 V (DC) • 30 V peak (AC)
- Max. load current	82 mA
- Voltage drop	< 1 V, typical at 50 mA
- Time delay (pre or post switching)	1 to 60 s
Rated operating conditions[1]	
Installation conditions	
• Location	Indoor/outdoor
Ambient conditions	
• Ambient temperature	-40 to +85 °C (-40 to +185 °F)[2]
• Installation category	II
• Pollution degree	4
Medium conditions	Liquids, bulk solids, slurries and interfaces
• Relative dielectric constant ε_r	Min. 1.5
• Process temperature	
- Without thermal isolator	-40 to +85 °C (-40 to +185 °F)[2]
- With thermal isolator	-40 to +125 °C (-40 to +257 °F)
• Process pressure (rod version)	-1 to +25 bar g (-14.6 to +365 psi g) (nominal)
• Process pressure (cable version)[3]	-1 to +10 bar g (-14.6 to +150 psi g) (nominal)
• Process pressure (sliding coupling version)	-1 to +10 bar g (-14.6 to +150 psi g) (nominal)

Design	
• Material	
- Enclosure	Epoxy-coated aluminum with gasket
- Optional thermal isolator	316L stainless steel
• Connection	Removable terminal block, max. 2.5 mm²
• Degree of protection	IP65/Type 4/NEMA 4 (optional IP68)
• Cable inlet	2 x M20x1.5 thread (option: 2 x ½" NPT conduit entry including 1 plugged entry)
Power supply	12 to 250 V AC/DC, 0 to 60 Hz max. 2 W
Certificates and approvals	
• General Purpose	CSA, FM, CE, C-TICK
• Dust Ignition Proof	ATEX II 1/2 D T100°C
• Flameproof Enclosure With IS Probe	ATEX II 1 G EEx d[ia] IIC T6...T4 ATEX II 1/2 D T100°C
• Dust Ignition Proof With IS Probe	CSA/FM Class II, Div. 1, Gr. E, F, G CSA/FM Class III T4
• Explosion Proof Enclosure With IS Probe	CSA/FM Class I, Div. 1, Gr. A, B, C, D CSA/FM Class II, Div. 1, Gr. E, F, G CSA/FM Class III T4
• Marine	Lloyds Register of Shipping, Categories ENV1, ENV2 and ENV5
• Overfill Protection	WHG (Germany) VLAREM II
• Others	SIL/IEC61508 Declaration of Conformity [SIL-2 (overfill)] Pattern Approval (China)

1) When operation is in areas classified as hazardous, observe restrictions according to relevant certificate.
See also Pressure/Temperature curves on page 5/34.
2) Thermal isolator is used if process connection temperature exceeds +85 °C (+185 °F)
3) Pressure rating of process seal is temperature dependent.
See Pressure/Temperature curves on page 5/34.

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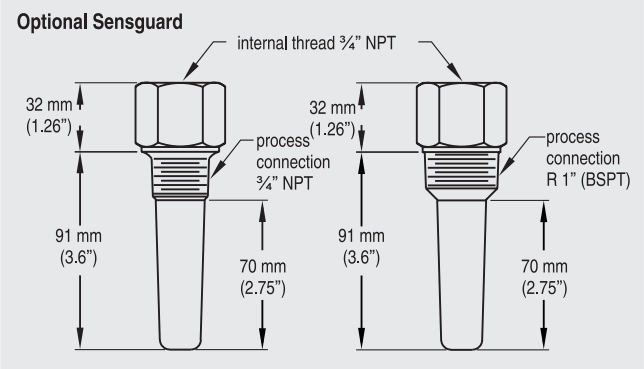
Design: Probe				
	Rod version	**Sanitary version**	**Cable version**	**Sliding Coupling version**
Max. length	5500 mm (216.53")	5500 mm (216.53")	30000 mm (1181.1") liquids and slurries 5000 mm (196.85") solids (under loads)	5500 mm (216.53")
Process connection	R ¾", 1", 1¼", 1½" [(BSPT), EN 10226/PT (JIS-T), JIS B 0203] ¾", 1", 1¼", 1½" NPT [(Taper), ANSI/ASME B1.20.1] G ¾", 1", 1½" [(BSPP), EN ISO 228-1/PF (JIS-P), JIS B 0202] 316L stainless steel ASME/EN flange	1½", 2" sanitary fitting clamp 316L stainless steel	R ¾", 1", 1¼", 1½" [(BSPT), EN 10226/PT (JIS-T), JIS B 0203] ¾", 1", 1¼", 1½" NPT [(Taper), ANSI/ASME B1.20.1] G ¾", 1", 1½" [(BSPP), EN ISO 228-1/PF (JIS-P), JIS B 0202] 316L stainless steel ASME/EN flange	R ¾", 1", 1¼", 1½" [(BSPT), EN 10226/PT (JIS-T), JIS B 0203] ¾", 1", 1¼", 1½" NPT [(Taper), ANSI/ASME B1.20.1] G ¾", 1", 1½" [(BSPP), EN ISO 228-1/PF (JIS-P), JIS B 0202]
Extension material	316L stainless steel optional PFA coated[1)]	316L stainless steel	Fluoroethylene propylene (FEP) cable with stainless steel core	316L stainless steel
Sensor wetted parts	PPS (optional PVDF)	PPS (optional PVDF)	PPS (optional PVDF)	PPS (optional PVDF)
O-ring seal material	FKM (optional FFKM)	FKM (optional FFKM)	FKM (optional FFKM)	FKM (optional FFKM)
Thermal isolator[2)]	Optional	Optional	Optional	Optional
Extension	User selected length	User selected length	Cable extension	User selected length

1) PFA coating (7ML5634 and 7ML5644) has 120 micron thickness.
2) Thermal isolator is used if process connection temperature exceeds +85 °C (+185 °F).

Options



Optional Sensguard dimensions

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Point level measurement - Capacitance switches

Pointek CLS200 - Standard

Selection and Ordering data		Order No.
Pointek CLS200 - Standard - Rod Version with Threaded or Flanged process connection Versatile inverse frequency shift capacitance level switch with optional rod/cable choices and configurable output, ideal for detection of liquids, solids, slurries, foam and interfaces	C)	7 M L 5 6 3 0 - ■■■■ - ■■■ 0
Process Connection		
Threaded, 316L stainless steel		
¾" NPT [(Taper), ANSI/ASME B1.20.1]		0 A
1" NPT [(Taper), ANSI/ASME B1.20.1]		0 B
1¼" NPT [(Taper), ANSI/ASME B1.20.1]		0 C
1½" NPT [(Taper), ANSI/ASME B1.20.1]		0 D
R ¾" [(BSPT), EN 10226/PT (JIS-T), JIS B 0203]		1 A
R 1" [(BSPT), EN 10226/PT (JIS-T), JIS B 0203]		1 B
R 1½" [(BSPT), EN 10226/PT (JIS-T), JIS B 0203]		1 D
G ¾" [(BSPP), EN ISO 228-1/PF (JIS-P), JIS B 0202]		3 A
G 1" [(BSPP), EN ISO 228-1/PF (JIS-P), JIS B 0202]		3 B
G 1½" [(BSPP), EN ISO 228-1/PF (JIS-P), JIS B 0202]		3 D
Welded flange, 316L stainless steel, raised face		
1" ASME, 150 lb		5 A
1" ASME, 300 lb		5 B
1" ASME, 600 lb		5 C
1½" ASME, 150 lb		5 D
1½" ASME, 300 lb		5 E
1½" ASME, 600 lb		5 F
2" ASME, 150 lb		5 G
2" ASME, 300 lb		5 H
2" ASME, 600 lb		5 J
3" ASME, 150 lb		5 K
3" ASME, 300 lb		5 L
3" ASME, 600 lb		5 M
4" ASME, 150 lb		5 N
4" ASME, 300 lb		5 P
4" ASME, 600 lb		5 Q
Welded flange, 316L stainless steel, Type A flat faced		
DN 25, PN 16		6 A
DN 25, PN 40		6 B
DN 40, PN 16		6 C
DN 40, PN 40		6 D
DN 50, PN 16		6 E
DN 50, PN 40		6 F
DN 80, PN 16		6 G
DN 80, PN 40		6 H
DN 100, PN 16		6 J
DN 100, PN 40		6 K
(Note: Flange bolting patterns and facings dimensionally correspond to the applicable ASME B16.5 or EN 1092-1 standard.)		
Probe length (length from flange face) (threaded lengths include process thread)		
Note: No Y01 needed in order code for standard lengths		
Compact [threaded 120 mm (4.72"), Flanged 98 mm (3.86")]		A
Extended rod, 250 mm (9.84")		B
Extended rod, 350 mm (13.78")		C
Extended rod, 500 mm (19.69")		D
Extended rod, 750 mm (29.53")		E
Extended rod, 1000 mm (39.37")		F
Extended rod, 1250 mm (49.21")		G
Extended rod, 1350 mm (53.15")		H
Extended rod, 1500 mm (59.06")		J
Extended rod, 1750 mm (68.90")		K
Extended rod, 2000 mm (78.74")		L

Selection and Ordering data		Order No.
Pointek CLS200 - Standard - Rod Version with Threaded or Flanged process connection Versatile inverse frequency shift capacitance level switch with optional rod/cable choices and configurable output, ideal for detection of liquids, solids, slurries, foam and interfaces	C)	7 M L 5 6 3 0 - ■■■■ - ■■■ 0
Add order code Y01 and plain text: "Insertion length ... mm"		
Extended rod, 200 to 1000 mm (7.87 to 39.37")		M
Extended rod, 1001 to 2000 mm (39.41 to 78.74")		N
Extended rod, 2001 to 3000 mm (78.78 to 118.11")		P
Extended rod, 3001 to 4000 mm (118.15 to 157.48")		Q
Extended rod, 4001 to 5000 mm (157.52 to 196.85")		R
Extended rod, 5001 to 5500 mm (196.89 to 216.53")		S
Thermal Isolator		
Without thermal isolator		0
With thermal isolator [for process connection temperatures over +85 °C (+185 °F)]		1
Remote mount electronics and mounting bracket		
With 2 m (79") of cable		2
With 5 m (197") of cable		3
Wetted Seals		
FKM		0
FFKM [for process temperatures above -20 °C (-4 °F)]		1
Probe Material		
316L Stainless Steel with PPS probe body		0
316L Stainless Steel with PVDF probe body		1
Approvals		
General Purpose (CSA, FM, CE, C-TICK)		A
General Purpose (CSA, FM, CE, C-TICK) with WHG Approval		B
Dust Ignition Proof: CE, C-TICK, ATEX II 1/2 D T100 °C		C
Flameproof Enclosure with IS Probe: CE, C-TICK, ATEX II 1 G EEx d[ia] IIC T6...T4, ATEX II 1/2 D T100°C		D
Flameproof Enclosure with IS Probe, with WHG Approval: CE, C-TICK, ATEX II 1/2 G EEx d[ia] IIC T6...T4, ATEX II 1/2 D T100 °C		E
Dust Ignition Proof with IS Probe: CSA/FM Class II, Div. 1, Gr. E, F, G CSA/FM Class III T4		F
Explosion Proof Enclosure with IS Probe: CSA/FM Class I, Div. 1, Gr. A, B, C, D CSA/FM Class II, Div. 1, Gr. E, F, G CSA/FM Class III T4		G
Enclosure and Lid		
Aluminum epoxy coated		
2 x ½" NPT via adapter - cable inlet, IP65		A
2 x M20 x 1.5 cable inlet IP65		B
2 x ½" NPT via adapter - cable inlet, IP68		C
2 x M20 x 1.5 cable inlet IP68		D

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Selection and Ordering data		Order No.
Pointek CLS200 - Standard - Rod Version with Threaded or Flanged process connection Versatile inverse frequency shift capacitance level switch with optional rod/cable choices and configurable output, ideal for detection of liquids, solids, slurries, foam and interfaces	C)	**7ML5630-** ■■■■-■■■**0**
Further designs		Order code
Please add "**-Z**" to Order No. and specify Order code(s).		
Total insertion length: enter the total insertion length in plain text description		**Y01**
Stainless steel tag [69 x 50 mm (2.71 x 1.97")]: Measuring-point number/identification (max. 16 characters) specify in plain text		**Y15**
Acceptance test certificate: Manufacturer's test certificate M to DIN 55350, Part 18 and ISO 9000		**C11**
Inspection Certificate Type 3.1 per EN 10204		**C12**
SIL/IEC61508 Declaration of Conformity [SIL-2 (overfill)]		**C20**

C) Subject to export regulations AL: N, ECCN: EAR99

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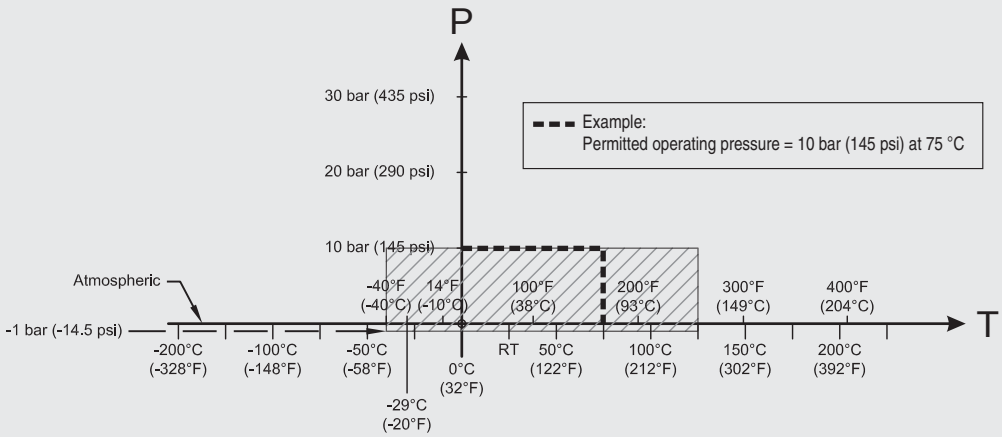
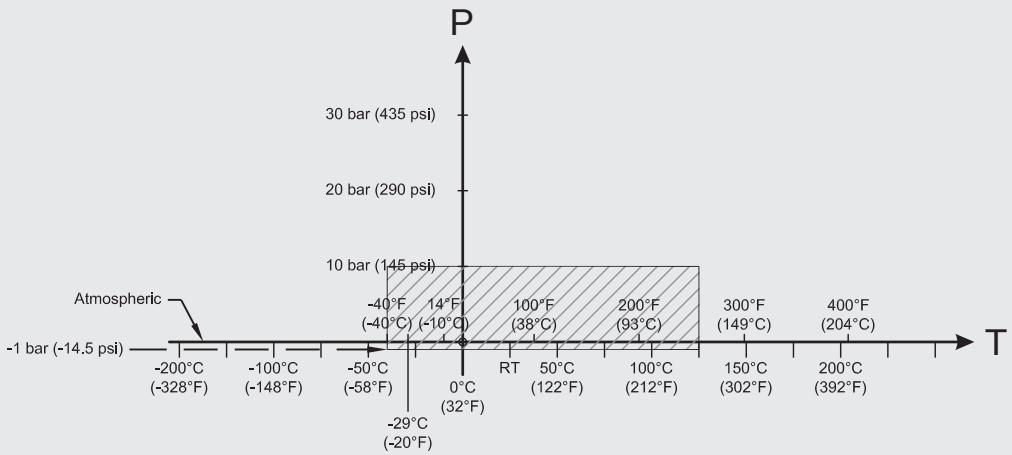
Characteristic curves



Pressure/Temperature Curve
CLS200 Sliding Coupling
Threaded Process Connections
(7ML5633 and 7ML5643)

P = Permitted Operating Pressures
T = Permitted Operating Temperature

Pointek CLS200 Process Pressure/Temperature derating curves (7ML5633 and 7ML5643)



Pressure/Temperature Curve
CLS200 Cable
Threaded Process Connections
(7ML5631 and 7ML5641)

P = Permitted Operating Pressures
T = Permitted Operating Temperature

Pointek CLS200 Process Pressure/Temperature derating curves (7ML5631 and 7ML5641)

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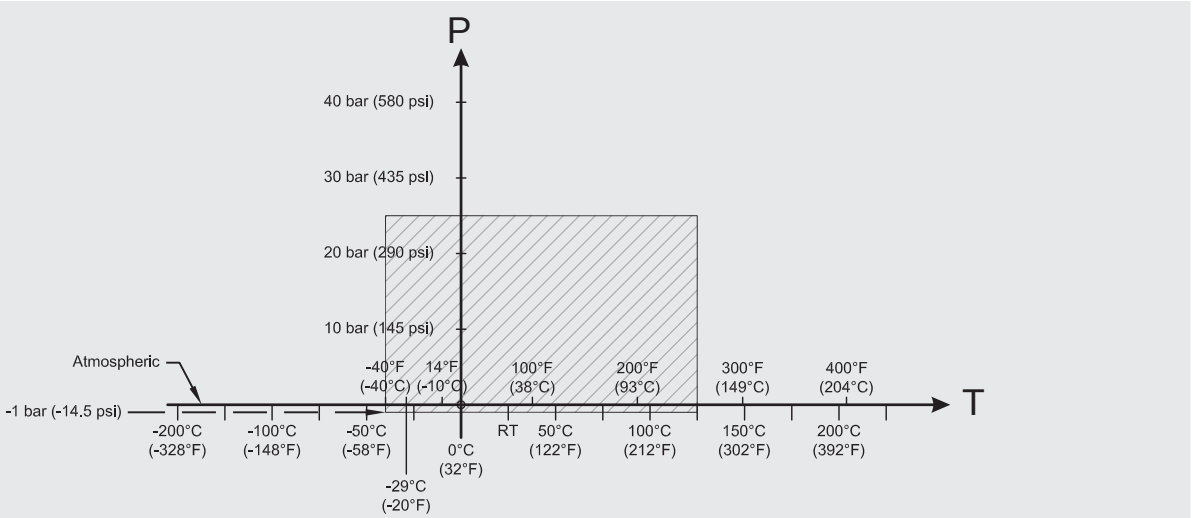
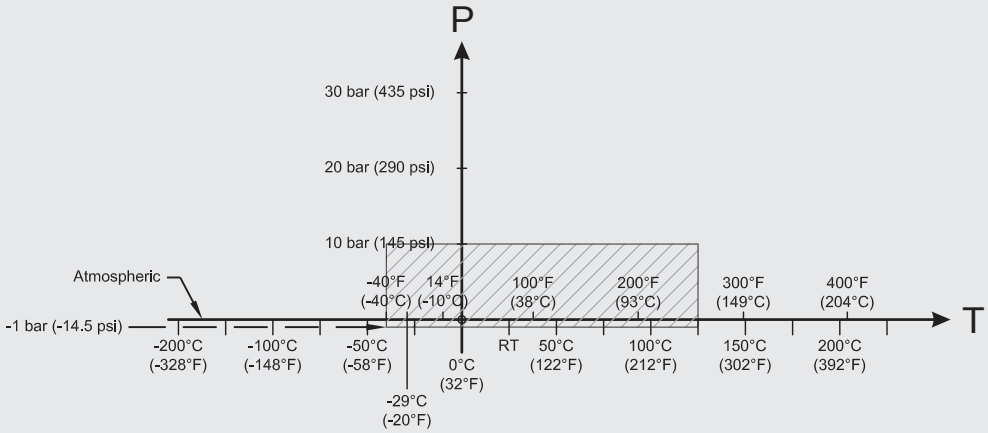


Pressure/Temperature Curve
CLS200 Compact and Extended Rod
Threaded Process Connections
(7ML5630 and 7ML5640)

P = Permitted Operating Pressures

T = Permitted Operating Temperature

Pointek CLS200 Process Pressure/Temperature derating curves (7ML5630 or 7ML5640)



Pressure/Temperature Curve
CLS200 Compact and Extended Sanitary Type
Sanitary Process Connections
(7ML5632 and 7ML5642)

P = Permitted Operating Pressures

T = Permitted Operating Temperature

Pointek CLS200 Process Pressure/Temperature derating curves (7ML5632 and 7ML5642)

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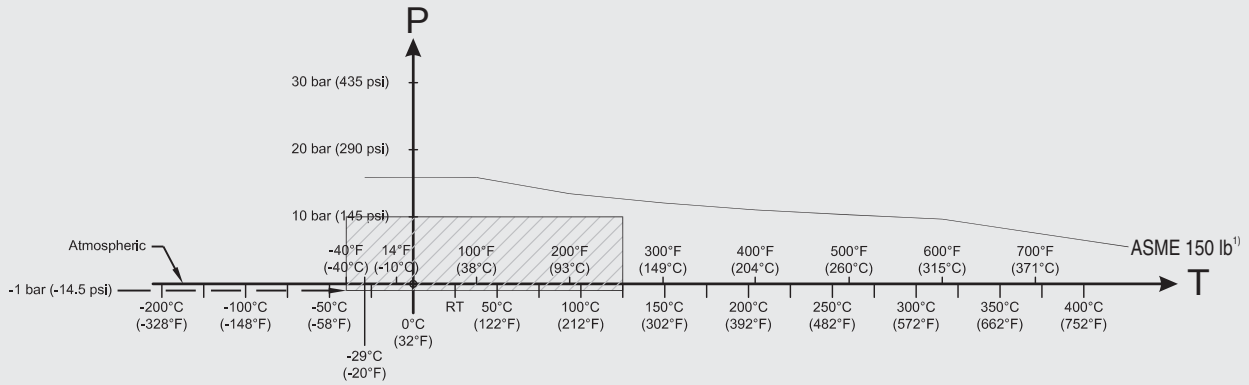
Pointek CLS200

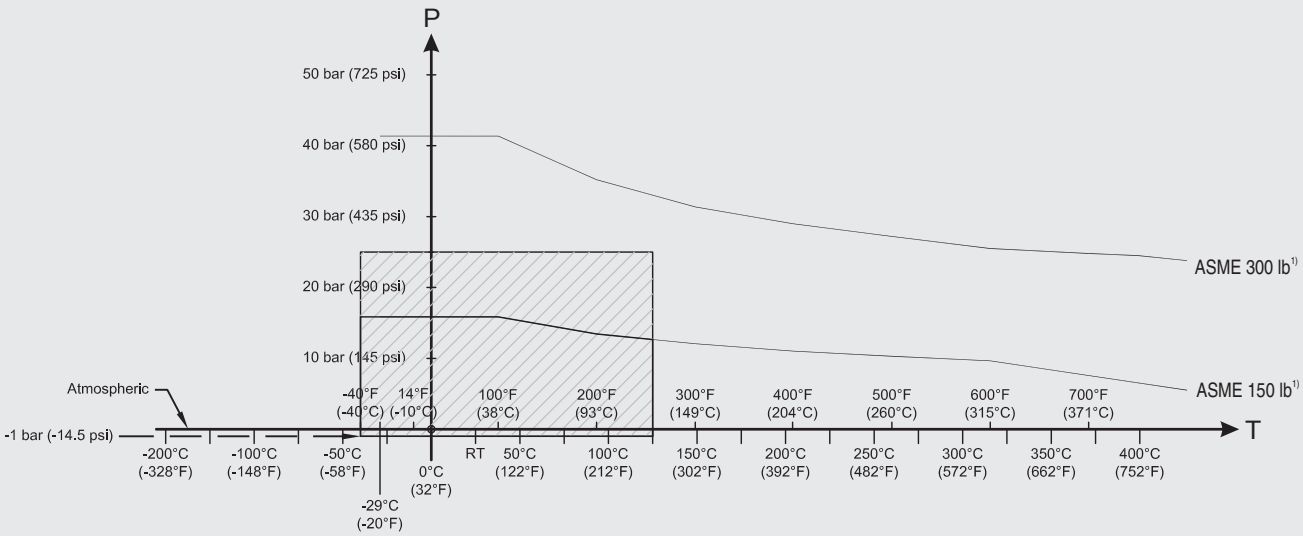


Pressure/Temperature Curve
CLS200 Cable
ASME Flanged Process Connections
(7ML5631 and 7ML5641)

P = Permitted Operating Pressures
T = Permitted Operating Temperature

1) The curve denotes the minimum allowable flange class for the shaded area below.

Pointek CLS200 Process Pressure/Temperature derating curves (7ML5631 and 7ML5641)



Pressure/Temperature Curve
CLS200 Compact and Extended Rod
ASME Flanged Process Connections (7ML5630 and 7ML5640)

P = Permitted Operating Pressures
T = Permitted Operating Temperature

1) The curve denotes the minimum allowable flange class for the shaded area below.

Pointek CLS200 Process Pressure/Temperature derating curves (7ML5630 and 7ML5640)

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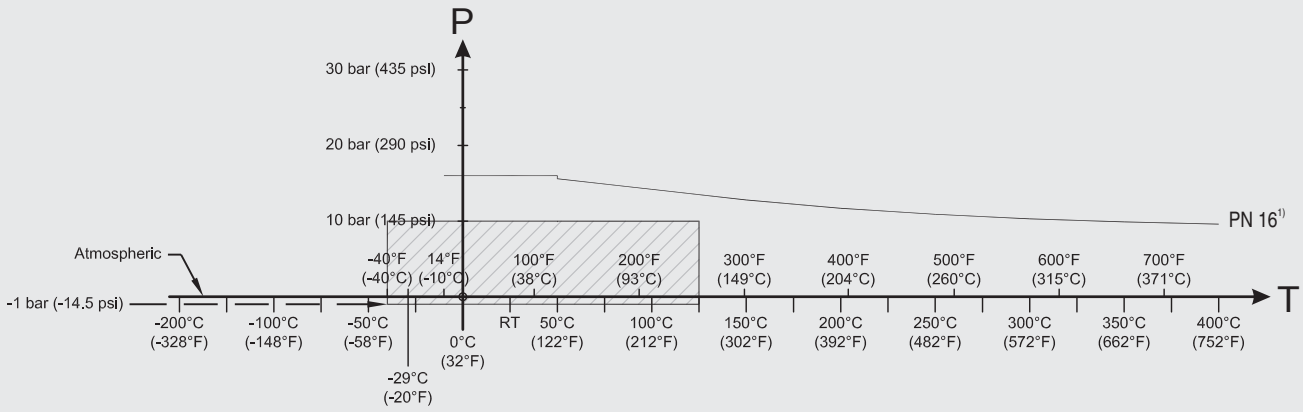
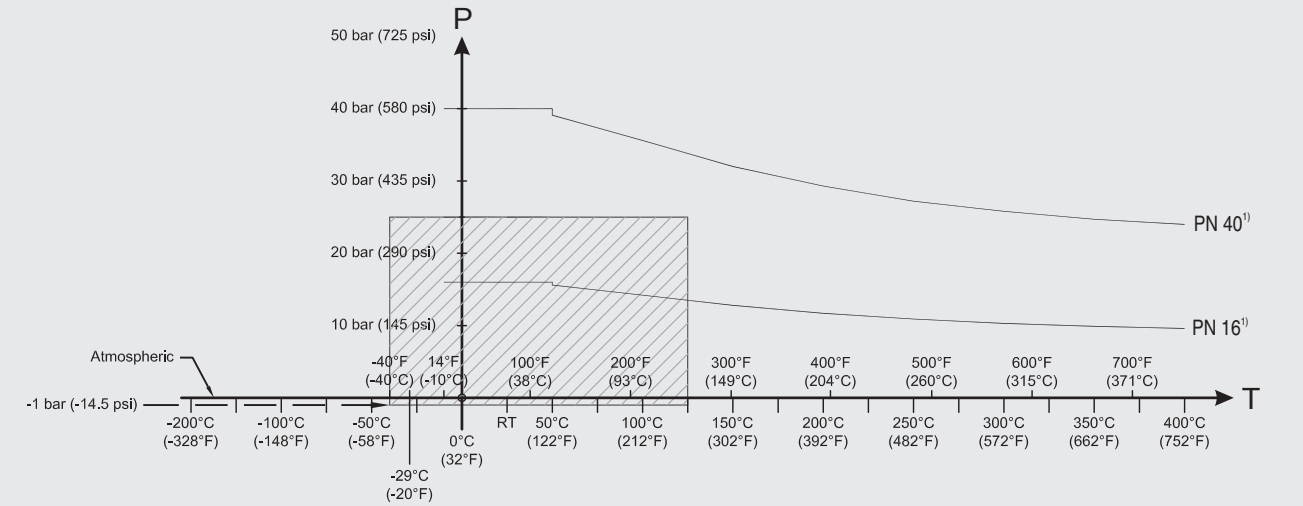


Pressure/Temperature Curve
CLS200 Cable
EN Flanged Process Connections
(7ML5631 and 7ML5641)

P = Permitted Operating Pressures
T = Permitted Operating Temperature

1) The curve denotes the minimum allowable flange class for the shaded area below.

Pointek CLS200 Process Pressure/Temperature derating curves (7ML5631 and 7ML5641)



Pressure/Temperature Curve
CLS200 Compact and Extended Rod
EN Flanged Process Connections (7ML5630 and 7ML5640)

P = Permitted Operating Pressures
T = Permitted Operating Temperature

1) The curve denotes the minimum allowable flange class for the shaded area below.

Pointek CLS200 Process Pressure/Temperature derating curves (7ML5630 and 7ML5640)

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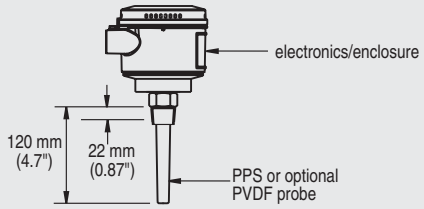
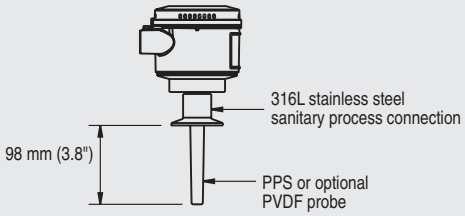
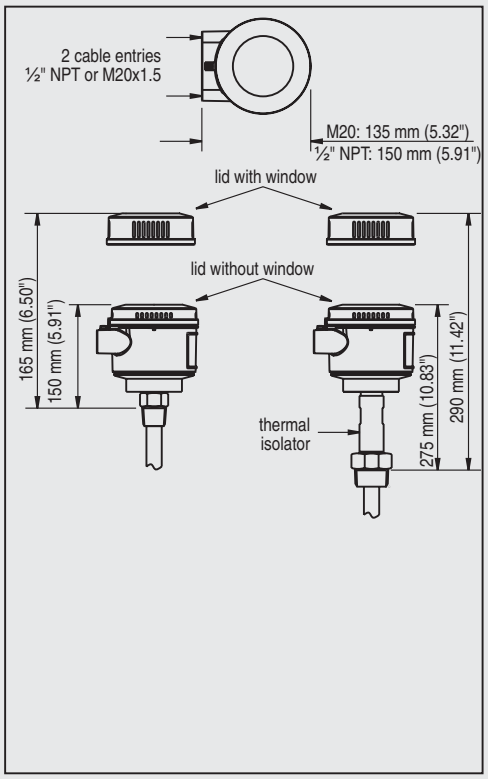
Dimensional drawings

**Compact version
Threaded
(7ML5630 and 7ML5640)**

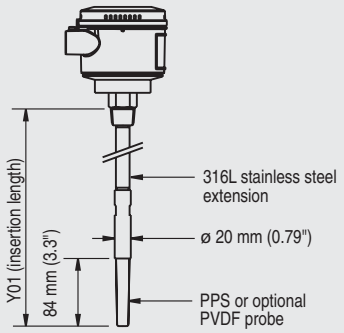


**Sanitary compact version
Sanitary fitting (7ML5632 and 7ML5642)**



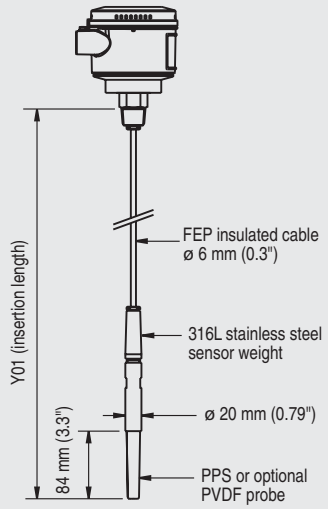


**Extended rod version
Threaded
(7ML5630 and 7ML5640)**



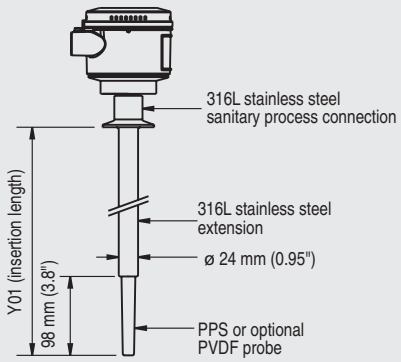
Min. insertion length = 200 mm (7.87")
Max. insertion length = 5500 mm (216")

**Extended cable version
Threaded
(7ML5631 and 7ML5641)**



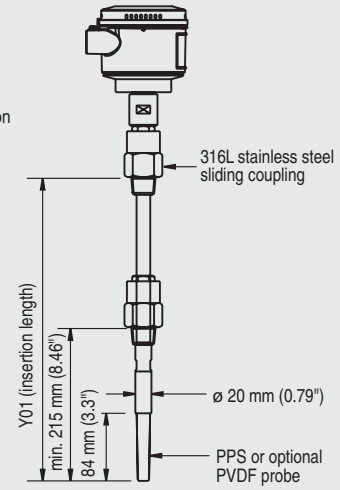
Min. insertion length = 500 mm (19.69")
Max. insertion length = 30000 mm (1181")
Applicable for liquids and solids applications.
Cable can be shortened on site.

**Sanitary extended version
Sanitary fitting (7ML5632 and 7ML5642)**



Min. insertion length = 110 mm (4.3")
Max. insertion length = 5500 mm (216")

**Sliding coupling version
Threaded (7ML5633 and 7ML5643)**



Min. insertion length = 350 mm (13.82")
Max. insertion length = 5500 mm (216")

Pointek CLS200 dimensions - Threaded/Sanitary Process Connections

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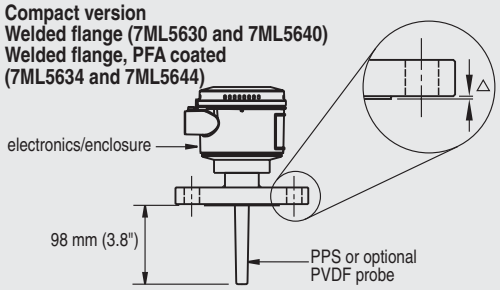
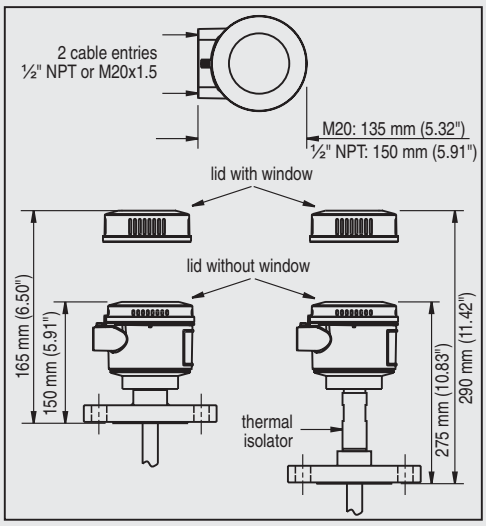
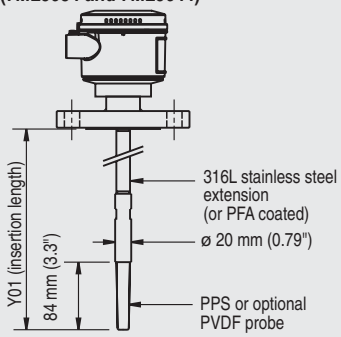
Compact version
Welded flange (7ML5630 and 7ML5640)
Welded flange, PFA coated
(7ML5634 and 7ML5644)



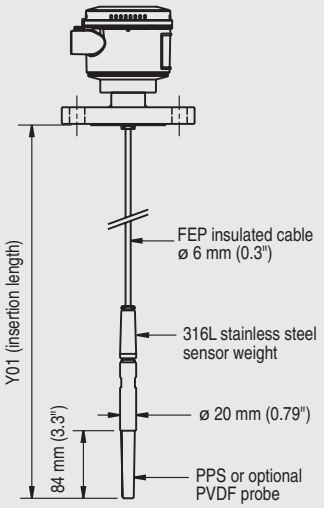


Extended rod version
Welded flange (7ML5630 and 7ML5640)
Welded flange, PFA coated
(7ML5634 and 7ML5644)



Min. insertion length = 200 mm (7.87")
Max. insertion length = 5500 mm (216.53")

Extended cable version
Welded flange
(7ML5631 and 7ML5641)



Min. insertion length = 500 mm (19.69")
Max. insertion length = 30000 mm (1181")
Applicable for liquids and solids applications.
Cable can be shortened on site.

Flange Facing (raised face)	
Flange Class	Facing thickness
△ ASME 150/300	2 mm (0.08")
△ ASME 600/900	7 mm (0.28")
△ PN16/40	2 mm (0.08")

Insertion length does not include any raised face/gasket face dimension (see Flange Facing table above).

Pointek CLS200 dimensions - Flanged Process Connections

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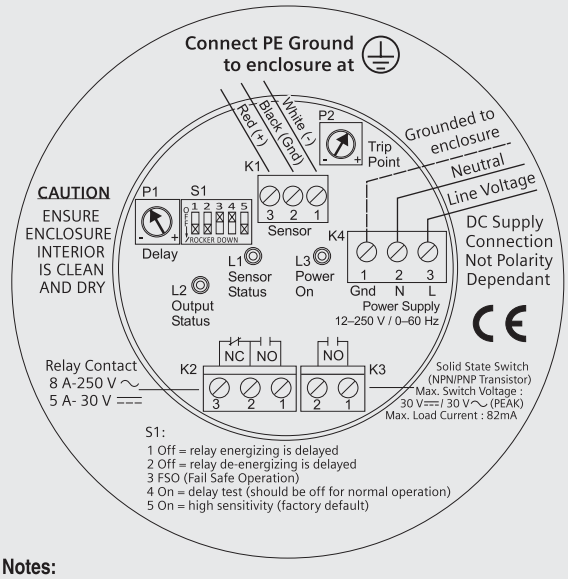
Pointek CLS200

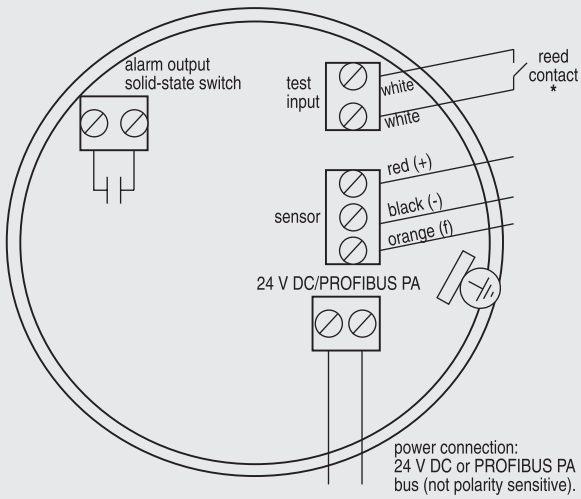
Schematics

Wiring: Pointek CLS200 Standard



Notes:
- Identification label is on underside of lid. Switch and Potentiometer settings are for illustration purposes only (Refer to Operation/Setup in manual).
- All field wiring must have insulation suitable for at least 250 V.
- Relay contact terminals are for use with equipment having no accessible live parts and wiring having insulation suitable for at least 250 V.
- Maximum working voltage between adjacent relay contacts shall be 250 V.
- Refer to the Instruction Manual or contact a Siemens representative for detailed wiring information.

Wiring: Pointek CLS200 Digital



Notes:
Refer to the Instruction Manual or contact a Siemens representative for detailed wiring information.

***Magnet Activated Sensor Test**
A magnet can be used to test the sensor without opening the lid of the Pointek CLS200 Digital version. Bring the magnet close to the test area indicated on the enclosure. The sensor test starts and finishes automatically after 10 seconds.

Pointek CLS200 connections

GREER
BLADDER PRODUCTS

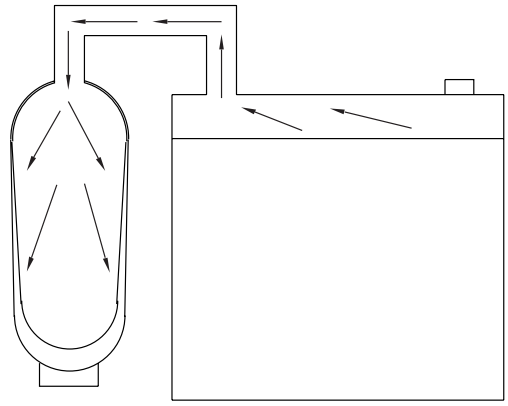
KleenVent KV Series

Hydraulic Reservoir Isolators

KleenVent Hydraulic Reservoir Isolators Feature:

- Capacities from 2-1/2 to 80 Gallons
- Four Bladder Polymers for a Wide Range of Fluids and Temperatures
- Fiberglas and Steel Shells
- Optional Pressure/Vacuum Breaker

Fluid contamination can lead to high maintenance costs and downtime in hydraulic systems. KleenVent reservoir isolators provide protection against the ingestion of airborne contaminants – dust, chemicals, and water vapor – into your hydraulic system though the reservoirs breather-vent. By using an elastomer bladder as a lung, the changes in gas volume in a hydraulic system's reservoir can be trapped and prevented from mixing with the outside atmosphere. And unlike conventional breather-vent filters, KleenVent reservoir isolators provide a positive separation without the possibility of clogging or need for maintenance.



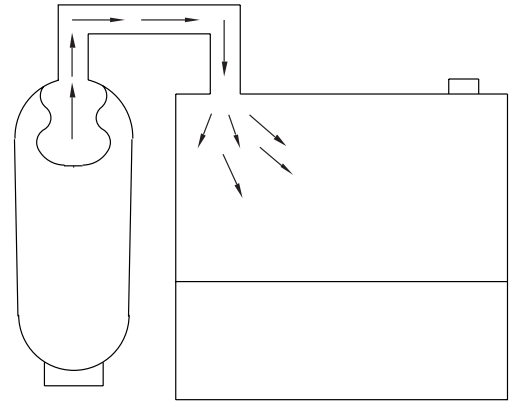
ATMOSPHERIC PRESSURE — RESERVOIR HIGH LEVEL

Why Use KleenVent Reservoir Isolators?

- reduce hydraulic system maintenance costs
- reduce hydraulic system downtime
- reduce waste disposal costs
- extends filter life
- low maintenance solution
- range of compounds for a variety of fluids

Greer KleenVent Reservoir Isolators – The Right Choice For . . .

- Steel/Primary Metal Mills
- Foundries
- Pulp and Paper Mills
- Power Generation Plants
- Automotive Plants
- Any Highly Contaminated or Humid Environment



ATMOSPHERIC PRESSURE — RESERVOIR LOW LEVEL

Specifications

Materials

- Shell – fiberglas or steel
- Ports – steel
- Bladders – choice of four compounds – Nitrile, Butyl, EPR, or Fluorocarbon, see chart below.

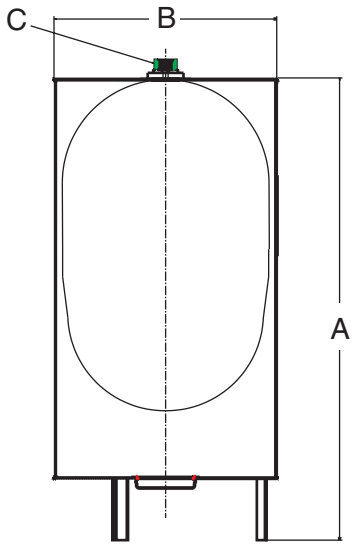
Pressure Ratings – Atmospheric pressure.

Fluids – Greer's KleenVent reservoir isolators are compatible with virtually any industrial fluid with the proper bladder selection. See chart below or consult factory.

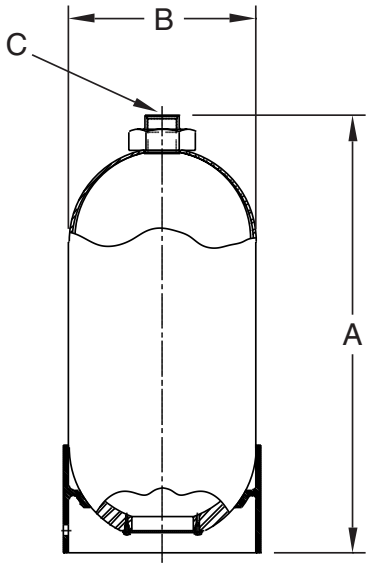
Options – Pressure/Vacuum Breakers for safety and reservoir protection, see next page.

Seal Code	Polymer	Recommended Operating Temperature Range	Maximum Temperature with Reduced Life	General Application & Compatibility
01	Buna-Nitrile	-20°F to 200°F -29°C to 93°C	225°F 107°C	Greer's Standard Compound – Compatible with most mineral oil based fluids
06	Butyl	-40°F to 200°F -40°C to 93°C	300°F 149°C	Compatible with most phosphate ester fluids and some synthetic fluids
28	Fluorocarbon Elastomer	-10°F to 250°F -23°C to 121°C	400°F 204°C	Compatible with most mineral oil based fluids at higher temperatures and some exotic fluids
08	Ethylene Propylene	-40°F to 200°F -40°C to 93°C	300°F 149°C	Compatible with some synthetic fluids and water

Models, Capacities and Dimensions



Steel KleenVent



Fiberglas KleenVent

Model	Nominal Capacity Gallons (Liters)	Actual Capacity Gallons (Liters)	Shell Material	A in. (mm)	B in. (mm)	C Port Size Thread Size	Weight lbs. (Kg)
KV02F0T01A1	2.5 (9.5)	1.64 (6.2)	Fiberglas	19.25 (489)	8.25 (210	SAE #16 1-5/16 - 12	14 (6.4)
KV05F0T01A1	5 (18.9)	3.78 (14.3)	Fiberglas	32.25 (819)	8.25 (210)	SAE #16 1-5/16 - 12	22 (10)
KV10F0T01A1	10 (37.8)	9.3 (35.2)	Fiberglas	50.19 (1275)	9.25 (235)	SAE #16 1-5/16 - 12	38 (17)
KV20F0T01A1	20 (75.6)	18.8 (71.1)	Fiberglas	55.50 (1410)	12 (305)	SAE #24 1-7/8 - 12	60 (27)
KV20M0T01A1	20 (75.6)	18.8 (71.1)	Steel	54.18 (1376)	12 (305)	SAE #24 1-7/8 - 12	80 (36)
KV40M0T01A1	40 (151)	32 (121)	Steel	35.00 (889)	22 (562)	SAE #24 1-7/8 - 12	115 (52)
KV60M0T01A1	60 (227)	54 (204)	Steel	47.50 (1206)	22 (562)	SAE #24 1-7/8 - 12	150 (68)
KV80M0T01A1	80 (302)	68 (257)	Steel	60.12 (1527)	22 (562)	SAE #24 1-7/8 - 12	190 (86)

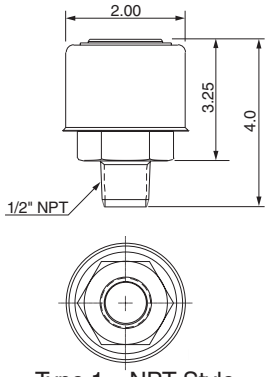
Optional Pressure/Vacuum Breaker

Greer recommends that every KleenVent installation be equipped with a Pressure/Vacuum Breaker to protect the reservoir in the event of a sudden fluid loss or over-filling. Greer offers two types of optional pressure/vacuum breakers, Type 1 that installs with a 1/2" male NPT, and Type 2 bayonet style that installs into your existing reservoirs fill-vent port.

Features & Specifications:

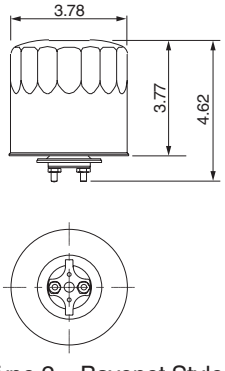
- Fixed pressure relief – 1 psid ± 0.5 psi (0.07 bar ± 0.035 bar)
- Fixed vacuum relief – 0.15 psid ± 0.15 psi (0.01 bar ± 0.01 bar)
- 10 micron filter – Type 1, reusable sintered bronze; Type 2, replaceable filter cartridge.

PN1486670000



Type 1 – NPT Style

PN1486680000



Type 2 – Bayonet Style

KleenVent Installation & Sizing Information

KleenVents should be installed when the reservoir is at its highest level. This will allow the bladder to deflate as the reservoir level drops. KleenVents should be installed in a vertical position for optimum performance. Multiple KleenVents should be installed in parallel when the required size exceeds 80 gallons. Always use “actual volumes” when sizing and select the next higher size when a capacity is required between size offerings.

Sizing a KleenVent on New and Existing Systems

On new systems, sum all single acting cylinder “differential” volumes (rod area x stroke) and all accumulator volumes in the system. Multiply this sum by 1.2 to find the KleenVent volume required. Select a KleenVent(s) with an actual capacity equal to or greater than the sum calculated. On existing systems, if the cylinder and accumulator sizes are known, the above method may be used. If not, calculate the total change in fluid volume in the system during operation by measuring the high and low fluid level of the reservoir. Multiply the difference in fluid levels by the width and length of the reservoir to calculate the total fluid volume change. Select a KleenVent(s) with an actual capacity equal to or greater than the sum calculated.

Installation Kits . . . Add Without Interruption

Add closed-loop protection without shutting down, purging the reservoir, contaminating existing fluids or losing time.

KleenVent Installation Kits

Part Number	Description
8708690006	Installation Kit with 6' hose
8708690009	Installation Kit with 9' hose
8708690012	Installation Kit with 12' hose
8708690018	Installation Kit with 18' hose
8708690024	Installation Kit with 24' hose

NEW!

How to Order KleenVents

KV Series KleenVents can be specified by using the symbols in the chart below to develop a model number. Select only those symbols that represent the features desired, and place them in the sequence indicated by the example at the top of the chart.

Series	Size	Construction	Pressure	Port	Bladder	Variation	Code
KV	**20**	**M**	**0**	**T**	**01**	**A**	**1**
KV KleenVent	**02** 2½ gallon **05** 5 gallon **10** 10 gallon **20** 20 gallon **40** 40 gallon **60** 60 gallon **80** 80 gallon	**F** Fiberglas (2½ - 20 gal. **M** Steel (20 - 80 gal.)	**0** Atmospheric	**T** SAE	**01** Buna-Nitrile **06** Butyl **08** EPR **28** Fluorocarbon	**A** Standard **X** Special	**1** Standard * Special Design No. Assigned

FLANGED BALL VALVES ANSI CLASS 150 & 300

FULL BORE:

1/2" – 12" (DN 15 – 300) SERIES 9000
14" – 24"(DN 350 – 600) AND LARGER SERIES 6000

The JAMESBURY® polymeric-seated flanged ball valves offer a patented flexible-lip seat design that provides positive bi-directional shut-off for a variety of applications in industries ranging from chemical and petrochemical to refining, pulp and paper, and power.

Polymeric-seated flanged ball valves are available in sizes 1/2" – 24" (DN 15 – 600) in both full-bore and standard-bore designs that fully conform to ASME B16.34 requirements.

A choice of body, trim, and seat materials is available to suit an extensive range of applications. As an option, valves can be prepared for special services, such as chlorine, oxygen, high-vacuum, hydrogen peroxide or NACE.

FIRE-TITE® Valves

Standard body and trim materials for FIRE-TITE valves are carbon steel with 316 stainless steel trim and all 316 stainless steel. Seat material options are PTFE (T) and XTREME® (X) for applications involving chemicals, petrochemicals, acids, caustics, and steam. PFA (B) seats are available to resist the effects of polymerizing monomers such as butadiene and styrene.

Non FIRE-TITE Valves

Non FIRE-TITE valves are available with UHMW (U) polyethylene and Peek® (L) seats.

CE Marked

CE marked and documented valves 9180, 9380, 6180 and 6380 which meet the European Pressure Equipment Directive (PED) 97/23/EC are available in ANSI Class 150/300. CE marked products also meet the requirements of BS 5351, including static grounding. Operating torques, construction options and valve dimensions are exactly the same as the standard ANSI 150/300 offering (see page 18 for ordering instructions).

FEATURES AND BENEFITS

- XTREME seat provides longer life, expanded performance boundaries, and greater value.
- Polymeric flexible lip-seat design offers tight shut-off in either direction and extended cycle life with minimum maintenance.
- FIRE-TITE version with non-metallic seats meets API 607, Edition 4, and BS6755-Part 2 requirements.
- Superior control characteristics, coupled with tight shut-off capabilities, make these valves ideal for a variety of on-off and control applications.
- API 608 compliance to serve refineries and related chemical and petrochemical industries.
- NACE MR0103 compliance available.
- Meets 23 standard and 7 optional industry standards and specifications. For details (see page 19).

NEW FEATURES AND BENEFITS
For 1/2" – 1-1/2" (DN 15 – 40) Series 9000

- New stem seal system is live loaded and engineered to assure long sealing life - patent pending.
- ISO 5211 Bonnet for global conformity.
- New stainless steel linkage for VPVL, ERV, ER and EU actuators has a guided coupling to align topworks during assembly and eliminate side load stress on stem seals for long life, clean environment and reduced maintenance.

Single-Source Responsibility

- Valves, actuators and accessories may be purchased completely mounted from one source.

metso
Expect results

SPECIFICATIONS

Flow Data

The table at right provides flow coefficients for JAMESBURY valves covered in this bulletin. C_v values represent the flow of water at +60˚F through the valve in U.S. gallons per minute at a pressure drop of 1 psi. The metric equivalent, K_v, is the flow of water at 16˚C through the valve in cubic meters per hour at a pressure drop of 1 kg/cm^2. To convert C_v to K_v, multiply by 0.8569.

Valve Size		Cv
Inches	DN	Full Bore
1/2	15	9
3/4	20	50
1	25	100
1-1/2	40	270
2	50	490
3	80	1160
4	100	2200
6	150	5100
8	200	9300
10	250	15,200
12	300	22,400
14	350	27,000
16	400	37,000
18	450	47,000
20	500	60,000

Valve Body Ratings

These are the maximum working pressure ratings of the valve body only. The seat ratings, shown on the next page, determine the practical temperature and pressure limitations according to actual service conditions. Test pressures are recommended pressures for hydrostatic test with ball half open.

Maximum Working Pressure, psi						
Temp ˚F	Class 150				Class 300	
	Carbon steel*	316 Stainless steel*	Alloy 20*	Monel®	Carbon steel*	316 Stainless steel*
-20 to 100	285	275	230	230	740	720
200	260	235	200	200	675	620
300	230	215	190	190	655	560
400	200	195	190	185	635	515
500	170	170	170	170	600	480
Test Pressure	450	425	350	350	1125	1100

Maximum Working Pressure, bar						
Temp ˚C	Class 150				Class 300	
	Carbon steel*	316 Stainless steel*	Alloy 20*	Monel	Carbon steel*	316 Stainless steel*
-29 to 38	19.6	19.0	15.9	15.9	51.1	49.6
100	17.7	16.2	13.5	13.5	46.6	42.2
150	15.8	14.8	13.1	13.1	45.1	38.5
200	13.8	13.7	13.1	13.1	43.8	35.7
250	11.7	11.7	11.7	11.7	41.9	33.4
Test Pressure	30	29	24	24	77	75

* In accordance with ANSI B16.34

Valve Seat Ratings

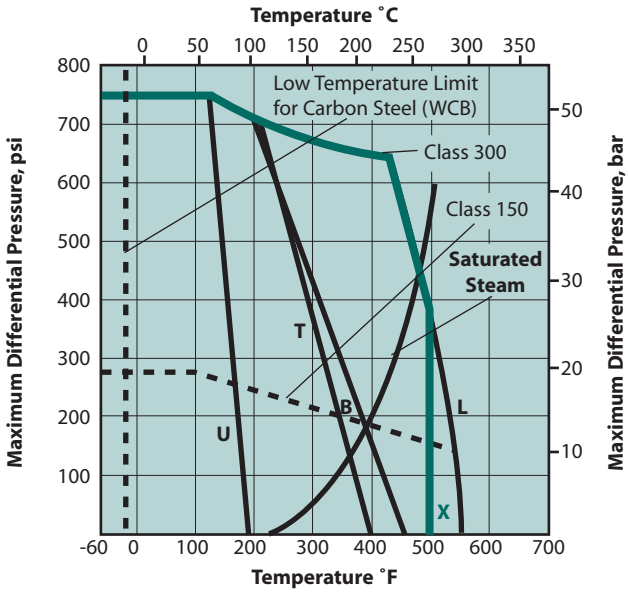
Seat ratings, indicated by solid lines in the charts on the next page, are based on differential pressure with the valve ball in the fully closed position and refer to seats only. The dotted lines indicate maximum working pressures for *WCB carbon steel* valve bodies. (Maximum working pressures of other body materials are shown in the tables above.) The combination of dotted and solid lines indicates the maximum valve rating at specific pressure and temperature conditions. Valves with PTFE, XTREME, PEEK®, PFA, and UHMW polyethylene seats can be used in service to -60˚F (-51˚C) provided that the valve body material is suitable for such a temperature. Carbon steel valves are rated to -20˚F (-29˚C).

On saturated steam service, stainless steel trim is recommended at all pressures and is required above 200 psi (14 bar). See Bulletin B150-1. Peek seats require 17-4 PH stainless steel stems. For more application information on seat materials, refer to Bulletin T140-1.

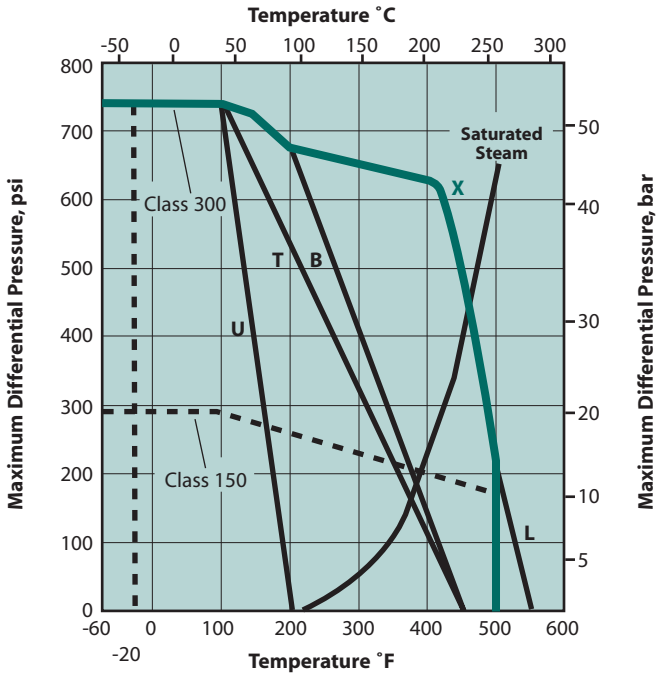
XTREME Performance and Value

XTREME seats provide longer life, expanded performance boundaries, and the greatest possible value. XTREME is a unique material that resulted from a technological breakthrough in our polymer research lab. The material is a fluoropolymer-based blend proprietary to JAMESBURY that provides superior quarter-turn performance.

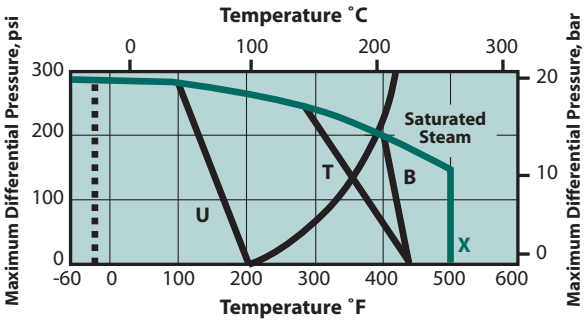
1/2" – 1-1/2" (DN 15 – 40) Full Bore



2" – 4" (DN 50 – 100) Full Bore

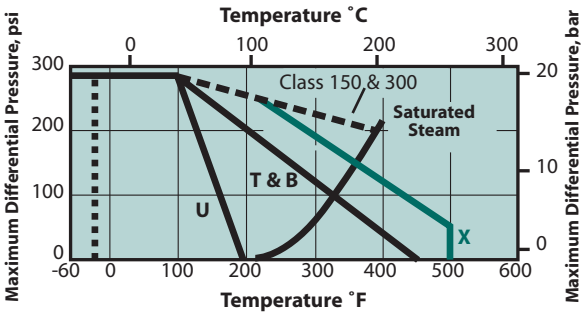


6" (DN 150) Full Bore Non-Trunnion



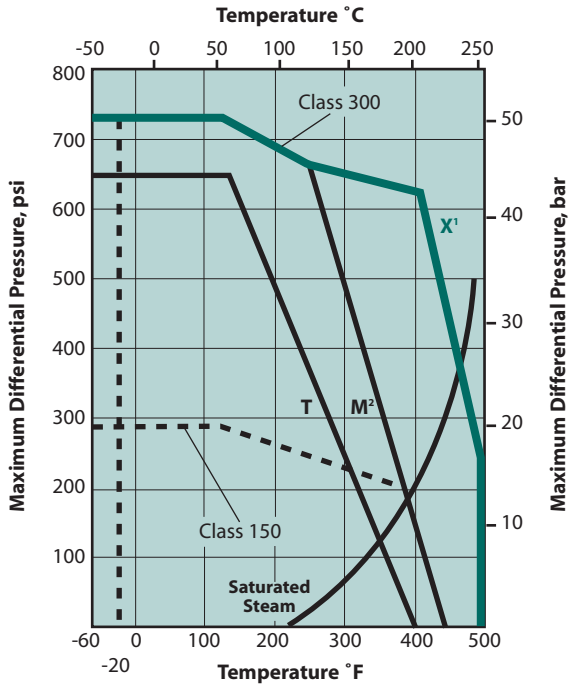
*** ANSI Class 300 Non-Trunnion is 275 psi (19 bar) max.**

8" (DN 200) Full Bore Non-Trunnion



*** ANSI Class 300 Non-Trunnion is 275 psi (19 bar) max.**

Trunnion Valves
6" – 24"(DN 150 – 600) Full Bore



X¹ 6" – 12" (DN 150 – 300) Only
M² 6" – 24" (DN 150 – 600)

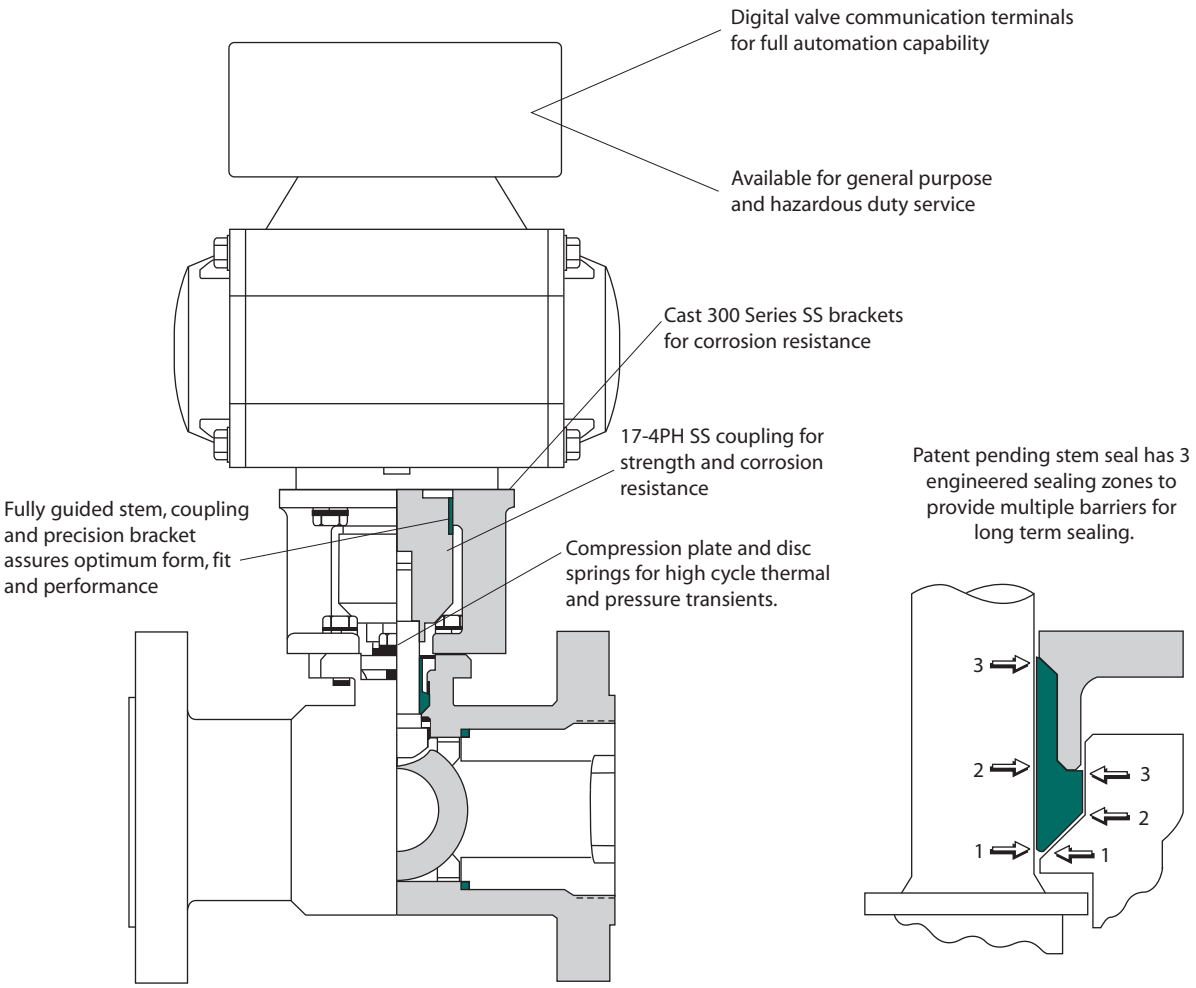
NOTE 1: For series 9000 **NOTE 2:** For series 6000

LEGEND:

T = PTFE	M = Filled PTFE	B = PFA
L = Peek	U = UHMW	X = XTREME

JAMESBURY 'The Ultimate Process Automation Package'
for VPVL Pneumatic Actuators, V-Series and ADC-Series Electric Actuators

For 1/2" – 1-1/2" (DN 15 – 40) Full Port Series 9000

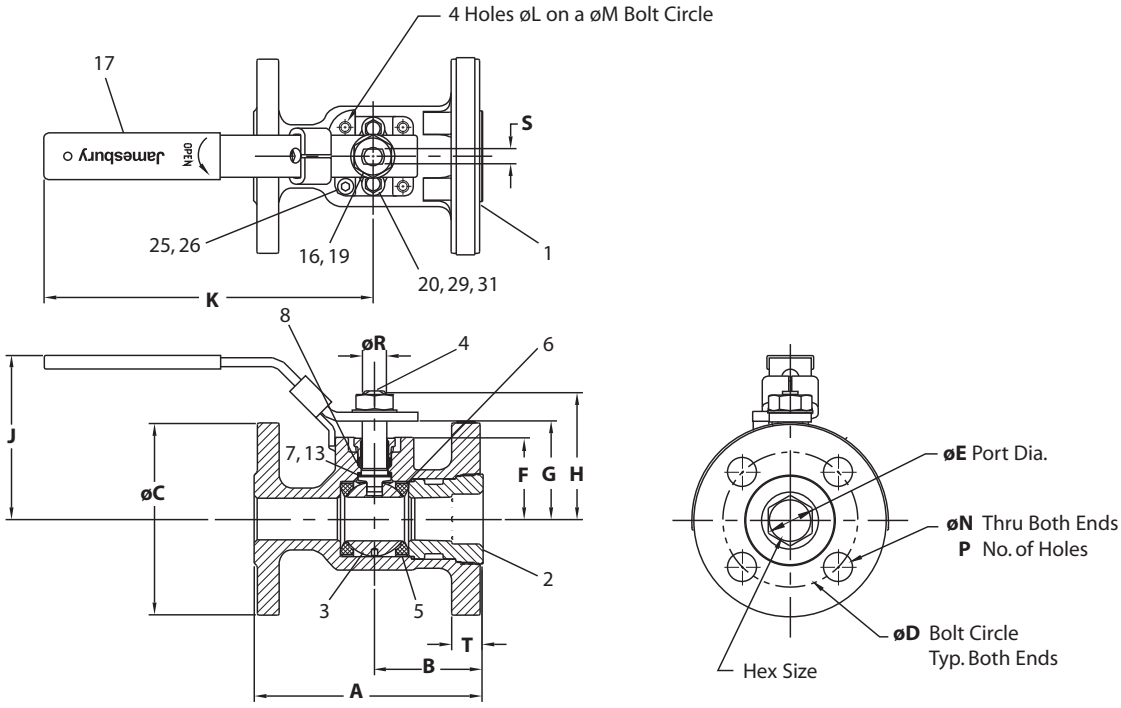


Automation Performance and Value

Valves combined with JAMESBURY actuators, network capable valve monitors and communication devices offer a total value and performance package. Available with pneumatic VALV-POWR® VPVL actuators, V-Series and ADC-Series electric actuators and with STONEL® QUARTZ®, ECLIPSE®, and HAWKEYE® digital monitors or VCTs, the packages have a wide range of applications. Visit our web-site at **www.metso.com/automation**.

DIMENSIONS

1/2" – 1-1/2" (DN 15 – 40) Series 9150 ANSI Class150 and Series 9300 ANSI Class 300 Valves



Valve Size inches	Series 9150 ANSI Class 150 Approximate Dimensions - inches																	Hex Size	ISO Bonnet	Approx Weight lb
	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T			
1/2	4.25	1.94	3.50	2.38	0.50	1.06	1.33	1.63	3.38	5.00	M5	1.42	0.62	4	0.31	0.18	0.50	0.50	F03	3.5
3/4	4.63	2.19	3.88	2.75	0.88	1.65	2.04	2.58	3.69	6.50	M5	1.65	0.62	4	0.31	0.31	0.63	0.88	F04	10
1	5.00	2.19	4.25	3.12	1.00	1.78	2.17	2.71	3.94	6.50	M5	1.65	0.62	4	0.50	0.31	0.63	1.00	F04	13
1-1/2	6.50	2.64	5.00	3.88	1.50	2.26	2.78	3.49	4.46	8.00	M6	1.97	0.62	4	0.62	0.37	0.69	1.50	F05	17

Valve Size DN	Series 9150 ANSI Class 150 Approximate Dimensions - mm																	Hex Size	ISO Bonnet	Approx Weight kg
	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T			
15	108	49	89	60	13	27	34	41	86	127	M5	36	16	4	8	5	13	13	F03	1.6
20	118	56	99	70	22	42	52	66	94	165	M5	42	16	4	8	8	16	22	F04	4.5
25	127	56	108	79	25	45	55	69	100	165	M5	42	16	4	13	8	16	25	F04	5.9
40	165	67	127	99	38	57	71	89	113	203	M6	50	16	4	16	9	18	38	F05	7.7

Valve Size inches	Series 9300 ANSI Class 300 Approximate Dimensions - inches																	Hex Size	ISO Bonnet	Approx Weight lb
	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T			
1/2	5.50	1.94	3.75	2.62	0.50	1.06	1.33	1.63	3.38	5.00	M5	1.42	0.62	4	0.31	0.18	0.56	0.50	F03	6
3/4	6.00	2.19	4.63	3.25	0.88	1.65	2.04	2.58	3.69	6.50	M5	1.65	0.75	4	0.50	0.31	0.63	0.88	F04	13
1	6.50	2.19	4.88	3.50	1.00	1.78	2.17	2.71	3.94	6.50	M5	1.65	0.75	4	0.50	0.31	0.69	1.00	F04	17
1-1/2	7.50	2.64	6.13	4.50	1.50	2.26	2.78	3.49	4.46	8.00	M6	1.97	0.88	4	0.62	0.37	0.81	1.50	F05	22

Valve Size DN	Series 9300 ANSI Class 300 Approximate Dimensions - mm																	Hex Size	ISO Bonnet	Approx Weight kg
	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T			
15	140	49	95	67	13	27	34	41	86	127	M5	36	16	4	8	5	14	13	F03	2.7
20	152	56	118	83	22	42	52	66	94	165	M5	42	19	4	13	8	16	22	F04	5.9
25	165	56	124	89	25	45	55	69	100	165	M5	42	19	4	13	8	18	25	F04	7.7
40	190	67	156	114	38	57	71	89	113	203	M6	50	22	4	16	9	21	38	F05	10.0

BILLS OF MATERIALS AND PARTS LIST

FIRE-TITE 1/2" – 1-1/2" (DN 15 – 40) Full Bore Series 9000 Valves

Part No.	Part Name	Body Material	
		Carbon Steel (22)	316 Stainless Steel (36)
1	Body	Carbon steel ASTM A216 Type WCB	316 Stainless steel ASTM A351 Type CF8M
2	Insert	Carbon steel ASTM A216 Type WCB	316L Stainless steel ASTM A351 Type CF3M
3	Ball	316 Stainless steel +	
4	Stem	316 Stainless steel +	
5	Seat	PTFE, XTREME, PFA, as specified	
6	Body Seal	TFM	
7	Secondary Stem Seal	Graphite	
8	Primary Stem Seal	PTFE, TFM (XTREME seated valves), UHMWPE (w/UHMWPE seats)	
13	Stem Bearing	Filled PTFE	
16	Hex Nut	Carbon steel (zinc plated)	300 Series Stainless steel
17	Handle	Carbon steel (zinc plated)	300 Series Stainless steel
19	Lockwasher	Carbon steel (zinc plated)	300 Series Stainless steel
20	Compression Plate [3]	316 Stainless steel	
25	Socket Cap Screw	300 Series Stainless steel	
26	Handle Stop Spacer	300 Series Stainless steel	
29	Hex Cap Screw [3]	300 Series Stainless steel	
31	Disc Springs	Inconel	

Non FIRE-TITE 1/2" – 1-1/2" (DN 15 – 40) Full Bore Series 9000 Valves

Part No.	Part Name	Body Material	
		Carbon Steel (22)	316 Stainless Steel (36)
1	Body	Carbon steel ASTM A216 Type WCB	316 Stainless steel ASTM A351 Type CF8M
2	Insert	Carbon steel ASTM A216 Type WCB	316L Stainless steel ASTM A351 Type CF3M
3	Ball	316 Stainless steel +	
4	Stem	316 Stainless steel + or 17-4 PH Stainless steel [2]	
5	Seat	PTFE, Peek #, UHMWPE, as specified	
6	Body Seal	TFM, UHMWPE (w/UHMWPE seats), Graphite (w/Peek seats)	
8	Primary Stem Seal	TFM (w/XTREME seats), PTFE (w/PTFE seats), Graphite (w/Peek seats), UHMWPE (w/UHMWPE seats)	
10	Stem Guide	Peek (Peek seated valves)	
16	Hex Nut	316 Stainless steel	
17	Handle	Carbon steel (zinc plated)	300 Series Stainless steel
19	Lockwasher	300 Series Stainless steel	
20	Compression Plate [3]	316 Stainless steel	
24	Stem Bearing	Filled PTFE (Peek when Peek seated), UHMWPE (w/UHMWPE seats)	
25	Socket Cap Screw	300 Series Stainless steel	
26	Handle Stop Spacer	300 Series Stainless steel	
29	Hex Cap Screw [3]	300 Series Stainless steel	
31	Disc Springs	Inconel	

Requires 17-4 PH stem

Note 1: When investment castings are used, chemical and physical properties are determined from a master heat in accordance with ANSI B16.34-1996 Sect. 5.1.2.

Note 2: 17-4 PH stems required with Peek seats.

Note 3: When trim is Monel or Hastelloy C, compression plate and hex cap screws are Monel.

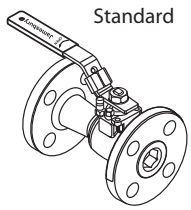
\+ Furnished with valves for NACE MR0103 service.

ACCESSORIES

Locking Devices

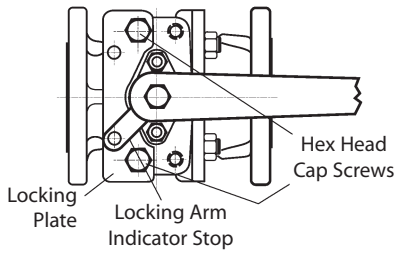
When safety measures are necessary, a reliable locking plate is available to allow the valve to be padlocked in either the open or closed position. Proper figure numbers are shown in the Accessory Table below.

Slide Lock
Standard



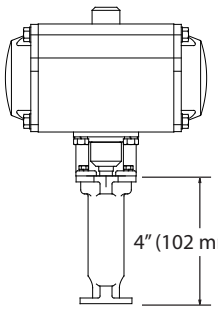
1/2" – 1-1/2" (DN 15 – 40)
Series 9000

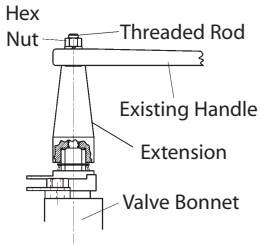
2" – 6" (DN 50 – 150) Series 9150
2" – 4" (DN 50 – 100) Series 9300
LD56, 57 & 58



Bonnet/Stem Extensions SE-084, 085 & 086

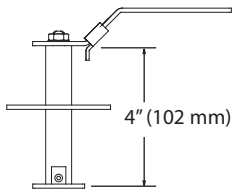
4" (102 mm) bonnet/stem extensions are available for applications that require insulated pipe, particularly useful for automated products, extensions can also be used to prevent interference between actuators and companion pipelines and equipment. They are ideal as extension that require locking lever or locking oval handle capability. Stainless steel construction offers the option of using the extension to complement the carbon steel stem extension (SE-093, 094 & 095) offering.





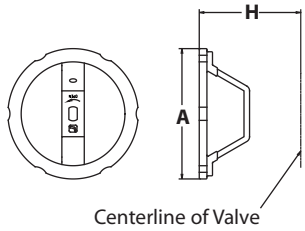
Stem Extensions SE-093, 094 & 095

A standard 4" (102 mm) stem extension is offered for Series 9000 valves (1/2 – 1-1/2" (DN15 – 40)) for improved accessibility, particularly when used in insulated pipelines. Stem extension kits can be ordered factory-mounted or shipped separately for field mounting



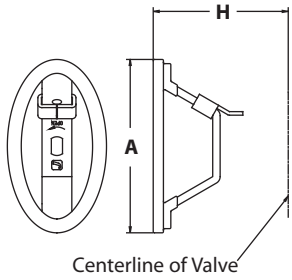
Round Handles

Series 9000 ball valves have optional round handles available. To order handles separately, specify the part number shown in the accessories table below.



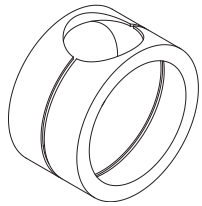
Oval handles with slide-lock

Optional oval handle saves space and may be padlocked to retain the valve in the open or closed position.



Cavity Fillers

Cavity fillers are available in 9000 series full bore valves. The fillers are PTFE and used for sanitary applications and in processes where cross contamination is a concern. Food processing, pharma-chemicals, cosmetics, paints, solvents, finishes and dyes are typical applications where fillers are employed.



Accessory Table – inches (DN)

Valve Size Full Bore	Locking Device	Stem Ext.	Bonnet/ Stem Ext.	Locking Oval	Round	Round/Oval Handle		Allowable Max. Torque FT•LBS (N•m)	
						Dimension A	Dimension H	Round	Oval
1/2" (15)	Standard Equipment	SE-093	SE-096	112-0108-30	112-0105-30	4.00 (101.6)	2.96 (75.2)	9 (12)	9 (12)
3/4" (20)		SE-093	SE-096	112-0109-30	112-0106-30	4.50 (114.3)	3.70 (94.0)	18 (24)	18 (24)
1" (25)		SE-094	SE-097	112-0109-30	112-0106-30	4.50 (114.3)	3.83 (97.3)	18 (24)	18 (24)
1-1/4" (30)		SE-095	SE-098	112-0110-30	112-0107-30	5.75 (146.0)	4.75 (120.7)	25 (34)	25 (34)
1-1/2" (40)		SE-095	SE-098	112-0110-30	112-0107-30	5.75 (146.0)	4.94 (125.5)	25 (34)	25 (34)
2" (50)	LD56	SE-60	NA						
3" (80) 9150	LD56	SE-60							
3" (80) 9300	LD57	SE-61							
4" (100) 9150	LD57	SE-61							
4" (100) 9300	LD58	SE-62							
6" (150) 9150	LD58	SE-62							

* For valves with PEEK(L) seats that require stem extensions use bonnet/stem extension SE-096, 097 or 098.

VALVE TORQUE DATA

Use these torque charts as a guide for actuator selection. Additional requirements may be imposed by media characteristics, trim, and frequency of valve operation. For clean lubricating fluid service, required torque for PTFE (T), XTREME (X) and filled PTFE (M) seated valves only may be reduced 20% when the valve is equipped with corrosion resistant trim. For difficult services such as slurries and semi-solids, and for oxygen, increase values by 50%. If in doubt, err on the side of safety by using a larger actuator than would normally be selected.

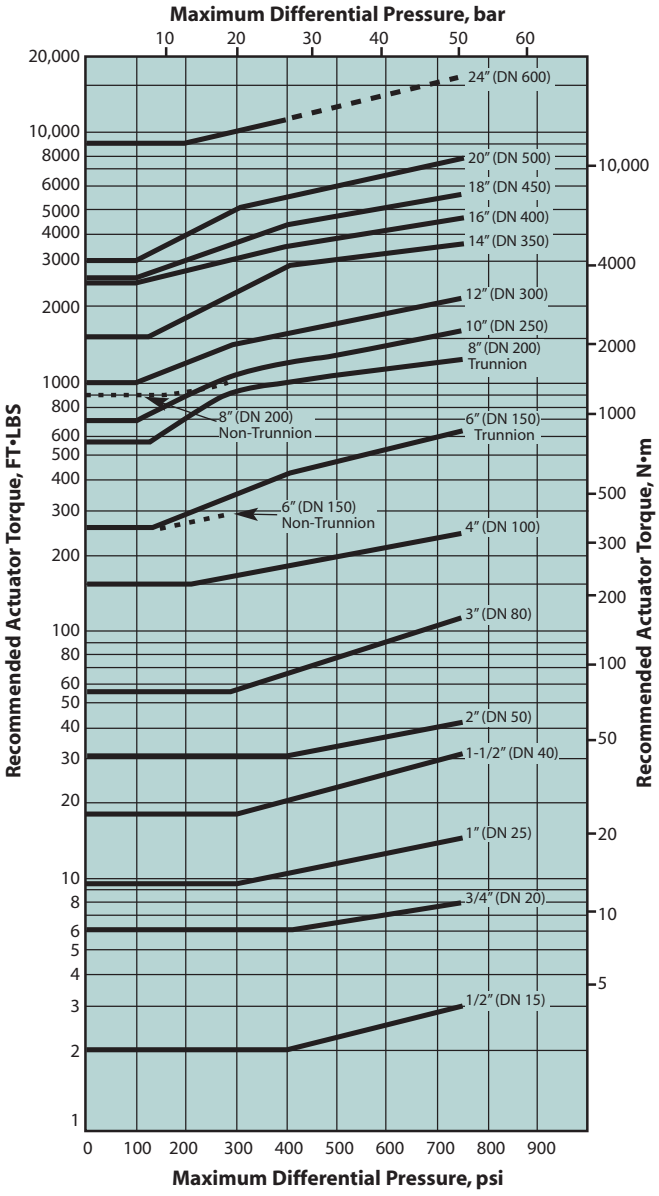
Valves with E-PAK® require an increase in operating torque. Refer to Bulletin B115-4 for additional information.

Torque output values and actuator selection tables for the different types of JAMESBURY actuators are contained in the bulletins listed below.

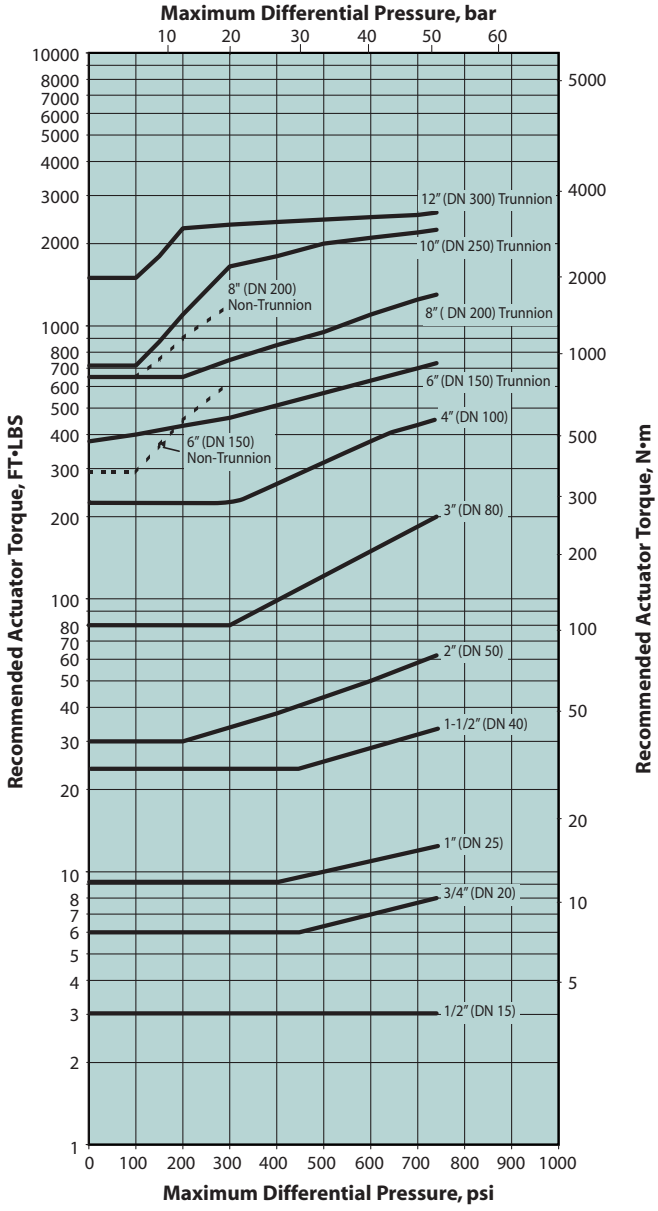
Manual Gear Actuators	A100-1
B-Series Piston Actuators	6B20
QUADRA-POWR® X Spring Diaphragm Rotary Actuators	A110-4
VALV-POWR® Series VPVL	A111-3
VPVL Stainless Steel	A111-4
V Series Electric Actuators	A200-1
ADC Series Electric Actuators	A201-1

ANSI Class 150 and 300 Valve Torque Data

PTFE (T) Seated Valves



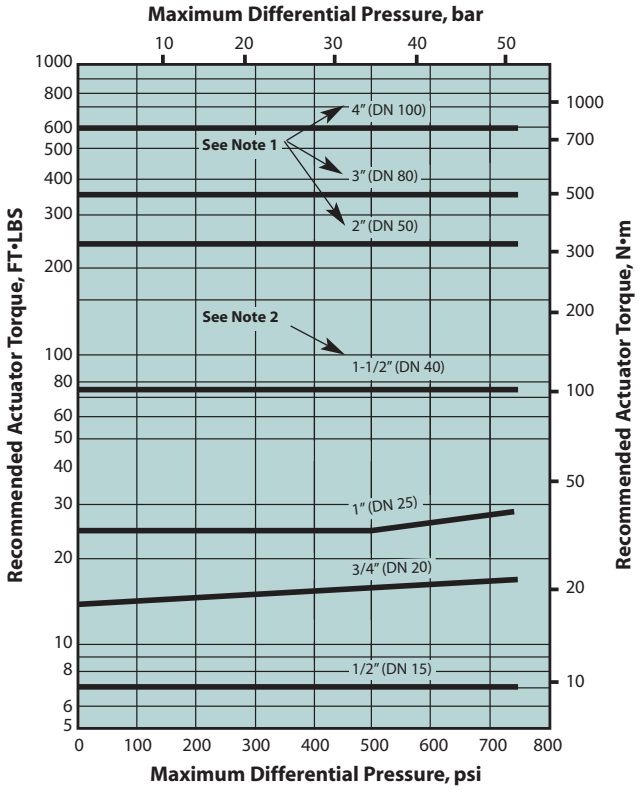
XTREME (X) Seated Valves 1/2" – 12" (DN 15 – 300)



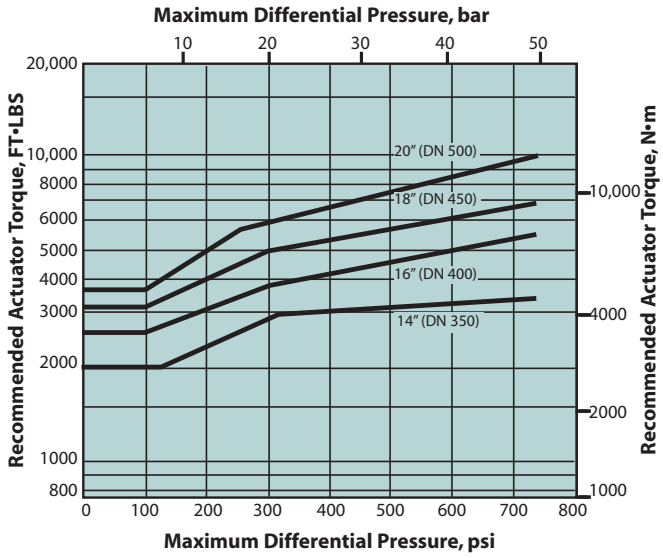
VALVE TORQUE DATA

ANSI Class 150 and 300 Valves

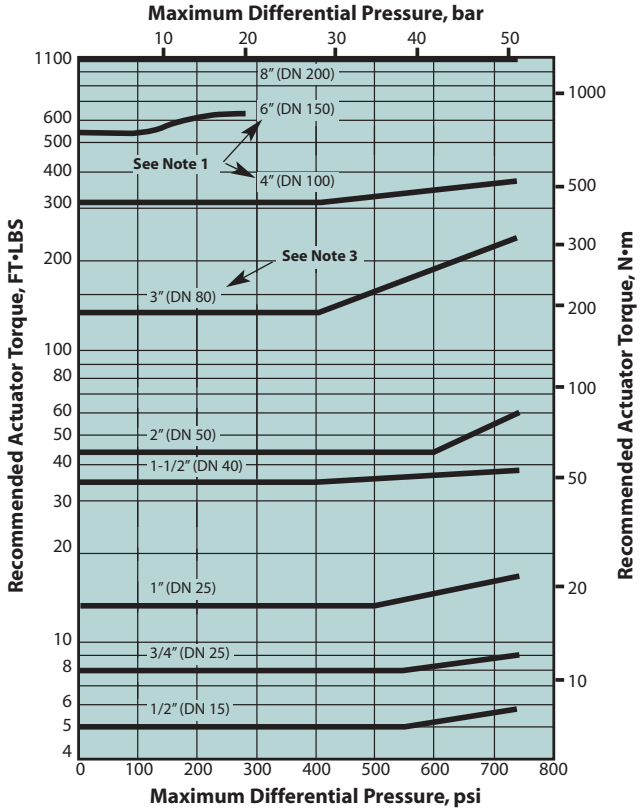
Peek (L) Seated Valves 1/2" – 6" (DN 15 – 150)



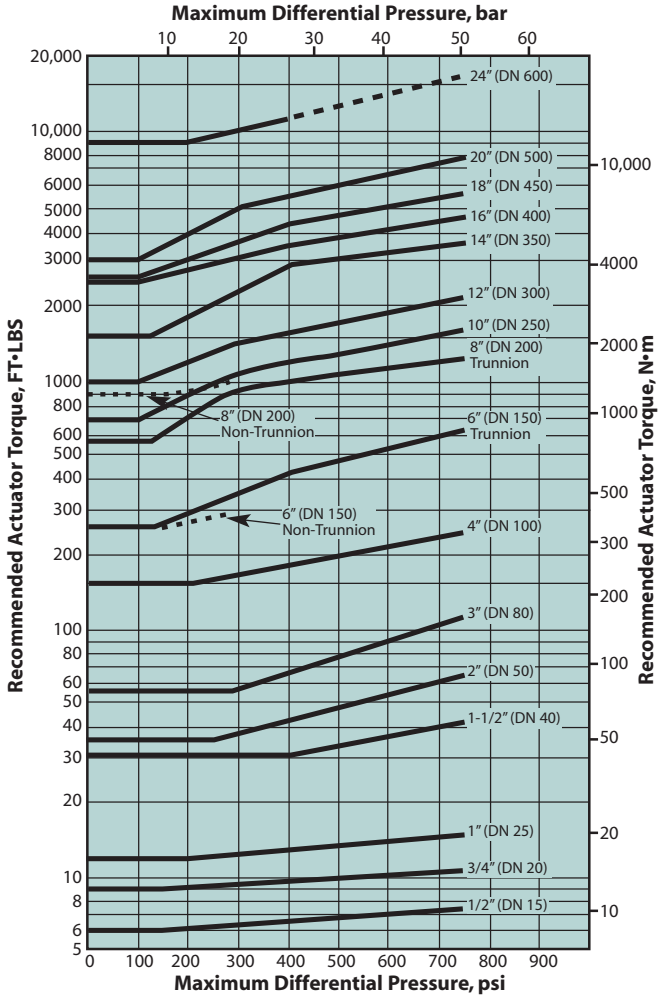
Filled PTFE (M) Seated Valves



PFA (B) Seated Valves 1/2" – 8" (DN 15 – 200)



UHMW Polyethylene (U) Seated Valves



Note 1: Actuator is required;
Note 2: Actuator is required for difficult service;
Note 3: Actuator is required for difficult service and pressure greater than 500 psi.

HOW TO ORDER

EXAMPLE: A 2" ANSI Class 300 short design valve (9150) in FIRE-TITE design (3) with raised-face flanges (31), carbon steel body (22), and 316 stainless steel trim (36), with XTREME seats (XTZ) and molecularly enhanced PTFE stem seals is written: 2" 9150-31-2236XTZ1.

1	2	3	—	4	—	5	6	7	8
2"	9150	–		31		22	36	XTZ	1

1	Size		
1/2" to 24"	1/2" (DN 15)	4" (DN 100)	14" (DN 350)
	3/4" (DN 20)	6" (DN 150)	16" (DN 400)
	1" (DN 25)	8" (DN 200)	18" (DN 450)
	1-1/2" (DN 40)	10" (DN 250)	20" (DN 500)
	2" (DN 50)	12" (DN 300)	24" (DN 600)
	3" (DN 80)		

2	Valve Series & Style	Size Range
9150	Full Bore Class 150	1/2" – 12" (DN 15 –300)
9180	Full Bore Class 150*	1/2" – 12" (DN 15 –300)
9300	Full Bore Class 300	1/2" – 12" (DN 15 –300)
930L	Full Bore Class 300 B16.10 long F-F	8" (DN 200)
9380	Full Bore Class 300*	1/2" – 12" (DN 15 –300)
938L	Full Bore Class 300 B16.10 long F-F	8" (DN 200)
6150	Full Bore Class 150	14" – 24" (DN 350 –600)
6180	Full Bore Class 150*	14" – 24" (DN 350 –600)
6300	Full Bore Class 300	14" – 24" (DN 350 –600)
6380	Full Bore Class 300*	14" – 24" (DN 350 –600)

* Metric units on nameplate. Valves larger than 1" (DN 25) are CE marked. Includes static grounding per BS 5351.

3	Special Construction
—	Standard (no entry)
C	Chlorine
N	NACE MR0103
O	Oxygen
DT	125 RMS Flange Finish
Q	PTFE Cavity Filler
STG	Grounded 9000 Series
STGR	Grounded 6000 Series
V	High Vacuum
VC	High Vacuum Certified
DBB	Double Block and Bleed (See Bulletin B151-1)

4	End Connection Construction	Size Range
11	Raised Face Non-FIRE-TITE Non-Trunnion	1/2 – 8" (DN 15 – 200) Full Bore
31	Raised Face FIRE-TITE Non-Trunnion	1/2 – 8" (DN 15 – 200) Full Bore
71	Raised Face FIRE-TITE Trunnion	8 – 24" (DN 200 – 600) Class 150 Full Bore 6 – 24" (DN 150 – 600) Class 300 Full Bore

5	Body Material*	Size Range
22	Carbon Steel (WCB)	All
35	Alloy 20 (CN7M)	Optional in all sizes
36	Stainless Steel (CF8M)	All
71	Monel	Optional in all sizes

* Other materials available on application

6	Ball & Stem Materials*	Size Range
35	Alloy 20	3/4 – 8" (DN 20 – 200) Full Bore
36	316 Stainless Steel	All
71	Monel	Optional
73	Hastelloy	Optional in all sizes
HB	316 SS, 17-4 PH	Required for seat & seal code LGG
00	Same as body	All (Carbon steel not available)

* Other materials available on application

7	Seat / Body Seal / Stem Seal Material*	Size Range
XTZ	XTREME/PTFE[2]/TFM	1/2 – 12" (DN 15 – 300) Full Bore
TTT	PTFE/PTFE[2]/PTFE[2]	All
MTT	Filled PTFE/PTFE/PTFE	14 – 24" (DN 350 – 600) Full Bore
BTT	PFA/PTFE[2]/PTFE[2]	1/2 – 6" (DN 20 – 150) Full Bore
LGG †[13]	Peek/Graphite/Graphite	1/2 – 4" (DN 20 – 100) Full Bore
UUU[1]	UHMW/UHMW/UHMW	1/2 – 8" (DN 15 – 250) Full Bore
MBT[1]	Barrier-filled PTFE	3 – 10" (DN 80 – 250) Full Bore
ZTT	TFM/PTFE[2]/PTFE[2]	1/2" – 10" (DN 15 – 250) Full Bore

* Use first two letters only for Series 6000 valves
† Requires 17-4PH Stem
1 Non-FIRE-TITE only
2 TFM on sizes 1-1/2" (DN 40) and smaller
3 Not a self relieving seat design

8	Bolts	Nuts	Application
1*	ASTM A193 Gr B7	ASTM A194 Gr 2H	Carbon Steel Monel
2	ASTM A193 Gr B8, B8C, B8M or B8T (Class 2)	ASTM A194 Gr 8B, 8CB, 8MB, 8TB, or 8FB	316 St. Stl. Alloy 20
5**[4]	ASTM A193 Gr B7M	ASTM A194 Gr 2HM	NACE
4**	Monel		Monel NACE All Cl_2

Bolts and nuts for 1-1/2" (DN40) and smaller valves apply to bonnet hardware only. For 2" (DN50) and larger bolts and nuts pertain to bonnet hardware and body and cap fasteners.

* Stainless bolting standard for 1-1/2" and smaller
** Required for compliance to NACE MR0103-2003 2" and larger.
4 1-1/2" (DN 40) and smaller use Monel bonnet hardware for NACE MR0103-203 compatibility.

Hastelloy is a registered trademark of Haynes International, Inc. Monel is a registered trademark of Inco. Delrin is a registered trademark of Dupont Co.

STANDARDS AND SPECIFICATIONS

The Company

ISO 9001 – 2000 ANSI/150/ASQ Q9001 – 2000
Pressure Equipment Directive 97/23/EC

The Product - Standard

API 598	American Petroleum Institute - Valve Inspection and testing
API 607 Edition 4	American Petroleum Institute - Fire Test for Soft Seated Valves (Division of refining)
API 608	Metal Ball Valves Used in On-Off Service that have Buttwelded or Flanged Ends for Size 1/2 – 2" (DN 15 – 50) NPS
ANSI/ASME B16.10	American National Standard - Face-to-Face and End-to-End Dimensions of Ferrous Valves
ANSI/ASME B16.5	American National Standard - Steel Pipe Flanges and Flanged Fittings
ANSI/ASME B16.34	American National Standard - Steel Valves - Flanged and Buttwelded End
ANSI/ASME B31.1	American National Standard - Power Piping
ANSI/ASME B31.3	American National Standard - Chemical Plant and Petroleum Refinery Piping
ANSI/FCI 70-2-1991	American National Standard - For Control Valve Seat Leakage
BS 2080:1989	British Standards Institute - Specification for Face-to-Face Dimensions of Flanged and Buttwelded Steel Valves
BS 6755-2:1987	Testing of Valves. Specification for Fire Type-Testing Requirements
ISO 15848-1	Industrial Valves - Fugitive Emissions - Measurement, Test & Qualification Procedures
ISO 5752:1982	International Standard for Organization Metal Valves for use in Flanged Piping Systems
ISA 75.02	Valve Sizing Coefficient Cv, Piping Geometry Factor Fp and Pressure Drop Limitation XT
ISA S75.19	Hydrostatic Testing of Control Valves
ISO 5211	Dimensions for Attachment of Actuators/Gear Boxes to Valves (ISO Mounting)
MSS SP-25	Manufacturers Standardization Society - Standard Marking System for Valves
MSS-SP-55	Manufacturers Standardization Society - Quality Standards for Steel Castings
MSS-SP-6-1996	Standard Finishes for Contact Faces of Pipe Flanges and Connecting-End Flanges of Valves and Fittings
MSS-SP-44-1996	Steel Pipe Line Flanges
MSS-SP-61-1992	Pressure Testing of Steel Valves
MSS SP-72-1992	Flanged or Butt and Weld End Ball Valves Having Full or Reduced Bores for General Liquid and Gas Service
MSS SP-96-1996	Terminology for Valves and Fittings

The Product - Optional

BS 5351	Steel Ball Valves for the Petroleum, Petrochemical and Allied Industries
97 / 23 / EC	European Pressure Equipment Directive
MSS SP-53-1995 (R-1990)	Quality Standard For Steel Castings and Forgings for Valves, Flanges and Fittings and Other Piping Components-Magnetic Particle Examination Method
MSS SP-93-1987 (R-1992)	Quality Standard For Steel Castings and Forgings for Valves, Flanges and Fittings and Other Piping Components-Liquid Penetrant Method
NACE Standard MR0103	National Association of Corrosion Engineers-Engineers - Materials Resistant to Sulfide Stress Cracking in Corrosive Petroleum Refining Environments
Factory Mutual (FM)	Figure 1052 Gas and Oil Shutoff Valves.
Underwriter Laboratory (UL)	Categories MHKZ, YQAR, YRBX, YRPV, YSDT.

Current Ratings

Contact Configurations – Direct opening contacts to meet IEC 947-5-1 requirements for positive opening contacts, snap action, slow make-slow break, Reed contacts and other terms used below are described in the glossary of the Product Catalogue.

Maximum Current Ratings For Control Circuit Contacts – All Types

Switch Type	Contacts	Direct Opening Contacts to Meet IEC 947-5-1 Requirements for Positive Opening Contacts	AC – 50 or 60 Hz					DC			AC or DC
			Volts	Inductive 35% Power Factor				Volts	Inductive and Resistive		
				Make		Break			Make and Break Amperes		Continuous Carrying Amperes
				Amps	VA	Amps	VA		Single Pole	Double Pole	
AO-1, AC	SPDT Form Z SPST● Form X or Y	No	120 240 480 600	40 20 10 8	4800 4800 4800 4800	15 10 6 5	1800 2400 2880 3000	15 10 6 5	125 250 600	0.5 0.25 0.05	0.25 0.1	15 15 15 15
AW, AO-2 and AO-6, AB, AP	SPDT Form Z SPST● Form X or Y	No	120 240 480 600	40 20 10 8	4800 4800 4800 4800	15 10 6 5	1800 2400 2880 3000	15 10 6 5	125 250 600	2.0 0.5 0.1	0.5 0.2 0.02	15 15 15 15
AW, CO-3 and CO-6, CB, CC, CP	DPDT Form ZZ DPST Form AA or BB	No	120 240 480 600	30 15 7.5 6	3600 3600 3600 3600	3 1.5 0.75 0.6	360 360 360 360	3 1.5 0.75 0.6	125 250 600	1.0 0.3 0.1	0.2 0.1	10 10 10 10
C (9007)	SPDT Form Z	No	120 240 480 600	60 30 15 12	7200 7200 7200 7200	6 3 1.5 1.2	720 720 720 720	6 3 1.5 1.2	125 250 600	0.55 0.27 0.1	0.22 0.11	10 10 10 10
C (9007)	DPDT Form ZZ	No	120 240 480 600	60 30 15 12	7200 7200 7200 7200	6 3 1.5 1.2	720 720 720 720	6 3 1.5 1.2	125 250 600	0.22 0.11	0.22 0.11	10 10 10 10
C (9007)	Reed✱ SPST Form A or B	No	120 240 480 600	15 7.5 3.75 3	1800 1800 1800 1800	1.5 0.75 0.375 0.3	180 180 180 180	1.5 0.75 0.375 0.300	125 250	0.55 0.27	. . . .	5 5 5 5
L	SPDT with 2 or 3 Contacts Form Z	No	120 240 480 600	60 30 15 12	7200 7200 7200 7200	6 3 1.5 1.2	720 720 720 720	6 3 1.5 1.2	125 250 600	2.2 1.1 0.4	. . . .	10 10 10 10
MS (9007)	SPST Form C	No	120 240	60.0 30.0	7200 7200	6.0 3.0	720 720	. . . .	. . . .	. . . .	. . . .	10 (AC) 5 Res @ 28Vdc
ML (9007)	SPDT Form Z	No	120 240	60.0 30.0	7200 7200	6.0 3.0	720 720	. . . .	. . . .	. . . .	. . . .	10 (AC) 5 Res @ 28Vdc
T and FT (9007)	SPDT Quick Make and Break Form Z	No	120 240 480 600	150 75 37.5 30	18000 18000 18000 18000	20 12.5 6.25 5	2400 3000 3000 3000	20 12.5 6.25 5.0	125 250 600	5.0 1.0 0.2	. . . .	20 20 20 20
	All Slow Make and Break Form Z	No	120 240 480 600	60 30 15 12	7200 7200 7200 7200	6 3 1.5 1.2	720 720 720 720	6 3 1.5 1.2	. . . .	. . . .	. . . .	20 20 20 20
XA (9007)	Reed✱ SPST Form A or B	No	120 240	2.0 1.0	240 240	0.2 0.1	24 24	0.2 0.1	125	0.2	. . . .	0.5 0.5
XCK-J Plug-in	SPDT Form Z	No	120 240	60 30	7200 7200	6 3	720 720	6 3	125 250	0.55 0.27	. . . .	10 10
	2SPDT Form ZZ	No	480 600	15 12	7200 7200	1.5 1.2	720 720	1.5 1.2	600	0.1	. . . .	10 10
XCKJ Non Plug-in	SPDT Form Zb	Yes	120 240	60 30	7200 7200	6 3	720 720	6 3	125 250	0.55 0.27	. . . .	10 10
	2SPDT Form ZZ	No										
XCKL	SPDT Form Zb	Yes	120 240	60 30	7200 7200	6 3	720 720	6 3	125 250	0.55 0.27	. . . .	10 10
XCKP/T	SPDT Form Zb	Yes	120 240	60 30	7200 7200	6 3	720 720	6 3	125 250	0.55 0.27	. . . .	10 10
XCM	SPDT Form C	No	120 240	60 30	7200 7200	6 3	720 720	6 3	125 250	0.55 0.27	. . . .	10 10
	SPDT Form Z	Yes	120 240	60 30	7200 7200	6 3	720 720	6 3	125 250	0.55 0.27	. . . .	10 10
XCK-ML	2 N/C Positive Opening	Yes	120 240	30 30	7200 7200	6 3	720 720	6 3	125 250	0.55 0.27	. . . .	3 .27

✱ Use of a transient suppressor will extend life of the switch when using on heavy electrical loads.
● SPST versions are rated $^1/_2$ HP at 110 and 200 Vac.

Alternate Current Ratings – Several product lines offer special versions or options with alternate contact configurations or contact materials, which may result in current ratings that differ from those listed above. Refer to the respective product sections for further information.

Application Data

Enclosure Construction

Enclosure Ratings

Type	NEMA Type											IEC Type		
	1	2	3	4	4X	6	6P	7	9	12	13	IP65	IP66	IP67
AF	X	X		X						X	X			
AW	X	X		X						X	X			
C (9007)	X	X		X		X	X			X	X			
CF	X	X		X		X	X			X	X			
CR	X	X		X		X	X	X	X	X	X			
FT	X	X		X						X	X			
L	X			X							X			
MS/ML ▼(9007)	X	X		X		X	X			X	X			X
T	X	X		X						X	X			
XA	X	X		X		X	X			X	X			
XCK-J	X	X	X	X						X			X	
XCK-L	X	X	X	X						X			X	
XCK-P & T ▲	X			X						X		X		
XCM														X
XCK-ML	X	X	X	X						X	X		X	

X Indicates NEMA or IEC Type Rating available for each product.
O Indicates ratings available through use of booted or other versions.
♦ The enclosure ratings for these switches are for the protection of the live electrical components. During installation and operation, precautions must be taken to prevent any ingress of contaminants, particles and corrosives, including liquids containing solids, from entering into the operating key entry area. If precautions are not taken, switches may not perform to publish specifications. Use in a salt atmosphere is not recommended.
▲ For indoor use only.
▼ Enclosure ratings are NEMA 1, 2, 3, 4, 6, 6P, 12, and 13 except for option 21 (low force) which is NEMA 1 only. The 9007 MOS5 (omni-directional operation) enclosure ratings are 1, 2, 12, and 13.

Ambient Temperature Ranges

Minimum Temperature: The minimum temperatures listed below are based on the absence of freezing moisture or water. Care should be taken to avoid sub-freezing temperatures where dripping or splashing water is present and to avoid bringing a cold switch into a warm humid atmosphere and then back into sub-freezing temperatures. The water or moisture can freeze around the switch lever arm or plunger and cause jamming.

	Low Temperature	High Temperature At Full Rated Load
AF, AW		
Lever Type	-65°F (-54°C)	185°F (85°C)
Plunger Type	0°F (-17.8°C)	185°F (85°C)
C (9007)		
Lever Type	-20°F (-28.9°C)	185°F (85°C)
Plunger & Wobble Stick Type	0°F (-17.8°C)	185°F (85°C)
FT, T ✱	-10°F (-23°C)	185°F (85°C)
L	0°F (-17.8°C)	200°F (93°C)
MS/ML (9007)	-40°F (-40°C)	221°F (105°C)
XA	-20°F (-28.9°C)	140°F (60°C)
XCK-J, L, P, T	-13°F (-25°C)	158°F (70°C)
XCM, XCK-ML	-13°F (-25°C)	158°F (70°C)

✱ The Type FT will withstand hot falling sand up to 300˚F (149˚C); **however,** ambient temperature for the FT switch is the same as the Type T above and **cannot be used in higher temperature ambients.**

Alternate Temperature Limits

Some switches are available with higher or lower temperature limits, by selecting special versions or special options. Refer to the respective product sections for further information.

Sealing

AF, AW
- Plunger seals . . . . . PTFE (Teflon)
- All other seals . . . . . nitrile (Buna N)

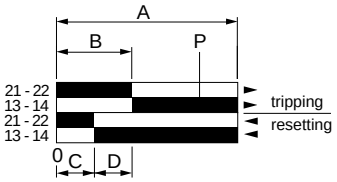
C, CF, CR (9007)
- Standard shaft seals on lever types . . . . . fluorocarbon (VITON)[1]
- Plunger and wobble stick boots . . . . . neoprene
- All other seals . . . . . nitrile (Buna N)
- Fluorocarbon seals are available in place of nitrile and neoprene on 9007 Type C.

L . . . . . PVC

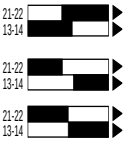
T and FT
- Shaft seal . . . . . nitrile (Buna N)
- Cover gasket . . . . . nitrile (Buna N)
- Base plate gasket . . . . . cellulose fiber laminate

XCK-J, P, T . . . . . nitrile

Contact Function Diagrams



A=Maximum travel of the operator in mm or degrees.
B=Tripping travel of the contact.
C=Resetting travel of contact.
D=B-C=Differential travel.
P=Point from which positive opening is assured.



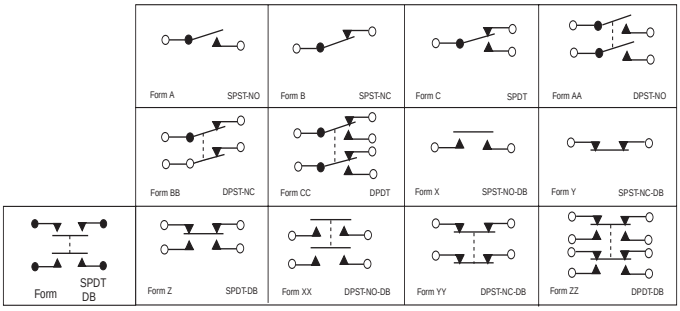
Make-before-break (overlapping) SPDT: the normally open contact closes before the normally closed contact opens.

Break-before-make (offset) SPDT: the normally closed contact opens before the normally open contact closes.

Simultaneous make and break - SPDT: the normally closed contact opens at the same time as the normally open contact closes.

Terms used in identifying ratings are defined in the glossary of the Product Catalogue.

Wiring Diagrams



1. VITON is a registered trademark fo DuPont.

Metal, Fixed or Plug-in Body
General Characteristics

Environment

Conforming to standards	Products	IEC 947-5-1, IEC 337-1, EN 60 947-5-1, NF C 63-146, VDE 0660-200, UL 508, CSA C22-2 n° 14
	Machine assemblies	IEC 204-1, EN 60 204-1, NF C 79-130
Approvals		CSA A300, UL A300 Listed, NEMKO FI 10 (4) A-400 V, GL, BV, USSR A300=fixed, A600=plug-in
Protective treatment		Standard version : "TC". Special version : "TH"
Ambient air temperature		Operation : - 25…+ 70 °C. Storage : - 40…+ 70 °C Special sub-assemblies available for extreme operating temperatures (- 40°C or + 120 °C)
Vibration resistance		25 gn (10…500 Hz) conforming to IEC 68-2-6
Shock resistance		50 gn (11 ms) conforming to IEC 68-2-27
Electric shock resistance		Class I conforming to IEC 536 and NF C 20-030
Degree of protection		**IP 66 conforming to IEC 529 ; IP 667 conforming to NF C 20-010**
Repeat accuracy		0.01 mm on the tripping points
Cable entry		1/2" NPT

Contact block characteristics

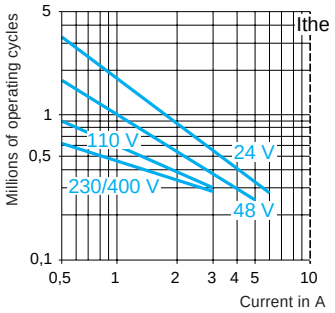
Rated operational characteristics	**~ AC-15 ; A300 (Ue = 240 V, Ie = 3 A)** **⎓ DC-13 ; Q300 (Ue = 250 V, Ie = 0.27 A) conforming to IEC 947-5-1 Appendix A, EN 60 947-5-1**
Rated insulation voltage	Ui = 500 V degree of pollution 3 conforming to IEC 947-1 and VDE 0110, group C conforming to NF C 20-040 Ui = 300 V conforming to UL 508, CSA C22-2 n° 14
Rated impulse withstand voltage	U imp = 6 kV conforming to IEC 947-1, IEC 664
Positive operation (varies by model)	N/C contacts with positive opening operation conforming to IEC 947-5-1 Section 3, EN 60 947-5-1
Resistance across terminals	≤ 25 mΩ conforming to NF C 93-050 method A or IEC 255-7 category 3
Short-circuit protection	10 A cartridge fuse type gG (gl)
Cabling	Screw and captive cable clamp terminals. **XESP2151** and **XESP2141** : Clamping capacity, min. : 1 x 0.34 mm², max. : 2 x 1.5 mm² **XENP21●1** : Clamping capacity, min. : 1 x 0.5 mm², max. : 2 x 2.5 mm² **XCKJ plug-in and XESP20●1:** Clamping capacity, min. : 1 x 0.75 mm², max. : 2 x 1.5 mm²
Minimum actuation speed	**XESP2151, XCKJ plug-in, XESP20●1** : 0.001 m/minute, **XENP21●1** : 0.001 m/second

Electrical durability

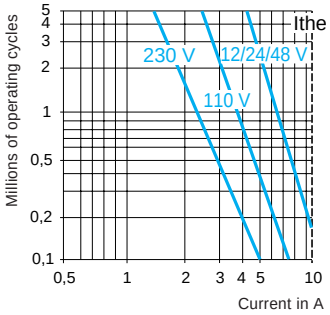
Conforming to IEC 947-5-1 Appendix C.
Utilisation categories AC-15 and DC-13.
Maximum operating rate : 3600 operating cycles per hour.
Load factor : 0.5

a.c. supply ~ 50/60 Hz
⌒ inductive circuit

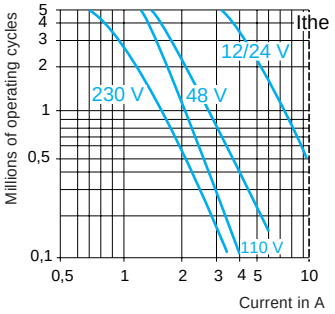
XESP2151, XESP2141



XENP21●1



XCKJ plug-in, XESP20●1



d.c. supply ⎓

Power broken in W for 5 million operating cycles

Voltage	V	24	48	120
⌒	W	10	7	4

For XES-P2151 on ⎓ or ~ N/C and N/O contacts simultaneously loaded to the values shown with reverse polarity.

Power broken in W for 5 million operating cycles

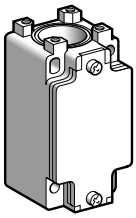
Voltage	V	24	48	120
⌒	W	13	9	7

Power broken in W for 5 million operating cycles

Voltage	V	24	48	120
⌒	W	10	7	4

5 MECHANICAL DETECTION

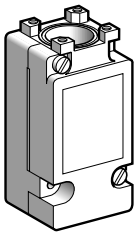
Metal, Fixed or Plug-in Body (2)
Adaptable Sub-Assemblies



ZCKJ●

Fixed body/contact assemblies for plunger or rotary head

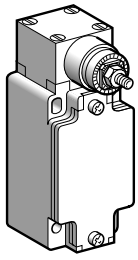
Type	Contact block	Scheme	Positive operation (1)	Catalogue number	Price
1 step	2-pole 1 N/C + 1 N/O snap action (XESP2151)	13 21 / 14 22	⊖	**ZCKJ1H7**	**$120.**
	Double-pole 2 C/O simultaneous snap action (XESP2021)	13 11 23 21 / 14 12 24 22	–	**ZCKJ2H7**	**160.**
	2-pole 1 N/C + 1 N/O break before make slow break (XENP2151)	13 21 / 14 22	⊖	**ZCKJ5H7**	**128.**
2 step	Double-pole 2 C/O staggered snap action (XESP2031)	13 11 23 21 / 14 12 24 22	–	**ZCKJ4H7**	**176.**



ZCKJ●1

Plug-in body/contact assemblies for plunger or rotary head

Type	Contact block	Scheme	Positive operation (1)	Catalogue number	Price
1 step	Single-pole 1 C/O snap action	13 11 / 14 12	–	**ZCKJ11H7**	**$120.**
	Double-pole 2 C/O simultaneous snap action	13 11 23 21 / 14 12 24 22	–	**ZCKJ21H7**	**160.**
2 step	Double-pole 2 C/O staggered snap action	13 11 23 21 / 14 12 24 22	–	**ZCKJ41H7**	**176.**



ZCKJ404

Body/contact assemblies with spring return rotary head (without operating lever)

Type	Contact block	Scheme	Positive operation (1)	Catalogue number	Price
Fixed body					
2 step 1 from the left and 1 from the right	Double-pole 2 C/O staggered snap action	13 11 23 21 / 14 12 24 22	–	**ZCKJ404H7**	**$280.**
Plug-in body					
2 step 1 from the left and 1 from the right	Double-pole 2 C/O staggered snap action	13 11 23 21 / 14 12 24 22	–	**ZCKJ4104H7**	**360.**

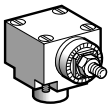
(1) ⊖ : N/C contact with positive opening operation.
(2) Special versions - 40°C or + 120°C available.

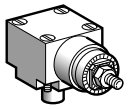
Accessories ..... see pages 5/15 - 5/17
Dimensions ..... see pages 5/19 - 5/20
Wiring ..... see page 5/18

How to Order:

To Order Specify:	Example
● Catalogue Number	ZCKJ1H7

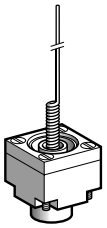
Metal, Fixed or Plug-in Body (4)
Adaptable Sub-Assemblies

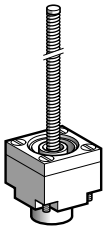

ZCKE05


ZCKE09

Rotary heads (without operating lever)

Type	Compatible bodies	Max. actuation speed	Positive operation (1)	Catalogue number	Price
Spring return, actuation from left AND right or from left OR right	ZCKJ●, ZCKJ●●, ZCKJ●D	1.5 m/s by 30° cam	⊖	**ZCKE05**	**$80.**
Stay put, actuation from left AND right	ZCKJ1, J2 ZCKJ11, J21 ZCKJ1D	0.5 m/s	–	**ZCKE09**	**104.**


ZCKE06


ZCKE08

Multi-directional heads

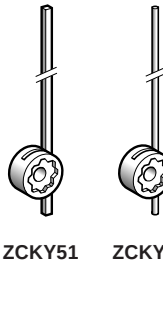
Type of operator	Compatible bodies	Max. actuation speed	Positive operation (1)	Catalogue number	Price
For actuation by any moving part					
"Cat's whisker"	ZCKJ●, ZCK●● ZCKJ●D except ZCKJ4 and J41	1 m/s in any direction	–	**ZCKE06**	**$80.**
Spring rod lever	ZCKJ●, ZCKJ●● ZCKJ●D except ZCKJ4 and J41	0.5 m/s in any direction	–	**ZCKE08**	**80.**

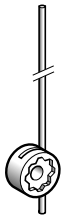
ZCKY1●

ZCKY4●

Operating levers for rotary heads

Description		Positive operation (1)	Catalogue number	Price
For actuation by 30° cam				
Roller lever (2)	thermoplastic	⊖	**ZCKY11**	**$24.**
	steel	⊖	**ZCKY13**	**24.**
	steel, ball bearing mounted	⊖	**ZCKY14**	**56.**
Variable length roller lever (3)	thermoplastic	–	**ZCKY41**	**24.**
	steel	–	**ZCKY43**	**24.**
For actuation by any moving part				
Square rod (2)	Ø 3 mm steel, L = 125 mm	–	**ZCKY51**	**24.**
Round rod (2)	Ø 3 mm steel, L = 125 mm	–	**ZCKY53**	**24.**
	Ø 3 mm glass fibre, L = 125 mm	–	**ZCKY52**	**24.**
	Ø 6 mm en thermoplastic, L = 200 mm	–	**ZCKY59**	**24.**
Spring lever (3)		–	**ZCKY81**	**24.**
Spring metal rod lever (3)		–	**ZCKY91**	**24.**
For actuation by specific cam (for operation with ZCKE09 head only)				
Forked arm (2) **and rollers** ermoplastic	1 track	–	**ZCKY71**	**40.**
	2 track	–	**ZCKY61**	**40.**

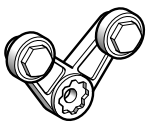

ZCKY51


ZCKY5●

ZCKY59

ZCKY81

ZCKY91


ZCKY71

ZCKY61

(1) ⊖ : operating head or lever able to guarantee positive opening operation .
(2) Adjustable throughout 360° in 5° steps, or in 45° steps by reversing the lever mounting or clamp.
(3) Adjustable throughout 360° in 5° steps.
(4) Special versions - 40°C or + 120°C available.

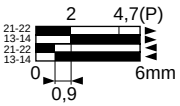
Metal, Fixed or Plug-in Body
Adaptable Sub-Assemblies

Setting-up

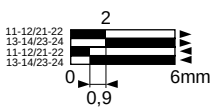
Function diagrams (positive operation only ensured with ⊖ type operators)

Heads ZCKE61, E619, E66 with body

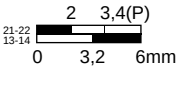
ZCKJ1●



ZCKJ2●

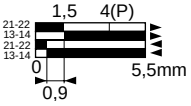


ZCKJ5●



Head ZCKE63 with body

ZCKJ1●



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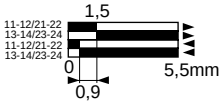

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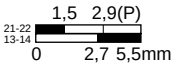
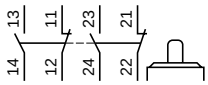
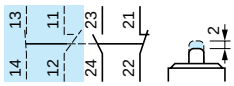


ZCKJ4●

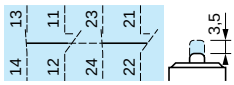
Unactuated



1st step

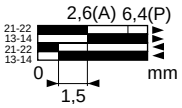


2nd step

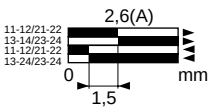


Heads ZCKE64, E65 with body

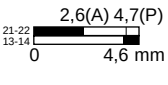
ZCKJ1●



ZCKJ2●

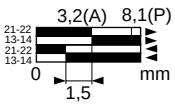


ZCKJ5●



Heads ZCKE67, E629 with body

ZCKJ1●



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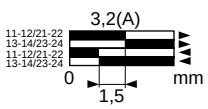

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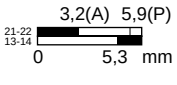
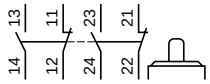


ZCKJ4●

Unactuated



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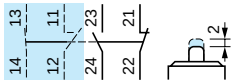
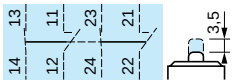
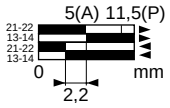


2nd step

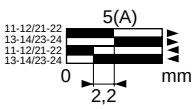


Heads ZCKE21, E23 with body

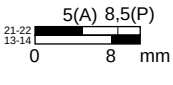
ZCKJ1●



ZCKJ2●

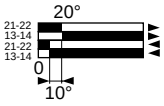


ZCKJ5●



Heads ZCKE06, E08 with body

ZCKJ1●



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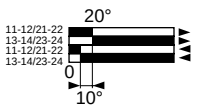

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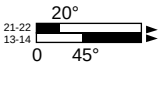
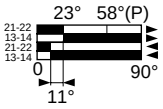


Function diagrams (positive operation only ensured with ⊖ type operators)

Head ZCKE05 with body

ZCKJ1●



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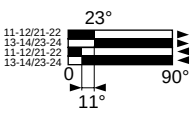

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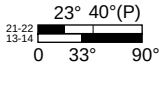
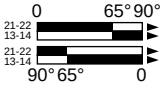


Head ZCKE09 with body

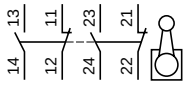
ZCKJ1●



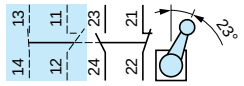
ZCKJ2●

ZCK-J4●

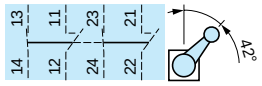
Unactuated



1st step, actuated from the left or the right

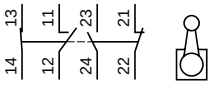


2nd step, actuated from the left or the right

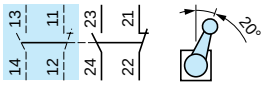


ZCKJ404, J4104 (body with head)

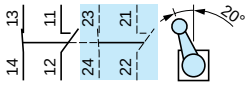
Unactuated



Actuated from the left



Actuated from the right

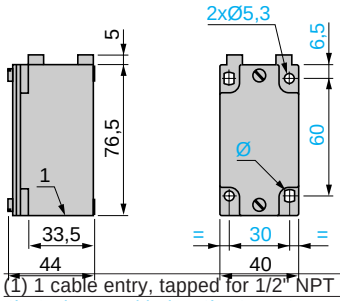


Contact operation
- ■ contact closed
- □ contact open

(A) = cam displacement
(P) = positive opening point

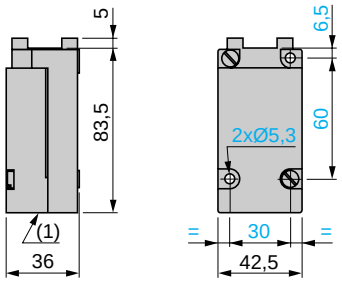
Metal, Fixed or Plug-in Body
Adaptable Sub-Assemblies

Dimensions
Bodies
ZCKJ1, J2, J5, J4, J●2●, J●3●

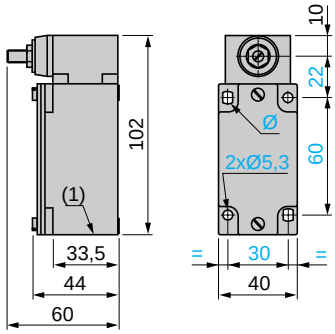


(1) 1 cable entry, tapped for 1/2" NPT
Ø : 2 elongated holes Ø 5.3 x 7.3

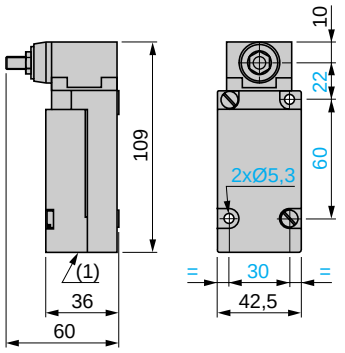
ZCKJ11, J21, J41, J11●●



Body/contact assemblies with rotary head mounted
ZCKJ404

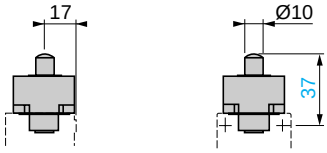


ZCKJ4104

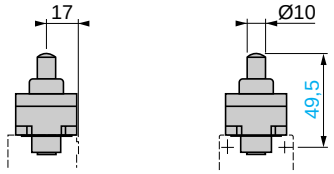


(1) 1 cable entry, tapped for 1/2" NPT
Ø : 2 elongated holes Ø 5.3 x 7.3

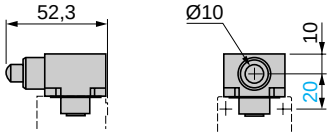
Plunger heads
ZCE61



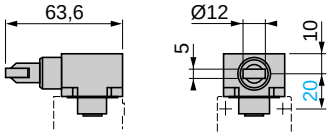
ZCKE619



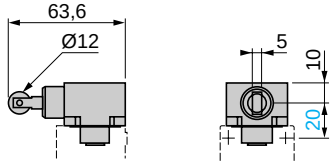
ZCKE63



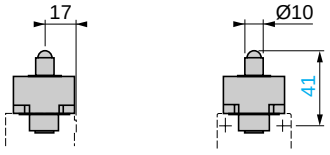
ZCKE64

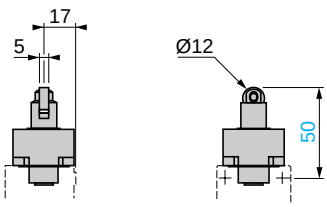


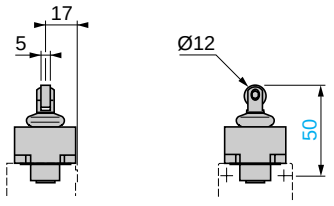
ZCKE65

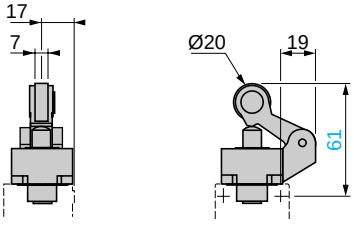


ZCKE66









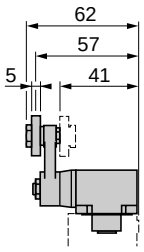
5 MECHANICAL DETECTION

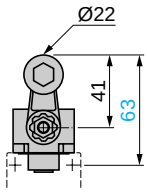
Metal, Fixed or Plug-in Body
Adaptable Sub-Assemblies

Dimensions

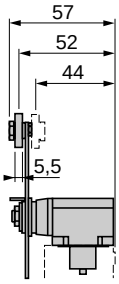
Rotary head ZCKE05 with operating lever

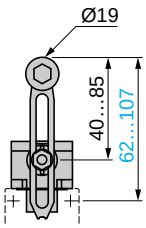
ZCKY11, Y13, Y14



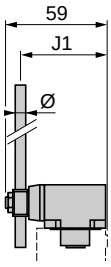


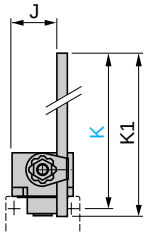
ZCKY41, Y43





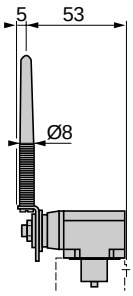
ZCKY51, Y52, Y53, Y59

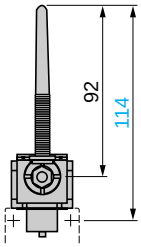




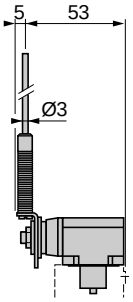
	J	J1	K max.	K1	Ø
ZCKY51	20	49	137	123	Ø3
ZCKY52	20	49	137	125	Ø3
ZCKY53	20	49	137	125	Ø3
ZCKY59	26.2	48	212	200	Ø6

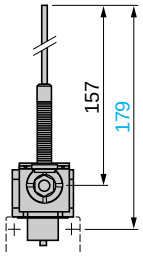
ZCKY81





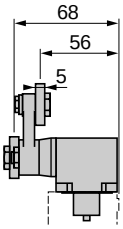
ZCKY91

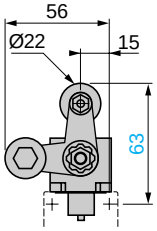




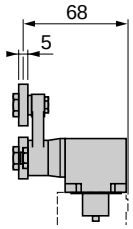
Rotary head ZCKE09 with operating lever

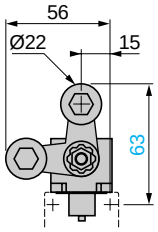
ZCKY61





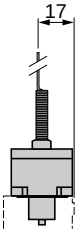
ZCKY71

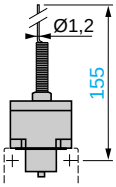




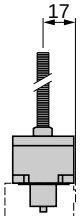
Multi-directional heads

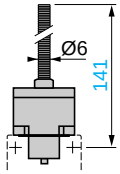
ZCKE06





ZCKE08





Moduflow™ Series

IL2/RF2/CF2 Low Pressure Filters

Applications for Moduflow Filters

- Power Unit Fabrication
- Off-line Filter Loops
- Mobile Equipment

The Moduflow filter is widely considered the most versatile filter available on the market. The unique diverter valve assembly, and inside to outside flow through the element, allows the Moduflow to be configured for in-line, in-tank or suction filtration. The flow diverter minimizes turbulence and pressure loss through the filter, improving system performance.

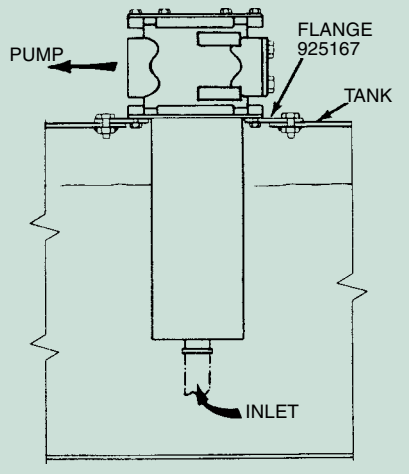
The newly designed closed bottom elements for the RF2 and IL2 models insures all contamination remains trapped within the element as the filter is serviced.

A wide variety of visual and electrical indicators allows you to know exactly when the element needs to be serviced. There is even a "no element" indicator that can sense when there is not an element installed in the filter.

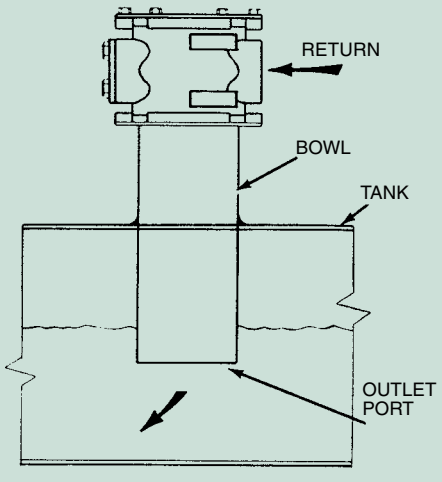
From top to bottom, the Moduflow filter series provides the high level of filtration and long term dependability so vital to today's hydraulic systems.

Mounting / Porting Styles

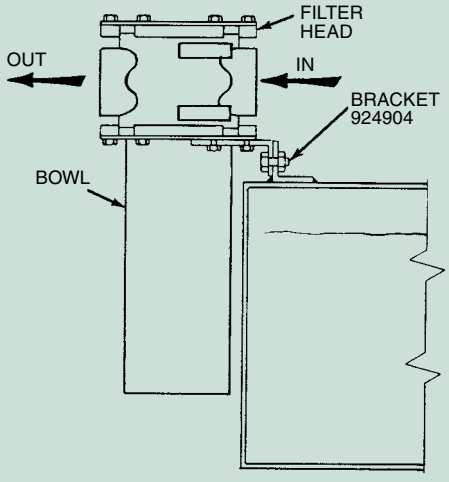
CF2 Suction Filter



RF2 Return Filter



IL2 In-Line Filter



Features

Flanges
- NPT or SAE ¾" to 2"
- Lightweight aluminum

Cover
- Slotted for quick release
- Lightweight aluminum

Indicators
- Visual or electrical
- Mounted on either side
- Optional "no element" indication

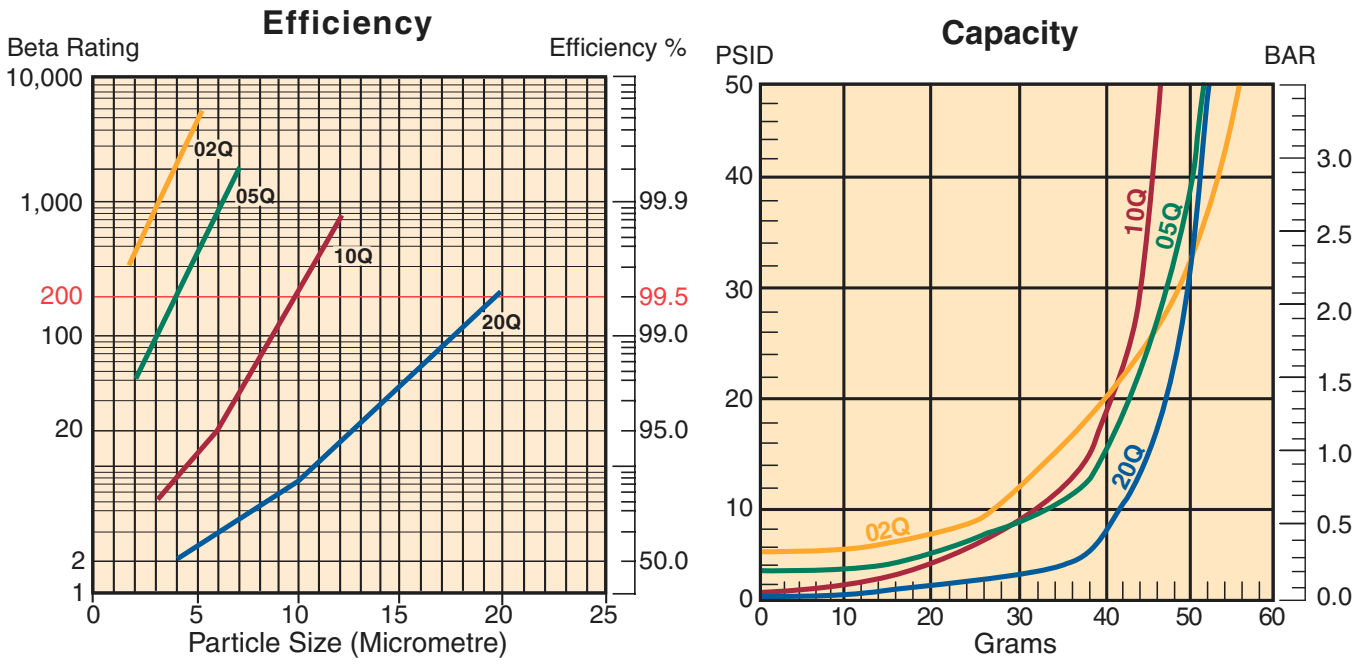
Bowl
- Single or double length
- Durable steel construction

Bypass/Diverter
(not visible)
- 5 different pressure settings
- No bypass option available

Element
(not visible)
- Available in cellulose, wire mesh or high performance Microglass II media
- Single or double length

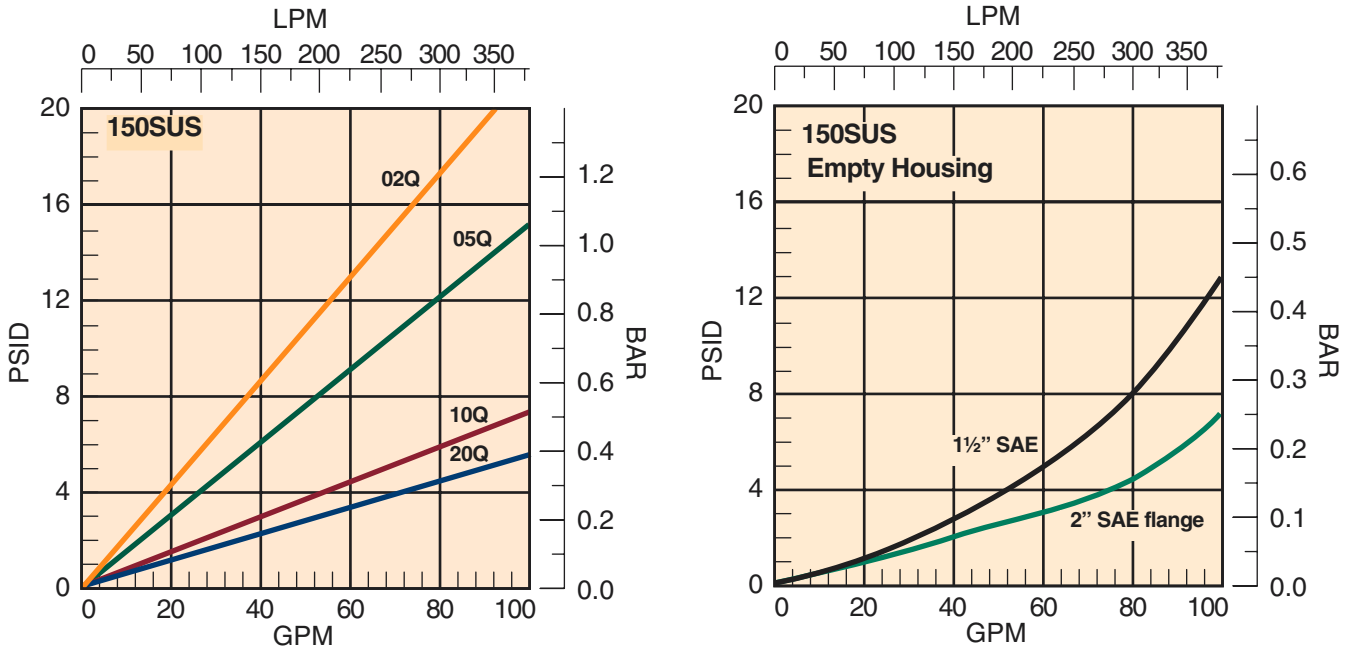
Feature	Advantage	Benefit
• Top access element service	• Oil remains in housing • Quicker element change	• No spills • Reduced maintenance costs
• Slotted cover	• Quick release cover • Cap screws remain in housing	• Reduced maintenance costs • No loose parts to lose
• Closed bottom elements (RF2 and IL2 only)	• Removes all contaminant during element service	• No downstream contamination from servicing
• Visual or electrical indicators	• Know exactly when to service elements	• Helps prevent bypass condition • No premature disposal
• Flange face ports	• Flexible mounting (3/4" to 2")	• Easy plumbing to your system

CF2-1, RF2-1 & IL2-1 Element Performance



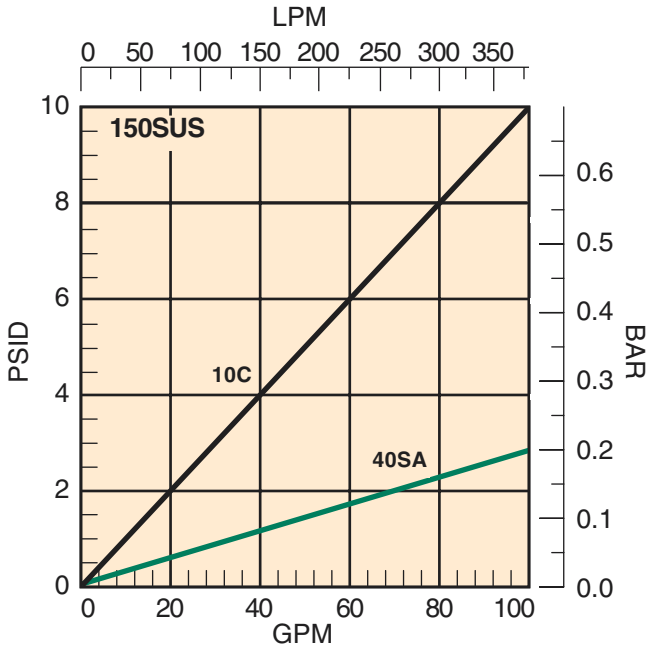
Multipass tests run @ 40 gpm to 50 psid terminal - 5mg/L BUGL

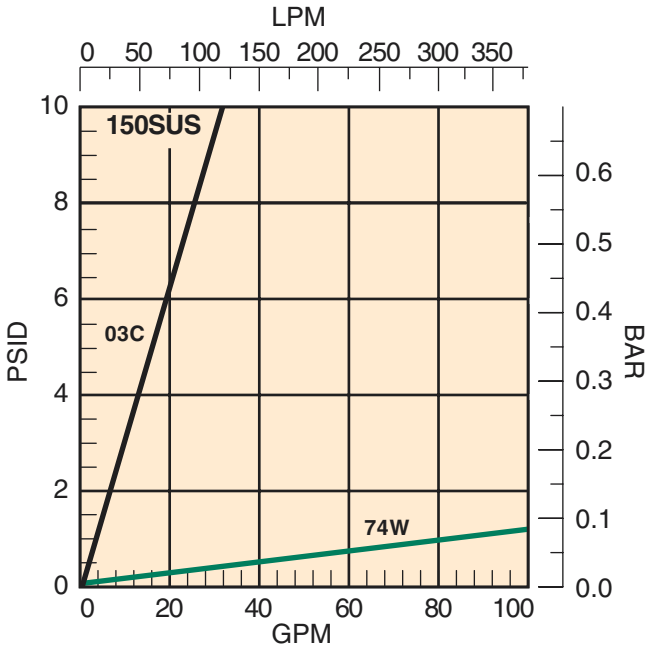
Flow vs. Pressure Loss



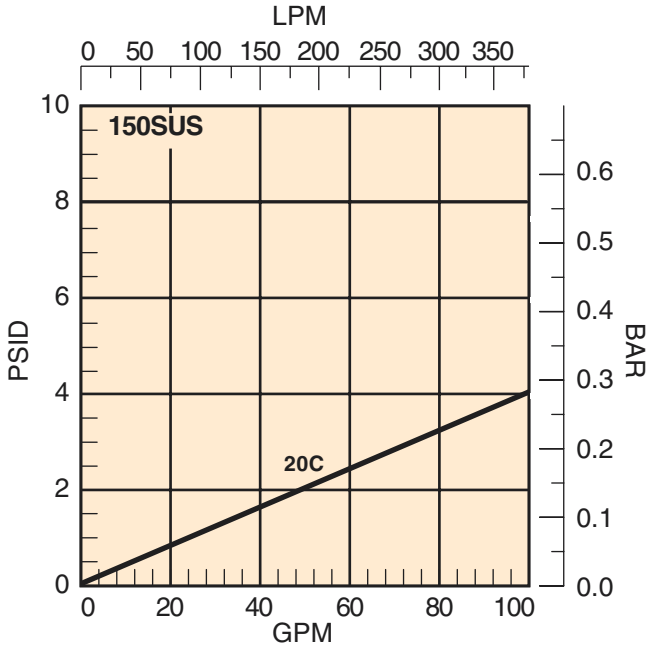
CF2-1, RF2-1 & IL2-1 Element Performance

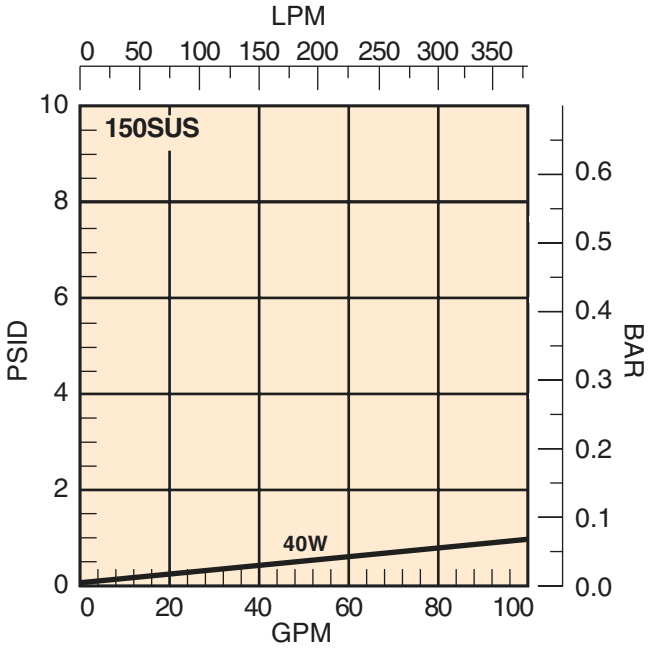
Flow vs. Pressure Loss



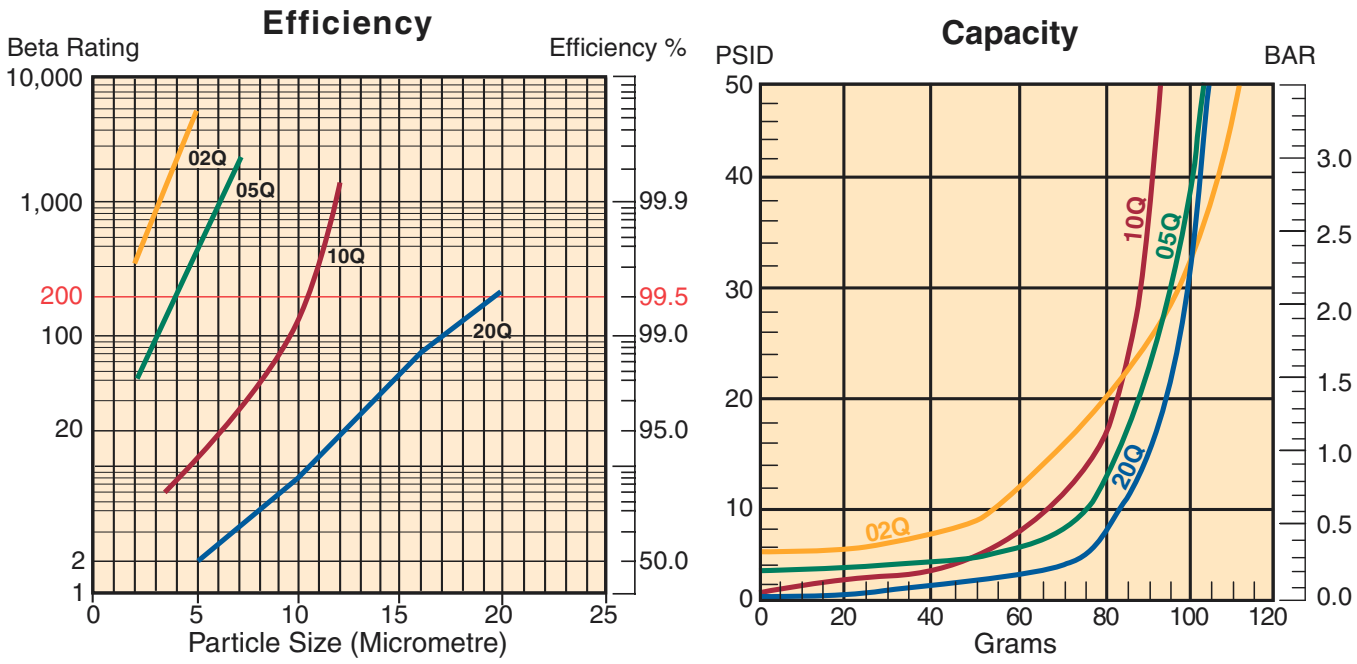


Flow vs. Pressure Loss



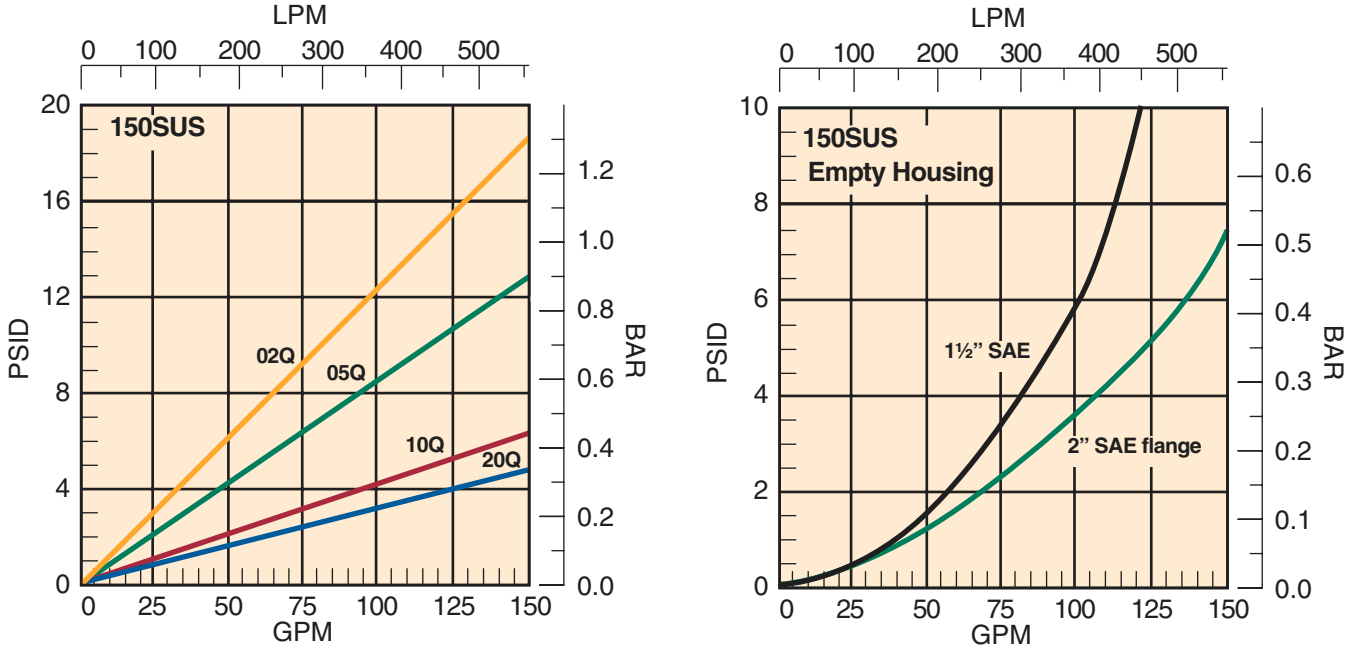


CF2-2, RF2-2 & IL2-2 Element Performance



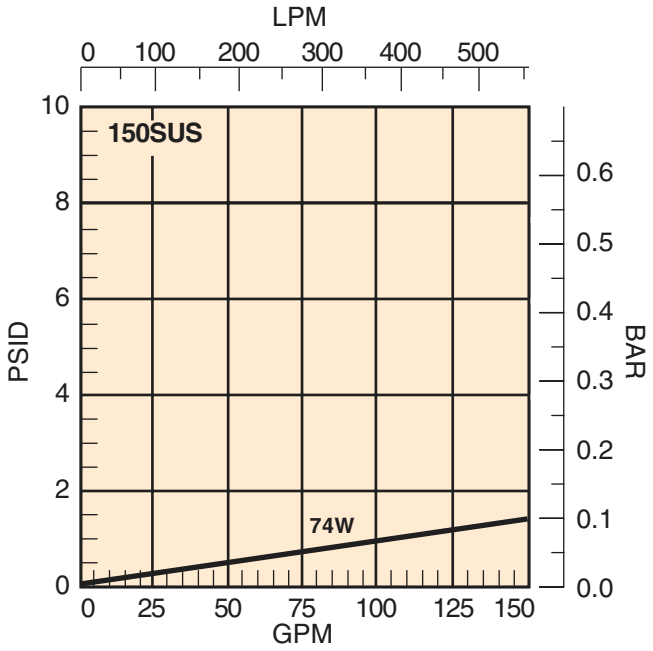
Multipass tests run @ 80 gpm to 50 psid terminal - 5mg/L BUGL

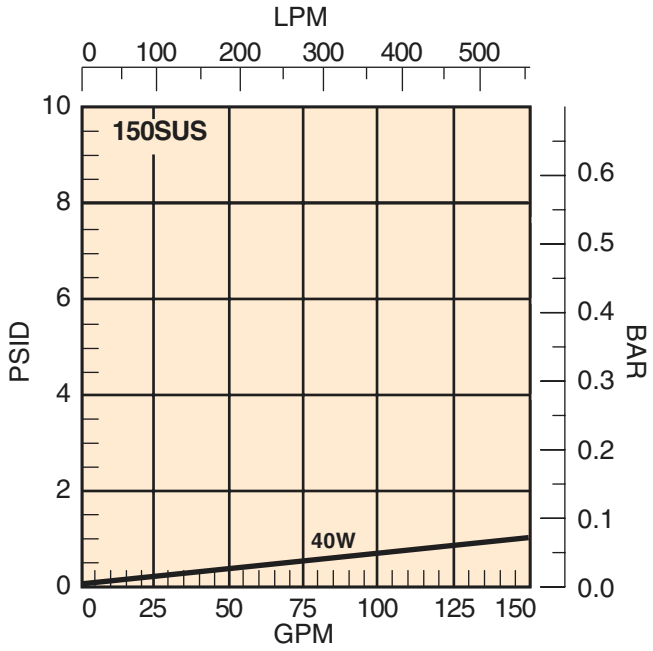
Flow vs. Pressure Loss



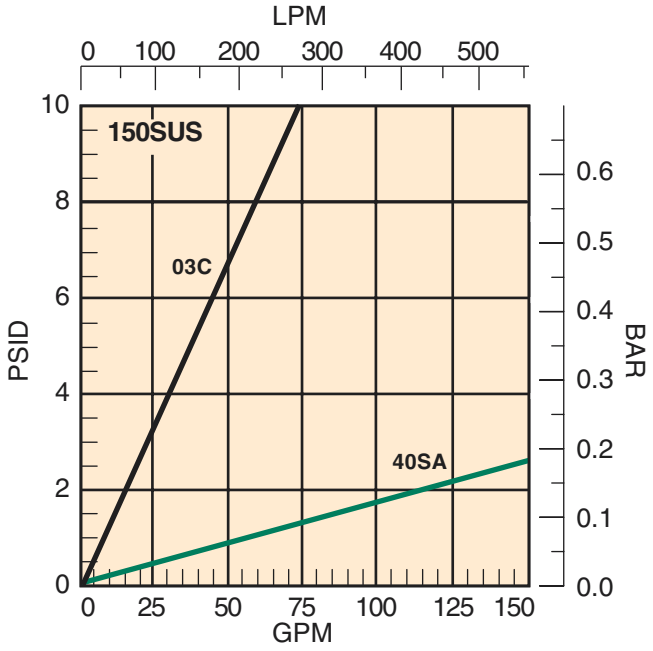
CF2-2, RF2-2 & IL2-2 Element Performance

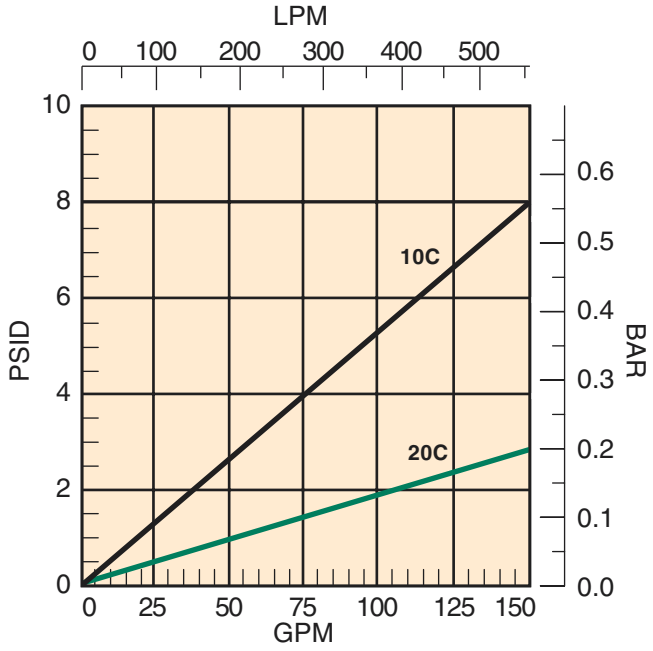
Flow vs. Pressure Loss





Flow vs. Pressure Loss





Specifications: CF2, RF2, IL2

Pressure Ratings:
Maximum Allowable Operating Pressure (MAOP): 200 psi (13.8 bar)
Design Safety Factor: 2:1
Rated Fatigue Pressure: 150 psi (10.3 bar)

Element Burst Rating: 70 psid (4.8 bar)

Filter Materials:
Head, Cover, Flanges: die cast aluminum
Bowl: steel

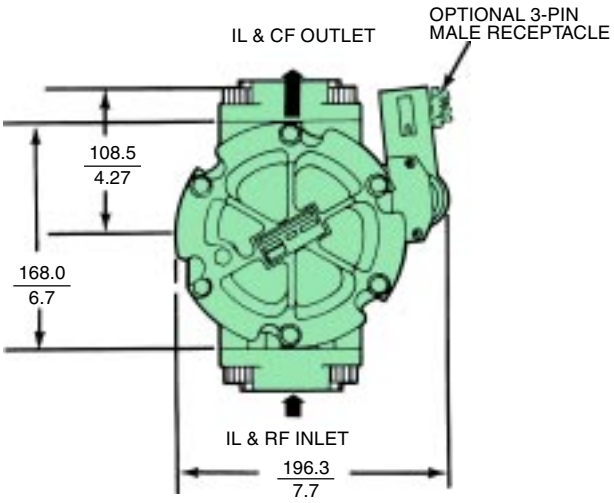
Operating Temperatures:
Buna: -40°F to 225°F (-40°C to 107°C)
Fluorocarbon: -15°F to 275°F (-26°C to 135°C)

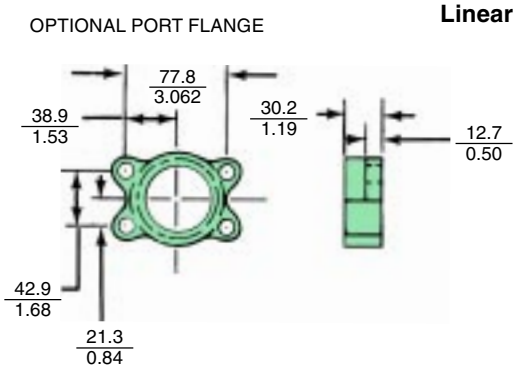
Weight (approximate):
Single: 20 lbs. (9.1 kg)
Double: 25 lbs. (11.3 kg)

Indicators:
Visual (optional)
Electrical (optional) 15A@250VAC / .5A@125 VDC
Electrical ("D" option) 5A@250VAC / 3A@28 VDC

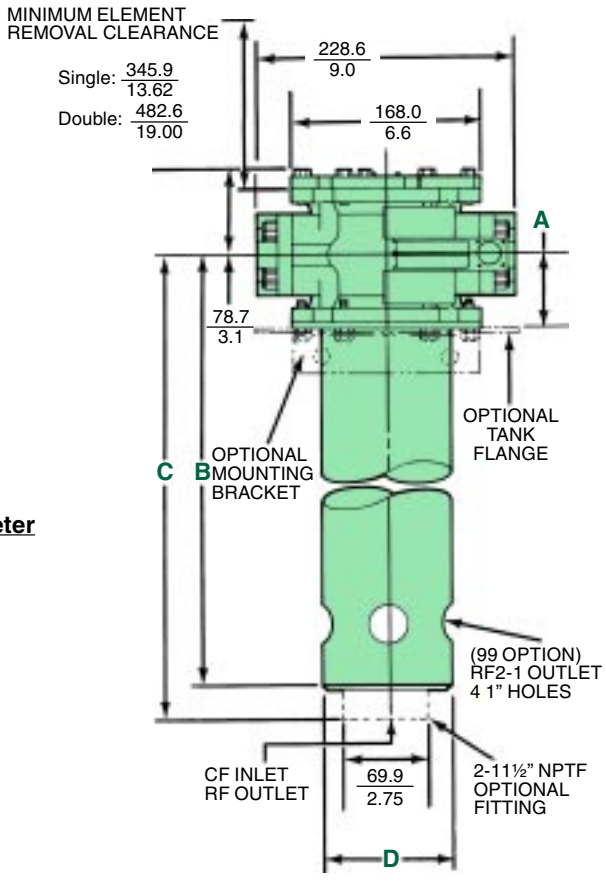
Color Coding:
White (normally closed)
Red (normally open)
Black (common)

MODEL	Dimensions: mm / inch			
	A	B	C	D
CF2-1	65.0 / 2.56	N/A	352.3 / 13.87	110.0 / 4.3
RF2-1 without optional 2" fitting	65.0 / 2.56	330.2 / 13.0	—	110.0 / 4.3
IL2-1	65.0 / 2.56	330.2 / 13.0	N/A	110.0 / 4.3
RF2-1 with optional 2" fitting	68.3 / 2.69	—	383.4 / 15.07	114.0 / 4.5
CF2-2	68.3 / 2.69	N/A	623.8 / 24.56	114.0 / 4.5
RF2-2	68.3 / 2.69	617.5 / 24.31	623.8 / 24.56	114.0 / 4.5
IL2-2	68.3 / 2.69	617.5 / 24.31	N/A	114.0 / 4.5





Linear Measure: millimeter / inch



Specifications: DIL2

Pressure Ratings:
Maximum Allowable Operating Pressure (MAOP): 200 psi (13.8 bar)
Design Safety Factor: 2:1
Rated Fatigue Pressure: 150 psi (10.3 bar)

Element Burst Rating: 70 psid (4.8 bar)

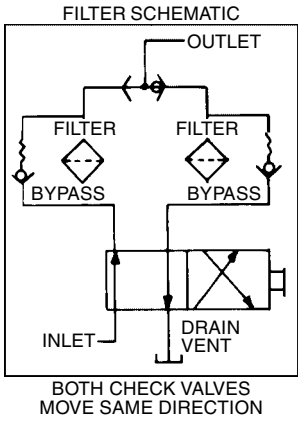
Filter Materials:
Diverter Valve Assembly: die cast aluminum
Check Valve Assembly: die cast aluminum
Filter Assembly: see IL2 specifications

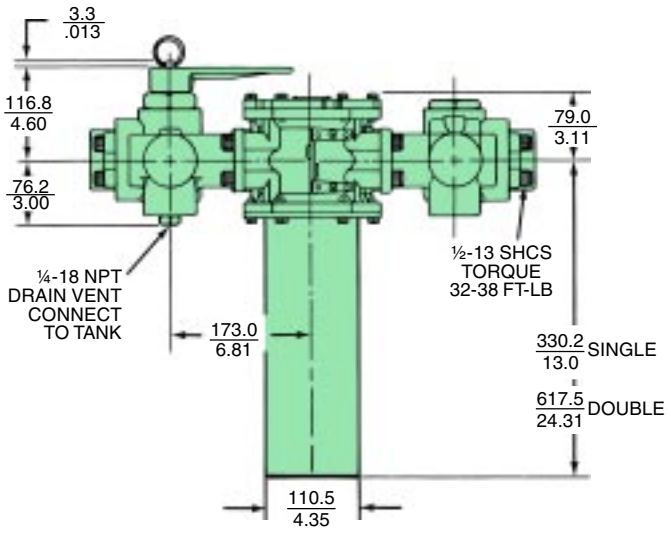
Operating Temperatures:
Buna: -40°F to 225°F (-40°C to 107°C)
Fluorocarbon: -15°F to 275°F (-26°C to 135°C)

Weight (approximate):
Single: 55 lbs. (24.9 kg) / Double: 65 lbs. (29.5 kg)

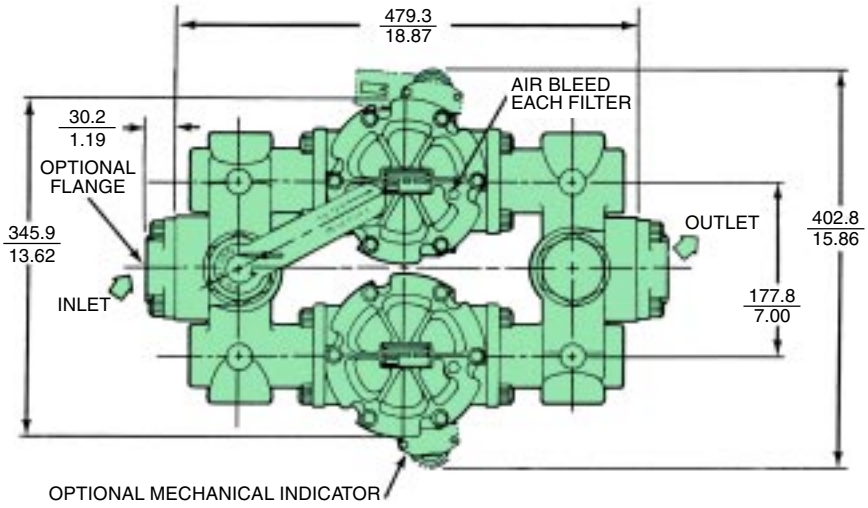
Indicators:
Visual (optional)
Electrical (optional) 15A@250VAC / .5A@125 VDC
Electrical ("D" option) 5A@250VAC / 3A@28 VDC

Color Coding:
White (normally closed)
Red (normally open)
Black (common)

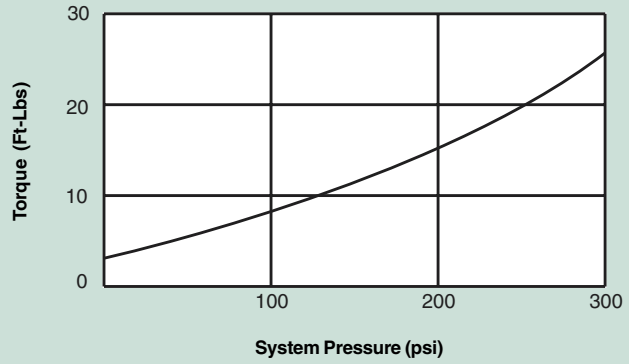




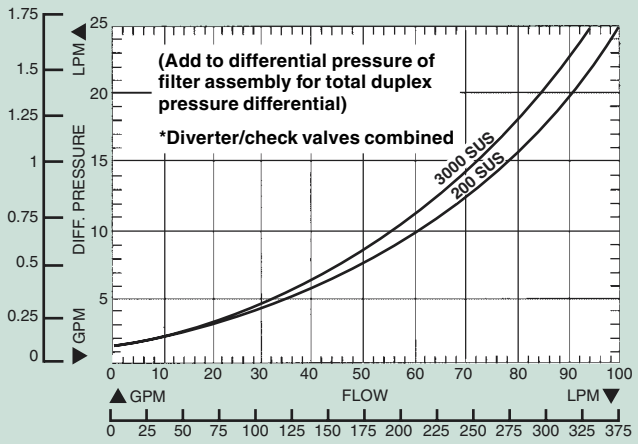
Linear Measure: millimeter / inch



Approximate handle torque required for changeover.



Typical Flow/Pressure Curves For Duplex Valves

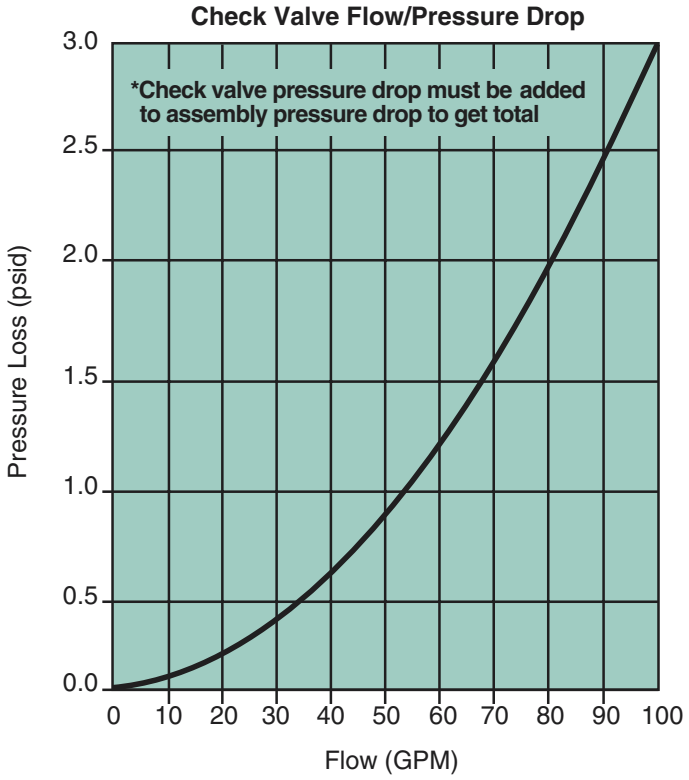


Submersible Option

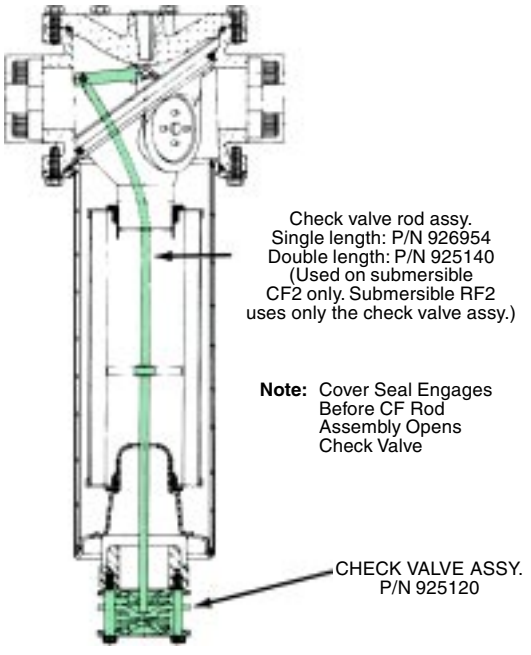
When there is a limited amount of space on the top of the reservoir, the Moduflow filter can be mounted in the side of a reservoir.

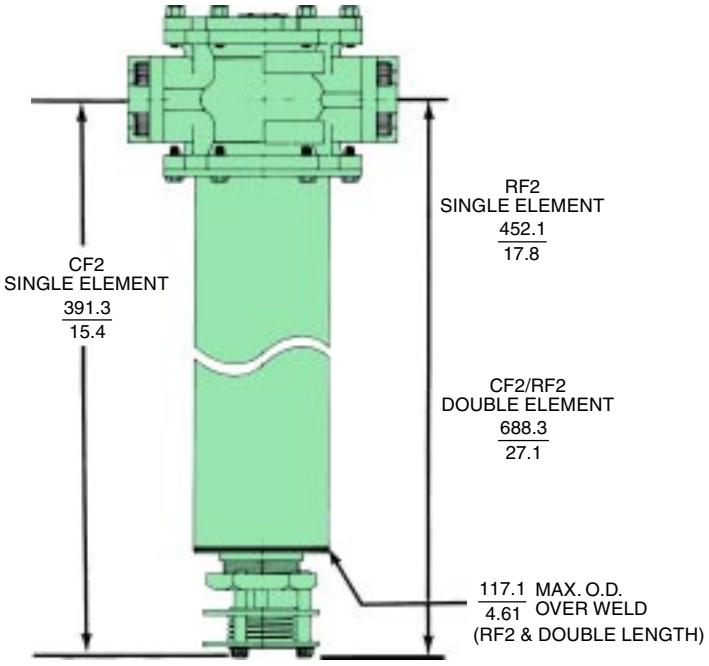
A check valve mounted on the filter bowl prevents the reservoir from being drained during servicing of the element. The only fluid drained is from the inside of the filter housing.

For return line applications(RF2), the fluid returning to the reservoir holds the check valve open. When the system is shut down, the check valve closes automatically. In suction applications (CF2), the check valve is held open by a check rod assembly extending from the cover to the check valve at the base of the filter bowl. When the cover is in place, fluid enters the filter. When the cover is removed for servicing, the check valve closes.



Linear Measure: millimeter / inch

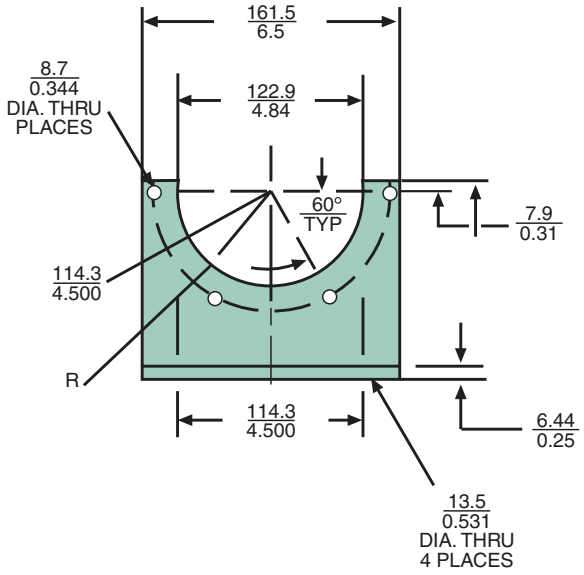


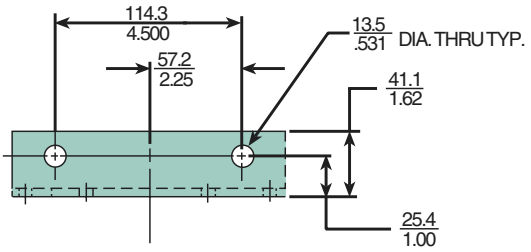


Accessories

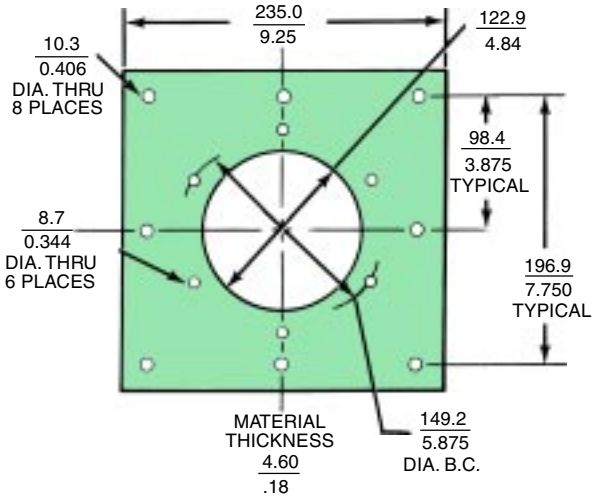
Linear Measure: millimeter / inch

OPTIONAL MOUNTING BRACKET (924904)





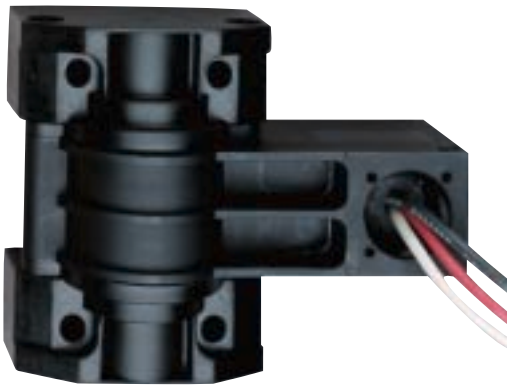
OPTIONAL TANK FLANGE (925167)



"M" OPTION-VISUAL INDICATOR, NO ELEMENT WARNING

"V" OPTION-VISUAL INDICATOR

"E" OPTION-ELECTRICAL INDICATOR



Parts List

Index	Description	Part No.	Quanity
1	**Screws**, Nameplate	900028	2
2	**Name Plate**, Unstamped	924928	1
3	**Cover Screws**, 5/16-18 UNC x 1"	926633	6
4	**Bowl Screws**, 5/16-18 UNC x 1"	926633	6
5	**Cover**, Without nameplate	924634	1
6	**O-Ring**, cover, bowl and diverter		
	Buna	N72350	3
	Fluorocarbon	V72350	3
7	**Diverter/Bypass Valve Assembly**		1
	35 psid, Purple	926783	
	25 psid, Metalic Aluminum	926582	
	15 psid, Light Blue	926581	
	3 psid, Yellow	926580	
	2 psid, Pink	926579	
	No Bypass	926578	
8	**Head**, Machined only	925972	1
9	**Flange Kits**	Refer to Table	1
10	**Grommet** (Buna)	924433	2
	Grommet, (Fluorocarbon)	925026	2
11	**Single Elements**, RF, IL	Refer to Table	1
12	**Bowl**, Select desired model		
	IL2-1	925916	
	IL2-2	924816	
	RF2-1	925917	
	RF2-1 with 2 inch NPTF fitting	924676	
	RF2-2	924815	
	RF2-2 with 2 inch NPTF fitting	924818	
	CF1-1 with 2 inch NPTF fitting	926207	
	CF2-2 with 2 inch NPTF fitting	924817	
13	**Double Elements**, CF	Refer to Table	1
14	**Plug Kit**, Fastener, self-sealing, o-ring seal included with fastener	925974	2
15	**Indicator Electrical**		Optional
	35 psid	926643	
	25 psid	924964	
	15 psid	924965	
	3 psid	924966	
	2 psid	924967	
16	**Indicator Visual**		Optional
	35 psid 4-band	926748	
	25 psid 4-band	924776	
	15 psid 4-band	924777	
	3 psid 4-band	924778	
	2 psid 4-band	924779	
	35 psid 3-band	926750	
	25 psid 3-band	924929	
	15 psid 3-band	924824	
	3 psid 3-band	924927	
	2 psid 3-band	924926	
	Flange, In-tank mounting	925167	Optional
	Bracket, Inline mounting	924904	Optional
	Indicator Kit Remote mount	924894	Optional
17	**Check Valve Assy.** (Submersible)	925120	Optional
18	**Check Rod Assy.**		Optional
	2" - 1 CF	926954	
	2" - 2 CF	925140	
19	**Changeover Valve Assy.**, Duplex	926758	Optional
20	**Check Valve Assy.**, Duplex	926757	Optional

*Two kits required for differential indication

Flange Kits (flange, 4 bolts, o-ring)

Size	Code	Part Number	
		Buna	Fluorocarbon
¾ inch NPTF	YB	924788	926013
1 inch NPTF	YC	924787	926012
1¼ inch NPTF	YD	924912	926004
1½ inch NPTF	YE	924786	926011
2 inch NPTF	YF	924785	926010
SAE - 12	YM	924784	926009
SAE - 16	YN	924783	926008
SAE - 20	YO	924913	926005
SAE - 24	YP	924782	926007
BLANK FLANGE	—	924781	926006

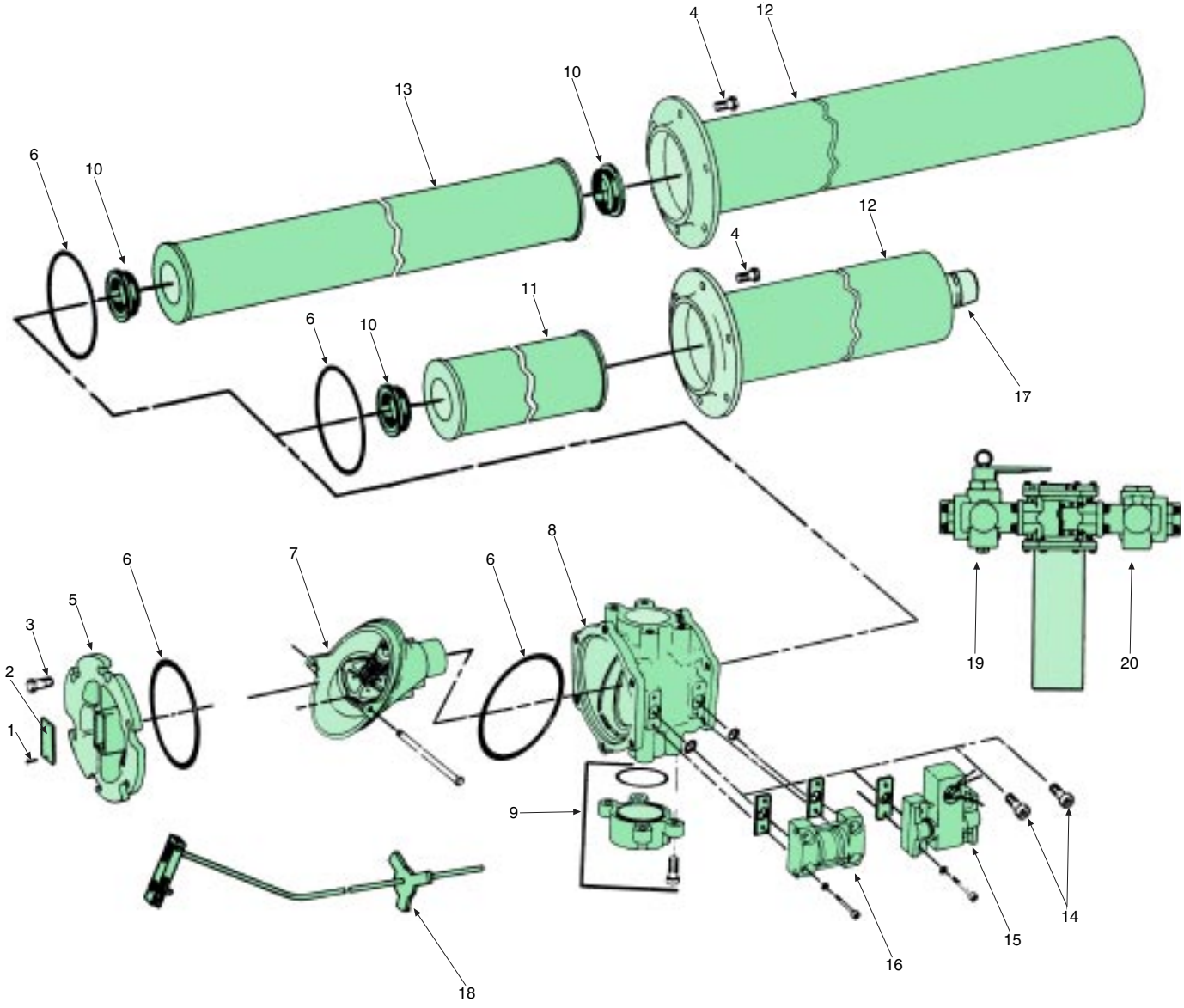
RF2 / IL2 / DIL2 Replacement Elements

MEDIA	BUNA		Fluorocarbon	
	Single	Double	Single	Double
02Q	932686Q	932692Q	932689Q	932695Q
05Q	932687Q	932693Q	932690Q	932696Q
10Q	932688Q	932694Q	932691Q	932697Q
20Q	933116Q	933117Q	933118Q	933119Q
03C	932361	932567	932367	932574
10C	932360	932467	932366	932473
20C	932359	932469	932365	932474
40SA	932358	932468	932364	932475
25W	932563	932566	932570	932573
40W	932562	932565	932569	932572
74W	932561	932564	932568	932571
WR	932363	932476	932370	932575

CF2 Replacement Elements

MEDIA	BUNA		Fluorocarbon	
	Single	Double	Single	Double
05Q	924452Q	934264Q	925039Q	935534Q
10Q	924453Q	934265Q	925040Q	935535Q
03C	924449	924791	925036	925046
10C	924450	924792	925037	925047
20C	924451	924793	925038	925048
40SA	924448	924790	925035	925045
25W	924454	924796	925041	925051
40W	924455	924797	925042	925052
74W	924456	924798	925043	925053
WR	927584	927585	928908	928925

Filter Assembly Exploded View



HOW TO ORDER: Select the desired symbol (in the correct position) to construct a model code.
Example:

BOX 1	BOX 2	BOX 3	BOX 4	BOX 5	BOX 6	BOX 7	BOX 8	BOX 9
	IL2	1	10Q	MP	35	Y9Y9	1	Design number assigned by Parker

BOX 1: Seals

Symbol	Description
None	***Buna***
F3	Fluorocarbon
E8	EPR

BOX 2: Basic Assembly

Symbol	Description
CF2	***Suction filter, inlet on bottom; outlet on side***
RF2	***Return-line filter, inlet on side; outlet on bottom***
IL2	***In-line filter***
DIL2	In-line duplex

Note: Add "W" after "2" for HWCF modification.

BOX 3: Length

Symbol	Description
1	***Single element***
2	***Double element***

BOX 4: Filter Media

Symbol	Description
74W	74-micron wire mesh
40W	40-micron wire mesh
25W	25-micron wire mesh
40SA	40-micron synthetic
20C	20-micron cellulose
10C	***10-micron cellulose***
03C	3-micron cellulose
02Q	***Microglass III***
05Q	***Microglass III***
10Q	***Microglass III***
20Q	***Microglass III***
WR	Water removal

Please note the bolded options reflect standard options with a reduced lead-time. Consult factory on all other lead-time options.

BOX 5: Indicators (See Note A)

Symbol (Two Required)	Description
P	***Pressure ports drilled and plugged; no indicator***
M	***Visual indicator w/ no element warning***
E	Electrical indicator; no visual
V	***Visual indicator***
D	Electrical indicator; 3-pin male quick disconnect
S	Pressure or vacuum switch (Selected based on bypass setting.)

Note A: (First letter of indicator code = left side of filter head when looking into inlet with bowl down; second letter = right side of filter head when looking into inlet with bowl down.)

BOX 6: Bypass & Indicator Setting

Symbol	Pressure Setting
2	2 psid
3	***3 psid***
15	15 psid
25	***25 psid***
35	***35 psid***

Note: Indicators installed on filters will be matched to the bypass valve.

BOX 7: Port Options

Filter Model	Inlet Symbol	Inlet Description	Outlet Symbol	Outlet Description
CF2			***Y9***	***2" flange face***
	F9	***2" NPTF***	P9	SAE-24 integral threads
	F8	External check valve	E9	1½ NPTF integral threads
				*See table below
RF2	***Y9***	***2" flange face***	***99***	***No fitting***
	P9	SAE-24 integral threads	F9	2" NPTF
	E9	1½ NPTF integral threads	F8	External check value
		*See table below		
IL2	***Y9***	***2" flange face***	***Y9***	***2" flange face***
	P9	SAE-24 integral threads	P9	SAE-24 integral threads
	E9	1½ NPTF integral threads	E9	1½ NPTF integral threads
		*See table below		*See table below
DIL2	Y9	2" flange face	Y9	2" flange face
		*See table below		*See table below

1) First pair of symbols denotes inlet for all filter styles; second pair of symbols denotes outlet.
2) Four symbols required: two for inlet, two for outlet.
3) Unused ports in CF2 and RF2 filters come plugged with a blank flange.
4) On CF2, F8 option includes internal rod assembly.

*** Available Port Flange Options For Filter Head**

YB	¾" NPTF flange
YC	1" NPTF flange
YD	1¼" NPTF flange
YE	1½" NPTF flange
YF	2" NPTF flange
YM	SAE-12 flange
YN	SAE-16 flange
YO	SAE-20 flange
YP	SAE-24 flange

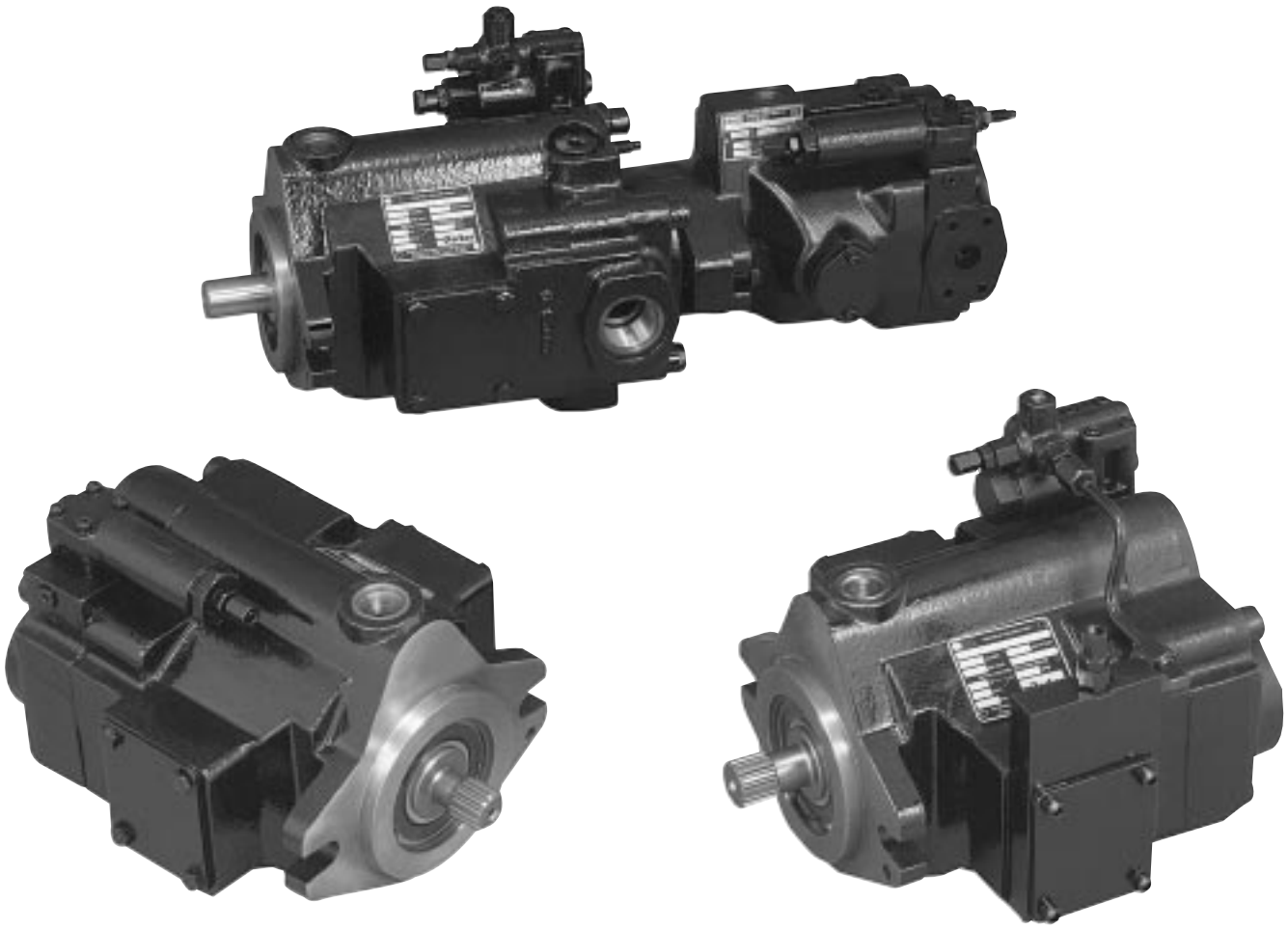
BOX 8: Modifications

Symbol	Description
1	***None***
3	Magnets
11	No-bypass
12	No-bypass with magnets

BOX 9: Design Number

Applied to the filter by Parker Hydraulic Filter Division. Use the full model code, including the design number when ordering replacement parts.

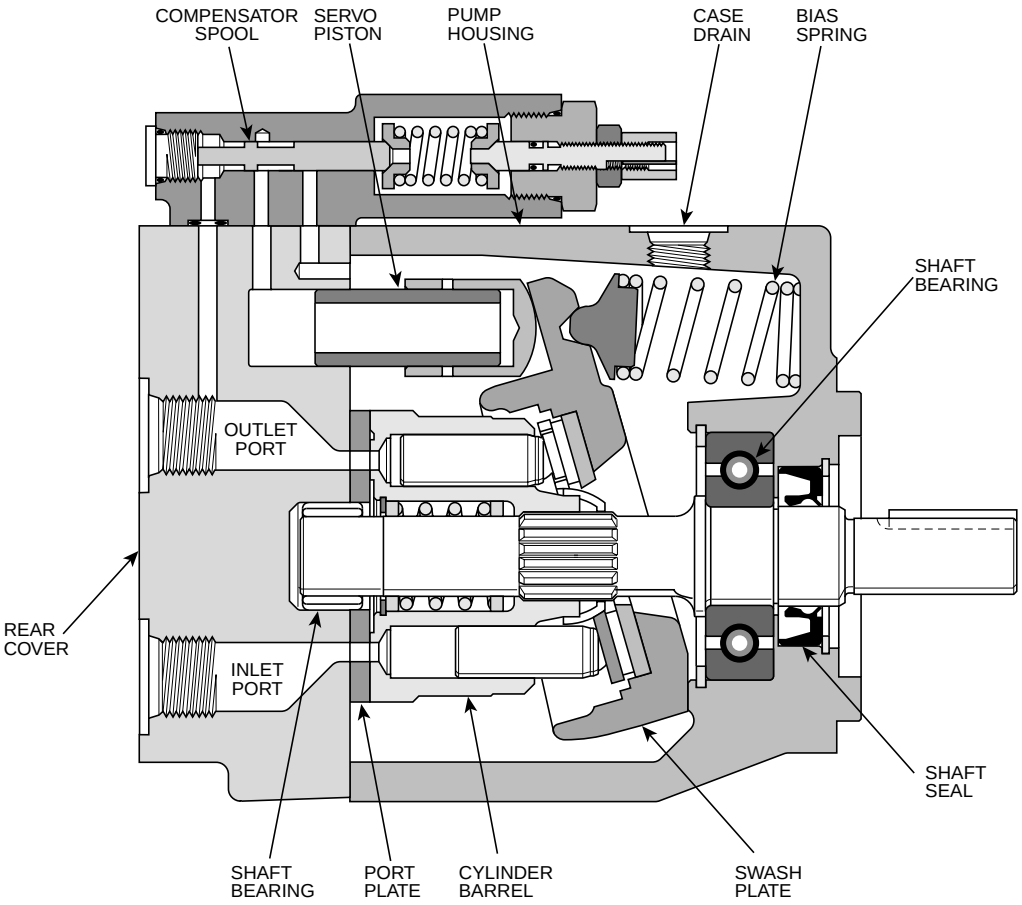
Introduction



Quick Reference Data Chart

Pump Model	Displacement cc/rev (In³/rev)	Pump Delivery @ 300 PSI (21 bar) in GPM (LPM)		*Approx. Noise Levels dB(A) @ Full Flow 1800 RPM (1200 RPM)					Horsepower At 1800 RPM, Max. Displacement & 3600 PSI	Operating Speed (RPM) (Maximum)	Pressure PSI (bar) Continuous (Maximum)
		1200 RPM	1800 RPM	500 PSI (34 bar)	1000 PSI (69 bar)	2000 PSI (138 bar)	3000 PSI (207 bar)	3600 PSI (248 bar)			
PVP16	16 (.98)	5.2 (19.7)	7.8 (29.5)	74 (69)	75 (70)	77 (75)	80 (75)	68 (64)	14.2	3000	3600 (248)
PVP23	23 (1.4)	7.4 (28.0)	11.1 (42.0)	74 (69)	75 (70)	77 (75)	80 (75)	68 (63)	20.5	3000	3600 (248)
PVP33	33 (2.0)	10.4 (39.4)	15.6 (59.0)	74 (69)	75 (70)	77 (75)	80 (75)	69 (65)	28.5	3000	3600 (248)
PVP41	41 (2.5)	13.0 (49.2)	19.5 (73.8)	72 (67)	70 (67)	73 (68)	74 (71)	71 (71)	44.5	2800	3600 (248)
PVP48	48 (2.9)	15.2 (57.6)	22.8 (86.4)	74 (68)	72 (67)	77 (69)	78 (72)	73 (73)	54.0	2400	3600 (248)
PVP60	60 (3.7)	19.0 (71.9)	28.0 (106.0)	72 (68)	73 (69)	75 (70)	77 (70)	77 (70)	64.0	2200	3600 (248)
PVP76	76 (4.6)	24.1 (91.2)	35.5 (134.4)	75 (70)	75 (69)	75 (70)	77 (70)	78 (72)	83.0	2200	3600 (248)

* Since many variables such as mounting, tank style, plant layout, etc., effect noise levels, it cannot be assumed that the above readings will be equal to those in the field. The above values are for guidance in selecting the proper pump. Noise levels are A-weighted, mean sound pressure levels at 1 meter from the pump, measured and recorded in accordance with applicable ISO and NFPA standards.



Features

- High Strength Cast-Iron Housing
- Fast Response Times
- Two Piece Housing For Ease of Service
- Metric Pilot, Shaft and Ports Available
- Replaceable Bronze Clad Port Plate
- Thru-Shaft Capability
- Low Noise Levels
- Replaceable Piston Slipper Plate

Controls

- Pressure Compensation
- Load Sensing
- Horsepower Limiting
- Horsepower and Load Sensing
- Remote Pressure Compensation
- Adjustable Maximum Volume Stop
- Hi/Lo Torque (Horsepower) Limiting (PVP 41/48, 60/76 Only)
- Low Pressure Standby

Control Options

General Description

All control is achieved by the proper positioning of the swash plate. This is achieved by a servo piston acting on one end of the swash plate working against the combined effect of the off-setting forces of the pistons and centering spring on the other end. The control spool acts as a metering valve which varies the pressure behind the servo piston.

As shown in Figure 1, the amount of flow produced by the Parker Piston Pump is dependent upon the length of stroke of the pumping pistons. This length of stroke, in turn, is determined by the position of the swash plate. Maximum flow is achieved at an angle of 15-17 degrees. The rotating barrel, driven by the prime mover, moves the pistons in a circular path and the piston slippers are supported hydrostatically against the face of the swash plate. When the swash plate is in a vertical position, perpendicular to the centerline of the piston barrel, there is no piston stroke and consequently no fluid displacement. When the swash plate is positioned at an angle, the pistons are forced in and out of the barrel and fluid displacement takes place. The greater the angle of the swash plate, the greater the piston stroke.

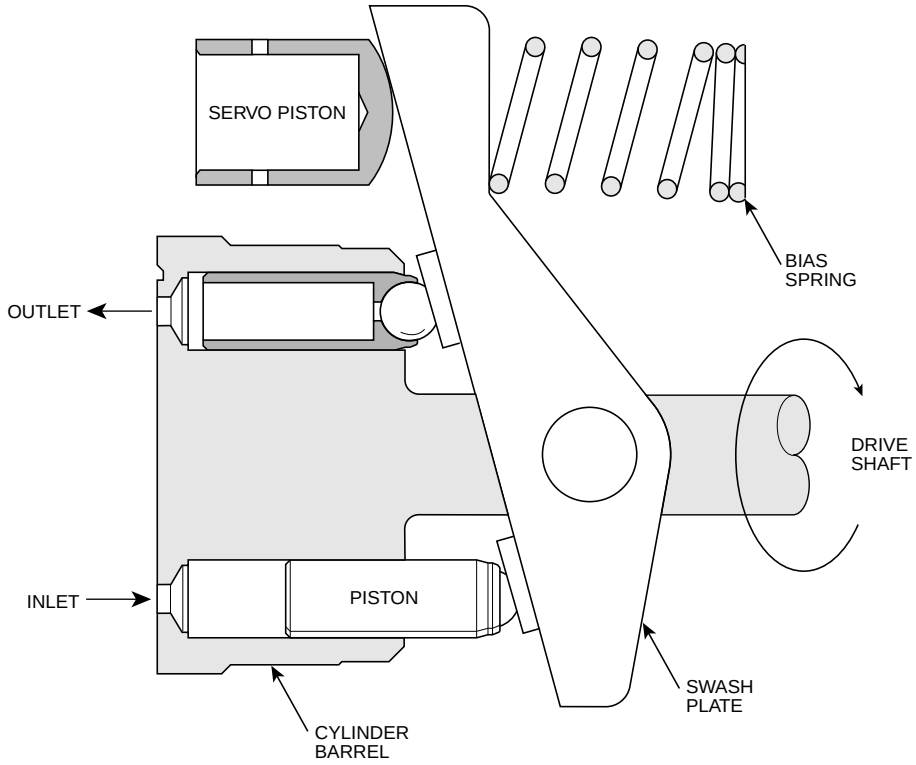


FIGURE 1

Control Options

Pressure Compensated Control

The swash plate angle controls the output flow of the pump. Swash plate angle is generated by the hydraulic force of the pumping pistons and the mechanical force of the swash plate bias spring.

Control of the pump's outlet flow is obtained by overriding the force of the pumping pistons and bias spring with the hydraulic force of the servo piston by means of internal porting. Pressure is connected from the outlet port to the servo piston via a compensator spool.

The compensator spool is held against the spring guide by the outlet pressure. When the outlet pressure reaches the setting of the compensator control, the compensator spool moves, allowing outlet pressure oil to be metered into the servo piston. This metered oil provides adequate force to power the servo piston and override and swash plate forces. The outlet pressure causes the servo piston to move which reduces the angle of the swash plate and thereby reduces the pump's output flow. When flow is again demanded by the system, the outlet pressure will momentarily fall allowing the compensator spool to move. This movement closes off the outlet pressure to the servo piston and vents the servo piston to case. The result of this venting allows the swash plate forces to move the swash plate angle to maximum displacement, thus responding to the demand for additional flow. Note that the compensator spring chamber is vented to the pump case via a hole internal to the compensator spool.

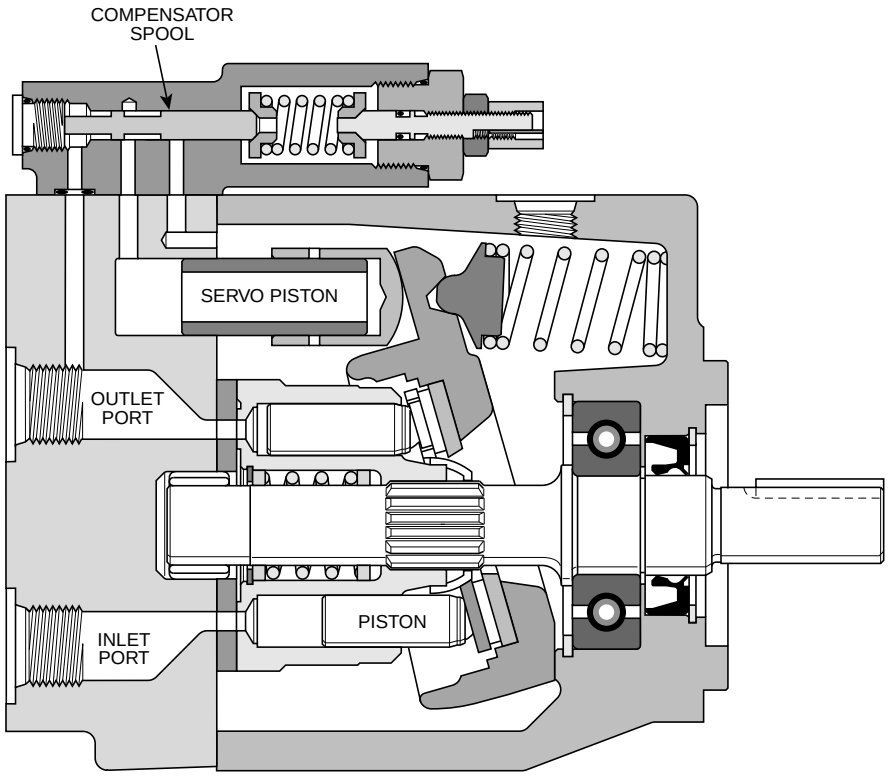


FIGURE 2

Remote Pressure Control (M)

The pump swash plate actuation is identical to the standard pressure compensator but can be controlled via a remote pressure control.

Remote control of the pump output pressure can be achieved by controlling the pressure at port A, Figure 3 on the compensator. Flow is metered through the orifice in the spool from outlet pressure into the spring chamber. The spring chamber pressure is limited by an external relief connected to port A. The controlled pressure at port A is sensed at the differential spring chamber. The compensator spool will move to the right when the pump outlet pressure reaches a force equal to the differential spring setting plus the controlled port pressure setting. When the spool moves to the right, outlet pressure oil is metered to the servo piston and the pump swash plate angle is controlled accordingly. With this option the pump outlet pressure can be controlled and varied from a remote location.

This control also incorporates a pressure limiting feature preset at the factory. When the pressure in the differential spring chamber reaches the maximum relief setting, the dart unseats allowing the spring chamber to vent to the pump case and limits the maximum pressure attainable.

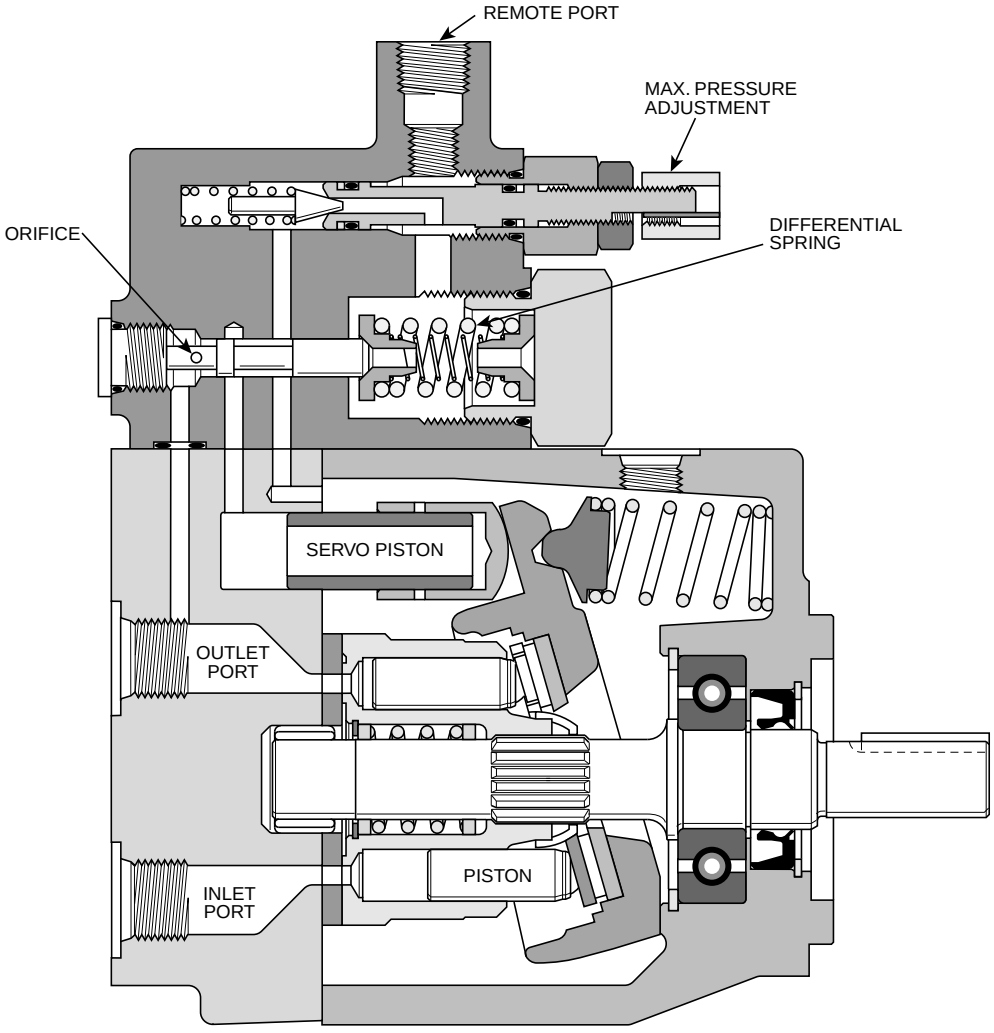


FIGURE 3

Control Options

Flow Control (Load Sensing) (A)

Figure 4 shows a PVP pump with flow control. The control is identical to the remote pressure compensation control except for an integral orifice, a solid compensator spool and adjustable differential pressure control. Port A is connected downstream of an orifice (variable or fixed) to sense the actual working pressure required. This pressure plus the differential spring force act on the right side of the compensator spool and will urge the spool to the left until output pressure acting on the left side of the spool balances the forces. As the load increases, output pressure will increase and maintain a constant differential pressure across the orifice and thus a constant flow. Maximum pressure is limited by the internal dart setting. This setting is adjustable up to the maximum preset at the factory.

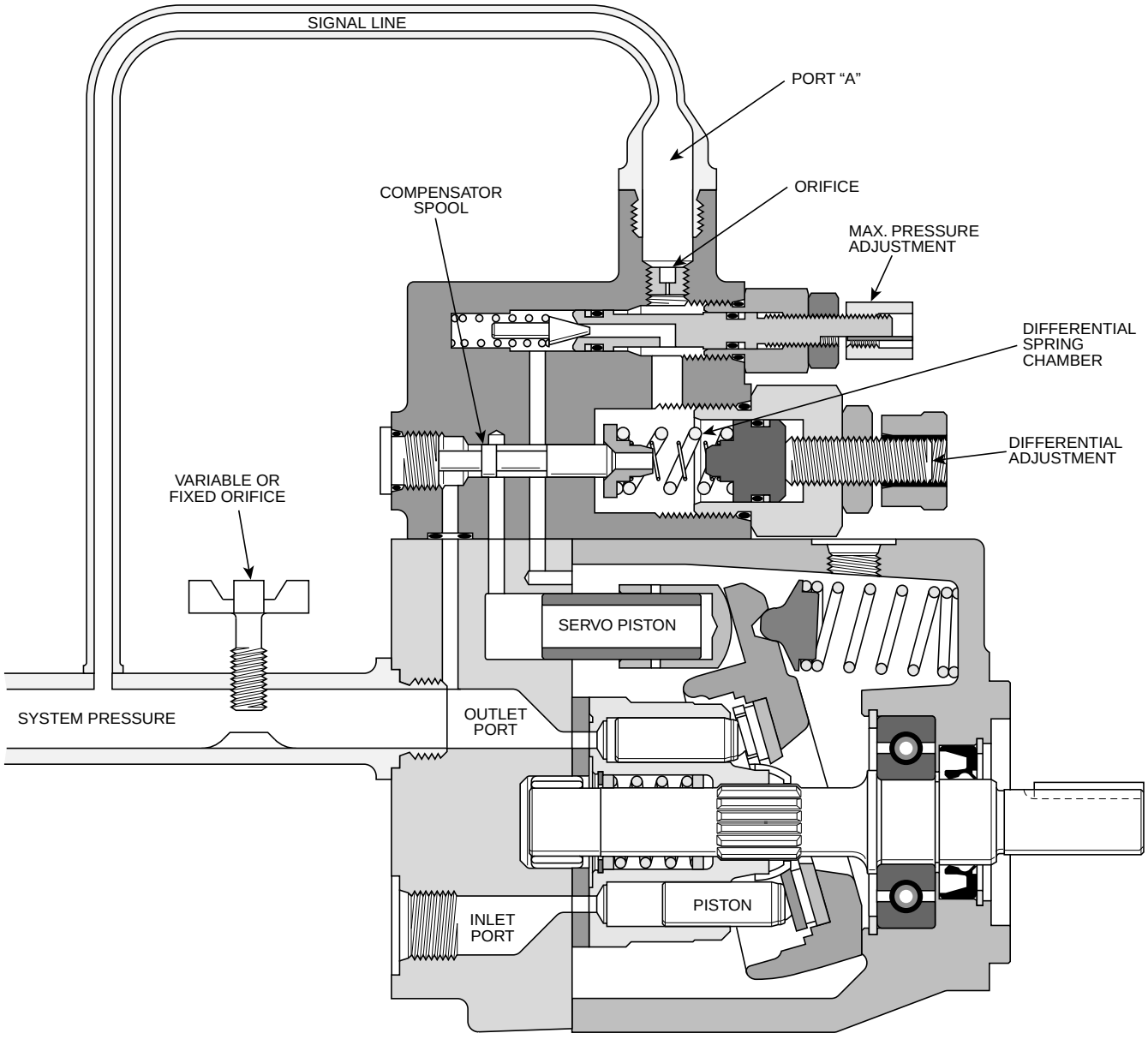


FIGURE 4

Pressure & Horsepower Control (H)

This control option is a Torque Limiting Control, but for constant speed applications it is generally referred to as a Horsepower Control. This control works in conjunction with the Remote Pressure Compensator, control option “M”. A second pressure control device called a horsepower control block, is assembled to the main pump housing. The HP block is plumbed to one of the ports on the remote compensator via steel tubing. The control dart in the HP block and the maximum pressure compensator dart in the remote compensator are connected in parallel. What makes the control dart in the HP block different from any other external relief valve is the pressure setting is mechanically linked to the pump swashplate angle.

The cracking pressure of the HP dart is generally lower than the cracking pressure of the remote compensator dart. When the HP dart opens the pressure in the differential spring cavity is lowered allowing the compensator spool to meter system pressure in the servo piston. As the servo piston extends, it rotates the swashplate and in turn rotates the HP cam. As the cam rotates it increases the force on the HP dart control spring. As the system pressure is allowed to increase, the pump gradually reduces its stroke (flow). When the system pressure reaches the setting of the maximum pressure dart the normal action of the remote compensator takes over. If the HP control is set low enough, the pump may reach zero stroke before the system pressure ever gets a chance to open the maximum compensator dart. This should be considered when making low power settings on systems requiring high working pressures.

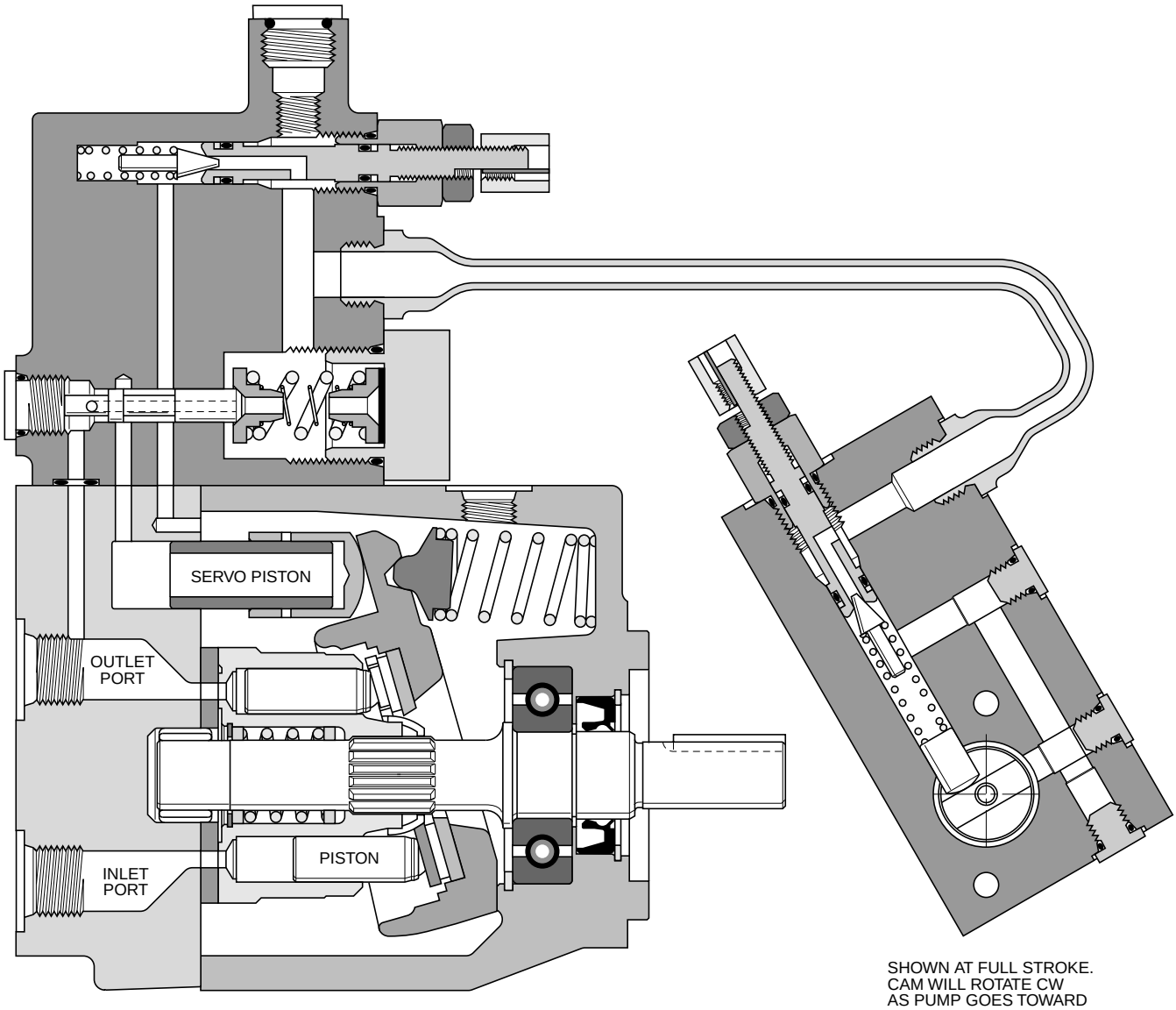


FIGURE 5

Pressure, Horsepower & Flow Control (C)

Refer to the previous section(s) on Flow Control and Power Control. This is another case where multiple controls can be combined in parallel. Since the Power Control is just a special version of Remote Pressure Control, it can be combined with the Flow Control (Load Sense) option. The main point to remember here is that the pressure drop which is required to begin and maintain compensation comes from an external device (such as a proportional valve). This sensed pressure drop will control flow until one of the limits of the other controls has been exceeded. The pump will always respond to the lowest control setting for any given pressure. In addition to Load Sensing, Power Control, and on-pump Pressure Control, Remote Pressure Control can also be included in this parallel device package. There is a remote port on the compensator body and one on the HP Control body, either of which may be used for remote pressure control. The important concept to remember in load sense circuits is that each pressure control device in and connected to the compensator must be protected from saturation. For this reason, use only the uppermost port on the compensator for connection of the load sense line and insure that an appropriate orifice is installed. All control options using a load sense compensator spool are supplied with this orifice.

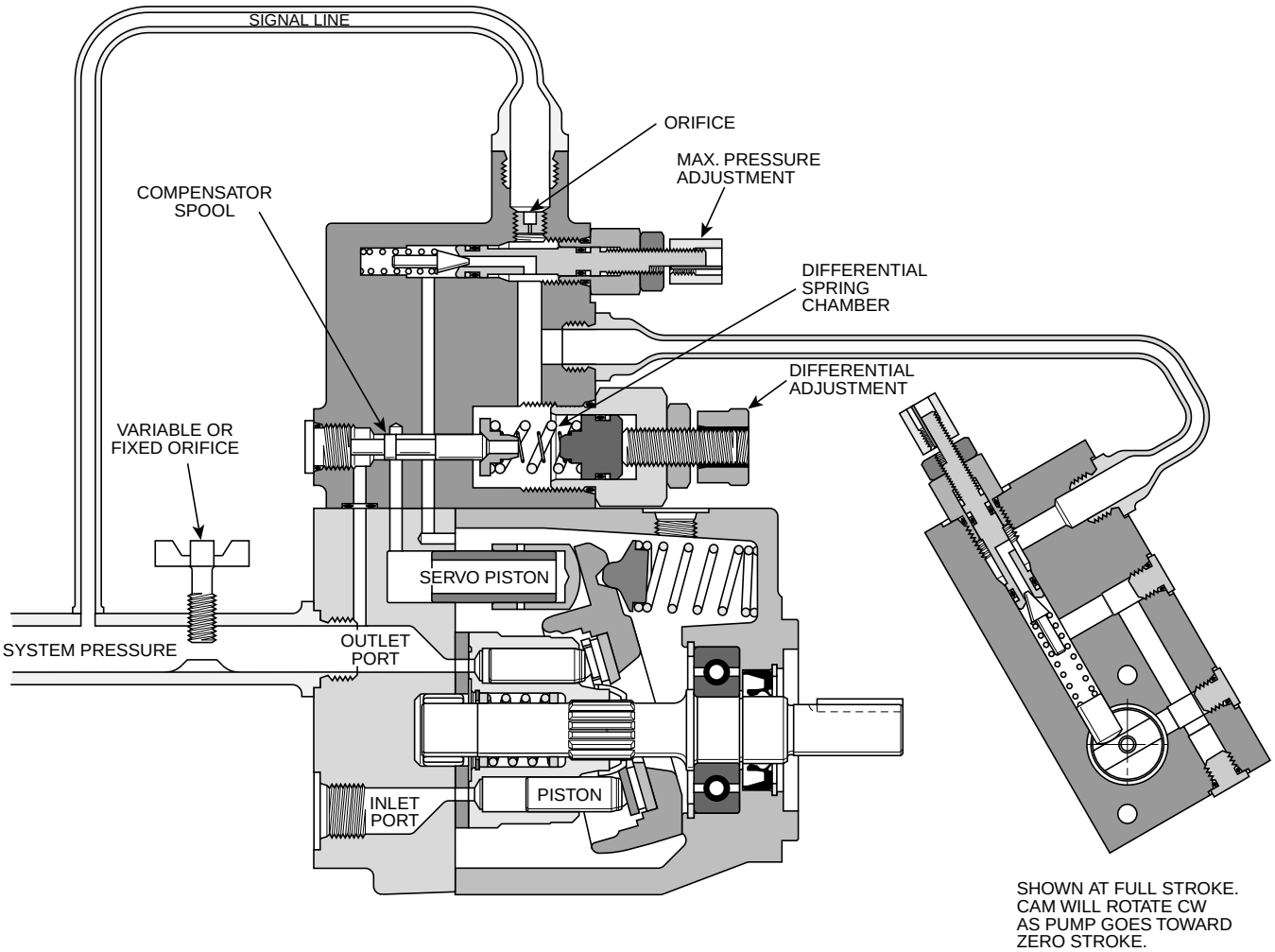


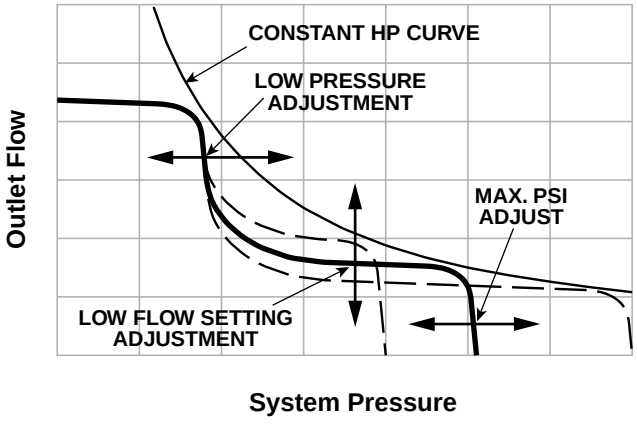
FIGURE 6

Hi/Lo Horsepower Control (HLM) available with PVP41 through PVP76 only

The graph shown below represents the flow-pressure characteristics of a Hi-Lo control for PVP pumps. There are up to four separate adjustments that must be made with the pump controls to get a particular setting, all of which influence the shape of the curve. To get the proper settings, it is very important that all pertinent information is supplied with each Hi-Lo pump ordered. As you can see from the graph below, there are two peak HP points. Our intention is to have the same magnitude of HP required for both peaks. Of course many combination of settings are possible but specification of the settings becomes very difficult. To make factory settings, we need to know the required **flow** (applicable if pump has a maximum volume stop), the **shaft speed**, the required **HP limit**, and the **compensation pressure**. Based on these requirements, we will adjust the low pressure set point and the reduced flow set point of the Hi-Lo control to best match the requested parameters called out on the order.

Important note: As with HP controls, not all combinations of flow, HP, pressure, etc. are possible. The first rule is that the settings must conceptually be achievable (i.e. HP out is ALWAYS less than HP in). Be careful in assuming efficiencies when estimating the Out/In relationship, since a pump operating at low pressure or in a de-stroked condition can have a much lower overall efficiency than expected. The other thing to keep in mind is that the pump will require the peak HP at only two points. All other operating pressures will require less than maximum HP and therefore the pump will deliver less hydraulic HP in the appropriate ratio based on the actual pump efficiency at those conditions.

Typical Hi-Lo Control Flow/Pressure Characteristics



Performance Information

Series PVP 23/33 Pressure Compensated, Variable Volume, Piston Pumps

Features

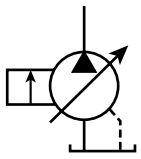
- **High Strength Cast-Iron Housing** for Reliability and Quiet Operation
- **Vickers Porting Interchange**
- **Optional Inlet/Outlet Locations** for Ease of Installation
- **Replaceable Bronze Port Plate**
- **Replaceable Piston Slipper Plate**
- **Thru-Shaft Capability** SAE A, AA and B Pilots Offered
- **Low Noise Levels**
- **Fast Response Times**
- **Metric Pilot Shaft and Ports Available**

Controls

- Pressure Compensation
- Remote Pressure Compensation
- Load Sensing
- Torque (Horsepower) Limiting
- Adjustable Maximum Volume Stop
- Low Pressure Standby

Schematic Symbol

(Basic Pump)



Specifications

Pressure Ratings

Outlet Port: 3600 PSI (248 bar) Continuous (P1)
4500 PSI (310 bar) Peak (P3)

Inlet Port: 25 PSI (1.72 bar) Maximum
5 In. Hg. Minimum @ 1800 RPM
(See inlet chart for other speeds)

Speed Ratings: 600-3000 RPM

Operating Temperature Range: – 40°F to 160°F
(– 40°C to 71°C)

Housing Material: Cast-Iron

Filtration: Maintain SAE Class 4,
ISO 16/13,
ISO 18/15 Maximum

Mounting: SAE "B" 2-Bolt Flange Mount

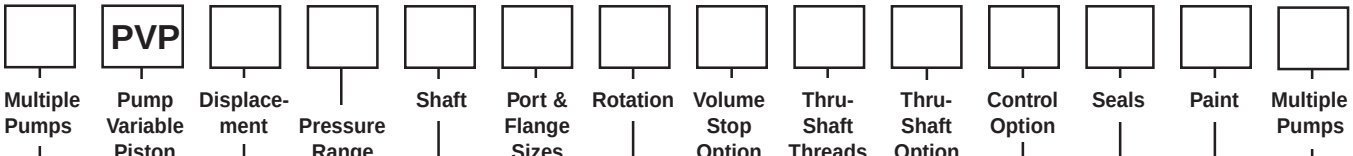
Installation Data: See page 54 of this catalog for specific recommendations pertaining to system cleanliness, fluids, start-up, inlet conditions, shaft alignment, drain line restrictions and other important factors relative to the proper installation and use of these pumps.

Quick Reference Data Chart

Pump Model	Displacement cc/rev (In³/rev)	Pump Delivery @ 300 PSI (21 bar) in GPM (LPM)		*Approx. Noise Levels dB(A) @ Full Flow 1800 RPM (1200 RPM)					Horsepower At 1800 RPM, Max. Displacement & 3600 PSI
		1200 RPM	1800 RPM	500 PSI (34 bar)	1000 PSI (69 bar)	2000 PSI (138 bar)	3000 PSI (207 bar)	3600 PSI (248 bar)	
PVP23	23 (1.4)	7.4 (28.0)	11.1 (42.0)	74 (69)	75 (70)	77 (75)	80 (75)	68 (63)	20.5
PVP33	33 (2.0)	10.4 (39.4)	15.6 (59.0)	4 (69)	75 (70)	77 (75)	80 (75)	69 (65)	28.5

* Since many variables such as mounting, tank style, plant layout, etc., effect noise levels, it cannot be assumed that the above readings will be equal to those in the field. The above values are for guidance in selecting the proper pump. Noise levels are A-weighted, mean sound pressure levels at 1 meter from the pump, measured and recorded in accordance with applicable ISO and NFPA standards.

Ordering Information



Code	CM³/REV (In³/Rev.)
23	23 (1.4)
33	33 (2.0)

Code	Painting
Omit	No Paint
P	Paint

Code	Multiple Pumps
Omit	Single Pump
—	Factory Mounted to Rear of Another Pump

Code	Rotation*
R	(CW)
L	(CCW)

* Viewed from shaft end.

Code	Seals
Omit	Buna-N
V	Fluoroelastomers*

* "**FLUOROELASTOMERS** are available under various registered trademarks, including **VITON** (a registered trademark of DuPont) and **FLUOREL** (a registered trademark of 3M)."

Code	Pressure Range*
10	250-1000 PSI (17-69 bar)
20	250-2000 PSI (17-138 bar)
30	250-3000 PSI (17-207 bar)
36	250-3600 PSI (17-248 bar)

* Minimum value of pressure range only applies on control option "omit" code.

Code	Thru-Shaft Threads
6*	UNC
9**	Metric

* Available with 2 or 3 port option only.
**Available with 8 or 9 port option only.

Code	Multiple Pumps
Omit	Single Pump
—	Pump Factory Mounted on Rear

Code	Shaft Option
Omit	7/8" Keyed (SAE B)
B	13T Spline (SAE B)
C	1" Keyed (SAE BB)
D	15T Spline (SAE BB)
K*	25mm Keyed, Metric Pilot

* Available with 8 or 9 port option only.

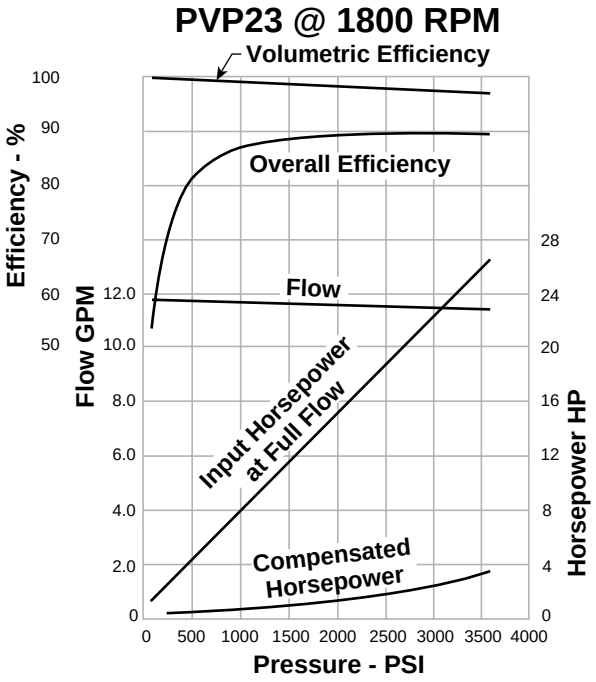
Code	Volume Stop Options
Omit	No Volume Stop
2	Adj. Maximum Volume Stop

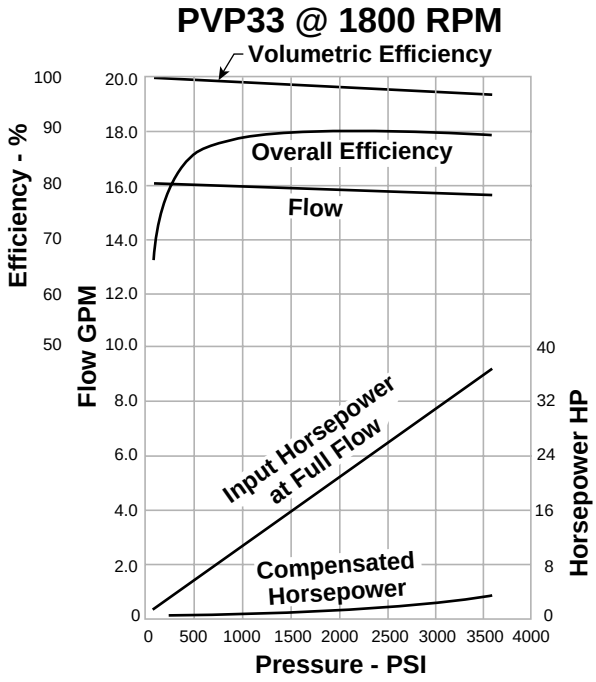
Code	Control Options
Omit	Pressure Compensated
M	Remote Pressure (Int.)
ME	Remote Pressure (Ext.)
A	Pressure and Flow
C	Pressure, Flow and HP Limiting
H	Pressure Compensated and HP Limiting

Code	Ports	
	Type	Location
Omit	SAE	Rear - Straight Thread
2	SAE	Side - Flange (Inch Threads)
3	SAE	Side - Straight Thread
8	ISO 6149	Side - Flange (Metric Threads)
9	BSPP	Side - Flange (Metric Threads)

Code	Thru-Shaft Option
Omit	No Thru-Shaft
A1	"AA" Pilot 1/2" Keyed
A2	"A" Pilot 3/4" Keyed
A4	"A" Pilot 9T (SAE A)
B1	"B" Pilot 7/8" Keyed
B2	"B" Pilot 1" Keyed
B3	"B" Pilot 13T (SAE B)
B4	"B" Pilot 15T (SAE B)

Typical Performance Data - Fluid: Standard Hydraulic Oil 100 SSU @ 120°F (49°C)



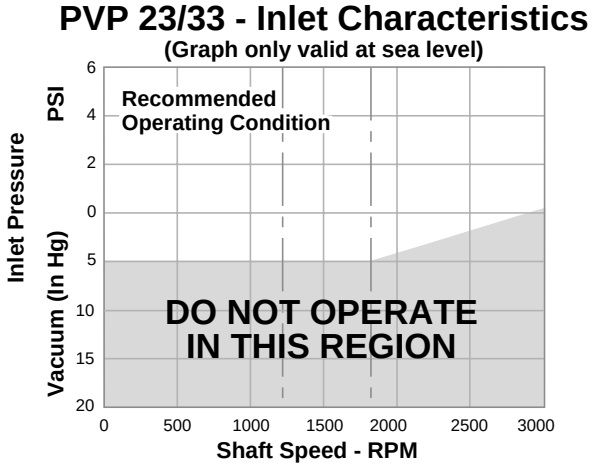


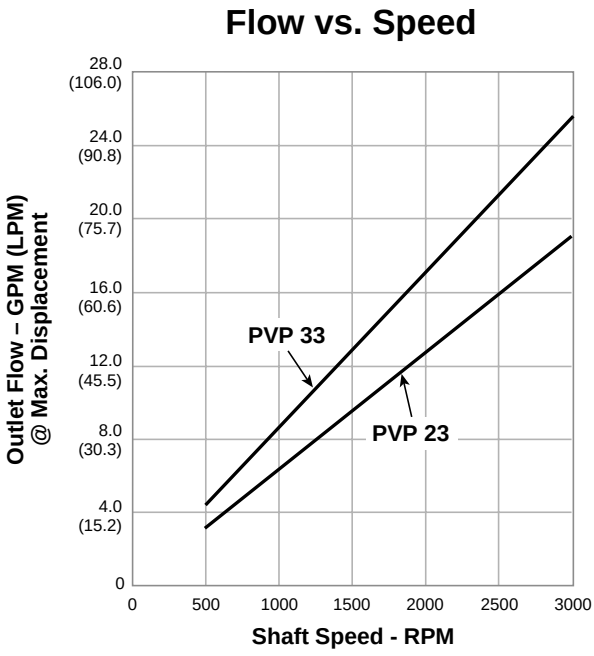
NOTE: The efficiencies and data in the graph are good only for pumps running at 1800 RPM and stroked to maximum. To calculate approximate horsepower for the other conditions, use the following formula:

$$HP = \left[\frac{Q \times (PSI)}{1714}\right] + (CHp)$$

Actual GPM is directly proportional to drive speed and maximum volume setting. Flow loss, however, is a function of pressure only.

WHERE:
Q = Actual Output Flow in GPM
PSI = Pressure At Pump Outlet
CHp = Input Horsepower @ Full Compensation @ 1800 RPM (from graph read at operating pressure)

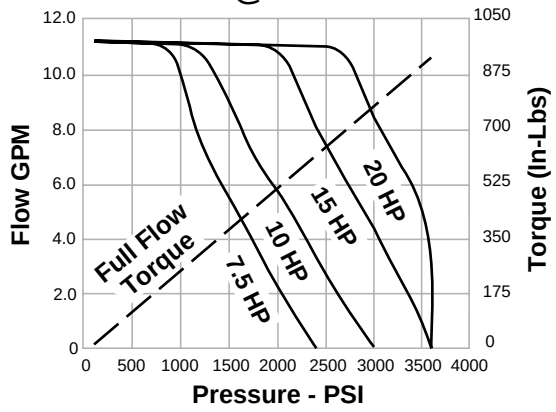




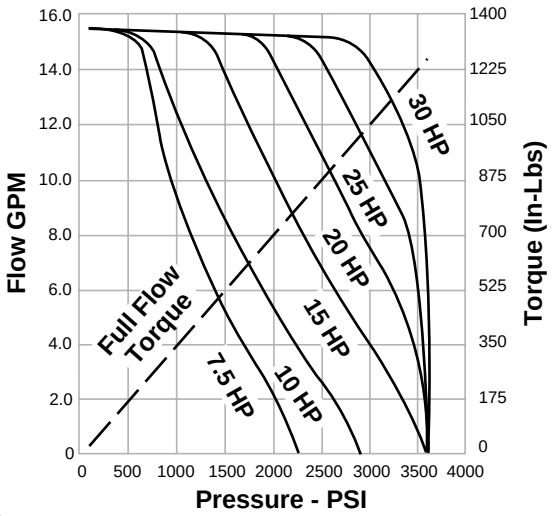
Typical Performance Data - Fluid: Standard Hydraulic Oil 100 SSU @ 120°F (49°C)

Horsepower Control

PVP23 @ 1800 RPM

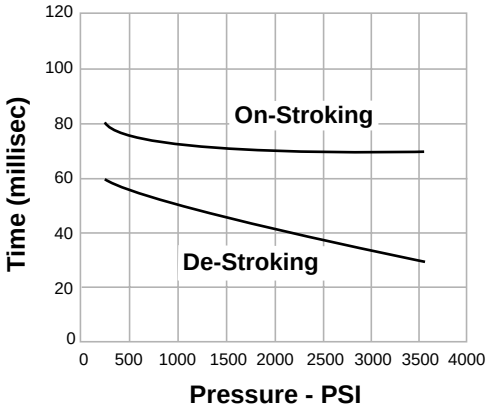


PVP33 @ 1800 RPM

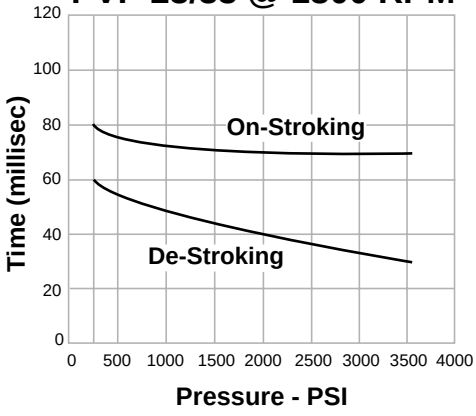


Response Times

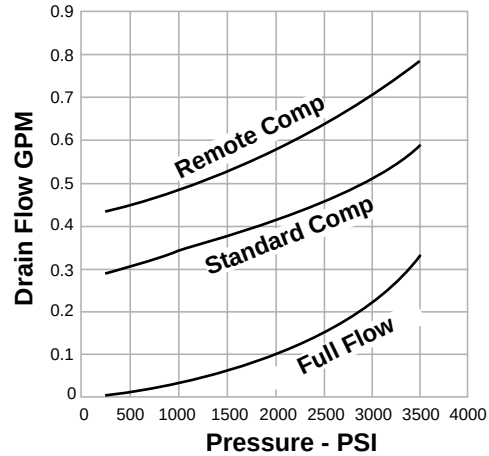
PVP 23/33 @ 1200 RPM



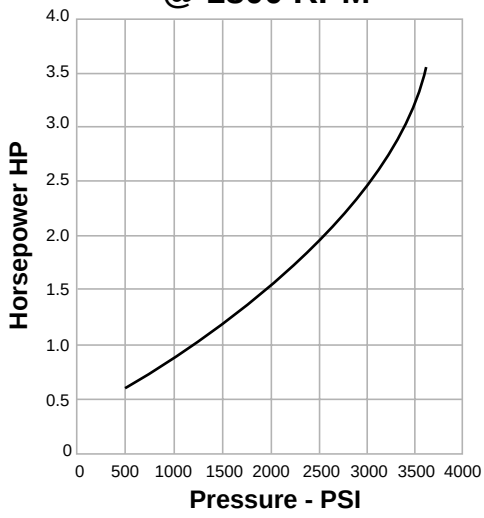
PVP 23/33 @ 1800 RPM



PVP 23/33 Case Drain Flow @ 1800 RPM



PVP23/33 Compensated Horsepower @ 1800 RPM



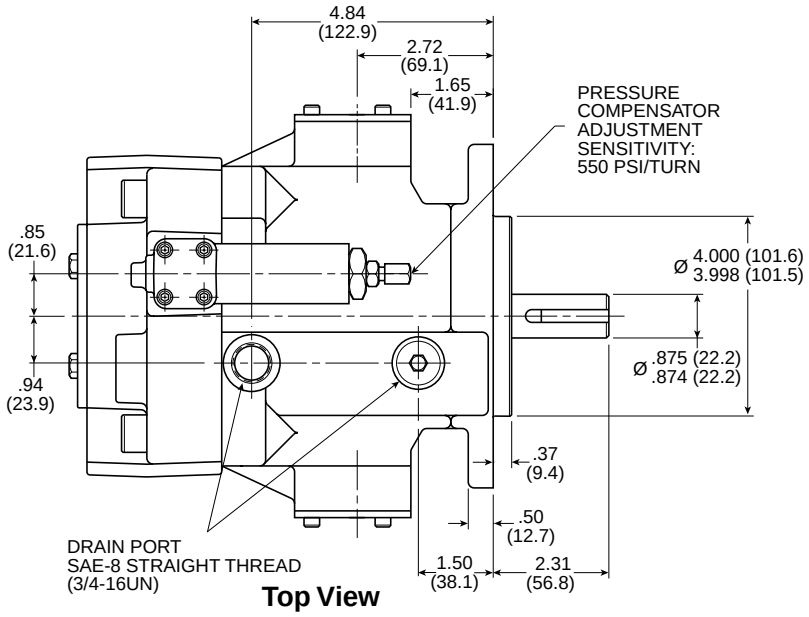
Dimensions – Side Ported – Options 2 & 3

Millimeter equivalents for inch dimensions are shown in (**).

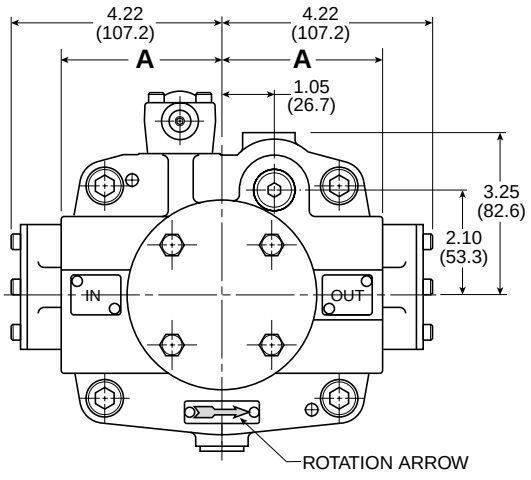
NOTES:

1. Righthand (CW) rotation pump shown. Lefthand (CCW) pumps have inlet and outlet ports reversed.
2. Pump shown with standard pressure compensator (control option "omit").

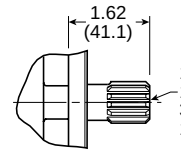
Port Location		
A	**Option**	**Inlet and Outlet Port**
3.100 (148.84)	2	1-1/4" SAE 4-Bolt Flange 7/16-14 Threads Standard Pressure Series (Code 61)
3.220 (152.40)	3	SAE-20 Straight Thread (1-5/8-12UN-2B)



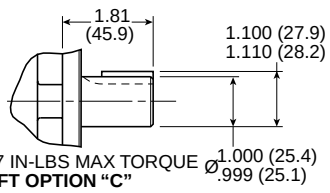
Top View



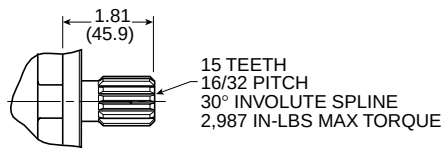
Rear View



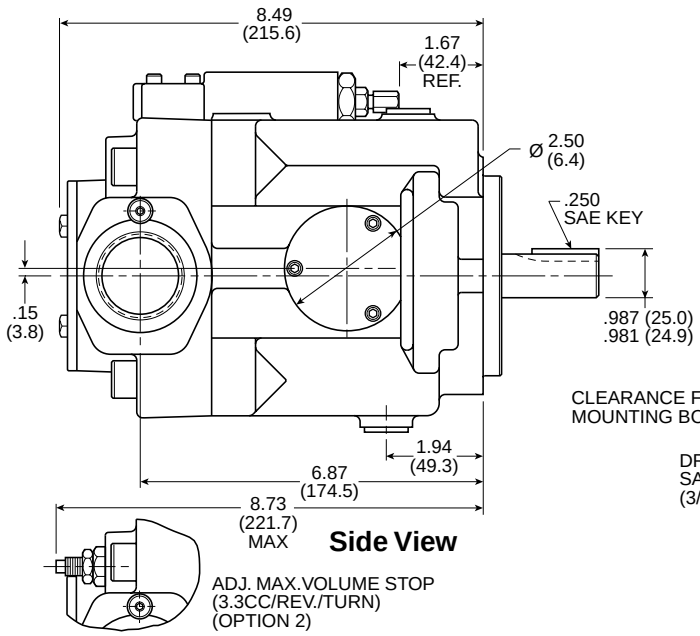
SHAFT OPTION "B"



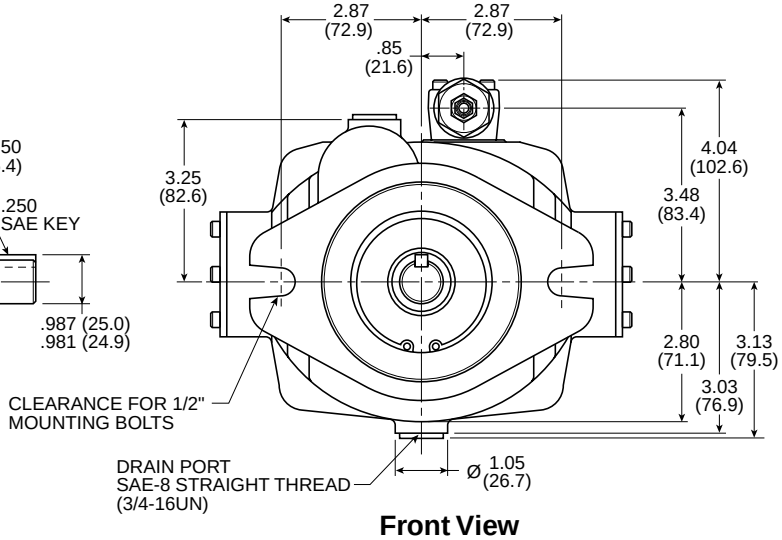
SHAFT OPTION "C"



SHAFT OPTION "D"



Side View

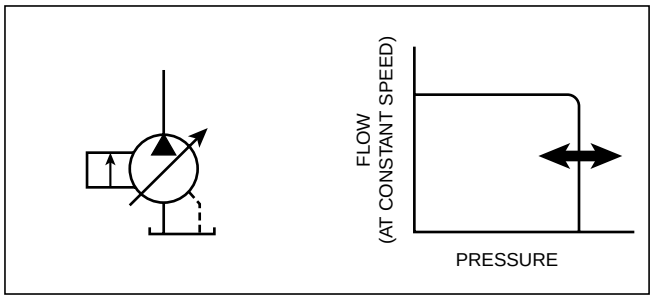


Front View

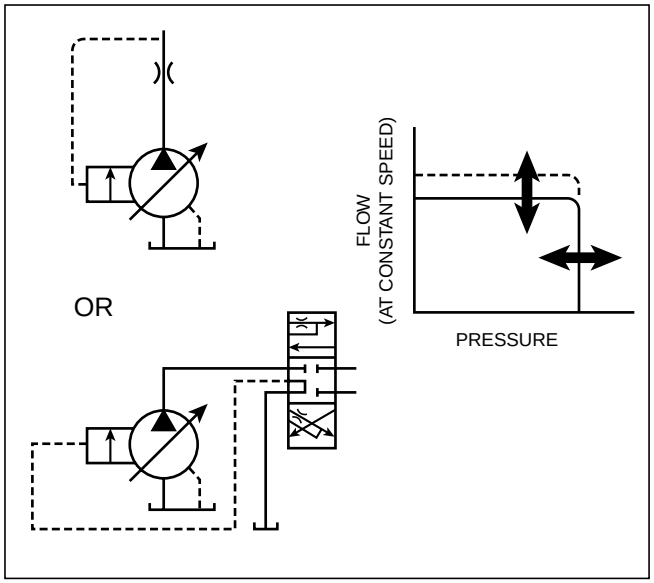
Summary of Control Circuits

All options shown are not available on all pumps.

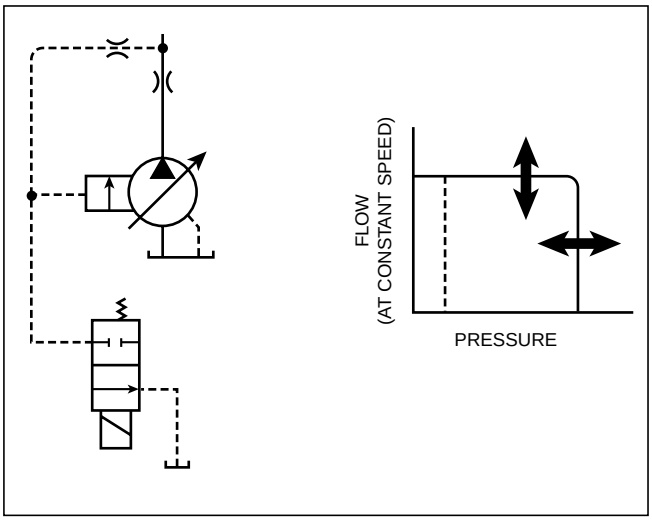
Pressure Control Option
Code: Omit



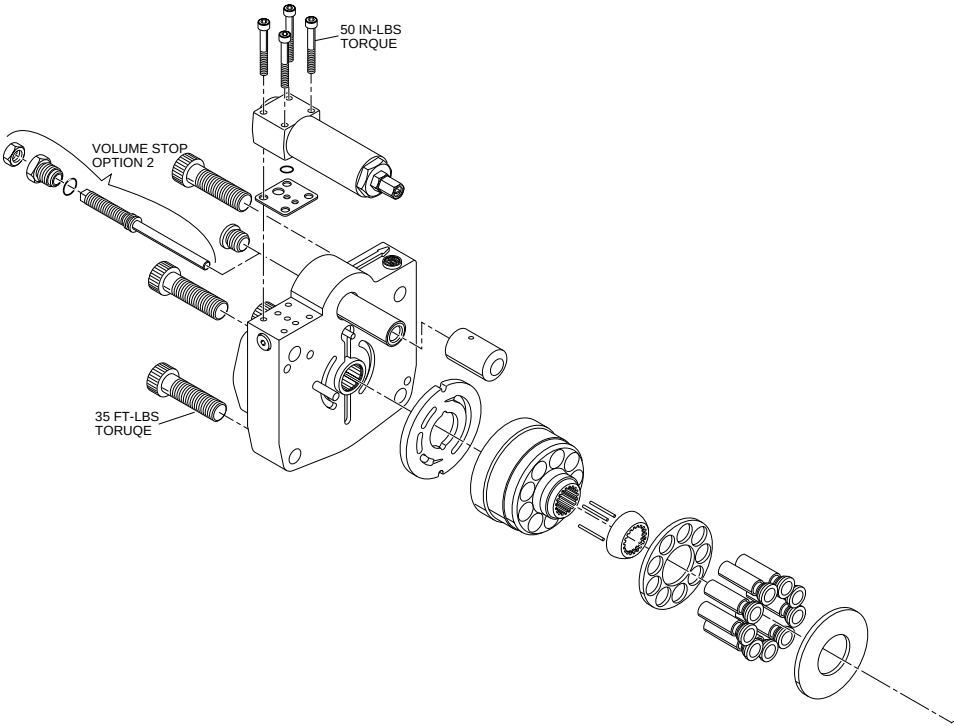
Load Sensing (Flow Control) Option
Code: A

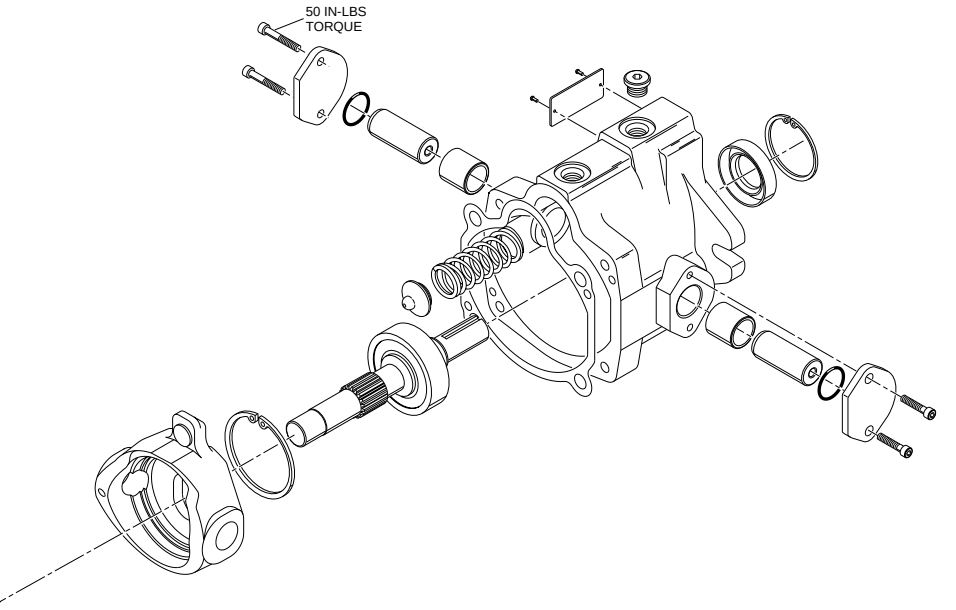


Low Pressure Standby Option
Code: A



Standard Pump Assembly




50 IN-LBS
TORQUE

Use of a Relief Valve

The use of a relief valve, while not mandatory is recommended in the main circuit to suppress hydraulic shock loads and adds additional system protection.

Fluid Recommendations

Premium quality hydraulic oil with a viscosity range between 150-250 SSU (30-50 cst.) at 100°F (38°C). Normal operating viscosity range between 80-1000 SSU (17-180 cst.). Maximum start-up viscosity is 4000 SSU (1000 cst.).

NOTE: Consult Parker when exceeding 160°F (71°C) Inlet Fluid Temperatures. Oil should have maximum anti-wear properties, rust and oxidation treatment.

Filtration

For maximum pump and system component life, the system should be protected from contamination at a level not to exceed 125 particles greater than 10 microns per milliliter of fluid. (SAE Class 4/ISO 16/13.) Due to the nature of variable displacement pumps, variations in pump inlet conditions, fluid acceleration losses, system aeration, and duty cycle we do not recommend suction line filters. We do recommend the use of a properly sized, in-tank, suction strainer. Contact your Parker representative for assistance.

Start-Up

On initial start-up, the case should be filled with oil, pressure adjustments should be reduced and the circuit should be open to permit priming.

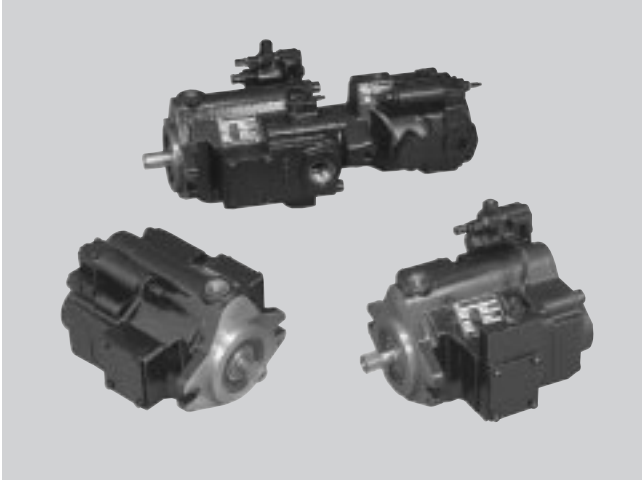
Inlet Conditions

Not to exceed 5 inched Hg. Vacuum at 1800 RPM on petroleum base fluids. See recommended speed spectrum for specific inlet conditions.

Shaft Rotation and Line Up

Pump and motor shaft alignment must be within .010 TIR maximum, using a standard floating coupling. Please follow coupling manufacturer's recommended installation instructions to prevent end thrust on pump shaft. Turn pump to assure freedom of rotation. Pump and motor must be on a rigid base.

The coupling should be sized to absorb the peak horsepower developed.



Installation and Mounting

When mounting a PVP Series Pump, the "case drain" must be on top of the pump. The "case drain" should be a separate line unrestricted to the reservoir and extend below the oil level as far from the inlet line as possible. The "case drain" line must not exceed **10 PSI (.7 bar)** back pressure. Suggested maximum line length is 10 feet.

Special Installations

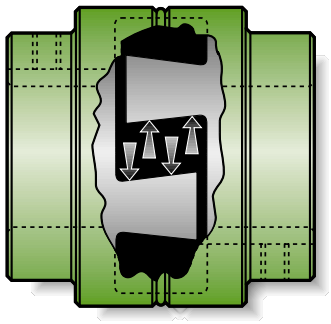
Consult your Parker representative for any application requiring the following:

Pressure above rated, drive speed above maximum, indirect drive, fluid other than petroleum oil, oil temperature above 160°F (71°C).

Inlet Pressure

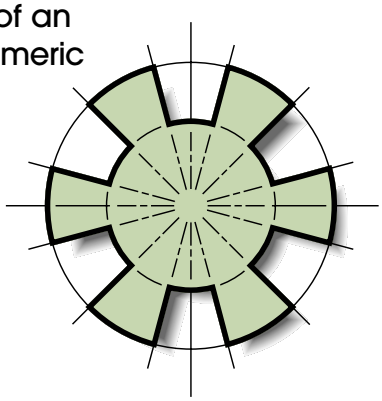
Not to exceed 25 PSI (1.72 bar).

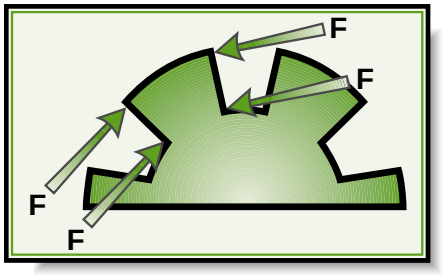
Magnaloy Coupling Design Features



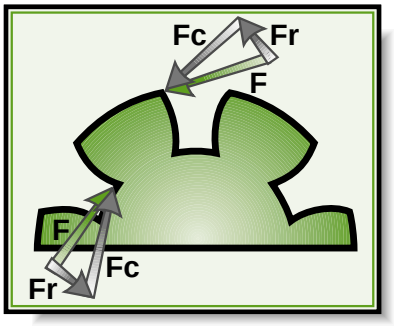
"Load-Lock" Design is simple and effective. The drive-lug configuration is tapered from top to base, as are the mating lugs of the opposing coupling hub. Under load, the insert conforms to the tapers, inter-locking the two hubs. This load-lock design protects bearings and equipment by eliminating end thrust in both directions... and it requires only one set-screw in each hub.

Radial Lug Design is logical and efficient. The most common failure of an elastomeric insert type drive coupling is hysteresis failure of the elastomeric element - breakdown of the elastomer due to cyclical overworking and associated heat generation. Magnaloy Coupling's drive lugs are in a true radial orientation. Applied forces are evenly distributed in the compressive direction only, eliminating the heat generating radial component. True compressive loading reduces internal heat generation and improves elastomer life.

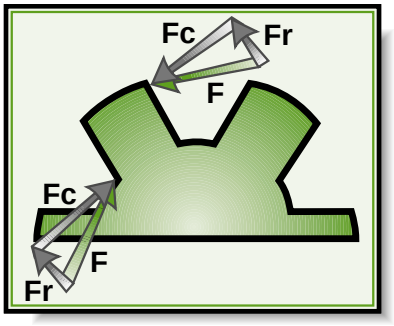




MAGNALOY COUPLING DESIGN
Under loaded conditions, the resultant forces applied on the element segments are evenly distributed in the compressive direction only. This results in no radial forces to multiply the internal heat generation.



CONVENTIONAL DESIGN A
Under loaded conditions this jaw design results in the applied forces exerting components in the compressive and radical directions. These forces change direction and magnitude along the jaw arc which greatly increase the internal movement of the element which causes heat generation.



CONVENTIONAL DESIGN B
This more conventional straight sided jaw design also exerts component forces in the compressive and radial directions when under load. The radial component is outward (acting to extrude the element) and changes in magnitude only, as does the compressive component, along the jaw surface. The component forces resulting from this design also causes increased internal movement in the element.

magnaloy coupling company P.O. Box 455 Alpena, MI 49707 989-356-2186
A Division of Douville Johnston Corporation Fax: 989-354-4190 http://www.magnaloy.com

Magnaloy ® is a registered trademark of the Douville Johnston Corp.

Premium Flexible Drive Couplings

Magnaloy is the original lightweight, heavy-duty flexible drive coupling. Light weight magnesium construction makes Magnaloy couplings 76% lighter than cast iron and 36% lighter than aluminum units... and they're stronger than either!

The benefits are many... Reduced loads on bearings, shafts and pumps, for longer component life. Easier handling and installation. Rust proof and corrosion resistant.

Magnaloy's close machining tolerances (TIR of .002") assures vibration - free operation and easy, accurate alignment without need for special tools. Solid magnesium alloy permanent mold castings are heat treated and offer the highest strength-to-weight ratio available.

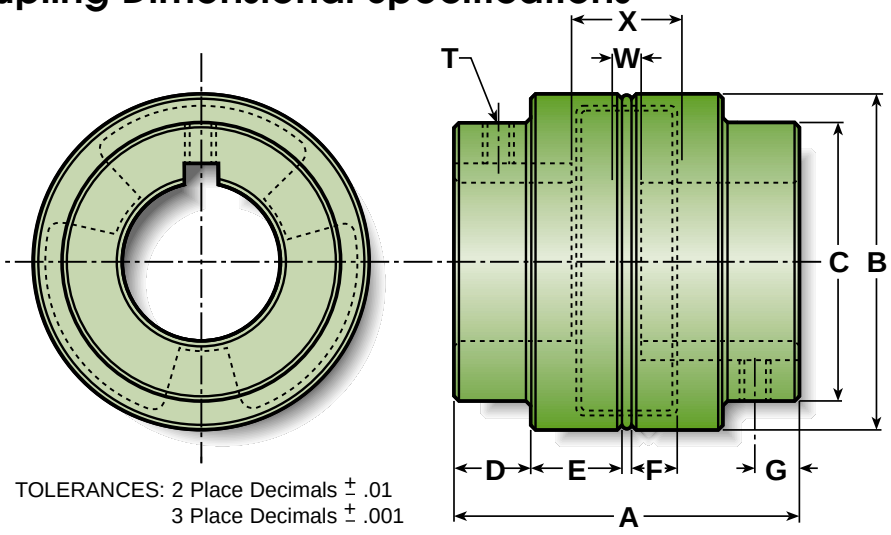
Coupling Performance Specifications

Coupling Model	Maximum Bore	Wr^2 lb.- ft^2.	Insert Number	Rated Torque lb.- in.	Torsional Rigidity lb-in/Deg	Horse Power Rating@ 100 rpm	1200 rpm	1800 rpm
100	1-1/8	.0046	170N 170U 170H	340.7 511.0 1,022.1	42 53 182	.55 .82 1.65	6.5 9.8 19.8	9.8 14.7 29.7
200	1-3/8	.0068	270N 270U 270H	398.3 597.4 1,194.9	55 68 234	.64 .96 1.92	7.6 11.5 23.0	11.5 17.2 34.5
300	1-5/8	.022	370N 370U 370H	701.4 1,052.1 2,104.2	81 148 336	1.12 1.68 3.36	13.5 20.2 40.4	20.2 30.3 60.6
400	1-7/8	.031	470N 470U 470H	1,056.3 1,584.5 3,168.9	138 310 488	1.69 2.5 5.1	20.3 30.4 60.8	30.4 45.6 91.3
500	2-3/8	.071	570N 570U 570H	2,194.8 3,292.2 6,584.4	314 695 1,571	3.5 5.3 10.5	42.1 63.2 126.4	63.2 94.8 189.6
600	2-5/8	.16	670N 670U 670H	4,946.7 7,420.1 14,840.1	676 1,510 2,960	7.9 11.9 23.7	94.9 142.5 284.9	142.5 213.7 427.4
700	2-7/8	.34	770N 770U 770H	11,639.8 17,459.7 29,099.5	1,805 2,104 -	18.6 27.9 46.5	223.5 335.2 558.75	335.2 502.8 838.0
800	3-7/8	.95	870N 870U 870H	21,889.4 32,834.1 47,062.2	3,680 - -	35.0 52.5 75.2	420.3 630.4 903.0	630.4 945.6 1,354.5
900	4-3/4	4.20	970N 970U	47,842.3 71,763.5	8,428 -	76.5 114.8	918.6 1,377.9	1,377.9 2,066.8

Magnaloy Coupling Dimensional Specifications

Models 100, 200, 300, 400

	100	200	300	400
A	2.54	3.10	3.58	4.24
B	2.600	2.900	3.450	3.980
C	2.00	2.25	2.90	3.05
D	0.56	0.68	0.78	1.00
E	0.68	0.84	0.96	1.06
F	0.42	0.42	0.44	0.54
G	0.31	0.43	0.56	0.73
W	1/16	1/16	1/16	1/16
X	0.90	0.90	0.98	1.20
T	1/4-20	5/16-18	5/16-18	3/8-16



TOLERANCES: 2 Place Decimals ± .01
3 Place Decimals ± .001

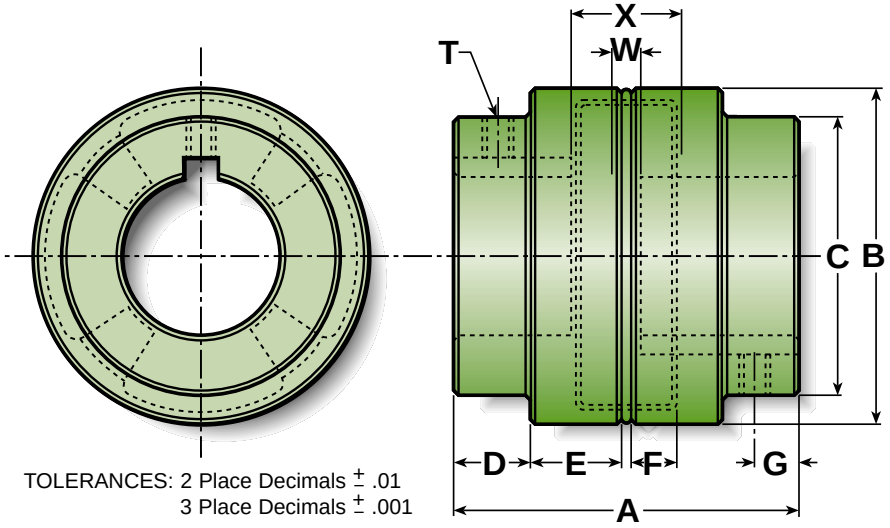
Model 500

	500
A	4.67
B	4.800
C	4.00
D	1.04
E	1.23
F	0.64
G	0.70
W	1/16
X	1.41
T	3/8-16

X*: **Maximum Space between shaft ends to allow full shaft engagement in Hub Bore.**

Y*: **Minimum spacing between shaft ends.**

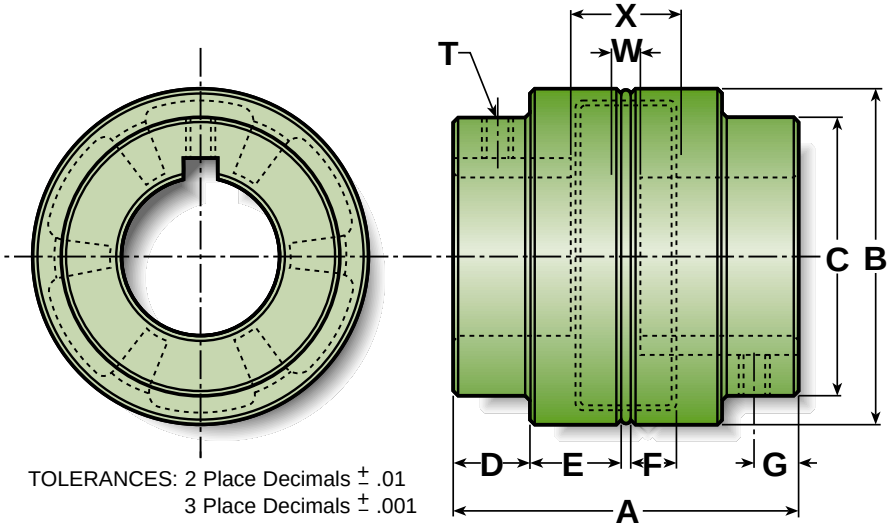
***** Given for reference only.



TOLERANCES: 2 Place Decimals ± .01
3 Place Decimals ± .001

Models 600, 700, 800, 900

	600	700	800	900
A	5.98	6.99	7.99	10.15
B	5.975	6.900	8.600	11.400
C	4.50	5.19	7.00	8.30
D	1.60	2.08	2.25	2.75
E	1.33	1.32	1.62	2.20
F	0.62	0.89	1.00	1.32
G	1.13	1.13	1.58	1.88
W	1/16	1/16	1/16	1/16
X	1.36	1.97	2.25	2.89
T	3/8-16	1/2-13	1/2-13	3/4-10



TOLERANCES: 2 Place Decimals ± .01
3 Place Decimals ± .001

Standard Bore and Keyway Combinations

Magnaloy "Standard" Bore & Key Combinations											
Model Code	Bore/Key Code	Model → Bore	Key	100	200	300	400	500	600	700	800	900
M ___ ___ ___	01203	3/8	x 3/32	•	•							
M ___ ___ ___	01403	7/16	x 3/32	•	•							
M ___ ___ ___	01404	7/16	x 1/8	•	•							
M ___ ___ ___	01604	1/2	x 1/8	•	•	•						
M ___ ___ ___	01804	9/16	x 1/8	•	•	•						
M ___ ___ ___	02005	5/8	x 5/32	•	•	•						
M ___ ___ ___	02006	5/8	x 3/16	•	•	•	•					
M ___ ___ ___	02206	11/16	x 3/16	•	•	•	•					
M ___ ___ ___	02404	3/4	x 1/8	•	•	•						
M ___ ___ ___	02406	3/4	x 3/16	•	•	•	•	•	•			
M ___ ___ ___	02806	7/8	x 3/16	•	•	•	•	•	•			
M ___ ___ ___	02808	7/8	x 1/4	•	•	•	•	•	•			
M ___ ___ ___	03008	15/16	x 1/4		•	•						
M ___ ___ ___	10006	1	x 3/16	•	•	•	•	•	•			
M ___ ___ ___	10008	1	x 1/4	•	•	•	•	•	•			
M ___ ___ ___	10408	1 1/8	x 1/4	•	•	•	•	•	•			
M ___ ___ ___	10608	1 3/16	x 1/4			•		•				
M ___ ___ ___	10808	1 1/4	x 1/4		•	•	•	•	•			
M ___ ___ ___	10810	1 1/4	x 5/16		•	•	•	•	•	•	•	
M ___ ___ ___	11210	1 3/8	x 5/16		•	•	•	•	•	•	•	
M ___ ___ ___	11212	1 3/8	x 3/8			•						
M ___ ___ ___	11412	1 7/16	x 3/8			•	•	•				
M ___ ___ ___	11610	1 1/2	x 5/16				•	•	•			
M ___ ___ ___	11612	1 1/2	x 3/8			•	•	•	•	•	•	
M ___ ___ ___	12012	1 5/8	x 3/8			•	•	•	•	•	•	
M ___ ___ ___	12412	1 3/4	x 3/8				•	•	•	•	•	

Magnaloy "Standard" Bore & Key Combinations											
Model Code	Bore/Key Code	Model → Bore	Key	100	200	300	400	500	600	700	800	900
M ___ ___ ___	12414	1 3/4	x 7/16				•	•	•	•	•	
M ___ ___ ___	12816	1 7/8	x 1/2				•	•	•	•	•	•
M ___ ___ ___	13016	1 15/16	x 1/2					•	•			
M ___ ___ ___	20016	2	x 1/2					•	•	•	•	•
M ___ ___ ___	20416	2 1/8	x 1/2					•	•	•	•	•
M ___ ___ ___	20816	2 1/4	x 1/2					•	•	•	•	•
M ___ ___ ___	21220	2 3/8	x 5/8					•	•	•	•	•
M ___ ___ ___	21620	2 1/2	x 5/8						•	•	•	•
M ___ ___ ___	22020	2 5/8	x 5/8						•	•	•	•
M ___ ___ ___	22420	2 3/4	x 5/8							•	•	•
M ___ ___ ___	22824	2 7/8	x 3/4							•	•	•
M ___ ___ ___	30024	3	x 3/4								•	•
M ___ ___ ___	30824	3 1/4	x 3/4								•	•
M ___ ___ ___	31228	3 3/8	x 7/8								•	•
M ___ ___ ___	31628	3 1/2	x 7/8								•	•
M ___ ___ ___	32028	3 5/8	x 7/8								•	•
M ___ ___ ___	32428	3 3/4	x 7/8								•	•
M ___ ___ ___	32832	3 7/8	x 1								•	•
M ___ ___ ___	40032	4	x 1									•
M ___ ___ ___	40432	4 1/8	x 1									•
M ___ ___ ___	40832	4 1/4	x 1									•
M ___ ___ ___	41232	4 3/8	x 1									•
M ___ ___ ___	41632	4 1/2	x 1									•
M ___ ___ ___	41640	4 1/2	x 1 1/4									•
M ___ ___ ___	42040	4 5/8	x 1 1/4									•
M ___ ___ ___	42440	4 3/4	x 1 1/4									•

Shaded Area: AGMA semi-standard bore key combinations.

Bore Tolerances

Over	Include	Tolerance
--	1	+.0008/ +.0003
1	2	+.0013/ +.0005
2	3	+.0018/ +.0008
3	4	+.0020/ +.0010
4	5	+.0023/ +.0010

Part Number Usage: Magnaloy Coupling Hub part numbers may be specified using the following format: Start with letter "M" designating Magnaloy, followed by 3 digit Model Code (100, 200, etc.), then the specific 5 digit Bore Key Code.

Example: Model 500 hub with a 1 3/8 bore and 5/16 keyway would be specified as: M50011210 - No bore hubs are designated as 'R' code, ie: M500R.

Additional Coupling Specifications

Model Number	100	200	300	400	500	600	700	800	900
Maximum Bore	1-1/8	1-3/8	1-5/8	1-7/8	2-3/8	2-5/8	2-7/8	3-7/8	4-3/4
Complete Coupling Approx. Wght. (Solid Hub)	3/4	1	2	3	4	7	12	18	38
Number of Drive Lugs	3	3	3	3	4	6	6	6	6
Hub Movement for Insert Removal	.74	.74	.75	.98	1.12	1.02	1.50	1.63	2.27
Basic Insert Number	170	270	370	470	570	670	770	870	970

magnaloy coupling company P.O. Box 455 Alpena, MI 49707 989-356-2186
A Division of Douville Johnston Corporation Fax: 989-354-4190 http://www.magnaloy.com

Magnaloy Coupling's full range of flexible inserts permit custom design performance for a wide range of applications. All insert materials offer complete electrical insulation, as Magnaloy's design eliminates all metal-to-metal contact.

Part Number Usage: Magnaloy Coupling Insert part numbers may be specified using the following format: Start with letter 'M' designating Magnaloy followed by 3 digit insert model size (170, 270, etc.) then the specific material code letter. If an optional durometer is being specified, after the material code letter supply the durometer number divided by 10.

EXAMPLES: Urethane insert for Model 300, M370U; 80 Duro Neoprene for Model 200, M270N8.

Neoprene (Code N) - Black material - Standard material with Magnaloy Coupling. Good general purpose material offering good resiliency and load capabilities. Temp range -30°F to +250°F (-34°C to =121°C) optional 80A durometer (painted gold) and 90A durometer (painted silver) are available for slight increased load capability and less resiliency.

Nitrile (Buna N) (Code B) - Painted blue - Excellent material with petroleum products. Excellent compression set and abrasion resistance characteristics. Temp range -60°F to +250°F (-51°C to +121°C).

Urethane (Code U) - Yellow
Excellent mechanical and physical properties. Offers good medium duty durability and resiliency. Urethane tends to soften in higher temperatures and humid conditions. Temp Range -30°F to +150°F (-34°C to +66°C).

Viton (Fluorocarbon) (Code V) - Red material - Excellent fluid compatibility and high temperature characteristics. Good compression set and resiliency. Temp range -20°F to +350°F (-29°C to +177°C).

Hytrel (Code H) - Blue-green material - Superior physical and mechanical properties and excellent fluid compatibility and high temperature characteristics. Hardness (50D) approaches that of plastic and offers little resiliency. Excellent performance under heavy duty conditions. Temp range -65°F to +300°F (-54°C to +149°C).

Other materials are available for special applications. Consult factory for recommendations and availability.

Service Factors - Load Characteristics

Load Classification	Type of Prime Mover			
	Standard Motor or Turbine	High Torque Motor	I.C. Engine 6 or more cyl.	I.C. Engine less than 6 cyl.
Uniform (U)	1.0	1.5	1.5	2.0*
Moderate (M)	1.5	2.0	2.0*	2.5*
Heavy (H)	2.0*	2.5*	2.5*	3.0*

Uniform Load: Steady loading, non-reversing, torque does not exceed rating.
Moderate Load: Uneven loading with moderate shock, frequent starts, infrequent reversals, peak torque may exceed average rate of prime mover by 125%.
Heavy Load: Uneven loading with heavy shock, frequent reversals, peak torque may exceed average rating of prime mover by 150%.
*Recommend use of Urethane or Hytrel Insert.

Drive Unit		Load Sym.
Agitators		U
Blowers		U
Compressors	• Centrifugal	U
	• Rotary	M
	• Reciprocating	H*
Conveyors		U
	• Reciprocating	M
	• Screw	M
	• Shaker	H
Cranes & Hoists		M
Crushers		H*
Elevators		M
	• Freight & Pass.	H*
Fans	• Centrifugal	U
	• Propeller	M
	• Cooling Tower	H
Generators		U
	• Welding	H
Mills		H*
Machine Tools		M
Mixers		M
Paper Mill Machinery		M
Pumps	• Centrifugal	U
	• Rotary	M
	• Reciprocating	H*
	• On Injection Molding Equip.	H*
Screens	• Air & Water Washing	U
	• Freight & Pass.	H
Stokers		U
Textile Machinery		M
Woodworking Machinery		M
Winches		H*

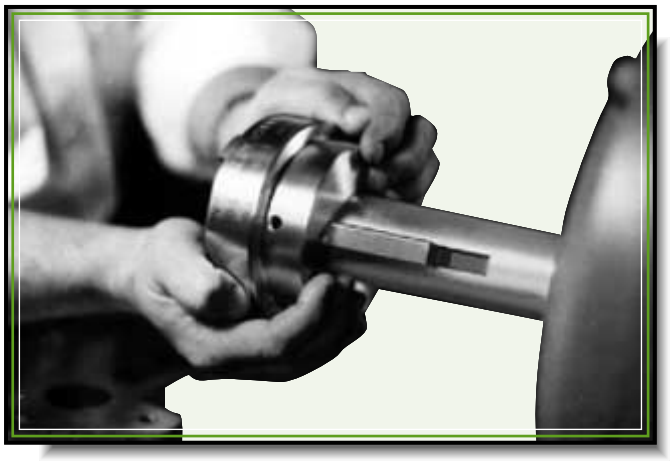
Selection Method

1. Several specifics must be considered to make the best choice of couplings:
   A. Type of prime mover and load characteristics (see table above).
   B. Shaft diameter and key size or spline configuration (No. of teeth, pitch ratio, pressure angle).
   C. Horsepower rating of loads to be transmitted.
   D. Maximum operating speed (rpm).
   E. Maximum operating misalignment.
   F. Clearance limitations.
2. Calculate effective hp/100 rpm by use of table above and select the minimum size couplings recommended.
3. VERIFY YOUR SELECTION:
   A. Check for maximum bore size.
   B. Check dimensions for adequate clearance.
   C. Indicate any special insert specification and/or coupling coating for environmental protection, if required.

   Equation: Effective HP per 100 RPM = rated HP x Service Factor x 100/RPM

   Example: 150 HP 4 cyl. Diesel Engine Driving Reciprocating Irrigation Pump operating at 3250 RPM
   Service Factor = 3.0 (Hytrel Insert recommended)
   Eff. HP per 100 RPM = 150 HP x 3.0 x 100/3250 RPM = 13.85 HP/100 RPM Model 600 rating with Hytrel Insert is 23.7 HP/100 RPM

NOTE: Above service factors are intended for use as a general guide only.
* Recommend use of Steel Bushing and Clamp with Splined Bores.



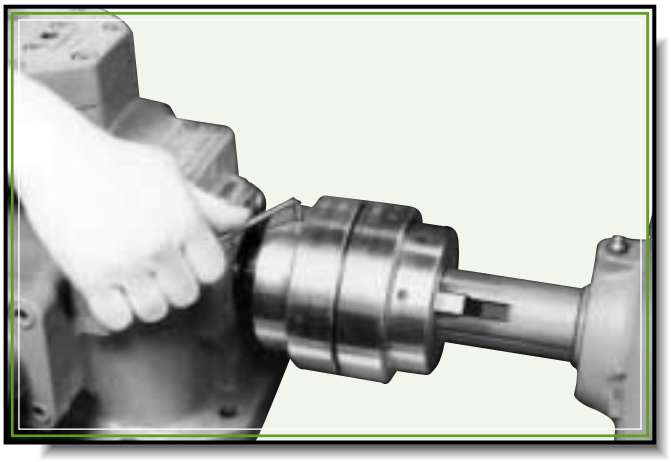
Shaft spacing should be within range given by dimensions 'W' and 'X' as shown in charts on page 4.

Position each hub on proper size shaft - Magnaloy couplings are bored to standard "push fit" tolerances, if a tight fit exists check shaft for burrs.

Maximum benefits are obtained with hubs positioned to allow complete shaft engagement within bore. However, some equipment designs do not permit this condition - maximum shaft engagement should be utilized in any case.

Alignment - Place a straight edge (scale) at top and side of coupling. Use a .005 inch feeler gauge under scale for final inspection. This will indicate accurate parallel and angular alignment.

Magnaloy's precision tooled outside surfaces permit this simple, but accurate alignment method.



Secure equipment mounts and recheck alignment for movement.

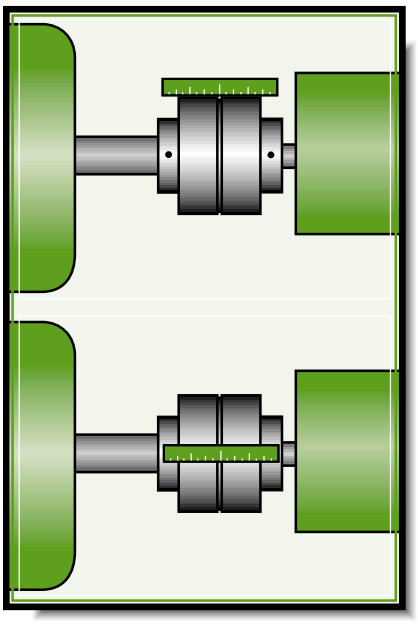
Install the insert in the coupling positioning hubs in contact with lip around outside of insert.

Before tightening set screws, run the coupling and check for separation of hubs or creep . Recheck alignment and tighten set screws.

With the Steel Bushed/Clamp type couplings, to facilitate installation on the shaft, it may be necessary to slightly loosen the set-screw over the keystock. When securing the coupling to the shaft, first tighten the clamp bolt, then tighten the set--screw against the keystock.

Mis-Alignment Capabilities

Magnaloy couplings offer four-way flexibility (parallel, angular, axial and torsional) and require no lubrication. They are easily installed and properly aligned without use of special tools or equipment - a straight edge and hex wrench are the only tools required. Magnaloy's insert reduces noise and vibration and permits needed flexibility for proper operation within alignment capabilities.

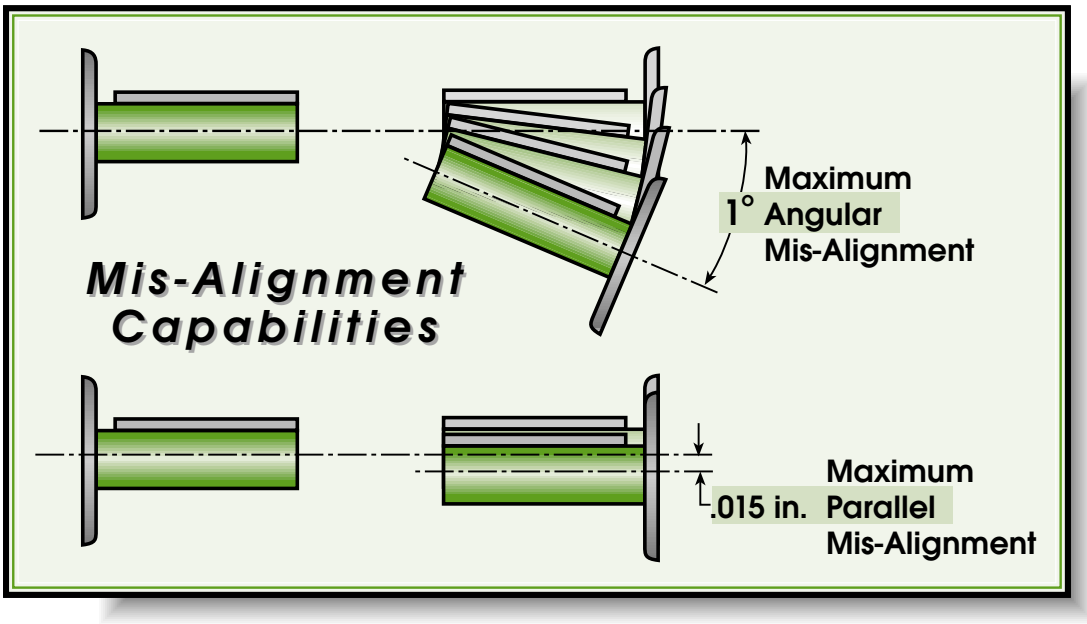


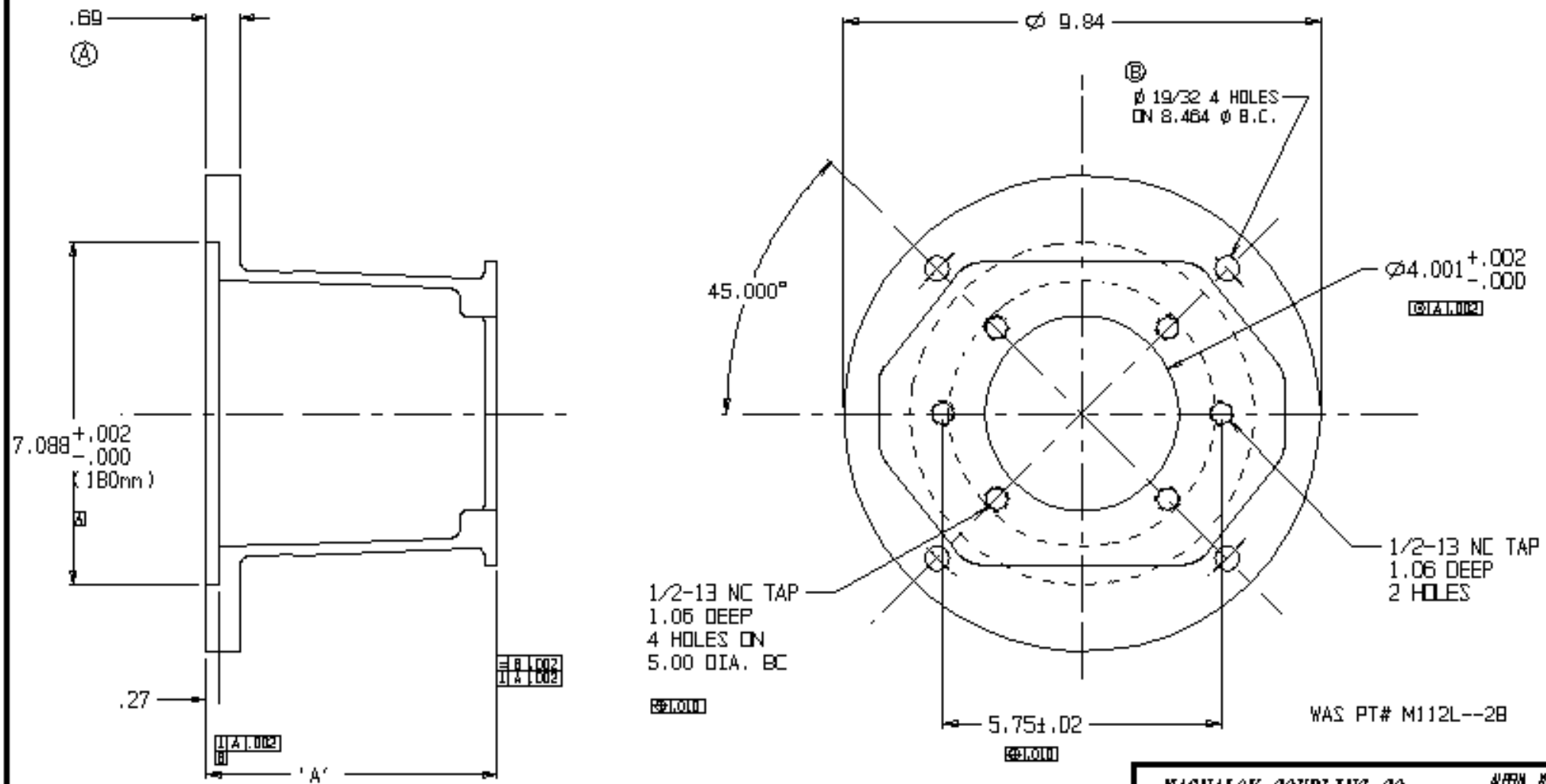
Recommended Torques for Fasteners

Model	Set Screw	Clamp Screw
100	60-70 in. lbs.	130-140 in. lbs.
200	130-140 in. lbs.	130-140 in. lbs.
300	130-140 in. lbs.	210-220 in. lbs.
400	190-200 in. lbs.	210-220 in. lbs.
500	190-200 in. lbs.	300-310 in. lbs.
600	190-200 in. lbs.	35-36 ft. lbs.
700	300-310 in. lbs.	35-36 ft. lbs.
800	300-310 in. lbs.	49-50 ft. lbs.
900	100-110 ft. lbs.	100-110 ft. lbs.

Intended as a general guide for fastener torques with Magnaloy Couplings.

Perfect alignment of equipment shafts, in most cases, is impractical to obtain or maintain, and misaligned equipment produces excess stress on bearings and coupling. Magnaloy's insert design will accept misalignment strain and, when excessive, will cause insert wear as a visual and audible indication of misalignment problems. However, Magnaloy's inserts are inexpensive and easily replaced; under normal conditions the insert seldom requires replacement.





M180ML722B	18270-BV	7.25
M180ML702B	18268-BV	7.00
M180ML602B	18258-BV	6.00
M180ML552B	18252-BV	5.50
PART #	CASTING #	"A"

SYM.	DATE	CHANGE	SYM.	DATE	CHANGE
B	11/10	WAS .62			
A	2/02	WAS .70			

TOLERANCES NOT SPECIFIED LINEAR ±.005 ANGULAR 30 minutes

MAGNALOY COUPLING CO. ALPENA, MI 49707

DATE: 10/ 1/96 | SCALE: 1/2 | DRAWN BY: S.S.

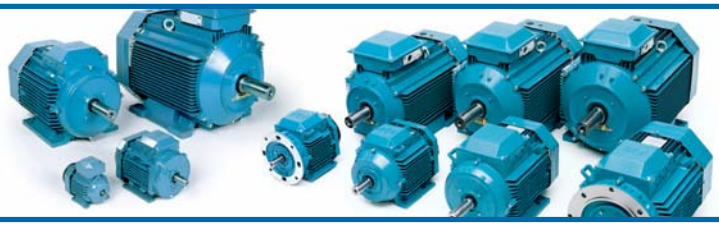
180MM MOTOR FLANGE TO SAE B

182-BV CASTING | M180ML 2B

ABB Motors	Technical Data Sheet - DOL			
	Project		Location	
Department/Author	Customer name		Customer ref.	Item name **1.00001**
Our ref.	Rev/Changed by **A**	Date of issue **11/19/2010**	Saving ident **untitled.xls**	Pages **1(3)**

No.	Definition	Data	Unit	Remarks	
1	Product	***TEFC, 3-phase, squirrel cage induction motor***			
2	Product code	***3GAA 162 031-DG***			
3	Type/Frame	***M3AA 160 MLA 4***			
4	Mounting	***IM2101***			
5	Rated output P_N	***11***	kW		
6	Service factor	***1***			
7	Type of duty	***S1(IEC) 100%***			
8	Rated voltage U_N	***460***	VD	± 5 % (IEC 60034-1)	
9	Rated frequency f_N	***60***	Hz	± 2 % (IEC 60034-1)	
10	Rated speed n_N	***1772***	r/min		
11	Rated current I_N	***18.2***	A		
12	No-load current	***7.3***	A		
13	Starting current I_s/I_N	***7.7***			
14	Nominal torque T_N	***59***	Nm		
15	Locked rotor torque T_S/T_N	***2.4***			
16	Maximum torque T_{max}/T_N	***3.2***			
17	Minimum torque T_{min}/T_N	***1.7***			
18	Speed at minimum torque	***360***	r/min		
	Load characteristics (IEC 60034-2-1:2007)	Load %	Current A	Efficiency %	Power factor
19	PLL determined from residual loss	*100*	**18.2**	**91.3**	**0.83**
20		*75*	**14.3**	**91.6**	**0.79**
21		*50*	**11**	**90.6**	**0.69**
22		*Start*	**140**		**0.44**
23	Maximum starting time from hot	***15***	s		
24	Maximum starting time from cold	***27***	s		
25	Insulation class / Temperature class	***F / B***			
26	Ambient temperature	***55***	℃		
27	Altitude	***1000***	m.a.s.l.		
28	Enclosure	***IP55***			
29	Cooling system	***IC411 self ventilated***			
30	Bearing DE/NDE	***6309-2Z/C3 - 6209-2Z/C3***			
31	Type of Grease				
32	Sound pressure level (LP dB(A) 1m)	***66***	dB(A)	at load	
33	Moment of inertia J = ¼ GD2	***0.081***	kg-m2		
34	Balancing				
35	Vibration class				
36	Position of terminal box	***Top***			
37	Terminal box entries; no, dimens.				
38	Number of power terminals				
39	Direction of rotation	***CW or CCW***			
40	Total weight of motor	***99***	kg		
41	Dimension drawing no.				
42					
43					
44					

– Made in ABB



Certified for Global Use

Global motors are certified, labeled and fulfill requirements for global use:

CE = European safety certified

EFF1 = European Community efficiency classification, highest class EFF1

CSA = Canadian safety certified

EEV = Canadian Energy Efficient certified

UR = US safety certified

EPAct = US Energy Efficiency certified.

Ratings

- Rated for use on both 50 Hz and 60 Hz systems
- Voltage ratings covering the world with one and the same motor
- Efficiency and safety ratings meeting or exceeding all mandatory requirements

Advantages

- One motor design in stock ready to ship anywhere in the world
- No problem moving production equipment internationally
- Easy to specify – fulfills all requirements globally
- Reduced operating costs thanks to high reliability and low losses
- IEC – CENELEC harmonized
- Backed by the extensive collection of ABB application knowledge

Quality

Quality, Reliability, Service & Support, from the worldwide leader in motors, ABB.

EFF 1

EPAct

Global motors according to EFF1, EPAct, CSA, EEV, UR

Technical data
Totally enclosed squirrel cage three phase motors, aluminum frame

Power			Motor type		Product code		Speed r/min	NEMA Nom. Eff. % [1]	Efficiency acc. to IEC 100%	75%	Power factor	Current I_N A	$\frac{I_s}{I_N}$	Torque Nm	$\frac{T_s}{T_N}$	$\frac{T_{max}}{T_N}$	Moment of inertia kgm²	Weight kg	lbs
3600 r/min (2-pole)					**460 V 60 Hz**														
0.25	**0.18**		**M3VA**	**63 A**	3GVA	061 391-•••	3400	[2]	70.1	67.5	0.60	0.5	4.6	0.5	4.0	4.0	0.00013	3.9	8.6
0.35	**0.25**		**M3VA**	**63 B**	3GVA	061 392-•••	3400	[2]	76.4	75.3	0.70	0.6	5.4	0.7	3.9	3.9	0.00016	4.4	9.7
0.50	**0.37**		**M3VA**	**71 A**	3GVA	071 391-•••	3450	[2]	76.5	74.5	0.70	0.9	6.6	1.0	4.2	4.4	0.00040	5.5	12
0.75	**0.55**		**M3VA**	**71B**	3GVA	071 392-•••	3450	[2]	79.8	78.6	0.75	1.2	7.1	1.5	4.2	4.5	0.00045	6.5	14
1	**0.75**		**M3VA**	**80 A**	3GVA	081 731-•••	3480	75.5	80.6	79.2	0.81	1.45	8.4	2.06	4.9	4.5	0.000722	9	20
1.5	**1.1**		**M3VA**	**80 C**	3GVA	081 773-•••	3460	82.5	83.5	83.1	0.85	2.0	9.5	3.04	4.8	4.7	0.001093	11	24
2	**1.5**		**M3AA**	**90 L**	3GAA	091 312-•••	3535	86.5	87.5	86.5	0.85	2.6	8.1	4.1	2.8	3.8	0.0024	16	35
3	**2.2**		**M3AA**	**90 LB**	3GAA	091 313-•••	3530	87.5	87.9	87.5	0.85	3.7	7.5	6.0	3.2	3.7	0.0027	18	40
4	**3**		**M3AA**	**100 LB**	3GAA	101 312-•••	3560	88.0	88.0	88.0	0.85	5.1	11.0	8.0	3.9	5.0	0.0005	25	55
5	**4**		**M3AA**	**112 M**	3GAA	111 022-•••CG2	3475	87.5	87.5	87.5	0.93	6.1	9.1	11	2.8	3.5	0.012	33	73
7.5	**5.5**		**M3AA**	**132 SA**	3GAA	131 023-•••CG2	3500	88.5	88.5	88.5	0.88	8.7	9.4	15	3.3	4.0	0.016	42	92
10	**7.5**		**M3AA**	**132 SB**	3GAA	131 024-•••CG2	3465	89.5	89.5	89.5	0.88	11.8	14.5	20.7	4.5	6.0	0.022	56	123
15	**11**		**M3AA**	**160 MA**	3GAA	161 121-•••CG2	3545	90.2	90.2	90.2	0.90	16.8	8.6	30	2.8	3.3	0.039	105	231
20	**15**		**M3AA**	**160 M**	3GAA	161 122-•••CG2	3545	90.2	90.2	90.2	0.90	22.5	9.2	40	3.2	3.7	0.047	84	185
25	**18.5**		**M3AA**	**160 L**	3GAA	161 123-•••CG2	3545	91.0	91.0	91.0	0.89	27.5	9.8	50	2.8	3.5	0.053	94	207
30	**22**		**M3AA**	**180 M**	3GAA	181 121-•••CG2	3560	91.0	91.0	91.0	0.90	32.8	8.3	59	2.6	3.0	0.077	119	262
40	**30**		**M3AA**	**200 MLB**	3GAA	201 021-•••CG2	3555	91.7	91.7	91.7	0.90	44.5	9.0	81	3.2	3.2	0.15	175	385
50	**37**		**M3AA**	**200 MLC**	3GAA	201 022-•••CG2	3560	92.4	92.4	92.4	0.88	56	9.7	99	3.7	3.6	0.18	200	440
60	**45**		**M3AA**	**225 SMC**	3GAA	221 021-•••CG2	3575	93.0	93.0	93.0	0.88	68	7.9	121	2.5	3.2	0.26	235	517
75	**55**		**M3AA**	**250 SMB**	3GAA	251 021-•••CG2	3570	93.0	93.0	93.0	0.90	81	8.7	147	2.7	3.2	0.49	285	627
100	**75**	[3]	**M3AA**	**250 SMC**	3GAA	251 022-•••CG2	3565	93.6	93.6	93.6	0.92	108	9.9	201	2.4	3.1	0.57	375	825
100	**75**		**M3AA**	**280 SMB**	3GAA	281 021-•••CG2	3565	93.6	93.6	93.6	0.92	108	9.9	201	2.4	3.1	0.59	390	858
1800 r/min (4-pole)					**460 V 60 Hz**														
0.16	**0.12**		**M3VA**	**63 A**	3GVA	062 391-•••	1680	[2]	58.8	54.5	0.55	0.5	2.8	0.7	2.6	2.7	0.00019	4	8.8
0.25	**0.18**		**M3VA**	**63 B**	3GVA	062 392-•••	1680	[2]	62.8	59.5	0.57	0.6	2.9	1.0	2.5	2.6	0.00026	4.5	9.9
0.35	**0.25**		**M3VA**	**71 A**	3GVA	072 391-•••	1700	[2]	66.7	63.9	0.68	0.7	4.3	1.4	3.1	3.1	0.00066	5.5	12
0.50	**0.37**		**M3VA**	**71 B**	3GVA	072 392-•••	1700	[2]	70.6	68.3	0.69	0.9	4.5	2.1	3.2	3.2	0.00089	6.5	14
0.75	**0.55**		**M3VA**	**80 A**	3GVA	082 391-•••	1700	[2]	73.3	71.6	0.74	1.3	5.1	3.1	3.0	3.0	0.001250	9.0	20
1	**0.75**		**M3VA**	**80 C**	3GVA	082 733-•••	1730	82.5	82.5	82.1	0.78	1.5	6.6	4.14	4.1	3.1	0.001848	11	24
1.5	**1.1**		**M3AA**	**90 L**	3GAA	092 312-•••	1750	84.0	85.5	84.0	0.78	2.1	7.1	6.1	3.0	3.8	0.0043	16	35
2	**1.5**		**M3AA**	**100 LA**	3GAA	102 311-•••	1765	86.5	87.2	86.0	0.79	2.8	7.5	8.2	3.0	4.0	0.0069	21	46
3	**2.2**		**M3AA**	**100 LC**	3GAA	102 313-•••	1770	87.5	87.5	87.5	0.75	4.2	9,0	11.9	4.1	4.8	0.009	25	55
4	**3**		**M3AA**	**100LB**	3GAA	102 342-•••	1740	87.5	87.5	87.5	0.82	5.4	7.6	16.5	3.1	3.7	0.0082	25	55
5	**4**		**M3AA**	**112 M**	3GAA	112 022-•••CG2	1775	87.5	87.5	87.5	0.75	7.6	10.4	21.8	3.9	4.6	0.018	34	75
7.5	**5.5**		**M3AA**	**132 SA**	3GAA	132 023-•••CG2	1760	89.5	89.5	89.5	0.83	9.3	8.9	29.8	2.7	3.5	0.038	48	106
10	**7.5**		**M3AA**	**132 M**	3GAA	132 024-•••CG2	1765	89.5	89.5	89.5	0.85	12.4	9.7	40.7	3.5	3.6	0.048	59	130
15	**11**		**M3AA**	**160 M**	3GAA	162 121-•••CG2	1775	91.0	91.0	91.0	0.81	18.4	8.9	59	3.5	3.7	0.091	94	207
20	**15**		**M3AA**	**160 L**	3GAA	162 122-•••CG2	1770	91.0	91.0	91.0	0.83	24.5	8.8	81	3.5	3.6	0.102	103	227
25	**18.5**		**M3AA**	**180 M**	3GAA	182 121-•••CG2	1775	92.4	92.4	92.4	0.84	29.5	7.7	100	3.0	3.1	0.161	124	273
30	**22**		**M3AA**	**180 L**	3GAA	182 122-•••CG2	1780	92.4	92.4	92.4	0.83	35	9.1	118	3.4	3.8	0.225	161	354
40	**30**		**M3AA**	**200 MLB**	3GAA	202 021-•••CG2	1780	93.0	93.0	93.0	0.83	48.5	9.2	161	4.1	3.4	0.34	205	451
50	**37**		**M3AA**	**225 SMB**	3GAA	222 021-•••CG2	1785	93.0	93.0	93.0	0.84	59	9.1	198	3.9	3.3	0.37	215	473
60	**45**		**M3AA**	**225 SMC**	3GAA	222 022-•••CG2	1780	93.6	93.6	93.6	0.86	69	9.1	241	3.9	3.5	0.49	265	583
75	**55**	[3]	**M3AA**	**225 SMD**	3GAA	222 023-•••CG2	1785	94.1	94.1	94.1	0.86	85	9.9	295	4.5	3.7	0.56	290	638
75	**55**		**M3AA**	**250 SMB**	3GAA	252 021-•••CG2	1780	94.1	94.1	94.1	0.86	85	8.5	295	3.2	3.4	0.88	335	737
100	**75**	[3]	**M3AA**	**250 SMC**	3GAA	252 022-•••CG2	1785	94.5	94.5	94.5	0.84	117	9.8	402	3.2	3.4	0.95	360	792
100	**75**		**M3AA**	**280 SMB**	3GAA	282 021-•••CG2	1785	94.5	94.5	94.5	0.84	117	9.8	402	3.2	3.4	0.95	405	891

The bullets in the product indicate:

Mounting arrangement

A = Foot-mounted motor
B = Flange-mounted motor.
Large flange with clearance holes.
C = Flange-mounted motor.
Small flange with tapped holes.

Voltage and frequency code

Frame size	Code S
63 - 100	200-240 VD 50 Hz
	380-420 VY 50 Hz
	440-480 VY 60 Hz
	Code D
112 - 132	380-420 VD 50 Hz
	440-480 VD 60 Hz
	660-690 VY 50 Hz

Frame size	Code D
160-280	380 VD 50 Hz
	400 VD 50 Hz
	415 VD 50 Hz
	660 VY 50 Hz
	690 VY 50 Hz
	460 VD 60 Hz

Other voltages on request.

Global motor fulfilling EFF1, CSA-EEV and EPAct certification requirements CC031A.

[1] NEMA nominal efficiency according to IEEE112.

[2] EPAct classification is valid for motors from 1HP to 200 HP.

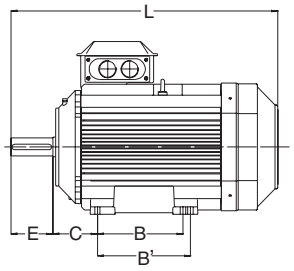
[3] High output designs are non-CENELEC harmonized.

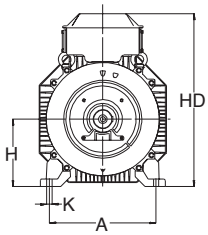
Motor size		160	180	200	225	250	280
Stator	Material	Die-cast aluminum alloy.		Extruded aluminum alloy.			
	Paint color shade	Munsell blue 8B 4.5/3.25 / NCS 4822-B05G.					
	Paint	Polyester powder paint, ≥ 50 mm.					
Feet		Aluminum alloy, integrated with stator.		Aluminum alloy, bolted to the stator. Size 250, 2p cast iron.			Cast iron
Bearing end shields	Material	Die-cast aluminum alloy.	Flanged bearing end shields of cast iron, other die-cast aluminum alloy				Cast iron
	Paint color shade	Munsell blue 8B 4.5/3.25 / NCS 4822-B05G. ≥ 50 mm.					
	Paint	Polyester powder paint, ≥ 50 mm.					
Bearings	D-end	6309-2Z/C3	6310-2Z/C3	6312/C3	6313/C3	6315/C3	6316/C3 [1)]
	N-end	6209-2Z/C3	6209-2Z/C3	6210/C3	6212/C3	6213/C3	6213/C3
		[1)] 6315/C3 for 2-pole motor					
Axially-locked bearings	Inner bearing cover	D-end					
Bearing seals	D-end	V-ring.		Outer and inner V-rings.			
	N-end	Labyrinth seal.		Outer and inner V-rings.			
Lubrication		Permanent grease lubrication.		Regreasable bearings.			
		Grease for bearing temperatures -40 to +160°C.		Grease for bearing temperatures -40 to +150°C.			
Terminal box	Material	Die-cast aluminum alloy.		Deep-drawn steel sheet, bolted to stator.			
		Base integrated with stator.					
	Surface treatment	Similar to stator.		Phosphated. Polyester paint.			
	Screws	Steel 5G. Galvanised.					
Connections	Knock-out openings	2 x (2 x M40 + M16)					
	Flange-openings			2 x FL 13.2 x M40 2 x FL 21.2 x M63 voltage code S			2 x FL21, 2 x M63, 1 x M16
	Terminal box	Cable lugs, 6 terminals.					
	Screws	M6		M10			
	Max Cu-area, mm^2	35		70			
Fan	Material	Polypropylene. Reinforced with 20% glass fibre.					
Fan cover	Material	Steel sheet.					
		Phosphated. Polyester paint.					
Stator winding	Material	Copper					
	Impregnation	Polyester vanish. Tropicalised.					
	Insulation class	Insulation class F. Temperature rise class B, unless otherwise stated.					
	Winding protection	Optional.		PTC-thermistors, 150°C			
Rotor winding	Material	Die-cast aluminum.					
Balancing method		Half key balancing.					
Key way		Closed key way					
Heating elements		25 W	50 W				
Drain holes		Drain holes with closable plastic plugs. Open on delivery.					
Enclosure		IP 55					
Cooling method		IC 411					

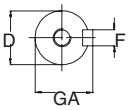
Global motors

Dimension drawings

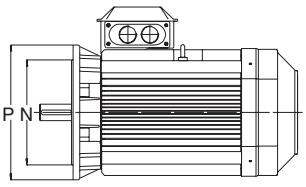
Foot-mounted motor IM 1001 / B3

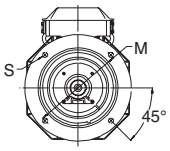


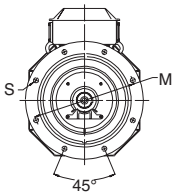




Flange-mounted motor IM 3001 / B5







Motor size		IM 1001, IM B3 AND IM 3001, IM B5										IM 1001, IM B3							IM 3001, IM B5			
		D		GA		F		E		L max												
		poles		poles		poles		poles		poles												
		2	4	2	4	2	4	2	4	2	4	A	B	B'	C	H	HD	K	M	N	P	S
63		11	11	12.5	12.5	4	4	23	23	205	205	100	80	–	40	63	171	7	115	95	140	10
71		14	14	16	16	5	5	30	30	238	238	112	90	–	45	71	176	7	130	110	160	10
80		19	19	21.5	21.5	6	6	40	40	265	265	125	100	–	50	80	190	10	165	130	200	12
90		24	24	27	27	8	8	50	50	320	320	140	125		56	90	212	10	165	130	200	12
100		28	28	31	31	8	8	60	60	358.5	358.5	160	140		63	100	236	12	215	180	250	15
112		28	28	31	31	8	8	60	60	388	388	190	140	–	70	112	258	12	215	180	250	14.5
132	**SA**	38	38	41	41	10	10	80	80	447	447	216	140	178	89	132	295.5	12	265	230	300	14.5
132	**SB, M**	38	38	41	41	10	10	80	80	481.5	481.5	216	140	178	89	132	295.5	12	265	230	300	14.5
160		42	42	45	45	12	12	110	110	602.5	602.5	254	210	254	108	160	370	15	300	250	350	19
180	**M**	48	48	51.5	51.5	14	14	110	110	680	680	279	241	279	121	180	405	15	300	250	350	19
180	**L**	48	48	51.5	51.5	14	14	110	110	700.5	700.5	279	241	279	121	180	405	15	300	250	350	19
200		55	55	59	59	16	16	110	110	774	774	318	267	305	133	200	533	18	350	300	400	19
225	**SMB, SMC**	55	60	59	64	16	18	110	140	836	866	356	286	311	149	225	578	18	400	350	450	19
225	**SMD**	55	60	59	64	16	18	110	140	861	891	356	286	311	149	225	578	18	400	350	450	19
250	**SMB**	60	65	64	69	18	18	140	140	875	875	406	311	349	168	250	626	22	500	450	550	19
250	**SMC**	60	65	64	69	18	18	140	140	900	900	406	311	349	168	250	626	22	500	450	550	19
280		65	75	69	79.5	18	20	140	140	900	900	457	368	419	190	280	656	24	500	450	550	19

IM 3601, IM B14

Motor size	M	N	P	S
63	75	60	90	M5
71	85	70	105	M6
80	100	80	120	M6
90	115	95	140	M8
100	130	110	160	M8
112	130	130	160	M8
132	165	165	200	M10

Tolerances:

A, B	± 0.8
D, DA	ISO k6 < Ø 50 mm
	ISO m6 > Ø 50 mm
F, FA	ISO h9
H	+ 0 -0.5
N	ISO j6
C, CA	± 0.8

Above table gives main dimensions in mm.

For detailed drawings please check our web site 'www.abb.com/motors&drives' or contact ABB.

It’s the details that make the difference

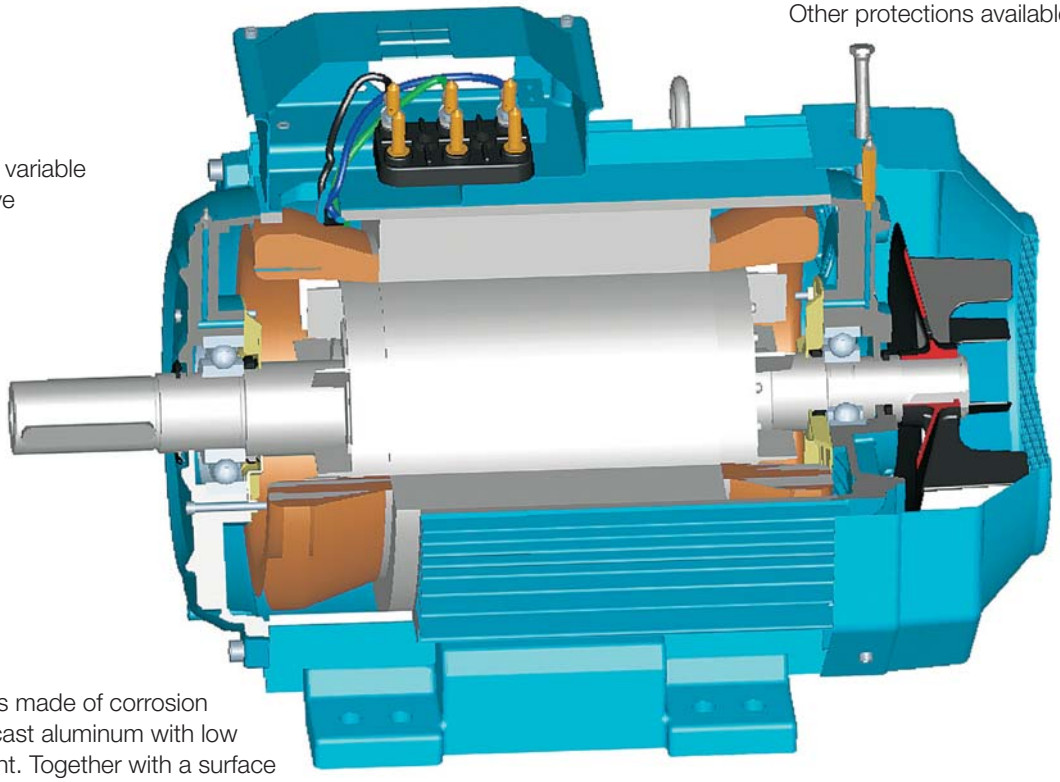
■ Designed, certified and labeled to meet the safety requirements according to CE, UL/UR and CSA, and the efficiency requirements according to CE, EFF1, EPAct and CSA/EEV.

■ Terminal box with 6 lead terminal board, the winding can be connected in either D or Y configuration. The terminal box has plenty of space and is designed for easy and secure installation.

■ Degree of protection/Enclosure: IP 55/Totally enclosed (TEFC) WaterProof Motor
- Protected against Dust/Limited ingress permitted (no harmful deposit)
- Protected against low pressure jets of water from all directions/Limited ingress permitted.

Other protections available on request.

■ Suitable for variable frequency drive applications.

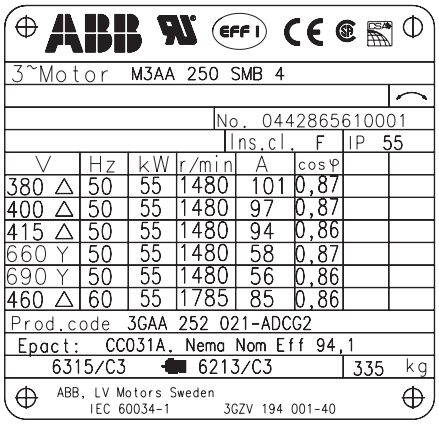


■ The frame is made of corrosion resistant die-cast aluminum with low copper content. Together with a surface treatment and final powder painting with Epoxy/Polyester powder, it gives a very high corrosion protection suitable for industrial applications, indoors and outdoors.

■ Reliable grease-lubricated ball bearings with C3 clearance as standard, designed for low running temperature and long service life.

■ Made by ABB according to the highest quality standards.

Rating plate example



3~Motor M3AA 250 SMB 4

No. 0442865610001

Ins.cl. F IP 55

V	Hz	kW	r/min	A	cosφ
380 Δ	50	55	1480	101	0,87
400 Δ	50	55	1480	97	0,87
415 Δ	50	55	1480	94	0,86
660 Y	50	55	1480	58	0,87
690 Y	50	55	1480	56	0,86
460 Δ	60	55	1785	85	0,86

Prod.code 3GAA 252 021-ADCG2

Epact: CC031A. Nema Nom Eff 94,1

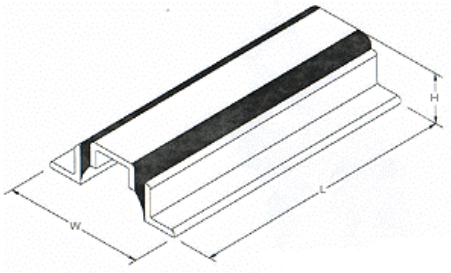
6315/C3 — 6213/C3 335 kg

ABB, LV Motors Sweden
IEC 60034-1 3GZV 194 001-40

VibraSystems Inc.

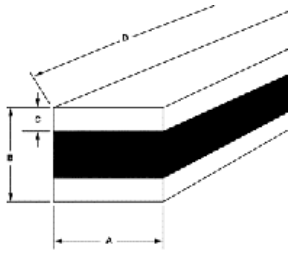
FSM / SM Series
SANDWICH MOUNTS

VibraSystems channel mounts, type FSM, are versatile anti-vibration bars where both the top C channel and bottom angle flanges are accessible from both sides. This configuration allows the top and bottom plates to be drilled anywhere along their length for ease of installation. The plates are bonded together with neoprene elements, which allow up to 3/8" deflection at the maximum load of 50 psi.. Available in standard or custom-made lengths.



Product Code	Dimensions (ins)			Max Load (lbs)	Max Load (lbs / inch)
	L	W	H		
FSM-4	4	4-1/2	1-5/16	200	50
FSM-6	6	4-1/2	1-5/16	300	50
FSM-12	12	4-1/2	1-5/16	600	50
FSM-40	40	4-1/2	1-5/16	2000	50

VibraSystems type SM Sandwich Bars consist of two metal plates bonded with a neoprene insert. SM mounts effectively isolates against horizontal and vertical shock and vibration. SM mounts can be made in custom lengths up to 48" and also in custom widths and thickness. Threaded holes in the metal plates can be supplied on special orders.



Product Code	Dimensions (ins)				Max Load (lbs)
	A	B	C	D	
SM-1-(D)	2	1-3/4	3/8	2, 4, 6, 12, 40	800/1"
SM-2-(D)	3	2	3/8	3, 6, 12, 40	1100/1"
SM-3-(D)	4	2-3/8	5/8	4, 8, 12, 40	1400/1"

FEATURES:

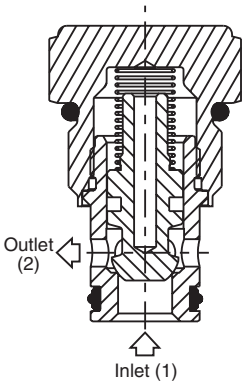
- **Low installation height provides good stability**
- **Effectively isolates against horizontal and vertical vibration and shock**
- **High deflection in the horizontal plane while vertical deflection is low**
- **Resistant to oil and grease**
- **Strong, reliable construction provides long life**
- **Increases machine accuracy and extends life of machinery and tools**

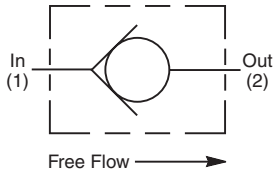
General Description

Cartridge Style Check Valve. For additional information see Technical Tips on pages CV1-CV4.

Features

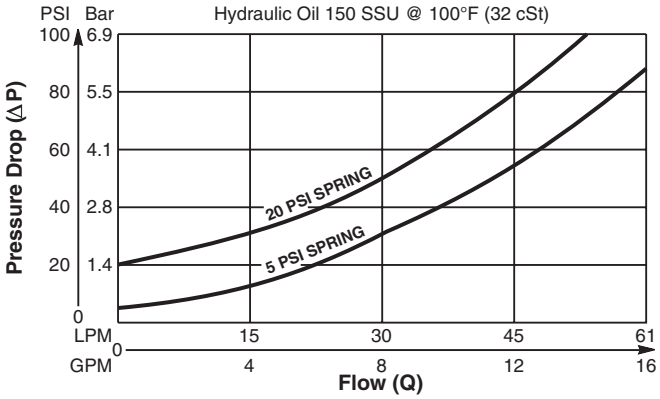
- Spherical poppet for low leakage
- "D"-Ring eliminates back-up rings
- Dual sense paths for reduced ΔP
- All external parts zinc plated



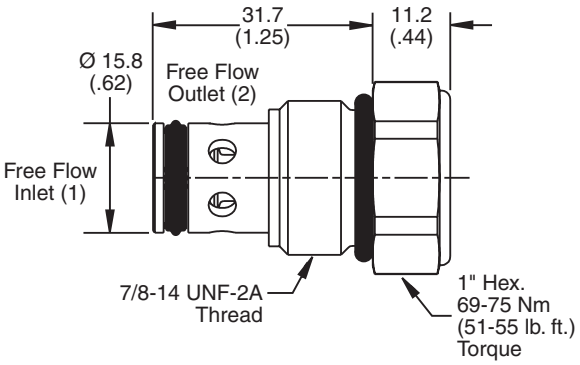


Performance Curve

Pressure Drop vs. Flow (Through cartridge only)



Dimensions Millimeters (Inches)



Specifications

Rated Flow	60 LPM (16 GPM)
Maximum Inlet Pressure	350 Bar (5000 PSI)
Leakage at 150 SSU (32 cSt)	2 drops/min. (.13 cc/min.) at 350 Bar (5000 PSI)
Cartridge Material	All parts steel. All operating parts hardened steel.
Operating Temp. Range/Seals	-45°C to +93.3°C ("D" Ring) (-50°F to +200°F) -31.7°C to +121.1°C (Fluorocarbon) (-25°F to +250°F)
Fluid Compatibility/ Viscosity	Mineral-based or synthetic with lubricating properties at viscosities of 45 to 2000 SSU (6 to 420 cSt)
Filtration	ISO code 16/13, SAE Class 4 or better
Approx. Weight	.09 kg (0.2 lbs.)
Cavity	C10-2 (See BC Section for more details)
Form Tool	Rougher None Finisher NFT10-2F

Ordering Information

CVH103P			—		
10 Size Check Valve	Cracking Pressure	Seals		Body Material	Port Size

Code	Cracking Pressure
Omit	0.3 Bar (5 PSI)
20	1.4 Bar (20 PSI)
50	3.5 Bar (50 PSI)
65	4.5 Bar (65 PSI)
80	5.5 Bar (80 PSI)
100	6.9 Bar (100 PSI)

Code	Seals / Kit No.
Omit	"D"-Ring / (SK10-2)
N	Nitrile / (SK10-2N)
V	Fluorocarbon / (SK10-2V)

Code	Body Material
Omit	Steel
A	Aluminum

Code	Port Size	Body Part No.
Omit	Cartridge Only	
4P	1/4″ NPTF	(B10-2-*4P)
6P	3/8″ NPTF	(B10-2-*6P)
8P	1/2″ NPTF	(B10-2-*8P)
6T	SAE-6	(B10-2-*6T)
T6T	SAE-6	(B10-2-T6T)†
8T	SAE-8	(B10-2-*8T)
T8T	SAE-8	(B10-2-T8T)†
6B	3/8″ BSPG	(B10-2-6B)†

**** Add "A" for aluminum, omit for steel.***
† Steel body only.

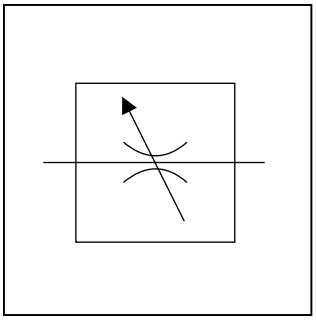
General Description

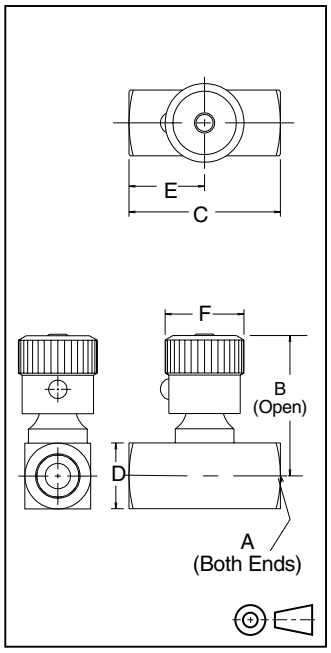
Series PN Needle Valves provide excellent speed control for pneumatic and hydraulic applications where a reverse flow check is not required.

ParTrol valves are standard with a two step needle. Fine metering is accomplished over the first adjustment turns and nominal metering is provided over the last turns. Once the desired flow is selected, a set screw can be tightened to hold the setting.

These valves are available with NPTF ports in 1/8", 1/4", 3/8" and 1/2" sizes. Additionally, SAE ported valves are available in SAE 6 and SAE 8.

Brass valves are recommended for pneumatic service. Steel valves are recommended for hydraulic service.





Specifications

Maximum Operating Pressure	Brass (ASTM B-16), 138 Bar (2000 PSI) Steel* (ASTM 12L14), 345 Bar (5000 PSI)
Component Materials	Needle (ASTM 416), Stainless Steel Needle Seals: Standard — Nitrile Optional — Fluorocarbon Knob (ASTM 2024-T351), Aluminum
Cracking pressure for return check poppet	.35 Bar (5 PSI) Nominal

* Steel valves are zinc plated and sealed with clear dichromate.

Performance Data

Model Number	Controlled Flow Needle Full Open		
	Flow @ 100 PSI ΔP GPM	C_V Hyd.	Area Sq. Inches
PN200	2.0	.16	.006
PN400	4.0	.35	.013
PN620	4.0	.35	.013
PN600	6.5	.60	.023
PN820	6.5	.60	.023
PN800	11.0	1.00	.038

Ordering Information

PN — ParTrol Needle Valve

Size

Code	Description
200**	1/8 NPTF
400	1/4 NPTF
620*	9/16 - UNF (SAE 6)
600	3/8 NPTF
820*	3/4 - 16 UNF (SAE 8)
800	1/2 NPTF

* SAEs Available Only in Steel
** 200 Size Available Only in Brass

Material

Code	Description
B	Brass
S	Steel
SS*	Stainless

* For sizes 400, 600 and 800 only.

Needle Option

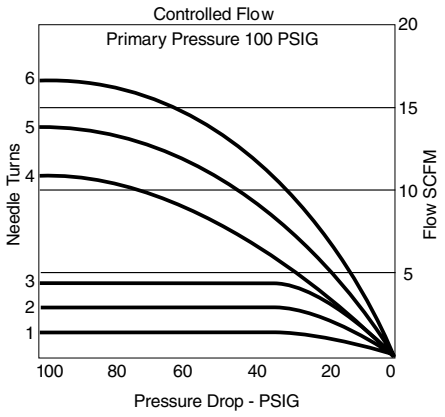
Code	Description
Omit	Standard
4	Fine

Needle Seals

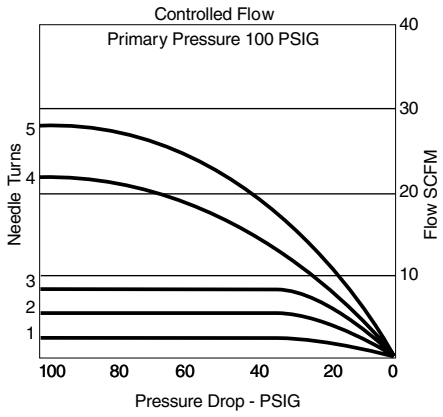
Code	Type
Omit	Nitrile
V	Fluorocarbon

Performance Curves

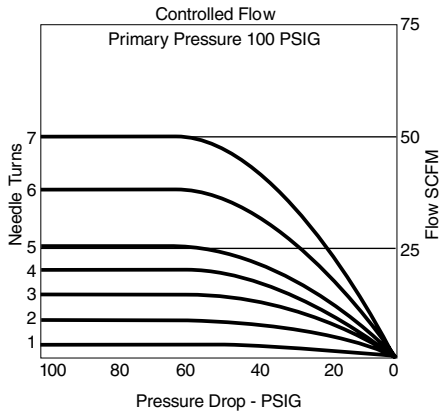
1/8" NPT Port
Pneumatic Flow Data



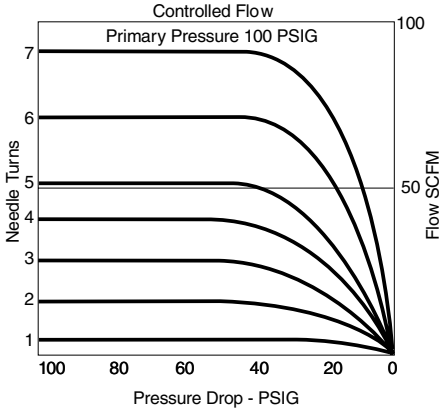
1/4" NPT Port
Pneumatic Flow Data



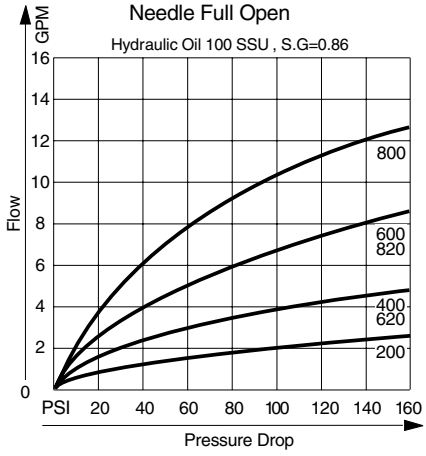
3/8" NPT Port
Pneumatic Flow Data



1/2" NPT Port
Pneumatic Flow Data



1/8 " - 1/2" Ports
Hydraulic Data
Controlled Flow
Needle Full Open



Dimensions

Model Number	A Port Size	B	C	D	E	F
PN200	1/8-27 NPTF	1.50	1.50	.625	.75	.75
PN400	1/4-18 NPTF	1.80	2.00	.812	1.00	.81
PN620	9/16-18 UNF (SAE 6)	1.80	2.00	1.000	1.00	.81
PN600	3/8-18 NPTF	2.25	2.25	1.000	1.13	1.00
PN820	3/4-16 UNF (SAE 8)	2.25	2.25	1.125	1.13	1.00
PN800	1/2-14 NPTF	2.72	2.62	1.250	1.31	1.19

G

PPC | Process Gauge

1. Optional Hinged Case
2. Optional Flush Mounting Ring

RoHS compliant

Note: RoHS applies only to SS internals version

Description & Features:

- Field liquid-fillable, phenolic solid front blowout back safety case
- ±0.5% accuracy
- Stainless steel full rotary movement for longer life
- Micrometer pointer for ease in calibration
- Under and overload stops
- 316L stainless steel, brass, Monel® or carbon steel wetted parts
- Restrictor screws standard on dual scale (optional on single scale gauges)
- CRN registered
- 5 year warranty

Applications:

- Used where operator safety is a must
- Ideally suited for process, chemical and petroleum industries
- Highly corrosive media

Specifications	Stainless Steel Internals	Brass Internals
Dial	4.5" (115mm) white aluminum with black and red markings	4.5" (115mm) white aluminum with black and red markings
Case	Black phenolic with safety blowout back, solid front, integral back flange	Black phenolic with safety blowout back, solid front, integral back flange
Solid Wall	Phenolic	Phenolic
Lens	Polycarbonate	Polycarbonate
Ring	Phenolic	Phenolic
Pointer	Aluminum, anodized black, micrometer adjustable	Aluminum, anodized black, micrometer adjustable
Socket	316L SS	OT 58 brass
Connection	¼" NPT or ½" NPT standard, bottom	¼" NPT or ½" NPT standard, bottom
Bourdon Tube	316L SS, drawn seamless	Phosphor bronze
Movement	304 SS with over/under stops	304 SS with over/under stops
Gasket Materials	Silicone	Silicone
Welding	TIG	Silver alloy
Over-pressure Limit	25% for pressures up to 1500 psi/kPa, 15% for pressures 1501 to 8700 psi/kPa, 10% for pressures above 8701 psi/kPa	25% for pressures up to 1500 psi/kPa, 15% for pressures 1501 to 8700 psi/kPa, 10% for pressures above 8701 psi/kPa
Working Pressure	Maximum 75% of full scale value	Maximum 75% of full scale value
Ambient/Process Temperature	-40°F to 200°F (-40°C to 93°C) dry / -4°F to 150°F (-20°C to 65°C) glycerin-filled	-40°F to 200°F (-40°C to 93°C) dry / -4°F to 150°F (-20°C to 65°C) glycerin-filled
Accuracy	±0.5% ANSI/ASME Grade 2A	±0.5% ANSI/ASME Grade 2A
Enclosure Rating	IP65	IP65

Monel® is a registered trademark of Inco Alloys International

Single Scale Order Codes (products in bold are normally in stock)

Connection	¼" Bottom	¼" Back (LB)	½" Bottom	½" Back (LB)
Socket, Tube	SS	SS	SS	SS
30" Hg Vacuum	**PPC5040R1**	PPC5340R1	**PPC5060R1**	PPC5460R1
30"-0-15 psi	PPC5130R1	PPC5330R1	**PPC5140R1**	PPC5440R1
30"-0-30 psi	PPC5131R1	PPC5331R1	**PPC5141R1**	PPC5441R1
30"-0-60 psi	PPC5132R1	PPC5332R1	PPC5142R1	PPC5442R1
30"-0-100 psi	PPC5133R1	PPC5333R1	**PPC5143R1**	PPC5443R1
30"-0-160 psi	PPC5134R1	PPC5334R1	**PPC5144R1**	PPC5444R1
30"-0-200 psi	PPC5135R1	PPC5335R1	PPC5145R1	PPC5445R1
30"-0-300 psi	PPC5136R1	PPC5336R1	PPC5146R1	PPC5446R1
0-15 psi	**PPC5041R1**	PPC5341R1	**PPC5061R1**	PPC5461R1
0-30 psi	PPC5042R1	PPC5342R1	**PPC5062R1**	PPC5462R1
0-60 psi	**PPC5043R1**	PPC5343R1	**PPC5063R1**	PPC5463R1
0-100 psi	**PPC5044R1**	PPC5344R1	**PPC5064R1**	PPC5464R1
0-160 psi	**PPC5045R1**	PPC5345R1	**PPC5065R1**	PPC5465R1
0-200 psi	**PPC5046R1**	PPC5346R1	**PPC5066R1**	PPC5466R1
0-300 psi	**PPC5047R1**	PPC5347R1	**PPC5067R1**	PPC5467R1
0-400 psi	**PPC5048R1**	PPC5348R1	**PPC5068R1**	PPC5468R1
0-600 psi	**PPC5049R1**	PPC5349R1	**PPC5069R1**	PPC5469R1
0-1,000 psi	**PPC5050R1**	PPC5350R1	**PPC5070R1**	PPC5470R1
0-1,500 psi	PPC5051R1	PPC5351R1	**PPC5071R1**	PPC5471R1
0-2,000 psi	PPC5052R1	PPC5352R1	**PPC5072R1**	PPC5472R1
0-3,000 psi	**PPC5053R1**	PPC5353R1	**PPC5073R1**	PPC5473R1
0-5,000 psi	PPC5054R1	PPC5354R1	**PPC5074R1**	PPC5474R1
0-10,000 psi	PPC5055R1	PPC5355R1	**PPC5075R1**	PPC5475R1
0-15,000 psi	PPC5056R1	PPC5356R1	PPC5076R1	PPC5476R1
0-20,000 psi	PPC5057R1	PPC5357R1	PPC5077R1	PPC5477R1

Note: Restrictor screws are not standard on single scale gauges

Other ranges and connection sizes available upon request. For scale change, refer to How to Order Guide for scale codes.

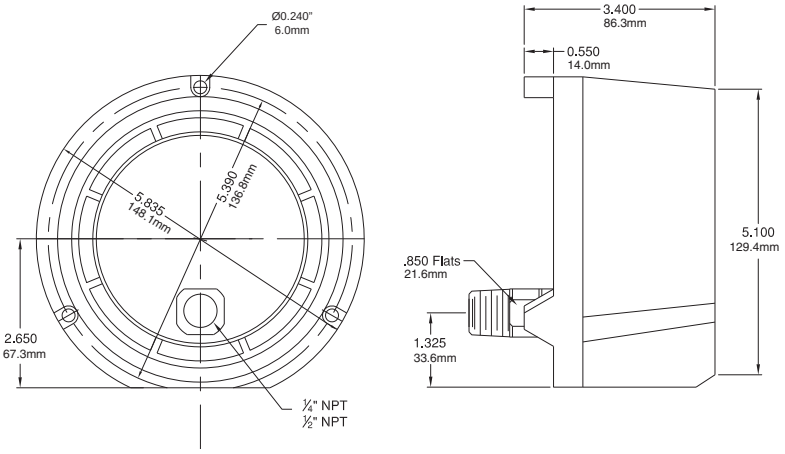
Option suffix:

6HCS = 6" Solid front hinged case (back connection only)
CS = Carbon steel socket
FMR = Flush mounting ring
G = Glycerin (bottom connect only)
HCSF = Solid front hinged case (back connection only)
MS = Monel® tube and socket
SG-45 = Safety glass
SF45 = Silicone fill
REST = Restrictor Screw

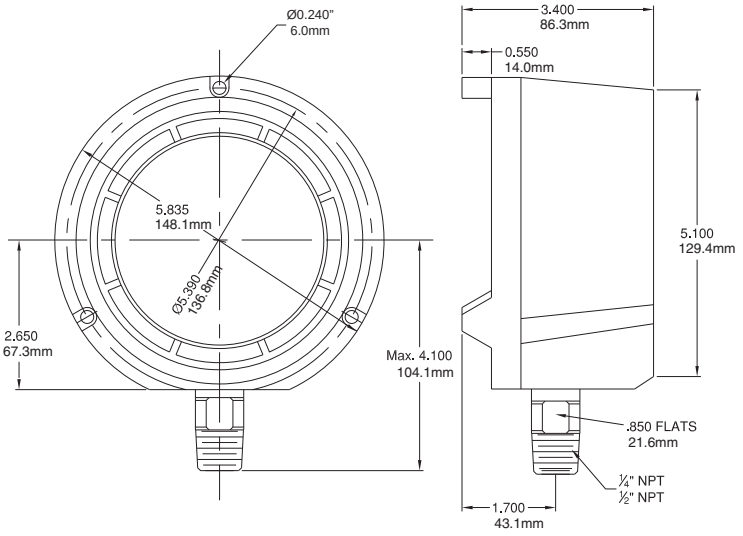
Dual Scale Order Codes (products in bold are normally in stock)

Connection	¼" Bottom	¼" Back (LB)	½" Bottom	½" Back (LB)	¼" Bottom	¼" Back (LB)	½" Bottom	½" Back (LB)
Socket, Tube	SS	SS	SS	SS	Brass	Brass	Brass	Brass
30" Hg Vacuum/kPa	**PPC5040**	PPC5340	**PPC5060**	PPC5460	**PPC5080**	PPC5280	**-**	-
30"-0-15 psi/kPa	PPC5130	PPC5330	**PPC5140**	PPC5440	PPC5120	PPC5220	-	-
30"-0-30 psi/kPa	**PPC5131**	PPC5331	PPC5141	PPC5441	PPC5121	PPC5221	-	-
30"-0-60 psi/kPa	PPC5132	PPC5332	PPC5142	PPC5442	PPC5122	PPC5222	-	-
30"-0-100 psi/kPa	**PPC5133**	PPC5333	PPC5143	PPC5443	PPC5123	PPC5223	-	-
30"-0-160 psi/kPa	**PPC5134**	PPC5334	PPC5144	PPC5444	PPC5124	PPC5224	-	-
30"-0-200 psi/kPa	PPC5135	PPC5335	PPC5145	PPC5445	PPC5125	PPC5225	-	-
30"-0-300 psi/kPa	PPC5136	PPC5336	PPC5146	PPC5446	PPC5126	PPC5226	-	-
0-15 psi/kPa	**PPC5041**	PPC5341	**PPC5061**	PPC5461	**PPC5081**	PPC5281	**-**	-
0-30 psi/kPa	**PPC5042**	PPC5342	**PPC5062**	PPC5462	**PPC5082**	PPC5282	**-**	-
0-60 psi/kPa	**PPC5043**	PPC5343	**PPC5063**	PPC5463	**PPC5083**	PPC5283	**-**	-
0-100 psi/kPa	**PPC5044**	PPC5344	**PPC5064**	**PPC5464**	**PPC5084**	PPC5284	**-**	-
0-160 psi/kPa	**PPC5045**	PPC5345	**PPC5065**	PPC5465	**PPC5085**	PPC5285	**-**	-
0-200 psi/kPa	**PPC5046**	**PPC5346**	**PPC5066**	PPC5466	**PPC5086**	PPC5286	**-**	-
0-300 psi/kPa	**PPC5047**	PPC5347	**PPC5067**	PPC5467	**PPC5087**	**PPC5287**	**-**	**-**
0-400 psi/kPa	**PPC5048**	PPC5348	**PPC5068**	PPC5468	**PPC5088**	**PPC5288**	**-**	**-**
0-600 psi/kPa	**PPC5049**	**PPC5349**	**PPC5069**	PPC5469	**PPC5089**	**PPC5289**	**-**	**-**
0-1,000 psi/kPa	PPC5050	PPC5350	**PPC5070**	PPC5470	PPC5098	PPC5298	**PPC5090**	PPC5290
0-1,500 psi/kPa	PPC5051	PPC5351	**PPC5071**	PPC5471	-	-	PPC5091	PPC5291
0-2,000 psi/kPa	**PPC5052**	PPC5352	**PPC5072**	PPC5472	-	-	PPC5092	PPC5292
0-3,000 psi/kPa	PPC5053	PPC5353	**PPC5073**	PPC5473	-	-	PPC5093	PPC5293
0-5,000 psi/kPa	**PPC5054**	PPC5354	**PPC5074**	PPC5474	**-**	-	**PPC5094**	PPC5294
0-10,000 psi/kPa	PPC5055	PPC5355	PPC5075	PPC5475	-	-	PPC5095	PPC5295
0-15,000 psi/kPa	PPC5056	PPC5356	PPC5076	PPC5476	-	-	PPC5096	PPC5296
0-20,000 psi/kPa	PPC5057	PPC5357	PPC5077	PPC5477	-	-	PPC5097	PPC5297

4.5” Back Connection



4.5” Bottom Connection



General Description

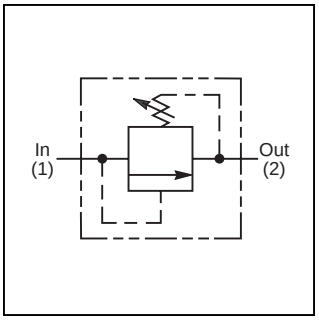
The RAH101 Series, Pilot Operated, Spool-Type Relief Valves are suited for continuous duty applications and are primarily used to limit main system pressure.

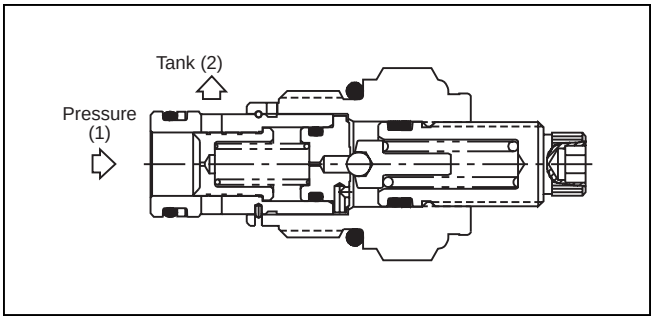
Operation

When inlet pressure exceeds the valve setting, the pilot section opens. This pilot flow creates a pressure imbalance across the main section causing the valve to open, permitting relief flow to tank.

Features

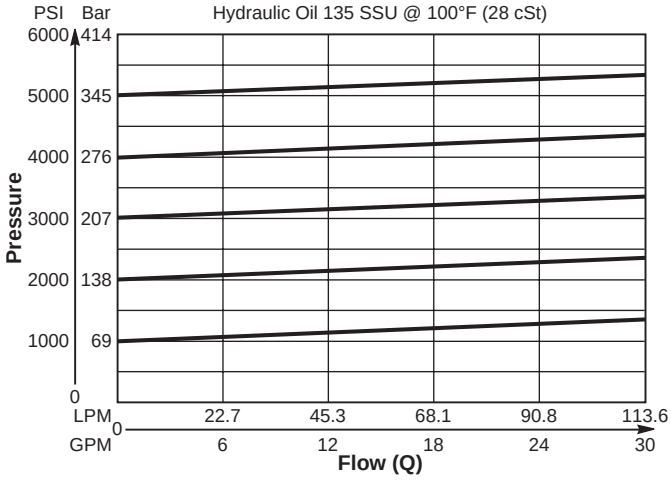
- Low override curve
- Ball-type pilot for added stability
- High accuracy - pilot operated design
- Hardened, precision ground parts for durability
- Compact size for reduced space requirements
- All external parts have yellow zinc dichromate. This coating allows them to withstand a 200 hour salt spray test.





Performance Curve

Flow vs. Inlet Pressure
(Pressure rise through cartridge only)

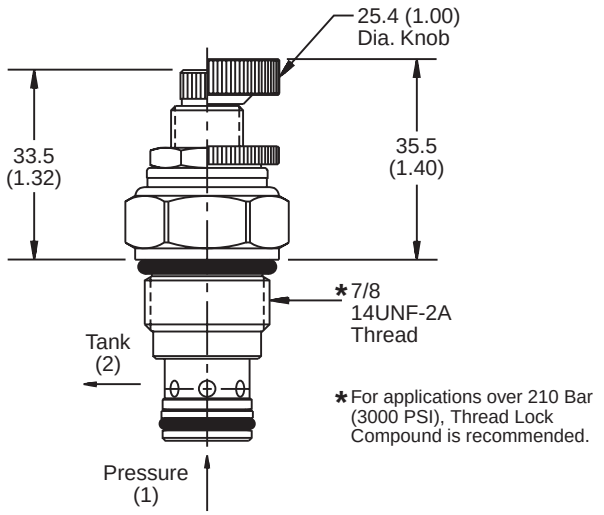


Specifications

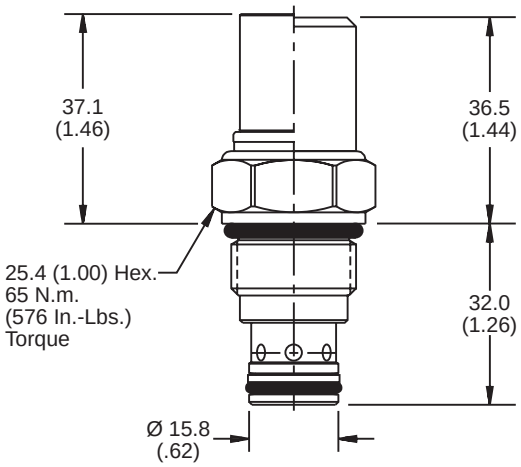
Rated Flow	112.5 LPM (30 GPM)
Maximum Inlet Pressure	380 Bar (5500 PSI) - Steel 210 Bar (3000 PSI) - Aluminum
Maximum Setting Pressure	345 Bar (5000 PSI) - Steel 210 Bar (3000 PSI) - Aluminum
Reseat Pressure (Valve returns to non-relieving mode)	80% of crack pressure
Operating Temp. Range (Ambient)	-40°C to +93.3°C (Nitrile) (-40°F to +200°F) -31.7°C to +121.1°C (Fluorocarbon) (-25°F to +250°F)
Cartridge Material	All parts steel. All operating parts hardened steel.
Body Material	Steel or Aluminum
Filtration	ISO Code 16/13, SAE Class 4 or better
Mounting	No restrictions
Cavity	Common Cavity No. C10-2

*Inch equivalents for millimeter dimensions are shown in (**)

Cartridge Only

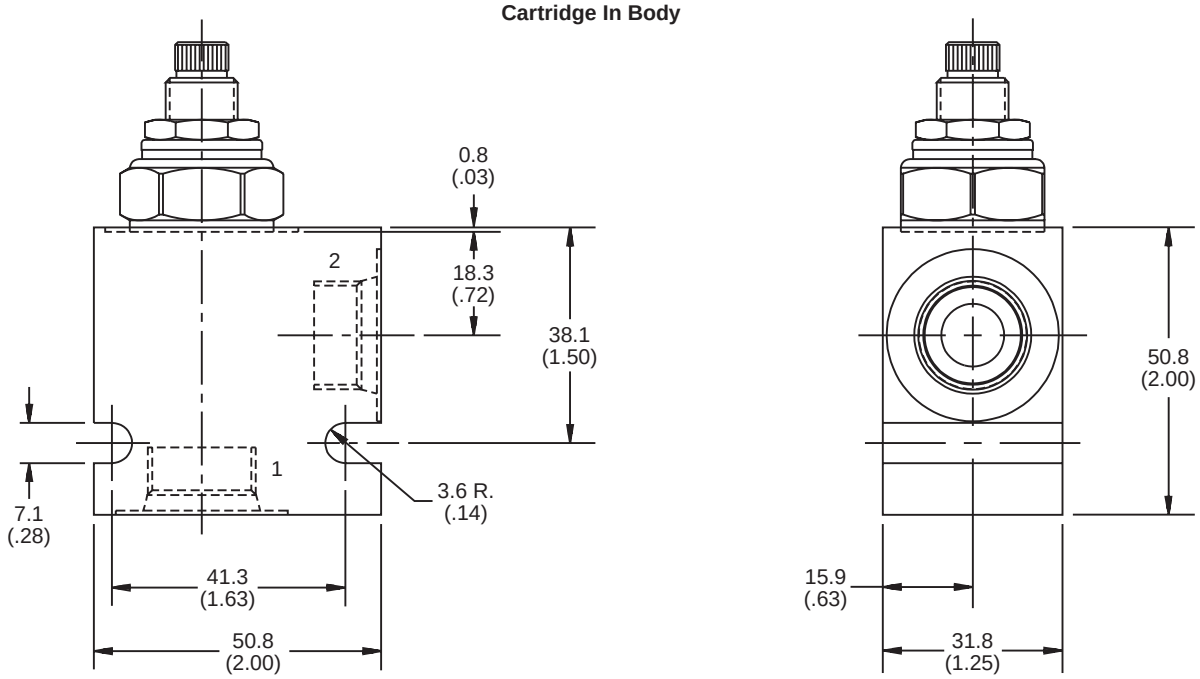


Screw/Knob Version



Fixed Cap/Tamper Resistant Version

Cartridge In Body



Note: Static pressure in Port 2 to be 210 Bar (3000 PSI) maximum.

THIRD-ANGLE PROJECTION

rah101.pm6.5, bl, lk

RAH	10	1					—	
5000 PSI Design Pilot Operated Relief Valve	Size	Style	Adjustment Style	Pressure Range	Optional Pressure Setting	Seals		Body Option

7/8-14UNF-2B Threaded Cavity with .62″ Dia. Seat

Code	Style
1	Pilot Operated Spool - Type

Code	Type
Omit	Nitrile
V	Fluorocarbon

Description
Pressure ÷ 10 i.e. 16.2 = 162 Bar (235 = 2350 PSI) Setting Range: 6.9 to 345 Bar (100 to 5000 PSI) All settings at 11.3 LPM (3 GPM)

Code	Type
F	Fixed style, preset at factory. Specify desired flow and pressure. i.e. 172.4 Bar (2500 PSI) @ 11.3 LPM (3 GPM). Note: For any given valve setting, any change in flow will cause a change in pressure.
K	Knob Adjust
S	Screw Adjust
T	Tamper Resistant Cap

Code	Type
10	6.9 - 69 Bar (100 - 1000 PSI) Standard Setting: 34.5 Bar (500 PSI) @ 11.3 LPM (3 GPM)
20	6.9 - 138 Bar (100 - 2000 PSI) Standard Setting: 69 Bar (1000 PSI) @ 11.3 LPM (3 GPM)
30	6.9 - 207 Bar (100 - 3000 PSI) Standard Setting: 103.5 Bar (1500 PSI) @ 11.3 LPM (3 GPM)
50	6.9 - 345 Bar (100 - 5000 PSI) Standard Setting: 172.4 Bar (2500 PSI) @ 11.3 LPM (3 GPM)

Code	Port Size & Material		
Omit	Cartridge Only		
4P	1/4″ NPTF	(B10-2-4P)	Steel
A4P	1/4″ NPTF	(B10-2-A4P)	Aluminum
6P	3/8″ NPTF	(B10-2-6P)	Steel
A6P	3/8″ NPTF	(B10-2-A6P)	Aluminum
8P	1/2″ NPTF	(B10-2-8P)	Steel
A8P	1/2″ NPTF	(B10-2-A8P)	Aluminum
6T	SAE-6	(B10-2-6T)	Steel
A6T	SAE-6	(B10-2-A6T)	Aluminum
8T	SAE-8	(B10-2-8T)	Steel
A8T	SAE-8	(B10-2-A8T)	Aluminum
4B	1/4″ BSPG	(B10-2-4B)	Steel
A4B	1/4″ BSPG	(B10-2-A4B)	Aluminum
6B	3/8″ BSPG	(B10-2-6B)	Steel
A6B	3/8″ BSPG	(B10-2-A6B)	Aluminum
8B	1/2″ BSPG	(B10-2-8B)	Steel
A8B	1/2″ BSPG	(B10-2-A8B)	Aluminum

NOTE:
If system pressure does not exceed 210 Bar (3000 PSI), aluminum bodies can be used. Higher pressures require steel bodies.

SERVICE PARTS

Knob Option: 852605 & 852634
(To convert screw adjust to knob adjust)
Nitrile Seal Kit: SK10-2
Fluorocarbon Seal Kit: SK10-2V

Shipping Weight
Cartridge Only .23 kg (.50 lbs.)
Cartridge in Body .68 kg (1.5 lbs.)

rah101.pm6.5, bl, lk

15P/30P Series

High Pressure Filters

Applications for 15P/30P Series filters

- Saw mills
- Aircraft ground support equipment
- Asphalt pavers
- Hydraulic fan drives
- Power steering circuits
- Waste trucks
- Cement trucks
- Servo control protection
- Logging equipment

These application examples have one thing in common...the need for clean hydraulic fluid.

Modern high pressure hydraulic systems are demanding. Better controls and long component life are expected. To deliver the high standards of performance, hydraulic components are built with tighter tolerances which increases their sensitivity to contamination.

That's where Parker pressure filters come into play. They filter out ingressed contamination before it jams a valve or scores a cylinder. They block pump generated debris before it gets to servo or proportional valves. Parker pressure filters are a key ingredient in meeting today's system demands.

Put your hydraulic systems in the care of Parker Hydraulic Filter Division. We are committed to designing and building the best filters available to industry.

Indicators
- Both visual auto reset style and dual indicator visual/ electrical style available to suit your application. New patented design resists false signaling due to vibration.

Straight Thread Ports
- SAE straight thread for positive sealing

Bypass Valve (not visible)
- May be blocked for critical applications

Bowl Construction
- Formed of high grade 6061 T6 aluminum
- Black anodized, corrosion resistant finish
- Knurled for easier gripping when removing and re-assembling

Hex (not visible)
- Hex formed at base of bowl for easy removal

Bowl Configurations
- Single and double length bowls available to cover a wide range of flows
- 30P available in a duplex version.

Drain Port (not visible)
- Clean and easy servicing
- Lets you drain bowl before element changes

Quality elements make the difference

The important item in a filter assembly is the element. It must capture and retain contaminants that can damage system components. At the same time it must allow flow to pass as freely as possible to perform it's function.

There are many ways to design and build an element, and it's easy to produce a low cost element. However, cost is not the only selection criteria, especially when the risk is loss of critical machine performance.

For instance, wire mesh reinforcement. Not all filter elements have it. It's used in Parker elements to keep the pleats from bunching or collapsing. If pleats bunch, the effective surface area of the element is reduced, excessive pressure drop develops, and the filter assembly may go into premature bypass mode.

There are many other features that are included standard with every quality Parker element. The table below outlines several.

O-Ring Seal
- Positive sealing for optimum element efficiency

Wire Reinforced Media
- Prevents pleat bunching
- Helps prevent media migration
- Maintains media efficiency

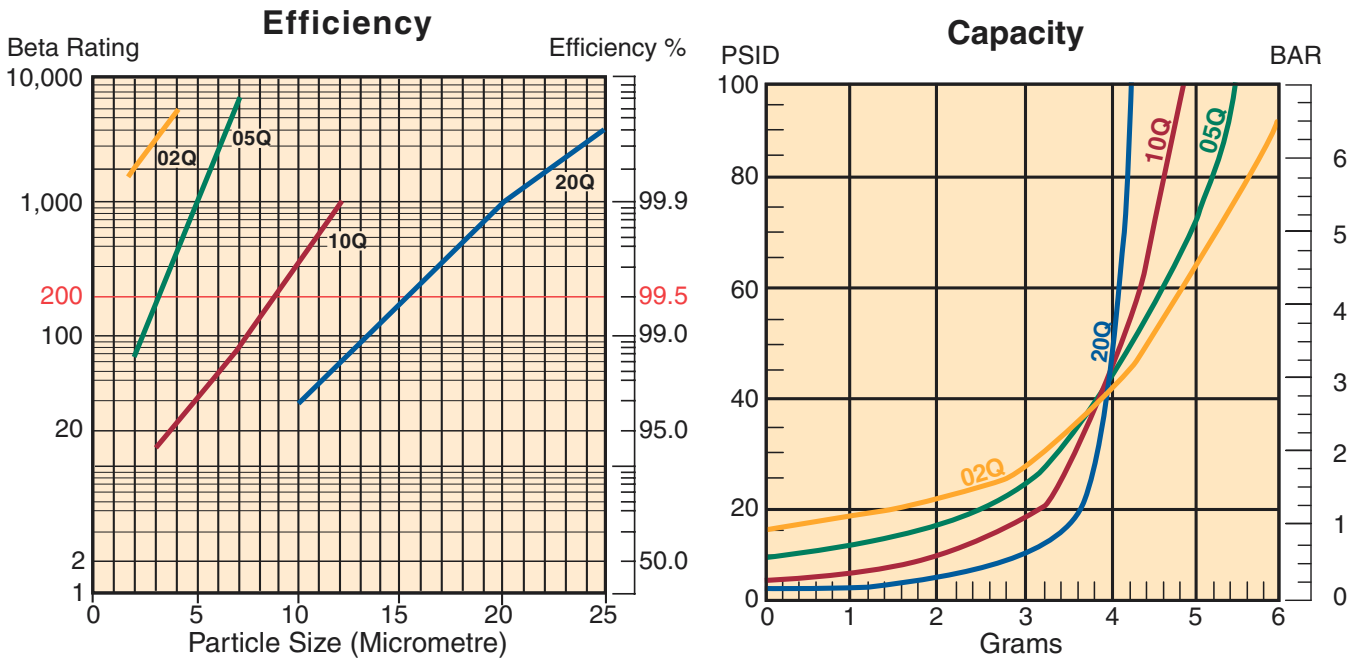
Zinc Dichromate End Caps (15P)
- Excellent corrosion protection
- Strong adhesion means no element separation

Engineered Element Design
- The right combination of pleat depth and number of pleats means lower pressure losses (longer life)
- Dirt holding capacity is maximized for less frequent element change-out

Elements for Every Application
- Standard Microglass III media for long life and excellent system protection

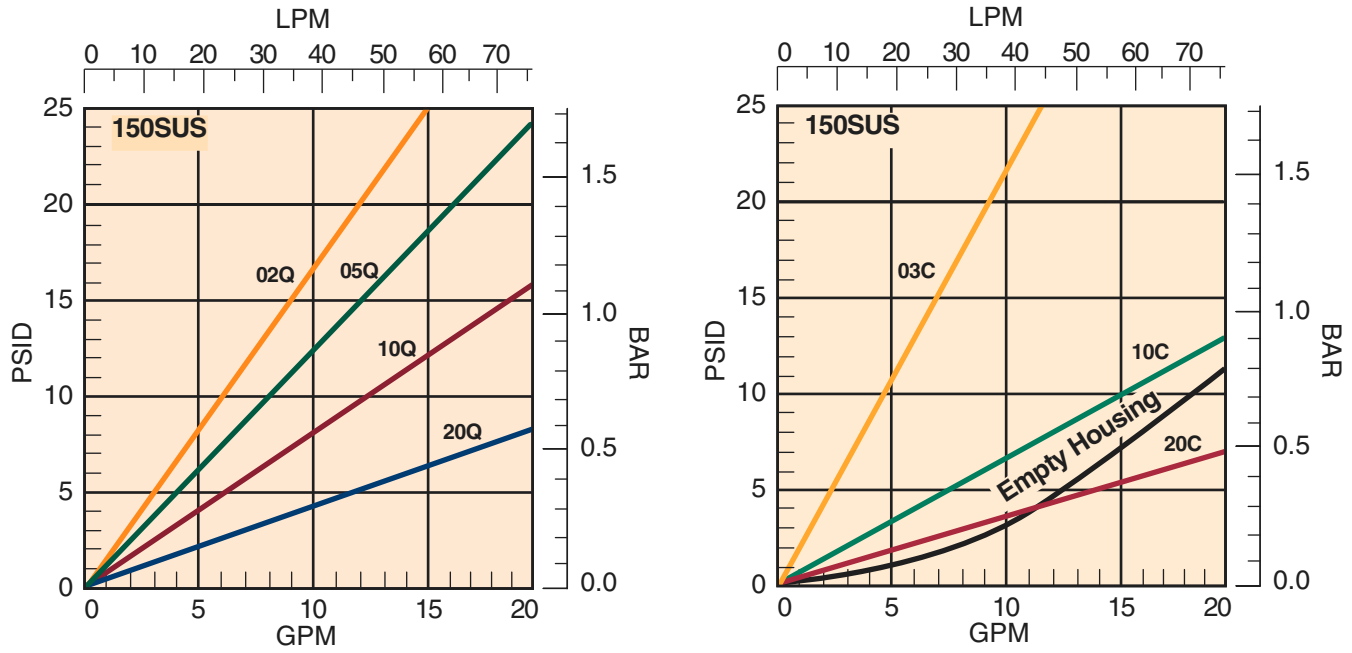
Feature	Advantage	Benefit
• Wire reinforced Microglass III elements	• Rugged construction, stands up to abuse of cyclic flows without performance loss • Wire support reduces pleat bunching, keeps pressure drops consistent	• The reliable filtration provided assures equipment protection, reduces down-time, maximizes element life, and allows the hydraulic system to operate properly
• Multipass tested elements (per ANSI/NFPA T3.10.8.8 R1-1990)	• Filter performance backed by recognized and accepted laboratory test standards	• Filters you select have known performance levels
• Complete element performance data disclosure	• All pertinent information is provided in an easy-to-compare format	• Provides an easy guide to proper filter selection

15P-1 Element Performance

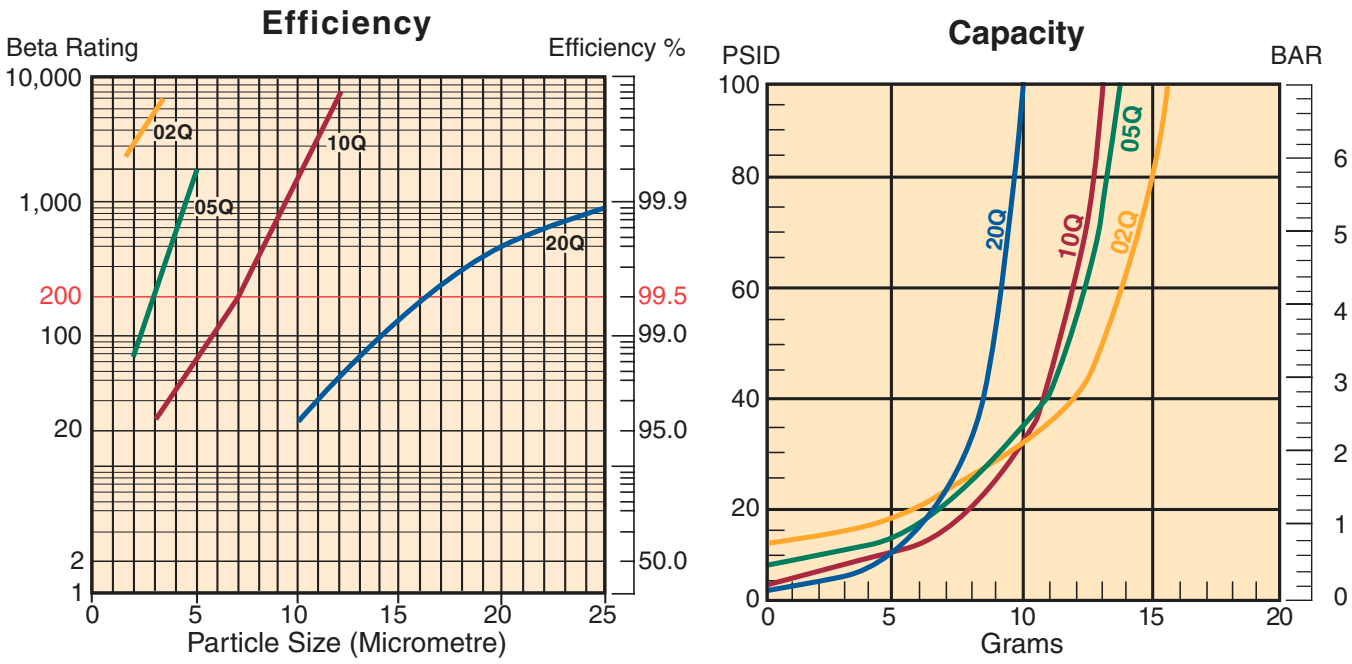


Multipass tests run @ 10 gpm to 100 psid terminal - 5mg/L BUGL

Flow vs. Pressure Loss

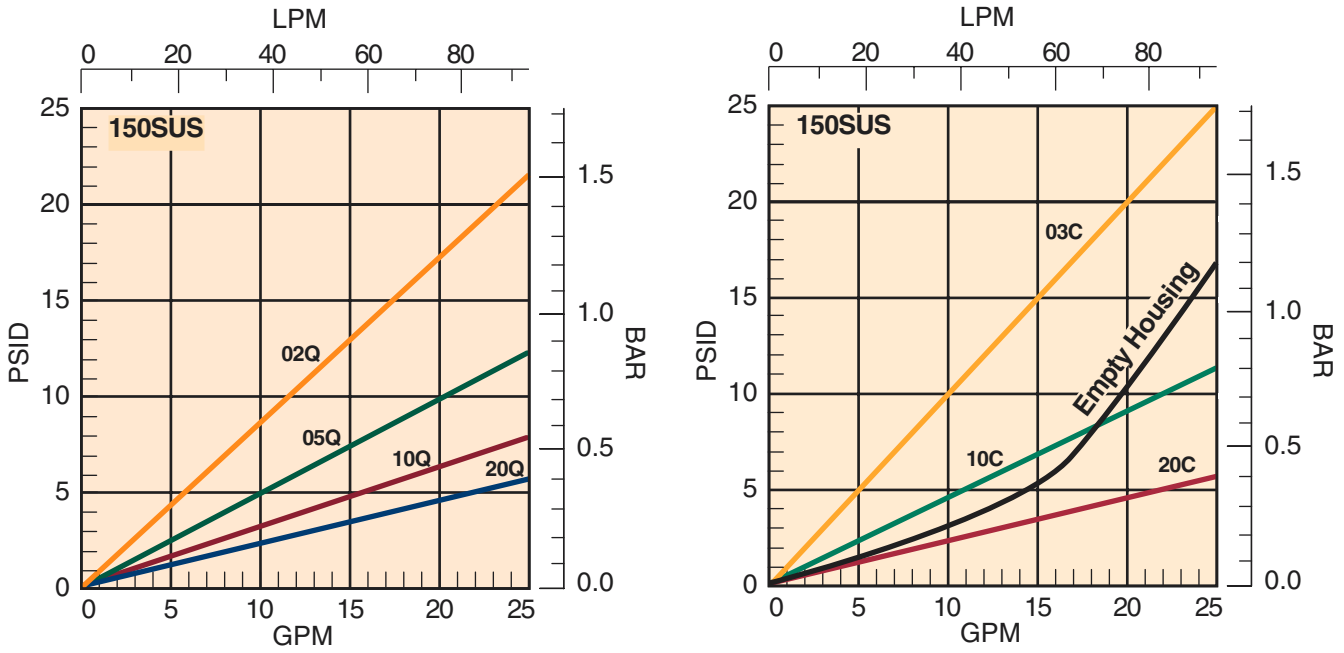


15P-2 Element Performance



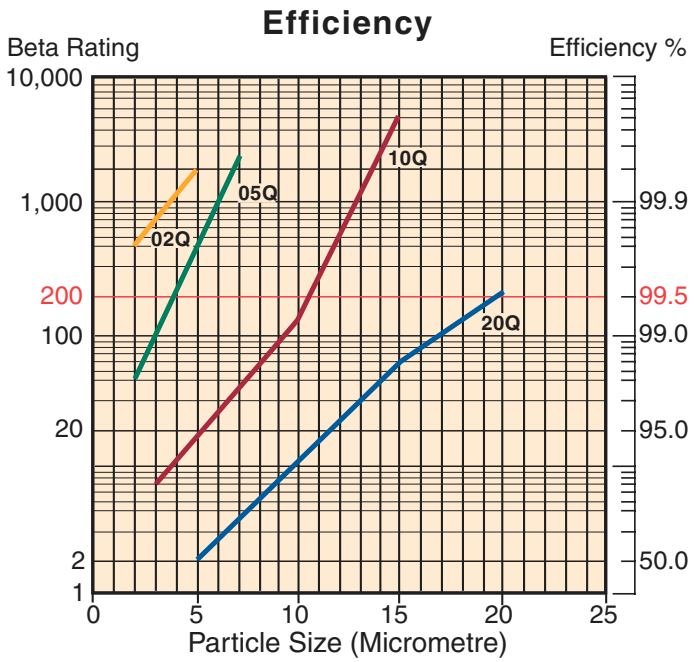
Multipass tests run @ 15 gpm to 100 psid terminal - 5mg/L BUGL

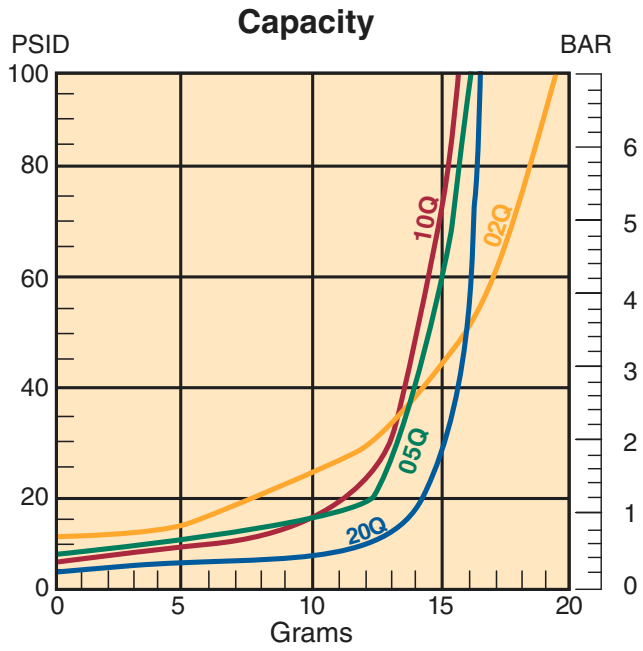
Flow vs. Pressure Loss



Parker Hannifin Corporation
Hydraulic Filter Division
Metamora, OH

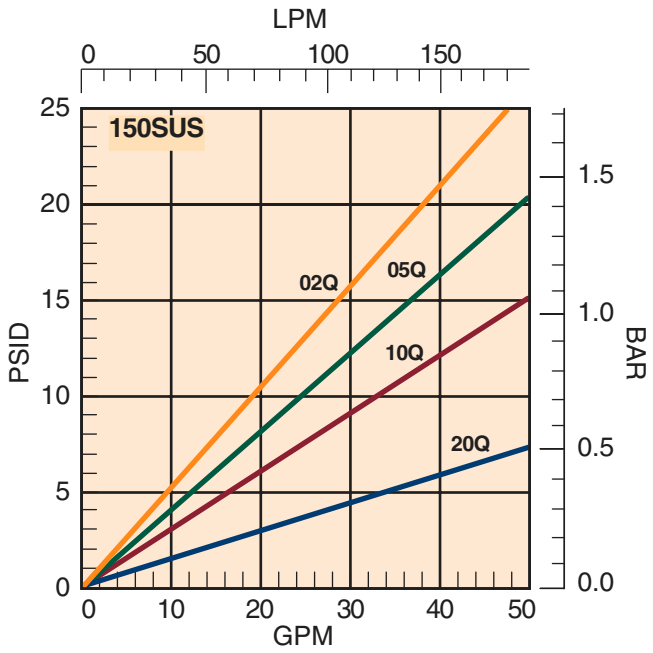
30P-1 Element Performance

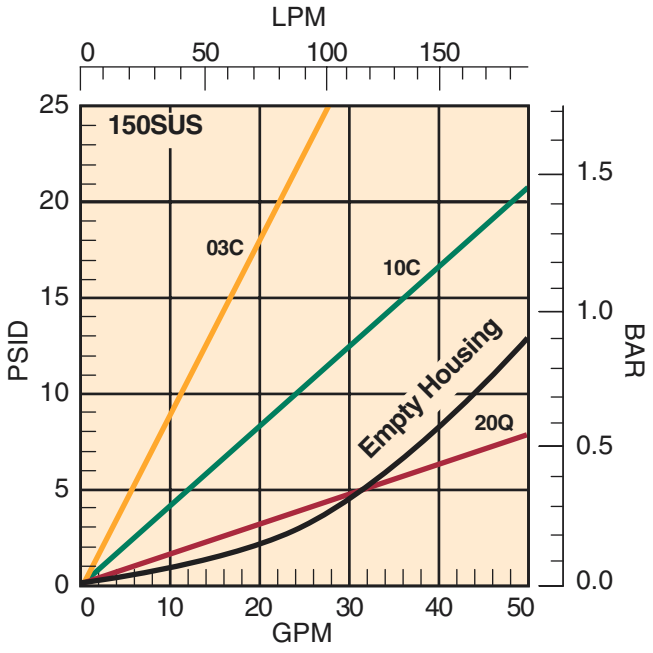




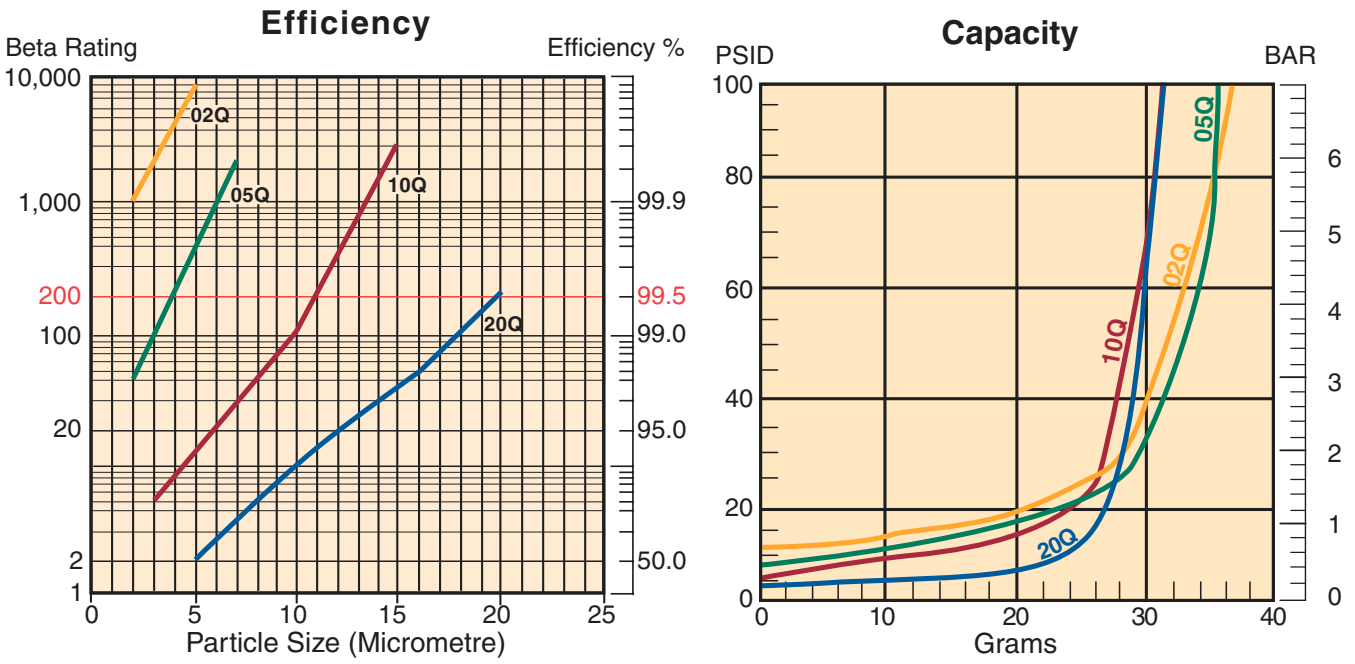
Multipass tests run @ 20 gpm to 100 psid terminal - 5mg/L BUGL

Flow vs. Pressure Loss



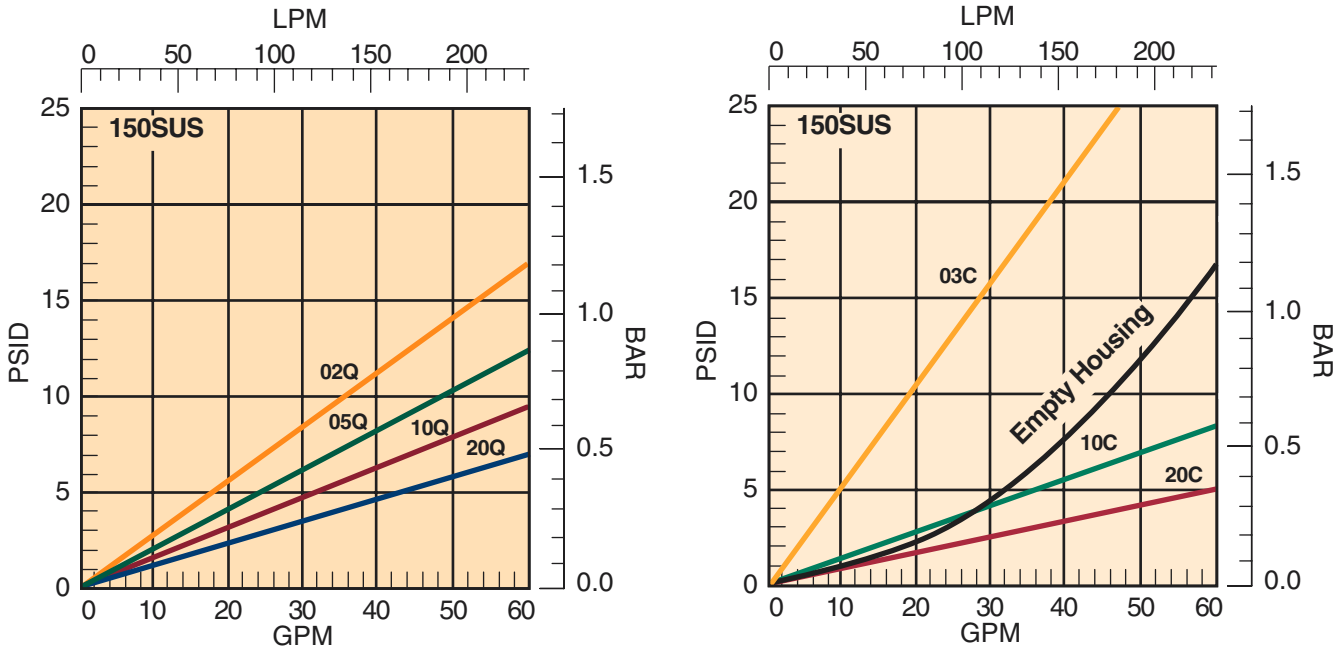


30P-2 Element Performance



Multipass tests run @ 30 gpm to 100 psid terminal - 5mg/L BUGL

Flow vs. Pressure Loss



Specifications: 15P

Pressure Ratings:
Maximum Allowable Operating Pressure (MAOP): 3000 psi (206.9 bar)
Rated Fatigue Pressure: 2000 psi (138 bar)
Design Safety Factor: 3:1

Operating Temperatures:
Buna: -40°F (-40°C) to 225°F (107°C)
Fluorocarbon: -15°F (-26°C) to 275°F (135°C)

Element Collapse Rating:
Standard- 350 psid (24.1 bar)
"H" Option- 2000 psid (138 bar)
"X" Option- 3000 psid (206.9 bar)

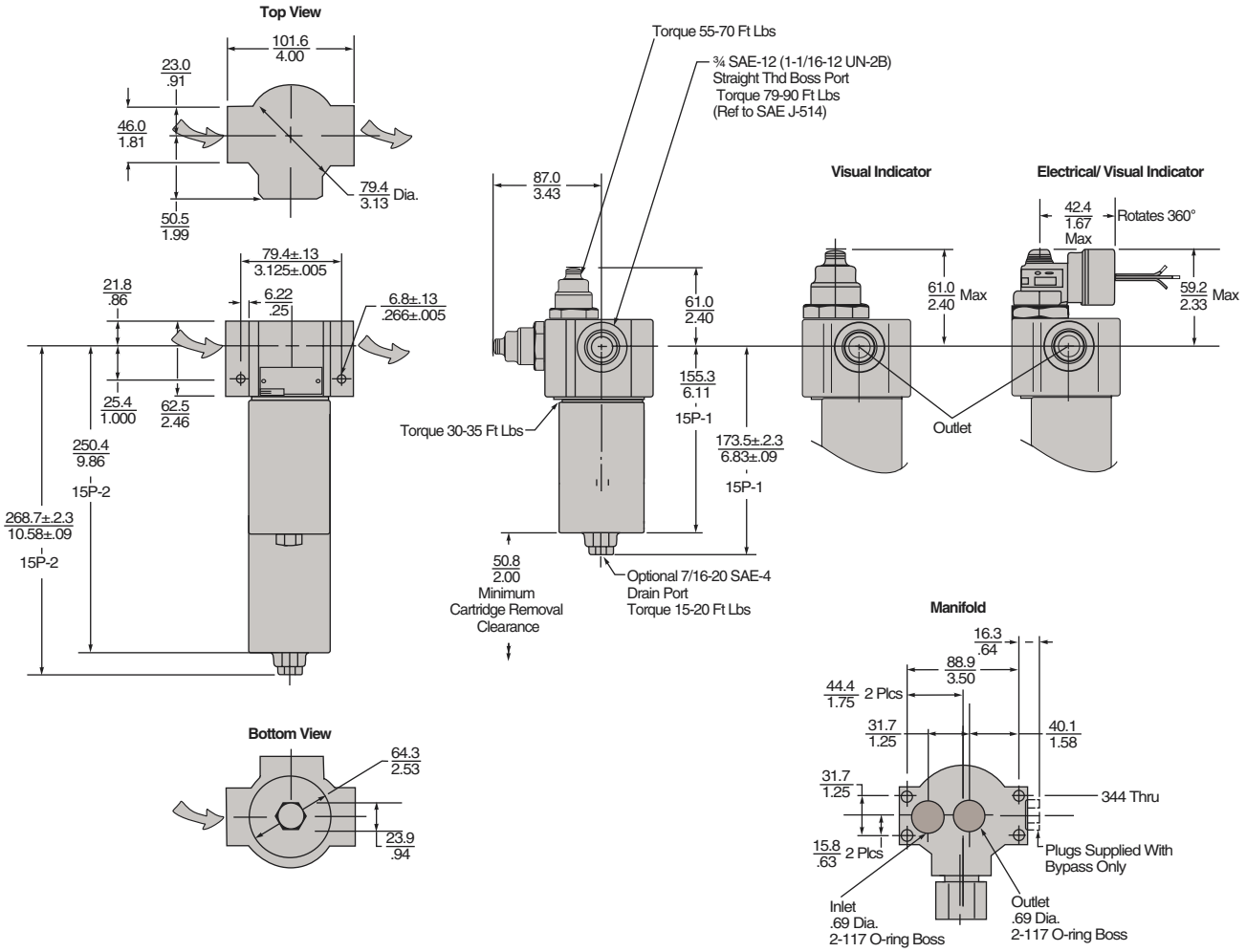
Materials:
Bowl: impacted aluminum (anodized 6061-T6)
Head: extruded aluminum (anodized 6061-T6)
Bypass: nylon

Element Condition Indicators:
Visual (optional) 360° green/ red
Electrical/ Visual (optional)
5A @ 240VAC, 3A @ 28VDC
Electrical-heavy duty (optional)
.25A (resistive) MAX 5 watts
12 to 28 VDC & 110 to 175 VAC

Color Coding:
White (common)
Black (normally open)
Blue (normally closed)

Weights (approximate):
15P-1 3.5 lb. (1.6 kg.)
15P-2 4.6 lb. (2.1 kg.)

Linear Measure: millimeter / inch



Dimensional drawings are for reference only.

Specifications: 30P/30PD

Pressure Ratings:
Maximum Allowable Operating Pressure (MAOP): 3000 psi (206.9 bar)
Rated Fatigue Pressure: 2000 psi (138 bar)
Design Safety Factor: 3:1

Operating Temperatures:
Buna: -40°F (-40°C) to 225°F (107°C)
Fluorocarbon: -15°F (-26°C) to 275°F (135°C)

Element Collapse Rating:
Standard- 350 psid (24.1 bar)
"H" Option- 2000 psid (138 bar)
"X" Option- 3000 psid (206.9 bar)

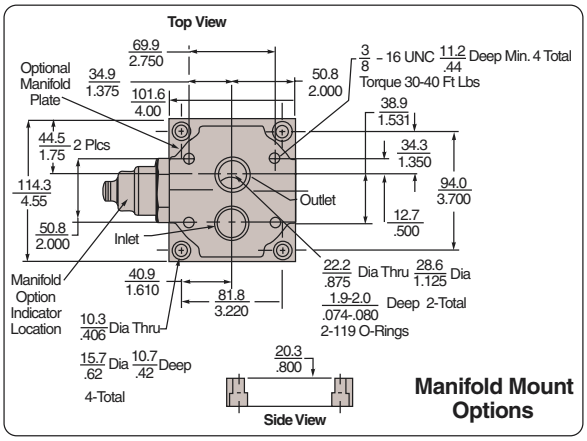
Materials:
Bowl: impacted aluminum (anodized 6061-T6)
Head: extruded aluminum (anodized 6061-T6)
Bypass: Nylon

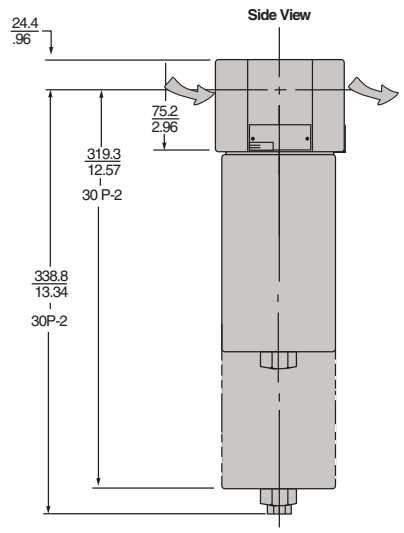
Element Condition Indicators:
Visual (optional) 360° green/ red
Electrical/ Visual (optional)
5A @ 240VAC, 3A @ 28VDC
Electrical-heavy duty (optional)
.25A (resistive) MAX 5 watts
12 to 28 VDC & 110 to 175 VAC

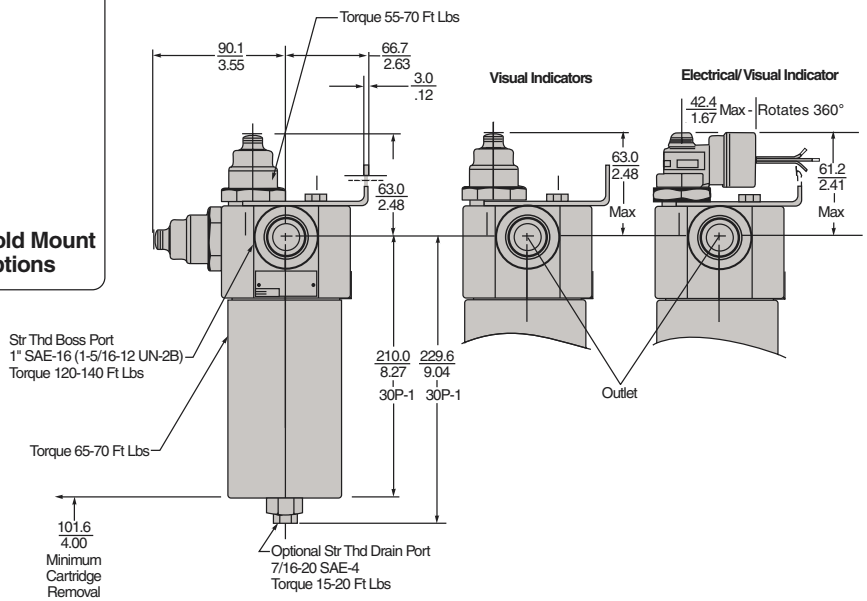
Color Coding:
White (common)
Black (normally open)
Blue (normally closed)

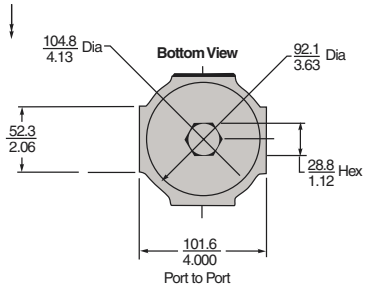
Weights (approximate):
30P-1 6.4 lb.(2.9 kg.)
30PD-1 36 lb. (16.3 kg.)
30P-2 8.7 lb. (3.9 kg.)
30PD-2 40 lb. (18.1 kg.)

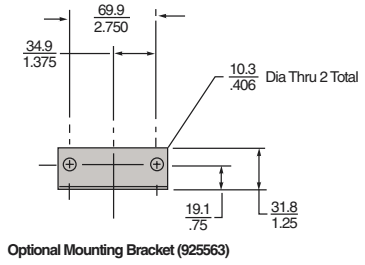
Linear Measure: millimeter / inch











Dimensional drawings are for reference only.

30PD Duplex Filter

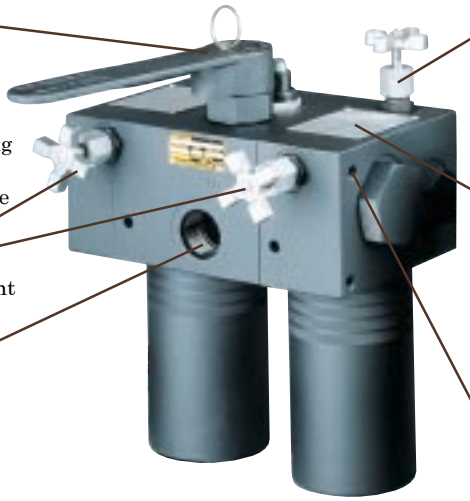
The Parker 30PD duplex pressure filter provides uninterrupted filtration for equipment that cannot be shut down for servicing.

The 30PD allows you to simply switch the diverter valve and service the element while the other side is in service.

Pressure balancing valves and check valves are all neatly assembled in a compact manifold head that makes operation safe, smooth and easy.

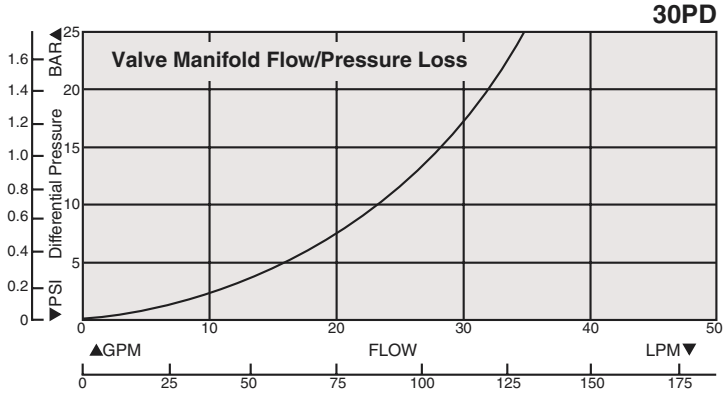
Vent valves are also included to insure that all air is purged during service so that maximum system performance is achieved.

The Parker 30PD makes use of industry proven components. Elements are multi-pass tested in accordance with ANSI/NFPA T3.10.8.8 R1 -1990. Bowls and head are subjected to rigorous fatigue testing to insure a trouble free service life.

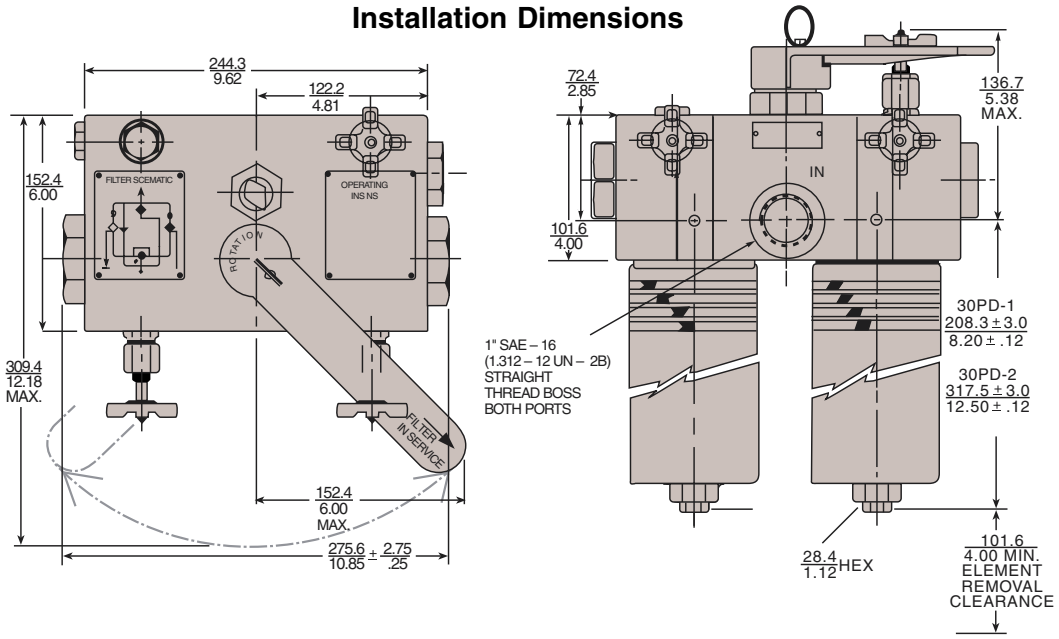


30PD Empty Housing Flow vs Pressure Loss

To obtain total filter assembly pressure loss, add empty housing loss to the pressure loss of selected element on 30P element performance pages.



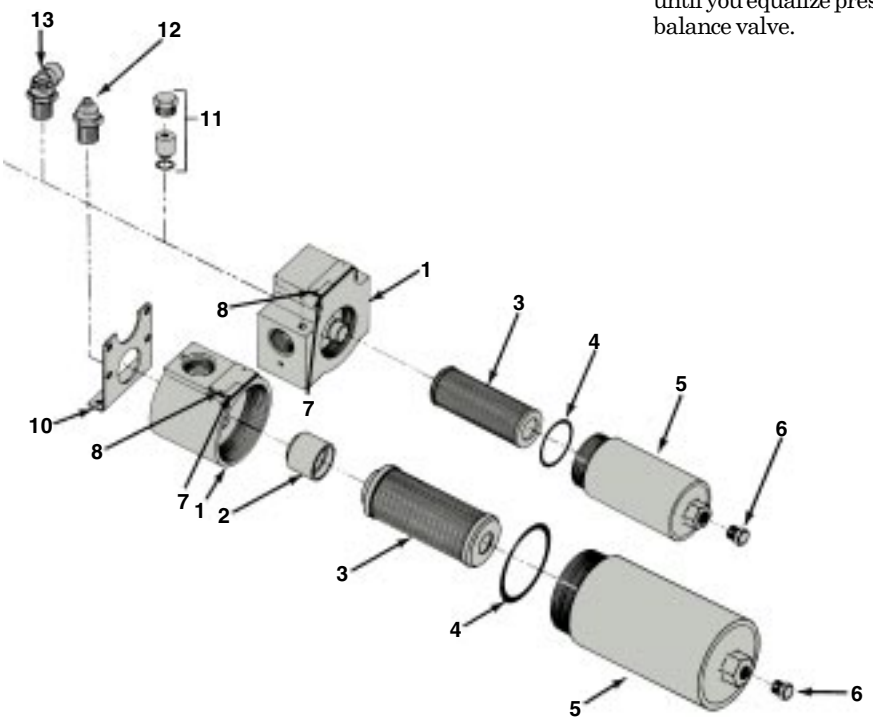
Installation Dimensions



Parts List

Index	Description	15P	30P
1	**Head**		
	In-line Porting		
	Bypass w/top indicator port	931520	933956
	No bypass w/top indicator port	931519	933956
	Bypass w/side indicator port	931522	933955
	No bypass w/side indicator port	931521	933955
	Manifold Porting		
	Bypass w/indcator port	931135	933954
	No bypass w/ indicator port	931523	933954
2	**Bypass Valve Assembly**		
	50 psid (in-line model only)	928981	925127
	No bypass	935744*	925209
3	**Elements (see chart on model code page)**		
4	**Bowl O-Ring**		
	Buna	N92138	N92151
	Fluorocarbon	V92138	V92151
5	**Bowl**		
	Single without drain	926102	926038
	Single with drain	926450	926040
	Double without drain	926103	926039
	Double with drain	926451	926041
6	**Drain Plug**		
	W/buna o-ring	920462	920462
	W/fluorocarbon o-ring	922521	922521
7	**Nameplate(unstamped)**	920928	920928
8	**Drive Screws**	903393	903393
9	**Mounting Spacer Tube (not shown)**	925650	N/A
10	**Mounting Bracket Kit**	N/A	925563
11	**Blank Indicator Kit**	925515	925515
	Indicators (viton seals)		
12	Visual auto reset	933124	933124
	H option (1/2" conduit connection)	932905	932905
	E2 option (DIN 43650 connection)	929599	929599
13	E3 option (3 pin ANSI/B93.55M connection)	932773	932773
	Manifold Mounting Kit	N/A	925562
	Manifold O-Rings (2 required)		
	Buna	N92117	N92119
	Fluorocarbon	V92117	V92119

Note: consult factory for EPR part numbers
*Not for manifold-style head



Element Servicing

15P/30P

A. Stop the system's power unit.
B. Relieve any pressure in the filter line and drain filter bowl if drain port is provided.
C. Loosen and remove bowl.
D. Remove element from housing.
E. Place new, clean element in housing, centering it on the element locator.
F. Inspect the bowl o-ring and replace if necessary.
G. Install bowl and tighten to specified torque.

30PD

A. Arrow on diverter handle points to the on-duty chamber.
B. Open off-duty vent valve (vent port should be plumbed back to reservoir).
C. Open balance valve slowly to admit fluid into off duty chamber.
D. When fluid is discharged from vent port, close and tighten.
E. Pull up on detent pin and rotate diverter approximately 90° until detent relocates in seat.
F. Close and tighten balance valve.
G. Open new off-duty vent valve to relieve pressure.
H. Follow steps C-G from 15P/30P instructions above.
I. Close and tighten vent valve.

Warning: Do not try and rotate handle until you equalize pressure with the balance valve.

HOW TO ORDER:

Select the desired symbol (in the correct position) to construct a model code.
Example:

BOX 1	BOX 2	BOX 3	BOX 4	BOX 5	BOX 6	BOX 7	BOX 8	BOX 9
F3	30P	1	10Q	M2	50	NN	19	(Assigned By Parker)

BOX 1: Seals

Symbol	Description
None	***Buna N (nitrile)***
F3	***Fluorocarbon***
E8	EPR

BOX 2: Basic Assembly

Symbol	Description
15P	***Pressure filter***
30P	***Pressure filter***
30PD	Duplex style 30P

BOX 3: Length

Symbol	Description
1	***Single***
2	***Double***

BOX 4: Element Media

Symbol	Description
20C	Cellulose
10C	Cellulose
03C	Cellulose
20Q	***Microglass III***
10Q*	***Microglass III***
05Q	***Microglass III***
02Q*	***Microglass III***

Note: For high collapse rated (2000 psid) elements, add "H" behind Q. For Microglass media only. *For 3000 psid collapse rated elements, add "X" behind Q.

BOX 5: Indicator

Symbol	Description
N	No indicator, no pressure port
P	***Port plugged***
M2	***Visual auto reset***
H	Electrical indicator, w/½"-14 NPT connection and 12" leads
E	Electrical/visual w/ ½" NPT conduit connection and wire leads
E2	***Electrical/visual (DIN 43650 Hirschman style connection)***
E3	Electrical/visual (ANSI/ B93.55M 3-pin Brad Harrison style connection)

Note: For side mount indicators, place a "s" after indicator symbol. Not available on 30PD model.

BOX 6: Bypass Or Indicator Setting

Symbol	Pressure Setting
50	***50 psid***

Note: If "no bypass" option (-11) and an indicator is selected, "50" denotes indicator calibration.

BOX 7: Ports

Model	Symbol	Description
15P	***MM***	***SAE-12***
15P	XX	¾"-manifold porting
30P	***NN***	***SAE-16***
30P	XX	1"-manifold porting
30PD	NN	SAE-16

Note: Customer supplies subplate adaptor, or purchases optional Parker subplate.

BOX 8: Options

Symbol	Description
1	***None***
11	No bypass
19	SAE-5 drain port on bowl
21	No bypass and drain port

BOX 9: Design Number

Applied to filter assembly by Parker Filter Division. Use the full filter model code, including the design number when ordering replacement parts, elements and cartridges.

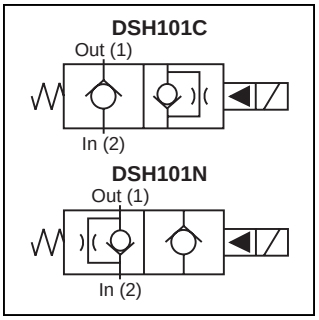
REPLACEMENT ELEMENTS

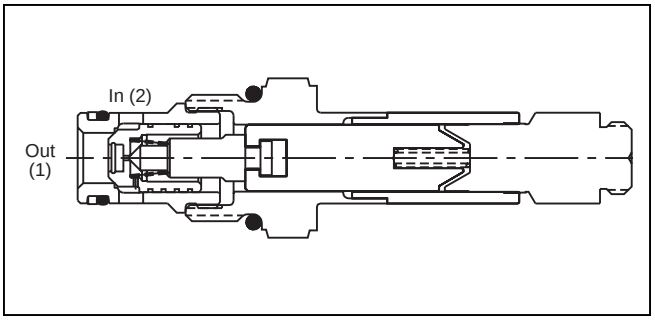
Filter Model (Flourocarbon seals)				
Media	**15P-1**	**15P-2**	**30P/30PD-1**	**30P/30PD-2**
20C	925576	925596	922625	925834
10C	925385	925394	922624	925835
03C	925578	925598	922923	925836
20Q	***930369Q***	***930370Q***	***933135Q***	***933136Q***
10Q	***932612Q***	***932618Q***	***932624Q***	***932630Q***
05Q	***932611Q***	***932617Q***	***932623Q***	***932629Q***
02Q	***932610Q***	***932616Q***	***932622Q***	***932628Q***
20QH	934983Q	930544Q	NA	NA
I0QH	932615Q	932621Q	932627Q	932633Q
05QH	932614Q	932620Q	932626Q	932632Q
02QH	932613Q	932619Q	932625Q	932631Q
I0QX	933577Q	933579Q	933581Q	933583Q
02QX	933576Q	933578Q	933580Q	933582Q

Please note the bolded options reflect standard options with a reduced lead-time. Consult factory on all other lead-time options.

General Description

The DSH101C and DSH101N 2-way, poppet-type, solenoid valves are used in applications requiring on/off valves and low leakage. Single acting cylinder applications typically utilize valves of this type. Valves can be used for bleed down flow and/or raising and lowering a vertical cylinder. Normally open and normally closed configurations plus manual overrides are available.





Operation

Normally Closed

The valve pilot is held on its seat by spring force, blocking pilot flow. This allows pressure at the inlet to hold the poppet on its seat, thus, preventing flow through the valve (inlet to outlet). When the coil is energized, the valve pilot is pulled off its seat. This vents pressure inside the poppet to the outlet port, creating a pressure imbalance across the main poppet which allows flow from the inlet to the outlet.

Normally Closed, Fast Response

The operation of this version is identical to the normally closed valve except for the travel of the poppet. The distance that the poppet travels is much shorter. This gives the fast response valve a faster opening time and a reduced maximum flow rate.

Normally Open

The valve pilot is held off of its seat by spring force. Pilot flow is vented to the outlet port, creating a pressure imbalance that moves the main poppet off it's seat, allowing flow from the inlet to the outlet. When the coil is energized, the valve pilot and main poppet are forced to close, thus blocking flow from the inlet to the outlet.

Features

- Low hysteresis
- Replaceable, one piece encapsulated, coils with minimal amperage draw
- Variety of coil terminations and voltages
- Variety of manual override options available

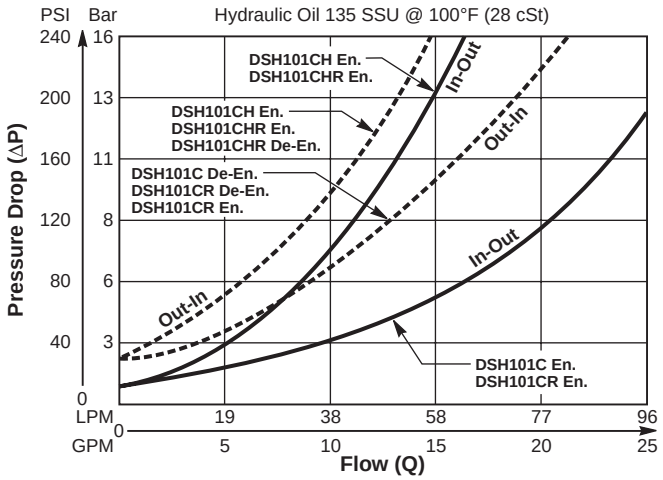
Specifications

Rated Flow	**DSH101CH** & **DSH101CHR** 30 LPM (8 GPM) **All other versions** 60 LPM (15 GPM)
Maximum Inlet Pressure	345 Bar (5000 PSI) - Steel 210 Bar (3000 PSI) - Aluminum
Leakage	10 drops/min. (2/3 cc/min.) at 345 Bar (5000 PSI)
Operating Temp. Range (Ambient)	-40°C to +93.3°C (Nitrile) (-40°F to +200°F) -31.7°C to +121.1°C (Fluorocarbon) (-25°F to +250°F)
Cartridge Material	All parts steel. All operating parts hardened steel.
Body Material	Steel or Aluminum
Filtration	ISO Code 16/13, SAE Class 4 or better
Mounting	No restrictions
Cavity	Common Cavity No. C10-2

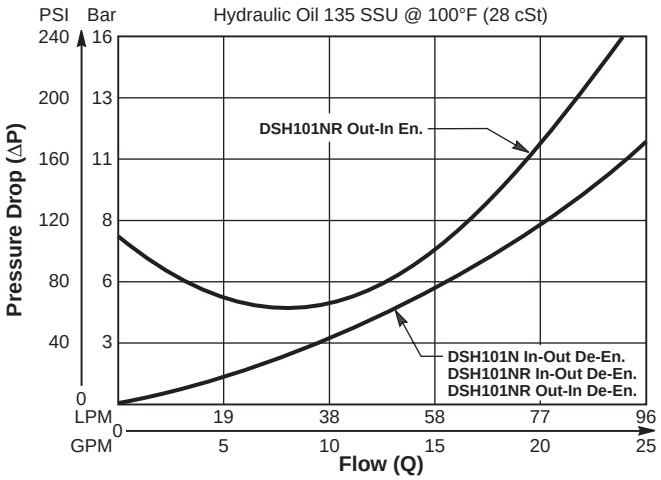
Performance Curves

Pressure Drop vs. Flow (Through cartridge only)

Normally Closed



Normally Open



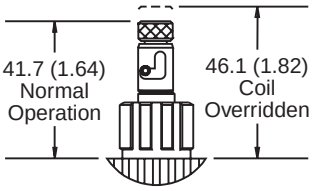
Solenoid Coil Specifications

Voltage	10 VDC	12 VDC	24 VDC	120 VAC	240 VAC
Watts	20	20	20	20	20
Amps	1.45	1.17	0.57	.144	.079

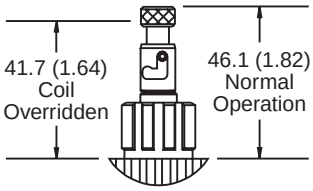
Response Time (at nominal flow, 5000 PSI)	**DSH101C & DSH101CR** (Normally Closed)	**DSH101CH & DSH101CHR** (N.C. Fast Res.)	**DSH101N & DSH101NR** (Normally Open)
Open	100ms	50ms	35ms
Close	175ms	90ms	175ms

Wire Class	"H" for all voltages
A.C. Rectifiers	Integral full wave bridge

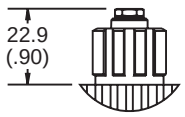
*Inch equivalents for millimeter dimensions are shown in (**)



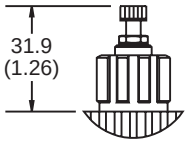
Push & Twist
Manual Override
(N.C. Valves Only)



Push & Twist
Manual Override
(N.O. Valves Only)

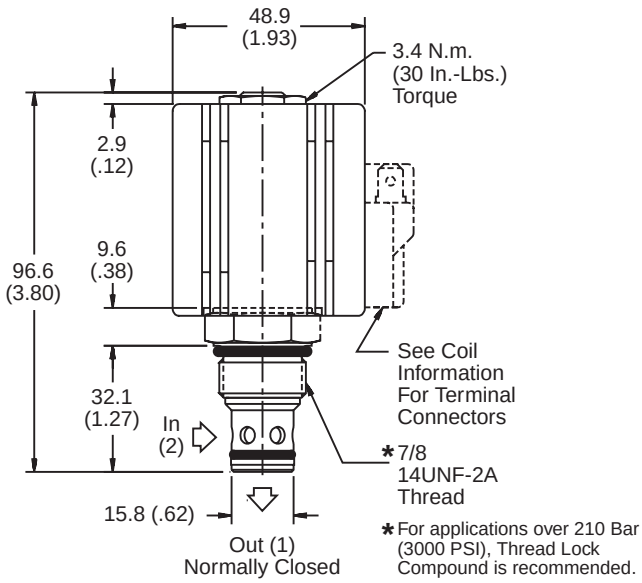


Flush
Manual Override
(N.O. Valves Only)

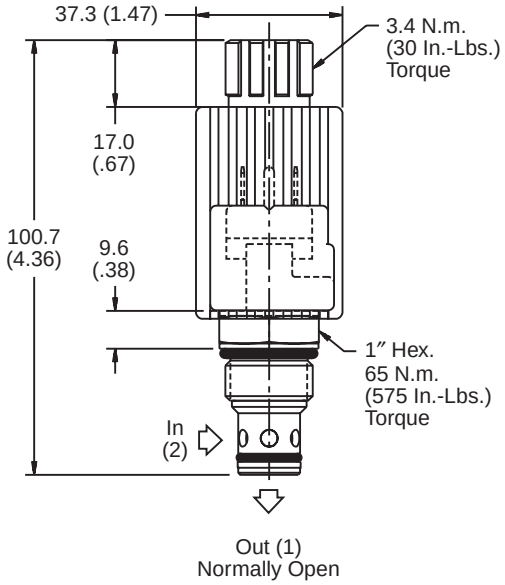


Extended
Manual Override
(N.O. Valves Only)

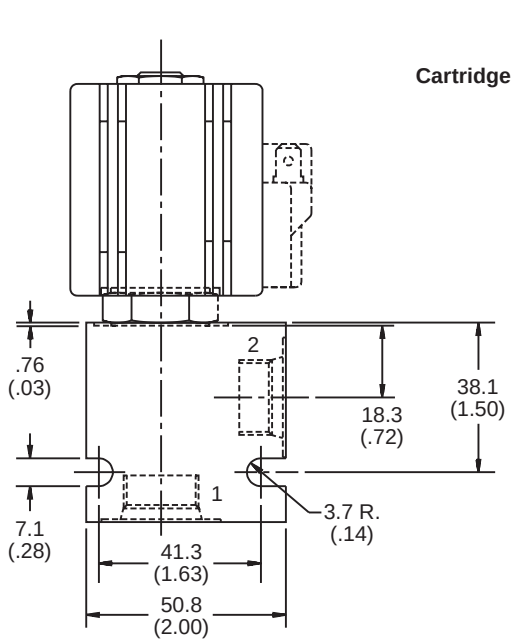
Cartridge Only

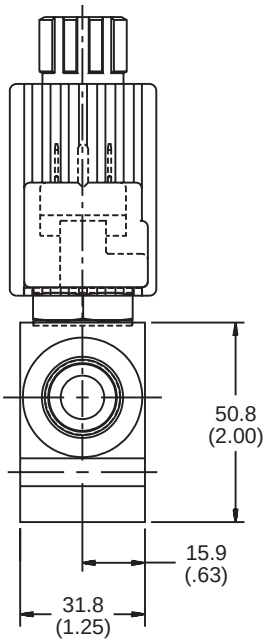


*For applications over 210 Bar (3000 PSI), Thread Lock Compound is recommended.



Cartridge In Body





THIRD-ANGLE PROJECTION

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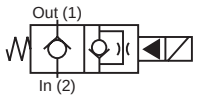
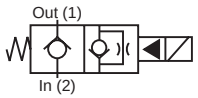
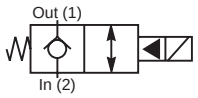
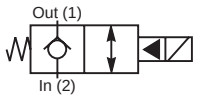
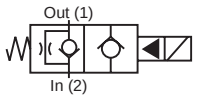
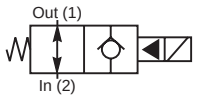
DSH	10	1							—	
Solenoid Valve	Size	Poppet Type	Style	Override Option	Seals	Coil Voltage	Coil Wattage	Coil Termination		Body Option

Code	Style
10	1 7/8″ - 14UNF-2B Threaded Cavity with .625″ Dia. Seat

Code	Type
Omit	Nitrile
V	Fluorocarbon

Code	Type
Omit	Cartridge without Coil
L	20 Watt

Code	Description
C	Normally Closed, Metered reverse flow. 
CH	Normally Closed, Metered reverse flow. Fast response 
CHR	Normally Closed, Full reverse flow. Fast response 
CR	Normally Closed, Full reverse flow. 
N	Normally Open, Metered reverse flow. 
NR	Normally Open, Full reverse flow. 

Code	Type
Omit	Without Manual Override
E	Push Type Manual Override with Extended Rod (Normally Open Only)
M	Push Type Manual Override with Flush Rod (Normally Open Only)
T	Push & Twist Manual Override

Code	Description
Omit	Cartridge without Coil
D010	10 VDC
D012	12 VDC
D024	24 VDC
A120	120/110 VAC, 60/50 Hz
A240	240/220 VAC, 60/50 Hz

Code	Description
Omit	Cartridge without Coil
C	1/2″ NPTF Conduit Connector with 24″ Class H Wires
D	DIN 43650 (Hirschmann) Plug Face
P	SAE 1B-0.25 SAE Double Spade (DC Only)
W	Double Wire, 24″ Class H (DC Only)
WP	Waterproof Double Wire, 24″ Class H (DC Only)

Code	Port Size & Material		
Omit	Cartridge Only		
4P	1/4″ NPTF	(B10-2-4P)	Steel
A4P	1/4″ NPTF	(B10-2-A4P)	Aluminum
6P	3/8″ NPTF	(B10-2-6P)	Steel
A6P	3/8″ NPTF	(B10-2-A6P)	Aluminum
8P	1/2″ NPTF	(B10-2-8P)	Steel
A8P	1/2″ NPTF	(B10-2-A8P)	Aluminum
6T	SAE-6	(B10-2-6T)	Steel
A6T	SAE-6	(B10-2-A6T)	Aluminum
8T	SAE-8	(B10-2-8T)	Steel
A8T	SAE-8	(B10-2-A8T)	Aluminum
4B	1/4″ BSPG	(B10-2-4B)	Steel
A4B	1/4″ BSPG	(B10-2-A4B)	Aluminum
6B	3/8″ BSPG	(B10-2-6B)	Steel
A6B	3/8″ BSPG	(B10-2-A6B)	Aluminum
8B	1/2″ BSPG	(B10-2-8B)	Steel
A8B	1/2″ BSPG	(B10-2-A8B)	Aluminum

SERVICE PARTS

Coil Size

Code	Size
S10	5/8″ I.D.

Coil Wattage

Code	Type
L	20 Watts

Coil Termination

Code	Description
C	Conduit
D	DIN 43650
P	Double Spade
S	Double Screw
W	Double Wire
WP	Waterproof Double Wire

Coil Voltage

Code	Description
D010	10 VDC
D012	12 VDC
D024	24 VDC
A120	120 VAC
A240	240 VAC

DIN Connector:
Grey — 692914
Black — 692915

Coil Nut:
DSH101C, CR, CH — 118127-00
DSH101N, NR — 118113-00

Nitrile Seal Kit:
DSH101 — SK10-2

Fluorocarbon Seal Kit:
DSH101 — SK10-2V

Notes: See Series 10 Coil Data Sheet.
For other coil voltages and terminations, consult factory.

Shipping Weight
Cartridge Only .20 kg (0.41 lbs.)
Cartridge in Body .97 kg (2.11 lbs.)

NOTE: If system pressure does not exceed 210 Bar (3000 PSI), aluminum bodies can be used. Higher pressures require steel bodies.

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Moduflow™ *Plus* Series

ILP and RFP Low Pressure Filters

Applications for Moduflow Filters

- Power Unit Fabrication
- Off-line Filter Loops
- Mobile Equipment

The Moduflow filter is widely considered the most versatile filter available on the market. The unique diverter valve assembly, and inside to outside flow through the element, allows the Moduflow to be configured for in-line, in-tank or suction filtration.

The flow diverter minimizes turbulence and pressure loss through the filter, improving system performance.

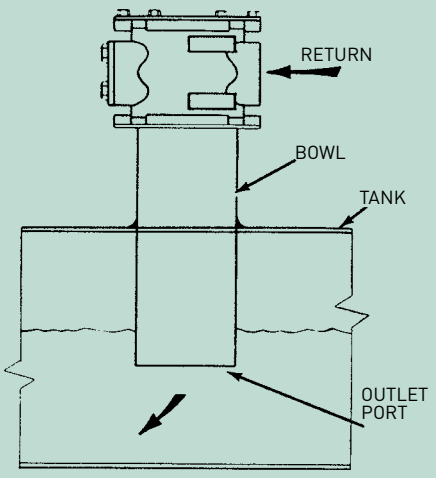
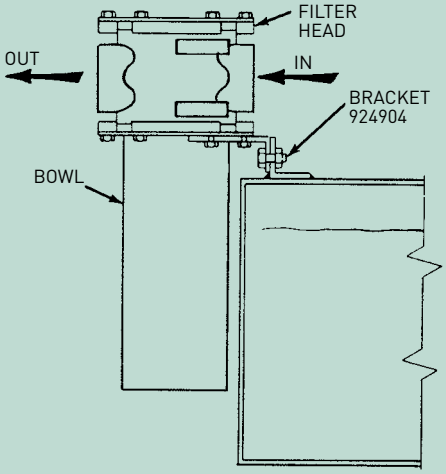
The newly designed closed bottom elements for the RFP and ILP models insures all contamination remains trapped within the element as the filter is serviced.

A wide variety of visual and electrical indicators allows you to know exactly when the element needs to be serviced. There is even a "no element" indicator that can sense when there is not an element installed in the filter.

From top to bottom, the Moduflow filter series provides the high level of filtration and long term dependability so vital to today's hydraulic systems.

Parker's new patented Moduflow element was designed with built-in diverter cone and bypass valve, to meet your application needs.

Mounting / Porting Styles

RFP Return Filter	ILP In-Line Filter
	

Features

Flanges
- NPT or SAE ¾" to 2"
- Lightweight aluminum

Cover
- Slotted for quick release
- Lightweight aluminum

Indicators
- Visual or electrical
- Mounted on either side
- Optional "no element" indication

Bowl
- Single or double length
- Durable steel construction

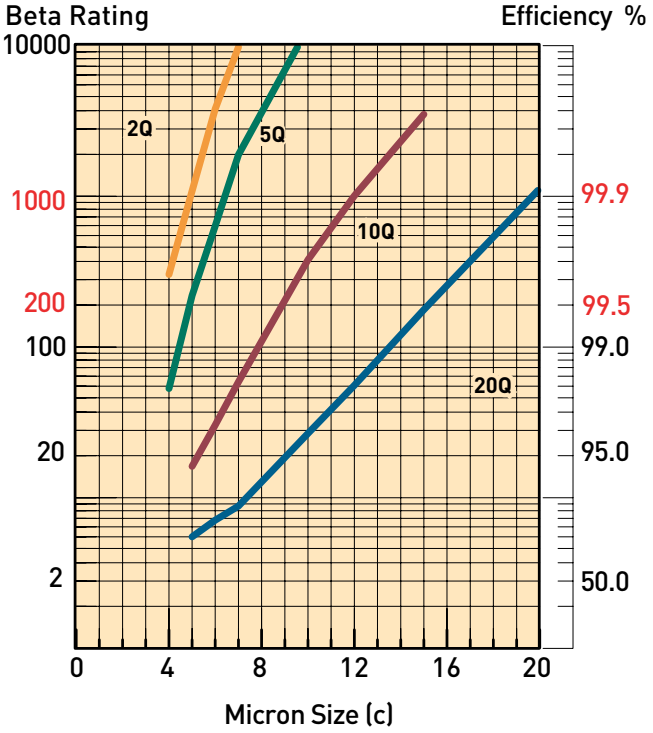
Bypass
(not visible)
- Integral bypass replaced with every element change

Element
(not visible)
- Available in cellulose, wire mesh or high performance Microglass II media
- Single or double length

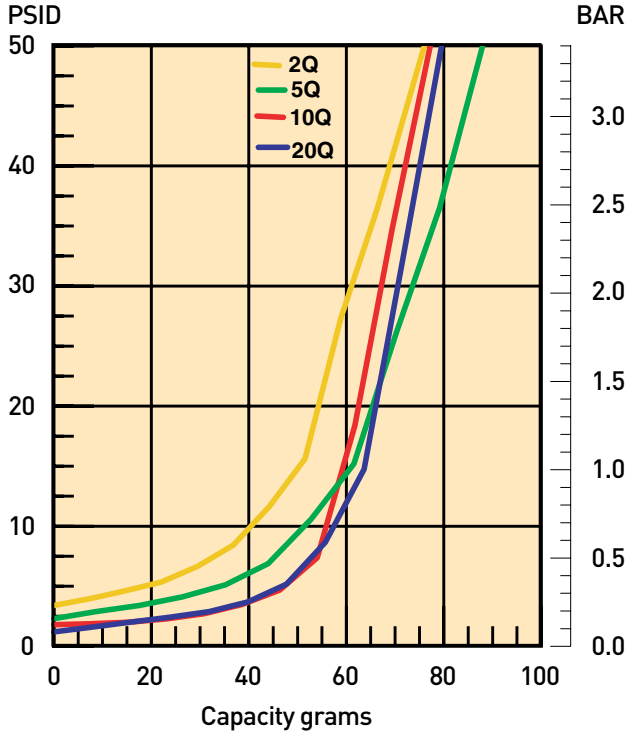
Feature	Advantage	Benefit
• Top access element service	• Oil remains in housing • Quicker elements change	• No Spills • Reduced maintenance costs
• Slotted cover	• Quick release cover • Cap screws remain in housing	• Reduced maintenance costs • No loose parts to lose
• Closed bottom elements	• Removes all contaminant during element service	• No downtime contamination from servicing
• Visual or electrical indicators	• Know exactly when to service elements	• Helps prevent bypass condition • No premature disposal
• Flange face ports	• Flexible mounting (3/4" to 2")	• Easy plumbing to your system

RFP-1 & ILP-1 Element Performance

Efficiency

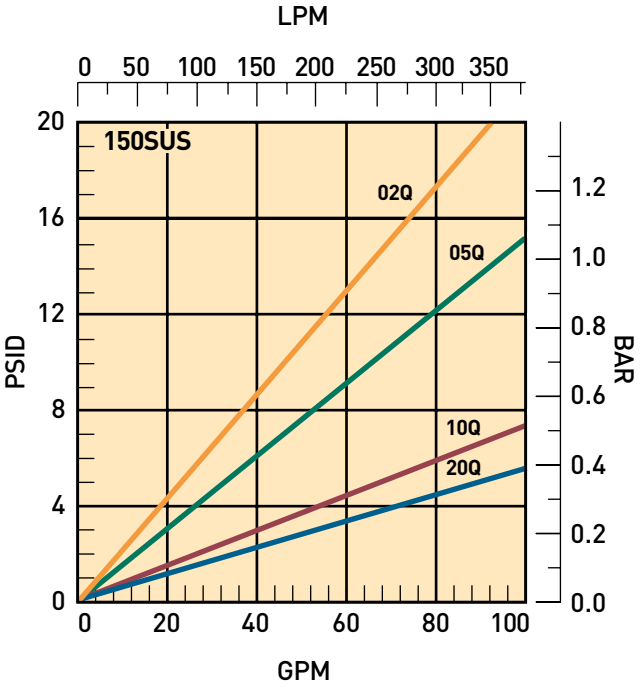


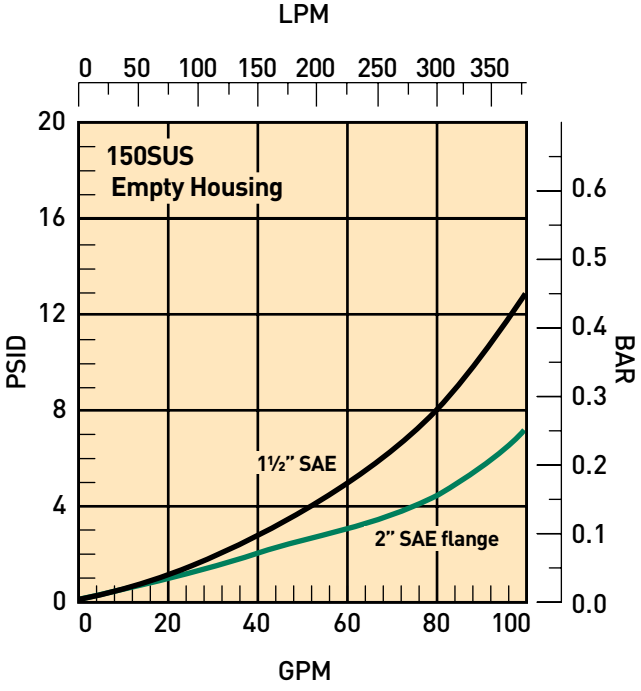
Capacity



Multipass tests run @ 40 gpm to 50 psid terminal - 5mg/L BUGL

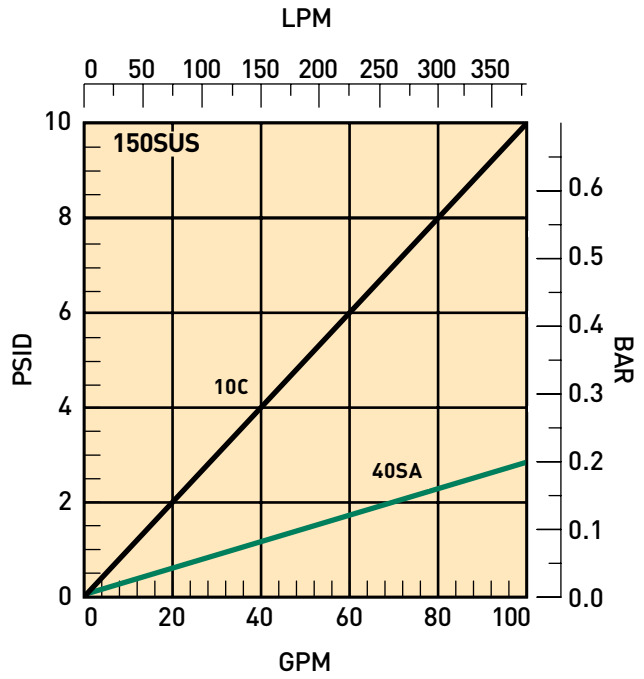
Flow vs. Pressure Loss

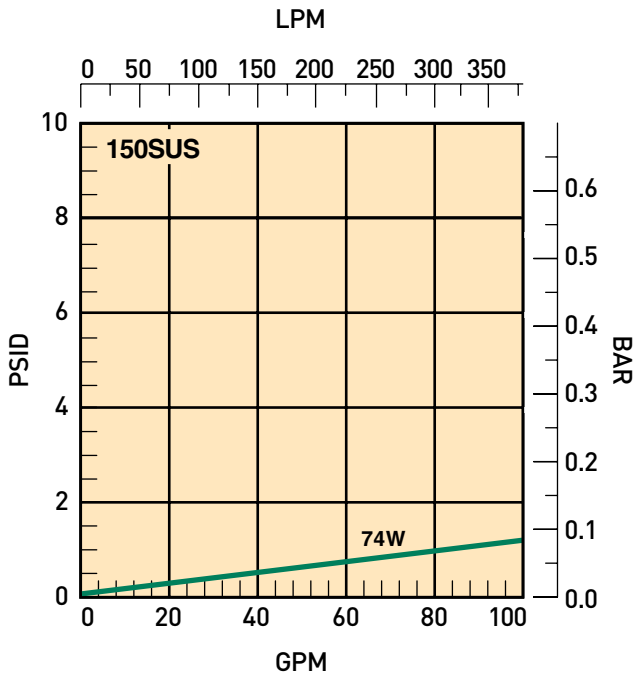




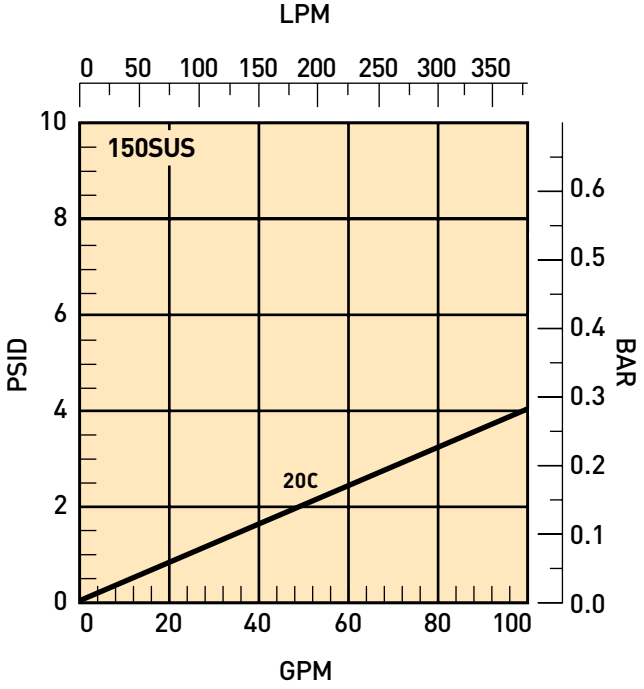
RFP-1 & ILP-1 Element Performance

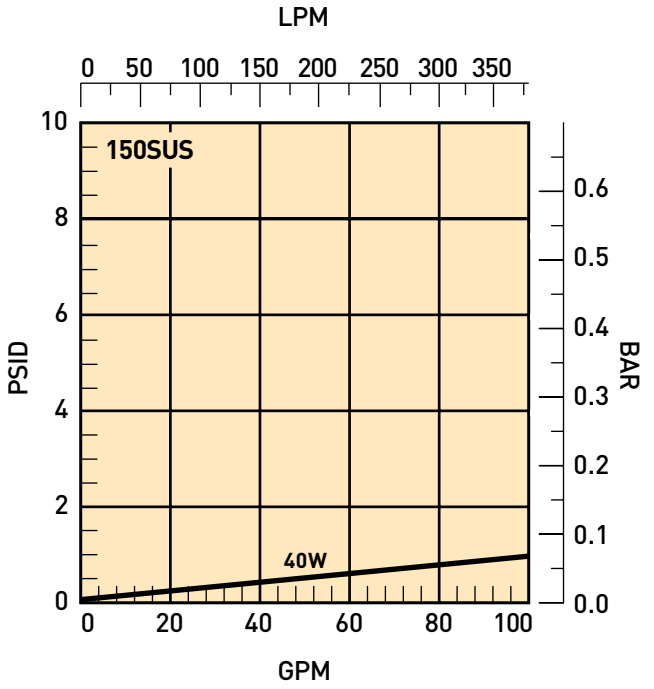
Flow vs. Pressure Loss





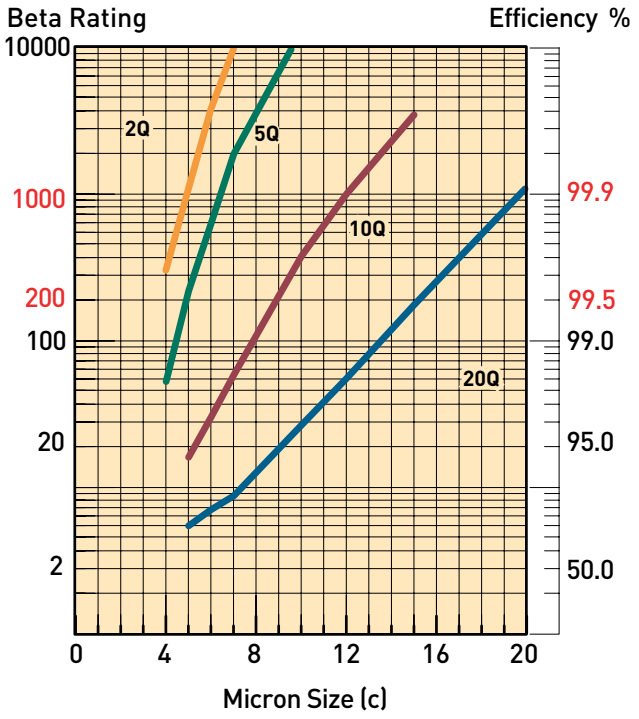
Flow vs. Pressure Loss



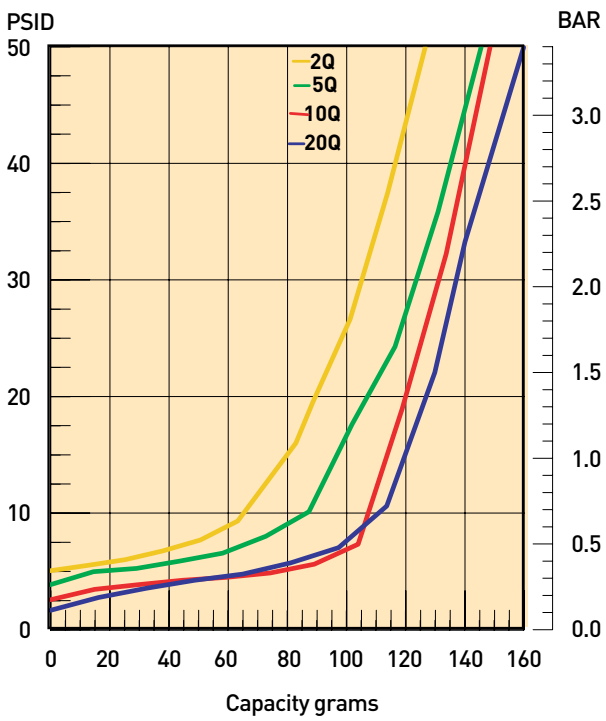


RFP-2 & ILP-2 Element Performance

Efficiency

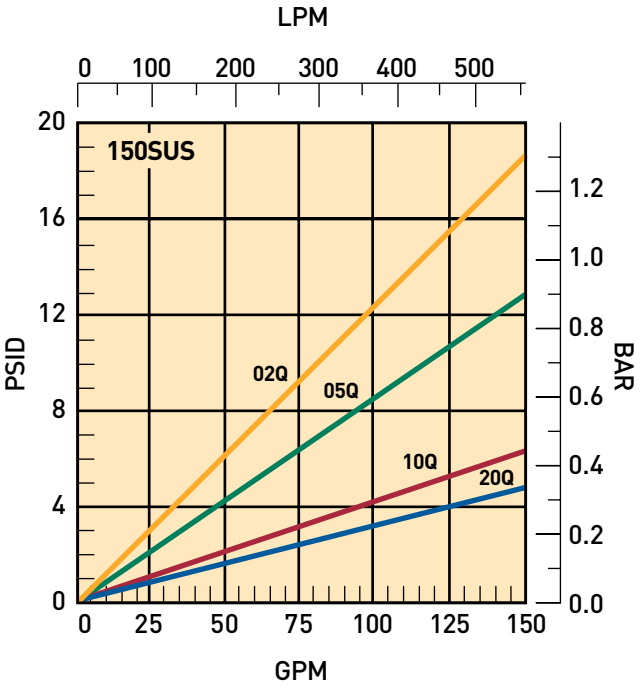


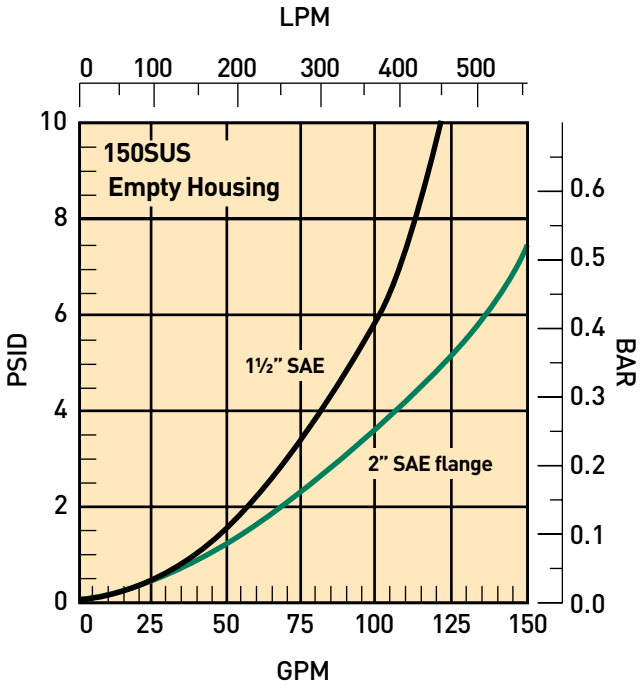
Capacity



Multipass tests run @ 80 gpm to 50 psid terminal - 5mg/L BUGL

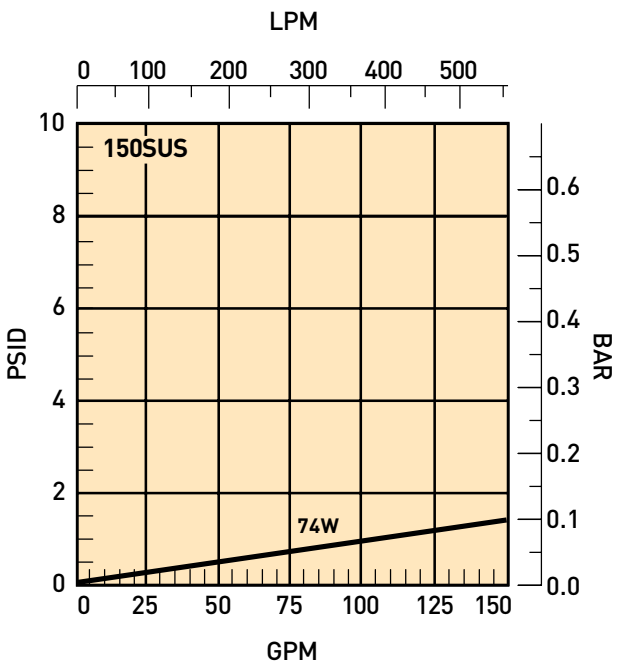
Flow vs. Pressure Loss

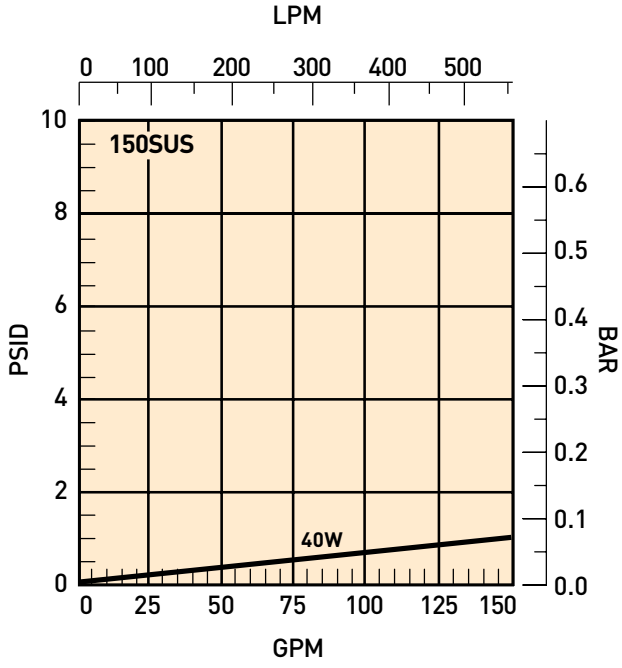




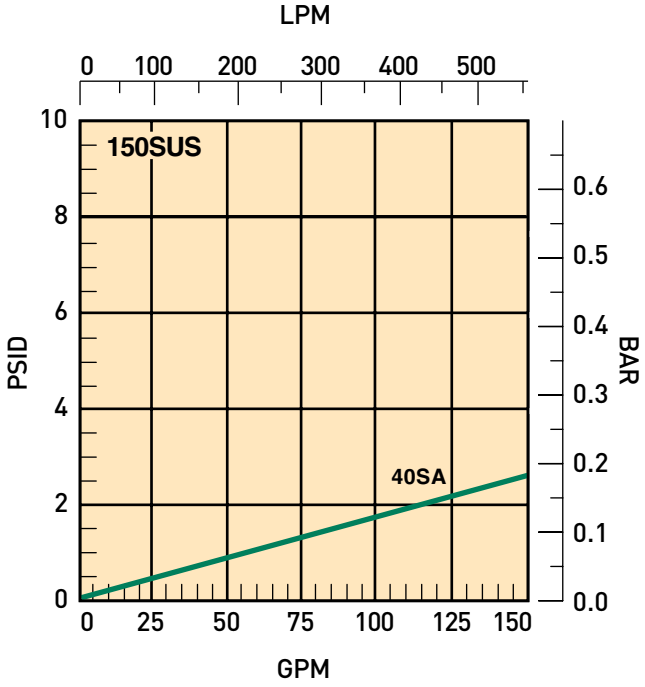
RFP-2 & ILP-2 Element Performance

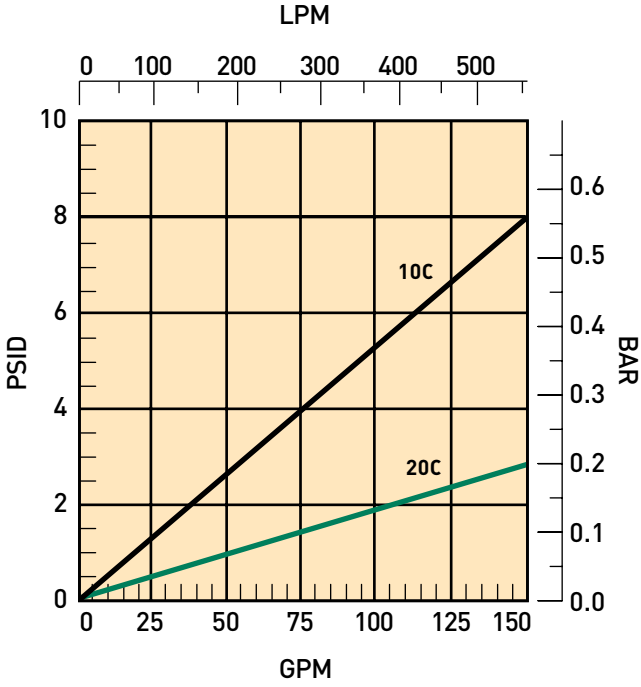
Flow vs. Pressure Loss





Flow vs. Pressure Loss





Specifications: RFP, ILP

Pressure Ratings:
Maximum Allowable Operating Pressure (MAOP): 200 psi (13.8 bar)
Design Safety Factor: 2:1
Rated Fatigue Pressure: 150 psi (10.3 bar)

Element Burst Rating: 70 psid (4.8 bar)

Filter Materials:
Head, Cover, Flanges: die cast aluminum
Bowl: steel

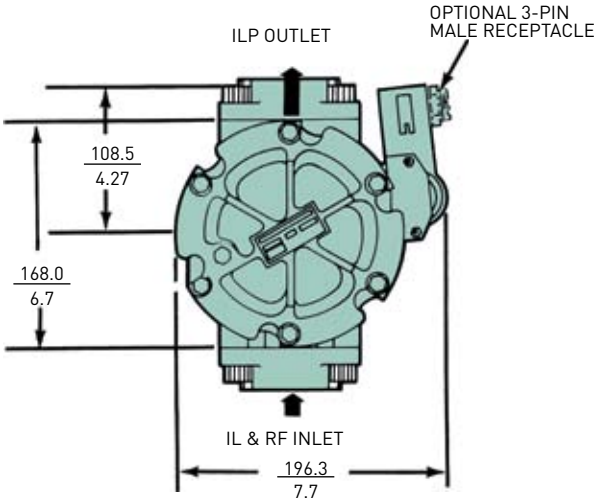
Operating Temperatures:
Nitrile: -40°F to 225°F (-40°C to 107°C)
Fluorocarbon: -15°F to 275°F (-26°C to 135°C)

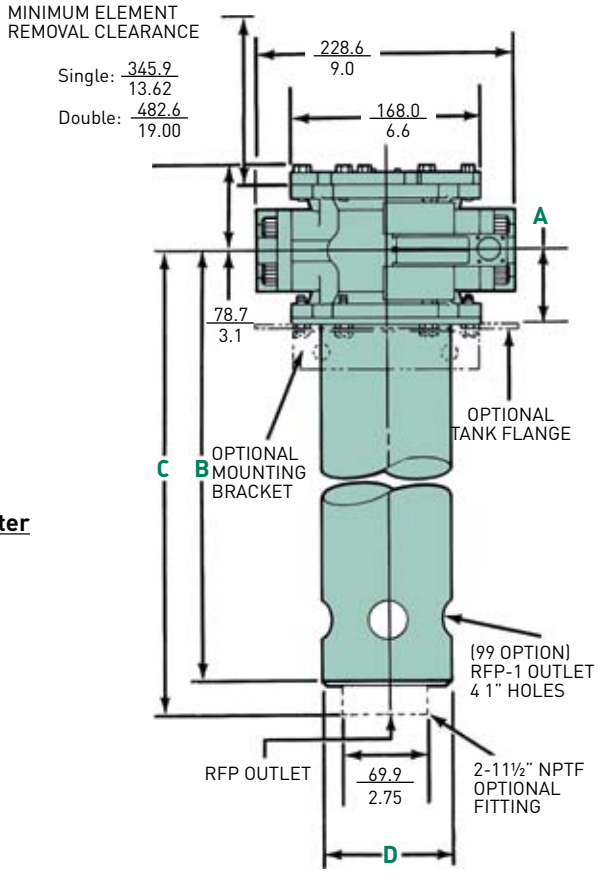
Weight (approximate):
Single: 20 lbs. (9.1 kg)
Double: 25 lbs. (11.3 kg)

Indicators:
Visual (optional)
Electrical (optional) 15A @ 250VAC / .5A @ 125 VDC
Electrical ("D" option) 5A @ 250VAC / 3A @ 28 VDC

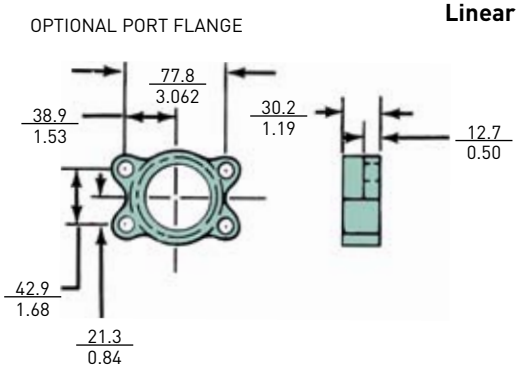
Color Coding:
White (normally closed)
Red (normally open)
Black (common)

	Dimensions: mm / inch			
Model	**A**	**B**	**C**	**D**
RFP-1 without optional 2" fitting	65.0 / 2.56	330.2 / 13.0	—	110.0 / 4.3
ILP-1	65.0 / 2.56	330.2 / 13.0	N/A	110.0 / 4.3
RFP-1 with optional 2" fitting	68.3 / 2.69	—	383.4 / 15.07	114.0 / 4.5
RFP-2	68.3 / 2.69	617.5 / 24.31	623.8 / 24.56	114.0 / 4.5
ILP-2	68.3 / 2.69	617.5 / 24.31	N/A	114.0 / 4.5





Linear Measure: millimeter / inch



Specifications: DILP

Pressure Ratings:
Maximum Allowable Operating Pressure (MAOP): 200 psi (13.8 bar)
Design Safety Factor: 2:1
Rated Fatigue Pressure: 150 psi (10.3 bar)

Element Burst Rating: 70 psid (4.8 bar)

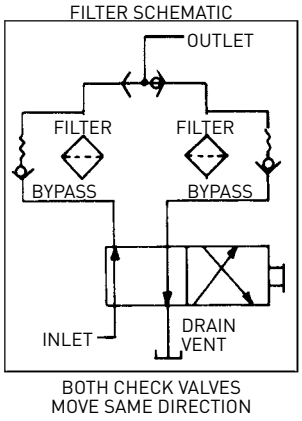
Filter Materials:
Diverter Valve Assembly: die cast aluminum
Check Valve Assembly: die cast aluminum
Filter Assembly: see IL2 specifications

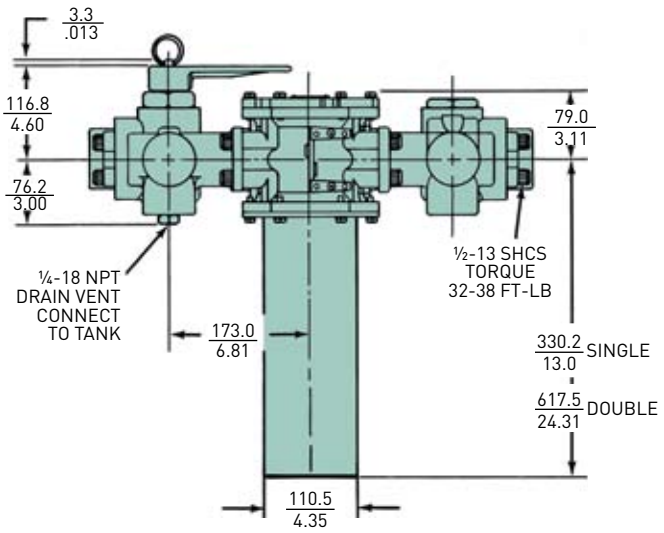
Operating Temperatures:
Nitrile: -40°F to 225°F (-40°C to 107°C)
Fluorocarbon: -15°F to 275°F (-26°C to 135°C)

Weight (approximate):
Single: 55 lbs. (24.9 kg) / Double: 65 lbs. (29.5 kg)

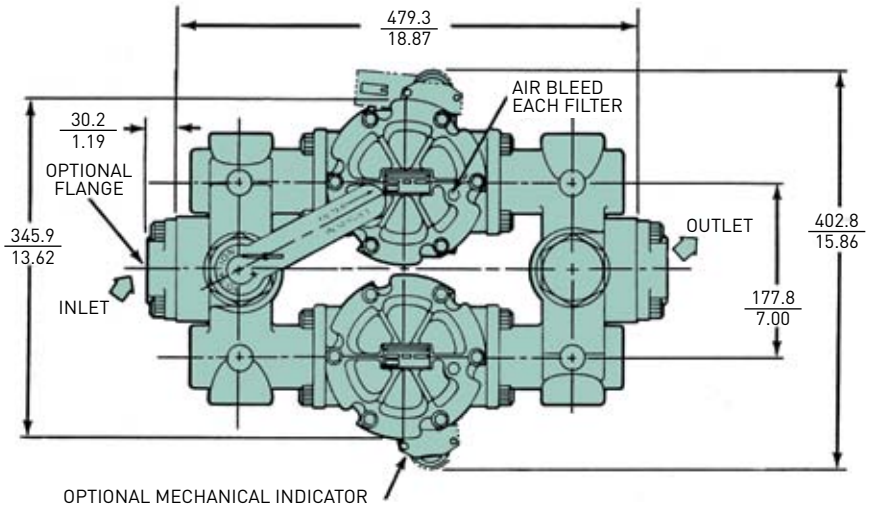
Indicators:
Visual (optional)
Electrical (optional) 15A @ 250VAC / .5A @ 125 VDC
Electrical ("D" option) 5A @ 250VAC / 3A @ 28 VDC

Color Coding:
White (normally closed)
Red (normally open)
Black (common)

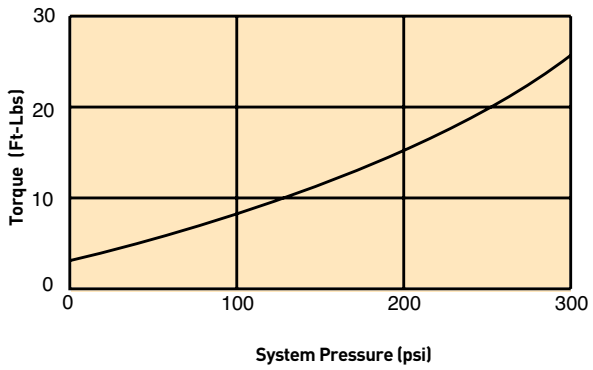




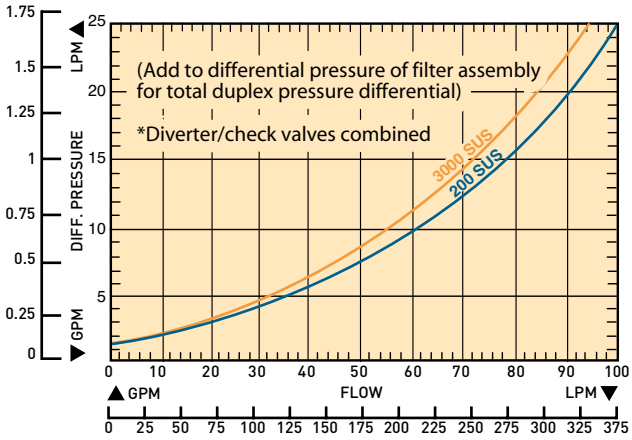
Linear Measure: millimeter / inch



Approximate handle torque required for changeover.



Typical Flow/Pressure Curves For Duplex Valves



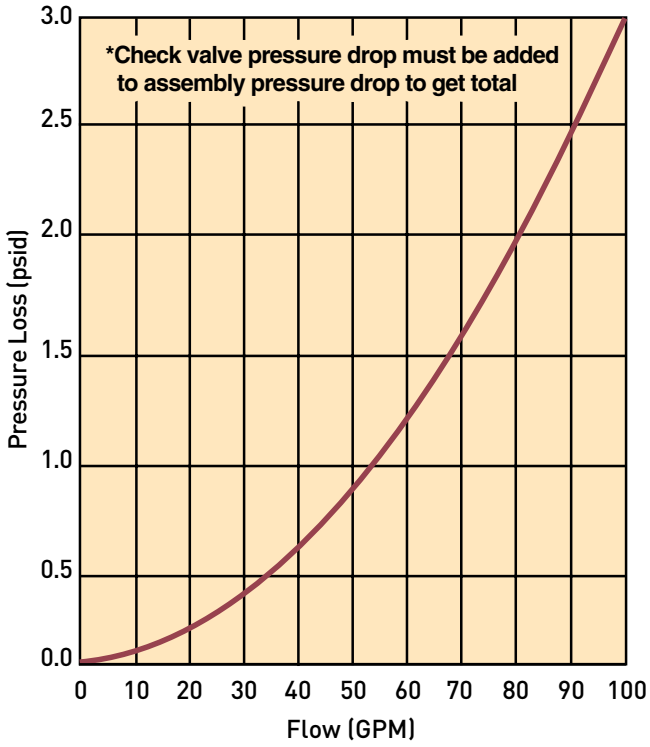
Submersible Option

When there is a limited amount of space on the top of the reservoir, the Moduflow filter can be mounted in the side of a reservoir.

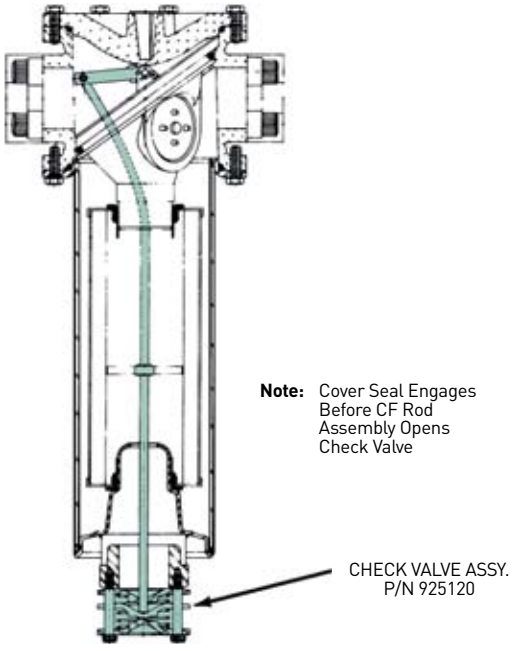
A check valve mounted on the filter bowl prevents the reservoir from being drained during servicing of the element. The only fluid drained is from the inside of the filter housing.

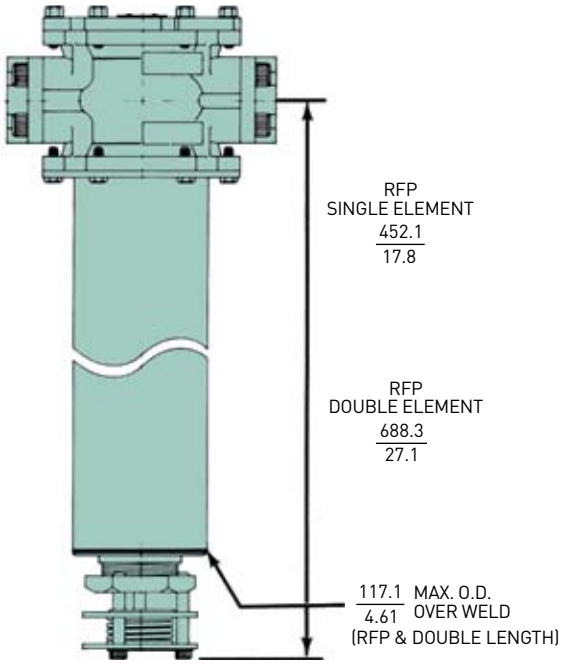
For return line applications (RFP), the fluid returning to the reservoir holds the check valve open. When the system is shut down, the check valve closes automatically.

Check Valve Flow/Pressure Drop



Linear Measure: millimeter / inch

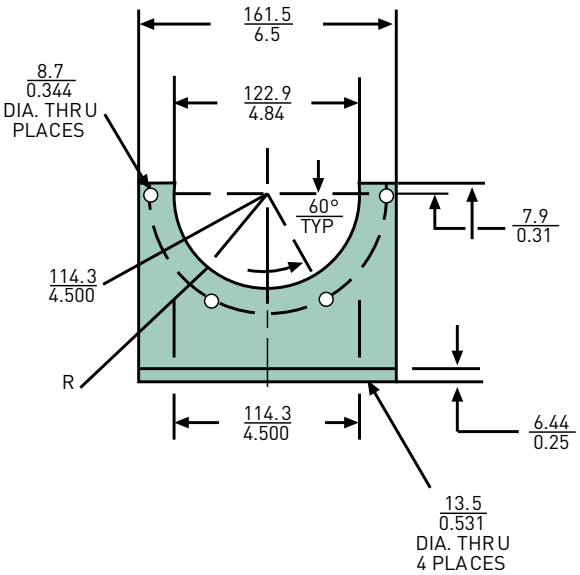


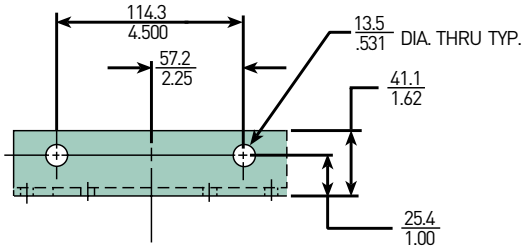


Accessories

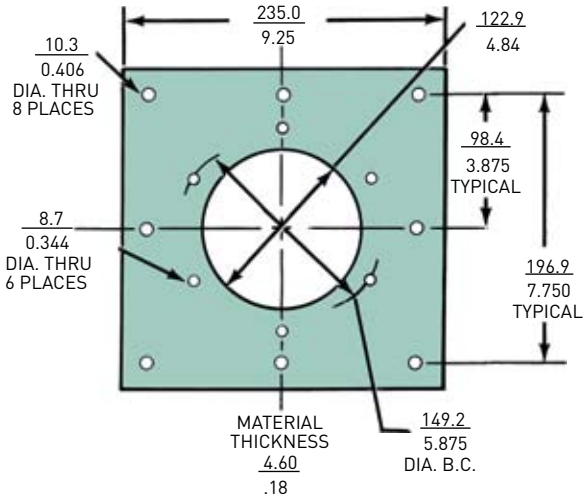
Linear Measure: millimeter / inch

OPTIONAL MOUNTING BRACKET (924904)





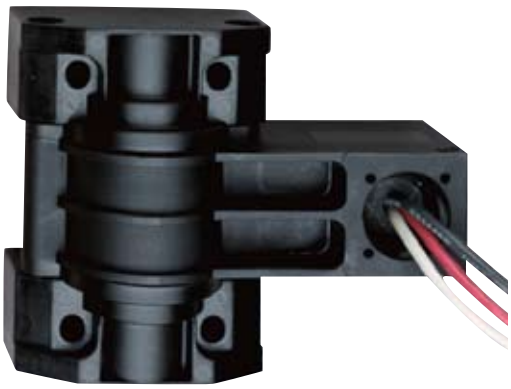
OPTIONAL TANK FLANGE (925167)



"M" OPTION-VISUAL INDICATOR, NO ELEMENT WARNING

"V" OPTION-VISUAL INDICATOR

"E" OPTION-ELECTRICAL INDICATOR



Lower Cost than many single unit filters.

Moduflow™ Manifold Extended Filter Range

Use Model MM Manifold to handle return line flows up to 130 gpm.

- Rated static pressure: 300 psi
- Typical burst pressure: 900 psi
- 23 Porting options
- 6 Gage port options
- Easily mounted on ModuFlow™

High Flows At Low Cost

The model MM manifold is designed to extend the flow range of ModuFlow™ Filters when operating with 10 Micron and finer filter media. When mounted to a pair of RFP-2 or ILP-2 filters, this manifold will allow flows up to 130 gpm in return lines (15 fps velocity).
Note: The Model MM manifold is not applicable to suction lines due to its pressure drop characteristics.

When used with two ModuFlow™ filters, the total cost is often less than a single unit filter rated for 130 gpm flow. Tank-top mounted (Model RFP) filters will require only one manifold on the filter inlet pports. In-line mounted (Model ILPav) filters will require two manifolds, one on the inlet and one on the outlet ports.

Multiple Uses

Although designed for manifold ModuFlow™ filters, the Model MM can be used in a variety of applications which require:

- Splitting flow between components
- Connecting multiple lines to a single component

Such applications are frequently encountered on mobile equipment, machine tools, and large lubricating systems. In such applications, use of a manifold can often reduce total piping and installation costs. With 23 porting options, Model MM manifolds will fulfill a wide variety of needs. See "How-To-Order" and installation drawings for port sizes and location options.

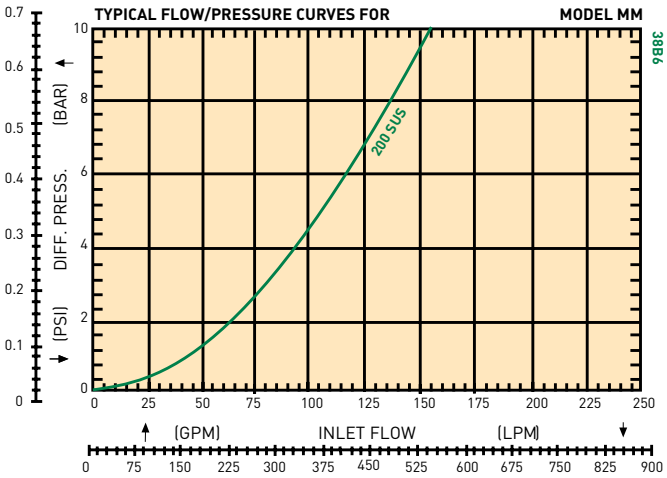
Proven Reliability

The rugged design of the Model MM manifold has been proven in demanding mobil equipment applications, At the factory, we have cycle tested the Model MM through the full range of rated flow and pressure to insure reliable service.

Parker Filter Division maintains the same high standards in delivery, quality, and service. Considering this, plus features, flexibility, price, and performance, the Model MM manifold is a valuable addition to your fluid power component list.

For off-the-shelf delivery, contact your local Parker stocking distributor or Parker Hannifin Corporation, Filter Division, 16810 Fulton County Road #2, Metamora, OH 43540, (419) 644-4311.

FLOW/PRESSURE CURVE



SPECIFICATIONS

Rated Static Pressure, maximum:
20.7 bar (300 psi)
Typical Burst Pressure:
62.1 bar (900 psi)
Operating Temperature (Buna seals):
+121°C to —40°C (+250°F to 40°F)

Housing Material:
ANSI 356-T6 cast aluminum
Approximate Shipping Weight:
3.6 kg (8 lbs)
Porting: See Options Below

Order Screws and O-Rings Seperately:
Inlet & outlet screws (12 required):
Order P/N 900228
Outlet port o-rings (2 required):
Nitrite: Order P/N N72228
Fluorocarbon: Order P/N V92228

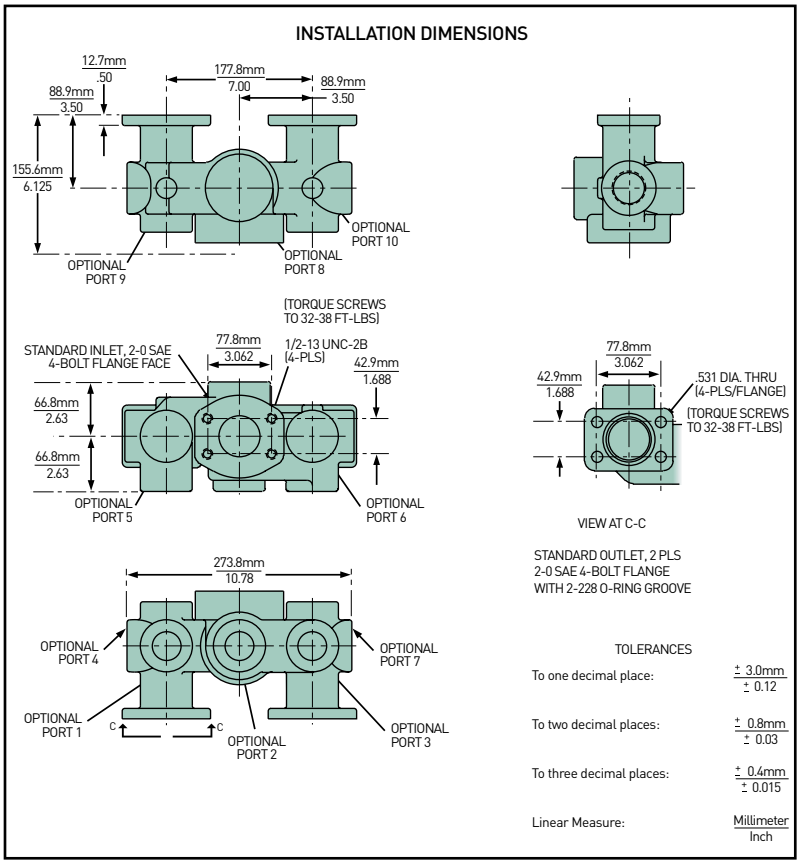
HOW TO ORDER MANIFOLDS: Select desired port option number for each box.

Model		BOX 1	BOX 2	BOX 3	BOX 4	BOX 5	Box 6	BOX 7	BOX 8	BOX 9	BOX 10
	MM										

ORDERING INSTRUCTIONS

1. Insert option number into appropriate box for each of the port options selected.
2. If standard inlet and outlets are the only ports needed, insert the number "0" in Box 1 and leave the rest blank.
3. Order port o-rings and screws as listed under specifications.
4. If standard inlet will not be used, order blank flange kit, P/N 924781 to seal this port, and order only 8 outlet port screws, P/N 900228.
5. Using manifolds with ModuFlow™ filters:*
   a. Calculate flow through each filter by dividing manifold inlet flow in hlaf.
   b. Find pressure drop across each filter using Catalog 2300 data for the flow found in (a.)
   c. Calculate total energy losses by adding energy loss calculated from manifold flow/ pressure curve.
   d. Find overall installation dimensions by adding manifold dimensions to those in Catalog 2300.

* Tank-top mounted RFP filters will require one manifold on filter inlets: in-line mounted ILP filters will require two manifolds on both inlets and outlets.



OPTION NUMBER	OPTIONAL PORTS									
	1	2	3	4	5	6	7	8	9	10
0	--	--	--	--	--	--	--	--	--	--
1	1-¼ SAE-20	1-¼ SAE-20	1-¼ SAE-20	1-¼ SAE-20	1-¼ SAE-20	1-¼ SAE-20	1-¼ SAE-20	1-¼ SAE-20	5/16 SAE-5	5/16 SAE-5
2	1-¼–11-½ NPTF-1	1-¼–11-½ NPTF-1	1-¼–11-½ NPTF-1	1-¼–11-½ NPTF-1	1-¼–11-½ NPTF-1	1-¼–11-½ NPTF-1	1-¼–11-½ NPTF-1	1-¼–11-½ NPTF-1	1/8-27 NPTF-1	1/8-27 NPTF-1
3	--	--	--	--	--	--	--	1-½ SAE-24	¼–18 NPTF-1	¼-18 NPTF-1
4	--	--	--	--	--	--	--	1-½–11 NPTF-1	--	--
5	--	--	--	--	--	--	--	2-0 SAE-32	--	--
6	--	--	--	--	--	--	--	2-0 –11-½ NPTF-1	--	--

Flange Kits (flange, 4 bolts, o-ring)

Size	Code	Part Number	
		Buna	Fluorocarbon
¾ inch NPTF	YB	924788	926013
1 inch NPTF	YC	924787	926012
1¼ inch NPTF	YD	924912	926004
1½ inch NPTF	YE	924786	926011
2 inch NPTF	YF	924785	926010
SAE - 12	YM	924784	926009
SAE - 16	YN	924783	926008
SAE - 20	YO	924913	926005
SAE - 24	YP	924782	926007
BLANK FLANGE	—	924782	926006

RFP / ILP / DILP Replacement Elements

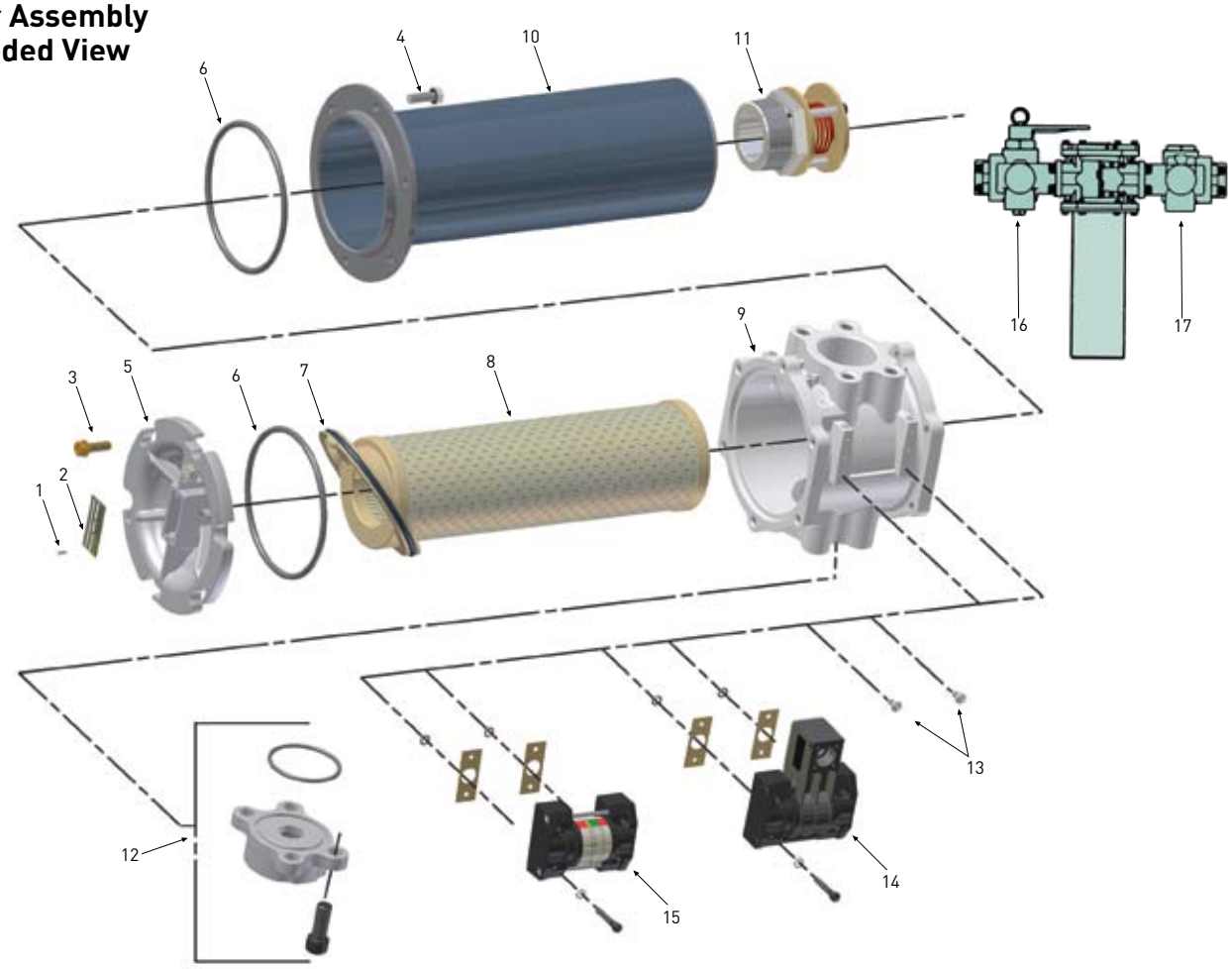
Media	Nitrile Seals				Fluorocarbon Seals			
	New Single	Replaces Old Single	New Double	Replaces Old Double	New Single	Replaces Old Single	New Double	Replaces Old Double
02Q	937393Q	932686Q	937397Q	932692Q	937401Q	932689Q	937405Q	932695Q
05Q	937394Q	932687Q	937398Q	932693Q	937402Q	932690Q	937406Q	932696Q
10Q	937395Q	932688Q	937399Q	932694Q	937403Q	932691Q	937407Q	932697Q
20Q	937396Q	933116Q	937400Q	933117Q	937404Q	933118Q	937408Q	933119Q

Parts List

Index	Description	Part No.	Quantity
1	**Screws**, Nameplate	900028	2
2	**Name Plate**, Unstamped	920928	1
3	**Cover Screws**, 5/16-18 UNC x 1"..	926633	6
4	**Bowl Screws**, 5/16-18 UNC x 1"...	926633	6
5	**Cover**, Without nameplate	924634	1
6	**O-Ring**, cover		
	Nitrile	N72350	2
	Fluorocarbon	V72350	2
7	**Element Seal**		
	Nitrile	937410	1
	Fluorocarbon	937411	1
8	**Element**	Refer to Table	1
9	**Head,** Machined only		1
	2" SAE Flange	925972	1
	1½"SAE Flange	926164	1
	1½" NPTF	925949	
10	**Bowl,** Select desired model		1
	ILP-1	925916	
	ILP-2	924816	
	RFP-1	937626	
	RFP-1 with 2 inch NPTF fitting	924676	
	RFP-2	937627	
	RFP-2 with 2 inch NPTF fitting	924818	

Index	Description	Part No.	Quantity
11	**Check Valve Assy.**	925120	1
12	**Flange Kits**	Refer to Table	1
13	**Plug Kit,** Fastener, self-sealing, o-ring seal included with fastener	925974	2
14	**Indicator Electrical**		Optional
	35 psid	926643	
	35 psid, 3-pin male receptacle	926753	
15	**Indicator Visual**		Optional
	35 psid 4-band	926748	
	Flange, In-tank mounting	925167	Optional
	Bracket, Inline mounting	924904	Optional
	Indicator Kit, Remote mount	924894	Optional
16	**Changeover Valve Assy.,** Duplex	926758	Optional
17	**Check Valve Assy.,** Duplex	926757	Optional
Not Shown	**Drain Plug,** SAE-24 for RFP model		
	Nitrile	909992	1
	Fluorocarbon	928363	1

Filter Assembly Exploded View



Low Pressure Filters

Moduflow™ *Plus* Series

HOW TO ORDER: Select the desired symbol (in the correct position) to construct a model code.

Example:

BOX 1	BOX 2	BOX 3	BOX 4	BOX 5	BOX 6	BOX 7	BOX 8
ILP	1	10Q	B	MP	35	Y9Y9	1

BOX 1: Filter Series Symbol	Description
RFP	Return-line filter, inlet on side outlet on bottom
ILP	In-line filter
DILP	In-line duplex

BOX 2: Element Length Symbol	Description
1	Single
2	Double

BOX 3: Media Code Symbol	Description
02Q	Microglass III, 2 micron
05Q	Microglass III, 5 micron
10Q	Microglass III, 10 micron
20Q	Microglass III, 20 micron
WR	Water Removal

BOX 4: Seals Symbol	Description
B	Nitrile
E	EPR
V	Fluorocarbon

BOX 5: Indicator Symbol	Description
P	Pressure ports drilled & plugged only; no indicator
M	Visual indicator w/"no element" warning
E	Electrical indicator only
D	Electrical indicator only, 3-pin male receptacle

Note: First letter of indicator code = left side of filter head when looking into inlet with bowl down; second letter = right side of filter head when looking into inlet with bowl down.

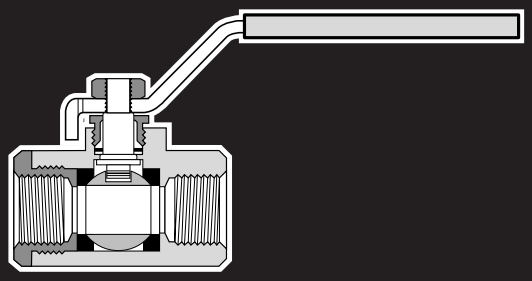
BOX 6: Bypass Setting Symbol	Description
35	35 psid

BOX 7: Port Options

Filter Model	Inlet Symbol/Description		Outlet Symbol/Description	
RFP	Y9	2" flange face	**99**	**No fitting**
	P9	**SAE-24 integral threads**	F9	2" NPTF
	E9	1½ NPTF integral threads	F8	External check valve
ILP	**Y9**	**2" flange face**	**99**	**No fitting**
	P9	SAE-24 integral threads	P9	SAE-24 integral threads
	E9	1½ NPTF integral threads	E9	1½ NPTF integral threads
DILP	**Y9**	**2" flange face**	**Y9**	**2" flange face**

1) First pair of symbols denotes inlet for all filter styles; second pair of symbols denotes outlet.
2) Four symbols required: two for inlet, two for outlet.
3) Unused ports in filters come plugged with a blank flange.
4) See Flange Kits table for port flange options. Flange Kits are ordered separately.

BOX 8: Options Symbol	Description
1	None



Brass Ball Valves Series 500

Advantages

Parker's forged body ball valve provides extended service life and resists failure caused by severe temperature applications. Optimum flow design assures maximum system efficiency. Highly inert PTFE seats and seals provide resistance to chemical corrosion. Parker also provides a blow-out proof stem, chrome plated brass ball and a specially designed handle enabling increased turning leverage for ease of opening and closing. Parker's ball valve can be readily identified assuring high quality engineering and reliability. This economical ball valve is available in female pipe sizes. Parker's ball valve bodies are machined from high quality CA 377 forgings.

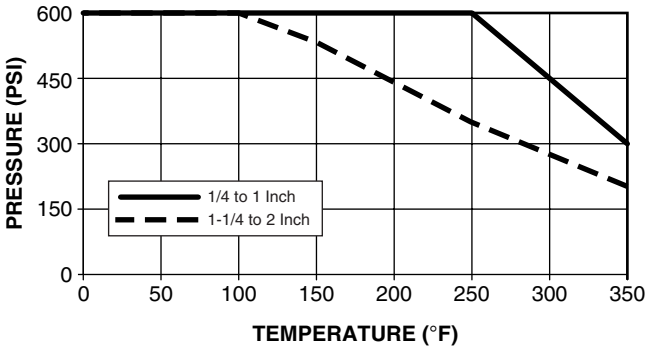
Applications

Parker's industrial ball valve product line is intended for general purpose use. Please be aware that ball valves are intended for use in the fully open or closed positions. Depending on application conditions, throttling of the valve may result in premature seal failure and/or inability to turn the valve handle.

For use as fuel line shutoffs for gasoline and diesel powered over the highway, off highway, and construction equipment vehicles. Water and air service lines on capital equipment and plant design plumbing that require total shutoff capability.

Working Pressure and Temperature

Saturated steam service up to 150 PSI and 400° F
Vacuum, 29 Inches of Mercury
Vented up to 250 PSI



Operating Instructions

Quarter turn is "ON" or "OFF".
(Provides positive stop action for full shutoff.)

NOTE: PERIODICALLY CHECK THE ADJUSTABLE PACKING NUT AND TIGHTEN AS REQUIRED.

Style	Type	Material	Size	Options
V	**500**	**P**	**-4**	**-00**
Style	V-Valve VP-Valve, Padlocking Handle VV-Valve, Vented VVP-Valve, Vented, Padlocking Handle			
Type	500-Female/Female PTF Ports			
Material	P- Brass PN-Nickel Plated			
Size	4-1/4" 6-3/8" 8-1/2" 12-3/4" 16-1"			
Options	01-Stainless Steel Ball & Stem 02-Stainless Steel Handle & Nut 03-Stainless Steel Ball, Stem, Handle & Nut 04-Tee Handle 08-Unmarked Yellow Vinyl Handle Cover 21-Oval Handle			

Style	Type	Material	Size
V	**500**	**P**	**-20**
Style	V-Valve VP-Valve, Padlocking Handle		
Type	500-Female/Female PTF Ports		
Material	P- Brass		
Size	20-1 1/4" 24-1 1/2" 32-2"		

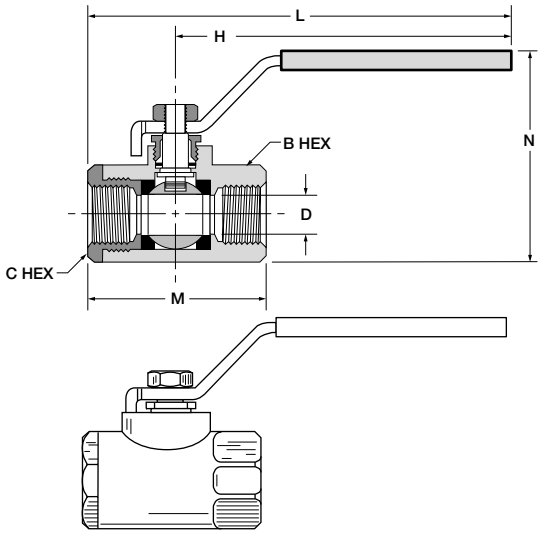
Flow Data

VALVE SIZE	CV
1/4	4.0
3/8	5.8
1/2	12.0
3/4	25.0
1	35.0
1-1/4	57.0
1-1/2	92.0
2	224.0

Female-Female Pipe Ends XV500P

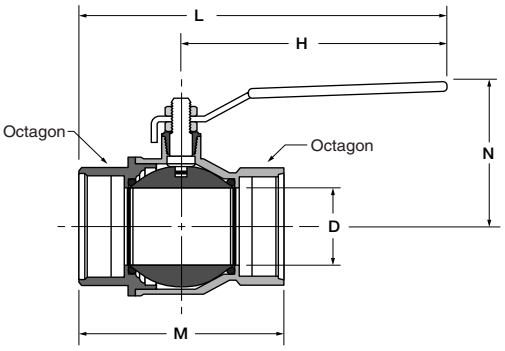
PART NO.	PIPE THREAD [PTF]	B HEX	C HEX	H	L	M	N	FLOW DIA.D
XV500P-4	1/4	15/16	15/16	3.96	4.90	2.03	2.47	.375
XV500P-6	3/8	15/16	15/16	3.96	4.90	2.03	2.47	.375
XV500P-8	1/2*	1-1/16	1-1/16	3.96	5.00	2.20	2.58	.500
XV500P-12†	3/4**	1-1/4	1-5/16	3.96	5.25	2.42	2.81	.685
XV500P-16†	1**	1-1/2	1-9/16	3.96	5.34	2.75	3.08	.875

† Available in Full Flow Panel Mount see XV508P Series



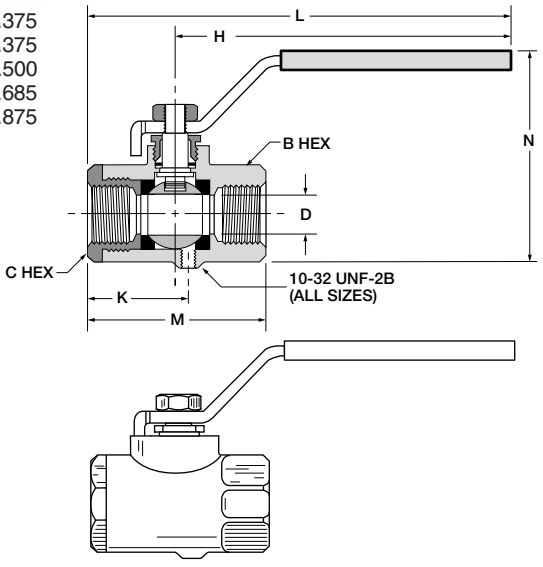
Female-Female Pipe Ends XV500P-20, XV500P-24, XV500P-32

PART NO.	PIPE THREAD [NPT]	OCTAGON	H	L	M	N	FLOW DIA.D
XV500P-20	1-1/4	1.93	6.22	8.05	3.66	3.01	1.18
XV500P-24	1-1/2	2.13	6.22	8.23	4.02	3.25	1.50
XV500P-32	2	2.69	6.22	8.58	4.76	3.52	1.89



Vented, Female Pipe Ends XVV500P

PART NO.	PIPE THREAD	B HEX	C HEX	K	H	L	M	N	D FLOW Ø
XVV500P-4	1/4	15/16	15/16	1.11	3.96	4.90	2.03	2.47	.375
XVV500P-6	3/8	15/16	15/16	1.11	3.96	4.90	2.03	2.47	.375
XVV500P-8	1/2*	1-1/16	1-1/16	1.23	3.96	5.00	2.20	2.58	.500
XVV500P-12	3/4**	1-1/4	1-5/16	1.45	3.96	5.25	2.42	2.81	.685
XVV500P-16	1**	1-1/2	1-9/16	1.58	3.96	5.34	2.75	3.08	.875



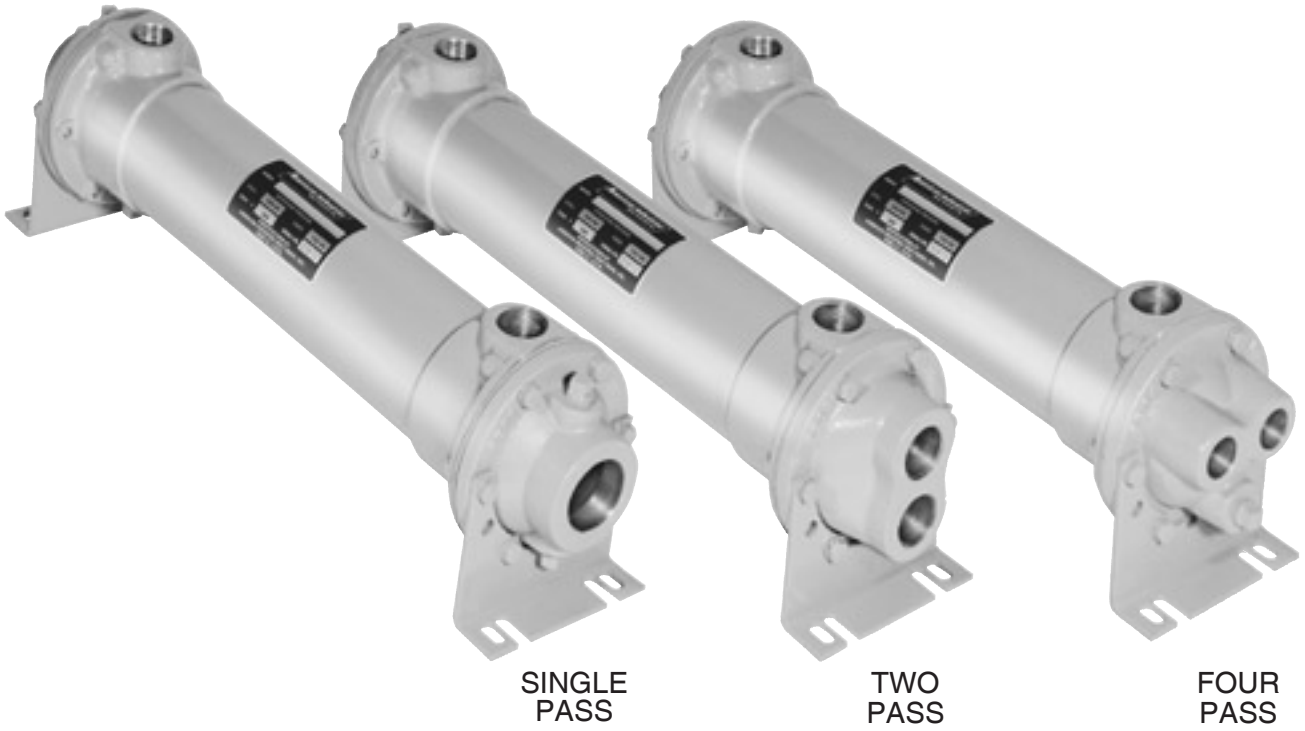
*PTF special short. **PTF special extra short

J

American Industrial Heat Transfer Inc.®

Manufacturer of Quality Heat Exchangers

AB - SAE - STS - EAB SERIES



Fixed Tube Bundle / Liquid Cooled

HEAT EXCHANGERS

- Operating pressure for tubes 150 PSI.
- Operating pressure for shell 300 PSI.
- Operating temperature 300 °F.
- Can be customized to fit your needs.
- Cools: Fluid power systems, rock crushers, presses, shears, lubrication equipment for paper machinery, gear drives, marine transmissions, etc.

note: AIHTI reserves the right to make reasonable design changes without notice.
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AB, SAE, STS, & EAB Series *overview*

AB Series

Fixed tube construction heat exchangers with NPT connections. Made of brass with copper cooling tubes and cast iron end bonnets. Standard sizes from 2" through 8" diameters, and from 1.4 to 308 sq.ft. Standard one, two, and four pass models are available. Options include 90/10 copper nickel and 316 stainless steel cooling tubes, bronze bonnets and zinc anodes. Can be customized to fit your requirements.

Optional 10" diameter units in brass are available upon request.

SAB Series

Similar to AB series with the exception of steel shell material. For use in applications where the shell fluid is non-corrosive with steel. Offered in 5" through 8" shell diameter.

SAE Series

Similar to AB series with the exception of the shell ports. SAE series from 2" through 6" diameter has SAE O-ring strait thread shell port connections. Size 8" diameter has SAE code 61 four bolt flange shell port connections.

SSAE Series

Similar to SAE series with the exception of steel shell material. For use in applications where the shell fluid is non-corrosive with steel. *Offered in 5" through 8" shell diameter.*

STS Series

Similar in design to AB series with fixed tube construction and NPT connections made of all 316 stainless steel. Standard sizes from 2" through 8" diameters, and from 1.4 to 308 sq.ft. Standard one, two and four pass models are available. Larger diameters available upon request. Can be customized to fit your requirements.

EAB Series

Expansion bellow minimizes the effects of differential expansion and contraction between the shell and cooling tubing, prolonging the overall life of the heat exchanger by reducing fatigue. Fixed tube construction heat exchangers with NPT connections. Made of brass with 90/10 copper nickel cooling tubes, stainless steel expansion bellows, and cast iron end bonnets. Standard sizes from 3.5" through 8" diameters, and from 3.6 to 308 sq.ft. Standard one, two and four pass models are available.

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TUBE JOINT
Roller expanded tube joint to integral forged hub.

THREAD
CNC precision threading to provide accurate leak-proof connections.

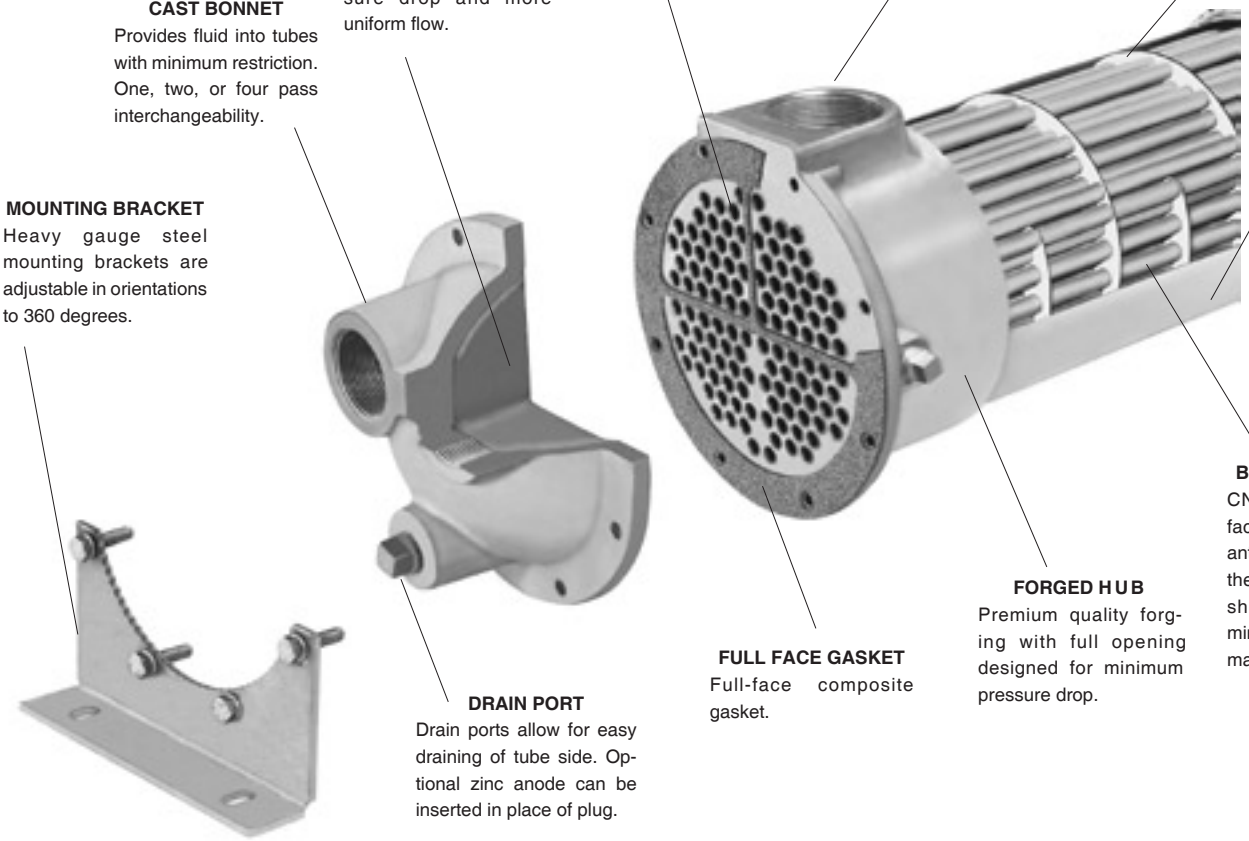
BAFFLES
CNC manufactured baffles to provide maximum turbulence and heat transfer with a minimum fluid pressure drop.

FLOW CAVITY
Generously sized to allow for minimum pressure drop and more uniform flow.

CAST BONNET
Provides fluid into tubes with minimum restriction. One, two, or four pass interchangeability.

FINISH
Gray semigloss enamel. Can be used as a base for additional coats.

MOUNTING BRACKET
Heavy gauge steel mounting brackets are adjustable in orientations to 360 degrees.



BUNDLE ASSEMBLY
CNC precision manufactured parts to guarantee a close fit between the baffles, tubes, and shell. Clearances are minimized to provide for maximum heat transfer.

FORGED HUB
Premium quality forging with full opening designed for minimum pressure drop.

FULL FACE GASKET
Full-face composite gasket.

DRAIN PORT
Drain ports allow for easy draining of tube side. Optional zinc anode can be inserted in place of plug.

UNIT CODING

Example Model

Options

AB - 1204 - C 4 - TP - CNT - B - Z

Model	Shell Diameter	Effective Tube Length (9" increments)	Baffle Spacing Code	Cooling Tube Diamenter	Tube Side Passes	Tubing	End Bonnets	Zinc Anode
AB	400 = 2.13"		A = 1 1/8"	4 = 1/4"	SP = 1 pass	Blank = Copper	Blank = Cast Iron	Z = 1 Zinc Anode
SAB	700 = 3.65"		B = 2 1/4"	6 = 3/8"	TP = 2 pass	*Options*		2Z = 2 Zinc Anode etc.
SAE	1000 = 5.13"		C = 4 1/2"	10 = 5/8"	FP = 4 pass	CNT= 90/10 Cu Ni	*Options*	
SSAE	1200 = 6.13"		D = 9 "			STS = Stainless Steel	B = Bronze	
STS	1600 = 8.00"		E = 18 "			C = Carbon Steel		
EAB								

STANDARD CONSTRUCTION MATERIALS & RATINGS

Standard Model	AB Series	SAB & SSAE Series*	SAE Series	STS Series	EAB Series	Standard Unit Ratings
Shell	Brass	Steel	Brass	316 Stainless Steel	Steel	Operating Pressure
Tubes	Copper	Copper	Copper	316 Stainless Steel	90/10 Copper Nickel	Tubes.....150 psig
Baffle	Brass	Steel	Brass	316 Stainless Steel	Brass	
Integral End Hub	Forged Brass	Forged Brass	Forged Brass	316 Stainless Steel	Forged Brass	Operating Pressure
End Bonnets	Cast Iron	Cast Iron	Cast Iron	316 Stainless Steel	Cast Iron	Shell.....300 psig
Mounting Brackets	Steel	Steel	Steel	Steel	Steel	
Gasket	Hypalon Composite	Hypalon Composite	Hypalon Composite	Hypalon Composite	High Temp Gasket	Operating Temperature
Expansion Bellows	–	–	–	–	Stainless Steel	300 °F

*Offered in 5" through 8" shell diameter.

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AB, SAE, STS, & EAB Series *selection*

STEP 1: Calculate the heat load

The heat load in BTU/HR or (Q) can be derived by using several methods. To simplify things, we will consider general specifications for hydraulic system oils and other fluids that are commonly used with shell & tube heat exchangers.

Terms

GPM = Gallons Per Minute
CN = Constant Number for a given fluid
△T = Temperature differential across the potential
PSI = Pounds per Square Inch (pressure) of the operating side of the system
MHP = Horsepower of the electric motor driving the hydraulic pump
Kw = Kilowatt (watts x 1000)
T_{in} = Hot fluid entering temperature in °F
T_{out} = Hot fluid exiting temperature in °F
t_{in} = Cold fluid temperature entering in °F
t_{out} = Cold fluid temperature exiting in °F
Q = BTU / HR

For example purposes, a hydraulic system has a 125 HP (93Kw) electric motor installed coupled to a pump that produces a flow of 80 GPM @ 2500 PSIG. The temperature differential of the oil entering the pump *vs* exiting the system is about 5.3°F. Even though our return line pressure operates below 100 psi, we must calculate the system heat load potential (Q) based upon the prime movers (pump) capability. We can use one of the following equations to accomplish this:

To derive the required heat load (Q) to be removed by the heat exchanger, apply ONE of the following. Note: The calculated heat loads may differ slightly from one formula to the next. This is due to assumptions made when estimating heat removal requirements. The factor *(v)* represents the percentage of the overall input energy to be rejected by the heat exchanger. The *(v)* factor is generally about 30% for most hydraulic systems, however it can range from 20%-70% depending upon the installed system components and heat being generated (ie. servo valves, proportional valves, etc…will increase the percentage required).

Formula	Example
A) Q = GPM x CN x actual △T	A) Q =80 x 210 x 5.3°F = 89,040 BTU/HR
B) Q = [(PSI x GPM) / 1714] x (*v*) x 2545	B) Q =[(2500x80)/1714] x .30 x 2545 = 89,090 BTU/HR
C) Q = MHP x (*v*) x 2545	C) Q =125 x .30 x 2545 = 95,347 BTU/HR
D) Q = Kw to be removed x 3415	D) Q =28 x 3415 = 95,620 BTU/HR
E) Q = HP to be removed x 2545	E) Q =37.5 x 2545 = 95,437 BTU/HR

Constant for a given fluid (CN)

1) Oil ..... CN = 210
2) Water..... CN = 500
3) 50% E. Glycol..... CN = 450

STEP 2: Calculate the Mean Temperature Difference

When calculating the MTD you will be required to choose a liquid flow rate to derive the cold side △T. If your water flow is unknown you may need to assume a number based on what is available. As a normal rule of thumb, for oil to water cooling a 2:1 oil to water ratio is used. For applications of water to water or 50 % Ethylene Glycol to water, a 1:1 ratio is common.

Formula

$$\textbf{HOT FLUID Oil } \triangle T = \frac{Q}{CN \times GPM}$$

$$\textbf{COLD FLUID Water } \triangle t = \frac{BTU / hr}{CN \times GPM}$$

Example

$$\triangle T = \frac{89{,}090\ BTU/hr}{210\ CN \times 80GPM} \text{ (from step 1,example B)} = 5.3°F = \triangle T \text{ Rejected}$$

$$\triangle t = \frac{89{,}090\ BTU/hr}{500\ CN \times 40GPM \text{ (for a 2:1 ratio)}} = 4.5°F = \triangle t \text{ Absorbed}$$

T_{in} = Hot Fluid entering temperature in degrees F
T_{out} = Hot Fluid exiting temperature in degrees F
t_{in} = Cold Fluid entering temperature in degrees F
t_{out} = Cold Fluid exiting temperature in degrees F

$T_{in} = 125.3$ °F
$T_{out} = 120.0$ °F
$t_{in} = 70.0$ °F
$t_{out} = 74.5$ °F

$$\frac{T_{out} - t_{in}}{T_{in} - t_{out}} = \frac{S\text{[smaller temperature difference]}}{L\text{ [larger temperature difference]}} = \left(\frac{S}{L}\right)$$

$$\frac{120.0°F - 70.0°F = 50.0°F}{125.3°F - 74.5°F = 50.8°F} = \frac{50.0°F}{50.8°F} = .984$$

STEP 3: Calculate Log Mean Temperature Difference (LMTD)

To calculate the LMTD please use the following method;

L = Larger temperature difference from step 2.
M = S/L number (LOCATED IN TABLE A).

$LMTD_i = L \times M$

$LMTD_i = 50.8 \times .992$ (FROM TABLE A) = 50.39

To correct the $LMTD_i$ for a multipass heat exchangers calculate **R** & **K** as follows:

Formula

$$R = \frac{T_{in} - T_{out}}{t_{out} - t_{in}}$$

$$K = \frac{t_{out} - t_{in}}{T_{in} - t_{in}}$$

Example

$$R = \frac{125.3°F - 120°F}{74.5°F - 70°F} = \frac{5.3°F}{4.5°F} = \textbf{\{1.17=R\}}$$

$$K = \frac{74.5°F - 70°F}{124.5°F - 70°F} = \frac{4.5°F}{55.4°F} = \textbf{\{0.081=K\}}$$

Locate the correction factor CF_B (FROM TABLE B)
$LMTD_c = LMTD_i \times CF_B$
$LMTD_c = 50.39 \times 1 =$ **50.39**

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STEP 4: Calculate the area required

Required Area sq.ft. = $\frac{\text{Q (BTU / HR)}}{\text{LMTD}_c \text{ x U (FROM TABLE C)}}$ $\frac{89{,}090}{50.39 \text{ x } 100}$ = **17.68 sq.ft.**

STEP 5: Selection

a) From TABLE E choose the correct series size, baffle spacing, and number of passes that best fits your flow rates for both shell and tube side. Note that the tables suggest minimum and maximum information. Try to stay within the 20-80 percent range of the indicated numbers.

Example

Oil Flow Rate = 80 GPM = Series Required from Table E = **1200 Series**
Baffle Spacing from Table E = **C baffle**
Water Flow Rate = 40 GPM = Passes required in 1200 series = **4 (FP)**

b) From TABLE D choose the heat exchanger model size based upon the sq.ft. or surface area in the series size that will accommodate your flow rate.

Example

Required Area = 17.68sq.ft Closest model required based upon sq.ft. & series= **AB-1202-C6-FP**

If you require a computer generated data sheet for the application, or if the information that you are trying to apply does not match the corresponding information, please contact our engineering services department for further assistance.

TABLE A- FACTOR M/LMTD = L x M

S/L	M	S/L	M	S/L	M	S/L	M
		.25	.541	.50	.721	.75	.870
.01	.215	.26	.549	.51	.728	.76	.864
.02	.251	.27	.558	.52	.734	.77	.879
.03	.277	.28	.566	.53	.740	.78	.886
.04	.298	.29	.574	.54	.746	.79	.890
.05	.317	.30	.582	.55	.753	.80	.896
.06	.334	.31	.589	.56	.759	.81	.902
.07	.350	.32	.597	.57	.765	.82	.907
.08	.364	.33	.604	.58	.771	.83	.913
.09	.378	.34	.612	.59	.777	.84	.918
.10	.391	.35	.619	.60	.783	.85	.923
.11	.403	.36	.626	.61	.789	.86	.928
.12	.415	.37	.634	.62	.795	.87	.934
.13	.427	.38	.641	.63	.801	.88	.939
.14	.438	.39	.648	.64	.806	.89	.944
.15	.448	.40	.655	.65	.813	.90	.949
.16	.458	.41	.662	.66	.818	.91	.955
.17	.469	.42	.669	.67	.823	.92	.959
.18	.478	.43	.675	.68	.829	.93	.964
.19	.488	.44	.682	.69	.836	.94	.970
.20	.497	.45	.689	.70	.840	.95	.975
.21	.506	.46	.695	.71	.848	.96	.979
.22	.515	.47	.702	.72	.852	.97	.986
.23	.524	.48	.709	.73	.658	.98	.991
.24	.533	.49	.715	.74	.864	.99	.995

TABLE B- LMTD correction factor for Multipass Exchangers

R \ K	.05	.1	.15	.2	.25	.3	.35	.4	.45	.5	.6	.7	.8	.9	1.0
.2	1	1	1	1	1	1	1	.999	.993	.984	.972	.942	.908	.845	.71
.4	1	1	1	1	1	1	.994	.983	.971	.959	.922	.855	.70		
.6	1	1	1	1	1	.992	.980	.965	.948	.923	.840				
.8	1	1	1	1	.995	.981	.965	.945	.916	.872					
1.0	1	1	1	1	.988	.970	.949	.918	.867	.770					
2.0	1	1	.977	.973	.940	.845	.740								
3.0	1	1	.997	.933	.835										
4.0	1	.993	.950	.850											
5.0	1	.982	.917												
6.0	1	.968	.885												
8.0	1	.930													
10.0	.996	.880													
12.0	.985	.720													
14.0	.972														
16.0	.958														
18.0	.940														
20.0	.915														

TABLE D- Surface Area

Model Number	Surface Area in Sq.ft. 1/4" O.D Tubing	3/8" O.D Tubing	5/8 O.D Tubing	Model Number	Surface Area in Sq.ft. 1/4" O.D Tubing	3/8" O.D Tubing	5/8 O.D Tubing
AB-401	1.4	–	–	AB-1602	44.4	30.3	17.6
AB-402	3.0	–	–	AB-1603	66.3	45.3	26.5
AB-403	4.6	–	–	AB-1604	88.3	60.3	35.3
				AB-1605	110.3	75.6	44.1
AB-701	3.6	2.6	–	AB-1606	132.3	90.4	53.0
AB-702	7.3	5.2	–	AB-1607	154.3	105.4	61.8
AB-703	11.1	7.9	–	AB-1608	176.3	120.4	70.6
AB-704	14.9	10.6	–	AB-1609	197.9	135.2	79.5
AB-705	18.7	13.3	–	AB-1610	219.9	150.2	88.3
				AB-1611	241.9	165.2	97.1
AB-1002	17.7	11.2	5.9	AB-1612	263.9	180.2	105.9
AB-1003	26.5	16.8	8.8	AB-1613	285.9	195.2	114.7
AB-1004	35.4	22.4	11.8				
AB-1005	44.3	28.0	14.7	AB-2004	155.1	110.7	60.8
AB-1006	53.2	33.6	17.6	AB-2005	193.8	138.4	76.1
				AB-2006	232.6	166.1	91.3
AB-1202	25.5	17.9	8.8	AB-2007	271.4	193.8	106.5
AB-1203	38.0	26.7	13.2	AB-2008	310.2	221.4	121.7
AB-1204	50.3	35.4	17.6	AB-2009	349.0	249.1	137.0
AB-1205	63.0	44.2	22.1	AB-2010	387.7	276.8	152.2
AB-1206	75.6	53.2	26.5	AB-2011	426.5	304.5	167.4
AB-1207	88.2	62.0	30.9	AB-2012	465.3	332.2	182.7
AB-1208	100.6	70.7	35.3	AB-2013	504.1	359.9	197.9
AB-1209	113.0	79.4	39.6	AB-2014	542.9	387.6	213.2
AB-1210	125.4	88.1	44.1	AB-2015	581.7	415.3	228.4

TABLE E- Flow Rate for Shell & Tube

Shell dia . Code	Max. Liquid Flow - Shell Side Baffle Spacing A	B	C	D	E	Liquid Flow - Tube Side SP Min.	SP Max.	TP Min.	TP Max.	FP Min.	FP Max.
400	10	15	20	–	–	3.5	21	–	–	–	–
700	17	29	30	35	–	9	61	4.5	30	2.2	15
1000	24	48	68	70	–	20	120	10	70	5.0	37
1200	29	56	105	115	120	30	250	15	112	7.5	56
1600	38	70	150	200	220	57	460	29	180	14	90
2000	–	–	190	370	550	90	650	45	320	25	160

TABLE C

U	TUBE FLUID	SHELL FLUID
400	Water	Water
350	Water	50% E. Glycol
100	Water	Oil
300	50% E. Glycol	50% E. Glycol
90	50% E. Glycol	Oil

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AB, SAE, STS, & EAB Series *performance*

Instructions

The selection chart provided contains an array of popular sizes for quick sizing. It does not provide curves for all models available. Refer to page 4 & 5 for detailed calculation information.

Computer selection data sheets for standard or special models are available through the engineering department of American Industrial. To use the followings graphs correctly, refer to the instruction notes "1-5".

1) HP Curves are based upon a 40°F approach temperature; for example: oil leaving a cooler at 125°F, using 85°F cooling water (125°F – 85°F = 40°F).

2) The oil to water ratio of 1:1 or 2:1 means that for every 1 gallon of oil circulated, a minimum of 1 or 1/2 gallon (respectively) of 85°F water must be circulated to match the curve results.

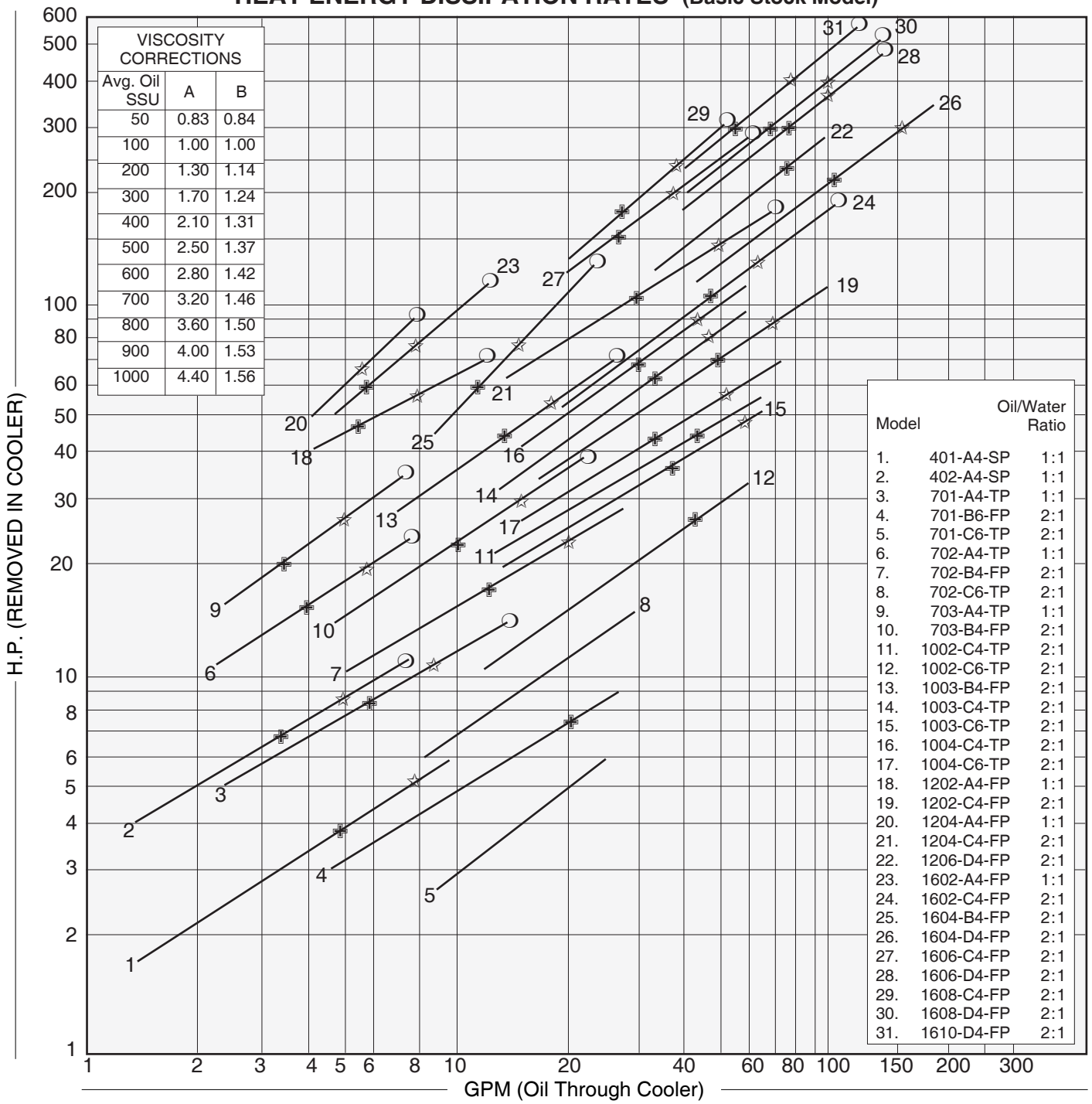
3) OIL PRESSURE DROP CODING: ✙ = 5 psi; ☆= 10 psi; ❍ = 20 psi; △ = 50psi. Curves that have no pressure drop code symbols indicate that the oil pressure drop is less than 5 psi for the flow rate shown.

4) Pressure Drop is based upon oil with an average viscosity of 100 SSU. If the average oil viscosity is other than 100 SSU, then multiply the indicated Pressure Drop by the corresponding value from corrections table A.

5) Corrections for approach temperature and oil viscosity are as follows:

$$H.P.\left(\tfrac{\text{Removed}}{\text{In Cooler}}\right) = H.P.\left(\tfrac{\text{Actual}}{\text{Heat Load}}\right) \times \left(\frac{40}{\text{Actual Approach}}\right) \times B.$$

HEAT ENERGY DISSIPATION RATES (Basic Stock Model)



VISCOSITY CORRECTIONS		
Avg. Oil SSU	A	B
50	0.83	0.84
100	1.00	1.00
200	1.30	1.14
300	1.70	1.24
400	2.10	1.31
500	2.50	1.37
600	2.80	1.42
700	3.20	1.46
800	3.60	1.50
900	4.00	1.53
1000	4.40	1.56

	Model	Oil/Water Ratio
1.	401-A4-SP	1:1
2.	402-A4-SP	1:1
3.	701-A4-TP	1:1
4.	701-B6-FP	2:1
5.	701-C6-TP	2:1
6.	702-A4-TP	1:1
7.	702-B4-FP	2:1
8.	702-C6-TP	2:1
9.	703-A4-TP	1:1
10.	703-B4-FP	2:1
11.	1002-C4-TP	2:1
12.	1002-C6-TP	2:1
13.	1003-B4-FP	2:1
14.	1003-C4-TP	2:1
15.	1003-C6-TP	2:1
16.	1004-C4-TP	2:1
17.	1004-C6-TP	2:1
18.	1202-A4-FP	1:1
19.	1202-C4-FP	2:1
20.	1204-A4-FP	1:1
21.	1204-C4-FP	2:1
22.	1206-D4-FP	2:1
23.	1602-A4-FP	1:1
24.	1602-C4-FP	2:1
25.	1604-B4-FP	2:1
26.	1604-D4-FP	2:1
27.	1606-C4-FP	2:1
28.	1606-D4-FP	2:1
29.	1608-C4-FP	2:1
30.	1608-D4-FP	2:1
31.	1610-D4-FP	2:1

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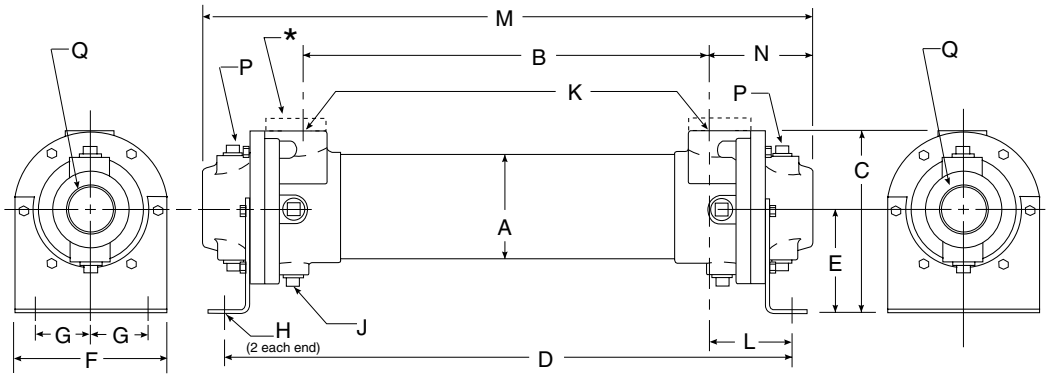
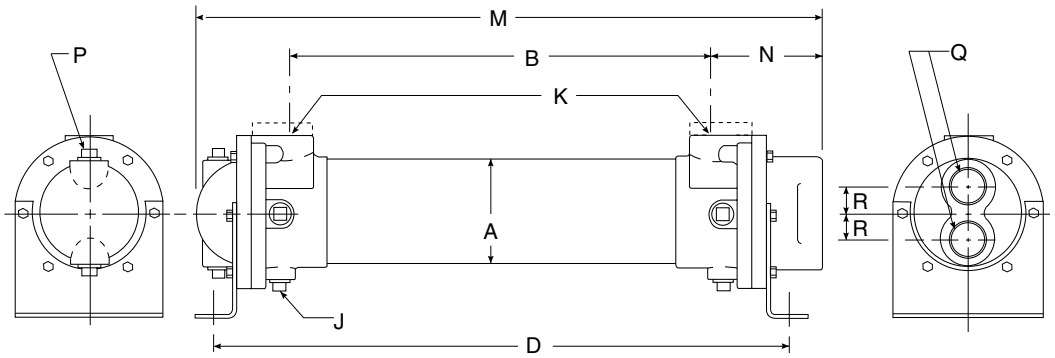
SAE Series *dimensions*



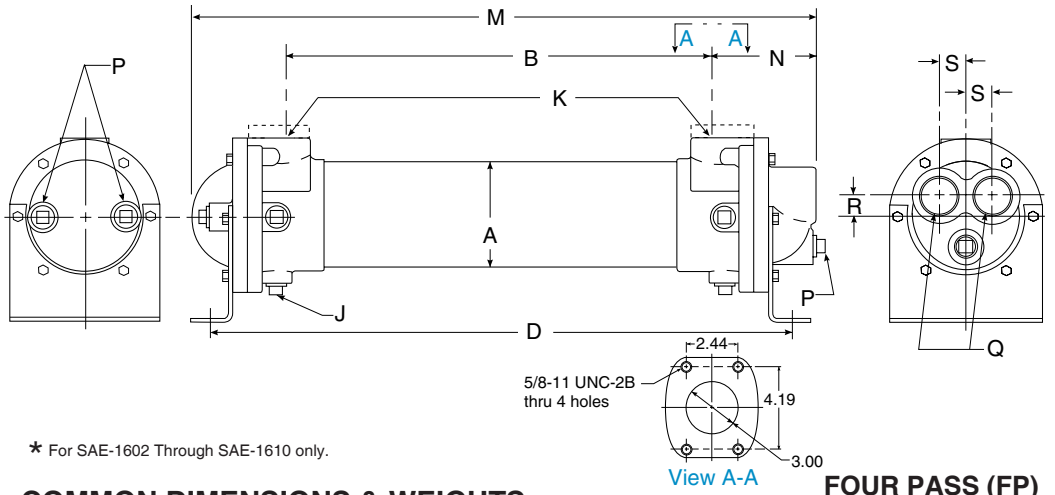
SINGLE PASS (SP)

Model	M	N	P NPT	Q NPT
SAE-401	11.24	1.81	-	1.00
SAE-402	20.24			
SAE-701	13.47	3.24	(4) .38	1.50
SAE-702	22.47			
SAE-703	31.47			
SAE-704	40.47			
SAE-1002	23.60	4.05	(4) .38	2.00
SAE-1003	32.60			
SAE-1004	41.60			
SAE-1202	24.38	4.88	(4) .50	3.00
SAE-1203	33.25			
SAE-1204	42.12			
SAE-1205	51.12			
SAE-1206	60.25			
SAE-1207	69.25			
SAE-1208	78.12			
SAE-1209	87.12			
SAE-1210	96.12			
SAE-1602	26.62	6.52	(4) .50	4.00
SAE-1603	35.62			
SAE-1604	44.62			
SAE-1605	53.62			
SAE-1606	62.62			
SAE-1607	71.62			
SAE-1608	80.62			
SAE-1609	89.62			
SAE-1610	98.62			



TWO PASS (TP)

Model	M	N	P NPT	Q NPT	R
SAE-701	13.28	3.30	(2) .38	1.00	.88
SAE-702	22.28				
SAE-703	31.28				
SAE-704	40.28				
SAE-1002	23.29	3.80	(2) .38	1.50	1.19
SAE-1003	32.29				
SAE-1004	41.29				
SAE-1202	23.94	4.56	(2) .50	2.00	1.44
SAE-1203	32.81				
SAE-1204	41.69				
SAE-1205	50.69				
SAE-1206	59.81				
SAE-1207	68.81				
SAE-1208	77.69				
SAE-1209	86.69				
SAE-1210	95.69				
SAE-1602	25.10	6.08	(2) .50	2.50	1.88
SAE-1603	34.10				
SAE-1604	43.10				
SAE-1605	52.10				
SAE-1606	61.10				
SAE-1607	70.10				
SAE-1608	79.10				
SAE-1609	88.10				
SAE-1610	97.10				



FOUR PASS (FP)

Model	M	N	P NPT	Q NPT	R	S
SAE-701	13.42	3.24	(3) .38	.75	.62	.88
SAE-702	22.42					
SAE-703	31.42					
SAE-704	40.42					
SAE-1002	23.55	4.06	(3) .38	1.00	.75	1.19
SAE-1003	32.55					
SAE-1004	41.55					
SAE-1202	24.44	4.90	(3) .50	1.50	1.06	1.44
SAE-1203	33.31					
SAE-1204	42.19					
SAE-1205	51.19					
SAE-1206	60.31					
SAE-1207	69.31					
SAE-1208	78.19					
SAE-1209	87.19					
SAE-1210	96.19					
SAE-1602	25.05	6.48	(3) .50	2.00	1.38	1.88
SAE-1603	34.05					
SAE-1604	43.05					
SAE-1605	52.05					
SAE-1606	61.05					
SAE-1607	70.05					
SAE-1608	79.05					
SAE-1609	88.05					
SAE-1610	97.05					

* For SAE-1602 Through SAE-1610 only.

COMMON DIMENSIONS & WEIGHTS

Model	A	B	C	D	E	F	G	H	J NPT	K SAE	L	Approx. Weight	Model
SAE-401	2.13	7.62	3.50	11.12	1.94	2.62	.88	.41ϕ	-	#8	1.72	7	SAE-401
SAE-402		16.62		20.12						3/4-16		10	SAE-402
SAE-701	3.66	7.00	6.25	12.38	3.62	5.25	1.50	.44ϕ x 1.00	(2) .38	#16	2.69	23	SAE-701
SAE-702		16.00		21.38						1 5/16-12		29	SAE-702
SAE-703		25.00		30.38								33	SAE-703
SAE-704		34.00		39.38								49	SAE-704
SAE-1002	5.13	15.50	7.38	21.62	4.00	6.75	2.00	.44ϕ x 1.00	(6) .38	#24	3.06	54	SAE-1002
SAE-1003		24.50		30.62						1 7/8-12		76	SAE-1003
SAE-1004		33.50		39.62								82	SAE-1004
SAE-1202	6.13	14.62	8.81	21.50	4.75	7.50	2.50	.44ϕ x 1.00	(6) .38	#32	3.44	79	SAE-1202
SAE-1203		23.50		30.38						2 1/2-12		98	SAE-1203
SAE-1204		32.38		39.25								115	SAE-1204
SAE-1205		41.38		48.25								130	SAE-1205
SAE-1206		50.50		57.38								150	SAE-1206
SAE-1207		59.50		66.38								170	SAE-1207
SAE-1208		68.38		75.25								190	SAE-1208
SAE-1209		77.38		84.25								210	SAE-1209
SAE-1210		86.38		93.25								230	SAE-1210
SAE-1602	8.00	13.60	12.13	22.38	6.50	10.00	3.50	.44ϕ x 1.00	(6) .38	3.0" Four bolt Flange	4.39	145	SAE-1602
SAE-1603		22.60		31.38								170	SAE-1603
SAE-1604		31.60		40.38								200	SAE-1604
SAE-1605		40.60		49.38								225	SAE-1605
SAE-1606		49.60		58.38								250	SAE-1606
SAE-1607		58.60		67.38								275	SAE-1607
SAE-1608		67.60		76.38								315	SAE-1608
SAE-1609		76.60		85.38								350	SAE-1609
SAE-1610		85.60		94.38								390	SAE-1610

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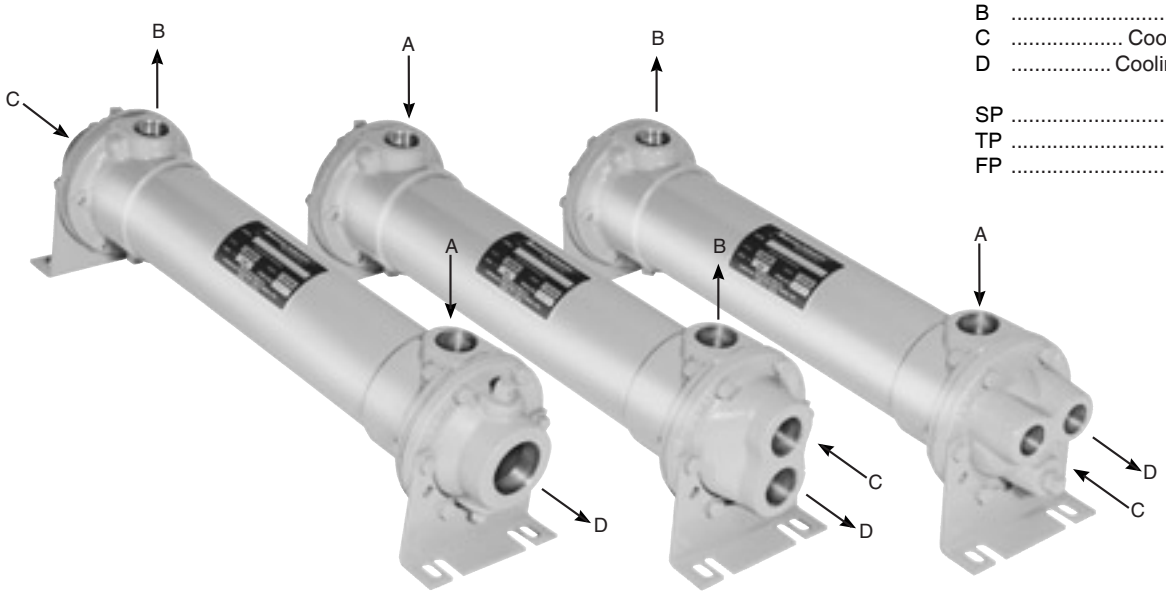
PIPING HOOK-UP

A ..... Hot fluid to be cooled
B ..... Cooled fluid
C ..... Cooling water in
D ..... Cooling water out

SP ..... Single Pass
TP ..... Two Pass
FP .....Four Pass



SINGLE PASS **TWO PASS** **FOUR PASS**

Receiving / Installation

a) Inspect unit for any shipping damage before uncrating. Indicate all damages to the trucking firms' delivery person, and mark it on the receiving bill before accepting the freight. Make sure that there is no visible damage to the outside surface of the heat exchanger. The published weight information located in this brochure is approximate. True shipment weights are determined at the time of shipping and may vary. Approximate weight information published herein is for engineering approximation purposes and should not be used for exact shipping weight. Since the warranty is based upon the unit date code located on the model identification tags, removal or manipulation of the identification tags will void the manufacturers warranty.

b) When handling the shell & tube heat exchanger, special care should be taken to avoid dropping the unit since mishandling could cause the heat exchanger to crack and leak externally. Mishandling of the unit is not covered under the manufacturers warranty. All units are shipped with partial wood/corrugated cardboard containers for safe handling.

c) Storage: American Industrial heat exchangers are protected against the elements during shipment. If the heat exchanger cannot be installed and put into operation immediately upon receipt, certain precautions are required to prevent deterioration during storage. The responsibility for integrity of the heat exchanger(s) is assumed by the user. American Industrial will not be responsible for damage, corrosion, or other deterioration of the heat exchanger during transit or storage.
Proper storage practices are important when considering the high costs of repair or replacement, and the possible delays for items which require long lead times for manufacture. The following listed practices are provided solely as a convenience to the user, who shall make their own decision on whether to use all or any of them.

1) Heat exchangers not to be placed in immediate service, require precautionary measures to prevent corrosion or contamination.
2) Heat exchangers made of ferrous materials, may be pressure-tested using compressed air at the factory. Residual oil coating on the inside surfaces of the heat exchanger(s) as a result of flushing does not discount the possibility of internal corrosion. Upon receipt, fill the heat exchanger(s) with the appropriate grade of oil or apply a corrosion preventing inhibitor for storage.
3) Corrosion protection compounds for interior surfaces for long term storage or other applications are applied solely at the request of customers. Upon request, American Industrial can provide a customer approved corrosion preventative if available when included in the original purchase order specifications.
4) Remove all dirt, water, ice, or snow and wipe dry before moving heat exchanger(s) into storage. Heat exchangers are generally shipped empty, open drain plugs to remove any accumulated condensation moisture, then reseal. Accumulation of moisture usually indicates corrosion has already started and remedial action should be taken.
5) Store in a covered, environmentally stable area. The ideal storage environment for heat exchangers is in a dry, low-humidity atmosphere which is sealed to prevent the entry of blowing dust, rain, or snow. Maintain in atmospheric temperatures between 70°F and 105°F (Large temperature swings may cause condensation and moisture to form on steel components, threads, shell, etc...) Use thermometers and humidity indicators and maintain the atmosphere at 40% relative humidity, or lower.

d) Standard Enamel Coating: American Industrial provides its standard products with a normal base coat of oil base air cure enamel paint. The enamel paint is applied as a temporary protective and esthetic coating prior to shipment. While the standard enamel coating is durable, American Industrial does not warranty it as a long-term finish coating. It is strongly suggested that a more durable final coating be applied after installation or prior to long-term storage in a corrosive environment to cover any accidental scratches, enhance esthetics, and further prevent corrosion. It is the responsibility of the customer to provide regular maintenance against chips, scratches, etc... and regular touch up maintenance must be provided for long-term benefits and corrosion prevention.

e) Special Coatings: American Industrial offers as customer options, Air-Dry Epoxy, and Heresite (Air-Dry Phenolic) coatings at additional cost. American Industrial offers special coatings upon request, however American Industrial does not warranty coatings to be a permanent solution for any equipment against corrosion. It is the responsibility of the customer to provide regular maintenance against chips, scratches, etc... and regular touch up maintenance must be provided for long-term benefits and corrosion prevention.

f) American Industrial recommends that the equipment supplied should be installed by qualified personnel who have solid understanding of system design, pressure and temperature ratings, and piping assembly. Verify the service conditions of the system prior to applying any shell & tube heat exchanger. If the system pressure or temperature does not fall within the parameters on model rating tag located on the heat exchanger, contact our factory prior to installation or operation.

g) Plan the installation to meet the requirements indicated on the piping installation diagram as illustrated above. It is recommended to put the hot fluid to be cooled through the shell side and the cold fluid through the tube side. The indicated port assembly sequence in the diagram maximizes the performance, and minimizes the possibility of thermal shock.

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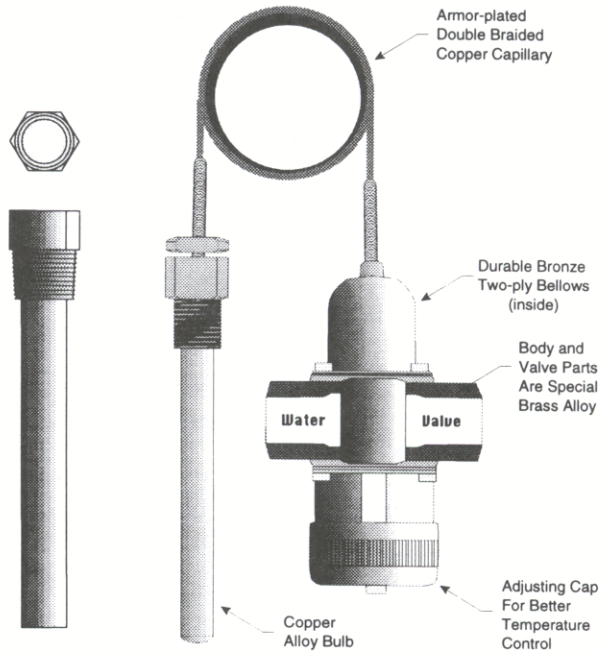
THERMOSTATIC MODULATING WATER VALVE WITH BULB WELL ASSEMBLY (for Shell & Tube Heat Exchangers And Air/Oil Coolers)

SPECIFICATIONS

Sizes	0.375", 0.50", 0.75", 1.00", 1.25" FPT
Fluid Pressure	125psi (max.)
Standard temperature	40° - 100° F., 60° - 140° F., 100° - 175° F., 125° - 200° F., 140° - 240° F., 200° - 275°F.
Body	Brass alloy casting
Valve parts	Brass alloy
Standard capillary length	6 foot, but for other sizes contact factory
Standard Bulbs	For 3/8" & 1/2" valve sizes: 5/8" x 6 with 3/4" union connections. For 3/4" & 1" valve sizes: 5/8" x 8-1/4" with 3/4" union connections.
Special Bulbs	Valve sizes: 9/16" (3-1/4" with 1/2" union connections; 9/16" x 6-3/4" with 1/2" union connection. Stainless steel construction available.
Standard bulb mounting	3/4" NPT
Seat disk	Buna-N-replaceable
Seat bead	Stainless Steel - replaceable



APPLICATION INFORMATION

- Built for rugged machine tool and hydraulic applications.
- Six temperature ranges to meet your requirements.
- Quick response to temperature changes.
- Extra heavy-duty direct acting bellows for longer service.

Note: Please consult factory if a non-cataloged temperature is required.

The type 56-T valve gives smooth regulation of water and other fluids. It's designed for the most rugged applications, for example: hydraulic power packaging equipment, hydraulic presses, plastic molding equipment, and anywhere reliability in temperature control is demanded.
The type 56-t valve is a better designed product that won't leak or chatter. To insure dependability, every valve is factory tested three times in different temperature baths. Extra performance can be expected of the bellows also. They are direct acting with sturdy walls, and the inner spring is zinc coated. The seat beads are stainless steel to resist the erosive effects of *wire drawing* and provide longer life for your needs. Additional features include mounting in any position, Buna-N seat disc, and manual flushing.

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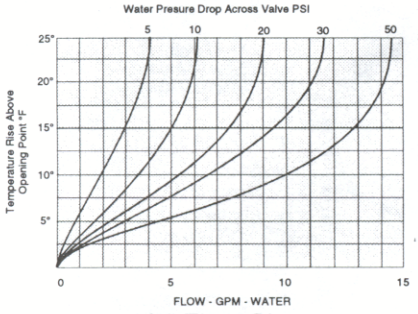
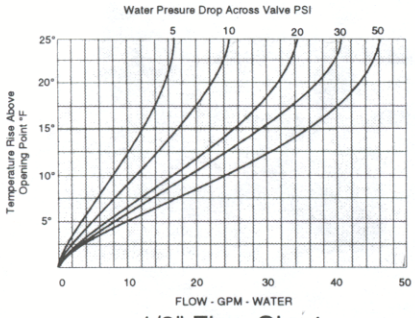
THERMOSTATIC MODULATING WATER VALVE WITH BULB WELL ASSEMBLY (for Shell & Tube Heat Exchangers And Air/Oil Coolers)

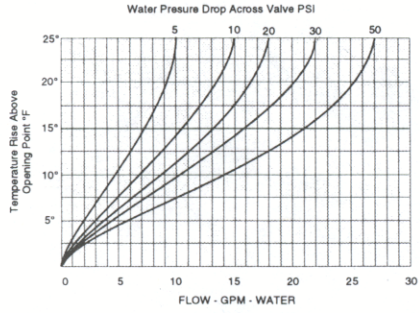
Note the excellent flow characteristics of the Type 56-T.



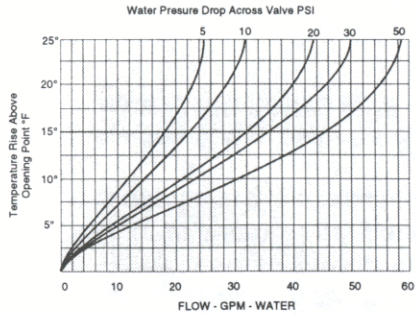
3/8" Flow Chart



1/2" Flow Chart



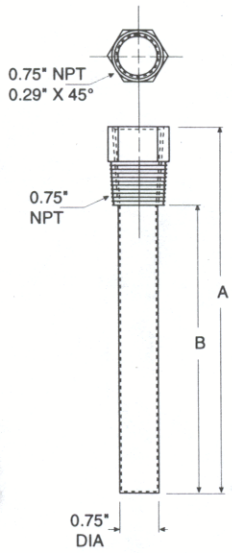
3/4" Flow Chart

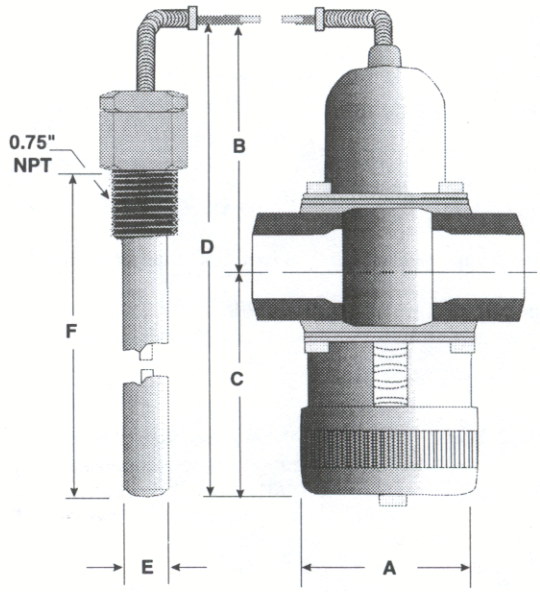


1" Flow Chart

Note: Consult factory on flow chart information for 1-1/4" Water valve.

DIMENSIONS & WEIGHTS





PART NUMBER	A	B
310 - 2001	7.13"	5.63"
310 - 2003	9.44"	7.94"

MODEL	A	B	C	D	E	F	Width	Net Wt.
3/8" NPT (60° - 140°)	2.812	3.156	2.843	6.000	0.625	6.000	2.125	2lb 2oz
1/2" NPT (60° - 140°)	3.093	3.343	3.031	6.375	0.625	6.000	2.125	2lb 6oz
3/4" NPT (60° - 140°)	3.375	4.062	3.250	7.312	0.625	8.250	2.125	3lb 6oz
1" NPT (60° - 140°)	4.750	4.187	4.843	8.062	0.625	8.250	2.750	6lb 2oz

ADJUSTMENT & SERVICING

To decrease flow or raise temperature (reduce water consumption) turn adjusting cup clockwise. After making adjustment give the regulator time to adjust itself against temperature change. To remove adjusting cup remove retainer ring.

The Type 56-T valve may be flushed manually after installation to remove dirt and grit from the line. To flush valve, place a sturdy screwdriver on top of the push plate and spring assembly. (An opening in the lower housing provides ample room to insert a screwdriver). Then, compress and release the spring assembly several times.

STANDARD WATER VALVES & BULB WELL

Part Number	Description	Bulb Well To Use (Part#)*
310 - 1001	3/8" NPT (60° - 140°)	310 - 2001
310 - 1004	1/2" NPT (60° - 140°)	310 - 2001
310 - 1008	3/4" NPT (60° - 140°)	310 - 2002
310 - 1014	1" NPT (60° - 140°)	310 - 2002
310 - 1020	1-1/4" NPT (60° - 140°)	310 - 2002

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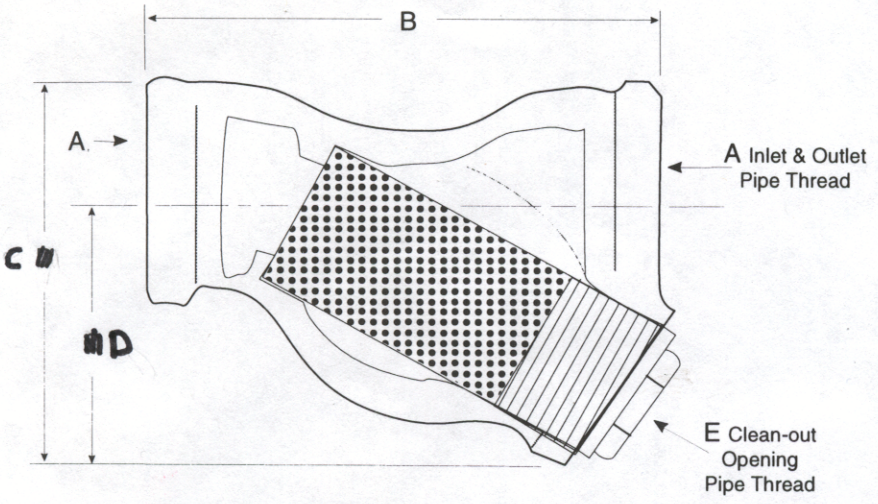
"Y" STRAINER (for Shell & Tube Heat Exchangers And Air/Oil Coolers)



MODEL	SIZE A	DIMENSIONS (Inches) B	C	D	E	WT. (lbs.)
18 - Y	0.38"	2.50"	2.63"	2.00"	0.25"	0.75
	0.50"	2.50"	2.63"	2.00"	0.25"	0.75
	0.75"	3.50"	3.75"	2.75"	0.50"	1.75
	1.00"	3.50"	3.75"	2.75"	0.50"	1.75
20 - Y	0.50"	4.00"	3.25"	2.50"	0.38"	1.75
	0.75"	4.00"	3.25"	2.50"	0.38"	1.75
	1.00"	4.75"	4.38"	3.38"	0.75"	4.00
	1.25"	6.00"	5.13"	3.88"	0.75"	4.75
	1.50"	6.00"	5.13"	3.88"	0.75"	4.75
	2.00"	8.13"	6.38"	4.63"	0.75"	13.00
PRESSURE RATINGS, ALL MODELS: 125lbs. per Sq.In.						

APPLICATIONS & SPECS. ("Y" Strainers)

These strainers are engineered for water or steam, and are adaptable for many other uses. Cleaning is accomplished by simply removing a pipe plug without disconnecting any piping. Or if it is desirable to clean without interrupting service, a blow-off valve can be connected to the clean-out opening. ***Note:*** Pumps, control valves, traps, or other equipment controlling the flow of liquids or gases require proper protection with strainers for trouble free operation.

18 - Y BRASS STRAINERS

The 18 - Y strainer body is a sturdy red brass casting. Standard units have 50 mesh brass wire screens. Brazing connections available on special order instead of pipe threads.

20 - Y STRAINERS

The 20 - Y strainer has a heavy cast iron body, with accurately machined pipe thread inlet and outlet (National Pipe Thread N.P.T.). It contains a strainer screen of 0.02" thick brass with 100, 1/16" perforations per inch.

ORDERING INFORMATION

Part Number	Description (20-Y Cast Iron)	Part Number	Description (18-Y Cast Brass)
310 - 3002	1/2" NPT	310 - 3001	3/8" NPT
310 - 3004	3/4" NPT	310 - 3003	1/2" NPT
310 - 3006	1" NPT	310 - 3005	3/4" NPT
310 - 3008	1-1/4" NPT	310 - 3007	1" NPT
310 - 3009	1-1/2" NPT	—	—
310 - 3010	2" NPT	—	—

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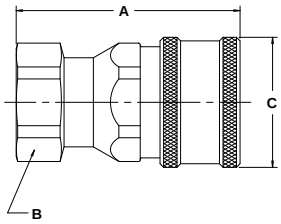
Couplers

Female Thread

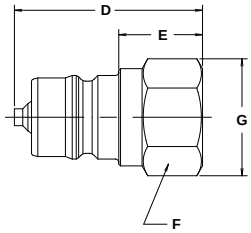


Body Size (in.)	Part No. Steel	Thread Size NPTF	Thread Size ORB	Dimensions (in.) Overall Length	Hex Size	Largest Diameter	Wt. (LB.) P/Piece
				A	B	C	
1/4	6601-2-4	1/8-27	—	1.85	.88	1.08	0.27
1/4	6601-4-4	1/4-18	—	1.85	.88	1.08	0.26
3/8	6601-6-6	3/8-18	—	2.18	1.06	1.27	0.39
3/8	6608-6-6	—	9/16-18	2.18	1.06	1.27	0.38
1/2	6601-8-10	1/2-14	—	2.75	1.25	1.52	0.67
1/2	6601-12-10	3/4-14	—	2.88	1.38	1.52	0.71
1/2	6608-8-10	—	3/4-16	2.74	1.25	1.52	0.67
1/2	6608-10-10	—	7/8-14	2.79	1.25	1.52	0.64
1/2	6608-12-10	—	1 1/16-12	3.01	1.38	1.52	0.77
3/4	6601-12-12	3/4-14	—	3.36	1.62	1.90	1.31
3/4	6608-12-12	—	1 1/16-12	3.35	1.62	1.90	1.31
1	6601-16-16	1-11 1/2	—	4.11	1.88	2.14	0.73
1	6608-16-16	—	1 5/16-12	4.11	1.88	2.14	1.73

Contact division for BSPP port availability

Nipples

Female Thread



Body Size (in.)	Part No. Steel	Thread Size NPTF	Thread Size ORB	Dimensions (in.) Overall Length	Exposed Length	Hex Size	Largest Diameter	Wt. (LB.) P/Piece
				D	E	F	G	
1/4	6602-2-4	1/8-27	—	1.27	.50	.56	.65	0.05
1/4	6602-4-4	1/4-18	—	1.27	.58	.75	.87	0.07
3/8	6602-6-6	3/8-18	—	1.47	.72	.88	1.01	0.11
3/8	6610-6-6	—	9/16-18	1.47	.72	.88	1.01	0.13
1/2	6602-8-10	1/2-14	—	1.94	.78	1.06	1.23	0.21
1/2	6602-12-10	3/4-14	—	2.03	.78	1.38	1.59	0.33
1/2	6610-8-10	—	3/4-16	1.89	.76	1.06	1.23	0.22
1/2	6610-10-10	—	7/8-14	1.94	.82	1.12	1.30	0.21
1/2	6610-12-10	—	1 1/16-12	2.16	1.04	1.38	1.59	0.33
3/4	6602-12-12	3/4-14	—	2.28	1.18	1.38	1.59	0.49
3/4	6610-12-12	—	1 1/16-12	2.28	1.18	1.38	1.59	0.47
1	6602-16-16	1-11 1/2	—	2.78	1.34	1.62	1.88	0.75
1	6610-16-16	—	1 5/16-12	2.78	1.34	1.62	2.17	0.72

Contact division for BSPP port availability

Replacement Parts

6600 Series

Body Size (in.)	1/4	3/8	1/2	3/4	1
O-Rings - Buna N	2-112N0674-70	2-115N0674-70	2-211N0674-70	2-123NN0674-70	2-126N0674-70
Back-up Rings	4118006	4118005	50-140-4	4138001	4148002

Contact division for BSPP port availability

Parker FluidConnectors

Quick Coupling Division
8145 Lewis Road • Minneapolis, MN 55427
www.parker.com/quickcouplings

Applications

Parker offers a complete line of dust plugs and caps for their hydraulic quick couplings. Each series shown in this catalog has a dust plug and cap specifically designed to be used with that style of coupling.

Dust plugs and caps serve a twofold function. They keep the mating surface clean and free of contamination and protect the critical mating elements of the coupling halves when they are disconnected. In this way the nipple is protected from damage that would make the total coupling unusable.

Protective dust plugs and caps play a crucial role in the use of quick couplings and no purchase of a hydraulic quick coupling is complete without the selection of an appropriate dust plug and cap. When ordering the dust cap/plug body size must correspond to that of the coupler or nipple.

Parker's full line of dust plugs and caps can be found below and on the following pages.

Dust Plug: Used on Coupler (female half)

Dust Cap: Used on Nipple (male half)

Dust Plugs

60 Series

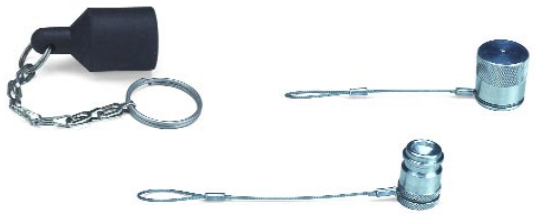
Body Size (in.)	Dust Plug Part No. Aluminum	Dust Plug Part No. Geolast	Dust Cap Part No. Aluminum	Dust Cap Part No. Geolast
1/8	H1-65	H1-65M	H1-66	H1-66M
1/4	H2-65	H2-65M	H2-66	H2-66M
3/8	H3-65	H3-65M	H3-66	H3-66M
1/2	H4-65	H4-65M	H4-66	H4-66M
3/4	H6-65	H6-65M	H6-66	H6-66M
1	H8-65	H8-65M	H8-66	H8-66M
1 1/2	H12-65	NA	H12-66	NA
2 1/2	H20P-65	NA	H20P-66	NA

NA = Not Available

6600 Series

Body Size (in.)	Dust Plug Part No. Rubber	Dust Cap Part No. Rubber
1/4	H1-65M	H166M
3/8	TR-37	TR-37
1/2	5205-4M	5209-4M
3/4	6659-12M	6657-12M
1	6659-16M	6657-16M

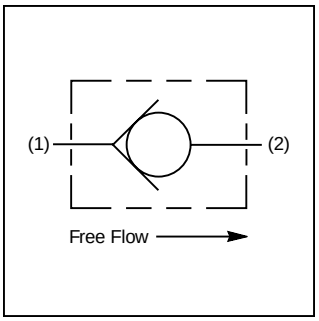
SM Series

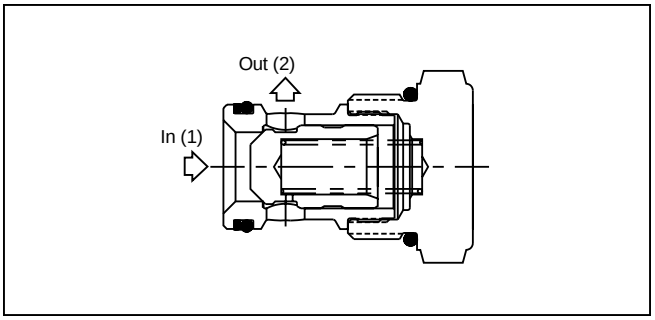


Body Size (in.)	Dust Plug Part No.	Dust Cap Part No.	Material
1/4	PL-25	N/A	Plastic
1/4	PR-25	CR-25	Rubber
1/4	P-25	C-25	Aluminum
1/2	DP-50	DC-50	Rubber
1/2	P-50	C-50	Aluminum
3/4	P-75	C-75	Aluminum

General Description

The CVH161P Series, Poppet-Type, Check Valves allow free flow in one direction while preventing flow in the reverse direction. They can be used to isolate portions of a hydraulic circuit or to provide a free flow path around a restrictive valve.





Operation

Pressure on the inlet of the check creates a force against the poppet, pushing it off its seat and permitting free flow. Reverse flow through the check is blocked by the poppet.

Features

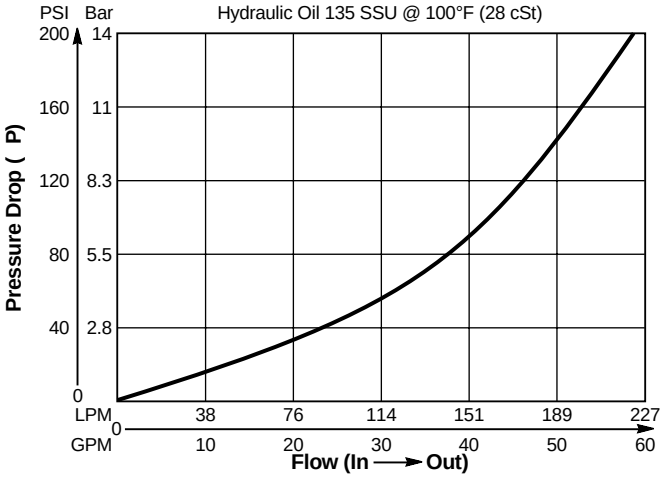
- Hardened, precision ground parts for durability
- Compact size for reduced space requirements
- Low leakage design
- Fully guided poppet for smooth operation

Specifications

Maximum Flow	225 LPM (60 GPM)
Maximum Inlet Pressure	345 Bar (5000 PSI)
Leakage	5 drops/min. (1/3 cc/min.) at 210 Bar (3000 PSI)
Operating Temp. Range (Ambient)	-40°C to +93.3°C (Nitrile) (-40°F to +200°F) -31.7°C to +121.1°C (Fluorocarbon) (-25°F to +250°F)
Cartridge Material	All parts steel. All operating parts hardened steel.
Body Material	Steel or Aluminum
Filtration	ISO code 16/13, SAE Class 4 or better
Mounting	No Restrictions
Cavity	Common Cavity No. C16-2

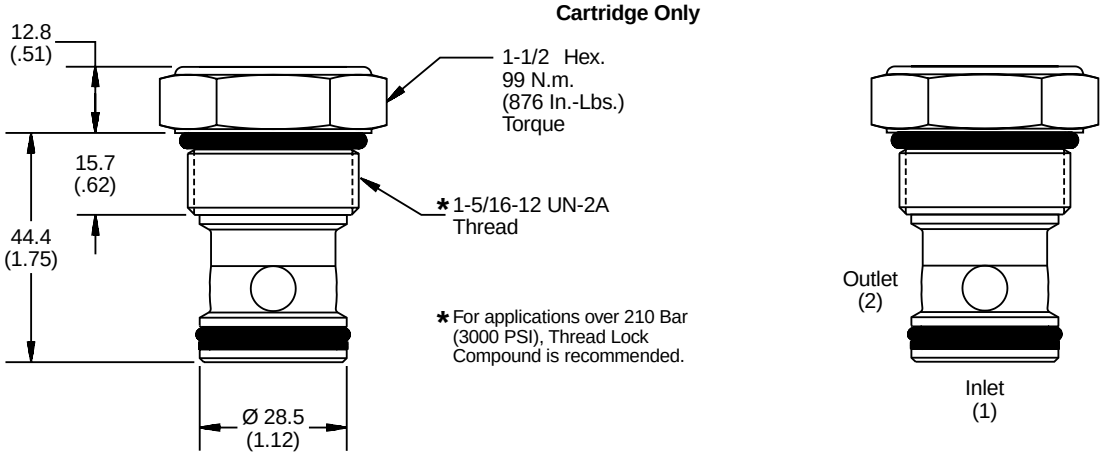
Performance Curve

Flow vs. Pressure Drop
(Through cartridge only)

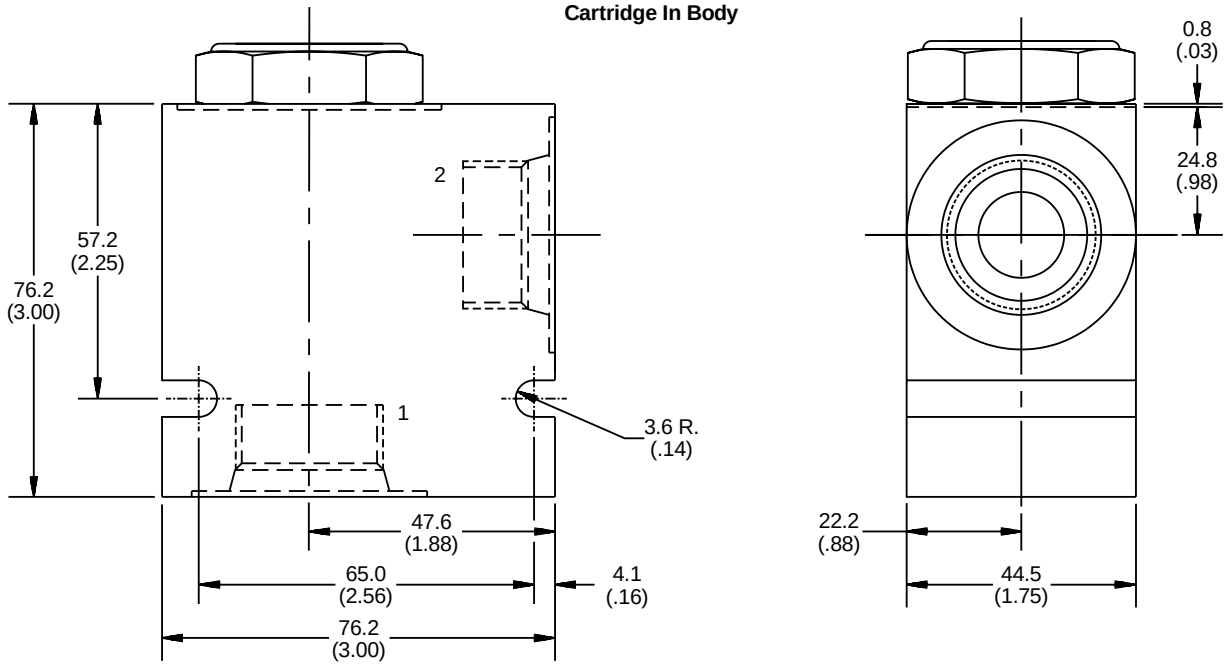


*Inch equivalents for millimeter dimensions are shown in (**)

Cartridge Only

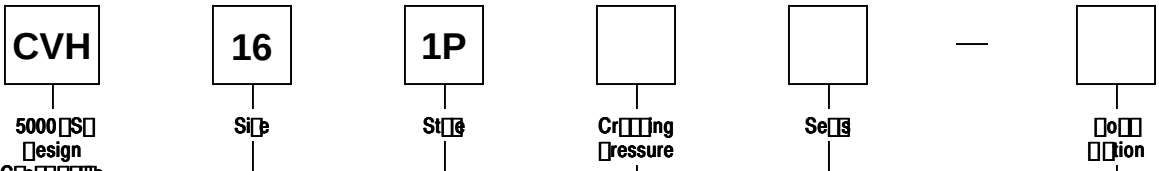


Cartridge In Body



THIRD-ANGLE PROJECTION

cvh161p.pm6.5, bl, ll



Code	Style
1P	Guided Poppet

Code	Type
Omit	Nitrile
V	Fluorocarbon

Code	Type
16	1-5/16-12 UN-2B Threaded Cavity

Code	Type
Omit	0.3 Bar (5 PSI)
20	1.4 Bar (20 PSI)
65	4.5 Bar (65 PSI)

Code	Port Size & Material
Omit	Cartridge Only
8P	1/2″ NPTF (B16-2-8P) Steel
A8P	1/2″ NPTF (B16-2-A8P) Aluminum
12P	3/4″ NPTF (B16-2-12P) Steel
A12P	3/4″ NPTF (B16-2-A12P) Aluminum
16P	1″ NPTF (B16-2-16P) Steel
A16P	1″ NPTF (B16-2-A16P) Aluminum
8T	SAE-8 (B16-2-8T) Steel
A8T	SAE-8 (B16-2-A8T) Aluminum
12T	SAE-12 (B16-2-12T) Steel
A12T	SAE-12 (B16-2-A12T) Aluminum
16T	SAE-16 (B16-2-16T) Steel
A16T	SAE-16 (B16-2-A16T) Aluminum
8B	1/2″ BSPG (B16-2-8B) Steel
A8B	1/2″ BSPG (B16-2-A8B) Aluminum
12B	3/4″ BSPG (B16-2-12B) Steel
A12B	3/4″ BSPG (B16-2-A12B) Aluminum
16B	1″ BSPG (B16-2-16B) Steel
A16B	1″ BSPG (B16-2-A16B) Aluminum

NOTE:
If system pressure does not exceed 210 Bar (3000 PSI), aluminum bodies can be used. Higher pressures require steel bodies.

SERVICE PARTS
Nitrile Seal Kit: SK16-2
Fluorocarbon Seal Kit: SK16-2V

Shipping Weight
Cartridge Only .27 kg (0.6 lbs.)
Cartridge in Body 1.8 kg (4.0 lbs.)

Features

- Knurled sleeve allows simple twist-to-connect operation without the use of tools
- Rugged design allows connect-under-pressure operation up to 5800 psi
- Maximum rated working pressure of 9000 psi exceeds the requirements of most applications
- Integral threaded dust cap protects the test point from damage and contamination
- EMA fittings are machined from solid barstock and protected with zinc plating and a dichromate finish for reliability and long life.
- Stainless steel springs for corrosion resistance
- Elastomeric interface and valve seals provide leak free operation
- Compact design and optional high pressure hose assemblies provide flexibility for tight space requirements
- EMA3/14X1.SED nipple meets the ISO15171-2 standard

Applications

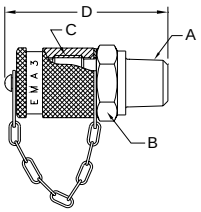
EMA couplings provide easy diagnostic connections for Parker SensoControl® equipment or mechanical gages. EMA test points are typically permanently plumbed into a fluid system at locations where pressure measurements are required for maintenance or testing. Integral pressure cap protects the test point from damage and prevents contamination of the fluid system. Proven twist-to-connect design allows the test points to be connected even when the system is in operation and the test points are pressurized. EMA's compact design and optional high pressure hose assemblies allow extra flexibility for the location of system test points.

Although designed primarily for diagnostic applications, EMA fittings and hose assemblies are idea for a wide range of applications that require compact high pressure connections and limited flow rates.

Specifications

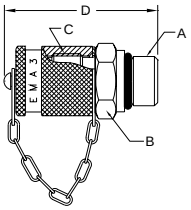
Body Size	**1/8**
Rated Pressure (PSI)	9000 psi
Max Connect-Under-Pressure (PSI)	5800
Rated Flow (GPM)	0.8
Body Material	Carbon Steel
Seal Material (std.)	Nitrile
Temperature Range (std. seals)	-40° to +250° F

Male Pipe Thread



Part No.	Port Thread Size	Hex Size	Interface Thread Size	Overall Length	Wt. (LB.) P/Piece
	A	B	C	D	
EMA3/1/8NPT	1/8-27NPT	0.67	M16X2.0	1.81	0.15
EMA3/1/4NPT	1/4-18NPT	0.67	M16X2.0	1.98	0.16
EMA3/1/4NPT71 Stainless Steel	1/4-18NPT	0.67	M16X2.0	1.95	0.16

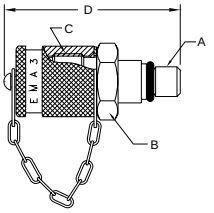
SAE Straight Thread



Part No.	Port Thread Size	Hex Size	Interface Thread Size	Overall Length	Wt. (LB.) P/Piece
	A	B	C	D	
EMA3/7/16-20UNF-2A*	7/16-20UNF-2A	0.67	M16X2.0	1.88	0.15
EMA3/9/16-18UNF-2A*	9/16-18UNF-2A	0.75	M16X2.0	1.88	0.17

* O-Ring seal on port

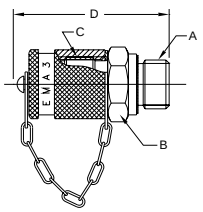
Metric Straight Thread



Part No.	Replaces Part No.	Port Thread Size	Hex Size	Interface Thread Size	Overall Length	Wt. (LB.) P/Piece
		A	B	C	D	
EMA3/M8X1OR*	NEW	M8X1	0.67	M16X2.0	1.81	0.15
EMA3/10X1ED**	NEW	M10X1	0.67	M16X2.0	1.85	0.15
EMA3/12X1.5ED**	EMA3/12X1.5	M12X1.5	0.67	M16X2.0	1.94	0.16
EMA3/14X1.5ED**	NEW	M14X1.5	0.75	M16X2.0	1.94	0.16

* O-Ring seal on port
** Molded seal on port

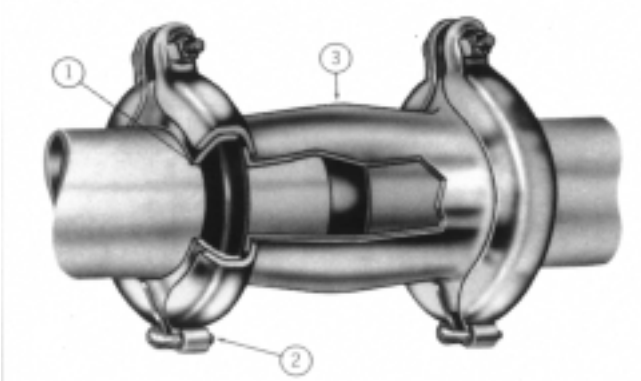
British Parallel Pipe



Part No.	Replaces Part No.	Port Thread Size	Hex Size	Interface Thread Size	Overall Length	Wt. (LB.) P/Piece
		A	B	C	D	
EMA3/1/8ED**	EMA3/R1/8	1/8 BSPP	0.75	M16X2.0	1.77	0.15
EMA3/1/4ED**	EMA3/R1/4	1/4 BSPP	0.75	M16X2.0	1.94	0.16
EMA3/3/8ED**	NEW	3/8 BSPP	0.87	M16X2.0	1.94	0.16

** Molded seal on port

Flexmaster® Joints in Standard and Self-Restrained Configurations



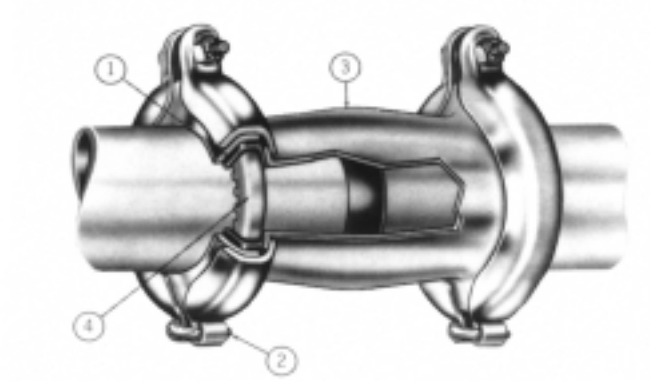
STANDARD FEATURES

① Gasket provides compression seal when tightened against tube or pipe.

② Hinged coupling provides for quick, easy assembly.

③ Bulged sleeve allows for ±4° angular misalignment.

All gasket materials listed on page 248 are available in the standard style, increasing the number of suitable applications.



SELF-RESTRAINED FEATURES

① Gasket provides compression seal when tightened against tube or pipe.

② Hinged coupling provides for quick, easy assembly.

③ Bulged sleeve allows for ±4° angular misalignment.

Plus

④ Notched channel ring which grips pipe firmly to restrict movement along pipe or tubing.

Gasket materials available include the C (Buna-N) and D (EPDM) compounds.

Flexmaster® joints are available in both standard and self-restrained styles. The self-restrained style has a stainless steel gripping ring inside each gasket. This feature allows the joint to maintain a firm grip on the pipe or tube, preventing movement along the pipe or tube.

The bulged, straight-through Flexmaster joints accommodate angular misalignment up to ±4° per end. Tees, elbows, and crosses accommodate angular misalignment up to ±2° per end. See pages 254 thru 259 for the angular misalignment allowed on each specific part. Flexmaster joints are designed for up to 300 psi (2.07 MPa) service, depending on application and size. Refer to pressure ratings on page 248.

Flexmaster joints absorb vibration and are ideal for making quick connections and disconnections when repairing or disassembling a system. They can be furnished with several types of gasket compounds and sleeve materials, including stainless steel for marine and corrosive applications.

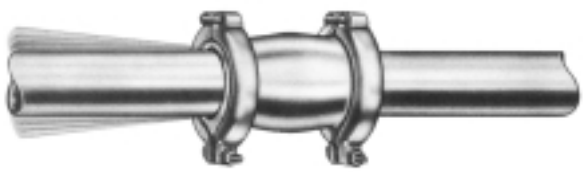
Flexmaster joints are currently in use in thousands of applications throughout the world. For typical Flexmaster joint applications see photos on page 260.

SAVE TIME – MAKE PIPE AND TUBE CONNECTION EASIER

used on plain end tube or pipe

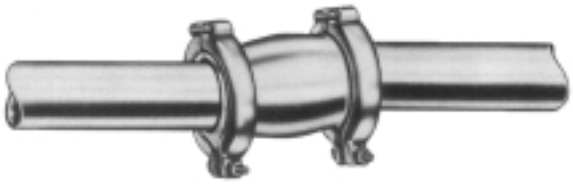
No threading, flanging, welding, grooving or other special end preparation of tube or pipe is required. Use pipe after it is cut to appropriate lengths. The Flexmaster joint will accommodate large tolerances in the length of the gap. See Table 1, page 253 for insertion depth tolerances.

absorbs vibration



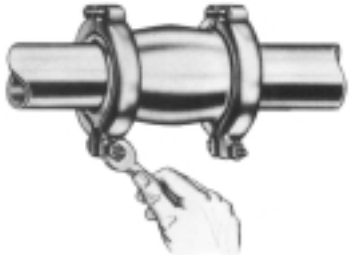
Pipe vibration and noise can be drastically reduced with Flexmaster joints. The resilient, thick rubber of the Flexmaster joint gasket absorbs vibration and noise. Use of the self-restrained style restricts movement along vibrating pipes and tubes.

even misaligned piping is no problem



The Flexmaster joint design eliminates flanged bolt holes and pipe threads that require careful alignment. The Flexmaster bulged joint permits up to a total of ±4° angular installation misalignment at each end while maintaining a leakproof seal.

easy to install



Installation time can be slashed by using Flexmaster joints. Basic assembly tools are all that's needed. After extensive use, the gaskets can be replaced easily and quickly. See page 252 for complete assembly instructions.

Gasket Temperature Ratings††

C Buna-N (standard)	water **-25°F. to +180°F.** (-32°C. to +82° C.)
	oils **-25°F. to +215°F.** (-32°C. to +101°C.)
V Fluorocarbon	**-25°F. to +450°F.** (-32°C. to +232°C.)
S Silicone	**-65°F. to +350°F.** (-54°C. to +177°C.)
D EPDM	water and water/glycol mixture **+20°F. to +275°F.** (+29°C. to +137°C.)
G Mineral Fiber Non-asbestos	**+70°F. to +1200°F.** (+21°C. to +649°C.)
N Buna-N (High Temp.)	water and steam **-25°F. to +225°F.** (-32°C. to +107°C.)
	-25°F. to +250°F. (-32°C. to +121°C.) oils

††Maximum temperature ratings are meant as a guide only.
For extreme temperature conditions, consult factory.

Vacuum Ratings†

Size Range		Standard Gasket	Self-Restrained Gasket
Pipe	**Tube**		
All Sizes	All Sizes	**25 in. Hg.** 1.79 bar	**25 in. Hg.** 1.79 bar

NOTE:
°F, inches, in. Hg., psi in bold
°C, mm, bar, MPa in light

Pressure Ratings†

Size Range		Standard Gasket	Self-Restrained Gasket
Pipe	**Tube**		
$^3/_8$ - $^3/_4$	**$^1/_2$ - $1^3/_8$** 12.7 - 35.1	**300 psi** (2.07 MPa)	**300 psi** (2.07 MPa)
1 - 2	**$1^1/_2$ - $2^1/_2$** 38.1 - 63.5	**200 psi** (1.38 MPa)	**200 psi** (1.38 MPa)
$2^1/_2$ - 6	**3-6** 76.2 - 152.4	**150 psi** (1.03 MPa)	**150 psi** (1.03 MPa)

†Warning: The Flexmaster® joint is designed to seal pipe and tube connections. The Flexmaster joint is not intended to hold piping systems together. Normal hangers, guides, anchors and other external piping restraints must be used to restrain the piping or tubing system from movement.

Pipe and tube materials, which can be connected by Flexmaster joints*

Pipe or Tube Material	Standard Gasket	Self-Restrained Gasket**
Carbon Steel	X	X
Stainless Steel	X	X
Aluminum	X	Not Recommended
P.V.C. (Plastic)	X	Not Recommended
Copper	X	Not Recommended

*All piping and tubing connected by Flexmaster® joints must meet the nominal O.D. dimensions presented on pages 254-259.

**Piping and Tubing, which use self-restrained gaskets, must have a hardness between 45-85 on a Rockwell "B" scale (45-85 Rb).

AEROQUIP GASKET IDENTIFIER CHART

Gasket Designation	Gasket Compound	Gasket Color	Identifying Color Patch
C	Buna-N (standard)	Black	Yellow or White
N	Buna-N (high temp)	Black	Rust Orange
D	EPDM	Black	Dark Blue
V	Fluorocarbon	Black	Light Green
S	Silicone	Rust Orange	None
B**	Butyl	Off White	None
G	Mineral Fiber	Metallic Silver	None

****Obsolete. Contact Eaton Aeroquip for replacement information.**

GASKET MATERIAL: C - BUNA-N (Standard)
D – EPDM (high temperature)
N – BUNA-N
S – SILICONE
V – FLUOROCARBON

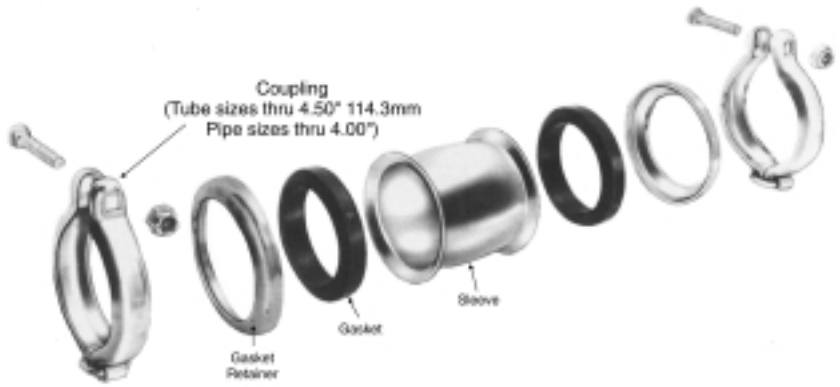
KEY: G GOOD
F FAIR
– NOT RECOMMENDED

⚠ WARNING: Compatibility of gasket material with conveyed fluid is an essential factor in avoiding chemical reactions that may result in release of fluids or failure of the connection with the potential of causing severe personal injury or property damage. The list below provides recommendations for fluid and gasket compatibility. However, the final responsibility for determining compatibility rests with the user.

FLUID	Gasket Material D	C/N	V	S
Acetic Acid (concentrated) RT	F	F	G	F
Acetic Acid (dilute) RT (to 10%)	F	F	G	G
Acetic Acid Vapors	F	F	F	F
Acedit Anhydride	–	F	–	F
Acetone	G	–	–	F
Acetylene	G	G	G	F
Air	G	G	G	G
Air (Hot) 215°	G	F	G	G
Alcohols, Aliphatic	G	F	G	G
Alcohols, Aromatic	F	–	F	F
Alkaline Solutions (Hydroxides)	F	G	F	G
Aluminum Salt Solutions	G	G	G	G
Ammonia Gas (Cold)	G	G	–	–
Ammonia, Liquid (Anhydrous)	G	G	–	F
Ammonia Aqueous	G	F	–	G
Ammonium Salt Solutions	G	G	F	F
Aniline Dyes	F	–	G	F
Aniline Oils	F	–	F	F
Asphalt	–	–	G	–
Benzine (Gasoline)	–	G	G	–
Bromine	–	–	G	–
Butylene	–	F	G	–
Calcium Hypochlorite (no free Chlorine)	G	–	G	F
Calcium Salt Solutions	G	G	G	F
Carbolic Acid (Phenol) RT or Hot	F	–	G	–
Carbon Dioxide (Dry)	G	G	F	F
Carbonic Acid	G	F	G	G
Carbon Disulphide RT	–	–	G	–
Carbon Tetrachloride RT	–	–	G	–
Chlorinated Solvents	–	–	G	G
Chlorine (Dry)	–	–	G	–
Chlorine (wet or solutions)	F	–	G	–
Cottonseed Oil	G	G	G	G
Creosote (wood or coal tar)	–	G	G	–
Chromic Acid 50%	–	F	G	–
Citric Acid	G	G	G	G
Copper Salt Solutions	G	F	G	G
Diesel Fuel	–	G	G	–
Ethers RT	F	F	G	–
Ethylene Glycol	G	G	G	G
Ethylene Dichloride	–	–	G	–
Ferric Salt Solutions	G	G	G	G
Ferrous Salt Solutions	G	G	G	G
Formaldehyde RT	F	–	–	G
Fuel Oil	–	G	F	–
Furfural	G	–	–	–
Freon 12 (Refrigerant)	G	G	G	–
Freon 13 (Refrigerant)	F	G	G	–
Gasoline (Sour or refined)	–	G	G	–
Glycerin (Glycerol)	G	G	G	G
Heptane	–	G	G	–
Hexane	–	G	G	–

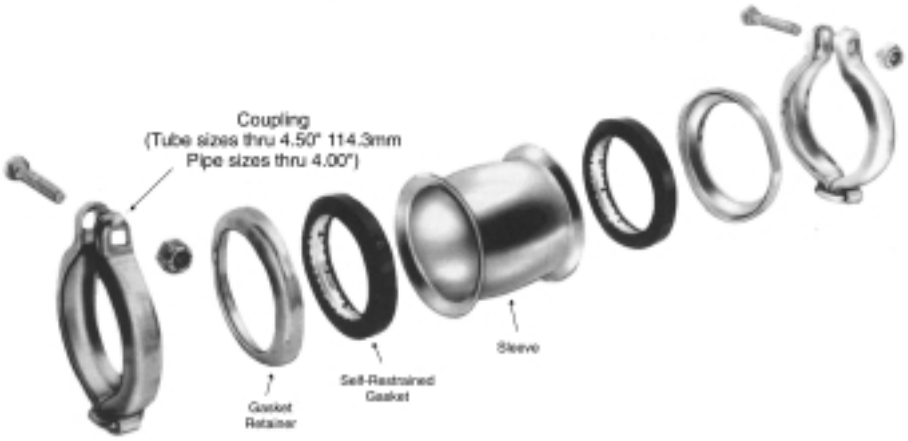
FLUID	Gasket Material D	C/N	V	S
Hydraulic Oils				
Straight Petroleum Base	–	G	G	–
Water Petroleum Emulsion	–	G	G	F
Water Glycol	G	G	G	F
Straight Phosphate Ester	G	–	F	F
Phos. Ester/Petroleum Blend	–	–	F	–
Ester Blend	G	G	F	F
Silicone Oils	G	G	G	–
Hydrochloric Acid RT	G	F	G	–
Hydrofluoric Acid (48% sol) RT	–	–	G	–
Hydrolube	G	G	G	F
Hydrogen Peroxide (dilute)	F	F	G	G
Hydrogen Peroxide (concentrated)	–	–	F	F
Hydrogen Sulfide (dry) RT	F	F	–	–
Hydrogen Sulfide (wet) RT	F	–	G	–
Hypochlorite Solutions (no free Chlorine)	G	F	G	F
Kerosene RT	–	G	G	–
Linseed Oil	–	G	G	–
Lube Oil (Mineral)	–	G	G	–
Lubricating Oils (Diester Base)	–	F	G	–
Magnesium Salt Solutions	G	G	G	G
Mercuric Chloride	G	G	G	–
Mercury	G	G	G	F
Mineral Oil	–	G	G	G
Naphtha	–	F	G	–
Napthalene	–	–	G	–
Nitric Acid (less than 20%)	F	–	G	–
Oleic Acid	–	G	F	–
Oxalic Acid	G	F	G	F
Oxygen, Gaseous	G	F	G	G
Paraffin	–	G	G	F
Petroleum Oils (Sour or Refined)	–	G	G	–
Phosphoric Acid (Commercial)	G	–	G	–
Potassium Salt Solutions	G	G	G	G
Pydraul C Series, F	F	–	G	F
F Series	G	–	–	–
Sodium Salt Solutions	G	G	G	F
Steam	F	–	–	–
Sulfur	G	–	–	–
Sulfur Dioxide (wet or dry)	G	–	–	F
Sulfuric Acid (10-75%)	F	–	G	–
Sulfuric Acid (75-95%)	–	–	G	–
Sulfuric Acid (95%) RT	–	–	G	–
Sulfurous Acid	–	F	G	–
Tannic Acid	F	G	F	F
Trichlorethylene	–	–	G	–
Turpentine	–	F	G	–
Vegetable Oils	G	G	G	G
Water (fresh or salt) cold	G	G	G	G
Water (fresh or salt) hot +215°F. max.	G	⚠	G	–
Xylene	–	–	G	–
Zinc Salt Solutions	G	G	G	G

⚠ C maximum + 180°F., N maximum +225°F.



Coupling
(Tube sizes over 4.50" 114.3mm
Pipe sizes over 4.00" 101.6 mm)

Standard (Un-Restrained) Style



Self-Restrained Style

NH16XX ( ) 000 ( ) 0000

Basic Part Number (from pages 254-259)
Example: NH1600

Gasket Material:
- C = Buna-N (Standard)
- D = EDPM
- * N = BUNA-N (High Temperature)
- * S = Silicone
- * V = Fluorocarbon
- * G = Mineral Fiber (EXHAUST APPLICATIONS NOT SUBJECT TO FLEXING)

* Available in Standard (Un-Restrained) Model Only.

Example Part Number: NH1600C075B0250
Complete assemblies may be ordered by the procedure shown above. Standard components may be ordered as shown on page 251.

Size of Pipe or Tube to be connected: (in hundredths of inch)
Example: .75" = 075

Sleeve Material:
B = Plated Steel (Standard)
S = Stainless Steel (Sleeve only – consult Eaton Aeroquip for availability)

Joint Length (in thousands of inch).
Example: 2.5" = 0250
Style is available in lengths shown. Other lengths are available in multiples of 1-inch on special requests. Contact Eaton Aeroquip for availability.

Pipe and tubing preparation and Flexmaster® joint installation instructions

1. Pipe (Tube) End Preparation
- a) Deburr and clean pipe (tube) ends.
- b) Surface should be free of deep scratches, gouges, dents, dirt, etc.

2. Joint Installation
- a) Install retainer (1), gasket* (2) and sleeve (3) on one side of pipe in sequence shown in Figure 1.
- b) Install remaining retainer (4) and gasket (5) on other pipe end.
- c) Position retainer (4) and gasket (5) to proper pipe insertion depth (“D”) as shown in Table 1.

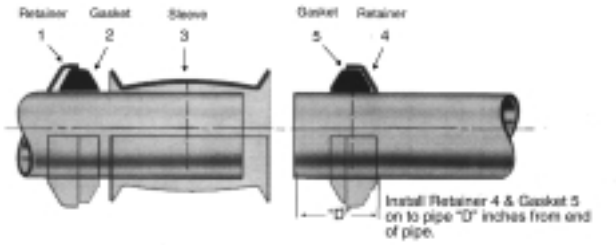


Figure 1

- d) Slide sleeve (3) to gasket (5) and move gasket (2) and retainer (1) into position as shown in Figure 2. Pipe must be inserted to proper depth (“D”) into both gaskets as shown in Table 1.

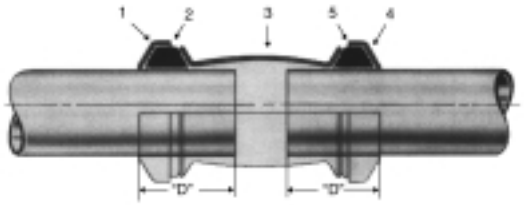


Figure 2

***3.** Special Notes
- a) Assembly of gaskets can be made easier by dipping gaskets in water or the fluid to be sealed. The use of other rubber lubricants can be detrimental to the life of the gaskets. Never lubricate the metal parts.
- b) Self-restrained gasket installation. To simplify installation of a self-restrained gasket, install lower gasket halfway onto the pipe first, leaving the split area in the steel retaining ring free at the top. See Figure 3. Then, stretch the gasket and split area of the retaining ring until they slip
over the tube or pipe and into position. Refer to Figure 3.

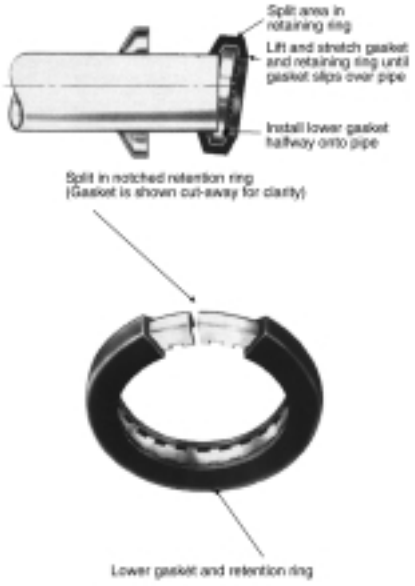


Figure 3

4. Coupler Installation
Install both V-couplings, encompassing the retainer, gasket and sleeve as shown in Figure 4. Do not tighten either coupling until the entire joint is assembled (See Figure 2). Tighten nuts to the torque specified in Table 2. Do not lubricate the nut or bolt before assembly. The gap method outlined in Table 3 may be used for standard gaskets only.

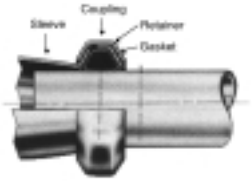


Figure 4

WARNING

Maximum temperature ratings are meant as a guide only. For extreme temperature conditions, consult factory.

Improper installation, use or selection of the Flexmaster joint can result in personal injury, property damage or death.

This page is part of a complete catalog which contains technical and safety data that must be reviewed when selecting a product.

Table 1. Required insertion depth* of pipe and tube

Pipe			Tube		
Pipe Size	**"D" min.**	**"D" max.**	**Tube Size**	**"D" min.**	**"D" max.**
.38	**.71** 18	**1.00** 25.4	**.75** 19.1	**.74** 18.8	**1.10** 27.9
.50	**.71** 18	**1.09** 27.7	**.88** 22.3	**.65** 16.5	**1.00** 25.4
.75	**1.00** 25.4	**1.21** 30.7	**1.00** 25.4	**.72** 18.3	**1.21** 30.7
1.00	**1.14** 29	**1.39** 35.3	**1.12** 28.4	**.93** 23.6	**1.21** 30.7
1.25	**1.15** 29.2	**1.56** 39.6	**1.25** 31.8	**1.16** 29.5	**1.40** 35.6
1.50	**1.16** 29.5	**1.62** 41.1	**1.38** 35.1	**1.20** 30.5	**1.46** 37.1
2.00	**1.18** 30	**1.84** 46.7	**1.50** 38.1	**1.18** 30	**1.45** 36.8
2.50	**1.68** 42.7	**2.38** 60.5	**1.75** 44.5	**1.22** 31	**1.69** 42.9
3.00	**1.70** 43.2	**2.40** 61	**2.00** 50.8	**1.15** 29.2	**1.68** 42.7
3.50	**1.72** 33.7	**2.42** 61.5	**2.25** 57.2	**1.24** 31.5	**1.84** 46.7
4.00	**1.74** 44.2	**2.44** 62	**2.38** 60.3	**1.18** 30	**1.84** 46.7
5.00	**2.08** 52.8	**2.24** 56.9	**2.50** 63.5	**1.17** 29.7	**1.83** 46.5
6.00	**1.86** 47.2	**2.33** 59.2	**2.75** 69.9	**1.74** 44.2	**1.90** 48.3
			2.88 73.0	**1.68** 42.7	**2.38** 60.5
			3.00 76.2	**1.67** 42.4	**2.30** 58.4
			3.25 82.6	**1.67** 42.4	**2.48** 63
			3.50 88.9	**1.70** 43.2	**2.40** 61
			4.00 101.6	**1.72** 33.7	**2.42** 61.5
			4.50 114.3	**1.74** 44.2	**2.44** 62
			5.00 127	**1.75** 44.5	**2.07** 52.6

**Dimensions shown are for standard, straight, bulged sleeves only. Elbows, tees and specials must meet the minimum insertion depths.*

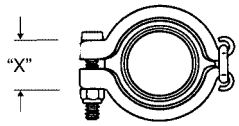
NOTE: **inches and inch-lbs in bold**, mm and N·m in light.

Table 2. Flexmaster® joint assembly tightening guide. Torque Method of Installation**

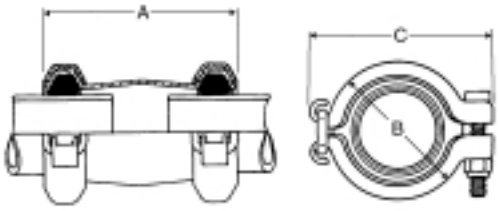
Size	Standard	Self-restrained
.75" to 1.12" Tube (19.1 to 28.4 mm) **.38" to .75" Pipe**	**40-60 inch-lbs.** (4.55-6.88 N·m)	**40-60 inch-lbs.** (4.55-6.88 N·m)
1.25" to 2.75" Tube (31.8 to 69.9mm) **1" to 2" Pipe**	**90-110 inch-lbs.** (10.14-12.39 N·m)	**140-160 inch-lbs.** (15.78-18.13 N·m)
2.88" to 3.50" Tube (73 to 88.9 mm) **2.50" to 3" Pipe**	**180-200 inch-lbs.** (20.27-22.52 N·m)	**220-240 inch-lbs.** (24.79-27.14 N·m)
4" to 5" Tube (101.6 to 127 mm) **3.50" to 4" Pipe**	**240-260 inch-lbs.** (27.14-29.28 N·m)	**280-300 inch-lbs.** (31.53-33.8 N·m)
6" Tube (152.4 mm) **5" to 6" Pipe**	**300-320 inch-lbs.** (33.8-36.15 N·m)	**480-500 inch-lbs.** (54.05-56.42 N·m)

**Note: The torque values specified are for an un-lubricated (dry) nut and bolt.

Table 3. Optional Clearance Method for Installation of Standard Gaskets. (Self-restrained gaskets must be installed by Torque Method).



Tube Size	Pipe Size	Dimension x ± .06 1.5
.50, .63, .75 12.7, 16.0, 19.1	**3/8, 1/2**	**.62** 15.8
1.00, 1.13 25.4, 28.7	**3/4**	**.69** 17.5
1.25, 1.38 31.8, 35.1 **1.50, 1.75** 38.1, 44.5	**1**	**.94** 23.9
	1 1/4	**.94** 23.9
	1 1/2	**.94** 23.9
2.25 57.2	**2**	**.88** 22.4
2.50, 2.75 63.5, 69.9	**2 1/2**	**1.50** 38.1
3.00, 3.25 76.2, 82.6	**3**	**1.56** 39.6
	3 1/2	**1.56** 39.6
	4	**1.56** 39.6
5.00, 6.00 127, 152.4	**5,6**	Use Torque Method



Basic part number: NH1600
NH1650

Allowable misalignment: ±4° per end

Dimensions: **inches in bold**
mm in light

Pipe Size	Pipe O.D.	B	C	Straight Part Number*	A
.38	**.675** 17.1	**1.48** 37.6	**2.34** 59.4	**NH1600X038X0200 –	**2.00** 50.8
.50	**.840** 21.3	**1.65** 41.9	**2.53** 64.3	NH1600X050X0225 NH1650X050X0225	**2.25** 57.2
.75	**1.050** 26.7	**1.86** 47.2	**2.75** 69.9	NH1600X075X0250 NH1650X075X0250	**2.50** 63.5
1.00	**1.315** 33.4	**2.37** 60.2	**3.48** 88.4	NH1600X100X0288 NH1650X100X0288	**2.88** 73.2
1.25	**1.660** 42.2	**2.71** 68.8	**3.85** 97.8	NH1600X125X0325 NH1650X125X0325	**3.25** 82.6
1.50	**1.900** 48.3	**2.96** 75.2	**4.11** 104.4	NH1600X150X0350 NH1650X150X0350	**3.50** 88.9
2.00	**2.375** 60.3	**3.43** 87.1	**4.60** 116.8	NH1600X200X0400 NH1650X200X0400	**4.00** 101.6
2.50	**2.875** 73.0	**4.73** 120.1	**6.23** 158.2	NH1600X250X0650 NH1650X250X0650	**6.50** 165.1
3.00	**3.500** 88.9	**5.36** 136.1	**6.87** 174.5	NH1600X300X0650 NH1650X300X0650	**6.50** 165.1
3.50	**4.000** 101.6	**5.86** 148.8	**7.38** 187.5	NH1600X350X0650 NH1650X350X0650	**6.50** 165.1
4.00	**4.500** 114.3	**6.36** 161.5	**7.89** 200.5	NH1600X400X0650 NH1650X400X0650	**6.50** 165.1
5.00	**5.563** 141.4	**8.22** 208.8	**10.62** 269.7	**NH1600X500X0650 NH1650X500X0650	**6.50** 165.1
6.00	**6.625** 168.3	**8.86** 225.0	**11.24** 285.5	**NH1600X600X0650 NH1650X600X0650	**6.50** 165.1

NOTE: Letter X in part numbers shown indicates a code letter to be filled in. See page 250 for explanation of part numbers and how to order.
**Black part numbers are standard type. Gray part numbers are self-restrained type.*
***Sleeve in this size is cylindrical (no-bulge). Allowable misalignment is ±2° per end for this size.*

This page is part of a complete catalog which contains technical and safety data that must be reviewed when selecting a product.

General Description

Series “C” check valves permit free flow in one direction, and dependable shut-off in the reverse direction.

Operation

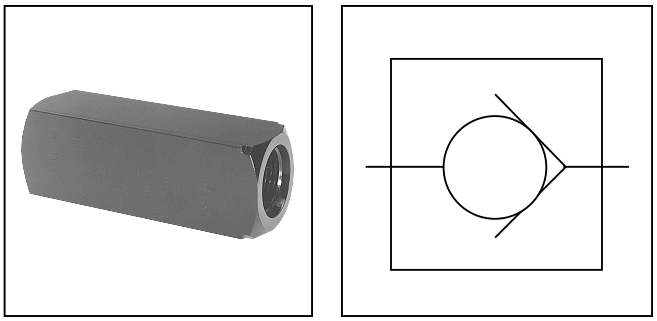
When pressure going throught the valve is increased to the cracking level the valve opens. When the pressure is reduced to below the cracking level the valve closes.

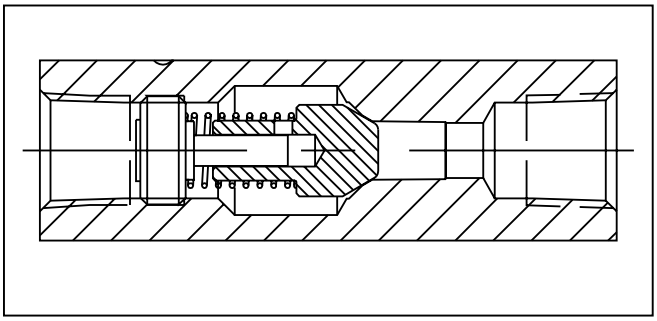
Features

- Stainless steel poppets standard.
- Soft seal poppets are available.
- Triangular retainers guide the poppets, and hold the spring firmly in place even under high velocity and shock.

Specifications

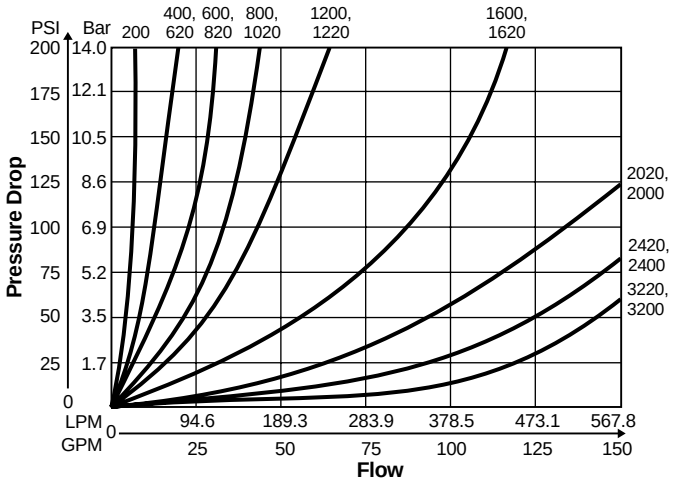
Maximum Operating Pressure	Brass: 140 Bar (2000 PSI); except for C1600 brass which is 35 Bar (500 PSI) Steel: 345 Bar (5000 PSI) for 200 thru 1220; 207 Bar (3000 PSI) for all other sizes and styles
Maximum Flow	C200: 11 LPM (3 GPM) C400: 19 LPM (5 GPM) C600: 30 LPM (8 GPM) C620: 19 LPM (5 GPM) C800: 57 LPM (15 GPM) C820: 30 LPM (8 GPM) C1020: 57 LPM (15 GPM) C1200: 95 LPM (25 GPM) C1220: 95 LPM (25 GPM) C1600: 151 LPM (40 GPM) C1620: 151 LPM (40 GPM) C2000: 265 LPM (70 GPM) C2020: 265 LPM (70 GPM) C2400: 379 LPM (100 GPM) C2420: 379 LPM (100 GPM) C3200: 569 LPM (150 GPM) C3220: 569 LPM (150 GPM)





Performance Curves

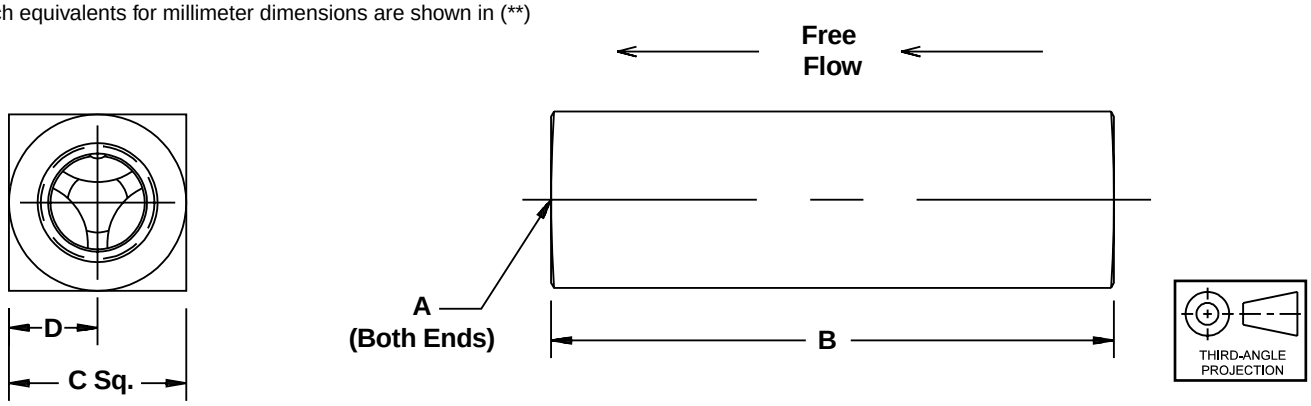
Controlled Flow vs. Pressure Drop
Free Flow 0.3 Bar (5 PSI) Cracking
100 SSU, Hydraulic Oil



G

Dimensions

*Inch equivalents for millimeter dimensions are shown in (**)



Model Number	A	B	C	D
C200	1/8–27 NPTF	50.8 (2.00)	16.0 (0.63)	7.9. (0.31)
C400	1/4–18 NPTF	66.8 (2.63)	20.6 (0.81)	10.4 (0.41)
C420	7/16–20 UNF #4 SAE	68.3 (2.69)	20.6 (0.81)	10.4 (0.41)
C600	3/8–18 NPTF	69.9 (2.75)	25.4 (1.00)	12.7 (0.50)
C620	9/16–18 UNF #6 SAE	79.2 (3.12)	25.4 (1.00)	12.7 (0.50)
C800	1/2–14 NPTF	87.4 (3.44)	31.8 (1.25)	16.0 (0.63)
C820	3/4–16 UNF #8 SAE	88.9 (3.50)	28.4 (1.12)	14.2 (0.56)
C1020	7/8–14 UNF #10 SAE	101.6 (4.00)	31.8 (1.25)	15.7 (0.62)
C1200	3/4–14 NPTF	98.6 (3.88)	38.1 (1.50)	19.1 (0.75)
C1220	1 1/6–12 UN #12 SAE	117.3 (4.62)	38.1 (1.50)	19.1 (0.75)
C1600	1–11 1/2 NPTF	127.0 (5.00)	44.5 (1.75)	22.4 (0.88)
C1620	1 5/16–12 UN #16 SAE	142.7 (5.62)	57.2 (2.25)	28.4 (1.12)
C2000	1 1/4–11 1/2 NPTF	143.0 (5.63)	57.2 (2.25)	28.7 (1.13)
C2020	1 5/8–12 UN #20 SAE	165.1 (6.50)	69.9 (2.75)	35.1 (1.38)
C2400	1 1/2–11 1/2 NPTF	143.0 (5.63)	69.9 (2.75)	35.1 (1.38)
C2420	1 7/8–12 UN #24 SAE	184.2 (7.25)	76.2 (3.00)	38.1 (1.50)
C3200	2–11 1/2 NPTF	165.1 (6.50)	88.9 (3.50)	44.5 (1.75)
C3220	2 1/2–12 UN #32 SAE	228.6 (9.00)	101.6 (4.00)	50.8 (2.00)

Ordering Information

Options	Series C	Size	Material	Cracking Pressure (nominal)	Seal Compound	Design Series
	C					

Size

200 *	800 *†	1600 *	2400
400 *†	820	1620	2420
600 *†	1020	2000	3200
620	1200 *	2020	3220
	1220		

* Sizes available in Brass
† Sizes available in Stainless Steel

Material

Code	Description
B	Brass
S	Steel
* SS	Stainless Steel

Series C Brass Valves can be used for both air and oil service.
* Available in 400, 600 and 800 sizes.

Cracking Pressure (nominal)

Code	Description
Omit	Standard 0.4 Bar (5 PSI)
65	4.5 Bar (65 PSI)

Seal Compound

Code	Description
Omit	Nitrile (Standard)
V	Fluorocarbon

Design Series
Not required for ordering

Options

Code	Description
Omit	Standard
8	BSPT
9	BSPP

Model Number	Weight Kg (lbs.)	Model Number	Weight Kg (lbs.)	Model Number	Weight Kg (lbs.)	Model Number	Weight Kg (lbs.)
C200	0.0 (0.1)	C820	0.3 (0.7)	C1600	1.5 (3.3)	C2400	3.8 (8.4)
C400	0.2 (0.4)	C1020	0.6 (1.3)	C1620	1.5 (3.3)	C2420	3.8 (8.4)
C600	0.2 (0.5)	C1200	0.9 (2.0)	C2000	2.8 (6.2)	C3200	7.0 (15.4)
C620	0.2 (0.5)	C1220	0.9 (2.0)	C2020	2.8 (6.2)	C3220	7.0 (15.4)
C800	0.6 (1.3)						

Quick Selection Guide

	836E Pressure Switches	836E Nondisplay Pressure Switches	840E Level Switches
Features	• Microprocessor based with no moving parts for longer life and reduced downtime • Rugged, corrosion-resistant 316L stainless steel housing features an IP66 enclosure rating to withstand harsh industrial conditions • Operating pressures from -15…6000 psi (gauge) • Industry-leading four-digit 14-segment digital display • Independently programmable dual PNP N.O./N.C. outputs or 4…20 mA analog output • Stainless steel sensing element	• Microprocessor based with no moving parts for longer life and reduced downtime • Rugged, corrosion-resistant 304L stainless steel housing features an IP65 enclosure rating to withstand harsh industrial conditions • Operating pressures from 0…6000 psi (gauge) • 4…20 mA analog output • Stainless steel sensing element	• Liquid level switch used in tanks, containers and pipelines • On-site control using external LED display • Easy-to-install • Microprocessor based with no moving parts for longer life and reduced downtime • Rugged, corrosion-resistant 316L stainless steel housing features an IP67 enclosure rating to withstand harsh industrial conditions • DC PNP version with M12 connector • AC version with NPT 1/2 valve connector • 316L stainless steel sensing element
Applications	• Automotive industry • Machine tool • Injection molding machines • Hydraulics • Pneumatics	• Automotive industry • Machine tool • Injection molding machines • Hydraulics • Pneumatics	• Liquid level monitoring • Tanks, containers and pipelines • Filtering systems • Coolant and lubricant tanks • Pump protector
Supply Voltage	• 12…30V DC	• 12…30V DC	• DC PNP 10...35 V DC • AC 19...253 V AC
Output	• Dual PNP N.O./N.C. or 4…20 mA analog with single PNP N.O./N.C. programmable outputs	• 4…20 mA analog	• DC PNP • AC
Supply Current	• <60 mA	• <30 mA	• DC PNP <15 mA • AC <3.8 mA
Load Current	• 250 mA (each output)	• 250 mA (each output)	• 250 mA
Certifications	• cULus • CE Marked for all applicable directives	• CE Marked for all applicable directives	• CE Marked for all applicable directives • CSA C US
Additional Info	• See page 7-4	• See page 7-7	• See page 7-7

Visit our website: *www.ab.com/catalogs*.
Preferred availability cat. nos. are printed in **bold**.

836E Pressure Switches

Features

- Microprocessor based with no moving parts for longer life and reduced downtime
- Rugged, corrosion-resistant 316L stainless steel housing features an IP66 enclosure rating to withstand harsh industrial conditions
- Operating pressures from –15…6000 psi (gauge)
- Industry-leading four-digit 14-segment digital display
- Independently programmable dual PNP NO/NC outputs or 4…20 mA analog output with single PNP NO/NC output
- Stainless steel sensing element

Applications

- Automotive industry
- Machine tool
- Injection molding machines
- Hydraulics
- Pneumatics
- Food and beverage
- Pharmaceuticals

Specifications

Certifications	cULus, CE Marked for all applicable directives, and 3 A authorized only with sanitary adaptor
Supply Voltage	12…30V DC
Output	Dual PNP N.O./N.C. or 4…20 mA analog with single PNP N.O./N.C.
Supply Current	<60 mA (no load)
Load Current, Max.	250 mA (per PNP output)
Analog Output Impedance	Max (Vsupply - 6.5V)/0.22 A
Accuracy	<0.5% of upper pressure range limit Analog Nonlinearity: <0.2% (as per limit point method)
Repeatability	<0.2% of upper pressure range limit
Long Term Drift	<0.15% per year
Media Temperature [C (F)]	-40…100° (-40…212°)
Operating Temperature [C (F)]	-40…85° (-40…185°)
Housing Material	316L stainless steel
Wetted Parts	316L stainless steel
Enclosure Type Rating	IP66 ❶
Switch Cycles, Min.	>10,000,000
Over Pressure Limit (psi) ❷	1.5 times MWP
Burst Pressure Limit	3 times MWP
Response Time	Switch Output: ≤20 ms; Analog Output: Rise Time: T_{90} ≤200 ms; Analog Output: Settling Time: T_{99} ≤500 ms

❶ Pressure sensors up to 60 psi are rated IP60.

❷ Maximum working pressure (MWP) is the maximum pressure that switches can tolerate for an indefinite period of time. Over pressure limit is the maximum pressure that switches can tolerate for a short period of time without sustaining permanent damage. Burst pressure limit is the maximum pressure that switches can tolerate without sustaining permanent damage or leakage.

Product Selection

Process Connection	Pressure Range [psi]	Set Point Range [psi]	Reset Point Range [psi]	Max. Working Pressure [psi]❶	Cat. No.	
					Dual PNP Output	420 mA Analog Output w/Single PNP Output❷
1/4 inch NPT (female)	-15…15	-14.92+15	-15.00…14.92	40.5	836E-DA1CC1D4	836E-DC1CC1D4
	0…60	0.30…60	0…59.70	160.5	836E-DA1EL1D4	836E-DC1EL1D4
	0…150	0.75…150	0…149.25	400.5	836E-DA1EN1D4	836E-DC1EN1D4
	0…600	3.00…600	0…597.00	1600.5	836E-DA1EQ1D4	836E-DC1EQ1D4
	0…1,500	7.50…1,500	0…1,492.50	1600.5	836E-DA1ER1D4	836E-DC1ER1D4
	0…6,000	0.30…6000	0…5,970.00	6,000	836E-DA1EU1D4	836E-DC1EU1D4
SAE 7/16-20 UNF (female)	-15…15	-14.92…+15	-15.00…14.92	40.5	836E-DA1CC2D4	836E-DC1CC2D4
	0…60	0.30…60	0…59.70	160.5	836E-DA1EL2D4	836E-DC1EL2D4
	0…150	0.75…150	0…149.25	400.5	836E-DA1EN2D4	836E-DC1EN2D4
	0…600	3.00…600	0…597.00	1600.5	836E-DA1EQ2D4	836E-DC1EQ2D4
	0…1,500	7.50…1,500	0…1,492.50	1600.5	836E-DA1ER2D4	836E-DC1ER2D4
	0…6,000	0.30…6000	0…5,970.00	6,000	836E-DA1EU2D4	836E-DC1EU2D4
G1/4 BSPP (female)	-1…1 (bar)	-1.0…+1.03 (bar)	-1.03…1 (bar)	2.7 (bar)	836E-DA1CC3D4	836E-DC1CC3D4
	0…4 (bar)	0.02…4.14 (bar)	0…4 (bar)	10.7 (bar)	836E-DA1EL3D4	836E-DC1EL3D4
	0…10 (bar)	0.05…10.30 (bar)	0…10 (bar)	26.7 (bar)	836E-DA1EN3D4	836E-DC1EN3D4
	0…40 (bar)	0.21…41.38 (bar)	0…40 (bar)	106.7 (bar)	836E-DA1EQ3D4	836E-DC1EQ3D4
	0…100 (bar)	0.52…103.45 (bar)	0…100 (bar)	106.7 (bar)	836E-DA1ER3D4	836E-DC1ER3D4
	0…400 (bar)	2.07…413.79 (bar)	0…400 (bar)	400 (bar)	836E-DA1EU3D4	836E-DC1EU3D4
Sanitary Connection						
1…1.5 inch Clamp	0…150	0.75…150	0…149.25	400.5	836E-DA1ENBD4	836E-DC1ENBD4
	0…600	3.00…600	0…597.00	600	836E-DA1EQBD4	836E-DC1EQBD4
2 inch Clamp	0…150	0.75…150	0…149.25	400.5	836E-DA1ENCD4	836E-DC1ENCD4
	0…600	3.00…600	0…597.00	600	836E-DA1EQCD4	836E-DC1EQCD4
Base Switch (No Adaptor)	0…150	0.75…150	0…149.25	400.5	836E-DA1EN7D4	836E-DC1EN7D4
	0…600	3.00…600	0…597.00	600	836E-DA1EQ7D4	836E-DC1EQ7D4
Recommended cordset: 2 m (6.5 ft) 4-pin DC micro (straight) ❸						889D-F4AC-2
Recommended cordset: 2 m (6.5 ft) 4-pin DC micro (right angle) ❸						889D-R4AC-2

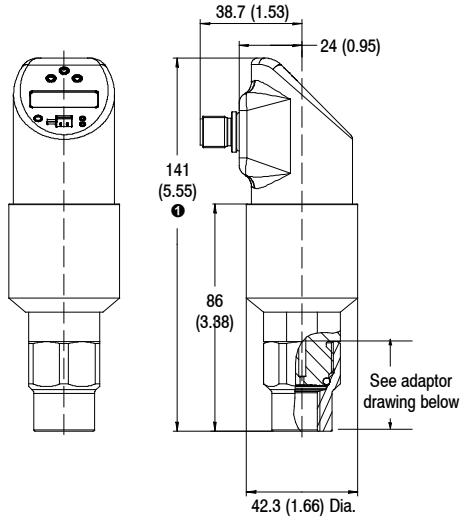
❶ Maximum working pressure (MWP) is the maximum pressure that switches can tolerate for an indefinite period of time. Over pressure limit is the maximum pressure that switches can tolerate for a short period of time without sustaining permanent damage. Burst pressure limit is the maximum pressure that switches can tolerate without sustaining permanent damage or leakage.

❷ Analog output version may be set up to output dual PNP NO/NC.

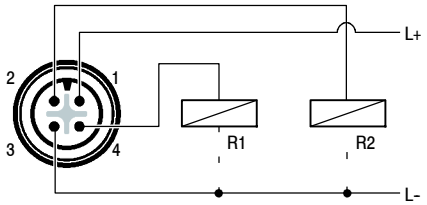
❸ Additional cable lengths are available. Shielded cables may be used to protect analog signal quality in an electrically noisy environment—refer to the *On-Machine Connectivity* catalog for options.

836E Pressure Switches

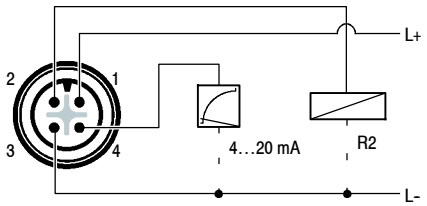
Approximate Dimensions [mm (in.)]



Wiring Diagram



Dual PNP



4…20 mA Analog with Single PNP

Note: Output 2 operates as diagnostic/break contact in DESINA mode.

❶ 145.2 (5.71) for 6000psi switch.

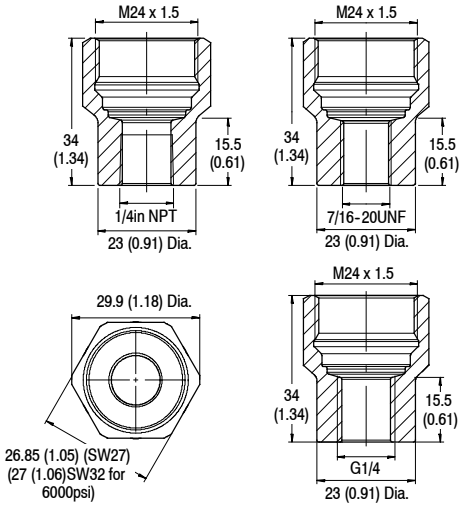
Accessories

Description	Cat. No.
Configuation kit (includes converter cable and ReadWin 2000 software)	836E-NSR
1/4 in. NPT (female) adaptor	836E-NP71
7/16-20 UNF (female) adaptor	836E-NP72
G1/4 BSPP (female) adaptor	836E-NP73
1/4 in. NPT (male) adaptor	836E-NP74

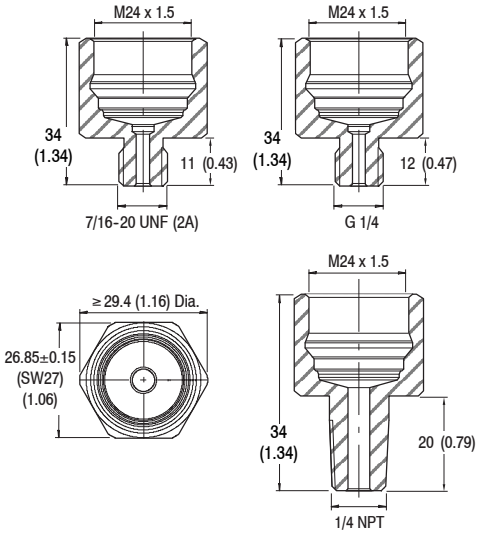
Description	Cat. No.
7/16-20 UNF (male) adaptor	836E-NP75
G1/4 BSPP (male) adaptor	836E-NP76
1…1.5 inch sanitary clamp	836E-NH7B
2 inch sanitary clamp	836E-NH7C
O-ring (EPDM)	836E-NV1
O-ring (fluorinated elastomer seal)	836E-NV2

Note: Maximum female adaptor pressure range = 1,450psi (100 bar).
Maximum male adaptor pressure range = 580psi (40 bar).

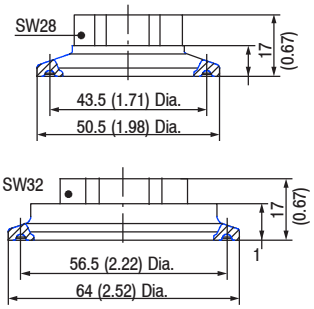
Female Adaptors



Male Adaptors



Sanitary Connectors



836E Nondisplay Pressure Switches

Features

- Microprocessor based with no moving parts for longer life and reduced downtime
- Rugged, corrosion-resistant 304 stainless steel housing features an IP65 enclosure rating to withstand harsh industrial conditions
- Operating pressures from 0...6000 psi (gauge)
- 4...20 mA analog output
- 316L stainless steel sensing element

Applications

- Automotive industry
- Machine tool
- Injection molding machines
- Hydraulics
- Pneumatics

Specifications

Certifications	CE Marked for all applicable directives
Supply Voltage	12…30V DC
Output	4…20 mA analog
Supply Current	<30 mA
Analog Output Impedance	Max. (Vsupply - 12V)/0.02 A
Accuracy	<0.5% of upper pressure range limit analog nonlinearity
Repeatability	< 0.2% of upper pressure range limit
Long Term Drift	<0.15% per year
Media Temperature [C (F)]	-25…70° (-13…158°)
Operating Temperature [C (F)]	-25…70° (-13…158°) [ambient]
Storage Temperature [C (F)]	-40…85° (-40…185°)
Housing Material	304 stainless steel
Sensor Diaphragm	316L stainless steel
Enclosure Type Rating	IP65/NEMA 4
Over Pressure Limit (psi) ❶	1.5 times MWP
Response Time	2…5 ms

❶ Maximum working pressure (MWP) is the maximum pressure that switches can tolerate for an indefinite period of time. Over pressure limit is the maximum pressure that switches can tolerate for a short period of time without permanent damage.

836E Nondisplay Pressure Switches

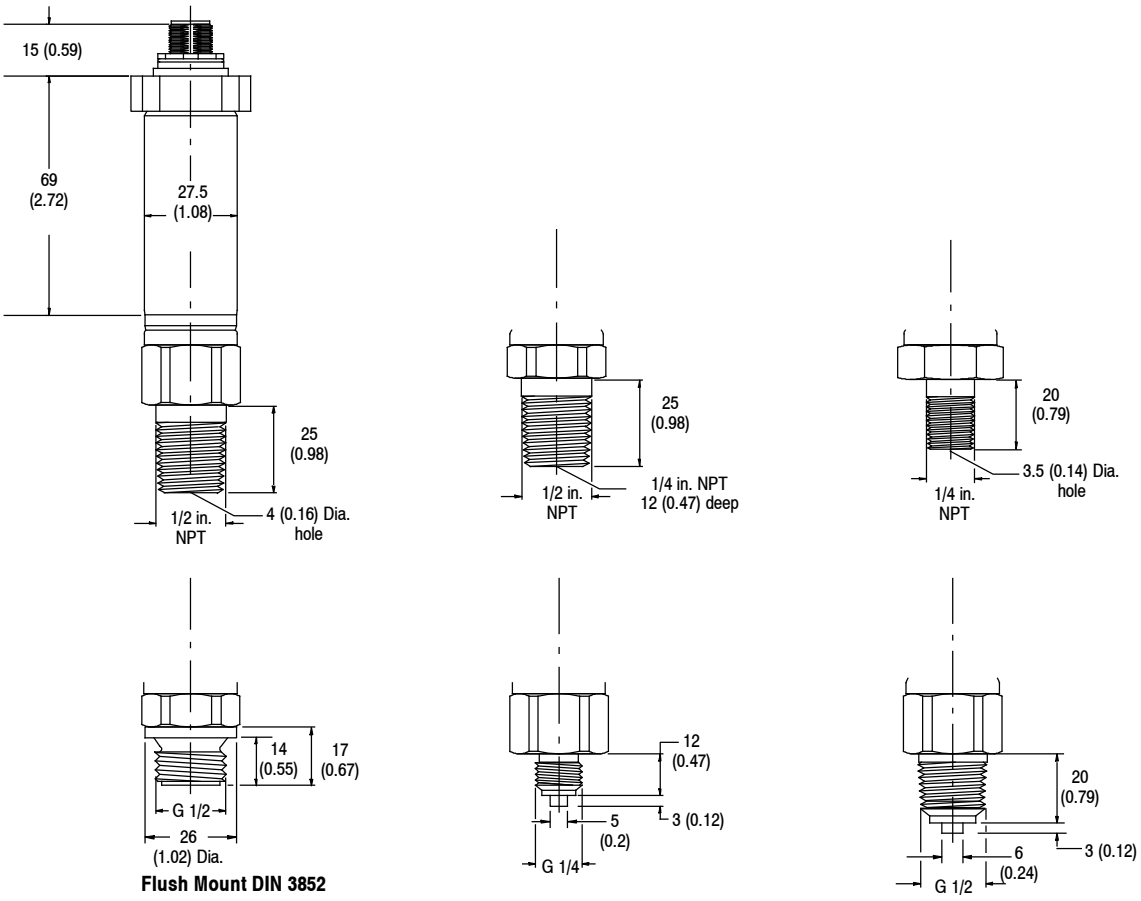
Product Selection

Process Connection	Pressure Range [psi]	Max. Working Pressure [psi] ❶	Cat. No.
1/2 inch NPT (male)	0…500	1,000	836E-TD1EQ8-D4
	0…1,500	1,500	836E-TD1ER8-D4
	0…6,000	6,000	836E-TD1EU8-D4
1/4 inch NPT (male)	0…15	40	836E-TD1CC4-D4
	0…50	160	836E-TD1EL4-D4
	0…150	400	836E-TD1EN4-D4
	0…500	1,000	836E-TD1EQ4-D4
	0…1,500	1,500	836E-TD1ER4-D4
	0…6,000	6,000	836E-TD1EU4-D4
1/2 inch NPT (male) 1/4 inch NPT (female)	0…15	40	836E-TD1CC9-D4
	0…50	160	836E-TD1EL9-D4
	0…150	400	836E-TD1EN9-D4
	0…500	1,000	836E-TD1EQ9-D4
	0…1,500	1,500	836E-TD1ER9-D4
G1/2 (flush mount)	0…15	40	836E-TD1CC62-D4
	0…50	160	836E-TD1EL62-D4
	0…150	400	836E-TD1EN62-D4
	0…500	1,000	836E-TD1EQ62-D4
	0…1,500	1,500	836E-TD1ER62-D4
	0…6,000	6,000	836E-TD1EU62-D4
G1/4 (male)	0…15	40	836E-TD1CC6-D4
	0…50	160	836E-TD1EL6-D4
	0…150	400	836E-TD1EN6-D4
	0…500	1,000	836E-TD1EQ6-D4
	0…1,500	1,500	836E-TD1ER6-D4
	0…6,000	6,000	836E-TD1EU6-D4
Recommended cordset: 2 m (6.5 ft) 4-pin DC micro (straight) ❷			889D-F4AC-2
Recommended cordset: 2 m (6.5 ft) 4-pin DC micro (right angle) ❷			889D-R4AC-2

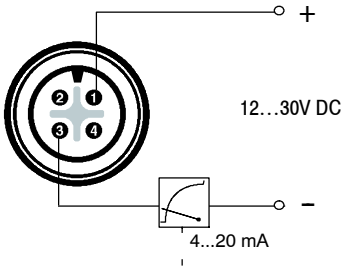
❶ Maximum working pressure (MWP) is the maximum pressure that switches can tolerate for an indefinite period of time. Over pressure limit is the maximum pressure that switches can tolerate for a short period of time without sustaining permanent damage.

❷ Additional cable lengths are available. Shielded cables may be used to protect analog signal quality in an electrically noisy environment—refer to the *On-Machine Connectivity* catalog for options.

Approximate Dimensions [mm (in.)]



Wiring Diagram



Rosemount 3051 Pressure Transmitter

THE PROVEN INDUSTRY LEADER IN PRESSURE MEASUREMENT

- *Best-in-Class performance with 0.04% High Accuracy option*
- *Industry first installed five-year stability*
- *Unmatched Dynamic Performance*
- *Coplanar™ platform enables integrated pressure, flow, and level solutions*
- *Advanced PlantWeb® Functionality to increase plant productivity*

Contents

Setting the Standard for Pressure Measurement

Ordering Information

Rosemount 3051T Gage and Absolute Pressure Transmitter

Specifications

Product Certifications

Dimensional Drawings

Setting the Standard for Pressure Measurement

Proven best-in-class performance, reliability and safety

- Over 4 million installed
- Meet your application needs with extensive offering
- Real world total performance of ±0.15%
- Reference accuracy of ±0.04%

Flow

Pressure

Maximize Installation Flexibility with Coplanar Platform

- Improve reliability and performance with integrated DP Flowmeters, DP Level and manifolds
- Easy installation with all solutions fully assembled, leak-tested and calibrated
- Meet your application needs with an unsurpassed offering

Level

Unlock the Value of Devices with the Smart Wireless THUM™ Adapter

- Gain access to field intelligence and improve quality, safety, availability, operations and maintenance costs
- Remotely manage devices and monitor health
- Enable new wireless measurement points
- Utilize existing loop power

Innovative, Integrated DP Flowmeters

- Fully assembled and leak tested for out-of-the-box installation
- Reduce straight pipe requirements, lower permanent pressure loss and achieve accurate measurement in small line sizes
- Up to 1.65% volumetric flow accuracy at 8:1 turndown

Proven, Reliable and Innovative DP Level Technologies

- Connect to virtually any process with a comprehensive offering of process connections, fill fluids, direct mount or capillary connections and materials
- Quantify and optimize total system performance with QZ option
- Operate at higher temperature and in vacuum applications
- Optimize level measurement with cost efficient Tuned-System™ Assemblies

Instrument Manifolds – Quality, Convenient, and Easy

- Design and engineered for optimal performance with Rosemount transmitters
- Save installation time and money with factory assembly
- Offers a variety of styles, materials and configurations

Rosemount 3051T Gage and Absolute Pressure Transmitter

3051T Gage and Absolute Pressure Transmitter

Rosemount 3051T Inline Pressure transmitters provide reliable Gage and Absolute pressure measurement in a compact inline design. Select from the following capabilities for seamless integration:

- Performance up to 0.04% accuracy
- Manifolds and Seal Solutions
- 4-20 mA HART, FOUNDATION fieldbus, and Profibus PA protocols
- Calibrated spans/ranges from 0.3 to 10,000 psi (10,3 mbar to 689 bar)
- 316 SST and Alloy C-276 process isolators

Additional Information
Specifications: page 35
Certifications: page 44
Dimensional Drawings: page 49

Table 2. 3051T Gage and Absolute Pressure Transmitter Ordering Information

★ The Standard offering represents the most common options. The starred options (★) should be selected for best delivery.
The Expanded offering is subject to additional delivery lead time.

Model	**Transmitter Type**		
3051T	Pressure Transmitter		
Pressure Type			
Standard			**Standard**
G	Gage		★
A	Absolute		★
Pressure Upper Range Limit - Configurable Description			
	3051TG(1)	**3051TA**	
Standard			**Standard**
1	30 psi (2,1 bar)	30 psia (2,1 bar)	★
2	150 psi (10,3 bar)	150 psia (10,3 bar)	★
3	800 psi (55,2 bar)	800 psia (55,2 bar)	★
4	4000 psi (275,8 bar)	4000 psia (275,8 bar)	★
5	10000 psi (689,5 bar)	10000 psia (689,5 bar)	★
Transmitter Output			
Standard			**Standard**
A	4–20 mA with Digital Signal Based on HART Protocol		★
F	FOUNDATION fieldbus Protocol		★
W(2)	Profibus PA Protocol		★
Expanded			
M	Low-Power 1–5 V dc with Digital Signal Based on HART Protocol		
Process Connection Style			
Standard			**Standard**
2B	1/2–14 NPT Female		★
2C	G½ A DIN 16288 Male (Available in SST for Range 1–4 only)		★
Expanded			
2F	Coned and Threaded, Compatible with Autoclave Type F-250-C *(Includes Gland and Collar, Available in SST for Range 5 only)*		
61	Non-threaded Instrument flange (Range 1-4 only)		
Isolating Diaphragm		**Process Connection Wetted Parts Material**	
Standard			**Standard**
2(3)	316L SST	316L SST	★
3(3)	Alloy C-276	Alloy C-276	★

Table 2. 3051T Gage and Absolute Pressure Transmitter Ordering Information

★ The Standard offering represents the most common options. The starred options (★) should be selected for best delivery.
The Expanded offering is subject to additional delivery lead time.

Sensor Fill Fluid			
Standard			**Standard**
1	Silicone		★
2	Inert (Fluorinert® FC-43)		★
Housing Material		**Conduit Entry Size**	
Standard			**Standard**
A	Polyurethane-covered Aluminum	½–14 NPT	★
B	Polyurethane-covered Aluminum	M20 × 1.5 (CM20)	★
J	SST	½–14 NPT	★
K	SST	M20 × 1.5 (CM20)	★
Expanded			
D	Polyurethane-covered Aluminum	G½	
M	SST	G½	

Options (Include with selected model number)

PlantWeb Control Functionality		
Standard		**Standard**
A01	Advanced Control Function Block Suite	★
PlantWeb Diagnostic Functionality		
Standard		**Standard**
D01	FOUNDATION fieldbus Diagnostics Suite	★
Integral Assembly		
Standard		**Standard**
S5(4)	Assemble to Rosemount 306 Integral Manifold	★
Seal Assemblies		
Standard		**Standard**
S1(4)	Assemble to one Rosemount 1199 seal	★
Mounting Bracket		
Standard		**Standard**
B4	Bracket for 2-in. Pipe or Panel Mounting, All SST	★
Product Certifications		
Standard		**Standard**
C6	CSA Explosion-proof, Dust Ignition-proof, Intrinsically Safe, and Division 2	★
E2	INMETRO Flameproof	★
E3	China Flameproof	★
E4(5)	TIIS Flameproof	★
E5	FM Explosion-proof, Dust Ignition-proof	★
E7(5)	IECEx Flameproof, Dust Ignition-proof	★
E8	ATEX Flameproof and Dust Certification	★
I1(5)	ATEX Intrinsic Safety and Dust	★
I2	INMETRO Intrinsic Safety	★
I3	China Intrinsic Safety	★
I5	FM Intrinsically Safe, Division 2	★
I7(5)	IECEx Intrinsic Safety	★
IA	ATEX Intrinsic Safety for FISCO; for *FOUNDATION* fieldbus protocol only	★
IE	FM FISCO Intrinsically Safe; for FOUNDATION fieldbus protocol only	★
K2	INMETRO Flameproof, Intrinsic Safety	★
K5	FM Explosion-proof, Dust Ignition-proof, Intrinsically Safe, and Division 2	★
K6(5)	CSA and ATEX Explosion-proof, Intrinsically Safe, and Division 2 (combination of C6 and K8)	★
K7(5)	IECEx Flameproof, Dust Ignition-proof, Intrinsic Safety, and Type n (combination of I7, N7, and E7)	★
K8(5)	ATEX Flame-proof, Intrinsic Safety, Type n, Dust (combination of E8, I1 and N1)	★
KB	FM and CSA Explosion-proof, Dust Ignition-proof, Intrinsically Safe, and Division 2 (combination of K5 and C6)	★
KD(5)	FM, CSA, and ATEX Explosion-proof, Intrinsically Safe (combination of K5, C6, I1, and E8)	★
N1(5)	ATEX Type n Certification and Dust	★
N3	China Type n	★
N7(5)	IECEx Type n Certification	★

Table 2. 3051T Gage and Absolute Pressure Transmitter Ordering Information

★ The Standard offering represents the most common options. The starred options (★) should be selected for best delivery.
The Expanded offering is subject to additional delivery lead time.

Custody Transfer		
Standard		**Standard**
C5	Measurement Canada Accuracy Approval *(Limited availability depending on transmitter type and range. Contact an Emerson Process Management representative)*	★
Calibration Certification		
Standard		**Standard**
Q4	Calibration Certificate	★
QG	Calibration Certificate and GOST Verification Certificate	★
QP	Calibration Certification and tamper evident seal	★
Material Traceability Certification		
Standard		**Standard**
Q8	Material Traceability Certification per EN 10204 3.1.B *NOTE: This option applies to the process connection only.*	★
Quality Certification for Safety		
Standard		**Standard**
QS	Certificate of FMEDA Data	★
Zero/Span Adjustment		
Standard		**Standard**
J1[(6)(7)]	Local Zero Adjustment Only	★
J3[(6)(7)]	No Local Zero or Span Adjustment	★
Expanded		
D1	Hardware adjustments (zero, span, alarm, security)	
Display and Interface Options		
Standard		**Standard**
M4[(8)]	LCD Display with Local Operator Interface	★
M5	LCD Display	★
M6	LCD Display for SST Housing (Housing Codes J, K, L and M only)	★
Conduit Plug		
Standard		**Standard**
DO	316 SST Conduit Plug	★
Transient Terminal Block		
Standard		**Standard**
T1	Transient Protection Terminal Block	★
Software Configuration		
Standard		**Standard**
C1[(6)]	Custom Software Configuration (Completed CDS 00806-0100-4001 required with order)	★
Expanded		
C2[(6)]	0.8–3.2 V dc Output with Digital Signal Based on *HART* Protocol (Output Code M only)	
Alarm Limit		
Standard		**Standard**
C4[(6)(9)]	Analog Output Levels Compliant with NAMUR Recommendation NE 43, Alarm High	★
CN[(6)(9)]	Analog Output Levels Compliant with NAMUR Recommendation NE 43, Low Alarm	★
Pressure Testing		
Expanded		
P1	Hydrostatic Testing with Certificate	
Cleaning Process Area		
Expanded		
P2	Cleaning for Special Service	
P3	Cleaning for <1 PPM Chlorine/Fluorine	
High Accuracy		
Standard		**Standard**
P8	0.04% accuracy to 5:1 turndown (Range 2-4)	★

Table 2. 3051T Gage and Absolute Pressure Transmitter Ordering Information

★ The Standard offering represents the most common options. The starred options (★) should be selected for best delivery.
The Expanded offering is subject to additional delivery lead time.

Ground Screw		
Standard		**Standard**
V5[10]	External Ground Screw Assembly	★
Drinking Water Approval		
Standard		**Standard**
DW	NSF drinking water approval	★
Surface Finish		
Standard		**Standard**
Q16	Surface finish certification for sanitary remote seals	★
Toolkit Total System Performance Reports		
Standard		**Standard**
QZ	Remote Seal System Performance Calculation Report	★
Conduit Electrical Connector		
Standard		**Standard**
GE	M12, 4-pin, Male Connector (eurofast®)	★
GM	A size Mini, 4-pin, Male Connector (minifast®)	★
Typical Model Number:	**3051T G 5 F 2A 2 1 A B4**	

(1) 3051TG lower range limit varies with atmospheric pressure.

(2) Option code M4 - LCD Display with Local Operator Interface required for local addressing and configuration.

(3) Materials of Construction comply with recommendations per NACE MR0175/ISO 15156 for sour oil field production environments. Environmental limits apply to certain materials. Consult latest standard for details. Selected materials also conform to NACE MR0103 for sour refining environments.

(4) "Assemble-to" items are specified separately and require a completed model number.

(5) Not available with low-power Option Code M.

(6) Not available with fieldbus (output code F) or Profibus protocols (output code W).

(7) Local zero and span adjustments are standard unless Option Code J1 or J3 is specified.

(8) Available only with output code W - Profibus PA.

(9) NAMUR-Compliant operation is pre-set at the factory and cannot be changed to standard operation in the field.

(10) The V5 option is not needed with T1 option; external ground screw assembly is included with the T1 option.

Specifications

PERFORMANCE SPECIFICATIONS

This product data sheet covers both HART, FOUNDATION fieldbus and Profibus PA protocols unless specified.
For zero-based spans, reference conditions, silicone oil fill, glass-filled PTFE o-rings, SST materials, Coplanar flange (3051C) or $^1/_2$ in.- 14 NPT (3051T) process connections, digital trim values set to equal range points.

Conformance To Specification (±3σ (Sigma))

Technology leadership, advanced manufacturing techniques and statistical process control ensure specification conformance to at least ±3σ.

Reference Accuracy

Stated reference accuracy equations include terminal based linearity, hysteresis, and repeatability.
For FOUNDATION fieldbus and Profibus PA devices, use calibrated range in place of span.

Models	Standard	High Accuracy Option
3051CD, 3051CG Range 0 (CD)	±0.10% of span For spans less than 2:1, accuracy = ±0.05% of URL	
Range 1	±0.10% of span For spans less than 15:1, accuracy = $\pm\left[0.025 + 0.005\left(\frac{URL}{Span}\right)\right]$% of Span	
Ranges 2-5	±0.065% of span For spans less than 10:1, accuracy = $\pm\left[0.015 + 0.005\left(\frac{URL}{Span}\right)\right]$% of Span	Ranges 2-4 High Accuracy Option, P8 ±0.04% of span For spans less than 5:1, accuracy = $\pm\left[0.015 + 0.005\left(\frac{URL}{Span}\right)\right]$% of Span
3051T Ranges 1-4	±0.065% of span For spans less than 10:1, accuracy = $\pm\left[0.0075\left(\frac{URL}{Span}\right)\right]$% of Span	Ranges 2-4 High Accuracy Option, P8 ±0.04% of span For spans less than 5:1, accuracy = $\pm\left[0.0075\left(\frac{URL}{Span}\right)\right]$% of Span
Range 5	±0.075% of span For spans less than 10:1, accuracy = $\pm\left[0.0075\left(\frac{URL}{Span}\right)\right]$% of Span	
3051CA Ranges 1-4	±0.065% of span For spans less than 10:1, accuracy = $\pm\left[0.0075\left(\frac{URL}{Span}\right)\right]$% of Span	Ranges 2-4 High Accuracy Option, P8 ±0.04% of span For spans less than 5:1, accuracy = $\pm\left[0.0075\left(\frac{URL}{Span}\right)\right]$% of Span
3051L All Ranges	±0.075% of span For spans less than 10:1, accuracy = $\pm\left[0.025 + 0.005\left(\frac{URL}{Span}\right)\right]$% of Span	

Flow Performance - Flow Reference Accuracy

3051CFA Annubar Flowmeter		
Ranges 2-3		±1.60% of Flow Rate at 8:1 flow turndown
3051CFC Compact Orifice Flowmeter – Conditioning Option C		
Ranges 2-3	β =0.4	±1.75% of Flow Rate at 8:1 flow turndown
	β =0.65	±1.95% of Flow Rate at 8:1 flow turndown
3051CFC Compact Orifice Flowmeter – Orifice Type Option P(1)		
Ranges 2-3	β =0.4	±2.00% of Flow Rate at 8:1 flow turndown
	β =0.65	±2.00% of Flow Rate at 8:1 flow turndown
3051CFP Integral Orifice Flowmeter		
Ranges 2-3	β <0.1	±3.00% of Flow Rate at 8:1 flow turndown
	0.1< β <0.2	±1.95% of Flow Rate at 8:1 flow turndown
	0.2< β <0.6	±1.75% of Flow Rate at 8:1 flow turndown
	0.6< β <0.8	±2.15% of Flow Rate at 8:1 flow turndown

(1) For smaller line sizes, see Rosemount Compact Orifice

Total Performance

Total Performance is based on combined errors of reference accuracy, ambient temperature effect, and static pressure effect.

For ±50 °F (28 °C) temperature changes, up to 1000 psi (6,9 MPa) line pressure (CD only), from 1:1 to 5:1 rangedown.

Models	Total Performance
3051C Ranges 2-5	±0.15% of span
3051T Ranges 1-4	±0.15% of span

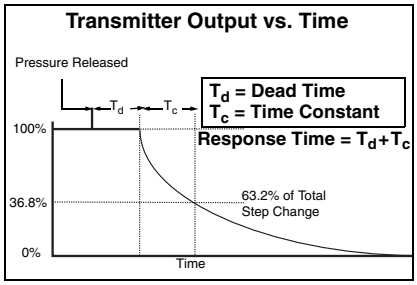
Long Term Stability

Models	Long Term Stability
3051C Ranges 2-5	±0.125% of URL for 5 years ±50 °F (28 °C) temperature changes, and up to 1000 psi (6,9 MPa) line pressure.
3051CD Low/Draft Range Ranges 0-1	±0.2% of URL for 1 year
3051T Ranges 1-4	±0.125% of URL for 5 years ±50 °F (28 °C) temperature changes, and up to 1000 psi (6,9 MPa) line pressure.

Dynamic Performance

	4 - 20 mA HART(1) 1-5 Vdc HART Low Power	FOUNDATION fieldbus and Profibus PA protocols(3)	Typical HART Transmitter Response Time
Total Response Time (T_d + T_c)(2):			
3051C, Ranges 2-5:	100 ms	152 ms	
Range 1:	255 ms	307 ms	
Range 0:	700 ms	N/A	
3051T:	100 ms	152 ms	
3051L:	See Instrument Toolkit®	See Instrument Toolkit	
Dead Time (Td)	45 ms (nominal)	97 ms	
Update Rate	22 times per second	22 times per second	

(1) Dead time and update rate apply to all models and ranges; analog output only
(2) Nominal total response time at 75 °F (24 °C) reference conditions.
(3) Transducer block response time, Analog Input block execution time not included.



Line Pressure Effect per 1000 psi (6,9 MPa)

For line pressures above 2000 psi (13,7 MPa) and Ranges 4-5, see user manual (Document number 00809-0100-4001 for HART, 00809-0100-4774 for FOUNDATION fieldbus, and 00809-0100-4797 for Profibus PA).

Models	Line Pressure Effect
3051CD, 3051CF	Zero Error(1)
Range 0	±0.125% of URL/100 psi (6,89 bar)
Range 1	±0.25% of URL/1000 psi (68,9 bar)
Ranges 2-3	±0.05% of URL/1000 psi (68,9 bar) for line pressures from 0 to 2000 psi (0 to 13,7 MPa)
	Span Error
Range 0	±0.15% of reading/100 psi (6,89 bar)
Range 1	±0.4% of reading/1000 psi (68,9 bar)
Ranges 2-3	±0.1% of reading/1000 psi (68,9 bar)

(1) Can be calibrated out at line pressure.

Ambient Temperature Effect per 50°F (28°C)

Models	Ambient Temperature Effect
3051CD, 3051CG, 3051CF	
Range 0	±(0.25% URL + 0.05% span)
Range 1	±(0.1% URL + 0.25% span)
Ranges 2-5	±(0.0125% URL + 0.0625% span) from 1:1 to 5:1 ±(0.025% URL + 0.125% span) from 5:1 to 100:1
3051T	
Range 1	±(0.025% URL + 0.125% span) from 1:1 to 10:1 ±(0.05% URL + 0.125% span) from 10:1 to 100:1
Range 2-4	±(0.025% URL + 0.125% span) from 1:1 to 30:1 ±(0.035% URL + 0.125% span) from 30:1 to 100:1
Range 5	±(0.1% URL + 0.15% span)
3051CA	
All Ranges	±(0.025% URL + 0.125% span) from 1:1 to 30:1
	±(0.035% URL + 0.125% span) from 30:1 to 100:1
3051L	See Instrument Toolkit software.

Mounting Position Effects

Models	Mounting Position Effects
3051C	Zero shifts up to ±1.25 inH_2O (3,11 mbar), which can be calibrated out. No span effect.
3051L	With liquid level diaphragm in vertical plane, zero shift of up to 1 inH_2O (2,49 mbar). With diaphragm in horizontal plane, zero shift of up to 5 inH_2O (12,43 mbar) plus extension length on extended units. All zero shifts can be calibrated out. No span effect.
3051CA, 3051T	Zero shifts up to 2.5 inH_2O (6,22 mbar), which can be calibrated out. No span effect.

Vibration Effect

Less than ±0.1% of URL when tested per the requirements of IEC60770-1 field or pipeline with high vibration level (10-60 Hz 0.21 mm displacement peak amplitude / 60-2000 Hz 3g).

Power Supply Effect

Less than ±0.005% of calibrated span per volt.

RFI Effects

±0.1% of span from 20 to 1000 MHz and for field strength up to 30 V/m.

Electromagnetic Compatibility (EMC)

Meets all relevant requirements of EN 61326 and Namur NE-21.

Transient Protection (Option Code T1)

Meets IEEE C62.41, Category Location B

6 kV crest (0.5 μs - 100 kHz)
3 kV crest (8 × 20 microseconds)
6 kV crest (1.2 × 50 microseconds)

NOTE
Calibrations at 68 °F (20 °C) per ASME Z210.1 (ANSI)

FUNCTIONAL SPECIFICATIONS

Range and Sensor Limits

Table 7. 3051CD, 3051CG, 3051CF, and 3051L Range and Sensor Limits

Range	Minimum Span		Range and Sensor Limits			
			Lower (LRL)			
	3051CD[(1)], 3051CG, 3051CF, 3051L	Upper (URL)	3051CD Differential 3051CF Flowmeters	3051CG Gage	3051L Differential	3051LGage
0	0.1 inH_2O (0,25 mbar)	3.0 inH_2O (7,47 mbar)	-3.0 inH_2O (-7,47 mbar)	NA	NA	NA
1	0.5 inH_2O (1,2 mbar)	25 inH_2O (62,3 mbar)	-25 inH_2O (-62,1 mbar)	-25 inH_2O (-62,1 mbar)	NA	NA
2	2.5 inH_2O (6,2 mbar)	250 inH_2O (0,62 bar)	-250 inH_2O (-0,62 bar)	-250 inH_2O (-0,62 bar)	-250 inH_2O (-0,62 bar)	-250 inH_2O (-0,62 bar)
3	10 inH_2O (24,9 mbar)	1000 inH_2O (2,49 bar)	-1000 inH_2O (-2,49 bar)	0.5 psia (34,5 mbar abs)	-1000 inH_2O (-2,49 bar)	0.5 psia (34,5 mbar abs)
4	3 psi (0,20 bar)	300 psi (20,6 bar)	-300 psi (-20,6 bar)	0.5 psia (34,5 mbar abs)	-300 psi (-20,6 bar)	0.5 psia (34,5 mbar abs)
5	20 psi (1,38 bar)	2000 psi (137,9 bar)	- 2000 psi (-137,9 bar)	0.5 psia (34,5 mbar abs)	NA	NA

(1) Range 0 only available with 3051CD. Range 1 only available with 3051CD, 3051CG, or 3051CF.

Table 8. Range and Sensor Limits

Range	3051CA				Range	3051T			
		Range and Sensor Limits					Range and Sensor Limits		
	Minimum Span	Upper (URL)	Lower (LRL)			Minimum Span	Upper (URL)	Lower (LRL)	Lower[(1)] (LRL) (Gage)
1	0.3 psia (20,6 mbar)	30 psia (2,07 bar)	0 psia (0 bar)		1	0.3 psi (20,6 mbar)	30 psi (2,07 bar)	0 psia (0 bar)	-14.7 psig (-1,01 bar)
2	1.5 psia (0,103 bar)	150 psia (10,3 bar)	0 psia (0 bar)		2	1.5 psi (0,103 bar)	150 psi (10,3 bar)	0 psia (0 bar)	-14.7 psig (-1,01 bar)
3	8 psia (0,55 bar)	800 psia (55,2 bar)	0 psia (0 bar)		3	8 psi (0,55 bar)	800 psi (55,2 bar)	0 psia (0 bar)	-14.7 psig (-1,01 bar)
4	40 psia (2,76 bar)	4000 psia (275,8 bar)	0 psia (0 bar)		4	40 psi (2,76 bar)	4000 psi (275,8 bar)	0 psia (0 bar)	-14.7 psig (-1,01 bar)
					5	2000 psi (137,9 bar)	10000 psi (689,4 bar)	0 psia (0 bar)	-14.7 psig (-1,01 bar)

(1) Assumes atmospheric pressure of 14.7 psig.

Service

Liquid, gas, and vapor applications

4-20 mA HART (Output Code A)

Output

Two-wire 4-20 mA, user-selectable for linear or square root output. Digital process variable superimposed on 4-20 mA signal, available to any host that conforms to the *HART* protocol.

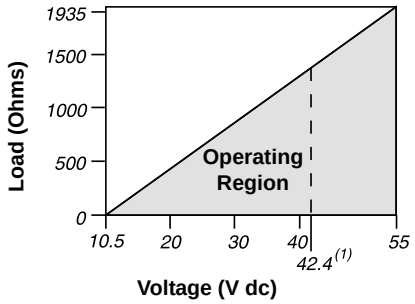
Power Supply

External power supply required. Standard transmitter (4-20 mA) operates on 10.5 to 55 V dc with no load.

Load Limitations

Maximum loop resistance is determined by the voltage level of the external power supply, as described by:

Max. Loop Resistance = 43.5 (Power Supply Voltage – 10.5)



Communication requires a minimum loop resistance of 250 ohms.

(1) For CSA approval, power supply must not exceed 42.4 V.

Zero and Span Adjustment Requirements

Zero and span values can be set anywhere within the range limits stated in Table 7 and Table 8.

Span must be greater than or equal to the minimum span stated in Table 7 and Table 8.

Indication

Optional two line LCD display

FOUNDATION fieldbus (Output code F)

Power Supply

External power supply required; transmitters operate on 9.0 to 32.0 V dc transmitter terminal voltage.

Current Draw

17.5 mA for all configurations (including LCD display option)

Indication

Optional two line LCD display

FOUNDATION fieldbus Function Block Execution Times

Block	Execution Time
Resource	-
Transducer	-
LCD Block	-
Analog Input 1, 2	30 milliseconds
PID	45 milliseconds
Input Selector	30 milliseconds
Arithmetic	35 milliseconds
Signal Characterizer	40 milliseconds
Integrator	35 milliseconds

FOUNDATION fieldbus Parameters

Schedule Entries	7 (max.)
Links	20 (max.)
Virtual Communications Relationships (VCR)	12 (max.)

Standard Function Blocks

Resource Block

Contains hardware, electronics, and diagnostic information.

Transducer Block

Contains actual sensor measurement data including the sensor diagnostics and the ability to trim the pressure sensor or recall factory defaults.

LCD Block

Configures the local display.

2 Analog Input Blocks

Processes the measurements for input into other function blocks. The output value is in engineering units or custom and contains a status indicating measurement quality.

PID Block

Contains all logic to perform PID control in the field including cascade and feedforward.

Backup Link Active Scheduler (LAS)

The transmitter can function as a Link Active Scheduler if the current link master device fails or is removed from the segment.

Advanced Control Function Block Suite (Option Code A01)

Input Selector Block

Selects between inputs and generates an output using specific selection strategies such as minimum, maximum, midpoint, average or first “good.”

Arithmetic Block

Provides pre-defined application-based equations including flow with partial density compensation, electronic remote seals, hydrostatic tank gauging, ratio control and others.

Signal Characterizer Block

Characterizes or approximates any function that defines an input/output relationship by configuring up to twenty X, Y coordinates. The block interpolates an output value for a given input value using the curve defined by the configured coordinates.

Integrator Block

Compares the integrated or accumulated value from one or two variables to pre-trip and trip limits and generates discrete output signals when the limits are reached. This block is useful for calculating total flow, total mass, or volume over time.

FOUNDATION fieldbus Diagnostics Suite (Option Code D01)

The 3051C FOUNDATION fieldbus Diagnostics provide Abnormal Situation Prevention (ASP) indication. The integral statistical process monitoring (SPM) technology calculates the mean and standard deviation of the process variable 22 times per second. The 3051C ASP algorithm uses these values and highly flexible configuration options for customization to many user-defined or application specific abnormal situations. The detection of plugged impulse lines is the first available predefined application.

Profibus PA (Output Code W)

Profile Version

3.02

Power Supply

External power supply required; transmitters operate on 9.0 to 32.0 V dc transmitter terminal voltage.

Current Draw

17.5 mA for all configurations (including LCD display option)

Output Update Rate

Four times per second

Standard Function Blocks

Analog Input (AI Block)

The AI function block processes the measurements and makes them available to the host device. The output value from the AI block is in engineering units and contains a status indicating the quality of the measurement.

Physical Block

The physical block defines the physical resources of the device including type of memory, hardware, electronics and diagnostic information.

Transducer Block

Contains actual sensor measurement data including the sensor diagnostics and the ability to trim the pressure sensor or recall factory defaults.

Indication

Optional two line LCD display

Local Operator Interface

Optional external configuration buttons

1-5 Vdc HART Low Power (Output Code M)

Output

Three wire 1-5 V dc or 0.8-3.2 V dc (Option Code C2) user-selectable output. Also user selectable for linear or square root output configuration. Digital process variable superimposed on voltage signal, available to any host conforming to the *HART* protocol. Low-power transmitter operates on 6-12 V dc with no load.

Power Consumption

3.0 mA, 18-36 mW

Minimum Load Impedance

100 kΩ (V_{out} wiring)

Indication

Optional 5-digit LCD display

Overpressure Limits

Rosemount 3051CD/CG/CF

- Range 0: 750 psi (51,7 bar)
- Range 1: 2000 psig (137,9 bar)
- Ranges 2-5: 3626 psig (250 bar)
  4500 psig (310,3 bar) for option code P9

Rosemount 3051CA

- Range 1: 750 psia (51,7 bar)
- Range 2: 1500 psia (103,4 bar)
- Range 3: 1600 psia (110,3 bar)
- Range 4: 6000 psia (413,7 bar)

Rosemount 3051TG/TA

- Range 1: 750 psi (51,7 bar)
- Range 2: 1500 psi (103,4 bar)
- Range 3: 1600 psi (110,3 bar)
- Range 4: 6000 psi (413,7 bar)
- Range 5: 15000 psi (1034,2 bar)

For 3051L or Level Flange Option Codes FA, FB, FC, FD, FP, and FQ, limit is 0 psia to the flange rating or sensor rating, whichever is lower.

Table 9. 3051L and Level Flange Rating Limits

Standard	Type	CS Rating	SST Rating
ANSI/ASME	Class 150	285 psig	275 psig
ANSI/ASME	Class 300	740 psig	720 psig
ANSI/ASME	Class 600	1480 psig	1440 psig
At 100 °F (38 °C), the rating decreases with increasing temperature, per ANSI/ASME B16.5.			
DIN	PN 10-40	40 bar	40 bar
DIN	PN 10/16	16 bar	16 bar
DIN	PN 25/40	40 bar	40 bar
At 248 °F (120 °C), the rating decreases with increasing temperature, per DIN 2401.			

Static Pressure Limit

Rosemount 3051CD Only

Operates within specifications between static line pressures of 0.5 psia and 3626 psig (4500 psig (310, 3 bar) for Option Code P9).

Range 0: 0.5 psia and 750 psig (3, 4 bar and 51, 7 bar)

Range 1: 0.5 psia and 2000 psig (3, 4 bar and 137, 9 bar)

Burst Pressure Limits

3051C, 3051CF Coplanar or Traditional process flange

10000 psig (69 MPa)

3051T Inline

Ranges 1-4: 11000 psi (75,8 MPa)

Range 5: 26000 psig (179 MPa)

Failure Mode Alarm

If self-diagnostics detect a sensor or microprocessor failure, the analog signal is driven either high or low to alert the user. High or low failure mode is user-selectable with a jumper on the transmitter. The values to which the transmitter drives its output in failure mode depend on whether it is factory-configured to *standard* or *NAMUR-compliant* operation. The values for each are as follows:

Standard Operation			
Output Code	**Linear Output**	**Fail High**	**Fail Low**
A	3.9 ≤ I ≤ 20.8	I ≥ 21.75 mA	I ≤ 3.75 mA
M	0.97 ≤ V ≤ 5.2	V ≥ 5.4 V	V ≤ 0.95V

NAMUR-Compliant Operation			
Output Code	**Linear Output**	**Fail High**	**Fail Low**
A	3.8 ≤ I ≤ 20.5	I ≥ 22.5 mA	I ≤ 3.6 mA

Output Code F and W

If self-diagnostics detect a gross transmitter failure, that information gets passed as a status along with the process variable.

Temperature Limits

Ambient

-40 to 185 °F (-40 to 85 °C)

With LCD display(1): -4 to 175 °F (-20 to 80 °C)

Storage

-50 to 230 °F (-46 to 110 °C)

With LCD display: -40 to 185 °F (-40 to 85 °C)

Process

At atmospheric pressures and above. See Table 10

(1) LCD display may not be readable and LCD updates will be slower at temperatures below -4 °F (-20 °C).

Table 10. 3051 Process Temperature Limits

3051CD, 3051CG, 3051CF, 3051CA	
Silicone Fill Sensor(1)	
with Coplanar Flange	–40 to 250 °F (–40 to 121 °C)(2)
with Traditional Flange	–40 to 300 °F (–40 to 149 °C)(2)(3)
with Level Flange	–40 to 300 °F (–40 to 149 °C)(2)
with 305 Integral Manifold	–40 to 300 °F (–40 to 149 °C)(2)
Inert Fill Sensor(1)	0 to 185 °F (–18 to 85 °C)(4)(5)
3051T (Process Fill Fluid)	
Silicone Fill Sensor(1)	–40 to 250 °F (–40 to 121 °C)(2)
Inert Fill Sensor(1)	–22 to 250 °F (–30 to 121 °C)(2)
3051L Low-Side Temperature Limits	
Silicone Fill Sensor(1)	–40 to 250 °F (–40 to 121 °C)(2)
Inert Fill Sensor(1)	0 to 185 °F (–18 to 85 °C)(2)
3051L High-Side Temperature Limits (Process Fill Fluid)	
Syltherm® XLT	–100 to 300 °F (–73 to 149 °C)
D.C. Silicone 704®	32 to 400 °F (0 to 205 °C)
D.C. Silicone 200	–40 to 400 °F (–40 to 205 °C)
Inert	–50 to 350 °F (–45 to 177 °C)
Glycerin and Water	0 to 200 °F (–18 to 93 °C)
Neobee M-20	0 to 400 °F (–18 to 205 °C)
Propylene Glycol and Water	0 to 200 °F (–18 to 93 °C)

(1) Process temperatures above 185 °F (85 °C) require derating the ambient limits by a 1.5:1 ratio.

(2) 220 °F (104 °C) limit in vacuum service; 130 °F (54 °C) for pressures below 0.5 psia.

(3) 3051CD0 process temperature limits are –40 to 212 °F (–45 to 100 °C)

(4) 160 °F (71 °C) limit in vacuum service.

(5) Not available for 3051CA.

Humidity Limits

0–100% relative humidity

Turn-On Time

Performance within specifications less than 2.0 seconds (10.0 s for Profibus protocol) after power is applied to the transmitter

Volumetric Displacement

Less than 0.005 in^3 (0,08 cm^3)

Damping

4-20 mA HART

Analog output response to a step input change is user-selectable from 0 to 36 seconds for one time constant. This software damping is in addition to sensor module response time.

FOUNDATION fieldbus

Transducer block: 0.4 seconds fixed

AI Block: User configurable

Profibus PA

AI Block only: User configurable

PHYSICAL SPECIFICATIONS

Electrical Connections

1/2–14 NPT, PG 13.5, G1/2, and M20 × 1.5 (CM20) conduit. *HART* interface connections fixed to terminal block.

Process Connections

Rosemount 3051C

1/4–18 NPT on 2 1/8-in. centers
1/2–14 NPT on 2-, 2 1/8-, or 2 1/4-in. centers

Rosemount 3051L

High pressure side: 2-, 3-, or 4-in., ASME B 16.5 (ANSI) Class 150, 300 or 600 flange; 50, 80 or 100 mm, PN 40 or 10/16 flange
Low pressure side: 1/4–18 NPT on flange 1/2–14 NPT on adapter

Rosemount 3051T

1/2–14 NPT female. A DIN 16288 Male (available in SST for Range 1–4 transmitters only), or Autoclave type F-250-C (Pressure relieved 9/16–18 gland thread; 1/4 OD high pressure tube 60° cone; available in SST for Range 5 transmitters only).

Rosemount 3051CF

For 3051CFA, see 00813-01000-4485 in the 485 section
For 3051CFC, see 00813-01000-4485 in the 405 section
For 3051CFP, see 00813-01000-4485 in the 1195 section

Process-Wetted Parts

Drain/Vent Valves

316 SST, Alloy C-276, or Alloy 400 material (Alloy 400 not available with 3051L)

Process Flanges and Adapters

Plated carbon steel, SST cast CF-8M (cast version of 316 SST, material per ASTM-A743), C-Type cast alloy CW12MW, or cast alloy M30C

Wetted O-rings

Glass-filled PTFE or Graphite-filled PTFE

Process Isolating Diaphragms

Isolating Diaphragm Material	3051CD 3051CG	3051T	3051CA
316L SST	•	•	•
Alloy C-276	•	•	•
Alloy 400	•		•
Tantalum	•		
Gold-plated Alloy 400	•		•
Gold-plated SST	•		•

Rosemount 3051L Process Wetted Parts

Flanged Process Connection (Transmitter High Side)

Process Diaphragms, Including Process Gasket Surface

316L SST, Alloy C-276, or Tantalum

Extension

CF-3M (Cast version of 316L SST, material per ASTM-A743), or Alloy C-276. Fits schedule 40 and 80 pipe.

Mounting Flange

Zinc-cobalt plated CS or SST

Reference Process Connection (Transmitter Low Side)

Isolating Diaphragms

316L SST or Alloy C-276

Reference Flange and Adapter

CF-8M (Cast version of 316 SST, material per ASTM-A743)

Non-Wetted Parts

Electronics Housing

Low-copper aluminum or CF-8M (Cast version of 316 SST). Enclosure Type 4X, IP 65, IP 66, IP 68

Coplanar Sensor Module Housing

CF-3M (Cast version of 316L SST, material per ASTM-A743)

Bolts

ASTM A449, Type 1 (zinc-cobalt plated carbon steel)
ASTM F593G, Condition CW1 (Austenitic 316 SST)
ASTM A193, Grade B7M (zinc plated alloy steel)
Alloy K-500

Sensor Module Fill Fluid

Silicone oil (D.C. 200) or Fluorocarbon oil (Halocarbon or Fluorinert® FC-43 for 3051T)

Process Fill Fluid (3051L only)

Syltherm XLT, D.C. Silicone 704,
D.C. Silicone 200, inert, glycerin and water, Neobee M-20 or propylene glycol and water

Paint

Polyurethane

Cover O-rings

Buna-N

Shipping Weights

Table 11. Transmitter Weights without Options

Transmitter	Add Weight In lb. (kg)
3051C	6.0 (2,7)
3051T	3.0 (1,4)
3051L	Table 12 on page 43

Table 12. 3051L Weights without Options

Flange	Flush lb. (kg)	2-in. Ext. lb. (kg)	4-in. Ext. lb. (kg)	6-in. Ext. lb. (kg)
2-in., 150	12.5 (5,7)	—	—	—
3-in., 150	17.5 (7,9)	19.5 (8,8)	20.5 (9,3)	21.5 (9,7)
4-in., 150	23.5 (10,7)	26.5 (12,0)	28.5 (12,9)	30.5 (13,8)
2-in., 300	17.5 (7,9)	—	—	—
3-in., 300	22.5 (10,2)	24.5 (11,1)	25.5 (11,6)	26.5 (12,0)
4-in., 300	32.5 (14,7)	35.5 (16,1)	37.5 (17,0)	39.5 (17,9)
2-in., 600	15.3 (6,9)	—	—	—
3-in., 600	25.2 (11,4)	27.2 (12,3)	28.2 (12,8)	29.2 (13,2)
DN 50/PN 40	13.8 (6,2)	—	—	—
DN 80/PN 40	19.5 (8,8)	21.5 (9,7)	22.5 (10,2)	23.5 (10,6)
DN 100/ PN 10/16	17.8 (8,1)	19.8 (9,0)	20.8 (9,5)	21.8 (9,9)
DN 100/ PN 40	23.2 (10,5)	25.2 (11,5)	26.2 (11,9)	27.2 (12,3)

Table 13. Transmitter Options Weights

Code	Option	Add lb. (kg)
J, K, L, M	Stainless Steel Housing (T)	3.9 (1,8)
J, K, L, M	Stainless Steel Housing (C, L, H, P)	3.1 (1,4)
M4/M5	LCD display for Aluminum Housing	0.5 (0,2)
M4/M6	LCD display for SST Housing	1.25 (0,6)
B4	SST Mounting Bracket for Coplanar Flange	1.0 (0,5)
B1, B2, B3	Mounting Bracket for Traditional Flange	2.3 (1,0)
B7, B8, B9	Mounting Bracket for Traditional Flange	2.3 (1,0)
BA, BC	SST Bracket for Traditional Flange	2.3 (1,0)
H2	Traditional Flange	2.4 (1,1)
H3	Traditional Flange	2.7 (1,2)
H4	Traditional Flange	2.6 (1,2)
H7	Traditional Flange	2.5 (1,1)
FC	Level Flange—3 in., 150	10.8 (4,9)
FD	Level Flange—3 in., 300	14.3 (6,5)
FA	Level Flange—2 in., 150	10.7 (4,8)
FB	Level Flange—2 in., 300	14.0 (6,3)
FP	DIN Level Flange, SST, DN 50, PN 40	8.3 (3,8)
FQ	DIN Level Flange, SST, DN 80, PN 40	13.7 (6,2)

Product Certifications

Approved Manufacturing Locations

Rosemount Inc. — Chanhassen, Minnesota USA
Emerson Process Management GmbH & Co. — Wessling, Germany
Emerson Process Management Asia Pacific Private Limited — Singapore
Beijing Rosemount Far East Instrument Co., LTD — Beijing, China

European Directive Information

The EC declaration of conformity for all applicable European directives for this product can be found on the Rosemount website at www.rosemount.com. A hard copy may be obtained by contacting an Emerson Process Management representative.

ATEX Directive (94/9/EC)
All 3051 transmitters comply with the ATEX Directive.

European Pressure Equipment Directive (PED) (97/23/EC)
3051CA4; 3051CG2, 3, 4, 5; 3051CD2, 3, 4, 5 *(also with P9 option)*; Pressure Transmitters
— QS Certificate of Assessment - EC No. PED-H-100 Module H Conformity Assessment

All other 3051/3001 Pressure Transmitters
— Sound Engineering Practice

Transmitter Attachments: Diaphragm Seal - Process Flange - Manifold
— Sound Engineering Practice

Electro Magnetic Compatibility (EMC) (2004/108/EC)
All 3051 Pressure Transmitters meet all of the requirements of EN61326: 1997 - A1, A2, and A3 and NAMUR NE-21

Ordinary Location Certification for Factory Mutual
As standard, the transmitter has been examined and tested to determine that the design meets basic electrical, mechanical, and fire protection requirements by FM, a nationally recognized testing laboratory (NRTL) as accredited by the Federal Occupational Safety and Health Administration (OSHA).

HART PROTOCOL

Hazardous Locations Certifications

North American Certifications

FM Approvals

E5 Explosion-Proof for Class I, Division 1, Groups B, C, and D. Dust-Ignition-Proof for Class II, Division 1, Groups E, F, and G. Dust-Ignition-Proof for Class III, Division 1.
Factory Sealed, Enclosure Type 4X

I5 Intrinsically Safe for use in Class I, Division 1, Groups A, B, C, and D; Class II, Division 1, Groups E, F, and G; Class III, Division 1 when connected per Rosemount drawing 03031-1019; Non-incendive for Class I, Division 2, Groups A, B, C, and D.
Temperature Code:T4 (Ta = 40 °C), T3 (Ta = 85 °C), Enclosure Type 4X
For input parameters see control drawing 03031-1019.

Canadian Standards Association (CSA)

E6 Explosion-Proof for Class I, Division 1, Groups B, C, and D. Dust-Ignition-Proof for Class II and Class III, Division 1, Groups E, F, and G. Suitable for Class I, Division 2 Groups A, B, C, and D for indoor and outdoor hazardous locations. Enclosure type 4X, factory sealed

C6 Explosion-Proof and intrinsically safe approval. Intrinsically safe for Class I, Division 1, Groups A, B, C, and D when connected in accordance with Rosemount drawings 03031-1024. Temperature Code T3C.
Explosion-Proof for Class I, Division 1, Groups B, C, and D. Dust-Ignition-Proof for Class II and Class III, Division 1, Groups E, F, and G. Suitable for Class I, Division 2 Groups A, B, C, and D hazardous locations. Enclosure type 4X, factory sealed
For input parameters see control drawing 03031-1024.

FOUNDATION FIELDBUS AND PROFIBUS PA PROTOCOLS

Hazardous Locations Certifications

North American Certifications

FM Approvals

E5 Explosion-Proof for Class I, Division 1, Groups B, C, and D. Dust-Ignition-Proof for Class II, Division 1, Groups E, F, and G. Dust-Ignition-Proof for Class III, Division 1.

I5 Intrinsically Safe for use in Class I, Division 1, Groups A, B, C, and D; Class II, Division 1, Groups E, F, and G; Class III, Division 1 when connected per Rosemount drawing 03031-1019; Non-incendive for Class I, Division 2, Groups A, B, C, and D.

Temperature Code:T4 (Ta = 60 °C), T3 (Ta = 85 °C), Enclosure Type 4X
For input parameters see control drawing 03031-1019.

Canadian Standards Association (CSA)

E6 Explosion-Proof for Class I, Division 1, Groups B, C, and D. Dust-Ignition-Proof for Class II and Class III, Division 1, Groups E, F, and G. Suitable for Class I, Division 2 Groups A, B, C, and D for indoor and outdoor hazardous locations. Enclosure type 4X, factory sealed

C6 Explosion-Proof and intrinsically safe approval. Intrinsically safe for Class I, Division 1, Groups A, B, C, and D when connected in accordance with Rosemount drawings 03031-1024. Temperature Code T3C.
Explosion-Proof for Class I, Division 1, Groups B, C, and D. Dust-Ignition-Proof for Class II and Class III, Division 1, Groups E, F, and G. Suitable for Class I, Division 2 Groups A, B, C, and D hazardous locations. Enclosure type 4X, factory sealed
For input parameters see control drawing 03031-1024.

European Certifications

I1 ATEX Intrinsic Safety and Dust
Certification No.: BAS 98ATEX1355X ⟨Ex⟩ II 1 GD
Ex ia IIC T4 (T_{amb} = –60 to +60 °C)
CE 1180

TABLE 18. Input Parameters

U_i = 30V
I_i = 300 mA
P_i = 1.3 W
C_i = 0 µF

TABLE 19. RTD Assembly (3051CFx Option T or R)

U_i = 5 Vdc
I_i = 500 mA
P_i = 0.63W

Special Conditions for Safe Use (X):
1. If the apparatus is fitted with an optional 90V transient suppressor, it is not capable of withstanding the 500V insulation test required by clause 6.3.12 of IEC 60079-11. This must be taken into account when installing the apparatus.
2. The enclosure may be made of aluminium alloy and given a protective polyurethane paint finish; however, care should be taken to protect it from impact or abrasion if located in Zone 0.

IA ATEX FISCO Intrinsic Safety
Certification No.: BAS 98ATEX1355X ⟨Ex⟩ II 1 G
Ex ia IIC T4 (T_{amb} = –60 to +60 °C)
IP66
CE 1180

TABLE 20. Input Parameters

U_i = 17.5 V
I_i = 380 mA
P_i = 5.32 W
C_i = ≤ 5 µF
L_i = ≤ 10 µH

Special Conditions for Safe Use (X):
When the optional transient protection terminal block is installed, the apparatus is not capable of withstanding the 500V insulation test required by Clause 6.3.12 of EN60079-11. This must be taken into account when installing the apparatus.
The enclosure may be made of aluminium alloy and given a protective polyurethane paint finish; however care should be taken to protect it from impact or abrasion located in Zone 0.

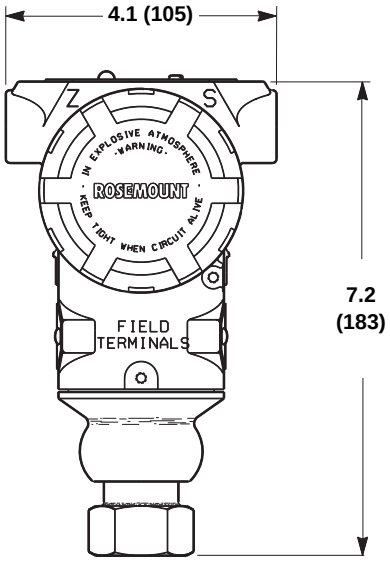
N1 ATEX Type n and Dust
Certification No.: BAS 98ATEX3356X ⟨Ex⟩ II 3 GD
U_i = 40 Vdc max
Ex nA nL IIC T5 (T_a = –40°C to 70 °C)
Dust rating: Ex tD A22 T80 °C (T_{amb} = –20 to 40 °C) IP66

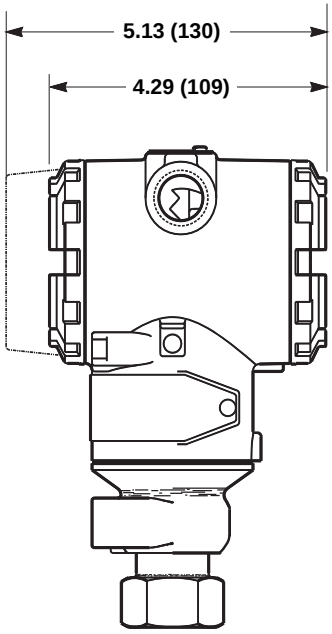
Special Conditions for Safe Use (X):
The apparatus is not capable of withstanding the 500V insulation test required by clause 6.8.1 of IEC 60079-15. This must be taken into account when installing the apparatus.

E8 ATEX Flame-Proof and Dust
Certification No.: KEMA 00ATEX2013X ⟨Ex⟩ II 1/2 GD
Ex d IIC T6 (T_{amb} = –50 to 65 °C)
Dust rating: Ex tD A20/21 T90 °C, IP66
CE 1180
Vmax = 55 V dc

Special Conditions for Safe Use (X):
This device contains a thin wall diaphragm. Installation, maintenance, and use shall take into account the environmental conditions to which the diaphragm will be subjected. The manufacturer's instructions for installation and maintenance shall be followed in detail to assure safety during its expected lifetime.

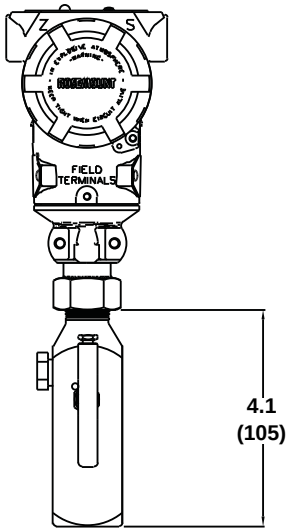
3051T Dimensional Drawings(1)

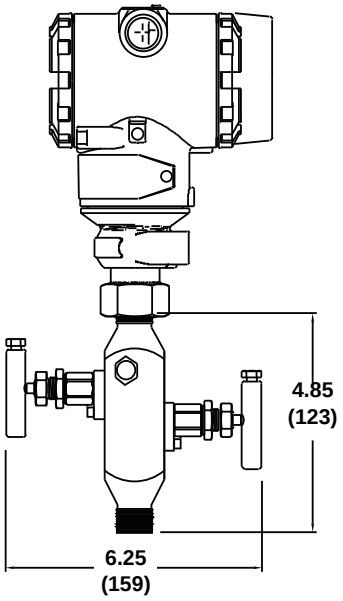




(1) For FOUNDATION fieldbus and Profibus PA transmitters with LCD Display, housing length is 5.36 in. (136 mm).

3051T with Rosemount 306 Integral Manifold

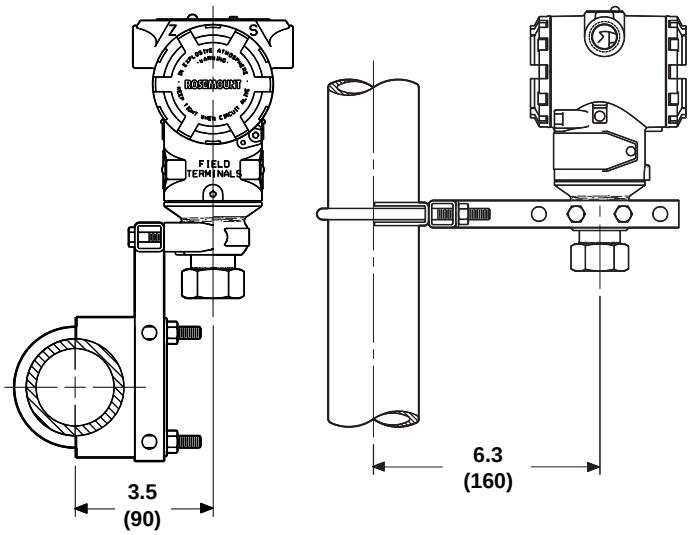




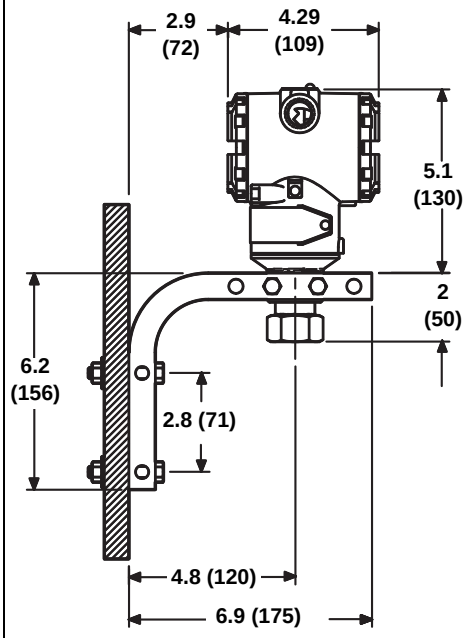
Dimensions are in inches (millimeters)

3051T Typical Mounting Configurations with Optional Mounting Bracket

Pipe Mounting



Panel Mounting



Dimensions are in inches (millimeters)

OPTIONS

Standard Configuration

Unless otherwise specified, transmitter is shipped as follows:

ENGINEERING UNITS	
***Differential/Gage*:**	inH_2O (Range 0, 1, 2, and 3) psi (Range 4 and 5)
***Absolute/3051TA*:**	psi (all ranges)
4 mA (1 V dc)[(1)]:	0 (engineering units above)
20 mA (5 V dc)[(1)]:	Upper range limit
Output:	Linear
Flange type:	Specified model code option
Flange material:	Specified model code option
O-ring material:	Specified model code option
Drain/vent:	Specified model code option
LCD Display:	Installed or none
Alarm[(1)]:	High
Software tag:	(Blank)

(1) Not applicable to FOUNDATION fieldbus or Profibus PA.

Custom Configuration[(1)]

If Option Code C1 is ordered, the customer may specify the following data in addition to the standard configuration parameters.

- Output Information
- Transmitter Information
- LCD display Configuration
- Hardware Selectable Information
- Signal Selection

Refer to the "Rosemount 3051 Configuration Data Sheet" document number 00806-0100-4001.

Tagging (3 options available)

- Standard SST hardware tag is wired to the transmitter. Tag character height is 0.125 in. (3,18 mm), 56 characters maximum.
- Tag may be permanently stamped on transmitter nameplate upon request, 56 characters maximum.
- Tag may be stored in transmitter memory (30 characters maximum). Software tag is left blank unless specified.

Commissioning Tag[(2)]

A temporary commissioning tag is attached to all transmitters. The tag indicates the device ID and allows an area for writing the location.

Optional Rosemount 304, 305 or 306 Integral Manifolds

Factory assembled to 3051C and 3051T transmitters. Refer to the following Product Data Sheet (document number 00813-0100-4839 for Rosemount 304 and 00813-0100-4733 for Rosemount 305 and 306) for additional information.

(1) Not applicable to FOUNDATION fieldbus or Profibus PA protocols.
(2) Only applicable to FOUNDATION fieldbus.

Other Seals

Refer to Product Data Sheet 00813-0100-4016 for additional information.

Output Information

Output range points must be the same unit of measure. Available units of measure include:

Pressure			
atm	inH2O@4 °C[(1)]	g/cm^2	psi
mbar	mmH_2O	kg/cm^2	torr
bar	mmHg	Pa	
inH_20	mmH2O@4 °C[(1)]	kPa	
inHg	ftH_20	MPa[(2)]	
Flow[(2)(3)]			
bbl	kg	cm^3	
ft^3	lb	m^3	
gal	L	ton	
Level[(2)]			
%	ft	cm	
in	mm		

(1) Only available on 4-20mA HART.

(2) Only available on Profibus PA.

(3) All flow units are available per second, minute, hour or day.

Display and Interface options

M4 Digital Display with Local Operator Interface (LOI)

- Available for Profibus PA
- Commission the device with external Local Configuration Buttons
- LOI Menu includes: Address, Units, Calibration, Damping, Display, Identification Number

M5 Digital Display

- 2-Line, 5-Digit LCD for 4-20 mA HART
- 1-Line, 4-Digit LCD for 1-5 Vdc HART Low Power
- 2-Line, 8-Digit LCD for FOUNDATION fieldbus and Profibus PA
- Direct reading of digital data for higher accuracy
- Displays user-defined flow, level, volume, or pressure units
- Displays diagnostic messages for local troubleshooting
- 90-degree rotation capability for easy viewing

M6 Digital Display with 316 Stainless Steel Cover

- For use with stainless steel housing option (housing codes J, K, and L)

Local Span and Zero Adjustment[(1)]

4-20 mA HART and 1-5 Vdc HART Low Power transmitters ship with local span and zero adjustments standard unless otherwise specified.

- Non-interactive external zero and span adjustments ease calibration
- Magnetic switches replace standard potentiometer adjustments to optimize performance

J1 Local Zero Adjustment Only[(1)]

J3 No Local Zero or Span Adjustment[(1)]

Transient Protection

T1 Integral Transient Protection Terminal Block
Meets IEEE C62.41, Category Location B
6 kV crest (0.5 ms - 100 kHz)
3 kV crest (8 × 20 microseconds)
6 kV crest (1.2 × 50 microseconds)

Bolts for Flanges and Adapters

- Options permit bolts for flanges and adapters to be obtained in various materials
- Standard material is plated carbon steel per ASTM A449, Type 1

L4 Austenitic 316 Stainless Steel Bolts
L5 ASTM A 193, Grade B7M Bolts
L6 Alloy K-500 Bolts

Conduit Plug

Single carbon steel plug ships standard, not installed in the transmitter

Rosemount 3051C Coplanar Flange and 3051T Bracket Option

B4 Bracket for 2-in. Pipe or Panel Mounting
- For use with the standard Coplanar flange configuration
- Bracket for mounting of transmitter on 2-in. pipe or panel
- Stainless steel construction with stainless steel bolts

Traditional Flange Bracket Options

B1 Bracket for 2-in. Pipe Mounting
- For use with the traditional flange option
- Bracket for mounting on 2-in. pipe
- Carbon steel construction with carbon steel bolts
- Coated with polyurethane paint

B2 Bracket for Panel Mounting
- For use with the traditional flange option
- Bracket for mounting transmitter on wall or panel
- Carbon steel construction with carbon steel bolts
- Coated with polyurethane paint

B3 Flat Bracket for 2-in. Pipe Mounting
- For use with the traditional flange option
- Bracket for vertical mounting of transmitter on 2-in. pipe
- Carbon steel construction with carbon steel bolts
- Coated with polyurethane paint

B7 B1 Bracket with SST Bolts
- Same bracket as the B1 option with Series 300 stainless steel bolts

B8 B2 Bracket with SST Bolts
- Same bracket as the B2 option with Series 300 stainless steel bolts

B9 B3 Bracket with SST Bolts
- Same bracket as the B3 option with Series 300 stainless steel bolts

BA Stainless Steel B1 Bracket with SST Bolts
- B1 bracket in stainless steel with Series 300 stainless steel bolts

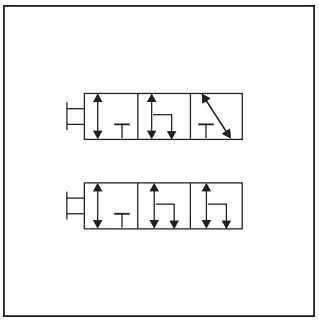
BC Stainless Steel B3 Bracket with SST Bolts
- B3 bracket in stainless steel with Series 300 stainless steel bolts

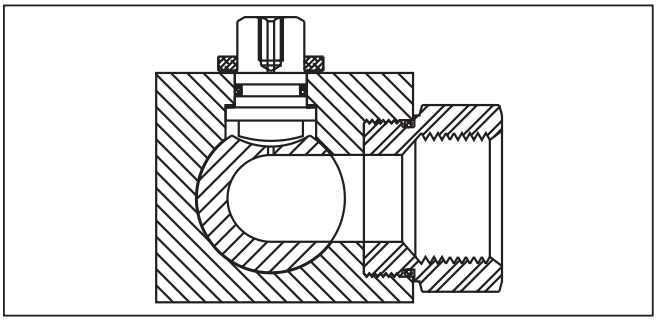
General Description

The BV3D Series is a 3-way diverter. The product is rated at 207 Bar (3000 PSI) and designed to economically satisfy many 3-way applications.

Operation

The BV3D Series operates by rotating the handle 90° or 180° depending on the chosen ball pattern. There is a slight port to port overlap.





Specifications

Maximum Pressure	207 Bar (3000 PSI)
Body Material	Carbon Steel, Black Oxide
Ball Material	Steel, Chrome Plated
Stem Material	Steel, Zinc Plated
Standard Handle	Steel Offset, Nickel Plated
Ball Seals	Delrin + MoS_2
Spindle Seals	O-Ring & Backup, Nitrile
Operating Temperature	-30°C to +100°C (-22°F to +212°F)

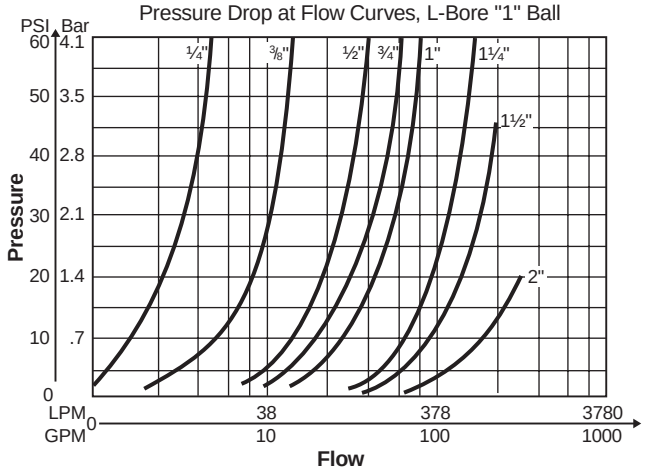
Features

- The standard L-bore ball and T-bore option allows the valve to be utilized in a variety of applications.
- Slight port overlap reduces upstream shock during shifting.
- Utilizing the unique spindle thrust bearing design reduces actuation torque.
- The BV3D can be panel mounted which allows a variety of installation options.
- Delrin seals with molybdenum disulphide (MoS_2) results in lower actuation torque and will increase high duty life cycle expectancy.

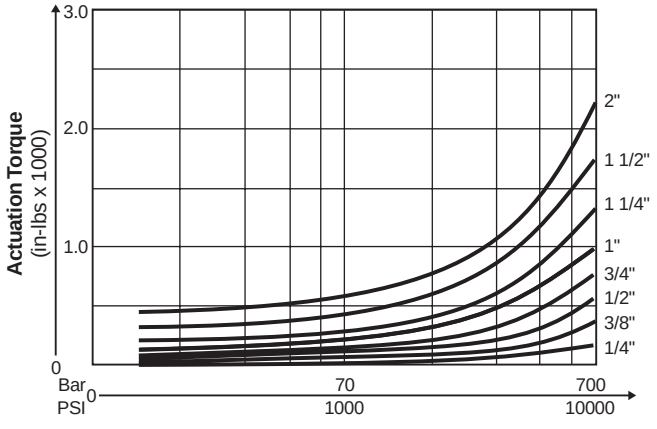
Performance Curves

Pressure Drop

Pressure Drop at Flow Curves, L-Bore "1" Ball

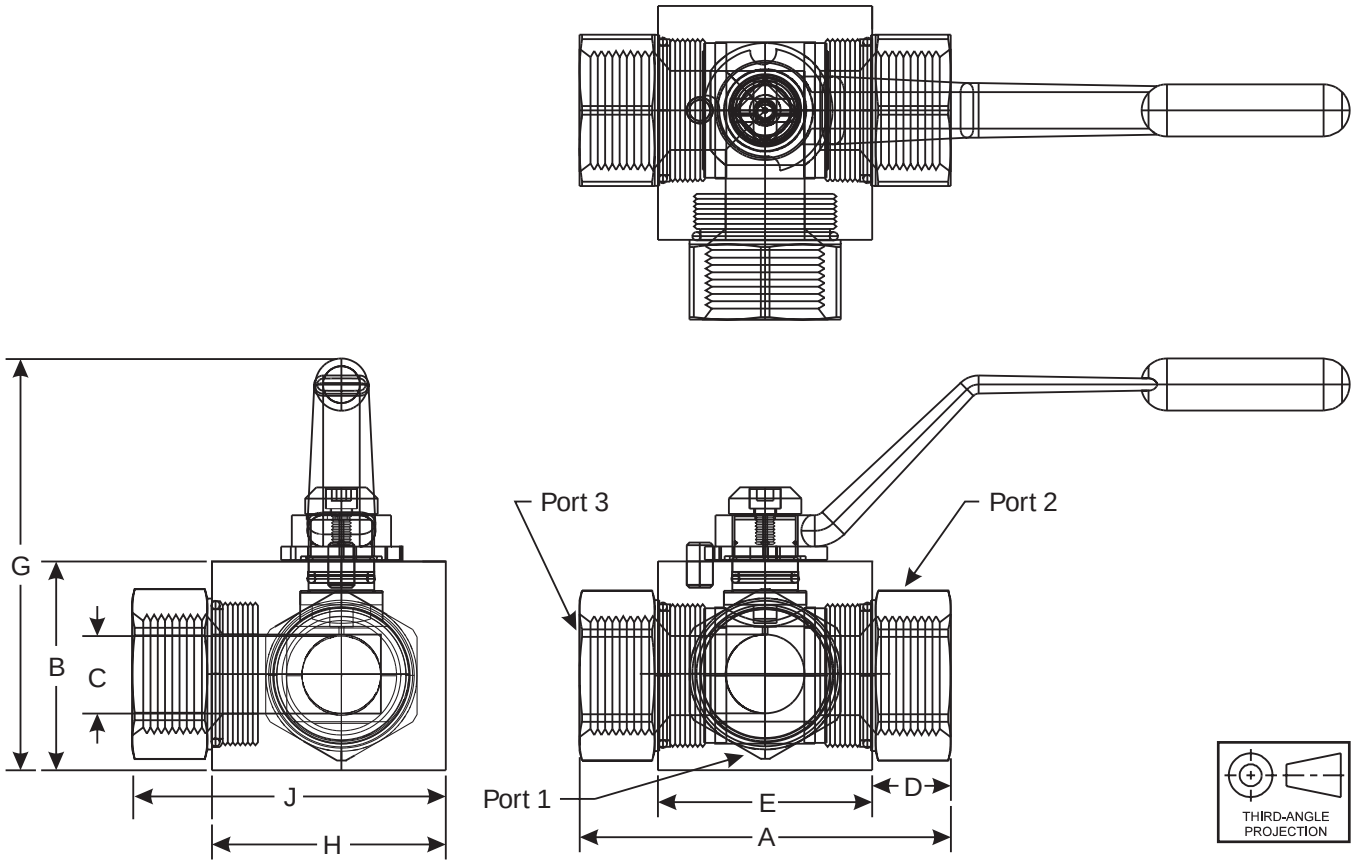


Actuation Torque



bv3d.pm6, dd, hj

Threaded Ports



Code	Port Thread Size	Working Pressure	Dimensions mm (in)									
			A	B	C_L	C_T	D	E	F	G	H	J
NPT and SAE Thread												
04	1/4"	207 Bar (3000 PSI)	69.6 (2.74)	35.1 (1.38)	6.1 (0.24)	6.1 (0.24)	17.0 (0.67)	35.1 (1.38)	114.3 (4.50)	75.7 (2.98)	35.1 (1.38)	52.1 (2.05)
06	3/8"	207 Bar (3000 PSI)	72.9 (2.87)	38.1 (1.50)	9.7 (0.38)	9.7 (0.38)	15.2 (0.60)	41.9 (1.65)	114.3 (4.50)	79.0 (3.11)	41.9 (1.65)	57.4 (2.26)
08	1/2"	207 Bar (3000 PSI)	85.1 (3.35)	41.4 (1.63)	13.0 (0.51)	13.0 (0.51)	19.1 (0.75)	47.0 (1.85)	114.3 (4.50)	82.0 (3.23)	50.8 (2.00)	69.9 (2.75)
12	3/4"	207 Bar (3000 PSI)	96.5 (3.80)	57.2 (2.25)	20.1 (0.79)	20.1 (0.79)	17.8 (0.70)	61.0 (2.40)	177.8 (7.00)	119.4 (4.70)	54.1 (2.13)	71.6 (2.82)
16	1"	207 Bar (3000 PSI)	114.0 (4.49)	63.5 (2.50)	24.1 (0.95)	24.1 (0.95)	24.4 (0.96)	65.3 (2.57)	177.8 (7.00)	125.7 (4.95)	63.5 (2.50)	87.9 (3.46)
20	1 1/4"	207 Bar (3000 PSI)	122.9 (4.84)	81.3 (3.20)	32.0 (1.26)	32.0 (1.26)	21.6 (0.85)	80.0 (3.15)	254.0 (10.00)	160.3 (6.31)	93.7 (3.69)	115.3 (4.54)
24	1 1/2"	207 Bar (3000 PSI)	135.4 (5.33)	92.5 (3.64)	38.1 (1.50)	38.1 (1.50)	25.1 (0.99)	85.1 (3.35)	254.0 (10.00)	171.7 (6.76)	106.4 (4.19)	131.6 (5.18)
32	2"	207 Bar (3000 PSI)	166.1 (6.54)	109.2 (4.30)	48.0 (1.89)	48.0 (1.89)	33.0 (1.30)	100.1 (3.94)	254.0 (10.00)	188.5 (7.42)	127.0 (5.00)	160.0 (6.30)

BV3D | Series | Size | Port | Ball Pattern | Body Material | Ball & Stem Material | Ball Seals | Stem Seals | Options | Design Series

Code	Series
BV3D	

Code	Size
04	1/4"
06	3/8"
08	1/2"
12	3/4"
16	1"
20	1 1/4"
24	1 1/2"
32	2"

Code	Type
N	NPT Thread
S	SAE Thread
B	BSPP Thread
U	ISO 6149 Thread

Code	Type
S	Steel
K	Stainless Steel

Code	Type
S	Steel
K	Stainless Steel

Code	Type
1	Delrin
2	PTFE
4	Peek

Code	Type
N	Nitrile
V	Fluorocarbon
E	EPR

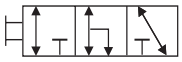
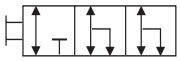
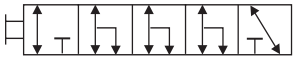
Code	Type
A	Locking Handle
C	1 Way Limit Switch
*E	Panel Mount
G	Flat Non-offset Handle
**K	1 Way Limit Switch w/Lock

Not required for ordering

* Cannot be combined with other options

** Switch is set to indicate valve open condition

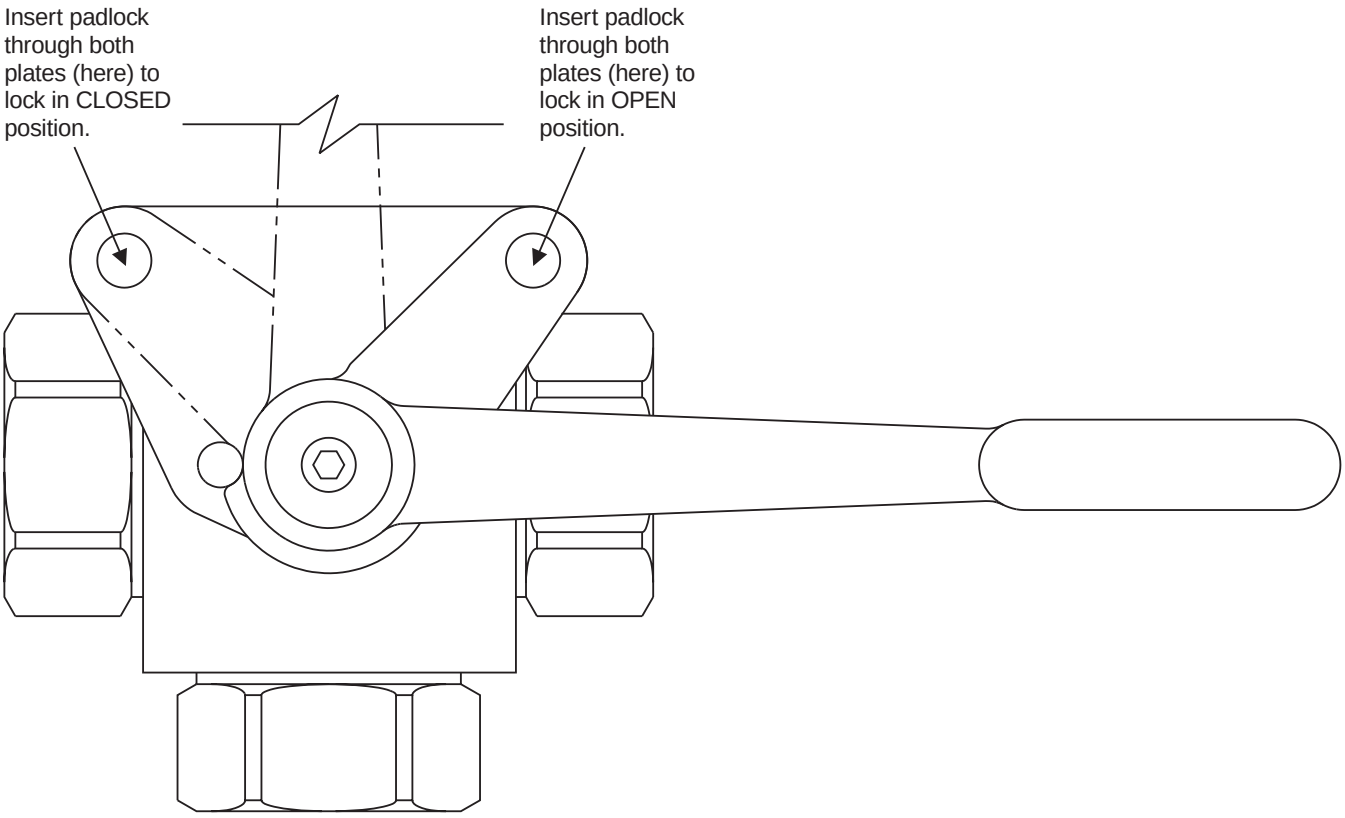
Diverter Valve Ball Porting Options

Ball Code	ISO Circuit Symbol	Ball Pattern	Handle Phase 90° 45° 0° -45° -90°	Stop Washer Type
1		L-Bore Standard		
2		T-Bore 90°		
3		T-Bore 180°		

Weights

Code	kg (lbs)	Code	kg (lbs)
04	0.7 (1.5)	16	3.4 (7.5)
06	0.9 (2.0)	20	4.5 (10.0)
08	1.1 (2.5)	24	6.4 (14.0)
12	2.7 (6.0)	32	9.5 (21.0)

BVHPLK: Standard Series 'BVHPLK-*' kit replaces the stopwasher with a stationary and moving plate, as illustrated below. As the handle is actuated, the moving plate aligns with one of the two locking positions in the stationary plate, enabling the valve to be locked in either **fully closed** or **fully open** position.



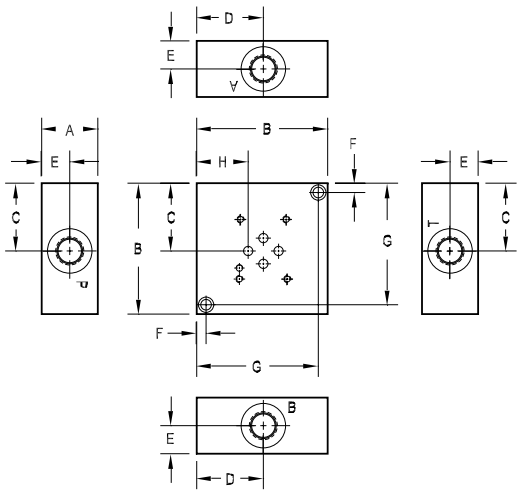
Ordering Information

BV3D		Standard Locking (Part Number)
Code	Size	
04	1/4"	BVHPLK-1
06	3/8"	BVHPLK-1
08	1/2"	BVHPLK-1
12	3/4"	BVHPLK-2
16	1"	BVHPLK-2
20	1 1/4"	BVHPLK-3
24	1 1/2"	BVHPLK-3
32	2"	BVHPLK-3

D03 Subplates

Side Ported Subplate

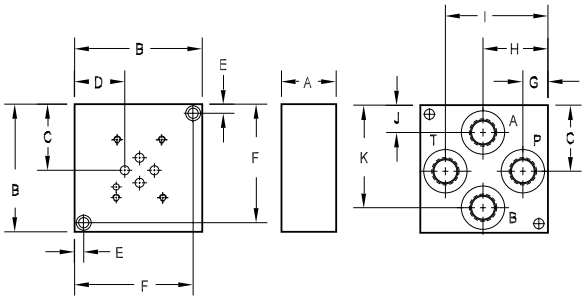
Valve mtg: UNC #10-24 x 0.63 DP or
Metric M5-0.8mm ISO 6H x [16] DP
Subplate hardware kit is supplied.
See page 121 for itemized list.



A	B	C	D	E	F	G	H
1.00 [25.4]	2.50 [63.5]	1.31 [33.3]	1.25 [31.8]	0.50 [12.7]	0.25 [6.4]	2.25 [57.2]	0.88 [22.4]
1.50 [38.1]	3.50 [88.9]	1.81 [46.0]	1.78 [45.2]	0.75 [19.1]	0.25 [6.4]	3.25 [82.6]	1.38 [34.9]
1.75 [44.5]	4.00 [101.6]	2.06 [52.4]	2.03 [51.6]	0.88 [22.2]	0.38 [9.5]	3.63 [92.1]	1.63 [41.3]

Back Ported Subplate

Valve mtg: UNC #10-24 x 0.63 DP or
Metric M5-0.8mm ISO 6H x [16] DP
Subplate hardware kit is supplied.
See page 121 for itemized list.



Dimension	A	B	C	D	E	F	G	H	I	J	K
*D03SPB4P	1.00 [25.4]	2.50 [63.5]	1.31 [33.3]	0.88 [22.4]	0.25 [6.4]	2.25 [57.2]	0.66 [16.7]	1.28 [32.5]	1.91 [48.4]	0.75 [19.1]	1.88 [47.6]
*D03SPB6B	1.00 [25.4]	2.50 [63.5]	1.25 [31.8]	0.84 [21.4]	0.25 [6.4]	2.25 [57.2]	0.51 [13.0]	1.25 [31.8]	1.98 [50.4]	0.52 [13.2]	1.97 [50.0]
*D03SPB6[M,P,S,T]	1.00 [25.4]	2.50 [63.5]	1.31 [33.3]	0.88 [22.4]	0.25 [6.4]	2.25 [57.2]	0.59 [15.1]	1.28 [32.5]	1.97 [50.0]	0.69 [17.5]	1.94 [49.2]
D03SPB8	1.50 [38.1]	3.50 [88.9]	1.81 [46.0]	1.38 [34.9]	0.25 [6.4]	3.25 [82.6]	0.69 [17.5]	1.78 [45.2]	2.81 [71.4]	0.75 [19.1]	2.81 [71.4]
D03SPB12	1.50 [38.1]	4.50 [114.3]	2.31 [58.8]	1.88 [47.6]	0.38 [9.5]	4.13 [104.8]	0.94 [23.8]	2.28 [57.9]	3.56 [90.5]	0.94 [23.8]	3.56 [90.5]

Specifications, descriptions, and dimensional data are subject to correction or change without notice or incurring obligation.
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Ordering Information

Material	Valve Pattern	Product Type	Port Location	Port Threads

Material

A	Aluminum - 6061-T6 3000† psi • 20.7 MPa
D	Ductile Iron - D4512 5000† psi • 34.5 MPa

† Working pressure should be considered in accordance with ISO 4413 to determine appropriate material type.

Product Type

SP	Subplate

Valve Pattern

D03	ISO 4401-03-02 NFPA T3.5.1-D03 See Tech Information

Port Location

S	Side ported
B	Back Ported

Port Threads

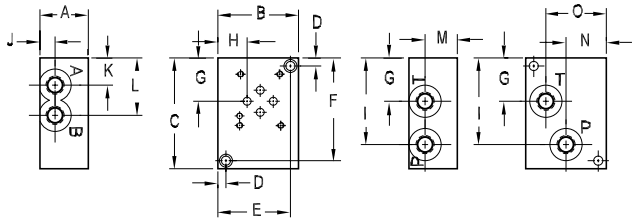
4P	0.25-18 NPTF ANSI B1.20.3				
6P	0.38-18 NPTF ANSI B1.20.3	**8P**	0.50-14 NPTF ANSI B1.20.3	**12P**	0.75-14 NPTF ANSI B1.20.3
6S	-6 SAE ISO 11926; SAE 1926	**8S**	-8 SAE ISO 11926; SAE 1926	**12S**	-12 SAE ISO 11926; SAE 1926
6B	0.38-19 BSPP ISO 1179; BS 2779	**8B**	0.50-14 BSPP ISO 1179; BS 2779	**12B**	0.75-14 BSPP ISO 1179; BS 2779
6M	M14 x 1.5 ISO 6149	**8M**	M18 x 1.5 ISO 6149	**12M**	M27 x 2.0 ISO 6149
6T	0.38-19 BSPT ISO 7; BS 21	**8T**	0.50-14 BSPT ISO 7; BS 21	**12T**	0.75-14 BSPT ISO 7; BS 21

Daman Products Company, Inc.
1811 North Home Street • Mishawaka, Indiana 46545-7267 USA • North America: 800.959.7841 • Fax: 800.241.7664
International: 574.259.7841 • Fax: 574.259.7665 • Email: sales@damanifolds.com • Web: www.damanifolds.com

D03 Subplates

Dual Ported Subplate

Valve mtg: UNC #10-24 x 0.50 DP or
Metric M5-0.8mm ISO 6H x [12.7] DP
Subplate hardware kit is supplied.
See page 121 for itemized list.

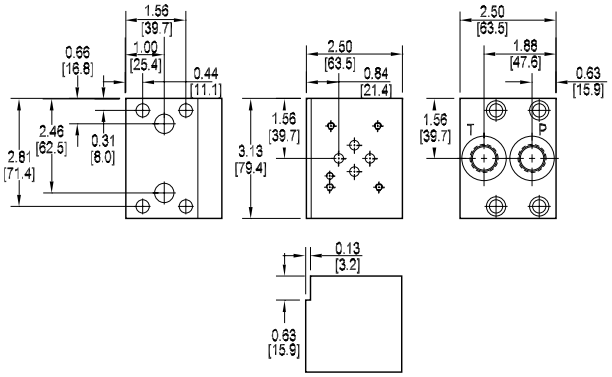


Dimension	A	B	C	D	E	F	G	H
D03SPSB6	1.50 [38.1]	2.50 [63.5]	3.44 [87.4]	0.25 [6.4]	2.25 [57.2]	3.19 [81.0]	1.34 [34.0]	0.91 [23.1]
D03SPSB8	2.00 [50.8]	2.75 [69.9]	3.75 [95.3]	0.25 [6.4]	2.50 [63.5]	3.50 [88.9]	1.34 [34.0]	0.91 [23.1]

Dimension	I	J	K	L	M	N	O
*D03SPSB6B	2.69 [68.3]	0.50 [12.7]	0.72 [18.3]	1.78 [45.2]	1.00 [25.4]	1.25 [31.8]	1.88 [47.8]
*D03SPSB6[M,P,S,T]	2.69 [68.3]	0.47 [11.9]	0.84 [21.4]	1.78 [45.2]	1.00 [25.4]	1.25 [31.8]	1.88 [47.8]
*D03SPSB8B	3.00 [76.2]	0.88 [22.2]	0.69 [17.5]	1.97 [50.0]	1.38 [34.9]	1.44 [36.5]	1.94 [49.2]
*D03SPSB8[M,P,S,T]	3.00 [76.2]	0.88 [22.2]	0.69 [17.5]	1.94 [49.2]	1.38 [34.9]	1.44 [36.5]	1.94 [49.2]

Motor Mounted Subplate

Available with NPTF or SAE ports only.
Valve mtg: UNC #10-24 x 0.63 DP
Subplate hardware kit is supplied.
See page 121 for itemized list.



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Download latest catalog page revisions at www.damanifolds.com.

Ordering Information

Material	Valve Pattern	Product Type	Port Location	Port Threads

Material

A	Aluminum - 6061-T6 3000† psi • 20.7 MPa
D	Ductile Iron - D4512 5000† psi • 34.5 MPa

† Working pressure should be considered in accordance with ISO 4413 to determine appropriate material type.

Valve Pattern

D03	ISO 4401-03-02 NFPA T3.5.1-D03 See Tech Information

Product Type

SP	Subplate

Port Location

SB	Side P,A,B,T ports Back P & T ports
M	Motor mounting 8P or 8S ports only

Port Threads

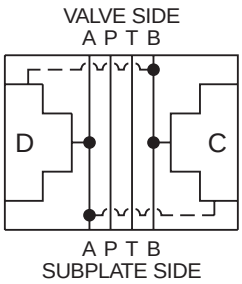
Port location SB only		Port location SB or M	
6P	0.38-18 NPTF ANSI B1.20.3	**8P**	0.50-14 NPTF ANSI B1.20.3
6S	-6 SAE ISO 11926; SAE 1926	**8S**	-8 SAE ISO 11926; SAE 1926
6B	0.38-19 BSPP ISO 1179; BS 2779	Port location SB only	
6M	M14 x 1.5 ISO 6149	**8B**	0.50-14 BSPP ISO 1179; BS 2779
6T	0.38-19 BSPT ISO 7; BS 21	**8M**	M18 x 1.5 ISO 6149
		8T	0.50-14 BSPT ISO 7; BS 21

General Description

A and B Crossover D03 Cartpak Body.
For additional information see Technical Tips on pages BC1-BC6.

Body Schematic

UPRIGHT



Ordering Information

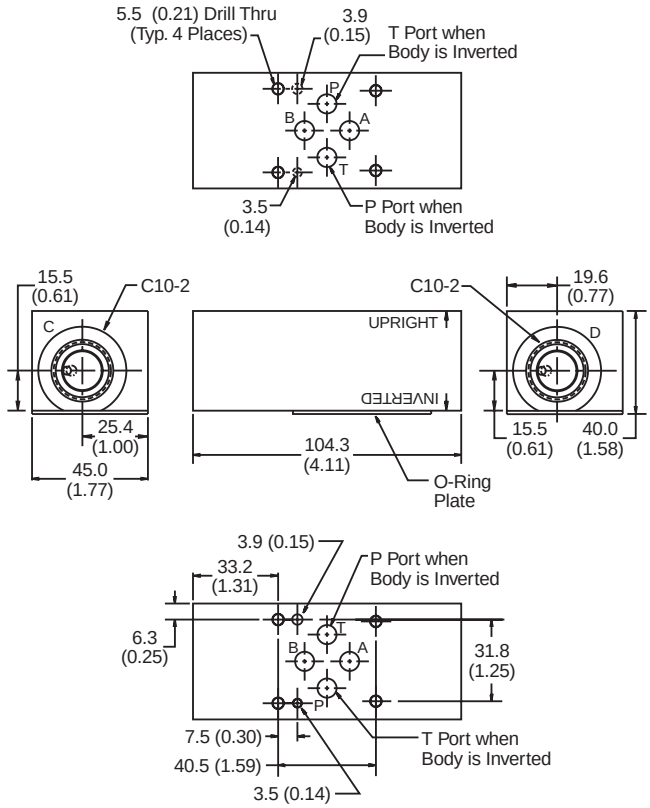
BD03	—	ABX	—			
D03 Cartpak Body		A & B Crossover		Plug Seals		Body Material

Code	Plug Seals
Omit	Nitrile
V	Fluorocarbon

Code	Body Material
A	Aluminum
S	Steel (Ductile Iron)

Body supplied with:
- O-Ring Plate, O-Rings and Drive Pin Kit

Dimensions Millimeters (Inches)



Option 1
Cavity C: RAH101, RD102
Cavity D: RAH101, RD102

Option 2
Cavity C: RDH103
Cavity D: RDH103

Direction: Upright

Dual Crossover Relief

Option 1
Cavity C: P10-2
Cavity D: RDH103

Option 2
Cavity C: RAH101, RD102
Cavity D: P10-2

Direction: Upright

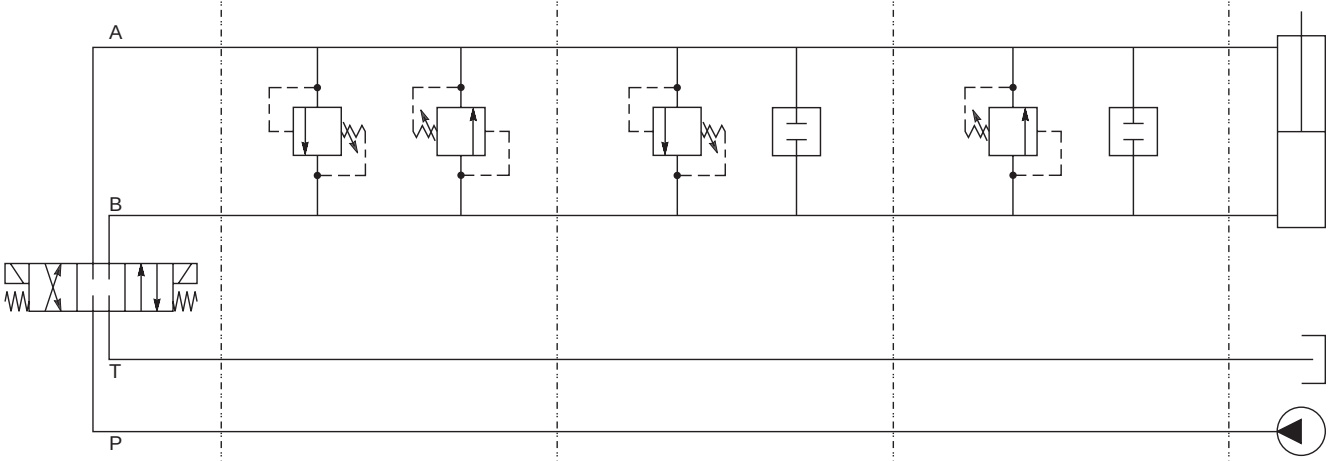
Relief In A Port

Option 1
Cavity C: RDH103
Cavity D: P10-2

Option 2
Cavity C: P10-2
Cavity D: RAH101, RD102

Direction: Upright

Relief In B Port



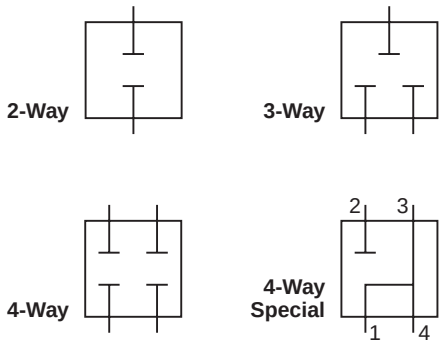
General Description

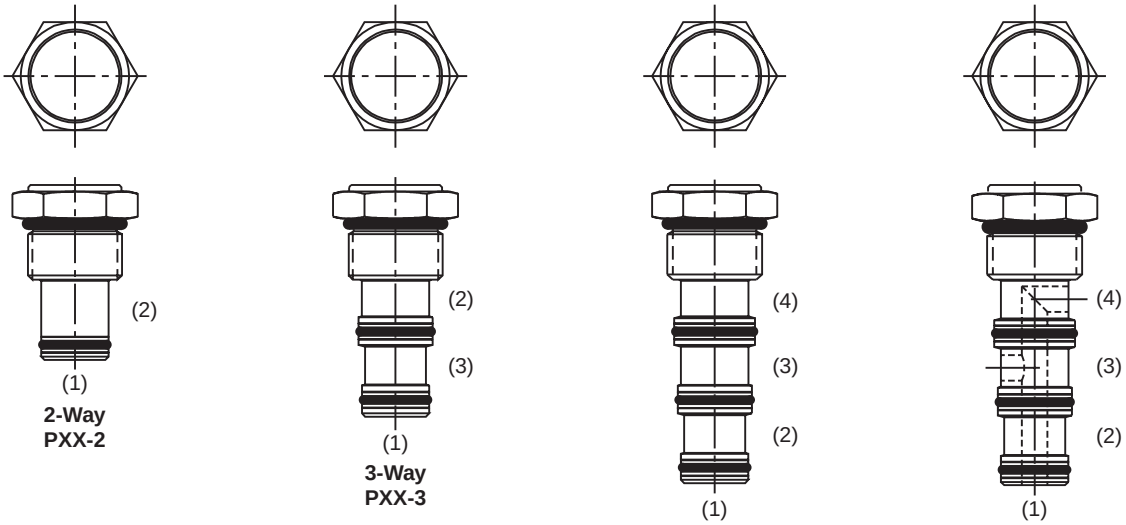
Parker cavity plugs can be used in any Integrated Hydraulic Circuit where one valve serves several machines and/or options. Two machines may have identical circuits except for one having a pressure reducing function, and the other not having this function. The machine that does not require this function can have the pressure reducing function replaced by a cavity plug; thereby utilizing a common body for both machines.

Specifications

Maximum Working Pressure - 245 Bar (3500 PSI)
Material - Steel

Symbols





Ordering Information

P		—			—	
Plug	Cavity Plug		Cavity Type	Type		Seals

Code	Thread Size
04	7/16 - 20
06	9/16 - 18
07	5/8 - 18
08**	3/4 - 16
09***	3/4 - 16
10	7/8 - 14
12	1-1/16 - 12
16	1-5/16 - 12

** 08 Nose Dia. = 1/2″
*** 09 Nose Dia. = 5/8″

Code	Cavity
2	Two Way
3	Three Way
4	Four Way

Type	Two Way		Three Way			Four Way			
	1	2	1	2	3	1	2	3	4
Omit	C	C	C	C	C	C	C	C	C
A			O	C	O	O	O	O	C
B			O	O	C	O	O	C	O
C			C	O	O	O	C	O	O
D						*O	*O	*C	*C

C = Blocked
O = Open

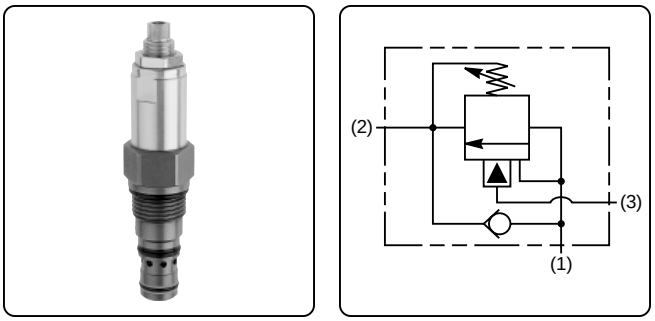
* Only Available In Sizes 08 and 10.

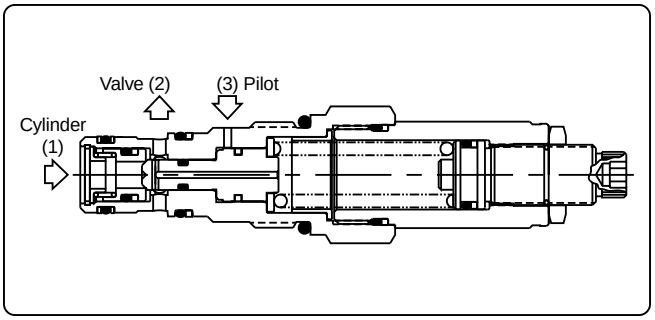
Code	Type
Omit	Nitrile
V	Fluorocarbon

plugs.pm6.5, bl, lk

General Description

Cartridge Style Counterbalance Valve.
For additional information see Technical Tips on pages LM1-LM5.





Features

- Sealed spool type design for improved stability and accuracy as well as low leakage
- Low leakage poppet-type check valve for reliable load holding
- All external parts have yellow zinc dichromate finish.
- Parker cartridge design for ease of installation and maintenance
- Compact size for reduced space requirements

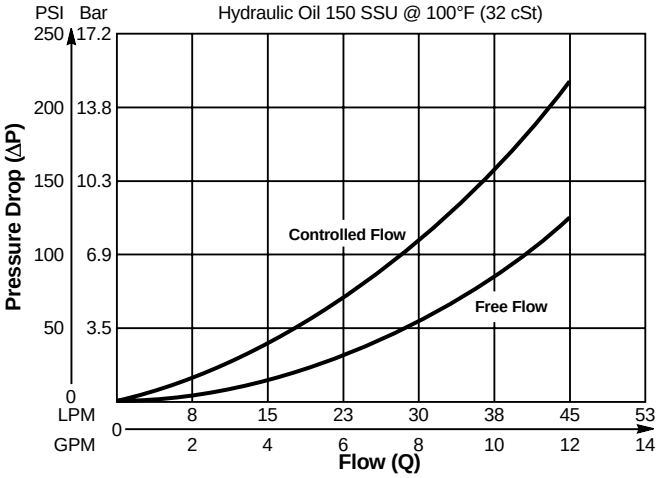
Specifications

Rated Flow	45 LPM (12 GPM)
Maximum Inlet Pressure	380 Bar (5500 PSI) - Steel 210 Bar (3000 PSI) - Aluminum
Maximum Setting Pressure	350 Bar (5000 PSI) - Steel 210 Bar (3000 PSI) - Aluminum
Leakage at 150 SSU (32 cSt)	5 drops/min. (.33 cc/min.) @ 80% of thermal crack pressure
Cartridge Material	All parts steel. All operating parts hardened steel.
Operating Temp. Range (Ambient)	-40°C to +93.3°C (Nitrile) (-40°F to +200°F) -31.7°C to +121.1°C (Fluorocarbon) (-25°F to +250°F)
Filtration	ISO Code 16/13, SAE Class 4 or better
Fluids	Mineral-based or synthetic with lubricating properties at viscosities of 45 to 2000 SSU (6 to 420 cSt)
Approx. Weight Cartridge Only	.23 kg (0.5 lbs.)
Cavity	C10-3
Form Tool	Rougher NFT10-3R Finisher NFT10-3F

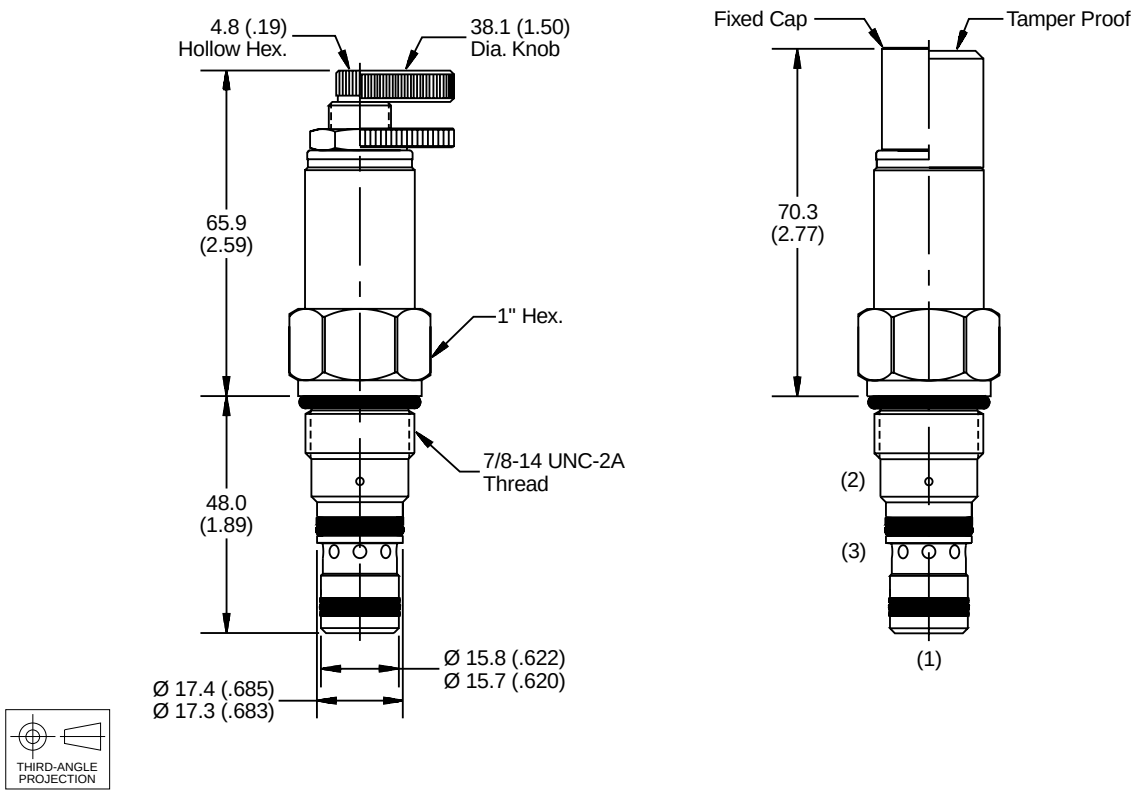
Performance Curve

Flow vs. Pressure Drop

(Through cartridge only)



Dimensions *Inch equivalents for millimeter dimensions are shown in (**)



Ordering Information

CB101					—		—	
Counterbalance Cartridge Valve	Pilot Ratio	Adjustment Style	Pressure Range	Seals		Optional Pressure Setting	Body Material	Port Size

Code	Pilot Ratio
A	3:1
B	4.5:1
C	7:1

Code	Adjustment Style/Kit No.
F	Fixed style, preset at factory.
K	Knob Adjust (717784-10)
S	Screw Adjust
T	Tamper Resistant Cap (717785)

Code	Pressure Range
10	20.7 - 103.5 Bar (300 - 1500 PSI) Standard Setting: 69 Bar (1000 PSI) @ 11.3 LPM (3 GPM)
20	69 - 172.4 Bar (1000 - 2500 PSI) Standard Setting: 138 Bar (2000 PSI) @ 11.3 LPM (3 GPM)
30	138 - 350 Bar (2000 - 5000 PSI) Standard Setting: 210 Bar (3000 PSI) @ 11.3 LPM (3 GPM)

Code	Seals / Kit No.
Omit	Nitrile / (SK10-3N)
V	Fluorocarbon / (SK10-3V)

Optional Pressure Setting
Pressure ÷ 10 i.e. 235 = 2350 PSI Setting Range: 300 to 5000 PSI All settings at 11.3 LPM (3 GPM)

Code	Body Material
Omit	Steel
A	Aluminum

Code	Port Size	Body Part No.
Omit	Cartridge Only	
6T	SAE-6	(B10-3-*6T)
8T	SAE-8	(B10-3-*8T)
4B	1/4″ BSPG	(B10-3-4B)†
6B	3/8″ BSPG	(B10-3-6B)†
8B	1/2″ BSPG	(B10-3-*8P)

**** Body is available in steel or aluminum.***
† Steel body only.

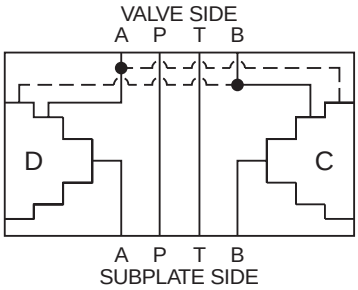
cb101.pm6.5, bl, 1/03

General Description

Dual (Ports A and B) Drain to Crossover Port D03 Cartpak Body. For additional information see Technical Tips on pages BC1-BC6.

Body Schematic

UPRIGHT



Ordering Information

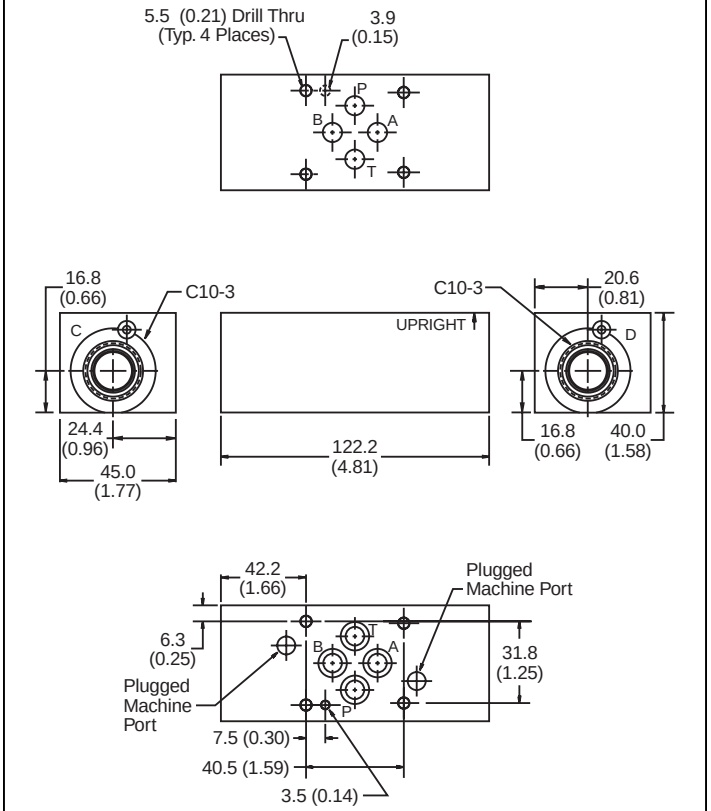
BD03	—	DDX	—			
D03 Cartpak Body		**Dual (Ports A & B) Drain to Crossover**		**Plug Seals**		**Body Material**

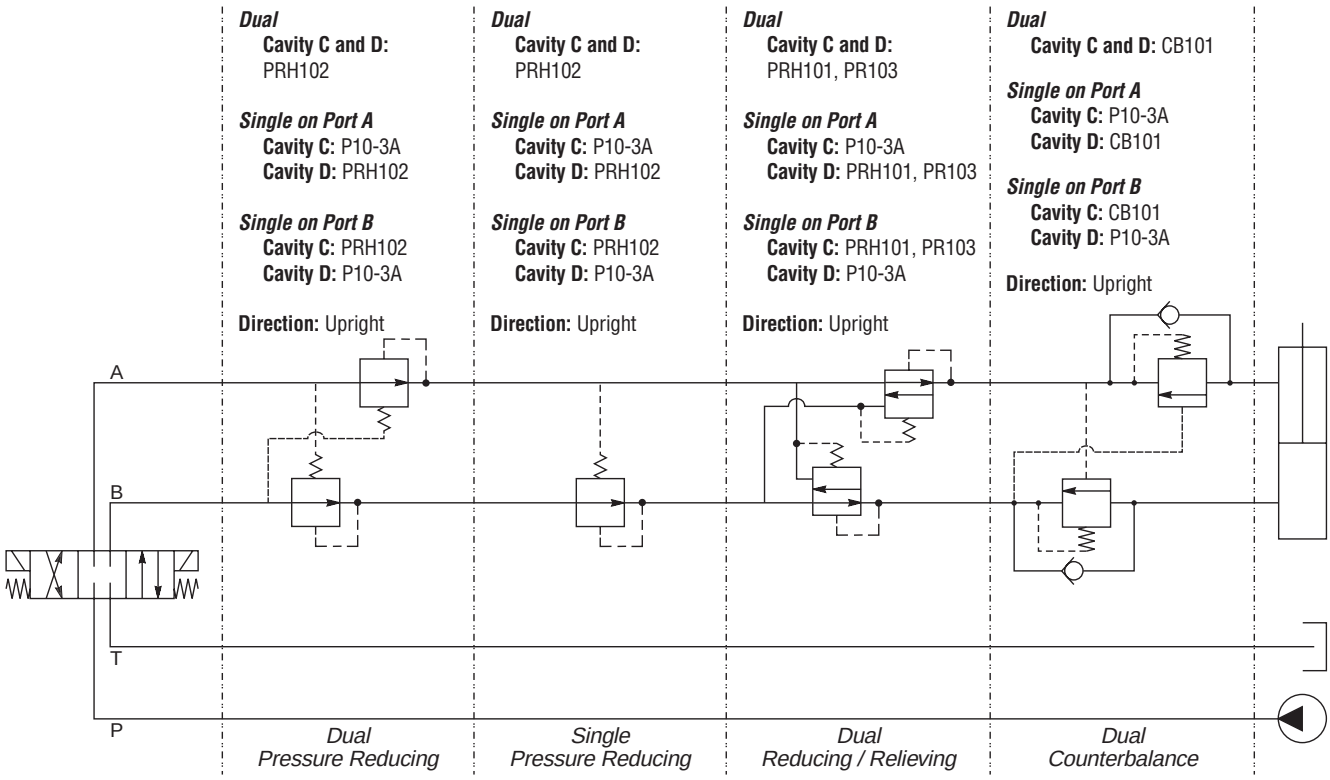
Code	Plug Seals
Omit	Nitrile
V	Fluorocarbon

Code	Body Material
A	Aluminum
S	Steel (Ductile Iron)

Body supplied with:
- O-Rings and Drive Pin

Dimensions Millimeters (Inches)





bd03ddx.pm6.5, bl, 3/03

Parker Hannifin Corporation
Integrated Hydraulics Division
Lincolnshire, Illinois, USA

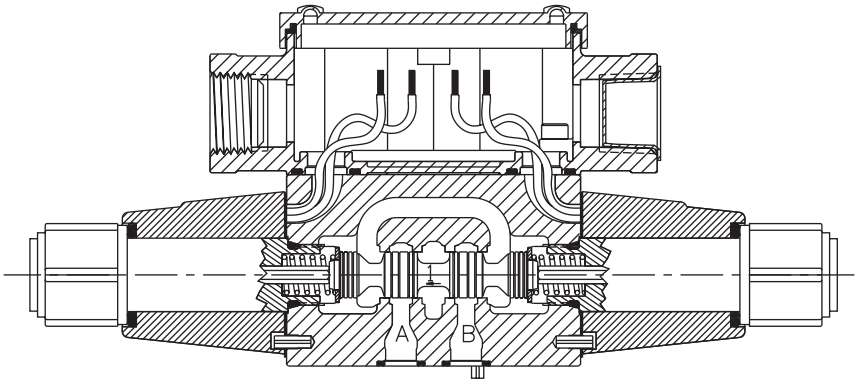
Application

Parker D1V Series hydraulic directional control valves are high performance, direct operated 4-way valves. They are available in 2 or 3 position styles. They are manifold mounted valves, which conform to NFPA's D03 mounting pattern. These valves were designed for industrial and mobile hydraulic applications which require high cycle rates, long life and high efficiency.

Operation

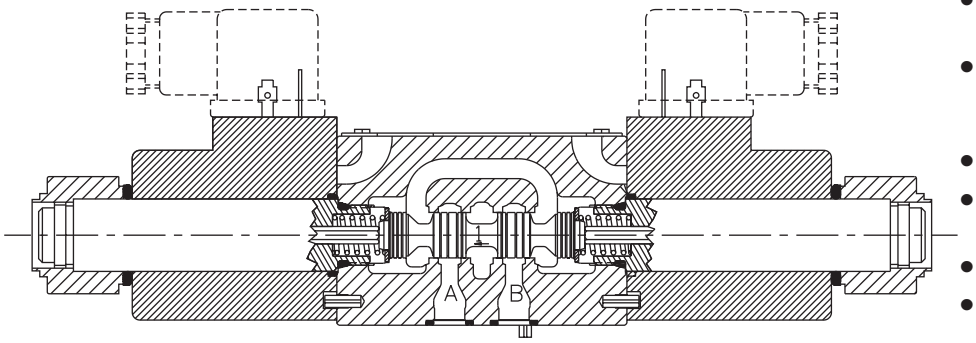
Parker's D1V Series directional control valves consist of a four chamber style body, and a case hardened sliding spool. The spool is directly shifted by a variety of operators including: solenoid, lever, cam, air or oil pilots.

D1VW Solenoid Operated Conduit Box Style



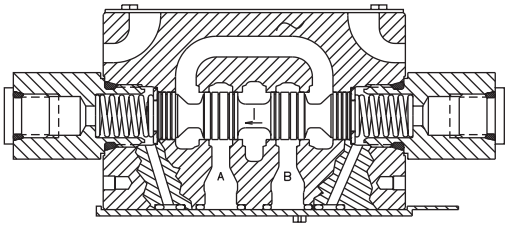
- Easy access mounting bolts
- Waterproof (NEMA 4 rated)
- No tools required for coil removal
- 21 spool styles available
- Four electrical connection options
- AC & DC lights available (CSA approval for solenoids and lights)

D1VW Solenoid Operated Hirschmann (DIN) Style



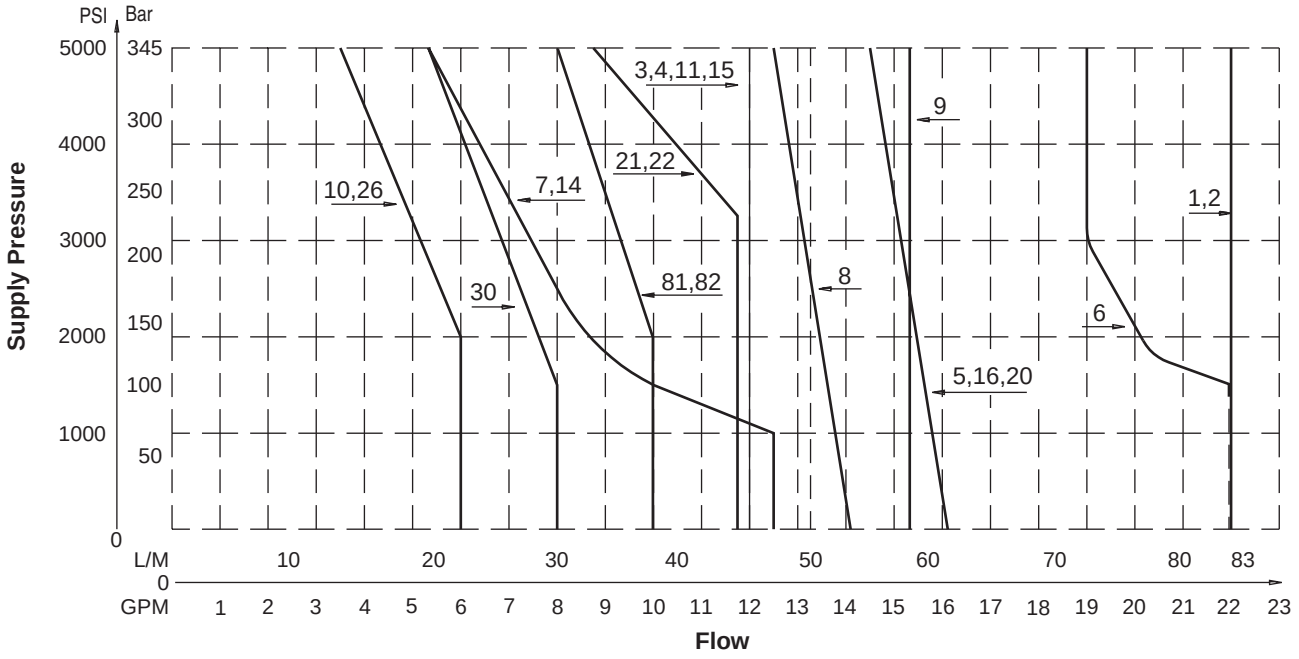
- DIN Style (43650) Hirschmann
- Dual and single spade (SAE type 1B) lug styles also available
- 21 spool styles available
- No tools required for coil removal
- Easy coil replacement
- AC & DC lights available (CSA approval for solenoids and lights)

D1VP Oil Pilot Operated



- Subplate pilot option
- Pilot pressure: 15.2 Bar (220 PSI) to 207 Bar (3000 PSI)

D1V Shift Limits



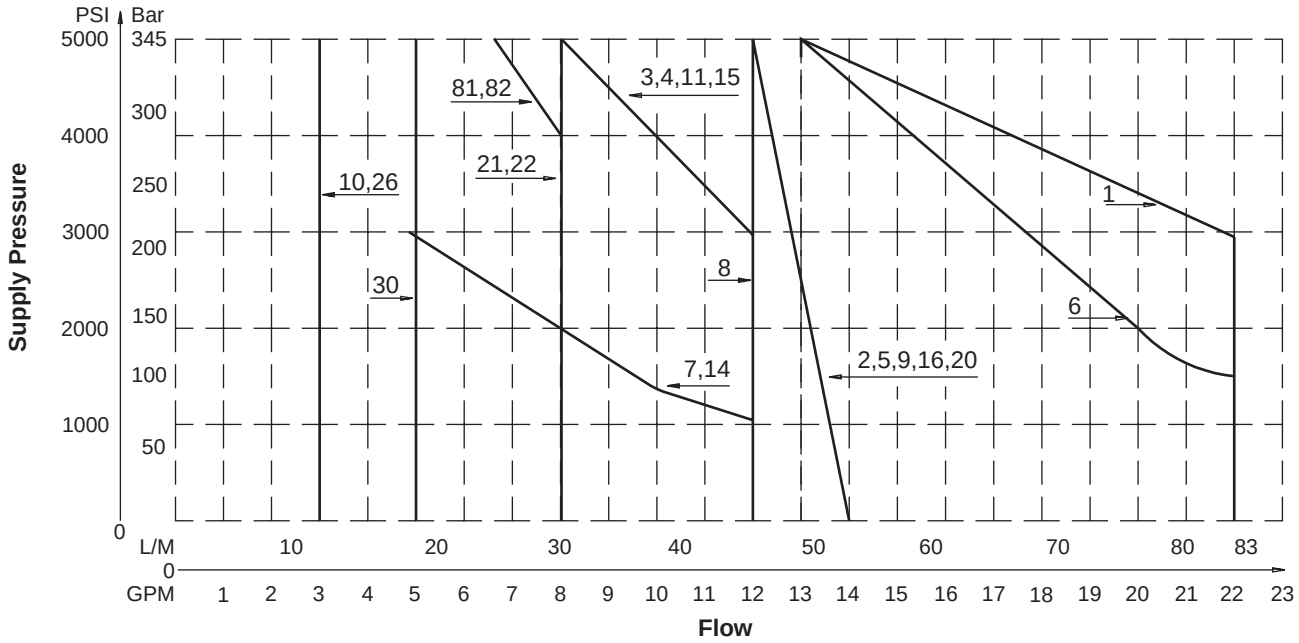
Example:

Determine the maximum allowable flow of a D1V Series valve (#30 spool) at 83 Bar (1200 PSI) supply pressure. Locate the curve marked “30”. At 83 Bar (1200 PSI) supply pressure, the maximum flow is 30 L/M (8 GPM). At 138 Bar (2000 PSI), the flow is 28 L/M (7.5 GPM)

Important Notes for Switching Limit Charts

1. For F & M style valves, reduce flow to 70% of that shown.
2. Shift limits charted for equal flow A and B ports. Unequal A and B port flows may reduce shift limits.

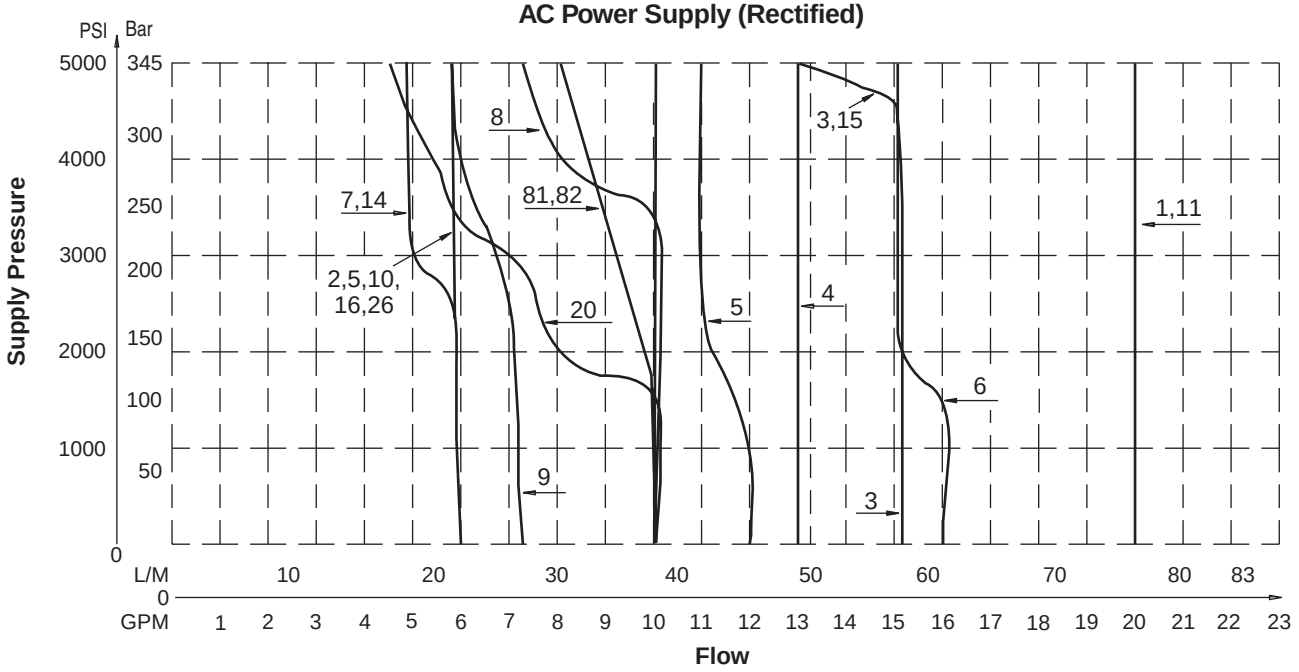
D1VW*****F Shift Limits



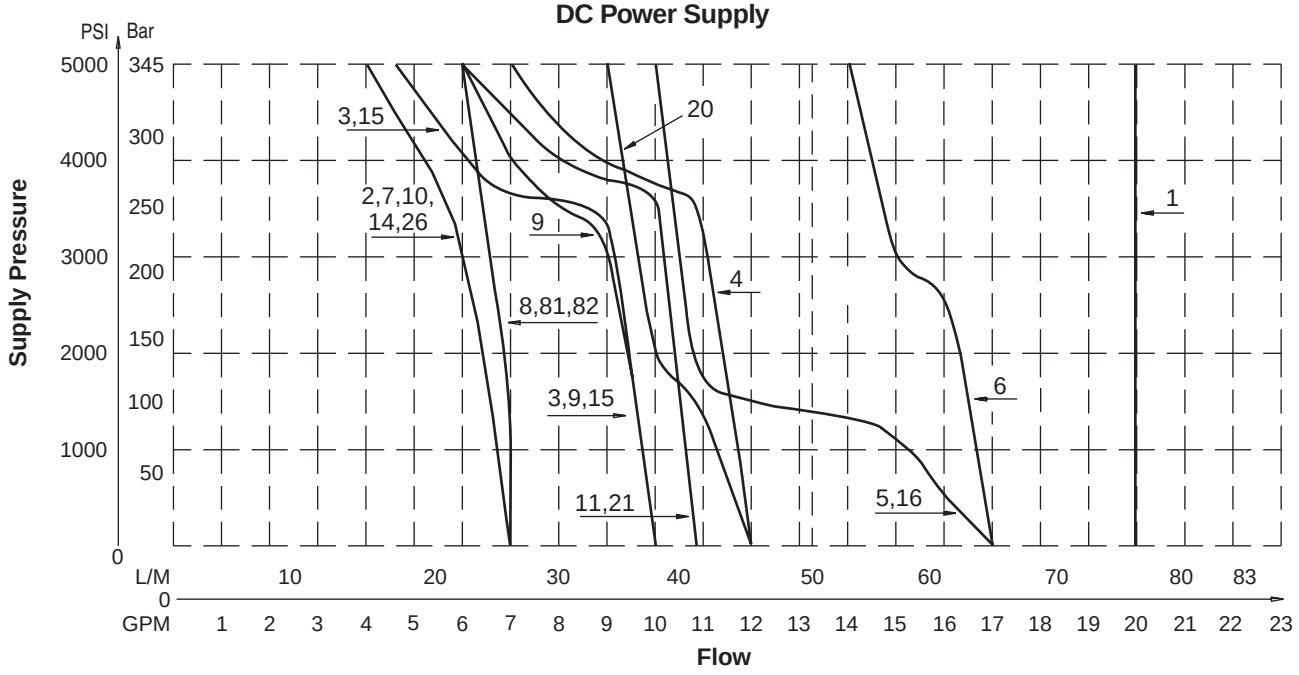
D1V.pm6, sm, hj

Soft Shift Limit Curves

AC Power Supply (Rectified)



DC Power Supply



Pressure Drop vs. Flow

The table to the right provides the flow vs. pressure drop curve reference for standard and high performance D1V Series valves by spool type.

The chart below demonstrates graphically the performance characteristics of the standard D1VW*****F and the high performance D1V. The low watt coil and other design features of the standards D1VW*****F accommodate a maximum flow of 50 L/M (13 GPM) at 345 Bar (5000 PSI).

Viscosity Correction Factor

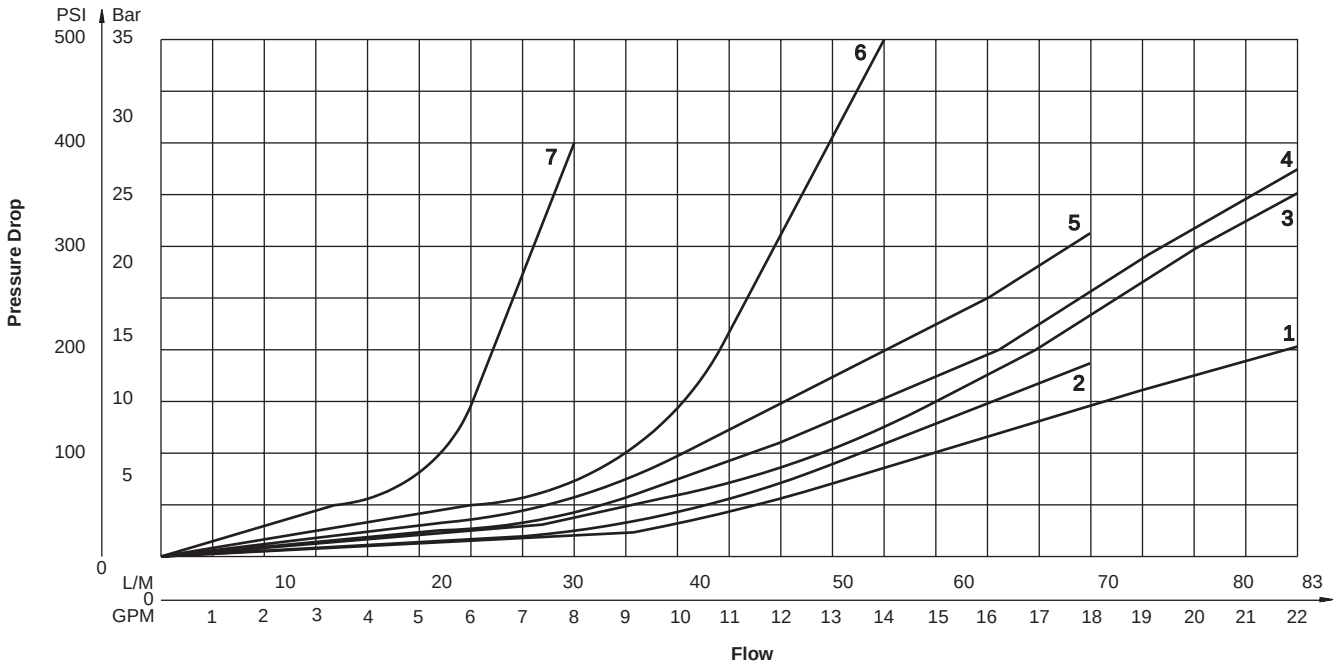
Viscosity (SSU)	75	150	200	250	300	350	400
% of DP (Approx.)	93	111	119	126	132	137	141

Curves were generated using 100 SSU hydraulic oil.
For any other viscosity, pressure drop will change per chart.

D1V Pressure Drop Reference Chart

Spool No.	Curve Number						
	P–A	P–B	P–T	A–T	B–T	B–A	A–B
1	4	4	—	1	1	—	—
2	3	3	4	1	1	—	4
3	4	4	—	1	1	—	—
4	4	4	—	1	1	—	—
5	3	4	—	1	1	—	—
6	3	3	—	1	1	—	—
7	4	3	6	1	1	—	6
8	2	2	6	4	4	—	6
9	2	2	6	4	4	—	6
10	4	4	—	—	—	—	—
11	4	4	—	1	1	—	—
14	3	4	—	1	1	—	—
15	4	4	—	1	1	—	—
16	4	3	—	1	1	—	—
20	5	5	—	2	2	—	—
21	4	7	—	1	—	4	—
22	7	4	—	—	1	—	4
26	4	4	—	—	—	—	—
30	5	5	—	2	2	—	—

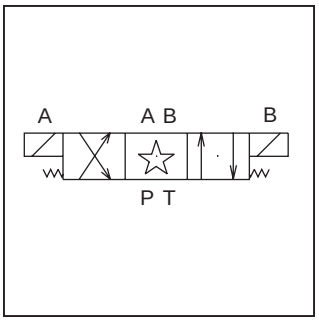
Performance Curves

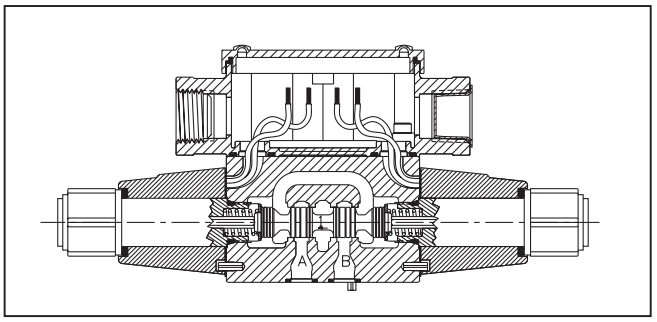


D1V.pm6, sm, hj

General Description

The D1VW Series directional control valves are high-performance, 4-chamber, direct operated, wet armature solenoid controlled, 3 or 4-way valves. They are available in 2 or 3-position and conform to NFPA's D03 mounting patterns.





Features

- Mechanically tunable soft shift.
- Proportional spools. 21 spool styles available.
- Repairable override
- DC surge suppression
- Four electrical connection options
- AC & DC lights available (CSA approval for solenoids and lights
- Internally ground
- Easy access mounting bolts
- Waterproof (NEMA 4 rated)
- Explosion proof
- CSA and UL approved
- No tools required for coil removal

Response Time*

Nominal response time (milliseconds) at 345 Bar (5000 PSI) is 32 L/M (8.5 GPM).

Solenoid Type	Pull-In	Drop-Out
AC	13	20
DC	32	40

* For soft shift, see ordering code X-number.

Specifications

Mounting Pattern	NFPA D03, CETOP 3; NG 6
Mounting Interface	DIN 24340-A6 ISO 4401-AB-03-4-A CETOP R35H 4.2-4-03, NFPA D03
Maximum Pressure	P, A, B 345 Bar (5000 PSI) C.S.A. 276 Bar (4000 PSI) Tank: 103 Bar (1500 PSI) Standard 207 Bar (3000 PSI) Optional with H or FH

Solenoid Ratings**

Insulation	Class F
Allowable Deviation from rated voltage	-10% to +15%
Armature	Wet pin type
CSA file LR60407	

** DC Solenoids available with optional molded metal oxide varistor (MOV) for surge suppression.
Leadwire length 6" from coil face.

D1VW Solenoid Electrical Characteristics†

Solenoid Code	Nominal Volts/Hz	In Rush Amps	Holding Amps	Watts
Y	120/60 110/50	2.00 2.10	0.49 0.58	25 27
T	240/60 220/50	1.00 1.05	0.26 0.31	25 27
Q	100/50	2.05	24	24
R	24/60	10. 50	2.70	27
A	24/50	8.7	2.65	28
L	6 VDC	—	5.00	30
K	12 VDC	—	2.50	30
J	24 VDC	—	1.25	30
D	120 VDC	—	0.25	30
Z	250 VDC	—	0.12	30

D1VW*****F Solenoid Electrical Characteristics†

Solenoid Code	Nominal Volts/Hz	In Rush Amps	Holding Amps	Watts
YF	120/60 110/50	1.90 2.00	0.42 0.50	21 23
TF	240/60 220/50	0.95 1.00	0.22 0.26	21 23
LF	6 VDC	—	4.00	24
KF	12 VDC	—	2.00	24
JF	24 VDC	—	1.00	24
DF	120 VDC	—	0.20	24
ZF	250 VDC	—	0.10	24

† Based on nominal voltage @ 22°C (72°F)

D1VW Soft Shift AC Electrical Characteristics

Solenoid Code	Input Volts/Hz	Coil Voltage	Holding Amps	Watts
Q	100/50	86 VDC	2.87	30
Y	120/60 110/50	98 VDC	3.27	30
T	240/60 220/50	214 VDC	7.13	30

Explosion Proof Solenoids

Explosion Proof Solenoid Ratings

U.L. (EU)	Class I, Div. 1 & 2, Groups C & D Class II, Div 1 & 2, Groups E, F & G As defined by the N.E.C
M.S.H.A. (EM)	Complies with 30 CFR, Part 18.
CENELEC (ED)	Complies with BASEEFA requirements for BS5501: Parts 1 and 5 Ex'd CENELEC EN50 – D18, Group II B
CSA Hazardous L	Class II, Groups E, F & G

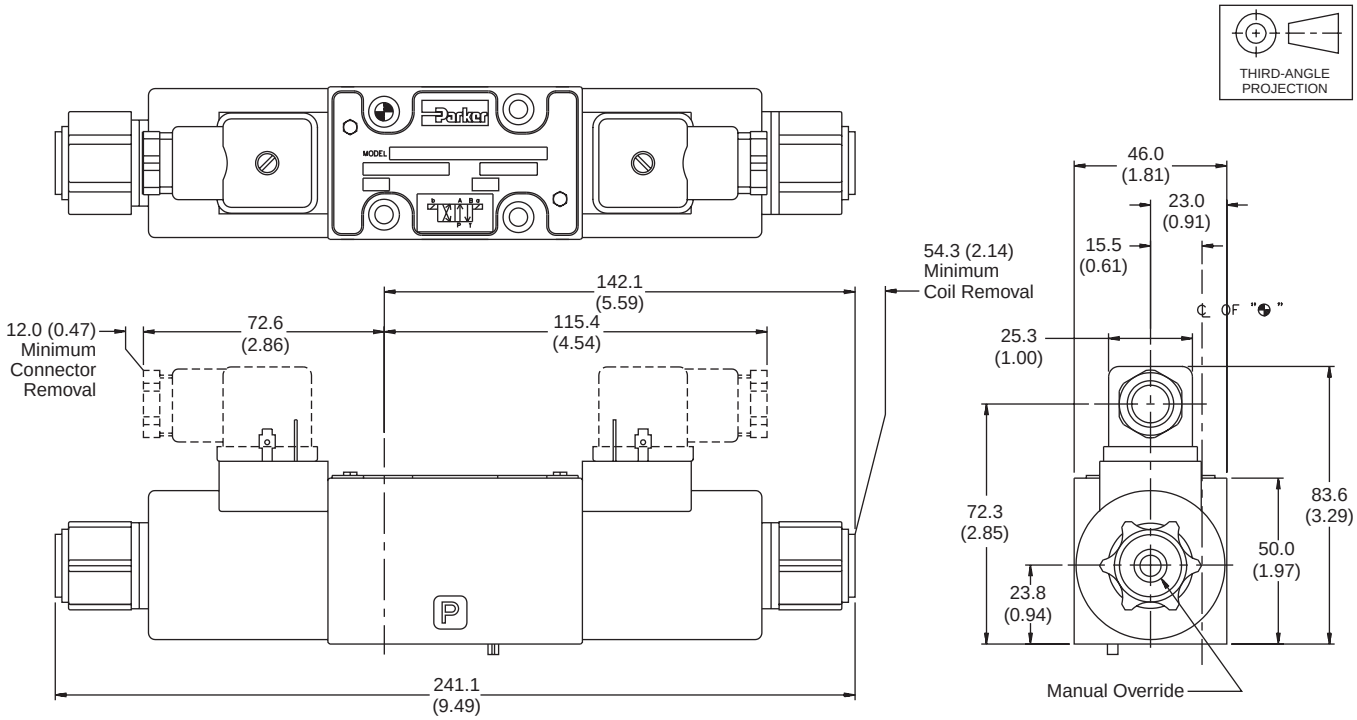
Electrical Characteristics* ED, EM and EU

Solenoid Code	Nominal Volts/Hz	In Rush Amps	Holding Amps	Watts
Q	100/60	2.60	0.70	27
Y	120/60	2.20	0.58	27
T	240/60	1.10	0.29	27
R	24/60	11.10	2.90	27
L	6 VDC	—	5.50	33
K	12 VDC	—	2.75	33
J	24 VDC	—	1.38	33
D	120 VDC	—	0.28	33
Z	250 VDC	—	0.13	33

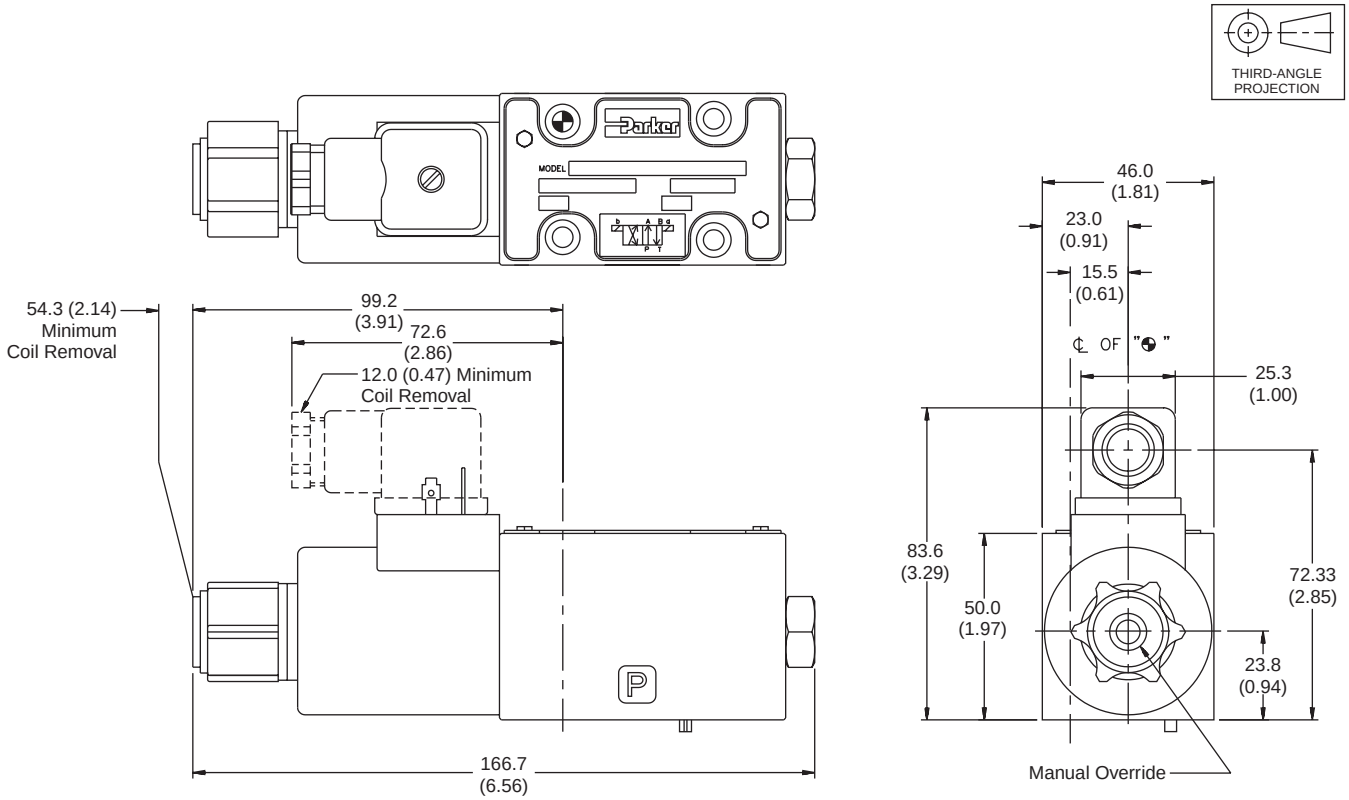
*Dual frequency not available on explosion proof coils.

Inch equivalents for millimeter dimensions are shown in (**).

Hirschmann, DC Solenoid, Double



Hirschmann, DC Solenoid, Single



D1V.pm6, sm, hj

Standard Valves

D	1V	W				
Directional Control Valve	Basic Valve	Actuator	Spool	Style	Seal	Solenoid Voltage

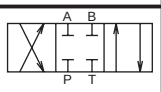
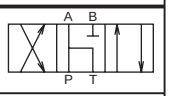
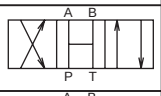
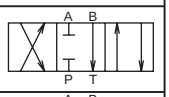
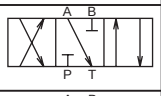
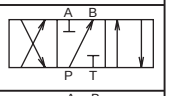
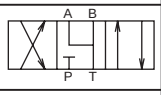
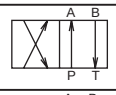
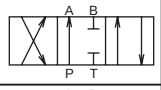
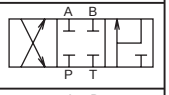
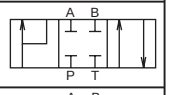
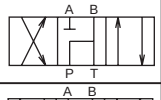
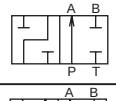
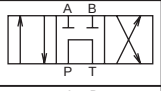
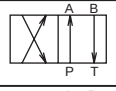
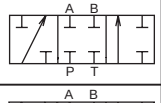
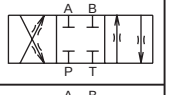
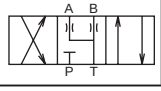
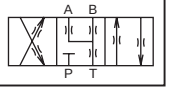
Basic Valve: NFPA D03, CETOP 3

Actuator: Wet armature solenoid

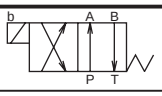
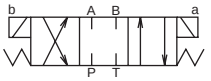
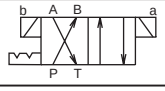
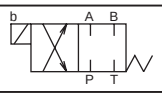
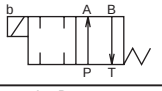
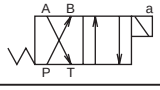
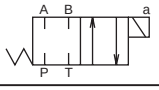
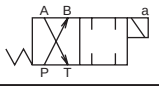
Code	Description
N	Nitrile
V	Fluorocarbon
E	EPR

Code	Description
A #	24/50 VAC
R #	24/60 VAC
Q #	100/50 VAC
Y	120/60 - 110/50 VAC
T	240/60 - 220/50 VAC
L	6 VDC
K	12 VDC
J	24 VDC
D	120 VDC
Z	250 VDC

High Watt Coil only.

Code	Symbol	Code	Symbol
1		14	
2		15	
3		16	
4		20*	
5		21	
6		22	
7		26*	
8*, 9**		30**	
10		81	
11		82	

* 8, 20 & 26 spool have closed crossover
** 9 & 30 spool have open crossover

Code	Description	
B *	Single solenoid, 2 position, spring offset P to A and B to T in offset position	
C	Double solenoid, 3 position, spring centered.	
D †	Double solenoid, 2 position, detent	
E	Single solenoid, 2 position, spring offset to center. P to B and A to T when energized.	
F	Single solenoid, 2 position. Spring offset, energized to center. Position spool spacer on a side. P to A and B to T in spring offset position.	
H *	Single solenoid, 2 position, spring offset. P to A and A to T in offset position.	
K	Single solenoid, 2 position. Spring offset to center. A side. P to A and B to T when energized.	
M	Single solenoid, 2 position, spring offset, energized to center position. Spool spacer on B side. P to B and A to T in spring offset position.	

* Only spools 20, 26 & 30.
† Only spools 20 & 30.

This condition varies with spool code

D1V.pm6, sm, hj

Parker Hannifin Corporation
Hydraulic Valve Division
Elyria, Ohio 44035 USA

Solenoid Connection

Code	Description
C	Conduit Box
E	Explosion Proof
P	Hirschmann w/ Plug
S # †	Dual Spade Lug
W †	Hirschmann w/o Plug
H* # †	Single Spade Lug

† Not available with lights
# Not CSA approved
* DC only

Solenoid/Tube Combination

Code	Coil	Tube
Omit	High Watt	Low Pressure
H*	High Watt	High Pressure
F	Low Watt	Low Pressure
FH*	Low Watt	High Pressure
D †	Explosion proof CENELEC	
M †	Explosion Proof M.S.H.A.	
U †	Explosion Proof UL/CSA	

* High pressure tube rating 210 Bar (3000 PSI)
† Explosion proof coils are 60Hz @ standard voltage and are high wattage only. Dual frequency rating not available.

Tube Variation

Code	Description
Omit	Standard Tube
P*	Extended Manual Override
R*	Repairable Manual Override
T*	Without Manual Override

* Tube variations not available on explosion proof.

Coil Variation

Code	Description
Omit	Standard Coil
B	Without Coil
C†	Hazardous Location
V*	Surge Suppression

† Conduit solenoid connection only.
* DC only, not available with solenoid connection H.

Valve Variations

Code	Description
Omit	Standard Valve
4*	C.S.A. Approved
5	Signal Lights
6	Manaplug Single Solenoid 3-Pin, Double Solenoid 5-Pin
P10†	Monitor Switch
56	Manaplug with Lights
630	Manaplug Single Solenoid 5-Pin

* Valve is derated with this option. See Technical Data.
† B, H, E, & K style only. Not CSA or CE approved.

Design Series

NOTE:
Not required when ordering.

Valve Weight:
Single Solenoid 1.36 kg (3.0 lbs)
Double Solenoid 1.6 kg (3.5 lbs)
Standard Bolt Kit:
BK209

Fluid Recommendations

Premium quality hydraulic oil with a viscosity range between 150-250 SSU (32 -54 cst) at 38° C (100°F) is recommended. The absolute operation viscosity range is from 80-1000 SSU (16-220 cst). Oil should have maximum anti-wear properties and rust and oxidation treatments.

Fluids and Seals

Valves using synthetic, fire-resistant fluids require special seals. When phospate ester or its blends are used, FLUOROCARBON seals are required. Water-glycol, water-in-oil emulsions, and petroleum oil may be used with NITRILE seals.

Temperature Recommendation

Recommended oil temperature:
-7° to +71°C (-20 to +160°F)

Filtration

For maximum valve and system component life, the system should be protected at a contamination level not to exceed 125 particles greater than 10 microns per milliliter of fluid. (SAE Class 4 or better, ISO Code 16/13).

Tank Line Surges

If several valves are piped with a common tank line, flow surges in the line may cause unexpected spool shift. Detent style valves are most susceptible to this. Separate tank lines should be used when line surges are expected in an application.

Recommended Mounting Position

Valve Type	Recommended Mounting Position
Detent (Solenoid)	Horizontal
Spring Offset	Unrestricted
Spring Centered	Unrestricted

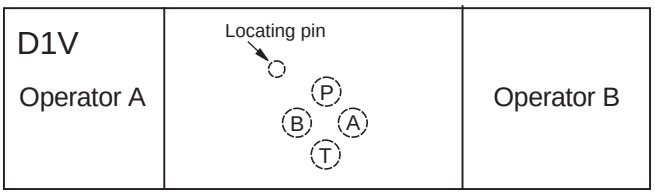
Silting

Silting can cause any sliding spool valve to stick and not spring return, if held shifted under pressure for long periods of time. The valve should be cycled periodically to prevent sticking.

Single Pass Operation

Valve flow ratings are for double pass operation (with equal flow in both paths). When using these components in single pass applications, flow capabilities may be reduced. Consult your local Parker representative for details.

Flow Path Data



*Note: On valves with 8 or 9 spool, A and/or B operators reverse sides. Flow paths remain the same as viewed from top of valve.

Double Solenoid. With solenoid "A" energized, flow path is P→A and B→T. When solenoid "B" is energized, flow path is P→B and A→T. The center condition on a spring-centered valve exists when both coils are de-energized, or during a complete shift, as the spool passes through center.

Detent and Spring Offset. The center condition exists on detent and spring offset valves only during spool crossover. To shift and hold a detented spool, only a momentary energizing of the solenoid is necessary. The minimum duration of the signal is aproximately 0.1 seconds for both AC and DC voltages. This position will be held provided the spool center line is in a horizontal plane, and no shock or vibration is present to displace the spool.

Single Solenoid. Spring offset valves can be ordered in six styles: B, E, F, H, K and M. Flow path data for the various styles are described in the order chart.

Lever Operated (on B end)

Pull lever away from valve P→A; B→T
Push lever toward valve P→B; A→T

Note: Reverse with a #8 or #9 spool.

Electrical Failure

Should electric power fail, spring offset and spring centered valves will shift to the spring held position. Detented valves will stay in the last position held before power failure. If main flow does not fail or stop simultaneously, machine actuators may continue to function in an undesirable manner or sequence.

Loss of Pilot Pressure (D1VA & D1VP)

Should a loss of pilot pressure occur, spring offset and spring centered valves will shift to the spring held position. Detented valves will remain in the last position held. If main hydraulic flow does not simultaneously stop, machine actuators may continue to function in an undesirable manner or sequence.

Torque Specifications

Torque values recommended for the bolts which mount the valve to the manifold or subplate are as follows:

#10-24 thread (M5-0.8) torque 5.6 Nm (50 in-lbs).

Subplate Mounting
NFPA D03, CETOP 3 & NG6.

Recommended Mounting Surface

Surface must be flat within .102 mm (0.0004 inch) T.I.R and smooth within 812.8 (32 micro-inch). Torque bolts to 5.6 N (50 in-lbs).

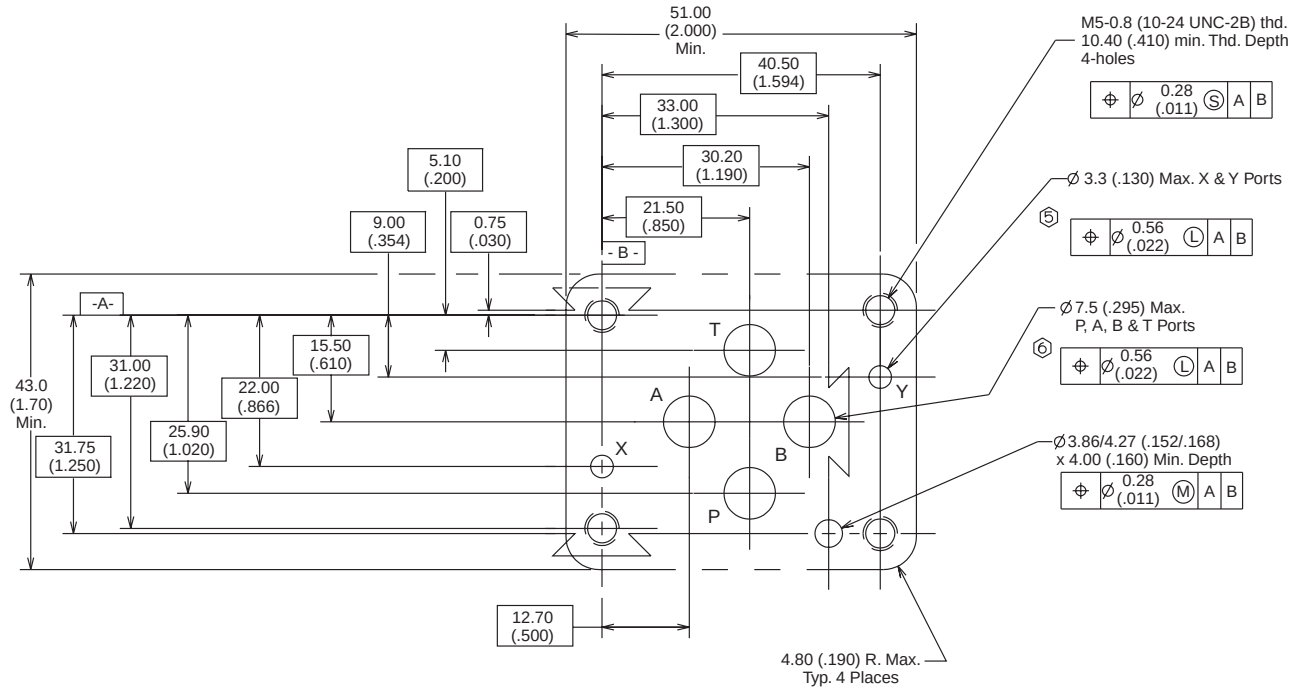
For maximum valve reliability, adhere to the following installation information.

Mounting Position

Valve Type	Mounting Position
Detent (Solenoid)	Horizontal
Spring Offset	Unrestricted
Spring Centered	Unrestricted

Mounting Pattern

Inch equivalents for millimeter dimensions are shown in (**).



Note: X and Y ports are required for subplate piloted D1VP valves only.

Mounting Bolt Kits

UNC Bolt Kits for use with D1V Directional Control Valves & Manapaks/Cartpaks (D1V*-70/75 Design, Solenoid Operated & D1V*-60 Design, Non-Solenoid Operated)

Number of Manapaks @ 1.75" (44.5 mm)	Number of Manapaks/Cartpaks @ 1.58" (40 mm) thickness				
	0	1	2	3	4
0	BK209 1.25"	BK243 2.88"	BK225 4.38"	BK244 6.00"	BK245 7.50"
1	BK246 3.00"	BK247 4.62"	BK248 6.12"	BK249 7.75"	
2	BK250 4.75"	BK251 6.38"	BK252 7.88"		
3	BK253 6.50"	BK254 8.12"			
4	BK103 8.25"				

Note: All bolts are SAE Grade 8, 10-24 UNC–2A thread. Torque to 5.6 Nm (50 in-lb).

UNC Bolt Kits for use with D1V*-70/75 Design Explosion Proof Valves & Manapaks/Cartpaks

Number of Manapaks @ 1.75" (44.5 mm)	Number of Manapaks/Cartpaks @ 1.58" (40 mm) thickness				
	0	1	2	3	4
0	BK50 2.00"	BK100 3.50"	BK101 5.12"	BK102 6.75"	BK103 8.25"
1	BK51 3.75"	BK104 5.25"	BK105 6.87"	BK106 8.50"	
2	BK52 5.50"	BK107 7.00"	BK108 8.62"		
3	BK53 7.25"	BK109 8.75"			
4	BK54 9.00"				

Note: All bolts are SAE Grade 8, 10-24 UNC–2A thread. Torque to 5.6 Nm (50 in-lb).

Sandwich Valve Dimensional Data

All D03 Manapak valves (starting with 31 Series) including CM2, CPOM2, FM2, PRM2 and RM2 measure 40mm (1.58") thickness. All D03 Cartpak bodies "A" through "H" also measure 40mm (1.58") thick.

For additional technical information about Manapak valvees, refer to the Manapak Sandwich Valve Catalog.

For additional technical information about Cartpak valves, refer to the Cartpak Sandwich Valve Catalog.

Cartpak Styles and Functions

Cartpak Body	Description	Body Dimensions mm (inches)	Cartridge Functions	Cartridge Options
C3A	"P" Port Interrupt	104x40x44 (4.11x1.58x1.75)	Load Holding Off-On P.C. Flow Control P.C. Flow Regulator Hand Pump Needle Relief Velocity Fuse	CV10*P DS102 FC101 FR101 HP101 NV101 RA101, RD101, RD102 VF101
C3B	"P" Port to "T" Port	104x40x44 (4.11x1.58x1.75)	N.C. Dump N.O. Dump Relief	DS101* DS102C DS102N RA101, RD101, RD102, RD103
C3C	"A" and "B" Port Interrupt	93 x40x44 (3.69x1.58x1.75)	P.C. Flow Control Flow Control Needle Velocity Fuse	FC101 *FV10* *NV101 VF101
C3D	"A" and "B" Port to Tank	93 x40x44 (3.69x1.58x1.75)	Dump P.C. Flow Regulator Flow Control Needle Relief	*DS102C *FR101 *FV10* *NV101 *RA101, *RD101, *RD102
C3E	"A" and "B" Port Crossover	104x40x44 (4.11x1.58x1.75)	Solenoid Crossover Needle Relief	*DS102 *NV101 *RD101, *RD102, *RA101, *RD103
C3F	"P" Port Interrupt, 1st Land Inlet	104x40x44 (4.11x1.58x1.75)	3-Way DCV Reducing/Relieving Pressure Reducing	DS103 PR101 PR102
C3G	"P" Port Interrupt, Nose Inlet	104x40x44 (4.11x1.58x1.75)	Sequence	SV101
C3H	"A" and "B" Port Interrupt	122x40x44 (4.81x1.58x1.75)	Dual Reducing/Relieving	DPR101

D1V.pm6, sm, hj

General Description

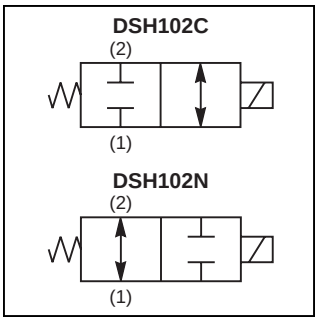
The DSH102, 2-way spool valves are used in circuits requiring flow to be blocked in both directions and/or flow to pass in both directions. When considering this valve series, allow for normal spool valve leakage. Normally open and normally closed configuration plus manual override models are available.

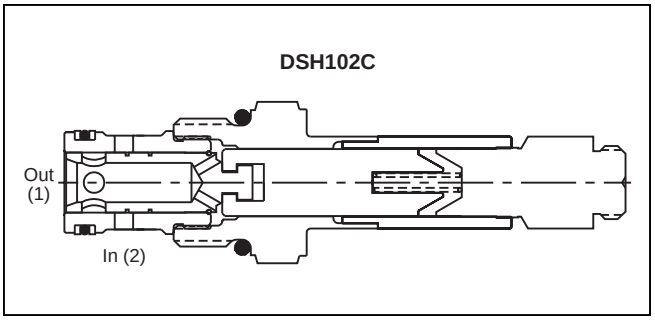
Operation

In the de-energized mode, the spool is positioned by spring force. The solenoid, when energized, directly shifts the spool against the spring, thus opening a normally closed valve or closing a normally open valve.

Specifications

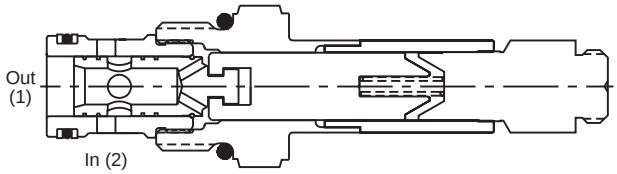
Rated Flow	**DSH102C** N.C. 30 LPM (8 GPM) **DSH102N** N.O. 26 LPM (7 GPM)
Maximum Inlet Pressure	345 Bar (5000 PSI) - Steel 210 Bar (3000 PSI) - Aluminum
Leakage	160 cc/min. (10 cu. in./min.) maximum at 345 Bar (5000 PSI)
Minimum Operating Voltage	90% of rated voltage at 345 Bar (5000 PSI)
Operating Temp. Range (Ambient)	-40°C to +93.3°C (Nitrile) (-40°F to +200°F) -31.7°C to +121.1°C (Fluorocarbon) (-25°F to +250°F)
Cartridge Material	All parts steel. All operating parts hardened steel.
Body Material	Steel or Aluminum
Filtration	ISO Code 16/13, SAE Class 4 or better
Mounting	No restrictions
Cavity	Common Cavity No. C10-2





Construction

DSH102N

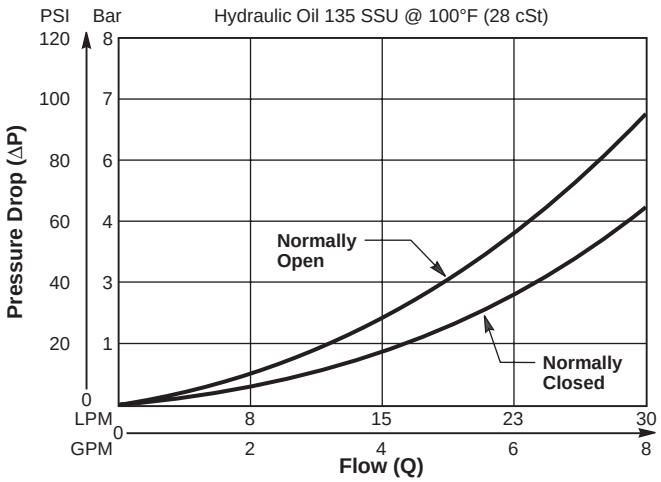


Features

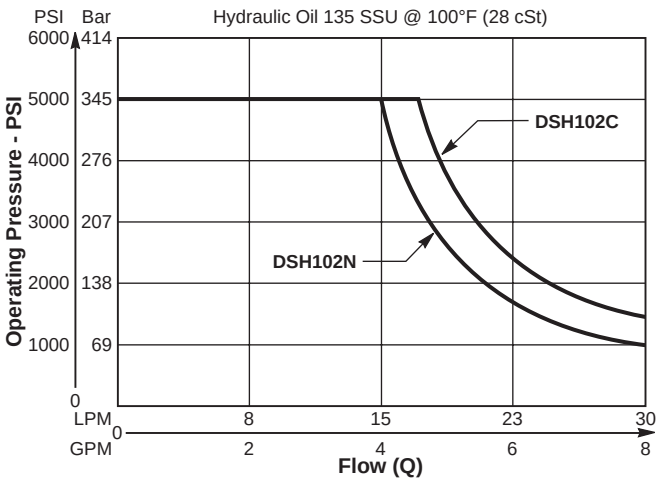
- High flow capacity with reduced space requirements
- Standard valve bodies and common cavities
- One-piece encapsulated coil with minimal amperage draw
- Manual overrides, seal variations and other options available
- No dynamic seals
- Variety of coil terminations

Performance Curves

Pressure Drop vs. Flow (Through cartridge only)



Operating Characteristics (Through cartridge only)



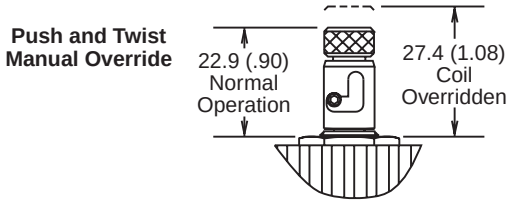
Solenoid Coil Specifications

Voltage	10 VDC	12 VDC	24 VDC	120 VAC	240 VAC
Watts	20	20	20	20	20
Amps	1.45	1.17	0.57	.144	.079

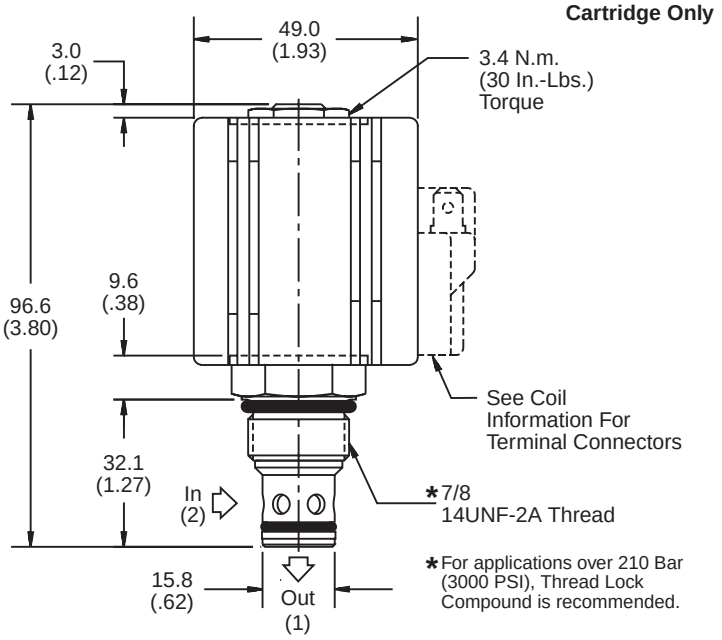
Response Time (at nominal flow and maximum pressure)	
Normally Closed	Open - 60 ms Close - 20 ms
Normally Open	Open - 80 ms Close - 40 ms

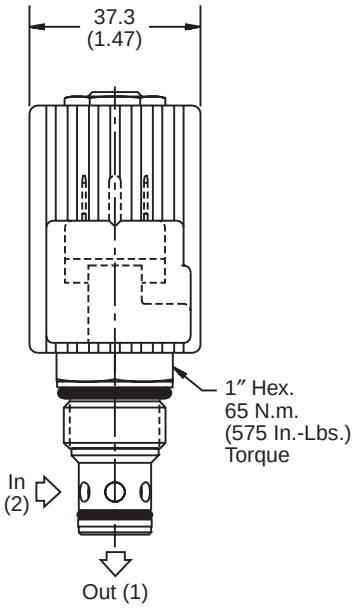
Wire Class	"H" for all voltages
A.C. Rectifiers	Integral full wave bridge

*Inch equivalents for millimeter dimensions are shown in (**)

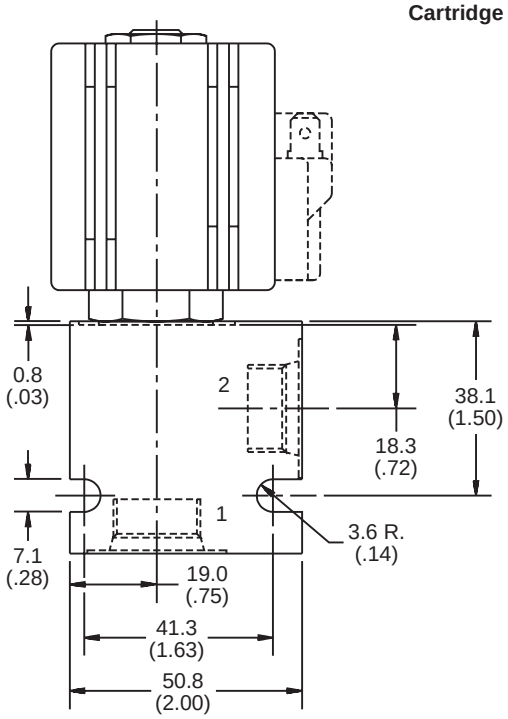


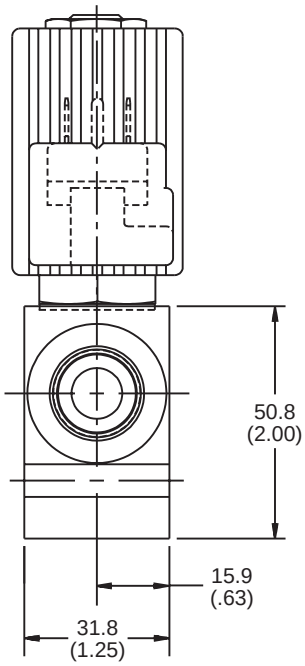
Cartridge Only

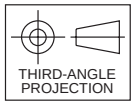




Cartridge In Body







dsh102.pm6.5, bl, lk

DSH	10	2							—	
Solenoid Valve	Size	Spool Type	Style	Override Option	Seals	Coil Voltage	Coil Wattage	Coil Termination		Body Option

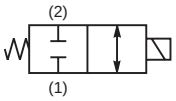
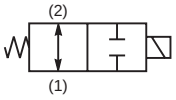
Code	Style
10	7/8″ - 14UNF-2B Threaded Cavity with .625″ Dia. Seat

Code	Type
Omit	Nitrile
V	Fluorocarbon

Code	Type
Omit	Without Manual Override
T	Push & Twist Manual Override

Code	Type
Omit	Cartridge without Coil
L	20 Watt

Code	Description
Omit	Cartridge without Coil
C	1/2″ NPTF Conduit Connector with 24″ Class H Wires
D	DIN 43650 (Hirschmann) Plug Face
P	SAE 1B-0.25 SAE Double Spade (DC Only)
W	Double Wire, 24″ Class H (DC Only)
WP	Waterproof Double Wire, 24″ Class H (DC Only)

Code	Description
C	
N	

Code	Description
Omit	Cartridge without Coil
D010	10 VDC
D012	12 VDC
D024	24 VDC
A120	120/110 VAC, 60/50 Hz
A240	240/220 VAC, 60/50 Hz

Code	Port Size & Material		
Omit	Cartridge Only		
4P	1/4″ NPTF	(B10-2-4P)	Steel
A4P	1/4″ NPTF	(B10-2-A4P)	Aluminum
6P	3/8″ NPTF	(B10-2-6P)	Steel
A6P	3/8″ NPTF	(B10-2-A6P)	Aluminum
8P	1/2″ NPTF	(B10-2-8P)	Steel
A8P	1/2″ NPTF	(B10-2-A8P)	Aluminum
6T	SAE-6	(B10-2-6T)	Steel
A6T	SAE-6	(B10-2-A6T)	Aluminum
8T	SAE-8	(B10-2-8T)	Steel
A8T	SAE-8	(B10-2-A8T)	Aluminum
4B	1/4″ BSPG	(B10-2-4B)	Steel
A4B	1/4″ BSPG	(B10-2-A4B)	Aluminum
6B	3/8″ BSPG	(B10-2-6B)	Steel
A6B	3/8″ BSPG	(B10-2-A6B)	Aluminum
8B	1/2″ BSPG	(B10-2-8B)	Steel
A8B	1/2″ BSPG	(B10-2-A8B)	Aluminum

SERVICE PARTS

Coil Size

Code	Size
S10	5/8″ I.D.

Coil Wattage

Code	Type
L	20 Watts

Coil Termination

Code	Description
C	Conduit
D	DIN 43650
P	Double Spade
S	Double Screw
W	Double Wire
WP	Waterproof Double Wire

Coil Voltage

Code	Description
D010	10 VDC
D012	12 VDC
D024	24 VDC
A120	120 VAC
A240	240 VAC

DIN Connector:
See Coil Data Sheet

Coil Nut:
DSH102 — 118127-00

Nitrile Seal Kit:
DSH102 — SK10-2

Fluorocarbon Seal Kit:
DSH102 — SK10-2V

Notes: See Series 10 Coil Data Sheets.
For other coil voltages and terminations, consult factory.

Shipping Weight
Cartridge Only .17 kg (.38 lbs.)
Cartridge in Body .62 kg (1.4 lbs.)

NOTE: If system pressure does not exceed 210 Bar (3000 PSI), aluminum bodies can be used. Higher pressures require steel bodies.

dsh102.pm6.5, bl, lk

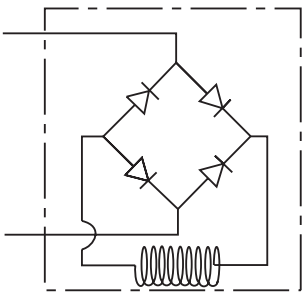
Features

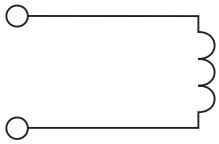
- **Integral Deutsch connector coil exceeds IP69K standards**
- Integral Deutsch connector coil thermal shock dunk test rated
- Integral Amp Jr. coil exceeds IP67 standards for thermal shock, water resistance and “dunk capability”
- Universal 50/60 Hz operation
- Coil hermetically sealed, requires no O-rings or waterproofing kits
- External plated steel flux-carrying band (unlike encapsulated band) enables coil to withstand severe thermal shocks without cracking
- Symmetrical coil can be reversed without affecting performance

Specifications

Coil Type	**S** Standard **P** Puissant
Nominal Wattage (See Ordering Information For Exact Wattage)	**S** 18 Watts **P** 28 Watts
Duty Cycle	Continuous @ 100% voltage
Magnetic Wire Insulation Class	‘N’ Rated at 200°C (392°F)
Temperature Range	-40°C to +200°C (-40°F to +392°F)
Temperature Rise At Nominal Voltage And Natural Ventilation	**S** 75°C (135°F) **P** 95°C (172°F)
Dielectric Strength Maximum Current Leakage (Amps)	.0005 In dry lab condition at 1000V AC for 30 seconds .001 After being immersed in 23°C (77°F) water with waterproof connector for 24 hours at 500V AC
Encapsulating Material	Glass filled rynite
Color Identification On The Terminal Boss	**S** Black Ring **P** Red Ring
Weight	0.29 kg (0.64 lbs.)

AC Coil Assembly





Ordering Information

CA			
Super Coil 5/8″ I.D.	Wattage	Voltage	Termination

Code	Wattage
S	Standard
P	Puissant

Code	Voltage						
		Watts		Amps		Ohms**	
	Volts	S	P	S	P	S	P
010	10 VDC	18	28	1.80	2.80	5.56	3.57
012*	12 VDC	18	28	1.50	2.33	8.00	5.14
018	18 VDC	18	28	1.00	1.56	18.0	11.6
024*	24 VDC	18	28	0.75	1.17	32.0	20.6
048	48 VDC	18	28	0.38	0.58	128.0	82.3
115*	115 VAC	18	28	0.20	0.26	554	417
230	230 VAC	18	28	0.10	0.15	2100	1430

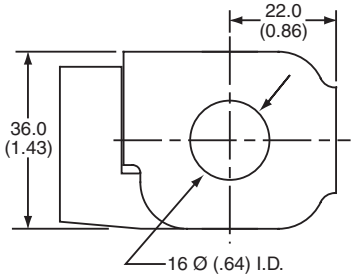
Standard** ****Resistance ±10% at 68°F

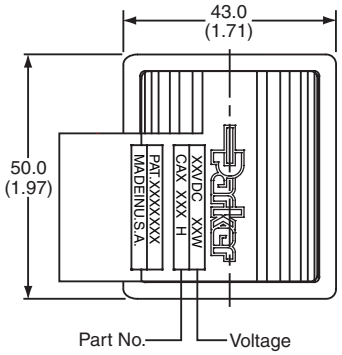
Code	Termination
A	Amp Jr. (DC Only)
AD	Amp Jr. with 3 Amp Diode (DC Only)
C	Double Lead Wire with Conduit Connector (AC Only)
D	DIN 43650 (AC or DC, Supplied without DIN Connector)
H	Integral Deutsch
HE	Integral Deutsch with 3 Amp Diode
HS	Integral Deutsch with Internal Seal
L	Double Lead (DC Only)
LD	Double Lead with Deutsch Connector DT04-2P-EP04 (DC Only) (Use ‘H’ series if possible)
LE	Double Lead with 3 Amp Diode (DC Only)
PF	Double Lead Wire with Packard Female Weather Pack Connector 1201 5792 (DC Only)
PM	Double Lead Wire with Packard Male Weather Pack Connector 1201 0973 (DC Only)
S	Double Spade (DC Only)
W	Double Screw (DC only)
WE	Double Screw with 3 Amp Diode (DC Only)
Y	Single Screw (Internally Grounded, DC Only)

***Note:** Additional voltages and other terminals are available. Some coils are UL approved. For details please consult factory.*

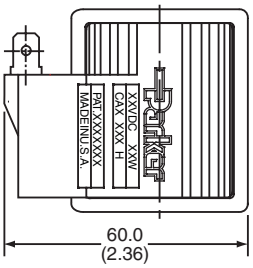
DIN Female Mating Connector: See page CL2
Deutsch Mating Connector: # DT06-25
Packard Male Weather Pack Connector: 12010973
Packard Female Weather Pack Connector: 12015792

Terminal Styles and Dimensions

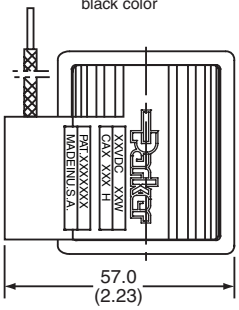




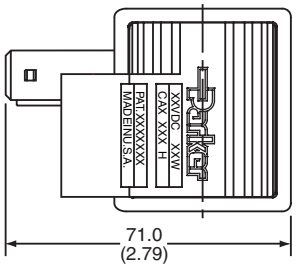
S - Double Spade



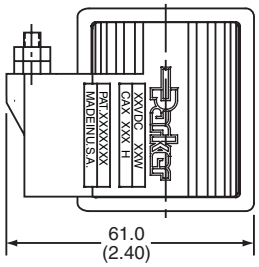
L - Double Lead
18 gauge 457mm *18″* long
black color



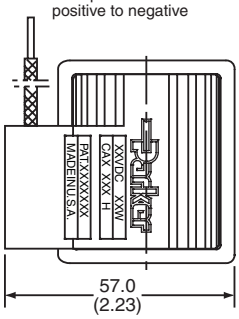
A - Amp Junior
AD - Amp Junior
with 3 Amp Diode
(+ and - metered)



Y - Single Screw
(Internal ground)
8-32 UNC screw & nut
W - Double Screw
8-32 UNC screw & nut
WE - Double Screw
with 3 Amp Diode
(+ and - metered)

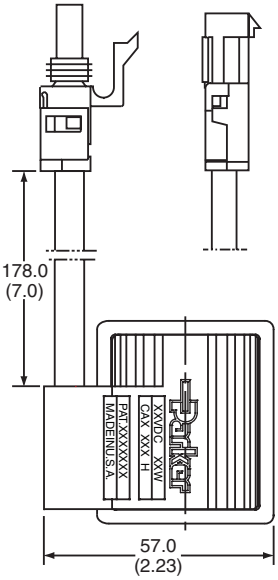


LE - Double Lead
with 3 Amp Diode
18 gauge 457mm *18″* long
Red wire positive,
Black wire negative
Diode protection from
positive to negative

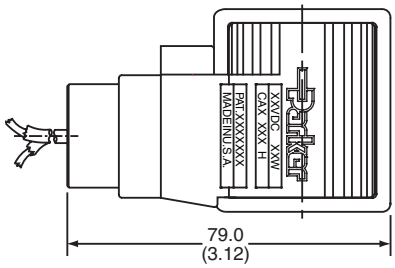


PF - Female
Packard
Connector

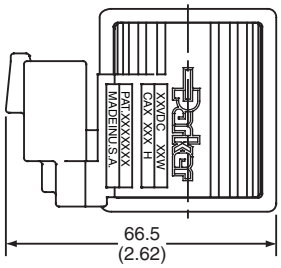
PM - Male
Packard
Connector



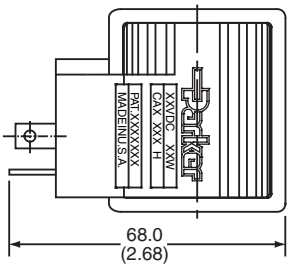
C - Double Lead
Conduit (1/2" NPTF)
18 gauge 457mm *18″* long, black color



H - Integral Deutsch
DT04 - 2P - EP04
HE - Integral Deutsch
with 3 Amp Diode
(+ and - metered)



D - DIN 43650
(ground wire on AC only)

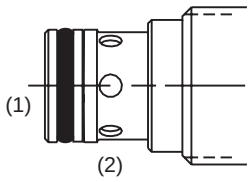


NOTES:
1. The standard A.C. coil includes a molded-in full wave rectifier rated for 800 peak reverse voltage.
2. All P Puissant (high wattage) coils use a red ring as an indiction marker on the terminal boss. (No ring on Integral Deutsch connector.)

General Description

The B10-2-** Series Bodies are designed to be used in conjunction with No. 10 two step cartridges.
(Parker Common Cavity C10-2)

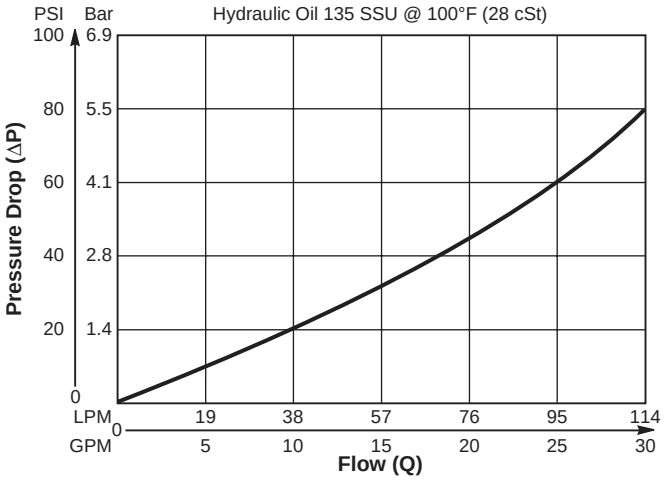
Cartridge Flow Path



Body Markings

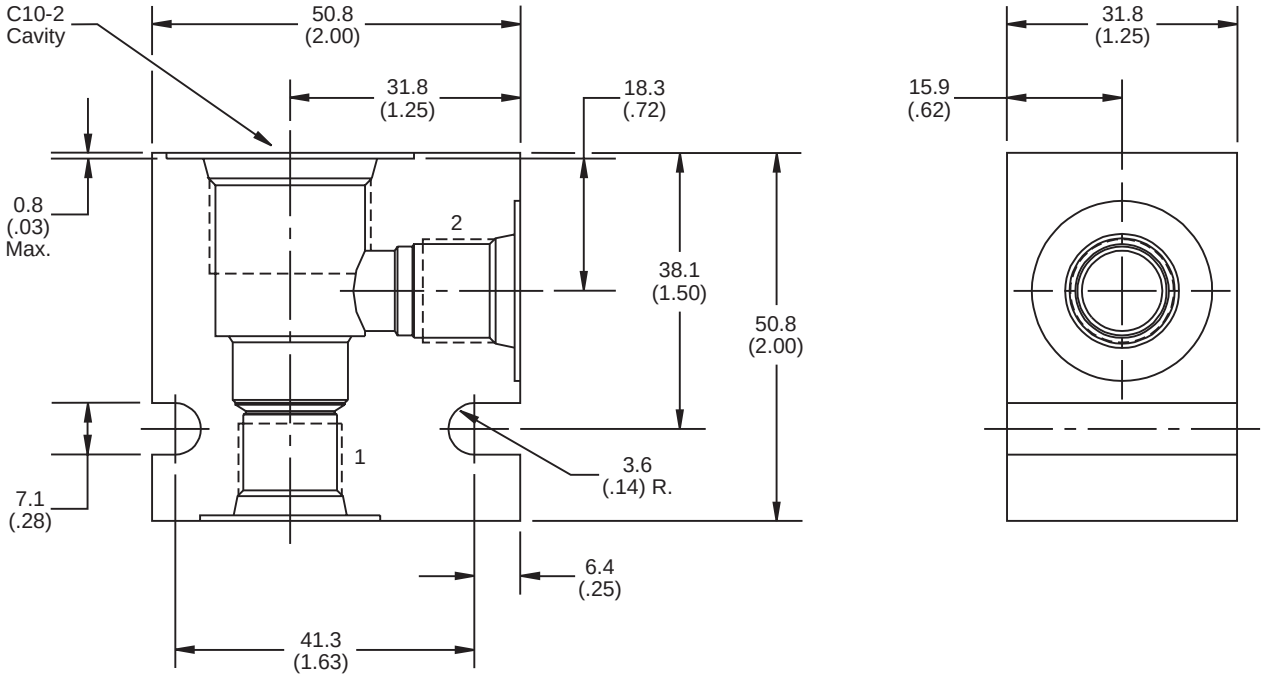
Performance Curve

Pressure Drop vs. Flow (Through cartridge only)



Dimensions

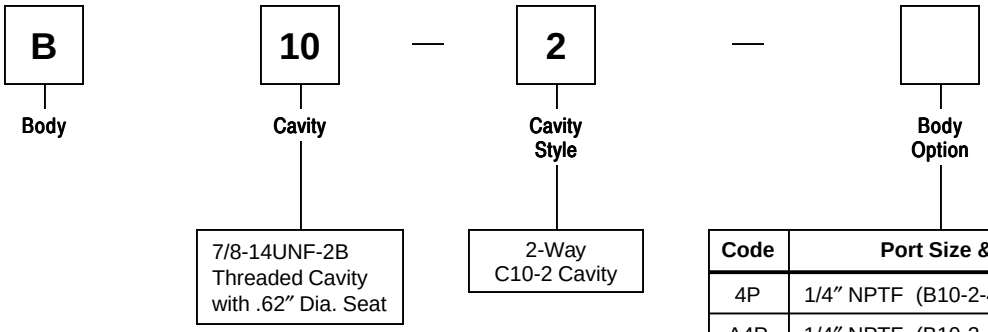
*Inch equivalents for millimeter dimensions are shown in (**)



THIRD-ANGLE PROJECTION

b10-2.pm6.5, bl, lk

Ordering Information



Code	Port Size & Material		
4P	1/4″ NPTF	(B10-2-4P)	Steel
A4P	1/4″ NPTF	(B10-2-A4P)	Aluminum
6P	3/8″ NPTF	(B10-2-6P)	Steel
A6P	3/8″ NPTF	(B10-2-A6P)	Aluminum
8P	1/2″ NPTF	(B10-2-8P)	Steel
A8P	1/2″ NPTF	(B10-2-A8P)	Aluminum
6T	SAE-6	(B10-2-6T)	Steel
A6T	SAE-6	(B10-2-A6T)	Aluminum
8T	SAE-8	(B10-2-8T)	Steel
A8T	SAE-8	(B10-2-A8T)	Aluminum
4B	1/4″ BSPG	(B10-2-4B)	Steel
A4B	1/4″ BSPG	(B10-2-A4B)	Aluminum
6B	3/8″ BSPG	(B10-2-6B)	Steel
A6B	3/8″ BSPG	(B10-2-A6B)	Aluminum
8B	1/2″ BSPG	(B10-2-8B)	Steel
A8B	1/2″ BSPG	(B10-2-A8B)	Aluminum

Shipping Weight .45 kg (1.0 lbs.)

Ordering Conversion

Cartridge	Port 1	Port 2
RDH101	Pressure/Inlet	Tank/Outlet
RD102	Pressure/Inlet	Tank/Outlet
RDH103	Tank/Outlet	Pressure/Inlet
RAH101	Pressure/Inlet	Tank/Outlet
XR101	Inlet or Tank	Tank or Inlet
NV101	*	*
NV102	*	*
FV101	Free Flow Inlet Metered Flow Out	Free Flow Outlet Metered Flow In
FV102	Free Flow Inlet Metered Flow Out	Free Flow Outlet Metered Flow In
FR101	Pressure/Inlet	Regulated
FC101	Metered Flow In Full Flow Outlet	Metered Flow Out Full Flow Inlet
VF101	Inlet	Outlet
CV101P	Free Flow Inlet	Free Flow Outlet
CV102P	Free Flow Inlet	Free Flow Outlet
CVH103P	Free Flow Inlet	Free Flow Outlet
CVH104P	Free Flow Outlet	Free Flow Inlet

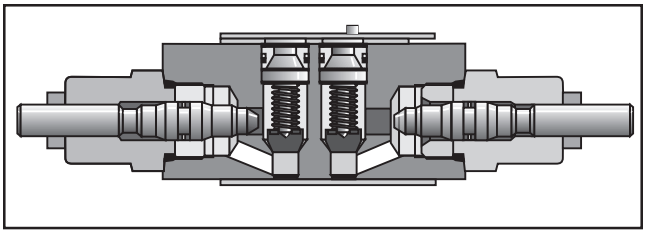
Cartridge	Port 1	Port 2
DL101	Tank/Outlet	Pressure/Inlet
HP101	Tank/Outlet	Pressure/Inlet
DSH101C	Tank/Outlet**	Pressure/Inlet**
DSL101C	Tank/Outlet**	Pressure/Inlet**
DSH101N	Tank/Outlet**	Pressure/Inlet**
DSL101N	Tank/Outlet**	Pressure/Inlet**
DSH102C	Tank/Outlet**	Pressure/Inlet**
DSL102C	Tank/Outlet**	Pressure/Inlet**
DSH102N	Tank/Outlet**	Pressure/Inlet**
DSL102N	Tank/Outlet**	Pressure/Inlet**
DSH106C6M	Tank/Outlet**	Pressure/Inlet**
DF102C	Tank/Outlet	Pressure/Inlet
DF102N	Pressure/Inlet	Tank/Outlet
ERV101N	Pressure/Inlet	Tank/Outlet
ERV102N	Pressure/Inlet	Tank/Outlet

***** Either port can be used as an inlet or an outlet.
****** All ports can be pressurized.

b10-2.pm6.5, bl, lk

Flow Control Valves

Series FM

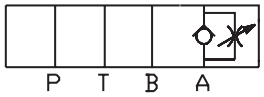


- Parker Manapak style FM flow control valves can be provided in either single or double configurations.

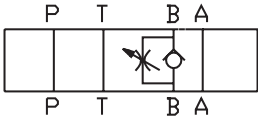
  The flow controls may be positioned in 'A' port or 'B' port; or both 'A' and 'B' ports.

- Valve bodies are manufactured from steel which provide extra strength and durability for longer life. Internal hardened steel components also provide longer life.
- Two step needles (standard) provide fine adjustment for the first three turns and course adjustment for the last three turns. Fine and microfine metering needles are available as an option.
- Large bypass checks allow high flow at a low pressure drop.
- Reversible (invert 180°) for meter-in or meter-out (D03 & D05 only).

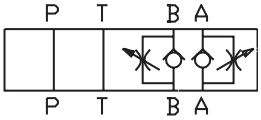
FM*AA
(Meter Out)



FM*BB
(Meter Out)

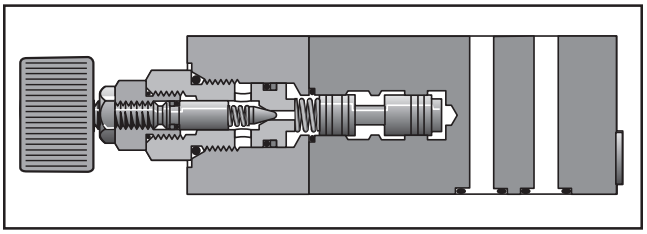


FM*DD
(Meter Out)



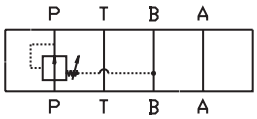
Pressure Reducing Valves

Series PRM

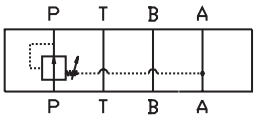


- Parker Manapak PRM sandwich style pressure reducing valves can be used to reduce pressure on the 'P' port, the 'A' port, or the 'B' port.
- Three pressure adjustment options available: slotted screw, knob and locking knob.
- Valve bodies are manufactured from steel which provide extra strength and durability for longer life. Internal hardened steel components also provide longer life.

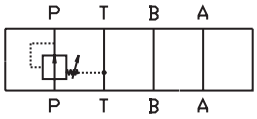
PRM*AA



PRM*BB

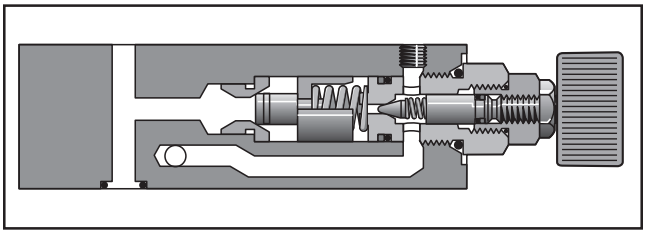


PRM*PP



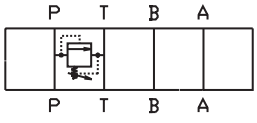
Pressure Relief Valves

Series RM



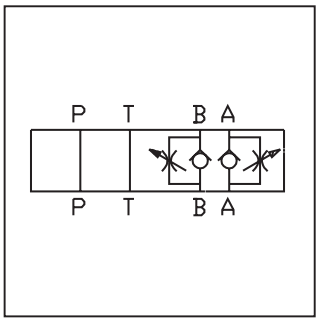
- Parker Manapak RM sandwich style relief valve is a 'P' port to 'T' port relief.
- Valve bodies are manufactured from steel which provide extra strength and durability for longer life. Internal hardened steel components also provide longer life.
- Three pressure adjustment options available: slotted screw, knob and locking knob.

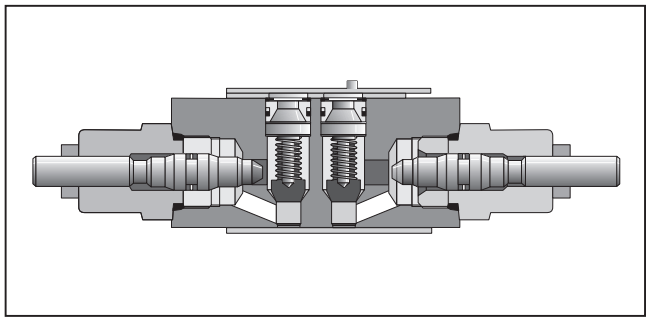
RM*PT



General Description

The FM double Manapak flow control valves permit free flow from the direction valve to the actuator and adjustable independent flow regulation in each return line from the actuator (meter-out). The FM2, and FM3 have a seal plate and can be inverted for meter-in applications (see installation drawing for flow direction).





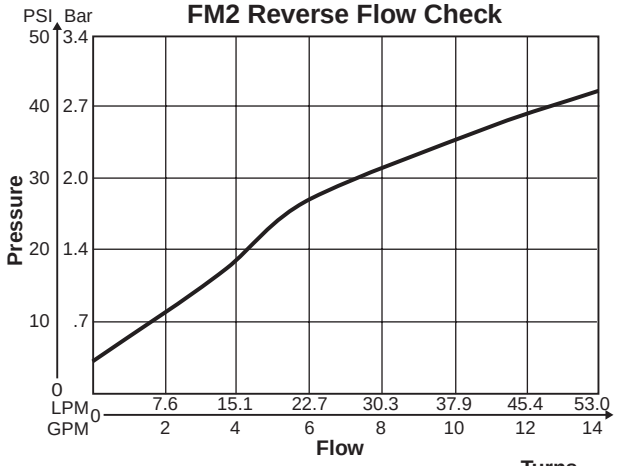
Features

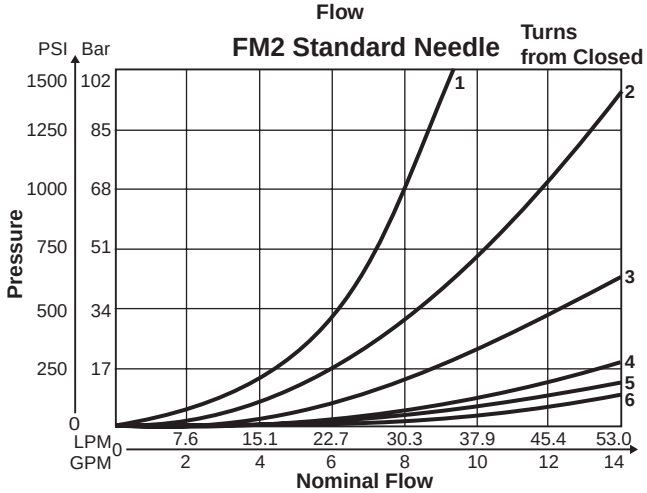
- Manapak style FM flow control valves can be provided in either single or double configurations.
- The flow controls may be positioned in 'A' port or 'B' port; or both 'A' and 'B' ports.
- Valve bodies are manufactured from steel providing extra strength and durability for longer life. Internal hardened steel components also provide longer life.
- Two step needles provides fine adjustment for the first three turns and course adjustment for the last three turns. Fine and micro fine adjustment available.
- Large bypass checks allow high flow at a low pressure drop.
- Reversible (invert 180°) for meter-in or meter-out (D03 and D05 size only).

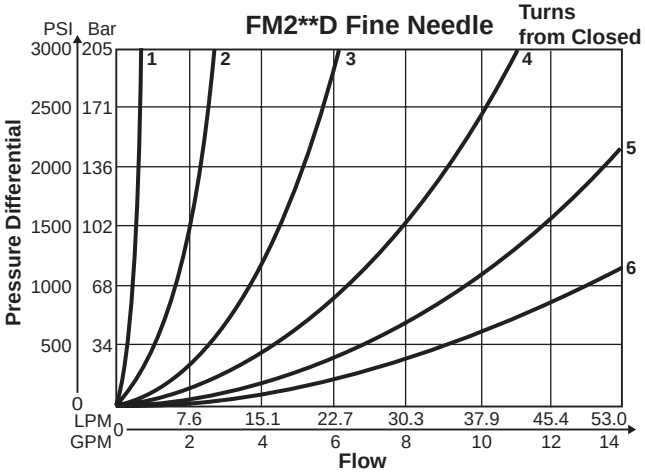
Specifications

	FM2	FM3	FM6
Mounting Pattern	NFPA D03, CETOP 3, NG 6	NFPA D05, CETOP 5, NG 10	NFPA D08, CETOP 8, NG 25
Maximum Pressure	345 Bar (5000 PSI)	345 Bar (5000 PSI)	200 Bar (3000 PSI)
Maximum Flow	53 LPM (14 GPM)	76 LPM (20 GPM)	341 LPM (90 GPM)
Cracking Pressure	0.3 Bar (5 PSI)	0.3 Bar (5 PSI)	0.3 Bar (5 PSI)

Performance Curves





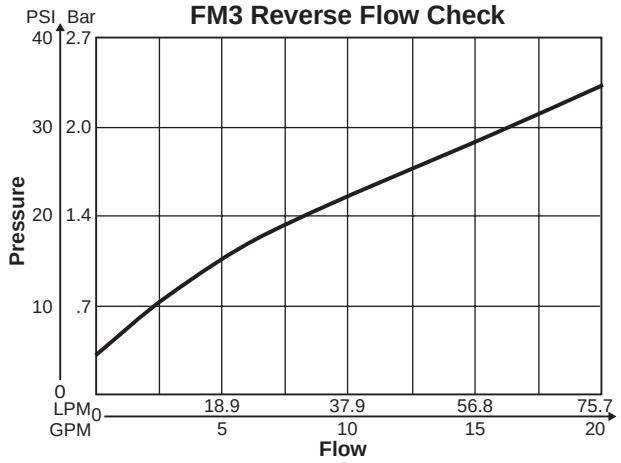


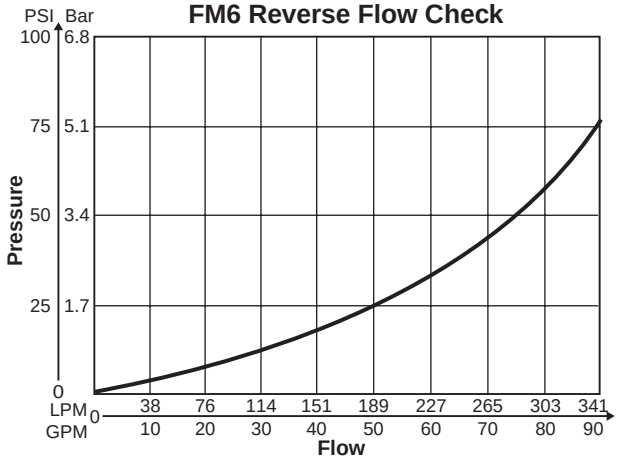
Curves were generated using 100 SSU hydraulic oil. For any other viscosity, pressure drop will change as per chart.

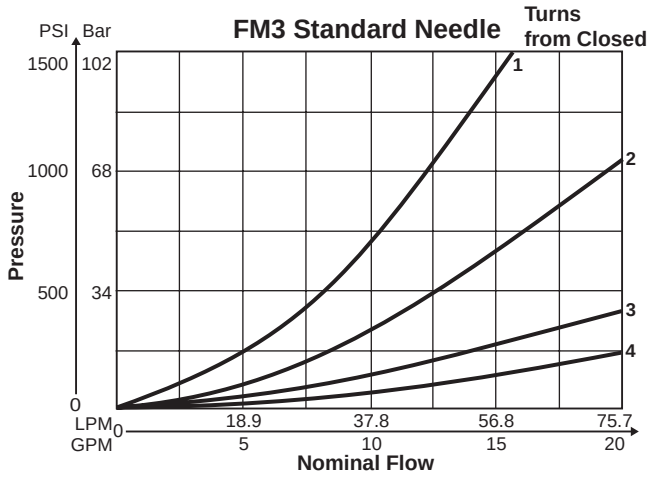
Viscosity Correction Factor							
Viscosity (SSU)	75	150	200	250	300	350	400
Percentage of ΔP (Approx.)	93	111	119	126	132	137	141

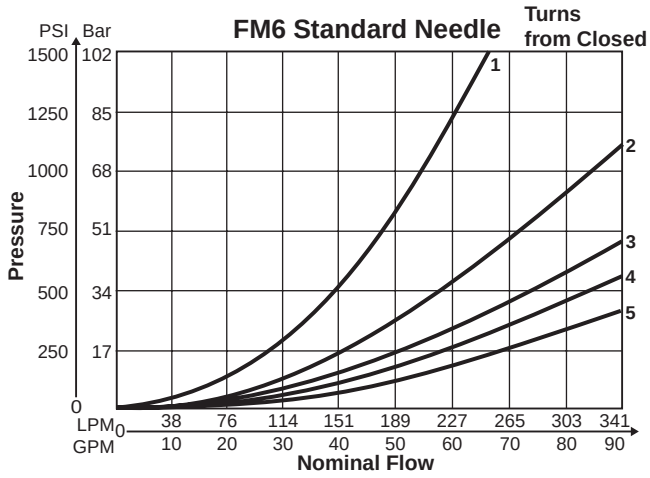
manapak.pm5, dd, hh

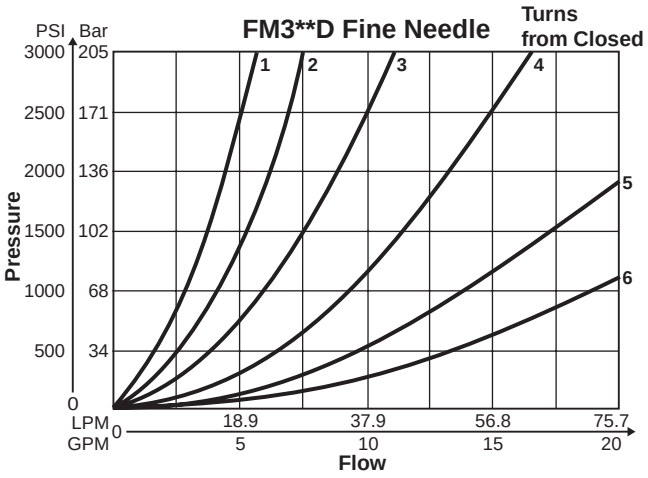
Parker Hannifin Corporation
Hydraulic Valve Division
Elyria, Ohio 44035 USA

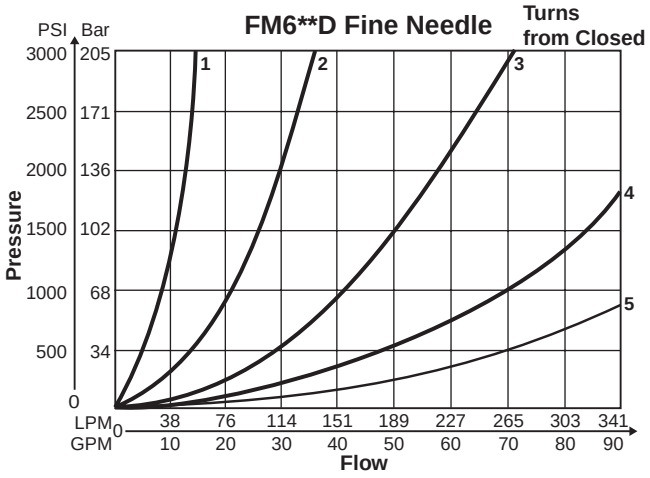

FM3 Reverse Flow Check
PSI Bar
40 2.7
30 2.0
20 1.4
10 .7
0
Pressure
LPM 0 18.9 37.9 56.8 75.7
GPM 5 10 15 20
Flow


FM6 Reverse Flow Check
PSI Bar
100 6.8
75 5.1
50 3.4
25 1.7
0
Pressure
LPM 0 38 76 114 151 189 227 265 303 341
GPM 10 20 30 40 50 60 70 80 90
Flow

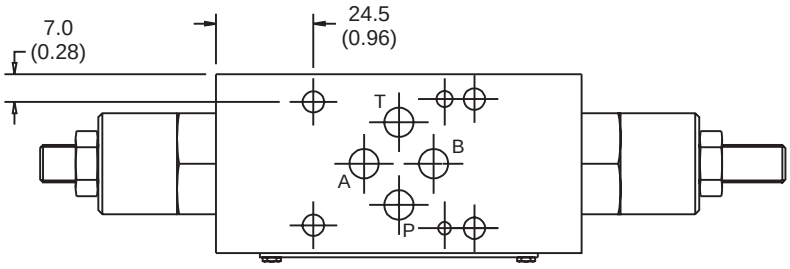

FM3 Standard Needle
Turns from Closed
PSI Bar
1500 102
1000 68
500 34
0
Pressure
1
2
3
4
LPM 0 18.9 37.8 56.8 75.7
GPM 5 10 15 20
Nominal Flow


FM6 Standard Needle
Turns from Closed
PSI Bar
1500 102
1250 85
1000 68
750 51
500 34
250 17
0
Pressure
1
2
3
4
5
LPM 0 38 76 114 151 189 227 265 303 341
GPM 10 20 30 40 50 60 70 80 90
Nominal Flow

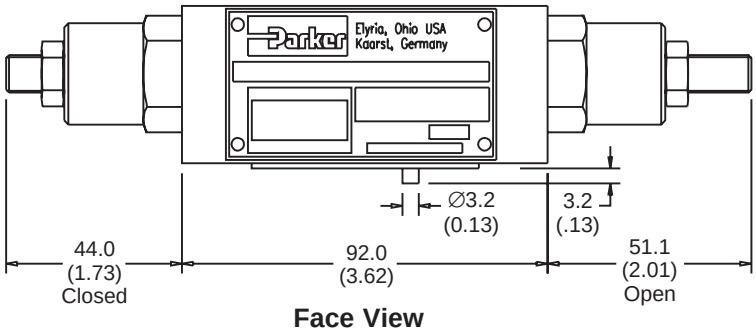

FM3**D Fine Needle
Turns from Closed
PSI Bar
3000 205
2500 171
2000 136
1500 102
1000 68
500 34
0
Pressure
1
2
3
4
5
6
LPM 0 18.9 37.9 56.8 75.7
GPM 5 10 15 20
Flow


FM6**D Fine Needle
Turns from Closed
PSI Bar
3000 205
2500 171
2000 136
1500 102
1000 68
500 34
0
Pressure
1
2
3
4
5
LPM 0 38 76 114 151 189 227 265 303 341
GPM 10 20 30 40 50 60 70 80 90
Flow

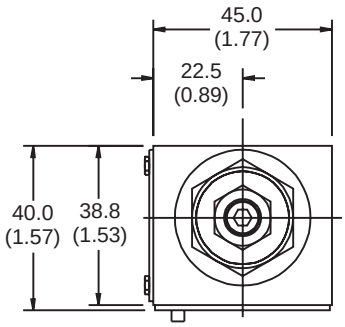
*Inch equivalents for millimeter dimensions are shown in (**)



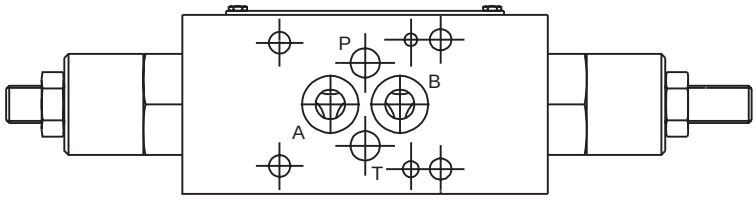
Top View



Face View

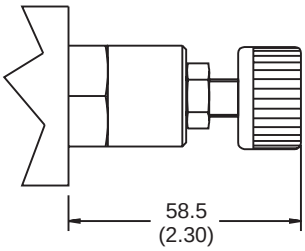


End View



SHOWN WITHOUT O-RING PLATE

Bottom View



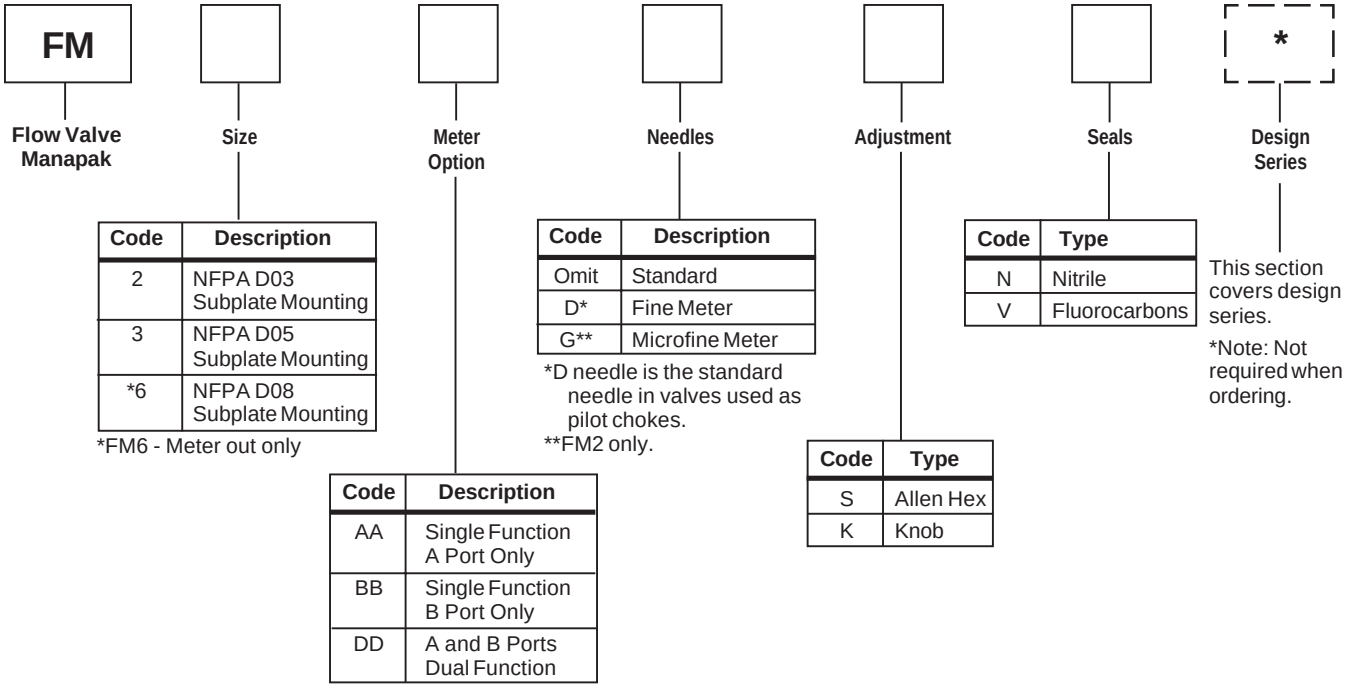
KNOB OPTION SHOWN
IN OPEN POSITION

Note: For meter-in option, invert body 180°.

THIRD-ANGLE PROJECTION

manapak.pm5, dd, hh

Ordering Information



Code	Description
2	NFPA D03 Subplate Mounting
3	NFPA D05 Subplate Mounting
*6	NFPA D08 Subplate Mounting

*FM6 - Meter out only

Code	Description
AA	Single Function A Port Only
BB	Single Function B Port Only
DD	A and B Ports Dual Function

Code	Description
Omit	Standard
D*	Fine Meter
G**	Microfine Meter

*D needle is the standard needle in valves used as pilot chokes.
**FM2 only.

Code	Type
S	Allen Hex
K	Knob

Code	Type
N	Nitrile
V	Fluorocarbons

This section covers design series.

*Note: Not required when ordering.

Manapak Bolt Kits

Size "2"				Size "3"						
No. of Manapaks	Manapak & Valve Combination	Bolt Kit	Bolt Length mm (in)	No. of Manapaks	Manapak & Valve Combination	D3W	D3 Manaplug w/Extension	Bolt Length mm (in)	D3DW & D31VW*	Bolt Length mm (in)
1	Manapak & D1	BK243	73.2 (2.88)	1	Manapak & D3	BK61	BK91	108.0 (4.25)	BK141	88.9 (3.50)
2	Manapak & D1	BK225	111.3 (4.38)	2	Manapak & D3	BK62	BK94	158.8 (6.25)	BK142	139.7 (5.50)
3	Manapak & D1	BK244	152.4 (6.00)	3	Manapak & D3	BK63	BK95	209.6 (8.25)	BK33	190.5 (7.50)
4	Manapak & D1	BK245	190.5 (7.50)							

*D31VW with internal pilot and internal drain only.

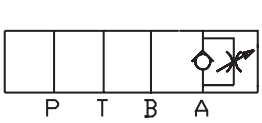
Size "6"			
No. of Manapaks	Manapak & Valve Combination	Bolt Kit	Bolt Length mm (in)
1	Manapak & D6	BK121	133.4 (5.25)
2	Manapak & D6	BK122	203.2 (8.00)
3	Manapak & D6	BK123	273.1 (10.75)
4	Manapak & D6	BK124	342.9 (13.5)

Bolt Kits must be ordered separately.

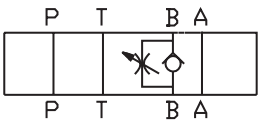
Unit Weight:

Valve	Weight
FM2	1.7 Kg (3.8 lbs.)
FM3	2.4 Kg (5.2 lbs)
FM6	7.9 Kg (17.5 lbs.)

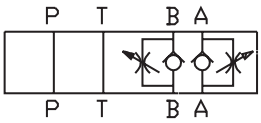
Schematics



AA Option



BB Option

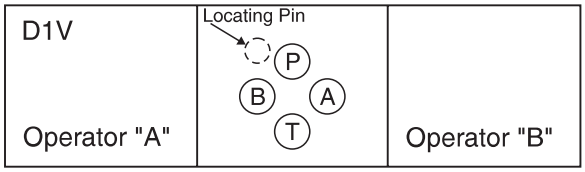


DD Option

CAUTION:

Manapak Installation

Prior to installation of Manapaks, please review flow paths. Due to the reversibility of the DO3 size, incorrect installation will alter the hydraulic circuit. Care must be taken during installation to insure that the Manapak is installed in compliance with the hydraulic schematic. Please consult with your Parker representative with any questions that may arise.



Pressure Ratings

Unless otherwise specified, all Parker Manapaks have continuous duty pressure rating as shown in this catalog.

Special Requirements

Consult your Parker representative for factory recommendations on such situations as:

- Installations that will operate at pressures higher than published catalog ratings.
- Use of hydraulic fluids which do not meet our recommended specifications.
- Operations where fluid temperature will exceed 121°C (250°F).

Recommended Mounting Surface

Surface must be flat within .0004 inch T.I.R. and smooth with 32 micro-inch.

System Cleanliness

Any hydraulic system that includes Parker valves should be carefully protected against dirt and fluid contamination. Life of the valves, as well as of all other components, will be greatly lengthened. Operation will be smoother and more precise. Maintenance and repairs will be reduced. Lost production because of low pressure and flow will be minimized. Fluid contamination should be maintained to less than 500 particles larger than 10 micrometers per milliliter of fluid (SAE class 4 or better/ISO Code 16/13).

Hydraulic Fluids

Parker recommends using top-quality hydraulic fluids having a viscosity range of 150 to 250 SSU (32 to 54 cst.) at 38°C (100°F). The absolute viscosity range should be 80 to 1000 SSU (16 to 220 cst.). Fluids should have highest anti-wear characteristics and be treated to avoid rust and oxidation.

Seals

When used with water-glycol, water/oil emulsions, and high-grade petroleum base hydraulic fluids, Parker standard nitrile seals are suitable.

When using phosphate ester fluids or their blends, specify Parker optional seals made of DuPont Viton. Synthetic fire-resistant fluids require special seal materials which your Parker representative can recommend.

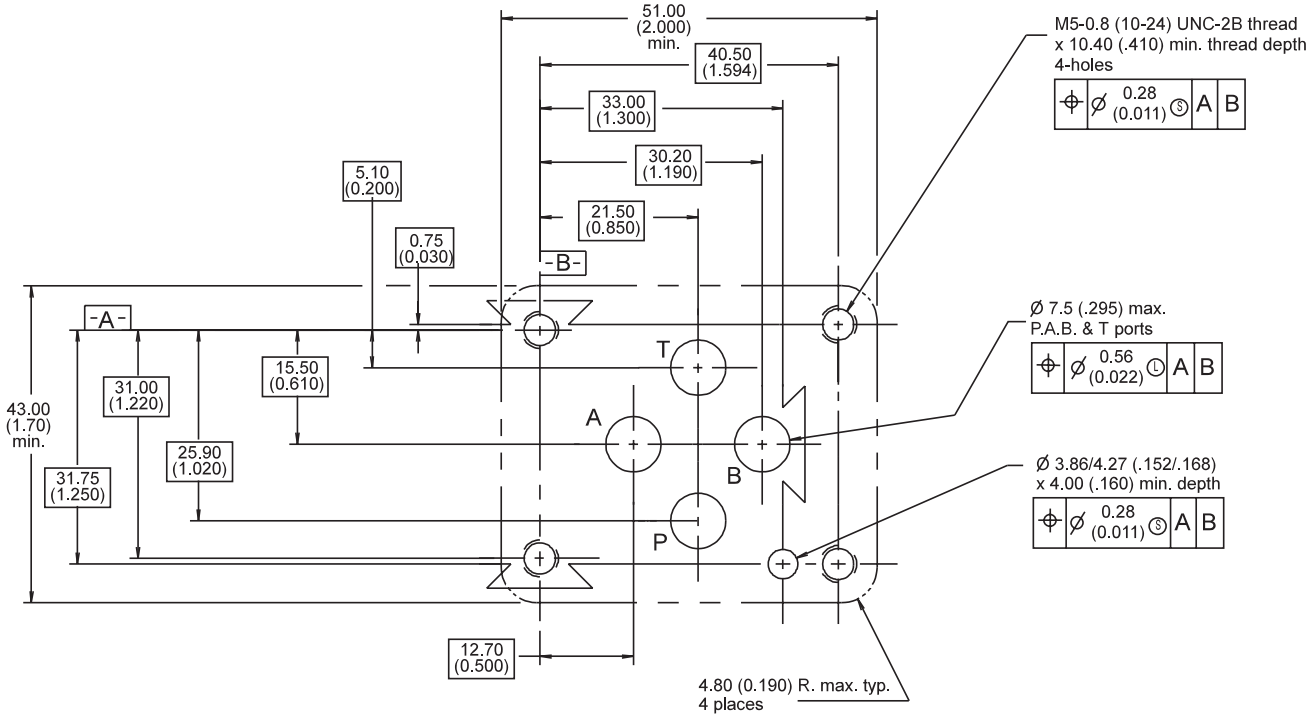
Torque Specifications

The recommended torque valves are for the bolts which mount the valve to the manifold or subplate are as follows:

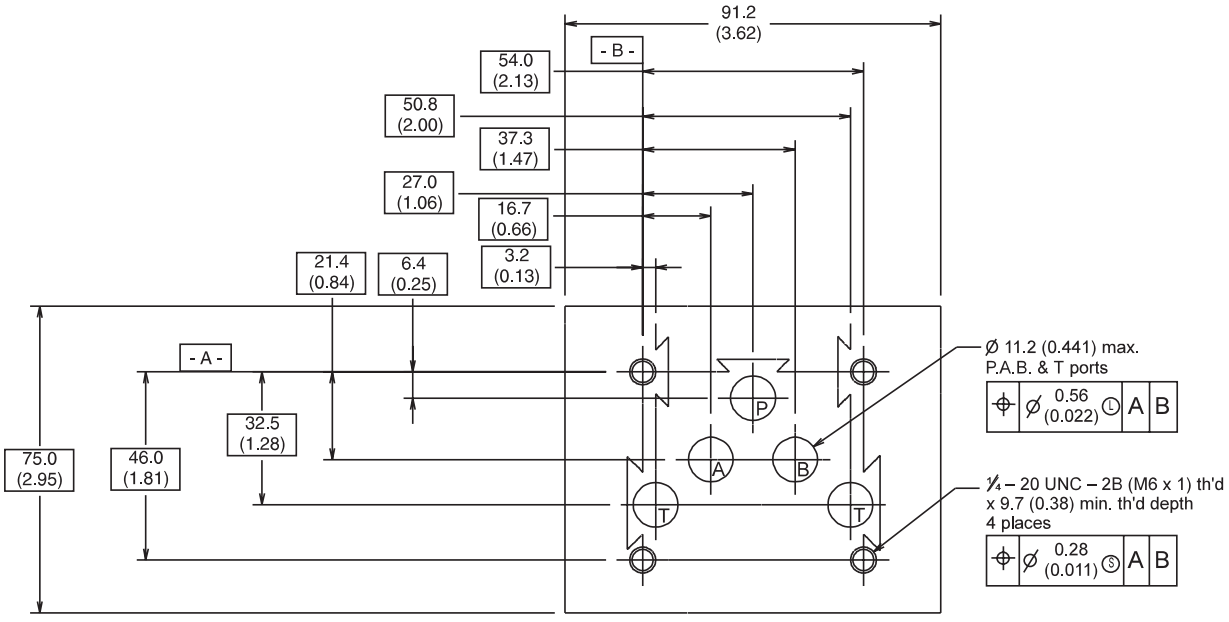
Size	Torque Valve
2	5.7 N.m. (50 in.-lbs.)
3	16.3 N.m. (12 ft.-lbs.)
6	108.5 N.m. (80 ft.-lbs.)

Dimensions

*Inch equivalents for millimeter dimensions are shown in (**)"

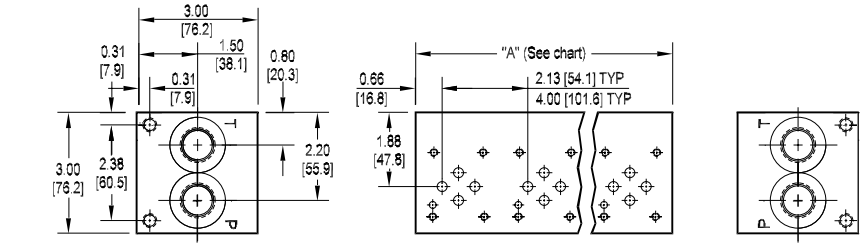


Mounting Surface for Directional Control Valve Manifold M'TD. (NFPA, D03); CETOP 3 & NG 6

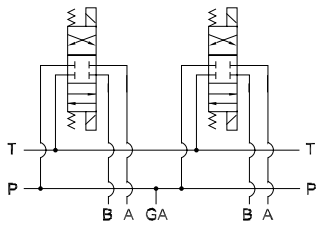


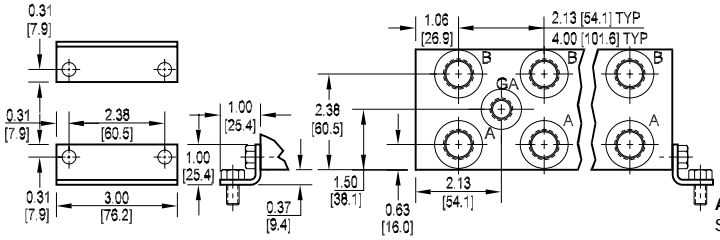
Mounting Surface for Directional Control Valve (NFPA, D05); CETOP 5 & NG 10

D03 Standard Flow Parallel Circuit Manifold



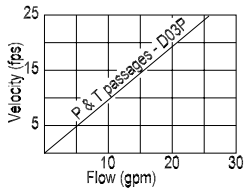
Parallel Circuit





All mounting hardware is supplied.
See page 35 for itemized list.

Flow Curve



Rated flow 14 gpm @ 15 fps

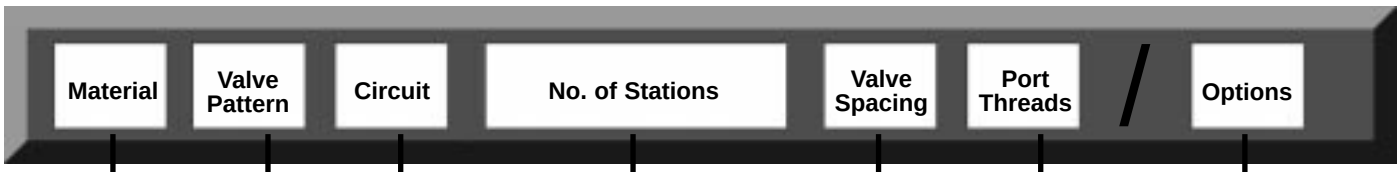
No. of stations	* 01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
"A" length (code 2 spa.) inch [mm]	2.13 [54.0]	4.25 [108.0]	6.38 [162.1]	8.50 [215.9]	10.63 [270.0]	12.75 [323.9]	14.88 [378.0]	17.00 [431.8]	19.13 [485.9]	21.25 [539.8]	23.38 [593.9]	25.50 [647.7]	27.63 [701.8]	29.75 [755.7]	31.88 [809.8]	34.00 [853.6]
apx. weight alum lb [kg]	3 [1]	4 [2]	6 [3]	8 [4]	9 [4]	11 [5]	12 [5]	14 [6]	16 [7]	18 [8]	20 [9]	21 [10]	22 [10]	24 [11]	26 [12]	27 [12]
apx. weight iron lb [kg]	5 [2]	9 [4]	13 [6]	17 [8]	21 [10]	26 [12]	30 [14]	34 [15]	38 [17]	42 [19]	47 [21]	51 [23]	55 [25]	59 [27]	63 [29]	68 [31]
"A" length (code 4 spa.) inch [mm]	--	6.13 [155.7]	10.13 [257.3]	14.13 [358.9]	18.13 [460.5]	22.13 [562.1]	26.13 [663.7]	30.13 [765.3]								
apx. weight alum lb [kg]	--	6 [3]	9 [4]	12 [5]	15 [7]	19 [9]	22 [10]	25 [11]								
apx. weight iron lb [kg]	--	12 [5]	20 [9]	28 [13]	36 [16]	45 [20]	53 [24]	57 [26]								

Port code	Valve mtg.	Manifold mtg.
P, S	#10-24 UNC x 0.63 [16] DP	0.31-18 UNC x 0.44 [11.1] DP
B, M, T	M5 ISO 6H x 0.63 [16] DP	M8 ISO 6H x 0.44 [11.1] DP

* Length of 01 station with relief cavity is 3.00 [76.2]. Gauge port not available on 01 station.

Specifications, descriptions, and dimensional data are subject to correction or change without notice or incurring obligation.

Ordering Information



Material	
A	Aluminum - 6061-T6 3000 psi • 20.7 MPa
D	Ductile Iron - D4512 5000 psi • 34.5 MPa

Valve Pattern	
D03	ISO 4401-03-02 NFPA T3.5.1-D03 See section 9

Circuit	
P	Parallel Circuit Standard Flow

No. of Stations	
Aluminum	
01...16	Available with spacing code 2
02...08	Available with spacing code 4
Ductile Iron	
01...16	Available with spacing code 2
02...08	Available with spacing code 4

Valve Spacing	
2	2.13 inch 54.0 mm
4	4.00 inch 101.6 mm

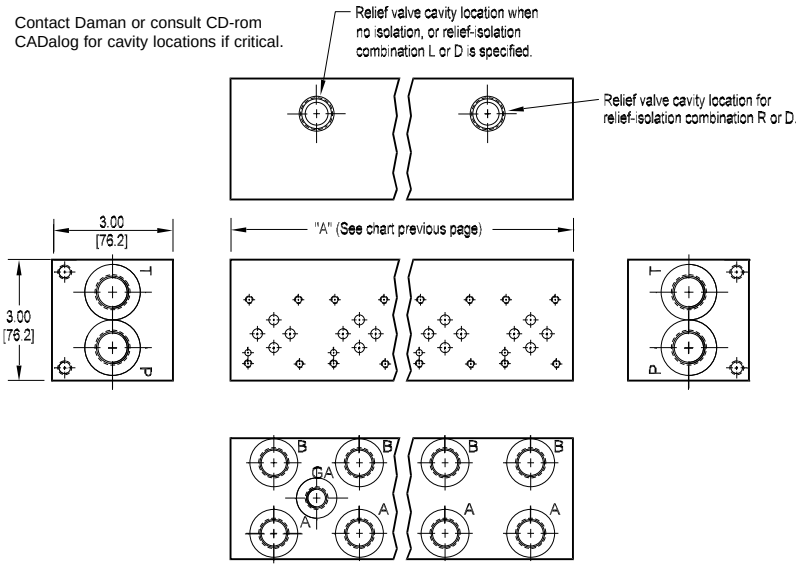
Port Threads		P & T	A & B	GA
P	NPTF • ANSI B1.20.3	0.50	0.38	0.25
S	SAE • ISO 11926	-10	-8	-6
B	BSPP • ISO 1179	0.50	0.38	none
M	ISO • ISO 6149	M22	M18	none
T	BSPT • ISO 7	0.50	0.38	none

Options
See next page for available options and ordering codes.

DAMAN PRODUCTS COMPANY, INC. • 1811 N. Home Street, Mishawaka, IN 46545-7267 USA
North America • Ph: 800·959·7841 Fx: 800·241·7664 • International • Ph: 219·259·7841 Fx: 219·259·7665
e-mail: daman@damanifolds.com • Internet: http://www.damanifolds.com

Options - D03 Standard Flow Parallel Manifold

Contact Daman or consult CD-rom CADalog for cavity locations if critical.



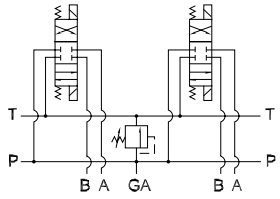
ISOLATIONS

Daman isolation options allow a manifold to have two independent pressure and/or tank ports. Isolations are drilled rather than plugged to ensure a leakproof and failproof isolation.

Ordering code letter:	* Isolation is between stations:	Available # of stations:
2.125 [54.0] spacing		
A	01 & 02	02-10
B	02 & 03	03-11
C	03 & 04	04-12
D	04 & 05	05-13
E	05 & 06	06-14
F	06 & 07	07-15
G	07 & 08	08-16
H	08 & 09	09-16
J	09 & 10	10-16
4.00 [101.6] spacing		
A	01 & 02	02-06
B	02 & 03	03-07
C	03 & 04	04-08
D	04 & 05	05-08
E	05 & 06	06-08
F	06 & 07	07-08

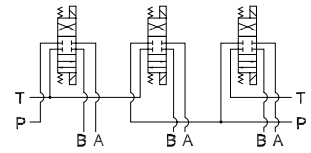
* Stations are numbered left to right.

Parallel Circuit with Relief



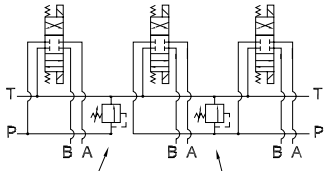
Valve with P in nose must be used.

Parallel Circuit with Isolations



Manifold shown with P isolation between 1 & 2 (PA), and T isolation between 2 & 3 (TB).

Relief / Isolation Combination

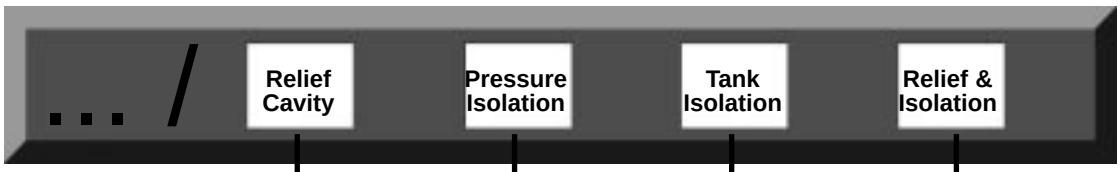


Option code L relief left of isolation

Option code R relief right of isolation

Option code D includes both reliefs

Ordering Information



Relief Cavity	
Omit if relief not required	
C	Common cavity C-10-2 (P in nose)
S	Sun Cavity T-10A (P in nose) See section 9 for valves.

Tank Isolation	
Omit if T isolation not required	
TA...TJ	Available with spacing code 2
TA...TF	Available with spacing code 4

Relief / Isolation Combination	
Specify when using both relief and isolation options.	
L	Relief cavity is located left of the isolation.
R	Relief cavity is located right of the isolation.
D	Two relief cavities, one each side of isolation.

Pressure Isolation	
Omit if P isolation not required	
PA...PJ	Available with spacing code 2
PA...PF	Available with spacing code 4

canfield connector
8510 Foxwood Court
Youngstown, Ohio 44514
(330) 758-8299 Fax: (330) 758-8912
www.canfieldconnector.com

SERIES 5000
SOLENOID VALVE CONNECTORS

GENERAL PRODUCT OVERVIEW

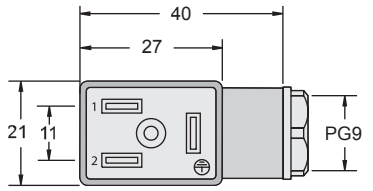
General Description

The ISO and 8mm Sub-Micro connectors are made according to DIN 43650 / ISO 4400, EN175301-803:2000. The MINI and 9.4mm Sub-Micro connectors are industry standards. All are used as protective enclosures for electrical connection in conjunction with hydraulic and pneumatic solenoid valves. These connectors offer distinct advantages over "hardwired" solenoid valves because of their modular design. Used where rapid installation and service are a must. Better than molded construction when special wire is needed or when using one long wire run.

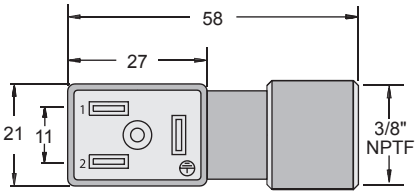
Dimensional Data

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED (COMPLETE DIMENSIONAL INFORMATION IS PROVIDED ON INDIVIDUAL PAGES)

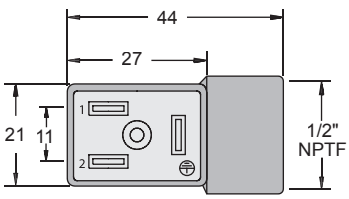
MINI



PG9



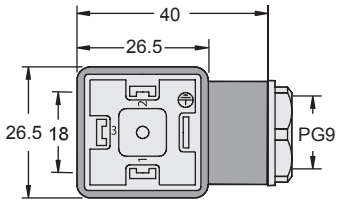
3/8" Conduit



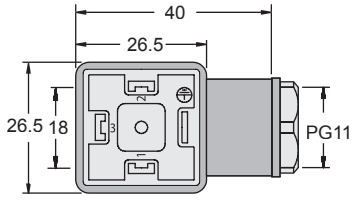
1/2" Conduit

ISO

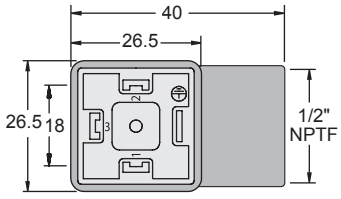
DIN 43650 Form "A" / ISO 4400, EN175301-803:2000



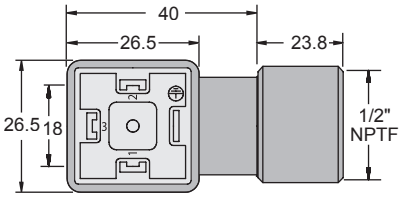
PG9 / HT PG9



PG11 / HT PG11



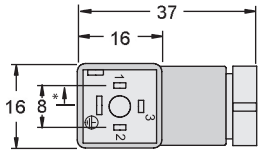
1/2" Conduit



HT 1/2" Conduit

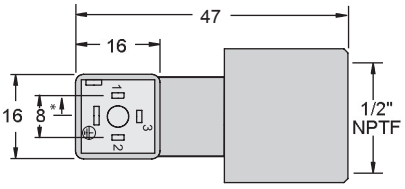
Sub-Micro

(8mm) DIN 43650 Form "C" / ISO 4400, EN175301-803:2000



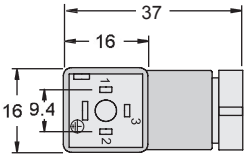
8mm Strain Relief

*Ground spade offset by 0.2mm toward pin 1.

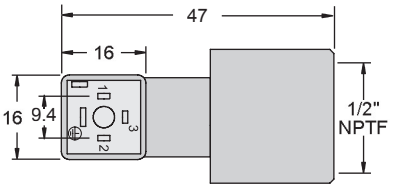


8mm 1/2" Conduit

*Ground spade offset by 0.2mm toward pin 1.



9.4mm Strain Relief



9.4mm 1/2" Conduit

Ordering Information

Use a prefix of "G" for Individually Bagged

5 □□□ - □□□□□□□

Orientation
1 - ground down
2 - ground right*
3 - ground up
4 - ground left*

Wire Length
0 - unwired
3 - 3 ft
6 - 6 ft
9 - 9 ft
C - 12 ft

Lighting Specification
0 - unlighted
3 - 6 - 48V AC/DC 50/60 Hz
7 - 48 - 120 VDC
100 - 240 VAC 50/60 Hz

Gasket
1 - nitrile
2 - silicone
3 - nitrile profile**

Wire Type
00 - unwired or standard for connector type 01, 08 & 11
07 - standard for connector type 02, 03, 10 & 13
09 - standard for connector type 09 & 12
11 - standard for connector type 90 & 99
25 - type 09 & 12 (3+ ground version)
36 - standard for connector type 91 & 95
47 - type 90 & 99 (3+ ground version)
75 - type 08 & 11 (3+ ground version)
76 - type 10 & 13 (3+ ground version)
77 - type 91 & 95 (3+ ground version)

For additional Wire Types, refer to *Appendix A*.
For wire installation, refer to *Appendix B*.

Housing Color
0 - standard "B"
1 - gray "A"

Contacts
0 - 2+ ground
1 - 3+ ground*

Connector Types
01 - MINI Strain Relief PG9
02 - MINI 3/8" Conduit
03 - MINI 1/2" Conduit
08 - ISO Strain Relief PG9
09 - ISO Strain Relief PG11
10 - ISO 1/2" Conduit
11 - ISO HT Strain Relief PG9†
12 - ISO HT Strain Relief PG11†
13 - ISO HT 1/2" Conduit†
90 - Sub-Micro PG7 DIN Interface (8mm)
91 - Sub-Micro 1/2" Conduit Interface (8mm)
95 - Sub-Micro 1/2" Conduit (9.4mm)
99 - Sub-Micro Strain Relief PG7 (9.4mm)

NOTE: When using MAC Valves with 9.4mm Sub-Micro, consult our factory.

Ordering Example:

5137 - 1030007

Ground down, 3 ft wire length, lighted 48 - 120 VDC, 100 - 240 VAC 50/60 Hz, nitrile gasket, MINI 1/2" Conduit Connector, 2+ ground contacts

Each connector kit contains fastening hardware and gasket assembly.

* *NOT* Available in MINI
** *NOT* Available in Sub-Micro

Not all combinations are available. Consult factory for details.

† High Top Housing for easy wiring.

Consult factory for available versions listed by Canadian Standards Association for use with certified electrical equipment.

General Description

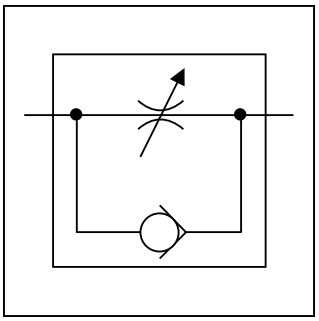
Series “F” flow control valves provide precise control of flow and shut-off in one direction, and automatically permit full flow in the opposite direction.

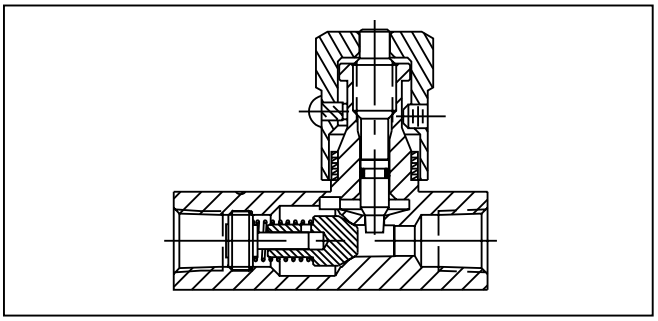
Operation

A two-step needle allows fine adjustment at low flow by using the first three turns of the adjusting knob. The next three turns open the valve to full flow, and also provide standard throttling adjustments.

Features

- The exclusive “Colorflow” color-band reference scale on the valve stem is a great convenience and time-saver in setting the valve originally and in returning it to any previous setting.
- A simple set screw locks the valve on any desired setting.
- A tamperproof option (T) feature is also available to prevent accidental or intentional adjustment of flow setting.



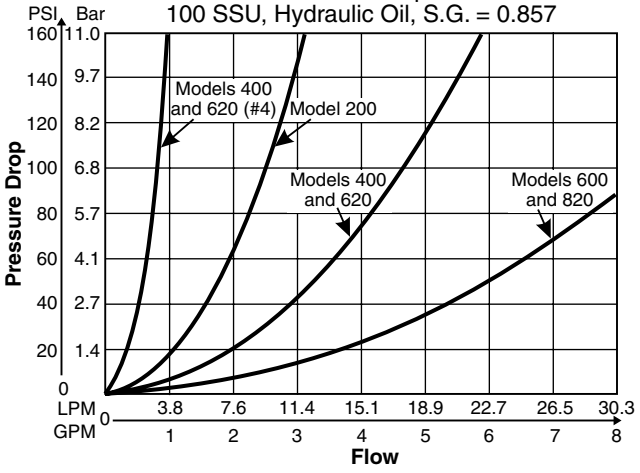


Specifications

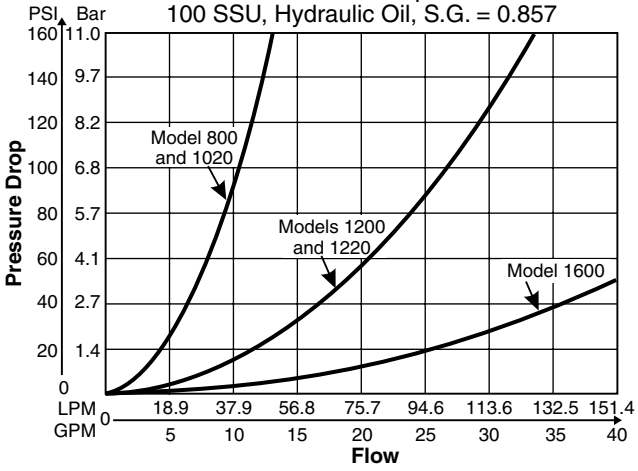
Maximum Operating Pressure	Brass:	140 Bar (2000 PSI); except for F1600 brass which is 35 Bar (500 PSI)
	Steel & Stainless Steel:	345 Bar (5000 PSI) for 200 thru 1020; 207 Bar (3000 PSI) for all other sizes
Return Check Poppet, Nominal Cracking Pressure	0.4 Bar (5 PSI)	
Poppets	Soft seal poppet in brass 200 - 820 sizes Solid metal 416 stainless steel poppet on all other sizes and styles	
Operating Temperature	-40°C to +121°C (-40°F to +250°F)	

Performance Curves

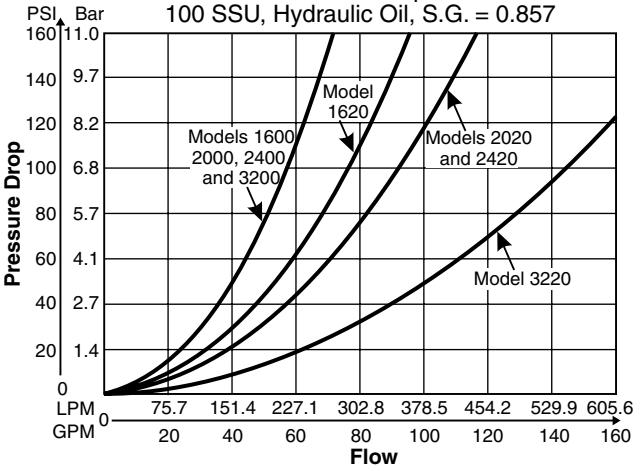
Controlled Flow vs. Pressure Drop
Needle Full Open
100 SSU, Hydraulic Oil, S.G. = 0.857



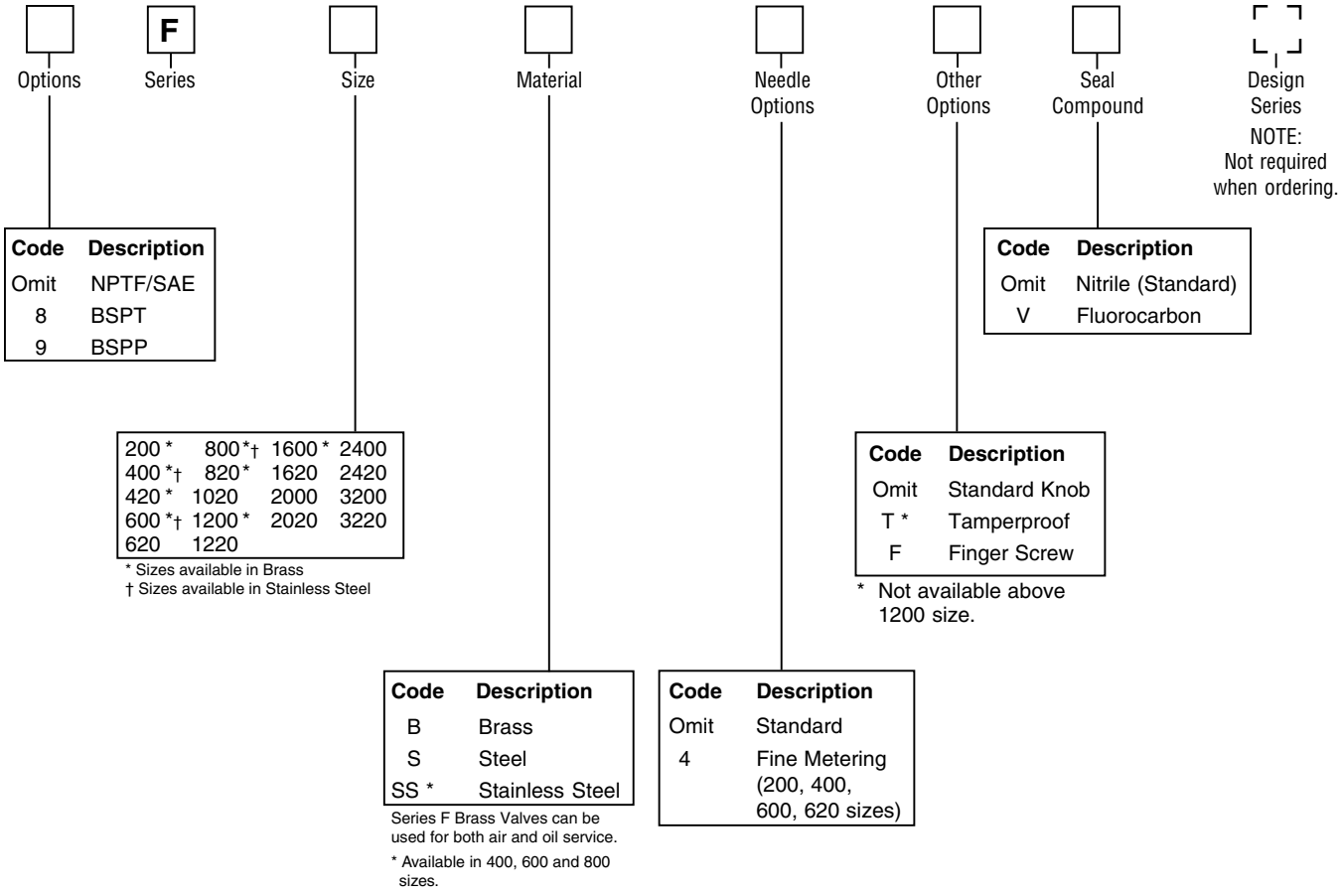
Controlled Flow vs. Pressure Drop
Needle Full Open
100 SSU, Hydraulic Oil, S.G. = 0.857



Controlled Flow vs. Pressure Drop
Needle Full Open
100 SSU, Hydraulic Oil, S.G. = 0.857



2502-F2.p65, dd



Code	Description
Omit	NPTF/SAE
8	BSPT
9	BSPP

200 *	800 *†	1600 *	2400
400 *†	820 *	1620	2420
420 *	1020	2000	3200
600 *†	1200 *	2020	3220
620	1220		

* Sizes available in Brass
† Sizes available in Stainless Steel

Code	Description
B	Brass
S	Steel
SS *	Stainless Steel

Series F Brass Valves can be used for both air and oil service.

* Available in 400, 600 and 800 sizes.

Code	Description
Omit	Standard
4	Fine Metering (200, 400, 600, 620 sizes)

Code	Description
Omit	Standard Knob
T *	Tamperproof
F	Finger Screw

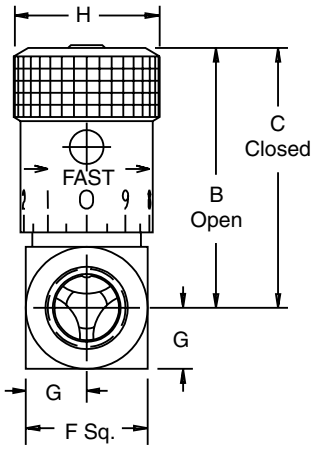
* Not available above 1200 size.

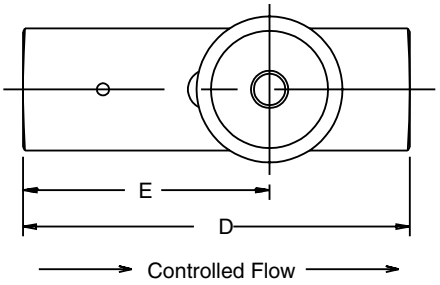
Code	Description
Omit	Nitrile (Standard)
V	Fluorocarbon

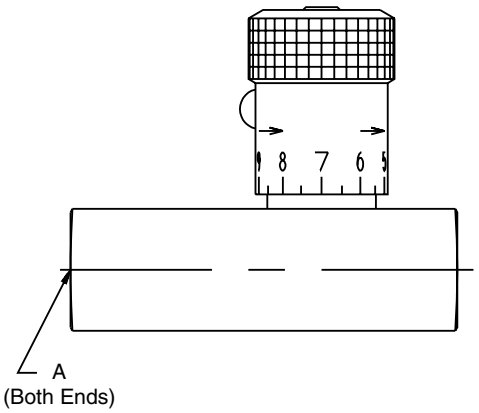
F

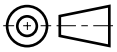
Model Number	Weight kg	(lbs.)	Model Number	Weight kg	(lbs.)
F200	0.1	(0.3)	F1220	1.2	(2.6)
F400	0.2	(0.5)	F1600	2.3	(5.1)
F420	0.2	(0.5)	F1620	2.3	(5.1)
F600	0.3	(0.7)	F2000	3.7	(8.1)
F620	0.3	(0.6)	F2020	3.7	(8.1)
F800	0.7	(1.5)	F2400	4.6	(10.2)
F820	0.5	(1.0)	F2420	4.6	(10.2)
F1020	0.8	(1.8)	F3200	7.9	(17.4)
F1200	1.2	(2.6)	F3220	7.9	(17.4)

Inch equivalents for millimeter dimensions are shown in (**)









F

Model Number	Max Flow LPM (GPM)	A	B	C	D	E	F	G	H
F200	11 (3)	1/8–27 NPTF	39.1 (1.54)	35.3 (1.39)	50.8 (2.00)	32.5 (1.28)	16.0 (0.63)	7.9 (0.31)	19.1 (0.75)
F400	19 (5)	1/4–18 NPTF	45.5 (1.79)	40.4 (1.59)	66.8 (2.63)	42.2 (1.66)	20.6 (0.81)	10.4 (0.41)	20.6 (0.81)
F420	11 (3)	7/16–20 UNF #4 SAE	41.4 (1.63)	37.6 (1.48)	68.3 (2.69)	42.9 (1.69)	20.6 (0.81)	10.4 (0.41)	19.1 (0.75)
F600	30 (8)	3/8–18 NPTF	55.4 (2.18)	49.5 (1.95)	69.9 (2.75)	44.5 (1.75)	25.4 (1.00)	12.7 (0.50)	25.4 (1.00)
F620	19 (5)	9/16–18 UNF #6 SAE	47.7 (1.88)	42.7 (1.68)	79.2 (3.12)	48.8 (1.92)	25.4 (1.00)	12.7 (0.50)	20.6 (0.81)
F800	57 (15)	1/2–14 NPTF	68.6 (2.70)	61.5 (2.42)	87.4 (3.44)	56.6 (2.23)	31.8 (1.25)	16.0 (0.63)	30.2 (1.19)
F820	30 (8)	3/4–16 UNF #8 SAE	56.9 (2.24)	51.1 (2.01)	88.9 (3.50)	53.8 (2.12)	28.4 (1.12)	14.2 (0.56)	25.4 (1.00)
F1020	57 (15)	7/8–14 UNF #10 SAE	68.6 (2.70)	61.5 (2.42)	101.6 (4.00)	65.0 (2.56)	31.8 (1.25)	15.7 (0.62)	30.2 (1.19)
F1200	95 (25)	3/4–14 NPTF	85.9 (3.38)	71.4 (2.81)	98.6 (3.88)	65.5 (2.58)	38.1 (1.50)	19.1 (0.75)	35.1 (1.38)
F1220	95 (25)	1 1/6–12 UN #12 SAE	85.9 (3.38)	71.4 (2.81)	117.3 (4.62)	76.5 (3.01)	38.1 (1.50)	19.1 (0.75)	35.1 (1.38)
F1600	151 (40)	1–11 1/2 NPTF	123.7 (4.87)	106.9 (4.21)	127.0 (5.00)	81.8 (3.22)	44.5 (1.75)	22.4 (0.88)	47.8 (1.88) *
F1620	151 (40)	1 5/16–12 UN #16 SAE	130.8 (5.15)	114.0 (4.49)	142.7 (5.62)	88.9 (3.50)	57.2 (2.25)	28.4 (1.12)	47.8 (1.88) *
F2000	265 (70)	11/4–11 1/2 NPTF	130.0 (5.12)	113.3 (4.46)	143.0 (5.63)	98.6 (3.88)	57.2 (2.25)	28.7 (1.13)	47.8 (1.88) *
F2020	265 (70)	1 5/8–12 UN #20 SAE	140.2 (5.52)	123.4 (4.86)	165.1 (6.50)	108.0 (4.25)	69.9 (2.75)	35.1 (1.38)	47.8 (1.88) *
F2400	379 (100)	1 1/2–11 1/2 NPTF	136.4 (5.37)	119.6 (4.71)	143.0 (5.63)	113.5 (4.47)	69.9 (2.75)	35.1 (1.38)	47.8 (1.88) *
F2420	379 (100)	1 7/8–12 UN-2B #24 SAE	143.5 (5.65)	126.7 (4.99)	184.2 (7.25)	127.0 (5.00)	76.2 (3.00)	38.1 (1.50)	47.8 (1.88) *
F3200	568 (150)	2–11 1/2 NPTF	146.1 (5.75)	129.3 (5.09)	165.1 (6.50)	134.9 (5.31)	88.9 (3.50)	44.5 (1.75)	47.8 (1.88) *
F3220	568 (150)	2 1/2–12 UN #32 SAE	163.6 (6.44)	139.4 (5.49)	228.6 (9.00)	155.7 (6.13)	101.6 (4.00)	50.8 (2.00)	47.8 (1.88) *

* = Hex

2502-F2.p65, dd

Parker Heavy Duty Hydraulic Cylinders

Series 2H

Exclusive with the Parker Stepped Cushion for increased performance and productivity

- **Faster cycle time**
- **Reduced hydraulic shock**
- **Reduced machine noise**
- **Lower machine maintenance**

- **Heavy Duty Service – Industrial Tie-Rod Construction**
- **Nominal Pressure – 3000 PSI**
- **Standard Bore Sizes – 1-1/2" through 6"**
- **Piston Rod Diameters – 5/8" through 4"**
- **18 Standard Mounting Styles**

For Cylinder Division Plant Locations – See Page II.

Series 2H
Heavy Duty Hydraulic Cylinders

Standard Specifications

- Heavy Duty Service – NFPA specifications and ANSI B93.15-1981 mounting dimension standards
- Standard Construction – Square Head – Tie Rod Design
- Nominal Pressure – 3000 P.S.I.*
- Standard Fluid – Hydraulic Oil
- Standard Temperature – -10½ F to +165½ F**
- Bore Sizes – 1½" through 6" (Larger sizes available)
- Piston Rod Diameter – ⅝" through 4"
- Mounting Styles – 18 standard styles at various application ratings
- Strokes – Available in any practical stroke length
- Cushions – Optional at either end or both ends of stroke. "Float Check" at cap end.
- Rod Ends – Three Standard Choices – Specials to Order

*If hydraulic operating pressure exceeds 3000 P.S.I., send application data for engineering evaluation and recommendation. See section C, page 84 for actual design factors.

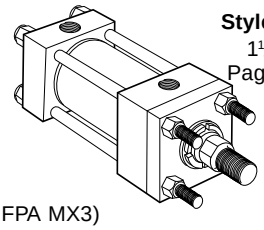
** See section C, page 83 for higher temperature service.

In line with our policy of continuing product improvement, specifications in this catalog are subject to change.

Note: Series 2H Hydraulic Cylinders fully meet N.F.P.A. Standards and ANSI Standard B93.15-1981 for Mounting Dimensions for Square Head Industrial Fluid Power Cylinders.

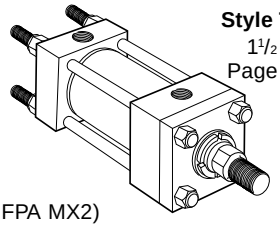
Available Mounting Styles

Tie Rods Extended Head End



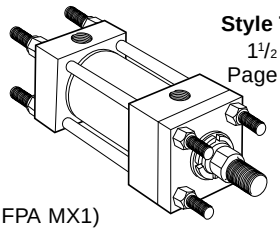
Style TB
1½-6"
Page 44
(NFPA MX3)

Tie Rods Extended Cap End



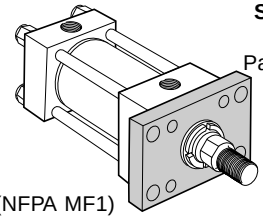
Style TC
1½-6"
Page 44
(NFPA MX2)

Tie Rods Extended Both Ends



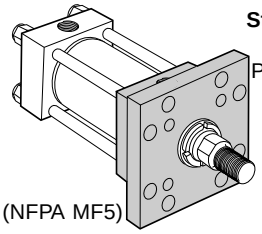
Style TD
1½-6"
Page 44
(NFPA MX1)

Head Rectangular Flange



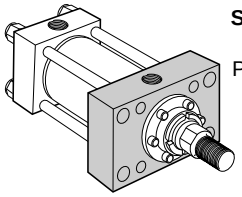
Style J
1½-6"
Page 46
(NFPA MF1)

Head Square Flange



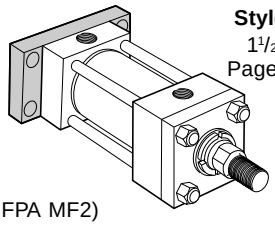
Style JB
1½-6"
Page 46
(NFPA MF5)

Head Rectangular



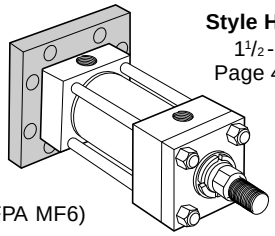
Style JJ
1½-6"
Page 46
(NFPA ME5)

Cap Rectangular Flange



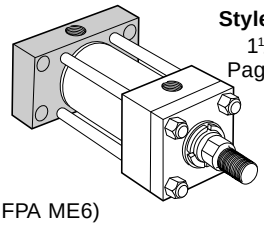
Style H
1½-6"
Page 48
(NFPA MF2)

Cap Square Flange



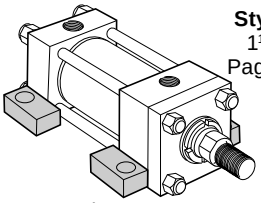
Style HB
1½-6"
Page 48
(NFPA MF6)

Cap Rectangular



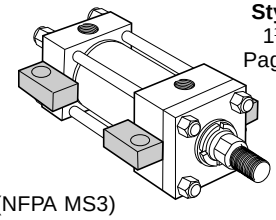
Style HH
1½-6"
Page 48
(NFPA ME6)

Side Lug



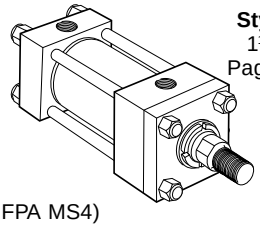
Style C
1½-6"
Page 50
(NFPA MS2)

Centerline Lugs



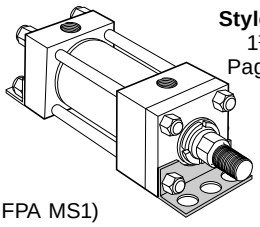
Style E
1½-6"
Page 50
(NFPA MS3)

Side Tapped



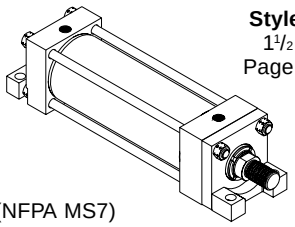
Style F
1½-6"
Page 50
(NFPA MS4)

Side End Angles



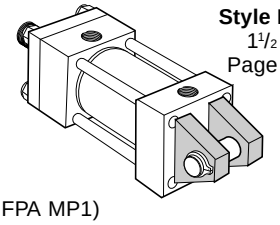
Style CB
1½-6"
Page 52
(NFPA MS1)

Side End Lugs



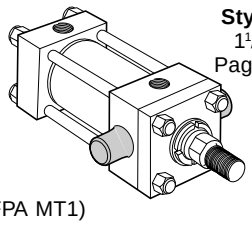
Style G
1½-6"
Page 52
(NFPA MS7)

Cap Fixed Clevis



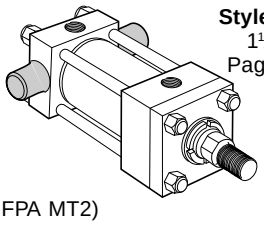
Style BB
1½-6"
Page 52
(NFPA MP1)

Head Trunnion



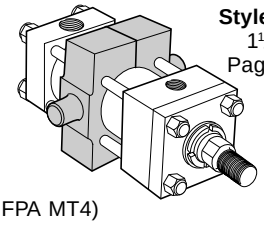
Style D
1½-6"
Page 54
(NFPA MT1)

Cap Trunnion



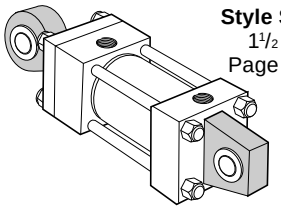
Style DB
1½-6"
Page 54
(NFPA MT2)

Intermediate Fixed Trunnion



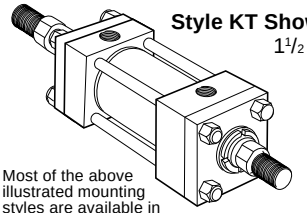
Style DD
1½-6"
Page 54
(NFPA MT4)

Spherical Bearing



Style SB
1½-6"
Page 56

Double Rod Cylinders



Style KT Shown
1½-6"

Most of the above illustrated mounting styles are available in double rod cylinders. See Catalog Page 58.

For Cylinder Division Plant Locations – See Page II.

Parker
Cylinder

B

The inside story on why series 2H is your best choice in heavy duty hydraulic cylinders

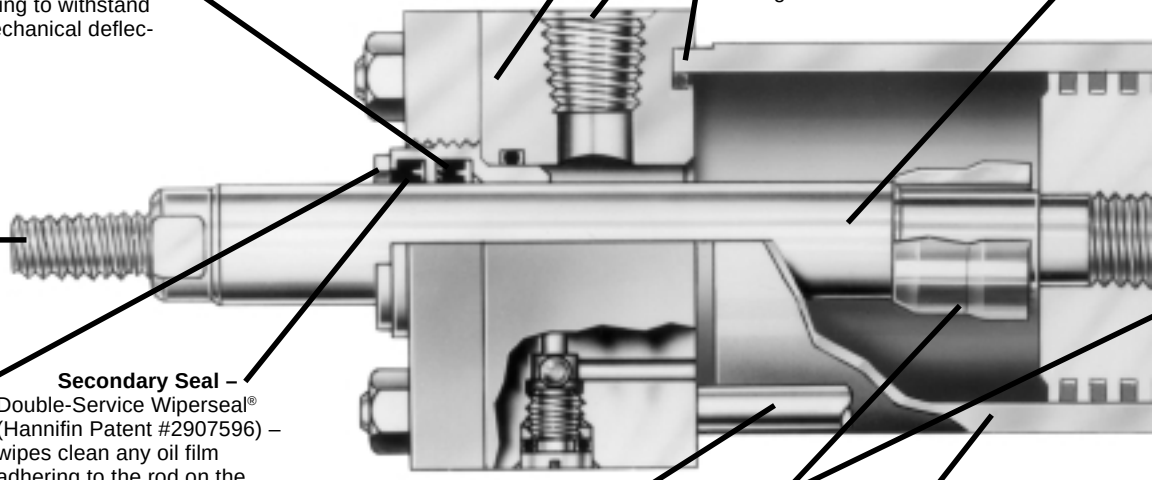
Steel Head – Bored and grooved to provide concentricity for mating parts.

Ports – S.A.E. "O" ring ports are standard.

End Seals – Pressure-actuated cylinder body-to-head and cap "O" rings.

Primary Seal – New TS-2000 Rod Seal is a proven leakproof design – completely self-compensating and self-relieving to withstand variations and conform to mechanical deflection that may occur.

Piston Rod Stud – Furnished on 2" diameter rods and smaller when standard style #4 rod end threads are required or on $1^{3}/_{8}$" diameter rods and smaller when style #8 threads are required. Also available in 2 times the catalog "A" dimension length. Studs have rolled threads and are made from high strength steel. Anaerobic adhesive is used to permanently lock the stud to the piston rod.

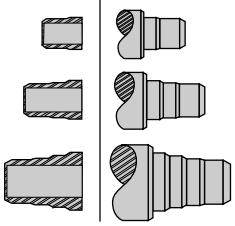


"Jewel" Rod Gland Assembly – Externally removable without cylinder disassembly. Long bearing surface is inboard of the seals, assuring positive lubrication from within the cylinder. An "O" ring is used as a seal between gland and head, and also serves as a prevailing torque-type lock.

Secondary Seal – Double-Service Wiperseal® (Hannifin Patent #2907596) – wipes clean any oil film adhering to the rod on the extend stroke and cleans the rod on the return stroke.

Stepped Cushions

Sleeve Design | Spear Design



High Strength Tie Rods – Made from 100,000 psi minimum yield steel with rolled threads for added strength.

The Cylinder Body – Heavy-wall steel tubing, honed to a micro finish bore.

Adjustable Floating Stepped Cushions – For maximum performance – economical and flexible for even the most demanding applications – provides superior performance in reducing shock. Cushions are optional and can be supplied at head end, cap end, or both ends without change in envelope or mounting dimensions.

Parker's New, Exclusive
Stepped floating cushions combine the best features of known cushion technology.

Deceleration devices or built-in "cushions" are optional and can be supplied at head end, cap end, or both ends without change in envelope or mounting dimensions. Parker cylinder cushions are a stepped design and combine the best features of known cushion technology.

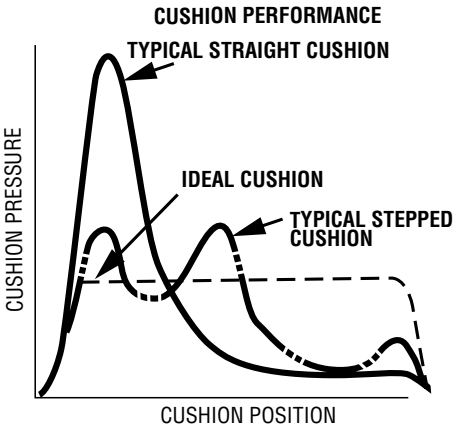
Standard straight or tapered cushions have been used in industrial cylinders over a very broad range of applications. Parker research has found that both designs have their limitations.

As a result, Parker has taken a new approach in cushioning of industrial hydraulic cylinders and for specific load and velocity conditions have been able to obtain deceleration curves that come very close to the ideal. The success lies in a stepped sleeve or spear concept where the steps are calculated to approximate theoretical orifice areas curves.

In the cushion performance chart, pressure traces show the results of typical orifice flow conditions. Tests of a three-step sleeve or spear show three pressure pulses coinciding with the steps. The deceleration cushion plunger curves shape comes very close to being theoretical, with the exception of the last $^{1}/_{2}$ inch of travel. This is a constant shape in order to have some flexibility in application. The stepped cushion design shows reduced pressure peaks for most load and speed conditions, with comparable reduction of objectionable stopping forces being transmitted to the load and the support structure.

All Parker Hannifin cushions are adjustable.

The Series 2H cylinder design incorporates the longest cushion sleeve and cushion spear that can be provided in the standard envelope without decreasing the rod bearing and piston bearing strengths.



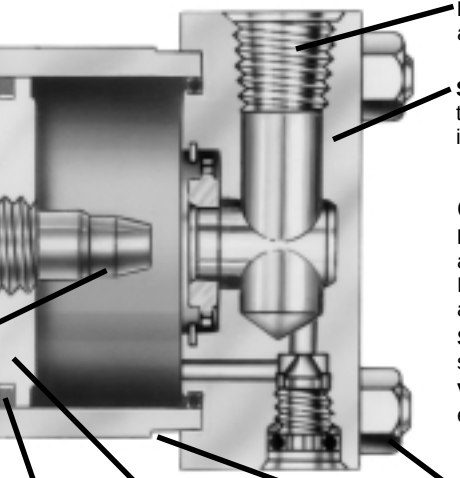
(1) When a cushion is specified at the head end:

a. A self-centering stepped sleeve is furnished on the piston rod assembly.

b. A needle valve is provided that is flush with the side of the

For additional information – call your local Parker Cylinder Distributor.

Piston Rod – Medium carbon steel, induction case-hardened to 54 R_c, hard chrome-plated and polished to 10 RMS finish. Piston rods are made from 90,000 to 100,000 psi minimum yield material in $^5/_8$" through 4" diameters. Larger diameters vary between 57,000 and 90,000 psi minimum material, depending on rod diameter. The piston thread equals the catalog style #4 rod end thread for each rod diameter to assure proper piston-to-rod thread strength. Two wrench flats are provided for rod end attachment.



Ports – S.A.E. "O" ring ports are standard.

Steel Cap – Bored and grooved to provide concentricity for mating parts.

Optional Ports

Ports – N.P.T.F. ports are optional at no extra charge. Oversize N.P.T.F. and S.A.E. ports are available at extra charge.

Seals – Buna-N (Nitrile) seals are standard.

Viton Seals – Optional at extra charge.

Alloy Steel Tie Rod Nuts

Align-A-Groove – (Patent #3043639) – A $^3/_{16}$" wide surface machined at each end of the cylinder body. Makes precise mounting quick and easy.

One-Piece Fine Grained Cast Iron Piston – The wide piston surface contacting cylinder bore reduces bearing loads, and a long thread engagement with rod provides greater shock absorption. Anaerobic adhesive is used to permanently lock and seal the piston to the rod.

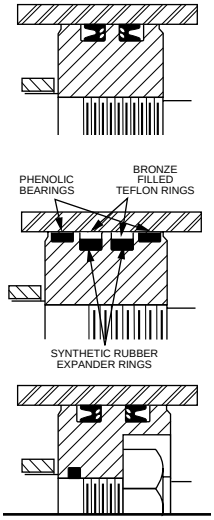
Step Cut Iron Piston Rings are standard.

The exclusive "Jewel" gland gives you longer cylinder life, better performance and lower costs.

An extra-long inboard bearing surface insures lubrication from within the cylinder. Outboard of the bearing surface are two leakproof seals – The TS-2000 and Wiperseal. The serrated TS-2000 (primary seal) is completely self-compensating and self-relieving. It adjusts to mechanical deflections or any pressure variation from near-zero to rated operating pressure. The result is positive, no-leak sealing – regardless of conditions.

The Wiperseal does double duty. On the advance stroke, it acts as a secondary pressure seal. On the return, it wipes away any dirt on the rod. This means less wear on bearing surfaces and internal parts. Longer life for working parts. And, less loss of fluid. Plus, you can replace a "Jewel" gland without removing the tie rods or the retainer. Just a few twists with a spanner wrench does the job.

Optional Pistons



Lipseal® Piston – Optional at no extra charge. Zero leakage under static conditions for hydraulic pressures up to 3000 psi. Seals are self-compensating to conform to variations in pressure, mechanical deflection, and wear. Back-up washers prevent extrusion.

Hi Load Piston – Optional at extra charge. Includes wear rings and bronze-filled teflon seals. Two wear rings serve as bearings which deform radially under side-loading, enabling the load to be spread over a larger area and reduce unit loading. Bronze-filled teflon seals are designed for extrusion-free, leak-proof service and longer cylinder life than the lipseal type piston.

Nut Retained Piston – Optional at extra charge.

B

head even when wide open. It may be identified by the fact that it is socket-keyed. It is located on side number 2, in all mounting styles except D, DB, DD, JJ, HH and E. In these styles it is located on side number 3.

c. On 5" bore and larger cylinders (except for $2^1/_2$" bore with code 2 rod), a springless check valve is provided that is also flush with the side of the head and is mounted adjacent to the needle valve except on mounting style C, where it is mounted opposite the needle valve. It may be identified by the fact that it is slotted.

d. On $1^1/_2$" - 4" bore cylinders a slotted sleeve design is used in place of the check valve.

e. $1^1/_2$" - 2" bore cylinders use a cartridge style needle valve (see Figure A).

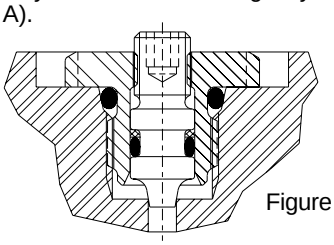


Figure A

(2) When a cushion is specified at the cap end:

a. A cushion stepped spear is provided on the piston rod.

b. A "float check" self-centering bushing is provided which incorporates a large flow check valve for fast "out-stroke" action.

c. A socket-keyed needle valve is provided that is flush with the side of the cap when wide open. It is located on side number 2 in all mounting styles except D, DB, DD, JJ, HH and E. In these styles it is located on side number 3.

Cushion Length

Cyl. Bore In.	Rod Dia. In.	Rod No.	Cushion Length – Inch	
			Head*	Cap
$1^1/_2$	$^5/_8$	1	$1^1/_8$	$1^3/_{16}$
	1	2	$1^1/_8$	$1^3/_{16}$
2	1	1	$1^1/_8$	$1^1/_8$
	$1^3/_8$	2	$1^1/_8$	$1^1/_8$
$2^1/_2$	1	1	$1^1/_8$	$1^1/_8$
	$1^3/_4$	2	$1^1/_8$	$1^1/_8$
$3^1/_4$	$1^3/_8$	1	$1^3/_8$	$1^5/_{16}$
	2	2	$1^1/_{16}$	$1^5/_{16}$
4	$1^3/_4$	1	$1^3/_8$	$1^1/_4$
	$2^1/_2$	2	$1^1/_{16}$	$1^1/_4$
5	2	1	$1^1/_{16}$	$1^1/_8$
	$3^1/_2$	2	$1^1/_{16}$	$1^1/_8$

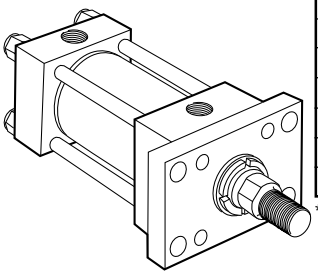
Cyl. Bore In.	Rod Dia. In.	Rod No.	Cushion Length – Inch	
			Head*	Cap
6	$2^1/_2$	1	$1^5/_{16}$	$1^1/_2$
	4	2	$1^5/_{16}$	$1^1/_2$
7	3	1	$1^{13}/_{16}$	$1^{15}/_{16}$
	5	2	$1^{11}/_{16}$	$1^{15}/_{16}$
8	$3^1/_2$	1	$2^1/_{16}$	2
	$5^1/_2$	2	$1^{15}/_{16}$	2

*Head end cushions for rod diameters not listed have cushion lengths with the limits shown.

For Cylinder Division Plant Locations – See Page II.

Series 2H
Heavy Duty Hydraulic Cylinders

Head Rectangular Flange Mounting Style J
(NFPA Style MF1)

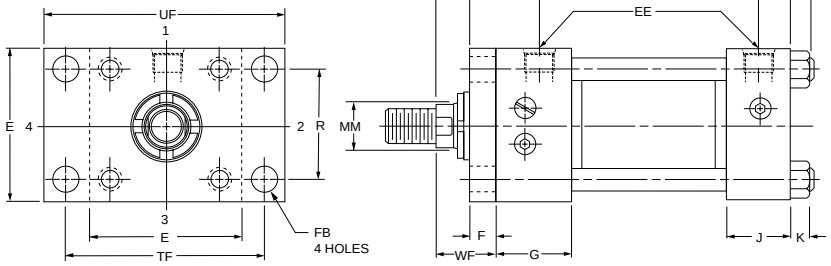


For Style "J" Mount

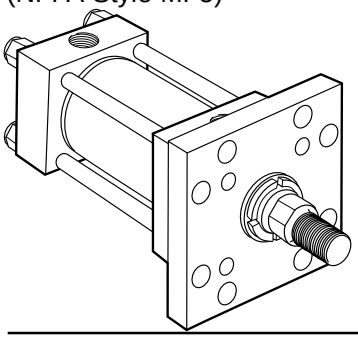
Bore Size	Max. PSI — Push* Rod Code 1	2	3	4	5
1½	2500	1500	—	—	—
2	2500	1500	—	—	—
2½	2500	1500	1900	—	—
3¼	2500	1500	2100	—	—
4	2500	1500	1800	—	—
5	2200	750	1650	1200	—
6	1800	750	1450	1100	—

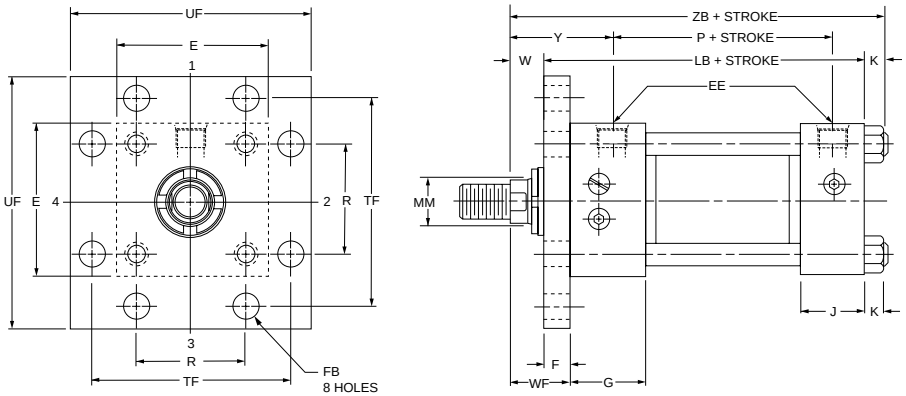
*Maximum pressure rating — push application.

For pressures exceeding those shown use mounting styles JB or JJ.

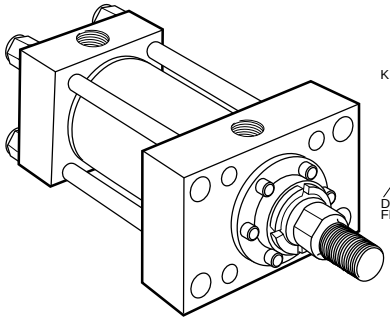


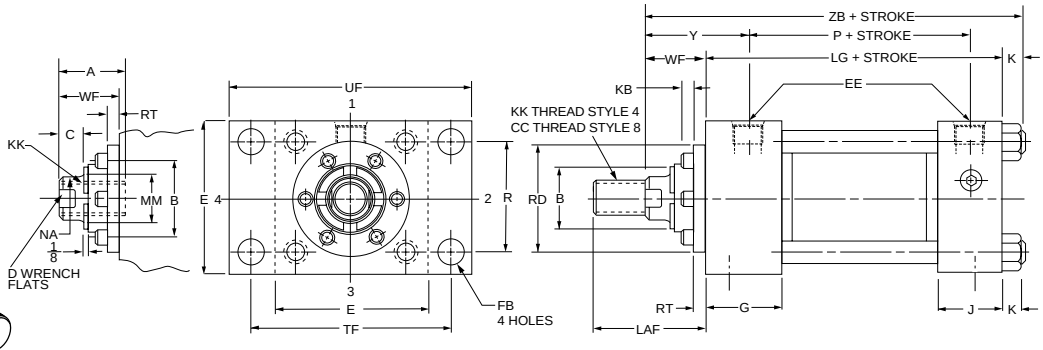
Head Square Flange Mounting Style JB
(NFPA Style MF5)





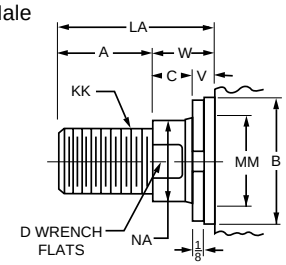
Head Rectangular Mounting Style JJ
(NFPA Style ME5)





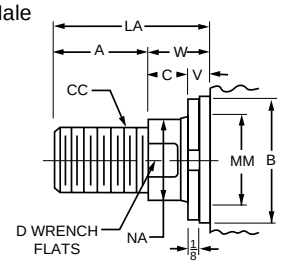
Rod End Dimensions — see table 2

Thread Style 4
(NFPA Style SM)
Small Male



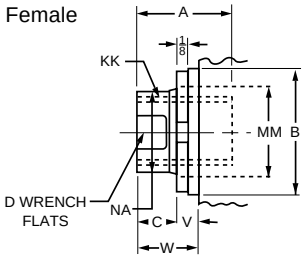
A high strength rod end stud is supplied on thread style 4 through 2" diameter rods and on thread style 8 through 1⅜" diameter rods. Larger sizes or special rod ends are cut threads. Style 4 rod ends are recommended where the workpiece is secured against the rod shoulder.

Thread Style 8
(NFPA Style IM)
Intermediate Male



When the workpiece is not shouldered, style 4 rod ends are recommended through 2" piston rod diameters and style 8 rod ends are recommended on larger diameters. Use style 9 for applications where female rod end threads are required. If rod end is not specified, style 4 will be supplied.

Thread Style 9
(NFPA Style SF)
Small Female



"Special" Thread Style 3

Special thread, extension, rod eye, blank, etc., are also available.

To order, specify "Style 3" and give desired dimensions for CC or KK, A and LA. If otherwise special, furnish dimensioned sketch.

For additional information – call your local Parker Cylinder Distributor.

Table 1—Envelope and Mounting Dimensions

Bore	E	EE NPTF⊖	EE SAE★	F	FB	G	J	K	R	TF	UF	Add Stroke LB	Add Stroke LG	Add Stroke P
1½	2½	½	10	⅜	7/16	1¾	1½	⅜	1.63	3 7/16	4¼	5	4 5/8	2 7/8
2	3	½	10	⅝	9/16	1¾	1½	7/16	2.05	4⅛	5⅛	5¼	4 5/8	2 7/8
2½	3½	½	10	⅝	9/16	1¾	1½	7/16	2.55	4 5/8	5 5/8	5 3/8	4¾	3
3¼	4½	¾	12	¾	11/16	2	1¾	9/16	3.25	5⅞	7⅛	6¼	5½	3½
4	5	¾	12	⅞	11/16	2	1¾	9/16	3.82	6⅜	7 5/8	6 5/8	5¾	3¾
5	6½	¾	12	⅞	15/16	2	1¾	13/16	4.95	8 3/16	9¾	7⅛	6¼	4¼
6	7½	1	16	1	1 1/16	2¼	2¼	⅞	5.73	9 7/16	11¼	8⅜	7⅜	4 7/8

★ SAE straight thread ports are standard and are indicated by port number.
⊖ NPTF ports are available at no extra charge.

B

Table 3 — Envelope and Mounting Dimensions

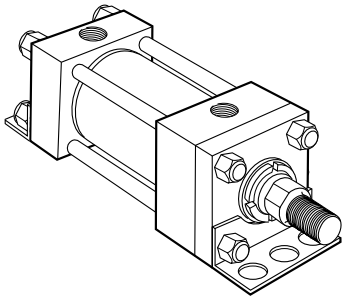
Table 2—Rod Dimensions

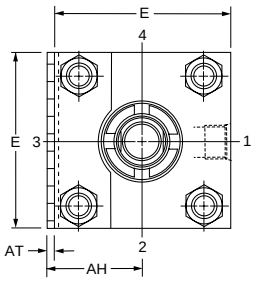
Bore	Rod No.	Rod Dia. MM	Thread Style 8 CC	Thread Style 4 & 9 KK	Rod Extensions and Pilot Dimensions A	+.000 -.002 B	C	D	KB	LA	LAF	NA	V	W	RD	RT	WF	Y	Add Stroke ZB
1½	1(Std.)	⅝	½-20	7/16-20	¾	1.124	⅜	½	0	1⅜	1¾	9/16	¼	⅝	2⅛	⅜	1	2	6
	2	1	⅞-14	¾-16	1⅛	1.499	½	⅞	0	2⅛	2½	15/16	½	1	2½	⅜	1 3/8	2 3/8	6 3/8
2	1(Std.)	1	⅞-14	¾-16	1⅛	1.499	½	⅞	0	1⅞	2½	15/16	¼	¾	2½	⅜	1 3/8	2 3/8	6 7/16
	2	1⅜	1¼-12	1-14	1⅝	1.999	⅝	1⅛	¼	2⅝	3¼	1 5/16	⅜	1	3	⅜	1 5/8	2 5/8	6 11/16
2½	1(Std.)	1	⅞-14	¾-16	1⅛	1.499	½	⅞	0	1⅞	2½	15/16	¼	¾	2½	⅜	1 3/8	2 3/8	6 9/16
	2	1¾	1½-12	1¼-12	2	2.374	¾	1½	¼	3¼	3⅞	1 11/16	½	1¼	3½	⅜	1⅞	2⅞	7 1/16
	3	1⅜	1¼-12	1-14	1⅝	1.999	⅝	1⅛	¼	2⅝	3¼	1 5/16	⅜	1	3	⅜	1 5/8	2 5/8	6 13/16
3¼	1(Std.)	1⅜	1¼-12	1-14	1⅝	1.999	⅝	1⅛	¼	2½	3¼	1 5/16	¼	⅞	3	⅜	1 5/8	2¾	7 11/16
	2	2	1¾-12	1½-12	2¼	2.624	⅞	1 11/16	⅛	3½	4¼	1 15/16	⅜	1¼	4	⅝	2	3⅛	8 1/16
	3	1¾	1½-12	1¼-12	2	2.374	¾	1½	¼	3⅛	3⅞	1 11/16	⅜	1⅛	3½	⅜	1⅞	3	7 15/16
4	1(Std.)	1¾	1½-12	1¼-12	2	2.374	¾	1½	¼	3	3⅞	1 11/16	¼	1	3½	⅜	1⅞	3	8 3/16
	2	2½	2¼-12	1⅞-12	3	3.124	1	2 1/16	¼	4⅜	5¼	2⅜	⅜	1⅜	4½	⅝	2¼	3⅜	8 9/16
	3	2	1¾-12	1½-12	2¼	2.624	⅞	1 11/16	⅛	3⅜	4¼	1 15/16	¼	1⅛	4	⅝	2	3⅛	8 5/16
5	1(Std.)	2	1¾-12	1½-12	2¼	2.624	⅞	1 11/16	⅛	3⅜	4¼	1 15/16	¼	1⅛	4	⅝	2	3⅛	9 1/16
	2	3½	3¼-12	2½-12	3½	4.249	1	3	¼	4⅞	5¾	3⅜	⅜	1⅜	5¾	⅝	2¼	3⅜	9 5/16
	3	2½	2¼-12	1⅞-12	3	3.124	1	2 1/16	¼	4⅜	5¼	2⅜	⅜	1⅜	4½	⅝	2¼	3⅜	9 5/16
	4	3	2¾-12	2¼-12	3½	3.749	1	2⅝	¼	4⅞	5¾	2⅞	⅜	1⅜	5¼	⅝	2¼	3⅜	9 5/16
6	1(Std.)	2½	2¼-12	1⅞-12	3	3.124	1	2 1/16	¼	4¼	5¼	2⅜	¼	1¼	4½	⅝	2¼	3½	10½
	2	4	3¾-12	3-12	4	4.749	1	3⅜	¼	5¼	6¼	3⅞	¼	1¼	6½	¾	2¼	3½	10½
	3	3	2¾-12	2¼-12	3½	3.749	1	2⅝	¼	4¾	5¾	2⅞	¼	1¼	5¼	⅝	2¼	3½	10½
	4	3½	3¼-12	2½-12	3½	4.249	1	3	¼	4¾	5¾	3⅜	¼	1¼	5¾	⅝	2¼	3½	10½

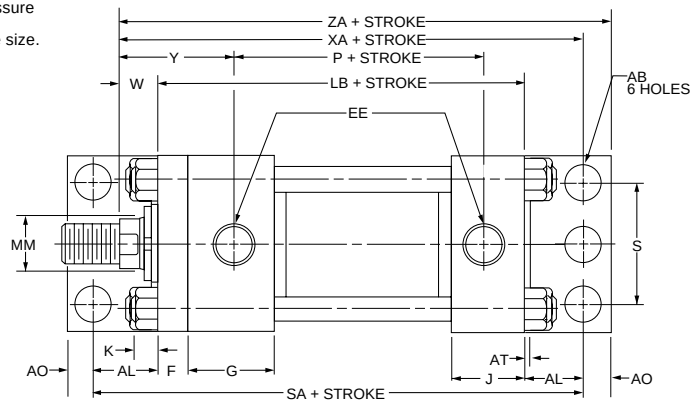
Series 2H
Heavy Duty Hydraulic Cylinders

Side End Angles Mounting Style CB
(NFPA Style MS1)

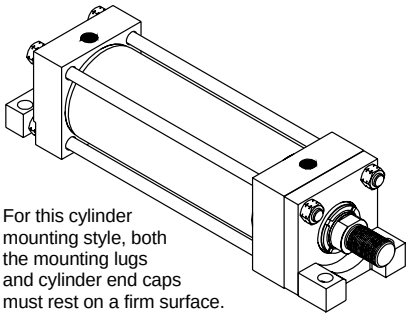
The maximum recommended operating pressure for Style CB is 500 psi. The recommended minimum stroke length is two times the bore size.



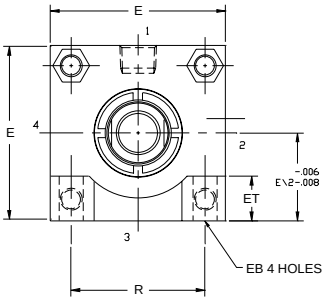


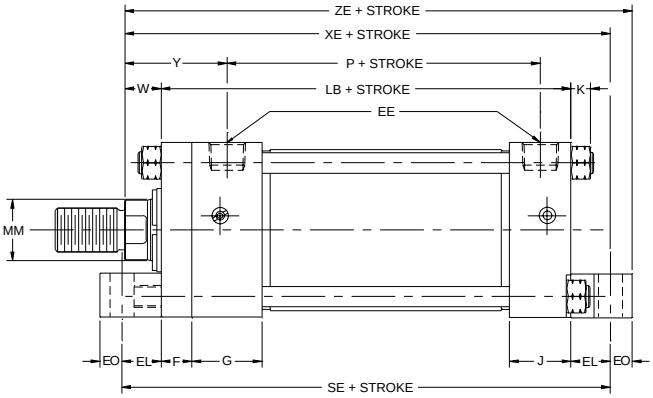


Side End Lugs Mounting Style G
(NFPA Style MS7)

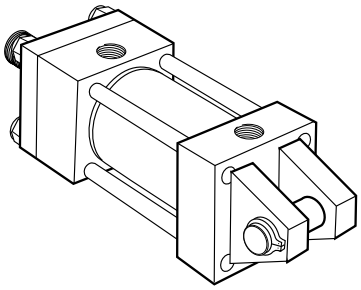


For this cylinder mounting style, both the mounting lugs and cylinder end caps must rest on a firm surface.

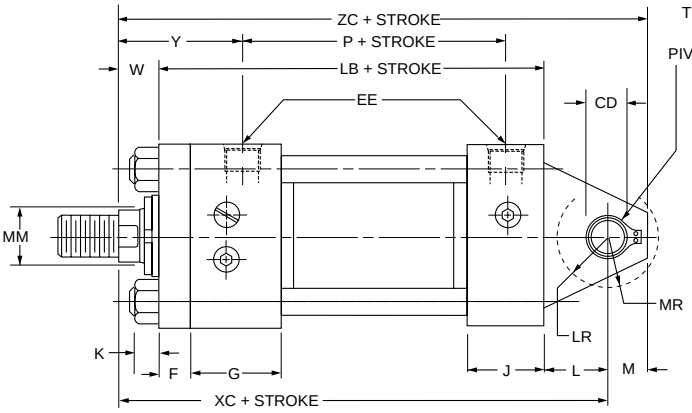


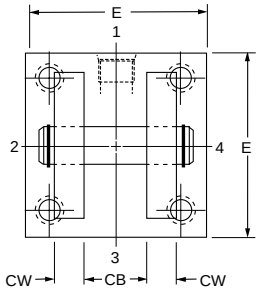


Cap Fixed Clevis Mounting Style BB
(NFPA Style MP1)



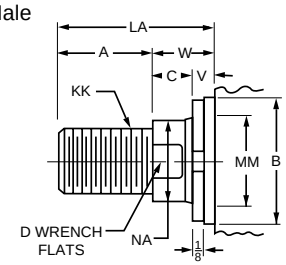
Tie rods thread into cap on all bore sizes.





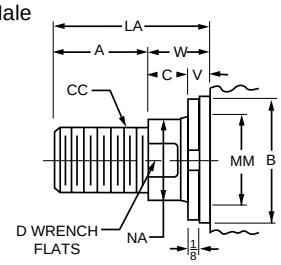
Rod End Dimensions — see table 2

Thread Style 4
(NFPA Style SM)
Small Male



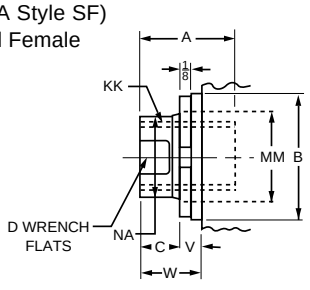
A high strength rod end stud is supplied on thread style 4 through 2" diameter rods and on thread style 8 through 1⅜" diameter rods. Larger sizes or special rod ends are cut threads. Style 4 rod ends are recommended where the workpiece is secured against the rod shoulder.

Thread Style 8
(NFPA Style IM)
Intermediate Male



When the workpiece is not shouldered, style 4 rod ends are recommended through 2" piston rod diameters and style 8 rod ends are recommended on larger diameters. Use style 9 for applications where female rod end threads are required. If rod end is not specified, style 4 will be supplied.

Thread Style 9
(NFPA Style SF)
Small Female



"Special" Thread Style 3

Special thread, extension, rod eye, blank, etc., are also available.

To order, specify "Style 3" and give desired dimensions for CC or KK, A and LA. If otherwise special, furnish dimensioned sketch.

For additional information – call your local Parker Cylinder Distributor.

Table 1—Envelope and Mounting Dimensions

Bore	AB	AH	AL	AO	AT	CB	+.000 -.002 CD*	CW	E	EB	EE ⊖NPTF	EE ★SAE	EL	EO	ES	ET	F	G	J	K	L	LR	M	MR	R	S	Add Stroke LB	P	SA	SE
1½	7/16	1 3/8	1	3/8	1/8	3/4	.501	1/2	2 1/2	7/16	1/2	10	7/8	3/8	7/8	3/4	3/8	1 3/4	1 1/2	3/8	3/4	9/16	1/2	5/8	1.63	1 3/4	5	2 7/8	7	6 3/4
2	9/16	1 11/16	1 1/4	1/2	1/8	1 1/4	.751	5/8	3	9/16	1/2	10	15/16	1/2	15/16	13/16	5/8	1 3/4	1 1/2	7/16	1 1/4	1	3/4	15/16	2.05	2	5 1/4	2 7/8	7 3/4	7 1/8
2½	11/16	1 15/16	1 3/16	9/16	1/8	1 1/4	.751	5/8	3 1/2	9/16	1/2	10	15/16	1/2	15/16	13/16	5/8	1 3/4	1 1/2	7/16	1 1/4	15/16	3/4	15/16	2.55	2 3/8	5 3/8	3	7 3/4	7 1/4
3¼	13/16	2 9/16	1 13/16	11/16	1/4	1 1/2	1.001	3/4	4 1/2	11/16	3/4	12	1 1/8	5/8	1 1/4	1 1/8	3/4	2	1 3/4	9/16	1 1/2	1 1/4	1	1 3/16	3.25	3 1/8	6 1/4	3 1/2	9 7/8	8 1/2
4	1 1/16	2 13/16	2 1/8	7/8	1/4	2	1.376	1	5	11/16	3/4	12	1 1/8	5/8	1 1/4	1 1/16	7/8	2	1 3/4	9/16	2 1/8	1 3/4	1 3/8	1 5/8	3.82	3 1/4	6 5/8	3 3/4	10 7/8	8 7/8
5	1 1/16	3 11/16	2 1/8	7/8	5/16	2 1/2	1.751	1 1/4	6 1/2	15/16	3/4	12	1 1/2	3/4	1 1/2	1 7/16	7/8	2	1 3/4	13/16	2 1/4	2 1/16	1 3/4	2 1/8	4.95	4 3/4	7 1/8	4 1/4	11 3/8	10 1/8
6	1 5/16	4 1/4	2 7/16	1 1/16	3/8	2 1/2	2.001	1 1/4	7 1/2	1 1/16	1	16	1 11/16	7/8	1 3/4	1 5/8	1	2 1/4	2 1/4	7/8	2 1/2	2 5/16	2	2 3/8	5.73	5 3/8	8 3/8	4 7/8	13 1/4	11 3/4

★ SAE straight thread ports are standard and are indicated by port number.
⊖ NPTF ports are available at no extra charge.
* Dimension CD is pin diameter.

Table 2—Rod Dimensions

Bore	Rod No.	Rod Dia. MM	Thread Style 8 CC	Thread Style 4 & 9 KK	Rod Extensions and Pilot Dimensions A	+.000 -.002 B	C	D	LA	NA	V	W	Y	Add Stroke XA	XC	XE	ZA	ZC	ZE
1½	1(Std.)	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	1 3/8	9/16	1/4	5/8	2	6 5/8	6 3/8	6 1/2	7	6 7/8	6 7/8
	2	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	2 1/8	15/16	1/2	1	2 3/8	7	6 3/4	6 7/8	7 3/8	7 1/4	7 1/4
2	1(Std.)	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	1 7/8	15/16	1/4	3/4	2 3/8	7 1/4	7 1/4	6 15/16	7 3/4	8	7 7/16
	2	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 5/8	1 5/16	3/8	1	2 5/8	7 1/2	7 1/2	7 3/16	8	8 1/4	7 11/16
2½	1(Std.)	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	1 7/8	15/16	1/4	3/4	2 3/8	7 5/16	7 3/8	7 1/16	7 7/8	8 1/8	7 9/16
	2	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/4	1 11/16	1/2	1 1/4	2 7/8	7 13/16	7 7/8	7 9/16	8 3/8	8 5/8	8 1/16
	3	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 5/8	1 5/16	3/8	1	2 5/8	7 9/16	7 5/8	7 5/16	8 1/8	8 3/8	7 13/16
3¼	1(Std.)	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 1/2	1 5/16	1/4	7/8	2 3/4	8 15/16	8 5/8	8 1/4	9 5/8	9 5/8	8 7/8
	2	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 1/2	1 15/16	3/8	1 1/4	3 1/8	9 5/16	9	8 5/8	10	10	9 1/4
	3	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/8	1 11/16	3/8	1 1/8	3	9 3/16	8 7/8	8 1/2	9 7/8	9 7/8	9 1/8
4	1(Std.)	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3	1 11/16	1/4	1	3	9 3/4	9 3/4	8 3/4	10 5/8	11 1/8	9 3/8
	2	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 3/8	2 3/8	3/8	1 3/8	3 3/8	10 1/8	10 1/8	9 1/8	11	11 1/2	9 3/4
	3	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 3/8	1 15/16	1/4	1 1/8	3 1/8	9 7/8	9 7/8	8 7/8	10 3/4	11 1/4	9 1/2
5	1(Std.)	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 3/8	1 15/16	1/4	1 1/8	3 1/8	10 3/8	10 1/2	9 3/4	11 1/4	12 1/4	10 1/2
	2	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	4 7/8	3 3/8	3/8	1 3/8	3 3/8	10 5/8	10 3/4	10	11 1/2	12 1/2	10 3/4
	3	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 3/8	2 3/8	3/8	1 3/8	3 3/8	10 5/8	10 3/4	10	11 1/2	12 1/2	10 3/4
	4	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	4 7/8	2 7/8	3/8	1 3/8	3 3/8	10 5/8	10 3/4	10	11 1/2	12 1/2	10 3/4
6	1(Std.)	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 1/4	2 3/8	1/4	1 1/4	3 1/2	12 1/16	12 1/8	11 5/16	13 1/8	14 1/8	12 3/16
	2	4	3 3/4-12	3-12	4	4.749	1	3 3/8	5 1/4	3 7/8	1/4	1 1/4	3 1/2	12 1/16	12 1/8	11 5/16	13 1/8	14 1/8	12 3/16
	3	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	4 3/4	2 7/8	1/4	1 1/4	3 1/2	12 1/16	12 1/8	11 5/16	13 1/8	14 1/8	12 3/16
	4	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	4 3/4	3 3/8	1/4	1 1/4	3 1/2	12 1/16	12 1/8	11 5/16	13 1/8	14 1/8	12 3/16

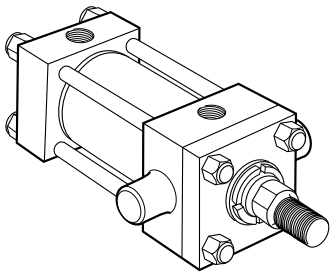
Caution: When using mounting styles CB and G, check clearance between mounting members and rod attachment or accessory. If necessary, specify longer rod extension to avoid interference with mounting members.

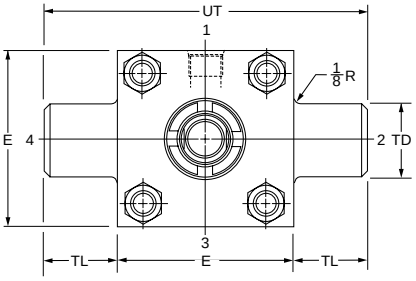
Table 3 — Envelope and Mounting Dimensions

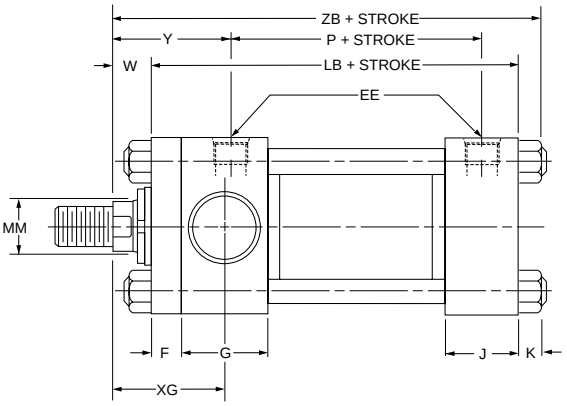
B

Series 2H
Heavy Duty Hydraulic Cylinders

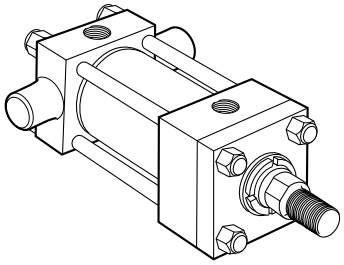
Head Trunnion Mounting
Style D
(NFPA Style MT1)

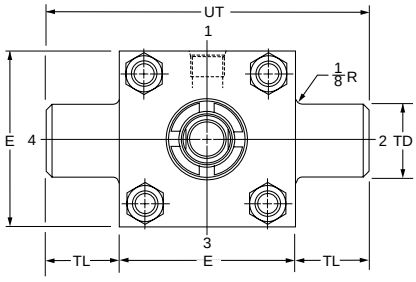


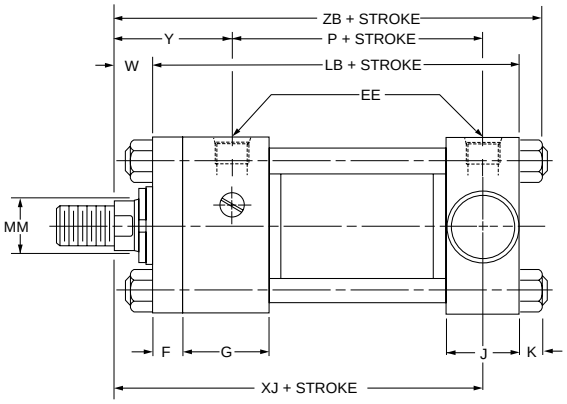




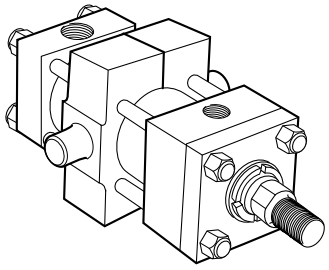
Cap Trunnion Mounting
Style DB
(NFPA Style MT2)

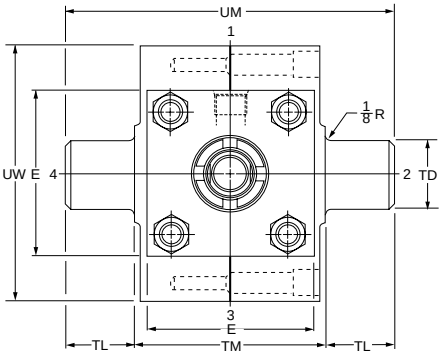


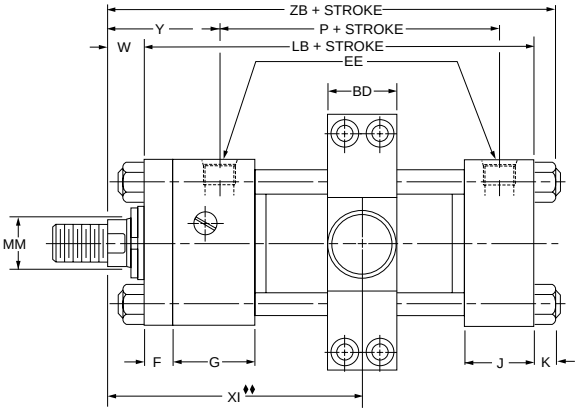




Intermediate Fixed Trunnion Mounting
Style DD
(NFPA Style MT4)

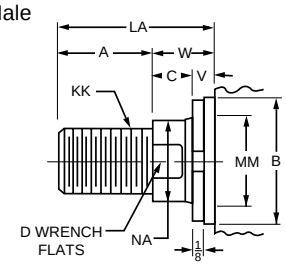






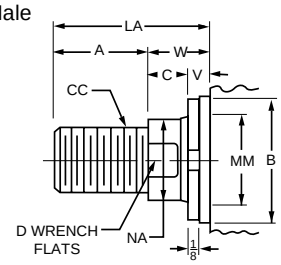
Rod End Dimensions — see table 2

Thread Style 4
(NFPA Style SM)
Small Male



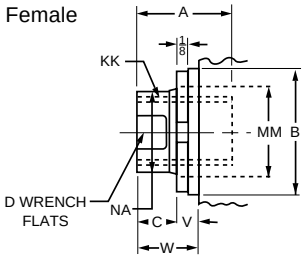
A high strength rod end stud is supplied on thread style 4 through 2" diameter rods and on thread style 8 through 1⅜" diameter rods. Larger sizes or special rod ends are cut threads. Style 4 rod ends are recommended where the workpiece is secured against the rod shoulder.

Thread Style 8
(NFPA Style IM)
Intermediate Male



When the workpiece is not shouldered, style 4 rod ends are recommended through 2" piston rod diameters and style 8 rod ends are recommended on larger diameters. Use style 9 for applications where female rod end threads are required. If rod end is not specified, style 4 will be supplied.

Thread Style 9
(NFPA Style SF)
Small Female



"Special" Thread Style 3

Special thread, extension, rod eye, blank, etc., are also available.

To order, specify "Style 3" and give desired dimensions for CC or KK, A and LA. If otherwise special, furnish dimensioned sketch.

For additional information – call your local Parker Cylinder Distributor.

Table 1—Envelope and Mounting Dimensions

Bore	BD	E	EE NPTF⊖	EE SAE★	F	G	J	K	+.000 -.001 TD	TL	TM	UM	UT	UW	Add Stroke LB	Add Stroke P	Style DD Minimum Stroke
1½	1 1/4	2½	1/2	10	3/8	1 3/4	1½	3/8	1.000	1	3	5	4½	3 3/8	5	2 7/8	0
2	1½	3	1/2	10	5/8	1 3/4	1½	7/16	1.375	1 3/8	3 1/2	6 1/4	5 3/4	4 1/8	5 1/4	2 7/8	1/4
2½	1½	3½	1/2	10	5/8	1 3/4	1½	7/16	1.375	1 3/8	4	6 3/4	6 1/4	4 5/8	5 3/8	3	1/8
3¼	2	4½	3/4	12	3/4	2	1 3/4	9/16	1.750	1 3/4	5	8 1/2	8	5 13/16	6 1/4	3 1/2	3/8
4	2	5	3/4	12	7/8	2	1 3/4	9/16	1.750	1 3/4	5 1/2	9	8 1/2	6 3/8	6 5/8	3 3/4	1/8
5	2	6½	3/4	12	7/8	2	1 3/4	13/16	1.750	1 3/4	7	10 1/2	10	7 3/4	7 1/8	4¼	0
6	3	7½	1	16	1	2 1/4	2¼	7/8	2.000	2	8½	12 1/2	11 1/2	10 3/8	8 3/8	4 7/8	1/4

★ SAE straight thread ports are standard and are indicated by port number.
⊖ NPTF ports are available at no extra charge.

Table 2—Rod Dimensions

Bore	Rod No.	Rod Dia. MM	Thread Style 8 CC	Thread Style 4 & 9 KK	Rod Extensions and Pilot Dimensions A	+.000 -.002 B	C	D	LA	NA	V	W
1½	1(Std.)	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	1 3/8	9/16	1/4	5/8
	2	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	2 1/8	15/16	1/2	1
2	1(Std.)	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	1 7/8	15/16	1/4	3/4
	2	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 5/8	1 5/16	3/8	1
2½	1(Std.)	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	1 7/8	15/16	1/4	3/4
	2	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/4	1 11/16	1/2	1 1/4
	3	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 5/8	1 5/16	3/8	1
3¼	1(Std.)	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 1/2	1 5/16	1/4	7/8
	2	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 1/2	1 15/16	3/8	1 1/4
	3	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/8	1 11/16	3/8	1 1/8
4	1(Std.)	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3	1 11/16	1/4	1
	2	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 3/8	2 3/8	3/8	1 3/8
	3	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 3/8	1 15/16	1/4	1 1/8
5	1(Std.)	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 3/8	1 15/16	1/4	1 1/8
	2	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	4 7/8	3 3/8	3/8	1 3/8
	3	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 3/8	2 3/8	3/8	1 3/8
	4	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	4 7/8	2 7/8	3/8	1 3/8
6	1(Std.)	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 1/4	2 3/8	1/4	1 1/4
	2	4	3 3/4-12	3-12	4	4.749	1	3 3/8	5 1/4	3 7/8	1/4	1 1/4
	3	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	4 3/4	2 7/8	1/4	1 1/4
	4	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	4 3/4	3 3/8	1/4	1 1/4

◆◆ Dimension XI to be specified by customer.

Table 3 — Envelope and Mounting Dimensions

Bore	XG	Min.◆◆ XI	Y	Add Stroke XJ	Add Stroke ZB
1½	1 7/8	3 7/16	2	4 7/8	6
	2 1/4	3 13/16	2 3/8	5 1/4	6 3/8
2	2 1/4	3 15/16	2 3/8	5 1/4	6 7/16
	2 1/2	4 3/16	2 5/8	5 1/2	6 11/16
2½	2 1/4	3 15/16	2 3/8	5 3/8	6 9/16
	2 3/4	4 7/16	2 7/8	5 7/8	7 1/16
	2 1/2	4 3/16	2 5/8	5 5/8	6 13/16
3¼	2 5/8	4 11/16	2 3/4	6 1/4	7 11/16
	3	5 1/16	3 1/8	6 5/8	8 1/16
	2 7/8	4 15/16	3	6 1/2	7 15/16
4	2 7/8	4 15/16	3	6 3/4	8 3/16
	3 1/4	5 5/16	3 3/8	7 1/8	8 9/16
	3	5 1/16	3 1/8	6 7/8	8 5/16
5	3	5 1/16	3 1/8	7 3/8	9 1/16
	3 1/4	5 5/16	3 3/8	7 5/8	9 5/16
	3 1/4	5 5/16	3 3/8	7 5/8	9 5/16
	3 1/4	5 5/16	3 3/8	7 5/8	9 5/16
6	3 3/8	6 1/16	3 1/2	8 3/8	10 1/2
	3 3/8	6 1/16	3 1/2	8 3/8	10 1/2
	3 3/8	6 1/16	3 1/2	8 3/8	10 1/2
	3 3/8	6 1/16	3 1/2	8 3/8	10 1/2

Series 2H
Heavy Duty Hydraulic Cylinders

Bore	Max. Op. PSI†
1½	1250
2	2200
2½	1450
3¼	1500
4	1850
5	2000
6	1800

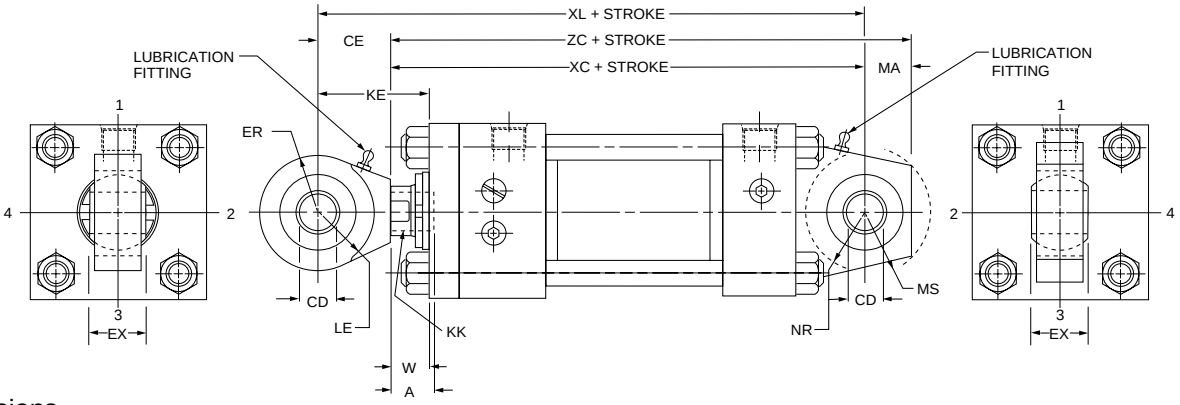


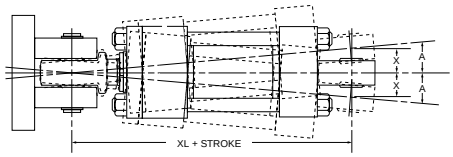
Table 1 — Dimensions

Bore	Rod No.	Rod Dia. MM	Thread Style 9 KK	Thread Style 7 KK	A	W	Add Stroke XC	Add Stroke XL	Add Stroke ZC	KE	CD*	CE	ER	EX	LE	MA	MS	NR
1½	1(Std.)	5/8	7/16-20	—	3/4	5/8	6 3/8	7 1/4	7 1/8	1 1/2	-.0005	7/8	13/16	7/16	3/4	3/4	15/16	5/8
	2	1	—	7/16-20	3/4	1	6 3/4	7 5/8	7 1/2	1 7/8	.5000							
2	1(Std.)	1	3/4-16	—	1 1/8	3/4	7 1/4	8 1/2	8 1/4	2	-.0005	1 1/4	1 1/8	21/32	1 1/16	1	1 3/8	1
	2	1 3/8	—	3/4-16	1 1/8	1	7 1/2	8 3/4	8 1/2	2 1/4	.7500							
2½	1(Std.)	1	3/4-16	—	1 1/8	3/4	7 3/8	8 5/8	8 3/8	2	-.0005	1 1/4	1 1/8	21/32	1 1/16	1	1 3/8	1
	2	1 3/4	—	3/4-16	1 1/8	1 1/4	7 7/8	9 1/8	8 7/8	2 1/2								
	3	1 3/8	—	3/4-16	1 1/8	1	7 5/8	8 7/8	8 5/8	2 1/4	.7500							
3¼	1(Std.)	1 3/8	1-14	—	1 5/8	7/8	8 5/8	10 1/2	9 7/8	2 3/4	-.0005	1 7/8	1 1/4	7/8	1 7/16	1 1/4	1 11/16	1 1/4
	2	2	—	1-14	1 5/8	1 1/4	9	10 7/8	10 1/4	3 1/8								
	3	1 3/4	—	1-14	1 5/8	1 1/8	8 7/8	10 3/4	10 1/8	3	1.0000							
4	1(Std.)	1 3/4	1 1/4-12	—	2	1	9 3/4	11 7/8	11 5/8	3 1/8	-.0005	2 1/8	1 11/16	1 3/16	1 7/8	1 7/8	2 7/16	1 5/8
	2	2 1/2	—	1 1/4-12	2	1 3/8	10 1/8	12 1/4	12	3 1/2								
	3	2	—	1 1/4-12	2	1 1/8	9 7/8	12	11 3/4	3 1/4	1.3750							
5	1(Std.)	2	1 1/2-12	—	2 1/4	1 1/8	10 1/2	13	13	3 5/8	-.0005	2 1/2	2 1/16	1 17/32	2 1/8	2 1/2	2 7/8	2 1/16
	2	3 1/2	—	1 1/2-12	2 1/4	1 3/8	10 3/4	13 1/4	13 1/4	3 7/8								
	3	2 1/2	—	1 1/2-12	2 1/4	1 3/8	10 3/4	13 1/4	13 1/4	3 7/8	1.7500							
	4	3	—	1 1/2-12	2 1/4	1 3/8	10 3/4	13 1/4	13 1/4	3 7/8								
6	1(Std.)	2 1/2	1 7/8-12	—	3	1 1/4	12 1/8	14 7/8	14 5/8	4	-.0005	2 3/4	2 1/2	1 3/4	2 1/2	2 1/2	3 5/16	2 3/8
	2	4	—	1 7/8-12	3	1 1/4	12 1/8	14 7/8	14 5/8	4								
	3	3	—	1 7/8-12	3	1 1/4	12 1/8	14 7/8	14 5/8	4								
	4	3 1/2	—	1 7/8-12	3	1 1/4	12 1/8	14 7/8	14 5/8	4	2.0000							

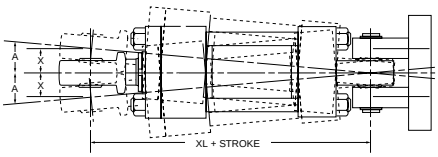
†Maximum operating pressure at 4:1 design factor is based on tensile strength of material. Pressure ratings are based on standard commercial bearing ratings.
Note: for additional dimensions see Series 2H Style BB mount.
Rod No. 1 is standard.
*Dimension "CD" is hole diameter.

Mounting Information

Head End Mounting



Cap End Mounting



Recommended maximum swivel angle on each side of the cylinder centerline.

Table 1

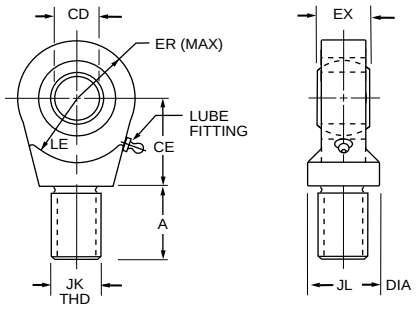
Bore	Head End Mounted Angle a	Head End Mounted Tan. of a	Cap End Mounted Angle a	Cap End Mounted Tan. of a
1½	2½	.035	2½	.035
2	2½½	.044	4½½	.079
2½	2½½	.044	4½½	.079
3¼	3½	.052	3½	.052
4	2½½	.044	3½	.052
5	3½	.052	3½	.052
6	3½	.052	3½	.052

Note: Dimension X is the maximum off center mounting of the cylinder. To determine dimension X for various stroke lengths multiply the distance between pivot pin holes by tangent of angle a. For extended position use X = XL times 2X stroke.

For additional information – call your local Parker Cylinder Distributor.

Parker offers a complete range of Cylinder Accessories to assure you of the greatest versatility in present or future cylinder applications. Accessories offered for the respective cylinder include the Rod Eye, Pivot Pin and Clevis Bracket. To select the proper part number for any desired accessory refer to the charts below.

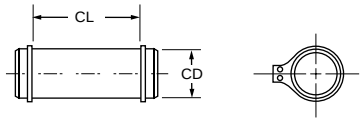
Spherical Rod Eye



Bore Sizes	Series 2H	1 1/2	2 & 2 1/2	3 1/4	4	5	6
Rod Eye	Part No.	132290	132291	132292	132293	132294	132295
	CD	.5000-0005	.7500-0005	1.0000-0005	1.3750-0005	1.7500-0005	2.0000-0005
	A	11/16	1	1 1/2	2	2 1/8	2 7/8
	CE	7/8	1 1/4	1 7/8	2 1/8	2 1/2	2 3/4
	EX	7/16	21/32	7/8	1 3/16	1 17/32	1 3/4
	ER	13/16	1 1/8	1 1/4	1 11/16	2 1/16	2 1/2
	LE	3/4	1 1/16	1 7/16	1 7/8	2 1/8	2 1/2
	JK	7/16-20	3/4-16	1-14	1 1/4-12	1 1/2-12	1 7/8-12
	JL	7/8	1 5/16	1 1/2	2	2 1/4	2 3/4
	LOAD CAPACITY LBS.	2644	9441	16860	28562	43005	70193

Order to fit Piston Rod Thread Size.

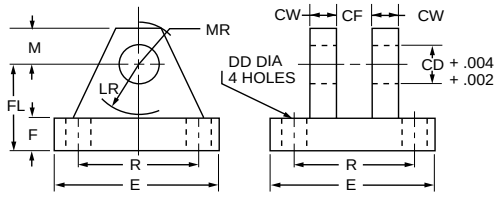
Pivot Pin



Bore Sizes	Series 2H	1 1/2	2 & 2 1/2	3 1/4	4	5	6
Pivot Pin	Part No.	83962	83963	83964	83965	83966	83967
	CD	.4997-0004	.7497-0005	.9997-0005	1.3746-0006	1.7496-0006	1.9996-0007
	CL	1 9/16	2 1/32	2 1/2	3 5/16	4 7/32	4 15/16
	SHEAR CAPACITY LBS.	8600	19300	34300	65000	105200	137400

Pivot Pins are furnished with
(2) Retainer Rings.

Clevis Bracket

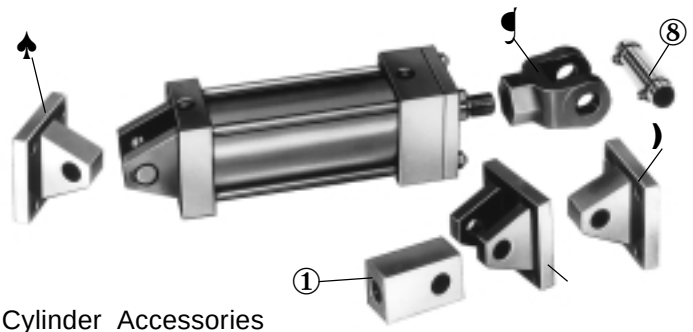


Bore Sizes	Series 2H	1 1/2	2 & 2 1/2	3 1/4	4	5	6
Clevis Bracket	Part No.	83947	83948	83949	83950	83951	83952
	CD	1/2	3/4	1	1 3/8	1 3/4	2
	CF	7/16	21/32	7/8	1 3/16	1 17/32	1 3/4
	CW	1/2	5/8	3/4	1	1 1/4	1 1/2
	DD	13/32	17/32	17/32	21/32	29/32	29/32
	E	3	3 3/4	5 1/2	6 1/2	8 1/2	10 5/8
	F	1/2	5/8	3/4	7/8	1 1/4	1 1/2
	FL	1 1/2	2	2 1/2	3 1/2	4 1/2	5
	LR	15/16	1 3/8	1 11/16	2 7/16	2 7/8	3 5/16
	M	1/2	7/8	1	1 3/8	1 3/4	2
	MR	5/8	1	1 3/16	1 5/8	2 1/16	2 3/8
	R	2.05	2.76	4.10	4.95	6.58	7.92
	LOAD CAPACITY LBS.	5770	9450	14300	20322	37800	50375

Order to fit Mounting Plate or
Rod Eye.

B

Series 2H
Heavy Duty Hydraulic Cylinders



Cylinder Accessories

Parker offers a complete range of cylinder accessories to assure you of greatest versatility in present or future cylinder applications.

Rod End Accessories

Accessories offered for the rod end of the cylinder include Rod Clevis, Eye Bracket, Knuckle, Clevis Bracket and Pivot Pin. To select the proper part number for any desired accessory, refer to Chart A below and look opposite the thread size of the rod end as indicated in the first column. The Pivot Pins, Eye Brackets and Clevis Brackets are listed opposite the thread size which their mating Knuckles or Clevises fit.

Chart A

Thread Size	Mating Parts			Mating Parts			Alignment Coupler
	Rod Clevis	Eye Bracket	Pin	Knuckle	Clevis Bracket	Pin	
5/16-24	51221	74077	—	74075	74076	74078	144500-0105
7/16-20	50940	69195	68368	69089	69205	68368	144500-0107
1/2-20	50941	69195	68368	69090	69205	68368	144500-0108
3/4-16	50942	69196	68369	69091	69206	68369	144500-0112
3/4-16	133284	69196	68369	69091	69206	68369	144500-0112
7/8-14	50943	*85361	68370	69092	69207	68370	144500-0114
1-14	50944	*85361	68370	69093	69207	68370	144500-0116
1-14	133285	*85361	68370	69093	69207	68370	144500-0116
1 1/4-12	50945	69198	68371	69094	69208	68371	144500-0120
1 1/4-12	133286	69198	68371	69094	69208	68371	144500-0120
1 1/2-12	50946	*85362	68372	69095	69209	68372	Consult Factory
1 3/4-12	50947	*85363	68373	69096	69210	69215	
1 7/8-12	50948	*85363	68373	69097	69210	69215	
2 1/4-12	50949	*85364	68374	69098	69211	68374	
2 1/2-12	50950	*85365	68375	69099	69212	68375	
2 3/4-12	50951	*85365	68375	69100	69213	69216	
3 1/4-12	50952	73538	73545	73536	73542	73545	
3 1/2-12	50953	73539	73547	73437	73542	73545	
4-12	50954	73539	73547	73438	73543	82181	

For alignment coupler dimensions, see section C.

*Cylinder accessory dimensions conform to NFPA recommended standard NFPA/T3.6.8 R1-1984, NFPA recommended standard fluid power systems — cylinder — dimensions for accessories for cataloged square head industrial types. Parker adopted this standard in April, 1985. Eye Brackets or Mounting Plates shipped before this date may have different dimensions and will not necessarily interchange with the NFPA standard. For dimensional information on older style Eye Brackets or Mounting Plates consult Drawing #144805 or previous issues of this catalog.

Accessory Load Capacity

The various accessories on this and the following pages have been load rated for your convenience. The load capacity in lbs., shown on the following page is the recommended maximum load for that accessory based on a 4:1 design factor in tension. (Pivot Pin is rated in shear.) Before specifying, compare the actual load or the tension (pull) force at maximum operating pressure of the cylinder with the load capacity of the accessory you plan to use. If load or pull force of cylinder exceeds load capacity of accessory, consult factory.

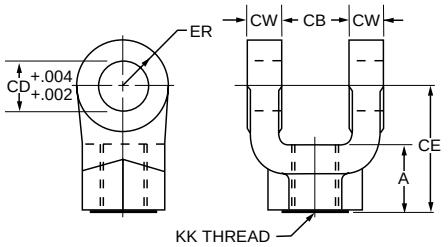
Chart B

Mtg. Plate Part No.	Series 2H Bore Size
69195	1 1/2"
69196	2", 2 1/2"
*85361	3 1/4"
69198	4"
*85362	5"
*85363	6"

Mounting Plates

Mounting Plates for Style BB (clevis mounted) cylinders are offered. To select proper part number for your application, refer to Chart B, above right.

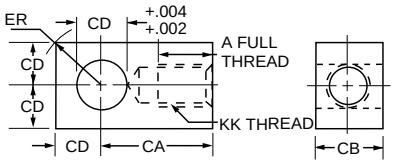
❩ Female Rod Clevis



②

Order to fit thread size.

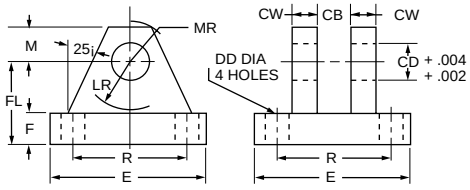
① Knuckle (Female Rod Eye)



②

Order to fit thread size.

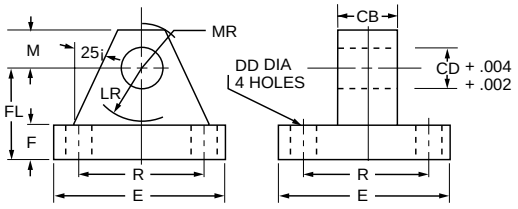
Clevis Bracket for Knuckle



②

Order to fit Knuckle.

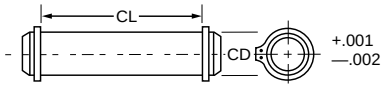
♠ Mounting Plate or ❩ Eye Bracket



②

1. When used to mate with the Rod Clevis, select from Chart A.
2. When used to mount the Style BB cylinders, select from the Mounting Plate Selection Table. See Chart B at lower left.

⑧ Pivot Pin



②

1. Pivot Pins are furnished with Clevis Mounted Cylinders as standard.
2. Pivot Pins are furnished with (2) Retainer Rings.
3. Pivot Pins must be ordered as separate item if to be used with Knuckles, Rod Clevises, or Clevis Brackets.

For additional information – call your local Parker Cylinder Distributor.

	Female Rod Clevis Part Number																		
	51221†	**50940**	**50941**	**50942**	**133284**	**50943**	**50944**	**133285**	**50945**	**133286**	**50946**	**50947**	**50948**	**50949**	**50950**	**50951**	**50952**	**50953**	**50954**
A	13/16	3/4	3/4	1 1/8	1 1/8	1 5/8	1 5/8	1 5/8	2	2	2 1/4	3	3	3 1/2	3 1/2	3 1/2	3 1/2‡†	4††	4‡†
CB	11/32	3/4	3/4	1 1/4	1 1/4	1 1/2	1 1/2	1 1/2	2	2	2 1/2	2 1/2	2 1/2	3	3	3	4	4 1/2	4 1/2
CD	5/16	1/2	1/2	3/4	3/4	1	1	1	1 3/8	1 3/8	1 3/4	2	2	2 1/2	3	3	3 1/2	4	4
CE	2 1/4	1 1/2	1 1/2	2 1/8	2 3/8	2 15/16	2 15/16	3 1/8	3 3/4	4 1/8	4 1/2	5 1/2	5 1/2	6 1/2	6 3/4	6 3/4	7 3/4	8 13/16	8 13/16
CW	13/64	1/2	1/2	5/8	5/8	3/4	3/4	3/4	1	1	1 1/4	1 1/4	1 1/4	1 1/2	1 1/2	1 1/2	2	2 1/4	2 1/4
ER	19/64	1/2	1/2	3/4	3/4	1	1	1	1 3/8	1 3/8	1 3/4	2	2	2 1/2	2 3/4	2 3/4	3 1/2	4	4
KK	15/16-24	7/16-20	1/2-20	3/4-16	3/4-16	7/8-14	1-14	1-14	1 1/4-12	1 1/4-12	1 1/2-12	1 3/4-12	1 7/8-12	2 1/4-12	2 1/2-12	2 3/4-12	3 1/4-12	3 1/2-12	4-12
Load Capacity Lbs. ⊖	2600	4250	4900	11200	11200	18800	19500	19500	33500	33500	45600	65600	65600	98200	98200	98200	156700	193200	221200

	Knuckle Part Number																
	74075	**69089**	**69090**	**69091**	**69092**	**69093**	**69094**	**69095**	**69096**	**69097**	**69098**	**69099**	**69100**	**73536**	**73437**	**73438**	**73439**
A	3/4	3/4	3/4	1 1/8	1 1/8	1 5/8	2	2 1/4	2 1/4	3	3 1/2	3 1/2	3 5/8	4‡	5	5 1/2	5 1/2
CA	1 1/2	1 1/2	1 1/2	2 1/16	2 3/8	2 13/16	3 7/16	4	4 3/8	5	5 13/16	6 1/8	6 1/2	7 5/8	7 5/8	9 1/8	9 1/8
CB	7/16	3/4	3/4	1 1/4	1 1/2	1 1/2	2	2 1/2	2 1/2	2 1/2	3	3	3 1/2	4	4	4 1/2	5
CD	7/16	1/2	1/2	3/4	1	1	1 3/8	1 3/4	2	2	2 1/2	3	3	3 1/2	3 1/2	4	4
ER	19/32	23/32	23/32	1 1/16	1 7/16	1 7/16	1 31/32	2 1/2	2 27/32	2 27/32	3 9/16	4 1/4	4 1/4	4 31/32	4 31/32	5 11/16	5 11/16
KK	5/16-24	7/16-20	1/2-20	3/4-16	7/8-14	1-14	1 1/4-12	1 1/2-12	1 3/4-12	1 7/8-12	2 1/4-12	2 1/2-12	2 3/4-12	3 1/4-12	3 1/2-12	4-12	4 1/2-12
Load Capacity Lbs. ⊖	3300	5000	5700	12100	13000	21700	33500	45000	53500	75000	98700	110000	123300	161300	217300	273800	308500

	Clevis Bracket for Knuckle Part Number												
	74076	**69205**	**69206**	**69207**	**69208**	**69209**	**69210**	**69211**	**69212**	**69213**	**73542**	**73543**	**73544**
CB	15/32	3/4	1 1/4	1 1/2	2	2 1/2	2 1/2	3	3	3 1/2	4	4 1/2	5
CD	7/16	1/2	3/4	1	1 3/8	1 3/4	2	2 1/2	3	3	3 1/2	4	4
CW	3/8	1/2	5/8	3/4	1	1 1/4	1 1/2	1 1/2	1 1/2	1 1/2	2	2	2
DD	17/64	13/32	17/32	21/32	21/32	29/32	1 1/16	1 3/16	1 5/16	1 5/16	1 13/16	2 1/16	2 1/16
E	2 1/4	3 1/2	5	6 1/2	7 1/2	9 1/2	12 3/4	12 3/4	12 3/4	12 3/4	15 1/2	17 1/2	17 1/2
F	3/8	1/2	5/8	3/4	7/8	7/8	1	1	1	1	1 11/16	1 15/16	1 15/16
FL	1	1 1/2	1 7/8	2 1/4	3	3 5/8	4 1/4	4 1/2	6	6	6 11/16	7 11/16	7 11/16
LR	5/8	3/4	1 3/16	1 1/2	2	2 3/4	3 3/16	3 1/2	4 1/4	4 1/4	5	5 3/4	5 3/4
M	3/8	1/2	3/4	1	1 3/8	1 3/4	2 1/4	2 1/2	3	3	3 1/2	4	4
MR	1/2	5/8	29/32	1 1/4	1 21/32	2 7/32	2 25/32	3 1/8	3 19/32	3 19/32	4 1/8	4 7/8	4 7/8
R	1.75	2.55	3.82	4.95	5.73	7.50	9.40	9.40	9.40	9.40	12.00	13.75	13.75
Load Capacity Lbs. ⊖	3600	7300	14000	19200	36900	34000	33000	34900	33800	36900	83500	102600	108400

	Eye Bracket and Mounting Plate Part Number										
	74077	**69195**	**69196**	**85361***	**69198**	**85362***	**85363***	**85364***	**85365***	**73538**	**73539**
CB	5/16	3/4	1 1/4	1 1/2	2	2 1/2	2 1/2	3	3	4	4 1/2
CD	5/16	1/2	3/4	1	1 3/8	1 3/4	2	2 1/2	3	3 1/2	4
DD	17/64	13/32	17/32	21/32	21/32	29/32	1 1/16	1 3/16	1 5/16	1 13/16	2 1/16
E	2 1/4	2 1/2	3 1/2	4 1/2	5	6 1/2	7 1/2	8 1/2	9 1/2	12 5/8	14 7/8
F	3/8	3/8	5/8	7/8	7/8	1 1/8	1 1/2	1 3/4	2	1 11/16	1 15/16
FL	1	1 1/8	1 7/8	2 3/8	3	3 3/8	4	4 3/4	5 1/4	5 11/16	6 7/16
LR	5/8	3/4	1 1/4	1 1/2	2 1/8	2 1/4	2 1/2	3	3 1/4	4	4 1/2
M	3/8	1/2	3/4	1	1 3/8	1 3/4	2	2 1/2	2 3/4	3 1/2	4
MR	1/2	9/16	7/8	1 1/4	1 5/8	2 1/8	2 7/16	3	3 1/4	4 1/8	5 1/4
R	1.75	1.63	2.55	3.25	3.82	4.95	5.73	6.58	7.50	9.62	11.45
Load Capacity Lbs. ⊖	1700	4100	10500	20400	21200	49480	70000	94200	121900	57400	75000

	Pivot Pin Part Number												
	74078	**68368**	**68369**	**68370**	**68371**	**68372**	**68373**	**69215**	**68374**	**68375**	**69216**	**73545**	**82181**	**73547•**
CD	7/16	1/2	3/4	1	1 3/8	1 3/4	2	2	2 1/2	3	3	3 1/2	4	4
CL	1 5/16	1 7/8	2 5/8	3 1/8	4 1/8	5 3/16	5 3/16	5 11/16	6 3/16	6 1/4	6 3/4	8 1/4	8 5/8	9
Shear Capacity Lbs.⊖	6600	8600	19300	34300	65000	105200	137400	137400	214700	309200	309200	420900	565800	565800

*Cylinder accessory dimensions conform to NFPA recommended standard NFPA/T3.6.8 R1-1984, NFPA recommended standard fluid power systems — cylinder — dimensions for accessories for cataloged square head industrial types. Parker adopted this standard in April, 1985. Eye Brackets or Mounting Plates shipped before this date may have different dimensions and will not necessarily interchange with the NFPA standard. For dimensional information on older style Eye Brackets or Mounting Plates consult Drawing #144805 or previous issues of this catalog.

⊖ See Accessory Load Capacity note on previous page.

•These sizes supplied with cotter pins.

†Includes Pivot Pin.

‡Consult appropriate cylinder rod end dimensions for compatibility.

For Cylinder Division Plant Locations – See Page II.

How to Order Series "2H" Cylinders

Data Required on All Cylinder Orders

When ordering Series "2H" cylinders, be sure to specify each of the following requirements:

Note: Duplicate cylinders can be ordered by giving the SERIAL NUMBER from the nameplate of the original cylinder. Factory records supply a quick, positive identification.

a) Bore

b) Mounting Style
Specify your choice of mounting style — as shown and dimensions in this catalog. If double rod is wanted, specify "with double rod".

c) Series Designation ("2H")

d) Length of Stroke

e) Piston Rod Diameter
Call out rod diameter or rod code number. In Series "2H" cylinders, standard rod diameters (Code No. 1) will be furnished if not otherwise specified, unless length of stroke makes the application questionable.

f) Piston Rod End Thread Style
Call out thread style number or specify dimensions. Thread style number 4 will be furnished if not otherwise specified.

g) Cushions (If required)
Specify "Cushion-head end", "Cushion-cap end" or "Cushion both ends" as required. If cylinder is to have a double rod and only one cushion is required, be sure to specify clearly which end of the cylinder is to be cushioned.

h) Alternate Lipseal® or Hi Load Piston (If desired)
Parker Lipseal® pistons are offered as an option at no extra cost in the Series "2H" cylinders. With this feature, zero leakage under static holding conditions is attained. Call out "with Lipseal® piston" if this type of piston is desired. If not specified, the ring type piston will be furnished.

i) Ports
Parker recommends SAE Straight Thread Ports for leak-proof port connections on Series "2H" hydraulic cylinders.

j) Fluid Medium
Series "2H" hydraulic cylinders are equipped with seals for use with hydraulic oil. If other than hydraulic oil will be used, specify class of fluid (see Catalog section C).

Additional data is required on orders for cylinders with special modifications. For further information, consult factory.

Class 1 Seals

Class 1 seals are the seals provided as standard in a cylinder assembly unless otherwise specified. For further information on fluid compatibility on operating limitations of all compounds, see section C.

For the 2H series cylinders the following make-up Class 1 Seals:
Primary Piston Rod Seal – Enhanced Polyurethane
Piston Rod Wiper – Nitrile
Piston Seals – Cast Iron Rings
Option – Nitrile lipseals with polymyte back-up washers
Option – Hi Load. Filled P.T.F.E. seals with a nitrile expander.
O-Rings – Nitrile (nitrile back-up washer when used)

Service Policy

On cylinders returned to the factory for repairs, it is standard policy for the Cylinder Division to make such part replacements as will put the cylinder in as good as new condition. Should the condition of the returned cylinder be such that expenses for repair would exceed the costs of a new one, you will be notified.

Address all correspondence and make shipments to, Service Department at your nearest regional plant listed in the pages of this catalog.

Certified Dimensions

Parker Cylinder Division guarantees that all cylinders ordered from this catalog will be built to dimensions shown. All dimensions are certified to be correct, and thus it is not necessary to request certified drawings.

Warranty

Seller warrants the goods sold hereunder to be free from defects in material and workmanship. This warranty shall terminate eighteen months after date of shipment from Seller's plant and claims not made in writing within such period are waived.

The above warranty does not extend to goods damaged after date of shipment from Seller's plant where the damage is not directly due to a defect in material or workmanship, nor does it apply to goods altered or repaired by anyone other than Seller's authorized employees, nor to goods furnished by Buyer or acquired at Buyer's request and/or to Buyer's specifications.

If the goods are in accordance with or in reference to an engineering drawing specified by or furnished to the customer, the specifications and information on the drawing shall be applicable in determining such correct use, operation and application.

When claiming a breach of warranty, Buyer must notify Seller promptly whereupon Seller will either examine the goods at their site, or issue shipping instructions for return to Seller (transportation costs prepaid by Buyer). When any goods sold hereunder are proved as not warranted, Seller's sole obligation under this warranty shall be to repair or replace the goods, at its option, without charge to Buyer.

The above warranty comprises Seller's sole and entire warranty obligation and liability to Buyer, its customers and assigns in connection with goods sold hereunder. All other warranties, express or implied, including but not limited to, warranties of merchantability and fitness, are expressly excluded.

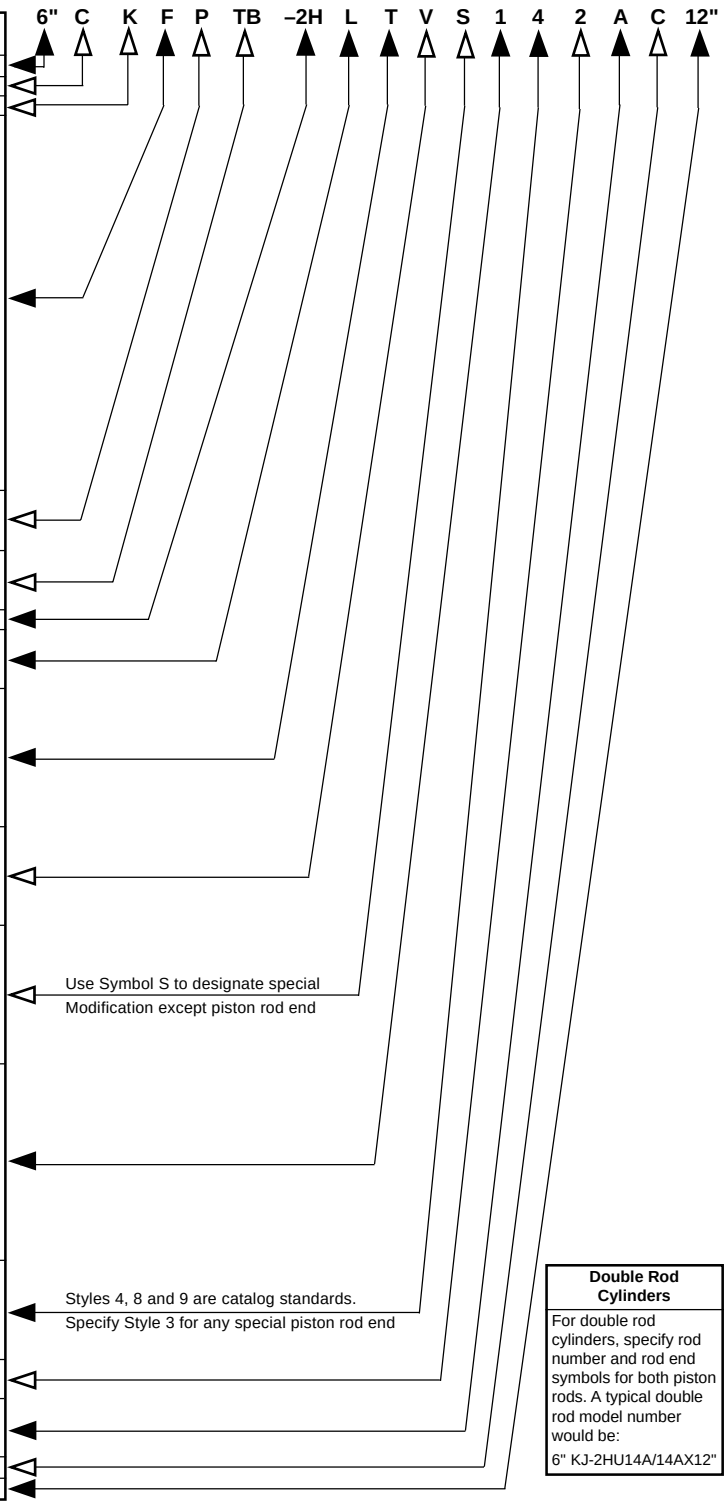
For additional information – call your local Parker Cylinder Distributor.

Series "2H" Model Numbers – How to Develop Them – How to "Decode" Them

Parker Series 2H cylinders can be completely and accurately described by a model number consisting of coded symbols. For single rod cylinders a maximum of 17 places for digits and letters are used in a prescribed sequence to produce a model number. Only nine places are needed to completely describe a standard noncushioned Series 2H cylinder. To develop a model number, select only those symbols that represent the cylinder required, and place them in the sequence indicated below.

Note: Page numbers with a letter prefix, ie: C77, are located in section C of this catalog.

Feature	Description	Page No.	Symbol
Bore*	Specify in inches		
Cushion-Head	Used **only** if cushion required	C94,42 & 43	C
Double-Rod	Used **only** if double-rod cylinder is required	58	K
Mounting* Style	Head Tie Rods Extended	44	TB
	Cap Tie Rods Extended	44	TC
	Both End Tie Rods Extended	44	TD
	Head Rectangular Flange	46	J
	Head Square Flange	46	JB
	Head Rectangular	46	JJ
	Cap Rectangular Flange	48	H
	Cap Square Flange	48	HB
	Cap Rectangular	48	HH
	Side Lugs	50	C†
	Centerline Lugs	50	E
	Side Tapped	50	F†
	Side End Angles	52	CB
	Side End Lugs	52	G†
	Cap Fixed Clevis	52	BB
	Head Trunnion	54	D
	Cap Trunnion	54	DB
	Intermediate Fixed Trunnion	54	DD
	Spherical Bearing	56	SB
Mounting Modifications	Used **only** for Thrust Key (Styles C,F,G, & CB)	C93	P
	Used **only** for Manifold Port O-Ring Seal (Style C)	C91	M
Combination Mounting Style	Any Practical Mounting Style	–	As
	Listed Above	–	listed
		–	above
Series*	Used in **all** 2H Model Numbers	–	–2H
Piston	Ring packed piston standard	–	C
	Used **only** for Lipseal® Piston	43	L
	Used **only** for Hi-Load Piston	43	K
Ports*	SAE Straight Thread O-Ring Port (Standard)	C89	T
	Used **only** for NPTF (Dry Seal Pipe Thread)	C89	U
	Used **only** for BSP (Parallel Thread ISO 228)	C89	R
	Used **only** for SAE Flange Ports (3000 psi)	C89	P
	Used **only** for BSPT (Taper Thread)	C89	B
	Used **only** for Metric Thread	C89	G
	Used **only** for Metric Thread per ISO 6149	C89	Y
Common Modifications	High Water Content Fluid	C83	J
	Nut Retained Piston	43	F
	Viton Seals	C83	V
	Water Service	C83	W
	EPR Seals	C83	X
Special Modifications	Used **only** if special Modifications are required: Oversize Ports	C91	S
	Port Position Change	C89	
	Special Seals	C83	
	Stop Tube	C95	
	Stroke Adjuster	C93	
	Tie Rod Supports	C93	
Piston Rod* Number	For Single Rod Cylinders, select one only.	–	1
	Refer to Rod number listing, Table 2,	–	2
	Pages 44 through 55	–	3
	See chart in Section C for minimum piston rod	–	4
	diameter	–	5
		–	6
		–	7
		–	8
		–	9
		–	0
Piston* Rod End	Select:		
	Style 4 Small Male	C92	4
	Style 8 Intermediate Male	C92	8
	Style 9 Short Female	C92	9
	Style 3 Special (Specify)	C92	3
Piston Rod Alternate Thds.	Used **only** for stud two times longer than standard.	C92	2
Piston Rod* Threads	UNF Standard	C92	A
	BSF (British Fine)	C92	W
	Metric	C92	M
Cushion-Cap	Used **only** if cushion required	C94, 42 & 43	C
Stroke*	Specify in inches	C93	–



Double Rod Cylinders

For double rod cylinders, specify rod number and rod end symbols for both piston rods. A typical double rod model number would be:

6" KJ-2HU14A/14AX12"

*Required for Basic Cylinder Model Number

Dark Arrows Indicate Basic Minimum Model Number †Cylinders with these mounting styles should have a minimum stroke length equal to or greater than their bore size.

PNEUTECH ROUSSEAU INC.
GARANTIE

Le matériel et la main d'oeuvre sont garantie pour une période de trois (3) mois à partir de la date de démarrage ou six (6) mois après la date de livraison selon la première échéance.

Si durant la période de garantie, un vice de construction ou d'exécution est décelé, la réparation ou le remplacement se fera aux frais de Pneutech Rousseau Inc., ci-après appllée "La Compagnie", et ce choix de la Compagnie.

La garantie devant être accordée par Pneutech Rousseau Inc. prévaut expressément sur toute autre garantie, expresse ou tacite, y compris toute garantie portant sur la qualité marchande des équipements ou leur conformtié pour un usage déterminé.

Les dédommagements au titre de la présente garantie se limitent expressément à la fourniture des pièces et de services au conditions spécifiées, et toutes réclamations pour toutes autres pertes et dommages (y compris mais sans s`y limiter, les pertes d'ordre économique ou moral, ou encore tous autres dommages directs, indirects, spéciaux previsibles ou imprévisibles) sont expressément exclus.

La présente garantie ne couvrira pas les coûts associés à ce qui suit :
- Tous les frais relatifs au transport du produit ou de l`équipement au site;
- Les frais de déplacement du personnel pour réparation des produit sur le terrain;
- Les heures suppplémentairs ou autre frais de main d'oeuvre exceptionnels;
- Les frais de transport des pièces en sus des frais ordinaires et d'usage;
- Tous les frais reliés à la recherche d'un défaut de rendement du produit relié à son utilisation sauf si ledit défaut est imputable à un vice de matière ou fabrication.

La garantie cesse de plein droit si l'acheteur a effectué des modifications, adjonctions ou des réparation sur les équipements de sa propre initiative et sans notre accord autorisé.

GARANTIE FORMULAIRE 1
22 Février 1989

PNEUTECH ROUSSEAU INC.
WARRANTY

Equipment and labor are guaranteed for a period of three (3) months from date of start up or six (6) months from date of shipment whichever occurs the first.

If a defect in material or workmanship is found during the warranty period, it will be repaired or replaced at Pneutech Rousseau Inc. option and cost. This warranty is expressly in lieu of any other warranty, express or implied, including any warranty or merchantability of the equipment or fitness for a particular purpose. Remedies under this warranty are limited to repair or replacement as specified above and any claims for other loss or damages of any kind (including, without limitation, loss from the use of the equipment or failure of the equipment to operate for any period of time, economic loss or other direct, indirect or consequential damages) are expressly excluded.

This warranty shall not cover the cost of the following:
- All related costs for transporting the product or the equipment to site;
- Travel expenses of our personnel for field repair of products;
- Premium or overtime labor cost;
- Parts shipping charges and other expenses other than those which are usual and customary;
- All costs to investigate performance complaints unless the problem is caused by a defect covered by this warranty.

This warranty legally ceases if the buyer has, under his own initiative and without our explicit consent made any modification, addition or repairs on the equipment.

WARRANTY FORM 1
February 22 1989

REV.	ECN#	DATE	DESCRIPTION	BY
01	--	Nov. 23 2010	Internal Modifications	E.L.
02	--	Nov. 30 2010	Modifications due to customers demands where indicated	A.T.
03	--	Jan. 17 2011	Modified where indicated, Added Flange Symbol and Notes.	E.L.
04	--	Mar. 01 2011	Modified item 63 to 69 and reverse 62 group	E.L.

Page 2 of 5

Page 3 of 5

Page 4 of 5

T1
COOLING & TURNING STATION
4481-MJUT-0001
TILT
2.5"BORE X 1 3/4"ROD X 23"STROKE (2.50-CS82HMTVS27ACx23.00")
Q MAX=25 LPM Q MAX=25 LPM

G1
POSITIONING GANTRY
4481-MQLK-0001
CLAMPING
4"BORE X 2.5"ROD X 19"STROKE (4.00-C8B2HKPVS24ACx19.00")
Q MAX=25 LPM
LOWER/RAISE
4"BORE X 1 3/4"ROD X 20"STROKE (4.00-C8B2HKPVS14ACx20.00")
Q MAX=25 LPM

R1
BLOCK OVEN EXIT CONVEYOR
4481-MJRO-0005
RAISE/LOWER
2.5"BORE X 1 3/8"ROD X 7 7/8"STROKE (2.50-C2G1HKPVS33ACx7.886")
Q MAX=23 LPM

R2
BLOCK & BAR ASSEMBLY CONVEYOR
4481-MJRO-0007
WIDTH CENTERING
4"BORE X 1"ROD X 7"STROKE (2.00-C5B2HKTVS19ACx7.00")
Q MAX=23 LPM
LENGTH CENTERING
2"BORE X 1"ROD X 8 3/4"STROKE (2.00-C5B2HKTVS14ACx8.75")
Q MAX=23 LPM

R5
BLOCK COOLING AND TURNING CONVEYOR
4481-MJRO-0008
PUSHER
2.5"BORE X 1 3/8"ROD X 11"STROKE (2.50-C4B2HKPVS34ACx11.00")
Q MAX=12 LPM

R7
BAR FURNACE FEED CONVEYOR
4481-MJRO-0003
RAISE/LOWER
2.5"BORE X 1"ROD X 2 1/8"STROKE (2.50-B8D1HKPVS14ACx2.125")
Q MAX=23 LPM

R8
SHOT BLAST EXIT CONVEYOR
4481-MJRO-0002
TILT BAR
2.5"BORE X 1"ROD X 6"STROKE (2.50-C2D1HKPVS13ACx6.00")
Q MAX=12 LPM

R9
SHOT BLAST FEED CONVEYOR
4481-MJRO-0001
RAISE/LOWER
2.5"BORE X 1"ROD X 10 9/16"STROKE (2.50-C2D1HKPVS13ACx10.562")
Q MAX=12 LPM

P1+R4A
CARBON BLOCK PRE-STRESSING & PRE-STRESSING CONVEYOR
4481-MZAC-0001
RAISE/LOWER
4"BORE X 1 3/4"ROD X 1 3/4"STROKE (4.00-HH2HKPVS38Ax1.75")
Q MAX=23 LPM
WIDTH CENTERING
2-1/2" BORE X 1" ROD X 1" STROKE (2.50-SB2HKPVS19Ax1.00")
Q MAX=23 LPM

P1+R4B
CARBON BLOCK PRE-STRESSING & PRE-STRESSING CONVEYOR
4481-MZAC-0002
RAISE/LOWER
4"BORE X 1 3/4"ROD X 1 3/4"STROKE (4.00-HH2HKPVS38Ax1.75")
Q MAX=23 LPM
WIDTH CENTERING
2-1/2" BORE X 1" ROD X 1" STROKE (2.50-SB2HKPVS19Ax1.00")
Q MAX=23 LPM

SEE NOTE 5 ON PAGE 1 OF 5

Page 5 of 5
HYDRAULIC POWER UNIT LIMITS

NOTE:
1) DESIGNED TO OPERATED IN HIGHLY ABRASIVE, DUST LADEN ATM AND SUITABLE FOR HIGH PRESSURE WASH DOWN WITH DETERGENTS
2) SPECIFICATION : 1347-H1-3001-00 2547-4480-POA-MXA0-0001
3) NOISE LEVEL 85 dB(A)
4) ALL INTERCONNECTION HOSES BY OTHERS
5) G1 CYLINDER #102 LOWERS ONLY BY GRAVITY
6) ITEMS #42 x 2 MOTOR STATION BOX, AND #26 JUNCTION BOX FREE ISSUE BY GNA

Refer to Bill of Material on dwg. 100579-04 and Schematic dwg 100579-01

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
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ENG. GROUP SUP.		DRAWING SCALE:	NTS
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Vendor or Subcontractor Logo:
GNA alutech inc. Département Ingénierie Engineering Department 9495 Trans-Canada Saint-Laurent, Quebec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
HYDRAULIC
SCHEMATIC

MA'ADEN

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx-	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
—	—	—		A3-		-AZ	

Légende / Legend

- ligne de pression / pressure line (rouge / red)
- ligne de retoure / return line (bleu / blue)
- ligne de sucction / suction line (vert / green)
- ligne de débit controle / controled flow line (Jaune / Yellow)
- ligne de pression réduite / pressure reduced line (Orange)
- ligne de pression augmenté / pressure increase line (Mauve / Violet)
- ligne de drainage / drain Line (Blanc/Noir - White/Black)
- ligne de pilotage / pilot line (red)

Les tolérances s'appliquent aux surfaces machinées, sinon telle que spécifiées

Tolerances apply to machined surfaces, unless otherwise specified

Inches			Millimeters		
X.	=	±.040"	X.	=	±1mm
X.X	=	±.010"	X.X	=	±0.3mm
X.XX	=	±.005"	X.XX	=	±0.1mm
X.XXX	=	±.001"	Angle	=	±1/2°
Fraction	=	±1/32"			
Angle	=	±1/2°			

Material required for machining

Material: Qty.

PNEUTECH ROUSSEAU

1475 32nd Ave., Lachine, Quebec H8T 3J1 Tel: 514 635 7000 Fax: 514 635 7012 Fax: 514 635 7010	445 Rue Des Adirondacks Beauport, Quebec G1C 6S2 Tel: 418 660 0566 Fax: 418 660 0570	1200 Boul. de Royaume Chicoutimi, Quebec G7H 5B1 Tel: 418 693 5892 Fax: 418 693 1755	345 Superior Blvd. Unit 1 Mississauga, Ontario L5T 2L6 Tel: 905 565 6403 Fax: 905 565 6417
205 Enterprise Ave., Kitimat British Columbia V8C 2C8 Tel: 250 632 3271 Fax: 250 632 3278	Hydramen Fluid Power Ltd. 121 Welham Road Barrie, Ontario L4N 8Y3 Tel: 705 722 7985 Fax: 705 722 4558		

	Initials	Date
Fichier / File: 100579-01		
Dessine par / Drawn by: Eric Lussier		Nov. 12 2010
Verifier par / Checked by: Alfredo Tarabuta		Nov. 12 2010
Approuve par / Approved by: Patrick Berry		Nov. 12 2010

Client / Customer: GNA

Projet / Project: Hydraulic Power Unit Full Hydraulic Schematic Assy. 1394757-00

Bon de Cmmande / Purchase Order: 00006518

Dessin / Drawing: 100579-01

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B	fit	1 of 5	04

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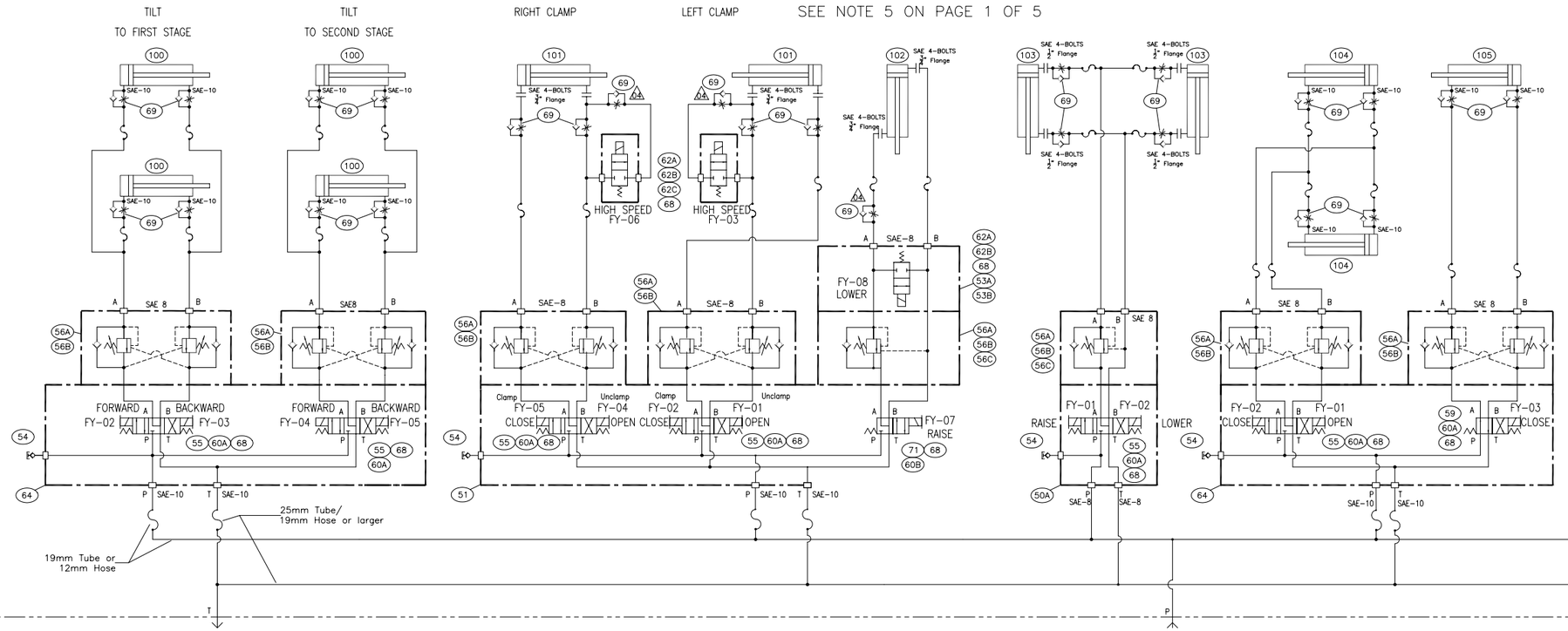
02	--	Nov. 30 2010	Modifications due to customers demands where indicated	A.T.
03	--	Jan. 17 2011	Modified where indicated, Added Flange Symbol and Notes.	E.L.
04	--	Mar. 01 2011	Modified item 63 to 69 and reverse 62 group	E.L.

T1
COOLING & TURNING STATION
4481-MJUT-0001
TILT
2.5"BORE X 1 3/4"ROD X 23"STROKE (2.50-CSB2HKTVS27ACx23.00")
Q MAX=25 LPM Q MAX=25 LPM

G1
POSITIONING GANTRY
4481-MQLK-0001
CLAMPING
4"BORE X 2.5"ROD X 19"STROKE
(4.00-CBB2HKPVS24ACx19.00")
Q MAX=25 LPM Q MAX=25 LPM
LOWER/RAISE
4"BORE X 1 3/4"ROD X 20"STROKE
(4.00-CDB2HKPVS14ACx20.00")
Q MAX=25 LPM

R1
BLOCK OVEN EXIT CONVEYOR
4481-MJRO-0005
RAISE/LOWER
2.5"BORE X 1 3/8"ROD X 7 7/8"STROKE
(2.50-CD2HKPVS33ACx7.880")
Q MAX=23 LPM

R2
BLOCK & BAR ASSEMBLY CONVEYOR
4481-MJRO-0007
WIDTH CENTERING
2"BORE X 1"ROD X 7"STROKE
(2.00-CSB2HKTVS19ACx7.00")
Q MAX=23 LPM
LENGTH CENTERING
2"BORE X 1"ROD X 8 3/4"STROKE
(2.00-CBB2HKTVS14ACx8.73")
Q MAX=23 LPM



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Vendor or Subcontractor Logo: GNA alutech inc. Département Ingénierie Engineering Department 9650 Trans-Canada Saint-Laurent, Quebec H4S 1V3 Canada

BECHTEL

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
HYDRAULIC
SCHEMATIC

Project Title: **Ras Az Zawr Aluminium Smelter**

MA'ADEN ALCOA

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx	xxxx	xxxx	xxx	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

Légende / Legend

- ligne de pression / pressure line (rouge / red)
- ligne de retoure / return line (bleu / blue)
- ligne de suction / suction line (vert / green)
- ligne de débit controle / controled flow line (Jaune / Yellow)
- ligne de pression réduite / pressure reduced line (Orange)
- ligne de pression augmenté / pressure increase line (Mauve / Violet)
- ligne de drainage / drain Line (Blanc/Noir - White/Black)
- ligne de pilotage / pilot line (red)

Les tolérances s'appliquent aux surfaces machinées, sinon telle que spécifiées
Tolerances apply to machined surfaces, unless otherwise specified

Inches		Millimeters	
X.	±.040"	X.	±1mm
X.X	±.010"	X.X	±0.3mm
X.XX	±.005"	X.XX	±0.1mm
X.XXX	±.001"	Angle	±1/2°
Fraction	±1/32"		
Angle	±1/2°		

Material required for machining

Material: Qty.

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1200 Boul. de Royaume Chicoutimi, Quebec G7H 5B1 Tel: 418 693 5892 Fax: 418 693 1755
345 Superior Blvd, Unit 1 Mississauga, Ontario L5T 2L6 Tel: 905 565 6403 Fax: 905 565 6417
1205 Enterprise Ave., Kitimat British Columbia V8C 2C8 Tel: 250 632 3271 Fax: 250 632 3278
Hydramen Fluid Power Ltd. 121 Welham Road Barrie, Ontario L4N 8Y3 Tel: 705 722 7985 Fax: 705 722 4558

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Dessine par / Drawn by	Eric Lussier	Initials	Date: Nov. 12 2010
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Approuve par / Approved by	Patrick Berry	Initials	Date: Nov. 12 2010

Client / Customer	GNA		
Projet / Project	Hydraulic Power Unit Page 2 of 5 Hydraulic Schematic Assy.		
Bon de Cmmande / Purchase Order	00006518		
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04	--	Mar. 01 2011	Modified item 63 to 69 and reverse 62 group	E.L.

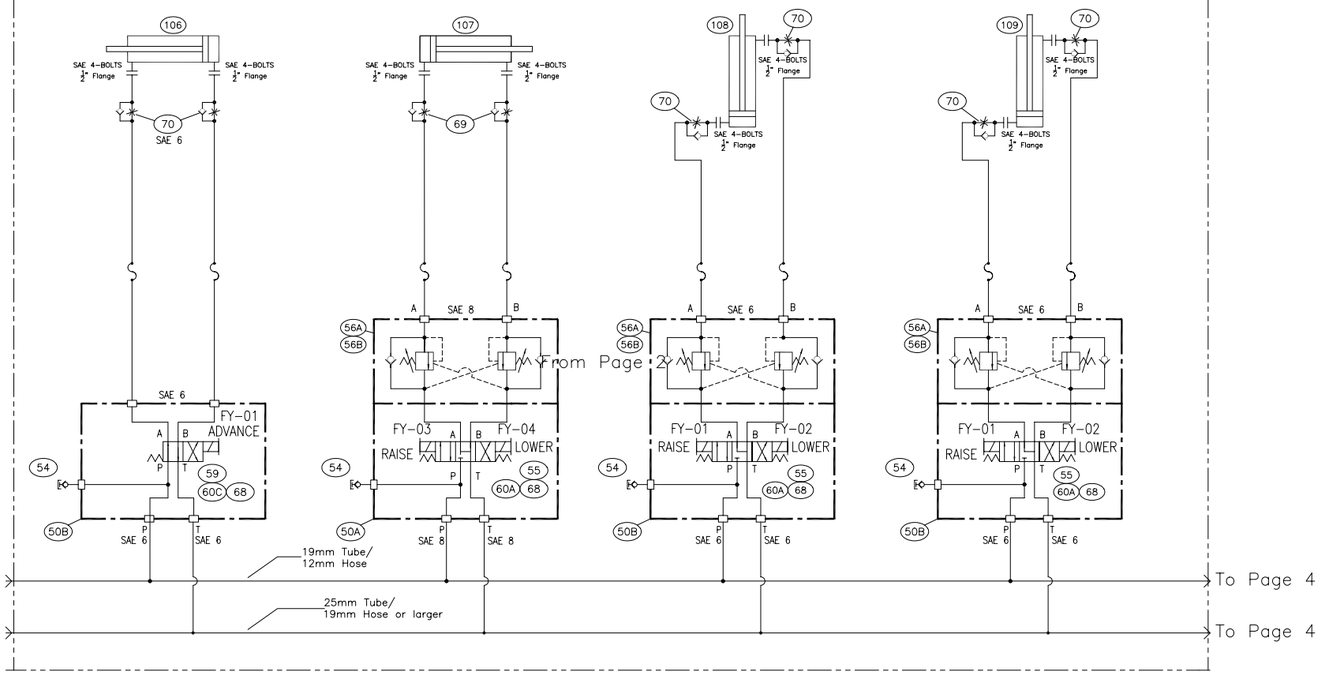
R5
BLOCK COOLING AND TURNING CONVEYOR
4481-MJRO-0008
PUSHER
2.5"BORE X 1 3/8"ROD X 11"STROKE
(2.50-CJB2HKPVS34ACx11.00")
Q MAX=12 LPM

R7
BAR FURNACE FEED CONVEYOR
4481-MJRO-0003
RAISE/LOWER
2.5"BORE X 1"ROD X 2 1/8"STROKE
(2.50-BB2HKPVS14Ax2.125")
Q MAX=23 LPM

R8
SHOT BLAST EXIT CONVEYOR
4481-MJRO-0002
TILT BAR
2.5"BORE X 1"ROD X 6"STROKE
(2.50-CD2HKPVS13ACx6.00")
Q MAX=12 LPM

R9
SHOT BLAST FEED CONVEYOR
4481-MJRO-0001
RAISE/LOWER
2.5"BORE X 1"ROD X 10 9/16"STROKE
(2.50-CD2HKPVS13ACx10.562")
Q MAX=12 LPM

ADVANCE BLOCK
TO FIRST STAGE



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GNA alutech inc. — Département Ingénierie, Engineering Department, 9695 Transcanada, Saint-Laurent, Québec, H4S 1V3, Canada

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
HYDRAULIC
SCHEMATIC

Project Title: Ras Az Zawr Aluminium Smelter

MA'ADEN

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx	xxxx	xxxx	xxx	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
				A3-		-AZ	

Légende **Legend**

- ligne de pression / pressure line (rouge / red)
- ligne de retoure / return line (bleu / blue)
- ligne de suction / suction line (vert / green)
- ligne de débit controle / controled flow line (Jaune / Yellow)
- ligne de pression réduite / pressure reduced line (Orange)
- ligne de pression augmenté / pressure increase line (Mauve / Violet)
- ligne de drainage / drain Line (Blanc/Noir - White/Black)
- ligne de pilotage / pilot line (red)

Les tolérances s'appliquent aux surfaces machinées, sinon telle que spécifiées
Tolerances apply to machined surfaces, unless otherwise specified

Inches		Millimeters	
X.	±.040"	X.	±1mm
X.X	±.010"	X.X	±0.3mm
X.XX	±.005"	X.XX	±0.1mm
X.XXX	±.001"	Angle	±1/2°
Fraction	±1/32"		
Angle	±1/2°		

Material required for machining
Material: Qty.

PNEUTECH ROUSSEAU

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2205 Enterprise Ave. Kitimat British Columbia V8C 2C8 Tel: 250 632 3271 Fax: 250 632 3278
Hydramen Fluid Power Ltd 121 Waltham Road Barrie, Ontario L4N 8Y3 Tel: 705 722 7865 Fax: 705 722 4558

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Verifier par / Checked by	Alfredo Tarabuta	Initials	Date: Nov. 12 2010
Approuve par / Approved by	Patrick Berry	Initials	Date: Nov. 12 2010

Client / Customer: GNA
Projet / Project: Hydraulic Power Unit
Page 3 of 5 Hydraulic Schematic Assy. 1394757-00
Bon de Cmmande / Purchase Order: 00006518
Dessin / Drawing: 100579-01

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04	--	Mar. 01 2011	Modified item 63 to 69 and reverse 62 group	E.L.

P1+R4A

CARBON BLOCK PRE-STRESSING & PRE-STRESSING CONVEYOR

4481-MZAC-0001

RAISE/LOWER
4"BORE X 1 3/4"ROD X 1 3/4"STROKE
(4.00-HH2HKPVS38Ax1.75")
Q MAX=23 LPM

WIDTH CENTERING
2-1/2" BORE X 1" ROD X 1" STROKE
(2.50-SB2HKPVS19Ax1.00")
Q MAX=23 LPM

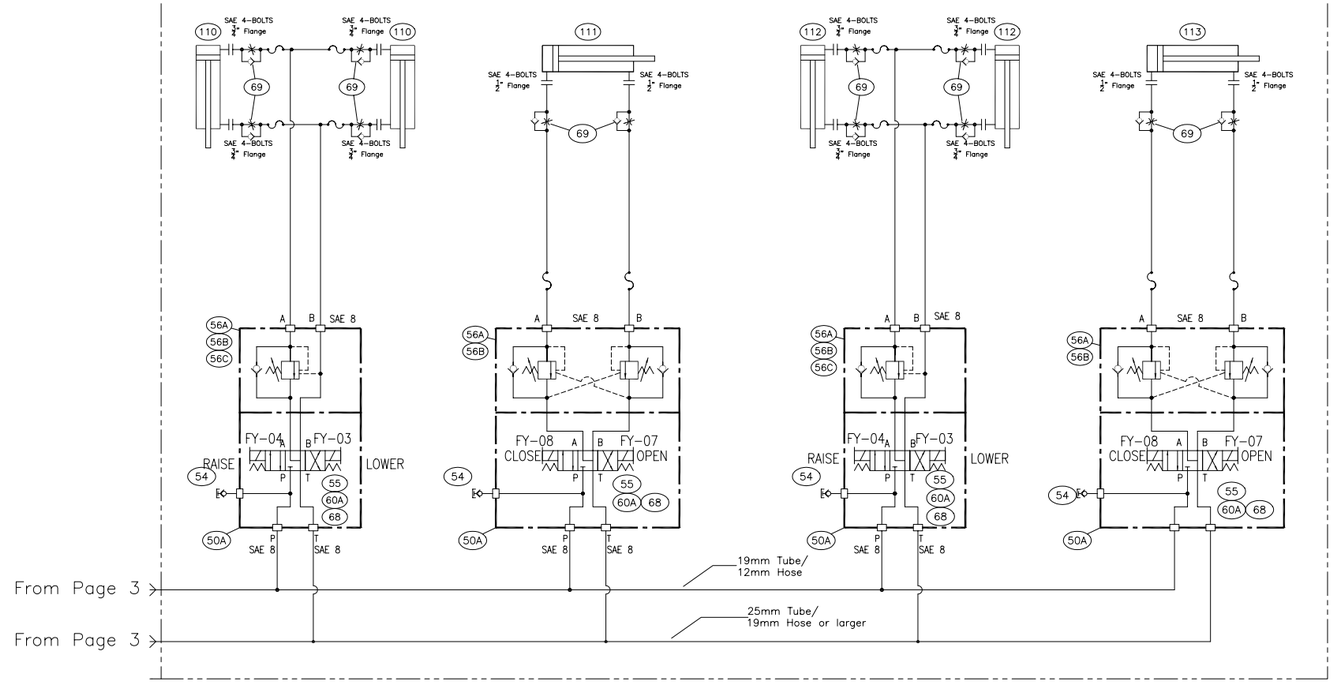
P1+R4B

CARBON BLOCK PRE-STRESSING & PRE-STRESSING CONVEYOR

4481-MZAC-0002

RAISE/LOWER
4"BORE X 1 3/4"ROD X 1 3/4"STROKE
(4.00-HH2HKPVS38Ax1.75")
Q MAX=23 LPM

WIDTH CENTERING
2-1/2" BORE X 1" ROD X 1" STROKE
(2.50-SB2HKPVS19Ax1.00")
Q MAX=23 LPM



Refer to Bill of Material on dwg. 100579-04 and Schematic dwg 100579-01

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DATE:	---	DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NTS
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Vendor or Subcontractor Logo: GNA alutech inc. — Département Ingénierie / Engineering Department, 9695 Trans-Canada, Saint-Laurent, Québec, H4S 1V3, Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx-	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
—	—	—		A3-		-AZ	

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SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
HYDRAULIC
SCHEMATIC

MA'ADEN ALCOA

Légende / Legend

- ligne de pression / pressure line (rouge / red)
- ligne de retoure / return line (bleu / blue)
- ligne de succion / suction line (vert / green)
- ligne de débit controle / controled flow line (Jaune / Yellow)
- ligne de pression réduite / pressure reduced line (Orange)
- ligne de pression augmenté / pressure increase line (Mauve / Violet)
- ligne de drainage / drain Line (Blanc/Noir - White/Black)
- ligne de pilotage / pilot line (red)

Les tolérances s'appliquent aux surfaces machinées, sinon telle que spécifiées

Tolerances apply to machined surfaces, unless otherwise specified

Inches			Millimeters		
X.	=	±.040"	X.	=	±1mm
X.X	=	±.010"	X.X	=	±0.3mm
X.XX	=	±.005"	X.XX	=	±0.1mm
X.XXX	=	±.001"	Angle	=	±1/2°
Fraction	=	±1/32"			
Angle	=	±1/2°			

Material required for machining

Material: | Qty.

PNEUTECH ROUSSEAU

[1] 1475 32nd Ave, Lachine, Quebec H8T 3J1 Tel: 514 635 7000 Fax: 514 635 7012 Fax: 514 635 7010
[2] 445 Rue Des Adirondacks Beauport, Quebec G1C 6S2 Tel: 418 660 0566 Fax: 418 660 0570
[3] 1200 Boul. de Royaume Chicoutimi, Quebec G7H 5B1 Tel: 418 693 5892 Fax: 418 693 1755
[4] 345 Superior Blvd, Unit 1 Mississauga, Ontario L5T 2L6 Tel: 905 565 6403 Fax: 905 565 6417
[5] 205 Enterprise Ave., Kitimat British Columbia V8C 2C8 Tel: 250 632 3271 Fax: 250 632 3278
[6] Hydromen Fluid Power Ltd. 121 Welham Road Barrie, Ontario L4N 8Y3 Tel: 705 722 7985 Fax: 705 722 4556

Fichier / File	100579-01		
Dessine par / Drawn by	Eric Lussier	**Initials**	**Date** Nov. 12 2010
Verifier par / Checked by	Alfredo Tarabuta	**Initials**	**Date** Nov. 12 2010
Approuve par / Approved by	Patrick Berry	**Initials**	**Date** Nov. 12 2010

Client / Customer: GNA

Projet / Project: Hydraulic Power Unit
Page 4 of 5 Hydraulic Schematic Assy.
1394757-00

Bon de Commande / Purchase Order: 00006518

Dessin / Drawing: 100579-02

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HYDRAULIC POWER UNIT LIMITS

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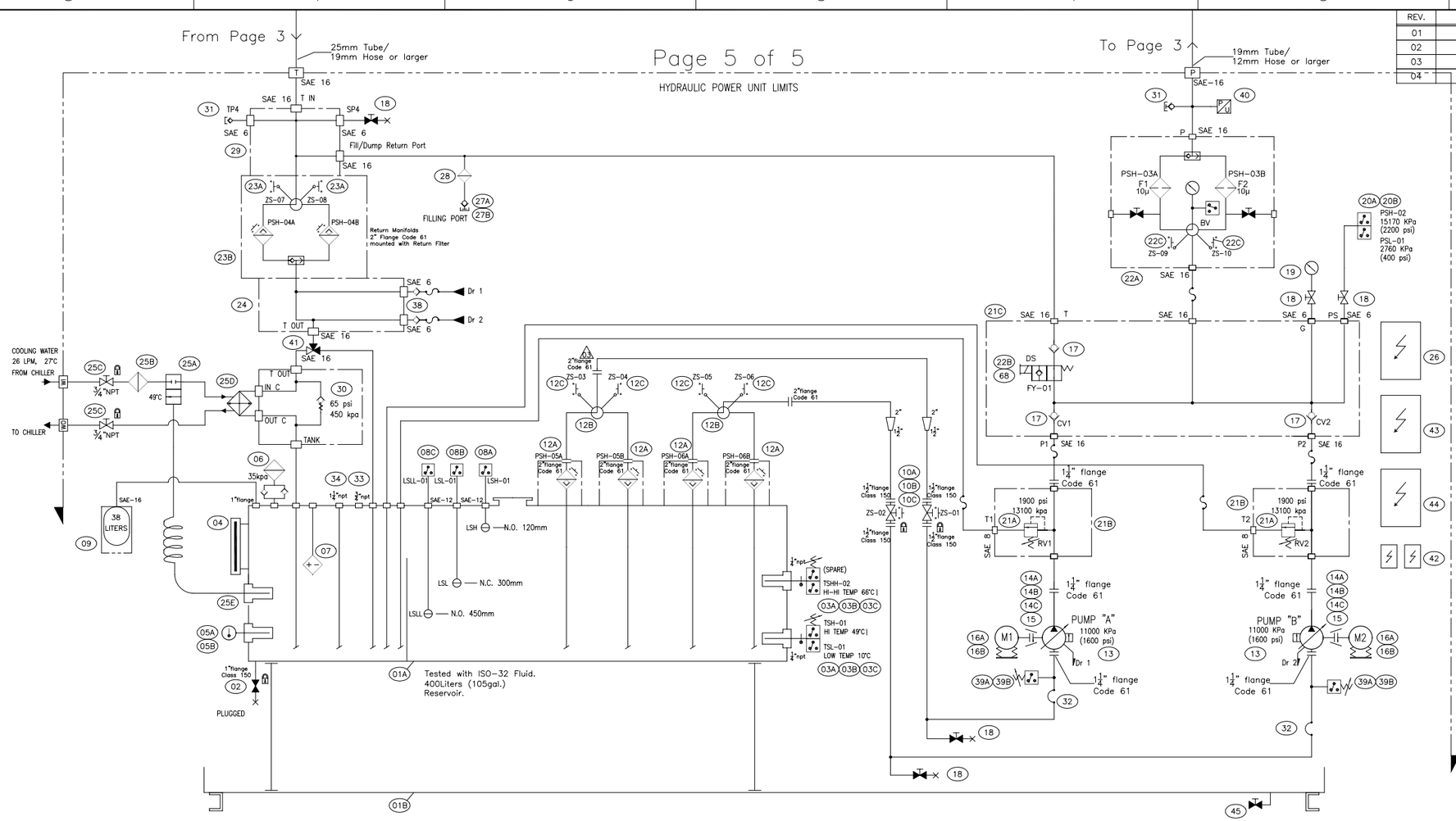

Refer to Bill of Material on dwg. 100579-04 and Schematic dwg 100579-01

NOTE:

1) DESIGNED TO OPERATED IN HIGHLY ABRASIVE, DUST LADEN ATM AND SUITABLE FOR HIGH PRESSURE WASH DOWN WITH DETERGENTS

2) SPECIFICATION : 1347-H1-3001-00
2547-4480-POA-MXA0-0001

3) NOISE LEVEL 85 dB(A)

4) ALL INTERCONNECTION HOSES BY OTHERS

5) G1 CYLINDER #102 LOWERS ONLY BY GRAVITY

6) ITEMS #42 x 2 MOTOR STATION BOX, AND #26 JUNCTION BOX FREE ISSUE

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		0		REVISIONS				

NOTES

STATUS

DRAWN/DES'D:	--	AREA ENG.:	
DATE:	SE.27.'10	DATE:	
CHECKED:	--	PRJ ENG MGR:	
DATE:	---	DATE:	
RESPONSIBLE ENG.	--	CLIENT:	
DATE:	---	DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NTS
DATE:			

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SELLER DRAWING No. 1347-H1-3001 REV. 0

Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie Engineering Department 1010 Jean-Gauvin Saint-Laurent, Québec H4S 1V3 Canada

BECHTEL

Project Title: **Ras Az Zawr Aluminium Smelter**

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
HYDRAULIC
SCHEMATIC

MA'ADEN

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	xx -	xxxx-	xxxx -	xxx -	xxx

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
—	—	—		A3-		-AZ	

Légende **Legend**

ligne de pression / pressure line (rouge / red)
ligne de retoure / return line (bleu / blue)
ligne de sucction / suction line (vert / green)
ligne de débit controle / controled flow line (Jaune / Yellow)
ligne de pression réduite / pressure reduced line (Orange)
ligne de pression augmenté / pressure increase line (Mauve / Violet)
ligne de drainage / drain Line (Blanc/Noir - White/Black)
ligne de pilotage / pilot line (red)

Les tolérances s'appliquent aux surfaces machinées, sinon telle que spécifiées

Tolerances apply to machined surfaces, unless otherwise specified

Inches		Millimeters	
X.	±.040"	X.	±1mm
X.X	±.010"	X.X	±0.3mm
X.XX	±.005"	X.XX	±0.1mm
X.XXX	±.001"	Angle	±1/2°
Fraction	±1/32"		
Angle	±1/2°		

Material required for machining

Material: Qty.

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11475 32nd Ave., Lachine, Quebec H8T 3J1 Tel: 514 635 7000 Fax: 514 635 7012 Fax: 514 635 7010	845 Rue Des Adirondacks Beauport, Quebec G1C 6S2 Tel: 418 660 0566 Fax: 418 660 0570	1200 Boul. de Royaume Chicoutimi, Quebec G7H 5B1 Tel: 418 693 5892 Fax: 418 693 1755	2345 Superior Blvd. Unit 1 Mississauga, Ontario L5T 2L6 Tel: 905 565 6403 Fax: 905 565 6417	2205 Enterprise Ave., Kitimat British Columbia V8C 2C8 Tel: 250 632 3271 Fax: 250 632 3278	Hydramen Fluid Power Ltd. 121 Witham Road Barrie, Ontario L4M 6Y3 Tel: 705 722 7985 Fax: 705 722 4556

Fichier / File	100579-01		
Dessine par / Drawn by	Eric Lussier	**Initials**	**Date** Nov. 12 2010
Verifier par / Checked by	Alfredo Tarabuta	**Initials**	**Date** Nov. 12 2010
Approuve par / Approved by	Patrick Berry	**Initials**	**Date** Nov. 12 2010

Client / Customer: GNA

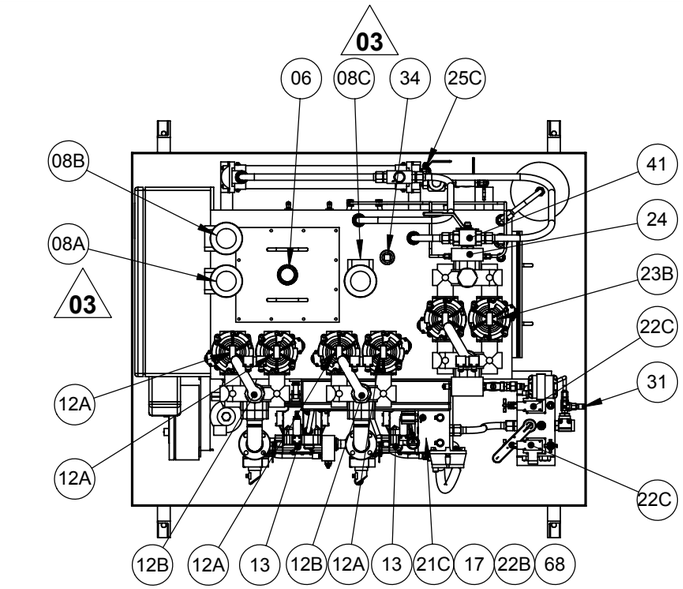
Projet / Project: Hydraulic Power Unit
Page 5 of 5 Hydraulic Schematic Assy.
1394757.00

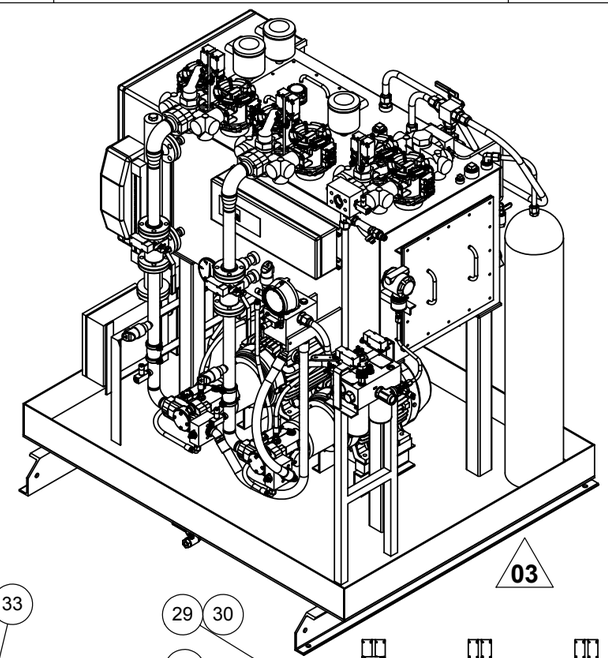
Bon de Cmmande / Purchase Order: 00006518

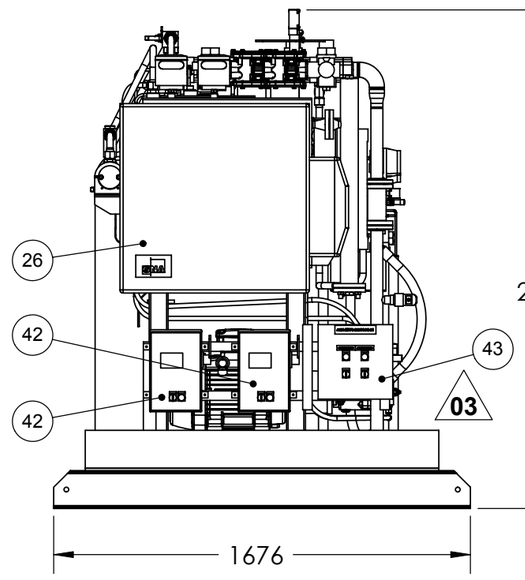
Dessin / Drawing: 100579-01

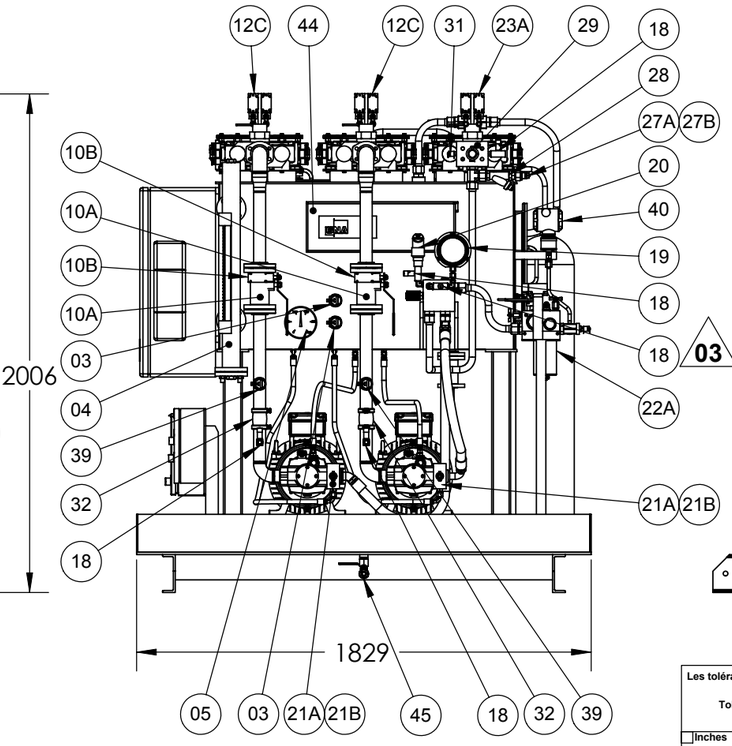
Format / Size	Echelle / Scale	Feuille / Sheet	Rev.
B	fit	5 of 5	04

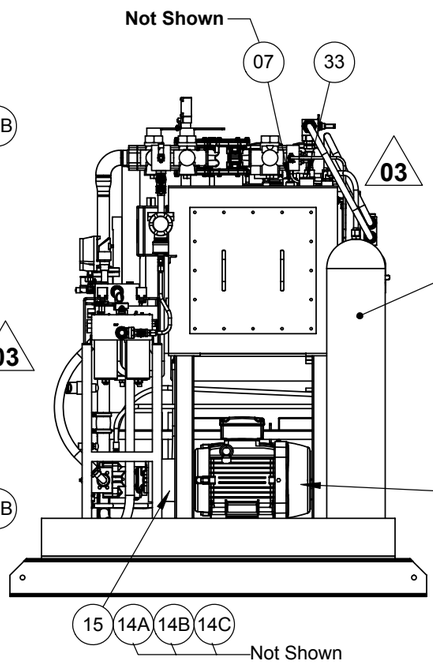
Rev.	Description	Date	By
03	As Built Drawing	2/18/2011	E.L.











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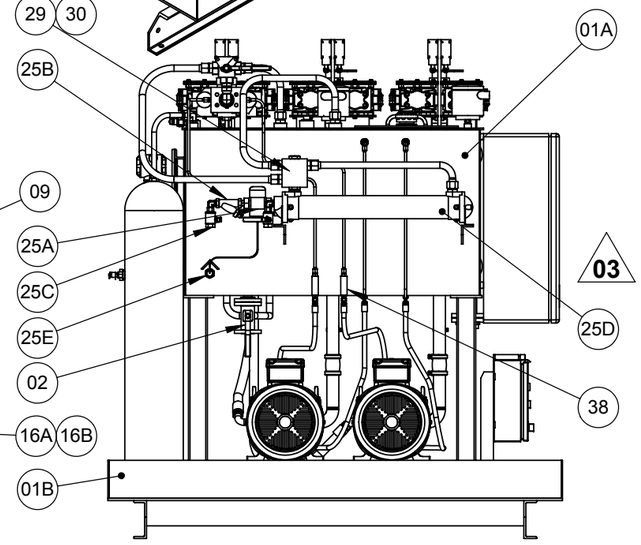

Refer to Schematic 100579-04 and 100579-04 for Bill of Material

Les tolérances s'appliquent aux surfaces machinées, sinon telle que spécifiées

Tolerances apply to machined surfaces, unless otherwise specified

Inches			Millimeters		
X.	=	±.040"	X.	=	±1mm
X.X	=	±.010"	X.X	=	±0.3mm
X.XX	=	±.005"	X.XX	=	±0.1mm
X.XXX	=	±.001"	Angle	=	±1/2°
Fraction	=	±1/32"			
Angle	=	±1/2°			

Material required for machining

Material:	Qty.

PNEUTECH ROUSSEAU

1475 32nd Ave. Lachine, Quebec H8T 3J6 Tel: 514 635 7000 Fax: 514 635 7012 Fax: 514 635 7010

445 Rue Des Adirondacks Beauport, Quebec G1C 6S5 Tel: 418 660 0566 Fax: 418 660 0070

1200 Boul. de Royaume Chicoutimi, Quebec G7H 5B1 Tel: 418 693 5992 Fax: 418 693 1765

345 Superior Blvd. Unit 1 Mississauga, Ontario L5T 2L6 Tel: 905 565 6463 Fax: 905 565 6477

205 Enterprise Ave., Kitimat British Columbia V8C 2J3 Tel: 250 632 3271 Fax: 250 632 3278

Hydramen Fluid Power Ltd. 121 Welham Road Barrie, Ontario L4N 8Z6 Tel: 705 722 7885 Fax: 705 722 4056

Fichier / File: 100579-02

Dessine par / Drawing by: Eric Lussier	Initials	Date: Dec. 21 2010	Bon de command/Purchase Order: 00006518
Vérfier par / Cecked by: Alfredo Tarabuta	Initials	Date: Dec. 21 2010	Dessin / Drawing: 100579-02
Aprouver par / Approved by: Patrick Berry	Initials	Date: Dec. 21 2010	Format / Size: B; Echelle / Scale: SCALE: 1:24; Feuille/ Sheet: SHEET 1 of 4; Rev.: 03

Client / Customer: GNA

Projet / Project: 400L Hydraulic Power Unit

Drawing assembly

1394757-02

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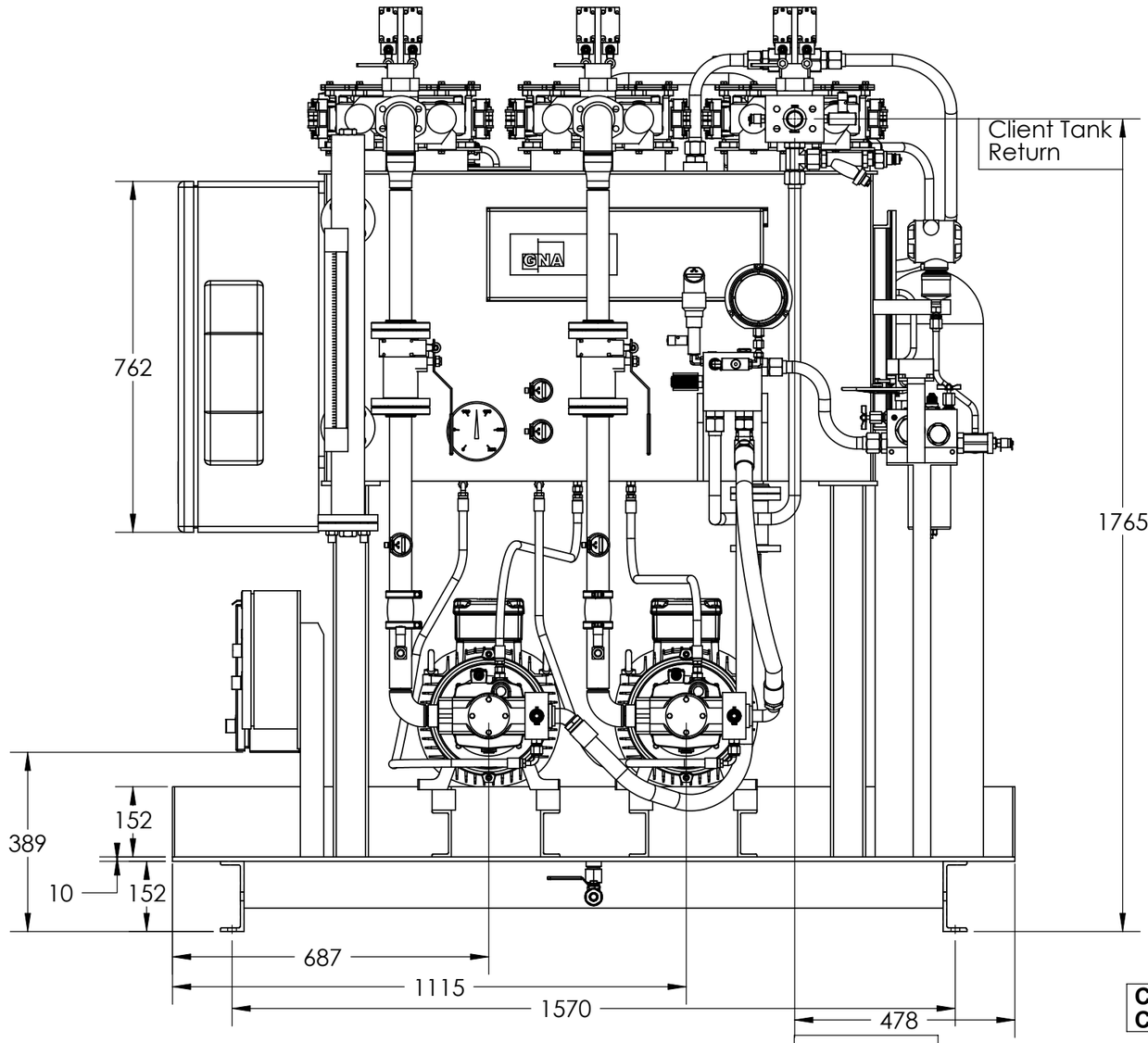
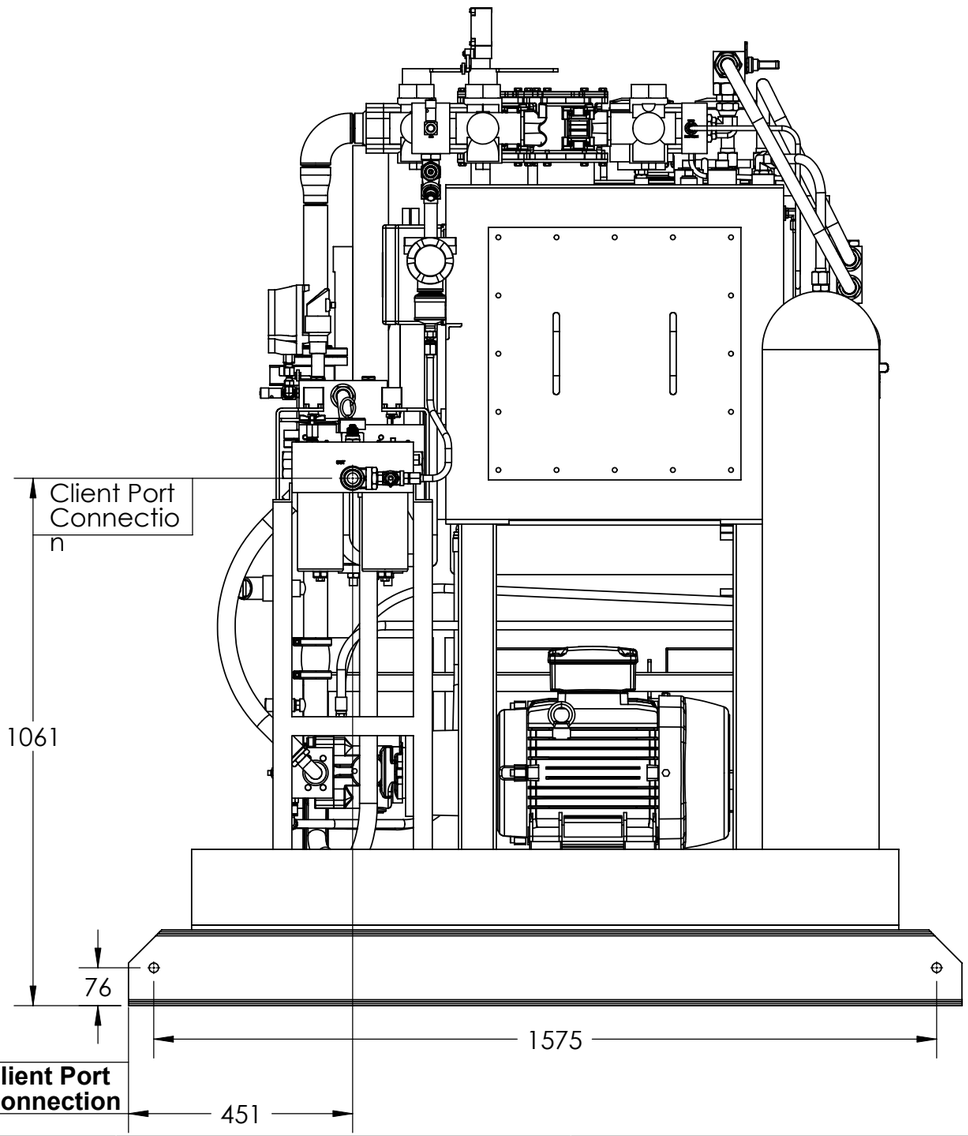
REV.	ECN#	DATE	DESCRIPTION		BY
Rev.	ECN#	Date	Description fr.	Description Eng.	By.





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Angle	=	±1/2°			

Material required for machining

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Fichier / File: 100579-02

Dessine par / Drawing by	Initials	Date
Eric Lussier		Dec. 21 2010
Vérfier par / Cecked by	Initials	Date
Alfredo Tarabuta		Dec. 21 2010
Aprouver par / Approved by	Initials	Date
Patrick Berry		Dec. 21 2010

Client / Customer: GNA

Projet / Project: 400L Hydraulic Power Unit

Drawing assembly

1394757-02

Bon de command/Purchase Order: 00006518

Dessin / Drawing: 100579-02

Format / Size	Echelle / Scale	Feuille/ Sheet	Rev.:
B	SCALE: 1:32	SHEET 2 of 4	03

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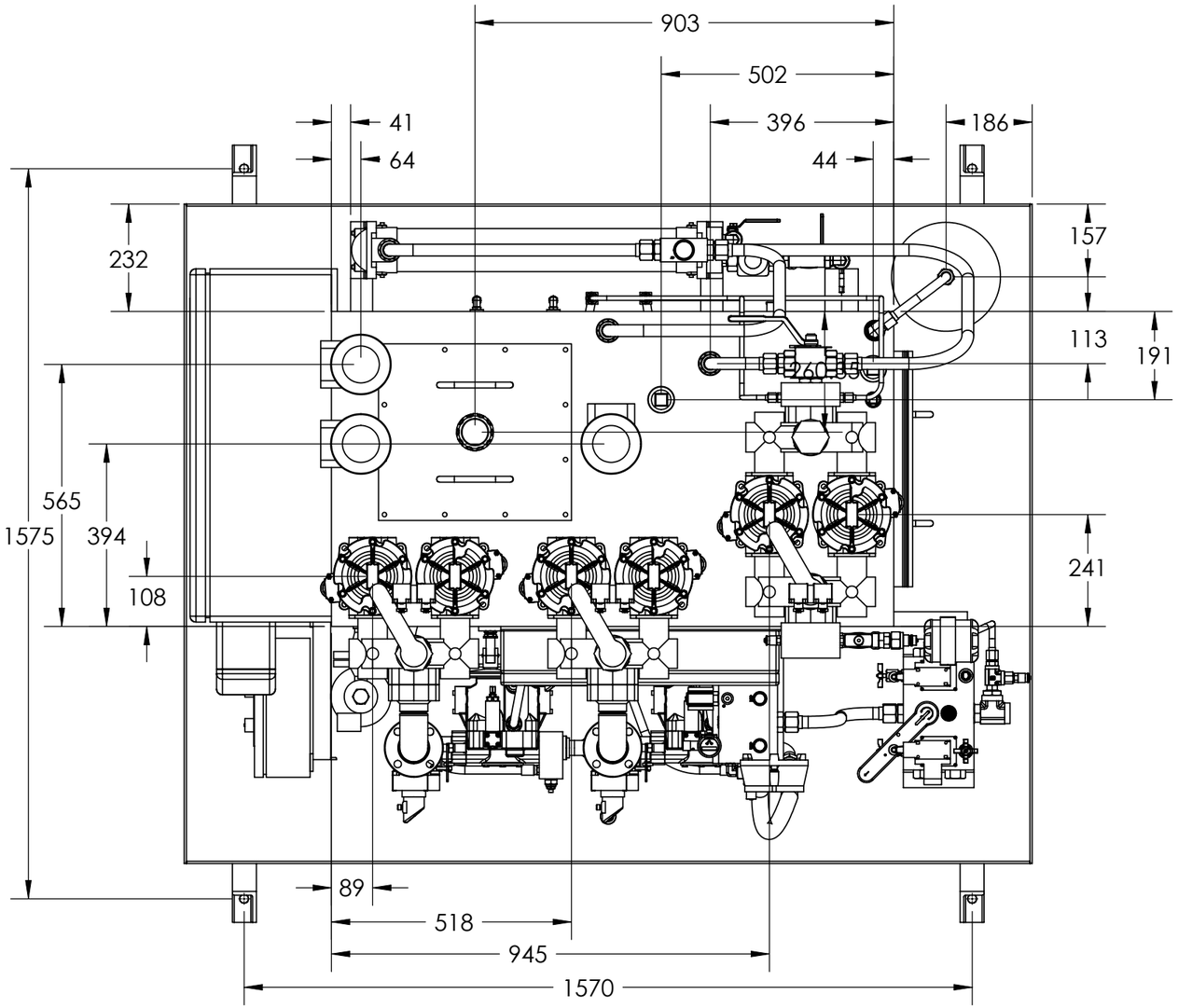

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Angle	=	±1/2°			

Material required for machining

Material:	Qty.

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Fichier / File			
100579-02			
Dessine par / Drawing by	Initials	Date	
Eric Lussier		Dec. 21 2010	
Vérfier par / Cecked by	Initials	Date	
Alfredo Tarabuta		Dec. 21 2010	
Aprouver par / Approved by	Initials	Date	
Patrick Berry		Dec. 21 2010	

Client / Customer			
GNA			
Projet / Project			
400L Hydraulic Power Unit			
Drawing assembly			
1394757-02			
Bon de command/Purchase Order			
00006518			
Dessin / Drawing			
100579-02			
Format / Size	Echelle / Scale	Feuille/ Sheet	Rev.:
B	SCALE: 1:32	SHEET 3 of 4	03

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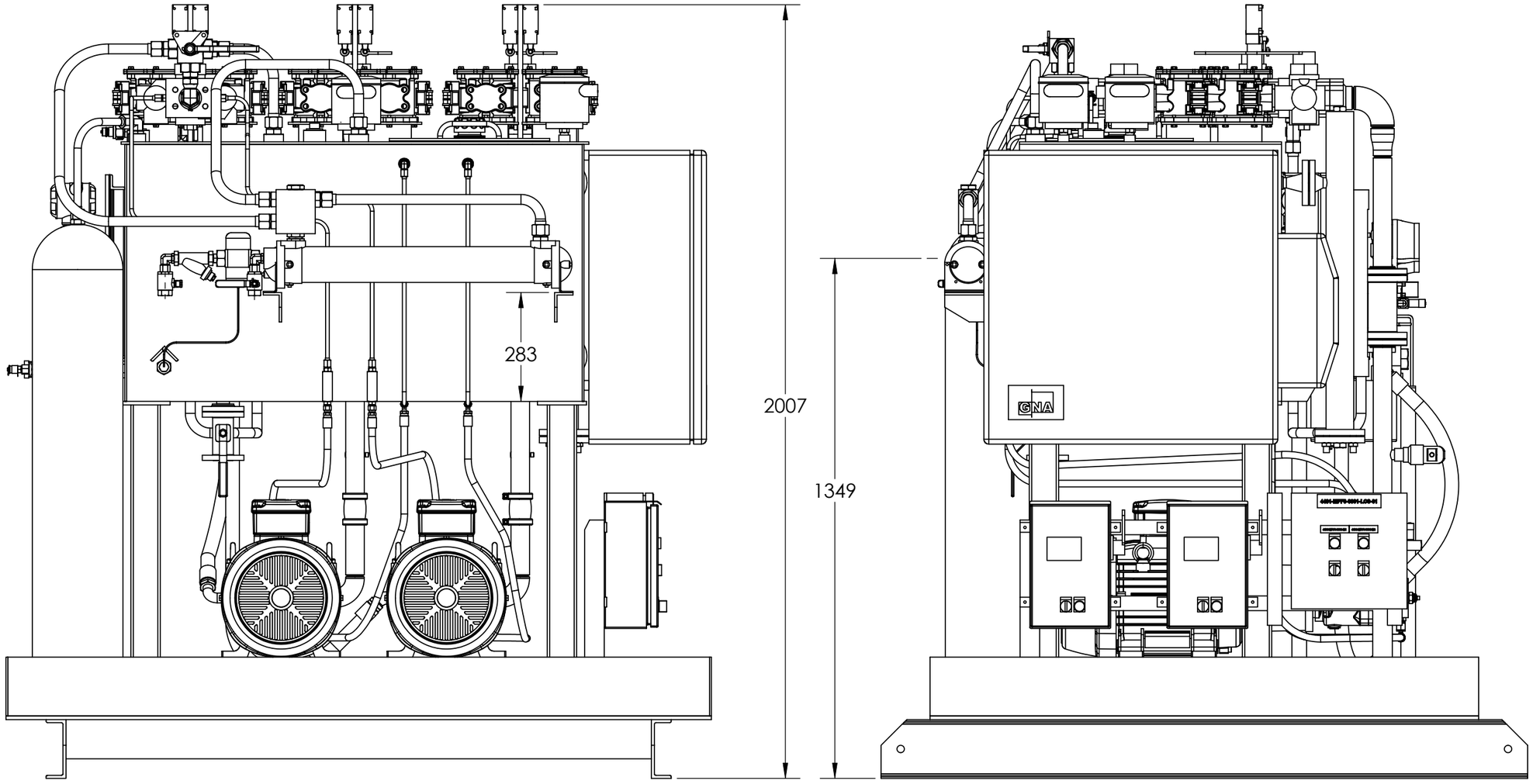
Rev.	ECN#	Date	Description fr.	Description Eng.	By.



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X.XXX	=	±.001"	Angle	=	±1/2°
Fraction	=	±1/32"			
Angle	=	±1/2°			

Material required for machining

Material:	Qty.

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Fichier / File			
100579-02			
Dessine par / Drawing by	Initials	Date	
Eric Lussier		Dec. 21 2010	
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Client / Customer			
GNA			
Projet / Project			
400L Hydraulic Power Unit			
Drawing assembly			
1394757-02			
Bon de command/Purchase Order			
00006518			
Dessin / Drawing			
100579-02			
Format / Size	Echelle / Scale	Feuille/ Sheet	Rev.:
B	SCALE: 1:32	SHEET 4 of 4	03

REV.	ECN#	DATE	DESCRIPTION	BY
01	--	Nov. 16 2010	Completed the Bill of Material 103-113 and correction of dwg #	E.L.
02	--	Nov. 30 2010	Modified componants where indicated	A.T.
03	--	Jan. 17 2011	Componants and quantity correction where indicated	E.L.
04	--	Mar. 01 2011	Componants and quantity correction where indicated	E.L.

ITEM	QTY	PART No.	DESCRIPTION	MANUFACTURE
25B	1	310-3004	Y-STRAINER 3/4"npt	American Industrial
25A	1	310-1008	THERMOSTATIC VALVE 3/4"npt c/w BULB 310-2001	American Industrial
24	1	110-000144	DRAIN LINE RETURN MANIFOLD	Pneutech-Rousseau
23B	1	---------->	DILP110QVMEME35Y9Y91	
			RETURN FILTER 10mic. 25psid	PARKER
23A	2	XCK-J...H7	LIMIT SWITCH c/w ZCK-E05	TELEMECANIQUE
22C	2	XCK-J...H7	LIMIT SWITCH c/w ZCK-E05	TELEMECANIQUE
22B	1	DSH101NRMVD024LDR	2/2 SOLENOID VALVE N.O.	PARKER
22A	1	30PD110QHVEKS1621	DUPLEX PRESSURE FILTER 10mic.	PARKER
21C	1	110-000142	PRESSURE BLOCK	Pneutech-Rousseau
21B	2	110-000141	FLANGE BLOCK WITH RELIEF	Pneutech-Rousseau
21A	2	RAH101S30V	RELIEF VALVE	PARKER
20B	1	889D-F4AC-5	CABLE	ALLEN BRADLEY
20A	1	836E-DA1CC1D4	PROGRAMMABLE DUAL PNP PRESSURE SWITCH 6000psi	ALLEN BRADLEY
19	1	PPC5073-SF45-TC	4 1/2" GAUGE Kpa/PSI 1/2" NPT CONNECTION	WINTERS
18	5	PN620SV	PARTROL NEEDLE VALVE	PARKER
17	3	CVH103PV	CARTRIDGE CHECK VALVE	PARKER
16B	4	SM2-160M	VIBRATION PAD	PNEUTECH
16A	2	M3AA160MLA	11kW(15hp) 1772rpm,460/3/60, TEFC, 160M metric frame	ABB
15	2	M180ML722B	BELLHOUSING	MAGNALOY
14C	2	M470V8	COUPLING INSERT	MAGNALOY
14B	2	M40002808	HALF COUPLING METRIC BORE	MAGNALOY
14A	2	M400M4212	HALF COUPLING METRIC BORE	MAGNALOY
13	2	PVP23362R2V21	VARI. PIST. PUMP 23cc/rev, 35lpm(9.2gpm)max @ 1800rpm	PARKER
12C	4	XCK-J...H7	LIMIT SWITCH c/w ZCK-E05	TELELMECANIQUE
12B	2	926758	CHANGEOVER VALVE ASSY.	PARKER
12A	4	F3CF2174PE3-F9Y91	SUCTION FILTER	PARKER
11		NOT USED		
10C	2	--	BRACKET	Pneutech-Rousseau
10B	2	XCK-J...H7	LIMIT SWITCH c/w ZCK-E05	TELEMECANIQUE
10A	2	1.5"9150313636TTT2	1.5" FLANGE SS BODY c/w SS STEM FULL PORT	METSO-JAMESBURY
09	1	KV10FOT-28-A2	KLEENVENT, 10gal, viton ** Fiberglass	PARKER
08C	1	---------->	75ML56300AD000HA0-Zy01=120mm	
			CLS POINTEK LEVEL SWITCH	SIEMENS
08B	1	---------->	75ML56300AD000HA0-Zy01=300mm	
			CLS POINTEK LEVEL SWITCH	SIEMENS
08A	1	---------->	75ML56300AD000HA0-Zy01=450mm	
			CLS POINTEK LEVEL SWITCH	SIEMENS
07	1	SL-11	MAGNET	VESCOR
06	1	PAB.1730.10.5	BREATHER PRESSURISABLE, 5psi, 3/4"npt, 10mic.	PARKER
05B	1	TW01-A12-L04	4 " SS WELL 1/2" npt INSIDE 3/4" npt OUTSIDE	--
05A	1	50-EL42E-040-XCS	5" THERMOMETER W/ TILT HEAD	DRESSER-ASCHCROFT
04	1	BM26A	SIGHT GLASS	KROHNE
03C	2	889D-F4AC-5	CABLE	ALLEN-BRADLEY
03B	2	TBR25-1	THERMO WELL	WINTERS
03A	2	837E-DA1BN1A1D4	DUAL PNP PROGRAMMABLE TEMERATURE SWITCH	ALLEN BRADLEY
02	1	1"7150-313636TTT2	1"FLANGE SS BODY c/w SS STEM	METSO-JAMESBURY
01B	1		110% DRIP TRAY	Pneutech-Rousseau
01A	1		400L (105gal.) RESERVOIR OVERHEAD TYPE	Pneutech-Rousseau

ITEM	QTY	PART No.	DESCRIPTION	MANUFACTURE
		72-99 Not Used		
71	1	D1VW004KVJP	Description Eng.	Manufacture
70	6	F620SV	FLOW CONTROL VALVE SAE-6	PARKER
69	39	F820SV	FLOW CONTROL VALVE SAE-8	PARKER
68	33	P5103-3831000	DIN CONNECTOR 24vdc	CANFIELD
		65-67 Not Used		
64	2	DD03P022S	MANIFOLD, DO3, SAE-8, DUCTILE IRON	DAMAN
63	1	FM2AAKV	FLOW CONTROL VALVE	PARKER
62C	2	B10-2-8T	CARTRIDGE BODY	PARKER
62B	3	CAP024D	COIL 28w 24vdc DIN	PARKER
62A	3	DSH102CTV	2/2 SOLENOID VALVE N.C. VITON 24vdc	PARKER
		61 Not Used		
60C	1	BK209	BOLT KIT	PARKER
60B	1	BK244	BOLT KIT	PARKER
60A	14	BK243	BOLT KIT	PARKER
59	2	D1VW020BVJW	DIRECTIONAL VALVE DO3	PARKER
		57 TO 58 Not Used		
56C	4	P10-3A-V	PLUG VITON	PARKER
56B	15	BD03-DDX-VS	BODY FOR CB VALVE SANDWICH	PARKER
56A	26	CB101-AS10V	COUNTERBALANCE VALVE	PARKER
55	13	D1VW004CVJW	DIRECTIONAL VALVE DO3 24vdc	PARKER
54	12	EMA3/7/16-20UNF2A	TEST COUPLER	PARKER
53B	1	P10-2-V	PLUG VITON	PARKER
53A	1	BD03-ABX-VS	CARTPAK BODY, SANDWICH DO3, STEEL	PARKER
--	--	52 Not used		
51	1	DD03P032S	MANIFOLD 3 STATIONS, DO3, SAE-8 DUCTLE IRON	DAMAN
50B	3	DD3SPSB6S	SUBPLATE DO3, 1 STATION, SAE-6, DUCTILE IRON	DAMAN
50A	6	DD3SPSB8S	SUBPLATE DO3, 1 STATION, SAE-8, DUCTILE IRON	DAMAN
		46-49 Not Used		
45	1	XV500P-12	DRAIN BALL VALVE 3/4npt	PARKER
44	REF	1534510	GNA JUNCTION BOX	GNA
43	REF	4481MPF00001LCS01	GNA MOTOR CONTROL BOX	GNA
42	REF	4481MPF00001M*LDS	GNA DISCONNECT BOX	GNA
41	1	BV3D16S1SS1VA	3WAY BALL VALVE	PARKER
40	1	3051T-G4A2B21A	PRESSURE TRANSMITTER	ROSEMOUNT
39B	2	889D-F4AC-5	CABLE	ALLEN BRADLEY
39A	2	836E-DA1EU1D4	PROGRAMMABLE DUAL PNP PRESSURE SWITCH	ALLEN BRADLEY
38	2	C620SV*	CHECK VALVE MODIFIED	PARKER
		35 to 37 Not Used		
34	1	--	SPARE RETURN 1 1/4"npt	Pneutech-Rousseau
33	1	--	SPARE DRAIN 3/4"npt	Pneutech-Rousseau
32	2	NH1600V125B0325	FLEXMASTER	AEROQUIP
31	2	EMA3/7/16-20UNF2A	TEST COUPLER	PARKER
30	1	CVH161P65V	CHECK VALVE	PARKER
29	1	110-000143	RETURN MANIFOLD	Pneutech-Rousseau
28	1	310-3004	Y-STRAINER 3/4"npt	American Industrial
27B	1	5209-4M	DUST COVER	PARKER
27A	1	6610-12-10	FILLING COUPLER	PARKER
26	REF	4481MPF00001CP01	CONTROL CABINET	GNA
25E	1	310-2002	WELL	American Industrial
25D	1	SAE703-A4-FP	WATER/OIL COOLER	American Industrial
25C	2	XV500P-12	BRASS BALL VALVES 3/4"npt	PARKER

ITEM	QTY	PART No.	DESCRIPTION	MANUFACTURE
113	1	---------->	2.50SB2HKPVS19Ax1.00"	
			2H HYD. CYL. 2.50"bore, 1.00" stroke, METALIC ROD WIPER	
			c/w 132291 ROD EYE, 83963 PIVOT PIN	
			83948 CLEVIS BRACKET	PARKER
112	2	---------->	4.00HH2HKPVS38Ax1.75" 3/4 Flange	
			2H HYD. CYL. 4.00"bore, 1.75" stroke, METALIC ROD WIPER	
111	1	---------->	2.50SB2HKPVS19Ax1.00"	
			2H HYD. CYL. 2.50"bore, 1.00" stroke, METALIC ROD WIPER	
			c/w 132291 ROD EYE, 83963 PIVOT PIN 1/2 Flange	
			83948 CLEVIS BRACKET	PARKER
110	2	---------->	4.00CHH2HKPVS38ACx1.75" 3/4 Flange	
			2H HYD. CYL. 4.00"bore, 1.75" stroke, METALIC ROD WIPER	
109	1	---------->	2.50CD2HKPVS13ACx10.562"	
			2H HYD. CYL. 2.50"bore, 10.562" stroke, METALIC ROD WIPER	
			c/w 132291 ROD EYE, 83963 PIVOT PIN	
			83948 CLEVIS BRACKET 1/2 Flange	PARKER
108	1	---------->	2.50CD2HKPVS13ACx6.00"	
			2H HYD. CYL. 2.50"bore, 6.00" stroke, METALIC ROD WIPER	
			c/w 132291 ROD EYE, 83963 PIVOT PIN 1/2 Flange	
			83948 CLEVIS BRACKET	PARKER
107	1	---------->	2.50BB2HKPVS14Ax2.125"	
			2H HYD. CYL. 2.50"bore, 2.125" stroke, METALIC ROD WIPER	
			c/w 50942 ROD CLEVIS, 68369 PIVOT PIN 1/2 Flange	
			69196 MOUNTING PLATE	PARKER
106	1	---------->	2.50CJB2HKPVS34ACx11.00" 1/2 Flange	
			2H HYD. CYL. 2.50"bore, 11.00" stroke, METALIC ROD WIPER	
105	1	---------->	2.00CBB2HKTVS14ACx8.73"	
			2H HYD. CYL. 2.00"bore, 8.73" stroke, METALIC ROD WIPER	
			c/w 50942 ROD CLEVIS, 68369 PIVOT PIN	
			69196 EYE BRACKET SAE-10	PARKER
104	2	---------->	2.00CSB2HKTVS19ACx7.00"	
			2H HYD. CYL. 2.00"bore, 7.0" stroke, METALIC ROD WIPER	
			c/w 132291 ROD EYE, 83963 PIVOT PIN	
			83948 CLEVIS BRACKET SAE-10	PARKER
103	2	---------->	2.50CD2HKPVS33ACx7.88"	
			2H HYD. CYL. 2.50"bore, 7.88" stroke, METALIC ROD WIPER	
			STOP TUBE 3" NET STROKE 4.88" 1/2 Flange	
			c/w 85361 EYE BRACKET, 50994 ROD CLEVIS	
			68370 PIVOT PIN, 69198 EYE BRACKET, 68371 PIVOT PIN	
102	1	---------->	4.00CDB2HKPVS14ACx20.00"	
			2H HYD. CYL. 4.00"bore, 20.0" stroke, METALIC ROD WIPER	
			c/w 50945 ROD CLEVIS, 68371 PIVOT PIN 3/4 Flange	PARKER
101	2	---------->	4.00CBB2HKPVS24ACx19.00"	
			2H HYD. CYL. 4.00"bore, 19.0" stroke, METALIC ROD WIPER	
			c/w 50948 ROD CLEVIS, 68373 PIVOT PIN 3/4 Flange	PARKER
100	4	---------->	2.50CSB2HKTVS27ACx23.00"	
			2H HYD. CYL. 2.50"bore, 11.0" stroke, METALIC ROD WIPER	
			c/w 132291 ROD EYE, 83963 PIVOT PIN	
			83948 CLEVIS BRACKET SAE-10	PARKER

Refer to dwg. 100579-01 and 100579-02

DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
REFERENCES		REVISIONS						

NOTES

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SELLER DRAWING No. 1347-H1-3001 REV. 0

STATUS

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DATE:	---	DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NTS
DATE:			

Vendor or Subcontractor Logo: GNA alutech inc. Département Ingénierie Engineering Department 6600 Trans-Canada Suite/Laurent, Quebec H4S 1V3 Canada

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
HYDRAULIC
SCHEMATIC

MA'ADEN ALCOA

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-00AZ-	XX -	XXXX -	XXXX -	XXX -	XXX

Type	Building	Discipline	Phase	Format	Sequentiel	Location	Rev. No.
	-	-	-	A3-		-AZ	

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PNEUTECH ROUSSEAU

COSTUMER APROUVAL
APPROBATION DU CLIENT

NAME:

DATE:

Légende	Legend
ligne de pression / pressure line	(rouge / red)
ligne de retoure / return line	(bleu / blue)
ligne de sucction / suction line	(vert / green)
ligne de débit controle / controled flow line	(Jaune / Yellow)
ligne de pression réduite / pressure reduced line	(Orange)
ligne de pression augmenté / pressure increase line	(Mauve / Violet)
ligne de dralnage / drain Line	(Blanc/Noir - White/Black)
ligne de pilotage / pilot line	(red)

Les tolérances s'appliquent aux surfaces machinées, sinon telle que spécifiées

Tolerances apply to machined surfaces, unless otherwise specified

Inches			Millimeters		
X.	=	±.040"	X.	=	±1mm
X.X	=	±.010"	X.X	=	±0.3mm
X.XX	=	±.005"	X.XX	=	±0.1mm
X.XXX	=	±.001"	Angle	=	±1/2°
Fraction	=	±1/32"			
Angle	=	±1/2°			

Matertal required for machining

Material: Qty.

PNEUTECH ROUSSEAU

1475 32nd Ave. Lachine, Quebec H8T 3J1 Tel: 514 635 7000 Fax: 514 635 7012 Fax: 514 635 7010	645 Rue Des Adirondacks Beauport, Quebec G1C 6S2 Tel: 418 660 0566 Fax: 418 660 0570	1200 Boul. de Royaume Chicoutimi, Quebec G7H 5B1 Tel: 418 693 5892 Fax: 418 693 1755
345 Superior Blvd. Unit 1 Mississauga, Ontario L5T 2L6 Tel: 905 565 6403 Fax: 905 565 6417	1205 Enterprise Ave., Kelowna British Columbia V8C 2C8 Tel: 250 632 3271 Fax: 250 632 3278	Hydramen Fluid Power Ltd. 121 Waltham Road Barrie, Ontario L4N 8Y3 Tel: 705 722 7985 Fax: 705 722 4558

Fichier / File	100579-04		
Dessine par / Drawn by	Eric Lussier	Initials	Date: Nov. 12 2010
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Approuve par / Approved by	Patrick Berry	Initials	Date: Nov. 12 2010

Client / Customer	GNA			
Projet / Project	Hydraulic Power Unit Bill of Material 1394757-00			
Bon de Cmmande / Purchase Order	00006518			
Dessin / Drawing	100579-04			
Format / Size	B	Echelle / Scale	fit	Feuille / Sheet: 1 of 1
Rev.	04			

ITEM	QTY	D E S C R I P T I O N			TOTAL QUANTITY INSTALLED FOR THE PACKAGE	QUANTITY RECOMENDED SPARES FOR 2 YEARS OPERATIONS	QUANTITY RECOMENDED FOR CAPITAL/ INSURANCE SPARES	SIZE AND DIMENSIONS L X W X H (mm)	GROSS WEIGHT (Kg)	UNIT WEIGHT (Kg)	PLANNED DELIVERY TIME (WORKING DAYS)	UNIT PRICE CURRENCY
No.	Req'd	Model	Manufacturer	Equipment type								
SPARE PARTS LIST												
5A	1	50-EL42E-040-XCS	Dresser -aschroft	5" THERMOMETER W/ TILT HEAD	1	1		200X200X400	1	1	30	CAD
6	1	PAB.1730.10.5		Parker breather pressurisable, 5psi, 3/4"npt, 10microns	1	1		100X100X100	0.5	0.5	15	CAD
12	4	925043	Parker	Element 74W single length Viton	4	4		150X150X400	8	2	15	CAD
12	1	924966	Parker	3 PSID Electrical	2	1		200X200X200	0.5	0.5	15	CAD
12B	2	XCKJ10511H7	Sneider Telemecanique	Limit switch (installed on item 10)	11	2		50X50X100	2	1	15	CAD
13	2	SKPVP23/33V20	Parker	Pump Seal kit		2		200X200X10	1	0.5	30	CAD
13	1	PVP23362R2V	Parker	var piston pump, 23cc/rev, 35lpm (9.2gpm)max. @ 1800rpm	2	1	1	400X400X300	20	20	45	CAD
14B	2	M470N6	Magnaloy	Insert	2	2		100X100X100	1	0.5	15	CAD
19	1	PPC5073SF	Winters	Dual scale pressure gauge 0-3000psi	1	1	1	200X200X400	1	1	30	CAD
22	1	929599	Parker	Visual elecric indicator	4	1		100X200X200	0.5	0.5	15	CAD
22	2	932627Q	Parker	10 micron high collapse, single, viton	2	2		150X150X400	2	1	15	CAD
22B	1	DSH101NRMV-D024LDR	Parker	2/2 solenoid valve, N.O, overide, viton, 24vdc with diode	1	1	1	100X50X50	0.5	0.5	30	CAD
22b	1	CAP024D	Parker	24 VDC coil	1	1		50X50X50	0.5	0.5	15	CAD
23	2	937403Q	Parker	Element 10micron, single, viton	2	2		150X150X400	2	1	15	CAD
23	2	926643	Parker	Electrical indicator	2	2		100X200X200	1	0.5	15	CAD
23	2	926748	Parker	Visual indicator	2	2		100X200X200	1	0.5	15	CAD
31	2	EMA3/7/16-20UNF-2A	Parker	Test coupler, SAE-4 with cover	4	2		50X50X50	1	0.5	15	CAD
55	1	D1VW004CVJW	Parker	dcv D03, spring center, 24vdc, to receive din conn. (signal ligths required)	11	1	1	300X100X100	5	5	30	CAD
55A	1	SKD1VW	Parker	Seal kit	11	1	1	50X50X50	0.1	0.1	15	CAD
55B	5	CK1860414-30-24	Parker	24 VDC Coils	33	5		50X50X100	2.5	0.5	15	CAD
68	5	P5103-3831000	Canfield	Connector din 24vdc w. ligth, ISO 1/2"npt conduit, w. transorb	38	5	1	50X50X50	2.5	0.5	15	CAD
56	2	CB101-AS10V	Parker	Counterbalance valve, ratio 3:1,300-1500 psi, viton	26	2		50X50X100	1	0.5	30	CAD
56A	1	BD03-DDX-VS	Parker	Body for cb valve, sandwich D03, steel (need plug to make single if required)	15	1		50X50X100	1	1	45	CAD
59	1	D1VW20BVJW	Parker	DCV D03, spring offset, 24vdc, to receive din conn.	2	1	1	300X100X100	5	5	30	CAD
60	1	D1VW004KVJW	Parker	DCV D03, 2 position spring to center, 24vdc, to receive din conn.	13	1	1	300X100X100	5	5	30	CAD
62	3	DSH102CVSP-D024D	Parker	2/2 solenoid valve, N.C, overide, viton, 24vdc with diode	3	3	1	100X50X50	1.5	0.5	30	CAD
69	2	F820SV	Parker	Flow control, SAE8	38	2	2	100X50X50	4	2	30	CAD
70	2	F620SV	Parker	Flow control, SAE6	6	2	2	100X50X50	2	1	30	CAD

ITEM	QTY	D E S C R I P T I O N			TOTAL QUANTITY INSTALLED FOR THE PACKAGE	QUANTITY RECOMENDED SPARES FOR 2 YEARS OPERATIONS	QUANTITY RECOMENDED FOR CAPITAL/ INSURANCE SPARES	SIZE AND DIMENSIONS L X W X H (mm)	GROSS WEIGHT (Kg)	UNIT WEIGHT (Kg)	PLANNED DELIVERY TIME (WORKING DAYS)	UNIT PRICE CURRENCY
No.	Req'd	Model	Manufacturer	Equipment type								
CYLINDER SPARE PARTS LIST												
101	1	RGWAHL0255	Parker	2 1/2" Gland Kit metalic rod wiper	4	1		100X100X100	5	5	15	CAD
101	2	RKWAHL0255	Parker	2 1/2" Rod Kit metalic rod wiper	4	2		100X100X100	10	5	15	CAD
101	2	PK402HK005	Parker	4" Piston kit Hi-load	2	2		100X100X10	1	0.5	15	CAD
102	1	RGWAHL0175	Parker	1 3/4" Gland Kit metalic rod wiper	2	1		100X100X100	5	5	15	CAD
102	2	RKWAHL0175	Parker	1 3/4" Rod Kit metalic rod wiper	2	2		100X100X100	10	5	15	CAD
102	2	PK402HK005	Parker	4" Piston kit Hi-load	1	2		100X100X10	1	0.5	15	CAD
103	1	RGWAHL0135	Parker	1 3/8" Gland Kit metalic rod wiper	1	1		100X100X100	5	5	15	CAD
103	2	RKWAHL0135	Parker	1 3/8" Rod Kit metalic rod wiper	1	2		100X100X100	10	5	15	CAD
103	2	PK252HK005	Parker	2.5" Piston kit Hi-load	2	2		100X100X10	1	0.5	15	CAD
104	1	RGWAHL0105	Parker	1 " Gland Kit metalic rod wiper	2	1		100X100X10	0.5	0.5	15	CAD
104	2	RKWAHL0105	Parker	1 " Rod Kit metalic rod wiper	2	2		100X100X10	1	0.5	15	CAD
104	2	PK202HK005	Parker	2.0" Piston kit Hi-load	2	2		100X100X10	1	0.5	15	CAD
105	0	RGWAHL0105	Parker	1 " Gland Kit metalic rod wiper	2	0		100X100X100	0	5	15	CAD
105	1	RKWAHL0105	Parker	1 " Rod Kit metalic rod wiper	2	1		100X100X10	0.5	0.5	15	CAD
105	1	PK202HK005	Parker	2.0" Piston kit Hi-load	1	1		100X100X10	0.5	0.5	15	CAD
106	0	RGWAHL0135	Parker	1 3/8" Gland Kit metalic rod wiper	1	0		100X100X100	0	5	15	CAD
106	1	RKWAHL0135	Parker	1 3/8" Rod Kit metalic rod wiper	1	1		100X100X10	0.5	0.5	15	CAD
106	1	PK252HK005	Parker	2.5" Piston kit Hi-load	1	1		100X100X10	0.5	0.5	15	CAD
107	0	RGWAHL0105	Parker	1 " Gland Kit metalic rod wiper	1	0		100X100X100	0	5	15	CAD
107	1	RKWAHL0105	Parker	1 " Rod Kit metalic rod wiper	1	1		100X100X10	0.5	0.5	15	CAD
107	1	PK252HK005	Parker	2.5" Piston kit Hi-load	1	1		100X100X10	0.5	0.5	15	CAD
108	0	RGWAHL0105	Parker	1 " Gland Kit metalic rod wiper	1	0		100X100X100	0	5	15	CAD
108	1	RKWAHL0105	Parker	1 " Rod Kit metalic rod wiper	1	1		100X100X10	0.5	0.5	15	CAD
108	1	PK252HK005	Parker	2.5" Piston kit Hi-load	1	1		100X100X10	0.5	0.5	15	CAD
109	0	RGWAHL0105	Parker	1 " Gland Kit metalic rod wiper	1	0		100X100X100	0	5	15	CAD
109	1	RKWAHL0105	Parker	1 " Rod Kit metalic rod wiper	1	1		100X100X10	0.5	0.5	15	CAD
109	1	PK252HK005	Parker	2.5" Piston kit Hi-load	1	1		100X100X10	0.5	0.5	15	CAD
110	1	RGWAHL0205	Parker	2 " Gland Kit metalic rod wiper	1	1		100X100X100	5	5	15	CAD
110	2	RKWAHL0205	Parker	2 " Rod Kit metalic rod wiper	1	2		100X100X100	10	5	15	CAD
110	2	PK402HK005	Parker	4" Piston kit Hi-load	2	2		100X100X10	1	0.5	15	CAD
111	0	RGWAHL0105	Parker	1 " Gland Kit metalic rod wiper	2	0		100X100X100	0	5	15	CAD
111	1	RKWAHL0105	Parker	1 " Rod Kit metalic rod wiper	2	1		100X100X10	0.5	0.5	15	CAD
111	1	PK252HK005	Parker	2.5" Piston kit Hi-load	1	1		100X100X10	0.5	0.5	15	CAD
112	0	RGWAHL0205	Parker	2 " Gland Kit metalic rod wiper	1	0		100X100X10	0	0.5	15	CAD

ITEM	QTY	D E S C R I P T I O N			TOTAL QUANTITY INSTALLED FOR THE PACKAGE	QUANTITY RECOMENDED SPARES FOR 2 YEARS OPERATIONS	QUANTITY RECOMENDED FOR CAPITAL/ INSURANCE SPARES	SIZE AND DIMENSIONS L X W X H (mm)	GROSS WEIGHT (Kg)	UNIT WEIGHT (Kg)	PLANNED DELIVERY TIME (WORKING DAYS)	UNIT PRICE CURRENCY
No.	Req'd	Model	Manufacturer	Equipment type								
112	2	RKWAHL0205	Parker	2 " Rod Kit metalic rod wiper	1	2		100X100X10	1	0.5	15	CAD
112	2	PK402HK005	Parker	4" Piston kit Hi-load	2	2		100X100X10	1	0.5	15	CAD
113	0	RGWAHL0105	Parker	1 " Gland Kit metalic rod wiper	2	0		100X100X100	0	5	15	CAD
113	1	RKWAHL0105	Parker	1 " Rod Kit metalic rod wiper	2	1		100X100X10	0.5	0.5	15	CAD
113	1	PK252HK005	Parker	2.5" Piston kit Hi-load	1	1		100X100X10	0.5	0.5	15	CAD

ITEM No.	QTY Req'd	DESCRIPTION Model	Manufacturer	Equipment type	TOTAL QUANTITY INSTALLED FOR THE PACKAGE	QUANTITY RECOMENDED SPARES FOR 2 YEARS OPERATIONS	QUANTITY RECOMENDED FOR CAPITAL/ INSURANCE SPARES	SIZE AND DIMENSIONS L X W X H (mm)	GROSS WEIGHT (Kg)	UNIT WEIGHT (Kg)	PLANNED DELIVERY TIME (WORKING DAYS)	UNIT PRICE CURRENCY
PNEUMATIC SPARE PARTS LIST												
1	2	RG2AHL0105	Parker	3.25 CD-2AUV14ACx18.00 Rod Gland Kit	4	2		100X200X200	4	2	15	CAD
	2	PK3202A005	Parker	3.25 CD-2AUV14ACx18.00 Piston Kit	4	2		100X200X200	2	1	15	CAD
2	4	RG2AHL0105	Parker	2.50 CBB-2AUV34ACx3.00 Rod Gland Kit	8	4		100X200X200	8	2	15	CAD
	4	PK2502A005	Parker	2.50 CBB-2AUV34ACx3.00 Piston Kit	8	4		100X200X200	4	1	15	CAD
3	2	RGWAHL0135	Parker	6.00 CSB-2AUVS19ACx4.625 Rod Gland Kit	2	2		100X200X200	4	2	15	CAD
	2	PK6002A005	Parker	6.00 CSB-2AUVS19ACx4.625 Piston Kit	4	2		100X200X200	2	1	15	CAD
4	4	RG2AHL0105	Parker	4.00 CSB-2AUV19ACx6.00 Rod Gland Kit	8	4		100X200X200	8	2	15	CAD
	4	PK4002A005	Parker	4.00 CSB-2AUV19ACx6.00 Piston kit	8	4		100X200X200	4	1	15	CAD
5	2	RGWAHL0135	Parker	6.00 CD-2AUVS13ACx30.236 Rod gland kit	4	2		100X200X200	4	2	15	CAD
	2	PK6002A005	Parker	6.00 CD-2AUVS13ACx30.236 piston kit	4	2		100X200X200	2	1	15	CAD
6	2	RG2AHL0105	Parker	2.50 CBB-2AUV34ACx3.00 Rod gland kit	4	2		100X200X200	4	2	15	CAD
	2	PK2502A005	Parker	2.50 CBB-2AUV34ACx3.00 piston kit	4	2		100X200X200	2	1	15	CAD
7	1	RGWAHL0135	Parker	8.00 CSB-2AUVS19ACx18.00 Rod gland kit	2	1		100X200X200	2	2	15	CAD
	1	PK8002A005	Parker	8.00 CSB-2AUVS19ACx18.00 piston kit	2	1		100X200X200	1	1	15	CAD
8	2	P32KA00ESE	Parker	P32QA93SEANGLND reg element	7	2		100X200X200	2	1	15	CAD
9	3	P33KA00ESE	Parker	P33QX96SEANGLND reg element	11	3		100X200X200	3	1	15	CAD
10	3	PS4041B9P	Parker	H22VXBG0B9C solenoid kit	14	3		100X200X200	3	1	15	CAD
	2	PS4101CP	Parker	H22VXBG0B9C body service kit	14	2		100X200X200	2	1	15	CAD

APPENDICE 2
Chiller
Freeze Co.

FREEZE CO. SYSTEMS LTD.

AIR COOLED CHILLER

MANUFACTURER: FREEZE CO SYSTEMS LTD
OPERATION & MAINTENANCE MANUAL

Manufacturers of Industrial Process Cooling Systems
Freeze Co Systems, Ltd. • 2100 Steeles Ave. • Brampton, Ontario • L6T 1A7
Phone: (905) 789-9988 • Fax: (905) 789-9989 • www.freezeco.com

GNA ALUTECH INC.
4.5 TON AIR COOLED CHILLER
SERIAL # 001102717
MODEL# FCAC-007.5-2-P

SEQUENCE OF OPERATIONS

Hot water (10% EG) coming from the secondary heat exchanger is entering Evaporator at 65°F and leaving at 55°F to the reservoir. Chiller pump will circulate cold water (10% EG) through 3 ways modulating valve to secondary heat exchanger to cool Hydraulic oil. Three ways valve will modulate water flow to maintain 100°F hydraulic oil temperature.

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SUMMARY OF PERFORMANCE

Technical	
Model Number of Chiller	FCAC-007.5-2-P
Quantity of chillers	1
Fluid in	95ºF
Fluid out	85ºF
Capacity	4.5 TR
Refrigerant used	R134 a
Main Power	460V-3-60
Ambient Condition	131ºF
Type of Unit	Air Cooled
Type of condenser	Air Cooled
Type of Fan	Axial Flow
Temperature Control	Johnson Controls
Fluid to be cooled	Water
Unit casing	Epoxy coated
Commercial	
1. Freight	Prepay & add
2. Parts Warranty	1 year Parts
3. Unit Serial Number	001102717
5. Date of Shipment	
6. Date of Start Up	

CHILLER DESCRIPTION

Semi-hermetic reciprocating compressor

Semi-hermetic reciprocating compressors with two-step of capacity control by cylinder un-loading ideal for energy saving at low load conditions. It has an advantage over hot gas by-pass capacity control where capacity control is limited to 80% of capacity with negligible energy saving whereas with reciprocating compressor cylinder un-loading compressor motor consumes approximately 50% less power and capacity reduces to 50%. Chances of evaporator freezing reduce because refrigerant mass flow to evaporator reduces when compressor unloads.

- Exclusive design of reciprocating compressors.
- High efficiency motors.
- Equipped with protection devices.
- High efficiency UL approved compressor
- Cylinder unloading for capacity control.
- Lightweight

Brazed plate evaporator

Brazed plate heat exchangers are highly efficient in refrigerant service. Their small size, low refrigerant charge and superior efficiency make them ideal for the particular application. The brazed plate heat exchanger is constructed entirely of corrosion resistant materials. The design of the plates creates a high turbulence resulting in outstanding heat transfer. The heat transfer plates and the connections are made from highly resistant 316SS. Fouling of the heat transfer surfaces of brazed plate heat exchangers is extraordinarily low. This is a result of uniform product distribution, constant velocity profile and smooth plate surfaces. The result is many years of dependable service.

- Rated for 450 PSI operating pressure
- Extremely compact design
- Maximum material efficiency due no “dead zone”
- Enhanced surface.
- Operates efficiently
- 316 SS copper brazed plate
- True counter-current flow allows close temperature approach.
- Fluid connection for quick disassembly for service
- 2’’ Armaflex insulation

Air-cooled condenser

Condensing coils are constructed using high efficiency aluminum fins mechanically bonded to seamless copper tubing. All headers and connections are copper. Coils are factory leak tested at 400 psig, dehydrated, sealed and braced to seamless copper headers. Direct drive, permanently lubricated fan motors require no belts, no pulleys or mandrels thus eliminating lubrication, and periodic maintenance requirements. Fan motors are factory wired and interlocked with the compressor in the weather resistant control panel. Heavy grade steel wire fan guards are weather coated for corrosion protection.

- Rated for 400 PSI operating pressure
- Extremely efficient design
- Maximum material efficiency due no “dead zone”
- Large hold up volume-uses large surface of heat transfer (refrigerant) medium.
- Copper tube aluminum fins construction.
- Can operate on high working pressure.
- Propeller fans
- TEFC high efficiency fan motor
- Fan Cycling control to maintain condensing temperature.

Refrigeration components

- High quality components are employed
- Access to all components is made easy for maintenance purpose therefore shutdown to entire is not required for replacing defective part.
- Brazed plate DX type evaporator
- Relief valve
- Electronic TX valve with sensor and transducer to control superheat
- High and low pressure Transducers
- Liquid line serviceable drier core
- Liquid line moisture sight glass
- Suction and discharge service valves
- ACR refrigeration pipes.
- Liquid line service valve
- Hot gas bypass valve

Modular Electronic Control Systems

A350P SERIES: TEMPERATURE MODULAR CONTROL

Description

The A350P is an electronic, proportional plus integral temperature control. This control has an integration feature that forces the control point to match the setpoint. Over time, the A350P will control the heating/cooling equipment to balance the system load at the control setpoint.
As are all System 350™ products, the A350P control is housed in a NEMA 1, high-impact plastic enclosure. The modular design provides easy, plug-together connections for quick installation and future expandability.

Features

- Field-selectable proportional only or proportional plus integral control
- Plug-together connectors and 35 mm DIN rail mounting eliminate wiring between models and reduce installation costs
- Ten segment LED displays percent of output signal
- Field-selectable reverse or direct-acting mode
- Minimum output adjustable from 0 to 60%
- Two models cover a wide setpoint range of -30 to 250°F (-35 to 121°C

High Pressure Control – is connected to the high side of the refrigeration system and automatically shutdown the system when discharge pressure exceeds control setting . High pressure indicating light will show the high pressure fault. This control must be manually reset once the problem has been rectified.

Low Pressure Control – serves two functions. It is connected to the low side of the refrigeration system and acts as a safety devices to prevent the compressor from running in case of excessive refrigerant shortage or abnormally low suction pressure. It is also used for system pump down control.

Anti-Short Cycle Timer – prevents the compressor from cycling on and off too frequently which causes premature wear to the compressor components. Factory set at 5 minutes.

Chilled Water Flow Switch – is a safety device which prevents the unit from operating with little or no water flows through the evaporator / heat exchanger.

Motor Overload Protection – All motors are equipped with either internal or external, thermal motor overload protection. External overloads are factory set to full load amperage of the motors.

Crankcase Heater – is provided for extra protection against refrigeration vapor immigration to the compressor crankcase during off cycles. The heater heats the oil at a temperature high enough so that any liquid refrigerant in the crankcase will evaporate and create pressure sufficient to prevent further migration to the compressor. If liquid refrigerant exists in the compressor on startup the reduction in suction pressure will cause the liquid to evaporate thus causing oil foaming. This oil / refrigerant mixture may enter into the compressor cylinders causing "slugging". The refrigerant also dilutes the oil and reduces effective lubrication.

Control Thermostat – The unit temperature controller monitors the process return water temperature and cycles the refrigeration system to maintain accurate process water temperature.

Chiller pumping station

Pumps employed in Freeze Co. chillers are specially designed for industrial process cooling applications. Centrifugal pumps are fitted with bronze impellers (optional stainless steel) and mechanical seals. End suction pumps are driven by premium efficiency totally enclosed motors. Refer owner's manual for operation instructions.

- Process Pump
- Bronze impellers
- Mechanical seal
- Low noise 3450 RPM pumps
- Pre piped skid
- Isolating valves, and check valves included
- Insulated Pre piped assembly
- Fluid connection for quick disassembly for service
- Insulated 304 stainless steel reservoir
- Fill and drain port
- Low level switch
- Three ways bypass valve
- Secondary heat exchanger

Pump Motors

General Specifications:

- Use with close-coupled pumps having NEMA JM mounting dimensions
- Continuous Duty service
- 1.15 Service Factor rating
- Mechanically locked bearing – shaft-end limits axial shaft movement
- UL and C.S.A recognized
- Quiet operation through “Super Hush” flow-through ventilation system
- Class F insulation

Ratings:

ODP	Rigid base	3450 RPM	230/460V	2 - 50 HP
ODP	Rigid base	1740 RPM	230/460V	1 - 40 HP
TEFC	Rigid base	3450 RPM	230/460V	1.5 - 40 HP
TEFC	Rigid base	1740 RPM	230/460V	1 - 40 HP
Washguard Duty	Rigid base	3450 RPM	230/460V	1.5 - 15 HP
Washguard Duty	Rigid base	1740 RPM	230/460V	1 - 10 HP

Steel structure and cabinet

- Chiller and condenser package is assembled on a 4''X 4'' X 0.25'' Steel beams.
- Steel frame is coated with high quality corrosion resistance paint. (powder coating as an option)
- Casing is made out of powder coated white aluminum sheets

INSTALLATION

Shipment

All Freeze Co air-cooled portable chillers are shipped completely assembled fully charged with refrigerant and oil.

Receiving

Immediately after receiving the unit at site, it must be inspected carefully for shipment damage(s). Should any damage be found, it must be reported to the transporter and Freeze Co Systems Ltd.

Unit Placement

Unit is designed for outdoor use with adequate weather protection and under an ambient temperature of 131 °F. Base or foundation is not required if the selected unit location is level and strong enough to support the unit's operating weight. Generally, foundation should support at least 150% of the operating weight of unit.

Unobstructed flow of condenser air is essential to maintain chillers' capacity and operating efficiency. When determining unit placement, careful consideration must be given to assuring a sufficient flow of air across the condenser heat transfer surface. Two detrimental conditions are possible and must be avoided, warm air circulation and coil starvation.

Warm air re-circulation occurs when discharge air from the condenser fans is recycled back to the condenser coil inlet. Coil starvation, occurs when free airflow to the condenser is restricted.

Condenser coils and fan discharge must be kept free of snow or other obstructions to permit adequate airflow for satisfactory unit operation. Debris, trash, supplies etc. should not be allowed to accumulate in the vicinity of the air-cooled chillers'. Supply air movement may draw debris into the condenser coil, blocking spaces between coil fins and causing coil starvation.

Both warm air circulation and coil starvation cause reductions in unit efficiency and capacity because of the higher head pressures. Crosswinds those perpendicular to the condenser, tend to aid efficient operation in warmer ambient conditions, however they tend to be detrimental to operation in lower ambient conditions.

Adequate clearance for evaporator and compressor servicing should be provided. Recommended minimum space envelope is 3 feet of free area on either side of the unit for maintenance. (Service clearance must allow for compressor and evaporator removal)
Unit should be located as close to pump station as conveniently possible to avoid any pressure drop and unnecessary excess piping.

Fluid Connections

Water connection should be provided as shown in the associated drawing. Check for labels on the unit for process supply and return, city water, overflow and drain connections. To reduce heat loss and prevent condensation, insulation should be applied.

Fluid Treatment

Dirt, scale, products of corrosion and other foreign material in the fluid will adversely affect heat transfer between the fluid and system components. Foreign matter in the chilled fluid system can also increase pressure drop and, consequently, reduce fluid flow. Proper fluid treatment must be determined locally and depends on the type of system and fluid characteristics. It is recommended that the services of a qualified fluid treatment specialist, familiar with local fluid condition, to assist in the establishment of a proper fluid treatment program. Freeze Co Systems Ltd. assumes no responsibility for equipment failures, which are the result of untreated or improperly treated fluid.

Refrigerant Charge

See manufacturer name plate.

START-UP PROCEDURE

Check List

General information

Job Name: _____

Location: _____

City _____

Contact Name: _____

Contact Phone: _____

Installing Contractor: _____

General Contractor: _____

Mechanical Contractor: _____

Start Up Contractor: _____

Start Up Technician Name:_____

Date of Startup: _____

Equipment chiller is serving:

Manufacturer:_____

Type of Machine(s):_____

Model of Machine(s):_____

Chiller Model: _____

Chiller Serial Number: _____

Visual inspection:

1. Installation correctness:

a. Pipe sizes to chiller: _____

b. Insulated? _____

c. Distance, each way to equipment: _____

d. Approx. number of elbows each line:_____

e. Height (up) (down) to equipment: _____

2. List any devices installed in line between the chiller and the equipment and their pressure drops, if known _____

3. Chiller foundation:
a. Roof mount? _____

b. Ground pad? _____

c. Indoor mechanical room?:_____

d. Outdoor other? _____

4. Electrical Service:
a. Fused disconnect?:_____

b. Non-fused disconnect?:_____

c. Circuit breaker rating:_____amps

d. Rated power supply:_____volts_____ph

e. Frequency of supply:_____

f. Check the power supply voltage to ground and record each leg (phase) below:

L-1:_____ L-2:_____ L-3:_____

****Place the high leg on the center L-2 terminal inside the chiller cabinet on the distribution block or disconnect.**

WARNING
Disconnect all electrical power sources before making wiring connections to the unit. Failure to do so may result in injury or death due to electrical shock.

Inspect all wiring connections. Connections should be tight and clean. Electrical routing should be as indicated on the wiring diagram provided on or with the unit.

- Measure supply voltage and voltage phase balance at the compressor terminals. Voltage readings should be within the range given on the motor nameplate (usually 10 percent). Maximum voltage phase imbalance is 2 percent.
- Measure meg-ohm-winding resistance.
- Energize crankcase heaters by keeping the compressor switch off, and turning the control power switch on. After 10 minutes, feel the compressor to verify heater operation.
- The crankcase heaters must be energized for at least eight hours before unit start-up.

CAUTION: Compressor crankcase heaters must be energized for at least 8 hours before normal operation of the unit. Failure to do so may result in severe damage to the compressor due to the presence of liquid refrigerant in the compressor.

- Check compressors oil level. Oil should be visible in the sight glass.
- Open compressor service discharge and suction valves and receiver inlet outlet valves.
- Open the evaporator process fluid briefly to check the entire circuit for leaks or blocked fluid flow, by starting the pumps manually. The system should already been flushed.
- Stop the pump immediately after the inspection.
- Check the operation of solenoid valves, contactors, starters and control relays.
- Be sure all sensing bulbs are securely installed in their wells with heat transfer compound.
- Set controls at their proper settings.
- Energize heat tape for all exposed piping.
- Open isolating valves.
- Adjust the flow switch if required

Voltage Imbalance

Voltage imbalance must not exceed 2 percent. Voltage imbalance is defined as 100 times the maximum deviation of the three phase voltages from the average, regardless of sign, divided by the average voltage. For example, if the three measured voltages were 221, 230 and 227 the average voltage would be 226 and the percent of voltage imbalance would be:

$$\frac{100 \times (226 - 221)}{226} = 2.2\%$$

In this case, 2.2 percent of voltage imbalance is not acceptable. Check the voltage readings at the disconnect switch to determine if the imbalance is present in the incoming power lines. If the imbalance is due to problems within the unit, check the unit electrical wiring connections.
Compressor Meg-ohm Resistance

Measure the voltage between each set of phases:
L-1 to L-2:_____
L-2 to L-3:_____
L-1 to L-3:_____
g. Does the supply voltage comply with the minimum rating on the chiller name plate
If it does not, call FreezeCo Technical Support immediately for instructions before turning on the power.

To determine the insulation between each compressor motors winding and earth:

1. Open the units electrical disconnect switch.
2. Open compressor motor circuit breaker (fuse).
3. Using a 500-volt meg-ohm meters (motor megger), determine the resistance between each compressor motor terminal and earth. Place one of the test lead against bare metal, such as the suction or discharge line, and the other lead against one of the motor terminals.
4. Repeat step 3 for the other two terminals.

The readings on all terminal-ground combinations should be at least 2.0 meg-ohms, at 70 F.

CAUTION: Do not Meg or apply power to the windings of the compressor motor while it is in a vacuum. Damage to the motor windings may result.

Check Control Settings

Voltage drops on control voltage are serious matters and must be found before problems occur.

a. Check all connections inside the chiller control panel for tightness and possible problems that may have occurred during shipment. Ensure all components are securely mounted.
b. Voltage at compressor contactor coil _____
c. Voltage at pump contactor coil _____
Are there any field supplied wiring junction boxes located between the chiller and any remote panels? _____
Are there any splices made in the junction boxes? _____
Are there any customer supplied devices connected to the chiller wiring? _____ What? _____
Are there any FreezeCo remote devices connected to the chiller wiring? _____ What? _____
If voltage drops are being detected, call FreezeCo service department before operating the system.

Set all adjustable controls to their required settings. Design temperatures can be determined from the original sales order and must be known for the setting of controls.

Expansion Valve Superheat Adjustment

The importance of proper suction gas superheat cannot be over-emphasized. Accurate superheat measurements should be taken with other trouble analysis procedures to monitor refrigerant flow, coil efficiency and compressor protection. The recommended setting range for superheat on Freeze Co. System's equipment is 10°F

Flushing the water lines

Flushing the system is the installing contractor's responsibility. If the water lines have not been properly flushed clean, inform the site supervisor, owner, or mechanical contractor representative. Please call FreezeCo, also. Flushing procedures are outlined in the chiller manual.
Water lines have been flushed and cleaned _____.
Note: While flushing under no circumstances water should be circulated through evaporator and condenser. Chiller pump on the package shall never be utilized to flush system piping

Filling the system with glycol

In most instances the installing contractor is responsible for charging glycol into the system. If not charged, please do so according to the following instructions.
1. First, mix the concentrate of propylene glycol in a tank or drum for transfer into the chiller tank. Mixing externally before filling will prevent clogging of the chiller piping and pump suction with the heavy concentrate.
2. Fill the tank through the manual fill port on the cabinet and fill to near the top. Stop so the level can be seen.

Installation instructions

WARNING!! DO NOT ATTEMPT TO START THE UNIT WITHOUT FREEZE CO REPRESENTATIVES ON SITE. ONLY CARRY OUT THE FOLLOWING INSTALLATION:

1. Inspect the location desired for unit installation and verify adequate service access clearance
2. Do not switch unit on without making a complete visual check of unit for damage(s) sustained during installation
3. Inspect all piping connections visually for poor fit
4. Remove and discard shipping materials.(cartons, wooden skid)
5. Place unit on pad and level unit and secure unit
6. bring in 208/3/60 main power to unit disconnect as per attached electrical drawings
7. Refer drawings and use conductor size as per local codes
8. Install suitable fittings and conduits for power connection
9. Complete pump interlocks as per drawings if required
10. All wiring must comply with local codes
11. A heat load to the chiller must be available for start-up
12. Complete external fluid piping and test for leaks
13. Air vents to be provided for venting air at the highest points
14. Provide pressure gauges and shut off valves as required
15. Install drain point at appropriate location
16. Flush all field piping before making final connection to the unit
17. Install strainer in the water circuit
18. Charge the fluid system

NOTE: AT LEAST 2 WEEKS NOTICE IS REQUIRED FOR START UP. ALL WORKS REQUIRED TO BE CARRIED OUT PRIOR TO OUR TECHNICIANS AT SITE SUCH AS INCOMING POWER AND FLUID CIRCUIT MUST BE COMPLETED.

Quick Start-up

- Inspect all piping connections visually for poor fit.
- Check to ensure that all pipe supports are secure.
- Check all electrical main and control connections to ensure that they are tight.
- Supply voltage should correspond to that indicated on cooling system nameplate.
- Control settings are factory set and don't require any alteration.
- Open receiver service valves
- Turn main disconnects switch on, leaving control and compressor switch off.
- A minimum of 8 Hours (Recommended 24 hours) compressor oil warm up required before start-up. This allows the compressor crankcase heater to evaporate the refrigerant in the crankcase oil.
- Check process pump rotation by starting manually.
- A heat load to the chiller must be available for start-up
- Turn control and compressor and process pump switches, "on". Process pump should start. After 5-minutes delay the compressor will start.
- Check for proper direction of rotation of the condenser fan.
- Allow unit to run continuously for ten minutes under full load conditions. Check sight glass for adequate refrigerant charge and condition of moisture indicator (yellow or green dot).
- Check total piping system and pump seals for water leaks.
- The control thermostat should be set at desired temperature. The unit should be observed for abnormalities under operating conditions for a minimum of two hours.
- Record all the readings on start up log sheet. (enclosed in this brochure)
- When shutting down the unit, turn control switch to "off", leaving main disconnect "on" to keep power for crankcase heater

MAINTENANCE

Periodic Maintenance

The start-up log, supplied with each unit should be used to record the periodic maintenance and inspection observations.

Maintenance Inspections

If the unit does not perform properly during these inspections, consult the Troubleshooting section for possible cause and recommended procedures.

CAUTION: The refrigeration system of this equipment is pressurized. Use proper service procedures to relieve pressure before servicing.

CAUTION: The chilled fluid system of this equipment may be pressurized. Use proper service procedures to relieve pressure before servicing.

CAUTION: Turn off unit and disconnect before servicing unit electrical components. Failure to do so may result in injury or death from electrical shock.

Maintenance Procedures

Once a week

1. Check liquid line sight glasses. Flow should appear smooth with no evidence of gas bubbles. If gas bubbles appear, a refrigerant shortage is indicated. Check for refrigerant leak, repair and add refrigerant.
2. Inspect entire system for any unusual conditions such as noisy compressor, loose access panels, pipe or joint leakage or chattering contactors.

Once a month

1. Perform monthly inspections.
2. Start unit and observe operating pressures. If pressures are above or below normal, see "Trouble Analysis" section.
3. Check fan alignment and clean condenser fins from any foreign particle or dust.

Once a year

1. Perform the weekly and monthly inspection.
2. Clean the chilled brazed plate heat exchanger.
3. Inspect contacts of motors contactors and system controls.
4. Check setting and functions of each system control.
5. Inspect system for leaks. Also inspect all valves, pumps and related equipment for proper operation.

6. Remove rust and corrosion from any surfaces.
7. Inspect expansion valve sensing bulb for cleanliness, proper installation and insulation.
8. Perform an oil analysis to determine the acidity of the compressor oil and record the results.

WARNING/CAUTION: The oil analysis procedure must be performed by a qualified service technician. Incorrect interpretation or analysis results can cause damage to the unit. The use of improper analysis procedures can cause hazardous conditions that may result in injury to service personnel

Compressor motor

Open motor windings

1. Open the master disconnects switch.
2. Remove compressor fuses.
3. Touch the leads of an ohmmeter to each combination of two terminals. In additions to continuity test make sure that this correlation is satisfied : SR = SC + RC

Earth motor windings

1. Turn off master disconnect switch.
2. Remove compressor fuses.
3. Place one test lead of an insulation tester or meg-ohmmeter against bare metal (earth).
4. Touch the other lead to each motor terminal, in turn. The readings obtained should exceed 2 meg-ohms. If any reading is below the range, an earth winding is indicated. Do not start the compressor if the reading is below 2 meg-ohms.

Voltage

Check the voltage across the compressor terminals, when the system is operating.

1. Voltage not to exceed plus or minus 10% of compressor motor rating (voltage utilization range).
2. Voltage unbalance between phases not to exceed 2%

Contactor

Inspect the contacts. If they appear pitted or burned, replace the contacts or contactor.Using an ohmmeter, test continuity of the contactor holding coil. If the coil does not test continuous, replace it.

Liquid line solenoid valve, drier

Restricted drier is indicated by:

1. Low suction pressure.
2. Temperature drops across valve or drier.
3. Frosting of valve or drier in severe cases.

If these symptoms are observed, Change drier core

Low Side Repairs

If the drier, solenoid valve, expansion valve or low side piping requires repair:

1. Pump down the system. Allow temperature of all parts to stabilize. This will prevent moisture from condensing on inside surfaces of open system.
2. When a new part is being installed, make the brazed joint nearest to the liquid line valve first. With the joint made, crack the liquid line valve for an instant to purge the air from the part. When the air has been purged, complete the remaining joint.
3. It should be noted that this method is applicable only after minor repairs. Should any major work, such as opening the chiller or compressor, be necessary, it is recommended that the entire low side of the system be evacuated.

Condenser Relief Valve

A relief valve is located at compressor refrigeration discharge line for air-cooled condenser and brazed plate water cooled condenser. This valve will relieve the pressure at a preset valve, releasing the pressure in the circuit. Should this happen, make sure that the value is closed and recharge the system.

High side repairs

If the condenser, compressor or high side piping and fittings require repair, remove the refrigerant charge from the system. After the repairs have been completed, leak test, evacuate and charge.

START-UP LOG

Date:
Job Name:

I. NAMEPLATE INFORMATION.

Model#: Serial#: Job#:

Voltage: ___/3/60 Control volt: __V RLA: ___A Refrigerant:

II. COMPRESSOR

Make: Model#: Qty:

Voltage: ____V Phase: 3 Hertz: 60Hz

RLA: ___A LRA: ___A

III. CONDENSER FAN:

Voltage: ____ Phase: 3 Hertz: 60 QTY: __

HP:____ RPM: ____ FLA: ___A

IV. PROCESS PUMP:
PUMP MOTOR

Voltage: ___ Phase: 3 Hertz: 60 Inlet Pressure: _____FT

HP: ___ RPM:____ FLA:____A Outlet Pressure: _____FT

V. OPERATING CONDITIONS

COMPRESSOR

Discharge pressure: _____Psig RLA: ____A

Suction Pressure: _____Psig Superheat: ___ºF

EVAPORATOR

Evaporator Entering Fluid Temperature: ___F

Evaporator Leaving Fluid temperature: ___ºF

Evap. Flow: ___USgpm Type of Fluid:

CONDENSER

Fan RLA: _____A Ambient Temp.: _____F

PROCESS PUMP

RLA : ____A

TROUBLE SHOOTING AND FAULT DIAGNOSTICS

COMPRESSOR FAILS TO START

POSSIBLE CAUSE	SYMPTOMS	RECOMMENDED ACTION
Power failure	Electric circuit test shows no voltage on in coming terminal block.	Check for blown fuses and open disconnects.
Breaker tripped	Electric circuit shows no voltage on motor side of breaker.	Reset breaker. Check load on compressor motor.
Low Voltage	Voltmeter indicates insufficient Voltage at main.	Call power company.
Burned- out motor	Full voltage at motor terminal but motor will not run.	Replace.
Inoperative motor starter	Test for burned-out holding coil or broken contacts.	Repair or replace.
Open control circuit	Motor starter holding coil is not energized.	Locate open control and determine cause. See individual control instructions
Frozen compressor due to locked or damaged mechanism	Compressor will not operate.	Repair compressor.
Discharge pressure above cut-out setting of high pressure cut-out switch	Open contacts on high pressure switch. Discharge pressure above cut-in setting.	See complaint " Discharge pressure too high ".
Overload contacts open	Starter will not pull in.	Reset overload and determine cause.
Flow switch contacts open	System will not start.	Restore water flow, check flow switch operation.
Faulty temperature controller	Control circuit will not energize.	Check control set points, contacts.

COMPRESSOR SHORT CYCLES

POSSIBLE CAUSE	SYMPTOMS	RECOMMENDED ACTION
Intermittent contact in Electrical control circuit	Normal operation except too frequent Stopping and starting.	Repair or replace faulty control.
Low pressure controller Differential set too close	Normal operation except too frequent Stopping and starting.	Reset differential in accordance with proper job conditions.
Leaky liquid line solenoid valve	Valve may hiss when closed. Also temperature change in refrigerant line through valve.	Repair or replace.
Lack of refrigerant	Normal operation except too frequent stopping and starting on low pressure control switch. Bubbles in sight glass.	Repair refrigerant leak and recharge.
Restricted liquid line drier.	Suction pressure too low and frosting at drier.	Replace drier core.
Faulty motor	Motor starts and stops rapidly.	Replace faulty motor.
Inoperative compressor Unloading system	Compressor will not load or unload.	Repair or replace faulty control.

COMPRESSOR IS NOISY

POSSIBLE CAUSE	SYMPTOMS	RECOMMENDED ACTION
Lack of oil	Compressor cuts out on oil failure control	Add oil. Check crankcase heater
Internal parts of compressor	Compressor knocks	Replace compressor
Liquid “flood back”.	Abnormally cold suction line	Check and adjust superheat, Verify correct bulb mounting.
Expansion valve stuck in open position.	Abnormally cold suction line. Compressor knocks	Repair or replace

COMPRESSOR LOSES OIL

POSSIBLE CAUSE	SYMPTOMS	RECOMMENDED ACTION
Clogged drier	Oil level gradually drops	Replace drier core.
Liquid flooding back to compressor	Excessively cold suction. Noisy compressor operation	Readjust superheat setting and verify correct bulb mounting
Short cycling	Too frequent starting and Stopping of compressor	See “Compressor short cycles”.

COMPRESSOR RUNS CONTINUOUSLY

POSSIBLE CAUSE	SYMPTOMS	RECOMMENDED ACTION
Excessive load	High leaving chilled water temperature	Check for excessive water flow.
Temperature controller set at too low a temperature	Low temperature in conditioned area	Reset or repair
“welded” contacts on electrical Control in motor starter circuit	Low temperature in conditioned space	Repair or replace contacts
Leaky valves in compressor	Compressor noisy or operating at Abnormally low discharge pressure or abnormally high suction pressure	Replace compressor
Solenoid liquid valve stuck open	Leaving air too cold	Repair valve or replace

SYSTEM SHORT OF CAPACITY

POSSIBLE CAUSE	SYMPTOMS	RECOMMENDED ACTION
Low refrigerant charge	Expansion valve hisses. Flash gas in liquid line.	Add refrigerant.
Clogged drier or restriction in Solenoid valve	Temperature change in refrigerant line through drier or solenoid valve.	Replace.
Expansion valve stuck or obstructed	Short cycling.	Replace expansion valve.
Excessive pressure drop in evaporator	Superheat too high.	Check superheat and reset Thermal expansion valve
Improper superheat adjustment.	Leaving chilled water temperature too high or too low and oil foaming	Adjust expansion valve. Check superheat.
Hot bypass solenoid or bypass Valve defective	Leaving air temperature too high	Replace
Obstructed chilled water lines.	Reduced water flow	Remove obstruction

SUCTION PRESSURE TOO LOW

POSSIBLE CAUSE	SYMPTOMS	RECOMMENDED ACTION
Lack of refrigerant.	Bubbles in sight glass.	Repair leak and charge.
Light load on chiller.	Compressor short cycles.	See “Compressor short cycles”.
Clogged liquid line drier.	Temperature change in refrigerant line through drier or solenoid valve.	Replace drier core.
Expansion valve power Assembly has lost charge.	No flow of refrigerant through valve.	Replace expansion valve assembly.
Obstructed expansion valve.	Loss of capacity.	Clean valve or replace if necessary.
Low water flow.	Low evaporator water pressure drop.	Check water flow. Check for clogged strainers, And obstruction in chilled water lines.

SUCTION PRESSURE TOO HIGH

POSSIBLE CAUSE	SYMPTOMS	RECOMMENDED ACTION
Excessive load on chiller.	Compressor runs continuously.	See “Compressor runs continuously”.
Overfeeding of expansion valve.	Abnormally cold suction line. Liquid flooding back to compressor.	Regulate superheat setting of expansion Valve and check to see that remote bulb Is properly installed.
Expansion valve stuck in Open position.	Abnormally cold suction line. Liquid flooding back to compressor.	Replace valve.
Broken suction valves in compressor.	Noisy compressor.	Replace compressor

DISCHARGE PRESSURE TOO HIGH

POSSIBLE CAUSE	SYMPTOMS	RECOMMENDED ACTION
High-pressure too high.	Excessively warm air leaving condenser cuts out on high-pressure control.	Clean condenser fouling.
Air or non-condensable gas in system.	Exceptionally hot condenser and Excessive discharge pressure.	Remove air or non-condensable.
Overcharge or refrigerant.	High leaving chilled water temperature.	Remove excess refrigerant gradually. Normal sub-cooling is 12 degrees.
Excessive system load.	Excessive discharge pressure.	Reduce load. Reduce water flow to evaporator if excessive.
Faulty hot gas solenoid valve	Excessive discharge temperature	Replace valve

DISCHARGE PRESSURE TOO LOW

POSSIBLE CAUSE	SYMPTOMS	RECOMMENDED ACTION
Lack of refrigerant.	Bubbles in sight glass.	Repair leaky and charge.
Broken or leaky compressor Discharge valves.	Suction and discharge pressures Equalize rapidly after pump down.	Replace compressor.

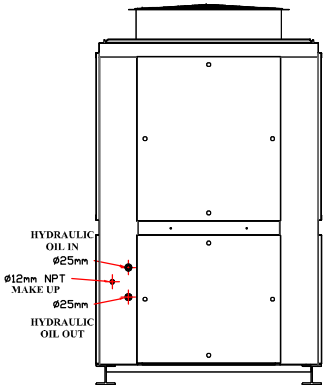
PLC NOT FUNCTIONING (OPTIONAL)

POSSIBLE CAUSE	SYMPTOMS	RECOMMENDED ACTION
Blown PLC fuse	No power supply at PLC	Check for short to ground and replace fuse
Program problem	LED error on or improper program	Contact Freeze Systems Limited

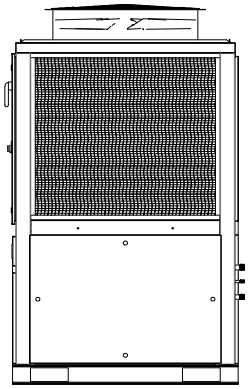
TOUCH SCREEN (OPTIONAL)

POSSIBLE CAUSE	SYMPTOMS	RECOMMENDED ACTION
Power failure	No DC power supply at screen	Check 24V DC power supply
No Communication	Display Frozen	Check communication cable connection
Communication settings	Display does not react	Contact FREEZE CO. SYSTEMS LTD.

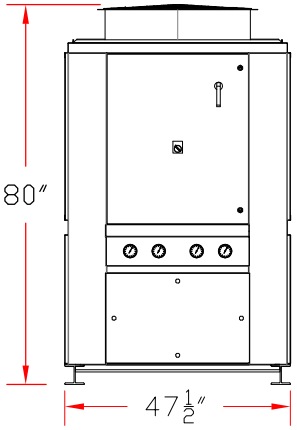
Mechanical Drawings



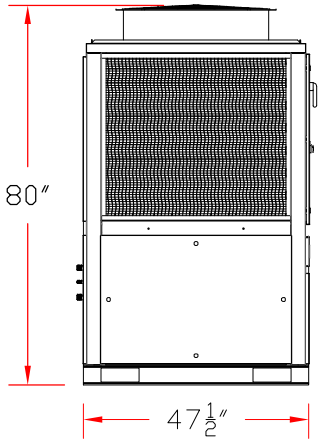
REAR VIEW



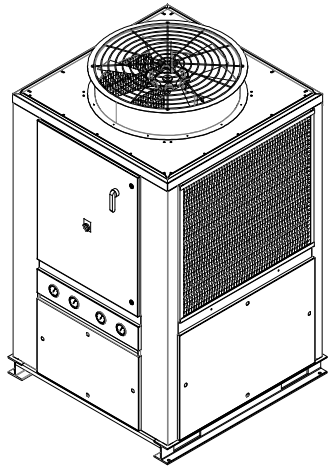
R.H. SIDE VIEW



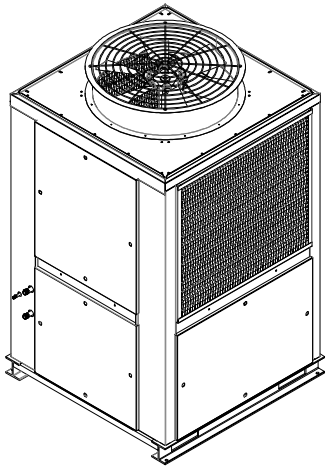
FRONT VIEW



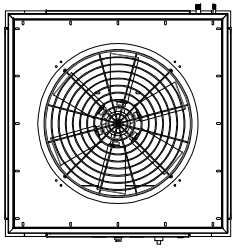
L.H. SIDE VIEW



ISOMETRIC VIEW



ISOMETRIC VIEW



TOP VIEW

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ALL DRAWINGS SUBJECT TO CHANGE

No.	Date	Description	By	Chk'd	App'd	Client
1	FEB. 24, 2011	AS BUILT DRAWING	A.F.	P.R.	B.A.	
1	FEB. 9, 2011	REVISED MAKE UP PIPE LOCATION ADD WATER GAUGES IN THE GAUGE PANEL	A.F.	P.R.	B.A.	

REVISIONS

MANUFACTURER CANADA

FREEZECO. SYSTEMS LIMITED
2100 STEELES AVE. E. BRAMPTON
BRAMPTON E. ON. L6T 1A7
TEL:9057899988 FAX:9057899989

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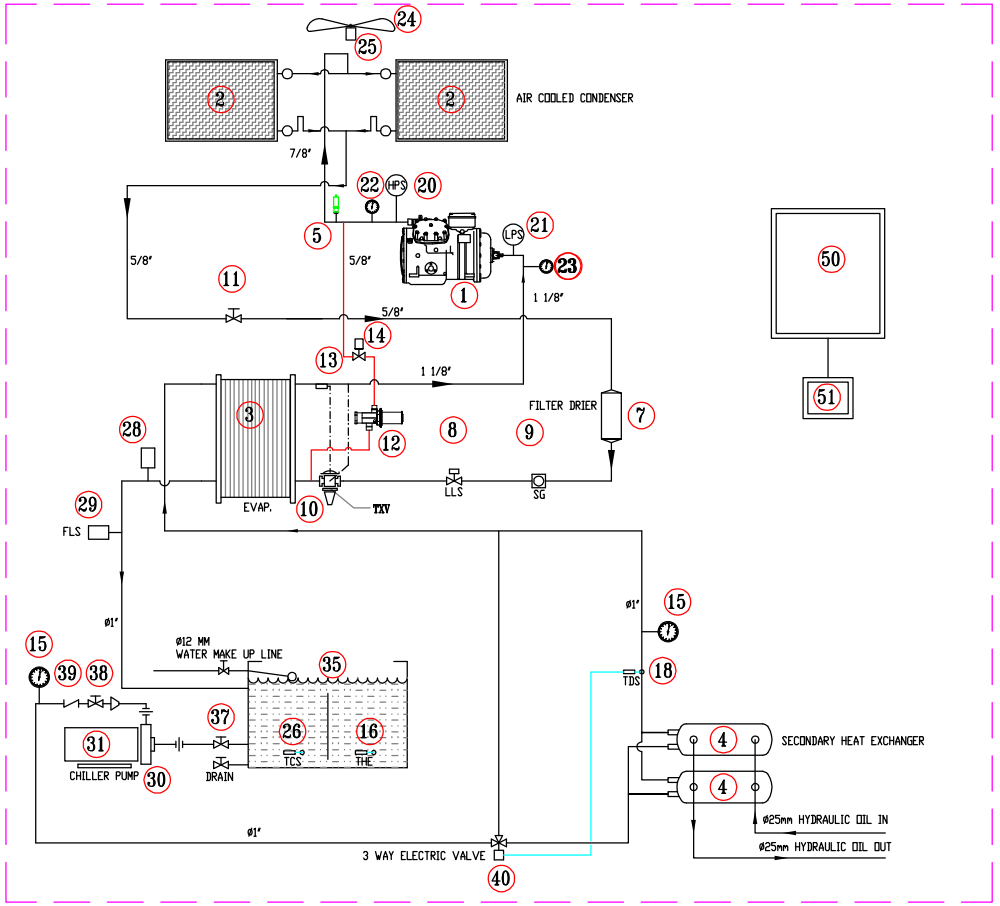
GNA ALUTECH INC.	–		
RAS AZ ZAWR ALUMINUM	JOB No.		10-3635
SAUDI PROJECT	Drawn by	A.F.	FEB. 9, 2011
	Checked	P.R.	
MODEL No. FCAC-0007.5-2-P	Approved	B.A.	
SERIAL No. 001102717	Client-App	CLIENT_APP_BY	

4.5 TON CHILLER
GENERAL LAY-OUT

Scale: NTS	Dwg. No. GNA-M-0002	Rev. 2
FILE: FILE_NAME		

ELECTRIC WATER CHILLER AIR COOLED- OUTDOOR R-134a

AIR-COOLED CHILLER	EVAPORATOR BRAZED PLATE											CONDENSER AIR CCOOLED COIL										COMPRESSOR FRASCOLD - RECIPROCATING							CHILLER PUMP				SECONDARY HEAT EXCHANGER SHELL & TUBE				DESIGN CONDITIONS													
DESCRIPTION	QTY	CAPACITY	NO. OF CIRCUITS	OPERATING PRESSURE	REFRIGERANT	FLUID	FLOW	MINIMUM FLOW	EVI°F	LVI°F	PRESSURE DROP	VELOCITY	FOULING FACTOR	SST	CONNECTION	QTY	MIC CAPACITY	NUMBER OF CIRCUITS	OPERATING PRESSURE	REFRIGERANT	AIR FLOW	FAN MOTOR	AIR IN/OUT	FAN SIZE	RPM	TSP	CONDENSING TEMPERATURE	CONNECTION	RELIEF VALVE	QTY	VOLTAGE	HP	CAPACITY	RLA	HEATER	EER	OIL TYPE/SEP CAPACITY	POWER INPUT	CAPACITY CONTROL	QTY	FLUID	FLOW	HEAD	PUMP/MOTOR	RPM	HP	QTY	CAPACITY	COLD SIDE	HOT SIDE	HYDRAULIC OIL	HYDRAULIC OIL TEMP. IN	HYDRAULIC OIL TEMP. OUT	DESIGN PRESSURE SHELL	DESIGN PRESSURE TUBE	QTY	AMBIENT	LOCATION	CAPACITY	FLOW	FLUID IN/OUT	VOLTAGE	CONTROL VOLTAGE	REFRIGERANT	PROCESS FLUID	HYDRAULIC OIL	RLA INCLUDING PUMPS	MCA	MFS	APPROXIMATE SHIPPING WEIGHT	APPROXIMATE OPERATING WEIGHT	OVERALL DIMENSIONS	FLUID CONNECTION	CHILLER MODEL	MANUFACTURER
1	4.5 TONS		1	400 PSIG	134a	10% EG	110 US GPM	635°F	535°F	56 PSI	53 FPS	0.0001	45°F	THREADED/SWEAT	1	350 MBH EACH CIRCUIT	2	400 PSIG	134a	6600 CFM	3 HP	130/240°F	30" - PROPELLER	1130	0.36" WG	120dB	SWEAT	400 PSI	2	460/3/60	7.5	4.5 TONS	12	700 WATTS	7.84	PDE/380 FL OZ	7.29 KV	50% 100%	1	10% EG	110 US GPM	60HP	ROTECH/LEESON	3500	5.0 HP	1	2.25 TONS	10% EG	HYDRAULIC OIL	95.0°F	85.0°F	240 PSIG	300 PSIG	2	131°F	OUTDOORS	4.5 TONS	15 GPM	95/85°F	460/3/60	380.0	134a	HYDRAULIC OIL	60.0	25.0	39.0	2,300 LBS	3,000 LBS	47.5"L X 47.5"W X 80"H	ø25mm OIL IN ø25mm OIL OUT	FCAC-0075-2-P	FREEZECO.



NOTE: TRAP IS REQUIRED IN THE HIGHEST POINT IN PROCESS RETURN PIPING

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COMPONENT DESCRIPTION

	COMPONENT	CAPACITY	MODEL	MAKE	QTY
1	COMPRESSOR	7.5 HP	G 7 2BLY	FRASCOLD	1
2	CONDENSER COIL	350 MBH	BC4192	CANCOIL	2
3	EVAPORATOR	4.5 TON	BL26-10BH	HEX	1
4	SECONDARY HEAT EXCHANGER SHELL & TUBE	2.25 TON	ANT-4 Brass	API Brasco	2
5	RELIEF VALVE	400PSI	AH05503	STREAMLINE	1
6	-	-	-	-	-
7	FILTER DRIER	7/8" SAE	DCP-41 7 S PCH: 868599	EMERSON	1
8	LIQUID LINE S.V.	5/8"	EVRH 0 1.3 N PCH 868845	EMERSON	1
9	LIQUID INDICATOR	5/8"	HSE-1/16 PCH 065448	EMERSON	1
10	THERMOSTATIC EXPANSION VALVE	5/8" X 7/8" SAE	SJE-5-C	SPORLAN	1
11	BALL VALVE	5/8"	BVS 650 PCH 896756	EMERSON	1
12	HOT GAS BY-PASS VALVE	5/8" X 5/8" SAE	ADRSE-2-0080	SPORLAN	1
13	HOT GAS S.V.	5/8"	EVRH 0 1.3 N PCH 868845	EMERSON	1
14	COIL FOR SOLENOID VALVE	-	MKC 120/50-60	EMERSON	2
15	PRESSURE GAUGE	3"DIAL	0-100 PSIG	WEIKA	2
16	THERMOMETER	0-150°F		-	1
17	-	-		-	-
18	TEMPERATURE SENSOR	-30 - 120°F	A350P	JOHNSON CONTROLS	1
19	-	-	-	-	-
20	HIGH PRESS. SWITCH	0-400 PSIG	HNS2C130YM05	SAGINOMIYA	1
21	LOW PRESSURE SWITCH	30"-0 HG	SNS-2C26YG01	SAGINOMIYA	1
22	HIGH PRESSURE GAUGE	3"DIAL	0-400psig	WEIKA	1
23	LOW PRESSURE GAUGE	3"DIAL	30"-0-150PSIG	WEIKA	1
24	CONDENSER FAN	6000 CFM	30"	HEMRO	1
25	CONDENSER FAN MOTOR	3HP	1130RPM,460/3/60	HEMRO	1
26	TEMPERATURE SENSOR	-	XR-30	IDELL	1
27					
28	FREEZESTAT	35°F	CNS 2C14YR003	SAGINOMIYA	1
29	FLOW SWITCH(FM)	1"	SC0505		1
30	CHILLER PUMP	110 GPM/60'	3M 32/15	ROTECH	1
31	CHILLER PUMP MOTOR	TEFC	3500RPM,460/3/60 5 HP	LEESON	1
32	-	-	-	-	-
33	-	-	-	-	-
34					
35	RESERVOIR	50 GALLON	304 SS	FREEZECO	1
36					
37	BALL VALVE	ø1 1/2"			1
38	BALL VALVE	ø1"			1
39	CHECK VALVE	ø1"			1
40	3 WAY ELECTRIC VALVE	ø1"	ESBE 90 SERIES	DANFOSS	1
41					
42					
43					
44					
45					
46					
47					
48					
49					
50	ELECTRICAL PANEL	NEMA 4	30" W X36" H	-	1
51	CONTROLLER	-		IDELL	1
52					
53					

No.	Date	Description	By	Chk'd	App'd	Client
1	FEB. 24, 2011	CHANGE SECONDARY FLUID TO 10% EG	A.F.	P.R.	B.A.	
1	JAN. 12, 2011	USE ONLY ONE PUMP	A.F.	P.R.	B.A.	

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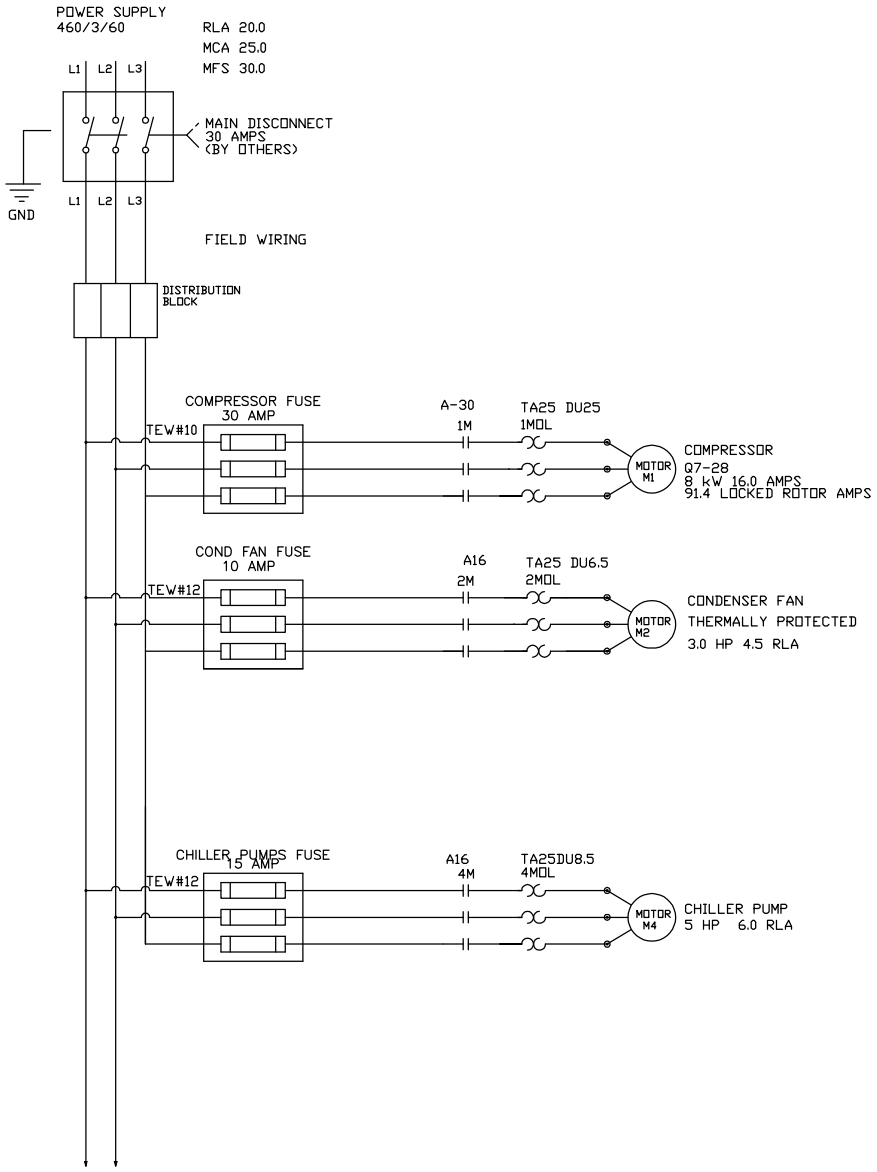
GNA ALUTECH INC.
RAS AZ ZAWR ALUMINUM
SAUDI PROJECT

		JOB No.	10-3635
		Drawn by	A.F. DEC. 28, 2010
		Checked	P.R.
MODEL No.	FCAC-0007.5-2-P	Approved	B.A.
SERIAL No.	001102717	Client-App	CLIENT_APP_BY

4.5 TON CHILLER FLOW DIAGRAM

Scale: NTS	Dwg. No. GNA-M-0001	Rev. 2
FILE: FILE_NAME		

Electrical Drawings



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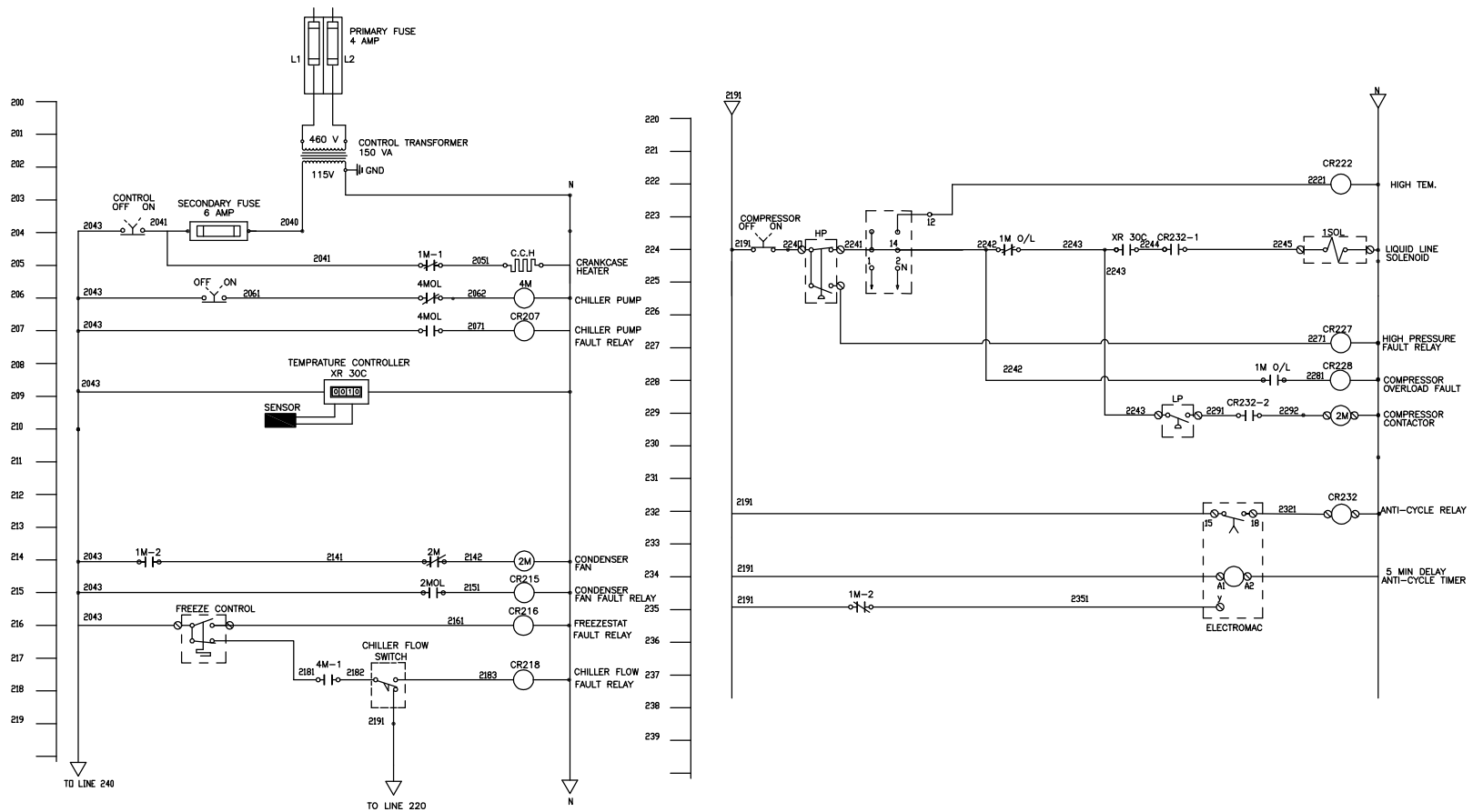
		Checked	P.R.
MODEL No.	FCAC-0007.5-2-P	Approved	B.A.
SERIAL No.	001102717	Client-App	CLIENT_APP_BY

4.5 TON CHILLER POWER SCHEMATIC

Scale: NTS	Dwg. No. GNA-E-0001	Rev. 0
FILE: FILE_NAME		



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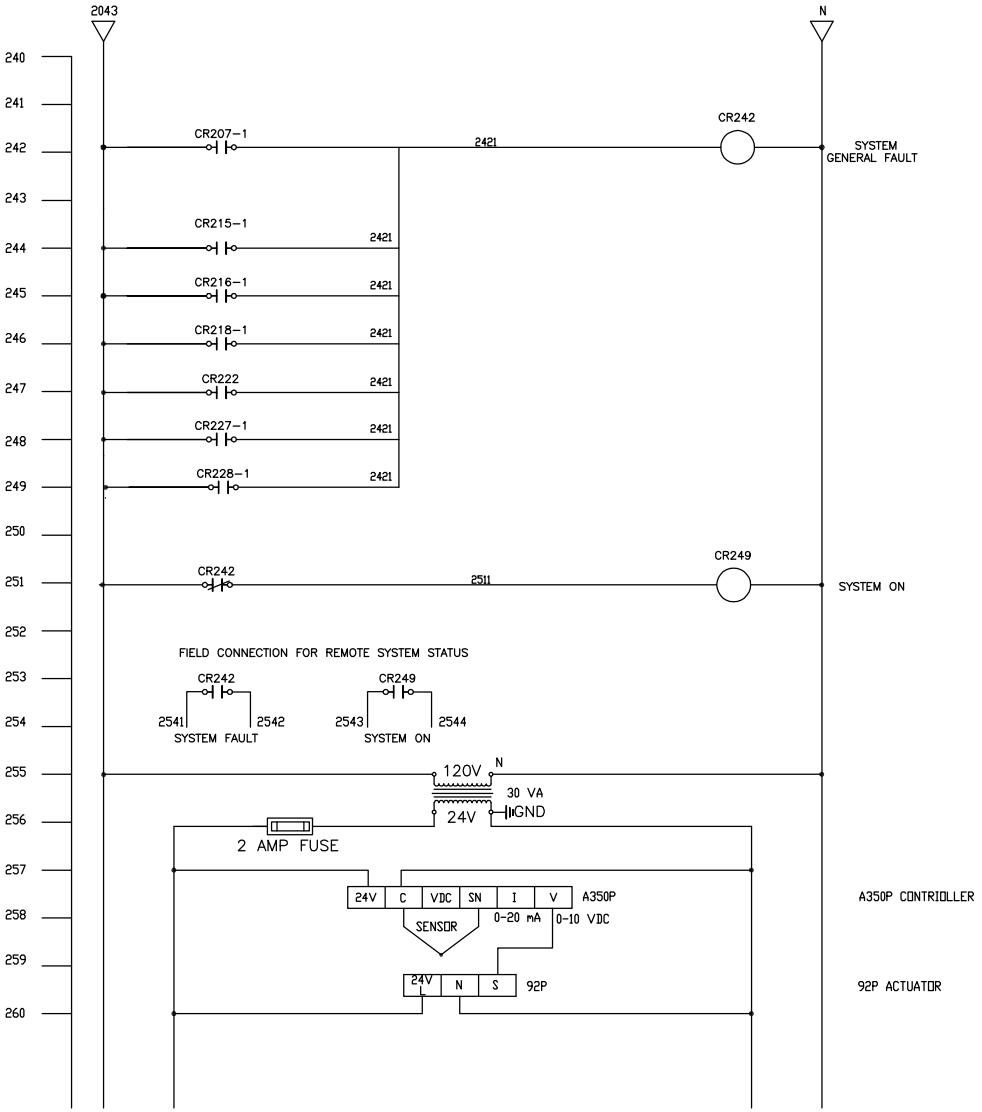
Checked	P.R.		
Approved	B.A.		
Client-App	CLIENT_APP_BY		
MODEL No.	FCAC-0007.5-2-P		
SERIAL No.	001102717		

4.5 TON CHILLER
CHILLER PANEL

Scale: NTS
FILE: FILE_NAME

Dwg. No. GNA-E-0002

Rev. 0



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GNA ALUTECH INC.
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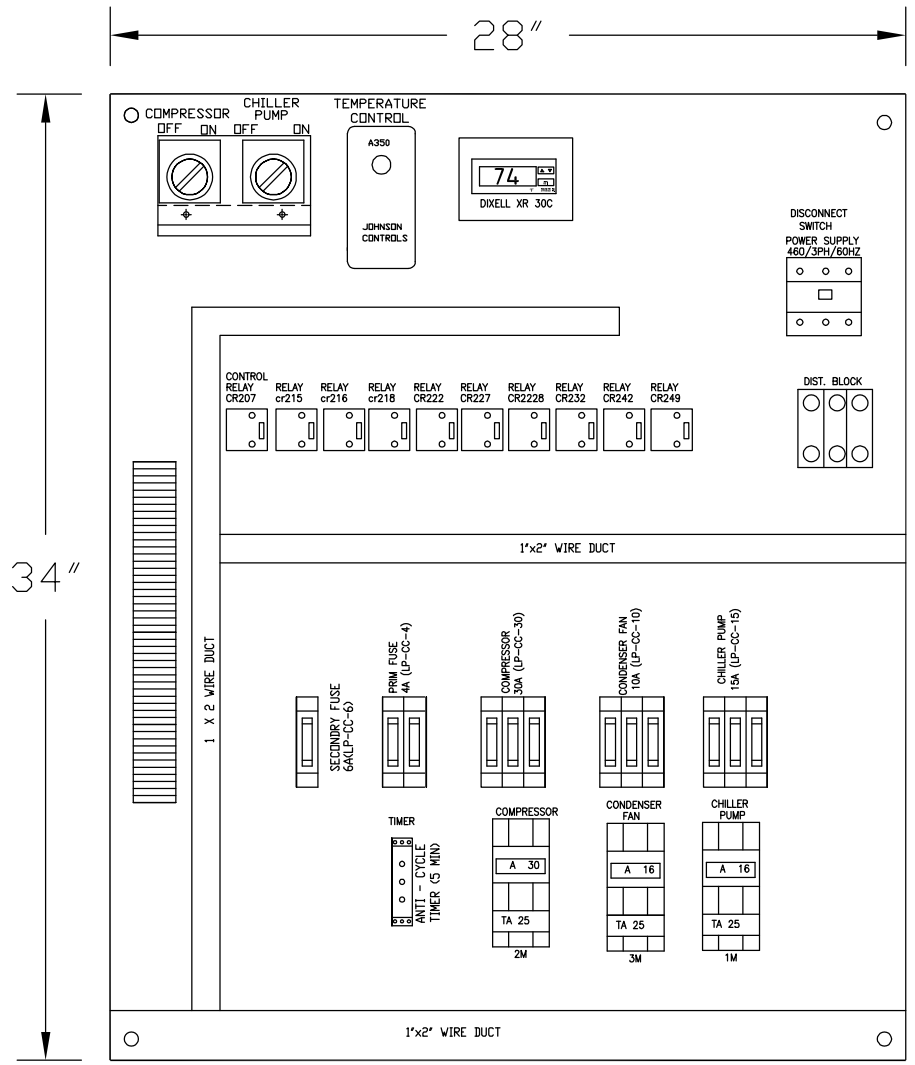
Checked	P.R.		
Approved	B.A.		
Client-App	CLIENT_APP_BY		
MODEL No.	FCAC-0007.5-2-P		
SERIAL No.	001102717		

4.5 TON CHILLER
CHILLER PANEL

Scale: NTS	Dwg. No. GNA-E-0003	Rev. 0
FILE: FILE_NAME		



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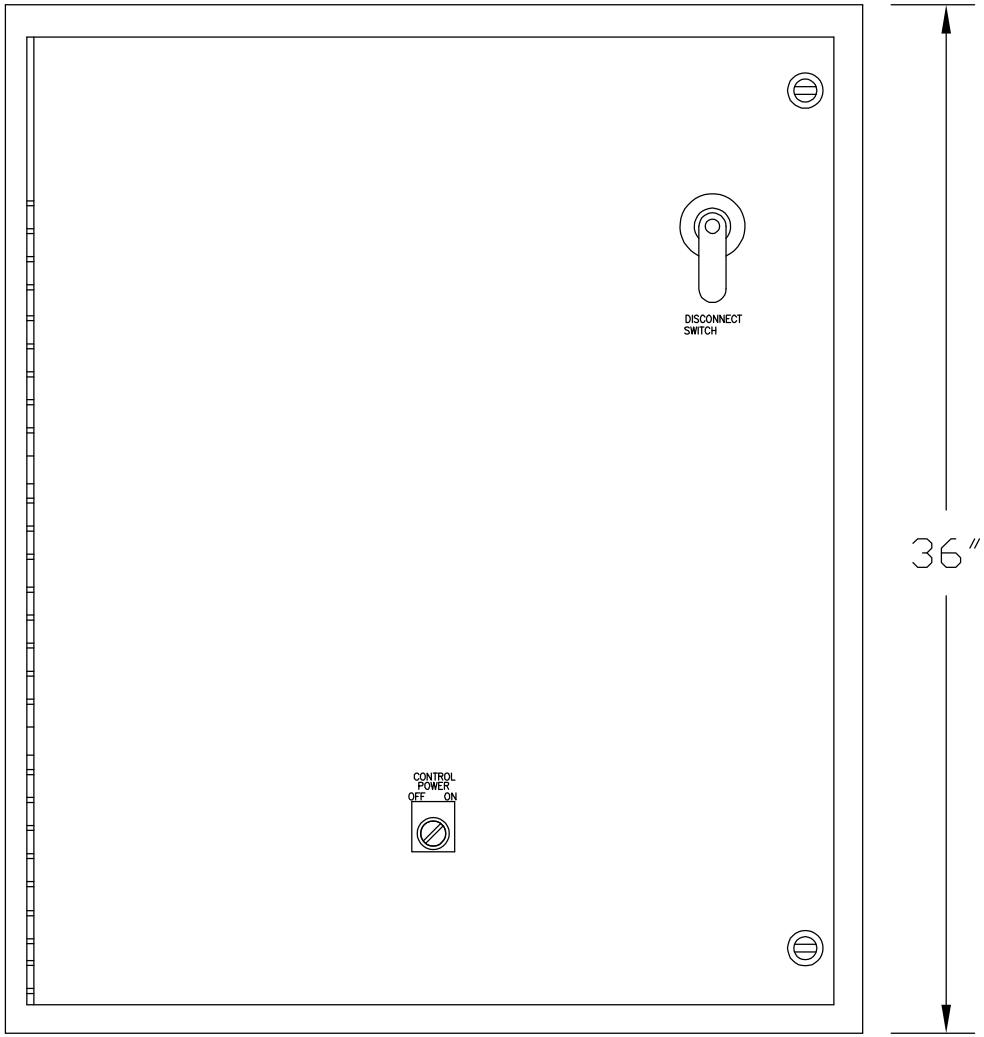
GNA ALUTECH INC.		JOB No.	10-3635
RAS AZ ZAWR ALUMINUM SAUDI PROJECT		Drawn by	A.F. JAN. 12, 2011
		Checked	P.R.
MODEL No.	FCAC-0007.5-2-P	Approved	B.A.
SERIAL No.	001102717	Client-App	CLIENT_APP_BY

4.5 TON CHILLER COMPONENT LAYOUT

Scale: NTS	Dwg. No. GNA-E-0004	Rev. 0
FILE: FILE_NAME		



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		Drawn by	A.F. DEC. 28, 2010
		Checked	P.R.
MODEL No.	FCAC-0007.5-2-P	Approved	B.A.
SERIAL No.	001102717	Client-App	CLIENT_APP_BY

4.5 TON CHILLER ENCLOSURE

Scale: NTS FILE: FILE_NAME	Dwg. No. GNA-E-0005	Rev. 0

PART LISTS
&
RECOMMENDED
PART LIST

ELECTRICAL PART LIST

PROJECT: GNA		**MODEL: FCAC-0007.5-2-P**		**REFRIGERANT: R-134a**	
JOB NO. : 10-3635		**SERIAL NO. : 001102717**	**CAPACITY: 4.5 TONS**	**VOLTAGE: 460/3/60**	
NO.	**COMPONENT**	**CAPACITY/SIZE**	**MODEL**	**MAKE**	**QTY**
1-	POWER DISTRIBUTING BLOCK		63163	FERRAZ SHAWMUT	1
2-	TRANSFORMER	150VA	SP150MQMJ	HPS	1
3-	COMPRESSOR FUSES	30A	JT60030 (LPJ 30SP)	BUSS	3
4-	COMPRESSOR CONTACTOR		A30	ABB	1
5-	COMP.O/L RELAY		TA25DU25	ABB	1
6-	CONDENSER FAN FUSE	10A	USCC3 (LP CC 10)	FERRAZ SHAWMUT	
7-	CONDENSER FAN CONTACTOR		A16-30-10	ABB	1
8-	CONDENSER FAN OVERLOAD		TA25DU6.5	ABB	1
9-	CHILLER PUMP FUSE	15A	UCC3 (LP CC 15)	FERRAZ SHAWMUT	3
10-	CHILLER PUMP CONTACTOR		A16	ABB	1
11-	CHILLER PUMP OVERLOAD		TA25DU8.5	ABB	1
12-	ENCLOSURE	12,4	A-2, 192		1
13-	PRIMARY FUSE	CLASS CC 4AML	CHCC2D (LP CC 4)	BUSS	2
14-	SECONDARY FUSE		6AMP USCC2 (LP CC 6)	FERRAZ SHAWMUT	1
15-	SELECTOR SWITCH 2 WAY		RB2BE101	RAAS	4
16-	RELAY	120V	RY2S-U	IDEC	9
	RELAY	24V	RU4SU	IDEC	1
17-	TEMPERATURE CONTROLLER		XR30C	DIXELL	1
18-	H.P. CONTROL		HNS2C130YM1Q5	SAGINOMIYA	1
19-	L.P. CONTROL		SNS-2C106YQ11	SAGINOMIYA	1
20-	FREEZE CONTROL		CNS 2C114YM2Q3	SAGINOMIYA	1
21-	CHILLER FLOW SWITCH(IFM)		SC0505		1
22-	TEMPERATURE CONTROLLER		A350P	JOHNSON CONTROLS	1
23-	STELDEW TRANSFORMER	50VA/480/24V 60 HZ		MARCUS	1
24-	24 VAC CIRCUITE FUSE	24AMP	USCC1		1
25-	MULTI TIMER		DMB51	CARLO GAVAZZI	1
26	3 WAY VALVE MOTOR(ACTUATOR)	24V/60/90/20SEC/15 NM	92P	DANFOSS	1

MECHANICAL PART LIST

PROJECT: GNA		**MODEL: FCAC-0007.5-2-P**		**REFRIGERANT: R-134a**	
JOB NO. : 10-3635		**SERIAL NO. : 001102717**	**CAPACITY: 4.5 TONS**	**VOLTAGE: 460/3/60**	
NO.	**COMPONENT**	**CAPACITY/SIZE**	**MODEL**	**MAKE**	**QTY**
1-	COMPRESSOR	7.5 HP	Q 7 28.1Y	FRASCOLD	1
2-	CONDENSER COIL		BC4192	CANCOIL	2
3-	EVAPORATOR	4.5 TON	BL26-100H	HEX	1
4-	SECONDARY HEAT EXCHANGER SHELL & TUBE	2.25 TON	AHT-4 Bass	API Basco	2
5-	RELIEF VALVE	400PSI	AH15503	STREAMLINE	1
6-					
7-	FILTER DRIER	7/8" ODF	EKP-41 7 S PCN : 062539	EMERSON	1
8-	LIQUID LINE S.V.	5/8"	240RA 8 T 5 M PCN 040845	EMERSON	1
9-	LIQUID INDICATOR	5/8"	HMI-1TT5 - PCN 065408	EMERSON	1
10-	THERMOSTATIC EXPANSION VALVE	5/8" X 7/8" ODF	SJE-5-C	SPORLAN	1
11-	BALL VALVE	5/8"	BVS 058 PCN 806756	EMERSON	1
12-	HOT GAS BY-PASS VALVE	5/8" X 5/8" ODF	ADRSE-2-0180	SPORLAN	1
13-	HOT GAS S.V.	5/8"	240RA 8 T 5 M PCN 040845	EMERSON	1
14-	COIL FOR SOLENOID VALVE		AMG 120/50-60	EMERSON	2
15-	PRESSURE GAUGE	3"DIAL	0-100 PSI	WEIKA	2
16-	THERMOMETER	0 - 150˚F			1
17-					
18-	TEMPERATURE SENSOR	-30 TO 150˚F	A350P	JOHNSON CONTROLS	1
19-					
20-	HIGH PRESS. SWITCH	0-400 PSIG	HNS2C130YM1Q5	SAGINOMIYA	1
21-	LOW PRESSURE SWITCH	30"-0-150	SNS-2C106YQ11	SAGINOMIYA	1
22-	HIGH PRESSURE GAUGE	3"DIAL	0-400 PSIG	WEIKA	1
23-	LOW PRESSURE GAUGE	3"DIAL	30"-0-150	WEIKA	1
24-	CONDENSER FAN	6000 CFM	30"	KEMAO	1
25-	CONDENSER FAN MOTOR	3HP	1130RPM,460/3/60	KEMAO	1
26-	SENSOR		XR30	DIXELL	1
27-					
28-	FREEZESTAT	38˚F	CNS 2C114YM2Q3	SAGINOMIYA	1
29-	FLOW SWITCH(IFM)	1"	SC0505		1
30-	CHILLER PUMP	11.0 GPM/60'	DN 32/16	ROTECH	1
31-	CHILLER PUMP MOTOR	TEFC	5 HP, 3510RPM, 460/3/60	LEESON	1
32-					
33-					
34-					
35-	RESERVOIR	50 GALLON	304 SS	PREEZECO	1
36-					
37-	BALL VALVE	ø1 1/2"			2
38-	BALL VALVE	ø1"			2
39-	CHECK VALVE	ø1"			1
40-	3 WAY ELECTRIC VALVE	ø1"	ESBE 90 SERIES	DANFOSS	1

	A	B	C	D	E	F	G
1	**RECOMENDED ELECTRICAL PART LIST**						
2	**PROJECT: GNA**		**MODEL: FCAC-0007.5-2-P**		**REFRIGERANT: R-134a**		**JAN13,11**
3	**JOB NO. : 10-3635**		**SERIAL NO. : 001102717**	**CAPACITY: 4.5 TONS**	**VOLTAGE: 460/3/60**		
4							
5	**NO.**	**COMPONENT**	**CAPACITY/SIZE**	**MODEL**	**MAKE**	ACTUAL QTY	**RECOMMENDED**
6	1-	POWER DISTRIBUTING BLOCK	60 AMPS	16321-3	BUSS	1	
7	2-	TRANSFORMER	150VA	460/120 60HZ 150VA	DELTA	1	1
8	3-	COMPRESSOR FUSES	30A	JT60030 (LPJ 25SP)	BUSS	3	6
9	4-	COMPRESSOR CONTACTOR		A30	ABB	1	2
10	5-	COMP.O/L RELAY		TA25DU25	ABB	1	2
11	6-	CONDENSER FAN FUSE	10A	CHCC3D (LP CC 10)	BUSS	3	
12	7-	CONDENSER FAN CONTACTOR		A16-30-10	ABB	1	
13	8-	CONDENSER FAN OVERLOAD		TA25DU6.5	ABB	1	
14	9-	CHILLER PUMP FUSE	15A	CHCC3D (LP CC 15)	BUSS	3	3
15	10-	CHILLER PUMP CONTACTOR		A16	ABB	1	2
16	11-	CHILLER PUMP OVERLOAD		TA25DU8.5	ABB	1	2
17	12-	ENCLOSURE	NEMA 4			1	
18	13-	PRIMARY FUSE		CHCC2D (LP CC 4)	BUSS	2	6
19	14-	SECONDARY FUSE		CHCC1D (LP CC 6)	BUSS	1	6
20	15-	SELECTOR SWITCH 2 WAY		RB2BE101	RAAS	4	1
21	16-	RELAY		RY2S-U	IDEC	10	2
22	17-	TEMPERATURE CONTROLLER		XR30C	DIXELL	1	1
23	18-	H.P. CONTROL		HNS2C130YM1Q5	SAGINOMIYA	1	1
24	19-	L.P. CONTROL		SNS-2C106YQ11	SAGINOMIYA	1	1
25	20-	FREEZE CONTROL		CNS 2C114YM2Q3	SAGINOMIYA	1	1
26	21-	CHILLER FLOW SWITCH		FQSU30G	SAGINOMIYA	1	1
27	22-	TEMPERATURE SENSOR		A350P	JOHNSON CONTROLS	1	2
28	23-	TEMPERATURE SENSOR		NTC	JOHNSON CONTROL	1	2
29	24-	3 WAYS VALVE MOTOR		92P	DANFOSS	1	1
30	25-						
31	26-						

RECOMENDED MECHANICAL PART LIST

PROJECT: GNA		**MODEL: FCAC-0007.5-2-P**		**REFRIGERANT: R-134a**		**JAN13,11**
JOB NO. : 10-3635		**SERIAL NO. : 001102717**	**CAPACITY: 4.5 TONS**	**VOLTAGE: 460/3/60**		
NO.	**COMPONENT**	**CAPACITY/SIZE**	**MODEL**	**MAKE**	**ACTUAL QTY**	**RECOMMENDED**
1-	COMPRESSOR	7.5 HP	Q 7 28.1Y	FRASCOLD	1	1
2-	CONDENSER COIL		BC4192	CANCOIL	2	
3-	EVAPORATOR	4.5 TON	BL26-100H	HEX	1	1
4-	SECONDARY HEAT EXCHANGER SHELL & TUBE		AHT-4 Bass	API Basco	2	1
5-	RELIEF VALVE	400PSI	AH15503	STREAMLINE	1	1
6-						
7-	FILTER DRIER	7/8" ODF	EKP-41 7 S	EMERSON	1	2
8-	LIQUID LINE S.V.	5/8"	240RA 8 T 5 M	EMERSON	1	1
9-	LIQUID INDICATOR	5/8"	HMI-1TT5 - PCN 065408	EMERSON	1	
10-	THERMOSTATIC EXPANSION VALVE	5/8" X 7/8" ODF	SJE-5-C	SPORLAN	1	2
11-	BALL VALVE	5/8"	BVS 058 PCN 806756	EMERSON	1	1
12-	HOT GAS BY-PASS VALVE	5/8" X 5/8" ODF	ADRSE-2-0180	SPORLAN	1	
13-	HOT GAS S.V.	5/8"	240RA 8 T 5 M	EMERSON	1	
14-	COIL FOR SOLENOID VALVE				2	2
15-						
16-						
17-						
18-	TEMPERATURE SENSOR	-30 TO 150˚F	A350P	JOHNSON CONTROLS	1	1
19-						
20-	HIGH PRESS. SWITCH	0-400 PSIG	HNS2C130YM1Q5	SAGINOMIYA	1	1
21-	LOW PRESSURE SWITCH	30"-0-150	SNS-2C106YQ11	SAGINOMIYA	1	1
22-	HIGH PRESSURE GAUGE	3"DIAL	0-400 PSIG	WEIKA	1	
23-	LOW PRESSURE GAUGE	3"DIAL	30"-0-150	WEIKA	1	
24-	CONDENSER FAN	6000 CFM	30"	KEMAO	1	1
25-	CONDENSER FAN MOTOR	3HP	1130RPM,460/3/60	KEMAO	1	1
26-	SENSOR		XR30	DIXELL	1	1
27-						
28-	FREEZESTAT	38˚F	CNS 2C114YM2Q3	SAGINOMIYA	1	1
29-	FLOW SWITCH	1"	FQSU30G	SAGINOMIYA	1	1
30-						
31-						

32-	CHILLER PUMP	11.0 GPM/60'	DN 32/16	ROTECH	1	1
33-	CHILLER PUMP MOTOR	TEFC	5 HP, 3510RPM, 460/3/60	LEESON	1	1
34-						
35-	RESERVOIR	50 GALLON	304 SS	PREEZECO	1	
36-						
37-	BALL VALVE	ø1 1/2"			2	
38-	BALL VALVE	ø1"			2	
39-	CHECK VALVE	ø1"			1	
40-	3 WAY ELECTRIC VALVE	ø1"	ESBE 90 SERIES	DANFOSS	1	1
41-						

FACTORY START UP

FACTORY START-UP

CHILLER INFORMATION

PROJECT NAME: GNA	JOB NO : 10-3635	CAPACITY: 4.5 TONS
MODEL NO : FCAC-007.5-2-P	REFRIGERANT: R-134a	NO. OF CIRCUITS: 1
POWER: 480/3/60	RLA: 30	DATE: 2/24/2011

DESIGN CONDITION

EACH CIRCUIT	TONS	FLUID	FLOW RATE (GPM)	TEMP. IN (F)	TEMP. OUT (F)	PRESSURE DROP (PSI)
EVAPORATOR	4.5	WATER/R134a	11.0	65.0	55.0	5.6
CONDENSER	6.5	AIR COOLED	---	130.0	140.0	
SECONDRY H.X	4.5	WATER/OIL		95.0	85.0	5.0

NOISE LEVEL: 82db

GENERAL

No	ITEMS	CHECKED
1.	CHILLER PIPING	OK
2.	CONDENSER PIPING	OK
3.	COIL PIPING	OK
4.	INSTRUMENTS INSTALLED	OK
5.	SYSTEM PIPED AS PER DRAWING	OK
6.	LEAK TEST	OK
7.	PRESSURE GAUGES INSTALLED	OK
8.	THERMOMETER INSTALLED	OK
9.	TEST POINTS PROVIDED	OK

COMPRESSOR

MAKE: FRASCOLD HP: 7.5 MAX AMP: 17.5A MODEL: Q 7 28.1 Y RPM: 1740

				REMARKS
1.	CHILLED FLUID TEMP IN (F)	60.0		
2.	CHILLED FLUID TEMP OUT (F)	57.0		
3.	CHILLED FLUID FLOW (GPM)	----		
4.	AMBIENT TEMP (F)	67.0		
5.	CONDENSER TEMP. IN (F)	67.0		
6.	CONDENSER TEMP. OUT(F)	72.0		
7.	HIGH PRESSURE (PSI)	110		
8.	LOW PRESSURE(PSI)	30		
9.	SUPERHEAT(F)	10		
10.	VOLTAGE (T1/T2/T3)	480		
11.	RLA (L1/L2/L3)	9.95	9.92	9.65

CONDESNER FAN

RLA: 4.5 HP: 3.0

				AMP			ROTATION CHECK
FAN #	SERIAL#	RPM	STATIC	L1	L2	L3	
1	27329	1130		3.62	3.67	3.63	OK

CHILLER PUMP

MOTOR: 5.0 HP
RLA: 6.0

	READINGS			REMARK
RLA (L1/L2/L3)	6.05 A	6.08 A	6.06 A	
SUCTION PRESSURE (PSI)	ATMOSPHERIC TANK			
DISCHARGE PRESSURE (PSI)	60 PSI			

SET POINTS

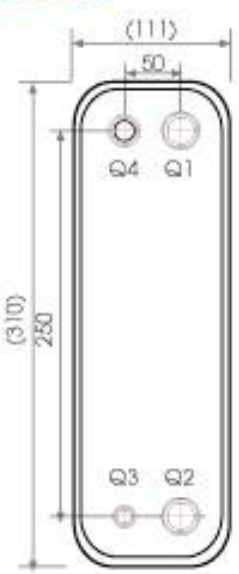
No	ITEMS		STD
1.	NITROGEN HIGH SIDE PRESSURE TEST		400PSI
2.	NITROGEN LOW SIDE PRESSURE TEST		150PSI
3.	EVACUATION TEST		1500MICRONS
4.	LOW PRESSURE SWITCH CUT IN		40 PSI
5.	LOW PRESSURE SWITCH CUT OUT		10 PSI
6.	HIGH PRESSURE SWITCH CUT IN		350PSI
7.	HIGH PRESSURE SWITCH CUT OUT		370PSI
8.	SUPERHEAT		10F
9.	CHILLER SET POINT		60.0
10.	ANTI SHORT CYCLE TIMER		5 MIN
11.	COMPRESSOR OVERLOAD		19 A
12.	CONDESNER FAN MOTOR OVERLOAD		5 A
13.	CHILLER PUMP OVERLOAD		7 A

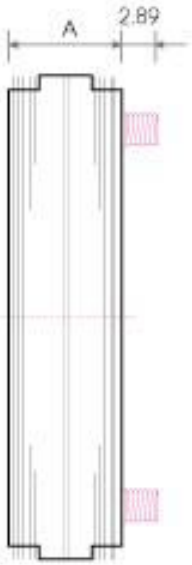
Heat Exchanger

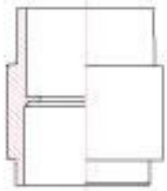
Hex

Brazed Plate Heat Exchangers

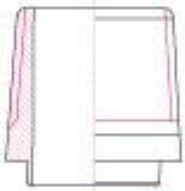
Model B3-027/BL26







Conexión soldable
El diámetro máximo de la conexión soldable es 1" 3/8



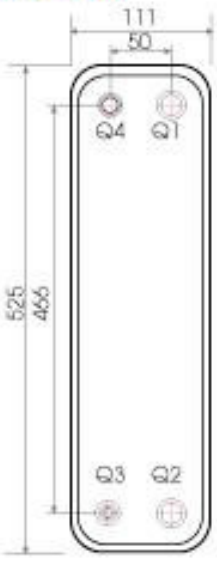
Conexión roscada
El diámetro máximo de la conexión roscada es 1" 1/4

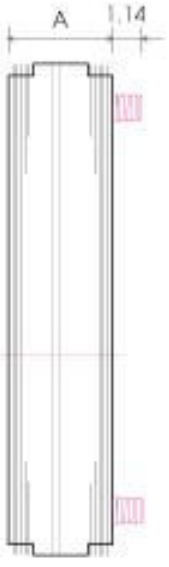
This unit can be manufactured with copper or nickel brazing, plate material available is SS304, SS316L or SM0254.

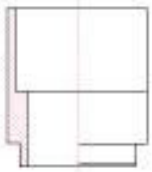
Quantity of plates	A (in)	Weight (lb)	Side volume (USGal)Q1Q2/Q3Q4	Heat exchanger area(ft²)
n	0.35+0.095n	2.6+0.28n	0.0132(1/2)n/0.0132(1/2)(n-2)	(n-2)0.28

Parameters	
Design pressure	435psi (A)
Design pressure	580psi (B)
Testing pressure	652psi (A)
Testing pressure	870psi (B)
Design Temperature	-319 to 392F
Available plate flow pattern	H,L,M
Heat load (KBtu/h)	~13.65-85.30
Quantity of max plates	150

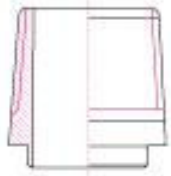
Model B3-052/BL50







Conexión soldable
El diámetro máximo de la conexión soldable es 1" 5/8



Conexión roscada
El diámetro máximo de la conexión roscada es 1" 1/4

Esta unidad puede ser fabricada con termosoldadura de cobre o de níquel, el material de las placas esta disponible en SS316L y SMO254

Cantidad de Placas	A (mm)	Peso (kg)	Q1Q2 / Q3Q4 Volumen por lado (L)	Area de Transferencia (m²)
n	9 +2.4n	1.8+0.23n	0.094x(1/2)xn / 0.094 x (1/2)x(n-2)	(n-2) x 0.050

Parametros	
Presión de Diseño	30.6 Kg/cm² (A)
Presión de Diseño	40.8 Kg/cm² (B)
Presión de Prueba	45.9 Kg/cm² (A)
Presión de Prueba	61.2 Kg/cm² (B)
Temperatura de Diseño	-195 to 200°C
Patrón de Flujo Disponible	H, L, M
Carga Térmica Máxima (Kcal/h)	~8,600-51,590
Cantidad Máxima de Placas	150

NOTE: ALL DIMENSIONS IN INCHES

Hex

Brazed Plate Heat Exchangers

Hex

Brazed Plate Heat Exchangers

Typical Uses

- General Heating and cooling duties in a wide range of industries
- Central Heating
- Heating and Cooling in HVAC installations
- Hydraulic and Lube Oil Coolers
- Tap water and radiator heating
- Hydronic Heating
- Geothermic and Solar Heating
- Evaporation and Condensation in Refrigeration Systems
- Heat recovery

Refrigeration

Our Brazed Plate Heat Exchangers are widely used in chillers, refrigerant systems, brine coolers and air dryers, due to its high resistance to elevated pressures they are an excellent choice when using high-pressure refrigerants.

Our Brazed Plate Heat Exchangers are designed to distribute the refrigerant uniformly in the port for the optimization of the heat transfer area.

Heating

Our main applications include Domestic Hot Water, Radiant Floor Systems, Boilers, Heat Pumps and Substations.

Our Brazed Plate Heat Exchangers effectiveness and efficiency is ideal for this applications, our compact heat exchangers can help reduce the overall size of any heating system.

Industrial

Our compact Brazed Plate Heat Exchangers are ideally suited for the most widely and diverse applications in the industrial environments, from Lube and Hydraulic Oil Coolers to Heat recovery and Steam Heating Systems our outstanding performance is highly recommended.

High Performance

Brazed Plate Heat Exchangers

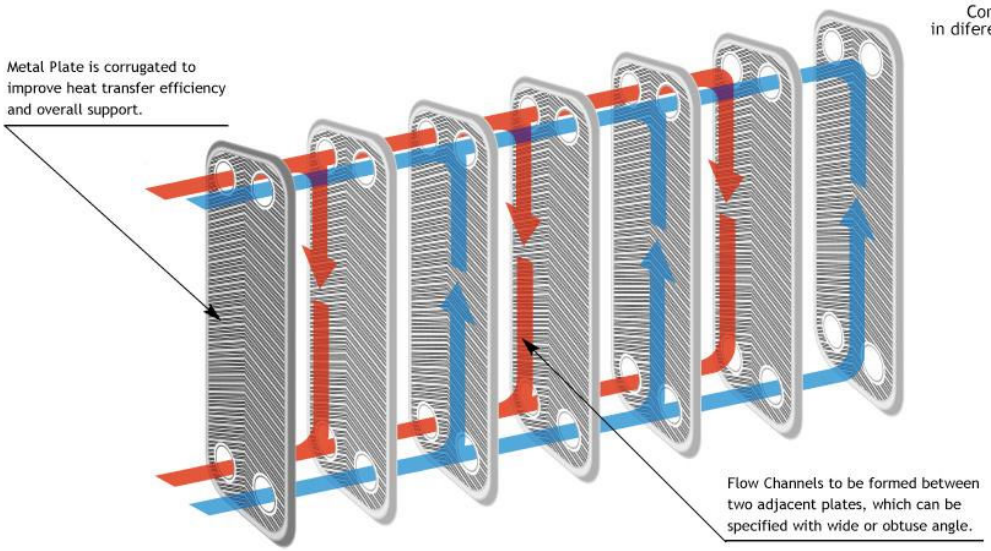
Features and Advantages

Brazed Plate Heat Exchangers are made from thin corrugated stainless steel plates, brazed with pure copper wich result in a solid and reliable device that can handle high pressures and temperatures with a outstanding thermal efficiency.

Our unique plate design enables an unlimited number of combinations in a plate package to match your specific needs of heat transfer duties.

- Stainless Steel 316L (super-low carbon stainless steel plates brazed together with 99.9% pure copper)
- Compact Durable and Cost Effective
- Outstanding Overall Heat Transfer Coeficient
- Wide Variety of Plate Sizes and Patterns
- Single & Double Distributor as well as Premixer for Refrigeration Duties
- Easy Installation & Maintenance

Stainless Steel
Connections avaliable
in diferent sizes and types



▫Compact Brazed Plate Heat Exchangers offers the same performance as large shell and tube units in a compact and reliable way.▫

Technical & Dimensional Data

Parameters

Heat Exchanger Model	Dimensions in (mm) A	B	C	D	E	Channel Volume USGallon (L)	Maximum Number of Plates	Weight lb (kg)
B3-012	0.27+0.090n	6.06	7.32	1.57	2.83	0.0047	50	1.3+0.10n
	(7+2.3n)	(154)	(186)	(40)	(72)	(0.018)		(0.6+0.04n)
B3-014	0.27+0.090n	6.77	8.15	1.65	3.26	0.0052	50	1.5+0.13n
	(7+2.3n)	(172)	(207)	(42)	(77)	(0.020)		(0.7+0.6n)
B3-014C	0.27+0.090n	6.06	7.59	1.65	3.26	0.0058	50	0.9+0.13n
	(7+2.3n)	(154)	(193)	(42)	(83)	(0.022)		(0.4+0.06n)
B3-020	0.27+0.090n	10.95	12.36	1.65	2.83	0.0105	80	2.4+0.20n
	(7+2.3n)	(278)	(314)	(42)	(72)	(0.040)		(1.1+0.09n)
B3-027	0.35+0.95n	9.84	12.24	1.97	4.37	0.0132	120	2.6+0.28n
	(9+2.4n)	(250)	(311)	(50)	(111)	(0.050)		(1.2+0.13n)
B3-052	0.35+0.095n	18.35	20.74	1.97	4.37	0.0248	150	4.0+0.50n
	(9+2.4n)	(466.3)	(527)	(50)	(111)	(0.094)		(1.8+0.23n)
B3-095	0.39+0.095n	20.43	24.29	3.62	7.55	0.660	250	10.1+0.90n
	(10+2.4n)	(519)	(617)	(92)	(192)	(0.250)		(4.6+0.41n)

n=number of plates

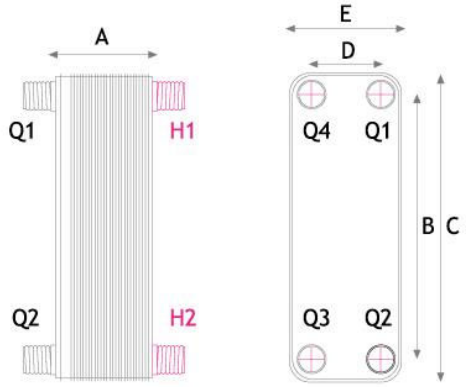
Standard Materials

- Plates SS316L / 304
- Brazing Copper

Design Parameters

- Maximum Working Pressure 435PSI, 145 PSI* (3MPa, 1MPa)*
- Maximum Working Temperature 392°F (200°C)
- Minimum Working Temperature -319°F (-195°C)

* Pressure rating depending on unit type



Standard Connections

Heat Exchanger Model	Solder* (in)	Threaded NPT (in)
B3-012	3/4"	3/4"
B3-014	7/8"	3/4"
B3-014C	7/8"	3/4"
B3-020	7/8"	3/4"
B3-027	1 1/8"	1"
B3-052	1 5/8"	1"
B3-095	2 1/8"	2"

* Copper Pipe OD

Our manufacturing process is certified under ISO9001:2000 and our product quality meets the most rigorous international standards.

HEX is our name, superb quality and efficiency is our standard.
Heat Transfer Solutions is Our Way of Life.

CE /ULC

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Authorized Representative

Standard Shell & Tube

Basco / Whitlock Hub-Design Heat Exchanger

API Heat Transfer's extensive line of Basco/Whitlock HT, AHT, heat exchangers offers the benefits of non-ferrous construction in a highly standardized design for maximum flexibility at minimum cost. Hub design advantages include increased corrosion resistance, maximum obtainment of tube quantity in a given diameter for better efficiency, and lower entrance velocity and pressure drop as a result of the dome shell nozzle.

Sizes: 2" to 8" diameter; 8" to 96" length

Shells: Brass or 316 Stainless Steel

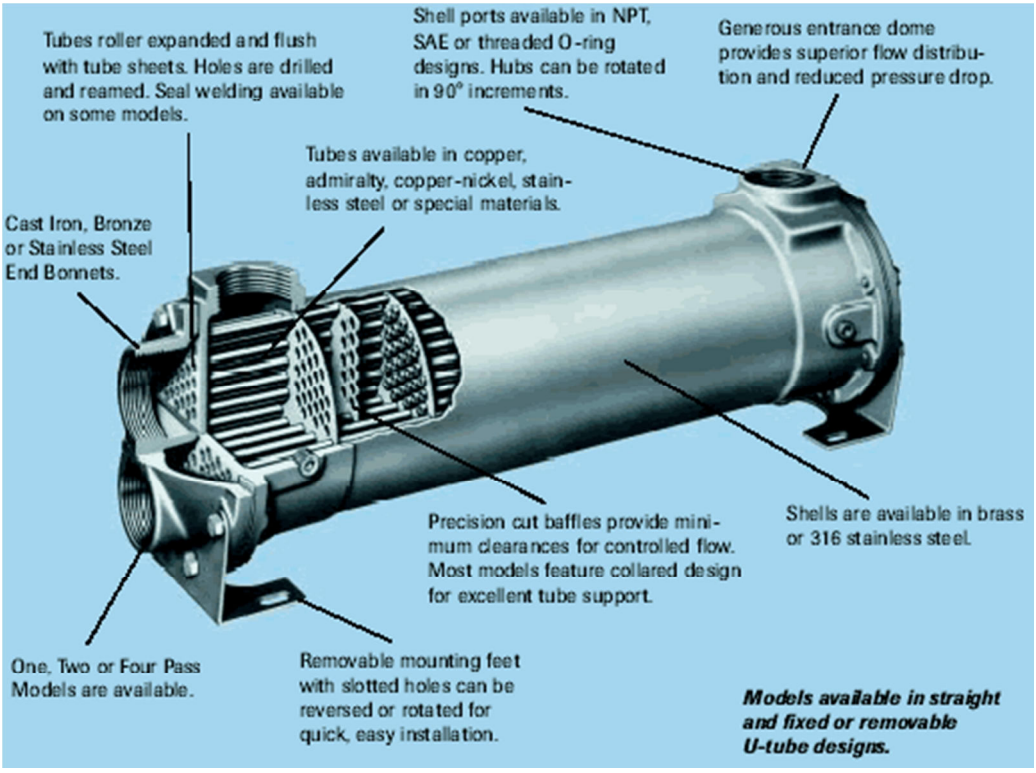
Tubes: 1/4", 3/8" or 5/8" diameter tubes available Copper, Admiralty, or 316 S/S Straight tube or U-Tube configurations

Baffles: Precision punched Brass or 316 S/S

Heads: Cast iron, Bronze, 316 S/S; Fabricated heads available in Steel, 304 S/S, or 90/10 CuNi.

Flow: Available in 1-pass, 2-pass, and 4-pass designs

Codes: Commercial Standard (non-code)
ASME (available above 4" diameter)



Type HT heat exchangers have been in production since 1965. Standard HT models feature low-cost, non-ferrous construction with brass shell, brass tubesheet and straight copper tubes. End bonnets are cast iron. Numerous

options including special materials and nozzle orientation are available.

Type AHT heat exchangers feature all 316 Stainless Steel construction in a wide variety of configurations. Modified units are suitable for critical service where ultra-clean conditions are paramount. Options include seal welding of tube to tube sheet joints and polished surfaces for pharmaceutical and food processing applications.

Type HTR and **AHTR** feature a removable tube bundle design allowing shellside cleaning and bundle replacement, rare in a low cost small diameter design where tubesheets are typically fixed. Available in non-ferrous or stainless designs.

Typical applications for Hub-Design heat exchangers include:

- Lube Oil Cooling
- Engine Jacket Water Cooling
- Hydraulic Systems
- Molding Machines
- Vegetable Oil Cooling
- Marine Applications
- Refrigerant Evaporating
- Refrigerant Condensing
- Paints and Coatings
- Vapor Recovery Systems

For complete information on this product visit our Literature section for a free download of the Basco/Whitlock Hub-Design Heat Exchangers brochure.

To contact an API Heat Transfer Sales Engineer directly, click here

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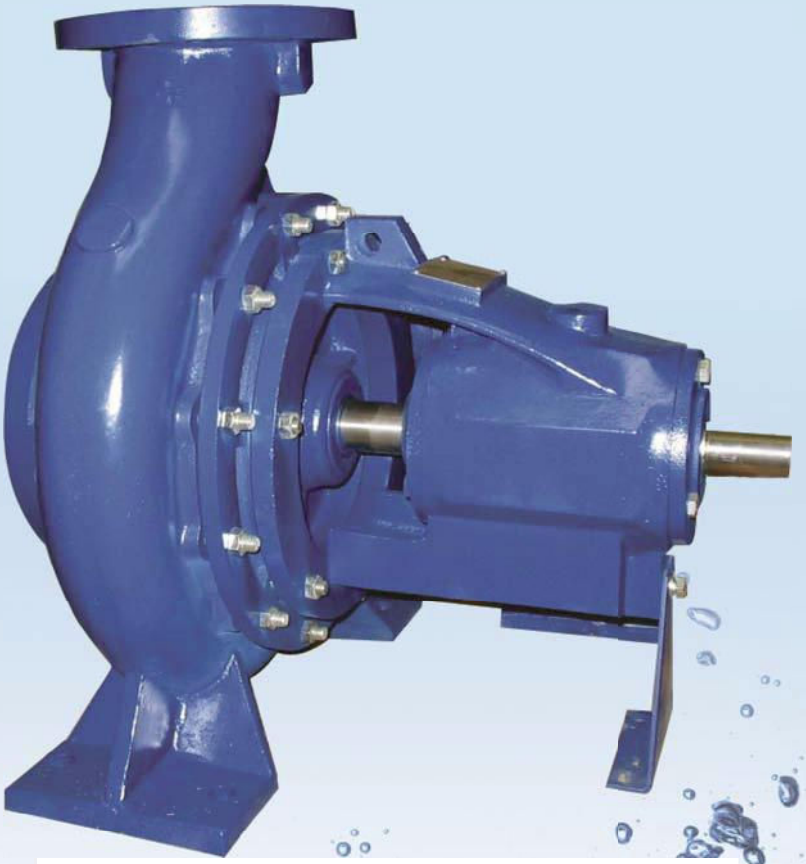
Pump

Rotech DN Series Pumps



General Purpose
End Suction Pumps

rotech
PUMPS & SYSTEMS INC.

Rotech DN Series Pumps

are general purpose, frame mounted end suction pumps flexibly Coupled to drivers. Each entire unit can be mounted on a common base plate.

Applications

DN Series pumps are designed for applications in medium duty service, providing maximum pump value in heating and air conditioning, booster and general circulating services.

Specifications

Capacities	: Up to 3000 GPM
Head	: Up to 400 feet
Pressure	: Up to 175 psi
Horsepower	: Up to 200 hp
Temperature	: From 32 F to 200 F
Drives	: Electric Motors
Liquids	: Water and Light Hydrocarbons
Materials	: Cast Iron, Bronze, Stainless Steel

Features

DN Series Pumps are available in cast iron bronze fitted and all iron Materials of Construction with type 21 mechanical seals. All stainless steel MOC can be supplied upon request.

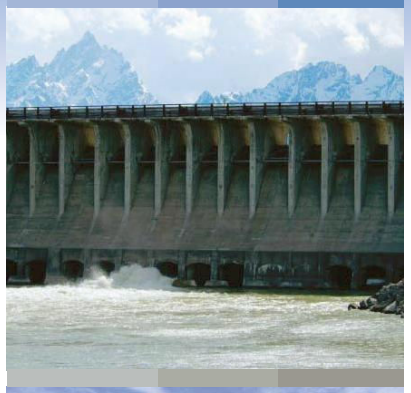
Pump casing is fitted with a bronze/Cast Iron replaceable wear ring . Suction and Discharge connection flanges are ANSI rated 150# maximum working pressure. Rotech can supply 200# or higher rated ANSI flanges connections if required.

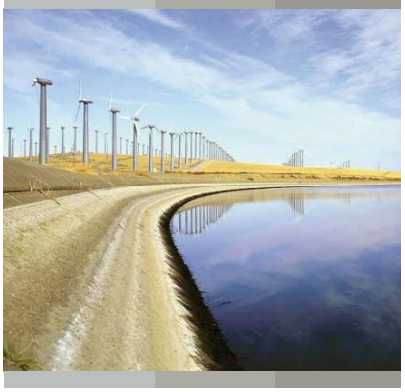
Motor bearings are grease lubricated and are sized for a minimum of 20,000 hours L10 basic rating life or 100,000 hours median bearing life. Shaft is designed to limit the shaft deflection to no more than .022" at the seal faces.

The motor/impeller shaft is protected with a replaceable (bronze/stainless steel) sleeve installed between the shaft and mechanical seal.

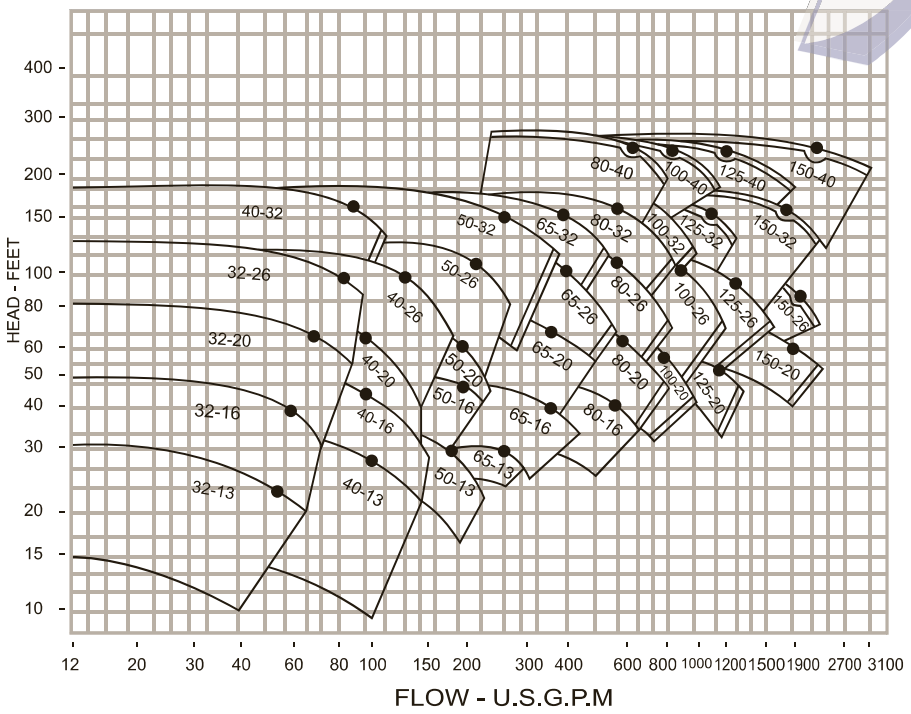
Mechanical seals are designed for water service and light hydrocarbons up to 200F. Seals are face type with Ceramic seat, carbon washer, stainless steel metal parts and Buna elastomers. MOC for mating faces and elastomers can be supplied based on application and customers requirements.

Rotech DN Series Pumps are supplied with enclosed dynamically balanced impellers for smooth, low vibration operation. The impeller is keyed to the shaft for positive driving and is secured in place with a stainless steel washer and self locking cap screw.

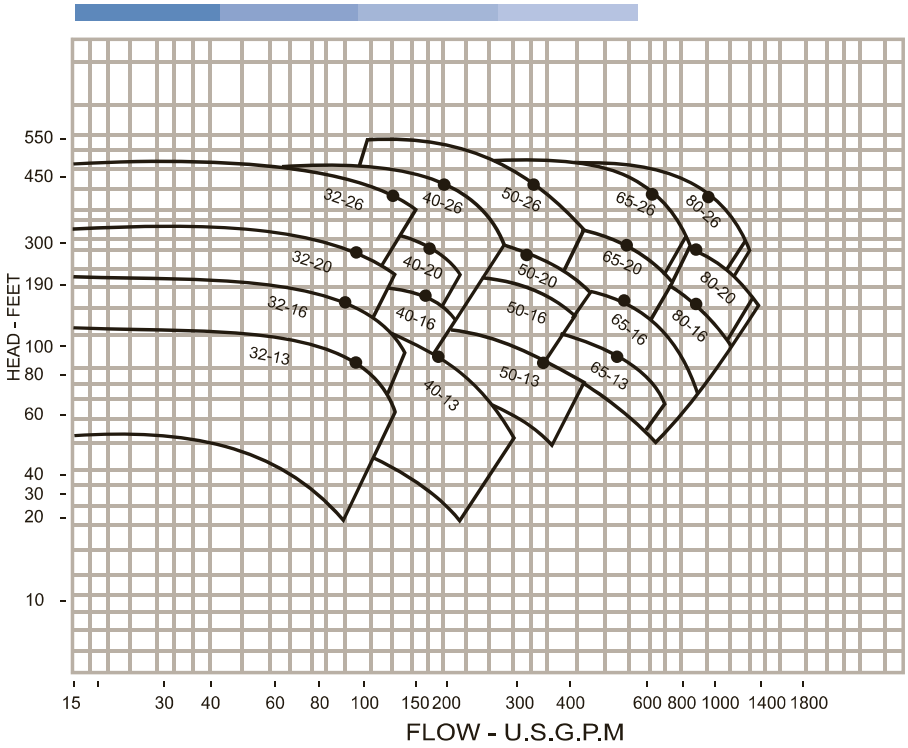




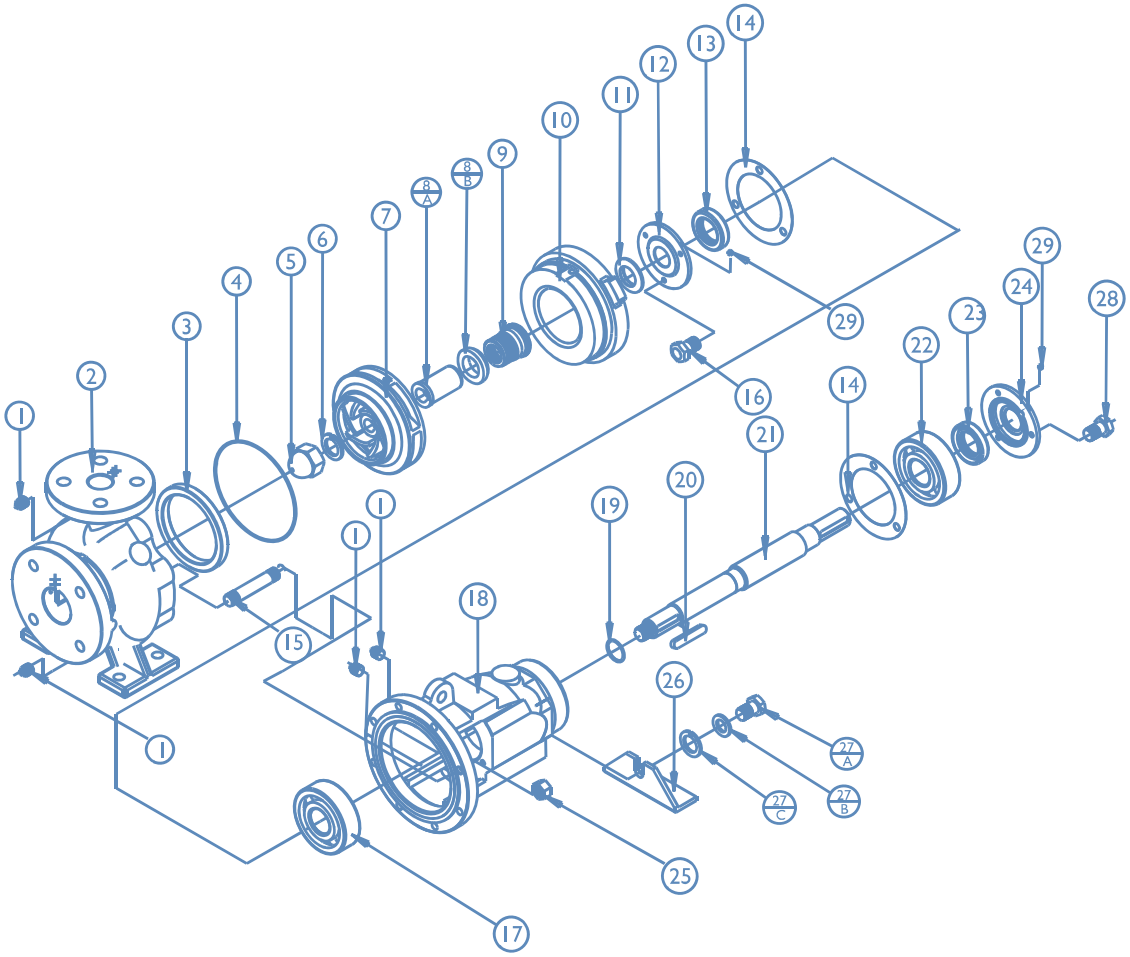
Selection Chart 1800 RPM



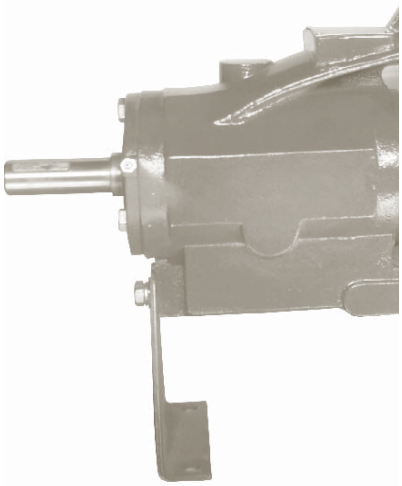
Selection Chart 3600 RPM



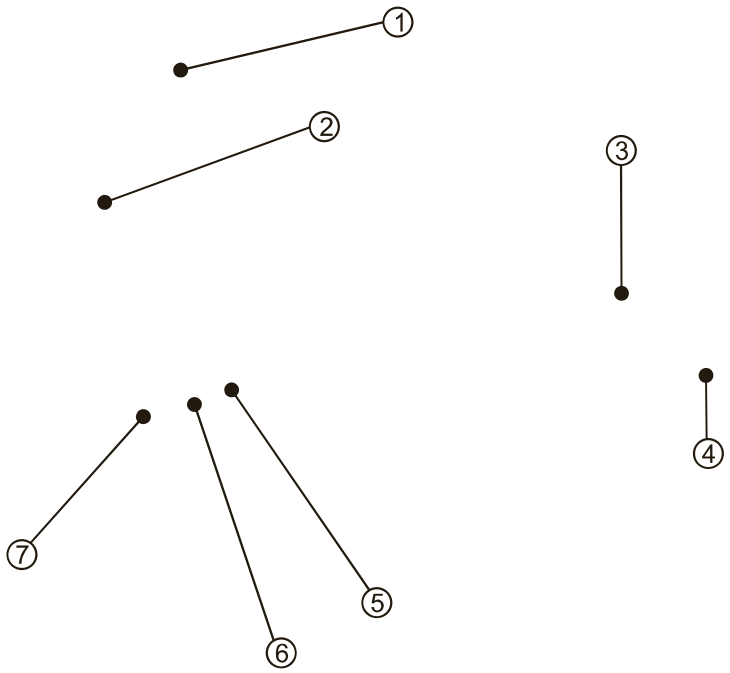
DN Pump Blown-up Drawing



Part #	Part Name	Part #	Part Name
1	Plug	16	Bolt
2	Pump casing	17	Inboard bearing
3	Casing wear ring	18	Bearing housing
4	Casing O Ring	19	Shaft sleeve O ring
5	Impeller Nut	20	Key shaft
6	Spring washer	21	Shaft
7	Impeller	22	Outboard bearing
8A	Shaft sleeve	23	Outboard lip seal
8B	Abutment ring	24	Outboard bearing cover
9	Mechanical seal	25	Nut
10	Casing cover	26	Rear foot support
11	Slinger	27C	Flat washer
12	Inboard bearing cover	27B	Spring washer
13	Inboard lip seal	27A	Bolt
14	Gasket	28	Bolt
15	Stud	29	Grease nipple



Cross Sectional View



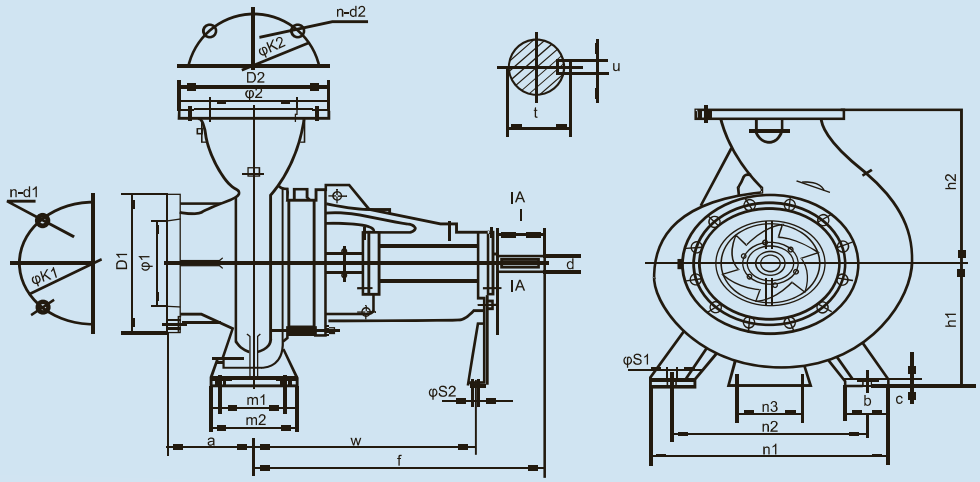
Item	Description
1	Casing
2	Impeller
3	Power Frame
4	Shaft
5	Shaft Sleeve
6	Mech Seal
7	Stuffing box
	(There is white box underneath mech seal which is called stuffing box)
8	Casing wearing ring

Modular Interchangeability Chart

Rotech DN Series / Part Name		Casing	Imp	Casing Cover	Wear Ring	Shaft Sleeve	Mech Seal
Model	Pump Size	C.I	BR C95200	C.I	BR C83600	KITS	RS21
DN 32/13	1 1/4x2-5	UDN XX/XX-001	UDN XX/XX-002	13-1	70	1.25"	1.25"
DN 40/13	1 ½x2½-5				80		
DN 50/13	2x2 ½-5				95		
DN 65/13	2 ½x3-5				115		
DN 32/16	1 1/4x2-7			16-2	70		
DN 40/16	1 1/2x2 ½-7				80		
DN 50/16	2x2 ½-7				95		
DN 65/16	2 ½x3-7				115		
DN 80/16	3x4-7				130		
DN 100/16	4x5-7				130		
DN 32/20	1 1/4x2-8			20-3	80		
DN 40/20	1 ½x2 ½-8				80		
DN 50/20	2x2 ½-8				95		
DN 65/20	2 1/2x3-8				115		
DN 80/20	3x4-8			20-5	130	1.625"	1.625"
DN 100/20	4x5-8				160		
DN 125/20	5x6-8				180		
DN 150/20	6x8-8			20-5G	185/185	1.625"G	
DN 32/26	1 1/4x2-10			26-4	80	1.25"	1.25"
DN 40/26	1 ½ x2 ½-10				95		
DN 50/26	2x2 ½-10				115		
DN 65/26	2 1/2x3-10			26-6	115	1.625"	1.625"
DN 80/26	3x4-10				130		
DN 100/26	4x5-10			26-7	160		
DN 125/26	5x6-10				180		
DN 150/26	6x8-10			26-10	200/200	2.125"	2.125"
DN 200/26	8x10-10			26-10G	220/200		
DN 40/32	1 ½x2 ½-13			32-8	95/95A	1.625"	1.625"
DN 50/32	2x2 ½ -13				115/115		
DN 65/32	2 ½x3-13			32-9	130/125		
DN 80/32	3x4-13				140/135		
DN 100/32	4x5-13				160/155		
DN 125/32	5x6-13			32-11	180/180A	2.125"	2.125"
DN 150/32	6x8-13				200/200		
DN 200/32	8x10-13			32-13	250/250	2.125"	2.125"
DN 250/32	10x12-13			32-16	270/270	2.75"	2.75"
DN 80/40	3x4-16			40-12	140/160A	2.125"	2.125"
DN 100/40	4x5-16				160/160A		
DN 125/40	5x6-16				180/180A		
DN 150/40	6x8-16				200/200		
DN 200/40	8x10-16			40-14	265/265	2.75"	2.75"
DN 250/40	10x12-16			40-19	270/270	3.375"	3.375"
DN 150/50	6x8-20			50-18	215/215	2.75"	2.75"
DN 200/50	8x10-20			50-20	250/250	3.375"	3.375"

Sleeve Ring	Casing Ring	Bearing Housing Assembly			
		Frame	Shaft	Bearing Cover	Bearing
NBR	NBR	C.I	SS	C.I	NTN
φ23.6x1.8	φ140x3.1	25A-01	25-01	25-02	6305 (2)
	φ175x3.1	25B-01			
	φ215x3.1	25A-01			
φ31.5x1.8		35-01	35-01	35-02	6307 (2)
			35G-01		
φ23.6x1.8	φ265x3.1	25B-01	25-01	25-02	6305 (2)
φ31.5x1.8		35-01	35-01	35-02	6307 (2)
φ43.7x2.65		45A-01	45-01	45-02	6309 (2)
		45-01			
φ31.5x1.8	φ330x3.1	35-01	35-01	35-02	6307 (2)
φ43.7x2.65		45-01	45-01	45-02	6309 (2)
φ55x3.1	φ345x3.55	55-01	55-01	55-02	6311 (2)
φ60x2.65	φ330x3.1	60-01	60-01	60-02	6312 (2)
φ43.7x2.65	φ410x3.1	45-01	45-01	45-02	6309 (2)
φ55x3.1		55-01	55-01	55-02	6311(2)
φ69x2.65	φ425x7	70-01	70-01	70-02	3314(1) NU314(1)
φ60x2.65	φ505x7	60-0	60-01	60-02	63
φ69x2.65	φ505x7	70-01	70-01	70-02	3314 1

Dimensional Data



MODEL	PUMP DIMENSION												PUMP FOOT DIMENSION										SHAFT END				WEIGHT
	φ1	φ2	D1	φK1	n-d1	D2	φK2	n-d2	a	f	h1	h2	b	c	m1	m2	n1	n2	n3	φS1	φS2	w	d	l	t	u	(lbs)
DN32/13	2	1.25	6	4.75	4-0.75	4.62	3.5	4-0.62	3.15	14.2	4.5	5.34	1.97	0.55	3.94	2.76	7.48	5.51	3.94	0.563	0.55	10.5	0.875	1.97	0.969	0.25	60.6
DN32/16	2	1.25	6	4.75	4-0.75	4.62	3.5	4-0.62	3.15	14.2	5.25	6.17	1.97	0.55	3.94	2.76	9.45	7.48	3.94	0.563	0.55	10.5	0.875	1.97	0.969	0.25	77.1
DN32/20	2	1.25	6	4.75	4-0.75	4.62	3.5	4-0.62	3.15	14.2	6.25	6.9	1.97	0.55	3.94	2.76	9.45	7.48	4.33	0.563	0.55	10.5	0.875	1.97	0.969	0.25	90.3
DN32/26	2	1.25	6	4.75	4-0.75	4.62	3.5	4-0.62	3.94	14.2	7	8.67	2.56	0.55	4.92	3.74	12.6	9.84	4.33	0.563	0.55	10.5	0.875	1.97	0.969	0.25	130.0
DN40/13	2.5	1.5	7	5.5	4-0.75	5	3.88	4-0.62	3.15	14.2	4.5	5.42	1.97	0.55	3.94	2.76	8.27	6.3	3.94	0.563	0.55	10.5	0.875	1.97	0.969	0.25	66.1
DN40/16	2.5	1.5	7	5.5	4-0.75	5	3.88	4-0.62	3.15	14.2	5.25	6.17	1.97	0.55	3.94	2.76	9.45	7.48	3.94	0.563	0.55	10.5	0.875	1.97	0.969	0.25	79.3
DN40/20	2.5	1.5	7	5.5	4-0.75	5	3.88	4-0.62	3.94	14.2	6.25	6.98	1.97	0.55	3.94	2.76	10.4	8.35	4.33	0.563	0.55	10.5	0.875	1.97	0.969	0.25	96.9
DN40/26	2.5	1.5	7	5.5	4-0.75	5	3.88	4-0.62	3.94	14.2	7	8.75	2.56	0.55	4.92	3.74	12.6	9.84	4.33	0.563	0.55	10.5	0.875	1.97	0.969	0.25	134.4
DN40/32	2.5	1.5	7	5.5	4-0.75	5	3.88	4-0.62	4.92	18.5	8	9.72	2.56	0.55	4.92	3.74	13.6	11	4.33	0.563	0.55	13.5	1.25	3.15	1.25	0.313	211.0
DN50/13	2.5	2	7	5.5	4-0.75	6	4.75	4-0.75	3.94	14.2	5.25	6.17	1.97	0.55	3.94	2.76	9.45	7.48	3.94	0.563	0.55	10.5	0.875	1.97	0.969	0.25	74.9
DN50/16	2.5	2	7	5.5	4-0.75	6	4.75	4-0.75	3.94	14.2	6.25	6.98	1.97	0.55	3.94	2.76	10.4	8.35	4.33	0.563	0.55	10.5	0.875	1.97	0.969	0.25	83.7
DN50/20	2.5	2	7	5.5	4-0.75	6	4.75	4-0.75	3.94	14.2	6.25	7.77	1.97	0.55	3.94	2.76	10.4	8.35	4.33	0.563	0.55	10.5	0.875	1.97	0.969	0.25	101.3
DN50/26	2.5	2	7	5.5	4-0.75	6	4.75	4-0.75	3.94	14.2	7	8.75	2.56	0.55	4.92	3.74	12.6	9.84	4.33	0.563	0.55	10.5	0.875	1.97	0.969	0.25	138.8
DN50/32	2.5	2	7	5.5	4-0.75	6	4.75	4-0.75	4.92	18.5	9	10.9	2.56	0.63	4.92	3.74	13.6	11	4.33	0.563	0.55	13.5	1.25	3.15	1.25	0.313	222.5
DN65/13	3	2.5	7.5	6	4-0.75	7	5.5	4-0.75	3.94	14.2	6.25	7.88	2.56	0.55	4.92	3.74	11	8.35	4.33	0.563	0.55	10.5	0.875	1.97	0.969	0.25	85.9
DN65/16	3	2.5	7.5	6	4-0.75	7	5.5	4-0.75	3.94	14.2	6.25	7.88	2.56	0.55	4.92	3.74	11	8.35	4.33	0.563	0.55	10.5	0.875	1.97	0.969	0.25	94.7
DN65/20	3	2.5	7.5	6	4-0.75	7	5.5	4-0.75	3.94	14.2	7	8.87	2.56	0.55	4.92	3.74	12.6	9.84	4.33	0.563	0.55	10.5	0.875	1.97	0.969	0.25	154.2
DN65/26	3	2.5	7.5	6	4-0.75	7	5.5	4-0.75	3.94	18.5	8	9.83	3.15	0.63	6.3	4.72	14.2	11	4.33	0.752	0.55	13.5	1.25	3.15	1.25	0.313	178.4
DN65/32	3	2.5	7.5	6	4-0.75	7	5.5	4-0.75	4.92	18.5	9	11.02	3.15	0.63	6.3	4.72	15.7	12.4	4.33	0.752	0.55	13.5	1.25	3.15	1.25	0.313	242.3
DN80/16	4	3	9	7.5	8-0.75	7.5	6	4-0.75	4.92	14.2	7	8.83	2.56	0.55	4.92	3.74	12.6	9.84	4.33	0.563	0.55	10.5	0.875	1.97	0.969	0.25	118.9
DN80/20	4	3	9	7.5	8-0.76	7.5	6	4-0.75	4.92	18.5	7	9.81	2.56	0.55	4.92	3.74	13.6	11	4.33	0.563	0.55	13.5	1.25	3.15	1.25	0.313	154.2
DN80/26	4	3	9	7.5	8-0.77	7.5	6	4-0.75	4.92	18.5	8	10.98	3.15	0.63	6.3	4.72	15.7	12.4	4.33	0.752	0.55	13.5	1.25	3.15	1.25	0.313	200.4
DN80/32	4	3	9	7.5	8-0.78	7.5	6	4-0.75	4.92	18.5	10	12.36	3.15	0.63	6.3	4.72	15.7	12.4	4.33	0.752	0.55	13.5	1.25	3.15	1.25	0.313	264.3
DN80/40	4	3	9	7.5	8-0.79	7.5	6	4-0.75	4.92	20.9	11	13.96	3.35	0.63	6.3	4.72	17.3	13.4	4.33	0.752	0.55	14.5	1.625	4.33	1.25	0.313	354.6
DN100/16	5	4	10	8.5	8-0.88	9	7.5	8-0.75	4.92	14.2	7	8.75	2.56	0.55	4.92	3.74	12.6	9.84	4.33	0.563	0.55	10.5	0.875	1.97	0.969	0.25	160.0
DN100/20	5	4	10	8.5	8-0.88	9	7.5	8-0.75	4.92	18.5	8	10.9	3.15	0.63	6.3	4.72	14.2	11	4.33	0.752	0.55	13.5	1.25	3.15	1.25	0.313	187.2
DN100/26	5	4	10	8.5	8-0.88	9	7.5	8-0.75	5.51	18.5	9	10.88	3.15	0.63	6.3	4.72	15.7	12.4	4.33	0.752	0.55	13.5	1.25	3.15	1.25	0.313	233.5
DN100/32	5	4	10	8.5	8-0.88	9	7.5	8-0.75	5.51	18.5	10	12.28	3.15	0.63	6.3	4.72	15.7	12.4	4.33	0.752	0.55	13.5	1.25	3.15	1.25	0.313	295.2
DN100/40	5	4	10	8.5	8-0.88	9	7.5	8-0.75	5.51	20.9	11	13.88	3.94	0.71	7.87	5.91	19.7	15.7	4.33	0.874	0.55	14.6	1.625	4.33	1.625	0.5	383.3
DN125/20	6	5	11	9.5	8-0.88	10	8.5	8-0.88	5.51	18.5	10	12.2	3.15	0.63	6.3	4.72	15.7	12.4	4.33	0.752	0.55	13.5	1.25	3.15	1.25	0.313	233.5
DN125/26	6	5	11	9.5	8-0.88	10	8.5	8-0.88	5.51	18.5	10	13.78	3.15	0.63	6.3	4.72	15.7	12.4	4.33	0.752	0.55	13.5	1.25	3.15	1.25	0.313	253.3
DN125/32	6	5	11	9.5	8-0.88	10	8.5	8-0.88	5.51	20.9	11	13.76	3.94	0.63	7.87	5.91	19.7	15.7	4.33	0.874	0.55	14.6	1.625	4.33	1.625	0.5	359.0
DN125/40	6	5	11	9.5	8-0.88	10	8.5	8-0.88	5.51	20.9	12.5	15.55	3.94	0.71	7.87	5.91	19.7	15.7	4.33	0.874	0.55	14.6	1.625	4.33	1.625	0.5	398.7
DN150/20	8	6	13.5	11.75	8-0.88	11	9.5	8-0.88	6.3	19.5	11	15.69	3.94	0.79	7.87	5.91	21.7	17.7	4.33	0.874	0.55	14.4	1.25	3.15	1.25	0.313	343.6
DN150/26	8	6	13.5	11.75	8-0.88	11	9.5	8-0.88	6.3	20.9	11	13.9	3.94	0.71	7.87	5.91	17.7	13.8	4.33	0.874	0.55	14.6	1.625	4.33	1.625	0.5	326.0
DN150/32	8	6	13.5	11.75	8-0.88	11	9.5	8-0.88	6.3	20.9	11	15.69	3.94	0.71	7.87	5.91	21.7	17.7	4.33	0.874	0.55	14.6	1.625	4.33	1.625	0.5	374.4
DN150/40	8	6	13.5	11.75	8-0.88	11	9.5	8-0.88	6.3	20.9	12.5	17.62	3.94	0.71	7.87	5.91	21.7	17.7	4.33	0.874	0.55	14.6	1.625	4.33	1.625	0.5	460.4

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Controller

Digital controller with off cycle defrost

XR30C XR30D

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1. GENERAL WARNING

1.1 PLEASE READ BEFORE USING THIS MANUAL

- This manual is part of the product and should be kept near the instrument for easy and quick reference.
- The instrument shall not be used for purposes different from those described hereunder. It cannot be used as a safety device.
- Check the application limits before proceeding.

1.2 SAFETY PRECAUTIONS

- Check the supply voltage is correct before connecting the instrument.
- Do not expose to water or moisture: use the controller only within the operating limits avoiding sudden temperature changes with high atmospheric humidity to prevent formation of condensation
- Warning: disconnect all electrical connections before any kind of maintenance.
- Fit the probe where it is not accessible by the End User. The instrument must not be opened.
- In case of failure or faulty operation send the instrument back to the distributor or to Dixell S.p.A. (see address) with a detailed description of the fault.
- Consider the maximum current which can be applied to each relay (see Technical Data).
- Ensure that the wires for probes, loads and the power supply are separated and far enough from each other, without crossing or intertwining.
- In case of applications in industrial environments, the use of mains filters (our mod. FT1) in parallel with inductive loads could be useful.

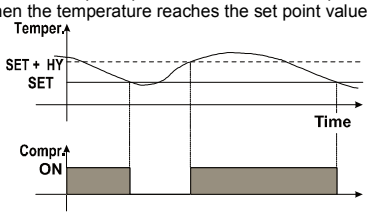
2. GENERAL DESCRIPTION

Model **XR30C**, format 32 x 74 mm, and **XR30D**, DIN rail format, are digital thermostats with off cycle defrost designed for refrigeration applications at normal temperature. They provide two relay outputs, one for the compressor, the other one can be used for alarm signalling or as auxiliary output. The probe input can be selected between PTC or NTC. The instrument has a digital input, for alarm signalling, for switching the auxiliary output or for start a defrost cycle.

3. CONTROLLING LOADS

3.1 COMPRESSOR

The regulation is performed according to the temperature measured by the thermostat probe with a positive differential from the set point: if the temperature increases and reaches set point plus differential the compressor is started and then turned off when the temperature reaches the set point value again.



In case of fault in the thermostat probe the start and stop of the compressor are timed through parameters **COn** and **COF** .

3.2 DEFROST

Defrost is performed through a simple stop of the compressor. Parameter **IdF** controls the interval between defrost cycles, while its length is controlled by parameter **MdF** .

4. FRONT PANEL COMMANDS

XR30C

XR30D

SET: To display target set point; in programming mode it selects a parameter or confirm an operation.

❄ **(DEF)** To start a manual defrost

▲ (**UP**): To see the last temperature alarm happened; in programming mode it browses the parameter codes or increases the displayed value.

▼ (**DOWN**) To see the last temperature alarm happened; hold pressed it switches the auxiliary output; in programming mode it browses the parameter codes or decreases the displayed value.

KEY COMBINATIONS:

▲ + ▼ To lock & unlock the keyboard.

SET + ▼ To enter in programming mode.

SET + ▲ To return to the room temperature display.

4.1 USE OF LEDS

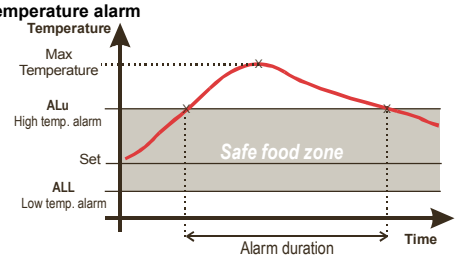
Each LED function is described in the following table.

LED	MODE	FUNCTION
❄	ON	Compressor enabled
❄	Flashing	-Programming Phase (flashing with ❄) - Anti-short cycle delay enabled
❄	ON	Defrost enabled
❄	Flashing	- Programming Phase (flashing with ❄)
AUX	ON	Second relay ON
🔔	ON	An temperature alarm happened

5. TEMPERATURE ALARM AND ITS DURATION RECORDING (HACCP)

XR30C signals and records temperature alarms, together with their duration and max value reached. See drawing:

Ex. High temperature alarm



5.1 HOW TO SEE THE ALARM DURATION AND MAX (MIN) TEMPERATURE

If the alarm LED is on, an alarm has taken place.
To see the kind of alarm, the max (min) reached temperature and alarm duration do as follows:

1. Push the Up or Down key.
2. On the display the following message is shown:: **HAL** for high temperature alarm (**LAL** fot the minimum allarm), followed by the **Maximum (minimum) temperature.** Then the **tiM** (**tiM**e) message is displayed, followed by the **Duration** in h.mm.
3. Then the instrument displays the temperature once again.

NOTE1: if an alarm is still occurring the **tim** shows the partial duration.
NOTE2: the alarm is recorded when the temperature come back to normal values

5.2 HOW TO RESET A RECORDED ALARM OR ONE THAT IS STILL OCCURRING

1. Hold the SET key pressed for more than 3s, while the recorded alarm is displayed. (the rSt message will be displayed)
2. To confirm the operation, the rSt message starts blinking and the normal temperature will be displayed.

6. MAIN FUNCTIONS

6.1 HOW TO SEE THE SETPOINT

1. Push and immediately release the **SET** key: the display will show the Set point value;
2. Push and immediately release the **SET** key or wait for 5 seconds to display the probe value again.

6.2 HOW TO CHANGE THE SETPOINT

1. Push the **SET** key for more than 2 seconds to change the Set point value;
2. The value of the set point will be displayed and the ❄ LED starts blinking;
3. To change the Set value push the ▲ or ▼ arrows within 10s.
4. To memorise the new set point value push the **SET** key again or wait 10s.

6.3 HOW TO START A MANUAL DEFROST

Push the **DEF** key for more than 2 seconds and a manual defrost will start.

6.4 HOW TO SWITCH ON OR OFF THE SECOND RELAY (OAC= LHt)

Hold pressed the ▼ key for some seconds, till the **AUX** LED is turned ON or OFF

6.5 HOW TO CHANGE A PARAMETER VALUE

To change the parameter s value operate as follows:

1. Enter the Programming mode by pressing the Set and DOWN key for 3s (❄ and ❄ start blinking).
2. Select the required parameter.
3. Press the **SET** key to display its value (now only the ❄ LED is blinking).
4. Use **UP** or **DOWN** to change its value.

5. Press **SET** to store the new value and move to the following parameter.

To exit: Press **SET + UP** or wait 15s without pressing a key.
NOTE: the set value is stored even when the procedure is exited by waiting the time-out to expire.

6.6 THE HIDDEN MENU

The hidden menu Includes all the parameters of the instrument.

6.6.1 HOW TO ENTER THE HIDDEN MENU

1. Enter the Programming mode by pressing the Set + ▼ key for 3s (LED 1 and ❄ start blinking).
2. When a parameter is displayed keep pressed the Set+▼ for more than 7s. The Pr2 label will be displayed immediately followed from the HY parameter. **NOW YOU ARE IN THE HIDDEN MENU.**
3. Select the required parameter.
4. Press the **SET** key to display its value (Now only the ❄ LED is blinking).
5. Use ▲ or ▼ to change its value.
6. Press **SET** to store the new value and move to the following parameter.

To exit: Press **SET +** ▲ or wait 15s without pressing a key.
NOTE: the set value is stored even when the procedure is exited by waiting the time-out to expire.

6.6.2 HOW TO MOVE A PARAMETER FROM THE HIDDEN MENU TO THE FIRST LEVEL AND VICEVERSA.

Each parameter present in the HIDDEN MENU can be removed or put into THE FIRST LEVEL (user level) by pressing **SET +** ▼ .
In HIDDEN MENU when a parameter is present in First Level the decimal point is on.

6.7 HOW TO LOCK THE KEYBOARD

1. Keep pressed for more than 3 s the ▲ and ▼ keys.
2. The **POF** message will be displayed and the keyboard will be locked. At this point it will be possible only to see the set point or the MAX o Min temperature stored
3. If a key is pressed more than 3s the POF message will be displayed.

6.8 TO UNLOCK THE KEYBOARD

Keep pressed together for more than 3s the ▲ and ▼ keys, till the **Pon** message will be displayed.

6.9 THE CONTINUOUS CYCLE

When defrost is not in progress, it can be activated by holding the ▲ key pressed for about 3 seconds.

The compressor operates in continuous mode for the time set through the **CCt** parameter. The cycle can be terminated before the end of the set time using the same activation key ▲ for 3 seconds.

7. PARAMETERS

NOTE: the parameters preceded by dots are in the Hidden Menu.

REGULATION

Hy Differential: (0,1 ÷ 25,5°C / 1÷255 °F) Intervention differential for set point. Compressor Cut IN is Set Point Plus Differential (Hy). Compressor Cut OUT is when the temperature reaches the set point.

- ***LS Minimum set point**: (- 50°C÷SET/-58°F÷SET): Sets the minimum acceptable value for the set point.*
- ***US Maximum set point**: (SET÷110°C/ SET÷230°F). Set the maximum acceptable value for set point.*

Ot Thermostat probe calibration: (-12.0÷12.0°C; -120÷120°F) allows to adjust possible offset of the thermostat probe.

- ***OdS Outputs activation delay at start up:** (0÷255min) This function is enabled at the initial start up of the instrument and inhibits any output activation for the period of time set in the parameter.*

AC Anti-short cycle delay: (0÷50 min) minimum interval between the compressor stop and the following restart.

- ***CCt Compressor ON time during continuous cycle**: (0.0÷24.0h; res. 10min) Allows to set the length of the continuous cycle: compressor stays on without interruption for the CCt time. Can be used, for instance, when the room is filled with new products.*
- ***COn Compressor ON time with faulty probe**: (0÷255 min) time during which the compressor is active in case of faulty thermostat probe. With COn=0 compressor is always OFF.*
- ***COF Compressor OFF time with faulty probe**: (0÷255 min) time during which the compressor is OFF in case of faulty thermostat probe. With COF=0* compressor is always active.

CH Type of action: CL = cooling; Ht = heating.

DISPLAY

- ***CF Temperature measurement unit**: **°C**=Celsius; **°F**=Fahrenheit. **WARNING**: When the measurement unit is changed the SET point and the values of the parameters Hy, LS, US, Ot, ALU and ALL have to be checked and modified if necessary).*

rES Resolution (for °C): (in = 1°C; dE = 0.1 °C) allows decimal point display.

DEFROST

IdF Interval between defrost cycles: (0÷120h) Determines the time interval between the beginning of two defrost cycles.

MdF (Maximum) length for defrost: (0÷255min) When **P2P = n**, (not evaporator probe: timed defrost) it sets the defrost duration, when **P2P = y** (defrost end based on temperature) it sets the maximum length for defrost.

- ***dFd Temperature displayed during defrost**: (**rt** = real temperature; **it** = temperature at defrost start; **SEt** = set point; **dEF** = dEF label)*
- ***dAd MAX display delay after defrost**: (0÷255min). Sets the maximum time between the end of defrost and the restarting of the real room temperature display.*

ALARMS

- ***ALC Temperature alarms configuration**: (Ab; rE)*
  ***Ab**= absolute temperature: alarm temperature is given by the ALL or ALU values. **rE** = temperature alarms are referred to the set point. Temperature alarm is enabled when the temperature exceeds the SET+ALU or SET-ALL values.*

ALU MAXIMUM temperature alarm: (SET÷110°C; SET÷230°F) when this temperature is reached the alarm is enabled, after the ALd delay time.

ALL Minimum temperature alarm: (-50.0 ÷ SET°C; -58÷230°F when this temperature is reached the alarm is enabled, after the ALd delay time.

- ***ALd Temperature alarm delay**: (0÷255 min) time interval between the detection of an alarm condition and alarm signalling.*
- ***dAO Exclusion of temperature alarm at startup**: (from 0.0 min to 23.5h) time interval between the detection of the temperature alarm condition after instrument power on and alarm signalling.*

SECOND RELAY AND DIGITAL INPUT (IF AVAILABLE)

- ***tbA Alarm relay silencing (with oAC=ALr)**:*
  *(**n**= silencing disabled: alarm relay stays on till alarm condition lasts, **y** =silencing enabled: alarm relay is switched OFF by pressing a key during an alarm).*

OA1 Second relay configuration: ALr: alarm; **LHt**: auxiliary; **onF**: always on; **dEF:** do not select it!.; **FAn:** do not select it!.;

AoP Alarm relay polarity: it set if the alarm relay is open or closed when an alarm happens. **CL**= the relay is closed; **oP** = the relay is open

i1P Digital input polarity: oP: the digital input is activated by opening the contact; **CL:** the digital input is activated by closing the contact.

i1F Digital input configuration: EAL = external alarm: EA message is displayed; **bAL** = serious alarm CA message is displayed. **PAL** = pressure switch alarm, CA message is displayed; **dor** = door switch function; **dEF** = activation of a defrost cycle; **LHt** =switch on the second relay if oA1=LHt; **Htr** = kind of action inversion (cooling heating).

did: (0÷255 min)
with i1F= EAL or i1F = bAL digital input alarm delay: delay between the detection of the external alarm condition and its signalling.
with i1F= dor: door open signalling delay

with i1F = PAL: time for pressure switch function: time interval to calculate the number of the pressure switch activation.

nPS Pressure switch number: (0 ÷15) Number of activation of the pressure switch, during the **did** interval, before signalling the alarm event (I2F= PAL). **If the nPS activation in the did time is reached, switch off and on the instrument to restart normal regulation.**

- ***odc*** ***Compressor status when open door: no, Fan*** *= normal;* ***CPr, F_C*** *= Compressor OFF*

OTHER

PbC Type of probe: it allows to set the kind of probe used by the instrument: **PbC** = PBC probe, **ntC =** NTC probe.

- ***rEL*** ***Software release*** *for internal use.*
- ***Ptb*** ***Parameter table code:*** *readable only.*

8. DIGITAL INPUT (IF AVAILABLE)

The free contact digital input is programmable in five different configurations by the **i1F** parameter.

8.1 DOOR SWITCH INPUT (i1F = dor)

It signals the door status and the corresponding relay output status through the **odc** parameter: **no, Fan** = normal (any change);
CPr, F_C = Compressor OFF;
Since the door is opened, after the delay time set through parameter **did** , the door alarm is enabled, the display shows the message **dA** and **the regulation restarts**. The alarm stops as soon as the external digital input is disabled again. With the door open, the high and low temperature alarms are disabled.

8.2 GENERIC ALARM (i1F = EAL)

As soon as the digital input is activated the unit will wait for **did** time delay before signalling the **EAL** alarm message. The outputs status don t change. The alarm stops just after the digital input is de-activated.

8.3 SERIOUS ALARM MODE (i1F = bAL)

When the digital input is activated, the unit will wait for **did** delay before signalling the **CA** alarm message. The relay outputs are switched OFF. The alarm will stop as soon as the digital input is de-activated.

8.4 PRESSURE SWITCH (i1F = PAL)

If during the interval time set by **did** parameter, the pressure switch has reached the number of activation of the **nPS** parameter, the **CA** pressure alarm message will be displayed. The compressor and the regulation are stopped. When the digital input is ON the compressor is always OFF.
If the nPS activation in the did time is reached, switch off and on the instrument to restart normal regulation.

8.5 SWITCHING SECOND RELAY ON (i1F = LHt)

With **oA1= LHt** it switches on and off the second relay.

8.6 START DEFROST (i1F = dFr)

It starts a defrost if there are the right conditions. After the defrost is finished, the normal regulation will restart only if the digital input is disabled otherwise the instrument will wait until the MdF safety time is expired.

8.7 INVERSION OF THE KIND OF ACTION: HEATING-COOLING (i1F = Htr)

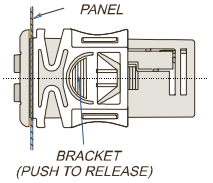
This function allows to invert the regulation of the controller: from cooling to heating and viceversa.

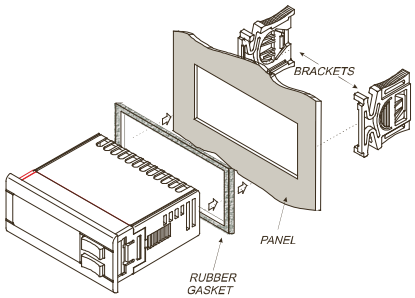
8.8 DIGITAL INPUTS POLARITY

The digital input polarity depends on the **i1P** parameter.
i1P=CL: the input is activated by closing the contact.
i1P=OP: the input is activated by opening the contact

9. INSTALLATION AND MOUNTING

Instrument **XR30C** shall be mounted on vertical panel, in a 29x71 mm hole, and fixed using the special bracket supplied.
To obtain an IP65 protection grade use the front panel rubber gasket (mod. RG-C) as shown in figure.
Instrument **XR30D** shall be mounted on an omega DIN rail





The temperature range allowed for correct operation is 0÷60 °C. Avoid places subject to strong vibrations, corrosive gases, excessive dirt or humidity. The same recommendations apply to probes. Let air circulate by the cooling holes.

10. ELECTRICAL CONNECTIONS

The instrument is provided with screw terminal block to connect cables with a cross section up to 2,5 mm^2. Before connecting cables make sure the power supply complies with the instrument s requirements. Separate the probe cables from the power supply cables, from the outputs and the power connections. Do not exceed the maximum current allowed on each relay, in case of heavier loads use a suitable external relay.

10.1 PROBE CONNECTION

The probes shall be mounted with the bulb upwards to prevent damages due to casual liquid infiltration. It is recommended to place the thermostat probe away from air streams to correctly measure the average room temperature. Place the defrost termination probe among the evaporator fins in the coldest place, where most ice is formed, far from heaters or from the warmest place during defrost, to prevent premature defrost termination.

11. HOW TO USE THE HOT KEY

11.1 HOW TO PROGRAM A HOT KEY FROM THE INSTRUMENT (UPLOAD)

1. Program one controller with the front keypad.
2. When the controller is ON, insert the **Hot key** and push ▲ key; the **"uPL"** message appears followed a by flashing **End**
3. Push **SET** key and the **End** will stop flashing.
4. Turn OFF the instrument remove the **Hot Key ,** then turn it ON again.

NOTE: the **Err** message is displayed for failed programming. In this case push again ▲ key if you want to restart the upload again or remove the **Hot key** to abort the operation.

11.2 HOW TO PROGRAM AN INSTRUMENT USING A HOT KEY (DOWNLOAD)

1. Turn OFF the instrument.
2. Insert a **programmed Hot Key into the 5 PIN receptacle** and then turn the Controller ON.
3. Automatically the parameter list of the **Hot Key** is downloaded into the Controller memory, the **doL** message is blinking followed a by flashing **End .**
4. After 10 seconds the instrument will restart working with the new parameters.
5. Remove the **Hot Key ..**

NOTE the message **Err** is displayed for failed programming. In this case turn the unit off and then on if you want to restart the download again or remove the **Hot key** to abort the operation.

12. ALARM SIGNALS

Message	Cause	Outputs
P1	Room probe failure	Compressor output according to par. Con and COF
HA	Maximum temperature alarm	Outputs unchanged.
LA	Minimum temperature alarm	Outputs unchanged.
dA	Door open	Regulation restarts
EA	External alarm	Output unchanged.
CA	Serious external alarm (i1F=bAL)	All outputs OFF.
CA	Pressure switch alarm (i1F=PAL)	All outputs OFF

12.1 ALARM RECOVERY

Probe alarm **P1** starts some seconds after the fault in the related probe; it automatically stops some seconds after the probe restarts normal operation. Check connections before replacing the probe.
Temperature alarms **HA** and **LA** automatically stop as soon as the thermostat temperature returns to normal values and when defrost starts.
Alarms **EA** and **CA** (with i1F=bAL) recover as soon as the digital input is disabled.
Alarm **CA** (with i1F=PAL) recovers only by **switching off and on** the instrument.

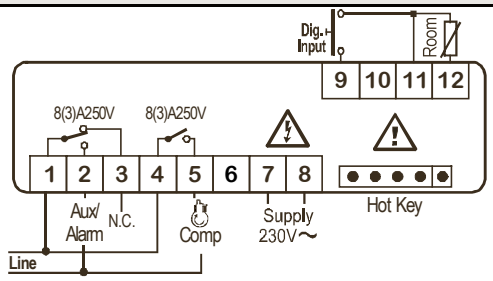
13. TECHNICAL DATA

Housing: self extinguishing ABS.
Case: XR30C frontal 32x74 mm; depth 60mm;
XR30D 4 DIN modules 70x85 mm; depth 61mm
Mounting: XR30C panel mounting in a 71x29mm panel cut-out
XR30D DIN RAIL mounted in a omega (3) din rail
Protection: IP20.
Frontal protection: XR30C IP65 with frontal gasket RG-C (optional).
Connections: Screw terminal block ≤ 2,5 mm^2 wiring.
Power supply: according to the model: 12Vac/dc, ±10%; 24Vac/dc, ±10%; 230Vac ±10%, 50/60Hz, 110Vac ±10%, 50/60Hz
Power absorption: 3VA max
Display: 3 digits, red LED, 14,2 mm high.
Inputs: 1 NTC or PTC probe.
Digital input: free contact
Relay outputs
compressor: SPST relay 8(3) A, 250Vac or

SPST relay 20(8)A; 250Vac
second relay: SPDT relay 8(3) A, 250Vac or
Data storing: on the non-volatile memory (EEPROM).
Kind of action: 1B; **Pollution grade:** normal; **Software class:** A.
Operating temperature: 0÷60 °C.
Storage temperature: -30÷85 °C.
Relative humidity: 20÷85% (no condensing)
Measuring and regulation range:
NTC probe: -40÷110°C (-40÷230°F)
PTC probe: -50÷150°C (-58÷302°F)
Resolution: 0,1 °C or 1°C or 1 °F (selectable).
Accuracy (ambient temp. 25°C): ±0,7 °C ±1 digit

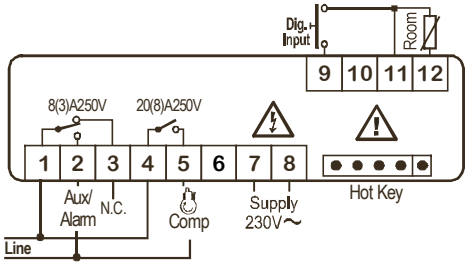
14. CONNECTIONS

14.1 XR30C: 8A COMPRESSOR



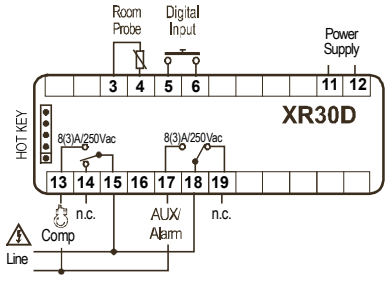
12Vac/dc supply: connect to the terminals 7 and 8.
24Vac/dc supply: connect to the terminals 7 and 8.
120Vac supply: connect to the terminals 7 and 8.

14.2 XR30C: 20A COMPRESSOR



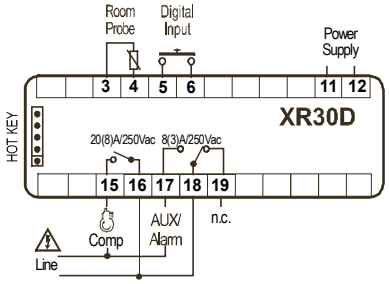
12Vac/dc supply: connect to the terminals 7 and 8.
24Vac/dc supply: connect to the terminals 7 and 8.
120Vac supply: connect to the terminals 7 and 8.

14.3 XR30D: 8A COMPRESSOR



24Vac/dc supply: connect to the terminals 11 and 12.
120Vac supply: connect to the terminals 11 and 12.
230Vac supply: connect to the terminals 11 and 12.

14.4 XR30D: 20A COMPRESSOR



24Vac/dc supply: connect to the terminals 11 and 12.
120Vac supply: connect to the terminals 11 and 12.
230Vac supply: connect to the terminals 11 and 12.

15. DEFAULT SETTING VALUES

Label	Name	Range	°C/°F
Set	Set point	LS÷US	3.0/37
Hy	Differential	0,1÷25.5°C/ 1÷ 255°F	2.0/4
LS	Minimum set point	-50°C÷SET/-58°F÷SET	-50,0/-58
US	Maximum set point	SET÷110°C/ SET ÷ 230°F	110/230
Ot	Thermostat probe calibration	-12÷12°C /-120÷120°F	0.0
OdS	Outputs delay at start up	0÷255 min	0
AC	Anti-short cycle delay	0 ÷ 50 min	1
CCt	Continuos cycle duration	0.0÷24.0h	0.0
COn	Compressor ON time with faulty probe	0 ÷ 255 min	15
COF	Compressor OFF time with faulty probe	0 ÷ 255 min	30
CH	Kind of action	CL=cooling; Ht= heating	CL
CF	Temperature measurement unit	°C ÷ °F	°C/°F
rES	Resolution	in=integer; dE= dec.point	dE/-
IdF	Interval between defrost cycles	1 ÷ 120 ore	8
MdF	(Maximum) length for defrost	0 ÷ 255 min	20
dFd	Displaying during defrost	rt, it, SEt, DEF	it
dAd	MAX display delay after defrost	0 ÷ 255 min	30
ALc	Temperat. alarms configuration	rE= related to set; Ab = absolute	Ab
ALU	MAXIMUM temperature alarm	Set÷110.0°C; Set÷230°F	110/230
ALL	Minimum temperature alarm	-50.0°C÷Set/ -58°F÷Set	-50/-58
ALd	Temperature alarm delay	0 ÷ 255 min	15
dAO	Delay of temperature alarm at start up	0 ÷ 23h e 50	1.3
tbA	Alarm relay silencing	n=no; y=yes	Y
oA1	2nd relay configuration	ALr= alarm; dEF=no select it; LHt=auxiliary; onF=always on; Fan= no select it	LHt
AoP	Second relay polarity (oA1=ALr)	oP; cL	cL
i1P	Digital input polarity	oP=opening;CL=closing	cL
i1F	Digital input configuration	EAL=extern. alarm; bAL=lock regulation; PAL=press. switch; dor=door switch; dEF=defrost; LHt=switch on 2nd relay; Htr= cooling - heating	LHt
did	Digital input alarm delay	0÷255min	5
Nps	Number of activation of pressure switch	0 ÷15	15
odc	Compressor status with open door:	no, Fan = normal; CPr; F_C = Compr. OFF;	no
PbC	Kind of probe	Ptc; ntc	ntc/Ptc
rEL	Software release	--	4.0
Ptb	Map code	--	-

Hidden parameters

CE

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Compressor

Frascold™

60Hz

SEMIHERMETIC COMPRESSORS

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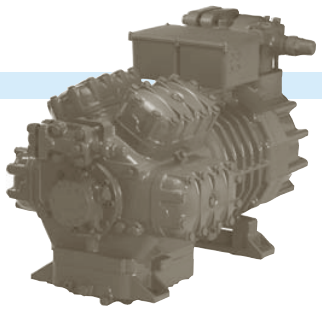
Compresseurs semi-hermétiques
Semi-hermetic compressors
Compresores semihermeticos
Compressores semi-herméticos



Dotation standard
Les compresseurs sont entièrement équipés de soupapes d'aspiration et de refoulement (raccords à souder), supports anti-vibrations en caoutchouc, remplis d'huile lubrifiante, charge d'azote (1 bar) pour les préserver de l'humidité, indicateur de niveau d'huile, dispositives de protection.
Les compresseurs série V, Z et W sont équipés de pompe de lubrification et bride universelle pour monter le pressostat d'huile.
La dotation standard peut être complétépar une vaste gamme d'accessoires propes à garantir rendement et fiabilité à tous les conditions de fonctionnement prévues.
Tous les modéles sont vernis par une couche d'antirouille et par une couche de peinture en émail bleu.

Moteurs électriques
Toute la gamme des moteurs électriques disponibles et leurs caratteristiques électriques sont illustrés à la page 22 "Données électriques".
Tous les modéles peuvent être demander en version 50 Hz.
Pour d'autres voltages, consulter notre service technique.

Protection du compresseur
Les compresseurs avec moteur triphasé sont entièrement fournis de protection constitué d'une série de thermisteurs PTC introduits dans le stator du moteur électrique et branchés au module électronique de commande (T00ECA01 pour les compresseurs série A, B, C, D, F, Q et S; T00ECA11 pour les compresseurs série V, Z et W).
Les compresseurs série V, Z et W sont aussi équipés par une sensor à thermistor sur le refoulement, il est relié au module électronique pour la commande de la température de compression.
Pour les compresseurs série Q et S le sensor à thermisteur est fourni sur demande.

Graissage
Sur les séries A, B, C, D, F, Q et S le graissage se fait par centrifugation.
Sur les séries V, Z et W le graissage s'effectue par pompe à huile à haute pression.
Les compresseurs lubrifiés par pompe à huile sont pourvus de filtre à huile et de raccords pour le contrôle de la pression de l'huile.

Accessoires
FRASCOLD a sélectionné et mis au point, pour ses compresseurs, une série complète d'accessoires propres à garantir l'efficacité et la fiabilité à toutes les conditions d'application prevues.
Toute la gamme d'accessoires disponible est illustré à la page 35.

Standard equipment
The compressors are supplied with suction and discharge valves (sweat connections), rubber vibration absorbers, oil lubrication charge, nitrogen charge (1 bar) to protect compressor against humidity, oil sight glass and protection devices.
V, Z and W series are equipped with oil pump and universal bracket suitable for oil pressure switch mounting.
On request, compressor can be completed with a large range of optional equipments suitable for efficient and reliable functioning at every operative condition.
Compressors are coated with anti-rust protective primer and blue enamel coat.

Electric motors
Page 22 "Electric data" features the electric characteristics and performances of the whole range of available motors.
All models are also available with 50Hz electric motor.
For different voltages, please contact our Technical Department.

Protection devices
For all compressors, protection is performed by means a series of PTC thermistors placed into the stator winding of the electric motor and plugged to an electronic control module (T00ECA01 for A, B, C, D, F, Q and S compressors and model T00ECA11 for V, Z and W compressors).
V, Z and W series compressors are supplied with discharge gas high temperature protection composed of a PTC thermistor sensor plugged to the electronic control module.
PTC thermistor sensor is supplied on request for Q and S series compressors.

Lubrication
For compressors of A, B, C, D, F, Q and S series, lubrication is carried out by centrifugation with an oil thrower disc.
V, Z and W series compressors lubrication is performed by an high pressure oil pump and equipment includes oil filter and oil pressure connections.

Optional equipments
FRASCOLD has selected and developed a complete range of accessories to equipe, on request, the compressor for an efficient and reliable running at every operating condition. The whole range of available optional equipments is featured on page 35.

Equipamiento estándard
Los compresores se suministran con la válvula de aspiración y de descarga (conexiones a soldar), soportes de goma antivibración , carga de aceite lubricante, carga de nitrógeno (1 bar) para proteger el compresor contra humedad, visor de nivel de aceite y dispositivos de protección. Las series V, Z y W, incorporan bomba de aceite y soporte universal para el montaje del interruptor electronico de presión del aceite.
Bajo demanda, el compresor puede incorporar una gama completa de accesorios idóneos para garantizar la eficiencia y fiabilidad en todas las condiciones de funcionamiento previstas.
Los compresores están protegidos con pintura protectora antioxidante de color azul.

Motor eléctrico
Toda la gama de motores eléctricos disponibles y sus características eléctricas están documentadas en la página 22 "Datos eléctricos". Todos los modelos están disponibles también para una frecuencia 50 Hz. Para otras tensiones, contactar con el Departamento Técnico.

Protección del compresor
Todos los compresores disponen de un dispositivo de protección constituido por una serie de termistores PTC instalados en los bobinados del estator del motor eléctrico y unidos a un módulo de control electrónico (T00ECA01 para las series A, B, C. D, F. Q y S y , modelo T00ECA11 para los compresores de la serie V, de Z y de W).
Los compresores de la serie V, Z y W, incorporan la protección de temperatura de descarga del compresor, integrada por un termistor PTC conectado al módulo de control electrónico.
Este termistor PTC es opcional para los compresores de la serie de Q y S.

Lubricación
Para las series de compresores A, B, C, D, F, Q y S, la lubricación se realiza mediante un disco centrifugador de aceite.
Para las series V, Z y W, la lubricación se realiza mediante una bomba de alta presión de aceite y el equipo incluye un filtro de aceite y conexiónes de aceite.

Equipamiento opcional
FRASCOLD ha seleccionado y desarrollado para sus compresores una gama completa de accesorios idóneos para garantizar la eficiencia y fiabilidad en todas las condiciones de funcionamiento previstas.
La gama completa de opcionales se encuentra descrita en la página 35.

Equipamento standard
Os compressores vêm equipados com válvulas de aspiração e compressão (conexões de soldar), pés amortecedores em borracha, carga de óleo lubrificante, carga de nitrogênio a 1 bar (para proteger o compressor da umidade), visor de nível de óleo e proteção elétrica. As séries V, Z e W estão dotadas com bomba de óleo e um suporte universal para montagem do pressostato eletrônico de óleo.
A pedido, os compressores podem ser equipados com uma larga gama de acessórios opcionais concebidos para um funcionamento seguro e eficiente em todas as condições de trabalho.
Os compressores são pintados com uma proteção primária anti-ferrugem e revestidos com tinta esmalte azul.

Motores elétricos
Na página 22 estão detalhadas as características elétricas e performances da gama completa de motores elétricos disponíveis. Todos os modelos estão disponíveis com motores elétricos a 60 Hz. Para voltagens ou freqüências diferentes, contatar o Departamento Técnico.

Proteção do compressor
Todos os compressores são dotados de proteção constituída por uma série de sondas PTC inseridas no estator do motor elétrico e ligadas ao módulo eletrônico de controle (T00ECA01 para os compressores das séries A, B, C, D, F, Q e S; T00ECA11 para os compressores das séries V, Z e W).
Os compressores das séries V, Z e W estão equipados com um sensor (sonda PTC) na compressão, ligado ao módulo eletrônico, para controle da temperatura de descarga pode ser fornecido sob pedido.

Lubrificação
Para os compressores das séries A, B, C, D, F, Q e S, a lubrificação é efetuada por spray de óleo, através de um disco centrifugador de óleo.
Nos compressores das séries V, Z e W, a lubrificação realiza-se por médio de uma bomba de óleo de alta pressão e o equipamento inclui filtro de óleo, conexão para ligação do pressostato diferencial de pressão de óleo.

Acessórios opcionais
A FRASCOLD desenvolveu e selecionou uma gama completa de acessórios para equipar os compressores de modo a garantir um funcionamento seguro e eficiente em todas as condições de trabalho admitidas. Estes acessórios podem ser fornecidos sob pedido.
A gama completa de acessórios opcionais está descrita na página 35.

Puissances frigorifiques

Les puissances frigorifiques, reportées sur les tableaux de la page 6 à la page 21, ont été calculées selon les conditions suivantes:
- alimentation 60Hz
- sans sous-refroidissement du liquide
- température ambiante 32°C
- **température du gaz aspiré 20°C**

R407c - les températures d'evaporation et de condensation se réfèrent aux point de roseé, in conformité avec la norme EN12900.

Refrigerating capacity

Refrigerating capacities shown in page 6 up to page 21 are based on the following conditions:
- power supply 60Hz
- without liquid subcooling
- ambient temperature 32°C
- **suction gas temperature 20°C**

R407c - Evaporating and condensing temperatures are based on dew temperature, according to EN12900 standard.

Capacidades frigoríficas

Las capacidades frigoríficas indicadas en las tablas desde la pág.6 a la pág.21 se han calculado en las condiciones siguientes:
- alimentación 60Hz
- no subenfriamiento liquido
- temperatura ambiente 32°C
- **temperatura gas aspirado 20°C**

R407c - Evaporación y condensación se refieren a los valores de punto de rocío según EN12900

Capacidades frigorificas

As capacidades frigoríficas, transcritas nas tabelas a partir da pagina 6 ate pagina 21, foram calculadas nas seguintes condições:
- freqüência em 60Hz
- nenhum sub-resfriamento do liquido
- temperatura ambiente 32°C
- **temperatura gas aspirado 20°C**

R407c - Evaporação e condensação são baseados nos valores de ponto de orvalho conforme EN12900

Facteurs de correction / Conversion factors / Factores de conversión / Fatores de conversão

Réfrigérant / Refrigerant / Refrigerante / Refrigerante **R507**

Température de condensation / Condensing temperature / Temperatura de condensacion / Temperatura de condensação	Température d'évaporation °C / Evaporating temperature °C / Temperatura de evaporación °C / Temperatura de evaporação °C												
	12.5	7.5	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
	Facteur de correction / Conversion factor / Factor de correción / Fator de conversão												
30°C						1.02	1.02	1.02	1.03	1.03	1.03	1.03	1.03
40°C						1.02	1.03	1.03	1.03	1.04	1.04	1.04	1.04
45°C						1.03	1.03	1.04	1.04	1.04	1.04	1.04	1.04
50°C						1.03	1.04	1.04	1.04	1.04	1.05	1.05	1.05

Les valeurs de puissance frigorifique peuvent être calculées en multipliant les données des tableaux de la page 6 à la page 9 par le facteur concernant les températures d'évaporation et de condensation considérées; par exemple:
compresseur modèle D 3 18 Y
réfrigérant R507
temp. d'évaporation -25°C
temp. de condensation 50°C
puissance frigorifique 4940 W
facteur de correction 1.04
puissance frigorifique correcte:
4940 x 1.04 = 5138 W

To calculate actual refrigerating capacity, multiply capacity table value (see page 6 up to page 9) by proper conversion factor related to considered condensing and evaporating temperatures; example:
compressor model D 3 18 Y
refrigerant R507
evaporating temperature -25°C
condensing temperature 50°C
refrigerating capacity 4940 W
conversion factor 1.04
actual refrigerating capacity:
4940 x 1.04 = 5138 W

Los valores de capacidades frigoríficas pueden calcularse miltiplicando los datos de las tablas desde la pág. 6 a la pág. 9 por el factor relativo a las temperaturas de evaporación y condensación consideradas; ejemplo:
compresor modelo D 3 18 Y
refrigerante R507
temp. de evaporación -25°C
temp. de condensación 50°C
capacidad frigorífica 4940 W
factor de correción 1.04
capacidad frigorífica correcta:
4940 x 1.04 = 5138 W

Os valores de capacidade frigorífica podem ser calculados multiplicando os dados das tabelas da página 6 ate pagina 9 por um fator relativo as temperaturas de evaporação e condensação consideradas. Exemplo:
compressor modelo D 3 18 Y
refrigerante R507
temperatura de evaporação -25°C
temperatura de condensação 50°C
capacidade frigorífica 4940 W
fator de conversão 1.04
capacidade frigorífica correta:
4940 x 1.04 = 5138 W

Réfrigérant / Refrigerant / Refrigerante / Refrigerante **R22**

Température de condensation / Condensing temperature / Temperatura de condensacion / Temperatura de condensação	Température d'évaporation °C / Evaporating temperature °C / Temperatura de evaporación °C / Temperatura de evaporação °C												
	12.5	7.5	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
	Facteur de correction / Conversion factor / Factor de correción / Fator de conversão												
30°C												0.890	0.871
40°C										0.911	0.896	0.875	0.857
45°C									0.927	0.908	0.892	0.871	0.852
50°C								0.940	0.924	0.905	0.888	0.846	0.846

I valori di capacità frigorifera durante l'iniezione di liquido possono essere calcolati moltiplicando i dati delle tabelle da pagina15 a pagina 17 per il fattore relativo alle temperature di evaporazione e condensazione considerate; esempio:
compressore modello S 7 39 Y
refrigerante R22
temp. di evaporazione -30°C
temp. di condensazione 50°C
resa frigorifera 7240 W
fattore di correzione 0.905
resa frigorifera corretta:
7240 x 0.905 = 6552 W

To calculate actual refrigerating capacity during liquid injection, multiply capacity table value (see page 15 and page 17) by proper conversion factor related to considered condensing and evaporating temperatures.
Example:
compressor model S 7 39 Y
refrigerant R22
evaporating temperature -30°C
condensing temperature 50°C
refrigerating capacity 7240 W
conversion factor 0.905
actual refrigerating capacity:
7240 x 0.905 = 6552 W

Los valores de capacidades frigorífica durante la inyección de liquido pueden calcularse multiplicando los datos de las pág 6 y 17 por el factor relativo a las temperaturas de evaporación y condensación consideradas.
Ejemplo:
compresor modelo S 7 39 Y
refrigerante R22
temp. de evaporación -30°C
temp. di condensación 50°C
capacidad frigorífica 7240 W
factor de corrección 0.905
capacidad frigorífica correcta:
7240 x 0.905 = 6552 W

Os valores de capacidade frigorífica durante a injeção podem ser calculados multiplicando os dados das tabelas das paginas 16 e 17 por um fator relativo as temperaturas de evaporação e condensação consideradas.
Exemplo:
compressor modelo S 7 39 Y
refrigerante R22
temperatura de evaporação -30°C
temperatura de condensação 50°C
capacidade frigorífica 7240 W
fator de conversão 0.905
capacidade frigorífica correta:
7240 x 0.905 = 6552 W

Données techniques — Technical data — Datos técnicos — Dados técnicos

Compresseur / Compressor / Compresor / Compressor	Moteur électrique / Electric motor / Motor eléctrico / Motor elétrico		Volume balayé / Displacement / Desplazamiento / Capacidade volumétrica (60 Hz)	Cylindres / Cylinders / Cilindros / Cilindros	Robinet d'aspiration / Suction valve / Válvula aspiración / Válvula aspiração		Robinet de refoulement / Discharge valve / Válvula descarga / Válvula descarga		Lubrifiant / Lubrificant / Aceite / Óleo	Poids / Weights / Peso / Pesos		Volume emballage / Packing volume / Volumen emballaje / Volume embalagem
										net / net / neto / liquido	brut / gross / bruto / bruto	
	HP	kW	m³/h	nr	∅ "	∅ mm	∅ "	∅ mm	l	kg	kg	dm³
A 0.5 4 Y	0.5	0.37	4.74	2	⅝	15.8	½	12.7	1.2	36	37	37
A 0.5 5 Y	0.5	0.37	5.92	2	⅝	15.8	½	12.7	1.2	36	37	37
A 0.7 5 Y	0.75	0.55	5.92	2	⅝	15.8	½	12.7	1.2	36	37	37
A 0.7 6 Y	0.75	0.55	6.56	2	⅝	15.8	½	12.7	1.2	36	37	37
A 1 6 Y	1	0.75	6.56	2	⅝	15.8	½	12.7	1.2	36	37	37
A 1 7 Y	1	0.75	8.29	2	⅝	15.8	½	12.7	1.2	36	37	37
A 1.5 7 Y	1.5	1	8.29	2	⅝	15.8	½	12.7	1.2	36	37	37
A 1.5 8 Y	1.5	1	9 18	2	⅝	15.8	½	12.7	1.2	36	37	37
B 1.5 9 Y	1.5	1	10.75	2	⅝	15.8	½	12.7	1.2	38	39	37
B 1.5 10 Y	1.5	1	11.86	2	⅝	15.8	½	12.7	1.2	38	39	37
B 2 10 Y	2	1.5	11.86	2	¾	19.0	⅝	15.8	1.2	40	41	37
D 2 11 Y	2	1.5	13.51	2	⅞	22.2	⅝	15.8	1.2	45	46	47
C 2 12 Y	2	1.5	14.46	2	⅞	22.2	⅝	15.8	1.2	40	41	37
C 3 12 Y	3	2.2	14.46	2	⅞	22.2	⅝	15.8	1.2	40	41	37
D 2 13 Y	2	1.5	15.78	2	⅞	22.2	⅝	15.8	1.2	45	46	47
D 3 13 Y	3	2.2	15.78	2	1"⅛	28.6	⅝	15.8	1.2	49	50	47
D 2 15 Y	2	1.5	18.43	2	⅞	22.2	⅝	15.8	1.2	45	46	47
D 3 15 Y	3	2.2	18.43	2	1"⅛	28.6	⅝	15.8	1.2	49	50	47
D 3 16 Y	3	2.2	19.68	2	1"⅛	28.6	⅝	15.8	1.2	49	50	47
D 4 16 Y	4	3	19.68	2	1"⅛	28.6	¾	19.0	1.2	51	52	47
F 4 16 Y	4	3	19.68	2	1"⅛	28.6	¾	19.0	2.1	74	77	76
D 3 18 Y	3	2.2	21.52	2	1"⅛	28.6	⅝	15.8	1.2	49	50	47
D 4 18 Y	4	3	21.52	2	1"⅛	28.6	¾	19.0	1.2	51	52	47
D 3 19 Y	PAS DISPONIBLE				NOT AVAILABLE		NO DISPONIBLE				NÃO DISPONÍVEL	
D 4 19 Y	PAS DISPONIBLE				NOT AVAILABLE		NO DISPONIBLE				NÃO DISPONÍVEL	
F 4 19 Y	4	3	22.94	2	1"⅛	28.6	¾	19.0	2.1	74	77	76
Q 4 19 Y	4	3	22.96	4	1"⅛	28.6	¾	19.0	1.8	74	77	76
F 5 19 Y	5	3.7	22.94	2	1"⅛	28.6	¾	19.0	2.1	76	79	76
Q 5 19 Y	5	3.7	22.96	4	1"⅛	28.6	¾	19.0	1.8	74	77	76
Q 4 21 Y	4	3	25.42	4	1"⅛	28.6	¾	19.0	1.8	79	82	76
Q 5 21 Y	5	3.7	25.42	4	1"⅛	28.6	¾	19.0	1.8	79	82	76
F 4 24 Y	4	3	28.32	2	1"⅛	28.6	¾	19.0	2.1	74	77	76
Q 4 24 Y	4	3	28.69	4	1"⅛	28.6	¾	19.0	1.8	79	82	76
F 5 24 Y	5	3.7	28.32	2	1"⅛	28.6	⅞	22.2	2.1	76	79	76
Q 5 24 Y	5	3.7	28.69	4	1"⅛	28.6	⅞	22.2	1.8	79	82	76
Q 4 25 Y	4	3	29.63	4	1"⅛	28.6	¾	19.0	1.8	77	80	76
Q 5 25 Y	5	3.7	29.63	4	1"⅛	28.6	⅞	22.2	1.8	79	82	76
Q 7 25 Y	7.5	5.5	29.63	4	1"⅛	28.6	⅞	22.2	1.8	79	82	76
Q 5 28 Y	5	3.7	33.62	4	1"⅜	35.0	⅞	22.2	1.8	79	82	76
Q 7 28 Y	7.5	5.5	33.62	4	1"⅜	35.0	1"⅛	28.6	1.8	79	82	76
Q 5 33 Y	5	3.7	39 19	4	1"⅜	35.0	1"⅛	28.6	1.8	79	82	76
S 5 33 Y	5.5	4	39.36	4	1"⅜	35.0	1"⅛	28.6	3.3	115	129	201
Q 7 33 Y	7.5	5.5	39 19	4	1"⅜	35.0	1"⅛	28.6	1.8	79	82	76
S 7 33 Y	7.5	5.5	39.36	4	1"⅜	35.0	1"⅛	28.6	3.3	117	131	201
S 7 39 Y	7.5	5.5	45.90	4	1"⅜	35.0	1"⅛	28.6	3.3	117	131	201
S 10 39 Y	10	7.5	45.90	4	1"⅜	35.0	1"⅛	28.6	3.3	120	134	201
S 10 51 Y	10	7.5	60.52	4	1"⅜	35.0	1"⅛	28.6	3.3	120	134	201
S 15 51 Y	15	11	60.52	4	1"⅝	42.0	1"⅛	28.6	3.3	126	140	201
S 15 56 Y	15	11	67.20	4	1"⅝	42.0	1"⅛	28.6	3.3	130	144	201
S 20 56 Y	20	15	67.20	4	1"⅝	42.0	1"⅛	28.6	3.3	132	146	201
V 15 59 Y	15	11	70 18	4	1"⅝	42.0	1"⅛	28.6	4.5	170	184	285
V 20 59 Y	20	15	70 18	4	1"⅝	42.0	1"⅛	28.6	4.5	174	188	285
V 15 71 Y	15	11	84.92	4	1"⅝	42.0	1"⅛	28.6	4.5	170	184	285
V 25 71 Y	25	18.5	84.92	4	2"⅛	54.0	1"⅜	35.0	4.5	184	198	285
V 20 84 Y	20	15	100.57	4	1"⅝	42.0	1"⅛	28.6	4.5	180	194	285
V 30 84 Y	30	22	100.57	4	2"⅛	54.0	1"⅜	35.0	4.5	187	201	285
V 25 93 Y	25	18.5	111.66	4	2"⅛	54.0	1"⅜	35.0	4.5	190	204	285
V 32 93 Y	32	23.5	111.66	4	2"⅛	54.0	1"⅜	35.0	4.5	192	206	285
Z 25 106 Y	25	18.5	127.39	6	2"⅛	54.0	1"⅜	35.0	4.5	220	242	355
Z 35 106 Y	35	26	127.39	6	2"⅛	54.0	1"⅜	35.0	4.5	223	245	355
Z 30 126 Y	30	22	150.86	6	2"⅛	54.0	1"⅜	35.0	7.5	229	251	355
Z 40 126 Y	40	30	150.86	6	2"⅝	67.0	1"⅝	42.0	7.5	240	262	355
W 40 142 Y	40	30	169.80	8	2"⅝	67.0	1"⅝	42.0	8	295	320	450
Z 40 154 Y	40	30	185.26	6	2"⅝	67.0	1"⅝	42.0	7.5	240	262	355
Z 50 154 Y	50	37	185.26	6	2"⅝	67.0	1"⅝	42.0	7.5	244	266	355
W 40 168 Y	40	30	201 12	8	2"⅝	67.0	1"⅝	42.0	8	299	325	450
W 50 168 Y	50	37	201 12	8	3"⅛	79.4	1"⅝	42.0	8	305	331	450
W 50 187 Y	50	37	223.32	8	3"⅛	79.4	1"⅝	42.0	8	311	337	450
W 60 187 Y	60	44.5	223.32	8	3"⅛	79.4	1"⅝	42.0	8	315	341	450
W 60 206 Y	60	44.5	246.96	8	3"⅛	79.4	2"⅛	54.0	8	320	346	450
W 70 206 Y	70	52	246.96	8	3"⅛	79.4	2"⅛	54.0	8	328	354	450
W 70 228 Y	70	52	273.32	8	3"⅛	79.4	2"⅛	54.0	8	328	354	450
W 75 228 Y	75	55.5	273.32	8	3"⅛	79.4	2"⅛	54.0	8	328	354	450
W 75 240 Y	75	55.5	286.82	8	3"⅛	79.4	2"⅛	54.0	8	328	354	450
W 80 240 Y	80	60	286.82	8	3"⅛	79.4	2"⅛	54.0	8	328	354	450

Puissances frigorifiques — Refrigerating capacity — Capacidades frigoríficas — Capacidades frigorificas

R404a - R507 (*)

Compresseur Compressor Compresor Compressor	Condensation Condensing Condensación Condensação	Puissances frigorifiques W / Refrigerating capacity W / Capacidad frigorífica W / Capacidade frigorifica W											
		Température d'évaporation °C / Evaporating temperature °C / Temperatura de evaporación °C / Temperatura de evaporação °C											
	°C	7.5	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
A 0.5 4 Y	30	5760	5280	4430	3680	3040	2480	1990	1580	1220	910	660	
	40	4910	4500	3780	3140	2580	2100	1670	1310	980	720	480	
	45	4480	4100	3440	2870	2350	1910	1510	1160	860	610	400	
	50	4040	3720	3120	2590	2120	1700	1340	1030	760	520	310	
A 0.5 5 Y	30				4480	3700	3020	2440	1930	1490	1120	800	540
	40				3800	3130	2560	2040	1600	1210	880	600	360
	45				3470	2860	2320	1840	1430	1070	760	490	260
	50				3120	2570	2080	1640	1260	920	640	400	
A 0.7 5 Y	30		6410	5360	4480	3700	3020	2440	1930	1490	1120	800	540
	40		5420	4560	3800	3130	2560	2040	1600	1210	880	600	360
	45		4940	4150	3470	2860	2320	1840	1430	1070	760	490	260
	50			3760	3120	2570	2080	1640	1260	920	640	400	
A 0.7 6 Y	30				4910	4070	3320	2690	2120	1640	1240	890	600
	40				4160	3440	2810	2240	1750	1330	970	660	400
	45				3790	3130	2540	2030	1570	1180	840	540	300
	50				3420	2820	2280	1800	1380	1020	710	430	200
A 1 6 Y	30	7850	7200	6020	5020	4140	3380	2720	2150	1670	1250	890	600
	40	6680	6130	5150	4270	3520	2860	2280	1780	1340	970	660	400
	45	6100	5600	4690	3900	3200	2590	2050	1600	1190	840	550	300
	50	5510	5060	4250	3530	2890	2330	1840	1400	1030	710	430	
A 1 7 Y	30				6220	5150	4210	3400	2690	2090	1560	1130	760
	40				5270	4360	3550	2840	2220	1680	1220	830	500
	45				4800	3960	3220	2560	1980	1490	1060	680	370
	50				4320	3560	2880	2280	1750	1280	890	550	
A 1.5 7 Y	30	10040	9200	7700	6400	5280	4310	3460	2740	2110	1580	1130	
	40	8600	7900	6600	5470	4490	3640	2890	2260	1700	1240	840	
	45	7870	7220	6040	4990	4090	3300	2620	2020	1500	1070	700	
	50	7130	6540	5470	4520	3700	2960	2330	1780	1310	900	550	
A 1.5 8 Y	30		10200	8530	7090	5840	4760	3830	3020	2340	1740	1250	830
	40		8700	7280	6050	4970	4020	3200	2500	1880	1360	910	540
	45		7960	6660	5520	4520	3650	2890	2230	1660	1160	760	400
	50		7200	6020	4990	4080	3280	2570	1960	1430	970	590	
B 1.5 9 Y	30	12900	11810	9820	8080	6580	5290	4210	3300	2540	1940	1460	1080
	40	11040	10080	8340	6840	5540	4440	3520	2750	2110	1610	1200	880
	45	10090	9190	7580	6190	5000	4000	3160	2460	1900	1440	1070	780
	50	9110	8290	6800	5530	4450	3550	2800	2170	1670	1270	950	
B 1.5 10 Y	30				8760	7220	5880	4720	3710	2840	2120	1510	1010
	40				7380	6060	4910	3920	3060	2340	1720	1200	760
	45				6710	5500	4450	3540	2760	2100	1540	1060	650
	50				6060	4960	4010	3180	2480	1880	1370	940	
B 2 10 Y	30	14060	12910	10810	8950	7330	5930	4720	3700	2840	2140	1560	
	40	11920	10930	9120	7540	6160	4970	3950	3100	2360	1780	1280	
	45	10870	9960	8300	6850	5590	4510	3590	2810	2150	1610	1150	
	50	9840	9010	7500	6180	5040	4070	3240	2530	1940	1450		
D 2 11 Y	30	16840	15430	12890	10660	8720	7040	5600	4390	3370	2520	1840	
	40	14230	13030	10860	8960	7310	5880	4670	3640	2760	2030	1400	
	45	12920	11830	9840	8100	6590	5300	4190	3250	2450	1760	1180	
	50	11620	10620	8810	7240	5880	4700	3710	2870	2140	1510		
C 2 12 Y	30				11660	9580	7800	6280	4990	3900	2960	2150	1430
	40				9980	8160	6600	5280	4160	3200	2380	1630	950
	45				9130	7440	6000	4780	3740	2840	2060	1370	
	50				8270	6710	5390	4260	3310	2480	1750	1090	
C 3 12 Y	30	17390	15940	13330	11060	9110	7400	5950	4690	3620	2720		
	40	14960	13720	11470	9500	7790	6310	5030	3940	2990	2200		
	45	13730	12590	10510	8700	7130	5750	4570	3550	2680	1940		
	50	12460	11420	9540	7880	6440	5200	4100	3170	2380			
D 2 13 Y	30				12400	10210	8300	6660	5260	4070	3080	2280	1640
	40				10510	8630	7000	5590	4400	3400	2570	1880	1340
	45				9600	7870	6370	5090	4000	3080	2330	1720	
	50				8710	7120	5760	4580	3610	2780	2100	1550	
D 3 13 Y	30	19790	18140	15170	12540	10260	8290	6590	5140	3910			
	40	16640	15250	12720	10510	8580	6910	5470	4240	3170			
	45	15110	13850	11540	9530	7790	6280	4960	3820	2820			
	50	13620	12470	10390	8580	7010	5650	4460	3420	2510			
D 2 15 Y	30				13850	11410	9300	7460	5900	4570	3470	2560	1820
	40				11600	9550	7780	6240	4920	3820	2890	2110	1480
	45				10550	8680	7060	5660	4480	3470	2630	1910	1320
	50				9530	7840	6370	5120	4040	3140	2360	1720	
D 3 15 Y	30		20590	17300	14410	11890	9720	7850	6280	4940			
	40		17440	14630	12180	10040	8200	6620	5280	4140			
	45		15830	13270	11040	9110	7440	6000	4790	3740			
	50		14200	11890	9890	8160	6660	5390	4300	3360			
D 3 16 Y	30				15320	12610	10270	8260	6520	5040	3790	2740	1860
	40				12960	10640	8630	6900	5400	4120	3040	2110	1340
	45				11800	9670	7820	6230	4860	3670	2660	1810	1100
	50				10630	8710	7030	5580	4320	3240	2320	1520	

Avec refroidissement de la culasse
With head cooling
Con culata enfriada
Com resfriamento do cabeçote

* R507 puissances frigorifiques à calculer comme indiqué à la page 4
refrigerating capacities to be calculated as indicated on page 4
calcularse las capacidades frigoríficas como indicado a la pág. 4
capacidades frigoríficas calculadas como indicado na pág. 4

Puissances frigorifiques — Refrigerating capacity — Capacidades frigoríficas — Capacidades frigorificas

R404a - R507 (*)

Compresseur Compressor Compresor Compressor	Condensation Condensing Condensación Condensação	Puissances frigorifiques W / Refrigerating capacity W / Capacidad frigorífica W / Capacidade frigorifica W											
		Température d'évaporation °C / Evaporating temperature °C / Temperatura de evaporación °C / Temperatura de evaporação °C											
	°C	7.5	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
D 4 16 Y	30	24650	22580	18860	15640	12840	10420	8330	6540	5020			
	40	21130	19370	16180	13390	10970	8870	7060	5500	4160			
	45	19340	17720	14810	12250	10030	8100	6430	4990	3770			
	50	17520	16070	13430	11110	9100	7330	5810	4500	3370			
F 4 16 Y	30	24430	22370	18660	15440	12650	10240	8160	6370	4850			
	40	20890	19130	15940	13150	10740	8650	6840	5280	3960			
	45	19120	17510	14580	12020	9800	7870	6200	4760	3540			
	50	17330	15880	13220	10900	8870	7100	5580	4260	3130			
D 3 18 Y	30					13850	11380	9230	7390	5820	4500	3400	2500
	40					11710	9600	7780	6200	4870	3740	2810	2030
	45					10680	8740	7060	5630	4420	3400	2530	
	50					9650	7880	6370	5080	3970	3050	2270	
D 4 18 Y	30		23800	20100	16810	13930	11410	9230	7360	5750			
	40		20300	17120	14330	11870	9720	7860	6260	4880			
	45		18500	15610	13060	10820	8880	7190	5740	4490			
	50		16690	14080	11780	9780	8050	6540	5240	4120			
D 3 19 Y	30	PAS DISPONIBLE			NOT AVAILABLE			NO DISPONIBLE			NAO DISPONÍVEL		
	40												
	45												
	50												
D 4 18 Y	30	PAS DISPONIBLE			NOT AVAILABLE			NO DISPONIBLE			NAO DISPONÍVEL		
	40												
	45												
	50												
F 4 19 Y	30				17870	14800	12100	9740	7720	5960	4490	3250	2240
	40				15230	12550	10200	8150	6380	4860	3580	2480	1570
	45				13860	11380	9220	7320	5700	4300	3110	2100	1260
	50				12440	10180	8200	6470	4990	3720	2640	1720	
Q 4 19 Y	30				17780	14420	11510	9010	6900	5150	3720	2580	1700
	40				14810	11890	9380	7260	5470	4000	2810	1870	1160
	45				13370	10670	8360	6420	4800	3470	2400	1560	920
	50				11950	9480	7380	5620	4150	2960	2020	1280	
F 5 19 Y	30	28660	26340	22090	18360	15080	12240	9780	7670	5870			
	40	24420	22420	18780	15580	12780	10340	8230	6410	4810			
	45	22240	20410	17090	14170	11620	9400	7460	5780	4320			
	50	20040	18380	15370	12740	10440	8450	6710	5180	3840			
Q 5 19 Y	30	28260	25900	21590	17800	14500	11630	9160	7060	5280			
	40	23860	21820	18110	14860	12020	9580	7450	5640	4070			
	45	21660	19790	16390	13420	10820	8570	6640	4960	3500			
	50	19500	17780	14690	11990	9640	7600	5830	4300	2960			
Q 4 21 Y	30				19620	16020	12910	10240	7970	6070	4510	3240	2230
	40				16630	13480	10760	8450	6490	4870	3540	2460	1600
	45				15070	12140	9650	7520	5740	4260	3050	2080	1280
	50				13480	10800	8510	6590	4980	3650	2580	1700	
Q 5 21 Y	30	30730	28280	23770	19760	16200	13080	10340	7970	5940			
	40	25880	23800	19960	16550	13510	10850	8510	6460	4680			
	45	23450	21540	18040	14930	12160	9720	7570	5690	4030			
	50	21010	19280	16120	13300	10800	8590	6650	4920	3400			
F 4 24 Y	30				22240	18380	15000	12070	9550	7400	5600	4100	2880
	40				18770	15460	12560	10070	7920	6110	4570	3300	2240
	45				17090	14000	11390	9110	7150	5500	4100	2940	1970
	50					12660	10250	8180	6420	4920	3660	2600	
Q 4 24 Y	30				21910	18060	14660	11720	9210	7080	5290	3800	2570
	40				18310	15060	12180	9700	7550	5740	4200	2900	1810
	45				16560	13600	10980	8700	6740	5080	3660	2460	1440
	50				14820	12140	9780	7720	5940	4430	3130	2030	
F 5 24 Y	30	34660	31820	26640	22080	18080	14600	11620	9060	6890	5080	3580	
	40	29340	26900	22480	18580	15180	12230	9700	7520	5690	4130	2800	
	45	26630	24400	20340	16790	13690	11030	8740	6770	5100	3670	2450	
	50	23880	21850	18190	14990	12220	9830	7780	6040	4660			
Q 5 24 Y	30		32470	27060	22330	18250	14760	11760	9170	6900			
	40		27440	22850	18830	15350	12360	9790	7560	5590			
	45		24900	20740	17080	13910	11180	8830	6800	5000			
	50		22300	18550	15260	12420	9960	7850	6010	4380			
Q 4 25 Y	30				22540	18530	15010	11960	9350	7130	5280	3740	2510
	40				18970	15490	12470	11050	7610	5720	4140	2830	1780
	45				17230	14020	11230	8820	6780	5050	3610	2420	1450
	50				15500	12560	10010	7820	5960	4400	3070	2040	
Q 5 25 Y	30		33440	27950	23120	18920	15300	12190	9200	7360	5540	4040	
	40		28250	23570	19480	15910	12840	11410	7970	6060	4450	3080	
	45		25640	21370	17640	14400	11600	9220	7160	5410	3900	2600	
	50		23030	19160	15790	12890	10370	8210	6350	4740			
Q 7 25 Y	30	37920	34680	28760	23590	19120	15290	12050	9340	7120	5330	3920	
	40	31640	28880	23870	19520	15790	12610	9940	7720	5890	4420	3240	
	45	28640	26120	21550	17600	14230	11380	8980	6980	5340	4020	2940	
	50	25740	23450	19320	15770	12740	10190	8050	6290	4840			

Avec refroidissement de la culasse
With head cooling
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Com resfriamento do cabeçote

* R507 puissances frigorifiques à calculer comme indiqué à la page 4
refrigerating capacities to be calculated as indicated on page 4
calcularse las capacidades frigoríficas como indicado a la pág. 4
capacidades frigoríficas calculadas como indicado na pág. 4

Puissances frigorifiques — Refrigerating capacity — Capacidades frigoríficas — Capacidades frigorificas

R404a - R507 (*)

Compresseur Compressor Compresor Compressor	Condensation Condensing Condensación Condensação	Puissances frigorifiques W / Refrigerating capacity W / Capacidad frigorífica W / Capacidade frigorifica W											
		Température d'évaporation °C / Evaporating temperature °C / Temperatura de evaporación °C / Temperatura de evaporação °C											
	°C	7.5	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
Q 5 28 Y	30				26200	21650	17660	14200	11220	8690	6550	4790	3340
	40				22100	18190	14800	11840	9310	7150	5330	3790	2510
	45				20060	16490	13370	10670	8360	6380	4720	3310	2110
	50				18050	14780	11950	9520	7430	5640	4130	2830	
Q 7 28 Y	30		38350	32180	26740	21970	17840	14290	11240	8680			
	40		32560	27280	22630	18580	15060	12020	9430	7200			
	45		29650	24820	20570	16870	13660	10900	8510	6460			
	50		26740	22340	18490	15140	12250	9740	7570	5690			
Q 5 33 Y	30				30240	25080	20580	16670	13310	10440	8020	5990	4310
	40				25570	21130	17280	13960	11100	8680	6610	4880	3420
	45					19240	15700	12660	10060	7840	5960	4370	3010
	50						14160	11400	9050	7040	5340	3890	
S 5 33 Y	30					25900	21280	17300	13870	10960	8470	6360	4600
	40					22210	18220	14740	11740	9160	6960	5110	3540
	45					20300	16640	13450	10660	8260	6220	4480	3010
	50						15050	12130	9560	7360	5460	3860	
Q 7 33 Y	30		44360	37160	30850	25340	20590	16520	13090	10200			
	40		37640	31500	26120	21440	17400	13920	10960	8440			
	45		34250	28640	23740	19480	15790	12610	9890	7550			
	50		30840	25760	21340	17480	14160	11290	8810	6660			
S 7 33 Y	30	48350	44330	37140	30940	25560	20920	16910	13450	10500			
	40	41470	38050	31870	26520	21880	17820	14320	11270	8660			
	45	37970	34860	29230	24300	19990	16250	13000	10160	7740			
	50		31620	26530	22040	18100	14650	11660	9060	6800			
S 7 39 Y	30				36180	30060	24770	20210	16260	12890	10010	7580	5540
	40				31220	25930	21300	17320	13860	10880	8340	6190	4380
	45				28680	23810	19560	15840	12640	9860	7500	5480	3790
	50					21660	17760	14350	11390	8840	6650	4790	
S 10 39 Y	30	56480	51850	43550	36370	30170	24800	20160	16180	12760			
	40	48660	44710	37570	31380	25990	21300	17240	13730	10720			
	45	44660	41060	34560	28860	23860	19520	15760	12480	9670			
	50	40610	37360	31460	26270	21700	17710	14240	11230	8630			
S 10 51 Y	30				47390	39350	32350	26350	21160	16720	12920	9710	7010
	40				40720	33790	27760	22490	17930	14000	10660	7800	5400
	45					30970	25400	20540	16300	12640	9520	6850	4610
	50						23020	18550	14640	11270	8360	5900	
S 15 51 Y	30	73460	67390	56510	47110	38990	31970	25930	20700	16220			
	40	63100	57920	48550	40450	33400	27260	21940	17380	13430			
	45	57820	53110	44590	37100	30560	24890	19960	15680	12010			
	50	52440	48190	40500	33700	27680	22480	17930	13990	10600			
S 15 56 Y	30				53600	44420	36480	29630	23740	18670	14340	10670	7580
	40				46130	38110	31190	25180	19980	15530	11700	8440	5690
	45				42290	34940	28500	22920	18100	13930	10370	7320	4750
	50				38390	31700	25780	20650	16180	12350	9040	6220	
S 20 56 Y	30	83520	76600	64310	53650	44600	36600	29760	23830	18880			
	40	72590	66530	55780	46420	38450	31390	25340	20100	15720			
	45	66850	61260	51310	42640	35240	28690	23060	18190	14100			
	50	60530	55450	46420	38510	31760	25760	20620	16150	12400			
V 15 59 Y	30				55360	46040	37810	30760	24660	19560	15160	11500	8170
	40				47930	39720	32460	26230	20840	16330	12420	9170	6230
	45				44050	36440	29690	23900	18890	14680	11030	8000	5240
	50				39800	32860	26690	21380	16790	12920	9580	6790	
V 20 59 Y	30	88630	81360	67970	56160	45820	36950	29400	23030	17680	13160	9310	
	40	75360	69120	57590	47390	38470	32000	24280	18780	14160	10270	7070	
	45	68630	62900	52330	42950	34750	27700	21700	16630	12380	8810	5750	
	50	61800	56620	47020	38480	31020	24590	19100	14500	10620			
V 15 71 Y	30				65780	54590	44870	36430	29200	22990	17710	13220	9420
	40				56180	46630	38280	30970	24580	19120	14440	10460	7080
	45					42610	34930	28190	22250	17160	12800	9080	
	50						31560	25380	19910	15220	11170	7730	
V 25 71 Y	30	107400	98520	82210	67820	55320	44600	35510	27880	21480	16100	11520	
	40	90530	83000	69130	56890	46240	37080	29320	22790	17300	12680	8710	
	45	82250	75400	62740	51540	41780	33410	26290	20290	15240	10970	7280	
	50	74020	67820	56390	46250	37390	29770	23290	17820	13200			
V 20 84 Y	30				78110	64580	52700	42370	33470	25880	19490	14180	9860
	40				65780	54260	44200	35470	27970	21590	16200	11710	7990
	45				59290	48830	39720	31850	25100	19370	14540	10500	7130
	50				52630	43250	35120	28140	22190	17150	12900	9350	
V 30 84 Y	30	126680	116410	97620	81050	66540	53950	43120	33900	26140	19670	14360	
	40	107870	98930	82630	68330	55870	45100	35840	27980	21350	15790	11160	
	45	98480	90220	75190	62030	50600	40740	32300	25130	19070	13970	9680	
	50	89150	81560	67790	55790	45400	36460	28820	22340	16860			
V 25 93 Y	30				86600	71480	58220	46690	36760	28270	21100	15100	10140
	40				72470	59450	48080	38230	29770	22540	16420	11260	6920
	45					53590	43160	34150	26420	19810	14210	9470	
	50					47840	38350	30180	23170	17180	12100	7750	

Avec refroidissement de la culasse
With head cooling
Con culata enfriada
Com resfriamento do cabeçote

* R507 puissances frigorifiques à calculer comme indiqué à la page 4
refrigerating capacities to be calculated as indicated on page 4
calcularse las capacidades frigoríficas como indicado a la pág. 4
capacidades frigoríficas calculadas como indicado na pág. 4

Puissances frigorifiques — Refrigerating capacity — Capacidades frigoríficas — Capacidades frigorificas

R404a - R507 (*)

Compresseur Compressor Compresor Compressor	Condensation Condensing Condensación Condensação	Puissances frigorifiques W / Refrigerating capacity W / Capacidad frigorífica W / Capacidade frigorifica W											
		Température d'évaporation °C / Evaporating temperature °C / Temperatura de evaporación °C / Temperatura de evaporação °C											
	°C	7.5	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
V 32 93 Y	30	140840	129140	107740	88850	72340	58010	33700	35260	26500	19250	13360	
	40	119210	109030	90500	74240	60080	47860	37400	28550	21120	14950	9890	
	45	108550	99140	82060	67100	54130	42970	33440	25380	18640	13010	8350	
	50	98000	89380	73740	60110	48320	38220	29630	22370	16300			
Z 25 106 Y	30				103160	84880	68870	54980	43060	32940	24480	17530	11930
	40				87260	71450	57670	45780	35600	27010	19840	13920	9110
	45				79250	64690	52060	41180	31920	24110	17600	12230	7860
	50				71200	57920	46450	36620	28280	21280	15440	10660	
Z 35 106 Y	30	163420	149920	125270	103620	84740	68470	54560	42840	33080	25080	18650	
	40	138170	126500	105320	86820	70790	57040	45340	35500	27310	20580	15080	
	45	125650	114920	95470	78550	63950	51460	40860	31980	24590	18490	13480	
	50	113220	103420	85720	70380	57200	45970	36500	28570	21980			
Z 30 126 Y	30				119160	98150	79780	63850	50180	38590	28880	20900	14440
	40				100020	82070	66420	52920	41380	31580	23390	16580	10990
	45				90470	74040	59780	47510	37030	28160	20720	14520	9380
	50				80930	66050	53180	42140	32740	24790	18120	12540	
Z 40 126 Y	30	189770	174160	145600	120430	98440	79380	63050	49220	37670	28180	20510	
	40	161440	147860	123140	101470	82620	66380	52520	40840	31080	23040	16500	
	45	146920	134390	111650	91780	74570	59800	47240	36670	27890	20640	14720	
	50	132200	120760	100030	82020	66480	53220	42000	32600	24820			
W 40 142 Y	30			176090	146300	120380	97920	78540	61850	47460			
	40			152200	125950	103200	83560	66650	52080	39470			
	45				114960	93970	75940	60430	47110	35560			
	50				103550	84460	68120	54170	42200	31840			
Z 40 154 Y	30				144770	120130	98820	80380	64380	50760	39140	29300	21040
	40				124010	102840	84410	68360	54410	42340	32060	23360	16000
	45				113600	94120	77110	62270	49330	38090	28510	20390	
	50					85330	69740	56120	44210	33840	24970		
Z 50 154 Y	30	228560	210080	175980	145730	119280	96430	82910	60370	46400	34610	24520	
	40	194720	178880	149580	123540	100740	81020	64190	49930	37910	27740	19030	
	45	177550	163060	136210	112320	91380	73270	57800	44710	33670	24350	16360	
	50	160160	147060	122740	101030	82000	65520	51460	39540	29500			
W 40 168 Y	30					132590	107410	85430	66480	50440	37120	26390	
	40					111730	89990	71020	54660	40780	29200	19780	
	45						81300	63880	48850	36100	25420	16680	
	50						72650	56800	43140	31510	21770		
W 50 168 Y	30	258440	237120	198260	164140	134400	108710	86720	68080	52430			
	40	220780	202340	168830	139490	113980	91940	73060	56950	43270			
	45	201180	184240	153520	126670	103390	83300	66070	51340	38770			
	50	181130	165720	137860	113590	92600	74530	59040	45760	34360			
W 50 187 Y	30				178850	146420	118210	93880	73100	55570	40960	28930	19180
	40				150280	122410	98260	77480	59770	44800	32230	21770	
	45				136280	110660	88500	69480	53260	39520	27950		
	50				122460	99060	78880	61560	46810	34300			
W 60 187 Y	30	290630	265980	221260	182270	148550	119680	95200	74660	57620			
	40	246160	225040	186840	153650	125030	100520	79690	62100	47280			
	45	223610	204280	169380	139140	113100	90830	71870	55780	42120			
	50	200840	183310	151750	124490	101060	81050	63980	49440	36960			
W 60 206 Y	30				198340	163280	132580	105920	83030	63590	47300	33880	23000
	40				168020	137620	111110	88210	68620	52030	38150	26680	
	45				152840	124800	100440	79450	61550	46430	33790		
	50				137680	112020	89830	70790	54600	40980			
W 70 206 Y	30	309200	283860	237670	197090	161720	131120	104880	82570	63770			
	40	264370	242350	202320	167270	136760	110390	87730	68350	51830			
	45	241760	221440	184540	152290	124270	100070	79250	61380	46060			
	50	219040	200410	166680	137270	111780	89760	70810	54500	40390			
W 70 228 Y	30				213740	176300	143540	115140	90740	70060	52730	38450	26880
	40				181960	149300	120880	96340	75360	57610	42770	30520	
	45				166210	135970	109730	87130	67870	51620	38040		
	50				150580	122760	98700	78070	60540	45790			
W 75 228 Y	30	335320	307630	257150	212780	174080	140580	111830	87360	66730			
	40	285490	261600	218140	180050	146880	118180	93470	72300	54230			
	45	259940	238010	198170	163330	133040	106840	84260	64860	48180			
	50	234040	214090	177950	146420	119090	95460	75100	57530	42310			
W 75 240 Y	30				226600	185930	150610	120250	94460	72860	55070	40690	29350
	40				192050	156700	126190	100140	78160	59870	44870	32800	
	45				175120	142420	114310	90410	70330	53690	40090		
	50				158400	128350	102650	80890	62710	47720			
W 80 240 Y	30	347460	318850	266720	220970	181100	146660	117180	92170	71160			
	40	297180	272230	226870	187190	152700	122940	97440	75710	57290			
	45	271630	248540	206660	170090	138370	111020	87590	67570	50510			
	50	245830	224630	186250	152860	123950	99070	77750	59500	43860			

Avec refroidissement de la culasse
With head cooling
Con culata enfriada
Com resfriamento do cabeçote

* R507 puissances frigorifiques à calculer comme indiqué à la page 4
refrigerating capacities to be calculated as indicated on page 4
calcularse las capacidades frigoríficas como indicado a la pág. 4
capacidades frigorificas calculadas como indicado na pág. 4

Puissances frigorifiques — Refrigerating capacity — Capacidades frigoríficas — Capacidades frigorificas

R407c

Compresseur Compressor Compresor Compressor	Condensation Condensing Condensación Condensação	Puissances frigorifiques W / Refrigerating capacity W / Capacidad frigorífica W / Capacidade frigorifica W								
		Température d'évaporation °C / Evaporating temperature °C / Temperatura de evaporación °C / Temperatura de evaporação °C								
	°C	12.5	7.5	5	0	-5	-10	-15	-20	-25
A 0.5 4 Y	30	6280	5210	4740	3900	3190	2580	2050	1610	1220
	40	5510	4570	4160	3420	2780	2230	1760	1360	1020
	45	5110	4250	3860	3170	2570	2050	1610	1240	910
	50	4720	3920	3560	2920	2360	1870	1460	1100	790
A 0.5 5 Y	30 / 40 / 45 / 50	SUR DEMANDE / ON REQUEST / A PEDIDO / SOB PEDIDO								
A 0.7 5 Y	30	7730	6420	5840	4810	3940	3180	2540	1990	1520
	40	6730	5600	5100	4200	3420	2760	2170	1680	1260
	45	6230	5180	4730	3890	3170	2530	1990	1520	1130
	50	5740	4780	4340	3580	2890	2320	1800	1370	980
A 0.7 6 Y	30 / 40 / 45 / 50	SUR DEMANDE / ON REQUEST / A PEDIDO / SOB PEDIDO								
A 1 6 Y	30	8650	7190	6540	5390	4400	3550	2830	2220	1700
	40	7580	6300	5740	4720	3840	3080	2440	1880	1400
	45	7040	5860	5330	4380	3550	2830	2220	1700	1260
	50	6500	5400	4910	4020	3250	2590	2020	1520	1100
A 1 7 Y	30 / 40 / 45 / 50	SUR DEMANDE / ON REQUEST / A PEDIDO / SOB PEDIDO								
A 1.5 7 Y	30	11020	9190	8360	6880	5600	4510	3580	2800	2140
	40	9710	8050	7320	6010	4880	3910	3080	2390	1790
	45	9050	7500	6820	5580	4520	3610	2830	2160	1600
	50	8360	6940	6300	5150	4150	3300	2560	1930	1400
A 1.5 8 Y	30	12140	10190	9180	7560	6170	4980	3970	3110	2390
	40	10690	8880	8080	6620	5390	4320	3410	2630	1970
	45	9950	8260	7510	6160	4980	3980	3120	2390	1760
	50	9190	7630	6940	5680	4580	3640	2830	2140	1550
B 1.5 9 Y	30 / 40 / 45 / 50	SUR DEMANDE / ON REQUEST / A PEDIDO / SOB PEDIDO								
B 1.5 10 Y	30 / 40 / 45 / 50	SUR DEMANDE / ON REQUEST / A PEDIDO / SOB PEDIDO								
B 2 10 Y	30	15530	12900	11740	9670	7900	6380	5090	4000	3060
	40	13620	11320	10300	8470	6890	5530	4370	3370	2530
	45	12620	10510	9560	7860	6370	5090	4000	3060	2260
	50	11600	9670	8810	7220	5840	4660	3620	2740	1980
D 2 11 Y	30	18850	15640	14220	11700	9540	7700	6130	4790	3650
	40	16500	13690	12440	10210	8280	6620	5220	4010	2980
	45	15310	12710	11540	9460	7640	6080	4750	3610	2640
	50	14060	11690	10630	8690	7000	5530	4270	3200	2290
C 2 12 Y	30 / 40 / 45 / 50	SUR DEMANDE / ON REQUEST / A PEDIDO / SOB PEDIDO								
C 3 12 Y	30	19570	16260	14800	12170	9920	8000	6370	4980	3820
	40	17300	14350	13040	10700	8690	6960	5480	4220	3160
	45	16140	13380	12160	9950	8050	6420	5020	3830	2820
	50	14940	12380	11230	9180	7390	5870	4550	3430	2470
D 2 13 Y	30 / 40 / 45 / 50	SUR DEMANDE / ON REQUEST / A PEDIDO / SOB PEDIDO								
D 3 13 Y	30	21370	17770	16180	13330	10880	8800	7010	5480	4190
	40	18820	15650	14230	11700	9500	7620	6010	4630	3460
	45	17520	14570	13240	10860	8800	7020	5500	4190	3070
	50	16210	13450	12230	10010	8080	6410	4970	3740	2690
D 2 15 Y	30 / 40 / 45 / 50	SUR DEMANDE / ON REQUEST / A PEDIDO / SOB PEDIDO								
D 3 15 Y	30	24610	20440	18580	15260	12440	10030	7980	6230	4740
	40	21560	17880	16250	13330	10810	8640	6790	5210	3860
	45	20020	16600	15070	12340	9970	7940	6190	4690	3430
	50	18440	15290	13870	11330	9130	7220	5580	4180	2980
D 3 16 Y	30 / 40 / 45 / 50	SUR DEMANDE / ON REQUEST / A PEDIDO / SOB PEDIDO								

Avec refroidissement de la culasse
With head cooling
Con culata enfriada
Com resfriamento do cabeçote

Puissances frigorifiques — Refrigerating capacity — Capacidades frigoríficas — Capacidades frigorificas

R407c

Compresseur Compressor Compresor Compressor	Condensation Condensing Condensación Condensação	Puissances frigorifiques W / Refrigerating capacity W / Capacidad frigorífica W / Capacidade frigorifica W								
		Température d'évaporation °C / Evaporating temperature °C / Temperatura de evaporación °C / Temperatura de evaporação °C								
	°C	12.5	7.5	5	0	-5	-10	-15	-20	-25
D 4 16 Y	30	26530	22010	20020	16450	13420	10810	8590	6700	5100
	40	23280	19310	17540	14380	11660	9320	7320	5620	4160
	45	21610	17930	16280	13330	10760	8570	6680	5060	3680
	50	19920	16510	15000	12250	9850	7800	6020	4500	3200
F 4 16 Y	30	27600	22900	20810	17100	13920	11210	8890	6940	5270
	40	24320	20150	18300	14980	12120	9680	7600	5820	4310
	45	22640	18740	17000	13900	11210	8900	6920	5240	3820
	50	20940	17320	15700	12780	10270	8100	6250	4670	3320
D 3 18 Y	30	SUR DEMANDE		ON REQUEST			A PEDIDO		SOB PEDIDO	
	40									
	45									
	50									
D 4 18 Y	30	29420	24430	22240	18320	14980	12120	9680	7620	5870
	40	25870	21490	19550	16080	13090	10540	8350	6480	4900
	45	24040	19980	18170	14930	12130	9720	7660	5890	4390
	50	22190	18430	16760	13750	11150	8890	6960	5300	3890
D 3 19 Y	30	PAS DISPONIBLE		NOT AVAILABLE			NO DISPONIBLE		NAO DISPONÍVEL	
	40									
	45									
	50									
D 4 19 Y	30	PAS DISPONIBLE		NOT AVAILABLE			NO DISPONIBLE		NAO DISPONÍVEL	
	40									
	45									
	50									
F 4 19 Y	30	32060	26620	24200	19880	16200	13060	10370	8100	6180
	40	28240	23400	21250	17410	14110	11280	8870	6820	5060
	45	26300	21760	19740	16140	13040	10380	8100	6160	4500
	50	24290	20100	18230	14860	11950	9460	7320	5480	3940
Q 4 19 Y	30	SUR DEMANDE		ON REQUEST			A PEDIDO		SOB PEDIDO	
	40									
	45									
	50									
F 5 19 Y	30	31200	28440	23480	19190	15520	12410	9790	7630	5860
	40	27340	24900	20540	16790	13570	10850	8560	6650	5040
	45	25420	23160	19090	15590	12610	10080	7940	6140	4640
	50	23520	21420	17640	14410	11650	9310	7330	5650	4220
Q 5 19 Y	30	29680	27070	22300	18120	14520	11450	8840	6640	4760
	40	26120	23800	19540	15800	12580	9700	7460	5470	3780
	45	24240	22060	18070	14570	11540	8960	6760	4880	3300
	50	22310	20280	16570	13320	10500	8100	6050	4310	2830
Q 4 21 Y	30	SUR DEMANDE		ON REQUEST			A PEDIDO		SOB PEDIDO	
	40									
	45									
	50									
Q 5 21 Y	30	33760	30770	25360	20650	16610	13160	10260	7860	5890
	40	29400	26750	21960	17820	14270	11260	8720	6640	4920
	45	27190	24710	20230	16380	13090	10310	7980	6050	4460
	50	24960	22660	18520	14950	11930	9380	7260	5500	4060
F 4 24 Y	30	SUR DEMANDE		ON REQUEST			A PEDIDO		SOB PEDIDO	
	40									
	45									
	50									
Q 4 24 Y	30	SUR DEMANDE		ON REQUEST			A PEDIDO		SOB PEDIDO	
	40									
	45									
	50									
F 5 24 Y	30	38980	32380	29410	24180	19700	15890	12620	9880	7540
	40	34270	28400	25800	21160	17170	13760	10840	8340	6230
	45	31870	26410	23980	19630	15980	12660	9910	7550	5560
	50	29360	24320	22080	18050	14560	11540	8960	6760	4870
Q 5 24 Y	30	38360	34970	28800	23470	18900	15060	11840	9170	6950
	40	33230	30250	24880	20220	16250	12900	10100	7780	5840
	45	30730	27980	22980	18660	14980	11870	9280	7130	5330
	50	28300	25750	21140	17150	13740	10870	8480	6500	4840
Q 4 25 Y	30	SUR DEMANDE		ON REQUEST			A PEDIDO		SOB PEDIDO	
	40									
	45									
	50									
Q 5 25 Y	30	SUR DEMANDE		ON REQUEST			A PEDIDO		SOB PEDIDO	
	40									
	45									
	50									
Q 7 25 Y	30	38600	32170	29260	24000	19460	15560	12250	9460	7100
	40	33890	28140	25550	20870	16840	13380	10430	7920	5800
	45	31560	26150	23710	19330	15550	12310	9540	7190	5170
	50	29260	24190	21910	17820	14290	11270	8690	6480	4580

Avec refroidissement de la culasse
With head cooling
Con culata enfriada
Com resfriamento do cabeçote

FCAT04-14

Puissances frigorifiques — Refrigerating capacity — Capacidades frigoríficas — Capacidades frigorificas

R407c

Compresseur Compressor Compresor Compressor	Condensation Condensing Condensación Condensação	Puissances frigorifiques W / Refrigerating capacity W / Capacidad frigorífica W / Capacidade frigorifica W								
		Température d'évaporation °C / Evaporating temperature °C / Temperatura de evaporación °C / Temperatura de evaporação °C								
	°C	12.5	7.5	5	0	-5	-10	-15	-20	-25
Q 5 28 Y	30 40 45 50	**SUR DEMANDE**		**ON REQUEST**			**A PEDIDO**		**SOB PEDIDO**	
Q 7 28 Y	30	44860	40940	33860	27710	22420	17900	14090	10900	8270
	40	39130	35690	29480	24110	19490	15550	12200	9380	7020
	45	36340	33130	27360	22360	18070	14400	11290	8650	6410
	50	33580	30600	25260	20640	16670	13280	10390	7920	5800
Q 5 33 Y	30 40 45 50	**SUR DEMANDE**		**ON REQUEST**			**A PEDIDO**		**SOB PEDIDO**	
S 5 33 Y	30 40 45 50	**SUR DEMANDE**		**ON REQUEST**			**A PEDIDO**		**SOB PEDIDO**	
Q 7 33 Y	30	52390	47890	39670	32480	26270	20960	16510	12890	10010
	40	45190	41340	34320	28190	22880	18360	14570	11440	8940
	45	41840	38290	31820	26170	21290	17120	13610	10690	8330
	50	38640	35380	29440	24240	19740	15890	12620	9900	7640
S 7 33 Y	30	56080	46480	42240	34680	28220	22720	18040	14050	10690
	40	49300	40810	37040	30320	24550	19610	15400	11800	8750
	45	45800	37900	34380	28090	22670	18010	14040	10630	7750
	50	42320	34980	31700	25800	20750	16390	12670	9470	6760
S 7 39 Y	30 40 45 50	**SUR DEMANDE**		**ON REQUEST**			**A PEDIDO**		**SOB PEDIDO**	
S 10 39 Y	30	66050	54770	49790	40960	33310	26780	21350	16670	12700
	40	58070	48120	43700	35820	29030	23220	18250	14020	10430
	45	54060	44770	40630	33200	26830	21350	16670	12660	9260
	50	49920	41300	37460	30560	24580	19450	15050	11290	8090
S 10 51 Y	30 40 45 50	**SUR DEMANDE**		**ON REQUEST**			**A PEDIDO**		**SOB PEDIDO**	
S 15 51 Y	30	83530	69240	62950	51770	42230	34080	27130	21220	16200
	40	73310	60770	55210	45260	36730	29410	23180	17860	13320
	45	68270	56540	51290	41960	33940	27050	21160	16130	11840
	50	63070	52220	47360	38620	31100	24650	19100	14390	10360
S 15 56 Y	30 40 45 50	**SUR DEMANDE**		**ON REQUEST**			**A PEDIDO**		**SOB PEDIDO**	
S 20 56 Y	30	94150	78280	71260	58740	48020	38880	31090	24470	18890
	40	83290	69230	62980	51850	42220	33970	26940	20950	15880
	45	77680	64550	58700	48230	39240	31450	24800	19140	14340
	50	72040	59760	54340	44570	36130	28850	22620	17290	12770
V 15 59 Y	30 40 45 50	**SUR DEMANDE**		**ON REQUEST**			**A PEDIDO**		**SOB PEDIDO**	
V 20 59 Y	30	93130	77640	70630	57980	47040	37660	29660	22920	17280
	40	81590	67780	61540	50300	40610	32280	25190	19180	14080
	45	75890	62900	57060	46540	37450	29660	23030	17360	12550
	50	70240	58090	52630	42820	34360	27110	20920	15620	11080
V 15 71 Y	30 40 45 50	**SUR DEMANDE**		**ON REQUEST**			**A PEDIDO**		**SOB PEDIDO**	
V 25 71 Y	30	122210	100970	91400	74230	59520	47040	36640	28060	21100
	40	105250	86660	78320	63410	50700	39980	31040	23690	17700
	45	97210	79910	72170	58360	46630	36760	28540	21770	16250
	50	89440	73420	66260	53540	42770	33730	26210	20020	14930
V 20 84 Y	30 40 45 50	**SUR DEMANDE**		**ON REQUEST**			**A PEDIDO**		**SOB PEDIDO**	
V 30 84 Y	30	138640	115880	105590	87020	70960	57180	45470	35580	27290
	40	122410	101980	92750	76140	61790	49490	39000	30090	22550
	45	114240	94980	86290	70670	57180	45620	35750	27350	20180
	50	106060	87960	79810	65180	52570	41760	32520	24620	17840
V 25 93 Y	30 40 45 50	**A RICHIESTA**		**ON REQUEST**			**A PEDIDO**		**SOB PEDIDO**	

Avec refroidissement de la culasse
With head cooling
Con culata enfriada
Com resfriamento do cabeçote

Puissances frigorifiques — Refrigerating capacity — Capacidades frigoríficas — Capacidades frigorificas

R407c

Compresseur Compressor Compresor Compressor	Condensation Condensing Condensación Condensação	Puissances frigorifiques W / Refrigerating capacity W / Capacidad frigorífica W / Capacidade frigorifica W — Température d'évaporation °C / Evaporating temperature °C / Temperatura de evaporación °C / Temperatura de evaporação °C								
	°C	12.5	7.5	5	0	-5	-10	-15	-20	-25
V 32 93 Y	30	153710	127990	116350	95350	77180	61600	48340	37150	27780
	40	135230	112090	101640	82810	66560	52610	40720	30620	22080
	45	125940	104100	94250	76540	61240	48120	36910	27380	19270
	50	116640	108120	86870	70250	55920	43640	33140	24180	16500
Z 25 106 Y	30	SUR DEMANDE / ON REQUEST / A PEDIDO / SOB PEDIDO								
	40									
	45									
	50									
Z 35 106 Y	30	175990	160540	132490	108170	87370	69840	55200	43090	33080
	40	153100	139440	114670	93240	74990	59660	46970	36540	28010
	45	141760	129010	105910	85960	68990	54790	43070	33490	25720
	50	130520	118720	97300	78820	63140	50080	39350	30640	23600
Z 30 126 Y	30	SUR DEMANDE / ON REQUEST / A PEDIDO / SOB PEDIDO								
	40									
	45									
	50									
Z 40 126 Y	30	205700	188000	155710	127510	103200	82460	64920	50170	37730
	40	179760	164220	135830	110990	89530	71200	55640	42470	31270
	45	166420	151970	125560	102430	82450	65360	50840	38530	28020
	50	152900	139560	115140	93760	75280	59450	46000	34560	24780
W 40 142 Y	30	233760	194740	177250	146020	119300	96560	77270	60890	46870
	40	207190	172150	156490	128560	104700	84360	67020	52130	39160
	45	193720	160670	145920	119640	97200	78060	61690	47560	35110
	50	180110	149050	135200	110580	89570	71640	56230	42850	30940
Z 40 154 Y	30	SUR DEMANDE / ON REQUEST / A PEDIDO / SOB PEDIDO								
	40									
	45									
	50									
Z 50 154 Y	30	251470	229860	190640	156470	126890	101520	79920	61700	46430
	40	219230	200060	165380	135250	109240	86930	67910	51770	38100
	45	203530	185580	153160	125030	100780	79990	62260	47150	34260
	50	173040	157520	129590	105460	84710	66940	51720		
W 40 168 Y	30	SUR DEMANDE / ON REQUEST / A PEDIDO / SOB PEDIDO								
	40									
	45									
	50									
W 50 168 Y	30	281520	257110	212860	174280	140900	112270	87910	67340	50100
	40	247070	225250	185770	151450	121810	96400	74740	56350	40760
	45	230150	209620	172520	140340	112580	88780	68460	51170	36420
	50	213440	194210	159520	129470	103580	81400	62440	46240	32320
W 50 187 Y	30	SUR DEMANDE / ON REQUEST / A PEDIDO / SOB PEDIDO								
	40									
	45									
	50									
W 60 187 Y	30	310200	283420	234850	192500	155840	124390	97610	75010	56080
	40	273830	249800	206290	168440	135720	107620	83640	63280	46000
	45	254940	232340	191470	155960	125300	99000	76510	57360	41020
	50	235690	214550	176380	143290	114770	90310	69400	51530	36180
W 60 206 Y	30	SUR DEMANDE / ON REQUEST / A PEDIDO / SOB PEDIDO								
	40									
	45									
	50									
W 70 206 Y	30	341460	311980	258530	211960	171680	137140	107740	82900	62050
	40	300580	274150	226370	184850	149030	118310	92140	69910	51060
	45	280440	255550	210610	171620	138040	109250	84680	63780	45950
	50	260540	237190	195100	158660	127310	100450	77520	57940	41110
W 70 228 Y	30	SUR DEMANDE / ON REQUEST / A PEDIDO / SOB PEDIDO								
	40									
	45									
	50									
W 75 228 Y	30	363190	332160	275900	226880	184500	148140	117200	91080	69180
	40	320870	293030	242660	198890	161100	128700	101080	77620	57730
	45	299860	273610	226210	185080	149600	119200	93240	71140	52270
	50	278960	254330	209900	171420	138280	109860	85580	64840	36220
W 75 240 Y	30	SUR DEMANDE / ON REQUEST / A PEDIDO / SOB PEDIDO								
	40									
	45									
	50									
W 80 240 Y	30	395560	361210	299040	244990	198430	158700	125180	97210	74150
	40	351140	320180	264260	215820	174200	138770	108890	83890	63170
	45	327840	298640	246010	200530	161540	128410	100500	77160	57740
	50	303900	276530	227290	184870	148620	117900	92060	70480	52490

Avec refroidissement de la culasse
With head cooling
Con culata enfriada
Com resfriamento do cabeçote

FCAT04-14

Puissances frigorifiques — Refrigerating capacity — Capacidades frigoríficas — Capacidades frigorificas

R22

Compresseur / Compressor / Compresor / Compressor	Condensation / Condensing / Condensación / Condensação	Puissances frigorifiques W / Refrigerating capacity W / Capacidad frigorífica W / Capacidade frigorifica W												
		Température d'évaporation °C / Evaporating temperature °C / Temperatura de evaporación °C / Temperatura de evaporação °C												
	°C	12.5	7.5	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
A 0.5 4 Y	30	6120	5100	4640	3830	3120	2530	2000	1560	1190	890	640	440	
	40	5420	4500	4090	3360	2740	2210	1730	1330	1000	730	520	350	
	45	5080	4210	3830	3140	2540	2040	1600	1220	910	660	460	300	
	50	4730	3910	3550	2920	2350	1880	1460	1100	820	230	400	250	
A 0.5 5 Y	30					3910	3180	2530	1980	1520	1140	840	590	
	40					3430	2770	2200	1700	1310	960	680	470	
	45					3190	2580	2030	1570	1190	860	610	410	
	50					2950	2380	1860	1430	1070	780	540	350	
A 0.7 5 Y	30	7630	6350	5780	4780	3910	3180	2530	1980	1520	1140	840	590	
	40	6730	5600	5100	4200	3430	2770	2200	1700	1300	960	680	470	
	45	6290	5230	4760	3920	3200	2580	2030	1570	1190	860	610	410	
	50	5830	4860	4420	3640	2960	2380	1870	1440	1070	780	540	350	
A 0.7 6 Y	30					4310	3500	2800	2200	1690	1270	940	660	440
	40					3780	3060	2420	1880	1440	1070	760	520	340
	45					3520	2840	2240	1740	1310	960	680	460	290
	50					3250	2620	2060	1580	1190	860	600	400	
A 1 6 Y	30	8510	7090	6460	5340	4380	3550	2820	2210	1700	1280	940	660	
	40	7540	6280	5710	4720	3850	3110	2460	1910	1450	1070	770	530	
	45	7070	5880	5350	4400	3590	2890	2280	1760	1330	970	680	460	
	50	6580	5470	4980	4090	3340	2680	2100	1610	2270	880	600	400	
A 1 7 Y	30					5580	4540	3660	2900	2270	1730	1300	940	660
	40					4930	4020	3230	2540	1970	1490	1100	780	530
	45					4620	3760	3010	2360	1820	1380	1010	710	470
	50					4280	3490	2780	2200	1680	1260	910	620	
A 1.5 7 Y	30	10870	9100	8300	6890	5680	4630	3720	2940	2290	1750	1310		
	40	9730	8140	7430	6140	5050	4100	3280	2580	2000	1510	1100		
	45	9160	7660	6980	5780	4740	3850	3070	2410	1850	1390	1010		
	50	8590	7180	6540	5410	4430	3590	2860	2230	1700	1270	910		
A 1.5 8 Y	30	12420	10340	9430	7790	6380	5220	4210	3360	2620	2000	1490	1070	
	40	11080	9230	8400	6920	5660	4600	3710	2940	2270	1720	1250	860	
	45	10430	8680	7900	6500	5290	4320	3460	2720	2100	1570	1130	770	
	50	9740	8110	7380	6070	4930	4010	3200	2510	1920	1420	1010	670	
B 1.5 9 Y	30			11060	9160	7540	6160	5000	4010	3170	2450	1850	1360	950
	40			9830	8140	6680	5440	4390	3490	2720	2090	1550	1100	730
	45			9230	7630	6260	5080	4090	3240	2520	1910	1390	970	640
	50			8600	7120	5830	4720	3790	2990	2300	1730	1250	860	
B 1.5 10 Y	30					8470	6940	5620	4500	3540	2750	2080	1520	1080
	40					7510	6130	4940	3940	3070	2350	1750	1260	860
	45					7040	5740	4620	3660	2840	2160	1600	1130	760
	50					6560	5340	4280	3380	2620	1970	1440	1000	
B 2 10 Y	30	16340	13660	12470	10330	8510	6940	5600	4450	3480	2650			
	40	14580	12170	11090	9170	8060	6110	4880	3850	2980	2230			
	45	13700	11420	10420	8590	7030	5700	4540	3560	2720	2030			
	50	12790	10670	9720	8020	6540	5280	4200	3260	2480	1820			
D 2 11 Y	30	18460	15360	14000	11650	9620	7880	6380	5100	3970	3020	2220		
	40	16330	13620	12420	10340	8530	6970	6800	4440	3410	2530	1810		
	45	15340	12790	11650	9700	7990	6520	5220	4100	3120	2290	1600		
	50	14330	11950	10880	9050	7450	6050	4820	3770	2830	2050	1390		
C 2 12 Y	30					10510	8590	6950	5540	4360	3360	2510	1800	1200
	40					9370	7630	6130	4860	3780	2870	2090	1430	840
	45					8800	7140	5710	4510	3480	2620	1870	1220	
	50					8220	6640	5290	4150	3180	2350	1640		
C 3 12 Y	30	20620	17390	15940	13300	11030	9070	7390	5950	4720	3660			
	40	18520	15590	14270	11890	9840	8060	6550	5230	4100	3100			
	45	17450	14680	13420	11170	9230	7560	6120	4910	3780	2810			
	50	16370	13740	12560	10450	8620	7040	5690	4510	3470	2530			
D 2 13 Y	30			16640	13880	11510	9460	7680	6140	4850	3730	2800	1990	1330
	40			14720	12290	10180	8340	6740	5350	4160	3160	2290	1570	970
	45			13800	11510	9530	7790	6280	4960	3820	1660	2040	1360	790
	50			12820	10700	8860	7220	5800	4560	3480	2570	1790	1150	
D 3 13 Y	30	22040	18410	16800	13960	11510	9410	7600	6050	4720	3590			
	40	19580	16370	14940	12380	10180	8280	6650	5230	4020	3000			
	45	18420	15380	14020	11620	9530	7730	6170	4820	3670	2700			
	50	17220	14360	13090	10840	8870	7160	5690	4420	3320	2410			
D 2 15 Y	30					12770	10480	8500	6800	5360	4140	3110	2230	1520
	40					11280	9240	7460	5930	4730	3490	2560	1760	1120
	45					10540	8630	6950	5480	4240	3180	2280	1540	920
	50					9780	7990	6420	5050	3860	2860	2020	1310	
D 3 15 Y	30		20660	18860	15650	12890	10540	8510	6780	5320	4070	3040		
	40		18400	16790	13910	11440	9300	7460	5890	4550	3420	2480		
	45		17280	15770	13040	10700	8690	6950	5450	4180	3100	2210		
	50		16150	14740	12180	9970	8060	6420	5000	3790	2780	1930		
D 3 16 Y	30			19820	16560	13730	11290	9180	7380	5820	4500	3370	2440	
	40			17480	14620	12130	9970	8090	6460	5040	3830	2810	1940	
	45			16360	13680	11350	9310	7540	5990	4640	3490	2520	1700	
	50			15220	12730	10560	8650	6970	5520	4240	3160	2220		

Avec refroidissement de la culasse
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Puissances frigorifiques — Refrigerating capacity — Capacidades frigoríficas — Capacidades frigorificas

R22

Compresseur Compressor Compresor Compressor	Condensation Condensing Condensación Condensação	Puissances frigorifiques W / Refrigerating capacity W / Capacidad frigorífica W / Capacidade frigorifica W												
		Température d'évaporation °C / Evaporating temperature °C / Temperatura de evaporación °C / Temperatura de evaporação °C												
	°C	12.5	7.5	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
D 4 16 Y	30	26380	22070	20150	16840	13970	11480	9340	7500	5900	4560			
	40	23340	19540	17830	14920	12370	10150	8230	6550	5110	3880			
	45	21900	18320	16730	13980	11580	9490	7670	6080	4720	3540			
	50	20420	17090	15590	13040	10800	8830	7100	5600	4310	3190			
F 4 16 Y	30	27260	22810	20830	17280	14230	11600	9360	7430	5800	4420			
	40	24240	20280	18520	15340	12590	10220	8180	6440	4960	3700			
	45	22750	19030	17380	14380	11780	9530	7600	5940	4520	3340			
	50	21260	17780	16220	13400	10960	8840	7010	5450	4100	2990			
D 3 18 Y	30					15290	12590	10260	8240	6520	5050	3800	2750	1860
	40					13560	11140	9020	7200	5620	4270	3130	2170	1380
	45					12720	10420	8410	6670	5170	3890	2800	1900	1140
	50					11870	9680	7790	6140	4720	3490	2470	1610	
D 4 18 Y	30	29700	24840	22680	18840	15540	12800	10430	8380	6620	5110			
	40	26530	22220	20290	16820	13840	11350	9190	7320	5710	4330			
	45	25020	20940	19120	15840	13010	10630	8570	6790	5260	3940			
	50	23420	19610	17890	14820	12160	9900	7940	7450	4790	3550			
D 3 19 Y	30	**PAS DISPONIBLE**				**NOT AVAILABLE**			**NO DISPONIBLE**			**NAO DISPONÍVEL**		
	40													
	45													
	50													
D 4 19 Y	30	**PAS DISPONIBLE**				**NOT AVAILABLE**			**NO DISPONIBLE**			**NAO DISPONÍVEL**		
	40													
	45													
	50													
F 4 19 Y	30		26750	24400	20200	16610	13550	10910	8680	6790	5210	3890	2780	
	40		23980	21860	18070	14820	12020	9640	7580	5870	4420	3200	2200	
	45		22610	20600	17020	13930	11270	8990	7060	5400	4020	2870	1910	
	50		21220	19320	15950	13020	10500	8340	6490	4930	3620	2520	1630	
Q 4 19 Y	30				20180	16620	13550	10920	8660	6780	5200	3850	2740	1820
	40				18000	14750	11980	9560	7510	5800	4340	3130	2120	1310
	45				16910	13840	11180	8890	6940	5300	3940	2770	1840	1070
	50				15790	12890	10390	8220	6360	4810	3520	2420	1540	
F 5 19 Y	30	32000	26710	24350	20110	16500	13390	10750	8500	6640	5060			
	40	28880	24010	21860	18010	14720	11870	9460	7390	5690	4250			
	45	27230	22640	20590	16930	13800	11110	8800	6830	5210	3840			
	50	25560	21230	19300	15840	12880	10320	8140	6280	4730	3430			
Q 5 19 Y	30	31970	26760	24430	20270	16680	13580	10940	8680	6760	5150			
	40	28600	23920	21830	18060	14810	12000	9590	7520	5770	4300			
	45	26930	22500	20520	16960	13870	11210	8920	6950	5280	3880			
	50	25220	21060	19200	15830	12920	10400	8230	6370	4790	3470			
Q 4 21 Y	30	**SUR DEMANDE**			**ON REQUEST**				**A PEDIDO**			**SOB PEDIDO**		
	40													
	45													
	50													
Q 5 21 Y	30	34210	28580	26080	21600	17770	14480	11680	9260	7220	5500			
	40	30480	25500	23270	19260	15790	12830	10280	8090	6220	4630			
	45	28690	23980	21880	18100	14830	12000	9580	7490	5700	4200			
	50	26830	22430	20460	16910	13840	11170	8870	6890	5320				
F 4 24 Y	30					20220	16550	13420	10720	8460	6540	4920	3560	2440
	40					17990	14690	11820	9370	7360	5630	4150	2920	1860
	45					16870	13740	11020	8690	6790	5160	3760	2580	1570
	50					15720	12780	10220	8000	6230	4680	3360	2230	
Q 4 24 Y	30				25020	20590	16760	13520	10730	8400	6430	4760	3380	2240
	40				22210	18230	14780	11830	9290	7180	5380	3860	2630	1610
	45				20840	17050	13800	10980	8570	6560	4860	3430	2260	1310
	50				19430	15880	12790	10130	7850	5950	4330	2990	1900	
F 5 24 Y	30	38270	32040	29290	24360	20060	16390	13240	10540	8200	6230			
	40	34300	28680	26180	21710	17840	14520	11650	9190	7120	5360			
	45	32300	27010	24660	20410	16740	13580	10860	8510	6560	4910			
	50	30220	25270	23060	19080	15640	12640	10060	7820	6010	4450			
Q 5 24 Y	30	38920	32540	29710	24620	20270	16510	13300	10550	8210	6240			
	40	34880	29170	26620	22030	18070	14650	11720	9200	7070	5270			
	45	32870	27480	25070	20720	16970	13740	10930	8530	6490	4780			
	50	30800	25750	23480	19390	15850	12780	10130	7850	5900	4280			
Q 4 25 Y	30					21790	17900	14540	11640	9160	7030	5240	3740	2500
	40					19310	15830	12780	10140	7870	5940	4310	2940	1820
	45					18070	14780	11900	9400	7240	5390	3830	2540	1490
	50					16820	13720	11000	8630	6590	4840	3360	2150	
Q 5 25 Y	30			30190	25000	20570	16780	13520	10750	8390	6380	4720	3340	2220
	40			26870	22250	18260	14840	11890	9370	7210	5390	3860	2620	1610
	45			25240	20880	17120	13880	11090	8680	6620	4880	3430	2260	1320
	50			23580	19500	15960	12900	10260	7970	6020	4380	3010	1900	
Q 7 25 Y	30	39780	33370	30500	25320	20830	16970	13640	10800	8390	6360			
	40	36070	30220	27590	22820	18700	15140	12070	9460	7220	5360			
	45	34180	28600	26080	21540	17600	14200	11270	8760	6640	4860			
	50	32230	26940	24550	20230	16490	13250	10450	8060	6050	4360			

Avec refroidissement de la culasse
With head cooling
Con culata enfriada
Com resfriamento do cabeçote

Refroidissement par injection de liquide et par motoventilateur sur la culasse
Cooling with liquid injection and head fan motor
Enfriamiento con inyección de líquido y culata enfriada por aire
Resfriamento com injeção de liquido e cabeçote resfriado a ar

Puissances frigorifiques — Refrigerating capacity — Capacidades frigoríficas — Capacidades frigorificas

R22

Compresseur Compressor Compresor Compressor	Condensation Condensing Condensación Condensação	Puissances frigorifiques W / Refrigerating capacity W / Capacidad frigorífica W / Capacidade frigorifica W												
		Température d'évaporation °C / Evaporating temperature °C / Temperatura de evaporación °C / Temperatura de evaporação °C												
	°C	12.5	7.5	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
Q 5 28 Y	30				28380	23530	19330	15710	12580	9880	7580	5640	4020	2680
	40				25340	20990	17200	13900	11040	8570	6440	4660	3180	1970
	45				23810	19720	16130	12970	10250	7900	5860	4160	2750	1620
	50				22240	18400	15020	12040	9460	7210	5280	3660	2340	
Q 7 28 Y	30	47300	39560	36120	30010	24760	20220	16320	12980	10100	7690			
	40	42240	35290	32200	26720	21940	17830	14290	11240	8620	6420			
	45	39760	33190	30260	25060	20540	16640	13270	10370	7880	5780			
	50	37250	31070	28310	23400	19130	15440	12240	9500	7140	5160			
Q 5 33 Y	30					27000	22400	18420	14990	12040	9500	7360	5540	4010
	40					24240	20090	16480	13360	10640	8340	6370	4700	3310
	45					22850	18910	15500	12530	9950	7750	5870	4280	2960
	50					21420	17720	14500	11690	9240	7150	5380	3880	
S 5 33 Y	30					28060	22930	18500	14710	11470	8740	6460	4570	3040
	40					24420	20020	16190	12850	9960	7510	5450	3760	2350
	45					22640	18610	15040	11920	9200	6880	4930	3340	2030
	50					20890	17180	13870	10970	8420	6240	4420	2920	
Q 7 33 Y	30	51530	43300	39640	33080	27460	22780	18710	15200	12190	9620			
	40	46570	39170	35860	29920	24790	20510	16790	13580	10810	8450			
	45	44150	37130	33980	28330	23460	19380	15830	12760	10120	7860			
	50	41650	35040	32060	26720	22090	18220	14840	11930	9410	7260			
S 7 33 Y	30	55340	45980	41830	34420	28080	22760	18220	14330	11040	8290			
	40	48760	40440	36730	30120	24440	19820	15820	12370	9430	6970			
	45	45550	37740	34260	28020	22670	18370	14620	11390	8630	6310			
	50	42370	35030	31780	25930	20900	16920	13440	10420	7820	5650			
S 7 39 Y	30					34210	27840	22400	17760	13850	10570	7850	5620	3840
	40					30200	24460	19550	15360	11820	8870	6430	4480	2930
	45					28280	22800	18140	14170	10840	8040	5760	3920	2510
	50					26320	21160	16740	13000	9840	7240	5110	3410	
S 10 39 Y	30	66010	54900	49980	41140	33600	27120	21660	16990	13070	9820			
	40	58550	48640	44210	36260	29460	23650	18700	14480	10970	8050			
	45	54910	45550	41390	33880	27430	21920	17240	13260	9950	7210			
	50	51260	42490	38530	31460	25400	20210	15790	12060	8940	6400			
S 10 51 Y	30					43010	34900	28020	22210	17340	13280	9950	7220	5100
	40					38240	30820	24520	19220	14810	11160	8180	5780	3950
	45					35900	28810	22800	17780	13600	10140	7340	5110	3420
	50					33530	26800	21100	16340	12400	9160	6540	4460	
S 15 51 Y	30	84010	69840	63640	52310	42720	34560	27650	21780	16840	12720			
	40	74780	62260	56680	46440	37720	30290	23990	18680	14230	10540			
	45	70480	58640	53320	43570	35270	28200	22210	17180	12960	9490			
	50	66050	54920	49960	40720	32810	26110	20440	15700	11720	8470			
S 15 56 Y	30			70310	58640	48560	39840	32300	25820	20280	15580	11620	8330	5630
	40			62660	52330	43270	35410	28600	22680	17640	13340	9740	6780	4370
	45			58940	49210	40690	33200	26720	21110	16300	12230	8810	6010	3770
	50			55120	46020	38030	30960	24830	19510	14950	11100	7880	5270	
S 20 56 Y	30	93380	77840	70940	59230	49070	40240	32590	26000	20360	15600			
	40	83620	69610	63380	52940	43820	35840	28910	22900	17740	13370			
	45	78760	65520	56350	49800	41180	33640	27040	21310	16400	12250			
	50	73840	61340	55800	46600	38500	31370	25130	19700	15050	11120			
V 15 59 Y	30			73510	61450	51130	41460	33340	26540	20900	16220	12370	9220	6850
	40			65870	55130	45830	36900	29420	23180	18050	13810	10360	7560	5510
	45			62180	52040	43300	34680	27520	21560	16670	12660	9400	6770	4880
	50			58360	48890	40690	32480	25630	19970	15320	11540	8470	6020	
V 20 59 Y	30	96230	80950	74150	61960	51480	41640	33370	26450	20680	15920			
	40	86330	72660	66490	55610	46150	37090	29480	23140	17880	13560			
	45	81460	68580	62820	52460	43490	34850	27560	21520	16510	12430			
	50	76500	64430	59030	49300	40860	32580	25660	19910	15170	11320			
V 15 71 Y	30					60300	49030	40750	31620	25000	19540	15020	11320	8510
	40					53760	43480	34800	27550	21550	16630	12610	9320	6910
	45					50520	40740	32510	25600	19910	15250	11460	8390	6170
	50					47260	38000	30230	23680	18300	13910	10360	7490	
V 25 71 Y	30	115240	97080	88980	73360	60130	48940	39470	31510	24860	19340			
	40	104210	87850	80540	66010	53750	43380	34700	27410	21350	16370			
	45	98780	83300	76380	62400	50620	40720	32360	25420	19660	14950			
	50	93220	78650	72120	58740	47460	37990	30060	23460	18010	13570			
V 20 84 Y	30					73260	59240	47460	37610	29440	22720	17230	12790	9490
	40					65410	52520	41720	32760	25360	19320	14420	10500	7660
	45					61520	49200	38920	30400	23390	17680	13090	9420	6790
	50					57620	45900	36130	28070	21460	16090	11800	8390	
V 30 84 Y	30	139820	118150	108420	89050	72670	58810	47160	37420	29320	22640			
	40	127130	107340	98450	80380	65140	52320	41580	32660	25300	19270			
	45	120680	101870	93400	76010	61380	49090	38840	30340	23350	17650			
	50	114170	96320	88280	71620	57610	45890	36120	28060	21440	16080			
V 25 93 Y	30					78610	64670	52640	42310	33490	26020	19700	14410	10030
	40					69520	57020	46220	36950	29020	22300	16620	11870	7920
	45					65030	53260	43080	34330	26860	20510	15160	10670	6940
	50					62700	50980	40820	32110	24650	18310	12960	8480	

Avec refroidissement de la culasse
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Refroidissement par injection de liquide et par motoventilateur sur la culasse
Cooling with liquid injection and head fan motor
Enfriamiento con inyección de liquido y culata enfriada por aire
Resfriamento com injeção de liquido e cabeçote resfriado a ar

FCAT04-14

Puissances frigorifiques — Refrigerating capacity — Capacidades frigoríficas — Capacidades frigorificas

R22

Compresseur Compressor Compresor Compressor	Condensation Condensing Condensación Condensação	Puissances frigorifiques W / Refrigerating capacity W / Capacidad frigorífica W / Capacidade frigorifica W — Température d'évaporation °C / Evaporating temperature °C / Temperatura de evaporación °C / Temperatura de evaporação °C												
	°C	12.5	7.5	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
V 32 93 Y	30	155390	130100	118820	98570	81120	66070	53120	42000	32480	24400			
	40	139010	116320	106190	87960	72200	58610	46760	36600	27860	20440			
	45	130870	109500	99950	82730	67810	54880	43660	33960	25630	18520			
	50	123500	103150	94030	77540	63190	50770	39980	30620	22560	15670			
Z 25 106 Y	30					97330	77270	61560	48540	37810	29060	21950	16250	
	40					86680	69440	55040	43160	33360	25360	18940	13790	
	45					81970	65560	51890	40520	31180	23580	17470	12600	
	50						61610	48650	37860	29000	21820	16030		
Z 35 106 Y	30	178780	151040	138590	113340	92040	74120	59120	46640					
	40	163320	137880	126440	102950	83180	66610	52760	41290					
	45	155420	131150	120240	97680	78720	62830	49580	38640					
	50	147380	124310	113930	92330	74210	59030	46420	35990					
Z 30 126 Y	30					107690	89100	71760	57170	45050	34980	26710	19960	
	40					95590	79090	63520	50500	39580	30520	23060	17000	
	45					89720	74220	59500	47210	36900	28320	21290	15580	
	50					83800	69310	55540	43920	34220	26160	19540		
Z 40 126 Y	30	203920	171370	156970	129660	106570	87040	70500	56540					
	40	181860	153250	140500	115840	94920	77120	62150	49540					
	45	171360	144480	132480	109090	89230	72380	58100	46140					
	50	160700	135620	124400	102290	83520	67580	54060	42770					
W 40 142 Y	30	230260	192840	176030	146020	120360	98590	80260	64860					
	40	207020	173260	158140	131150	108100	88510	71930	57860					
	45	195320	163380	149090	123600	101830	83330	67600	54190					
	50	183740	153600	140120	116120	95640	78190	63310	50540					
Z 40 154 Y	30				153820	126790	103880	84440	67970	54160	42610	33010	25070	
	40				137650	113410	92810	75280	60380	47800	37340	28670	21490	
	45				129880	106930	87400	70760	56640	44690	34760	26530	19750	
	50				122030	100380	81950	6620	52900	41580	32200	24430		
Z 50 154 Y	30	242510	203720	186560	154330	127040	103910	84290	67720					
	40	216890	182700	167460	138430	113760	92780	74920	59880					
	45	210240	172450	158100	130630	107240	87310	70320	56050					
	50	192070	162040	148610	122710	100640	81800	65780	52210					
W 40 168 Y	30					143570	117830	96130	77940	62720	49970	39160	29750	
	40					129430	106040	86380	69890	56080	44410	34370	25400	
	45						100100	81430	65780	52660	41510	31820	23090	
	50							76460	61640	49190	38560	29220		
W 50 168 Y	30	278920	232980	212700	176620	145900	119700	97390	78440					
	40	247600	207140	189230	157270	129920	106520	86500	69460					
	45	232460	194630	177840	147840	122110	100090	81140	65030					
	50				138350	114250	93550	75780	60600					
W 50 187 Y	30				195920	161750	132550	107720	86680	69600	55150	43000	32820	
	40				173620	142800	116560	94220	75300	60190	47390	36610	27610	
	45				162770	133630	108800	87670	69820	55660	43640	33540	25100	
	50					124460	101110	81240	64420	51190	39970	30540		
W 60 187 Y	30	310600	261410	239510	197690	162220	132120	106640	85150					
	40	276180	232570	213170	175360	143290	116100	93110	73760					
	45	259210	218300	200050	164380	134080	108310	86530	68260					
	50	241920	203890	186890	153350	124820	100580	80050	62830					
W 60 206 Y	30				222600	185470	150660	121340	96740	76240	59270	45320	33960	
	40				197230	164360	132950	106420	84200	65750	50540	38150	28100	
	45				184810	154030	124300	99180	78140	60700	46380	34730	25330	
	50				172510	143660	115660	92020	72180	55750	42310	31420		
W 70 206 Y	30	342180	288380	264370	221240	184120	148720	119000	94200					
	40	304760	256880	235490	197040	163850	131520	104440	81890					
	45	286380	241460	221360	185170	153900	123080	97320	75910					
	50	267980	226030	207230	173300	143940	114680	90280	70030					
W 70 228 Y	30				238140	197720	162780	133010	106610	84370	65480	49510	36070	
	40				215350	178380	146290	118500	94500	73910	56390	41560	29060	
	45				203840	168540	137880	111280	88300	68530	51710	37460		
	50				192100	158440	129240	103900	81950	63060	46960			
W 75 228 Y	30	369740	311590	285560	238660	198080	163000	132720						
	40	335650	282740	259010	216160	178970	146680	118690						
	45	318280	268040	245460	204650	169150	138300	111500						
	50	300000	252710	231350	192780	159060	129700	104160						
W 75 240 Y	30				256600	213500	172440	137940	109160	87460	69120	53720	40860	
	40				228360	189900	152440	121060	94870	75590	59300	45640	34240	
	45				214310	178300	142630	112790	87940	69840	54550	41740		
	50				200390	166730	132850	104590	81120	64200	49910			
W 80 240 Y	30	396860	334520	306710	256680	213600	172520	138040						
	40	353440	297850	273050	228470	190010	152560	121160						
	45	331730	279880	256560	214440	178420	142750	100910						
	50	309590	261160	239510	200520	166870	132980	104720						

Avec refroidissement de la culasse
With head cooling
Con culata enfriada
Com resfriamento do cabeçote

Refroidissement par injection de liquide et par motoventilateur sur la culasse
Cooling with liquid injection and head fan motor
Enfriamiento con inyección de líquido y culata enfriada por aire
Resfriamento com injeção de líquido e cabeçote resfriado a ar

Puissances frigorifiques — Refrigerating capacity — Capacidades frigoríficas — Capacidades frigorificas

R134a

Compresseur Compressor Compresor Compressor	Condensation Condensing Condensación Condensação	Puissances frigorifiques W / Refrigerating capacity W / Capacidad frigorífica W / Capacidade frigorifica W							
		Température d'évaporation °C / Evaporating temperature °C / Temperatura de evaporación °C / Temperatura de evaporação °C							
	°C	12.5	7.5	5	0	-5	-10	-15	-20
A 0.5 4 Y	30	4080	3380	3070	2520	2040	1640	1300	1010
	40	3640	3010	2740	2230	1800	1430	1120	850
	45	3420	2830	2570	2090	1680	1330	1030	780
	50	3190	2640	2390	1940	1550	1220	940	700
A 0.5 5 Y	30	5140	4270	3880	3180	2580	2080	1640	1270
	40	4560	3790	3440	2820	2280	1810	1430	1090
	45	4280	3550	3230	2640	2120	1680	1310	1000
	50	4010	3310	3010	2450	1970	1550	1200	890
A 0.7 5 Y	**50**	**4010**	**3320**	**3010**	**2450**	**1970**	**1550**	**1200**	**890**
	60	**3430**	**2840**	**2570**	**2080**	**1660**	**1280**	**970**	**700**
	70	**2860**	**2350**	**2120**	**1700**	**1330**	**1020**	**740**	**500**
	80	**2270**	**1860**	**1670**	**1320**	**1020**	**760**	**530**	**320**
A 0.7 6 Y	30	5710	4700	4270	3520	2860	2290	1810	1420
	40	5030	4180	3790	3110	2520	2000	1570	1200
	45	4720	3910	3550	2900	2350	1860	1450	1090
	50	4390	3650	3310	2700	2170	1720	1320	980
A 1 6 Y	**50**	**4480**	**3710**	**3360**	**2740**	**2200**	**1730**	**1330**	**1000**
	60	**3850**	**3180**	**2870**	**2320**	**1850**	**1430**	**1080**	**780**
	70	**3200**	**2630**	**2380**	**1900**	**1490**	**1130**	**830**	**560**
	80	**2540**	**2080**	**1870**	**1480**	**1140**	**840**	**580**	**360**
A 1 7 Y	30	7370	6110	5560	4560	3710	2990	2360	1840
	40	6530	5420	4930	4030	3280	2600	2040	1560
	45	6120	5080	4620	3770	3050	2410	1880	1420
	50	5710	4740	4300	3500	2820	2220	1720	1280
A 1.5 7 Y	**50**	**5860**	**4840**	**4380**	**3560**	**2860**	**2260**	**1730**	**1280**
	60	**5030**	**4140**	**3740**	**3020**	**2400**	**1860**	**1400**	**1010**
	70	**4190**	**3430**	**3100**	**2470**	**1930**	**1460**	**1070**	**730**
	80	**3340**	**2710**	**2440**	**1920**	**1480**	**1080**	**760**	**470**
A 1.5 8 Y	30	8220	6830	6200	5090	4140	3320	2630	2030
	40	7320	6070	5510	4510	3650	2900	2270	1730
	45	6880	5690	5160	4210	3400	2690	2090	1570
	50	6420	5320	4810	3910	3140	2470	1900	1420
B 1.5 9 Y	30	9700	8040	7310	5990	4860	3900	3070	2380
	40	8600	7130	6480	5290	4270	3400	2640	2000
	45	8080	6680	6060	4930	3970	3130	2420	1810
	50	7540	6230	5640	4580	3670	2880	2200	1620
B 1.5 10 Y	30	10930	9070	8240	6770	5500	4420	3490	2700
	40	9710	8040	7310	5980	4840	3850	3010	2290
	45	9100	7540	6840	5580	4500	3560	2760	2080
	50	8480	7030	6370	5180	4160	3280	2520	1870
B 2 10 Y	**50**	**8300**	**6860**	**6220**	**5050**	**4040**	**3170**	**2410**	**1780**
	60	**7120**	**5860**	**5280**	**4260**	**3360**	**2590**	**1930**	**1360**
	70	**5900**	**4870**	**4340**	**3460**	**2690**	**2020**	**1440**	**950**
	80	**4670**	**3790**	**3400**	**2660**	**2020**	**1460**	**970**	**560**
D 2 11 Y	**50**	**9430**	**8590**	**7060**	**5700**	**4510**	**3490**	**2630**	**1910**
	60	**7880**	**7160**	**5860**	**4690**	**3670**	**2780**	**2020**	**1380**
	70	**6370**	**5770**	**4670**	**3680**	**2820**	**2050**	**1380**	**800**
	80	**4930**	**4440**	**3540**	**2720**	**1990**	**1340**		
C 2 12 Y	30	13300	11040	10030	8210	6640	5300	4180	3230
	40	11860	9820	8900	7250	5830	4620	3590	2720
	45	11120	9190	8330	6770	5420	4270	3300	2460
	50	10390	8570	7750	6280	5020	3920	3000	2200
C 3 12 Y	**50**	**9710**	**7980**	**7210**	**5830**	**4660**	**3660**	**2810**	**2100**
	60	**8290**	**6800**	**6140**	**4940**	**3920**	**3050**	**2300**	**1680**
	70	**6910**	**5650**	**5090**	**4080**	**3200**	**2460**	**1820**	**1280**
	80	**5530**	**4520**	**4060**	**3230**	**2510**	**1900**	**1360**	
D 2 13 Y	30	14600	13330	11030	9010	7270	5790	4550	3530
	40	12880	11740	9670	7880	6340	5000	3900	2990
	45	12000	10930	9000	7320	5870	4630	3590	2740
	50	11140	10140	8330	6760	5400	4260	3290	2480
D 3 13 Y	**50**	**11230**	**10180**	**8260**	**6610**	**5220**	**4040**	**3080**	**2300**
	60	**9470**	**8540**	**6880**	**5460**	**4270**	**3280**	**2460**	**1810**
	70	**7720**	**6920**	**5520**	**4340**	**3360**	**2540**	**1900**	**1370**
	80	**5990**	**5340**	**4200**	**3260**	**2500**	**1870**		
D 2 15 Y	30	16570	13780	12520	10280	8380	6710	5290	4070
	40	14700	12190	11080	9050	7310	5810	4510	3400
	45	13760	11400	10340	8420	6780	5350	4120	3060
	50	12830	10610	9610	7800	6240	4880	3720	2710
D 3 15 Y	**50**	**12860**	**10600**	**9590**	**7750**	**6170**	**4810**	**3640**	**2640**
	60	**10970**	**9000**	**8100**	**6490**	**5090**	**3890**	**2840**	**1960**
	70	**9060**	**7370**	**6610**	**5220**	**4020**	**2960**	**2060**	**1300**
	80	**7120**	**5750**	**5110**	**3960**	**2960**	**2090**	**1320**	**670**
D 3 16 Y	30	17420	14420	13090	10700	8680	6920	5450	4180
	40	15410	12740	11560	9410	7570	5990	4630	3480
	45	14420	11900	10780	8760	7020	5510	4220	3130
	50	13430	11080	10010	8100	6460	5030	3820	2770

* puissances frigorifiques à -25°C et -30°C disponibles sur demande
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valores de capadidades frigoríficas a -25°C y -30°C están disponible a pedido
valores de capacidades frigoríficas a -25°C e -30°C disponível sob pedido

Avec refroidissement de la culasse
With head cooling
Con culata enfriada
Com resfriamento do cabeçote

Puissances frigorifiques — Refrigerating capacity — Capacidades frigoríficas — Capacidades frigoríficas

R134a

Compresseur Compressor Compresor Compressor	Condensation Condensing Condensación Condensação	Puissances frigorifiques W / Refrigerating capacity W / Capacidad frigorífica W / Capacidade frigorifica W							
		Température d'évaporation °C / Evaporating temperature °C / Temperatura de evaporación °C / Temperatura de evaporação °C							
	°C	12.5	7.5	5	0	-5	-10	-15	-20
D 4 16 Y	50	13670	12460	10270	8360	6730	5340	4160	3170
	60	11650	10610	8710	7080	5680	4490	3470	2600
	70	9670	8800	7200	5830	4670	3670	2820	2090
	80	7740	7020	5740	4630	3680	2890		
F 4 16 Y	50	13850	11350	10240	8230	6500	5040	3780	2720
	60	11760	9590	8620	6860	5360	4070	2980	2050
	70	9680	7850	7020	5540	4260	3160	2220	1430
	80	7630	6140	5470	4260	3200	2300	1520	
D 3 18 Y	30	19670	17980	14900	12230	9920	7970	6320	4980
	40	17400	15890	13150	10780	8720	6980	5520	4310
	45	16260	14840	12280	10040	8120	6490	5110	3970
	50	15110	13780	11390	9300	7510	5990	4700	3640
D 4 18 Y	50	16100	13270	12000	9710	7740	6040	4580	3350
	60	13730	11260	10150	8150	6410	4910	3620	2520
	70	11340	9240	8290	6580	5080	3780	2660	1700
	80	8920	7210	6430	5020	3780	2690	1750	950
D 3 19 Y	30	PAS DISPONIBLE		NOT AVAILABLE		NO DISPONIBLE		NAO DISPONÍVEL	
	40								
	45								
	50								
D 4 19 Y	50	PAS DISPONIBLE		NOT AVAILABLE		NO DISPONIBLE		NAO DISPONÍVEL	
	60								
	70								
	80								
F 4 19 Y	50	16520	13580	12260	9910	7880	6170	4700	3470
	60	14180	11600	10450	8380	6600	5080	3790	2700
	70	11810	9610	8630	6850	5330	4010	2900	1960
	80	9400	7610	6790	5330	4070	2980	2050	
Q 4 19 Y	50	17060	14150	12840	10490	8460	6720	5240	3980
	60	14740	12180	11030	8950	7180	5650	4360	3230
	70	12380	10160	9180	7400	5890	4580	3460	2470
	80		8140	7320	5840	4580	3500		
F 5 19 Y	50	16270	14780	12110	9790	7820	6160	4750	3610
	60	13840	12540	10210	8210	6500	5080	3880	2890
	70	11400	10300	8320	6640	5220	4030	3050	2230
	80	8980	8060	6460	5110	3980	3050		
Q 5 19 Y	50	15550	12580	11240	8880	6890	5260	3910	2830
	60	12900	10360	9230	7220	5540	4160	3050	2160
	70	10360	8260	7320	5660	4280	3170	2280	1600
	80	7910	6250	5520	4220	3160	2290		
Q 4 21 Y	30	23340	21200	17330	13970	11090	8650	6650	5030
	40	20580	18650	15170	12140	9580	7400	5620	4160
	45	19150	17340	14050	11220	8800	6770	5090	3730
	50	17710	16010	12920	10270	8020	6130	4570	3310
Q 5 21 Y	50	17900	16160	13030	10330	8040	6120	4520	3240
	60	15160	13630	10870	8520	6530	4870	3520	2420
	70	12400	11080	8730	6730	5060	3700	2590	1700
	80	9650	8560	6610	5000	3670	2600		
F 4 24 Y	30	25690	21300	19360	15910	12960	10440	8300	6480
	40	22860	18970	17230	14140	11460	9180	7240	5580
	45	21460	17800	16160	13240	10700	8540	6700	5120
	50	20060	16620	15080	12320	9950	7900	6160	4660
Q 4 24 Y	30	26090	23750	19510	15820	12640	9950	7690	5860
	40	22880	18860	17040	13780	10960	8560	6560	4910
	45	21290	17520	15820	12760	10120	7880	6000	4450
	50	19700	16190	14600	11750	9300	7210	5450	4000
F 5 24 Y	50	19880	16430	14870	12110	9720	7670	5940	4450
	60	17060	14080	12720	10300	8180	6380	4840	3530
	70	14220	11680	10520	8460	6650	5090	3760	2620
	80	11300	9240	8300	6600	5110	3820	2690	1740
Q 5 24 Y	50	20160	16460	14800	11810	9260	7100	5290	3800
	60	17030	13800	12360	9770	7570	5700	4140	2840
	70	13860	11120	9900	7730	5880	4330	3040	1940
	80	10680	8470	7460	5720	4250	3020		
Q 4 25 Y	30	27160	22500	20450	16740	13570	10850	8540	6580
	40	24100	19940	18080	14750	11880	9410	7310	5510
	45	22570	18660	16910	13750	11020	8680	6670	4960
	50	21060	17360	15710	12730	10150	7930	6040	4420
Q 5 25 Y	30	27650	22940	20840	17120	13960	11240	8950	7010
	40	24610	20420	18550	15220	12360	9910	7820	6060
	45	23080	19140	17390	14240	11540	9230	7260	5570
	50	21560	17880	16220	13270	10730	8560	6680	5090
Q 7 25 Y	50	21560	17880	16220	13270	10730	8560	6680	5090
	60	18520	15320	13900	11330	9100	7180	5520	4120
	70	15430	12760	11540	9350	7440	5800	4370	3140
	80	12310	10150	9160	7370	5800	4430	3240	2220

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valores de capacidades frigoríficas a -25°C e -30°C disponível sob pedido

Avec refroidissement de la culasse
With head cooling
Con culata enfriada
Com resfriamento do cabeçote

Puissances frigorifiques — Refrigerating capacity — Capacidades frigoríficas — Capacidades frigorificas

R134a

Compresseur Compressor Compresor Compressor	Condensation Condensing Condensación Condensação	Puissances frigorifiques W / Refrigerating capacity W / Capacidad frigorífica W / Capacidade frigorifica W							
		Température d'évaporation °C / Evaporating temperature °C / Temperatura de evaporación °C / Temperatura de evaporação °C							
	°C	12.5	7.5	5	0	-5	-10	-15	-20
Q 5 28 Y	30	30240	27540	22660	18420	14800	11720	9170	7090
	40	26800	24370	20000	16210	12970	10220	7940	6060
	45	25040	22760	18650	15100	12050	9470	7320	5540
	50	23280	21140	17290	13970	11120	8710	6710	5040
Q 7 28 Y	**50**	**23500**	**21290**	**17330**	**13920**	**11020**	**8580**	**6540**	**4860**
	60	**19970**	**18040**	**14590**	**11650**	**9160**	**7060**	**5290**	**3840**
	70	**16420**	**14770**	**11860**	**9380**	**7300**	**5560**	**4090**	**2870**
	80	**12850**	**11510**	**9130**	**7140**	**5480**	**4090**		
Q 5 33 Y	30	34540	31500	26030	21290	17210	13730	10760	8240
	40	30370	27680	22860	18700	15120	12050	9420	7160
	45	28330	25820	21320	17440	14100	11230	8770	6640
	50	26330	24000	19810	16200	13090	10430	8120	6110
S 5 33 Y	30	36650	30460	27720	22820	18650	15060	12010	9420
	40	32660	27160	24710	20320	16520	13280	10510	8150
	45	30680	25510	23200	19030	15460	12380	9760	7510
	50	28700	23840	21670	17760	14380	11470	8990	6850
Q 7 33 Y	**50**	**27350**	**24890**	**20450**	**16580**	**13250**	**10400**	**7990**	**5980**
	60	**23300**	**21180**	**17340**	**14020**	**11160**	**8710**	**6640**	**4870**
	70	**19220**	**17440**	**14230**	**11470**	**9100**	**7080**	**5350**	**3880**
	80	**15120**	**13690**	**11140**	**8960**	**7100**	**5530**		
S 7 33 Y	**50**	**28620**	**23680**	**21470**	**17500**	**14090**	**11170**	**8680**	**6550**
	60	**24600**	**20320**	**18380**	**14920**	**11920**	**9340**	**7130**	**5240**
	70	**20530**	**16910**	**15260**	**12300**	**9720**	**7500**	**5580**	**3950**
	80	**16400**	**13440**	**12110**	**9660**	**7520**	**5680**	**4070**	**2700**
S 7 39 Y	30	43160	35840	32590	26810	21850	17640	14050	11000
	40	38500	31980	29080	23870	19400	15580	12310	9540
	45	36160	30040	27300	22390	18160	14530	11440	8800
	50	33800	28080	25510	20890	16880	13480	10540	8040
S 10 39 Y	**50**	**33480**	**27730**	**25190**	**20590**	**16640**	**13250**	**10370**	**7910**
	60	**28880**	**23900**	**21660**	**17620**	**14160**	**11050**	**8600**	**6430**
	70	**24200**	**19980**	**18070**	**14630**	**11650**	**9060**	**6850**	**4960**
	80	**19420**	**15970**	**14410**	**11580**	**9110**	**6970**	**5120**	**3530**
S 10 51 Y	30	55210	45820	41640	34250	27890	22460	17860	13930
	40	49160	40800	37080	30400	24660	19750	15560	11990
	45	46130	38280	34760	28460	23030	18370	14390	10990
	50	47450	35740	32440	26510	21380	16970	13210	10000
S 15 51 Y	**50**	**43130**	**35700**	**32380**	**26400**	**21260**	**16850**	**13080**	**9860**
	60	**37020**	**30550**	**27640**	**22440**	**17940**	**14050**	**10730**	**7870**
	70	**30860**	**25380**	**22910**	**18440**	**14600**	**11260**	**8380**	**5900**
	80	**24640**	**20150**	**18130**	**14460**	**11280**	**8500**	**6100**	**4010**
S 15 56 Y	30	62240	51680	47000	38680	31550	25450	20260	15830
	40	55310	45960	41770	34310	27900	22390	17680	13630
	45	51920	43130	39190	32120	26060	20840	16360	12530
	50	48540	40280	36590	29930	24200	19270	15040	11400
S 20 56 Y	**50**	**49480**	**40960**	**37140**	**30300**	**24410**	**19360**	**15060**	**11390**
	60	**42620**	**35210**	**31870**	**25860**	**20680**	**16210**	**12400**	**9140**
	70	**35630**	**29350**	**26530**	**21370**	**16910**	**13040**	**9740**	**6910**
	80	**28480**	**23380**	**21050**	**16820**	**13120**	**9900**	**7140**	**4760**
V 15 59 Y	30	66190	54960	49980	41100	33500	26990	21440	16730
	40	58800	48830	44380	36420	29590	23700	18670	14360
	45	55190	45800	41600	34090	27610	22040	17260	13160
	50	51560	42770	38820	31730	25620	20350	15830	11950
V 20 59 Y	**50**	**52970**	**43720**	**39580**	**32140**	**25730**	**20230**	**15540**	**11540**
	60	**45440**	**37380**	**33760**	**27220**	**21560**	**16690**	**12530**	**8980**
	70	**37790**	**30940**	**27840**	**22240**	**17360**	**13150**	**9550**	**6460**
	80	**29990**	**24420**	**21860**	**17240**	**13200**	**9680**	**6660**	**4070**
V 15 71 Y	30	78020	64790	58920	48470	39590	31980	25480	19920
	40	69360	57590	52370	43010	34970	28100	22210	17160
	45	65100	54070	49100	40270	32660	26140	20560	15760
	50	60780	50510	45880	37510	30340	24170	18890	14340
V 25 71 Y	**50**	**60080**	**49640**	**44980**	**36590**	**29380**	**23200**	**17940**	**13450**
	60	**51710**	**42600**	**38510**	**31130**	**24760**	**19280**	**14620**	**10630**
	70	**43160**	**35410**	**31910**	**25580**	**20100**	**14500**	**11320**	**7860**
	80	**34430**	**28090**	**25210**	**20000**	**15440**	**11500**	**8110**	**5210**
V 20 84 Y	30	90610	75290	68480	56340	45940	37040	29480	23050
	40	80630	67070	61000	50100	40720	32650	25780	19900
	45	75670	62940	57230	46990	38080	30420	23880	18300
	50	70800	58800	53440	43780	35400	28160	21970	16680
V 30 84 Y	**50**	**71440**	**59110**	**53590**	**43690**	**35170**	**27860**	**21640**	**16330**
	60	**61580**	**50820**	**45980**	**37280**	**29760**	**23290**	**17770**	**13070**
	70	**51500**	**42370**	**38240**	**30770**	**24300**	**18710**	**13920**	**9830**
	80	**41150**	**33770**	**30350**	**24190**	**18820**	**14160**	**10150**	**6720**
V 25 93 Y	30	100480	83410	75820	62360	50830	40970	32590	25490
	40	89570	74410	67640	55510	45080	36130	28500	22000
	45	84120	69910	63520	52040	42140	33660	26410	20230
	50	78730	65340	59360	48550	39240	31180	24300	18430

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Avec refroidissement de la culasse
With head cooling
Con culata enfriada
Com resfriamento do cabeçote

FCAT04-14

Puissances frigorifiques — Refrigerating capacity — Capacidades frigoríficas — Capacidades frigorificas

R134a

Compresseur Compressor Compresor Compressor	Condensation Condensing Condensación Condensação	Puissances frigorifiques W / Refrigerating capacity W / Capacidad frigorífica W / Capacidade frigorifica W							
		Température d'évaporation °C / Evaporating temperature °C / Temperatura de evaporación °C / Temperatura de evaporação °C							
	°C	12.5	7.5	5	0	-5	-10	-15	-20
V 32 93 Y	**50**	**79840**	**66230**	**60120**	**49120**	**39650**	**31500**	**24550**	**18620**
	60	**68810**	**57000**	**51660**	**42010**	**33650**	**26440**	**20280**	**15010**
	70	**57560**	**47580**	**43040**	**34780**	**27580**	**21350**	**16000**	**11420**
	80	**46130**	**37940**	**34240**	**27420**	**21470**	**16270**	**11800**	**7960**
Z 25 106 Y	30	116080	96370	87620	72010	58680	47270	37570	29330
	40	103360	85870	78040	64010	52000	41600	32770	25250
	45	97060	80560	73210	59960	48540	38720	30340	23170
	50	90650	75290	68320	55880	45100	35820	27860	21080
Z 35 106 Y	**50**	**91440**	**75500**	**68380**	**55610**	**44640**	**35280**	**27310**	**20570**
	60	**79130**	**65090**	**58820**	**47530**	**37840**	**29520**	**22450**	**16450**
	70	**66440**	**54430**	**49030**	**39310**	**30920**	**23720**	**17590**	**12370**
	80	**53300**	**43440**	**38990**	**30940**	**23960**	**17950**	**12820**	**8450**
Z 30 126 Y	30	138940	115340	104870	86180	70210	56560	44950	35100
	40	123620	102730	93400	76620	62160	49780	39220	30220
	45	115930	96350	87580	71810	58090	46330	36290	27730
	50	108370	89930	81710	66860	53980	42850	33350	25220
Z 40 126 Y	**50**	**107100**	**88560**	**80260**	**65350**	**52510**	**41480**	**32050**	**23980**
	60	**91960**	**75710**	**68450**	**55380**	**44080**	**34340**	**25980**	**18820**
	70	**76480**	**62800**	**56590**	**45340**	**35620**	**27200**	**19960**	**13730**
	80	**60740**	**49630**	**44560**	**35280**	**27220**	**20200**	**14140**	**8900**
W 40 142 Y	**50**	**120060**	**99290**	**89950**	**73260**	**58940**	**46660**	**36170**	**27170**
	60	**103300**	**85080**	**76930**	**62340**	**49800**	**39020**	**29720**	**21610**
	70	**86330**	**70700**	**63730**	**51290**	**40580**	**31340**	**23270**	**16080**
	80	**69170**	**56180**	**50420**	**40150**	**31320**	**23650**	**16840**	**10610**
Z 40 154 Y	30	167440	138830	125900	102640	82620	65560	51220	39320
	40	147460	121810	110270	89540	71770	56690	44030	33530
	45	137380	113230	102370	82940	66310	52220	40420	30640
	50	127260	104620	94460	76320	60840	47760	36830	27770
Z 50 154 Y	**50**	**130060**	**107220**	**96910**	**78360**	**62390**	**48780**	**37320**	**27780**
	60	**109940**	**90110**	**81190**	**65220**	**51560**	**39980**	**30290**	**22250**
	70	**89980**	**73200**	**65710**	**52390**	**41100**	**31630**	**23760**	
	80	**70370**	**56710**	**50680**	**40070**	**31220**	**23920**		
W 40 168 Y	30	185020	153890	139910	114840	93350	75070	59630	46670
	40	165280	137200	124580	102000	82630	66110	52070	40140
	45	155330	128760	116830	95510	77210	61570	48240	36830
	50	145310	120260	109040	88970	71750	57000	44380	33500
W 50 168 Y	**50**	**141080**	**116720**	**105710**	**85860**	**68710**	**54010**	**41510**	**30960**
	60	**119820**	**98460**	**88820**	**71520**	**56620**	**43850**	**32990**	**23780**
	70	**98710**	**80340**	**72100**	**57340**	**44680**	**33860**	**24650**	
	80	**77870**	**62500**	**55640**	**43440**	**33020**	**24170**		
W 50 187 Y	30	205420	170530	155040	127380	103730	83520	66350	51780
	40	183340	152170	138250	113320	91880	73520	57890	44580
	45	172240	142780	129780	106190	85880	68450	53580	40920
	50	161080	133560	121160	98990	79810	63320	49240	37220
W 60 187 Y	**50**	**155040**	**128410**	**116380**	**94640**	**75860**	**59750**	**46030**	**34460**
	60	**132320**	**108850**	**98270**	**79240**	**62830**	**48780**	**36820**	**26690**
	70	**109540**	**89260**	**80150**	**63840**	**49840**	**37870**	**27700**	
	80	**86860**	**69790**	**62170**	**48600**	**37030**	**27190**		
W 60 206 Y	30	228910	190300	172820	141360	114230	91070	71520	55250
	40	204140	168940	153070	124560	100070	79250	61740	47200
	45	191650	158180	143120	116110	92960	73340	56870	43210
	50	179110	147400	133140	107650	85870	67450	52030	39280
W 70 206 Y	**50**	**177300**	**145850**	**131690**	**106250**	**84430**	**65920**	**50390**	**37540**
	60	**150170**	**123010**	**110830**	**89050**	**70490**	**54820**	**41710**	**30880**
	70	**123460**	**100610**	**90430**	**72370**	**57080**	**44280**	**33640**	
	80	**97300**	**78820**	**70670**	**56330**	**44380**	**34490**		
W 70 228 Y	30	250150	207380	188040	153220	123220	97630	76090	58210
	40	222770	183830	166280	134770	107750	84800	65560	49620
	45	209110	172100	155460	125630	100120	78500	60420	45470
	50	195480	160430	144680	116560	92560	72300	55390	41450
W 75 228 Y	**50**	**191810**	**157130**	**141530**	**113590**	**89720**	**69590**	**52810**	**39070**
	60	**162700**	**132430**	**118900**	**94780**	**74330**	**57200**	**43040**	**31510**
	70	**134510**	**108670**	**97200**	**76910**	**59890**	**45780**	**34250**	
	80	**107380**	**85980**	**76560**	**60110**	**46510**	**35440**		
W 75 240 Y	30	267880	222840	202440	165620	133750	106430	83240	63780
	40	234830	194590	176410	143690	115460	91320	70850	53630
	45	218810	180940	163860	133160	106730	84140	64990	48880
	50	203120	167620	151620	122930	98270	77230	59400	44360
W 80 240 Y	**50**	**203650**	**168280**	**152400**	**123970**	**99580**	**78710**	**60880**	**45610**
	60	**175320**	**144260**	**130360**	**105470**	**84110**	**65760**	**49960**	**36190**
	70	**146520**	**119840**	**107940**	**86700**	**68450**	**52700**	**39000**	
	80	**117290**	**95090**	**85240**	**67690**	**52640**	**39590**		

* puissances frigorifiques à -25°C et -30°C disponibles sur demande
refrigerating capacities at -25°C and -30°C available upon request
valores de capacidades frigoríficas a -25°C y -30°C están disponible a pedido
valores de capacidades frigoríficas a -25°C e -30°C disponível sob pedido

Avec refroidissement de la culasse
With head cooling
Con culata enfriada
Com resfriamento do cabeçote

Données électriques — Electrical data — Datos eléctricos — Dados elétricos

Compresseur / Compressor / Compresor / Compressor				208-230/3/60 Δ MRA ①	208-230/3/60 Δ LRA ①	380-420/3/60 Y MRA ①	380-420/3/60 Y LRA ①	380-420/3/60 PWS DOL MRA ①	380-420/3/60 PWS DOL LRA ①	380-420/3/60 PWS PWS MRA ①	380-420/3/60 PWS PWS LRA ①	208-230/3/60 PWS MRA ①	208-230/3/60 PWS LRA ①	460/3/60 DOL MRA ①	460/3/60 DOL LRA ①
				Démarrage direct / Direct on line / Arranque directo / Partida direta				Démarrage bobinage fractionné / Part winding starting / Arranque en Part Winding / Partida Part Winding				Double tension (9 cables) / Dual voltage (9 cables) / Voltaje doble (9 cables) / Dupla voltagem (9 cabinhos)			
A	0.5	4	Y	5.7	24.0	3.3	13.9								
A	0.5	5	Y	5.7	24.0	3.3	13.9								
A	0.7	5	Y	5.7	24.0	3.3	13.9								
A	0.7	6	Y	5.7	24.0	3.3	13.9								
A	1	6	Y	7.2	30.1	4.2	17.4								
A	1	7	Y	7.2	30.1	4.2	17.4								
A	1.5	7	Y	11.1	40.9	6.3	23.6								
A	1.5	8	Y	11.1	40.9	6.3	23.6								
B	1.5	9	Y	11.1	40.9	6.3	23.6								
B	1.5	10	Y	11.1	40.9	6.3	23.6								
B	2	10	Y	11.8	45.1	6.8	26.0								
D	2	11	Y	14.1	51.7	8.1	29.9								
C	2	12	Y	13.6	51.7	7.8	29.9								
C	3	12	Y	14.9	68.4	8.6	39.5								
D	2	13	Y	14.1	51.7	8.1	29.9								
D	3	13	Y	19.9	68.4	11.5	39.5								
D	2	15	Y	14.1	51.7	8.1	29.9								
D	3	15	Y	19.9	68.4	11.5	39.5								
D	3	16	Y	19.9	68.4	11.5	39.5								
D	4	16	Y	21.8	87.1	12.6	50.3								
F	4	16	Y	22.7	102.0	13.1	59.4								
D	3	18	Y	19.9	68.4	11.5	39.5								
D	4	18	Y	21.8	87.1	12.6	50.3								
D	3	19	Y	PAS DISPONIBLE				NOT AVAILABLE				NO DISPONIBLE		NAO DISPONÍVEL	
D	4	19	Y	PAS DISPONIBLE				NOT AVAILABLE				NO DISPONIBLE		NAO DISPONÍVEL	
F	4	19	Y	22.7	102.0	13.1	59.4								
Q	4	19	Y	22.7	102.0	13.1	59.4								
F	5	19	Y	25.4	118.0	14.6	68.3								
Q	5	19	Y	25.4	118.0	14.6	68.3								
Q	4	21	Y	22.7	102.0	13.1	59.4								
Q	5	21	Y	25.4	118.0	14.6	68.3								
F	4	24	Y	22.7	102.0	13.1	59.4								
Q	4	24	Y	22.7	102.0	13.1	59.4								
F	5	24	Y	25.4	118.0	14.6	68.3								
Q	5	24	Y	25.4	118.0	14.6	68.3								
Q	4	25	Y	22.7	102.0	13.1	59.4								
Q	5	25	Y	25.4	118.0	14.6	68.3								
Q	7	25	Y	36.0	189.0	21.0	109.0								
Q	5	28	Y	25.4	118.0	14.6	68.3								
Q	7	28	Y	36.0	189.0	21.0	109.0								
Q	5	33	Y	25.4	118.0	14.6	68.3								
S	5	33	Y					19.0	69.4	19.0	42.6				
Q	7	33	Y	36.0	189.0	21.0	109.0								
S	7	33	Y					24.4	90.0	24.4	56.4				
S	7	39	Y					24.4	90.0	24.4	56.4				
S	10	39	Y					28.5	105.0	28.5	64.7				
S	10	51	Y					28.5	105.0	28.5	64.7				
S	15	51	Y					37.6	143.0	37.6	72.5				
S	15	56	Y					37.6	143.0	37.6	72.5				
S	20	56	Y					42.3	217.0	42.3	128.0				
V	15	59	Y					37.6	143.0	37.6	72.5	*62.0*	*154.0*	*31.0*	*119.0*
V	20	59	Y					42.3	217.0	42.3	128.0	*76.9*	*198.0*	*38.4*	*152.0*
V	15	71	Y					37.6	143.0	37.6	72.5	*62.0*	*154.0*	*31.0*	*119.0*
V	25	71	Y					52.2	243.0	52.2	142.0	*93.5*	*232.0*	*46.7*	*178.0*
V	20	84	Y					42.3	217.0	42.3	128.0	*76.9*	*198.0*	*38.4*	*152.0*
V	30	84	Y					59.8	295.0	59.8	173.0	*110.0*	*250.0*	*55.0*	*192.0*
V	25	93	Y					62.7	243.0	62.7	142.0	*93.5*	*232.0*	*54.9*	*178.0*
V	32	93	Y					63.8	287.0	63.8	173.0	*111.0*	*304.0*	*52.7*	*253.0*
Z	25	106	Y					52.2	243.0	52.2	142.0	*93.5*	*232.0*	*46.7*	*178.0*
Z	35	106	Y					63.8	287.0	63.8	173.0	*126.0*	*304.0*	*63.1*	*253.0*
Z	30	126	Y					59.8	295.0	59.8	173.0	*110.0*	*250.0*	*55.0*	*192.0*
Z	40	126	Y					81.0	319.0	81.0	188.0	*155.0*	*355.0*	*77.9*	*273.0*
W	40	142	Y					107.0	358.0	107.0	258.0	*178.0*	*406.0*	*89.2*	*313.0*
Z	40	154	Y					107.0	358.0	107.0	258.0	*155.0*	*355.0*	*77.9*	*273.0*
Z	50	154	Y					108.0	440.0	108.0	310.0	*190.0*	*438.0*	*109.0*	*337.0*
W	40	168	Y					107.1	358.0	107.1	258.0	*178.0*	*406.0*	*89.2*	*313.0*
W	50	168	Y					114.0	440.0	114.0	310.0	*190.0*	*438.0*	*109.0*	*337.0*
W	50	187	Y					114.0	440.0	114.0	310.0	*190.0*	*438.0*	*109.0*	*337.0*
W	60	187	Y					124.0	581.0	124.0	416.0	*207.0*	*606.0*	*119.0*	*466.0*
W	60	206	Y	xx.x = standard				119.0	581.0	119.0	416.0	*198.0*	*606.0*	*114.0*	*466.0*
W	70	206	Y	*xx.x* = optional				140.0	658.0	140.0	468.0	*233.0*	*730.0*	*134.0*	*561.0*
W	70	228	Y					131.0	658.0	131.0	468.0	*219.0*	*730.0*	*126.0*	*561.0*
W	75	228	Y					154.0	723.0	154.0	516.0	*257.0*	*778.0*	*148.0*	*561.0*
W	75	240	Y					138.0	723.0	138.0	516.0	*230.0*	*778.0*	*133.0*	*561.0*
W	80	240	Y					163.0	723.0	163.0	516.0	*271.0*	*778.0*	*156.0*	*561.0*

moteur électrique standard
moteur électrique sur demand

① MRA Intensité maximum de fonctionnement A
LRA Courant rotor bloqué A
Données provisoires

standard electric motor
electric motor on request

① MRA Maximum operating current A
LRA Locked rotor current A
Tentative data

motor eléctrico estandard
motor eléctrico a pedido

① MRA máxima corriente de funcionamiento A
LRA Locked rotor current A
Datos provisionales

motor elétrico standard
motor elétrico sob pedido

① MRA máxima corrente de funcionamento A
LRA corriente de rotor bloqueado A
Dados provisionais

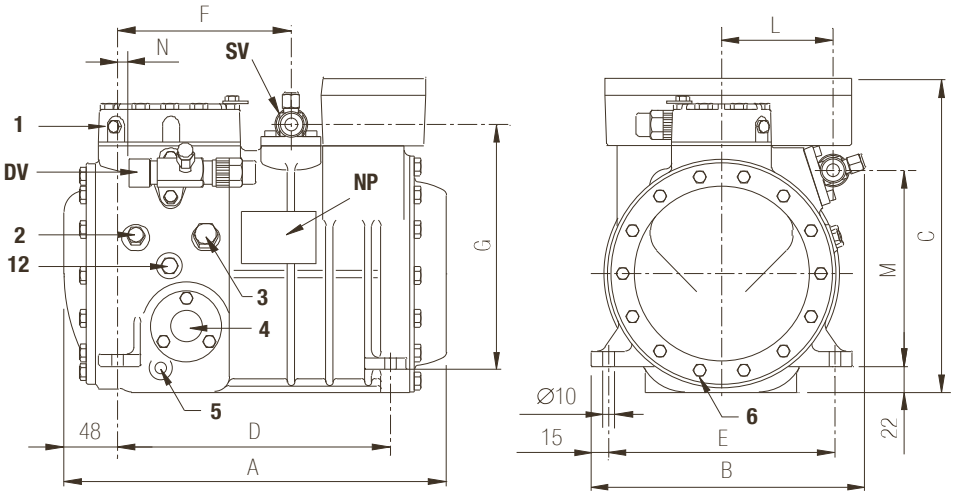
Puissance absorbée — Power input — Potencias absorbidas — Potências absorvidas

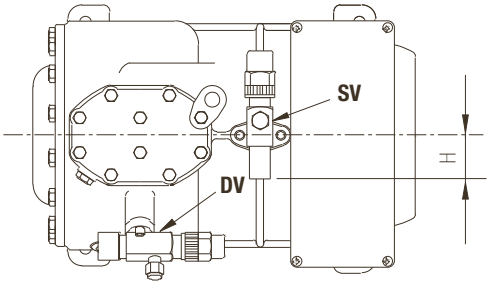
Compresseur Compressor Compresor Compressor				R404a - R507 puissance absorbée W * power input W * potencia absorbida W * potência absorvida W *					R407c puissance absorbée W * power input W * potencia absorbida W * potência absorvida W *				R22 puissance absorbée W * power input W * potencia absorbida W * potência absorvida W *					R134a puissance absorbée W * power input W * potencia absorbida W * potência absorvida W *			
				te °C					te °C				te °C					te °C			
				+5	-10	-20	-30	-40	+7.5	0	-10	-20	+5	-10	-20	-30	-40	+12.5	+5	0	-10
A	0.5	4	Y	1440	1130	890	670	470	1220	1120	940	770	1000	860	730	580	410	820	730	680	560
A	0.5	5	Y		1380	1080	800	560						1100	910	710	490	1030	910	830	670
A	0.7	5	Y	1740	1380	1080	800	560	1550	1400	1160	940	1250	1190	910	710	500	**1220**	**1030**	**910**	**710**
A	0.7	6	Y		1540	1200	890	610						1220	1010	770	540	1150	1020	920	740
A	1	6	Y	1880	1490	1190	900	640	1600	1510	1270	1030	1360	1190	1010	790	560	**1330**	**1130**	**1010**	**790**
A	1	7	Y		1940	1520	1130	770						1580	1340	1040	760	1500	1330	1210	970
A	1.5	7	Y	2200	1790	1450	1130	800	2050	1870	1570	1300	1720	1520	1340	970		**1680**	**1440**	**1300**	**1010**
A	1.5	8	Y	2680	2120	1670	1250	840	2270	2060	1730	1400	2080	1820	1520	1180	830	1730	1510	1370	1090
B	1.5	9	Y	3040	2480	2050	1640	1280					2470	2180	1820	1400	1010	2030	1760	1580	1260
B	1.5	10	Y		2770	2320	1790	1280						2510	2110	1660	1070	2240	1970	1780	1390
B	2	10	Y	3310	2840	2390	1910	1490	2950	2700	2270	1820	2650	2470	2090	1550		**2570**	**2170**	**1910**	**1420**
D	2	11	Y	3610	3100	2590	2060	1570	3540	3220	2690	2140	3120	2800	2300	1700		**2940**	**2650**	**2420**	**1940**
C	2	12	Y	3720	3400	3000	2520	1910						3000	2560	1970	1310	2630	2350	2150	1720
C	3	12	Y	4440	3780	3140	2500		3700	3380	2840	2300	3260	3080	2690	2120		**3840**	**3350**	**3020**	**2410**
D	2	13	Y		3700	3120	2470	1850					3590	3410	2920	2230	1480	2600	2510	2390	2060
D	3	13	Y	4210	3600	3010	2380		3980	3550	2950	2390	3580	3250	2750	2090		**3550**	**3160**	**2860**	**2270**
D	2	15	Y		4340	3680	2930	2120						3730	3170	2410	1600	3460	2940	2620	2000
D	3	15	Y	5210	4570	3840	3050		4380	4030	3420	2800	3950	3660	3120	2440		**3710**	**3130**	**2780**	**2160**
D	3	16	Y		4810	3920	3010	2090					4400	4120	3500	2740	1880	3470	3140	2890	2330
D	4	16	Y	5600	4790	4000	3110		4910	4500	3830	3100	4370	4100	3540	2780		**4820**	**4360**	**4010**	**3280**
F	4	16	Y	5390	4540	3700	2840		4620	4280	3670	3000	4210	3790	3170	2400		**4400**	**3980**	**3650**	**2840**
D	3	18	Y		5420	4500	3530	2620						4460	3800	2950	2020	3920	3670	3470	2980
D	4	18	Y	6190	5220	4400	3600		4960	4670	4090	3460	4690	4310	3770	2990		**4510**	**3960**	**3580**	**2800**
D	3	19	Y	**PAS DISPONIBLE**					**NOT AVAILABLE**				**NO DISPONIBLE**					**NAO DISPONÍVEL**			
D	4	19	Y	**PAS DISPONIBLE**					**NOT AVAILABLE**				**NO DISPONIBLE**					**NAO DISPONÍVEL**			
F	4	19	Y		5210	4320	3360	2410	5160	4850	4210	3500	5220	4760	4000	3000	1980	**5350**	**4740**	**4300**	**3420**
Q	4	19	Y		4690	3800	2840	1900						4660	3780	2830	1810	**5080**	**4600**	**4210**	**3400**
F	5	19	Y	6290	5230	4310	3320		5150	4990	4310	3500	5110	4640	3890	2930		**5220**	**4600**	**4160**	**3320**
Q	5	19	Y	5450	4630	3780	2800		4730	4460	3840	3000	4900	4560	3850	2820		**4450**	**3920**	**3550**	**2770**
Q	4	21	Y		5360	4370	3310	2350						5180	4400	3340	2140	3900	3680	3440	2860
Q	5	21	Y	6110	5350	4400	3190		5620	5030	4310	3400	5470	4930	4080	3080	2020	**5110**	**4490**	**4030**	**3100**
F	4	24	Y		6740	5450	4140	2920						5870	4820	3880	2700	5030	4690	4370	3610
Q	4	24	Y		6190	5050	3880	2740						5830	4700	3490	2200	4420	4210	3970	3350
F	5	24	Y	7450	6120	4990	3800	2650	6360	6060	5350	4480	6180	5580	4610	3410		**5780**	**5180**	**4740**	**3790**
Q	5	24	Y	7330	6170	5090	3910		6120	5830	4990	3970	6200	5500	4520	3680		**5890**	**5160**	**4640**	**3600**
Q	4	25	Y		6260	5020	3720	2500					6410	6070	5170	3940	2590	5210	4580	4150	3280
Q	5	25	Y	7610	6440	5380	4150	2880					6430	5800	4750	3530	2290	4560	4390	4180	3610
Q	7	25	Y	7720	6440	5350	4250	3290	6580	6180	5390	4400	6530	5930	4960	3760		**6670**	**6050**	**5580**	**4560**
Q	5	28	Y		7540	6220	4810	3370						6590	5500	4140	2700	5440	5080	4750	3980
Q	7	28	Y	9010	7550	6350	5020		8020	7040	6110	4930	7200	6520	5420	4020		**7220**	**6350**	**5740**	**4490**
Q	5	33	Y		9130	7460	5710	4130						7390	6500	5240	3840	6410	5890	5520	4680
S	5	33	Y		8580	7360	5920	4370						7560	6590	5080	3380	7000	6340	5840	4780
Q	7	33	Y	10610	8800	7250	5750		8580	8450	7270	5910	7790	7280	6480	5290		**8710**	**7760**	**7040**	**5570**
S	7	33	Y	10140	8650	7200	5620		8640	8210	7200	5950	8340	7420	6370	4840		**8380**	**7430**	**6730**	**5260**
S	7	39	Y		10370	8680	6880	5060						9120	7740	5890	3910	8050	7510	7000	5760
S	10	39	Y	11780	9970	8330	6620		10610	9900	8480	6800	9610	8770	7220	5280		**9560**	**8570**	**7800**	**6190**
S	10	51	Y		13570	11110	8620	6220						11620	9530	7090	4700	10250	9370	8710	7160
S	15	51	Y	15260	12720	10500	8270		13310	12400	10620	8680	13550	11340	8990	6440		**11740**	**10570**	**9710**	**7790**
S	15	56	Y		14460	11770	9120	6560					14810	13450	11110	8320	5450	12480	11340	10420	8390
S	20	56	Y	17840	14660	12020	9410		14980	14020	12140	10070	15280	13640	11260	8270		**14510**	**12830**	**11630**	**9180**
V	15	59	Y		15720	12620	9610	6780					14840	13420	11120	8590	6120	12400	11200	10260	8200
V	20	59	Y	17870	15060	12470	9670	6950	15410	14390	12380	9960	14530	13020	10690	8140		**14420**	**12620**	**11410**	**8960**
V	15	71	Y		18900	15400	11660	8160						16060	13180	10080	7200	14640	13240	12120	9660
V	25	71	Y	22260	18420	15120	11640	8300	18440	17260	14870	12050	18500	15540	12560	9460		**16730**	**14570**	**13100**	**10240**
V	20	84	Y		22450	18230	13910	9790						19420	15780	12070	8630	17640	15830	14410	11590
V	30	84	Y	25940	21900	18110	14000	10070	21950	20520	17690	14230	22210	19070	15470	11600		**21260**	**18430**	**16480**	**12600**
V	25	93	Y		24300	19580	14650	9830						22180	18800	14620	9940	20560	18460	16810	13280
V	32	93	Y	29110	23770	19190	14360	9820	24350	22490	18980	14740	25300	22610	18370	12680		**26040**	**22250**	**19600**	**14630**
Z	25	106	Y		28790	23620	18010	12670						24660	20330	15370	10780	21900	19820	18110	14350
Z	35	106	Y	31380	26340	21700	16750	12130	30250	25100	21420	17140	28500	23840	19020			**26440**	**22780**	**20290**	**15610**
Z	30	126	Y		34420	28080	21380	14650						29160	24420	18670	12970	25730	23360	21370	16850
Z	40	126	Y	37570	31300	25720	19870	14500	35400	29740	25360	19920	32890	27970	22630			**31730**	**27440**	**24470**	**18430**
W	40	142	Y		38650	32440	25390		40630	36820	30430	23800	36980	32060	26180			**34840**	**30910**	**27970**	**21730**
Z	40	154	Y		43200	35100	26800	18610						36070	29630	22510	15620	29270	27000	25090	20650
Z	50	154	Y	48310	39220	31620	23690	16080	46330	37810	31780	24740	40490	35520	29300			**38410**	**33560**	**30120**	**23110**
W	40	168	Y		42460	34760	26300	17090						39140	31860	24280	18110	32880	30440	28260	23050
W	50	168	Y	50040	42350	35140	27370		47820	40300	34730	27620	47800	40490	32660			**40540**	**36050**	**32720**	**25660**
W	50	187	Y		46140	37500	28300	18720						44470	35750	28330	20940	40850	36970	33850	27170
W	60	187	Y	54980	46020	37900	29390		51660	44050	37920	29920	50890	41400	32600			**44580**	**39410**	**35650**	**27730**
W	60	206	Y		52190	42770	32690	22460						49210	38630	28500	19420	39170	36440	34040	28300
W	70	206	Y	61220	51040	41870	32060		58430	50300	42720	33550	53690	47280	37030			**50940**	**45050**	**40780**	**31920**
W	70	228	Y	69300	56520	45660	34210							52450	41030	31520	22570	42220	39650	37240	31250
W	75	228	Y		56650	46520	35650	24490	63140	54260	46080	36340	59500	52510				**54780**	**48100**	**43300**	**33480**
W	75	240	Y		59630	48640	37240	26580						55100	43190	33170	23580	45260	42290	39600	33000
W	80	240	Y	72840	59200	47840	36110		66280	57910	49260	39360	60600	53500				**57410**	**51340**	**46660**	**36470**

* Les valeurs sont calculées d'après une température d'évaporation **te** indiquée ci-dessus et une température de condensation de 40°C
Values calculated at evaporating temperature **te** indicated in above table and condensing temperature 40°C
Valores medidos a temperatura de evaporación **te** indicada en la tabla y a temperatura de condensación de 40°C
Valores medidos com temperatura de evaporação **te** como indicado na tabela e temperatura de condensação de 40°C

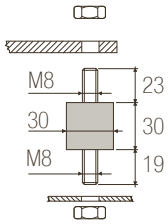
(**température de condensation de 60°C avec R134a**)
(**condensing temperature 60°C with R134a**)
(**temperatura de condensación de 60°C con R134a**)
(**temperatura de condensação de 60°C com R134a**)

Plans cotés — Dimensional drawing — Plano de dimensiones — Dimensões





Support anti-vibrations
Vibration absorber
Antivibrador
Sinoblocos



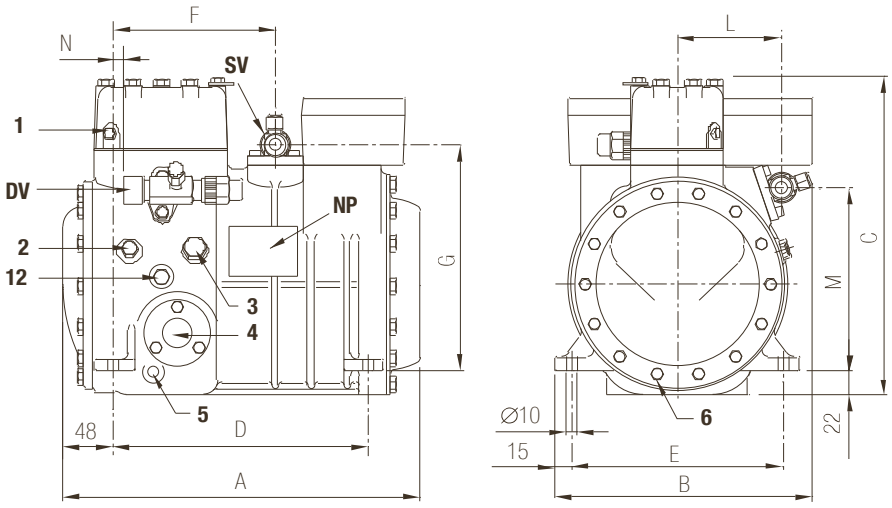
Série / Series / Série / Serie **A**

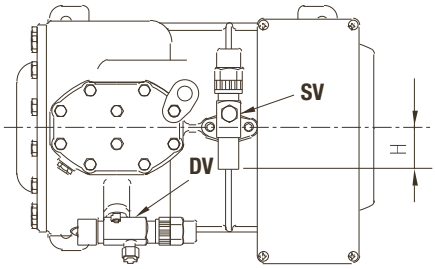
FCAT04-14

Compresseur / Compressor / Compresor / Compressor		Vanne d'aspiration / Suction valve / Válvula aspiración / Válvula de aspiração		Vanne de refoulement / Discharge valve / Válvula descarga / Válvula de descarga		Longueur / Length / Longitud / Comprime.	Largeur / Width / Amplitud / Largura	Hauteur / Height / Altura / Altura	Trous de fixation / Base mounting / Anclajes / Distancia de fixação		Vanne d'aspiration / Suction valve / Válvula aspiración / Válvula de aspiração			Vanne de refoulement / Discharge valve / Válvula descarga / Válvula de descarga		
		∅ "	∅ mm	∅ "	∅ mm	A mm	B mm	C mm	D mm	E mm	F mm	G mm	H mm	L mm	M mm	N mm
A 0.5 4 Y		⅝	15.8	½	12.7	315	237	275	234	194	150	209	29	97	167	18
A 0.5 5 Y		⅝	15.8	½	12.7	315	237	275	234	194	150	209	29	97	167	18
A 0.7 5 Y		⅝	15.8	½	12.7	315	237	275	234	194	150	209	29	97	167	18
A 0.7 6 Y		⅝	15.8	½	12.7	315	237	275	234	194	150	209	29	97	167	18
A 1 6 Y		⅝	15.8	½	12.7	315	237	275	234	194	150	209	29	97	167	18
A 1 7 Y		⅝	15.8	½	12.7	315	237	275	234	194	150	209	29	97	167	18
A 1.5 7 Y		⅝	15.8	½	12.7	315	237	275	234	194	150	209	29	97	167	18
A 1.5 8 Y		⅝	15.8	½	12.7	315	237	275	234	194	150	209	29	97	167	18
A 0.5 4 Y	1ph	⅝	15.8	½	12.7	315	237	275	234	194	150	209	29	97	167	18
A 0.5 5 Y	1ph	⅝	15.8	½	12.7	315	237	275	234	194	150	209	29	97	167	17
A 0.7 5 Y	1ph	⅝	15.8	½	12.7	315	237	275	234	194	150	209	29	97	167	18
A 0.7 6 Y	1ph	⅝	15.8	½	12.7	315	237	275	234	194	150	209	29	97	167	18
A 1 6 Y	1ph	⅝	15.8	½	12.7	315	237	275	234	194	150	209	29	97	167	18
A 1 7 Y	1ph	⅝	15.8	½	12.7	315	237	275	234	194	150	209	29	97	167	18
A 1.5 7 Y	1ph	⅝	15.8	½	12.7	329	237	275	234	194	150	209	29	97	167	18
A 1.5 8 Y	1ph	⅝	15.8	½	12.7	329	237	275	234	194	150	209	29	97	167	18

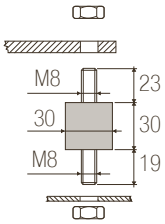
1	bouchon haute pression	high pressure plug	toma de alta presión	tomada de alta pressão
2	bouchon basse pression	low pressure plug	toma de baja presión	tomada de baixa pressão
3	bouchon charge d'huile	oil charge plug	toma de carga de aceite	ponto de carga do óleo
4	voyant de niveau huile	oil level sight glass	visor nivel de aceite	visor do nível de óleo
5	doigt de gant pour résistance de carter	crankcase heater seat	ubicación resistencia aceite	sede da resisténcia do cárter
6	bouchon vidange d'huile	oil drain plug	toma de descarga aceite	descarga do óleo
12	bouchon retour d'huile	oil return plug	toma retorno aceite	tampa retorno óleo
DV	vanne de refoulement	discharge valve	válvula descarga	válvula de serviço de descarga
NP	plaque signalétique	name plate	tarjeta	plaqueta
SV	vanne d'aspiration	suction valve	válvula aspiración	válvula de serviço de aspiração

Plans cotés — Dimensional drawing — Plano de dimensiones — Dimensões





Support anti-vibrations
Vibration absorber
Antivibrador
Sinoblocos



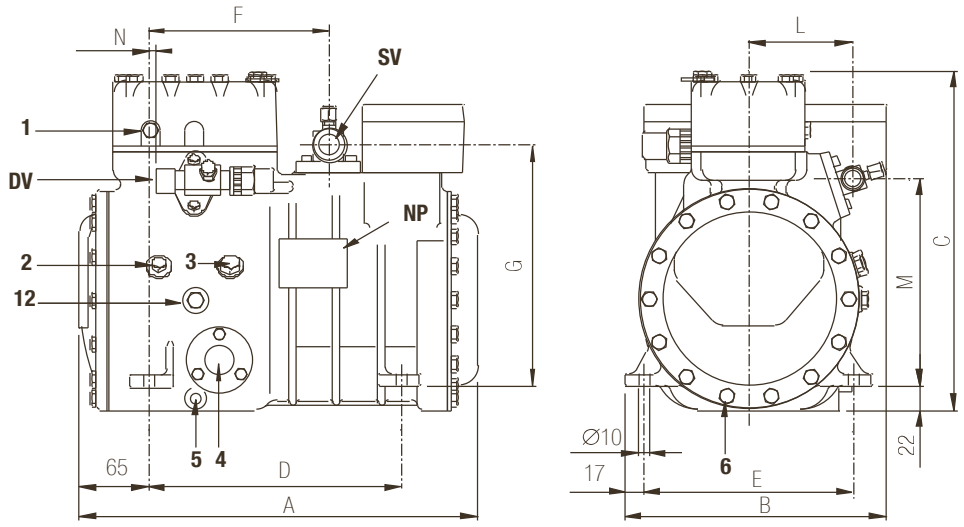
FCAT04-14

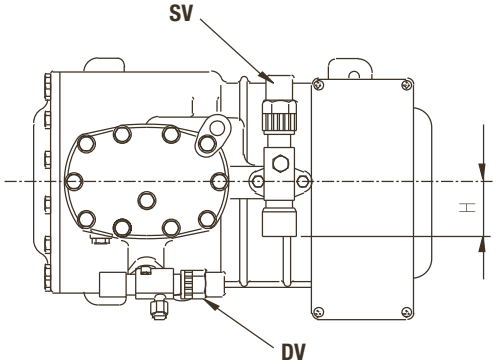
Série / Series / Série / Serie **B-C**

Compresseur / Compressor / Compresor / Compressor	Vanne d'aspiration / Suction valve / Válvula aspiración / Válvula de aspiração		Vanne de refoulement / Discharge valve / Válvula descarga / Válvula de descarga		Longueur / Length / Longitud / Comprime.	Largeur / Width / Amplitud / Largura	Hauteur / Height / Altura / Altura	Trous de fixation / Base mounting / Anclajes / Distancia de fixação		Vanne d'aspiration / Suction valve / Válvula aspiración / Válvula de aspiração			Vanne de refoulement / Discharge valve / Válvula descarga / Válvula de descarga		
	∅ "	∅ mm	∅ "	∅ mm	A mm	B mm	C mm	D mm	E mm	F mm	G mm	H mm	L mm	M mm	N mm
B 1.5 9 Y	⅝	15.8	½	12.7	315	237	292	234	194	150	209	29	97	167	18
B 1.5 10 Y	⅝	15.8	½	12.7	315	237	292	234	194	150	209	29	97	167	18
B 2 10 Y	¾	19.0	⅝	15.8	329	237	292	234	194	150	209	31	97	167	16
B 1.5 9 Y 1ph	⅝	15.8	½	12.7	329	237	292	234	194	150	209	29	97	167	18
B 1.5 10 Y 1ph	⅝	15.8	½	12.7	329	237	292	234	194	150	209	29	97	167	18
B 2 10 Y 1ph	¾	19.0	⅝	15.8	329	237	292	234	194	150	209	31	97	167	16
C 2 12 Y	⅞	22.2	⅝	15.8	334	237	292	234	194	143	209	42	97	167	18
C 3 12 Y	⅞	22.2	⅝	15.8	334	237	292	234	194	143	209	42	97	167	18
C 2 12 Y 1ph	⅞	22.2	⅝	15.8	361	237	292	234	194	143	209	42	97	167	18
C 3 12 Y 1ph	⅞	22.2	⅝	15.8	361	237	292	234	194	143	209	42	97	167	18

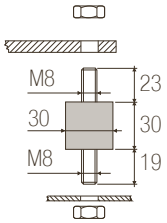
1	bouchon haute pression	high pressure plug	toma de alta presión	tomada de alta pressão
2	bouchon basse pression	low pressure plug	toma de baja presión	tomada de baixa pressão
3	bouchon charge d'huile	oil charge plug	toma de carga de aceite	ponto de carga do óleo
4	voyant de niveau huile	oil level sight glass	visor nivel de aceite	visor do nível de óleo
5	doigt de gant pour résistance de carter	crankcase heater seat	ubicación resistencia aceite	sede da resisténcia do cárter
6	bouchon vidange d'huile	oil drain plug	toma de descarga aceite	descarga do óleo
12	bouchon retour d'huile	oil return plug	toma retorno aceite	tampa retorno óleo
DV	vanne de refoulement	discharge valve	válvula descarga	válvula de serviço de descarga
NP	plaque signalétique	name plate	tarjeta	plaqueta
SV	vanne d'aspiration	suction valve	válvula aspiración	válvula de serviço de aspiração

Plans cotés — Dimensional drawing — Plano de dimensiones — Dimensões





Support anti-vibrations
Vibration absorber
Antivibrador
Sinoblocos



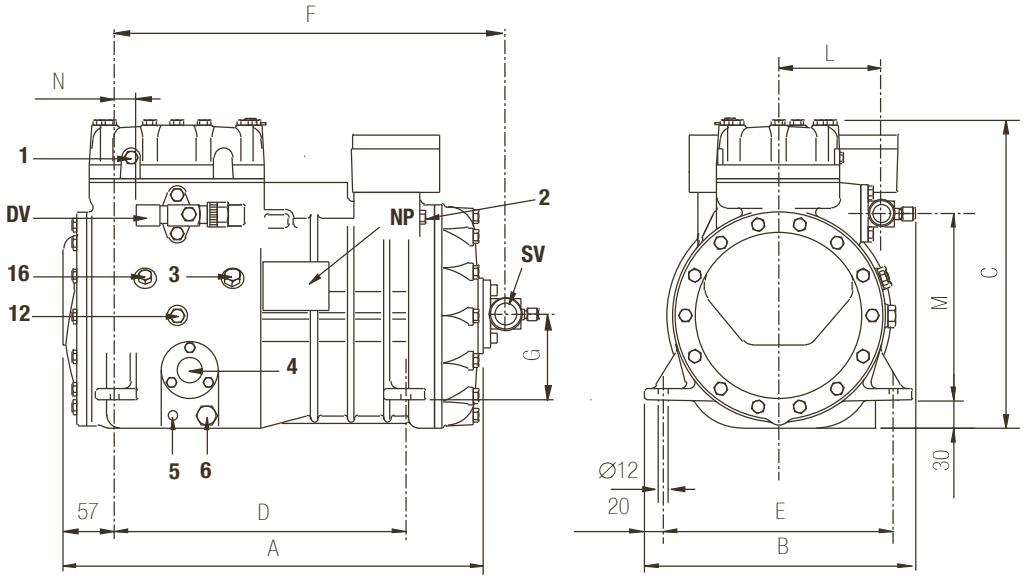
Série / Series / Série / Serie **D**

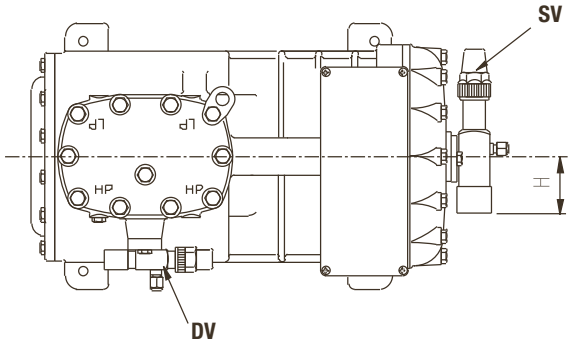
FCAT04-14

Compresseur / Compressor / Compresor / Compressor		Vanne d'aspiration / Suction valve / Válvula aspiración / Válvula de aspiração		Vanne de refoulement / Discharge valve / Válvula descarga / Válvula de descarga		Longueur / Length / Longitud / Comprime.	Largeur / Width / Amplitud / Largura	Hauteur / Height / Altura / Altura	Trous de fixation / Base mounting / Anclajes / Distancia de fixação		Vanne d'aspiration / Suction valve / Válvula aspiración / Válvula de aspiração			Vanne de refoulement / Discharge valve / Válvula descarga / Válvula de descarga		
		∅ "	∅ mm	∅ "	∅ mm	A mm	B mm	C mm	D mm	E mm	F mm	G mm	H mm	L mm	M mm	N mm
D 2 11 Y		7/8	22.2	5/8	15.8	353	242	294	234	194	165	221	42	94	192	13
D 2 13 Y		7/8	22.2	5/8	15.8	353	242	294	234	194	165	221	42	94	192	13
D 3 13 Y		1"1/8	28.6	5/8	15.8	369	242	317	234	194	165	225	53	94	192	13
D 2 15 Y		7/8	22.2	5/8	15.8	353	242	294	234	194	165	221	42	94	192	13
D 3 15 Y		1"1/8	28.6	5/8	15.8	369	242	317	234	194	165	225	53	94	192	13
D 3 16 Y		1"1/8	28.6	5/8	15.8	369	242	317	234	194	165	225	53	94	192	13
D 4 16 Y		1"1/8	28.6	3/4	19.0	374	242	317	234	194	165	225	53	94	192	5
D 3 18 Y		1"1/8	28.6	5/8	15.8	369	242	317	234	194	165	225	53	94	192	13
D 4 18 Y		1"1/8	28.6	3/4	19.0	374	242	317	234	194	165	225	53	94	192	5
D 3 19 Y		PAS DISPONIBLE				NOT AVAILABLE			NO DISPONIBLE					NAO DISPONÍVEL		
D 4 19 Y		PAS DISPONIBLE				NOT AVAILABLE			NO DISPONIBLE					NAO DISPONÍVEL		
D 2 11 Y	1ph	7/8	22.2	5/8	15.8	374	242	294	234	194	165	221	42	94	192	13
D 2 13 Y	1ph	7/8	22.2	5/8	15.8	374	242	294	234	194	165	221	42	94	192	13
D 3 13 Y	1ph	1"1/8	28.6	5/8	15.8	401	242	317	234	194	165	225	53	94	192	13
D 2 15 Y	1ph	7/8	22.2	5/8	15.8	374	242	294	234	194	165	221	42	94	192	13
D 3 15 Y	1ph	1"1/8	28.6	5/8	15.8	401	242	317	234	194	165	225	53	94	192	13
D 3 16 Y	1ph	1"1/8	28.6	5/8	15.8	401	242	317	234	194	165	225	53	94	192	13
D 3 18 Y	1ph	1"1/8	28.6	5/8	15.8	401	242	317	234	194	165	225	53	94	192	13
D 3 19 Y	1ph	1"1/8	28.6	5/8	15.8	401	242	317	234	194	165	225	53	94	192	13

1	bouchon haute pression	high pressure plug	toma de alta presión	tomada de alta pressão
2	bouchon basse pression	low pressure plug	toma de baja presión	tomada de baixa pressão
3	bouchon charge d'huile	oil charge plug	toma de carga de aceite	ponto de carga do óleo
4	voyant de niveau huile	oil level sight glass	visor nivel de aceite	visor do nível de óleo
5	doigt de gant pour résistance de carter	crankcase heater seat	ubicación resistencia aceite	sede da resisténcia do cárter
6	bouchon vidange d'huile	oil drain plug	toma de descarga aceite	descarga do óleo
12	bouchon retour d'huile	oil return plug	toma retorno aceite	tampa retorno óleo
DV	vanne de refoulement	discharge valve	válvula descarga	válvula de serviço de descarga
NP	plaque signalétique	name plate	tarjeta	plaqueta
SV	vanne d'aspiration	suction valve	válvula aspiración	válvula de serviço de aspiração

Plans cotés — Dimensional drawing — Plano de dimensiones — Dimensões



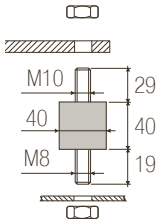


Support anti-vibrations

Vibration absorber

Antivibrador

Sinoblocos



Série	Series
Série	Serie

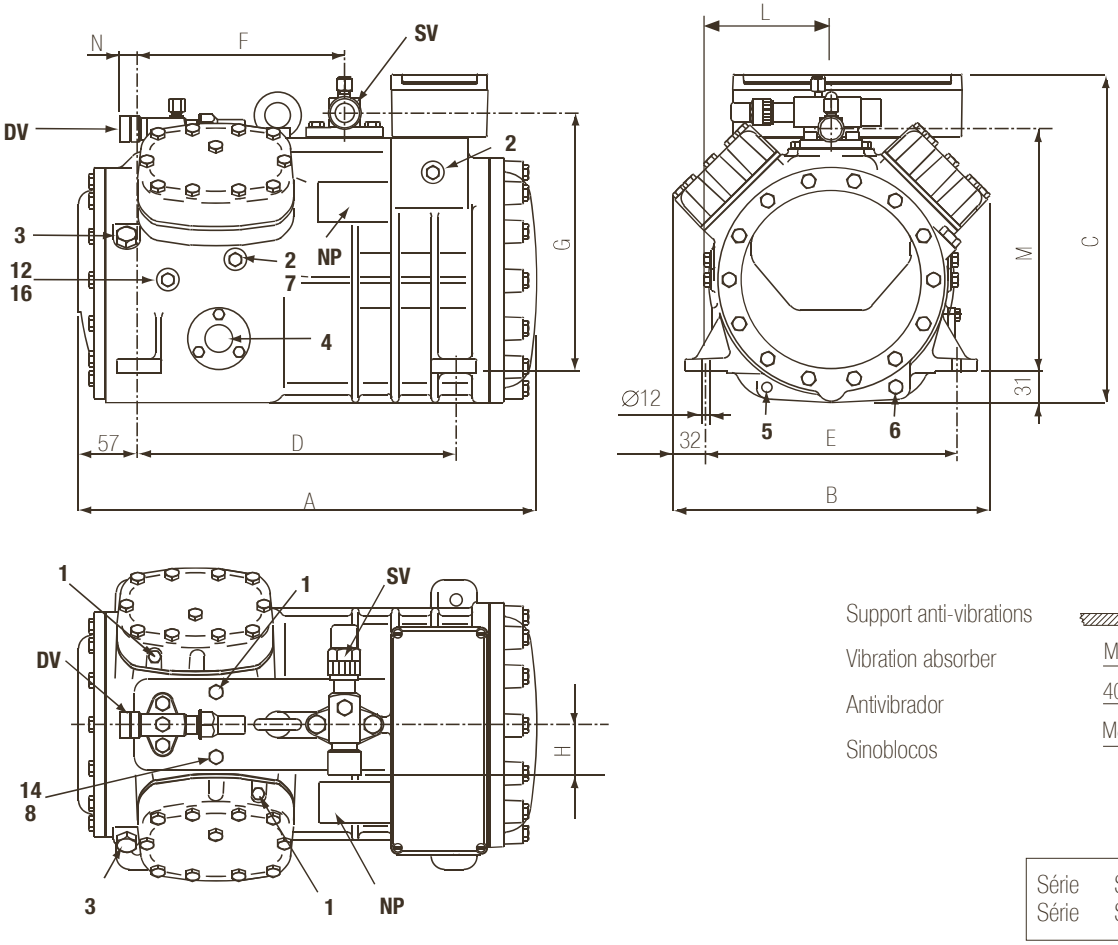
F

FCAT04-14

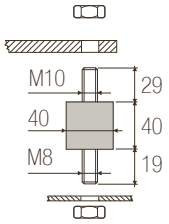
Compresseur / Compressor / Compresor / Compressor	Vanne d'aspiration / Suction valve / Válvula aspiración / Válvula de aspiração		Vanne de refoulement / Discharge valve / Válvula descarga / Válvula de descarga		Longueur / Length / Longitud / Comprime.	Largeur / Width / Amplitud / Largura	Hauteur / Height / Altura / Altura	Trous de fixation / Base mounting / Anclajes / Distancia de fixação		Vanne d'aspiration / Suction valve / Válvula aspiración / Válvula de aspiração			Vanne de refoulement / Discharge valve / Válvula descarga / Válvula de descarga		
	Ø "	Ø mm	Ø "	Ø mm	A mm	B mm	C mm	D mm	E mm	F mm	G mm	H mm	L mm	M mm	N mm
F 4 16 Y	1"⅛	28.6	¾	19.0	517	286	336	312	246	426	91	53	108	199	29
F 4 19 Y	1"⅛	28.6	¾	19.0	517	286	336	312	246	426	91	53	108	199	29
F 5 19 Y	1"⅛	28.6	¾	19.0	517	286	336	312	246	426	91	53	108	199	29
F 4 24 Y	1"⅛	28.6	¾	19.0	517	286	336	312	246	426	91	53	108	198	29
F 5 24 Y	1"⅛	28.6	⅞	22.2	517	286	336	312	246	426	91	53	108	199	29

1	bouchon haute pression	high pressure plug	toma de alta presión	tomada de alta pressão
2	bouchon basse pression	low pressure plug	toma de baja presión	tomada de baixa pressão
3	bouchon charge d'huile	oil charge plug	toma de carga de aceite	ponto de carga do óleo
4	voyant de niveau huile	oil level sight glass	visor nivel de aceite	visor do nível de óleo
5	doigt de gant pour résistance de carter	crankcase heater seat	ubicación resistencia aceite	sede da resisténcia do cárter
6	bouchon vidange d'huile	oil drain plug	toma de descarga aceite	descarga do óleo
12	bouchon retour d'huile	oil return plug	toma retorno aceite	tampa retorno óleo
DV	vanne de refoulement	discharge valve	válvula descarga	válvula de serviço de descarga
NP	plaque signalétique	name plate	tarjeta	plaqueta
SV	vanne d'aspiration	suction valve	válvula aspiración	válvula de serviço de aspiração

Plans cotés — Dimensional drawing — Plano de dimensiones — Dimensões



Support anti-vibrations
Vibration absorber
Antivibrador
Sinoblocos



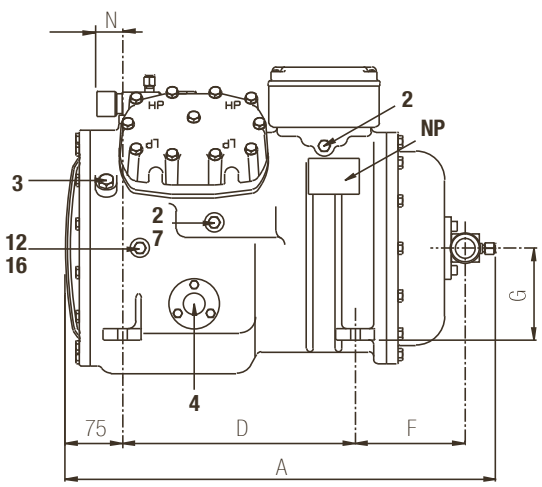
Série Series Série Serie **Q**

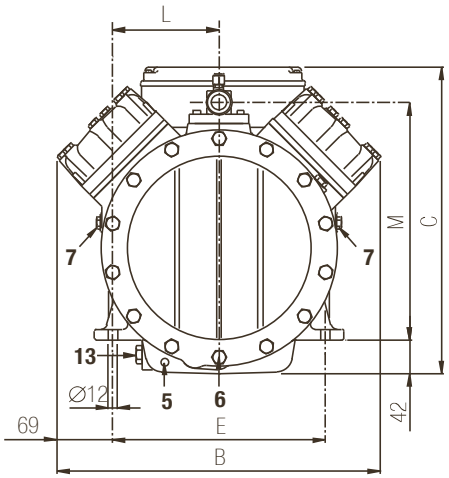
FCAT04-14

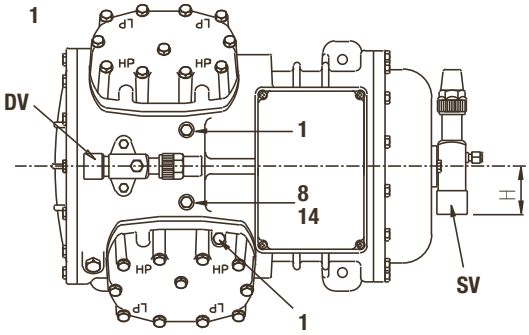
Compresseur Compressor Compresor Compressor	Vanne d'aspiration Suction valve Válvula aspiración Válvula de aspiração		Vanne de refoulement Discharge valve Válvula descarga Válvula de descarga		Longueur Length Longitud Comprime.	Largeur Width Amplitud Largura	Hauteur Height Altura Altura	Trous de fixation Base mounting Anclajes Distancia de fixação		Vanne d'aspiration Suction valve Válvula aspiración Válvula de aspiração			Vanne de refoulement Discharge valve Válvula descarga Válvula de descarga		
	∅ "	∅ mm	∅ "	∅ mm	A mm	B mm	C mm	D mm	E mm	F mm	G mm	H mm	L mm	M mm	N mm
Q 4 19 Y	1"⅛	28.6	¾	19.0	449	315	325	312	246	203	258	53	123	239	12
Q 5 19 Y	1"⅛	28.6	¾	19.0	449	315	325	312	246	203	258	53	123	239	12
Q 4 21 Y	1"⅛	28.6	¾	19.0	449	315	325	312	246	203	258	53	123	239	12
Q 5 21 Y	1"⅛	28.6	¾	19.0	449	315	325	312	246	203	258	53	123	239	12
Q 4 24 Y	1"⅛	28.6	¾	19.0	449	315	325	312	246	203	258	53	123	239	12
Q 5 24 Y	1"⅛	28.6	⅞	22.2	449	315	325	312	246	203	258	53	123	239	17
Q 4 25 Y	1"⅛	28.6	¾	19.0	449	315	325	312	246	203	258	53	123	239	12
Q 5 25 Y	1"⅛	28.6	⅞	22.2	449	315	325	312	246	203	258	53	123	239	17
Q 7 25 Y	1"⅛	28.6	⅞	22.2	449	315	325	312	246	203	258	53	123	239	17
Q 5 28 Y	1"⅜	35.0	⅞	22.2	449	315	328	312	246	203	261	58	123	239	17
Q 7 28 Y	1"⅜	35.0	1"⅛	28.6	449	315	328	312	246	203	261	58	123	244	28
Q 5 33 Y	1"⅜	35.0	1"⅛	28.6	449	315	328	312	246	203	261	58	123	244	28
Q 7 33 Y	1"⅜	35.0	1"⅛	28.6	449	315	328	312	246	203	261	58	123	244	28

1	bouchon haute pression	high pressure plug	toma de alta presión	tomada de alta pressão
2	bouchon basse pression	low pressure plug	toma de baja presión	tomada de baixa pressão
3	bouchon charge d'huile	oil charge plug	toma de carga de aceite	ponto de carga do óleo
4	voyant de niveau huile	oil level sight glass	visor nivel de aceite	visor do nível de óleo
5	doigt de gant pour résistance de carter	crankcase heater seat	ubicación resistencia aceite	sede da resistência do cárter
6	bouchon vidange d'huile	oil drain plug	toma de descarga aceite	descarga do óleo
7	bouchon électrov.injection de liquide	liquid injection valve plug	toma valvúla inyección de liquido	tampa válvula injeção de liquido
8	bouchon sensor injection de liquide	liquid injection sensor plug	toma sensor inyección de liquido	tampa sensor injeção de liquido
12	bouchon retour d'huile	oil return plug	toma retorno aceite	tampa retorno óleo
14	bouchon sensor max.temp.de refoulement	max. discharge temperature sensor plug	toma sensor alta temperatura de descarga	tampa sensor da max. temperatura de descarga
16	bouchon pression de carter	crankcase pressure plug	toma de presión carter	tampa de pressão do cárter
DV	vanne de refoulement	discharge valve	válvula descarga	válvula de serviço de descarga
NP	plaque signalétique	name plate	tarjeta	plaqueta
SV	vanne d'aspiration	suction valve	válvula aspiración	válvula de serviço de aspiração

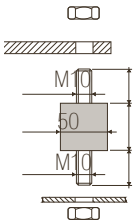
Plans cotés — Dimensional drawing — Plano de dimensiones — Dimensões







Support anti-vibrations
Vibration absorber
Antivibrador
Sinoblocos



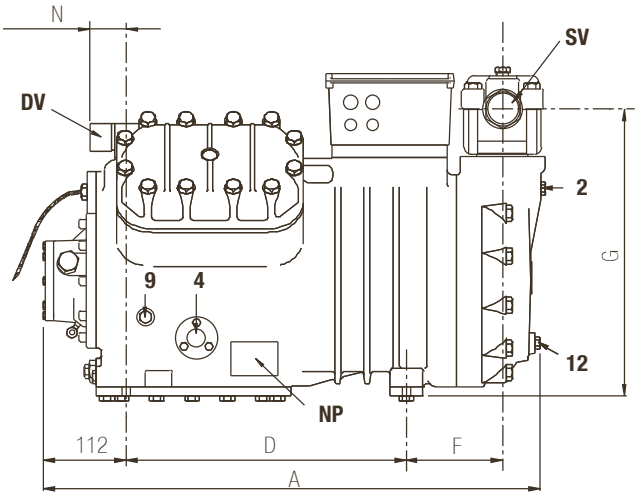
FCAT04-14

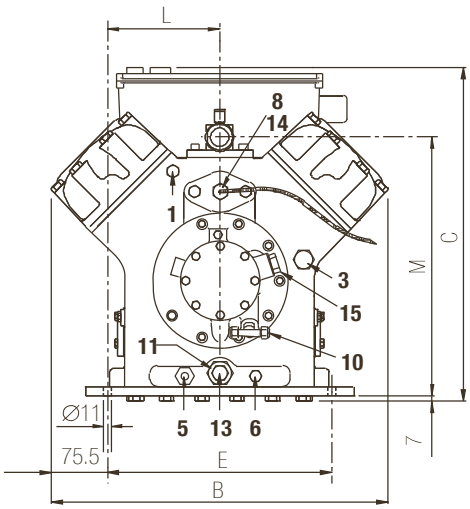
Série Series
Série Serie **S**

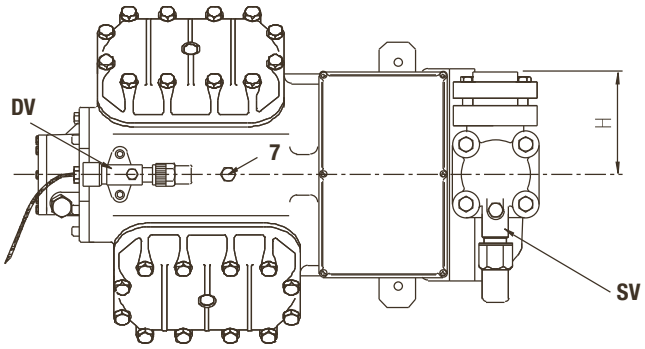
Compresseur Compressor Compresor Compressor	Vanne d'aspiration Suction valve Válvula aspiración Válvula de aspiração		Vanne de refoulement Discharge valve Válvula descarga Válvula de descarga		Longueur Length Longitud Comprime.	Largeur Width Amplitud Largura	Hauteur Height Altura Altura	Trous de fixation Base mounting Anclajes Distancia de fixação		Vanne d'aspiration Suction valve Válvula aspiración Válvula de aspiração			Vanne de refoulement Discharge valve Válvula descarga Válvula de descarga		
	∅ "	∅ mm	∅ "	∅ mm	A mm	B mm	C mm	D mm	E mm	F mm	G mm	H mm	L mm	M mm	N mm
S 5 33 Y	1"⅜	35.0	1"⅛	28.6	550	405	390	292	266	147	115	58	133	298	23
S 7 33 Y	1"⅜	35.0	1"⅛	28.6	550	405	390	292	266	147	115	58	133	298	23
S 7 39 Y	1"⅜	35.0	1"⅛	28.6	550	405	390	292	266	147	115	58	133	298	23
S 10 39 Y	1"⅜	35.0	1"⅛	28.6	550	405	390	292	266	147	115	58	133	298	23
S 10 51 Y	1"⅜	35.0	1"⅛	28.6	550	405	390	292	266	147	115	58	133	298	23
S 15 51 Y	1"⅝	42.0	1"⅛	28.6	550	405	390	292	266	147	115	61	133	298	23
S 15 56 Y	1"⅝	42.0	1"⅛	28.6	550	405	390	292	266	147	115	61	133	298	23
S 20 56 Y	1"⅝	42.0	1"⅛	28.6	550	405	390	292	266	147	115	61	133	298	23

1	bouchon haute pression	high pressure plug	toma de alta presión	tomada de alta pressão
2	bouchon basse pression	low pressure plug	toma de baja presión	tomada de baixa pressão
3	bouchon charge d'huile	oil charge plug	toma de carga de aceite	ponto de carga do óleo
4	voyant de niveau huile	oil level sight glass	visor nivel de aceite	visor do nível de óleo
5	doigt de gant pour résistance de carter	crankcase heater seat	ubicación resistencia aceite	sede da resisténcia do cárter
6	bouchon vidange d'huile	oil drain plug	toma de descarga aceite	descarga do óleo
7	bouchon électrov.injection de liquide	liquid injection valve plug	toma valvúla inyección de liquido	tampa válvula injeção de liquido
8	bouchon sensor injection de liquide	liquid injection sensor plug	toma sensor inyección de liquido	tampa sensor injeção de liquido
12	bouchon retour d'huile	oil return plug	toma retorno aceite	tampa retorno óleo
14	bouchon sensor max.temp.de refoulement	max. discharge temperature sensor plug	toma sensor alta temperatura de descarga	tampa sensor da max. temperatura de descarga
16	bouchon pression de carter	crankcase pressure plug	toma de presión carter	tampa de pressão do cárter
DV	vanne de refoulement	discharge valve	válvula descarga	válvula de serviço de descarga
NP	plaque signalétique	name plate	tarjeta	plaqueta
SV	vanne d'aspiration	suction valve	válvula aspiración	válvula de serviço de aspiração

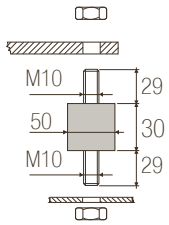
Plans cotés — Dimensional drawing — Plano de dimensiones — Dimensões







Support anti-vibrations
Vibration absorber
Antivibrador
Sinoblocos



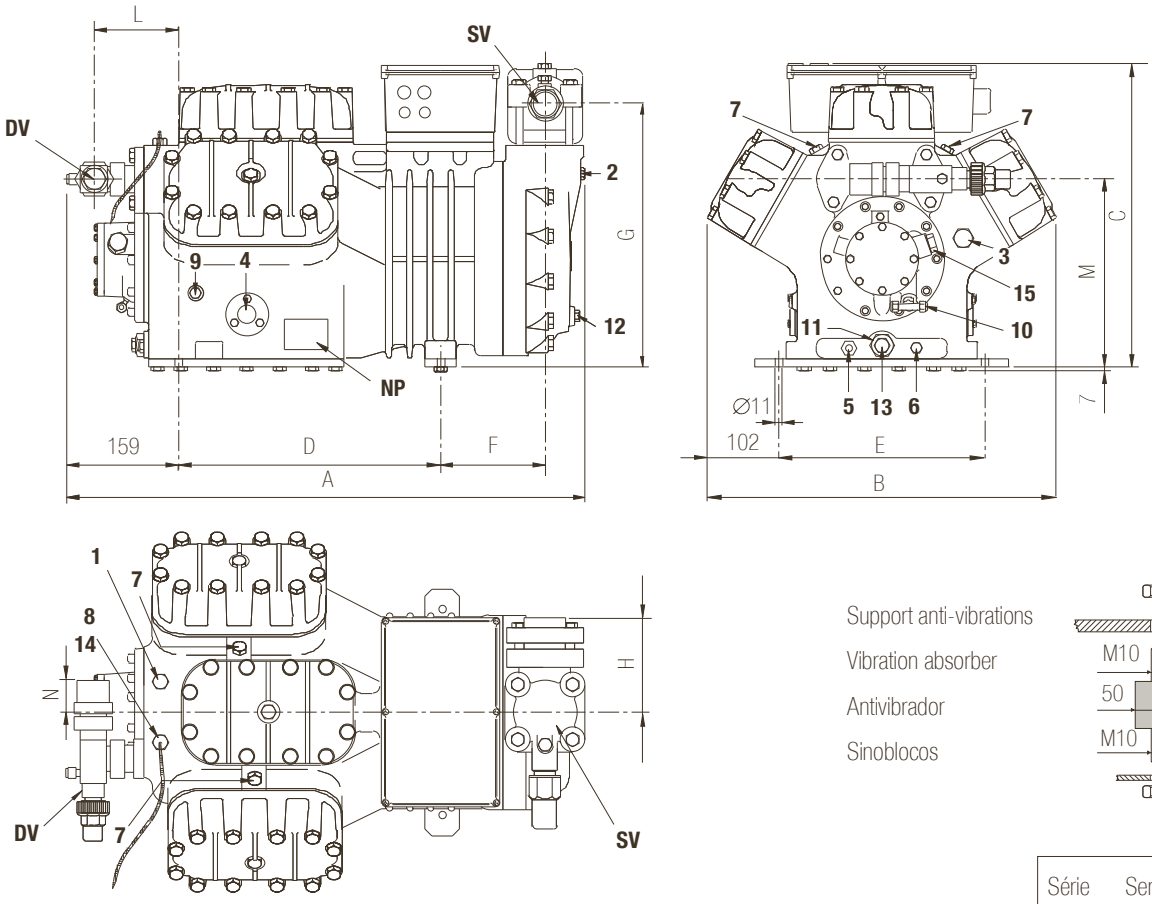
Série Series Série Serie **V**

FCAT04-14

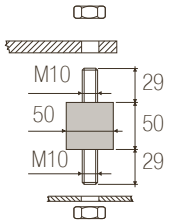
Compresseur Compressor Compresor Compressor	Vanne d'aspiration Suction valve Válvula aspiración Válvula de aspiração		Vanne de refoulement Discharge valve Válvula descarga Válvula de descarga		Longueur Length Longitud Comprime.	Largeur Width Amplitud Largura	Hauteur Height Altura Altura	Trous de fixation Base mounting Anclajes Distancia de fixação		Vanne d'aspiration Suction valve Válvula aspiración Válvula de aspiração			Vanne de refoulement Discharge valve Válvula descarga Válvula de descarga		
	∅ "	∅ mm	∅ "	∅ mm	A mm	B mm	C mm	D mm	E mm	F mm	G mm	H mm	L mm	M mm	N mm
V 15 59 Y	1"⅝	42.0	1"⅛	28.6	672	460	463	381	305	120	367	95	152	352	43
V 20 59 Y	1"⅝	42.0	1"⅛	28.6	672	460	463	381	305	120	367	95	152	352	43
V 15 71 Y	1"⅝	42.0	1"⅛	28.6	672	460	463	381	305	120	367	95	152	352	43
V 25 71 Y	2"⅛	54.0	1"⅜	35.0	703	460	463	381	305	133	389	130	152	355	48
V 20 84 Y	1"⅝	42.0	1"⅛	28.6	672	460	463	381	305	120	367	95	152	352	43
V 30 84 Y	2"⅛	54.0	1"⅜	35.0	703	460	463	381	305	133	389	130	152	355	48
V 25 93 Y	2"⅛	54.0	1"⅜	35.0	703	460	463	381	305	133	389	130	152	355	48
V 32 93 Y	2"⅛	54.0	1"⅜	35.0	743	460	463	381	305	158	389	130	152	355	48

1	bouchon haute pression	high pressure plug	toma de alta presión	tomada de alta pressão
2	bouchon basse pression	low pressure plug	toma de baja presión	tomada de baixa pressão
3	bouchon charge d'huile	oil charge plug	toma de carga de aceite	ponto de carga do óleo
4	voyant de niveau huile	oil level sight glass	visor nivel de aceite	visor do nível de óleo
5	doigt de gant pour résistance de carter	crankcase heater seat	ubicación resistencia aceite	sede da resisténcia do cárter
6	bouchon vidange d'huile	oil drain plug	toma de descarga aceite	descarga do óleo
7	bouchon électrov.injection de liquide	liquid injection valve plug	toma valvúla inyección de liquido	tampa válvula injeção de liquido
8	bouchon sensor injection de liquide	liquid injection sensor plug	toma sensor inyección de liquido	tampa sensor injeção de liquido
9	raccord pressostat diff. huile (b.p.)	oil pressure switch connection (l.p.)	conexión presostato diferencial aceite (b.p.)	conexão para pressostato de óleo (b.p.)
10	raccord pressostat diff. huile (h.p.)	oil pressure switch connection (h.p.)	conexión presostato diferencial aceite (a.p.)	conexão para pressostato de óleo (a.p.)
11	filtre à huile	oil filter	filtro aceite	filtro de óleo
12	bouchon retour d'huile	oil return plug	toma retorno aceite	tampa retorno óleo
13	bouchon magnetique	magnetic plug	toma magnético	tampa magnético
14	bouchon sensor max.temp.de refoulement	max. discharge temperature sensor plug	toma sensor alta temperatura de descarga	tampa sensor da max. temperatura de descarga
15	raccord pressostat diff. huile électronique	electronic oil pressure switch connection	conexión presostato electrónico aceite	conexão sensor do pressostato eletrónico
DV	vanne de refoulement	discharge valve	válvula descarga	válvula de serviço de descarga
NP	plaque signalétique	name plate	tarjeta	plaqueta
SV	vanne d'aspiration	suction valve	válvula aspiración	válvula de serviço de aspiração

Plans cotés — Dimensional drawing — Plano de dimensiones — Dimensões



Support anti-vibrations
Vibration absorber
Antivibrador
Sinoblocos



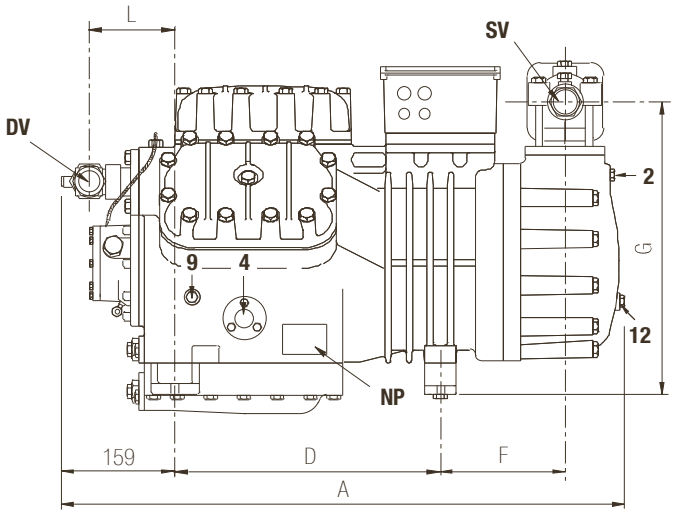
Série Series Série Serie **Z**

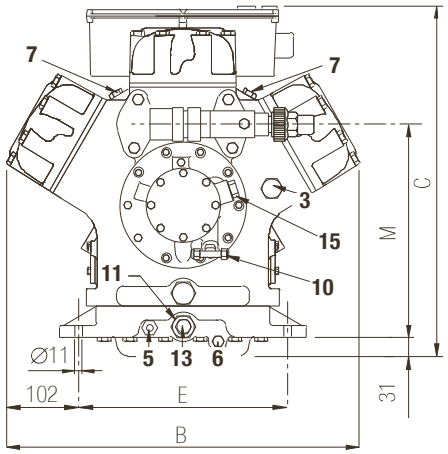
FCAT04-14

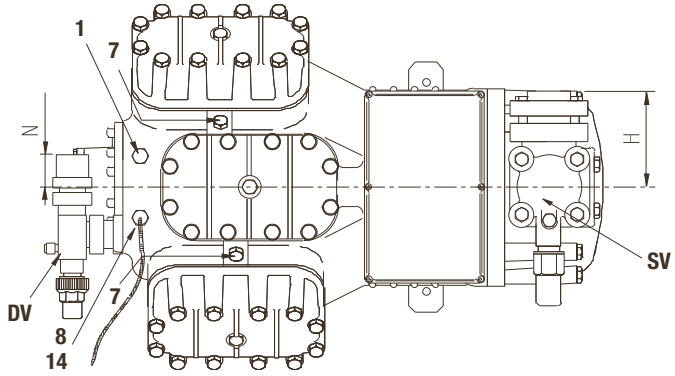
Compresseur Compressor Compresor Compressor	Vanne d'aspiration Suction valve Válvula aspiración Válvula de aspiração		Vanne de refoulement Discharge valve Válvula descarga Válvula de descarga		Longueur Length Longitud Comprime.	Largeur Width Amplitud Largura	Hauteur Height Altura Altura	Trous de fixation Base mounting Anclajes Distancia de fixação		Vanne d'aspiration Suction valve Válvula aspiración Válvula de aspiração			Vanne de refoulement Discharge valve Válvula descarga Válvula de descarga		
	∅ "	∅ mm	∅ "	∅ mm	A mm	B mm	C mm	D mm	E mm	F mm	G mm	H mm	L mm	M mm	N mm
Z 25 106 Y	2"⅛	54.0	1"⅜	35.0	765	509	457	381	305	155	386	130	123	274	42
Z 35 106 Y	2"⅛	54.0	1"⅜	35.0	806	509	457	381	305	180	386	130	123	274	42

1	bouchon haute pression	high pressure plug	toma de alta presión	tomada de alta pressão
2	bouchon basse pression	low pressure plug	toma de baja presión	tomada de baixa pressão
3	bouchon charge d'huile	oil charge plug	toma de carga de aceite	ponto de carga do óleo
4	voyant de niveau huile	oil level sight glass	visor nivel de aceite	visor do nível de óleo
5	doigt de gant pour résistance de carter	crankcase heater seat	ubicación resistencia aceite	sede da resisténcia do cárter
6	bouchon vidange d'huile	oil drain plug	toma de descarga aceite	descarga do óleo
7	bouchon électrov.injection de liquide	liquid injection valve plug	toma valvúla inyección de liquido	tampa válvula injeção de liquido
8	bouchon sensor injection de liquide	liquid injection sensor plug	toma sensor inyección de liquido	tampa sensor injeção de liquido
9	raccord pressostat diff. huile (b.p.)	oil pressure switch connection (l.p.)	conexión presostato diferencial aceite (b.p.)	conexão para pressostato de óleo (b.p.)
10	raccord pressostat diff. huile (h.p.)	oil pressure switch connection (h.p.)	conexión presostato diferencial aceite (a.p.)	conexão para pressostato de óleo (a.p.)
11	filtre à huile	oil filter	filtro aceite	filtro de óleo
12	bouchon retour d'huile	oil return plug	toma retorno aceite	tampa retorno óleo
13	bouchon magnetique	magnetic plug	toma magnético	tampa magnético
14	bouchon sensor max.temp.de refoulement	max. discharge temperature sensor plug	toma sensor alta temperatura de descarga	tampa sensor da max. temperatura de descarga
15	raccord pressostat diff. huile électronique	electronic oil pressure switch connection	conexión presostato electrónico aceite	conexão sensor do pressostato eletrónico
DV	vanne de refoulement	discharge valve	válvula descarga	válvula de serviço de descarga
NP	plaque signalétique	name plate	tarjeta	plaqueta
SV	vanne d'aspiration	suction valve	válvula aspiración	válvula de serviço de aspiração

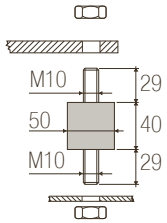
Plans cotés — Dimensional drawing — Plano de dimensiones — Dimensões







Support anti-vibrations
Vibration absorber
Antivibrador
Sinoblocos



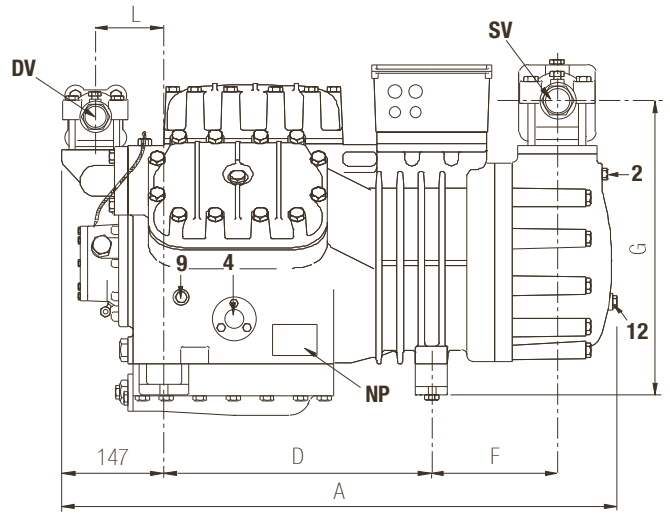
Série Series Série Serie **Z**

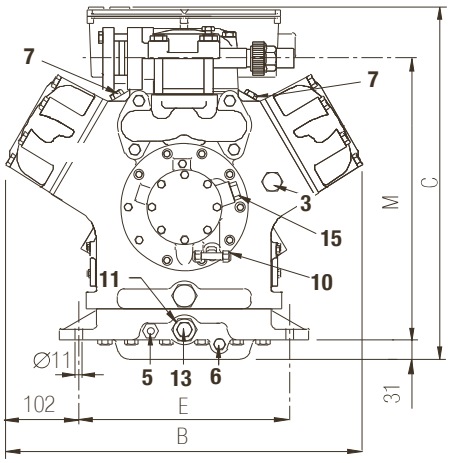
FCAT04-14

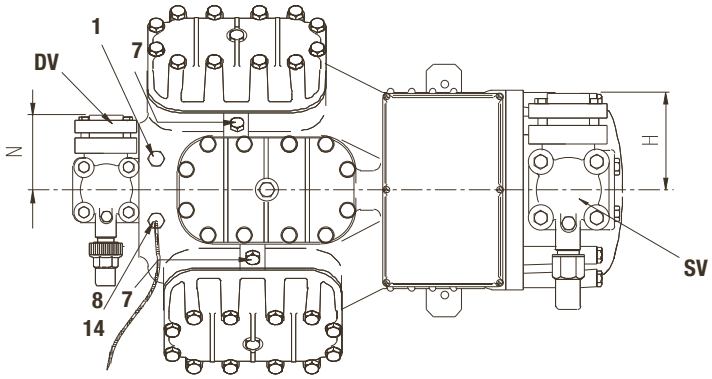
Compresseur Compressor Compresor Compressor	Vanne d'aspiration Suction valve Válvula aspiración Válvula de aspiração		Vanne de refoulement Discharge valve Válvula descarga Válvula de descarga		Longueur Length Longitud Comprime.	Largeur Width Amplitud Largura	Hauteur Height Altura Altura	Trous de fixation Base mounting Anclajes Distancia de fixação		Vanne d'aspiration Suction valve Válvula aspiración Válvula de aspiração			Vanne de refoulement Discharge valve Válvula descarga Válvula de descarga		
	∅ "	∅ mm	∅ "	∅ mm	A mm	B mm	C mm	D mm	E mm	F mm	G mm	H mm	L mm	M mm	N mm
Z 30 126 Y	2"⅛	54.0	1"⅜	35.0	765	509	536	381	305	155	433	130	123	321	42
Z 40 126 Y	2"⅝	67.0	1"⅝	42.0	806	509	536	381	305	180	433	130	123	321	42

1	bouchon haute pression	high pressure plug	toma de alta presión	tomada de alta pressão
2	bouchon basse pression	low pressure plug	toma de baja presión	tomada de baixa pressão
3	bouchon charge d'huile	oil charge plug	toma de carga de aceite	ponto de carga do óleo
4	voyant de niveau huile	oil level sight glass	visor nivel de aceite	visor do nível de óleo
5	doigt de gant pour résistance de carter	crankcase heater seat	ubicación resistencia aceite	sede da resisténcia do cárter
6	bouchon vidange d'huile	oil drain plug	toma de descarga aceite	descarga do óleo
7	bouchon électrov.injection de liquide	liquid injection valve plug	toma valvúla inyección de liquido	tampa válvula injeção de liquido
8	bouchon sensor injection de liquide	liquid injection sensor plug	toma sensor inyección de liquido	tampa sensor injeção de liquido
9	raccord pressostat diff. huile (b.p.)	oil pressure switch connection (l.p.)	conexión presostato diferencial aceite (b.p.)	conexão para pressostato de óleo (b.p.)
10	raccord pressostat diff. huile (h.p.)	oil pressure switch connection (h.p.)	conexión presostato diferencial aceite (a.p.)	conexão para pressostato de óleo (a.p.)
11	filtre à huile	oil filter	filtro aceite	filtro de óleo
12	bouchon retour d'huile	oil return plug	toma retorno aceite	tampa retorno óleo
13	bouchon magnetique	magnetic plug	toma magnético	tampa magnético
14	bouchon sensor max.temp.de refoulement	max. discharge temperature sensor plug	toma sensor alta temperatura de descarga	tampa sensor da max. temperatura de descarga
15	raccord pressostat diff. huile électronique	electronic oil pressure switch connection	conexión presostato electrónico aceite	conexão sensor do pressostato eletrónico
DV	vanne de refoulement	discharge valve	válvula descarga	válvula de serviço de descarga
NP	plaque signalétique	name plate	tarjeta	plaqueta
SV	vanne d'aspiration	suction valve	válvula aspiración	válvula de serviço de aspiração

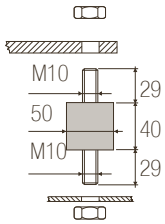
Plans cotés — Dimensional drawing — Plano de dimensiones — Dimensões







Support anti-vibrations
Vibration absorber
Antivibrador
Sinoblocos



Série Series Série Serie **Z**

FCAT04-14

Compresseur Compressor Compresor Compressor	Vanne d'aspiration Suction valve Válvula aspiración Válvula de aspiração		Vanne de refoulement Discharge valve Válvula descarga Válvula de descarga		Longueur Length Longitud Comprime.	Largeur Width Amplitud Largura	Hauteur Height Altura Altura	Trous de fixation Base mounting Anclajes Distancia de fixação		Vanne d'aspiration Suction valve Válvula aspiración Válvula de aspiração			Vanne de refoulement Discharge valve Válvula descarga Válvula de descarga		
	Ø "	Ø mm	Ø "	Ø mm	A mm	B mm	C mm	D mm	E mm	F mm	G mm	H mm	L mm	M mm	N mm
Z 40 154 Y	2"⅝	67.0	1"⅝	42.0	794	509	536	381	305	180	433	130	100	411	95
Z 50 154 Y	2"⅝	67.0	1"⅝	42.0	794	509	536	381	305	180	433	130	100	411	95

1	bouchon haute pression	high pressure plug	toma de alta presión	tomada de alta pressão
2	bouchon basse pression	low pressure plug	toma de baja presión	tomada de baixa pressão
3	bouchon charge d'huile	oil charge plug	toma de carga de aceite	ponto de carga do óleo
4	voyant de niveau huile	oil level sight glass	visor nivel de aceite	visor do nível de óleo
5	doigt de gant pour résistance de carter	crankcase heater seat	ubicación resistencia aceite	sede da resisténcia do cárter
6	bouchon vidange d'huile	oil drain plug	toma de descarga aceite	descarga do óleo
7	bouchon électrov.injection de liquide	liquid injection valve plug	toma valvúla inyección de liquido	tampa válvula injeção de liquido
8	bouchon sensor injection de liquide	liquid injection sensor plug	toma sensor inyección de liquido	tampa sensor injeção de liquido
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11	filtre à huile	oil filter	filtro aceite	filtro de óleo
12	bouchon retour d'huile	oil return plug	toma retorno aceite	tampa retorno óleo
13	bouchon magnetique	magnetic plug	toma magnético	tampa magnético
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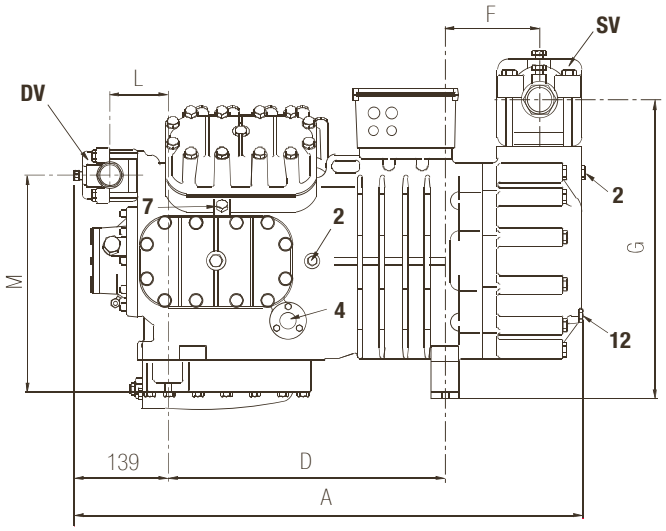
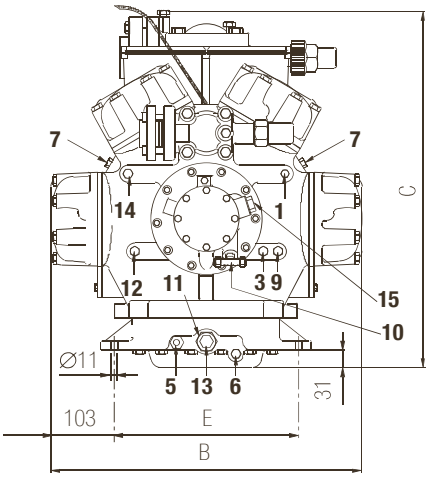
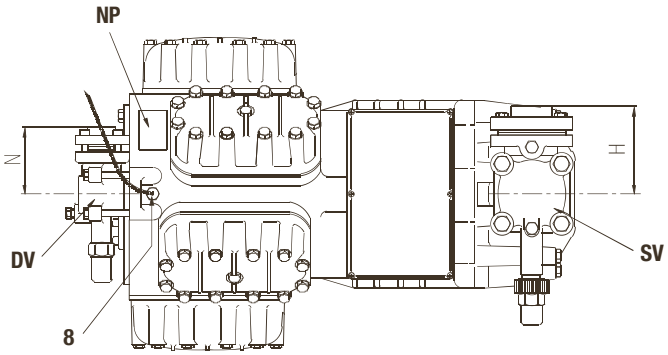
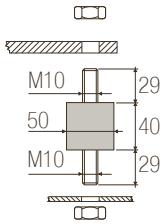
Plans cotés — Dimensional drawing — Plano de dimensiones — Dimensões







Support anti-vibrations
Vibration absorber
Antivibrador
Sinoblocos



Série / Series / Série / Serie **W**

FCAT04-14

Compresseur / Compressor / Compresor / Compressor	Vanne d'aspiration / Suction valve / Válvula aspiración / Válvula de aspiração		Vanne de refoulement / Discharge valve / Válvula descarga / Válvula de descarga		Longueur / Length / Longitud / Comprime.	Largeur / Width / Amplitud / Largura	Hauteur / Height / Altura / Altura	Trous de fixation / Base mounting / Anclajes / Distancia de fixação		Vanne d'aspiration / Suction valve / Válvula aspiración / Válvula de aspiração			Vanne de refoulement / Discharge valve / Válvula descarga / Válvula de descarga		
	∅ "	∅ mm	∅ "	∅ mm	A mm	B mm	C mm	D mm	E mm	F mm	G mm	H mm	L mm	M mm	N mm
W 40 142 Y	2"⅝	67.0	1"⅝	42.0	838	511	588	458	305	158	486	160	95	358	95
W 40 168 Y	2"⅝	67.0	1"⅝	42.0	838	511	588	458	305	158	486	160	95	358	95
W 50 168 Y	3"⅛	79.4	1"⅝	42.0	838	511	588	458	305	158	486	160	95	358	95
W 50 187 Y	3"⅛	79.4	1"⅝	42.0	838	511	588	458	305	158	486	160	95	358	95
W 60 187 Y	3"⅛	79.4	1"⅝	42.0	838	511	588	458	305	158	486	160	95	358	95
W 60 206 Y	3"⅛	79.4	2"⅛	54.0	838	511	588	458	305	158	486	160	95	358	162
W 70 206 Y	3"⅛	79.4	2"⅛	54.0	864	511	588	458	305	190	486	160	95	358	162
W 70 228 Y	3"⅛	79.4	2"⅛	54.0	864	519	588	458	305	190	486	160	95	358	162
W 75 228 Y	3"⅛	79.4	2"⅛	54.0	864	519	588	458	305	190	486	160	95	358	162
W 75 240 Y	3"⅛	79.4	2"⅛	54.0	864	519	588	458	305	190	486	160	95	358	162
W 80 240 Y	3"⅛	79.4	2"⅛	54.0	864	519	588	458	305	190	486	160	95	358	162

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4	voyant de niveau huile	oil level sight glass	visor nivel de aceite	visor do nível de óleo
5	doigt de gant pour résistance de carter	crankcase heater seat	ubicación resistencia aceite	sede da resisténcia do cárter
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SV	vanne d'aspiration	suction valve	válvula aspiración	válvula de serviço de aspiração

Accessories — Optional equipments — Equipamiento opcional — Acessórios opcionais

	serie compresseur - compressor series - serie compresor - serie compressor									
	A	B	C	D	F	Q	S	V	Z	W
Régulateur de puissance Capacity control Regulación de capacidad Contrôle de capacidade frigorifica	▯	▯	▯	▯	▯	○	○	○	○	○
Démarrage à vide Unload starting Arranque sin carga Dispositivo de partida em vazio	▯	▯	▯	▯	○	○	○	○	○	○
Résistance de carter Crankcase heater Calefactor aceite cárter Resistência de cárter	○	○	○	○	○	○	○	○	○	○
Motoventilateur refroid. des culasses Head motorfan Motoventilador enfriamiento culata Motoventilador resfriamento do cabeçote	○	○	○	○	○	○	○	○	○	○
Injection de liquide Liquid injection Inyección de liquido Injeção de liquido	▯	▯	▯	▯	▯	▯	○	○	○	○
Pressostat diff. huile électronique Electronic oil pressure switch Presostato electrónico diferencial aceite Pressostato eletrônico de óleo	▯	▯	▯	▯	▯	▯	▯	◆	◆	◆
Sensor max. temperature de refoulement Maximum discharge temperature sensor Sensor alta temperatura de descarga Sensor da max. temperatura de descarga	▯	▯	▯	▯	▯	○	○	◆	◆	◆

▯ pas disponible - not available - no disponible - não disponível
○ sur demande - on request - a pedido - sob pedido
◆ dotation standard - standard equipment - equipo estandard - standard de fornecimento

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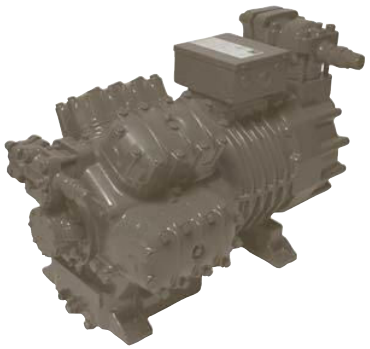

Istruzioni per la installazione e l'avviamento

Installation and start-up instruction

COMPRESSORI SEMIERMETICI
SEMI-HERMETIC COMPRESSORS

FRASCOLD SpA si riserva il diritto di modificare i dati e le caratteristiche contenute nel presente catalogo, senza obbligo di preavviso.

FRASCOLD SpA reserves the right to change at any time, specifications or design without notice and without incurring obligations.

Ref: **FTEC01-03**

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Realizzazione:	FRASCOLD SpA	Design:	FRASCOLD SpA

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FTEC01-03

NORME DI SICUREZZA

- queste apparecchiature sono destinate esclusivamente ad operatori professionalmente preparati che devono conoscere i fondamenti della refrigerazione, i sistemi frigoriferi, i gas refrigeranti e gli eventuali danni che possono provocare le apparecchiature in pressione.
- leggere attentamente il presente manuale che deve essere conservato per tutta la durata del compressore; la scrupolosa osservanza delle procedure illustrate è condizione essenziale per la sicurezza dell'operatore, l'integrità delle apparecchiature e la costanza delle prestazioni dichiarate.
- il compressore deve funzionare esclusivamente con fluidi refrigeranti indicati dal costruttore.
- durante le varie operazioni, evitare assolutamente di disperdere in ambiente il refrigerante; tale precauzione, oltre ad essere richiesta dalle norme internazionali a tutela dell'ambiente, è indispensabile al fine di evitare che la presenza di refrigerante in ambiente renda difficile la localizzazione delle eventuali perdite.
- non manomettere o modificare la taratura dei sistemi di sicurezza e di controllo.
- in nessun caso, introdurre ossigeno all'interno del compressore.
- verificare che le caratteristiche della rete elettrica di alimentazione siano adeguate alle caratteristiche del compressore.
- prima di alimentare elettricamente il compressore, verificare che i rubinetti di aspirazione e di compressione siano completamente aperti e che il coperchio della morsettiera sia stato sigillato.
- verificare sempre che il compressore sia collegato a una rete elettrica di alimentazione adeguatamente protetta e dotata di efficiente linea di messa a terra.
- rimuovere il coperchio della scatola terminale solo dopo aver interrotto l'alimentazione elettrica del compressore.
- non avviare il compressore quando al suo interno sussistono condizioni di alto vuoto.
- evitare di inalare i vapori di refrigerante.
- è consigliabile indossare adeguate protezioni quali occhiali e guanti; la bassa temperatura di ebollizione del refrigerante può provocare danni fisici all'operatore.
- evitare il contatto tra refrigerante e fiamme libere o superfici calde; alle alte temperature, il refrigerante si decompone liberando sostanze tossiche, dannose sia per l'ambiente che per l'operatore.
- il compressore viene fornito con una carica di tenuta di azoto alla pressione di 1 bar; rimuovere i bulloni del compressore solo dopo avere eliminato la carica di tenuta.
- toccare il compressore solo dopo un lungo periodo di inattività; durante il funzionamento, alcune sue parti possono raggiungere temperature superiori a 100°C e richiedono tempo per raffreddarsi.

SAFETY PRECAUTIONS

- only trained operators with knowledge of refrigeration fundamentals, cooling systems, refrigerants and the potential harm of handling pressurised equipment can work on system.
- read carefully the instructions in the literature, keep this pubblication for the whole service life of the compressor; strict observance of the procedures are essential for safety of the operator, mantaining declared performances and satisfactory operation.
- compressor must only operate with refrigerants indicated by manufacturer.
- during maintenance do not release refrigerants to the environment; this is not only required by international law for protecting the environment, but also to avoid difficulties in detecting leaks in a heavily polluted atmosphere.
- do not adjust safety valves and control settings.
- do not use oxygen to press test the compressor.
- verify that characteristics of electric power are suitable to compressor characteristics.
- before switching on the compressor check that the suction and discharge valves are fully open and that the terminal box cover is fitted.
- compressor must always be suitably connected to a protected and earthed power line.
- turn off the compressor and disconnect it from power line before removing the terminal box cover.
- do not start the compressor with the system in high vacuum condition.
- avoid breathing refrigerant vapour.
- wear safety glasses and gloves when handling refrigerant or performing maintenance procedures; avoid contact with refrigerant, blindness and injuries may result to operator.
- keep away from flames and hot surfaces; high temperature decomposes refrigerant releasing toxic contaminants which are very dangerous for environment and operator.
- compressor is supplied with a nitrogen holding charge with pressure 1 bar; remove compressor bolts only after the holding charge has been vented.
- do not touch the compressor until it has been inoperative for a long period; when operating temperatures can reach 100°C / 212°F and needs time to cool.

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1. Descrizione generale

FRASCOLD offre una moderna ed efficiente linea di prodotti per la refrigerazione e il condizionamento dell'aria tra i quali compressori semiermetici, di tipo alternativo monostadio.
Per maggiori dettagli, consultare il catalogo "Compressori semiermetici FRASCOLD".

1.1 La dotazione standard

Ogni compressore viene fornito completo di:
- carica di olio lubrificante
- carica di tenuta con azoto alla pressione manometrica di 1 bar
- supporti antivibranti in gomma
- dispositivo di protezione del motore elettrico
- scatola terminale completa di barrette a ponticello e dadi di bloccaggio
- kit di guarnizioni di ricambio per rubinetti di scarico e aspirazione, collocate all'interno della scatola terminale
- bollettino tecnico "Istruzioni per l'installazione e l'avviamento" inserito all'interno della scatola parti elettriche
- pressostato differenziale olio elettronico per i compressori serie V, Z, W

A richiesta, è possibile fornire il compressore equipaggiato con una vasta gamma di accessori idonei a garantire efficienza e affidabilità a tutte le condizioni di funzionamento previste.
Per maggiori dettagli, consultare i manuali di installazione relativi ai singoli accessori (vedi pagina 17, "7. Equipaggiamenti e accessori") .

1.2 La targhetta

Ogni compressore è dotato di targhetta metallica rivettata, sulla quale sono riportati indelebilmente tutti i dati caratteristici del compressore stesso.
Per maggiori dettagli, vedi figura 1.

1.3 La protezione

I compressori vengono forniti completi di protezione integrale, conforme alla norma DIN44081, costituita da una catena di termistori PTC inseriti nello statore del motore elettrico e collegati a un modulo elettronico di controllo KRIWAN (modello T00ECA01 per i compressori serie A, B, C, D, F, Q e S; modello T00ECA11 per i compressori serie V, Z e W.
Il modulo modello T00ECA11, è dotato di circuito di ritardo che permette l'avviamento del compressore solo dopo che sono trascorsi 5 minuti dal

1. Introduction

FRASCOLD offers a modern and high performance range of products for refrigeration and air-conditioning including single stage reciprocating semi-hermetic compressors.
For further details, please consult the catalogue "FRASCOLD semi-hermetic compressors".

1.1 Standard equipment

Each compressor is supplied complete with:
- oil charge
- nitrogen holding charge at 1 bar gauge pressure
- rubber vibration absorbers
- electric motor protection
- terminal box complete with staple bars and nuts
- spare parts set for discharge and suction valves, placed inside the terminal box
- technical leaflet "Installation and start-up instructions" placed inside the terminal box of the compressor
- electronic oil pressure switch, compressors of the series V, Z, W

Upon request, it is possible to supply the compressor equipped with a large range of accessories suitable to achieve better efficiency and reliability for any foreseen operational condition.
For further details, consult installation manuals concerning the individual accessories (see page 17, "7. Equipments and accessories") .

1.2 Name plate

Each compressor is equipped with a rivetted name plate, on which are indicated indelebly all compressor characteristic data.
For further details, see figure1.

1.3 Protection

Compressors A, B, C, D, Q, F, S, V, Z and W series are supplied with integral protection, in accordance to DIN44081 standard, with PTC thermistors placed into the electrical motor stator and connected to an electronic control module KRIWAN (model T00ECA01 for A, B, C, D, Q, F and S series compressors; model T00ECA11 for V, Z and W series compressors).
The module model T00ECA11 is equipped with 5 minute delay circuit that protects against "short cycling (see page 7, "1.10 Maximum stop/starts per hour" and "1.11 Application limits").

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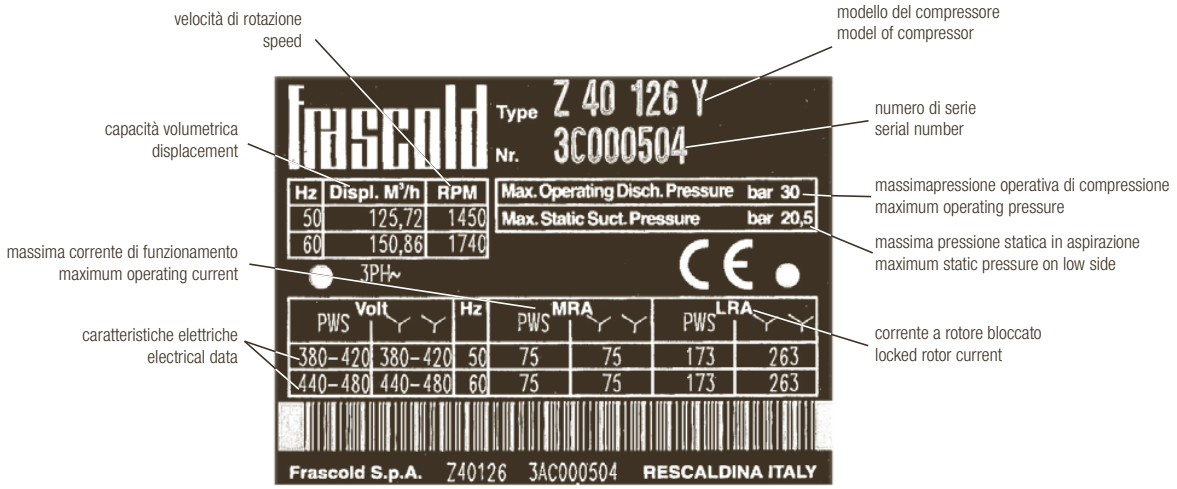


la targhetta - name plate
fig. 1

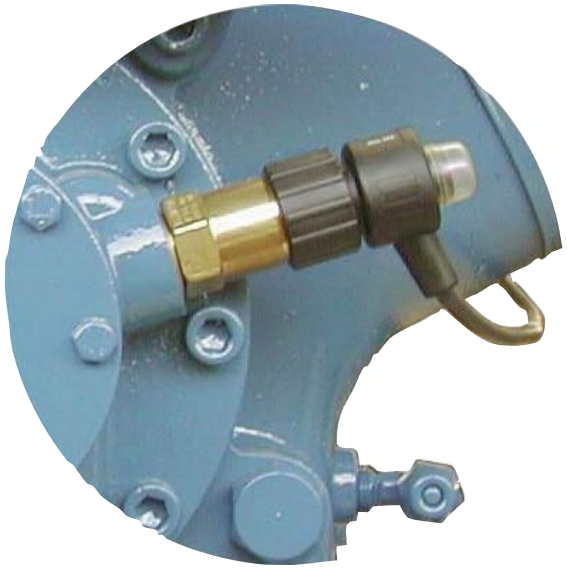
suo intervento, impedendo così una successione troppo frequente di avviamenti e arresti (vedi pagina 7, §1.10 I cicli di funzionamento e §1.11 Limiti di impiego).
L'equipaggiamento standard per i compressori serie V, Z e W è completo di un sensore di temperatura direttamente inserito sul lato compressione del compressore (vedi fig.2).
Tale accessorio a reinserzione automatica, tarato a 130°C e collegato in serie ai termistori PTC, arresta il funzionamento del compressore quando la temperatura di fine compressione raggiunge valori critici.
A richiesta, è possibile equipaggiare anche i compressori serie Q ed S con il sensore di massima temperatura di compressione.
Per il collegamento dei dispositivi di protezione, consultare il presente manuale a pagina 10 §3.3 Collegamenti elettrici e gli schemi elettrici menzionati al capitolo 11.

1.4 La scatola terminali

All'interno della scatola, sono alloggiati tutti i terminali per il collegamento del compressore alla rete di alimentazione elettrica e al circuito di controllo e protezione.
Il corpo della scatola è realizzato in un unico pezzo ed il coperchio è dotato di guarnizione tipo O-ring; grado di protezione IP55.
N.B. La scatola terminali contiene una serie completa di guarnizioni per i rubinetti di scarico e di aspirazione e il circuito di controllo del pressostato differenziale olio.
La morsettiera di alimentazione dei compressori trifase, è completa di barrette a ponticello e dadi di bloccaggio.
Per il collegamento elettrico del compressore, consultare il presente manuale a pagina 10 §3.3 Collegamenti elettrici e gli schemi riportati sul documento M041.

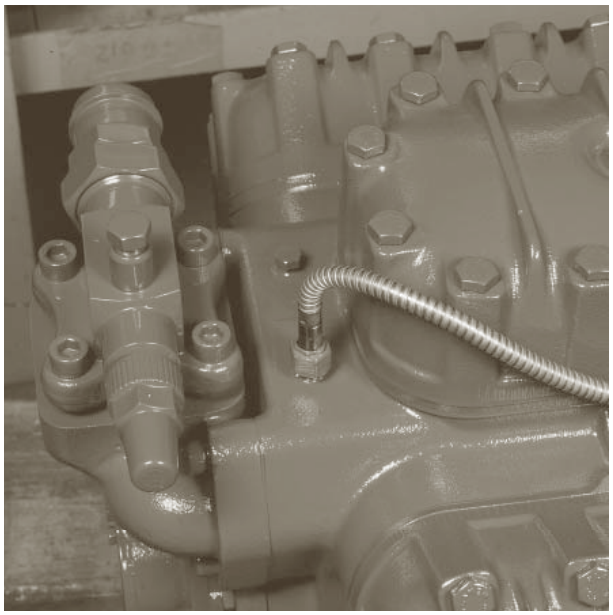
1.5 La lubrificazione

I compressori serie A, B, C, D, F, Q, e S sono lubrificati mediante disco centrifugatore dell'olio; nei compressori serie V, Z e W, la lubrificazione è garantita da una pompa ad alta pressione.
Tutti i compressori con pompa di lubrificazione sono dotati di filtro olio e attacchi per rilevare la pressione di mandata della pompa e di pressostato differenziale elettronico (vedi figura 3) per proteggere il compressore da danni causati da scarsa lubrificazione.



pressostato differenziale olio elettronico
electronic oil pressure switch
fig.3

Standard equipment of V, Z and W series compressors includes a maximum discharge temperature sensor (see fig. 2).
This accessory with automatic reset, it is connected in series with PTC thermistors and is calibrated at 130°C to stop compressor operating when the discharge temperature reachs that critical value.
Upon request, discharge temperature sensor can fits Q and S series compressors.



sensore di massima temperatura di compressione
maximum discharge temperature sensor
fig.2

As concern protection device connection, consult the present manual on page 10 §3.3 Electrical connections and the wiring diagrams on M041.

1.4 Terminal box

Inside the box, there are all the terminals for compressor connection to the electrical net and to the check and protection circuit.
The body of the box is manufactured as a single piece with the cover having a O-ring seal giving an enclosure rating of IP55.
N.B. The terminal box contains a complete gasket set for discharge and suction valves and the control circuit of oil pressuse switch.
The electric terminal box for three phase compressors are complete with staple bars and stop nuts.
As per compressor electrical connection, consult the present manual on page 10 §3.3 Electrical connections and the the wiring diagrams starting from page 60.

1.5 Lubrication

Compressors A, B, D, F, Q, and S series are lubricated by means oil thrower disc.
In compressors V, Z and W series, lubrication is achieved by high pressure oil pump.
All compressors with oil pump are complete with oil filter and connections for pump discharge pressure and oil differential pressure electronic switch to protect the compressor from damages caused by lack of lubrication.

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1.6 Il lubrificante

Tutti i compressori FRASCOLD vengono caricati in fabbrica con una adeguata quantità di lubrificante estere di polioli POE.
Il tipo di lubrificante e la sua viscosità sono commisurati sia al refrigerante che al campo delle temperature di evaporazione alle quali il compressore può operare; per maggiori dettagli, vedere FTEC27.
Ogni sostituzione del lubrificante o eventuale reintegro della carica, deve assolutamente essere effettuata con lo stesso tipo di olio contenuto originariamente oppure di tipo approvato dalla FRASCOLD e seguendo scrupolosamente la procedura illustrata a pagina 21, «9.1 Sostituzione del lubrificante».

1.7 I rubinetti di compressione e aspirazione

Il compressore viene fornito con i rubinetti di compressione e di aspirazione già montati sul compressore e completi di guarnizioni.
Nel caso fosse necessario smontare i rubinetti dal corpo del compressore (per esempio, prima della saldatura dei tubi del circuito frigorifero), le guarnizioni devono essere rimosse e successivamente sostituite con quelle fornite a corredo e poste all'interno della scatola terminale.
Il collegamento dei rubinetti ai tubi del circuito frigorifero deve essere eseguito seguendo la procedura illustrata a pagina 9, «3.2 Collegamenti frigoriferi».

1.8 I supporti antivibranti

Ogni compressore viene fornito completo di quattro supporti antivibranti in gomma, uguali tra loro e confezionati separatamente con la minuteria necessaria per il loro montaggio.
Il montaggio deve essere eseguito seguendo le istruzioni illustrate a pagina 8, «3.1 Fissaggio del compressore al basamento».

1.9 La carica di tenuta

Al termine del collaudo in linea, il compressore viene pressurizzato con azoto alla pressione manometrica di 1 bar.
Tale carica di tenuta, che ha lo scopo di impedire infiltrazioni di umidità all'interno del compressore durante il trasporto e lo stoccaggio, deve essere rimossa prima delle operazioni di carica del refrigerante nel circuito

ATTENZIONE

Prima di rimuovere qualsiasi vite o rubinetto del compressore, eliminare la carica di tenuta allentando lentamente il dado cieco del rubinetto di compressione.

1.10 I cicli di funzionamento

Una successione troppo frequente di avviamenti e arresti del compressore è causa di notevoli sollecitazioni meccaniche e surriscaldamento del motore elettrico che riducono sensibilmente la vita operativa del compressore.
Tale inconveniente potrebbe derivare dall'avere scelto un compressore troppo potente rispetto al carico termico o da un termostato di regolazione con un differenziale troppo piccolo.

1.11 Limiti di impiego

Sbilanciamento della corrente tra due fasi	10%
Sbilanciamento della tensione tra due fasi	2%
Tolleranza sulla tensione nominale	±5%
Numero di cicli *	10/ora
Pressione statica sul lato di bassa pressione	20.5 bar
Pressione operativa sul lato di alta pressione	30 bar
Temperatura di scarico	130°C

* con almeno 5 minuti di funzionamento continuo
Tali valori sono da considerare limiti da non superare in qualsiasi condizione operativa.

1.6 Lubricant

All FRASCOLD compressors are charged in the factory with an adequate quantity of POE polyol ester lubricant.
The lubricant type and its viscosity are fitted both to refrigerant and to evaporating temperatures field at which the compressor may work.
For further details, consult FTEC27.
Each lubricant replacement or eventual charge recovery have to be absolutely effected with the same oil type originally contained or with a type approved by FRASCOLD and following strictly the procedure illustrated on page 21, «9.1 Lubricant replacement».

1.7 Discharge and suction valves

The compressor is supplied with discharge and suction valves already assembled on the compressor and complete with gaskets.
In case it is necessary to disassemble the valves from compressor body (for example before refrigerating circuit pipes welding), the gaskets have to be removed and then replaced with those supplied as spares and placed inside the terminal board.
The valve connection to the refrigerating circuit pipes has to be executed following the procedure illustrated on page 9, «3.2 Refrigerating connections».

1.8 Vibration absorbers

Each compressor is supplied complete with four rubber vibration absorbers, all equal and packed separately with the necessary small parts for their assembling.
The assembly has to be executed following the instructions illustrated on page 9, «3.1 Compressor fixing to frame».

1.9 Holding charge

At the end of the test on-line, the compressor is pressurized with nitrogen at 1 bar gauge; this holding charge has the purpose to avoid humidity infiltrations inside the compressor during transport and stockage.

WARNING

Before removing any compressor bolt or valve, vent the holding charge by opening slowly the discharge valve

1.10 Maximum stop/start per hour

A too frequent sequence of compressor start and stop causes of many mechanical stresses and electrical motor overheating, which reduce considerably the compressor lifetime.
This inconvenience could have a source in the choice of a too powerful compressor with respect to the thermal charge or of a regulation thermostat with a too small differential.

1.11 Application limits

Current unbalance between two phases	10%
Tension unbalance between two phases	2%
Tolerance on nominal tension	±5%
Cycle number *	10/hour
Static pressure on low pressure side	20.5 bar
Working pressure on high pressure side	30 bar
Discharge temperature	130°C

* with 5 min. of minimum continuous running

These values are to be considered as limits not to exceed in every working condition.

2. Controlli, operazioni preliminari prima della installazione

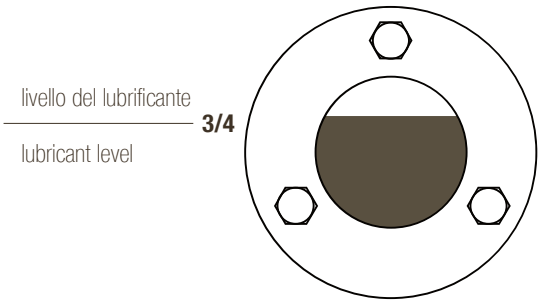
Una volta ricevuto il compressore e prima di procedere alla sua installazione, eseguire alcune semplici operazioni allo scopo di verificarne la sua integrità e idoneità al montaggio nel circuito frigorifero.

2.1 Controlli e verifiche

a) al momento del ricevimento del compressore, verificare che il suo imballo non abbia subito danni durante il trasporto
b) rimuovere l'imballo del compressore
c) verificare che il compressore non sia danneggiato

N.B. Nel caso venissero riscontrati danni o manomissioni, inviare tempestivamente una segnalazione scritta.

d) verificare che la dotazione di componenti forniti a corredo del compressore sia completa così come illustrato a pagina 5 "1.1 La dotazione standard"
e) adagiare su un piano orizzontale il compressore e verificare che il livello del lubrificante sia sempre superiore a 3/4 della spia di livello (vedi figura 4)



livello dell'olio - oil level
fig. 4

f) verificare che le caratteristiche elettriche riportate sulla targhetta del compressore (vedi figura 1, pagina 5) siano compatibili con i valori della rete di alimentazione

2.2 Il sollevamento del compressore

Tutti i compressori sono dotati di una apposita asola o anello di sollevamento (vedi figura 5).
Gli strumenti utilizzati per il sollevamento (ganci, corde, etc) devono avere caratteristiche di resistenza compatibili con i pesi dei compressori.
Non sollevare il compressore agganciandolo ai rubinetti di servizio o altri accessori, per evitare danni permanenti al compressore e/o perdite di refrigerante.
Durante il sollevamento, tenere fermo il compressore per evitare le oscillazioni.

2. Preliminary checks and operations before installation

Upon compressor receipt and before its installation, execute some easy operations in order to verify its integrity and fitness for assembly in the refrigerating circuit.

2.1 Checks and testings

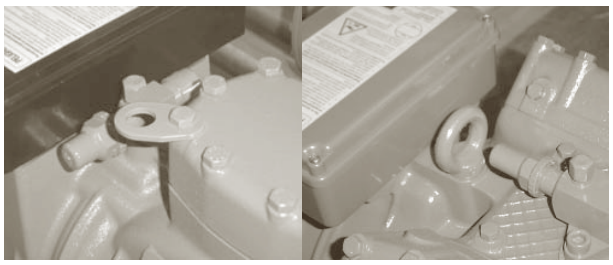
a) at compressor receipt, verify that its packing has not been damaged during transport
b) remove compressor packing
c) verify that the compressor is not damaged

N.B. In case damage or tampering found, send immediately a written communication.

d) verify that the components supplied as compressor equipment are complete as illustrated on page 5 "1.1 Standard equipment"
e) put the compressor on a horizontal surface and verify that the lubricant
level is not lower than 3/4 of level sight glass (see figure 4)
f) verify that the electrical characteristics on the compressor name plate (see figure 1, page 5) are in accordance with the electrical net values.

2.2 Compressor lifting

All compressors are equipped with a suitable lifting slot or ring placed between the heads and the terminal board.
Compressors should only be moved with equipments suitable for the weight involved.



sollevamento del compressore - compressor lifting
fig.5

Never lift the compressor, hooking suction and discharge valves as well other accessories to avoid damages and refrigerant leakages.
During lifting, keep the compressor still to avoid oscillations.

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3. Installazione del compressore

3.1 Fissaggio del compressore al basamento

È importante che il compressore venga fissato a un basamento perfettamente orizzontale che, oltre a garantire un funzionamento privo di anomale sollecitazioni, è indispensabile per la perfetta lubrificazione delle parti in movimento.

L'impiego dei supporti antivibranti forniti a corredo impedisce alle vibrazioni, che si manifestano durante il funzionamento, l'arresto e l'avviamento, di venire trasmesse al basamento sul quale il compressore è montato.

a) allestire il posto di installazione del compressore rispettando gli spazi tecnici necessari così come indicato nei disegni dimensionali

b) mediante i quattro supporti intivibranti forniti a corredo, fissare il compressore al posto di installazione, applicando ai dadi la coppia di serraggio qui di seguito riportata.

Supporti antivibranti - coppia di serraggio dei dadi			
dimensioni del dado		M8	M10
serraggio	Nm	20	30

3.2 Collegamenti frigoriferi

ATTENZIONE

Prima di rimuovere qualsiasi vite o rubinetto del compressore, eliminare la carica di tenuta allentando lentamente il dado cieco del rubinetto di compressione.

La realizzazione dei collegamenti frigoriferi del compressore richiede interventi di brasatura dei rubinetti di aspirazione e di compressione; la affidabilità di un circuito frigorifero è condizionata dalla quantità di prodotti estranei al lubrificante e al refrigerante presenti all'interno del circuito stesso. Mentre aria atmosferica e umidità (inevitabilmente infiltrati durante il montaggio) possono essere rimossi attraverso la vuotatura (vedi pagina 13, "5. Il vuoto e la carica di refrigerante"), l'estrazione dei residui del disossidante e gli ossidi che si formano durante la brasatura è una operazione nè semplice nè economica.

Le dimensioni delle impurità sono talmente ridotte da sfuggire in parte alla azione dei filtri installati sulla linea del liquido; durante l'assemblaggio del circuito frigorifero, è consigliabile adottare tutte le precauzioni possibili atte ad evitare l'introduzione di impurità.

Oltre alle elementari precauzioni da mettere in atto durante il taglio del tubo, è necessario evitare un uso esagerato di disossidanti e, quando possibile, immettere azoto secco o altro gas inerte nella tubazione durante la sua brasatura; per evitare di esporre le parti interne del rubinetto a un pericoloso surriscaldamento, si consiglia di smontare il rubinetto o il solo manicotto (rimuovendone le guarnizioni) e avvolgerlo in un panno bagnato.

a) allentare lentamente il dado cieco del rubinetto di compressione e lasciare sfiatare la carica di tenuta di azoto
b) al termine della operazione serrare accuratamente il dado cieco
c) smontare i rubinetti (o i manicotti) dal compressore (vedi figura 6)
d) rimuovere le guarnizioni (vedi figura 7)
e) procedere alla brasatura dei rubinetti alle tubazioni di compressione e aspirazione del circuito frigorifero, adottando le precauzioni necessarie ad evitare sia il surriscaldamento delle parti interne che l'introduzione di prodotti estranei
f) sostituire le guarnizioni precedentemente rimosse con quelle fornite a corredo poste all'interno della scatola terminale
g) rimontare i rubinetti (o i manicotti) applicando alle viti la coppia di serraggio qui di seguito riportata

Rubinetti - coppie di serraggio delle viti					
dimensione della vite		M8	M10	M12	M16
serraggio	Nm	32	48	64	112

3. Compressor installation

3.1 Compressor fixing to frame

It is important that the compressor is fixed to a frame perfectly horizontal that, as well as guarantees working without anomalous stresses, is indispensable for the perfect lubrication of parts in motion.

The vibration absorbers supplied will reduce operational and stop/start vibrations being transmitted to the compressor frame to which it is fitted.

a) prepare the compressor installation seat, respecting the necessary technical space as indicated on drawings
b) through the four vibration absorbers supplied as equipment, fix the compressor on installation seat, applying the correct tightening torque, as below.

Vibration absorbers - bolt tightening torque			
bolt dimension		M8	M10
tightening torque	Nm	20	30

3.2 Refrigerating connections

WARNING

Before removing any compressor bolt or valve, discharge the holding charge by opening slowly the discharge valve plug.

The compressor refrigerating connections realization require suction and discharge valve brazing operations; the refrigeration system's reliability will be reduced if foreign particles are allowed into the circuit.

While atmospherical air and humidity (infiltrated inevitably during assembly) can be removed through vacuum (see page 13, "5. Vacuum and charge"), the removal of the deoxidizer and oxide residual, which develops during brazing, is an operation neither simple nor cheap.

The impurity dimensions are so small to bypass partly the action of filters installed in liquid lines; during refrigerating circuit assembly, it is advisable to use all possible precautions in order to avoid impurity introduction.

Besides to elementary precautions to take during pipe cutting, it is necessary to avoid an excessive use of deoxidizers and, when possible,to put dry nitrogen or other inert gas in the piping during its brazing;to avoid to offer valve internalparts at a dangerous overheating,it is suggested to disassemble the valve or only the coupling (by removing the gaskets) and wrap it in a wet cloth.

a) open slowly the compressor suction valve plug and vent the nitrogen holding charge
b) close carefully the plug
c) disassemble the valves (or coupling) from the compressor (see figure 6)
d) remove the gaskets (see figure 7)

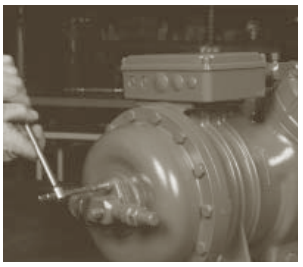

fig. 6

fig. 7

e) effect the brazing of the valves of the discharge and suction pipes of the refrigerating circuit, taking necessary precautions to avoid both internal part overheating and foreign product introduction
f) replace the gaskets previously removed, with those supplied as spares

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Prima di procedere nelle operazioni di installazione, si consiglia di predisporre il compressore per il collegamento dei dispositivi di sicurezza e controllo quali pressostati e manometri, oppure per gli interventi di reintegro della carica di olio.
Il corpo del compressore è dotato di attacchi filettati femmina con tappo di chiusura; la rimozione di alcuni tappi (vedi figura 8) e la loro sostituzione con semplici nipli o, meglio ancora, con valvole di servizio di tipo Schrader (vedi figura 9), metterà a disposizione dell'operatore le necessarie prese di pressione per i collegamenti ai vari dispositivi di controllo e sicurezza.

ATTENZIONE

Non collegare alcun dispositivo di sicurezza e controllo agli attacchi presenti sui rubinetti di aspirazione e di compressione; questi vengono esclusi quando il rubinetto è completamente aperto (intercettazione in retrochiusura).

fig. 8

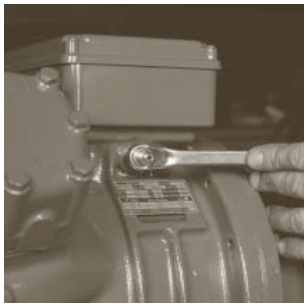

fig. 9

Per identificare i possibili impieghi degli attacchi, fare riferimento ai disegni riportati sui cataloghi.
Per la scelta e il montaggio di equipaggiamenti secondari e/o accessori quali pressostati, termostati, manometri, separatore di olio, etc. si consiglia di prendere visione di quanto riportato a pagina 18, "8. Accessori vari".

3.3 Collegamenti elettrici e del pressostato olio

I collegamenti elettrici devono essere eseguiti in accordo con gli schemi elettrici allegati al presente manuale e nel rispetto delle norme di sicurezza in vigore nel luogo di installazione.
Le norme attualmente in vigore nella Comunità Europea e alle quali è necessario fare riferimento sono EN60204 (Equipaggiamenti elettrici per macchine industriali - Requisiti generali) e EN60355 (Sicurezza degli apparecchi elettrici di uso domestico o similari - Requisiti particolari per i motocompressori).
Per il corretto collegamento del compressore, consultare lo schema elettrico applicato nella parte interna del coperchio della scatola terminali oppure lo schema elettrico e comunque prendere visione di quanto riportato a pagina 12, "4, Avviamento del compressore".

ATTENZIONE

I collegamenti elettrici devono essere eseguiti esclusivamente da personale specializzato.

a) rimuovere il coperchio della scatola terminali
b) posizionare le barrette a ponticello seguendo le indicazioni riportate sul documento M041.

ATTENZIONE

L'errato collegamento elettrico può dare luogo a cortocircuito o collegamenti in contro fase (nel caso di avviamento frazionato PWS) e causare la bruciatura del motore.

c) inserire negli appositi fori della scatola terminali degli idonei pressacavi PG per assicurare il grado di protezione originale della scatola stessa
d) collegare la rete di alimentazione alla morsettiera, utilizzando cavi elettrici isolati e capicorda a occhiello per i terminali
e) applicare ai dadi la seguente coppia di serraggio

Morsettiera - coppia di serraggio

bullone		M4	M6
coppia di serraggio	Nm	4	10

placed inside the terminal box
g) re-assemble the valves (or coupling), applying the following tightening torque

Valves - bolt tightening torque

bolt dimension		M8	M10	M12	M16
tightening torque	Nm	32	48	64	112

Before proceeding to installation operations, it is suggested to arrange the compressor for safety and check devices connection, like pressure switches and manometers, or for oil charge fulfilment interventions.
The compressor body is equipped with different female threaded connections with closing plug; the removal of some plugs (see figure 8) and their replacement with a niple or, better, a Schrader service valves (see figure 9), will put at operator's disposal the necessary pressure connections for various safety and check devices.

WARNING

Do not connect any safety and check device to the connections placed on suction and discharge valves, because they are closed off when the valve is completely open (interception in retroclosing).

See drawings on catalogues for description of their possible use.
For the selection and assembly of secondary equipments and/or accessories like pressure switches, thermostats, manometers, oil separators, etc. it is suggested to look at paragraph on page 18, "8. Various accessories".

3.3 Oil pressure switch and electrical connections

Electrical connections have to be executed in accordance with the wiring diagrams enclosed to the present manual and in observance of installation place safety regulations.
Regulations presently in force in EC and to which it is necessary make reference, are EN60204 (Electrical equipments for industrial machines - General requirements) and EN60355 (Electrical instrument safety for domestic use or similar - Particular requirements for motocompressors).
For the right compressor connection, look at the electrical scheme placed in the inside of terminal box cover or the electrical scheme.

WARNING

Electrical connections have to be executed only by skilled operators.

a) remove the terminal box cover
b) replace the staple bars following the indications of document M041

WARNING

The incorrect electrical connections may cause short circuit or counter phase connections and therefore the motor burn-out.

c) put in the terminal box holes some suitable PG cable-presses to assure the box's original protection grade
d) connect the feeding net to the teminal box, using suitable insulated electrical cable and eyelet cable terminals fitted to terminals
e) apply to nuts the following tightening torque

Terminal box - bolt tightening torque

bolt dimension		M4	M6
tightening torque	Nm	4	10

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d) collegare la rete di alimentazione alla morsettiera utilizzando idoneo cavo elettrico isolato e capicorda ad occhiello adatti ai terminali
e) applicare ai dadi la coppia di serraggio qui di seguito riportata

Scatola terminali - coppia di serraggio dei dadi			
dimensioni dei dadi		M4	M6
serraggio	Nm	4	10

f) rimuovere il coperchio del dispositivo di protezione
g) collegare il dispositivo al circuito elettrico di controllo seguendo quanto
indicato nello schema elettrico e rimontare il coperchio

ATTENZIONE

Non alimentare direttamente i terminali A e B collegati ai termistori PTC.

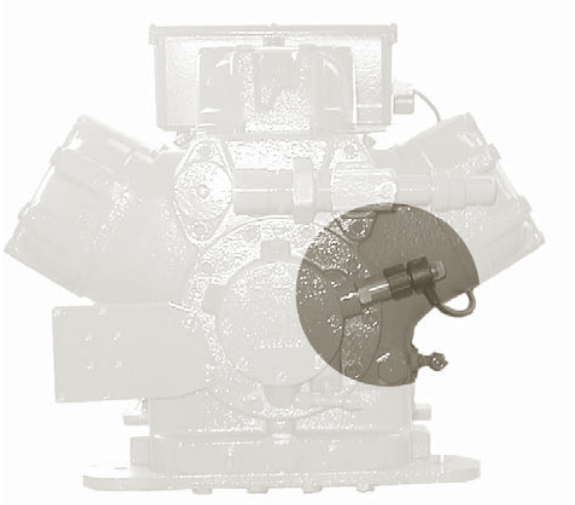
h) prelevare il circuito di controllo del pressostato dalla scatola elettrica del compressore
i) inserire il circuito di controllo nel sensore e serrare a mano la ghiera girevole dopo averne rimosso il suo cappuccio in plastica
l) collegare elettricamente il pressostato differenziale, seguendo lo schema elettrico.
m) rimontare il coperchio sulla scatola terminali

N.B. Equipaggiare il compressore con riscaldatore olio carter e collegarlo in modo da poter essere alimentato manualmente almeno 2 ore prima dell'avviamento successivo a un lungo periodo di inattività e, durante il normale funzionamento, solo a compressore fermo.

3.4 Selezione del teleruttore, dei fusibili e dei cavi

La selezione di idonei teleruttori, fusibili e cavi, deve soddisfare quanto richiesto dalla norma EN60204 (Equipaggiamenti elettrici per macchine industriali - Requisiti generali) facendo riferimento ai valori di massima corrente di funzionamento MRA riportati sulla targhetta del compressore (vedi pagina 5, "1.2 La targhetta") e di massima potenza assorbita.

N.B. La potenza nominale del compressore non è equivalente alla potenza massima del suo motore elettrico.



pompa di lubrificazione con pressostato differenziale olio elettronico
oil pump with electronic oil pressure switch
fig. 10

f) after removing its cover, connect the protection device to check and protection circuit, following the electrical scheme

WARNING

Do not power directly terminals A and B connected to PTC thermistors.

g) reassemble the protection device cover
h) take the control circuit off the electric box of the compressor
i) remove the plastic cap from the sensor then put the control circuit into the sensor and close tightly by hand the screwcap
l) connect the oil pressure switch in accordance with the wiring diagram

m) reassemble the cover of the terminal box

N.B. Complete the compressor with oil crankcase heater and connect it so that it can be feed manually at least 2 hours before starting after a long period of inactivity and, during the normal working, only with the compressor not running.

3.4 Contactor, fuse and cable selection

The suitable remote control switch, fuse and cable selection has to satisfy what requested from EN60204 regulation (Electrical equipments for industrial machines - General requirements), with reference to MRA maximum operating current values reported on the compressor name plate (see page 5, "1.2 Name plate") and maximum input power.

N.B. The compressor nominal power is not equivalent to the maximum input power of its electrical motor.

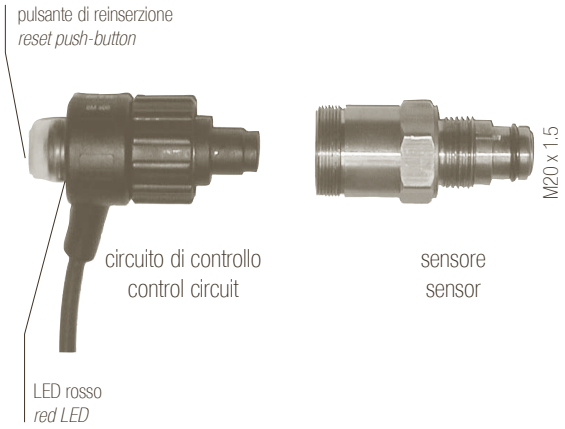


fig. 11

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4. Avviamento del compressore

4.1 Avviamento diretto DOL (Direct On Line) - monofase

I motori monofase sono di tipo CSR (Capacitor Start Run - avviamento e marcia capacitivi) e si avvalgono di due distinti avvolgimenti, uno di marcia (terminali U-W) e uno di avviamento (terminali U-V).
La dotazione standard del compressore monofase comprende una scatola parti elettriche all'interno della quale sono alloggiate i seguenti componenti già tra loro cablati:

- condensatore di marcia
- condensatore di avviamento
- relay di avviamento

Per il suo funzionamento, il compressore deve essere collegato secondo lo schema elettrico.

4.2 Avviamento diretto DOL (Direct On Line) - trifase

Questo tipo di motore è adatto esclusivamente per avviamento diretto.
Posizionando opportunamente le barrette a ponticello, il compressore può funzionare con alimentazione 230V oppure 400V e precisamente:

- collegamento Δ; alimentazione 230V, avviamento diretto
- collegamento 人; alimentazione 400V, avviamento diretto

Gli schemi di collegamento sono riportati sul documento M041.

4.3 Avviamento frazionato PWS (Part Winding Start)

L'avviamento frazionato PWS del motore del compressore permette una sensibile riduzione della corrente di spunto rispetto a quella di un avviamento diretto.
Il motore elettrico con avviamento frazionato PWS è formato da due avvolgimenti completamente separati, tra loro uguali ($^1/_2 \div ^1/_2$) e che operano in parallelo.
Durante il normale funzionamento del compressore, la corrente assorbita da ogni avvolgimento è solo la metà della corrente totale assorbita dal motore.
Con il motore con avviamento frazionato PWS è possibile alimentare i due avvolgimenti indipendentemente e in tempi successivi; questo si ottiene equipaggiando la linea di alimentazione del primo avvolgimento con un normale teleruttore tripolare, la linea di alimentazione del secondo avvolgimento con un teleruttore tripolare e relay temporizzato.
Al momento dell'avvio del compressore, la chiusura istantanea dei contatti del primo teleruttore consente l'alimentazione del primo avvolgimento, con la chiusura ritardata dei contatti del secondo teleruttore si ottiene l'alimentazione del secondo avvolgimento e quindi dell'intero motore elettrico.
Rispetto ai motori PWS con avvolgimenti frazionati in diversi rapporti, i motori con rapporto $^1/_2 \div ^1/_2$ hanno i seguenti vantaggi:

- l'operatore può utilizzare indifferentemente l'uno o l'altro quale primo avvolgimento evitando così ogni possibile errore nell'identificare l'avvolgimento primario
- i due teleruttori necessari per l'avviamento devono avere caratteristiche
  identiche con indubbio vantaggio per la gestione dei ricambi

Il relay temporizzato del secondo teleruttore deve essere tarato per un tempo di ritardo di 0.5÷1 secondo.

N.B. Al fine di evitare danni al motore elettrico, il collegamento tra L1, L2 e L3 della linea di alimentazione elettrica e la morsettiera del compressore deve essere eseguita in modo tale da evitare campi magnetici contrapposti; per esempio la linea che viene collegata al morsetto Z deve essere la stessa collegata al morsetto U, lo stesso vale per le coppie di morsetti X-V e Y-W (vedi fig. 12).

4. Compressor starting

4.1 Direct On Line (DOL) start - single phase

Single phase motors are of CSR type (Capacitor Start Run) with two distinct windings, one for compressor running (terminals U-W) and another one for compressor start (terminals U-V).
Standard equipment for single phase compressor includes a box for electrical components with inside the following parts already cabled:

- run capacitor
- start capacitor
- start relay

For a correct running, compressor must be connected in accordance with the wiring diagram.

4.2 Direct On Line (DOL) start - three phase

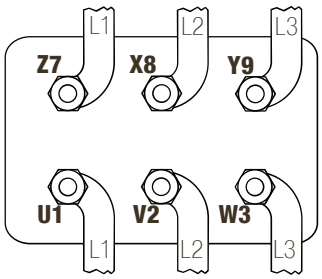
This type of motor is suitable for direct on line start only.
Placing the staple bars suitably, the compressor can be supplied with 230V voltage or 400V voltage, in detail:

- connection Δ; supply 230V, direct on line start
- connection 人; supply 400V, direct on line start

Wiring diagrams for direct on line starting of three phase compressors are reproduced on document M041.

4.3 Part Winding Start (PWS)

The starting of the compressor equipped with a PWS electric motor is distinguished by a lower starting torque than the one of direct on line start motor.
The electric motor with part winding start is of two distinct windings, equivalent partition ($^1/_2 \div ^1/_2$) operating in parallel.
During normal operation of the compressor, the input current by each single winding is only half of the total input current of the whole motor.
With the part winding start motor it is possible to power the two windings indipendently and in different time.



esempio di collegamento PWS - PWS connection example
fig. 12

This is possible by means the installation of a couple of regular three-pole contactors, one on the supply of the first winding and the second on the supply of the second winding; the latter has to be completed with a delayed relay.
Just as the compressor is powered, the closing of the contacts of the first contactor gives power to the first winding, with the delayed contact closing of the second contactor the electric motor is fully powered and the motor starting takes place.
Compared to the part winding start motor with different partition, the motor with $^1/_2 \div ^1/_2$ winding partition are distinguished with following advantages:

- without distinction, operator can use one of the two as first winding; in
  this way it is avoided any mistake in first winding identification
- real advantage in spare parts stock management results because the

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Il compressore con avviamento PWS può essere collegato per avviamento diretto posizionando le barrette a ponticello secondo i disegni riportati sul documento M041.

4.4 Avviamento 人 / Δ (stella/triangolo)

Nel motore elettrico con avviamento 人 / Δ (stella/triangolo) i tre avvolgimenti fanno capo ai sei terminali della morsettiera del compressore.
Per l'avviamento, il collegamento linea di alimentazione/motore avviene in due fasi; prima gli avvolgimenti devono essere collegati a 人 poi a Δ, modificando i ponti tra i vari morsetti.
A tale scopo è necessario utilizzare un teleruttore 人 / Δ che, una volta inserito, provvede autonomamente a commutare i ponti tra i vari morsetti fino al completo avviamento del motore del compressore.
Il ritardo alla commutazione del teleruttore 人 / Δ deve essere tarato a un valore pari a 1÷2 secondi.
Per il collegamento elettrico dei compressori con avviamento 人 / Δ consultare gli schemi riportati sul documento M041.
Il compressore con avviamento 人 / Δ può essere collegato per avviamento diretto posizionando le barrette a ponticello secondo i disegni riportati sul documento M041.

equal characteristics of the two required contactors
The delayed relay for the second contactor has to to be set with a time delay of 0.5÷1 second.
N.B. To save the electric motor from damages due to opposing magnetic fields, linkage between L1, L2 and L3 of power line and terminals of the compressor must be done with the care to connect the same line to the terminals Z and U; the same procedure must be applied for the couples of terminal X-V and Y-W (see fig.12)

By positioning of the staple bars as per the drawings on document M041, it is allowed the direct on line start of the compressor.

4.4 Star-delta (人 / Δ) start

The 人 / Δ (star/delta) start motor has the three wirings leading to the six terminals. For compressor starting, the six terminals are connected first 人 then Δ by means the changing of terminal connection.
To perform this changing, it is necessary a 人 / Δ start contactor that automatically switch the connections of the terminals until the complete compressor starting.
The time delay of the contactor between switching must be set to 1÷2 seconds.
Refer to the wiring diagrams on document M041 for 人 / Δ start of the compressor.
By positioning of the staple bars as per the drawings of document M041, it is allowed the direct on line start of the compressor.

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5. Il vuoto e la carica di refrigerante

Una volta ultimato l'assemblaggio del circuito frigorifero, è necessario procedere alla sua evacuazione e successiva carica con refrigerante; il buon esito di queste due operazioni, condizione essenziale per il buon funzionamento del circuito frigorifero, è determinato dalla assoluta assenza di perdite nel circuito stesso.
Molti sono i metodi e i mezzi utilizzabili per la verifica della tenuta del circuito frigorifero; il più semplice e che dà sufficienti garanzie di affidabilità è articolato in due fasi; la prima da attuarsi al termine della evacuazione con lo scopo di individuare tutte quelle perdite che si manifestano in condizioni di vuoto, la seconda da attuarsi dopo le operazioni di carica per individuare le perdite che si manifestano quando il circuito è in pressione.
A tale proposito leggere attentamente il presente manuale a pagina 13 al punto "5.2 Prova di tenuta in vuoto" e a pagina 14 , "5.4 Ricerca delle fughe di refrigerante".

5.1 L'evacuazione del circuito frigorifero

Prima di effettuare la carica di refrigerante, è indispensabile estrarre dal circuito frigorifero i residui dei gas tecnici utilizzati per la pressatura, l'aria atmosferica, il vapore d'acqua ed eventuali frazioni d'acqua condensate all'interno durante il montaggio del circuito.
Grazie alle basse pressioni residue ottenibili, l'unico mezzo che garantisce una efficace vuotatura è la pompa per vuoto possibilmente del tipo a doppio stadio.
Un vacuometro elettronico collegato alla bocca di aspirazione della pompa, permetterà di verificare il grado di vuoto raggiunto (o pressione residua) e in seguito eseguire il controllo della tenuta in vuoto del circuito.

5. Vacuum and refrigerant charge

After completing the refrigerating circuit, it is necessary to effect its evacuation and following charge with refrigerant.
The successful completion of these two operations are essential for satisfactory operation of the system and total elimination of refrigerant leaks to the environment.
Many methods are available to eliminate leaks in the circuit.
The simplest one that grants sufficient reliability warranties is composed by two phases.
The first one to be executed at the end of circuit evacuation operation checking all the leaks that occur in vacuum condition; the second one to be executed after charge operation to check the leaks that occur when the circuit is under pressure.
On this regard read carefully the present manual at paragraph "5.2 Sealing proof in vacuum" and "5.4 Refrigerant leak detection".

5.1 Refrigerating circuit evacuation

Before effecting the refrigerant charge, it is essential to remove from the refrigerating circuit the gas residuals used for pressure testing, the atmospherical air, the water vapour and eventual water fractions internally condensed during circuit assembly.
Thanks to residual low pressures that can be obtained, the only way that grants an efficient vacuum, is two stage vacuum pump..
An electronic vacuometer connected to the pump suction side, will allow to verify the obtained vacuum level (or residual pressure) and then to effect the check of circuit vacuum sealing.
To obtain an acceptable vacuum degree in reasonably short times, it is

Per ottenere un accettabile grado di vuoto in tempi ragionevolmente contenuti, si consiglia di collegare alla pompa per vuoto sia il lato di alta pressione che quello di bassa pressione del circuito frigorifero.
Le tubazioni flessibili utilizzate per il collegamento alla pompa per il vuoto, devono essere le più corte possibili e con una sezione di passaggio pari alla sezione dell'attacco di aspirazione della pompa stessa.

ATTENZIONE

Durante l'intero periodo di evacuazione, tutti i rubinetti del compressore e ogni altra valvola del circuito frigorifero devono essere completamente aperti.

Una volta raggiunto un grado di vuoto pari ad almeno 0.2 mbar, continuare ad evacuare il circuito mantenendolo in queste condizioni per un tempo commisurato al suo volume interno.
Al termine del periodo di evacuazione, spegnere la pompa solo dopo averne chiuso il rubinetto posto sulla linea di aspirazione della pompa stessa.

ATTENZIONE

Non avviare il compressore in condizioni di alto vuoto.

5.2 Prova di tenuta in vuoto

Ultimata l'evacuazione del circuito frigorifero, è possibile eseguire un primo controllo della sua tenuta, verificando la eventuale presenza delle perdite che si manifestano in condizioni di vuoto.
Dopo lo spegnimento della pompa per vuoto, l'operatore deve leggere il vacuometro collegato alla bocca di aspirazione della pompa e registrare il valore di pressione residua indicato, attendere almeno 5 minuti e verificare se la pressione residua indicata è aumentata a causa di infiltrazioni di aria.
In tale caso, è necessario individuare i punti di infiltrazione, sigillarli, ripetere le operazioni di evacuazione e, per maggiore sicurezza, anche la prova di tenuta in vuoto.

5.3 La carica di refrigerante

La carica di refrigerante deve essere effettuata immettendo refrigerante in forma liquida nel lato di alta pressione del circuito e utilizzando tubi flessibili preventivamente evacuati così da evitare l'introduzione di gas incondensabili.
Nel caso in cui la bombola utilizzata per la carica fosse priva di pescante, è altamente raccomandabile l'uso di un idoneo filtro deidratore installato tra la bombola e l'attacco di ingresso del refrigerante nel circuito frigorifero.
Tale precauzione eviterà che eventuali impurità contenute nella bombola o nei tubi flessibili, vengano trascinate all'interno del circuito stesso.
Si consiglia di alimentare la resistenza di riscaldamento del carter prima di iniziare le operazioni di carica, così da impedire la condensazione del refrigerante nel lubrificante.
La carica dal lato di alta pressione, evita che il refrigerante allo stato liquido raggiunga il carter del compressore diluendone il lubrificante contenuto al suo interno.
Il refrigerante liquido immesso, provoca la chiusura delle valvole di scarico del compressore (che agiscono così come valvole di ritegno), si espande attraverso la valvola termostatica e raggiunge il lato di aspirazione del compressore in forma di vapore.
Le operazioni di carica saranno tanto più rapide quanto maggiore sarà la temperatura (e quindi la pressione) del refrigerante contenuto nella bombola; per problemi di sicurezza, la temperatura della bombola non deve mai essere superiore a +40°C.
Per mantenerne costante la temperatura durante la carica, si consiglia di immergere la bombola in un recipiente contenente acqua calda oppure utilizzare una apposita resistenza riscaldante termostatata a fascia.
Per nessuna ragione la bombola deve essere riscaldata con il cannello di saldatura o altri mezzi a fiamma.

suggested to connect to the vacuum pump both the refrigerating circuit high pressure side and the low pressure side.
The flexible pipes used for vacuum pump connection, have to be as short as possible and with thesame diameter of the pump's suction connection.

WARNING

During the whole evacuation period, all compressor valves and each other refrigerating circuit valve must be completely open.

After reaching a vacuum degree equal at least to 0,2 mbar, continue evacuation the circuit keeping it in these conditions for a time that depends from its internal volume.
At the end of the evacuating period, switch off the vacuum pump only after closing the suction valve.

WARNING

Do not start the compressor in high vacuum conditions.

5.2 Sealing proof in vacuum

After completing the refrigerating circuit evacuation, it is possible to check its seal, veryfing the eventual leakages that occurs under vacuum conditions.
After switching off the vacuum pump, the operator has to read the vacuometer connected to the pump suction side and record the indicated residual pressure value, wait at least 5 minutes and verify if the indicated residual pressure is increased due to air infiltrations.
In this case it is necessary to find the infiltration points, seal them, repeat the venting operations and, for higher safety, also the sealing proof in vacuum.

5.3 Refrigerant charge

The refrigerant charge has be to executed, introducing liquid refrigerant in the circuit high pressure side and using flexible hoses previously evacuated in order to avoid uncondensable gas introduction.
If the refrigerant cylinder does not have a liquid tube, it is highly recommended to use a suitable dryer filter installed between the cylinder and the refrigerant inlet connection in the refrigerating circuit.
This precaution will avoid eventual impurities contained in the cylinder or in the flexible hoses being passed into the circuit.
It is suggested to energize the crankcase heater before starting charging in order to avoid refrigerant condensation in the lubricant.
The charge from high pressure side avoids that refrigerant in liquid state reachs the compressor crankcase, diluting the lubricant contained inside.
The introduced liquid refrigerant causes the compressor discharge valve to close (which act as check valves), expands through the thermal valve and reachs compressor suction valve as vapour.
Charge operations will be faster with higher refrigerant temperatures (and therefore pressure) inside the cylinder; for safety problems, the cylinder temperature must never to be higher than +40°C.
To maintain constant temperature during charge, it is suggested to immerge the cylinder in one vessel with warm water or use a suitable band thermostat crankcase heater.
The cylinder must never be heated with welding torch or other instruments with flames.

5.4 Refrigerant leak detection

Among the indispensable instruments for refrigerating system installation and service, has to be included a leak detector.
Considering both the new enviroment protection requirements and the characteristics of new used refrigerating fluids, for refrigerant leaks research it is suggested the use of one electronic leakage tester.
Available are portable leak detectors with excellent sensibility characteristics,

5.4 Ricerca delle fughe di refrigerante

Tra gli strumenti indispensabili per l'installazione e l'assistenza di impianti frigoriferi, vanno inclusi i cercafughe.
In considerazione sia delle nuove esigenze di protezione dell'ambiente che delle caratteristiche dei nuovi fluidi frigoriferi utilizzati, per la ricerca delle fughe di refrigerante si consiglia l'impiego di un cercafughe di tipo elettronico.
Attualmente sono disponibili cercafughe portatili con eccellenti caratteristiche di sensibilità, idonei sia per refrigeranti CFC/HCFC che per refrigeranti HFC.
La ricerca delle fughe deve essere condotta seguendo le istruzioni suggerite dal costruttore dello strumento e verificando con la sonda tutti i punti di giunzione del circuito frigorifero (saldature, attacchi filettati, attacchi di servizio, flange, etc.).
Qualora si fossero individuate fughe di refrigerante, prima di procedere alla loro riparazione, è necessario rimuovere l'intera carica di refrigerante per mezzo di un adeguato recuperatore (vedi pagina 23, "9.4 Recupero del refrigerante").

suitable both for CFC/HCFC refrigerants and for HFC refrigerants.
The leak detection has to be executed following instructions suggested by the instrument manufacturer and veryfing every refrigerating circuit connections (welded, threaded connections, service connections, flanges, etc.).
In case refrigerant leaks have been found, before repairing them, it is necessary to remove the complete refrigerant charge through a suitable

6. Avviamento del compressore, controlli e rilievi finali

L'inserimento dell'interruttore generale predispone l'alimentazione diretta della eventuale resistenza di riscaldamento del carter e della bobina del teleruttore di comando del compressore.
Si consiglia di predisporre il collegamento elettrico in modo tale da permettere l'alimentazione della resistenza del carter almeno 2 ore prima dell'avviamento che segue un lungo periodo di inattività del compressore così che la temperatura del lubrificante sia superiore a quella ambiente di circa 10K.
Con l'avviamento del compressore, l'operatore ha l'occasione di effettuare misurazioni elettriche molto importanti per una diagnosi del buon funzionamento del compressore quali:

- corrente a rotore bloccato (LRA)
- tensione di alimentazione
- corrente a pieno carico

La corrispondenza tra valori misurati e valori dichiarati, indice di una buona installazione, acquista una rilevante importanza se si considera che le anomalie nella alimentazione elettrica del compressore, rappresentano una delle più frequenti cause della bruciatura del suo motore elettrico.

ATTENZIONE

Tutte le misurazioni elettriche devono essere eseguite all'esterno della scatola terminali.

Nella fase di avviamento, per limitare il pericolo del ritorno di refrigerante liquido al compressore, si consiglia di aprire solo parzialmente il rubinetto di aspirazione e completarne poi l'apertura dopo circa 10 minuti di funzionamento.

6.1 Misurazione della corrente a rotore bloccato

Nei sistemi trifase, è un rilevamento molto utile per verificare il dimensionamento del contattore, dei fusibili e dei cavi della linea di collegamento (vedi pagina 11, "3.4 Selezione del teleruttore, dei fusibili e dei cavi").
Il valore di LRA, misurato con un amperometro digitale, deve corrispondere a quello indicato nella tabella dei dati elettrici del compressore e riportato anche dalla targhetta metallica che equipaggia il compressore stesso (vedi pagina 5, "1.2 La targhetta").

6. Compressor start-up, checks and final reliefs

The general switch insertion arranges the direct feeding of the eventual crankcase heater and of the remote control switch.
It is suggested to arrange the electrical connection in order to allow the crankcase heater feeding at least 2 hours before the start-up which follows a long period of compressor inactivity, so that the lubricant temperature is higher than the environment one by approximately 10K.
During compressor start-up, the operator has the opportunity to take important electrical measurements for a diagnosis of compressor satisfactory operation, like:

- current with locked rotor (LRA)
- feeding tension
- current with full charge

Comparison between measured values and declared values, good installation index, becomes very important if we consider that the compressor electrical feeding anomalies represent one of the most frequent electrical motor burn-out causes.

WARNING

All electrical measurements have to be executed outside the terminal box.

In starting phase, to limit the danger of liquid refrigerant returning to the compressor, it is suggested to open only partially the suction valve and complete then the opening after approximately 10 working minutes.

6.1 Locked rotor current measurement

In three phases systems, it is a very useful measurement to verify the contactor, fuse and connection line cable dimensioning (see page 11, "3.4 Contactor, fuse and cable selection").
The LRA value, measured with a digital amperometer, has to correspond to the one indicated in the compressor electrical data table and also to the metallic nameplate on the compressor (see page 5, "1.2 Name plate").

6.2 Feed voltage measurement

The feed voltage has to be within the tolerance limits (+/-10% of nominal voltage) not only during the compressor working, but also during its start, when from feeding line it verifies the maximum current drawing.

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6.2 Misurazione della tensione di alimentazione

La tensione di alimentazione deve restare entro i limiti di tolleranza (±10% della tensione nominale) non solo durante il funzionamento del compressore ma anche durante il suo avviamento, quando dalla linea di alimentazione si verifica il massimo prelievo di corrente.
Linee di alimentazione di insufficiente portata, sono spesso causa di abbassamenti di tensione; il massimo abbassamento ammissibile è pari al 4% (minima tensione misurata all'avviamento del compressore = tensione di alimentazione -4%).

6.3 Misurazione della corrente a pieno carico

Per eseguire tale misurazione, è necessario avviare il compressore e attendere che le temperature di aspirazione e di scarico si stabilizzino sui valori di progetto.

ATTENZIONE

In presenza di rumori o vibrazioni anomale all'avviamento, fermare subito il compressore, individuarne le cause e applicare i giusti rimedi.

La misurazione della corrente a pieno carico deve essere effettuata contemporaneamente alla lettura delle temperature di lavoro del compressore; il valore di corrente misurato deve essere inferiore o uguale a quello dichiarato dal costruttore alle stesse condizioni di temperatura.
Valori superiori possono essere causati da uno squilibrio della tensione tra le fasi, da una inadeguata carica di refrigerante oppure dalla presenza di gas incondensabili nel refrigerante.

6.4 Controlli finali

Dopo un sufficiente periodo di funzionamento regolare del compressore alle condizioni di progetto dell'impianto, è necessario osservare la spia dell'olio per controllare il livello del lubrificante all'interno del carter.
Fermo restando che il livello minimo accettabile è pari a 1/4 della spia olio, il massimo livello non deve essere maggiore di 3/4 della spia così come illustrato nella figura 13.
Se fosse necessario modificare la quantità di lubrificante contenuta nel carter, è indispensabile seguire scrupolosamente le procedure illustrate a pagina 21, "9.1 Sostituzione del lubrificante".

Voltage drop by compressor starting (often caused by low load lines) cannot exceed 4% (minimum starting voltage = regular voltage - 4%).

6.3 Full load current measurement

To effect this measurement, it is necessary to start the compressor and wait for suction and discharge temperatures settle on designed values.

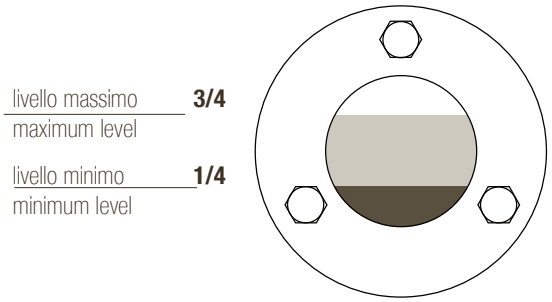
WARNING

By anomalous noises or vibrations on starting, immediately stop the compressor, find the causes and apply the right cures.

The current measurement with full charge has to be executed at the same time as the compressor working temperature reading; the measured current value has to be lower or equal to the one declared by the manufacturer at the same temperature conditions.
Higher values may be caused by a tension unbalance among the phases, by an inadequate refrigerant charge or by uncondensable gas in the refrigerant.

6.4 Final checks

After a suitable period of compressor regular working, it is necessary to check the lubricant oil.
Considering that the acceptable minimum level is 1/4 of oil sight glass, the maximum level cannot be higher than 3/4 of the sight glass, as illustrated in figure 13.
If it is necessary to modify the lubricant quantity contained in the crankcase, follow the procedures illustrated on page 21, "9.1 Lubricant



livello dell'olio - oil level
fig. 13

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7. Equipaggiamenti e accessori

In determinate condizioni di lavoro e di installazione, è necessario garantire il funzionamento ottimale del compressore, equipaggiandolo con accessori idonei che devono essere montati direttamente sul compressore a cura del costruttore oppure, grazie alle istruzioni contenute nei singoli manuali di installazione editi dalla FRASCOLD, montati in un secondo tempo sul compressore già in opera.
Questa parte del manuale di installazione e avviamento, indica brevemente quali sono le condizioni per le quali è necessario installare tali accessori e/o equipaggiamenti.

7.1 Dispositivi per il raffreddamento supplementare del compressore

Tutti i compressori FRASCOLD sono raffreddati dal refrigerante aspirato in condizioni di gas surriscaldato.
Nel percorso che compie attraverso il compressore, il refrigerante lambisce il motore elettrico e lo raffredda, così facendo assorbe calore che produce un aumento sia del suo contenuto entalpico che della sua temperatura.
Successivamente, l'energia impiegata per comprimere il refrigerante si trasferisce in gran parte al gas stesso sotto forma di calore (calore di compressione) causando un ulteriore aumento di temperatura.
In condizioni normali, la temperatura del gas alla fine della compressione non supera mai +130°C.
La temperatura durante il funzionamento gioca un ruolo determinante nella durata del compressore, perchè è in presenza di alte temperature che si creano, nel compressore stesso, situazioni di rischio per la sua incolumità e tali alte temperature possono verificarsi in condizioni operative particolarmente spinte.
Nelle tabelle delle capacità frigorifere, riportate nei cataloghi dei compressori FRASCOLD, è segnalato in modo inequivocabile quando le condizioni operative sono tali da richiedere il raffreddamento supplementare del compressore e anche quale è il dispositivo da adottare in relazione alle specifiche condizioni di lavoro.
Per il raffreddamento supplementare dei compressori FRASCOLD, i dispositivi disponibili sono:

- dispositivo di iniezione di liquido
- motoventilatore per il raffreddamento delle testate
- testate raffreddate ad acqua

Una volta verificata la necessità di tali dispositivi, gli stessi possono essere montati sul compressore direttamente in fabbrica (ordinando il dispositivo congiuntamente al compressore), oppure anche dopo la installazione del compressore.

7.2 Riscaldatore dell'olio del carter

Durante il periodo di arresto dell'impianto frigorifero, il refrigerante tende a migrare verso il compressore.
La presenza di refrigerante liquido nella linea di aspirazione ne rende inevitabile il suo fluire nel carter del compressore miscelandosi con il lubrificante contenuto; una miscela tra lubrificante e una grande quantità di refrigerante è la premessa a una serie di problemi spesso causa di danni irreversibili.
L'impiego del riscaldatore olio carter, è il modo per ridurre (ma non per elimare) il fenomeno del ritorno di refrigerante liquido nonchè del suo accumulo o stratificazione nel compressore.

7.3 Controllo di capacità

Nel corso della progettazione di un impianto di raffreddamento, il compressore selezionato ha una capacità sufficiente a smaltire il picco del carico termico della struttura e alternare periodi di arresto e funzionamento con una frequenza compatibile con il massimo numero di cicli per ora del compressore stesso (vedi pagina 7, "1.10 I cicli di funzionamento").
In condizioni di carico termico ridotto, il compressore è in grado di portare la

7. Equipment and accessories

In some working and installation conditions, it is necessary to grant the optimal compressor working, equipping it with suitable accessories.
These accessories can be directly assembled on the compressor by the manufacturer or, thanks to instructions contained in the single FRASCOLD installation manuals, assembled onto the compressor already operating at site.
This installation and start-up manual shows the conditions for which it is necessary to install these accessories and/or equipments.

7.1 Devices for compressor additional cooling

All FRASCOLD compressors are suction gas cooled.
As the superheated suction vapour passes through the compressor and over the electrical motor, it cools the windings; in this way it absorbes heat which produces an increase both of enthalpic content and of its temperature.
Successively, the energy used to compress the refrigerant transfers heat to the gas (discharge heat), causing a further temperature increase.
In normal conditions, gas temperature at compression end must never exceed +130°C.
The temperature during working has a determinant role in compressor life, because it is with high temperatures that, in the compressor, risk situations for its safety create and these high temperatures can verify in particularly forced operative conditions.
In the refrigerating capacity tables, on FRASCOLD compressor catalogues, is indicated, in unequivocal way, when the operative conditions are such to request the compressor additional cooling and also what is the device to use with respect of specific working conditions.
For additional cooling, the devices available are:

- liquid injection
- head fan motor
- water-cooled heads

After veryfing these devices necessity, these may be assembled on the compressor directly in factory (by ordering the device together with the compressor).

7.2 Oil crankcase heater

During refrigerating system stop period, the refrigerant migrates towards the compressor.
The liquid refrigerant in the suction line will inevitably flow to the compressor crankcase mixing with the contained lubricant.
A mixture between lubricant and a big refrigerant quantity is the cause of a series of problems that is often cause of irreversible damages for the compressor.
The oil crankcase heater use is the way to reduce (but not to eliminate) the case of liquid refrigerant return to the compressor, refrigerant accumulation or stratification .

7.3 Capacity control

By designing a cooling plant, the selected compressor has a capacity sufficient to carry off the structure thermal charge peak and alternate stopping and working periods with a frequency compatible with the maximum compressor cycle number per hour (see page 7, "1.10 Maximum stop/start per hour").
In reduced thermal charge conditions, the compressor is able to bring the structure at the designed temperature in a shorter time.
It is necessary to verify if the increased number of compressor starts (which results from a shorter cooling period) is compatible with the maximum that the compressor can stand.
The capacity control device installation allows to compensate this situation to avoid to compromise the complete cooling plant efficiency.

7.4 Unloaded start

The unlaoded start device has been designed to reduce the start current of

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struttura alla temperatura di progetto in un tempo più breve; in tale caso, è necessario verificare se l'aumentato numero di avviamenti del compressore (che deriva da un più breve periodo di raffreddamento) è compatibile con il massimo che il compressore può sopportare.
L'installazione del dispositivo per il controllo della capacità permette di compensare tale situazione per evitare di compromettere l'efficienza dell'intero impianto di raffreddamento.

7.4 Avviamento in vuoto

Il dispositivo per l'avviamento in vuoto è stato progettato per ridurre la corrente di spunto di compressori con potenza nominale superiore a 5 HP.
L'impiego di tale dispositivo è particolarmente consigliato per compressori con avviamento di tipo PWS (Part Winding Start) oppure di tipo ⅄ / Δ (stella/triangolo); il suo funzionamento all'avviamento del compressore, riduce la coppia di spunto ed il momento di inerzia delle masse.

N.B. Per limitare la quantità di lubrificante e refrigerante nel compressore dotato di dispositivo per l'avviamento in vuoto, fare funzionare il compressore con la massima riduzione di capacità per almeno 5 secondi prima del suo arresto.

compressor with nominal power higher than 5 HP; the use of this device is particularly suggested for compressors with PWS (Part Winding Start) or ⅄ / Δ (star/delta) start; its target is to reduce the start torque to the inertia of the moving masses.

N.B. To limit the amount of oil and refrigerant into the compressor equipped with unloaded start device, run it for 5 seconds approx. with largest capacity reduction, the stop the compressor.

8. Accessori vari

Spesso è necessario equipaggiare l'impianto frigorifero con accessori e/o dispositivi non di stretta competenza del costruttore del compressore ma indispensabili per il suo buon funzionamento.
Considerata la inevitabile interazione tra compressore e tali accessori, è necessario che questi ultimi rispondano a precisi requisiti tecnici.
Il montaggio deve essere comunque eseguito attenendosi scrupolosamente alle istruzioni rilasciate dal costruttore dell'accessorio che deve essere comunque conforme ai requisiti qui di seguito descritti.

8.2 Tubi antivibranti

Anche se il compressore è equilibrato staticamente e dinamicamente, si consiglia di montare tubi antivibranti sia sulla linea di aspirazione che sulla linea di mandata.
I tubi antivibranti non sopportano carichi in trazione e compressione, pertanto vanno installati parallelamente all'asse di rotazione del compressore e il più vicino possibile ad esso (vedi figura 14).

8.3 Separatore d'olio

L'installazione di un separatore d'olio è raccomandato in quegli impianti dove sussistono le condizioni per importanti travasi di olio dal compressore o eccessive diluizioni dell'olio da parte del refrigerante come:

- impianti dove l'unità condensatrice, installata all'esterno, sia soggetta a basse temperature ambientali
- impianti che lavorano con elevati rapporti di compressione (basse temperature di evaporazione, alte temperature di scarico)
- impianti che utilizzano compressori con dispositivo di controllo della capacità
- impianti con più compressori in parallelo

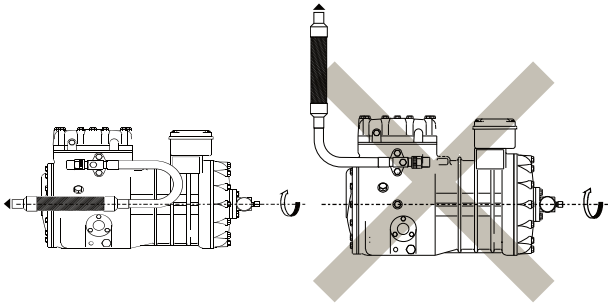

fig. 14

8. Various accessories

Often it is necessary to equip the refrigerating system with accessories and/or devices that are not of compressor manufacturer tight competence, but indispensable for its good working.
Considering the inevitable interaction between compressor and these accessories, it is necessary that these last ones correspond to precise technical requirements.
The assembly has to be, however, executed following strictly the instructions given by the accessory manufacturer, that has to be in accordance with the following requirements.

8.2 Vibration absorber tubings

Even if the compressor is statically and dynamically balanced, it is suggested to assemble vibration absorber pipes both on suction line and on discharge line.
The vibration absorber pipes will not bear stretching and compression, they have therefore to be installed parallelly to the axis of rotation of the compressor and as near as possible to it (see figure 14).

8.3 Oil separator

The oil separator installation is recommended in those plants, in which there are the conditions for potential oil transfers from compressor or excessive oil dilutions from refrigerant, like:

- plants, in which the condensing unit, installed outside, is subject to low ambient temperatures
- plants that work with high pressure ratio (low evaporating temperatures, high discharge temperatures)
- plants that use compressors with capacity control device
- plants with a number of compressors in parallel
- plants with refrigerant charge (in kg) that is six times higher than the

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- impianti con carica di refrigerante (espressa in kg) maggiore di sei volte rispetto la normale carica di olio del compressore (espressa in litri).

Il separatore di olio deve essere installato sulla linea di scarico, dopo l'eventuale silenziatore e il tubo antivibrante e il più vicino possibile al compressore.
Prima del suo montaggio, è necessario introdurre all'interno del separatore una quantità (suggerita dal costruttore) di olio dello stesso tipo di quello contenuto nel compressore; tale quantità rimane sempre all'interno del separatore e serve per "attivare" la valvola di ritorno olio del separatore.
L'attacco di ritorno olio del separatore deve essere collegato all'attacco posto sul carter del compressore (vedi disegni del catalogo), dopo che ne è stato rimosso il tappo e sostituito con un niplo.
Una valvola di ritegno montata sulla linea di scarico in uscita dal separatore, eviterà il riflusso di refrigerante durante le fasi di arresto del compressore.

8.4 Separatore di liquido

Il separatore di liquido (o accumulatore di aspirazione) è l'unico dispositivo che può evitare danni irreversibili al compressore quando, durante il funzionamento, si verifica afflusso di refrigerante liquido nella linea di aspirazione.
In aspirazione, il refrigerante può essere in forma liquida per cattiva esecuzione delle tubazioni, insufficiente potenza dell'evaporatore, ma anche per le cause più comuni quali la brinatura dell'evaporatore, il mancato funzionamento del suo ventilatore oppure la linea di aspirazione non isolata con temperatura ambiente molto bassa.
Il separatore di liquido deve essere montato nel tratto terminale della linea di aspirazione e il più possibile in prossimità del compressore.

8.5 Termostato di regolazione

È un apparecchio di controllo la cui regolazione del differenziale (differenza tra la temperatura alla quale il suo interruttore apre e quella alla quale chiude il circuito di alimentazione del compressore) è importante nei confronti della vita operativa del compressore.
Il differenziale del termostato deve essere commisurato al comportamento della temperatura rilevata dal suo elemento sensibile e tale da evitare che il compressore funzioni con un numero di cicli superiore al suo limite massimo (vedi pagina 7, "1.10 I cicli di funzionamento").
Il collegamento elettrico del termostato di regolazione deve essere eseguito come indicato negli schemi elettrici .

8.6 Pressostato di alta pressione

Per salvaguardare il buon funzionamento del compressore e garantirne la sua integrità, è consigliabile dotare il circuito frigorifero di un pressostato di alta pressione, la cui corretta selezione, installazione e taratura evita il funzionamento del compressore in condizioni non accettabili (vedi pagina 7,"1.11 Limiti di impiego").
Il pressostato dovrà intervenire, interrompendo il circuito di alimentazione del compressore, quando la pressione di compressione assume valori prossimi ai limiti di impiego.
Conoscendo perfettamente le condizioni operative dell'impianto, è possibile fare intervenire il pressostato quando, a causa di anomalie durante il funzionamento, la pressione di compressione del compressore supera di poco la pressione di condensazione ma rimane comunque inferiore alla pressione di taratura della valvola di sicurezza.
La pressione alla quale avviene la chiusura del circuito di alimentazione del compressore (pressione di apertura dei contatti-differenziale) deve essere inferiore alla pressione di funzionamento del circuito frigorifero.
Si consiglia l'impiego di un pressostato dotato di reinserzione manuale che è un dispositivo meccanico che mantiene aperto il circuito di alimentazione del compressore anche quando la pressione è scesa al di sotto del valore di chiusura; tale impedimento all'avvio del compressore rimane fino a quando l'operatore, dopo avere rimosso le cause di intervento, non preme

normal compressor oil charge (in litres)

The oil separator has to be installed on the discharge line, after the eventual muffler and the vibration absorber pipe.
Before its assembly, it is necessary to introduce inside the separator an oil quantity (suggested by manufacturer) of the same type of the one contained in the compressor; this quantity remains always inside the separator and is useful to "activate" the separator oil return valve.
The separator oil return connection has to be connected to the connection on the compressor crankcase (see drawings on catalogue), after the plug has been removed and replaced with a nipple.
It is recommended to install a check-valve on outlet pipe of the oil separator.

8.4 Liquid separator

The liquid separator (or suction accumulator) is the sole device that can avoid irreversible damage to the compressor when, during working, there is liquid refrigerant that flows back to the suction line.
In the suction line, the refrigerant may be in liquid form due to bad pipe execution, insufficient evaporator power, but also for the most common causes like the evaporator frosting, the inoperative fan or insifficient insulation of the suction line with very low environment temperature.
The liquid separator has to be assembled in the suction line terminal section and as near as possible to the compressor.

8.5 Regulating thermostat

It is a check instrument and its differential regulation (difference between the temperature at which its switch opens and the one at which it closes the compressor feeding circuit) is important towards the compressor operative life.
The thermostat differential has to be compared to the temperature behavior pointed out from its sensible element and in order to avoid that the compressor works with a cycle number that is higher than its maximum limit (see page 7, "1.10 Maximum stop/start per hour").
The regulating thermostat electrical connection has to executed as indicated in the wiring diagrams.

8.6 High pressure switch

To safe the compressor good working and grant its integrity, it is advisable to equip the refrigerating circuit with an high pressure switch; its right selection, installation and calibration avoids the compressor working in unacceptable conditions (see page 7, "1.11 Application limits").
The pressure switch should intervene, by interrupting the compressor feed, when the discharge pressure reachs values near application limits.
By knowing perfectly the plant operative conditions, it is possible for the pressure switch to intervene when, due to anomalies during working, the compressor discharge pressure exceeds by only a little the condensing pressure, but it remains however lower than the safety valve calibrating pressure.
The most common causes of these anomalies are condenser fouling, lack or shortage of condenser cooling fluid, incondensable gas in the refrigerant, excessive refrigerant charge.
The pressure at which there is the compressor feeding circuit closing (opening pressure of contacts - differential) has to be lower than refrigerating circuit designed working pressure.
It is recommended that a pressure switch with manual reset is used; this is a mechanical device that ensures the contacts remain open and the compressor does not restart after the pressure falls below the closing value.
This requires the operator to investigate the anomaly and rectify before resetting the switch.
The pressure switches with manual reset are characterized by a fixed differential and considering this thay have to be selected with particular care.

l'apposito pulsante del pressostato.
I pressostati con reinserzione manuale sono caratterizzati da un differenziale fisso e in considerazione di ciò vanno selezionati con particolare cura.
Il pressostato deve essere collegato a una presa di alta pressione del compressore (vedi pagina 9, "3.2 Collegamenti frigoriferi") o, eventualmente, anche a un punto qualsiasi della linea di compressione e comunque a monte di un eventuale rubinetto di intercettazione della linea stessa.
Evitare assolutamente di collegare il pressostato di alta pressione a connessioni che possono essere involontariamente intercettate come, per esempio le connessioni di servizio dei rubinetti del compressore.
Il collegamento elettrico del pressostato deve essere eseguito come indicato negli schemi elettrici.

8.7 Pressostato di bassa pressione

Il corretto funzionamento del pressostato di bassa pressione evita che il compressore lavori per periodi più o meno lunghi in condizioni di insufficiente pressione di aspirazione.
Le più comuni cause di anomale pressioni di aspirazione sono insufficiente carica di refrigerante, ostruzioni oppure eccessive perdite di carico della linea del liquido, formazione di brina sull'evaporatore.
Qualsiasi sia la causa, l'abbassamento della temperatura di aspirazione conseguente all'abbassamento della pressione si rivela, quasi sempre, inadeguato a compensare la riduzione di portata ponderale di refrigerante, pregiudicando il buon raffreddamento del compressore.
Negli impianti frigoriferi funzionanti con temperatura di evaporazione positiva, il pressostato di bassa pressione può essere utilizzato anche come sicurezza anti-gelo tarandolo in modo da arrestare il compressore quando la pressione di evaporazione scende a valori corrispondenti a temperature di saturazione negative.
Deve essere collegato a una presa di bassa pressione del compressore o, eventualmente, anche a un punto qualsiasi della linea di aspirazione e comunque a valle di un eventuale rubinetto di intercettazione della linea stessa.
Evitare assolutamente di collegare il pressostato di alta pressione a connessioni che possono essere involontariamente intercettate come, per esempio le connessioni di servizio dei rubinetti del compressore.
Il collegamento elettrico del pressostato deve essere eseguito come indicato negli schemi elettrici.

8.8 Manometri

I manometri sono strumenti essenziali per la messa a punto e per il controllo del funzionamento di un circuito frigorifero.
Una volta montati sul pannello di comando e collegati, permettono la lettura a distanza delle pressioni di lavoro del circuito frigorifero.
Il collegamento permanente di manometri prevede l'impiego di tubi (in rame o materiale plastico) e di rubinetti di intercettazione a due vie, che consentono di attivare i manometri soltanto quando sia necessario effettuare i rilevamenti.
Il quadro manometri prevede per ogni compressore, un manometro di bassa pressione, un manometro di alta pressione e, per i soli compressori dotati di pompa di lubrificazione, un manometro per olio.
I manometri di alta e bassa pressione forniscono oltre ai valori delle pressioni anche le corrispondenti temperature di saturazione.
Un preciso limite dei manometri per refrigerante, è costituito dalla loro inadeguatezza a misurare i livelli di vuoto; tali livelli possono essere misurati efficacemente soltanto da adatti vacuometri elettronici.
Il manometro per olio permette di leggere la pressione di mandata della pompa di lubrificazione del compressore così da verificarne il corretto funzionamento e permettere la taratura del pressostato differenziale olio, come indicato a pagina 18, "8.1 Pressostato differenziale olio".
I manometri devono essere collegati tenendo conto delle indicazioni riportate a pagina 9, "3.2 Collegamenti frigoriferi".

The pressure switch has to be connected to a compressor high pressure tap (see page 9, "3.2 Refrigerating connections") or, eventually, also to any discharge line point and, however, upstream an eventual interception valve of the line.
Avoid absolutely to connect the high pressure switch at connections that can be involuntarily intercepted like,for example, the compressor valve service connections; the connection has to be executed as indicated in the wiring diagrams.

8.7 Low pressure switch

The low pressure switch avoids the compressor working for more or less long periods in conditions of insufficient suction pressure.
The most common cause of anomalous suction pressures are insufficient refrigerant charge, obstructions or excessive charge leaks of liquid line, frost formation on the evaporator.
Apart every cause, the suction temperature fall resulting from the pressure fall is, almost always, inadequate to compensate the refrigerant ponderal capacity reduction, compromising the good compressor cooling.
In refrigerating plants that work with positive evaporating temperature, the low pressure switch may be used also like anti-freeze safety, calibrating it in order to stop the compressor when evaporating pressure falls at values which correspond to saturation negative temperatures.
The pressure switch has to be connected to a compressor low pressure tap or, eventually, also to any suction line point and, however, upstream an eventual interception valve of the line.
Avoid absolutely to connect the high pressure switch at connections that can be involuntarily intercepted like, for example, the compressor valve service connections.
The pressure switch electrical connection has to be executed as indicated in the wiring diagrams.

8.8 Pressure gauges

Gauges are indispensable instruments for the refrigerating circuit setting up and working check; after their assembly on the control panel and their connections, they allow the remote reading of the refrigerating circuit working pressures.
The permanent gauge connection foresees the use of two-way pipes (in copper or plastic material) and interception valves, which allow to activate the gauges only when it is necessary to effect measurements.
The gauge panel foresees, for each compressor, a low pressure gauge, an high pressure gauge and, only for compressors equipped with lubricating pump, an oil pressure gauge.
The high and low pressure gauges furnish, besides the pressure values, also the corresponding saturation temperatures.
A precise gauges limit for refrigerant is characterized by their inadequacy to measure the vacuum levels; these levels can be efficiently measured only from suitable electronic gauges.
The oil gauge allows to read the compressor lubricating pump discharge pressure in order to verify the right working and permit the oil pressure switch calibration, as indicated on page 18, "8.1 Oil pressure switch".
Pressure gauges have to be connected following the indications on page 9, "3.2 Refrigerating connections".

8.9 Filter dryer

The use of the new HFC refrigerants and of foreign lubricants, requires a particular attention as concerns their compatibility with the material contained in the dryer filters.
The filter has to guarantee a screen of at least 3Å and a residual humidity not higher than 50PPM, this both if it contains dryer material like solid cartridge and like compact grains.
The filter with solid cartridge may be assembled in any position; in the second case, to avoid that the dryer material abrades because of liquid column pulsations, it is necessary that the filter is assembled with vertical axis and

8.9 Filtro deidratore

L'impiego dei nuovi refrigeranti HFC e dei lubrificanti esteri, richiede una particolare attenzione per quanto riguarda la loro compatibilità con il materiale contenuto nei filtri deidratori.
Il filtro deve garantire un vaglio di almeno 3Å e una umidità residua non superiore a 50PPM, questo sia che contenga materiale deidratante in forma di cartuccia solida che in grani compatti.
Nel secondo caso, per evitare che il materiale deidratante si abrada per effetto delle pulsazioni della colonna liquida, occorre che il filtro sia montato con asse verticale e che la linea del liquido entri dall'alto e esca dal basso.
In tale modo, durante il funzionamento del compressore, il materiale deidratante viene spinto verso il basso dal refrigerante e il suo assetto non viene modificato all'arresto del compressore.

8.10 Le linee di compressione, del liquido e di aspirazione

Ciascuna linea deve essere dimensionata e realizzata in modo da favorire la circolazione del refrigerante e il ritorno dell'olio con il compressore in funzione ma ostacolare il ritorno di refrigerante liquido con il compressore fermo.
I principali criteri generali che stanno alla base di una buona progettazione delle linee frigorifere sono:

- per tutte le linee

that the liquid line enters from upper and goes out from bottom.
In this way, during the compressor working, the dryer material is pushed towards the bottom by refrigerant and its attitude is not modified by compressor stopping.

8.10 Discharge, liquid and suction lines

Each line has to be dimensioned and realized in order to favour the refrigerant circulation and the oil return with the compressor operative, but restrict the liquid refrigerant return with the standstill compressor.
The main general principles which are the basis of a good refrigerating lines design are:

- for every lines
  - slope of at least 1% in the flow direction
  - refrigerant velocity to allow the refrigerant entrainment without excessive pressure drop
- for suction and discharge lines

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9. Controlli periodici e manutenzione

Il periodico controllo delle pressioni di lavoro e del livello del lubrificante sono garanzia sufficiente per una lunga vita operativa del compressore e la costanza delle sue prestazioni dichiarate.
Gli interventi di manutenzione routinaria richiesti sono:

- sostituzione del lubrificante dopo circa 100 ore di funzionamento dall'avviamento iniziale del compressore per rimuovere le impurità rimaste nel sistema e raccolte nel carter dal flusso di refrigerante e di lubrificante
- sostituzione della carica di lubrificante ogni 10.000 ore di funzionamento per garantirne le originali caratteristiche di viscosità

9.1 Sostituzione del lubrificante

Tutte le operazioni di sostituzione del lubrificante devono essere eseguite solamente quando il compressore è fermo.
Tutti i lubrificanti, in particolare modo quelli di tipo sintetico, sono altamente igroscopici; per evitare la contaminazione del lubrificante, è necessario conservare i contenitori ben sigillati, aprirli appena prima del loro utilizzo quindi richiuderli immediatamente dopo.
Il lubrificante utilizzato, deve essere esclusivamente di tipo approvato dal costruttore così come illustrato nel documento FTEC27.
Per la sostituzione del lubrificante sono necessari alcuni strumenti che fanno parte della normale attrezzatura di ogni frigorista.
Gli attrezzi necessari per eseguire le operazioni di manutenzione ordinaria sono:

- pompa per vuoto
- pompa a mano per lubrificante
- tubi flessibili con attacchi girevoli e percussore

9. Periodical checks and servicing

The periodical working pressure and lubricant level check are sufficient warranty for a long compressor operative life and for the reliability of the declared performances.
The requested maintenance interventions are:

- lubricant replacement after approx. 100 working hours from the initial compressor start to remove impurities remained in the system and collected in the crankcase from refrigerant and lubricant flow
- lubricant charge replacement each 10000 working hours to grant the original viscosity characteristics

9.1 Lubricant replacement

All lubricant replacement operations have to be executed when the compressor is at standstill.
All lubricants, especially the ones of synthetic type, are highly hygroscopic; to avoid the lubricant contamination, it is necessary to keep the packages well sealed, open them just before their use and therefore reclose them after immediately.
The used lubricant has to be exclusively approved by the manufacturer, as illustrated document FTEC27.
For lubricant replacement are required instruments that are part of the normal equipment of each refrigerator technician; the necessary instruments to execute the ordinary maintenance operations are:

- vacuum pump
- lubricant hand pump
- flexible hoses with swivel connections and valve opener
- ratchet wrench for square stems

a) with working compressor, close the suction valve

- chiave a cricco per aste quadre

Per la sostituzione del lubrificante del compressore, procedere come segue:

a) con il compressore in funzione, chiudere il rubinetto di aspirazione
b) non appena la pressione di aspirazione si riduce a 0.1 ÷ 0.2 bar, spegnere il compressore

ATTENZIONE

Non allentare alcuna vite o tappo di chiusura del compressore.

c) chiudere il rubinetto di compressione
d) rimuovere i dadi ciechi dagli i rubinetti del compressore
e) rimuovere, lentamente, il tappo di scarico olio (vedere disegni a catalogo) e lasciare fluire tutto il lubrificante in un idoneo contenitore

ATTENZIONE

Non disperdere il lubrificante nell'ambiente; è un rifiuto speciale e come tale deve essere smaltito secondo le norme in vigore.

f) avvitare e serrare bene il tappo di scarico olio
g) avvitare i dadi ciechi dei rubinetti del compressore precedentemente rimossi
h) rimuovere il tappo di carico olio (riferimento 3, vedi disegni sul catalogo) applicando al suo posto una valvola di servizio tipo Schrader
i) rimuovere il cappuccio di protezione dalla valvola di servizio e collegare la mandata della pompa a mano per lubrificante
j) collegare l'aspirazione della pompa a mano al contenitore del lubrificante
k) azionando la pompa a mano, introdurre la esatta quantità di olio nel carter del compressore
l) rimuovere la pompa a mano dalla valvola di servizio
m) collegare l'aspirazione della pompa per vuoto alla valvola di servizio tipo Schrader
n) avviare la pompa per vuoto ed evacuare il compressore per almeno 15 minuti
o) scollegare la pompa dalla valvola di servizio e spegnerla
p) avvitare il cappuccio di protezione alla valvola di servizio
q) aprire i rubinetti di compressione e di aspirazione del compressore

ATTENZIONE

La mancata apertura del rubinetto di compressione prima dell'avviamento può causare notevoli danni sia al compressore che all'operatore.

r) avviare il compressore e dopo un adeguato periodo di funzionamento, controllare il livello del lubrificante.

Fermo restando che il livello minimo accettabile è pari a 1/4 della spia olio, il massimo livello non deve essere maggiore di 3/4 della spia così come illustrato nella figura 15.

9.2 Controllo dei termistori

I compressori serie F, S, V, Z e W vengono forniti completi di protezione integrale, conforme alla norma DIN44081 ed è costituita da termistori PTC inseriti nello statore del motore elettrico e collegati a un modulo elettronico di controllo KRIWAN (modello T00ECA01 per i compressori serie A, B, C, D, F, Q e S; modello T00ECA11 per i compressori serie V, Z e W).

Qualora fosse necessario verificare la continuità della catena dei termistori, procedere come segue:

a) scollegare il compressore dalla rete di alimentazione elettrica
b) rimuovere il coperchio della scatola terminali

b) when the suction pressure reduces at 0.1÷0.2 bar, switch off the compressor

WARNING

Do not loose any compressor bolt or closing plug.

c) close the discharge valve
d) remove, slowly, discharge valve plug
e) remove the oil discharge plug (ref.6, see drawings on catalogue) and let flow all the lubricant in a suitable package.

WARNING

Do not pollute the environment with lubricant; it is a special waste and it hase therefore to be carried off as per the regulations in force.

f) screw and close well the oil discharge plug and discharge valve plug
g) remove the oil charge plug (ref.3, see drawings on catalogue), applying at its place a Schrader service valve
h) remove the protection cap from the service valve and connect the lubricant hand pump discharge
i) connect the hand pump suction to the lubricant package
j) by acting the hand pump, introduce the right oil quantity in the compressor crankcase
k) remove the hand pump from the service valve
l) connect the vacuum pump suction line to the Schrader service valve
m) start the vacuum pump and evacuate the compressor for at least 15 minutes
n) disconnect the pump from the service valve and switch off
o) screw the protection cap to the service valve
p) open the compressor discharge and suction valves

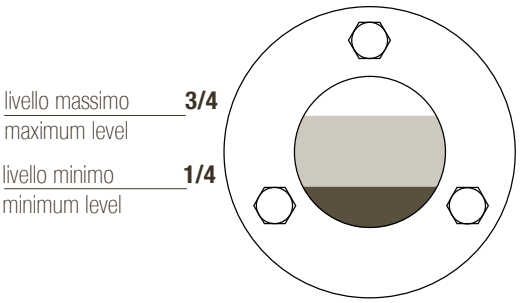
WARNING

Failure to open the valve before starting, will cause many damages both to compressor and possibly to operator.

q) start the compressor
r) after 15 ÷ 20 working minutes, check the lubricant level

The level at which the lubricant settles during compressor working is highly influenced by the discharge ratio and therefore by the working temperatures.

Considering that the acceptable minimum level is 1/4 of oil sight glass, the maximum level has not to be higher than 3/4 of the sight glass, as illustrated in figure 15.



livello dell'olio - oil level

fig. 15

9.2 Thermistor check

All compressors are supplied complete with integral protection, in accordance with DIN44081 regulation and it is composed by PTC thermistors introduced in the electrical motor stator and connected to an electronic control module KRIWAN (model T00ECA01 for compressors A, B, D, F, Q and S series;

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c) rimuovere i capicorda femmina dai terminali a baionetta A e B dei termistori
d) porre a contatto dei terminali A e B i puntali di un ohmetro avente ai capi una tensione massima di 2,5V; se l'ohmetro indica una resistenza infinita significa che la catena dei termistori è interrotta
I valori di resistenza misurati devono essere coerenti con quelli riportati in tabella "11.20 caratteristiche dei termistori".
e) collegare i capicorda ai terminali A e B dei termistori
f) montare e fissare il coperchio della scatola terminali
g) collegare il compressore alla rete di alimentazione elettrica

9.3 Sostituzione del sensore di temperatura

Per la sostituzione del sensore di temperatura inserito sul lato compressione della testata, procedere come segue:
a) con il compressore in funzione, chiudere il rubinetto di aspirazione
b) non appena la pressione di aspirazione si riduce a 0.1 ÷ 0.2 bar, spegnere il compressore
c) chiudere i rubinetti di compressione e di aspirazione del compressore
d) scollegare il compressore dalla rete di alimentazione elettrica
e) rimuovere i conduttori del sensore di temperatura dal circuito di controllo e protezione del compressore

ATTENZIONE

Il sensore di temperatura è in contatto diretto con la zona di compressione del compressore .

f) allentare lentamente il dado cieco del rubinetto di compressione e riavvitarlo dopo avere lasciato sfiatare la pressione residua
g) con una chiave da 17 mm, rimuovere lentamente il sensore in avaria
h) avvitare il nuovo sensore dopo avere spalmato di pasta sigillante la sua filettatura
i) collegare i conduttori del sensore agli appositi morsetti del circuito di controllo e protezione
j) evacuare adeguatamente il compressore
k) aprire i rubinetti di compressione e di aspirazione del compressore
l) con un cercafughe elettronico, verificare la tenuta del sensore di temperatura

9.4 Recupero del refrigerante

Tutte le volte che le operazioni di riparazione o sostituzione di un componente del circuito frigorifero ne compromettono la sua tenuta, si rende necessario prima procedere al recupero del refrigerante.
Il recupero parziale della carica di refrigerante è possibile se il punto di intervento è situato nella parte di circuito compresa tra il rubinetto di intercettazione posto all'uscita del ricevitore di liquido (o del condensatore ad acqua) e il rubinetto di intercettazione sullo scarico del compressore.
In questo caso, si provvede a trasferire buona parte del refrigerante nel ricevitore di liquido (o nel condensatore ad acqua) applicando la seguente procedura.
a) cortocircuitare il pressostato di bassa pressione e avviare il compressore
b) chiudere il rubinetto di intercettazione della linea del liquido
c) non appena tutto il refrigerante è stato aspirato, spegnere il compressore
d) chiudere il rubinetto di intercettazione sullo scarico del compressore
e) **scollegare il compressore dalla rete di alimentazione elettrica**
f) eseguire i necessari interventi di manutenzione
g) evacuare la parte di circuito frigorifero sulla quale si è intervenuto
h) aprire i rubinetti di intercettazione

Qualora non fosse possibile operare come precedentemente descritto, è necessario procedere al recupero della intera carica di refrigerante per mezzo di una idonea unità di recupero.
In questo caso si consiglia di adottare i seguenti accorgimenti.
- collegare l'unità di recupero a due attacchi di servizio del circuito frigorifero, uno posto sul lato di bassa e l'altro sul lato di alta

model T00ECA11 for compressors V, Z and W series).
If it is necessary to verify the thermistor chain continuity, proceed as follows:
a) **disconnect the compressor from the electrical feeding net**
b) remove the terminal box cover
c) remove the female quick connect terminals from the thermistor A and B bayonet terminals
d) connect to A and B terminals the test prods of the ohmmeter, that has at the ends a maximum tension of 2.5V; if the ohmmeter shows an infinite strength, it means that the thermistor chain is interrupted
The reading of values in accordance with those indicated on table "11.20 Thermistor data", shows a suitable and continue thermistor chain.
e) connect the quick connect terminals to the thermistor A and B terminals
f) assemble and fix the terminal box cover
g) connect the compressor to the electrical feeding net

9.3 Temperature sensor replacement

For replacement of the temperature sensor inserted on the compressor head discharge side, proceed as follows:
a) close suction shut off valve with compressor running
b) as oon as the suction pressure decreases down to 0.1 ÷ 0.2 bar, switch off the compressor
c) close thesuction and discharge shut off valves
d) disconnect the compressor from the electrical feeding net
e) remove the temperature sensor conductors from the compressor check and protection circuit

WARNING

The sensor is in direct connection with the refrigerating circuit high pressure side.

f) release the discharge valve plug and screw on it as soon the residual pressure has been vented
g) close the compressor discharge and suction valves
h) with one key of 17mm, remove slowly the failed sensor
i) screw the new sensor after having smeared its thread with a sealing paste
j) connect the sensor conductors to the suitable check and protection circuit clamps
k) evacuate adequately the compressor
l) open the compressor discharge and suction valves
m) with an electronic leak detector, verify the temperature sensor sealing

9.4 Refrigerant recovery

Every time that the repair or replacement operations of a refrigerating circuit component compromise its sealing, it is necessary to proceed at first to the refrigerant recovery.
The partial refrigerant charge recovery is possible if the intervention point is placed in the system between the shut-off valve placed at the liquid receiver (or water condenser) exit and the shut-off valve on the compressor discharge.
In this case, a considerable quantity of refrigerant is transferred in the liquid receiver (or in the water condenser) applying the following procedure:
a) short-circuit the low pressure switch and start the compressor
b) close the liquid line shut-off valve
c) as soon as the whole refrigerant has been removed, switch off the compressor
d) close the discharge shut-off valve of the compressor
e) **disconnect the compressor from the electrical feeding net**
f) execute the necessary maintenance interventions
g) evacuate the refrigerating circuit part on which it has been opened
h) open the shut-off valves

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pressione; il recupero avverrà in tempi più ridotti

- durante il recupero, all'interno dell'evaporatore e del condensatore la pressione (e quindi la temperatura) scende a valori molto bassi. Per evitare la dannosa formazione di ghiaccio all'interno di evaporatori e condensatori ad acqua, gli stessi devono essere preventivamente vuotati oppure mantenere costantemente in funzione le pompe di circolazione fino alla fine del recupero.
- durante il recupero è possibile che dal circuito frigorifero, insieme al refrigerante, venga estratto anche del lubrificante. Al termine del recupero, è necessario verificare la quantità di lubrificante fuoriuscito e, una volta ultimato l'intervento di riparazione, immettere nel carter del compressore del lubrificante nuovo in quantità e tipo identico a quello rimosso.

ATTENZIONE

Non disperdere il lubrificante nell'ambiente; è un rifiuto speciale e come tale deve essere smaltito secondo le norme in vigore.

9.5 Sostituzione del pressostato differenziale olio

Il pressostato differenziale olio di tipo elettronico che equipaggia i compressori FRASCOLD con pompa di lubrificazione è essenzialmente composto da (vedi fig. 16):

- circuito di controllo; completo di ghiera di fissaggio, pulsante di reinserzione, LED di segnalazione, cavi di collegamento. Questo componente è fisicamente alloggiato all'interno della scatola terminali del compressore con il foglio di istruzioni per l'uso.
- sensore; con attacco maschio M20 x 1.5 fissato, in fabbrica, all'attacco filettato del compressore.

Il sensore non ha parti mobili soggette ad avarie e, anche se viene rimosso il circuito di controllo, non permette la fuoriuscita di refrigerante.

ATTENZIONE

Il sensore è contatto diretto con zone in pressione della pompa di lubrificazione .

Per la sostituzione del circuito di controllo è necessario procedere come segue:

a) spegnere il compressore
b) rimuovere il coperchio della scatola terminali
c) rimuovere i conduttori del pressostato dal circuito di controllo e protezione del compressore
d) agendo sulla ghiera girevole, rimuovere il circuito di controllo dal sensore
e) avvitare accuratamente il nuovo circuito di controllo sul sensore
f) collegare i conduttori del pressostato agli appositi morsetti del circuito di controllo e protezione del compressore
g) rimontare il coperchio sulla scatola terminali
h) evacuare adeguatamente il compressore
i) aprire i rubinetti di compressione e aspirazione del compressore

If it is not possible to operate as previously described, it is necessary to proceed to the complete refrigerant charge recovery by a suitable recovery unit.

In this case it is suggested to adopt the following procedure:

- connect the recovery unit at two refrigerating circuit service connections, one placed on low pressure side and the other on high pressure side; the recovery will occur in more reduced times.
- during recovery, inside the evaporator and condenser, the pressure (and therefore the temperature) falls to very low values. To avoid the harmful ice formation inside the evaporators and water condensers, they have to be previously empted or keep costantly in function the circulation pumps till the recovery end
- during recovery, it is possible that from the refrigerating circuit, together with the refrigerant, it is removed also lubricant.

At recovery end, it is necessary to verify the quantity of lubricant that came out and, after ending the reparation intervention, put new lubricant in the

WARNING

Do not pollute the environment with lubricant; it is a special waste and it hase therefore to be carried off as per the regulations in force.

9.5 Oil pressure switch replacement

Electronic oil pressure switch fitting all Frascold compressors with oil pump mainly includes (see figure 16):

- control circuit; complete with fixing screw cap, reset push-button, LED signal lamp, cables. This component is located in to the terminal box of the compressor with instruction leaflet.
- sensor; M20 x 1.5 male threaded, mounted in factory to the pressure connection of the compressor.

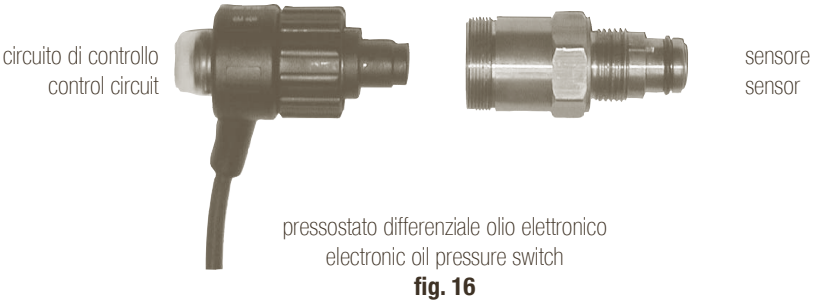
Sensor has no moving parts exposed to damages and no leakages can

WARNING

The sensor is in direct connection with pressure side of oil pump.

Apply following procedure to replace the broken control circuit:

a) switch off the compressor
b) remove the cover of terminal box
c) remove the cables of the oil pressure switch from the terminal board of the compressor
d) by means the screwcap, unscrew from the sensor the control circuit
e) put the new control circuit in to the sensor and close tightly by hand the screwcap
f) connect the cables of the pressure switch to the suitable terminal of the compressor terminal board
g) reassemble the cover on the terminal box



pressostato differenziale olio elettronico
electronic oil pressure switch

fig. 16

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10. Tabella diagnostica

Disfunzione accertata	Causa	Intervento suggerito
1. Pressione di scarico troppo bassa rispetto alla prevista pressione di condensazione.	**1.1** Insufficiente carica di refrigerante.	**1.1.1** Verificare la presenza di fughe di refrigerante ed eventualmente eliminarle, quindi ripristinare la carica ottimale.
	1.2 Temperatura del fluido di raffreddamento del condensatore eccessivamente bassa.	**1.2.1** Controllare la temperatura di ingresso al condensatore del fluido di raffreddamento e, eventualmente, intervenire per ridurne la portata.
	1.3 Imperfetta tenuta delle valvole a lamella del compressore.	**1.3.1** Collegare un manometro alla linea di aspirazione del compressore. La imperfetta tenuta delle valvole provoca un repentino aumento della pressione di aspirazione quando il compressore si arresta. In questo caso, riparare il compressore e rimuovere la causa di tale inconveniente.
	1.4 Notevole usura del compressore.	**1.4.1** Riparare o sostituire il compressore.
	1.5 Pressione di aspirazione troppo bassa rispetto alla pressione di evaporazione di progetto.	**1.5.1** Per gli interventi suggeriti, si rimanda alla disfunzione accertata 4. Pressione di aspirazione troppo bassa rispetto alla prevista pressione di evaporazione, con eventuale intervento del pressostato di bassa pressione.
2. Pressione di scarico troppo alta rispetto alla prevista pressione di condensazione con probabile intervento del dispositivo di protezione o del pressostato di alta pressione.	**2.1** Presenza di gas incondensabili all'interno del circuito frigorifero.	**2.1.1** Collegare un recuperatore di refrigerante sia al lato di alta che al lato di bassa pressione del circuito frigorifero e rimuovere l'intera carica di refrigerante. Evacuare a lungo il circuito, effettuare la ricarica con refrigerante nuovo, avviare il compressore e controllare le pressioni di lavoro.
	2.2 Linea di scarico parzialmente occlusa.	**2.2.1** Controllare che tutti i rubinetti sulla linea di scarico siano completamente aperti e che non ci siano restrizioni all'interno delle giunture (per esempio, eccessi di lega saldante).
	2.3 Condensatore in avaria o con insufficiente scambio termico.	**2.3.1** Confrontate le prestazioni del condensatore, dichiarate dal costruttore, con il bilancio termico di progetto; in caso di prestazioni insufficienti, sostituire il condensatore. **2.3.2** Se il condensatore è del tipo raffreddato ad aria, eseguire le seguenti operazioni: - controllare lo stato delle ventole del motoventilatore - controllare il senso di rotazione del motoventilatore - pulire il pacco alettato - raddrizzare le alette deformate Se il condensatore è del tipo raffreddato ad acqua, eseguire le seguenti operazioni: - disincrostare i tubi di alimentazione e il fascio tubiero - verificare l'efficienza della torre evaporativa - misurare la portata d'acqua - misurare la temperatura di ingresso dell'acqua
	2.4 Eccessiva carica di refrigerante.	**2.4.1** Collegare un recuperatore di refrigerante in un punto del circuito dove vi sia solo refrigerante liquido e recuperarne l'eccedenza. Terminate le operazioni di recupero, avviare il compressore e verificare le pressioni di lavoro.
	2.5 Pressione di aspirazione troppo elevata rispetto alla pressione di evaporazione di progetto.	**2.5.1** Controllare che il bulbo della valvola termostatica sia adeguatamente posizionato, fissato e coibentato. **2.5.2** Controllare che la capacità della valvola termostatica sia proporzionata alla reale capacità frigorifera del compressore e che la taratura del surriscaldamento sia corretta.

Disfunzione accertata	Causa	Intervento suggerito
		2.5.3 Se l'impianto è dotato di valvola limitatrice della pressione di aspirazione, verificarne la taratura.
3. Temperatura di scarico, misurata all'uscita del compressore, che supera il valore limite, con probabile intervento del dispositivo di protezione.	**3.1** Condensatore in avaria o con insufficiente scambio termico.	**3.1.1** Confrontate le prestazioni del condensatore, dichiarate dal costruttore, con il bilancio termico di progetto; in caso di prestazioni insufficienti, sostituire il condensatore. **3.1.2** Se il condensatore è del tipo raffreddato ad aria, eseguire le seguenti operazioni: - controllare lo stato delle ventole del motoventilatore - controllare il senso di rotazione del motoventilatore - pulire il pacco alettato - raddrizzare le alette deformate Se il condensatore è del tipo raffreddato ad acqua, eseguire le seguenti operazioni: - disincrostare i tubi di alimentazione e il fascio tubiero - verificare l'efficienza della torre evaporativa - misurare la portata d'acqua - misurare la temperatura di ingresso dell'acqua
	3.2 Presenza di gas incondensabili all'interno del circuito frigorifero.	**3.2.1** Collegare un recuperatore di refrigerante sia al lato di alta che al lato di bassa pressione del circuito frigorifero e rimuovere l'intera carica di refrigerante. Evacuare a lungo il circuito, effettuare la ricarica con refrigerante nuovo, avviare il compressore e controllare le pressioni di lavoro.
	3.3 Valvola termostatica sovraddimensionata.	**3.3.1** Sostituire la valvola termostatica o, se possibile, il solo orifizio.
	3.4 Bulbo della valvola termostatica non correttamente fissato alla linea di aspirazione.	**3.4.1** Fissare correttamente il bulbo utilizzando le apposite fascette metalliche fornite a corredo della valvola termostatica.
	3.5 Flusso di aria fredda che investe il bulbo della valvola termostatica.	**3.5.1** Rivestire con materiale coibente il bulbo della valvola termostatica e il tratto di linea di aspirazione sul quale è fissato.
	3.6 Eccessiva chiusura della valvola termostatica causata dalla errata taratura del surriscaldamento.	**3.6.1** Modificare la taratura della valvola termostatica in modo da ridurre il surriscaldamento.
	3.7 Valvola termostatica con elemento sensibile scarico.	**3.7.1** Sostituire la valvola termostatica o, se possibile, il solo elemento sensibile.
	3.8 Evaporatore eccessivamente brinato.	**3.8.1** Controllare il buon funzionamento dei dispositivi di sbrinamento. **3.8.2** Verificare che la quantità e le temperature del fluido raffreddato dall'evaporatore siano come da progetto.
	3.9 Linea di aspirazione con eccessive cadute di pressione.	**3.9.1** Controllare che tutti i rubinetti sulla linea di aspirazione siano completamente aperti. **3.9.2** Verificare l'efficienza di eventuali filtri installati sulla linea di aspirazione. **3.9.3** Se la linea di aspirazione è equipaggiata con valvola limitatrice, verificarne la taratura e la efficienza.
	3.10 Linea del liquido parzialmente occlusa.	**3.10.1** Controllare che tutti i rubinetti sulla linea del liquido siano completamente aperti e che non ci siano restrizioni all'interno delle giunture (per esempio, eccessi di lega saldante). **3.10.2** Verificare l'efficienza del filtro deidratore; una temperatura dell'attacco di uscita sensibilmente più bassa di quella dell'attacco di ingresso è provocata dalla sua
	3.11 Linea di scarico parzialmente occlusa.	

Disfunzione accertata	Causa	Intervento suggerito
		ostruzione anche parziale. In questo caso è necessario sostituire il filtro deidratore.
	3.12 Valvola termostatica sottodimensionata.	**3.11.1** Controllare che tutti i rubinetti sulla linea di scarico siano completamente aperti e che non ci siano restrizioni all'interno delle giunture (per esempio, eccessi di lega saldante).
	3.13 Insufficiente carica di refrigerante.	**3.12.1** Sostituire la valvola termostatica o, se possibile, il solo orifizio.
	3.14 Il fluido contenuto nell'elemento sensibile con carica MOP della valvola termostatica, è condensato nel soffietto.	**3.13.1** Verificare la presenza di fughe di refrigerante ed eventualmente eliminarle, quindi ripristinare la carica ottimale.
	3.15 Insufficiente isolamento della linea di aspirazione.	**3.14.1** Scaldare il soffietto (e la parte del corpo valvola adiacente) mediante un getto di aria moderatamente calda.
	3.16 Insufficiente lubrificazione del compressore.	**3.15.1** Sostituire l'isolamento o sostituirlo se danneggiato.
	3.17 Insufficiente raffreddamento del compressore.	**3.16.1** Controllare la qualità e il livello del lubrificante e ripristinarlo se necessario.
	3.18 Eccessivo numero di interventi orari del compressore.	**3.16.2** Verificare l'efficienza della pompa di lubrificazione e sostituirla se necessario.
	4.1 Insufficiente carica di refrigerante	**3.17.1** Verificare l'efficienza dei dispositivi per il raffreddamento supplementare del compressore.
	4.2 Linea del liquido parzialmente occlusa.	**3.17.2** Rimuovere gli eventuali ostacoli alla libera circolazione dell'aria attorno al compressore.
		3.18.1 Aumentare il differenziale del termostato di regolazione.
		4.1.1 Verificare la presenza di fughe di refrigerante ed eventualmente eliminarle, quindi ripristinare la carica ottimale.
		4.2.1 Controllare che tutti i rubinetti sulla linea del liquido siano completamente aperti e che non ci siano restrizioni all'interno delle giunture (per esempio, eccessi di lega saldante).
4. Pressione di aspirazione troppo bassa rispetto alla prevista pressione di evaporazione, con eventuale intervento del pressostato di bassa pressione.	**4.3** Linea di aspirazione con eccessive cadute di pressione.	**4.2.2** Verificare l'efficienza del filtro deidratore; una temperatura dell'attacco di uscita sensibilmente più bassa di quella dell'attacco di ingresso è provocata dalla sua ostruzione anche parziale. In questo caso è necessario sostituire il filtro deidratore.
	4.4 Eccessiva chiusura della valvola termostatica causata dalla errata taratura del surriscaldamento.	**4.3.1** Controllare che tutti i rubinetti sulla linea di aspirazione siano completamente aperti, verificare l'efficienza di eventuali filtri installati sulla linea di aspirazione.
	4.5 Il fluido contenuto nell'elemento sensibile con carica MOP della valvola termostatica, è condensato nel soffietto	**4.3.2** Se la linea di aspirazione è equipaggiata con valvola limitatrice, verificarne la taratura e la efficienza.
	4.6 Valvola termostatica con elemento sensibile scarico.	**4.4.1** Modificare la taratura della valvola termostatica in modo da ridurre il surriscaldamento.
	4.7 Valvola termostatica sottodimensionata.	**4.5.1** Scaldare il soffietto (e la parte del corpo valvola adiacente) mediante un getto d'aria moderatamente calda.
	4.8 Evaporatore eccessivamente brinato.	**4.6.1** Sostituire la valvola termostatica o, se possibile, il solo elemento sensibile.
		4.7.1 Sostituire la valvola termostatica, o, se possibile,

Disfunzione accertata	Causa	Intervento suggerito
		il solo orifizio.
5. Pressione di aspirazione troppo alta rispetto alla prevista pressione di evaporazione, con eventuale intervento del dispositivo di protezione e probabile brinatura parziale del compressore.	**5.1** Valvola termostatica sovraddimensionata.	**4.8.1** Controllare il buon funzionamento dei dispositivi di sbrinamento.
	5.2 Eccessiva apertura della valvola termostatica causata dalla errata taratura del surriscaldamento.	**4.8.2** verificare che la quantità e le temperature del fluido raffreddato dall'evaporatore siano come da progetto.
	5.3 Bulbo della valvola termostatica non correttamente fissato alla linea di aspirazione.	
	5.4 Flusso di aria fredda che investe il bulbo della valvola termostatica.	**5.1.1** Sostituire la valvola termostatica o, se possibile, il solo orifizio.
	5.5 Errata taratura della valvola limitatrice della pressione di aspirazione.	**5.2.1** Modificare la taratura della valvola termostatica in modo da aumentare il surriscaldamento.
		5.3.1 Fissare correttamente il bulbo utilizzando le apposite fascette metalliche fornite a corredo della valvola termostatica.
6. Il compressore dotato di pompa di lubrificazione, si ferma per intervento del pressostato differenziale olio.	**6.1** Pompa di lubrificazione inefficiente o in avaria.	**5.4.1** Rivestire con materiale coibente il bulbo della valvola termostatica e il tratto di linea di aspirazione sul quale è fissato.
	6.2 Pressostato differenziale olio non correttamente tarato o in avaria.	**5.5.1** Mediante un manometro collegato alla aspirazione del compressore, verificare la taratura della valvola limitatrice.
	6.3 Per le cause, si rimanda alla disfunzione accertata "7. Livello del lubrificante nel carter del compressore inferiore al previsto".	**6.1.1** Collegare un manometro per olio all'attacco di mandata della pompa, avviare il compressore e confrontare il valore di pressione letto con quello indicato nel presente manuale.
7. Il livello del lubrificante nel carter del compressore è inferiore al previsto.	**7.1** Circuito frigorifero con perdite di refrigerante.	**6.2.1** Verificare la taratura del pressostato differenziale olio e, se necessario, sostituirlo.
	7.2 Separatore d'olio in avaria.	**6.3.1** Per gli interventi suggeriti, si rimanda alla disfunzione accertata "7. Livello del lubrificante nel carter del compressore inferiore al previsto".
	7.3 Il lubrificante fuoriuscito dal compressore durante il funzionamento è rimasto intrappolato nel circuito frigorifero.	**7.1.1** Per mezzo di un cercafughe elettronico, individuare i punti di perdita ed eliminarli, quindi ripristinare la carica ottimale.
		7.2.1 Riparare o sostituire il separatore di olio.
	7.4 La presenza di refrigerante liquido nel carter del compressore, al momento del suo avviamento, ha favorito la schiumatura del lubrificante che è stato aspirato e mandato in circolazione.	**7.3.1** Il mancato ritorno di lubrificante è generalmente causato da un notevole abbassamento della velocità del refrigerante e, conseguentemente della sua pressione. Per gli interventi suggeriti, si rimanda alla disfunzione accertata "4. Pressione di aspirazione troppo bassa rispetto alla prevista pressione di evaporazione, con eventuale intervento del pressostato di bassa pressione".
		7.4.1 Verificare l'efficienza del riscaldatore olio carter, se necessario sostituirlo e se mancante, provvedere alla sua installazione.
8. Periodi di arresto del compressore troppo brevi, oppure il compressore effettua più di sei interventi all'ora.	**8.1** Forti rientri di calore nella zona refrigerata.	**7.4.2** Il ritorno di refrigerante liquido è da addebitare anche a una pressione di aspirazione troppo elevata rispetto alla prevista pressione di evaporazione. Per gli interventi suggeriti, si rimanda alla disfunzione accertata "5. Pressione di aspirazione troppo alta rispetto alla prevista pressione di evaporazione, con eventuale intervento del dispositivo di protezione e probabile brinatura parziale del compressore".
	8.2 Termostato di regolazione con differenziale troppo ristretto.	
	8.3 Imperfetta tenuta delle valvole a lamella del compressore.	**8.1.1** Verificare la tenuta delle porte isotermiche della cella frigorifera e di tutti gli accessi in generale.

Disfunzione accertata	Causa	Intervento suggerito
9. Il compressore si ferma per intervento del dispositivo di protezione.	**9.1** Presenza di gas incondensabili all'interno del circuito frigorifero.	**8.2.1** Aumentare il differenziale del termostato di regolazione. **8.3.1** Collegare un manometro alla linea di aspirazione del compressore. La imperfetta tenuta delle valvole provoca un repentino aumento della pressione di aspirazione quando il compressore si arresta. In questo caso, riparare il compressore e rimuovere la causa di tale inconveniente.
	9.2 Carica di refrigerante eccessiva.	**9.1.1** Collegare un recuperatore di refrigerante sia al lato di alta che al lato di bassa pressione del circuito frigorifero e rimuovere l'intera carica di refrigerante. Evacuare a lungo il circuito, effettuare la ricarica con refrigerante nuovo, avviare il compressore e controllare le pressioni di lavoro.
	9.3 Condensatore in avaria o con insufficiente scambio termico.	**9.2.1** Collegare il recuperatore di refrigerante in un punto del circuito dove vi sia solo refrigerante liquido e recuperarne l'eccedenza. Terminate le operazioni di recupero, avviare il compressore e verificare le pressioni di lavoro. **9.3.1** Confrontate le prestazioni del condensatore, dichiarate dal costruttore, con il bilancio termico di progetto; in caso di prestazioni insufficienti, sostituire il condensatore. **9.3.2** Se il condensatore è del tipo raffreddato ad aria, eseguire le seguenti operazioni: - controllare lo stato delle ventole del motoventilatore - controllare il senso di rotazione del motoventilatore - pulire il pacco alettato - raddrizzare le alette deformate Se il condensatore è del tipo raffreddato ad acqua, eseguire le seguenti operazioni: - disincrostare i tubi di alimentazione e il fascio tubiero - verificare l'efficienza della torre evaporativa - misurare la portata d'acqua - misurare la temperatura di ingresso dell'acqua.
	9.4 Condensatore raffreddato ad aria con ricircolo di aria calda.	**9.4.1** Verificare che la dislocazione del condensatore sia tale da impedire al flusso d'aria in uscita di essere, anche parzialmente, deviato sulla aspirazione del ventilatore.
	9.5 Linea di scarico parzialmente occlusa.	**9.5.1** Controllare che tutti i rubinetti sulla linea di scarico siano completamente aperti e che non ci siano restrizioni all'interno delle giunture (per esempio, eccessi di lega saldante).
	9.6 Pressione di aspirazione troppo elevata rispetto alla pressione di evaporazione di progetto.	**9.6.1** Controllare che il bulbo della valvola termostatica sia adeguatamente posizionato, fissato e coibentato. **9.6.2** Controllare che la capacità della valvola termostatica sia proporzionata alla reale capacità frigorifera del compressore e che la taratura del surriscaldamento sia corretta. **9.6.3** Se l'impianto è dotato di valvola limitatrice della pressione di aspirazione, verificarne la taratura.
	9.7 Tensione della rete di alimentazione inferiore ai limiti di tolleranza del motore elettrico del compressore.	**9.7.1** Misurare la tensione tra le fasi della linea di alimentazione. Se la tensione misurata è nei limiti ma diminuisce mentre il compressore funziona, la disfunzione è da imputare alla insufficiente sezione della linea di alimentazione; in questo caso, sostituire la linea di alimentazione con una di sezione adeguata.
	9.8 Motore elettrico con avvolgimento a massa oppure in corto circuito.	**9.8.1** Verificare la resistenza degli avvolgimenti, la rigidità dielettrica (isolamento verso massa); provvedere alla riparazione o sostituzione del compressore.
	9.9 Linea di alimentazione elettrica trifase sbilanciata.	**9.9.1** Controllare la tensione tra le fasi, se sbilanciata chiedere l'intervento dell'ente erogatore.
	9.10 Dispositivo di protezione difettoso o con taratura errata.	

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Disfunzione accertata	Causa	Intervento suggerito
	9.11 Collegamenti elettrici errati.	**9.10.1** Misurare i valori delle correnti allo spunto, in marcia e la temperatura del compressore. Se i valori misurati evidenziano assenza di sovraccarichi e di surriscaldamento del compressore: - per i compressori trifase verificare la continuità e la resistenza della catena dei termistori - per i compressori monofase verificare che alla temperatura ambiente il protettore elettrotermico sia chiuso.
	9.12 Relais di avviamento montato non correttamente.	**9.11.1** Ripristinare i collegamenti facendo riferimento agli schemi elettrici del presente manuale.
	9.13 Eccessiva temperatura del compressore.	**9.12.1** Verificare che il relais sia stato collegato come indicato negli schemi elettrici del presente manuale.
	9.14 Principio di grippaggio oppure accoppiamenti albero-bronzine e/o pistone-cilindro non sufficientemente scorrevoli.	**9.13.1** Verificare l'efficienza del raffreddamento supplementare del compressore (motoventilatore sulle testate, testate raffreddate ad acqua, iniezione di liquido) e che la sua superficie esterna sia pulita e libera.
10. Il compressore monofase non si avvia, ronza a intermittenza e ciclicamente interviene la protezione elettrotermica.	**10.1** Collegamenti elettrici errati.	**9.14.1** Provvedere alla riparazione o sostituzione del compressore.
	10.2 Alimentazione elettrica con tensione inferiore ai limiti di tolleranza.	**10.1.1** Ripristinare i collegamenti facendo riferimento agli schemi elettrici del presente manuale.
	10.3 Carica di refrigerante eccessiva.	**10.2.1** Misurare la tensione della linea di alimentazione mentre il compressore si avvia. Se la tensione diminuisce mentre il compressore ronza ma non si avvia, la disfunzione è da imputare alla insufficiente sezione della linea di alimentazione; in questo caso, sostituire la linea di alimentazione con una di sezione adeguata.
	10.4 Relais di avviamento difettoso o non adatto.	**10.3.1** Collegare un recuperatore di refrigerante in un punto del circuito dove vi sia solo refrigerante liquido e recuperarne l'eccedenza, quindi avviare il compressore e verificare le pressioni di lavoro.
	10.5 Blocco meccanico del compressore.	**10.4.1** Sostituire il relais con uno nuovo.
	10.6 Avvolgimento del motore elettrico difettoso.	**10.5.1** Mediante un collegamento elettrico provvisorio, dare al motore elettrico del compressore un impulso tendente a farlo girare in senso inverso al precedente. Nel caso il tentativo non avesse esito positivo, riparare o sostituire il compressore.
	10.7 Dispositivo di protezione difettoso.	**10.6.1** Scollegare il compressore dalla rete di alimentazione elettrica, rimuovere i conduttori dalla morsettiera e, mediante un ohmetro, verificare se i valori di resistenza degli avvolgimenti sono corretti. Riparare o sostituire il compressore se necessario.
		10.6.2 Verificare la rigidità dielettrica del compressore (isolamento verso massa). Riparare o sostituire il compressore se necessario.
	10.8 Condensatore di avviamento difettoso o con tensione di targa inferiore a quella prescritta.	**10.7.1** Misurare i valori delle correnti allo spunto, in marcia e la temperatura del compressore. Se i valori misurati evidenziano assenza di sovraccarichi e di surriscaldamento del compressore: - per i compressori trifase verificare la continuità e la resistenza della catena dei termistori - per i compressori monofase verificare che alla temperatura ambiente il protettore elettrotermico sia chiuso.
	10.9 Condensatore di marcia difettoso.	**10.8.1** Sostituire il condensatore di avviamento.
11. Il compressore trifase non si avvia, ronza a intermittenza e ciclicamente interviene il modulo di protezione (o analogo dispositivo predisposto dall'installatore).	**11.1** Rete di alimentazione elettrica con tensione inferiore ai limiti di tolleranza.	

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Disfunzione accertata	Causa	Intervento suggerito
		10.9.1 Sostituire il condensatore di marcia.
	11.2 Mancanza di una delle tre fasi di alimentazione.	**11.1.1** Verificare la tensione di ognuna delle fasi mentre il compressore si avvia. Se la tensione diminuisce mentre il compressore ronza ma non si avvia, la disfunzione è da imputare alla insufficiente sezione della linea di alimentazione.
	11.3 Dispositivo di protezione difettoso o non correttamente tarato.	**11.2.1** Partendo dalla morsettiera del compressore e risalendo lungo la linea di alimentazione, verificare la tensione tra le tre fasi. La mancanza di una fase può essere dovuta a morsetti allentati, usura dei contatti del teleruttore, fusibile interrotto, etc.
	11.4 Avvolgimento del motore elettrico interrotto.	**11.3.1** Misurare i valori delle correnti allo spunto, in marcia e la temperatura del compressore. Se i valori misurati evidenziano assenza di sovraccarichi e di surriscaldamento del compressore, verificare la continuità e la resistenza della catena dei termistori e se necessario sostituire il compressore.
	11.5 Blocco meccanico del compressore.	
	11.6 Motore elettrico con avvolgimento a massa.	**11.4.1** Scollegare il compressore dalla rete di alimentazione elettrica, rimuovere i conduttori dalla morsettiera e, mediante un ohmetro, verificare se i valori di resistenza degli avvolgimenti sono corretti. Riparare o sostituire il compressore se necessario.
12. Il compressore non si avvia e non ronza anche se il quadro di comando è regolarmente		
	12.1 Interruttore della linea di alimentazione elettrica.	**11.5.1** Riparare o sostituire il compressore.
	12.2 Elemento sensibile del termostato scarico.	**11.6.1** Verificare la rigidità dielettrica del compressore (isolamento verso massa). Riparare o sostituire il compressore se necessario.
	12.3 Bobina del teleruttore in avaria.	
	12.4 Intervento di un dispositivo di sicurezza con dispositivo di reinserzione manuale	**12.1.1** Verificare la continuità della linea di alimentazione elettrica.
	12.5 Motore elettrico del compressore con avvolgimento interrotto.	**12.2.1** Sostituire il termostato.
13. Rapida usura dei contatti del relais di avviamento.		**12.3.1** Sostituire la bobina del teleruttore
	13.1 Eccessivo numero di interventi orari del compressore.	**12.4.1** Rimuovere la causa dell'intervento, quindi

ATTENZIONE

Gli interventi suggeriti devono essere eseguiti nel rispetto delle norme di sicurezza illustrate a pagina 4.
Per maggiori dettagli o suggerimenti in merito, contattare il Servizio Tecnico della

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10. Troubleshooting

Established failure	Cause	Suggested remedy
1. Too low discharge pressure with respect to the previous condensing pressure.	**1.1** Insufficient refrigerant charge.	**1.1.1** Verify the refrigerant leaks and eventually eliminate them, restore therefore the optimal charge.
	1.2 Excessive low condenser cooling fluid temperature.	**1.2.1** Check the cooling fluid entry temperature to condenser and, eventually, intervene to reduce the capacity.
	1.3 Imperfect compressor reed valve sealing.	**1.3.1** Connect a gauge to the compressor suction line. The imperfect valve sealing causes a sudden suction pressure increase when the compressor stops. In this case, repair the compressor and remove the cause of this inconvenience.
	1.4 High compressor wear.	**1.4.1** Repair or replace the compressor.
	1.5 Too low suction pressure with respect to the designed evaporating pressure.	**1.5.1** For the suggested interventions, it refers to the established failure 4. Too low suction pressure with respect to the foreseen evaporating pressure, with eventual low pressure switch intervention.
2. Too high discharge pressure with respect to the foreseen condensing pressure with probable intervention of the protection device or of the high pressure switch.	**2.1** Incondensable gas inside the refrigerating circuit.	**2.1.1** Connect a refrigerant recovery unit both to refrigerating circuit high pressure side and to low pressure side and remove the whole refrigerant charge. Evacuate for a long time the circuit, effect the recharge with new refrigerant, start the compressor and check the working pressures.
	2.2 Partially obstructed discharge line.	**2.2.1** Check that all discharge line valves are completely open and that there are no restrictions inside the joints (for example, solder alloy excesses).
	2.3 Condenser failure or with insufficient thermal exchange.	**2.3.1** Compare the condenser performances, declared by manufacturer, with the designed heat balance; in case of insufficient performances, replace the condenser. **2.3.2** If the condenser is air-cooled, execute the following operations: - check the fan motor fans state - check the fan motor direction of rotation - clean the finned coil - rectify any distorted fins. If the condenser is water-cooled, execute the following operations: - descale the feeding pipes and the tube bundle - verify the evaporating tower efficiency - measure the water capacity - measure the water entry temperature.
	2.4 Excessive refrigerant charge.	**2.4.1** Connect a refrigerant recovery unit in a circuit point, where there is only liquid refrigerant and recover the excess. At the end of recovery operations, start the compressor and verify the working pressures.
	2.5 Too high suction pressure with respect to the designed evaporating pressure.	**2.5.1** Check that the thermostatic expansion valve bulb is suitably placed, fixed and insulated. **2.5.2** Check that the thermostatic expansion valve capacity is proportional to the real compressor refrigerating capacity and that the superheat setting is correct. **2.5.3** If the plant is equipped with suction pressure regulating valve, verify the calibration.
3. Discharge temperature, measured at compressor discharge, which exceeds the limit value, with probable protection device intervention.	**3.1** Condenser failure or with insufficient thermal exchange.	**3.1.1** Compare the condenser performances, declared by manufacturer, with the designed heat balance; in case of insufficient performances, replace the condenser. **3.1.2** If the condenser is air-cooled, perform the

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Established failure	Cause	Suggested remedy
		following operations: - check the fan motor fans state - check the fan motor direction of rotation - clean the finned coil - rectify any distorted fins If the condenser is water-cooled, perform the following operations: - descale the feeding pipes and the tube bundle - verify the evaporating tower efficiency - measure the water capacity - measure the water entry temperature.
	3.2 Incondensable gas inside the refrigerating circuit.	**3.2.1** Connect a refrigerant recovery unit both to refrigerating circuit high pressure side and to low pressure side and remove the whole refrigerant charge. Evacuate for a long time the circuit, effect the recharge with new refrigerant, start the compressor and check the working pressures.
	3.3 Overdimensioned thermostatic expansion valve.	**3.3.1** Replace the thermostatic expansion valve or, if possible, only the orifice.
	3.4 Thermostatic expansion valve bulb, which incorrectly fixed to the suction line.	**3.4.1** Fix correctly the bulb, using the suitable metallic clamps supplied as spares of the thermostatic expansion valve.
	3.5 Cold air flow that wraps the thermostatic expansion valve bulb.	**3.5.1** Line with insulating material the thermostatic expansion valve bulb and the suction line section, on which it is fixed.
	3.6 Excessive thermostatic expansion valve closing, due to wrong superheat setting.	**3.6.1** Modify the thermostatic expansion valve setting in order to reduce superheat.
	3.7 Thermostatic expansion valve with discharge bellow.	**3.7.1** Replace the thermostatic expansion valve or, if possible, only the sensible element.
	3.8 Excessive frosted evaporator.	**3.8.1** Check the defrosting devices in good working order.
		3.8.2 Verify that the quantity and temperatures of the fluid cooled from evaporator are as designed.
	3.9 Suction line with excessive pressure drops.	**3.9.1** Check that all suction line valves are completely open.
		3.9.2 Verify the efficiency of any filters, installed in suction line.
		3.9.3 If the suction line is equipped with pressure relief valve, verify the calibration and efficiency.
	3.10 Partially obstructed liquid line.	**3.10.1** Check that all liquid line valves are completely open and that there are no restrictions inside the joints (for example, solder alloy excesses).
		3.10.2 Verify the dryer filter efficiency; an exit connection temperature lower than the entry connection temperature is caused by its obstruction, also partial. In this case, it is necessary to replace the dryer filter.
	3.11 Partially obstructed discharge line.	**3.11.1** Check that all discharge line valves are completely open and that there are no restrictions inside the joints (for example, solder alloy excesses).
	3.12 Underdimensioned thermostatic expansion valve.	**3.12.1** Replace the thermostatic expansion valve or, if possible, only the orifice.
	3.13 Insufficient refrigerant charge.	**3.13.1** Verify the refrigerant leaks and eventually eliminate them, restore therefore the optimal charge.
		3.14.1 Heat the bellows (and the adjacent valve body

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Established failure	Cause	Suggested remedy
		part) twith warm air flow.
	3.14 The fluid inside the thermostatic expansion valve sensor element with MOP charge, is condensed in the bellows.	**3.15.1** Replace the insulation or replace it if it is damaged.
	3.15 Insufficient suction line insulation.	**3.16.1** Check the lubricant quantity and level and restore it if necessary.
	3.16 Insufficient compressor lubrication.	**3.16.2** Verify the lubricating pump efficiency and replace it if necessary.
		3.17.1 Verify efficiency of the compressor's additional cooling devices.
	3.17 Insufficient compressor cooling.	**3.17.2** Remove any restriction for the free air circulation around the compressor.
		3.18.1 Increase the regulating thermostat differential.
4. Too low suction pressure with respect to the foreseen evaporating pressure, with eventual low pressure switch intervention.	**3.18** Excessive compressor cycling.	**4.1.1** Verify the refrigerant leaks and eventually eliminate them, restore therefore the optimal charge.
	4.1 Insufficient refrigerant charge.	**4.2.1** Check that all liquid line valves are completely open and that there are not restrictions inside the joints (for example, solder alloy excesses).
	4.2 Partially obstructed liquid line.	**4.2.2** Verify the dryer filter efficiency; an exit connection temperature lower than the entry connection temperature is caused by its obstruction, also partial. In this case, it is necessary to replace the dryer filter.
		4.3.1 Check that all suction line valves are completely open. Verify the efficiency any filters, installed in suction line.
	4.3 Suction line with excessive pressure falls.	**4.3.2** If the suction line is equipped with pressure relief valve, verify the calibration and efficiency.
		4.4.1 Modify the thermostatic expansion valve calibration in order to reduce superheat.
	4.4 Excessive thermostatic expansion valve closing, due to wrong superheat setting.	**4.5.1** Heat the bellows (and the adjacent valve body part) with warm air flow.
	4.5 The fluid inside the thermostatic expansion valve sensor element with MOP charge is condensed in the bellows.	**4.6.1** Replace the thermal expansion valve or, if possible, only the sensor element.
	4.6 Thermostatic expansion valve with discharge sensible element.	**4.7.1** Replace the thermal expansion valve or,if possible, only the orifice.
	4.7 Underdimensioned thermostatic expansion valve.	**4.8.1** Check the defrosting device good working.
	4.8 Excessive frozed evaporator.	**4.8.2** Verify that the quantity and temperatures of the fluid cooled from evaporator are like design.
5. Too high suction pressure with respect to the foreseen evaporating pressure, with eventual protection device intervention and probable partial compressor freezing.		**5.1.1** Replace the thermal expansion valve or, if possible, only the orifice.
	5.1 Overdimensioned thermostatic expansion valve.	**5.2.1** Modify the thermostatic expansion valve calibration in order to increase the superheat.
	5.2 Excessive thermostatic expansion valve opening, due to wrong superheat setting.	**5.3.1** Fix correctly the bulb, using the suitable metallic clamps supplied as spares of thermostatic expansion valve.
	5.3 Thermostatic expansion valve bulb which is incorrectly fixed to the suction line.	**5.4.1** Line with insulating material the thermostatic expansion valve bulb and the suction line section, on which it is fixed.
	5.4 Cold air flow, which wraps the thermostatic	**5.5.1** Throug a gauge connected to the compressor

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Established failure	Cause	Suggested remedy
	expansion valve bulb.	suction, verify the pressure regulating valve calibration.
6. The compressor equipped with lubricating pump, stops for oil pressure switch intervention.	**5.5** Wrong suction pressure regulating valve calibration.	**6.1.1** Connect an oil gauge to the pump discharge connection, start the compressor and compare the read pressure value with the one indicated in the present manual.
	6.1 Inefficient or failured lubricating pump.	**6.2.1** Verify the oil pressure switch calibration and, if necessary, replace it.
	6.2 Oil pressure switch that is wrong calibrated or on failure.	**6.3.1** For the suggested interventions, we refer to the established failure "7.Lubricant lever in the compressor crankcase lower than the one foreseen".
7. The lubricant level in the compressor crankcase is lower than the one foreseen.	**6.3** For the causes, we refer to the established failure "7.Lubricant level in the compressor crankcase lower than the one foreseen".	**7.1.1** Through an electronic leak detector, find the leakage points and eliminate them, restore therefore the optimal charge.
	7.1 Refrigerant circuit with refrigerant leaks.	**7.2.1** Repair or replace the oil separator.
	7.2 Failured oil separator.	**7.3.1** The missed lubricant return is generally caused by a considerable drop of the refrigerant speed and, consequently, of its pressure. For the suggested interventions, we refer to the established failure "4.Too low suction pressure with respect to the foreseen evaporating pressure, with eventual low pressure switch intervention".
	7.3 The lubricant is pumped out from the compressor during working, remains trapped in the refrigerating circuit.	**7.4.1** Verify the oil crankcase heater efficiency, if necessary replace it and, if it is missing, install it.
	7.4 The liquid refrigerant in the compressor crankcase, on start-up has foamed in the oil causing the oil to be pumped into system.	**7.4.2** The liquid refrigerant return is to charged also at a suction pressure that is too high with respect to the foreseen evaporating pressure. For the suggested interventions, we refer to the established failure "5.Too high suction pressure with respect to the foreseen evaporating pressure, with eventual protection device intervention and probable partial compressor frozing".
8. Too short compressor stop periods, or the compressor effects more of six interventions per hour.		**8.1.1** Verify the sealing of refrigerating room isothermal doors and of all accessories.
	8.1 Strong heat re-enters in the refrigerated area.	**8.2.1** Increase the regulating thermostat differential.
	8.2 Regulating thermostat with too small differential.	**8.3.1** Connect a manometer to the compressor suction line. The imperfect valve sealing causes a sudden suction pressure increase when the compressor stops. In this case, repair the compressor and remove the cause of this inconvenience.
	8.3 Imperfect compressor reed valve sealing.	
9. The compressor stops for protection device intervention.		**9.1.1** Connect a refrigerant recovery unit both to refrigerating circuit high pressure side and to low pressure side and remove the whole refrigerant charge. Evacuate for a long time the circuit, effect the recharge with new refrigerant, start the compressor and check the working pressures.
	9.1 Incondensable gas inside the refrigerating circuit.	**9.2.1** Connect a refrigerant recovery unit in a circuit point, where there is only liquid refrigerant and recover the excess. At the end of recovery operations, start the compressor and verify the working pressures.
	9.2 Excessive refrigerant charge.	**9.3.1** Compare the condenser performances, declared by manufacturer, with the designed heat balance; in case the performaces are insufficient, replace the condenser.
	9.3 Condenser on failure or with insufficient thermal exchange.	**9.3.2** If the condenser is air-cooled, execute the

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Established failure	Cause	Suggested remedy
		following operations: - check the fan motor fans state - check the fan motor direction of rotation - clean the finned coil - rectify any distorted fins. If the condenser is water-cooled, execute the following operations: - scale the feeding pipes and the tube nest - verify the cooling tower efficiency - measure the water capacity - measure the water inlet temperature
		9.4.1 Verify that the condenser location is in such way to avoid at the outlet air flow to be, also partially, deviated on the fan suction.
	9.4 Air-cooled condenser with hot air blow-by.	**9.5.1** Check that all liquid line valves are completely open and that there are not restrictions inside the joints (for example, solder alloy excesses).
	9.5 Partially obstructed discharge line.	**9.6.1** Check that the thermostatic expansion valve bulb is suitably positioned, fixed and insulated.
	9.6 Too high suction pressure with respect to the designed evaporating pressure.	**9.6.2** Check that the thermostatic expansion valve capacity is proportional to the real compressor refrigerating capacity and that the superheat setting is correct.
		9.6.3 If the plant is equipped with suction pressure relief valve, verify the calibration.
		9.7.1 Measure the tension between the feeding line phases. If the measured tension is within the limits, but it decreases during compressor working, the failure is to charge to the insufficient feeding line section; in this case, replace the feeding line with one of suitable section.
	9.7 Feeding net tension lower than the compressor electrical motor tolerance limits.	**9.8.1** Verify the wiring strength, the dielectric rigidity (insulation towards earth); repair or replace the compressor.
	9.8 Electrical motor with earthed or in short circuit wiring.	**9.9.1** Check the tension between phases; if it is unbalanced, ask for output institution intervention.
	9.9 Unbalanced three-phase electrical feeding line.	**9.10.1** Measure values of start, run currents and of the compressor temperature. If the measured values shows compressor overloads and overheating absence: - for three phase compressors verify the thermistor chain continuity and strength - or single phase compressors verify that at ambient temperature, theelectrothermal protector is closed.
	9.10 Defective protection device or with wrong calibration.	**9.11.1** Restore the connections, referring to the electrical schemes of the present manual.
	9.11 Wrong electrical connections.	**9.12.1** Verify that the relay has been connected as indicated in the electrical schemes of the present manual.
	9.12 Starting relay wrong mounted.	**9.13.1** Verify the compressor additional cooling efficiency (head fan motors, water-cooled heads, liquid injection) and that its external surface is clean and free.
	9.13 Excessive compressor temperature.	**9.14.1** Repair or replace the compressor.
10. The single phase compressor doesn't start, hums intermittently and cyclical intervens the electrothermal protection.	**9.14** Seizure starting or shaft-bearings and/or piston-cylinder couplings,which are not sufficiently sliding.	**10.1.1** Restore the connections, referring to the electrical wiring of the present manual.
	10.1 Wrong electrical connections.	**10.2.1** Measure the feeding line tension while the

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Established failure	Cause	Suggested remedy
		compressor is starting. If the tension decreases while the compressor is humming, but it doesn't start, the failure is to charge to the insufficient feeding line section; in this case, replace the feeding line with one of suitable section.
	10.2 Electrical feeding with lower tension than tolerance limits.	**10.3.1** Connect a refrigerant recovery unit in a circuit point, where there is only liquid refrigerant and recover the excess, start therefore the compressor and verify the working pressures.
	10.3 Excessive refrigerant charge.	**10.4.1** Replace the relay with one new.
	10.4 Defective or not suitable starting relay.	**10.5.1** Through a provisional electrical connection, going to the compressor electrical motor an impulse that makes it rotate in a direction contrary to the previous. In case the tentative has not positive result, repair or replace the compressor.
	10.5 Compressor mechanical lock.	**10.6.1** Disconnect the compressor from the electrical feeding net, remove the conductors from the terminal box and, through an ohmmeter, verify if the wiring strength values are correct. Repair or replace the compressor if necessary.
	10.6 Defective electrical motor wiring.	**10.6.2** Verify the compressor dielectrical rigidity (insulation towards earth). Repair or replace the compresor if necessary.
	10.7 Defective protection device.	**10.7.1** Measure values of start, run currents and of the compressor temperature. If the measured values shows compressor overloads and overheating absence: - for three phase compressors verify the thermistor chain continuity and strength - for single phase compressors verify that at ambient temperature, the electrothermic protector is closed.
	10.8 Defective start capacitor or with rating tension lower than the one prescribed.	**10.8.1** Replace the start capacitor.
	10.9 Defective run capacitor.	**10.9.1** Replace the run capacitor.
11. The three phase compressor does not start, hums intermittently and cyclical intervens the protection module (or similar device arranged by installer).	**11.1** Electrical feeding net with tension lower than the tolerance limits.	**11.1.1** Verify the tension of each phase while the compressor is starting. It the tension decreases while the compressor is humming, but it doesn't start, the failure is to charge to the insufficient feeding line section.
	11.2 One of three phases missing.	**11.2.1** Starting from the compressor terminal box and ascending along the feeding line, verify the tension between the three phases. One phase missing can be due to loose clamps, contactor connection wear, interrupted fuse, etc.
	11.3 Defective protection device or wrong calibrated.	**11.3.1** Measure values of start, run currents and of the compressor temperature. If the measured values show compressor overloads and overheating absence, verify the thermistor chain continuity and strength and, if necessary, replace the compressor.
	11.4 Interrupted electrical motor wiring.	**11.4.1** Disconnect the compressor from the electrical feeding net, remove the conductors from the terminal box and, through an ohmmeter, verify if the wiring strength values are correct. Repair or replace the compressor if necessary.
	11.5 Compressor mechanical lock.	**11.5.1** Repair or replace the compressor. **11.6.1** Verify the compressor dielectrical rigidity (insulation towards earth). Repair or replace the compressor if necessary.

Established failure	Cause	Suggested remedy
12. The compressor doesn't start and doesn't hum also if the control panel is regularly feeded.	**11.6** Electrical motor with earthed wiring.	**12.1.1** Verify the electrical feeding line continuity.
	12.1 Electrical feeding line interrupter.	**12.2.1** Replace the thermostat.
	12.2 Discharged thermostat power element.	**12.3.1** Replace the contactor coil.
	12.3 Contactor coil on failure.	**12.4.1** Remove the intervention cause, push therefore the safety valve manual reset botton.
	12.4 Intervention of a safety device with manual reset.	**12.5.1** Verify the compressor electrical motor wiring continuity, repare or replace therefore the compressor.
13. Speed starting relay connection wear.	**12.5** Compressor electrical motor with interrupted wiring.	**13.1.1** Increase the regulating thermostat differential.
	13.1 Excessive compressor cycling.	**13.2.1** Replace the start capacitor.

WARNING

The suggested interventions have to be executed in observance of the safety precautions illustrated on page 4.
For further details or suggestions, please contact FRASCOLD Technical Department.

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11. Tabelle tecniche

11.1 quantità di olio, vedi catalogo FCAT01/FCAT04
11.2 tipo di lubrificante, vedi manuale FTEC26
11.3 Attacchi di servizio, vedi catalogo FCAT01/FCAT04
11.4 Coppie di serraggio, contattare Frascold
11.5 Supporti antivibranti, vedi catalogo FCAT01/FCAT04
11.6 Dimensioni di ingombro, vedi catalogo FCAT01/FCAT04
11.7 Dimensioni di ingombro, vedi catalogo FCAT01/FCAT04
11.8 Dimensioni di ingombro, vedi catalogo FCAT01/FCAT04
11.9 Dimensioni di ingombro, vedi catalogo FCAT01/FCAT04
11.10 Dimensioni di ingombro, vedi catalogo FCAT01/FCAT04
11.11 Dimensioni di ingombro, vedi catalogo FCAT01/FCAT04
11.12 Dimensioni di ingombro, vedi catalogo FCAT01/FCAT04
11.13 Dimensioni di ingombro, vedi catalogo FCAT01/FCAT04
11.14 Dimensioni di ingombro, vedi catalogo FCAT01/FCAT04
11.15 Dimensioni di ingombro, vedi catalogo FCAT01/FCAT04
11.16 Dimensioni di ingombro, vedi catalogo FCAT01/FCAT04
11.17 Dimensioni di ingombro, vedi catalogo FCAT01/FCAT04
11.18 Dati elettrici 50 Hz, vedi catalogo FCAT01
11.19 Dati elettrici 60 Hz, vedi catalogo FCAT04
11.20 Caratteristiche dei termistori
11.21 Caratteristiche dei moduli elettronici
11.22 Caratteristiche dei condensatori
11.23 Caratteristiche dei relais
11.24 Collegamenti morsettiera 50/60 Hz, vedi doc. M041
11.25 Collegamenti morsettiera 50/60 Hz, vedi doc. M041
11.26 Collegamenti morsettiera 50/60 Hz, vedi doc. M041
11.27 Collegamenti morsettiera 50/60 Hz, vedi doc. M041
11.28 Collegamenti morsettiera 50/60 Hz, vedi doc. M041
11.29 Collegamenti morsettiera 50/60 Hz, vedi doc. M041
11.30 Collegamenti morsettiera 50/60 Hz, vedi doc. M041

Tutti i manuali e cataloghi citati sono disponibili sul sito internet www.frascold.it in area Pubblicazioni

Data tables

11.1 quantity of oil, see catalogue FCAT01/FCAT04
11.2 type of lubricant, see manual FTEC26
11.3 Service connections, see catalogue FCAT01/FCAT04
11.4 Tightening torque, contact Frascold
11.5 Vibration absorbers, see catalogue FCAT01/FCAT04
11.6 Dimensional drawing, see catalogue FCAT01/FCAT04
11.7 Dimensional drawing, see catalogue FCAT01/FCAT04
11.8 Dimensional drawing, see catalogue FCAT01/FCAT04
11.9 Dimensional drawing, see catalogue FCAT01/FCAT04
11.10 Dimensional drawing, see catalogue FCAT01/FCAT04
11.11 Dimensional drawing, see catalogue FCAT01/FCAT04
11.12 Dimensional drawing, see catalogue FCAT01/FCAT04
11.13 Dimensional drawing, see catalogue FCAT01/FCAT04
11.14 Dimensional drawing, see catalogue FCAT01/FCAT04
11.15 Dimensional drawing, see catalogue FCAT01/FCAT04
11.16 Dimensional drawing, see catalogue FCAT01/FCAT04
11.17 Dimensional drawing, see catalogue FCAT01/FCAT04
11.18 50 Hz electrical data, see catalogue FCAT01
11.19 60 Hz electrical data, see catalogue FCAT04
11.20 Thermistors data
11.21 Electronic modules data
11.22 Capacitors data
11.23 Relay data
11.24 50/60 Hz terminal connections, see doc. M041
11.25 50/60 Hz terminal connections, see doc. M041
11.26 50/60 Hz terminal connections, see doc. M041
11.27 50/60 Hz terminal connections, see doc. M041
11.28 50/60 Hz terminal connections, see doc. M041
11.29 50/60 Hz terminal connections, see doc. M041
11.30 50/60 Hz terminal connections, see doc. M041

All cited manuals and catalogues are available for download on www.frascold.it websiste, Publications area.

11.20 Caratteristiche dei termistori - Thermistors data

massima tensione di prova maximum test voltage	resistenza della catena dei termistori alla temperatura di 25°C thermistor chain resistance at temperature 25°C		
	serie - series W	P.W.S.	altri - others
2.5 V	≤ 600 Ω	≤ 600 Ω	≤ 300 Ω

11.21 Caratteristiche dei moduli elettronici - Electronic modules data

modello model		temperatura ambiente ambient temperature °C	durata operativa service life cicli-cycles	ritardo delay min
T00ECA01	24 V 50/60 Hz	-30 ÷ +70	1 x 10^6 ~	-
T00ECA01	230 V 50-60 Hz	-30 ÷ +70	1 x 10^6 ~	-
T00ECA11	200-240 V 50-60 Hz	-20 ÷ +60	1 x 10^6 ~	5 (±15%)

11.22 Caratteristiche dei condensatori - Capacitors data

motore elettrico monofase single phase electric motor		condensatore di spunto start capacitor	condensatore di marcia run capacitor
0.37 kW	50 Hz	160-200 µF 380V 42-60 Hz	16 µF 450V 50 Hz
0.50 kW	50 Hz	160-200 µF 380V 42-60 Hz	16 µF 450V 50 Hz
0.75 kW	50 Hz	160-200 µF 380V 42-60 Hz	20 µF 450V 50 Hz
1.10 kW	50 Hz	200-250 µF 380V 42-60 Hz	25 µF 450V 50 Hz
1.50 kW	50 Hz	250-315 µF 380V 42-60 Hz	30 µF 450V 50 Hz
0.37 kW	60 Hz	160-200 µF 380V 42-60 Hz	16 µF 450V 50 Hz
0.50 kW	60 Hz	160-200 µF 380V 42-60 Hz	16 µF 450V 50 Hz
0.75 kW	60 Hz	160-200 µF 380V 42-60 Hz	16 µF 450V 50 Hz
1.10 kW	60 Hz	200-250 µF 380V 42-60 Hz	30 µF 450V 50 Hz
1.50 kW	60 Hz	250-315 µF 380V 42-60 Hz	32 µF 450V 50 Hz

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11.23 Caratteristiche dei relais - Relay data

motore elettrico monofase single phase electric motor		modello model	tensione di stacco pick up	tensione di riattacco drop out
0.37 kW	50 Hz	RVA 4M3C	242 - 272 V	50 - 110 V
0.50 kW	50 Hz	RVA 4M3C	242 - 272 V	50 - 110 V
0.75 kW	50 Hz	RVA 4M3C	242 - 272 V	50 - 110 V
1.10 kW	50 Hz	RVA 4N3C	262 - 290 V	60 - 121 V
1.50 kW	50 Hz	RVA 4O3C	280 - 310 V	60 - 121 V
0.37 kW	60 Hz	RVA 4N3C	262 - 290 V	60 - 121 V
0.50 kW	60 Hz	RVA 4N3C	262 - 290 V	60 - 121 V
0.75 kW	60 Hz	RVA 4N3C	262 - 290 V	60 - 121 V
1.10 kW	60 Hz	RVA 4N3C	262 - 290 V	60 - 121 V
1.50 kW	60 Hz	RVA 4N3C	262 - 290 V	60 - 121 V

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Compressori semiermetici
Istruzioni per la installazione e l'avviamento

Semi-hermetic compressors
Installation and start-up instructions

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1. Controlli e operazioni preliminari

Una volta ricevuto il compressore e prima di procedere alla sua installazione, eseguire alcune semplici operazioni allo scopo di verificarne la sua integrità e idoneità al montaggio nel circuito frigorifero.

1.1 Controlli e verifiche

a) al momento del ricevimento del compressore, verificare che il suo imballo non abbia subito danni durante il trasporto
b) rimuovere l'imballo del compressore
c) verificare che il compressore non sia danneggiato

N.B. Nel caso venissero riscontrati danni o manomissioni, inviare tempestivamente una segnalazione scritta.

d) verificare che la dotazione di accessori forniti a corredo del compressore sia completa
e) adagiare su un piano orizzontale il compressore e verificare che il livello del lubrificante sia sempre superiore a 3/4 della spia di livello (vedi figura 1)
f) verificare che le caratteristiche elettriche riportate sulla targhetta del compressore siano compatibili con i valori della rete di alimentazione

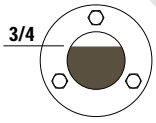


figura 1

1.2 Il sollevamento del compressore

I compressori serie S, V, Z e W sono dotati di una apposita asola di sollevamento posta tra testate e scatola terminale; per il loro sollevamento, utilizzare un cavo di appropriata sezione e gancio infilato dentro l'asola (vedi figura 2).
I compressori serie A, B, D, F e Q sono privi di asola e devono essere sollevati utilizzando una cinghia che avvolge il compressore nella parte mediana (vedi figura 3).
Durante il sollevamento, tenere fermo il compressore per evitare le oscillazioni.

figura 2

figura 3

1. Preliminary checks and operations

After compressor receipt and before its installation, execute some easy operations in order to verify its integrity and fitness for assembly in the refrigerating circuit.

1.1 Checks and testings

a) at compressor receipt, verify that its packing has not been damaged during transport
b) remove compressor packing
c) verify that the compressor is not damaged

N.B. In case damages or tamperings are found, send immediately a written communication.

d) verify that accessories supplied as compressor equipment are complete
e) put the compressor on a horizontal surface and verify that the lubricant level is not lower than 3/4 of level sight glass (see figure 1)
f) verify that the electrical characteristics on the compressor name plate are in accordance with the electrical net values.

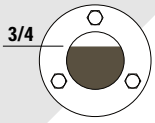


figure 1

1.2 Compressor lifting

Compressors S, V, Z and W series are equipped with a suitable lifting slot placed between the heads and the terminal board.
For their lifting, use a cable with suitable section and hook inside the slot (see figure 2).
Compressors A, B, D and F series are without slot and have to be lifted with a belt, that wraps the compressor in the medial side (see figure 3).
During lifting, keep the compressor still to avoid oscillations.

figure 2

figure 3

2. Installazione del compressore

2.1 Fissaggio del compressore al basamento

È importante che il compressore venga fissato a un basamento perfettamente orizzontale che, oltre a garantire un funzionamento privo di anomale sollecitazioni, è indispensabile per la perfetta lubrificazione delle parti in movimento.
L'impiego dei supporti antivibranti forniti a corredo, impedisce che le vibrazioni che si manifestano durante il funzionamento, l'arresto e l'avviamento del compressore, vengano trasmesse al basamento sul quale lo stesso è montato.

a) allestire il posto di installazione del compressore rispettando gli spazi tecnici necessari così come indicato nei disegni riportati nei cataloghi e nel manuale di installazione
b) mediante i quattro supporti antivibranti forniti a corredo, fissare il compressore al posto di installazione, applicando alle viti la coppia di serraggio qui di seguito riportata

Supporti antivibranti - coppia di serraggio dei dadi

dimensioni del dado		M8	M10
serraggio	Nm	20	30

2.2 Collegamenti frigoriferi

⚠ ATTENZIONE

Prima di rimuovere qualsiasi bullone o rubinetto del compressore, eliminare la carica di tenuta allentando lentamente il dado cieco del rubinetto di compressione.

La realizzazione dei collegamenti frigoriferi del compressore richiede interventi di brasatura dei rubinetti di aspirazione e di compressione.
La affidabilità di un circuito frigorifero è condizionata dalla quantità di prodotti estranei al lubrificante e al refrigerante presenti all'interno del circuito stesso.
Mentre aria atmosferica e umidità (inevitabilmente infiltrati durante il montaggio) possono essere rimossi attraverso la vuotatura, l'estrazione dei residui del disossidante e gli ossidi che si formano durante la brasatura è una operazione nè semplice nè economica.
Le dimensioni delle impurità sono talmente ridotte da sfuggire in parte alla azione dei filtri installati sulla linea del liquido; durante l'assemblaggio del circuito frigorifero, è consigliabile adottare tutte le precauzioni possibili atte a evitare l'introduzione di impurità.
Oltre alle elementari precauzioni da mettere in atto durante il taglio del tubo, è necessario evitare un uso esagerato di disossidanti e, quando possibile, immettere azoto secco o altro

2. Compressor installation

2.1 Compressor fixing to frame

It is important that the compressor is fixed to a frame perfectly horizontal that, besides to guarantee a working without anomalous stresses, is indispensable for the perfect lubrication of parts in motion.
The use of the supplied vibration absorbers avoid that the compressor vibrations during the work, the stop and the start are transmitted to the frame on which the compressor is assembled.

a) prepare the compressor installation seat, respecting the necessary technical spaced as indicated on drawings included in the catalogues and installation manual
b) through the four vibration absorbers supplied as equipment, fix the compressor on installation seat, applying the correct tightening torque, as below

Vibration absorbers - bolt tightening torque

bolt dimension		M8	M10
tightening torque	Nm	20	30

⚠ WARNING

Before removing any compressor bolt or valve, discharge the holding charge by opening slowly the suction valve plug.

The compressor refrigerating connections realization require suction and discharge valve brazing operations.
The refrigeration system's reliability will be reduced if foreign particles are allowed into the circuit.
While atmospherical air and humidity (infiltrated inevitably during assembly) can be removed through vacuum, the removal of the deoxidizer and oxide residual, which develops during brazing, is an operation neither simple nor cheap.
The impurity dimensions are so small to bypass partly the action of filters installed in liquid lines; during refrigerating circuit assembly, it is advisable to use all possible precautions in order to avoid impurity introduction.
Besides to elementary precautions to take during pipe cutting, it is necessary to avoid an excessive use of deoxidizers and, when possible, to put dry nitrogen or other inert gas in the piping during its brazing; to avoid to offer valve internal parts at a dangerous overheating, it is suggested to disassemble the valve or only the coupling (by removing the gaskets) and wrap it in a wet cloth.

gas inerte nella tubazione durante la sua brasatura; per evitare di esporre le parti interne del rubinetto a un pericoloso surriscaldamento, si consiglia di smontare il rubinetto o il solo manicotto (rimuovendone le guarnizioni) e avvolgerlo in un panno bagnato.

a) allentare lentamente il dado cieco situato sul rubinetto di compressione del compressore e lasciare sfiatare la carica di tenuta di azoto
b) serrare accuratamente il tappo
c) smontare i rubinetti (o il manicotto) dal compressore e rimuovere le guarnizioni
d) procedere alla brasatura dei rubinetti alle tubazioni di scarico e aspirazione del circuito frigorifero, adottando le precauzioni necessarie ad evitare sia il surriscaldamento delle parti interne che l'introduzione di prodotti estranei
e) sostituire le guarnizioni precedentemente rimosse con quelle fornite a corredo poste all'interno della scatola terminale
f) rimontare i rubinetti (o il manicotto) applicando alle viti la coppia di serraggio qui di seguito riportata

Rubinetti - coppia di serraggio delle viti

dimensioni della vite		M8	M10	M12
serraggio	Nm	35	50	67

Prima di procedere nelle operazioni di installazione, si consiglia di predisporre il compressore per il collegamento dei dispositivi di sicurezza e controllo quali pressostati e manometri oppure per gli interventi di reintegro della carica di olio.
Il corpo del compressore è dotato di diversi attacchi filettati femmina con tappo di chiusura; la rimozione di alcuni tappi e la loro sostituzione con semplici nipli, metterà a disposizione dell'operatore le necessarie prese di pressione per i collegamenti ai vari dispositivi di sicurezza e controllo (vedi "Istruzioni per la installazione e l'avviamento" pagina 8).

⚠ ATTENZIONE

Non collegare alcun dispositivo di sicurezza e controllo agli attacchi presenti sui rubinetti di aspirazione e di compressione; questi vengono esclusi quando il rubinetto è completamente aperto (intercettazione in retrochiusura).

Per la scelta e il montaggio di equipaggiamenti secondari e/o accessori quali pressostati, termostati, manometri, separatore di olio, etc. si consiglia di prendere visione di quanto riportato nel manuale di installazione a pagina 11, "7. Accessori vari".

2.3 Collegamenti elettrici

I collegamenti elettrici devono essere eseguiti in accordo con gli schemi elettrici allegati al presente manuale e nel rispetto delle norme di sicurezza in vigore nel luogo di installazione.
Per il corretto collegamento del compressore, consultare lo schema elettrico applicato nella parte interna del coperchio della scatola terminali oppure lo schema elettrico riportato nel manuale di installazione.

⚠ ATTENZIONE

I collegamenti elettrici devono essere eseguiti esclusivamente da personale specializzato.

a) rimuovere il coperchio della scatola terminali
b) svitare i dadi; posizionare le barrette a ponticello seguendo le indicazioni

⚠ ATTENZIONE

L'errato collegamento elettrico può dare luogo a cortocorcuiti o collegamenti in contro fase e causa la bruciatura del motore.

c) inserire negli appositi fori della scatola terminali degli idonei pressacavi PG per assicurare il grado di protezione originale della scatola stessa
d) collegare la rete di alimentazione alla morsettiera utilizzando idoneo cavo elettrico isolato e capicorda ad occhiello adatti ai terminali
e) applicare ai dadi la coppia di serraggio qui di seguito riportata

Scatola terminali - coppia di serraggio dei dadi

dimensioni del dado		M4	M6
serraggio	Nm	5	10

f) rimuovere il coperchio del dispositivo di protezione
g) collegare il dispositivo al circuito elettrico di controllo seguendo quanto indicato nello schema elettrico e rimontare il coperchio sulla scatola terminali

⚠ ATTENZIONE

Non alimentare direttamente i terminali A e B collegati ai termistori PTC.

N.B. Se il compressore è dotato di riscaldatore olio carter, quest'ultimo deve essere collegato in modo da poter essere alimentato manualmente almeno 2 ore prima dell'avviamento successivo a un lungo periodo di inattività e, durante il normale funzionamento, solo a compressore fermo.

2.4 Selezione del teleruttore, dei fusibili e dei cavi

La selezione di idonei teleruttori, fusibili e cavi, deve soddisfare quanto richiesto dalla norma EN60204 (Equipaggiamenti elettrici per macchine industriali - Requisiti generali) facendo riferimento ai valori di massima corrente di funzionamento MRA riportati sulla targhetta del compressore e di massima potenza assorbita.
N.B. La potenza nominale del compressore non è equivalente alla potenza massima del suo motore elettrico.

Per informazioni più dettagliate, richiedere il manuale: "**FTEC01 - Istruzioni per la installazione e l'avviamento**".

a) open slowly the compressor suction valve plug and let off the nitrogen holding charge
b) close carefully the plug
c) disassemble the valves (or the coupling) from compressor
d) remove the gaskets
e) effect the brazing of the valves of the discharge and suction pipes of the refrigerating circuit, taking the necessary precautions to avoid both internal part overheating and foreign product introduction
f) replace the gaskets previously removed, with those supplied as spares placed inside the terminal box
g) re-assemble the valves (or the coupling), applying the following tightening torque

Valves - bolt tightening torque

bolt dimensions		M8	M10	M12
tightening torque	Nm	35	50	67

Before proceeding to installation operations, it is suggested to arrange the compressor for safety and check devices connection, like pressure switches and manometers, or for oil charge fulfilment interventions.
The compressor body is equipped with different female threaded connections with closing plug; the removal of some plugs and their replacement with Schrader service valves or niple, will put at operator's disposal the necessary pressure connections for various safety and check devices (see "Installation and start-up instructions" page 8).

⚠ WARNING

Do not connect any safety and check device to the connections placed on suction and discharge valves, because they are closed off when the valve is completely open (interception in retroclosing).

For the choice and assembly of secondary equipments and/or accessories like pressure switches, thermostats, manometers, oil separators, etc. it is suggested to look up the installation manual at paragraph "7. Various accessories" on page 11.

2.3 Electrical connections

Electrical connections have to be executed in accordance with the electrical schemes enclosed to the present manual and in observance of installation place safety regulations.
For the right compressor connection, look at the electrical scheme placed in the inside of terminal box cover or the electrical scheme shown on installation manual.

⚠ WARNING

Electrical connections have to be executed only by skilled operator.

a) remove the terminal box cover
b) unscrew the nuts and place the staple bars following the indications

⚠ WARNING

The incorrect electrical connections may cause short circuit or counter phase connections and therefore the motor burn-out.

c) put in the terminal box holes some suitable PG cable-presses to assure the box's original protection grade
d) connect the feeding net to the teminal box, using suitable insulated electrical cable and eyelet cable terminals fitted to terminals
e) apply to nuts the following tightening torque

Terminal box - bolt tightening torque

bolt dimensions		M4	M6
tightening torque	Nm	5	10

f) after removing its cover, connect the protection device to check and protection circuit, following the electrical scheme

⚠ WARNING

Do not feed directly terminals A and B connected to PTC thermistors.

g) reassemble the protection device cover and the one of the terminal box

N.B. If the compressor is equipped with oil crankcase heater, this has to be connected so that it can be feed manually at least 2 hours before starting after a long period of inactivity and, during the normal working, only with not running compressor.

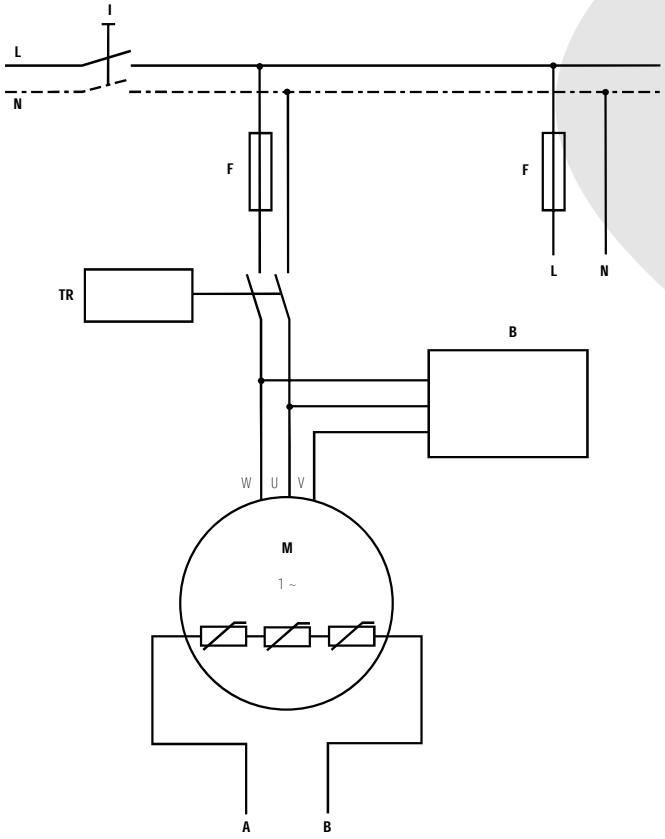
2.4 Contactor, fuse and cable selection

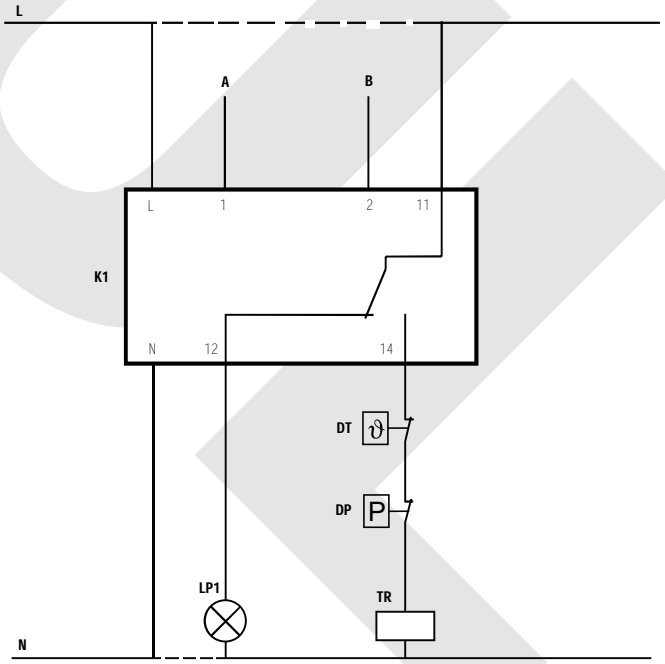
The suitable remote control switch, fuse and cable selection has to satisfy what requested from EN60204 regulation (Electrical equipments for industrial machines - General requirements), with reference to MRA maximum operating current values reported on the compressor name plate and maximum input power.
N.B. The compressor nominal power is not equivalent to the maximum input power of its electrical motor.

For more detailed informations, please request the manual: "**FTEC01 - Installation and start-up instructions**".

Schema elettrico — 1 ph D.O.L. — Wiring diagram

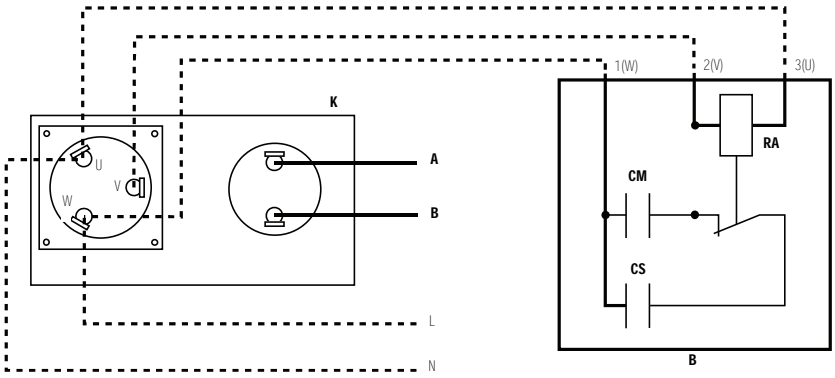
208-230/1/60	115/1/60





Non alimentare direttamente i terminali A - B dei termistori

Do not feed directly terminals A - B of the thermistors



* **Potenza del teleruttore ≥ massima potenza assorbita**
Contactor power ≥ maximum input power

N.B. Se necessario, è possibile dotare il teleruttore di salvamotore termico
If necessary, it is possible to fit the contactor with thermal overcurrent protector

Legenda schemi elettrici - Wiring diagrams key

A-B	terminali dei termistori	thermistor terminals
B	scatola dei condensatori	capacitors box
CS	condensatore di avviamento	start capacitor
CM	condensatore di marcia	run capacitor
DP	pressostato	pressure switch
DT	termostato di regolazione	temperature switch
F	fusibile	fuse
I	interruttore di linea	main switch
K	piastra terminali	terminal board

K1	modulo elettronico KRIWAN	KRIWAN electronic module
LP1	spia intervento termistori	thermistor warning lamp
L	fase della rete di alimentazione	phase of electrical net
N	neutro	neutral
RA	relay di avviamento	start relay
TR	teleruttore principale *	main contactor *

Schema elettrico

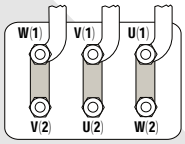
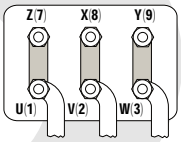
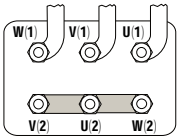
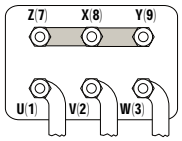
3 ph D.O.L.

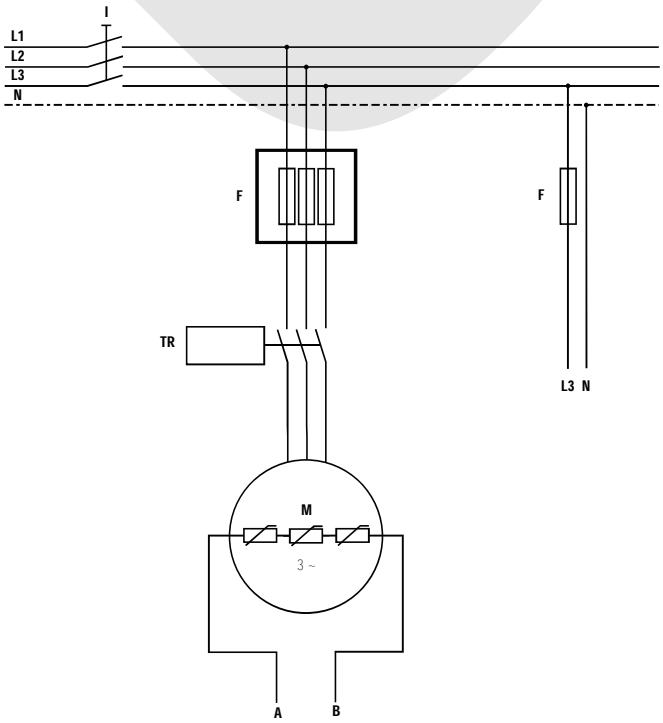
Wiring diagram

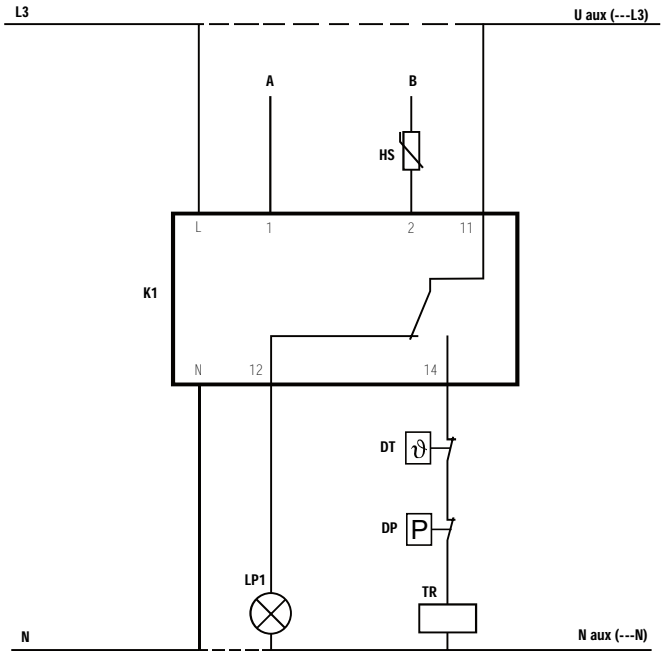
220-240/3/60 380-420/3/60	250-280/3/60 440-480/3/60	230/3/60 460/3/60

Collegamenti della morsettiera

Terminal connections

220-240/3/60 Δ • 250-280/3/60 Δ • 230/3/60 Δ		380-420/3/60 人 • 440-480/3/60 人 • 460/3/60 人	
Serie **A-B-D-F-Q** Series	Serie **S-V-Z-W** Series	Serie **A-B-D-F-Q** Series	Serie **S-V-Z-W** Series
			





* **Potenza del teleruttore ≥ massima potenza assorbita**
Contactor power ≥ maximum input power

** **Portata dei fusibili (tipo GL) = 1.3 ÷ 4 x LRA (vedi targhetta del compressore)**
Fuses capacity (GL type) = 1.3 ÷ 4 x LRA (see name plate on the compressor)

N.B. Se necessario, è possibile dotare il teleruttore di salvamotore termico
If necessary, it is possible to fit the contactor with thermal overcurrent protector

Non alimentare direttamente i terminali A - B dei termistori

Do not feed directly terminals A - B of the thermistors

Legenda schemi elettrici - Wiring diagrams key

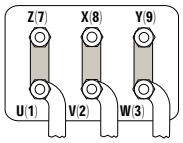
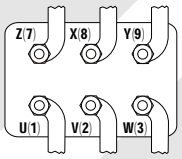
A-B	terminali dei termistori	thermistor terminals
DP	pressostato	pressure switch
DT	termostato di regolazione	temperature switch
F	fusibile **	fuse **
HS	sensore max. temperatura di compressione	max discharge temperature sensor
I	interruttore di linea	main switch
K	piastra terminali	terminal board
K1	modulo elettronico KRIWAN	KRIWAN electronic module
LP1	spia intervento termistori	thermistor warning lamp

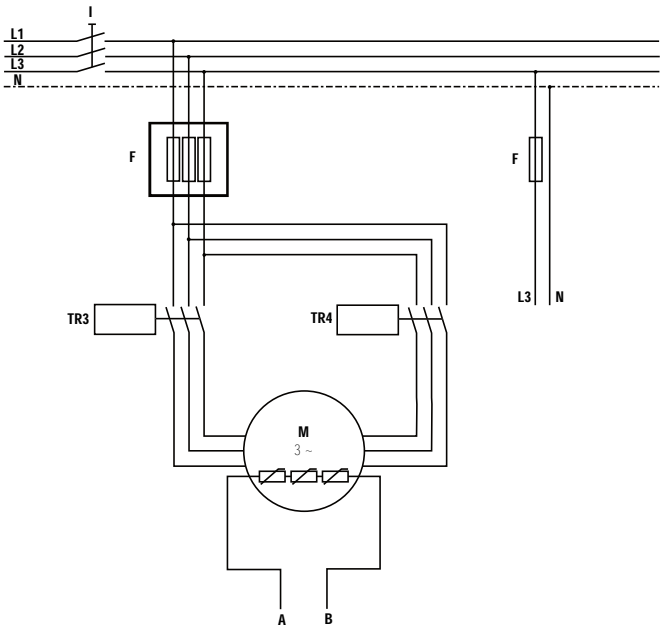
L1	fase della rete di alimentazione	phase of electrical net
L2	fase della rete di alimentazione	phase of electrical net
L3	fase della rete di alimentazione	phase of electrical net
N	neutro	neutral
TR	teleruttore principale *	main contactor *

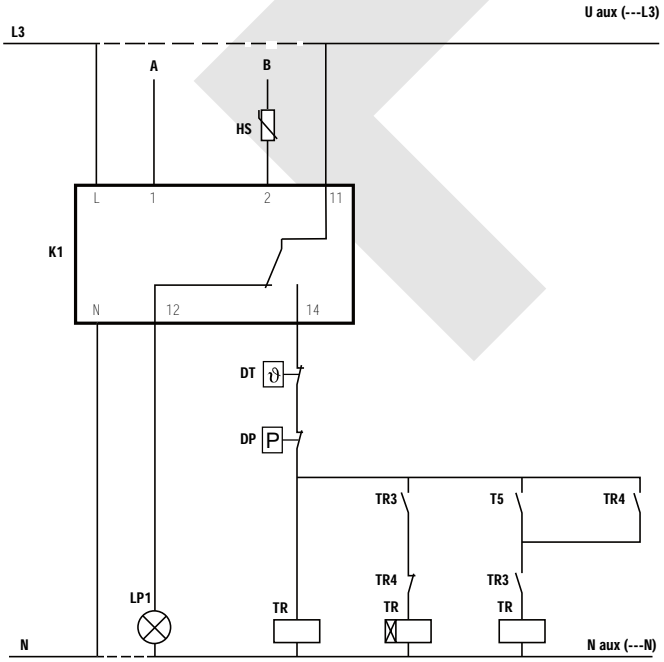
Schema elettrico — 3 ph P.W.S. — Wiring diagram

230/3/60	400/3/60	440-480/3/60

Collegamenti della morsettiera — Terminal connections

230/3/60 DOL ⅄⅄ • 400/3/60 DOL ⅄⅄ • 440-480/3/60 DOL ⅄⅄	230/3/60 PWS ⅄/⅄ • 400/3/60 PWS ⅄/⅄ • 440-480/3/60 PWS ⅄/⅄
Serie **F - S - V - Z - W** Series	Serie **F - S - V - Z - W** Series
	





* **Potenza del teleruttore massima potenza assorbita**
Contactor power ≥ 0.65 x maximum input power

** **Portata dei fusibili (tipo GL) = 1.1 ÷ 1.5 x LRA (vedi targhetta del compressore)**
Fuses capacity (GL type) = 1.1 ÷ 1.5 x LRA (see name plate on the compressor)

N.B. Se necessario, è possibile dotare il teleruttore di salvamotore termico
If necessary, it is possible to fit the contactor with thermal overcurrent protector

Non alimentare direttamente i terminali A - B dei termistori

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Legenda schemi elettrici - Wiring diagrams key

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L3	fase della rete di alimentazione	phase of electrical net
N	neutro	neutral
TR	teleruttore principale *	main contactor *

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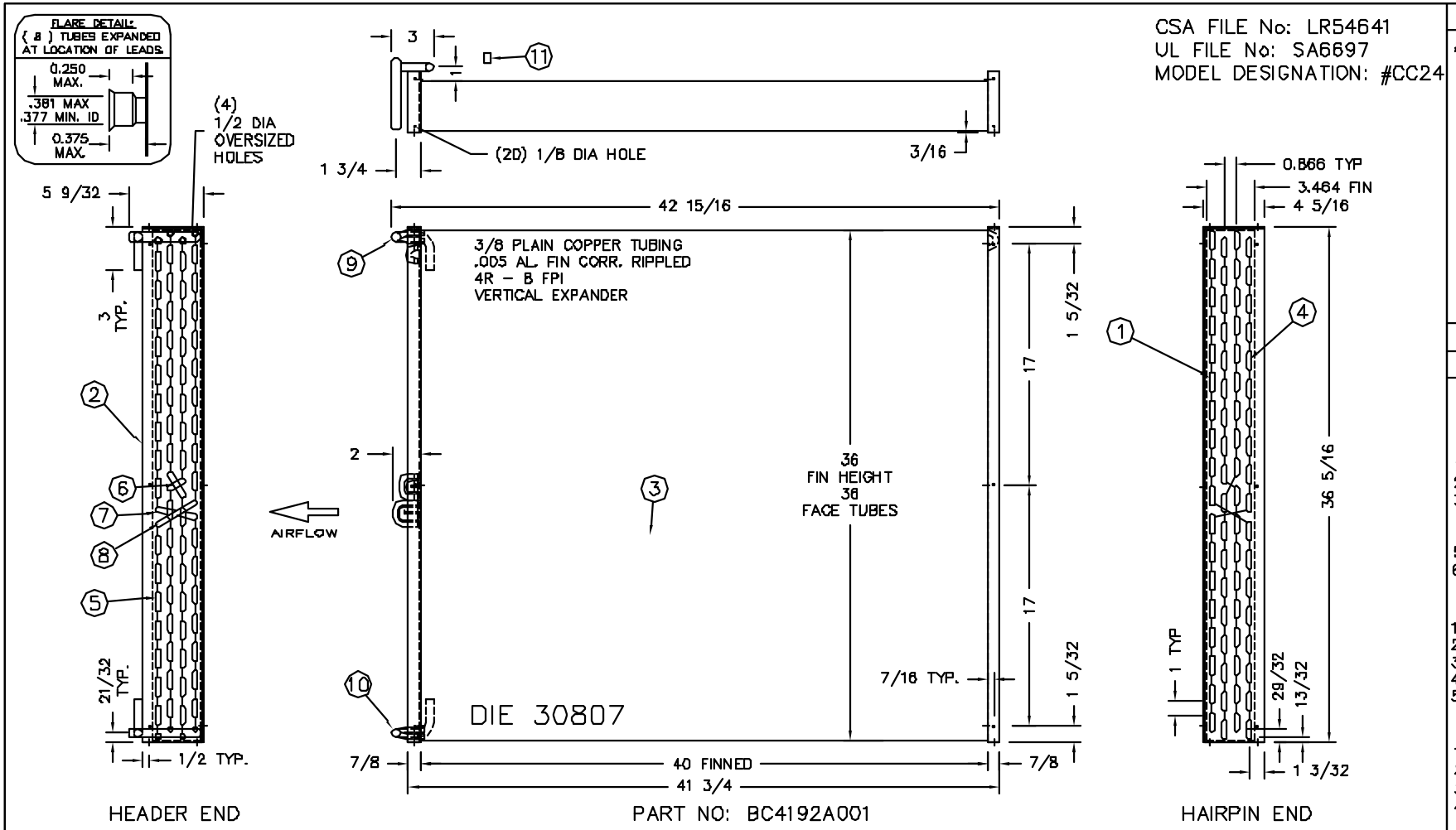

CSA FILE No: LR54641
UL FILE No: SA6697
MODEL DESIGNATION: #CC24

REVISIONS

A-ECN 3978 V.K. APR. 30/01

TOLERANCES UNLESS OTHERWISE SPECIFIED

SHEET METAL

1. CUTTING SIZE±1/64
2. HOLE DIA.±.002
3. CTR. TO CTR. DISTANCE OF HOLES±1/64
4. ANGLES ±2 DEG.
5. HOLE LOCATION±1/64
6. FORMED DIM.± 1/32

TUBING

1.DECIMAL DIM.±.005
2.FRACT. DIM.±1/32
3.1" THRU 40"±1/16
4.OVER 40"±1/8
5.ANGLES ±5 DEG.

COIL ASSEMBLY

1.SAME AS TUBING TOL.
2.FIN QUANTITY±3%
3.MAX BOW ON HGT.±1/16"
4.MAX BOW ON LGTH±1/16"

NO.	QTY	DESCRIPTION	PART NO.	NO.	QTY	DESCRIPTION	PART NO.
1.	1	END PLATE (16 GA GALV)	BS6574A002	9.	1	HEADER ASSEMBLY 5/8 OD X 0.025W	BT7630A001
2.	1	END PLATE (16 GA GALV)	BS6574A001	10.	1	HEADER ASSEMBLY 5/8 OD X 0.025W	BT7631A001
3.	320	FIN .005 AL. (AA1012)	FA38704A36CR05	11.	2	CAP TO 5/8 OD	JA1016
4.	72	HAIRPIN 3/8 OD X .014 PLAIN (AT1001)	BT1268C093	12.			
5.	65	RETURN BENDS	AR1004	13.			
6.	1	CROSSOVER	CT5053B001	14.			
7.	1	CROSSOVER	CT5053B005	15.			
8.	1	CROSSOVER	CT5053B006	16.			

CANCOIL THERMAL CORPORATION
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BC4192 REV A

Controller

System 350™ A350P Electronic Proportional Plus Integral Temperature Control

The A350P is an electronic, proportional plus integral temperature control with analog 0 to 10 VDC and 0 to 20 mA outputs. The control is equipped with three user-selectable time integration constants and an adjustable throttling range of 2 to 30F° (1 to 17C°). Two models cover a setpoint range of -30 to 130°F (-35 to 55°C) and 90 to 250°F (32 to 121°C).

As are all System 350 products, the A350P control is housed in a NEMA 1, high-impact plastic enclosure. The modular design provides easy, plug-together connections for quick installation and future expandability.

Figure 1: A350P Electronic Proportional Plus Integral Temperature Control

Features and Benefits

❑ **Modular Design**	Enables stage, display, and power modules to be purchased and installed as needed
❑ **Plug-Together Connectors and 35 mm DIN Rail Mounting**	Eliminates wiring between modules, which reduces installation costs
❑ **Two Models Cover a Wide Setpoint Range of -30 to 250°F (-35 to 121°C)**	Reduces inventory by encompassing temperature ranges required to support the majority of Heating, Ventilation, Air Conditioning, and Refrigeration (HVAC/R) applications
❑ **Minimum Output Adjustable from 0 to 60%**	Tailors the output to the requirements of the controlled device; can be used to set minimum valve or damper position
❑ **Adjustable Throttling Range of 2 to 30F° (1 to 17C°)**	Enables the user to tune the system for optimum stable performance
❑ **Field-selectable Reverse or Direct Acting Mode**	Works in heating or cooling applications
❑ **Three User-Selectable Integration Time Constants**	Provides selection of the integration constant for applications requiring proportional plus integral control
❑ **Interchangeable Temperature Sensors**	Increase versatility and serviceability

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Part No. 24-7664-192, Rev. F
Code No. LIT-930020

Application

The A350P Temperature Control can be used as a standalone device or in conjunction with plug-together accessory modules. The addition of S350 Stage Modules allows for the control of multiple stage HVAC/R applications. Typical application for the A350P includes:

- proportional heating control with staged direct expansion cooling
- simple temperature control for air handling units
- modulating damper actuators for mixed air control
- simple proportional mixed air control

A typical System 350 Temperature Control setup includes the following:

- A350P Temperature Control
- A99B Series Temperature Sensor
- Y350R Power Module (or 24 VAC Class 2 transformer)
- S350 Stage Modules
- D350 Digital Temperature Display Module

Operation

The A350P control operates on 24 VAC/VDC and provides two simultaneous analog outputs: 0 to 10 VDC and 0 to 20 mA. A cover-mounted, 10-segment Light-Emitting Diode (LED) bar graph indicates percentage of output.

Features include:

- adjustable setpoint
- adjustable minimum output
- adjustable throttling range (proportional band)
- selectable integration time constant
- selectable Reverse Acting (RA) or Direct Acting (DA) mode of operation

IMPORTANT:	All System 350 controls are designed for use **only** as operating controls. Where an operating control failure would result in personal injury and/or loss of property, it is the responsibility of the installer to add devices (safety, limit controls) or systems (alarm, supervisory systems) that protect against, or warn of, control failure.

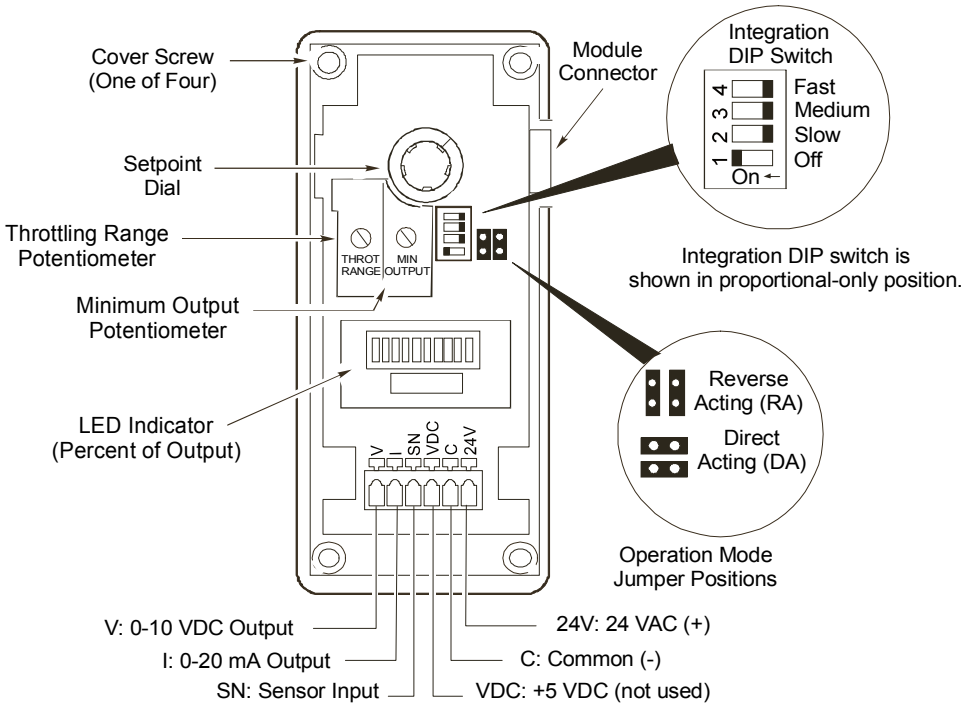

Figure 2: Interior View Showing A350P Control s Features

Minimum Output Adjustment

The minimum output adjustment sets the minimum voltage or milliampere output provided by the A350P control. It can be adjusted from 0 to 60% (0 to 6 VDC or 0 to 12 mA) of the output range.

Example:

A controlled device responding to a 4-20 mA output would require the minimum output to be adjusted to 20% or 4 mA. (See Figure 3.) The minimum output adjustment may also be used to set valves or dampers to minimum positions.

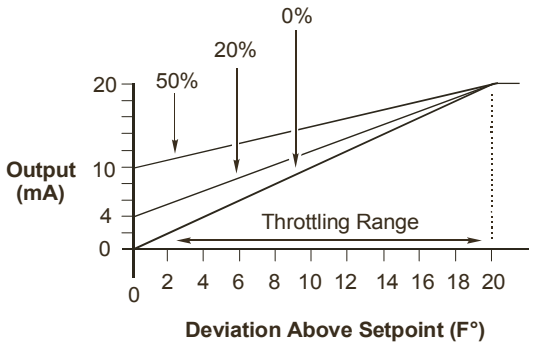

Figure 3: Output vs. Deviation from Setpoint for: Minimum Output = 0, 20, and 50%, Throttling Range = 20°F (DA)

Make the adjustment at the minimum output potentiometer marked as MIN OUTPUT. (See Figure 2.) For each 10% increase in output, the **next** bar on the LED indicator will light (only one bar is lit at any time).

Note: Before setting the minimum output potentiometer, verify that the control reads zero output (that is, no LEDs are lit).

Throttling Range (Proportional Band)

The throttling range is the range over which a control is active. Throttling range for the A350P control can be adjusted from 2 to 30F° (1 to 17C°). Make the adjustment at the throttling range potentiometer marked THROT RANGE (see Figure 2).

Integration Function

Proportional-only controls cannot hold a process at the exact setpoint. A proportional offset is always present because the control output is 0% at setpoint. Any load on the system will cause the control point to be offset from the setpoint. The greater the load on the system, the further the control point will be offset from the setpoint. (This is commonly referred to as proportional offset, and under maximum load this error will approach the throttling range.)

Some proportional-only controls are designed with their setpoint located midway through the proportional band to help compensate for this offset. This results in a plus/minus error from the setpoint rather than a single-ended error. Refer to Figure 4.

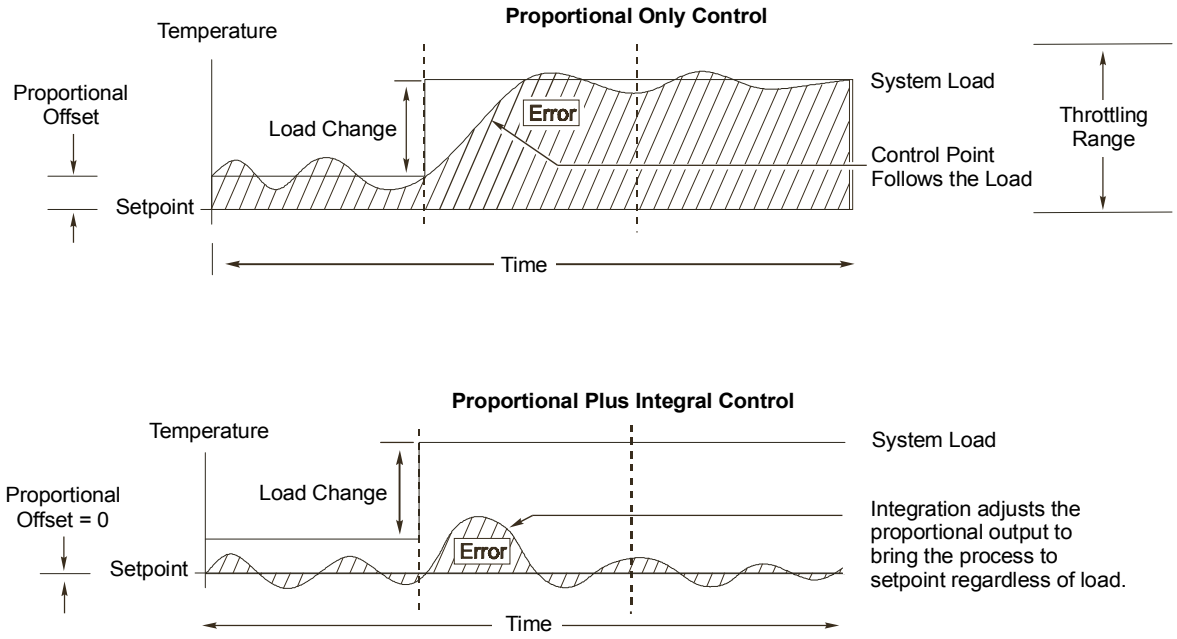

Figure 4: Comparison Between Proportional Only and Proportional Plus Integral Control

The A350P control has an integration feature that forces the control point to match the setpoint. Over time, the A350P will control the heating/cooling equipment to balance the system load at the control setpoint. (See Figure 4.)

On traditional proportional plus integral controls, the amount of correction will become too large if the system load exceeds the capacity of the equipment. When the actuated device (valve or damper) is fully open or closed and the setpoint still cannot be reached, the integration error continues to grow. The result is called *integral windup*.

The A350P control avoids *integral windup* with a patented circuit that puts a dynamic ceiling on the integrator. This resets the integration error when the sensor goes just above the setpoint plus the throttling range (in DA mode) or just below the setpoint minus the throttling range (in RA mode). This allows the process to recover from an out-of-range condition without a large overshoot.

The A350P control has three field-selectable integration constants and an off position. The integration DIP switch selects the integration constant. (See Figure 2 for location.)

The field-selectable integration constants include:

- **OFF: Switch 1 to On position, all others Off** provides proportional-only operation.

Note: In open-loop (without feedback) applications, select OFF (proportional-only) operation.

- **Slow (C3): Switch 2 to On position, all others Off** is the slowest integration constant (26 minute), and is suitable for most proportional plus integral applications. Slow is the recommended initial setting.
- **Medium (C2): Switch 3 to On position, all others Off** selects a 13-minute integration constant. If the rate of system recovery to setpoint is sluggish with the control set to slow, and if the system has enough capacity to drive the process to setpoint at a faster rate, the medium setting may be used.
- **Fast (C1): Switch 4 in On position, all others Off** is the fastest integration constant (6.5 minutes). Use fast only in instances where the rate of change at the sensor is extremely rapid and system capacity can compensate for that rapid change.

Reverse or Direct Acting Operation

With the operation jumpers in the Reverse Acting (RA) position, the analog output increases as the temperature drops below setpoint. (See Figure 5.)

With the operation jumpers in the Direct Acting (DA) position, the analog output will increase as the temperature rises above the setpoint.

Select the RA/DA mode by positioning the operation jumpers vertically or horizontally. (See Figure 2.) Position the operation jumpers vertically for RA and horizontally for DA.

The RA/DA operation jumpers are installed in the RA mode at the factory.

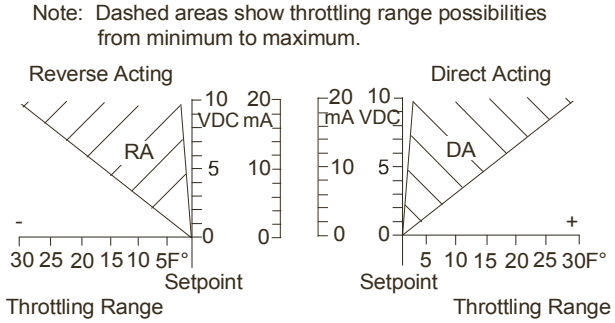

Figure 5: RA and DA Proportional Bands Shown in Proportional-Only Mode

Add-on Modules

The maximum number of add-on modules is listed in Table 1.

Table 1: Maximum Number of S350 Stage Modules per A350P

Power Source	Number of S350A or S350C Stage Modules Allowed	Number of S350A or S350C Modules (with One S350P) Allowed	Number of S350A or S350C Modules (with Two S350Ps) Allowed
Y350R	4	2	0
External Class 2 Transformer	9	8	7

S350A On-Off Stage Modules

S350A On-Off stage modules receive power, setpoint, and sensor input from the A350P control. S350A stage modules perform switching functions based on the control s setpoint and sensor information, as well as the offset and differential selected at the S350A stage module.

For more information on these modules, refer to the *System 350™ S350 Temperature, S351 Humidity, and S352 Pressure On/Off Stage Modules Product/Technical Bulletin (LIT-930080)*.

S350C Slave Stage Module

S350C slave stage modules receive power and sensor input from the A350P control. S350C slave stage modules perform switching functions based upon the control s sensor information, as well as the setpoint and differential selected at the S350C stage module.

For more information on these modules, refer to the *System 350™ S350C Temperature Slave Stage Module Product/Technical Bulletin (LIT-930084)*.

S350P Proportional Stage Modules

S350P proportional stage modules receive power, setpoint, and sensor input from the A350P control. The S350P stage module responds with an analog 0 to 10 VDC and 0 to 20 mA output signal. This is based upon the control s setpoint and sensor information, as well as the offset, throttling range, and minimum output selected at the S350P stage module.

For more information on these modules, refer to the *System 350™ S350P Proportional Plus Integral Temperature Stage Module Product/Technical Bulletin (LIT-930086)*.

Dimensions

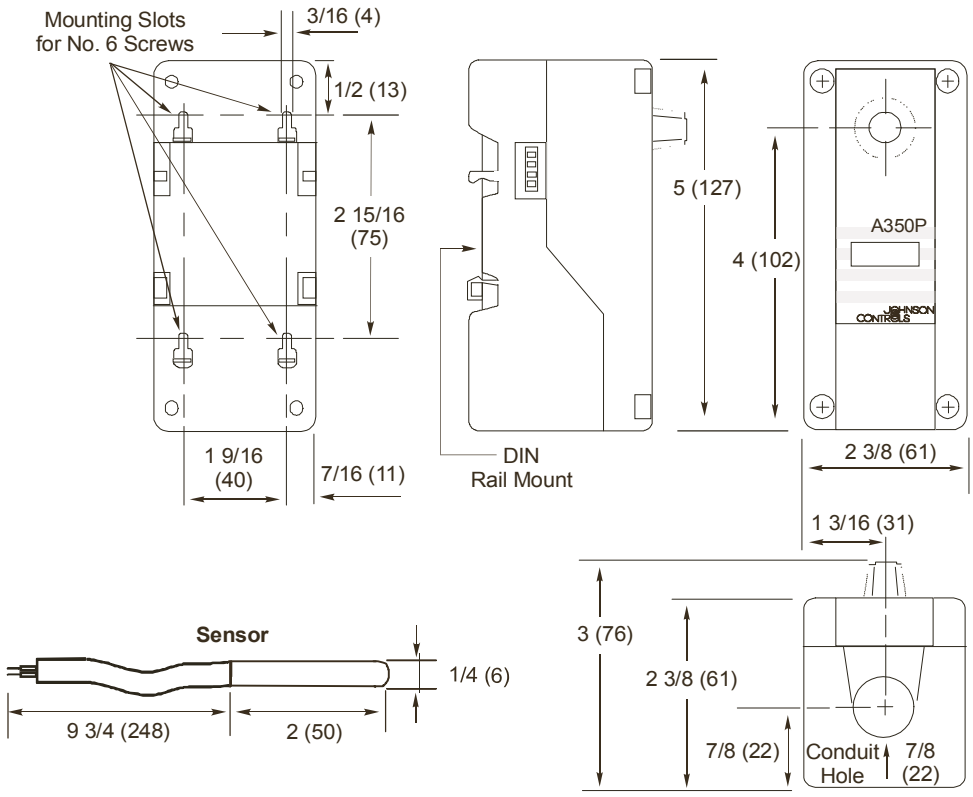

Figure 6: A350P Control and Sensor Dimensions, in. (mm)

Installation and Wiring

Celsius Scale Conversion

A Celsius scale throttling range decal is included with the A350P control. If the Celsius scale is desired:

1. Locate the throttling range and minimum output potentiometers on the main PC board. (See Figure 2.) Carefully remove the knobs and the existing decal.
2. Apply the Celsius scale decal in the same place as the original decal.
3. Rotate both knob stems completely counterclockwise (CCW).
4. Reinstall the potentiometer knobs so the arrows point to the minimum values.

The A350P Temperature Control is housed in a compact NEMA 1 plastic enclosure designed for standard 35 mm DIN rail mounting. Four key-slot mounting holes on the back of the control case are provided should surface mounting be required. If a Y350R is used, it should be mounted immediately to the right of the control. Any S350 modules would follow on the right, with the D350 being the last module mounted, also on the right.

Note: When mounting any System 350 module to rigid conduit, attach the hub to the conduit before securing the hub to the control enclosure.

WARNING: **Risk of Electrical Shock.** Disconnect power supply before making electrical connections to avoid possible electrical shock or equipment damage.

Wiring Terminals

Install all wiring to conform to the National Electrical Code and local regulations. For maximum electrical rating of control, refer to the label inside the control cover. Terminals will accept 12 to 26 AWG wire. Use only copper conductors.

1. Use a 1/8 in. (3 mm) flat-blade screwdriver to push the clamp arm down.
2. Insert the appropriate wire into the opening. Refer to Table 2 for terminal designations.
3. Release the clamp arm to secure the wire. See Figure 7.

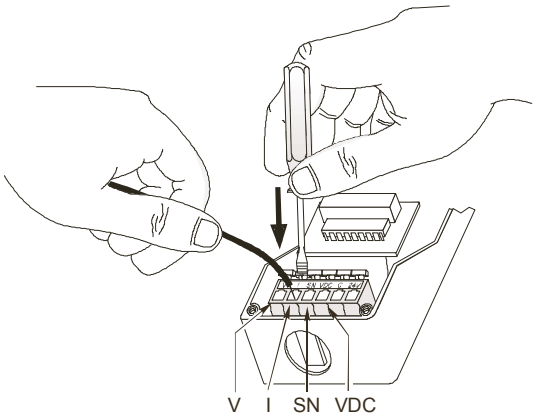

Figure 7: Cage Clamp Terminal Block

Table 2: Terminal Designations

Terminal	Description
V	0 to 10 VDC output
I	0 to 20 mA output
SN	Temperature sensor input
VDC	5 VDC power supply (not used)
C	Common for power supply, temperature sensor, and outputs
24V	24 Volts AC

Note: Output signals from the A350P control vary from 0 to 10 VDC and 0 to 20 mA. (Both outputs can be used simultaneously.) Connections can be made to both the V and I terminals, allowing the control to drive two outputs from the same RA or DA ramp simultaneously. This feature can be used to drive motor actuators of different types in a single application.

Sensor Connection

Shielded cable is not generally required for sensor wiring on runs of less than 50 feet. When using shielded cable, isolate and tape the shield at the sensor. Connect the shield to Terminal C on the A350P control.

Refer to Table 3 for the maximum recommended cable lengths for particular sizes of wire.

Table 3: Maximum Recommended Sensor Cable Lengths

Wire Gauge	Shielded Cable Length	
	Feet	Meters
14 AWG	800	244
16 AWG	500	152
18 AWG	310	94
20 AWG	200	61
22 AWG	124	38

- Various A99B Series Temperature Sensors and mounting hardware are available for use with A350P Series controls.

  The sensor must be connected to Terminals SN and C. (See Figure 2.) The sensors are not polarity sensitive.

- The sensor must be mounted so that it can accurately sense the temperature of the controlled medium.

Table 4: A350P Controls And Sensors

Control	Sensor Included Sensor Lead Length is 9-3/4 in. (0.25 m)
A350PS-1C	A99BB-25C; Range: -40 to 212°F (-40 to 100°C)
A350PS-1CM	A99BB-25C; Range: -40 to 212°F (-40 to 100°C)
A350PS-2C	A99BC-25; Range: -40 to 248°F (-40 to 120°C)
A350PS-2CM	A99BC-25; Range: -40 to 248°F (-40 to 120°C)
A350PT-1C	No Sensor Included
A350BA-2C	A99BC-25; Range: -40 to 248°F (-40 to 120°C)

- For more information regarding sensor options and installation, refer to the *A99B Series Temperature Sensors Product/Technical Bulletin (LIT-125186).*

Adjustments

Follow this procedure to set up the A350P control for the types of operation desired.

1. Remove its cover by loosening the four captive cover screws. (See Figure 2.)
2. Set the RA/DA operation jumpers to the desired mode of operation. Position the operation jumpers vertically for RA (Reverse Acting) or horizontally for DA (Direct Acting). (See Figure 2.)
3. Adjust the throttling range potentiometer to desired setting. Rotate Clockwise (CW) to increase the throttling range.

Notes: Included with the control is a Celsius scale throttling range decal. If the Celsius scale is desired, refer to the *Celsius Scale Conversion* section for decal installation instructions.

If the A350P is to be used in proportional plus integral control, the initial throttling range adjustment is seldom set below 6F° (3C°). A narrow proportional band used in conjunction with the integration may result in unstable control.

4. If minimum output is required, set the minimum output potentiometer (see Figure 2) to the desired position. The 10-segment front LED panel or a voltmeter can be used to read the minimum output. (The minimum setting for the **control** is designated by the 0 on the decal.)

Notes: Before adjusting the minimum output potentiometer, verify that the control reads zero output (that is, no LEDs are lit).

For each 10% increase in output, the **next** bar will light on the LED bar graph (only one bar is lit at anytime). In a milliampere application, each bar equals 2 mA. In a voltage application, each bar equals 1 VDC. (Refer to Figure 3.)

Example:

To set the control for a minimum output of 4 mA, turn the minimum output potentiometer clockwise until the second LED segment just lights.

5. Make sure the system is stable in the proportional mode before selecting integration. Refer to the *Checkout Procedure* section.
6. Reinstall the cover and secure in place with the four captive cover screws.
7. Adjust the setpoint dial to the desired setpoint.

   If using the D350 Display Module, press and hold the setpoint button on the D350 while rotating the setpoint dial.

Note: The control s setpoint is factory calibrated at midscale to a tolerance of ±1F° (0.6C°). The setpoint tolerance at the extreme ends of the setpoint scale may be ± 4F° (2.2C°). The D350 Display Module is unaffected by this tolerance shift. Use the D350 for the most accurate setpoint selection.

Checkout Procedure

Follow this procedure to verify the A350P control is connected and functioning properly.

1. Before applying power, make sure that the installation and wiring connections are according to job specifications.
2. Set up the system for proportional mode (Integration = OFF), and make any necessary adjustments to the setpoint, throttling range, and minimum output. Then select Reverse or Direct Acting mode.
3. After making adjustments and electrical connections, apply power to the system, and observe it for stable operation.
4. If integration is required, select the fast (C1), medium (C2), or slow (C3) integration constant. Slow is the recommended initial setting. (Refer to the *Integration Function* section.)
5. Put the system back into operation. If instability occurs, consider increasing the throttling range.

Troubleshooting

If the control system does not function properly, verify that the proper operation mode is selected on each module (DA or RA), and perform the following procedures to determine the cause of the problem:

1. Check for proper voltages on the A350P control.

   a. Connect a digital voltmeter (DVM) between Terminals 24V (+) and C (-) located on the A350P s terminal block. (See Figure 2.)

      If an external transformer is used, select AC volts on the DVM. Verify that the voltage is between 20 and 30 VAC.

      If a Y350R Power Module is used, select DC volts on the DVM. Verify that the voltage is between 16 and 38 VDC.

      If an external DC power supply is used, select DC volts on the DVM. Verify that the voltage is between 22 and 29 VDC.

   b. If the DVM reading is within the indicated voltage range, select DC volts on the DVM (DVM must be accurate to +/-0.01 VDC), and connect the (+) lead to Terminal VDC and the (-) lead to Terminal C.

      If the DVM voltage is between 4.9 and 5.1 VDC, proceed to Step 2.

      If the DVM voltage is above 5.1 VDC, replace the A350P.

   c. If the DVM voltage is below 4.9 VDC, check the control using the following procedure.

      Disconnect all loads from the A350P control. (If in Direct Acting mode with power on, the system will go to full output when the sensor is disconnected. Thus, ensure that any loads are disconnected *before* disconnecting the temperature sensor.)

      Disconnect the temperature sensor completely, and recheck the DVM voltage.

      If the DVM voltage rises to a value between 4.9 and 5.1 VDC, replace the sensor.

      If the DVM voltage is still below 4.9 VDC, replace the A350P control.

2. Check sensor for proper resistance at a given temperature. (The resistance across the sensor changes with the temperature of the sensor.)

   a. Disconnect power from the A350P control.

   b. Disconnect the sensor from the control and measure the resistance across sensor leads.

   c. When measuring the sensor s resistance, use an accurate thermometer to measure the temperature at the sensor.

   d. Refer to Figure 8 to determine the optimal resistance for the measured temperature.

   e. If the measured resistance varies substantially from the optimal resistance for that temperature, the sensor or wiring must be replaced.

   f. If the sensor s resistance conforms to the chart in Figure 8, reconnect the sensor to the control.

   g. Reconnect power to the control.

Note: The sensor reading indicated by the D350 may differ somewhat from thermometer readings due to sensor tolerances, time constants, thermometer accuracy, and other factors.

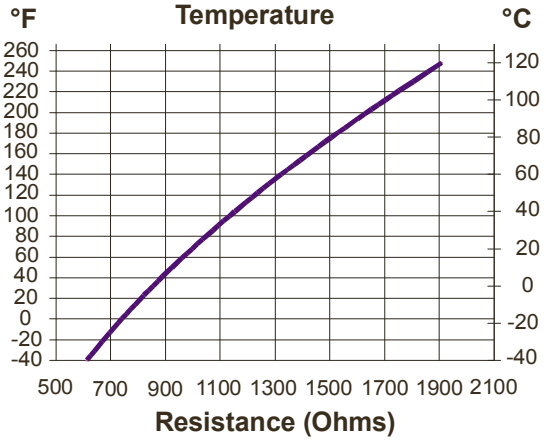

Figure 8: Temperature vs. Resistance Chart for the A99B Series Sensor

3. Check the A350P control for proper operation.

Note: Perform Steps 1 and 2 first.

a. Reconnect the sensor to the control and re-apply power.

b. Turn the throttling range and the minimum output to minimum by turning both potentiometers counterclockwise.

c. Switch off the integration.

d. Select the RA mode.

e. Connect the DVM (+) lead to the A350P control s Terminal SN and the (-) lead to Terminal C.

If the sensor voltage is less than 1.8 VDC on model A350PS-1C or less than 2.3 VDC on model A350PS-2C, go to Step 3g.

f. If the voltage is greater than 1.8 VDC on model A350PS 1C or greater than 2.3 VDC on model A350PS-2C, adjust the setpoint to 120°F (49°C) on model A350PS-1C or 240°F (116°C) on model A350PS-2C.

The output Terminal V should be less than 0.1 VDC, and all LEDs in the bar graph display should be off. If not, replace the A350P.

1. Adjust the minimum output to the maximum by turning the potentiometer CW. As the potentiometer is turned CW, the LEDs in the bar graph should turn on from left to right until the fifth or sixth bar is on. If not, replace the A350P control.

2. Adjust the minimum output to zero again, and select the DA mode.

3. If the right most LED in the bar graph is on (Terminal V = 10 VDC, Terminal I = 20 mA), go to Step 3h. If the LED is not on, replace the A350P.

g. If the sensor voltage is above 1.1 VDC on A350PS-1C or above 1.6 VDC on A350PS-2C, adjust the setpoint to match the actual temperature (T_S). The output Terminal V should be less than 0.1 VDC, and all LEDs in the bar graph should be off.

Note: Some tolerance error is present between the setpoint scale and the setpoint knob pointer. Refer to the *Adjustments* section.

1. Make sure the A350P control is in RA mode.

2. Increase the setpoint in increments of 2F° (1C°).

3. As the setpoint is increased, the control s Terminal V output voltage should go from 0 to 10 VDC, the Terminal I output current should go from 0 to 20 mA, and the LEDs should turn on, one at a time from left to right.

4. If the LEDs do not turn on and if the outputs of terminals V and I do not change as described above, replace the control.

h. Readjust the A350P control to the desired control settings.

Repairs and Replacement

Do not make field repairs or perform calibration. A99B Temperature Sensors and replacement controls are available through the nearest Johnson Controls representative. (See Tables 5 and 6 for ordering information.)

Ordering Information

Table 5: System 350 Products

Item	Product Code Number	Description
A350P Proportional Plus Integral Temperature Controls	A350PS-1C	Range: -30 to 130°F (-35 to 55°C) Throttling Range: 2 to 30 F° (1 to 17C°) (Includes the A99BC-25C Temperature Sensor)
	A350PS-2C	Range: 90 to 250°F (30 to 120°C) Throttling Range: 2 to 30 F° (1 to 17C°) (Includes the A99BC-25C Temperature Sensor)
	A350PT-1C	Range: -30 to 130°F (-35 to 55°C) Throttling Range: 2 to 30F° (1 to 17C°) (Sensor not included)
Display Modules	D350AA-1C D350BA-1C	Digital Temperature Display Module (Fahrenheit Scale) Digital Temperature Display Module (Celsius Scale)
On/Off Stage Modules	S350AA-1C S350AB-1C	Fahrenheit Scale Celsius Scale
Slave Stage Module	S350CC-1C	Dual Scale (°F and °C)
Proportional Stage Module	S350PQ-1C	Dual Scale (°F and °C)
Power Module	Y350R-1C	120 or 240 VAC, 50/60 Hz Input, Rectified Class 2, 24 VAC Output

Table 6: System 350 Accessories

Item	Product Code Number	Description
Wall Mount Plate	TE-6001-4	Includes sensor mounting clip
Cover	T-4000-2644	For wall mount plate
Mounting Clip	A99-CLP-1	Surface mounting clip for the A99B Temperature Sensor
Duct Mounting	TE-6001-1	Duct-mounting hardware with handy box
Duct Mounting	TE-6001-11	Duct-mounting hardware without handy box
Conduit Adaptor	ADP11A-600R	1/2 in. snap-fit EMT conduit adaptor (box of 10)
Immersion Well	WEL11A-601R	For liquid sensing applications
Sun Shield	SHL10A-603R	For use with outside sensors in sunny locations
DIN Rail Sections	BKT287-1R BKT287-2R	12 in. (0.3 m) long 39-1/3 in. (1.0 m) long
DIN Rail End Clamp	PLT344-1R	Consists of two end clamps
Cables for Remote Mounting of D350 Display Module	WHA29A-600R* WHA29A-603R WHA29A-604R	3 ft (0.9 m) 25 ft (7.6 m) 50 ft (15.2 m)

*WHA29A-600R may be used to daisy chain S350 modules together.

Specifications

Product	A350P Proportional Plus Time Integral Temperature Control	
Supply Voltage	Y350R Power Module:	Input: 120/240 VAC 50/60 Hz
		Output: 24 VDC, unfiltered, 10 VA
	External Source:	24 VAC, 50/60 Hz, Class 2 (20-30 VAC)
	Note: Only one supply voltage source may be used.	
Power Consumption	3.2 VA maximum	
Ambient Temperature	Operating:	-30 to 150°F (-34 to 66°C)
	Shipping:	-40 to 185°F (-40 to 85°C)
Humidity (all modules)	0 to 95% RH non-condensing; maximum dew point 85°F (29°C)	
Setpoint Adjustment Range	A350PS-1C:	-30 to 130°F (-35 to 55°C)
	A350PS-2C:	90 to 250°F (30 to 120°C)
	A350PT-1C:	-30 to 130°F (-35 to 55°C)
Throttling Adjustment Range	2 to 30F° (1 to 17C°)	
Analog Outputs	0 to 10 VDC (550 ohm load minimum) and 0 to 20 mA (600 ohm load maximum)	
Minimum Output	Adjustable from 0 to 60% of the output	
Output Indication	A ten segment LED bar graph indicates percentage of output.	
Control Action	Direct or reverse action is jumper selectable.	
Integration Constant	Four selectable rates: fast, medium, slow, and off	
Sensor	Replaceable positive temperature coefficient sensor	
	Reference resistance 1035 ohms at 77°F (25°C)	
Material	Case and cover:	NEMA 1 high-impact thermoplastic
Agency Listing	UL Listed, CCN XAPX, File E27734	
	UL Listed for Canada, CCN XAPX7, File E27734	

The performance specifications are nominal and conform to acceptable industry standards. For application at conditions beyond these specifications, consult Johnson Controls Application Engineering at (414) 274-5535. Johnson Controls, Inc. shall not be liable for damages resulting from misapplication or misuse of its products.

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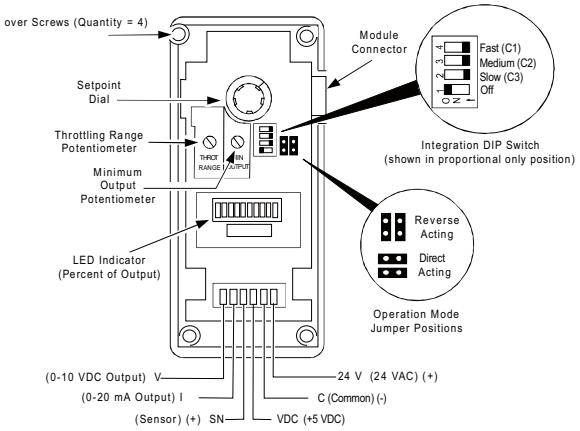
A350P Series

Electronic Proportional Plus Integral Temperature Control

A350P



Features

- field-selectable proportional only or proportional plus integral control
- plug-together connectors and 35 mm DIN rail mounting eliminate wiring between models and reduce installation costs
- ten segment LED displays percent of output signal
- field-selectable reverse or direct-acting mode
- minimum output adjustable from 0 to 60%
- two models cover a wide setpoint range of -30 to 250°F (-35 to 121°C)

Applications

- modulating heating and cooling valves
- maintain mixed air duct temperature via damper modulation

Description

The A350P Electronic Proportional Plus Integral Temperature Control Series has two proportional outputs of 0 to 10 VDC and 0 to 20 mA. This control is used in conjunction with the A99B Series (PTC silicon) Temperature Sensors. Two controls cover a temperature range from -30 to 250°F with an adjustable throttling range (proportional band) of 2 to 30F°.

Proportional plus integral (PI) control is an option to hold setpoint regardless of load shifts on the system. A temperature sensor (A99BC-25C) is included with each A350P control. The S350 Staging Module, D350 Display Module, and Y350R Power Module can be used with the A350P.

To Order

Specify code number from the selection chart, along with additional staging, power and display modules, and temperature sensing enclosures, if required.

Selection Chart

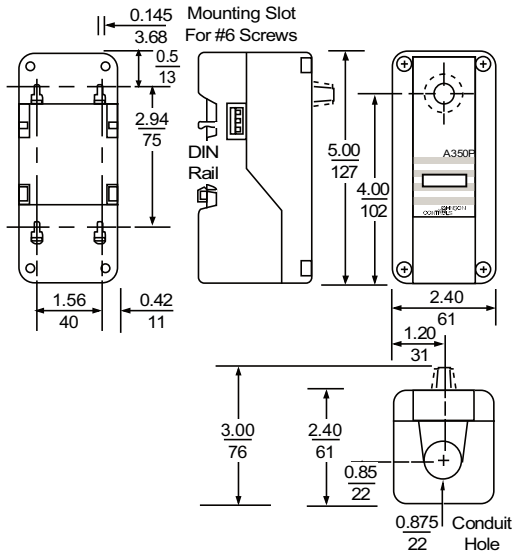
Code Number	Output Signal	Range	Throttling Range	Sensor (Included)
A350PS-1C	Proportional Voltage: 0 to 10 VDC and Proportional Current: 0 to 20 mA	-30 to 130°F -35 to 55°C	2 to 30F° 1 to 17C°	A99BC-25C
A350PT-1C				None
A350PS-2C		90 to 250°F 30 to 121°C		A99BC-25C

Specifications

A350P Electronic Temperature Control with Proportional Output		
Supply Voltage [a]	**Transformer**	20 to 30 VAC, 50/60 Hz, Class 2
	Y350R	120/240 VAC, 50/60 Hz
Proportional Output		0 to 10 VDC (550 ohm load minimum) and 0 to 20 mA. (600 ohm load maximum).
Minimum Output		Adjustable from 0 to 60% of the output span
Output Indication		A ten segment LED indicates percentage of output
Control Action		Direct or reverse action is jumper selectable
Power Consumption		3.2 VA
Integration Constant		Three selectable rates fast, medium, slow and an Off position
Ambient Temperature	**Operating**	-30 to 150°F (-34 to 66°C)
	Shipping	-40 to 185°F (-40 to 85°C)
Humidity		0 to 95% RH non-condensing
Case and Cover Material		NEMA 1, high-impact thermoplastic

(a) Only one voltage source may be used.

A350P Dimensions, in. (mm)



The performance specifications are nominal and conform to acceptable industry standards. For applications at conditions beyond these specifications, consult the local Johnson Controls office. Johnson Controls, Inc. shall not be liable for damages resulting from misapplication or misuse of its products. © 08/02 Johnson Controls, Inc

Data sheet

ESBE Series 90 Electronic Motor Actuator (Combined with ESBE 3&4-Way Rotary Valves)

Features:

The ESBE 24 volt electronic series of motors are direct mounted actuators that rotate ESBE 3 & 4-way rotary valves for hydronic heating and cooling systems. The Series 90 actuator provides additional torque compared to the Series 60 and ARA series of actuators, and can be installed on all ESBE 3 & 4 way rotary valves, in sizes from ½" – 6" valves. The Series 90 motors also have linkage kits available capable of adapting to Viessmann, Honeywell, Centra DR/ZR, Landis & Staefa and TA VTR styles of valves.

Features:

- ESBE control motor series are of a compact design
- Direct mount actuators
- Easy manual override of motor actuator
- Adjustable rotation between 30° and 180° with internal cams
- Floating 3-point and proportional signal operation
- Several motors with an auxiliary contact switch activated through an adjustable cam

Ordering information:

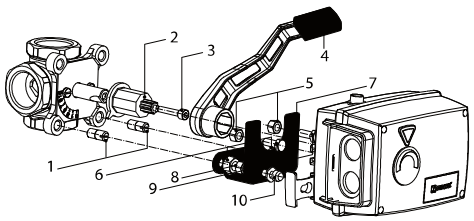
90 Series Actuator: All ESBE rotary mixing valves*

Code No.	Series	Signal	Run Time (90°@60Hz)
065F8952	91EM	Floating 3 point, with Aux. Switch	12 sec.
065F8953	92EM		50 sec.
065F8959	92-2EM		100 sec.
065F8954	93EM		4 min.
065F8955	92P	Proportional	60, 90 or 120 sec.
065F8956	92K2	Built-in Temperature controller	50 sec.

*91EM, valves up to 2" only for diverting application

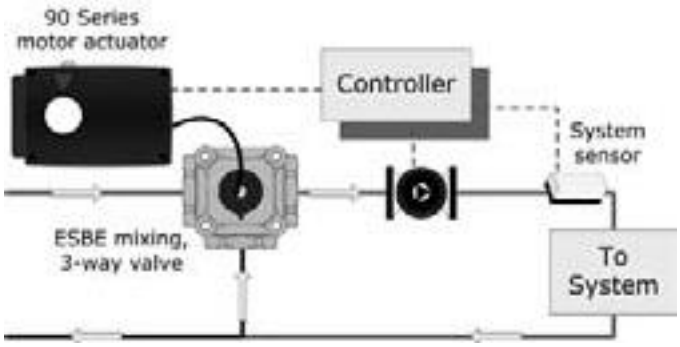
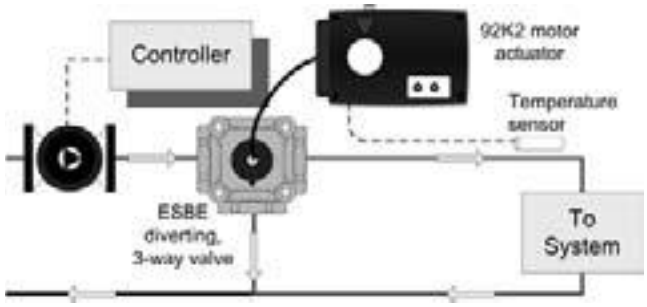
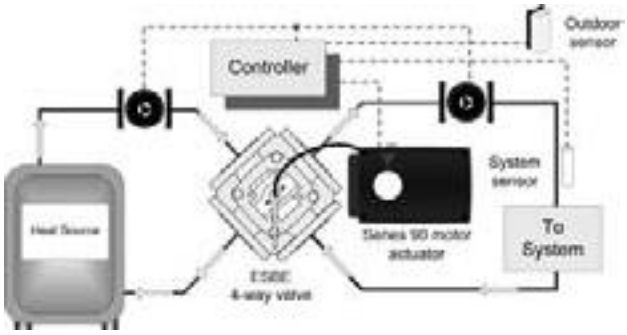
Replacement Parts ESBE:

90 Series Actuator



Code No.	Description	Item #
25413000	Metal drive sleeve	2
193B1615	Mounting kit for 90 series	1-10
193B1616	Series 90 actuators to ESBE VRG valves	(Not shown)
25430000	Remote Sensor for 92K2 motor	(Not shown)

Applications:

3-way mixing valve application	
	When coupled with a controller the assembly of the 90 Series motor actuator and ESBE rotary valve provide regulation of the fluid through the system.
3-way diverting valve application	
	The self contained 92K2 motor actuator with temperature controller provides constant temperature regulation of system fluid. The adjustability of time in the reading of the sensor, provides flexibility for mixing and diverting applications.
4-way mixing valve application	
	The Series 90 motor actuator provides higher torque capabilities allowing use on larger sized valves requiring up to 135 in. lbs. of torque.

Accessories:

Linkage Kit	Non ESBE Valves
065F8957	Viessmann Valve
065F8958	Centra #900 Valve
065F8990	Landis & Staefa Valve
065F8991	Oventrop Valve
065F8992	TA VTR Valve

3 & 4-way Mixing Valves:

3-way Valves

Code No.	Reference	Connection	Cv◊
193B1500	VRG 131	½", FNPT	2.9
193B1501	VRG 131	¾", FNPT	4.7
193B1502	VRG 131	¾", FNPT	7.3
193B1503	VRG 131	1", FNPT	7.3
193B1504	VRG 131	1", FNPT	11.7
193B1505	VRG 131	1-¼", FNPT	18.7
193B1506	VRG 131	1-½", FNPT	29.3
193B1507	VRG 131	2", FNPT	46.8
065B8960	3 F 65-50	2-½" Flanged	75
065B8961	3 F 65	2-½" Flanged	105
065B8962	3 F 80	3" Flanged	175
065B8963	3 F 100	4" Flanged	265
065B8964	3 F 125	5" Flanged	325
065B8965	3 F 150	6" Flanged	465

4-way Valves

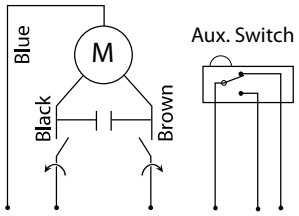
Code No.	R eference	Connection	Cv◊
193B1531	VRG 141	¾", FNPT	4.7
193B1532	VRG 141	¾", FNPT	7.3
193B1533	VRG 141	1", FNPT	11.7
193B1534	VRG 141	1-¼", FNPT	18.7
193B1535	VRG 141	1-½", FNPT	29.3
193B1536	VRG 141	2", FNPT	46.8
193B1537	VRG 141	¾", Solder	2.9
193B1538	VRG 141	1", Solder	7.3
193B1539	VRG 141	1-¼", Solder	13.9
065B6150	4 F 50	2" Flanged	75
065B6165	4 F 65	2-½" Flanged	105
065B6180	4 F 80	3" Flanged	175
065B6200	4 F 100	4" Flanged	265
065B6225	4 F 125	5" Flanged	325
065B6250	4 F 150	6" Flanged	465

◊Cv value in GPM at pressure drop of 1 psi
Contact Danfoss for information on MG or G styles of valves

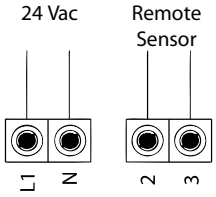
Technical Specifications:

Supply Voltage	24VAC 50/60 Hz, (92P: 24VAC/DC 50/60 Hz)
Power Consumption	91EM / 92EM / 92-2EM / 93EM: 2VA 92P / 92K2: 5VA
Rotation (Factory set)	90°, adjustable b/w 30° and 180° (92P only 90° rotation)
Torque	135 in. lb (15Nm) [91EM: 45 in. lb (5Nm)]
Mountable Valve Styles and Valve Sizes	ESBE rotary mixing valves MG / G / F / VRG styles Valve Sizes ½" to 6", (91EM: Up to 2")
Enclosure	NEMA 13, IP 54
Ambient Temp. Range	5 to 131°F (-15 to 55°C)
Weight	1.8lb (0.8kg)
Signal / Run Time	**3-point floating:** 50 Hz / 60 Hz 91EM: 15 sec. / 12 sec. 92EM: 1 min. / 50 sec. 92-2EM: 2 min. / 100sec. 93EM: 5 min. / 4 min. **Proportional:** (selectable) 92P- Signal: 0-10V, 2-10V, 1-5V, 0-20mA, 4-20mA Run Time: 60, 90 or 120 sec.
Auxiliary Switch	All motors except 92P and 92K2 are with an adjustable cam position, max. 2A
92K2 Set point Controller	Adjustable range: 59° to 158°F (15° to 70°C) Adjustable sensor reading: 1 to 70 sec.

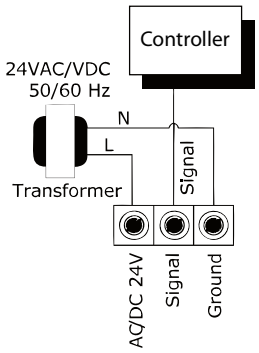
Electrical Wiring:



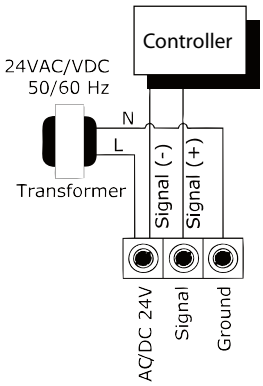
91EM, 92EM,
92-2EM & 93EM Motor



92K2 Motor



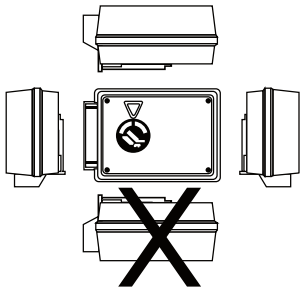
92P Motor
Single Wire Signal

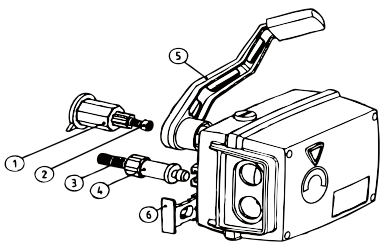


92P Motor
2-Wire Signal

Installation:

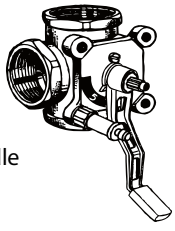
The actuator should be mounted with the valve stem in either a horizontal position or pointing upwards. The actuator should not be installed in a downward orientation.



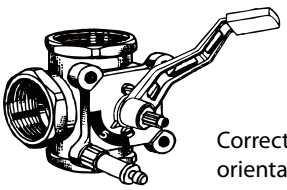


1) Threaded stud
2) Drive sleeve
3) Locking screw
4) Handle
5, 6, 8, 9) Mounting hardware
7) Mounting base

When installing the handle (5), it should be installed opposite to the indicator on the drive sleeve and the end of the handle should be facing away from the valve. Failure to properly install the handle will result in damage to the 90 series motor actuator due to the interference of the mounting stud (4) with the rotation of the handle



Incorrect handle orientation

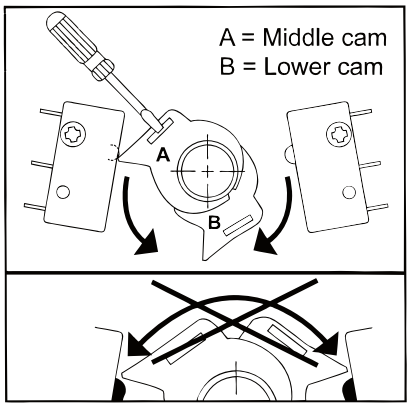


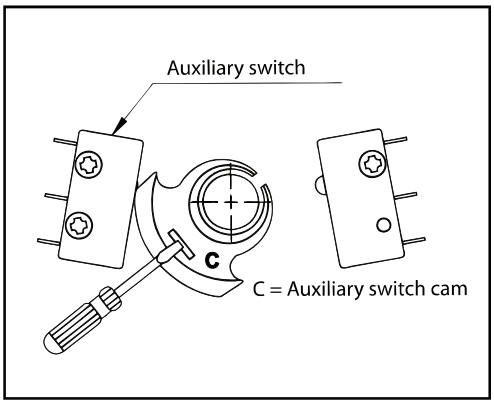
Correct handle orientation

VDKIG122 © Danfoss 02/10

Adjustment of Rotation and Auxiliary Switch Cam:

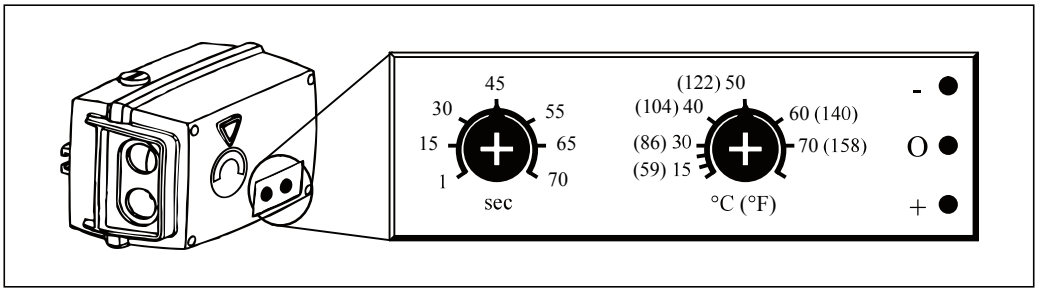
Within the 90 Series motors, the factory set 90°of rotation can be adjustable between 30° and 180°. The adjustment of the angle of rotation and the engagement of the auxiliary switch is set via internal cams within the motor actuator for the 91EM, 92EM, 92-2EM and 93EM. Care should be taken to ensure the cams are engaging the switches properly.



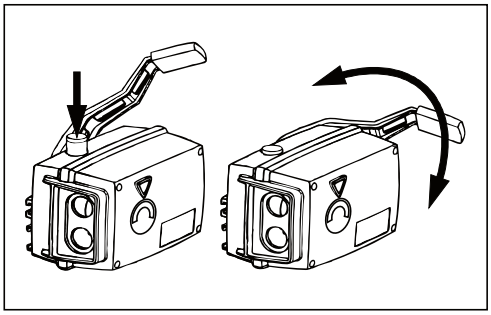


Setting of 92K2 Temperature Controller:

The 92K2 style of electronic motor actuator has a built in set point controller. Included with the actuator is a 6ft remote sensor that can be inserted in a temperature well or pipe mounted. Located on the front of the actuator are two knobs; left knob sets the frequency of time (in seconds) the controller reads the remote sensor, and the right knob is the set point temperature. Setting these two knobs are dependent on the application requirement and how often the controller will take a temperature reading.



Manual Operation:



When placing the actuator in manual operation power should be turned off to the actuator. In the event the actuator is powered and is left in a manual position, the result could lead to the internal damage of the actuator.

When placing the 90 Series motor in manual operation, the gray button must be pushed in. Then the handle can be rotated either clockwise or counter clockwise. To return back to automatic operation, rotate the handle until the button pops out.

VDKIG122 © Danfoss 02/10

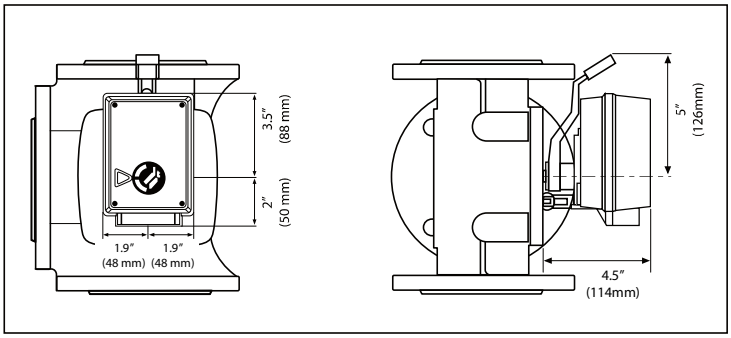
ESBE Series 90 Electronic Motor Actuator (Combined with ESBE 3&4-Way Rotary Valves)

Proportional Actuator Settings:

92P Actuator
Internal settable jumpers

Actuating time			
	60s	90s	120s
60s	••	▭	••
90s	••	▭	••
120s	••	••	▭
Rotation direction			
Clock wise		**Counter clock wise**	
▭		••	
••		▭	
Control signal			
	0-10V	2-10V	1-5V
OFS	••	••	••
DIV	▭	▭	••
CUR	••	▭	▭
	0-5V	0-20mA	4-20mA
OFS	••	••	▭
DIV	••	••	••
CUR	••	▭	▭

Dimensions:



Typical Specifications:

The electric actuator shall be a compact style, mountable on a rotary valve. The actuator shall be 24Vac powered with an ability for manual override via push in button. It shall have a clear indication of the actuator's position and be available as either a floating point or proportional style of actuator.

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TYPE EVR 2 TO 40 - SOLENOID VALVES

Ordering

Separate valve bodies, normally closed (NC)

TYPE	Rated capacity R22 (liquid) tons	Connection in	Port size in	Cv value gal/min	Part no.Valve body without coil type Flare			
					With manual stem operation in.	Without manual stem operation in.	With manual stem operation in.	Without manual stem operation in
EVR 2	1.17	1/4	3/32	0.19	--	032F8058	--	032F7100
EVR 3	2.03	1/4	1/8	0.32	--	032F8106	--	032F7105
EVR 3	2.03	3/8	1/8	0.32	--	032F8115	--	032F1157
EVR 4	4.15	3/8	5/32	0.66	--	032F8087	--	032F7110
EVR 4	4.15	1/2	5/32	0.66	--	032F8089	--	032F7111
EVR 6	5.83	3/8	15/64	0.93	032F1185	032F8071	032F7116	032F7115
EVR 6	5.83	1/2	15/64	0.93	--	032F8078	--	032F1162
EVR 6	5.83	5/8	15/64	0.93	--	--	--	032F7117
EVR 6	5.83	5/8	15/64	0.93	--	--	--	032F7117
EVR 8	8.01	3/8	9/32	1.30	--	--	--	032F7120
EVR 8	8.01	1/2	9/32	1.30	--	032F7123	--	032F7121
EVR 8	8.01	5/8	9/32	1.30	--	--	--	032F7122
EVR 10	13.8	3/8	3/8	2.20	--	--	--	032F7125
EVR 10	13.8	1/2	3/8	2.20	032F1187	032F1165	032F1188	032F1166
EVR 10	13.8	5/8	3/8	2.20	--	--	--	032F1168
EVR 15	18.9	5/8	9/16	3.00	--	--	032F1172	032F1171
EVR 15	18.9	7/8	1/4	3.00	--	--	--	032F7130
EVR 18	24.6	7/8	19/32	3.90	--	--	032F1004	032F7135
EVR 18	24.6	1 1/8	19/32	3.90	--	--	--	--
EVR 20	36.4	7/8	7/8	5.80	--	--	032F1177	032F1176
EVR 20	36.4	1 1/8	7/8	5.80	--	--	032F2272	032F1178
EVR 22	43.7	1 1/8	9/16	6.90	--	--	--	032F7145
EVR 22	43.7	1 3/8	9/16	6.90	--	--	--	032F7146
EVR 25	72.8	1 1/8	1	12.00	--	--	032F1190	032F1189
EVR 25	72.8	1 3/8	1	12.00	--	--	032F1194	032F1193
EVR 32	116.5	1 5/8	7/8	18.00	--	--	042H1179	042H1178
EVR 40	182.0	1 5/8	1	29.00	--	--	042H1186	042H1185
EVR 40	182.0	2 1/8	1	29.00	--	--	042H1188	042H1187
EVR 40	182.0	2 1/8	1	29.00	--	--	042H1188	042H1187

Metric conversions 1 ton = 3.5 kW
1 psi = 0.07 bars 1 in. = 25.4 mm
5/9 (t1°F 32) = t2°C US gal/min = 8.6 m3/h

Ordering-II

Separate valve bodies, normally open (NO)

TYPE	Rated capacity R22 (liquid) tons	Connection in	Port size in	Cv value gal/min	Solder ODF in
EVR 6	5.8	3/8	1/4	0.93	032F1164
EVR 10	13.8	1/2	3/8	2.20	032F1169
EVR 15	18.9	5/8	9/16	3.00	032F1174

Coils, see next page.

TYPE EVR 2 TO 40 - SOLENOID VALVES

GENERAL PURPOSE CLICK-ON COIL,TYPE GP

INTRODUCTION

General purpose Click-on coil, type GP sealed to protect against moisture, Easy click-on mounting system

Approvals:

Listed EVR MH7648

Conformity with LV D 73/23/EC with amendments EN 60730-2-8

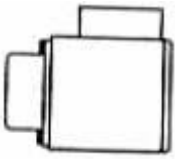
TECHNICAL DATA

Design	In accordance with UL 429
Power supply	Alternating current (a.c) and direct current (d.c)
Permissible voltage variation	Alternating current (a.c) : +10 to 15% Direct current (d.c) : +10 to -10
Power consumption	Alternating current (a.c) : Inrush; 49 VA; Holding; 28VA,14W Direct current (d.c) ; 20 W
Insulation of coil wire	Class H according to IEC 85
Connection	Junction box or Conduit boss
Enclosure, IEC 529	Junction box NEMA 2 0- IP 12-32 Conduit boss NEMA 4 IP 54
Ambient temperature	-40 to 140°F (-40 to + 50°C)

Cross reference list - GP Coils	
Old Part No.	New Part No.
018Z7613	018F7683
018Z7612	018F7682
018Z7611	018F7681
018Z7603	018F7689
018Z7623	018F7693
018Z7622	018F7692
018Z7621	018F7691
018Z7625	018F7699

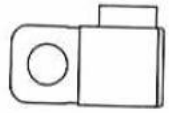
Ordering

Alterting Current(a.c)



Valve Type	Voltage V	Frequency Hz	PART NO. Junction Box NEMA 2	PART NO. Conduit Boss NEMA 4	Power Consumption
EVR	24	50/60	018F7683	018F7693	Holding: 14W 20 VA Inrush: 49 V
EVM	110	50/60			
EVRA/T	120	60	018F7682	018F7692	
EVRS/T	208-240	60			
AKV/A	230	50	018F7681	018F7691	

Direct Current (d.c)



Valve Type	Voltage V	Frequency Hz	PART NO. Junction Box NEMA 2	PART NO. Conduit Boss NEMA 4	Power Consumption
	120		018F7689	018F7699	20W

Motors

ESBE
90 SERIES MOTOR
INSTALLATION INSTRUCTION

Danfoss shall not be responsible for any errors in catalogues, broschures or other printed material. Danfoss reserves the right to alter its products at any time without notice, provided thet alterations to products already on order shall not require material changes in specifications previously agreed upon by Danfoss and Purchaser.

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Art.nr 25516 / Ritn.nr 3459 / Utg.C

ESBE 90 SERIES MOTOR INSTALLATION INSTRUCTION

Mounting all 90 Series Motors on ESBE Valves (see Figs. 1-4)

- Place the sleeve (1) on the valve shaft, install and tighten the screw (2).
- Rotate the sleeve until the pointer is aligned with number 5 on the scale of the faceplate of the valve.
- The stud (3) and mounting pin (4) must be screwed into the hole on the lower left hand corner of the valve.
- The manual adjustment handle (5) must be placed on the shaft sleeve (1) facing away from the motor mounting pin. Note: If it is not facing away, the valve will not rotate fully.
- Pull out the locking clip (6) and place the motor on the valve with the red triangle facing up, push in the locking clip (6) to secure the motor.

Manual Operation, all 90 Series Motors

- To operate the valve manually, push the button on the side of the motor (item A) and hold in to turn the lever. Once the button is pressed in, the lever can be used freely. Electrical power to the motor is automatically disconnected while the button is in the lower position.

Wiring: 91M, 92M, 92-2M and 93M for "Floating" Signals (see Fig. 5)

For ESBE 92P motors, see separate section.

Warning: Always turn off all electrical power before removing or servicing the motor.

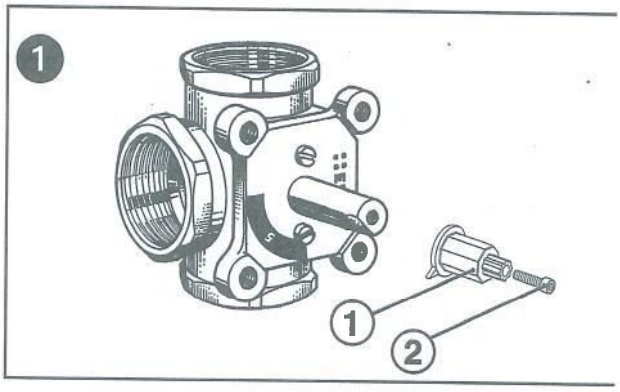
- The motor is powered using a 24VAC transformer, *3VA minimum.*
- Remove the four cover screws and lift the cover off the motor.
- Remove one (or two) of the wiring knockouts and install one (or two) of the "conduit fittings", all wires must go through these fittings.
- Attach the "common" from the control (or trans former) to terminal "N".
- Connect the control output for clockwise rotation to "Upper terminal L1", and connect the control output for counterclockwise rotation to "Lower terminal L1"

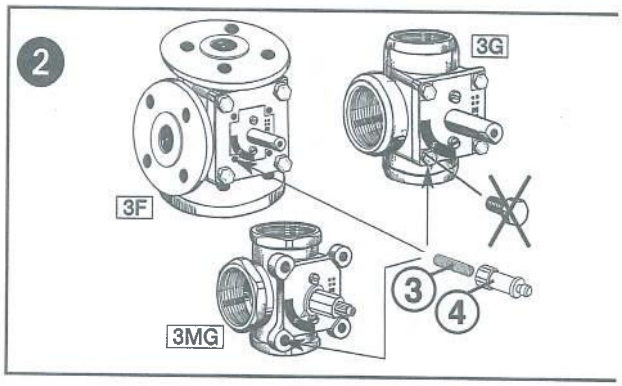
Auxiliary Switch

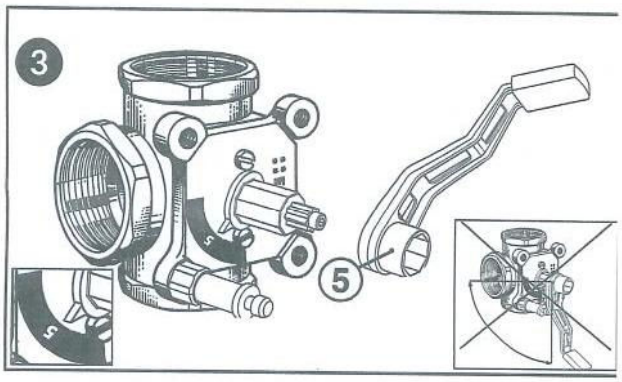
- ESBE 91M, 92M, 92-2M and 93M motors include one fully adjustable auxiliary switch. The wiring should be connected as shown in Fig. 5. To set the switching position, turn the cam (see fig 6).
  Reinstall the cover and secure it, before turning on the power.

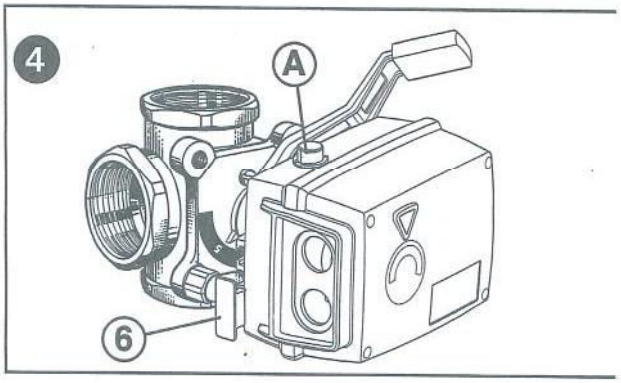
Adjusting the Degree of Rotation

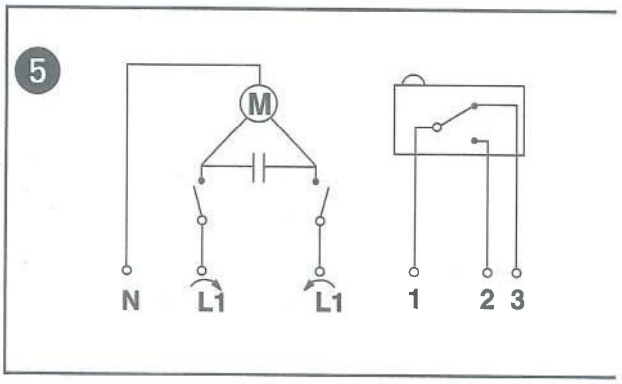
- ESBE 90 series motors do not require adjustment when used with ESBE valves, however if the motor is used for an application that requires a different degree of rotation, the cams can be adjusted to provide between 30° and 180° of rotation. For access to the cams, the cam operating the aux switch must be removed. See Fig. 7.
  Always turn off all power before adjustments are made.











Motor Speed and Signal Selection, 92P Only, for "Proportional" Signals

- With power turned off, follow instructions for removing the cover.
- The 92P is designed for operating signals of 0-5vdc, 1-5vdc, 0-10vdc, 2-10vdc, 0-20mA and 4-20mA signals. The factory default setting is 0-10vdc.
- Running speed for 90° rotation is factory set at 60 seconds, but can be changed to 90 seconds or 120 seconds.
- If required, the motor speed and operating signal can be changed to different values, as shown on the PCB card. See Fig. 9.

Wiring, 92P Only

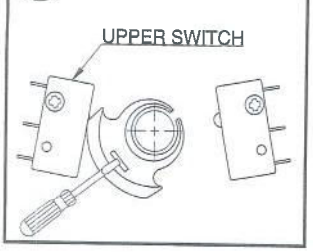
- Connect the 24V AC or DC power supply to terminals 1 and 2. See Fig. 8.
- Connect the control signal to terminal 3.

Direction of Rotation, 92P Only

- The 92P is factory set to rotate in the clockwise direction. To change the direction of rotation to Counter-clockwise, change the position of the jumper as shown on the PCB card. See Fig. 9.

Reinstall the cover and secure it, before turning on the power

6



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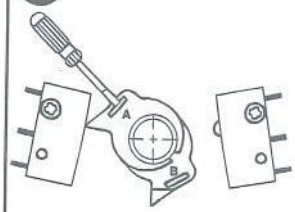

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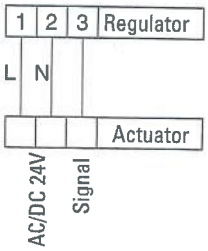

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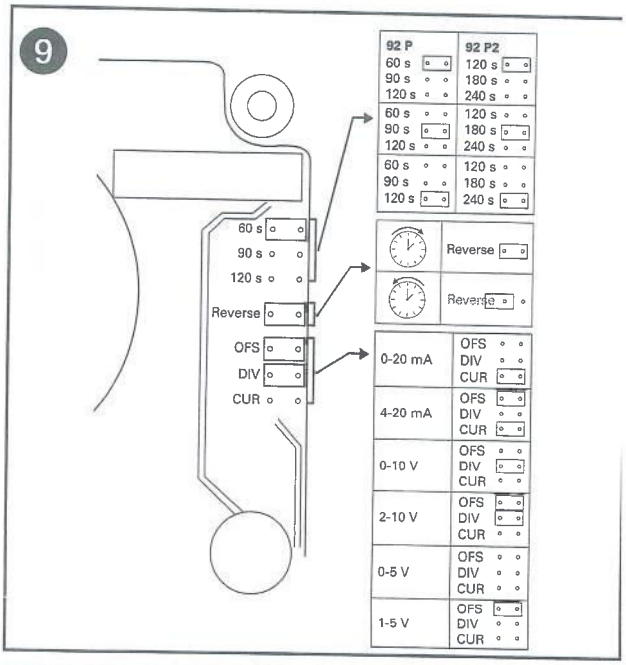


ESBE REGULATOR SERIES 92K2

Motor 92K2 – a complete unit for constant temperature regulating of
- return water to gas-, oil and solid fuel fired boilers
- under-floor heating systems
- industrial processoes

Handling

For the best control the sensor shall be placed about 3' (1 m) downstream from the valve. The sensor must be carefully insulated from the ambient temperature.

Adjusting

The function of the motor 92K2 is adjusted by two knobs:

Right hand knob

for temperature setting from 59 – 158° F
(+ 15° C to + 70° C)

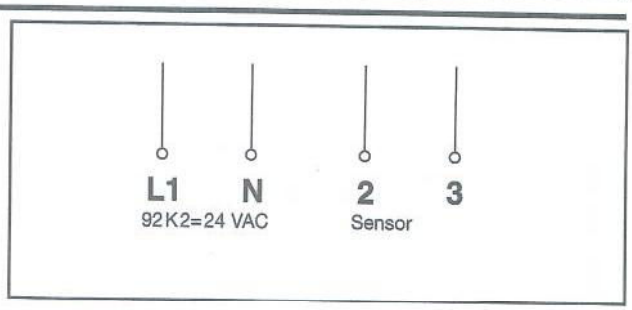
Left hand knob

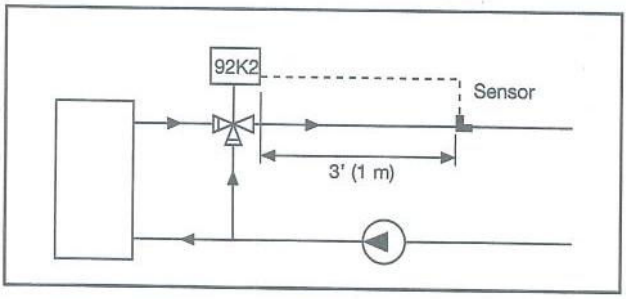
for selection of intervals between control signals from 1 to 70 seconds. Normally 30 seconds is suitable but depending on installation characteristics a longer or shorter interval can be used.

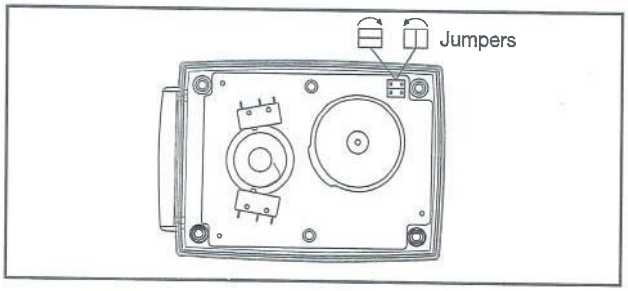
Direction of rotation

The direction of rotation can be reversed by changing the position of the two jumpers.

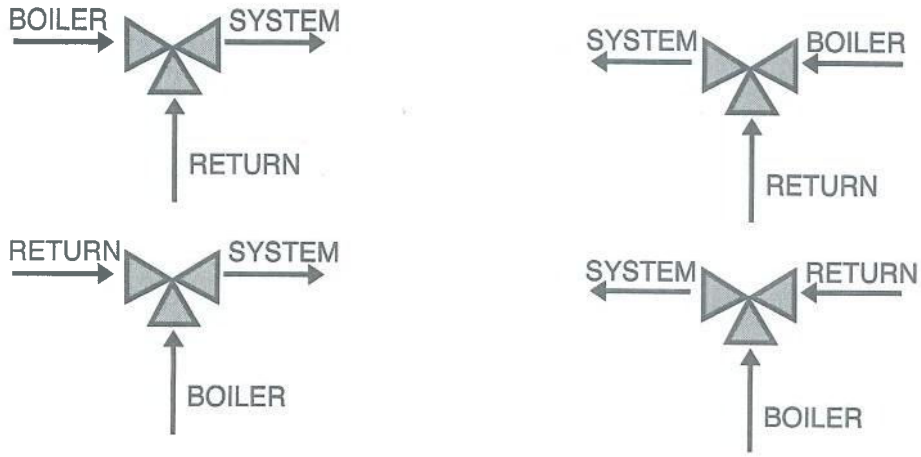
The installation shall include an approved means to disconnect the power, should service be required.



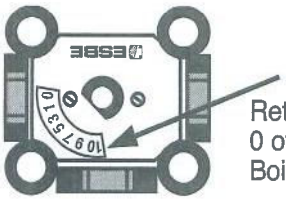




PIPING ARRANGEMENT



FACE PLATE POSITION



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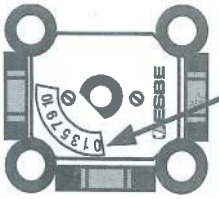

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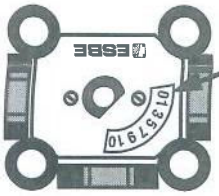

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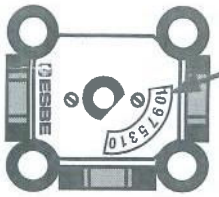

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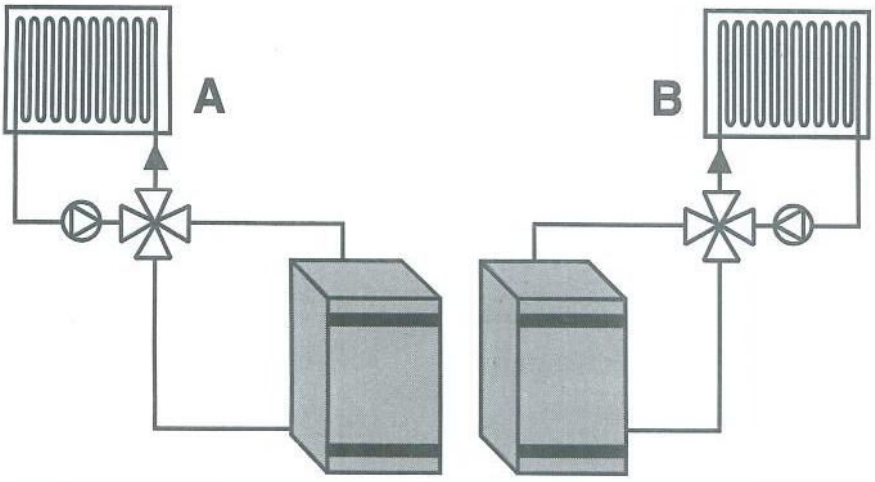

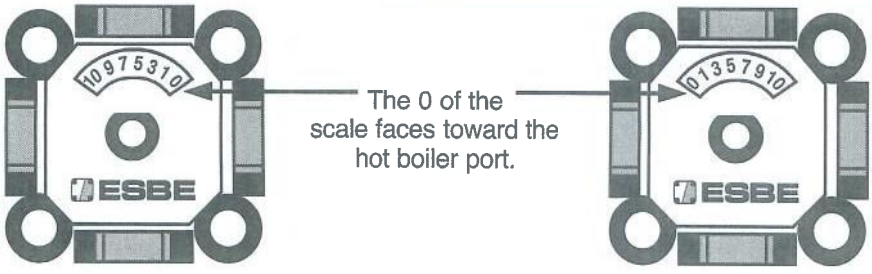

The 0 of the
scale faces toward the
hot boiler port.

APPENDICE 3
Shotblasting machine and dust collector Wheelabrator

wheelabrator
shaping industry

WHEELABRATOR GROUP

OPERATION & MAINTENANCE

GENERIC SYSTEM MANUAL

If you need any assistance, please do not hesitate to call and we will gladly assist you.

Technical:	Spare Parts:
Wheelabrator 1219 Corporate Drive Burlington, Ontario L7L 5V5 Telephone: (800) 845-8508 Telephone: (905) 319-7930 Fax: (905) 319-7561	**Wheelabrator** 1606 Executive Drive LaGrange, Georgia 30240 Telephone: (800) 544-4144 Telephone: (706) 884-6884 Fax: (706) 884-0710

Web Site: www.wheelabratorgroup.com

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Section 1 Introduction

1.1 Statement

This manual will benefit you in several ways:

1. It will provide you with safety warnings and instructions to protect you and your equipment from injuries or damage.
2. It will assist you in keeping this equipment in the best possible mechanical condition at all times.
3. It will help you obtain the maximum performance from your equipment.

The instructions and suggestions contained in this manual are based upon practical operating experience. If followed they will help you get the most production and satisfaction from the equipment.

Everyone responsible for the operation and maintenance of your equipment must read and understand this manual before using or working on the equipment.

Our interest in the safest and most successful operation of your equipment continues throughout the life of the equipment. We want it to serve you well. For that reason, please feel free to discuss any problems you may have concerning it or the work you are doing. It will be a pleasure to help you.

Addition copies of this manual can be purchased from the equipment manufacturer.

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1.2 Instruction and Warning Symbols

In this operation and maintenance manual the following symbols are used to identify important operation, maintenance and safety instructions:

1.2.1 Read!

This sign indicates advice regarding operation and maintenance.

1.2.2 Caution!

Yellow background with black text

This sign indicates rules and guidelines for a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

1.2.3 Warning!

Orange background with black text

This sign indicates rules and guidelines for a potentially hazardous situation which, if not avoided, could result in death or serious injury.

1.2.4 Danger!

Red background with black text

This sign indicates rules and guidelines for an imminently hazardous situation which, if not avoided, will result in death or serious injury. It may also be used to alert against unsafe practices

1.2.5 Electrical Hazard!

This sign indicates rules and guidelines to prevent possible severe or fatal injuries to the person and/or damage to the equipment by electrical causes.

1.3 Instructions

1.3.1 Reading about Equipment

This manual has been prepared to assist operator and maintenance personnel in understanding the equipment, so that it may be operated safely in the most efficient manner and maintained in the best condition. All personnel responsible for the operation and maintenance of the equipment must read and understand the manual, before using or working on the equipment.

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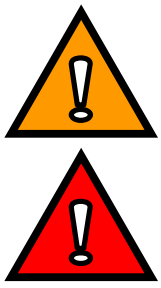
1.3.2 Understanding the Equipment

Before attempting to operate, service or maintain the equipment, personnel should thoroughly familiarize themselves with the physical make-up of the equipment, be familiar with the major components of the equipment, and have a general understanding of overall operations.

1.3.3 Equipment Operators & Maintenance Personnel Qualifications

1. Person must be of legal age for the location to operate and/or service equipment.
2. Person must be able to read and understand the English language to operate and/or service equipment.
3. Person must read and understand operation and maintenance manual before operating and or servicing the equipment.
4. Person must be trained in the operation and safety of the equipment before operating.
5. Only qualified maintenance personnel may service this equipment.

1.3.4 Warnings & Precautions



Operating and maintenance personnel must obey all the warnings and safety precautions posted on the equipment. Serious injury to personnel or severe damage to the equipment may result if the warnings and precautions are not followed.

1.3.5 Receipt of Equipment

Examine the shipment carefully for possible damage in transit. If damage is found, note the damage on the bill of lading, notify the transportation carrier immediately and advise the Wheelabrator Group.

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Section 2 Safety – Warnings & Precautions

2.1 Lockout/Tagout

One of the most widely applicable industrial safety principles is Lockout/Tagout. The Occupational Safety and Health Administration (OSHA) and the American National Standards Institute (ANZI) have both addressed the requirement for Lockout/Tagout. OSHA requires that each employer formulates a written procedure for implementing a Lockout/Tagout safety program, including training employees to assure that it is properly utilized. The following are a few important points to keep in mind.

1. The principle of Lockout/Tagout is to protect personnel from the unexpected energization, start up, or release of stored energy from the equipment or process.
2. The Lockout/Tagout principle requires that locks and tags be affixed to the point where energy can be disconnected from the equipment or process.
3. Sources of energy are not restricted to electrical; that is, disconnecting the main power switch may not eliminate all sources of unexpected activation. While electrical power always should be disconnected, a person knowledgeable about the equipment or process must assess the system for circumstances in which other forms of energy may be stored and released.
4. Personnel who are most vulnerable to injury from the activation of energy are maintenance personnel who must disassemble, expose and work on the equipment in the process of repair or service.

   The following serves as a reminder to apply this important safety principle when working on the equipment.

Disconnect or remove all sources of stored energy before performing maintenance or other service actions.

Failure to eliminate or block sources of stored energy can result in unexpected movement of equipment elements and cause serious injury or death.

Follow your Lockout/Tagout procedure.

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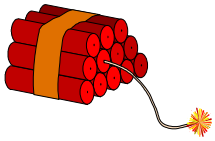
2.2 Media Warnings



2.2.1 Highly Explosive Dust

Products (parts), which produce highly explosive dust, such as **Magnesium, Titanium**, **Zirconium, Thorium**, etc., should not be processed in this equipment, unless appropriate safety measures are followed (consult expert authority). Obtain approval of your plant safety director and comply with applicable NFPA (National Fire Protection Association) guidelines.

Note: Personnel should not smoke, use matches nor have open flames around this equipment during operation.

2.2.2 Aluminum Media & Parts

Comply with all applicable sections of NFPA guidelines for processing or handling of aluminum dust and fines that may be pertinent to your specific operation.

In applications involving the use of dry type bag or cartridge dust collector system and Aluminum Media or surface blasting of Aluminum Parts, precautionary measures must be taken to minimize the risk of dust collector fires and/or explosions. The following procedures should be followed.

2.2.2.1 Adding Limestone – Dry Type Collectors

No. 200 mesh agricultural limestone ($CaCO_3$) should be added to the ventilation system at a continuous rate of 0.2 oz per hour per square foot of filter area. **Caution:** $CaCO_3$ is crushed limestone rock (not to be confused with lime, otherwise known as hot lime, burnt lime or hydrated lime. These highly reactive lime products should not be used).

2.2.2.2 Dust Collector Hopper(s)

The dust collector's refuse hopper(s) must be emptied at frequent intervals and at the end of each shift of operation. Collection of more than 1/3 the hopper capacity should not be exceeded. If external containers are used to collect refuse, they must never be allowed to overfill and back up into the collector hopper. All equipment must be grounded in accordance with the National Electrical Codes (NEC) to minimize static electric charges.

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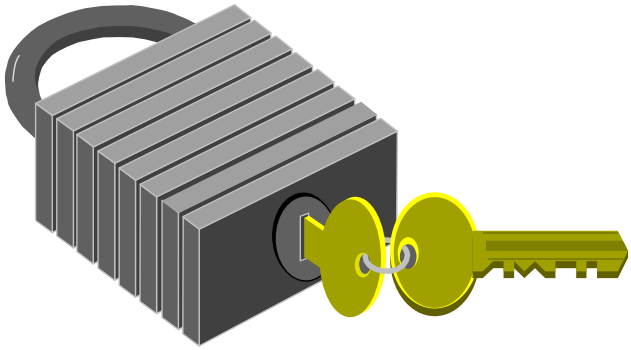
2.2.2.3 Ductwork Velocity – Aluminum Applications

Maintain ductwork air velocity of not less than 4500 FPM.

2.3 Maintenance Warning - Electrical



W A R N I N G

BEFORE ANY MAINTENANCE WORK IS CARRIED OUT ON THIS EQUIPMENT, THE MAIN ELECTRICAL SUPPLY SWITCH MUST BE IN THE "OFF" POSITION. ANY PERSONNEL PREFORMING ANY MAINTENANCE ON THIS EQUIPMENT MUST FOLLOW ALL APPLICABLE PLANT SAFETY STANDARD OPERATING PROCEDURES SUCH AS LOCK-OUT, TAG-OUT, ETC…

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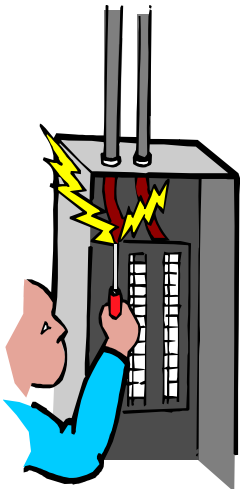
2.4 Electrical Precautions

Throughout this manual are safety warnings and precautions that must be obeyed by maintenance and operating personnel. Although the precautions which follow may seem to be over simplified, they should be included in the "Buyer's Safety Program." These are minimum safety requirements for this equipment and any additional plant safety requirements for your facility shall also be obeyed.

2.4.1 Control Panel



1. ***DO NOT*** operate the equipment with the control panel door open.

2. ***DO NOT*** use oversized fuses or bypass any fuses. Refer to Electrical Drawing.

3. ***DO*** verify the correct thermal overload(s) are installed for the motor starter(s) for the full load amp rating of the motor(s) as shown on the motor nameplate.

4. ***DO*** verify the set point knob on motor starter overload relay(s) are set to match amperage called out for on electrical drawing and matches motor nameplate data.

2.4.2 Electrical Motors

Only qualified personnel should perform electrical installation, operation and maintenance work.

1. ***DO*** verify all power sources are disconnected before attempting maintenance or repair.

2. ***DO*** follow your plants Lockout/Tagout procedures.

3. ***DO NOT*** come in contact with rotating parts.

4. ***DO*** verify motor(s) are effectively grounded. All the motor(s) on this equipment are securely fastened by metal-to-metal contact on the equipment and effectively grounded provided that the equipment is grounded. Refer to Item **3.4.4** on equipment grounding.

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5. ***DO*** verify the motor's nameplate before starting the motor(s), to ensure that the correct power supply (voltage, frequency, and phase) is being used and that the motor(s) is/are connected according to the connection diagram on the nameplate. Verify that the motor is connected properly for the correct rotation. If motor(s) rotate in the wrong direction, a qualified electrical person may interchange any two line leads at the starter in the control panel.

6. ***DO NOT*** use the eyebolt on the motor(s) to lift the motor with any additional equipment attached to the motor(s).

2.4.3 Equipment Installation Wiring

DO verify the equipment is wired and connected with wire of the correct size and correct insulation.

2.4.4 Equipment Safety Grounding

1. ***DO*** verify the equipment, as installed, is effectively grounded.
2. ***DO*** verify the equipment is grounded in accordance with NEC and any other applicable state or local codes.
3. ***DO*** verify effective grounding is accomplished by providing a ground path from the equipment to a grounding electrode with a copper conductor. The ground electrode may be:
   - **a.)** An underground metal water pipe
   - **b.)** A grounded metal building frame
   - **c.)** Other local metallic underground systems, such as tanks, plates, or driven pipe or rod.
4. ***DO*** verify the grounding conductor from equipment to grounding electrode is fastened by a pressure type cable connector (no solder) to a surface that is free of dirt and paint. Electrical devices (motors, controls, etc.) securely fastened to the equipment are grounded if the equipment is grounded.

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2.5 Maintenance Warning - Mechanical

2.5.1 Installation

2.5.1.1 Lift points

Safety during installation and start up requires placing the equipment without damage or injury and proper hook up to the required utility service.

The equipment may be lifted using the designated lift points that are located at a balance point. Be sure to lift the load with a proper size lifting device and follow safe rigging practices when performing this work. The proper lift points are designated on the equipment by the following sign.

2.5.1.2 Tipping Hazard

Some equipment may have work doors that may cause a change in the equipment's center of gravity when opened. Make sure all doors are securely closed before lifting and make sure equipment is securely anchored before doors are opened.

Note: DO NOT open doors on equipment until the equipment is anchored securely.

2.5.1.3 Equipment Placement

1. Be sure to allow sufficient space around the equipment to ensure that operation and maintenance can be performed without endangering personnel.
2. Inspect all access covers to make sure each is in place and secure.
3. Install vent piping to customer's dust collector system or to the dust collector supplied with the equipment.
4. Remove all foreign objects that might have been dropped or left in hoppers, elevator boot, etc.

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2.5.2 Items to be checked and completed before start-up

1. Install breathers on speed reducers.✱

   a.) Remove solid fill plug(s) located at the highest position and on the slow (output) side of each reducer. Ensure oil level(s) is/are correct with recommended lubricant(s).

   b.) Replace solid fill plug with breather plug(s) which is/are enclosed in packet inside electrical panel.

   ✱ **Note:** Some units may be equipped with combination plugs that do not require replacement. Check for air/pressure vent hole in plug before removing. Only un-vented plugs need to be changed.

2. Check motor rotation on all drives.

3. This equipment is normally wired to operate from 460V AC, 3 Phase, and 60 HZ electrical supply. Factory supplied options for 575V AC, 3 Phase, 60 HZ or 230V AC, 3 Phase, 60 HZ operation are available.

4. Before starting the equipment, check that the equipment is properly wired for the voltage it will operate on.

5. Make sure all drive guards, inspection plates, etc. are in place.

2.6 Mechanical Precautions

Throughout this manual are safety warnings and precautions that must be obeyed by maintenance and operating personnel. Although the precautions that follow may seem to be over simplified, they should be included in the "Buyer's Safety Program." These are minimum safety requirements for this equipment and any additional plant safety requirements for your facility shall also be obeyed.

2.6.1 Mechanical Do's & Don'ts Items:

1. ***DO*** Achieve **Zero Mechanical State (ZMS)** before performing maintenance on the equipment.

   a.) ***DO*** lockout every power source that can produce mechanical movement.

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b.) ***DO*** lockout shut off valves for pressurized fluid (air, oil or other).

c.) ***DO*** reduce all accumulators and air surge tanks to atmospheric pressure.

d.) ***DO*** achieve the lowest practical value for mechanical potential energy for all portions of the equipment.

Example: A belt and bucket elevator system that has stopped with the buckets containing abrasive may reverse from the weight of the abrasive in the buckets.

e.) ***DO*** achieve the lowest practical value for kinetic energy of the equipment members. Loose or freely movable equipment members and parts must be secured against accidental movement.

Example: A rotating part, such as an airless blast wheel, will continue to rotate for a period of time after the electrical power has been disconnected.

2. ***DO*** keep all guards in place, except during maintenance or repair work. Remount all guards upon completion of any maintenance or repair work.

3. ***DO*** wear safety glasses while working near or on the equipment.

4. ***DO*** wear gloves, when applicable, when working near and on the equipment.

5. ***DO NOT*** wear loose fitting clothes, jewelry and watches, while working near belts, chains, sprockets, shafts or other components that are movable.

6. ***DO*** keep the areas around all equipment clean. Loose abrasive media and dust can cause hazardous conditions.

7. ***DO*** immediately correct any condition(s) that may result in damage to the equipment or cause injury to personnel.

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8. ***DO NOT*** use your hands to remove excess abrasive from the elevator boot section, rotary screen, screw conveyor or shaker conveyor. Always use a scoop or scraper for removing this abrasive.

9. ***DO NOT*** attempt to adjust the feed spout, or other wheel parts while the blast wheel is operating or rotating.

10. ***DO NOT*** attempt to adjust the component parts of the abrasive recycling system or the work parts conveyor system while any part of the blast equipment is in operation.

11. ***DO NOT*** remove access covers or panels while equipment is operating. Always follow your facility's Lockout/Tagout procedures before removing any covers or panels.

12. ***DO*** obey all safety signs (caution, warning & danger) and other precautionary information posted on the equipment or in the equipment operating area.

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2.7 Safety Signs

The following safety and danger signs may appear on and around the equipment, it is important that their meaning is fully understood by all operators and maintenance personnel who will come in contact with the equipment.

2.7.1 Notice Signs

Notice Signs	Description
 	Part Number: **C81261 & C253704** Location: This sign is located at eye level on ladders to service platforms, at the operator's station and all access doors on the equipment. Meaning: This sign warns that only authorized personnel and operators should have admittance to the area.

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2.7.2 Warning Signs

Warning Signs	Description
 	Part Number: **C80805 & C253707** Location: This sign is located at eye level on all inspection, access and work doors on the equipment. Meaning: This sign warns the operator or service personnel to wear safety glasses when servicing or operating the equipment.
 	Part Number: **C59602 & C253707** Location: This sign is located at eye level on ladders to service platforms, at the operator's station and all access doors on the equipment. Meaning: This sign warns the operator or service personnel to watch their step around the equipment due to possible media on floor.

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2.7.3 Danger Signs

Danger Signs	Description
	Part Number: **C243990-1** Location: This sign is located on the main control panel. Meaning: This sign warns against having an open flame, creating a spark and smoking around the equipment.
	Part Number: Location: This sign is located on conveyors, and the entrance and exit of the equipment. Meaning: This equipment includes for moving conveyors at the entrance and exit, and a belt and bucket elevator system.

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Danger Signs	Description
 	Part Number: **C243991-1** Location: This sign is located on the entrance and exit of the equipment. Meaning: This sign warns the operator or service personnel that the equipment is controlled through the main control panel and once initiated by the operator and the system starts automatically.

Signs to be Translated

English	Arabic
DANGER HIGH VOLTAGE	خطر التيار العالي
DANGER STARTS AUTOMATICALLY	الخطر ينطلق تلقائيا
AUTHORIZED PERSONNEL ONLY	الأفراد المصرح لهم فقط
WATCH FOR MOVING EQUIPMENT	آنظر حولك لنقل المعدات
SLIPPERY	حذار من الانزلاق
WEAR EYE PROTECTION	ضع النظارات لحماية العينين

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Section 3 Media Handling System

3.1 Function of the Lower Reclaim:

The lower reclaim function is to collect contaminants spent media thrown by the blast wheels. The media and contaminants are then delivered by the lower reclaim to the bucket elevator boot section. The lower reclaim is part of a total media recovery system to clean and recycle media back to the blast wheel.

3.1.1 Types of Lower Reclaims:

3.1.1.1 Full Gravity Reclaims:

a. Gravity hoppers are used for directing spent media directly to the bucket elevator boot section.

b. Gravity hoppers are generally used on small equipment.

c. There are no drives or mechanical moving parts in gravity reclaims.

3.1.1.2 Lower Screw Conveyor Reclaims:

a. Lower screw conveyors are used when full gravity is not feasible and the product application does not have significant amounts of tramp metal entering the screw area that would otherwise result in jams. Screws may be protected by shed plates, grating and/or screen.

b. The volume of media flow determines the size of screw conveyor and horsepower required to move the abrasive to the bucket elevator boot section.

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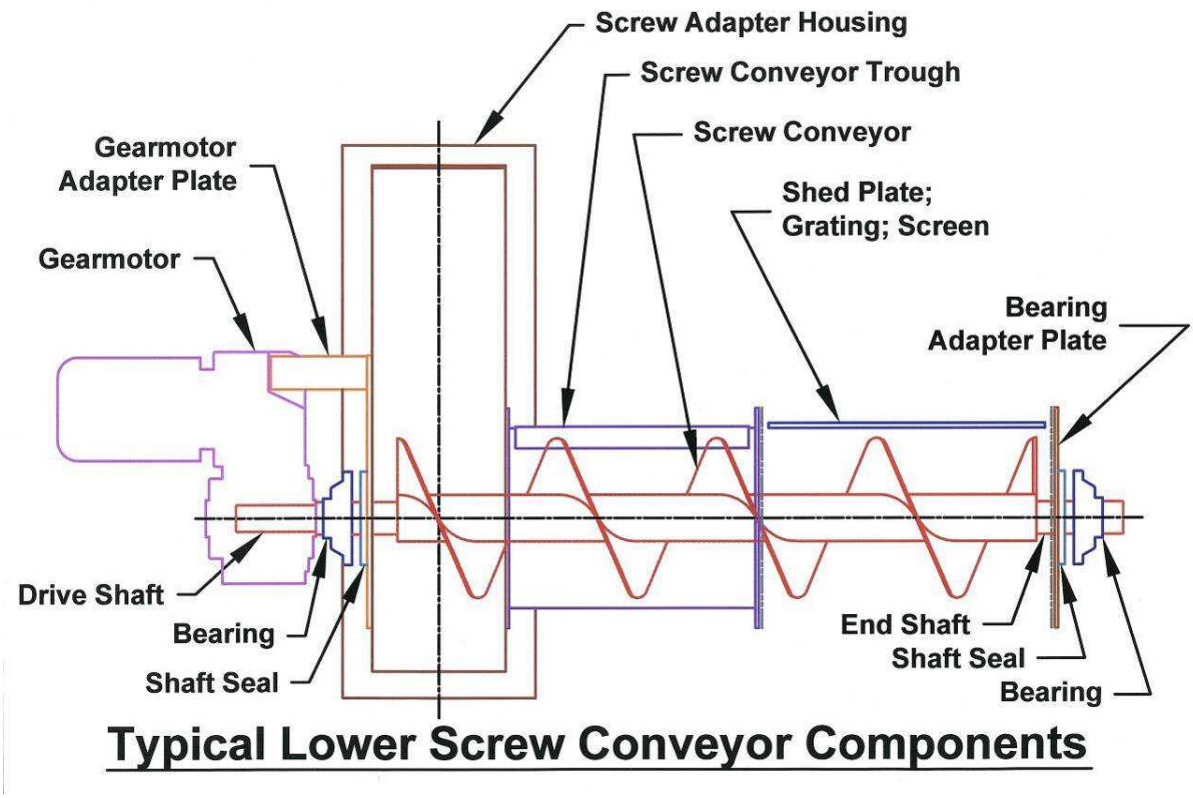

Figure 3-1

c. Typical components of a lower screw conveyor reclaim are shown in **Figure 3-1**.

1. **Screw Conveyor** – flighting and tube construction to deliver media to the bucket elevator boot section.

2. **Screw Conveyor Trough** – connects and encloses the screw conveyor between the blast chamber and elevator boot. This may not be required on all applications.

3. **Shed Plate; Grating; Screen** – may be provided to protect the screw from objects that could jam the screw conveyor and also to meter the abrasive to the screw conveyor.

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4. **Screw Adapter Housing** – joins the screw conveyor trough to the elevator boot or cabinet. This may not be required on all applications.

5. **Drive Shaft** – fixed to the screw conveyor and mounted through the bearing to drive the conveyor.

6. **End Shaft** - fixed to the screw conveyor and mounted through the bearing to support the conveyor opposite the drive.

7. **Shaft Seals** – prevents media leaking out the ends of the conveyor and protects the bearings from the media. (see **Figures 3-2** & **3-3**)

8. **Bearings** – supports ends of the screw conveyor.

9. **Bearing Adapter Plate** – closes the end of the conveyor and supports the bearing.

10. **Gearmotor Adapter Plate** - closes the end of the conveyor and supports the bearing and Gearmotor.

11. **Gearmotor** – mounted on drive shaft to power screw conveyor.

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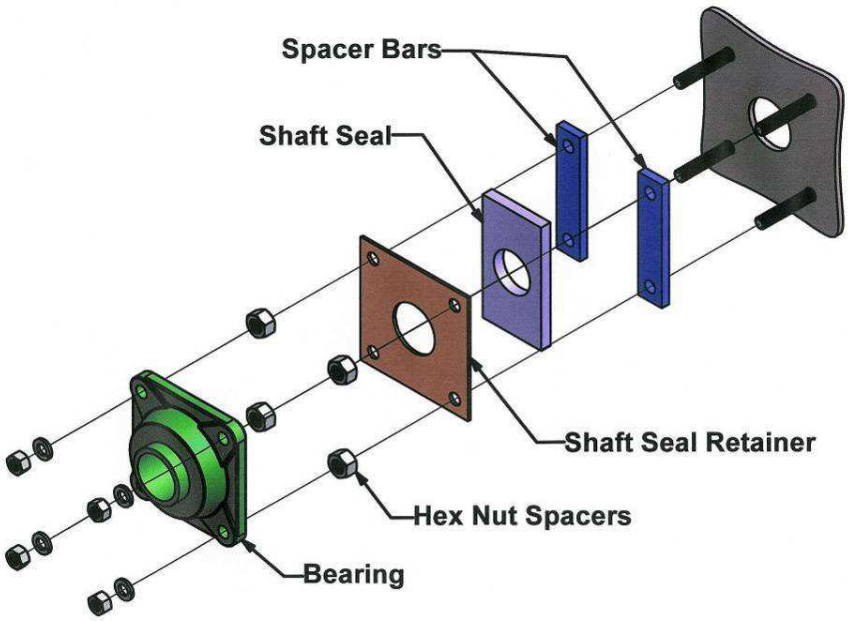

Typical Shaft Seal Assembly

Figure 3-2

d. A typical shaft seal assembly for a lower screw conveyor is shown in **Figure 3-2**.

1. **Shaft Seal Spacer Bars** – maintains a space between the adapter plate and the shaft seal retainer for the shaft seal to mount. This allows maintains proper compression of the felt shaft seal.
2. **Shaft Seal** – prevents media leaking out the ends of the conveyor and protects the bearings from the media.
3. **Shaft Seal Retainer** – retains the shaft seal between the shaft seal spacer bars.
4. **Hex Nut Spacers** – maintains a space between the shaft seal retainer and the flange bearing. This allows any media that made it by the shaft seal to drain before contaminating the flange bearing.
5. **Bearing** – supports ends of the screw conveyor.

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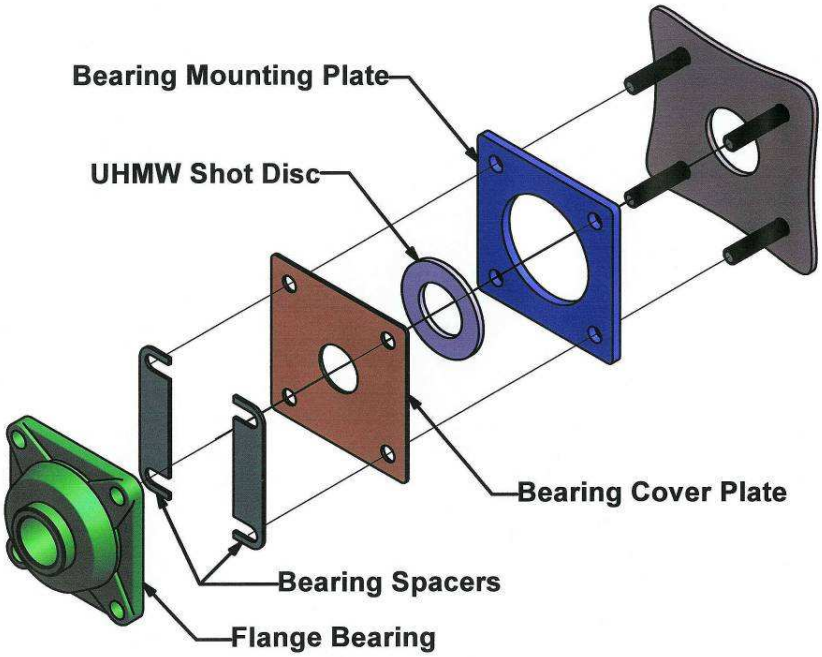

Typical Shaft Seal Assembly

Figure 3-3

e. Another variation of a shaft seal assembly for a lower screw conveyor is shown in **Figure 3-3**.

1. **Bearing Mounting Plate** – is the base for mounting the other components of the bearing assembly.
2. **UHMW Shot Disc** – prevents media leaking out the ends of the conveyor and protects the bearings from the media.
3. **Bearing Cover Plate** – retains the UHMW shot disc in the bearing mounting plate.
4. **Bearing Spacers** – maintains a space between the bearing cover plate and the flange bearing. This allows any media that made it by the shot disc seal to drain before contaminating the flange bearing.
5. **Flange Bearing** – supports ends of the screw conveyor.

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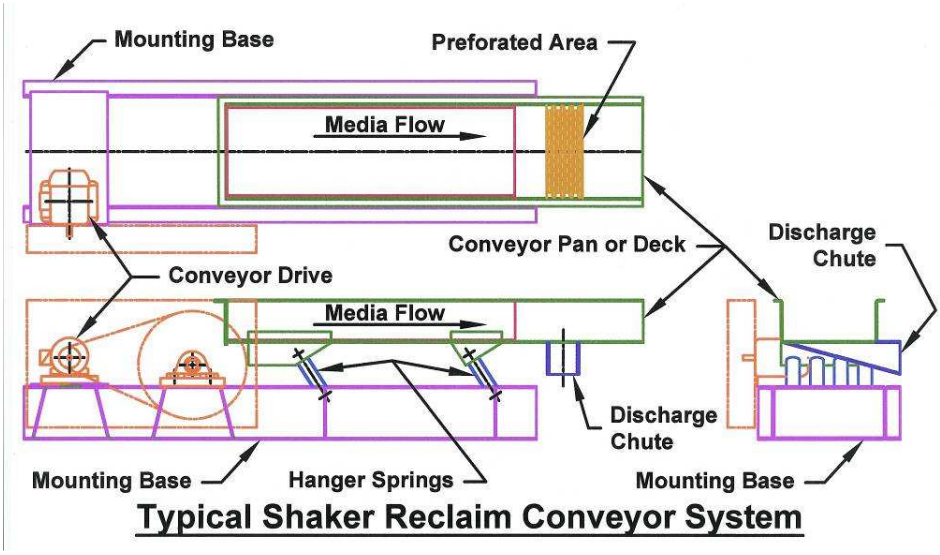
3.1.1.3 Shaker Conveyor Reclaims:

a. Shaker conveyors are used when full gravity is not feasible and the product application contains significant tramp metal material entering the reclaim.

b. Shaker conveyors are able to separate large trash from the media to prevent it entering the remaining media handling system components and causing damage or jams.

c. Shaker conveyors are generally self cleaning.



Typical Shaker Reclaim Conveyor System

Figure 3-4

d. A typical shaker conveyor reclaim system is shown in **Figure 3-4**.

1. **Conveyor Pan or Deck** – controls media and trash while it is being conveyed and reclaimed.
2. **Conveyor Pan Liner** – protects pan from abrasion and impact.
3. **Perforated Area** – separates large trash from media before media is delivered to the elevator boot section.
4. **Discharge Chute** – delivers media to the elevator boot section.

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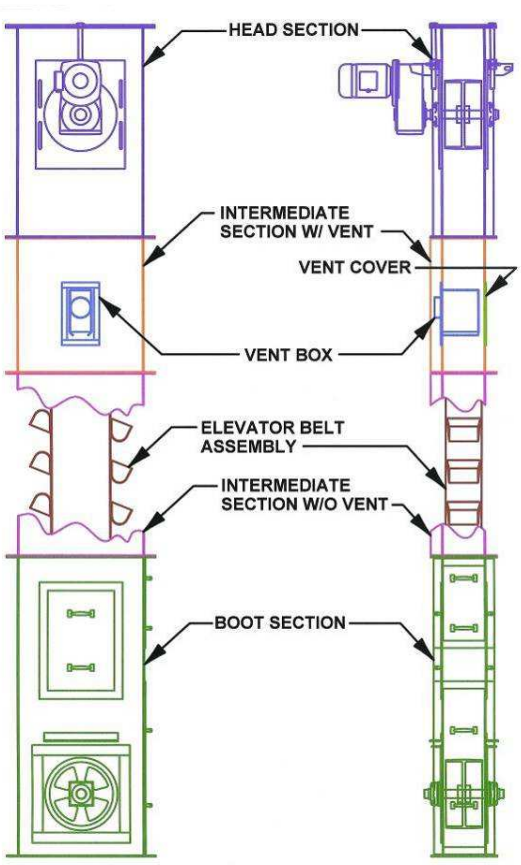
5. **Mounting Base** – supports the shaker conveyor and secures it to the foundation.
6. **Hanger Springs** – are sized to control stroke, frequency and angle of attack designed to proper conveying action for type media.
7. **Conveyor Drive** – powers the shaker conveyor.

3.2 Function of the Bucket Elevator

a. The belt and bucket centrifugal discharge elevator lifts the abrasive material from the boot (lower) section to the head (upper) section. The contaminated abrasive material is discharged from the head section of the elevator, and then delivered to the separator.



Typical Elevator Arrangement

Figure 3-5

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b. A typical elevator arrangement is shown in **Figure 3-5**.

1. **Head Section** – This is the upper section of the bucket elevator casing. It usually contains the elevator drive.
2. **Intermediate Section with Vent** – This is the part of the elevator casing that contains the vent box.
3. **Vent Box** – This is the outlet to remove the dust from of the elevator casing. It can usually be mounted on either side of the intermediate section depending on the vent piping requirement.
4. **Vent Cover** – Covers the opening in the intermediate section opposite the vent box when part of design.
5. **Intermediate Section without Vent** – This is the part of the elevator casing used to increase the height of the elevator. This section is not always required.
6. **Boot Section** – This is the lower section of the bucket elevator casing. This section receives the spent media from the blast chamber and lower reclaim.
7. **Elevator Belt Assembly** - This bucket and belt assembly transports the abrasive media from the boot section to the head section and discharges it to the upper reclaim system.

3.2.1 Elevator Head Section

a. The head section is the upper section of the bucket elevator casing. It receives the abrasive media from the boot section of the elevator and discharges the abrasive media into the upper reclaim system.

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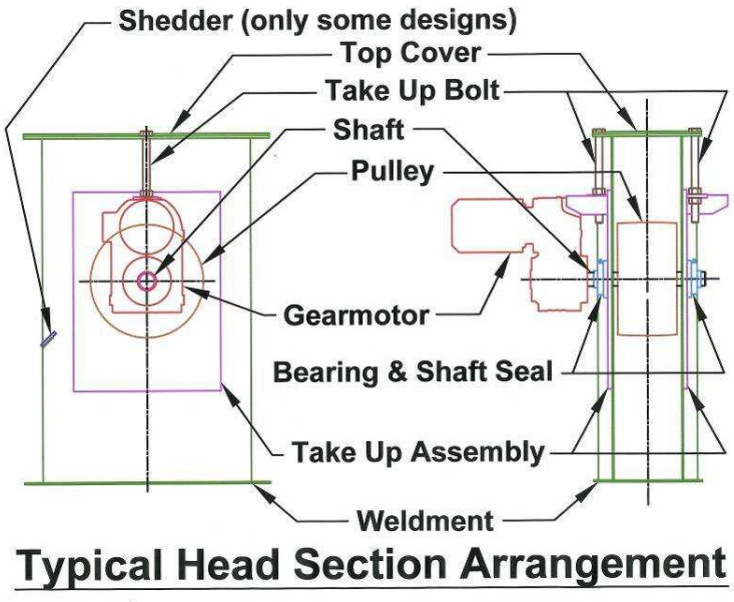

Figure 3-6

b. A typical elevator head section arrangement is shown in **Figure 3-6**.

1. **Weldment** – is a fabricated housing that the head section components mount to.
2. **Take Up Assembly** – supports the bearings, shaft seals, shaft and pulley on the weldment. They slide up and down to adjust the tension of the elevator belt assembly. There are two take up assemblies per head section.
3. **Take Up Bolts** – are the links between the weldment and the take up assemblies. Turning the bolts clockwise will tighten the elevator belt and turning the bolts counter-clockwise will loosen the elevator belt. These bolts are also used to adjust the tracking of the elevator belt.
4. **Pulley** – provides a rotating surface to drive the elevator belt assembly. The pulley is usually crowned and lagged to assist in tracking the elevator belt assembly.
5. **Shaft** – supports the elevator head section pulley.
6. **Shaft Seal** – prevents media leaking out from the take up assembly plates and protect the bearings from the media.

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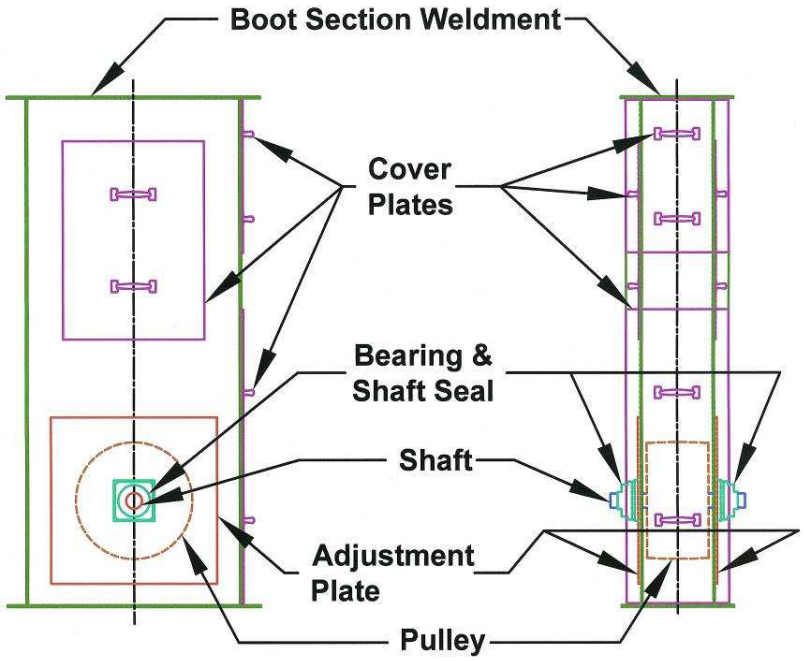
7. **Bearing** – supports ends of the elevator head section shaft.
8. **Gearmotor** – is mounted to the head section shaft to power the elevator.
9. **Top Cover** – is the access cover to the elevator head section and a safety cover to guard against the rotating components inside the elevator head section weldment.
10. **Shedder** – is a wear component to assist in delivery of abrasive media and contaminants to the upper reclaim system. This is only used on some designs of elevator head sections.

3.2.2 Elevator Boot Section

a. The boot section is the lower section of the bucket elevator casing. It receives the abrasive media and contaminant from the lower reclaim of the equipment and moves the media and contaminants to the head section with the elevator belt assembly.



Typical Boot Section Arrangement

Figure 3-7

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b. A typical elevator boot section arrangement is shown in **Figure 3-7**.

1. **Boot Section Weldment** – is a fabricated housing that the boot section components mount to.

2. **Adjustment Plate** – supports the bearings, shaft seals, shaft and pulley on the boot section weldment. There are usually two of these plates per boot section.

3. **Pulley** – provides a rotating surface for the elevator belt assembly to ride on.

4. **Shaft** – supports the elevator boot section pulley.

5. **Shaft Seal** – prevents media leaking around the shaft and protects the bearings from the media.

6. **Bearing** – supports ends of the elevator boot section shaft.

Note: See Section 3.1.1.2 (d & e) for the two types of typical shaft seal assemblies. Also see Figures 3-2 and 3-3.

7. **Cover Plates** – are the access covers to the elevator boot section and a safety cover to guard against the rotating components inside the elevator boot section weldment.

3.2.3 Elevator Belt Assembly

a. The elevator belt assembly carries the abrasive media and contaminants in buckets from the elevator boot section to the elevator head section. The belt tracks on the elevator head and boot pulleys.

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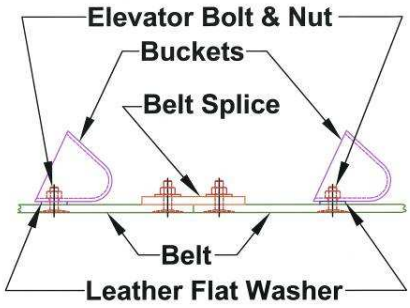
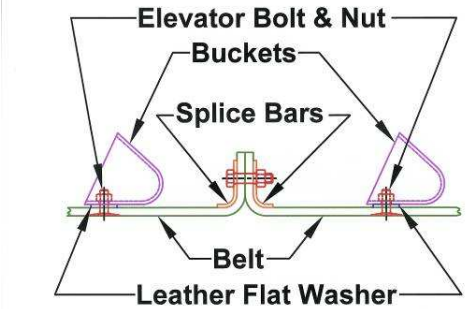


Typical Elevator Belt Assembly with Dutchman Splice

Figure 3-8



Typical Elevator Belt Assembly with Oil Well Splice

Figure 3-9

b. Typical elevator belt assemblies are shown in **Figure 3-8** with a Dutchman splice and **Figure 3-9** with an Oil Well splice.

1. **Elevator Belt** – is manufactured from a multi-ply rubber belting material with an abrasive resistant top cover for protection against abrasion and cutting. The elevator buckets and splice are mounted to the belt.

2. **Buckets** – carry the abrasive media. They are usually made out of cast ductile iron for better wear life.

3. **Leather Flat Washer** – spaces the buckets off the belt to help prevent edge of buckets cutting into the belt.

4. **Belt Splice & Splice Bars** – joins the two ends of the elevator belt together to make one continuous belt. There are two types of splices. The Dutchman splice is usually used on low temperature belts and in smaller size elevators. The Oil Well splices are usually used on high temperature belts and in larger size elevators.

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3.3 Functions of Upper Reclaims

The upper reclaim function is to collect media and contaminants delivered from the elevator. Media and contaminants are then conveyed by the upper reclaim to the media separator. The upper reclaim is a part of a total media recovery system to clean and recycle media back to the blast wheel.

3.3.1 Types of Upper Reclaims:

3.3.1.1 Full Gravity Reclaims

a. Gravity reclaims are used for transferring media directly from the elevator head section to the separator.

b. There are no drives in upper gravity reclaims.

3.3.1.2 Upper Screw Conveyor Reclaims

a. Upper screw conveyors are used to reduce system height when full gravity is not feasible.

b. The volume of media flow determines the size of screw conveyor and horsepower required to move the abrasive media from the bucket elevator to the separator.

c. There are two styles of upper screw reclaim. One is a standard screw conveyor and the other is a screw conveyor with a rotary screen.
(See **Figures 3-10** & **3-11**)

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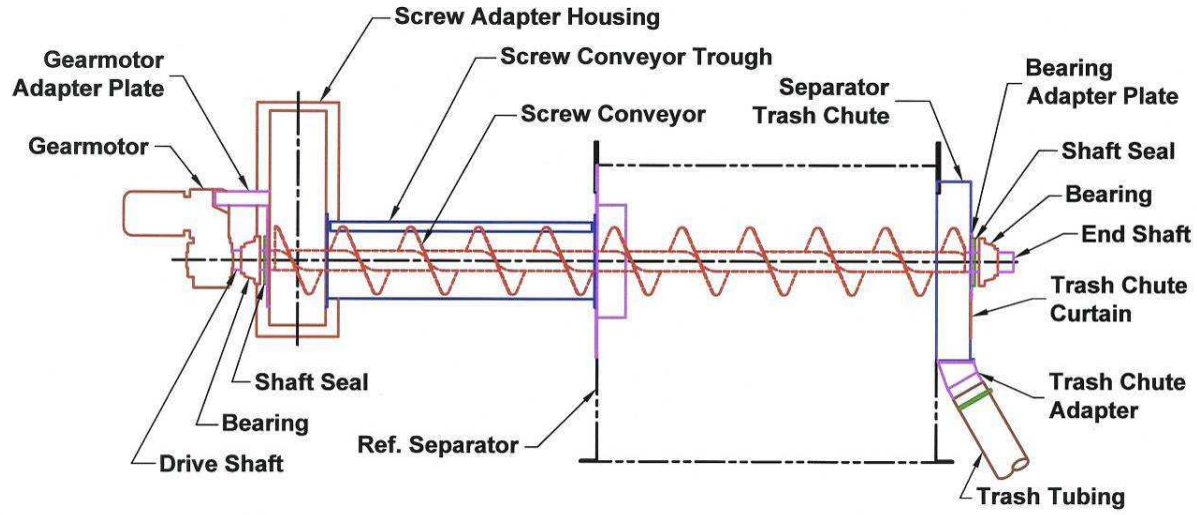
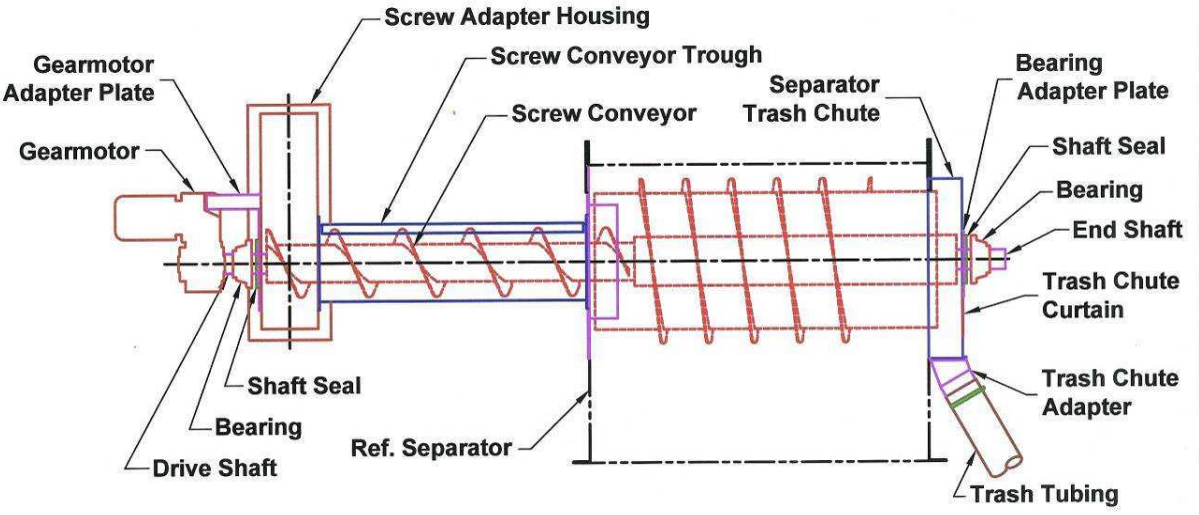


Typical Upper Screw Conveyor Components

Figure 3-10



Typical Upper Screw Conveyor Components with Rotary Screen

Figure 3-11

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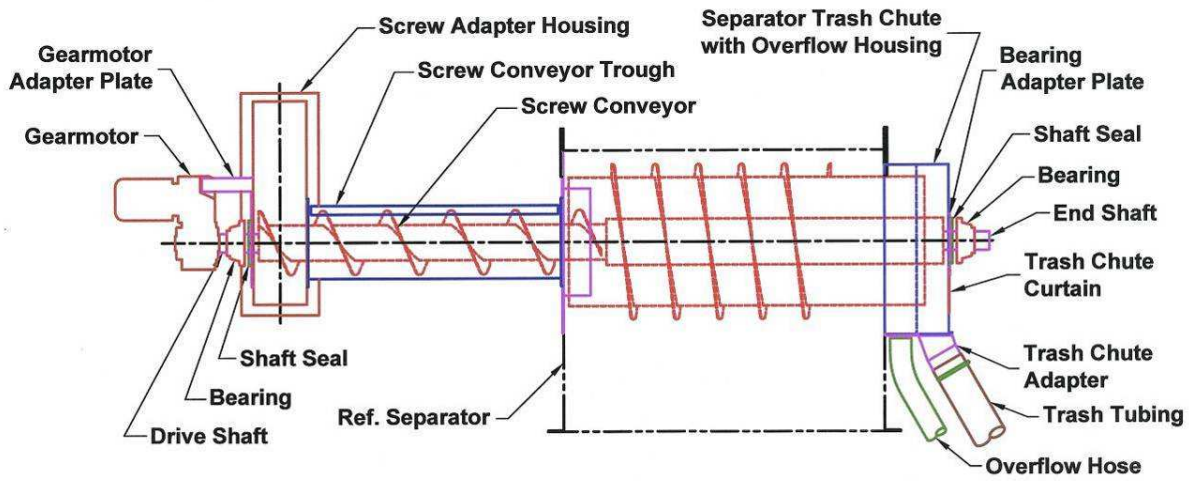

Typical Upper Screw Conveyor Components with Rotary Screen and Trash Chute with Overflow Housing & Hose

Figure 3-12

d. The following are typical components of an upper screw conveyor reclaim are shown in **Figure 3-10** upper screw conveyor and **Figure 3-11** upper screw conveyor with rotary screen **Figure 3-12** upper screw conveyor with rotary screen screw and trash chute with overflow housing & hose.

1. **Screw Conveyor** – flighting and tube construction to deliver media and contaminants from the bucket elevator to the separator.

2. **Rotary Screen** – is a scalping drum that allows the abrasive and contaminants to flow through a screen, but holds large tramp material inside the screen where it is conveyed to a trash chute. The rotary screen directs any large particles away from the air wash and discharges them into the trash chute to a refuse container.

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3. **Screw Conveyor Trough** – connects and encloses the screw conveyor between the bucket elevator and the separator.

4. **Screw Adapter Housing** – joins the screw conveyor trough to the elevator head section.

5. **Separator Trash Chute** – the rotary screen empties the large trapped particles into this housing.

6. **Separator Trash Chute with Overflow Housing**– when there is a surge of media the media is overflowed into the first compartment of the housing. The rotary screen empties the large trapped particles into the second compartment of the housing.

7. **Overflow Hose** – directs the overflow media back to lower reclaim to be recycled.

8. **Trash Chute Curtain** – allows access to clean out any trapped particles that are clogging the entrance to the trash tube.

Warning: DO NOT clean out separator trash chute with power on the equipment or with the screw conveyor or screen running.

9. **Trash Chute Adapter** – attaches the separator trash chute to the trash tubing.

10. **Trash Tubing** – conveys discharged trash particles from the rotary screen to the buyer's trash receptacle.

11. **Drive Shaft** – fixed to the screw conveyor and mounted through the bearing to drive the conveyor.

12. **End Shaft** - fixed to the screw conveyor and mounted through the bearing to support the conveyor opposite the drive.

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13. **Shaft Seals** – prevents media leaking out the ends of the conveyor and protects the bearings from the media.

14. **Bearings** – supports both ends of the screw conveyor.

15. **Bearing Adapter Plate** – mounts to the separator trash chute for mounting the bearing.

16. **Gearmotor Adapter Plate** - closes the end of the conveyor and for mounting the bearing and gearmotor.

17. **Gearmotor** – mounted on drive shaft to power screw conveyor.

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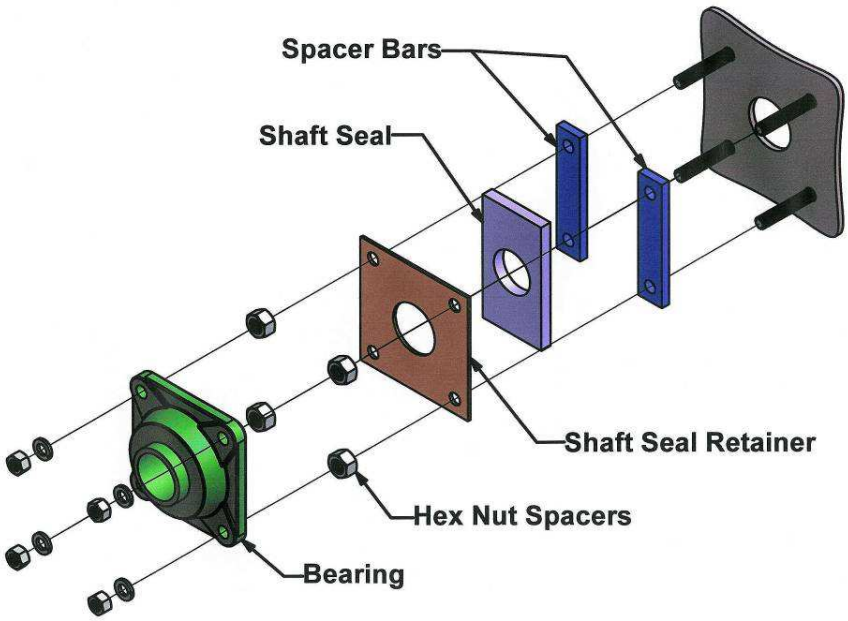

Typical Shaft Seal Assembly

Figure 3-13

e. A typical shaft seal assembly for an upper screw conveyor is shown in **Figure 3-13**.

1. **Shaft Seal Spacer Bars** – maintains a space between the adapter plate and the shaft seal retainer for the shaft seal to mount. This allows maintains proper compression of the felt shaft seal.
2. **Shaft Seal** – prevents media leaking out the ends of the conveyor and protects the bearings from the media.
3. **Shaft Seal Retainer** – retains the shaft seal between the shaft seal spacer bars.
4. **Hex Nut Spacers** – maintains a space between the shaft seal retainer and the flange bearing. This allows any media that made it by the shaft seal to drain before contaminating the flange bearing.
5. **Bearing** – supports both ends of the screw conveyor.

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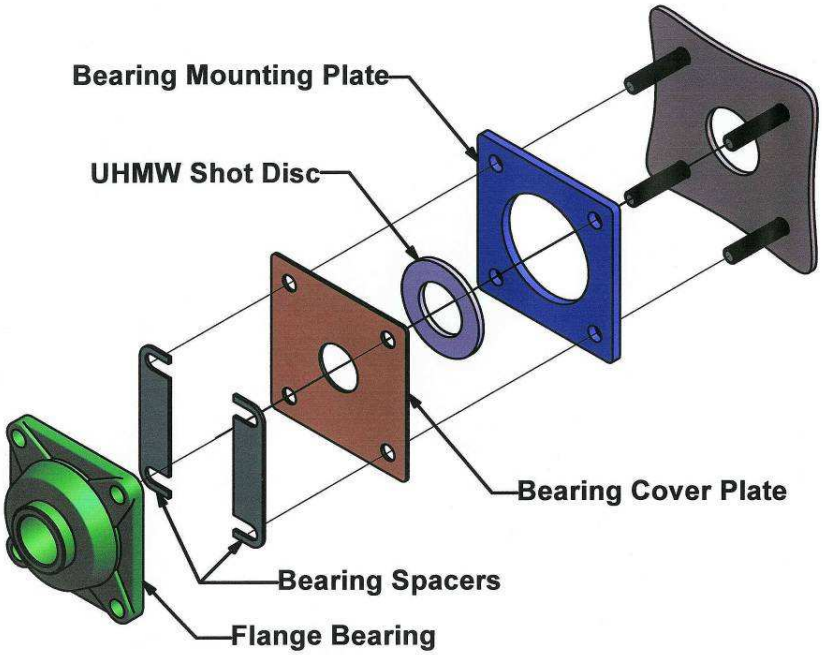

Figure 3-14

f. Another variation of a shaft seal assembly for an upper screw conveyor is shown in **Figure 3-14**.

1. **Bearing Mounting Plate** – is the base for mounting the other components of the bearing assembly.
2. **UHMW Shot Disc** – prevents media leaking out the ends of the conveyor and protects the bearings from the media.
3. **Bearing Cover Plate** – retains the UHMW shot disc in the bearing mounting plate.
4. **Bearing Spacers** – maintains a space between the bearing cover plate and the flange bearing. This allows any media that made it by the shot disc seal to drain before contaminating the flange bearing.
5. **Flange Bearing** – supports ends of the screw conveyor.

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3.4 Functions of a Separator

The separator receives contaminated abrasive media from the upper reclaim. In the separating process, the abrasive media is spread out for uniform distribution through the separator to remove the contaminants from the abrasive media. The abrasive contaminants are delivered to the refuse side of the separator. These contaminants are conveyed to the customer's refuse container by means of flexible tubing with a dribble valve.

3.4.1 Types of Separators:

3.4.1.1 Gravity CFS Separator (Figure 3-15)

a. The gravity CFS (Compensating Flow Straight) separator receives the abrasive media and contaminants from the head section of the elevator.

b. The large contaminants are screened out through a stationary screen.

c. The usable abrasive media is separated from the fine abrasive media, sand and scale.

- This is achieved by pulling air through a curtain of abrasive media.
- This curtain is maintained across the full width of the separator by a sliding baffle and counterweighted swinging baffle system.

d. The cleaned usable abrasive media is directed to the storage hopper.

e. The fines, sand and scale are directed to the buyer's receptacle at floor level.

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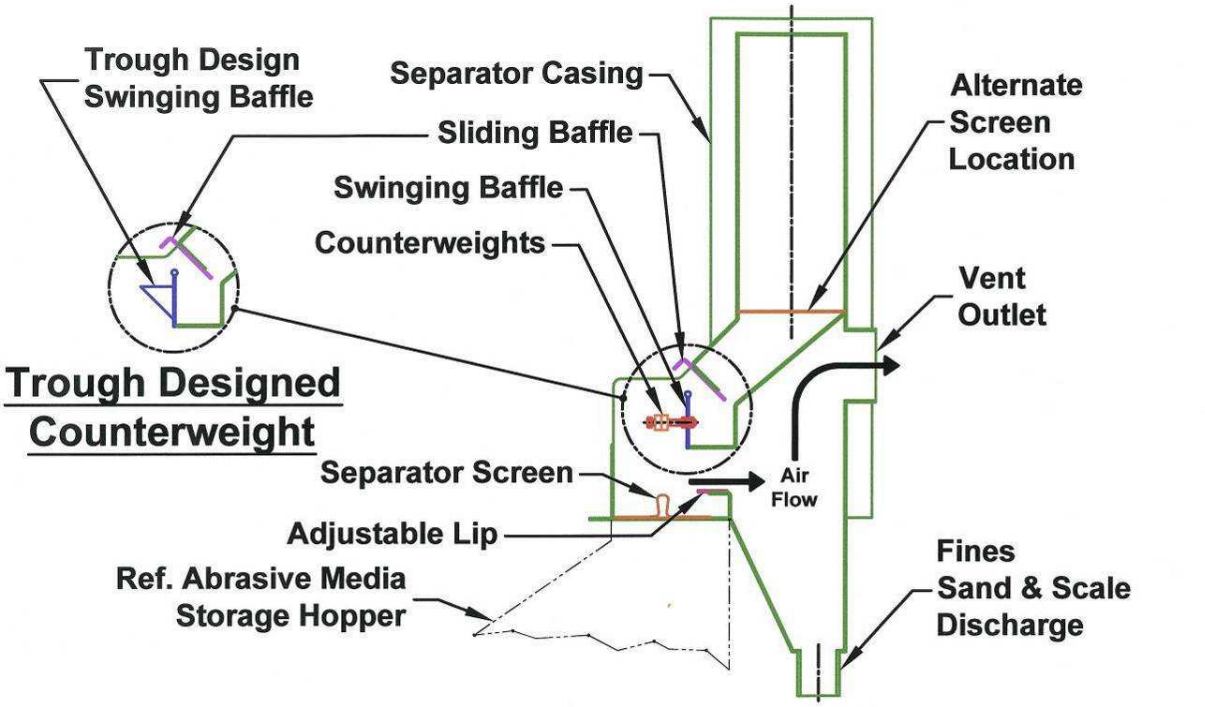

Typical Gravity CFS Separator Arrangement

Figure 3-15

f. The following are typical components of a gravity CFS separator as shown in **Figure 3-15**.

1. **Separator Casing** – is used to mount the separator components and retain the abrasive media and contaminants to be cleaned.

2. **Sliding Baffle** – is adjustable and regulates the volume of abrasive media and contaminants flowing to the swinging baffle.

3. **Swinging Baffle** – is the mechanism which controls the flow of contaminated abrasive media in a thin curtain across the entire width of the separator at the point of separation.

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Make sure the swinging baffle will not stick on the ends near the vertical housing wall. Grind the edges for clearance if required. The vertical back of the swinging baffle should be perpendicular with the edge of the adjustable lip. Use the slotted holes for the bearing mounts to adjust the position of the baffle as required. The bottom edge of the baffle should clear the adjustable lip by approximately 1/8". This gap may change, based on the size abrasive used, to prevent sticking of the baffle on the horizontal lip. Correct clearance allows the baffle to push against the build up of abrasive on top of the lip and prevent any partial curtain leakage of abrasive.

4. **Counterweights** – are used to adjust the swinging baffle to obtain a full width curtain. By moving the adjustable counterweights up and back on the rod or adding or removing abrasive from the trough designed counterweights the thickness and width of the abrasive curtain of abrasive can be adjusted.

5. **Adjustable Lip** – is adjusted back about ½" behind the vertical fall line from the upper lip that swinging baffle closes on. The lower lip may need additional adjustment depending on the size, weight and volume of contaminants.

6. **Separator Screen** – stops large contaminants before they can get to the wheel unit. The screen should be cleaned daily to assure unrestricted abrasive flow to the wheels. Care should be taken when cleaning the screen to assure the contaminants do not fall into the abrasive storage hopper.

3.4.1.2 CFS Separator w/Upper Screw Conveyor Reclaim (Figure 3-16)

a. The CFS (Compensating Flow Straight) separator receives contaminated abrasive media from the upper screw conveyor reclaim.

b. The large contaminants are screened out through a rotary screen.

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c. The usable abrasive media is separated from the fine abrasive media, sand and scale.

- This is achieved by pulling air through a curtain of abrasive media.
- This curtain is maintained across the full width of the separator by a sliding baffle and counterweighted swinging baffle system.

d. The screened usable abrasive media is directed to the storage hopper.

e. The fines, sand and scale are directed to the buyer's receptacle at floor level.

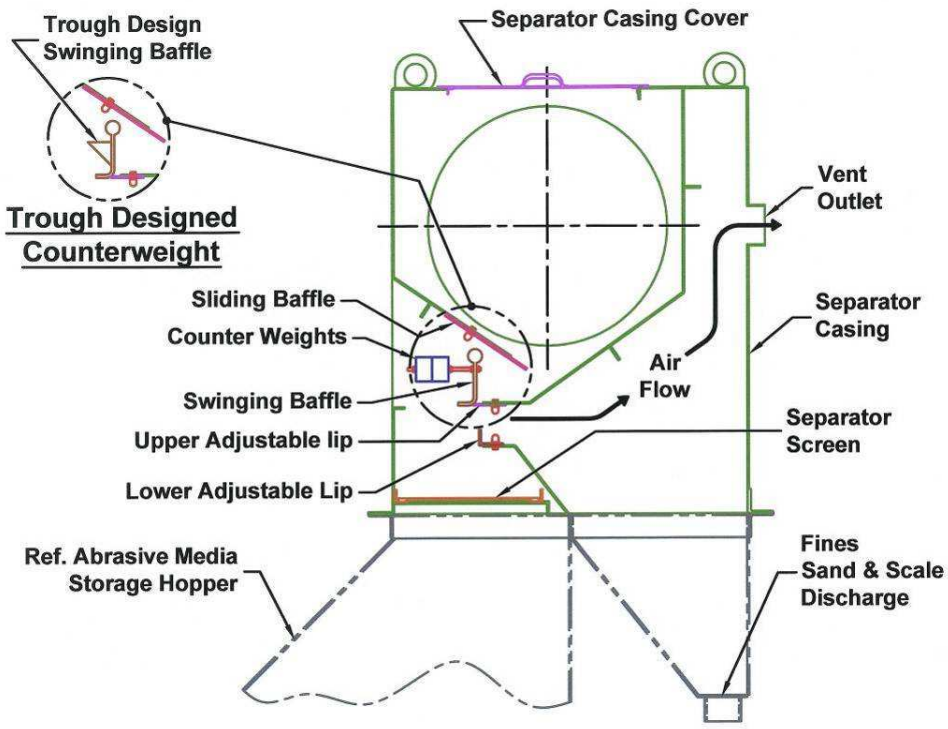

Figure 3-16

f. The following are typical components found in a CFS separator with upper screw conveyor reclaim as shown in **Figure 3-16**.

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1. **Separator Casing** – is used to mount the separator components and retain the abrasive media and contaminants to be cleaned.
2. **Separator Casing Cover** – is for access to the upper screw conveyor and rotary screen.

Warning: DO NOT remove separator casing cover with power on the equipment or with the screw conveyor or screen running.

3. **Sliding Baffle** – is adjustable and regulates the volume of abrasive media and contaminants flowing to the swinging baffle.
4. **Swinging Baffle** – is the mechanism which controls the flow of contaminated abrasive media in a thin curtain across the entire width of the separator at the point of separation.

   Make sure the swinging baffle will not stick on the ends near the vertical housing wall. Grind the edges for clearance if required. The vertical back of the swinging baffle should be perpendicular with the edge of the adjustable lip. Use the slotted holes for the bearing mounts to adjust the position of the baffle as required. The bottom edge of the baffle should clear the adjustable lip by approximately 1/8”. This gap may change, based on the size abrasive used, to prevent sticking of the baffle on the horizontal lip. Correct clearance allows the baffle to push against the build up of abrasive on top of the lip and prevent any partial curtain leakage of abrasive.
5. **Counterweights** – are used to adjust the swinging baffle to obtain a full width curtain. By moving the adjustable counterweights up and back on the rod or adding or removing abrasive from the trough designed counterweights the thickness and width of the abrasive curtain of abrasive can be adjusted.

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6. **Upper Adjustable Lip** – is adjusted to keep the back face of the swinging baffle vertical and parallel with the air opening behind the abrasive media curtain.

7. **Lower Adjustable Lip** – is adjusted back about ½" behind the vertical fall line from the upper lip that swinging baffle closes on. The lower lip may need additional adjustment depending on the size, weight and volume of contaminants.

8. **Separator Screen** – stops large contaminants before they can get to the wheel unit. The screen should be cleaned daily to assure unrestricted abrasive flow to the wheels. Care should be taken when cleaning the screen to assure the contaminants do not fall into the abrasive storage hopper.

3.4.1.3 LP Magnetic Separators

The LP (Low Profile) series of magnetic separators provide a significant improvement in operating efficiency and cost reduction for blast cleaning equipment in a typical foundry.

Using a two (2) stage approach, the LP units remove coarse and fine non metallic contaminants from the steel abrasive operating mix and metallic fines from the non metallic waste stream.

The primary benefits are:

1. Increased life of wheel components over systems with air wash only separators.

2. Reduced maintenance on the blast equipment and dust collector.

3. Reduced loss of usable abrasive and sand.

4. Reduced ventilation air requirement for separators.

5. Reduced metallic content in reclaimed sand.

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The achievement of these benefits and the safe and efficient operation of the LP system units are dependent on the complete understanding and proper use of the information in this manual.

3.4.1.3.1 Primary LP Magnetic Separators (See Figure 3-17)

a. A mixture of ferrous abrasive media and sand enters the primary LP magnetic separator unit from an upper screw conveyor and rotary screen.

b. The rotary screen removes oversize contaminants from the mixture and directs this material to a suitable customer provided floor level container through a flexible steel tube.

Note: Overflow material can bypass the system through a separate overflow pipe and be recycled.

c. The ferrous abrasive media and sand mixture that passes through the rotary screen is spread across the width of the separator by the external screw flighting of the rotary screen.

d. This mixture is then metered by a sliding baffle to generate a maximum 3/8 “thick controlled flow of material onto the rotating stainless steel drum.

e. The flowing curtain of material passes between the adjustable burden plate and the rotating drum with its internal hemispherical (215 degree) section alternating pole adjustable magnet system. **[See Figure 3-17 (A-A)]**

f. Alternating pole magnets agitate the mixture of ferrous abrasive media and sand to achieve the maximum release of sand particles and the maximum retention of ferrous particles on the drum surface.

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g. The retained magnetic (ferrous) particles are released from the face of the drum at the end of the magnetic field.

h. The released sand with some magnetic particles passes to the Secondary LP separator.

i. Released metallic particles are directed to the air wash separator section for classification and operating mix control.

j. This uniform curtain of material from the magnetic drum falls onto the sloped surface behind the air wash separator swinging baffle.

k. When the abrasive particles build up to the proper height behind the swinging baffle (and adjustable baffle if so equipped) to overcome the resistance of the counter -weights, the swinging baffle will open and permit a uniform thickness curtain of abrasive to flow over the entire edge of the adjustable lip. **[See Figure 3-17 (B-B)]**

Note: A properly adjusted air wash separator permits only a full width curtain to be presented to the air flow through the separator.

l. This air flow passes between the adjustable lip and the lower adjustable lip.

m. Usable abrasive is directed to a stationary tray screen to capture any oversize material that may have by-passed the rotary screen.

n. Usable abrasive passes through the tray screen into the storage hopper for the blast wheels.

o. The fine metallic waste material and the small amount of sand removed at the air wash separator pass by the lower adjustable lip and drain into a suitable customer provided waste container at floor level.

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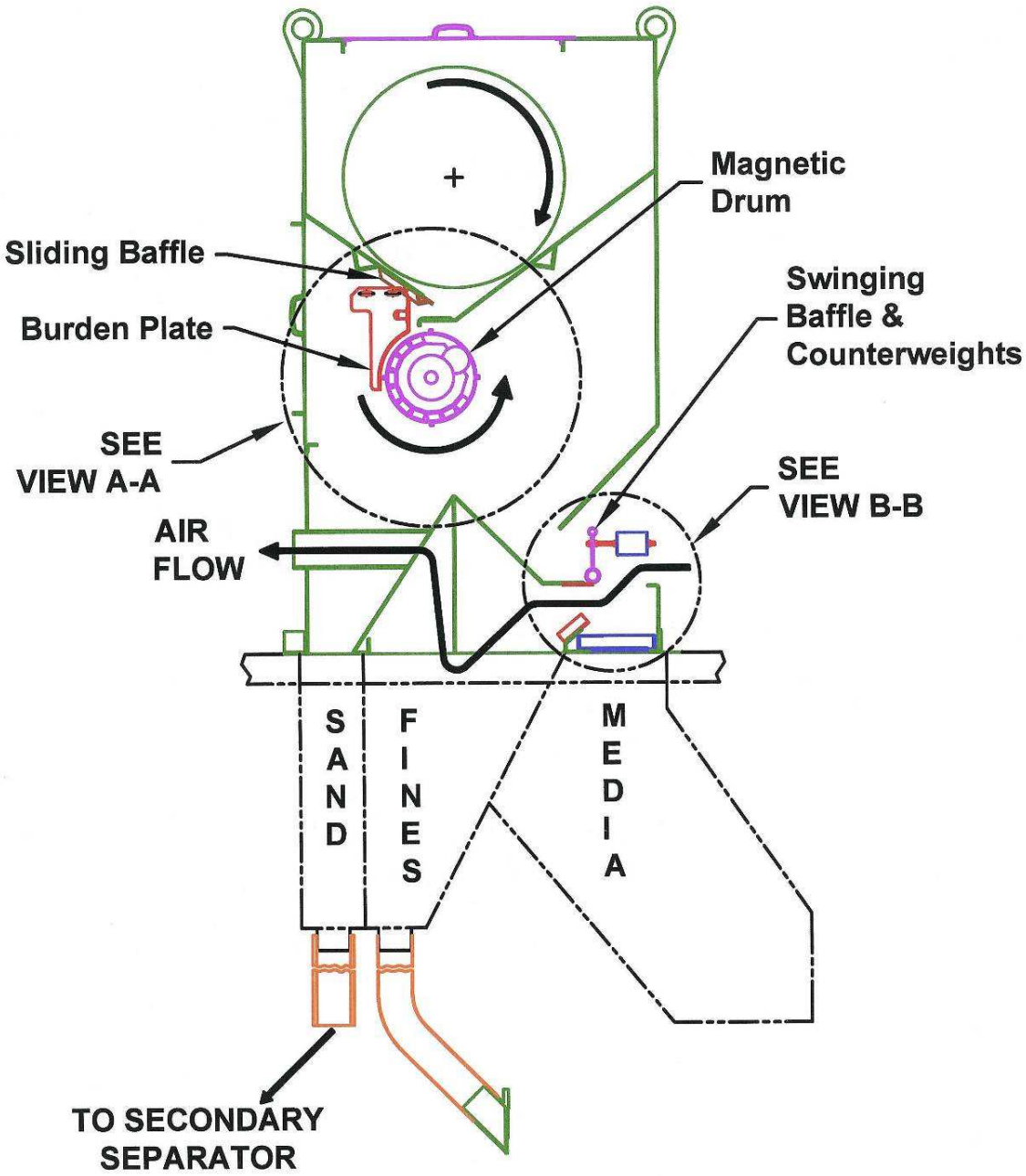

Typical Primary LP Magnetic Separator

Figure 3-17

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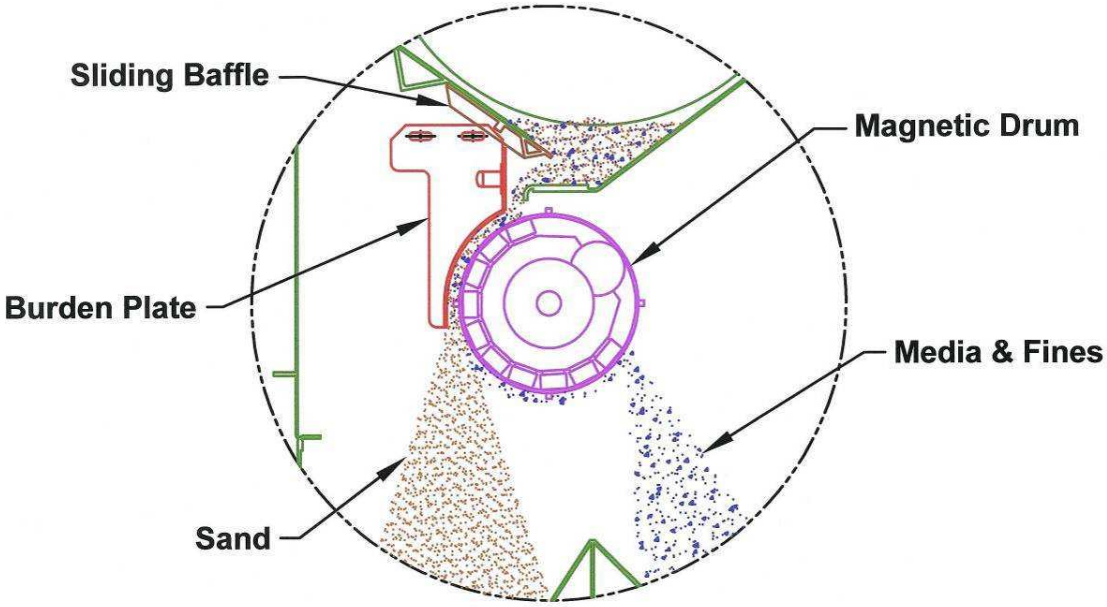
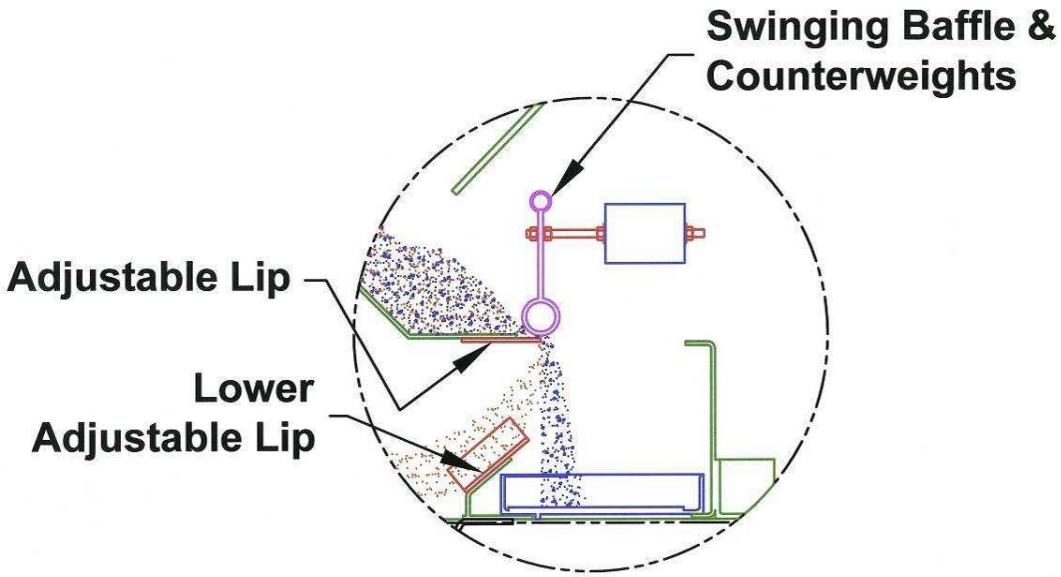


VIEW A-A

Figure 3-17 (A-A)



VIEW B-B

Figure 3-17 (B-B)

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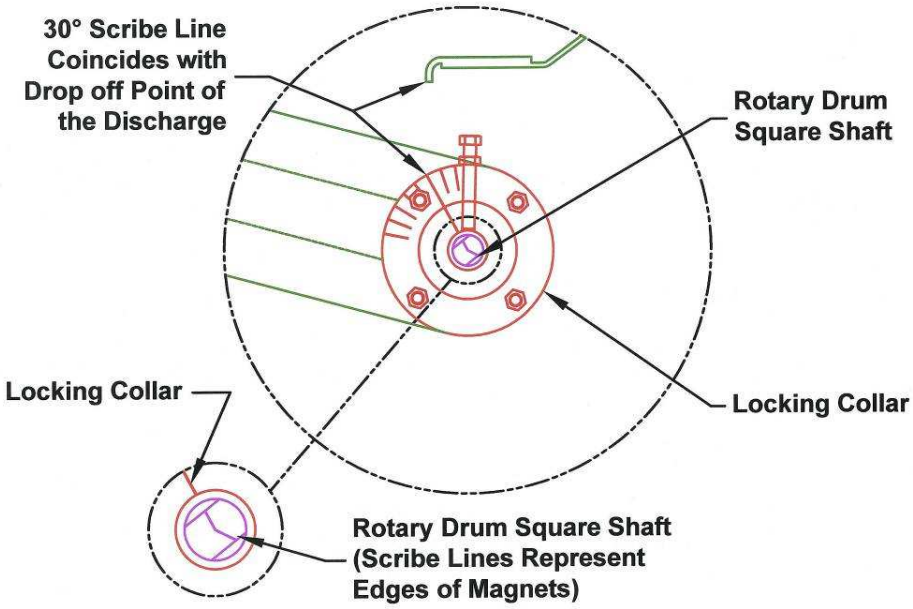
p. Key components will require adjustment to achieve the expected operating efficiency in a safe and reliable manner. **Reference Figures 3-17, 3-17 (A-A) and 3-17 (B-B).**

1. **Sliding Baffle** - The sliding baffle must be positioned to control the thickness of the abrasive and sand mixture from the rotary screen so it flows onto the outer surface of the rotating stainless steel drum without flooding or overloading the magnetic field. **[See Figures 3-17 & 3-17 (A-A)]**

2. **Burden Plate** - keeps the falling mixture of abrasive and sand close to the rotating drum surface and in the magnetic field of the alternating pole magnet system. **[See Figures 3-17 & 3-17 (A-A)]**



Positioning Upper Magnet Edge

Figure 3-18

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3. **Alternating Pole Magnetic Drum** - The magnetic drum system requires proper positioning of the fixed alternating pole magnet inside the rotating stainless steel drum **(Refer to Figure 3-18)**. Using an adjustable wrench on the square end shaft, align the upper end of the scribe mark on the end of the shaft with the longer scribe mark on the face of the locking collar. Record the short scribe mark reference point from the locking collar. This will position the upper magnet edge with the drop off point of the discharge. The initial setting may need further adjustment to use the magnetic field to minimize the impact of the falling abrasive and sand on the drum surface and maintain a good discharge arc for the metallic particles under the drum.

   [See Figures 3-17, 3-17 (A-A) and 3-18]

4. **Swinging Baffle & Counterweights** -The swinging baffle should swing freely but remain closed until sufficient abrasive material builds up behind the baffle to insure the flow of a full width curtain. The air wash will then flow uniformly through the falling material to remove unusable metallic fines and residual non metallic contaminants. The counterweights must be positioned to hold the baffle closed without causing an overflow or partial curtain condition. Make sure the swinging baffle will not stick on the ends near the vertical housing wall. Grind the edges for clearance if required. The vertical back of the swinging baffle should be perpendicular with the edge of the adjustable lip. Use the slotted holes for the bearing mounts to adjust the position of the baffle as required. The bottom edge of the baffle should clear the adjustable lip by approximately 1/8". This gap may change, based on the size abrasive used, to prevent sticking of the baffle on the horizontal lip. Correct clearance allows the baffle to push

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against the build up of abrasive on top of the lip and prevent any partial curtain leakage of abrasive.
[See Figures 3-17 and 3-17 (B-B)]

5. **Adjustable Lip** - can be adjusted along with the swinging baffle adjustment to achieve the position and relationships described in paragraph 4 above.
[See Figures 3-17 and 3-17 (B-B)]

6. **Lower Adjustable Lip** - Establish a minimum gap of ½' between the top front edge of this lip and the back edge of the falling abrasive mix. Additional adjustments of this lip may be required in conjunction with adjustments in air flow through the separator and size, weight & volume of contaminants. An air gap is necessary to allow some horizontal movement of usable abrasive particles as the horizontal air stream carries the lighter weight contaminants and unusable metallic fines out of the abrasive mix.
[See Figures 3-17 and 3-17 (B-B)]

3.4.1.3.2 Secondary LP Magnetic Separators (See Figure 3-19)

a. A mixture of sand with small amounts of metallic particles enters the secondary LP magnetic separator unit from the primary separator discharge pipe/hose.

b. This hose directs the mixture to the top of the separator casing where internal deflector baffles uniformly spread the incoming material out across the width of the separator housing.

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c. The sand and metallic material is allowed to build up in the upper casing to an optimum level for effective operation of the fixed pole magnet system.

d. When the abrasive particles build up to the proper height behind the swinging baffle to overcome the resistance of the counter -weights, the swinging baffle will open and permit a uniform thickness curtain of abrasive to flow over the entire edge of the upper casing.

Note: A properly adjusted swinging baffle permits only a full width curtain to be presented to the magnetic drum through the separator.

e. The flowing curtain of material passes between the adjustable burden plate and the rotating drum with its internal hemispherical (~225 degree) section fixed pole adjustable magnet system.

f. Sand flows directly off the drum into a hopper and then into a discharge container or transporter provided by the purchaser.

g. Metallic particles retained by the magnetic field are released at the rear of the separator unit and pass into a waste metallic container provided by the purchaser.

h. An adjustable angle under the magnetic drum is positioned for effective splitting of the sand and metallic discharge material.

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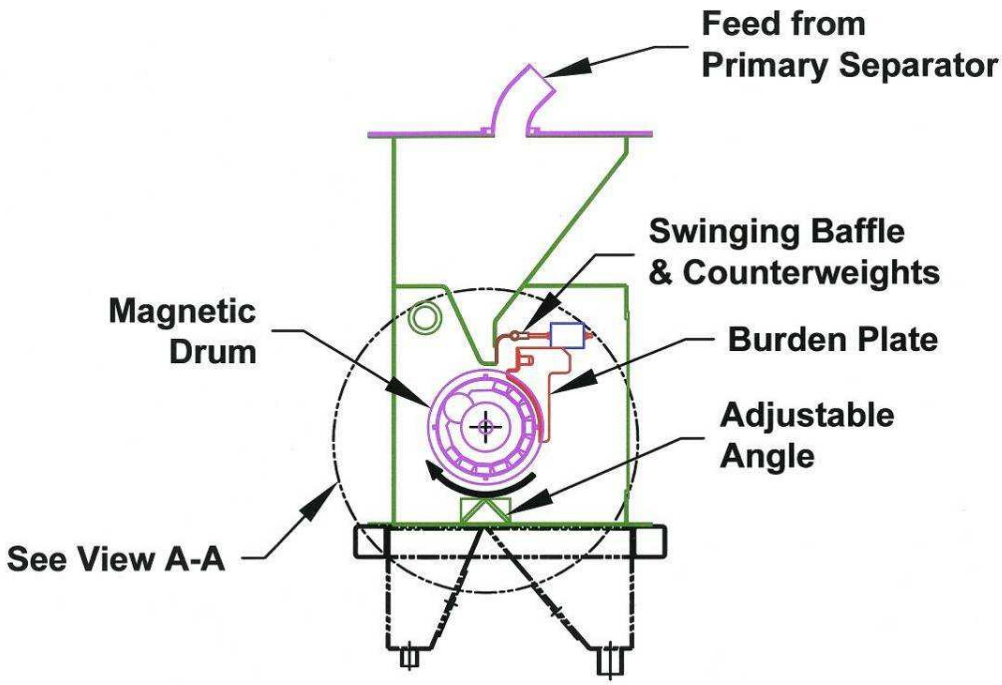
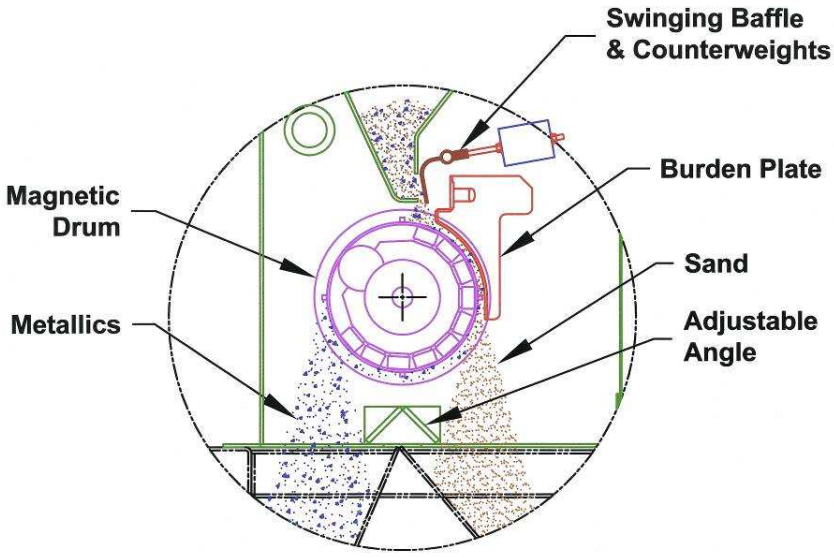


Typical Secondary LP Magnetic Separator

Figure 3-19



View A-A

Figure 3-19 (A-A)

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i. Key components will require adjustments to achieve the expected operating efficiency in a safe and reliable manner. **Reference Figures 3-19, 3-19 (A-A) and 3-19 (B-B).**

1. **Swinging Baffle & Counterweights** -The swinging baffle should swing freely but remain closed until sufficient abrasive material builds up behind the baffle to insure the flow of a full width curtain. The counterweights must be positioned to hold the baffle closed without causing an overflow or partial curtain condition. Make sure the swinging baffle will not stick on the ends near the vertical housing wall. Grind the edges for clearance if required. The vertical back of the swinging baffle should be perpendicular with the edge of the upper casing lip. Use the slotted holes for the bearing mounts to adjust the position of the baffle as required. The bottom edge of the baffle should clear the upper casing lip by approximately 1/8". This gap may change, based on the size abrasive used, to prevent sticking of the baffle on the horizontal lip. Correct clearance allows the baffle to push against the build up of abrasive on top of the lip and prevent any partial curtain leakage of abrasive.
[See Figures 3-19 and 3-19 (A-A)]

2. **Burden Plate** - keeps the falling mixture of metallic particles and sand close to the rotating drum surface and in the magnetic field of the fixed pole magnet system.
[See Figures 3-19 and 3-19 (A-A)]

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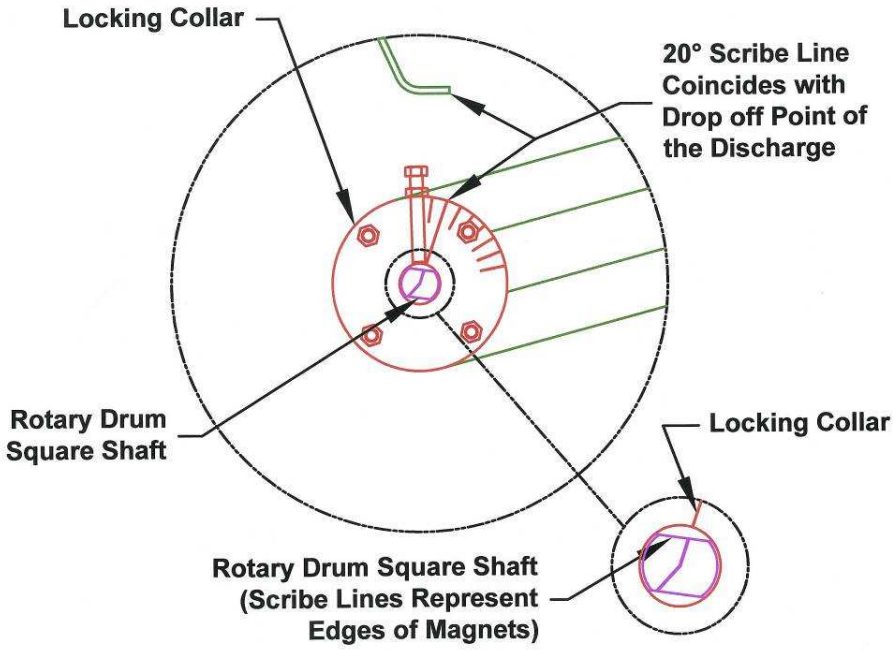

Positioning Upper Magnet Edge

Figure 3-20

3. **Fixed Pole Magnetic Drum** - The magnetic drum system requires proper positioning of the fixed pole magnet inside the rotating stainless steel drum **(Refer to Figure 3-20)**. Using an adjustable wrench on the square end shaft, align the upper end of the scribe mark on the end of the shaft with the longer scribe mark on the face of the locking collar. This will position the upper magnet edge directly below the discharge lip drop point below the swinging baffle and the lower edge past the lower hopper adjustable angle. This initial setting may need further adjustment to maintain a good discharge arc for the metallic particles under the drum.
   [See Figures 3-19, 3-19 (A-A) and 3-20]

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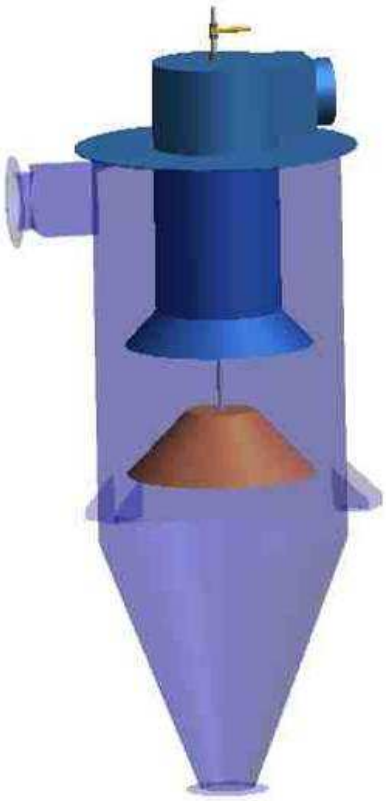
This top setting will provide immediate attraction to the small quantities of magnetic material mixed in with the sand. The bottom setting insures effective discharge of metallic particles into the waste hopper area.

4. **Adjustable Angle** - The adjustable angle must be located to allow all metallic particles to discharge from the magnetic drum without contaminating the reclaimed sand material. Moving of the angle will be dependent on the results of a screening and magnetic content analysis of the discharged reclaimed sand. **[See Figures 3-19 and 3-19 (A-A)]**

3.4.1.4 Cyclone Separator (Figure 3-21)



Typical Cyclone Separator
Figure 3-21

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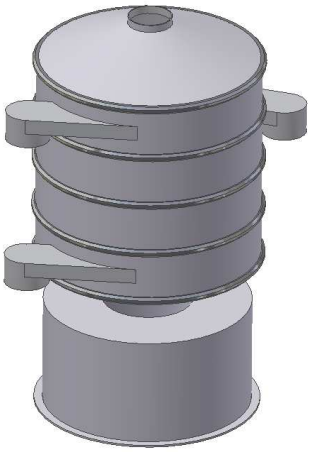
a. Dusty air form the surface preparation process enters the Cyclone tangentially at it's inlet at the top portion. The air along with abrasive media and dust particles swirl around the Cyclone insides, travelling towards the bottom along the walls (Cyclones come with a suitable lining on the interior walls to reduce wear). Heavy particles in the stream, mainly consisting of usable abrasive media separate from the stream at the bottom of the cyclone.

b. An inner concentric tube in the Cyclone, with its opening at the bottom portion of the Cyclone is provided for passage of air stream with fine dust particles moving towards the top, to the dust collector.

c. The opening to this inner tube is fitted with a tuning cone having a threaded stem extending through the top of the Cyclone for vertical adjustment of the cone. Air velocity inside the Cyclone is increased by closing the gap between the inner tube and the tuning cone. Similarly the velocity can be decreased by increasing the gap between the two.

3.4.1.5 Vibratory Classifiers (Figure 3-22)



Typical Cyclone Separator
Figure 3-22

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a. The primary function of the Vibratory Classifier is to remove oversized contaminants, broken or small abrasive media, and any other undersized contaminants that may be in the abrasive media mix.

b. The nature of the application determines the number of "Screens" in the Vibratory Classifier, each screen between the first and last screen is only in place to remove a particular size of abrasive from the next screen down. This may be required in Peening applications which use multiple abrasive media sizes.

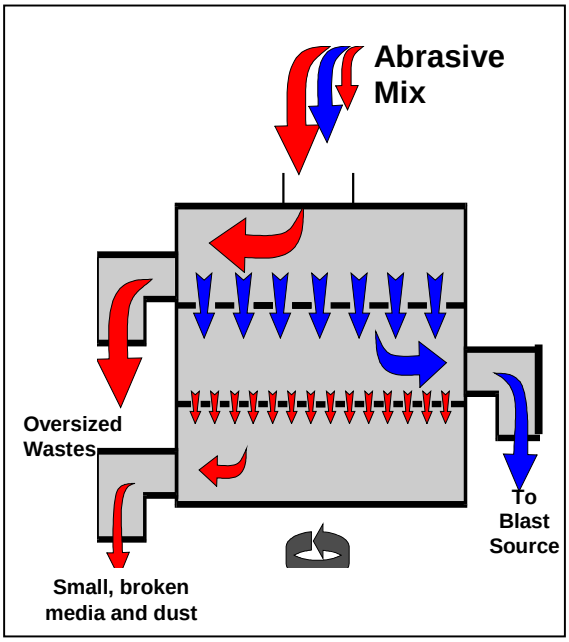

Figure 3-23

c. In **Figure 3-23**, a two screen Vibratory classifier is illustrated. The first screen is designed to remove all oversized materials from the abrasive media mix and discharge them to a waste receptacle. Allowing only smaller of particles to pass through up to a specific size.

d. The Abrasive that does not pass through the second screen is considered the usable size and is discharged to the storage hopper or the blast source.

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e. Anything passing through the second screen is also considered waste and discharged to a waste receptacle.

Note: Holes of any size in the separator screens are not acceptable. If a hole develops or a screen is torn it needs to be replaced immediately. Consult the manufacturers supplement, regarding screen replacement procedures.

The Vibratory Classifier is pre-set from the factory for its motion. Any adjustment in the Vibratory Classifier must be done in full compliance with the written instructions of the Vibratory Classifier manufacturer.

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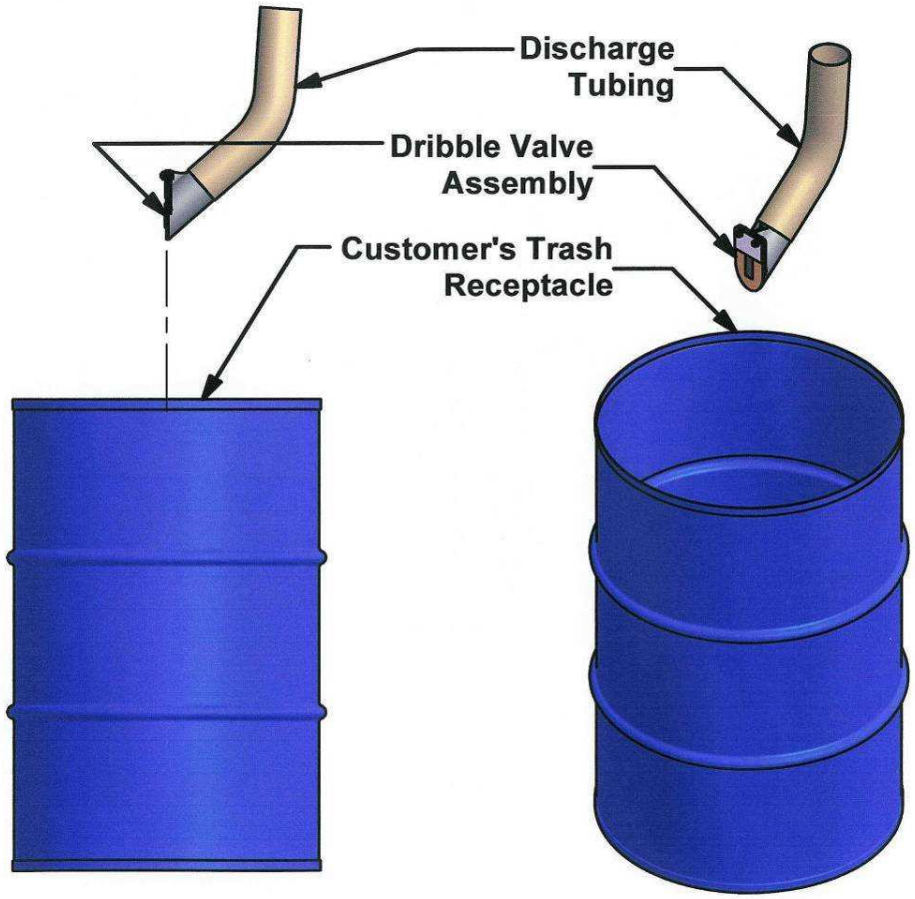

Figure 3-24

3.5 Function of a Dribble Valve

See Figure 3-24

The dribble valve prevents air flow up the separator discharge tube and allows sand, scale and fines to flow to customer's trash receptacle.

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3.5.1 Mounting and locating dribble valve

See Figure 3-24

1. Dribble valve should be positioned with rubber flap vertical.
2. Dribble valve should be positioned over customer's trash receptacle above the trash angle of repose to prevent material backing up into the tubing.
3. Secure trash discharge tubing to dribble valve with screws.

3.6 Function of an Abrasive Media Storage Hopper

a. Abrasive storage hopper collects and stores the abrasive media during cleaning cycles and when equipment is not operating.

b. The holding capacity of the storage hopper is designed so that when all the blast wheel units are running and the abrasive media has reached a state of equilibrium there remains sufficient reserve capacity to prevent starving the wheel and to protect the hopper from wear.

c. Storage hoppers are equipped with a hand hole cover to facilitate mounting of the feed line parts and for clean out. This opening is usually mounted on a vertical wall on the hopper.

Do not remove hand hole covers in hopper without safely discharging of abrasive storage hopper contents.

3.7 Function of an Abrasive Controls Assembly

a. The abrasive controls assembly regulates the feed of abrasive media between the storage hopper and the blast wheel.

b. Adjustable abrasive control valves are provided to regulate the flow of abrasive to the wheels. An air cylinder or magnetic control unit opens and closes each valve. Cylinders are adjustable to obtain the specified flow with different types and sizes of abrasive. Magnetic

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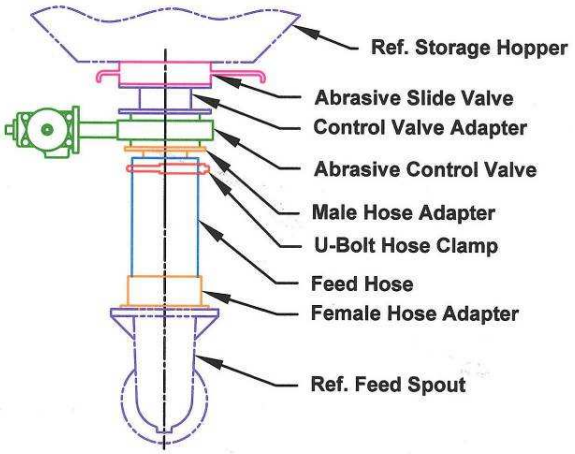
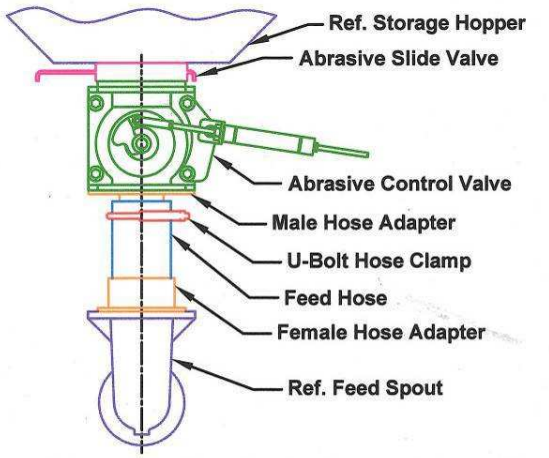
controls provide variable flow adjustment. This meters the abrasive from the storage hopper to the wheels.



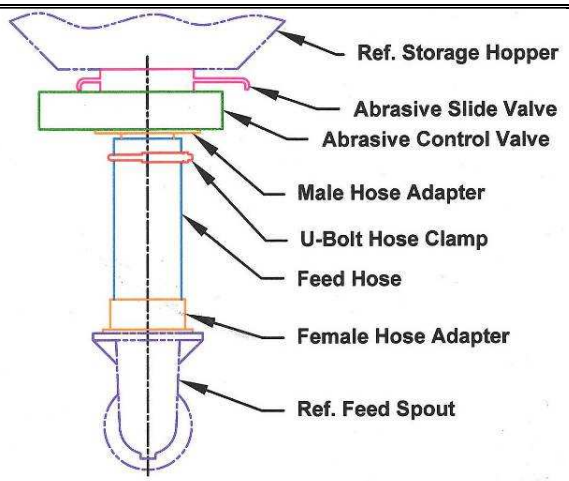
Abrasive Controls Assembly with Butterfly Type Abrasive Control Valve

Figure 3-25



Abrasive Controls Assembly with Dipper Type Abrasive Control Valve

Figure 3-26



Abrasive Controls Assembly with MagnaValve Type Abrasive Control Valve

Figure 3-27

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c. The following are common components of a typical abrasive controls assembly as shown in **Figures 3-25**, **3-26** and **3-27**.

1. **Abrasive Slide Valve** - This is a manually operated slide valve to open or close the media flow from the storage hopper to the blast wheel. This valve makes it possible to close off the flow of media to perform repairs and maintenance on the abrasive controls system with have to drain the storage hopper.

Do not use slide valve to meter abrasive media flow.

2. **Abrasive Control Valve** - This meters the abrasive from the storage hopper to the wheels. There are three (3) types of abrasive control valves.
[See Figures 3-25, 3-26 and 3-27]

   - **Butterfly Type** - An air cylinder opens and closes a wafer type paddle valve. The cylinder is adjustable to obtain the specified flow with different types and sizes of abrasive.
   - **Dipper Type** - An air cylinder opens and closes a totally enclosed dipper cup type valve. An adjustable stop, with coarse and fine adjustments, on the valve controls where the cylinder stops to obtain the specified flow with different types and sizes of abrasive.
   - **MagnaValve Type** – This valve is a normally closed magnetic valve suitable for regulation of steel shot and grit. The valve construction includes a permanent magnet for normally closed operation and an electromagnet for controlling shot flow rates. By regulating the voltage to the electromagnetic any desired flow rate may be achieved. When power is off, the valve will hold shot due to the permanent magnet.

3. **Male Hose Adapter** – This is used to attach rubber hose type feed lines to the abrasive control valve.

4. **U-Bolt Hose Clamp** – this secures the rubber hose type feed line to the hose adapter.

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5. **Feed Hose** – This conveys the abrasive media from the abrasive control valve to the blast wheel. There are two (2) types of feed lines.
   - **Abrasive Resistant Rubber Hose** – This consists of abrasive resistant rubber hose and is the most common feed line type. It is flexible and easy to install.
   - **Hard Piping** – This consists of a network of hard pipe and weld elbows to feed the wheels.
6. **Female Hose Adapter** - This is used to attach rubber hose type feed lines to the feed spout of the blast wheel.

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Section 4 Ventilation

A properly sized and efficiently operating dust collector system is required for effective control of dust and separation and collection of broken down abrasive media and contaminants generated by the blasting action. See **Figure 4-1** for typical ventilation arrangement.

Each ventilation point requires a specific volume and velocity of air to keep particulates suspended in the air stream; avoid dusting at the machine and provide adequate separation of contaminants. A reduction in surface preparation effectiveness and gradual process degradation will occur without proper ventilation.

After effective operation of ventilation system has been confirmed, air volume and velocity readings should be taken at each vent point and recorded as the standard. Periodic checks should be made to watch for changes in these readings that would indicate potential ventilation problems.

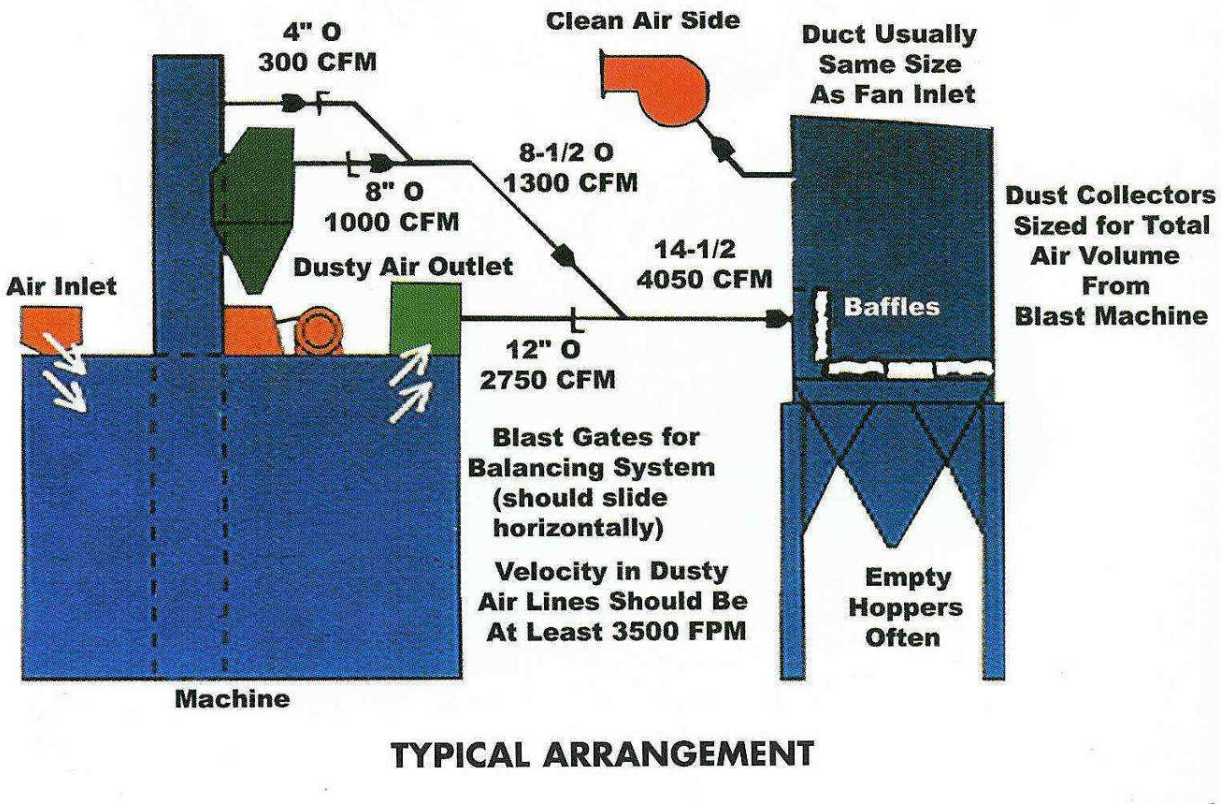

Figure 4-1

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4.1 Dust Collectors

Dust collectors provide three very important functions related to the clean and efficient operation of a blast cleaning machine.

1. The dust collector exhaust fan maintains a steady air flow through the separator, required for the air wash operation. The air flow pulls dust, fines and other contaminants from the thin curtain of abrasive media that falls over the lip of the separator. Operating properly, a dust collector will take out only unusable fines.

2. The dust collector exhauster provides a negative pressure in the blast cabinet. This is needed to keep dust from puffing out of the blast machine. The puffing effect is caused by the air pump action from blast wheel units.

   By creating a negative pressure and controlling the flow of air to the dust collector, air outside the cabinet is dawn into the cabinet, rather than air and dust inside the cabinet being forced out.

3. The dust collector retains the fine particles, which otherwise would be exhausted to the atmosphere and cause a potential air pollution problem. Because of the potential environmental problems created by dust and the need for good plant housekeeping and good community relations, it is necessary for all blast equipment to be operated with an efficient dust collector system.

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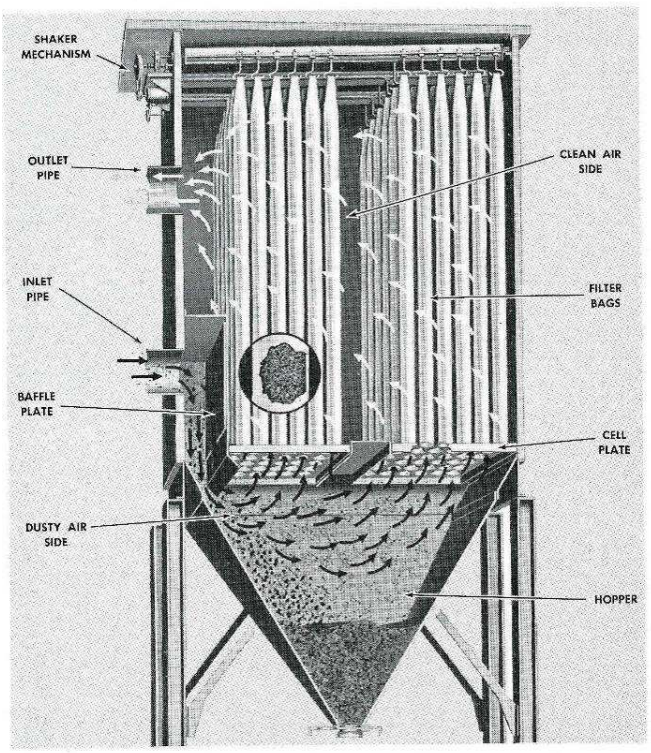
4.2 Three Types of Dust Collectors

4.2.1 Shaker Bag Style

The shaker bag style dust collector is an intermittent duty, automatic or manual shaker type unit. Its construction incorporates multiple tubular bags with internal access required for maintenance and inspections. Dust particles are captured on the inner surfaces of the inflated bags when the fan is operating. Bags may be made of various fabrics with the most common being cotton sateen or polyester for blast equipment applications. Incoming air is diverted by a baffle and slowed via expansion into the hopper. Large contaminants drop into the hopper and finer material is collected on the inside of the bags. Cleaning is performed by stopping the fan to allow the bags to go slack before shaking them for a specific interval, usually about three minutes. This action removes most of the dust from the inner surface of the bags so the dust can then fall into the hopper. See **Figure 4-2** for Typical Shaker Bag Style Dust Collector.



Typical Shaker Bag Style Dust Collector
Figure 4-2

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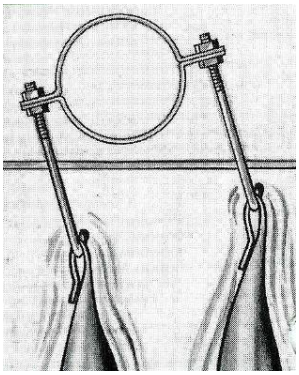
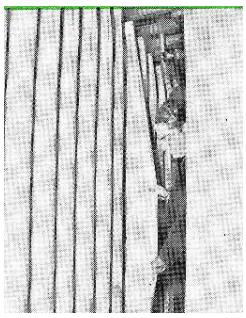
4.2.1.1 Elements of a Typical Shaker Bag Style Dust Collector:

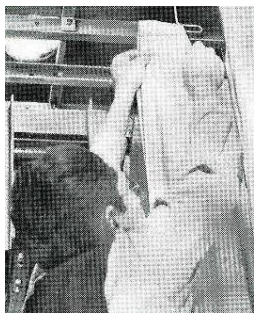
4.2.1.1.1 Shaker Mechanism



Dustubes are cleaned by the gentle but highly efficient motion of the shaker mechanism which is driven by a totally enclosed motor located at the clean air side or outside the dust collector. The shaker provides a gentle wave-like action from top to bottom of each bag. The motion is similar to the action obtained by hand shaking a rug.

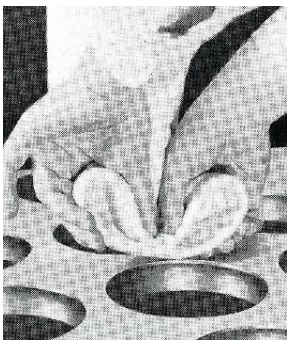
4.2.1.1.2 Filter Bags





Filter bags are usually made of cotton sateen fabric, making them inexpensive cloth filters. No metal contacts the filtering area of the cloth filter bags.

4.2.1.1.3 Cell Plate



The cell plate retains the bottom or open end of the filter bags that features a sewed-in ring-type spring. This end is folded in half and inserted through a cell plate hole for installation (see picture). When pressure on the hoop spring is released, the tube snaps into place, providing an instant, positive seal with the cell plate surface.

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4.2.1.1.4 Inlet Vent

The dust-laden air enters the dust collector from the equipment vent piping through the inlet vent as shown in **Figure 4-2**.

4.2.1.1.5 Baffle Plate/Liner

The dust-laden air entering the dust collector strikes the baffle plate/liner where the sudden change in direction and reduction in air velocity cause heavier particles to drop out immediately into the hopper. All materials large enough to wear the filter fabric drop out of the air stream so only the small dust particles reach the filter bags as shown in **Figure 4-2**.

4.2.1.1.6 Fan Outlet Vent

The cleaned air from the dust collector is exhausted through the fan outlet vent to the atmosphere as shown in **Figure 4-2**.

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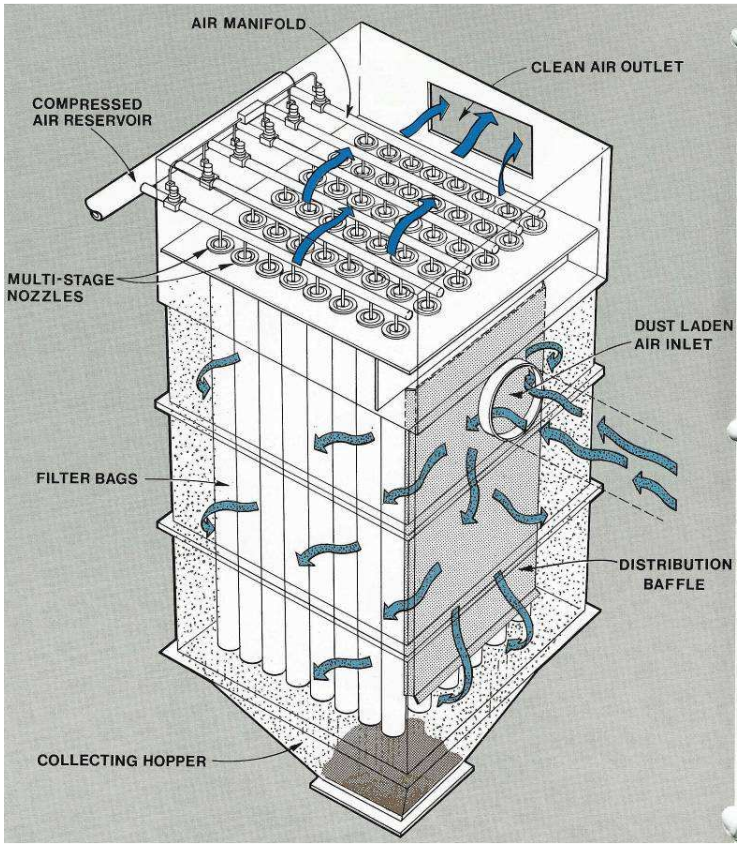
4.2.2 Pulse Bag Style

The pulse bag dust collector is a continuous, automatic, pulse-type unit. Its construction incorporates multiple tubular bags supported by tubular steel wire cages. Access may be from outside or from an integral enclosure on the roof. Dust particles are effectively captured on the outer surface of the tubular bags as the air flows through the material into the center of the cage frames. The bags may be made of various fabrics with the most common being cotton sateen or polyester for blast equipment applications. Cleaning is performed by various venturi systems using periodic metered pulses of high pressure air down the center of the wire cages. This reverse air pulse halts the inflow of air and releases the collected dust from the outer surface of the bags. Each pulse sequence frees the dust particles to work their way down the bags and into the hopper.



Typical Pulse Bag Style Dust Collector

Figure 4-3

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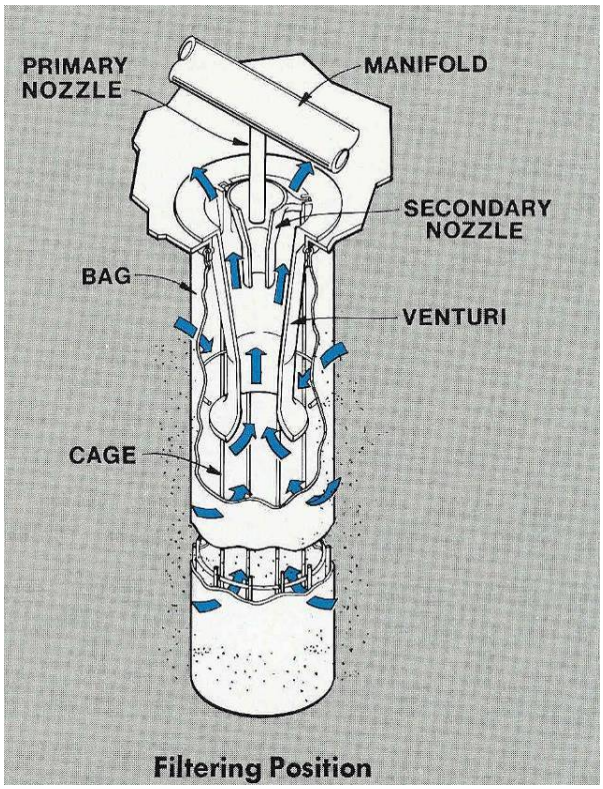

Figure 4-4

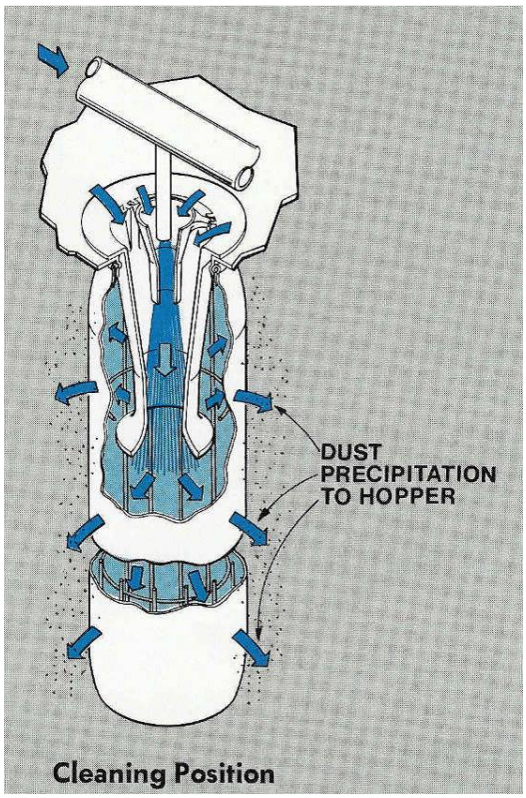

Figure 4-5

4.2.2.1 Elements of a Typical Pulse Bag Style Dust Collector:

4.2.2.1.1 Inlet Vent

The dust-laden air enters the dust collector from the equipment vent piping through the inlet vent as shown in **Figure 4-3**.

4.2.2.1.2 Baffle Plate/Liner

The dust-laden air entering the dust collector strikes the baffle plate/liner where the sudden change in direction and reduction in air velocity cause heavier particles to drop out immediately into the hopper. All materials large enough to wear the filter fabric drop out of the air stream so only the small dust particles reach the filter bags as shown in **Figure 4-3**.

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4.2.2.1.3 Filter Bags

Filter bags are supported by tubular steel wire cages see **Figures 4-4** and **4-5**. The bags may be made of various fabrics with the most common being cotton sateen or polyester for blast equipment applications.

4.2.2.1.4 Compressed Air Reservoir

The compressed air reservoir stores compressed air to insure minimum pressure drop and maximum air storage for each valve. (See **Figure 4-3**)

4.2.2.1.5 Air Manifold

The air manifold distributes the air from the compressed air reservoir evenly to the multi-stage nozzles to clean the filter bags. (See **Figure 4-3**)

4.2.2.1.6 Multi-Stage Nozzles

A controlled blast of compressed air is released from the primary nozzle into the secondary nozzle located in the throat of the venturi nozzle. The volume of air is magnified by the addition of the secondary and tertiary air being drawn into the dust-laden filter bag. (See **Figure 4-4**)

This sudden release of energy into the filter bag causes it to instantly expand to its maximum diameter throwing the dust off the outer surface. As soon as the cleaning energy is spent the bag returns to its normal filtering position and the now airborne dust falls to the collection hopper with an assist from the downward air patterns.

4.2.2.1.7 Venturi

The Venturi cone, as shown in **Figures 4-4** & **4-5**, helps funnel the pulsed air from the manifold header into the center of the filter bag and cage.

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4.2.2.1.8 Fan Outlet Vent

The cleaned air from the dust collector is exhausted through the fan outlet vent to the atmosphere as shown in **Figure 4-3**.

4.2.3 Cartridge Style

A cartridge style collector is a continuous, automatic, pulse-type unit. Its construction offers a compact design with ease of servicing. Dust particles are effectively captured on the outer surfaces of cartridge filter elements made of various materials appropriate to the individual applications. Cleaning is performed by various venturi systems using periodic metered pulses of high pressure air into the center of the cartridges. This reverse air pulse halts the inflow of air and releases the collected dust from the outer surface of the cartridge. Each pulse sequence frees the dust particles to work their way down the side of the cartridge into the waste hopper and container. (See **Figure 4-6**)

Typical Cartridge Style Dust Collector

Figure 4-6

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4.2.3.1 Elements of a Typical Cartridge Style Dust Collector:

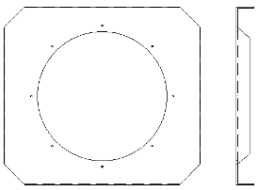
4.2.3.1.1 Inlet Vent

The dust-laden air enters the dust collector from the equipment vent piping through the inlet vent.

4.2.3.1.2 Baffle Plate/Liner

The dust-laden air entering the dust collector strikes the baffle plate/liner where the sudden change in direction and reduction in air velocity cause heavier particles to drop out immediately into the hopper. All materials large enough to wear the filter fabric drop out of the air stream so only the small dust particles reach the cartridge filters.

4.2.3.1.3 Typical Cartridge with Clamping Plate



The cartridge clamping plate as shown here in this sketch is attached to the cartridge filter as shown in this picture. This enables it to be clamped into the tube sheet with the cartridge clamp assembly.

4.2.3.1.4 Typical Cartridge Filters w/o Clamping Plate

The dust collector cartridge filter as shown here is composed of cellulose pleated filter with reinforced polyester screen inside and outside encasement.

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4.2.3.1.5 Compressed Air Reservoir

The compressed air reservoir stores compressed air to insure minimum pressure drop and maximum air storage for each valve.

4.2.3.1.6 Air Manifold

The air manifold distributes the air from the compressed air reservoir evenly to the multi-stage nozzles to clean the filter bags.
Note: Similar to **Figure 4-3**

4.2.3.1.7 Nozzles

A controlled blast of compressed air is released from the nozzle into the throat of the venturi nozzle. The volume of air is magnified by the addition of the secondary and tertiary air being drawn into the dust-laden cartridge filter.

4.2.3.1.8 Typical Venturi

The Venturi cone shown here helps funnel the pulsed air from the cartridge header into the center of the cartridge filter element. The venturi is dropped into the filter element before clamping and installing the filter element into the tube sheet in the dust collector chamber.

4.2.3.1.9 Fan Outlet Vent

The cleaned air from the dust collector is exhausted through the fan outlet vent to the atmosphere.

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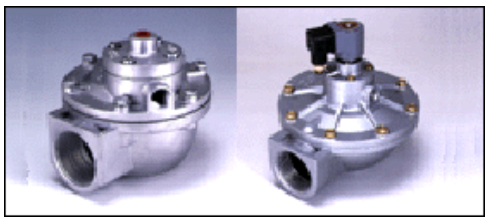
4.3 Diaphragm Valve used on Pulse Bag & Cartridge Style



The reverse pulse diaphragm valve delivers a short high pressure pulse of compressed air, reversing the air flow through a cartridge filter or filter bag. This action removes particulate from the filter surface, allowing the dust to fall towards the dust hopper.

The valve relies on system pressure acting on a flexible diaphragm membrane to maintain a closed condition against the valve seat. The pressurized cover chamber above the diaphragm is exhausted when an electrical signal is supplied to the solenoid operator of the direct pilot operator (CA). This lowers the pressure differential about the diaphragm and allows the diaphragm to lift off the valve body seat. Compressed air is discharged through the valve outlet. When the electrical signal is switched off the valve exhausts are closed, the pressure differential is balanced by air bleeding from the body to cover the chamber and the diaphragm membrane moves back onto the valve body seat shutting down the sir flow.

4.4 Pressure Gages used on All Three Styles of Collectors

4.4.1 Manometer Unit

The manometer is a U-tube type to measure air pressure drop across the dust collector filter elements and indicates a need for cleaning or replacement of filter elements. The manometer should be mounted at a convenient height for reading vertically on dust collector and it must be level.

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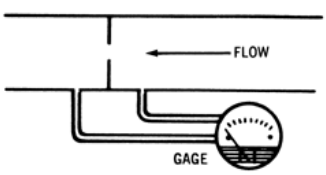
4.4.2 Magnehelic® Differential Pressure Gage

The Magnehelic gage gives a continual reading of the differential air pressure across the dust collector filter elements for monitoring the build up of dust and the need for cleaning or replacement of filter elements.



4.4.3 Photohelic® Differential Pressure Gage

The Photohelic pressure cage gives a continual reading of the differential air pressure across the dust collector filter elements and electronically controls the cleaning cycle for the dust collector

4.5 Exhaust Piping Construction

The gauge/thickness of material used to fabricate vent piping is critical to the effective life and performance of the vent piping system. Duct routing and intersecting duct construction methods must be compatible with the highly abrasive particulates being carried in the air stream. Follow appropriate guidelines for construction of your exhaust piping system.

Contact your blast equipment supplier for copies of the recommended exhaust piping construction information.

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Section 5 Maintenance

5.1 Inspection, Repair/Replacement of Parts & Components

For the blast equipment to perform efficiently, periodic inspection and preventive and predictive maintenance must be accomplished through a regular maintenance program, “Have a Good program and Practice It.” The purpose of this program is:

1) To detect minor necessary repairs and prevent major ones.

2) To anticipate repairs by locating probable causes – i.e., preventive maintenance.

3) To plan repairs for convenient times (predictive maintenance).

4) To prevent breakdowns.

5) To be certain that the machine is being operated safely and at the highest possible efficiency level.

6) To keep an accurate record of maintenance activity and replacement parts usage in order to manage the spare parts inventory and monitor operating and maintenance costs.

CAUTION: When performing inspection and maintenance on the machine, electric power must be disconnected and safety glasses and gloves should be worn.

The components of the machine which require periodic inspection and eventual repair/replacement include, but are not limited to, the following:

5.1.1 Blast Wheel Assembly

A basic inspection of the wheel assembly can be made by removing the top cover and top liner and then looking inside the assembly while slowly rotating the bladed-wheel manually. Removing the components from the housing will permit a more detailed inspection. Refer to Section 6.1 Troubleshooting for blast wheel assemblies malfunctions and suggested remedies.

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5.1.1.1 Liners

The liners should be inspected and replaced before any holes are worn through. All liners are easy to replace. When installing liners in the wheel housing, it is vitally important that the liner pieces fit up against one another as tightly as possible to minimize housing wear from the blast.

5.1.1.2 Wheel Housing

During replacement of liners, the housing should be inspected for wear. A defective housing should be repaired or replaced promptly to prevent the escape of abrasive media.

5.1.1.3 Wheel Blades, Control Cage & Impeller

The wheel parts should be inspected at the same time that liner inspection is made. Parts should be replaced when worn in accordance with the following criteria:

One of the main objects of wheel assembly inspection and maintenance is to keep the wheel in balance. Severe vibration can be a major cause of motor bearing failure.

The most frequent cause of vibration is worn, chipped or broken wheel blades. Wear on the wheel blades varies greatly from one installation to another. Blade life is dependent on various operating conditions. Although the wheel blades may be wearing evenly and may not be causing any abnormal vibrations, blades should be replaced before wearing half-way through. Holes in the wheel blade surfaces will cause wear on other parts and disrupt the blast pattern.

The edge of the control cage opening and impeller openings will eventually wear and this wear must not be allowed to exceed 1/8” for the impeller and 1/4” for the control cage before replacement. The effect of wear will move the blast pattern and this in turn will cause wear on the machine structure and reduced cleaning of the work.

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To replace the control cage and impeller, remove the feed spout and control cage clamps. Remove impeller cap screw and impeller. Withdraw the control cage and fit the new one, make sure that the opening of the new control cage is replaced in exactly the same position as the old one. Re-clamp and replace the impeller and feed spout.

5.1.1.4 Removal and Replacement of Blast Wheel Impeller Bolt

When removing and/or replacing the impeller cap screw, it is very important that the following procedure be implemented to prevent wheel parts from coming loose and a wheel failure from occurring. This pertains to all blast wheels containing a threaded insert in the wheel shaft.

After removing impeller cap screw from the wheel assembly, check the threaded insert in the wheel shaft to assure that it is fully seated (below the surface of the end of the shaft). If the insert screws out of the shaft when removing the impeller cap screw, **replace both the cap screw and threaded insert. Do not reuse the threaded insert that has been removed from the shaft.** If the threaded insert must be reused, apply loctite #242 thread locker (or equal) to the external threads of the insert prior to reinserting.

It is very important that the threads of the cap screw and the threaded insert be clean and free of abrasive contaminants. Prior to reinserting cap screw, use an air hose to remove contaminants. (Comply with O.S.H.A. regulations for use of compress air for cleaning.)

Make sure the centering plate is correctly positioned on the hub/wheel drive pins and the impeller is securely locked in the centering plate slots when assembled. Use **only** the special impeller bolt hi-collar lock washer, listed on your wheel assembly drawing. **Do not** assemble with a standard lock washer. Tighten the impeller cap screw to 100 ft/lbs of torque.

Ez-lock insert number 329-12 Wheelabrator part number 294212.

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5.1.2 Blast pot

At regular inspection intervals, the Blast pot, valves, piping and hoses should be checked for wear. Refer to manufacturers recommendations found in Media Delivery Addendum and follow the inspection list found in Section 5.

5.1.2.1 Reclaim Ducting: (Vacuum Recovery)

a. When a vacuum system is used as the transport for abrasive media in a surface preparation system, the common component requiring maintenance is the Reclaim Ducting.

b. The primary function of the Reclaim ducting is to transport the spent abrasive media and other finer materials from the Blast cabinet to the next stage of abrasive separation; typically this is a Cyclone separator.

c. Only visual inspection can be performed on the Reclaim duct, to ensure no leaks or worn areas have occurred. The design of the system itself is intended to minimize wear, unfortunately due to the nature of abrasive wear will occur.

d. Inspect joints between elbows and straight sections on a monthly basis. Repairs for leaking air can be made using duct tape.

e. Inspect for wear on elbows on a weekly basis. Wear on elbows is usually where the first signs of wear appear. Replace ducting components as needed.

Note: The wear on these components is not linear; it increases exponentially and must be addressed sooner rather than later.

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5.1.3 Cabinet Assembly

At regular inspection intervals, the inside surfaces of the cabinet should be inspected to detect any wear points that could lead to structural damage or abrasive leakage. If abnormal wear occurs, immediate action should be taken to determine the cause and make necessary repairs/replacement. All liners should be inspected and replaced before any holes are worn through. Any worn or damaged components should be replaced to prevent structural damage and leakage of abrasive.

5.1.4 Work Conveyor Assembly

Regular inspection should be given to the work conveyor structure, bearings, and alignment.

5.1.5 Work Conveyor Drive Assembly

The work conveyor drive should be checked for alignment and proper operation. The gear motor should be checked for oil level. If required, refer to gear motor's instruction sheet in Commercial Parts Manuals, Section 10 for proper lubricant. Refer to Section 8, Paragraph 8.2 for recommendations on lubricating machine components.

5.1.6 Abrasive Recycling System

The abrasive recycling system, cleans the media, removes fines from the abrasive, conditions and returns the reusable abrasive to the wheel, and is designed to adequately handle the abrasive load requirements of the machine.

The components of the abrasive recycling system are subjected to wear and damage due to their contact with abrasive material. Regular inspection of the abrasive recycling system components will help detect any wear, physical damage, or component failures. Check the following frequently:

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5.1.6.1 Abrasive Hopper

Inspection of the sloping sides of the hopper should be made at regular intervals to detect any wear points. Immediate repair/replacement of sections worn away or damaged is necessary to minimize loss of abrasive and any disruption in cycling of the abrasive. Periodically, clean the hopper screen of accumulated objects and debris.

5.1.6.2 Elevator Belt Assembly

The elevator belt assembly should be checked for wear or damage to the belt, worn or damaged buckets, proper tension of the belt and proper alignment on the head pulley. Normally, a new belt assembly is required to replace a worn or damaged elevator belt assembly.

Buckets are the bolt-on type and easily replaced. Check condition of bolt heads for damage and wear. Badly worn bolt heads can lead to the buckets pulling off of the belt. All buckets should be inspected periodically for wear or damage. They should be replaced when the front lip of the buckets wear down 3/4 inch.

After a long period of use, the stretching of the rubber belt may cause the belt take-up arrangement to become ineffective, making it necessary to shorten the belt. Remove the side panel located at the bottom section of the elevator in front of the boot pulley for access to the belt and its splice. Make sure that the head pulley is lowered to its lowest position. Undo the belt splice. By measurement, cut off the excess length and punch new holes in the belt for reconnection. Use a belt puller while making the splice. This will result in a tight belt and allow ample take-up for future needed belt tension. Retighten the belt by the take-up screw at the head section.

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When a worn elevator belt needs replacement, remove the elevator side panel at the boot of the elevator to undo the splice and carefully take out the old belt. You may use the old belt to help pull in the new belt if desired. See note below. Since every belt is “tailor” fitted to each individual elevator assembly, the new belt supplied will probably be 4” to 8” longer than needed. To determine the correct belt length required, measure the distance of the path of the belt around both top and bottom pulleys. Make sure that the head pulley is lowered to the lowest position at the time of measurement. Cut-off must be square. This will result in a tight belt to begin with and allow ample take-up for future needed tension. After the belt is cut, punch in the holes for the splice and bolt the splice on one end of the belt only.

Note: While the belt is out of the machine, inspect the boot pulley and head pulley and bearings for wear or damage. Replace any defective parts. The belt assembly can be fed into the elevator housing through the bottom panel opening and pulled up and over the top pulley (use the old belt or rope wrapped over the top (head) pulley), making sure that the buckets are headed in the proper direction for discharge of abrasive into the elevator from the top and fed down the sides of the head pulley. After the belt is “hung” on the top pulley, pass one end of it under and around the boot pulley and complete the belt splicing by using a belt puller while making splices.

Proper belt tension can be judged by making the following observations:

A. The boot pulley should rotate constantly without slipping or hesitation.

B. The unloaded belt should run generally on the center of the elevator pulleys with a minimum of movement from side to side. The elevator buckets should not strike the sides of the housing.

C. It should be difficult to manually slide the elevator belt back and forth across the face of the boot pulley when the elevator is stopped. The tension of the elevator belt,

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however, should not be so great that there is danger of tearing out the splice.
Belt tension can be adjusted by the screw take-up arrangement at the head section of the elevator. The head pulley can be raised or lowered, within the mechanical take-up limits, by the take-up bolts.

Inspection of the elevator belt alignment is very important. If the belt is permitted to run off center and rub against the elevator housing, the abrading action will eventually damage the elevator housing and belt. Also, an overload is put on the drive motor, which may cause the overload relays to kick out. A take-up screw is provided on each side of the head shaft for maintaining proper alignment. When aligning the elevator belt, make only a slight adjustment at a time, raising the head shaft on the side toward which the belt is riding. Using caution and keeping hands away from top opening, the top cover plate can be removed to permit viewing the belt alignment on the head pulley while the belt is running. Refer to Section 9 “Troubleshooting” for elevator malfunctions and suggested remedies.

5.1.6.3 Elevator Drive

The gear motor for the elevator drive should be checked for oil level. If required, refer to gear motor’s instruction sheet in Commercial Parts Manuals, Section 10 for proper lubricant. Refer to Section 8, Paragraph 8.2 for recommendations on lubricating machine components.

5.1.6.4 Elevator Casing, Dribble Valve & Refuse Tubing

Regular inspection of the above parts should be made to detect any wear conditions, physical damage, missing parts or component failure. Repair or replace components as required.

5.1.6.5 Slide Valve Assembly, Control Valve & Feed Hose

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Regular inspection of the above parts should be made to detect any wear conditions, physical damage or component failure. Repair or replace components as required.

5.1.6.6 Bearings

The bearings should be checked for wear. If serious bearing wear is evident the bearings should be replaced. Most bearings are **lubricated for life** and **do not require lubrication**.

5.1.6.7 CFS Separator Assembly

The purpose of the separator is to remove scale, dust and other fine materials from the usable shot (media). This separation is extremely important, since failure to remove these contaminants from the media will not only decrease the productivity (cleaning capability) of the machine, but will also increase the rate of wear on the machine and may cause dust build up on parts.

The satisfactory performance of the machine is dependent on the proper adjustment and maintenance of the separator. It is of utmost importance that the operation be constantly checked. Particular attention should be given to the flow of abrasive as it passes through the separator baffle assembly. The separator assembly should be adjusted so that a uniformly thick falling stream of abrasive material is spread across the full width of the separator. This insures that the abrasive material will be properly exposed to a uniform flow of air through the separator for the air wash separation.

NOTE: A full width uniformly thick curtain must be maintained in the separator at all times for proper cleaning of the media.

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To maintain a uniformly thick full curtain of media across the full width of the separator, the swinging baffle must be properly balanced. This can be accomplished using the counterweight system supplied for the swinging baffle.

Be sure the swinging baffle and adjustable lip are straight and have not been damaged in shipment. The blast gate, at the air outlet vent on the separator, can be adjusted to accurately control the size of the abrasive material that will be removed from the good shot (media).
The components of the separator are subject to very little wear. However, they should be inspected periodically and any damaged components should be repaired or replaced.

Refer to Section 9.3 “Troubleshooting” for separator malfunctions and remedies.

WARNING: If tramp metal or large particles fall into the storage hopper and enter the wheel, the wheel components may shatter and clause severe damage or possible injury.

5.1.7 Ventilation System – Provided by customer or as an option

The ventilation system requires regular inspection of parts and components to insure design performance, and to insure that an adequate flow of air exists and is maintained.

The vent piping from the machine to the dust collector should be checked periodically for wear and leaks. Replace or repair defective parts. The blast gates that adjust machine ventilation should be inspected regularly and replaced as required.

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5.1.8 Electrical

DANGER: Before initiating maintenance procedures, be sure that all power sources are disconnected from the machine and accessories to avoid personal injury from electrical power or from rotating parts. This machine operates on 230, 460 or 575 volts, 3 phase, 60 hertz electrical power.

For the machine to perform efficiently, the electrical equipment must undergo periodic inspection to detect any wear conditions, physical damage, loose connections or component failure. Refer to Section 9 “Troubleshooting” for electrical equipment malfunctions and remedies. Regular maintenance inspections should be performed with particular emphasis on the following:

5.1.8.1 Control Panel

Check out electrical wires and connections for looseness, damage and proper insulation. Tighten, repair or replace.

5.1.8.2 Electric Motors

Periodically inspect the motors for excessive dirt, vibration, or abnormal conditions. Clean, correct, or replace as necessary. Keep the ventilation openings of the motor clear to allow free passage of air.

If excessive friction and overheating of bearings is noted, it is usually caused by the following factors:

1) Bent motor shaft
2) Poor alignment
3) Lubrication – over/under

The bearings of these motors are pre-lubricated with grease by the Manufacturer and should be lubricated after one year of operation. Refer to the Manufacturer’s nameplate for type

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of lubricant. An accurate greasing program should be followed when greasing motors for it has been determined that the greatest cause of bearing failure in motors is over greasing rather than under greasing. Refer to Section 8, Paragraph 8.2 for recommendations on lubricating machine components.

5.2 Lubrication-Oil & Grease

The life and performance of many components of the equipment are dependent on proper lubrication of components. **Most bearings are lube for life** and do not require lubrication. Only electric motors and reducers will require lubrication. Thorough lubrication, performed at regular intervals will aid greatly in prolonging the life of the machine components and in improving efficiency of operation.

Note: The intervals of lubrication are based on normal operating conditions. If severe operating conditions exist, such as extremely dusty conditions or an abnormal amount of stopping and starting, it may be necessary to perform the lubrication more frequently.

While lubrication of the required components is essential, lubrication of some drive components of blast cleaning equipment can be detrimental. For example, chains and sprockets should not be lubricated with petroleum base material because the lubricant tends to accumulate metallic dust in the environment. This causes excessive wear on the chains and sprockets.

The following recommendations should be followed when lubricating machine components:

1) Shut off power to machine during lubrication.

2) Clean dust and contaminants from the points of lubrication.

3) Clean up excessive or spilled lubricants from the equipment.

4) Use clean lubricants.

5) Do not over lubricate. This could result in overheating and possible damage of the components.

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6) The oil in oil-lubricated devices should be changed if the oil shows traces of dirt or shows the effects of high temperature operation, which is evident, by the discoloration of the oil or odor.

7) Drain dirty oil while the unit is still warm, examining for contamination by metal particles.

8) **KEEP IT CLEAN & MAINTAIN CLEANLINESS.**

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5.3 Daily Inspection Checklist – Wheel Blast

LOCK IT OUT – THE LIFE YOU SAVE MAY BE YOUR OWN

Daily Inspection Checklist Wheel Blast

Date: _____ **Checked By:** _____ **Wheel Hour Meter:** _____

Inspection Item	*Sun*	*Mon*	*Tue*	*Wed*	*Thu*	*Fri*	*Sat*	*Remarks*
Pre-Production								
Visual inspection of the machine								
Check abrasive level in adder hopper								
During Production								
Blast wheel amperage								
Listen for unusual noises or operation								
Dust collector Photohelic gauge								
Dust collector after filter Magnehelic gauge								
Dust emissions								
Dust collector pulse valves are operating								
Dust collector – drain water from header								
Dust discharge drum								
Separator curtain								
Abrasive control valves								
Abrasive leaks								
Compressed air leaks								
Fines drum								
Trash drum								
Drain water traps								
General machine operation								
Gearbox condition and any leaks								
Post-Production								
Check for debris around machine								
Check trash drum								
Check fines drum								
Check dust collector drum								
Check separator screen								

Comments:

_____

_____

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5.4 Weekly Inspection Checklist – Wheel Blast

LOCK IT OUT – THE LIFE YOU SAVE MAY BE YOUR OWN

Weekly Inspection Checklist Wheel Blast

Date: _____ **Checked By:** _____ **Wheel Hour Meter:** _____

Inspection Item	*Checked*	*Remarks*
Blast Wheels		
Blades, impellers, control cages		
Blast wheel liners		
Blast Cabinet Interior		
Cabinet integrity & general condition		
Cast liner package		
Reclaim System		
Elevator belt condition and tracking		
Elevator buckets		
Separator screen – clear of debris		
Feed pipes wear and connections		
Overflow hoses wear and connections		
Abrasive valves and Bimba cylinders		
General		
Check for debris in/around machine		
Trash and fines drums – also check daily		
Dust collector Photohelic gauge		
Dust collector after filter Magnehelic gauge		
Dust collector drums – also check daily		
Dust collector header – drain water		
Drain water and oil from filters/water traps		
Gearbox condition – condition and leaks		
Proximity switches		

Comments:

_____

_____

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5.5 Operator's Operation & History Report – Wheel Blast

Operator's Operation & History Report (example)

Date	Shift	Blast Hour Meter Reading	Wheel Amperages				DC Filter Readings		Abrasive Additions in lbs
			Wheel # 1	Wheel # 2	Wheel # 3	Wheel # 4	Primary	Afterfilter	

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5.6 Daily Inspection Checklist – Air Blast

LOCK IT OUT – THE LIFE YOU SAVE MAY BE YOUR OWN

Daily Inspection Checklist Air Blast

Date: _____ **Checked By:** _____ **Wheel Hour Meter:** _____

Inspection Item	*Sun*	*Mon*	*Tue*	*Wed*	*Thu*	*Fri*	*Sat*	*Remarks*
Pre-Production								
Visual inspection of the machine								
Check abrasive level in storage hopper								
Check paint filters								
Check air blast nozzle and gasket								
Check air blast coupling wired connections								
Check CO monitor equipment								
During Production								
Listen for unusual noises or operation								
Dust collector Photohelic gauge								
Dust collector after filter Magnehelic gauge								
Dust Emissions								
Dust collector pulse valves are operating								
Dust collector – drain water from header								
Dust discharge drum								
Separator abrasive curtain								
Abrasive leaks								
Compressed air leaks								
Fines drum								
Trash drum								
Drain water traps								
General machine operation								
Gearbox condition and any leaks								
Post-Production								
Check for debris around machine								
Check trash drum								
Check fines drum								
Check dust collector drum								
Check rotary screen								

Comments:

_____

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5.7 Daily Inspection Checklist – Air Blast

LOCK IT OUT – THE LIFE YOU SAVE MAY BE YOUR OWN

Weekly Inspection Checklist Air Blast

Date: _____ **Checked By:** _____ **Wheel Hour Meter:** _____

Inspection Item	*Checked*	*Remarks*
Air Blast Tank		
Nozzle		
Hoses		
Combo valve		
Thompson valve		
Blast Cabinet Interior		
Cabinet Integrity & General Condition		
Door Seals		
Reclaim System		
Elevator belt condition and tracking		
Elevator buckets		
Rotary Screen – Clear of debris		
Feed pipes wear and connections		
Overflow hoses wear and connections		
Abrasive valves and Bimba cylinders		
General		
Check for Debris in/around machine		
Trash and Fines Drums –Also check daily		
Dust collector Photohelic gauge		
Dust collector after filter Magnehelic gauge		
Dust Collector Drums – Also check daily		
Dust Collector Header – Drain water		
Drain water and oil from filters/water traps		
Gearbox condition – Condition and Leaks		
Proximity Switches		

Comments:

_____

_____

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5.8 Maintenance Do's & Do Not's

DO ensure that the proper shutdown procedures have been executed before performing any internal inspection or maintenance on your machine or associated equipment and that all pressurized elements have been depressurized appropriately, and the machine is electrically isolated.

DO read all manufacturers instructions before performing any maintenance work and follow their recommendations with regard to safety procedures and safe working practices.

DO ensure a good inspection and maintenance program is the best assurance of a productive machine.

DO ensure for safety and performance, always use genuine Wheelabrator Group replacement parts.

DO incorporate preventative maintenance to reduce maintenance and operating costs.

DO keep a log of all inspections and maintenance operations. List all parts replaced, when and who by. Frequent inspection determines what maintenance is required and whether or not a maintenance operation should be performed immediately or may be safely deferred until the next scheduled maintenance period.

DO ensure only experienced personnel should perform the inspection. Inspectors should be thoroughly instructed and experienced in both the function and adjustment of the various components.

DO ensure that suitable protective measures due to the nature of the equipment to be inspected.

DO adequately ventilate while carrying out maintenance work.

DO NOT use the dust collector fan as the ventilation source.

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Section 6 Troubleshooting

Before attempting any troubleshooting, maintenance personnel and operating personnel should become thoroughly familiar with the equipment.

Follow your Lockout/Tagout procedure (See Safety – Warning & Precautions Section)

Before making any repair or replacement of defective parts, it is very important that the reason for the original failure be determined and corrected. A failure to correct the cause of the problem will inevitably lead to a reoccurrence of the problem, etc.

Blast equipment will often continue to operate and will do an acceptable job even though some of the mechanisms or components are not functioning properly causing a decrease in efficiency. It is important for maximum efficiency, that troubleshooting be performed if either of the following is noted:

1) Increase in abrasive consumption,

2) Decrease in cleaning efficiency.

As an aid to troubleshooting when a deficiency is noted in one of the elements or mechanism of the equipment, the following tables are provided. These tables list the most common troubles, their probable cause and remedies:

6.1 Group No. 04 – Work Door

Trouble	*Probable Cause*	*Possible Remedy*
☹ Limit Switch Fault	😐 Doors physically open.	☺ Close the door.
	😐 Door bracket loose.	☺ Reposition bracket and secure.
	😐 Faulty limit switch.	☺ Remove limit switch, repair or replace.
	😐 No power to limit switch.	☺ Check power connection and check control panel.

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6.2 Group No. 05 – Man Door

Trouble	Probable Cause	Possible Remedy
☹ Limit Switch Fault	😐 Doors physically open.	☺ Close the door.
	😐 Door bracket loose.	☺ Reposition bracket and secure.
	😐 Faulty limit switch.	☺ Remove limit switch, repair or replace.
	😐 No power to limit switch.	☺ Check power connection and check control panel.

6.3 Group No. 09 - Elevator

Trouble	Probable Cause	Possible Remedy
☹ Elevator shutdown	😐 Loose belt or boot jam	☺ Tension the belt or clear the jam. ***Follow safety instructions sign when working on elevator. Reference Safety – Warning & Precaution, Section 2, 2.7.4 Safety Instruction Sign, Part No. 495079***
☹ Elevator Belt Slippage	😐 Loose elevator belt.	☺ Tighten belt by screw take-up arrangement at head section. If belt is stretched so that take-up is ineffective, shorten belt.
	😐 Worn pulleys, travel of belt and rotation of boot pulley are erratic.	☺ Rubber lagging on pulley may be worn. Replace or re-lag pulley.

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Trouble	Probable Cause	Possible Remedy
☹ Jammed Elevator Belt	😐 Foreign objects in elevator boot jam against buckets and casing causing stall.	☺ Inspect and clean boot section periodically. ***Follow safety instructions sign when working on elevator. Reference Safety – Warning & Precaution, Section 2, 2.7.4 Safety Instruction Sign, Part No. 495079***
	😐 Worn buckets - Elevator buckets are worn so that they no longer carry the pre-determined load.	☺ Replace buckets. If belt shows considerable wear, replace complete assembly.
	😐 Excessive abrasive loading	☺ Make abrasive (media) additions slowly. Check abrasive control valve flow rate adjustment. DO NOT overload wheel above rated capacity.
	😐 Belt rubs casing causing motor overload relays to kick out.	☺ Check belt alignment to keep elevator belt centered on pulleys.
	😐 Mechanical bind – motor overload relays kick out.	☺ Check for mechanical binds in motor or gearbox. Check for bad bearings.
	😐 Abrasive control valve leaks abrasive	☺ Lack of air pressure to keep valve closed. ☺ Worn parts. Check and replace worn parts.

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Trouble	Probable Cause	Possible Remedy
☹ Elevator Belt Failure	😐 Belt too tight – breakage may occur at splice	☺ Belt should be adjusted to proper tension. When belt is under proper tension, splice is not overstressed.
	😐 Foreign objects in boot cause sudden jamming, belt stretches and breaks.	☺ Sudden jams should be avoided. Keep boot section clean; remove foreign objects. ***Follow safety instructions sign when working on elevator. Reference Safety – Warning & Precaution, Section 2, 2.7.4 Safety Instruction Sign, Part No. 495079***
	😐 Badly worn belt may suddenly break.	☺ Inspect belt and splice. Replace when necessary.
☹ Belt does not run at center of head pulley.	😐 Improper adjustment of head pulley.	☺ Realign pulley by means of the adjusting screws on elevator head section.
	😐 Improper splicing results in crooked belt, which rides from side to side on head pulley.	☺ Be sure that splice and belt are squarely assembled.
	😐 Worn crown on head pulley causes belt to ride on one side or the other.	☺ Check head pulley. These are crown face pulleys. If crown is worn, replace pulley.
	😐 Belt cannot be aligned properly although all components seem to be in proper condition.	☺ Check overall alignment of head and boot pulley by dropping plumb line from top to bottom –

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Trouble	Probable Cause	Possible Remedy
		realign if necessary.
☹ Zero Speed Fault	😐 No power to the gearmotor.	☺ Check power connection and check control panel.
	😐 Frozen gearmotor.	☺ Remove gearmotor, repair or replace.
	😐 Frozen bearing.	☺ Remove bearing, repair or replace.
	😐 Slack belt or boot jam.	☺ Tension the belt or check to see if there are any foreign bodies, if so remove. ***Follow safety instructions sign when working on elevator. Reference Safety – Warning & Precaution, Section 2, 2.7.4 Safety Instruction Sign, Part No. 495079***
☹ Noisy Gear Motor.	😐 Lack of oil.	☺ Check oil levels, add oil if necessary.
	😐 Bad gears.	☺ Remove gearmotor, repair or replace.
☹ Noisy Bearing	😐 Lack of lubricant.	☺ Check if seals are dry, add lubricant as necessary.
	😐 Bad bearing	☺ Remove bearing, repair or replace.

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6.4 Group No. 10 & 14 – Separator & Upper Screw

To determine if the separator is functioning properly, make a visual analysis of the abrasive after separation and of the material from the separator refuse discharge spout.

Trouble	*Probable Cause*	*Possible Remedy*
☹ Removing good abrasive	😐 Too much air on separator	☺ Adjust blast gate setting.
	😐 Full curtain is not maintained across separator.	☺ Check stationary baffle and swinging baffle operation. Adjust baffles as needed to obtain a full curtain.
☹ Reduced air flow	😐 Air leaks in metal case or vent piping connections.	☺ Repair or replace as necessary.
	😐 Air leak from discharge tubing.	☺ Verify the dribble valve on the fines discharge tube is sealing and in good operating condition.
☹ Contaminated Abrasive.	😐 Insufficient flow of air delivered by ventilation.	☺ Adjust blast gate setting. ☺ Check line for blockage. ☺ Check fan output.
	😐 Full curtain is not maintained across separator.	☺ Check stationary baffle and swinging baffle operation. Adjust baffles as needed to obtain a full curtain.

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Trouble	Probable Cause	Possible Remedy
	Fines hopper and tube are plugged.	Clean out tube and fines hopper.
	Magnets on drum not properly positioned. (This is only on magnetic separator designs.)	Confirm proper position and secure mounting of magnet assembly using external scribe mark reference guides on shaft end and locking collar.
	Burden Plate not in proper position. (This is only on magnetic separator designs.)	Verify position of burden plate to insure effective retention of abrasive and sand mixture against rotating drum.
Good abrasive in separator fines discharge.	Too much air through separator.	Adjust slide gate. Check fan output.
	Hopper overfilled.	Control additions.
	Hole worn in separator chute.	Patch hole.
	Magnets on drum not properly positioned. (This is only on magnetic separator designs.)	Confirm proper position and secure mounting of magnet assembly using external scribe mark reference guides on shaft end and locking collar.
	Burden Plate not in proper position. (This is only on magnetic separator designs.)	Verify position of burden plate to insure effective retention of abrasive and sand mixture against rotating drum.

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Trouble	Probable Cause	Possible Remedy
☹ Zero Speed Fault	😐 No power to the gearmotor.	☺ Check power connection and check control panel.
	😐 Frozen gearmotor.	☺ Remove gearmotor, repair or replace.
	😐 Frozen bearing.	☺ Remove bearing, repair or replace.
	😐 Slack belt or boot jam.	☺ Tension the belt or check to see if there are any foreign bodies, if so remove. ***Follow safety instructions sign when working on Upper Screw. Reference Safety – Warning & Precaution, Section 2.***
☹ Noisy Gear Motor.	😐 Lack of oil.	☺ Check oil levels, add oil if necessary.
	😐 Bad gears.	☺ Remove gearmotor, repair or replace.
☹ Noisy Bearing	😐 Lack of lubricant.	☺ Check if seals are dry, add lubricant as necessary.
	😐 Bad bearing	☺ Remove bearing, repair or replace.

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6.5 Group No. 16 – Manual Blast Tank

Trouble	Probable Cause	Possible Remedy
☹ Air Blast but No Abrasives	😐 The pot is empty.	☺ Fill the pot
	😐 The abrasive in the pot is wet.	☺ Close the choke valve until some abrasive is pumped out. Operating the unit in the "choked" condition will allow the use of media that is too damp to flow properly, but it greatly accelerates wear in the metering valve. Continuous running in the "choked" position also reduces productivity and therefore should be avoided if possible.
	😐 Foreign matter is plugging the abrasive metering valve.	☺ Close the choke valve and opening the abrasive metering valve momentarily to see if that will blow the obstruction out. If that does not work then it will be necessary to depressurize the pot and remove the obstruction by hand.
☹ Reduced Pressure at the Nozzle (with or without abrasive flow)	😐 Insufficient air compressor (see air requirements chart).	☺ Air hose is too small. ☺ Abrasive adjustment is open too far. ☺ Pop-up not seating properly. ☺ Obstruction in line of blast hose.

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Trouble	Probable Cause	Possible Remedy
☹ Unit is Slow to Turn or Will Not Turn On	Air hose is too small. The air hose diameter should be at least three (3) times the nozzle diameter. (Air blows out the blow down but the pot does not pressurize.)	☺ Insufficient air compressor. (Air blows out the blow down but the pot does not pressurize.). ☺ Check quick disconnects couplings on control hoses to be sure they are engaged properly. ☺ Control hoses are leaking. (The pot turns on slowly or does not turn on at all.) Control hoses are plugged. (If the black hose is disconnected from the cylinder of the combo valve, there should be air pressure whenever the dead man is depressed.) ☺ Worn piston seal in the combo valve. (Air blows out the brass breather vent on the combo valve.)
☹ Unit is Slow to Turn or Will Not Turn On	😐 Air hose is too small. The air hose diameter should be at least three (3) times the nozzle diameter. (Air blows out the blow down but the pot does not pressurize.)	☺ Deadman is plugged. (Only a weak air signal, or none at all, comes from the deadman when the black control hose is disconnected. ☺ Defective cartridge in the deadman. (Air blows out the deadman whenever the lever is depressed.)

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Trouble	Probable Cause	Possible Remedy
		☺ On normally closed systems only: Defective diaphragm in automatic air valve. ☺ On normally closed systems only: Defective diaphragm in blow down valve
☹ Unit is Slow to Turn Off or Will Not Turn Off	😐 Twin line hoses crossed. The left part of the deadman should be connected to the combo valve using the black hose.	☺ The lower rod guide seal is defective. (If you disconnect the black hose from the 1/8" port on the combo valve, air should not blow out of the combo valve). ☺ The lower pod guide "O" ring is damaged or missing. ☺ The lower pod guide is installed upside down (the pot turns on as soon as the compressed air is turned on). ☺ The valve plug in the combo valve is defective and will not seal. ☺ Bleeder type deadman has been installed.
	😐 Unit Turns On Accidentally	☺ The lever on the deadman is worn out. Replace the lever . ☺ The safety button on the deadman is missing.

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Trouble	Probable Cause	Possible Remedy
		☺ Bleeder type deadman has been installed. A bleeder type deadman is unsafe because a piece of dirt from the air hose can plug the hole in the deadman and cause the blast unit to turn on.

6.6 Group No. 17 – Paint Ventilation

Trouble	Probable Cause	Possible Remedy
☹ Visible Stack Emissions.	😐 Improperly Installed Filters.	☺ No gaps around the filters. ☺ The filters are not damaged.
☹ High Differential Pressure.	😐 Over Volume.	☺ Check fan and motor speeds and V-belt drive ratio.
	😐 Plugged Magnehelic Line.	☺ Check and clean out if lines are plugged.
	😐 Filter Blinding.	☺ Check system so that oil or free moisture is not entering the filters either from the process or the compressed air system.
☹ Inadequate System Volume	😐 Fan Rotating Backwards.	☺ Check rotation of fan and correct if necessary.
	😐 Fan RPM & Volume Too Low.	☺ Check drive ratio between fan and motor. Check drive for slippage - re-tighten or replace as required.

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Trouble	Probable Cause	Possible Remedy
☹ Noisy Gear Motor.	😐 Lack of oil.	☺ Check oil levels, add oil if necessary.
	😐 Bad gears.	☺ Remove gearmotor, repair or replace.
☹ Noisy Bearing	😐 Lack of lubricant.	☺ Check if seals are dry, add lubricant as necessary.
	😐 Bad bearing	☺ Remove bearing, repair or replace.

6.7 Group No. 19 - Ducting (Ventilation System)

Proper maintenance of the ventilation system is just as important as the servicing of other elements of the blast equipment.

The following troubleshooting chart is provided as an aid for maintaining adequate and efficient ventilation.

Trouble	Probable Cause	Possible Remedy
☹ Abrasive carryout to dust collector.	😐 Too much air.	☺ Close cabinet vent blast gate slightly.
☹ Fines and contaminants not properly removed from abrasive.	😐 Too little air or improper separator adjustments.	☺ Open separator blast gate slightly. ☺ Check for build-up of particles in ductwork, clean out as needed. ☺ Check dust collector discharge container – every shift. Empty before container is full.

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Trouble	Probable Cause	Possible Remedy
		☺ Overloaded ventilation system cannot function properly. Check for holes in flexible hose and any obstructions. Repair/remove. System should be as free as possible from air leakage.
☹ Loss of abrasive – carryout of good abrasive from machine.	😐 The dust collector is delivering too great a flow of air.	☺ Close the dust collector blast gate slightly for proper ventilation.
☹ Contaminated abrasive – fines and contaminants not properly removed from abrasive.	😐 Insufficient flow of air through separator to collector.	☺ Check exhausts fan rotation. ☺ Open blower exhaust damper if present. ☺ Check Magnehelic reading. ☺ Check pulse or shaker operation of collector and increase, if necessary. ☺ Replace filters, if necessary.

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6.8 Group No. 20 Blast Wheel Assembly

Trouble	Probable Cause	Possible Remedy
☹ Excessive vibration – usually indicates that the Wheel Assembly is out of balance. This condition will eventually cause motor or unit bearing failures.	😐 Unevenly worn wheel, blades, hub, and/or impeller.	☺ Replace worn parts and check separator operation for removal of contaminants.
	😐 Broken or chipped blades.	☺ This condition will throw the wheel permanently out of balance and cause damage to other parts of the unit. Replace broken blades immediately using full set of new blades. Retrieve all broken parts before operating the equipment.
	😐 Improperly mounted wheel.	☺ Wheel must be squarely mounted and evenly tightened onto hub or motor shaft – check wheel for wobble.
☹ Drop in blast wheel amperage.	😐 Not enough abrasive getting to the blast wheel.	☺ Check the level of abrasive in the storage hopper. If the level is low, add abrasive to the system. If the abrasive level seems adequate, check the abrasive valve & blast wheel feed spout for blockage.

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Trouble	Probable Cause	Possible Remedy
☹ Excessive noise – besides being undesirable, it may also indicate misalignment of wheel components that cause failures or wear.	😐 Improper clearances between wheel and feed spout, wheel and wheel compartment liner or control cage and impeller.	☺ Check alignment and clearance of components in relation to each other. Allow equal clearances between moving parts to avoid pinch points and prevent contact against one another.
	😐 Loose bolts or misalignment	☺ Make certain that all components are firmly secured.
	😐 Defective bearings	☺ Check the rotation of the unit bearing or the drive motor. Both should rotate freely and smoothly. Repair or replace bad bearings or motors.
☹ Increased Cleaning Time	😐 Improper abrasive feed to wheel.	☺ If an ammeter check indicates a lower ampere reading than the normal full load rating, check: **a)** Quantity of abrasive and add if level is low. **b)** Abrasive control valve adjustment for proper abrasive flow rate.

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Trouble	Probable Cause	Possible Remedy
		c) Abrasive may contain a large percentage of fines and other contaminants, which should have been removed by the separator – check ventilation system, swinging baffle operation, and abrasive screen analysis. **d)** Feed line obstructions may cause reduced flow to the wheel, check and clean out.
	😐 Loss of Directional Control of Blast Pattern. Abrasive will strike sections of the wheel housing, or cabinet components other than work to be blasted. This increases cleaning time, wear and maintenance.	☺ Conduct a blast pattern test. Make certain that you have definitely located the usable blast pattern. Adjust control cage accordingly so that the blast pattern is directed onto the work most effectively.
☹ Blast wheel shutdown	😐 Abrasive valve worn causing overload.	☺ Replace the worn abrasive valve parts.
☹ Abrasive Leakage	😐 Improper sealing.	☺ Check wheel housing and motor shaft seal.

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6.9 roup No. 30 - Dust Collector

Trouble	Probable Cause	Possible Remedy
☹ Visible Stack Emissions	😐 Improperly Installed Filters	☺ Check to ensure that the locking cams are fully locked. ☺ Check to ensure that venturi lip is located within the gasket. ☺ Check and make sure all gaskets are properly seated and compressed against the tube sheet. ☺ Check and make sure for respective number of filters installed inside the housing.
	😐 Dirty/Clean Air Plenum.	☺ Always clean the tube sheet when dust accumulation is present. ☺ After filter failure or sometimes during routine filter change-outs, dust can accumulate in dead air zones on the clean air side of the unit.
	😐 Torn or Punctured Filters	☺ Inspect filters for tears or punctures caused by mechanical damage, abrasion, thermal or chemical attack. Replace filters as and where required.

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Trouble	Probable Cause	Possible Remedy
☹ High Differential Pressure	😐 Over Volume	☺ Check fan and motor speeds and V-belt drive ratio. ☺ Reset fan speed to handle collector design volume.
	😐 System Resistance Static is too low	☺ Re-calculate ductwork design to ensure proper static losses. If too low reduce fan speed or add system resistance with balancing dampers.
	😐 Plugged Magnehelic Line	☺ Check and clean out if lines are plugged.
	😐 Lack of Compressed Air	☺ Check pulsing system for compressed air leakage and seal as required. ☺ Check compressor output to ensure it exceeds pulse cleaning system usage, Add extra volume as required. ☺ Compressed air pressure too low - increase line pressure from regulator - compressor. (Not to exceed 90 P.S.I.) ☺ Check clogged feed lines for oil, water, rust or debris.
	😐 Malfunctioning Timer	☺ Check timer outputs to ensure all terminals are firing. If timer is faulty, return to Wheelabrator for repair.

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Trouble	Probable Cause	Possible Remedy
		☺ On some system, all the channels may not be used. A faulty channel may be bypassed and a spare channel used in this case.
	😐 Dust Re-Entrainment	☺ Check dust removal system for worn or faulty seals. Repair or replace as required. ☺ Check mating flanges - apply gasketing and/or tighten fasteners as required. ☺ Dust disposal system plugged or jammed - clean and check disposal system for capacity. Speed up system, install vibrators or enlarge hopper opening as required. ☺ Check baffle for abrasion and wear.
	😐 Dust on Clean Air Side	☺ Check tube-sheet floor and clean as necessary to prevent dust from entering cartridges from clean air side. ☺ Check inside of filters for dust and empty as required. Dust in filters will cause stack emissions on a cycle synchronized with pulse blasts.

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Trouble	Probable Cause	Possible Remedy
	😐 Filter Blinding	☺ Check system so that oil or free moisture is not entering the filters either from the process or the compressed air system. ☺ Check fan to ensure collector was started under ***throttled*** conditions. Extra high speed impingements of fine particles on new media can permanently blind filter media.
☹ Inadequate System Volume	😐 Fan Rotating Backwards	☺ Check rotation of fan and correct if necessary.
	😐 High Differential Pressure	☺ Refer to the section above.
	😐 Fan RPM & Volume Too Low	☺ Check drive ratio between fan and motor. Check drive for slippage - re-tighten or replace as required.
	😐 Leakage in System	☺ Check all ducting and flanges to and from collector for leaks. Re-gasket and tighten fasteners as required.
	😐 System Resistance Static Too High	☺ Re-calculate ductwork design to ensure proper static losses. If too high, increase fan speed or lower system resistance by changing ductwork and/or hoods.

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Trouble	Probable Cause	Possible Remedy
		☺ Check ductwork for material build-up or blockages. Clean and re-design if necessary.
	😐 Blinded Filters	☺ Inspect filter elements for possible blinding. ☺ Blinded filters usually result in high differential pressure. Clean with fan off until differential pressure drops off. If differential pressure is still high, install new cartridges.
	😐 Fugitive Air Entrainment	☺ Check all doors and cover plates for proper sealing. ☺ Check all ductwork flanges for airtight seals. Apply gaskets and retighten fasteners.
☹ Low Compressed Air Pressure At the Header	😐 Sticking Solenoid Valves	☺ Check solenoid plungers for dirt. Clean or replace as required. ☺ Short circuit in wiring may cause one or more solenoids to remain open - check wiring and repair or replace as required.
	😐 Pulse Time is Too Long	☺ The “Pulse Time” is factory preset and sealed at 100 m/s elect time maximum. If this has been tampered with, set back to original setting

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Trouble	Probable Cause	Possible Remedy
		of 100 m/s.
	😐 Sticking Diaphragm Valves	☺ Check for torn or damaged diaphragms.
	😐 Debris in Diaphragm Valves	☺ Check for dirt, desiccant, oil or ice on diaphragm. Clean or replace as required. If oil, water or ice is present, repair or install dryer on compressed air system to eliminate.
	😐 Leaks in Compressed Air Piping	☺ Inspect compressed air lines for leaks and seal failure.
	😐 Insufficient Supply of Compressed Air	☺ Check capacity of air compressor to ensure proper sizing. See Detail of Order to determine demand of unit. Also check for undersized branch lines in compressed air run.
	😐 Header/Air Valve Connection is Faulty	☺ Inspect connection and repair as required.
	😐 Check Physical and Chemical Characteristics of process Against Filter Media Rating.	☺ Adjust system gas stream or install new media compatible with gas stream.
☹ Filter Element Problems (Poor Life, Blinding, etc.)	😐 Check System Operating Temperature against Filter Media Rating.	☺ Lower temperature of system or refurbish with media suitable to higher temperatures encountered.

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Trouble	Probable Cause	Possible Remedy
☹ Check Abrasion Patterns on Collector Walls, Baffles, Etc.	😐 Check Material Build-up in Hopper	☺ Inspect dust disposal equipment for proper operation. Repair as required. ☺ Check for hopper bridging. ☺ Install vibrators, poke hole, etc. or enlarge discharge opening.
	😐 Incorrectly Installed Filter Elements	☺ Check for proper seating of filters to tube sheet.
	😐 Dirty/Clean Air Plenum	☺ Inspect tube sheet floor for dust accumulations. Dust on tube sheet can reenter into the inside surface and blinding the filters by reverse pulse-jet cleaning action.

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6.10 Group No. 96 - Electrical Equipment

NOTE: DISCONNECT ALL ELECTRICAL POWER SOURCES BEFORE ATTEMPTING MAINTENANCE OR REPAIR.

6.10.1 Motors

Trouble	Probable Cause	Possible Remedy
☹ Wheel Motor	😐 Overheats and overloads trip out.	☺ Check for mechanical binds.
☹ Elevator Motor	😐 Overheats or motor stops.	☺ Check tightness of elevator belt and if centered on top pulley.
☹ Electric Motors do not Start	😐 Main power cable disconnected at electrical source.	☺ Check main power cable at electrical source. Must be 230, 460 or 575 volt, 60 hertz, 3 phase
	😐 Blown Fuses	☺ Check fuses. Replace if defective.
	😐 Applicable motor starter overload relay trips out.	☺ Reset starter.
☹ Electric Motors do not Come Up to Speed, Run Slow	😐 All phases of 230, 380, 460 or 575-volt supply not connected properly.	☺ Recheck wiring for loose or improper connections.
	😐 One fuse blown in disconnect box.	☺ Check all fuses. Replace as required.

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6.10.2 Starters and Control Panel

Trouble	Probable Cause	Possible Remedy
☹ Overload Relay	😐 Overloads trip out.	☺ Do not increase the overload setting; check load with ammeter; compare with overload relay setting. If load is excessive, determine cause and correct.
☹ Contacts and Contact Springs	😐 Contacts badly pitted.	☺ Replace
☹ Fuse Protection	😐 Fuses blow.	☺ For the occasional "blow", fuses may be loose in fuse holders, or temporarily overloaded. If persistent, check for grounded circuit, bare wire.
☹ Overload Relays Trip continuously	😐 Overload in circuit low power.	☺ Shut down particular circuit. Check power source for proper voltage.
	😐 Broken, damaged or loose wiring.	☺ Inspect wiring for broken, cut wires and loose terminals. Replace/repair as required.
	😐 Dirt or contaminants at terminals.	☺ Clean contacts and terminals.

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Trouble	Probable Cause	Possible Remedy
☹ Wheel Motor Sound Not Continuous	😐 Abrasive level low.	☺ Add abrasive to specified level.
	😐 Loose connectors.	☺ Tighten electrical connectors.
	😐 Abrasive system clogged or damaged.	☺ Clean or replace defective parts.

6.10.3 Control Accessories – Operator's Control Panel

Trouble	Probable Cause	Possible Remedy
☹ Pushbuttons	😐 Buttons stick.	☺ Probable cause – abrasive dust. Remove cover and clean.
	😐 Erratic Operation	☺ Check contacts for dirt, springs broken or out of place.
☹ Ammeter	😐 Dirty	☺ Carefully clean ammeter with a fine brush.
	😐 Inaccurate reading	☺ Bent indicator pointer. Replace meter.
	😐 Failure	☺ Replace meter.

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Section 7 Parts & Service Group

7.1 The Wheelabrator Plus Program

The Wheelabrator Group is the preeminent provider of blasting equipment, parts, and services in the industry. The manufacturing and technology leader in the field of wheel blasting for nearly 100 years, the Wheelabrator Group continues to stand by its customers through the latest in surface preparation parts, services and techniques. Our Wheelabrator Plus family of products and services are designed for the industrial professional who is looking to optimize the potential of his/her current blasting process. The scope of supply is not exclusive to the Wheelabrator Group, as the technical expertise is process focused and has been successfully applied to all equipment types. No matter the opportunity or brand, Wheelabrator Plus is available to answer your most significant process questions and opportunities.

7.2 Equipment Modernization Programs (EMP)

Wheelabrator makes the latest technology and process improvements available for all wheelblast equipment. Prior to any equipment modernization recommendations, Wheelabrator professionals will provide inspection services for your current blasting equipment to determine the optimal solution for your requirements. Part of the assessment includes reviewing the available modernization options with the customer to determine what cost savings or efficiencies will be realized as a result of the modernization process.

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7.3 Replacement Parts

The Wheelabrator Group offers a wide variety of blast technologies, and has the most extensive knowledge of the industry. Wheelabrator Plus offers replacement parts for a wide variety of equipment. If you are looking to replace a part from a Wheelabrator machine, or looking for a competitive part, Wheelabrator will assist you in determining the specific part for your equipment.

U.S.A. – Parts	
1606 Executive Drive	
LaGrange, Georgia 30240	
Telephone:	**(800) 544-4144**
Telephone:	**(706) 884-6884**
Fax:	**(706) 884-0710**
Email:	**parts@wheelabratorgroup.com**

Canada – Parts	
1219 Corporate Drive	
Burlington, Ontario, Canada L7L 5V5	
Telephone:	**(800) 845-8508 ext: 6764**
Telephone:	**(905) 319-7930 ext: 6764**
Toll Free Fax:	**(877) 789-1267**
Email:	**parts@wheelabratorgroup.com**

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7.4 Service, Maintenance and Training

At Wheelabrator Plus, our goal is to assist you in ensuring that your blast equipment performs to your expectations. Wheelabrator will define a service and maintenance schedule that fits in with your requirements, as well as providing training to your staff to ensure that the equipment continues to work in the most productive manner.

Service, Maintenance & Training	
1606 Executive Drive	
LaGrange, Georgia 30240	
Telephone:	(800) 544-4144
Telephone:	(706) 884-6884
Fax:	(706) 883-8233
Email:	service@wheelabratorgroup.com

7.5 Warranty Parts & Service

At Wheelabrator Group is committed to 100% customer satisfaction. Our goal is to assist you in ensuring that your blast equipment performs to your expectations.

Warranty – Parts & Service	
1219 Corporate Drive	
Burlington, Ontario, Canada L7L 5V5	
Telephone:	(800) 845-8508 ext: 6764
Telephone:	(905) 319-7930 ext: 6764
Fax:	(905) 319-0662
Email:	service@wheelabratorgroup.com

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Section 8 Operations & Maintenance Manual Addendums

8.1 See Media Delivery System Addendum

(Individual supplements, provided based on type of media delivery system)

- **Wheel Media Delivery System:**
  - 25 EZEFIT® Wheel
  - Autoblast® Wheel
  - BD Wheel
  - EZEFIT® Wheel
  - Micro Wheel
  - SH35 Wheel
  - Etc.

- **Air Blast Media Delivery System:**
  - Air Blast Equipment Manual
  - Air Blast Equipment Automated

8.2 See Operations of Equipment Addendum

- **Operations – Wheel Blast**
  - Functions of Control Panel Instruments
  - Sequence of Operation
  - Start-Up & Checkout Procedure

- **Operations – Air Blast**
  - Functions of Control Panel Instruments
  - Sequence of Operation
  - Start-Up & Checkout Procedure

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8.3 See Commercial Parts Addendum

- Commercial Parts consisting the following:
  - Commercial Part Supplements (Links and/or physical copies)

8.4 See Recommended Spare Parts List Addendum

- Recommended Spare Parts consisting the following:
  - High Wear Parts, Common Consumables, etc.

8.5 See Equipment Drawings Addendum

- Equipment Drawings consisting the following:
  - General Arrangement, Major Assembly, Schematics, etc.

8.6 See Exhaust Piping Construction Addendum

- General Exhaust Piping Construction

8.7 See Dust Collector Addendum (If Purchased)

- Dust Collector consisting the following:
  - Safety Instructions
  - How the Dust Collector Works
  - Inspection Schedule & Checklist
  - Troubleshooting

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Machine Serial No. :	**J3783**
Date:	**March 7, 2011**
Customer:	**GNA ALUTECH**
Customer P.O. No.:	**00006492**
State/ Province:	**Saint-Laurent, Quebec**
Country:	**Canada**
Machine Model:	**4 WHEEL BILLET DESCALING MACHINE**
Dust Collector Model: (if purchased)	**JPSM 3D9**

If you need any assistance, please do not hesitate to call and we will gladly assist you.

Technical:	Spare Parts:
Wheelabrator 1219 Corporate Drive Burlington, Ontario L7L 5V5 Telephone: (800) 845-8508 Telephone: (905) 319-7930 Fax: (905) 319-7561	**Wheelabrator** 1606 Executive Drive LaGrange, Georgia 30240 Telephone: (800) 544-4144 Telephone: (706) 884-6884 Fax: (706) 884-0710

Web Site: www.wheelabratorgroup.com

WARRANTY 3783

Serial # 3783 – GNA Alutech
9495 Transcanada Highway, St-Laurent Qc
Purchase Order: 00006492

WARRANTY

Seller warrants that the equipment described herein will be free from defects in material and workmanship for a period of twelve (12) months from shipment ("Warranty Period"). If within the Warranty Period Seller receives written notice promptly after the discovery of any defect in the material or workmanship Seller shall correct each such defect FOB point of manufacture. Seller shall undertake its warranty obligation of repair, replacement within a reasonable time of receiving actual notice of the warranty defect. Seller shall be fully compensated for expenses of travel and for job time (at Seller's then prevailing per diem rates for straight time and premium time, as applicable) of its service representatives who inspect warranty claims that are not warranty issues. Buyer shall issue a purchase order for these expenses prior to Seller's representatives arrival on site Purchaser has no right to and may not backcharge Seller for warranty claims without prior approval. Normal wear parts and labor are not included. The liability of Seller to Purchaser/Buyer arising out of or the supplying of the equipment whether under warranty, tort, contract, negligence, strict liability or otherwise, shall not in any case exceed the cost of correcting defects in Equipment and upon the expiration of said warranty, all such liability shall terminate. This warranty is conditioned upon the Equipment being handled, operated, and maintained in accordance with written instructions provided or approved in writing by Seller. This Warranty is not applicable to commercial items used on Seller's assembled equipment; such issues shall be covered by any terms provided by the
original equipment manufacturer for any respective commercial item. Seller makes no warranties which extend to damage to the Equipment due to deterioration or wear occasioned by chemicals, abrasion, corrosion or erosion, improper erection, operation or maintenance, abnormal conditions of temperature or dirt, or operation of the Equipment, and Purchaser's exclusive remedy shall be limited as above provided. THE WARRANTY IS EXPRESSLY IN LIEU OF ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABLITY OR FITNESS FOR PARTICULAR PURPOSE. The remedies set forth herein are expressly declared to be the sole and exclusive remedies hereunder. There shall be no liability to anyone for special, incidental or consequential damages with respect to the Equipment or for any related economic loss or property damage.

APPENDICE 4
Motor Control Center
NCE

GNA Alutech Inc.
AZ Zabirah Aluminium Smelter
460V Cathode Sealing Motor Control Centre
P.O. – 00006589
O&M MANUAL

REF No.C6608

a growing company with a growing reputation

TITLE INDEX

1) DRAWINGS

2) MATERIALS' LIST

3) SPARES' LIST

4) CERTIFICATION

5) MAINTENANCE

6) SAFETY

7) NAMEPLATE DETAILS

8) INSTALLATION

GNA alutech inc.

NCE switchgear

P.O. No. - 00006528 **DRAWING LIST** **CONTRACT No. - C6608**

DRAWING No.	DRAWING TITLE	REV No.	DRAWING SIZE		
D6608-1	Cathode Sealing MCC GA	1	A1	DWG	PDF
D6608-2	Main Incomer	1	A1	DWG	PDF
D6608-3	230V AC Distribution	1	A1	DWG	PDF
D6608-4	24V DC Supply	2	A1	DWG	PDF
D6608-5A	Starter Plug/Terminations	0	A1	DWG	PDF
D6608-5B	Starter Plug/Terminations	0	A1	DWG	PDF

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1 ☐ Work may proceed.
2 ☐ Revise & Resubmit. Work may proceed subject to incorporation of changes.
3 ☐ Revise & Resubmit. Work may NOT proceed.
4 ☐ Revise not required. Work may proceed.
5 ☐ VOID / Superseded.

DDR Nbr : 178

Reviewed by : _____ Date : _____

Discipline :

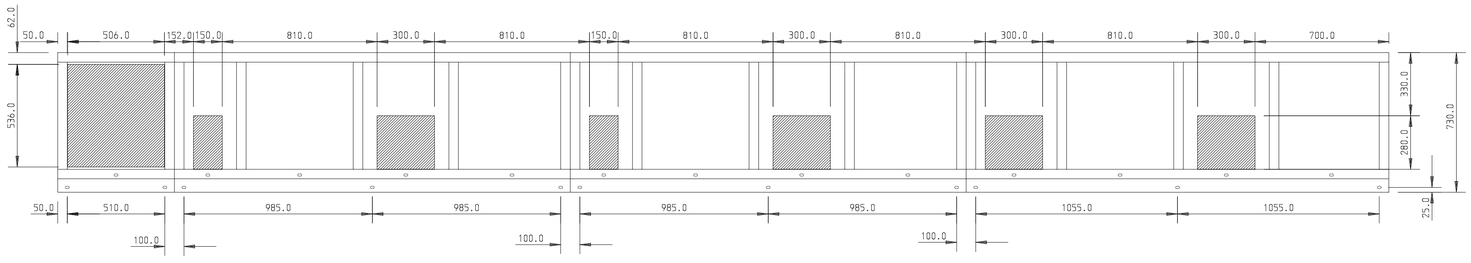
Document No : 25457-4480-V1A-MXA0-0071 | Rev. : 000

SWITCHBOARD SPECIFICATION - 25457-0000-3PS-ECM1-0001

1. FORM - FORM 4B
2. I.P RATING - 42
3. FAULT LEVEL - 80KA FOR 1 SECOND
4. CONSTRUCTION - 2MM ZINTEC
5. PAINT COLOUR - RAL 7032 - EXTERNAL WHITE - BACKPANS AND PLATES
6. FRONT ACCESS/CABLE ENTRY FRONT/BOTTOM

F - FAN
HIM - HUMAN INTERFACE MODULE
V - VENT
M - MULTI-FUNCTION METER

Comp Ref	Circuit Reference	KW Rating	Description
A1	Spare (with breaker only type 140M-F8E-C20)	11Kw DOL	
A2	Spare (empty tray)		
A3	Spare (empty tray)		
A4	Spare (empty tray)		
A5	Spare (empty tray)		
A6	Incoming Supply Metering		
A7	Incoming Cable connections		
B1	4480-MBMB-0001-M1-ST	0.75kW VSD	F2 Cathode Bar Heating Furnace Conveyor No 1 Starter
B2	4480-MBMB-0001-M2-ST	0.75kW VSD	F2 Cathode Bar Heating Furnace Conveyor No 2 Starter
B3	4480-MBMB-0001-M3-ST	0.75kW VSD	F2 Cathode Bar Heating Furnace Conveyor No 3 Starter
B4	4480-MBMB-0001-M4-ST	0.75kW VSD	F2 Cathode Bar Heating Furnace Conveyor No 4 Starter
C1	4480-MJRO-0004-M1-ST	0.75kW VSD	R6 Roller Conveyor At Bar Furnace Exit Starter
C2	4480-MJRO-0007-M1-ST	1.1kW VSD	R2 Roller Conveyor For Block & Bar Assembly Starter
C3	4480-MZAC-0002-M1-ST	1.1kW VSD	R4B Prestressing & Sealing Station Conveyor A Starter
C4	4480-MZAC-0001-M1-ST	1.1kW VSD	R4A Prestressing & Sealing Station Conveyor A Starter
D1	Spare (with breaker only type 140M-D8N-B25)	0.75Kw DOL	
D2	4480-MJRO-0003-M1-ST	0.75Kw Rv DOL	R7 Roller Conveyor At Bar Furnace Entrance Starter
D3	Spare (empty tray)		
D4	4480-MJRO-0005-M1-ST	0.75Kw DOL	R1 Roller Conveyor At Block Oven Exit Starter
D5	4480-MPFO-0001-M1-ST	11Kw DOL	H1 Hydraulic Power Unit Pump A Starter
D6	4480-MJRO-0006-M1-ST	1.1Kw DOL	R3 Roller Conveyor After Sealing Station Starter
D7	4480-MPFO-0001-M2-ST	11Kw DOL	H1 Hydraulic Power Unit Pump B Starter
D8	4480-MJRO-0008-M1-ST	1.1Kw DOL	R5 Roller Conveyor At Cooling & Turning Station Starter
D9	Spare (empty tray)		
D10	Spare (with breaker only type 140M-D8N-B40)	1.1Kw DOL	
D11	4480-MHCO-0003-M1-ST	0.75kW VSD	C3 Conveyor Between Shotblasting Machine & Oven Starter
D12	4480-MQLK-0001-M1-ST	4.0kW VSD	G1 Positioning Gantry For Block And Bars Starter
E1	4480-MHCO-0001-M1-ST	3.7Kw Rv DOL	C1 Chain Conveyor Of Block Oven Starter
E2	4480-MZBP-0001-M1-ST	11Kw DOL	S1 Cathode Bar Shotblasting Machine Blast Wheel No.1 Starter
E3	4480-MHCO-0002-M1-ST	1.1Kw DOL	C2 Conveyor Upstream Of Shot blasting Machine Starter
E4	4480-MZBP-0001-M2-ST	11Kw DOL	S1 Cathode Bar Shotblasting Machine Blast Wheel No.2 Starter
E5	4480-MHCO-0004-M1-ST	3.7Kw DOL	C4 Chain Conveyor For Sealed Cathode Starter
E6	4480-MZBP-0001-M7-ST	2.2Kw DOL	S1 Cathode Bar Shotblasting Machine Screw Starter
E7	4480-MEEP-0001-M1-ST	15Kw DOL	F1 Cathode Block Oven Fan A Starter
E8	4480-MEEP-0001-M2-ST	15Kw DOL	F1 Cathode Block Oven Fan B Starter
E9	4480-MJRO-0001-M1-ST	0.37kW VSD	R9 Roller Conveyor at Shotblasting Machine Entrance Starter
E10	4480-MJRO-0002-M1-ST	0.37kW VSD	R8 Roller Conveyor at Shotblasting Machine Entrance Starter
F1	4480-MACO-0001-M1-ST	7.5Kw DOL	D1 Dust Collector For Shotblasting Machine Fan Starter
F2	Spare (with breaker only type 140M-F8E-C16)	3.7Kw DOL	
F3	4480-MZBP-0001-M3-ST	11Kw DOL	S1 Cathode Bar Shotblasting Machine Blast Wheel No.3 Starter
F4	4480-MBAD-0001-M1-ST	1.1Kw DOL	F3 Ladle Pre-Heating Combustion Fan Starter
F5	4480-MZBP-0001-M4-ST	11Kw DOL	S1 Cathode Bar Shotblasting Machine Blast Wheel No 4 Starter
F6	4480-MEVD-0001-M1-ST	1.1Kw DOL	F4A Cast Iron Ingot Drying Station A Combustion Fan Starter
F7	4480-MZBP-0001-M5-ST	2.2Kw DOL	S1 Cathode Bar Shotblasting Machine Elevator Starter
F8	4480-MEVD-0002-M1-ST	1.1Kw DOL	F4B Cast Iron Ingot Drying Station B Combustion Fan Starter
F9	4480-MEEP-0001-M3-ST	15Kw DOL	F1 Cathode Block Oven Fan C Starter
F10	4480-MZBP-0001-M6-ST	0.37kW VSD	S1 Cathode Bar Shotblasting Machine Work Conveyor Starter
F11	Spare (empty tray)		
G1	Cisco IE3000-8TC Ethernet Sw		Ethernet Equipment
G2	4480-MEHX-0001-W1-ST	63A MCCB	W1 Chiller For Hydraulic Power Unit Starter
G3	Space		
G4	230V Distribution		16 Way MCB 230V Section Control & Utilities
G5	460/230V 10KVA Transformer		



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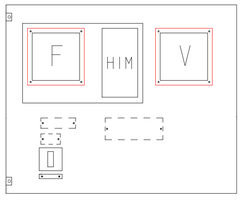

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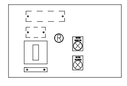

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CATHODE SEALING EQUIPMENT MCC

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TITLE
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GENERAL ARRANGEMENT

SCALE NTS | DRAWING No D6608-1 | REV No 5

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BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR CONTROL PANEL 4480-ECM1-0003

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PROJ. No	SUBC.	DISC.	SECTOR	SEQUENCE	REV.
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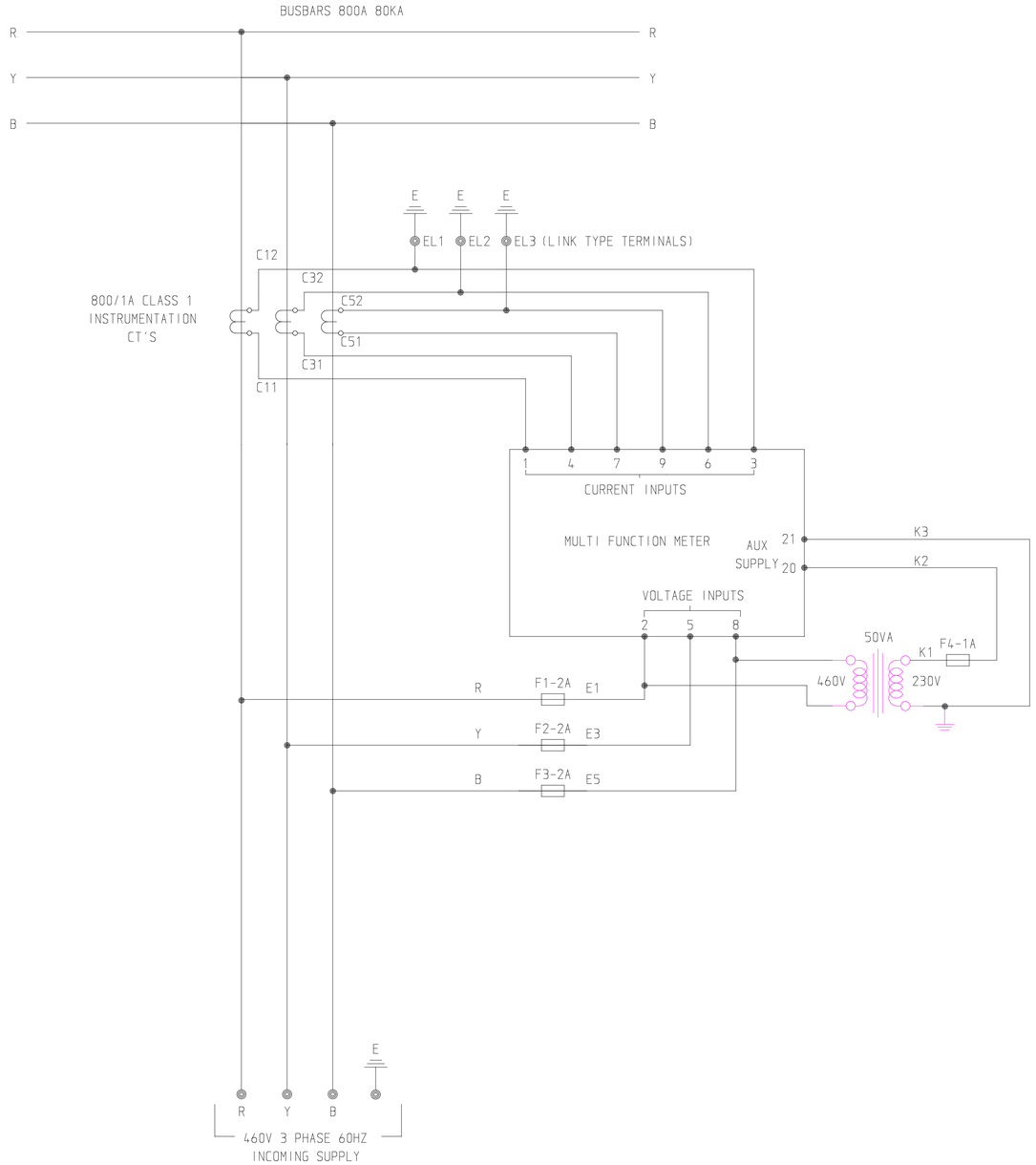

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BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR CONTROL PANEL 4480-ECM1-0001

MA'ADEN talum

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457	00AZ	xx	xxxx	xxxx	xxx xxx

Type	Building	Discipline	Phase	format	Sequence	Location	Rev. No
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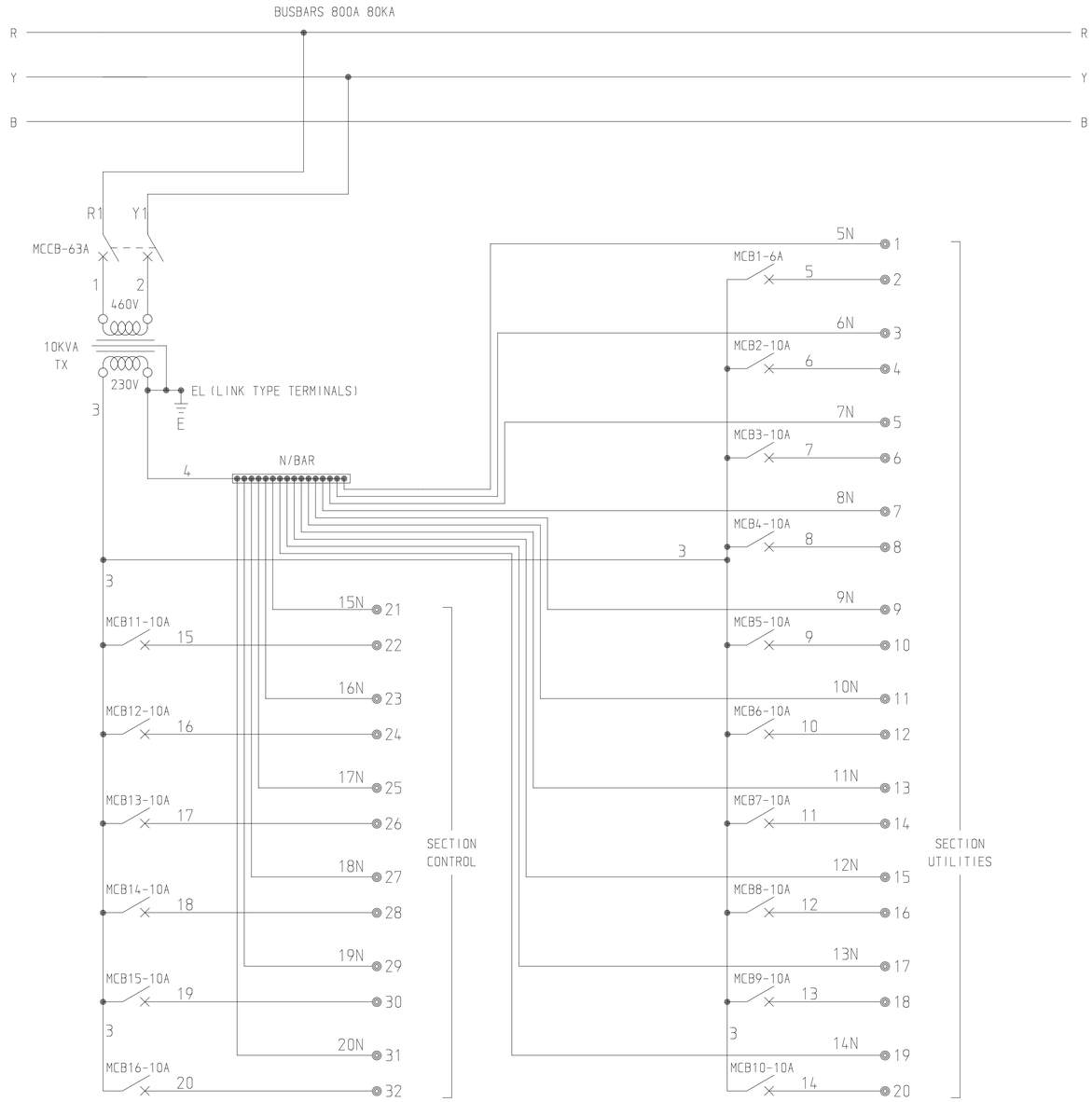

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CATHODE SEALING EQUIPMENT MCC

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Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR CONTROL PANEL 4480-ECM1-0001

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
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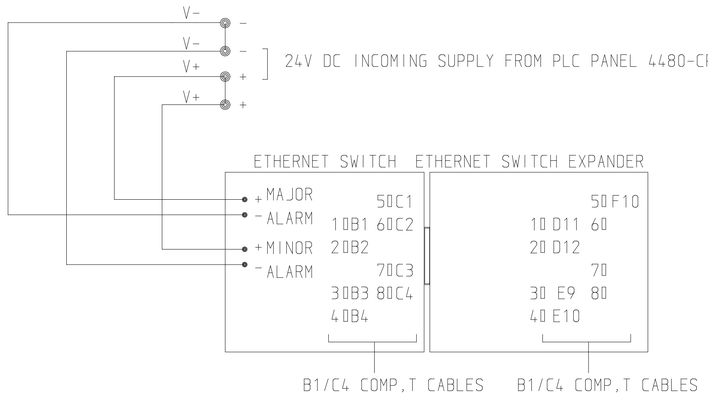

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PROJECT AZ ZABIRAH SMELTER PROJECT
CATHODE SEALING EQUIPMENT MCC

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TITLE: 24V DC SUPPLY | SCALE: NTS | DRAWING No: D6608-4 | REV No: 3

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Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR CONTROL PANEL 4480-ECM1-0001

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-	00AZ-	xx -	xxxx -	xxxx -	xxx — xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
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Document No : 25457-4480-V1A-MXA0-00xx | Rev. : 000

COMP,TS
B1
B2
B3
B4
E9
E10

CABLEWAY TERMINALS

E
4L1 U
4L2 V
4L3 W
L230C L
N230A N
V+ 1
V- 2
8 3
3
4
4
5
5
5
9E 7
17 9
11
11
12
12
13
13
14 14
15 15
20 20
18 21
16 22
19 23
24
25

PLUG/SOCKET LH BLOCK: V+ V- L230C N230A 20 18 8 17 9E

PLUG/SOCKET RH BLOCK: 16 19 BR BR/WH BL BL/WH OR OR/WH GR GR/WH

ETHERNET CABLE

E
BLUE
YELLOW
RED
4L3
4L2
4L1

14
15

PLUG/SOCKET SIDE BLOCK 3 OFF

COMP,TS
D4
D5
D6
D7
D8
E2
E3
E4
E5
E6
E7
E8
F1
F3
F5
F7
F9

CABLEWAY TERMINALS

E
3L1 U
3L2 V
3L3 W
V+ 1
V- 2
9 3
3
4
4
5
5
5
9E 7
17 9
10
10
13
13
20 20
18 21
16 22
19 23
24
25

PLUG/SOCKET LH BLOCK: V+ V- 9 17 9E

PLUG/SOCKET RH BLOCK: 20 18 16 19

E
BLUE
YELLOW
RED
3L3
3L2
3L1

PLUG/SOCKET SIDE BLOCK 2 OFF

COMP,TS
C1
C2
C3
C4
D11
F10

CABLEWAY TERMINALS

E
4L1 U
4L2 V
4L3 W
V+ 1
V- 2
8 3
3
4
4
5
5
5
9E 7
17 9
11
11
12
12
13
13
14 14
15 15
20 20
18 21
16 22
19 23
24
25

PLUG/SOCKET LH BLOCK: V+ V- 20 18 8 17 9E

PLUG/SOCKET RH BLOCK: 16 19 BR BR/WH BL BL/WH OR OR/WH GR GR/WH

ETHERNET CABLE

E
BLUE
YELLOW
RED
4L3
4L2
4L1

14
15

PLUG/SOCKET SIDE BLOCK 3 OFF

COMP,TS
D2
E1

CABLEWAY TERMINALS

E
3L1 U
3L2 V
3L3 W
V+ 1
V- 2
9 3
3
4
4
5
5
5
9E 7
10 8
17 9
10
10
13
13
20 20
18 21
16 22
19 23
24
25

PLUG/SOCKET LH BLOCK: V+ V- 9 17 9E 10

PLUG/SOCKET RH BLOCK: 20 18 16 19

E
BLUE
YELLOW
RED
3L3
3L2
3L1

PLUG/SOCKET SIDE BLOCK 2 OFF

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PROJECT AZ ZABIRAH SMELTER PROJECT
CATHODE SEALING EQUIPMENT MCC

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TITLE: STARTER PLUG/TERMINATIONS | SCALE: NTS | DRAWING No: D6608-5A (1 OFF 2) | REV No: 0

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BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR CONTROL PANEL 4480-ECM1-0001

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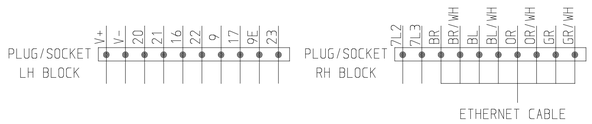
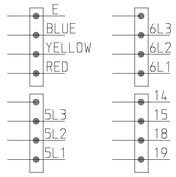




COMP,T D12

CABLEWAY TERMINALS

E	
5L1	U1
5L2	V1
5L3	W1
E	
6L1	U2
6L2	V2
6L3	W2
7L2	B1
7L3	B2
V+	1
V-	2
9	3
	3
	4
	4
	5
	5
	5
9E	7
23	8
17	9
	11
	11
	12
	12
	13
	13
14	14
15	15
18	18
19	19
20	20
21	21
16	22
22	23
	24
	25

COMP,T G1

CABLEWAY TERMINALS

V-	-
V-	-
V+	+
V+	+

COMP,T G2

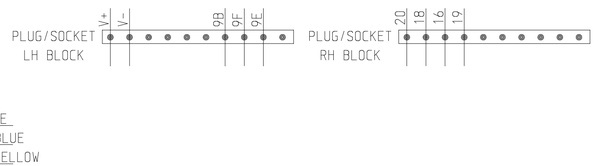
CABLEWAY TERMINALS

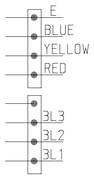
E	
1L1	U1
1L2	V1
1L3	W1

COMP,T G4

CABLEWAY TERMINALS

5N	1
5	2
6N	3
6	4
7N	5
7	6
8N	7
8	8
9N	9
9	10
10N	11
10	12
11N	13
11	14
12N	15
12	16
13N	17
N	18
14N	19
14	20
15N	21
15	22
16N	23
16	24
17N	25
17	26
18N	27
18	28
19N	29
19	30
20N	31
20	32





COMP,TS F4 F6 F8

CABLEWAY TERMINALS

E	
3L1	U
3L2	V
3L3	W
V+	1
V-	2
9B	3
	4
	5
9F	6
9E	7
20	20
18	21
16	22
19	23
	24
	25

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PROJECT AZ ZABIRAH SMELTER PROJECT
CATHODE SEALING EQUIPMENT MCC

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DRAWING NUMBER	TITLE	No	STATUS	DESCRIPTION	DATE	BY	CHK	APP
		0						

NOTES

REFERENCES — REVISIONS

STATUS: FOR DESIGN

DRAWN/DESD:	F.P.	AREA ENG.:	
DATE:	10/08/10	DATE:	
CHECKED:	E.B.	PRJ ENG MGR:	
DATE:	10/08/10	DATE:	
RESPONSIBLE ENG.	M.B.	CLIENT:	
DATE:	10/08/10	DATE:	
ENG. GROUP SUP.		DRAWING SCALE:	NONE
DATE:			

Vendor or Subcontractor Logo: GNA alutech Inc. — Département Ingénierie / Engineering Department, 6488 Route Transcanadienne, Saint-Laurent, Québec, Canada, H4T 1V3

BECHTEL

Project Title: Ras Az Zawr Aluminium Smelter

SMELTER PLANT FACILITY
CATHODE SEALING EQUIPMENT
MOTOR CONTROL PANEL 4480-ECM1-0001

MAADEN

PROJ. No	SUBD.	DISC.	SECTOR	SEQUENCE	REV.
25457-	00AZ-	xx -	xxxx -	xxxx -	xxx — xxx

Type	Building	Discipline	Phase	Format	Sequential	Location	Rev. No.
				A3-	AZ		

AZ Zabirah Aluminium Smelter
460V Cathode Sealing Motor Control Centre

	DATE	REVISION
	13/03/11	0
PURCHASE ORDER NUMBER	00006528	
CONTRACT NUMBER	C6608	
DOCUMENT NUMBER	C6608H	
TAG NUMBER	4480-ECM1-0003	

PARTS LIST

ITEM No.	FUNCTIONAL LOCATION No.	EQUIPMENT No.	COMPONENTS (MATERIAL) DESCRIPTION	COMPONENT DESCRIPTION (LONG TEXT)	MANUFACTURER/ VENDOR NAME	MANUFACTURER'S MODEL	MANUFACTURER PART No.	MANUFACTURER SERIAL No.	SUPPLIER NAME	SUPPLIER CODE	MATERIAL NUMBER	DRAWING/ DOCUMENT No.	RECOMMENDED SPARES QUANTITY	TOTAL SPARES INSTALLED ON THE PLANT	PLANNED DELIVERY TIME (DAYS)	UNIT PRICE/ CURRENCY	WARRANTY PERIOD
1	E7, E8, F9		CIRCUIT BREAKER 32A	N/A	ALLEN BRADLEY	N/A	140M-F8N-C32	N/A	ROUTECO	N/A	N/A	N/A			10		
2	D8, D10, E3, F4, F6, F8		CIRCUIT BREAKER 4.0A	N/A	ALLEN BRADLEY	N/A	140M-D8N-B40	N/A	ROUTECO	N/A	N/A	N/A			10		
3	E6, F7		CIRCUIT BREAKER 6.3A	N/A	ALLEN BRADLEY	N/A	140M-D8N-B63	N/A	ROUTECO	N/A	N/A	N/A			10		
4	D1, D2, D4		CIRCUIT BREAKER 2.5A	N/A	ALLEN BRADLEY	N/A	140M-D8N-B25	N/A	ROUTECO	N/A	N/A	N/A			10		
5	B1, B2, B3, B4, C1, D11		CIRCUIT BREAKER 1.6-2.5A	N/A	ALLEN BRADLEY	N/A	140M-C2E-B25	N/A	ROUTECO	N/A	N/A	N/A			10		
6	E9, E10, F10		CIRCUIT BREAKER 1.0-1.6A	N/A	ALLEN BRADLEY	N/A	140M-C2E-B16	N/A	ROUTECO	N/A	N/A	N/A			10		
7	C2, C3, C4, D6		CIRCUIT BREAKER 2.5-4.0A	N/A	ALLEN BRADLEY	N/A	140M-C2E-B40	N/A	ROUTECO	N/A	N/A	N/A			10		
8	D12		CIRCUIT BREAKER 6.3-10A	N/A	ALLEN BRADLEY	N/A	140M-C2E-C10	N/A	ROUTECO	N/A	N/A	N/A			10		
9	E1, E5, F1, F2		CIRCUIT BREAKER 10-16A	N/A	ALLEN BRADLEY	N/A	140M-F8E-C16	N/A	ROUTECO	N/A	N/A	N/A			10		
10	A1, D5, D7, E2, E4, F3, F5		CIRCUIT BREAKER 14.5-20A	N/A	ALLEN BRADLEY	N/A	140M-F8E-C20	N/A	ROUTECO	N/A	N/A	N/A			10		
11	B1, B2, B3, B4, C1, C2, C3, C4, D2, D4, D5, D6, D7, D8, D11, D12, E1, E2, E3, E4, E5, E6, E7, E8, E9, E10, F1, F3, F4, F5, F6, F7, F8, F9, F10		EXTENSION SHAFT	N/A	ALLEN BRADLEY	N/A	140MCDS	N/A	ROUTECO	N/A	N/A	N/A			10		
12	G4		MCB BUSBAR	N/A	ALLEN BRADLEY	N/A	1492-ASPCL1	N/A	ROUTECO	N/A	N/A	N/A			10		
13	B1, B2, B3, B4, C1, C2, C3, C4, D11		LINE REACTOR 0.75-1.5kW	N/A	ALLEN BRADLEY	N/A	1321-3R4-B	N/A	ROUTECO	N/A	N/A	N/A			10		
14	E9, E10, F10		LINE REACTOR 0.37-0.55kW	N/A	ALLEN BRADLEY	N/A	1321-3R2-B	N/A	ROUTECO	N/A	N/A	N/A			10		
15	D12		LINE REACTOR 4kW	N/A	ALLEN BRADLEY	N/A	1321-3R8-B	N/A	ROUTECO	N/A	N/A	N/A			10		
16	B1, B2, B3, B4, C1, C2, C3, C4, D2, D4, D5, D6, D7, D8, D11, D12, E1, E2, E3, E4, E5, E6, E7, E8, E9, E10, F1, F3, F4, F5, F6, F7, F8, F9, F10		RELAY	N/A	ALLEN BRADLEY	N/A	700-HC24Z24-3	N/A	ROUTECO	N/A	N/A	N/A			10		
17	B1, B2, B3, B4, C1, C2, C3, C4, D2, D4, D5, D6, D7, D8, D11, D12, E1, E2, E3, E4, E5, E6, E7, E8, E9, E10, F1, F3, F4, F5, F6, F7, F8, F9, F10		RELAY BASE	N/A	ALLEN BRADLEY	N/A	700-HN104	N/A	ROUTECO	N/A	N/A	N/A			10		
18	B1, B2, B3, B4, C1, C2, C3, C4, D2, D4, D5, D6, D7, D8, D11, D12, E1, E2, E3, E4, E5, E6, E7, E8, E9, E10, F1, F3, F4, F5, F6, F7, F8, F9, F10		RELAY CLIP	N/A	ALLEN BRADLEY	N/A	700-HN114	N/A	ROUTECO	N/A	N/A	N/A			10		
19	B1, B2, B3, B4, C1, C2, C3, C4, D2, D4, D5, D6, D7, D8, D11, D12, E1, E2, E3, E4, E5, E6, E7, E8, E9, E10, F1, F3, F4, F5, F6, F7, F8, F9, F10		HANDLE	N/A	ALLEN BRADLEY	N/A	140M-C-DRY66	N/A	ROUTECO	N/A	N/A	N/A			10		
20	B1, B2, B3, B4, C1, C2, C3, C4, D11, D12, E9, E10, F10, F11		HIM KEYPAD	N/A	ALLEN BRADLEY	N/A	20-HIM-C35	N/A	ROUTECO	N/A	N/A	N/A			10		
21	B1, B2, B3, B4, C1, C2, C3, C4, D11, D12, E9, E10, F10		ETHERNET CARD	N/A	ALLEN BRADLEY	N/A	20-COMM-E	N/A	ROUTECO	N/A	N/A	N/A			10		

GNA alutech inc.

AZ Zabirah Aluminium Smelter
460V Cathode Sealing Motor Control Centre

NCE switchgear

	DATE	REVISION
	13/03/11	0
PURCHASE ORDER NUMBER	00006528	
CONTRACT NUMBER	C6608	
DOCUMENT NUMBER	C6608H	
TAG NUMBER	4480-ECM1-0003	

PARTS LIST

ITEM No.	FUNCTIONAL LOCATION No.	EQUIPMENT No.	COMPONENTS (MATERIAL) DESCRIPTION	COMPONENT DESCRIPTION (LONG TEXT)	MANUFACTURER/V ENDOR NAME	MANUFACTURER'S MODEL	MANUFACTURER PART No.	MANUFACTURER SERIAL No.	SUPPLIER NAME	SUPPLIER CODE	MATERIAL NUMBER	DRAWING/ DOCUMENT No.	RECOMMENDED SPARES QUANTITY	TOTAL SPARES INSTALLED	PLANNED DELIVERY TIME	UNIT PRICE/ CURRENCY	WARRANTY PERIOD
22	B1, B2, B3, B4, C1, C2, C3, D2, D4, D5, D6, D7, D8, D11, D12, E1, E2, E3, E4, E5, E6, E7, E8, E9, E10, F1, F3, F4, F5, F6, F7, F8, F9, F10		BREAKER AUXILIARY	N/A	ALLEN BRADLEY	N/A	140M-C-AFA10	N/A	ROUTECO	N/A	N/A	N/A			10		
23	E9, E10, F10		0.37KW DRIVE	N/A	ALLEN BRADLEY	N/A	20AC1P3AOAYNANCO	N/A	ROUTECO	N/A	N/A	N/A			10		
24	B1, B2, B3, B4, C1, D11		0.75KW DRIVE	N/A	ALLEN BRADLEY	N/A	20AC2P1AOAYNANCO	N/A	ROUTECO	N/A	N/A	N/A			10		
25	C2, C3, C4, D12		1.1KW DRIVE	N/A	ALLEN BRADLEY	N/A	20AC3P5AOAYNANCO	N/A	ROUTECO	N/A	N/A	N/A			10		
26	B1, B2, B3, B4, C1, C2, C3, D2, D4, D6, D8, D11, E1, E3, E5, E6, E9, E10, F4, F6, F7, F8, F10		3P CONTACTOR 9A	N/A	ALLEN BRADLEY	N/A	100C09B10	N/A	ROUTECO	N/A	N/A	N/A			10		
27	F1		3P CONTACTOR 16A	N/A	ALLEN BRADLEY	N/A	100C16B10	N/A	ROUTECO	N/A	N/A	N/A			10		
28	D5, D7, E2, E4, F3, F5		3P CONTACTOR 23A	N/A	ALLEN BRADLEY	N/A	100C23B10	N/A	ROUTECO	N/A	N/A	N/A			10		
29	E7, E8, F9		3P CONTACTOR 30A	N/A	ALLEN BRADLEY	N/A	100C30B00	N/A	ROUTECO	N/A	N/A	N/A			10		
30	D12		3P CONTACTOR 12A	N/A	ALLEN BRADLEY	N/A	100C12B10	N/A	ROUTECO	N/A	N/A	N/A			10		
31	D12		3P CONTACTOR 9A 24V DC COIL	N/A	ALLEN BRADLEY	N/A	100C09DJ10	N/A	ROUTECO	N/A	N/A	N/A			10		
32	D2, D4, D6, D8, D12, E3, F4, F6, F8		OVERLOAD 1-5A	N/A	ALLEN BRADLEY	N/A	193EECB	N/A	ROUTECO	N/A	N/A	N/A			10		
33	E1, E5, E6, F7		OVERLOAD 3.2-16A	N/A	ALLEN BRADLEY	N/A	193EEDB	N/A	ROUTECO	N/A	N/A	N/A			10		
34	D5, D7, E2, E4, F1, F3, F5		OVERLOAD 5.4-27A	N/A	ALLEN BRADLEY	N/A	193EEEB	N/A	ROUTECO	N/A	N/A	N/A			10		
35	E7, E8. F9		OVERLOAD 9-45A	N/A	ALLEN BRADLEY	N/A	193EEFD	N/A	ROUTECO	N/A	N/A	N/A			10		
36	E7, E8, F9		OVERLOAD HOLDER	N/A	ALLEN BRADLEY	N/A	193EPD	N/A	ROUTECO	N/A	N/A	N/A			10		
37	D2, D4, D5, D6, D7, D8, E1, E2, E3, E4, E5, E6, E7, E8, F1, F2, F3, F4, F5, F6, F7, F8, F9		EXTERNAL RESET ADAPTER	N/A	ALLEN BRADLEY	N/A	193ERA	N/A	ROUTECO	N/A	N/A	N/A			10		
38	D2, D4, D5, D6, D7, D8, D12, E1, E2, E3, E4, E5, E6, F1, F3, F4, F5, F6, F7, F8		OVERLOAD HOLDER	N/A	ALLEN BRADLEY	N/A	193EPB	N/A	ROUTECO	N/A	N/A	N/A			10		
39	D2, D4, D5, D6, D7, D8, E1, E2, E3, E4, E5, E6, E7, E8, F1, F2, F3, F4, F5, F6, F7, F8, F9		RESET PUSH BUTTON	N/A	ALLEN BRADLEY	N/A	800FPR611	N/A	ROUTECO	N/A	N/A	N/A			10		
40	D2, D4, D5, D6, D7, D8, E1, E2, E3, E4, E5, E6, E7, E8, F1, F2, F3, F4, F5, F6, F7, F8, F9		RESET ROD	N/A	ALLEN BRADLEY	N/A	800FATR08	N/A	ROUTECO	N/A	N/A	N/A			10		
41	B1, B2, B3, B4, C1, C2, C3, D2, D4, D5, D6, D7, D8, D11, D12, E1, E2, E3, E4, E5, E6, E7, E8, E9, E10, F1, F3, F4, F5, F6, F7, F8, F9, F10		AUXILIARY CONTACT	N/A	ALLEN BRADLEY	N/A	100FA22	N/A	ROUTECO	N/A	N/A	N/A			10		
42	G4		MCB 10A SP TYPE C	N/A	ALLEN BRADLEY	N/A	1492-SP1C100	N/A	ROUTECO	N/A	N/A	N/A			10		
43	G4		MCB 6A SP TYPE C	N/A	ALLEN BRADLEY	N/A	1492-SP1C060	N/A	ROUTECO	N/A	N/A	N/A			10		
44	E1		REVERSER KIT	N/A	ALLEN BRADLEY	N/A	105 PW23	N/A	ROUTECO	N/A	N/A	N/A			10		
45	D12		THERMISTOR	N/A	ALLEN BRADLEY	N/A	817E1	N/A	ROUTECO	N/A	N/A	N/A			10		
46	G1		ETHERNET SWITCH	N/A	CISCO	N/A	CISCO-IE-3000-8TC	N/A	INSIGHT	N/A	N/A	N/A			10		
47	G1		ETHERNET EXPANDER	N/A	CISCO	N/A	CISCO-IEM-3000-8TM	N/A	INSIGHT	N/A	N/A	N/A			10		
48	A6, B1, B2, B3, B4, C1, C2, C3, C4, D2, D4, D5, D6, D7, D8, D11, D12, E1, E2, E3, E4, E5, E6, E7, E8, E9, E10, F1, F3, F4, F5, F6, F7, F8, F9, F10		FUSEHOLDER	N/A	ENTRELEC	N/A	0115 375.22	N/A	ABB	N/A	N/A	N/A			10		

AZ Zabirah Aluminium Smelter
460V Cathode Sealing Motor Control Centre

	DATE	REVISION
	13/03/11	0
PURCHASE ORDER NUMBER	00004154	
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DOCUMENT NUMBER	C6608H	
TAG NUMBER	4480-ECM1-0003	

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ITEM No.	FUNCTIONAL LOCATION No.	EQUIPMENT No.	COMPONENTS (MATERIAL) DESCRIPTION	COMPONENT DESCRIPTION (LONG TEXT)	MANUFACTURER/V ENDOR NAME	MANUFACTURER'S MODEL	MANUFACTURER PART No.	MANUFACTURER SERIAL No.	SUPPLIER NAME	SUPPLIER CODE	MATERIAL NUMBER	DRAWING/ DOCUMENT No.	RECOMMENDED SPARES QUANTITY	TOTAL SPARES INSTALLED	PLANNED DELIVERY TIME	UNIT PRICE/ CURRENCY	WARRANTY PERIOD
49	A6, C1, C2, C3, C4, D11, D12, F10		460V OPEN TYPE TRANSFORMER	N/A	EASTERN TRANSFORMERS	N/A	50VA 460/230V 60HZ	N/A	N/A	N/A	N/A	N/A			10		
50	B1, B2, B3, B4, E9, E10		460V OPEN TYPE TRANSFORMER	N/A	EASTERN TRANSFORMERS	N/A	100VA 460/230V 60HZ	N/A	N/A	N/A	N/A	N/A			10		
51	G6		460V OPEN TYPE TRANSFORMER	N/A	EASTERN TRANSFORMERS	N/A	10KVA 460/230V 60HZ	N/A	N/A	N/A	N/A	N/A			10		
52	B1, B2, B3, B4, C1, C2, C3, C4, D2, D4, D5, D6, D7, D8, D11, D12, E1, E2, E3, E4, E5, E6, E7, E8, E9, E10, F1, F3, F4, F5, F6, F7, F8, F9, F10		SOCKET	N/A	KLIPPON / WEIDMULLER	N/A	0645260000	N/A	SCATTERGOOD & JOHNSON	N/A	N/A	N/A			10		
53	B1, B2, B3, B4, C1, C2, C3, C4, D2, D4, D5, D6, D7, D8, D11, D12, E1, E2, E3, E4, E5, E6, E7, E8, E9, E10, F1, F3, F4, F5, F6, F7, F8, F9, F10		PLUG	N/A	KLIPPON / WEIDMULLER	N/A	0645060000	N/A	SCATTERGOOD & JOHNSON	N/A	N/A	N/A			10		
54	A6, B1, B2, B3, B4, C1, C2, C3, C4, D2, D4, D5, D6, D7, D8, D11, D12, E1, E2, E3, E4, E5, E6, E7, E8, E9, E10, F1, F3, F4, F5, F6, F7, F8, F9, F10		1A FUSE	N/A	LEGRAND	N/A	123 01	N/A	N/A	N/A	N/A	N/A			10		
55	B1, B2, B3, B4, C1, C2, C3, C4, D2, D4, D5, D6, D7, D8, D11, D12, E1, E2, E3, E4, E5, E6, E7, E8, E9, E10, F1, F3, F4, F5, F6, F7, F8, F9, F10		SOCKET	N/A	MULTI-CONTACT	N/A	15 0114	N/A	N/A	N/A	N/A	N/A			10		
56	B1, B2, B3, B4, C1, C2, C3, C4, D2, D4, D5, D6, D7, D8, D11, D12, E1, E2, E3, E4, E5, E6, E7, E8, E9, E10, F1, F3, F4, F5, F6, F7, F8, F9, F10		PLUG	N/A	MULTI-CONTACT	N/A	15 0113	N/A	N/A	N/A	N/A	N/A			10		
57	A6		C/T 800/1A	N/A	RAYLEIGH	N/A	TASN 800/1	N/A	N/A	N/A	N/A	N/A			10		
58	A6		MULTI-METER	N/A	RAYLEIGH	N/A	NEMO 96 - 13520225	N/A	N/A	N/A	N/A	N/A			10		
59	A6		2A FUSE	N/A	SOCOMEC	N/A	6A10 0002	N/A	N/A	N/A	N/A	N/A			10		
60	B1, B2, B3, B4, C1, C2, C3, C4, D11, D12, E9, E10, F10		FAN	N/A	RITTAL	N/A	SK3322107	N/A	N/A	N/A	N/A	N/A			10		
61	B1, B2, B3, B4, C1, C2, C3, C4, D11, D12, E9, E10, F10		VENT	N/A	RITTAL	N/A	SK3322207	N/A	N/A	N/A	N/A	N/A			10		
62	D2, D4, D5, D6, D7, D8, E1, E2, E3, E4, E5, E6, E7, E8, F1, F3, F4, F5, F6, F7, F8, F9		INDICATING LIGHT WHITE	N/A	TELEMECANIQUE	N/A	XB4 BVB1	N/A	SCHNEIDER	N/A	N/A	N/A			10		
63	D2, D4, D5, D6, D7, D8, E1, E2, E3, E4, E5, E6, E7, E8, F1, F3, F4, F5, F6, F7, F8, F9		INDICATING LIGHT YELLOW	N/A	TELEMECANIQUE	N/A	XB4 BVB5	N/A	SCHNEIDER	N/A	N/A	N/A			10		
64	G2, G5		125/63A MCCB 3P H125NJ	N/A	TERASAKI	N/A	255458	N/A	N/A	N/A	N/A	N/A			10		
65	G2, G5		125A MCCB 3P PLUG-IN BASE	N/A	TERASAKI	N/A	060267	N/A	N/A	N/A	N/A	N/A			10		
66	G2, G5		HANDLE	N/A	TERASAKI	N/A	750199	N/A	N/A	N/A	N/A	N/A			10		
67	B1, B2, B3, B4, C1, C2, C3, C4, D11, D12, E9		RESISTOR 3.3K	N/A	TYCO ELECTRONICS	N/A	ROX3SJ3K3	N/A	RS COMPONENTS	N/A	N/A	N/A			10		

AZ Zabirah Aluminium Smelter
460V Cathode Sealing Motor Control Centre

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2-Years Spares

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1	E7, E8, F9		CIRCUIT BREAKER 32A	N/A	ALLEN BRADLEY	N/A	140M-F8N-C32	N/A	ROUTECO	N/A	N/A	N/A	1		10		
2	D8, D10, E3, F4, F6, F8		CIRCUIT BREAKER 4.0A	N/A	ALLEN BRADLEY	N/A	140M-D8N-B40	N/A	ROUTECO	N/A	N/A	N/A	1		10		
3	E6, F7		CIRCUIT BREAKER 6.3A	N/A	ALLEN BRADLEY	N/A	140M-D8N-B63	N/A	ROUTECO	N/A	N/A	N/A	1		10		
4	D1, D2, D4		CIRCUIT BREAKER 2.5A	N/A	ALLEN BRADLEY	N/A	140M-D8N-B25	N/A	ROUTECO	N/A	N/A	N/A	1		10		
5	B1, B2, B3, B4, C1, D11		CIRCUIT BREAKER 1.6-2.5A	N/A	ALLEN BRADLEY	N/A	140M-C2E-B25	N/A	ROUTECO	N/A	N/A	N/A	1		10		
6	E9, E10, F10		CIRCUIT BREAKER 1.0-1.6A	N/A	ALLEN BRADLEY	N/A	140M-C2E-B16	N/A	ROUTECO	N/A	N/A	N/A	1		10		
7	C2, C3, C4, D6		CIRCUIT BREAKER 2.5-4.0A	N/A	ALLEN BRADLEY	N/A	140M-C2E-B40	N/A	ROUTECO	N/A	N/A	N/A	1		10		
8	D12		CIRCUIT BREAKER 6.3-10A	N/A	ALLEN BRADLEY	N/A	140M-C2E-C10	N/A	ROUTECO	N/A	N/A	N/A	1		10		
9	E1, E5, F1, F2		CIRCUIT BREAKER 10-16A	N/A	ALLEN BRADLEY	N/A	140M-F8E-C16	N/A	ROUTECO	N/A	N/A	N/A	1		10		
10	A1, D5, D7, E2, E4, F3, F5		CIRCUIT BREAKER 14.5-20A	N/A	ALLEN BRADLEY	N/A	140M-F8E-C20	N/A	ROUTECO	N/A	N/A	N/A	1		10		
16	B1, B2, B3, B4, C1, C2, C3, C4, D2, D4, D5, D6, D7, D8, D11, D12, E1, E2, E3, E4, E5, E6, E7, E8, E9, E10, F1, F3, F4, F5, F6, F7, F8, F9, F10		RELAY	N/A	ALLEN BRADLEY	N/A	700-HC24Z24-3	N/A	ROUTECO	N/A	N/A	N/A	3		10		
17	B1, B2, B3, B4, C1, C2, C3, C4, D2, D4, D5, D6, D7, D8,		RELAY BASE	N/A	ALLEN BRADLEY	N/A	700-HN104	N/A	ROUTECO	N/A	N/A	N/A	3		10		
22	B1, B2, B3, B4, C1, C2, C3, D2, D4, D5, D6, D7, D8, D11,		BREAKER AUXILIARY	N/A	ALLEN BRADLEY	N/A	140M-C-AFA10	N/A	ROUTECO	N/A	N/A	N/A	3		10		
26	B1, B2, B3, B4, C1, C2, C3, D2, D4, D6, D8, D11, E1, E3,		3P CONTACTOR 9A	N/A	ALLEN BRADLEY	N/A	100C09B10	N/A	ROUTECO	N/A	N/A	N/A	1		10		
27	F1		3P CONTACTOR 16A	N/A	ALLEN BRADLEY	N/A	100C16B10	N/A	ROUTECO	N/A	N/A	N/A	1		10		
28	D5, D7, E2, E4, F3, F5		3P CONTACTOR 23A	N/A	ALLEN BRADLEY	N/A	100C23B10	N/A	ROUTECO	N/A	N/A	N/A	1		10		
29	E7, E8, F9		3P CONTACTOR 30A	N/A	ALLEN BRADLEY	N/A	100C30B00	N/A	ROUTECO	N/A	N/A	N/A	1		10		
30	D12		3P CONTACTOR 12A	N/A	ALLEN BRADLEY	N/A	100C12B10	N/A	ROUTECO	N/A	N/A	N/A	1		10		
31	D12		3P CONTACTOR 9A 24V DC COIL	N/A	ALLEN BRADLEY	N/A	100C09DJ10	N/A	ROUTECO	N/A	N/A	N/A	1		10		
32	D2, D4, D6, D8, D12, E3, F4, F6, F8		OVERLOAD 1-5A	N/A	ALLEN BRADLEY	N/A	193EECB	N/A	ROUTECO	N/A	N/A	N/A	1		10		
33	E1, E5, E6, F7		OVERLOAD 3.2-16A	N/A	ALLEN BRADLEY	N/A	193EEDB	N/A	ROUTECO	N/A	N/A	N/A	1		10		
34	D5, D7, E2, E4, F1, F3, F5		OVERLOAD 5.4-27A	N/A	ALLEN BRADLEY	N/A	193EEEB	N/A	ROUTECO	N/A	N/A	N/A	1		10		
35	E7, E8, F9		OVERLOAD 9-45A	N/A	ALLEN BRADLEY	N/A	193EEFD	N/A	ROUTECO	N/A	N/A	N/A	1		10		

	DATE	REVISION
	13/03/11	0
PURCHASE ORDER NUMBER	00006528	
CONTRACT NUMBER	C6608	
DOCUMENT NUMBER	C6608W	
TAG NUMBER	4480-ECM1-0003	

AZ Zabirah Aluminium Smelter
460V Cathode Sealing Motor Control Centre

2-Years Spares

ITEM No.	FUNCTIONAL LOCATION No.	EQUIPMENT No.	COMPONENTS (MATERIAL) DESCRIPTION	COMPONENT DESCRIPTION (LONG TEXT)	MANUFACTURER/V ENDOR NAME	MANUFACTURER'S MODEL	MANUFACTURER PART No.	MANUFACTURER SERIAL No.	SUPPLIER NAME	SUPPLIER CODE	MATERIAL NUMBER	DRAWING/ DOCUMENT No.	RECOMMENDED SPARES QUANTITY	TOTAL SPARES INSTALLED	PLANNED DELIVERY TIME	UNIT PRICE/ CURRENCY	WARRANTY PERIOD
36	D2, D4, D5, D6, D7, D8, E1, E2, E3, E4, E5, E6, E7, E8, F1, F2, F3, F4, F5, F6, F7, F8, F9		RESET PUSH BUTTON	N/A	ALLEN BRADLEY	N/A	800FPR611	N/A	ROUTECO	N/A	N/A	N/A	2		10		
37	B1, B2, B3, B4, C1, C2, C3, D2, D4, D5, D6, D7, D8, D11, D12, E1, E2, E3, E4, E5, E6, E7, E8, E9, E10, F1, F3, F4, F5, F6, F7, F8, F9, F10		AUXILIARY CONTACT	N/A	ALLEN BRADLEY	N/A	100FA22	N/A	ROUTECO	N/A	N/A	N/A	2		10		
38	G4		MCB 10A SP TYPE C	N/A	ALLEN BRADLEY	N/A	1492-SP1C100	N/A	ROUTECO	N/A	N/A	N/A	2		10		
39	G4		MCB 6A SP TYPE C	N/A	ALLEN BRADLEY	N/A	1492-SP1C060	N/A	ROUTECO	N/A	N/A	N/A	2		10		
40	A6, B1, B2, B3, B4, C1, C2, C3, C4, D2, D4, D5, D6, D7, D8, D11, D12, E1, E2, E3, E4, E5, E6, E7, E8, E9, E10, F1, F3, F4, F5, F6, F7, F8, F9, F10		1A FUSE	N/A	LEGRAND	N/A	123 01	N/A	N/A	N/A	N/A	N/A	6		10		
41	A6		2A FUSE	N/A	SOCOMEC	N/A	6A10 0002	N/A	N/A	N/A	N/A	N/A	6		10		
42	D2, D4, D5, D6, D7, D8, E1, E2, E3, E4, E5, E6, E7, E8, F1, F3, F4, F5, F6, F7, F8, F9		INDICATING LIGHT WHITE	N/A	TELEMECANIQUE	N/A	XB4 BVB1	N/A	SCHNEIDER	N/A	N/A	N/A	2		10		
43	D2, D4, D5, D6, D7, D8, E1, E2, E3, E4, E5, E6, E7, E8, F1, F3, F4, F5, F6, F7, F8, F9		INDICATING LIGHT YELLOW	N/A	TELEMECANIQUE	N/A	XB4 BVB5	N/A	SCHNEIDER	N/A	N/A	N/A	2		10		

AZ Zabirah Aluminium Smelter
460V Cathode Sealing Motor Control Centre

Commissioning Spare

	DATE	REVISION
	13/03/11	0
PURCHASE ORDER NUMBER	00006528	
CONTRACT NUMBER	C6608	
DOCUMENT NUMBER	C6608V	
TAG NUMBER	4480-ECM1-0003	

ITEM No.	FUNCTIONAL LOCATION No.	EQUIPMENT No.	COMPONENTS (MATERIAL) DESCRIPTION	COMPONENT DESCRIPTION (LONG TEXT)	MANUFACTURER/ VENDOR NAME	MANUFACTURER'S MODEL	MANUFACTURER PART No.	MANUFACTURER SERIAL No.	SUPPLIER NAME	SUPPLIER CODE	MATERIAL NUMBER	DRAWING/ DOCUMENT No.	RECOMMENDED SPARES QUANTITY	TOTAL SPARES INSTALLED ON THE PLANT	PLANNED DELIVERY TIME (DAYS)	UNIT PRICE/ CURRENCY	WARRANTY PERIOD
2	B1, B2, B3, B4, C1, C2, C3, C4, D2, D4, D5, D6, D7, D8, D11, D12, E1, E2, E3, E4, E5, E6, E7, E8, E9, E10, F1, F3, F4, F5, F6, F7, F8, F9, F10		RELAY	N/A	ALLEN BRADLEY	N/A	700-HC24Z24-3	N/A	ROUTECO	N/A	N/A	N/A	1		10		
3	B1, B2, B3, B4, C1, C2, C3, D2, D4, D5, D6, D7, D8, D11, D12, E1, E2, E3, E4, E5, E6, E7, E8, E9, E10, F1, F3, F4, F5, F6, F7, F8, F9, F10		BREAKER AUXILIARY	N/A	ALLEN BRADLEY	N/A	140M-C-AFA10	N/A	ROUTECO	N/A	N/A	N/A	1		10		
4	B1, B2, B3, B4, C1, C2, C3, D2, D4, D6, D8, D11, E1, E3, E5, E6, E9, E10, F4, F6, F7, F8, F10		3P CONTACTOR 9A	N/A	ALLEN BRADLEY	N/A	100C09B10	N/A	ROUTECO	N/A	N/A	N/A	1		10		
5	F1		3P CONTACTOR 16A	N/A	ALLEN BRADLEY	N/A	100C16B10	N/A	ROUTECO	N/A	N/A	N/A	1		10		
6	D5, D7, E2, E4, F3, F5		3P CONTACTOR 23A	N/A	ALLEN BRADLEY	N/A	100C23B10	N/A	ROUTECO	N/A	N/A	N/A	1		10		
7	E7, E8, F9		3P CONTACTOR 30A	N/A	ALLEN BRADLEY	N/A	100C30B00	N/A	ROUTECO	N/A	N/A	N/A	1		10		
8	D12		3P CONTACTOR 12A	N/A	ALLEN BRADLEY	N/A	100C12B10	N/A	ROUTECO	N/A	N/A	N/A	1		10		
9	D2, D4, D6, D8, D12, E3, F4, F6, F8		OVERLOAD 1-5A	N/A	ALLEN BRADLEY	N/A	193EECB	N/A	ROUTECO	N/A	N/A	N/A	1		10		
10	E1, E5, E6, F7		OVERLOAD 3.2-16A	N/A	ALLEN BRADLEY	N/A	193EEDB	N/A	ROUTECO	N/A	N/A	N/A	1		10		
11	D5, D7, E2, E4, F1, F3, F5		OVERLOAD 5.4-27A	N/A	ALLEN BRADLEY	N/A	193EEEB	N/A	ROUTECO	N/A	N/A	N/A	1		10		
12	E7, E8, F9		OVERLOAD 9-45A	N/A	ALLEN BRADLEY	N/A	193EEFD	N/A	ROUTECO	N/A	N/A	N/A	1		10		
13	B1, B2, B3, B4, C1, C2, C3, D2, D4, D5, D6, D7, D8, D11, D12, E1, E2, E3, E4, E5, E6, E7, E8, E9, E10, F1, F3, F4, F5, F6, F7, F8, F9, F10		AUXILIARY CONTACT	N/A	ALLEN BRADLEY	N/A	100FA22	N/A	ROUTECO	N/A	N/A	N/A	1		10		
14	A6, B1, B2, B3, B4, C1, C2, C3, C4, D2, D4, D5, D6, D7, D8, D11, D12, E1, E2, E3, E4, E5, E6, E7, E8, E9, E10, F1, F3, F4, F5, F6, F7, F8, F9, F10		1A FUSE	N/A	LEGRAND	N/A	123 01	N/A	N/A	N/A	N/A	N/A	3		10		
15	A6		2A FUSE	N/A	SOCOMEC	N/A	6A10 0002	N/A	N/A	N/A	N/A	N/A	3		10		
16	D2, D4, D5, D6, D7, D8, E1, E2, E3, E4, E5, E6, E7, E8, F1, F3, F4, F5, F6, F7, F8, F9		INDICATING LIGHT WHITE	N/A	TELEMECANIQUE	N/A	XB4 BVB1	N/A	SCHNEIDER	N/A	N/A	N/A	1		10		
17	D2, D4, D5, D6, D7, D8, E1, E2, E3, E4, E5, E6, E7, E8, F1, F3, F4, F5, F6, F7, F8, F9		INDICATING LIGHT YELLOW	N/A	TELEMECANIQUE	N/A	XB4 BVB5	N/A	SCHNEIDER	N/A	N/A	N/A	1		10		

Certificate No. 13991

ASTA CERTIFICATION SERVICES

(Incorporated in the year 1938) ASTA House, Chestnut Field, Rugby, CV21 2TL, England

Laboratory Ref. No. QZA

CERTIFICATE OF SHORT-CIRCUIT RATING.

APPARATUS:	The three phase and neutral main horizontal and vertical riser busbars of a five cubicle incomer, feeder and bussection assembly, suitable for TNS systems. U_e = 440V U_i = 1000V.
DESIGNATION:	Main Switchboard with AT air circuit breakers.
MANUFACTURER:	New Circut Engineering, 117 Ruchill Street, Glasgow.
TESTED BY:	Fluvent Technical Services, Mosley Road, Trafford Park, Manchester.
DATE(S) OF TESTS:	8th & 9th December, 1998.

The apparatus, constructed in accordance with the description, drawings and photographs incorporated in this certificate has been subjected to the series of proving tests in accordance with IEC 439-1:1992 including AMD1 11/95 and AMD2 11/96, BSEN 60439-1: 1994 incorporating amendments 1, 2 & 3 clause 8.2.3 sub clauses 8.2.3.2.3 (b) and (d).

The results are shown in the Record of Proving Tests and the oscillograms attached hereto. The values obtained and the general performance are considered to comply with the above Standard(s) and to justify the ratings assigned by the manufacturer as stated below.

Short-time peak and withstand current tests on copper busbars.
2 x 160 x 10mm, 1 x 160 x 10mm main horizontal and bussection busbars.
1 x 100 x 10mm bussection to AT25 ACB 1 x 160 x 10mm vertical riser busbars to the AT25 ACB.
65kArms for 1 second 143kApk (n=2.2) three phase and single phase.
2 x 160 x 10mm and 2 x 120 x 10mm vertical riser busbars to the AT40 and AT32 ACB's respectively.
80kArms for 1 second 176kApk (n=2.2) three phase and single phase.
1 x 120 x 10mm vertical riser busbars to the AT20 ACB.
50kArms for 3 seconds 105kapk (n=2.1) three phase.
30kArms for 3 seconds 63kApk (n=2.1) single phase.
1 x 80 x 10mm vertical riser busbars to the AT12 ACB.
50kArms for 1 second 105kApk (n=2.1) three phase.
30kArms for 1 second 63kApk (n=2.1) single phase.

The record of Proving Tests apply only to the apparatus tested. The responsibility for conformity of any apparatus having the same designations with that tested rests with the Manufacturer.

This Certificate comprises 21 pages, 3 diagrams, 28 oscillograms, 9 photographs, 11 drawings and no other sheets as detailed on page 1.

integral reproduction of this Certificate, or reproductions of this page accompanied by any page(s) on which are the assigned rated characteristics of the apparatus tested, are permitted without written permission from ASTA, House, Chestnut Field, Rugby CV21 2TL England (see overleaf)

NATIONAL ACCREDITATION OF CERTIFICATION BODIES

Registration Number 010

The use of the Accreditation Mark indicates accreditation in respect of those activities covered by the accreditation certificate number 010.

G V Radcliffe ASTA Observer
G.V. RADCLIFFE

W. J. Swan Director

29th July 1999 Date

Declaration of Conformity

We, NCE Switchgear of 79 Beardmore Way, Dalmuir, Glasgow, G81 4HT, Scotland, declare the Low Voltage and Controlgear assembly described by documents:

Arrangement Drawing: ***D6608-1 General Arrangement***

Electrical Diagrams: ***D6608-2, D6608-3, D6608-4, D6608-5A, D6608-5B AS WELL AS CLIENT DRAWINGS***

to which this declaration relates, is in conformity with:

BSEN 60439/1 1999 - *Low voltage switchgear and Control gear assemblies. Part 1 Specification for type-tested and partially type-tested assemblies.*

The components have been assembled under the instructions and methods stated by the suppliers, the assembly is deemed to comply with the following provisions of the Council of European Communities Directives.

* 89 336/EEC EMC Directive

* 73 23/EEC Low Voltage Directive

If the assembly is incorporated into machinery to which Council directive 89/392/EEC applies, it must not be put into service until the machinery has been declared in conformity with that directive.

Authorised Signature..... R. Cairns

Name: Ronnie Cairns

Position: Senior Project Engineer

CE

Date: 01/Mar/11

Test and Inspection Report (FACTORY)	**NCE Switchgear** **79 Beardmore Way** **Clydebank Industrial Estate,** **Dalmuir, Glasgow G81 4HT** **Tel: 0141 952 1166** **Fax: 0141 952 1188**
Report No. Date 28/2/11	
Customer: GNA	
Project Ref:	
Schematic Drg No. D6608-1-5	
Layout Drg No	
Job No. C6608	

The following equipment has been inspected and tested to criteria laid down in the attached schedules and in accordance with the above customer documentation.

Equipment: CATHODE SEALING SHOP MCC AZ ZABIRAH SMELTER

		Tick section if relevant
Schedule 1	Visual Inspection	✓
Schedule 2	Parts list verification	✓
Schedule 3	Earthing	✓
Schedule 4	Insulation / Flash test	✓
Schedule 5	Functional Operation	✓
Schedule 6	Phase check & Connections	✓
Schedule 7	C.T. Polarity check	✓
Schedule 8	Pre-Delivery check list	O

The equipment detailed in this report has been passed and released for delivery taking cognizance of schedule 8

The signatures below confirm all sections marked above have been tested & witnessed

On behalf of NCE Switchgear		Report Circulation
Signed: M. Young	Date: 28/2/11	1 CLIENT O+M
On behalf of Customer:		
Signed:	Date: 1/3/11	2 JOB FILE.
On behalf of Customers Client		
Signed:	Date: 1/3/11	3

MOODY INTERNATIONAL Reviewed Witnessed Date: 1/3/11 UK - 0011

Visual Inspection

Schedule 1

Enclosure

1.1	✓	Size
1.2	✓	Colour
1.3	✓	Finish shade
1.4	✓	General Fabrication
1.5	✓	G Plate seal
1.6	✓	Door seal
1.7	✓	Door component seal

Wiring

1.8	✓	Power cable size
1.9	✓	Power cable colours
1.1	✓	Power cable type
1.11	✓	Colour
1.12	✓	Control cable size
1.13	✓	Control cable type
1.14	✓	Cable markers per schematic
1.15	✓	Sufficient Lgth / Reconnect
1.16	✓	Ducting capacity

Terminations

1.17	✓	Mechanically secure
1.18	✓	Correct crimp / lug size
1.19	✓	Terminal rail as layout drg.
1.2	✓	Voltage segregation

Shrouds

1.21	✓	Isol. (incoming)
1.22	✓	Isol. (outgoing)
1.23	✓	Dist. Busbars
1.24	✓	Terminal rail
1.25	N/A	~~Unisolated equipment~~

Entries

1.26	✓	Bottom
		Top

Access

1.28	✓	Front
		All round

Painting

1.29	✓	Satisfactory
		Unsatisfactory

Labelling

1.31	✓	Spelling
1.32	✓	Translation
1.33	✓	Text as per drgs
1.34	✓	Text unobscured by fixings
1.35	✓	ID of all Comps.
1.36	✓	Danger / Warnings
1.37	✓	Appearance (sq. neat layout)

Mechanical Operation

1.38	✓	Isolator
1.39	✓	Door Int / Lock
1.4	N/A	~~Mechanical Int / Lock~~
1.41	✓	O/L Resets
1.42	✓	PB's & SW's
1.43	N/A	~~Latches~~
1.44	✓	Door locks

Mechanical layout, Clearance and Security

1.45	✓	Wires clear / Potentially H/equip
1.46	✓	Wires protected against sharp objects
1.47	✓	Door loom protected
1.48	✓	Door loom anchored securely
1.49	✓	Door loom unrestrained
1.50	✓	Components secure
1.51	✓	Square neat layout of each compartment

Busbars

1.52	✓	Busbar - supports
1.53	✓	Support - Clicks
1.54	✓	Support - Spacer retainers
1.55	✓	Support - Spacers
1.56	✓	Support - Steel bars
1.57	✓	Support - Rods

Comments:

Signed:-

Parts List Survey

Schedule 2

Check that all fitted components are as specified on parts list No.

Particular attention to be paid to the following features:

Incomer

2.1	N/A	Rating
2.2	N/A	Trip setting (if applicable)
2.3	N/A	Fuse sizes (if applicable)
2.4	✓	Busbar rating
2.5		

Outgoing Sections

2.6	✓	Fuse sizes
2.7	✓	Contactor rating
2.8	✓	Coil voltage
2.9	✓	O'Load range / settings
2.10	✓	MCCB ratings,Circuit breaker frame sizes & ratings

D.C. Components

2.11	N/A	PSU Input voltage
2.12	N/A	PSU Output voltage
2.13	✓	Voltages of DC device
2.14		

Other Components

2.15	✓	Relay voltages
2.16	N/A	Timer voltages
2.17	N/A	Timer range / setting
2.18	N/A	Lamp TX voltages
2.19	✓	Bulb voltages
2.20	N/A	Hrs run, Counters, Inst, etc voltages
2.21	N/A	Ammeter scale range
2.22	✓	CT Ratio's
2.23	✓	Voltmeter, Ammeter, Multimeter readings in each switch position CROMPTON DIGITAL ENERGY METER.
2.24	N/A	Restricted earth fault

Pneumatics

2.25	N/A	Pressure switch range / setting
2.26	/	Pressure range guage
2.27	/	Pressure guage set points
2.28	/	
2.29	/	
2.30		

Comments:			

Signed:-

Earthing

Schedule 3

Visual check of earthing points

- ✓ Earth stud
- ✓ Terminal rail
- ✓ Enclosure
- ✓ Door
- ✓ Gland plates
- ✓ TX Section & screen
- ~~N/A~~ Additional equipment

- ✓ Earth stud / correct size / material complete with nuts, washers etc.
- ✓ CSA of earth cables correct all terminations
- ✓ Mechanically secure

Comments:

Signed:-

Insulation

Schedule 4

NOTE - All electronic devices must be unplugged or disconnected

Ducter test

Insulation resistance test

Dielectric test

Test Voltage	**500/1000 DC Megger**		**2.5KV RMS (415V Power) FOR 1 MINUTE**		**MA Leakage**	
L1-L2	>	999 MEGOHMS			<	3
L2-L3	>	999 MEGOHMS			<	3
L3-L1	>	999 MEGOHMS			<	3
L1-NEUTRAL	>	999 MEGOHMS			<	3
L2-NEUTRAL	>	999 MEGOHMS			<	3
L3-NEUTRAL	>	999 MEGOHMS			<	3
L1-EARTH	>	999 MEGOHMS			<	3
L2-EARTH	>	999 MEGOHMS			<	3
L3-EARTH	>	999 MEGOHMS			<	3

Comments:

Signed:-

Function Tests

Schedule 5

Measured Voltage Checks

Power Supply	460	Volts	3	Phase	50 HZ
Control Supply		Volts		Phase	HZ
DC Power	1 24	Volts	2	Volts	3 Volts

Incoming & Systems Check

1) Prove Incomer to switchboard	✓
2) Prove Multiple Incomers to switchboard	N/A
3) Prove any change-over & Control operations	N/A

Section Functionability

Check all sections from left hand row to far right hand row for functional acceptability

Item	CCT Ref.	Description of items proved using links, switches etc to simulate sequence of operation	Results - Operations of devices, lamps etc

Comments:

Signed:-

Busbar Ratings, Phase Markings & Connections

Schedule 6

Visually check phase markings
Main incoming connection

L1	✓
L2	✓
L3	✓
N	

N/A

Tick in box - Phasing is correct

Back-up fuse phase
Rotation/Dirus check

L1	✓
L2	✓
L3	✓
N	

N/A

Visually check phase rotation correct and marked incoming feeds to compartments

L1	✓
L2	✓
L3	✓
N	

N/A

Tick in box - Phasing is correct

Visually check phase rotations are correct and marked outgoing connections from compartments

L1	✓
L2	✓
L3	✓
N	

N/A

Tick in box - Phasing is correct

Comments:

Signed:-

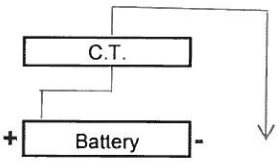
Polarity and Continuity Test on Protection and Information C/T's

Schedule 7

NCE

Polarity and Continuity Tests

For each CT connect meter (AVO or DC Voltmeter) across S1 and S2:
Positive terminal to S1 and negative terminal to S2.
Connect cable to positive side of battery.
Pass charge through P1 side of current transformer towards P2 and flick cable end to negative side of battery and observe deflection.



✓

800/1. C/T's.

Correct deflection: make circuit - deflection
break circuit - return to zero

Protection C/T's			Information C/T's		
Primary Current	Ferrule Nos Secondary S1	Secondary S2	Primary Current	Ferrule Nos Secondary S1	Secondary S2
			RED	S11	C12
			YELLOW	C31	C32
			BLUE	C51	C52

Pre-Delivery Check List

Schedule 8

NCE

[ ] Drawings require updating as a result of testing

Details:

[ ] Drawings supplied with equipment

[✓] Loose items secured (keys, Tools, etc)

[ ] Manuals supplied with equipment

[ ] Spares despatched with equipment

Details: INSTALLATION PARTS – FISH PLATES, NUTS & BOLTS ETC.

[✓] Equipment ~~removed and~~ despatched separately

Details: SPLIT INTO 3 SECTIONS FOR DESPATCH.

[ ] Outstanding work to be completed on site

Details:

[✓] Photographs - all relevant photographs to be taken

Details: NCE RECORDS

Comments:

Signed: R. Cairns

Maintenance of Electrical Control Gear

1 Introduction

The maintenance of electrical control gear means keeping the gear in good working condition, but those concerned with this work should also familiarise themselves with the plant driven by the electrical control gear and report any changes which affect the system. Many of the failures in electrical control gear are caused by incorrect allocation of particular components and can only be cured by replacement with a suitable model.

Recommended procedures for testing, inspection and maintenance of the principle components of electrical control gear are detailed below.

Note: Some of the more complicated components used in the system require specialised maintenance, and we do not attempt to cover these in this section. Refer to the component literature section for further information.

2 General

The essence of good maintenance is applied common sense. Good maintenance is an important part of good housekeeping in a plant. If the staff responsible give due regard to the safety of personnel, safety of plant and continuity of operation then, generally speaking, costs will take care of themselves and there will be few troubles with the maintenance of electrical control gear.

3 Analysis of Faults

Every fault should be recorded, analysed, and consideration should be given to the cause of the breakdown. Wherever possible the appropriate remedial action should be taken to avoid the reoccurrence of the fault.

4 Change in Service Conditions

The maintenance staff should always be on the look out for, and should report immediately, any changes in service conditions which may have a detrimental effect on the control gear. Such changes may either necessitate more frequent maintenance or the replacement of the electrical control gear. These changes may occur in:

- load conditions
- safety conditions
- site conditions

5 End of Useful Life of Components

There comes a time with electrical control gear when various components such as contactor contacts become worn and require large scale replacement. It is often difficult to decide when this moment has arrived, but when routine maintenance becomes costly the position should be reviewed and the equipment completely overhauled or replaced. Improvement in design over a long period may alone make a change worthwhile.

6 Isolation Before Maintenance Work

Before any work is carried out on or near parts which are normally live, or where danger would arise to personnel working if the equipment was inadvertently started, it is essential that the equipment be isolated and proved dead. In the case of equipment operating above 650 volts the conductors should also be efficiently earthed.

7 Cleanliness

For equipment to operate satisfactorily it is essential that it be kept clean. Before removing covers and opening doors, loose dirt and dust resting on the top of the enclosure should be removed using a brush.

7.1 When air is used for cleaning, a suction type device with dust collection should preferably be used. It is not recommended to use blown compressed air.

7.2 'Cotton waste' should not be used for cleaning. If cloths are used they should be chemically cleaned and free from loose fibres. This is particularly important with oil immersed equipment as the loose fibres may aline under dielectric stress and lead to failure of the equipment.

7.3 When solvents are used for cleaning or degreasing they should be of a non-flammable and non toxic nature, and at all times precautions against fire should be observed.

After maintenance work all covers and doors including those of instruments and relays should be securely replaced to prevent the ingress of dust.

8 Marking of Covers and Connections

All covers, cables, shields etc should be marked carefully before removal to ensure correct replacement.

If connections are disturbed or temporary connections made for testing purposes, they should be clearly marked to facilitate reconnection. The permanent connection must be restored and the temporary connections removed before the unit is returned to service.

9 Tightness of Connections

After maintenance, the bolts, screws and locking devices of all current carrying and earth connections should be securely replaced.

Connections which have not been disturbed should be checked for soundness. It is not sufficient for nuts and bolts to appear tight, sometimes a bolt will not be threaded quite far enough and will give the impression of a tight connection when in fact, the connection is loose. A millivolt drop test will reveal bad connections and it may be possible to detect a bad connection by looking for signs of overheating.

Connecting aluminium to aluminium, copper or brass satisfactorily requires care, particularly if the joint is to be made and broken from time to time, and the use of proprietary compounds may be advantageous.

10 Maintenance of Insulation

Reliable insulation is as important as conductors and with this in mind close visual inspection and regular testing are most essential.

10.1 Testing

Visual examinations usually suffice for moulded insulators but other insulation such as synthetic resin bonded paper (S R B P) are particularly susceptible to the ingress of moisture, overheating or tracking and visual inspection should be supplemented by regular testing.

Insulation resistance measurements are easily made and the most suitable for routine tests, but for their proper interpretation, systematic testing and recording methods are essential. It is only possible to judge the condition of insulation by comparing insulation resistance readings taken over a considerable period. If these show a steady decline in value, the danger is greater than if a steady low value is recorded. If humidity and/or temperature readings are taken at the same time as the insulation tests this may prove advantageous. Where possible insulation should be allowed to reach ambient temperature before tests are carried out.

Thorough visual examination for cracks or other mechanical damage is as important as electrical tests.

10.2 Cleaning

It is advisable when cleaning insulation to wipe across the likely tracking path and not in line with it. The use of a brush in conjunction with caution is recommended and note should also be taken of the recommendations set out in paragraph 7.

11 Isolators and Fuse Switches

Because one side of most isolating devices carries the incoming supply and other control voltages on the auxiliary contacts, special care must be taken to ensure it is fully isolated before any maintenance is carried out.

The correct operation of isolators and fuse switches plays a major part in safety of personnel, most modern day types do not have removable contacts etc and as such require little more maintenance than a visual inspection, cleaning is necessary, and checking of tightness of connections. However as they normally control access to starter compartments proving the operation of any door interlocking must be carried out.

12 Fuses

Where cartridge type fuses are used, replacements should be of the same type and rating as the original. In no circumstance should attempts be made to rewire non rewirable type

fuses. Where a locking device is employed to hold the fuse in position it should be replaced when the work is finished.

If any one or more fuses in sets (eg three phase circuit) has blown it is recommended that all three are replaced and the old ones destroyed.

If any fuse has blown the reason for this must be traced and rectified before replacing the fuse.

13 Fuse Holders

The only maintenance required for fuse holders is a visual inspection, checking for tightness of connections and lightly smearing knife contacts with petroleum jelly.

14 Pushbuttons/Selector Switches etc

Local and remote 'stop' buttons are an important part of electrical installations. Failure to ensure proper maintenance of either operational or emergency stop pushbuttons can therefore constitute a major safety hazard. Maintenance work on control equipment must always include a careful visual and operational check on all pushbutton/selector switched etc. The fact that emergency stop pushbuttons may seldom be used makes it more important to regularly inspect them.

All pushbuttons that have a spring return operation should also be checked for any jamming.

15 Air Break Contactors and Block Relays

Most air break contactors of modern design are of the block type, at the lower ratings of contactors and block relays maintenance consists of a visual inspection and checking tightness of connections. Normally the only spare parts available are operating coils which can be replaced according to manufacturers instructions. With larger rating contactors the above still applies but replacement contacts are also normally available. After any maintenance work has been carried out the contactors operation should be proved with the main supply isolated.

If a mechanical latching attachment is used operation of this should also be included in regular maintenance.

If a contactor hums during operation it is likely that swarf or some other foreign material has got onto the magnet armature face, if this is the case the contactor should be disassembled and the magnet armature face cleaned, failure to do this could lead to an overheated operating coil. Under no circumstance should any attempt be made to clean the surface of contacts and also no lubricating material such as oil be used unless specifically stated elsewhere in this manual.

16 Time Delay Devices

Most timing devices used in modern equipment are fully sealed pneumatic or electronic types. These do not contain any user serviceable parts and maintenance should consist of

a visual inspection and checking of connection tightness. If available the control supply can be applied to prove the operation.

17 Overload Protection Devices

There are many types of overload protection devices the three most commonly used are:

- electronic
- thermal
- oil dashpot

17.1 Electronic overloads are normally fairly complex and this being the case have specific maintenance requirements. The literature for these, if fitted, will be found in the component literature section of this manual.

17.2 Thermal overloads require little maintenance other than a visual inspection and checking the connections for tightness, however it is adviseable to periodically electrically test them with a current injection test set and compare the results with the previous test results.

17.3 Oil dashpot devices require similar maintenance to thermal devices with the addition of checking the level and condition of the oil, the oil should always be topped up/replaced with the correct type as specified by the manufacturer.

18 Control Circuit Transformers

Control circuit transformers, having no moving parts, are generally very reliable and as such the only routine maintenance required is a visual inspection, checking of connections for tightness and if required checking the tightness of armature clamping bars.

19 Power Supply Units

Power supply units are generally sealed and have no user serviceable parts, the routine maintenance therefore being a visual inspection and checking the tightness of connections.

20 PLC’s

PLC’s are generally sealed and have no user serviceable parts, the routine maintenance therefore being a visual inspection and checking the tightness of connections

21 Level Control Units

Level Control Units are generally sealed and have no user serviceable parts, the routine maintenance therefore being a visual inspection and checking the tightness of connections

1321 Power Conditioning Products

Technical Data

LINE REACTORS
REFLECTED WAVE DEVICES
ISOLATION TRANSFORMERS
COMMON MODE CHOKES
DC LINK CHOKES

DON'T IGNORE THE COST OF POWER LINE DISTURBANCE

LISTEN.
THINK.
SOLVE.®

Allen-Bradley • Rockwell Software

Rockwell Automation

Overview

Allen-Bradley reactors help keep equipment running longer by absorbing many of the power line disturbances which can shut down your drive. Allen-Bradley isolation transformers can provide both voltage change and isolation for your variable speed drive. These designs are harmonic compensated and IGBT protected to assure optimum performance in the presence of harmonics.

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Reference Materials

For additional information, refer to the following publications:

Title	Publication	Available...
Wiring and Grounding Guidelines for PWM Drives	DRIVES-IN001...	www.rockwellautomation.com/literature
Safety Guidelines for the Application, Installation and Maintenance of Solid State Control	SGI-1.1	

For Allen-Bradley Drives Technical Support:

Title	Online at...
Allen-Bradley Drives Technical Support	www.ab.com/support/abdrives or call (1) 262.512.8176

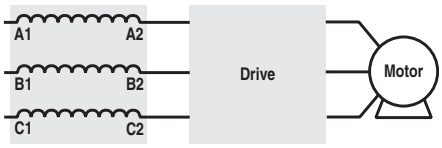
1321-3R and 3RA Series Line Reactors

Applying Allen-Bradley Line Reactors

At the Input of the Drive

At the input of a drive, line reactors help protect against surges or spikes on the incoming power lines and help reduce harmonic distortion.

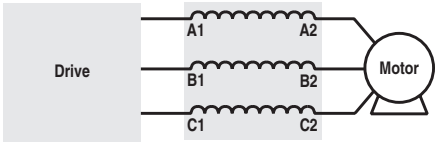
- Eliminate Nuisance Tripping
- Extend Semiconductor Life
- Reduce Harmonic Distortion
- Improve True Power Factor
- Reduce Voltage Notching
- Meet IEEE-519 or EN-61800



At the Output of the Drive

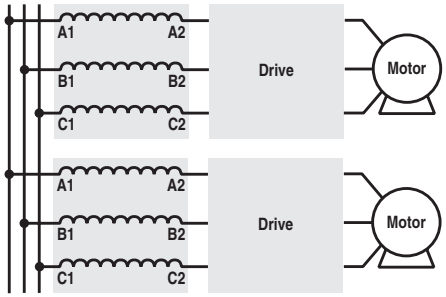
In long motor lead applications, Allen-Bradley load reactors located between the drive and motor help reduce dv/dt and motor terminal peak voltages. The use of a load reactor also helps protect the drive from surge currents caused by rapid changes in the load.

- Protect Motors from Long Lead Effects
- Reduce Output Voltage dv/dt
- Extend Semiconductor Life
- Reduce Surge Currents
- Reduce Motor Temperature
- Reduce Audible Motor Noise



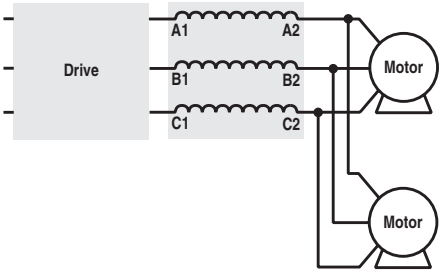
With Multiple Drives

Multiple drives on a common power line should each have their own line reactor. Individual line reactors provide filtering between each drive to help reduce any crosstalk while providing optimum surge protection for each drive.



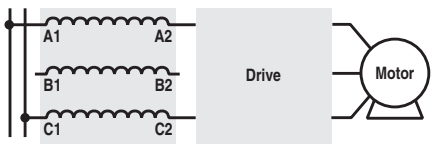
With Multiple Motors

When more than one motor is controlled by a single drive, a single line reactor can typically be used between the drive and all the motors. Size the line reactor based on the total motor/load horsepower.



With Single-Phase Input

A three-phase reactor can be used for single-phase applications by routing each of the two input power conductors to the outside two coils, and leaving the center coil disconnected. The sum of the inductance of the two coils is the total inductance applied to the circuit. Contact Rockwell Automation Technical Support for assistance in specifying the proper reactor.



1321-3R and 3RA Series Line Reactors

Selecting the Correct Impedance Rating

Why is the Right Impedance Rating Important?

Selecting the correct impedance rating is critical for your job. An impedance value too low may not limit peak current. Too high of an impedance may reduce input voltage. Allen-Bradley line reactors offer two impedance ratings.

3% Impedance Rated Reactors to Reduce Nuisance Trips

Allen-Bradley line reactors rated at 3% are typically sufficient to absorb line spikes and motor current surges and will help prevent nuisance tripping of drive and circuit breakers in most applications.

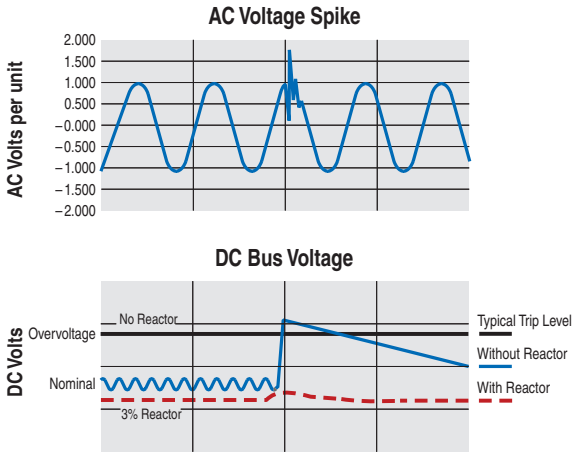
5% Impedance Rated Reactors to Reduce Harmonic Content

Allen-Bradley reactors rated at 5% are best for reducing harmonic current and frequencies. These line reactors help comply with IEEE-519 (not normally used as load reactors).

Voltage Spike Protection

Voltage spikes on AC power lines can cause elevation of the DC bus voltage which may cause the drive to trip on an overvoltage condition.

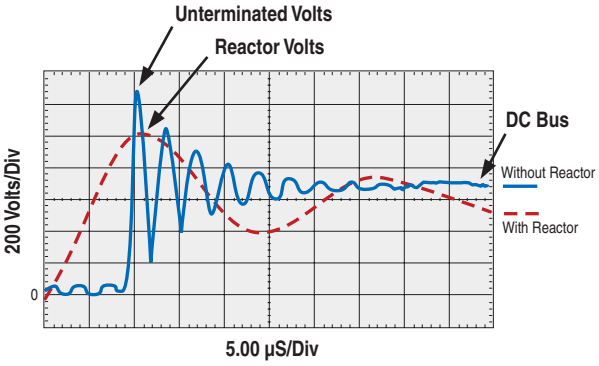
3% impedance reactors are very effective at protecting drives against voltage spikes and nuisance tripping. Allen-Bradley line reactors absorb these line spikes protecting the drive from nuisance tripping and damage.



Motor Protection

Allen-Bradley load reactors can help protect motors from high peak voltages.

For IGBT drive applications with long drive-to-motor lead lengths, Allen-Bradley load reactors can help protect against fast dv/dt rise times.



1321-3R and 3RA Series Line Reactors

Catalog Number Explanation

Position Number

1-4		*6*	*7*	*8*		*10*
1321	–	3	R	4	–	B
a		*b*	*c*	*d*		*e*

a

Product	
Code	**Type**
1321	1321 Power Component

b

Phases	
Code	**Description**
3	Three-Phase

c

Device	
Code	**Description**
R	Reactor, Open
RA, RB	Reactor, NEMA 1
RAB	Reactor, NEMA 1, Cabinet Style 2 Only

d

Fundamental Amps	
Code	**Amps**
1	1
2	2
4	4
8	8
12	12
18	18
25	25
35	35
45	45
55	55
80	80
100	100
130	130
160	160
200	200
250	250
320	320
400	400
500	500
600	600
750	750
850	850
1000	1000

e

Inductance Rating	
Code	**Description**
A	Each reactor current rating has four inductance ratings also available. See the IP00 dimension table.
B	
C	
D	

1321-3R and 3RA Series Line Reactors

Common Specifications

Specification		Rating
Material	Enclosures	IP11 (NEMA/UL Type 1) — Sheet steel in accordance with UL, NEMA requirements
		IP00 (Open) or IP20 (Open - with finger safe terminals)
	Terminations	1-45 Amp (fundamental) Ratings – Finger guard IP20 terminal block
		80-160 Amp (fundamental) Ratings – Solid copper box lugs
		200-400 Amp (fundamental) Ratings – Copper tab terminals
		401 Amps and Above – Copper tab terminals
Harmonic Compensation	All line reactors are compensated for the additional currents and high frequencies caused by the presence of harmonics	
General Protection	Impedance	3% or 5% based on the fundamental current ratings
	Overload Rating	200% of fundamental current for 30 minutes 300% of fundamental current for 1 minute
	dv/dt Protection	Meets NEMA MG-1, part 31
Electrical	Max. Rated Voltage	600V AC (units with terminal blocks) 690V AC (units with box lugs or tab terminals)
	Max. Switching Freq.	20 kHz
	Fundamental Frequency	Line/Load - 50/60 Hz
	Temperature Rise	135 degrees C average
	Dielectric Strength	3,000 Volts rms (4,243 volts peak)
	Inductance Curve (Typical)	100% at 100% current 100% at 150% current 50% at 350% current (minimum)
	Inductance Tolerance	±10%
	Insulation System	Class N (200 degrees C)
	Impregnation	High bond strength solventless epoxy, 200 degrees C, UL94HB recognized
Environmental	Ambient Temperature	45 degrees C (maximum)
	Altitude	1000 meters (3280 feet)
Agency Approvals	UL-508	File E180243 Component Listed (1-2400 amps) File E180243 UL Listed NEMA Type 1 units (1-2400 amps) Note: Short Circuit rating not required under Exception No.1 of UL508A SB4.2.1 effective 4/25/06
	CSA C22.2, Class N, 200° C	File LR29753-13 CSA Certified (1 amp - 2400 amps) File E66214, Type 200-18, UL Recognized Insulation System
	CE	TUV certified to EN61558-2-20:2000

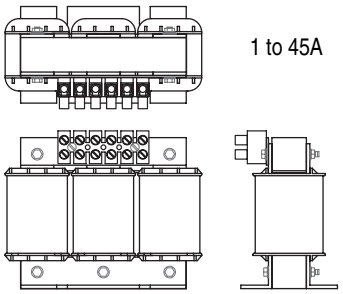
1321-3R and 3RA Series Line Reactors

Termination

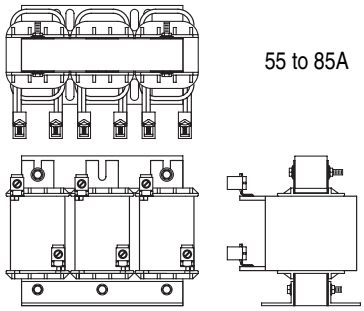
Allen-Bradley reactors rated 45 Amps (fundamental) and below are supplied with an integral mounted terminal block. Reactors rated from 55 to 160 Amps (fundamental) are supplied with box lugs. Reactors rated 200 to 400 Amps (fundamental) will be supplied with front facing copper tabs. Above 400 Amps (fundamental), side facing copper tabs are used.

The "3R" and "3RA" designations for the 1321 line reactors indicate the following: 3R = Open Enclosure Line Reactor and 3RA = NEMA 1 Enclosure Line Reactor.

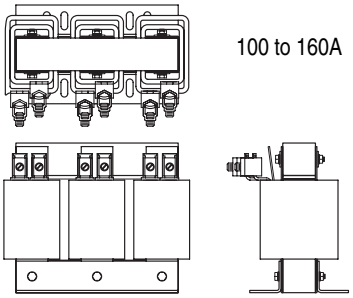
Typical Termination Types and Specifications



Terminal Blocks

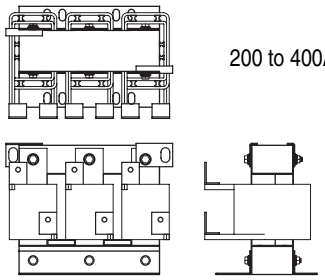


SLU-125 Box Lugs

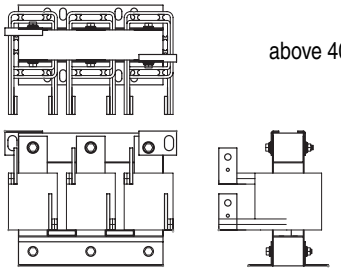


SLU-225 Box Lugs

Reactor Catalog Number		Termination	Max./Min. Wire Size	Max. Torque
IP00 (Open) or IP20	*IP11 (NEMA/UL Type 1)*	*Type*	*mm^2 (AWG)*	*Nm (lb.-in.)*
1321-3R1-A to 1321-3R8-D	1321-3RA1-A to 1321-3RA8-D	20A Terminal Block	2.1/0.3 (14/22)	0.51 (4.5)
1321-3R12-A to 1321-3R35-B	1321-3RA12-A to 1321-3RA35-B	65A Terminal Block	16.0/0.3 (5/22)	1.81 (16)
1321-3R35-C to 1321-3R45-C	1321-3RA35-C to 1321-3RA45-C	85A Terminal Block	21.2/0.8 (4/18)	2.26 (20)
1321-3R55-A to 1321-3R80-C	1321-3RA55-A to 1321-3RA80-C	SLU-125 Box Lug	50.0/10.0 (0/6)	5.09 (45)
1321-3R100-A to 1321-3R160-C	1321-3RA100-A to 1321-3RA160-C	SLU-225 Box Lug	120.0-27.0 (0000/2)	16.95 (150)



Front Facing Copper Tabs



Side Facing Copper Tabs

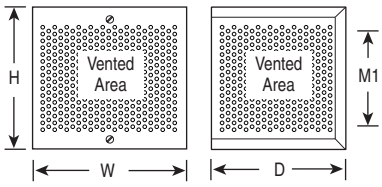
Reactor Catalog Number		Termination	Contact Surface *(H x W)*	Hole Diameter	Thickness
IP00 (Open) or IP20	*IP11 (NEMA/UL Type 1)*	*Type*	*mm (in.)*	*mm (in.)*	*mm (in.)*
1321-3R200-A to 1321-3R200-C	1321-3RA200-A to 1321-3RA200-C	Front Facing Copper Tab	41.3 x 25.4 (1.63 x 1.0)	10.36 (0.408)	3.18 (0.125)
1321-3R250-B to 1321-3RB250-C	1321-3RAB250-A to 1321-3RAB250-C	Front Facing Copper Tab	57.2 x 19.1 (2.25 x 0.75)	10.31 (0.406)	4.75 (0.187)
1321-3RB320-A to 1321-3R400-A	1321-3RAB320-A to 1321-3RA400-A	Front Facing Copper Tab	44.5 x 38.1 (1.75 x 1.5)	10.31 (0.406)	3.18 (0.125)
1321-3R500-A	1321-3RA500-A	Side Facing Copper Tab	44.5 x 38.1 (1.75 x 1.5)	10.31 (0.406)	3.18 (0.125)
1321-3R500-B to 1321-3R500-C	–	Front Facing Copper Tab	76.2 x 38.1 (3.00 x 1.5)	13.49 & 6.35 (0.531 & 0.25)	6.35 (0.25)
–	1321-3RA500-B	Side Facing Copper Tab	44.5 x 38.1 (1.75 x 1.5)	10.31 (0.406)	3.18 (0.125)

1321-3R and 3RA Series Line Reactors

Mounting Dimensions and Weights

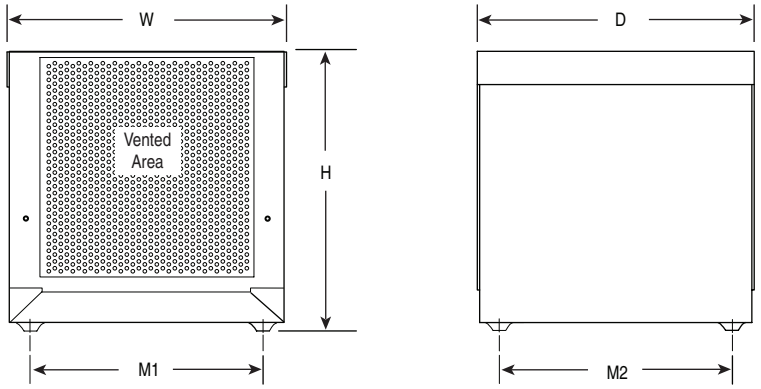
Important: The dimensions and weights provided on the following pages are for estimating purposes only. Conduit entry locations for floor mounted enclosures are the responsibility of the installer. Contact your Allen-Bradley Sales Office if certified drawings are required for planning and installation.

IP11 (NEMA/UL Type 1)



Cabinet 1 – Wall Mounted

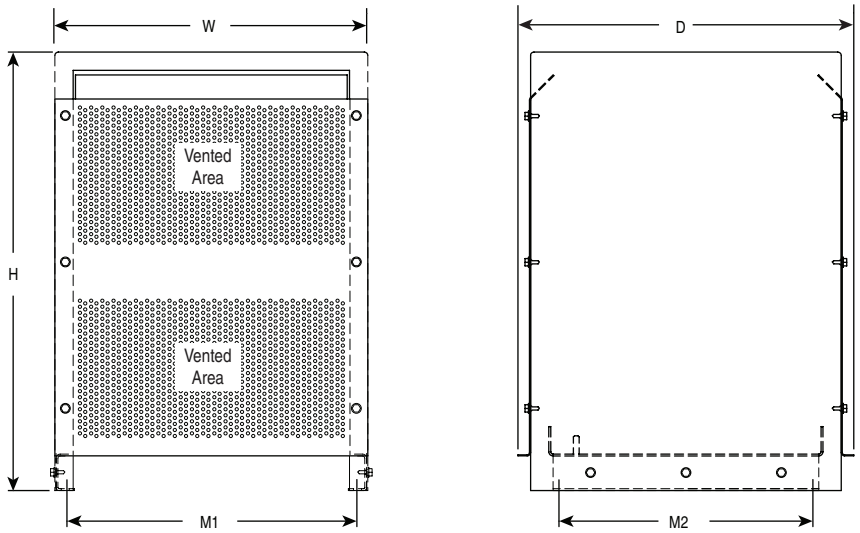
Catalog Number *1321- …*	Unit	*Dimensions in mm (in.) and Weights in kg (lbs.)*				
		H	**W**	**D**	**M1**	**Weight** *(Cabinet Only)*
3RA1-A to 3RA18-B	Cabinet 1	203 (8.0)	203 (8.0)	152 (6.0)	140 (5.5)	3.2 (7)



Cabinet 2 –Floor Mounted

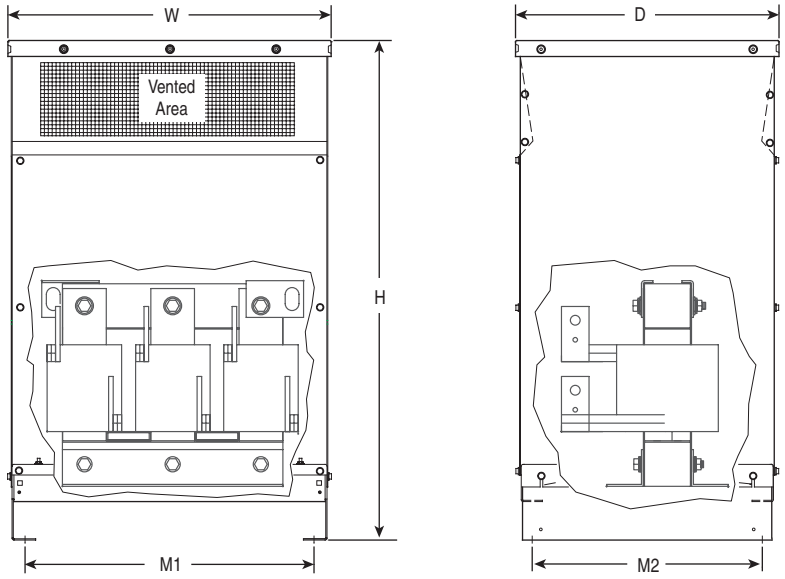
Catalog Number *1321- …*	Unit	*Dimensions in mm (in.) and Weights in kg (lbs.)*					
		H	**W**	**D**	**Feet M1**	**Feet M2**	**Weight** *(Cabinet Only)*
3RA18-C to 3RAB250-A	Cabinet 2	330 (13.0)	336 (13.2)	332 (13.1)	279 (11.0)	279 (11.0)	8.2 (18)

1321-3R and 3RA Series Line Reactors



Cabinet 3 – Floor Mounted

Catalog Number *1321- …*	Unit	*Dimensions in mm (in.) and Weights in kg (lbs.)*					
		H	**W**	**D**	**Feet M1**	**Feet M2**	**Weight** *(Cabinet Only)*
3RA250-B to 3RA500-A	Cabinet 3	610 (24.0)	429 (16.9)	467 (18.4)	406 (16.0)	343 (13.5)	12.2 (27)



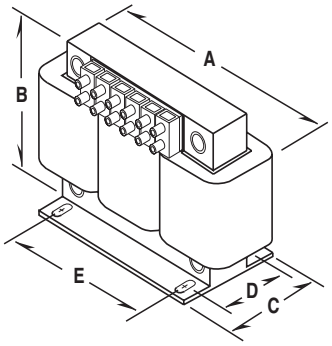
Cabinets 4, 5 & 6 – Floor Mounted

Catalog Number *1321- …*	Unit	*Dimensions in mm (in.) and Weights in kg (lbs.)*					
		H	**W**	**D**	**Feet M1**	**Feet M2**	**Weight**(1) *(Cabinet Only)*
3RA500-B to 3RA600-C	Cabinet 4	787 (31.0)	446 (17.5)	531 (20.9)	363 (14.3)	450 (17.8)	65.3 (144)
3RA750-A to 3RA850-B	Cabinet 5	1194 (47.0)	674 (26.6)	633 (24.9)	592 (23.3)	554 (21.8)	72.1 (159)
3RA850-C to 3RA1000-C	Cabinet 6	1829 (72.0)	676 (26.6)	633 (24.9)	592 (23.3)	554 (21.8)	72.1 (159)

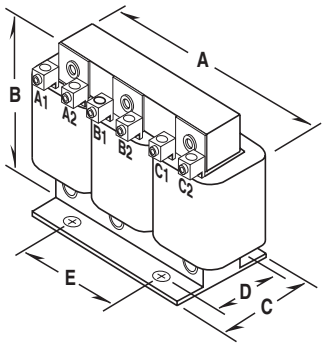
(1) For total weight - add enclosure weight to specific reactor weight.

1321-3R and 3RA Series Line Reactors

IP00 (Open)



IP00 (Open)
45 Amps (fundamental) and Below



IP00 (Open)
80 Amps (fundamental) and Above

Sizing Guidelines

Fundamental amps are used for sizing the reactor to be equal to or slightly higher than the total motor FLA. Sizing reactors to drive ampere ratings alone may result in mis-sizing the reactor.

Catalog Number	Fundamental Amps	Inductance - *mH* (Based on Fundamental Amps)	Watts Loss	*Dimensions in mm (in.) and Weight in kg (lbs.)*					
				A	B	C	D(1)	E	Weight
1321-3R1-A	1	100.0	14	112 (4.40)	104 (4.10)	79 (3.10)	60 (2.35)	37 (1.44)	1.8 (4)
1321-3R1-B		50.0	14.8	112 (4.40)	104 (4.10)	71 (2.80)	50 (1.98)	37 (1.44)	1.8 (4)
1321-3R1-C		36.0	12	112 (4.40)	104 (4.10)	71 (2.80)	50 (1.98)	37 (1.44)	1.4 (3)
1321-3R1-D		18.0	5	112 (4.40)	104 (4.10)	71 (2.80)	50 (1.98)	37 (1.44)	1.4 (3)
1321-3R2-A	2	12.0	7.5	112 (4.40)	104 (4.10)	71 (2.80)	50 (1.98)	37 (1.44)	1.8 (4)
1321-3R2-B		20.0	11.3	112 (4.40)	104 (4.10)	71 (2.80)	50 (1.98)	37 (1.44)	1.8 (4)
1321-3R2-C		32.0	16	112 (4.40)	104 (4.10)	71 (2.80)	50 (1.98)	37 (1.44)	1.8 (4)
1321-3R2-D		6.0	10.7	112 (4.40)	104 (4.10)	64 (2.50)	44 (1.73)	37 (1.44)	1.4 (3)
1321-3R4-A	4	3.0	14.5	112 (4.40)	104 (4.10)	71 (2.80)	50 (1.98)	37 (1.44)	1.8 (4)
1321-3R4-B		6.5	20	112 (4.40)	104 (4.10)	71 (2.80)	50 (1.98)	37 (1.44)	1.8 (4)
1321-3R4-C		9.0	20	112 (4.40)	104 (4.10)	86 (3.40)	60 (2.35)	37 (1.44)	2.3 (5)
1321-3R4-D		12.0	21	112 (4.40)	104 (4.10)	86 (3.40)	66 (2.60)	37 (1.44)	2.7 (6)
1321-3R8-A	8	1.5	19.5	152 (6.00)	121 (4.75)	76 (3.00)	53 (2.10)	51 (2.00)	3.2 (7)
1321-3R8-B		3.0	29	152 (6.00)	121 (4.75)	76 (3.00)	53 (2.10)	51 (2.00)	3.6 (8)
1321-3R8-C		5.0	25.3	152 (6.00)	121 (4.75)	86 (3.40)	67 (2.62)	51 (2.00)	5.0 (11)
1321-3R8-D		7.5	28	152 (6.00)	121 (4.75)	86 (3.40)	63 (2.48)	51 (2.00)	5.9 (13)
1321-3R12-A	12	1.25	26	152 (6.00)	127 (5.00)	84 (3.30)	53 (2.10)	51 (2.00)	4.1 (9)
1321-3R12-B		2.5	31	152 (6.00)	127 (5.00)	84 (3.30)	53 (2.10)	51 (2.00)	4.5 (10)
1321-3R12-C		4.2	41	152 (6.00)	127 (5.00)	99 (3.90)	70 (2.75)	51 (2.00)	8.2 (18)
1321-3R18-A	18	0.8	36	152 (6.00)	135 (5.30)	81 (3.20)	53 (2.10)	51 (2.00)	4.1 (9)
1321-3R18-B		1.5	43	152 (6.00)	135 (5.30)	89 (3.50)	63 (2.48)	51 (2.00)	5.5 (12)
1321-3R18-C		2.5	43	206 (8.10)	155 (6.10)	102 (4.00)	66 (2.60)	76 (3.00)	7.3 (16)
1321-3R25-A	25	0.5	48	183 (7.20)	147 (5.80)	89 (3.50)	60 (2.35)	76 (3.00)	5.0 (11)
1321-3R25-B		1.2	52	183 (7.20)	147 (5.80)	89 (3.50)	60 (2.35)	76 (3.00)	6.4 (14)
1321-3R25-C		2.0	61	183 (7.20)	147 (5.80)	109 (4.30)	79 (3.10)	76 (3.00)	9.1 (20)
1321-3R35-A	35	0.4	49	183 (7.20)	147 (5.80)	102 (4.00)	66 (2.60)	76 (3.00)	6.4 (14)
1321-3R35-B		0.8	54	183 (7.20)	147 (5.80)	102 (4.00)	70 (2.75)	76 (3.00)	7.3 (16)
1321-3R35-C		1.2	54	229 (9.00)	188 (7.40)	119 (4.70)	80 (3.16)	76 (3.00)	14.0 (30)
1321-3R45-A	45	0.3	54	229 (9.00)	188 (7.40)	119 (4.70)	80 (3.16)	76 (3.00)	10.0 (22)
1321-3R45-B		0.7	62	229 (9.00)	188 (7.40)	119 (4.70)	80 (3.16)	76 (3.00)	13.0 (28)
1321-3R45-C		1.2	65	229 (9.00)	185 (7.30)	135 (5.30)	93 (3.66)	76 (3.00)	18.0 (39)

continued on next page

1321-3R and 3RA Series Line Reactors

IP00 (Open), *continued from previous page*

Catalog Number	Fundamental Amps	Inductance - *mH* (Based on Fundamental Amps)	Watts Loss	*Dimensions in mm (in.) and Weight in kg (lbs.)*					
				A	B	C	D(1)	E	Weight
1321-3R55-A	55	0.25	64	229 (9.00)	185 (7.30)	135 (5.30)	80 (3.16)	76 (3.00)	11.0 (24)
1321-3R55-B		0.5	67	229 (9.00)	178 (7.00)	135 (5.30)	80 (3.16)	76 (3.00)	12.0 (26)
1321-3R55-C		0.85	71	229 (9.00)	178 (7.00)	152 (6.00)	99 (3.91)	76 (3.00)	16.0 (35)
1321-3R80-A	80	0.2	82	229 (9.00)	183 (7.20)	160 (6.30)	88 (3.47)	92 (3.63)	11.3 (25)
1321-3R80-B		0.4	86	229 (9.00)	183 (7.20)	165 (6.50)	88 (3.47)	92 (3.63)	14.9 (33)
1321-3R80-C		0.7	96	274 (10.80)	216 (8.50)	173 (6.80)	106 (4.16)	92 (3.63)	28.0 (61)
1321-3R100-A	100	0.15	94	229 (9.00)	185 (7.30)	165 (6.50)	84 (3.30)	92 (3.63)	13.1 (29)
1321-3R100-B		0.3	84	229 (9.00)	185 (7.30)	173 (6.80)	93 (3.66)	92 (3.63)	16.8 (37)
1321-3R100-C		0.45	108	274 (10.80)	210 (8.30)	156 (6.20)	106 (4.16)	92 (3.63)	34.0 (74)
1321-3R130-A	130	0.1	108	229 (9.00)	178 (7.00)	118 (4.70)	80 (3.16)	76 (3.00)	13.1 (29)
1321-3R130-B		0.2	180	229 (9.00)	183 (7.20)	173 (6.80)	93 (3.66)	92 (3.63)	19.5 (43)
1321-3R130-C		0.3	128	279 (11.00)	216 (8.50)	156 (6.20)	106 (4.16)	92 (3.63)	29.0 (64)
1321-3R160-A	160	0.075	116	229 (9.00)	183 (7.20)	173 (6.80)	80 (3.16)	92 (3.63)	18.6 (41)
1321-3R160-B		0.15	149	274 (10.80)	211 (8.30)	152 (6.00)	88 (3.47)	92 (3.63)	23.0 (50)
1321-3R160-C		0.23	138	292 (11.50)	216 (8.50)	229 (9.00)	119 (4.69)	92 (3.63)	30.0 (67)
1321-3R200-A	200	0.055	124	229 (9.00)	191 (7.50)	185 (7.30)	106 (4.16)	76 (3.00)	17.2 (38)
1321-3R200-B(1)		0.110	168	229 (9.00)	191 (7.50)	211 (8.30)	112 (4.41)	76 (3.00)	24.5 (54)
1321-3R200-C(1)		0.185	146	274 (10.80)	211 (8.30)	254 (10.00)	150 (5.91)	92 (3.63)	45.4 (100)
1321-3RB250-A(1)	250	0.045	154	229 (9.00)	191 (7.50)	229 (9.00)	106 (4.19)	76 (3.00)	21.3 (47)
1321-3RB250-B(1)		0.090	231	274 (10.80)	216 (8.50)	229 (9.00)	131 (5.16)	117 (4.60)	36.3 (80)
1321-3RB250-C(1)		0.150	219	366 (14.40)	284 (11.20)	262 (10.30)	148 (5.82)	117 (4.60)	57.0 (125)
1321-3RB320-A(1)	320	0.040	224	274 (10.80)	229 (9.00)	211 (8.30)	131 (5.16)	117 (4.60)	36.3 (80)
1321-3RB320-B(1)		0.075	264	274 (10.80)	229 (9.00)	254 (10.00)	149 (5.88)	117 (4.60)	46.3 (102)
1321-3RB320-C(1)		0.125	351	366 (14.40)	286 (11.30)	267 (10.50)	181 (7.13)	117 (4.60)	72.6 (160)
1321-3RB400-A(1)	400	0.030	231	274 (10.80)	254 (10.00)	254 (10.00)	131 (5.16)	117 (4.60)	38.1 (84)
1321-3RB400-B(1)		0.060	333	381 (15.00)	286 (11.30)	292 (11.50)	172 (6.76)	117 (4.60)	53.5 (118)
1321-3RB400-C(1)		0.105	293	366 (14.40)	286 (11.30)	318 (12.50)	184 (7.26)	117 (4.60)	67.6 (149)
1321-3R500-A(1)	500	0.025	266	274 (10.80)	229 (9.00)	267 (10.50)	140 (5.50)	117 (4.60)	42.2 (93)
1321-3R500-B(1)		0.050	340	366 (14.40)	292 (11.50)	292 (11.50)	172 (6.76)	117 (4.60)	53.5 (118)
1321-3R500-C(1)		0.085	422	366 (14.40)	292 (11.50)	338 (13.30)	248 (9.76)	117 (4.60)	95.3 (210)
1321-3R600-A(1)	600	0.020	307	366 (14.40)	292 (11.50)	254 (10.00)	134 (5.26)	117 (4.60)	54.4 (120)
1321-3R600-B(1)		0.040	414	366 (14.40)	286 (11.30)	305 (12.00)	203 (8.00)	117 (4.60)	79.4 (175)
1321-3R600-C(1)		0.065	406	366 (14.40)	286 (11.30)	381 (15.00)	235 (9.26)	117 (4.60)	122.5 (270)
1321-3R750-A(1)	750	0.015	427	366 (14.40)	292 (11.50)	279 (11.00)	168 (6.63)	183 (7.20)	63.5 (140)
1321-3R750-B(1)		0.029	630	366 (14.40)	292 (11.50)	318 (12.50)	204 (8.01)	183 (7.20)	86.2 (190)
1321-3R750-C(1)		0.048	552	366 (14.40)	368 (14.50)	356 (14.00)	235 (9.26)	183 (7.20)	120.2 (265)
1321-3R750-E(1)		0.060	810	366 (14.40)	368 (14.50)	381 (15.00)	276 (10.88)	183 (7.20)	147.4 (325)
1321-3R850-A(1)	850	0.015	799	451 (17.80)	394 (15.50)	368 (14.50)	191 (7.50)	183 (7.20)	88.0 (195)
1321-3R850-B(1)		0.027	756	451 (17.80)	394 (15.50)	394 (15.50)	208 (8.20)	183 (7.20)	98.0 (215)
1321-3R850-C(1)		0.042	758	451 (17.80)	400 (15.80)	445 (17.50)	208 (8.20)	183 (7.20)	143.0 (315)
1321-3R1000-B(1)	1000	0.022	964	514 (20.25)	425 (16.80)	330 (13.00)	216 (8.50)	183 (7.20)	185.0 (408)
1321-3R1000-C(1)		0.038	960	514 (20.25)	425 (16.80)	381 (15.00)	273 (10.76)	183 (7.20)	267.2 (589)

(1) Removable lifting rings are supplied with the unit.

1321 Reflective Wave Reduction (RWR) Devices

Description of Reflected Wave Phenomenon

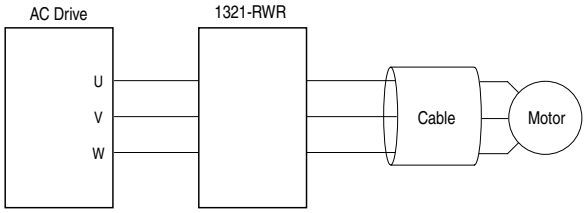
The inverter section of a drive does not produce sinusoidal voltage, but rather a series of voltage pulses created from the DC bus. These pulses travel down the motor cables to the motor and then reflected back to the drive. The reflection is dependant on the rise time of the drive output voltage, cable characteristics, cable length and motor impedance. If the voltage reflection is combined with another subsequent pulse, peak voltages can be at a destructive level. A single IGBT drive output may have reflected wave transient voltage stresses of up to twice (2 pu or per unit) the DC bus voltage between its own output wires. Multiple drive output wires in a single conduit or wire tray further increase output wire voltage stress between multi-drive output wires that are touching. Drive #1 may have a (+) 2 pu stress while drive #2 may simultaneously have a (–) 2 pu stress.

Refer to the *Wiring & Grounding Guidelines for PWM Drives* (publication DRIVES-IN001) for details.

Applying RWR Devices

At the Output of the Drive

In long motor lead applications, an Allen-Bradley 1321 RWR located between the drive and motor helps to reduce dv/dt and motor terminal peak voltages. The use of an RWR device also helps protect the drive from surge currents caused by rapid changes in the load.

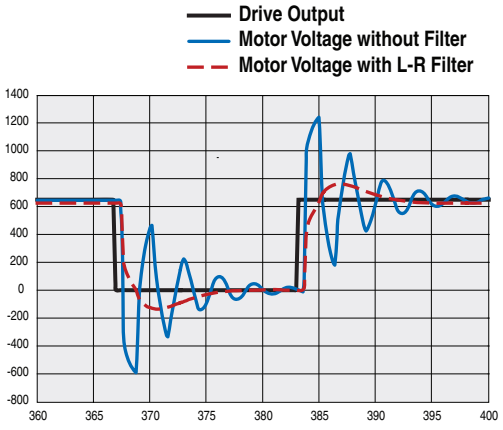


- Protect Motors from Long Lead Effects
- Reduce Output Voltage dv/dt
- Extend Semiconductor Life
- Reduce Surge Currents
- Reduce Motor Temperature
- Reduce Audible Motor Noise

Motor Protection

Allen-Bradley Reflective Wave Reduction devices can help protect motors from high peak voltages.

For IGBT drive applications with long drive-to-motor lead lengths, Allen-Bradley RWR devices can help protect against fast dv/dt rise times.



1321 Reflective Wave Reduction (RWR) Devices

Catalog Number Explanation

Important: 1321-RWR products replace existing 1204-RWR products. However, 1204-RWRC modules (RWR and Common Mode Choke assembly) are still available.

Position	1-8	9	11	12
	1321 – RWR	8	– D	P
	a	b	c	d

a

Product	
Code	Type
1321-RWR	Reflective Wave Reduction Device

b1

Rating	
400-480V ac	
Code	Fundamental Amps
8	8
12	12
18	18
25	25
35	35
45	45
55	55
80	80
100	100
130	130
160	160
200	200
250	250
320	320

b2

Rating	
600V ac	
Code	Fundamental Amps
8	8
12	12
18	18
25	25
35	35
45	45
55	55
80	80
100	100
130	130
160	160
200	200
250	250

c

Voltage Rating	
Code	Voltage
D	400/480V ac
E	600V ac

d

Enclosure	
Code	Description
P	Panel Mount
A	NEMA/UL Type 1 ∗
W	NEMA/UL Type 3R ∗

∗ Not available

Specifications

Specification		Rating
Material	Enclosures	IP00 (Open)
	Terminations	1-45 Amp (fundamental) Ratings – Finger guard IP20 terminal block
		80-160 Amp (fundamental) Ratings – Solid copper box lugs
		200-400 Amp (fundamental) Ratings – Copper tab terminals
		401 Amps and Above – Copper tab terminals
Harmonic Compensation	All line reactors are compensated for the additional currents and high frequencies caused by the presence of harmonics	
General Protection	Impedance	3%
	Overload Rating	300% of fundamental current for (1) minute
IGBT Protection	First turn triple insulated offering protection up to 16kV	16,000 Volts per Microsecond dv/dt Protection 20 kHz Maximum Switching Frequency
Electrical	Max. Rated Voltage	600V AC, 50/60 Hz frequency
	Max. Switching Freq.	4 kHz
	Temperature Rise	115 degrees C.
	Dielectric Strength	4,000 Volts rms (5,600 volts peak)
	Inductance Curve	100% at 100% current, 100% at 150% current, 50% at 350% current
	Insulation System	Class H (180 degrees C or better)
	Impregnation	High bond strength epoxy impregnation, 4,000V high dielectric strength
Environmental	Ambient Temperature	45 degrees C.
	U.L. Listed	UL-508 - IP00, IP20, and IP11
	International	Conforms to VDE 0550
	CE	Not certified

1321 Reflective Wave Reduction (RWR) Devices

Termination

Allen-Bradley 1321 RWR devices rated 45 Amps (fundamental) and below are supplied with an integral mounted terminal block. Devices rated from 55 to 160 Amps (fundamental) are supplied with box lugs. Devices rated 200 to 400 Amps (fundamental) can be supplied with box lugs or copper tabs. Above 400 Amps (fundamental), solid copper tabs are used.

Approximate Dimensions, Weights, Wire Size and Terminal Blocks

Important: The dimensions and weights provided on the following page is for estimating purposes only. Contact your Allen-Bradley Sales Office if certified drawings are required for planning and installation.

RWR Catalog No.	Fund.	Cont.	Wire Size	Watts Loss		Figure	Dimensions *mm (in.)*					Weight
x = D (400V), E (600V)	Amps	Amps	*mm² (AWG)*	*400V*	*600V*	*(see page 15)*	A	B	C	D	E	*kg (lbs.)*
1321-RWR8-xP	8	12	2.5-4.0 (14-12)	389	536	1	282.6 (11.13)	298.5 (11.75)	171.5 (6.75)	7.4 (0.29)	7.4 x 11.6 (0.29 x 0.46)	4.8 (10.5)
1321-RWR12-xP	12	18	2.5-4.0 (14-12)	391	406	1	282.6 (11.13)	298.5 (11.75)	174.6 (6.88)	7.4 (0.29)	7.4 x 11.6 (0.29 x 0.46)	5.7 (12.5)
1321-RWR18-xP	18	27	2.5-4.0 (14-12)	403	551	1	282.6 (11.13)	298.5 (11.75)	174.6 (6.88)	7.4 (0.29)	7.4 x 11.6 (0.29 x 0.46)	7.3 (16)
1321-RWR25-xP	25	37.5	6.0 (10)	412	562	1	282.6 (11.13)	298.5 (11.75)	193.7 (7.63)	7.4 (0.29)	7.4 x 11.6 (0.29 x 0.46)	7.7 (17)
1321-RWR35-xP	35	52.5	10.0-16.0 (8-6)	414	429	1	282.6 (11.13)	298.5 (11.75)	193.7 (7.63)	7.4 (0.29)	7.4 x 11.6 (0.29 x 0.46)	8.8 (19.5)
1321-RWR45-xP	45	67.5	16.0 (6)	422	572	2	319.1 (12.56)	392.1 (15.44)	158.8 (6.25)	10.5 (0.41)	10.3 x 17.9 (0.41 x 0.70)	17.5 (38.5)
1321-RWR55-xP	55	82.5	25.0 (4)	427	577	2	320.7 (12.63)	392.1 (15.44)	158.8 (6.25)	10.5 (0.41)	10.3 x 17.9 (0.41 x 0.70)	18.4 (40.5)
1321-RWR80-xP	80	120	35.0-50.0 (2-1/0)	446	341	2	322.3 (12.69)	395.3 (15.56)	177.8 (7.00)	10.5 (0.41)	10.3 x 17.9 (0.41 x 0.70)	20.4 (45)
1321-RWR100-xP	100	150	50.0-70.0 (1/0-2/0)	444	339	2	320.7 (12.63)	393.7 (15.50)	187.3 (7.38)	10.5 (0.41)	10.3 x 17.9 (0.41 x 0.70)	22.5 (49.5)
1321-RWR130-xP	130	195	70.0-120.0 (2/0-4/0)	630	495	2	317.5 (12.50)	390.5 (15.38)	187.3 (7.38)	10.5 (0.41)	10.3 x 17.9 (0.41 x 0.70)	24.5 (54)
1321-RWR160-xP	160	240	120.0 (4/0)	599	464	3	355.6 (14.00)	438.2 (17.25)	250.8 (9.88)	10.5 (0.41)	10.3 x 25.8 (0.41 x 1.02)	30.8 (68)
1321-RWR200-xP	200	300	120.0-185.0 (4/0-350 MCM)	618	612	2	317.5 (12.50)	393.7 (15.50)	214.3 (8.44)	10.5 (0.41)	10.3 x 17.9 (0.41 x 0.70)	29.9 (66)
1321-RWR250-xP	250	375	185.0 (350 MCM)	681	546	3	358.8 (14.13)	439.8 (17.31)	225.4 (8.88)	10.5 (0.41)	10.3 x 25.8 (0.41 x 1.02)	41.7 (92)
1321-RWR320-DP	320	480	240.0 (500 MCM)	489	NA	3	358.8 (14.13)	438.2 (17.25)	250.8 (9.88)	10.5 (0.41)	10.3 x 25.8 (0.41 x 1.02)	52.2 (115)

1321-RWR Assembly Components

400/480V

Reactor	Resistor Ohms	Resistor Watts	Wire Size *(AWG)*
1321-3R8-B	50	250	14-12
1321-3R12-B	50	250	14-12
1321-3R18-B	50	250	14-12
1321-3R25-B	50	250	10
1321-3R35-B	50	250	8-6
1321-3R45-B	50	250	6
1321-3R55-B	50	250	4
1321-3R80-B	50	250	2-1/0
1321-3R100-B	50	250	1/0-2/0
1321-3R130-B	50	300	2/0-4/0
1321-3R160-B	50	300	4/0
1321-3R200-B	50	300	4/0-350 MCM
1321-3RB250-B	50	300	350 MCM
1321-3R320-B	50	300	500 MCM

600V

Reactor	Resistor Ohms	Resistor Watts	Wire Size *(AWG)*
1321-3R8-B	50	375	14-12
1321-3R12-B	50	375	14-12
1321-3R18-B	50	375	14-12
1321-3R25-B	50	375	10
1321-3R35-B	50	375	8-6
1321-3R45-B	50	375	6
1321-3R55-B	50	375	4
1321-3R80-B	50	375	2-1/0
1321-3R100-B	50	375	1/0-2/0
1321-3R130-B	50	420	2/0-4/0
1321-3R160-B	50	420	4/0
1321-3R200-B	50	420	4/0-350 MCM
1321-3RB250-B	50	420	350 MCM

1321 Reflective Wave Reduction (RWR) Devices

Dimension Reference

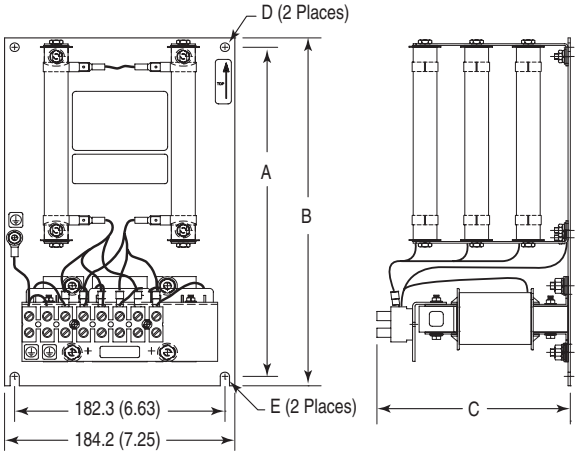


Figure 1

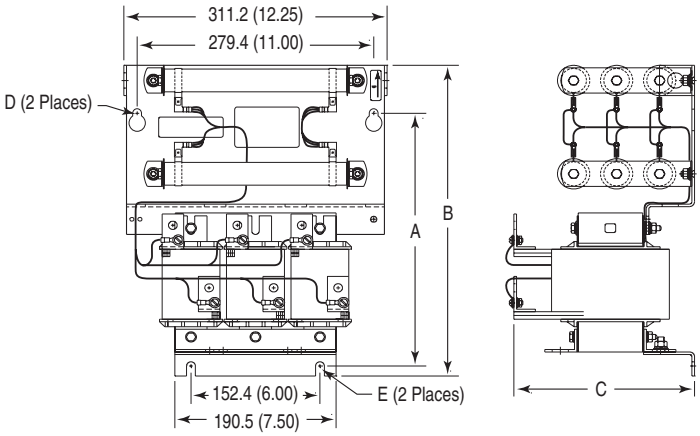


Figure 2

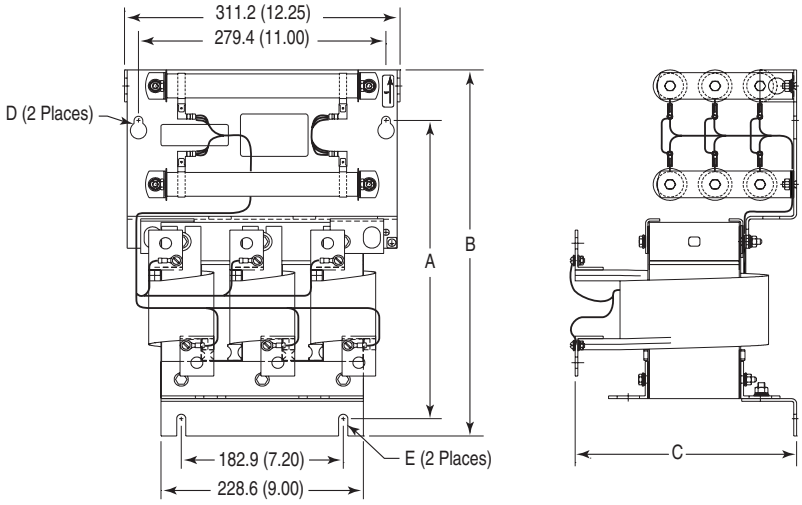


Figure 3

Terminal Block Details

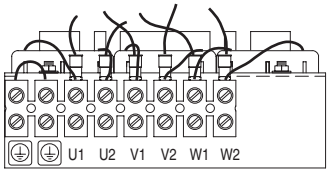
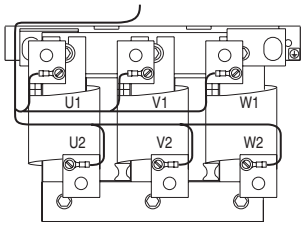


Figure 1



Figures 2 & 3

1321-3TH/3TW Series Three-Phase Isolation Transformers

Allen-Bradley 1321 Isolation Transformers are designed to meet the standard horsepower, voltage ratings and harmonics of the Allen-Bradley variable speed drives.

Catalog Number Explanation

Position	1-4		6	7	8	9		11	12
	1321	–	3	T	W	005	–	A	A
	a		*b*	*c*	*d*	*e*		*f*	*g*

a

Product	
Code	Type
1321	Power Component

b

Phases	
Code	Description
3	Three-Phase

c

Device	
Code	Description
T	Transformer

d

Mounting	
Code	Description
W	Wall
H	Floor

e

Rating	
Code	kVA
005	5
007	7.5
011	11
014	14
020	20
027	27
034	34
040	40
051	51
063	63
075	75
093	93
118	118
145	145
175	175
220	220
275	275
330	330
440	440
550	550
660	660
770	770
880	880

f

Primary Voltage	
Code	Voltage
A	230V ac
B	460V ac
C	575V ac
X	208V ac

g

Secondary Voltage	
Code	Voltage
A	230V ac
B	460V ac
C	575V ac
X	208V ac

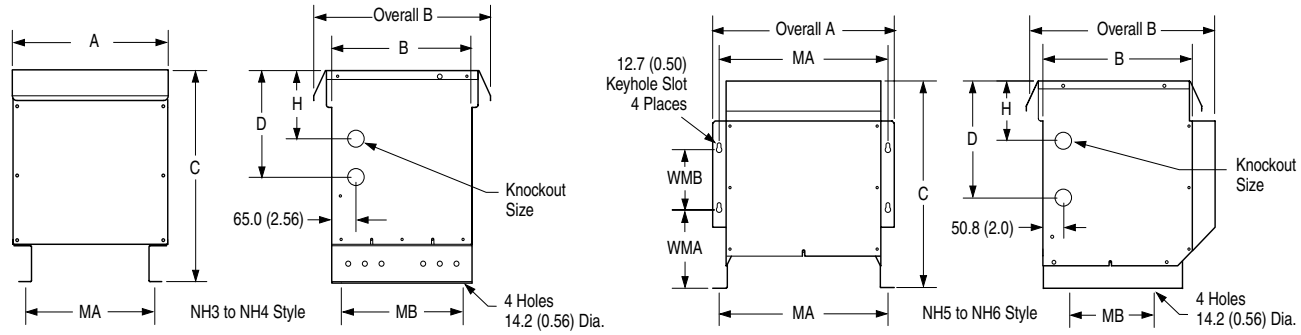
Specifications

Specification		Rating
Electrical	General	Delta primary, wye secondary, 60 Hz, Aluminum wound, Neutral terminal available for customer use
	Standard Voltage Taps	5.0-175 kVA 1-5.0% FCAN & FCBN
		220-880 kVA 1-2.5% FCAN & FCBN
	Insulation System	Class 220
		150 degrees C Rise Over 40 degrees C Ambient
		Peak 40 degrees C Ambient with 30 degrees C 24 Hour Avg.
	Efficiency	98% (2% losses)
Environmental	Elevation	Up to 1,000 Meters. Above 1,000 Meters, consult factory for derating
	U.L. Listed	File E112313
Construction	Enclosure	NEMA/UL Type 3R (IP32)
		Heavy duty ventilated enclosure with metal screens protecting all vents and finished in ANSI 61 grey
	Termination	Transformers up to 75kVA have integral high and low voltage lugs installed, suitable for copper or aluminum cable installation
	Conduit Entry	Standard knockouts on all enclosures
	Mounting	5-51 kVA units suitable for either floor or wall mounting. 63-75 kVA units suitable for floor, wall or ceiling mounting with mounting kit 1321-3TWM2 (Style NH3). Larger units are floor mount only
General	Impedance	4-6% impedance (nominal)
	Short Circuit Capability	Meets UL short circuit withstand capability
	Overload Rating	Windings designed to withstand overcurrent of 150% of rated load for 60 Seconds or 200% of rated load for 30 Seconds
	Duty Cycle	(1) start every (2) hours
	Thermostats	Thermostats with 1 N.C contact in each coil, wired in series and integral on all units
	K Factor	4
	Custom Options (consult factory for operating information)	50 Hz units
		Electrostatic shield (60dB attenuation typical)
		NEMA/UL Type 2 or IP20 (NEMA/UL Type 1)
		Core and coil construction (open)
		Additional HP or kVA sizes, voltages, extra primary taps, copper wound units, etc.

1321-3TH/3TW Series Three-Phase Isolation Transformers

Approximate Mounting Dimensions

IP32, NEMA/UL Type 3R - Styles NH3 through NH4

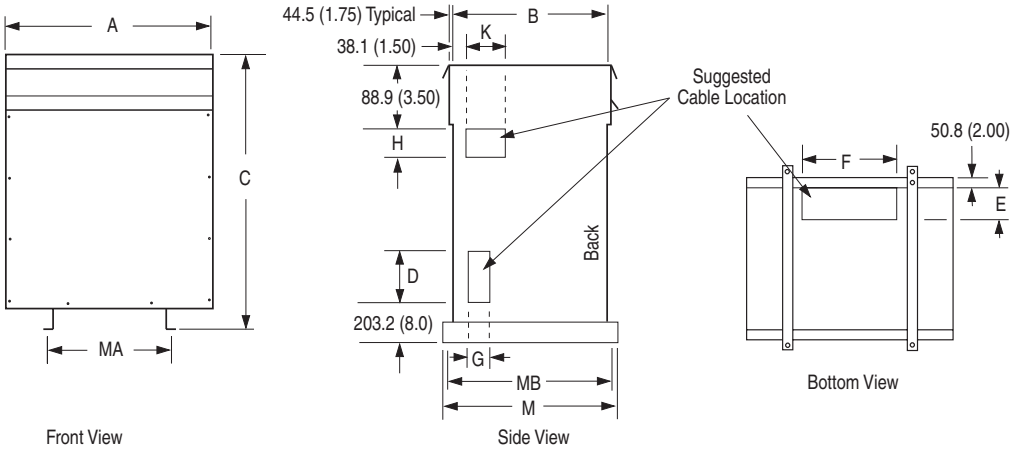


Dimensions in mm (in.)

Style	A	Overall A	B	Overall B	C	D	H	K	MA	MB	WMB	WMA
NH3	660.4 (26.00)	—	533.4 (21.00)	635.0 (25.00)	66.0 (38.00)	609.6 (24.00)	355.6 (14.00)	50.8 x 76.2 (2.00 x 3.00)	546.1 (21.50)	482.6 (19.00)	—	—
NH4	812.8 (32.00)	—	647.7 (25.50)	749.3 (29.50)	68.0 (41.00)	609.6 (24.00)	304.8 (12.00)	50.8 x 76.2 (2.00 x 3.00)	596.9 (23.50)	596.9 (23.50)	—	—
NH5 (1)	425.5 (16.75)	492.8 (19.40)	381.0 (15.00)	513.1 (20.20)	546.1 (21.50)	304.8 (12.00)	152.4 (6.00)	35.1 x 44.4 (1.38 x 1.75)	457.2 (18.00)	228.6 (9.00)	177.8 (7.00)	184.4 (7.26)
NH6 (1)	546.1 (21.50)	607.1 (23.90)	495.3 (19.50)	730.3 (28.75)	730.3 (28.75)	431.8 (17.00)	215.9 (8.50)	35.1 x 44.4 (1.38 x 1.75)	577.9 (22.75)	228.6 (9.00)	203.2 (8.00)	247.1 (9.73)

(1) Enclosure Styles NH1 and NH2 are replaced by NH5 and NH6 through 1321-3TH005 - 1321-3TH051 ratings.

IP32, NEMA/UL Type 3R -Styles NJ1 through NJ6

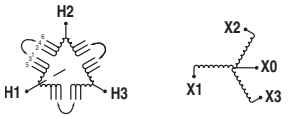


Dimensions in mm (in.)

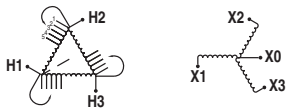
Style	A	B	C	D	E	F	G	H	K	M	MA	MB
NJ1	1003.3 (39.50)	762.0 (30.00)	1308.1 (51.50)	254.0 (10.00)	190.5 (7.50)	546.1 (21.50)	203.2 (8.00)	165.1 (6.50)	342.9 (13.50)	863.6 (34.00)	609.6 (24.00)	812.8 (32.00)
NJ2	1239.1 (48.50)	836.6 (34.00)	1498.6 (59.00)	330.2 (13.00)	215.9 (8.50)	635.0 (25.00)	228.6 (9.00)	215.9 (8.50)	393.7 (15.50)	965.2 (38.00)	698.5 (27.50)	914.4 (36.00)
NJ3	1308.1 (51.50)	990.6 (39.00)	1676.4 (66.00)	406.4 (16.00)	241.3 (9.50)	800.1 (31.50)	254.0 (10.00)	292.1 (11.50)	457.2 (18.00)	1092.2 (43.00)	863.6 (34.00)	1041.4 (41.00)
NJ6	1625.6 (64.00)	1016.0 (40.00)	1727.2 (68.00)	406.4 (16.00)	266.7 (10.50)	952.5 (37.50)	279.4 (11.00)	292.1 (11.50)	457.2 (18.00)	1117.6 (44.00)	1016.0 (40.00)	1066.8 (42.00)

1321-3TH/3TW Series Three-Phase Isolation Transformers

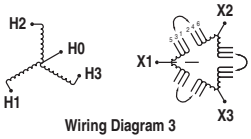
Wiring Diagrams, Ratings and Weights



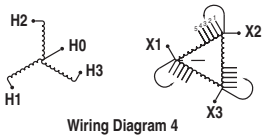
Wiring Diagram 1



Wiring Diagram 2



Wiring Diagram 3



Wiring Diagram 4

kVA	Catalog Number	Style	Primary Voltage	Secondary Voltage	Wiring Diagram	Weight *kg (lbs.)*
5	1321-3TW005-AA	NH5	230	230	1	63.5 (140)
	1321-3TW005-AB	NH5	230	460	3	63.5 (140)
	1321-3TW005-AC	NH5	230	575	3	63.5 (140)
	1321-3TW005-BA	NH5	460	230	1	63.5 (140)
	1321-3TW005-BB	NH5	460	460	1	63.5 (140)
	1321-3TW005-BC	NH5	460	575	3	63.5 (140)
	1321-3TW005-CA	NH5	575	230	1	63.5 (140)
	1321-3TW005-CB	NH5	575	460	1	63.5 (140)
	1321-3TW005-CC	NH5	575	575	1	63.5 (140)
	1321-3TW005-XX	NH5	208	208	1	63.5 (140)
7.5	1321-3TW007-AA	NH5	230	230	1	63.5 (140)
	1321-3TW007-AB	NH5	230	460	3	63.5 (140)
	1321-3TW007-AC	NH5	230	575	3	63.5 (140)
	1321-3TW007-BA	NH5	460	230	1	63.5 (140)
	1321-3TW007-BB	NH5	460	460	1	63.5 (140)
	1321-3TW007-BC	NH5	460	575	3	63.5 (140)
	1321-3TW007-CA	NH5	575	230	1	63.5 (140)
	1321-3TW007-CB	NH5	575	460	1	63.5 (140)
	1321-3TW007-CC	NH5	575	575	1	63.5 (140)
	1321-3TW007-XX	NH5	208	208	1	63.5 (140)
11	1321-3TW011-AA	NH5	230	230	1	70.3 (155)
	1321-3TW011-AB	NH5	230	460	3	70.3 (155)
	1321-3TW011-AC	NH5	230	575	3	70.3 (155)
	1321-3TW011-BA	NH5	460	230	1	70.3 (155)
	1321-3TW011-BB	NH5	460	460	1	70.3 (155)
	1321-3TW011-BC	NH5	460	575	3	70.3 (155)
	1321-3TW011-CA	NH5	575	230	1	70.3 (155)
	1321-3TW011-CB	NH5	575	460	1	70.3 (155)
	1321-3TW011-CC	NH5	575	575	1	70.3 (155)
	1321-3TW011-XX	NH5	208	208	1	70.3 (155)
14	1321-3TW014-AA	NH5	230	230	1	79.4 (175)
	1321-3TW014-AB	NH5	230	460	3	79.4 (175)
	1321-3TW014-AC	NH5	230	575	3	79.4 (175)
	1321-3TW014-BA	NH5	460	230	1	79.4 (175)
	1321-3TW014-BB	NH5	460	460	1	79.4 (175)
	1321-3TW014-BC	NH5	460	575	3	79.4 (175)
	1321-3TW014-CA	NH5	575	230	1	79.4 (175)
	1321-3TW014-CB	NH5	575	460	1	79.4 (175)
	1321-3TW014-CC	NH5	575	575	1	79.4 (175)
	1321-3TW014-XX	NH5	208	208	1	79.4 (175)
20	1321-3TW020-AA	NH6	230	230	2	104.3 (230)
	1321-3TW020-AB	NH6	230	460	4	104.3 (230)
	1321-3TW020-AC	NH6	230	575	4	104.3 (230)
	1321-3TW020-BA	NH6	460	230	2	104.3 (230)
	1321-3TW020-BB	NH6	460	460	2	104.3 (230)
	1321-3TW020-BC	NH6	460	575	4	104.3 (230)
	1321-3TW020-CA	NH6	575	230	2	104.3 (230)
	1321-3TW020-CB	NH6	575	460	2	104.3 (230)
	1321-3TW020-CC	NH6	575	575	2	104.3 (230)
	1321-3TW020-XX	NH6	208	208	2	104.3 (230)
27	1321-3TW027-AA	NH6	230	230	2	113.4 (250)
	1321-3TW027-AB	NH6	230	460	4	113.4 (250)
	1321-3TW027-AC	NH6	230	575	4	113.4 (250)
	1321-3TW027-BA	NH6	460	230	2	113.4 (250)
	1321-3TW027-BB	NH6	460	460	2	113.4 (250)
	1321-3TW027-BC	NH6	460	575	4	113.4 (250)
	1321-3TW027-CA	NH6	575	230	2	113.4 (250)
	1321-3TW027-CB	NH6	575	460	2	113.4 (250)
	1321-3TW027-CC	NH6	575	575	2	113.4 (250)
	1321-3TW027-XX	NH6	208	208	2	113.4 (250)
34	1321-3TW034-AA	NH6	230	230	2	127.0 (280)
	1321-3TW034-AB	NH6	230	460	4	127.0 (280)
	1321-3TW034-AC	NH6	230	575	4	127.0 (280)
	1321-3TW034-BA	NH6	460	230	2	127.0 (280)
	1321-3TW034-BB	NH6	460	460	2	127.0 (280)
	1321-3TW034-BC	NH6	460	575	4	127.0 (280)
	1321-3TW034-CA	NH6	575	230	2	127.0 (280)
	1321-3TW034-CB	NH6	575	460	2	127.0 (280)
	1321-3TW034-CC	NH6	575	575	2	127.0 (280)
	1321-3TW034-XX	NH6	208	208	2	127.0 (280)
40	1321-3TW040-AA	NH6	230	230	2	145.2 (320)
	1321-3TW040-AB	NH6	230	460	4	145.2 (320)
	1321-3TW040-AC	NH6	230	575	4	145.2 (320)
	1321-3TW040-BA	NH6	460	230	2	145.2 (320)
	1321-3TW040-BB	NH6	460	460	2	145.2 (320)
	1321-3TW040-BC	NH6	460	575	4	145.2 (320)
	1321-3TW040-CA	NH6	575	230	2	145.2 (320)
	1321-3TW040-CB	NH6	575	460	2	145.2 (320)
	1321-3TW040-CC	NH6	575	575	2	145.2 (320)
51	1321-3TW051-AA	NH6	230	230	2	190.5 (420)
	1321-3TW051-AB	NH6	230	460	4	190.5 (420)
	1321-3TW051-AC	NH6	230	575	4	190.5 (420)
	1321-3TW051-BA	NH6	460	230	2	190.5 (420)
	1321-3TW051-BB	NH6	460	460	2	190.5 (420)
	1321-3TW051-BC	NH6	460	575	4	190.5 (420)
	1321-3TW051-CA	NH6	575	230	2	190.5 (420)
	1321-3TW051-CB	NH6	575	460	2	190.5 (420)
	1321-3TW051-CC	NH6	575	575	2	190.5 (420)
63	1321-3TH063-AA	NH3	230	230	2	244.9 (540)
	1321-3TH063-AB	NH3	230	460	4	244.9 (540)
	1321-3TH063-AC	NH3	230	575	4	244.9 (540)
	1321-3TH063-BA	NH3	460	230	2	244.9 (540)
	1321-3TH063-BB	NH3	460	460	2	244.9 (540)
	1321-3TH063-BC	NH3	460	575	4	244.9 (540)
	1321-3TH063-CA	NH3	575	230	2	244.9 (540)
	1321-3TH063-CB	NH3	575	460	2	244.9 (540)
	1321-3TH063-CC	NH3	575	575	2	244.9 (540)

continued on next page

kVA	Catalog Number	Style	Primary Voltage	Secondary Voltage	Wiring Diagram	Weight *kg (lbs.)*
75	1321-3TH075-AA	NH3	230	230	2	263.1 (580)
	1321-3TH075-AB	NH3	230	460	4	263.1 (580)
	1321-3TH075-AC	NH3	230	575	4	263.1 (580)
	1321-3TH075-BA	NH3	460	230	2	263.1 (580)
	1321-3TH075-BB	NH3	460	460	2	263.1 (580)
	1321-3TH075-BC	NH3	460	575	4	263.1 (580)
	1321-3TH075-CA	NH3	575	230	2	263.1 (580)
	1321-3TH075-CB	NH3	575	460	2	263.1 (580)
	1321-3TH075-CC	NH3	575	575	2	263.1 (580)
93	1321-3TH093-AA	NH3	230	230	2	285.8 (630)
	1321-3TH093-AB	NH3	230	460	4	285.8 (630)
	1321-3TH093-AC	NH3	230	575	4	285.8 (630)
	1321-3TH093-BA	NH3	460	230	2	285.8 (630)
	1321-3TH093-BB	NH3	460	460	2	285.8 (630)
	1321-3TH093-BC	NH3	460	575	4	285.8 (630)
	1321-3TH093-CA	NH3	575	230	2	285.8 (630)
	1321-3TH093-CB	NH3	575	460	2	285.8 (630)
	1321-3TH093-CC	NH3	575	575	2	285.8 (630)
118	1321-3TH118-AA	NH3	230	230	2	328.9 (725)
	1321-3TH118-AB	NH3	230	460	4	328.9 (725)
	1321-3TH118-AC	NH3	230	575	4	328.9 (725)
	1321-3TH118-BA	NH3	460	230	2	328.9 (725)
	1321-3TH118-BB	NH3	460	460	2	328.9 (725)
	1321-3TH118-BC	NH3	460	575	4	328.9 (725)
	1321-3TH118-CA	NH3	575	230	2	328.9 (725)
	1321-3TH118-CB	NH3	575	460	2	328.9 (725)
	1321-3TH118-CC	NH3	575	575	2	328.9 (725)
145	1321-3TH145-AA	NH4	230	230	2	408.2 (900)
	1321-3TH145-AB	NH4	230	460	4	408.2 (900)
	1321-3TH145-AC	NH4	230	575	4	408.2 (900)
	1321-3TH145-BA	NH4	460	230	2	408.2 (900)
	1321-3TH145-BB	NH4	460	460	2	408.2 (900)
	1321-3TH145-BC	NH4	460	575	4	408.2 (900)
	1321-3TH145-CA	NH4	575	230	2	408.2 (900)
	1321-3TH145-CB	NH4	575	460	2	408.2 (900)
	1321-3TH145-CC	NH4	575	575	2	408.2 (900)
175	1321-3TH175-AA	NH4	230	230	2	453.6 (1000)
	1321-3TH175-AB	NH4	230	460	4	453.6 (1000)
	1321-3TH175-AC	NH4	230	575	4	453.6 (1000)
	1321-3TH175-BA	NH4	460	230	2	453.6 (1000)
	1321-3TH175-BB	NH4	460	460	2	453.6 (1000)
	1321-3TH175-BC	NH4	460	575	4	453.6 (1000)
	1321-3TH175-CA	NH4	575	230	2	453.6 (1000)
	1321-3TH175-CB	NH4	575	460	2	453.6 (1000)
	1321-3TH175-CC	NH4	575	575	2	453.6 (1000)
220	1321-3TH220-AA	NJ1	230	230	2	589.7 (1300)
	1321-3TH220-AB	NJ1	230	460	4	589.7 (1300)
	1321-3TH220-AC	NJ1	230	575	4	589.7 (1300)
	1321-3TH220-BA	NJ1	460	230	2	589.7 (1300)
	1321-3TH220-BB	NJ1	460	460	2	589.7 (1300)
	1321-3TH220-BC	NJ1	460	575	4	589.7 (1300)
	1321-3TH220-CA	NJ1	575	230	2	589.7 (1300)
	1321-3TH220-CB	NJ1	575	460	2	589.7 (1300)
	1321-3TH220-CC	NJ1	575	575	2	589.7 (1300)
275	1321-3TH275-AA	NJ1	230	230	2	680.4 (1500)
	1321-3TH275-AB	NJ1	230	460	4	680.4 (1500)
	1321-3TH275-AC	NJ1	230	575	4	680.4 (1500)
	1321-3TH275-BA	NJ1	460	230	2	680.4 (1500)
	1321-3TH275-BB	NJ1	460	460	2	680.4 (1500)

kVA	Catalog Number	Style	Primary Voltage	Secondary Voltage	Wiring Diagram	Weight *kg (lbs.)*
275	1321-3TH275-BC	NJ1	460	575	4	680.4 (1500)
	1321-3TH275-CA	NJ1	575	230	2	680.4 (1500)
	1321-3TH275-CB	NJ1	575	460	2	680.4 (1500)
	1321-3TH275-CC	NJ1	575	575	2	680.4 (1500)
330	1321-3TH330-AA	NJ1	230	230	2	771.1 (1700)
	1321-3TH330-AB	NJ1	230	460	4	771.1 (1700)
	1321-3TH330-AC	NJ1	230	575	4	771.1 (1700)
	1321-3TH330-BA	NJ1	460	230	2	771.1 (1700)
	1321-3TH330-BB	NJ1	460	460	2	771.1 (1700)
	1321-3TH330-BC	NJ1	460	575	4	771.1 (1700)
	1321-3TH330-CA	NJ1	575	230	2	771.1 (1700)
	1321-3TH330-CB	NJ1	575	460	2	771.1 (1700)
	1321-3TH330-CC	NJ1	575	575	2	771.1 (1700)
440	1321-3TH440-AA	NJ2	230	230	1	907.2 (2000)
	1321-3TH440-AB	NJ2	230	460	3	907.2 (2000)
	1321-3TH440-AC	NJ2	230	575	3	907.2 (2000)
	1321-3TH440-BA	NJ2	460	230	1	907.2 (2000)
	1321-3TH440-BB	NJ2	460	460	1	907.2 (2000)
	1321-3TH440-BC	NJ2	460	575	3	907.2 (2000)
	1321-3TH440-CA	NJ2	575	230	1	907.2 (2000)
	1321-3TH440-CB	NJ2	575	460	1	907.2 (2000)
	1321-3TH440-CC	NJ2	575	575	1	907.2 (2000)
550	1321-3TH550-AA	NJ2	230	230	1	1134.0 (2500)
	1321-3TH550-AB	NJ2	230	460	3	1134.0 (2500)
	1321-3TH550-AC	NJ2	230	575	3	1134.0 (2500)
	1321-3TH550-BA	NJ2	460	230	1	1134.0 (2500)
	1321-3TH550-BB	NJ2	460	460	1	1134.0 (2500)
	1321-3TH550-BC	NJ2	460	575	3	1134.0 (2500)
	1321-3TH550-CA	NJ2	575	230	1	1134.0 (2500)
	1321-3TH550-CB	NJ2	575	460	1	1134.0 (2500)
	1321-3TH550-CC	NJ2	575	575	1	1134.0 (2500)
660	1321-3TH660-AA	NJ3	230	230	1	1360.8 (3000)
	1321-3TH660-AB	NJ3	230	460	3	1360.8 (3000)
	1321-3TH660-AC	NJ3	230	575	3	1360.8 (3000)
	1321-3TH660-BA	NJ3	460	230	1	1360.8 (3000)
	1321-3TH660-BB	NJ3	460	460	1	1360.8 (3000)
	1321-3TH660-BC	NJ3	460	575	3	1360.8 (3000)
	1321-3TH660-CA	NJ3	575	230	1	1360.8 (3000)
	1321-3TH660-CB	NJ3	575	460	1	1360.8 (3000)
	1321-3TH660-CC	NJ3	575	575	1	1360.8 (3000)
770	1321-3TH770-AA	NJ3	230	230	1	1587.6 (3500)
	1321-3TH770-AB	NJ3	230	460	3	1587.6 (3500)
	1321-3TH770-AC	NJ3	230	575	3	1587.6 (3500)
	1321-3TH770-BA	NJ3	460	230	1	1587.6 (3500)
	1321-3TH770-BB	NJ3	460	460	1	1587.6 (3500)
	1321-3TH770-BC	NJ3	460	575	3	1587.6 (3500)
	1321-3TH770-CA	NJ3	575	230	1	1587.6 (3500)
	1321-3TH770-CB	NJ3	575	460	1	1587.6 (3500)
	1321-3TH770-CC	NJ3	575	575	1	1587.6 (3500)
880	1321-3TH880-AA	NJ6	230	230	1	1678.3 (3700)
	1321-3TH880-AB	NJ6	230	460	3	1678.3 (3700)
	1321-3TH880-AC	NJ6	230	575	3	1678.3 (3700)
	1321-3TH880-BA	NJ6	460	230	1	1678.3 (3700)
	1321-3TH880-BB	NJ6	460	460	1	1678.3 (3700)
	1321-3TH880-BC	NJ6	460	575	3	1678.3 (3700)
	1321-3TH880-CA	NJ6	575	230	1	1678.3 (3700)
	1321-3TH880-CB	NJ6	575	460	1	1678.3 (3700)
	1321-3TH880-CC	NJ6	575	575	1	1678.3 (3700)

1321-M Common Mode Chokes

1321-M Common Mode Chokes can be installed with 1305, 1336 PLUS II, 1336 IMPACT™ and PowerFlex® 70/700 AC drives. When installed at the drive output the common mode choke helps to guard against interference with other electrical equipment (Programmable Controllers, sensors, analog circuits, etc.). In addition, reducing the PWM carrier frequency reduces the effects and lowers the risk of common mode noise interference.

Catalog Number Explanation

		Position		
1-4		6	7	
1321	–	M	009	
a		*b*	*c*	

a

Product	
Code	Type
1321	Power Component

b

Device	
Code	Description
M	Common Mode Choke

c

Current Rating	
Code	Amps
001 ∗	1
009	9
048	48
180	180
670	670

∗ Same core as 1321-M009. Can be used in place of the M009, M048 or M180 if the terminal block and windings typical of those ratings are not desired.

Ratings

Choke Type	Used With	Ratings	Catalog Number
Open Style, 9A (with terminal strip)	All Drives	Communication Cables, Analog Signal Cables, etc.	**1321-M001**
	PowerFlex 70/700	0.37-1.5 kW (0.5-2 HP) 230V 0.37-4 kW (0.5-5 HP) 480V	**1321-M009**
	1305 and 1336 PLUS II	0.37-2.2 kW (0.5-2 HP) 230V 0.37-3.7 kW (0.5-5 HP) 480V	
	1336 IMPACT	0.37-3.7 kW (0.5-5 HP) 480V	
Open Style, 48A	PowerFlex 70/700	2.2-11 kW (3-15 HP) 230V 5.5-22 kW (7.5-30 HP) 480V 5.5-30 kW (7.5-40 HP) 600V	**1321-M048**
	1336 PLUS II	2.2-11 kW (3-15 HP) 230V 5.5-22 kW (7.5-30 HP) 480V 0.75-30 kW (1-40 HP) 600V	
	1336 IMPACT	5.5-22 kW (7.5-30 HP) 480V 5.5-30 kW (7.5-40 HP) 600V	
Open Style, 180A	PowerFlex 70/700	15-45 kW (20-60 HP) 230V 30-110 kW (40-150 HP) 480V 37-110 kW (50-150 HP) 600V	**1321-M180**
	1336 PLUS II	15-45 kW (20-60 HP) 230V 30-112 kW (40-150 HP) 480V 37-112 kW (50-150 HP) 600V	
	1336 IMPACT	30-112 kW (40-150 HP) 480V 37-93 kW (50-125 HP) 600V	

continued on next page

1321-M Common Mode Chokes

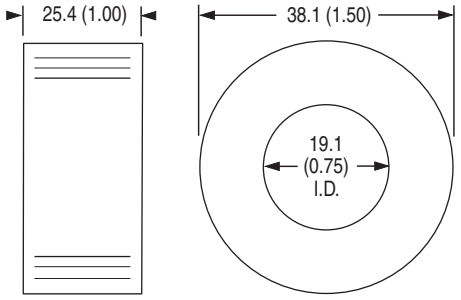
continued from previous page

Choke Type	Used With	Ratings	Catalog Number
Open Style, 670A	PowerFlex 70/700	55-66 kW (75-100 HP) 230V 110-350 kW (150-500 HP) 480V 132-223 kW (200-300 HP) 600V	**1321-M670**
	1336 PLUS II	56-93 kW (75-125 HP) 230V 112-448 kW (150-600 HP) 480V 149-448 kW (200-600 HP) 600V	
	1336 IMPACT	112-448 kW (150-600 HP) 480V 149-448kW (200-600 HP) 600V	

Approximate Mounting Dimensions

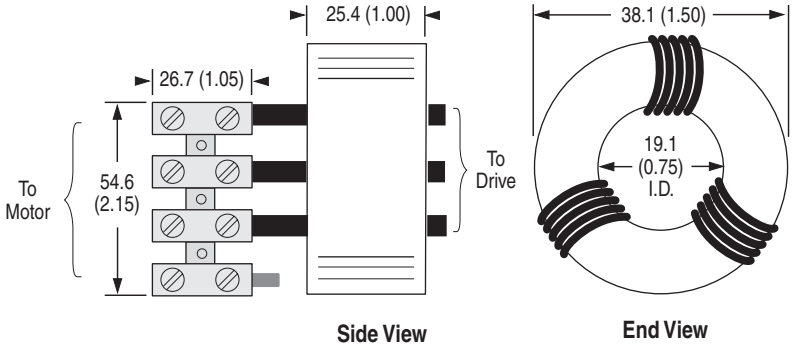
1321-M001

Dimensions are in mm (in.)



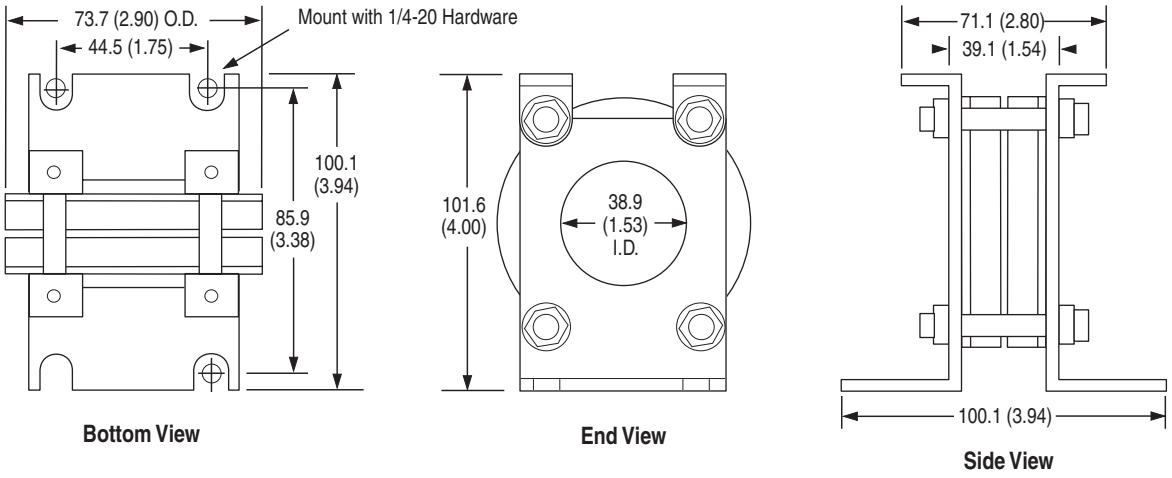
1321-M009

Dimensions are in mm (in.)



1321-M048

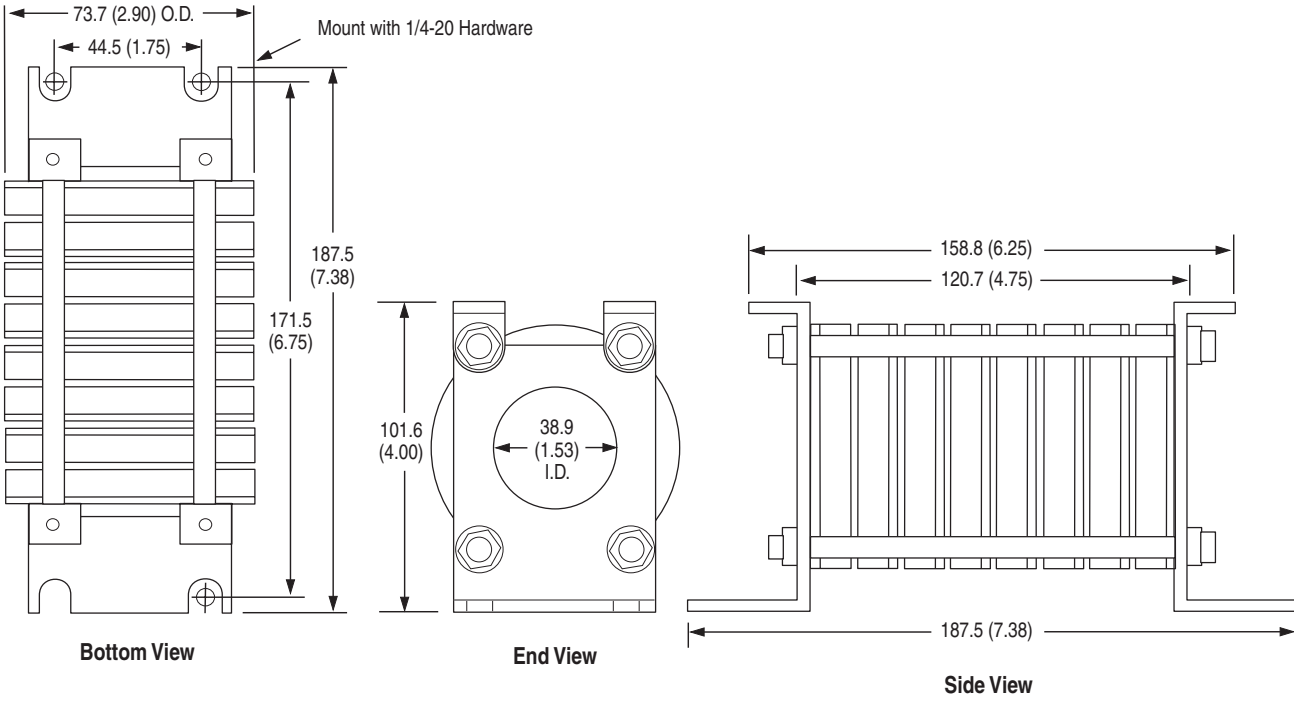
Dimensions are in mm (in.)



1321-M Common Mode Chokes

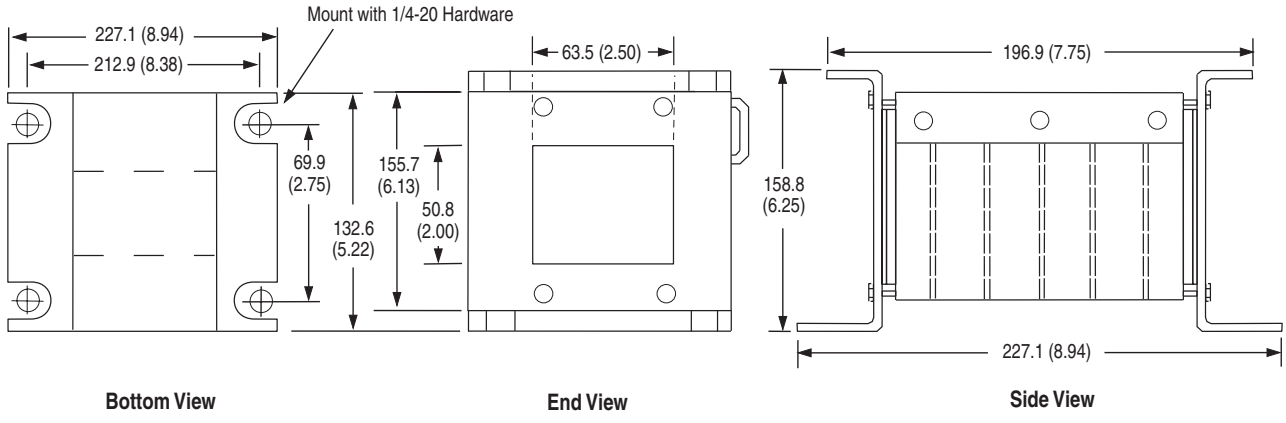
1321-M180

Dimensions are in mm (in.)



1321-M670

Dimensions are in mm (in.)



1321-DC DC Link Chokes

1321-DC DC Link Chokes can be installed with Frame C PowerFlex® 40 and all PowerFlex 400 drives. Add DC Link Chokes in series with the internal DC Bus to:

- Reduce AC Input Line Harmonics
- Help meet IEEE-519 limits
- Absorb Voltage/Current Spikes
- Reduce AC Ripple on DC Bus
- Reduce dV/dT and dI/dT rates
- Solve nuisance overvoltage tripping
- Reduce DC Bus Transient Overvoltage

Catalog Number Explanation

Position	1-4	6	7		9
	1321	– DC	12	–	1
	a	*b*	*c*		*d*

a

Product	
Code	Type
1321	Power Component

b

Device	
Code	Description
DC	DC Link Choke

c

Current Rating	
Code	Amps
9	9
12	12
18	18
25	25
32	32
40	40

d

Inductance Rating	
Code	Description
1	Each DC Link Choke current rating may have more than one inductance rating. Refer to *Ratings* on page 25 for specific values.
2	
3	
4	

Specifications

Specification	Rating
General	UL-508 component recognized (File E180243)
	1000 Volts DC maximum
	For ripple frequency of 300 Hz or 360 Hz
	50 degrees C temperature rise
	Suitable for 40 degrees C ambient temperature
	Class B insulation system (130 degrees C)
	Suitable for ripple current of 10% peak-to-peak
	Touchsafe terminals in many ratings

1321-DC DC Link Chokes

Special Features

- Solid copper box lug type terminals on most sizes
- Specially constructed and epoxy impregnated for low noise
- Customized ratings also available - contact the factory for custom mounting, inductance, current or ripple requirements

Ratings

Catalog Number	Type	DC Amps	mH	Watts	Lug Size	Torque
1321-DC9-2	Open Style	9	3.22	7	22-14	4.5
1321-DC12-1	Open Style	12	1	5	22-14	4.5
1321-DC12-2	Open Style	12	2.1	7	18-4	20
1321-DC18-1	Open Style	18	0.65	5	18-4	20
1321-DC18-4	Open Style	18	3.75	17	18-4	20
1321-DC25-4	Open Style	25	1.75	13	18-4	20
1321-DC32-1	Open Style	32	0.85	11	18-4	20
1321-DC32-2	Open Style	32	1.62	14	18-4	20
1321-DC32-3	Open Style	32	2.68	21	18-4	20
1321-DC40-2	Open Style	40	0.75	15	18-4	20
1321-DC40-4	Open Style	40	2	29	18-4	20

Approximate Mounting Dimensions

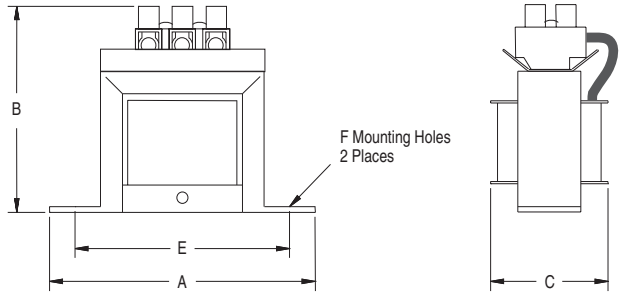


Figure 1

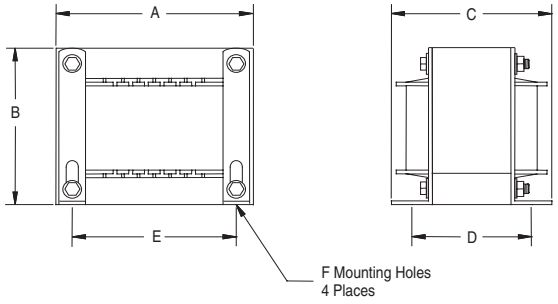


Figure 2

Catalog Number	Figure	*Dimensions in mm (in.)* A	B	C	D	E	F
1321-DC9-2	1	95.3 (3.75)	82.6 (3.25)	50.8 (2)	(NA)	79.5 (3.13)	47.5 DIA. (0.187 DIA.)
1321-DC12-1	1	95.3 (3.75)	82.6 (3.25)	44.5 (1.75)	(NA)	79.5 (3.13)	47.5 DIA. (0.187 DIA.)
1321-DC12-2	2	96.8 (3.81)	114.3 (4.5)	71.6 (2.82)	50.8 (2)	79.5 (3.13)	5.2 x 8.3 (0.203 x 0.328)
1321-DC18-1	1	95.3 (3.75)	82.6 (3.25)	50.8 (2)	(NA)	79.5 (3.13)	47.5 DIA. (0.187 DIA.)
1321-DC18-4	2	117.6 (4.63)	133.4 (5.25)	101.6 (4)	63.5 (2.5)	95.3 (3.75)	5.2 x 8.3 (0.203 x 0.328)
1321-DC25-4	2	96.8 (3.81)	114.3 (4.5)	76.2 (3)	63.5 (2.5)	79.5 (3.13)	5.2 x 8.3 (0.203 x 0.328)
1321-DC32-1	2	96.8 (3.81)	114.3 (4.5)	84.3 (3.32)	63.5 (2.5)	79.5 (3.13)	5.2 x 8.3 (0.203 x 0.328)
1321-DC32-2	2	117.6 (4.63)	133.4 (5.25)	108.0 (4.25)	76.2 (3)	95.3 (3.75)	5.2 x 8.3 (0.203 x 0.328)
1321-DC32-3	2	117.6 (4.63)	133.4 (5.25)	133.4 (5.25)	101.6 (4)	95.3 (3.75)	5.2 x 8.3 (0.203 x 0.328)
1321-DC40-2	2	96.8 (3.81)	114.3 (4.5)	95.3 (3.75)	76.2 (3)	79.5 (3.13)	5.2 x 8.3 (0.203 x 0.328)
1321-DC40-4	2	165.1 (6.5)	166.4 (6.55)	152.4 (6)	85.9 (3.38)	134.9 (5.31)	7.1 x 13.2 (0.28 x 0.52)

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20-COMM-E EtherNet/IP Adapter

Allen-Bradley

Series A FRN 2.xxx
Series B FRN 4.xxx

User Manual

Allen-Bradley • Rockwell Software

Rockwell Automation

Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. *Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls* (Publication SGI-1.1 available from your local Rockwell Automation sales office or online at **http://www.rockwellautomation.com/literature**) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

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Throughout this manual, when necessary we use notes to make you aware of safety considerations.

WARNING: Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.

Important: Identifies information that is critical for successful application and understanding of the product.

ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequences.

Shock Hazard labels may be located on or inside the equipment (e.g., drive or motor) to alert people that dangerous voltage may be present.

Burn Hazard labels may be located on or inside the equipment (e.g., drive or motor) to alert people that surfaces may be at dangerous temperatures.

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The information below summarizes the changes made to this manual since its last release (May 2007):

Description of Changes	Page
Reformatted document from half size (5.5 x 8.5 in.) to full size (8.5 x 11 in.)	Throughout manual
Revised Figures 2.2 and 2.3 to show PowerFlex 700H/S Frames 9 and larger. Added ground tab details in Figure 2.3.	2-4 and 2-5
Added “Flash Updating the Adapter” section.	3-18
Added information for use with PowerFlex 750-Series drives.	Throughout manual
Added “Using RSLinx Classic” section.	4-1
Revised Tables 4.A, 4.B, and 4.C to include configured settings for Parameters 13 - [DPI I/O Cfg], 25 - [M-S Input], and 26 - [M-S Output].	4-17
Added section “Limitations When Using PLC-5, SLC 500, and MicroLogix 1100.”	4-21
Added titles to the controller I/O image tables (Table 5.A through Table 5.F) for easier referral.	5-2 to 5-5
Added footnotes to explicit messaging screen configuration tables for all controller type examples to clarify required settings for the Size in Words/Elements/Bytes fields when reading/writing to 16-bit and 32-bit parameters.	Throughout Chapter 6
The 20-COMM-E adapter firmware version 4.001 added support for use with PowerFlex 750-Series drives (included related information where applicable).	Throughout Appendix C

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Related Documentation

For:	Refer to:	Publication
EtherNet/IP	EtherNet/IP Media Planning and Installation Manual (1) EtherNet/IP Network Infrastructure Guidelines (1) EtherNet/IP Performance Application Solution	ODVA Pub. 148 ODVA Pub. 35 ENET-AP001
DriveExplorer™	http://www.ab.com/drives/driveexplorer/, and DriveExplorer online help (2)	—
DriveTools™ SP (includes DriveExecutive™)	http://www.ab.com/drives/drivetools/, and DriveExecutive online help (2)	—
PowerFlex® 20-HIM-A3/-A5/-C3S/-C5S HIM PowerFlex® 20-HIM-A6/-C6S HIM	PowerFlex 20-HIM-A3/-A5/-C3S/-C5S HIM Quick Reference PowerFlex 20-HIM-A6/-C6S HIM (Human Interface Module) User Manual	20HIM-QR001
PowerFlex® 70/70EC Drive	PowerFlex 70 User Manual PowerFlex 70/700 Reference Manual PowerFlex 70EC/700VC Reference Manual	20A-UM001 PFLEX-RM001 PFLEX-RM004
PowerFlex® 700/700VC Series A Drive PowerFlex® 700VC Series B Drive	PowerFlex 700 Series A User Manual PowerFlex 700 Series B User Manual PowerFlex 70/700 Reference Manual PowerFlex 70EC/700VC Reference Manual	20B-UM001 20B-UM002 PFLEX-RM001 PFLEX-RM004
PowerFlex® 700H Drive	PowerFlex 700H Installation Instructions PowerFlex 700H Programming Manual	PFLEX-IN006 20C-PM001
PowerFlex® 700S Drive	PowerFlex 700S with Phase I Control Installation Manual (Frames 1…6) PowerFlex 700S with Phase I Control Installation Manual (Frames 9 and 10) PowerFlex 700S with Phase I Control User Manual (All Frame Sizes) PowerFlex 700S with Phase I Control Reference Manual PowerFlex 700S with Phase II Control Installation Manual (Frames 1…6) PowerFlex 700S with Phase II Control Installation Manual (Frames 9…14) PowerFlex 700S with Phase II Control Programming Manual (All Frame Sizes) PowerFlex 700S with Phase II Control Reference Manual	20D-IN024 PFLEX-IN006 20D-UM001 PFLEX-RM002 20D-IN024 PFLEX-IN006 20D-PM001 PFLEX-RM003
PowerFlex® 700L Liquid-Cooled AC Drive	PowerFlex 700L User Manual	20L-UM001
PowerFlex® 750-Series AC Drives	PowerFlex 750-Series Drive Installation Instructions PowerFlex 750-Series Drive Programming Manual PowerFlex 755 Drive Embedded EtherNet/IP Adapter User Manual PowerFlex 20-750-20COMM Option Card	750-IN001 750-PM001 750COM-UM001 750COM-IN001
PowerFlex® Digital DC Drive	PowerFlex Digital DC Drive User Manual	20P-UM001
RSLinx® Classic	Getting Results with RSLinx Guide, and online help (2)	LINX-GR001
RSLogix™ 5 RSLogix™ 500 RSLogix™ 5000	RSLogix 5 Getting Results Guide, and online help (2) RSLogix 500 Getting Results Guide, and online help (2) RSLogix 5000 Getting Results Guide, and online help (2)	LG5-GR002 LG500-GR002 9399-RLD300GR
ControlLogix® and 1756-ENBT or 1756-EN2T	EtherNet/IP Modules in Logix5000 Control Systems User Manual	ENET-UM001
PLC-5®	Enhanced and Ethernet PLC-5 Programmable Controllers User Manual	1785-UM012
SLC™500 and 1747-L5-xxx	SLC 500 Modular Hardware Style User Manual	1747-UM011
MicroLogix™ 1100 MicroLogix™ 1400	MicroLogix 1100 Programmable Controllers User Manual MicroLogix 1400 Programmable Controllers User Manual	1763-UM001 1766-UM001

(1) Use this link to the ODVA EtherNet/IP library for these publications: http://odva.org/Home/ODVATECHNOLOGIES/EtherNetIP/EtherNetIPLibrary/tabid/76/Default.aspx

(2) The online help is installed with the software.

Documentation can be obtained online at http://literature.rockwellautomation.com. To order paper copies of technical

documentation, contact your local Rockwell Automation distributor or sales representative.

To find your local Rockwell Automation distributor or sales representative, visit www.rockwellautomation.com/locations.

For information such as firmware updates or answers to drive-related questions, go to the Drives Service & Support web site at www.ab.com/support/abdrives and click on the “Downloads” or “Knowledgebase” link.

Rockwell Automation Support

Rockwell Automation, Inc. offers support services worldwide, with over 75 sales/support offices, over 500 authorized distributors, and over 250 authorized systems integrators located through the United States alone. In addition, Rockwell Automation, Inc. representatives are in every major country in the world.

Local Product Support

Contact your local Rockwell Automation, Inc. representative for:

- Sales and order support
- Product technical training
- Warranty support
- Support service agreements

Technical Product Assistance

For technical assistance, please review the information in Chapter 7, Troubleshooting, first. If you still have problems, then access the Allen-Bradley Technical Support web site at www.ab.com/support/abdrives or contact Rockwell Automation, Inc.

Conventions Used in This Manual

This manual provides information about the adapter and using it with PowerFlex 7-Class (Architecture-Class) drives. The adapter can be used with other products that support a DPI™ adapter, such as the DPI External Comms Kit (20-XCOMM-DC-BASE). Refer to the documentation for your product for specific information about how it works with the adapter.

The following conventions are used throughout this manual:

- Parameter names are shown in the format **Parameter xx - [*]**. The xx represents the parameter number. The * represents the parameter name—for example **Parameter 01 - [DPI Port]**.
- Menu commands are shown in bold type face and follow the format **Menu > Command**. For example, if you read "Select **File > Open**," you should click the **File** menu and then click the **Open** command.
- The firmware release is displayed as FRN X.xxx. The "FRN" signifies Firmware Release Number. The "X" is the major release number. The "xxx" is the minor update number.
- RSLinx (version 2.51), RSLogix 5 (version 7.20), RSLogix 500 (version 7.20), and RSLogix 5000 (version 16) were used for the screen shots in this manual. Different versions of the software may differ in appearance and procedures.

Notes:

Getting Started

The adapter is intended for installation into a PowerFlex 7-Class drive and is used for network communication. The Series B 20-COMM-E adapter (FRN 3.xxx or later) can also be installed in an External DPI Comms Kit (20-XCOMM-DC-BASE).

For PowerFlex 755 drives, it is recommended to use its embedded EtherNet/IP adapter instead of the 20-COMM-E adapter to take advantage of the embedded adapter's advanced capability. When used with PowerFlex 750-Series drives (including the PowerFlex 753 drive), the 20-COMM-E adapter must have firmware version 4.001 (or later) and must be installed using the 20-750-20COMM Option Card. This manual includes information on using the 20-COMM-E adapter with the PowerFlex 753 drive, but it also applies to the PowerFlex 755 drive.

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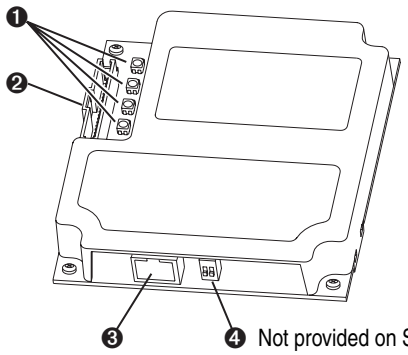
Components

Figure 1.1 Components of the Adapter



Item	Part	Description
❶	Status Indicators	Four LEDs that indicate the status of the DPI, the adapter, and network connection. Refer to Chapter 7, Troubleshooting.
❷	DPI Connector	A 20-pin, single-row shrouded male header. An Internal Interface cable is connected to this connector and a connector on the drive.
❸	Ethernet Connector	An RJ-45 connector for the Ethernet cable. The connector is CAT-5 compliant to ensure reliable data transfer on 100Base-TX Ethernet connections.
❹	Web Pages Switch (SW2)	Enables or disables the adapter web pages. Refer to Setting the Web Pages Switch (Series B only) on page 2-2. SW1 is unused.

Features

The features of the adapter include:

- Typical mounting in a PowerFlex 7-Class drive. The Series B 20-COMM-E adapter (FRN 3.xxx or later) can also be installed in a DPI External Comms Kit and used with the kit's optional I/O board. See Chapter 9, Using the Adapter in a DPI External Comms Kit (20-XCOMM-DC-BASE) for more information.

  DPI External Comms Kit Compatibility

20-COMM-E Adapter		Operation With	
Series	Firmware Version	DPI External Comms Kit (20-XCOMM-DC-BASE)	Optional I/O Board (20-XCOMM-IO-OPT1)
A	2.xxx and earlier	No	No
B	3.xxx and later	Yes	Yes

- Captive screws to secure and ground the adapter to the drive or, when mounted in a DPI External Comms Kit, to the kit's metal enclosure.
- Compatibility with various configuration tools to configure the adapter and connected drive. The tools include the PowerFlex HIM on the drive, and drive-configuration software such as DriveExplorer (version 2.01 or later) or DriveExecutive (version 3.01 or later). In addition, you can use a BOOTP server to configure the network address for the adapter.
- Status indicators that report the status of the drive communications, the adapter, and network. They are visible when the drive cover is open or closed.
- Parameter-configured I/O (Logic Command/Reference and up to four pairs of Datalinks) to accommodate application requirements.
- Explicit Messaging support.
- Master-Slave or Peer-to-Peer hierarchy that can be set up so that the adapter and connected PowerFlex drive transmit data to and from either a scanner or another PowerFlex drive on the network.
- User-defined fault actions to determine how the adapter and connected PowerFlex drive respond to:
  - I/O messaging communication disruptions (Comm Flt Action)
  - Controllers in idle mode (Idle Flt Action)
- Web pages, viewed using a web browser, that show information about the adapter, connected drive, and other DPI devices connected to the drive.
- Configurable e-mail messaging to desired addresses when selected drive faults occur and/or are cleared, and/or when the adapter takes a communication or idle fault action.
- Access to any PowerFlex drive and its connected peripherals on the network to which the adapter is connected.

Compatible Products

DPI is a second generation peripheral communication interface and a functional enhancement to SCANport. The adapter is compatible with Allen-Bradley PowerFlex 7-Class drives and other products that support DPI. At the time of publication, compatible products include:

- PowerFlex 70/70EC drives
- PowerFlex 700/700VC drives
- PowerFlex 700H drives
- PowerFlex 700S drives
- PowerFlex 700L drives
- PowerFlex 750-Series drives [1]
- PowerFlex Digital DC drives
- DPI External Comms Kit
- SMC™ Flex

[1] The 20-COMM-E adapter must have firmware version 4.001 (or later) to be compatible with PowerFlex 750-Series drives.

Required Equipment

Equipment Shipped with the Adapter

When you unpack the adapter, verify that the package includes:

- ❑ One adapter
- ❑ A 2.54 cm (1 in.) and a 15.24 cm (6 in.) Internal Interface cable (only one cable is needed to connect the adapter to the drive; for which cable to use, see Figure 2.2 on page 2-4)
- ❑ One *PowerFlex 7-Class DPI (Drive Peripheral Interface) Network Communication Adapter Installation Instructions* (publication 20COMM-IN004)

TIP: When mounting the 20-COMM-E adapter in a PowerFlex 750-Series drive, you must use a 20-750-20COMM Option Card (publication 750COM-IN001) and the adapter must have firmware version 4.001 (or later).

User-Supplied Equipment

To install and configure the adapter, you must supply:

- ❑ A small flathead screwdriver
- ❑ Ethernet cable – refer to the *EtherNet/IP Media Planning and Installation Manual* (publication ENET-IN001)
- ❑ Ethernet switch – refer to the *EtherNet/IP Performance Application Solution* (publication ENET-AP001)
- ❑ Configuration tool, such as:
  - PowerFlex 7-Class HIM (20-HIM-xx)
  - DriveExplorer (version 2.01 or later)
  - DriveExecutive stand-alone software (version 3.01 or later) or bundled with the DriveTools SP suite (version 1.01 or later)
  - BOOTP Server (version 2.1 or higher) (network setup only)
- ❑ Controller configuration software (such as RSLogix 5/500/5000)
- ❑ A PC connection to the EtherNet/IP network

Safety Precautions

Please read the following safety precautions carefully.

ATTENTION: Risk of injury or death exists. The PowerFlex drive may contain high voltages that can cause injury or death. Remove all power from the PowerFlex drive, and then verify power has been discharged before installing or removing an adapter.

ATTENTION: Risk of injury or equipment damage exists. Only personnel familiar with drive and power products and the associated machinery should plan or implement the installation, start up, configuration, and subsequent maintenance of the product using an adapter. Failure to comply may result in injury and/or equipment damage.

ATTENTION: Risk of equipment damage exists. The adapter contains ESD (Electrostatic Discharge) sensitive parts that can be damaged if you do not follow ESD control procedures. Static control precautions are required when handling the adapter. If you are unfamiliar with static control procedures, refer to *Guarding Against Electrostatic Damage* (publication 8000-4.5.2).

ATTENTION: Risk of injury or equipment damage exists. If the adapter is transmitting control I/O to the drive, the drive may fault when you reset the adapter. Determine how your drive will respond before resetting an adapter.

ATTENTION: Risk of injury or equipment damage exists. **Parameters 21 - [Comm Flt Action]**, **22 - [Idle Flt Action]**, and **41 - [Peer Flt Action]** let you determine the action of the adapter and connected drive if communications are disrupted or the controller is idle. By default, these parameters fault the drive. You can set these parameters so that the drive continues to run. Precautions should be taken to ensure that the settings of these parameters do not create a risk of injury or equipment damage. When commissioning the drive, verify that your system responds correctly to various situations (for example, a disconnected cable or a faulted controller).

ATTENTION: Risk of injury or equipment damage exists. When a system is configured for the first time, there may be unintended or incorrect machine motion. Disconnect the motor from the machine or process during initial system testing.

ATTENTION: Risk of injury or equipment damage exists. The examples in this publication are intended solely for purposes of example. There are many variables and requirements with any application. Rockwell Automation, Inc. does not assume responsibility or liability (to include intellectual property liability) for actual use of the examples shown in this publication.

Quick Start

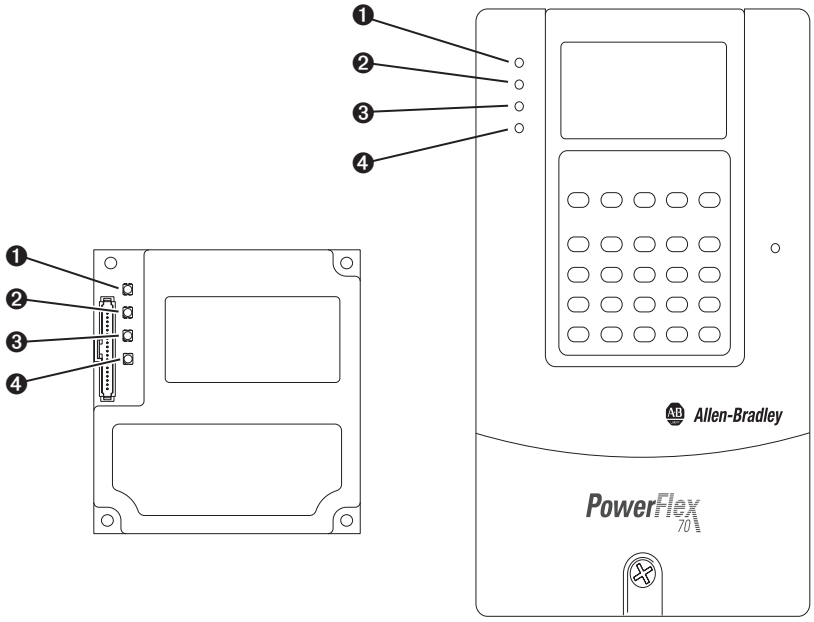
This section is provided to help experienced users quickly start using the adapter. If you are unsure how to complete a step, refer to the referenced chapter.

Step	Action	Refer to…
1	**Review the safety precautions for the adapter.**	Throughout This Manual
2	**Verify that the PowerFlex drive is properly installed.**	Drive User Manual
3	**Install the adapter.** Verify that the PowerFlex drive is not powered. Then, connect the adapter to the network using an Ethernet cable and to the drive using the Internal Interface cable. Use the captive screws to secure and ground the adapter to the drive. **NOTE:** When installing the adapter in a: • DPI External Comms Kit, refer to the *20-XCOMM-DC-BASE Installation Instructions* (publication 20COMM-IN001) supplied with the kit. • PowerFlex 750-Series drive, refer to the *20-750-20COMM Option Card Installation Instructions* (publication 750COM-IN001) supplied with the option card.	*PowerFlex 7-Class DPI Network Communication Adapter Installation Instructions* (publication 20COMM-IN004) and Chapter 2, Installing the Adapter
4	**Apply power to the adapter.** A. The adapter receives power from the drive. Verify that the adapter is installed correctly and then apply power to the drive. The status indicators should be green. If they flash red, there is a problem. Refer to Chapter 7, Troubleshooting. B. Configure/verify key drive parameters.	Chapter 2, Installing the Adapter
5	**Configure the adapter for your application.** Set adapter parameters for the following functions as required by your application: • IP address, subnet mask, and gateway address • Data rate • I/O configuration • Master-Slave or Peer-to-Peer hierarchy • Fault actions	Chapter 3, Configuring the Adapter
6	**Configure the controller to communicate with the adapter.** Use a controller configuration tool such as RSLogix to configure the master on the EtherNet/IP network to recognize the adapter and drive.	Chapter 4, Configuring the I/O
7	**Create a ladder logic program.** Use a controller configuration tool such as RSLogix to create a ladder logic program that enables you to: • Control the adapter and connected drive using I/O. • Monitor or configure the drive using Explicit messages.	Chapter 5, Using the I/O Chapter 6, Using Explicit Messaging

Status Indicators

The adapter uses four status indicators to report its operating status. They can be viewed on the adapter or through the drive cover (Figure 1.2).

Figure 1.2 Status Indicators (location on drive may vary)



Item	Name
❶	PORT
❷	MOD
❸	NET A
❹	NET B

After installing the adapter and applying power to the drive, refer to Start-Up Status Indications on page 2-6 for possible start-up status indications and their descriptions.

Installing the Adapter

This chapter provides instructions for installing the adapter in a PowerFlex 7-Class drive. This adapter can also be installed in a DPI External Comms Kit. In this case, refer to Chapter 9 or the separate *20-XCOMM-DC-BASE Installation Instructions* (publication 20COMM-IN001) supplied with the kit.

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Preparing for an Installation

Before installing the adapter:

- Make sure the Ethernet switch is the correct type. A “managed” switch that supports IGMP snooping is usually recommended. An “unmanaged” switch can be used instead if RSLogix 5000 version 18 (or later) is used and all devices on the network are configured for “unicast” I/O. For more details, see the following documents:
  - *EtherNet/IP Media Planning and Installation Manual* (ODVA publication 148)
  - *EtherNet/IP Network Infrastructure Guidelines* (ODVA publication 35)
  - *EtherNet/IP Performance Application Solutions* (Rockwell publication ENET-AP001)
- Understand IGMP Snooping/Ethernet Switches

  The 20-COMM-E adapter is a multicast device. In most situations, an IGMP snooping (managed) switch is required. If more than one or two 20-COMM-E adapters are connected to the switch, a managed switch is required—otherwise the drive may fault on a DPI Port x network loss. The 20-COMM-E Series B adapter (firmware version 4.001 or later), RSLogix 5000 version 18 (or later), and a ControlLogix or CompactLogix controller will support unicast. When all ethernet connections are set up as unicast devices in RSLogix 5000, then an IGMP snooping (managed) switch is not needed.

  Much of EtherNet/IP implicit (I/O) messaging uses IP multicast to distribute I/O control data, which is consistent with the CIP producer/consumer model. Historically, most switches have treated multicast packets the same as broadcast packets. That is, all multicast packets are re-transmitted to all ports.

IGMP snooping constrains the flooding of multicast traffic by dynamically configuring switch ports so that multicast traffic is forwarded only to ports associated with a particular IP multicast group.

Switches that support IGMP snooping (managed switches) "learn" which ports have devices that are part of a particular multicast group and only forward the multicast packets to the ports that are part of the multicast group.

Be careful as to what level of support a switch has of IGMP snooping. Some layer 2 switches that support IGMP snooping require a router (which could be a layer 3 switch) to send out IGMP polls to learn what devices are part of the multicast group. Some layer 2 switches can use IGMP snooping without a router sending polls. If your control system is a stand-alone network or is required to continue performing if the router is out of service, make sure the switch you are using supports IGMP snooping without a router being present.

- Refer to Appendix A for the number of CIP connections supported by the 20-COMM-E adapter.
- Verify that you have all required equipment. Refer to Required Equipment on page 1-3.

Setting the Web Pages Switch (Series B only)

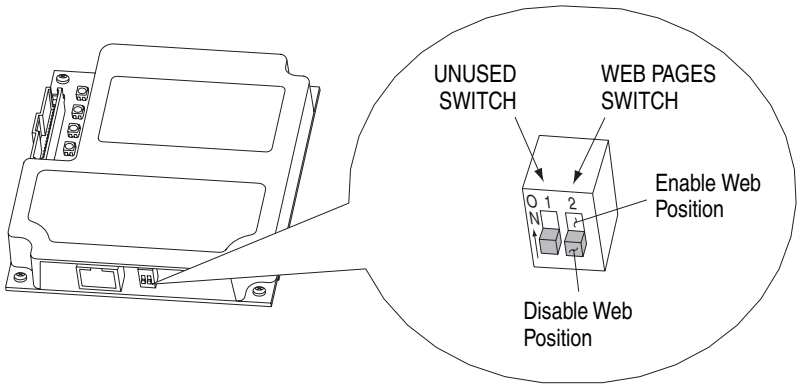
To use the adapter web pages, the Web Pages Switch (not provided on Series A adapter) must be set to its "Enable Web" position. For information to enable/disable web pages for a Series A adapter, refer to Setting Web Access Control on page 3-16.

Important: A new switch setting is recognized only when power is applied to the adapter, or the adapter is reset. If you change a switch setting, cycle power or reset the adapter to apply the change.

ATTENTION: Risk of equipment damage exists. The adapter contains ESD (Electrostatic Discharge) sensitive parts that can be damaged if you do not follow ESD control procedures. Static control precautions are required when handling the adapter. If you are unfamiliar with static control procedures, refer to *Guarding Against Electrostatic Damage* (publication 8000-4.5.2).

Set the Web Pages Switch (SW2 in Figure 2.1) to enable or disable the adapter web pages. By default, the adapter web pages are disabled. For complete details on adapter web pages, see Viewing the Adapter's Web Pages on page 8-1.

Figure 2.1 Setting Web Pages Switch



SW2 Setting	Description
Down (OFF) position	Disables the adapter web pages (default setting)
Up (ON) position	Enables the adapter web pages

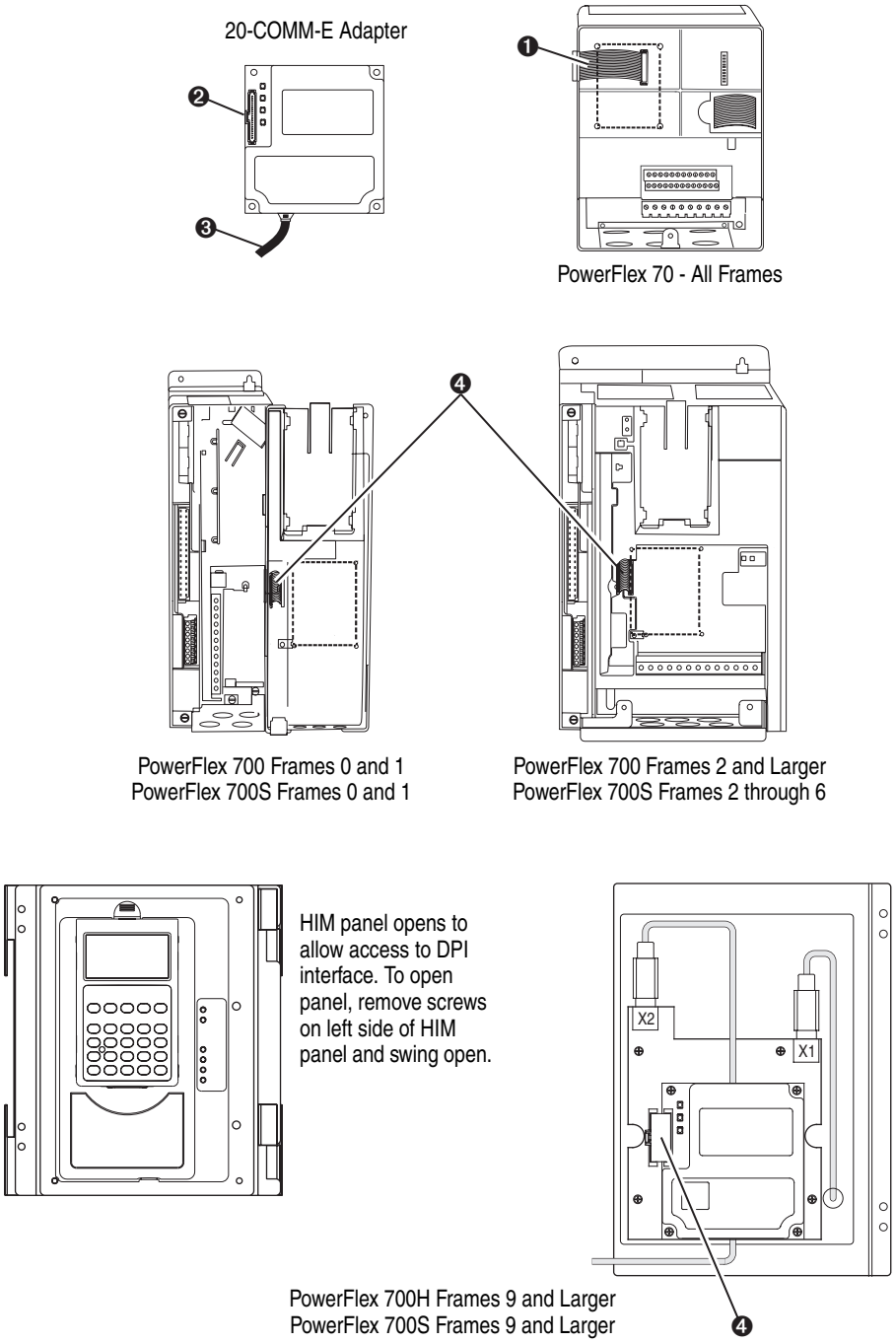
Connecting the Adapter to the Drive

ATTENTION: Risk of injury or death exists. The PowerFlex drive may contain high voltages that can cause injury or death. Remove power from the drive, and then verify power has been discharged before installing or removing the adapter.

1. Remove power from the drive.
2. Use static control precautions.
3. Remove the drive cover or open the drive door.
4. Connect the Internal Interface cable to the DPI port on the drive and then to the DPI connector on the adapter (see Figure 2.2).
5. Secure and ground the adapter to the drive (see Figure 2.3) by doing the following:
   - On a PowerFlex 70 drive, fold the Internal Interface cable behind the adapter and mount the adapter on the drive using the four captive screws.
   - On a PowerFlex 700, PowerFlex 700H or PowerFlex 700S drive, mount the adapter on the drive using the four captive screws.

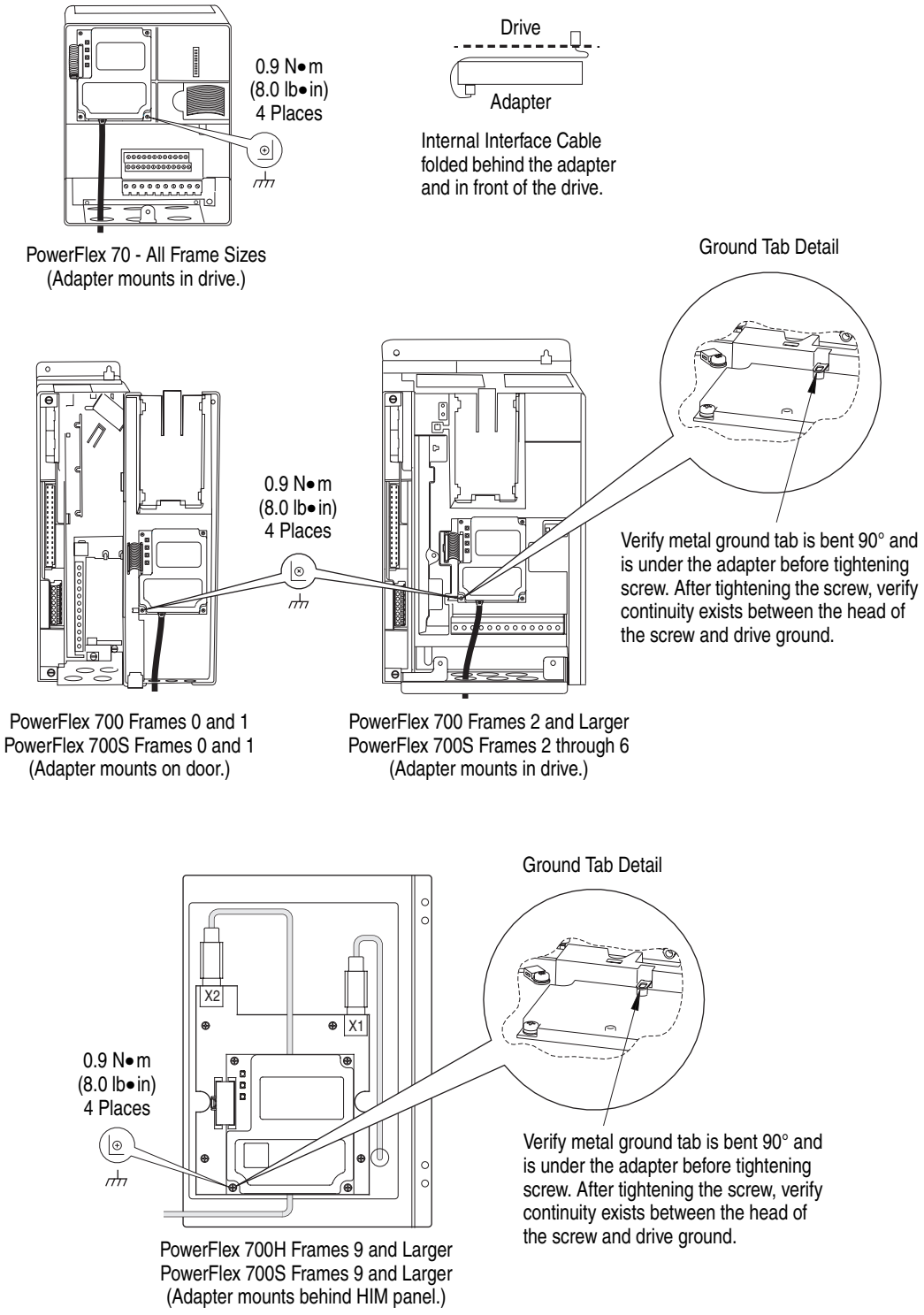
Important: Tighten all screws to properly ground the adapter. Recommended torque is 0.9 N•m (8.0 lb•in).

Figure 2.2 DPI Ports and Internal Interface Cables



Item	Description
❶	15.24 cm (6 in.) Internal Interface cable
❷	DPI Connector
❸	Ethernet cable
❹	2.54 cm (1 in.) Internal Interface cable

Figure 2.3 Mounting and Grounding the Adapter



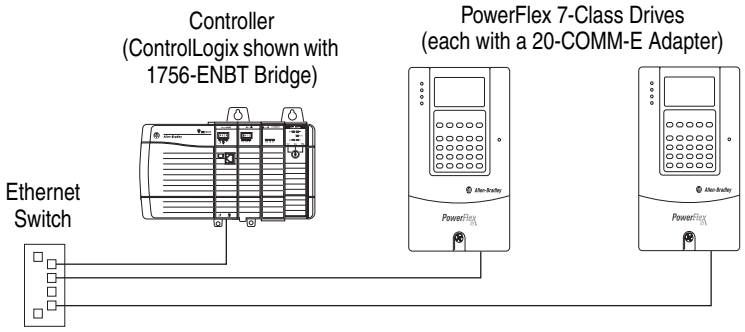
NOTE: When installing the adapter in a PowerFlex 750-Series drive, refer to the *20-750-20COMM Option Card Installation Instructions* (publication 750COM-IN001) supplied with the option card.

Connecting the Adapter to the Network

ATTENTION: Risk of injury or death exists. The PowerFlex drive may contain high voltages that can cause injury or death. Remove power from the drive, and then verify power has been discharged before installing or removing the adapter.

1. Remove power from the drive.
2. Use static control precautions.
3. Connect one end of an Ethernet cable to the network. See Figure 2.4 for an example of wiring to an EtherNet/IP network.

Figure 2.4 Connecting the Ethernet Cable to the Network



4. Route the other end of the Ethernet cable through the bottom of the PowerFlex drive (Figure 2.3) and insert its Ethernet cable plug into the mating adapter receptacle.

Applying Power

ATTENTION: Risk of equipment damage, injury, or death exists. Unpredictable operation may occur if you fail to verify that parameter settings are compatible with your application. Verify that settings are compatible with your application before applying power to the drive.

Install the drive cover or close the drive door, and apply power to the drive. The adapter receives its power from the connected drive. When you apply power to the adapter for the first time, its topmost "PORT" status indicator should be steady green or flashing green after an initialization. If it is red, there is a problem. Refer to Chapter 7, Troubleshooting.

Start-Up Status Indications

After power has been applied, the status indicators for the drive and communications adapter can be viewed on the front of the drive (Figure 2.5). Possible start-up status indications are shown in Table 2.A.

Figure 2.5 Drive and Adapter Status Indicators (location on drive may vary)

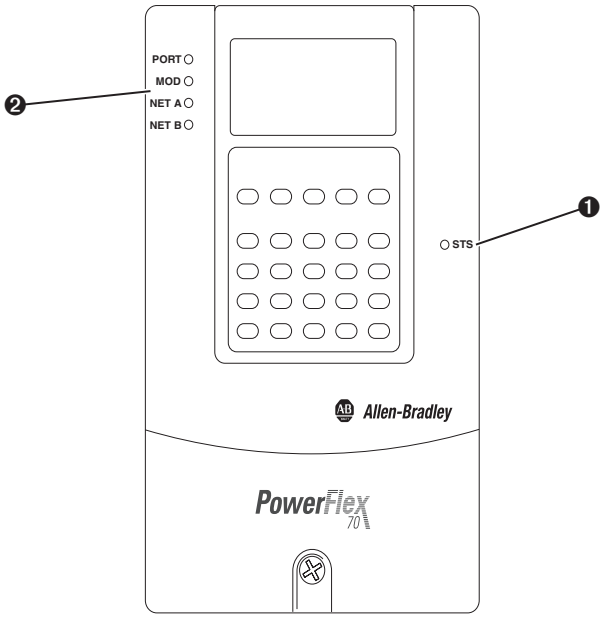


Table 2.A Drive and Adapter Start-Up Status Indications

Item	Name	Color	State	Description
Drive STS Indicator				
❶	STS (Status)	Green	Flashing	Drive ready but not running, and no faults are present.
			Steady	Drive running, no faults are present.
		Yellow	Flashing, Drive Stopped	An inhibit condition exists – the drive cannot be started. Check drive Parameter 214 - [Start Inhibits].
			Flashing, Drive Running	An intermittent type 1 alarm condition is occurring. Check drive Parameter 211 - [Drive Alarm 1].
			Steady, Drive Running	A continuous type 1 alarm condition exists. Check drive Parameter 211 - [Drive Alarm 1].
		Red	Flashing	A fault has occurred.
			Steady	A non-resettable fault has occurred.
Adapter Status Indicators				
❷	PORT	Green	Flashing	Normal Operation. The adapter is establishing an I/O connection to the drive. It will turn steady green or red.
			Steady	Normal Operation. The adapter is properly connected and communicating with the drive.
	MOD	Green	Flashing	Normal Operation. The adapter is operating but is not transferring I/O data to a controller.
			Steady	Normal Operation. The adapter is operating and transferring I/O data to a controller.
	NET A	Green	Off	Normal operation. BOOTP is enabled or a valid IP address is not set.
			Flashing	Normal Operation. BOOTP is disabled, the adapter is properly connected, has an IP address, and is connected to an EtherNet/IP network but does not have an I/O connection.
			Steady	Normal Operation. The adapter is properly connected and communicating on the network to a controller.
	NET B	Green	Off	Normal Operation. The adapter is properly connected but is idle.
			Flashing	Normal Operation. The adapter is properly connected, BOOTP is enabled, and the adapter is transmitting data packets on the network.

For more details on status indicator operation, refer to page 7-2 and page 7-3.

Configuring/Verifying Key Drive Parameters

The PowerFlex 7-Class drive can be separately configured for the control and Reference functions in various combinations. For example, you could set the drive to have its control come from a peripheral or terminal block with the Reference coming from the network. Or you could set the drive to have its control come from the network with the Reference coming from another peripheral or terminal block. Or you could set the drive to have both its control and Reference come from the network.

The following steps in this section assume that the drive will receive the Logic Command and Reference from the network.

1. Use drive Parameter 090 - [Speed Ref A Sel] to set the drive speed Reference to “22” (DPI Port 5).
2. If hard-wired discrete digital inputs are not used to control the drive, verify that unused digital input drive Parameters 361 - [Dig In1 Sel] and 362 - [Dig In2 Sel] are set to “0” (Not Used).
3. Verify that drive Parameter 213 - [Speed Ref Source] is reporting that the source of the Reference to the drive is “22” (DPI Port 5). This ensures that any Reference commanded from the network can be monitored by using drive Parameter 002 - [Commanded Speed]. If a problem occurs, this verification step provides the diagnostic capability to determine whether the drive/adapter or the network is the cause.

▶ **TIP:** For PowerFlex 750-Series drives, use drive Parameter 545 - [Speed Ref A Sel] to set the drive speed Reference:

A. Set the Port field to “Port 0 - PowerFlex 75x.”

B. Set the Parameter field to point to the port in which the 20-COMM-E adapter/20-750-20COMM Option Card are installed (for example, “876 - Port 6 Reference”).

Commissioning the Adapter

To commission the adapter, you must set a unique IP address on the network. (Refer to the Glossary for details about IP addresses.) After installing the adapter and applying power, you can set the IP address by using a BOOTP server or by setting adapter parameters. See Setting the IP Address, Subnet Mask, and Gateway Address on page 3-6 for details.

By default, the adapter is configured so that you must set the IP address using a BOOTP server. To set the IP address using adapter parameters, you must disable the BOOTP feature. See Disabling the BOOTP Feature on page 3-6 for details.

Important: New settings for some adapter parameters (for example, **Parameters 04 - [IP Addr Cfg 1]** through **07 - [IP Addr Cfg 4]**) are recognized only when power is applied to the adapter or it is reset. After you change parameter settings, cycle power or reset the adapter.

Configuring the Adapter

This chapter provides instructions and information for setting the parameters in the adapter.

Topic	Page
Configuration Tools	3-1
Using the PowerFlex 7-Class HIM	3-2
Using BOOTP	3-3
Setting the IP Address, Subnet Mask, and Gateway Address	3-6
Setting the Data Rate	3-8
Setting the I/O Configuration	3-8
Selecting Master-Slave or Peer-to-Peer	3-9
Setting the Reference Adjustment	3-14
Setting a Fault Action	3-15
Setting Web Access Control	3-16
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Viewing the Adapter Status Using Parameters	3-18
Flash Updating the Adapter	3-18

For a list of parameters, refer to Appendix B, Adapter Parameters. For definitions of terms in this chapter, refer to the Glossary.

Configuration Tools

The adapter stores parameters and other information in its own non-volatile memory. You must, therefore, access the adapter to view and edit its parameters. The following tools can be used to access the adapter parameters:

Tool	Refer to…
PowerFlex 7-Class HIM	page 3-2
BOOTP Server	page 3-3
DriveExplorer Software (version 2.01 or later)	http://www.ab.com/drives/driveexplorer, or DriveExplorer online help (installed with the software)
DriveExecutive Software (version 3.01 or later)	http://www.ab.com/drives/drivetools, or DriveExecutive online help (installed with the software)

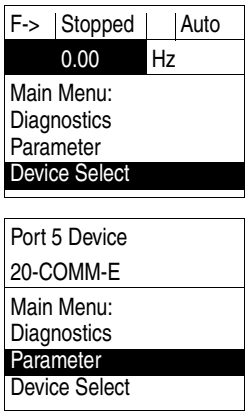
Using the PowerFlex 7-Class HIM

If your drive has either an LED or LCD HIM (Human Interface Module), it can be used to access parameters in the adapter as shown below. It is recommended that you read through the steps for your HIM before performing the sequence. For additional information, refer to the drive documentation or the *PowerFlex 7-Class HIM Quick Reference* (publication 20HIM-QR001).

Using an LED HIM

Step	Example Screens
1. Press the ALT key and then the Device Sel (Sel) key to display the Device Screen. 2. Press the ▲ or ▼ key to scroll to the adapter. Letters represent files in the drive, and numbers represent ports. The adapter is usually connected to port 5. 3. Press the ↵ (Enter) key to enter your selection. A parameter database is constructed, and then the first parameter is displayed. 4. Edit the parameters using the same techniques that you use to edit drive parameters.	

Using an LCD HIM

Step	Example Screens
1. In the main menu, press the ▲ or ▼ key to scroll to **Device Select**. 2. Press the ↵ (Enter) key to enter your selection. 3. Press the ▲ or ▼ key to scroll to the adapter (20-COMM-E). 4. Press the ↵ (Enter) key to select the adapter. A parameter database is constructed, and then the main menu for the adapter is displayed. 5. Edit the parameters using the same techniques that you use to edit drive parameters.	

NOTE: All configuration procedures throughout this chapter use the PowerFlex 7-Class LCD HIM to access parameters in the adapter and show example LCD HIM screens.

TIP: When using a PowerFlex 20-HIM-A6 or 20-HIM-C6S HIM, refer to its User Manual, publication 20-HIM-UM001).

Using BOOTP

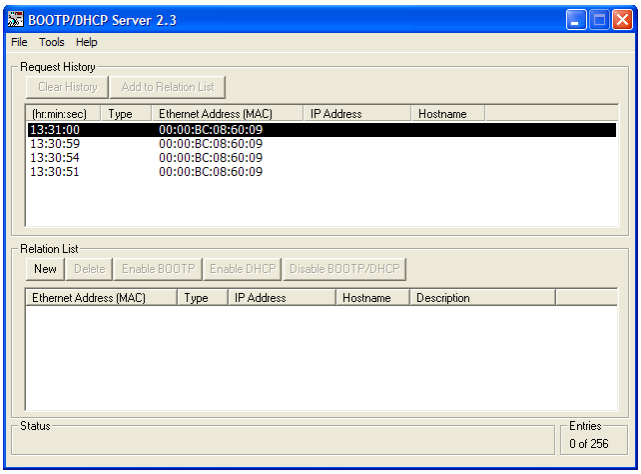
By default, the adapter is configured so that you can set its IP address, subnet mask, and gateway address by using a BOOTP utility. You can select from a variety of BOOTP utilities. These instructions use Rockwell's BOOTP Server (version 2.3 or later), a free stand-alone program that incorporates the functionality of standard BOOTP utilities with a graphical interface. It is available from http://www.software.rockwell.com/support/download/detail.cfm?ID=3390. Refer to the Readme file and online Help for directions and more information.

TIP: If desired, you can disable BOOTP and configure the IP address, subnet mask, and gateway address by setting parameters. For details, see Setting the IP Address, Subnet Mask, and Gateway Address on page 3-6.

Configuring the Adapter Using BOOTP Server

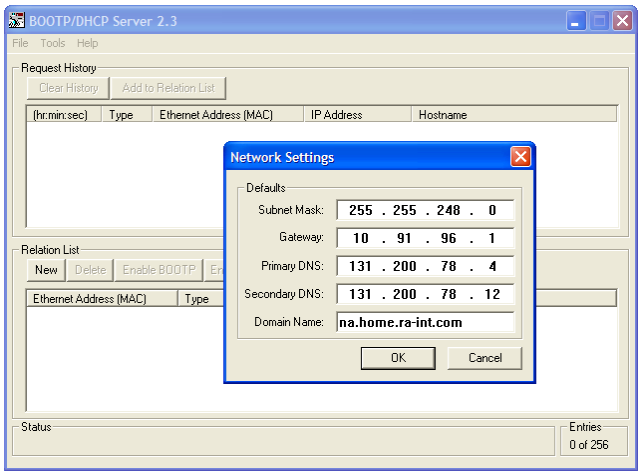
1. On the adapter label, note the adapter's hardware Ethernet Address (MAC), which will be used in Step 6.
2. On a computer connected to the EtherNet/IP network, start the BOOTP software. The BOOTP Server window (Figure 3.1) appears.

Figure 3.1 BOOTP Server Window



3. To properly configure devices on your EtherNet/IP network, you must configure settings in the BOOTP software to match the network. Select **Tools > Network Settings** to display the Network Settings window (Figure 3.2).

Figure 3.2 Network Settings Window



4. Edit the following:

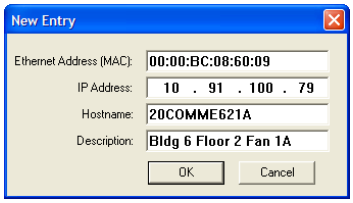
Box	Type
Subnet Mask (1)	The subnet mask for the adapter's network.
Gateway (1)	The IP address of the gateway device on the adapter's network.
Primary DNS	The address of the primary DNS server to be used on the local end of the link for negotiating with remote devices.
Secondary DNS	Optional — the address of the secondary DNS server to be used on the local end of the link for negotiating with remote devices when the primary DNS server is unavailable.
Domain Name	The text name corresponding to the numeric IP address that was assigned to the server that controls the network.

(1) For definitions of these terms, refer to the Glossary.

5. Click **OK** to apply the settings. Devices on the network issuing BOOTP requests appear in the BOOTP Request History list.

6. In the BOOTP Request History list, either double-click the adapter's Ethernet Address (MAC) noted in Step 1, or click **New** in the Relation List. The New Entry dialog box (Figure 3.3) appears. In the first case, the Ethernet Address (MAC) is automatically entered. In the latter case, you must manually enter it.

Figure 3.3 New Entry Dialog Box



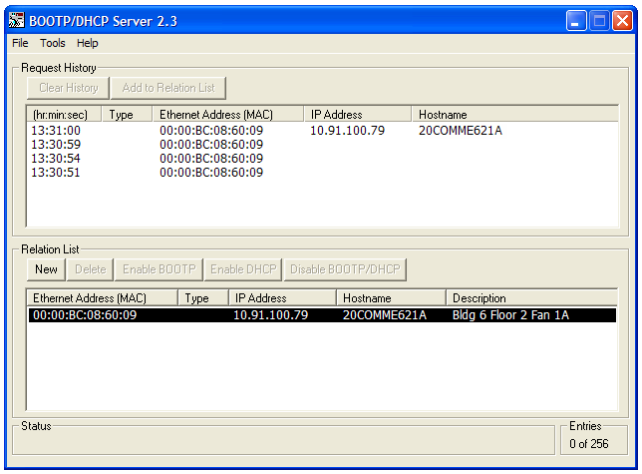
7. Edit the following:

Box	Type
IP Address [1]	A unique IP address for the adapter
Host Name	Optional
Description	Optional

[1] For a definition of this term, refer to the Glossary.

8. Click **OK** to apply the settings. The adapter appears in the Relation List (Figure 3.4) with the new settings.

Figure 3.4 BOOTP Server Window with Adapter in the Relation List



9. To assign this configuration to the adapter permanently, select the device in the Relation List and click **Disable BOOTP/DHCP**. When power is cycled on the adapter, it will use the configuration you assigned it and not issue new BOOTP requests.

TIP: To enable BOOTP for an adapter that has had BOOTP disabled, first select the adapter in the Relation List, then click **Enable BOOTP**, and finally reset the adapter or power cycle the drive.

10. To save the Relation List, select **File > Save**.

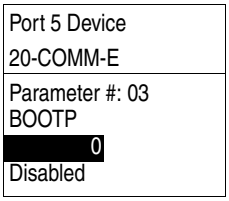
Setting the IP Address, Subnet Mask, and Gateway Address

By default, the adapter is configured so that you set its IP address, subnet mask, and gateway address using a BOOTP server. If you want to set these attributes using the adapter parameters instead, you must disable BOOTP and then set the appropriate parameters in the adapter.

Disabling the BOOTP Feature

1. Set the value of **Parameter 03 - [BOOTP]** to "0" (Disabled).

Figure 3.5 Example BOOTP LCD HIM Screen



Value	Setting
0	Disabled
1	Enabled (Default)

2. Reset the adapter (see Resetting the Adapter on page 3-17).

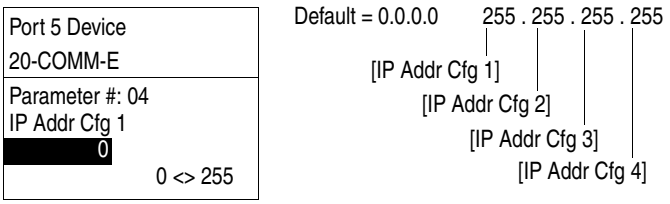
   After disabling the BOOTP feature, you can then configure the IP address, subnet mask, and gateway address using adapter parameters.

Setting an IP Address Using Parameters

1. Verify that **Parameter 03 - [BOOTP]** is set to "0" (Disabled). This parameter must be set to Disabled to configure the IP address using the adapter parameters.

2. Set the value of **Parameters 04 - [IP Addr Cfg 1]** through **07 - [IP Addr Cfg 4]** to a unique IP address.

Figure 3.6 Example IP Addr Cfg 1 LCD HIM Screen



3. Reset the adapter (see Resetting the Adapter on page 3-17).

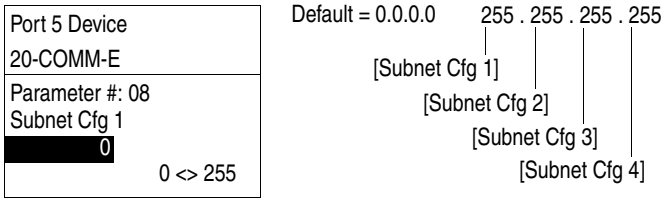
   The NET A status indicator will be steady green or flashing green if the IP address is correctly configured, and is connected to an operating ethernet network.

Setting a Subnet Mask Using Parameters

1. Verify that **Parameter 03 - [BOOTP]** is set to “0” (Disabled). This parameter must be set to Disabled to configure the subnet mask using the adapter parameters.

2. Set the value of **Parameters 08 - [Subnet Cfg 1]** through **11 - [Subnet Cfg 4]** to the desired value for the subnet mask.

Figure 3.7 Example Subnet Cfg 1 LCD HIM Screen



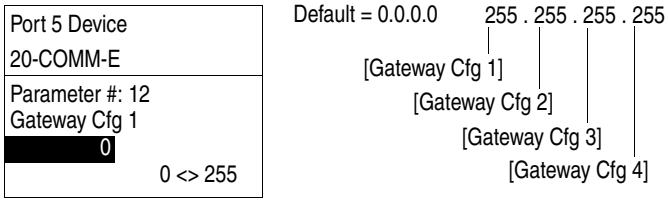
3. Reset the adapter (see Resetting the Adapter on page 3-17).

Setting a Gateway Address for the Adapter Using Parameters

1. Verify that **Parameter 03 - [BOOTP]** is set to “0” (Disabled). This parameter must be set to Disabled to configure the gateway address using the adapter parameters.

2. Set the value of **Parameters 12 - [Gateway Cfg 1]** through **15 - [Gateway Cfg 4]** to the IP address of the gateway device.

Figure 3.8 Example Gateway Cfg 1 LCD HIM Screen



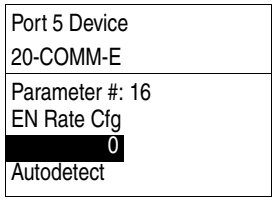
3. Reset the adapter (see Resetting the Adapter on page 3-17).

Setting the Data Rate

By default, the adapter is set to autodetect, so it automatically detects the data rate and duplex setting used on the network. If you need to set a specific data rate and duplex setting, the value of **Parameter 16 - [EN Rate Cfg]** determines the Ethernet data rate and duplex setting that the adapter will use to communicate. For definitions of data rate and duplex, refer to the Glossary.

1. Set the value of **Parameter 16 - [EN Rate Cfg]** to the data rate at which your network is operating.

Figure 3.9 Example Ethernet Rate Cfg LCD HIM Screen



Value	Data Rate
0	Autodetect (default)
1	10 Mbps Full
2	10 Mbps Half
3	100 Mbps Full
4	100 Mbps Half

TIP: Auto detection of baud rate and duplex works properly only if the device (usually a switch) on the other end of the cable is also set to auto detect the baud rate/duplex. If one device has the baud rate/duplex hard coded, the other device must be hard-coded to the same settings.

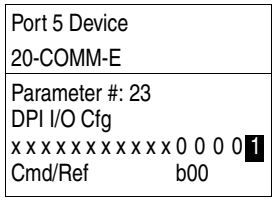
2. Reset the adapter (see Resetting the Adapter on page 3-17).

Setting the I/O Configuration

The I/O configuration determines the data that is sent to and from the drive. Logic Command/Status, Reference/Feedback, and Datalinks may be enabled or disabled. (Datalinks allow you to read/write directly to parameters in the drive using implicit I/O.) A “1” enables the I/O and a “0” disables the I/O.

1. Set the bits in **Parameter 23 - [DPI I/O Cfg]**.

Figure 3.10 Example DPI I/O Cfg LCD HIM Screen



Bit	Description
0	Logic Command/Reference (Default)
1	Datalink A
2	Datalink B
3	Datalink C
4	Datalink D
5…15	Not Used

Bit 0 is the right-most bit. In Figure 3.10, it is highlighted and equals “1.”

2. If a controller is used to control the drive, adapter **Parameters 35 - [M-S Input]** and **36 - [M-S Output]** for Master-Slave Hierarchy must be set (see Setting a Master-Slave Hierarchy (Scanner-to-Drive Communication) on page 3-9).

3. If Logic Command/Reference is enabled, configure the parameters in the drive to accept the Logic Command and Reference from the adapter.

For example, set Parameter 90 - [Speed Ref A Sel] in a PowerFlex 70 or 700 drive to “22” (DPI Port 5) so that the drive uses the Reference from the adapter. Also, verify that the mask parameters (for example, Parameter 276 - [Logic Mask]) in the drive are configured to receive the desired logic from the adapter. Refer to the documentation for your drive for details.

4. If you enabled one or more Datalinks, configure parameters in the drive to determine the source and destination of data in the Datalink(s). When using Datalinks, up to 8 drive [Data In xx] parameters (300…307) and/or up to 8 [Data Out xx] parameters (310…317) must be assigned to point to the appropriate drive parameters for your application. See Chapter 4 for an example.

5. Reset the adapter (see Resetting the Adapter on page 3-17).

The adapter is ready to receive I/O. You must now configure the adapter to receive I/O from a master or peer device. See Selecting Master-Slave or Peer-to-Peer. If you select a Master-Slave hierarchy, you must also configure the master to communicate with the adapter. See Chapter 4, Configuring the I/O.

Selecting Master-Slave or Peer-to-Peer

A hierarchy determines the type of device with which the adapter exchanges data. In a Master-Slave hierarchy, the adapter exchanges data with a master, such as a scanner or bridge (1756-ENBT, 1756-EN2T, 1747-L5-xxx, etc.). In a Peer-to-Peer hierarchy, the adapter exchanges data with one or more EtherNet/IP adapters connected to other drives. (The drives must have compatible Logic Command/Status words.)

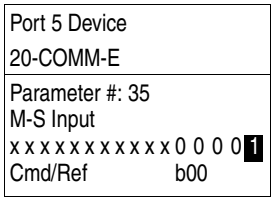
For both Master-Slave and Peer-to-Peer hierarchies, the devices exchanging data must be on the same IP subnet. See “IP Addresses” in the Glossary for information about IP subnets.

Setting a Master-Slave Hierarchy (Scanner-to-Drive Communication)

1. Enable the desired I/O in **Parameter 23 - [DPI I/O Cfg]**. See Figure 3.10.

2. Set the bits in **Parameter 35 - [M-S Input]**. This parameter determines the data received from the master by the drive. A “1” enables the I/O and a “0” disables the I/O.

Figure 3.11 Example M-S Input LCD HIM Screen

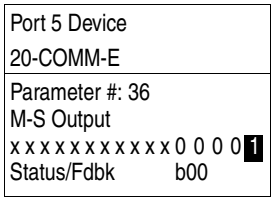


Bit	Description
0	Logic Command/Reference (Default)
1	Datalink A Input
2	Datalink B Input
3	Datalink C Input
4	Datalink D Input
5…15	Not Used

Bit 0 is the right-most bit. In Figure 3.11, it is highlighted and equals “1.”

3. Set the bits in **Parameter 36 - [M-S Output]**. This parameter determines the data transmitted from the drive to the scanner. A "1" enables the I/O and a "0" disables the I/O.

Figure 3.12 Example M-S Output LCD HIM Screen



Bit	Description
0	Status/Feedback (Default)
1	Datalink A Output
2	Datalink B Output
3	Datalink C Output
4	Datalink D Output
5...15	Not Used

Bit 0 is the right-most bit. In Figure 3.12, it is highlighted and equals "1."

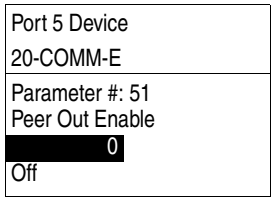
4. Reset the adapter (see Resetting the Adapter on page 3-17).

The adapter is ready to receive I/O from the master (that is, scanner). You must now configure the scanner to recognize and transmit I/O to the adapter. See Chapter 4, Configuring the I/O.

Setting the Adapter to Transmit Peer-to-Peer Data (Drive-to-Drive Communication)

1. Verify that **Parameter 51 - [Peer Out Enable]** is set to "0" (Off). This parameter must be Off while you configure peer output parameters.

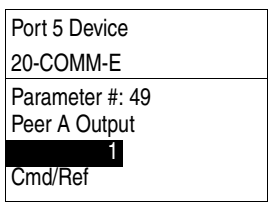
Figure 3.13 Example Peer Out Enable LCD HIM Screen



Value	Setting
0	Off (Default)
1	On

2. Set **Parameter 49 - [Peer A Output]** to select the source of the data to output to the network.

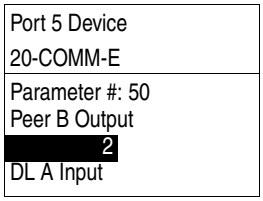
Figure 3.14 Example Peer A Output LCD HIM Screen



Value	Description
0	Off (Default)
1	Logic Command/Reference
2...5	Datalink A, B, C, or D Input
6...9	Datalink A, B, C, or D Output

3. If desired, set **Parameter 50 - [Peer B Output]** to select an additional source of the data to output to the network.

Figure 3.15 Example Peer B Output LCD HIM Screen



Value	Description
0	Off (Default)
1	Logic Command/Reference
2…5	Datalink A, B, C, or D Input
6…9	Datalink A, B, C, or D Output

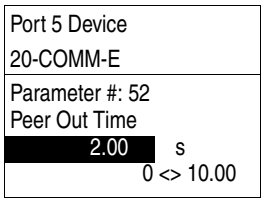
4. Set **Parameters 52 - [Peer Out Time]** and **53 - [Peer Out Skip]** to establish the minimum and maximum intervals between Peer messages. Because the adapter transmits Peer messages when a change-of-state condition occurs, minimum and maximum intervals are required.

   – The minimum interval ensures that the adapter does not transmit messages on the network too often, thus minimizing network traffic. It is set using **Parameter 52 - [Peer Out Time]**.

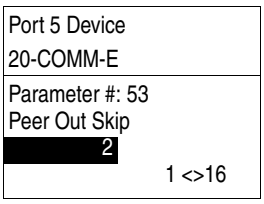
   – The maximum interval ensures that the adapter transmits messages often enough so that the receiving adapter(s) can receive recent data and verify that communications are working or, if communications are not working, can timeout. The maximum interval is the value of **Parameter 52 - [Peer Out Time]** multiplied by the value of **Parameter 53 - [Peer Out Skip]**.

   In the Figure 3.16 example, the minimum interval is set to 2.00 seconds (**Parameter 52 - [Peer Out Time]**), and the maximum interval is set to 4.00 seconds (2.00 x “2” setting of **Parameter 53 - [Peer Out Skip]**).

Figure 3.16 Example Peer Out Time and Peer Out Skip LCD HIM Screens



Default = 10.00 s



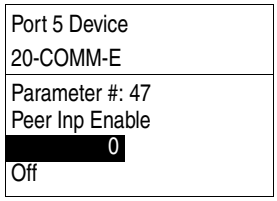
Default = 1

5. Set **Parameter 51 - [Peer Out Enable]** to “1” (On). The adapter will transmit the data selected in **Parameters 49 - [Peer A Output]** and **50 - [Peer B Output]** to the network. Another adapter must be configured to receive the Peer I/O data.

Setting the Adapter to Receive Peer-to-Peer Data

1. Verify that **Parameter 47 - [Peer Inp Enable]** is set to "0" (Off). This parameter must be Off while you configure the peer input parameters.

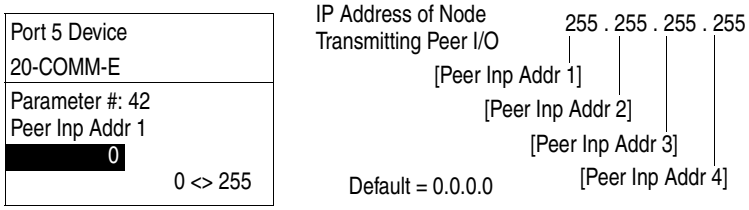
Figure 3.17 Example Peer Inp Enable LCD HIM Screen



Value	Setting
0	Off (Default)
1	On

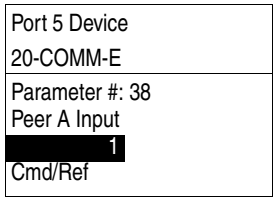
2. Set **Parameters 42 - [Peer Inp Addr 1]** through **45 - [Peer Inp Addr 4]** to the IP address of the node from which you want to receive data. Valid nodes must have 20-COMM-E adapters connected to drives with compatible Logic Command/Status words.

Figure 3.18 Example Peer Inp Addr 1 LCD HIM Screen



3. Set **Parameter 38 - [Peer A Input]** to select the destination of the data that is input to the drive as Peer A.

Figure 3.19 Example Peer A Input LCD HIM Screen



Value	Description
0	Off (Default)
1	Logic Command/Reference
2…5	Datalink A, B, C, or D Input

With the Series A adapter, if you select a Reference or Datalink as an input, note the following:

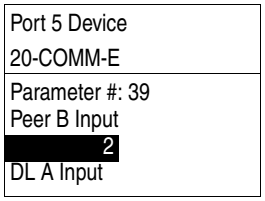
– If a drive that uses a 32-bit Reference and 32-bit Datalinks receives a 16-bit Reference or Datalink, it uses the data in its most significant word, and its least significant word is zero.

– If a drive that uses a 16-bit Reference and 16-bit Datalinks receives a 32-bit Reference or Datalink, it uses the data in the most significant word of the 32-bit Reference or Datalink and ignores the data in the least significant word.

With the Series B adapter, data is used from the least significant word in the event of a mismatch in Reference or Datalink sizes.

4. If desired, set **Parameter 39 - [Peer B Input]** to select the destination of the data to input to the drive as Peer B.

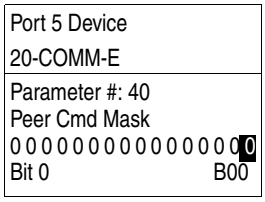
Figure 3.20 Example Peer B Input LCD HIM Screen



Value	Description
0	Off (Default)
1	Logic Command/Reference
2...5	Datalink A, B, C, or D Input

5. If the adapter receives a Logic Command, set the bits in **Parameter 40 - [Peer Cmd Mask]** that the drive should use. The bit definitions for the Logic Command word will depend on the drive to which the adapter is connected. Refer to Appendix D or drive documentation.

Figure 3.21 Example Peer Cmd Mask LCD HIM Screen



Value	Description
0	Ignore this command bit. (Default)
1	Use this command bit.

If the adapter receives a Logic Command from both a Master device and a Peer device, each command bit must have only one source. The source of command bits set to "0" will be the Master device. The source of command bits set to "1" will be the Peer device.

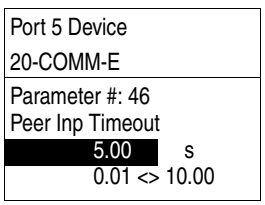
6. Reset the adapter (see Resetting the Adapter on page 3-17) so that changes to **Parameter 40 - [Peer Cmd Mask]** take effect.

7. Set **Parameter 46 - [Peer Inp Timeout]** to the maximum amount of time the adapter will wait for a message before timing out.

Important: This value must be greater than the product of **Parameter 52 - [Peer Out Time]** multiplied by **Parameter 53 - [Peer Out Skip]** in the adapter from which you are receiving I/O.

For example, if the value of **Parameter 52 - [Peer Out Time]** is 2.00 seconds and the value of **Parameter 53 - [Peer Out Skip]** is 2 (see Figure 3.16), then **Parameter 46 - [Peer Inp Timeout]** needs to have a value greater than 4.00, such as 5.00 (see Figure 3.22).

Figure 3.22 Example Peer Inp Timeout LCD HIM Screen

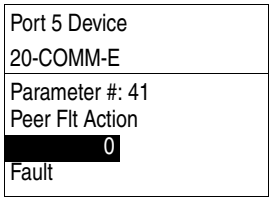


Default = 10.00 s

8. Set **Parameter 41 - [Peer Flt Action]** to the action that the adapter will take if it times out.

ATTENTION: Risk of injury or equipment damage exists. **Parameter 41 - [Peer Flt Action]** lets you determine the action of the adapter and connected drive if peer communications are disrupted. By default, this parameter faults the drive. You can set this parameter so that the drive continues to run. Precautions should be taken to ensure that the setting of this parameter does not create a hazard of injury or equipment damage. When commissioning the drive, verify that your system responds correctly to various situations (for example, a disconnected cable).

Figure 3.23 Example Peer Flt Action LCD HIM Screen



Value	Description
0	Fault (Default)
1	Stop
2	Zero Data
3	Hold Last
4	Send Flt Cfg

For more details, see Setting a Fault Action on page 3-15.

9. Set **Parameter 47 - [Peer Inp Enable]** to "1" (On).

The adapter is now configured to receive Peer I/O from the specified node. Ensure that the specified node is configured to transmit Peer I/O.

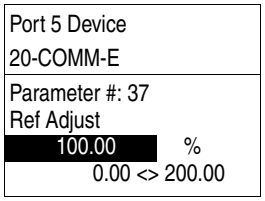
Setting the Reference Adjustment

A Reference Adjustment is a percent scaling factor for the Reference from the network. It can be set from 0.00 to 200.00% to allow the drive's Reference to either match the network Reference (= 100.00%), scale below the network Reference (< 100.00%), or scale above the network Reference (> 100.00%).

ATTENTION: To guard against equipment damage and/or personal injury, note that changes to adapter **Parameter 37 - [Ref Adjust]** take effect immediately. A drive receiving its Reference from the adapter will receive the newly scaled Reference, resulting in a change of speed.

If the adapter is receiving a Reference, set **Parameter 37 - [Ref Adjust]** to the desired scaling factor.

Figure 3.24 Example Ref Adjust LCD HIM Screen



Default = 100.00%

The adjustment takes effect as soon as it is entered.

Setting a Fault Action

By default, when I/O communications are disrupted (for example, a cable is disconnected) or the controller is idle (in program mode or faulted), the drive responds by faulting if it is using I/O from the network. You can configure a different response to:

- Disrupted I/O communication using **Parameter 21 - [Comm Flt Action]**
- An idle controller using **Parameter 22 - [Idle Flt Action]**

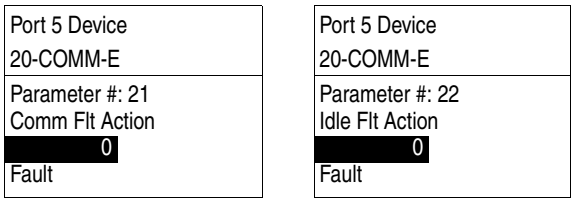
ATTENTION: Risk of injury or equipment damage exists. **Parameters 21 - [Comm Flt Action]** and **22 - [Idle Flt Action]** let you determine the action of the adapter and connected drive if I/O communications are disrupted or the controller is idle. By default, these parameters fault the drive. You can set these parameters so that the drive continues to run. Precautions should be taken to ensure that the settings of these parameters do not create a risk of injury or equipment damage. When commissioning the drive, verify that your system responds correctly to various situations (for example, a disconnected cable or faulted controller).

Changing the Fault Action

Set the values of **Parameters 21 - [Comm Flt Action]** and **22 - [Idle Flt Action]** to the desired responses:

Value	Action	Description
0	Fault	The drive is faulted and stopped. (Default)
1	Stop	The drive is stopped, but not faulted.
2	Zero Data	The drive is sent 0 for output data. This does not command a stop.
3	Hold Last	The drive continues in its present state.
4	Send Flt Cfg	The drive is sent the data that you set in the fault configuration parameters (**Parameters 25 - [Flt Cfg Logic]** through **34 - [Flt Cfg D2 In]**).

Figure 3.25 Example Fault Action LCD HIM Screens



Changes to these parameters take effect immediately. A reset is not required.

If communication is disrupted and then is re-established, the drive will automatically take commands from the network again.

Setting the Fault Configuration Parameters

If you set **Parameter 21 - [Comm Flt Action]** or **22 - [Idle Flt Action]** to "Send Flt Cfg," the values in the following parameters are sent to the drive after an I/O communications fault and/or idle fault occurs. You must set these parameters to values required by your application.

Parameter	Description
25 - [Flt Cfg Logic]	A 16-bit value sent to the drive for Logic Command.
26 - [Flt Cfg Ref]	A 32-bit value (0…4294967295) sent to the drive as a Reference or Datalink.
27 - [Flt Cfg x1 In] through **34 - [Flt Cfg x2 In]**	**Important:** If the drive uses a 16-bit Reference or 16-bit Datalinks, the most significant word of the value must be set to zero (0) or a fault will occur.

Changes to these parameters take effect immediately. A reset is not required.

Setting Web Access Control

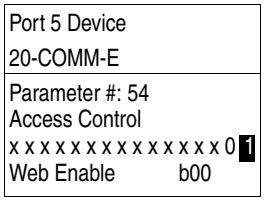
By using a web browser to access the IP address set for the adapter, you can view the adapter's web pages for information about the adapter, its connected drive, and other DPI devices connected to the drive, such as HIMs or converters. Additionally, the adapter can be configured to automatically send e-mail messages to desired addresses when selected drive faults occur and/or are cleared, and/or when the adapter takes a communication or idle fault action. For more details on the adapter's web pages, refer to Chapter 8, Viewing the Adapter's Web Pages.

TIP: Series A adapter web pages are accessed differently than Series B web pages. Enabling/disabling e-mail configuration is also different.

Series A Adapter (firmware version 2.002 or earlier)

By default, the Series A adapter web pages are enabled. To disable the adapter web pages, use **Parameter 54 - [Access Control]** to set the Web Enable Bit 0 value to "0" (Disabled). To protect the configured settings for adapter e-mail messaging, use **Parameter 54 - [Access Control]** to set the E-mail Config Bit 1 value to "0" (Disabled). E-mail messaging will remain active regardless of whether or not its settings are protected — unless e-mail messaging was *never* configured. For more information about configuring adapter e-mail messaging, see Configure E-mail Notification Web Page on page 8-6).

Figure 3.26 Example Web Access Control LCD HIM Screen



Bit	Description
0	Web Enable (Default = 1 = Enabled)
1	E-mail Config (Default = 0 = Disabled)
2…31	Not Used

Bit 0 is the right-most bit. In Figure 3.26 it is highlighted and equals "1."

Changes to this parameter take effect immediately. A reset is not required.

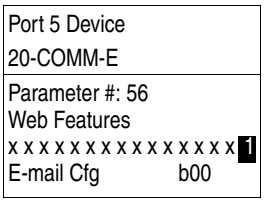
Series B Adapter (firmware version 3.xxx or later)

By default, the Series B adapter web pages are disabled. See Figure 2.1 and set the Web Pages Switch (SW2) to the "Enable Web" (up) position.

Important: For a change to the switch setting to take effect, the adapter must be reset (see Resetting the Adapter on page 3-17).

Bit 0 of **Parameter 56 - [Web Features]** is used to protect the configured settings for e-mail messaging. By default, settings are not protected and the user can make changes. To protect the configured settings, set the value of E-mail Cfg Bit 0 to "0" (Disabled). You can unprotect the configuration by changing Bit 0 back to "1" (Enabled). E-mail messaging will always remain active regardless of whether or not its settings are protected — unless e-mail messaging was *never* configured. For more information about configuring adapter e-mail messaging or to stop e-mail messages, see Configure E-mail Notification Web Page on page 8-6.

Figure 3.27 Example Web Features LCD HIM Screen



Bit	Description
0	E-mail Cfg (Default = 1 = Enabled)
1…7	Not Used

Bit 0 is the right-most bit. In Figure 3.27 it is highlighted and equals "1."

Changes to this parameter take effect immediately. A reset is not required.

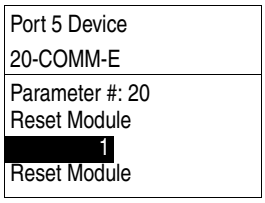
Resetting the Adapter

Changes to switch settings and some adapter parameters require that you reset the adapter before the new settings take effect. You can reset the adapter by power cycling the drive or by using **Parameter 20 - [Reset Module]**.

ATTENTION: Risk of injury or equipment damage exists. If the adapter is transmitting control I/O to the drive, the drive may fault when you reset the adapter. Determine how your drive will respond before resetting a connected adapter.

Set **Parameter 20 - [Reset Module]** to "1" (Reset Module).

Figure 3.28 Example Reset Module LCD HIM Screen



Value	Description
0	Ready (Default)
1	Reset Module
2	Set Defaults

When you enter "1" (Reset Module), the adapter will be immediately reset. When you enter "2" (Set Defaults), the adapter will set all adapter

parameters to their factory-default values. After performing a Set Defaults, enter “1” (Reset Module) so that the new values take effect. The value of this parameter will be restored to “0” (Ready) after the adapter is reset.

Viewing the Adapter Status Using Parameters

The following parameters provide information about the status of the adapter. You can view these parameters at any time.

Parameter	Description
17 - [EN Rate Act]	The data rate used by the adapter.
18 - [Ref/Fdbk Size]	The size of the Reference/Feedback. It will either be 16 bits or 32 bits. It is set in the drive and the adapter automatically uses the correct size.
19 - [Datalink Size]	The size of the Datalinks. It will either be 16 bits or 32 bits. It is set in the drive and the adapter automatically uses the correct size.
24 - [DPI I/O Act]	The Reference/Feedback and Datalinks used by the adapter. This value is the same as **Parameter 23 - [DPI I/O Cfg]** unless the parameter was changed and the adapter was not reset. Bit Definition: Not Used, Not Used, Not Used, Datalink D, Datalink C, Datalink B, Datalink A, Cmd/Ref Default: x, x, x, 0, 0, 0, 0, 1 Bit: 7, 6, 5, 4, 3, 2, 1, 0 0 = I/O disabled 1 = I/O enabled
48 - [Peer Inp Status]	The status of the consumed peer input connection: Values 0 = Off 1 = Waiting 2 = Running 3 = Faulted

Flash Updating the Adapter

The adapter can be flash updated over the network or serially through a direct connection from a computer to the drive using a 1203-USB or 1203-SSS serial converter.

When flashing over the network, you can use the Allen-Bradley software tool ControlFLASH, the built-in flash capability of DriveExplorer Lite or Full, or the built-in flash capability of DriveExecutive.

When flashing through a direct serial connection from a computer to a drive, you can use the same Allen-Bradley software tools described above, or you can use HyperTerminal set to the X-modem protocol.

To obtain a flash update for this adapter, go to http://www.ab.com/support/abdrives/webupdate. This site contains all firmware update files and associated Release Notes that describe firmware update enhancements/anomalies, how to determine the existing firmware version, and how to flash update using DriveExplorer, DriveExecutive, ControlFLASH or HyperTerminal.

Configuring the I/O

This chapter provides instructions on how to configure a Rockwell Automation ControlLogix, PLC-5, SLC 500 or MicroLogix 1100/1400 controller to communicate with the adapter and connected PowerFlex drive.

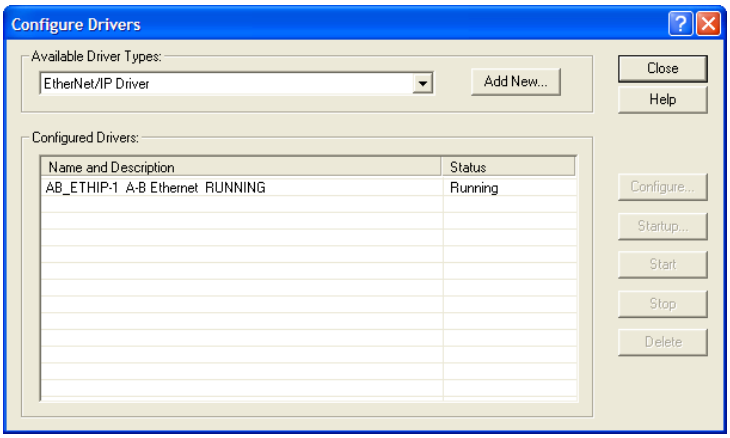
Topic	Page
Using RSLinx Classic	4-1
ControlLogix Example	4-2
Limitations When Using PLC-5, SLC 500 or MicroLogix 1100/1400	4-21
PLC-5 Example	4-22
SLC 500 Example	4-30
MicroLogix 1100/1400 Example	4-38

Using RSLinx Classic

RSLinx Classic, in all its variations (Lite, Gateway, OEM, etc.), is used to provide a communication link between the computer, network, and controller. RSLinx Classic requires its network-specific driver to be configured before communications are established with network devices. To configure the RSLinx driver:

1. Start RSLinx and select **Communications > Configure Drivers** to display the Configure Drivers screen.
2. From the Available Driver Types pull-down box, choose "EtherNet/IP Driver" and then click **Add New…** to display the Add New RSLinx Driver screen.
3. Use the default name or type a new name and click **OK**. The "Configure driver:" screen appears.
4. Depending on your application, select either the browse local or remote subnet option, and click **OK**. The Configure Drivers screen reappears with the new driver in the Configured Drivers list (Figure 4.1).

Figure 4.1 Configure Drivers Screen with a Configured Driver



5. Click **Close** to close the Configure Drivers screen. Keep RSLinx running.

6. Verify that your computer recognizes the drive. Select **Communications > RSWho** and, in the menu tree, click the "+" symbol next to the Ethernet driver.

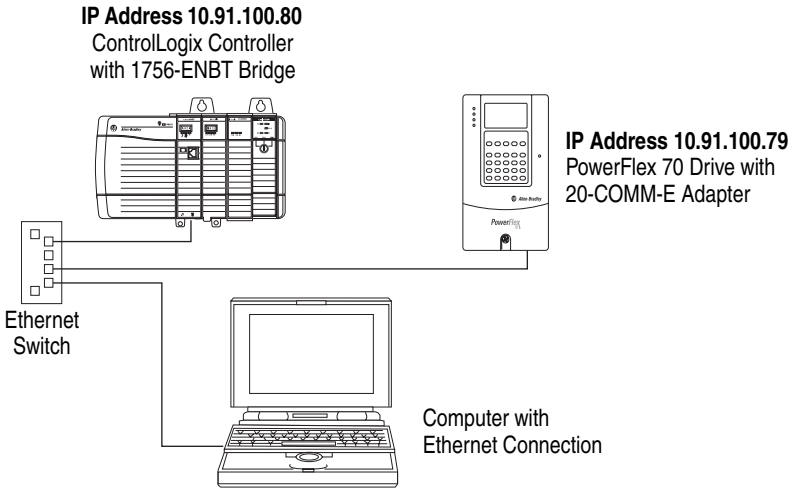
   Note that two other RSLinx drivers (Ethernet devices or Remote Devices via Linx Gateway) may be used. Use one of these drivers if the "EtherNet/IP driver" cannot see your drive.

ControlLogix Example

Example Network

After the adapter is configured, the connected drive and adapter will be a single node on the network. This section provides the steps needed to configure a simple EtherNet/IP network (see Figure 4.2). In our example, we will configure a ControlLogix controller with 1756-ENBT (Series A) bridge to communicate with a drive using Logic Command/Status, Reference/Feedback, and 16 Datalinks (8 to read and 8 to write) over the network.

Figure 4.2 Example ControlLogix EtherNet/IP Network



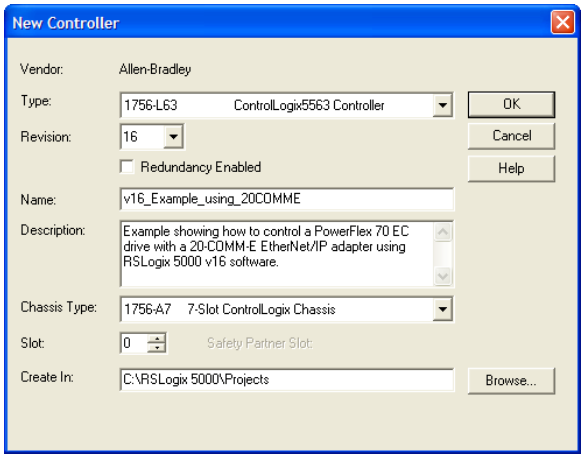
NOTE: Information for PowerFlex 750-Series drives has been added to this manual where applicable.

Adding the Bridge to the I/O Configuration

To establish communications between the controller and adapter over the network, you must first add the ControlLogix controller and its bridge to the I/O configuration. This procedure is similar for all RSLogix 5000 versions.

1. Start RSLogix 5000. The RSLogix 5000 window appears. Select **File > New** to display the New Controller screen (Figure 4.3).

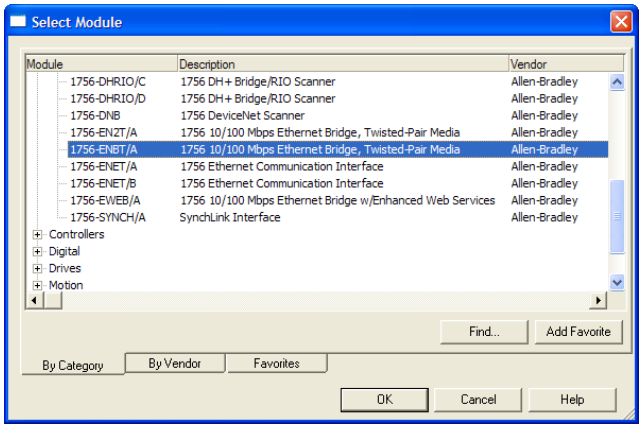
Figure 4.3 New Controller Screen (RSLogix 5000 v16 shown)



Select the appropriate choices for the fields in the screen to match your application. Then click **OK**. The RSLogix 5000 window reappears with the treeview in the left pane.

2. In the treeview, right-click the I/O Configuration folder and select **New Module…** The Select Module screen appears. Expand the Communications group to display all of the available communication modules (Figure 4.4).

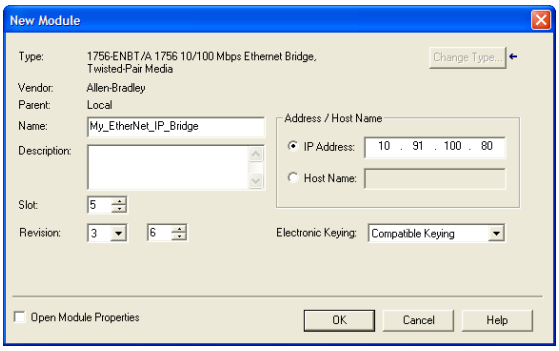
Figure 4.4 Bridge Select Module Screen



3. In the list, select the EtherNet/IP bridge used by your controller. In this example, we use a 1756-ENBT EtherNet/IP Bridge (Series A), so the 1756-ENBT/A option is selected. Then click **OK**. In the Select Major Revision pop-up dialog box, select the major revision of its firmware.

4. Click **OK**. The bridge's New Module screen (Figure 4.5) appears.

Figure 4.5 Bridge New Module Screen

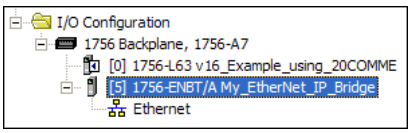


5. Edit the following:

Box	Setting
Name	A name to identify the EtherNet/IP bridge.
Description	Optional – description of the EtherNet/IP bridge.
IP Address	The IP address of the EtherNet/IP bridge.
Host Name	Not used.
Slot	The slot of the EtherNet/IP bridge in the rack.
Revision	The minor revision of the firmware in the bridge. (You already set the major revision by selecting the bridge series in Step 3.)
Electronic Keying	**Compatible Keying**. The "Compatible Keying" setting for Electronic Keying ensures the physical module is consistent with the software configuration before the controller and bridge make a connection. Therefore, ensure that you have set the correct revision in this screen. Refer to the online Help for additional information on this and other Electronic Keying settings. If keying is not required, select "Disable Keying." Disable keying is recommended.
Open Module Properties	When this box is checked, additional module properties screens will appear to further configure the bridge after clicking **OK**. When unchecked, the bridge's New Module screen will close after clicking **OK**. For this example, uncheck this box.

6. Click **OK**. The bridge is now configured for the EtherNet/IP network and added to the RSLogix 5000 project. It appears in the I/O Configuration folder. In our example, a 1756-ENBT bridge appears under the I/O Configuration folder (Figure 4.6) with its assigned name. For convenience, keep the project open. Later in this chapter the project will need to be downloaded to the controller.

Figure 4.6 RSLogix 5000: I/O Configuration Folder



There are three ways to add the adapter into the I/O configuration:

- Drive Add-On Profiles (RSLogix 5000 version 16 or later)
- Classic Profile (RSLogix 5000 versions 13…15)
- Generic Profile (RSLogix 5000 all versions)

These are described in separate sections below. If your version of RSLogix 5000 supports Add-On Profiles, we highly recommend using this method.

Using RSLogix 5000 Drive Add-On Profiles (version 16 or later)

When compared to using the RSLogix 5000 Classic Profile (versions 13…15) or Generic Profile (all versions), the RSLogix 5000 Drive Add-On Profiles provide these advantages:

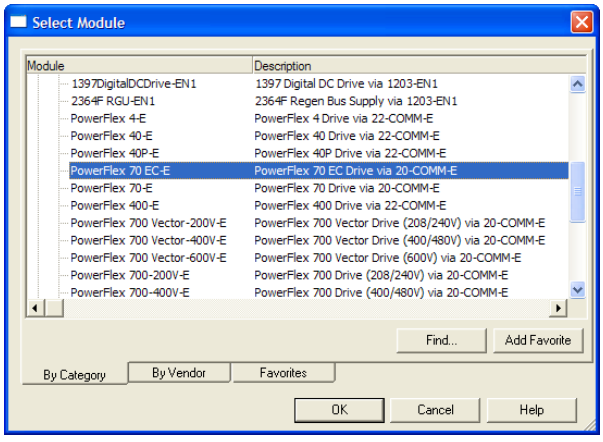
- Profiles for specific drives that provide descriptive controller tags for basic control I/O words (Logic Command/Status and Reference/Feedback) and Datalinks. Additionally, Datalinks automatically take the name of the drive parameter to which they are assigned. These profiles virtually eliminate I/O mismatch errors and substantially reduce drive configuration time.
- New Drive tab eliminates the need for a separate drive software configuration tool.
- Drive configuration settings are saved as part of the RSLogix 5000 (v16 or later) project file (.ACD) and also downloaded to the controller.
- Unicast connection (version 18 or later)
- Drive Add-On Profiles can be updated anytime. When a new drive is used or to benefit from new updates for Add-On Profiles, you will need the newest Add-On Profile update. Go to www.ab.com/support/abdrives/webupdate to download the latest RSLogix 5000 drive Add-On Profile. To determine your drive Add-On Profile version, refer to Allen-Bradley Knowledgebase document #65882.

Adding the Drive/Adapter to the I/O Configuration

To transmit data between the bridge and the drive, you must add the drive as a child device to the parent bridge. In this example, RSLogix 5000 version 16 is used with drive Add-On Profile version 3.01.

1. In the treeview, right-click on the bridge and select **New Module…** to display the Select Module screen. In our example, we right-click on the 1756-ENBT/A bridge. Expand the Drives group to display all of the available drives with their communication adapters.

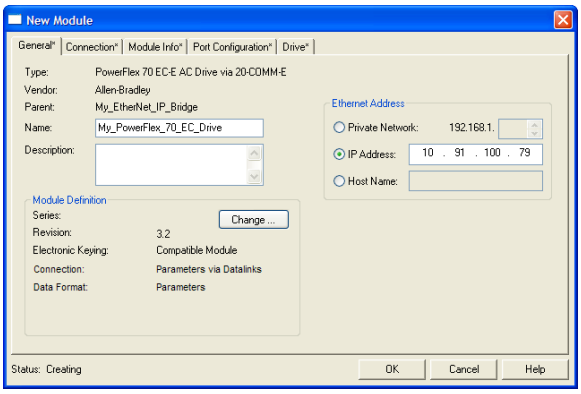
Figure 4.7 Drive Select Module Screen



TIP: If the PowerFlex drive is not shown, go to www.ab.com/support/abdrives/webupdate and download the latest RSLogix 5000 drive Add-On Profile.

2. From the list (Figure 4.7), select the drive and its connected adapter. For this example, we selected "PowerFlex 70 EC-E." Then click **OK**. The drive's New Module screen (Figure 4.8) appears.

Figure 4.8 Drive New Module Screen



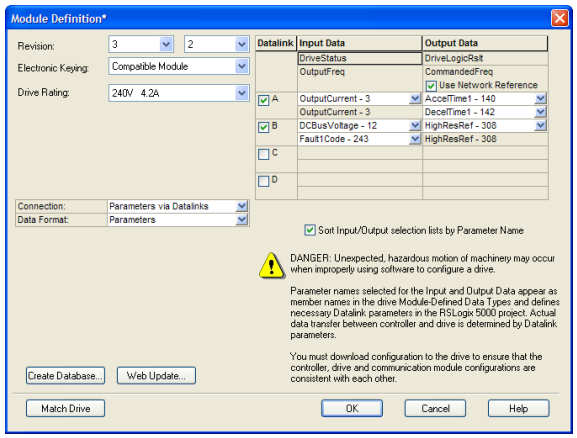
3. On the General tab, edit the following data about the drive/adapter:

Box	Setting
Name	A name to identify the drive.
Description	Optional – description of the drive/adapter.
IP Address	The IP address of the adapter.

4. On the New Module screen in the Module Definition section, click **Change…** to launch the Module Definition screen (Figure 4.9) and begin the drive/adapter configuration process. In this example, Datalinks are used to do the following:

Read...	Write to...
Output Current (Parameter 3)	Accel Time 1 (Parameter 140)
DC Bus Voltage (Parameter 12)	Decel Time 1 (Parameter 142)
Fault 1 Code (Parameter 243)	High Resolution Reference (Parameter 308)

Figure 4.9 Module Definition Screen



TIP: To get the latest RSLogix 5000 drive Add-On Profile, go to www.ab.com/support/abdrives/webupdate.

5. In the Module Definition screen, edit the following information:

Box	Setting
Revision	The major and minor revision of the firmware (database) in the drive. If the drive's major and minor revision is not available, the drive database is not installed on your computer. To get the correct database revision, use one of the following buttons at the bottom left of the Module Definition screen: • **Create Database...** Creates a database from an online network drive. Clicking this button displays an RSLinx RSWho window. Browse to the online drive (for this example, PowerFlex 70 EC), select it, and click **OK**. The database will be uploaded and stored on the computer. Thereafter, close the Module Definition screen and then re-open it to display the new revision. • **Web Update...** When a drive is not available online, opens the Allen-Bradley Drives Web Updates web site to download a specific database file. After downloading the file, close the Module Definition screen and then re-open it to display the new revision. • **Match Drive:** Use this button when the drive being added to the network matches the drive profile (revision, rating, configuration settings, etc.) of an existing online network drive. Click this button to conveniently create a duplicate drive profile from the online drive, and automatically load this identical information into the Module Definition screen. This eliminates the need to manually enter the information each time a new drive with a matching profile is added to the network.
Electronic Keying	**Compatible Module**. The "Compatible Module" setting for Electronic Keying ensures the physical module is consistent with the software configuration before the controller and bridge make a connection. Therefore, ensure that you have set the correct revision in this screen. Refer to the online Help for additional information on this and other Electronic Keying settings. If keying is not required, select "Disable Keying." Drives do not require keying, and so "Disable Keying" is recommended.
Drive Rating	The voltage and current rating of the drive. If the drive rating is not listed, the drive database is not installed on your computer. To get the correct drive rating, use the **Create Database...**, **Web Update...**, or **Match Drive** button described above.
Connection	**Parameters via Datalinks.** When selecting "Parameters via Datalinks" (default), the controller tags for the Datalinks use the drive parameter names to which they are assigned. When selecting "Datalinks," the controller tags for the Datalinks have non-descriptive UserDefinedData[n] names like those used in RSLogix 5000 version 15.
Data Format	**Parameters.** When the Connection field is set to "Parameters via Datalinks," "Parameters" is automatically selected. When the Connection field is set to "Datalinks," you must select the number of Datalinks required for your application in the "Data Format" field.
Datalink A, B, C, D	In the Input Data column, assigns selected drive parameters to be READ by the controller. In the Output Data column, assigns selected drive parameters to be WRITTEN by the controller.
Sort Input/ Output selection...	When this box is checked, sorts the Input Data and Output Data assigned parameters by name and then by number, and enables parameter search by name. When unchecked, sorts the assigned parameters by parameter number and then by name, and enables parameter search by number.
Use Network Reference	Conveniently selects the speed reference for the drive to come from the network. This box is checked by default.

When a 32-bit parameter is selected for Input Data or Output Data for a drive with 16-bit Datalinks, two contiguous Datalinks (for example, x1 and x2, where x = A, B, C or D) are automatically assigned as a pair to represent that parameter. See Datalink examples in Figure 4.9. For more information on Datalinks, see Using Datalinks on page 5-7.

On the Module Definition screen, notice that the automatically-assigned controller tags DriveStatus, OutputFreq, DriveLogicRslt, and CommandedFreq are always used.

When a Datalink is enabled, the following 20-COMM-E adapter I/O parameters are automatically set:

– **Parameter 23 - [DPI I/O Cfg]** turns on the enabled Datalink bit so the 20-COMM-E adapter will communicate that Datalink's information with the drive.

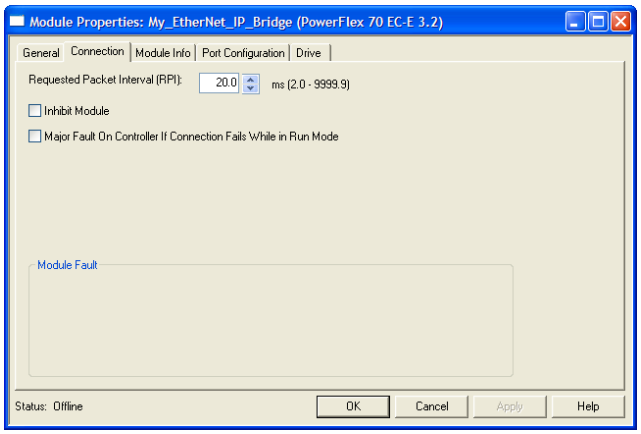
– **Parameter 35 - [M-S Input]** turns on the enabled Datalink bit so the 20-COMM-E adapter will input that Datalink's information from the controller.

– **Parameter 36 - [M-S Output]** turns on the enabled Datalink bit so the 20-COMM-E adapter will output that Datalink's information to the controller.

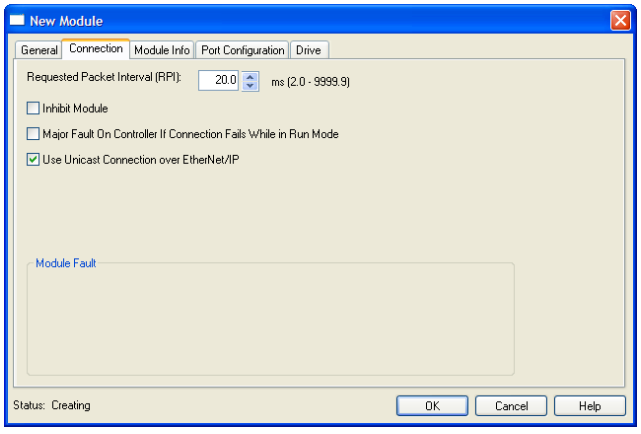
6. Click **OK** on the Module Definition screen to save the drive and adapter configuration and close the screen. The drive's New Module screen reappears.

7. On the New Module screen, click the Connection tab (Figure 4.10).

Figure 4.10 New Module Connection Tab Screen



Screen for RSLogix 5000 versions 16 and 17



Screen for RSLogix 5000 version 18 (or later)

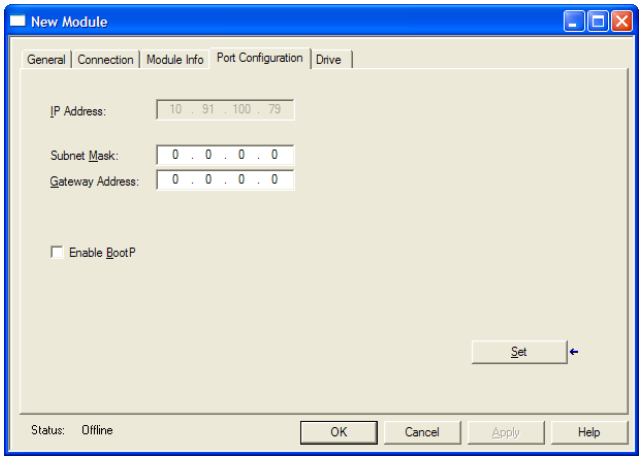
8. In the “Requested Packet Interval (RPI)” box, set the value to 5.0 milliseconds or greater. This value determines the maximum interval that a controller should use to move data to and from the adapter. To conserve bandwidth, use higher values for communicating with low priority devices.

   The “Inhibit Module” box, when checked, inhibits the module from communicating with the RSLogix 5000 project. When the “Major Fault on …” box is checked, a major controller fault will occur when the module’s connection fails while the controller is in the Run Mode. For this example, leave the “Inhibit Module” and “Major Fault On …” boxes unchecked.

   Unicast support has been added to RSLogix 5000 version 18. However, to also support unicast, the controller firmware must be version 18 (or later) and the 20-COMM-E Series B adapter at version 4.001 (or later). Unicast is recommended whenever possible. For the benefits of unicast operation, see Preparing for an Installation on page 2-1. If unicast is selected and the 20-COMM-E adapter does not support it, the connection will be rejected. In this case, either update the 20-COMM-E firmware to version 4.001 (or later) or uncheck the “Use Unicast Connection over EtherNet/IP” checkbox (Figure 4.10).

9. On the New Module screen, click the Port Configuration tab (Figure 4.11).

Figure 4.11 New Module Port Configuration Tab Screen



10. In the Port Configuration tab screen, edit the following information:

Box	Setting
IP Address	The IP address of the adapter that was already set in the General tab. This field is not configurable (grayed out).
Subnet Mask	The Subnet Mask configuration setting of the network. This setting must match the setting of other devices on the network (for example, 255.255.255.0).
Gateway Address	The Gateway Address configuration setting of the network. This setting must match the setting of other devices on the network (for example, 10.91.100.1).
Enable BootP	When this box is checked, BOOTP is enabled in the adapter and will ignore the IP address set in the General tab. When unchecked, the controller uses the set IP address. This is another method to enable/disable BOOTP in the adapter. For this example, leave this box unchecked.

11. Click **Set** to save the Port Configuration information which sets the corresponding offline Subnet Cfg x and Gateway Cfg x parameters in the adapter.

12. Click **OK** on the New Module screen. The new node (for this example, “My_PowerFlex_70_EC_Drive”) now appears under the bridge (for this example, “My_EtherNet_IP_Bridge”) in the I/O Configuration folder. If you double-click on the Controller Tags, you will see that module-defined data types and tags have been automatically created (Figure 4.12). Note that all tag names are defined and Datalinks include the assigned drive parameter name. After you save and download the configuration, these tags allow you to access the Input and Output data of the drive via the controller’s ladder logic.

Figure 4.12 Controller Tags

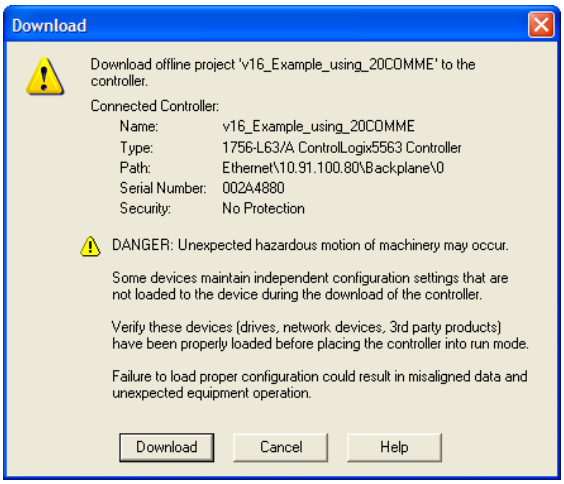
Name	Value	Force Mask	Style	Data Type
My_PowerFlex_70_EC_Drive:I	{...}	{...}		AB:PowerFlex70E...
My_PowerFlex_70_EC_Drive:I.DriveStatus	2#0000...		Binary	INT
My_PowerFlex_70_EC_Drive:I.DriveStatus_Ready	0		Decimal	BOOL
My_PowerFlex_70_EC_Drive:I.DriveStatus_Active	0		Decimal	BOOL
My_PowerFlex_70_EC_Drive:I.DriveStatus_CommandDir	0		Decimal	BOOL
My_PowerFlex_70_EC_Drive:I.DriveStatus_ActualDir	0		Decimal	BOOL
My_PowerFlex_70_EC_Drive:I.DriveStatus_Accelerating	0		Decimal	BOOL
My_PowerFlex_70_EC_Drive:I.DriveStatus_Decelerating	0		Decimal	BOOL
My_PowerFlex_70_EC_Drive:I.DriveStatus_Alarm	0		Decimal	BOOL
My_PowerFlex_70_EC_Drive:I.DriveStatus_Faulted	0		Decimal	BOOL
My_PowerFlex_70_EC_Drive:I.DriveStatus_AtSpeed	0		Decimal	BOOL
My_PowerFlex_70_EC_Drive:I.DriveStatus_LocalID0	0		Decimal	BOOL
My_PowerFlex_70_EC_Drive:I.DriveStatus_LocalID1	0		Decimal	BOOL
My_PowerFlex_70_EC_Drive:I.DriveStatus_LocalID2	0		Decimal	BOOL
My_PowerFlex_70_EC_Drive:I.DriveStatus_SpdRefID0	0		Decimal	BOOL
My_PowerFlex_70_EC_Drive:I.DriveStatus_SpdRefID1	0		Decimal	BOOL
My_PowerFlex_70_EC_Drive:I.DriveStatus_SpdRefID2	0		Decimal	BOOL
My_PowerFlex_70_EC_Drive:I.DriveStatus_SpdRefID3	0		Decimal	BOOL
My_PowerFlex_70_EC_Drive:I.OutputFreq	0		Decimal	INT
My_PowerFlex_70_EC_Drive:I.OutputCurrent	0		Decimal	DINT
My_PowerFlex_70_EC_Drive:I.DCBusVoltage	0		Decimal	INT
My_PowerFlex_70_EC_Drive:I.Fault1Code	0		Decimal	INT
My_PowerFlex_70_EC_Drive:O	{...}	{...}		AB:PowerFlex70E...
My_PowerFlex_70_EC_Drive:O.DriveLogicRslt	2#0000...		Binary	INT
My_PowerFlex_70_EC_Drive:O.DriveLogicRslt_Stop	0		Decimal	BOOL
My_PowerFlex_70_EC_Drive:O.DriveLogicRslt_Start	0		Decimal	BOOL
My_PowerFlex_70_EC_Drive:O.DriveLogicRslt_Jog	0		Decimal	BOOL
My_PowerFlex_70_EC_Drive:O.DriveLogicRslt_ClearFault	0		Decimal	BOOL
My_PowerFlex_70_EC_Drive:O.DriveLogicRslt_Forward	0		Decimal	BOOL
My_PowerFlex_70_EC_Drive:O.DriveLogicRslt_Reverse	0		Decimal	BOOL
My_PowerFlex_70_EC_Drive:O.DriveLogicRslt_LocalContrl	0		Decimal	BOOL
My_PowerFlex_70_EC_Drive:O.DriveLogicRslt_MOPInc	0		Decimal	BOOL
My_PowerFlex_70_EC_Drive:O.DriveLogicRslt_Accel1	0		Decimal	BOOL
My_PowerFlex_70_EC_Drive:O.DriveLogicRslt_Accel2	0		Decimal	BOOL
My_PowerFlex_70_EC_Drive:O.DriveLogicRslt_Decel1	0		Decimal	BOOL
My_PowerFlex_70_EC_Drive:O.DriveLogicRslt_Decel2	0		Decimal	BOOL
My_PowerFlex_70_EC_Drive:O.DriveLogicRslt_SpdRefID0	0		Decimal	BOOL
My_PowerFlex_70_EC_Drive:O.DriveLogicRslt_SpdRefID1	0		Decimal	BOOL

Saving the I/O Configuration to the Controller

After adding the bridge and drive/adapter to the I/O configuration, you must download the configuration to the controller. You should also save the configuration to a file on your computer.

1. In the RSLogix 5000 window, select **Communications > Download**. The Download dialog box (Figure 4.13) appears.

Figure 4.13 Download Dialog Box



TIP: If a message box reports that RSLogix 5000 is unable to go online, select **Communications > Who Active** to find your controller in the Who Active screen. After finding and selecting the controller, click **Set Project Path** to establish the path. If your controller does not appear, you need to add or configure the EtherNet/IP driver in RSLinx. Refer to the RSLinx online help.

2. Click **Download** to download the configuration to the controller. When the download is successfully completed, RSLogix 5000 goes into the Online mode and the I/O Not Responding box in the upper-left of the window should be flashing green. Also, a yellow warning symbol should be displayed on the I/O Configuration folder in the treeview and on the drive profile.

   If the controller was in Run Mode before clicking **Download**, RSLogix 5000 prompts you to change the controller mode back to Remote Run. In this case, choose the appropriate mode for your application. If the controller was in Program Mode before clicking **Download**, this prompt will not appear.

3. Select **File > Save**. If this is the first time you saved the project, the Save As dialog box appears. Navigate to a folder, type a file name, and click **Save** to save the configuration to a file on your computer.

   To ensure that the present project configuration values are saved, RSLogix 5000 prompts you to upload them. Click **Yes** to upload/save.

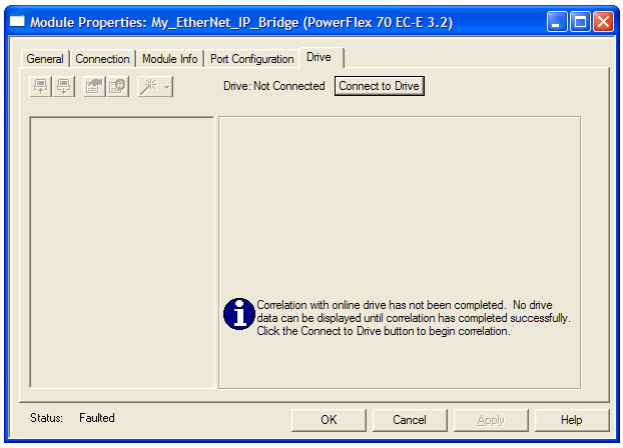
Correlating the Drive with the Controller

You must now correlate the drive settings to the RSLogix 5000 project I/O settings so that they match. This requires loading the project I/O settings into the drive.

1. In the treeview under I/O Configuration, right-click on the drive profile (for this example My_PowerFlex_70_EC_Drive) and select **Properties**.

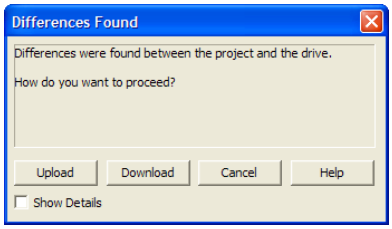
2. Click the Drive tab and then click **Connect to Drive** (Figure 4.14) to begin the correlation process.

Figure 4.14 Drive Correlation Screen



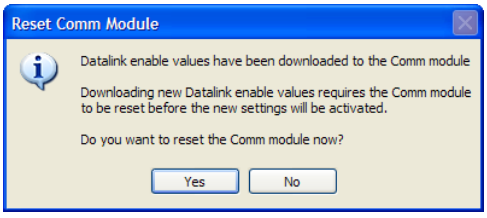
If the Differences Found screen (Figure 4.15) appears—which is typical, click **Download**. This will download the project settings from the controller to the drive and its connected adapter. If **Upload** is clicked, the drive and adapter settings are uploaded to the controller.

Figure 4.15 Differences Found Screen



3. When the Reset Comm Module screen (Figure 4.16) appears, click **Yes** to reset the communication adapter so that the new I/O settings take effect.

Figure 4.16 Reset Comm Module Screen

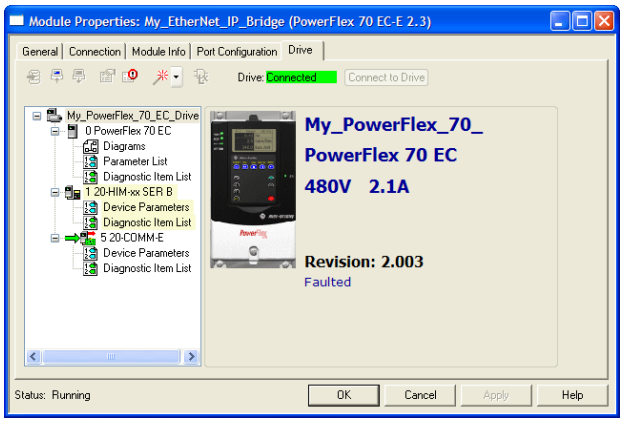


After resetting the communication module, which may take up to a minute to complete, the I/O OK box in the upper-left of the RSLogix 5000 window should now be steady green and the yellow warning symbols ⚠ in the treeview under the I/O Configuration folder and drive profile should be gone.

TIP: If the yellow warning symbol ⚠ for your drive remains displayed, first try power cycling the drive. Otherwise, double-click the drive under the I/O tree and click the Connection tab to find the cause of the problem.

4. The Module Properties Drive Tab screen (Figure 4.17) re-appears. You can view the drive's Parameter List, Diagnostic Items List, and lists for any connected peripheral, including the 20-COMM-E. While connected to the drive, you can dynamically change values of parameters. Diagnostic items and diagram views can be used for troubleshooting. Table 7.A on page 7-4 provides diagnostic items for troubleshooting the adapter.

Figure 4.17 Module Properties Drive Tab Screen



5. When finished, click **OK** to close the Module Properties screen for the drive.

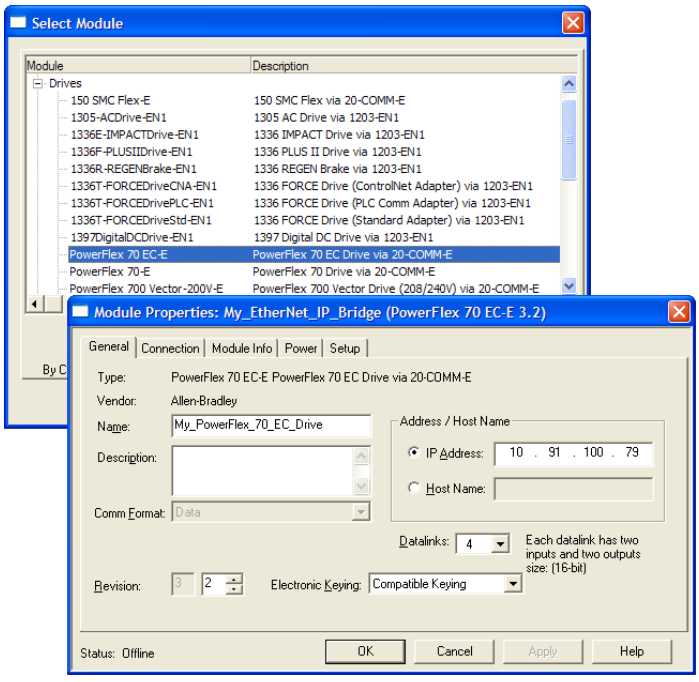
Using the RSLogix 5000 Classic Profile (versions 13...15)

When compared to using the RSLogix 5000 Generic Profile (all versions), the RSLogix 5000 Classic Profile provides these advantages:

- Profiles for specific drives (Figure 4.18) that provide descriptive controller tags for basic control I/O words (Logic Command/Status and Reference/Feedback). The controller tags for Datalinks, however, have non-descriptive UserDefinedData[n] names.
- Improved I/O configuration—no I/O assembly configuration required. Basic control I/O is defined, but Datalinks still need to be configured/mapped.
- The Setup tab includes a DriveExecutive icon link to conveniently launch DriveExecutive (when installed on computer) to match the adapter I/O configuration with the controller, and to assign the Datalink parameters in the drive. This reduces I/O mismatches.

TIP: Since the RSLogix 5000 Classic Profile has been significantly improved upon by RSLogix 5000 Drive Add-On Profiles (version 16 or later), it is highly recommended to use RSLogix 5000 Drive Add-On Profiles to take advantage of its benefits (more intuitive, time saving, and less likely to make I/O configuration errors).

Figure 4.18 Classic Profile Screens for Drives



When Datalinks are used, you must enable the desired Datalinks and assign names to their non-descriptive controller tags. When a Datalink is enabled, you must set the following adapter I/O parameters:

- **Parameter 23 - [DPI I/O Cfg]** turns on the enabled Datalink bit so the 20-COMM-E adapter will communicate that Datalink's information with the drive.
- **Parameter 35 - [M-S Input]** turns on the enabled Datalink bit so the 20-COMM-E adapter will input that Datalink's information from the controller.
- **Parameter 36 - [M-S Output]** turns on the enabled Datalink bit so the 20-COMM-E adapter will output that Datalink's information to the controller.

When using Datalinks, up to 8 drive [Data In xx] parameters (300…307) and/or up to 8 [Data Out xx] parameters (310…317) must be assigned to point to the appropriate drive parameters for your application.

Using the RSLogix 5000 Generic Profile (all versions)

The basic RSLogix 5000 Generic Profile is only recommended when:

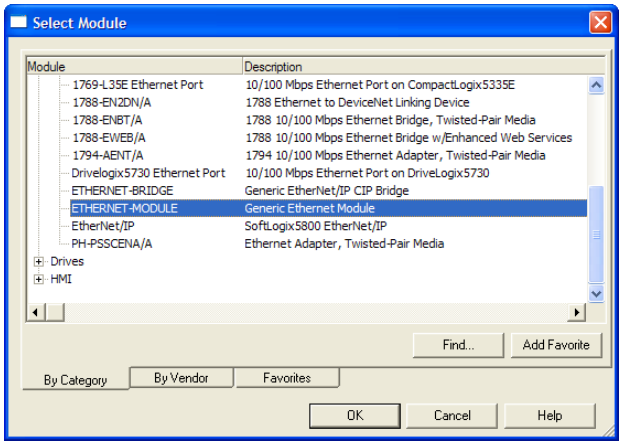
- A specific drive profile in other versions of RSLogix 5000 is unavailable.
- Users are already familiar with a drive Generic Profile and do not want to convert an existing project to a Classic Profile (versions 13…15) or a drive Add-On Profile (version 16 or later).
- A project must maintain specific revision level control.
- The controller cannot be taken offline. RSlogix 5000 version 16 (or later) enables the drive Generic Profile to be added while the controller is online and in the Run mode.

Adding the Drive/Adapter to the I/O Configuration

To transmit data between the bridge and the drive, you must add the drive as a child device to the parent bridge.

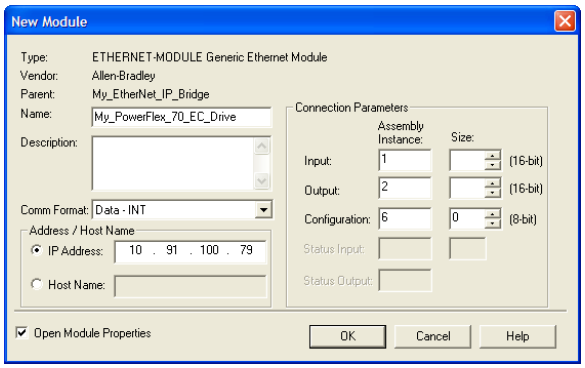
1. In the treeview, right-click on the bridge and select **New Module…** to display the Select Module screen (Figure 4.19). In our example, we right-click on the 1756-ENBT/A bridge. Expand the Communications group to display all of the available communication modules.

Figure 4.19 Select Module Screen



2. Select “ETHERNET-MODULE” from the list (Figure 4.19) to configure the drive and its connected 20-COMM-E adapter, and then click **OK**. The drive’s New Module screen (Figure 4.20) appears.

Figure 4.20 Drive New Module Screen



3. Edit the following information about the drive/adapter:

Box	Setting
Name	A name to identify the drive and adapter.
Description	Optional – description of the drive/adapter.
Comm Format	**Data - INT** (This setting formats the data in 16-bit words.)
IP Address	The IP address of the adapter.
Open Module Properties	When this box is checked, the drive’s New Module screen will close when clicking **OK**. When unchecked, additional module properties screens will appear to further configure the drive/adapter when **OK** is clicked. For this example, check this box.

4. Under Connection Parameters, edit the following:

Box	Assembly Instance	Size
Input	**1** (This value is required.)	The value will vary based on your application (setting of **Parameters 23 - [DPI I/O Cfg]** and **36 - [M-S Output]**) and the size (16-bit or 32-bit) of the Reference/Feedback and Datalinks in the drive. Refer to Table 4.A, Table 4.B or Table 4.C on page 4-17.
Output	**2** (This value is required.)	The value will vary based on your application (setting of **Parameters 23 - [DPI I/O Cfg]** and **35 - [M-S Input]**) and the size (16-bit or 32-bit) of the Reference/Feedback and Datalinks in the drive. Refer to Table 4.A, Table 4.B or Table 4.C on page 4-17.
Configuration	**6** (This value is required.)	**0** (This value is required.)

The following tables define the number of 16-bit words that you need to enter for the Input Size and Output Size boxes depending on your configuration.

Table 4.A PowerFlex 70/700/700H and SMC Flex (16-bit Reference/Feedback and 16-bit Datalinks)

Logic Command/ Status	Ref/Fdbk (16-bit)	Datalinks (16-bit)				User Configured Settings				
						Size in Words		Par. 23 - [DPI I/O Cfg]	Par. 35 - [M-S Input]	Par. 36 - [M-S Output]
		A	B	C	D	Input	Output			
✔	✔					4	2	...0 0001	...0 0001	...0 0001
✔	✔	✔				6	4	...0 0011	...0 0011	...0 0011
✔	✔	✔	✔			8	6	...0 0111	...0 0111	...0 0111
✔	✔	✔	✔	✔		10	8	...0 1111	...0 1111	...0 1111
✔	✔	✔	✔	✔	✔	12	10	...1 1111	...1 1111	...1 1111

Table 4.B PowerFlex 700 VC (16-bit Reference/Feedback and 32-bit Datalinks)

Logic Command/ Status	Ref/Fdbk (16-bit)	Datalinks (32-bit)				User Configured Settings				
						Size in Words		Par. 23 - [DPI I/O Cfg]	Par. 35 - [M-S Input]	Par. 36 - [M-S Output]
		A	B	C	D	Input	Output			
✔	✔					4	2	...0 0001	...0 0001	...0 0001
✔	✔	✔				8	6	...0 0011	...0 0011	...0 0011
✔	✔	✔	✔			12	10	...0 0111	...0 0111	...0 0111
✔	✔	✔	✔	✔		16	14	...0 1111	...0 1111	...0 1111
✔	✔	✔	✔	✔	✔	20	18	...1 1111	...1 1111	...1 1111

Table 4.C PowerFlex 700S/750-Series (32-bit Reference/Feedback and 32-bit Datalinks)

Logic Command/ Status	Ref/Fdbk (32-bit)	Datalinks (32-bit)				User Configured Settings				
						Size in Words		Par. 23 - [DPI I/O Cfg]	Par. 35 - [M-S Input]	Par. 36 - [M-S Output]
		A	B	C	D	Input	Output			
✔	✔					6	4	...0 0001	...0 0001	...0 0001
✔	✔	✔				10	8	...0 0011	...0 0011	...0 0011
✔	✔	✔	✔			14	12	...0 0111	...0 0111	...0 0111
✔	✔	✔	✔	✔		18	16	...0 1111	...0 1111	...0 1111
✔	✔	✔	✔	✔	✔	22	20	...1 1111	...1 1111	...1 1111

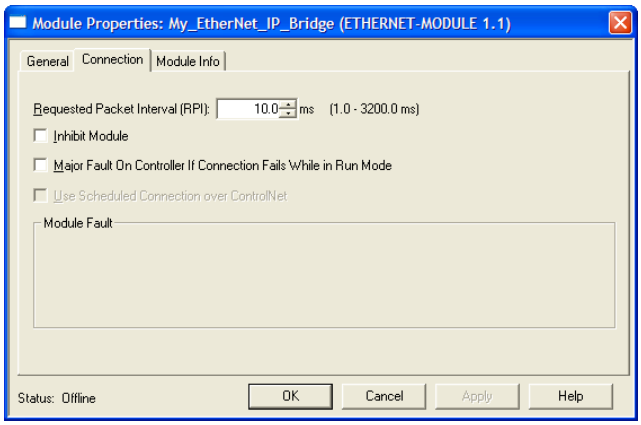
TIP: For instructions on configuring the I/O for the adapter using **Parameter 23 - [DPI I/O Cfg]** and its Master-Slave Hierarchy using **Parameters 35 - [M-S Input]** and **36 - [M-S Output]**, see Setting the I/O Configuration on page 3-8.

When using Datalinks, up to 8 drive [Data In xx] parameters (300…307) and/or up to 8 [Data Out xx] parameters (310…317) must be assigned to point to the appropriate drive parameters for your application.

5. After setting the information in the drive's New Module screen, click **OK**. The Module Properties screen appears.

6. Click the Connection tab (Figure 4.21).

Figure 4.21 Module Properties Connection Tab Screen



7. In the "Requested Packet Interval (RPI)" box, set the value to 5.0 milliseconds or greater. This value determines the maximum interval that a controller should use to move data to and from the adapter. To conserve bandwidth, use higher values for communicating with low priority devices. For this example, leave the "Inhibit Module" and Major Fault …" boxes unchecked.

8. Click **OK**. The new node (for this example, "My_PowerFlex_70_EC_Drive") now appears under the bridge (for this example, "My_EtherNet_IP_Bridge") in the I/O Configuration folder. If you double-click on the Controller Tags, you will see that module-defined data types and tags have been automatically created (Figure 4.22). After you save and download the configuration, these tags allow you to access the Input and Output data of the drive via the controller's ladder logic.

For this example, all Datalinks (A, B, C, and D) are enabled. The Input Size is set to 12 words and the Output Size is set to 10 words. Also, the following adapter I/O parameters are set to these values:

Adapter Parameter No.	Setting
23 - [DPI I/O Cfg]	xxxx xxxx xxx1 1111
35 - [M-S Input]	xxxx xxxx xxx1 1111
36 - [M-S Output]	xxxx xxxx xxx1 1111

9. Reset the adapter (see Resetting the Adapter on page 3-17) or power cycle the drive.

   For the drive speed reference and Datalink parameter values and the adapter setup parameter values, refer to Drive and Adapter Parameter Settings on page 5-12.

Figure 4.22 Controller Tags

Name	Value	Force Mask	Style	Data Type
+ My_PowerFlex_70_EC_Drive:C	{...}	{...}		AB:ETHERNET_...
− My_PowerFlex_70_EC_Drive:I	{...}	{...}		AB:ETHERNET_...
− My_PowerFlex_70_EC_Drive:I.Data	{...}	{...}	Decimal	INT[12]
+ My_PowerFlex_70_EC_Drive:I.Data[0]	0		Decimal	INT
+ My_PowerFlex_70_EC_Drive:I.Data[1]	0		Decimal	INT
+ My_PowerFlex_70_EC_Drive:I.Data[2]	0		Decimal	INT
+ My_PowerFlex_70_EC_Drive:I.Data[3]	0		Decimal	INT
+ My_PowerFlex_70_EC_Drive:I.Data[4]	0		Decimal	INT
+ My_PowerFlex_70_EC_Drive:I.Data[5]	0		Decimal	INT
+ My_PowerFlex_70_EC_Drive:I.Data[6]	0		Decimal	INT
+ My_PowerFlex_70_EC_Drive:I.Data[7]	0		Decimal	INT
+ My_PowerFlex_70_EC_Drive:I.Data[8]	0		Decimal	INT
+ My_PowerFlex_70_EC_Drive:I.Data[9]	0		Decimal	INT
+ My_PowerFlex_70_EC_Drive:I.Data[10]	0		Decimal	INT
+ My_PowerFlex_70_EC_Drive:I.Data[11]	0		Decimal	INT
− My_PowerFlex_70_EC_Drive:O	{...}	{...}		AB:ETHERNET_...
− My_PowerFlex_70_EC_Drive:O.Data	{...}	{...}	Decimal	INT[10]
+ My_PowerFlex_70_EC_Drive:O.Data[0]	0		Decimal	INT
+ My_PowerFlex_70_EC_Drive:O.Data[1]	0		Decimal	INT
+ My_PowerFlex_70_EC_Drive:O.Data[2]	0		Decimal	INT
+ My_PowerFlex_70_EC_Drive:O.Data[3]	0		Decimal	INT
+ My_PowerFlex_70_EC_Drive:O.Data[4]	0		Decimal	INT
+ My_PowerFlex_70_EC_Drive:O.Data[5]	0		Decimal	INT
+ My_PowerFlex_70_EC_Drive:O.Data[6]	0		Decimal	INT
+ My_PowerFlex_70_EC_Drive:O.Data[7]	0		Decimal	INT
+ My_PowerFlex_70_EC_Drive:O.Data[8]	0		Decimal	INT
+ My_PowerFlex_70_EC_Drive:O.Data[9]	0		Decimal	INT

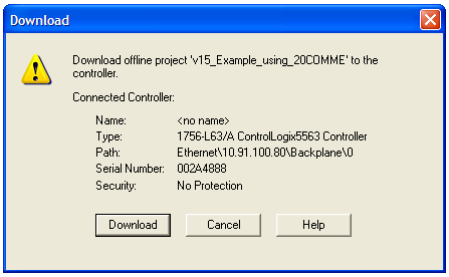
Saving the I/O Configuration to the Controller

After adding the bridge and drive/adapter to the I/O configuration, you must download the configuration to the controller. You should also save the configuration to a file on your computer.

TIP: When using RSLogix 5000 version 16 (or later), you can add the I/O configuration of a Generic Profile while the controller is online and in the Run mode.

1. In the RSLogix 5000 window, select **Communications > Download**. The Download dialog box (Figure 4.23) appears.

Figure 4.23 Download Dialog Box



TIP: If a message box reports that RSLogix 5000 is unable to go online, select **Communications > Who Active** to find your controller in the Who Active screen. After finding and selecting the controller, click **Set Project Path** to establish the path. If your controller does not appear, you need to add or configure the EtherNet/IP driver in RSLinx. See Using RSLinx Classic on page 4-1 for details.

2. Click **Download** to download the configuration to the controller. When the download is successfully completed, RSLogix 5000 goes into the Online mode and the I/O OK box in the upper-left of the screen should be steady green.

3. Select **File > Save**. If this is the first time you saved the project, the Save As dialog box appears. Navigate to a folder, type a file name, and click **Save** to save the configuration to a file on your computer.

   To ensure that the present project configuration values are saved, RSLogix 5000 prompts you to upload them. Click **Yes** to upload/save.

4. Any Datalinks that were enabled in the controller and adapter during I/O configuration (Table 4.A, Table 4.B or Table 4.C) must also be configured in the drive (for example, Datalink parameters 300…317 in PowerFlex 70/700 drives). Each Datalink being used must be assigned to a specific parameter in the drive or connected peripheral. If this is not done, the controller will receive or send placeholder data instead of actual drive or peripheral parameter values.

5. Place the controller in Remote Run or Run Mode.

Limitations When Using PLC-5, SLC 500 or MicroLogix 1100/1400

Controlling I/O with explicit messages is relatively complex compared to normal implicit I/O control.

ControlLogix and CompactLogix controllers with EtherNet/IP provide the easiest and most integrated form of implicit I/O control for a PowerFlex drive. Programming software RSLogix 5000 version 16 (or later) for ControlLogix and CompactLogix controllers contains Drive Add-On Profiles for PowerFlex drives that, with a few clicks of the mouse, automatically create all controller tags and an implicit connection at the specified Requested Packet Interval to control the drive. This connection is monitored at both ends to ensure that the controller and drive are communicating. A watchdog will cause a drive fault if the drive does not respond within approximately 100 milliseconds. Therefore, using a ControlLogix or CompactLogix controller is by far the much preferred method of controlling drives on EtherNet/IP.

If you are not using either of these type of controllers, then PowerFlex drives on EtherNet/IP can be controlled with explicit messages using PLC-5, SLC 500 or MicroLogix 1100/1400 controllers with the following limitations:

- An explicit message is a much slower form of control and is non-deterministic. This means that you cannot guarantee how long the drive will take to start up or stop when the command is given. Therefore, all equipment used in this manner should be subject to a risk assessment, taking into account the mechanical and electrical implementation.
- A timeout value (in seconds) in the adapter will issue a drive fault if a message is not received from the controller within the specified time. However, the controller has no way of detecting a loss of communications to the drive until the next cycle of explicit messages. This is another factor in the risk assessment.
- Any additional drives to be controlled will require additional explicit messages for their control, and they need to be carefully sequenced. Most controllers have small communication queues (refer to its User Manual), which need to be carefully managed if messages are not to be lost.
- Each controller has a limited number of communication connections (refer to its User Manual for maximum connections), which will limit the number of drives that can be connected.

In summary, unlike a ControlLogix or CompactLogix controller, programming a PLC-5, SLC 500 or MicroLogix 1100/1400 controller using RSLogix 5 or RSLogix 500 software with explicit messages is more difficult, and produces a more complex program.

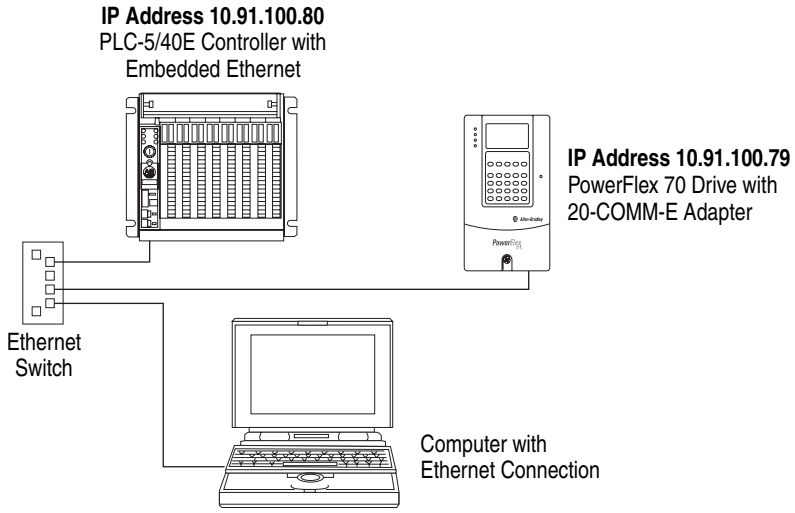
PLC-5 Example

Important: The PLC-5 must be Series E (Rev. D.1 or higher) to support the MultiHop feature that routes messaging to the drive.

Example Network

After the adapter is configured, the connected drive and adapter will be a single node on the network. This section provides the steps needed to configure a simple EtherNet/IP network (see Figure 4.24). In our example, we will configure a PLC-5/40E controller to communicate with a drive using Logic Command/Status, Reference/Feedback, and Datalinks over the network.

Figure 4.24 PLC-5 Example EtherNet/IP Network



NOTE: Information for PowerFlex 750-Series drives has been added to this manual where applicable.

Configuring Parameters for Network I/O

Since the I/O for the drive is message-based, there is no need to configure any I/O inside the RSLogix 5 (version 7 or later) project until using the I/O as described in Chapter 5.

However, to get the adapter to operate with the I/O created in Chapter 5, you need to configure the adapter to accept the I/O and the drive to point to the appropriate Datalinks.

1. For this example, the following adapter I/O parameters are set to these values:

Adapter Parameter No.	Setting
23 - [DPI I/O Cfg]	xxxx xxxx xxx1 1111
35 - [M-S Input]	xxxx xxxx xxx1 1111
36 - [M-S Output]	xxxx xxxx xxx1 1111

2. Reset the adapter (see Resetting the Adapter on page 3-17) or power cycle the drive.

   For the drive speed reference and Datalink parameter values and the adapter setup parameter values, refer to Drive and Adapter Parameter Settings on page 5-18.

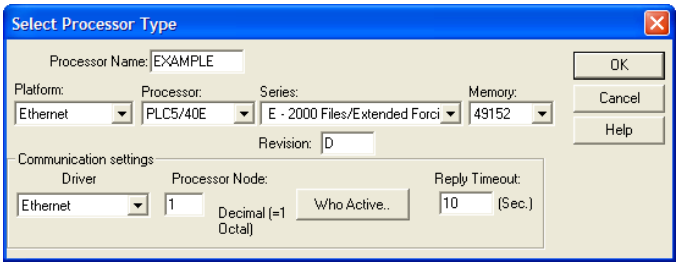
Creating RSLogix 5 (version 7 or later) Project

To transmit (read and write) data between the controller and drive, you must create message instructions that allocate data table addresses in the controller for Logic Command/Status, Reference/Feedback, and Datalinks.

Selecting the Controller

1. Start RSLogix 5. The RSLogix 5 window appears. Select **File > New** to display the Select Processor Type screen (Figure 4.25).

Figure 4.25 PLC-5 Select Processor Type Screen



2. Assign a name for the processor. From the pull-down fields, select the appropriate choices to match your PLC-5 controller and application, and click **OK**. The RSLogix 5 project window appears.

Creating PLC-5 Ladder Logic for the Control Timeout

1. In the RSLogix 5 project window treeview under Program Files double-click on LAD 2.

2. Insert a ladder rung, double-click on the rung to display the rung editor, and enter **MSG MGxx:n**, where:

   xx is an unused data file number (for example, MG10:n), and
   n is an unused element of the data file chosen for xx (for example, MG10:0)

   Then press **Enter**.

3. Insert another separate rung, double-click on the rung to display the rung editor, and enter **BST XIC MGxx:n/DN NXB XIC MGxx:n/ER BND OTU MGxx:n/EN**, where:

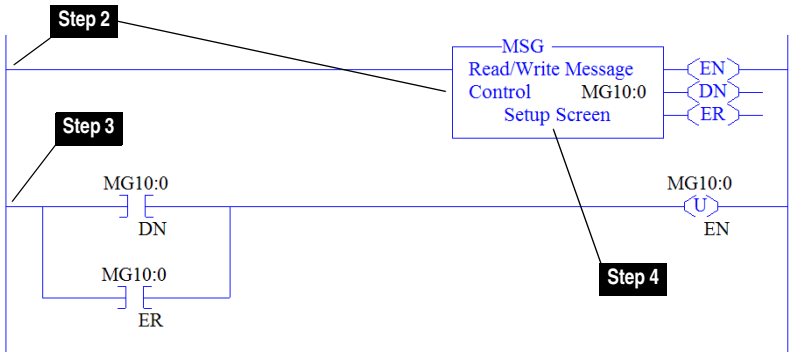
   xx and n must correspond to the assigned data file number and element (for example, MG10:0) for the message created in Step 2.

   Important: The information must be entered with appropriate numbers for “xx” and “n” for your application, and with spaces and forward slashes exactly as shown.

   Then press **Enter**.

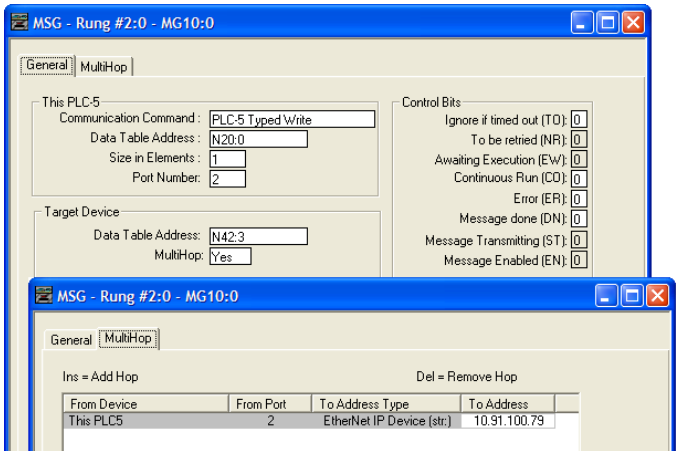
4. In the MSG instruction, double-click on Setup Screen to launch the message configuration screen (Figure 4.27).

Figure 4.26 PLC-5 Ladder Logic for the Control Timeout



5. Configure the General tab by entering or verifying the information shown in the screen.

Figure 4.27 PLC-5 Message Configuration Screens for the Control Timeout



General Tab Box	Setting
This PLC-5	
Communication Command	**PLC-5 Typed Write**. The controller type and command type for the controller to write the control timeout value to the drive.
Data Table Address (1)	**N20:0**. An unused controller data table address containing the control timeout value to be written.
Size in Elements (2)	**1**. Number of elements (words) to be transferred. Each element size is a 16-bit integer.
Port Number	**2**. Controller port to which the network is connected.
Target Device (data for adapter/drive)	
Data Table Address (3)	**N42:3**. Specific starting address of the destination file in the drive.
MultiHop	**Yes**. Enables communication to allow network messaging to be routed to the adapter/drive. When "Yes" is selected, a MultiHop tab appears on the message configuration screen.
MultiHop Tab Box	**Setting**
To Address	**10.91.100.79.** The IP address of the adapter connected to the drive.

(1) For details on data table addresses for this example project, refer to Table 5.G...Table 5.J starting on page 5-20.

(2) For details to determine element size for a specific drive, refer to Understanding Controller Data Table Addresses on page 5-19.

(3) For details on setting the control timeout value and its function, see N-Files on page C-10. The Control Timeout (N42:3) is stored in RAM. If the 20-COMM-E adapter is power cycled, the Control Timeout Message must be re-sent. If the Control Timeout is not changed from a non-zero value, the control message (page 4-28) will error out.

TIP: The Control Timeout (N42:3) must be changed to a non-zero value (5…20 seconds recommended). If the Control Timeout is not changed from a non-zero value, the control message (page 4-28) will error out. The Control Timeout is stored in RAM. If the adapter is power cycled, the Control Timeout Message must be re-sent.

Creating PLC-5 Ladder Logic for the Logic Status, Feedback, and Datalink Out

1. Insert another separate rung, double-click on the rung to display the rung editor, and enter **MSG MGxx:n**, where:

   xx is an unused data file number (for example, MG11:n), and
   n is an unused element of the data file chosen for xx (for example, MG11:0)

   Then press **Enter**.

2. Insert another separate rung, double-click on the rung to display the rung editor, and enter **BST XIC MGxx:n/DN NXB XIC MGxx:n/ER BND OTU MGxx:n/EN**, where:

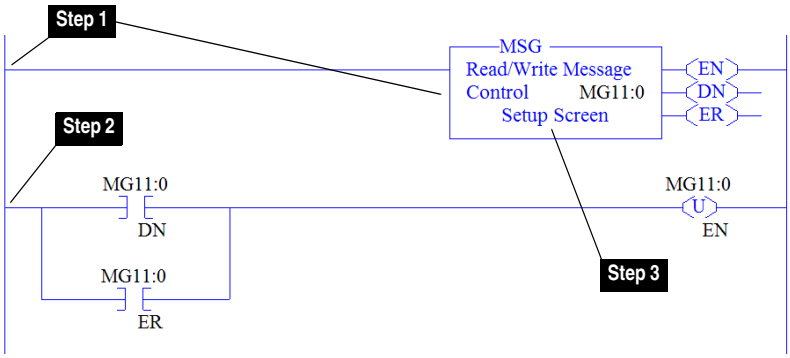
   xx and n must correspond to the assigned data file number and element (for example, MG11:0) for the message created in Step 1.

   Important: The information must be entered with appropriate numbers for “xx” and “n” for your application, and with spaces and forward slashes exactly as shown.

   Then press **Enter**.

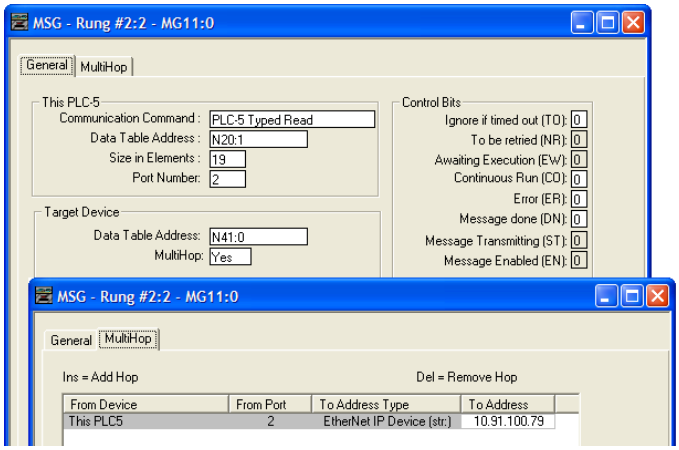
3. In the MSG instruction, double-click on Setup Screen to launch the message configuration screen (Figure 4.29).

Figure 4.28 PLC-5 Ladder Logic for the Logic Status, Feedback, and Datalink Out



4. Configure the General tab by entering or verifying the information shown in the screen.

Figure 4.29 PLC-5 Message Configuration Screens for the Logic Status, Feedback, and Datalink Out



General Tab Box	Setting
This PLC-5	
Communication Command	**PLC-5 Typed Read**. The controller type and command type for the controller to read data from the drive.
Data Table Address (1)	**N20:1**. An unused controller data table address containing the data to be read from the drive.
Size in Elements (2)	**19**. Number of elements (words) to be transferred. Each element size is a 16-bit integer.
Port Number	**2**. Controller port to which the network is connected.
Target Device (data for adapter/drive)	
Data Table Address (3)	**N41:0**. Specific starting address of the source file in the drive.
MultiHop	**Yes**. Enables communication to allow network messaging to be routed to the adapter/drive. When "Yes" is selected, a MultiHop tab appears on the message configuration screen.
MultiHop Tab Box	**Setting**
To Address	**10.91.100.79.** The IP address of the adapter connected to the drive.

(1) For details on data table addresses for this example project, refer to Table 5.G…Table 5.J starting on page 5-20.

(2) For details to determine element size for a specific drive, refer to Understanding Controller Data Table Addresses on page 5-19.

(3) For N-File details, see N-Files on page C-10.

Creating PLC-5 Ladder Logic for the Logic Command, Reference, and Datalink In

1. Insert another separate rung, double-click on the rung to display the rung editor, and enter **MSG MGxx:n**, where:

   xx is an unused data file number (for example, MG12:n), and
   n is an unused element of the data file chosen for xx (for example, MG12:0)

   Then press **Enter**.

2. Insert another separate rung, double-click on the rung to display the rung editor, and enter **BST XIC MGxx:n/DN NXB XIC MGxx:n/ER BND OTU MGxx:n/EN**, where:

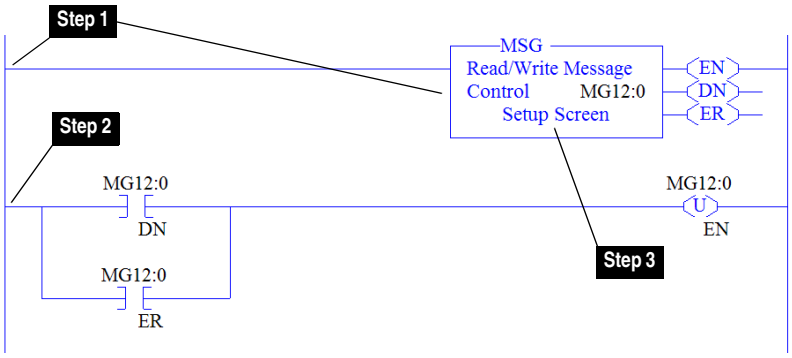
   xx and n must correspond to the assigned data file number and element (for example, MG12:0) for the message created in Step 1.

   Important: The information must be entered with appropriate numbers for “xx” and “n” for your application, and with spaces and forward slashes exactly as shown.

   Then press **Enter**.

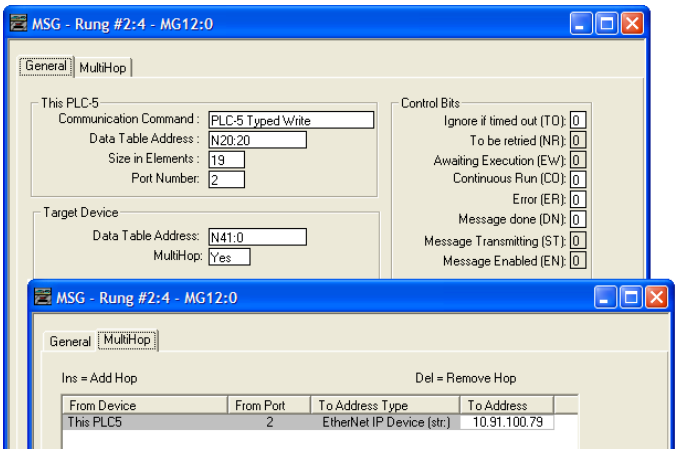
3. In the MSG instruction, double-click on Setup Screen to launch the message configuration screen (Figure 4.31).

Figure 4.30 PLC-5 Ladder Logic for the Logic Command, Reference, and Datalink In



4. Configure the General tab by entering or verifying the information shown in the screen.

Figure 4.31 PLC-5 Message Configuration Screens for the Logic Command, Reference, and Datalink In



General Tab Box	Setting
This PLC-5	
Communication Command	**PLC-5 Typed Write**. The controller type and command type for the controller to write data to the drive.
Data Table Address (1)	**N20:20**. An unused controller data table address containing the data to be written to the drive.
Size in Elements (2)	**19**. Number of elements (words) to be transferred. Each element size is a 16-bit integer.
Port Number	**2**. Controller port to which the network is connected.
Target Device (data for adapter/drive)	
Data Table Address (3)	**N41:0**. Specific starting address of the destination file in the drive.
MultiHop	**Yes**. Enables communication to allow network messaging to be routed to the adapter/drive. When "Yes" is selected, a MultiHop tab appears on the message configuration screen.
MultiHop Tab Box	**Setting**
To Address	**10.91.100.79.** The IP address of the adapter connected to the drive.

(1) For details on data table addresses for this example project, refer to Table 5.G…Table 5.J starting on page 5-20.

(2) For details to determine element size for a specific drive, refer to Understanding Controller Data Table Addresses on page 5-19.

(3) For N-File details, see N-Files on page C-10.

TIP: This message will error out if the Control Timeout value is not changed from a non-zero value. Refer to page 4-24 for writing a value to the Control Timeout.

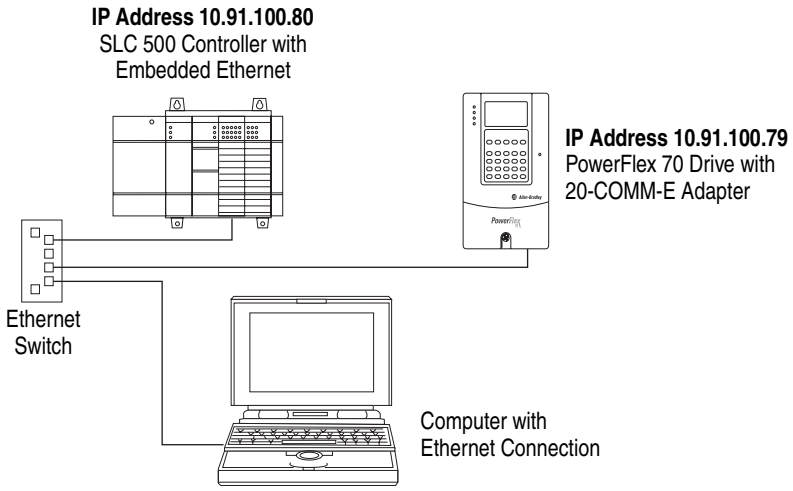
TIP: If the controller is controlling more than one drive, it is recommended to intersperse the control I/O messaging for each drive to conserve network bandwidth and decrease response time. That is, sequence the message instructions for each drive so that its group of messages will occur at a different time than those for another drive.

SLC 500 Example

Example Network

After the adapter is configured, the connected drive and adapter will be a single node on the network. This section provides the steps needed to configure a simple EtherNet/IP network (see Figure 4.32). In our example, we will configure a SLC 500 controller to communicate with a drive using Logic Command/Status, Reference/Feedback, and Datalinks over the network.

Figure 4.32 SLC 500 Example EtherNet/IP Network



NOTE: Information for PowerFlex 750-Series drives has been added to this manual where applicable.

Configuring Parameters for Network I/O

Since the I/O for the drive is message-based, there is no need to configure any I/O inside the RSLogix 500 (version 7 or later) project until using the I/O as described in Chapter 5.

However, to get the adapter to operate with the I/O created in Chapter 5, we need to configure the adapter to accept the I/O and drive to point to the appropriate Datalinks.

1. For this example, the following adapter I/O parameters are set to these values:

Adapter Parameter No.	Setting
23 - [DPI I/O Cfg]	xxxx xxxx xxx1 1111
35 - [M-S Input]	xxxx xxxx xxx1 1111
36 - [M-S Output]	xxxx xxxx xxx1 1111

2. Reset the adapter (see Resetting the Adapter on page 3-17) or power cycle the drive.

   For the drive speed reference and Datalink parameter values and the adapter setup parameter values, refer to Drive and Adapter Parameter Settings on page 5-18.

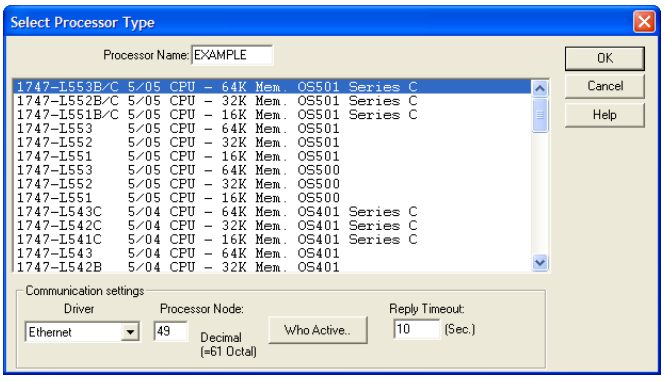
Creating RSLogix 500 (version 7 or later) Project

To transmit (read and write) data between the controller and drive, you must create message instructions that allocate data table addresses in the controller for Logic Command/Status, Reference/Feedback, and Datalinks.

Selecting the Controller

1. Start RSLogix 500. The RSLogix 500 window appears. Select **File > New** to display the Select Processor Type screen (Figure 4.33).

Figure 4.33 SLC 500 Select Processor Type Screen



2. Assign a name for the processor. In the list, select a 1747-L55x type controller. Then select the appropriate choices for the fields in the screen to match your application, and click **OK**. The RSLogix 500 project window appears.

Creating SLC 500 Ladder Logic for the Control Timeout

1. In the RSLogix 500 project window treeview under Program Files double-click on LAD 2.

2. Insert a ladder rung, double-click on the rung to display the rung editor, and enter **MSG WRITE 500CPU LOCAL Nxx:n**, where:

   xx is an unused data file number (for example, N10:n), and
   n is an unused element of the data file chosen for xx (for example, N10:0)

   Then press **Enter**.

3. Insert another separate rung, double-click on the rung to display the rung editor, and enter **BST XIC Nxx:n/DN NXB XIC Nxx:n/ER BND OTU Nxx:n/EN**, where:

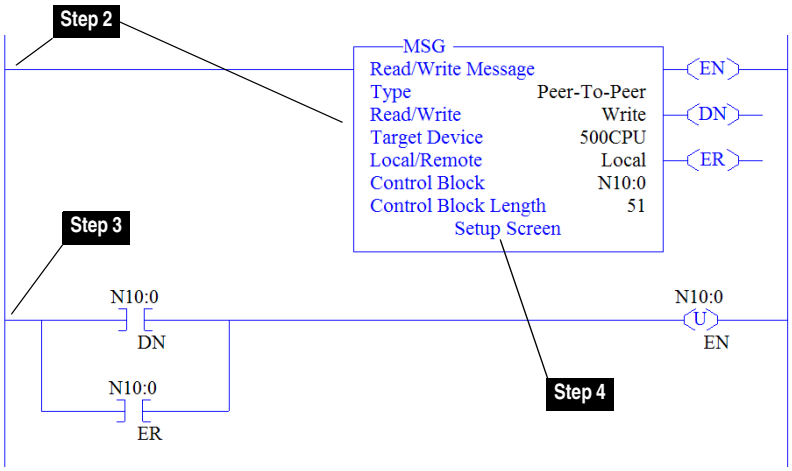
   xx and n must correspond to the assigned data file number and element (for example, N10:0) for the message created in Step 2.

   Important: The information must be entered with appropriate numbers for “xx” and “n” for your application, and with spaces and forward slashes exactly as shown.

   Then press **Enter**.

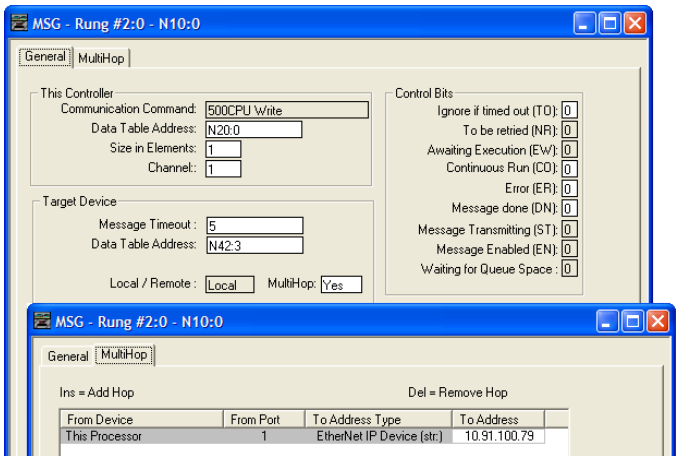
4. In the MSG instruction, double-click on Setup Screen to launch the message configuration screen (Figure 4.35).

Figure 4.34 SLC 500 Ladder Logic for the Control Timeout



5. Configure the General tab by entering or verifying the information shown in the screen.

Figure 4.35 SLC 500 Message Configuration Screens for the Control Timeout



General Tab Box	Setting
This Controller	
Communication Command	This setting is unavailable (grayed out) and is established when the message is created in the ladder rung.
Data Table Address (1)	**N20:0**. An unused controller data table address containing the control timeout value to be written.
Size in Elements (2)	**1**. Number of elements (words) to be transferred. Each element size is a 16-bit integer.
Channel	**1**. Controller port to which the network is connected.
Target Device (data for adapter/drive)	
Message Timeout	**5**. Message timeout duration in seconds.
Data Table Address (3)	**N42:3**. Specific starting address of the destination file in the drive.
MultiHop	**Yes**. Enables communication to allow network messaging to be routed to the adapter/drive. When "Yes" is selected, a MultiHop tab appears on the message configuration screen.
MultiHop Tab Box	**Setting**
To Address	**10.91.100.79.** The IP address of the adapter connected to the drive.

(1) For details on data table addresses for this example project, refer to Table 5.G…Table 5.J starting on page 5-20.

(2) For details to determine element size for a specific drive, refer to Understanding Controller Data Table Addresses on page 5-19.

(3) For details on setting the control timeout value and its function, see N-Files on page C-10. The Control Timeout (N42:3) is stored in RAM. If the 20-COMM-E adapter is power cycled, the Control Timeout Message must be re-sent. If the Control Timeout is not changed from a non-zero value, the control message (page 4-36) will error out.

TIP: The Control Timeout (N42:3) must be changed to a non-zero value (5…20 seconds recommended). If the Control Timeout is not changed from a non-zero value, the control message (page 4-36) will error out. The Control Timeout is stored in RAM. If the adapter is power cycled, the Control Timeout Message must be re-sent.

Creating SLC 500 Ladder Logic for the Logic Status, Feedback, and Datalink Out

1. Insert another separate rung, double-click on the rung to display the rung editor, and enter **MSG READ 500CPU LOCAL Nxx:n**, where:

   xx is an unused data file number (for example, N11:n), and
   n is an unused element of the data file chosen for xx (for example, N11:0)

   Then press **Enter**.

2. Insert another separate rung, double-click on the rung to display the rung editor, and enter **BST XIC Nxx:n/DN NXB XIC Nxx:n/ER BND OTU Nxx:n/EN**, where:

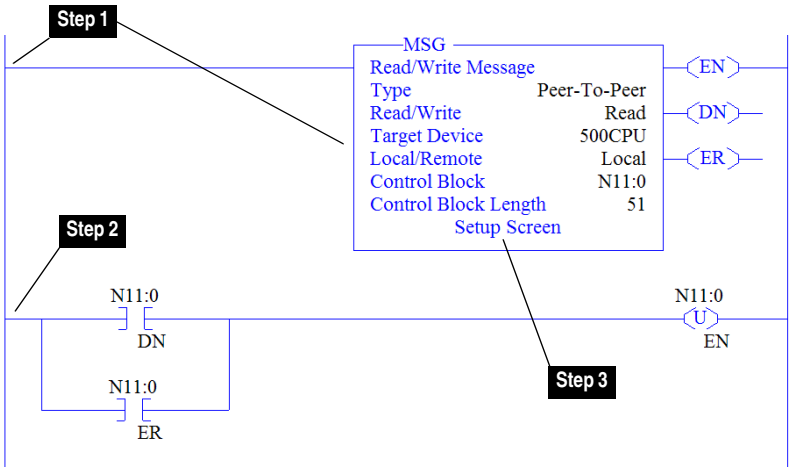
   xx and n must correspond to the assigned data file number and element (for example, N11:0) for the message created in Step 1.

   Important: The information must be entered with appropriate numbers for “xx” and “n” for your application, and with spaces and forward slashes exactly as shown.

   Then press **Enter**.

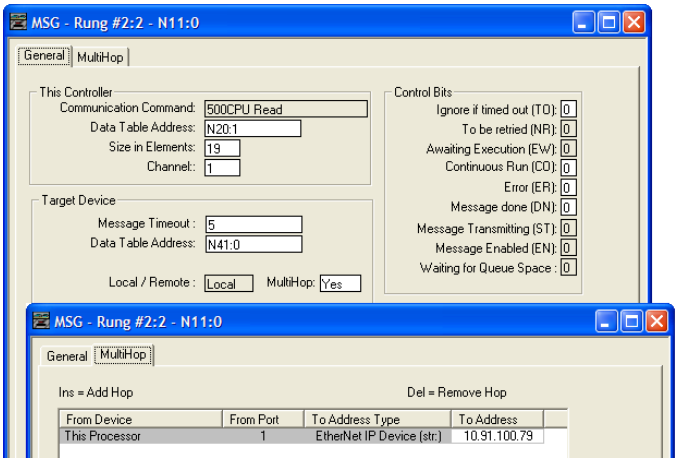
3. In the MSG instruction, double-click on Setup Screen to launch the message configuration screen (Figure 4.37).

Figure 4.36 SLC 500 Ladder Logic for the Logic Status, Feedback, and Datalink Out



4. Configure the General tab by entering or verifying the information shown in the screen.

Figure 4.37 SLC 500 Message Configuration Screens for the Logic Status, Feedback, and Datalink Out



General Tab Box	Setting
This Controller	
Communication Command	This setting is unavailable (grayed out) and is established when the message is created in the ladder rung.
Data Table Address (1)	**N20:1**. An unused controller data table address containing the data to be read from the drive.
Size in Elements (2)	**19**. Number of elements (words) to be transferred. Each element size is a 16-bit integer.
Channel	**1**. Controller port to which the network is connected.
Target Device (data for adapter/drive)	
Message Timeout	**5**. Message timeout duration in seconds.
Data Table Address (3)	**N41:0**. Specific starting address of the source file in the drive.
MultiHop	**Yes**. Enables communication to allow network messaging to be routed to the adapter/drive. When "Yes" is selected, a MultiHop tab appears on the message configuration screen.
MultiHop Tab Box	**Setting**
To Address	**10.91.100.79.** The IP address of the adapter connected to the drive.

(1) For details on data table addresses for this example project, refer to Table 5.G…Table 5.J starting on page 5-20.

(2) For details to determine element size for a specific drive, refer to Understanding Controller Data Table Addresses on page 5-19.

(3) For N-File details, see N-Files on page C-10.

Creating SLC 500 Ladder Logic for the Logic Command, Reference, and Datalink In

1. Insert another separate rung, double-click on the rung to display the rung editor, and enter **MSG WRITE 500CPU LOCAL Nxx:n**, where:

   xx is an unused data file number (for example, N12:n), and
   n is an unused element of the data file chosen for xx (for example, N12:0)

   Then press **Enter**.

2. Insert another separate rung, double-click on the rung to display the rung editor, and enter **BST XIC Nxx:n/DN NXB XIC Nxx:n/ER BND OTU Nxx:n/EN**, where:

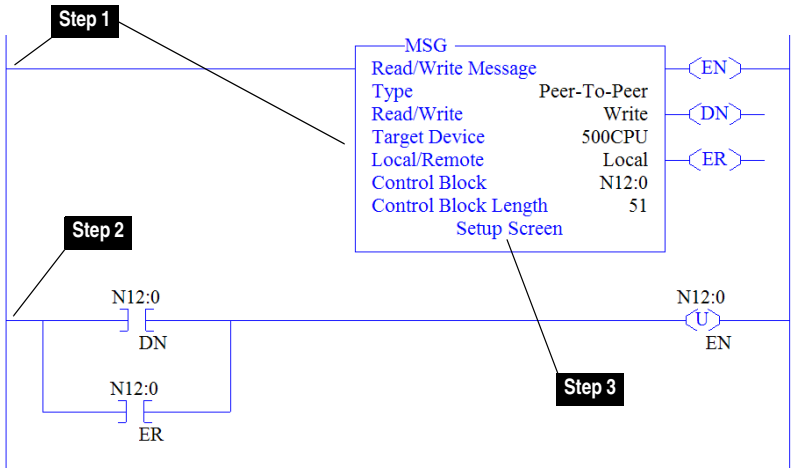
   xx and n must correspond to the assigned data file number and element (for example, N12:0) for the message created in Step 1.

   Important: The information must be entered with appropriate numbers for “xx” and “n” for your application, and with spaces and forward slashes exactly as shown.

   Then press **Enter**.

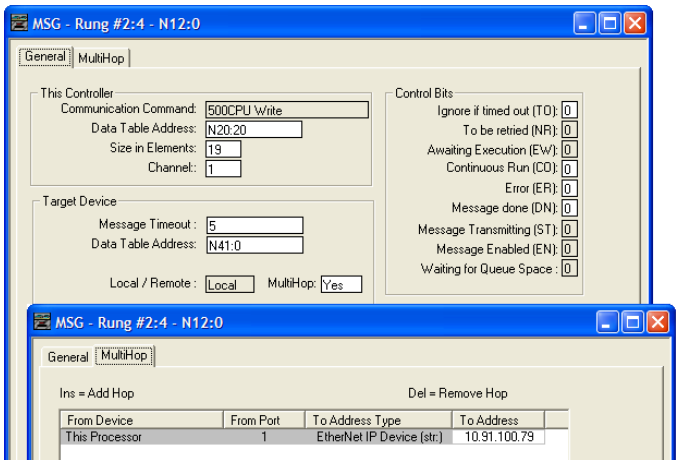
3. In the MSG instruction, double-click on Setup Screen to launch the message configuration screen (Figure 4.39).

Figure 4.38 SLC 500 Ladder Logic for the Logic Command, Reference, and Datalink In



4. Configure the General tab by entering or verifying the information shown in the screen.

Figure 4.39 SLC 500 Message Configuration Screens for the Logic Command, Reference, and Datalink In



General Tab Box	Setting
This Controller	
Communication Command	This setting is unavailable (grayed out) and is established when the message is created in the ladder rung.
Data Table Address [1]	**N20:20**. An unused controller data table address containing the data to be written to the drive.
Size in Elements [2]	**19**. Number of elements (words) to be transferred. Each element size is a 16-bit integer.
Channel	**1**. Controller port to which the network is connected.
Target Device (data for adapter/drive)	
Message Timeout	**5**. Message timeout duration in seconds.
Data Table Address [3]	**N41:0**. Specific starting address of the destination file in the drive.
MultiHop	**Yes**. Enables communication to allow network messaging to be routed to the adapter/drive. When "Yes" is selected, a MultiHop tab appears on the message configuration screen.
MultiHop Tab Box	**Setting**
To Address	**10.91.100.79.** The IP address of the adapter connected to the drive.

[1] For details on data table addresses for this example project, refer to Table 5.G…Table 5.J starting on page 5-20.

[2] For details to determine element size for a specific drive, refer to Understanding Controller Data Table Addresses on page 5-19.

[3] For N-File details, see N-Files on page C-10.

TIP: This message will error out if the Control Timeout value is not changed from a non-zero value. Refer to page 4-32 for writing a value to the Control Timeout.

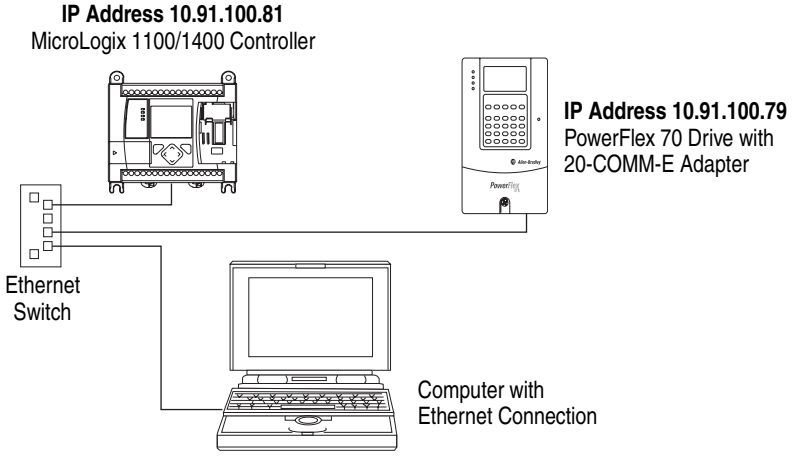
TIP: If the controller is controlling more than one drive, it is recommended to intersperse the control I/O messaging for each drive to conserve network bandwidth and decrease response time. That is, sequence the message instructions for each drive so that its group of messages will occur at a different time than those for another drive.

MicroLogix 1100/1400 Example

Example Network

After the adapter is configured, the connected drive and adapter will be a single node on the network. This section provides the steps needed to configure a simple EtherNet/IP network (see Figure 4.40). In our example, we will configure a MicroLogix 1100 controller to communicate with a drive using Logic Command/Status, Reference/Feedback, and Datalinks over the network.

Figure 4.40 MicroLogix 1100/1400 Example EtherNet/IP Network



NOTE: Information for PowerFlex 750-Series drives has been added to this manual where applicable.

Configuring Parameters for Network I/O

Since the I/O for the drive is message-based, there is no need to configure any I/O inside the RSLogix 500 (version 7 or later) project until using the I/O as described in Chapter 5.

However, to get the adapter to operate with the I/O created in Chapter 5, we need to configure the adapter to accept the I/O and drive to point to the appropriate Datalinks.

1. For this example, the following adapter I/O parameters are set to these values:

Adapter Parameter No.	Setting
23 - [DPI I/O Cfg]	xxxx xxxx xxx1 1111
35 - [M-S Input]	xxxx xxxx xxx1 1111
36 - [M-S Output]	xxxx xxxx xxx1 1111

2. Reset the adapter (see Resetting the Adapter on page 3-17) or power cycle the drive.

   For the drive speed reference and Datalink parameter values and the adapter setup parameter values, refer to Drive and Adapter Parameter Settings on page 5-18.

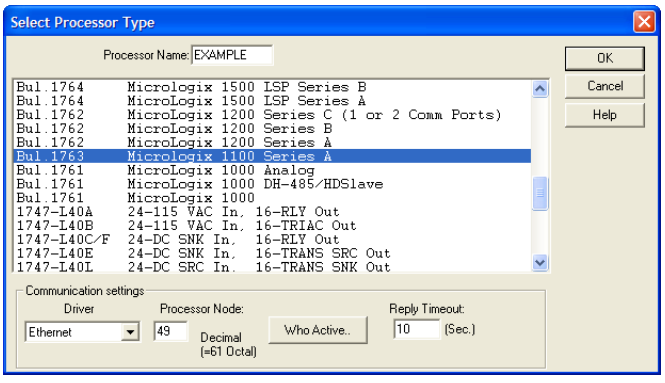
Creating RSLogix 500 (version 7 or later) Project

To transmit (read and write) data between the controller and drive, you must create message instructions that allocate data table addresses in the controller for Logic Command/Status, Reference/Feedback, and Datalinks.

Selecting the Controller

1. Start RSLogix 500. The RSLogix 500 window appears. Select **File > New** to display the Select Processor Type screen (Figure 4.41).

Figure 4.41 MicroLogix 1100 Select Processor Type Screen



2. Assign a name for the processor. In the list, select the MicroLogix 1100. Then select the appropriate choices for the fields in the screen to match your application, and click **OK**. The RSLogix 500 project window appears.

Creating MicroLogix 1100/1400 Ladder Logic for the Control Timeout

1. In the RSLogix 500 project window treeview under Program Files double-click on LAD 2.

2. Insert a ladder rung, double-click on the rung to display the rung editor, and enter **MSG MGxx:n**, where:

   xx is an unused data file number (for example, MG10:n), and
   n is an unused element of the data file chosen for xx (for example, MG10:0)

   Then press **Enter**.

3. Insert another separate rung, double-click on the rung to display the rung editor, and enter **BST XIC MGxx:n/DN NXB XIC MGxx:n/ER BND OTU MGxx:n/EN**, where:

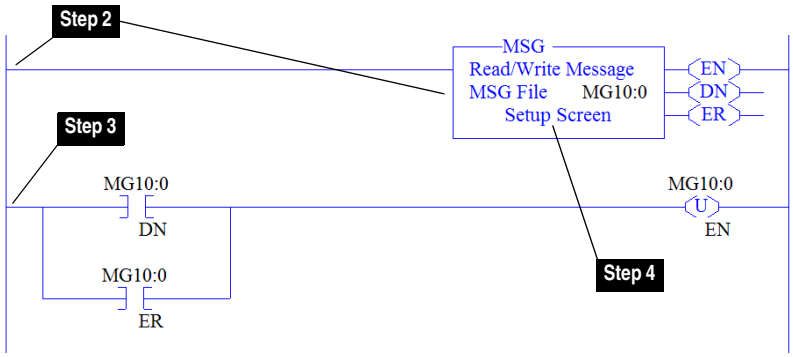
   xx and n must correspond to the assigned data file number and element (for example, MG10:0) for the message created in Step 2.

   Important: The information must be entered with appropriate numbers for “xx” and “n” for your application, and with spaces and forward slashes exactly as shown.

   Then press **Enter**.

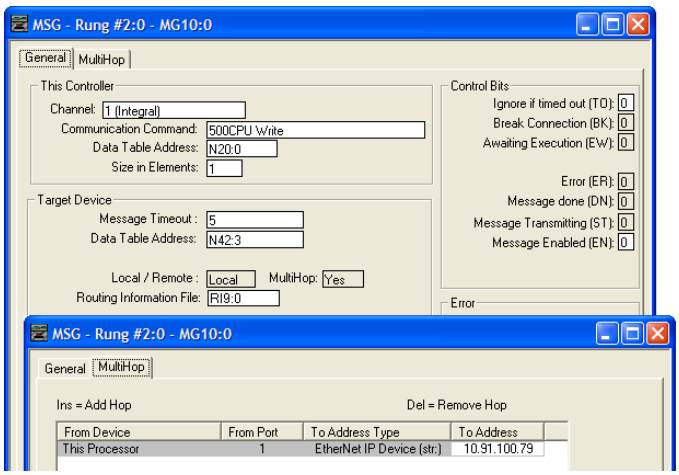
4. In the MSG instruction, double-click on Setup Screen to launch the message configuration screen (Figure 4.43).

Figure 4.42 MicroLogix 1100/1400 Ladder Logic for the Control Timeout



5. Configure the General tab by entering or verifying the information shown in the screen.

Figure 4.43 MicroLogix 1100/1400 Message Configuration Screens for the Control Timeout



General Tab Box	Setting
This Controller (data for MicroLogix 1100)	
Channel	**1 (integral)**. Controller port to which the network is connected.
Communication Command	**500CPU Write**. The controller type and command type for the controller to read or write data. Since the MicroLogix 1100 is part of the SLC-500 controller family, the “500CPU” controller type was selected. The “Write” command type was selected to write the control timeout value to the drive.
Data Table Address (1)	**N20:0**. An unused controller data table address containing the control timeout value to be written.
Size in Elements (2)	**1**. Number of elements (words) to be transferred. Each element size is a 16-bit integer.
Target Device (data for adapter/drive)	
Message Timeout	**5**. Message timeout duration in seconds.
Data Table Address (3)	**N42:3**. Specific starting address of the destination file in the drive.
Routing Information File	**RI9:0**. An unused routing information file for the controller.
MultiHop Tab Box	**Setting**
To Address	**10.91.100.79.** The IP address of the adapter connected to the drive.

(1) For details on data table addresses for this example project, refer to Table 5.G…Table 5.J starting on page 5-20.

(2) For details to determine element size for a specific drive, refer to Understanding Controller Data Table Addresses on page 5-19.

(3) For details on setting the control timeout value and its function, see N-Files on page C-10. The Control Timeout (N42:3) is stored in RAM. If the 20-COMM-E adapter is power cycled, the Control Timeout Message must be re-sent. If the Control Timeout is not changed from a non-zero value, the control message (page 4-44) will error out.

TIP: The Control Timeout (N42:3) must be changed to a non-zero value (5…20 seconds recommended). If the Control Timeout is not changed from a non-zero value, the control message (page 4-44) will error out. The Control Timeout is stored in RAM. If the adapter is power cycled, the Control Timeout Message must be re-sent.

Creating MicroLogix 1100/1400 Ladder Logic for the Logic Status, Feedback, and Datalink Out

1. Insert another separate rung, double-click on the rung to display the rung editor, and enter **MSG MGxx:n**, where:

   xx is an unused data file number (for example, MG11:n), and
   n is an unused element of the data file chosen for xx (for example, MG11:0)

   Then press **Enter**.

2. Insert another separate rung, double-click on the rung to display the rung editor, and enter **BST XIC MGxx:n/DN NXB XIC MGxx:n/ER BND OTU MGxx:n/EN**, where:

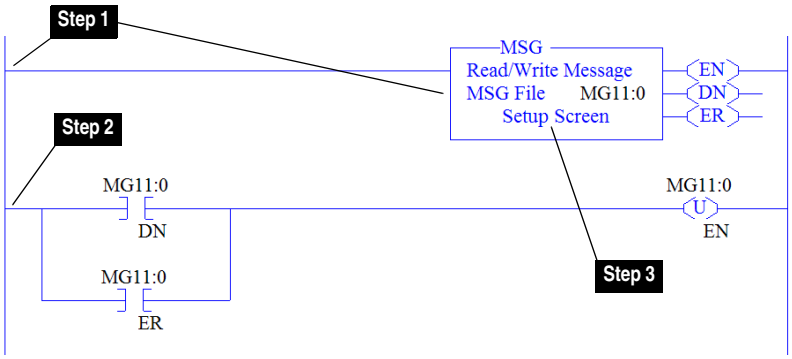
   xx and n must correspond to the assigned data file number and element (for example, MG11:0) for the message created in Step 1.

   Important: The information must be entered with appropriate numbers for “xx” and “n” for your application, and with spaces and forward slashes exactly as shown.

   Then press **Enter**.

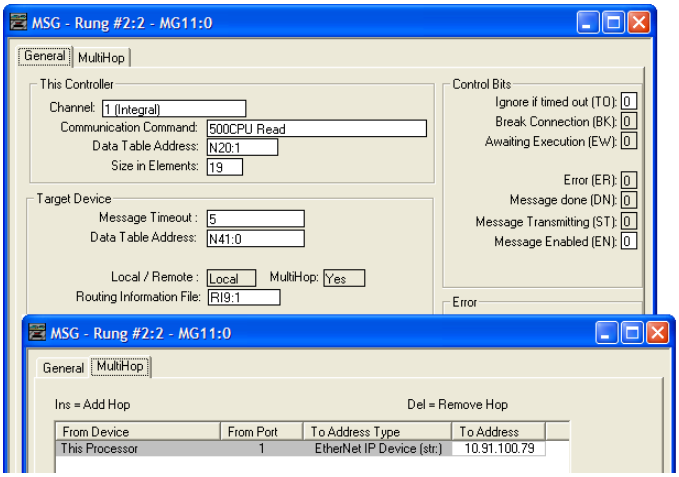
3. In the MSG instruction, double-click on Setup Screen to launch the message configuration screen (Figure 4.45).

Figure 4.44 MicroLogix 1100/1400 Ladder Logic for the Logic Status, Feedback, and Datalink Out



4. Configure the General tab by entering or verifying the information shown in the screen.

Figure 4.45 MicroLogix 1100/1400 Message Configuration Screens for the Logic Status, Feedback, and Datalink Out



General Tab Box	Setting
This Controller (data for MicroLogix 1100)	
Channel	**1 (integral)**. Controller port to which the network is connected.
Communication Command	**500CPU Read**. The controller type and command type for the controller to read or write data. Since the MicroLogix 1100 is part of the SLC-500 controller family, the “500CPU” controller type was selected. The “Read” command type was selected to read data from the drive.
Data Table Address [1]	**N20:1**. An unused controller data table address containing the data to be read from the drive.
Size in Elements [2]	**19**. Number of elements (words) to be transferred. Each element size is a 16-bit integer.
Target Device (data for adapter/drive)	
Message Timeout	**5**. Message timeout duration in seconds.
Data Table Address [3]	**N41:0**. Specific starting address of the source file in the drive.
Routing Information File	**RI9:1**. An unused routing information file for the controller.
MultiHop Tab Box	**Setting**
To Address	**10.91.100.79.** The IP address of the adapter connected to the drive.

[1] For details on data table addresses for this example project, refer to Table 5.G…Table 5.J starting on page 5-20.

[2] For details to determine element size for a specific drive, refer to Understanding Controller Data Table Addresses on page 5-19.

[3] For N-File details, see N-Files on page C-10.

Creating MicroLogix 1100/1400 Ladder Logic for the Logic Command, Reference, and Datalink In

1. Insert another separate rung, double-click on the rung to display the rung editor, and enter **MSG MGxx:n**, where:

   xx is an unused data file number (for example, MG12:n), and
   n is an unused element of the data file chosen for xx (for example, MG12:0)

   Then press **Enter**.

2. Insert another separate rung, double-click on the rung to display the rung editor, and enter **BST XIC MGxx:n/DN NXB XIC MGxx:n/ER BND OTU MGxx:n/EN**, where:

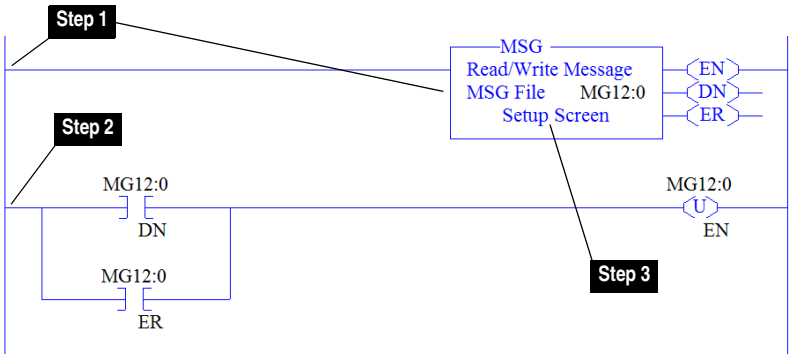
   xx and n must correspond to the assigned data file number and element (for example, MG12:0) for the message created in Step 1.

   Important: The information must be entered with appropriate numbers for “xx” and “n” for your application, and with spaces and forward slashes exactly as shown.

   Then press **Enter**.

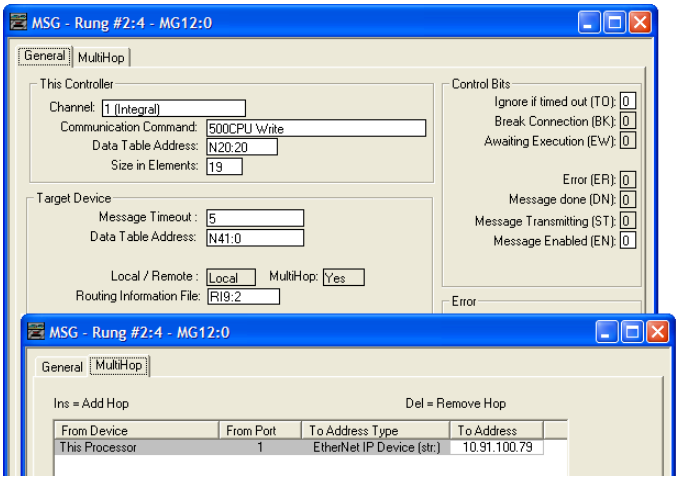
3. In the MSG instruction, double-click on Setup Screen to launch the message configuration screen (Figure 4.47).

Figure 4.46 MicroLogix 1100/1400 Ladder Logic for the Logic Command, Reference, and Datalink In



4. Configure the General tab by entering or verifying the information shown in the screen.

Figure 4.47 MicroLogix 1100/1400 Message Configuration Screens for the Logic Command, Reference, and Datalink In



General Tab Box	Setting
This Controller (data for MicroLogix 1100)	
Channel	**1 (integral)**. Controller port to which the network is connected.
Communication Command	**500CPU Write**. The controller type and command type for the controller to read or write data. Since the MicroLogix 1100 is part of the SLC-500 controller family, the “500CPU” controller type was selected. The “Write” command type was selected to write data to the drive.
Data Table Address (1)	**N20:20**. An unused controller data table address containing the data to be written to the drive.
Size in Elements (2)	**19**. Number of elements (words) to be transferred. Each element size is a 16-bit integer.
Target Device (data for adapter/drive)	
Message Timeout	**5**. Message timeout duration in seconds.
Data Table Address (3)	**N41:0**. Specific starting address of the destination file in the drive.
Routing Information File	**RI9:2**. An unused routing information file for the controller.
MultiHop Tab Box	**Setting**
To Address	**10.91.100.79.** The IP address of the adapter connected to the drive.

(1) For details on data table addresses for this example project, refer to Table 5.G…Table 5.J starting on page 5-20.

(2) For details to determine element size for a specific drive, refer to Understanding Controller Data Table Addresses on page 5-19.

(3) For N-File details, see N-Files on page C-10.

TIP: This message will error out if the Control Timeout value is not changed from a non-zero value. Refer to page 4-40 for writing a value to the Control Timeout.

TIP: If the controller is controlling more than one drive, it is recommended to intersperse the control I/O messaging for each drive to conserve network bandwidth and decrease response time. That is, sequence the message instructions for each drive so that its group of messages will occur at a different time than those for another drive.

Notes:

Using the I/O

This chapter provides information and examples that explain how to control, configure, and monitor a PowerFlex 7-Class drive using the configured I/O.

Topic	Page
About I/O Messaging	5-1
Understanding the I/O Image	5-2
Using Logic Command/Status	5-5
Using Reference/Feedback	5-5
Using Datalinks	5-7
Example Ladder Logic Program Information	5-9
ControlLogix Example	5-10
PLC-5, SLC 500 or MicroLogix 1100/1400 Example	5-18

ATTENTION: Risk of injury or equipment damage exists. The examples in this publication are intended solely for purposes of example. There are many variables and requirements with any application. Rockwell Automation, Inc. does not assume responsibility or liability (to include intellectual property liability) for actual use of the examples shown in this publication.

About I/O Messaging

On CIP-based networks, including EtherNet/IP, I/O connections are used to transfer the data which controls the PowerFlex drive and sets its Reference. I/O can also be used to transfer data to and from Datalinks in PowerFlex 7-Class drives.

The adapter provides many options for configuring and using I/O, including:

- Configuring the size of I/O by enabling or disabling the Logic Command/Reference and Datalinks.
- Setting a Master-Slave hierarchy or a Peer-to-Peer hierarchy.

Chapter 3, Configuring the Adapter, and Chapter 4, Configuring the I/O, discuss how to configure the adapter and controller on the network for these options. The Glossary defines the different options. This chapter discusses how to use I/O after you have configured the adapter and controller.

Understanding the I/O Image

The terms *input* and *output* are defined from the controller's point of view. Therefore, output I/O is data that is produced by the controller and consumed by the adapter. Input I/O is status data that is produced by the adapter and consumed as input by the controller. The I/O image will vary based on:

- Size (either 16-bit or 32-bit) of the Reference/Feedback words and Datalink words used by the drive. To determine the size of the Reference/Feedback and Datalinks, view adapter **Parameters 18 - [Ref/Fdbk Size]** and **19 - [Datalink Size]**. For information to access parameters, see Using the PowerFlex 7-Class HIM on page 3-2.
- Configuration of I/O (**Parameter 23 - [DPI I/O Cfg]**). If all I/O is not enabled, the image is truncated. The image always uses consecutive words starting at word 0.
- **ControlLogix/CompactLogix Controllers only**—The drive profile used in RSLogix 5000 (drive Add-On Profile in version 16 or later, Classic Profile in versions 13…15, or Generic Profile in all versions).

ControlLogix Controller Image

Since the drive Add-On Profile in RSLogix 5000 version 16 (or later) and the Classic Profile (versions 13…15) provide descriptive controller tags, the I/O image (tag size and location) is automatically configured based on the drive being used. When using the Generic Profile (page 4-15) in RSLogix 5000, however, controller tags are not descriptive or defined.

The ControlLogix controller I/O image changes depending on the size of the drive's Reference/Feedback and Datalinks. Table 5.A, Table 5.B, and Table 5.C show the I/O image when using various PowerFlex 7-Class drives, and all Datalinks enabled.

Table 5.A ControlLogix I/O Image for PowerFlex 70/700/700H Drives and SMC Flex (16-bit Reference/Feedback and 16-bit Datalinks) – Using Generic Profile

Word	Output I/O
0	Logic Command
1	Reference
2	Datalink In A1
3	Datalink In A2
4	Datalink In B1
5	Datalink In B2
6	Datalink In C1
7	Datalink In C2
8	Datalink In D1
9	Datalink In D2

Word	Input I/O
0	Pad Word
1	Pad Word
2	Logic Status
3	Feedback
4	Datalink Out A1
5	Datalink Out A2
6	Datalink Out B1
7	Datalink Out B2
8	Datalink Out C1
9	Datalink Out C2
10	Datalink Out D1
11	Datalink Out D2

Table 5.B ControlLogix I/O Image for PowerFlex 700 VC Drives (16-bit Reference/Feedback and 32-bit Datalinks) – Using Generic Profile

Word	Output I/O
0	Logic Command
1	Reference
2	Datalink In A1 (LSW)
3	Datalink In A1 (MSW)
4	Datalink In A2 (LSW)
5	Datalink In A2 (MSW)
6	Datalink In B1 (LSW)
7	Datalink In B1 (MSW)
8	Datalink In B2 (LSW)
9	Datalink In B2 (MSW)
10	Datalink In C1 (LSW)
11	Datalink In C1 (MSW)
12	Datalink In C2 (LSW)
13	Datalink In C2 (MSW)
14	Datalink In D1 (LSW)
15	Datalink In D1 (MSW)
16	Datalink In D2 (LSW)
17	Datalink In D2 (MSW)

Word	Input I/O
0	Pad Word
1	Pad Word
2	Logic Status
3	Feedback
4	Datalink Out A1 (LSW)
5	Datalink Out A1 (MSW)
6	Datalink Out A2 (LSW)
7	Datalink Out A2 (MSW)
8	Datalink Out B1 (LSW)
9	Datalink Out B1 (MSW)
10	Datalink Out B2 (LSW)
11	Datalink Out B2 (MSW)
12	Datalink Out C1 (LSW)
13	Datalink Out C1 (MSW)
14	Datalink Out C2 (LSW)
15	Datalink Out C2 (MSW)
16	Datalink Out D1 (LSW)
17	Datalink Out D1 (MSW)
18	Datalink Out D2 (LSW)
19	Datalink Out D2 (MSW)

Table 5.C ControlLogix I/O Image for PowerFlex 700S/750-Series Drives (32-bit Reference/Feedback and 32-bit Datalinks) – Using Generic Profile

Word	Output I/O
0	Logic Command
1	Not Used
2	Reference (LSW)
3	Reference (MSW)
4	Datalink In A1 (LSW)
5	Datalink In A1 (MSW)
6	Datalink In A2 (LSW)
7	Datalink In A2 (MSW)
8	Datalink In B1 (LSW)
9	Datalink In B1 (MSW)
10	Datalink In B2 (LSW)
11	Datalink In B2 (MSW)
12	Datalink In C1 (LSW)
13	Datalink In C1 (MSW)
14	Datalink In C2 (LSW)
15	Datalink In C2 (MSW)
16	Datalink In D1 (LSW)
17	Datalink In D1 (MSW)
18	Datalink In D2 (LSW)
19	Datalink In D2 (MSW)

Word	Input I/O
0	Pad Word
1	Pad Word
2	Logic Status
3	Not Used
4	Feedback (LSW)
5	Feedback (MSW)
6	Datalink Out A1 (LSW)
7	Datalink Out A1 (MSW)
8	Datalink Out A2 (LSW)
9	Datalink Out A2 (MSW)
10	Datalink Out B1 (LSW)
11	Datalink Out B1 (MSW)
12	Datalink Out B2 (LSW)
13	Datalink Out B2 (MSW)
14	Datalink Out C1 (LSW)
15	Datalink Out C1 (MSW)
16	Datalink Out C2 (LSW)
17	Datalink Out C2 (MSW)
18	Datalink Out D1 (LSW)
19	Datalink Out D1 (MSW)
20	Datalink Out D2 (LSW)
21	Datalink Out D2 (MSW)

PLC-5, SLC 500 or MicroLogix 1100/1400 Controller Image

The I/O image for these controllers always has 19 words of output and 19 words of input. However, depending on the size of the drive's Reference/ Feedback and Datalinks, specific words in the I/O image may not be used. Table 5.D, Table 5.E, and Table 5.F show the I/O image when using various PowerFlex 7-Class drives, and all Datalinks enabled.

Table 5.D PLC-5, SLC 500 or MicroLogix 1100/1400 I/O Image for PowerFlex 70/ 700/700H Drives and SMC Flex (16-bit Reference/Feedback and 16-bit Datalinks)

Word	Output I/O
0	Logic Command
1	Not used
2	Reference (MSW)
3	Not used
4	Datalink In A1 (MSW)
5	Not used
6	Datalink In A2 (MSW)
7	Not used
8	Datalink In B1 (MSW)
9	Not used
10	Datalink In B2 (MSW)
11	Not used
12	Datalink In C1 (MSW)
13	Not used
14	Datalink In C2 (MSW)
15	Not used
16	Datalink In D1 (MSW)
17	Not used
18	Datalink In D2 (MSW)

Word	Input I/O
0	Logic Status
1	Not used
2	Feedback (MSW)
3	Not used
4	Datalink Out A1 (MSW)
5	Not used
6	Datalink Out A2 (MSW)
7	Not used
8	Datalink Out B1 (MSW)
9	Not used
10	Datalink Out B2 (MSW)
11	Not used
12	Datalink Out C1 (MSW)
13	Not used
14	Datalink Out C2 (MSW)
15	Not used
16	Datalink Out D1 (MSW)
17	Not used
18	Datalink Out D2 (MSW)

Table 5.E PLC-5, SLC 500 or MicroLogix 1100/1400 I/O Image for PowerFlex 700 VC Drives (16-bit Reference/Feedback and 32-bit Datalinks)

Word	Output I/O
0	Logic Command
1	Not used
2	Reference (MSW)
3	Datalink In A1 (LSW)
4	Datalink In A1 (MSW)
5	Datalink In A2 (LSW)
6	Datalink In A2 (MSW)
7	Datalink In B1 (LSW)
8	Datalink In B1 (MSW)
9	Datalink In B2 (LSW)
10	Datalink In B2 (MSW)
11	Datalink In C1 (LSW)
12	Datalink In C1 (MSW)
13	Datalink In C2 (LSW)
14	Datalink In C2 (MSW)
15	Datalink In D1 (LSW)
16	Datalink In D1 (MSW)
17	Datalink In D2 (LSW)
18	Datalink In D2 (MSW)

Word	Input I/O
0	Logic Status
1	Not used
2	Feedback (MSW)
3	Datalink Out A1 (LSW)
4	Datalink Out A1 (MSW)
5	Datalink Out A2 (LSW)
6	Datalink Out A2 (MSW)
7	Datalink Out B1 (LSW)
8	Datalink Out B1 (MSW)
9	Datalink Out B2 (LSW)
10	Datalink Out B2 (MSW)
11	Datalink Out C1 (LSW)
12	Datalink Out C1 (MSW)
13	Datalink Out C2 (LSW)
14	Datalink Out C2 (MSW)
15	Datalink Out D1 (LSW)
16	Datalink Out D1 (MSW)
17	Datalink Out D2 (LSW)
18	Datalink Out D2 (MSW)

Table 5.F PLC-5, SLC 500 or MicroLogix 1100/1400 I/O Image for PowerFlex 700S/ 750-Series Drives (32-bit Reference/Feedback and 32-bit Datalinks)

Word	Output I/O
0	Logic Command
1	Reference (LSW)
2	Reference (MSW)
3	Datalink In A1 (LSW)
4	Datalink In A1 (MSW)
5	Datalink In A2 (LSW)
6	Datalink In A2 (MSW)
7	Datalink In B1 (LSW)
8	Datalink In B1 (MSW)
9	Datalink In B2 (LSW)
10	Datalink In B2 (MSW)
11	Datalink In C1 (LSW)
12	Datalink In C1 (MSW)
13	Datalink In C2 (LSW)
14	Datalink In C2 (MSW)
15	Datalink In D1 (LSW)
16	Datalink In D1 (MSW)
17	Datalink In D2 (LSW)
18	Datalink In D2 (MSW)

Word	Input I/O
0	Logic Status
1	Feedback (LSW)
2	Feedback (MSW)
3	Datalink Out A1 (LSW)
4	Datalink Out A1 (MSW)
5	Datalink Out A2 (LSW)
6	Datalink Out A2 (MSW)
7	Datalink Out B1 (LSW)
8	Datalink Out B1 (MSW)
9	Datalink Out B2 (LSW)
10	Datalink Out B2 (MSW)
11	Datalink Out C1 (LSW)
12	Datalink Out C1 (MSW)
13	Datalink Out C2 (LSW)
14	Datalink Out C2 (MSW)
15	Datalink Out D1 (LSW)
16	Datalink Out D1 (MSW)
17	Datalink Out D2 (LSW)
18	Datalink Out D2 (MSW)

Using Logic Command/ Status

The *Logic Command* is a 16-bit word of control data produced by the scanner and consumed by the adapter. The *Logic Status* is a 16-bit word of status data produced by the adapter and consumed by the scanner. PowerFlex 750-Series drives have a 32-bit Logic Command/Status, but when using a 20-COMM-E adapter only the first 16 bits can be used.

This manual contains the bit definitions for most compatible products available at the time of publication in Appendix D, Logic Command/Status Words. For other products, refer to their documentation.

Using Reference/Feedback

The *Reference* is produced by the controller and consumed by the adapter. The *Feedback* is produced by the adapter and consumed by the controller. The size of the Reference/Feedback is determined by the drive and displayed using adapter **Parameter 18 - [Ref/Fdbk Size]**.

Size	Valid Values
16-bit	-32768 to 32767
32-bit	-2147483648 to 2147483647

When the Reference and Feedback are enabled and a ControlLogix controller with a drive Add-On Profile or Classic Profile is used, specific controller tags are automatically created, sized (16-bit or 32-bit), and placed in the I/O image.

PowerFlex 7-Class Drives (except PowerFlex 750-Series)

The Reference value is a scaled engineering value; it is NOT in Hertz or RPM. The Reference uses a “32767” scale. The “32767” endpoint of the scale is equal to the value of parameter 55 - [Maximum Freq], which has a default value of 130 Hz. For all PowerFlex 70/700 drives, default scaling is 0…15123 which is equal to 0…60.0 Hz. This is based on the formula shown below. Reference scaling is limited by drive parameter 82 - [Maximum Speed]. If the default value of 60 Hz. for parameter 82 - [Maximum Speed] is changed, the speed Reference scaling also changes. To determine Reference scaling, use:

(Parameter 82 ÷ Parameter 55) * 32767 = Scaling

Using parameter 82 and 55 default values, speed Reference scaling is:

(60 Hz ÷ 130 Hz) * 32767 = 15123

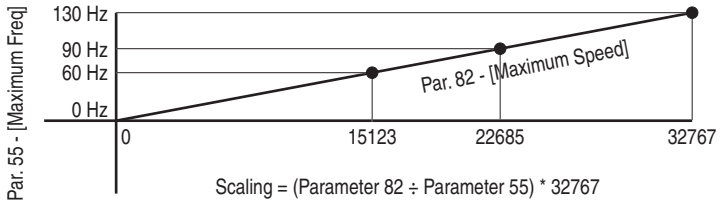
Therefore, 0…15123 = 0…60.0 Hz.

If parameter 82 - [Maximum Speed] is changed to 90 Hz, then:

(90 Hz ÷ 130 Hz) * 32767 = 22685

Therefore, 0…22685 = 0…90.0 Hz.

A graphic representation of this Reference scaling is shown below:



For PowerFlex 70 EC drives (firmware version 2.xxx or later) or PowerFlex 700 VC drives (firmware version 3.xxx or later), parameter 298 - [DPI Ref Select] was added to simplify scaling for the speed Reference. When parameter 298 - [DPI Ref Select] is set to its default “0” (Max Freq), the speed Reference scaling is as shown above. However, when parameter 298 - [DPI Ref Select] is set to “1” (Max Speed), the speed Reference scaling is equal to parameter 82 - [Max Speed]:

Parameter 82 = Scaling

Using the parameter 82 default value, speed Reference scaling is:

0…32767 = 0…60.0 Hz.

If parameter 82 - [Maximum Speed] is changed to 90 Hz, then:

90 Hz = 32767

Speed Feedback uses the same scaling as the speed Reference.

TIP: For PowerFlex 700 VC drives (firmware version 3.xxx or later), Parameter 299 - [DPI Fdbk Select] enables you to select the feedback data coming from the drive over DPI. The default is “Speed Fdbk” in Hz or RPM determined by Parameter 079 - [Speed Units]. The data selection for Parameter 299 is also displayed on the 1st line of the HIM and on DriveExplorer and DriveExecutive screens in the drive status area of the screen.

PowerFlex 750-Series Drives

The Reference value is Hz x 1000 or RPM x 1000. Drive Parameter 300 - [Speed Units] determines whether the scaling is Hz or RPM. The default scaling is Hz, where 0…60,000 equates to 0…60.000 Hz. When Parameter 300 is set to RPM, then 0…1,765,000 equates to 0…1765.000 RPM.

Using Datalinks

A Datalink is a mechanism used by PowerFlex drives to transfer data to and from the controller. Datalinks allow a drive parameter value to be read or written without using an Explicit Message. When enabled, each Datalink occupies two 16-bit or 32-bit words in both the input and output image. Use adapter **Parameter 19 - [Datalink Size]** to determine whether the drive uses 16-bit or 32-bit words for Datalinks.

Rules for Using Datalinks

- Each set of Datalink parameters in a PowerFlex drive can be used by only one adapter. If more than one adapter is connected to a single drive, multiple adapters cannot use the same Datalink.
- Parameter settings in the drive determine the data passed through the Datalink mechanism. Refer to the documentation for your drive.
- When you use a Datalink to change a value, the value is NOT written to the Non-Volatile Storage (NVS). The value is stored in volatile memory and lost when the drive loses power. Thus, use Datalinks when you need to change a value of a parameter frequently.

Datalink Scaling

PowerFlex 7-Class Drives (except PowerFlex 750-Series)

When using RSLogix 5000 version 16 (or later), Datalink scaling is done automatically. However, when using RSLogix 5000 version 15 (or earlier)—or when using a PLC-5, SLC 500 or MicroLogix 1100/1400 controller—Datalink scaling is not automatic and uses whole numbers (INTs or DINTs). Refer to the drive documentation to determine the unit resolution for the associated parameter Datalink. For example, PowerFlex 700VC drive Parameter 3 - [Output Current] has a 0.1 unit resolution.

Because Datalink scaling uses whole numbers, the Output Current value is multiplied by 10 in the adapter and then sent over the network. Suppose the actual Output Current value is 35.5 amps. Reading the associated parameter Datalink received by the controller, the value would be 355. By using ladder logic, divide the value by 10 in the controller to get the correct scaling.

PowerFlex 750-Series Drives

When using RSLogix 5000 version 16 (or later), Datalink scaling is done automatically. However, when using RSLogix 5000 version 15 (or earlier)—or when using a PLC-5, SLC 500 or MicroLogix 1100/1400 controller—Datalinks require scaling in the following way. Parameters are either 32-bit integers or REALs. When the parameter is a 32-bit integer, the data needs to be copied using a COP command to a DINT tag. (Since PLC-5, SLC 500, and MicroLogix 1100/1400 controllers do not support 32-bit integers, the data must be separated into two 16-bit integers.) When the parameter is a REAL, the data needs to be copied using a COP command to a REAL tag. Refer to subsequent sections in this chapter for ladder logic examples.

Using 16-Bit Datalinks to Read/Write 32-Bit Parameters

This subsection only pertains to PowerFlex 70 (SC or EC), PowerFlex 700 (SC), and PowerFlex 700H drives which use 16-bit Datalinks. To read or write a 32-bit parameter using 16-bit Datalinks, typically both Datalinks of a pair (A, B, C, D) are set to the same 32-bit parameter. For example, to read Parameter 10 - [Elapsed Run Time] in a PowerFlex 70 drive, both Datalink A1 Out (Parameter 310) and Datalink A2 Out (Parameter 311) are set to “10.” Datalink A1 Out will contain the least significant word (LSW) and Datalink A2 Out will contain the most significant word (MSW).

32-bit data is stored in binary as follows:

MSW	2^{31} through 2^{16}
LSW	2^{15} through 2^{0}

In this example, the Parameter 10 - [Elapsed Run Time] value of 6553.9 Hrs is read as “6553.9” in Datalink A1 Out (Parameter 310) and Datalink A2 Out (Parameter 311).

Datalink	Word	Parameter	Data (Hex)
A1 Out	LSW	10	0003
A2 Out	MSW	10	0001

Conversion Example:

Parameter 010 - [Elapsed Run Time] = 6553.9 Hrs
MSW = 0001_{hex} = 0001_{binary} = 2^{16} = 65536
LSW = 0003_{hex} =3
Engineering Value = 65536 + 3 = 65539
Parameter 10 Displayed Value = 6553.9 Hrs

Regardless of the Datalink combination, Datalink x1 Out will always contain the LSW and Datalink x2 Out will always contain the MSW. In the following example, the PowerFlex 70 drive Parameter 242 - [Power Up Marker] contains a value of 88.4541 hours.

Datalink	Word	Parameter	Data (Hex)
A2 Out	MSW	242	000D
B1 Out	LSW	242	7F3D

Conversion Example:

Parameter 242 - [Power Up Marker] = 88.4541 hours
MSW = $000D_{hex} = 1101_{binary} = 2^{19} + 2^{18} + 2^{16} = 851968$
LSW = $7F3D_{hex} = 32573$
Engineering Value = 851968 + 32573 = 884541
Parameter 242 Displayed Value = 88.4541 Hrs

Example Ladder Logic Program Information

The example ladder logic programs in the sections of this chapter are intended for and operate PowerFlex 7-Class drives.

Functions of the Example Programs

The example programs enable you to:

- Receive Logic Status information from the drive.
- Send a Logic Command to control the drive (for example, start, stop).
- Send a Reference to the drive and receive Feedback from the drive.
- Send/receive Datalink data to/from the drive.

Logic Command/Status Words

These examples use the Logic Command word and Logic Status word for PowerFlex 70/700 drives. Information for PowerFlex 750-Series drives has been added to the examples where applicable. Refer to Appendix D to view details. The definition of the bits in these words may vary if you are using a different DPI drive. Refer to the documentation for your drive.

ControlLogix Example

Creating Ladder Logic Using the RSLogix 5000 Drive Add-On Profiles (version 16 or later)

Since the drive Add-On Profile automatically created descriptive controller tags (Figure 4.12) for the entire I/O image in Chapter 4, you can use these tags to directly control and monitor the drive without creating any ladder logic program. However, if you intend to use Human Machine Interface devices (PanelView, etc.) to operate the drive and view its status, you will need to create descriptive user-defined Program tags (Figure 5.1) and a ladder logic program that will pass the Controller tag data to the Program tags.

Figure 5.1 ControlLogix Program Tags for Drive Add-On Profile Ladder Logic Program Example

Name	Style	Data Type
Command_Clear_Faults	Decimal	BOOL
Command_Forward_Reverse	Decimal	BOOL
Command_Jog	Decimal	BOOL
Command_Start	Decimal	BOOL
Command_Stop	Decimal	BOOL
+ Speed_Feedback	Decimal	DINT
+ Speed_Reference	Decimal	DINT
Status_Active	Decimal	BOOL
Status_At_Speed	Decimal	BOOL
Status_Faulted	Decimal	BOOL
Status_Forward	Decimal	BOOL
Status_Ready	Decimal	BOOL
Status_Reverse	Decimal	BOOL

An example ladder logic program that uses the automatically created descriptive Controller tags and passes their data to the user-defined Program tags is shown in Figure 5.2 and Figure 5.3. Note that the prefix for the drive Controller tags is determined by the name assigned when configuring the I/O (Chapter 4). For information on speed Reference and Feedback scaling, see PowerFlex 7-Class Drives (except PowerFlex 750-Series) on page 5-6 or PowerFlex 750-Series Drives on page 5-7.

Figure 5.2 ControlLogix Example Ladder Logic Program Using a Drive Add-On Profile for Logic Status/Feedback

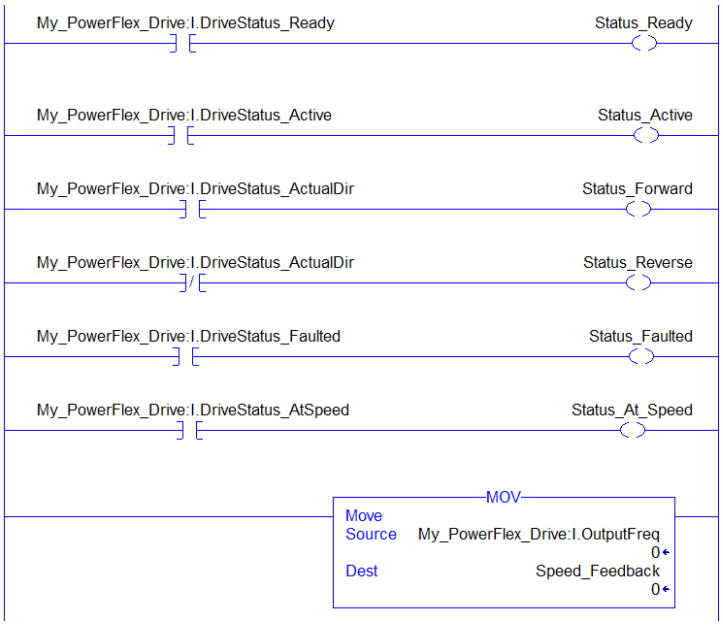
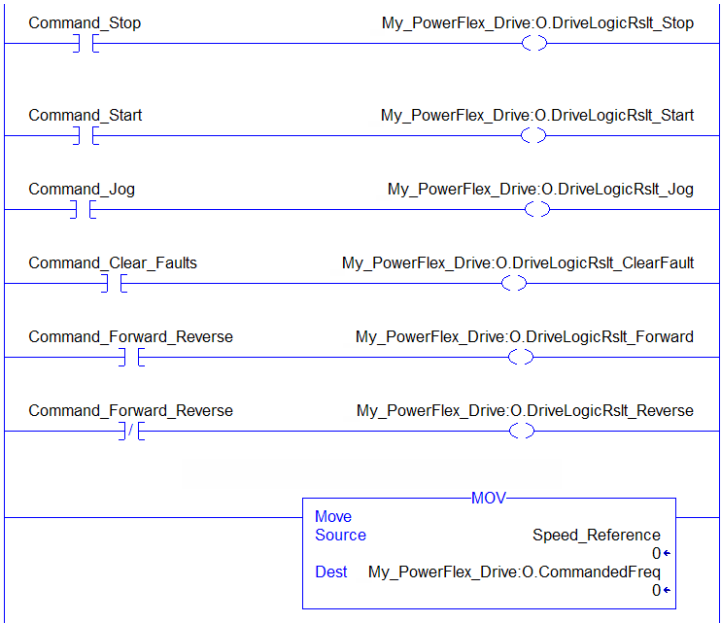


Figure 5.3 ControlLogix Example Ladder Logic Program Using a Drive Add-On Profile for Logic Command/Reference



Creating Ladder Logic Using the RSLogix 5000 Classic Profile (versions 13...15)

Since the RSLogix 5000 Classic Profile has been significantly improved upon by RSLogix 5000 drive Add-On Profiles (version 16 or later), it is highly recommended to use RSLogix 5000 drive Add-On Profiles to take advantage of its benefits (more intuitive, time saving, and less likely to make ladder logic program errors).

Creating Ladder Logic Using the RSLogix 5000 Generic Profile (all versions)

Drive and Adapter Parameter Settings

The following drive and adapter settings were used for the example ladder logic program in this section.

Device	Parameter	Value	Description
PowerFlex 70 EC Drive	90 - [Speed Ref A Sel]	22 (DPI Port 5)	Assigns 20-COMM-E to be used for the Reference.
	300 - [Data In A1]	140	Points to Par. 140 - [Accel Time 1]
	301 - [Data In A2]	142	Points to Par. 142 - [Decel Time 1]
	302 - [Data In B1]	100	Points to Par. 100 - [Jog Speed]
	303 - [Data In B2]	155	Points to Par. 155 - [Stop Mode A]
	304 - [Data In C1]	101	Points to Par. 101 - [Preset Speed 1]
	305 - [Data In C2]	102	Points to Par. 102 - [Preset Speed 2]
	306 - [Data In D1]	103	Points to Par. 103 - [Preset Speed 3]
	307 - [Data In D2]	104	Points to Par. 104 - [Preset Speed 4]
	310 - [Data Out A1]	140	Points to Par. 140 - [Accel Time 1]
	311 - [Data Out A2]	142	Points to Par. 142 - [Decel Time 1]
	312 - [Data Out B1]	100	Points to Par. 100 - [Jog Speed]
	313 - [Data Out B2]	155	Points to Par. 155 - [Stop Mode A]
	314 - [Data Out C1]	101	Points to Par. 101 - [Preset Speed 1]
	315 - [Data Out C2]	102	Points to Par. 102 - [Preset Speed 2]
	316 - [Data Out D1]	103	Points to Par. 103 - [Preset Speed 3]
	317 - [Data Out D2]	104	Points to Par. 104 - [Preset Speed 4]
PowerFlex 750-Series Drive (1)	545 - [Spd Ref A Sel]	Port 0: Port 6 Reference	Assigns 20-COMM-E to be used for the Reference.
	895 - [Data In A1]	Port 0: Accel Time 1	Points to Par. 535 in the drive.
	896 - [Data In A2]	Port 0: Testpoint Sel 1	Points to Par. 970 in the drive.
	897 - [Data In B1]	Port 5: Anlg Out1 Hi	Points to Par. 90 in Port 5 (I/O module).
	905 - [Data Out A1]	Port 0: DC Bus Volts	Points to Par. 11 in the drive.
	906 - [Data Out A2]	Port 0: Open Loop Fdbk	Points to Par. 137 in the drive.
	907 - [Data Out B1]	Port 5: Anlg Out0 Data	Points to Par. 77 in Port 5 (I/O module).
20-COMM-E Adapter	04 - [IP Addr Cfg 1] ⋮ 07 - [IP Addr Cfg 4]	10.91.100.79	IP address for the adapter.
	08 - [Subnet Cfg 1] ⋮ 11 - [Subnet Cfg 4]	255.255.248.0	Subnet mask for the adapter.
	23 - [DPI I/O Cfg]	xxx1 1111	Enables Cmd/Ref and Datalinks A…D.
	35 - [M-S Input]	xxx1 1111	Configures the I/O Data to be transferred from the controller on the network to the drive.
	36 - [M-S Output]	xxx1 1111	Configures the I/O Data to be transferred from the drive to the controller on the network.

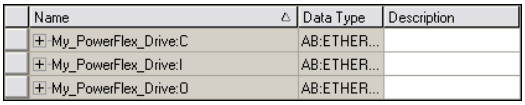
(1) In this example, the 20-COMM-E adapter/20-750-20COMM Option Card is installed in Port 6, and a 24V I/O module is installed in Port 5. Also, Data In B2…D2 (Parameters 898…902) and Data Out B2…D2 (Parameters 908…912) are enabled, but not used.

TIP: Data In parameters are inputs into the drive that come from controller outputs (for example, data to write to a drive parameter). Data Out parameters are outputs from the drive that go to controller inputs (for example, data to read a drive parameter).

Controller Tags

When you add the adapter and drive to the I/O configuration (Chapter 4), RSLogix 5000 automatically creates generic (non-descriptive) controller tags for them. In this example program, the following controller tags are used.

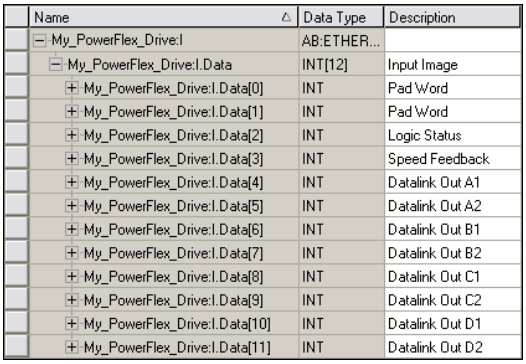
Figure 5.4 ControlLogix Controller Tags for Drive Generic Profile Example Ladder Logic Program



Name	Data Type	Description
My_PowerFlex_Drive:C	AB:ETHER...	
My_PowerFlex_Drive:I	AB:ETHER...	
My_PowerFlex_Drive:O	AB:ETHER...	

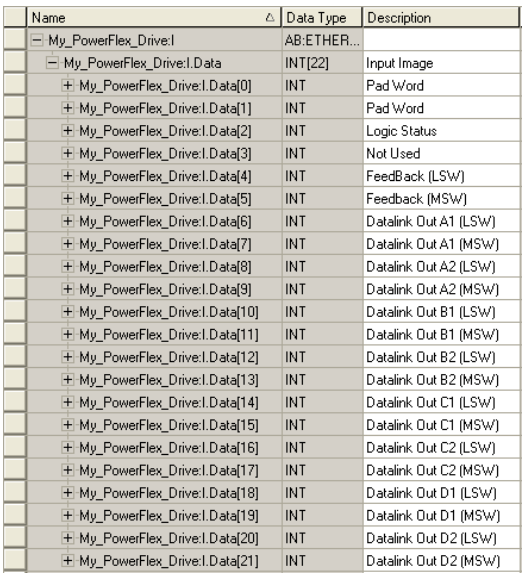
You can expand the Input and Output tags to reveal the input and output configuration.

Figure 5.5 ControlLogix Input Image for Drive Generic Profile Example Ladder Logic Program



Name	Data Type	Description
My_PowerFlex_Drive:I	AB:ETHER...	
My_PowerFlex_Drive:I.Data	INT[12]	Input Image
My_PowerFlex_Drive:I.Data[0]	INT	Pad Word
My_PowerFlex_Drive:I.Data[1]	INT	Pad Word
My_PowerFlex_Drive:I.Data[2]	INT	Logic Status
My_PowerFlex_Drive:I.Data[3]	INT	Speed Feedback
My_PowerFlex_Drive:I.Data[4]	INT	Datalink Out A1
My_PowerFlex_Drive:I.Data[5]	INT	Datalink Out A2
My_PowerFlex_Drive:I.Data[6]	INT	Datalink Out B1
My_PowerFlex_Drive:I.Data[7]	INT	Datalink Out B2
My_PowerFlex_Drive:I.Data[8]	INT	Datalink Out C1
My_PowerFlex_Drive:I.Data[9]	INT	Datalink Out C2
My_PowerFlex_Drive:I.Data[10]	INT	Datalink Out D1
My_PowerFlex_Drive:I.Data[11]	INT	Datalink Out D2

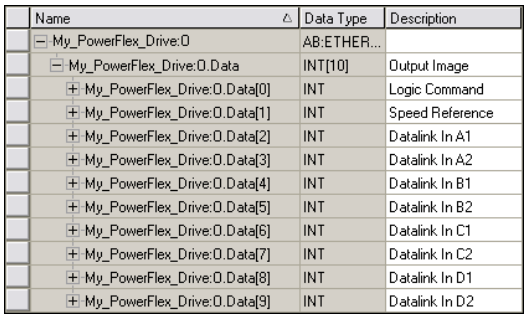
PowerFlex 70 Drive
16-bit Speed Feedback and Datalinks



Name	Data Type	Description
My_PowerFlex_Drive:I	AB:ETHER...	
My_PowerFlex_Drive:I.Data	INT[22]	Input Image
My_PowerFlex_Drive:I.Data[0]	INT	Pad Word
My_PowerFlex_Drive:I.Data[1]	INT	Pad Word
My_PowerFlex_Drive:I.Data[2]	INT	Logic Status
My_PowerFlex_Drive:I.Data[3]	INT	Not Used
My_PowerFlex_Drive:I.Data[4]	INT	FeedBack (LSW)
My_PowerFlex_Drive:I.Data[5]	INT	Feedback (MSW)
My_PowerFlex_Drive:I.Data[6]	INT	Datalink Out A1 (LSW)
My_PowerFlex_Drive:I.Data[7]	INT	Datalink Out A1 (MSW)
My_PowerFlex_Drive:I.Data[8]	INT	Datalink Out A2 (LSW)
My_PowerFlex_Drive:I.Data[9]	INT	Datalink Out A2 (MSW)
My_PowerFlex_Drive:I.Data[10]	INT	Datalink Out B1 (LSW)
My_PowerFlex_Drive:I.Data[11]	INT	Datalink Out B1 (MSW)
My_PowerFlex_Drive:I.Data[12]	INT	Datalink Out B2 (LSW)
My_PowerFlex_Drive:I.Data[13]	INT	Datalink Out B2 (MSW)
My_PowerFlex_Drive:I.Data[14]	INT	Datalink Out C1 (LSW)
My_PowerFlex_Drive:I.Data[15]	INT	Datalink Out C1 (MSW)
My_PowerFlex_Drive:I.Data[16]	INT	Datalink Out C2 (LSW)
My_PowerFlex_Drive:I.Data[17]	INT	Datalink Out C2 (MSW)
My_PowerFlex_Drive:I.Data[18]	INT	Datalink Out D1 (LSW)
My_PowerFlex_Drive:I.Data[19]	INT	Datalink Out D1 (MSW)
My_PowerFlex_Drive:I.Data[20]	INT	Datalink Out D2 (LSW)
My_PowerFlex_Drive:I.Data[21]	INT	Datalink Out D2 (MSW)

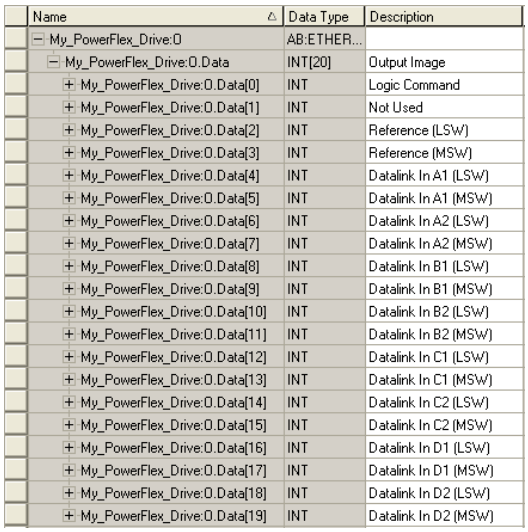
PowerFlex 750-Series Drive
32-bit Speed Feedback and Datalinks

Figure 5.6 ControlLogix Output Image for Drive Generic Profile Example Ladder Logic Program



Name	Data Type	Description
My_PowerFlex_Drive:O	AB:ETHER...	
My_PowerFlex_Drive:O.Data	INT[10]	Output Image
My_PowerFlex_Drive:O.Data[0]	INT	Logic Command
My_PowerFlex_Drive:O.Data[1]	INT	Speed Reference
My_PowerFlex_Drive:O.Data[2]	INT	Datalink In A1
My_PowerFlex_Drive:O.Data[3]	INT	Datalink In A2
My_PowerFlex_Drive:O.Data[4]	INT	Datalink In B1
My_PowerFlex_Drive:O.Data[5]	INT	Datalink In B2
My_PowerFlex_Drive:O.Data[6]	INT	Datalink In C1
My_PowerFlex_Drive:O.Data[7]	INT	Datalink In C2
My_PowerFlex_Drive:O.Data[8]	INT	Datalink In D1
My_PowerFlex_Drive:O.Data[9]	INT	Datalink In D2

PowerFlex 70 Drive
16-bit Speed Reference and Datalinks



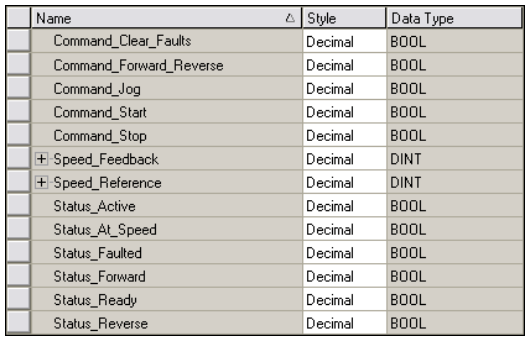
Name	Data Type	Description
My_PowerFlex_Drive:O	AB:ETHER...	
My_PowerFlex_Drive:O.Data	INT[20]	Output Image
My_PowerFlex_Drive:O.Data[0]	INT	Logic Command
My_PowerFlex_Drive:O.Data[1]	INT	Not Used
My_PowerFlex_Drive:O.Data[2]	INT	Reference (LSW)
My_PowerFlex_Drive:O.Data[3]	INT	Reference (MSW)
My_PowerFlex_Drive:O.Data[4]	INT	Datalink In A1 (LSW)
My_PowerFlex_Drive:O.Data[5]	INT	Datalink In A1 (MSW)
My_PowerFlex_Drive:O.Data[6]	INT	Datalink In A2 (LSW)
My_PowerFlex_Drive:O.Data[7]	INT	Datalink In A2 (MSW)
My_PowerFlex_Drive:O.Data[8]	INT	Datalink In B1 (LSW)
My_PowerFlex_Drive:O.Data[9]	INT	Datalink In B1 (MSW)
My_PowerFlex_Drive:O.Data[10]	INT	Datalink In B2 (LSW)
My_PowerFlex_Drive:O.Data[11]	INT	Datalink In B2 (MSW)
My_PowerFlex_Drive:O.Data[12]	INT	Datalink In C1 (LSW)
My_PowerFlex_Drive:O.Data[13]	INT	Datalink In C1 (MSW)
My_PowerFlex_Drive:O.Data[14]	INT	Datalink In C2 (LSW)
My_PowerFlex_Drive:O.Data[15]	INT	Datalink In C2 (MSW)
My_PowerFlex_Drive:O.Data[16]	INT	Datalink In D1 (LSW)
My_PowerFlex_Drive:O.Data[17]	INT	Datalink In D1 (MSW)
My_PowerFlex_Drive:O.Data[18]	INT	Datalink In D2 (LSW)
My_PowerFlex_Drive:O.Data[19]	INT	Datalink In D2 (MSW)

PowerFlex 750-Series Drive
32-bit Speed Reference and Datalinks

Program Tags

To use the Controller tags that are automatically created, you need to create the following Program tags for this example program.

Figure 5.7 ControlLogix Program Tags for Drive Generic Profile Example Ladder Logic Program



Name	Style	Data Type
Command_Clear_Faults	Decimal	BOOL
Command_Forward_Reverse	Decimal	BOOL
Command_Jog	Decimal	BOOL
Command_Start	Decimal	BOOL
Command_Stop	Decimal	BOOL
Speed_Feedback	Decimal	DINT
Speed_Reference	Decimal	DINT
Status_Active	Decimal	BOOL
Status_At_Speed	Decimal	BOOL
Status_Faulted	Decimal	BOOL
Status_Forward	Decimal	BOOL
Status_Ready	Decimal	BOOL
Status_Reverse	Decimal	BOOL

For information on speed Reference and Feedback scaling, see PowerFlex 7-Class Drives (except PowerFlex 750-Series) on page 5-6 or PowerFlex 750-Series Drives on page 5-7.

Figure 5.8 ControlLogix Example Ladder Logic Program Using a Drive Generic Profile for Logic Status/Feedback

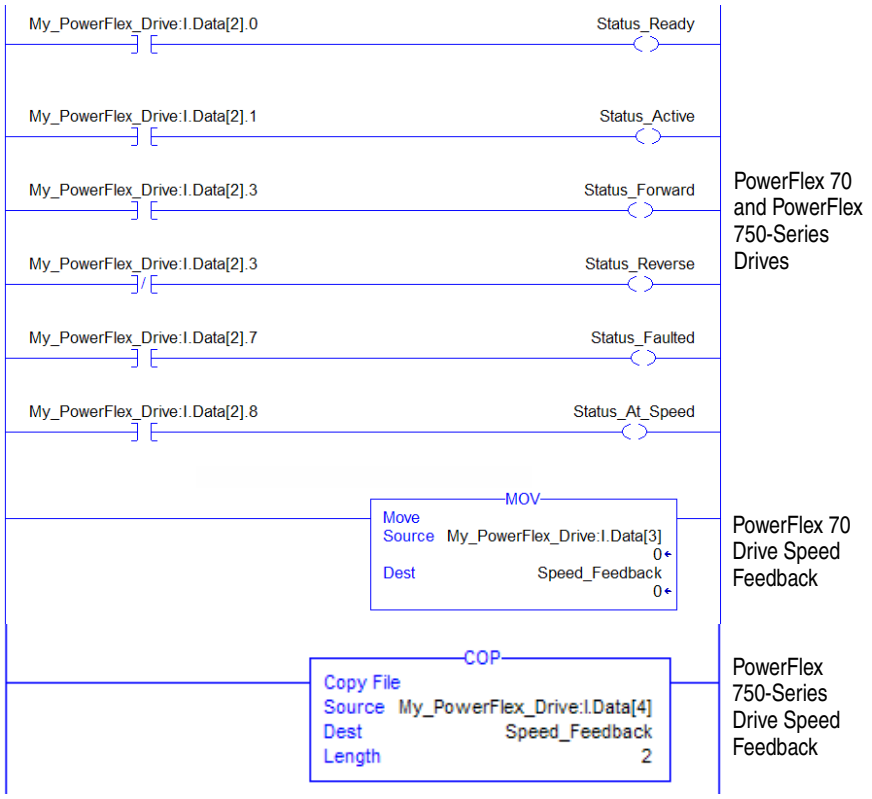
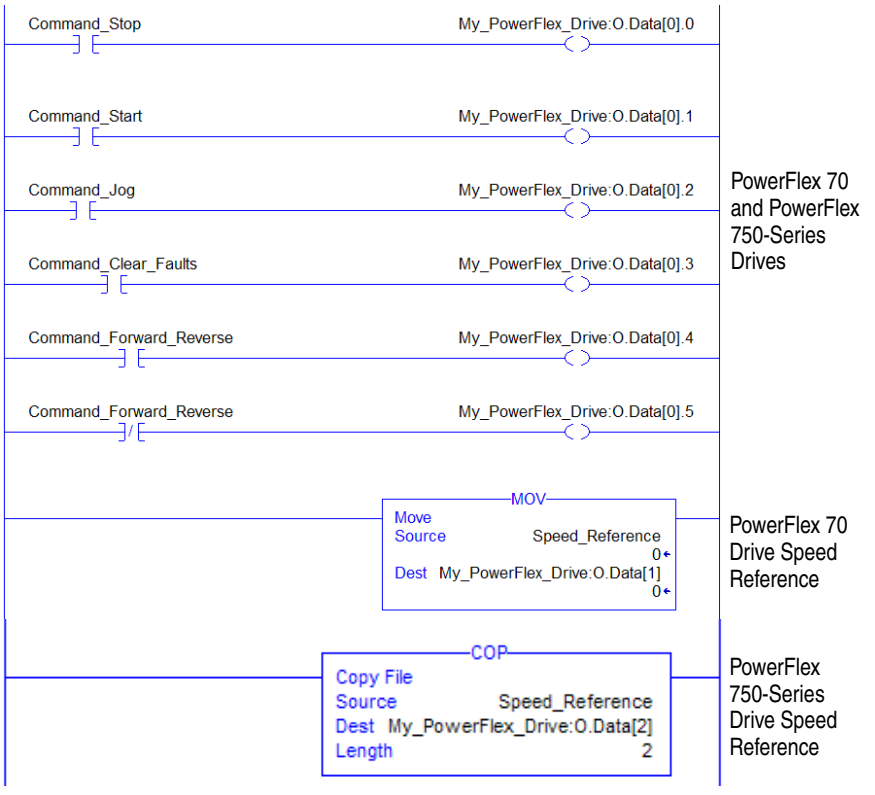


Figure 5.9 ControlLogix Example Ladder Logic Program Using a Drive Generic Profile for Logic Command/Reference



Example Datalink Data

The Datalink data used in the example program is shown in Figure 5.10. Note that to describe the parameters to which the Datalinks are assigned, you may want to add descriptions to the automatically-created generic controller tags or create a User Defined Data Types (UDDT).

Figure 5.10 ControlLogix Example Datalinks for Ladder Logic Program Using a Drive Generic Profile

Name	Value	Data Type	Description
My_PowerFlex_Drive:I	{...}	AB:ETHER...	
My_PowerFlex_Drive:I.Data	{...}	INT[12]	Input Image
My_PowerFlex_Drive:I.Data[0]	0	INT	Pad Word
My_PowerFlex_Drive:I.Data[1]	0	INT	Pad Word
My_PowerFlex_Drive:I.Data[2]	0	INT	Logic Status
My_PowerFlex_Drive:I.Data[3]	0	INT	Speed Feedback
My_PowerFlex_Drive:I.Data[4]	50	INT	Datalink Out A1
My_PowerFlex_Drive:I.Data[5]	50	INT	Datalink Out A2
My_PowerFlex_Drive:I.Data[6]	100	INT	Datalink Out B1
My_PowerFlex_Drive:I.Data[7]	1	INT	Datalink Out B2
My_PowerFlex_Drive:I.Data[8]	200	INT	Datalink Out C1
My_PowerFlex_Drive:I.Data[9]	300	INT	Datalink Out C2
My_PowerFlex_Drive:I.Data[10]	400	INT	Datalink Out D1
My_PowerFlex_Drive:I.Data[11]	500	INT	Datalink Out D2
My_PowerFlex_Drive:O	{...}	AB:ETHER...	
My_PowerFlex_Drive:O.Data	{...}	INT[10]	Output Image
My_PowerFlex_Drive:O.Data[0]	0	INT	Logic Command
My_PowerFlex_Drive:O.Data[1]	0	INT	Speed Reference
My_PowerFlex_Drive:O.Data[2]	50	INT	Datalink In A1
My_PowerFlex_Drive:O.Data[3]	50	INT	Datalink In A2
My_PowerFlex_Drive:O.Data[4]	100	INT	Datalink In B1
My_PowerFlex_Drive:O.Data[5]	1	INT	Datalink In B2
My_PowerFlex_Drive:O.Data[6]	200	INT	Datalink In C1
My_PowerFlex_Drive:O.Data[7]	300	INT	Datalink In C2
My_PowerFlex_Drive:O.Data[8]	400	INT	Datalink In D1
My_PowerFlex_Drive:O.Data[9]	500	INT	Datalink In D2

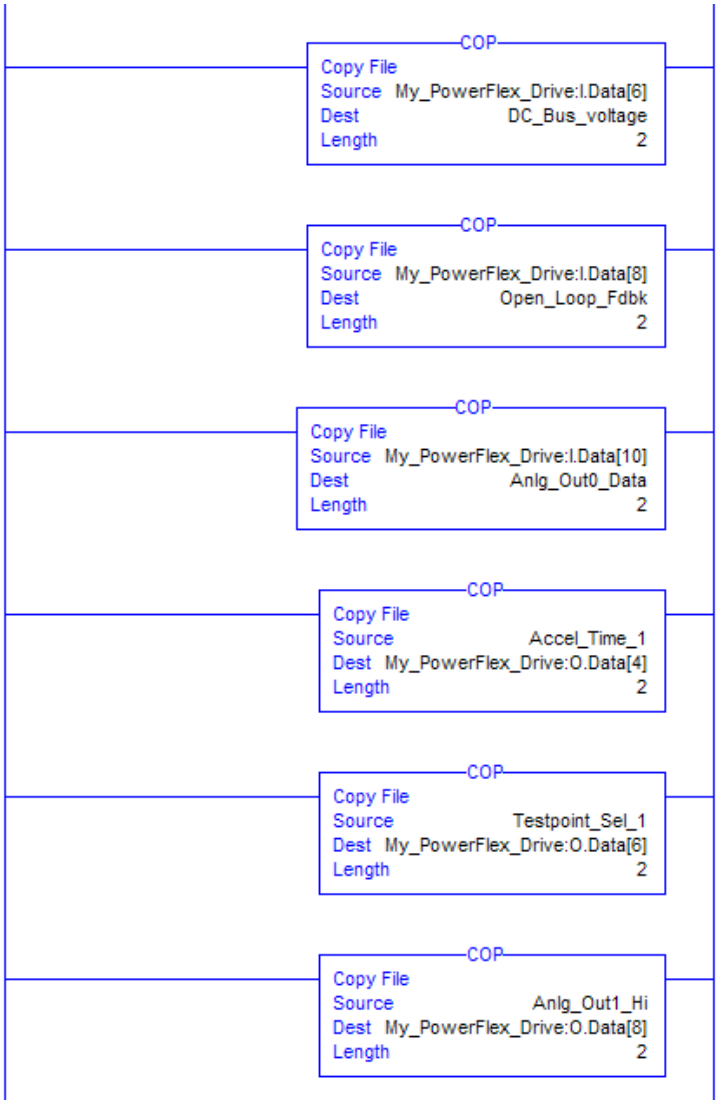
PowerFlex 70 Drive

Name	Value	Data Type	Description
My_PowerFlex_Drive:I	{...}	AB:ETHER...	
My_PowerFlex_Drive:I.Data	{...}	INT[22]	Input Image
My_PowerFlex_Drive:I.Data[0]	0	INT	Pad Word
My_PowerFlex_Drive:I.Data[1]	0	INT	Pad Word
My_PowerFlex_Drive:I.Data[2]	1295	INT	Logic Status
My_PowerFlex_Drive:I.Data[3]	0	INT	Not Used
My_PowerFlex_Drive:I.Data[4]	25000	INT	Feedback (LSW)
My_PowerFlex_Drive:I.Data[5]	0	INT	Feedback (MSW)
My_PowerFlex_Drive:I.Data[6]	-26970	INT	Datalink Out A1 (LSW)
My_PowerFlex_Drive:I.Data[7]	17432	INT	Datalink Out A1 (MSW)
My_PowerFlex_Drive:I.Data[8]	15562	INT	Datalink Out A2 (LSW)
My_PowerFlex_Drive:I.Data[9]	5457	INT	Datalink Out A2 (MSW)
My_PowerFlex_Drive:I.Data[10]	0	INT	Datalink Out B1 (LSW)
My_PowerFlex_Drive:I.Data[11]	16840	INT	Datalink Out B1 (MSW)
My_PowerFlex_Drive:I.Data[12]	0	INT	Datalink Out B2 (LSW)
My_PowerFlex_Drive:I.Data[13]	0	INT	Datalink Out B2 (MSW)
My_PowerFlex_Drive:I.Data[14]	0	INT	Datalink Out C1 (LSW)
My_PowerFlex_Drive:I.Data[15]	0	INT	Datalink Out C1 (MSW)
My_PowerFlex_Drive:I.Data[16]	0	INT	Datalink Out C2 (LSW)
My_PowerFlex_Drive:I.Data[17]	0	INT	Datalink Out C2 (MSW)
My_PowerFlex_Drive:I.Data[18]	0	INT	Datalink Out D1 (LSW)
My_PowerFlex_Drive:I.Data[19]	0	INT	Datalink Out D1 (MSW)
My_PowerFlex_Drive:I.Data[20]	0	INT	Datalink Out D2 (LSW)
My_PowerFlex_Drive:I.Data[21]	0	INT	Datalink Out D2 (MSW)
My_PowerFlex_Drive:O	{...}	AB:ETHER...	
My_PowerFlex_Drive:O.Data	{...}	INT[20]	Output Image
My_PowerFlex_Drive:O.Data[0]	0	INT	Logic Command
My_PowerFlex_Drive:O.Data[1]	0	INT	Not Used
My_PowerFlex_Drive:O.Data[2]	25000	INT	Reference (LSW)
My_PowerFlex_Drive:O.Data[3]	0	INT	Reference (MSW)
My_PowerFlex_Drive:O.Data[4]	0	INT	Datalink In A1 (LSW)
My_PowerFlex_Drive:O.Data[5]	16680	INT	Datalink In A1 (MSW)
My_PowerFlex_Drive:O.Data[6]	4430	INT	Datalink In A2 (LSW)
My_PowerFlex_Drive:O.Data[7]	1909	INT	Datalink In A2 (MSW)
My_PowerFlex_Drive:O.Data[8]	-2621	INT	Datalink In B1 (LSW)
My_PowerFlex_Drive:O.Data[9]	16664	INT	Datalink In B1 (MSW)
My_PowerFlex_Drive:O.Data[10]	0	INT	Datalink In B2 (LSW)
My_PowerFlex_Drive:O.Data[11]	0	INT	Datalink In B2 (MSW)

PowerFlex 750-Series Drive

For PowerFlex 7-Class drives, the scaling may need to be multiplied by 10 or 100, depending on the parameter. For more information, see Datalink Scaling on page 5-7.

Figure 5.11 ControlLogix Example Ladder Logic Program Using a Drive Generic Profile for PowerFlex 750-Series Drives Datalink Scaling



For PowerFlex 750-Series drives, the destination tag can be a REAL or DINT. Make the destination tag the same data type as the parameter being read. For information on Datalink scaling, see page 5-8.

PLC-5, SLC 500 or MicroLogix 1100/1400 Example

Drive and Adapter Parameter Settings

The following drive and adapter settings were used for the example ladder logic program in this section.

Device	Parameter	Value	Description
PowerFlex 70 EC Drive	90 - [Speed Ref A Sel]	22 (DPI Port 5)	Assigns 20-COMM-E to be used for the Reference.
	300 - [Data In A1]	140	Points to Par. 140 - [Accel Time 1]
	301 - [Data In A2]	142	Points to Par. 142 - [Decel Time 1]
	302 - [Data In B1]	100	Points to Par. 100 - [Jog Speed]
	303 - [Data In B2]	155	Points to Par. 155 - [Stop Mode A]
	304 - [Data In C1]	101	Points to Par. 101 - [Preset Speed 1]
	305 - [Data In C2]	102	Points to Par. 102 - [Preset Speed 2]
	306 - [Data In D1]	103	Points to Par. 103 - [Preset Speed 3]
	307 - [Data In D2]	104	Points to Par. 104 - [Preset Speed 4]
	310 - [Data Out A1]	140	Points to Par. 140 - [Accel Time 1]
	311 - [Data Out A2]	142	Points to Par. 142 - [Decel Time 1]
	312 - [Data Out B1]	100	Points to Par. 100 - [Jog Speed]
	313 - [Data Out B2]	155	Points to Par. 155 - [Stop Mode A]
	314 - [Data Out C1]	101	Points to Par. 101 - [Preset Speed 1]
	315 - [Data Out C2]	102	Points to Par. 102 - [Preset Speed 2]
	316 - [Data Out D1]	103	Points to Par. 103 - [Preset Speed 3]
	317 - [Data Out D2]	104	Points to Par. 104 - [Preset Speed 4]
PowerFlex 750-Series Drive (1)	545 - [Spd Ref A Sel]	Port 0: Port 6 Reference	Assigns 20-COMM-E to be used for the Reference.
	895 - [Data In A1]	Port 0: Accel Time 1	Points to Par. 535 in the drive.
	896 - [Data In A2]	Port 0: Testpoint Sel 1	Points to Par. 970 in the drive.
	897 - [Data In B1]	Port 5: Anlg Out1 Hi	Points to Par. 90 in Port 5 (I/O module).
	905 - [Data Out A1]	Port 0: DC Bus Volts	Points to Par. 11 in the drive.
	906 - [Data Out A2]	Port 0: Open Loop Fdbk	Points to Par. 137 in the drive.
	907 - [Data Out B1]	Port 5: Anlg Out0 Data	Points to Par. 77 in Port 5 (I/O module).
20-COMM-E Adapter	04 - [IP Addr Cfg 1] ⋮ 07 - [IP Addr Cfg 4]	10.91.100.79	IP address for the adapter.
	08 - [Subnet Cfg 1] ⋮ 11 - [Subnet Cfg 4]	255.255.248.0	Subnet mask for the adapter.
	23 - [DPI I/O Cfg]	xxx1 1111	Enables Cmd/Ref and Datalinks A…D.
	35 - [M-S Input]	xxx1 1111	Configures the I/O Data to be transferred from the controller on the network to the drive.
	36 - [M-S Output]	xxx1 1111	Configures the I/O Data to be transferred from the drive to the controller on the network.

(1) In this example, the 20-COMM-E adapter/20-750-20COMM Option Card is installed in Port 6, and a 24V I/O module is installed in Port 5. Also, Data In B2…D2 (Parameters 898…902) and Data Out B2…D2 (Parameters 908…912) are enabled, but not used.

TIP: Data In parameters are inputs into the drive that come from controller outputs (for example, data to write to a drive parameter). Data Out parameters are outputs from the drive that go to controller inputs (for example, data to read a drive parameter).

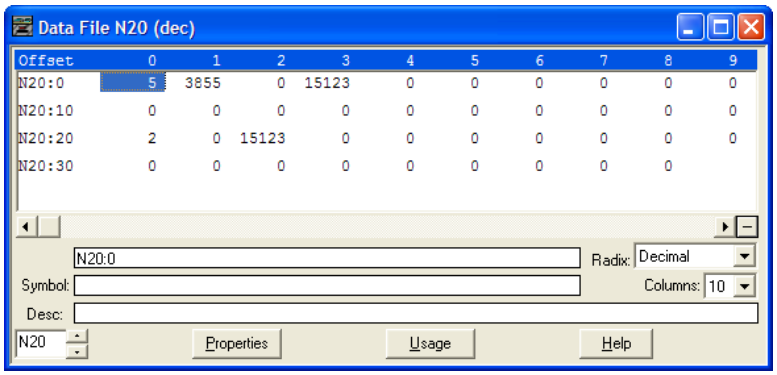
TIP: When using a drive that has 16-bit Datalinks (PowerFlex 70, PowerFlex 700, and PowerFlex 700H) to transfer a 32-bit parameter, two contiguous drive Datalink parameters (for example, Data Out A1/A2, B1/B2, etc.) are required. To determine if a parameter is a 32-bit parameter, see the Parameter section in the drive documentation and look for a 32 symbol in the "No." column. (All parameters in PowerFlex 700 Series B drives are 32-bit parameters.) For example, parameter 3 - [Output Current] in a PowerFlex 70 EC drive is a 32-bit parameter. When using a drive that has 32-bit Datalinks (PowerFlex 700 VC and PowerFlex 700S), only one drive Datalink parameter is required to transfer any parameter.

Understanding Controller Data Table Addresses

Since PLC-5, SLC 500, and MicroLogix 1100/1400 controllers are 16-bit platforms and are used with the 32-bit 20-COMM-E adapter, the data will be transposed from the least-significant word (LSW) to the most-significant word (MSW) in the controller.

When the I/O was configured (Chapter 4), an available data table address (N20:0) was used. Figure 5.12 shows the entire data file address structure for this example.

Figure 5.12 Data File Table for Example Ladder Logic Program



Important: The N20:0 data table address in this example is used to set a control timeout value (in seconds) which determines how long it will take the adapter to detect a communication loss. Enter a valid value (1…32767) for N20:0. A value of zero (0) is not valid, since it disables the timeout and all I/O connections (Logic Command/Status, Reference/Feedback, and Datalinks) intended for the drive will not execute. A timeout value of 5…20 seconds is recommended.

Depending on the drive you are using, Table 5.G, Table 5.H, Table 5.I, or Table 5.J show the I/O definitions as they relate to the N20:0 data table address (Figure 5.12) being used in this example.

When using PowerFlex 70 SC or 70 EC, PowerFlex 700 SC, PowerFlex 700H drives or SMC Flex, which all contain INT (16-bit format) data types, you will read from and write to the MSW data table address in the controller.

When using PowerFlex 700 VC drives, which contain DINT (32-bit format) data types, you will read from and write to the LSW data table address in the controller.

When using PowerFlex 700S and PowerFlex 750-Series drives, which contain both DINT (32-bit format) and REAL (floating point format) data types, you will always read from and write to the LSW data table address in the controller first. Then if the data value exceeds 16 bits, the remaining value will be in the MSW data table address.

Table 5.G Controller Data Table Addresses for PowerFlex 70 SC/EC, PowerFlex 700 SC, and PowerFlex 700H Drives, and SMC Flex

Data Table Address	Description
N20:1	Logic Status (see Appendix D)
N20:2	Reserved
N20:3	Speed Feedback
N20:4	Value of parameter assigned to Parameter 310 [Data Out A1] LSW
N20:5	Value of parameter assigned to Parameter 310 [Data Out A1] MSW
N20:6	Value of parameter assigned to Parameter 311 [Data Out A2] LSW
N20:7	Value of parameter assigned to Parameter 311 [Data Out A2] MSW
N20:8	Value of parameter assigned to Parameter 312 [Data Out B1] LSW
N20:9	Value of parameter assigned to Parameter 312 [Data Out B1] MSW
N20:10	Value of parameter assigned to Parameter 313 [Data Out B2] LSW
N20:11	Value of parameter assigned to Parameter 313 [Data Out B2] MSW
N20:12	Value of parameter assigned to Parameter 314 [Data Out C1] LSW
N20:13	Value of parameter assigned to Parameter 314 [Data Out C1] MSW
N20:14	Value of parameter assigned to Parameter 315 [Data Out C2] LSW
N20:15	Value of parameter assigned to Parameter 315 [Data Out C2] MSW
N20:16	Value of parameter assigned to Parameter 316 [Data Out D1] LSW
N20:17	Value of parameter assigned to Parameter 316 [Data Out D1] MSW
N20:18	Value of parameter assigned to Parameter 317 [Data Out D2] LSW
N20:19	Value of parameter assigned to Parameter 317 [Data Out D2] MSW
N20:20	Logic Command (see Appendix D)
N20:21	Reserved
N20:22	Speed Reference
N20:23	Value of parameter assigned to Parameter 300 [Data In A1] LSW
N20:24	Value of parameter assigned to Parameter 300 [Data In A1] MSW
N20:25	Value of parameter assigned to Parameter 301 [Data In A2] LSW
N20:26	Value of parameter assigned to Parameter 301 [Data In A2] MSW
N20:27	Value of parameter assigned to Parameter 302 [Data In B1] LSW
N20:28	Value of parameter assigned to Parameter 302 [Data In B1] MSW
N20:29	Value of parameter assigned to Parameter 303 [Data In B2] LSW
N20:30	Value of parameter assigned to Parameter 303 [Data In B2] MSW
N20:31	Value of parameter assigned to Parameter 304 [Data In C1] LSW
N20:32	Value of parameter assigned to Parameter 304 [Data In C1] MSW
N20:33	Value of parameter assigned to Parameter 305 [Data In C2] LSW
N20:34	Value of parameter assigned to Parameter 305 [Data In C2] MSW
N20:35	Value of parameter assigned to Parameter 306 [Data In D1] LSW
N20:36	Value of parameter assigned to Parameter 306 [Data In D1] MSW
N20:37	Value of parameter assigned to Parameter 307 [Data In D2] LSW
N20:38	Value of parameter assigned to Parameter 307 [Data In D2] MSW

Table 5.H Controller Data Table Addresses for PowerFlex 700 VC Drives

Data Table Address	Description
N20:1	Logic Status (see Appendix D)
N20:2	Reserved
N20:3	Speed Feedback
N20:4	Value of parameter assigned to Parameter 310 [Data Out A1] LSW
N20:5	Value of parameter assigned to Parameter 310 [Data Out A1] MSW
N20:6	Value of parameter assigned to Parameter 311 [Data Out A2] LSW
N20:7	Value of parameter assigned to Parameter 311 [Data Out A2] MSW
N20:8	Value of parameter assigned to Parameter 312 [Data Out B1] LSW
N20:9	Value of parameter assigned to Parameter 312 [Data Out B1] MSW
N20:10	Value of parameter assigned to Parameter 313 [Data Out B2] LSW
N20:11	Value of parameter assigned to Parameter 313 [Data Out B2] MSW
N20:12	Value of parameter assigned to Parameter 314 [Data Out C1] LSW
N20:13	Value of parameter assigned to Parameter 314 [Data Out C1] MSW
N20:14	Value of parameter assigned to Parameter 315 [Data Out C2] LSW
N20:15	Value of parameter assigned to Parameter 315 [Data Out C2] MSW
N20:16	Value of parameter assigned to Parameter 316 [Data Out D1] LSW
N20:17	Value of parameter assigned to Parameter 316 [Data Out D1] MSW
N20:18	Value of parameter assigned to Parameter 317 [Data Out D2] LSW
N20:19	Value of parameter assigned to Parameter 317 [Data Out D2] MSW
N20:20	Logic Command (see Appendix D)
N20:21	Reserved
N20:22	Speed Reference
N20:23	Value of parameter assigned to Parameter 300 [Data In A1] LSW
N20:24	Value of parameter assigned to Parameter 300 [Data In A1] MSW
N20:25	Value of parameter assigned to Parameter 301 [Data In A2] LSW
N20:26	Value of parameter assigned to Parameter 301 [Data In A2] MSW
N20:27	Value of parameter assigned to Parameter 302 [Data In B1] LSW
N20:28	Value of parameter assigned to Parameter 302 [Data In B1] MSW
N20:29	Value of parameter assigned to Parameter 303 [Data In B2] LSW
N20:30	Value of parameter assigned to Parameter 303 [Data In B2] MSW
N20:31	Value of parameter assigned to Parameter 304 [Data In C1] LSW
N20:32	Value of parameter assigned to Parameter 304 [Data In C1] MSW
N20:33	Value of parameter assigned to Parameter 305 [Data In C2] LSW
N20:34	Value of parameter assigned to Parameter 305 [Data In C2] MSW
N20:35	Value of parameter assigned to Parameter 306 [Data In D1] LSW
N20:36	Value of parameter assigned to Parameter 306 [Data In D1] MSW
N20:37	Value of parameter assigned to Parameter 307 [Data In D2] LSW
N20:38	Value of parameter assigned to Parameter 307 [Data In D2] MSW

Table 5.I Controller Data Table Addresses for PowerFlex 700S Drives with Phase I Control

Data Table Address	Description
N20:1	Logic Status (see Appendix D)
N20:2	Speed Feedback LSW
N20:3	Speed Feedback MSW
N20:4	Value of parameter assigned to Parameter 724/725 [Data Out A1] LSW
N20:5	Value of parameter assigned to Parameter 724/725 [Data Out A1] MSW
N20:6	Value of parameter assigned to Parameter 726/727 [Data Out A2] LSW
N20:7	Value of parameter assigned to Parameter 726/727 [Data Out A2] MSW
N20:8	Value of parameter assigned to Parameter 728/729 [Data Out B1] LSW
N20:9	Value of parameter assigned to Parameter 728/729 [Data Out B1] MSW
N20:10	Value of parameter assigned to Parameter 730/731 [Data Out B2] LSW
N20:11	Value of parameter assigned to Parameter 730/731 [Data Out B2] MSW
N20:12	Value of parameter assigned to Parameter 732/733 [Data Out C1] LSW
N20:13	Value of parameter assigned to Parameter 732/733 [Data Out C1] MSW
N20:14	Value of parameter assigned to Parameter 734/735 [Data Out C2] LSW
N20:15	Value of parameter assigned to Parameter 734/735 [Data Out C2] MSW
N20:16	Value of parameter assigned to Parameter 736/737 [Data Out D1] LSW
N20:17	Value of parameter assigned to Parameter 736/737 [Data Out D1] MSW
N20:18	Value of parameter assigned to Parameter 738/739 [Data Out D2] LSW
N20:19	Value of parameter assigned to Parameter 738/739 [Data Out D2] MSW
N20:20	Logic Command (see Appendix D)
N20:21	Speed Reference LSW
N20:22	Speed Reference MSW
N20:23	Value of parameter assigned to Parameter 707/708 [Data In A1] LSW
N20:24	Value of parameter assigned to Parameter 707/708 [Data In A1] MSW
N20:25	Value of parameter assigned to Parameter 709/710 [Data In A2] LSW
N20:26	Value of parameter assigned to Parameter 709/710 [Data In A2] MSW
N20:27	Value of parameter assigned to Parameter 711/712 [Data In B1] LSW
N20:28	Value of parameter assigned to Parameter 711/712 [Data In B1] MSW
N20:29	Value of parameter assigned to Parameter 713/714 [Data In B2] LSW
N20:30	Value of parameter assigned to Parameter 713/714 [Data In B2] MSW
N20:31	Value of parameter assigned to Parameter 715/716 [Data In C1] LSW
N20:32	Value of parameter assigned to Parameter 715/716 [Data In C1] MSW
N20:33	Value of parameter assigned to Parameter 717/718 [Data In C2] LSW
N20:34	Value of parameter assigned to Parameter 717/718 [Data In C2] MSW
N20:35	Value of parameter assigned to Parameter 719/720 [Data In D1] LSW
N20:36	Value of parameter assigned to Parameter 719/720 [Data In D1] MSW
N20:37	Value of parameter assigned to Parameter 721/722 [Data In D2] LSW
N20:38	Value of parameter assigned to Parameter 721/722 [Data In D2] MSW

Table 5.J Controller Data Table Addresses for PowerFlex 700S Drives with Phase II Control

Data Table Address	Description
N20:1	Logic Status (see Appendix D)
N20:2	Speed Feedback LSW
N20:3	Speed Feedback MSW
N20:4	Value of parameter assigned to Parameter 660 [DPI Data Out A1] LSW
N20:5	Value of parameter assigned to Parameter 660 [DPI Data Out A1] MSW
N20:6	Value of parameter assigned to Parameter 661 [DPI Data Out A2] LSW
N20:7	Value of parameter assigned to Parameter 661 [DPI Data Out A2] MSW
N20:8	Value of parameter assigned to Parameter 662 [DPI Data Out B1] LSW
N20:9	Value of parameter assigned to Parameter 662 [DPI Data Out B1] MSW
N20:10	Value of parameter assigned to Parameter 663 [DPI Data Out B2] LSW
N20:11	Value of parameter assigned to Parameter 663 [DPI Data Out B2] MSW
N20:12	Value of parameter assigned to Parameter 664 [DPI Data Out C1] LSW
N20:13	Value of parameter assigned to Parameter 664 [DPI Data Out C1] MSW
N20:14	Value of parameter assigned to Parameter 665 [DPI Data Out C2] LSW
N20:15	Value of parameter assigned to Parameter 665 [DPI Data Out C2] MSW
N20:16	Value of parameter assigned to Parameter 666 [DPI Data Out D1] LSW
N20:17	Value of parameter assigned to Parameter 666 [DPI Data Out D1] MSW
N20:18	Value of parameter assigned to Parameter 667 [DPI Data Out D2] LSW
N20:19	Value of parameter assigned to Parameter 667 [DPI Data Out D2] MSW
N20:20	Logic Command (see Appendix D)
N20:21	Speed Reference LSW
N20:22	Speed Reference MSW
N20:23	Value of parameter assigned to Parameter 651 [DPI Data In A1] LSW
N20:24	Value of parameter assigned to Parameter 651 [DPI Data In A1] MSW
N20:25	Value of parameter assigned to Parameter 652 [DPI Data In A2] LSW
N20:26	Value of parameter assigned to Parameter 652 [DPI Data In A2] MSW
N20:27	Value of parameter assigned to Parameter 653 [DPI Data In B1] LSW
N20:28	Value of parameter assigned to Parameter 653 [DPI Data In B1] MSW
N20:29	Value of parameter assigned to Parameter 654 [DPI Data In B2] LSW
N20:30	Value of parameter assigned to Parameter 654 [DPI Data In B2] MSW
N20:31	Value of parameter assigned to Parameter 655 [DPI Data In C1] LSW
N20:32	Value of parameter assigned to Parameter 655 [DPI Data In C1] MSW
N20:33	Value of parameter assigned to Parameter 656 [DPI Data In C2] LSW
N20:34	Value of parameter assigned to Parameter 656 [DPI Data In C2] MSW
N20:35	Value of parameter assigned to Parameter 657 [DPI Data In D1] LSW
N20:36	Value of parameter assigned to Parameter 657 [DPI Data In D1] MSW
N20:37	Value of parameter assigned to Parameter 658 [DPI Data In D2] LSW
N20:38	Value of parameter assigned to Parameter 658 [DPI Data In D2] MSW

Table 5.K Controller Data Table Addresses for PowerFlex 750-Series Drives

Data Table Address	Description
N20:1	Logic Status (see Appendix D)
N20:2	Speed Feedback LSW
N20:3	Speed Feedback MSW
N20:4	Value of parameter assigned to Parameter 905 [Data Out A1] LSW
N20:5	Value of parameter assigned to Parameter 905 [Data Out A1] MSW
N20:6	Value of parameter assigned to Parameter 906 [Data Out A2] LSW
N20:7	Value of parameter assigned to Parameter 906 [Data Out A2] MSW
N20:8	Value of parameter assigned to Parameter 907 [Data Out B1] LSW
N20:9	Value of parameter assigned to Parameter 907 [Data Out B1] MSW
N20:10	Value of parameter assigned to Parameter 908 [Data Out B2] LSW
N20:11	Value of parameter assigned to Parameter 908 [Data Out B2] MSW
N20:12	Value of parameter assigned to Parameter 909 [Data Out C1] LSW
N20:13	Value of parameter assigned to Parameter 909 [Data Out C1] MSW
N20:14	Value of parameter assigned to Parameter 910 [Data Out C2] LSW
N20:15	Value of parameter assigned to Parameter 910 [Data Out C2] MSW
N20:16	Value of parameter assigned to Parameter 911 [Data Out D1] LSW
N20:17	Value of parameter assigned to Parameter 911 [Data Out D1] MSW
N20:18	Value of parameter assigned to Parameter 912 [Data Out D2] LSW
N20:19	Value of parameter assigned to Parameter 912 [Data Out D2] MSW
N20:20	Logic Command (see Appendix D)
N20:21	Speed Reference LSW
N20:22	Speed Reference MSW
N20:23	Value of parameter assigned to Parameter 895 [Data In A1] LSW
N20:24	Value of parameter assigned to Parameter 895 [Data In A1] MSW
N20:25	Value of parameter assigned to Parameter 896 [Data In A2] LSW
N20:26	Value of parameter assigned to Parameter 896 [Data In A2] MSW
N20:27	Value of parameter assigned to Parameter 897 [Data In B1] LSW
N20:28	Value of parameter assigned to Parameter 897 [Data In B1] MSW
N20:29	Value of parameter assigned to Parameter 898 [Data In B2] LSW
N20:30	Value of parameter assigned to Parameter 898 [Data In B2] MSW
N20:31	Value of parameter assigned to Parameter 899 [Data In C1] LSW
N20:32	Value of parameter assigned to Parameter 899 [Data In C1] MSW
N20:33	Value of parameter assigned to Parameter 900 [Data In C2] LSW
N20:34	Value of parameter assigned to Parameter 900 [Data In C2] MSW
N20:35	Value of parameter assigned to Parameter 901 [Data In D1] LSW
N20:36	Value of parameter assigned to Parameter 901 [Data In D1] MSW
N20:37	Value of parameter assigned to Parameter 902 [Data In D2] LSW
N20:38	Value of parameter assigned to Parameter 902 [Data In D2] MSW

You can use the controller data table addresses to directly control and monitor the drive without creating any ladder logic program. However, if you intend to use Human Machine Interface devices (PanelView, etc.) to operate the drive and view its status, you will need to create descriptive controller data table addresses (Table 5.L and Table 5.M) and a ladder logic program that will pass that data to the data table addresses used for messaging.

Table 5.L Controller and Program Data Table Address Descriptions for Example Logic Status/Feedback Ladder Logic Program

Description	Controller Data Table Address
Drive Ready	N20:1/0
Drive Active	N20:1/1
Actual Direction (XIO)	N20:1/3
Actual Direction (XIC)	N20:1/3
Drive Faulted	N20:1/7
Drive At Speed	N20:1/8
Speed Feedback	N20:3

Description	Program Data Table Address
Status Ready	B3:1/0
Status Active	B3:1/1
Status Forward	B3:1/3
Status Reverse	B3:1/4
Status Faulted	B3:1/7
Status At Speed	B3:1/8
Speed Feedback	B30:3

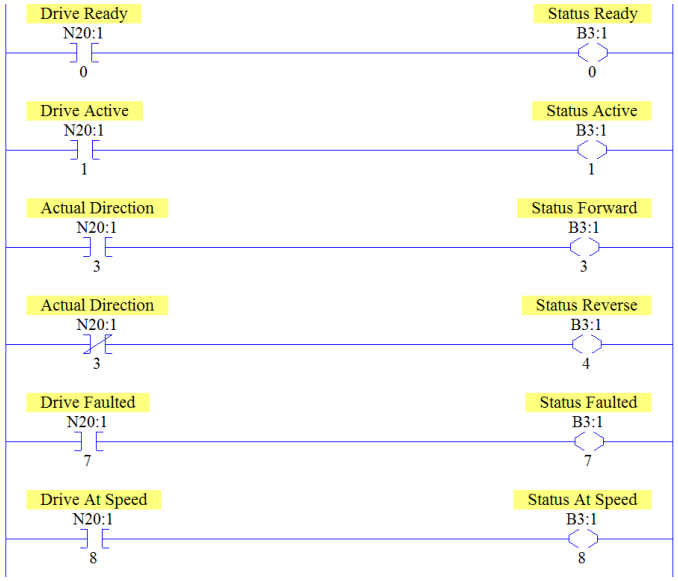
Table 5.M Program and Controller Data Table Address Descriptions for Example Logic Command/Reference Ladder Logic Program

Description	Program Data Table Address
Command Stop	B3:20/0
Command Start	B3:20/1
Command Jog	B3:20/2
Command Clear Faults	B3:20/3
Command Forward Reverse (XIO)	B3:20/4
Command Forward Reverse (XIC)	B3:20/4
Speed Reference	N30:22

Description	Controller Data Table Address
Drive Stop	N20:20/0
Drive Start	N20:20/1
Drive Jog	N20:20/2
Drive Clear Faults	N20:20/3
Drive Forward	N20:20/4
Drive Reverse	N20:20/5
Speed Reference	N20:22

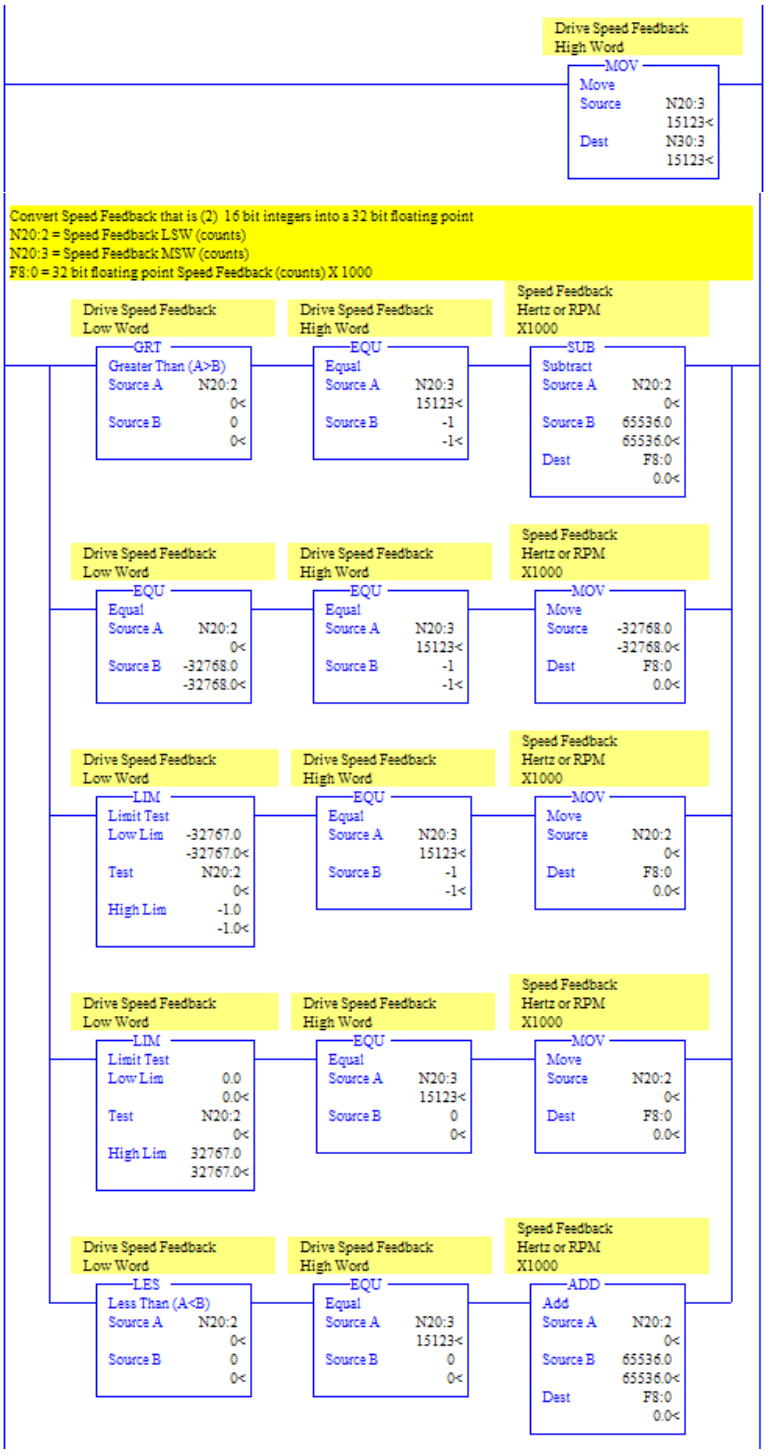
An example ladder logic program that uses these descriptive controller data table addresses and passes their data to the descriptive program data table addresses is shown in Figure 5.13, Figure 5.14, Figure 5.15, and Figure 5.16.

Figure 5.13 PLC-5, SLC 500 or MicroLogix 1100/1400 Example Ladder Logic Program for Logic Status



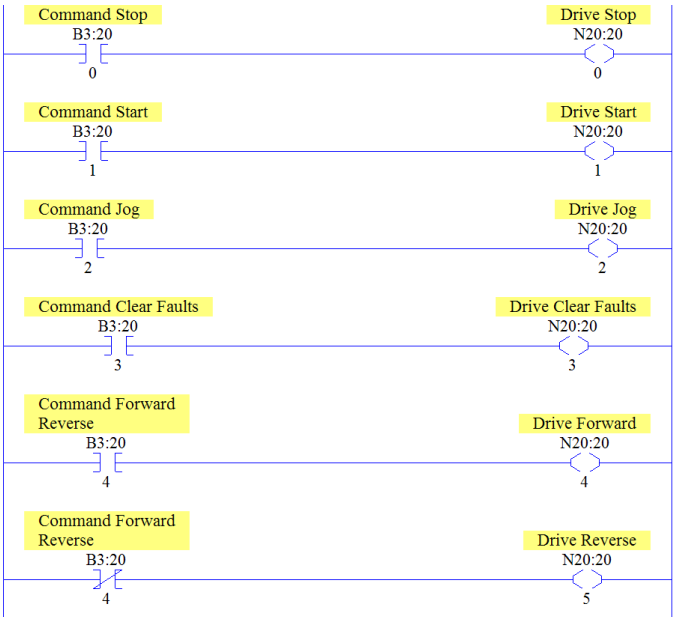
PowerFlex 70 and PowerFlex 750-Series Drives

Figure 5.14 PLC-5, SLC 500 or MicroLogix 1100/1400 Example Ladder Logic Program for Speed Feedback



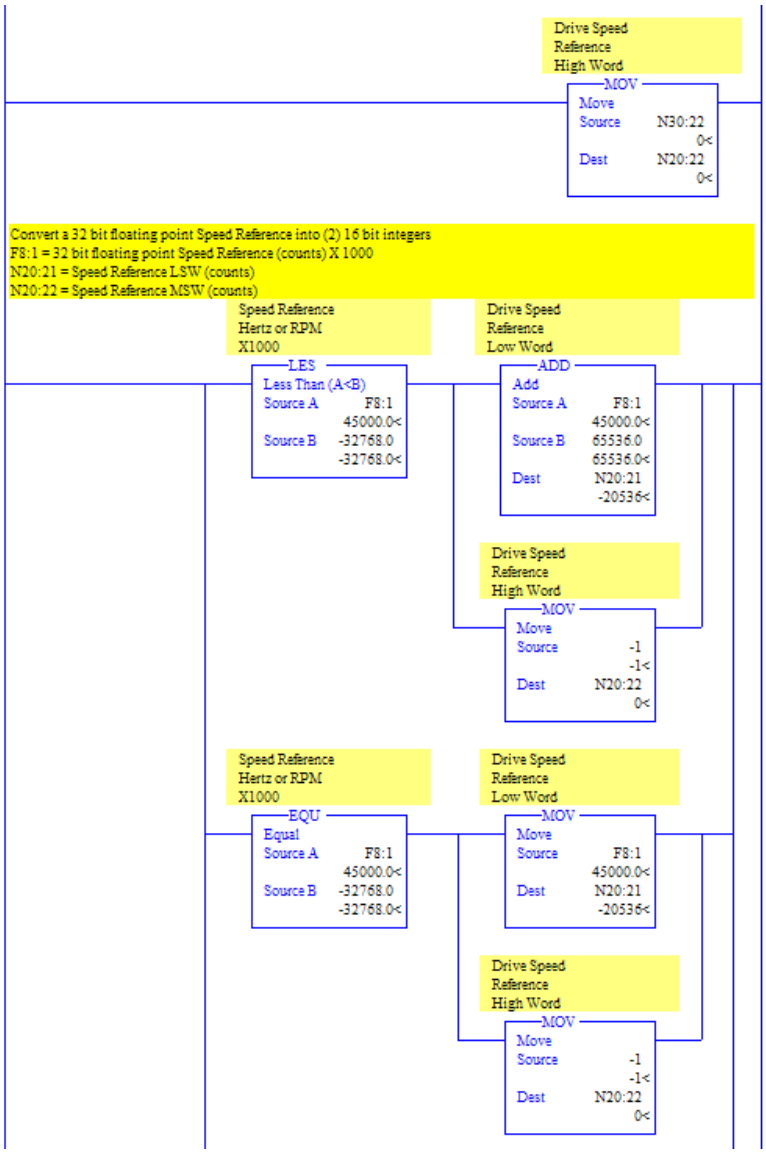
For information on speed Reference and Feedback scaling, see PowerFlex 7-Class Drives (except PowerFlex 750-Series) on page 5-6 or PowerFlex 750-Series Drives on page 5-7.

Figure 5.15 PLC-5, SLC 500 or MicroLogix 1100/1400 Example Ladder Logic Program for Logic Command

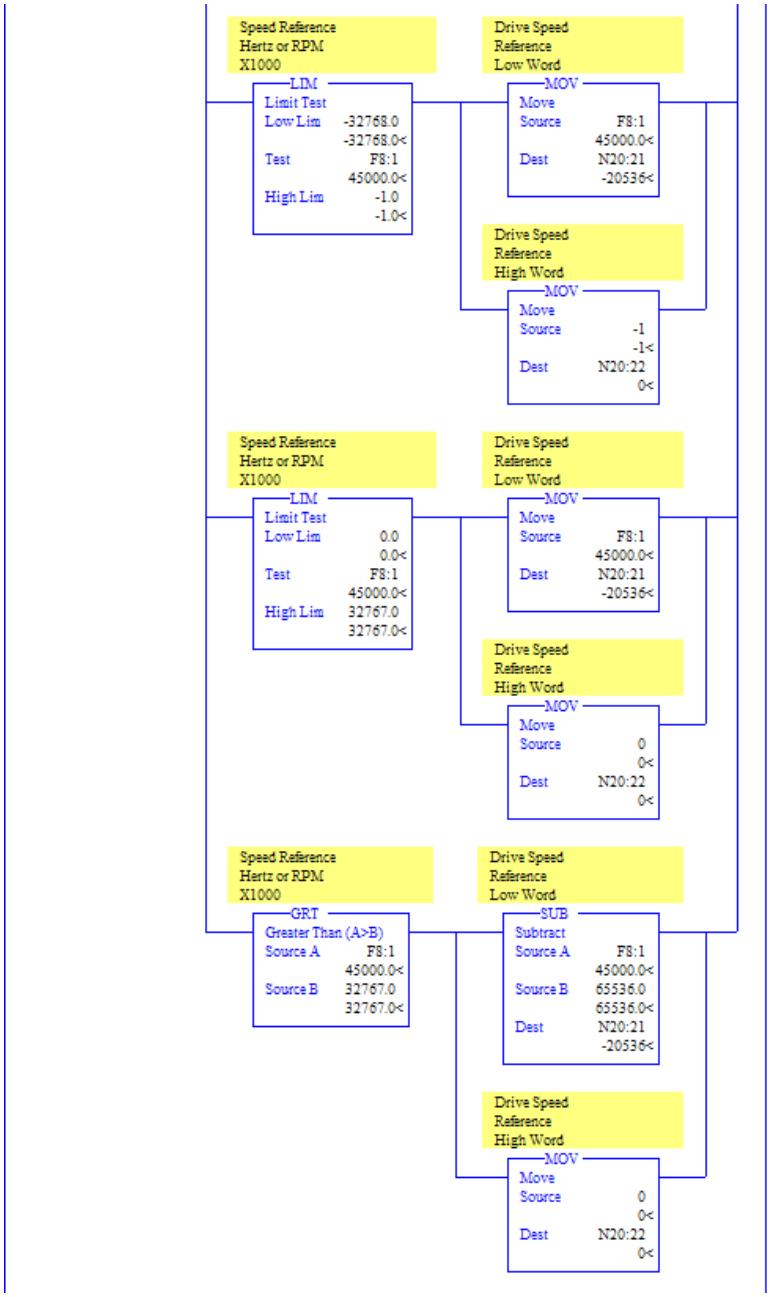


PowerFlex 70 and PowerFlex 750-Series Drives

Figure 5.16 PLC-5, SLC 500 or MicroLogix 1100/1400 Example Ladder Logic Program for Speed Reference



(Continued on next page.)



PowerFlex 750-Series Drive Speed Reference

Notes:

Using Explicit Messaging

This chapter provides information and examples that explain how to use Explicit Messaging to configure and monitor the adapter and connected PowerFlex 7-Class drive or PowerFlex 750-Series drive.

Important: When used in a PowerFlex 750-Series drive, the 20-COMM-E adapter must have firmware version 4.001 (or later) to support explicit messaging to drive parameters (Port 0). Furthermore, the adapter requires firmware version 4.002 (or later) for explicit messaging to parameters of peripherals in drive Ports 1…14.

Topic	Page
About Explicit Messaging	6-2
Performing Explicit Messages	6-3
ControlLogix Examples	6-4
PLC-5 Examples	6-23
SLC 500 Examples	6-29
MicroLogix 1100/1400 Examples	6-53

ATTENTION: Risk of injury or equipment damage exists. The examples in this publication are intended solely for purposes of example. There are many variables and requirements with any application. Rockwell Automation, Inc. does not assume responsibility or liability (to include intellectual property liability) for actual use of the examples shown in this publication.

ATTENTION: Risk of equipment damage exists. If Explicit Messages are programmed to write parameter data to Non-Volatile Storage (NVS) frequently, the NVS will quickly exceed its life cycle and cause the drive to malfunction. Do not create a program that frequently uses Explicit Messages to write parameter data to NVS. Datalinks do not write to NVS and should be used for frequently changed parameters.

Refer to Chapter 5 for information about the I/O Image, using Logic Command/Status, Reference/Feedback, and Datalinks.

About Explicit Messaging

Explicit Messaging is used to transfer data that does not require continuous updates. With Explicit Messaging, you can configure and monitor a slave device's parameters on the network.

Important: When an explicit message is performed, by default no connection is made since it is an "unconnected" message. When timing of the message transaction is important, you can create a dedicated message connection between the controller and drive by checking the "Connected" box on the Communications tab message configuration screen during message setup. These message connections are in addition to the I/O connection. However, the trade off for more message connections is decreased network performance. If your application cannot tolerate this, do not check the "Connected" box, which is recommended.

Important: PowerFlex 7-Class and PowerFlex 750-Series drives have explicit messaging limitations. Table 6.A shows the EtherNet/IP Object Class code compatibilities for these drives.

Table 6.A Explicit Messaging Class Code Compatibility with Drives

EtherNet/IP Object Class Code	PowerFlex 7-Class Drives	PowerFlex 750-Series Drives	Explicit Messaging Function
Parameter Object 0x0F	Yes	No	Single parameter reads/writes
DPI Parameter Object 0x93	Yes	Yes(1) with limitations	Single and scattered parameter reads/writes
Host DPI Parameter Object 0x9F	No	Yes(2) with limitations	Single and scattered parameter reads/writes

(1) Enables access to drive parameters (Port 0), DPI device parameters (Ports 1…6 only), and Host parameters (Ports 7…14 only). For example, DPI Parameter Object Class code 0x93 can access a 20-COMM-E adapter in Port 6. However, Class code 0x93 cannot access, for example, the Host parameters in a 24V I/O option module in Port 5. See DPI Parameter Object on page C-16 for instance (parameter) numbering.

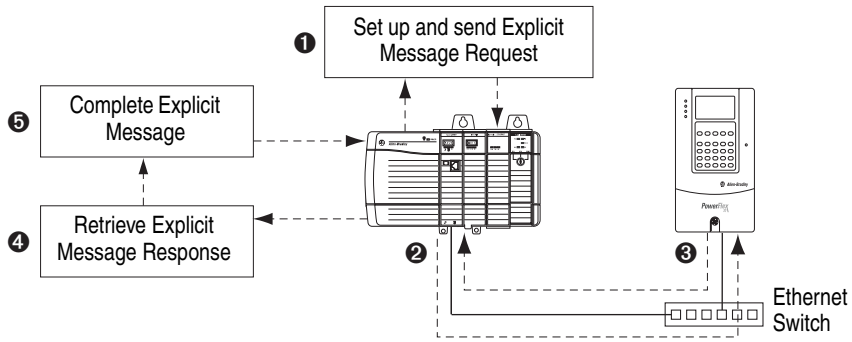
(2) Enables access to drive parameters (Port 0) and Host parameters for all ports (1…14). Host DPI Parameter Object Class code 0x9F cannot access DPI (device) parameters. For example, if a 20-750-DNET option module is in Port 4, its Host parameters can be accessed, but not its DPI (device) parameters. See Host DPI Parameter Object on page C-30 for instance (parameter) numbering.

Performing Explicit Messages

There are five basic events in the Explicit Messaging process. The details of each step will vary depending on the type of controller being used. Refer to the documentation for your controller.

Important: There must be a request message and a response message for all Explicit Messages, whether you are reading or writing data.

Figure 6.1 Explicit Message Process



Event	Description
❶	You format the required data and set up the ladder logic program to send an Explicit Message request to the scanner or bridge module (download).
❷	The scanner or bridge module transmits the Explicit Message Request to the slave device over the network.
❸	The slave device transmits the Explicit Message Response back to the scanner. The data is stored in the scanner buffer.
❹	The controller retrieves the Explicit Message Response from the scanner's buffer (upload).
❺	The Explicit Message is complete.

For information on the maximum number of Explicit Messages that can be executed at a time, refer to the user manual for the scanner or bridge and/or controller that is being used.

ControlLogix Examples

TIP: To display the Message Configuration screen in RSLogix 5000, add a message instruction (MSG), create a new tag for the message (Properties: Base tag type, MESSAGE data type, controller scope), and click the ... button in the message instruction.

For supported classes, instances, and attributes, refer to Appendix C, EtherNet/IP Objects.

Explicit Messaging Using RSLogix 5000 Version 15 (or later)

ControlLogix Example Ladder Logic Program to Read a Single Parameter

A Parameter Read message is used to read a single parameter. This read message example reads the value of parameter 003 - [Output Current] in a PowerFlex 7-Class drive.

Important: Parameter Object Class code 0x0F is not supported in PowerFlex 750-Series drives. To do a single parameter read, follow the RSLogix 5000 (all versions) single read example on page 6-19.

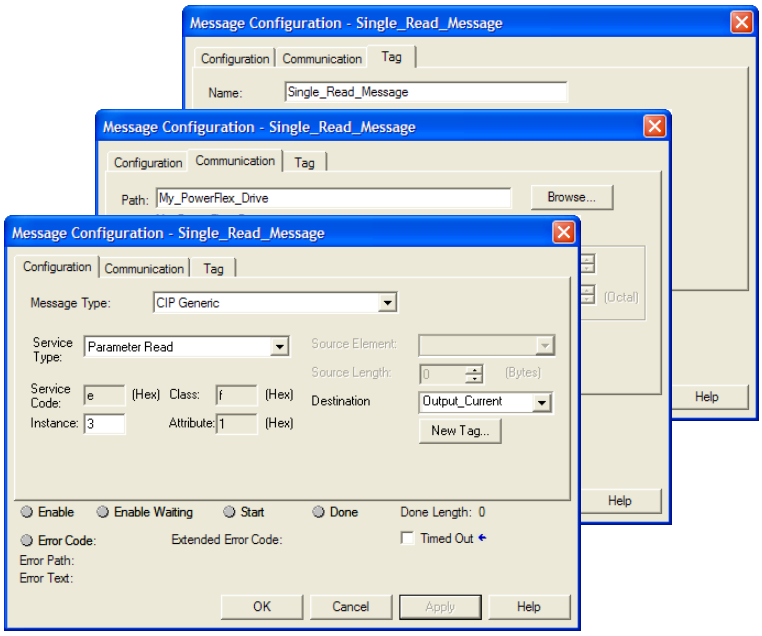
Table 6.B Example Controller Tags to Read a Single Parameter

Operand	Controller Tags for Single Read Message	Data Type
XIC	Execute_Single_Read_Message	BOOL
MSG	Single_Read_Message	MESSAGE

Figure 6.2 Example Ladder Logic to Read a Single Parameter

ControlLogix – Formatting a Message to Read a Single Parameter (version 15 or later)

Figure 6.3 Parameter Read Single Message Configuration Screens



The following table identifies the data that is required in each box to configure a message to read a single parameter.

Configuration Tab	Example Value	Description
Message Type	CIP Generic	Used to access the Parameter Object in the adapter.
Service Type [1]	Parameter Read	This service is used to read a parameter value.
Service Code [1]	e (Hex.)	Code for the requested service.
Class	f (Hex.)	Class ID for the DPI Parameter Object.
Instance [2]	3 (Dec.)	Instance number is the same as parameter number.
Attribute	1 (Hex.)	Attribute number for the Parameter Value attribute.
Destination	Output_Current [4]	The tag where the data that is read is stored.
Communication Tab	**Example Value**	**Description**
Path [3]	My_PowerFlex_Drive	The path is the route that the message will follow.
Tag Tab	**Example Value**	**Description**
Name	Single_Read_Message	The name for the message.

[1] The default setting for Service Type is “Custom,” enabling entry of a Service Code not available from the Service Type pull-down menu. When choosing a Service Type other than “Custom” from the pull-down menu, an appropriate Hex. value is automatically assigned to the Service Code box which is dimmed (unavailable).

[2] Only drive parameters (Port 0) can be read using Parameter Object Class code 0x0F. To read a parameter of a peripheral in another port, use DPI Parameter Object Class code 0x93 (see page 6-19).

[3] Click **Browse** to find the path, or type in the name of the device listed in the I/O Configuration folder.

[4] In this example, Output Current is a 32-bit parameter requiring the Data Type field to be set to “DINT” when creating the controller tag. If the parameter being read is a 16-bit parameter, the tag Data Type field must be set to “INT.” When using a PowerFlex 700S drive, Output Current is a floating point parameter requiring the Data Type field to be set to “REAL” when creating the controller tag. See the drive documentation to determine the size of the parameter and its data type (16-bit or 32-bit integer or REAL).

ControlLogix Example Ladder Logic Program to Write a Single Parameter (version 15 or later)

A Parameter Write message is used to write to a single parameter. This write message example writes a value to parameter 140 - [Accel Time 1] in a PowerFlex 7-Class drive.

Important: Parameter Object Class code 0x0F is not supported in PowerFlex 750-Series drives. To do a single parameter write, follow the RSLogix 5000 (all versions) single write example on page 6-21.

Table 6.C Example Controller Tags to Write a Single Parameter

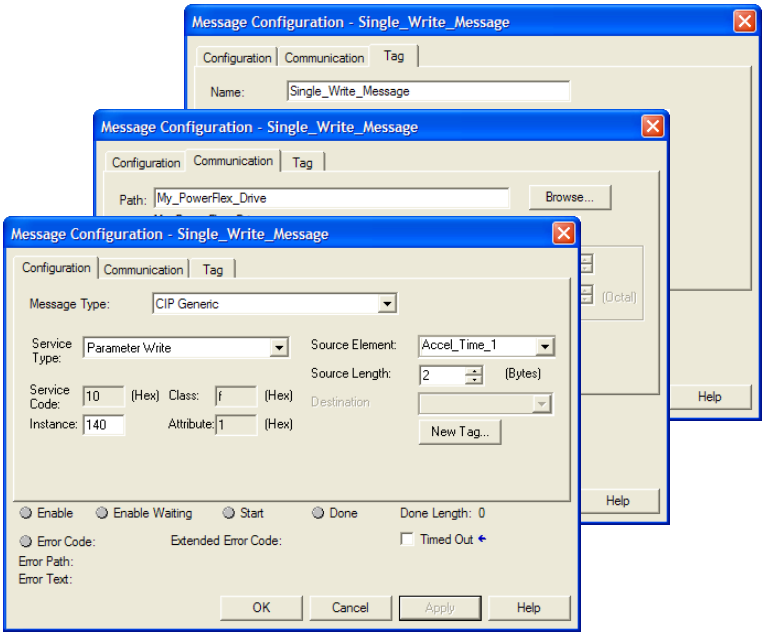
Operand	Controller Tags for Single Write Message	Data Type
XIC	Execute_Single_Write_Message	BOOL
MSG	Single_Write_Message	MESSAGE

Figure 6.4 Example Ladder Logic to Write a Single Parameter

Important: If the explicit message single write must be written continuously, use DPI Parameter Object Class code 0x93 or Host DPI Parameter Object Class code 0x9F and attribute A (10 decimal; see page 6-22). This writes to RAM—not NVS (EEPROM) memory. This example single write message using Class code F writes to NVS. Over time, continuous writes will exceed the EEPROM life cycle and cause the drive to malfunction.

ControlLogix – Formatting a Message to Write a Single Parameter (version 15 or later)

Figure 6.5 Parameter Write Single Message Configuration Screens



The following table identifies the data that is required in each box to configure a message to write a single parameter.

Configuration Tab	Example Value	Description
Message Type	CIP Generic	Used to access the Parameter Object in the adapter.
Service Type (1)	Parameter Write	This service is used to write a parameter value.
Service Code (1)	10 (Hex.)	Code for the requested service.
Class	f (Hex.)	Class ID for the DPI Parameter Object.
Instance (2)	140 (Dec.)	Instance number is the same as parameter number.
Attribute	1 (Hex.)	Attribute number for the Parameter Value attribute.
Source Element	Accel_Time_1 (4)	Name of the tag for any service data to be sent from the scanner or bridge to the adapter/drive.
Source Length	2 (4)	Number of bytes of service data to be sent in the message.
Communication Tab	**Example Value**	**Description**
Path (3)	My_PowerFlex_Drive	The path is the route that the message will follow.
Tag Tab	**Example Value**	**Description**
Name	Single_Write_Message	The name for the message.

(1) The default setting for Service Type is “Custom,” enabling entry of a Service Code not available from the Service Type pull-down menu. When choosing a Service Type other than “Custom” from the pull-down menu, an appropriate Hex. value is automatically assigned to the Service Code box which is dimmed (unavailable).

(2) Only drive parameters (Port 0) can be written to using Parameter Object Class code 0x0F. To write to a parameter of a peripheral in another port, use DPI Parameter Object Class code 0x93 (see page 6-21).

(3) Click **Browse** to find the path, or type in the name of the device listed in the I/O Configuration folder.

(4) In this example, Accel Time 1 is a 16-bit parameter requiring the tag Data Type field to be set to “INT” when creating the controller tag. If the parameter being written to is a 32-bit parameter, the tag Data Type field must be set to “DINT.” Also, the Source Length field on the Message Configuration screen must correspond to the selected Data Type in bytes (for example, 4 bytes for a DINT or a REAL). When using a PowerFlex 700S drive, Accel Time 1 is a floating point number requiring the Data Type field to be set to “REAL” when creating the controller tag. See the drive documentation to determine the size of the parameter and its data type (16-bit or 32-bit integer or REAL).

ControlLogix Example Ladder Logic Program to Read Multiple Parameters (all versions)

A Scattered Read message is used to read the values of multiple parameters. Up to 22 parameters can be read. This read message example reads the values of these five parameters:

PowerFlex 7-Class Drive	PowerFlex 750-Series Drive
• Parameter 001 - [Output Freq] • Parameter 003 - [Output Current] • Parameter 006 - [Output Voltage] • Parameter 012 - [DC Bus Voltage] • Parameter 017 - [Analog In1 Value]	• Parameter 001 - [Output Freq] • Parameter 007 - [Output Current] • Parameter 137 - [Open Loop Fdbk] • Parameter 21581 - [Port 5: Analog Out 0 Data] • Parameter 260 - [Analog In0 Value]

Refer to DPI Parameter Object on page C-16 (Class code 0x93) or Host DPI Parameter Object on page C-30 (Class code 0x9F) for parameter numbering.

Important: See Table 6.A on page 6-2 for limitations of PowerFlex 7-Class and PowerFlex 750-Series drives when using Class code 0x93 or Class code 0x9F for explicit messaging.

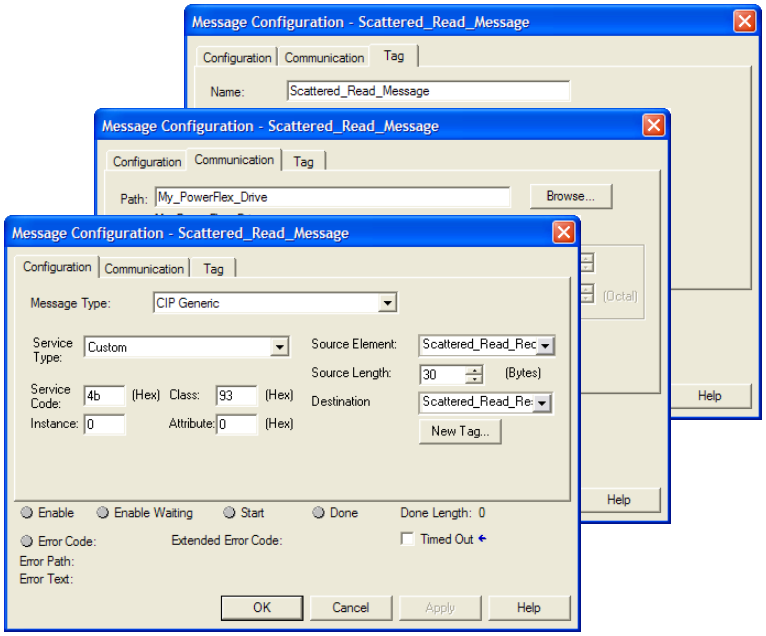
Table 6.D Example Controller Tags to Read Multiple Parameters

Operand	Controller Tags for Read Multiple Message	Data Type
XIC	Execute_Scattered_Read_Message	BOOL
MSG	Scattered_Read_Message	MESSAGE

Figure 6.6 Example Ladder Logic to Read Multiple Parameters

ControlLogix – Formatting a Message to Read Multiple Parameters (all versions)

Figure 6.7 Scattered Read Message Configuration Screens



The following table identifies the data that is required in each box to configure a message to read multiple parameters.

Configuration Tab	Example Value	Description
Message Type	CIP Generic	Used to access Parameter Object in the adapter.
Service Type (1)	Custom	Required for scattered messages.
Service Code (1)	4b (Hex.)	Code for the requested service.
Class	93 or 9F (Hex.) (3)	Class ID for the DPI Parameter Object.
Instance	0 (Dec.)	Required for scattered messages.
Attribute	0 (Hex.)	Required for scattered messages.
Source Element	Scattered_Read_Request (4)	Name of the tag for any service data to be sent from scanner or bridge to the adapter/drive.
Source Length	30 (4)	Number of bytes of service data to be sent in the message.
Destination	Scattered_Read_Response	The tag where the data that is read is stored.
Communication Tab	**Example Value**	**Description**
Path (2)	My_PowerFlex_Drive	The path is the route that the message will follow.
Tag Tab	**Example Value**	**Description**
Name	Scattered_Read_Message	The name for the message.

(1) The default setting for Service Type is “Custom,” enabling entry of a Service Code not available from the Service Type pull-down menu. When choosing a Service Type other than “Custom” from the pull-down menu, an appropriate Hex. value is automatically assigned to the Service Code box which is dimmed (unavailable).

(2) Click **Browse** to find the path, or type in the name of the device listed in the I/O Configuration folder.

(3) See Table 6.A on page 6-2 for limitations of PowerFlex 7-Class and PowerFlex 750-Series drives when using DPI Parameter Object Class code 0x93 or Host DPI Parameter Object Class code 0x9F for explicit messaging.

(4) In this example, we are reading five parameters. Each parameter being read requires an array of three INT registers. Therefore, a controller tag was created with its Data Type field set to “INT[15].” Also, the Source Length field on the Message Configuration screen must correspond to the selected Data Type in bytes (for this example, 30 bytes for an INT[15] array). Scattered read messages always assume that every parameter being read is a 32-bit parameter, regardless of its actual size. Maximum length is 132 bytes or 66 words which equates to 22 parameters. For parameter numbering, see DPI Parameter Object on page C-16 (Class code 0x93) or Host DPI Parameter Object on page C-30 (Class code 0x9F).

ControlLogix Example Scattered Read Request Data

In this message example, we use the data structure in Figure 6.8 or Figure 6.9 in the source tag named Scattered_Read_Request to read these five parameters:

PowerFlex 7-Class Drive	PowerFlex 750-Series Drive
• Parameter 001 - [Output Freq] • Parameter 003 - [Output Current] • Parameter 006 - [Output Voltage] • Parameter 012 - [DC Bus Voltage] • Parameter 017 - [Analog In1 Value]	• Parameter 001 - [Output Freq] • Parameter 007 - [Output Current] • Parameter 137 - [Open Loop Fdbk] • Parameter 21581 - [Port 5: Analog Out 0 Data] • Parameter 260 - [Analog In0 Value]

Refer to DPI Parameter Object on page C-16 (Class code 0x93) or Host DPI Parameter Object on page C-30 (Class code 0x9F) for parameter numbering.

Figure 6.8 Example Scattered Read Request Data for PowerFlex 7-Class Drive

Name	Value	Data Type	Description
Scattered_Read_Request	{...}	INT[15]	
Scattered_Read_Request[0]	1	INT	Parameter Number (decimal)
Scattered_Read_Request[1]	0	INT	Pad Word
Scattered_Read_Request[2]	0	INT	Pad Word
Scattered_Read_Request[3]	3	INT	Parameter Number (decimal)
Scattered_Read_Request[4]	0	INT	Pad Word
Scattered_Read_Request[5]	0	INT	Pad Word
Scattered_Read_Request[6]	6	INT	Parameter Number (decimal)
Scattered_Read_Request[7]	0	INT	Pad Word
Scattered_Read_Request[8]	0	INT	Pad Word
Scattered_Read_Request[9]	12	INT	Parameter Number (decimal)
Scattered_Read_Request[10]	0	INT	Pad Word
Scattered_Read_Request[11]	0	INT	Pad Word
Scattered_Read_Request[12]	17	INT	Parameter Number (decimal)
Scattered_Read_Request[13]	0	INT	Pad Word
Scattered_Read_Request[14]	0	INT	Pad Word

Figure 6.9 Example Scattered Read Request Data for PowerFlex 750-Series Drive

Name	Value	Data Type	Description
Scattered_Read_Request	{...}	INT[15]	
Scattered_Read_Request[0]	1	INT	Parameter Number (decimal)
Scattered_Read_Request[1]	0	INT	Pad Word
Scattered_Read_Request[2]	0	INT	Pad Word
Scattered_Read_Request[3]	7	INT	Parameter Number (decimal)
Scattered_Read_Request[4]	0	INT	Pad Word
Scattered_Read_Request[5]	0	INT	Pad Word
Scattered_Read_Request[6]	137	INT	Parameter Number (decimal)
Scattered_Read_Request[7]	0	INT	Pad Word
Scattered_Read_Request[8]	0	INT	Pad Word
Scattered_Read_Request[9]	21581	INT	Parameter Number (decimal)
Scattered_Read_Request[10]	0	INT	Pad Word
Scattered_Read_Request[11]	0	INT	Pad Word
Scattered_Read_Request[12]	260	INT	Parameter Number (decimal)
Scattered_Read_Request[13]	0	INT	Pad Word
Scattered_Read_Request[14]	0	INT	Pad Word

ControlLogix Example Scattered Read Response Data

The Scattered Read Request message reads the multiple parameters and returns their values to the destination tag (Scattered_Read_Response). Figure 6.10 or Figure 6.11 shows the parameter values.

Figure 6.10 Example Scattered Read Response Data for PowerFlex 7-Class Drive

Name	Value	Data Type	Description
Scattered_Read_Response	{...}	INT[15]	
Scattered_Read_Response[0]	1	INT	Parameter Number (decimal)
Scattered_Read_Response[1]	325	INT	Parameter Value LSW
Scattered_Read_Response[2]	0	INT	Parameter Value MSW
Scattered_Read_Response[3]	3	INT	Parameter Number (decimal)
Scattered_Read_Response[4]	1	INT	Parameter Value LSW
Scattered_Read_Response[5]	0	INT	Parameter Value MSW
Scattered_Read_Response[6]	6	INT	Parameter Number (decimal)
Scattered_Read_Response[7]	1187	INT	Parameter Value LSW
Scattered_Read_Response[8]	0	INT	Parameter Value MSW
Scattered_Read_Response[9]	12	INT	Parameter Number (decimal)
Scattered_Read_Response[10]	3292	INT	Parameter Value LSW
Scattered_Read_Response[11]	0	INT	Parameter Value MSW
Scattered_Read_Response[12]	17	INT	Parameter Number (decimal)
Scattered_Read_Response[13]	8318	INT	Parameter Value LSW
Scattered_Read_Response[14]	0	INT	Parameter Value MSW

In this message example, the parameters have the following values:

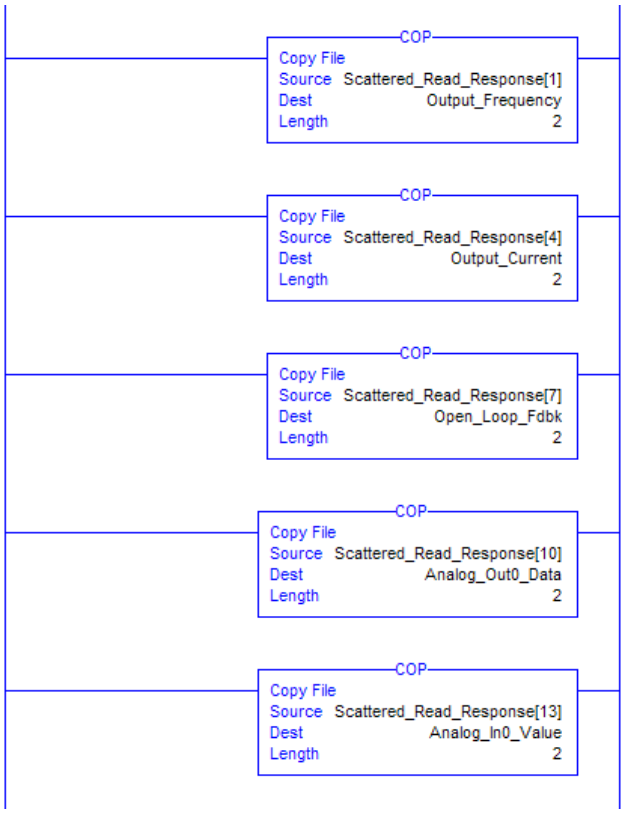
PowerFlex 7-Class Drive Parameter	Read Value
1 - [Output Freq]	32.5 Hz
3 - [Output Current]	0.01 Amp
6 - [Output Voltage]	118.7 VAC
12 - [DC Bus Voltage]	329.2 VDC
17 - [Analog In2 Value]	8.318 mA

Figure 6.11 Example Scattered Read Response Data for PowerFlex 750-Series Drive

Name	Value	Data Type	Description
Scattered_Read_Response	{...}	INT[15]	
Scattered_Read_Response[0]	1	INT	Parameter Number (decimal)
Scattered_Read_Response[1]	0	INT	Parameter Value LSW
Scattered_Read_Response[2]	16948	INT	Parameter Value MSW
Scattered_Read_Response[3]	7	INT	Parameter Number (decimal)
Scattered_Read_Response[4]	-15729	INT	Parameter Value LSW
Scattered_Read_Response[5]	15605	INT	Parameter Value MSW
Scattered_Read_Response[6]	137	INT	Parameter Number (decimal)
Scattered_Read_Response[7]	23698	INT	Parameter Value LSW
Scattered_Read_Response[8]	26035	INT	Parameter Value MSW
Scattered_Read_Response[9]	21581	INT	Parameter Number (decimal)
Scattered_Read_Response[10]	0	INT	Parameter Value LSW
Scattered_Read_Response[11]	16948	INT	Parameter Value MSW
Scattered_Read_Response[12]	260	INT	Parameter Number (decimal)
Scattered_Read_Response[13]	-9437	INT	Parameter Value LSW
Scattered_Read_Response[14]	16661	INT	Parameter Value MSW

The PowerFlex 750-Series drive uses 32-bit integer and REAL parameters. A COP command must be used to copy the Scattered_Read_Response integer array to a 32-bit integer or REAL tag. Figure 6.12 shows the ladder logic used for this example. If the parameter data type is a REAL, then the destination tag is a REAL. If the parameter data type is a 32-bit integer, then the destination tag is a DINT. See the drive documentation to determine the parameter data type (32-bit integer or REAL).

Figure 6.12 Example Ladder Logic to Copy Response Data for PowerFlex 750-Series Drive



In this message example, the parameters have the following values:

PowerFlex 750-Series Drive Parameter	Read Value	Data Type
1 - [Output Freq]	45.0 Hz	REAL
7 - [Output Current]	0.03 Amp	REAL
137 - [Open Loop Fdbk]	1706253458	DINT
21581 - [Port 5: Analog Out 0 Data]	45.0 Hz	REAL
260 - [Analog In0 Value]	9.366 Volts	REAL

ControlLogix Example Ladder Logic Program to Write Multiple Parameters (all versions)

A Scattered Write message is used to write to multiple parameters. This write message example writes the following values to these five parameters:

PowerFlex 7-Class Drive Parameter	Write Value
141 - [Accel Time 2]	11.1 Sec.
143 - [Decel Time 2]	22.2 Sec.
105 - [Preset Speed 5]	33.3 Hz.
106 - [Preset Speed 6]	44.4 Hz.
107 - [Preset Speed 7]	55.5 Hz.

PowerFlex 750-Series Drive Parameter	Write Value
536 - [Accel Time 2]	11.1 Sec.
538 - [Decel Time 2]	22.2 Sec.
725 - [Zero Position]	33
21555 - [Port 5: Analog In0 Hi]	5.5
780 - [PTP Setpoint]	-75,555

Refer to DPI Parameter Object on page C-16 (Class code 0x93) or Host DPI Parameter Object on page C-30 (Class code 0x9F) for parameter numbering.

Important: See Table 6.A on page 6-2 for limitations of PowerFlex 7-Class and PowerFlex 750-Series drives when using Class code 0x93 or Class code 0x9F for explicit messaging.

Table 6.E Example Controller Tags to Write Multiple Parameters

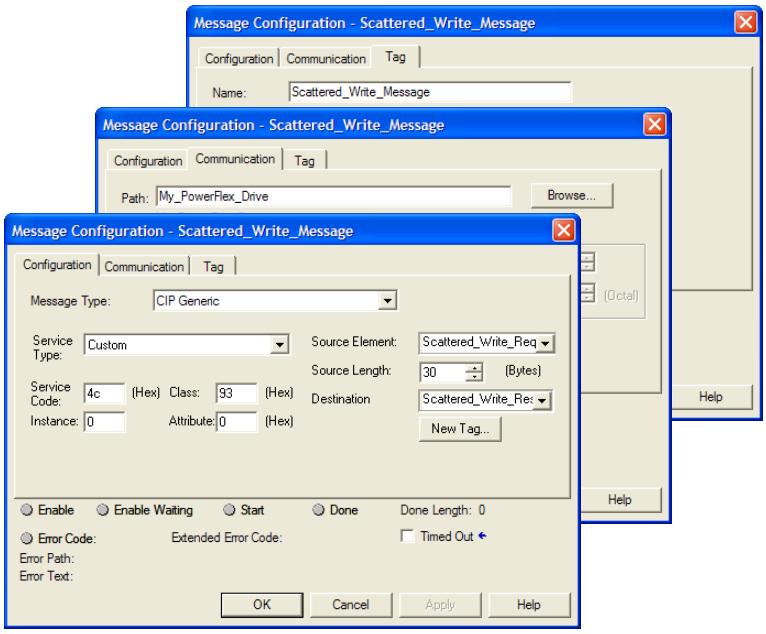
Operand	Controller Tags for Write Multiple Message	Data Type
XIC	Execute_Scattered_Write_Message	BOOL
MSG	Scattered_Write_Message	MESSAGE

Figure 6.13 Example Ladder Logic to Write Multiple Parameters

Important: If the explicit message scattered write must be written continuously, then use a separate explicit message single write for each parameter using DPI Parameter Object Class code 0x93 or Host DPI Parameter Object Class code 0x9F and attribute A (10 decimal; see page 6-22). Attribute A writes to RAM—not NVS (EEPROM) memory. This example scattered write message using attribute 0 writes to NVS. Over time, continuous writes will exceed the EEPROM life cycle and cause the drive to malfunction.

ControlLogix – Formatting a Message to Write Multiple Parameters (all versions)

Figure 6.14 Scattered Write Multiple Message Configuration Screens



The following table identifies the data that is required in each box to configure a message to write multiple parameters.

Configuration Tab	Example Value	Description
Message Type	CIP Generic	Used to access Parameter Object in the adapter.
Service Type (1)	Custom	Required for scattered messages.
Service Code (1)	4c (Hex.)	Code for the requested service.
Class	93 or 9F (Hex.) (3)	Class ID for the DPI Parameter Object.
Instance	0 (Dec.)	Required for scattered messages.
Attribute	0 (Hex.)	Required for scattered messages.
Source Element	Scattered_Write_Request (4)	Name of the tag for any service data to be sent from scanner or bridge to the adapter/drive.
Source Length	30 (4)	Number of bytes of service data to be sent in the message.
Destination	Scattered_Write_Response	The tag where the data that is read is stored.
Communication Tab	**Example Value**	**Description**
Path (2)	My_PowerFlex_Drive	The path is the route that the message will follow.
Tag Tab	**Example Value**	**Description**
Name	Scattered_Write_Message	The name for the message.

(1) The default setting for Service Type is “Custom,” enabling entry of a Service Code not available from the Service Type pull-down menu. When choosing a Service Type other than “Custom” from the pull-down menu, an appropriate Hex. value is automatically assigned to the Service Code box which is dimmed (unavailable).

(2) Click **Browse** to find the path, or type in the name of the device listed in the I/O Configuration folder.

(3) See Table 6.A on page 6-2 for limitations of PowerFlex 7-Class and PowerFlex 750-Series drives when using DPI Parameter Object Class code 0x93 or Host DPI Parameter Object Class code 0x9F for explicit messaging.

(4) In this example, we are writing to five parameters. Each parameter being written to requires an array of three INT registers. Therefore, a controller tag was created with its Data Type field set to “INT[15].” Also, the Source Length field on the Message Configuration screen must correspond to the selected Data Type in bytes (for this example, 30 bytes for an INT[15] array). Scattered write messages always assume that every parameter being written to is a 32-bit parameter, regardless of its actual size. Maximum length is 132 bytes or 66 words which equates to 22 parameters. For parameter numbering, see DPI Parameter Object on page C-16 (Class code 0x93) or Host DPI Parameter Object on page C-30 (Class code 0x9F).

ControlLogix Example Scattered Write Request Data

In this message example, we use the data structure in Figure 6.15 or Figure 6.18 in the source tag (Scattered_Write_Request) to write new values to these parameters:

PowerFlex 7-Class Drive Parameter	Write Value
141 - [Accel Time 2]	11.1 Sec.
143 - [Decel Time 2]	22.2 Sec.
105 - [Preset Speed 5]	33.3 Hz.
106 - [Preset Speed 6]	44.4 Hz.
107 - [Preset Speed 7]	55.5 Hz.

PowerFlex 750-Series Drive Parameter	Write Value	Data Type
536 - [Accel Time 2]	11.1 Sec.	REAL
538 - [Decel Time 2]	22.2 Sec.	REAL
725 - [Zero Position]	33	DINT
21555 - [Port 5: Analog In0 Hi]	5.5	REAL
780 - [PTP Setpoint]	-75,555	REAL

Refer to DPI Parameter Object on page C-16 (Class code 0x93) or Host DPI Parameter Object on page C-30 (Class code 0x9F) for parameter numbering.

Figure 6.15 or Figure 6.18 shows the parameter values.

Figure 6.15 Example Scattered Write Request Data for PowerFlex 7-Class Drive

Name	Value	Data Type	Description
Scattered_Write_Request	{...}	INT[15]	
Scattered_Write_Request[0]	141	INT	Parameter Number (decimal)
Scattered_Write_Request[1]	111	INT	Parameter Value LSW
Scattered_Write_Request[2]	0	INT	Parameter Value MSW
Scattered_Write_Request[3]	143	INT	Parameter Number (decimal)
Scattered_Write_Request[4]	222	INT	Parameter Value LSW
Scattered_Write_Request[5]	0	INT	Parameter Value MSW
Scattered_Write_Request[6]	105	INT	Parameter Number (decimal)
Scattered_Write_Request[7]	333	INT	Parameter Value LSW
Scattered_Write_Request[8]	0	INT	Parameter Value MSW
Scattered_Write_Request[9]	106	INT	Parameter Number (decimal)
Scattered_Write_Request[10]	444	INT	Parameter Value LSW
Scattered_Write_Request[11]	0	INT	Parameter Value MSW
Scattered_Write_Request[12]	107	INT	Parameter Number (decimal)
Scattered_Write_Request[13]	555	INT	Parameter Value LSW
Scattered_Write_Request[14]	0	INT	Parameter Value MSW

ControlLogix Example Scattered Write Response Data

The results of the message appear in the destination tag named Scattered_Write_Response (Figure 6.16). Values of “0” indicate no errors occurred.

Figure 6.16 Example Scattered Write Response Data for PowerFlex 7-Class Drive

Name	Value	Data Type	Description
Scattered_Write_Response	{...}	INT[15]	
Scattered_Write_Response[0]	141	INT	Parameter Number (decimal)
Scattered_Write_Response[1]	0	INT	Pad Word or Error Code
Scattered_Write_Response[2]	0	INT	Pad Word
Scattered_Write_Response[3]	143	INT	Parameter Number (decimal)
Scattered_Write_Response[4]	0	INT	Pad Word or Error Code
Scattered_Write_Response[5]	0	INT	Pad Word
Scattered_Write_Response[6]	105	INT	Parameter Number (decimal)
Scattered_Write_Response[7]	0	INT	Pad Word or Error Code
Scattered_Write_Response[8]	0	INT	Pad Word
Scattered_Write_Response[9]	106	INT	Parameter Number (decimal)
Scattered_Write_Response[10]	0	INT	Pad Word or Error Code
Scattered_Write_Response[11]	0	INT	Pad Word
Scattered_Write_Response[12]	107	INT	Parameter Number (decimal)
Scattered_Write_Response[13]	0	INT	Pad Word or Error Code
Scattered_Write_Response[14]	0	INT	Pad Word

The PowerFlex 750-Series drive uses 32-bit integer and REAL parameters. A COP command must be used to copy the 32-bit integer and REAL values to the Scattered_Write_Request integer array. Figure 6.17 shows the ladder logic used for this example. If the parameter data type is a REAL, then the source tag is a REAL. If the parameter data type is a 32-bit integer, then the source tag is a DINT. See the drive documentation to determine the parameter data type (32-bit integer or REAL).

Figure 6.17 Example Ladder Logic to Copy Request Data for PowerFlex 750-Series Drive

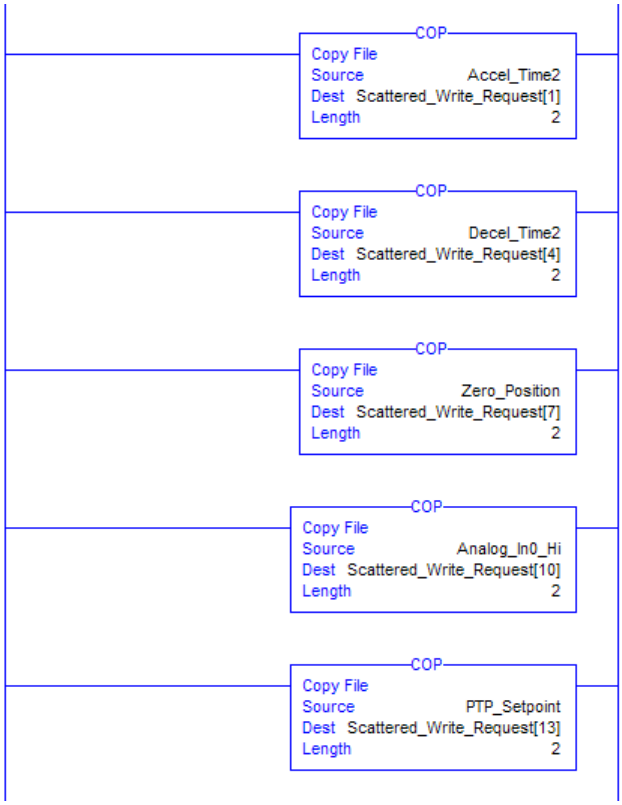


Figure 6.18 Example Scattered Write Request Data for PowerFlex 750-Series Drive

Name	Value	Data Type	Description
Scattered_Write_Request	{...}	INT[15]	
Scattered_Write_Request[0]	536	INT	Parameter Number (decimal)
Scattered_Write_Request[1]	-26214	INT	Parameter Value LSW
Scattered_Write_Request[2]	16689	INT	Parameter Value MSW
Scattered_Write_Request[3]	538	INT	Parameter Number (decimal)
Scattered_Write_Request[4]	-26214	INT	Parameter Value LSW
Scattered_Write_Request[5]	16817	INT	Parameter Value MSW
Scattered_Write_Request[6]	725	INT	Parameter Number (decimal)
Scattered_Write_Request[7]	33	INT	Parameter Value LSW
Scattered_Write_Request[8]	0	INT	Parameter Value MSW
Scattered_Write_Request[9]	21555	INT	Parameter Number (decimal)
Scattered_Write_Request[10]	0	INT	Parameter Value LSW
Scattered_Write_Request[11]	16560	INT	Parameter Value MSW
Scattered_Write_Request[12]	780	INT	Parameter Number (decimal)
Scattered_Write_Request[13]	-10019	INT	Parameter Value LSW
Scattered_Write_Request[14]	-2	INT	Parameter Value MSW

The results of the explicit message appear in the destination tag Scattered_Write_Response (Figure 6.19). Values of “0” indicate no errors occurred.

Figure 6.19 Example Scattered Write Response Data for PowerFlex 750-Series Drive

Name	Value	Data Type	Description
Scattered_Write_Response	{...}	INT[15]	
Scattered_Write_Response[0]	536	INT	Parameter Number (decimal)
Scattered_Write_Response[1]	0	INT	Pad Word or Error Code
Scattered_Write_Response[2]	0	INT	Pad Word
Scattered_Write_Response[3]	538	INT	Parameter Number (decimal)
Scattered_Write_Response[4]	0	INT	Pad Word or Error Code
Scattered_Write_Response[5]	0	INT	Pad Word
Scattered_Write_Response[6]	725	INT	Parameter Number (decimal)
Scattered_Write_Response[7]	0	INT	Pad Word or Error Code
Scattered_Write_Response[8]	0	INT	Pad Word
Scattered_Write_Response[9]	21555	INT	Parameter Number (decimal)
Scattered_Write_Response[10]	0	INT	Pad Word or Error Code
Scattered_Write_Response[11]	0	INT	Pad Word
Scattered_Write_Response[12]	780	INT	Parameter Number (decimal)
Scattered_Write_Response[13]	0	INT	Pad Word or Error Code
Scattered_Write_Response[14]	0	INT	Pad Word

ControlLogix – Explanation of Request and Response Data for Read/Write Multiple Messaging (all versions)

The data structures in Figure 6.20 and Figure 6.21 use 16-bit words and can accommodate up to 22 parameters in a single message. In the Response Message, a parameter number with the high bit set indicates that the associated parameter value field contains an error code (parameter number in response data will be negative).

Important: See Table 6.A on page 6-2 for limitations of PowerFlex 7-Class and PowerFlex 750-Series drives when using Class code 0x93 or Class code 0x9F for explicit messaging.

Figure 6.20 Data Structures for Scattered Read Messages

	Request (Source Data)		Response (Destination Data)
Word 0	Parameter Number	Word 0	Parameter Number
1	Pad Word	1	Parameter Value LSW
2	Pad Word	2	Parameter Value MSW
3	Parameter Number	3	Parameter Number
4	Pad Word	4	Parameter Value LSW
5	Pad Word	5	Parameter Value MSW
6	Parameter Number	6	Parameter Number
7	Pad Word	7	Parameter Value LSW
8	Pad Word	8	Parameter Value MSW
9	Parameter Number	9	Parameter Number
10	Pad Word	10	Parameter Value LSW
11	Pad Word	11	Parameter Value MSW
12	Parameter Number	12	Parameter Number
13	Pad Word	13	Parameter Value LSW
14	Pad Word	14	Parameter Value MSW
⋮		⋮	
63	Parameter Number	63	Parameter Number
64	Pad Word	64	Parameter Value LSW
65	Pad Word	65	Parameter Value MSW

Figure 6.21 Data Structures for Scattered Write Messages

	Request (Source Data)		Response (Destination Data)
Word 0	Parameter Number	Word 0	Parameter Number
1	Parameter Value LSW	1	Pad Word
2	Parameter Value MSW	2	Pad Word
3	Parameter Number	3	Parameter Number
4	Parameter Value LSW	4	Pad Word
5	Parameter Value MSW	5	Pad Word
6	Parameter Number	6	Parameter Number
7	Parameter Value LSW	7	Pad Word
8	Parameter Value MSW	8	Pad Word
9	Parameter Number	9	Parameter Number
10	Parameter Value LSW	10	Pad Word
11	Parameter Value MSW	11	Pad Word
12	Parameter Number	12	Parameter Number
13	Parameter Value LSW	13	Pad Word
14	Parameter Value MSW	14	Pad Word
⋮		⋮	
63	Parameter Number	63	Parameter Number
64	Parameter Value LSW	64	Pad Word
65	Parameter Value MSW	65	Pad Word

Explicit Messaging Using RSLogix 5000 (all versions)

ControlLogix Example Ladder Logic Program to Read a Single Parameter

A Get Attribute Single message is used to read a single parameter. This read message example reads the value of parameter 003 - [Output Current] in a PowerFlex 7-Class drive.

Important: See Table 6.A on page 6-2 for limitations of PowerFlex 7-Class and PowerFlex 750-Series drives when using DPI Parameter Object Class code 0x93 or Host DPI Parameter Object Class code 0x9F for explicit messaging.

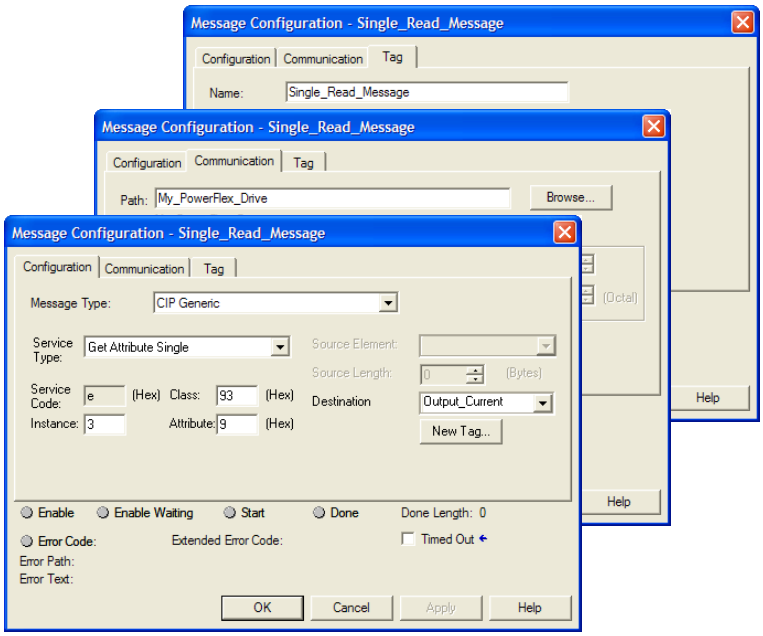
Table 6.F Example Controller Tags to Read a Single Parameter

Operand	Controller Tags for Single Read Message	Data Type
XIC	Execute_Single_Read_Message	BOOL
MSG	Single_Read_Message	MESSAGE

Figure 6.22 Example Ladder Logic to Read a Single Parameter

ControlLogix – Formatting a Message to Read a Single Parameter (all versions)

Figure 6.23 Get Attribute Single Message Configuration Screens



The following table identifies the data that is required in each box to configure a message to read a single parameter.

Configuration Tab	Example Value	Description
Message Type	CIP Generic	Used to access the Parameter Object in the adapter.
Service Type [1]	Get Attribute Single	This service is used to read a parameter value.
Service Code [1]	e (Hex.)	Code for the requested service.
Class	93 or 9F (Hex.) [4]	Class ID for the DPI Parameter Object.
Instance [2]	3 (Dec.)	Instance number is the same as parameter number.
Attribute	9 (Hex.)	Attribute number for the Parameter Value attribute.
Destination	Output_Current [5]	The tag where the data that is read is stored.
Communication Tab	**Example Value**	**Description**
Path [3]	My_PowerFlex_Drive	The path is the route that the message will follow.
Tag Tab	**Example Value**	**Description**
Name	Single_Read_Message	The name for the message.

[1] The default setting for Service Type is “Custom,” enabling entry of a Service Code not available from the Service Type pull-down menu. When choosing a Service Type other than “Custom” from the pull-down menu, an appropriate Hex. value is automatically assigned to the Service Code box which is dimmed (unavailable).

[2] The instance is the parameter number in the drive (Port 0). For example, to read parameter 4 of a peripheral in Port 5 of a PowerFlex 750-Series drive, the instance would be 21504 + 4 = 21508. See DPI Parameter Object on page C-16 (Class code 0x93) or Host DPI Parameter Object on page C-30 (Class code 0x9F) to determine the instance number.

[3] Click **Browse** to find the path, or type in the name of the device listed in the I/O Configuration folder.

[4] See Table 6.A on page 6-2 for limitations of PowerFlex 7-Class and PowerFlex 750-Series drives when using DPI Parameter Object Class code 0x93 or Host DPI Parameter Object Class code 0x9F for explicit messaging.

[5] In this example, Output Current is a 32-bit parameter requiring the Data Type field to be set to “DINT” when creating the controller tag. If the parameter being read is a 16-bit parameter, the tag Data Type field must be set to “INT.” When using a PowerFlex 700S or PowerFlex 750-Series drive, Output Current is a floating point number requiring the Data Type field to be set to “REAL” when the creating controller tag. See the drive documentation to determine the size of the parameter and its data type (16-bit or 32-bit integer or REAL).

ControlLogix Example Ladder Logic Program to Write a Single Parameter (all versions)

A Set Attribute Single message is used to write to a single parameter. This write message example writes a value to parameter 140 - [Accel Time 1] in a PowerFlex 7-Class drive.

Table 6.G Example Controller Tags to Write a Single Parameter

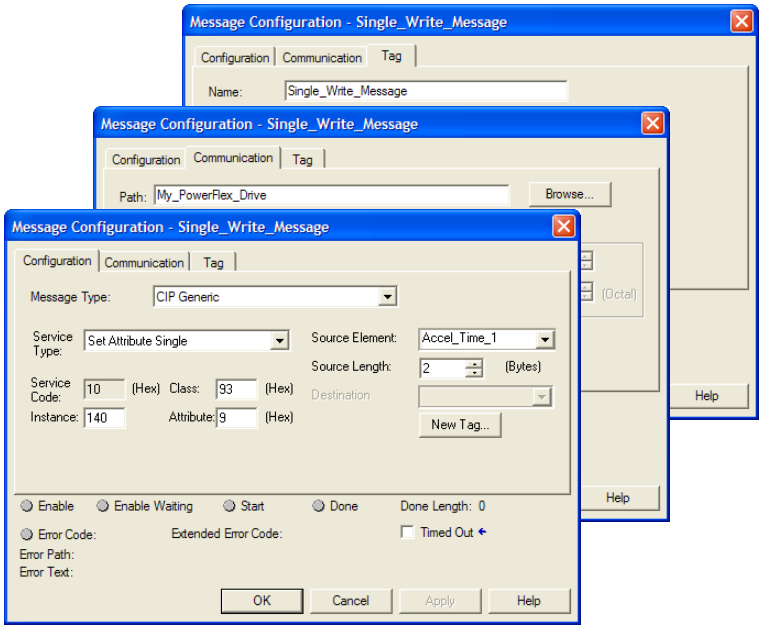
Operand	Controller Tags for Single Write Message	Data Type
XIC	Execute_Single_Write_Message	BOOL
MSG	Single_Write_Message	MESSAGE

Important: See Table 6.A on page 6-2 for limitations of PowerFlex 7-Class and PowerFlex 750-Series drives when using DPI Parameter Object Class code 0x93 or Host DPI Parameter Object 0x9F for explicit messaging.

Figure 6.24 Example Ladder Logic to Write a Single Parameter

ControlLogix – Formatting a Message to Write a Single Parameter (all versions)

Figure 6.25 Set Attribute Single Message Configuration Screens



The following table identifies the data that is required in each box to configure a message to write a single parameter.

Configuration Tab	Example Value	Description
Message Type	CIP Generic	Used to access the Parameter Object in the adapter.
Service Type (1)	Set Attribute Single	This service is used to write a parameter value.
Service Code (1)	10 (Hex.)	Code for the requested service.
Class	93 or 9F (Hex.) (5)	Class ID for the DPI Parameter Object.
Instance (2)	140 (Dec.)	Instance number is the same as parameter number.
Attribute (3)	9 or A (Hex.)	Attribute number for the Parameter Value attribute.
Source Element	Accel_Time_1 (6)	Name of the tag for any service data to be sent from the scanner or bridge to the adapter/drive.
Source Length	2 (6)	Number of bytes of service data to be sent in the message.
Communication Tab	**Example Value**	**Description**
Path (4)	My_PowerFlex_Drive	The path is the route that the message will follow.
Tag Tab	**Example Value**	**Description**
Name	Single_Write_Message	The name for the message.

(1) The default setting for Service Type is “Custom,” enabling entry of a Service Code not available from the Service Type pull-down menu. When choosing a Service Type other than “Custom” from the pull-down menu, an appropriate Hex. value is automatically assigned to the Service Code box which is dimmed (unavailable).

(2) The instance is the parameter number in the drive (Port 0). For example, to write to parameter 4 of a peripheral in Port 5 of a PowerFlex 750-Series drive, the instance would be 21504 + 4 = 21508. See DPI Parameter Object on page C-16 (Class code 0x93) or Host DPI Parameter Object on page C-30 (Class code 0x9F) to determine the instance number.

(3) Setting the Attribute value to “9” will write the parameter value to the drive’s Non-Volatile Storage (EEPROM) memory, so the parameter value will remain even after the drive is power cycled. **Important:** When set to “9,” be very cautious as the EEPROM may quickly exceed its life cycle and cause the drive to malfunction. Setting the Attribute value to “A” (10 decimal) will write the parameter value to temporary memory, so the parameter value will be lost after the drive is power cycled. It is recommended to use the “A” (10 decimal) setting when frequent write messages are required.

(4) Click **Browse** to find the path, or type in the name of the device listed in the I/O Configuration folder.

(5) See Table 6.A on page 6-2 for limitations of PowerFlex 7-Class and PowerFlex 750-Series drives when using DPI Parameter Object Class code 0x93 or Host DPI Parameter Object Class code 0x9F for explicit messaging.

(6) In this example, Accel Time 1 is a 16-bit parameter requiring the tag Data Type field to be set to “INT” when creating the controller tag. If the parameter being written to is a 32-bit parameter, the tag Data Type field must be set to “DINT.” Also, the Source Length field on the Message Configuration screen must correspond to the selected Data Type in bytes (for example, 4 bytes for a DINT or a REAL). When using a PowerFlex 700S or PowerFlex 750-Series drive, Accel Time 1 is a floating point number requiring the Data Type field to be set to “REAL” when creating the controller tag. See the drive documentation to determine the size of the parameter and its data type (16-bit or 32-bit integer or REAL).

ControlLogix Example Ladder Logic Program to Read or Write Multiple Parameters (all versions)

Since the example ladder logic rungs, configuration screens, and request/response data to read or write multiple parameters using RSLogix 5000 (all versions) are identical to those for RSLogix 5000 version 15 (or later), please refer to the information contained on page 6-8 through page 6-18 for complete details.

PLC-5 Examples

Important: The PLC-5 must be Series E (Rev. D.1 or later) to support the MultiHop feature that routes messaging to the drive.

Important: Due to inherent limitations with the PCCC N-File method, only contiguous multiple parameters can be read or written using explicit messaging.

For this explicit message example, we use the N150 N-Files because they are already mapped to specific parameters in the drive and its connected peripherals. This enables direct access to any parameter. The other available N40 N-File to use for explicit messaging requires considerably more configuration to achieve the same result. Every read or write message using the N40 N-Files requires configuring a request message, inputing data into the request data table, configuring a response message, and inputing data into the response data table. However, if accessing items other than parameters (for example, drive faults or events), the N40 N-Files must be used since only parameters can be accessed using the N150 N-Files.

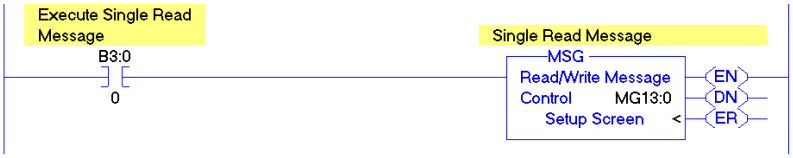
Important: When performing a write parameter message, the data will always be written to the drive's Non-Volatile Storage (NVS). Over time, continuous writes will exceed the EEPROM life cycle and cause the drive to malfunction.

For PCCC N150 N-File information, refer to page C-11.

PLC-5 Example Ladder Logic Program to Read a Single Parameter

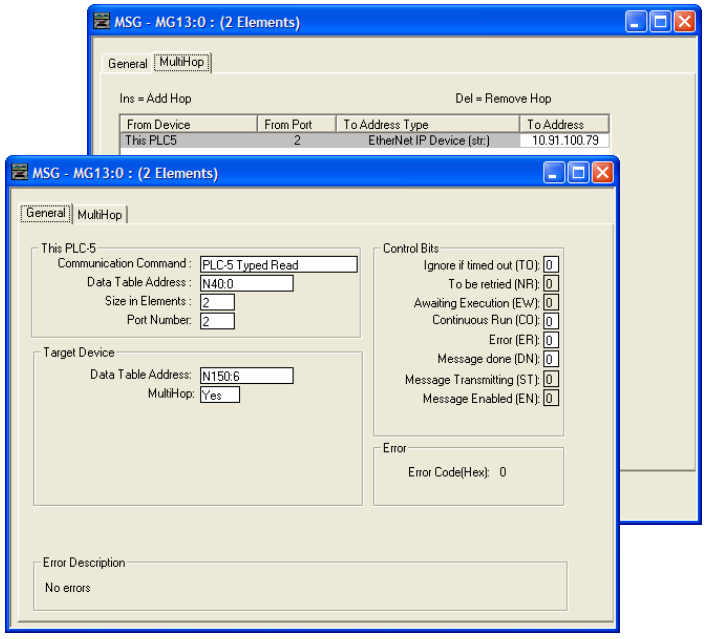
A read message is used to read a single parameter. The specific N150:6 address shown in this read message example reads the value of parameter 003 - [Output Current] in a PowerFlex 7-Class drive. Footnote 2 under the Figure 6.27 table shows other N-file addressing to read various integer and REAL (floating point) parameters in PowerFlex 7-Class and PowerFlex 750-Series drives.

Figure 6.26 Example Ladder Logic to Read a Single Parameter



PLC-5 – Formatting a Message to Read a Single Parameter

Figure 6.27 Read Single Message Configuration Screens



The following table identifies the data that is required in each box to configure a message to read a parameter.

General Tab	Example Value	Description
Communication Command	PLC-5 Typed Read	Controller type and command type for controller to read data from the drive.
Data Table Address	N40:0	An unused controller data table address containing the message instruction. This address is the starting word of the destination file.
Size in Elements	2 (1)	Number of elements (words) to be transferred. Each element size is a 16-bit integer.
Port Number	2	Controller port to which the network is connected.
Data Table Address	N150:6 (2)	Specific starting address of the source file in the drive.
MultiHop	Yes	Enables communication to allow network messaging to be routed to the drive.
MultiHop Tab	**Example Value**	**Description**
To Address	10.91.100.79	IP address of the adapter connected to the drive.

(1) Because the N-files used for the data transfer occupies two contiguous 16-bit words, the Size in Elements must always be set to 2 regardless of whether the parameter being read is a 16-bit parameter or a 32-bit parameter.

(2) See page C-11 for N-file addressing. Below are some examples of how to address N-files:

N-File Address	Data Type	Description	Notes
N150:6	32-bit integer	Parameter 3 of PowerFlex 70 drive	Example ladder logic rungs are shown in Figure 6.29 for these three different parameter data types.
N155:14	32-bit REAL	Parameter 7 of PowerFlex 750-Series drive	
N155:200	32-bit integer	Parameter 725 of PowerFlex 750-Series drive	
N209:154	32-bit REAL	Port 5: Parameter 77 of 24V I/O module in PowerFlex 750-Series drive	
N211:50	16-bit integer	Port 6: Parameter 25 of 20-COMM-E adapter in PowerFlex 750-Series drive	

PLC-5 Example Single Read Response Data

In this specific N150:6 message example, we use the data table address in Figure 6.28 to store the response value (0.13 amps) that was read from drive parameter 003 - [Output Current]. To determine the data type for the parameter and its required scaling, refer to the specific drive documentation.

Figure 6.28 Example Single Read Response Data File

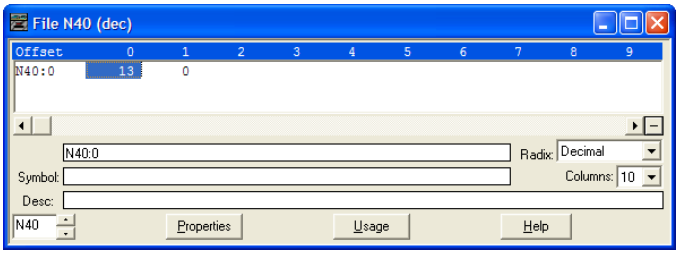
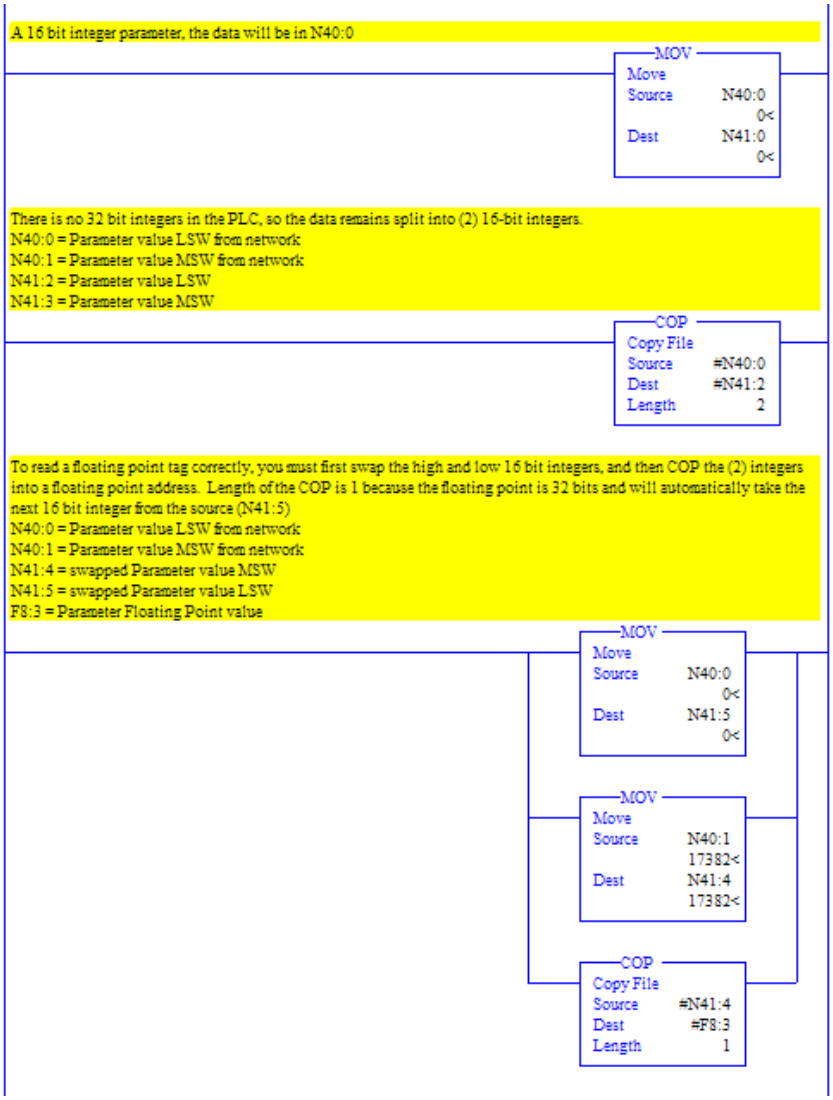


Figure 6.29 shows example ladder logic to correctly format the three possible data types for read messages in the PLC-5.

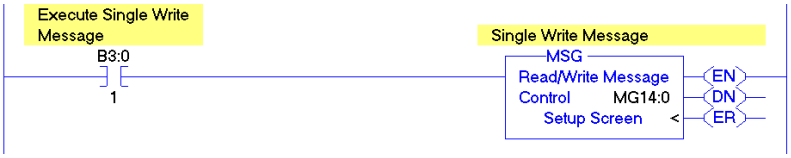
Figure 6.29 Example Ladder Logic to Format Parameter Data Types for Reads



PLC-5 Example Ladder Logic Program to Write a Single Parameter

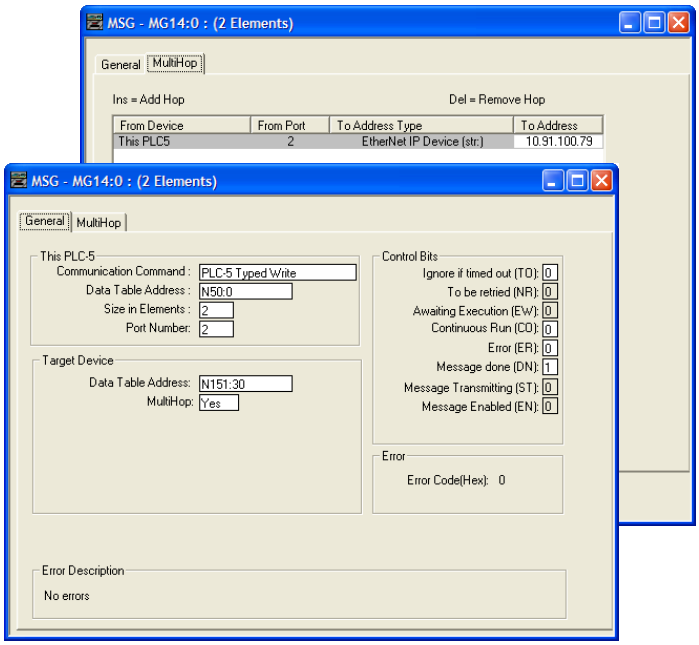
A write message is used to write to a single parameter. The specific N151:30 address shown in this write message example writes the value of parameter 140 - [Accel Time 1] in a PowerFlex 7-Class drive. Footnote 2 under the Figure 6.31 table shows other N-file addressing to write various integer and REAL (floating point) parameters in PowerFlex 7-Class and PowerFlex 750-Series drives.

Figure 6.30 Example Ladder Logic to Write a Single Parameter



PLC-5 – Formatting a Message to Write a Single Parameter

Figure 6.31 Write Single Message Configuration Screens



The following table identifies the data that is required in each box to configure a message to write a single parameter.

General Tab	Example Value	Description
Communication Command	PLC-5 Typed Write	Controller type and command type for controller to write data to the drive.
Data Table Address	N50:0	An unused controller data table address containing the message instruction. This address is the starting word of the source file.
Size in Elements	2 (1)	Number of elements (words) to be transferred. Each element size is a 16-bit integer.
Port Number	2	Controller port to which the network is connected.
Data Table Address	N151:30 (2)	Specific starting address of the destination file in the drive.
MultiHop	Yes	Enables communication to allow network messaging to be routed to the drive.
MultiHop Tab	**Example Value**	**Description**
To Address	10.91.100.79	IP address of the adapter connected to the drive.

(1) In this example, Accel Time 1 is a 16-bit parameter. Because the N151 file used for the data transfer occupies two contiguous 16-bit words, the Size in Elements must always be set to 2 regardless of whether the parameter being written to is a 16-bit parameter or a 32-bit parameter.

(2) See page C-11 for N-file addressing. Below are some examples of how to address N-files:

N-File Address	Data Type	Description	Notes
N151:30	16-bit integer	Parameter 140 of PowerFlex 70 drive	Example ladder logic rungs are shown in Figure 6.33 for these three different data types.
N150:50	32-bit REAL	Parameter 25 of PowerFlex 750-Series drive	
N155:200	32-bit integer	Parameter 725 of PowerFlex 750-Series drive	
N209:156	32-bit REAL	Port 5: Parameter 78 of 24V I/O module in PowerFlex 750-Series drive	
N201:14	16-bit integer	Port 1: Parameter 7 of 20-HIM-A6 HIM in PowerFlex 750-Series drive	

PLC-5 Example Single Write Response Data

In this specific N151:30 message example, we use the data table address in Figure 6.32 to store the request value (10.0 sec.) that was written to drive parameter 140 - [Accel Time 1]. To determine the data type for the parameter and its required scaling, refer to the specific drive documentation.

Figure 6.32 Example Single Write Response Data File

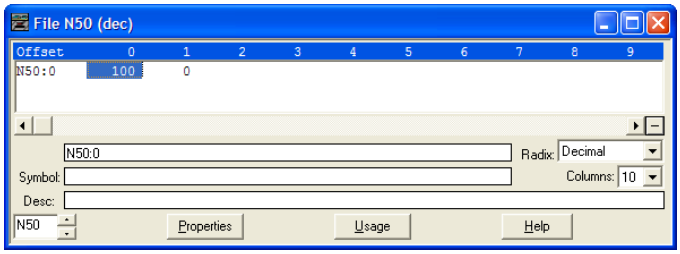
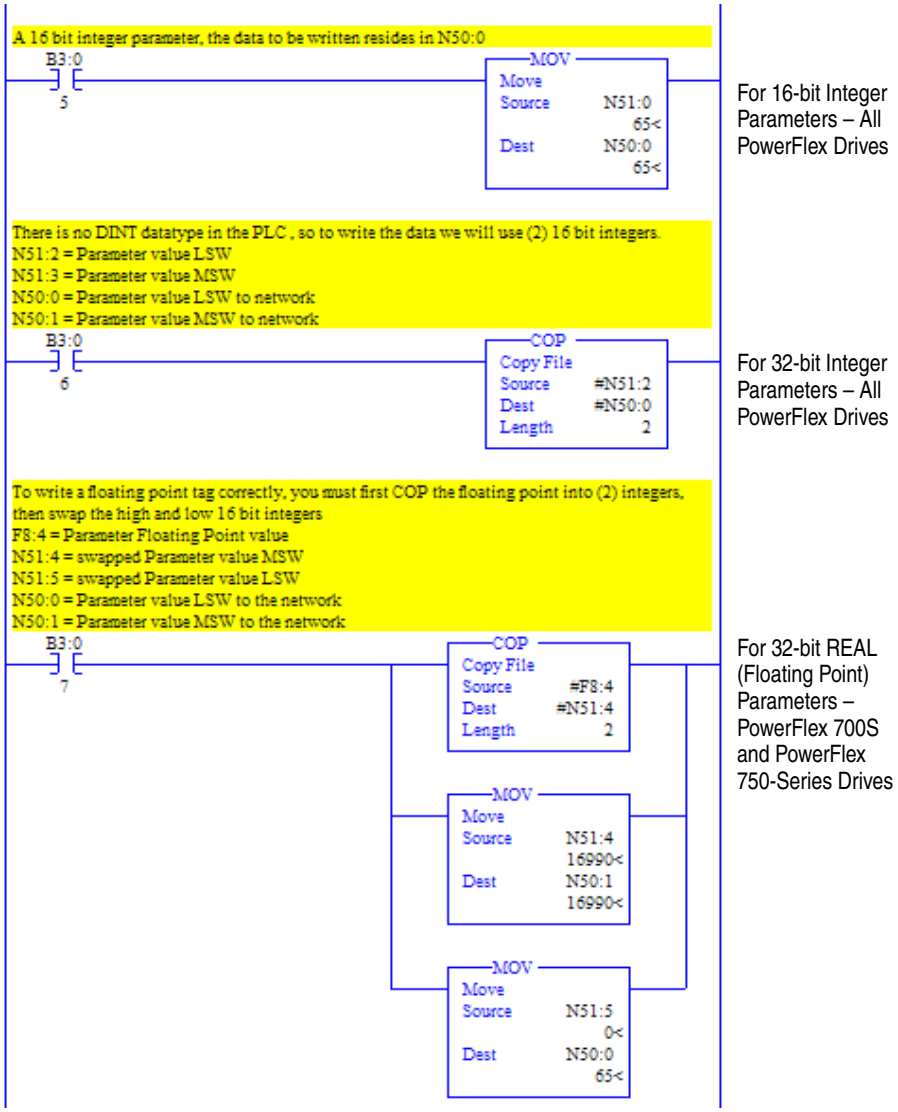


Figure 6.33 shows example ladder logic to correctly format the three possible data types for write messages in the PLC-5.

Figure 6.33 Example Ladder Logic to Format Parameter Data Types for Writes



PLC-5 Reading/Writing Multiple Parameters

You can read or write only contiguous parameters. Also, the range of contiguous parameters must be contained in the same N-File. Two elements (words) are required for each parameter being read or written. For example, to read 5 contiguous parameters, 10 elements (words) must be used.

SLC 500 Examples

When using RSLogix 500 version 7.10 or earlier, explicit messaging must be performed using the PCCC N-File method. For RSLogix 500 version 7.20 or later, the CIP messaging method has been added along with the PCCC N-File method. However, it is recommended to use the CIP method because it is easier to use and understand. For this reason, only instructions for the CIP method are provided. If you must use the PCCC N-File method, refer to the PLC-5 Examples on page 6-23.

The CIP messaging method provides two ways to perform explicit messaging:

- Read/Write Parameter Service simplifies setup by requiring less data to be entered in message configuration screens. However, the Read/Write Parameter Service can only be used to perform single parameter read or single parameter write explicit messages. (Multiple parameter reads or writes must be performed using the Generic Get/Set Attribute Service described below.)

  Important: When performing a Write Parameter message, the data will always be written to the drive's Non-Volatile Storage (NVS). Continuous NVS writes may damage the drive's EEPROM. If continuous writes are necessary, use the Generic Set Attribute Single Service and attribute A (10 decimal; see page 6-40).

- Generic Get/Set Attribute Service requires more setup data to be entered in message configuration screens, but can be used to perform single parameter read or write and multiple parameter read or write explicit messages. Also, the Generic Set Attribute Service offers the choice of writing the data to the drive's Non-Volatile Storage (NVS) or the drive's Random Access Memory (RAM; for Generic Set Attribute Single service only, see page 6-40). Note that when selecting the data to be written to RAM, the data will be lost if the drive loses power.

For supported classes, instances, and attributes, refer to Appendix C, EtherNet/IP Objects.

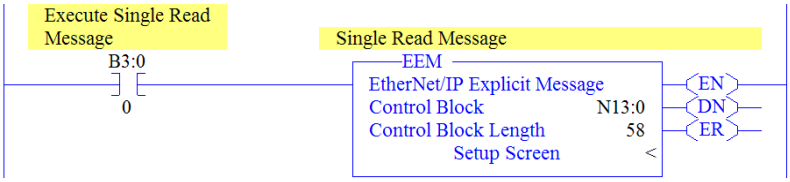
SLC 500 Explicit Messaging Using the Read/Write Parameter Service

SLC 500 Example Ladder Logic Program to Read a Single Parameter

A Read Parameter message is used to read a single parameter. This read message example reads the value of parameter 003 - [Output Current] in a PowerFlex 7-Class drive.

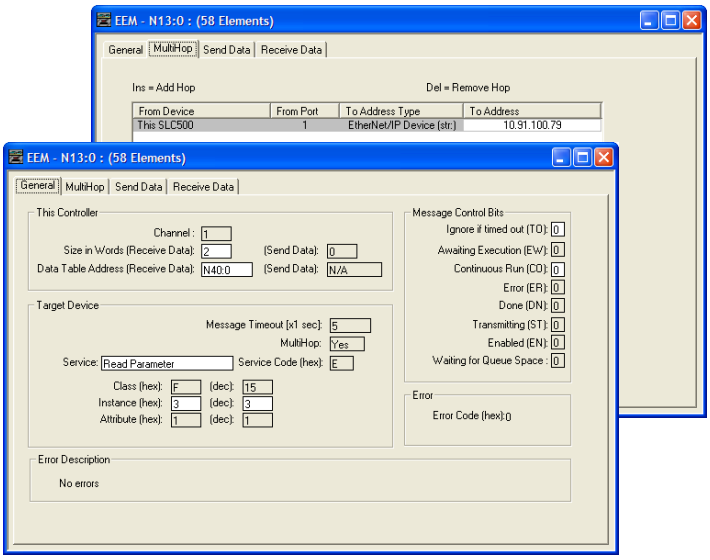
Important: Parameter Object Class code 0x0F is not supported in PowerFlex 750-Series drives. To do a single parameter read, follow the SLC 500 (Generic Attribute Service) single read example on page 6-36.

Figure 6.34 Example Ladder Logic to Read a Single Parameter



SLC 500 – Formatting a Message to Read a Single Parameter Using Read/Write Parameter Service

Figure 6.35 Read Parameter Message Configuration Screens



The following table identifies the data that is required in each box to configure a message to read a single parameter.

General Tab	Example Value	Description
Size in Words	2 (3)	Number of words to be transferred. Each word size is a 16-bit integer.
Data Table Address	N40:0	An unused controller data table address containing the message instruction. This address is the starting word of the destination file.
Service (1)	Read Parameter	Code for the requested service.
Instance (2)	3 (Dec.)	Instance number is the same as the parameter number.
MultiHop Tab	**Example Value**	**Description**
To Address	10.91.100.79	IP address of the adapter connected to the drive.

(1) The default setting for Service is “Custom,” enabling entry of a Service Code not available from the Service pull-down menu. When choosing a Service other than “Custom” from the pull-down menu, an appropriate Hex. value is automatically assigned to the Service Code box which is dimmed (unavailable).

(2) Only drive parameters (Port 0) can be read using Parameter Object Class code 0x0F. To read a parameter of a peripheral in another port, use DPI Parameter Object Class code 0x93 (see page 6-36).

(3) In this example, Output Current is a 32-bit parameter. If the parameter being read is a 16-bit parameter, the Size in Words would be set to 1. When the parameter being read is a 32-bit REAL (floating point) data type, the size in words would be set to 2. See the drive documentation to determine the size of the parameter and its data type (16-bit or 32-bit integer or REAL).

SLC 500 Example Read Single Response Data

In this message example, we use the data table address in Figure 6.36 to store the response value (0.13 amps) that was read from drive parameter 003 - [Output Current]. To determine the data type for the parameter and its required scaling, refer to the specific drive documentation.

Figure 6.36 Example Read Single Response Data File

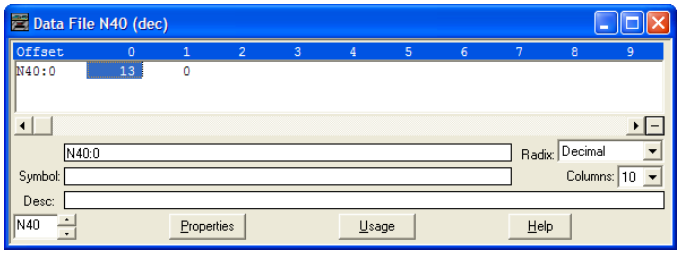
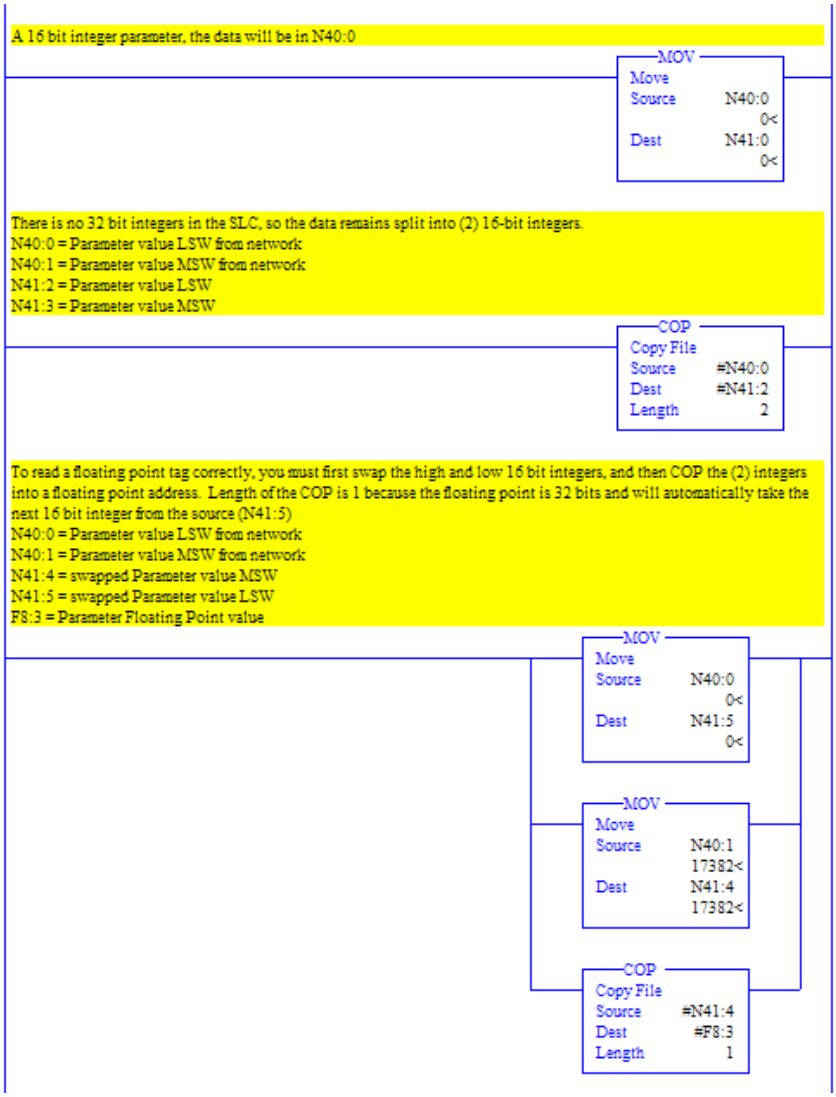


Figure 6.37 shows example ladder logic to correctly format the three possible data types for read messages in the SLC 500.

Figure 6.37 Example Ladder Logic to Format Parameter Data Types for Reads

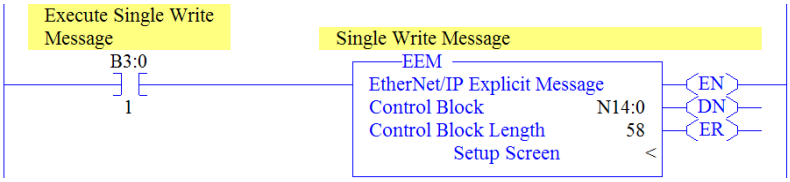


SLC 500 Example Ladder Logic Program to Write a Single Parameter Using Read/Write Parameter Service

A Write Parameter message is used to write to a single parameter. This write message example writes a value to parameter 140 - [Accel Time 1] in a PowerFlex 7-Class drive.

Important: Parameter Object Class code 0x0F is not supported in PowerFlex 750-Series drives. To do a single parameter write, follow the SLC 500 (Generic Attribute Service) single write example on page 6-39.

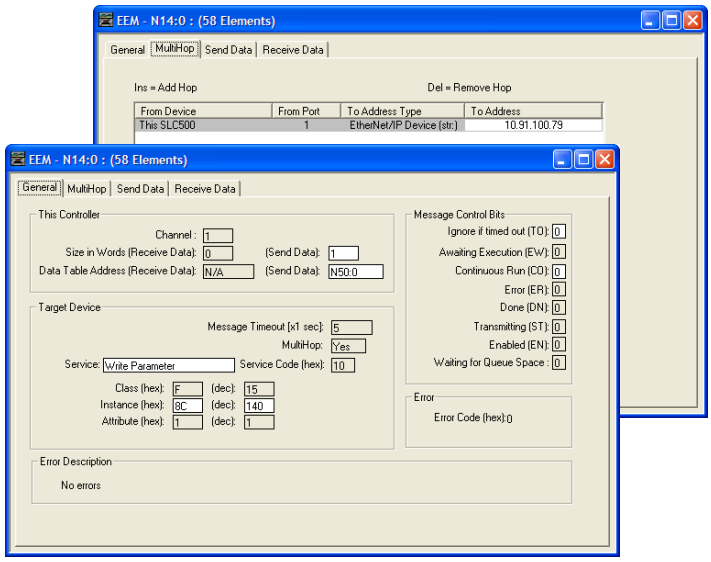
Figure 6.38 Example Ladder Logic to Write a Single Parameter



Important: If the explicit message single write must be written continuously, use DPI Parameter Object Class code 0x93 and attribute A (10 decimal; see page 6-40). This writes to RAM—not NVS (EEPROM) memory. This example single write message using Class code F writes to NVS. Over time, continuous writes will exceed the EEPROM life cycle and cause the drive to malfunction.

SLC 500 – Formatting a Message to Write a Single Parameter Using Read/Write Parameter Service

Figure 6.39 Write Parameter Message Configuration Screens



The following table identifies the data that is required in each box to configure a message to write a single parameter.

General Tab	Example Value	Description
Size in Words	1 (3)	Number of words to be transferred. Each word size is a 16-bit integer.
Data Table Address	N50:0	An unused controller data table address containing the message instruction. This address is the starting word of the source file.
Service (1)	Write Parameter	Code for the requested service.
Instance (2)	140 (Dec.)	Instance number is the same as the parameter number.
MultiHop Tab	**Example Value**	**Description**
To Address	10.91.100.79	IP address of the adapter connected to the drive.

(1) The default setting for Service is “Custom,” enabling entry of a Service Code not available from the Service pull-down menu. When choosing a Service other than “Custom” from the pull-down menu, an appropriate Hex. value is automatically assigned to the Service Code box which is dimmed (unavailable).

(2) Only drive parameters (Port 0) can be written to using Parameter Object Class code 0x0F. To write to a parameter of a peripheral in another port, use DPI Parameter Object Class code 0x93 (see page 6-39).

(3) In this example, Accel Time 1 is a 16-bit parameter. If the parameter being written to is a 32-bit parameter, the Size in Words would be set to 2. When the parameter being written to is a 32-bit REAL (floating point) data type, the size in words would be set to 2. See the drive documentation to determine the size of the parameter and its data type (16-bit or 32-bit integer or REAL).

SLC 500 Example Write Single Request Data

In this message example, we use the data table address in Figure 6.40 to store the request value (10.0 sec.) that was written to drive parameter 140 - [Accel Time 1]. To determine the data type for the parameter and its required scaling, refer to the specific drive documentation.

Figure 6.40 Example Write Single Request Data File

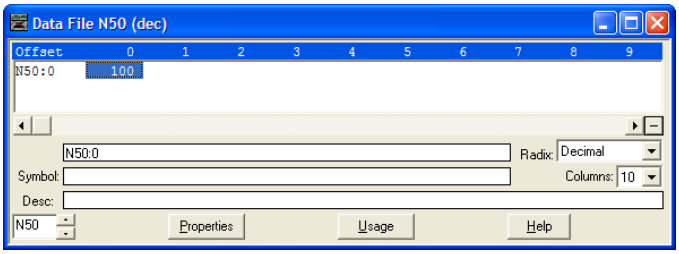
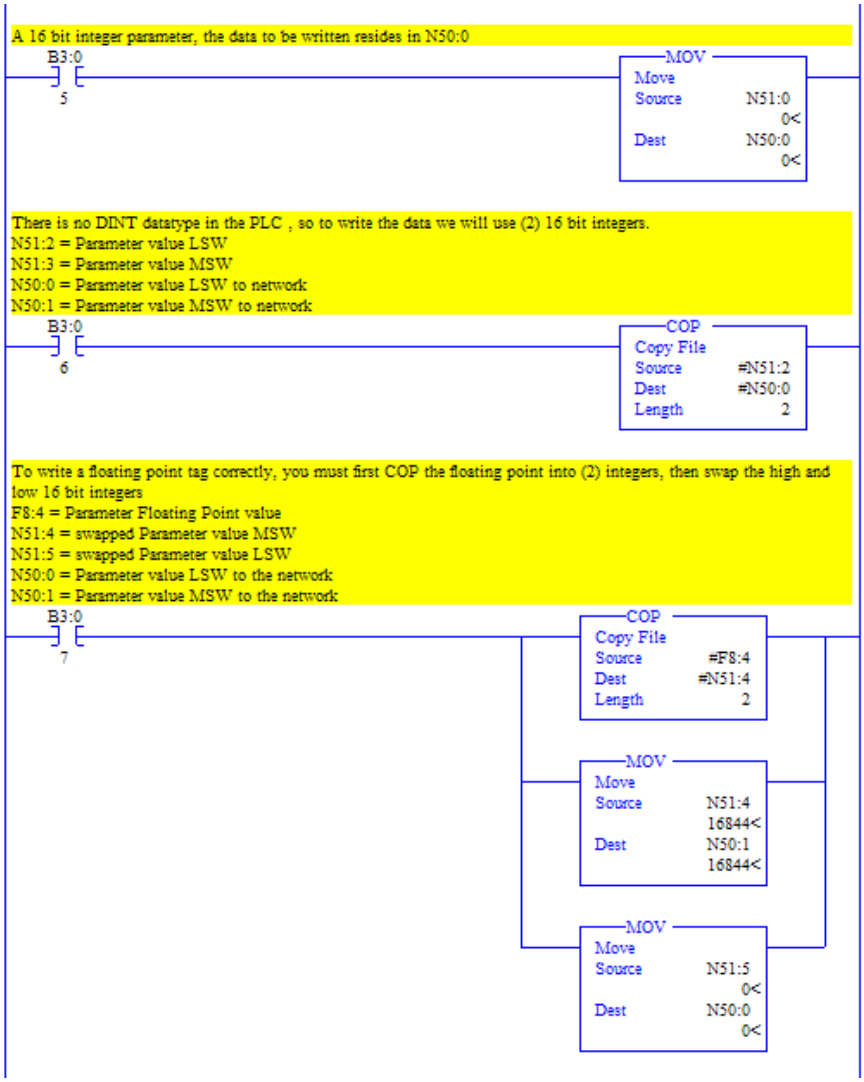


Figure 6.41 shows example ladder logic to correctly format the three possible data types for write messages in the SLC 500.

Figure 6.41 Example Ladder Logic to Format Parameter Data Types for Writes



For 16-bit Integer Parameters – All PowerFlex 7-Class Drives

For 32-bit Integer Parameters – All PowerFlex 7-Class Drives

For 32-bit REAL (Floating Point) Parameters – PowerFlex 700S Drives

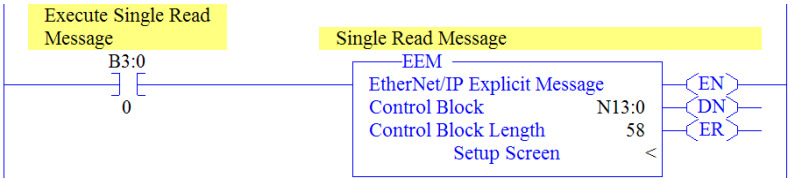
SLC 500 Explicit Messaging Using the Generic Get/Set Attribute Service

SLC 500 Example Ladder Logic Program to Read a Single Parameter

A Generic Get Attribute Single message is used to read a single parameter. This read message example reads the value of parameter 003 - [Output Current] in a PowerFlex 7-Class drive.

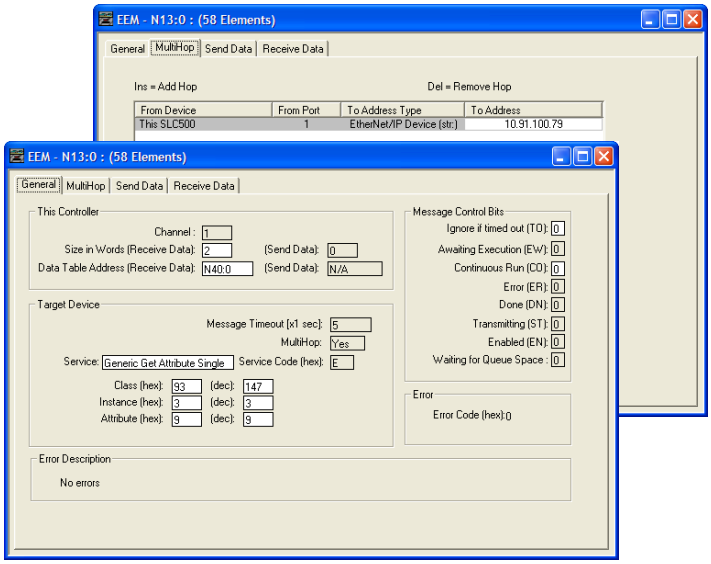
Important: See Table 6.A on page 6-2 for limitations of PowerFlex 7-Class and PowerFlex 750-Series drives when using Class code 0x93 or Class code 0x9F for explicit messaging.

Figure 6.42 Example Ladder Logic to Read a Single Parameter



SLC 500 – Formatting a Message to Read a Single Parameter Using Generic Get/Set Attribute Service

Figure 6.43 Generic Get Attribute Single Message Configuration Screens



The following table identifies the data that is required in each box to configure a message to read a single parameter.

General Tab	Example Value	Description
Size in Words	2 (3)	Number of words to be transferred. Each word size is a 16-bit integer.
Data Table Address	N40:0	An unused controller data table address containing the message instruction. This address is the starting word of the destination file.
Service (1)	Generic Get Attribute Single	Code for the requested service.
Class	93 or 9F (Hex.) (4)	Class ID for the DPI Parameter Object.
Instance (2)	3 (Dec.)	Instance number is the same as the parameter number.
Attribute	9 (Dec.)	Attribute number for the Parameter Value attribute.
MultiHop Tab	**Example Value**	**Description**
To Address	10.91.100.79	IP address of the adapter connected to the drive.

(1) The default setting for Service is “Custom,” enabling entry of a Service Code not available from the Service pull-down menu. When choosing a Service other than “Custom” from the pull-down menu, an appropriate Hex. value is automatically assigned to the Service Code box which is dimmed (unavailable).

(2) The instance is the parameter number in the drive (Port 0). For example, to read parameter 4 of a peripheral in Port 5 of a PowerFlex 750-Series drive, the instance would be 21504 + 4 = 21508. See DPI Parameter Object on page C-16 (Class code 0x93) or Host DPI Parameter Object on page C-30 (Class code 0x9F) to determine the instance number.

(3) In this example, Output Current is a 32-bit parameter. If the parameter being read is a 16-bit parameter, the Size in Words would be set to 1. When the parameter being read is a 32-bit REAL (floating point) data type, the size in words would be set to 2. See the drive documentation to determine the size of the parameter and its data type (16-bit or 32-bit integer or REAL).

(4) See Table 6.A on page 6-2 for limitations of PowerFlex 7-Class and PowerFlex 750-Series drives when using DPI Parameter Object Class code 0x93 or Host DPI Parameter Object Class code 0x9F for explicit messaging.

SLC 500 Example Get Attribute Single Response Data

In this message example, we use the data table address in Figure 6.44 to store the response value (0.13 amps) that was read from drive parameter 003 - [Output Current]. To determine the data type for the parameter and its required scaling, refer to the specific drive documentation.

Figure 6.44 Example Get Attribute Single Response Data File

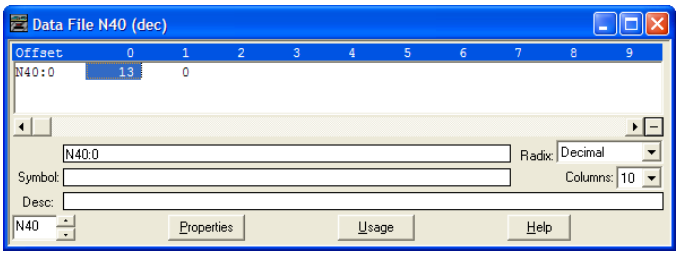
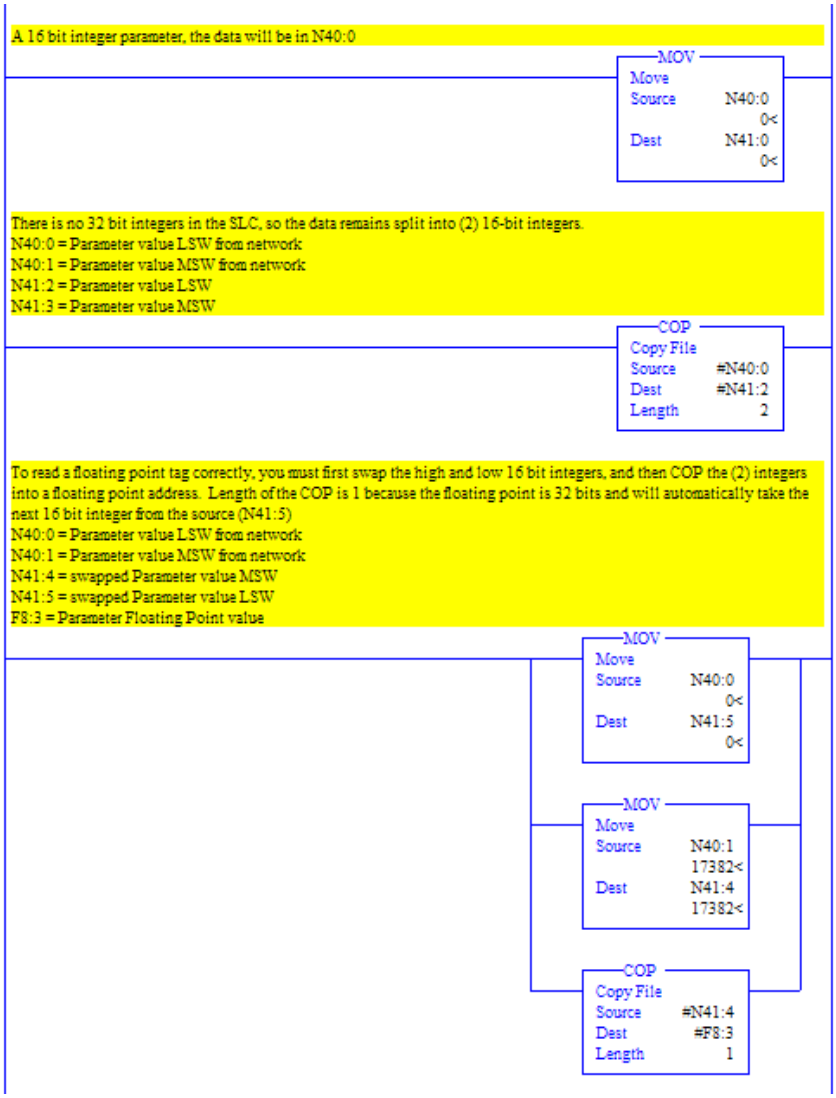


Figure 6.45 shows example ladder logic to correctly format the three possible data types for get messages in the SLC 500.

Figure 6.45 Example Ladder Logic to Format Parameter Data Types for Gets

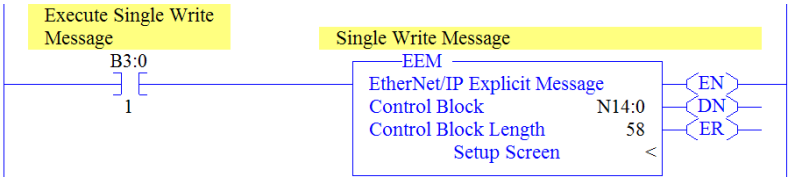


SLC 500 Example Ladder Logic Program to Write a Single Parameter Using Generic Get/Set Attribute Service

A Generic Set Attribute Single message is used to write to a single parameter. This write message example writes a value to parameter 140 - [Accel Time 1] in a PowerFlex 7-Class drive.

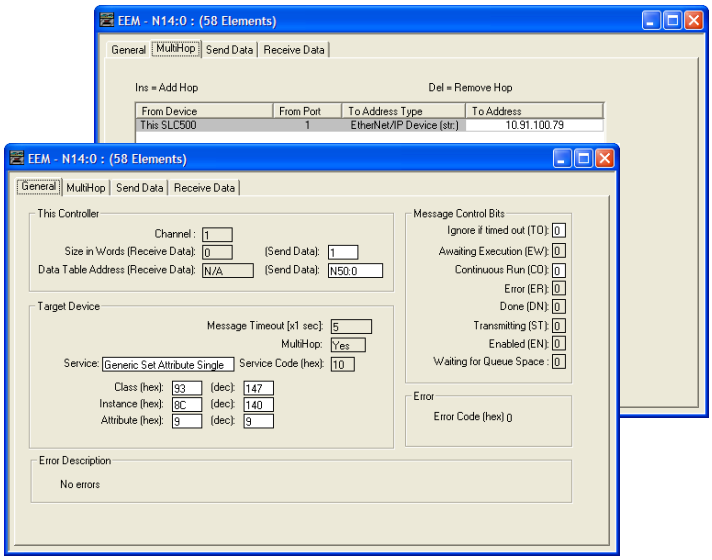
Important: See Table 6.A on page 6-2 for limitations of PowerFlex 7-Class and PowerFlex 750-Series drives when using Class code 0x93 or Class code 0x9F for explicit messaging.

Figure 6.46 Example Ladder Logic to Write a Single Parameter



SLC 500 – Formatting a Message to Write a Single Parameter Using Generic Get/Set Attribute Service

Figure 6.47 Generic Set Attribute Single Message Configuration Screens



The following table identifies the data that is required in each box to configure a message to write a single parameter.

General Tab	Example Value	Description
Size in Words	1 (4)	Number of words to be transferred. Each word size is a 16-bit integer.
Data Table Address	N50:0	An unused controller data table address containing the message instruction. This address is the starting word of the source file.
Service (1)	Generic Set Attribute Single	Code for the requested service.
Class	93 or 9F (Hex.) (5)	Class ID for the DPI Parameter Object.
Instance (2)	140 (Dec.)	Instance number is the same as the parameter number.
Attribute (3)	9 or 10 (Dec.)	Attribute number for the Parameter Value attribute.
MultiHop Tab	**Example Value**	**Description**
To Address	10.91.100.79	IP address of the adapter connected to the drive.

(1) The default setting for Service is “Custom,” enabling entry of a Service Code not available from the Service pull-down menu. When choosing a Service other than “Custom” from the pull-down menu, an appropriate Hex. value is automatically assigned to the Service Code box which is dimmed (unavailable).

(2) The instance is the parameter number in the drive (Port 0). For example, to write to parameter 4 of a peripheral in Port 5 of a PowerFlex 750-Series drive, the instance would be 21504 + 4 = 21508. See DPI Parameter Object on page C-16 (Class code 0x93) or Host DPI Parameter Object on page C-30 (Class code 0x9F) to determine the instance number.

(3) Setting the Attribute value to “9” will write the parameter value to the drive’s Non-Volatile Storage (EEPROM) memory, so the parameter value will remain even after the drive is power cycled. **Important:** When set to “9,” be very cautious as the EEPROM may quickly exceed its life cycle and cause the drive to malfunction. Setting the Attribute value to “A” (10 decimal) will write the parameter value to temporary memory, so the parameter value will be lost after the drive is power cycled. It is recommended to use the “A” (10 decimal) setting when frequent write messages are required.

(4) In this example, Accel Time 1 is a 16-bit parameter. If the parameter being written to is a 32-bit parameter, the Size in Words would be set to 2. When the parameter being written to is a 32-bit REAL (floating point) data type, the size in words would be set to 2. See the drive documentation to determine the size of the parameter and its data type (16-bit or 32-bit integer or REAL).

(5) See Table 6.A on page 6-2 for limitations of PowerFlex 7-Class and PowerFlex 750-Series drives when using DPI Parameter Object Class code 0x93 or Host DPI Parameter Object Class code 0x9F for explicit messaging.

SLC 500 Example Set Attribute Single Request Data

In this message example, we use the data table address in Figure 6.48 to store the request value (10.0 sec.) that was written to drive parameter 140 - [Accel Time 1]. To determine the data type for the parameter and its required scaling, refer to the specific drive documentation.

Figure 6.48 Example Set Attribute SIngle Request Data File

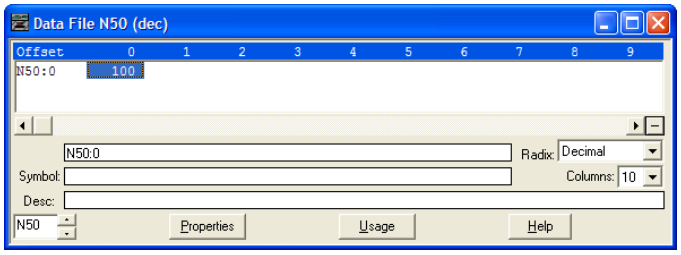
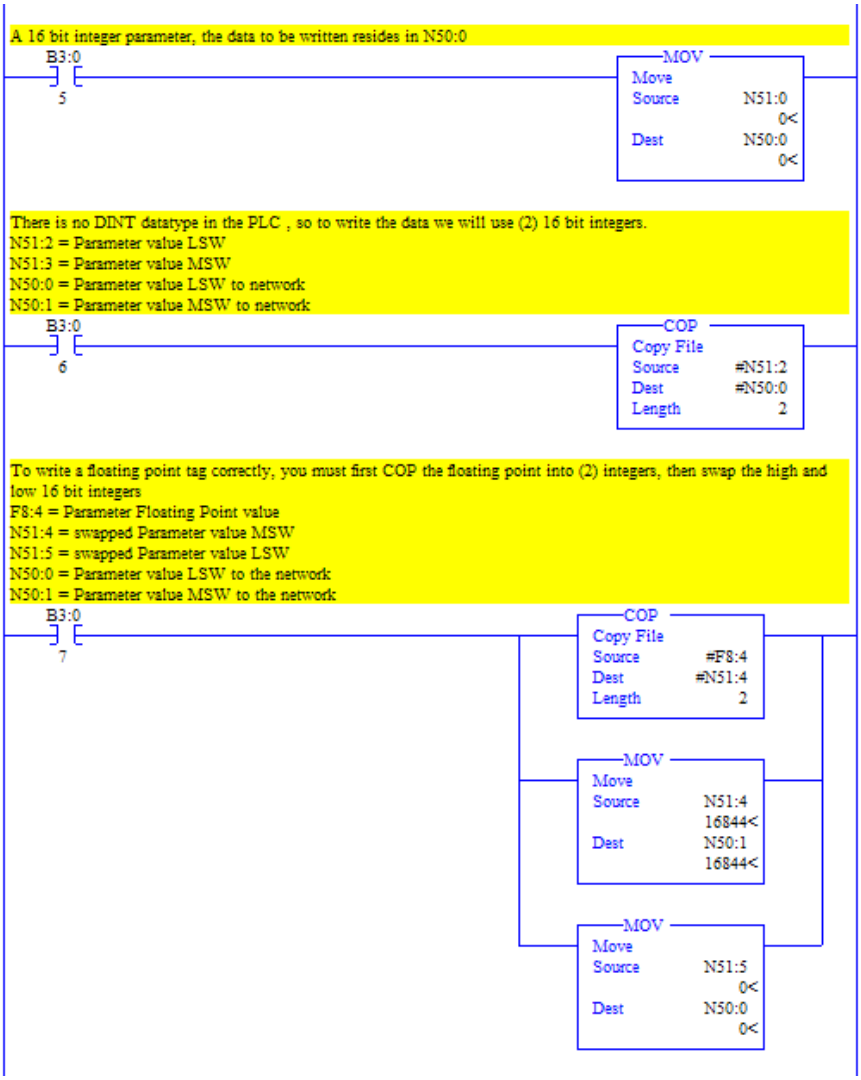


Figure 6.49 shows example ladder logic to correctly format the three possible data types for set messages in the SLC 500.

Figure 6.49 Example Ladder Logic to Format Parameter Data Types for Sets



For 16-bit Integer Parameters – All PowerFlex Drives

For 32-bit Integer Parameters – All PowerFlex Drives

For 32-bit REAL (Floating Point) Parameters – PowerFlex 700S and PowerFlex 750-Series Drives

SLC 500 Example Ladder Logic Program to Read Multiple Parameters Using Generic Get/Set Attribute Service

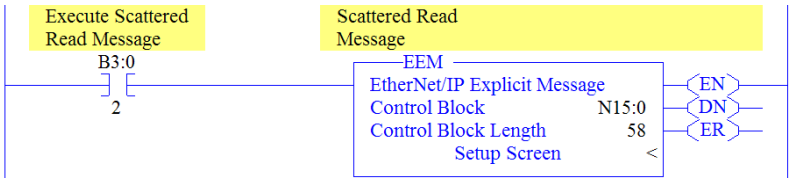
A Custom scattered read message is used to read the values of multiple parameters. This read message example reads the values of these five parameters:

PowerFlex 7-Class Drive	PowerFlex 750-Series Drive
• Parameter 001 - [Output Freq] • Parameter 003 - [Output Current] • Parameter 006 - [Output Voltage] • Parameter 012 - [DC Bus Voltage] • Parameter 017 - [Analog In1 Value]	• Parameter 001 - [Output Freq] • Parameter 007 - [Output Current] • Parameter 137 - [Open Loop Fdbk] • Parameter 21581 - [Port 5: Analog Out 0 Data] • Parameter 260 - [Analog In0 Value]

Refer to DPI Parameter Object on page C-16 (Class code 0x93) or Host DPI Parameter Object on page C-30 (Class code 0x9F) for parameter numbering.

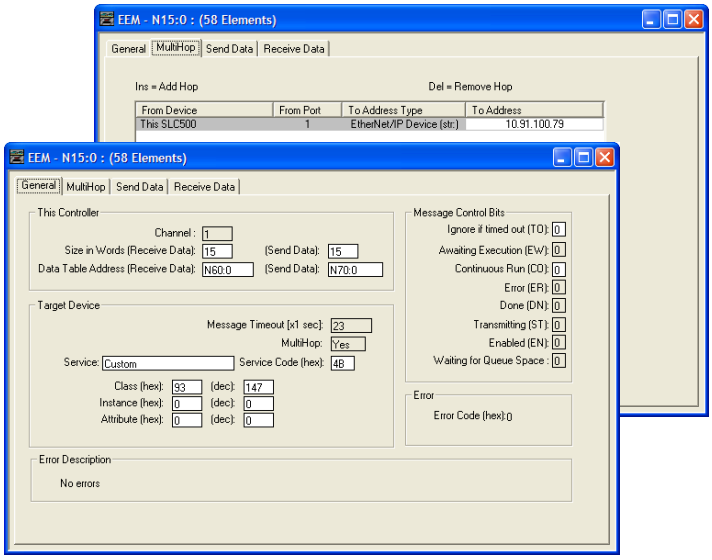
Important: See Table 6.A on page 6-2 for limitations of PowerFlex 7-Class and PowerFlex 750-Series drives when using Class code 0x93 or Class code 0x9F for explicit messaging.

Figure 6.50 Example Ladder Logic to Read Multiple Parameters



SLC 500 – Formatting a Message to Read Multiple Parameters Using Generic Get/Set Attribute Service

Figure 6.51 Custom Scattered Read Message Configuration Screens



The following table identifies the data that is required in each box to configure a message to read multiple parameters.

General Tab	Example Value	Description
Size in Words	15 (2)	Number of words to be transferred. Each word size is a 16-bit integer.
Data Table Address	N60:0	An unused controller data table address containing the message instruction. This address is the starting word of the destination file.
Service (1)	Custom	Required for scattered messages.
Service Code	4B (Hex.)	Code for the requested service.
Class	93 or 9F (Hex.) (3)	Class ID for the DPI Parameter Object.
Instance	0 (Dec.)	Required for scattered messages.
Attribute	0 (Dec.)	Required for scattered messages.
MultiHop Tab	**Example Value**	**Description**
To Address	10.91.100.79	IP address of the adapter connected to the drive.

(1) The default setting for Service is “Custom,” enabling entry of a Service Code not available from the Service pull-down menu. When choosing a Service other than “Custom” from the pull-down menu, an appropriate Hex. value is automatically assigned to the Service Code box which is dimmed (unavailable).

(2) In this example, we are reading five parameters. Each parameter being read requires three contiguous 16-bit words. Scattered read messages always assume that every parameter being read is a 32-bit parameter, regardless of its actual size. The data structure format is the same as shown on page 6-52. Maximum length is 66 words, which equates to 22 parameters. For parameter numbering, see DPI Parameter Object on page C-16 (Class code 0x93) or Host DPI Parameter Object on page C-30 (Class code 0x9F).

(3) See Table 6.A on page 6-2 for limitations of PowerFlex 7-Class and PowerFlex 750-Series drives when using DPI Parameter Object Class code 0x93 or Host DPI Parameter Object Class code 0x9F for explicit messaging.

SLC 500 Example Scattered Read Request Data

In this message example, we use the data table addresses in Figure 6.52 or Figure 6.53 to store the request values to be read from these drive parameters:

PowerFlex 7-Class Drive	PowerFlex 750-Series Drive
• Parameter 001 - [Output Freq] • Parameter 003 - [Output Current] • Parameter 006 - [Output Voltage] • Parameter 012 - [DC Bus Voltage] • Parameter 017 - [Analog In1 Value]	• Parameter 001 - [Output Freq] • Parameter 007 - [Output Current] • Parameter 137 - [Open Loop Fdbk] • Parameter 21581 - [Port 5: Analog Out 0 Data] • Parameter 260 - [Analog In0 Value]

Refer to DPI Parameter Object on page C-16 (Class code 0x93) or Host DPI Parameter Object on page C-30 (Class code 0x9F) for parameter numbering.

Figure 6.52 Example Scattered Read Request Data File for PowerFlex 7-Class Drive

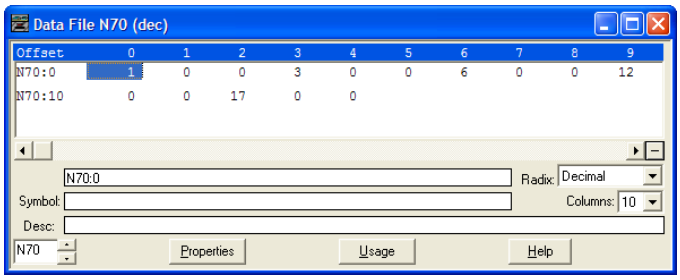
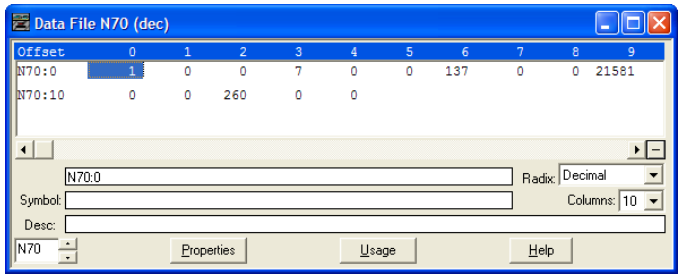


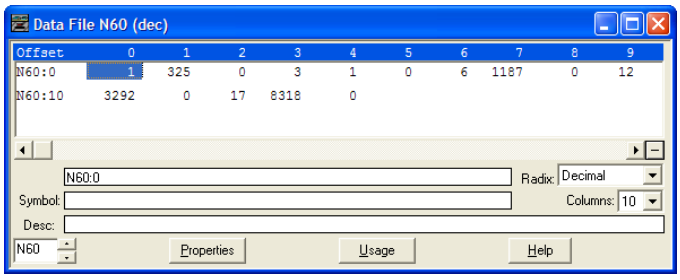
Figure 6.53 Example Scattered Read Request Data File for PowerFlex 750-Series Drive



SLC 500 Example Scattered Read Response Data

In this message example, we use the data table addresses in Figure 6.54 or Figure 6.55 to store the response values that were read from the requested drive parameters.

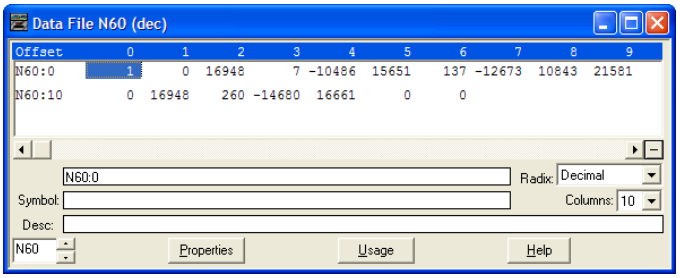
Figure 6.54 Example Scattered Read Response Data File for PowerFlex 7-Class Drive



In this example, the parameters have the following values:

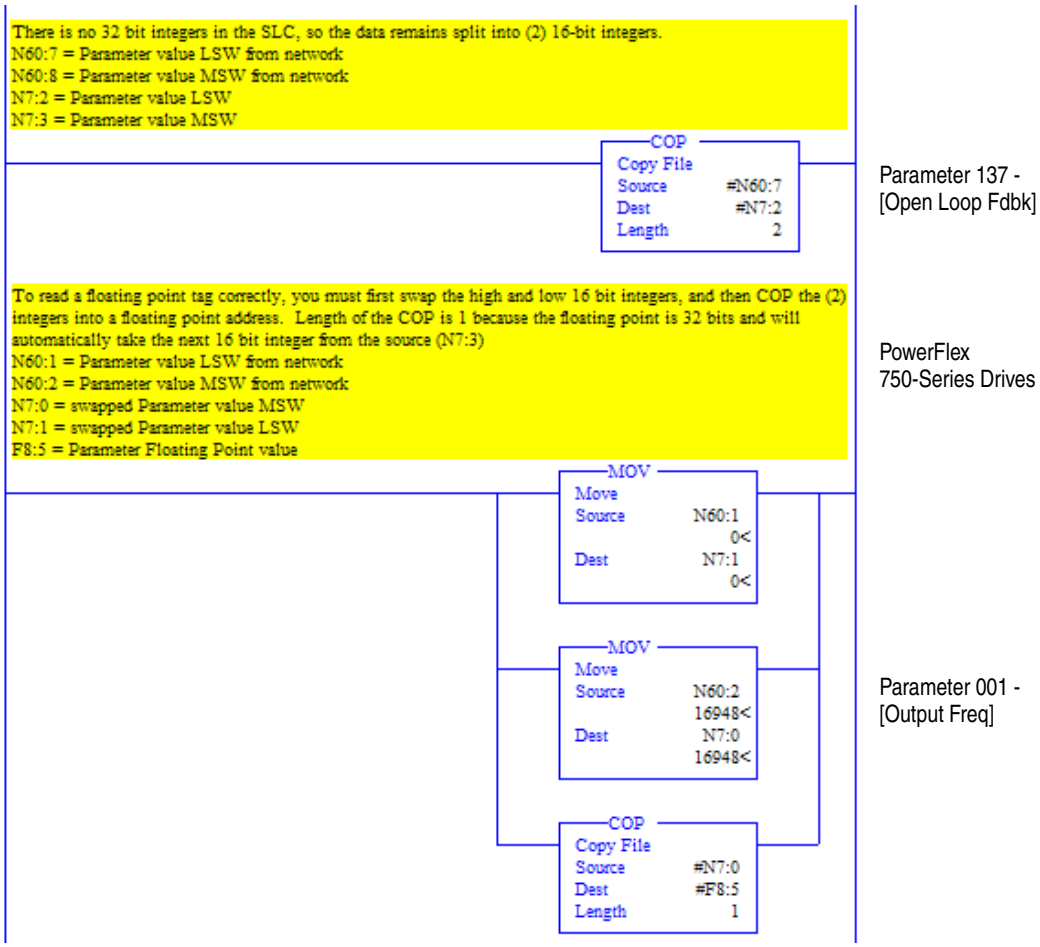
PowerFlex 7-Class Drive Parameter	Address	Read Value
1 - [Output Freq]	N60:1	32.5 Hz
3 - [Output Current]	N60:4	0.01 Amp
6 - [Output Voltage]	N60:7	118.7 VAC
12 - [DC Bus Voltage]	N60:10	329.2 VDC
17 - [Analog In2 Value]	N60:13	8.318 mA

Figure 6.55 Example Scattered Read Response Data File for PowerFlex 750-Series Drive



The PowerFlex 750-Series drive uses 32-bit integer and REAL parameters. A COP command must be used to copy the N60 integer array to a 16-bit integer or floating tag. Figure 6.56 shows the ladder logic used for this example. If the parameter data type is a 32-bit integer, the data remains split into two 16-bit integers since there are no 32-bit integers in the SLC 500. If the parameter data type is a REAL, then the destination tag is a floating point. In this case, the value must first be swapped with the high and low 16-bit integers, and then the two integers copied (COP) into a floating point address. See the drive documentation to determine the parameter data type (32-bit integer or REAL).

Figure 6.56 Example Ladder Logic to Copy Response Data for PowerFlex 750-Series Drive



In this message example, the parameters have the following values:

PowerFlex 750-Series Drive Parameter	Read Value	Data Type
1 - [Output Freq]	45.0 Hz	REAL
7 - [Output Current]	0.04 Amp	REAL
137 - [Open Loop Fdbk]	710659711	DINT
21581 - [Port 5: Analog Out 0 Data]	45.0 Hz	REAL
260 - [Analog In0 Value]	9.361 Volts	REAL

SLC 500 Example Ladder Logic Program to Write Multiple Parameters Using Generic Get/Set Attribute Service

A Custom scattered write message is used to write to multiple parameters. This write message example writes the following values to these five parameters:

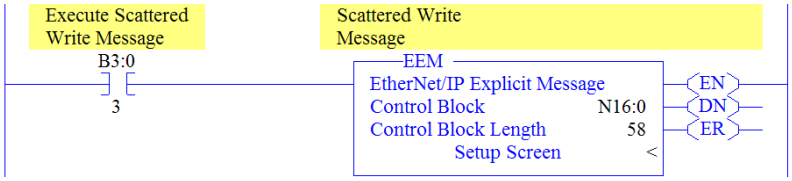
PowerFlex 7-Class Drive Parameter	Write Value
141 - [Accel Time 2]	11.1 Sec.
143 - [Decel Time 2]	22.2 Sec.
105 - [Preset Speed 5]	33.3 Hz.
106 - [Preset Speed 6]	44.4 Hz.
107 - [Preset Speed 7]	55.5 Hz.

PowerFlex 750-Series Drive Parameter	Write Value
536 - [Accel Time 2]	11.1 Sec.
538 - [Decel Time 2]	22.2 Sec.
725 - [Zero Position]	33
21555 - [Port 5: Analog In0 Hi]	5.5
780 - [PTP Setpoint]	-75,555

Refer to DPI Parameter Object on page C-16 (Class code 0x93) or Host DPI Parameter Object on page C-30 (Class code 0x9F) for parameter numbering.

Important: See Table 6.A on page 6-2 for limitations of PowerFlex 7-Class and PowerFlex 750-Series drives when using Class code 0x93 or Class code 0x9F for explicit messaging.

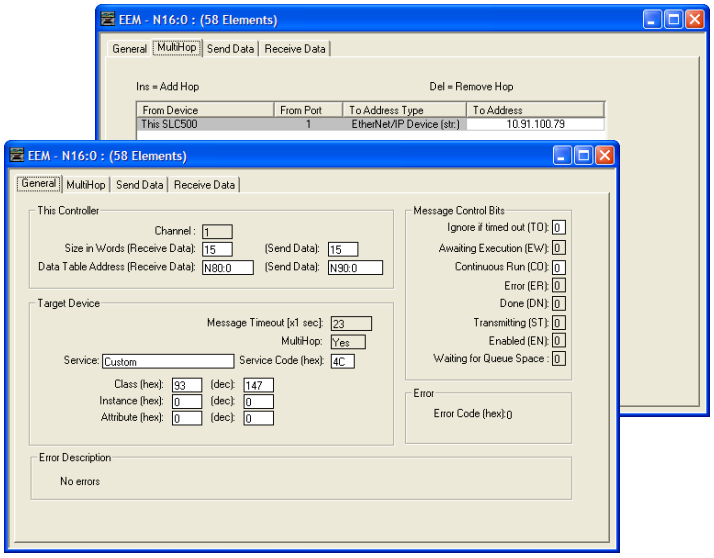
Figure 6.57 Example Ladder Logic to Write Multiple Parameters



Important: If the explicit message scattered write must be written continuously, then use a separate Generic Set service explicit message single write for each parameter using DPI Parameter Object Class code 0x93 or Host DPI Parameter Object Class code 0x9F and attribute A (10 decimal; see page 6-40). Attribute A writes to RAM—not NVS (EEPROM) memory. This example scattered write message using attribute 0 writes to NVS. Over time, continuous writes will exceed the EEPROM life cycle and cause the drive to malfunction.

SLC 500 – Formatting a Message to Write Multiple Parameters Using Generic Get/Set Attribute Service

Figure 6.58 Custom Scattered Write Multiple Message Configuration Screens



The following table identifies the data that is required in each box to configure a message to write multiple parameters.

General Tab	Example Value	Description
Size in Words	15 (2)	Number of words to be transferred. Each word size is a 16-bit integer.
Data Table Address	N80:0	An unused controller data table address containing the message instruction. This address is the starting word of the source file.
Service (1)	Custom	Required for scattered messages.
Service Code	4C (Hex.)	Code for the requested service.
Class	93 or 9F (Hex.) (3)	Class ID for the DPI Parameter Object.
Instance	0 (Dec.)	Required for scattered messages.
Attribute	0 (Dec.)	Required for scattered messages.
MultiHop Tab	**Example Value**	**Description**
To Address	10.91.100.79	IP address of the adapter connected to the drive.

(1) The default setting for Service is “Custom,” enabling entry of a Service Code not available from the Service pull-down menu. When choosing a Service other than “Custom” from the pull-down menu, an appropriate Hex. value is automatically assigned to the Service Code box which is dimmed (unavailable).

(2) In this example, we are writing to five parameters. Each parameter being written to requires three contiguous 16-bit words. Scattered write messages always assume that every parameter being written to is a 32-bit parameter, regardless of its actual size. The data structure format is the same as shown on page 6-52. Maximum length is 66 words, which equates to 22 parameters. For parameter numbering, see DPI Parameter Object on page C-16 (Class code 0x93) or Host DPI Parameter Object on page C-30 (Class code 0x9F).

(3) See Table 6.A on page 6-2 for limitations of PowerFlex 7-Class and PowerFlex 750-Series drives when using DPI Parameter Object Class code 0x93 or Host DPI Parameter Object Class code 0x9F for explicit messaging.

SLC 500 Example Scattered Write Request Data

In this message example, we use the data table addresses in Figure 6.59 or to store the request values to be written to these drive parameters:

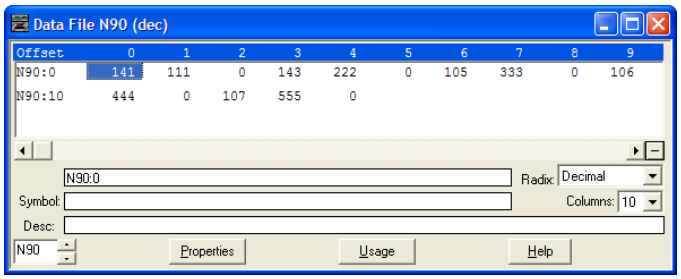
PowerFlex 7-Class Drive Parameter	Address	Write Value
141 - [Accel Time 2]	N90:1	11.1 Sec.
143 - [Decel Time 2]	N90:4	22.2 Sec.
105 - [Preset Speed 5]	N90:7	33.3 Hz.
106 - [Preset Speed 6]	N90:10	44.4 Hz.
107 - [Preset Speed 7]	N90:13	55.5 Hz.

PowerFlex 750-Series Drive Parameter	Write Value	Data Type
536 - [Accel Time 2]	11.1 Sec.	REAL
538 - [Decel Time 2]	22.2 Sec.	REAL
725 - [Zero Position]	33	32-bit integer
21555 - [Port 5: Analog In0 Hi]	5.5	REAL
780 - [PTP Setpoint]	-75,555	32-bit integer

Refer to DPI Parameter Object on page C-16 (Class code 0x93) or Host DPI Parameter Object on page C-30 (Class code 0x9F) for parameter numbering.

Figure 6.59 or Figure 6.62 shows the parameter values.

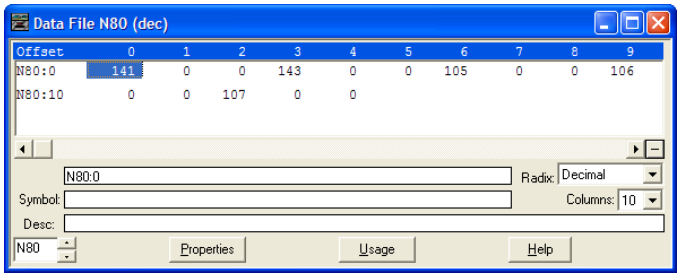
Figure 6.59 Example Scattered Write Request Data File for PowerFlex 7-Class Drive



SLC 500 Example Scattered Write Response Data

In this message example, we use the data table addresses in Figure 6.60 to store the response values that were written to the requested drive parameters. Values of “0” indicate no errors occurred.

Figure 6.60 Example Scattered Write Response Data File for PowerFlex 7-Class Drive



The PowerFlex 750-Series drive uses 32-bit integer and REAL parameters. A COP command must be used to copy the 16-bit integer or REAL values to the N90 integer array. Figure 6.61 shows the ladder logic used for this example. If the parameter data type is a 32-bit integer, the data remains split into two 16-bit integers since there are no 32-bit integers in the SLC 500. If the parameter data type is a REAL, the floating point value in the SLC 500

is copied (COP) to two 16-bit integers. Then the MSW (most significant word) and LSW (least significant word) must be swapped before moving (MOV) the values to the array to be written to. See the drive documentation to determine the parameter data type (32-bit integer or REAL).

Figure 6.61 Example Ladder Logic to Copy Request Data for PowerFlex 750-Series Drive

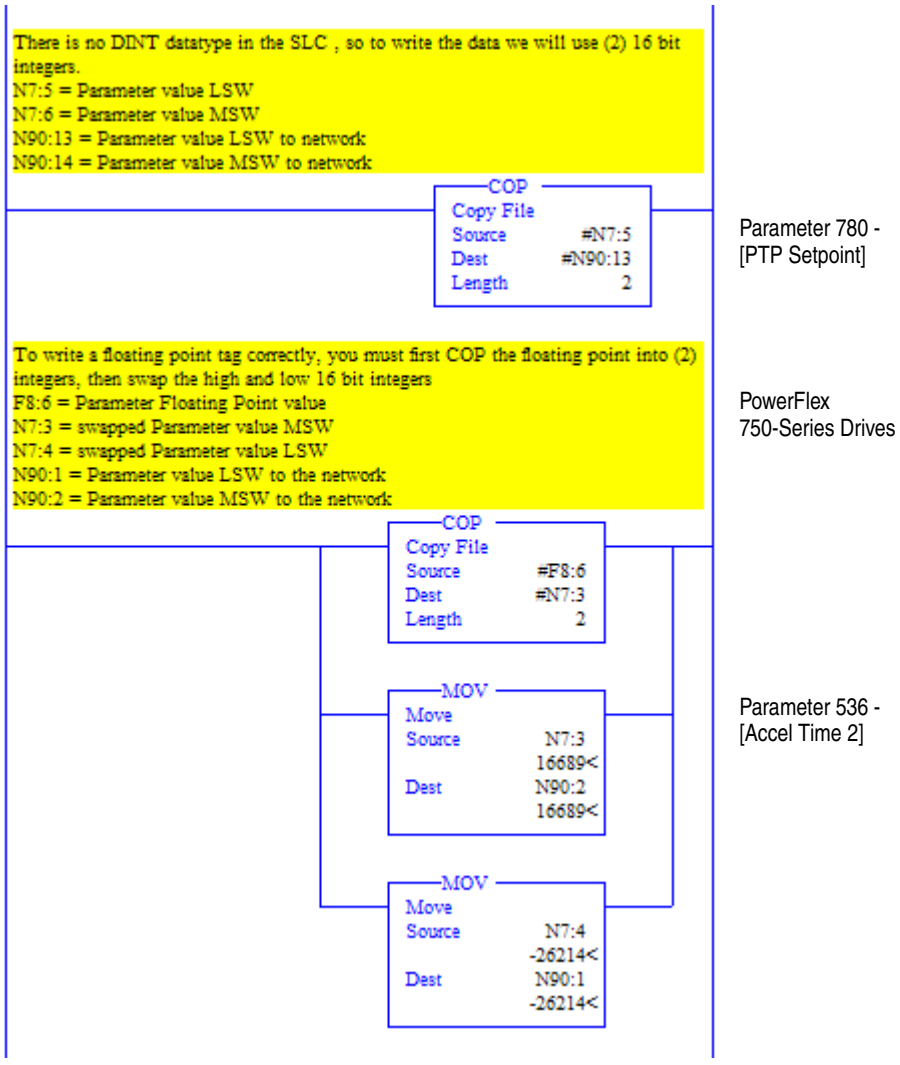
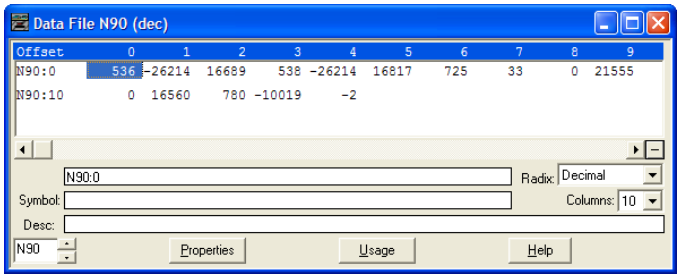
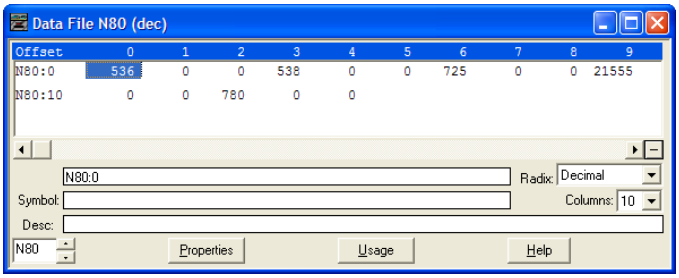


Figure 6.62 Example Scattered Write Request Data File for PowerFlex 750-Series Drive



The results of the explicit message appear in the destination tag array N80 (Figure 6.63). Values of “0” indicate no errors occurred.

Figure 6.63 Example Scattered Write Response Data File for PowerFlex 750-Series Drive



SLC 500 – Explanation of Request and Response Data for Read/Write Multiple Messaging

The data structures in Figure 6.64 and Figure 6.65 use 16-bit words and can accommodate up to 22 parameters in a single message. In the Response Message, a parameter number with the high bit set indicates that the associated parameter value field contains an error code (parameter number in response data will be negative).

Important: See Table 6.A on page 6-2 for limitations of PowerFlex 7-Class and PowerFlex 750-Series drives when using Class code 0x93 or Class code 0x9F for explicit messaging.

Figure 6.64 Data Structures for Scattered Read Messages

	Request (Source Data)		Response (Destination Data)
Word 0	Parameter Number	Word 0	Parameter Number
1	Pad Word	1	Parameter Value LSW
2	Pad Word	2	Parameter Value MSW
3	Parameter Number	3	Parameter Number
4	Pad Word	4	Parameter Value LSW
5	Pad Word	5	Parameter Value MSW
6	Parameter Number	6	Parameter Number
7	Pad Word	7	Parameter Value LSW
8	Pad Word	8	Parameter Value MSW
9	Parameter Number	9	Parameter Number
10	Pad Word	10	Parameter Value LSW
11	Pad Word	11	Parameter Value MSW
12	Parameter Number	12	Parameter Number
13	Pad Word	13	Parameter Value LSW
14	Pad Word	14	Parameter Value MSW
⋮		⋮	
63	Parameter Number	63	Parameter Number
64	Pad Word	64	Parameter Value LSW
65	Pad Word	65	Parameter Value MSW

Figure 6.65 Data Structures for Scattered Write Messages

	Request (Source Data)		Response (Destination Data)
Word 0	Parameter Number	Word 0	Parameter Number
1	Parameter Value LSW	1	Pad Word
2	Parameter Value MSW	2	Pad Word
3	Parameter Number	3	Parameter Number
4	Parameter Value LSW	4	Pad Word
5	Parameter Value MSW	5	Pad Word
6	Parameter Number	6	Parameter Number
7	Parameter Value LSW	7	Pad Word
8	Parameter Value MSW	8	Pad Word
9	Parameter Number	9	Parameter Number
10	Parameter Value LSW	10	Pad Word
11	Parameter Value MSW	11	Pad Word
12	Parameter Number	12	Parameter Number
13	Parameter Value LSW	13	Pad Word
14	Parameter Value MSW	14	Pad Word
⋮		⋮	
63	Parameter Number	63	Parameter Number
64	Parameter Value LSW	64	Pad Word
65	Parameter Value MSW	65	Pad Word

MicroLogix 1100/1400 Examples

When using RSLogix 500 version 7.10 or earlier, explicit messaging must be performed using the PCCC N-File method. For RSLogix 500 version 7.20 or later, the CIP messaging method has been added along with the PCCC N-File method. However, it is recommended to use the CIP method because it is easier to use and understand. For this reason, only instructions for the CIP method are provided. If you must use the PCCC N-File method, refer to the PLC-5 Examples on page 6-23.

The CIP messaging method provides two ways to perform explicit messaging:

- Read/Write Parameter Service simplifies setup by requiring less data to be entered in message configuration screens. However, the Read/Write Parameter Service can only be used to perform single parameter read or single parameter write explicit messages. (Multiple parameter reads or writes must be performed using the Generic Get/Set Attribute Service described below.)

  Important: When performing a Write Parameter message, the data will always be written to the drive's Non-Volatile Storage (NVS). Continuous NVS writes may damage the drive's EEPROM. If continuous writes are necessary, use the Generic Set Attribute Single Service and attribute A (10 decimal; see page 6-64).

- Generic Get/Set Attribute Service requires more setup data to be entered in message configuration screens, but can be used to perform single parameter read or write and multiple parameter read or write explicit messages. Also, the Generic Set Attribute Service offers the choice of writing the data to the drive's Non-Volatile Storage (NVS) or the drive's Random Access Memory (RAM; for Generic Set Attribute Single service only, see page 6-64). Note that when selecting the data to be written to RAM, the data will be lost if the drive loses power.

For supported classes, instances, and attributes, refer to Appendix C, EtherNet/IP Objects.

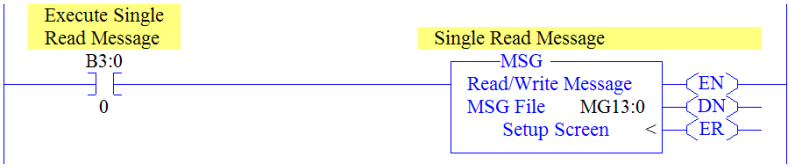
MicroLogix 1100/1400 Explicit Messaging Using the Read/Write Parameter Service

MicroLogix 1100/1400 Example Ladder Logic Program to Read a Single Parameter

A Read Parameter message is used to read a single parameter. This read message example reads the value of parameter 003 - [Output Current] in a PowerFlex 7-Class drive.

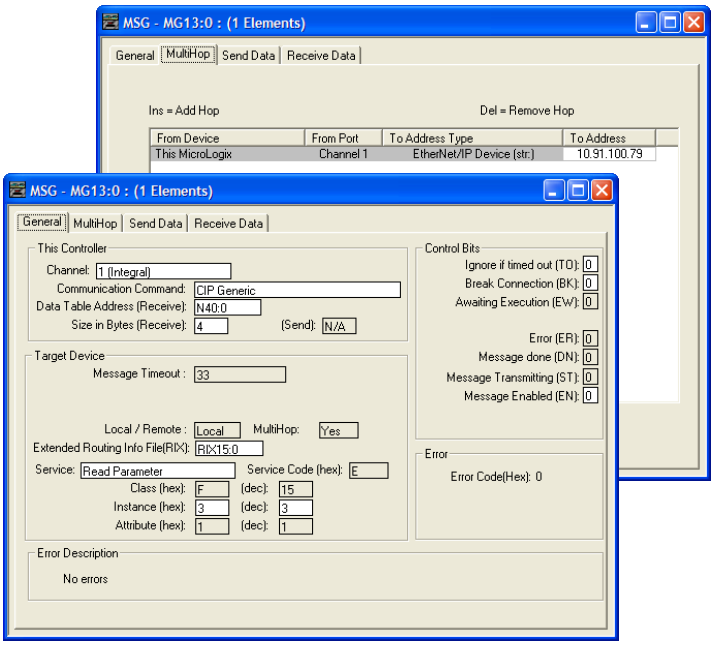
Important: Parameter Object Class code 0x0F is not supported in PowerFlex 750-Series drives. To do a single parameter read, follow the MicroLogix 1100/1400 (Generic Attribute Service) single read example on page 6-60.

Figure 6.66 Example Ladder Logic to Read a Single Parameter



MicroLogix 1100/1400 – Formatting a Message to Read a Single Parameter Using Read/Write Parameter Service

Figure 6.67 Read Parameter Message Configuration Screens



The following table identifies the data that is required in each box to configure a message to read a single parameter.

General Tab	Example Value	Description
Channel	1	Controller port to which the network is connected.
Comm… Command	CIP Generic	Used to access the Parameter Object in the adapter.
Data Table Address	N40:0	An unused controller data table address containing the message instruction. This address is the starting word of the destination file.
Size in Bytes	4 (3)	Number of bytes to be transferred. Each byte size is an 8-bit integer.
Extended Routing…	RIX15:0	An unused routing information file for the controller.
Service (1)	Read Parameter	Code for the requested service.
Instance (2)	3 (Dec.)	Instance number is the same as the parameter number.
MultiHop Tab	**Example Value**	**Description**
To Address	10.91.100.79	IP address of the adapter connected to the drive.

(1) The default setting for Service is “Custom,” enabling entry of a Service Code not available from the Service pull-down menu. When choosing a Service other than “Custom” from the pull-down menu, an appropriate Hex. value is automatically assigned to the Service Code box which is dimmed (unavailable).

(2) Only drive parameters (Port 0) can be read using Parameter Object Class code 0x0F. To read a parameter of a peripheral in another port, use DPI Parameter Object Class code 0x93 (see page 6-60).

(3) In this example, Output Current is a 32-bit parameter. If the parameter being read is a 16-bit parameter, the Size in Bytes would be set to 2. When the parameter being read is a 32-bit REAL (floating point) data type, the size in bytes would be set to 4. See the drive documentation to determine the size of the parameter and its data type (16-bit or 32-bit integer or REAL).

MicroLogix 1100/1400 Example Read Single Response Data

In this message example, we use the data table address in Figure 6.68 to store the response value (0.13 amps) that was read from drive parameter 003 - [Output Current]. To determine the data type for the parameter and its required scaling, refer to the specific drive documentation.

Figure 6.68 Example Read Single Response Data File

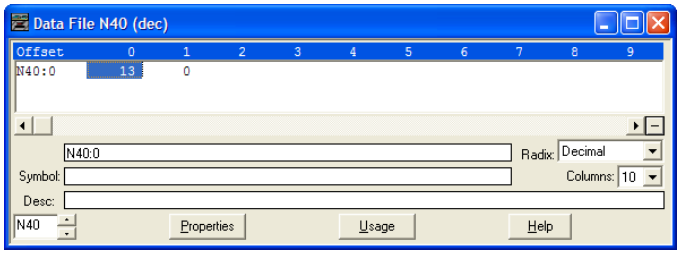
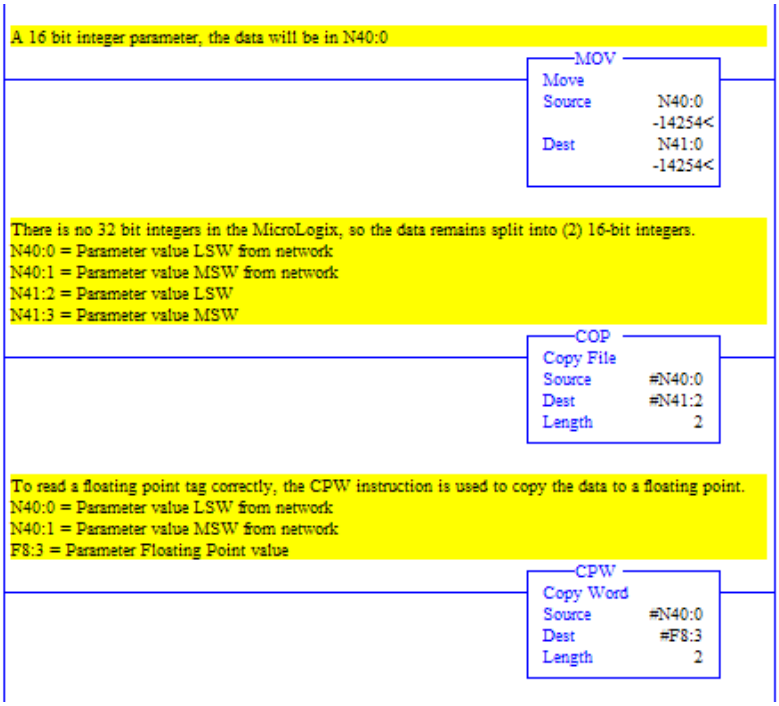


Figure 6.69 shows example ladder logic to correctly format the three possible data types for read messages in the MicroLogix 1100/1400.

Figure 6.69 Example Ladder Logic to Format Parameter Data Types for Reads

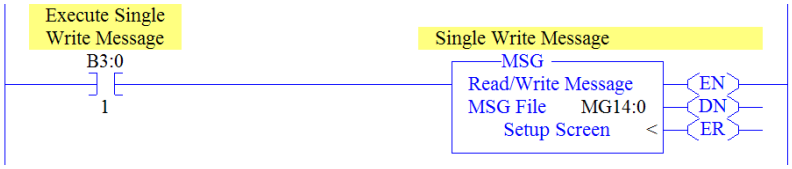


MicroLogix 1100/1400 Example Ladder Logic Program to Write a Single Parameter Using Read/Write Parameter Service

A Write Parameter message is used to write to a single parameter. This write message example writes a value to parameter 140 - [Accel Time 1] in a PowerFlex 7-Class drive.

Important: Parameter Object Class code 0x0F is not supported in PowerFlex 750-Series drives. To do a single parameter write, follow the SLC 500 (Generic Attribute Service) single write example on page 6-63.

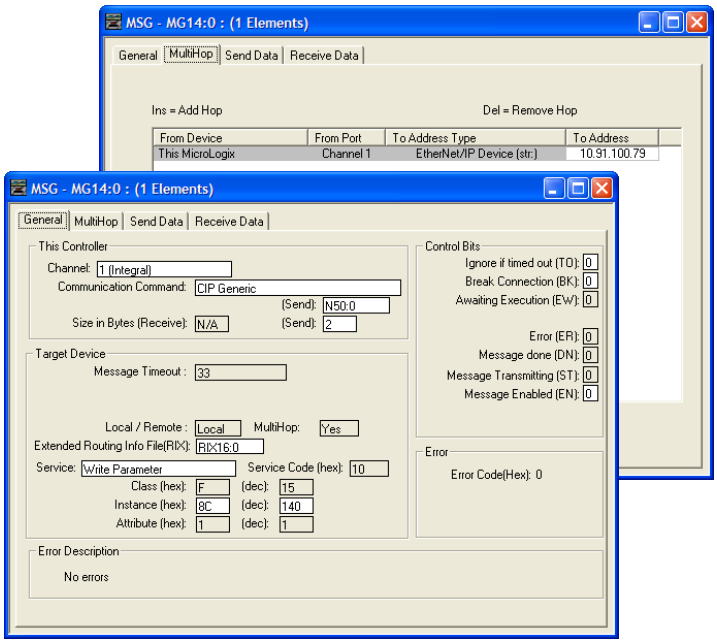
Figure 6.70 Example Ladder Logic to Write a Single Parameter



Important: If the explicit message single write must be written continuously, use DPI Parameter Object Class code 0x93 and attribute A (10 decimal; see page 6-64). This writes to RAM—not NVS (EEPROM) memory. This example single write message using Class code F writes to NVS. Over time, continuous writes will exceed the EEPROM life cycle and cause the drive to malfunction.

MicroLogix 1100/1400 – Formatting a Message to Write a Single Parameter Using Read/Write Parameter Service

Figure 6.71 Write Parameter Message Configuration Screens



The following table identifies the data that is required in each box to configure a message to write a single parameter.

General Tab	Example Value	Description
Channel	1	Controller port to which the network is connected.
Comm… Command	CIP Generic	Used to access the Parameter Object in the adapter.
Data Table Address	N50:0	An unused controller data table address containing the message instruction. This address is the starting word of the destination file.
Size in Bytes	2 (3)	Number of bytes to be transferred. Each byte size is an 8-bit integer.
Extended Routing…	RIX16:0	An unused routing information file for the controller.
Service (1)	Write Parameter	Code for the requested service.
Instance (2)	140 (Dec.)	Instance number is the same as the parameter number.
MultiHop Tab	**Example Value**	**Description**
To Address	10.91.100.79	IP address of the adapter connected to the drive.

(1) The default setting for Service is “Custom,” enabling entry of a Service Code not available from the Service pull-down menu. When choosing a Service other than “Custom” from the pull-down menu, an appropriate Hex. value is automatically assigned to the Service Code box which is dimmed (unavailable).

(2) Only drive parameters (Port 0) can be written to using Parameter Object Class code 0x0F. To write to a parameter of a peripheral in another port, use DPI Parameter Object Class code 0x93 (see page 6-63).

(3) In this example, Accel Time 1 is a 16-bit parameter. If the parameter being written to is a 32-bit parameter, the Size in Bytes would be set to 4. When the parameter being written to is a 32-bit REAL (floating point) data type, the size in bytes would be set to 4. See the drive documentation to determine the size of the parameter and its data type (16-bit or 32-bit integer or REAL).

MicroLogix 1100/1400 Example Write Single Request Data

In this message example, we use the data table address in Figure 6.72 to store the request value (10.0 sec.) that was written to drive parameter 140 - [Accel Time 1]. To determine the data type for the parameter and its required scaling, refer to the specific drive documentation.

Figure 6.72 Example Write Single Request Data File

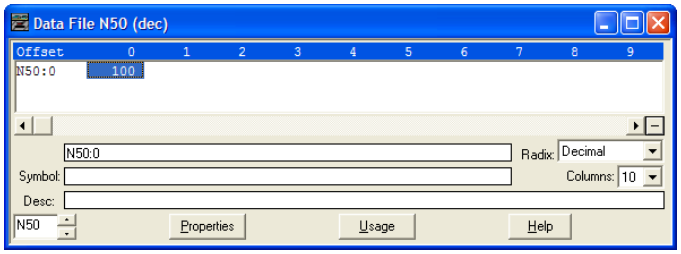
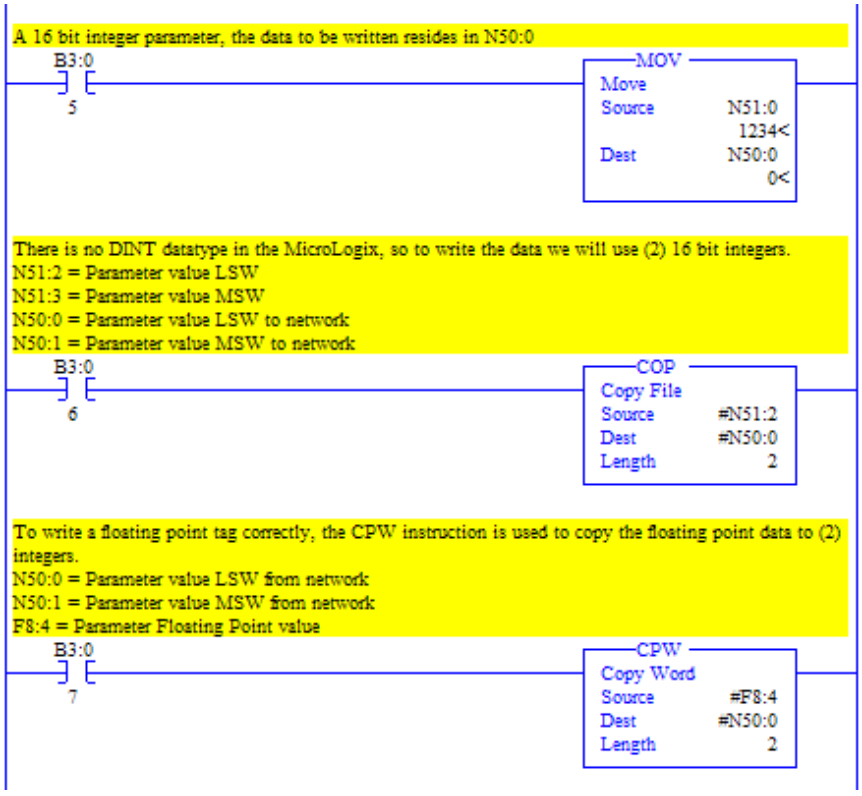


Figure 6.73 shows example ladder logic to correctly format the three possible data types for write messages in the MicroLogix 1100/1400.

Figure 6.73 Example Ladder Logic to Format Parameter Data Types for Writes



For 16-bit Integer Parameters – All PowerFlex 7-Class Drives

For 32-bit Integer Parameters – All PowerFlex 7-Class Drives

For 32-bit REAL (Floating Point) Parameters – PowerFlex 700S Drives

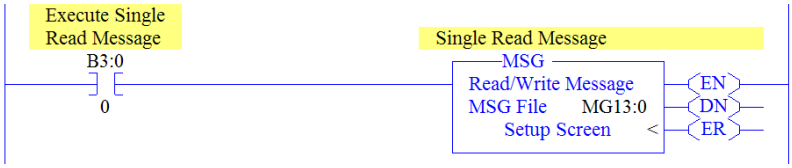
MicroLogix 1100/1400 Explicit Messaging Using the Generic Get/Set Attribute Service

MicroLogix 1100/1400 Example Ladder Logic Program to Read a Single Parameter

A Generic Get Attribute Single message is used to read a single parameter. This read message example reads the value of parameter 003 - [Output Current] in a PowerFlex 7-Class drive.

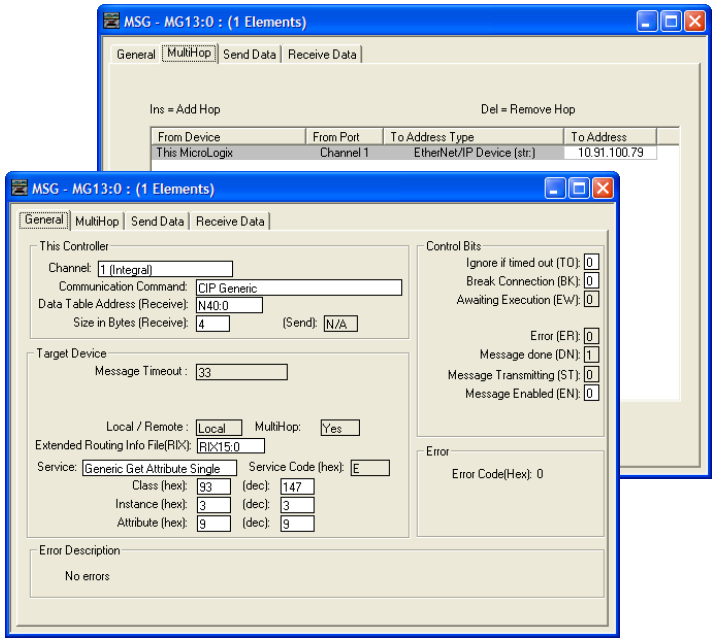
Important: See Table 6.A on page 6-2 for limitations of PowerFlex 7-Class and PowerFlex 750-Series drives when using Class code 0x93 or Class code 0x9F for explicit messaging.

Figure 6.74 Example Ladder Logic to Read a Single Parameter



MicroLogix 1100/1400 – Formatting a Message to Read a Single Parameter Using Generic Get/Set Attribute Service

Figure 6.75 Generic Get Attribute Single Message Configuration Screens



The following table identifies the data that is required in each box to configure a message to read a single parameter.

General Tab	Example Value	Description
Channel	1	Controller port to which the network is connected.
Comm… Command	CIP Generic	Used to access the Parameter Object in the adapter.
Data Table Address	N40:0	An unused controller data table address containing the message instruction. This address is the starting word of the destination file.
Size in Bytes	4 (3)	Number of bytes to be transferred. Each byte size is an 8-bit integer.
Extended Routing…	RIX15:0	An unused routing information file for the controller.
Service (1)	Generic Get Attribute Single	Code for the requested service.
Class	93 or 9F (Hex.) (4)	Class ID for the DPI Parameter Object.
Instance (2)	3 (Dec.)	Instance number is the same as the parameter number.
Attribute	9 (Dec.)	Attribute number for the Parameter Value attribute.
MultiHop Tab	**Example Value**	**Description**
To Address	10.91.100.79	IP address of the adapter connected to the drive.

(1) The default setting for Service is “Custom,” enabling entry of a Service Code not available from the Service pull-down menu. When choosing a Service other than “Custom” from the pull-down menu, an appropriate Hex. value is automatically assigned to the Service Code box which is dimmed (unavailable).

(2) The instance is the parameter number in the drive (Port 0). For example, to read parameter 4 of a peripheral in Port 5 of a PowerFlex 750-Series drive, the instance would be 21504 + 4 = 21508. See DPI Parameter Object on page C-16 (Class code 0x93) or Host DPI Parameter Object on page C-30 (Class code 0x9F) to determine the instance number.

(3) In this example, Output Current is a 32-bit parameter. If the parameter being read is a 16-bit parameter, the Size in Bytes would be set to 2. When the parameter being read is a 32-bit REAL (floating point) data type, the size in bytes would be set to 4. See the drive documentation to determine the size of the parameter and its data type (16-bit or 32-bit integer or REAL).

(4) See Table 6.A on page 6-2 for limitations of PowerFlex 7-Class and PowerFlex 750-Series drives when using DPI Parameter Object Class code 0x93 or Host DPI Parameter Object Class code 0x9F for explicit messaging.

MicroLogix 1100/1400 Example Get Attribute Single Response Data

In this message example, we use the data table address in Figure 6.76 to store the response value (0.13 amps) that was read from drive parameter 003 - [Output Current]. To determine the data type for the parameter and its required scaling, refer to the specific drive documentation.

Figure 6.76 Example Get Attribute Single Response Data File

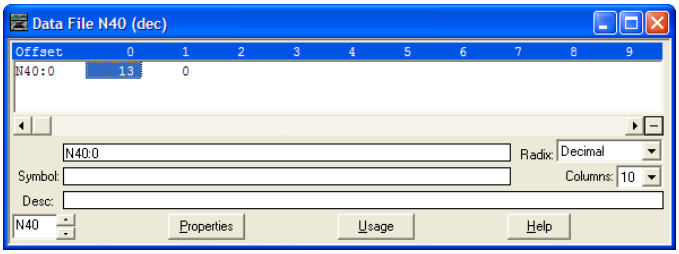
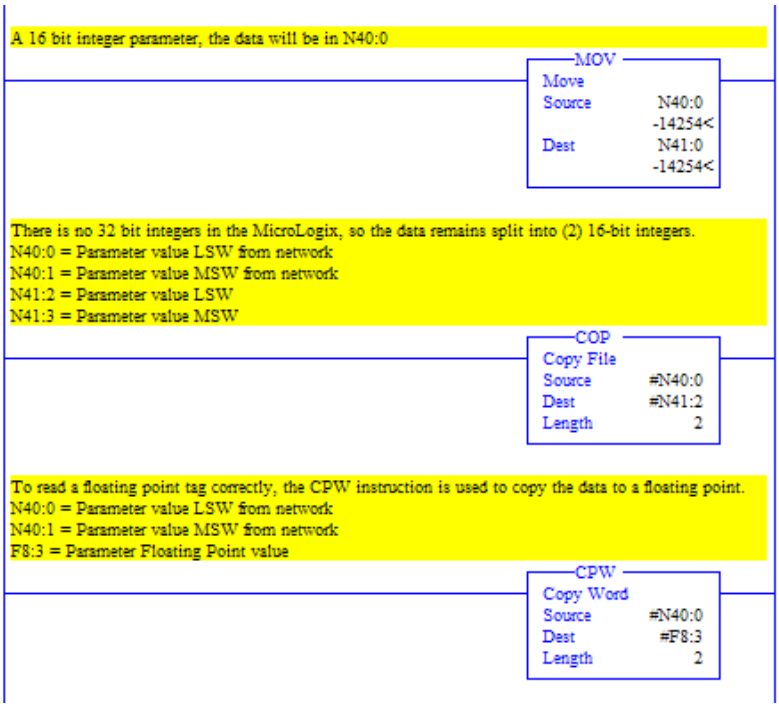


Figure 6.77 shows example ladder logic to correctly format the three possible data types for read messages in the MicroLogix 1100/1400.

Figure 6.77 Example Ladder Logic to Format Parameter Data Types for Gets



For 16-bit Integer Parameters – All PowerFlex 7-Class Drives

For 32-bit Integer Parameters – All PowerFlex 7-Class Drives

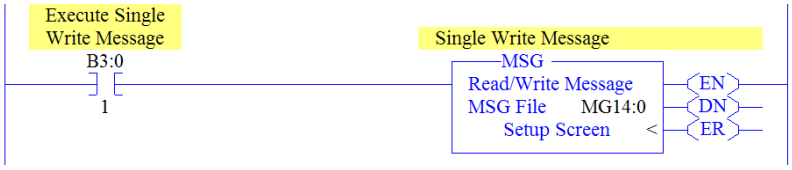
For 32-bit REAL (Floating Point) Parameters – PowerFlex 700S and PowerFlex 750-Series Drives

MicroLogix 1100/1400 Example Ladder Logic Program to Write a Single Parameter Using Generic Get/Set Attribute Service

A Generic Set Attribute Single message is used to write to a single parameter. This write message example writes a value to parameter 140 - [Accel Time 1] in a PowerFlex 7-Class drive.

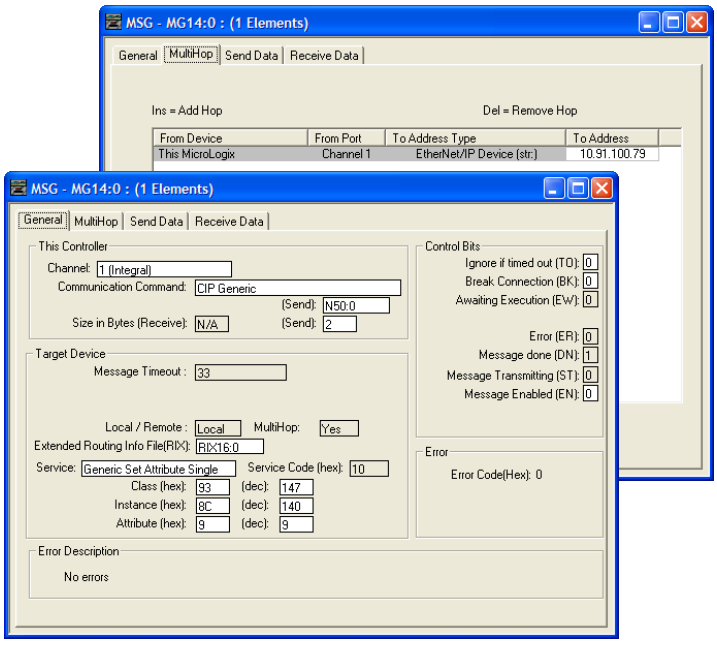
Important: See Table 6.A on page 6-2 for limitations of PowerFlex 7-Class and PowerFlex 750-Series drives when using Class code 0x93 or Class code 0x9F for explicit messaging.

Figure 6.78 Example Ladder Logic to Write a Single Parameter



MicroLogix 1100/1400 – Formatting a Message to Write a Single Parameter Using Generic Get/Set Attribute Service

Figure 6.79 Generic Set Attribute Single Message Configuration Screens



The following table identifies the data that is required in each box to configure a message to write a single parameter.

General Tab	Example Value	Description
Channel	1	Controller port to which the network is connected.
Comm… Command	CIP Generic	Used to access the Parameter Object in the adapter.
Data Table Address	N50:0	An unused controller data table address containing the message instruction. This address is the starting word of the destination file.
Size in Bytes	2 (4)	Number of bytes to be transferred. Each byte size is an 8-bit integer.
Extended Routing…	RIX16:0	An unused routing information file for the controller.
Service (1)	Generic Set Attribute Single	Code for the requested service.
Class	93 or 9F (Hex.) (5)	Class ID for the DPI Parameter Object.
Instance (2)	140 (Dec.)	Instance number is the same as the parameter number.
Attribute (3)	9 or 10 (Dec.)	Attribute number for the Parameter Value attribute.
MultiHop Tab	**Example Value**	**Description**
To Address	10.91.100.79	IP address of the adapter connected to the drive.

(1) The default setting for Service is “Custom,” enabling entry of a Service Code not available from the Service pull-down menu. When choosing a Service other than “Custom” from the pull-down menu, an appropriate Hex. value is automatically assigned to the Service Code box which is dimmed (unavailable).

(2) The instance is the parameter number in the drive (Port 0). For example, to write to parameter 4 of a peripheral in Port 5 of a PowerFlex 750-Series drive, the instance would be 21504 + 4 = 21508. See DPI Parameter Object on page C-16 (Class code 0x93) or Host DPI Parameter Object on page C-30 (Class code 0x9F) to determine the instance number.

(3) Setting the Attribute value to “9” will write the parameter value to the drive’s Non-Volatile Storage (EEPROM) memory, so the parameter value will remain even after the drive is power cycled. **Important:** When set to “9,” be very cautious as the EEPROM may quickly exceed its life cycle and cause the drive to malfunction. Setting the Attribute value to “10” will write the parameter value to temporary memory, so the parameter value will be lost after the drive is power cycled. It is recommended to use the “10” setting when frequent write messages are required.

(4) In this example, Accel Time 1 is a 16-bit parameter. If the parameter being written to is a 32-bit parameter, the Size in Bytes would be set to 4.

(5) See Table 6.A on page 6-2 for limitations of PowerFlex 7-Class and PowerFlex 750-Series drives when using DPI Parameter Object Class code 0x93 or Host DPI Parameter Object Class code 0x9F for explicit messaging.

MicroLogix 1100/1400 Example Set Attribute Single Request Data

In this message example, we use the data table address in Figure 6.80 to store the request value (10.0 sec.) that was written to drive parameter 140 - [Accel Time 1]. To determine the data type for the parameter and its required scaling, refer to the specific drive documentation.

Figure 6.80 Example Set Attribute Single Request Data File

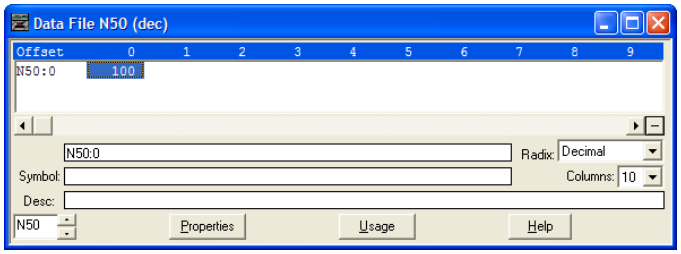
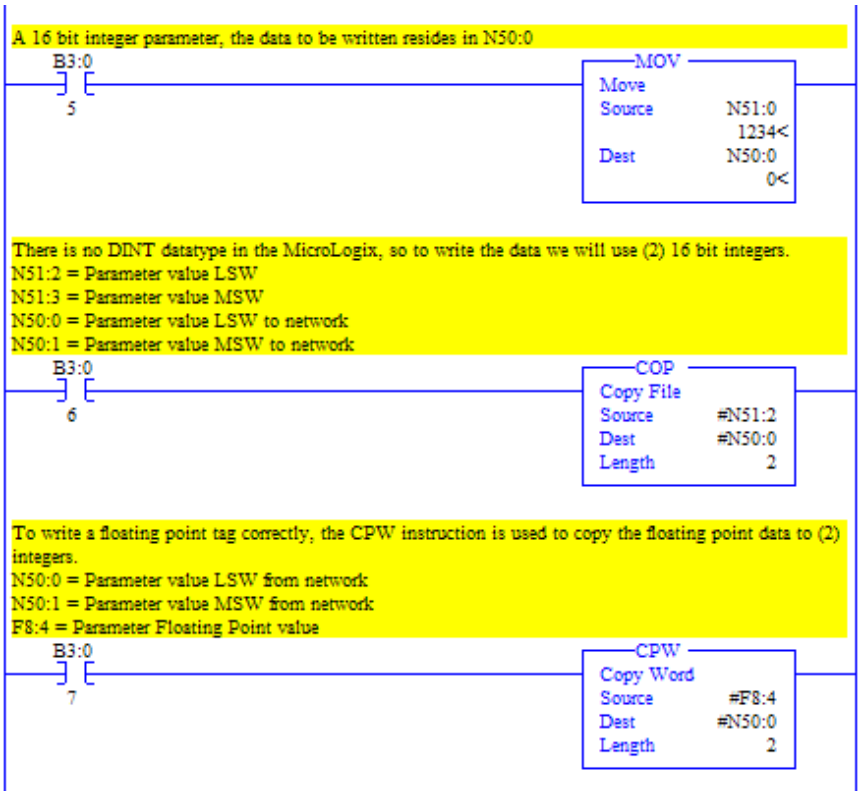


Figure 6.81 shows example ladder logic to correctly format the three possible data types for write messages in the MicroLogix 1100/1400.

Figure 6.81 Example Ladder Logic to Format Parameter Data Types for Sets



For 16-bit Integer Parameters – All PowerFlex 7-Class Drives

For 32-bit Integer Parameters – All PowerFlex 7-Class Drives

For 32-bit REAL (Floating Point) Parameters – PowerFlex 700S and PowerFlex 750-Series Drives

MicroLogix 1100/1400 Example Ladder Logic Program to Read Multiple Parameters Using Generic Get/Set Attribute Service

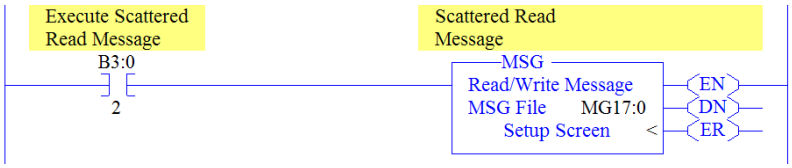
A Custom scattered read message is used to read the values of multiple parameters. This read message example reads the values of these five parameters:

PowerFlex 7-Class Drive	PowerFlex 750-Series Drive
• Parameter 001 - [Output Freq] • Parameter 003 - [Output Current] • Parameter 006 - [Output Voltage] • Parameter 012 - [DC Bus Voltage] • Parameter 017 - [Analog In1 Value]	• Parameter 001 - [Output Freq] • Parameter 007 - [Output Current] • Parameter 137 - [Open Loop Fdbk] • Parameter 21581 - [Port 5: Analog Out 0 Data] • Parameter 260 - [Analog In0 Value]

Refer to DPI Parameter Object on page C-16 (Class code 0x93) or Host DPI Parameter Object on page C-30 (Class code 0x9F) for parameter numbering.

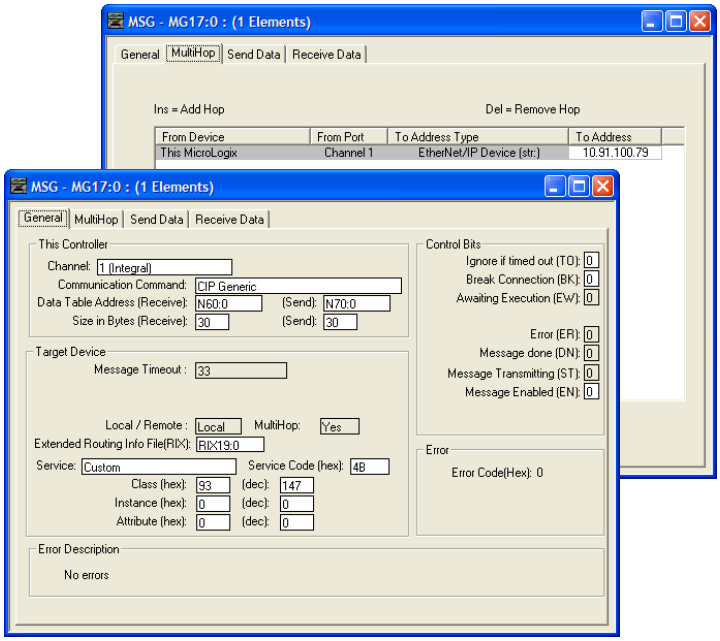
Important: See Table 6.A on page 6-2 for limitations of PowerFlex 7-Class and PowerFlex 750-Series drives when using Class code 0x93 or Class code 0x9F for explicit messaging.

Figure 6.82 Example Ladder Logic to Read Multiple Parameters



MicroLogix 1100/1400 – Formatting a Message to Read Multiple Parameters Using Generic Get/Set Attribute Service

Figure 6.83 Custom Scattered Read Message Configuration Screens



The following table identifies the data that is required in each box to configure a message to read multiple parameters.

General Tab	Example Value	Description
Channel	1	Controller port to which the network is connected.
Comm… Command	CIP Generic	Used to access the Parameter Object in the adapter.
Data Table Address	N60:0	An unused controller data table address containing the message instruction. This address is the starting word of the destination file.
Size in Bytes	30 (2)	Number of bytes to be transferred. Each byte size is an 8-bit integer.
Extended Routing…	RIX19:0	An unused routing information file for the controller.
Service (1)	Custom	Required for scattered messages.
Service Code	4B (Hex.)	Code for the requested service.
Class	93 or 9F (Hex.) (3)	Class ID for the DPI Parameter Object.
Instance	0 (Dec.)	Required for scattered messages.
Attribute	0 (Dec.)	Required for scattered messages.
MultiHop Tab	**Example Value**	**Description**
To Address	10.91.100.79	IP address of the adapter connected to the drive.

(1) The default setting for Service is “Custom,” enabling entry of a Service Code not available from the Service pull-down menu. When choosing a Service other than “Custom” from the pull-down menu, an appropriate Hex. value is automatically assigned to the Service Code box which is dimmed (unavailable).

(2) In this example, we are reading five parameters. Each parameter being read requires three contiguous 16-bit words. Scattered read messages always assume that every parameter being read is a 32-bit parameter, regardless of its actual size. Therefore, the Size in Bytes must be set to 30. The data structure format is the same as shown on page 6-74. Maximum length is 66 words (132 bytes), which equates to 22 parameters. For parameter numbering, see DPI Parameter Object on page C-16 (Class code 0x93) or Host DPI Parameter Object on page C-30 (Class code 0x9F).

(3) See Table 6.A on page 6-2 for limitations of PowerFlex 7-Class and PowerFlex 750-Series drives when using DPI Parameter Object Class code 0x93 or Host DPI Parameter Object Class code 0x9F for explicit messaging.

MicroLogix 1100/1400 Example Scattered Read Request Data

In this message example, we use the data table addresses in Figure 6.84 or Figure 6.85 to store the request values to be read from these drive parameters:

PowerFlex 7-Class Drive	PowerFlex 750-Series Drive
• Parameter 001 - [Output Freq] • Parameter 003 - [Output Current] • Parameter 006 - [Output Voltage] • Parameter 012 - [DC Bus Voltage] • Parameter 017 - [Analog In1 Value]	• Parameter 001 - [Output Freq] • Parameter 007 - [Output Current] • Parameter 137 - [Open Loop Fdbk] • Parameter 21581 - [Port 5: Analog Out 0 Data] • Parameter 260 - [Analog In0 Value]

Refer to DPI Parameter Object on page C-16 (Class code 0x93) or Host DPI Parameter Object on page C-30 (Class code 0x9F) for parameter numbering.

Figure 6.84 Example Scattered Read Request Data File for PowerFlex 7-Class Drive

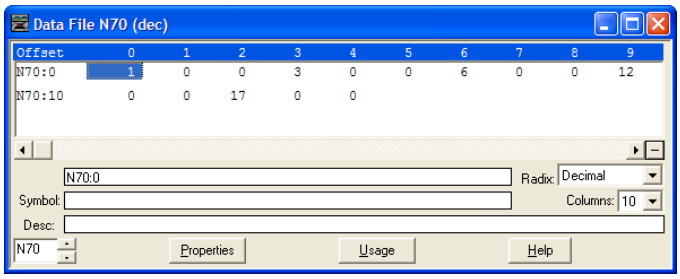
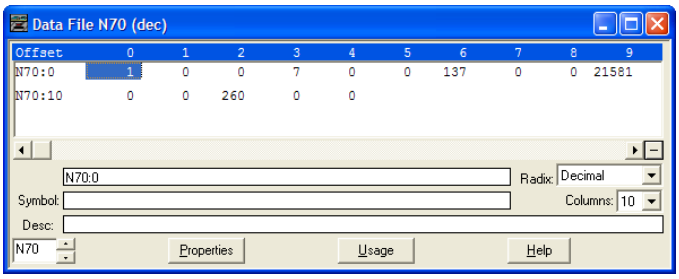


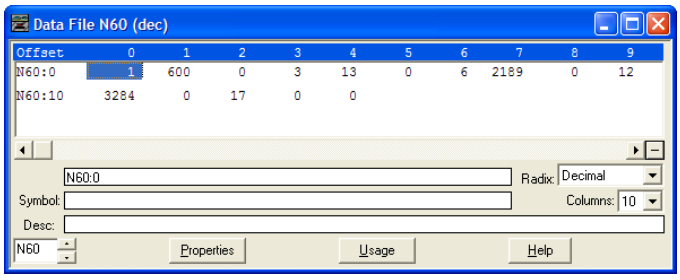
Figure 6.85 Example Scattered Read Request Data File for PowerFlex 750-Series Drive



MicroLogix 1100/1400 Example Scattered Read Response Data

In this message example, we use the data table addresses in Figure 6.86 or Figure 6.87 to store the response values that were read from the requested drive parameters.

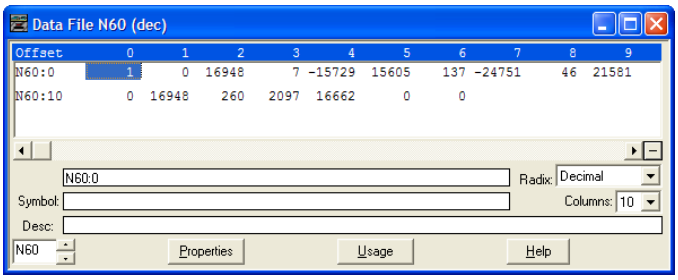
Figure 6.86 Example Scattered Read Response Data File for PowerFlex 7-Class Drive



In this example, the parameters have the following values:

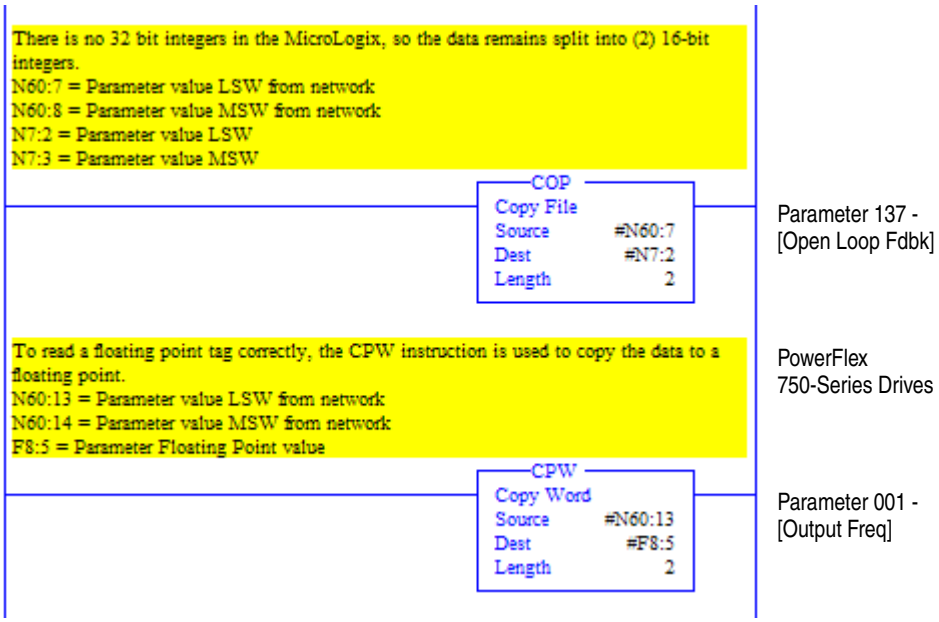
PowerFlex 7-Class Drive Parameter	Address	Read Value
1 - [Output Freq]	N60:1	32.5 Hz
3 - [Output Current]	N60:4	0.01 Amp
6 - [Output Voltage]	N60:7	118.7 VAC
12 - [DC Bus Voltage]	N60:10	329.2 VDC
17 - [Analog In2 Value]	N60:13	8.318 mA

Figure 6.87 Example Scattered Read Response Data File for PowerFlex 750-Series Drive



The PowerFlex 750-Series drive uses 32-bit integer and REAL parameters. A COP or CPW command must be used to copy the N60 integer array to a 16-bit integer or floating tag. Figure 6.88 shows the ladder logic used for this example. If the parameter data type is a 32-bit integer, the data remains split into two 16-bit integers since there are no 32-bit integers in the MicroLogix 1100/1400. If the parameter data type is a REAL, then the destination tag is a floating point. See the drive documentation to determine the parameter data type (32-bit integer or REAL).

Figure 6.88 Example Ladder Logic to Copy Response Data for PowerFlex 750-Series Drive



In this message example, the parameters have the following values:

PowerFlex 750-Series Drive Parameter	Read Value	Data Type
1 - [Output Freq]	45.0 Hz	REAL
7 - [Output Current]	0.03 Amp	REAL
137 - [Open Loop Fdbk]	3055441	DINT
21581 - [Port 5: Analog Out 0 Data]	45.0 Hz	REAL
260 - [Analog In0 Value]	9.377 Volts	REAL

MicroLogix 1100/1400 Example Ladder Logic Program to Write Multiple Parameters Using Generic Get/Set Attribute Service

A Custom scattered write message is used to write to multiple parameters. This write message example writes the following values to these five parameters:

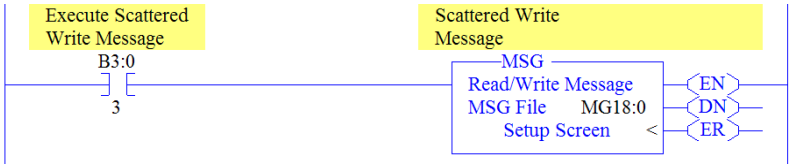
PowerFlex 7-Class Drive Parameter	Write Value
141 - [Accel Time 2]	11.1 Sec.
143 - [Decel Time 2]	22.2 Sec.
105 - [Preset Speed 5]	33.3 Hz.
106 - [Preset Speed 6]	44.4 Hz.
107 - [Preset Speed 7]	55.5 Hz.

PowerFlex 750-Series Drive Parameter	Write Value
536 - [Accel Time 2]	11.1 Sec.
538 - [Decel Time 2]	22.2 Sec.
725 - [Zero Position]	33
21555 - [Port 5: Analog In0 Hi]	5.5
780 - [PTP Setpoint]	-75,555

Refer to DPI Parameter Object on page C-16 (Class code 0x93) or Host DPI Parameter Object on page C-30 (Class code 0x9F) for parameter numbering.

Important: See Table 6.A on page 6-2 for limitations of PowerFlex 7-Class and PowerFlex 750-Series drives when using Class code 0x93 or Class code 0x9F for explicit messaging.

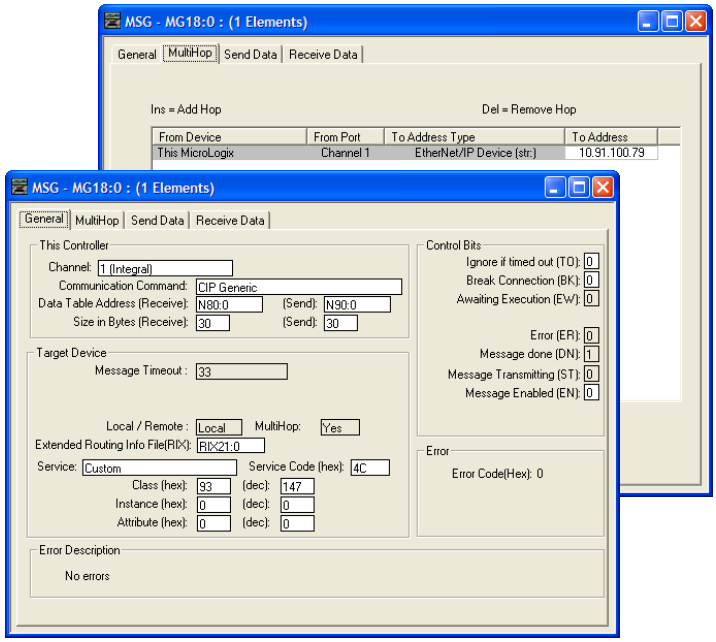
Figure 6.89 Example Ladder Logic to Write Multiple Parameters



Important: If the explicit message scattered write must be written continuously, then use a separate Generic Set service explicit message single write for each parameter using DPI Parameter Object Class code 0x93 or Host DPI Parameter Object Class code 0x9F and attribute A (10 decimal; see page 6-64). Attribute A writes to RAM—not NVS (EEPROM) memory. This example scattered write message using attribute 0 writes to NVS. Over time, continuous writes will exceed the EEPROM life cycle and cause the drive to malfunction.

MicroLogix 1100/1400 – Formatting a Message to Write Multiple Parameters Using Generic Get/Set Attribute Service

Figure 6.90 Custom Scattered Write Multiple Message Configuration Screens



The following table identifies the data that is required in each box to configure a message to write multiple parameters.

General Tab	Example Value	Description
Channel	1	Controller port to which the network is connected.
Comm… Command	CIP Generic	Used to access the Parameter Object in the adapter.
Data Table Address	N80:0	An unused controller data table address containing the message instruction. This address is the starting word of the destination file.
Size in Bytes	30 (2)	Number of bytes to be transferred. Each byte size is an 8-bit integer.
Extended Routing…	RIX21:0	An unused routing information file for the controller.
Service (1)	Custom	Required for scattered messages.
Service Code	4C (Hex.)	Code for the requested service.
Class	93 or 9F (Hex.) (3)	Class ID for the DPI Parameter Object.
Instance	0 (Dec.)	Required for scattered messages.
Attribute	0 (Dec.)	Required for scattered messages.
MultiHop Tab	**Example Value**	**Description**
To Address	10.91.100.79	IP address of the adapter connected to the drive.

(1) The default setting for Service is “Custom,” enabling entry of a Service Code not available from the Service pull-down menu. When choosing a Service other than “Custom” from the pull-down menu, an appropriate Hex. value is automatically assigned to the Service Code box which is dimmed (unavailable).

(2) In this example, we are writing to five parameters. Each parameter being written to requires three contiguous 16-bit words. Scattered write messages always assume that every parameter being written to is a 32-bit parameter, regardless of its actual size. Therefore, the Size in Bytes must be set to 30. The data structure format is the same as shown on page 6-18. Maximum length is 66 words (132 bytes), which equates to 22 parameters. For parameter numbering, see DPI Parameter Object on page C-16 (Class code 0x93) or Host DPI Parameter Object on page C-30 (Class code 0x9F).

(3) See Table 6.A on page 6-2 for limitations of PowerFlex 7-Class and PowerFlex 750-Series drives when using DPI Parameter Object Class code 0x93 or Host DPI Parameter Object Class code 0x9F for explicit messaging.

MicroLogix 1100/1400 Example Scattered Write Request Data

In this message example, we use the data table addresses in Figure 6.91 to store the request values to be written to these drive parameters:

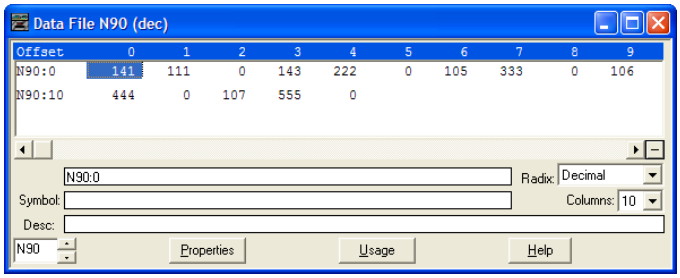
PowerFlex 7-Class Drive Parameter	Address	Write Value
141 - [Accel Time 2]	N90:1	11.1 Sec.
143 - [Decel Time 2]	N90:4	22.2 Sec.
105 - [Preset Speed 5]	N90:7	33.3 Hz.
106 - [Preset Speed 6]	N90:10	44.4 Hz.
107 - [Preset Speed 7]	N90:13	55.5 Hz.

PowerFlex 750-Series Drive Parameter	Write Value	Data Type
536 - [Accel Time 2]	11.1 Sec.	REAL
538 - [Decel Time 2]	22.2 Sec.	REAL
725 - [Zero Position]	33	32-bit integer
21555 - [Port 5: Analog In0 Hi]	5.5	REAL
780 - [PTP Setpoint]	-75,555	32-bit integer

Refer to DPI Parameter Object on page C-16 (Class code 0x93) or Host DPI Parameter Object on page C-30 (Class code 0x9F) for parameter numbering.

Figure 6.91 or Figure 6.94 shows the parameter values.

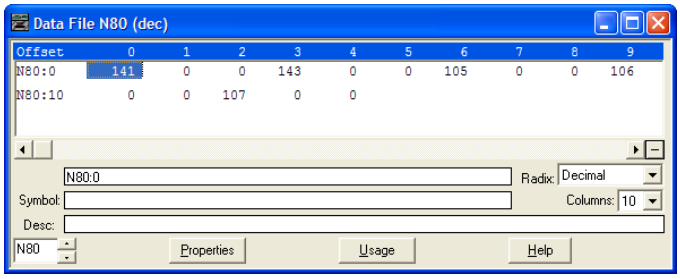
Figure 6.91 Example Scattered Write Request Data File for PowerFlex 7-Class Drive



MicroLogix 1100/1400 Example Scattered Write Response Data

In this message example, we use the data table addresses in Figure 6.92 to store the response values that were written to the requested drive parameters. Values of “0” indicate no errors occurred.

Figure 6.92 Example Scattered Write Response Data File for PowerFlex 7-Class Drive



The PowerFlex 750-Series drive uses 32-bit integer and REAL parameters. A COP or CPW command must be used to copy the 16-bit integer or REAL values to the N90 integer array. Figure 6.93 shows the ladder logic used for this example. If the parameter data type is a 32-bit integer, the data remains

split into two 16-bit integers since there are no 32-bit integers in the MicroLogix 1100/1400. If the parameter data type is a REAL, then the source tag is a floating point. See the drive documentation to determine the parameter data type (32-bit integer or REAL).

Figure 6.93 Example Ladder Logic to Copy Request Data for PowerFlex 750-Series Drive

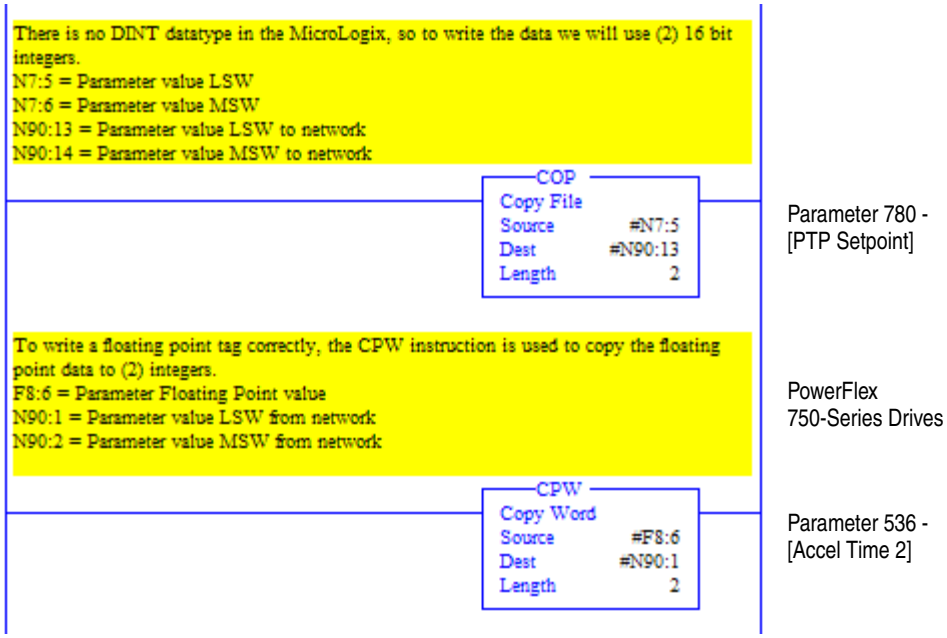
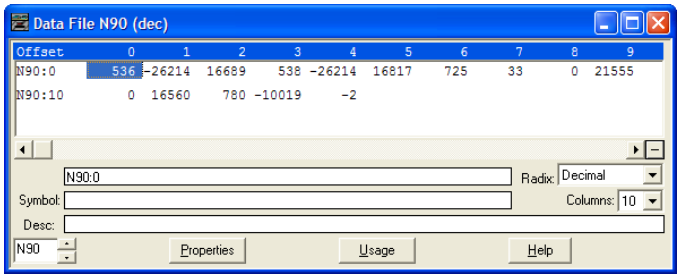
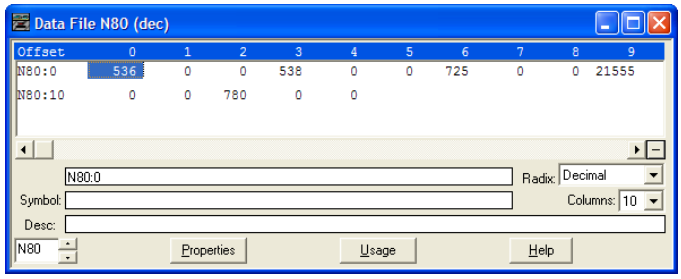


Figure 6.94 Example Scattered Write Request Data File for PowerFlex 750-Series Drive



The results of the explicit message appear in the destination tag array N80 (Figure 6.63). Values of “0” indicate no errors occurred.

Figure 6.95 Example Scattered Write Response Data File for PowerFlex 750-Series Drive



MicroLogix 1100/1400 – Explanation of Request and Response Data for Read/Write Multiple Messaging

The data structures in Figure 6.96 and Figure 6.97 use 16-bit words and can accommodate up to 22 parameters in a single message. In the Response Message, a parameter number with the high bit set indicates that the associated parameter value field contains an error code (parameter number in response data will be negative).

Important: See Table 6.A on page 6-2 for limitations of PowerFlex 7-Class and PowerFlex 750-Series drives when using Class code 0x93 or Class code 0x9F for explicit messaging.

Figure 6.96 Data Structures for Scattered Read Messages

	Request (Source Data)		Response (Destination Data)
Word 0	Parameter Number	Word 0	Parameter Number
1	Pad Word	1	Parameter Value LSW
2	Pad Word	2	Parameter Value MSW
3	Parameter Number	3	Parameter Number
4	Pad Word	4	Parameter Value LSW
5	Pad Word	5	Parameter Value MSW
6	Parameter Number	6	Parameter Number
7	Pad Word	7	Parameter Value LSW
8	Pad Word	8	Parameter Value MSW
9	Parameter Number	9	Parameter Number
10	Pad Word	10	Parameter Value LSW
11	Pad Word	11	Parameter Value MSW
12	Parameter Number	12	Parameter Number
13	Pad Word	13	Parameter Value LSW
14	Pad Word	14	Parameter Value MSW
⋮		⋮	
63	Parameter Number	63	Parameter Number
64	Pad Word	64	Parameter Value LSW
65	Pad Word	65	Parameter Value MSW

Figure 6.97 Data Structures for Scattered Write Messages

	Request (Source Data)		Response (Destination Data)
Word 0	Parameter Number	Word 0	Parameter Number
1	Parameter Value LSW	1	Pad Word
2	Parameter Value MSW	2	Pad Word
3	Parameter Number	3	Parameter Number
4	Parameter Value LSW	4	Pad Word
5	Parameter Value MSW	5	Pad Word
6	Parameter Number	6	Parameter Number
7	Parameter Value LSW	7	Pad Word
8	Parameter Value MSW	8	Pad Word
9	Parameter Number	9	Parameter Number
10	Parameter Value LSW	10	Pad Word
11	Parameter Value MSW	11	Pad Word
12	Parameter Number	12	Parameter Number
13	Parameter Value LSW	13	Pad Word
14	Parameter Value MSW	14	Pad Word
⋮		⋮	
63	Parameter Number	63	Parameter Number
64	Parameter Value LSW	64	Pad Word
65	Parameter Value MSW	65	Pad Word

Troubleshooting

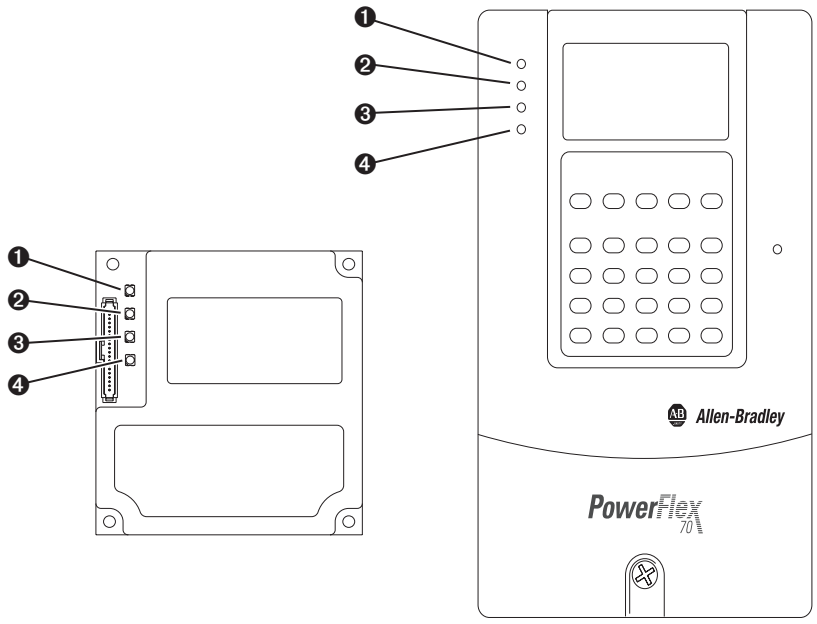
This chapter provides information for diagnosing and troubleshooting potential problems with the adapter and network.

Topic	Page
Understanding the Status Indicators	7-1
PORT Status Indicator	7-2
MOD Status Indicator	7-2
NET A Status Indicator	7-3
NET B Status Indicator	7-3
Viewing Adapter Diagnostic Items	7-4
Viewing and Clearing Events	7-6

Understanding the Status Indicators

The adapter has four status indicators. They can be viewed on the adapter or through the drive cover. See Figure 7.1.

Figure 7.1 Status Indicators (location on drive may vary)



Item	Status Indicator	Description	Page
1	PORT	DPI Connection Status	7-2
2	MOD	Adapter Status	7-2
3	NET A	EtherNet/IP Connection Status	7-3
4	NET B	EtherNet/IP Transmit Status	7-3

PORT Status Indicator

This red/green bicolor LED indicates the status of the adapter's connection to the drive as shown in the table below.

Status	Cause	Corrective Action
Off	The adapter is not powered or is not properly connected to the drive.	• Securely connect the adapter to the drive using the Internal Interface (ribbon) cable. • Apply power to the drive (or adapter if mounted in a DPI External Comms Kit).
Flashing Red	The adapter is not receiving a ping message from the drive.	• Verify that cables are securely connected and not damaged. Replace cables if necessary. • Cycle power to the drive (or adapter if mounted in a DPI External Comms Kit).
Steady Red	The drive has refused an I/O connection from the adapter. Another DPI peripheral is using the same DPI port as the adapter.	**Important:** Cycle power to the drive (or adapter if mounted in a DPI External Comms Kit) after making any of the following corrections: • Verify that all DPI cables on the drive are securely connected and not damaged. Replace cables if necessary. • Verify that the DPI drive supports Datalinks. • Configure the adapter to use a Datalink that is not already being used by another peripheral.
Steady Orange	The adapter is connected to a product that does not support Allen-Bradley DPI communications.	Connect the adapter to a product that supports Allen-Bradley DPI communications (for example, a PowerFlex 7-Class drive).
Flashing Green	The adapter is establishing an I/O connection to the drive.	No action required. Normal behavior if no DPI I/O is enabled.
Steady Green	The adapter is properly connected and is communicating with the drive.	No action required.

MOD Status Indicator

This red/green bicolor LED indicates the status of the adapter as shown in the table below.

Status	Cause	Corrective Action
Off	The adapter is not powered or is not properly connected to the drive.	• Securely connect the adapter to the drive using the Internal Interface (ribbon) cable. • Apply power to the drive (or adapter if mounted in a DPI External Comms Kit).
Flashing Red	The adapter has failed the firmware test. The adapter is being flash upgraded.	• Clear faults in the adapter. • Cycle power to the drive (or adapter if mounted in a DPI External Comms Kit). • If cycling power does not correct the problem, the adapter parameter settings may have been corrupted. Reset defaults and reconfigure the adapter. • If resetting defaults does not correct the problem, flash the adapter with the latest firmware release.
Steady Red	The adapter has failed the hardware test.	• Cycle power to the drive (or adapter if mounted in a DPI External Comms Kit). • Replace the adapter.
Flashing Green	The adapter is operational, but is not transferring I/O data to a controller.	• Place the scanner in RUN mode. • Program the controller to recognize and transmit I/O to the adapter. • Configure the adapter for the program in the controller. • Normal behavior if no DPI I/O is enabled.
Steady Green	The adapter is operational and transferring I/O data to a controller.	No action required.

NET A Status Indicator

This red/green bicolor LED indicates the status of the network connection as shown in the table below.

Status	Cause	Corrective Actions
Off	The adapter is not powered, the adapter is not properly connected to the network, the adapter needs an IP address, or BOOTP is enabled.	• Securely connect the adapter to the drive using the Internal Interface (ribbon) cable and to the network using an Ethernet cable. • Correctly connect the Ethernet cable to the Ethernet connector. • Set a unique IP address and disable BOOTP using a BOOTP server, or set a unique IP address by using adapter parameters. • Apply power to the drive (or adapter if mounted in a DPI External Comms Kit).
Steady Red	The adapter failed the duplicate IP address detection test.	Configure the adapter to use a unique IP address and cycle power.
Flashing Red	An EtherNet/IP connection has timed out.	• Place the scanner in RUN mode, or apply power to the peer device that will send I/O. • Check the IGMP Snooping/Ethernet Switches for correct operation. • Check the amount of traffic on the network.
Flashing Red/Green	The adapter is performing a self-test.	No action required.
Flashing Green	The adapter is properly connected, has an IP address, and is connected to an EtherNet/IP network but does not have an I/O connection.	• Place the controller in RUN mode, or apply power to the peer device that will send I/O. • Program the controller or peer device to recognize and transmit I/O or make a messaging connection to the adapter. • Configure the adapter for the program in the controller or the I/O from the peer device.
Steady Green	The adapter is properly connected and communicating on the network to a controller.	No action required.

NET B Status Indicator

This green LED indicates the status of the adapter transmitting on the network as shown in the table below.

Status	Cause	Corrective Actions
Off	The adapter is not powered or is not transmitting on the network.	If NET A indicator is off: • Securely connect the adapter to the drive using the Internal Interface (ribbon) cable and to the network using an Ethernet cable. • Correctly connect the Ethernet cable to the Ethernet connector. • Set a unique IP address using a BOOTP server or by disabling BOOTP and using adapter parameters. If NET A indicator is steady red: • Configure the adapter to use a unique IP address and cycle power. If NET A indicator is flashing red/green or red: • Check the IP address in the adapter and scanner, and verify that the controller can communicate with the adapter. • Ping the adapter. Normal condition if the adapter is idle.
Flashing Green	The adapter is properly connected, BOOTP is enabled, and the adapter is transmitting data packets on the network.	No action required.

Viewing Adapter Diagnostic Items

If you encounter unexpected communications problems, the adapter's diagnostic items may help you or Rockwell Automation personnel troubleshoot the problem. Adapter diagnostic items can be viewed using an LCD PowerFlex 7-Class HIM (Diagnostics/Device Items), DriveExplorer software (version 2.01 or later), or DriveExecutive software (version 3.01 or later).

Using the HIM to View Adapter Diagnostic Items

Step	Example Screen
1. Access parameters in the adapter. Refer to Using the PowerFlex 7-Class HIM on page 3-2. 2. Press the ▲ or ▼ key to scroll to **Diagnostics**. 3. Press the ↵ (Enter) key to display the Diagnostics menu in the adapter. 4. Repeat steps 2 and 3 to enter the **Device Items** option. 5. Press the ▲ or ▼ key to scroll through the items.	Main Menu: Diagnostics Parameter Device Select Device Item # 3 Reference

Table 7.A Adapter Diagnostic Items

No.	Name	Description
1	Common Logic Cmd	The present value of the Common Logic Command being transmitted to the drive by this adapter.
2	Prod Logic Cmd	The present value of the Product Logic Command being transmitted to the drive by this adapter from the controller.
3	Reference	The present value of the Reference being transmitted to the drive by this adapter. Note that a 16-bit value will be sent as the Most Significant Word of the 32-bit field.
4	Common Logic Sts	The present value of the Common Logic Status being received from the drive by this adapter.
5	Prod Logic Sts	The present value of the Product Logic Status being received from the drive by this adapter to the controller.
6	Feedback	The present value of the Feedback being received from the drive by this adapter. Note that a 16-bit value will be sent as the Most Significant Word of the 32-bit field.
7	Datalink A1 In	The present value of respective Datalink In being transmitted to the drive by this adapter. (If not using a Datalink, this parameter should have a value of zero.)
8	Datalink A2 In	
9	Datalink B1 In	
10	Datalink B2 In	
11	Datalink C1 In	
12	Datalink C2 In	
13	Datalink D1 In	
14	Datalink D2 In	
15	Datalink A1 Out	The present value of respective Datalink Out being received from the drive by this adapter. (If the drive indicates a 16-bit datalink size, the value appears in the least significant 16 bits of this diagnostic item, and the most significant 16 bits of this diagnostic item are zero.)
16	Datalink A2 Out	
17	Datalink B1 Out	
18	Datalink B2 Out	
19	Datalink C1 Out	
20	Datalink C2 Out	
21	Datalink D1 Out	
22	Datalink D2 Out	
23	DPI Rx Errors	The present value of the DPI Receive error counter.
24	DPI Rx Error Max	The maximum value (since reset) of the DPI Receive error counter.
25	DPI Tx Errors	The present value of the DPI Transmit error counter.

Table 7.A Adapter Diagnostic Items (Continued)

No.	Name	Description
26	DPI Tx Error Max	The maximum value (since reset) of the DPI Transmit error counter.
27	Boot Flash Count	Number of times the boot firmware in the adapter has been flash updated.
28	App Flash Count	Number of times the application firmware in the adapter has been flash updated.
29	M-S Input Size	Size of data transferred from the network to the drive.
30	M-S Output Size	Size of data transferred from the drive to the network.
31 32 33 34 35 36	HW Addr 1 HW Addr 2 HW Addr 3 HW Addr 4 HW Addr 5 HW Addr 6	Decimal value of each byte in the adapter's Ethernet hardware address. 255 : 255 : 255 : 255 : 255 : 255 [HW Addr 1] [HW Addr 2] [HW Addr 3] [HW Addr 4] HW Addr 5] [HW Addr 6]
37 38 39 40	IP Addr Act 1 IP Addr Act 2 IP Addr Act 3 IP Addr Act 4	Value of each byte in the adapter's present IP address. A value of "0" appears if the adapter does not currently have an IP address. 255 . 255 . 255 . 255 [IP Addr Act 1] [IP Addr Act 2] [IP Addr Act 3] [IP Addr Act 4]
41 42 43 44	Subnet Act 1 Subnet Act 2 Subnet Act 3 Subnet Act 4	Value of each byte in the adapter's present subnet mask. A value of "0" appears if the adapter does not currently have a subnet mask. 255 . 255 . 255 . 255 [Subnet Act 1] [Subnet Act 2] [Subnet Act 3] [Subnet Act 4]
45 46 47 48	Gateway Act 1 Gateway Act 2 Gateway Act 3 Gateway Act 4	Value of each byte in the adapter's present gateway address. A value of "0" appears if the adapter does not currently have a gateway address. 255 . 255 . 255 . 255 [Gateway Act 1] [Gateway Act 2] [Gateway Act 3] [Gateway Act 4]
49	EN Rx Overruns	Number of receive buffer overruns reported by the Ethernet hardware.
50	EN Rx Packets	Number of Ethernet packets that the adapter has received.
51	EN Rx Errors	Number of receive errors reported by the Ethernet hardware.
52	EN Tx Packets	Number of Ethernet packets that the adapter has sent.
53	EN Tx Errors	Number of transmit errors reported by the Ethernet hardware.
54	Last TCP Reset	Last reason that the adapter reset or rejected a TCP/IP connection.
55	Missed IO Pkts	Number of incoming I/O connection packets that the adapter did not receive.
56	OPT Status	Operating status of optional I/O board in DPI External Comms Kit. For the meanings of the individual bits, see Viewing Optional I/O Diagnostic Items on page 9-4.
57	OPT RX Errors	Number of optional I/O board receive errors.
58	OPT FW Version	Firmware version of optional I/O board (in DPI External Comms Kit).

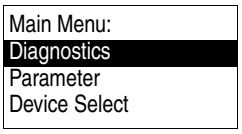
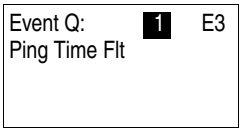
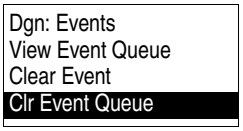
Viewing and Clearing Events

The adapter has an event queue to record significant events that occur in the operation of the adapter. When such an event occurs, an entry is put into the event queue. You can view the event queue using an LCD PowerFlex 7-Class HIM, DriveExplorer (version 2.01 or later) software, DriveExecutive (version 1.01 or later) software or other clients using the DPI Fault object.

The event queue can contain up to 32 entries. Eventually the event queue will become full, since its contents are retained through adapter resets. At that point, a new entry replaces the oldest entry. Only an event queue clear operation or adapter power cycle will clear the event queue contents.

Resetting the adapter to defaults has no effect on the event queue.

Using the HIM to View and Clear Events

Step	Example Screen
Viewing Events	
1. Access parameters in the adapter. Refer to Using the PowerFlex 7-Class HIM on page 3-2.	
2. Press the ▲ or ▼ key to scroll to **Diagnostics**.	
3. Press the ↵ (Enter) key to display the Diagnostics menu in the adapter.	
4. Repeat steps 2 and 3 to enter the **Events** option and then **View Event Queue** option.	
5. Press the ▲ or ▼ key to scroll through events. The most recent event is Event 1.	
Clearing Events	
1. Access parameters in the adapter. Refer to Using the PowerFlex 7-Class HIM on page 3-2.	
2. Press the ▲ or ▼ key to scroll to **Diagnostics**.	
3. Press the ↵ (Enter) key to display the Diagnostics menu in the adapter.	
4. Repeat steps 2 and 3 to enter the **Events** option and then the **Clear Event** option or **Clr Event Queue** option. A message will pop up to confirm that you want to clear the message or queue.	
5. Press the ↵ (Enter) key to confirm your request. If **Clr Event Queue** was selected, all event queue entries will then display "No Event."	

Events

Many events in the event queue occur under normal operation. If you encounter unexpected communications problems, the events may help you or Allen-Bradley personnel troubleshoot the problem. The following events may appear in the event queue:

Table 7.B Adapter Events

Code	Event	Description
1	No Event	Empty event queue entry.
2	DPI Bus Off Flt	A bus-off condition was detected on DPI. This event may be caused by loose or broken cables or by noise.
3	Ping Time Flt	A ping message was not received on DPI within the specified time.
4	Port ID Flt	The adapter is not connected to a correct port on a DPI product.
5	Port Change Flt	The DPI port changed after start up.
6	Host Sent Reset	The drive sent a reset event message.
7	EEPROM Sum Flt	The EEPROM in the adapter is corrupt.
8	Online @ 125kbps	The adapter detected that the drive is communicating at 125 kbps.
9	Online @ 500kbps	The adapter detected that the drive is communicating at 500 kbps.
10	Bad Host Flt	The adapter was connected to an incompatible product.
11	Dup Port Flt	Another peripheral with the same port number is already in use.
12	Type 0 Login	The adapter has logged in for Type 0 control.
13	Type 0 Time Flt	The adapter has not received a Type 0 status message within the specified time.
14	DL Login	The adapter has logged into a Datalink.
15	DL Reject Flt	The drive rejected an attempt to log in to a Datalink because the Datalink is not supported or is used by another peripheral.
16	DL Time Flt	The adapter has not received a Datalink message within the specified time.
17	Reserved	Not used.
18	Control Disabled	The adapter has sent a “Soft Control Disable” command to the drive.
19	Control Enabled	The adapter has sent a “Soft Control Enable” command to the drive.
20	Message Timeout	A Client-Server message sent by the adapter was not completed within 1 sec.
21	Flt Cfg Error	One of the Flt Cfg xx parameters is set to a value greater than 65535 and the drive requires a 16-bit value.
22	App Updated	Startup sequence detected new application firmware.
23	EN Comm Flt	The adapter detected a communications fault on the network.
24	EN Sent Reset	The adapter received a reset from the network.
25	EN Close Flt	An I/O connection from the network to the adapter was closed.
26	EN Idle Flt	The adapter is receiving “idle” packets from the network.
27	EN Open	An I/O connection from the network to the adapter has been opened.
28	EN Timeout Flt	An I/O connection from the network to the adapter has timed out.
29	PCCC IO Close	The device sending PCCC Control messages to the adapter has set the PCCC Control Timeout to zero.
30	PCCC IO Open	The adapter has begun receiving PCCC control messages (the PCCC Control Timeout was previously set to a non-zero value).
31	PCCC IO Time Flt	The adapter has not received a PCCC Control message for longer than the PCCC Control Timeout.
32	Watchdog T/O Flt	The software detects a failure.
33	EEPROM Init	Startup sequence detected a blank EEPROM map revision.
34	Normal Startup	The adapter successfully started up.
35	Manual Reset	The adapter was reset by changing its Reset Module parameter.
36	EN Link Down	The Ethernet link was removed from the adapter.
37	EN Link Up	An Ethernet link is available for the adapter.
38	BOOTP Response	The adapter received a response to its BOOTP request.
39	Dup IP Addr	The adapter uses the same IP address as another device on the network.
40	Peer IO Open	The adapter received the first Peer I/O message.
41	Peer IO Time Flt	The adapter has not received a Peer I/O message for longer than the Peer I/O Timeout.

Table 7.B Adapter Events (Continued)

Code	Event	Description
42	Email Failed	The adapter encountered an error attempting to send a requested e-mail message.
43	Msg Ctrl Open	The timeout attribute in either the CIP Register or Assembly object was written with a non-zero value, allowing control messages to be sent to the adapter.
44	Msg Ctrl Close	The timeout attribute in either the CIP Register or Assembly object was written with a zero value, disallowing control messages to be sent to the adapter.
45	Msg Ctrl Timeout	The timeout attribute in either the CIP Register or Assembly object elapsed between accesses of those objects.
46	OPT Open	The adapter began exchanging I/O data with the I/O option of the DPI External Comms Kit.
47	OPT Close	The adapter forced a fault condition on the I/O option of the DPI External Comms Kit.
48	OPT Timeout	Communication between the adapter and I/O option of the DPI External Comms Kit was disrupted.

Viewing the Adapter's Web Pages

This chapter provides instructions on how to monitor the adapter and connected PowerFlex drive by using the adapter's web interface.

Topic	Page
Accessing the Adapter's Web Home Page	8-1
Process Display Pop-up Window	8-4
TCP/IP Configuration Web Page	8-5
Configure E-mail Notification Web Page	8-6
DPI Device Information Pages	8-9

Future enhancements may result in adapter web pages that look different than the examples shown in this chapter.

Accessing the Adapter's Web Home Page

After configuring the adapter, you can view its web pages. These pages present information about the adapter, the drive to which it is connected, and the other DPI devices connected to the drive such as a HIM.

TIP: Series A adapter web pages are enabled differently than Series B.

- Series A adapter (version 2.003 or earlier)—By default the adapter web pages are enabled. To disable the web pages, use Bit 0 of **Parameter 54 - [Access Control]**. Refer to Setting Web Access Control on page 3-16 for more information.
- Series B adapter (version 3.xxx or later)—By default the adapter web pages are disabled. To enable the web pages, set the Web Pages Switch (SW2 in Figure 2.1) to its "Enable Web" position and reset the adapter. **Parameter 55 - [Web Enable]** can be used to display the setting (Enabled or Disabled) of this switch.

The adapter can be configured to automatically send e-mail messages to desired addresses when selected drive faults occur and/or are cleared, and/or when the adapter takes a communication or idle fault action.

For Series A adapters, Bit 1 of **Parameter 54 - [Access Control]** can be used to protect the configured settings for the e-mail messaging feature. For Series B adapters, Bit 0 of **Parameter 56 - [Web Features]** can be used to protect the configured settings. For more details, see Configure E-mail Notification Web Page on page 8-6.

Viewing the Web Pages of the Adapter

1. On a computer with access to the EtherNet/IP network on which the adapter/drive is installed, launch a web browser such as Microsoft™ Internet Explorer (version 5.0 or later).

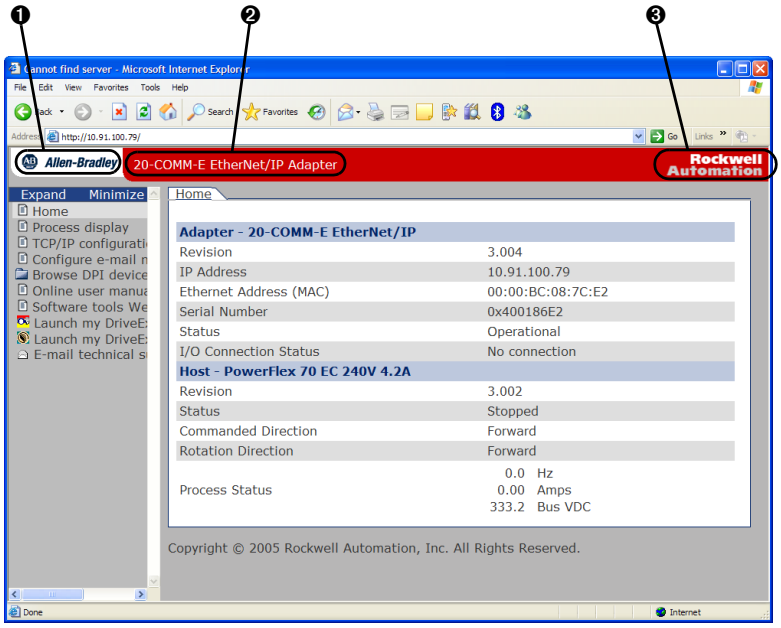
   The computer can access the adapter web pages if it is connected to:

   - The same network as the adapter.
   - A network with access to the adapter's network via a gateway device (for example, a router).

2. In the Address box, type the IP address of the adapter, and then press ENTER. The adapter web Home Page (Figure 8.1) should appear.

   Important: Using the browser's View > Refresh function will always re-display the adapter Home Page while viewing any of the adapter's other web pages.

Figure 8.1 Adapter Web Home Page Example



Title Bar on Adapter Web Pages

The title bar appears on the adapter Home Page and all of the adapter's other web pages. The title bar consists of three elements as shown in Figure 8.1:

Title Bar Element	Description
❶ Allen-Bradley logo	This logo is a hyperlink. Click it to view the ab.com web Home Page.
❷ Adapter Title	Shows the adapter type or user-configurable title.
❸ Rockwell Automation logo	This logo is a hyperlink. Click it to view the Rockwell Automation web Home Page.

Navigation Menu on Adapter Web Pages

The navigation menu appears on the left side of the adapter Home Page and all of the adapter's other web pages. The navigation menu consists of links and link folders which can be expanded or minimized. The following table shows all navigation menu links and link folders.

Table 8.A Navigation Menu Links and Link Folders

Link/Folder	Description
Home link	Click this link to view the adapter's Home Page (Figure 8.1).
Process Display link	Click this link to view the host drive's Process Display pop-up window (Figure 8.2).
TCP/IP configuration link	Click this link to view the adapter's TCP/IP Configuration web page showing information about the TCP/IP configuration, such as the adapter's IP address and the number of packets being sent. Figure 8.3 shows an example TCP/IP Configuration web page.
Configure e-mail notification link	Click this link to view the adapter's Configure E-mail Notification web page (Figure 8.4) to configure the adapter to send automatic e-mail messages. E-mail notification can accommodate specific needs such as when only selected faults occur (Figure 8.5). An example e-mail message is shown in Figure 8.7.
Browse DPI devices folder	Click this folder to expand and view the Port folders for all present DPI devices, including the drive, adapter, and other DPI devices connected to the drive such as a HIM.
Port x folders	Click a respective Port folder to expand and view its device's various links which take you to related information pages. For Port 0 (PowerFlex 70 Drive) example information pages, see Figure 8.8, Figure 8.9, and Figure 8.10.
Online user manuals link	Click this link to view Rockwell Automation's web page with documentation for drives and other devices.
Software tools Web site link	Click this link to view Allen-Bradley's web page with information about software tools such as DriveExplorer and DriveExecutive.
Launch my DriveExplorer software link	Click this link to launch the DriveExplorer software already installed on your PC.
Launch my DriveExecutive software link	Click this link to launch the DriveExecutive software already installed on your PC.
E-mail technical support link	Click this link to view a new e-mail message window to send a message to Allen-Bradley's Technical Support Team.

Information on Adapter Home Page

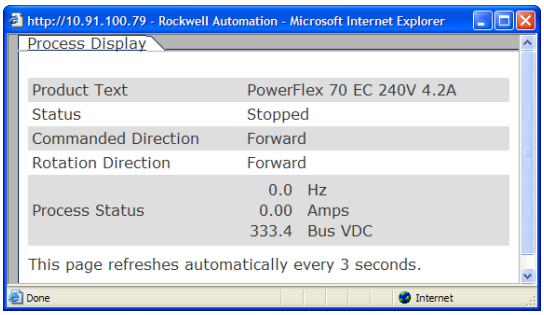
The adapter Home Page displays the following information for the adapter and its host drive:

Information for	Description
Adapter	• Revision • IP Address • Ethernet Address (MAC) • Serial Number • Status • I/O Connection Status
Host "X" Drive	• Revision • Status • Commanded Direction • Rotation Direction • Process Status

Process Display Pop-up Window

The Process Display pop-up window dynamically shows the host drive's information. To view this window, click the "Process display" link in the navigation menu.

Figure 8.2 Example of Process Display Pop-up Window

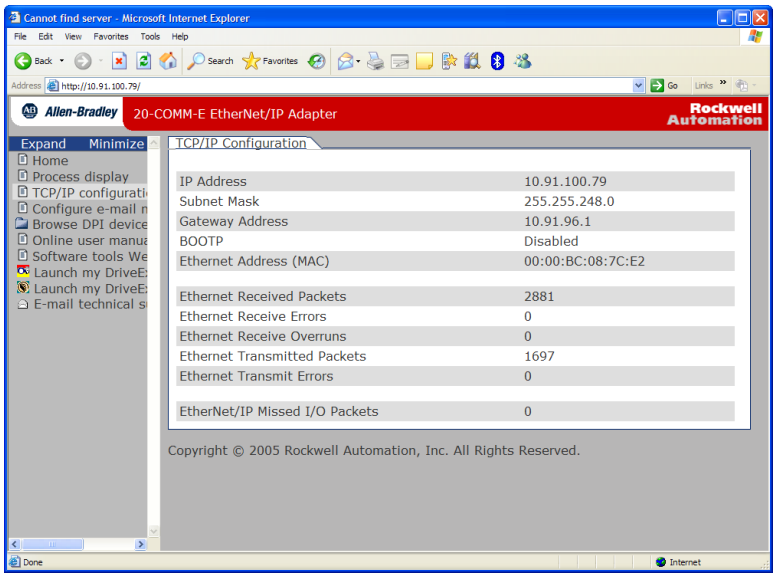


Information	Description
Product Text	Description of host drive.
Status	Status of host drive.
Commanded Direction	Commanded direction of host drive.
Rotation Direction	Rotation direction of host drive.
Process Status 1st Line Lines 2 and 3	 Dynamic value of the host drive feedback parameter (not selectable). Dynamic value of each default displayed host drive parameter (selectable). (Line 2 and 3 default displayed host drive parameters can be changed using a HIM, DriveExecutive software or DriveExplorer software.)

TCP/IP Configuration Web Page

The TCP/IP Configuration web page provides information about the adapter's Ethernet settings and network activities. To view this web page, click the "TCP/IP configuration" link (highlighted in Figure 8.3) in the navigation menu.

Figure 8.3 Example of TCP/IP Configuration Web Page

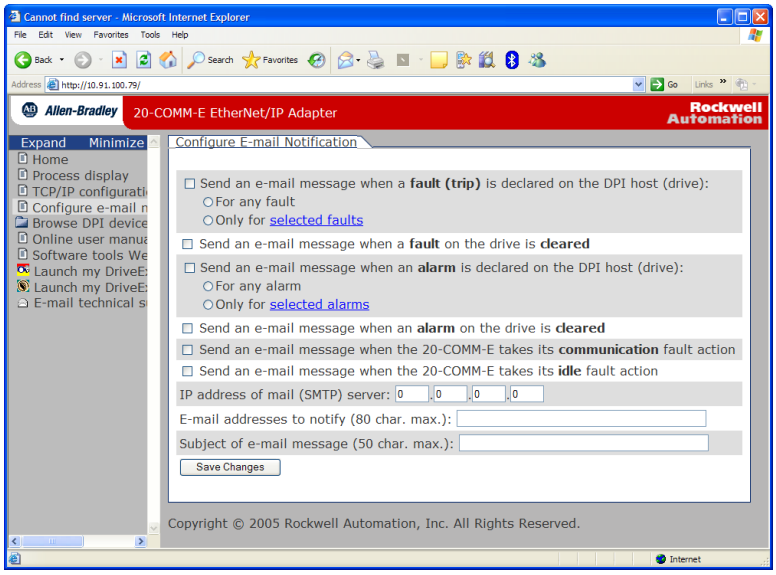


Information	Description
IP Address	IP address of the adapter.
Subnet Mask	Subnet mask for the adapter's network.
Gateway Address	Address for the gateway device on the adapter's network.
BOOTP	Shows status for BOOTP, which may be used to configure the adapter's network information.
Ethernet Address (MAC)	Hardware address for the adapter.
Ethernet Received Packets	Number of packets that the adapter has received.
Ethernet Receive Errors	Number of receive errors reported by the hardware.
Ethernet Receive Overruns	Number of receive buffer overruns reported by the hardware.
Ethernet Transmitted Packets	Number of packets that the adapter has sent.
Ethernet Transmit Errors	Number of transmit errors reported by the hardware.
EtherNet/IP Missed I/O Packets	Number of I/O connection packets that the adapter did not receive.

Configure E-mail Notification Web Page

The Configure E-mail Notification web page contains selections and data fields for configuring the adapter to automatically send e-mail messages to desired addresses when selected types of events occur. To view this web page, click the "Configure e-mail…" link (highlighted in Figure 8.4) in the navigation menu.

Figure 8.4 Example of Configure E-mail Notification Web Page



E-mail configuration for Series A adapters is enabled and disabled differently than Series B adapters.

- Series A adapters (version 2.003 or earlier)—By default, settings are protected and the user needs to enable configuration by using **Parameter 54 - [Access Control]** to set the E-mail Config Bit 1 value to "1" (Enabled). After configuration, settings can be protected by changing the E-mail Config Bit 1 value back to "0" (Disabled).

- Series B adapters (version 3.xxx or later)—By default, settings are not protected. After configuration, settings can be protected by using **Parameter 56 - [Web Features]** to set E-mail Cfg Bit 0 value to "0" (Disabled). To change a protected configuration, it must first be unprotected by setting the E-mail Cfg Bit 0 value back to "1" (Enabled).

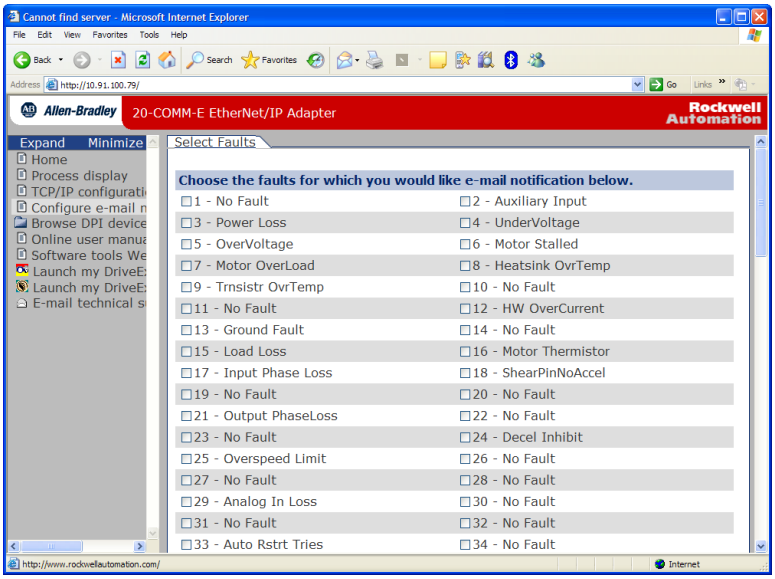
To configure e-mail notification:

1. Click the desired "Send an e-mail message when…" check boxes you want to occur that will send e-mail notification. If you only want e-mail notification when selected faults/alarms occur:

   A. Click the respective fault and/or alarm radio buttons.

   B. Click the "selected faults" link and/or "selected alarms" link. Figure 8.5 shows an example faults configuration page.

Figure 8.5 Example of Selected Faults Configuration Page



C. Click the desired fault/alarm check boxes, and click **Save Changes**.

D. Click the "Back to E-mail Configuration Page" link.

2. Type the following information in their respective boxes:

Information	Description
"IP address of..."	Type in the address of the mail server that will be used to deliver the e-mail messages. (When the IP address is unknown, read the TIP shown below this table to determine the mail server address.)
"E-mail addresses to notify..."	Type in addresses to where you want e-mail messages to be sent. Multiple addresses can be used, but they must be separated by commas (comma delimited).
"Subject of e-mail message..."	Type in the desired subject text for the e-mail message.

TIP: If the IP address of the e-mail server is unknown, you can contact your IT department or use the following DOS command instructions to find its IP address:

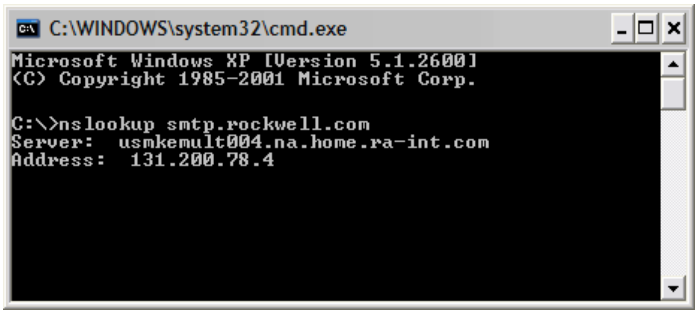
A. On the Windows task bar, click **Start > Run** to display the Run window.

B. In the Run window Open field, type "cmd" and click **OK** to display the DOS window.

C. On the c:\ > command line, type "nslookup [name of e-mail server]." The entry "c:\ > nslookup smtp.company.com" is an example.

D. Press **ENTER** to display the e-mail server IP address (Figure 8.6).

Figure 8.6 DOS Window Example Showing E-mail Server IP Address



The IP address shown in the DOS window (for this example, 131.200.78.4) should be typed into the E-mail Notification Web Page shown in Figure 8.4.

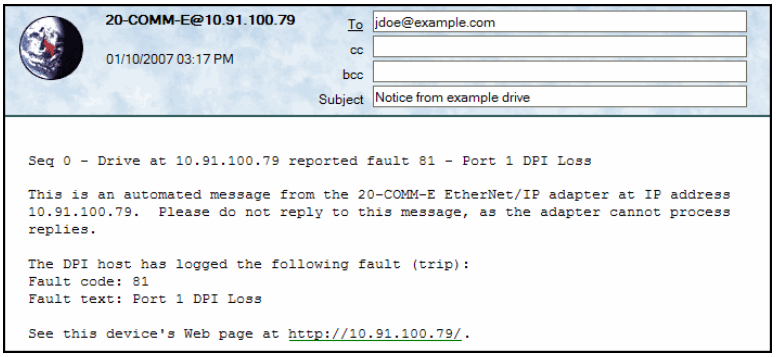
3. Click **Save changes**.

Important: After configuring E-mail Notification, it is recommended to protect the settings. Otherwise the configuration can be changed anytime the web page is accessed with a browser. To protect the settings:

- Series A Adapters—Use **Parameter 54 - [Access Control]** to set E-mail Config Bit 1 value to "0" (Disabled).
- Series B Adapters—Use **Parameter 56 - [Web Features]** to set E-mail Cfg Bit 0 value to "0" (Disabled).

Figure 8.7 shows an example e-mail message automatically sent by the adapter in response to selected events.

Figure 8.7 Example of E-mail Message Sent by Adapter



TIP: To stop e-mail messages, uncheck all of the "Send an e-mail message when…" boxes.

- For Series A adapters, disabling the adapter web pages by using **Parameter 54 - [Access Control]** to set the Web Enable Bit 0 value to "0" (Disabled) will NOT stop the adapter from sending e-mail messages.
- For Series B adapters, disabling the adapter web pages by setting the Web Pages Switch (SW2 in Figure 2.1) to the "Disable Web" position will NOT stop the adapter from sending e-mail messages.

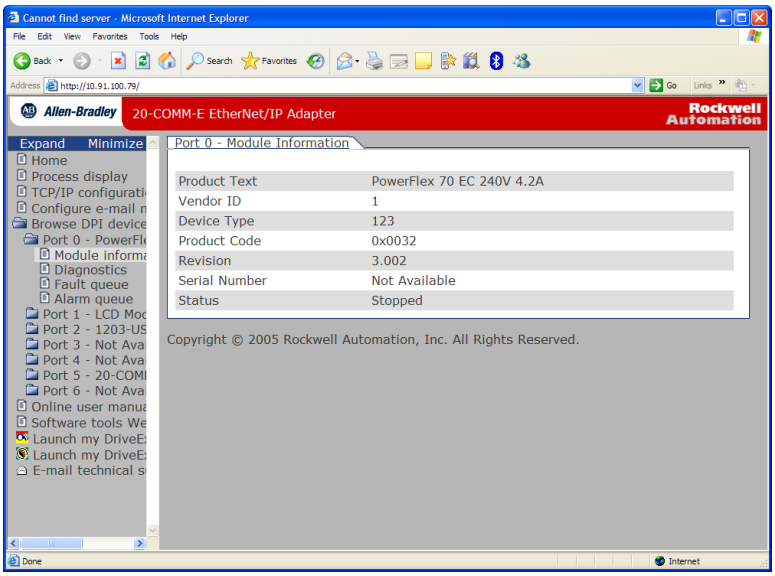
DPI Device Information Pages

DPI device information pages are viewed by clicking on the respective links in the navigation menu:

Web Page	Description
Module Information	Shows module information for the respective Port device. For example, Figure 8.8 shows module information for the Port 0 device (host drive).
Diagnostic Items	Shows diagnostic item information for the respective Port device. For example, Figure 8.9 shows diagnostic items for the Port 0 device (host drive).
Fault Queue	Shows fault queue information for the respective Port device. For example, Figure 8.10 shows the fault queue for the Port 0 device (host drive).
Alarm Queue (1)	Shows alarm queue information for the respective Port device. For example, Figure 8.11 shows the alarm queue for the Port 0 device (host drive).
Event Queue (1)	Shows event queue information for the respective Port device. For example, Figure 8.12 shows the event queue for the Port 5 device (22-COMM-E adapter).

(1) Information shown only when supported by the device.

Figure 8.8 Example of Port 0 (PowerFlex 70 Drive) Module Information Page



Information	Description
Product Text	Text identifying the device
Vendor ID	1 = Allen-Bradley
Device Type	123
Product Code	Code for the product name and its rating
Revision	Firmware revision used by the device
Serial Number	Serial number of the device
Status	Operating status of the device (for example, faulted)

Figure 8.9 Example of Port 0 (PowerFlex 70 Drive) Diagnostic Items Page

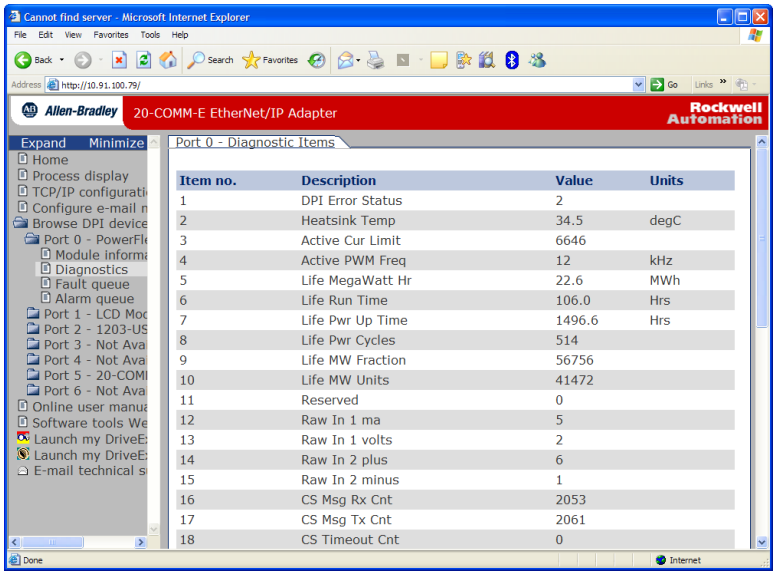
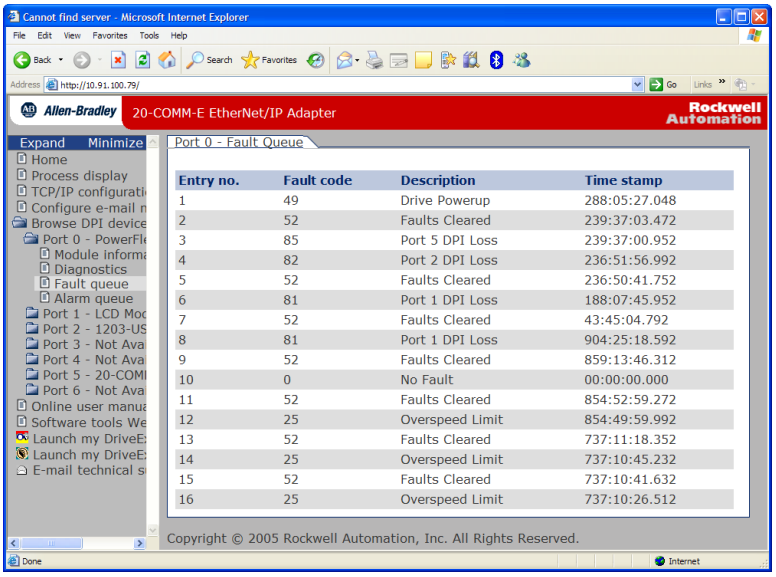


Figure 8.10 Example of Port 0 (PowerFlex 70 Drive) Fault Queue Page



NOTE: For drives that do not support an alarm queue, the adapter will still display an alarm queue web page (Figure 8.11), but show that the alarm queue is not available.

Figure 8.11 Example of Port 0 (PowerFlex 70 Drive) Alarm Queue Page

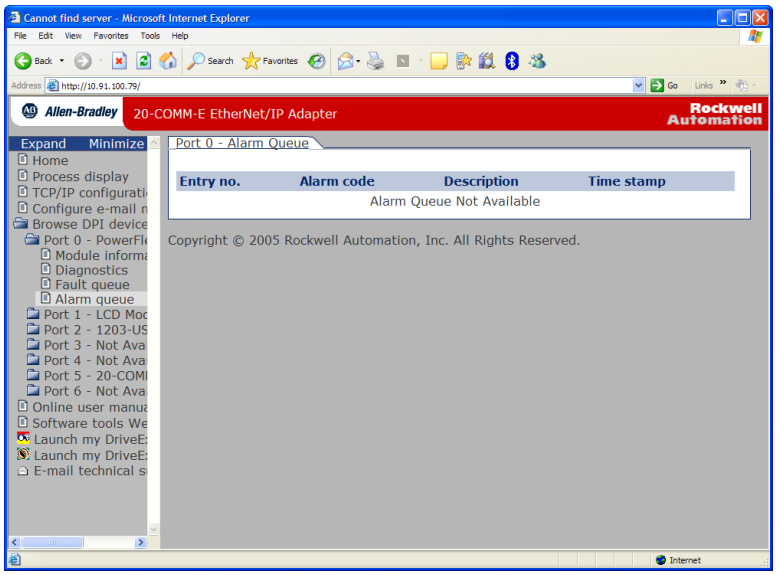
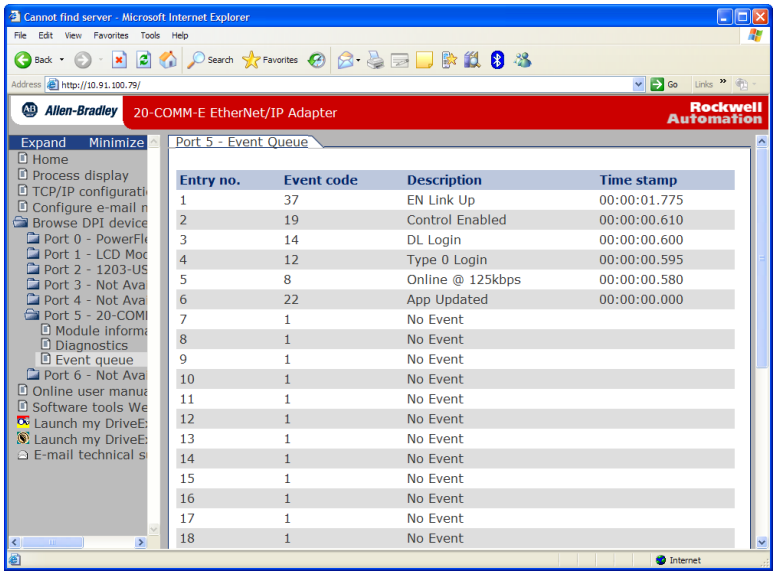


Figure 8.12 shows an example event queue page for the Port 5 device (20-COMM-E adapter).

Figure 8.12 Example of Port 5 (20-COMM-E Adapter) Event Queue Page



Notes:

Using the Adapter in a DPI External Comms Kit (20-XCOMM-DC-BASE)

This chapter provides information and examples that explain how to use the adapter in a DPI External Comms Kit (20-XCOMM-DC-BASE).

The adapter is typically installed in the internal communication slot on the PowerFlex 7-Class drive. However, an externally-mounted adapter may be desired when:

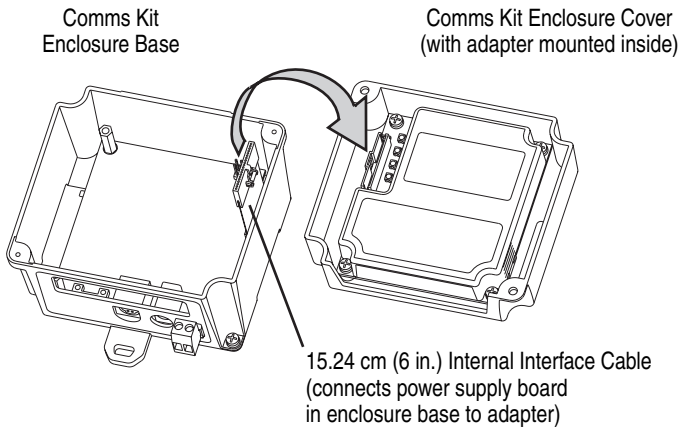
- The PowerFlex drive is already connected to an existing network, such as Remote I/O, and a second network is desired for software tools (DriveExplorer, DriveExecutive, etc.), data collection, etc.
- The PowerFlex drive is remotely located next to some I/O devices that also need to be networked. The DPI External Comms Kit has an option slot for general-purpose network I/O that a controller can use. Both the drive and I/O devices are handled as one node on the network to reduce the network node count.

Topic	Page
Installing the Adapter	9-1
I/O Board Option (20-XCOMM-IO-OPT1)	9-2
Understanding the I/O Image (Drive + I/O Option)	9-2
Configuring the Adapter to Use the Optional I/O Data	9-3
Viewing Optional I/O Diagnostic Items	9-4

Installing the Adapter

The adapter can be installed in a DPI External Comms Kit.

Figure 9.1 Mounting and Connecting the Adapter

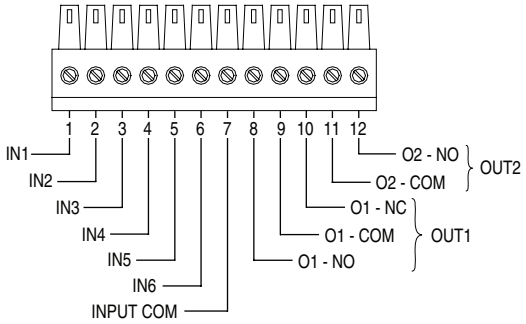


For more information, refer to the *DPI External Communications Kit Installation Instructions* (publication 20COMM-IN001).

I/O Board Option (20-XCOMM-IO-OPT1)

The I/O Board option, when installed in the DPI External Comms Kit, can be used with the adapter (Series B, firmware version 3.xxx or later required). The I/O Board provides (6) DC inputs and (2) Relay outputs for use by a controller on the network.

Figure 9.2 I/O Connector Function Descriptions

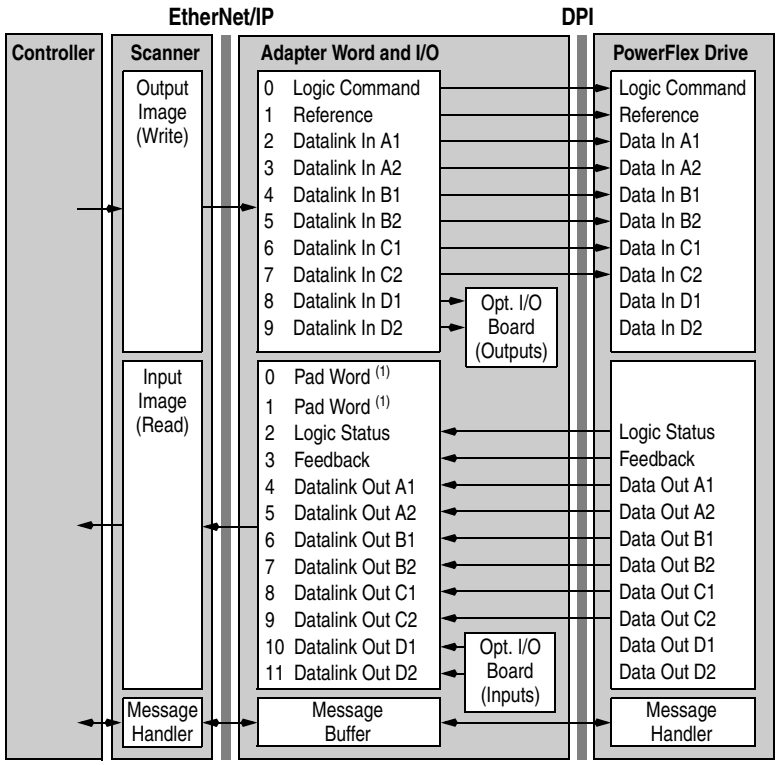


For more information, refer to the *I/O Board Option Installation Instructions* (publication 20COMM-IN002).

Understanding the I/O Image (Drive + I/O Option)

The data for the optional I/O Board is sent over the I/O connection using Datalink D. When the optional I/O Board is installed in the DPI External Comms Kit, Datalink D is dedicated for this function only and is not available for other uses. When the adapter detects the presence of the optional I/O Board, the I/O image is modified as shown in Figure 9.3.

Figure 9.3 Example I/O Image – Datalink D Dedicated to I/O Board and All I/O Enabled



(1) Required by ControlLogix when using the Generic Profile. May or may not be required by other types of controllers.

The data from the I/O Board is loaded into the Datalink word starting with bit 0 of Datalink D1 and concluding with bit 14. Bit 15 of Datalink D1 is reserved as an input valid Status flag. When the input data is valid, bit 15 = 1.

For example, for the 20-XCOMM-IO-OPT1, the digital inputs and digital outputs are mapped as shown in Figure 9.4 and Figure 9.5 respectively.

Figure 9.4 I/O Board Option Digital Input Mapping

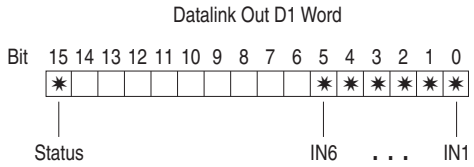
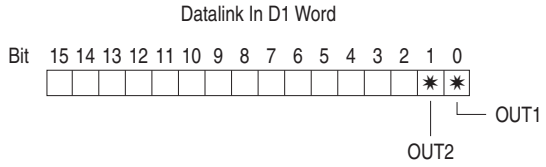


Figure 9.5 I/O Board Option Digital Output Mapping



Important: On power-up or reset, the outputs will be in a "non-activated" state.

Configuring the Adapter to Use the Optional I/O Data

To configure the adapter to use the optional I/O Board, **Parameters 23 - [DPI I/O Cfg]**, **35 - [M-S Input]**, and **36 - [M-S Output]** must be set. To send input/output data from the optional I/O board to the network:

- Turn on bit 4 ("1xxxx") in **Parameter 35 - [M-S Input]**.
- Turn on bit 4 ("1xxxx") in **Parameter 36 - [M-S Output]**.
- Turn off bit 4 ("0xxxx") in **Parameter 23 - [DPI I/O Cfg]**.

Setting the Datalink D bit 4 in the M-S Input and M-S Output parameters directs the communication adapter to send Datalink D back to the controller. Turning off bit 4 in the DPI I/O Cfg parameter directs the communication adapter to not send Datalink D data back to the drive. For more information on I/O Messaging and Configuring Datalinks, see Chapter 5, Using the I/O.

If the I/O Board Fault Action Jumper (JMP1) is set to the Fault Configurable position, **Parameter 33 - [Flt Cfg D1 In]** is used to set the states of the outputs when the I/O Board takes its Fault Action. For details on setting the Fault Action Jumper, see the *I/O Board Option Installation Instructions* (publication 20COMM-IN002).

Viewing Optional I/O Diagnostic Items

Viewing communication adapter diagnostic item 56 (OPT Status) shows the operating status of the optional I/O board:

Bit	State	Status Indication	Description
0	1 (On)	OPT Present	I/O data is being exchanged with the adapter.
1	1 (On)	OPT Faulted	The I/O board is taking its fault action.
2	1 (On)	Hold Last	Fault Action is “Hold Last.”
3	1 (On)	Send Flt Cfg	Fault Action is “Fault Config.”

Viewing communication adapter diagnostic item 57 (OPT RX Errors) shows the number of I/O board receive errors.

Viewing communication adapter diagnostic item 58 (OPT FW Version) shows the present firmware version of the optional I/O board.

Diagnostic item 13 (Datalink D1 In) will show the status of the outputs as a combined decimal value. For example, a “0” decimal (“00” binary) indicates both outputs are off and a “3” decimal (“11” binary) indicates both outputs are on. **NOTE:** A status bit is not used for outputs.

Diagnostic item 21 (Datalink D1 Out) will show the status of the inputs as a combined decimal value, including the status bit 15. For example, Figure 9.6 shows inputs that are valid and all on, and Figure 9.7 shows inputs that are valid and all off (zero).

Figure 9.6 Valid Inputs All On

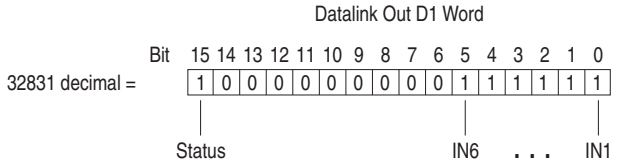
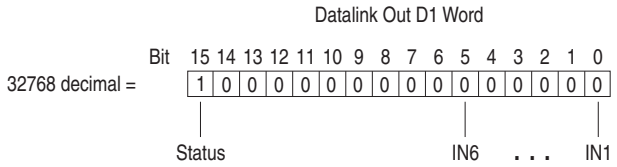


Figure 9.7 Valid Inputs All Off



Specifications

Appendix A presents the specifications for the adapter.

Topic	Page
Communications	A-1
Electrical	A-1
Mechanical	A-2
Environmental	A-2
Regulatory Compliance	A-2

Communications

Network	
Protocol	EtherNet/IP
Data Rates	10 Mbps Full Duplex 10 Mbps Half Duplex 100 Mbps Full Duplex 100 Mbps Half Duplex
Connection Limits	30 TCP connections 16 simultaneous CIP connections including 1 exclusive-owner I/O connection The following activities use a CIP connection: • Class I I/O connections (for example, from a ControlLogix controller) • Explicit messaging where “connected” is chosen (for example, in a checkbox in RSLogix 5000) • DriveExecutive connections to the drive The following activities DO NOT use a CIP connection: • Explicit messaging-based control using PCCC or the Register or Assembly objects, including the PLC-5, SLC 500, and MicroLogix 1100 examples in Chapter 4 • Explicit messaging where “connected” is NOT chosen, which is typically the default • DriveExplorer connections to the drive
Requested Packet Interval (RPI)	5 ms minimum
Packet Rate	Up to 400 total I/O packets per second (200 in and 200 out)
Drive	
Protocol	DPI
Data Rates	125 kbps or 500 kbps

Electrical

Consumption	
Drive	350 mA at 5 VDC supplied by the host (drive or DPI External Comms Kit)
Network	None

Mechanical

Dimensions	
Height	19 mm (0.75 inches)
Length	86 mm (3.39 inches)
Width	78.5 mm (3.09 inches)
Weight	85 g (3 oz.)

Environmental

Temperature	
Operating	-10…50°C (14…122°F)
Storage	-40…85°C (-40…185°F)
Relative Humidity	5…95% non-condensing
Atmosphere	**Important:** The adapter **must not** be installed in an area where the ambient atmosphere contains volatile or corrosive gas, vapors or dust. If the adapter is not going to be installed for a period of time, it must be stored in an area where it will not be exposed to a corrosive atmosphere.

Regulatory Compliance

Certification	Specification
UL	UL508C
cUL	CAN / CSA C22.2 No. 14-M91
CE	EN50178 and EN61800-3
CTick	EN61800-3

NOTE: This is a product of category C2 according to IEC 61800-3. In a domestic environment this product may cause radio interference in which case supplementary mitigation measures may be required.

Adapter Parameters

Appendix B provides information about the adapter parameters.

Topic	Page
About Parameter Numbers	B-1
Parameter List	B-1

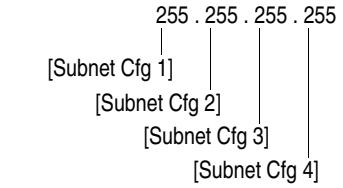
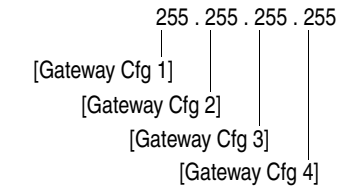
About Parameter Numbers

The parameters in the adapter are numbered consecutively. However, depending on which configuration tool you use, they may have different numbers.

Configuration Tool	Numbering Scheme
• HIM • DriveExplorer • DriveExecutive	The adapter parameters begin with parameter 01. For example, **Parameter 01 - [DPI Port]** is parameter 01 as indicated by this manual.
• Explicit Messaging	Refer to Chapter 6, Using Explicit Messaging and Appendix C, EtherNet/IP Objects for details.

Parameter List

Parameter No.	Name and Description	Details
01	**[DPI Port]** Displays the port to which the adapter is connected. This will usually be port 5.	Default: 5 Minimum: 0 Maximum: 7 Type: Read Only
02	**[DPI Data Rate]** Displays the data rate used by the drive. This data rate is set in the drive and the adapter detects it.	Default: 0 = 125 kbps Values: 0 = 125 kbps 1 = 500 kbps Type: Read Only
03	**[BOOTP]** Configures the adapter to use BOOTP so that you can set its IP address, subnet mask, and gateway address with a BOOTP server.	Default: 1 = Enabled Values: 0 = Disabled 1 = Enabled Type: Read/Write Reset Required: Yes
04 05 06 07	**[IP Addr Cfg 1]** **[IP Addr Cfg 2]** **[IP Addr Cfg 3]** **[IP Addr Cfg 4]** Sets the bytes in the IP address. 255 . 255 . 255 . 255 [IP Addr Cfg 1] [IP Addr Cfg 2] [IP Addr Cfg 3] [IP Addr Cfg 4] **Important:** To set the IP address using these parameters, **Parameter 03 - [BOOTP]** must be set to "0" (Disabled).	Default: 0 Default: 0 Default: 0 Default: 0 Minimum: 0 Maximum: 255 Type: Read/Write Reset Required: Yes

Parameter No.	Name and Description	Details
08 09 10 11	**[Subnet Cfg 1]** **[Subnet Cfg 2]** **[Subnet Cfg 3]** **[Subnet Cfg 4]** Sets the bytes of the subnet mask.  **Important:** To set the subnet mask using these parameters, **Parameter 03 - [BOOTP]** must be set to "0" (Disabled).	Default: 0 Default: 0 Default: 0 Default: 0 Minimum: 0 Maximum: 255 Type: Read/Write Reset Required: Yes
12 13 14 15	**[Gateway Cfg 1]** **[Gateway Cfg 2]** **[Gateway Cfg 3]** **[Gateway Cfg 4]** Sets the bytes of the gateway address.  **Important:** To set the gateway address using these parameters, **Parameter 03 - [BOOTP]** must be set to "0" (Disabled).	Default: 0 Default: 0 Default: 0 Default: 0 Minimum: 0 Maximum: 255 Type: Read/Write Reset Required: Yes
16	**[EN Rate Cfg]** Sets the network data rate at which the adapter communicates. (Updates **Parameter 17 - [EN Rate Act]** after a reset.)	Default: 0 = Autodetect Values: 0 = Autodetect 1 = 10 Mbps Full 2 = 10 Mbps Half 3 = 100 Mbps Full 4 = 100 Mbps Half Type: Read/Write Reset Required: Yes
17	**[EN Rate Act]** Displays the network data rate actually used by the adapter.	Default: 0 = No Link Values: 0 = No Link 1 = 10 Mbps Full 2 = 10 Mbps Half 3 = 100 Mbps Full 4 = 100 Mbps Half Type: Read Only
18	**[Ref/Fdbk Size]** Displays the size of the Reference/Feedback. The drive determines the size of the Reference/Feedback.	Default: 0 = 16-bit Values: 0 = 16-bit 1 = 32-bit Type: Read Only
19	**[Datalink Size]** Displays the size of each Datalink word. The drive determines the size of Datalinks.	Default: 0 = 16-bit Values: 0 = 16-bit 1 = 32-bit Type: Read Only

Parameter No.	Name and Description	Details
20	**[Reset Module]** No action if set to "0" (Ready). Resets the adapter if set to "1" (Reset Module). Restores the adapter to its factory default settings if set to "2" (Set Defaults). This parameter is a command. It will be reset to "0" (Ready) after the command has been performed.	Default: 0 = Ready Values: 0 = Ready 1 = Reset Module 2 = Set Defaults Type: Read/Write Reset Required: No
	ATTENTION: Risk of injury or equipment damage exists. If the adapter is transmitting I/O that controls the drive, the drive may fault when you reset the adapter. Determine how your drive will respond before resetting a connected adapter.	
21	**[Comm Flt Action]** Sets the action that the adapter and drive will take if the adapter detects that I/O messaging communications have been disrupted. This setting is effective only if I/O that controls the drive is transmitted through the adapter. When communication is re-established, the drive will automatically receive commands over the network again.	Default: 0 = Fault Values: 0 = Fault 1 = Stop 2 = Zero Data 3 = Hold Last 4 = Send Flt Cfg Type: Read/Write Reset Required: No
	ATTENTION: Risk of injury or equipment damage exists. **Parameter 21 - [Comm Flt Action]** lets you determine the action of the adapter and connected drive if I/O communications are disrupted. By default, this parameter faults the drive. You can set this parameter so that the drive continues to run. Precautions should be taken to ensure that the setting of this parameter does not create a risk of injury or equipment damage. When commissioning the drive, verify that your system responds correctly to various situations (for example, a disconnected cable).	
22	**[Idle Flt Action]** Sets the action that the adapter and drive will take if the adapter detects that the controller is in program mode or faulted. This setting is effective only if I/O that controls the drive is transmitted through the adapter. When the controller is put back in Run mode, the drive will automatically receive commands over the network again.	Default: 0 = Fault Values: 0 = Fault 1 = Stop 2 = Zero Data 3 = Hold Last 4 = Send Flt Cfg Type: Read/Write Reset Required: No
	ATTENTION: Risk of injury or equipment damage exists. **Parameter 22 - [Idle Flt Action]** lets you determine the action of the adapter and connected drive when the controller is idle. By default, this parameter faults the drive. You can set this parameter so that the drive continues to run. Precautions should be taken to ensure that the setting of this parameter does not create a risk of injury or equipment damage. When commissioning the drive, verify that your system responds correctly to various situations (for example, a faulted controller).	
23	**[DPI I/O Cfg]** Sets the I/O that is transferred through the adapter.	Default: xxx0 0001 Bit Values: 0 = I/O disabled 1 = I/O enabled Type: Read/Write Reset Required: Yes

Bit Definition	Not Used	Not Used	Not Used	Datalink D	Datalink C	Datalink B	Datalink A	Cmd/Ref
Default	x	x	x	0	0	0	0	1
Bit	7	6	5	4	3	2	1	0

Parameter No.	Name and Description	Details
24	**[DPI I/O Act]** Displays the I/O that the adapter is actively transmitting. The value of this parameter will usually be equal to the value of **Parameter 23 - [DPI I/O Cfg]**.	Default: xxx0 0001 Bit Values: 0 = I/O disabled 1 = I/O enabled Type: Read Only Bit Definition: Not Used, Not Used, Not Used, Datalink D, Datalink C, Datalink B, Datalink A, Cmd/Ref Default: x, x, x, 0, 0, 0, 0, 1 Bit: 7, 6, 5, 4, 3, 2, 1, 0
25	**[Flt Cfg Logic]** Sets the Logic Command data that is sent to the drive if any of the following is true: • **Parameter 21 - [Comm Flt Action]** is set to “4” (Send Flt Cfg) and I/O communications are disrupted. • **Parameter 22 - [Idle Flt Action]** is set to “4” (Send Flt Cfg) and the controller is idle. • **Parameter 41 - [Peer Flt Action]** is set to “4” (Send Flt Cfg) and Peer I/O communications are disrupted. The bit definitions will depend on the product to which the adapter is connected. See Appendix D or the documentation for the drive being used.	Default: 0000 0000 0000 0000 Minimum: 0000 0000 0000 0000 Maximum: 1111 1111 1111 1111 Type: Read/Write Reset Required: No
26	**[Flt Cfg Ref]** Sets the Reference data that is sent to the drive if any of the following is true: • **Parameter 21 - [Comm Flt Action]** is set to “4” (Send Flt Cfg) and I/O communications are disrupted. • **Parameter 22 - [Idle Flt Action]** is set to “4” (Send Flt Cfg) and the controller is idle. • **Parameter 41- [Peer Flt Action]** is set to “4” (Send Flt Cfg) and Peer I/O communications are disrupted.	Default: 0 Minimum: 0 Maximum: 4294967295 Type: Read/Write Reset Required: No **Important:** If the drive uses a 16-bit Reference, the most significant word of this value must be set to zero (0) or a fault will occur.
27 28 29 30 31 32 33 34	**[Flt Cfg A1 In]** **[Flt Cfg A2 In]** **[Flt Cfg B1 In]** **[Flt Cfg B2 In]** **[Flt Cfg C1 In]** **[Flt Cfg C2 In]** **[Flt Cfg D1 In]** **[Flt Cfg D2 In]** Sets the data that is sent to the Datalink in the drive if any of the following is true: • **Parameter 21 - [Comm Flt Action]** is set to “4” (Send Flt Cfg) and I/O communications are disrupted. • **Parameter 22 - [Idle Flt Action]** is set to “4” (Send Flt Cfg) and the controller is idle. • **Parameter 41 - [Peer Flt Action]** is set to “4” (Send Flt Cfg) and Peer I/O communications are disrupted.	Default: 0 Default: 0 Default: 0 Default: 0 Default: 0 Default: 0 Default: 0 Default: 0 Minimum: 0 Maximum: 4294967295 Type: Read/Write Reset Required: No **Important:** If the drive uses 16-bit Datalinks, the most significant word of this value must be set to zero (0) or a fault will occur.

Parameter No.	Name and Description	Details
35	**[M-S Input]** Sets the Master-Slave input data. This data is produced by the scanner and consumed by the adapter.	Default: xxx0 0001 Bit Values: 0 = I/O disabled 1 = I/O enabled Type: Read/Write Reset Required: Yes

Bit Definition	Not Used	Not Used	Not Used	Datalink D Input	Datalink C Input	Datalink B Input	Datalink A Input	Cmd/Ref
Default	x	x	x	0	0	0	0	1
Bit	7	6	5	4	3	2	1	0

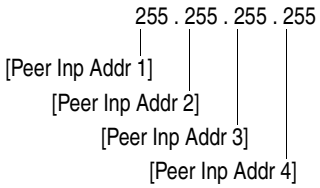
36	**[M-S Output]** Sets the Master-Slave output data. This data is produced by the adapter and consumed by the Master device (for example, scanner).	Default: xxx0 0001 Bit Values: 0 = I/O disabled 1 = I/O enabled Type: Read/Write Reset Required: Yes

Bit Definition	Not Used	Not Used	Not Used	Datalink D Output	Datalink C Output	Datalink B Output	Datalink A Output	Cmd/Ref
Default	x	x	x	0	0	0	0	1
Bit	7	6	5	4	3	2	1	0

37	**[Ref Adjust]** Sets the percent scale factor for the Reference received from the network.	Default: 100.00% Minimum: 0.00% Maximum: 200.00% Type: Read/Write Reset Required: No

ATTENTION: To guard against equipment damage and/or personal injury, note that changes to **Parameter 37 - [Ref Adjust]** take effect immediately. A drive receiving its Reference from the adapter will receive the newly scaled Reference, resulting in a change of speed.

38 39	**[Peer A Input]** **[Peer B Input]** Sets the destination of the Peer I/O input. The adapter receives this data from the network and sends it to the drive. **Important:** Changes to these parameters are ignored when **Parameter 47 - [Peer Inp Enable]** is "1" (On). **Important:** If the parameter is set to input a Logic Command, configure the mask in **Parameter 40 - [Peer Cmd Mask]** so that the desired bits from the Peer device are used.	Default: 0 = Off Default: 0 = Off Values: 0 = Off 1 = Cmd/Ref 2 = Datalink A Input 3 = Datalink B Input 4 = Datalink C Input 5 = Datalink D Input Type: Read/Write Reset Required: No
40	**[Peer Cmd Mask]** Sets the mask for the Logic Command word when it is received through peer input. If the mask bit is "0" (Off), the command bit is ignored and not used. If the mask bit is "1" (On), the command bit is checked and used. **Important:** If the adapter receives a Logic Command from both a Master device and a Peer device, each command bit must have only one source. The source of command bits set to "0" will be the Master device. The source of command bits set to "1" will be the Peer device.	Default: 0000 0000 0000 0000 Minimum: 0000 0000 0000 0000 Maximum: 1111 1111 1111 1111 Values: 0 = Ignore bit 1 = Check bit Type: Read/Write Reset Required: Yes

Parameter No.	Name and Description	Details
41	**[Peer Flt Action]** Sets the action that the adapter and drive will take if the adapter detects that Peer I/O communications have been disrupted. This setting is effective only if I/O is transmitted through the adapter.	Default: 0 = Fault Values: 0 = Fault 1 = Stop 2 = Zero Data 3 = Hold Last 4 = Send Flt Cfg Type: Read/Write Reset Required: No
	ATTENTION: Risk of injury or equipment damage exists. **Parameter 41 - [Peer Flt Action]** lets you determine the action of the adapter and connected drive if the adapter is unable to communicate with the designated peer. By default, this parameter faults the drive. You can set this parameter so that the drive continues to run. Precautions should be taken to ensure that the setting of this parameter does not create a risk of injury or equipment damage. When commissioning the drive, verify that your system responds correctly to various situations (for example, a disconnected cable).	
42 43 44 45	**[Peer Inp Addr 1]** **[Peer Inp Addr 2]** **[Peer Inp Addr 3]** **[Peer Inp Addr 4]** Sets the bytes in the IP address that specifies the device from which the adapter receives (consumes) Peer I/O data.  **Important:** The Peer Inp Addr must be on the same subnet as the 20-COMM-E. Refer to IP Addresses on page G-5 for more information. Changes to these parameters are ignored when **Parameter 47 - [Peer Inp Enable]** is “1” (On).	Default: 0 Default: 0 Default: 0 Default: 0 Minimum: 0 Maximum: 255 Type: Read/Write Reset Required: No
46	**[Peer Inp Timeout]** Sets the time-out for a Peer I/O connection. If the time is reached without the adapter receiving (consuming) a message, the adapter will respond with the action specified in **Parameter 41 - [Peer Flt Action]**. In an adapter receiving (consuming) Peer I/O, the value of this parameter must be greater than the product of the value of **Parameter 52 - [Peer Out Time]** in the adapter transmitting (producing) Peer I/O multiplied by the value of **Parameter 53 - [Peer Out Skip]** in the adapter transmitting (producing) Peer I/O.	Default: 10.00 Seconds Minimum: 0.01 Seconds Maximum: 10.00 Seconds Type: Read/Write Reset Required: No
47	**[Peer Inp Enable]** Determines if Peer I/O input is on or off.	Default: 0 = Off Values: 0 = Off 1 = On Type: Read/Write Reset Required: No
48	**[Peer Inp Status]** Displays the status of the consumed Peer I/O input connection.	Default: 0 = Off Values: 0 = Off 1 = Waiting 2 = Running 3 = Faulted Type: Read Only

Parameter No.	Name and Description	Details
49 50	**[Peer A Output]** **[Peer B Output]** Selects the source of the Peer I/O output data. The adapter transmits this data to the network. **Important:** Changes to these parameters are ignored when **Parameter 51 - [Peer Out Enable]** is “1” (On).	Default: 0 = Off Default: 0 = Off Values: 0 = Off 1 = Cmd/Ref 2 = Datalink A Input 3 = Datalink B Input 4 = Datalink C Input 5 = Datalink D Input 6 = Datalink A Output 7 = Datalink B Output 8 = Datalink C Output 9 = Datalink D Output Type: Read/Write Reset Required: No
51	**[Peer Out Enable]** Determines if Peer I/O output is on or off.	Default: 0 = Off Values: 0 = Off 1 = On Type: Read/Write Reset Required: No
52	**[Peer Out Time]** Sets the minimum time that an adapter will wait when transmitting data to a peer. **Important:** Changes to these parameters are ignored when **Parameter 51 - [Peer Out Enable]** is “1” (On).	Default: 10.00 Seconds Minimum: 0.01 Seconds Maximum: 10.00 Seconds Type: Read/Write Reset Required: No
53	**[Peer Out Skip]** Sets the maximum time that an adapter will wait when transmitting data to a peer. The value of **Parameter 52 - [Peer Out Time]** is multiplied by the value of this parameter to set the time. **Important:** Changes to these parameters are ignored when **Parameter 51 - [Peer Out Enable]** is “1” (On).	Default: 1 Minimum: 1 Maximum: 16 Type: Read/Write Reset Required: No
54	**[Access Control]** This parameter is only available for Series A (version 2.003 or earlier) adapters. Sets the access to the Web interface and Web-configurable e-mail notification feature.	Default: xxxx xx01 Bit Values: 0 = Disabled 1 = Enabled Type: Read/Write Reset Required: No
55	**[Web Enable]** This parameter is only available for Series B (version 3.xxx or later) adapters. Displays the setting of the adapter Web Pages Switch (SW2) when the adapter was last reset.	Default: 0 = Disabled Values: 0 = Disabled 1 = Enabled Type: Read Only

Bit Definition	Not Used	Not Used	Not Used	Not Used	...	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	E-mail Config	Web Enable
Default	x	x	x	x	...	x	x	x	x	x	x	0	1
Bit	31	30	29	28	...	7	6	5	4	3	2	1	0

Parameter No.	Name and Description	Details
56	**[Web Features]** This parameter is only available for Series B (version 3.xxx or later) adapters. Sets the access to the Web interface and Web-configurable e-mail notification feature.	Default: xxxx xxx1 Bit Values: 0 = Disabled 1 = Enabled Type: Read/Write Reset Required: No

Bit Definition	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	E-mail Cfg
Default	x	x	x	x	x	x	x	1
Bit	7	6	5	4	3	2	1	0

EtherNet/IP Objects

Appendix C presents information about the EtherNet/IP objects that can be accessed using Explicit Messages. For information on the format of Explicit Messages and example ladder logic programs, refer to Chapter 6, Using Explicit Messaging.

Object	Class Code		Page
	Hex.	Dec.	
Identity Object	0x01	1	C-2
Assembly Object	0x04	4	C-3
Register Object	0x07	7	C-4
Parameter Object (1)	0x0F	15	C-5
Parameter Group Object (1)	0x10	16	C-7
PCCC Object	0x67	103	C-8
DPI Device Object	0x92	146	C-13
DPI Parameter Object	0x93	147	C-16

Object	Class Code		Page
	Hex.	Dec.	
DPI Fault Object	0x97	151	C-22
DPI Alarm Object	0x98	152	C-24
DPI Diagnostic Object	0x99	153	C-26
DPI Time Object	0x9B	155	C-28
Host DPI Parameter Object (2)	0x9F	159	C-30
TCP/IP Interface Object	0xF5	245	C-36
Ethernet Link Object	0xF6	246	C-37

(1) These objects are NOT supported when the adapter is used with a PowerFlex 750-Series drive.

(2) This object is supported only when the adapter is used with a PowerFlex 750-Series drive.

TIP: Refer to the EtherNet/IP specification for more information about EtherNet/IP objects. Information about the EtherNet/IP specification is available on the ODVA web site (http://www.odva.org).

Supported Data Types

Data Type	Description
BOOL	8-bit value -- low bit is true or false
BOOL[n]	Array of n bits
BYTE	8-bit unsigned integer
CONTAINER	32-bit parameter value - sign extended if necessary
DINT	32-bit signed integer
DWORD	32-bit unsigned integer
INT	16-bit signed integer
LWORD	64-bit unsigned integer
REAL	32-bit floating point
SHORT_STRING	1-byte length indicator + that many characters
SINT	8-bit signed integer
STRING[n]	Array of n characters
STRUCT	Structure name only - no size in addition to elements
TCHAR	8 or 16-bit character
UDINT	32-bit unsigned integer
UINT	16-bit unsigned integer
USINT	8-bit unsigned integer
WORD	16-bit unsigned integer

Identity Object

Class Code

Hexadecimal	Decimal
0x01	1

Services

	Implemented for:		
Service Code	Class	Instance	Service Name
0x05	No	Yes	Reset
0x0E	Yes	Yes	Get_Attribute_Single
0x01	Yes	Yes	Get_Attributes_All

Instances

The number of instances depends on the number of components in the device connected to the adapter. This number of components can be read in Instance 0, Attribute 2.

Instance	Description
0	Class
1	Host
2…15	Peripherals on Ports 1…14

Class Attributes

Attribute ID	Access Rule	Name	Data Type	Description
2	Get	Max Instance	WORD	Total number of instances

Instance Attributes

Attribute ID	Access Rule	Name	Data Type	Description
1	Get	Vendor ID	WORD	1 = Allen-Bradley
2	Get	Device Type	WORD	123
3	Get	Product Code	WORD	Number identifying product name and rating
4	Get	Revision: Major Minor	STRUCT of: BYTE BYTE	 Value varies Value varies
5	Get	Status	WORD	Bit 0 = Owned Bit 8 = Minor recoverable fault Bit 10 = Major recoverable fault
6	Get	Serial Number	DWORD	Unique 32-bit number
7	Get	Product Name	SHORT_STRING	Product name and rating

Assembly Object

Class Code

Hexadecimal	Decimal
0x04	4

Services

	Implemented for:		
Service Code	Class	Instance	Service Name
0x0E	Yes	Yes	Get_Attribute_Single
0x10	Yes	Yes	Set_Attribute_Single

Instances

Instance	Description
1	All I/O data being read from the DPI device (read-only)
2	All I/O data written to the DPI device (read/write)

Class Attributes

Attribute ID	Access Rule	Name	Data Type	Description
1	Get	Revision	WORD	2
2	Get	Max Instance	WORD	2
100	Set	Control Timeout	WORD	Control timeout in seconds

Instance Attributes

Attribute ID	Access Rule	Name	Data Type	Description
1	Get	Number of Members	WORD	1
2	Get	Member List	ARRAY of STRUCT: WORD WORD Packed EPATH	 Size of member data Size of member path Member path
3	Conditional [1]	Data	Array of Bits	Data to be transferred
4	Get	Size	WORD	Size of assembly data in bits

[1] For instance 1, access rule for the data attribute is Get. For instance 2, it is Get/Set.

Important: Setting an assembly object attribute can be done only when the Control Timeout (class attribute 100) has been set to a non-zero value.

Register Object

Class Code

Hexadecimal	Decimal
0x07	7

Services

Service Code	Implemented for:		Service Name
	Class	Instance	
0x0E	Yes	Yes	Get_Attribute_Single
0x10	Yes	Yes	Set_Attribute_Single

Instances

Instance	Description
1	All I/O data being read from the DPI device (read-only)
2	All I/O data written to the DPI device (read/write)
3	Logic Status and Feedback data (read-only)
4	Logic Command and Reference data (read/write)
5	Datalink A (input data from device to scanner) (read only)
6	Datalink A (output data from scanner to device) (read/write)
7	Datalink B (input data from device to scanner) (read only)
8	Datalink B (output data from scanner to device) (read/write)
9	Datalink C (input data from device to scanner) (read only)
10	Datalink C (output data from scanner to device) (read/write)
11	Datalink D (input data from device to scanner) (read only)
12	Datalink D (output data from scanner to device) (read/write)
13	Logic Status and Feedback Data (read-only)
14	Mask (1) (read/write)
15	Logic Status (read-only)
16	Logic Command (read/write)
17	Feedback (read-only)
18	Reference (read/write)

(1) The mask command word is set to the value of the first word of the data where there are ones in the second word of the data. Command = (word 1 and not word 2) or (word 1 and word 2). This only controls specified bits in the Logic Command data to the DPI product and does not change the Reference value.

Class Attributes

Attribute ID	Access Rule	Name	Data Type	Description
100	Set	Control Timeout	WORD	Control timeout in seconds

Instance Attributes

Attribute ID	Access Rule	Name	Data Type	Description
1	Get	Bad Flag	BOOL	If set to 1, then attribute 4 may contain invalid data. 0 = good 1 = bad
2	Get	Direction	BOOL	Direction of data transfer 0 = Producer Register (drive to network) 1 = Consumer Register (network to drive)
3	Get	Size	WORD	Size of register data in bits
4	Conditional (1)	Data	ARRAY of BITS	Data to be transferred

(1) For this attribute, the Access Rule is Get if Direction = 0. The Access Rule is Set if Direction = 1.

Important: Setting a Register object attribute can be done only when the Control Timeout (class attribute 100) has been set to a non-zero value.

Parameter Object

Class Code

Hexadecimal	Decimal
0x0F	15

Important: This object is not supported when the adapter is used with a PowerFlex 750-Series drive.

Services

Service Code	Implemented for:		Service Name
	Class	Instance	
0x01	Yes	Yes	Get_Attributes_All
0x05	Yes	No	Reset
0x0E	Yes	Yes	Get_Attribute_Single
0x10	Yes	Yes	Set_Attribute_Single
0x4B	No	Yes	Get_Enum_String

Instances

The number of instances depends on the number of parameters in the DPI drive. The adapter parameters are appended to the list of drive parameters. The total number of parameters can be read in Instance 0, Attribute 2.

Instance	Description
0	Class Attributes
1	Drive Parameter 1 Attributes
⋮	⋮
n	Last Drive Parameter n Attributes (1)
n + 1	Adapter Parameter 1 Attributes
⋮	⋮
n + m	Last Adapter Parameter m Attributes (2)

(1) n represents the number of parameters in the drive.

(2) m represents the number of parameters in the adapter.

Class Attributes

Attribute ID	Access Rule	Name	Data Type	Description
1	Get	Revision	WORD	1
2	Get	Max Instance	WORD	Number of parameters
8	Get	Parameter Class Descriptor	WORD	0 = False, 1 = True Bit 0 = Supports parameter instances Bit 1 = Supports full attributes Bit 2 = Must do NVS save command Bit 3 = Parameters are stored in NVS
9	Get	Configuration Assembly Instance	WORD	0
10	Set	Native Language	BYTE	0 = English 1 = French 2 = Spanish 3 = Italian 4 = German 5 = Japanese 6 = Portuguese 7 = Mandarin Chinese 8 = Russian 9 = Dutch

Instance Attributes

Attribute ID	Access Rule	Name	Data Type	Description
1	(1)	Parameter Value	(2)	(3)
2	Get	Link Path Size	BYTE	0 = No link specified n = The size of Attribute 3 in bytes
3	Get	Link Path		(4)
4	Get	Descriptor	WORD	0 = False, 1 = True Bit 1 = Supports ENUMs Bit 2 = Supports scaling Bit 3 = Supports scaling links Bit 4 = Read only Bit 5 = Monitor Bit 6 = Extended precision scaling
5	Get	Data Type	BYTE	1 = WORD (16-bit) 2 = UINT (16-bit) 3 = INT (16-bit) 5 = SINT 6 = DINT 8 = USINT 9 = UDINT 11 = REAL 22 = SHORT_STRING 24 = BYTE 25 = DWORD
6	Get	Data Size	BYTE	(3)
7	Get	Parameter Name String	SHORT_STRING	(3)
8	Get	Units String	SHORT_STRING	(3)
9	Get	Help String	SHORT_STRING	Null string
10	Get	Minimum Value	(2)	(3)
11	Get	Maximum Value	(2)	(3)
12	Get	Default Value	(2)	(3)
13	Get	Scaling Multiplier	WORD	(3)
14	Get	Scaling Divisor	WORD	(3)
15	Get	Scaling Base	WORD	(3)
16	Get	Scaling Offset	WORD	(3)
17	Get	Multiplier Link	WORD	(3)
18	Get	Divisor Link	WORD	(3)
19	Get	Base Link	WORD	(3)
20	Get	Offset Link	WORD	(3)
21	Get	Decimal Precision	BYTE	(3)

(1) Access rule is defined in Bit 4 of instance attribute 4 (0 = Get/Set, 1 = Get).

(2) Specified in descriptor, data type, and data size.

(3) Value varies based on parameter instance.

(4) Refer to the EtherNet/IP specification for a description of the link path.

Parameter Group Object

Class Code

Hexadecimal	Decimal
0x10	16

Important: This object is not supported when the adapter is used with a PowerFlex 750-Series drive.

Services

Service Code	Implemented for:		Service Name
	Class	Instance	
0x0E	Yes	Yes	Get_Attribute_Single
0x10	Yes	No	Set_Attribute_Single

Instances

The number of instances depends on the number of groups in the device. A group of adapter parameters is appended to the list of groups in the device. The total number of groups can be read in Instance 0, Attribute 2.

Number	Description
0	Class Attributes
1	Drive Group 1 Attributes
⋮	⋮
n	Last Drive Group Attributes
n + 1	Adapter Group Attributes

Class Attributes

Attribute ID	Access Rule	Name	Data Type	Description
1	Get	Parameter group version	WORD	1
2	Get	Max Instance	WORD	Total number of groups
8	Set	Native Language	BYTE	0 = English 1 = French 2 = Spanish 3 = Italian 4 = German 5 = Japanese 6 = Portuguese 7 = Mandarin Chinese 8 = Russian 9 = Dutch

Instance Attributes

Attribute ID	Access Rule	Name	Data Type	Description
1	Get	Group Name String	SHORT_STRING	Group name
2	Get	Number of Members in Group	WORD	Number of parameters in group
3	Get	1st Parameter Number in Group	WORD	(1)
4	Get	2nd Parameter Number in Group	WORD	(1)
n	Get	⋮	WORD	(1)

(1) Value varies based on group instance.

PCCC Object

Class Code

Hexadecimal	Decimal
0x67	103

Services

Service Code	Implemented for:		Service Name
	Class	Instance	
0x4B	No	Yes	Execute_PCCC
0x4C	No	Yes	Execute_DH+

Instances

Supports Instance 1.

Class Attributes

Not supported.

Instance Attributes

Not supported.

Message Structure for Execute_PCCC

Request		
Name	**Data Type**	**Description**
Length	USINT	Length of requestor ID
Vendor	UINT	Vendor number of requestor
Serial Number	UDINT	ASA serial number of requestor
Other	Product Specific	Identifier of user, task, etc. on the requestor
CMD	USINT	Command byte
STS	USINT	0
TNSW	UINT	Transport word
FNC	USINT	Function code; not used for all CMDs.
PCCC_ params	ARRAY of USINT	CMD/FNC specific parameters

Response		
Name	**Data Type**	**Description**
Length	USINT	Length of requestor ID
Vendor	UINT	Vendor number of requestor
Serial Number	UDINT	ASA serial number of requestor
Other	Product Specific	Identifier of user, task, etc. on the requestor
CMD	USINT	Command byte
STS	USINT	Status byte
TNSW	UINT	Transport word. Same value as the request.
EXT_STS	USINT	Extended status; not used for all CMDs.
PCCC_ results	ARRAY of USINT	CMD/FNC specific result data

Message Structure for Execute_DH+

Request		
Name	**Data Type**	**Description**
DLink	UINT	Destination Link ID
DSta	USINT	Destination Station number
DUser	USINT	Destination “User” number
SLink	UINT	Source Link ID
SSta	USINT	Source Station number
SUser	USINT	Source User number
CMD	USINT	Command byte
STS	USINT	0
TNSW	UINT	Transport word
FNC	USINT	Function code; not used for all CMDs
PCCC_ params	ARRAY of USINT	CMD/FNC specific parameters

Response		
Name	**Data Type**	**Description**
DLink	UINT	Destination Link ID
DSta	USINT	Destination Station number
DUser	USINT	Destination “User” number
SLink	UINT	Source Link ID
SSta	USINT	Source Station number
SUser	USINT	Source User number
CMD	USINT	Command byte
STS	USINT	Status byte
TNSW	UINT	Transport word. Same value as the request.
EXT_STS	USINT	Extended status; not used for all CMDs
PCCC_ results	ARRAY of USINT	CMD/FNC specific result data

The adapter supports the following PCCC command types:

CMD	FNC	Description
0x06	0x03	Identify host and some status
0x0F	0x67	PLC-5 typed write
0x0F	0x68	PLC-5 typed read
0x0F	0x95	Encapsulate other protocol
0x0F	0xA2	SLC 500 protected typed read with 3 address fields
0x0F	0xAA	SLC 500 protected typed write with 3 address fields
0x0F	0xA1	SLC 500 protected typed read with 2 address fields
0x0F	0xA9	SLC 500 protected typed write with 2 address fields
0x0F	0x00	Word range read
0x0F	0x01	Word range write

For more information regarding PCCC commands, see *DF1 Protocol and Command Set Manual* (Allen-Bradley publication 1770-6.5.16).

N-Files

<table>
<tr><th>N-File</th><th colspan="4">Description</th></tr>
<tr><td>N40</td><td colspan="4">This N-file lets you use Emulated Block Transfer messages to read and write many types of DPI messages. To use Emulated Block Transfer messages, you send a Write message to N40:0…N40:63, wait until the adapter responds with a reply message, and then read the response data in N40:0…N40:63 with a Read message.

For details about Block Transfer messages and the data required for each byte in the N-File, refer to the Remote I/O Adapter User Manual (publication 20COMM-UM004).

Bits 15…8 are the Most Significant Byte. Bits 7…0 are the Least Significant Byte.</td></tr>
<tr><td></td><td colspan="2">Write</td><td colspan="2">Read</td></tr>
<tr><td>Bits</td><td colspan="2">15 0</td><td colspan="2">15 0</td></tr>
<tr><td>N40:0</td><td>0x00</td><td>Length (in Bytes)</td><td>0x00</td><td>Length (in Bytes)</td></tr>
<tr><td>N40:1</td><td>DPI Port</td><td>0x81</td><td>Status Size</td><td>Status Type</td></tr>
<tr><td>N40:2</td><td>0x00</td><td>CIP Service</td><td colspan="2" rowspan="5">Data
(length varies based on message)</td></tr>
<tr><td>N40:3</td><td colspan="2">CIP Class</td></tr>
<tr><td>N40:4</td><td colspan="2">CIP Instance</td></tr>
<tr><td>N40:5</td><td colspan="2">CIP Attribute</td></tr>
<tr><td>N40:6
⋮
N40:63</td><td colspan="2">Data
(length varies based on message)</td></tr>
<tr><td>N41</td><td colspan="4">This N-file lets you read and write control I/O messages. You can write control I/O messages only when all of the following conditions are true:
• The adapter is not receiving I/O from a scanner. For example, there is no scanner on the network, the scanner is in idle (program) mode, the scanner is faulted, or the adapter is not mapped to the scanner.
• The adapter is not receiving Peer I/O from another adapter.
• The value of N42:3 is set to a non-zero value.</td></tr>
<tr><td></td><td colspan="2">Write</td><td colspan="2">Read</td></tr>
<tr><td>N41:0</td><td colspan="2">Logic Command Word</td><td colspan="2">Logic Status Word</td></tr>
<tr><td>N41:1</td><td colspan="2">Reference (least significant word)</td><td colspan="2">Feedback (least significant word)</td></tr>
<tr><td>N41:2</td><td colspan="2">Reference (most significant word)</td><td colspan="2">Feedback (most significant word)</td></tr>
<tr><td>N41:3</td><td colspan="2">Datalink A1 (least significant word)</td><td colspan="2">Datalink A1 (least significant word)</td></tr>
<tr><td>N41:4</td><td colspan="2">Datalink A1 (most significant word)</td><td colspan="2">Datalink A1 (most significant word)</td></tr>
<tr><td>N41:5</td><td colspan="2">Datalink A2 (least significant word)</td><td colspan="2">Datalink A2 (least significant word)</td></tr>
<tr><td>N41:6</td><td colspan="2">Datalink A2 (most significant word)</td><td colspan="2">Datalink A2 (most significant word)</td></tr>
<tr><td>N41:7</td><td colspan="2">Datalink B1 (least significant word)</td><td colspan="2">Datalink B1 (least significant word)</td></tr>
<tr><td>N41:8</td><td colspan="2">Datalink B1 (most significant word)</td><td colspan="2">Datalink B1 (most significant word)</td></tr>
<tr><td>N41:9</td><td colspan="2">Datalink B2 (least significant word)</td><td colspan="2">Datalink B2 (least significant word)</td></tr>
<tr><td>N41:10</td><td colspan="2">Datalink B2 (most significant word)</td><td colspan="2">Datalink B2 (most significant word)</td></tr>
<tr><td>N41:11</td><td colspan="2">Datalink C1 (least significant word)</td><td colspan="2">Datalink C1 (least significant word)</td></tr>
<tr><td>N41:12</td><td colspan="2">Datalink C1 (most significant word)</td><td colspan="2">Datalink C1 (most significant word)</td></tr>
<tr><td>N41:13</td><td colspan="2">Datalink C2 (least significant word)</td><td colspan="2">Datalink C2 (least significant word)</td></tr>
<tr><td>N41:14</td><td colspan="2">Datalink C2 (most significant word)</td><td colspan="2">Datalink C2 (most significant word)</td></tr>
<tr><td>N41:15</td><td colspan="2">Datalink D1 (least significant word)</td><td colspan="2">Datalink D1 (least significant word)</td></tr>
<tr><td>N41:16</td><td colspan="2">Datalink D1 (most significant word)</td><td colspan="2">Datalink D1 (most significant word)</td></tr>
<tr><td>N41:17</td><td colspan="2">Datalink D2 (least significant word)</td><td colspan="2">Datalink D2 (least significant word)</td></tr>
<tr><td>N41:18</td><td colspan="2">Datalink D2 (most significant word)</td><td colspan="2">Datalink D2 (most significant word)</td></tr>
<tr><td>N42</td><td colspan="4">This N-file lets you read and write some values configuring the port.</td></tr>
<tr><td>N42:3</td><td colspan="4">Time-out (read/write): Time (in seconds) allowed between messages to the N41 file. If the adapter does not receive a message in the specified time, it performs the fault action configured in its [Comm Flt Action] parameter. A valid setting is between 1 and 32767 seconds (5…20 seconds is recommended).</td></tr>
<tr><td>N42:7</td><td colspan="4">Adapter Port Number (read only): DPI port on the drive to which the adapter is connected.</td></tr>
<tr><td>N42:8</td><td colspan="4">Peer Adapters (read only): Bit field of devices having DPI Peer capabilities.</td></tr>
</table>

N45	This N-file lets you read and write control I/O messages. You can write control I/O messages only when all of the following conditions are true: • The adapter is not receiving I/O from a scanner. For example, there is no scanner on the network, the scanner is in idle (program) mode, the scanner is faulted, or the adapter is not mapped to the scanner. • The adapter is not receiving Peer I/O from another adapter. • The value of N42:3 is set to a non-zero value.	
	Write	*Read*
N45:0	Logic Command (least significant)	Logic Status (least significant)
N45:1	Logic Command (most significant)	Logic Status (most significant)
N45:2	Reference (least significant)	Feedback (least significant)
N45:3	Reference (most significant)	Feedback (most significant)
N45:4	DL From Net 01 (least significant)	DL To Net 01 (least significant)
N45:5	DL From Net 01 (most significant)	DL To Net 01 (most significant)
N45:6	DL From Net 02 (least significant)	DL To Net 02 (least significant)
N45:7	DL From Net 02 (most significant)	DL To Net 02 (most significant)
N45:8	DL From Net 03 (least significant)	DL To Net 03 (least significant)
N45:9	DL From Net 03 (most significant)	DL To Net 03 (most significant)
N45:10	DL From Net 04 (least significant)	DL To Net 04 (least significant)
N45:11	DL From Net 04 (most significant)	DL To Net 04 (most significant)
N45:12	DL From Net 05 (least significant)	DL To Net 05 (least significant)
N45:13	DL From Net 05 (most significant)	DL To Net 05 (most significant)
N45:14	DL From Net 06 (least significant)	DL To Net 06 (least significant)
N45:15	DL From Net 06 (most significant)	DL To Net 06 (most significant)
N45:16	DL From Net 07 (least significant)	DL To Net 07 (least significant)
N45:17	DL From Net 07 (most significant)	DL To Net 07 (most significant)
N45:18	DL From Net 08 (least significant)	DL To Net 08 (least significant)
N45:19	DL From Net 08 (most significant)	DL To Net 08 (most significant)
N45:20	DL From Net 09 (least significant)	DL To Net 09 (least significant)
N45:21	DL From Net 09 (most significant)	DL To Net 09 (most significant)
N45:22	DL From Net 10 (least significant)	DL To Net 10 (least significant)
N45:23	DL From Net 10 (most significant)	DL To Net 10 (most significant)
N45:24	DL From Net 11 (least significant)	DL To Net 11 (least significant)
N45:25	DL From Net 11 (most significant)	DL To Net 11 (most significant)
N45:26	DL From Net 12 (least significant)	DL To Net 12 (least significant)
N45:27	DL From Net 12 (most significant)	DL To Net 12 (most significant)
N45:28	DL From Net 13 (least significant)	DL To Net 13 (least significant)
N45:29	DL From Net 13 (most significant)	DL To Net 13 (most significant)
N45:30	DL From Net 14 (least significant)	DL To Net 14 (least significant)
N45:31	DL From Net 14 (most significant)	DL To Net 14 (most significant)
N45:32	DL From Net 15 (least significant)	DL To Net 15 (least significant)
N45:33	DL From Net 15 (most significant)	DL To Net 15 (most significant)
N45:34	DL From Net 16 (least significant)	DL To Net 16 (least significant)
N45:35	DL From Net 16 (most significant)	DL To Net 16 (most significant)

Important: If your controller or HMI platform supports CIP messaging, use the CIP Parameter object to get and set parameters.

N-File	Description
N150…N199	These N-files let you read and write parameter values in DPI Port 0 (the host PowerFlex drive) as 32-bit double words. You can interpret the data in various ways (for example, 32-bit real, 32-bit integer) To read a parameter, you need to send a message with two elements. For example, to read parameter 1, read two elements beginning at N150:2. As another example, to read parameters 2…6, read ten elements beginning at N150:4.
N150:0…1	Number of parameters in the drive
N150:2…249	Drive parameters 1…124
N151:0…249	Drive parameters 125…249
N152:0…249	Drive parameters 250…374
N153:0…249	Drive parameters 375…499
⋮	⋮
N199:0…249	Drive parameters 6125…6249

N-File	Description
N201…N212	These N-files let you read and write values to DPI and Host parameters in Ports 1…14 (for example, a HIM or adapter) as 32-bit double words. You can interpret the data in various ways (for example, 32-bit real, 32-bit integer) To read a parameter, you need to send a message with two elements. For example, to read parameter 1 in the peripheral connected to DPI port 1, read two elements beginning at N201:2. As another example, to read parameters 2…6 in the peripheral connected to DPI port 5 (the adapter), read ten elements beginning at N209:4.
N201:0…1	Number of parameters in the DPI peripheral at DPI port 1
N201:2…249	Parameters 1…124 in the DPI peripheral at DPI port 1
N202:0…249	Parameters 125…249 in the DPI peripheral at DPI port 1
N203:0…1	Number of parameters in the DPI peripheral at DPI port 2
N203:2…249	Parameters 1…124 in the DPI peripheral at DPI port 2
N204:0…249	Parameters 125…249 in the DPI peripheral at DPI port 2
N205:0…1	Number of parameters in the DPI peripheral at DPI port 3
N205:2…249	Parameters 1…124 in the DPI peripheral at DPI port 3
N206:0…249	Parameters 125…249 in the DPI peripheral at DPI port 3
N207:0…1	Number of parameters in the DPI peripheral at DPI port 4
N207:2…249	Parameters 1…124 in the DPI peripheral at DPI port 4
N208:0…249	Parameters 125…249 in the DPI peripheral at DPI port 4
N209:0…1	Number of parameters in the DPI peripheral at DPI port 5
N209:2…249	Parameters 1…124 in the DPI peripheral at DPI port 5
N210:0…249	Parameters 125…249 in the DPI peripheral at DPI port 5
N211:0…1	Number of parameters in the DPI peripheral at DPI port 6
N211:2…249	Parameters 1…124 in the DPI peripheral at DPI port 6
N212:0…249	Parameters 125…249 in the DPI peripheral at DPI port 6
The following N-Files are supported only when the adapter is used with a PowerFlex 750-Series drive.	
N213:0…1	Number of parameters in the DPI peripheral at DPI port 7
N213:2…249	Parameters 1…124 in the DPI peripheral at DPI port 7
N214:0…249	Parameters 125…249 in the DPI peripheral at DPI port 7
N215:0…1	Number of parameters in the DPI peripheral at DPI port 8
N215:2…249	Parameters 1…124 in the DPI peripheral at DPI port 8
N216:0…249	Parameters 125…249 in the DPI peripheral at DPI port 8
N217:0…1	Number of parameters in the DPI peripheral at DPI port 9
N217:2…249	Parameters 1…124 in the DPI peripheral at DPI port 9
N218:0…249	Parameters 125…249 in the DPI peripheral at DPI port 9
N219:0…1	Number of parameters in the DPI peripheral at DPI port 10
N219:2…249	Parameters 1…124 in the DPI peripheral at DPI port 10
N220:0…249	Parameters 125…249 in the DPI peripheral at DPI port 10
N221:0…1	Number of parameters in the DPI peripheral at DPI port 11
N221:2…249	Parameters 1…124 in the DPI peripheral at DPI port 11
N222:0…249	Parameters 125…249 in the DPI peripheral at DPI port 11
N223:0…1	Number of parameters in the DPI peripheral at DPI port 12
N223:2…249	Parameters 1…124 in the DPI peripheral at DPI port 12
N224:0…249	Parameters 125…249 in the DPI peripheral at DPI port 12
N225:0…1	Number of parameters in the DPI peripheral at DPI port 13
N225:2…249	Parameters 1…124 in the DPI peripheral at DPI port 13
N226:0…249	Parameters 125…249 in the DPI peripheral at DPI port 13
N227:0…1	Number of parameters in the DPI peripheral at DPI port 14
N227:2…249	Parameters 1…124 in the DPI peripheral at DPI port 14
N228:0…249	Parameters 125…249 in the DPI peripheral at DPI port 14

DPI Device Object

Class Code

Hexadecimal	Decimal
0x92	146

Services

Service Code	Implemented for:		Service Name
	Class	Instance	
0x0E	Yes	Yes	Get_Attribute_Single
0x10	Yes	Yes	Set_Attribute_Single

Instances

The number of instances depends on the number of components in the device. The total number of components can be read in Instance 0, Class Attribute 4.

Instances (Hex.)	(Dec.)	Device
0x0000…0x3FFF	0…16383	Host
0x4000…0x43FF	16384…17407	Adapter
0x4400…0x47FF	17408…18431	DPI Port 1
0x4800…0x4BFF	18432…19455	DPI Port 2
0x4C00…0x4FFF	19456…20479	DPI Port 3
0x5000…0x53FF	20480…21503	DPI Port 4
0x5400…0x57FF	21504…22527	DPI Port 5
0x5800…0x5BFF	22528…23551	DPI Port 6
0x5C00…0x5FFF (1)	22552…24575	DPI Port 7
0x6000…0x63FF (1)	24576…25599	DPI Port 8
0x6400…0x67FF (1)	25600…26623	DPI Port 9
0x6800…0x6BFF (1)	26624…27647	DPI Port 10
0x6C00…0x6FFF (1)	27648…28671	DPI Port 11
0x7000…0x73FF (1)	28672…29695	DPI Port 12
0x7400…0x77FF (1)	29696…30719	DPI Port 13
0x7800…0x7BFF (1)	30720…31743	DPI Port 14

Example	Description
0	Class Attributes (Drive)
1	Drive Component 1
2	Drive Component 2
⋮	⋮
16384	Class Attributes (Adapter)
16385	Adapter Component 1
⋮	⋮

(1) These instances are supported only when the adapter is used with a PowerFlex 750-Series drive.

Class Attributes

Attribute ID	Access Rule	Name	Data Type	Description
0	Get	Family Code	BYTE	0x00 = DPI Peripheral 0x30 = PowerFlex 70 0x34 = PowerFlex 700H 0x38, 0x39, or 0x3A= PowerFlex 700 0x40 = PowerFlex 7000 0x48, 0x49, or 0x4A = PowerFlex 700S 0x5A = SMC Flex 0x68, 0x69, or 0x6A = PowerFlex 700VC 0x90 = PowerFlex 753/755 0xA0 = 20-750-xxx Option Module 0xFF = HIM
1	Get	Family Text	STRING[16]	Text identifying the device.

Attribute ID	Access Rule	Name	Data Type	Description
2	Set	Language Code	BYTE	0 = English 1 = French 2 = Spanish 3 = Italian 4 = German 5 = Japanese 6 = Portuguese 7 = Mandarin Chinese 8 = Russian 9 = Dutch
3	Get	Product Series	BYTE	1 = A 2 = B …
4	Get	Number of Components	BYTE	Number of components (e.g., main control board, I/O boards) in the device.
5	Set	User Definable Text	STRING[16]	Text identifying the device with a user-supplied name.
6	Get	Status Text	STRING[12]	Text describing the status of the device.
7	Get	Configuration Code	BYTE	Identification of variations.
8	Get	Configuration Text	STRING[16]	Text identifying a variation of a family device.
9	Get	Brand Code	WORD	0x0001 = Allen-Bradley
11	Get	NVS Checksum	WORD	Checksum of the Non-Volatile Storage in a device.
12	Get	Class Revision	WORD	2 = DPI
13	Get	Character Set Code	BYTE	0 = SCANport HIM 1 = ISO 8859-1 (Latin 1) 2 = ISO 8859-2 (Latin 2) 3 = ISO 8859-3 (Latin 3) 4 = ISO 8859-4 (Latin 4) 5 = ISO 8859-5 (Cyrillic) 6 = ISO 8859-6 (Arabic) 7 = ISO 8859-7 (Greek) 8 = ISO 8859-8 (Hebrew) 9 = ISO 8859-9 (Turkish) 10 = ISO 8859-10 (Nordic) 255 = ISO 10646 (Unicode)
14	Get	Product Option Support	BOOL[64]	
15	Get	Languages Supported	STRUCT of: BYTE BYTE[n]	 Number of Languages Language Codes (see Class Attribute 2)
16	Get	Date of Manufacture	STRUCT of: WORD BYTE BYTE	 Year Month Day
17	Get	Product Revision	STRUCT of: BYTE BYTE	 Major Firmware Release Minor Firmware Release
18	Get	Serial Number	DWORD	Value between 0x00000000 and 0xFFFFFFFF
19	Set	Language Selected	BYTE	0 = Default (HIM will prompt at start up) 1 = Language was selected (no prompt)
20	Set	Customer-Generated Firmware	STRING[36]	GUID (Globally Unique Identifier) identifying customer firmware flashed into the device.
30	Get	International Status Text	STRINGN	Text describing the status of device with support for Unicode.
31	Get/Set	International User Definable Text	STRINGN	Text identifying the device with a user-supplied name with support for Unicode.

Attribute ID	Access Rule	Name	Data Type	Description
34	Get	Key Information	STRUCT of: DWORD DWORD WORD WORD WORD BYTE BYTE BYTE BYTE BYTE BYTE[16]	 Rating Code Device Serial Number Customization Code Customization Revision Brand Code Family Code Config Code Language Code Major Revision Minor Revision Customer-Generated Firmware UUID
35	Get	NVS CRC	DWORD	A 32-bit CRC of the Non-Volatile Storage in a device.
39	Get	SI Driver Code	WORD	Code identifying the protocol between the device and host.
128	Get	Customization Code	WORD	Code identifying the customized device.
129	Get	Customization Revision Number	WORD	Revision of the customized device.
130	Get	Customization Device Text	STRING[32]	Text identifying the customized device.

Instance Attributes

Attribute ID	Access Rule	Name	Data Type	Description
3	Get	Component Name	STRING[32]	Name of the component
4	Get	Component Firmware Revision	STRUCT of: BYTE BYTE	 Major Revision Minor Revision
8	Get	Component Serial Number	DWORD	Value between 0x00000000 and 0xFFFFFFFF
9	Get	International Component Name	STRINGN	Name of the component with support for Unicode.

DPI Parameter Object

Class Code

Hexadecimal	Decimal
0x93	147

To access "Host Config" parameters, use the HOST DPI Parameter Object (Class code 0x9F).

Instances

The number of instances depends on the number of parameters in the device. The total number of parameters can be read in Instance 0, Attribute 0.

Instances (Hex.)	(Dec.)	Device
0x0000…0x3FFF	0…16383	Host
0x4000…0x43FF	16384…17407	Adapter
0x4400…0x47FF	17408…18431	DPI Port 1
0x4800…0x4BFF	18432…19455	DPI Port 2
0x4C00…0x4FFF	19456…20479	DPI Port 3
0x5000…0x53FF	20480…21503	DPI Port 4
0x5400…0x57FF	21504…22527	DPI Port 5
0x5800…0x5BFF	22528…23551	DPI Port 6
0x5C00…0x5FFF (1)	23552…24575	DPI Port 7
0x6000…0x63FF (1)	24576…25599	DPI Port 8
0x6400…0x67FF (1)	25600…26623	DPI Port 9
0x6800…0x6BFF (1)	26624…27647	DPI Port 10
0x6C00…0x6FFF (1)	27648…28671	DPI Port 11
0x7000…0x73FF (1)	28672…29695	DPI Port 12
0x7400…0x77FF (1)	29696…30719	DPI Port 13
0x7800…0x7BFF (1)	30720…31743	DPI Port 14

Example	Description
0	Class Attributes (Drive)
1	Drive Parameter 1 Attributes
2	Drive Parameter 2 Attributes
⋮	⋮
16384	Class Attributes (Adapter)
16385	Adapter Parameter 1 Attributes
⋮	⋮

(1) These instances are supported only when the adapter is used with a PowerFlex 750-Series drive.

Class Attributes

Attribute ID	Access Rule	Name	Data Type	Description
0	Get	Number of Instances	WORD	Number of parameters in the device
1	Set	Write Protect Password	WORD	0 = Password disabled n = Password
2	Set	NVS Command Write	BYTE	0 = No Operation 1 = Store values in active memory to NVS 2 = Load values in NVS to active memory 3 = Load default values to active memory
3	Get	NVS Parameter Value Checksum	WORD	Checksum of all parameter values in a user set in NVS
4	Get	NVS Link Value Checksum	WORD	Checksum of parameter links in a user set in NVS
5	Get	First Accessible Parameter	WORD	First parameter available if parameters are protected by passwords. A "0" indicates all parameters are protected.
7	Get	Class Revision	WORD	2 = DPI
8	Get	First Parameter Processing Error	WORD	The first parameter that has been written with a value outside of its range. A "0" indicates no errors.
9	Set	Link Command	BYTE	0 = No Operation 1 = Clear All Parameter Links (This does not clear links to function blocks.)

Instance Attributes

Attribute ID	Access Rule	Name	Data Type	Description
6	Get	DPI Offline Read Full	STRUCT of: BOOL[32] CONTAINER CONTAINER CONTAINER STRING[16] STRING[4] WORD WORD WORD WORD WORD WORD BYTE BYTE WORD WORD CONTAINER WORD WORD WORD INT	 Descriptor Offline minimum value Offline maximum value Offline default value Parameter name Offline parameter units Online minimum parameter instance Online maximum parameter instance Online default parameter instance Multiple parameter instance Divisor parameter instance Base parameter instance Offset parameter instance Formula number Pad byte (always zero) Help instance Pad word (always a value of zero) Parameter value Multiplier Divisor Base Offset
7	Get	DPI Online Read Full	STRUCT of: BOOL[32] CONTAINER(1) CONTAINER CONTAINER CONTAINER WORD WORD STRING[4] WORD WORD WORD INT BYTE[3] BYTE STRING[16]	 Descriptor (see page C-19) Parameter value Minimum value Maximum value Default value Next parameter Previous parameter Units (for example, Amp, Hz) Multiplier (2) Divisor (2) Base (2) Offset (2) Link (source of the value) (0 = no link) Always zero (0) Parameter name
8	Get	DPI Descriptor	BOOL[32]	Descriptor (see page C-19)
9	Get/Set	DPI Parameter Value	Various	Parameter value in NVS. (3)
10	Get/Set	DPI RAM Parameter Value	Various	Parameter value in temporary memory. Valid only for DPI drives.
11	Get/Set	DPI Link	BYTE[3]	Link (parameter or function block that is the source of the value) (0 = no link)
12	Get	Help Object Instance	WORD	ID for help text for this parameter
13	Get	DPI Read Basic	STRUCT of: BOOL[32] CONTAINER CONTAINER CONTAINER CONTAINER STRING[16] STRING[4]	 Descriptor (see page C-19) Parameter value Minimum value Maximum value Default value Parameter name Units (for example, Amp, Hz)
14	Get	DPI Parameter Name	STRING[16]	Parameter name
15	Get	DPI Parameter Alias	STRING[16]	Customer supplied parameter name.
16	Get	Parameter Processing Error	BYTE	0 = No error 1 = Value is less than the minimum 2 = Value is greater than the maximum

Attribute ID	Access Rule	Name	Data Type	Description
18	Get	International DPI Offline Parameter Text	STRUCT of: STRINGN STRINGN	 International parameter name International offline units
19	Get	International DPI Online Parameter Text	STRUCT of: STRINGN STRINGN	 International parameter name International offline units
20	Get	International DPI Online Read Full	STRUCT of: BOOL[32] CONTAINER CONTAINER CONTAINER CONTAINER WORD WORD WORD WORD WORD INT BYTE[3] BYTE BOOL[32] STRINGN STRINGN	 Descriptor Parameter value Online minimum value Online maximum value Online default value Next Previous Multiplier Divisor Base Offset Link Pad word (always zero) Extended descriptor International parameter name International online parameter units
21	Get	DPI Extended Descriptor	DWORD	Extended descriptor (see page C-20)
22	Get	International DPI Offline Read Full	STRUCT of: BOOL CONTAINER CONTAINER CONTAINER WORD WORD WORD WORD WORD WORD BYTE BYTE WORD WORD CONTAINER WORD WORD WORD INT BOOL[32] STRINGN STRINGN	 Descriptor Offline minimum value Offline maximum value Offline default value Online minimum parameter instance Online maximum parameter instance Online default parameter instance Multiple parameter instance Divisor parameter instance Base parameter instance Offset parameter instance Formula number Pad byte (always zero) Help instance Pad word (always a value of zero) Parameter value Multiplier Divisor Base Offset Extended DPI descriptor International DPI parameter name International DPI offline parameter units

(1) A CONTAINER is a 32-bit block of data that contains the data type used by a parameter value. If signed, the value is sign extended. Padding is used in the CONTAINER to ensure that it is always 32-bits.

(2) This value is used in the formulas used to convert the parameter value between display units and internal units. Refer to Formulas for Converting on page C-21.

(3) Do NOT continually write parameter data to NVS. Refer to the attention on page 6-1.

Descriptor Attributes

Bit	Name	Description
0	Data Type (Bit 1)	Right bit is least significant bit (0). 000 = BYTE used as an array of Boolean 001 = WORD used as an array of Boolean 010 = BYTE (8-bit integer) 011 = WORD (16-bit integer) 100 = DWORD (32-bit integer) 101 = TCHAR (8-bit (not unicode) or 16-bits (unicode) 110 = REAL (32-bit floating point value) 111 = Use bits 16, 17, 18
1	Data Type (Bit 2)	
2	Data Type (Bit 3)	
3	Sign Type	0 = Unsigned 1 = Signed
4	Hidden	0 = Visible 1 = Hidden
5	Not a Link Sink	0 = Parameter can sink a link 1 = Parameter cannot sink a link
6	Not Recallable	0 = Recallable from NVS 1 = Not Recallable from NVS
7	ENUM	0 = No ENUM text 1 = ENUM text
8	Writable	0 = Read only 1 = Read/write
9	Not Writable When Enabled	0 = Writable when enabled (for example, drive running) 1 = Not writable when enabled
10	Instance	0 = Parameter value is not a Reference to another parameter 1 = Parameter value refers to another parameter
11	Uses Bit ENUM Mask	This parameter instance supports the Bit ENUM Mask attribute. For more information, see the definition of the attribute.
12	Decimal Place (Bit 0)	Number of digits to the right of the decimal point. 0000 = 0 1111 = 15
13	Decimal Place (Bit 1)	
14	Decimal Place (Bit 2)	
15	Decimal Place (Bit 3)	
16	Extended Data Type (Bit 4)	Right bit is least significant bit (16). 000 = Reserved 001 = DWORD used as an array of Boolean 010 = Reserved 011 = Reserved 100 = Reserved 101 = Reserved 110 = Reserved 111 = Reserved
17	Extended Data Type (Bit 5)	
18	Extended Data Type (Bit 6)	
19	Parameter Exists	Used to mark parameters that are not available to network tools.
20	Not Used	Reserved
21	Formula Links	Indicates the Formula Data is derived from other parameters.
22	Access Level (Bit 1)	A 3-bit field used to control access to parameter data.
23	Access Level (Bit 2)	
24	Access Level (Bit 3)	
25	Writable ENUM	ENUM text: 0 = Read Only, 1 = Read/Write
26	Not a Link Source	0 = May be the source end of a link 1 = May not be the source end of a link
27	Enhanced Bit ENUM	Parameter supports enhanced bit ENUMs.
28	Enhanced ENUM	Parameter supports enhanced ENUMs.
29	Uses DPI Limits Object	Parameter uses the DPI LImits Object.
30	Extended Descriptor	Parameter uses Extended Descriptor bits, which can be obtained by reading the DPI Extended Descriptor attribute for this parameter.
31	Always Upload/Download	Parameter shall always be included in uploads and downloads.

Extended Descriptor Attributes

Bit	Name	Description
0	Indirect Mode	0 = Analog (selects entire parameters) 1 = Digital (selects individual bits within parameters)
1	Indirect Type 0	Analog input list (Instance 0xFFFF)
2	Indirect Type 1	Digital input list (Instance 0xFFFE)
3	Indirect Type 2	Feedback list (Instance 0xFFFD)
4	Indirect Type 3	Analog output list (Instance 0xFFFC)
5	Indirect Type 4	Digital output list (Instance 0xFFFB)
6	Indirect Type 5	Undefined (Instance 0xFFFA)
7	Indirect Type 6	Undefined (Instance 0xFFF9)
8	Indirect Type 7	Undefined (Instance 0xFFF8)
9	Indirect Type 8	Undefined (Instance 0xFFF7)
10	Indirect Type 9	Undefined (Instance 0xFFF6)
11	Indirect Type 10	Undefined (Instance 0xFFF5)
12	Indirect Type 11	Undefined (Instance 0xFFF4)
13	Indirect Type 12	Undefined (Instance 0xFFF3)
14	Indirect Type 13	Undefined (Instance 0xFFF2)
15	Indirect Type 14	Parameter-specific list
16	FP Max Decimals Bit 0	These four bits are used on REAL parameters only. They indicate the maximum number of decimal places to be displayed for small values. A value of 0 indicates to not limit the number of decimal places used.
17	FP Max Decimals Bit 1	
18	FP Max Decimals Bit 2	
19	FP Max Decimals Bit 1	
20	Extended Parameter Reference	0 = Not an Extended Parameter Reference 1 = Extended Parameter Reference An Extended Parameter Reference contains a reference to another parameter. The value is formatted the same as an analog mode Indirect Selector parameter (SSpppp, where SS = slot number of device to which this Extended Parameter Reference is pointing, and pppp = number of the parameter or diagnostic item to which this Extended Parameter Reference is pointing). Note that an Extended Parameter Reference can only select parameters unlike an Indirect Selector. An Extended Parameter Reference could be used to configure a Datalink or show the source of a Reference (among other uses).
21	Uses Rating Table Object	This parameter has rating-dependent defaults and limits that can be obtained from the Rating Table Object. The Offline Read Full will include the default value for the smallest rating and limits that will accommodate the full range of values allowed in the family of devices using this particular combination of Family Code and Config Code. The Online Read Full will include the rating-dependent default and limit values for this particular combination of Family Code, Config Code, and Rating Code.
22	Writable Referenced Parameter	This bit must be zero unless the parameter is an Extended Parameter Reference. If the parameter is an Extended Parameter Reference, then: 0 = The referenced parameter may be read-only or writable. 1 = The referenced parameter must always be writable (including while running).
23	Disallow Zero	This bit must be zero unless the parameter is an Indirect Selector or Extended Parameter Reference. If the parameter is an Indirect Selector or Extended Parameter Reference, then: 0 = Allow zero 1 = Disallow zero If this bit is cleared (indicating that a value of zero is allowed), the device must support the “Zero Text” parameter attribute so that a software tool or HIM can obtain text from the Zero Text parameter attribute. If this bit is set (indicating that a value of zero is disallowed), a software tool or HIM will not allow the user to enter a value of zero.
24	Datalink Out	This bit is used by offline tools and indicates that this is a Datalink Out parameter. Bit 20 must also be set.
25	Datalink In	This bit is used by offline tools and indicates that this is a Datalink In parameter. Bits 20 and 22 must also be set.
26	Not Writable While IO Active	This parameter cannot be written if the I/O data being exchanged between the Host and the peripheral is valid.

Bit	Name	Description
27	Command Parameter	This parameter commands the drive to take an action, such as “Reset Defaults” or “Autotune,” and then returns to a value of zero. Offline software tools will not allow setting this parameter to anything other than a value of zero. If an offline file contains a Command Parameter with a non-zero value, the offline software tool will change the value to zero. Note that command parameters cannot have values that do not return to zero.
28	Current Value Is Default	This bit identifies a parameter that will not change if a “Reset Defaults” is commanded. For example, if a drive contains a Language parameter that is set to German, setting defaults will leave the parameter set to German. Likewise, if the parameter is set to French, setting defaults will leave the parameter set to French.
29	Use Zero Text	If the “Disallow Zero” bit is set, this bit must be cleared. If the “Disallow Zero” bit is cleared, then: 0 = Use Disabled Text parameter class attribute. 1 = Use Zero Text parameter instance attribute.
30-31	Reserved	Reserved

Formulas for Converting

Display Value = ((Internal Value + Offset) x Multiplier x Base) / (Divisor x $10^{\text{Decimal Places}}$)

Internal Value = ((Display Value x Divisor x $10^{\text{Decimal Places}}$) / (Multiplier x Base)) - Offset

Common Services

Service Code	Implemented for:		Service Name
	Class	Instance	
0x0E	Yes	Yes	Get_Attribute_Single
0x10	Yes	Yes	Set_Attribute_Single

Object Specific Services

Service Code	Implemented for:		Service Name	Allocation Size (in bytes)	
	Class	Instance		Par. Number	Par. Value
0x4B	Yes	No	Get_Attributes_Scattered	2	2
0x4C	Yes	No	Set_Attributes_Scattered	2	2
0x4D (1)	Yes	No	Get_Attributes_Scattered	4	4
0x4E (1)	Yes	No	Set_Attributes_Scattered	4	4

(1) These services are supported only when the adapter is used with a PowerFlex 750-Series drive.

The table below lists the parameters for the Get_Attributes_Scattered and Set_Attributes_Scattered object-specific service:

Name	Data Type	Description
Parameter Number	DWORD	Parameter to read or write
Parameter Value	DWORD	Parameter value to read or write (zero when reading)

DPI Fault Object

Class Code

Hexadecimal	Decimal
0x97	151

Products such as PowerFlex drives use this object for faults. Adapters use this object for events.

Services

Service Code	Implemented for:		Service Name
	Class	Instance	
0x0E	Yes	Yes	Get_Attribute_Single
0x10	Yes	Yes	Set_Attribute_Single

Instances

The number of instances depends on the maximum number of faults or events supported in the queue. The maximum number of faults/events can be read in Instance 0, Attribute 2.

Instances (Hex.)	(Dec.)	Device
0x0000…0x3FFF	0…16383	Host
0x4000…0x43FF	16384…17407	Adapter
0x4400…0x47FF	17408…18431	DPI Port 1
0x4800…0x4BFF	18432…19455	DPI Port 2
0x4C00…0x4FFF	19456…20479	DPI Port 3
0x5000…0x53FF	20480…21503	DPI Port 4
0x5400…0x57FF	21504…22527	DPI Port 5
0x5800…0x5BFF	22528…23551	DPI Port 6
0x5C00…0x5FFF (1)	23552…24575	DPI Port 7
0x6000…0x63FF (1)	24576…25599	DPI Port 8
0x6400…0x67FF (1)	25600…26623	DPI Port 9
0x6800…0x6BFF (1)	26624…27647	DPI Port 10
0x6C00…0x6FFF (1)	27648…28671	DPI Port 11
0x7000…0x73FF (1)	28672…29695	DPI Port 12
0x7400…0x77FF (1)	29696…30719	DPI Port 13
0x7800…0x7BFF (1)	30720…31743	DPI Port 14

Example	Description
0	Class Attributes (Drive)
1	Most Recent Drive Fault
2	Second Most Recent Drive Fault
⋮	⋮
16384	Class Attributes (Adapter)
16385	Most Recent Adapter Event
⋮	⋮

(1) These instances are supported only when the adapter is used with a PowerFlex 750-Series drive.

Class Attributes

Attribute ID	Access Rule	Name	Data Type	Description
1	Get	Class Revision	WORD	Revision of object
2	Get	Number of Instances	WORD	Maximum number of faults/events that the device can record in its queue
3	Set	Fault Command Write	BYTE	0 = No Operation 1 = Clear Fault/Event 2 = Clear Fault/Event Queue 3 = Reset Device
4	Get	Fault Trip Instance Read	WORD	Fault that tripped the device. For adapters, this value is always 1 when faulted.

Attribute ID	Access Rule	Name	Data Type	Description
5	Get	Fault Data List	STRUCT of: BYTE BYTE WORD[n]	Number of faults/events in the queue. A “0” indicates the fault queue is empty.
6	Get	Number of Recorded Faults	WORD	Number of faults/events in the queue. A “0” indicates the fault queue is empty.
7	Get	Fault Parameter Reference	WORD	Number of faults/events in the queue. A “0” indicates the fault queue is empty.

Instance Attributes

Attribute ID	Access Rule	Name	Data Type	Description
0	Get	Full/All Information	STRUCT of WORD STRUCT of: BYTE BYTE STRING[16] STRUCT of: LWORD BOOL[16] WORD CONTAINER[n]	Fault code Fault source DPI port DPI Device Object Fault text Fault time stamp Timer value (0 = timer not supported) BOOL[0]: (0 = invalid data, 1 = valid data) BOOL[1]: (0 = elapsed time, 1 = real time) BOOL[2…15]: Not used Reserved Reserved
1	Get	Basic Information	STRUCT of WORD STRUCT of: BYTE BYTE STRUCT of: LWORD BOOL[16]	Fault code Fault source DPI port DPI Device Object Fault time stamp Timer value (0 = timer not supported) BOOL[0]: (0 = invalid data, 1 = valid data) BOOL[1]: (0 = elapsed time, 1 = real time) BOOL[2…15]: Not used
2	Get	International Fault Text	STRINGN	Text describing the fault with support for Unicode.

DPI Alarm Object

Class Code

Hexadecimal	Decimal
0x98	152

Products such as PowerFlex drives use this object for alarms or warnings. Adapters do not support this object.

Services

Service Code	Implemented for:		Service Name
	Class	Instance	
0x0E	Yes	Yes	Get_Attribute_Single
0x10	Yes	Yes	Set_Attribute_Single

Instances

The number of instances depends on the maximum number of alarms supported by the queue. The maximum number of alarms can be read in Instance 0, Attribute 2.

Instances (Hex.)	(Dec.)	Device
0x0000…0x3FFF	0…16383	Host
Only host devices can have alarms.		

Example	Description
0	Class Attributes (Drive)
1	Most Recent Alarm
2	Second Most Recent Alarm
⋮	⋮

Class Attributes

Attribute ID	Access Rule	Name	Data Type	Description
1	Get	Class Revision	WORD	Revision of object
2	Get	Number of Instances	WORD	Maximum number of alarms that the device can record in its queue
3	Set	Alarm Command Write	BYTE	0 = No Operation 1 = Clear Alarm 2 = Clear Alarm Queue 3 = Reset Device
4	Get	Fault Data List	STRUCT of: BYTE BYTE WORD[n]	Reserved
5	Get	Number of Recorded Alarms	WORD	Number of alarms in the queue. A “0” indicates the alarm queue is empty.

Instance Attributes

Attribute ID	Access Rule	Name	Data Type	Description
0	Get	Full/All Information	STRUCT of WORD STRUCT of: BYTE BYTE STRING[16] STRUCT of: LWORD BOOL[16] WORD CONTAINER[n]	Alarm code Alarm source DPI port DPI Device Object Alarm text Alarm time stamp Timer value (0 = timer not supported) BOOL[0]: (0 = invalid data, 1 = valid data) BOOL[1]: (0 = elapsed time, 1 = real time) BOOL[2…15] Reserved Reserved Reserved
1	Get	Basic Information	STRUCT of WORD STRUCT of: BYTE BYTE STRUCT of: LWORD BOOL[16]	Alarm code Alarm source DPI port DPI Device Object Alarm time stamp Timer value (0 = timer not supported) BOOL[0]: (0 = invalid data, 1 = valid data) BOOL[1]: (0 = elapsed time, 1 = real time) BOOL[2…15] Reserved
2	Get	International Alarm Text	STRINGN	Text describing the alarm with support for Unicode.

DPI Diagnostic Object

Class Code

Hexadecimal	Decimal
0x99	153

Services

Service Code	Implemented for:		Service Name
	Class	Instance	
0x0E	Yes	Yes	Get_Attribute_Single
0x10	Yes	Yes	Set_Attribute_Single

Instances

The number of instances depends on the maximum number of diagnostic items in the device. The total number of diagnostic items can be read in Instance 0, Attribute 2.

Instances (Hex.)	(Dec.)	Device
0x0000…0x3FFF	0…16383	Host
0x4000…0x43FF	16384…17407	Adapter
0x4400…0x47FF	17408…18431	DPI Port 1
0x4800…0x4BFF	18432…19455	DPI Port 2
0x4C00…0x4FFF	19456…20479	DPI Port 3
0x5000…0x53FF	20480…21503	DPI Port 4
0x5400…0x57FF	21504…22527	DPI Port 5
0x5800…0x5BFF	22528…23551	DPI Port 6
0x5C00…0x5FFF (1)	23552…24575	DPI Port 7
0x6000…0x63FF (1)	24576…25599	DPI Port 8
0x6400…0x67FF (1)	25600…26623	DPI Port 9
0x6800…0x6BFF (1)	26624…27647	DPI Port 10
0x6C00…0x6FFF (1)	27648…28671	DPI Port 11
0x7000…0x73FF (1)	28672…29695	DPI Port 12
0x7400…0x77FF (1)	29696…30719	DPI Port 13
0x7800…0x7BFF (1)	30720…31743	DPI Port 14

Example	Description
0	Class Attributes (Drive)
1	Drive Diagnostic Item 1
2	Drive Diagnostic Item 2
⋮	⋮
16384	Class Attributes (Adapter)
16385	Adapter Diagnostic Item1
⋮	⋮

(1) These instances are supported only when the adapter is used with a PowerFlex 750-Series drive.

Class Attributes

Attribute ID	Access Rule	Name	Data Type	Description
1	Get	Class Revision	WORD	1
2	Get	Number of Instances	WORD	Number of diagnostic items in the device.
3	Get	ENUM Offset	WORD	DPI ENUM object instance offset

Instance Attributes

Attribute ID	Access Rule	Name	Data Type	Description
0	Get	Full/All Information	STRUCT of:	
			BOOL[32]	Descriptor (see page C-19)
			CONTAINER (1)	Value
			CONTAINER	Minimum value
			CONTAINER	Maximum value
			CONTAINER	Default value
			WORD	Pad Word
			WORD	Pad Word
			STRING[4]	Units (for example, Amp, Hz)
			WORD	Multiplier (2)
			WORD	Divisor (2)
			WORD	Base (2)
			INT	Offset (2)
			DWORD	Link (source of the value) (0 = no link)
			STRING[16]	Diagnostic name text
1	Get/Set	Value	Various	Diagnostic item value
2	Get	International Diagnostic Item Text	STRUCT of:	
			STRINGN	Diagnostic name text
			STRINGN	Diagnostic units text
3	Get	International Full Read All	STRUCT of:	
			BOOL[32]	Descriptor
			CONTAINER	Value
			CONTAINER	Minimum
			CONTAINER	Maximum
			CONTAINER	Default
			WORD	Pad Word
			WORD	Pad Word
			WORD	Multiplier
			WORD	Divisor
			WORD	Base
			INT	Offset
			DWORD	Pad
			BOOL[32]	Extended descriptor
			STRINGN	Diagnostic name text
			STRINGN	Diagnostic units text

(1) A CONTAINER is a 32-bit block of data that contains the data type used by a value. If signed, the value is sign extended. Padding is used in the CONTAINER to ensure that it is always 32-bits.

(2) This value is used in the formulas used to convert the value between display units and internal units. Refer to Formulas for Converting on page C-21.

DPI Time Object

Class Code

Hexadecimal	Decimal
0x9B	155

Services

Service Code	Implemented for:		Service Name
	Class	Instance	
0x0E	Yes	Yes	Get_Attribute_Single
0x10	Yes	Yes	Set_Attribute_Single

Instances

The number of instances depends on the number of timers in the device. Instance 1 is always reserved for a real-time clock although a device may not support it. The total number of timers can be read in Instance 0, Attribute 2.

Instances (Hex.)	(Dec.)	Device
0x0000…0x3FFF	0…16383	Host
0x4000…0x43FF	16384…17407	Adapter
0x4400…0x47FF	17408…18431	DPI Port 1
0x4800…0x4BFF	18432…19455	DPI Port 2
0x4C00…0x4FFF	19456…20479	DPI Port 3
0x5000…0x53FF	20480…21503	DPI Port 4
0x5400…0x57FF	21504…22527	DPI Port 5
0x5800…0x5BFF	22528…23551	DPI Port 6
0x5C00…0x5FFF (1)	23552…24575	DPI Port 7
0x6000…0x63FF (1)	24576…25599	DPI Port 8
0x6400…0x67FF (1)	25600…26623	DPI Port 9
0x6800…0x6BFF (1)	26624…27647	DPI Port 10
0x6C00…0x6FFF (1)	27648…28671	DPI Port 11
0x7000…0x73FF (1)	28672…29695	DPI Port 12
0x7400…0x77FF (1)	29696…30719	DPI Port 13
0x7800…0x7BFF (1)	30720…31743	DPI Port 14

Example	Description
0	Class Attributes (Drive)
1	Real Time Clock (Predefined) (not always supported)
2	Timer 1
3	Timer 2
⋮	⋮

(1) These instances are supported only when the adapter is used with a PowerFlex 750-Series drive.

Class Attributes

Attribute ID	Access Rule	Name	Data Type	Description
1	Get	Class Revision	WORD	Revision of object
2	Get	Number of Instances	WORD	Number of timers in the object, excluding the real-time clock that is predefined.
3	Get	First Device Specific Timer	WORD	Instance of the first timer that is not predefined.
4	Set	Time Command Write	BYTE	0 = No Operation 1 = Clear all timers (Does not clear the real-time clock or read only timers)
5	Get	Number of Supported Time Zones	WORD	Number of time zones described in the Time Zone List attribute.
6	Get	Time Zone List	STRUCT	Identifies a time zone.
7	Get/Set	Active Time Zone ID	WORD	The ID field of the Time Zone List structure for the desired time zone.

Attribute ID	Access Rule	Name	Data Type	Description
8	Get	Active Time Zone Data	STRUCT of: INT BYTE BYTE BYTE BYTE BYTE BYTE INT BYTE BYTE BYTE BYTE BYTE BYTE	 Standard bias Standard month Standard day of week Standard week Standard hour Standard minute Standard second Daylight offset Daylight month Daylight day of week Daylight week Daylight hour Daylight minute Daylight second
9	Get/Set	Custom Time Zone Data	STRUCT of: INT BYTE BYTE BYTE BYTE BYTE BYTE INT BYTE BYTE BYTE BYTE BYTE BYTE	 Standard bias Standard month Standard day of week Standard week Standard hour Standard minute Standard second Daylight offset Daylight month Daylight day of week Daylight week Daylight hour Daylight minute Daylight second

Instance Attributes

Attribute ID	Access Rule	Name	Data Type	Description
0	Get	Read Full	STRUCT of: STRING[16] LWORD or STRUCT BOOL[16]	 Name of the timer Elapsed time in milliseconds unless timer is a real-time clock (see attribute 2) See attribute 3
1	Get	Timer Text	STRING[16]	Name of the timer
2	Get/Set	Timer Value	LWORD -or- STRUCT of: WORD BYTE BYTE BYTE BYTE BYTE BYTE	Elapsed time in milliseconds unless the timer is a real-time clock. Real-Time Clock Data: Milliseconds (0…999) Seconds (0…59) Minutes (0…59) Hours (0…23) Days (1…31) Months (1 = January, 12 = December) Years (since 1972)
3	Get	Timer Descriptor	BOOL[16]	BOOL[0]: (0 = invalid data, 1 = valid data) BOOL[1]: (0 = elapsed time, 1 = real time) BOOL[2…15]: Not used
4	Get	International Read Full	STRUCT of: STRINGN STRUCT BOOL[16]	 International timer text Timer value Timer descriptor
5	Get	International Timer Text	STRINGN	Name of this timer
6	Get	Clock Status	BOOL[32]	Identifies clock status
8	Get/Set	Number of Leap Seconds	INT	Identifies the current number of Leap Seconds.
9	Get	Clock Options	BOOL[32]	Identifies the optional functionality available in the device's System Clock.
10	Get/Set	Clock Options Enable	BOOL[32]	Identifies which of the clock's options are enabled.

Host DPI Parameter Object

Class Code

Hexadecimal	Decimal
0x9F	159

To access Device parameters, use the DPI Parameter Object (Class Code 0x93).

Important: The Host DPI Parameter Object is supported only when the adapter is used with a PowerFlex 750-Series drive.

Instances

The number of instances depends on the number of parameters in the device. The total number of parameters can be read in Instance 0, Attribute 0.

Instances (Hex.)	(Dec.)	Device
0x0000…0x3FFF	0…16383	Reserved
0x4000…0x43FF	16384…17407	Adapter
0x4400…0x47FF	17408…18431	DPI Port 1
0x4800…0x4BFF	18432…19455	DPI Port 2
0x4C00…0x4FFF	19456…20479	DPI Port 3
0x5000…0x53FF	20480…21503	DPI Port 4
0x5400…0x57FF	21504…22527	DPI Port 5
0x5800…0x5BFF	22528…23551	DPI Port 6
0x5C00…0x5FFF	23552…24575	DPI Port 7
0x6000…0x63FF	24576…25599	DPI Port 8
0x6400…0x67FF	25600…26623	DPI Port 9
0x6800…0x6BFF	26624…27647	DPI Port 10
0x6C00…0x6FFF	27648…28671	DPI Port 11
0x7000…0x73FF	28672…29695	DPI Port 12
0x7400…0x77FF	29696…30719	DPI Port 13
0x7800…0x7BFF	30720…31743	DPI Port 14

Example	Description
16384	Class Attributes (Adapter)
16385	Adapter Parameter 1 Attributes
16386	Adapter Parameter 2 Attributes
⋮	⋮
17408	Class Attributes (HIM)
17409	HIM Parameter 1 Attributes
17410	HIM Parameter 2 Attributes
⋮	⋮

Class Attributes

Attribute ID	Access Rule	Name	Data Type	Description
0	Get	Number of Instances	WORD	Number of parameters in the device
1	Set	Write Protect Password	WORD	0 = Password disabled n = Password
2	Set	NVS Command Write	BYTE	0 = No Operation 1 = Store values in active memory to NVS 2 = Load values in NVS to active memory 3 = Load default values to active memory
3	Get	NVS Parameter Value Checksum	WORD	Checksum of all parameter values in a user set in NVS
4	Get	NVS Link Value Checksum	WORD	Checksum of parameter links in a user set in NVS
5	Get	First Accessible Parameter	WORD	First parameter available if parameters are protected by passwords. A “0” indicates all parameters are protected.
7	Get	Class Revision	WORD	2 = DPI
8	Get	First Parameter Processing Error	WORD	The first parameter that has been written with a value outside of its range. A “0” indicates no errors.
9	Set	Link Command	BYTE	0 = No Operation 1 = Clear All Parameter Links (This does not clear links to function blocks.)

Instance Attributes

Attribute ID	Access Rule	Name	Data Type	Description
6	Get	DPI Offline Read Full	STRUCT of: BOOL[32] CONTAINER CONTAINER CONTAINER STRING[16] STRING[4] WORD WORD WORD WORD WORD WORD BYTE BYTE WORD WORD CONTAINER WORD WORD WORD INT	 Descriptor Offline Minimum value Offline Maximum value Offline Default value Parameter name Offline parameter units Online minimum parameter instance Online maximum parameter instance Online default parameter instance Multiplier parameter instance Divisor parameter instance Base parameter instance Offset parameter instance Formula number Pad byte (always zero) Help instance Pad word (always a value of zero) Parameter value Multiplier Divisor Base Offset
7	Get	DPI Online Read Full	STRUCT of: BOOL[32] CONTAINER(1) CONTAINER CONTAINER CONTAINER WORD WORD STRING[4] WORD WORD WORD INT BYTE[3] BYTE STRING[16]	 Descriptor (see page C-33) Parameter value Minimum value Maximum value Default value Next parameter Previous parameter Units (for example, Amps, Hz) Multiplier (2) Divisor (2) Base (2) Offset (2) Link (source of the value) (0 = no link) Always zero (0) Parameter name
8	Get	DPI Descriptor	BOOL[32]	Descriptor (see page C-33)
9	Get/Set	DPI Parameter Value	Various	Parameter value in NVS. (3)
10	Get/Set	DPI RAM Parameter Value	Various	Parameter value in temporary memory. Valid only for DPI drives.
11	Get/Set	DPI Link	BYTE[3]	Link (parameter or function block that is the source of the value) (0 = no link)
12	Get	Help Object Instance	WORD	ID for help text for this parameter
13	Get	DPI Read Basic	STRUCT of: BOOL[32] CONTAINER CONTAINER CONTAINER CONTAINER STRING[16] STRING[4]	 Descriptor (see page C-33) Parameter value Minimum value Maximum value Default value Parameter name Units (for example, Amps, Hz)
14	Get	DPI Parameter Name	STRING[16]	Parameter name
15	Get	DPI Parameter Alias	STRING[16]	Customer supplied parameter name.
16	Get	Parameter Processing Error	BYTE	0 = No error 1 = Value is less than the minimum 2 = Value is greater than the maximum

Attribute ID	Access Rule	Name	Data Type	Description
18	Get	International DPI Offline Parameter Text	Struct of: STRINGN STRINGN	 International parameter name International offline units
19	Get	International DPI Online Parameter Text	Struct of: STRINGN STRINGN	 International parameter name International online units
20	Get	International DPI Online Read Full	Struct of: BOOL[32] CONTAINER CONTAINER CONTAINER CONTAINER WORD WORD WORD WORD WORD INT BYTE[3] BYTE BOOL[32] STRINGN STRINGN	 Descriptor Parameter value Online minimum value Online maximum value Online default value Next Previous Multiplier Divisor Base Offset Link Pad word (always zero) Extended descriptor International parameter name International online parameter units
21	Get	DPI Extended Descriptor	UDINT	Extended Descriptor (see page C-34)
22	Get	International DPI Offline Read Full	Struct of: BOOL CONTAINER CONTAINER CONTAINER WORD WORD WORD WORD WORD WORD BYTE BYTE WORD WORD CONTAINER WORD WORD WORD INT BOOL[32] STRINGN STRINGN	 Descriptor Offline minimum value Offline maximum value Offline default value Online minimum parameter instance Online maximum parameter instance Online default parameter instance Multiplier parameter instance Divisor parameter instance Base parameter instance Offset parameter instance Formula number Pad word (always zero) Help instance Pad word (always a value of zero) Parameter value Multiplier Divisor Base Offset Extended DPI descriptor International DPI parameter name International DPI offline parameter units

(1) A CONTAINER is a 32-bit block of data that contains the data type used by a parameter value. If signed, the value is sign extended. Padding is used in the CONTAINER to ensure that it is always 32-bits.

(2) This value is used in the formulas used to convert the parameter value between display units and internal units. Refer to Formulas for Converting on page C-35.

(3) Do NOT continually write parameter data to NVS. Refer to the attention on page 6-1.

Descriptor Attributes

Bit	Name	Description
0	Data Type (Bit 1)	Right bit is least significant bit (0). 000 = USINT used as an array of Boolean 001 = UINT used as an array of Boolean 010 = USINT (8-bit integer) 011 = UINT (16-bit integer) 100 = UDINT (32-bit integer) 101 = TCHAR ((8-bit (not Unicode) or 16-bits (Unicode)) 110 = REAL (32-bit floating point value) 111 = Use bits 16, 17, 18
1	Data Type (Bit 2)	
2	Data Type (Bit 3)	
3	Sign Type	0 = unsigned 1 = signed
4	Hidden	0 = visible 1 = hidden
5	Not a Link Sink	0 = May be the sink end of a link 1 = May not be the sink end of a link
6	Not Recallable	0 = Recallable from NVS 1 = Not Recallable from NVS
7	ENUM	0 = No ENUM text 1 = ENUM text
8	Writable	0 = Read only 1 = Read/write
9	Not Writable When Enabled	0 = Writable when enabled (e.g., drive running) 1 = Not writable when enabled
10	Instance	0 = Parameter value is not a Reference to another parameter 1 = Parameter value refers to another parameter
11	Uses Bit ENUM Mask	This parameter instance supports the Bit ENUM Mask attribute. For more information, see the definition of the attribute.
12	Decimal Place (Bit 0)	Number of digits to the right of the decimal point. 0000 = 0 1111 = 15
13	Decimal Place (Bit 1)	
14	Decimal Place (Bit 2)	
15	Decimal Place (Bit 3)	
16	Extended Data Type (Bit 4)	Bit 16 is the least significant bit. 000 = Reserved 001 = UDINT used as an array of Boolean 010 = Reserved 011 = Reserved 100 = Reserved 101 = Reserved 110 = Reserved 111 = Reserved
17	Extended Data Type (Bit 5)	
18	Extended Data Type (Bit 6)	
19	Parameter Exists	Used to mark parameters that are not available to network tools.
20	Not Used	Reserved
21	Formula Links	Indicates the Formula Data is derived from other parameters.
22	Access Level (Bit 1)	A 3-bit field used to control access to parameter data.
23	Access Level (Bit 2)	
24	Access Level (Bit 3)	
25	Writable ENUM	ENUM text: 0 = Read Only, 1 = Read/Write
26	Not a Link Source	0 = May be the source end of a link 1 = May not be the source end of a link
27	Enhanced Bit ENUM	Parameter supports enhanced bit ENUMs.
28	Enhanced ENUM	Parameter supports enhanced ENUMs.
29	Uses DPI Limits Object	Parameter uses the DPI Limits Object. Intelligent offline tools make use of the Limits Object to select limits and units.
30	Extended Descriptor	Parameter uses Extended Descriptor bits, which can be obtained by reading the DPI Extended Descriptor attribute for this parameter.
31	Always Upload/Download	Parameter shall always be included in uploads and downloads.

Extended Descriptor Attributes

Bit	Name	Description
0	Indirect Mode	0 = Analog (selects entire parameters) 1 = Digital (selects individual bits within parameters)
1	Indirect Type 0	Analog input list (Instance 0xFFFF)
2	Indirect Type 1	Digital input list (Instance 0xFFFE)
3	Indirect Type 2	Feedback list (Instance 0xFFFD)
4	Indirect Type 3	Analog output list (Instance 0xFFFC)
5	Indirect Type 4	Digital output list (Instance 0xFFFB)
6	Indirect Type 5	Undefined (Instance 0xFFFA)
7	Indirect Type 6	Undefined (Instance 0xFFF9)
8	Indirect Type 7	Undefined (Instance 0xFFF8)
9	Indirect Type 8	Undefined (Instance 0xFFF7)
10	Indirect Type 9	Undefined (Instance 0xFFF6)
11	Indirect Type 10	Undefined (Instance 0xFFF5)
12	Indirect Type 11	Undefined (Instance 0xFFF4)
13	Indirect Type 12	Undefined (Instance 0xFFF3)
14	Indirect Type 13	Undefined (Instance 0xFFF2)
15	Indirect Type 14	Parameter-specific list
16	FP Max Decimals Bit 0	These four bits are used on REAL parameters only. They indicate the maximum number of decimal places to be displayed for small values. A value of 0 indicates to not limit the number of decimal places used.
17	FP Max Decimals Bit 1	
18	FP Max Decimals Bit 2	
19	FP Max Decimals Bit 1	
20	Extended Parameter Reference	0 = Not an Extended Parameter Reference 1 = Extended Parameter Reference An Extended Parameter Reference contains a reference to another parameter. The value is formatted the same as an analog mode Indirect Selector parameter (SSpppp, where SS = slot number of device to which this Extended Parameter Reference is pointing, and pppp = number of the parameter or diagnostic item to which this Extended Parameter Reference is pointing). Note that an Extended Parameter Reference can only select parameters unlike an Indirect Selector. An Extended Parameter Reference could be used to configure a Datalink or show the source of a Reference (among other uses).
21	Uses Rating Table Object	This parameter has rating-dependent defaults and limits that can be obtained from the Rating Table Object. The Offline Read Full will include the default value for the smallest rating and limits that will accommodate the full range of values allowed in the family of devices using this particular combination of Family Code and Config Code. The Online Read Full will include the rating-dependent default and limit values for this particular combination of Family Code, Config Code, and Rating Code.
22	Writable Referenced Parameter	This bit must be zero unless the parameter is an Extended Parameter Reference. If the parameter is an Extended Parameter Reference, then: 0 = The referenced parameter may be read-only or writable. 1 = The referenced parameter must always be writable (including while running).
23	Disallow Zero	This bit must be zero unless the parameter is an Indirect Selector or Extended Parameter Reference. If the parameter is an Indirect Selector or Extended Parameter Reference, then: 0 = Allow zero 1 = Disallow zero If this bit is cleared (indicating that a value of zero is allowed), the device must support the “Zero Text” parameter attribute so that a software tool or HIM can obtain text from the Zero Text parameter attribute. If this bit is set (indicating that a value of zero is disallowed), a software tool or HIM will not allow the user to enter a value of zero.
24	Datalink Out	This bit is used by offline tools and indicates that this is a Datalink Out parameter. Bit 20 must also be set.
25	Datalink In	This bit is used by offline tools and indicates that this is a Datalink In parameter. Bits 20 and 22 must also be set.
26	Not Writable While IO Active	This parameter cannot be written if the I/O data being exchanged between the Host and the peripheral is valid.

Bit	Name	Description
27	Command Parameter	This parameter commands the drive to take an action, such as “Reset Defaults” or “Autotune,” and then returns to a value of zero. Offline software tools will not allow setting this parameter to anything other than a value of zero. If an offline file contains a Command Parameter with a non-zero value, the offline software tool will change the value to zero. Note that command parameters cannot have values that do not return to zero.
28	Current Value Is Default	This bit identifies a parameter that will not change if a “Reset Defaults” is commanded. For example, if a drive contains a Language parameter that is set to German, setting defaults will leave the parameter set to German. Likewise, if the parameter is set to French, setting defaults will leave the parameter set to French.
29	Use Zero Text	If the “Disallow Zero” bit is set, this bit must be cleared. If the “Disallow Zero” bit is cleared, then: 0 = Use Disabled Text parameter class attribute. 1 = Use Zero Text parameter instance attribute.
30-31	Reserved	Reserved

Formulas for Converting

Display Value = ((Internal Value + Offset) x Multiplier x Base) / (Divisor x $10^{\text{Decimal Places}}$))

Internal Value = ((Display Value x Divisor x $10^{\text{Decimal Places}}$) / (Multiplier x Base)) - Offset

Common Services

Service Code	Implemented for:		Service Name
	Class	Instance	
0x0E	Yes	Yes	Get_Attribute_Single
0x10	Yes	Yes	Set_Attribute_Single

Object Specific Services

Service Code	Implemented for:		Service Name	Allocation Size (in bytes)	
	Class	Instance		Par. Number	Par. Value
0x4D	Yes	No	Get_Attributes_Scattered	4	4
0x4E	Yes	No	Set_Attributes_Scattered	4	4

The table below lists the parameters for the Get_Attributes_Scattered and Set_Attributes_Scattered object-specific service:

Name	Data Type	Description
Parameter Number	UDINT	Parameter to read or write
Parameter Value	UDINT	Parameter value to read or write (zero when reading)

TCP/IP Interface Object

Class Code

Hexadecimal	Decimal
0xF5	245

Services

Service Code	Implemented for:		Service Name
	Class	Instance	
0x0E	Yes	Yes	Get_Attribute_Single
0x10	No	Yes	Set_Attribute_Single

Instances

The adapter supports one instance of the TCP/IP Interface object.

Number	Description
0	Class Attributes
1	Object Attributes

Class Attributes

Attribute ID	Access Rule	Name	Data Type	Description
1	Get	Revision	WORD	The revision of this object

Instance Attributes

Attribute ID	Access Rule	Name	Data Type	Description
1	Get	Status of TCP/IP Network Interface	DWORD	0 = Not configured 1 = Valid configuration 2…15 = Reserved
2	Get	Configuration Capability	DWORD	Bit I Value (0 = False, 1 = True) 0 = Supports BOOTP 1 = DNS Client (able to resolve host names by query to DNS server) 2 = DHCP Client (able to obtain network configuration through DHCP) 3 = DHCP-DNS Update (able to send its host name in the DHCP request) 4 = Configuration Settable (able to set the network configuration via TCP/IP) 5…31 = Reserved
3	Set	Configuration Control	DWORD	Bit I Value 1…3 = Startup configuration 0 = Use configuration saved in NVS 1 = Obtain configuration via BOOTP 2 = Obtain configuration via DHCP 3…15 = Reserved 4 = DNS Enabled (resolves host names by query to DNS server) 5…31 = Reserved
4	Get	Physical Link Object	STRUCT of: WORD Padded EPATH	 Path size Path
5	Get	Interface Configuration	STRUCT of: DWORD DWORD DWORD DWORD DWORD STRING	 Adapter's IP address Adapter's subnet mask Adapter's gateway address Primary name server Secondary name server Default domain name
6	Get	Host Name	STRING	Host name when using DHCP

Ethernet Link Object

Class Code

Hexadecimal	Decimal
0xF6	246

Services

Service Code	Implemented for:		Service Name
	Class	Instance	
0x0E	Yes	Yes	Get_Attribute_Single
0x4C	No	Yes	Get_and_Clear

Instances

The adapter supports one instance of the TCP/IP Interface object.

Number	Description
0	Class Attributes
1	Object Attributes

Class Attributes

Attribute ID	Access Rule	Name	Data Type	Description
1	Get	Revision	WORD	The revision of this object

Instance Attributes

Attribute ID	Access Rule	Name	Data Type	Description
1	Get	Interface Speed	DWORD	Speed in megabits per second (Mbs)
2	Get	Interface Flags	DWORD	Bit | Value 0 = Link status (0 = inactive, 1 = active) 1 = Duplex (0 = half duplex, 1 = full duplex) 2...31 = Reserved
3	Get	Physical Address	BYTE[6]	MAC address (XX-XX-XX-XX-XX-XX) The first octet (USINT[0]) is on the left.
4	Get	Interface Counters	STRUCT of: DWORD DWORD DWORD DWORD DWORD DWORD DWORD DWORD DWORD DWORD DWORD	 Octets received Unicast packets received Non-unicast packets received Inbound packets received but discarded Inbound packets with errors (not discarded) Inbound packets with unknown protocol Octets sent Unicast packets sent Non-unicast packets sent Outbound packets discarded Outbound packets with errors

Attribute ID	Access Rule	Name	Data Type	Description
5	Get	Media Counters	STRUCT of:	RX = Received, TX = Transmitted
			DWORD	RX frames not having integral number of octets long
			DWORD	RX frames not passing FCS check
			DWORD	TX frames having one collision
			DWORD	TX frames having multiple collisions
			DWORD	Number of times of SQE test error message
			DWORD	TX Frames delayed first attempt by busy medium
			DWORD	Collisions detected later than 512 bit-times in trans.
			DWORD	TX frames failing due to excessive collisions
			DWORD	TX frames failing due to intern MAC sublayer TX error
			DWORD	Times of carrier sense condition loss during trans.
			DWORD	RX frames exceeding the maximum frame size
			DWORD	RX frames failing due to intern MAC sublayer RX error

Logic Command/Status Words

Appendix D presents the definitions of the Logic Command and Logic Status words that are used for some products that can be connected to the adapter. If the Logic Command/Logic Status for the product that you are using is not listed, refer to your product's documentation.

PowerFlex 70/70EC, PowerFlex 700/700VC, and PowerFlex 700H Drives

Logic Command Word

Logic Bits																	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Command	Description
															x	Stop [1]	0 = Not Stop 1 = Stop
														x		Start [1][2]	0 = Not Start 1 = Start
													x			Jog	0 = Not Jog (Par. 100) 1 = Jog
												x				Clear Faults	0 = Not Clear Faults 1 = Clear Faults
										x	x					Direction	00 = No Command 01 = Forward Command 10 = Reverse Command 11 = Hold Direction Control
									x							Local Control	0 = No Local Control 1 = Local Control
								x								MOP Increment	0 = Not Increment 1 = Increment
						x	x									Accel Rate	00 = No Command 01 = Accel Rate 1 Command (Par. 140) 10 = Accel Rate 2 Command (Par. 141) 11 = Hold Accel Rate
				x	x											Decel Rate	00 = No Command 01 = Decel Rate 1 Command (Par. 142) 10 = Decel Rate 2 Command (Par. 143) 11 = Hold Decel Rate
	x	x	x													Reference Select [3]	000 = No Command 001 = Ref A Select (Par. 90) 010 = Ref B Select (Par. 93) 011 = Preset 3 (Par. 103) 100 = Preset 4 (Par. 104) 101 = Preset 5 (Par. 105) 110 = Preset 6 (Par. 106) 111 = Preset 7 (Par. 107)
x																MOP Decrement	0 = Not Decrement 1 = Decrement

[1] A "0 = Not Stop" condition (logic 0) must first be present before a "1 = Start" condition will start the drive. The Start command acts as a momentary Start command. A "1" will start the drive, but returning to "0" will not stop the drive.

[2] This Start will not function if a digital input (parameters 361-366) is programmed for 2-Wire Control (option 7, 8 or 9).

[3] This Reference Select will not function if a digital input (parameters 361-366) is programmed for "Speed Sel 1, 2 or 3" (option 15, 16 or 17). Note that Reference Select is "Exclusive Ownership" – see drive User Manual for more information.

Logic Status Word

Logic Bits																	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	**Status**	**Description**
															x	Ready	0 = Not Ready (Par. 214) 1 = Ready
														x		Active	0 = Not Active (Running) 1 = Active
													x			Command Direction	0 = Reverse 1 = Forward
												x				Actual Direction	0 = Reverse 1 = Forward
											x					Accel	0 = Not Accelerating 1 = Accelerating
										x						Decel	0 = Not Decelerating 1 = Decelerating
									x							Alarm	0 = No Alarm (Par. 211 & 212) 1 = Alarm
								x								Fault	0 = No Fault (Par. 243) 1 = Fault
							x									At Speed	0 = Not At Reference 1 = At Reference
				x	x	x										Local Control (1)	000 = Port 0 (TB) 001 = Port 1 010 = Port 2 011 = Port 3 100 = Port 4 101 = Port 5 110 = Port 6 111 = No Local
x	x	x	x													Reference	0000 = Ref A Auto (Par. 90) 0001 = Ref B Auto (Par. 93) 0010 = Preset 2 Auto 0011 = Preset 3 Auto 0100 = Preset 4 Auto 0101 = Preset 5 Auto 0110 = Preset 6 Auto 0111 = Preset 7 Auto 1000 = Term Blk Manual 1001 = DPI 1 Manual 1010 = DPI 2 Manual 1011 = DPI 3 Manual 1100 = DPI 4 Manual 1101 = DPI 5 Manual 1110 = DPI 6 Manual 1111 = Jog Ref

(1) See “Owners” in drive User Manual for further information.

PowerFlex 700S Drives — Logic Command Word (Phase II Control)

Logic Bits																Command	Description
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0		
															x	Normal Stop	0 = Not Normal Stop 1 = Normal Stop
														x		Start [1]	0 = Not Start 1 = Start
													x			Jog 1	0 = Not Jog using [Jog Speed 1] (Par. 29) 1 = Jog using [Jog Speed 1] (Par. 29)
												x				Clear Fault [2]	0 = Not Clear Fault 1 = Clear Fault
										x	x					Unipolar Direction	00 = No Command 01 = Forward Command 10 = Reverse Command 11 = Hold Direction Control
									x							Reserved	
								x								Jog 2	0 = Not Jog using [Jog Speed 2] (Par. 39) 1 = Jog using [Jog Speed 2] (Par. 39)
							x									Current Limit Stop	0 = Not Current Limit Stop 1 = Current Limit Stop
						x										Coast Stop	0 = Not Coast to Stop 1 = Coast to Stop
					x											Reserved	
				x												Reserved	
			x													Spd Ref Sel0	
		x														Spd Ref Sel1	
	x															Spd Ref Sel2	
x																Reserved	

Bits			
14	13	12	
0	0	0	= Spd Ref A (Par. 27)
0	0	1	= Spd Ref B (Par. 28)
0	1	0	= Preset 2 (Par. 15)
0	1	1	= Preset 3 (Par. 16)
1	0	0	= Preset 4 (Par. 17)
1	0	1	= Preset 5 (Par. 18)
1	1	0	= Preset 6 (Par. 19)
1	1	1	= Preset 7 (Par. 20)

[1] A Not Stop condition (logic bit 0 = 0, logic bit 8 = 0, and logic bit 9 = 0) must first be present before a 1 = Start condition will start the drive.

[2] To perform this command, the value must switch from “0” to “1.”

Logic Status Word (Phase II Control)

Logic Bits																	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Status	Description
															x	Active	0 = Not Active 1 = Active
														x		Running	0 = Not Running 1 = Running
													x			Command Direction	0 = Reverse 1 = Forward
												x				Actual Direction	0 = Reverse 1 = Forward
											x					Accel	0 = Not Accelerating 1 = Accelerating
										x						Decel	0 = Not Decelerating 1 = Decelerating
									x							Jogging	0 = Not Jogging 1 = Jogging
								x								Fault	0 = No Fault (Par. 323, 324, 325) 1 = Fault
							x									Alarm	0 = No Alarm (Par. 326, 327, 328) 1 = Alarm
						x										Flash Mode	0 = Not in Flash Mode 1 = In Flash Mode
					x											Run Ready	0 = Not Ready to Run (Par. 156) 1 = Ready to Run
				x												At Limit (1)	0 = Not At Limit (Par. 304) 1 = At Limit
			x													Tach Loss Sw	0 = Not Tach Loss Sw 1 = Tach Loss Sw
		x														At Zero Spd	0 = Not At Zero Speed 1 = At Zero Speed
	x															At Setpt Spd	0 = Not At Setpoint Speed 1= At Setpoint Speed
x																Enable	0 = Not Enabled 1 = Enabled

(1) See Parameter 304 - [Limit Status] in the PowerFlex 700S drive User Manual for a description of the limit status conditions.

PowerFlex 750-Series Drives

Important: When using a 20-COMM-E adapter with a PowerFlex 750-Series drive, the upper word (bits 16…31) of the Logic Command and Logic Status words are not accessible and cannot be used. Only when using a PowerFlex 750-Series drive with a 20-750 communication Option Module (or the PowerFlex 755 drive's embedded EtherNet/IP adapter) is the upper word accessible and used.

Logic Command Word

Logic Bits																	
31…15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Command	Description
															x	Normal Stop	0 = Not Normal Stop 1 = Normal Stop
														x		Start (1)	0 = Not Start 1 = Start
													x			Jog 1 (2)	0 = Not Jog 1 (Par. 556) 1 = Jog 1
												x				Clear Fault (3)	0 = Not Clear Fault 1 = Clear Fault
										x	x					Unipolar Direction	00 = No Command 01 = Forward Command 10 = Reverse Command 11 = Hold Direction Control
									x							Manual	0 = Not Manual 1 = Manual
								x								Reserved	
						x	x									Accel Time	00 = No Command 01 = Use Accel Time 1 (Par. 535) 10 = Use Accel Time 2 (Par. 536) 11 = Use Present Time
				x	x											Decel Time	00 = No Command 01 = Use Decel Time 1 (Par. 537) 10 = Use Decel Time 2 (Par. 538) 11 = Use Present Time
			x													Ref Select 1	000 = No Command 001 = Ref A Select (Par. 545) 010 = Ref B Select (Par. 550) 011 = Preset 3 (Par. 573) 100 = Preset 4 (Par. 574) 101 = Preset 5 (Par. 575) 110 = Preset 6 (Par. 576) 111 = Preset 7 (Par. 577)
		x														Ref Select 2	
	x															Ref Select 3	
x																Reserved	

(1) A Not Stop condition (logic bit 0 = 0) must first be present before a 1 = Start condition will start the drive.

(2) A Not Stop condition (logic bit 0 = 0) must first be present before a 1 = Jog 1/Jog 2 condition will jog the drive. A transition to a "0" will stop the drive.

(3) To perform this command, the value must switch from "0" to "1."

Logic Status Word

Logic Bits																	
31…15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Command	Description
															x	Run Ready	0 = Not Ready to Run (Par. 933) 1 = Ready to Run
														x		Active	0 = Not Active 1 = Active
													x			Command Direction	0 = Reverse 1 = Forward
												x				Actual Direction	0 = Reverse 1 = Forward
											x					Accelerating	0 = Not Accelerating 1 = Accelerating
										x						Decelerating	0 = Not Decelerating 1 = Decelerating
									x							Alarm	0 = No Alarm (Par. 959 and 960) 1 = Alarm
								x								Fault	0 = No Fault (Par. 952 and 953) 1 = Fault
							x									At Setpt Spd	0 = Not at Setpoint Speed 1 = At Setpoint Speed
						x										Manual	0 = Manual Mode Not Active 1 = Manual Mode Active
					x											Spd Ref ID 0	00000 = Reserved 00001 = Auto Ref A (Par. 545) 00010 = Auto Ref B (Par. 550) 00011 = Auto Preset Speed 3 (Par. 573) 00100 = Auto Preset Speed 4 (Par. 574) 00101 = Auto Preset Speed 5 (Par. 575) 00110 = Auto Preset Speed 6 (Par. 576) 00111 = Auto Preset Speed 7 (Par. 577) 01000 = Reserved 01001 = Reserved 01010 = Reserved 01011 = Reserved 01100 = Reserved 01101 = Reserved 01110 = Reserved 01111 = Reserved 10000 = Man Port 0 10001 = Man Port 1 10010 = Man Port 2 10011 = Man Port 3 10100 = Man Port 4 10101 = Man Port 5 10110 = Man Port 6 10111 = Reserved 11000 = Reserved 11001 = Reserved 11010 = Reserved 11011 = Reserved 11100 = Reserved 11101 = Man Port 13 (Emb. ENET) 11110 = Man Port 14 (Drive Logix) 11111 = Alternate Man Ref Sel
				x												Spd Ref ID 1	
			x													Spd Ref ID 2	
		x														Spd Ref ID 3	
	x															Spd Ref ID 4	
x																Reserved	

A

Adapter

Devices such as drives, controllers, and computers usually require an adapter to provide a communication interface between them and a network such as EtherNet/IP. An adapter reads data on the network and transmits it to the connected device. It also reads data in the device and transmits it to the network.

The 20-COMM-E EtherNet/IP adapter connects PowerFlex 7-Class drives to an EtherNet/IP network. Adapters are sometimes also called “cards,” “embedded communication options,” “gateways,” “modules,” and “peripherals.”

B

BOOTP (Bootstrap Protocol)

BOOTP lets the adapter configure itself dynamically at boot time if the network has a BOOTP server. The BOOTP server assigns the adapter a preconfigured IP address, a subnet mask, and a gateway address; therefore, you do not have to configure these using the parameters in the adapter. BOOTP can make it easier to administer an Ethernet network. A free version of Rockwell Software’s BOOTP Server can be accessed at http://www.software.rockwell.com/support/download/detail.cfm?ID=3390.

Bridge

A network device that can route messages from one network to another. A bridge also refers to a communications module in a ControlLogix controller that connects the controller to a network. See also Scanner.

C

CAN (Controller Area Network)

CAN is a serial bus protocol on which DPI is based.

CIP (Common Industrial Protocol)

CIP is the transport and application layer protocol used for messaging over EtherNet/IP, ControlNet, and DeviceNet networks. The protocol is used for implicit messaging (real-time I/O) and explicit messaging (configuration, data collection, and diagnostics).

ControlFLASH

An Allen-Bradley software tool that lets users electronically update firmware on printed circuit boards.

Controller

A controller, also called programmable logic controller, is a solid-state control system that has a user-programmable memory for storage of instructions to implement specific functions such as I/O control, logic, timing, counting, report generation, communication, arithmetic, and data file manipulation. A controller consists of a central processor, input/output interface, and memory. See also Scanner.

D

Data Rate

The speed at which data is transferred on the EtherNet/IP network. You can set the adapter to a data rate of 10 Mbps Full-Duplex, 10 Mbps Half-Duplex, 100 Mbps Full-Duplex, or 100 Mbps Half-Duplex. If another device on the network sets or auto-negotiates the data rate, you can set the adapter to automatically detect the data rate.

Datalinks

A Datalink is a type of pointer used by PowerFlex 7-Class drives to transfer data to and from the controller. Datalinks allow specified parameters to be read or written to without using explicit messages. When enabled, each Datalink consumes either four bytes or eight bytes in both the input and output image table of the controller. The drive determines the size of Datalinks.

DPI (Drive Peripheral Interface)

A second generation peripheral communication interface used by various Allen-Bradley drives and power products, such as PowerFlex 7-Class drives. It is a functional enhancement to SCANport.

DPI Peripheral

A device that provides an interface between DPI and a network or user. Peripheral devices are also referred to as “adapters” or “modules.” The 20-COMM-E adapter, 1203-USB or 1203-SSS converter, and PowerFlex 7-Class HIMs (20-HIM-xxx) are examples of DPI peripherals.

DPI Product

A device that uses the DPI communications interface to communicate with one or more peripheral devices. For example, a motor drive such as a PowerFlex 7-Class drive is a DPI product. In this manual, a DPI product is also referred to as “drive” or “host.”

DriveExplorer Software

A tool for monitoring and configuring Allen-Bradley products and adapters. It can be run on computers running various Microsoft Windows operating systems. DriveExplorer (version 3.xx or higher) can be used to configure this adapter and PowerFlex drives. Information about DriveExplorer software and a free lite version can be accessed at http://www.ab.com/drives/driveexplorer.

DriveTools SP Software

A software suite designed for running on various Microsoft Windows operating systems. This software suite provides a family of tools, including DriveExecutive, that you can use to program, monitor, control, troubleshoot, and maintain Allen-Bradley products. DriveTools SP can be used with PowerFlex drives. Information about DriveTools SP can be accessed at http://www.ab.com/drives/drivetools.

Duplex

Duplex describes the mode of communication. *Full-duplex* communications let a device exchange data in both directions at the same time. *Half-duplex* communications let a device exchange data only in one direction at a time. The duplex used by the adapter depends on the type of duplex that other network devices, such as switches, support.

E

EDS (Electronic Data Sheet) Files

Simple text files that are used by network configuration tools such as RSNetWorx for EtherNet to describe products so that you can easily commission them on a network. EDS files describe a product device type and revision. EDS files for many Allen-Bradley products can be found at http://www.ab.com/networks/eds.

EtherNet/IP Network

EtherNet/IP (Industrial Protocol) is an open producer-consumer communication network based on the Ethernet standard (IEEE 802.3), TCP/IP, UDP/IP, and CIP. Designed for industrial communications, both I/O and explicit messages can be transmitted over the network. Each device is assigned a unique IP address and transmits data on the network. The number of devices that an EtherNet/IP network can support depends on the class of IP address. For example, a network with a Class C IP address can have 254 nodes.

General information about EtherNet/IP and the EtherNet/IP specification are maintained by the Open DeviceNet Vendor's Association (ODVA). ODVA is online at http://www.odva.org.

Explicit Messaging

Explicit Messages are used to transfer data that does not require continuous updates. They are typically used to configure, monitor, and diagnose devices over the network.

F

Fault Action

A fault action determines how the adapter and connected drive act when a communications fault (for example, a cable is disconnected) occurs or when the controller is switched out of run mode. The former uses a communications fault action, and the latter uses an idle fault action.

Fault Configuration

When communications are disrupted (for example, a cable is disconnected), the adapter and PowerFlex drive can respond with a user-defined fault configuration. The user sets the data that is sent to the drive using specific fault configuration parameters in the adapter. When a fault action parameter is set to use the fault configuration data and a fault occurs, the data from these parameters is sent as the Logic Command, Reference, and/or Datalink(s).

Flash Update

The process of updating firmware in a device. The adapter can be flash updated using various Allen-Bradley software tools. Refer to Flash Updating the Adapter on page 3-18 for more information.

G

Gateway

A device on a network that connects an individual network to a system of networks. When a node needs to communicate with a node on another network, a gateway transfers the data between the two networks. You need to configure the address for the gateway device in the adapter if you want the adapter to communicate with devices that are not on its network.

H

Hardware Address

Each Ethernet device has a unique hardware address (sometimes called a MAC address) that is 48 bits. The address appears as six digits separated by colons (for example, xx:xx:xx:xx:xx:xx). Each digit has a value between 0 and 255 (0x00 and 0xFF). This address is assigned in the hardware and cannot be changed. It is required to identify the device if you are using a BOOTP utility.

HIM (Human Interface Module)

A device that can be used to configure and control a drive. PowerFlex 7-Class HIMs (20-HIM-xxx) can be used to configure PowerFlex 7-Class drives and their connected peripherals.

Hold Last

When communication is disrupted (for example, a cable is disconnected), the adapter and PowerFlex drive can respond by holding last. Hold last results in the drive receiving the last data received via the network connection before the disruption. If the drive was running and using the Reference from the adapter, it will continue to run at the same Reference.

Host Parameters (PowerFlex 750-Series drives only)

Host parameters are used to configure peripherals connected to a PowerFlex 750-Series drive. Host parameters, when viewed using DriveExplorer or DriveExecutive, appear below the specific peripheral listing in the treeview in a separate Host Parameters folder. When using a PowerFlex 7-Class HIM (20-HIM-A3/-A5/-C3S/-C5S), these parameters do not appear. When viewed using a PowerFlex 750-Series HIM (20-HIM-A6/-C6S), these parameters appear in the HOST PARAM folder.

I

Idle Action

An idle action determines how the adapter and connected drive act when the controller is switched out of run mode.

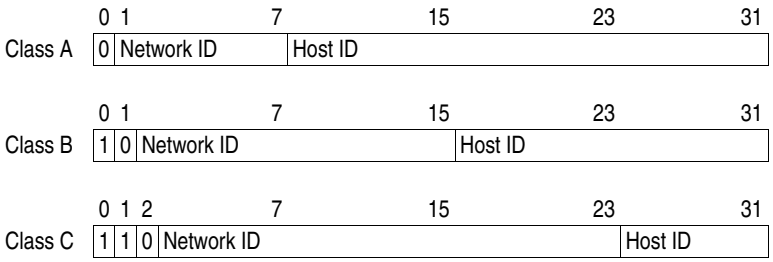
I/O Data

I/O data, sometimes called " implicit messages" or "input/output," is time-critical data such as a Logic Command and Reference. The terms "input" and "output" are defined from the controller's point of view. Output is produced by the controller and consumed by the adapter. Input is produced by the adapter and consumed by the controller.

IP Addresses

A unique IP address identifies each node on an EtherNet/IP network. An IP address consists of 32 bits that are divided into four segments of one byte each. It appears as four decimal integers separated by periods (xxx.xxx.xxx.xxx). Each "xxx" can have a decimal value from 0 to 255. For example, an IP address could be 192.168.0.1.

An IP address has two parts: a network ID and a host ID. The class of network determines the format of the address.



The number of devices on your EtherNet/IP network will vary depending on the number of bytes that are used for the network address. In many cases you are given a network with a Class C address, in which the first three bytes contain the network address (subnet mask = 255.255.255.0). This leaves 8 bits or 256 addresses on your network. Because two addresses are reserved for special uses (0 is an address for the network usually used by the router, and 255 is an address for broadcast messages to all network devices), you have 254 addresses to use on a Class C address block.

To ensure that each device on the Internet has a unique address, contact your network administrator or Internet Service Provider for unique fixed IP addresses. You can then set the unique IP address for the adapter by using a BOOTP server or by manually configuring parameters in the adapter. The adapter reads the values of these parameters only at power-up.

L

Logic Command/Logic Status

The Logic Command is used to control the PowerFlex 7-Class drive (for example, start, stop, direction). It consists of one 16-bit word of output to the adapter from the network. The definitions of the bits in this word depend on the drive, and are shown in Appendix D.

The Logic Status is used to monitor the PowerFlex 7-Class drive (for example, operating state, motor direction). It consists of one 16-bit word of input from the adapter to the network. The definitions of the bits in this word depend on the drive, and are shown in Appendix D.

M

Master-Slave Hierarchy

An adapter configured for a master-slave hierarchy exchanges data with the master device. Usually, a network has one scanner which is the master device, and all other devices (for example, drives connected to EtherNet/IP adapters) are slave devices.

On a network with multiple scanners (called a multimaster hierarchy), each slave device must have a scanner specified as a master.

N

NVS (Non-Volatile Storage)

NVS is the permanent memory of a device. Devices such as the adapter and drive store parameters and other information in NVS so that they are not lost when the device loses power. NVS is sometimes called “EEPROM.”

P

PCCC (Programmable Controller Communications Command)

PCCC is the protocol used by some controllers to communicate with devices on a network. Some software products (for example, DriveExplorer and DriveExecutive) also use PCCC to communicate.

Peer-to-Peer Hierarchy

An adapter that is configured for a peer-to-peer hierarchy can exchange data with a device on the network that is not a scanner. This type of hierarchy can be set up so that a scanner configures or transmits data to one PowerFlex 7-Class drive which then sends the same configuration or data to other PowerFlex 7-Class drives on the network. To use a peer-to-peer hierarchy, you configure one adapter to transmit data (2 or 4 words) and one or more adapters to receive the data.

Ping

A message that is sent by a DPI product to its peripheral devices. They use the ping to gather data about the product, including whether it can receive messages and whether they can log in for control. On EtherNet/IP, a ping can be used to determine if a node exists.

PowerFlex 7-Class (Architecture Class) Drives

The Allen-Bradley PowerFlex 7-Class family of drives supports DPI and, at the time of publication, includes the PowerFlex 70, PowerFlex 700, PowerFlex 700H, PowerFlex 700S, PowerFlex 700L, and PowerFlex 7000.

PowerFlex 750-Series (Architecture Class) Drives

The Allen-Bradley PowerFlex 750-Series of drives supports DPI and, at the time of publication, includes the PowerFlex 753 and PowerFlex 755.

R

Reference/Feedback

The Reference is used to send a setpoint (for example, speed, frequency, torque) to the drive. It consists of one word of output to the adapter from the network. The size of the word (either a 16-bit word or 32-bit word) is determined by the drive.

Feedback is used to monitor the speed of the drive. It consists of one word of input from the adapter to the network. The size of the word (either a 16-bit word or 32-bit word) is determined by the drive.

RSLogix 5/500/5000

RSLogix software is a tool for configuring and monitoring controllers to communicate with connected devices. It is a 32-bit application that runs on various Windows operating systems. Information about RSLogix software can be found at http://www.software.rockwell.com/rslogix.

S

Scanner

A scanner is a separate module (of a multi-module controller) or a built-in component (of a single-module controller) that provides communication with adapters connected to a network. See also Controller.

Status Indicators

Status indicators are LEDs that are used to report the status of the adapter, network, and drive. They are on the adapter and can be viewed on the front cover of the drive when the drive is powered.

Subnet Mask

An extension to the IP addressing scheme that lets you use a single network ID for multiple physical networks. A bit mask identifies the part of the address that specifies the network and the part of the address that specifies the unique node on the network. A “1” in the subnet mask indicates the bit is used to specify the network. A “0” in the subnet mask indicates that the bit is used to specify the node.

For example, a subnet mask on a network may appear as follows: 11111111 11111111 11111111 11000000 (255.255.255.192). This mask indicates that 26 bits are used to identify the network and 6 bits are used to identify devices on each network. Instead of a single physical Class C network with 254 devices, this subnet mask divides it into four networks with up to 62 devices each.

Switches

Network devices that provide virtual connections that help to control collisions and reduce traffic on the network. They are able to reduce network congestion by transmitting packets to an individual port only if they are destined for the connected device. In a control application, in which real time data access is critical, network switches may be required in place of hubs.

T **TCP (Transmission Control Protocol)**

EtherNet/IP uses this protocol to transfer Explicit Messaging packets using IP. TCP guarantees delivery of data through the use of retries.

U **UDP (User Datagram Protocol)**

EtherNet/IP uses this protocol to transfer I/O packets using IP. UDP provides a simple, but fast capability to send I/O messaging packets between devices. This protocol ensures that adapters transmit the most recent data because it does not use acknowledgements or retries.

Z **Zero Data**

When communications are disrupted (for example, a cable is disconnected), the adapter and drive can respond with zero data. Zero data results in the drive receiving zero as values for Logic Command, Reference, and Datalink data. If the drive was running and using the Reference from the adapter, it will stay running but at zero Reference.

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LISTEN. THINK. SOLVE.®

PRODUCT PROFILE

Thermistor Monitors

Machine Alert Bulletin Number 817

Protective Functions

- Overtemperature

Advantages

- Microprocessor technology provides highly accurate and repeatable protection
- No adjustments required
- Wide supply voltage rating (24... 240V AC/DC) covers a broad range of applications
- Compact 22.5 mm Euronorm housings
- Global application with CE, CSA and UL approval
- Connection of up-to six PTC thermistors in series
- Type E2 offers unlimited storage of status in event of power failure
- Open and short circuit detection
- Short circuit protected signal input

Typical Applications

- VFD-Controlled Motors
- Transformers
- Bearings
- Heating Systems

Overview

The new MachineAlert family of dedicated function electronic motor protection relays offers state-of-the-art supplementary protective functions that are easily added and applied to motor control circuits. A full range of products exists to allow selective addition of motor protective enhancing functions to meet specific application requirements. The MachineAlert relays are an economical choice for protecting equipment investments and minimizing production downtime.

PRODUCT SELECTION

Feature	Cat. No. 817-E1	Cat. No. 817-E2
Automatic Reset	X	X
Manual Reset	–	X
Remote Reset	–	X
Power On Indication	X	X
Trip Indication	X	X
Trip Identification	X	X
Test Button	–	X

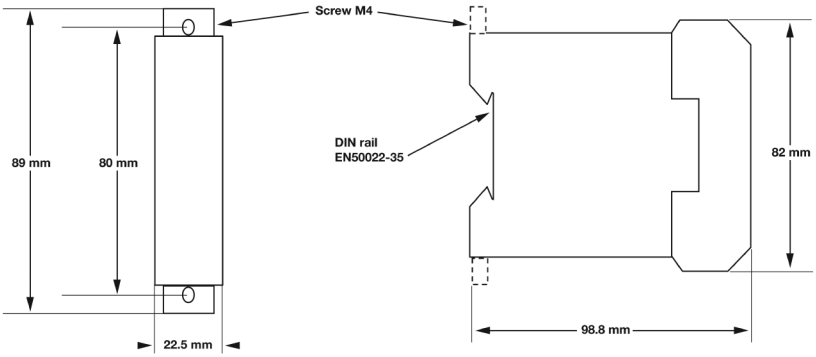
RELAY CONFIGURATION

	817-E1 1 Relay 1a 1b		817-E2 2 Relays each 1a	
	21/22	13/14	21/22	13/14
Power On	⅂	⅃	⅂	⅃
Tripped	⅃	⅂	⅃	⅂
Power Off	⅃	⅂	⅂	⅂

POWER/TRIP IDENTIFICATION

Power On	Green
Trip Temperature	Red
Trip Open Circuit (Sensor Wiring)	Red 2 Hz
Trip Short Circuit (Sensor Wiring)	Red Flashing

DIMENSIONAL DIAGRAMS



ELECTRICAL

Supply	
Rated Supply Voltage (Us)	24 . . . 240V AC/DC
Operating Range	AC: 0.8 . . . 1.1 Us DC: 0.9. . . 1.1 Us
Maximum Power Consumption	1.5 VA

Output Relay	
Type of Contacts	Type E1: (2) Form A, one relay Type E2: (2) Form A, independent relays
Rated Thermal Current	4 A
Rated Insulation Voltage	250V AC
Rated Operating Voltage	250V AC
Utilization Category	AC15/DC13

PTC Sensor Circuit	
Type of Control Unit	Mark A
PTC Sensor Characteristic	IEC 34-11-2
Max. Number of Sensors	6
Max. Cold Resistance of Sensor Chain	1500 ohm
Trip Resistance	3600 ohm (+/- 300 ohm):
Reset Resistance	1580 ohm (+/- 60 ohm):
Short Circuit Trip Resistance	<20 ohm (-5 ohm, +0 ohm):
Short Circuit Reset Resistance	24 ohm (-0 ohm, +6 ohm):
Open Circuit Trip Resistance	>20,000 ohm:

Measuring Line				
Minimum Cross Section (mm2)	0.5	0.75	1	1.5
Maximum Length (m)	200	300	400	600
	200 . . . 600m: twisted pair, shielded shield connection at r1			

Remote Reset	
Maximum Line Length	200 . . . 600m: twisted pair, shielded shield connection at r1

MECHANICAL

Environmental	
Ambient Temperature	-40C . . .+80C; (storage) -25C . . .+60C; (operating)
Humidity	5. . . 95% noncondensing
Maximum Altitude	2000 m
Pollution Environment	Pollution Degree 2
Degree of Protection	IP 20

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‡ NOTE: Information for this product line is available on the Industrial Controls Catalog web site: www.ab.com/catalogs.

Bulletin 140M Motor Protection Circuit Breakers

- Current Range 0.1…630 A
- UL Listed for Motor Loads
  - – Short Circuit Protection
  - – Overload Protection
- Visible Trip Indication
- High Current Limiting
- High Switching Capacity

The Bulletin 140M Motor Protection Circuit Breakers provide short circuit and overload protection for individual motor loads. Factory-installed internal accessories make installation and wiring easy.

Your order must include: cat. no. of the Motor Protection Circuit Breaker selected and, if required, cat. no. of any accessories.

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Standards Compliance

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IEC/EN 60204-1
CSA, C22.2 No.14
UL 508
UL 489

Certifications

CE Marked
cULus Listed (File No. E197878, E205542, Guide DIVQ/DIVQ7, NKJH/NKJH7)
CCC
CSA Certified

General Information

Motor Protection Circuit Breakers may provide the following protective and control functions.

- Disconnect for Motor Branch Circuit
- Branch-Circuit, Short-Circuit Protection (Magnetic Protection)
- Overload Protection (Thermal Protection)
- Switching (Manual)

In North America, electrical codes require that an individual Motor Branch Circuit be protected by a UL/CSA Listed Fuse, Circuit Breaker or Self-Protected Combination Motor Controller.

140M-C, D and F Frames:

The 140M-C, D and F frame Motor Protection Circuit Breakers may have 2 cULus Listings – as Manual, Self-Protected Combination Motor Controllers and as Manual Motor Controllers (with optional approvals for Motor Disconnect and Group Installation).

When UL/CSA listed as Manual, Self-Protected Combination Motor Controllers, the 140M Motor Protection Circuit Breakers provide all of the necessary NEC/CEC requirements for the protection and control of individual Motor Branch Circuits without additional protective devices.

At some higher voltages and currents (particularly at 600V), a few of the 140M-C, D and F frame devices are only UL/CSA Listed as Manual Motor Controllers (with optional approvals for Motor Disconnect and Group Installation). In NEC/CEC Group Installations, these devices must be applied per the appropriate rules which require the use of an upstream Branch-Circuit, Short-Circuit Protective Device (BCPD). See the table on page 2-17 for the specific ratings of each Motor Protection Circuit Breaker.

140-CMN Frame:

The 140-CMN frame Motor Protection Circuit Breakers are UL Listed/CSA Certified as Manual Motor Controllers (with optional approvals for Motor Disconnect and Group Installation). In NEC/CEC Group Installations, these devices must be applied per the appropriate rules which require the use of an upstream Branch-Circuit, Short-Circuit Protective Device (BCPD). See the table on page 2-17 for the specific ratings of each Motor Protection Circuit Breaker.

140M-I, J and L Frames:

The 140M-I, J and L frame Motor Protection Circuit Breakers are cULus Listed as Circuit Breakers as shown in the table on page 2-9. In these cases, the 140M Motor Protection Circuit Breakers provide all of the necessary NEC/CEC requirements for the protection and control of individual Motor Branch Circuits without additional protective devices.

For further details on the proper application of Motor Protection Circuit Breakers, please see the diagrams on the following pages.

	C-Frame	**D-Frame**	**F-Frame**	**CMN-Frame**	**I-Frame**	**J-Frame**	**L-Frame**
Max. Current I_e	25 A	25 A	45 A	90 A	205 A	250 A	630 A
Current Rating	0.1…25 A	1.6…25 A	6.3…45 A	16…90 A	40…205 A	20…250 A	100…630 A
Short Circuit Protection	✓	✓	✓	✓	✓	✓	✓
Standard Magnetic Trip	✓	✓	✓	✓	✓	✓	✓
High Magnetic Trip	✓	✓	✓	✓	—	—	—
Overload Protection	✓	✓	✓	✓	✓	✓	✓
Trip Class	10	10	10	10	5…20	10…30	10…30
Standards Compliance:							
CSA 22.2, No. 14	✓	✓	✓	✓	✓	✓	✓
CSA 22.2, No. 5	—	—	—	—	✓	✓	✓
UL 508 (Group Install.)	✓	✓	✓	✓	—	—	—
UL 508 Manual, Self Protected (Type E)	✓	✓	✓	—	—	—	—
UL 508 (Overload Protection)	✓	✓	✓	✓	✓	✓	✓
UL 489	—	—	—	—	✓	✓	✓
IEC 60947-1, -2	✓	✓	✓	✓	✓	✓	✓
IEC 60947-4-1	✓	✓	✓	✓	✓	✓	✓
CE	✓	✓	✓	✓	✓	✓	✓
ATEX	✓	✓	—	—	—	—	—
CCC	✓	✓	✓	—	—	—	—
Accessories							
Ext. Rotary Operator	✓	✓	✓	✓	✓	✓	✓
Flex Cable Operator	—	—	—	—	✓	✓	✓
Auxiliary Contacts	✓	✓	✓	✓	✓	✓	✓
Trip Indication Contacts	✓	✓	✓	✓	✓	✓	✓

Cat. No. Explanation

Examples given in this section are for reference purposes. This basic explanation should not be used for product selection; not all combinations will produce a valid catalog number.

140M – C – 2 – E – A63 – KN – CC – GJ

a b c d e f g h

2

a

Bulletin Number	
Code	Description
140M	Motor Protection Circuit Breakers (MPCBs)

b

Frame Size and Rating	
Code	Description
C	25 A
D	25 A
F	45 A
I	205 A
J	250 A
L	400 A and 600 A

c

Interrupting Rating / Breaking Capacity	
Code	Description
2	Normal Break
8	High Break

d

Protection Type	
Code	Description
E	Adj Thermal/ Fixed Mag (13 x In)
T	Adj Thermal / Fixed Mag (Fixed at 16...20 x In)

e

Current Range		
Code	Description	Example
A	A = .10	A16 = 0.16
B	B = 1.0	B16 = 1.6
C	C = 10	C16 = 16
D	D = 100	D16 = 160
E	E = 1000	E16 = 1600

f, g, h

Factory-Installed Options

f

Miscellaneous See page 2-33

g

Aux/Trip Contacts See page 2-33

h

UV and Shunt Trips See page 2-33

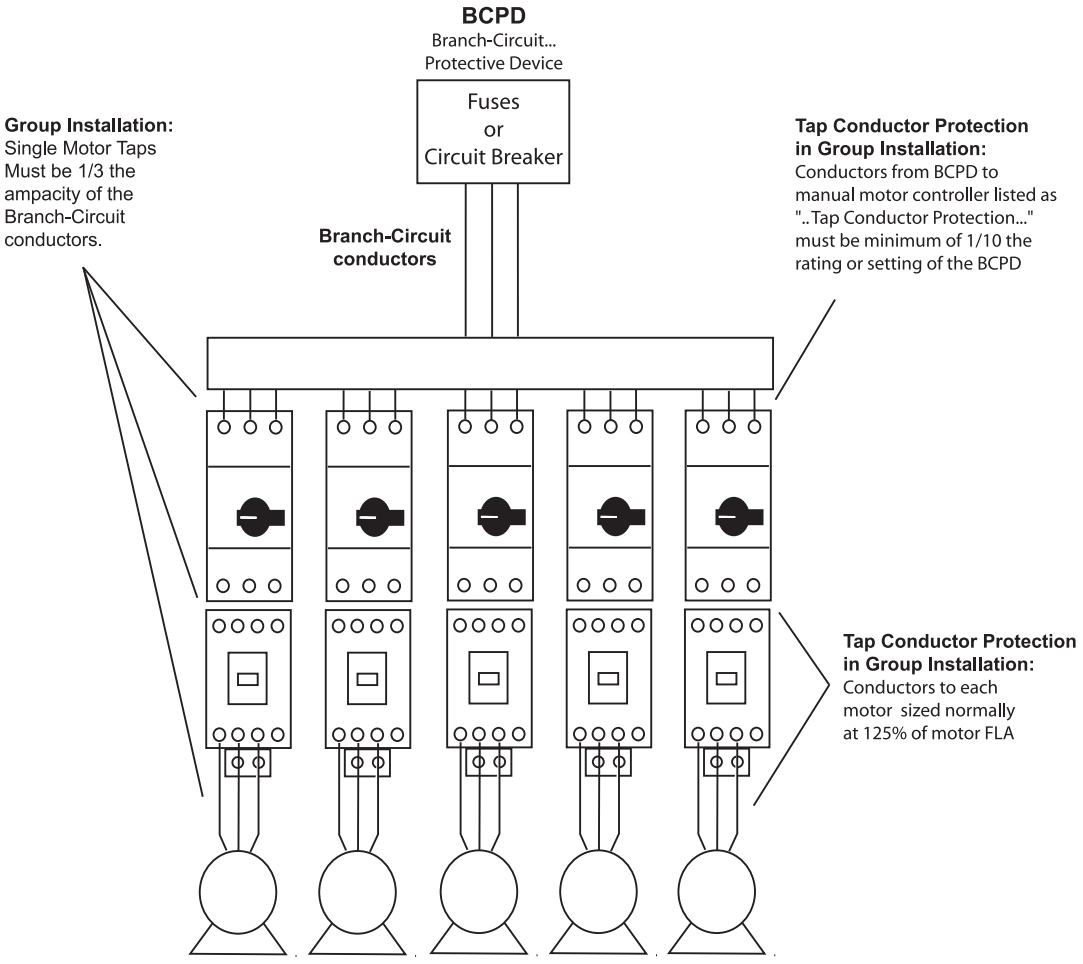
Group Installation with MPCBs

There is only one Branch Circuit Protective Device (BCPD) for the "Group"

Group Installation has been successfully used for many years in the U.S and Canada. It allows "two or more motors or one or more motors and other loads to be connected to the same branch-circuit...". The most restrictve part of the conditions specified for Group Installation is the requirement for the protection of the conductors for each motor circuit. In the U.S. NEC for 2002, a new rule for the conductor sizing was added for devices that are listed and marked "Suitable for use as Tap Conductor Protection". Below is an example that illustrates installations involving multiple motors with a single BCPD protecting the entire "Group".

Bulletin 140M Motor Protection Circuit Breakers UL/CSA listed for Group Installation
Conductors from the BCPD to each motor must be a minimum of 1/3 the ampacity of the Branch-Circuit conductors.

Bulletin 140M Motor Protection Circuit Breakers UL/CSA listed for Tap Conductor Protection in Group Installations.
Conductors from the BCPD to manual motor controller listed as "..Tap Conductor Protection..." must be minimum of 1/10 the rating or setting of the BCPD. Conductors from the controller to the motor must be 125% of the motor FLA.



Group Motor Installation

3-Phase Power Supply

Multiple Motor Installation with MPCBs

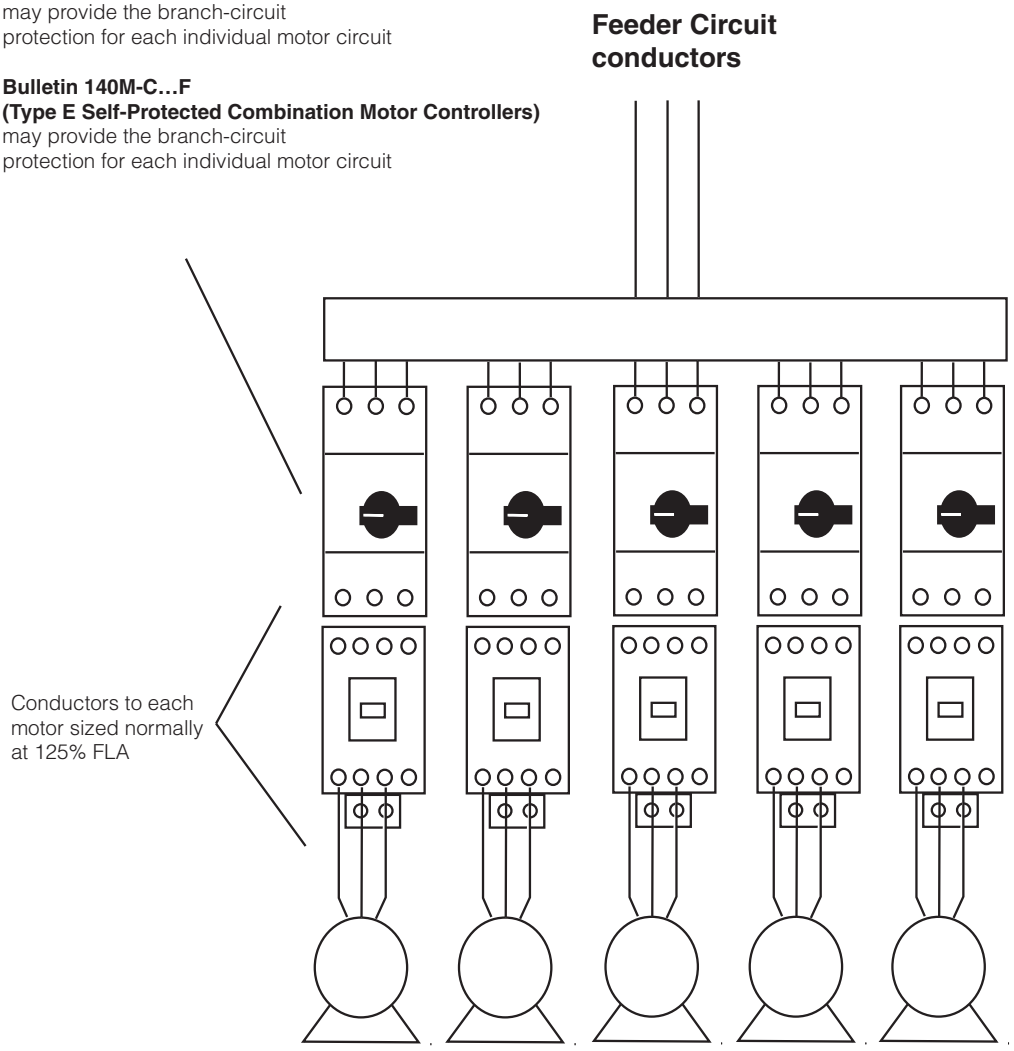
Each Motor has an Individual Branch Circuit Protective Device

Bulletin 140M Motor Protection Circuit Breakers (MPCBs) UL/CSA Listed as Type E Manual Self-Protected Combination Motor Controllers or UL/CSA Listed as Circuit Breakers

These UL/CSA Listings allow the Bulletin 140M MPCBs to provide the branch-circuit, short-circuit protection (as well as overload protection) for each individual motor circuit. Additional short-circuit protection is not required for the protection of the individual motor cuircuits, leaving only the requirement for protection of the feeder circuit conductors by an upstream protective device. Below is an example that illustrates installations involving multiple motors, each with its own branch-circuit protection (BCPD).

Bulletin 140M-J…L
(Inverse Time Circuit Breakers)
may provide the branch-circuit protection for each individual motor circuit

Bulletin 140M-C…F
(Type E Self-Protected Combination Motor Controllers)
may provide the branch-circuit protection for each individual motor circuit



Multi-Motor Installation

Type E and Type F Combination Motor Controllers

Most of the 140M-C…F motor protection circuit breakers are UL listed as a manual Type E self-protected combination motor controller. Although there are many tests involved, one of the critical tests a self-protected combination motor controller must pass, is to perform 6000 electrical ops. and an additional 4000 mechanical ops. after a short circuit.

By definition, a **Type F** combination motor controller consists of a Type E manual self protected combination motor controller and a magnetic or solid-state motor controller (such as a Bulletin 100-C contactor or an SMC). As with a manual Type E self-protected combination motor controller, additional short-circuit protection is not required for the individual motor circuits.

A combination of a Bulletin 140M manual self protected combination motor controller and 100-C contactor can be listed as a **Type E** self-protected combination motor controller. In this case, both the 140M and 100-C must pass the additional 6000 electrical and 4000 mechanical operational test. In some cases, this may require over sizing of the Bulletin 140M MPCB or the 100-C contactor to achieve weld free performance and meet the additional life requirements.

2

Product Selection — Motor Protection Circuit Breakers

- Short Circuit Protection — Standard Magnetic Trip (Fixed at 13 x I_e)
- Overload Protection — Trip Class 10

Cat. No. 140M-C

Cat. No. 140M-D

Cat. No. 140M-F

Cat. No. 140-CMN

Rated Operational Current (I_e) [A]	Motor Current Adjustment Range [A]	Magnetic Trip Current [A]	Ultimate Interrupting Current [kA] (I_{cu})		Max. 3-phase Hp Ratings*				Max. kW, 3-Phase*				Cat. No.
			400V	480V	200V	230V	460V	575V	230V	400/415V	500V	690V	
C-Frame													
0.16	0.10…0.16	2.1	100	65	—	—	—	—	—	0.02	—	—	**140M-C2E-A16**
0.25	0.16…0.25	3.3	100	65	—	—	—	—	—	0.06	—	—	**140M-C2E-A25**
0.4	0.25…0.40	5.2	100	65	—	—	—	—	—	0.09	—	—	**140M-C2E-A40**
0.63	0.40…0.63	8.2	100	65	—	—	—	—	0.09	0.18	0.18	0.25	**140M-C2E-A63**
1	0.63…1.0	13	100	65	—	—	0.5	0.75	0.12	0.25	0.37	0.55	**140M-C2E-B10**
1.6	1.0…1.6	21	100	65	—	—	1	1	0.25	0.55	0.75	1.1	**140M-C2E-B16**
2.5	1.6…2.5	33	100	65	0.5	0.75	1.5	2	0.37	0.75	1.1	1.8	**140M-C2E-B25**
4	2.5…4.0	52	100	65	1	1	3	3	0.75	1.5	2.2	3	**140M-C2E-B40**
6.3	4.0…6.3	82	100	65	1.5	2	5	5	1.5	2.2	3	4	**140M-C2E-B63**
10	6.3…10	130	100	65	3	3	7.5	10	2.2	4	6.3	7.5	**140M-C2E-C10**
16	10…16	208	50	30	5	5	10	15	4	7.5	10	13	**140M-C2E-C16**
20	14.5…20	260	15	30	5	7.5	15	20	5.5	10	11	17	**140M-C2E-C20**
25	18…25	325	15	25	7.5	7.5	15	20	—	11	15	22	**140M-C2E-C25**
D-Frame													
2.5	1.6…2.5	33	100	65	0.5	0.75	1.5	2	0.37	0.75	1.1	1.8	**140M-D8E-B25**
4	2.5…4.0	52	100	65	1	1	3	3	0.75	1.5	2.2	3	**140M-D8E-B40**
6.3	4.0…6.3	82	100	65	1.5	2	5	5	1.5	2.2	3	4	**140M-D8E-B63**
10	6.3…10	130	100	65	3	3	7.5	10	2.2	4	6.3	7.5	**140M-D8E-C10**
16	10…16	208	100	65	5	5	10	15	4	7.5	10	13	**140M-D8E-C16**
20	14.5…20	260	50	65	5	7.5	15	20	5.5	10	11	17	**140M-D8E-C20**
25	18…25	325	50	30	7.5	7.5	15	20	—	11	15	22	**140M-D8E-C25**
F-Frame													
10	6.3…10	130	65	65	3	3	7.5	10	2.2	4	6.3	7.5	**140M-F8E-C10**
16	10…16	208	65	65	5	5	10	15	4	7.5	10	13	**140M-F8E-C16**
20	14.5…20	260	65	65	5	7.5	15	20	5.5	10	11	17	**140M-F8E-C20**
25	18…25	325	65	65	7.5	10	20	25	6.3	11	15	22	**140M-F8E-C25**
32	23…32	416	65	65	7.5	10	25	30	7.5	15	20	25	**140M-F8E-C32**
45	32…45	585	65	65	10	15	30	40	13	22	30	40	**140M-F8E-C45**
CMN-Frame													
25	16…25	350	65	65	5	7.5	15	20	7.5	13	15	22	**140-CMN-2500**
40	25…40	560	65	65	10	10	30	30	11	22	25	30	**140-CMN-4000**
63	40…63	882	65	42	20	20	40	60	20	32	40	55	**140-CMN-6300**
90	63…90	1260	50	35	25	30	60	75	25	45	55	75	**140-CMN-9000**

* Horsepower/kW ratings shown in the table above are for reference. **The final selection of the MPCB depends on the actual motor full load current and, in North America, service factor.**

Visit our website: www.ab.com/catalogs
Preferred availability cat. nos. are printed in **bold**

Motor Protection Circuit Breakers

- Short Circuit Protection — Standard Magnetic Trip (Fixed at 12...15 x I_e)
- Overload Protection — Trip Class 10...30 (Adjustable)

Cat. No. 140M-I

Cat. No. 140M-J

Cat. No. 140M-L

Rated Operational Current [A] (I_e)	Motor Current Adjustment Range [A]	Magnetic Trip Current [A]	Ultimate Interrupting Current [kA] (I_{cm})		3-phase Hp Ratings∗				Max. kW, 3-Phase∗				Cat. No.
			400V	480V	200V	230V	460V	575V	230V	400/415 V	500V	690V	
I-Frame													
80	40…80	1200	70❄	65	25	30	60	75	22	37	55	75	**140M-I8E-C80❄‡**
100	80…100	1500	70❄	65	30	40	75	100	30	55	55	90	**140M-I8E-D10❄‡**
160	100…160	2400	70❄	65	50	60	125	150	45	75	110	132	**140M-I8E-D16❄‡**
205	160…205	2665	70❄	65	60	75	150	200	55	110	132	200	140M-I8E-D20❄§
J-Frame													
50	20…50	700	25	25	25	30	60	75	15	22	30	45	**140M-J2E-C50**
100	40…100	1400	25	25	30	40	75	100	30	55	55	90	**140M-J2E-D10**
160	64…160	2240	25	25	50	60	125	150	45	90	110	160	**140M-J2E-D16**
250	100…250	3500	25	25	75	100	200	250	55	132	160	250	**140M-J2E-D25**
50	20…50	700	70	65	25	30	60	75	15	22	30	45	**140M-J8E-C50**
100	40…100	1400	70	65	30	40	75	100	30	55	55	90	140M-J8E-D10
160	64…160	2240	70	65	50	60	125	150	45	90	110	160	**140M-J8E-D16**
250	100…250	3500	70	65	75	100	200	250	55	132	160	250	**140M-J8E-D25**
L-Frame													
250	100…250	3000	40	35	75	100	200	250	55	132	160	250	140M-L2E-D25
400	160…400	4800	40	35	125	150	300	400	132	200	250	400	**140M-L2E-D40**
630	250…630	7580	40	35	200	250	500	600	200	355	450	630	140M-L2E-D63
250	100…250	3000	70	65	75	100	200	250	55	132	160	250	140M-L8E-D25
400	160…400	4800	70	65	150	150	350	450	132	200	250	400	140M-L8E-D40
630	250…630	7560	70	65	200	250	500	600	200	355	450	630	140M-L8E-D63

∗ Horsepower/kW ratings shown in the table above are for reference. **The final selection of the MPCB depends on the actual motor full load current and, in North America, service factor.**

❄ For IEC approvals and CE marking, add an "E" to the end of the Cat. No. Example: 140M-18E-C80E.

‡ Overload Protection — adjustable Trip Class 5, 10, 15, or 20.

§ Overload Protection — fixed Trip Class 10.

Motor Protection Circuit Breakers

- Short Circuit Protection — High Magnetic Trip (Fixed at 16…20 x I_e)
- Overload Protection — Trip Class 10

Cat. No. 140M-C

Cat. No. 140M-D

Cat. No. 140M-F

Rated Operational Current [A] (I_e)	Motor Current Adjustment Range [A]	Magnetic Trip Current [A]	Ultimate Interrupting Current [kA] (I_{cm})		Max. 3-phase Hp Ratings∗				Max kW, 3-Phase∗				Cat. No.
			400V	480V	200V	230V	460V	575V	230V	400/415V	500V	690V	
C-Frame													
0.16	0.10…0.16	3.3	100	65	—	—	—	—	—	0.02	—	—	140M-C2T-A16
0.25	0.16…0.25	5.2	100	65	—	—	—	—	—	0.06	—	—	**140M-C2T-A25**
0.4	0.25…0.40	8.2	100	65	—	—	—	—	—	0.09	—	—	**140M-C2T-A40**
0.63	0.40…0.63	13	100	65	—	—	—	—	0.09	0.18	0.18	0.25	**140M-C2T-A63**
1	0.63…1.0	21	100	65	—	—	0.5	0.75	0.12	0.25	0.37	0.55	**140M-C2T-B10**
1.6	1.0…1.6	33	100	65	—	—	1	1	0.25	0.55	0.75	1.1	**140M-C2T-B16**
2.5	1.6…2.5	52	100	65	0.5	0.75	1.5	2	0.37	0.75	1.1	1.8	**140M-C2T-B25**
4	2.5…4	82	100	65	1	1	3	3	0.75	1.5	2.2	3	**140M-C2T-B40**
6.3	4…6.3	130	100	65	1.5	2	5	5	1.5	2.2	3	4	**140M-C2T-B63**
10	6.3…10	208	50	30	3	3	7.5	10	2.2	4	6.3	7.5	**140M-C2T-C10**
16	10…16	260	15	30	5	5	10	15	4	7.5	10	13	**140M-C2T-C16**
D-Frame													
16	10…16	260	50	65	5	5	10	15	4	7.5	10	13	**140M-D8T-C16**
20	14.5…20	325	50	30	5	7.5	15	20	5.5	10	11	17	**140M-D8T-C20**
F-Frame													
25	18…25	416	65	65	7.5	10	20	25	6.3	11	15	22	**140M-F8T-C25**
32	23…32	585	65	65	7.5	10	25	30	7.5	15	20	25	**140M-F8T-C32**

∗ Horsepower/kW ratings shown in the table above are for reference. **The final selection of the MPCB depends on the actual motor full load current and, in North America, service factor.**

Bulletin 140M Motor Circuit Protectors

- Current range 0.16…1200 A
- UL Listed/Recognized for motor loads
  - – Short-circuit protection
  - – Overload protection must be provided separately
- Visible trip indication
- High current limiting
- High switching capacity

The Bulletin 140M Motor Circuit Protectors provide short circuit protection for individual motor loads. Factory-installed internal accessories make installation and wiring easy.

Certifications (0.16…45 A)

cULus Listed (File No. E54612, Guide No. NLRV, NLRV7)
CCC
CE Marked

Certifications (3…1200 A)

UR Recognized component (File No. E224135, Guide DKPU2)
CSA Certified (Cleass No. 3211-07)

Table of Contents

Product Selection — Motor Circuit Protectors 2-15
Approximate Dimensions..... 2-49

Standards Compliance

IEC/EN 60947-1, 2, -4-1, -5-1
IEC/EN 60204-1
CSA, C22.2 No.14
UL 508
UL 489

Your order must include: cat. no. of the Motor Circuit Protector selected and, if required, cat. no. of any accessories.

2

General Information

Motor Circuit Protectors may provide the following protective and control functions.

- Disconnect for Motor Branch Circuit
- Branch-Circuit, Short-Circuit Protection (Magnetic Protection)
- Switching (Manual)

In North America, electrical codes require that an individual Motor Branch Circuit be protected by a UL/CSA Listed Fuse, Circuit Breaker or Self-Protected Combination Motor Controller.

140M-C, D and F Frames:

The 140M-C, D and F frame Motor Circuit Protectors have one UL/CSA Listing – as Manual Motor Controllers (with optional approvals for Motor Disconnect and Group Installation). In NEC/CEC Group Installations, these devices must be applied per the appropriate rules which require the use of an upstream Branch-Circuit, Short-Circuit Protective Device (BCPD). See the table on page 2-19 for the specific ratings of each Motor Circuit Protector.

The 140M-C, D and F Frame Motor Circuit Protectors are also UL/CSA Listed, together with a Bulletin 100C contactor and Bulletin 193 overload relay, as part of our Bulletin 103T and 107T Self-Protected IEC Combination Starters. These starters are then able to provide all of the necessary NEC/CEC requirements for the protection and control of individual Motor Branch Circuits without additional protective devices.

140M-H, J and L Frames:

The 140M-H, J and L frame Motor Circuit Protectors are UL/CSA Recognized as Circuit Breakers as shown in the table on page 2-19. They are UL/CSA Recognized, rather than UL/CSA Listed, since they only provide short circuit protection and not thermal overload protection for the motor.

140M-H, J and L frame Motor Circuit Protectors (MCPs) are also UL/CSA Listed, together with a Bulletin 100C contactor and Bulletin 193 overload relay, as part of our Bulletin 113 IEC Combination Starters. These starters are then able to provide all of the necessary NEC/CEC requirements for the protection and control of individual Motor Branch Circuits without additional protective devices.

Product Line Overview

	C-Frame	D-Frame	F-Frame	H-Frame	J-Frame	L-Frame	N-Frame
Max. Current I_e	25 A	25 A	45 A	100 A	250 A	600 A	1200 A
Current Rating	0.16…2.5 A	2.5…25 A	25…45 A	3…100	70…250	125…600	640…1200
Short Circuit Protection	✓	✓	✓	✓	✓	✓	✓
Standards Compliance:							
CSA 22.2, No. 14	✓	✓	✓				
CSA 22.2, No. 5	—	—	—	✓	✓	✓	✓
UL 508 (Group Install.)	✓	✓	✓				
UL489 (Recognized)	—	—	—	✓	✓	✓	✓
IEC 60947-2	✓	✓	✓	✓	✓	✓	✓
CE	✓	✓	✓	✓	✓	✓	✓
CCC	✓	✓	✓	—	—	—	—
Accessories							
Ext. Rotary Operator	✓	✓	✓	✓	✓	✓	✓
Flex Cable Operator	—	—	—	✓	✓	✓	✓
Auxiliary Contacts	✓	✓	✓	✓	✓	✓	✓
Trip Indication Contacts	✓	✓	✓	✓	✓	✓	✓

Cat. No. Explanation

Examples given in this section are for reference purposes. This basic explanation should not be used for product selection; not all combinations will produce a valid catalog number.

140M	–	C	–	2	–	N	–	A63	–	KN	–	CC	–	GJ
		a		*b*		*c*		*d*		*e*		*f*		*g*		*h*

a

Bulletin Number	
Code	Description
140M	Motor Circuit Protectors (MCPs)

b

Frame Size and Rating	
Code	Description
C	25 A
D	25 A
F	45 A
H	125 A
J	250 A
L	400 A and 600 A
N	800 A and 1200 A

c

Interrupting Rating / Breaking Capacity (I_c at 480V)	
Code	Description
2	Normal Break
8	High Break

d

Protection Type	
Code	Description
N	Fixed Mag Only (13 x In)
P	Adj Mag Only (less than 13 x In)- MCPs
R	Adj Mag Only (greater than 13 x In) - MCP's

e

Current Range		
Code	Description	Example
A	A = .10	A16 = 0.16
B	B = 1.0	B16 = 1.6
C	C = 10	C16 = 16
D	D = 100	D16 = 160
E	E = 1000	E16 = 1600

f, g, h

Factory-Installed Options

f

Miscellaneous See page 2-33

g

Aux/Trip Contacts See page 2-33

h

UV and Shunt Trips See page 2-33

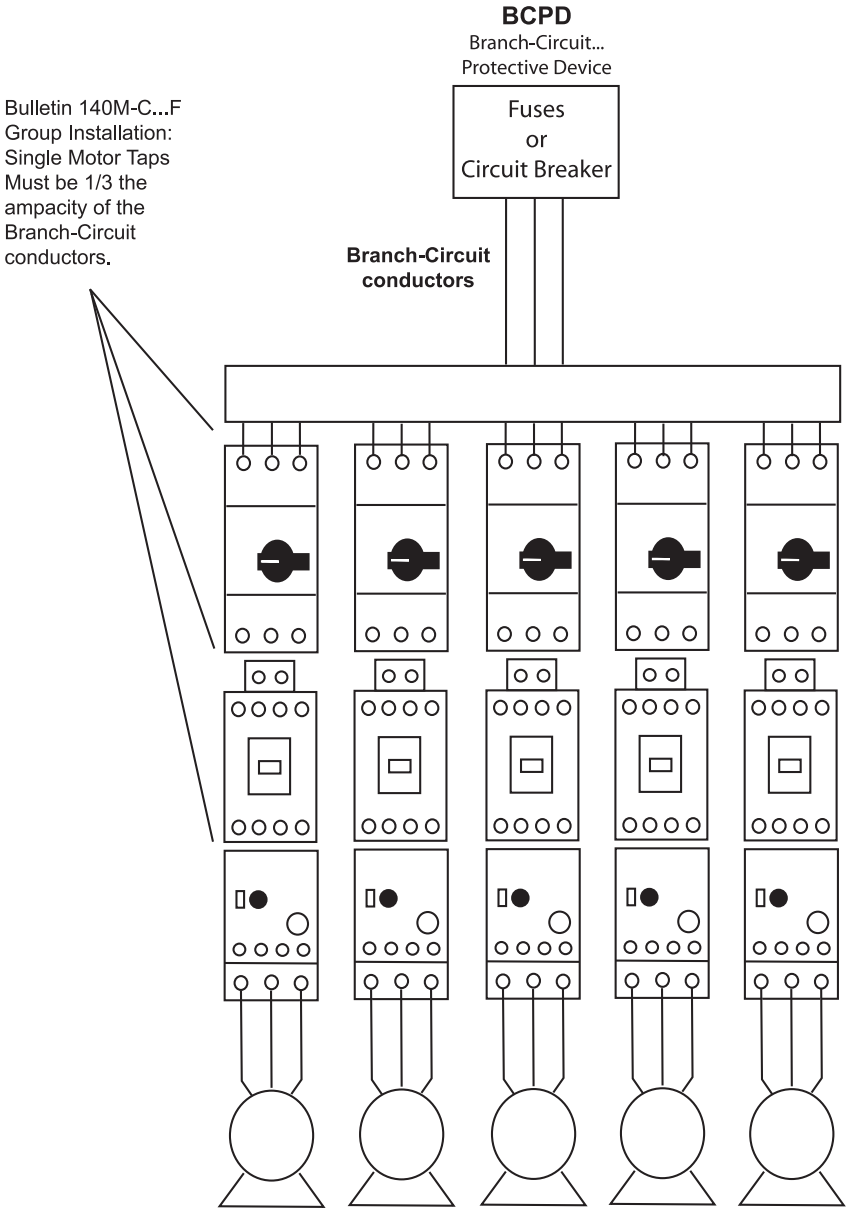
Group Installation with MCPs

There is only one Branch Circuit Protective Device (BCPD) for the "Group"

Group Installation has been successfully used for many years in the U.S and Canada. It allows "two or more motors or one or more motors and other loads to be connected to the same branch-circuit...". The most restrictve part of the conditions specified for Group Installation is the requirement for the protection of the conductors for each motor circuit.
Below is an example that illustrates installations involving multiple motors with a single BCPD protecting the entire "Group".

Bulletin 140M Motor Circuit Protectors UL/CSA listed for Group Installation

Conductors from the BCPD to each motor must be a minimum of 1/3 the ampacity of the Branch-Circuit conductors.
Motor Circuit Protectors do not provide thermal protection, so a separate Overload Relay must be used.
Therefore, MCP's cannot be UL/CSA listed for Tap Conductor Protection in Group Installations.



Group Motor Installation

3-Phase Power Supply

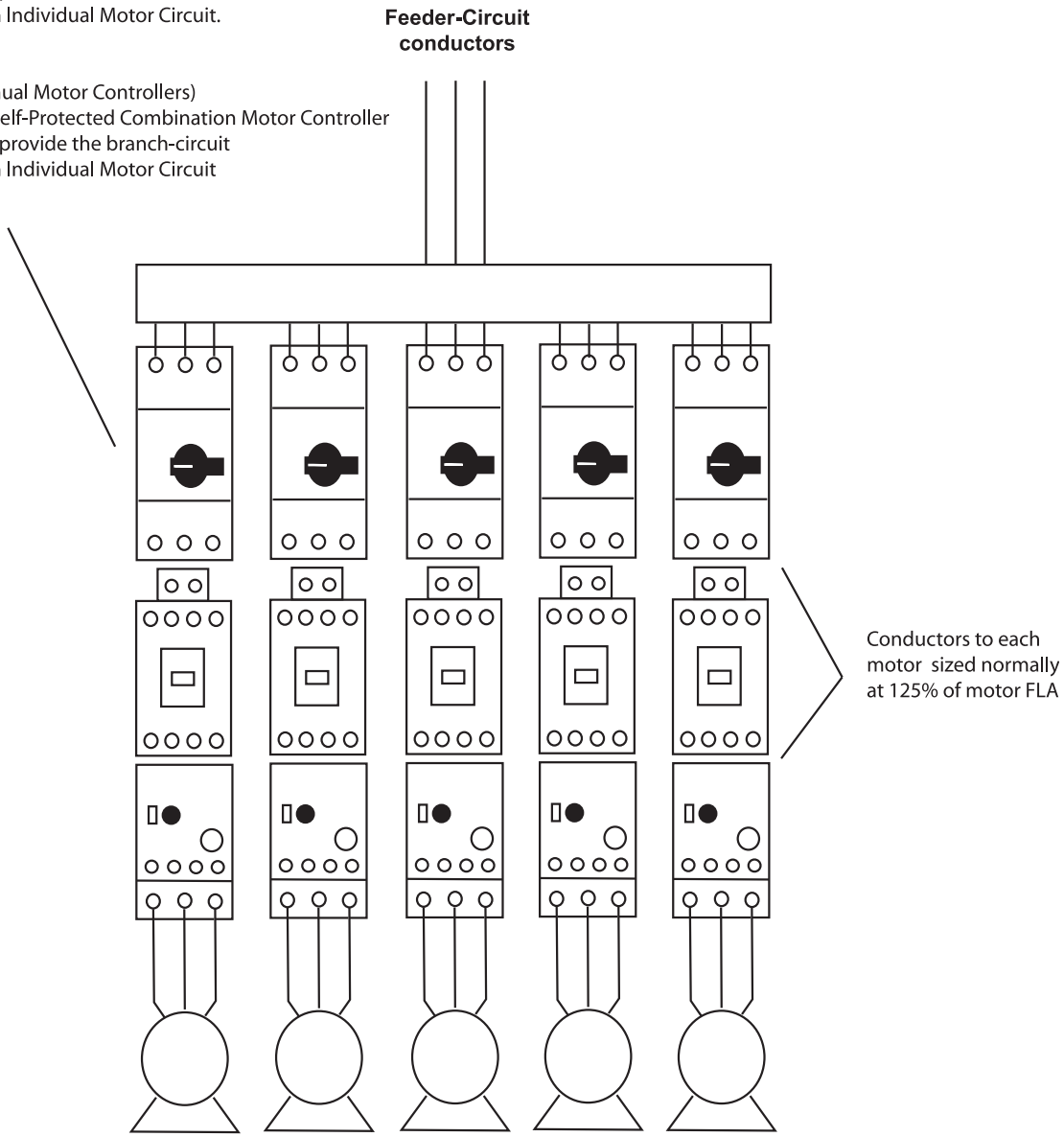
Multiple Motor Installation with MCPs

Each Motor has an Individual Branch Circuit Protective Device (BCPD)

Bulletin140M Motor Circuit Protectors are UL/CSA listed as part of a Combination Motor Controller or a Self-Protected Combination Motor Controller consisting of a 140M Motor Circuit Protector, a 100C Contactor and a 193 Overload Relay.
These UL/CSA listings allow the Bulletin 140M MCP's to provide the branch-circuit, short-circuit protection for each individual motor circuit. Additional short-circuit protection is not required for the protection of the individual motor circuits, leaving only the requirement for protection of the Feeder-Circuit conductors by an upstream protective device.
Below is an example that illustrates installations involving multiple motors, each with their own branch-circuit protection (BCPD).

Bulletin 140M-H..N
(UL/CSA recognized Instantaneous Trip Circuit Breakers)
As part of a listed Combination Motor Controller
these devices may provide the branch-circuit
protection for each Individual Motor Circuit.

Bulletin 140M-C..F
(UL/CSA listed Manual Motor Controllers)
As part of a listed Self-Protected Combination Motor Controller
these devices may provide the branch-circuit
protection for each Individual Motor Circuit



Multi-Motor Installation

Motor Circuit Protectors

- Short-circuit protection — standard magnetic trip (fixed at 13 x I_e)
- Overload protection — none (magnetic trip only)
- For Trip Class 10 motor applications‡

Cat. No. 140M-C

Cat. No. 140M-D

Cat. No. 140M-F

Rated Operational Current [A] (I_e)	Magnetic Trip Current [A]	Ultimate Interrupting Current [kA], (I_{cm})		Max. 3-phase Hp Ratings[1]				3-phase kW Ratings∗				Cat. No.
		400V	480V	200V	230V	460V	575V	230V	400/415V	500V	690V	
C-Frame												
0.16	2.1	100	65	—	—	—	—	—	0.02	—	—	140M-C2N-A16
0.25	3.3	100	65	—	—	—	—	—	0.06	—	—	**140M-C2N-A25**
0.4	5.2	100	65	—	—	—	—	—	0.09	—	—	**140M-C2N-A40**
0.63	8.2	100	65	—	—	—	—	0.09	0.18	0.18	0.25	**140M-C2N-A63**
1	13	100	65	—	—	0.5	0.75	0.12	0.25	0.37	0.55	**140M-C2N-B10**
1.6	21	100	65	—	—	1	1	0.25	0.55	0.75	1.1	**140M-C2N-B16**
2.5	33	100	65	0.5	0.75	1.5	2	0.37	0.75	1.1	1.8	**140M-C2N-B25**
D-Frame												
2.5	33	100	65	0.5	0.75	1.5	2	0.37	0.75	1.1	1.8	**140M-D8N-B25**
4	52	100	65	1	1	3	3	0.75	1.5	2.2	3	**140M-D8N-B40**
6.3	82	100	65	1.5	2	5	5	1.5	2.2	3	4	**140M-D8N-B63**
10	130	100	65	3	3	7.5	10	2.2	4	6.3	7.5	**140M-D8N-C10**
16	208	100	65	5	5	10	15	4	7.5	10	13	**140M-D8N-C16**
25	325	50	65	7.5	7.5	15	20	—	11	15	22	**140M-D8N-C25**
F-Frame												
25	325	65	65	7.5	10	20	25	6.3	11	15	22	**140M-F8N-C25**
32	416	65	65	7.5	10	25	30	7.5	15	20	25	**140M-F8N-C32**
45	585	65	65	10	15	30	40	13	22	30	40	**140M-F8N-C45**

∗ Horsepower/kW ratings shown in the table above are for reference. **The final selection of the manual starter depends on the actual motor full load current and, in North America, service factor.**

‡ For heavy-duty starting applications (exceeding Trip Class 10), please consult your local Rockwell Automation sales office or Allen-Bradley distributor.

Motor Circuit Protectors

- Short-Circuit Protection — Magnetic Trip (Adjustable at 3...10 x I_e)
- Overload Protection — None (Magnetic Trip Only)

Cat. No. 140M-H

Cat. No. 140M-J

Cat. No. 140M-L

Rated Operational Current [A] (I_e)	Magnetic Trip Current [A] Cam Setting									3-phase Hp Ratings∗				3-phase kW Ratings∗				Cat. No.❄
	A	B	C	D	E	F	G	H	I	200V	230V	460V	575V	230V	400/ 415V	500V	690V	
H-Frame																		
3	9	15	21	27	30	33	—	—	—	0.5	0.5	1.5	2	0.6	0.75	1.1	1.5	**140M-H8P-B30**
7	21	35	49	63	70	77	—	—	—	1.5	2	3	5	1.1	2.2	3	4	**140M-H8P-B70**
15	45	75	100	135	150	165	—	—	—	3	3	10	10	3	5.5	7.5	11	**140M-H8P-C15**
30	90	150	210	270	300	330	—	—	—	7.5	10	20	25	5.5	11	15	22	**140M-H8P-C30**
50	150	250	350	450	500	550	—	—	—	15	15	30	40	11	22	22	37	**140M-H8P-C50**
70	210	350	490	630	700	770	—	—	—	20	25	50	60	15	30	37	55	**140M-H8P-C70**
100	300	500	700	900	1000	1100	—	—	—	25	30	60	75	22	45	55	75	**140M-H8P-D10**
100	500	700	900	1100	1300	1500	—	—	—	30	30	75	100	30	55	75	110	**140M-H8R-D10**
J-Frame																		
100	500	600	700	800	900	1000	—	—	—	30	30	75	100	22	37	45	55	**140M-J8P-D10**
125	625	750	875	1000	1125	1250	—	—	—	40	40	100	125	22	45	55	90	**140M-J8P-D12**
150	750	900	1050	1200	1350	1500	—	—	—	50	50	100	150	30	55	75	110	**140M-J8P-D15**
175	875	1050	1225	1400	1575	1750	—	—	—	50	60	125	150	37	55	90	132	**140M-J8P-D17**
200	1000	1200	1400	1600	1800	2000	—	—	—	60	75	150	200	45	75	90	132	**140M-J8P-D20**
225	1125	1350	1575	1800	2025	2250	—	—	—	75	75	150	200	55	90	110	160	**140M-J8P-D22**
250	1250	1500	1750	2000	2250	2500	—	—	—	75	100	200	250	55	90	132	160	**140M-J8P-D25**
L-Frame																		
225	1125	1265	1410	1545	1690	1830	1970	2110	2250	50	60	125	150	55	90	110	160	**140M-L8P-D22**
250	1250	1405	1560	1720	1875	2030	2185	2340	2500	60	75	150	200	55	90	132	160	140M-L8P-D25
300	1500	1690	1875	2060	2250	2440	2625	2810	3000	75	75	150	200	55	110	160	200	**140M-L8P-D30**
350	1750	1970	2190	2410	2625	2840	3065	3285	3500	75	100	200	250	75	132	160	250	**140M-L8P-D35**
400	2000	2250	2500	2750	3000	3250	3500	3750	4000	100	100	250	300	90	160	200	250	140M-L8P-D40
450	2250	2530	2810	3098	3375	3660	3940	4220	4500	100	125	250	350	110	160	200	315	140M-L8P-D45
500	2500	2810	3125	3440	3750	4660	4375	4690	5000	125	150	300	400	110	200	250	355	140M-L8P-D50
600	3000	3375	3760	4110	4500	4880	5250	5630	6000	150	150	350	450	132	250	315	450	140M-L8P-D60
N-Frame																		
800	1600	2400	3200	4000	4800	5600	6400	—	—	150	200	400	500	160	250	355	500	140M-N8P-D80
1200	2400	3600	4800	6000	7200	8400	9600	—	—	250	300	600	700	200	250	500	710	140M-N8P-E12

∗ The Hp and kW ratings shown are for reference only. They allow for a magnetic trip setting of at least up to 13X the motor FLA. However, the final selection of the MCP should be made based on motor full load current and the requirements of local electrical codes.

❄ The interrupting rating for MCPs is dependent upon the controller used. Please contact your local Rockwell Automation sales office or Allen-Bradley distributor

UL/CSA Listed Application Ratings — Motor Protection Circuit Breaker (MPCB) Only

Cat. No.	UL 508 — Manual Motor Controller							UL 508 Self-Protected (Type E) Combination Motor Controller		UL 489 Inverse Time C.B. w/UL 508 Motor Overload Protection	
	Group Motor Installation			Motor Disconnect		Tap Conductor Protection					
	Max. Fuse or C.B. per NEC	Max. Short Circuit Current [kA]		Max. Short Circuit Current [kA]		Max. Short Circuit Current [kA]		Max. Short Circuit Current [kA]		Max. Short Circuit Current [kA]	
		480V	600V	480V	600V	480V	600V	480Y/277V‡	600Y/347V‡	480V	600V
C-Frame											
140M-C2E-A16	450	65	47	65	47	65	47	65	47	—	—
140M-C2E-A25	450	65	47	65	47	65	47	65	47	—	—
140M-C2E-A40	450	65	47	65	47	65	47	65	47	—	—
140M-C2E-A63	450	65	47	65	47	65	47	65	47	—	—
140M-C2E-B10	450	65	47	65	47	65	47	65	47	—	—
140M-C2E-B16	450	65	47	65	47	65	47	65	47	—	—
140M-C2E-B25	450	65	30	65	30	65	30	65	30	—	—
140M-C2E-B40	450	65	25	65	25	65	25	65	25	—	—
140M-C2E-B63	450	65	30	65	30	65	—	65	—	—	—
140M-C2E-C10	450	65	30	65	30	65	—	65	—	—	—
140M-C2E-C16	450	30	30	30	30	30	—	30	—	—	—
140M-C2E-C20	450	30	30	10	10	10	—	10	—	—	—
140M-C2E-C25	450	25	10	10	5	—	—	—	—	—	—
D-Frame											
140M-D8E-B25	450	65	30	65	30	65	30	65	30	—	—
140M-D8E-B40	450	65	30	65	30	65	30	65	30	—	—
140M-D8E-B63	450	65	30	65	30	65	30	65	30	—	—
140M-D8E-C10	450	65	30	65	30	65	30	65	30	—	—
140M-D8E-C16	450	65	30	65	30	65	30	65	30	—	—
140M-D8E-C20	450	65	30	65	30	65	—	65	—	—	—
140M-D8E-C25	450	30	30	30	30	30	—	30	—	—	—
F-Frame											
140M-F8E-C10	600	65	30	65	30	65	30	65	30	—	—
140M-F8E-C16	600	65	30	65	30	65	30	65	30	—	—
140M-F8E-C20	600	65	30	65	30	65	30	65	30	—	—
140M-F8E-C25	600	65	30	65	30	65	30	65	30	—	—
140M-F8E-C32	600	65	30	65	30	65	30	65	30	—	—
140M-F8E-C45	600	65	18	65	18	65	—	65	—	—	—
CMN-Frame											
140-CMN-2500	1000	65	42	—	—	—	—	—	—	—	—
140-CMN-4000	1000	65	42	—	—	—	—	—	—	—	—
140-CMN-6300	1000	42	18	—	—	—	—	—	—	—	—
140-CMN-9000	1000	35	10	—	—	—	—	—	—	—	—
I-Frame											
140M-I8E-C80	—	—	—	—	—	—	—	—	—	65	30
140M-I8E-D10	—	—	—	—	—	—	—	—	—	65	30
140M-I8E-D16	—	—	—	—	—	—	—	—	—	65	30
140M-I8E-D20	—	—	—	—	—	—	—	—	—	65	30
J-Frame											
140M-J2E-C50	—	—	—	—	—	—	—	—	—	25	18
140M-J2E-D10	—	—	—	—	—	—	—	—	—	25	18
140M-J2E-D16	—	—	—	—	—	—	—	—	—	25	18
140M-J2E-D25	—	—	—	—	—	—	—	—	—	25	18
140M-J8E-C50	—	—	—	—	—	—	—	—	—	65	25
140M-J8E-D10	—	—	—	—	—	—	—	—	—	65	25
140M-J8E-D16	—	—	—	—	—	—	—	—	—	65	25
140M-J8E-D25	—	—	—	—	—	—	—	—	—	65	25
L-Frame											
140M-L2E-D25	—	—	—	—	—	—	—	—	—	25	18
140M-L2E-D40	—	—	—	—	—	—	—	—	—	25	18
140M-L2E-D60	—	—	—	—	—	—	—	—	—	25	18
140M-L2E-D63	—	—	—	—	—	—	—	—	—	25	18
140M-L8E-D25	—	—	—	—	—	—	—	—	—	65	25
140M-L8E-D40	—	—	—	—	—	—	—	—	—	65	25
140M-L8E-D60	—	—	—	—	—	—	—	—	—	65	25
140M-L8E-D63	—	—	—	—	—	—	—	—	—	65	25

‡ For full voltage (delta) ratings above 277V or 347V, follow the NEC or CEC rules for group motor applications.

UL/CSA Listed Application Ratings — Motor Protection Circuit Breaker (MPCB) Only, Continued

Cat. No.	UL 508 Manual Motor Controller							UL 508 Self-Protected (Type E) Combination Motor Controller	
	Group Motor Installation			Motor Disconnect		Tap Conductor Protection			
	Max. Fuse or C.B. per NEC	Max. Short Circuit Current [kA]		Max. Short Circuit Current [kA]		Max. Short Circuit Current [kA]		Max. Short Circuit Current [kA]	
		480V	600V	480V	600V	480V	600V	480Y/277V‡	600Y/347V‡
C-Frame									
140M-C2T-A16	450	65	47	65	47	65	47	65	47
140M-C2T-A25	450	65	47	65	47	65	47	65	47
140M-C2T-A40	450	65	47	65	47	65	47	65	47
140M-C2T-A63	450	65	47	65	47	65	47	65	47
140M-C2T-B10	450	65	47	65	47	65	47	65	47
140M-C2T-B16	450	65	47	65	47	65	30	65	30
140M-C2T-B25	450	65	25	65	25	65	25	65	25
140M-C2T-B40	450	65	30	65	30	65	—	65	—
140M-C2T-B63	450	65	30	65	30	65	—	65	—
140M-C2T-C10	450	30	30	30	30	30	—	30	—
140M-C2T-C16	450	30	30	10	10	10	—	10	—
D-Frame									
140M-D8T-C16	450	65	30	65	30	65	30	65	30
140M-D8T-C20	450	30	30	30	30	30	—	30	—
F-Frame									
140M-F8T-C25	600	65	30	65	30	65	30	65	30
140M-F8T-C32	600	65	18	65	18	65	18	65	18

‡ For full voltage (delta) ratings above 277V or 347V, follow the NEC or CEC rules for group motor applications.

UL Listed Application Ratings — Motor Circuit Protectors Only§

Cat. No.	Manual Motor Controller					UL 489 Instantaneous Trip Circuit Breaker (Magnetic Only)	
	Group Motor Installation			Motor Disconnect		Motor Circuit Protector	
	Max. Fuse or C.B. per NEC	Max. Short Circuit Current [kA]		Max. Short Circuit Current [kA]		Max. Short Circuit Current [kA]‡	
		480V	600V	480V	600V	480V	600V
C-Frame							
140M-C2N-A16	450	65	47	65	47	—	—
140M-C2N-A25	450	65	47	65	47	—	—
140M-C2N-A40	450	65	47	65	47	—	—
140M-C2N-A63	450	65	47	65	47	—	—
140M-C2N-B10	450	65	47	65	47	—	—
140M-C2N-B16	450	65	47	65	47	—	—
140M-C2N-B25	450	65	30	65	30	—	—
D-Frame							
140M-D8N-B25	450	65	30	65	30	—	—
140M-D8N-B40	450	65	30	65	30	—	—
140M-D8N-B63	450	65	30	65	30	—	—
140M-D8N-C10	450	65	30	65	30	—	—
140M-D8N-C16	450	65	30	65	30	—	—
140M-D8N-C25	450	30	30	30	30	—	—
F-Frame							
140M-F8N-C25	600	65	30	65	30	—	—
140M-F8N-C32	600	65	30	65	30	—	—
140M-F8N-C45	600	65	18	65	18	—	—
H-Frame							
140M-H8P-B30	—	—	—	—	—	65	25
140M-H8P-B70	—	—	—	—	—	65	25
140M-H8P-C15	—	—	—	—	—	65	25
140M-H8P-C30	—	—	—	—	—	65	25
140M-H8P-C50	—	—	—	—	—	65	25
140M-H8P-C70	—	—	—	—	—	65	25
140M-H8P-D10	—	—	—	—	—	65	25
140M-H8R-D10	—	—	—	—	—	65	25
J-Frame							
140M-J8P-C70	—	—	—	—	—	65	25
140M-J8P-C90	—	—	—	—	—	65	25
140M-J8P-D10	—	—	—	—	—	65	25
140M-J8P-D12	—	—	—	—	—	65	25
140M-J8P-D15	—	—	—	—	—	65	25
140M-J8P-D17	—	—	—	—	—	65	25
140M-J8P-D20	—	—	—	—	—	65	25
140M-J8P-D22	—	—	—	—	—	65	25
140M-J8P-D25	—	—	—	—	—	65	25
L-Frame							
140M-L8P-D22	—	—	—	—	—	65	25
140M-L8P-D25	—	—	—	—	—	65	25
140M-L8P-D30	—	—	—	—	—	65	25
140M-L8P-D35	—	—	—	—	—	65	25
140M-L8P-D40	—	—	—	—	—	65	25
140M-L8P-D45	—	—	—	—	—	65	25
140M-L8P-D50	—	—	—	—	—	65	25
140M-L8P-D60	—	—	—	—	—	65	25
N-Frame							
140M-N8P-D80	—	—	—	—	—	65	35
140M-N8P-E12	—	—	—	—	—	65	35

§ Separate overload protection is required.
‡ The interrupting rating for MCPs is dependent upon the controller used. Contact your local Rockwell Automation sales office or Allen-Bradley distributor for further information.

UL Listed Application Ratings - Motor Protection Circuit Breakers with Bulletin 100-C Contactors

Cat. No.	UL 508 Manual Motor Controller						UL 508 Type F Combination Motor Controller			UL 508 Type E Self-Protected Combination Motor Controller		
	Group Motor Installation				Motor Disconnect							
	Max. Fuse or C.B. per NEC	Minimum Contactor Size	Max. Short Circuit Current [kA]		Max. Short Circuit Current [kA]		Minimum Contactor Size	Max. Short Circuit Current [kA]		Minimum Contactor Size	Max. Short Circuit Current [kA]	
			480V	600V	480V	600V		480Y/277V§	600Y/347V§		480Y/277V§	600Y/347V§
C-Frame												
140M-C2E-A16	450	100-C09	65	47	65	47	100-C09	65	47	100-C09	65	47
140M-C2E-A25	450	100-C09	65	47	65	47	100-C09	65	47	100-C09	65	47
140M-C2E-A40	450	100-C09	65	47	65	47	100-C09	65	47	100-C09	65	47
140M-C2E-A63	450	100-C09	65	47	65	47	100-C09	65	47	100-C09	65	47
140M-C2E-B10	450	100-C09	65	47	65	47	100-C09	65	47	100-C09	65	47
140M-C2E-B16	450	100-C09	65	47	65	47	100-C09	65	47	100-C09	65	47
140M-C2E-B25	450	100-C09	65	30	65	30	100-C09	65	30	100-C09	65	—
140M-C2E-B40	450	100-C09	65	25	65	25	100-C09	65	30	—	—	—
140M-C2E-B63	450	100-C09	65	30	65	30	100-C09	65	—	—	—	—
140M-C2E-C10	450	100-C09	65	30	65	30	100-C09	65	—	—	—	—
140M-C2E-C16	450	100-C12	30	30	30	30	100-C12	30	—	—	—	—
140M-C2E-C20	450	100-C16	30	30	10	10	100-C23	10	—	—	—	—
140M-C2E-C25	450	100-C23	25	10	10	10	—	—	—	—	—	—
140M-C2E-C25	450	100-C30	25	10	10	5	—	—	—	—	—	—
D-Frame												
140M-D8E-B25	450	100-C09	65	30	65	30	100-C09	65	30	100-C09	65	—
140M-D8E-B25	—	—	—	—	—	—	—	—	—	100-C23	65	30
140M-D8E-B40	450	100-C09	65	30	65	30	100-C09	65	30	100-C23	65	30
140M-D8E-B63	450	100-C09	65	30	65	30	100-C09	65	30	100-C30	65	30
140M-D8E-C10	450	100-C09	65	30	65	30	100-C09	65	30	100-C30	65	30
140M-D8E-C16	450	100-C12	65	30	65	30	100-C12	65	30	100-C30	65	30
140M-D8E-C20	450	100-C23	65	30	65	30	100-C23	65	—	100-C30	65	—
140M-D8E-C25	450	100-C23	30	30	30	30	100-C23	65	—	100-C30	30	—
F-Frame												
140M-F8E-C10	600	100-C30	65	30	65	30	100-C30	65	30	100-C30	65	30
140M-F8E-C16	600	100-C30	65	30	65	30	100-C30	65	30	100-C30	65	30
140M-F8E-C20	600	100-C30	65	30	65	30	100-C30	65	30	100-C30	65	30
140M-F8E-C25	600	100-C30	65	30	65	30	100-C30	65	30	100-C30	65	30
140M-F8E-C32	600	100-C30	65	30	65	30	100-C30	65	30	100-C30	65	30
140M-F8E-C45	600	100-C37	65	18	65	18	100-C37	65	—	100-C37	65	—
CMN-Frame												
140-CMN-2500	1000	100-C16	65	42	—	—	—	—	—	—	—	—
140-CMN-4000	1000	100-C30	65	42	—	—	—	—	—	—	—	—
140-CMN-6300	1000	100-C43	42	18	—	—	—	—	—	—	—	—
140-CMN-9000	1000	100-C72	35	10	—	—	—	—	—	—	—	—

§ For full voltage (delta) ratings above 277V or 347V, follow the NEC or CEC rules for group motor applications.

UL Listed Application Ratings - Motor Circuit Protectors with Bulletin 100-C Contactors§

Cat. No.	UL 508 Manual Motor Controller						UL 508 Type E (Self-Protected) Combination Motor Controller		
	Group Motor Installation				Motor Disconnect				
	Max. Fuse or C.B. per NEC	Minimum Contactor Size	Max. Short Circuit Current [kA]		Max. Short Circuit Current [kA]		Minimum Contactor Size	Max. Short Circuit Current [kA]	Max. Short Circuit Current [kA]
			480V	600V	480V	600V		480Y/277V❄	600Y/347V❄
C-Frame									
140M-C2N-A16	450	100-C09	65	47	65	47	100-C09	65	47
140M-C2N-A25	450	100-C09	65	47	65	47	100-C09	65	47
140M-C2N-A40	450	100-C09	65	47	65	47	100-C09	65	47
140M-C2N-A63	450	100-C09	65	47	65	47	100-C09	65	47
140M-C2N-B10	450	100-C09	65	47	65	47	100-C09	65	47
140M-C2N-B16	450	100-C09	65	47	65	47	100-C09	65	47
140M-C2N-B25	450	100-C09	65	30	65	30	100-C09	65	—
D-Frame									
140M-D8N-B25	450	100-C09	65	30	65	30	100-C09	65	—
140M-D8N-B25	—	—	—	—	—	—	100-C23	65	30
140M-D8N-B40	450	100-C09	65	30	65	30	100-C23	65	30
140M-D8N-B63	450	100-C09	65	30	65	30	100-C30	65	30
140M-D8N-C10	450	100-C09	65	30	65	30	100-C30	65	30
140M-D8N-C16	450	100-C12	65	30	65	30	100-C30	65	30
140M-D8N-C25	450	100-C23	30	30	30	30	100-C30	65	—
F-Frame									
140M-F8N-C25	600	100-C23	65	30	65	30	100-C30	65	30
140M-F8N-C32	600	100-C30	65	30	65	30	100-C30	65	30
140M-F8N-C45	600	100-C37	65	18	65	18	100-C37	65	—

§ Separate overload protection is required.
❄ For full-voltage (delta) ratings above277V or 347V, follow the NEC or CEC rules for group motor applications.

2

Definition of Type 2 Short Circuit Coordination:

- The contactor or starter must not endanger persons or plant in the event of a short circuit.
- No damage to the motor protection device or other parts may occur with the exception of welding of the contactor or starter contacts if these can be easily separated without appreciable deformation (such as with a screwdriver).

In the event of short circuit, fast-opening, current-limiting Bulletin 140M Motor Protection Circuit Breakers make it possible to build economical, fully short-circuit coordinated starter combinations with Type 2 coordination.

Type 2 Coordination 400V

Cat. No.			Max. Short Circuit Current [kA]	For Use With Contactors Below (or larger)
Standard Trip	High Trip	Mag Only Trip	400V	
		C-Frame		
140M-C2E-A16	—	140M-C2N-A16	100	100-C09
140M-C2E-A25	140M-C2T-A16	**140M-C2N-A25**	100	100-C09
140M-C2E-A40	**140M-C2T-A25**	**140M-C2N-A40**	100	100-C09
140M-C2E-A63	**140M-C2T-A40**	**140M-C2N-A63**	100	100-C09
140M-C2E-B10	**140M-C2T-A63**	**140M-C2N-B10**	100	100-C09
140M-C2E-B16	**140M-C2T-B10**	**140M-C2N-B16**	100	100-C09
140M-C2E-B25	**140M-C2T-B16**	**140M-C2N-B25**	50	100-C09
140M-C2E-B40	**140M-C2T-B25**	—	50	100-C09
140M-C2E-B63	**140M-C2T-B40**	—	50	100-C09
140M-C2E-C10	**140M-C2T-B63**	—	50	100-C09
140M-C2E-C16	**140M-C2T-C10**	—	50	100-C12∗
140M-C2E-C20	**140M-C2T-C16**	—	—	—
140M-C2E-C25	—	—	—	—
		D-Frame		
140M-D8E-B25	—	**140M-D8N-B25**	100	100-C09
140M-D8E-B40	—	**140M-D8N-B40**	100	100-C09
140M-D8E-B63	—	**140M-D8N-B63**	100	100-C09
140M-D8E-C10	—	**140M-D8N-C10**	65	100-C09
140M-D8E-C16	—	**140M-D8N-C16**	65	100-C12
140M-D8E-C20	**140M-D8T-C16**	—	65	100-C23
140M-D8E-C25	**140M-D8T-C20**	**140M-D8N-C25**	50	100-C23
		F-Frame		
140M-F8E-C10	—	—	100	100-C09
140M-F8E-C16	—	—	100	100-C12
140M-F8E-C20	—	—	100	100-C23
140M-F8E-C25	—	**140M-F8N-C25**	100	100-C30
140M-F8E-C32	**140M-F8T-C25**	**140M-F8N-C32**	100	100-C30
140M-F8E-C45	**140M-F8T-C32**	**140M-F8N-C45**	100	100-C37
		CMN-Frame		
140-CMN-2500	—	—	65	100-C16
140-CMN-4000	—	—	65	100-C30
140-CMN-6300	—	—	42	100-C43
140-CMN-9000	—	—	35	100-C72

∗ Cat. No. 100-C16 contactors Type 1 only

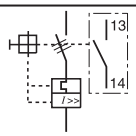
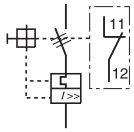
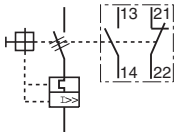
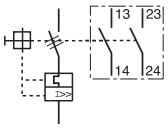
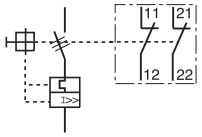
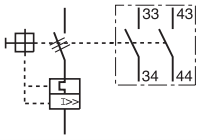
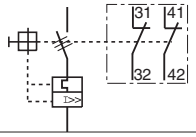
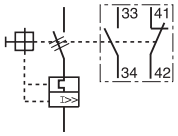
Type 2 Coordination 480V

Cat. No.			Max. Short Circuit Current [kA]	For Use With Contactors Below (or larger)
Standard Trip	High Trip	Mag Only Trip	480V	
		C-Frame		
140M-C2E-A16	—	140M-C2N-A16	65	100-K05, 100-C09
140M-C2E-A25	140M-C2T-A16	**140M-C2N-A25**	65	100-K05, 100-C09
140M-C2E-A40	**140M-C2T-A25**	**140M-C2N-A40**	65	100-K05, 100-C09
140M-C2E-A63	**140M-C2T-A40**	**140M-C2N-A63**	65	100-K05, 100-C09
140M-C2E-B10	**140M-C2T-A63**	**140M-C2N-B10**	65	100-K05, 100-C09
140M-C2E-B16	**140M-C2T-B10**	**140M-C2N-B16**	65	100-K05, 100-C09
140M-C2E-B25	**140M-C2T-B16**	**140M-C2N-B25**	50	100-C16
140M-C2E-B40	**140M-C2T-B25**	—	50	100-C30
140M-C2E-B63	**140M-C2T-B40**	—	50	100-C30
140M-C2E-C10	**140M-C2T-B63**	—	50	100-C30
140M-C2E-C16	**140M-C2T-C10**	—	10	100-C30
140M-C2E-C20	**140M-C2T-C16**	—	10	100-C30
140M-C2E-C25	—	—	10	100-C30
		D-Frame		
140M-D8E-B25	—	**140M-D8N-B25**	65	100-C09
140M-D8E-B40	—	**140M-D8N-B40**	65	100-C09
140M-D8E-B63	—	**140M-D8N-B63**	65	100-C09
140M-D8E-C10	—	**140M-D8N-C10**	65	100-C09
140M-D8E-C16	—	**140M-D8N-C16**	65	100-C12
140M-D8E-C20	**140M-D8T-C16**	—	65	100-C23
140M-D8E-C25	**140M-D8T-C20**	**140M-D8N-C25**	65	100-C23
		F-Frame		
140M-F8E-C10	—	—	65	100-C09
140M-F8E-C16	—	—	65	100-C12
140M-F8E-C20	—	—	65	100-C16
140M-F8E-C25	—	**140M-F8N-C25**	65	100-C23
140M-F8E-C32	**140M-F8T-C25**	**140M-F8N-C32**	65	100-C30
140M-F8E-C45	**140M-F8T-C32**	**140M-F8N-C45**	65	100-C37
		CMN-Frame		
140-CMN-2500	—	—	65	100-C16
140-CMN-4000	—	—	65	100-C30
140-CMN-6300	—	—	42	100-C43
140-CMN-9000	—	—	35	100-C72

2

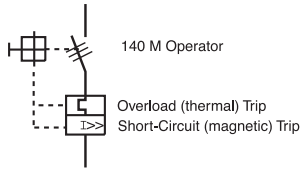
Type 2 Coordination 600V

Cat. No.			Max. Short Circuit Current [kA]	Max Fuse or C.B per NEC	For Use With Contactors Below (or larger)
Standard Trip	High Trip	Mag Only Trip	600V		
C-Frame					
140M-C2E-A16	—	140M-C2N-A16	47	450	100-K05, 100-C09
140M-C2E-A25	140M-C2T-A16	**140M-C2N-A25**	47	450	100-K05, 100-C09
140M-C2E-A40	**140M-C2T-A25**	**140M-C2N-A40**	47	450	100-K05, 100-C09
140M-C2E-A63	**140M-C2T-A40**	**140M-C2N-A63**	47	450	100-K05, 100-C09
140M-C2E-B10	**140M-C2T-A63**	**140M-C2N-B10**	47	450	100-K05, 100-C09
140M-C2E-B16	**140M-C2T-B10**	**140M-C2N-B16**	47	450	100-K05, 100-C09
140M-C2E-B25	**140M-C2T-B16**	**140M-C2N-B25**	10	450	100-C16
140M-C2E-B40	**140M-C2T-B25**	—	10	450	100-C16
140M-C2E-B63	**140M-C2T-B40**	—	5	450	100-C23
140M-C2E-C10	**140M-C2T-B63**	—	5	450	100-C30
140M-C2E-C16	**140M-C2T-C10**	—	5	450	100-C30
140M-C2E-C20	**140M-C2T-C16**	—	5	450	100-C30
140M-C2E-C25	—	—	5	450	100-C30
D-Frame					
140M-D8E-B25	—	**140M-D8N-B25**	30	450	100-C30
140M-D8E-B40	—	**140M-D8N-B40**	30	450	100-C30
140M-D8E-B63	—	**140M-D8N-B63**	30	450	100-C30
140M-D8E-C10	—	**140M-D8N-C10**	30	450	100-C30
140M-D8E-C16	—	**140M-D8N-C16**	30	450	100-C30
140M-D8E-C20	**140M-D8T-C16**	—	5	450	100-C30
140M-D8E-C25	**140M-D8T-C20**	**140M-D8N-C25**	5	450	100-C30
F-Frame					
140M-F8E-C10	—	—	30	600	100-C30
140M-F8E-C16	—	—	30	600	100-C30
140M-F8E-C20	—	—	30	600	100-C30
140M-F8E-C25	—	**140M-F8N-C25**	30	600	100-C30
140M-F8E-C32	**140M-F8T-C25**	**140M-F8N-C32**	30	600	100-C30
140M-F8E-C45	**140M-F8T-C32**	**140M-F8N-C45**	10	600	100-C37
CMN-Frame					
140-CMN-2500	—	—	42	1000	100-C16
140-CMN-4000	—	—	42	1000	100-C30
140-CMN-6300	—	—	18	1000	100-C43
140-CMN-9000	—	—	10	1000	100-C72

Description		Operator Position ✶			Term. No.	Description	Connection Diagram ❄	For Use With	Cat. No.
		OFF	ON	Tripped					
		O	X	O	13-14	N.O. Aux		140M-C, D, F	**140M-C-AFA10**
		X	O	X	11-12	N.C. Aux		140M-C, D, F	**140M-C-AFA01**
	Front-Mounted Auxiliary Contact 1-pole or 2-pole No additional space required -Only 1 per MPCB	O	X	O	13-14	N.O. Aux		140M-C, D, F	**140M-C-AFA11**
		X	O	X	21-22	N.C. Aux			
		O	X	O	13-14	N.O. Aux		140M-C, D, F	**140M-C-AFA20**
		O	X	O	23-24	N.O. Aux			
		X	O	X	11-12	N.C. Aux		140M-C, D, F	**140M-C-AFA02**
		X	O	X	21-22	N.C. Aux			
	Right Side-Mounted Auxiliary Contact 2-pole Adds 9 mm to the width of the device - 2 per MPCB	O	X	O	33-34	N.O. Aux		140M-C, D, F	**140M-C-ASA20**
		O	X	O	43-44	N.O. Aux			
		X	O	X	31-32	N.C. Aux		140M-C, D, F	**140M-C-ASA02**
		X	O	X	41-42	N.O. Aux			
		O	X	O	33-34	N.O. Aux		140M-C, D, F	**140M-C-ASA11**
		X	O	X	41-42	N.C. Aux			

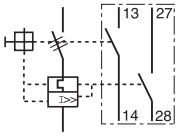
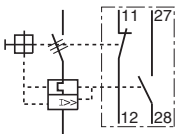
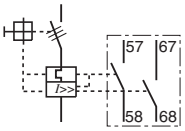
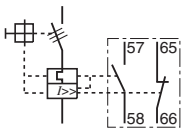
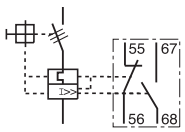
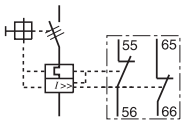
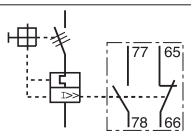
✶ X = Contact Closed; O = Contact Open

❄



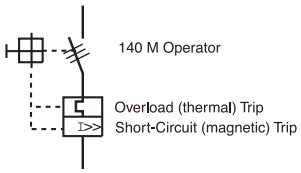
Motor Protection Circuit Breakers and Motor Circuit Protectors

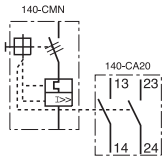
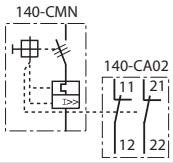
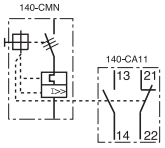
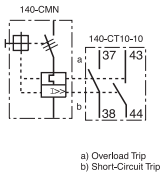
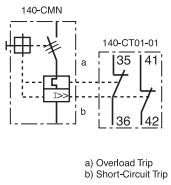
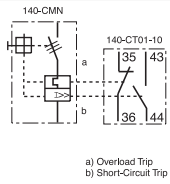
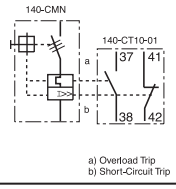
Accessories, Continued

Description		Operator Position ✶			Term. No.	Description	Connection Diagram ❄	For Use With	Cat. No.
		OFF	ON	Tripped					
	Front-Mounted Trip Contact 2-pole Indicates tripping of device No additional space required	O	X	O	13-14	N.O. Aux		140M-C, D, F	**140M-C-AFAR10A10**
		O	O	X	27-28	N.O. Trip (Short-Circuit & Overload)			
		X	O	X	11-12	N.C. Aux		140M-C, D, F	**140M-C-AFAR10A01**
		O	O	X	27-28	N.O. Trip (Short-Circuit & Overload)			
	Right-Side Mounted Trip Contact 2-pole Indicates tripping of Motor Protection Circuit Breaker Adds 9 mm to the width of the circuit breaker - Only 1 per MPCB - A right-side mounted auxiliary contact may be tandem mounted on top of this Trip Contact	O	O	X	57-58	N.O. Trip (Short-Circuit & Overload)		140M-C, D, F	**140M-C-ASAR10M10**
		O	O	X	67-68	N.O. Trip			
		O	O	X	57-58	N.O. Trip (Short-Circuit & Overload)		140M-C, D, F	**140M-C-ASAR10M01**
		X	X	O	65-66	N.C. Trip			
		X	X	O	55-56	N.C. Trip (Short-Circuit & Overload)		140M-C, D, F	**140M-C-ASAR01M10**
		O	O	X	67-68	N.O. Trip			
		X	X	O	55-56	N.C. Trip (Short-Circuit & Overload)		140M-C, D, F	**140M-C-ASAR01M01**
		X	X	O	65-66	N.C. Trip			
		O	O	X	77-78	N.O. Trip (Short-Circuit)		140M-C, D, F	**140M-C-ASAM11**
		X	X	O	65-66	N.C. Trip (Short-Circuit)			

✶ X = Contact Closed; O = Contact Open

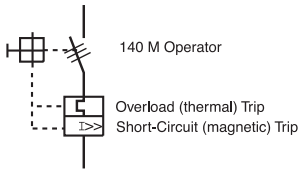
❄



Description		Operator Position∗			Term. No.	Description	Connection Diagram❄	For Use With	Cat. No.
		OFF	ON	Tripped					
	Front-Mounted Auxiliary Contact Internal 2-pole -1 per MPCB	O	X	O	13-14	N.O. Aux		140-CMN	**140-CA20**
		O	X	O	23-24	N.O. Aux			
		X	O	X	11-12	N.C. Aux		140-CMN	**140-CA02**
		X	O	X	21-22	N.C. Aux			
		O	X	O	13-14	N.O. Aux		140-CMN	**140-CA11**
		X	O	X	21-22	N.C. Aux			
	Front-Mounted Trip-Indicating Auxiliary Contact Internal 2-pole -1 per MPCB	O	O	X	37-38	N.O. Trip (Overload)		140-CMN	**140-CT10-10**
		O	O	X	43-44	N.O. Trip (Short-Circuit)			
		X	X	O	35-36	N.C. Trip (Overload)		140-CMN	**140-CT01-01**
		X	X	O	41-42	N.C. Trip (Short-Circuit)			
		X	X	O	35-36	N.C. Trip (Overload)		140-CMN	**140-CT01-10**
		O	O	X	43-44	N.O. Trip (Short-Circuit)			
		O	O	X	37-38	N.O. Trip (Overload)		140-CMN	**140-CT10-01**
		X	X	O	41-42	N.C. Trip (Short-Circuit)			

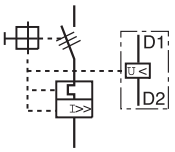
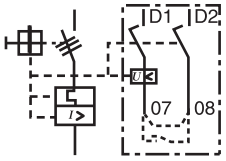
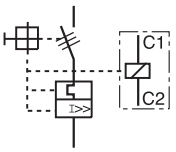
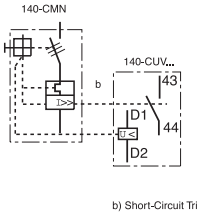
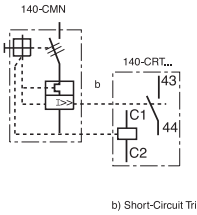
∗ X = Contact Closed
O = Contact Open

❄

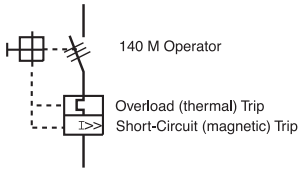


Motor Protection Circuit Breakers and Motor Circuit Protectors

Accessories, Continued

Description		Connection Diagram*	Trip Rating	For Use With	Cat. No.
	Undervoltage Trip Left-side mounted Adds 18 mm to the width of the circuit breaker Automatically trips MPCB/MCP when voltage falls below 35…70%		24V, 60 Hz	140M-C, D, F	140M-C-UXJ
			24V, 50 Hz		140M-C-UXK
			120V, 60 Hz		**140M-C-UXD**
			110V, 50 Hz		140M-C-UXC
			208V, 60 Hz		**140M-C-UXH**
			220…230V, 50 Hz		140M-C-UXF
			240…260V, 60 Hz		**140M-C-UXA**
			277V, 60 Hz		140M-C-UXT
			380…400V, 50 Hz		**140M-C-UXN**
			480V, 60 Hz/415V, 50 Hz		**140M-C-UXB**
			575V, 60 Hz/500V, 50 Hz		140M-C-UXM
			600V, 60 Hz		140M-C-UXVC
	Undervoltage Trip Left-side mounted 2 early make contacts integrated Adds 18 mm to the width of the circuit breaker Automatically trips MPCB/MCP when voltage falls below 35…70%		24V, 60 Hz	140M-C, D, F	140M-C-UCJ
			24V, 50 Hz		140M-C-UCK
			120V, 60 Hz		**140M-C-UCD**
			110V, 50 Hz		140M-C-UCC
			208V, 60 Hz		140M-C-UCH
			220…230V, 50 Hz		140M-C-UCF
			240…260V, 60 Hz		**140M-C-UCA**
			277V, 60 Hz		140M-C-UCT
			380…400V, 50 Hz		140M-C-UCN
			480V, 60 Hz/415V, 50 Hz		**140M-C-UCB**
			575V, 60 Hz/500V, 50 Hz		140M-C-UCM
			600V, 60 Hz		140M-C-UCVC
	Shunt Trip Left-side mounted Adds 18 mm to the width of the circuit breaker Provides remote tripping of the MPCB/MCP		24V, 60 Hz	140M-C, D, F	140M-C-SNJ
			24V, 50 Hz		140M-C-SNK
			120V, 60 Hz		**140M-C-SND**
			208V, 60 Hz		140M-C-SNH
			220…230V, 50 Hz		140M-C-SNF
			240…260V, 60 Hz		**140M-C-SNA**
			277V, 60 Hz		140M-C-SNT
			380…400V, 50 Hz		140M-C-SNN
			480V, 60 Hz/415V, 50 Hz		**140M-C-SNB**
			575V, 60 Hz/500V, 50 Hz		140M-C-SNM
			600V, 60 Hz		140M-C-SNVC
			24V DC		**140M-C-SNZJ**
	Undervoltage Trip Unit Internal, front-mounted Integrated short-circuit trip indication Automatically trips MPCB when voltage falls below 35…70%	 b) Short-Circuit Trip	24V, 50/60 Hz	140-CMN	140-CUV-KJ
			110V, 50 Hz/120V, 60 Hz		**140-CUV-D**
			220V, 50 Hz/240V, 60 Hz		140-CUV-A
	Shunt Trip Unit Internal, front-mounted Integrated short-circuit trip indication Provides remote tripping of the MPCB	 b) Short-Circuit Trip	24V, 50/60 Hz	140-CMN	**140-CRT-KJ**
			110V, 50 Hz/120V, 60 Hz		**140-CRT-D**
			220V, 50 Hz/240V, 60 Hz		140-CRT-A

*



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Preferred availability cat. nos. are printed in **bold**

	Description		For Use With	Cat. No.
	Anti-Tamper Shield Provides protection against inadvertent adjustment of the current setting	10 pcs/pkg	140M-C, D, F	**140M-C-CA**
	Lockable Twist Knob For 1 padlock 4…6 mm (1/4 in.) dia. shackle Can be locked in OFF position	Black	140M-C, D, F	**140M-C-KN**
		Red/Yellow	140M-C/-D	**140M-C-KRY**
		Red/Yellow	140M-F	**140M-F-KRY**
	Padlockable Operating Knob Accepts 8 mm (5/16 in.) padlock — up to three padlocks Permits padlocking in the off position	Black	140-CMN	**140-KN**
		Red/Yellow		**140-KRY**
	Door Coupling Handle For 3 padlocks 4…8 mm (5/16 in.) in diameter IP66 Protection/Type 1, 4, 4X, 12 Interlock override capability Can be modified for locking in ON position Ships with coupling — order extension shaft and legend plate separately Mounting depth (adapter-door): 140-C: 105.5 mm ± 5 mm (4.5 in. ± 3/16 in.) 140-D: 114.5 mm ± 5 mm (4.5 in. ± 3/16 in.) 140-F: 137.1 mm ± 5 mm (5.4 in. ± 3/16 in.)	Black	140M-C, D, F	**140M-C-DN66**
			140-CMN	**140-CDN66**
		Red/Yellow	140M-C, D, F	**140M-C-DRY66**
			140-CMN	**140-CDRY66**
	Extension Shaft Cut to required length for mounting depth (adapter-door): 140M-C: 117…338 mm (4.6 in.…13.3 in.) 140M-D: 126…347 mm (5.0 in.…13.7 in.) 140M-F: 149…369 mm (5.4 in.…14.5 in.) 140-CMN: 180…403 mm (7.1 in.…15.9 in.)		140M-C-DN66, 140M-C-DRY66, 140-CDN66, 140-CDRY66	**140M-C-DS**
	Extension Shaft (Extended Length) Cut to required length for mounting depth (adapter-door): 140M-C: 117…488 mm (4.6…19.2 in.) 140M-D: 126…497 mm (5.0…19.6 in.) 140M-F: 149…519 mm (5.4…20.4 in.) 140-CMN: 180…553 mm (7.1…21.8 in.)		140M-C-DN66, 140M-C-DRY66, 140-CDN66, 140-CDRY66	**140M-C-DSL**
	Coupler Included with Cat. Nos. 140M-C-DN66 and 140M-C-DRY66		140M-C, D, F	140M-C-DNC
	Legend Plate Marking: "Hauptschalter" and "Main Switch" Marking: "Not-Aus" and "Emergency Off"		140-CDN66	**140M-C-DFCN**
			140-CDRY66	**140M-C-DFCRY**
	Locking Tag Padlock attachment to the lockable handles Up to three padlocks 4…8 mm (5/16 in.) shackle		140M-C-KN 140M-C-KRY 140M-F-KRY	**140M-C-M3**
	IP65 Non-Metallic Enclosure Knockouts for M20 and M25 fittings Suitable for flexible cable with internal ground wire or conduit when externally grounded around the outside of the enclosure (no UL approval)	Black Handle	140M-C	**198E-AYTG2**
		Red/Yellow Handle	140M-C	**198E-AYTJ2**
	Terminal Cover For covering of unused commoning link terminals IP2X finger protection		140M-C, 140M-D	**140M-C-WS**
			140M-F	140M-F-WS
	Screw Adapter For screw arrangement of a Motor Protection Circuit Breaker	10 pcs/pkg	140M-C, D, F	**140M-C-N45**

Motor Protection Circuit Breakers and Motor Circuit Protectors

Accessories, Continued

	Description		For Use With	Cat. No.
	ECO Connecting Module — 12 A For DOL and reversing starters Eco-starters mount on single DIN Rail (140M on DIN Rail) Electrical and mechanical interconnection of 140M MPCB and 100-K contactors		140M-C to 100-K	**140M-C-PEK12**
	ECO Connecting Modules — 25 A Eco-starters mount on single DIN Rail (140M on DIN Rail) Electrical and mechanical interconnection of 140M MPCB and 100-C (with AC coils or 24V DC electronic coils) contactors		140M-C to 100-C09…C23	**140M-C-PEC23**
			140M-D to 100-C09…C23	**140M-D-PEC23**
	Connecting Modules — 25 and 45 A Contactor and MPCB **MUST BE** mounted separately on (2) DIN Rails Electrical interconnection between 140M MPCB and 100-C contactors (with AC coils)		140M-C to 100-C09…C23	**140M-C-PNC23**
			140M-D to 100-C09…C23	**140M-D-PNC23**
			140M-D to 100-C30…C37	**140M-D-PNC37**
			140M-F to 100-C30…C37	**140M-F-PNC37**
			140M-F to 100-C43	**140M-F-PNC43**
	Coil Modules — 25 A and 45 A • For use with Bulletin 103T/107T 3-component starters		140M-C, -D to 100-C09…C23	140M-C-PSC23
			140M-D, -F to 100-C30…C43	140M-F-PSC43
	Spacing Adapter Required for Self-Protected combination motor controller (Type E) applications of Bul. 140M-C, -D, and -F MPCBs		140M-C, -D	**140M-C-TE1**
			140M-F	**140M-F-TE**
	Compact Busbar Feeder Block Supply of compact busbars Increases terminal capacity		140M-C, -D	**140M-C-WBE**
			140M-F	**140M-F-WBE**
	Compact Busbar Feeder Terminal For supply of commoning links Top feed — overlaps commoning link Meets UL Type E spacing requirements		140M-C, -D	**140M-C-WTE**
			140M-F	**140M-F-WTE**
	Three-Phase Compact Busbar for 25 A Motor Protection Circuit Breakers — 63 A Max. Continuous Current 45 mm spacing For use with front-mounted auxiliary contact	2 connections	140M-C, -D	**140M-C-W452**
		3 connections		**140M-C-W453**
		4 connections		**140M-C-W454**
		5 connections		**140M-C-W455**
	Three-Phase Compact Busbar for 25 A Motor Protection Circuit Breakers — 63 A Max. Continuous Current 54 mm spacing For use with side-mounted auxiliary contact	2 connections	140M-C, -D	**140M-C-W542**
		3 connections		**140M-C-W543**
		4 connections		**140M-C-W544**
		5 connections		**140M-C-W545**
	Three-Phase Compact Busbar for 25 A Motor Protection Circuit Breakers — 63 A Max. Continuous Current 63 mm spacing For use with side-mounted undervoltage trip and shunt trip	2 connections	140M-C, -D	**140M-C-W632**
		3 connections		**140M-C-W633**
		4 connections		**140M-C-W634**
		5 connections		**140M-C-W635**
	Jumper for 140M-D to 140M-C Accommodates difference in depth from Bul. 140M-D to 140M-C 54 mm spacing Can be used with all other commoning links	2 connections	140M-D to 140M-C	**140M-C-WD542**
	Three-Phase Compact Busbar for 45 A Motor Protection Circuit Breakers — 115 A Max. Continuous Current 54 mm spacing For use with front-mounted auxiliary contact	2 connections	140M-F	**140M-F-W542**
		3 connections		**140M-F-W543**
		4 connections		**140M-F-W544**
	Three-Phase Compact Busbar for 45 A Motor Protection Circuit Breakers — 115 A Max. Continuous Current 63 mm spacing For use with side-mounted auxiliary contact	2 connections	140M-F	**140M-F-W632**
		3 connections		**140M-F-W633**
		4 connections		**140M-F-W634**
	DIN (#3) symmetrical Rail 35 mm x 7.5 mm x 1 m long	10 pcs/kg	140M-D 140M-F	**199-DR1**
	DIN (#3) Symmetrical Rail 35 mm x 15 mm x 1 m long Top Hat Rail (DIN #3 Symmetrical Rail)	5 pcs/kg	140M-C 140M-D 140M-F 140-CMN	**1492-DR9**

Notes: 1. See Bulletin 140U for Internal and External Accessories for Bulletin 140M-H, J, L and N frames.

2. Bulletin 140M-I frame Accessories such as auxiliaries, alarms, undervoltage and shunt trips are only available as factory installed modifications. See page 33.

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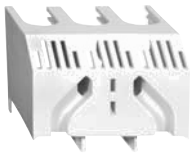
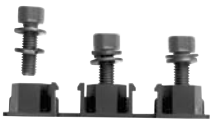
Preferred availability cat. nos. are printed in **bold**

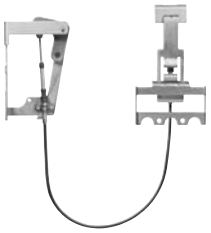
Description	For Use With	Pkg. Quantity	Cat. No.
Terminal End Cover — 0.25 in.	140M-I	1	140U-I-TC2
Terminal End Cover — 0.41 in.			**140U-I-TC4**
 **Terminal Shields (Plastic)** IP20 Ingress Protection	140M-I	1	**140U-I-TS1**
Padlockable Handle Lock Hasp — Off only Padlocking Hasp Lock-OFF only	140M-I	1	**140U-I-PL**
 **End Cap Kit** Provides 3-phase connections for terminal or bolt-on connections Metric Hardware	140M-I	1	140U-I-ECM
Phase Barriers Provides additional phase clearance when special connections are required	140M-I	2	**140U-I-PB**
Terminal Lugs Steel Terminal Copper/Aluminum wire #4-4/0 AWG	140M-I	3	**140U-I-TLS1**
Terminal Lugs Stainless Steel Terminal Copper/Aluminum wire #4-4/0 AWG			**140U-I-TLS2**
Rotary Close Couple Handle International Black handle	140M-I	1	**140U-I-RCB**
Rotary Close Couple Handle International Red/Yellow handle			140U-I-RCR
Operating Mechanism for External Handles	140M-I	1	**198-H2**
External Handles Black/Grey IP66 (Type 3/3R/4/4X/12)	140M-I	1	**190-HM4**
Red/Yellow IP66 (Type 3/3R/4/4X/12)			**190-HM4E**
Black/Grey IP55 (Type 1)			**190-HM1**
Red/Yellow IP55 (Type 1)			**190-HM1E**
Overload Pre-trip Auxiliary Contact (AX) Opens contactor coil circuit on overload before MPCB trips (Automatic reset)	140M-J, -L (MPCB only)	1	140U-J-ER1RX

Motor Protection Circuit Breakers and Motor Circuit Protectors

Accessories, Continued

Description			For Use With	Pkg. Quantity	Cat. No.
	Extension Shafts		140M-I	1	**194R-R3**
	Standard Enclosure Working Depth [mm (in.)]				
	Minimum	203 (8)			
	Maximum	305 (12)			
	Extended				**194R-R4**
	Minimum	203 (8)			
	Maximum	508 (20)			

2

Description			For Use With	Pkg. Quantity	Cat. No.
	**Flex-Cable Operating Mechanism** NEMA Type 1/3/12/4/4X Flange-Mount Handle	3 ft. (0.9 m) Cable	140M-I	1	140U-I-FCX03
		4 ft. (1.2 m) Cable			140U-I-FCX04
		6 ft. (1.9 m) Cable			140U-I-FCX06
		10 ft. (3.0 m) Cable			140U-I-FCX10
	Flex-Cable Operating Mechanism Stainless Steel - Type 4/4X Flange Mount Handle	3 ft. (0.9 m) Cable			140U-I-FCS03
		4 ft. (1.2 m) Cable			140U-I-FCS04
		6 ft. (1.9 m) Cable			140U-I-FCS06
		10 ft. (3.0 m) Cable			140U-I-FCS10

140M Factory Modifications (Open)

Note: For modifications add (option code *) for desired features to cat. no.

f

Miscellaneous		
Code	Description	Frame Size
KN	Black Lockable Knob	C, D, F, CMN
KY	Red/Yellow Lockable Knob	C, D, F, CMN
TE	Spacing Adapter for Self-Protected Starters (Type E)	C, D, F
MT	STD Bus Bar Mount, Top	C, D, F, H, CMN
MU	STD Bus Bar Mount, Universal	J, K, L

g

Aux / Trip Contacts - C, D, F			
1st Code	Description	2nd Code	Description
Bottom Front		Right Side	
X	Placeholder	X	Placeholder
A	1 N.C.	C	1 N.O. + 1 N.C.
B	1 N.O.	D	2 N.O.
C	1 N.O. + 1 N.C.	E	2 N.C.
D	2 N.O.	K	1 N.C. (SC+OL) + 1 N.C. (SC)
E	2 N.C.	L	1 N.O. (SC+OL) + 1 N.O. (SC)
R	1 N.C. + 1 N.O. (SC+OL)	M	1 N.C. (SC+OL) + 1 N.O. (SC)
S	1 N.O. + 1 N.O. (SC+OL)	N	1 N.O. (SC+OL) + 1 N.C. (SC)
		Q	1 N.O. (SC) + 1 N.C. (SC)

g

Aux / Trip Contacts - CMN			
1st Code	Description	2nd Code	Description
Bottom Front		Top Front‡	
X	Placeholder	X	Placeholder
C	1 N.O. + 1 N.C.	K	1 N.C. (OL) + 1 N.C. (SC)
D	2 N.O.	L	1 N.O. (OL) + 1 NO (SC)
E	2 N.C.	M	1 N.C. (OL) + 1 N.O. (SC)
		N	1 N.O. (OL) + 1 N.C. (SC)

‡Cannot be combined with option "h".

g

Aux / Trip Contacts - H, J, L			
1st Code	Description	2nd Code	Description
Bottom Front		Right Side	
X	Placeholder	X	Placeholder
		C	1 N.O. + 1 N.C.
		R❄	1 N.O. + 1 N.C. (Overload Function)
		F∗	2 N.O. + 2 N.C.
		N∗	1 N.O. (SC+OL) + 1 N.C. (SC)
		T∗	1 N.O. + 1 N.C. and 1 N.O. + 1 N.C. (SC+OL)

∗ Only available on MCPs.
❄ J- and L-Frame MPCB only.

g

Aux / Trip Contacts - I, N			
1st Code	Description	2nd Code	Description
Left Side		Right Side	
X	Placeholder	X	Placeholder
C	1 N.O. + 1 N.C.	C	1 N.O. + 1 N.C.
F	2 N.O. + 2 N.C.	F∗	2 N.O. + 2 N.C.
N	1 N.O. (SC+OL) + 1 N.C. (SC)	N∗	1 N.O. (SC+OL) + 1 N.C. (SC)
T	1 N.O. + 1 N.C. and 1 N.O. + 1 N.C. (SC+OL)	T∗	1 N.O. + 1 N.C. and 1 N.O. + 1 N.C. (SC+OL)

∗ Only available on MCPs.

h

UV and Shunt Trips - C, D, F			
1st Code	Description	2nd Code	Description
Left Side		Voltage	
G	Undervoltage Trip	J	24V AC, 60 Hz
P	Shunt Trip	K	24V AC, 50 Hz
		D	120V AC, 60 Hz
		C	110V AC, 50 Hz
		H	208V AC, 60 Hz
		F	220…230V AC, 50 Hz
		A	240V AC, 60 Hz
		T	277V AC, 50 Hz
		N	380…400V AC, 50 Hz
		B	480V AC, 60 Hz and 415V AC, 50 Hz
		VC	600V AC, 60 Hz
		M	575V AC, 60 Hz and 500V AC, 50 Hz
		ZR	9V DC
		ZQ	12V DC
		ZJ	24V DC
		ZW	36V DC
		ZY	48V DC
		ZZ	60V DC
		ZB	64V DC
		ZG	72V DC
		ZE	80V DC

2

140M Factory Modifications (Open); Continued

Note: For modifications add (option code *) for desired features to cat. no.

h

UV and Shunt Trips - CMN			
1st Code	Description	2nd Code	Description
Top Front‡		Voltage	
G	Undervoltage Trip	KJ	24V AC, 60 Hz and 24V AC, 50 Hz
P	Shunt Trip	D	120V AC, 60 Hz and 110V AC, 50 Hz
		A	240V AC, 60 Hz and 220…230V AC, 50 Hz

‡ Cannot be combined with option "g".

h

UV and Shunt Trips - H, J, L			
1st Code	Description	2nd Code	Description
Left Front		UV Voltage	
G	Undervoltage Trip	J	24V AC/DC
		D	110…127V AC
		A	208…240V AC
		B	380…500V AC
		C	525…600V AC
Left Front		Shunt Voltage	
P	Shunt Trip	J	12…60V AC/DC
		D	110…240V AC/DC
		B	380…600V AC

h

UV and Shunt Trips - I			
1st Code	Description	2nd Code	Description
Left Front		UV Voltage	
G	Undervoltage Trip	J	24V AC
		D	110…127V AC
		A	208…240V AC
		B	380…480V AC
Left Front		Shunt Voltage	
P	Shunt Trip	J	12…24V AC/DC
		D	48…127V AC and 48…60V DC
		N	208…380V AC and 110…127V DC
		B	415…600V AC and 220…250V DC

h

UV and Shunt Trips - N			
1st Code	Description	2nd Code	Description
Left Front		UV Voltage	
G	Undervoltage Trip	J	24V AC
		D	110…127V AC
		A	208…240V AC
		B	380…480V AC
Left Front		Shunt Voltage	
P	Shunt Trip	J	12…24V AC/DC
		D	110…240V AC and 110…125V DC
		N	380…440V AC and 220…250V DC
		B	480…600V AC

IEC Performance Data

		Cat. No. 140M-C2E-												
		A16	A25	A40	A63	B10	B16	B25	B40	B63	C10	C16	C20	C25
Rated Operational Current, I_e	[A]	0.16	0.25	0.4	0.63	1	1.6	2.5	4	6.3	10	16	20	25
Magnetic Release Current	[A]	2.1	3.3	5.2	8.2	13	21	33	52	82	130	208	260	325
Switching of Standard Three-Phase Motors														
AC-2, AC-3														
230/240V	[kW]	—	—	—	0.06/0.09	0.12	0.18/0.25	0.37	0.55/0.75	1.1/1.5	2.2	3.0/4.0	4.0/5.5	—
400/415V	[kW]	0.02	0.06	0.09	0.12/0.18	0.25	0.37/0.55	0.75	1.1/1.5	2.2	3.0/4.0	5.5/7.5	7.5/10	11
500V	[kW]	—	—	—	0.18	0.25/0.37	0.55/0.75	1.1	1.5/2.2	2.5/3.0	4.0/6.3	7.5/10	11	15
690V	[kW]	—	—	—	0.25	0.37/0.55	0.75/1.1	1.8	2.2/3.0	4.0	5.5/7.5	11/13	15/17	18.5/22
Back-Up Fuses														
gG, gL, only if $I_{cc} \geq I_{cu}$														
230/240V	[A]	∗	∗	∗	∗	∗	∗	∗	∗	∗	∗	∗	100	100
400/415V	[A]	∗	∗	∗	∗	∗	∗	∗	∗	∗	∗	80	100	100
440/460V	[A]	∗	∗	∗	∗	∗	∗	∗	∗	∗	∗	80	80	80
500V	[A]	∗	∗	∗	∗	∗	∗	∗	∗	∗	80	80	80	80
690V	[A]	∗	∗	∗	∗	∗	16	20	35	50	50	63	63	63
Ultimate Short Circuit Breaking Capacity														
I_{cu}														
230/240V	[kA]	100	100	100	100	100	100	100	100	100	100	100	50	50
400/415V	[kA]	100	100	100	100	100	100	100	100	100	100	65	50	15
440/460V	[kA]	100	100	100	100	100	100	100	100	100	50	10	6	6
500V	[kA]	100	100	100	100	100	100	100	100	100	50	10	6	6
690V	[kA]	100	100	100	100	100	8	8	8	4	4	3	3	3
Rated Service Short Circuit Breaking Capacity														
I_{cs}														
230/240V	[kA]	100	100	100	100	100	100	100	100	100	100	100	50	50
400/415V	[kA]	100	100	100	100	100	100	100	100	100	100	50	15	15
440/460V	[kA]	100	100	100	100	100	100	100	100	100	50	6	6	6
500V	[kA]	100	100	100	100	100	100	100	100	100	50	6	6	6
690V	[kA]	100	100	100	100	100	8	8	8	4	4	3	3	3

∗ No back-up fuse required.

IEC Performance Data, Continued

		Cat. No. 140M-D8E-							Cat. No. 140M-F8E-					
		B25	B40	B63	C10	C16	C20	C25	C10	C16	C20	C25	C32	C45
Rated Operational Current, I_e	[A]	2.5	4.0	6.3	10	16	20	25	10	16	20	25	32	45
Magnetic Release Current	[A]	33	52	82	130	208	260	325	130	208	260	325	416	585
Switching of Standard Three-Phase Motors														
AC-2, AC-3														
230/240V	[kW]	0.37	0.55/0.75	1.1/1.5	2.2	3.0/4.0	4.0/5.5	—	2.2	3.0/4.0	4.0/5.5	5.5/6.3	7.5	11/13
400/415V	[kW]	0.75	1.1/1.5	2.2	3.0/4.0	5.5/7.5	7.5/10	11	3.0/4.0	5.5/7.5	7.5/10	11	15	18.5/22
500V	[kW]	1.1	1.5/2.2	2.5/3.0	4.0/6.3	7.5/10	11	15	4.0/6.3	7.5/10	11	15	15/20	22/30
690V	[kW]	1.8	2.2/3.0	4.0	5.5/7.5	11/13	15/17	18.5/22	5.5/7.5	11/13	15/17	18.5/22	22/25	30/40
Back-Up Fuses														
gG, gL, only if $I_{cc} \geq I_{cu}$														
230/240V	[A]	*	*	*	*	*	*	*	*	*	*	*	*	*
400/415V	[A]	*	*	*	*	*	100	100	80	100	100	100	125	125
440/460V	[A]	*	*	*	*	*	100	100	80	100	100	100	125	125
500V	[A]	*	*	*	*	80	100	100	80	100	100	100	125	125
690V	[A]	20	35	50	50	63	63	63	63	80	80	80	100	100
Ultimate Short Circuit Breaking Capacity														
I_{cu}														
230/240V	[kA]	100	100	100	100	100	100	100	100	100	100	100	100	100
400/415V	[kA]	100	100	100	100	100	65	65	65	65	65	65	65	65
440/460V	[kA]	100	100	100	100	65	65	65	65	65	65	65	65	50
500V	[kA]	100	100	100	100	50	50	50	50	50	50	50	50	50
690V	[kA]	10	10	10	6	6	6	6	10	10	10	10	10	10
Rated Service Short Circuit Breaking Capacity														
I_{cs}														
230/240V	[kA]	100	100	100	100	100	100	100	100	100	100	100	100	100
400/415V	[kA]	100	100	100	100	50	25	25	50	50	50	50	50	50
440/460V	[kA]	100	100	100	100	50	25	25	50	50	50	50	50	50
500V	[kA]	100	100	100	100	50	25	25	50	50	50	50	50	50
690V	[kA]	10	10	10	6	4	4	4	10	10	10	10	6	6

IEC Performance Data, Continued

Cat. No.		140-CMN-...			
		-2500	-4000	-6300	-9000
Rated Operational Current, I_e	[A]	25	40	63	90
Magnetic Release Current	[A]	350	560	890	1260
Switching of Standard Three-Phase Motors					
AC-2, AC-3					
230/240V❄	[kW]	5.5/7.5	10/11	13/20	22/25
400/415V❄	[kW]	7.5/13	15/22	25/32	37/45
500V❄	[kW]	11/15	18.5/25	30/40	45/55
690V❄	[kW]	15/22	25/30	37/55	63/75
Back-up fuses					
gG, gL,, only if $I_{cc} \geq I_{cu}$					
230/240V	[A]	∗	∗	∗	∗
400/415V	[A]	160	160	160	160
500V	[A]	160	160	160	160
690V	[A]	160	160	160	160
Ultimate short-circuit breaking capacity I_{cu}					
230/240V	[kA]	100	100	100	100
400/415V	[kA]	65	65	65	50
500V	[kA]	50	30	30	25
690V	[kA]	15	8	8	6
Rated service short-circuit breaking capacity I_{cs}					
230/240V	[kA]	100	100	100	100
400/415V	[kA]	65	50	50	25
500V	[kA]	50	25	25	13
690V	[kA]	15	8	6	6

∗ No back-up fuse required.

❄ Power ratings: Preferred values according to IEC 60072-1.

IEC Performance Data, Continued

		Cat. No. 140M-C2N-						
		A16	A25	A40	A63	B10	B16	B25
Rated Operational Current, I_e	[A]	0.16	0.25	0.4	0.63	1	1.6	2.5
Magnetic Release Current	[A]	2.1	3.3	5.2	8.2	13	21	32
Switching of Standard Three-Phase Motors								
AC-2, AC-3								
230/240V	[kW]	—	—	—	0.06/0.09	0.12	0.18/0.25	0.37
400/415V	[kW]	0.02	0.06	0.09	0.12/0.18	0.25	0.37/0.55	0.75
500V	[kW]	—	—	—	0.18	0.25/0.37	0.55/0.75	1.1
690V	[kW]	—	—	—	0.25	0.37/0.55	0.75/1.1	1.8
Back-Up Fuses								
gG, gL, only if $I_{cc} \geq I_{cu}$*								
230/240V	[A]	*	*	*	*	*	*	*
400/415V	[A]	*	*	*	*	*	*	*
440/460V	[A]	*	*	*	*	*	*	*
500V	[A]	*	*	*	*	*	*	*
690V	[A]	*	*	*	*	*	16	20
Ultimate Short Circuit Breaking Capacity								
I_{cu}								
230/240V	[kA]	100	100	100	100	100	100	100
400/415V	[kA]	100	100	100	100	100	100	100
440/460V	[kA]	100	100	100	100	100	100	100
500V	[kA]	100	100	100	100	100	100	100
690V	[kA]	100	100	100	100	100	10	8
Rated Service Short Circuit Breaking Capacity								
I_{cs}								
230/240V	[kA]	100	100	100	100	100	100	100
400/415V	[kA]	100	100	100	100	100	100	100
440/460V	[kA]	100	100	100	100	100	100	100
500V	[kA]	100	100	100	100	100	100	100
690V	[kA]	100	100	100	100	100	8	8

* No back-up fuse required.

IEC Performance Data, Continued

		Cat. No. 140M-D8N-						Cat. No. 140M-F8N-		
		B25	B40	B63	C10	C16	C25	C25	C32	C45
Rated Operational Current, I_e	[A]	2.5	4.0	6.3	10	16	25	25	32	45
Magnetic Release Current	[A]	32	52	82	130	208	325	325	416	585
Switching of Standard Three-Phase Motors										
AC-2, AC-3										
230/240V	[kW]	0.37	0.55/0.75	1.1/1.5	2.2	3.0/4.0	—	5.5/6.3	7.5	11/13
400/415V	[kW]	0.75	1.1/1.5	2.2	3.0/4.0	5.5/7.5	11	11	15	18.5/22
500V	[kW]	1.1	1.5/2.2	2.5/3.0	4.0/6.3	7.5/10	15	15	15/20	22/30
690V	[kW]	1.8	2.2/3.0	4.0	5.5/7.5	11/13	18.5/22	18.5/22	22/25	30/40
Back-Up Fuses										
gG, gL, only if $I_{cc} \geq I_{cu}$										
230/240V	[A]	∗	∗	∗	∗	∗	∗	100	125	125
400/415V	[A]	∗	∗	∗	∗	∗	100	100	125	125
440/460V	[A]	∗	∗	∗	∗	80	100	100	125	125
500V	[A]	∗	∗	∗	∗	80	80	100	125	125
690V	[A]	20	35	50	50	63	63	80	100	100
Ultimate Short Circuit Breaking Capacity										
I_{cu}										
230/240V	[kA]	100	100	100	100	100	100	100	100	100
400/415V	[kA]	100	100	100	100	100	50	65	65	65
440/460V	[kA]	100	100	100	100	50	50	65	65	50
500V	[kA]	100	100	100	100	50	25	50	50	50
690V	[kA]	10	10	10	6	6	6	10	10	10
Rated Service Short Circuit Breaking Capacity										
I_{cs}										
230/240V	[kA]	100	100	100	100	100	100	100	100	100
400/415V	[kA]	100	100	100	100	50	25	50	50	50
440/460V	[kA]	100	100	100	100	50	25	50	50	50
500V	[kA]	100	100	100	100	50	25	50	50	50
690V	[kA]	10	10	10	6	4	4	10	6	6

∗ No back-up fuse required.

IEC Performance Data, Continued

		Cat. No. 140M-D8T-		Cat. No. 140M-F8T-	
		C16	C20	C25	C32
Rated Operational Current, I_e	[A]	16	20	25	32
Magnetic Release Current	[A]	260	325	416	585
Switching of Standard Three-Phase Motors					
AC-2, AC-3					
230/240V ❄	[kW]	3.0/4.0	4.0/5.5	5.5/6.3	7.5
400/415V ❄	[kW]	5.5/7.5	7.5/10	11	15
500V ❄	[kW]	7.5/10	11	15	15/20
690V ❄	[kW]	11/13	15/17	18.5/22	22/25
Back-up fuses					
gG, gL,, only if $I_{cc} \geq I_{cu}$					
230/240V	[A]	✶	✶	✶	✶
400/415V	[A]	80	100	100	125
440/460V	[A]	80	100	100	125
500V	[A]	80	80	100	125
690V	[A]	63	63	80	100
Ultimate short-circuit breaking capacity					
I_{cu}					
230/240V	[kA]	100	100	100	100
400/415V	[kA]	65	65	65	65
440/460V	[kA]	65	65	65	65
500V	[kA]	50	25	50	50
690V	[kA]	6	6	10	10
Rated service short-circuit breaking capacity I_{cs}					
I_{cs}					
230/240V	[kA]	100	100	100	100
400/415V	[kA]	25	25	50	50
440/460V	[kA]	25	25	50	50
500V	[kA]	25	25	50	50
690V	[kA]	4	4	6	6

✶ No back-up fuse required.
❄ Consult your local Rockwell Automation sales office or Allen-Bradley distributor.

IEC Performance Data, Continued

		Cat. No. 140M-C2T-										
		A16	A25	A40	A63	B10	B16	B25	B40	B63	C10	C16
Rated Operational Current, I_e	[A]	0.16	0.25	0.40	0.63	1.0	1.6	2.5	4.0	6.3	10	16
Magnetic Release Current	[A]	3.2	5.2	8.2	13	21	32	52	82	130	208	260
Switching of Standard Three-Phase Motors												
AC-2, AC-3												
230/240V	[kW]	—	—	—	0.06/0.09	0.12	0.18/0.25	0.37	0.55/0.75	1.1/1.5	2.2	3.0/4.0
400/415V	[kW]	0.02	0.06	0.09	0.12/0.18	0.25	0.37/0.55	0.75	1.1/1.5	2.2	3.0/4.0	5.5/7.5
500V	[kW]	—	—	—	0.18	0.25/0.37	0.55/0.75	1.1	1.5/2.2	2.5/3.0	4.0/6.3	7.5/10
690V	[kW]	—	—	—	0.25	0.37/0.55	0.75/1.1	1.8	2.2/3.0	4.0	5.5/7.5	11/13
Back-Up Fuses												
gG, gL, only if $I_{cc} \geq I_{cu}$												
230/240V	[A]	✶	✶	✶	✶	✶	✶	✶	✶	✶	✶	✶
400/415V	[A]	✶	✶	✶	✶	✶	✶	✶	✶	✶	✶	80
440/460V	[A]	✶	✶	✶	✶	✶	✶	✶	✶	✶	✶	80
500V	[A]	✶	✶	✶	✶	✶	✶	✶	✶	✶	80	80
690V	[A]	✶	✶	✶	✶	✶	16	20	35	50	50	63
Ultimate Short Circuit Breaking Capacity												
I_{cu}												
230/240V	[kA]	100	100	100	100	100	100	100	100	100	100	100
400/415V	[kA]	100	100	100	100	100	100	100	100	100	100	50
440/460V	[kA]	100	100	100	100	100	100	100	100	100	50	10
500V	[kA]	100	100	100	100	100	100	100	100	100	50	10
690V	[kA]	100	100	100	100	100	8	8	8	4	4	3
Rated Service Short Circuit Breaking Capacity												
I_{cs}												
230/240V	[kA]	100	100	100	100	100	100	100	100	100	100	100
400/415V	[kA]	100	100	100	100	100	100	100	100	100	100	15
440/460V	[kA]	100	100	100	100	100	100	100	100	100	50	6
500V	[kA]	100	100	100	100	100	100	100	100	100	50	6
690V	[kA]	100	100	100	100	100	8	8	8	4	4	3

✶ No back-up fuse required.

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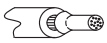
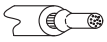
General Data

Cat. No.		140M-C	140M-D	140M-F	140-CMN
Rated Insulation Voltage U_i					
IEC, SEV, VDE 0660	[V]	690			690
UL, CSA	[V]	600			600
Rated Impulse Withstand Voltage U_{imp}					
Pollution degree		3			3
Main circuits U_{imp} /Overvoltage Category		6 kV/III			6 kV/III
Auxiliary circuits U_{imp} /Overvoltage Category		6 kV/III			6 kV/III
Rated Frequency	[Hz]	50/60			40…60
Utilization Category					
IEC 60947-2 (Circuit breaker)		A			A
IEC 60947-4-1 (Motor starter)		AC-3			AC-3
Life Span					
Mechanical	[operations]	100 000		30 000	30 000
Electrical (I_e max.)	[operations]	100 000		30 000	10 000 (up to 63 A) 5 000 (up to 90 A)
Switching Frequency	[operations/h]	max. 25 (motor starts)			max. 20
Ambient Temperature					
Storage	[°C]	-40 … +80			-25… +80
Operation	[°C]	-25… +60			
Resistance to Climatic Change		IEC 68-2			C IV (acc. to IEC 68)
Moisture/heat resistance		40 °C, 92% relative humidity, 56 days			
Moisture/change resistance		23 °C, 83%/40 °C, 92%, 50 cycles			
Site Altitude	[m]	to 2000 N.N.			
Protection Class		IP20, when wired			
Resistance to Shock	[g]	30, 11 ms			30, 11 ms
Resistance to Vibration		IEC 68-2			
Frequency range	[Hz]				10…150
in all directions	[g]				under testing
Rated Thermal Current I_{th}					
IEC, SEV, VDE 0660					
up to 40 °C ambient temperature	[A]	0.1…25	1.6…25	6.3…45	16… 90
up to 60 °C ambient temperature	[A]	0.1…25	1.6…25	6.3…45	16… 90
Rated Supply Current I_e	[A]	0.1…25	1.6…25	6.3…45	16… 90
Number of setting ranges		13	7	6	4
Dependence on Temperature					
40 °C	[A]	no reduction			
50 °C	[A]	no reduction			
60 °C	[A]	no reduction			
70 °C	[A]	15 % current reduction of the upper rated current I_e			
Overload Protection					
Characteristics		IEC 60947-4-1 Motor protection (except Cat. Nos. 140M-C2N, 140M-D8N, 140M-F8N)			IEC 60947-4-1 Motor protection
Ambient Temperature Compensation	[°C]	-20 …+60			
Phase-loss Protection		Differential release			
Trip class		10 (except Cat. Nos. 140M-C2N, 140M-D8N, 140M-F8N) fixed setting			10
Magnetic Release Release current		fixed setting 13 x I_e max. (for 140M-C2E, 140M-D8E, 140M-F8E, 140M-C2N, 140M-D8N, 140M-F8N) 16…20 x I_e max. (for 140M-C2T, 140M-D8T, 140M-F8T) I_e max. = maximum values of setting ranges			fixed setting 14 x I_e max.
Total Power loss P_v					
Circuit Breaker at rated load operating temperature	[W]	6…8	6…8	9…16	33
Main Circuit Breaker Application		Usable as main circuit breaker according to IEC 204 with corresponding accessories			

General Data, Continued

Cat. No.		140M-C…	140M-D…	140M-F…	140-CMN
Conformity to Standards		IEC 60947-1; -2; -4-1; EN 60947-1; -2; -4-1; UL 508; CSA 22.2, No. 14			IEC 60947-1; -2; -4-1; EN 60947-1; -2; -4-1; UL 508; CSA 22.2, No. 14
Approvals		CE, UL, CSA			CE, UL, CSA
Terminal Parts Type of terminals Screwdriver		 ***Pozidriv No. 2/Blade No. 3***		 ***Pozidriv No. 2/Blade No. 3***	
 1. conductor 2. conductor	[mm²]/[AWG] [mm²]/[AWG]	1…4/No. 16…10 1…4/No. 16…10		2.5…16/No. 14…4 2.5…10/No. 14…4	2.5…35
1. conductor 2. conductor	[mm²]/[AWG] [mm²]/[AWG]	1.5…6/No. 16…8 1.5…6/No. 16…8		2.5…16/No. 14…4 2.5…10/No. 14…4	4…50 / 12…2
1. conductor 2. conductor	[mm²]/[AWG] [mm²]/[AWG]	1…6/No. 16…10 1…6/No. 16…10		2.5…25/No. 14…4 2.5…16/No. 14…4	4…50 / 12…2
Tightening torque	[Nm]/[lb•in]	2…2.5/18…22		3…3.5/27…30	6…10/55…90

Accessories for Bulletin 140M Motor Protection Circuit Breakers

		Auxiliary Contact Blocks for Front Mounting Cat. No. 140M-C-AFA…, 140M-C-AFAR…			Auxiliary Contact Blocks for Right-Side Mounting Cat. No. 140M-C-ASA…, 140M-C-ASAR…				
Rated Thermal Current I_{th} at 40 °C ambient temperature at 60 °C ambient temperature	[A] [A]	5 4			10 6				
Contact Class Coordination According to NEMA (UL/CSA Standards)	AC DC	B 300 Q 300			B 600 Q 600				
Back-Up Fuses gG, gL	[A]	10			10				
Rated Supply Current	[V]	24	120	240	24	120	240	415	690
AC-15	[A]	4	3	1.5	6	5	3	2	0.7
DC-13	[V]	24	120	240	24	120	240	415	
	[A]	2	0.5	0.25	2	0.5	0.25	0.15	
Terminal Parts Type of terminals Screwdriver		 *Pozidriv No. 2/Blade No. 3*							
 1. conductor 2. conductor	[mm²]/[AWG] [mm²]/[AWG]	0.5…1.5/18…14 0.75…1.5/18…14			0.5…2.5/18…14 0.75…2.5/18…14				
1. conductor 2. conductor	[mm²]/[AWG] [mm²]/[AWG]	0.75…1.5/18…14 0.75…1.5/18…14			0.75…2.5/18…14 0.75…2.5/18…14				
1. conductor 2. conductor	[mm²]/[AWG] [mm²]/[AWG]	0.75…1.5/18…14 0.75…1.5/18…14			0.75…2.5/18…14 0.75…2.5/18…14				
Tightening torque	[N•m]/[lb•in]	1.2…1.5/10.6…13			1.2…1.5/10.6…13				

Accessories for Bulletin 140M Motor Protection Circuit Breakers, Continued

		Undervoltage Trip for Left-Side Mounting Cat. No. 140M-C-UX…	Undervoltage Trip with 2 Auxiliary Contacts for Left-Side Mounting Cat. No. 140M-C-UC…	Shunt Trip for Left-Side Mounting Cat. No. 140M-C-SN…
Actuating Voltage				
Pull-in		0.85…1.1 x U_s	0.85…1.1 x U_s	0.7…1.1 x U_s
Drop-out		0.7…0.35 x U_s	0.7…0.35 x U_s	
Rated Control Voltage	min.	21V 50 Hz, 24V 60 Hz	21V 50 Hz, 24V 60 Hz	21V 50 Hz, 24V 60 Hz
	max.	600V 50 Hz	600V 50 Hz	600V 50 Hz
On-Time		100%	100%	100%
Coil Rating	Pull-in	8.5 VA, 6 W	8.5 VA, 6 W	8.5 VA, 6 W
	Hold	3 VA, 1.2 W	3 VA, 1.2 W	3 VA, 1.2 W
Terminal Parts				
Type of terminals				
Screwdriver		Pozidriv No. 2/Blade No. 3		
1. conductor	[mm²]/[AWG]	0.5…2.5/No. 18…14		
2. conductor	[mm²]/[AWG]	0.75…2.5/No. 18…14		
1. conductor	[mm²]/[AWG]	0.75…2.5/No. 18…14		
2. conductor	[mm²]/[AWG]	0.75…2.5/No. 18…14		
1. conductor	[mm²]/[AWG]	0.75…2.5/No. 18…14		
2. conductor	[mm²]/[AWG]	0.75…2.5/No. 18…14		
Tightening torque	[N•m]/[lb•in]	1.25…1.5/10.6…13.3		

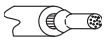
		Commoning Link Feeder Terminal 140M-C-WTE		Commoning Link	
Rated Thermal Current I_{th} at 60 °C ambient temperature		140M-C-WTE	140M-F-WTE	140M-C-W	140M-F-W
	[A]	64	120	64	120
1. conductor	[mm²]/[AWG]	1.5…16	4…50/12…110	—	—
1. conductor	[mm²]/[AWG]	1.5…25/No. 14…4	2.5…50/12…110	—	—
1. conductor	[mm²]/[AWG]	1.5…25/No. 14…4		—	—
Tightening torque	[N•m]/[lb•in]	3/27	5…6/45…54	—	—

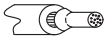
Weights

Description	Weight [g]	Cat.No.
Motor Protection Circuit Breakers	317	140M-C2E-…
	373	140M-D8E-…
	782	140M-F8E-…
	315	140M-C2N-…
	365	140M-D8N-…
	782	140M-F8N-…
	315	140M-C2T-…
	365	140M-D8T-…
	782	140M-F8T-…
	1845	140-CMN-…
Auxiliary Contacts	10	140M-C-AFA10
		140M-C-AFA01
		140M-C-AFA11
		140M-C-AFA20
		140M-C-ASA…
	15	140M-C-AFAR10A…
		140M-C-ASAR…M…
		140M-C-ASAM11
	31	140-CA…
Undervoltage Trip	108	140M-C-UX…
	110	140M-C-SN…
	116	140M-C-UC…
	94	140-CUV…
Trip Contact Blocks	31	140-CT…
Shunt Trip	94	140-CRT…

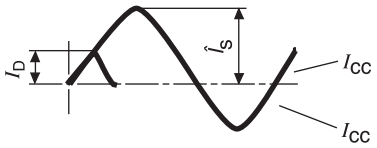
	Weight [g]	Cat.No.
Anti-Tamper Cover	2	140M-C-CA
Lockable Twist Knob	5	140M-C-KN
		140M-C-KRY
Locking Tag	30	140M-C-M3
Door Coupling Handle	123	140M-C-DN66
		140M-C-NRY66
Extension Shaft	46	140M-C-DS
Legend Plate	4	140M-C-DFC…
Feeder Terminal	172	140M-C-WT
		140M-F-WT
Commoning Links	47	140M-C-W452
	80	140M-C-W453
	104	140M-C-W454
	132	140M-C-W455
	52	140M-C-W542
	86	140M-C-W543
	118	140M-C-W544
	154	140M-C-W545
	56	140M-C-W632
	92	140M-C-W633
	134	140M-C-W634
	170	140M-C-W635

Accessories for Bulletin 140-CMN Circuit Breakers

		Cat. No. 140-CT Trip Contact Block for Flush Mounting on Cat. No. 140-CMN Circuit Breakers					Cat. No. 140-CRT, 140-CUV Undervoltage Trip and Shunt Trip for Flush Mounting on Cat. No. 140-CMN Circuit Breakers					
Rated Thermal Current I_{th} up to 40 °C ambient temperature up to 60 °C ambient temperature	[A] [A]	10 6					2 2					
NEMA contact class (UL/CSA-Approval)	AC DC	B 600 Standard Pilot Duty R 300 Light Pilot Duty					Make/Break max. voltage 432 VA72 VA480 V 28 VA28 VA250 V					
Back-Up Fuse gG, gL		16 A					16 A					
Rated Current I_e												
AC-15:	[V] [A]	230 3	400 2.5	500 1.5	690 0.75		AC-14:	24 1.5	110 1.5	230 1.0	400 1.0	500 0.75
DC-13:	[V] [A]	24 2	48 0.6	110 0.2	230 0.1	440 0.04	DC 13:	24 1.5	48 0.5	60 0.4	110 0.2	
Terminals												
Screwdriver												
 1.conductor 2.conductor	[mm2]/[AWG] [mm2]/[AWG]	0.75… 2.5/No. 18… 14 0.75… 2.5/No. 18… 14					0.75… 2.5/No. 18… 14 0.75… 2.5/No. 18… 14					
1.conductor 2.conductor	[mm2]/[AWG] [mm2]/[AWG]	0.75… 2.5/No. 18… 14 0.75… 2.5/No. 18… 14					0.75… 2.5/No. 18… 14 0.75… 2.5/No. 18… 14					
Tightening torque	[N•m]/[lb•in]	1… 1.5/8.8… 10.3					1… 1.5/8.8… 10.3					

		Cat. No. 140-CUV... Undervoltage Trip Unit for Right-Side Mounting on Cat. No. 140-CMN Circuit Breakers	Cat. No. 140-CRT... Shunt Trip for Flush Mounting on Cat. No. 140-CMN Circuit Breakers
Operating Voltage			
Pick-up		0.8… 1.1 x U_s	0.7… 1.1 x U_s
Drop-out		0.7… 0.35 x U_s	—
Duty cycle		100 % ED	100 % ED
Control Voltage			
	min.	12 V 50 Hz/14 V 60 Hz	12 V 50 Hz/14 V 60 Hz
	max.	600 V 50 Hz	600 V 50 Hz
Coil Performance			
Pick-up Drop-out	[VA/W] [VA/W]	11 / 8 4 / 1	12 / 7 6 / 2
Terminals **Terminal type**			
 Fine-stranded	[mm2]	2 x 0.75…2.5	2 x 0.75…2.5
Coarse-stranded	[mm2]	2 x 0.75…2.5	2 x 0.75…2.5
Tightening torque	[Nm]	1… 1.5	1… 1.5
Coarse-stranded	[AWG]	No. 18…. 14	No. 18…. 12
Tightening torque	[lb•in]	8.8… 10.3	8.8… 10.3

Cut-off current



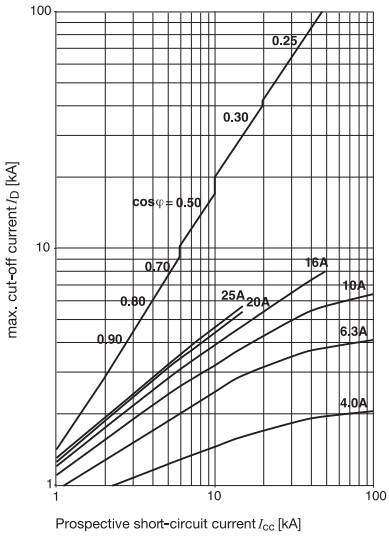
asymmetrical

symmetrical

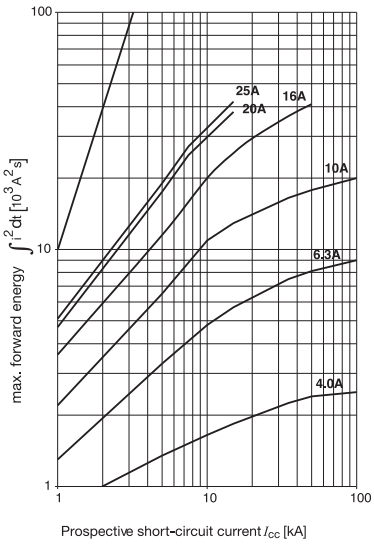
The Bulletin 140-M limits solid short-circuit current I_{CC} (prospective short-circuit current). ID is the maximum cut-off current (highest instantaneous value of the limited short-circuit current). This value is indicated in the following diagrams as a function of the progressive system short-circuit current.

Bulletin 140M-C Circuit Breaker

Maximum cut-off current
Rated operating voltage 415V

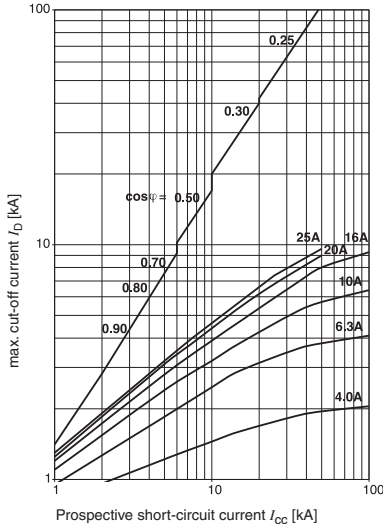


Maximum forward energy
Rated operating voltage 415V

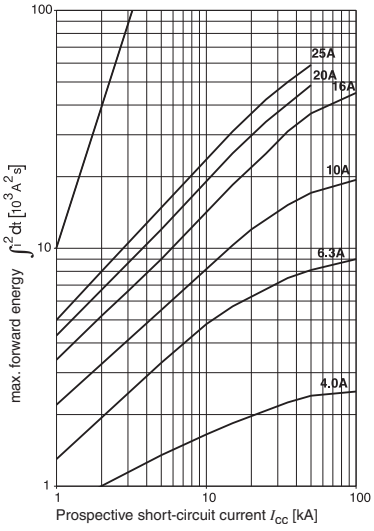


Bulletin 140M-D Circuit Breaker

Maximum cut-off current
Rated operating voltage 415V



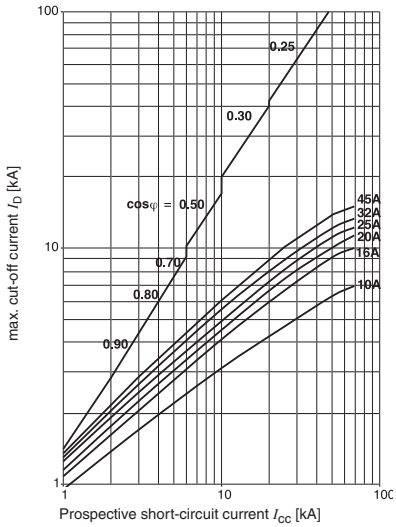
Maximum cut-off current
Rated operating voltage 415V



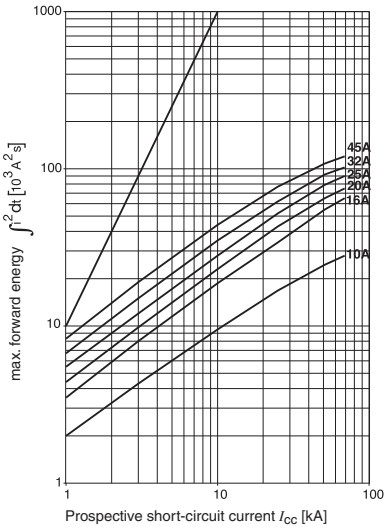
2

Bulletin 140M-F Circuit Breaker

Maximum cut-off current
Rated operating voltage 415V

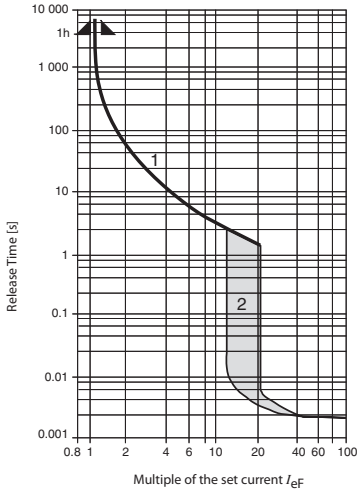


Maximum cut-off current
Rated operating voltage 415V

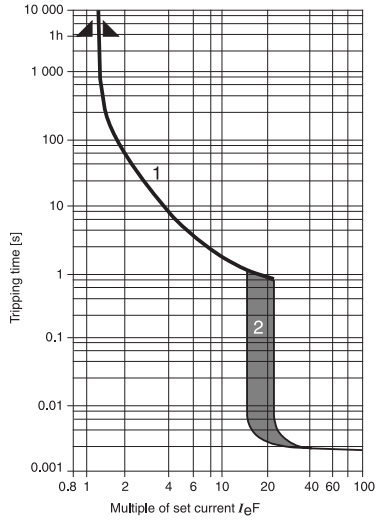


Time-Current Characteristic

Bulletin 140M-C, -D, -F Motor Protection Circuit Breakers



Bulletin 140-CMN Motor Protector



1) Thermal Release Trip Current

The adjustable current-dependent delayed bimetal release protects motors against overload. The curve shows the mean operating current at an ambient temperature of 20 °C starting from the cold state. Careful testing and setting ensures effective motor protection even in the case of single-phasing. The overload characteristic is also valid for transformer protection.

2) Magnetic Release Trip Current

The instantaneous magnetic trip has a fixed operating current setting. This corresponds to 13 times the maximum value of setting range. (Transformer protection up to 20 x I_e max.) At a lower setting it is correspondingly higher.

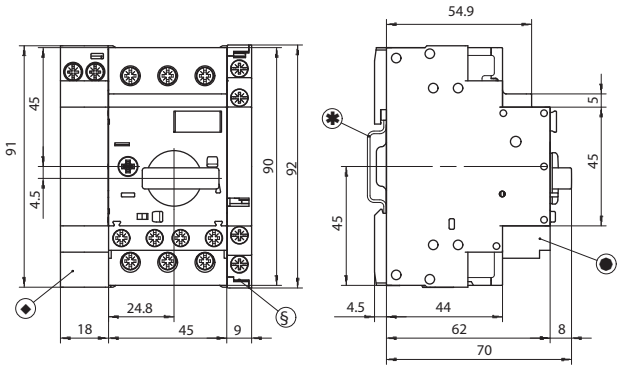
Current Setting I_{eF}

The overload trip corresponds to a thermal overload relay in a motor starter conforming to IEC947-4-1. If a different value is prescribed (e.g., reduced I_e for cooling medium having a temperature higher than 40 °C or a place of installation higher than 2000 m above sea level), the setting current is equal to the reduced rated current I_e of the motor.

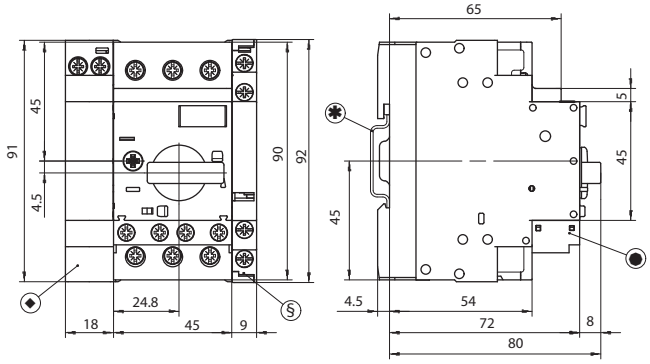
Cat. No. 140M-C, -D, -F

Dimensions are shown in millimeters. Dimensions are not intended to be used for manufacturing purposes.

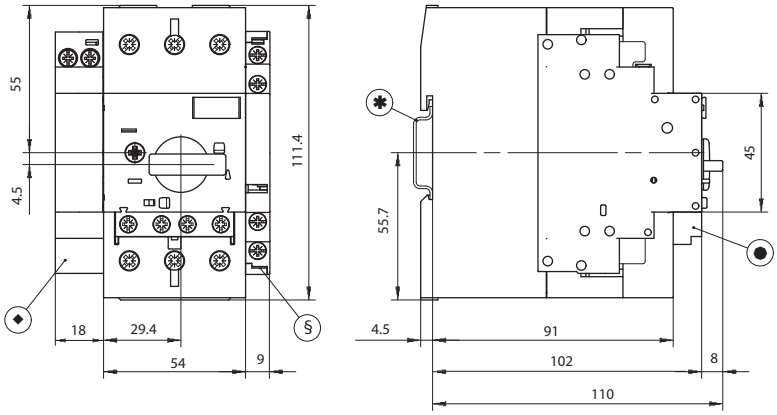
Cat. No. 140M-C2…



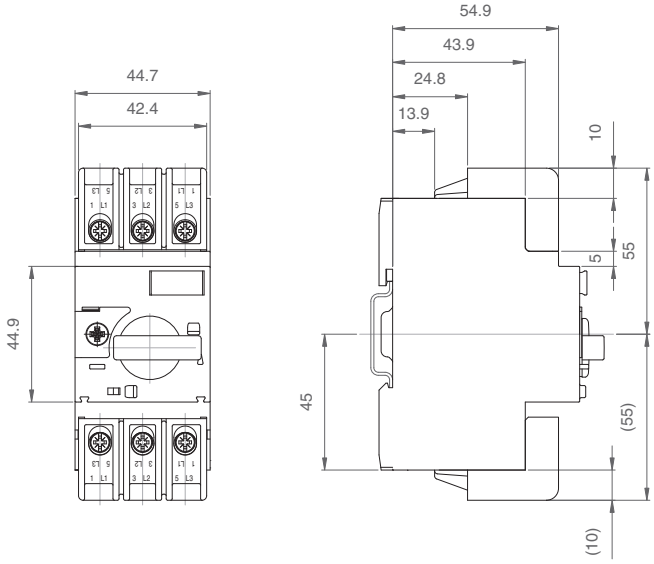
Cat. No. 140M-D8…



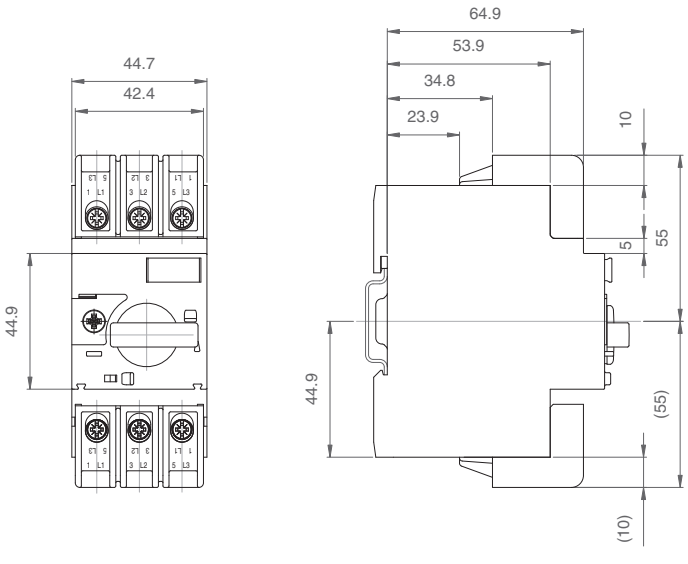
Cat. No. 140M-F8…



✱Mounting on 35 mm DIN Rail
§ Auxiliary contact (side mounted)
◆Undervoltage/shunt trip
● Auxiliary contact (front mounted)

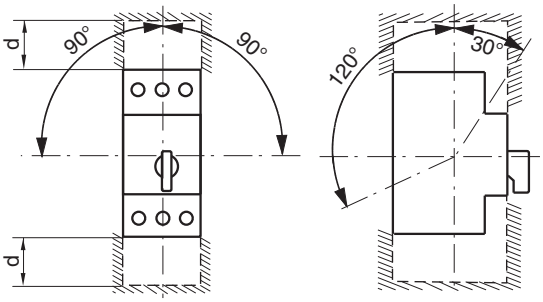


Cat. No. 140M-C-TE1 Type E adapter on Cat. No. 140M-C2E…

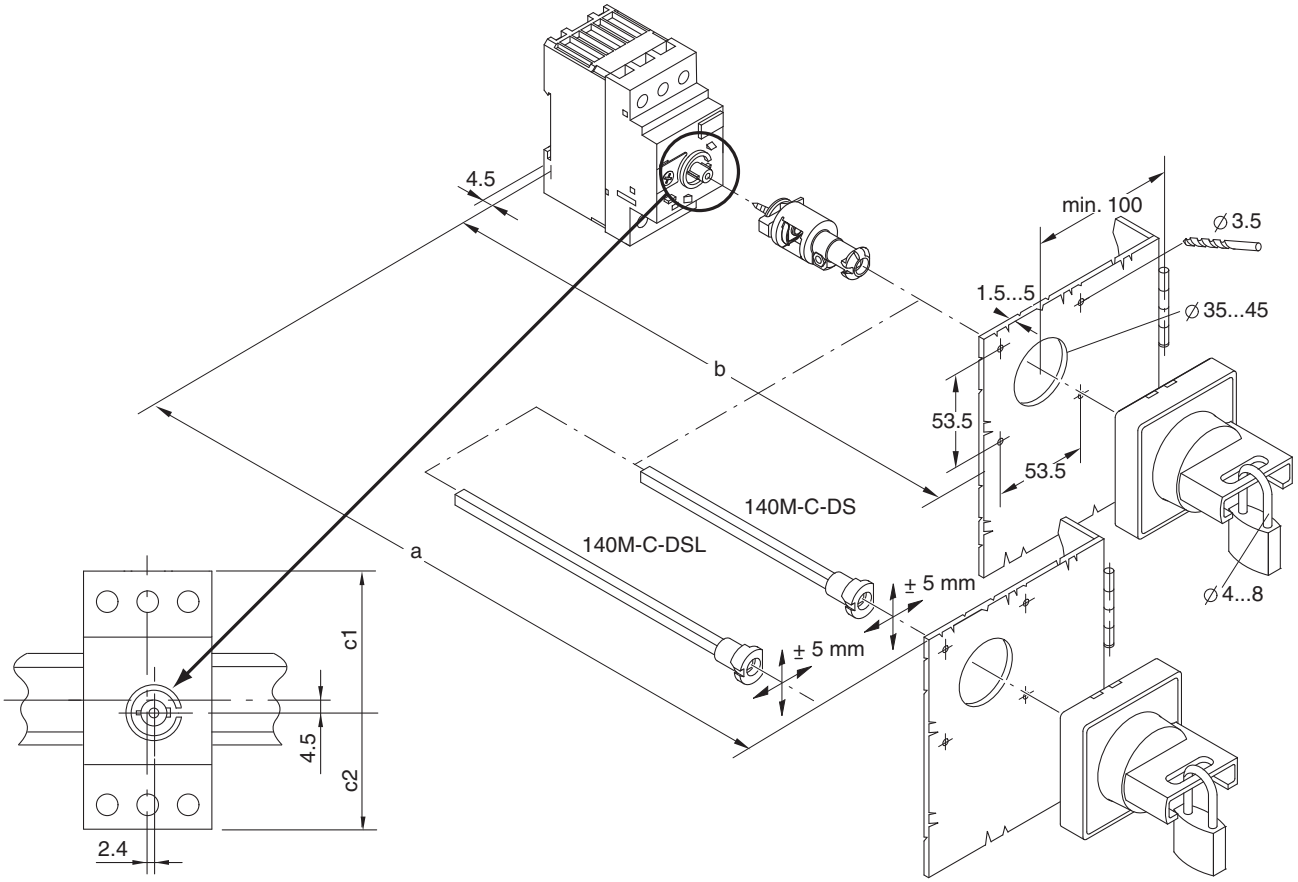


Cat. No. 140M-C-TE1 Type E adapter on Cat. No. 140M-D8E…

Dimensions are shown in millimeters. Dimensions are not intended to be used for manufacturing purposes.



Mounting position/safety clearance of Cat. No. 140M-C..., 140M-D..., 140M-F...



140M-C-D...66

With Cat. No. 140-M-C-DS Shaft

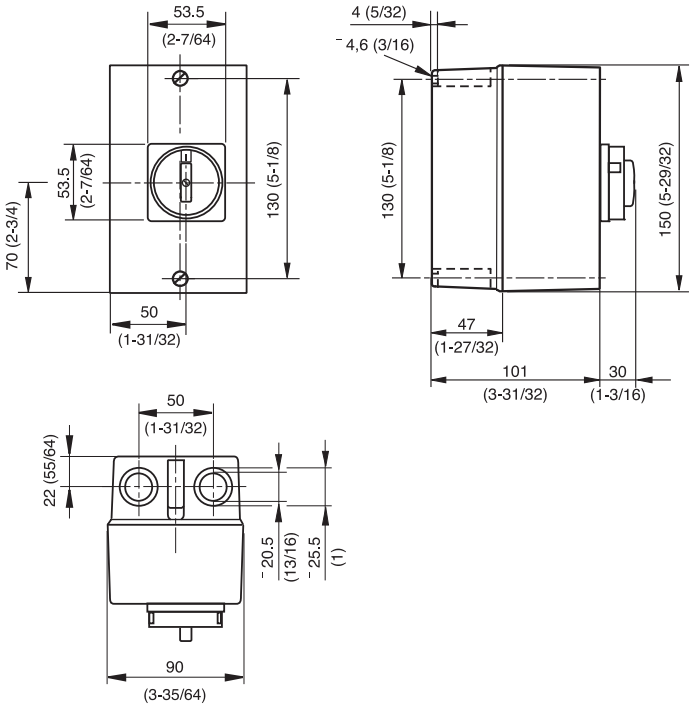
Cat. No.	a	b	c1	c2	d
140M-C	117...338	105.5 ±5	49.5	40.5	25
140M-D	126...347	114.5 ±5	49.5	40.5	25
140M-F	148.6...369.6	137.1 ±5	59.35	50.35	30

With Cat. No. 140-M-C-DSL Shaft

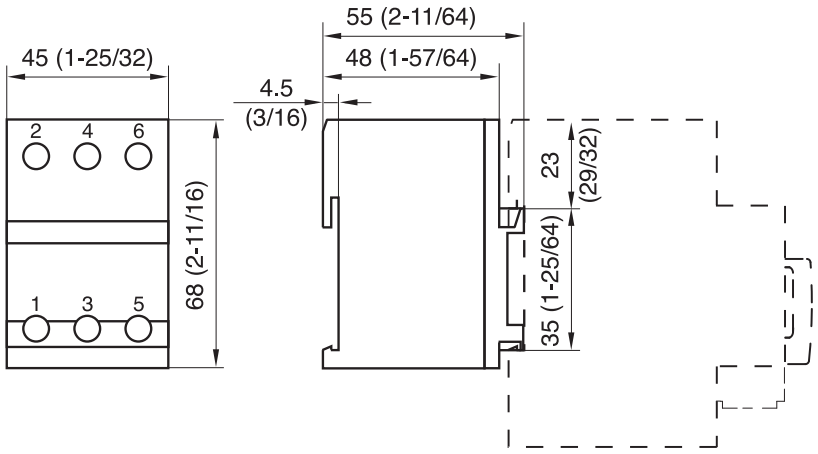
Cat. No.	a	b	c1	c2	d
140M-C	117...438	105.5 ±5	49.5	40.5	25
140M-D	126...497	114.5 ±5	49.5	40.5	25
140M-F	148.6...519	137.1 ±5	59.35	50.35	30

Dimensions are shown in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

Cat. No. 198E...



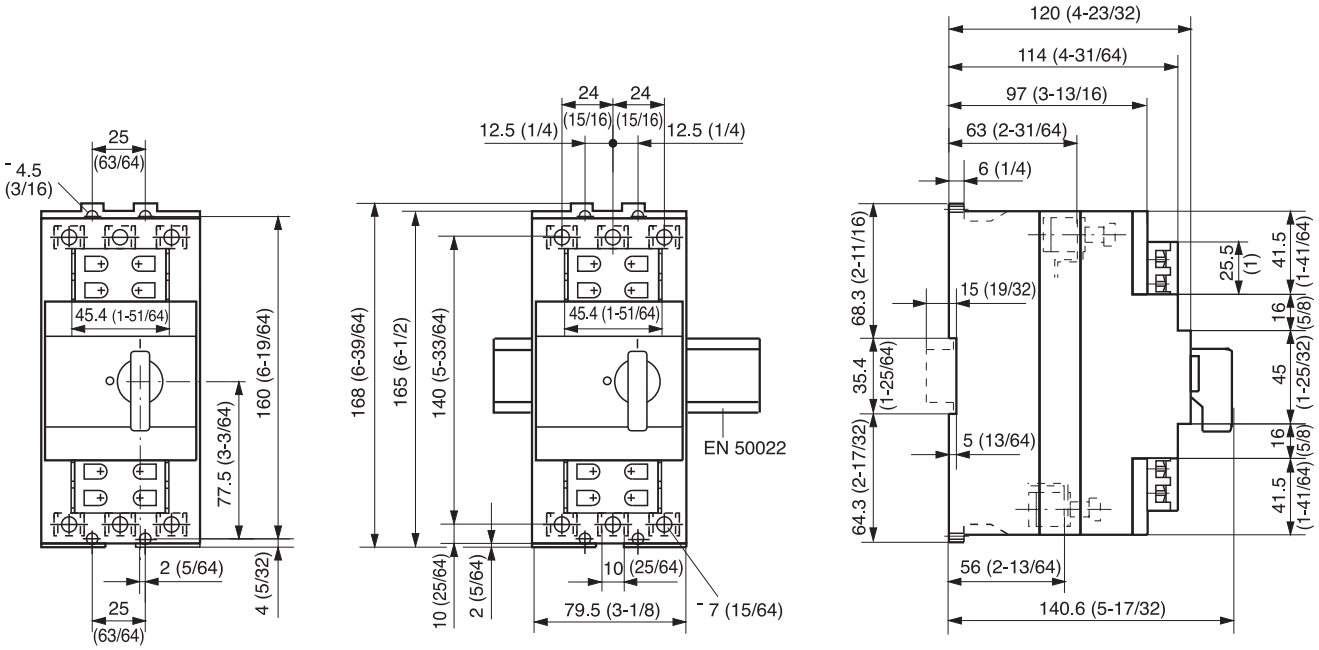
198E-AYT...



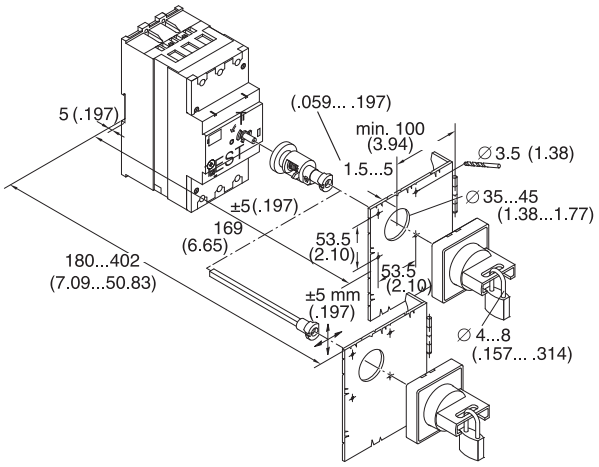
140M-C-WB

Dimensions are shown in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

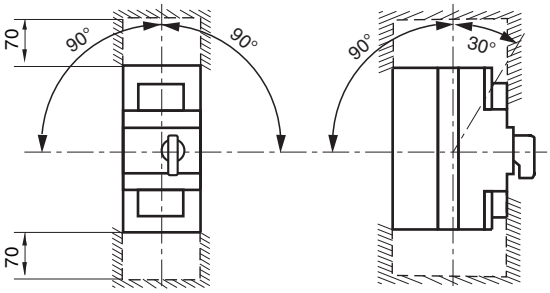
Cat. No. 140-CMN...



140-CMN



140-CD...

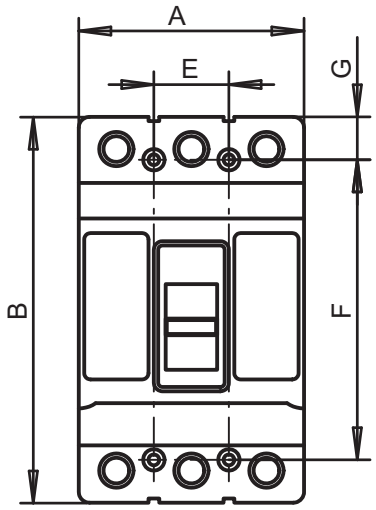


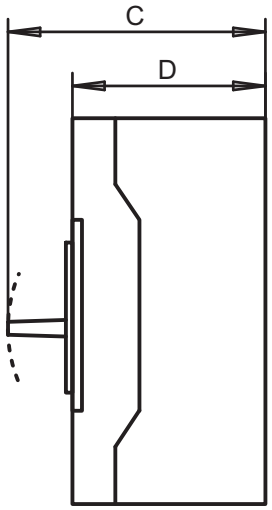
Mounting position/safety clearance of Cat. No. 140-CMN

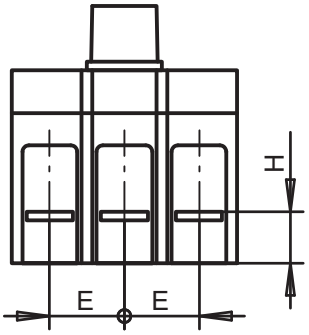
Note: See Bulletin 140U-H, J, L and N for dimensions of 140M-H, J, L and N frames.

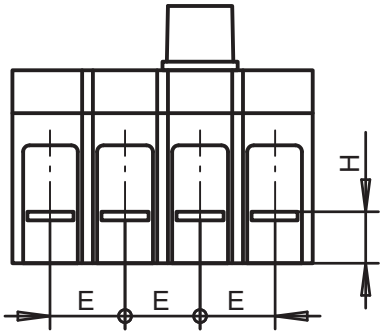
Dimensions are shown in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

Cat. Nos. 140M-H, -I, -J, -L, -N









	A	B	C	D	E	F	G	H
H-Frame	77 (3)	140 (5-1/2)	88 (3-1/2)	75 (3)	25.4 (1)	96.8 (3-13/16)	24.6 (31/32)	22.4 (7/8)
I-Frame	105 (4-1/8)	152 (6)	105 (4-1/8)	88 (3-1/2)	35 (1-3/8)	114 (4-1/2)	19 (3/4)	40 (1-9/10)
J-Frame	105 (4-1/8)	178 (7)	113 (4-29/64)	88 (3-1/2)	35 (1-3/8)	139.7 (5-1/2)	19.8 (25/32)	20.6 (13/16)
L-Frame	140 (5-1/2)	258 (10-5/32)	138 (5-7/16)	110 (4-21/64)	43.7 (1-23/32)	214.4 (8-7/16)	21.3 (27/32)	24.7 (31/32)
N-Frame	210 (8-17/64)	407 (16-1/64)	183 (7-13/64)	140 (5-1/2)	69.9 (2-3/4)	374.7 (14-3/4)	16 (5/8)	29.5 (1-5/32)

Bulletin 140U Molded Case Circuit Breakers

- 15…1200 A Molded Case Circuit Breakers
  - Thermal-Magnetic 15…800 A
  - Electronic 70…1200 A
    - LS — Long Time/Short Time
    - LSI — Long Time/Short Time/High Instantaneous
    - LSG — Long Time/Short Time/Ground Fault
    - LSIG — Long Time/Short Time/High Instantaneous/Ground Fault
  - Molded Case Switches 125…1200 A
- Factory- or field-installed accessories
- Flex cable operating mechanisms
- Rotary variable-depth operating mechanisms
- High interrupting ratings in compact dimensions
- Globally rated and approved product line for worldwide application

Standards Compliance

UL 489
CSA 22.2, No. 5
EN/IEC 60947-2

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Certifications

UL Listed
CSA Certified
CE Marked
KEMA-KEUR

Product Line Overview

Frame Reference	**G-Frame**	**H-Frame**	**J-Frame**	**K-Frame**	**L-Frame**	**M-Frame**	**N-Frame**
Max. Current I_n	100 A	125 A	250 A	400 A	600 A	800 A	1200 A
Current Range	15…100 A	15…125 A	70…250 A	100…400 A	300…600 A	300…800 A	600…1200 A
Thermal Magnetic	✓	✓	✓	✓	✓	✓	—
Electronic:							
LS	—	—	✓	✓	✓	✓	✓
LSI	—	—	✓	✓	✓	✓	✓
LSG	—	—	✓	✓	✓	✓	✓
LSIG	—	—	✓	✓	✓	✓	✓
Interrupting Ratings:							
380…415V (I_{cu})	14 22	25 40 70	25 40 70 100	40 65 100	45 70 100	50 70	50 70 100
480V	14 22	25 35 65 100	25 35 65 100	35 65 100	35 65 100	50 65	50 65 100
600V	—	18 22 25 35	18 18 25 35	25 35 50	25 35 50	25 35	25 35 50
690V (I_{cu})	—	3 4 6	6 6 7 12	10 13 18	20 25 15	20 25	20 25 30
Molded Case Switches	✓	✓	✓	✓	✓	✓	✓
Flex Cable Operators	✓	✓	✓	✓	✓	✓	✓
Rotary Operators	✓	✓	✓	✓	✓	✓	✓
Internal Control Modules (Field installed)	✓	✓	✓	✓	✓	✓	✓
Standards Compliance							
UL 489	✓	✓	✓	✓	✓	✓	✓
UL File E197878, Guide No. DIV Q	✓	✓	✓	✓	✓	✓	✓
CSA 22.2, No. 5	✓	✓	✓	✓	✓	✓	✓
CSA File Nos. 216034, 216035, 219884 Class No. 1432-01	✓	✓	✓	✓	✓	✓	✓
IEC 60947-2	✓	✓	✓	—	✓	✓	✓
CE	✓	✓	✓	—	✓	✓	✓
KEMA-KEUR	✓	✓	✓	✓	✓	✓	✓

Examples given in this section are for reference purposes. This basic explanation should not be used for product selection; not all combinations will produce a valid cat. no. Refer to the tables on the following pages for descriptions of options.

Complete Circuit Breaker Assemblies

140U	–	H	6	C	3	–	C50	–	H	
		a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	

a

Bulletin No.	
Code	Description
140U	Molded Case Circuit Breaker

b

Frame/Rating	
Code	Description
H	125 A
J	250 A
K	400 A
L	600 A
M	800 A
N	1200 A

c

Interrupting Rating/Breaking Capacity (based on I_c at 480V)	
Code	Description
2	20…29 kA
3	30…39 kA
5	50…59 kA
6	60…69 kA
8	80…89 kA
0	≥100 kA

d

Protection Type	
Code	Description
C	Fixed Thermal/Fixed Magnetic
D	Fixed Thermal/Adjust Magnetic
E	Adjust Thermal/Fixed Magnetic
F	Adjust Thermal/Adjust Magnetic
G	Electronic (LSG — Long, short, ground fault)
H	Electronic (LSI — Long, short, high instant)
I	Electronic (LSIG — Long, short, high instant, ground fault)
L	Electronic (LS — Long and Short time)
S	Molded Case Switch (Isolator)

e

Poles	
Code	Description
1	1 poles
2	2 poles
3	3 poles

f

Current Range	
Code	Description
C	10 rr. A
D	100 rr0 A
E	1000 rr00 A

g

Internal Control Modules	
Code	Description
A	1 Auxiliary contact
B	2 Auxiliary contacts
D	1 Alarm contact
F	1 Auxiliary + 1 Alarm contact
G	Undervoltage release only
P	Shunt trip only
Control Module Combinations	
Code	Description
H	1 Auxiliary contact + undervoltage release
J	2 Auxiliary contacts + undervoltage release
L	1 Auxiliary + 1 Alarm contact + undervoltage release
N	1 Alarm contact + undervoltage release
Q	1 Auxiliary contact + shunt trip
R	2 Auxiliary contacts + shunt trip
T	1 Auxiliary + 1 Alarm contact + shunt trip
V	1 Alarm contact + shunt trip

h

Voltage Code	
See the following pages for voltage code descriptions:	
All frame sizes	Page 2-92

Molded Case Circuit Breakers

Catalog Number Explanation, Continued

Examples given in this section are for reference purposes. This basic explanation should not be used for product selection; not all combinations will produce a valid cat. no. Refer to the tables on the following pages for descriptions of options.

Frames

140U	–	J	3	X	3
a		*b*	*c*	*d*	*e*

a

Bulletin No.	
Code	Description
140U	Molded Case Circuit Breaker

b

Frame/Rating	
Code	Description
J	250 A
K	400 A
Q	600 A
M	800 A

c

Interrupting Rating/Breaking Capacity (based on I_c at 480V)	
Code	Description
2	20…29 kA
3	30…39 kA
5	50…59 kA
6	60…69 kA
8	80…89 kA
0	≥100 kA

d

Protection Type	
Code	Description
X	Frame Only

e

Poles	
Code	Description
3	3 poles

Trip Units

140U	–	J	T	D	3	–	D25
a		*b*	*c*	*d*	*e*		*f*

a

Bulletin No.	
Code	Description
140U	Molded Case Circuit Breaker

b

Frame/Rating	
Code	Description
J	250 A
K	400 A
L	600 A
M	800 A

c

Trip Unit	
Code	Description
T	Trip Unit

d

Protection Type	
Code	Description
C	Fixed Thermal/Fixed Magnetic
D	Fixed Thermal/Adjust Magnetic
E	Adjust Thermal/Fixed Magnetic
F	Adjust Thermal/Adjust Magnetic
G	Electronic (LSG — Long, short, ground fault)
H	Electronic (LSI — Long, short, high instant)
I	Electronic (LSIG — Long, short, high instant, ground fault)
L	Electronic (LS — Long and Short time)
S	Molded Case Switch (isolator)

e

Poles	
Code	Description
3	3 poles

f

Current Range	
Code	Description
C	10 rr. A
D	100 rr0 A
E	1000 rr00 A

- UL 489
- CSA 22.2, No. 5

Note: Terminal box lugs provided as standard

Note: Accessories cannot be field installed to the G-Frame circuit breakers. Circuit breakers with 1 auxiliary contact are also available.

14 kA, Thermal-Magnetic, Fixed Thermal-Fixed Magnetic

Rated Current I_n [A]	Thermal Trip [A] $I_r = I_n$ (Fixed)	Magnetic Trip [A] $I_m = 10 \times I_n$	Interrupt Rating (50/60 Hz) I_{cu} /I_{cs} [kA]			Interrupt Rating [kA] ∗	2 Poles	2 Poles w/ 1 aux. contact
			208V AC	240V AC	480V AC	125/250V DC	Cat. No.	Cat. No.
15	15	150	65	65	14	10	**140U-G1C2-C15**	**140U-G1C2-C15-A**
20	20	200	65	65	14	10	**140U-G1C2-C20**	140U-G1C2-C20-A
25	25	250	65	65	14	10	**140U-G1C2-C25**	140U-G1C2-C25-A
30	30	300	65	65	14	10	**140U-G1C2-C30**	140U-G1C2-C30-A
35	35	350	65	65	14	10	140U-G1C2-C35	140U-G1C2-C35-A
40	40	400	65	65	14	10	**140U-G1C2-C40**	140U-G1C2-C40-A
45	45	450	65	65	14	10	140U-G1C2-C45	140U-G1C2-C45-A
50	50	500	65	65	14	10	**140U-G1C2-C50**	140U-G1C2-C50-A

∗ Time constant is 8 ms min.

22 kA, Thermal-Magnetic, Fixed Thermal-Fixed Magnetic

Rated Current I_n [A]	Thermal Trip [A] $I_r = I_n$ (Fixed)	Magnetic Trip [A] $I_m = 10 \times I_n$	Interrupt Rating (50/60 Hz) I_{cu} /I_{cs} [kA]			Interrupt Rating [kA] ∗	3 Poles	3 Poles w/ 1 aux. contact
			208V AC	240V AC	480V AC	125/250V DC	Cat. No.	Cat. No.
15	15	150	65	65	22	10	**140U-G2C3-C15**	**140U-G2C3-C15-A**
20	20	200	65	65	22	10	**140U-G2C3-C20**	**140U-G2C3-C20-A**
25	25	250	65	65	22	10	**140U-G2C3-C25**	140U-G2C3-C25-A
30	30	300	65	65	22	10	**140U-G2C3-C30**	**140U-G2C3-C30-A**
35	35	350	65	65	22	10	**140U-G2C3-C35**	140U-G2C3-C35-A
40	40	400	65	65	22	10	**140U-G2C3-C40**	140U-G2C3-C40-A
45	45	450	65	65	22	10	**140U-G2C3-C45**	140U-G2C3-C45-A
50	50	500	65	65	22	10	**140U-G2C3-C50**	140U-G2C3-C50-A
60	60	600	65	65	22	10	**140U-G2C3-C60**	140U-G2C3-C60-A
70	70	700	65	65	22	10	**140U-G2C3-C70**	140U-G2C3-C70-A
80	80	800	65	65	22	10	**140U-G2C3-C80**	140U-G2C3-C80-A
90	90	900	65	65	22	10	**140U-G2C3-C90**	140U-G2C3-C90-A
100	100	1000	65	65	22	10	**140U-G2C3-D10**	140U-G2C3-D10-A

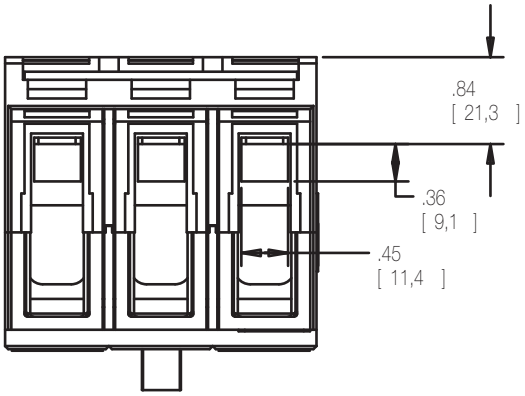
∗ Time constant is 8 ms min. and 2 poles of a 3-pole circuit breaker.

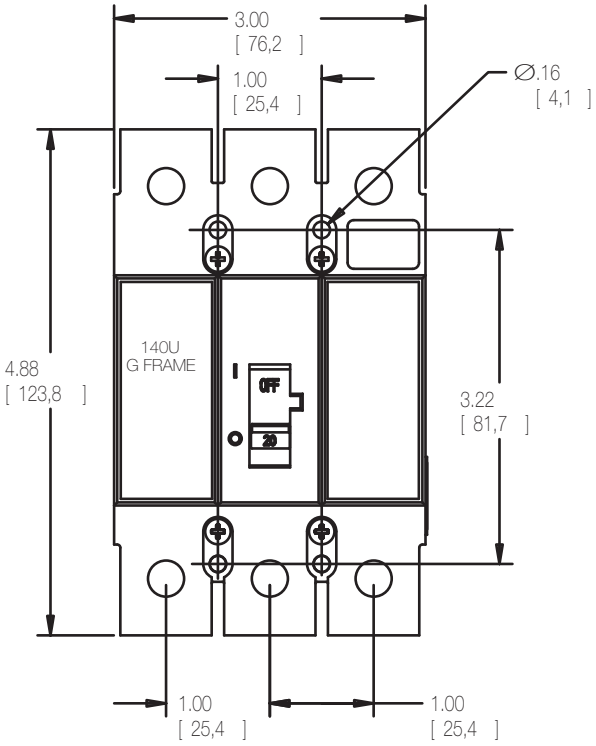
Accessories

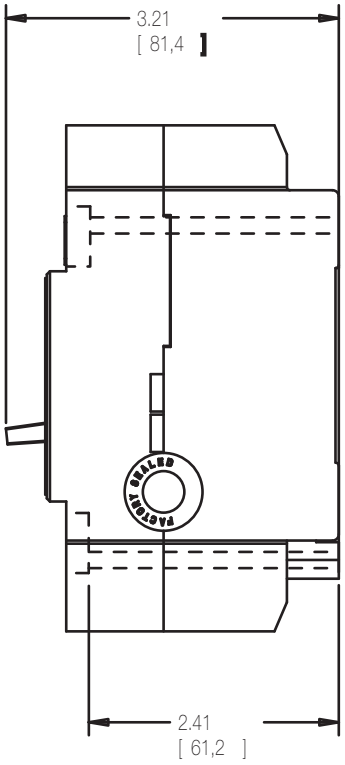
External Accessories

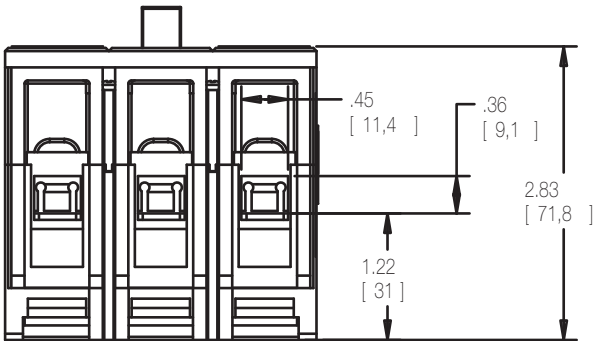
	Description		Cat. No.
	Rotary, Variable-Depth Operating Mechanism UL Type 3/12/4/4X, IP 66 Rotary handle 12 in. (30.48 cm) operating rod	Black Handle	140U-G-RVM12B
		Red/Yellow Handle	140U-G-RVM12R
	DIN Rail Adapter Allows 2-pole G-frame MCCB to mount to 35 mm DIN Rail	Qty: 1	**140U-G-DRA2**
	DIN Rail Adapter Allows 3-pole G-frame MCCB to mount to 35 mm DIN Rail	Qty: 1	**140U-G-DRA3**
	Padlock Kit Padlocking Hasp Lock-OFF only	Qty: 1	**140U-G-PL**

3-Pole Dimensions





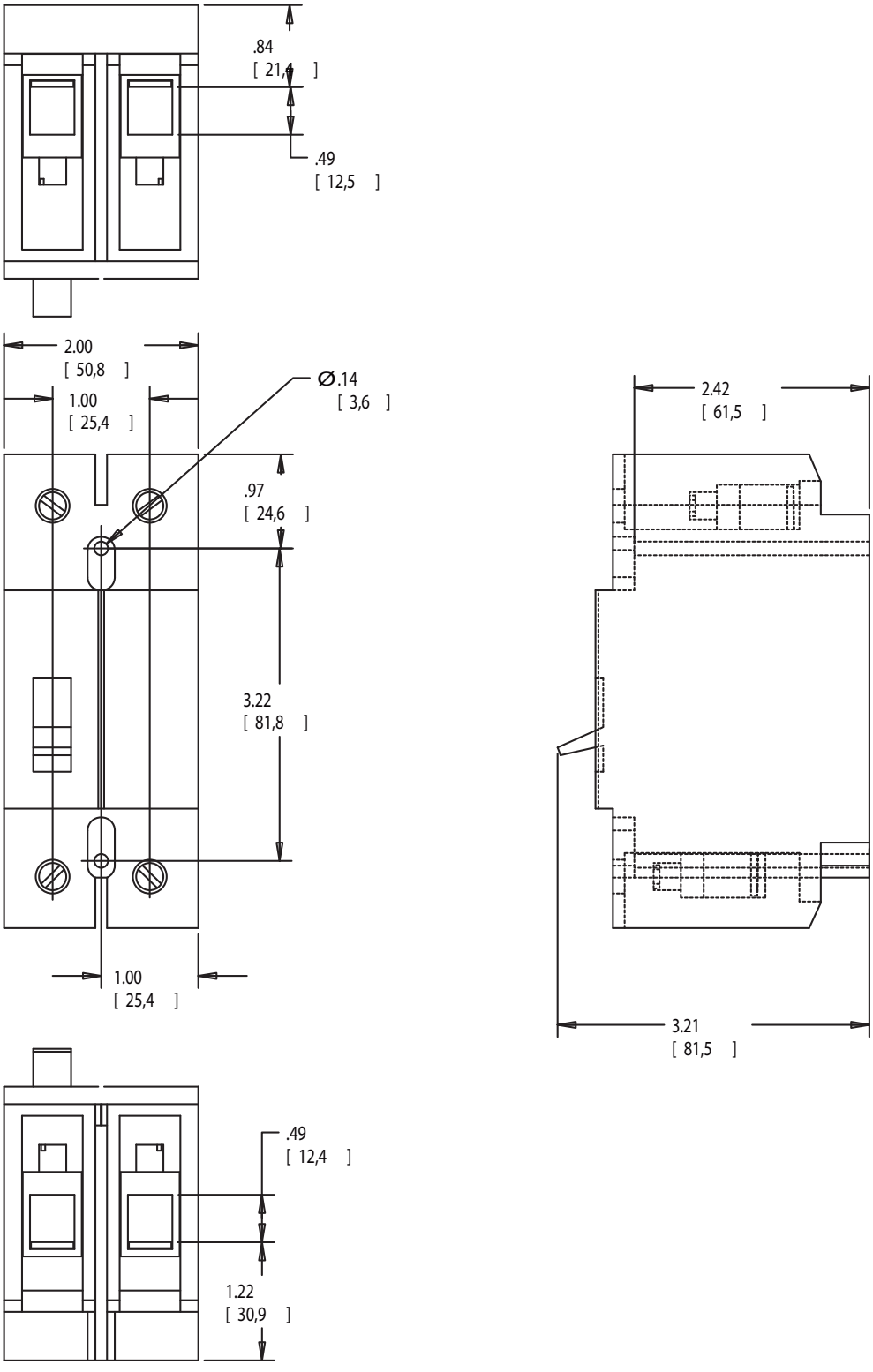




Dimensions are in inches (millimeters). Dimensions are not intended to be used for manufacturing purposes.

2-Pole Dimensions

15-100 AMP, PRESSURE COLLAR TERMINALS



Product Selection — 125 A, H-Frame

- UL 489
- CSA 22.2, No. 5
- IEC 60947-2
- CE
- KEMA-KEUR

Note: Terminal box lugs provided as standard

1-Pole 25/18 kA, Thermal-Magnetic, Fixed Thermal-Fixed Magnetic

Rated Current I_n [A]	Magnetic Trip [A] I_m = 10 x I_n	Breaking Capacity (50 Hz) I_{cu} /I_{cs} [kA]		Interrupting Rating (60 Hz) [kA]		Cat. No.
		220…240V		240V	277V	
15	500	25	25	25	18	**140U-H1C1-C15**
20	500	25	25	25	18	**140U-H1C1-C20**
25	500	25	25	25	18	**140U-H1C1-C25**
30	500	25	25	25	18	**140U-H1C1-C30**
35	500	25	25	25	18	140U-H1C1-C35
40	500	25	25	25	18	140U-H1C1-C40
45	500	25	25	25	18	140U-H1C1-C45
50	500	25	25	25	18	**140U-H1C1-C50**
60	600	25	25	25	18	140U-H1C1-C60
70	700	25	25	25	18	140U-H1C1-C70
80	800	25	25	25	18	140U-H1C1-C80
90	900	25	25	25	18	140U-H1C1-C90
100	1000	25	25	25	18	**140U-H1C1-D10**
110	1100	25	25	25	18	140U-H1C1-D11
125	1250	25	25	25	18	140U-H1C1-D12

2-Pole 25/25 kA, Thermal-Magnetic, Fixed Thermal-Fixed Magnetic

Rated Current I_n [A]	Magnetic Trip [A] I_m = 10 x I_n	Breaking Capacity (50 Hz) I_{cu} /I_{cs} [kA]								Interrupting Rating (60 Hz) [kA]			Cat. No.
		220…240V		380…415V		500V		690V		240V	480V	600/347V	
15	500	35	35	25	25	—	—	—	—	35	25	18	**140U-H2C2-C15**
20	500	35	35	25	25	—	—	—	—	35	25	18	**140U-H2C2-C20**
25	500	35	35	25	25	—	—	—	—	35	25	18	**140U-H2C2-C25**
30	500	35	35	25	25	—	—	—	—	35	25	18	**140U-H2C2-C30**
35	500	35	35	25	25	—	—	—	—	35	25	18	**140U-H2C2-C35**
40	500	35	35	25	25	—	—	—	—	35	25	18	**140U-H2C2-C40**
45	500	35	35	25	25	—	—	—	—	35	25	18	140U-H2C2-C45
50	500	35	35	25	25	—	—	—	—	35	25	18	**140U-H2C2-C50**
60	600	35	35	25	25	—	—	—	—	35	25	18	**140U-H2C2-C60**
70	700	35	35	25	25	—	—	—	—	35	25	18	**140U-H2C2-C70**
80	800	35	35	25	25	—	—	—	—	35	25	18	140U-H2C2-C80
90	900	35	35	25	25	—	—	—	—	35	25	18	140U-H2C2-C90
100	1000	35	35	25	25	—	—	—	—	35	25	18	**140U-H2C2-D10**
110	1100	35	35	25	25	—	—	—	—	35	25	18	140U-H2C2-D11
125	1250	35	35	25	25	—	—	—	—	35	25	18	140U-H2C2-D12

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Preferred availability cat. nos. are printed in **bold**

2-Pole 40/35 kA, Thermal-Magnetic, Fixed Thermal-Fixed Magnetic

Rated Current I_n [A]	Thermal Trip [A] $I_r = I_n$ (Fixed)	Magnetic Trip [A] $I_m = 10 \times I_n$	Breaking Capacity (50 Hz) I_{cu} / I_{cs} [kA]								Interrupting Rating (60 Hz) [kA]			Cat. No.
			220…240V		380…415V		500V		690V		240V	480V	600/347V	
15	Fixed	500	85	43	40	30	—	—	—	—	85	35	22	**140U-H3C2-C15**
20	Fixed	500	85	43	40	30	—	—	—	—	85	35	22	**140U-H3C2-C20**
25	Fixed	500	85	43	40	30	—	—	—	—	85	35	22	140U-H3C2-C25
30	Fixed	500	85	43	40	30	—	—	—	—	85	35	22	140U-H3C2-C30
35	Fixed	500	85	43	40	30	—	—	—	—	85	35	22	140U-H3C2-C35
40	Fixed	500	85	43	40	30	—	—	—	—	85	35	22	140U-H3C2-C40
45	Fixed	500	85	43	40	30	—	—	—	—	85	35	22	140U-H3C2-C45
50	Fixed	500	85	43	40	30	—	—	—	—	85	35	22	140U-H3C2-C50
60	Fixed	600	85	43	40	30	—	—	—	—	85	35	22	140U-H3C2-C60
70	Fixed	700	85	43	40	30	—	—	—	—	85	35	22	140U-H3C2-C70
80	Fixed	800	85	43	40	30	—	—	—	—	85	35	22	140U-H3C2-C80
90	Fixed	900	85	43	40	30	—	—	—	—	85	35	22	140U-H3C2-C90
100	Fixed	1000	85	43	40	30	—	—	—	—	85	35	22	140U-H3C2-D10
110	Fixed	1100	85	43	40	30	—	—	—	—	85	35	22	140U-H3C2-D11
125	Fixed	1250	85	43	40	30	—	—	—	—	85	35	22	140U-H3C2-D12

2-Pole 70/65 kA, Thermal-Magnetic, Fixed Thermal-Fixed Magnetic

Rated Current I_n [A]	Thermal Trip [A] $I_r = I_n$ (Fixed)	Magnetic Trip [A] $I_m = 10 \times I_n$	Breaking Capacity (50 Hz) I_{cu} / I_{cs} [kA]								Interrupting Rating (60 Hz) [kA]			Cat. No.
			220…240V		380…415V		500V		690V		240V	480V	600/347V	
15	Fixed	500	100	50	70	35	—	—	—	—	100	65	25	**140U-H6C2-C15**
20	Fixed	500	100	50	70	35	—	—	—	—	100	65	25	140U-H6C2-C20
25	Fixed	500	100	50	70	35	—	—	—	—	100	65	25	140U-H6C2-C25
30	Fixed	500	100	50	70	35	—	—	—	—	100	65	25	140U-H6C2-C30
35	Fixed	500	100	50	70	35	—	—	—	—	100	65	25	140U-H6C2-C35
40	Fixed	500	100	50	70	35	—	—	—	—	100	65	25	140U-H6C2-C40
45	Fixed	500	100	50	70	35	—	—	—	—	100	65	25	140U-H6C2-C45
50	Fixed	500	100	50	70	35	—	—	—	—	100	65	25	140U-H6C2-C50
60	Fixed	600	100	50	70	35	—	—	—	—	100	65	25	140U-H6C2-C60
70	Fixed	700	100	50	70	35	—	—	—	—	100	65	25	140U-H6C2-C70
80	Fixed	800	100	50	70	35	—	—	—	—	100	65	25	140U-H6C2-C80
90	Fixed	900	100	50	70	35	—	—	—	—	100	65	25	140U-H6C2-C90
100	Fixed	1000	100	50	70	35	—	—	—	—	100	65	25	140U-H6C2-D10
110	Fixed	1100	100	50	70	35	—	—	—	—	100	65	25	140U-H6C2-D11
125	Fixed	1250	100	50	70	35	—	—	—	—	100	65	25	140U-H6C2-D12

3-Pole 25/25 kA, Thermal-Magnetic, Fixed Thermal-Fixed Magnetic

Rated Current I_n [A]	Thermal Trip [A] $I_r = I_n$ (Fixed)	Magnetic Trip [A] $I_m = 10 \times I_n$	Breaking Capacity (50 Hz) I_{cu} / I_{cs} [kA]								Interrupting Rating (60 Hz) [kA]			Cat. No.
			220…240V		380…415V		525V		690V		240V	480V	600/347V	
15	15	500	35	35	25	25	22	17	3	3	35	25	18	**140U-H2C3-C15**
20	20	500	35	35	25	25	22	17	3	3	35	25	18	**140U-H2C3-C20**
25	25	500	35	35	25	25	22	17	3	3	35	25	18	**140U-H2C3-C25**
30	30	500	35	35	25	25	22	17	3	3	35	25	18	**140U-H2C3-C30**
35	35	500	35	35	25	25	22	17	3	3	35	25	18	**140U-H2C3-C35**
40	40	500	35	35	25	25	22	17	3	3	35	25	18	**140U-H2C3-C40**
45	40	500	35	35	25	25	22	17	3	3	35	25	18	**140U-H2C3-C45**
50	50	500	35	35	25	25	22	17	3	3	35	25	18	**140U-H2C3-C50**
60	60	600	35	35	25	25	22	17	3	3	35	25	18	**140U-H2C3-C60**
70	70	700	35	35	25	25	22	17	3	3	35	25	18	**140U-H2C3-C70**
80	80	800	35	35	25	25	22	17	3	3	35	25	18	**140U-H2C3-C80**
90	90	900	35	35	25	25	22	17	3	3	35	25	18	**140U-H2C3-C90**
100	100	1000	35	35	25	25	22	17	3	3	35	25	18	**140U-H2C3-D10**
110	110	1100	35	35	25	25	22	17	3	3	35	25	18	**140U-H2C3-D11**
125	125	1250	35	35	25	25	18	17	3	3	35	25	18	**140U-H2C3-D12**

2

3-Pole 40/35 kA, Thermal-Magnetic, Fixed Thermal-Fixed Magnetic

Rated Current I_n [A]	Thermal Trip [A] $I_r = I_n$ (Fixed)	Magnetic Trip [A] $I_m = 10 \times I_n$	Breaking Capacity (50 Hz) I_{cu} / I_{cs} [kA]								Interrupting Rating (60 Hz) [kA]			Cat. No.
			220…240V		380…415V		525V		690V		240V	480V	600/347V	
15	15	500	85	43	40	30	25	18	4	3	85	35	22	**140U-H3C3-C15**
20	20	500	85	43	40	30	25	18	4	3	85	35	22	**140U-H3C3-C20**
25	25	500	85	43	40	30	25	18	4	3	85	35	22	**140U-H3C3-C25**
30	30	500	85	43	40	30	25	18	4	3	85	35	22	**140U-H3C3-C30**
35	35	500	85	43	40	30	25	18	4	3	85	35	22	**140U-H3C3-C35**
40	40	500	85	43	40	30	25	18	4	3	85	35	22	**140U-H3C3-C40**
45	45	500	85	43	40	30	25	18	4	3	85	35	22	**140U-H3C3-C45**
50	50	500	85	43	40	30	25	18	4	3	85	35	22	**140U-H3C3-C50**
60	60	600	85	43	40	30	25	18	4	3	85	35	22	**140U-H3C3-C60**
70	70	700	85	43	40	30	25	18	4	3	85	35	22	**140U-H3C3-C70**
80	80	800	85	43	40	30	25	18	4	3	85	35	22	**140U-H3C3-C80**
90	90	900	85	43	40	30	25	18	4	3	85	35	22	**140U-H3C3-C90**
100	100	1000	85	43	40	30	25	18	4	3	85	35	22	**140U-H3C3-D10**
110	110	1100	85	43	40	30	25	18	4	3	85	35	22	**140U-H3C3-D11**
125	125	1250	85	43	40	30	25	18	4	3	85	35	22	**140U-H3C3-D12**

3-Pole 70/65 kA, Thermal-Magnetic, Fixed Thermal-Fixed Magnetic

Rated Current I_n [A]	Thermal Trip [A] $I_r = I_n$ (Fixed)	Magnetic Trip [A] $I_m = 10 \times I_n$	Breaking Capacity (50 Hz) I_{cu} / I_{cs} [kA]								Interrupting Rating (60 Hz) [kA]			Cat. No.‡
			220…240V		380…415V		525V		690V		240V	480V	600/347V	
15	Fixed	500	100	100	70	70	25	13	6	3	100	65	25	**140U-H6C3-C15**
20	Fixed	500	100	100	70	70	25	13	6	3	100	65	25	**140U-H6C3-C20**
25	Fixed	500	100	100	70	70	25	13	6	3	100	65	25	**140U-H6C3-C25**
30	Fixed	500	100	100	70	70	25	13	6	3	100	65	25	**140U-H6C3-C30**
40	Fixed	500	100	100	70	70	25	13	6	3	100	65	25	**140U-H6C3-C40**
50	Fixed	500	100	100	70	70	25	13	6	3	100	65	25	**140U-H6C3-C50**
60	Fixed	600	100	100	70	70	25	13	6	3	100	65	25	**140U-H6C3-C60**
70	Fixed	700	100	100	70	70	25	13	6	3	100	65	25	**140U-H6C3-C70**
80	Fixed	800	100	100	70	70	25	13	6	3	100	65	25	**140U-H6C3-C80**
90	Fixed	900	100	100	70	70	25	13	6	3	100	65	25	**140U-H6C3-C90**
100	Fixed	1000	100	100	70	70	25	13	6	3	100	65	25	**140U-H6C3-D10**
110	Fixed	1100	100	100	70	70	25	13	6	3	100	65	25	**140U-H6C3-D11**
125	Fixed	1250	100	100	70	70	25	13	6	3	100	65	25	**140U-H6C3-D12**

‡ Current Limiting

3-Pole 100/100 kA, Thermal-Magnetic, Fixed Thermal-Fixed Magnetic

Rated Current I_n [A]	Thermal Trip [A] $I_r = I_n$ (Fixed)	Magnetic Trip [A] $I_m = 10 \times I_n$	Breaking Capacity (50 Hz) I_{cu} / I_{cs} [kA]								Interrupting Rating (60 Hz) [kA]			Cat. No.‡
			220…240V		380…415V		525V		690V		240V	480V	600/347V	
15	Fixed	500	200	200	100	100	35	18	8	6	200	100	35	**140U-H0C3-C15**
20	Fixed	500	200	200	100	100	35	18	8	6	200	100	35	**140U-H0C3-C20**
25	Fixed	500	200	200	100	100	35	18	8	6	200	100	35	**140U-H0C3-C25**
30	Fixed	500	200	200	100	100	35	18	8	6	200	100	35	**140U-H0C3-C30**
40	Fixed	500	200	200	100	100	35	18	8	6	200	100	35	**140U-H0C3-C40**
50	Fixed	500	200	200	100	100	35	18	8	6	200	100	35	**140U-H0C3-C50**
60	Fixed	600	200	200	100	100	35	18	8	6	200	100	35	**140U-H0C3-C60**
70	Fixed	700	200	200	100	100	35	18	8	6	200	100	35	**140U-H0C3-C70**
80	Fixed	800	200	200	100	100	35	18	8	6	200	100	35	**140U-H0C3-C80**
90	Fixed	900	200	200	100	100	35	18	8	6	200	100	35	**140U-H0C3-C90**
100	Fixed	1000	200	200	100	100	35	18	8	6	200	100	35	**140U-H0C3-D10**
110	Fixed	1100	200	200	100	100	35	18	8	6	200	100	35	**140U-H0C3-D11**
125	Fixed	1250	200	200	100	100	35	18	8	6	200	100	35	**140U-H0C3-D12**

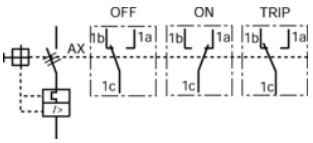
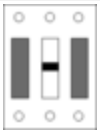
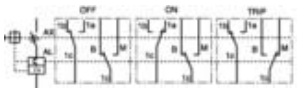
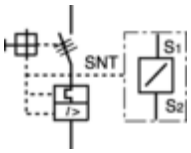
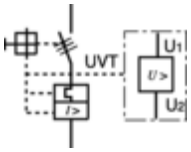
‡ Current Limiting

Molded Case Switch — UL 1087

Rated Current I_n [A]	Thermal Trip [A] $I_r = I_n$ (Fixed)	Magnetic Trip [A] $I_m = 10 \times I_n$	Breaking Capacity (50 Hz) I_{cu} / I_{cs} [kA]								Interrupting Rating (60 Hz) [kA]			Cat. No.
			220…240V		380…415V		525V		690V		240V	480V	600/347V	
125	—	1250	100	50	70	35	35	18	6	3	100	65	25	**140U-H6S3-D12**

Accessories — 125 A, H-Frame

Internal Control Modules — Field Installed

	Description		Diagram	Mounting Location	Cat. No.
	Auxiliary Contact (AX) Electrically indicates "ON/OFF" status of breakers	(1) 1a-1b		 ***Left AND Right side***	**140U-H-EA1**
		(2) 1a-1b			**140U-H-EA2**
	Alarm Contact (AL) Electrically indicates when the breaker is in the "TRIPPED" state	(1) 1M (make)-1B (break)		 ***Right side ONLY***	**140U-H-ER1**
	Auxiliary/Alarm Contact (AX/AL) Combination Combination of auxiliary contact and alarm contact	(1) 1a-1b (1) 1M (make)-1B (break)		 ***Right side ONLY***	**140U-H-EA1R1**
	Shunt Trip (SNT) Provides remote tripping of the circuit breaker Undervoltage trip not available when shunt trip is used	12V DC		 ***Left side ONLY***	140U-H-SNZQ
		24…60V, 50/60/DC			**140U-H-SNJ**
		110…240V, 50/60/DC			**140U-H-SND**
		380…440V AC, 220…250V DC			140U-H-SNN
		380…600V, 50/60 Hz			140U-H-SNB
	Undervoltage Release (UVT) Automatically trips breaker when voltage falls between preset value, 35…70% Shunt trip is not available when undervoltage release is used	24V, 50/60 Hz		 ***Left side ONLY***	**140U-H-UJ**
		110…127V, 50/60 Hz			**140U-H-UD**
		208…240V, 50/60 Hz			**140U-H-UA**
		380…500V, 50/60 Hz			**140U-H-UB**
		525…600V, 50/60 Hz			140U-H-UC

Note: For Factory-Installed internal control modules, please see page 2-92

125 A, H-Frame, Continued

External Accessories

	Description		Cat. No.
	Terminal End Cover 6.4 mm (0.25 in.) diameter cable entry		**140U-H-TC2**
	Terminal End Cover 10.4 mm (0.41 in.) diameter cable entry		**140U-H-TC4**
	Terminal Shields IP20 Ingress Protection Rating		**140U-H-TS**
	Flex-Cable Operating Mechanism Includes handle, cable, operating, and bail mechanism Pre-assembled and adjusted Non-Metallic - UL IP66, Type 1/3/12/4/4X Flange Mount Operating Handle	3 ft (0.9 m) Cable	**140U-H-FCX03**
		4 ft (1.3 m) Cable	**140U-H-FCX04**
		6 ft (1.9 m) Cable	**140U-H-FCX06**
		10 ft (3.0 m) Cable	140U-H-FCX10
	Flex-Cable Operating Mechanism Includes handle, cable, operating, and bail mechanism Pre-assembled and adjusted Stainless Steel - Type 4/4X Flange Mount Operating Handle	3 ft (0.9 m) Cable	**140U-H-FCS03**
		4 ft (1.2 m) Cable	**140U-H-FCS04**
		6 ft (1.9 m) Cable	140U-H-FCS06
		10 ft (3.0 m) Cable	140U-H-FCS10
	Rotary, Variable-Depth Operating Mechanism UL Type 3/12/4/4X, IP 66 Rotary handle 12 in. (30.48 cm) operating rod	Black Handle	**140U-H-RVM12B**
		Red/Yellow Handle	**140U-H-RVM12R**
	Rotary, Variable-Depth Operating Mechanism UL Type 3/12/4/4X, IP 66 Rotary handle 21 in. (53.34 cm) operating rod	Black Handle	140U-H-RVM21B
		Red/Yellow Handle	140U-H-RVM21R
	Rotary, Variable-Depth Operating Mechanism with Internal NFPA 79 Operating Handle Type 3/4/4X/12 IP66 Rotary Handle 12 in. (30.48 cm) operating rod	Black Handle	140U-H-NVM12B
		Red/Yellow Handle	140U-H-NVM12R
	Rotary, Variable-Depth Operating Mechanism with Internal NFPA 79 Operating Handle Type 3/4/4X/12 IP66 Rotary Handle 21 in. (53.34 cm) operating rod	Black Handle	140U-H-NVM21B
		Red/Yellow Handle	140U-H-NVM21R
	Motor Operator Remotely opens, closes, and resets the circuit breaker 110…240V AC	For use with 3- or 4-Pole MCCBs, 110…240V AC/DC	**140U-H-EOPD**
	Motor Operator Remotely opens, closes, and resets the circuit breaker 24V DC	For use with 3- or 4-Pole MCCBs, 24V DC	**140U-H-EOPZ**
	Mounting Hardware (4) M4 - 0.7 x 75 mm	For use with 3- or 4-Pole MCCBs	140U-H-MHM

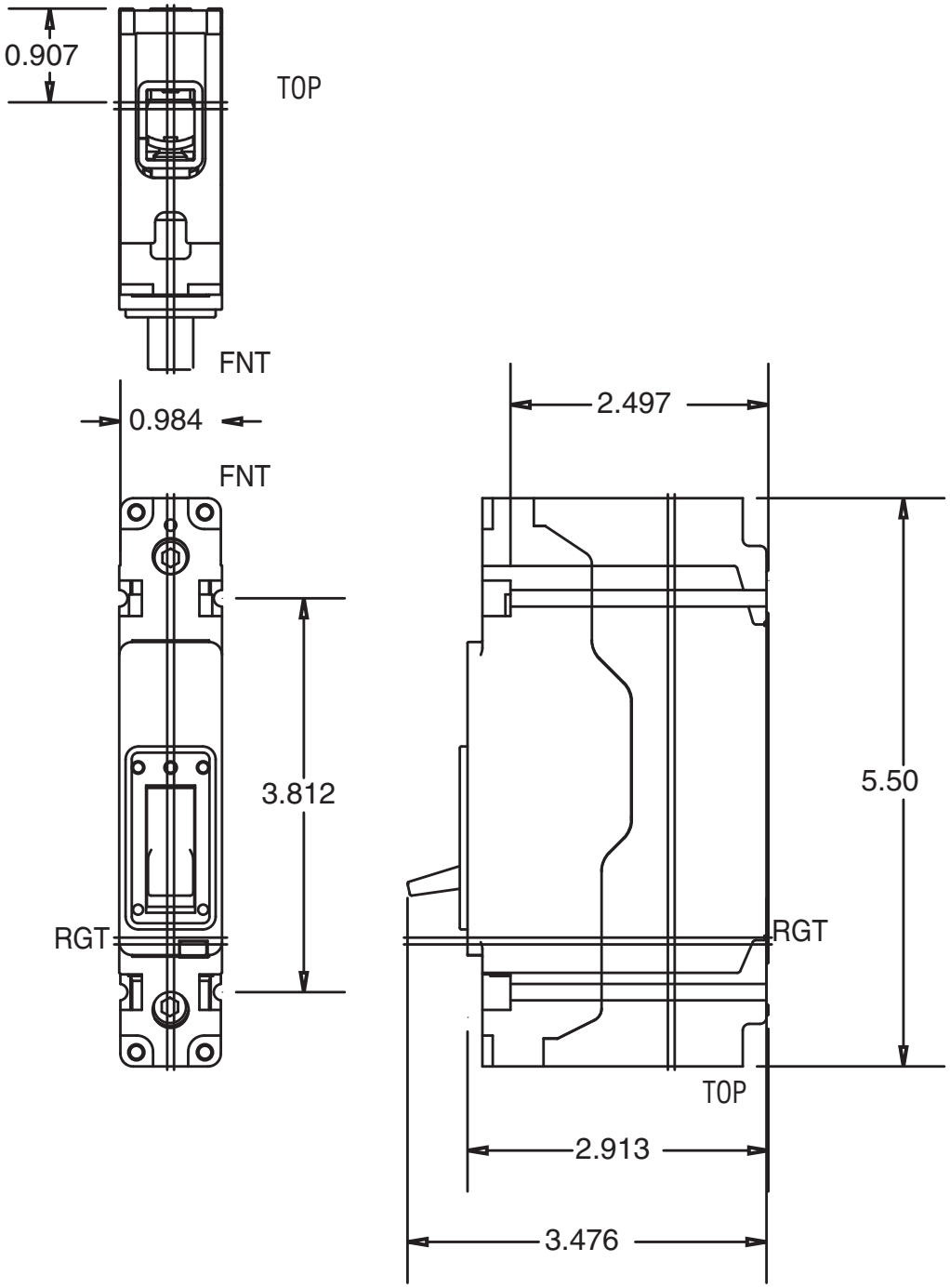
125 A, H-Frame, Continued

External Accessories, Continued

	Description			Cat. No.
	Rotary, Direct Couple Operating Mechanism Rotary handle - IP42 UL Type 1 Breaker mounted		Black Handle	**140U-H-RCB**
			Red/Yellow Handle	**140U-H-RCR**
	End Cap Kit Provides three-phase connections for terminal or bolt-on connections Metric hardware provided		Qty: 1	**140U-H-ECM**
	Phase Barriers Provides additional phase clearance when special connections that extend past the circuit breaker housing are required		Qty: 2	**140U-H-PB**
	Padlock Kit Padlocking hasp Lock-OFF only		Qty: 1	**140U-H-PL**
	Plug-in Base Adapters Plug-in provides power terminations and adapter for applications where the ability to quickly remove or replace the circuit breakers is required	For use with 3-Pole MCCBs	Qty: 1	140U-H-PAD3
	Plug-in Base Auxiliary Contacts Provides auxiliary contact functions to detect breaker installation status	For use with 3- or 4-Pole MCCBs	Qty: 1	140U-H-PDK
	DIN Rail Adapter Allows H-frame MCCB to mount to 35 mm DIN Rail	For use with 3-Pole H-Frame MCCBs	Qty: 1	**140U-H-DRA**
Cat. No. 140U-H-MTL3AN	**Multi-Tap Terminal Lug Kit —** with IP20 terminal cover	(3) #14…2 AWG or (3) 2.5…35 mm²	Qty: 3 with terminal shield	**140U-H-MTL3A**
			Qty: 3	**140U-H-MTL3AN**
	Multi-Tap Terminal Lug Kit — with IP20 terminal cover	(6) #14…6 AWG or (6) 2.5…10 mm²	Qty: 3 with terminal shield	**140U-H-MTL6A**
		(6) #14…6 AWG or (6) 2.5…10 mm²	Qty: 3	**140U-H-MTL6AN**

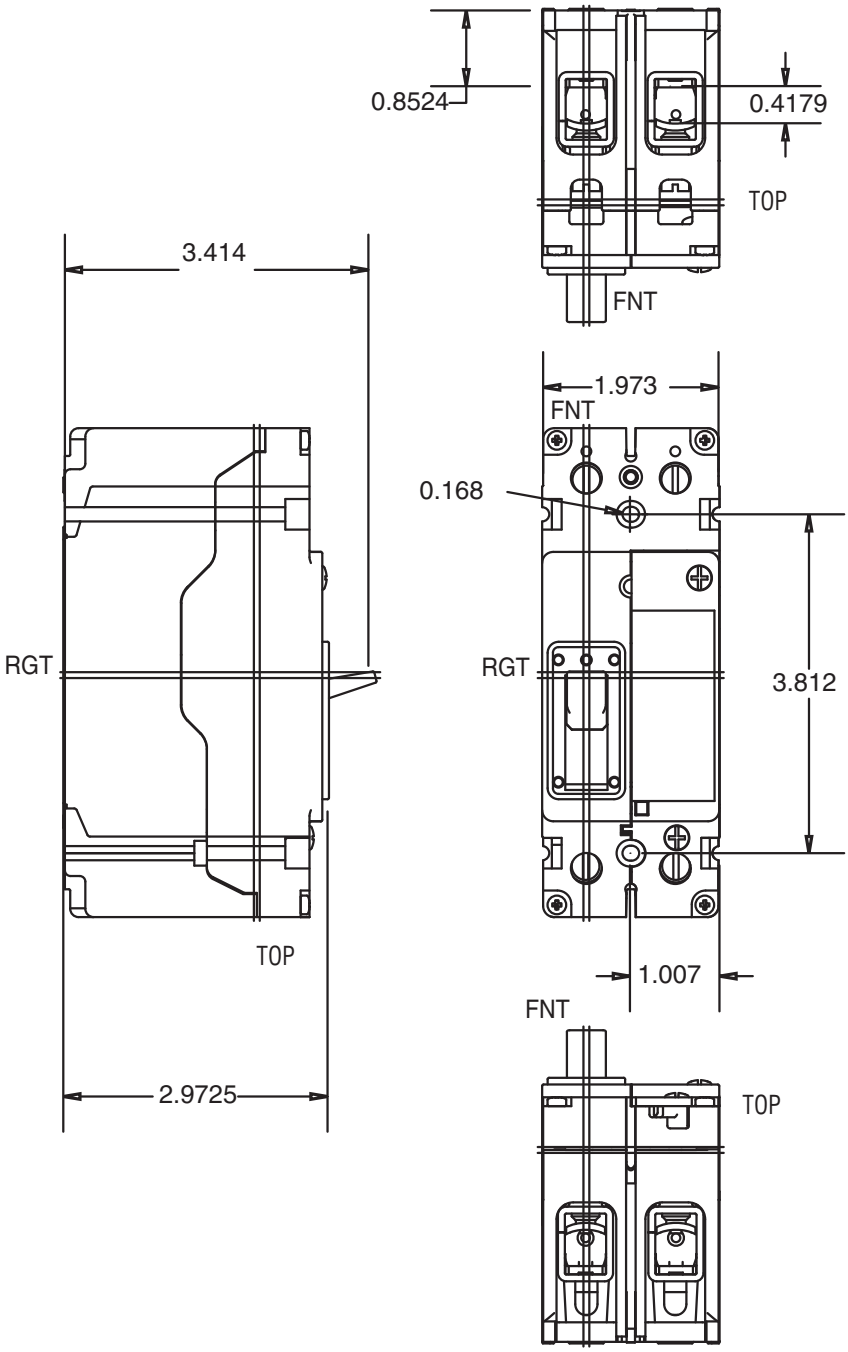
Dimensions are in inches. Dimensions are not intended to be used for manufacturing purposes.

1-Pole Molded Case Circuit Breakers



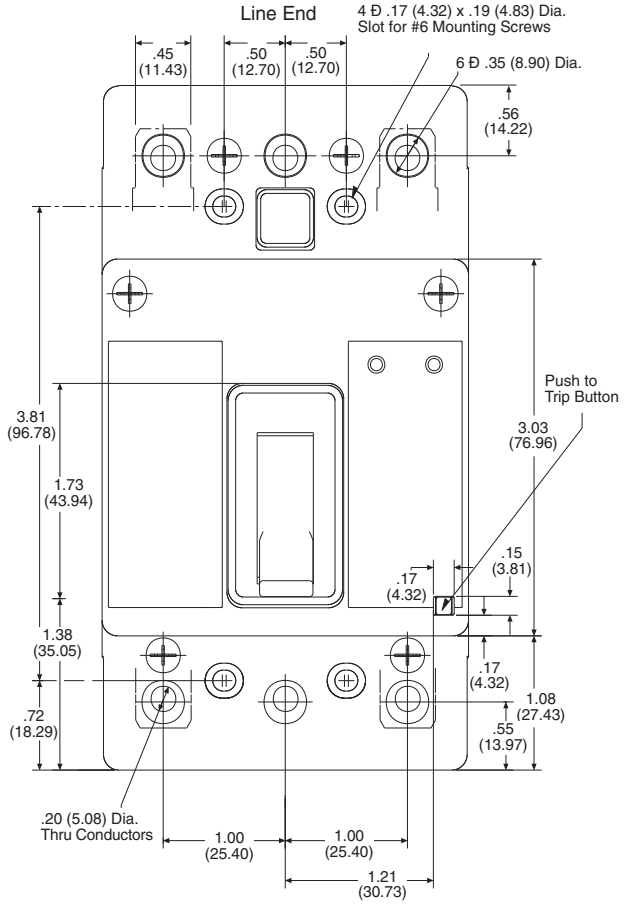
Dimensions are in inches. Dimensions are not intended to be used for manufacturing purposes.

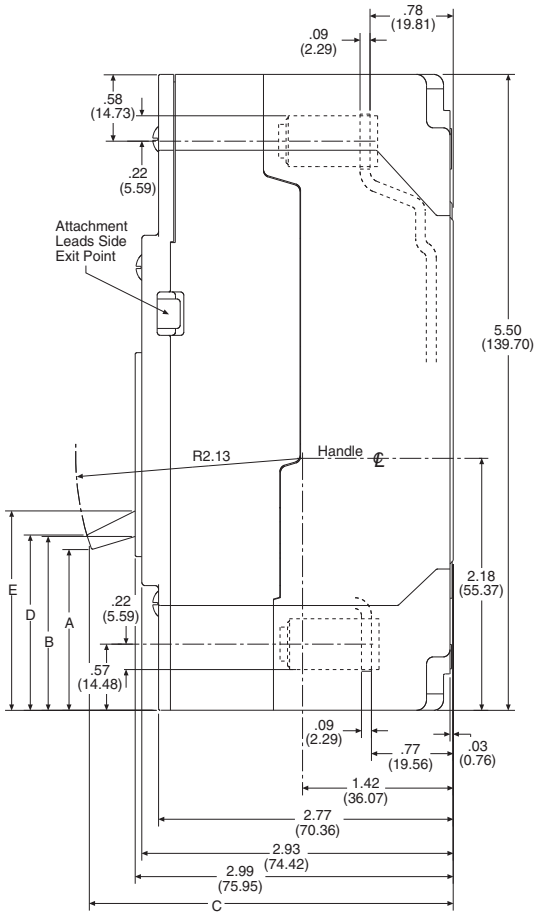
2-Pole Molded Case Circuit Breakers

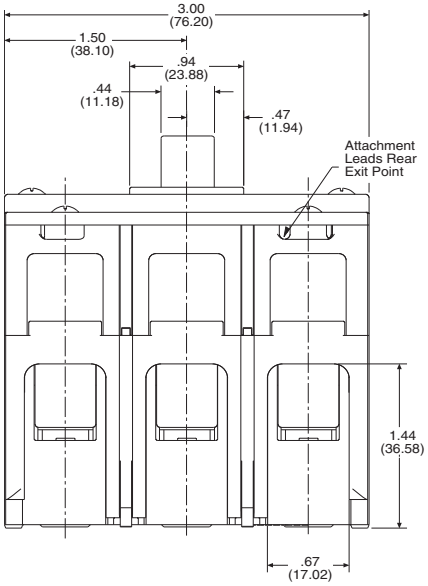


Dimensions are in inches (millimeters). Dimensions are not intended to be used for manufacturing purposes.

3-Pole Molded Case Circuit Breakers







Breaker Status	Dimension				
	A	B	C	D	E
On	2.71 (68.83)	2.53 (64.26)	3.46 (87.88)	2.83 (71.88)	2.75 (69.85)
Off	1.54 (39.12)	1.62 (41.15)	3.46 (87.88)	1.66 (42.16)	1.84 (46.74)
Tripped	2.33 (59.18)	2.23 (56.64)	3.54 (89.92)	2.46 (67.48)	2.45 (62.23)
Reset	1.39 (35.31)	1.49 (37.85)	3.42 (86.87)	1.52 (38.61)	1.70 (43.18)

- UL 489
- CSA 22.2, No. 5
- IEC 60947-2
- CE
- KEMA-KEUR (Pending)

Note: Terminal box lugs must be ordered separately. See page 2-72

Breaker Frames

Rated Current I_n [A]	Breaking Capacity (50 Hz) I_{cu} /I_{cs} [kA]								Interrupting Rating (60 Hz) [kA]			Cat. No.	
	220…240V		380…415V		525V		690V		240V	480V	600V		
250	65	65	25	25	18	12	12	6	65	25	18	140U-J2X3	
	85	85	45	45	18	12	12	6	85	35	18	**140U-J3X3**	
	100	100	70	70	25	13	14	7	100	65	25	‡	**140U-J6X3**
	200	200	100	100	35	18	16	12	200	100	35	‡	**140U-J0X3**

‡ Current Limiting

Trip Units

Thermal-Magnetic

Rated Current I_n [A]	Adjustment Range [A]		Cat. No.
	Thermal Trip $I_r = I_n$ (Fixed)	Magnetic Trip I_m = 5…10 x I_r	
90	90	450…900	140U-JTD3-C90
100	100	500…1000	140U-JTD3-D10
125	125	600…1250	140U-JTD3-D12
150	150	750…1500	140U-JTD3-D15
175	175	875…1750	**140U-JTD3-D17**
200	200	1000…2000	140U-JTD3-D20
225	225	1125…2250	140U-JTD3-D22
250	250	1250…2500	**140U-JTD3-D25**

Electronic

Rated Current I_n [A]	Adjustment Range [A]		Protection Type	Cat. No.
	Thermal Trip I_r = 0.4…1.0 x I_n	Magnetic Trip I_m = 2…14 x I_r		
50	20…50	40…700	LS	140U-JTL3-C50
50	20…50	40…700	LSI	140U-JTH3-C50
50	20…50	40…700	LSG	140U-JTG3-C50
50	20…50	40…700	LSIG	140U-JTI3-C50
100	40…100	80…1400	LS	140U-JTL3-D10
100	40…100	80…1400	LSI	140U-JTH3-D10
100	40…100	80…1400	LSG	140U-JTG3-D10
100	40…100	80…1400	LSIG	140U-JTI3-D10
160	63…160	126…2240	LS	140U-JTL3-D16
160	63…160	126…2240	LSI	140U-JTH3-D16
160	63…160	126…2240	LSG	140U-JTG3-D16
160	63…160	126…2240	LSIG	**140U-JTI3-D16**
250	100…250	200…3500	LS	**140U-JTL3-D25**
250	100…250	200…3500	LSI	140U-JTH3-D25
250	100…250	200…3500	LSG	**140U-JTG3-D25**
250	100…250	200…3500	LSIG	140U-JTI3-D25

Assembled Circuit Breakers with Thermal-Magnetic Trip Units

Rated Current I_n [A]	Breaking Capacity/ Interrupting Rating [kA]❄		Cat. No.	Breaking Capacity/ Interrupting Rating [kA]❄		Cat. No.	Breaking Capacity/ Interrupting Rating [kA]❄		Cat. No.
	400V	480V		400V	480V		400V	480V	
90	25	25	140U-J2D3-C90	40	35	140U-J3D3-C90	70	65	140U-J6D3-C90
100	25	25	**140U-J2D3-D10**	40	35	140U-J3D3-D10	70	65	**140U-J6D3-D10**
125	25	25	**140U-J2D3-D12**	40	35	140U-J3D3-D12	70	65	140U-J6D3-D12
150	25	25	**140U-J2D3-D15**	40	35	**140U-J3D3-D15**	70	65	140U-J6D3-D15
175	25	25	140U-J2D3-D17	40	35	140U-J3D3-D17	70	65	**140U-J6D3-D17**
200	25	25	140U-J2D3-D20	40	35	140U-J3D3-D20	70	65	140U-J6D3-D20
225	25	25	140U-J2D3-D22	40	35	140U-J3D3-D22	70	65	140U-J6D3-D22
250	25	25	140U-J2D3-D25	40	35	140U-J3D3-D25	70	65	140U-J6D3-D25

❄ Full ratings are found in the breaker frames table on this page

Assembled Circuit Breakers with Electronic Trip Units

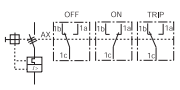
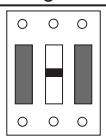
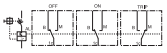
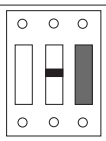
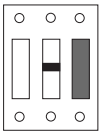
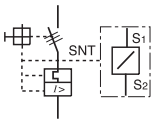
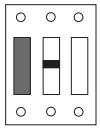
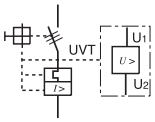
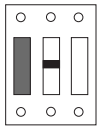
Rated Current I_n [A]	Protection Type	Breaking Capacity/ Interrupting Rating [kA]❄ 400V	480V	Cat. No.	Breaking Capacity/ Interrupting Rating [kA]❄ 400V	480V	Cat. No.	Breaking Capacity/ Interrupting Rating [kA]❄ 400V	480V	Cat. No.
50	LS	25	25	140U-J2L3-C50	40	35	**140U-J3L3-C50**	70	65	140U-J6L3-C50
50	LSI	25	25	140U-J2H3-C50	40	35	140U-J3H3-C50	70	65	140U-J6H3-C50
50	LSG	25	25	**140U-J2G3-C50**	40	35	**140U-J3G3-C50**	70	65	**140U-J6G3-C50**
50	LSIG	25	25	**140U-J2I3-C50**	40	35	**140U-J3I3-C50**	70	65	**140U-J6I3-C50**
100	LS	25	25	**140U-J2L3-D10**	40	35	**140U-J3L3-D10**	70	65	140U-J6L3-D10
100	LSI	25	25	140U-J2H3-D10	40	35	140U-J3H3-D10	70	65	140U-J6H3-D10
100	LSG	25	25	**140U-J2G3-D10**	40	35	**140U-J3G3-D10**	70	65	**140U-J6G3-D10**
100	LSIG	25	25	140U-J2I3-D10	40	35	**140U-J3I3-D10**	70	65	**140U-J6I3-D10**
160	LS	25	25	140U-J2L3-D16	40	35	140U-J3L3-D16	70	65	140U-J6L3-D16
160	LSI	25	25	140U-J2H3-D16	40	35	140U-J3H3-D16	70	65	140U-J6H3-D16
160	LSG	25	25	140U-J2G3-D16	40	35	**140U-J3G3-D16**	70	65	140U-J6G3-D16
160	LSIG	25	25	**140U-J2I3-D16**	40	35	**140U-J3I3-D16**	70	65	**140U-J6I3-D16**
250	LS	25	25	140U-J2L3-D25	40	35	140U-J3L3-D25	70	65	140U-J6L3-D25
250	LSI	25	25	140U-J2H3-D25	40	35	140U-J3H3-D25	70	65	140U-J6H3-D25
250	LSI	25	25	140U-J2G3-D25	40	35	140U-J3H3-D25	70	65	**140U-J6G3-D25**
250	LSIG	25	25	140U-J2I3-D25	40	35	**140U-J3I3-D25**	70	65	140U-J6I3-D25

❄ Full ratings are found in the breaker frames table on page 2-69

Molded Case Switch — UL 489

Rated Current I_n [A]	Thermal Trip $I_r = I_n$ [A]	Magnetic Trip [A] $I_m = 10 \times I_n$	Breaking Capacity (50 Hz) I_{cu} / I_{cs} [kA] 220…240V		380…415V		500V		690V		Interrupting Rating (60 Hz) [kA] 240V	480V	600V	Cat. No.
250	—	2500	100	100	70	70	42	20	7	3	100	65	25	**140U-J6S3-D25**

Internal Control Modules — Field Installed

	Description		Diagram	Mounting Location	Cat. No.
	Auxiliary Contact (AX) Electrically indicates "ON/OFF" status of breakers	(1) 1a-1b			**140U-H-EA1**
		(2) 1a-1b		***Left AND Right side***	**140U-H-EA2**
	Alarm Contact (AL) Electrically indicates when the breaker is in the "TRIPPED" state	(1) 1M (make)-1B (break)			**140U-J-ER1**
				Right side ONLY	
	Auxiliary/Alarm Contact (AX/AL) Combination Combination of auxiliary contact and alarm contact	(1) 1a-1b (1) 1M (make)-1B (break)			**140U-J-EA1R1**
				Right side ONLY	
	Shunt Trip (SNT) Provides remote tripping of the circuit breaker Undervoltage trip not available when shunt trip is used	12V DC			140U-H-SNZQ
		24…60V, 50/60/DC			**140U-H-SNJ**
		110…240V, 50/60/DC			**140U-H-SND**
		380…440V AC, 220…250V DC			140U-H-SNN
		380…600V, 50/60 Hz			140U-H-SNB
		12V DC		***Left side ONLY***	140U-H-SNZQ
	Undervoltage Release (UVT) Automatically trips breaker when voltage falls between preset value, 35…70% Shunt trip is not available when undervoltage release is used	24V, 50/60 Hz			**140U-H-UJ**
		110…127V, 50/60 Hz			**140U-H-UD**
		208…240V, 50/60 Hz			**140U-H-UA**
		380…500V, 50/60 Hz			**140U-H-UB**
		525…600V, 50/60 Hz		***Left side ONLY***	140U-H-UC

Note: For Factory-Installed internal control modules, please see page 2-92

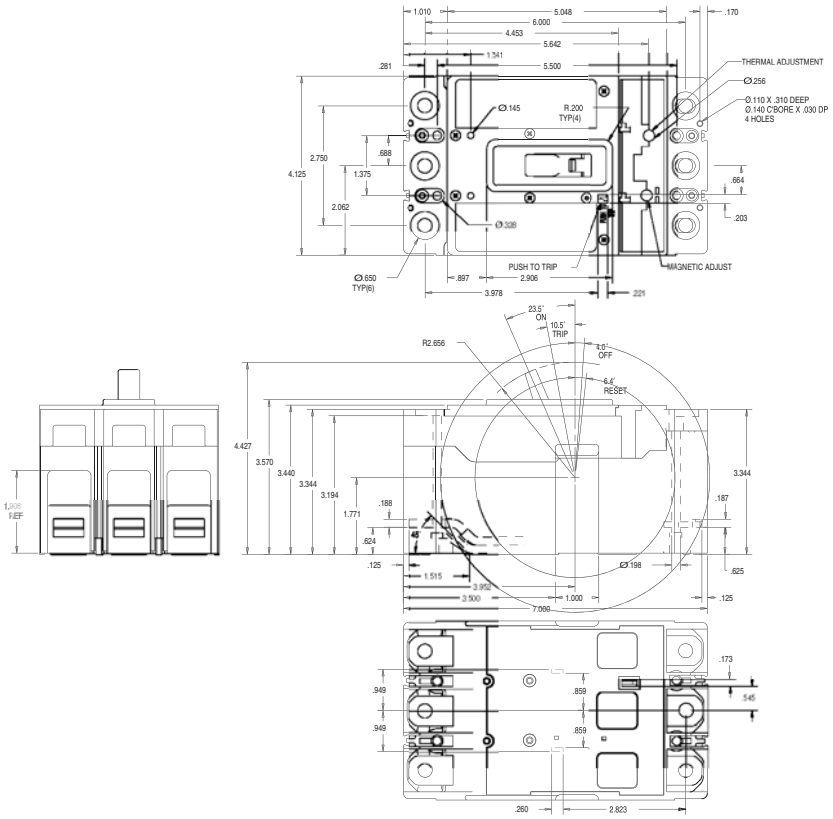
Terminal Lugs

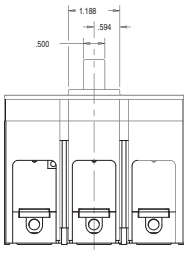
	Description			Frame Size	Cat. No.
	Terminal Lugs	Aluminum lugs, Al or Cu wire (1) 4…350 MCM or (1) 25…185 mm²	Qty: 1	J	**140U-J-TLA1**
		Stainless Steel Box Lugs, Cu wire Only (1) 4…350 MCM or (1) 25…185 mm²	Qty: 1	J	**140U-J-TLS1**

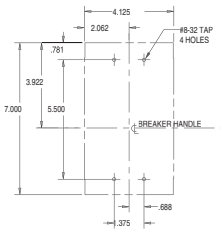
External Accessories

	Description			Cat. No.
	Terminal Shields IP20 Ingress Protection Rating			**140U-J-TS**
	Flex-Cable Operating Mechanism Includes handle, cable, operating, and bail mechanism Pre-assembled and adjusted Non-Metallic - UL IP66, Type 1/3/12/4/4X Flange Mount Operating Handle		3 ft (0.9 m) Cable	**140U-J-FCX03**
			4 ft (1.3 m) Cable	**140U-J-FCX04**
			6 ft (1.9 m) Cable	**140U-J-FCX06**
			10 ft (3.0 m) Cable	140U-J-FCX10
	Flex-Cable Operating Mechanism Stainless Steel IP66/ UL Type 1/3/12/4/4X Flange-Mount Operating Handle		3 ft (0.9 m) Cable	140U-J-FCS03
			4 ft (1.2 m) Cable	140U-J-FCS04
			6 ft (1.9 m) Cable	**140U-J-FCS06**
			10 ft (3.0 m) Cable	140U-J-FCS10
	Rotary, Variable-Depth Operating Mechanism UL Type 3/12/4/4X, IP 66 Rotary handle 12 in. (30.48 cm) operating rod		Black Handle	**140U-J-RVM12B**
			Red/Yellow Handle	**140U-J-RVM12R**
	Rotary, Variable-Depth Operating Mechanism UL Type 3/12/4/4X, IP 66 Rotary handle 21 in. (53.34 cm) operating rod		Black Handle	140U-J-RVM21B
			Red/Yellow Handle	140U-J-RVM21R
	Rotary, Variable-Depth Operating Mechanism with Internal NFPA 79 Operating Handle Type 3/4/4X/12 IP66 Rotary Handle 12 in. (30.48 cm) operating rod		Black Handle	140U-J-NVM12B
			Red/Yellow Handle	140U-J-NVM12R
	Rotary, Variable-Depth Operating Mechanism with Internal NFPA 79 Operating Handle Type 3/4/4X/12 IP66 Rotary Handle 21 in. (53.34 cm) operating rod		Black Handle	140U-J-NVM21B
			Red/Yellow Handle	140U-J-NVM21R
	Rotary, Direct Couple Operating Mechanism Breaker mounted		Black Handle	**140U-J-RCB**
			Red/Yellow Handle	**140U-J-RCR**
	End Cap Kit Provides 3-phase connections for terminal or bolt-on connections Metric hardware			**140U-J-ECM**
	Phase Barriers Provides additional phase clearance when special connections that extend past the circuit breaker housing are required		Qty: 2	**140U-J-PB**
	Padlock Kit Padlocking hasp Lock-OFF only		Qty: 1	**140U-J-PL**
	Multi-Tap Terminal Lug Kit — with IP20 terminal cover	(3) #14…#2 AWG or (3) 2.5…25 mm²	Qty: 3	**140U-J-MTL3A**
		(6) #14…#6 AWG or (6) 2.5…10 mm²	Qty: 3	**140U-J-MTL6A**
	Ground Fault Leakage Module Current pickup settings are selectable from 0.03…10 A with time delays up to. Time delays are also selectable from Instantaneous…1.0 s for 0.10 A settings and above. A current pickup setting of 0.03 A defaults to an Instantaneous time setting regardless of the time dial's position. Two alarm contacts come as standard: a 50% pretrip and a 100% after trip contact, both based only on earth leakage current levels.	150 A	For use with J-Frame 3 pole MCCBs up to 150 A	**140U-J-GFP1503**
		250 A	For use with J-Frame 3-pole MCCBs up to 250 A	140U-J-GFP2503
	Motor Operator Remotely opens, closes, and resets the circuit breaker 110…240V AC		For use with 3- or 4-Pole MCCBs, 110…240V AC/DC	140U-J-EOPD
			For use with 3- or 4-Pole MCCBs, 24V DC	140U-J-EOPZ
	Mounting Hardware (4) M4 - 0.7 x 90 mm		For use with 3- or 4-Pole MCCBs	140U-J-MHM

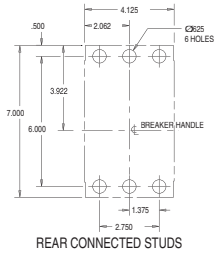
Dimensions are in inches (millimeters). Dimensions are not intended to be used for manufacturing purposes.



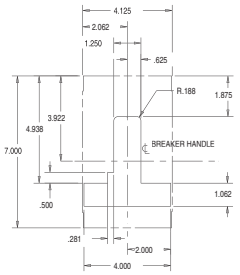




FRONT CONNECTED DRILL PLAN



REAR CONNECTED STUDS



Molded Case Circuit Breakers

Product Selection — 400 A, K-Frame

- UL 489
- CSA 22.2, No. 5
- IEC 157-1
- KEMA-KEUR

Note: Terminal lugs must be ordered separately. See page 2-75

Breaker Frames

Rated Current I_n [A]	Breaking Capacity (50 Hz) I_{cu} / I_{cs} [kA]								Interrupting Rating (60 Hz) [kA]			Cat. No.
	220…240V		380…415V		500V		690V		240V	480V	600V	
400	65	65	40	40	30	30	10	5	65	35	25	**140U-K3X3**
	100	100	35	35	50	38	13	6	100	65	35	**140U-K6X3**
	200	200	100	100	65	49	18	9	200	100	50	**140U-K0X3**

Trip Units and Rating Plugs

Thermal-Magnetic

Rated Current I_n [A]	Adjustment Range [A]		Cat. No.
	Thermal Trip [A] $I_r = I_n$ (Fixed)	Magnetic Trip I_m = 5…10 x I_n	
100	100	500…1000	140U-KTD3-D10
125	125	625…1250	140U-KTD3-D12
150	150	750…1500	140U-KTD3-D15
175	175	895…1750	140U-KTD3-D17
200	200	1000…2000	140U-KTD3-D20
225	225	1125…2250	140U-KTD3-D22
250	250	1250…2500	140U-KTD3-D25
300	300	1500…3000	**140U-KTD3-D30**
350	350	1750…3500	**140U-KTD3-D35**
400	400	2000…4000	**140U-KTD3-D40**

Electronic

Rated Current I_n [A]	Adjustment Range [A]		Protection Type	Cat. No.
	Thermal Trip I_r = 0.5…1.0 x I_n	Magnetic Trip I_m = 2…8 x I_r		
400	200…400∗	400…3200	LS	140U-KTL3-D40
			LSI	**140U-KTH3-D40**
			LSG	140U-KTG3-D40
			LSIG	140U-KTI3-D40

Rating Plugs

Thermal Trip I_n	Cat. No.	Thermal Trip I_n[A]	Cat. No.
200	140U-KRP3-D20	300	**140U-KRP3-D30**
225	140U-KRP3-D22	350	140U-KRP3-D35
250	140U-KRP3-D25	400	**140U-KRP3-D40**

Assembled Circuit Breakers, Thermal-Magnetic Trip Units

Rated Current I_n [A]	Breaking Capacity/ Interrupting Rating [kA]❄		Cat. No.	Breaking Capacity/ Interrupting Rating [kA]❄		Cat. No.	Breaking Capacity/ Interrupting Rating [kA]❄		Cat. No.
	400V	480V		400V	480V		400V	480V	
100	40	35	140U-K3D3-D10	65	65	140U-K6D3-D10	100	100	140U-K0D3-D10
125	40	35	140U-K3D3-D12	65	65	140U-K6D3-D12	100	100	**140U-K0D3-D12**
150	40	35	140U-K3D3-D15	65	65	**140U-K6D3-D15**	100	100	140U-K0D3-D15
175	40	35	140U-K3D3-D17	65	65	140U-K6D3-D17	100	100	140U-K0D3-D17
200	40	35	140U-K3D3-D20	65	65	140U-K6D3-D20	100	100	140U-K0D3-D20
225	40	35	140U-K3D3-D22	65	65	140U-K6D3-D22	100	100	140U-K0D3-D22
250	40	35	140U-K3D3-D25	65	65	140U-K6D3-D25	100	100	140U-K0D3-D25
300	40	35	140U-K3D3-D30	65	65	**140U-K6D3-D30**	100	100	140U-K0D3-D30
350	40	35	**140U-K3D3-D35**	65	65	**140U-K6D3-D35**	100	100	140U-K0D3-D35
400	40	35	140U-K3D3-D40	65	65	140U-K6D3-D40	100	100	140U-K0D3-D40

Assembled circuit breakers can be created by adding a trip unit and rating plugs (electronic only) to a circuit breaker frame. Example: Cat. No. **140U-K3X3** + **140U-KTL3-D40** + **140U-KRP3-D35**

❄ Full ratings are found in the breaker frames table on this page

Assembled Circuit Breakers, Electronic Trip Units

Rated Current I_n [A]	Thermal Trip I_r = 0.5…1.0 x I_n	Protection Type	Breaking Capacity/ Interrupting Rating [kA]❄ 400V	480V	Cat. No.	Breaking Capacity/ Interrupting Rating [kA]❄ 400V	480V	Cat. No.	Breaking Capacity/ Interrupting Rating [kA]❄ 400V	480V	Cat. No.
400	100…400∗	LS	40	35	140U-K3L3-D40	65	65	140U-K6L3-D40	100	100	**140U-K0L3-D40**
		LSI	40	35	140U-K3H3-D40	65	65	140U-K6H3-D40	100	100	140U-K0H3-D40
		LSG	40	35	140U-K3G3-D40	65	65	140U-K6G3-D40	100	100	140U-K0G3-D40

∗ Select proper rating plug to cover thermal trip requirement.
❄ Full ratings are found in the breaker frames table on page 2-74

Molded Case Switch — UL 489

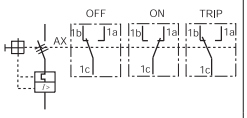
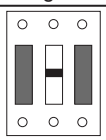
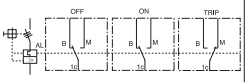
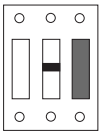
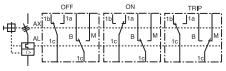
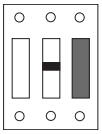
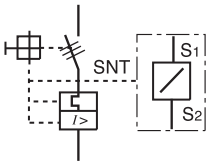
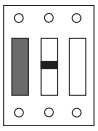
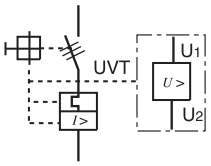
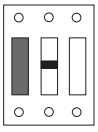
Rated Current I_n [A]	Magnetic Trip 10 x I_n	Breaking Capacity (50 Hz) I_{cu} /I_{cs} [kA] 220…240V		380…415V		500V		690V		Interrupting Rating (60 Hz) [kA] 240V	480V	600V	Cat. No.
400	4000	100	100	65	65	50	38	13	6	100	65	35	**140U-K6S3-D40**

Optional Terminal Lug Kits

	Description		Pkg. Quantity	Cat. No.
	Terminal Lugs	Aluminum lug, Al or Cu wire (1) 3…350 MCM or (1) 30…185 mm²	1	140U-K-TLA1A
		Aluminum lug, Al or Cu wire (1) 250…500 MCM or (1) 120…240 mm²		**140U-K-TLA1**
		Aluminum lug, Al or Cu wire (2) 3/0…250 MCM or (2) 95…120 mm²	3 (includes shield)	**140U-K-TLA2**
	Terminal Lugs	Copper lug, Cu wire only (1) 3…350 MCM or (1) 30…185 mm²	1	140U-K-TLC1A
		Copper lug, Cu wire only (1) 250…500 MCM or (1) 120…240 mm²		**140U-K-TLC1**
		Copper lug, Cu wire only (2) 3/0…250 MCM or (2) 95…120 mm²	3 (includes shield)	**140U-K-TLC2**
		Aluminum lug, Al or Cu wire (2) 2/0…250 MCM or (1) 2/0…500 MCM, (2) 70…120 mm² or (1) 70…240 mm²	3 (includes shield)	140U-K-TLA2A
		Aluminum lug, Al or Cu wire (1) 500…750 MCM or (1) 300…400 mm²		140U-K-TLA1B
	Terminal Lugs	Copper lug, Cu wire only (1) 500…750 MCM or (1) 300…400 mm²	3 (includes shield)	140U-K-TLC1B
	Multi-Tap Terminal Lug Kit — with IP20 terminal cover	(3) #12…2/0 AWG or (3) 4…67 mm²	3	**140U-K-MTL3A**
		(6) #14…#2 AWG or (6) 2.5…33 mm²	3	**140U-K-MTL6A**

2

Internal Control Modules — Field Installed

	Description		Diagram	Mounting Location	Cat. No.
	Auxiliary Contact (AX) Electrically indicates "ON/OFF" status of breakers	(1) 1a-1b			**140U-K-EA1**
		(2) 1a-1b		***Left AND Right side***	**140U-K-EA2**
	Alarm Contact (AL) Electrically indicates when the breaker is in the "TRIPPED" state	(1) 1M (make)-1B (break)		 ***Right side ONLY***	**140U-K-ER1**
	Auxiliary/Alarm Contact (AX/AL) Combination Combination of auxiliary contact and alarm contact	(1) 1a-1b (1) 1M (make)-1B (break)		 ***Right side ONLY***	140U-K-EA1R1
	Shunt Trip (SNT) Provides remote tripping of the circuit breaker Undervoltage trip not available when shunt trip is used	12…24V, 50/60/DC		 ***Left side ONLY***	**140U-K-SNJ**
		110…240V AC, 110…125V DC			**140U-K-SND**
		380…440V AC, 220…250V DC			140U-K-SNN
		480…600V, 50/60 Hz			140U-K-SNB
	Undervoltage Release (UVT) Automatically trips breaker when voltage falls between preset value, 35…70% Shunt trip is not available when undervoltage release is used	24V, 50/60 Hz		 ***Left side ONLY***	140U-K-UJ
		110…127V, 50/60 Hz			140U-K-UD
		208…240V, 50/60 Hz			140U-K-UA
		380…500V, 50/60 Hz			**140U-K-UB**

Note: For Factory-Installed internal control modules, please see page 2-92

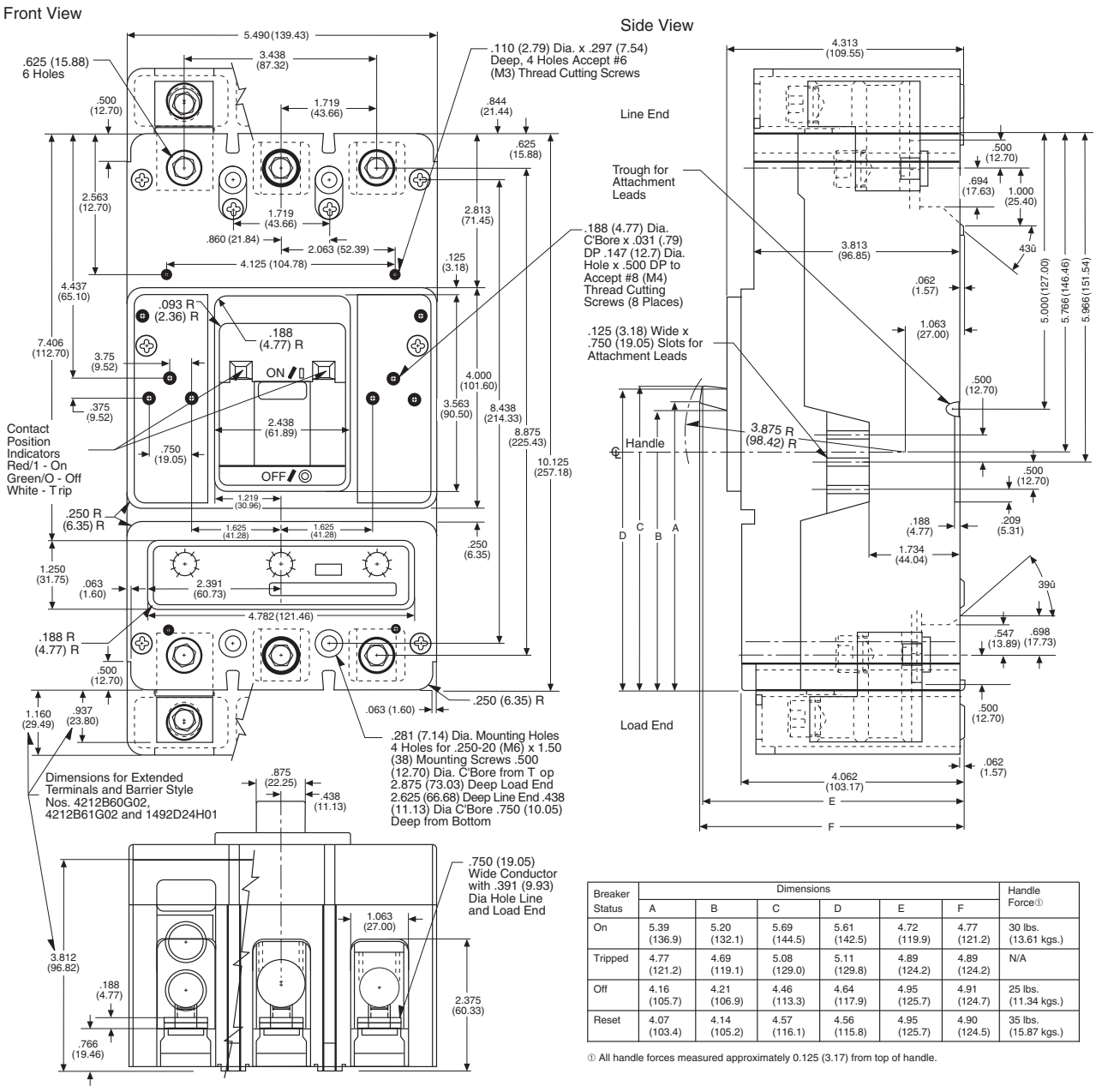
External Accessories

	Description		Cat. No.
	Terminal Shields		**140U-K-TS**
	Flex-Cable Operating Mechanism Includes handle, cable, operating, and bail mechanism Pre-assembled and adjusted UL Type 1/3/12/4/4X Flange-Mount Operating Handle Non-Metallic	4 ft (1.3 m) Cable	**140U-K-FCX04**
		6 ft (1.9 m) Cable	140U-K-FCX06
		10 ft (3.0 m) Cable	140U-K-FCX10
	Flex-Cable Operating Mechanism Includes handle, cable, operating, and bail mechanism Pre-assembled and adjusted UL Type 4/4X Flange-Mount Operating Handle Stainless Steel	4 ft (1.2 m) Cable	140U-K-FCS04
		6 ft (1.9 m) Cable	140U-K-FCS06
		10 ft (3.0 m) Cable	140U-K-FCS10
	Rotary, Variable-Depth Operating Mechanism UL Type 3/12/4/4X, IP 66 Rotary handle 12 in. (30.48 cm) operating rod	Black Handle	**140U-K-RVM12B**
		Red/Yellow Handle	**140U-K-RVM12R**
	Rotary, Variable-Depth Operating Mechanism UL Type 3/12/4/4X, IP 66 Rotary handle 21 in. (53.34 cm) operating rod	Black Handle	**140U-K-RVM21B**
		Red/Yellow Handle	140U-K-RVM21R
	Rotary, Variable-Depth Operating Mechanism with Internal NFPA 79 Operating Handle UL Type 3/12/4/4X, IP 66 Rotary Handle 12 in. (30.48 cm) operating rod	Black Handle	140U-K-NVM12B
		Red/Yellow Handle	140U-K-NVM12R
	Rotary, Variable-Depth Operating Mechanism with Internal NFPA 79 Operating Handle UL Type 3/12/4/4X, IP 66 Rotary Handle 21 in. (53.34 cm) operating rod	Black Handle	140U-K-NVM21B
		Red/Yellow Handle	140U-K-NVM21R
	Rotary, Direct Couple Operating Mechanism Type 1 Rotary Handle Breaker Mounted	Black Handle	**140U-K-RCG**
	Rotary, Direct Couple Operating Mechanism Type 1 Rotary Handle Breaker Mounted	Red/Yellow Handle	140U-K-RCR
	End Cap Kit Provides 3-phase connections for terminal or bolt-on connections Metric Hardware	Qty: 1	**140U-K-ECM**
	Phase Barriers Provides additional phase clearance when special connections that extend past the circuit breaker housing are required	Qty: 2	**140U-K-PB**
	Mounting Hardware (4) M6 - 1.0 x 45 mm	1	140U-K-MHM

Molded Case Circuit Breakers

Approximate Dimensions — 400 A, K-Frame

Dimensions are in inches (millimeters). Dimensions are not intended to be used for manufacturing purposes.



Breaker Status	Dimensions						Handle Force①
	A	B	C	D	E	F	
On	5.39 (136.9)	5.20 (132.1)	5.69 (144.5)	5.61 (142.5)	4.72 (119.9)	4.77 (121.2)	30 lbs. (13.61 kgs.)
Tripped	4.77 (121.2)	4.69 (119.1)	5.08 (129.0)	5.11 (129.8)	4.89 (124.2)	4.89 (124.2)	N/A
Off	4.16 (105.7)	4.21 (106.9)	4.46 (113.3)	4.64 (117.9)	4.95 (125.7)	4.91 (124.7)	25 lbs. (11.34 kgs.)
Reset	4.07 (103.4)	4.14 (105.2)	4.57 (116.1)	4.56 (115.8)	4.95 (125.7)	4.90 (124.5)	35 lbs. (15.87 kgs.)

① All handle forces measured approximately 0.125 (3.17) from top of handle.

- UL 489
- CSA 22.2, No. 5
- IEC 60947-2
- CE
- KEMA-KEUR

Note: Terminal box lugs must be ordered separately. See page 2-80

Breaker Frames

Rated Current I_n [A]	Breaking Capacity (50 Hz) I_{cu} /I_{cs} [kA]								Interrupting Rating (60 Hz) [kA]			Cat. No.	
	220…240V		380…415V		525V		690V		240V	480V	600V		
600	85	85	45	45	25	13	20	10	65	35	25		**140U-L3X3**
	100	100	70	70	35	18	25	13	100	65	35	‡	140U-L6X3
	200	200	100	100	50	25	30	15	200	100	50	‡	**140U-L0X3**

‡ Current Limiting

Trip Units and Rating Plugs

Thermal-Magnetic			
Rated Current I_n [A]	Adjustment Range [A]		Cat. No.
	Thermal Trip $I_r = I_n$ (Fixed)	Magnetic Trip $I_m = 5…10 \times I_n$	
250	250	1250…2500	140U-LTD3-D25
300	300	1500…3000	140U-LTD3-D30
350	350	1750…3500	140U-LTD3-D35
400	400	2000…4000	140U-LTD3-D40
500	500	2500…5000	140U-LTD3-D50
600	600	3000…6000	140U-LTD3-D60

Electronic				
Rated Current I_n [A]	Adjustment Range [A]		Protection Type	Cat. No.
	Thermal Trip $I_r = 0.5…1.0 \times I_n$	Magnetic Trip $I_m = 2…10 \times I_n$		
250	100…250	200…2500	LS	140U-LTL3-D25
			LSI	140U-LTH3-D25
			LSG	140U-LTG3-D25
			LSIG	140U-LTI3-D25
400	160…400	320…4000	LS	140U-LTL3-D40
			LSI	140U-LTH3-D40
			LSG	140U-LTG3-D40
			LSIG	140U-LTI3-D40
600	240…600	480…6000	LS	140U-LTL3-D60
			LSI	140U-LTH3-D60
			LSG	140U-LTG3-D60
			LSIG	140U-LTI3-D60

Assembled Circuit Breakers, Thermal-Magnetic Trip Units

Rated Current I_n [A]	Thermal Trip $I_r = I_n$	Breaking Capacity/Interrupting Rating [kA]❄		Cat. No.	Breaking Capacity/Interrupting Rating [kA]❄		Cat. No.
		400V	480V		400V	480V	
250	250	45	35	**140U-L3D3-D25**	70	65	140U-L6D3-D25
300	300	45	35	**140U-L3D3-D30**	70	65	**140U-L6D3-D30**
350	350	45	35	140U-L3D3-D35	70	65	**140U-L6D3-D35**
400	400	45	35	140U-L3D3-D40	70	65	140U-L6D3-D40
500	500	45	35	140U-L3D3-D50	70	65	140U-L6D3-D50
600	600	45	35	140U-L3D3-D60	70	65	140U-L6D3-D60

❄ Full ratings are found in the breaker frames table on this page

Assembled Circuit Breakers, Electronic Trip Units

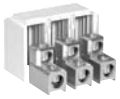
Rated Current I_n [A]	Thermal Trip I_r = 0.5…1.0 x I_n	Protection Type	Breaking Capacity/ Interrupting Rating [kA]❄ 400V	480V	Cat. No.	Breaking Capacity/ Interrupting Rating [kA]❄ 400V	480V	Cat. No.
250	100…250	LS	45	35	140U-L3L3-D25	70	65	**140U-L6L3-D25**
		LSI	45	35	140U-L3H3-D25	70	65	**140U-L6H3-D25**
		LSG	45	35	140U-L3G3-D25	70	65	**140U-L6G3-D25**
		LSIG	45	35	140U-L3I3-D25	70	65	**140U-L6I3-D25**
400	160…400	LS	45	35	140U-L3L3-D40	70	65	**140U-L6L3-D40**
		LSI	45	35	140U-L3H3-D40	70	65	**140U-L6H3-D40**
		LSG	45	35	140U-L3G3-D40	70	65	**140U-L6G3-D40**
		LSIG	45	35	140U-L3I3-D40	70	65	**140U-L6I3-D40**
600	240…600	LS	45	35	140U-L3L3-D60	70	65	140U-L6L3-D60
		LSI	45	35	140U-L3H3-D60	70	65	140U-L6H3-D60
		LSG	45	35	140U-L3G3-D60	70	65	**140U-L6G3-D60**
		LSIG	45	35	140U-L3I3-D60	70	65	140U-L6I3-D60

❄ Full ratings are found in the breaker frames table on page 2-79

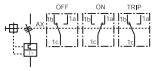
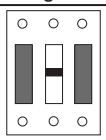
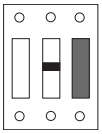
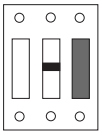
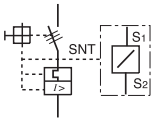
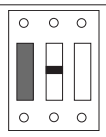
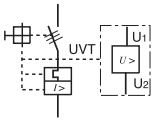
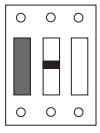
Molded Case Switch — UL 489

Rated Current I_n [A]	Magnetic Trip I_m = 10 x I_n [A]	Breaking Capacity (50 Hz) I_{cu} /I_{cs} [kA] 220…240V		380…415V		500V		690V		Interrupting Rating (60 Hz) [kA] 240V	480V	600V	Cat. No.
600	6000	100	100	70	70	50	38	25	13	100	65	35	140U-L6S3-D60

Terminal Lugs

	Description			Cat. No.
	Terminal Lugs	Aluminum lug, Al or Cu wire (1) 500…750 MCM or (1) 240…380 mm²	Qty: 3 (includes shield)	**140U-L-TL6A1**
		Copper lug, Cu wire only (1) 500…750 MCM or (1) 240…380 mm²	Qty: 3 (includes shield)	140U-L-TL6C1
		Aluminum lug, Al or Cu wire (2) 2…500 MCM or (2) 35…240 mm²	Qty: 3 (includes shield)	**140U-L-TL6A2**
	**Terminal Lugs**	Copper lug, Cu wire only (2) 2…500 MCM or (2) 35…240 mm²	Qty: 3 (includes shield)	**140U-L-TL6C2**
		Aluminum lug, Al or Cu wire (1) 2…500 MCM or (1) 35…240 mm²	Qty: 1	**140U-L-TL4A1**
		Copper lug, Cu wire only (1) 2…500 MCM or (1) 35…240 mm²	Qty: 1	**140U-L-TL4C1**

Internal Control Modules — Field Installed

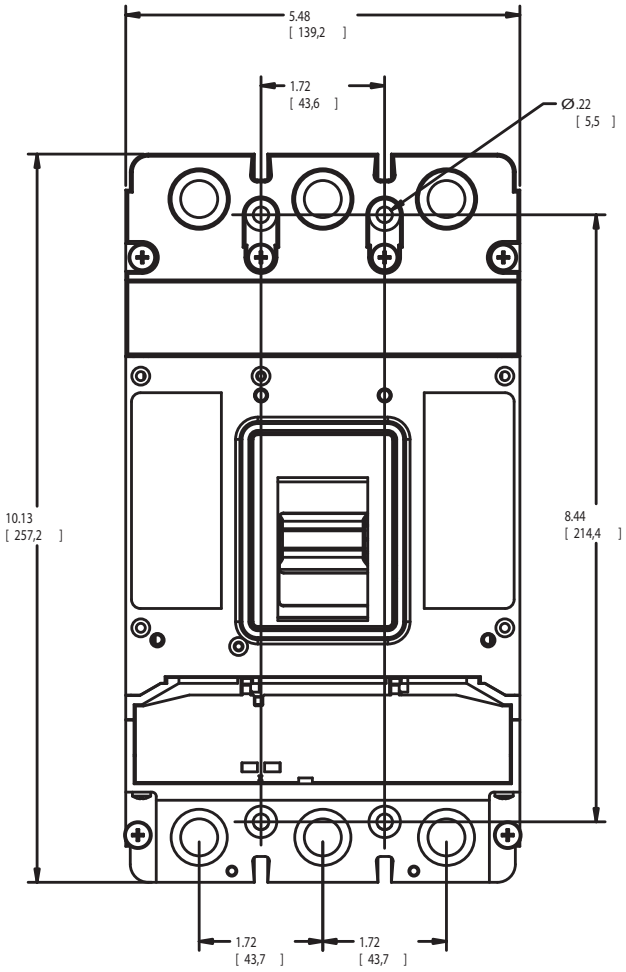
	Description		Diagram	Mounting Location	Cat. No.
	Auxiliary Contact (AX) Electrically indicates "ON/OFF" status of breakers	(1) 1a-1b		 ***Left AND Right side***	**140U-H-EA1**
		(2) 1a-1b			**140U-H-EA2**
	Alarm Contact (AL) Electrically indicates when the breaker is in the "TRIPPED" state	(1) 1M (make)-1B (break)		 ***Right side ONLY***	**140U-J-ER1**
	Auxiliary/Alarm Contact (AX/AL) Combination Combination of auxiliary contact and alarm contact	(1) 1a-1b (1) 1M (make)-1B (break)		 ***Right side ONLY***	**140U-J-EA1R1**
	Shunt Trip (SNT) Provides remote tripping of the circuit breaker Undervoltage trip not available when shunt trip is used	24…60V, 50/60/DC		 ***Left side ONLY***	**140U-H-SNJ**
		110…240V, 50/60/DC			**140U-H-SND**
		380…440V AC, 220…250V DC			140U-H-SNN
		380…600V, 50/60 Hz			140U-H-SNB
	Undervoltage Release (UVT) Automatically trips breaker when voltage falls between preset value, 35…70% Shunt trip is not available when undervoltage release is used	24V, 50/60 Hz		 ***Left side ONLY***	**140U-H-UJ**
		110…127V, 50/60 Hz			**140U-H-UD**
		208…240V, 50/60 Hz			**140U-H-UA**
		380…500V, 50/60 Hz			**140U-H-UB**
		525…600V, 50/60 Hz			140U-H-UC

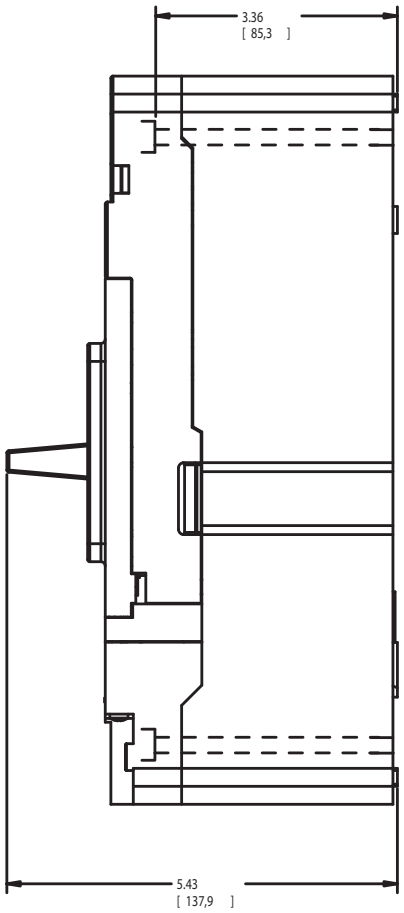
Note: For Factory-Installed internal control modules, please see page 2-92

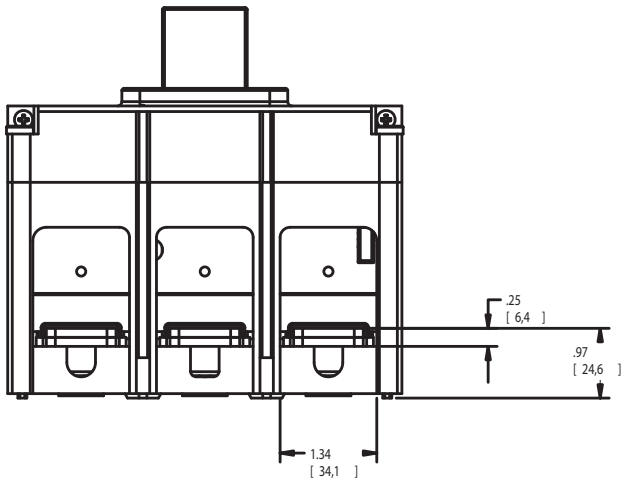
External Accessories

	Description			Cat. No.
	Terminal Shields IP20 Ingress Protection Rating			**140U-L-TS**
	Flex-Cable Operating Mechanism Includes handle, cable, operating, and bail mechanism Pre-assembled and adjusted UL Type 1/3/12/4/4X Flange-Mount Operating Handle Non-Metallic		4 ft (1.3 m) Cable	**140U-L-FCX04**
			6 ft (1.9 m) Cable	140U-L-FCX06
			10 ft (3.0 m) Cable	140U-L-FCX10
	Flex-Cable Operating Mechanism Includes handle, cable, operating, and bail mechanism Pre-assembled and adjusted UL Type 4/4X Flange-Mount Operating Handle Stainless Steel		4 ft (1.2 m) Cable	140U-L-FCS04
			6 ft (1.9 m) Cable	140U-L-FCS06
			10 ft (3.0 m) Cable	140U-L-FCS10
	Rotary, Variable-Depth Operating Mechanism UL Type 3/12/4/4X, IP 66 Rotary handle 12 in. (30.48 cm) operating rod		Black Handle	140U-L-RVM12B
			Red/Yellow Handle	140U-L-RVM12R
	Rotary, Variable-Depth Operating Mechanism UL Type 3/12/4/4X, IP 66 Rotary handle 21 in. (53.34 cm) operating rod		Black Handle	140U-L-RVM21B
			Red/Yellow Handle	140U-L-RVM21R
	Rotary, Variable-Depth Operating Mechanism with Internal NFPA79 Operating Handle UL Type 3/12/4/4X, IP 66 Rotary Handle 12 in. (30.48 cm) operating rod		Black Handle	140U-L-NVM12B
			Red/Yellow Handle	140U-L-NVM12R
	Rotary, Variable-Depth Operating Mechanism with Internal NFPA79 Operating Handle UL Type 3/12/4/4X, IP 66 Rotary Handle 21 in. (53.34 cm) operating rod		Black Handle	140U-L-NVM21B
			Red/Yellow Handle	140U-L-NVM21R
	Rotary, Direct Couple Operating Mechanism Breaker Mounted		Black Handle	140U-L-RMX
	End Cap Kit Provides 3-phase connections for terminal or bolt-on connections Metric hardware provided		Qty: 1	140U-L-ECM
	Phase Barriers Provides additional phase clearance when special connections that extend past the circuit breaker housing are required		Qty: 2	**140U-K-PB**
	Ground Fault Leakage Module Current pickup settings are selectable from 0.03…30 A with time delays up to1.0 s. Time delays are also selectable from Instantaneous…1.0 s for 0.10 A settings and above. A current pickup setting of 0.03 A defaults to an Instantaneous time setting regardless of the time dial's position. Two alarm contacts come as standard: a 50% pretrip and a 100% after trip contact, both based only on earth leakage current levels.	400 A	For use with L-Frame 3-pole MCCBs up to 400 A	140U-L-GFP4003
		600 A	For use with L-Frame 3-pole MCCBs up to 600 A	140U-L-GFP6003
	Motor Operator Remotely opens, closes, and resets the circuit breaker 110…240V AC		For use with 3- or 4-Pole MCCBs, 110…240V AC/DC	140U-L-EOPD
			For use with 3- or 4-Pole MCCBs, 24V DC	140U-L-EOPZ
	Mounting Hardware (4) M5 - 0.8 x 100 mm		For use with 3- or 4-Pole MCCBs	140U-L-MHM

Dimensions are in inches (millimeters). Dimensions are not intended to be used for manufacturing purposes.







Molded Case Circuit Breakers

Product Selection — 800 A, M-Frame

- UL 489
- CSA 22.2, No. 5
- IEC 60947-2
- CE
- KEMA-KEUR

Note: Terminal box lugs must be ordered separately. See page 2-86

Breaker Frames

Rated Current I_n [A]	Breaking Capacity (50 Hz) I_{cu} /I_{cs} [kA]								Interrupting Rating (60 Hz) [kA]			Cat. No.
	220…240V		380…415V		525V		690V		240V	480V	600V	
800	65	65	50	50	50	25	20	10	65	50	25	**140U-M5X3**
	100	100	70	70	70	50	25	13	100	65	35	**140U-M6X3**

Trip Units and Rating Plugs

Thermal-Magnetic

Rated Current I_n [A]	Adjustment Range [A]		Cat. No.
	Thermal Trip $I_r = I_n$	Magnetic Trip I_m = 5…10 x I_n	
300	300	1500…3000	**140U-MTD3-D30**
350	350	1750…3500	140U-MTD3-D35
400	400	2000…4000	140U-MTD3-D40
450	450	2250…4500	140U-MTD3-D45
500	500	2500…5000	140U-MTD3-D50
600	600	3000…6000	140U-MTD3-D60
700	700	3500…7000	140U-MTD3-D70
800	800	4000…8000	**140U-MTD3-D80**

Rating Plugs

Thermal Trip I_n [A]	Cat. No.	Thermal Trip I_n [A]	Cat. No.
400	140U-MRP3-D40	700	140U-MRP3-D70
500	140U-MRP3-D50	800	**140U-MRP3-D80**
600	140U-MRP3-D60	—	—

Electronic

Rated Current I_n [A]	Adjustment Range [A]		Protection Type	Cat. No.
	Thermal Trip I_r = 0.5… 1.0 x I_n	Magnetic Trip I_m = 2…8 x I_n		
800A	400…800∗	800…6400	400…800 A LS Electronic Trip Unit	140U-MTL3-D80
			400…800 A LSI Electronic Trip Unit	140U-MTH3-D80
			400…800 A LSG Electronic Trip Unit	140U-MTG3-D80
			400…800 A LSIG Electronic Trip Unit	**140U-MTI3-D80**

Assembled Circuit Breakers, Thermal-Magnetic Trip Units

Rated Current I_n [A]	Thermal Trip $I_r = I_n$	Breaking Capacity/Interrupting Rating [kA]❄		Cat. No.	Breaking Capacity/Interrupting Rating [kA]❄		Cat. No.
		400V	480V		400V	480V	
300	300	50	50	140U-M5D3-D30	70	65	**140U-M6D3-D30**
350	350	50	50	140U-M5D3-D35	70	65	140U-M6D3-D35
400	400	50	50	140U-M5D3-D40	70	65	140U-M6D3-D40
450	450	50	50	140U-M5D3-D45	70	65	140U-M6D3-D45
500	500	50	50	140U-M5D3-D50	70	65	140U-M6D3-D50
600	600	50	50	140U-M5D3-D60	70	65	140U-M6D3-D60
700	700	50	50	140U-M5D3-D70	70	65	140U-M6D3-D70
800	800	50	50	**140U-M5D3-D80**	70	65	**140U-M6D3-D80**

❄ Full ratings are found in the breaker frames table on this page

Assembled Circuit Breakers, Electronic Trip Units

Rated Current I_n [A]	Thermal Trip I_r = 0.5…1.0 x I_n	Protection Type	Breaking Capacity/ Interrupting Rating [kA]❄		Cat. No.	Breaking Capacity/ Interrupting Rating [kA]❄		Cat. No.
			400V	480V		400V	480V	
800	200…800∗	LS	50	50	140U-M5L3-D80	70	65	140U-M6L3-D80
		LSI	50	50	140U-M5H3-D80	70	65	140U-M6H3-D80
		LSG	50	50	140U-M5G3-D80	70	65	140U-M6G3-D80

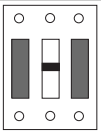
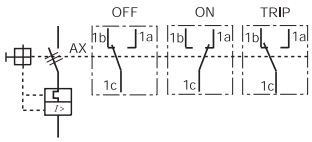
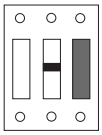
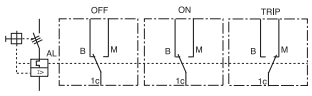
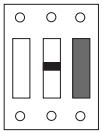
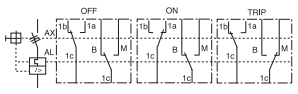
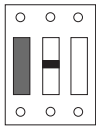
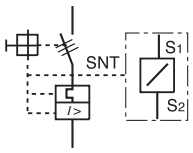
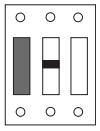
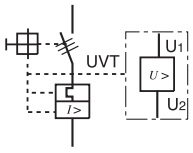
∗ Select proper rating plug to cover thermal trip requirement.

❄ Full ratings are found in the breaker frames table on this page

Molded Case Switch — UL 489

Rated Current I_n [A]	Magnetic Trip [A] I_m = 10 x I_n	Breaking Capacity (50 Hz) I_{cu} /I_{cs} [kA]								Interrupting Rating (60 Hz) [kA]			Cat. No.
		220…240V		380…415V		500V		690V		240V	480V	600V	
800	8000	100	100	70	70	70	50	25	13	100	65	35	**140U-M6S3-D80**

Internal Control Modules — Field Installed

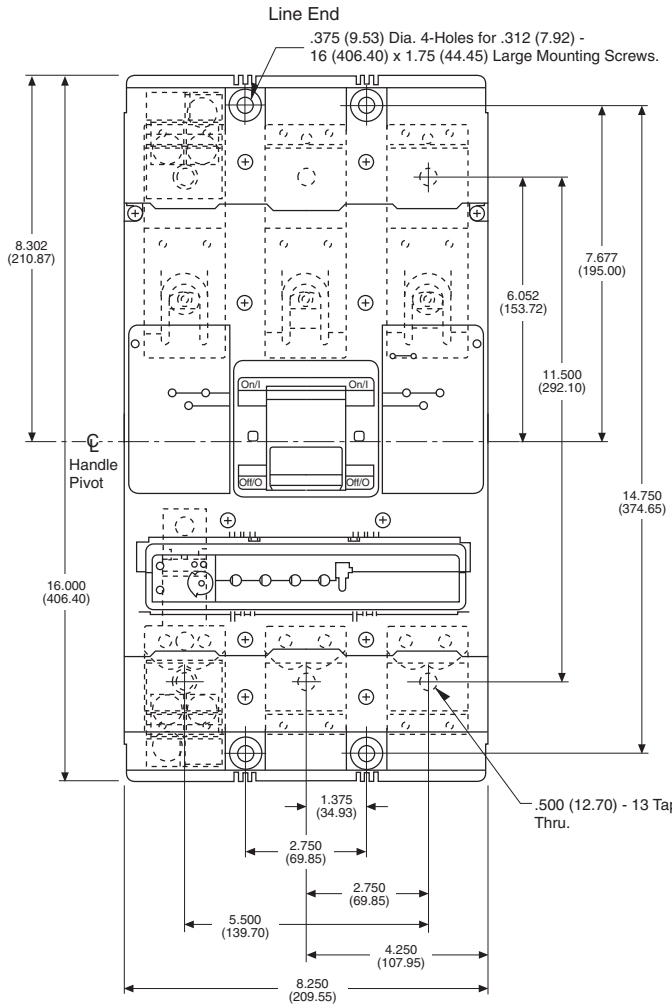
	Description		Mounting Location	Diagram	Cat. No.
	Auxiliary Contact (AX) Electrically indicates "ON/OFF" status of breakers	(1) 1a-1b			**140U-M-EA1**
		(2) 1a-1b	***Left AND Right Side***		**140U-M-EA2**
	Alarm Contact (AL) Electrically indicates when the breaker is in the "TRIPPED" state	(1) 1M (make)-1B (break)			**140U-M-ER1**
	Auxiliary/Alarm Contact (AX/AL) Combination Combination of auxiliary contact and alarm contact	(1) 1a-1b (1) 1M (make)-1B (break)	 ***Right Side Only***		140U-M-EA1R1
	Shunt Trip (SNT) Provides remote tripping of the circuit breaker Undervoltage trip not available when shunt trip is used	12…24V, 50/60/DC			140U-M-SNJ
		110…240V AC, 110…125V DC			140U-M-SND
		380…440V AC, 220…250V DC			140U-M-SNN
		480…600V, 50/60 Hz	***Left Side Only***		140U-M-SNB
	Undervoltage Release (UVT) Automatically trips breaker when voltage falls between preset value, 35…70% Shunt trip is not available when undervoltage release is used	24V, 50/60 Hz			140U-M-UJ
		110…127V, 50/60 Hz			140U-M-UD
		208…240V, 50/60 Hz			140U-M-UA
		380…500V, 50/60 Hz	***Left Side Only***		140U-M-UB

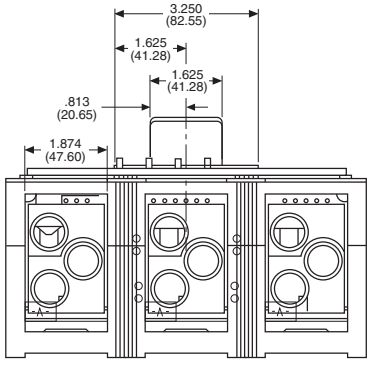
Note: For Factory-Installed internal control modules, please see page 2-92

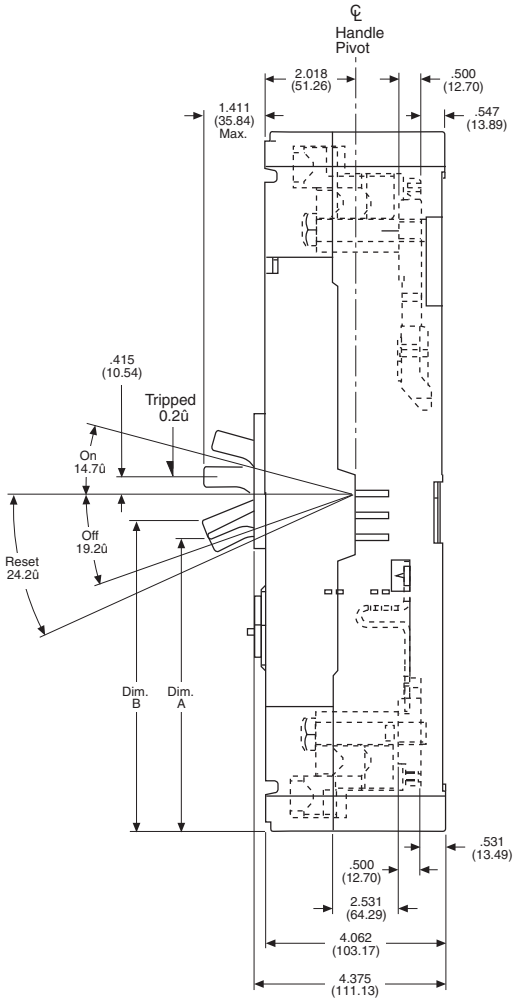
External Accessories

	Description			Cat. No.
	Flex-Cable Operating Mechanism Includes handle, cable, operating, and bail mechanism Pre-assembled and adjusted UL Type 1/3/12/4/4X Flange-Mount Operating Handle Non-Metallic		4 ft (1.3 m) Cable	**140U-M-FCX04**
			6 ft (1.8 m) Cable	140U-M-FCX06
			10 ft (3.0 m) Cable	140U-M-FCX10
	Flex-Cable Operating Mechanism Includes handle, cable, operating, and bail mechanism Pre-assembled and adjusted UL Type 4/4X Flange-Mount Operating Handle Stainless Steel		4 ft (1.3 m) Cable	140U-M-FCS04
			6 ft (1.8 m) Cable	140U-M-FCS06
			10 ft (3.0 m) Cable	140U-M-FCS10
	Rotary, Variable-Depth Operating Mechanism UL Type 3/12/4/4X, IP 66 Rotary Handle 12 in. (30.48 cm) operating rod		Black Handle	**140U-M-RVM12B**
			Red/Yellow Handle	**140U-M-RVM12R**
	Rotary, Variable-Depth Operating Mechanism UL Type 3/12/4/4X, IP 66 Rotary Handle 21 in. (53.34 cm) operating rod		Black Handle	140U-M-RVM21B
			Red/Yellow Handle	140U-M-RVM21R
	Rotary, Variable-Depth Operating Mechanism with Internal NFPA79 Operating Handle UL Type 3/12/4/4X, IP 66 Rotary Handle 12 in. (30.48 cm) operating rod		Black Handle	140U-M-NVM12B
			Red/Yellow Handle	140U-M-NVM12R
	Rotary, Variable-Depth Operating Mechanism with Internal NFPA79 Operating Handle UL Type 3/12/4/4X, IP 66 Rotary Handle 21 in. (53.34 cm) operating rod		Black Handle	140U-M-NVM21B
			Red/Yellow Handle	140U-M-NVM21R
	Terminal Lugs	Copper lug, Cu wire Only (3) 3/0…300 MCM or (3) 95…135 mm²	Qty: 1	**140U-M-TLC3**
		Aluminum lug, Al or Cu wire (3) 3/0…400 MCM or (3) 95…185 mm²	Qty: 1	**140U-M-TLA3**
	Terminal Lugs	Aluminum lug, Al or Cu wire (2) 1…500 MCM or (2) 50…240 mm²	Qty: 1	140U-M-TLA2
		Aluminum lug, Al or Cu wire (2) 500…750 MCM or (2) 240…400 mm²	Qty: 1	**140U-M-TLA2A**
		Copper lug, Cu wire only (2) 2/0…500 MCM or (2) 70…240 mm²	Qty: 1	140U-M-TLC2
	Phase Barriers Provides additional phase clearance when special connections that extend past the circuit breaker housing are required		Qty: 2	**140U-M-PB**
	Padlock Kit Padlocking Hasp Lock-OFF only		Qty: 1	140U-M-PL
	Mounting Hardware (4) M8 - 1 x 35 mm		For use with 3- or 4-Pole MCCBs	140U-M-MHM

Dimensions are in inches (millimeters). Dimensions are not intended to be used for manufacturing purposes.







Breaker Status	Dimension A	Dimension B
On	8.72 (221.49)	9.17 (232.92)
Off	6.72 (170.69)	7.14 (181.36)
Tripped	7.86 (199.64)	8.30 (210.82)
Reset	6.44 (163.58)	6.84 (173.74)

Molded Case Circuit Breakers

Product Selection — 1200 A, N-Frame

- UL 489
- CSA 22.2, No. 5
- IEC 60947-2
- CE
- KEMA-KEUR

Note: Terminal box lugs must be ordered separately. See page 2-90

Assembled Circuit Breakers, Electronic Trip Units

Rated Current I_n [A]	Adjustment Range I_r [A]		Protection Type	Breaking Capacity (50 Hz) I_{cu} / I_{cs} [kA]								Interrupting Rating (60 Hz) [kA]			Cat. No.
	Thermal Trip I_r = 0.5...1.0 x I_n	Magnetic Trip I_m = 2...8 x I_n		220...240V		380...415V		500V		690V		240V	480V	600V	
1200	600...1200∗	1200...10600	LS	85	85	50	50	40	20	20	10	65	50	25	**140U-N5L3-E12**
			LS	100	100	70	50	50	25	25	13	100	65	35	**140U-N6L3-E12**
1200	600...1200	1200...10600	LSI	100	100	70	50	50	25	25	13	100	65	35	140U-N6H3-E12
			LSG	100	100	70	50	50	25	25	13	100	65	35	140U-N6G3-E12
			LSIG	100	100	70	50	50	25	25	13	100	65	35	140U-N6I3-E12
1200	600...1200∗	1200...10600	LS	200	100	100	50	65	33	35	18	200	100	50	140U-N0L3-E12
			LSI	200	100	100	50	65	33	35	18	200	100	50	140U-N0H3-E12
			LSG	200	100	100	50	65	33	35	18	200	100	50	140U-N0G3-E12
			LSIG	200	100	100	50	65	33	35	18	200	100	50	140U-N0I3-E12

∗ Select proper rating plug to cover thermal trip equipment.

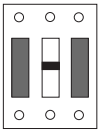
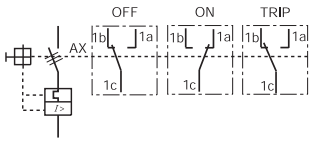
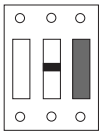
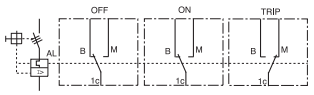
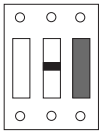
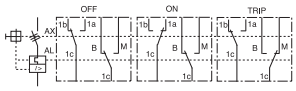
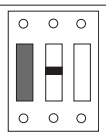
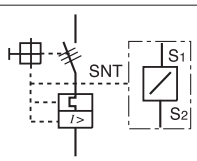
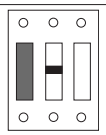
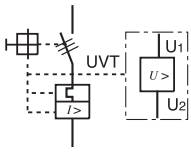
Rating Plugs

Rated Current I_n [A]	Cat. No.	Rated Operational Current I_n [A]	Cat. No.
600	140U-NRP3-D60	900	**140U-NRP3-D90**
700	140U-NRP3-D70	1000	**140U-NRP3-E10**
800	140U-NRP3-D80	1200	**140U-NRP3-E12**

Molded Case Switch — UL 489

Rated Current I_n [A]	Magnetic Trip 10 x I_n	Breaking Capacity (50 Hz) I_{cu} / I_{cs} [kA]								Interrupting Rating (60 Hz) [kA]			Cat. No.
		220...240V		380...415V		500V		690V		240V	480V	600V	
1200	12000	100	100	70	50	50	25	25	13	100	65	35	140U-N6S3-E12

Internal Control Modules — Field Installed

	Description		Mounting Location	Diagram	Cat. No.
	Auxiliary Contact (AX) Electrically indicates "ON/OFF" status of breakers	(1) 1a-1b			**140U-N-EA1**
		(2) 1a-1b	***Left AND Right side***		**140U-N-EA2**
	Alarm Contact (AL) Electrically indicates when the breaker is in the "TRIPPED" state	(1) 1M (make)-1B (break)			140U-N-ER1
			Right side ONLY		
	Auxiliary/Alarm Contact (AX/AL) Combination Combination of auxiliary contact and alarm contact	(1) 1a-1b (1) 1M (make)-1B (break)			**140U-N-EA1R1**
			Right side ONLY		
	Shunt Trip (SNT) Provides remote tripping of the circuit breaker Undervoltage trip not available when shunt trip is used	12…24V, 50/60/DC			140U-N-SNJ
		110…240V AC, 110…125V DC			140U-N-SND
		380…440V AC, 220…250V DC			140U-N-SNN
		480…600V, 50/60 Hz	***Left side ONLY***		140U-N-SNB
	Undervoltage Release (UVT) Automatically trips breaker when voltage falls between preset value, 35…70% Shunt trip is not available when undervoltage release is used	24V, 50/60 Hz			140U-N-UJ
		110…127V, 50/60 Hz			**140U-N-UD**
		208…240V, 50/60 Hz			140U-N-UA
		380…500V, 50/60 Hz	***Left side ONLY***		140U-N-UB

Note: For Factory-Installed internal control modules, please see page 2-92

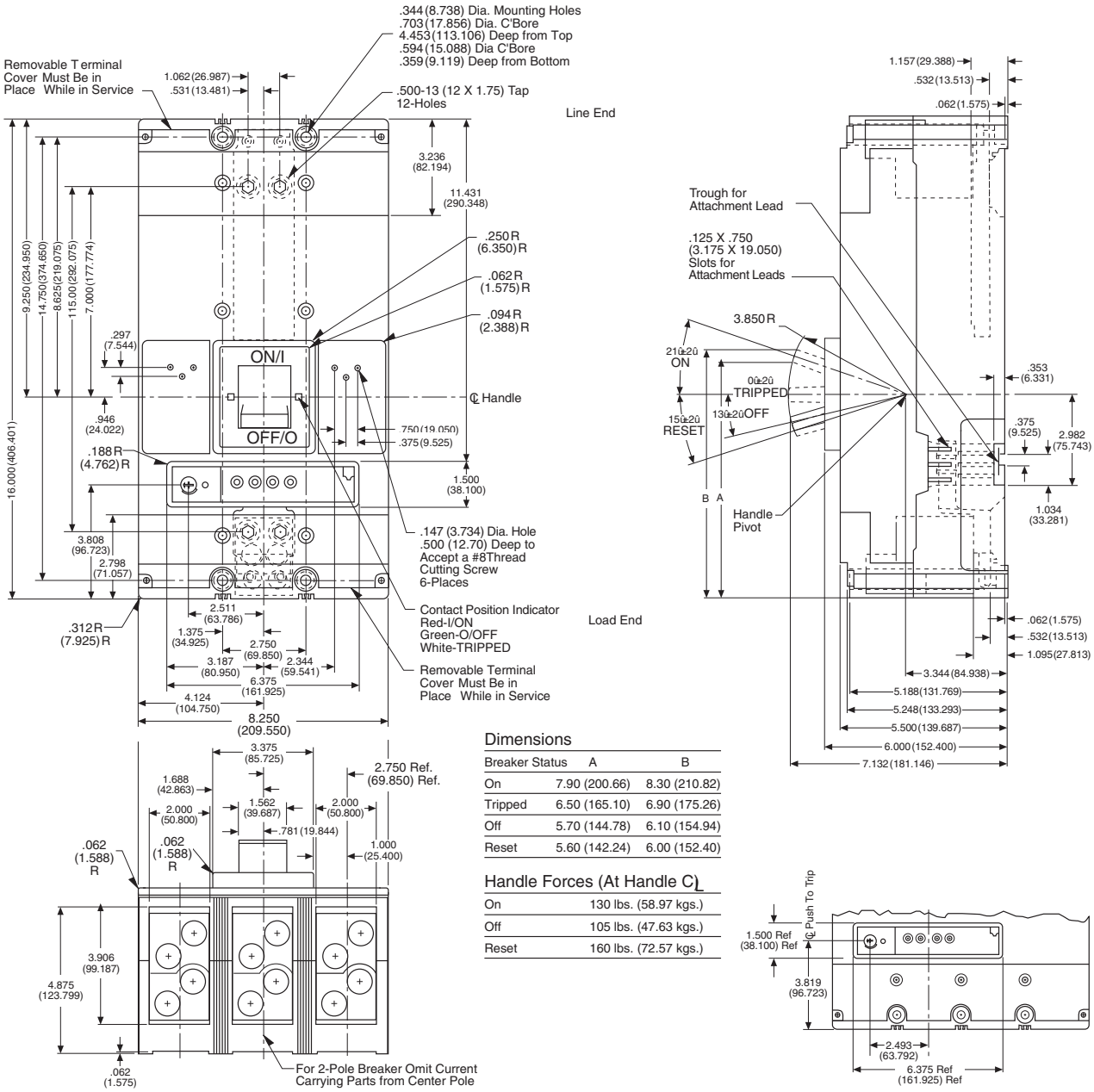
External Accessories

	Description		Cat. No.
	Flex-Cable Operating Mechanism NEMA Type 1/3/12/4/4X Flange-Mount Handle	4 ft. (1.2 m) Cable	**140U-N-FCX04**
		6 ft. (1.9 m) Cable	**140U-N-FCX06**
		10 ft. (3.0 m) Cable	140U-N-FCX10
	Rotary, Variable-Depth Operating Mechanism Type 1/12 Rotary Handle 12 in. (30.48 cm) operating rod	Black Handle	**140U-N-RM12B**
	Phase Barriers Provides additional phase clearance when special connections that extend past the circuit breaker housing are required	Qty: 2	**140U-N-PB**
	Padlock Kit Padlocking Hasp Lock-OFF only	Qty: 1	140U-N-PL
	Motor Operator Remotely opens, closes, and resets the circuit breaker 110…240V AC	Qty: 1	**140U-N-EOPD**
	Motor Operator, 230..240V AC	Qty: 1	**140U-N-EOPA**
	Mounting Hardware (4) M8 - 1 x 35 mm	For use with 3- or 4-Pole MCCBs	140U-M-MHM

Terminal Lugs

	Description		Pkg. Quantity	Cat. No.
	Terminal Lugs	Aluminum lug, Al or Cu wire (2) 1…500 MCM or (2) 50…240 mm²	Qty: 1	140U-N-TLA2
		Aluminum lug, Al or Cu wire (3) 3/0…400 MCM or (3) 95…185 mm²	Qty: 1	140U-N-TLA3
		Aluminum lug, Al or Cu wire (4) 4/0…500 MCM or (4) 120…300 mm²	Qty: 1	**140U-N-TLA4**
		Aluminum lug, Al or Cu wire (3) 500…750 MCM or (3) 300…400 mm²	Qty: 1	140U-N-TLA3A
		Copper lug, Cu wire only (2) 2/0…500 MCM or (2) 70…240 mm²	Qty: 1	140U-N-TLC2
		Copper lug, Cu wire only (3) 3/0…500 MCM or (3) 95…240 mm²	Qty: 1	140U-N-TLC3
		Copper lug, Cu wire only (4) 3/0…400 MCM or (4) 95…185 mm²	Qty: 1	**140U-N-TLC4**

Dimensions are in inches (millimeters). Dimensions are not intended to be used for manufacturing purposes.



Dimensions

Breaker Status	A	B
On	7.90 (200.66)	8.30 (210.82)
Tripped	6.50 (165.10)	6.90 (175.26)
Off	5.70 (144.78)	6.10 (154.94)
Reset	5.60 (142.24)	6.00 (152.40)

Handle Forces (At Handle ℄)

On	130 lbs. (58.97 kgs.)
Off	105 lbs. (47.63 kgs.)
Reset	160 lbs. (72.57 kgs.)

2

Internal Control Modules — Factory Installed
For use with G-Frame Molded Case Circuit Breakers

2-Pole Breaker

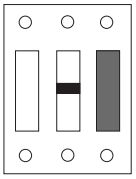
Mounting Location

Left side only

(1) Auxiliary contact (AX)
or
(1) Alarm contact (AL)
or
(1) Alarm contact (AL) + Auxiliary contact (AX)

Right side only

(1) Auxiliary contact (AX)



3-Pole Breaker

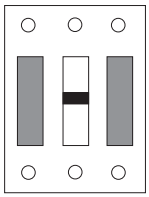
Mounting Location

Left side only

(1) Auxiliary contact (AX)
or
(1) Alarm contact (AL)
or
(1) Alarm contact (AL) + Auxiliary contact (AX)

Right side only

(1) Shunt Trip (SNT)
or
(1) Undervoltage Release (UVT)



Auxiliary and Alarm Contacts	Suffix	
	2-Pole	3-Pole
(1) AX	- A	- A

Internal Control Modules — Factory Installed
For use with H-, J-, K-, L-, M-, and N-Frame Molded Case Circuit Breakers

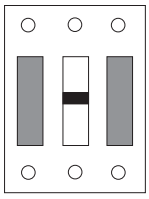
Mounting Location

Left side only

(1) Auxiliary contact (AX)
or
(2) Auxiliary contacts (AX)
or
(1) Alarm contact (AL)
or
(1) Alarm contact (AL) + Auxiliary contact (AX)

Right side only

(1) Shunt Trip (SNT)
or
(1) Undervoltage Release (UVT)



Auxiliary and Alarm Contacts	Suffix
(1) AX	- A
(2) AX	- B
(1) AL	- D
(1) AX + (1) AL	- F

Undervoltage Release Combinations	Suffix
(1) UVT only	- G⊗
(1) AX + (1) UVT	- H⊗
(2) AX + (1) UVT	- J⊗
(1) AX + (1) AL + (1) UVT	- L⊗
(1) AL + (1) UVT	- N⊗

⊗Standard Voltage Suffix Codes∗

Voltage [V]	24	110…127	208…240	380…480
AC, 50/60 Hz	J	D	A	B
Voltage [V]	—	—	—	—
DC	—	—	—	—

Shunt Trip Combinations	Suffix
(1) SNT only	- P⊗
(1) AX + (1) SNT	- Q⊗
(2) AX + (1) SNT	- R⊗
(1) AX + (1) AL + (1) SNT	- T⊗
(1) AL + (1) SNT	- V⊗

⊗Standard Voltage Suffix Codes∗

Voltage [V]	12…24	110…240	380…600
AC, 50/60 Hz	J	D	B
Voltage [V]	12…24	110…125	—
DC	J	D	—

∗ For additional voltages, consult your local Rockwell Automation sales office or Allen-Bradley distributor.

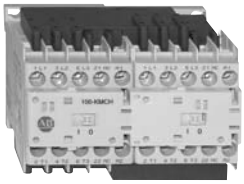
Contactors

Bulletin	**100-K/104-K**	**100-C/104-C**	**100Q-C**	**100-D/104-D**	**100-G**
Screw Terminals	✓	✓	✓	Thru-hole	Thru-hole
Max. Current I_e	12 A	85 A	37 A	860 A	1200 A
Current Rating	5…12 A	9…85 A	16, 32 A	95…860 A	550…1200 A
Features	• Mini-contactors • Uniform panel mounting dimensions • Panel mounting or mounting on 35 mm DIN Rail • AC or DC coil control • Made of environmentally friendly materials	• Panel mounting or mounting on 35 mm DIN Rail • AC or DC coil control • Reversible coil terminals (line or load side) • Common accessories • Made of environmentally friendly materials	• Panel mounting or mounting on 35 mm DIN Rail • AC or DC coil control • Reversible coil terminals (line or load side) • Common accessories • Made of environmentally friendly materials	• Panel mounting only • Made of environmentally friendly materials • AC or DC coil control (conventional or electronic) • Integrated PLC interface (electronic coil)	• Panel mounting • AC or DC coil control • Horizontal or vertical interlock • Latching • 4th pole
Contacts	3 power poles with internal N.O. or N.C. auxiliary contact, or 4 power poles. Optional front-mounted 2- or 4-pole external auxiliary contact block.	3 power poles with internal N.O. or N.C. auxiliary contact or 4 power poles. Optional front- or side-mounted 1-, 2- or 4-pole external auxiliary contact block.	3 main poles with front-mount resistor elements. Optional front- or side-mounted 1-, 2- or 4-pole external auxiliary contact block.	3 power poles with external N.O. and N.C. side-mounted auxiliary contact. Optional side-mounted 2-pole external auxiliary contact blocks	3 power poles with N.O. and N.C. front-mounted auxiliary contact. Optional 4th pole and auxiliary contacts
Coil Voltages	AC = 24…600V, 50/60Hz DC = 12…250V	AC = 12…600V, 50/60Hz DC = 9…250V	AC = 12…600V, 50/60Hz DC = 12…250V	**Conventional Coils** **Cat. Nos. 100-D95…D180** AC: 24…550V 50 Hz, 24…600V 60Hz, 100…277V 50/60Hz DC: 24…250V DC **Electronic Coils** **Cat. Nos. 100-D95…D300** AC: 24…500V 50/60 Hz DC: 24…255V DC **Cat. Nos. 100-D420** AC: 42…500V 50/60 Hz DC: 48…255V DC **Cat. Nos. 100-D630…D860** AC: 100…600V 50/60 Hz DC: 110…255V DC	AC = 110…480V, 50/60Hz DC = 100…440V
Optional Overload Relays	Electronic or bimetallic	Electronic or bimetallic	—	Electronic	Electronic
Optional Accessories	• Front-mount auxiliary contacts • Surge suppressors • Electronic timers • Mechanical interlocks	• Front or side-mount auxiliary contacts • Surge suppressors • Electronic or pneumatic timers • Mechanical interlocks • Mechanical latches	• Side-mount auxiliary contacts • Surge suppressors • Electronic timers	• Side-mount auxiliary contacts • Surge suppressors • IP20 terminal blocks • Terminal shields • Terminal covers • Connecting components • Terminal lugs • Mechanical/electrical interlocks	• Auxiliary contact • 4th pole • Vertical interlock • Horizontal interlock • Mechanical latch
Standards/ Certifications	UL CSA IEC CE Marked	UL CSA IEC CE Marked	UL CSA IEC CE Marked	UL CSA IEC CE Marked	UL CSA IEC CE Marked
Product Selection	**Page 2-95**	**Page 2-99**	**Page 2-105**	**Page 2-111**	**Page 2-120**

2

Safety Contactors

Bulletin	**100S-C/104S-C**	**100S-D**
Screw Terminals	✓	Thru-hole
Max. Current I_e	85 A	860 A
Current Rating	9…85 A	95…860 A
Features	• Positively guided/mechanically linked auxiliary contacts • Front-mounted auxiliary contacts: - Permanently fixed - Protective cover to prevent manual operation - Red contact housing for easy identification - Incorporates IEC 947-5-1 “Mechanically Linked” symbol • AC and DC operating coils • SUVA third-party certification	• Mirror contact performance on auxiliary contacts, which are required in feedback circuit for modern safety applications. • The N.C. auxiliary contacts will not change state when a power contact welds. • SUVA third-party certification • AC and DC operating coils • "Mirror Contact" symbol
Contacts	3 main poles with N.C. mechanically linked feedback contacts	3 main poles with N.C. mechanically linked feedback contacts
Coil Voltages	AC = 12…600V AC, 50/60Hz DC = 12…250V DC	**Conventional Coils** **Cat. Nos. 100S-D95…D180** AC: 24…550V, 50 Hz; 24…600V, 60Hz; 100…277V, 50/60Hz DC: 24…250V **Electronic Coils** **Cat. Nos. 100S-D95…D300** AC: 24…500V, 50/60 Hz DC: 24…255V **Cat. Nos. 100S-D420** AC: 42…500V 50/60 Hz DC: 48…255V **Cat. Nos. 100S-D630…D860** AC: 100…600V, 50/60 Hz DC: 110…255V
Optional Accessories	• Side-mount auxiliary contacts • Surge suppressors • Electronic timers • Mechanical interlocks	• Side-mount auxiliary contacts • Surge suppressors • IP20 terminal blocks • Terminal shields • Terminal covers • Connecting components • Terminal lugs • Mechanical/electrical interlocks
Standards Compliance	EN/IEC 60947-4 IEC 60947-5-1 Annex L — Mechanically Linked Contacts IEC 60947-4-1 Annex H — Mirror Contacts UL 508 CSA C22.2 No. 14 EN50205	EN/IEC 60947-4 IEC 60947-4-1, Annex H — Mirror Contacts IEC 60947-4-1/A1: 2002-09, Annex F UL 508 CSA C22.2, No. 14
Certifications	cULus Listed (File No. E3125; Guide NLDX, NLDX7) SUVA Third-Party Certified CE Marked	cULus Listed (File No. E3125; Guide No. NLDX, NLDX7) SUVA Third-Party Certified CE Marked
Product Selection	**Page 2-102**	**Page 2-115**



Bulletin 100-K/104-K IEC Contactors

- Compact size
- Same dimensions for AC and DC
- Full-voltage non-reversing and reversing contactors
- 5, 9, and 12 A contactors rated at 690V
- IP2X finger protection
- Optional integrated surge suppressor
- Compatible with Bulletin 193-K bimetallic overload relay
- Mirror contacts per IEC 60947-4-1 and mechanically linked contacts per IEC 60947-5-1 on main unit

Allen-Bradley Bulletin 100-K miniature contactors are designed for commercial and light industrial applications where panel space is at a premium. These miniature devices, while 45 mm wide, are shallower and have less panel depth requirements than standard IEC contactors.

The miniature contactors have been designed with flexibility in mind. They are available with AC or DC operating coils, several contact ratings, and optional 2- or 4-pole adder decks in a variety of auxiliary contact configurations.

Your order must include: cat. no. (with coil voltage code) of the mini contactor specified and, if required, cat. no. of any accessories

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Product Selection ..... this page
Accessories 2-97
Specifications 2-122
Approximate Dimensions 2-157

Standards Compliance

IEC/EN 60947-1,-4-1,-5-1,-5-4
UL 508
CSA 22.2. No. 14
NF F 62-000

Certifications

CE marked
cULus Listed (File No. E41850, Guide NLDX, NLDX7)

2

3-Pole AC- and DC-Operated Contactors

Rated Operational Current I_e [A]	Ratings for switching AC motors - AC-2, AC-3, AC-4										Auxiliary Contacts		Pkg. Qty.∗	Cat. No.
	3Ø kW (50 Hz)				Hp (60 Hz)									
40 °C					1Ø		3Ø							
AC-1	230V	400/415V	500V	690V	115V	230V	200V	230V	460V	575V	N.O.	N.C.		
20	1.5	2.2	2.2	2.2	1/2	1	1-1/2	1-1/2	3	3	1	0	1	**100-K05⊗10**
											0	1	1	**100-K05⊗01**
20	3	4	4	4	1/2	1-1/2	2	2	5	5	1	0	1	**100-K09⊗10**
											0	1	1	100-K09⊗01
20	3	5.5	5.5	5.5	3/4	2	3	3	7-1/2	7-1/2	1	0	1	**100-K12⊗10**
											0	1	1	100-K12⊗01

∗ May be ordered in package quantities of 20. Add letter M to the end of the cat. no. Example: **100-K09ZJ10M**.

⊗ The Cat. No. as listed is incomplete. Select a Coil Voltage Code from the table on page 2-96 to complete the Cat. No. Example: 24V DC: Cat. No. **100-K05⊗10** becomes Cat. No. **100-K05ZJ10**.

4-Pole AC- and DC-Operated Contactors

Rated Operational Current I_e [A]	Ratings for switching AC motors - AC-2, AC-3										Contact Configuration, Main Pole		Pkg. Qty.∗	Cat. No.
	3Ø kW (50 Hz)				Hp (60 Hz)									
40 °C					1Ø		3Ø							
AC-1	230V	400/415V	500V	690V	115V	230V	200V	230V	460V	575V	N.O.	N.C.		
20	1.5	2.2	2.2	2.2	1/2	1	1-1/2	1-1/2	3	3	4	0	1	**100-K05⊗400**
											3	1	1	100-K05⊗300
											2	2	1	100-K05⊗200
20	3	4	4	4	1/2	1-1/2	2	2	5	5	4	0	1	**100-K09⊗400**
											3	1	1	100-K09⊗300
											2	2	1	100-K09⊗200
20	3	5.5	5.5	5.5	3/4	2	3	3	7-1/2	7-1/2	4	0	1	**100-K12⊗400**
											3	1	1	100-K12⊗300
											2	2	1	100-K12⊗200

∗ May be ordered in package quantities of 20. Add letter M to the end of the cat. no. Example: **100-K09ZJ400M**.

⊗ The Cat. No. as listed is incomplete. Select a Coil Voltage Code from the table on page 2-96 to complete the Cat. No. Example: 24V DC: Cat. No. **100-K05⊗400** becomes Cat. No. **100-K05ZJ400**.

Reversing AC- and DC-Operated Contactors

Rated Operational Current I_e [A]	Ratings for switching AC motors - AC-2, AC-3, AC-4										Auxiliary Contacts per Contactor ∗		
	3Ø kW (50 Hz)				Hp (60 Hz)								
40 °C					1Ø		3Ø						
AC-1	230V	400/415V	500V	690V	115V	230V	200V	230V	460V	575V	N.O.	N.C.	Cat. No.
20	1.5	2.2	2.2	2.2	—	—	1-1/2	1-1/2	3	3	0	1	**104-K05⊗02**
20	3	4	4	4	—	—	2	2	5	5	0	1	**104-K09⊗02**
20	3	5.5	5.5	5.5	—	—	3	3	7-1/2	7-1/2	0	1	**104-K12⊗02**

∗ Used for electrical interlocking

⊗ The Cat. No. as listed is incomplete. Select a standard Coil Voltage Code from the table below to complete the Cat. No.
Example: 230V, 50/60 Hz: Cat. No. **104-K05⊗02** becomes Cat. No. **104-K05KF02**.

Bulletin 104-K reversing contactors are factory assembled and include contactors, mechanical interlock (Cat. No. 100-KMCH) and wiring kit (Cat. No. 100-KPR) for power and control circuit (electrical interlock).

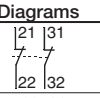
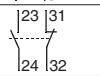
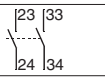
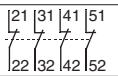
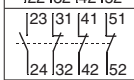
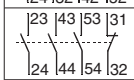
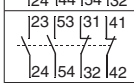
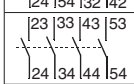
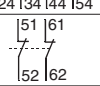
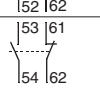
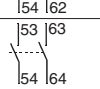
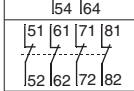
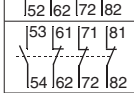
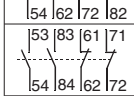
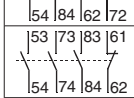
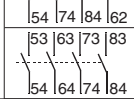
⊗ Coil Voltage Code

The Cat. No. as listed is incomplete. Select a coil voltage code from the table below to complete the Cat. No. Example: 120V, 60 Hz: **Cat. No. 100-K09⊗10** becomes **Cat. No.100-K09D10**.

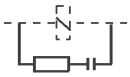
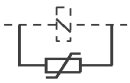
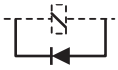
AC Voltages [V]	24	110	120	230	240	400	480	600
50 Hz	—	D	—	—	—	—	—	—
60 Hz	—	—	D	—	—	—	B	VC
50/60 Hz	**KJ**	—	—	KF	**KA**	**KN**	—	—

DC Voltages [V]	12	24	110	125	220	250
Standard	ZQ	ZJ	ZD	ZS	ZA	ZT
with Integrated Diode	—	**DJ**	—	—	—	—

Auxiliary Contact Blocks

	Description	Connection Diagrams	N.O.	N.C.	For Use With	Pkg. Qty.	Cat. No.
	Front-Mounted Auxiliary Contacts Auxiliary contact blocks 2- and 4-pole versions Choice of contact configurations Snap on, no tools required Electronic-compatible bifurcated contacts for signals down to 15V/2 mA Mirror Contact performance per IEC 60947-4-1		0	2	100-K05…K12⊗10	1	100-KFC02
			1	1	100-K05…K12⊗10	1	**100-KFC11**
			2	0	100-K05…K12⊗10	1	100-KFC20
			0	4	100-K05…K12⊗10	1	100-KFC04
			1	3	100-K05…K12⊗10	1	100-KFC13
			3	1	100-K05…K12⊗10	1	100-KFC31
			2	2	100-K05…K12⊗10	1	**100-KFC22**
			4	0	100-K05…K12⊗10	1	**100-KFC40**
			0	2	100/104-K, 700-K	1	100-KFA02E
			1	1	100/104-K, 700-K	1	100-KFA11E
			2	0	100/104-K, 700-K	1	100-KFA20E
			0	4	100/104-K, 700-K	1	**100-KFA04E**
			1	3	100/104-K, 700-K	1	100-KFA13E
			2	2	100/104-K, 700-K	1	**100-KFA22Z**
			3	1	100/104-K, 700-K	1	**100-KFA31Z**
			4	0	100/104-K, 700-K	1	**100-KFA40E**

Control Modules

	Description			Connection Diagrams	For Use With	Pkg. Qty.	Cat. No.
	Mechanical Interlock For interlocking of two adjacent contactors No added width to contactor assembly Front mount Plug-In type Optional auxiliary contact blocks and suppressor modules mount onto the interlock				100-K, 700-K (AC & DC Control)	1	100-KMCH
	Surge Suppressor Plug-in Type Limits surge voltage on coil drop-off	**RC Suppressor**	24…48V AC		100/104-K, 700-K	1 ∗	100-KFSC50
			110…280V AC			1 ∗	100-KFSC280
			380…480V AC			1 ∗	100-KFSC480
		MOV Suppressor	12…55V AC, 12…77V DC		100/104-K, 700-K	1 ∗	100-KFSV55
			56…136V AC, 78…180V DC			1 ∗	100-KFSV136
			137…277V AC, 181…250V DC			1 ∗	100-KFSV277
		Diode Suppressor	12…250V DC		100/104-K, 700-K	1 ∗	100-KFSD250

∗ May be ordered in package quantities of 10. Add letter M to the end of the cat. no. Example: **100-KFSC50M**.

Connecting Components

	Description		For Use With	Pkg. Qty.	Cat. No.
	ECO Connecting Module — 12 A For DOL and reversing starters Eco-starters mount on single DIN Rail (140M on DIN Rail) Electrical and mechanical interconnection of 140M MPCB and 100-K contactors	Connects: 140M-C circuit breakers with 100-K contactors	140M-C to 100-K	1 ∗	**140M-C-PEK12**
	Power Wiring Kit	For Reversing and Star/Delta combinations. Star-point bridge not included.	100-K	1	100-KPR
	Feeder Terminal for Compact Bus Bars Max. current 34 A	Supply of compact bus bars	100-K	1	100-KWT
	Three-Phase Compact Bus Bars Max. current 34 A	For 100-K, 5…12 A contactors 45 mm spacing (3 connections)❄	100-K	1	100-KW453
		For 100-K, 5…12 A contactors 45 mm spacing (4 connections)❄	100-K	1	100-KW454

∗ May be ordered in package quantities of 10. Add letter M to the end of the cat. no. Example: **140M-C-PEK12M**.
❄ Combinations possible. Example: For 6 contactor connections use one cat. no. 100-KW453 and one cat. no. 100-KW454.

Marking Systems

	Description	Pkg. Qty.	Cat. No.
	Label Sheet 105 self-adhesive paper labels each, 6 x 17 mm	10	**100-FMS**
	Snap-In Hinged Marker Card	5	**1492-MH6X12**

Bulletin 100-C/104-C IEC Contactors

- Compact sizes from 4…45 kW/5…60 Hp (9…85 A)
- AC and DC coil control
- Common accessories for all contactor sizes
- Front and side mounting of auxiliary contacts
- Electronic and pneumatic timing modules
- Space-saving coil-mounted control modules
- Reversible coil terminations (line or load side)
- All devices can be attached to 35 mm DIN mounting Rail
- Environmentally friendly materials

The Bulletin 100-C/104-C contactor family, along with a wide range of common accessories and Bulletin 193 solid-state overload relays, provides the most compact and flexible starter component system available.

Your order must include: cat. no. of the contactor specified with coil voltage code and, if required, cat. no. of any accessories and/or replacement coils.

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Standards Compliance

EN/IEC 60947-4-1, 60947-5-1
IEC 60947 Type "2" Coordination
CSA C22.2 No. 14
UL 508

Certifications

CE Marked
cULus Listed (File No. E3125; Guide No. NLDX, NLDX7)

2

3-Pole AC- and DC-Operated Contactors

I_e [A]		Ratings for Switching AC Motors — AC-2, AC-3, AC-4										Aux. Contacts		
		3Ø kW (50 Hz)				Hp (60 Hz)								
						1Ø		3Ø						
AC-3	AC-1	230V	400V/415V	500V	690V	115V	230V	200V	230V	460V	575V	N.O.	N.C.	Cat. No.
9	32	3	4	4	4	1/2	1-1/2	2	2	5	7-1/2	1	0	**100-C09⊗10**
												0	1	**100-C09⊗01**
12	32	4	5.5	5.5	5.5	1/2	2	3	3	7-1/2	10	1	0	**100-C12⊗10**
												0	1	**100-C12⊗01**
16	32	5.5	7.5	7.5	7.5	1	3	5	5	10	15	1	0	**100-C16⊗10**
												0	1	**100-C16⊗01**
23	32	7.5	11	13	10	2	3	5	7-1/2	15	15	1	0	**100-C23⊗10**
												0	1	**100-C23⊗01**
30	65	10	15	15	15	2	5	7-1/2	10	20	25	0	0	100-C30⊗00
												1	0	**100-C30⊗10**
												0	1	100-C30⊗01
37	65	11	18.5/20	20	18.5	3	5	10	10	25	30	0	0	100-C37⊗00
												1	0	**100-C37⊗10**
												0	1	100-C37⊗01
43	85	13	22	25	22	3	7-1/2	10	15	30	30	0	0	100-C43⊗00
												1	0	**100-C43⊗10**
												0	1	100-C43⊗01
60	100	18.5	32	37	32	5	10	15	20	40	50	0	0	100-C60⊗00
												1	0	**100-C60⊗10**
												0	1	100-C60⊗01
72	100	22	40	45	40	5	15	20	25	50	60	0	0	100-C72⊗00
												1	0	**100-C72⊗10**
												0	1	100-C72⊗01
85	100	25	45	55	45	7-1/2	15	25	30	60	60	0	0	100-C85⊗00
												1	0	**100-C85⊗10**
												0	1	100-C85⊗01

⊗Coil voltage code and terminal position—see page 2-101

4-Pole AC- and DC-Operated Contactors

I_e [A]		Ratings for Switching AC Motors — AC-2, AC-3										Contact Configuration, Main Pole		
		3Ø kW (50 Hz)∗				Hp (60 Hz)								
						1Ø		3Ø ∗						
AC-3	AC-1	230V	400V/415V	500V	690V	115V	230V	200V	230V	460V	575V	N.O.	N.C.	Cat. No.
9	32	3	4	4	4	1/2	1-1/2	2	2	5	7-1/2	4	0	100-C09⊗400
												3	1	100-C09⊗300
												2	2	100-C09⊗200
12	32	4	5.5	5.5	5.5	1/2	2	3	3	7-1/2	10	4	0	100-C12⊗400
												3	1	100-C12⊗300
												2	2	100-C12⊗200
16	32	5.5	7.5	7.5	7.5	1	3	5	5	10	15	4	0	100-C16⊗400
												3	1	100-C16⊗300
												2	2	100-C16⊗200
23	32	7.5	11	13	10	2	3	5	7-1/2	15	15	4	0	100-C23⊗400
												3	1	100-C23⊗300
												2	2	100-C23⊗200
37	75	11	18.5/20	20	18.5	3	5	10	10	25	30	4	0	100-C40⊗400
												2	2	100-C40⊗200
85	130	25	45	55	45	7-1/2	15	25	30	60	50	4	0	100-C90⊗400
												2	2	100-C90⊗200

∗ Three-phase ratings apply only to contactors with at least three N.O. power poles.

⊗Coil voltage code and terminal position—see page 2-101

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Preferred availability cat. nos. are printed in **bold**

Allen-Bradley

Reversing AC- and DC-Operated Contactors

- Includes Mechanical/Electrical Interlock
- Includes Reversing Power Wiring

Cat. No. 104-C09D22

Cat. No. 104-C30ZJ22

Cat. No. 104-C85D22

I_e [A]		Ratings for Switching AC Motors — AC-2, AC-3, AC-4										Auxiliary Contacts Installed per Contactor		
		3Ø kW (50 Hz)				Hp (60 Hz)								
						1Ø		3Ø						
AC-3	AC-1	230V	400V/415V	500V	690V	115V	230V	200V	230V	460V	575V	N.O.	N.C.∗	Cat. No.
9	32	3	4	4	4	1/2	1-1/2	2	2	5	7-1/2	1	1	**104-C09⊗22**
12	32	4	5.5	5.5	5.5	1/2	2	3	3	7-1/2	10	1	1	**104-C12⊗22**
16	32	5.5	7.5	7.5	7.5	1	3	5	5	10	15	1	1	**104-C16⊗22**
23	32	7.5	11	13	10	2	3	5	7-1/2	15	15	1	1	**104-C23⊗22**
30	65	10	15	15	15	2	5	7-1/2	10	20	25	0	1	104-C30⊗02
												1	1	**104-C30⊗22**
37	65	11	18.5/20	20	18.5	3	5	10	10	25	30	0	1	104-C37⊗02
												1	1	**104-C37⊗22**
43	85	13	22	25	22	3	7.5	10	15	30	30	0	1	104-C43⊗02
												1	1	**104-C43⊗22**
60	100	18.5	32	37	32	5	10	15	20	40	50	0	1	104-C60⊗02
												1	1	**104-C60⊗22**
72	100	22	40	45	40	5	15	20	25	50	60	0	1	104-C72⊗02
												1	1	**104-C72⊗22**
85	100	25	45	55	45	7-1/2	15	25	30	60	60	0	1	104-C85⊗02
												1	1	**104-C85⊗22**

∗ The N.C. auxiliary contact is supplied as part of the mechanical/electrical interlock.

⊗ Coil Voltage Code and Terminal Position

The Cat. No. as listed is incomplete. Select a coil voltage code from the table below to complete the Cat. No. Example: 120V, 60Hz: **Cat. No. 100-C09⊗10** becomes **Cat. No.100-C09D10**.

[V] / Hz	12	24	32	36	42	48	100	100-110	110	120	127	200	200-220	208	208-240	220-230	230	230-240	240	277	347	380	380-400	400	400-415	440	480	500	550	600
50 Hz	R	K	V	W	X	Y	KP	—	D	P	S	KG	L	—	—	F	—	VA	T	—	—	—	N	—	G	B	—	M	C	—
60 Hz	Q	J	—	V	—	X	—	KP	—	D	—	—	KG	H	L	—	—	—	A	T	I	E	—	—	—	N	B	—	—	C
50/60 Hz	—	KJ	—	—	—	KY	KP	—	KD	—	—	KG	KL	—	—	KL	KF	—	KA	—	—	—	—	KN	—	KB	—	—	—	—

DC Voltages [V]		9	12	24	36	48	60	64	72	80	110	115	125	220	230	250
100-C09…C43	Standard	ZR	ZQ	ZJ	ZW	ZY	ZZ	ZB	ZG	ZE	ZD	ZP	ZS	ZA	ZF	ZT
	with Integrated Diode	—	—	DJ	—	—	—	—	—	—	—	—	—	—	—	—
	Electronic with Integrated Diode	—	—	EJ	—	—	—	—	—	—	—	—	—	—	—	—
100-C60…C85	with Integrated Diode	DR	DQ	DJ	DW	DY	DZ	DB	DG	DE	DD	DP	DS	DA	DF	DT

Coil Terminal Position

- All contactors are delivered with the coil terminals located on the **line side**.
- For **load side** coil terminations, insert a **"U"** prior to the coil voltage code. Ordering example: **Cat. No. 100-C09UD10**.

Cat. No. 100-C09⊗10 Line Side

Cat. No. 100-C09U⊗10 Load Side

Bulletin 100S/104S Safety Contactors

- Mechanically linked N.C. auxiliary contacts
- Front-mounted auxiliary contacts:
  Gold bifurcated
  Permanently fixed
  Protective cover to prevent manual operation
  Red contact housing foreasy identification
  Incorporates IEC 60947-5-1 "Mechanically Linked" symbol
- AC and DC operating coils
- SUVA Third-Party certification

Bulletin 100S-C/104S-C safety contactors provide mechanically linked positively guided contacts, required in feedback circuits of modern safety applications. The mechanically linked N.C. auxiliary contacts will not change state when a power pole welds. In addition, the gold-plated bifurcated auxiliary contacts are ideally suited for low-energy applications or feedback control circuits with multiple series-connected N.C. auxiliary contacts.

Your order must include: cat. no. of the contactor specified with coil voltage code and, if required, cat. no. of any accessories and/or replacement coils.

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Standards Compliance

EN50205
CSA C22.2 No. 14
UL 508
EN/IEC 60947-4
IEC 60947-4-1 Annex H — Mirror Contacts
IEC 60947-5-1 Annex L — Mechanically Linked Contacts

Certifications

SUVA Third-Party Certified
CE Marked
cULus Listed (File No. E3125; Guide NLDX, NLDX7)

3-Pole AC- and DC-Operated Contactors

I_e [A]		Ratings for Switching AC Motors — AC-2, AC-3, AC-4										Aux. Contacts		
		3Ø kW (50 Hz)				Hp (60 Hz)								
						1Ø		3Ø						
AC-3	AC-1	230V	400V/ 415V	500V	690V	115V	230V	200V	230V	460V	575V	N.O.	N.C.	Cat. No.∗❄
9	32	3	4	4	4	1/2	1-1/2	2	2	5	7-1/2	0	5	100S-C09⊗05BC
												1	4	**100S-C09⊗14BC**
12	32	4	5.5	5.5	5.5	1/2	2	3	3	7-1/2	10	0	5	100S-C12⊗05BC
												1	4	100S-C12⊗14BC
16	32	5.5	7.5	7.5	7.5	1	3	5	5	10	15	0	5	100S-C16⊗05BC
												1	4	100S-C16⊗14BC
23	32	7.5	11	13	10	2	3	5	7-1/2	15	15	0	5	100S-C23⊗05BC
												1	4	100S-C23⊗14BC
30	65	10	15	15	15	2	5	7-1/2	10	20	25	0	4	100S-C30⊗04BC
												1	4	**100S-C30⊗14BC**
37	65	11	18.5/20	20	18.5	3	5	10	10	25	30	0	4	100S-C37⊗04BC
												1	4	**100S-C37⊗14BC**
43	85	13	22	25	22	3	7-1/2	10	15	30	30	0	4	100S-C43⊗04BC
												1	4	**100S-C43⊗14BC**
60	100	18.5	32	37	32	5	10	15	20	40	50	0	4	‡ 100S-C60⊗04BC
												1	4	‡ **100S-C60⊗14BC**
72	100	22	40	45	40	5	15	20	25	50	60	0	4	‡ 100S-C72⊗04BC
												1	4	‡ **100S-C72⊗14BC**
85	100	25	45	55	45	7-1/2	15	25	30	60	60	0	4	‡ 100S-C85⊗04BC
												1	4	‡ **100S-C85⊗14BC**

∗ For other contact configurations and full product details, please contact your local Rockwell Automation sales office or Allen-Bradley distributor.

❄ If standard cross-stamped front-mount auxiliary contacts are required, remove the letter "B" before the letter "C" in the cat. no. Example: Cat. No. **100S-C09⊗05BC** becomes Cat. No. **100S-C09⊗05C**.

‡ Bifurcated front-mount auxiliary contacts on Cat. Nos. **100S-C60...C85** conform to mirror contact performance only.

⊗Coil voltage code and terminal position—see page 2-104

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Preferred availability cat. nos. are printed in **bold**

4-Pole AC- and DC-Operated Contactors

I_e [A]		Ratings for Switching AC Motors										Contact Configuration				
		AC-2, AC-3, AC-4										Main Pole		Auxillary Contacts		
		3Ø kW (50 Hz)❄				Hp (60 Hz)										
						1Ø		3Ø ❄								
AC-3	AC-1	230V	400V/ 415V	500V	690V	115V	230V	200V	230V	460V	575V	N.O.	N.C.	N.O.	N.C.	Cat. No.∗‡
9	32	3	4	4	4	1/2	1-1/2	2	2	5	7-1/2	4	0	0	4	
												3	1	0	4	
12	32	4	5.5	5.5	5.5	1/2	2	3	3	7-1/2	10	4	0	0	4	
												3	1	0	4	**100S-C12⊗304BC**
16	32	5.5	7.5	7.5	7.5	1	3	5	5	10	15	4	0	0	4	**100S-C16⊗404BC**
												3	1	0	4	**100S-C16⊗304BC**
23	32	7.5	11	13	10	2	3	5	7-1/2	15	15	4	0	0	4	**100S-C23⊗404BC**
												3	1	0	4	**100S-C23⊗304BC**

∗ For other contact configurations, please contact your local Rockwell Automation sales office or Allen-Bradley distributor.

❄ Three-phase ratings only apply to contactors with at least three N.O. power poles.

‡ If standard cross-stamped front-mount auxiliary contacts are required, remove the letter "B" before the letter "C" in the cat. no. Example: Cat. No. **100S-C09⊗404BC** becomes Cat. No. **100S-C09⊗404C**.

⊗Coil voltage code and terminal position—see page 2-104

Safety Contactors

Product Selection, Continued

Reversing AC- and DC-Operated Contactors

- 3 Main Contacts
- Includes Mechanical/Electrical Interlock
- Includes Reversing Power Wiring

I_e [A]		Ratings for Switching AC Motors AC-2, AC-3, AC-4										Aux. Contacts Installed per Contactor		
		3Ø kW (50 Hz)				Hp (60 Hz)								
						1Ø		3Ø						
AC-3	AC-1	230V	400V/ 415V	500V	690V	115V	230V	200V	230V	460V	575V	N.O.	N.C. ‡	Cat. No.∗❄
9	32	3	4	4	4	1/2	1-1/2	2	2	5	7-1/2	0	6	104S-C09⊗012BC
												1	5	104S-C09⊗210BC
12	32	4	5.5	5.5	5.5	1/2	2	3	3	7-1/2	10	0	6	104S-C12⊗012BC
												1	5	104S-C12⊗210BC
16	32	5.5	7.5	7.5	7.5	1	3	5	5	10	15	0	6	104S-C16⊗012BC
												1	5	104S-C16⊗210BC
23	32	7.5	11	13	10	2	3	5	7-1/2	15	15	0	6	104S-C23⊗012BC
												1	5	**104S-C23⊗210BC**
30	65	10	15	15	15	2	5	7-1/2	10	20	25	0	5	**104S-C30⊗010BC**
												1	5	**104S-C30⊗210BC**
37	65	11	18.5/20	20	18.5	3	5	10	10	25	30	0	5	**104S-C37⊗010BC**
												1	5	**104S-C37⊗210BC**
43	85	13	22	25	22	3	7-1/2	10	15	30	30	0	5	**104S-C43⊗010BC**
												1	5	**104S-C43⊗210BC**
60	100	18.5	32	37	32	5	10	15	20	40	50	0	5	§ **104S-C60⊗010BC**
												1	5	§ **104S-C60⊗210BC**
72	100	22	40	45	40	5	15	20	25	50	60	0	5	§ **104S-C72⊗010BC**
												1	5	§ **104S-C72⊗210BC**
85	100	25	45	55	45	7-1/2	15	25	30	60	60	0	5	§ **104S-C85⊗010BC**
												1	5	§ **104S-C85⊗210BC**

∗ For other contact configurations, please contact your local Rockwell Automation sales office or Allen-Bradley distributor.

❄ If standard cross-stamped front-mount auxiliary contacts are required, remove the letter "B" before the letter "C" in the cat. no. Example: Cat. No. **104S-C09⊗05BC** becomes Cat. No. **104S-C09⊗05C**.

‡ One of the N.C. auxiliary contacts is supplied as part of the mechanical/electrical interlock.

§ Bifurcated front-mount auxiliary contacts on Cat. Nos. **104S-C60…C85** conform to mirror contact performance only.

⊗ Coil Voltage Code and Terminal Position

The Cat. No. as listed is incomplete. Select a coil voltage code from the table below to complete the Cat. No. Example: 120V, 60Hz: **Cat. No. 100S-C09⊗05BC** becomes **Cat. No.100S-C09D05BC.**

[V]	12	24	32	36	42	48	100	100-110	110	120	127	200	200-220	208	208-240	220-230
AC, 50 Hz	R	K	V	W	X	Y	KP	—	D	P	S	KG	L	—	—	F
AC, 60 Hz	Q	J	—	V	—	X	—	KP	—	D	—	—	KG	H	L	—
AC, 50/60 Hz	–	KJ	—	—	—	KY	KP	—	KD	—	—	KG	KL	—	—	KL

[V]	230	230-240	240	277	347	380	380-400	400	400-415	440	480	500	550	600
AC, 50 Hz	—	VA	T	—	—	—	N	—	G	B	—	M	C	—
AC, 60 Hz	—	—	A	T	I	E	—	—	—	N	B	—	—	C
AC, 50/60 Hz	KF	—	KA	—	—	—	—	KN	—	KB	—	—	—	—

[V]			9	12	24	36	48	60	64	72	80	110	115	125	220	230	250
100S-C09…C43	Standard	DC	ZR	ZQ	ZJ	ZW	ZY	ZZ	ZB	ZG	ZE	ZD	ZP	ZS	ZA	ZF	ZT
	with Integrated Diode		—	—	DJ	—	—	—	—	—	—	—	—	—	—	—	—
	Electronic with Integrated Diode		—	—	EJ	—	—	—	—	—	—	—	—	—	—	—	—
100S-C60…C85	with Integrated Diode		DR	DQ	DJ	DW	DY	DZ	DB	DG	DE	DD	DP	DS	DA	DF	DT

Coil Terminal Position

- All contactors are delivered with the coil terminals located on the **line side.**
- For **load side** coil terminations, insert a **"U"** prior to the coil voltage code. Example: **Cat. No. 100S-C09UD05BC.**

Cat. No. 100S-C09⊗05C Line Side

Cat. No. 100S-C09U⊗05C Load Side

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Preferred availability cat. nos. are printed in **bold**

Cat. No. 100Q-C37A11

Bulletin 100Q-C Capacitor-Switching Contactors

- Compact sizes
- Limits high inrush currents
- AC and DC coil control
- Reversible coil terminals
- Panel or 35 mm DIN Rail mounting
- Environmentally friendly materials

The Bulletin 100Q-C Capacitor-Switching contactors are designed for switching banks of capacitors. The unique design uses front-mounted resistor elements that limit the severely high inrush currents seen in these applications. This reduces stress to the contactors and the capacitors, as well as allowing a more compact and economical design without the use of air-core reactors.

Your order must include: cat. no. of the contactor specified with coil voltage code and, if required, cat. no. of any accessories.

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Standards Compliance

IEC 60947-4
CSA C22.2 No. 14
UL 508

Certifications

CE Marked
cULus Listed (File No. E 41850, Guide NLDX, NLDX7)

2

For Applications per IEC 60947-4 (AC-6b)

Ratings for Switching Capacitor Banks @ 40 °C

1-Phase 50 Hz (kVar)						3-Phase 50 Hz (kVar)						Aux. Contacts		
230V	240V	400V	415V	500V	690V	230V	240V	400V	415V	500V	690V	N.O.	N.C.	Cat. No.
5	5	8.5	9	10.5	15	8.5	8.5	15	15.5	18.5	25	1	1	**100Q-C16⊗11**
												2	0	**100Q-C16⊗20**
8	8.5	14	14.5	17.5	24	14	14	25	25	30	40	1	1	**100Q-C37⊗11**
												2	0	**100Q-C37⊗20**

Ratings for Switching Capacitor Banks @ 60 °C

1-Phase 50 Hz (kVar)						3-Phase 50 Hz (kVar)						Aux. Contacts		
230V	240V	400V	415V	500V	690V	230V	240V	400V	415V	500V	690V	N.O.	N.C.	Cat. No.
5	5	8.5	9	10.5	15	8.5	8.5	15	15.5	18.5	25	1	1	**100Q-C16⊗11**
												2	0	**100Q-C16⊗20**
8	8.5	14	14.5	17.5	24	14	14	25	25	30	40	1	1	**100Q-C37⊗11**
												2	0	**100Q-C37⊗20**

For Applications per UL/CSA

Ratings for Switching Capacitor Banks

1-Phase 60 Hz (kVar)		3-Phase 60 Hz (kVar)				Aux. Contacts		
115V	230V	200V	230V	460V	600V	N.O.	N.C.	Cat. No.
2.2	4.5	6.5	7.5	15	18.5	1	1	**100Q-C16⊗11**
						2	0	**100Q-C16⊗20**
3.6	7.5	11	12.5	20	25	1	1	**100Q-C37⊗11**
						2	0	**100Q-C37⊗20**

⊗ Coil Voltage Code

The Cat. No. as listed is incomplete. Select a coil voltage code from the table below to complete the Cat. No. Example: 120V, 60 Hz: **Cat. No. 100Q-C16⊗11** becomes **Cat. No.100Q-C16D11**.

[V] / Hz	12	24	32	36	42	48	100	100-110	110	120	127	200	200-220	208	208-240	220-230	230	230-240	240	277	347	380	380-400	400	400-415	440	480	500	550	600
50 Hz	R	K	V	W	X	Y	KP	—	D	P	S	KG	L	—	—	F	—	VA	T	—	—	—	N	—	G	B	—	M	C	—
60 Hz	Q	J	—	V	—	X	—	KP	—	D	—	—	KG	H	L	—	—	—	A	T	I	E	—	—	—	N	B	—	—	C
50/60 Hz	—	KJ	—	—	—	KY	KP	—	KD	—	—	KG	KL	—	—	KL	KF	—	KA	—	—	—	—	KN	—	KB	—	—	—	—

DC Voltages [V]	9	12	24	36	48	60	64	72	80	110	115	125	220	230	250
Standard	ZR	ZQ	ZJ	ZW	ZY	ZZ	ZB	ZG	ZE	ZD	ZP	ZS	ZA	ZF	ZT
with Integrated Diode	—	—	DJ	—	—	—	—	—	—	—	—	—	—	—	—
Electronic with Integrated Diode	—	—	EJ	—	—	—	—	—	—	—	—	—	—	—	—

Maximum Operational Rates

100Q-C16 200 operations/hour
100Q-C37 100 operations/hour

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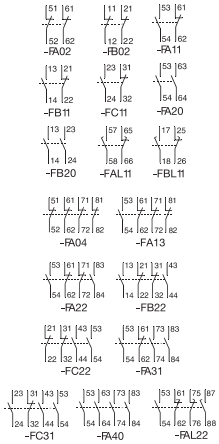
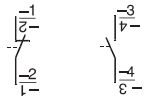
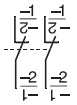
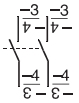
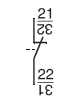
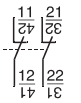
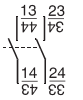
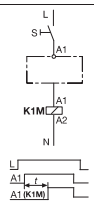
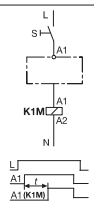
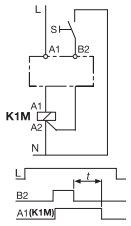
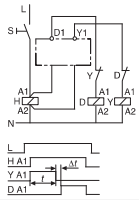
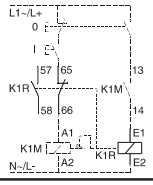
Auxiliary Contacts (For 100-C09…C85 contactors)

	Description	N.O.	N.C.	Connection Diagrams	For Use With	Standard Auxiliary Contact Cat. No.	Bifurcated Auxiliary Contact Cat. No.
	Auxiliary Contact Blocks for Front Mounting∗ • 2- and 4-pole • Quick and easy mounting without tools • Electronic-compatible contacts down to 17V, 5 mA • Mechanically linked performance between N.O. and N.C. poles and to the main contactor poles (except for L types) • Models with equal function with several terminal numbering choices • 1L = Late break N.C./early make N.O. • Bifurcated version for switching down to 8V, 5 mA also available	0	2		100-C all	**100-FA02**	100-FAB02
					C30⊗00…C85⊗00	**100-FB02**	100-FBB02
		1	1		100-C all	**100-FA11**	100-FAB11
					C30⊗00…C85⊗00	**100-FB11**	100-FBB11
					C09⊗10…C23⊗10	**100-FC11**	100-FCB11
		2	0		100-C all	**100-FA20**	**100-FAB20**
					C30⊗00…C85⊗00	**100-FB20**	100-FBB20
		1L	1L		C30⊗00…C85⊗00	**100-FAL11**	—
					C30⊗00…C85⊗00	**100-FBL11**	—
		0	4		100-C all	**100-FA04**	100-FAB04
		1	3		100-C all	**100-FA13**	100-FAB13
		2	2		100-C all	**100-FA22**	**100-FAB22**
					C30⊗00…C85⊗00	**100-FB22**	100-FBB22
					C09⊗10…C23⊗10	**100-FC22**	100-FCB22
		3	1		100-C all	**100-FA31**	100-FAB31
					C09⊗10…C23⊗10	**100-FC31**	100-FCB31
		4	0		100-C all	**100-FA40**	**100-FAB40**
		1+1L	1+1L		100-C all	**100-FAL22**	—
	Auxiliary Contact Blocks for Side Mounting without Sequence Terminal Designations∗ • 1- and 2-pole • Two-way numbering for right or left mounting on the contactor • Quick and easy mounting without tools • Electronic-compatible contacts down to 17V, 10 mA • Mirror contact performance to the main contactor poles • 1L = Late break N.C./early make N.O.	0	1		100-C all	**100-SA01**	—
		1	0		100-C all	**100-SA10**	—
		0	2		100-C all	**100-SA02**	—
		1	1		100-C all	**100-SA11**	—
		2	0		100-C all	**100-SA20**	—
		1L	1L		100-C all	**100-SAL11**	—
	Auxiliary Contact Blocks for Side Mounting with Sequence Terminal Designations∗ • 1- and 2-pole • Two-way numbering for right or left mounting on the contactor • Quick and easy mounting without tools • Electronic-compatible contacts down to 17V, 10 mA • Mirror contact performance to the main contactor poles • 1L = Late break N.C./early make N.O.	0	1		100-C	**100-SB01**	—
		1	0		100-C❄	**100-SB10**	—
		0	2		100-C❄	**100-SB02**	—
		1	1		100-C❄	**100-SB11**	—
		2	0		100-C❄	**100-SB20**	—
		1L	1L		100-C❄	**100-SBL11**	—

∗ Max. number of auxiliary contacts that may be mounted:
AC coil contactors — max. 4 N.O. contacts on the front of the contactor, 2 N.O. contacts on the side, 4 N.C. front or side, 6 total.
DC coil contactors — max. 4 N.O. contacts on the front of the contactor or max 2 N.O. contacts on the side, 4 N.C. front or side, 4 total.

❄ Double numbering — Left-side mounting only is recommended for **Cat. No. 100-C09…100-C23** due to double numbering.

Control Modules (For 100-C09…C85 contactors)

	Description		Connection Diagrams	For Use With	Cat. No.
	Pneumatic Timing Modules Pneumatic timing element contacts switch after the delay time. The contacts on the main control relay continue to operate without delay.	**On-Delay** 0.3…30 s Range		100-C with AC coils, 700-CF all	**100-FPTA30**
		1.8…180 s Range			**100-FPTA180**
		Off-Delay 0.3…30 s Range		100-C all, 700-CF all	**100-FPTB30**
		1.8…180 s Range			**100-FPTB180**
	Electronic Timing Modules — On-Delay Delay of the contactor or control relay solenoid. The contactor or control relay is energized at the end of the delay time.	0.1…3 s Range		100-C (all), 700-CF 110…240V 50/60 Hz 110…250V DC	**100-ETA3**
		1…30 s Range			**100-ETA30**
		10…180 s Range			**100-ETA180**
		0.1…3 s Range		100-C with 24…48V DC coils, 700-CF with DC coils	**100-ETAZJ3**
		0.1…3 s Range			**100-ETA3**
		10…180 s Range			**100-ETAZJ180**
	Electronic Timing Modules — Off-Delay Delay of the contactor or control relay solenoid. After interruption of the control signal, the contactor or control relay is deenergized at the end of the delay time.	0.3…3 s Range		100-C09…C37 with 24V 50/60 Hz coils, 700-CF with AC coils	**100-ETBKJ3**
		1…30 s Range			100-ETBKJ30
		10…180 s Range			100-ETBKJ180
		0.3…3 s Range		100-C with 110…240V 50/60 Hz coils, 700-CF with AC coils	**100-ETB3**
		1…30 s Range			**100-ETB30**
		10…180 s Range			**100-ETB180**
	Electronic Timing Modules Delay of the contactor solenoid. Contactor K 3 (Y) is de-energized (off) and K 2 (D) is energized (on) after the end of the set Y end time. (Switching delay at 50 ms.) Continuous adjustment range High repeat accuracy	**Transition Time Y Contactor** 1…30 s Range		100-C with 110…240V AC, 50/60 Hz coils	**100-ETY30**
	Mechanical Interlocks For interlocking of two contactors. Common interlock for all Bul. 100-C contactor sizes Interlocking of different sizes possible Mechanical and electrical interlocking possible in one module by means of integrated auxiliary contacts 9 mm dovetail connector included	Mechanical only without auxiliary contacts		100-C (except 100-C40, -C90)	**100-MCA00**
		Mechanical/ electrical with 2 N.C. auxiliary contacts		100-C (except 100-C40, -C90)	**100-MCA02**
	Mechanical Latch Following contactor latching, the contactor coil is immediately de-energized (off) by the N.C. auxiliary contact (65-66). Electrical or manual release 1 N.O. + 1 N.C. auxiliary contacts Suitable for all Bul. 100-C contactor sizes, 9…85 A	Maximum command duration 0.03…10 s		100-C with AC coils (except 100-C90)	**100-FL11⊗**

⊗ Coil Voltage Code

The cat. no. as listed is incomplete. Select a voltage suffix code from the table below to complete the cat. no. Example: 120V, 60 Hz: **Cat. No. 100-FL11⊗** becomes **Cat. No. 100-FL11D**.

Voltage∗ [V]	24	48	100	110	120	230-240	240	277	380-400	400-415	440	480
50 Hz	K	Y	KP	D	—	VA	T	—	N	G	B	—
60 Hz	J	—	—	—	D	—	A	T	—	—	N	B

∗ For special voltages, consult your local Rockwell Automation sales office or Allen-Bradley distributor.

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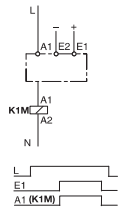
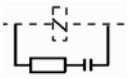
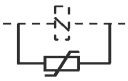
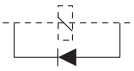
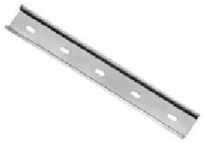
Control Modules (For 100-C09…C85 contactors), Continued

	Description		Voltage Range	Connection Diagrams	For Use With	Cat. No.
	DC Interface (Electronic) Interface between the DC control signal (PLC) and the AC operating mechanism of the contactor. Requires no additional surge suppression on the relay coils		Input: 12V DC Output: 110…240V AC		100-C with AC coils 110…240V AC	**100-JE12**
			Input: 18…30V DC Output: 110…240V AC			**100-JE**
			Input: 48V DC Output: 110…240V AC			**100-JE48**
	Surge Suppressors For limitation of coil switching transients. Plug-in, coil mounted Suitable for all Bul. 100-C contactor sizes, 9…85 A RC, varistor and diode versions	**RC Module** AC operating mechanism	24…48V AC, 50/60 Hz		100-C with AC coils	**100-FSC48**
			110…280V AC, 50/60 Hz			**100-FSC280**
			380…480V AC, 50/60 Hz			**100-FSC480**
		Varistor Module AC/DC operating mechanism	12…55V AC/12…77V DC		100-C	**100-FSV55**
			56…136V AC/78…180V DC		100-C	**100-FSV136**
			137…277V AC/181…350V DC		100-C	**100-FSV277**
			278…575V AC		100-C	**100-FSV575**
		Diode Module DC operating mechanism	12…250V DC		100-C with DC coils	**100-FSD250**

Assembly Components (For 100-C09…C85 contactors)

	Description	For Use With	Pkg. Quantity*	Cat. No.
 Cat. No. 100-S0	**Dovetail Connectors** For use in contactor and starter assemblies. Single Connector — 0 mm Spacing	100-C	10	**100-S0**
	Dovetail Connectors For use in contactor and starter assemblies. Dual Connector — 9 mm Spacing			**100-S9**
 Cat. No. 100-SCCA	**Protective Covers** Provides protection against unintended manual operation For contactors and front mounted auxiliary contacts, pneumatic timers and latches	100-C all	1	**100-SCCA**
 Cat. No. 100-SCFA		100-FA, -FB, -FC, -FP, -FL;	10	**100-SCFA**
 Cat. No. 105-PW23	**Reversing Power Wiring Kits** For reversing connection with a solid-state or thermal overload relay	100-C09…C23	1	**105-PW23**
		100-C30…C37		**105-PW37**
		100-C43		**105-PW43**
		100-C60…85		**105-PW85**
	**DIN (#3) symmetrical Rail** 35 mm x 7.5 mm x 1 m long	140M-D 140M-F	10	**199-DR1**

* Must be ordered in multiples of package quantities.

Visit our website: www.ab.com/catalogs
Preferred availability cat. nos. are printed in **bold**

Wye-Delta/Star-Delta Starter Kits

Wye-Delta power wiring kits were designed to aid in the field assembly of open-transition wye-delta starters that use Bulletin 100-C contactors. These kits include line, load, and start-point (shorting) connections. Assembling a wye-delta starter requires the use of the following additional components:

- Contactors
- Overload Relay
- Cat. No. 100-MCA02 Mechanical/Electrical Interlock
- Cat. No. 100-ETY30 Electronic Y-Δ Timer
- Cat. No. 100-S9 Base Coupler for 1M to 2M contactor (optional)

Cat. No. 170-PW23

3-Phase Rating											Pkg. Qty.	Cat. No.
kW (50 Hz)				Hp (60 Hz)				Use with Cat. No. 100-				
								Delta		Wye		
230V	380/415V	500V	690V	200V	230V	460V	575V	1M	2M	1S		
5.5	8	8	8	5	5	10	10	C09	C09	C09	1	**170-PW23**
7.5	11	11	11	5	7.5	15	15	C12	C12	C09	1	**170-PW23**
10	14	15	14	7.5	10	20	20	C16	C16	C12	1	**170-PW23**
14	21	21	19	7.5	10	25	25	C23	C23	C12	1	**170-PW23**
18	28	28	28	10	15	30	30	C30	C30	C16	1	**170-PW37**
19	35	35	32	15	20	40	40	C37	C37	C23	1	**170-PW37**
23	40	40	41	20	25	50	50	C43	C43	C30	1	**170-PW43**
33	58	60	56	30	40	75	75	C60	C60	C37	1	**170-PW72**
39	69	67	70	40	50	100	100	C72	C72	C43	1	**170-PW72**
47	82	82	81	50	60	125	125	C85	C85	C60	1	**170-PW85**

Marking Systems (For 100-C09…C85 contactors)

	Description	Pkg. Qty.∗	Cat. No.
	Label Sheet 105 self-adhesive paper labels each, 6 x 17 mm	10	**100-FMS**
	Marking Tag Sheet 160 perforated paper labels each, 6 x 17 mm To be used with a transparent cover	10	**100-FMP**
	Transparent Cover To be used with marking tag sheets	100	**100-FMC**
	Marking Tag Adapters To be used with marking tag	100	**100-FMA1**
	Marking Tag Adapters To be used with marking tag	100	**100-FMA2**

∗ Must be ordered in multiples of package quantities.

Terminal Kits (For 100-C09…C85 contactors)

	Description	Max. Current Ratings and Wire Sizes		Pkg. Qty.∗	Cat. No.
	Stab Connector Kit Dual stab (0.250 in.) for 100-C coil terminals For 100-C09…C85 contactors			20	**199-SC2**
	Stab Connector Kit Dual stab (0.250 in.) for 100-C power terminals For 100-C09…C23 contactors			100	**199-SC10**
	3-Pole Terminal Lug Kit For Cat. No. 100-C09…C23 (Line side)	IEC @ 40 °C IEC @ 40 °C UL/CSA (Encl.)	45 A (4…16 mm²❄, fine stranded w/ ferrule) 45 A (4…25 mm², coarse stranded/solid) 40 A (#10…4 AWG, stranded/solid)	1	**100-CTN23**
	3-Pole Terminal Lug Kit For Cat. No. 100-C09…C23 (Load side)	IEC @ 40 °C IEC @ 40 °C UL/CSA (Encl.)	45 A (4…16 mm²❄, fine stranded w/ ferrule) 45 A (4…25 mm², coarse stranded/solid) 40 A (#10…4 AWG, stranded/solid)	1	**100-CTL23**
	3-Pole Terminal Lug Kit For Cat. No. 100-C30…C37 (Line side)	IEC @ 40 °C IEC @ 40 °C UL/CSA (Encl.)	60 A (4…16 mm²❄, fine stranded w/ ferrule) 60 A (4…25 mm², coarse stranded/solid) 55 A (#10…4 AWG, stranded/solid)	1	**100-CT37**
	1-Pole Terminal Lug Kit For Cat. No. 100-C43	IEC @ 40 °C IEC @ 40 °C UL/CSA (Encl.)	90 A (6…35 mm², fine stranded w/ ferrule) 90 A (6…50 mm², coarse stranded/solid) 75 A (#8…2 AWG, stranded/solid)	3	**100-CT43**
	1-Pole Terminal Lug Kit For Cat. No. 100-C60…C85	IEC @ 40 °C IEC @ 40 °C UL/CSA (Encl.)	130 A (10…70 mm², fine stranded w/ ferrule) 130 A (10…95 mm², coarse stranded/solid) 130 A (#8…2/0 AWG, stranded/solid)	3	**100-CT85**
	3-Pole Paralleling Kit For Cat. No. 100-C09…C23	IEC @ 40 °C IEC @ 40 °C UL/CSA (Encl.)	100 A (35…70 mm², fine stranded w/ ferrule) 100 A (35…95 mm², coarse stranded/solid) 100 A (#0…2/0 AWG, stranded/solid)	2	**100-CP23**
	3-Pole Paralleling Kit For Cat. No. 100-C30…C37	IEC @ 40 °C IEC @ 40 °C UL/CSA (Encl.)	150 A (35…70 mm², fine stranded w/ ferrule) 150 A (35…95 mm², coarse stranded/solid) 150 A (#0…2/0 AWG, stranded/solid)	2	**100-CP37**

∗ Must be ordered in multiples of the package quantity.
❄ 16 mm² max. according to IEC 60947; actual max. 25 mm².

Bulletin 100-D IEC Contactors

- 50…500 kW @ 400V
- 60…600 Hp @ 460V
- 75…700 Hp @ 575V
- Electronic and conventional coils
  AC & DC
  Integrated PLC interface
  Low power pick-up & hold-in
  Wide voltage ranges
- Complete range of accessories
- Environmentally friendly
- Compact dimensions

The Bulletin 100-D/104-D contactor family, along with a wide range of common accessories and Bulletin 193 electronic overload relays, provides the most compact and flexible starter component system available.

Your order must include: cat. no. of the contactor specified with coil voltage code and, if required, cat. no. of any accessories and/or replacement coils.

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IEC 60947 Type “2” Coordination
CSA C22.2 No. 14
UL 508

Certifications

CE Marked
cULus Listed (File No. E 41850, Guide NLDX, NLDX7)

2

3-Pole AC-Operated Contactors

- Conventional and Electronic AC Coils
- 3 Main Contacts
- Non-Reversing or Reversing

Cat. No. 100-D180

Cat. No. 100-D420

I_e [A] 60 °C	I_e [A] 40 °C	Switching of 3-phase motors — AC-2, AC-3 kW (50 Hz)						Hp (60 Hz)				Auxiliary contacts N.O.	Auxiliary contacts N.C.	Non-Reversing Contactor Cat. No.	Reversing Contactor Cat. No.
AC-3	AC-1	230V	400V	415V	500V	690V	1000V	200V	230V	460V	575V				
95	160	30	50	55	63	90	45	25	30	60	75	0	0	100-D95⊗00	—
												1	1	**100-D95⊗11**	—
												2	4	—	104-D95⊗24
110	160	32	55	63	75	100	55	40	40	75	100	0	0	100-D110⊗00	—
												1	1	**100-D110⊗11**	—
												2	4	—	104-D110⊗24
140	250	45	75	80	80	110	75	40	50	100	125	0	0	100-D140⊗00	—
												1	1	**100-D140⊗11**	—
												2	4	—	104-D140⊗24
180	250	55	90	100	90	132	90	50	60	150	150	0	0	100-D180⊗00	—
												1	1	**100-D180⊗11**	—
												2	4	—	104-D180⊗24
210	350	63	110	125	150	200	110	60	75	150	200	0	0	100-D210⊗00	—
												1	1	**100-D210⊗11**	—
												2	4	—	104-D210⊗24
250	350	80	132	150	160	250	132	75	100	200	250	0	0	100-D250⊗00	—
												1	1	**100-D250⊗11**	—
												2	4	—	104-D250⊗24
300	450	90	160	160	200	300	160	100	125	250	300	0	0	100-D300⊗00	—
												1	1	**100-D300⊗11**	—
												2	4	—	104-D300⊗24
420	540	132	220	250	300	425	220	150	175	350	400	0	0	100-D420⊗00	—
												1	1	**100-D420⊗11**	—
												2	4	—	104-D420⊗24
630	800	200	355	355	450	500	—	200	250	500	600	0	0	100-D630⊗00	—
												1	1	100-D630⊗11	—
												2	4	—	104-D630⊗24
860	1000	250	500	500	560	600	—	250	300	600	700	0	0	100-D860⊗00	—
												1	1	100-D860⊗11	—
												2	4	—	104-D860⊗24

⊗ Coil Voltage Codes for AC Control

Conventional Coil	[V]	24	48	100	110	120	200	208	220… 230	230	240	277	380… 400	415	440	480	500	550	600
100-D95...100-D180	50 Hz	K	Y	—	D	—	—	—	A	—	T	—	N	B	G	—	M	C	—
	60 Hz	J	X	—	—	D	—	H	—	—	A	T	—	—	N	B	—	—	C
100-D95…100-D110	50/60 Hz	—	—	KP	KN	—	KG	—	KL	KF	KA	KT	—	—	—	—	—	—	—

Electronic Coil w/ El. Interface §	[V]	24	42…64	100	110…130	200	208…277	200…220	230…250	277	380…415	380…500	440…480	500
100-D95...100-D300	50/60 Hz	EJ♣	EY	EP	ED	EG	EA	—	—	—	—	EN	—	—
100-D420	50/60 Hz	—	—	EP	ED	EG	EA	—	—	—	—	EN	—	—
100-D630… 100-D860	50/60 Hz	—	—	EP	ED	EG	—	EG	EA	ET	EN	—	EB	EM

§ Signal voltage of the Cat. No. 100-D… electronic interface: nominal U_e: 24V DC/I_e: 15 mA
Pickup voltage: 13.0V DC...30.2V DC
Dropout Voltage: –3.0V DC...+5.0V DC.
♣ Not available with 100/104-D300.

Visit our website: www.ab.com/catalogs
Preferred availability cat. nos. are printed in **bold**

3-Pole DC-Operated Contactors

- Conventional and Electronic DC Coils
- 3 Main Contacts
- Non-Reversing or Reversing

Cat. No. 100-D180

Cat. No. 100-D420

I_e [A]		Switching of 3-phase motors AC-2, AC-3										Auxiliary contacts			
60 °C	40 °C	kW (50 Hz)						Hp (60 Hz)				N.O.	N.C.		
AC-3	AC-1	230V	400V	415V	500V	690V	1000V	200V	230V	460V	575V			Non-Reversing Contactor Cat. No.	Reversing Contactor Cat. No.
95	160	30	50	55	63	90	45	25	30	60	75	0	0	100-D95⊗00	—
												1	1	**100-D95⊗11**	—
												2	1/1L	**100-D95⊗22L**❄	—
												2	4	—	104-D95⊗24
												2	2/2L	—	104-D95⊗24L❄
110	160	32	55	63	75	100	55	40	40	75	100	0	0	100-D110⊗00	—
												1	1	**100-D110⊗11**	—
												2	1/1L	**100-D110⊗22L**❄	—
												2	4	—	104-D110⊗24
												2	2/2L	—	104-D110⊗24L❄
140	250	45	75	80	80	110	75	40	50	100	125	0	0	100-D140⊗00	—
												1	1	**100-D140⊗11**	—
												2	1/1L	**100-D140⊗22L**❄	—
												2	4	—	104-D140⊗24
												2	2/2L	—	104-D140⊗24L❄
180	250	55	90	100	90	132	90	50	60	150	150	0	0	100-D180⊗00	—
												1	1	**100-D180⊗11**	—
												—	—	**100-D180⊗22L**❄	—
												2	4	—	104-D180⊗24
												2	2/2L	—	104-D180⊗24L❄
210	350	63	110	125	150	200	110	60	75	150	200	0	0	100-D210⊗00	—
												1	1	**100-D210⊗11**	—
												2	4	—	104-D210⊗24
250	350	80	132	150	160	250	132	75	100	200	250	0	0	100-D250⊗00	—
												1	1	**100-D250⊗11**	—
												2	4	—	104-D250⊗24
300	450	90	160	160	200	300	160	100	125	250	300	0	0	100-D300⊗00	—
												1	1	**100-D300⊗11**	—
												2	4	—	104-D300⊗24
420	540	132	220	250	300	425	220	150	175	350	400	0	0	100-D420⊗00	—
												1	1	**100-D420⊗11**	—
												2	4	—	104-D420⊗24
630	800	200	355	355	450	500	—	200	250	500	600	0	0	100-D630⊗00	—
												1	1	100-D630⊗11	—
												2	4	—	104-D630⊗24
860	1000	250	500	500	560	600	—	250	300	600	700	0	0	100-D860⊗00	—
												1	1	100-D630⊗11	—
												2	4	—	104-D860⊗24

⊗ Coil Voltage Codes for DC Control

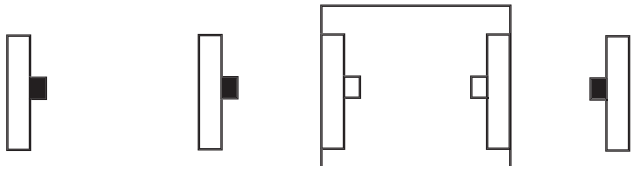
Conventional Coil	[V]	24	48	110	125	220
	DC	ZJ	ZY	ZD	ZS	ZA

Electronic Coil w/ EI Interface ♣	[V]	24	48…72	110…130	200…255
100-D95...100-D300	DC	EZJ	EZY	EZD	EZA
100-D420	DC	—	—	EZD	EZA
100-D630…100-D860	DC	—	—	ED	EA

❄ For conventional DC coils, the pickup winding must be interconnected with the N.C. late-breaking auxiliary contact(s).
♣ Signal voltage of the Cat. No. 100-D… electronic interface: nominal U_e: 24V DC/I_e: 15 mA
Pickup voltage: 13.0V DC...30.2V DC , Dropout Voltage: –3.0V DC...+5.0V DC.

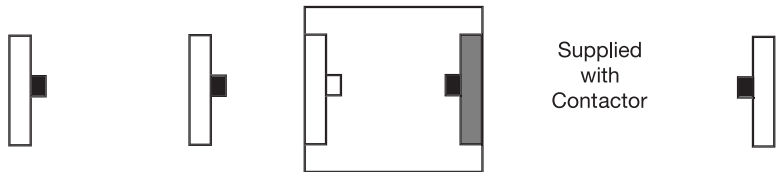
Auxiliary contacts with sequence numbering.

Cat. Nos. 100-D95…D420 — Electronic and Conventional AC Coils, Electronic DC Coils



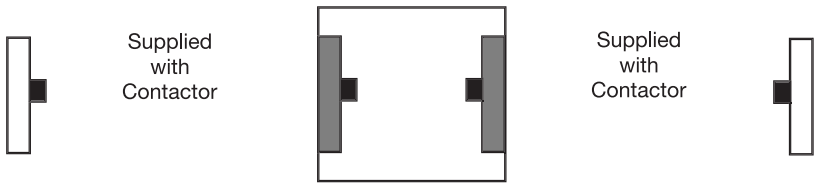
Contact Configuration		Auxiliary contact configurations				
		Left Side Mounting			Right Side Mounting	
N.O.	N.C.	Outside Cat. No.	Inside Cat. No.	For Use With	Inside Cat. No.	Outside Cat. No.
8	0	100-DS2-20	100-DS1-20	100-D…00	100-DS1-20	100-DS2-20
Sequence starts with…		7/8	3/4		1/2	5/6
7	1	100-DS2-20	100-DS1-20	100-D…00	100-DS1-11	100-DS2-20
Sequence starts with…		7/8	3/4		1/2	5/6
6	2	100-DS2-20	100-DS1-11	100-D…00	100-DS1-11	100-DS2-20
Sequence starts with…		7/8	3/4		1/2	5/6
5	3	100-DS2-20	100-DS1-11	100-D…00	100-DS1-11	100-DS2-11
Sequence starts with…		7/8	3/4		1/2	5/6
4	4	100-DS2-11	100-DS1-11	100-D…00	100-DS1-11	100-DS2-11
Sequence starts with…		7/8	3/4		1/2	5/6

Cat. Nos. 100-D95…D420 — Electronic and Conventional AC Coils, Electronic DC coils



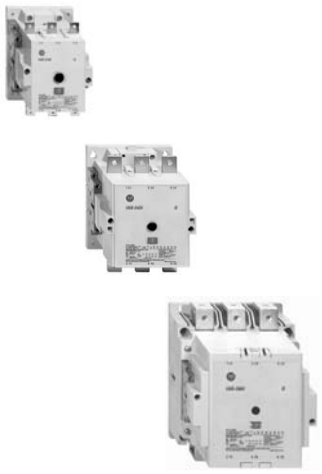
Contact Configuration		Auxiliary contact configurations				
		Left Side Mounting			Right Side Mounting	
N.O.	N.C.	Outside Cat. No.	Inside Cat. No.	For Use With	Inside Cat. No.	Outside Cat. No.
8	0	—	—	100-D…11	—	—
Sequence starts with…		—	—		—	—
7	1	100-DS2-20	100-DS1-20	100-D…11	100-DS1-11	100-DS2-20
Sequence starts with…		7/8	3/4		1/2	5/6
6	2	100-DS2-20	100-DS1-11	100-D…11	100-DS1-11	100-DS2-20
Sequence starts with…		7/8	3/4		1/2	5/6
5	3	100-DS2-20	100-DS1-11	100-D…11	100-DS1-11	100-DS2-11
Sequence starts with…		7/8	3/4		1/2	5/6
4	4	100-DS2-11	100-DS1-11	100-D…11	100-DS1-11	100-DS2-11
Sequence starts with…		7/8	3/4		1/2	5/6

Contactor cat. nos. 100-D95…D180 — Conventional DC coils



Contact Configuration		Auxiliary contact configurations				
		Left Side Mounting			Right Side Mounting	
N.O.	N.C.	Outside Cat. No.	Inside Cat. No.	For Use With	Inside Cat. No.	Outside Cat. No.
8	0	—	—	100-D…22L	—	—
Sequence starts with…		—	—		—	—
7	1	—	—	100-D…22L	—	—
Sequence starts with…		—	—		—	—
6	2	100-DS2-20	100-DS1-11	100-D…22L	100-DS1-L11∗	100-DS2-20
Sequence starts with…		7/8	3/4		1/2	5/6
5	3	100-DS2-20	100-DS1-11	100-D…22L	100-DS1-L11∗	100-DS2-11
Sequence starts with…		7/8	3/4		1/2	5/6
4	4	100-DS2-11	100-DS1-11	100-D…22L	100-DS1-L11∗	100-DS2-11
Sequence starts with…		7/8	3/4		1/2	5/6

∗ With conventional DC control, the pickup winding must be interconnected with the N.C. late-breaking auxiliary contacts.



Bulletin 100S-D Safety Contactors

- 50…500 kW @400V
- 60…600 Hp @460V
- 75…700 Hp @575V
- Electronic and conventional coils
  - AC & DC
  - Integrated PLC interface
  - Low power pick-up & hold-in
  - Wide voltage ranges
- Complete range of accessories
- Environmentally friendly
- Compact dimensions

Bulletin 100S-D safety contactors were designed to address the needs of modern safety applications requiring feedback and monitoring of the energy isolating switchgear used in hazardous motion loads. The 100S-D meets these needs through its "mirror contact" design. If a power contact welds, the N.C. auxiliary contacts will not change state. This feature provides reliable indication about the open/closed status of the main power poles. In addition, the gold-plated bifurcated auxiliary contacts are ideally suited for low-energy applications or feedback control circuits with multiple series-connected N.C. auxiliary contacts.

Your order must include: cat. no. of the contactor specified with coil voltage code and, if required, cat. no. of any accessories and/or replacement coils.

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Standards Compliance

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IEC 60947-4 Annex F
IEC 60947 Type "2" Coordination
CSA C22.2 No. 14
UL 508

Certifications

CE Marked
cULus Listed (File No. E 41850, Guide NLDX, NLDX7)
SUVA Certified

2

3-Pole AC-Operated Contactors

I_e [A]		Switching of 3-phase motors AC-2, AC-3										Auxiliary contacts		
60 °C	40 °C	kW (50 Hz)∗						Hp (60 Hz)				N.O.	N.C.❄	
AC-3	AC-1	230V	400V	415V	500V	690V	1000V	200V	230V	460V	575V			Cat. No.➢
95	160	25	50	50	55	90	45	25	30	60	75	2	2	100S-D95⊗22BC
110	160	32	55	55	63	100	55	40	40	75	100	2	2	100S-D110⊗22BC
140	250	45	75	75	80/100‡	110/132‡	75	40	50	100	125	2	2	100S-D140⊗22BC
180	250	55	90	100	90/125‡	132/160‡	90	50	60	150	150	2	2	100S-D180⊗22BC
210	350	63	110	110	150	200	110	60	75	150	200	2	2	100S-D210⊗22BC
250	350	80	132	150	160	250	133	75	100	200	250	2	2	100S-D250⊗22BC
300	450	90	160	160	200	300	160	100	125	250	300	2	2	100S-D300⊗22BC
420	540	132	220	250	300	425	220	150	175	350	400	2	2	100S-D420⊗22BC
630	800	200	355	355	450	500	—	200	250	500	600	2	2	100S-D630⊗22BC
860	1000	250	500	500	560	600	—	250	300	600	700	2	2	100S-D860⊗22BC

∗ Preferred values according to IEC 60072-1.
❄ The N.C. contacts meet IEC 60947-4 Annex F requirements for mirror contact performance. The N.C. mirror contacts are wired in series or parallel and must be used as monitoring contacts with feedback to the safety circuit.
‡ Higher kW rating only applies to contactors with electronic coil.
➢ If standard cross-stamped front-mount auxiliary contacts are required, remove the letter "B" before the letter "C" in the cat. no. Example: Cat. No. **100S-D95⊗22BC** becomes Cat. No. **100S-D95⊗22C**.

⊗Coil voltage code—see page 2-116

⊗ Coil Voltage Codes

Conventional Coil	[V]	24	48	100	110	120	200	208	220 …230	230	240	277	380 …400	415	440	480	500	550	600
100S-D95…100S-D180	AC, 50 Hz	K	Y	—	D	—	—	—	A	—	T	—	N	B	G	—	M	C	—
	AC, 60 Hz	J	X	—	—	D	—	H	—	—	A	T	—	—	N	B	—	—	C
100S-D95…100S-D110	AC, 50/60 Hz	—	—	KP	KN	—	KG	—	KL	KF	KA	KT	—	—	—	—	—	—	—

Electronic Coil w/ PLC Interface§	[V]	24	42…64	100	110… 130	200	208… 277	200… 220	230… 250	277	380… 415	380… 440	440… 480	380… 500	500
100S-D95…100S-D300	AC, 50/60 Hz	EJ♣	EY	EP	ED	EG	EA	—	—	—	—	VN	—	EN	—
100S-D420	AC, 50/60 Hz	—	—	EP	ED	EG	EA	—	—	—	—	—	—	EN	—
100S-D630…100S-D860	AC, 50/60 Hz	—	—	EP	ED	EG	—	EG	EA	ET	EN	—	EB	—	EM

§ Signal voltage of the Cat. No. 100S-D… electronic interface U_e: 24V DC/I_e: 15 mA
Pick-up voltage: 13.0V DC…30.2V DC
Drop-out voltage: -3.0V DC…+5.0V DC
♣ Not available with 100S-D300.

3-Pole DC-Operated Contactors

I_e [A]		Switching of 3-phase motors AC-2, AC-3										Auxiliary contacts			
60 °C	40 °C	kW (50 Hz) ∗						Hp (60 Hz)				N.O.	N.C. ❄		
AC-3	AC-1	230V	400V	415V	500V	690V	1000V	200V	230V	460V	575V			Conventional Coil Cat. No.	Electronic Coil Cat. No.➢
95	160	25	50	50	55	90	45	25	30	60	75	2	2	100S-D95⊗33LC‡	100S-D95⊗22BC
110	160	32	55	55	63	100	—	40	40	75	100	3	2/1L	100S-D110⊗33LC‡	100S-D110⊗22BC
140	250	45	75	75	80/100§	110/132§	—	40	50	100	125	3	2/1L	100S-D140⊗33LC‡	100S-D140⊗22BC
180	250	55	90	100	90/125§	132/160§	90	50	60	150	150	3	2/1L	100S-D180⊗33LC‡	100S-D180⊗22BC
210	350	63	110	110	150	200	110	60	75	150	200	2	2	—	100S-D210⊗22BC
250	350	80	132	150	160	250	133	75	100	200	250	2	2	—	100S-D250⊗22BC
300	450	90	160	160	200	300	160	100	125	250	300	2	2	—	100S-D300⊗22BC
420	540	132	220	250	300	425	220	150	175	350	400	2	2	—	100S-D420⊗22BC
630	800	200	355	355	450	500	—	200	250	500	600	2	2	—	100S-D630⊗22BC
860	1000	250	500	500	560	600	—	250	300	600	700	2	2	—	100S-D860⊗22BC

∗ Preferred values according to IEC 60072-1.
❄ The N.C. contacts meet IEC 60947-4 Annex F requirements for mirror contact performance. The N.C. mirror contacts are wired in series or parallel and must be used as monitoring contacts with feedback to the safety circuit.
‡ For conventional DC coil only. The pickup winding must be interconnected with the N.C. late-breaking auxiliary contacts.
§ Higher kW rating only applies to contactors with electronic coil.
➢ If standard cross-stamped front-mount auxiliary contacts are required, remove the letter "B" before the letter "C" in the cat. no. Example: Cat. No. 100S-D95⊗22BC becomes Cat. No. 100S-D95⊗22C.

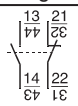
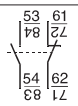
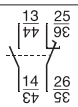
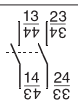
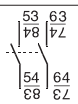
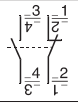
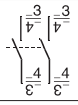
⊗ Coil Voltage Codes

Conventional Coil	[V]	24	48	110	125	220	250
100S-D95…100S-D180	DC	ZJ	ZY	ZD	ZS	ZA	ZT

Electronic Coil w/ EI Interface ♣	[V]	24	48…72	110…130	200…255
100S-D95…100S-D300	DC	EZJ	EZY	EZD	EZA
100S-D420	DC	—	—	EZD	EZA
100S-D630…860	DC	—	—	ED	EA

♣Signal voltage of the cat. no. 100S-S… electronic interface U_e: 24V DC/I_e: 15 mA
Pick-up voltage: 13.0V DC…30.2V DC
Drop-out voltage: -3.0V DC…+5.0V DC

Auxiliary Contacts

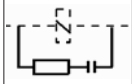
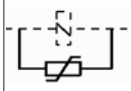
	Description	No. of N.O. Contacts	No. of N.C. Contacts	Connection Diagram	For Use With	Standard Auxiliary Contact Cat. No.	Bifurcated Auxiliary Contact Cat. No.
	Auxiliary Contacts Side-mounted With IEC sequence terminal designations Standard contacts 17V/10 mA Bifurcated contacts for signals down to 5V/2 mA	1	1		100-D left or right inside mounting	**100-DS1-11**	**100-DS1-B11H**
		1	1		100-D left or right outside mounting	**100-DS2-B11H**	**100-DS2-B11H**
		1	1L		100-D left or right inside mounting	**100-DS1-L11**	**100-DS1-BL11H**
		2	0		100-D left or right inside mounting	**100-DS1-20**	**100-DS1-B20H**
		2	0		100-D left or right outside mounting	**100-DS2-20**	**100-DS2-B20H**
	Auxiliary Contacts Electronically compatible auxiliary contacts Ideal for use when switching low-power control circuits With IEC sequence terminal designations Contact ratings: AC-12, 250V, 0.1 A AC-15, DC-13, 3...125V, 1...100 mA	1	1		100-D left or right inside mounting	**100-DS1-B11**	—
	Auxiliary Contacts Side-mounted Without IEC sequence terminal designations Standard contacts 17V/10 mA Bifurcated contacts for signals down to 5V/2 mA	1	1		100-D left or right inside mounting	**100-DS0-11**	**100-DS0-B11H**
		2	0		100-D left or right inside mounting	**100-DS0-20**	**100-DS0-B20H**
	Auxiliary Contacts Electronically compatible auxiliary contacts Ideal for use when switching low-power control circuits Without IEC sequence terminal designations Contact ratings: AC-12, 250V, 0.1 A AC-15, DC-13, 3...125V, 1...100 mA	1	1		100-D left or right inside mounting	**100-DS0-B11**	—

Marking Systems (For 100-D95…D860 contactors)

	Description	Pkg. Qty.*	Cat. No.
	Label Sheet 105 self-adhesive paper labels each, 6 x 17 mm	10	**100-FMS**
	Marking Tag Sheet 160 perforated paper labels each, 6 x 17 mm To be used with a transparent cover	10	**100-FMP**
	Transparent Cover To be used with marking tag sheets	100	**100-FMC**
	Marking Tag Adapters To be used with marking tag: System V4 / V5 System 1492 W	100 100	**100-FMA1** **100-FMA2**

* Must be ordered in multiples of package quantities.

Suppressor Modules

	Description	Connection Diagram	Suppressor Rating	For Use With	Cat. No.
	Suppressor Module for Bul. 100-D Contactors • For limiting surge voltage when coil circuits are interrupted • Can be plugged into all Bul. 100-D contactors • Supplied as standard on all conventional DC coil contactors and all electronic coil contactors (as part of the supply module or delivered with separate suppressor module)		**RC Module (AC control) for contactors with conventional coil** 21...48V, 50 Hz; 24...55V, 60 Hz	100-D95...100-D180	**100-DFSC48**
			95...110V, 50 Hz; 110...127V, 60 Hz		**100-DFSC110**
			180...277V, 50 Hz; 208...277V, 60 Hz		**100-DFSC240**
			380...550V, 50 Hz; 440...600V, 60 Hz		**100-DFSC550**
			**Varistor Module for contactors with conventional coil** 55V AC	100-D95...100-D180	**100-DFSV55**
			56...136V AC		**100-DFSV136**
			137...277V AC		**100-DFSV277**
			278...600V AC		**100-DFSV575**
			208...277V AC*	100-D95...100-D180	**100-DFSV550**

* For overvoltage category IV (IEC 947 for 100-D...-EI) e.g., lightning protection requirements.

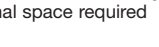
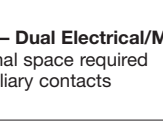
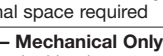
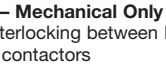
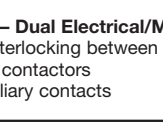
Connecting Components

	Description	Output Connection	For Use With			Terminal Connection	Cat. No.
			100-D95…180	100-D210…420	100-D630…860		
	Reversing: Input Connection Wye-Delta: Main-Delta connection	50 mm²	X			Lugs, 100-DL…	**100-D180-VL**
		120 mm²		X			**100-D420-VL**
		350 mm²			X		100-D860-VL
		50 mm²	X			Terminal Blocks, 100-DTB…	**100-D180-VLTB**
		120 mm²		X			**100-D420-VLTB**
	Reversing: Output Connection Wye-Delta: Delta-Wye connection	50 mm²	X			Lugs, 100-DL…	**100-D180-VT**
		120 mm²		X			**100-D420-VT**
		350 mm²			X		100-D860-VT
		50 mm²	X			Terminal Blocks, 100-DTB…	**100-D180-VTTB**
		120 mm²		X			100-D420-VTTB
	Delta-Wye connection if 100-D95…180 is used as a Wye contactor	80 mm²	—	X		Terminal Blocks, 100-DTB…	**100-D420-VYTB**
	Wye-Delta: Neutral bridge	—	X			—	**100-D180-VYU**
		—		X		—	**100-D420-VYU**
		—			X	—	100-D860-VYU
	Power Wiring Kits (for contactors using 100-DL lug kits)	For 100-D95…D100-D180 • Reversing • Two-speed, or changeover • Wye-Delta/Star-Delta					100-DPW180 100-D180-VL 100-DPY180
		For D100-D210…100-D420 • Reversing • Two-speed, or changeover • Wye-Delta/Star-Delta					100-DPW420 100-D420-VL 100-DPY420
		For 100-D630…100-D860 • Reversing • Two-speed, or changeover					100-DPW860 100-D860-VL

Connecting Components, Continued

	Description	For Use With		Cat. No.
	Terminal Lugs Set of 2 Protection class IP2X per IEC 60529 and DIN 40 050	100-D95, 100-D110		**100-DTB110**
		100-D140, 100-D180, 100-D95E…D180E, 193-EC_F, 193-EE_F		**100-DTB180**
		100-D210...100-D420, 193-EC_G, 193-EF2C, 193-EE_G		**100-DTB420**
	Terminal Lugs (UL/CSA), Copper Frame Set of 3	100-D95, 100-D110		**100-DL110**
		100-D95E, 100-D110E, 193-EC_F, 193-EE_F		**100-DLE110**
		100-D140, 100-D180, 193-EC_F, 193-EE_F		**100-DL180**
		100-D210…100-D420, 193-EC_G, 193-EE_G		**100-DL420**
		100-D630, 100-D860, 193-EC_H, 193-EE_H		**100-DL630**
		100-D630, 100-D860, 193-EC_H, 193-EE_H		**100-DL860**
	Control Circuit Terminal 2 x 2.5 mm^2	Connects to Cat. Nos. 100-D95...D180		**100-DAT1**
		Connects to Cat. Nos. 100-D210...D420		**100-DAT2**
	Terminal Shields Set of 2 Protection class IP10 per IEC 60529 and DIN 40 050 For direct-on-line, reversing, two-speed, and wye-delta/star-delta assemblies	100-D95, 100-D110		**100-DTS110**
		100-D140, 100-D180, 100-D95-E…100-D180-E		**100-DTS180**
		100-D210...100-D420		**100-DTS420**
	Terminal Covers Protection class IP20 per IEC 60529 and DIN 40 050 For direct-on-line, reversing, two-speed, and wye-delta/star-delta assemblies	100-D95…100-D180, 193-EC_F, 193-EE_F		**100-DTC180**
		100-D210...100-D420, 193-EC_G, 193-EE_G		**100-DTC420**
		100-D630…100-D860, 193-EC_H, 193-EE_H		**100-DTC860**
	Mounting Plate Galvanized steel plate for starter combinations For direct-on-line, reversing, two-speed, wye-delta/star-delta, and Dahlander assemblies	100-D95...100-D180	Direct-on-line	100-DMS180
			Reversing, two-speed or changeover	**100-DMU180**
			Y-Δ or Dahlander	100-DMY180
		100-D210...100-D420	Direct-on-line	100-DMS420
			Reversing, two-speed or changeover	**100-DMU420**
			Y-Δ or Dahlander	100-DMY420
		100-D630...100-D860	Direct-on-line	100-DMS860
			Reversing, two-speed or changeover	100-DMU860
			Y-Δ or Dahlander	100-DMY860
	Mounting Plate For two-speed or changeover switches	For interlocking between 100-C60…C85 and 100-D95…D180 contactors		100-DMU85

Interlocks

	Description	Circuit Diagram	For Use With	Cat. No.
	Interlock — Mechanical Only No additional space required		100-D95…100-D420	**100-DMA00**
	Interlock — Dual Electrical/Mechanical No additional space required 2 N.C. auxiliary contacts		100-D95…100-D860	**100-DMD02**
	Interlock — Mechanical Only No additional space required		100-D95…100-D860	**100-DMD00**
	Interlock — Mechanical Only Provides interlocking between Bul. 100-C and Bul. 100-D contactors		100-C60…100-C85 between 100-D95…100-D180	**100-DMC00**
	Interlock — Dual Electrical/Mechanical Provides interlocking between Bul. 100-C and Bul. 100-D contactors 2 N.C. auxiliary contacts		100-C60…100-C85 between 100-D95…100-D180	**100-DMC02**

Bulletin 100-G IEC Contactors

- 315...710 kW, 400V
- 350…900 Hp, 460/575V
- 3-Pole contactors
- 4th add-on neutral switching pole
- AC and DC control
- Horizontal and vertical interlocking
- Mechanical latching
- Meets IEC, CE, and cULus Standards and Certifications

The Bulletin 100-G contactor product family provides reliable switching of motor loads up to 1200 A. A complete range of accessories including auxiliary contacts, mechanical latches, horizontal and vertical interlocks, and 4th add-on neutral switching poles provides maximum flexibility to meet a wide variety of application requirements.

Your order must include: cat. no. of the contactor selected, coil voltage code, overload relay suffix code, and, if required, cat. no. of any accessories.

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Product Selection ..... this page
Accessories 2-121
Specifications 2-139
Approximate Dimensions 2-163

Standards Compliance

EN/IEC 60947-4-1
IEC 60947 Type "1" Coordination
CSA C22.2 No. 14
UL 508

Certifications

CE Marked
cULus Listed (File No. E 3125, Guide NLDX, NLDX7)

Product Selection

AC and DC Control

AC-1	Switching of 3-phase motors—AC-2, AC-3								Auxiliary Contacts		
I_e [A]	kW (50 Hz)‡				Hp (60 Hz)						
40 °C	230V	400V	500V	690V	200V	230V	460V	575V	N.O.	N.C.	Cat. No.
760	160	315	400	500	150	150	350	350	2	2	100-G550⊗22
1000	220	400	500	630	200	250	500	500	2	2	100-G700⊗22
1100	280	500	630	710	250	300	600	600	2	2	100-G860⊗22
1200	315	560	750	850	—	—	—	—	2∗	2	❄ 100-G1000⊗12
1350	375	710	850	1000	450	450	900	900	2∗	2	**100-G1200⊗12**

∗ 1 N.O. contact used in control circuit.
❄ No UL/cUL
‡ Preferred value according to IEC 60072-1.

⊗ Coil Voltage Code

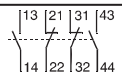
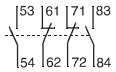
The Cat. No. as listed is incomplete. Select a coil voltage code from the table below to complete the Cat. No. Example: 120V, 50/60Hz: **Cat. No. 100-G550⊗22** becomes **Cat. No.100-G550KD22**.

For Use With:	[V]	100…110	110…120	200…220	220…240	345…380	380…415	400…440	440…480
100-G550...100-G860	50/60 Hz	—	KD	—	KF	—	KN	—	KB
	DC	KD	—	KF	—	KN	—	KB	—

For Use With:	[V]	110…115	110	220…230	220	240	380…400	440	480V
100-G1000...100-G1200	50/60 Hz	KD	—	KF	—	KA	KN	KB	KU
	DC	—	ZD	—	ZA	—	—	—	—

Price Adder For	Type	Available Control Voltages	No Surcharge
Special control voltages	100-G550…100-G860	24…600V 50/60 Hz, 24…440V DC	>25 pieces
	100-G1000…100-G1200	48…600V 50/60 Hz, 48…440V DC	

Control Modules

	Description		For Use With	Cat. No.
4-Pole	**Auxiliary Contact Block** For mounting between T1 & T2 or between T2 & T3 Adjustable; provides normal, delayed, or overlapping contacts Max. 2 blocks/contactor Alternate terminal marking tags included 2 N.O. and 2 N.C. contacts	 ***Standard Terminal marking for mounting between T1 & T2***  ***Alternate terminal marking for mounting between T2 & T3***	100-G550…100-G860	**100-EF22**
2-Pole	**Auxiliary Contact Block** For side mounting on either side of the contactor Max. 4 blocks/contactor Alternate terminal marking tags included 1 N.O. and 1 N.C. contact	***Standard terminal marking*** ***Alternate terminal markings***	100-G1000…100-G1200	**100-EB11**
	Fourth Add-On Neutral Switching Pole Left- or right-side mountable Note: no UL/cUL	I_{th} AC-1 500 A	100-G550	100-NP500-5
			100-G700, 100-G860	100-NP500-6
			100-G700, 100-G860	100-NP1000-6
		I_{th} AC-1 1000A	100-G1000, 100-G1200	100-NP1000-7
	Mechanical Latch Mechanical life: 0.5 million operations Direct and Impulse Control	Direct and Impulse Contact control	100-G550	100-FLAM5⊗
		Direct and Impulse Contact control	100-G700, 100-G860	100-FLAM6⊗
	Mechanical Interlock — Horizontal		100-G550 to 100-G550	100-MC00-5H
			100-G550 to 100-G700 or 100-G860	100-MC00-56H
			100-G700 or 100-G860 to 100-G700 or 100-G860	100-MC00-6H
			100-G700 or 100-G860 to 100-G1000 or 100-G1200	100-MC00-67H
			100-G1000 or 100-G1200 to 100-G1000 or 100-G1200	100-MC00-7H
	Mechanical Interlock — Vertical		100-G550 to 100-G550	100-MC00-5V
			100-G550 to 100-G700 or 100-G860	100-MC00-56V
			100-G700 or 100-G860 to 100-G700 or 100-G860	100-MC00-6V
			100-G700 or 100-G860 to 100-G1000 or 100-G1200	100-MC00-67V
			100-G1000 or 100-G1200 to 100-G1000 or 100-G1200	100-MC00-7V

⊗ Coil Voltage Codes∗

The Cat. No. as listed is incomplete. Select a coil voltage code from the table below to complete the Cat. No. Example: **Cat. No. 100-FLAM5⊗** becomes **Cat. No.100-FLAM5KD**.

For use with	[V]	110...120	220...240	380...415	440...480
100-G550... 100-G860	50-60 Hz	KD	KF	KN	KB

∗ For other voltages, consult your local Rockwell Automation sales office or Allen-Bradley distributor.

2

Bulletin 100/104-K, 100/104-C, 100/104-D, 100S/104S-C, 100S-D Specifications

			100/104-K			100/104-C, 100S/104S-C									
			05	09	12	09	12	16	23	30	37	40*200	40*400	43	60
Coil Type :	Conventional		X	X	X	X	X	X	X	X	X	X	X	X	X
	Electronic — EI		—	—	—	—	—	—	—	—	—	—	—	—	—
AC-1 Active Power Load (50 Hz); Ambient temperature 40 °C															
I_e	≤ 500V	[A]	20	20	20	32	32	32	32 (40)∗	65	65	75	75	85	100
	690V	[A]	20	20	20	32	32	32	32 (40)∗	65	65	75	75	85	100
	1000V	[A]	—	—	—	—	—	—	—	—	—	—	—	—	—
	230V	[kW]	8	8	8	13	13	13	13	26	26	30	30	34	40
	240V	[kW]	8.3	8.3	8.3	13	13	13	13	27	27	31	31	35	42
	400V	[kW]	14	14	14	22	22	22	22	45	45	52	52	59	69
	415V	[kW]	14	14	14	23	23	23	23	47	47	54	54	61	72
	500V	[kW]	17	17	17	28	28	28	28	56	56	65	65	74	87
	690V	[kW]	24	24	24	38	38	38	38	78	78	90	90	102	120
	1000V	[kW]	—	—	—	—	—	—	—	—	—	—	—	—	—
Ambient temperature 60 °C															
I_e	≤ 500V	[A]	16	16	16	32	32	32	32	65	65	60	60	80	100
	690V	[A]	16	16	16	32	32	32	32	65	65	60	60	80	100
	1000V	[A]	—	—	—	—	—	—	—	—	—	—	—	—	—
	230V	[kW]	6.4	6.4	6.4	13	13	13	13	26	26	24	24	25	40
	240V	[kW]	6.7	6.7	6.7	13	13	13	13	27	27	25	25	26	42
	400V	[kW]	11	11	11	22	22	22	22	45	45	42	42	44	69
	415V	[kW]	12	12	12	23	23	23	23	47	47	43	43	45	72
	500V	[kW]	14	14	14	28	28	28	28	56	56	52	52	55	87
	690V	[kW]	19	19	19	38	38	38	38	78	78	72	72	75	120
	1000V	[kW]	—	—	—	—	—	—	—	—	—	—	—	—	—
Switching of 3-phase Motors; (50 Hz) Ambient temperature 60 °C, AC-2, AC-3															
	230V	[A]	6.3	11.3	11.3	12	15	20	26.5	35	38	38	38	44	62
	240V	[A]	6.3	11.3	11.3	12	15	20	26.5	35	38	38	38	44	62
	400V	[A]	4.9	8.5	11.5	9	12	16	23	30	37	37	37	43	60
	415V	[A]	4.9	8.5	11.5	9	12	16	23	30	37	37	37	43	60
	500V	[A]	3.9	6.8	9.2	7	10	14	20	25	30	29	30	38	55
	690V	[A]	2.8	4.9	6.7	5	7	9	12	18	21	9	21	25	34
	1000V	[A]	—	—	—	—	—	—	—	—	—	—	—	—	—
	230V	[kW]	1.5	3	3	3	4	5.5	7.5	10	11	11	11	13	18.5
	240V	[kW]	1.5	3	3	3	4	5.5	7.5	10	11	11	11	13	18.5
	400V	[kW]	2.2	4	5.5	4	5.5	7.5	11	15	18.5	18.5	18.5	22	32
	415V	[kW]	2.2	4	5.5	4	5.5	7.5	11	15	20	20	20	22	32
	500V	[kW]	2.2	4	5.5	4	5.5	7.5	13	15	20	18.5	20	25	37
	690V	[kW]	2.2	4	5.5	4	5.5	7.5	10	15	18.5	7.5	18.5	22	32
	1000V	[kW]	—	—	—	—	—	—	—	—	—	—	—	—	—
Load Carrying Capacity per UL/CSA															
General Purpose Current (enclosed)															
		[A]	12	15	18	25	25	30	30	55	60	60	60	75	90
Rated power (enclosed)															
1-phase	115V	[A]	9.8	9.8	13.8	9.8	9.8	16	24	24	34	34	34	34	56
	230V	[A]	8	10	12	10	12	17	17	28	28	28	28	40	50
	115V	[Hp]	0.5	0.5	0.75	0.5	0.5	1	2	2	3	3	3	3	5
	230V	[Hp]	1	1.5	2	1.5	2	3	3	5	5	5	5	7.5	10
3-phase	200V	[A]	6.9	7.8	11	7.8	11	17.5	17.5	25.3	32.2	32.2	32.2	32.2	48.3
	230V	[A]	6	6.8	9.6	6.8	9.6	15.2	22	28	28	28	28	42	54
	460V	[A]	4.8	7.6	11	7.6	11	14	21	27	34	34	34	40	52
	575V	[A]	3.9	6.1	9	9	11	17	17	27	32	17	32	32	52
	200V	[Hp]	1.5	2	3	2	3	5	5	7.5	10	10	10	10	15
	230V	[Hp]	1.5	2	3	2	3	5	7.5	10	10	10	10	15	20
	460V	[Hp]	3	5	7.5	5	7.5	10	15	20	25	25	25	30	40
	575V	[Hp]	3	5	7.5	7.5	10	15	15	25	30	15	30	30	50

∗ Values in ( ) with increased cross-section and cable lug

100/104-C, 100S/104S-C				100/104-D, 100S-D											
72	85	90*200	90*400	95	110	140	140	180	180	210	250	300	420	630	860
X	X	X	X	X	X	X	—	X	—	—	—	—	—	—	—
—	—	—	—	X	X	—	X	—	X	X	X	X	X	X	X
AC-1 Active Power Load (50 Hz); Ambient temperature 40 °C															
100	100	130	130	160	160	250	250	250	250	350	350	450	540	800	1000
100	100	130	130	160	160	250	250	250	250	350	350	450	540	800	1000
—	—	—	—	160	160	250	250	250	250	350	350	450	540	—	—
40	40	52	52	64	64	100	100	100	100	139	139	179	199	319	398
42	42	54	54	67	67	104	104	104	104	145	145	187	208	333	416
69	69	90	90	111	111	173	173	173	173	242	242	312	346	554	693
72	72	93	93	115	115	180	180	180	180	252	252	323	359	575	719
87	87	113	113	139	139	217	217	217	217	303	303	390	433	693	866
120	120	155	155	191	191	299	299	299	299	418	418	538	598	956	1195
—	—	—	—	277	277	433	433	433	433	606	606	779	866	—	—
Ambient temperature 60 °C															
100	100	110	110	135	135	210	210	210	210	300	300	380	425	—	—
100	100	110	110	135	135	210	210	210	210	300	300	380	425	—	—
—	—	—	—	135	135	210	210	210	210	300	300	380	425	—	—
40	40	44	44	54	54	84	84	84	84	120	120	151	169	—	—
42	42	46	46	56	56	87	87	87	87	125	125	158	177	—	—
69	69	76	76	94	94	145	145	145	145	208	208	263	294	—	—
72	72	79	79	97	97	151	151	151	151	216	216	273	305	—	—
87	87	95	95	117	117	182	182	182	182	260	260	329	368	—	—
120	120	131	131	161	161	251	251	251	251	359	359	454	508	—	—
—	—	—	—	234	234	364	364	364	364	520	520	658	736	—	—
Switching of 3-phase Motors; (50 Hz) Ambient temperature 60 °C, AC-2, AC-3															
72	85	85	85	95	110	140	140	180	180	210	250	300	420	630	860
72	85	85	85	95	110	140	140	180	180	210	250	300	420	630	860
72	85	85	85	95	110	140	140	180	180	210	250	300	420	630	860
72	85	85	85	95	110 (130)‡	140 (155)‡	140 (155)‡	180 (189)‡	180 (189)‡	210 (227)‡	250 (258)‡	300 (315)‡	420	630	860
67	80	80	80	95	110	115	140	140	180	210	250	300	420	630	753
42	49	22	49	95	110	115	140	140	180	210	250	300	420	492	—
—	—	—	—	33	40	55	55	65	65	80	95	115	160	—	—
22	25	25	25	30	34	45	45	57	57	67	80	97	135	200	250
22	25	25	25	31	36	47	47	60	60	70	83	101	141	200	250
40	45	45	45	53	61	78	78	101	101	118	140	170	238	355	500
40	45	45	45	55	63 (75)‡	82 (90)‡	82 (90)‡	105 (110)‡	105 (110)‡	122 (132)‡	145 (150)‡	176 (185)‡	250	355	500
45	55	55	55	66	76	80	98	98	126	147	177	213	298	450	560
40	45	18.5	45	92	106	111	135	135	176	205	250	293	424	500	—
—	—	—	—	45	55	75	75	90	90	110	132	160	225	—	—
Load Carrying Capacity per UL/CSA															
General Purpose Current (enclosed)															
90	100	125	130	160	160	220	220	220	220	300	300	340	420	630	860
Rated power (enclosed)															
56	80	80	80	80	100	135	135	—	—	—	—	—	—	—	—
68	68	68	68	68	110	136	136	176	176	216	—	—	—	—	—
5	7.5	7.5	7.5	7.5	10	15	15	—	—	—	—	—	—	—	—
15	15	15	15	15	25	30	30	40	40	50	—	—	—	—	—
62.1	78.2	78.2	78.2	78.2	120	120	120	150	150	177	221	285	414	552	692
68	80	80	80	80	104	130	130	154	154	192	248	312	420	602	720
65	77	65	77	77	96	124	124	180	180	180	240	302	414	590	702
62	62	22	52	77	99	125	125	144	144	192	242	289	382	562	651
20	25	25	25	25	40	40	40	50	50	60	75	100	150	200	250
25	30	30	30	30	40	50	50	60	60	75	100	125	175	250	300
50	60	50	60	60	75	100	100	150	150	150	200	250	350	500	600
60	60	20	50	75	100	125	125	150	150	200	250	300	400	600	700

‡ 415 V: values in ( ) AC-3 and AC-4 lifespan -25 %

Contactors

Specifications, Continued

IEC Specifications

			100/104-K			100/104-C, 100S/104S-C							
			05	09	12	09	12	16	23	30	37	43	60
	Conventional		X	X	X	X	X	X	X	X	X	X	X
Coil Type :	Electronic — EI		—	—	—	—	—	—	—	—	—	—	—
Switching of 3-phase Motors, (50Hz); Ambient temperature 60 °C, AC-4													
	230V	[A]	6.3	11.3	11.3	12	15	20	26.5	35	38	44	62
	240V	[A]	6.3	11.3	11.3	12	15	20	26.5	35	38	44	62
	400V	[A]	4.9	8.5	11.5	9	12	16	23	30	37	43	60
	415V	[A]	4.9	8.5	11.5	9	12	16	23	30	37	43	60
	500V	[A]	3.9	6.8	9.2	7	10	14	20	25	30	38	55
	690V	[A]	2.8	4.9	6.7	5	7	9	12	18	21	25	34
	1000V	[A]	—	—	—	—	—	—	—	—	—	—	—
	230V	[kW]	1.5	3	3	3	4	5.5	7.5	10	11	13	18.5
	240V	[kW]	1.5	3	3	3	4	5.5	7.5	10	11	13	18.5
	400V	[kW]	2.2	4	5.5	4	5.5	7.5	11	15	18.5	22	32
	415V	[kW]	2.2	4	5.5	4	5.5	7.5	11	15	20	22	32
	500V	[kW]	2.2	4	5.5	4	5.5	7.5	13	15	20	25	37
	690V	[kW]	2.2	4	5.5	4	5.5	7.5	10	15	18.5	22	32
	1000V	[kW]	—	—	—	—	—	—	—	—	—	—	—
Electronic — EI													
	230V	[A]	2.3	3.9	3.9	4.3	6.6	9	9	12	14	16.5	25.5
	240V	[A]	2.3	3.9	3.9	4.3	6.6	9	9	12	14	16.5	25.5
	400/415V	[A]	2	3.6	3.6	4.3	6.6	9	9	12	14	16.5	25.5
	500V	[A]	1.9	3.2	3.2	4.3	6.6	9	9	12	14	16.5	25.5
	690V	[A]	—	—	—	4.3	6.6	9	9	12	14	16.5	25.5
	1000V	[A]	—	—	—	—	—	—	—	—	—	—	—
AC-4 at approximately 200,000 operations	230V∗	[kW]	0.37	0.75	0.75	0.75	1.5	2.2	2.2	3	3.7	4	6.3
	240V∗	[kW]	0.37	0.75	0.75	0.75	1.5	2.2	2.2	3	4	4	7.5
	400V∗	[kW]	0.75	1.5	1.5	1.8	3	4	4	5.5	6.3	7.5	13
	415V∗	[kW]	0.75	1.5	1.5	1.8	3	4	4	5.5	6.3	7.5	13
	500V∗	[kW]	0.75	1.5	1.5	2.2	3.7	5.5	5.5	7.5	7.5	10	15
	690V∗	[kW]	—	—	—	3	5.5	7.5	7.5	10	11	15	22
	1000V∗	[kW]	—	—	—	—	—	—	—	—	—	—	—
Max. switching frequency		Ops/h	250	250	250	250	250	220	200	200	200	200	120
Wye-Delta (60 Hz)													
	200V	[Hp]	2.2	3	5	5	5	7½	7½	10	15	20	30
	230V	[Hp]	2.2	3	5	5	7½	10	10	15	20	25	40
	460V	[Hp]	5	7.5	10	10	15	20	25	30	40	50	75
	575V	[Hp]	5	7.5	10	10	15	20	25	30	40	50	75
UL/CSA Elevator Duty❄													
	200V	[A]	—	—	—	7.8	11.0	11.0	17.5	25.3	25.3	32.2	32.2
	230V	[A]	—	—	—	6.8	9.6	15.2	15.2	22.0	28.0	28.0	42.0
	460V	[A]	—	—	—	7.6	11.0	14.0	21.0	27.0	27.0	34.0	40.0
	575V	[A]	—	—	—	6.1	9.0	11.0	17.0	22.0	27.0	32.0	41.0
	200V	[Hp]	—	—	—	2	3	3	5	7½	7½	10	10
	230V	[Hp]	—	—	—	2	3	5	5	7½	10	10	15
	460V	[Hp]	—	—	—	5	7½	10	15	20	20	25	30
	575V	[Hp]	—	—	—	5	7½	10	15	20	25	30	40
Star-Delta Starting (50 Hz)													
	≤ 230V	[A]	11.3	20	20	21	26	35	46	61	66	76	107
	≤ 240V	[A]	11.3	20	20	21	26	35	46	61	66	76	107
	400V	[A]	8.5	15.5	15.5	16	21	28	40	52	64	74	104
	415V	[A]	8.5	15.5	15.5	16	21	28	40	52	64	74	104
	500V	[A]	6.8	12.4	12.4	12	17	24	35	43	52	66	95
	690V	[A]	4.9	8.9	8.9	8.6	12	16	21	31	36	43	59
	1000V	[A]	—	—	—	—	—	—	—	—	—	—	—
	230V∗	[kW]	3	5.5	5.5	5.5	7.5	10	13	17	20	22	32
	240V∗	[kW]	3	5.5	5.5	5.5	7.5	10	13	18.5	20	22	32
	400V∗	[kW]	4	7.5	10	7.5	10	13	20	25	32	40	55
	415V∗	[kW]	4	7.5	11	7.5	11	15	22	25	37	40	55
	500V∗	[kW]	4	7.5	7.5	7.5	11	15	22	25	32	45	63
	690V∗	[kW]	4	7.5	7.5	7.5	10	13	18.5	25	32	40	55
	1000V∗	[kW]	—	—	—	—	—	—	—	—	—	—	—

∗ Power ratings at 50 Hz: Preferred values according to IEC 60072-1

❄ Approval pending on Cat. No. 100-D210…D860.

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100/104-C, 100S/104S-C		100/104-D, 100S-D											
72	85	95	110	140	140	180	180	210	250	300	420	630	860
X	X	X	X	X	—	X	—	—	—	—	—	—	—
—	—	X	X	—	X	—	X	X	X	X	X	X	X
Switching of 3-phase Motors, (50Hz); Ambient temperature 60 °C, AC-4													
72	85	95	110	140	140	180	180	210	250	300	420	—	—
72	85	95	110	140	140	180	180	210	250	300	420	—	—
72	85	95	110	140	140	180	180	210	250	300	420	—	—
72	85	95	110 (130)❄	140 (155)❄	140 (155)❄	180 (189)‡	180 (189)‡	210 (227)❄	250 (258)❄	300 (315)❄	420	—	—
67	80	85	105	115	140	140	170	210	250	300	360	—	—
42	49	85	105	115	140	140	170	210	250	300	360	—	—
—	—	33	40	55	55	65	65	80	95	115	160	—	—
22	25	30	34	45	45	57	57	67	80	97	135	—	—
22	25	31	36	47	47	60	60	70	83	101	141	—	—
40	45	53	61	78	78	100	100	118	140	170	238	—	—
40	45	55	63 (75)❄	82 (90)❄	82 (90)❄	105 (110)❄	105 (110)❄	125 (132)❄	145 (150)❄	176 (185)❄	250	—	—
45	55	59	73	80	98	98	119	147	177	213	255	—	—
40	45	81	102	110	135	135	167	205	250	293	356	—	—
—	—	45	55	75	75	90	90	110	132	160	225	—	—
Electronic — EI													
31	38	43	50	60	60	67	67	85	105	140	170	—	—
31	38	43	50	60	60	67	67	85	105	140	170	—	—
31	38	43	50	60	60	67	67	85	105	140	170	—	—
31	38	43	50	60	60	67	67	85	105	140	170	—	—
31	38	43	50	60	60	67	67	85	105	140	170	—	—
—	—	19	23	37	37	43	43	60	72	85	105	—	—
7.5	11	13	15	17	17	20	20	25	32	45	55	—	—
7.5	11	13	15	18.5	18.5	22	22	25	32	45	55	—	—
15	20	22	25	32	32	37	37	45	55	75	90	—	—
17	20	22	25	32	32	37	37	50	55	80	100	—	—
20	25	25	32	40	40	45	45	55	75	100	110	—	—
25	32	40	45	55	55	63	63	80	100	132	160	—	—
—	—	22	30	50	50	55	55	80	100	110	150	—	—
120	120	120	120	120	120	100	100	120	100	70	70	—	—
Electronic — EI													
40	50	40	60	60	60	75	75	100	125	175	250	—	—
50	60	50	60	75	75	100	100	125	175	200	250	—	—
100	125	100	125	175	175	200	200	250	350	450	600	—	—
100	125	125	150	200	200	250	250	300	450	500	650	—	—
UL/CSA Elevator Duty❄													
48.3	62.1	62.1	78	92	92	120	120	150	150	177	221	—	—
54.0	68.0	68.0	80	104	104	130	130	130	154	192	248	—	—
52.0	65.0	65.0	77	96	96	124	124	156	180	180	240	—	—
52.0	62.0	62.0	77	77	77	99	99	125	144	192	242	—	—
15	20	20	25	30	30	40	40	50	50	60	75	—	—
20	25	25	30	40	40	50	50	50	60	75	100	—	—
40	50	50	60	75	75	100	100	125	150	150	200	—	—
50	60	60	75	75	75	100	100	125	150	200	250	—	—
Star-Delta Starting (50 Hz)													
125	147	165	191	242	242	312	312	364	433	520	727	—	—
125	147	165	191	242	242	312	312	364	433	520	727	—	—
125	147	165	191	242	242	312	312	364	433	520	727	—	—
125	147	165	191 (225)❄	242 (268)❄	242 (268)❄	312 (332)‡	312 (332)‡	364 (393)❄	433 (447)❄	520 (546)❄	727	—	—
116	139	165	191	199	242	312	312	364	433	520	727	—	—
73	85	165	191	199	242	312	312	364	433	520	727	—	—
—	—	57	69	95	95	113	113	139	165	200	277	—	—
37	45	45	55	75	75	90	90	110	132	160	220	—	—
40	50	50	63	80	80	100	100	125	150	160	250	—	—
63	80	80	100	132	132	160	160	200	250	300	425	—	—
63	80	80 (90)❄	100 (132)❄	132 (160)❄	132 (160)❄	160	160	220	250	315 (335)❄	425	—	—
80	90	100	132	132	160	200	200	250	315	375	530	—	—
63	80	132	160	200	220	300	300	355	425	530	750	—	—
—	—	75	90	132	132	160	160	200	220	280	400	—	—

❄ 415V: Values in ( ) AC-3 and AC-4 lifespan -25%

Contactors

Specifications, Continued

IEC Specifications

			100/104-K			100/104-C, 100S/104S-C							
			05	09	12	09	12	16	23	30	37	43	60
	Conventional		X	X	X	X	X	X	X	X	X	X	X
Coil Type :	Electronic — EI		—	—	—	—	—	—	—	—	—	—	—
Switching of Power Transformers, AC-6a (50 Hz)													
Inrush Current / Rated transformer current		= n											
	≤ 230V	[A]	2.9	5.4	5.4	10.9	10.9	10.9	10.9	20	20	23	40.8
	≤ 240V	[A]	2.9	5.4	5.4	10.9	10.9	10.9	10.9	20	20	23	40.8
	≤ 400V	[A]	2.4	4.1	5.4	10.9	10.9	10.9	10.9	20	20	23	40.8
	≤ 415V	[A]	2.4	4.1	5.4	10.9	10.9	10.9	10.9	20	20	23	40.8
	≤ 500V	[A]	1.8	3.2	3.2	10.9	10.9	10.9	10.9	20	20	23	40.8
	≤ 690V	[A]	—	—	—	10.9	10.9	10.9	10.9	20	20	23	40.8
n = 30	≤ 1000V	[A]	—	—	—	—	—	—	—	—	—	—	—
	230V	[kVA]	1.2	2	2	4.3	4.3	4.3	4.3	8	8	9.2	16
	240V	[kVA]	1.2	2	2	4.5	4.5	4.5	4.5	8.3	8.3	10	17
	400V	[kVA]	1.7	2.8	3.4	7.5	7.5	7.5	7.5	14	14	16	28
	415V	[kVA]	1.7	2.8	3.4	7.8	7.8	7.8	7.8	14	14	17	29
	500V	[kVA]	1.7	2.8	3.4	9.4	9.4	9.4	9.4	17	17	20	35
	690V	[kVA]	2	4	5	13	13	13	13	24	24	27	49
	1000V	[kVA]	—	—	—	—	—	—	—	—	—	—	—
n = 20	≤ 690V	[A]	—	—	—	16.3	16.3	16.3	16.3	30	30	34.5	61.3
n = 15	≤ 690V	[A]	—	—	—	22	22	22	22	40	40	46	82
60 Hz Peak Inrush/peak rated transformer current													
	n = 30	[A]	—	—	—	10.9	10.9	10.9	10.9	20	20	23	40.8
	200V	[kVA]	—	—	—	3.8	3.8	3.8	3.8	6.9	6.9	8.0	14.1
	208V	[kVA]	—	—	—	3.9	3.9	3.9	3.9	7.2	7.2	8.3	14.7
	240V	[kVA]	—	—	—	4.5	4.5	4.5	4.5	8.3	8.3	9.6	17.0
	480V	[kVA]	—	—	—	9.1	9.1	9.1	9.1	16.6	16.6	19.1	33.9
	600V	[kVA]	—	—	—	11.3	11.3	11.3	11.3	20.8	20.8	23.9	42.4
	660V	[kVA]	—	—	—	12.5	12.5	12.5	12.5	22.9	22.9	26.3	46.6
60 Hz Peak Inrush/peak rated transformer current													
	n = 20	[A]	—	—	—	16.3	16.3	16.3	16.3	30	30	34.5	61.3
	200V	[kVA]	—	—	—	5.6	5.6	5.6	5.6	10.4	10.4	12.0	21.2
	208V	[kVA]	—	—	—	5.9	5.9	5.9	5.9	10.8	10.8	12.4	22.1
	240V	[kVA]	—	—	—	6.8	6.8	6.8	6.8	12.5	12.5	14.3	25.5
	480V	[kVA]	—	—	—	13.6	13.6	13.6	13.6	24.9	24.9	28.7	51.0
	600V	[kVA]	—	—	—	16.9	16.9	16.9	16.9	31.2	31.2	35.9	63.7
	660V	[kVA]	—	—	—	18.6	18.6	18.6	18.6	34.3	34.3	39.4	70.1
60 Hz Peak Inrush/peak rated transformer current													
	n=15	[A]	—	—	—	22	22	22	22	40	40	46	82
	200V	[kVA]	—	—	—	7.5	7.5	7.5	7.5	13.9	13.9	15.9	28.4
	208V	[kVA]	—	—	—	7.8	7.8	7.8	7.8	14.4	14.4	16.6	29.5
	240V	[kVA]	—	—	—	9.0	9.0	9.0	9.0	16.6	16.6	19.1	34.1
	480V	[kVA]	—	—	—	18.1	18.1	18.1	18.1	33.3	33.3	38.2	68.2
	600V	[kVA]	—	—	—	22.6	22.6	22.6	22.6	41.6	41.6	47.8	85.2
	660V	[kVA]	—	—	—	24.9	24.9	24.9	24.9	45.7	45.7	52.6	93.7

100/104-C, 100S/104S-C		100/104-D, 100S-D											
72	85	95	110	140	140	180	180	210	250	300	420	630	860
X	X	X	X	X	—	X	—	—	—	—	—	—	—
—	—	X	X	—	X	—	X	X	X	X	X	X	X
Switching of Power Transformers, AC-6a (50 Hz)													
Inrush Current													
Rated transformer current													
40.8	40.8	53	60	70	70	85	85	105	125	150	210	—	—
40.8	40.8	53	60	70	70	85	85	105	125	150	210	—	—
40.8	40.8	53	60	70	70	85	85	105	125	150	210	—	—
40.8	40.8	53	60	70	70	85	85	105	125	150	210	—	—
40.8	40.8	53	60	70	70	85	85	105	125	150	210	—	—
40.8	40.8	53	60	70	70	85	85	105	125	150	210	—	—
—	—	53	60	70	70	85	85	105	125	150	210	—	—
16	16	21	24	28	28	34	34	42	50	60	84	—	—
17	17	22	25	29	29	35	35	44	52	62	87	—	—
28	28	37	42	48	48	59	59	73	87	104	145	—	—
29	29	38	43	50	50	61	61	75	90	108	151	—	—
35	35	46	52	61	61	74	74	91	108	130	182	—	—
49	49	64	72	84	84	102	102	125	149	179	251	—	—
—	—	92	104	121	121	147	147	182	217	260	364	—	—
61.3	61.3	80	90	105	105	128	128	158	188	225	315	—	—
82	82	107	120	140	140	170	170	210	250	300	420	—	—
60 Hz Peak Inrush/peak rated transformer current													
40.8	40.8	53	60	70	70	85	85	105	125	150	210	—	—
14.4	14.4	18.4	20.8	24.2	24.2	29.4	29.4	36.4	43.3	52.0	72.7	—	—
14.7	14.7	19.1	21.6	25.2	25.2	30.6	30.6	37.8	45.0	54.0	75.7	—	—
17.0	17.0	22.0	24.9	29.1	29.1	35.3	35.3	43.6	52.0	62.4	87.3	—	—
33.9	33.9	44.1	49.9	58.2	58.2	70.7	70.7	87.3	104	125	175	—	—
42.4	42.4	55.1	62.4	72.7	72.7	88.3	88.3	109	130	156	218	—	—
46.6	46.6	60.6	68.6	80.0	80.0	97.2	97.2	120	143	171	240	—	—
60 Hz Peak Inrush/peak rated transformer current													
61.3	61.3	80	90	105	105	128	128	158	188	225	315	—	—
21.2	21.2	27.7	31.2	36.4	36.4	44.3	44.3	54.7	65.1	77.9	109	—	—
22.1	22.1	28.8	32.4	37.8	37.8	46.1	46.1	56.9	67.7	81.1	113	—	—
25.5	25.5	33.3	37.4	43.6	43.6	53.2	53.2	65.7	78.2	93.5	131	—	—
51.0	51.0	66.5	74.8	87.3	87.3	106	106	131	156	187	262	—	—
63.7	63.7	83.1	93.5	109	109	133	133	164	195	234	327	—	—
70.1	70.1	91.5	103	120	120	146	146	131	215	257	360	—	—
60 Hz Peak Inrush/peak rated transformer current													
82	82	107	120	140	140	170	170	210	250	300	420	—	—
28.4	28.4	37.1	41.6	48.5	48.5	58.9	58.9	72.7	86.6	104	145	—	—
29.5	29.5	38.5	43.2	50.4	50.4	61.2	61.2	75.7	90.1	108	151	—	—
34.1	34.1	44.5	49.9	58.2	58.2	70.7	70.7	87.3	104	125	175	—	—
68.2	68.2	89.0	99.8	116	116	141	141	175	208	249	349	—	—
85.2	85.2	111	125	145	145	177	177	218	260	312	436	—	—
93.7	93.7	122	137	160	160	194	194	240	286	343	480	—	—

Contactors

Specifications, Continued

IEC Specifications

			100/104-K			100/104-C, 100S/104S-C									
			05	09	12	09	12	16	23	30	37	40*200	40*400	43	60
	Conventional		X	X	X	X	X	X	X	X	X	X	X	X	X
Coil Type :	Electronic — EI		—	—	—	—	—	—	—	—	—	—	—	—	—
Switching of 3-phase Capacitors, AC-6b (50 Hz)∗															
	230V	[kVar]	—	—	—	8	8	8.5	9	14	14	—	—	24	28
	240V	[kVar]	—	—	—	8	8	8.5	9	14	14	—	—	25	29
	400V	[kVar]	—	—	—	8	8	10	12.5	20	24	—	—	35	48
Single capacitor 40 °C	415V	[kVar]	—	—	—	8	8	10	12.5	20	25	—	—	35	50
	500V	[kVar]	—	—	—	8	8	10	12.5	20	25	—	—	35	50
	690V	[kVar]	—	—	—	8	8	10	12.5	20	25	—	—	35	50
	1000V	[kVar]	—	—	—	—	—	—	—	—	—	—	—	—	—
	230V	[kVar]	—	—	—	8	8	8.5	9	12.5	12.5	—	—	18	28
	240V	[kVar]	—	—	—	8	8	8.5	9	12.5	12.5	—	—	18	29
	400V	[kVar]	—	—	—	8	8	10	12.5	20	21.5	—	—	30	42
60 °C	415V	[kVar]	—	—	—	8	8	10	12.5	20	22	—	—	30	42
	500V	[kVar]	—	—	—	8	8	10	12.5	20	25	—	—	30	42
	690V	[kVar]	—	—	—	8	8	10	12.5	20	25	—	—	30	42
	1000V	[kVar]	—	—	—	—	—	—	—	—	—	—	—	—	—
	230V	[kVar]	—	—	—	5	5	8	9	12.5	14	—	—	20	28
	240V	[kVar]	—	—	—	5	5	8	9	12.5	14	—	—	20	29
	400V	[kVar]	—	—	—	5	5	8	10	15	20	—	—	25	40
Group capacitors 40 °C	415V	[kVar]	—	—	—	5	5	8	10	15	20	—	—	25	40
	500V	[kVar]	—	—	—	5	5	8	10	15	20	—	—	25	40
	690V	[kVar]	—	—	—	5	5	8	10	15	20	—	—	25	40
	1000V	[kVar]	—	—	—	—	—	—	—	—	—	—	—	—	—
	230V	[kVar]	—	—	—	5	5	8	9	12.5	12.5	—	—	18	28
	240V	[kVar]	—	—	—	5	5	8	9	12.5	12.5	—	—	18	29
	400V	[kVar]	—	—	—	5	5	8	10	15	20	—	—	25	40
60 °C	415V	[kVar]	—	—	—	5	5	8	10	15	20	—	—	25	40
	500V	[kVar]	—	—	—	5	5	8	10	15	20	—	—	25	40
	690V	[kVar]	—	—	—	5	5	8	10	15	20	—	—	25	40
	1000V	[kVar]	—	—	—	—	—	—	—	—	—	—	—	—	—
60 Hz Single Capacitor — 40 °C															
	200V	[kVar]	—	—	—	5	5	8	9	12.5	14	—	—	20	28
	230V	[kVar]	—	—	—	5	5	8	9	12.5	14	—	—	20	29
	460V	[kVar]	—	—	—	5	5	8	10	15	20	—	—	25	40
	600V	[kVar]	—	—	—	5	5	8	10	15	20	—	—	25	40
60 Hz Group Capacitors — 40 °C															
	200V	[kVar]	—	—	—	5	5	8	9	12.5	12.5	—	—	18	28
	230V	[kVar]	—	—	—	5	5	8	9	12.5	12.5	—	—	18	29
	460V	[kVar]	—	—	—	5	5	8	10	15	20	—	—	25	40
	600V	[kVar]	—	—	—	5	5	8	10	15	20	—	—	25	40
Switching of Lamps															
Gas discharge lamps AC-5a, 40 °C	open	[A]	18	18	18	22.5	25	28	29	40.5	45	65	65	77	81
	enclosed	[A]	14.5	14.5	14.5	22.5	25	28	29	37	41	54	54	57	77
Individually compensated:															
Max. capacitance at expected															
	10 kA	[µF]	750	750	750	1 000	1 000	1 000	1 000	2 700	2 700	—	—	3 200	4 000
Short-circuit current of	20 kA	[µF]	400	400	400	500	500	500	500	1 350	1 350	—	—	1 600	2 000
	50 kA	[µF]	—	—	—	200	200	200	200	540	540	—	—	640	800
Filament AC-5b	230/240V	[A]	5	9	9	12	16	18	22	30	37	18	25	43	60
Switching of Low Inductive Loads in Home Appliances and Similar Applications per IEC 61095 (50 Hz)															
	230V	[A]	20	20	20	32	32	32	32	45	45	—	—	63	—
AC-7a	400V	[A]	20	20	20	32	32	32	32	45	45	—	—	63	—
	440V	[A]	—	—	—	32	32	32	32	45	45	—	—	63	—
Switching of Motor Load for Home Appliances (50 Hz)															
	230V	[A]	6	11	11	10.5	14	19	23	30	—	—	—	—	—
AC-7b	400V	[A]	6	11	11	9	12	16	20	30	—	—	—	—	—
	440V	[A]	—	—	—	7.5	10	13.5	18	27	—	—	—	—	—

∗ Inductance of leads between capacitors in parallel: min. 6 µH (100-C09…C30 contactors: min 30 µH)

100/104-C, 100S/104S-C				100/104-D, 100S-D											
72	85	90*200	90*400	95	110	140	140	180	180	210	250	300	420	630	860
X	X	X	X	X	X	X	—	X	—	—	—	—	—	—	—
—	—	—	—	X	X	—	X	—	X	X	X	X	X	X	X
Switching of 3-phase Capacitors, AC-6b (50 Hz)															
28	28	—	—	45	45	70	70	70	70	98	98	125	139	—	—
29	29	—	—	47	47	73	73	73	73	102	102	131	145	—	—
48	48	—	—	78	78	121	121	121	121	170	170	218	242	—	—
50	50	—	—	81	81	126	126	126	126	176	176	226	252	—	—
55	60	—	—	97	97	152	152	152	152	212	212	273	303	—	—
55	60	—	—	134	134	209	209	209	209	293	293	376	418	—	—
—	—	—	—	194	194	303	303	303	303	424	424	546	606	—	—
28	28	—	—	38	38	59	59	59	59	84	84	106	119	—	—
29	29	—	—	39	39	61	61	61	61	87	87	111	124	—	—
48	48	—	—	65	65	102	102	102	102	145	145	184	206	—	—
50	50	—	—	68	68	106	106	106	106	151	151	191	214	—	—
50	55	—	—	82	82	127	127	127	127	182	182	230	258	—	—
50	55	—	—	113	113	176	176	176	176	251	251	318	356	—	—
—	—	—	—	164	164	255	255	255	255	364	364	461	515	—	—
28	28	—	—	42	45	70	70	70	70	98	98	125	139	—	—
29	29	—	—	43	47	73	73	73	73	102	102	131	145	—	—
48	48	—	—	44	56	76	76	111	111	170	170	218	242	—	—
50	50	—	—	44	56	76	76	112	112	170	176	226	252	—	—
50	50	—	—	44	56	76	76	113	113	172	212	273	303	—	—
50	50	—	—	45	57	78	78	114	114	174	247	356	418	—	—
—	—	—	—	46	58	79	79	116	116	177	251	361	606	—	—
28	28	—	—	38	38	59	59	59	59	84	84	106	119	—	—
29	29	—	—	39	39	61	61	61	61	87	87	111	124	—	—
48	48	—	—	44	56	76	76	102	102	145	145	184	206	—	—
50	50	—	—	44	56	76	76	106	106	151	151	191	214	—	—
50	50	—	—	44	56	76	76	113	113	172	182	230	258	—	—
50	50	—	—	45	57	78	78	114	114	174	247	318	356	—	—
—	—	—	—	46	58	79	79	116	116	177	251	361	515	—	—
60 Hz Single Capacitor — 40 °C															
28	28	—	—	39	39	61	61	61	61	85	85	109	121	—	—
29	29	—	—	45	45	70	70	70	70	98	98	125	139	—	—
50	50	—	—	89	89	139	139	139	139	195	195	251	279	—	—
50	50	—	—	116	116	182	182	182	182	255	255	327	364	—	—
60 Hz Group Capacitors — 40 °C															
28	28	—	—	39	39	61	61	61	61	85	85	109	121	—	—
29	29	—	—	42	45	70	70	70	70	98	98	125	139	—	—
50	50	—	—	44	56	76	76	112	112	171	195	251	279	—	—
50	50	—	—	45	57	77	77	114	114	173	246	327	364	—	—
Switching of Lamps															
85	90	115	115	144	144	225	225	225	225	315	315	405	450	—	—
81	90	95	95	122	122	189	189	189	189	270	270	342	383	—	—
Individually compensated:															
Max. capacitance at expected															
4 000	4 700	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2 000	2 350	—	—	—	—	—	—	—	—	—	—	—	—	—	—
800	940	—	—	—	—	—	—	—	—	—	—	—	—	—	—
70	76	60	75	107	120	140	140	170	170	210	250	300	420	—	—
Switching of Low Inductive Loads in Home Appliances and Similar Applications per IEC 61095 (50 Hz)															
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Switching of Motor Load for Home Appliances (50 Hz)															
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Contactors

Specifications, Continued

Specifications

			100/104-K			100/104-C, 100S/104S-C									
			05	09	12	09	12	16	23	30	37	40*200	40*400	43	60
	Conventional		X	X	X	X	X	X	X	X	X	X	X	X	X
Coil Type :	Electronic — EI		—	—	—	—	—	—	—	—	—	—	—	—	—
Switching of Hermetically Sealed Cooling Compressor Motors - manual reset of overload release (50 Hz)															
	400V	[A]	11	18	18	12	16	22	32	38	45	—	—	63	72
AC-8a	500V	[A]	10	15	15	12	16	22	32	38	45	—	—	63	72
	690V	[A]	—	—	—	8	10	14	20	28	35	—	—	42	56
- automatic reset of overload release															
	400V	[A]	—	—	—	5.5	7	9.3	12	13	14	—	—	16	24
AC-8b	500V	[A]	—	—	—	5.5	7	9.3	12	13	14	—	—	16	24
	690V	[A]	—	—	—	5.5	7	9.3	12	13	14	—	—	16	24
Switching of DC Loads															
Non-inductive or slightly inductive loads or resistance furnaces DC-1 at 60 °C															
	24V	[A]	6	9	9	25	25	32	32	45	45	45	45	50	70
	48/60V	[A]	4/1	6/1.5	6/1.5	20	20	20	20	25	25	25	25	30	40
1 pole	110V	[A]	0.6	1	1	6	6	6	6	8	8	10	10	9	11
	220V	[A]	0.2	0.3	0.3	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2
	440V	[A]	0.08	0.1	0.1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5
	24V	[A]	6	9	9	25	25	32	32	45	45	45	45	50	70
	48/60V	[A]	6	8	8	25	25	32	32	45	45	45	45	50	70
2 poles in series	110V	[A]	4	6	6	25	25	32	32	45	45	45	45	50	70
	220V	[A]	0.8	1.2	1.2	8	8	8	10	10	10	10	10	10	15
	440V	[A]	0.2	0.3	0.3	1	1	1	1	1	1	1	1	1	1.5
	24V	[A]	6	9	9	25	25	32	32	45	45	—	45	63	90
	48/60V	[A]	6	9	9	25	25	32	32	45	45	—	45	63	90
3 poles in series	110V	[A]	6	9	9	25	25	32	32	45	45	—	45	63	90
	220V	[A]	3	4	4	25	25	32	32	45	45	—	45	50	70
	440V	[A]	0.4	0.6	0.6	3	3	3	3	3.5	3.5	—	3.5	4	5
Shunt-wound Motors Starting, reverse current braking, reversing, stepping DC-3, 60 °C															
	24V	[A]	5	9	9	25	25	32	32	45	45	—	—	63	90
	48/60V	[A]	4	6	6	25	25	32	32	45	45	—	—	50	70
3 poles in series	110V	[A]	2	3	3	20	20	25	25	30	30	—	—	35	70
	220V	[A]	0.8	1.2	1.2	6	6	6	10	15	15	—	—	20	25
	440V	[A]	0.15	0.2	0.2	0.6	0.6	0.6	0.6	0.6	0.6	—	—	0.6	0.6
Series-wound Motors Starting, reverse current braking, reversing, stepping DC-5, 60 °C															
	24V	[A]	5	9	9	25	25	32	32	45	45	—	—	63	90
	48/60V	[A]	2	3	3	25	25	32	32	45	45	—	—	50	70
3 poles in series	110V	[A]	0.6	1	1	20	20	25	25	30	30	—	—	35	70
	220V	[A]	0.1	0.1	0.1	6	6	6	10	15	15	—	—	20	25
	440V	[A]	—	—	—	0.6	0.6	0.6	0.6	0.6	0.6	—	—	0.6	0.6
Short Time Withstand I_{CW}, 60 °C															
	10 s	[A]	60	96	96	170	170	170	215	300	304	304	304	375	700
Resistance and Power Dissipation															
Main current circuit resistance		[mΩ]	2.2	2.2	2.2	2.7	2.7	2.7	2	2	2	2	1.5	1.5	0.9
Power dissipation by all circuits at I_e AC-3/400V		[W]	0.3	0.9	0.9	0.66	1.2	2.1	3.2	5.4	8.2	11.3	8.4	8.3	9.7
Total power dissipation															
At I_e AC-3/400V	AC control	[W]	2.1	2.7	2.7	3.3	3.8	4.7	6.2	8.4	11.2	26.1	37.4	11.5	11
	DC control	[W]	2.9	3.5	3.5	6.7	7.2	8.1	12.4	14.6	17.4	32.6	43.9	18.4	11
Lifespan															
Mechanical AC control		[Mil. operations]	15	15	15	13	13	13	13	13	13	10	10	12	10
Mechanical DC control		[Mil. operations]	15	15	15	13	13	13	13	13	13	10	10	13	10
Electrical AC-3 (400 V)		[Mil. operations]	0.7	0.7	0.7	1.3	1.3	1.3	1.3	1.3	1.3	—	—	1	1
Weight															
AC	Non-Reversing	kg (lbs.)	0.16 (0.35)	0.16 (0.35)	0.16 (0.35)	0.39 (0.86)	0.39 (0.86)	0.39 (0.86)	0.39 (0.86)	0.48 (1.06)	0.49 (1.08)	—	—	0.51 (1.12)	1.45 (3.20)
	Reversing	kg (lbs.)	—	—	—	0.85 (1.89)	0.85 (1.89)	0.85 (1.89)	0.85 (1.89)	1.08 (2.39)	1.08 (2.39)	—	—	1.15 (2.54)	3.14 (6.92)
DC	Non-Reversing	kg (lbs.)	0.2 (0.44)	0.2 (0.44)	0.2 (0.44)	0.6 (1.32)	0.6 (1.32)	0.6 (1.32)	0.73 (1.61)	0.85 (1.87)	0.85 (1.87)	—	—	1.0 (2.20)	1.47 (3.24)
	Reversing	kg (lbs.)	—	—	—	1.27 (2.81)	1.27 (2.81)	1.27 (2.81)	1.53 (3.39)	1.81 (4.0)	1.81 (4.0)	—	—	2.13 (4.7)	3.22 (7.1)

100/104-C, 100S/104S-C				100-D, 100S-D											
72	85	90*200	90*400	95	110	140	140	180	180	210	250	300	420	630	860
X	X	X	X	X	X	X	—	X	—	—	—	—	—	—	—
—	—	—	—	X	X	—	X	—	X	X	X	X	X	X	X
Switching of Hermetically Sealed Cooling Compressor Motors - manual reset of overload release (50 Hz)															
85	100	—	—	—	—	—	—	—	—	—	—	—	—	—	—
85	100	—	—	—	—	—	—	—	—	—	—	—	—	—	—
67	80	—	—	—	—	—	—	—	—	—	—	—	—	—	—
- automatic reset of overload release															
30	35	—	—	—	—	—	—	—	—	—	—	—	—	—	—
30	35	—	—	—	—	—	—	—	—	—	—	—	—	—	—
30	35	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Switching of DC Loads															
80	80	80	80	135	135	210	210	210	210	300	300	380	425	—	—
40	40	40	40	135	135	210	210	210	210	300	300	380	425	—	—
11	11	11	11	135	135	210	210	210	210	300	300	380	425	—	—
2	2	1.8	1.8	3	3	3.3	3.3	3.3	3.3	4.9	4.9	4.9	5.2	—	—
0.5	0.5	0.5	0.5	0.6	0.6	0.75	0.75	0.75	0.75	1	1	1	1.2	—	—
80	80	80	80	135	135	210	210	210	210	300	300	380	425	—	—
80	80	80	80	135	135	210	210	210	210	300	300	380	425	—	—
80	80	80	80	135	135	210	210	210	210	300	300	380	425	—	—
15	15	15	15	135	135	210	210	210	210	300	300	380	425	—	—
1.5	1.5	1.5	1.5	3	3	3.3	3.3	3.3	3.3	4.9	4.9	4.9	5.2	—	—
90	100	—	100	135	135	210	210	210	210	300	300	380	425	—	—
90	100	—	100	135	135	210	210	210	210	300	300	380	425	—	—
90	100	—	100	135	135	210	210	210	210	300	300	380	425	—	—
80	80	—	80	135	135	210	210	210	210	300	300	380	425	—	—
5	5	—	5	11	11	11	11	11	11	14	14	14	15	—	—
Shunt-wound Motors Starting, reverse current braking, reversing, stepping DC-3, 60 °C															
90	100	—	—	135	135	210	210	210	210	300	300	380	425	—	—
70	80	—	—	135	135	210	210	210	210	300	300	380	425	—	—
70	80	—	—	135	135	210	210	210	210	300	300	380	425	—	—
25	30	—	—	135	135	210	210	210	210	300	300	380	425	—	—
0.6	0.6	—	—	3	3	3.5	3.5	3.5	3.5	4.1	4.1	4.1	5.8	—	—
Series-wound Motors Starting, reverse current braking, reversing, stepping DC-5, 60 °C															
90	100	—	—	135	135	210	210	210	210	300	300	380	425	—	—
70	80	—	—	135	135	210	210	210	210	300	300	380	425	—	—
70	80	—	—	135	135	210	210	210	210	300	300	380	425	—	—
25	30	—	—	135	135	210	210	210	210	300	300	380	425	—	—
0.6	0.6	—	—	1.2	1.2	2.1	2.1	2.1	2.1	2.4	2.4	2.4	3	—	—
Short Time Withstand I_{CW}, 60 °C															
700	700	700	700	1040	1040	1240	1360	1480	1480	2360	2520	2840	4700	—	—
Resistance and Power Dissipation															
0.9	0.9	0.8	0.7	0.4	0.4	0.42	0.42	0.42	0.42	0.22	0.22	0.18	0.15	0.19	0.14
14	19.5	13.5	11.8	10.8	14.5	24.6	24.6	40.8	40.8	29.4	41.7	48.6	79.5	78.4	103.2
Total power dissipation															
13.8	17.5	36	56.3	20.8 (16.8)	24.5 (20.5)	34.6	30.6	50.8	46.8	35.4	47.7	54.6	86.5	105.4	133.2
13.8	17.5	32.5	52.8	18.8 (16.8)	22.5 (20.5)	32.6	30.6	48.8	46.8	35.4	47.7	54.6	86.5	105.4	133.2
Lifespan															
10	10	10	10	10	10	10	10	10	10	10	10	10	10	2	2
10	10	10	10	10	10	10	10	10	10	10	10	10	10	2	2
1	1	—	—	1	1	1	1	1	1	1	1	1	1	—	—
Weight															
1.45 (3.2)	1.45 (3.2)	—	—	3.3 (7.28) [3.8 (8.38)]*	3.3 (7.28) [3.8 (8.38)]*	3.3 (7.28)	3.8 (8.38)	3.3 (7.28)	3.8 (8.38)	7.5 (16.53)	7.5 (16.53)	7.5 (16.53)	7.5 (16.53)	28.6 (63)	28.6 (63)
3.14 (6.92)	3.14 (6.92)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1.47 (3.24)	1.47 (3.24)	—	—	3.3 (7.28) [3.8 (8.38)]*	3.3 (7.28) [3.8 (8.38)]*	3.3 (7.28)	3.8 (8.38)	3.3 (7.28)	3.8 (8.38)	7.5 (16.53)	7.5 (16.53)	7.5 (16.53)	7.5 (16.53)	28.6 (63)	28.6 (63)
3.22 (7.1)	3.22 (7.1)	—	—	—	—	—	—	—	—	—	—	—	—	—	—

* Values in brackets refer to electronic coil (EI) version.

Contactors

Specifications, Continued

Coil Type :			100/104-K			100/104-C, 100S/104S-C										
			05	09	12	09	12	16	23	30	37	40	43	60	72	85
	Conventional		X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Electronic — EI		—	—	—	—	—	—	—	—	—	—	—	—	—	—
Conductor Cross Sections - Main Contacts Terminal type					✶				✶			❄				‡
	(1) conductor (2) conductors	[mm²] [mm²]	0.75…2.5 0.75…2.5			1…4 1…4				2.5…10 2.5…10		2.5…16 2.5…16		2.5…35 2.5…25		
	(1) conductor (2) conductors	[mm²] [mm²]	1…4 1…2.5+ 1…4			1.5…6 1.5…6				2.5…16 2.5…16		2.5…25 2.5…16		2.5…50 2.5…35		
	b max.	[mm]	—			—				—		—		—		
	c max.	[mm]	—			—				—		—		—		
	s max.	[mm]	—			—				—		—		—		
	Ø min.	[mm]	—			—				—		—		—		
Recommended torque		[N•m]	1.2			1.5…2.5				2.5…3.5		2.5…3.5		3.5…6		
Cross section per UL/CSA		[AWG]	18…12			16…10				14…4		14…6	14…4	14…1		
Recommended torque		[lb-in]	10.6			13.3…22				22…31		22…31		31…53		
With terminal lug kit			—			—				—		—	—	—		
Cross section per UL/CSA		[AWG]	—			—				—		—	—	—		
Recommended torque		[lb-in]	—			—				—		—	—	—		
With Frame Terminal Block			—			—				—		—	—	—		
	top opening bottom opening	[mm²] [mm²]	—			—				—		—	—	—		
	top opening bott. opening	[mm²] [mm²]	—			—				—		—	—	—		
	b max. s top s bottom	[mm] [mm] [mm]	—			—				—		—	—	—		
Recommended torque		[N•m]	—			—				—		—	—	—		
Cross section per UL/CSA top		[AWG]	—			—				—		—	—	—		
bottom		[AWG]	—			—				—		—	—	—		
Recommended torque		[lb-in]	—			—				—		—	—	—		

✶ Pozidriv No. 2 / Blade No. 3 screw
❄ Pozidriv No. 2 / Blade No. 4 screw
‡ Hexagonal socket screw

100-D, 100S-D											
95	110	95	110	140	180	210	250	300	420	630	860
X	X	—	—	X	X	—	—	—	—	—	—
—	—	X	X	X	X	X	X	X	X	X	X
§		§				§				§	
— —		— —				— —				— —	— —
— —		— —				— —				— —	— —
20		25				30				52	52
10		12.5				15				22	22
5		5				6				2 x 8	2 x 8
6.1		8.3				10.5				13	13
9		22				43				68	68
—		—				—				—	—
80		195				380				600	600
100-DL110‡		100-DLE110‡		100-DL180‡		100-DL420‡				100-DL630	100-DL860
8…2/0		8…2/0		6…300 MCM		(2x) 4…350 MCM				(2X) 2/0… 500MCM	(4X) 2/0… 500MCM
90		90		250		250				400	400
100-DTB110‡		100-DTB180‡				100-DTB420✶				—	—
16…35 16…70		16…35 16…95				25…240♣ 25…240				—	—
16…50 16…95		16…50 16…120				25…300 25…300				—	—
16 3…9 3…12		20 3…9 3…14				25 4…20 4…20				—	—
12		14				25				—	—
6…1 / 0 AWG		6…1 / 0 AWG				4 AWG…600 MCM				—	—
6…3 / 0 AWG		6 AWG…250 MCM				4 AWG…600 MCM				—	—
106		124				220				—	—

✶ Pozidriv No. 2 / Blade No. 3 screw
❄ Pozidriv No. 2 / Blade No. 4 screw
‡ Hexagonal socket screw
§ Hexagonal screw
♣ 25…95 mm² with sleeve per DIN 46228

Contactors

Specifications, Continued

Short-Circuit Coordination Data‡

		100/104-K			100/104-C, 100S/104S-C													
		05	09	12	09	12	16	23	30	37	40*200	40*400	43	60	72	85	90*200	90*400
	Conventional	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Coil Type :	Electronic – EI	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Short Circuit Coordination (Max. Fuse or Circuit Breaker Rating)																		
Per IEC 60947-4-1 (contactor and fuses only)																		
DIN Fuses - gG, gL		50 kA Available Fault Current																
Type "1" (690V)	[A]	35	35	35	50	50	50	80	125	125	160	160	160	250	250	250	250*	250*
Type "2" (400V)	[A]	16	20	20	25	35	35	40	80	80	63	80	100	160	160	160	160*	100*
Type "2" (690V)	[A]	—	—	—	25	35	35	40	80	80	63	80	100	160	160	160	160*	100*
BS88 Fuses		65 kA Available Fault Current																
Type "1" (415V)	[A]	—	—	—	25	32	40	50	63	80	—	—	80	100	160	160	—	—
Type "2" (415V)	[A]	—	—	—	20	25	32	50	63	80	—	—	80	100	125	160	—	—
Per UL 508 and CSA 22.2 No. 14 (contactor and fuses or circuit breaker only)																		
UL Class K5 and RK5 Fuses		5 kA Available Fault Current																
UL Listed Combination (600V)	[A]	40	40	40	35	40	70	90	110	125	125	125	150	200	—	—	—	—
UL Class K5 and RK5 Fuses		10 kA Available Fault Current																
UL Listed Combination (600V)	[A]	—	—	—	—	—	—	—	—	—	—	—	—	—	250	300	300	300
UL Class L Fuses		18 kA Available Fault Current																
UL Listed Combination (600V)	[A]	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
UL Class L Fuses		30 kA Available Fault Current																
UL Listed Combination (600V)	[A]	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
UL Class L Fuses		42 kA Available Fault Current																
UL Listed Combination (600V)	[A]	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
UL Class CC and CSA HRCI-MISC Fuses		100 kA Available Fault Current																
UL verified combination to IEC 60947-4-1 "Type 2"	[A]	—	—	—	15	20	20	30	—	—	—	—	—	—	—	—	—	—
UL Class J and CSA HRCI-J Fuses		100 kA Available Fault Current																
UL verified combination to IEC 60947-4-1 "Type 2"	[A]	—	—	—	15	20	20	30	40	50	—	—	50	80	100	100	—	—
UL Inverse-Time Circuit Breaker		5 kA Available Fault Current																
UL Listed Combination (480V)	[A]	—	—	—	30	30	50	50	125	125	—	—	125	250	—	—	—	—
UL Listed Combination (600V)	[A]	—	—	—	—	—	—	—	125	125	—	—	125	250	—	—	—	—
UL Inverse-Time Circuit Breaker		10 kA Available Fault Current																
UL Listed Combination (600V)	[A]	—	—	—	—	—	—	—	—	—	—	—	—	—	250	250	—	—
UL Inverse-Time Circuit Breaker		18 kA Available Fault Current																
UL Listed Combination (600V)	[A]	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
UL Inverse-Time Circuit Breaker		30 kA Available Fault Current																
UL Listed Combination (600V)	[A]	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
UL Inverse-Time Circuit Breaker		42 kA Available Fault Current																
UL Listed Combination (600V)	[A]	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

* 50 kA available fault current.

‡ See www.ab.com/certifications/ul508a for complete short-circuit current ratings.

100/104-D, 100S-D											
95/110	140/180	95	110	140	180	210	250	300	420	630	860
X	X	—	—	—	—	—	—	—	—	—	—
—	—	X	X	X	X	X	X	X	X	X	X
50 kA Available Fault Current											
250	315	250	250	315	355	500	500	630	630	❄	❄
200	250	200	200	250	315	400	400	500	500	❄	❄
200	250	200	200	250	315	400	400	500	500	❄	❄
65 kA Available Fault Current											
160	250	200	200	250	250	355	355	450	630	❄	❄
160	250	200	200	250	250	355	355	450	560	❄	❄
5 kA Available Fault Current											
—	—	—	—	—	—	—	—	—	—	—	—
10 kA Available Fault Current											
225/250	350/450	225	250	350	450	500	—	—	—	—	—
18 kA Available Fault Current											
—	—	—	—	—	—	—	700	700	1000	—	—
30 kA Available Fault Current											
—	—	—	—	—	—	—	—	—	—	2500	—
42 kA Available Fault Current											
—	—	—	—	—	—	—	—	—	—	—	2500
100 kA Available Fault Current											
—	—	—	—	—	—	—	—	—	—	—	—
100 kA Available Fault Current											
❄	❄	❄	❄	❄	❄	❄	❄	❄	❄	❄	❄
5 kA Available Fault Current											
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
10 kA Available Fault Current											
125/150	200/250	125	150	200	250	300	—	—	—	—	—
18 kA Available Fault Current											
—	—	—	—	—	—	—	350	400	500	—	—
30 kA Available Fault Current											
—	—	—	—	—	—	—	—	—	—	1200	—
42 kA Available Fault Current											
—	—	—	—	—	—	—	—	—	—	—	1200

❄ To be determined.

Contactors

Specifications, Continued

Coil Data

Coil Type			100/104-K			100/104-C, 100S/104S-C												
			05	09	12	09	12	16	23	30	37	40*200	40*400	43	60	72	85	90*200	90*400
Conventional			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Electronic — EI			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Operating Limits																			
50 Hz, 60 Hz, 50/60 Hz	pick-up	[x *Us*]	0.85…1.1			0.85…1.1						0.85….1.1		0.85….1.1					
	dropout	[x *Us*]	0.2…0.75			0.3…0.6						0.3…0.6		0.3…0.6					
DC (conventional)	pick-up	[x *Us*]	0.85…1.1 0.7…1.25§			0.8…1.1						0.8…1.1		0.8…1.1					
	dropout	[x *Us*]	0.1…0.75			0.1…0.6						0.1…0.6		0.1…0.6					
DC (electronic)	pick-up	[x *Us*]	—			0.7…1.25								—					
	dropout	[x *Us*]	—			0.1…0.5								—					
Coil Consumption																			
50 Hz, 60 Hz, 50/60 Hz	pick-up	[VA/W]	35/32			70/50		70/50		80/60		130/90		130/90	200/110			400/240	
	hold-in	[VA/W]	5/1.8			8/2.6		9/3		9/3		12/3.6		10/3.2	16/4.5			24/9	
DC (conventional)	pick-up	[W]	cold 3.0, warm 2.6			6.5		9.2		9.2		10.1		10.1	200			325	
	hold-in	[W]	cold 3.0, warm 2.6			6.5		9.2		9.2		10.1		10.1	4.5			5.5	
DC (electronic)	pick-up (avg/peak)	[W]	—			10/22				10/22		12/28			—			—	
	hold-in	[W]	—			1.5						2.5			—			—	
Operating Times																			
AC	closing delay	[ms]	15…40			15…30		15…30		15…30		15…30		15…30	20…40			20…30	
	opening delay	[ms]	15…33			10…60		10…60		10…60		10…60		10…60	10…60			20…40	
With RC module	opening delay	[ms]	15…28			10…60		10…60		10…60		10…60		10…60	10…60			20…40	
DC (conventional)	closing delay	[ms]	18…40			40…70		40…70		50…80		50…80		50…80	20…40			15…25	20…25
	opening delay	[ms]	6…12			7…15		7…15		7…15		7…15		7…15	—			20…25	
With integ. diode	opening delay	[ms]	8…12			14…20		17…23		17…23		—		17…23	≤ 220V 20…35			—	
With external diode	opening delay	[ms]	35…50			70…95		80…125		80…125		—		80…125	≤ 220V 80…125			—	
DC (electronic)	closing delay	[ms]	—			20…40									—			—	
	opening delay	[ms]	—			20…40									—			—	
Max. Ripple			—			± 15%									—			—	—

§ For 9, 12, 24, and 110V DC coils

Coil Type			100/104-D, 100S-D											
			95/110	140/180	95	110	140	180	210	250	300	420	630	860
Conventional			X	X	—	—	—	—	—	—	—	—	—	—
Electronic — EI			—	—	X	X	X	X	X	X	X	X	X	X
Operating Limits														
50 Hz, 60 Hz, 50/60 Hz	pick-up	[x *Us*]	0.85…1.1				0.85…1.1						0.8…1.1	
	dropout	[x *Us*]	0.3…0.6				0.3…0.5						0.3…0.8	
DC control	pick-up	[x *Us*]	0.85…1.1				0.85…1.1						0.85…1.1	
	dropout	[x *Us*]	0.3…0.6				0.3…0.5						0.3…0.8	
Coil Consumption														
50 Hz, 60 Hz, 50/60 Hz	pick-up	[VA/W]	650/310				380/240*					490/270*	1915/1720*	
	hold-in	[VA/W]	50/10				13/6					18/7	33/30	
DC control	pick-up	[W]	540				265*					340*	1980*	
	hold-in	[W]	8				6					7	30	
Operating Times														
AC	closing delay	[ms]	20…47				20…45						60…100	
	opening delay	[ms]	6…12				25…110						70…145	
With RC module	opening delay	[ms]	9…18				—						—	
DC	closing delay	[ms]	27…47				25…50						60…100	
	opening delay	[ms]	12…20				35…110						70…145	
With integrated diode	opening delay	[ms]	12…20				—						—	
With external diode	opening delay	[ms]	—				—					—	—	

* Electronic coil drives are designed to minimize power requirements, but this control may exhibit a higher inrush (540 W, < 10 ms) when energizing. This must be taken into account for the proper sizing of supply devices, all-or-nothing relays and cross-sections of coil supply lines. Please contact your local Rockwell Automation sales office or Allen-Bradley distributor for detailed information.

Auxiliary Contacts and Auxiliary Contact Blocks

			100-K		100-C, 100S-C				100-D, 100S-D		
									Side-mounted		
			Internal	Front-mounted	Internal	Front-mounted	Front-mounted (Bifurcated)	Side-mounted	Convent'l	Bifurcated	Electronically compatible
Switching of AC Loads											
AC-12 I_{th}	at 40 °C	[A]	10	10	20	10	10	10	16	10	0.1
	at 60 °C	[A]	6	6	20	6	6	6	12	6	at 250V
AC-15 at rated voltage of											
	24V	[A]	6	3	10	6	3	6	5.5	3	(1…100 mA) at 3…125V
	42/48V	[A]	6	3	10	6	3	6	5.5	3	
	120V	[A]	6	3	10	6	3	6	5.5	3	
	230V	[A]	3	2	10	5.5	3	5.5	5.5	3	
	240V	[A]	3	2	10	5	3	5	5	3	
	400V	[A]	1.8	1.2	6	3	2	3	3	2	
	415V	[A]	1.8	1.2	6	3	2	3	2.5	2	
	500V	[A]	1.4	1.0	2.5	1.6	1.2	1.6	1.6	1.2	
	690V	[A]	1.0	0.6	1	1	0.7	1	1	0.7	
Switching of DC Loads											
DC-12 L/R< 1 ms resistive loads at											
	24V DC	[A]	6	—	12	12	6	6	16	16	—
	48V DC	[A]	4	—	9	9	3.2	3.2	9	9	—
	110V DC	[A]	0.6	—	3.5	3.5	0.45	0.45	3.5	3.5	—
	220V DC	[A]	0.2	—	0.55	0.55	0.18	0.18	0.55	0.55	—
	440V DC	[A]	0.08	—	0.2	0.2	0.1	0.1	0.2	0.2	—
DC-14 L/R< 15 ms inductive loads with economy resistor in series at											
	24V DC	[A]	4	—	9	9	2	2	9	9	—
	48V DC	[A]	2.5	—	5	5	1.6	1.6	5	5	—
	110V DC	[A]	0.4	—	2	2	0.3	0.3	2	2	—
	220V DC	[A]	0.12	—	0.4	0.4	0.12	0.12	0.4	0.4	—
	440V DC	[A]	0.05	—	0.16	0.16	0.05	0.05	0.16	0.1	—
DC-13 switching electromagnets at											
	24V DC	[A]	2.8	2.3	5	5	2.5	5	5	5	(1…100 mA) at 3…125V
	48V DC	[A]	1.2	1	3	3	1.5	3	2	2	
	110V DC	[A]	0.55	0.55	1.2	1.2	0.6	1.2	0.7	0.7	
	220V DC	[A]	0.27	0.27	0.6	0.6	0.3	0.6	0.25	0.25	
	440V DC	[A]	0.15	0.15	0.3	0.15	0.15	0.15	0.12	0.12	
Fuse gG											
Short-circuit protection with no welding of contacts per IEC 60947-5-1											
		[A]	10	10	20	10	10	10	16	16	—
		[A]	10	10	20	10	10	10	16	16	—
Protective Separation per IEC 60947-1, Annex N			—	—	between load and auxiliary circuit 320V	between load and auxiliary circuit 440V	between load and auxiliary circuit 440V				
Min. switching capacity according to IEC 60947-5-4			—	15V/ 2 mA	17V/10 mA	17V/5 mA	8V/5 mA	17V/10 mA	17V/10 mA	5V/2 mA (1 Mio. ops.)	3V/1 mA
Failure rate			—	—	—	—	—	—	—	<10-8 (less than 1 failure to 100 Mio. operations)	—
Load Carrying Capacity per UL/CSA											
Rated voltage	AC	[V]	max. 600		max. 600				max. 600		max. 250
Continuous rating	40 °C	[A]	10		10	10	10	10	10 General purpose		0.1
Switching capacity	AC	[A]	A 600	B 600	A 600				Heavy pilot duty (A 600)		0.1
Rated voltage	DC	[V]	max. 600		max. 600				max. 600		max. 250
Switching capacity	DC	[A]	Q 600		P 600	P 300/Q 600	Q 600		Standard pilot duty (P 600)	Standard pilot duty (Q 600)	0.1

General

		100-K	100-C, 100S-C	100-D, 100S-D
		05…12	09…85	95…420
Rated Isolation Voltage U_i				
IEC	[V]	690	690	1000
UL, CSA	[V]	600	600	600
Rated Impulse Voltage Withstand U_{imp}	[kV]	6	8	12
Rated Voltage U_e				
AC 50/60 Hz	[V]	230, 240, 400, 415, 500, 690	115, 230, 400, 500, 690	230, 240, 400, 415, 500, 690, 1000
DC	[V]	24, 48, 110, 220, 440	24, 48, 110, 220, 440	24, 48, 110, 220, 440
Insulation Class of the Coil		Class F per IEC 60085 Class 105 insulation system per UL 508	Class F per IEC 60085	Class B per VDE 0660, Table 22
Rated coil frequency		AC 50/60 Hz, DC	AC 50/60 Hz, DC	AC 50 Hz, 50/60 Hz, DC
Ambient Temperature				
Storage	[°C]	-55…+80	-55…+80	-40…+80
Operation at rated voltage	[°C]	-25…+60	-25…+60	-25…+60
at 70 °C		15% current reduction against 60°C values		
Climatic Withstand		IEC 60068-2	IEC 60068-2	IEC 60068-2
Max. Altitude of Installation Site	[m]	2000 NN, per IEC 60947-4	2000 NN, per IEC 60947-4	2000 NN, per IEC 60947-4
Protection Class		IP2X	IP2X	IP00 IEC 60529 / DIN 40 050
Single contactor cover		—		IP10 IEC 60529 / DIN 40 050
Contactor with frame terminal block		—		IP20 IEC 60529 / DIN 40 050
Auxiliary contact		IP2X		IP20 IEC 60529 / DIN 40 050
Protection against Accidental Contact		—	Finger and back-of-hand proof per VDE 0106, part 100	Finger and back-of-hand proof per VDE 0106, part 100
Resistance to Shock		IEC 60068-2	IEC 60068-2-27	IEC 60068-2-27
Resistance to Vibration		IEC 60068-2	IEC 60068-2-6	IEC 60068-2-6
Mechanically Linked Contacts IEC 60947-5-1, Annex L		100-K… (on main device)	100-C09…C23, 100S-C09…C85, 100-C + 100-FA/FB/FC (except L11, L22), 100-C09…C43 + 100-FAB/FBB/FCB	—
Mirror Contacts IEC 60947-4 Annex F		100-K… + 100-KF…	100-C09…C23, 100S-C09…C85, 100-C + 100-FA/FB/FC + 100-SA/SB, 100-C60…C85 + 100-FAB/FBB/FCB, 100S-C + 100-SA/SB	100-D… + 2 x 100-DS1-11 100S-D… + 2 x 100S-DS1-11
Standards Compliance		IEC/EN 60947-1/-4-1/-5-1; UL 508; CSA 22.2. No. 14	IEC/EN 60947-1/-4-1/-5-1; UL 508; CSA 22.2. No. 14	IEC/EN 60947-1/-4-1/-5-1; UL 508; CSA 22.2. No. 14
Certifications		CE, cULus CCC in prep.	CE, cULus, CCC	CE, cULus, CCC

Electrical Data

Cat. No.			100-G550...	100-G700...	100-G860...	100-G1000	100-G1200
AC-1, Three-phase Switching - IEC Ambient temperature: 40 °C							
I_e	≤ 690V	[A]	760	1000	1100	1200	1350
	230V	[kW]	303	398	438	478	538
	240V	[kW]	316	416	457	499	561
	400V	[kW]	527	693	762	831	935
	415V	[kW]	546	719	791	863	970
	500V	[kW]	658	866	953	1039	1169
	690V	[kW]	908	1195	1315	1434	1613
Ambient temperature: 60 °C							
	≤ 690V	[A]	605	800	870	960	1,085
	230V	[kW]	241	319	347	382	432
	240V	[kW]	251	333	362	399	451
I_e	400V	[kW]	419	554	603	665	752
	415V	[kW]	435	575	625	690	780
	500V	[kW]	524	693	753	831	940
	690V	[kW]	723	956	1040	1147	1297
Continuous Current - UL/CSA General Purpose Rating 40 °C		**[A]**	520	700	810	—	1215
Switching of 3-phase Motors - IEC							
AC-2, AC-3	230/240V	[A]	550	700	860	1000	1200
	400/415V	[A]	550	700	860	1000	1200
	500V	[A]	550	700	860	1000	1200
	690V	[A]	500	630	700	860	1000
	230V	[kW]	179	228	280	326	391
50 Hz/60 °C	240V	[kW]	187	238	293	340	408
	400V	[kW]	312	414	509	592	710
	415V	[kW]	324	430	528	628	737
	500V	[kW]	407	518	636	756	888
	690V	[kW]	510	657	730	897	1043
AC-4 at 200000 operations							
	230/240V	[A]	140	180	210	260	300
	400/415V	[A]	140	180	210	260	300
	230V	[kW]	45	57	67	83	97
50 Hz	240V	[kW]	47	60	70	87	101
	400V	[kW]	78	101	118	146	170
	415V	[kW]	81	105	122	151	176
AC-4, Squirrel-cage motors with reversing and jogging at 20,000 (25,000), operations							
	230/240V	[A]	360	430	520	(630)	(700)
	400/415V∗	[A]	350	420	520	(630)	(700)
	230V	[kW]	116	139	170	(205)	(228)
	240V	[kW]	120	151	177	(214)	(245)
	400V	[kW]	198	238	295	(357)	(414)
	415V	[kW]	206	247	300	(359)	(424)

∗ At rated Voltage 415V and rated current: Life span - 25%.

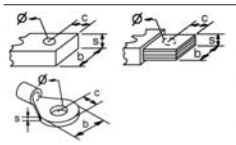
Electrical Data, Continued

Cat. No.			100-G550	100-G700	100-G860	100-G1000...	100-G1200...
Switching of 3-phase Motors - UL/CSA							
60 Hz/60 °C	200V	[A]	414	552	692	—	1185
	230V	[A]	360	602	722	—	1130
	460V	[A]	414	590	708	—	1062
	575V	[A]	336	472	576	—	864
	200V	[Hp]	150	200	250	—	450
	230V	[Hp]	150	250	300	—	450
	460V	[Hp]	350	500	600	—	900
	575V	[Hp]	350	500	600	—	900
Rated making capacity							
AC-3 I_e	≤ 415V	[A]	5500	7000	8600	10000	12000
	500V	[A]	5500	7000	8600	10000	12000
	690V	[A]	5500	7000	8600	10000	12000
Rated Breaking capacity							
AC-3 I_e	≤ 240V	[A]	4400	5600	6900	8000	9600
	400V	[A]	4400	5600	6900	8000	9600
	415V	[A]	4400	5600	6900	8000	9600
	500V	[A]	4400	5600	6900	8000	9600
	690V	[A]	4000	5100	5600	6900	8000
Star-Delta Staring							
50 Hz	230V	[A]	953	1212	1490	1732	2078
	240V	[A]	953	1212	1490	1732	2078
	400V	[A]	953	1212	1490	1732	2078
	415V	[A]	953	1212	1490	1732	2078
	500V	[A]	953	1212	1490	1732	2078
	690V	[A]	831	1091	1195	1490	1732
	230V	[kW]	310	395	485	565	677
	240V	[kW]	324	412	507	589	707
	400V	[kW]	540	717	882	1025	1250
	415V	[kW]	561	745	915	1088	1278
	500V	[kW]	705	897	1102	1309	1538
	690V	[kW]	883	1138	1247	1554	2078
Wye-Delta Starting							
60 Hz	230V	[Hp]	250	400	500	650	750
	460V	[Hp]	600	800	1000	1300	1500
	575V	[Hp]	600	800	1000	1500	1500
Short-circuit Protection of Contactors without Overload Relay							
Fuse gG (aM) Type 1 coordination (per IEC 60947-4-1)	500V	[A]	(630)	800	1000	1000	1250
	690V	[A]	(630)	800	1000	1000	1000
Switching of Three-phase Capacitor Inductivity of dispatching between parallel switched capacitor: min. 6 pH							
Single capacitors 40 °C	230V	[kVar]	180	220	250	290	330
	240V	[kVar]	200	250	300	325	360
	400V	[kVar]	320	400	450	500	575
	415V	[kVar]	350	430	500	550	630
	500V	[kVar]	450	520	600	660	750
	690V	[kVar]	580	700	800	875	1000
55 °C	230V	[kVar]	150	180	220	275	325
	240V	[kVar]	170	200	260	300	350
	400V	[kVar]	280	330	400	460	550
	415V	[kVar]	300	360	450	500	600
	500V	[kVar]	360	420	540	600	720
	690V	[kVar]	500	580	720	800	950

Electrical Data, Continued

Cat. No.			100-G550…	100-G700…	100-G860…	100-G1000…	100-G1200…
Capacitor Banks 40 °C	230V	[kVar]	180	220	250	290	330
	240V	[kVar]	200	250	300	325	360
	400V	[kVar]	320	400	450	500	575
	415V	[kVar]	350	430	500	550	430
	500V	[kVar]	450	520	600	660	750
	690V	[kVar]	580	700	800	875	1000
Capacitor Banks 55 °C	230V	[kVar]	150	180	220	275	325
	240V	[kVar]	170	200	260	300	350
	400V	[kVar]	280	330	400	460	550
	415V	[kVar]	300	360	450	500	600
	500V	[kVar]	360	420	540	600	720
	690V	[kVar]	500	580	720	800	950
DC Switching Switching of non- or slightly inductive loads, resistance furnaces DC-1 at 60 °C							
1 Pole	24/48V	[A]	645	760	930	1020	1150
2 Poles in series	24/48V	[A]	645	760	930	1020	1150
3 Poles in series	24/48V	[A]	645	760	930	1020	1150
	110V	[A]	480	560	630	800	900
	220V	[A]	315	400	450	500	600
Shunt-Wound Motors Starting, plugging, reversing, plugging DC-3 at 60 °C							
3 Poles in series	24/48V	[A]	605	800	870	960	1085
Series-Wound Motors Starting, plugging, reversing, plugging DC-5 at 60 °C							
3 Poles in series	24/48V	[A]	605	800	870	960	1085
Lighting Loads Elec. Discharge. Lamps - AC - 5a,							
Non-Compensated		[A]	450	570	700	850	1000
Compensated		[A]	360	460	550	660	800
Incandescent Lamps - AC - 5b, Electrical Endurance @ 100 000 ops		[A]	315	440	500	560	630
Switching Power Transformers AC - 6a							
Inrush = n · I_e		[A]	7440	9450	11700	13500	16200
I_e Rated transformer current		[A]	248	315	390	450	540
n = 30	400V AC	[kVA]	172	218	270	312	374
	500V AC	[kVA]	215	273	338	390	468
	690V AC	[kVA]	269	339	376	538	645
n = 20		[A]	371	472	580	675	810
n = 15		[A]	435	630	774	900	1080
Rated Short-Time Withstand ICW, 60 °C							
	1 s	[A]	5500	7000	8000	10000	12000
	4 s	[A]	5500	7000	8000	10000	12000
	10 s	[A]	4400	5600	6900	8000	9600
	15 s	[A]	3800	5000	6000	7400	8500
	60 s	[A]	2300	2800	3400	4000	4800
	240 s	[A]	1300	1800	2000	2300	2700
	900 s	[A]	850	1150	1350	1600	1900
Minimum cooling time at zero current		[Min.]	60	60	60	60	60
Resistance and Energy Dissipation							
Main circuit resistance		[mΩ]	0.11	0.1	0.08	0.06	0.05
Total energy dissipation at I_e AC-3		[W]	99	147	177	180	216
Excess energy dissipation at I_e AC-3							
	AC Control	[W]	110	172	202	250	286
	DC Control	[W]	109	169	199	240	276

Mechanical Data

Cat. No.			100-G550…	100-G700…	100-G860…	100-G1000…	100-G1200…
Life Span in Millions of Operations							
Mechanical	AC Control	[Mil.]	5	5	5	1	1
	DC Control	[Mil.]	5	5	5	1	1
Shipping Weights	AC Control	[kg]	13.8	26.4	28.4	50.3	53.4
		[lb]	30.4	58.1	62.5	110.8	117.6
	DC Control	[kg]	13.8	26.4	28.4	50.3	53.4
		[lb]	30.4	58.1	62.5	110.8	117.6
Terminals∗							
Terminal Dimensions		[mm]	6 x 40	8 x 50	8 x 50	10 x 50	10 x 60
Terminal screw hole size		[mm]	(1) x Ø 13	(1) x Ø 13	(1) x Ø 15	(2) x Ø 13	(2) x Ø 13
Terminations - Power Type			Hexagonal Bolt				
Direct Connection							
	b max.	[mm]	50	60	60	60	60
	c max.	[mm]	20	20	25	25	25
	s max.	[mm]	2 x 5	2 x 5	2 x 6	2 x 6	2 x 8
	Ø min.	[mm]	12.5	13	15	2 x 13	2 x 13
Recommended Torque		[N•m]	50	60	75	60	60
		[ft.-lb]	37	44	55	44	44
Conductor/Wire Terminations∗							
Bus bar (Width)		[mm]	40	50	50	50	60
Hex screw		[in]	1/2	3/8	3/8	3/8	3/8
Recommended Torque		[N•m]	42	62	62	56	56
		[lb•in]	375	550	550	500	500
Auxiliary Contact		[mm²]	(2) x 2.5	(2) x 2.5	(2) x 2.5	(2) x 2.5	(2) x 2.5
Coils		[mm²]	(2) x 2.5	(2) x 2.5	(2) x 2.5	(2) x 2.5	(2) x 2.5

∗ Quantity indicated in ( ).

Coil Data

Cat. No.			100-G550…	100-G700…	100-G860…	100-G1000…	100-G1200…
Operating Limits							
AC- 50 Hz	Pick-up	[x U_s]	0.85…1.1				
	Drop-out	[x U_s]	0.2…0.5	0.2…0.75		0.1…0.6	
AC- 60 Hz	Pick-up	[x U_s]	0.85…1.1				
	Drop-out	[x U_s]	0.2…0.5	0.2…0.75		0.1…0.6	
DC Control	Pick-up	[x U_s]	0.85…1.1				
	Drop-out	[x U_s]	0.2…0.5	0.2…0.75		0.1…0.6	
Pickup and Holding Power							
AC- 50 Hz	Pick-up	[VA]	800…950	1350…1600		2400	
	Hold-in	[VA]	9…11	21…25		70	
AC- 60 Hz	Pick-up	[VA]	800…950	1350…1600		2400	
	Hold-in	[VA]	9…11	21…25		70	
DC Control	Pick-up	[W]	700…850	1300…1550		2100	
	Hold-in	[W]	8…10	18…22		60	
Operating Times: Switching Delay							
AC	Making delay	[ms]	50…100			50…100	
	Breaking delay	[ms]	20…50❄/150…200/500…1000‡			25…50	
DC	Making delay	[ms]	50…100			50…100	
	Breaking delay	[ms]	20…50❄/150…200/500…1000‡			25…50	

❄ Accelerates
‡ Delays

Auxiliary Contacts

Cat. No.				100-G550…	100-G700…	100-G860…	100-G1000…	100-G1200…
AC Switching								
AC-1	I_{th}	at 40 °C	[A]	16			16	
		at 60 °C	[A]	12			12	
AC- 15 at rated voltage		120V	[A]	6			6	
		230V	[A]	3			3	
		240V	[A]	3			3	
		400V	[A]	2			2	
		415V	[A]	2			2	
		500V	[A]	1.5			1.5	
		690V	[A]	1			1	
DC Switching DC-13 control of electromagnets		24V DC	[A]	6			6	
		48V DC	[A]	3			3	
		110V DC	[A]	1			1	
		220V DC	[A]	0.5			0.5	
Back-up Fuse Short-circuit protection without contact welding per IEC 60947-5								
Fuse gG			[A]	10			16	

General Data

Cat. No.			100-G550…	100-G700…	100-G860…	100-G1000…∗	100-G1200…
Rated Isolation Voltage U_i							
IEC, AS, BS, SEV, VDE, 0660		[V]	1,000V			690V	
UL/CSA			600V			600V	
Impulse Voltage U_{imp}							
1 minute per IEC 947-4		[KV]	3,500V			2,500V	
Rated Voltage - Main Control U_e							
AC	50/60 Hz	[V]	230, 240, 400, 415, 460, 500, 575, 690V			230, 240, 400, 415, 460, 500, 575, 690V	
DC		[V]	24, 48, 110, 220, 440V				
Operating Frequency for AC Loads 50/60 Hz		[Hz]	180/hr. for 0.25s start time - 42/hr. for 1s start time				
Insulation Class of the Magnetic Coil			Class B per VDE 0660, table 22				
Rated frequency of the Coil			AC 50/60 Hz, DC				
Ambient Temperature							
Storage			-40 °C…+80 °C				
Operation at rated current			-25 °C…+60 °C				
Climatic Withstand			Damp alternating conditions cyclical, per DIN 50 016 and 40 046, part 38, IEC 60068				
Altitude			2000 m above sea level, per IEC 60947-1				
Type of Protection			IP00 IEC 60529/DIN 40 050				
Standards Compliance			IEC 60947, UL 508, CSA C22.2, No. 14				
Certifications			cULus, CE				

∗ Cat. No. 100-G1000… is not cULus certified.

Electrical Life in Utilization Category

Bulletin 100-C/104-C IEC contactors are designed for superior performance in a wide variety of applications. When selecting IEC products, the user must give consideration to the specific load, utilization category and required electrical life of the application. The life-load curves shown here are based on Rockwell Automation tests according to the requirements defined in IEC 60947-4-1. Since contact life in application is dependent on environmental conditions and duty cycle, actual application contact life may vary from that indicated by the curves shown here.

To find the contactor's estimated electrical life, follow these guidelines:

1. Identify the appropriate utilization category from the table below.
2. Choose the graph for the utilization category selected.
3. Locate the intersection of the life-load curve for the appropriate contactor with the application's operational current (I_e) found on the horizontal axis.
4. Read the estimated contact life along the vertical axis.

2

Contact Life for Mixed Utilization Categories AC-3 and AC-4:

In many applications, the utilization category cannot be defined as either purely AC-3 or AC-4. In those applications, the electrical life of the contactor can be estimated from the following equation:

Lmixed = Lac3/[1 + Pac4*(Lac3/Lac4 – 1)], where:

Lmixed Approximate contact life in operations for a mixed AC-3/AC-4 utilization category application.

Lac3 Approximate contact life in operations for a pure AC-3 utilization category (from the AC-3 life-load curves).

Lac4 Approximate contact life in operations for a pure AC-4 utilization category (from the AC-4 life-load curves).

Pac4 Percentage of AC-4 operations.

Test Conditions			Making			Breaking		
			I/I_e	U/U_e	cosϕ	I_c/I_e	U_r/U_e	cosϕ
AC-1	**Resistance Furnaces:** Non inductive or slightly inductive loads		1	1	0.95	1	1	0.95
AC-2	**Slip-ring motors:** Starting and reversing		2.5	1	0.65	2.5	1	0.65
AC-3	**Squirrel - cage motors:** Starting and stopping of running motors	I_e < 17 A I_e > 17 A	6 6	1 1	0.65 0.35	1 1	0.17 0.17	0.65 0.35
AC-4	**Squirrel - cage motors:** Starting, plugging✶, inching❄	I_e < 17 A I_e > 17 A	6 6	1 1	0.65 0.35	6 6	1 1	0.65 0.35
AC-15	**Soleniods:** Contactors, valves and lifting magnets		10	1	0.7	1	1	0.4

I_e Rated operational current — I Making Current
U_e Rated voltage — Ic Breaking Current
U_r Recovery voltage — U Off-load voltage

✶ Plugging is understood as stopping or reversing the motor rapidly by reversing motor primary connections while the motor is running.

❄ Inching (jogging) is understood as energizing a motor once or repeatedly for short periods to obtain small movements of the driven mechanism.

Life-Load Curves

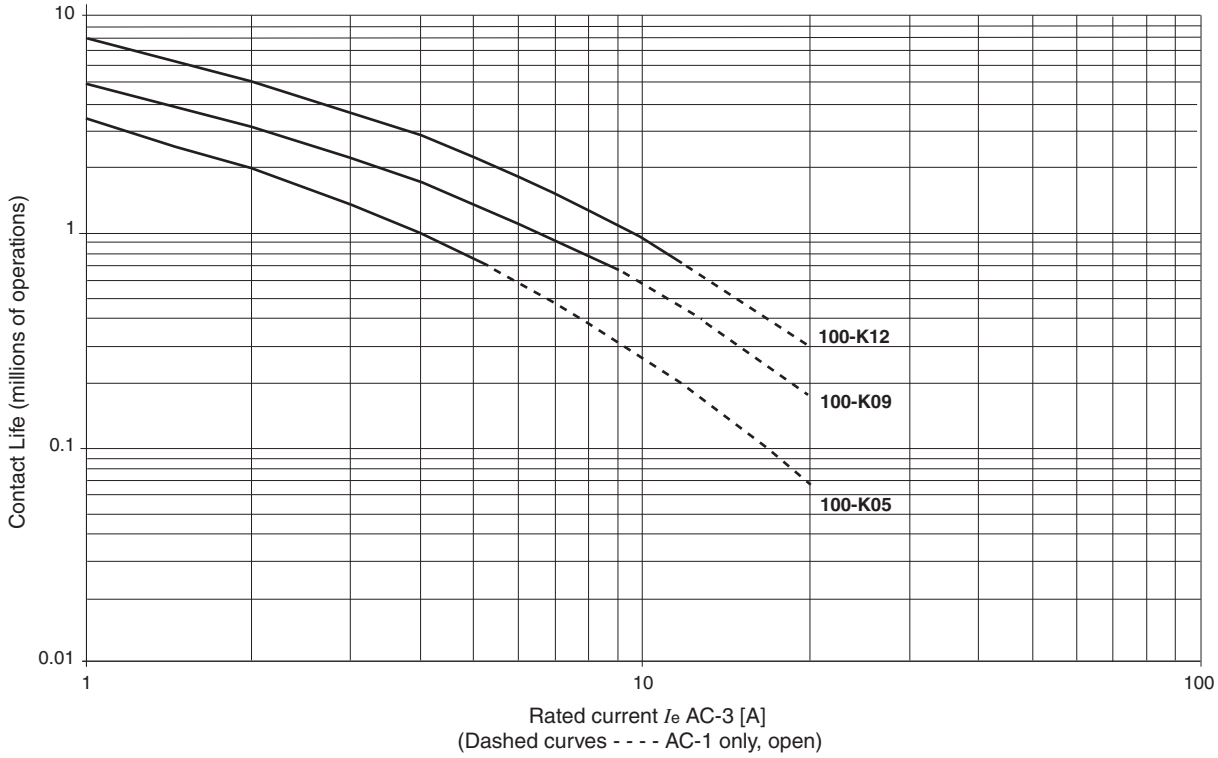
Electrical life; U_e = 400…460V AC

AC-3

Switching of squirrel-cage motors while starting

AC-1

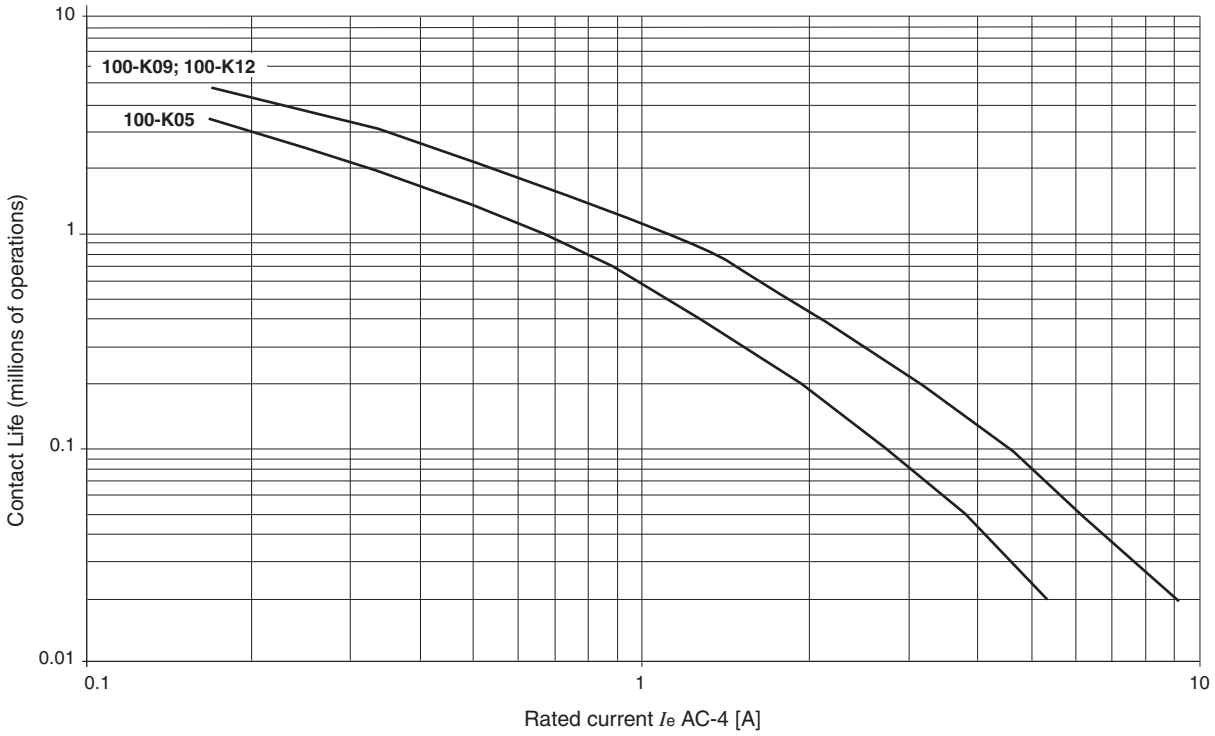
Non- or slightly inductive loads, resistance furnaces



Electrical life; U_e = 400…460V AC

AC-4

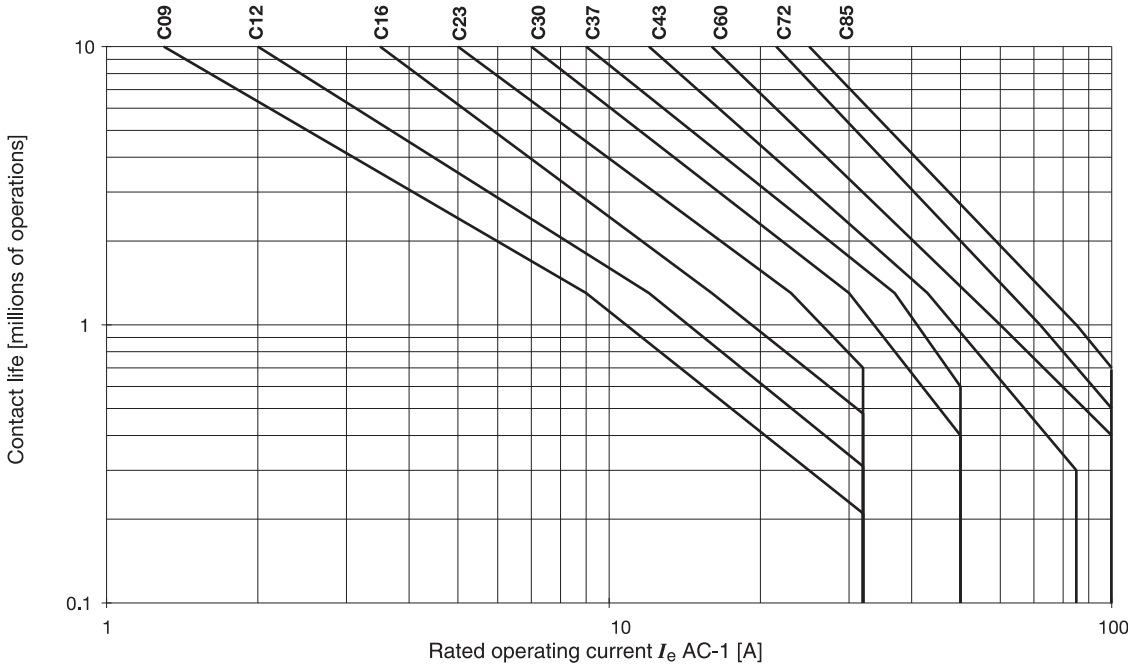
Stepping of squirrel-cage motors



Life-Load Curves

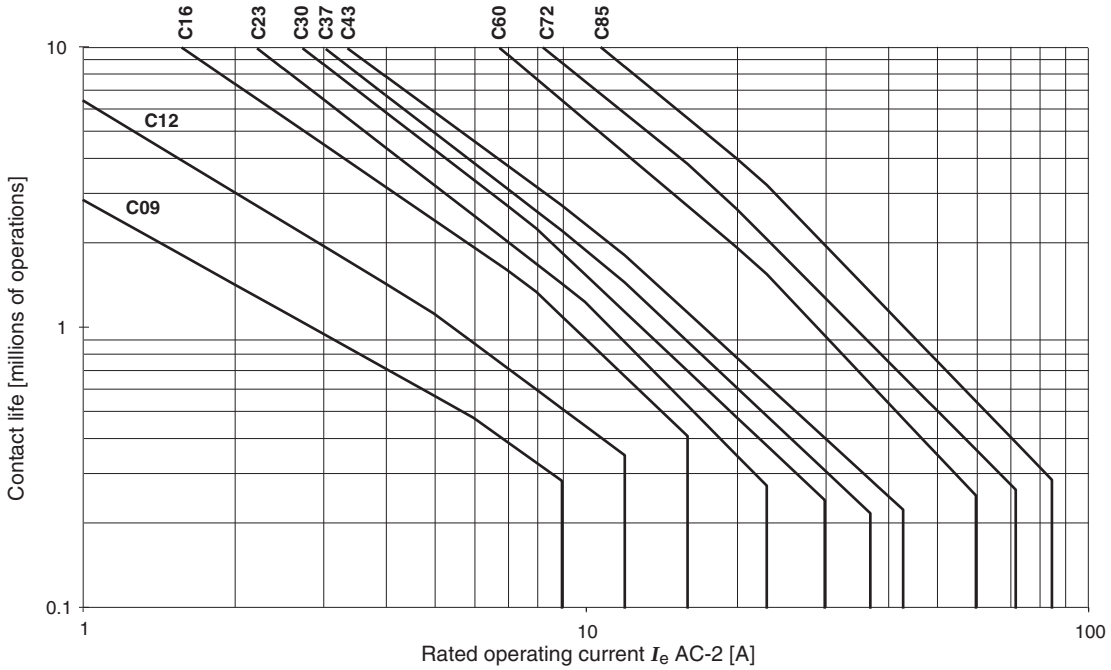
AC-1

40 °C Non- or slightly inductive loads, resistance furnaces; U_e = 230…690V



AC-2

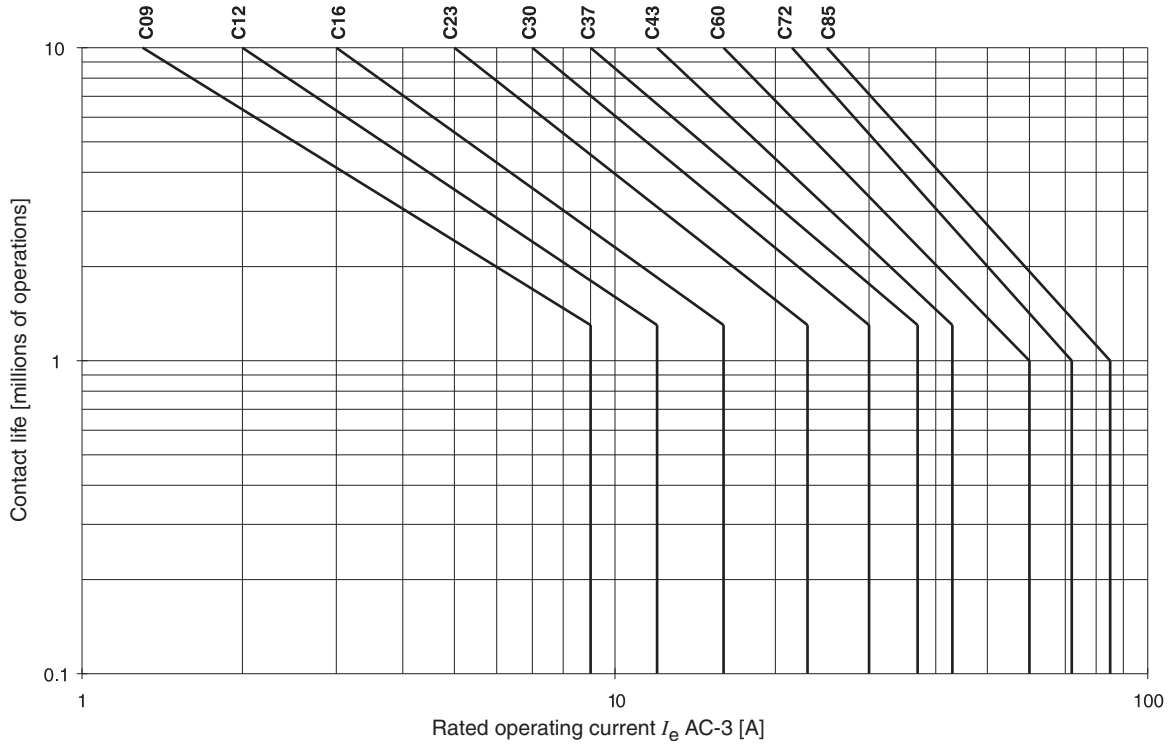
Switching of slip-ring motors; U_e = 230…400…460V



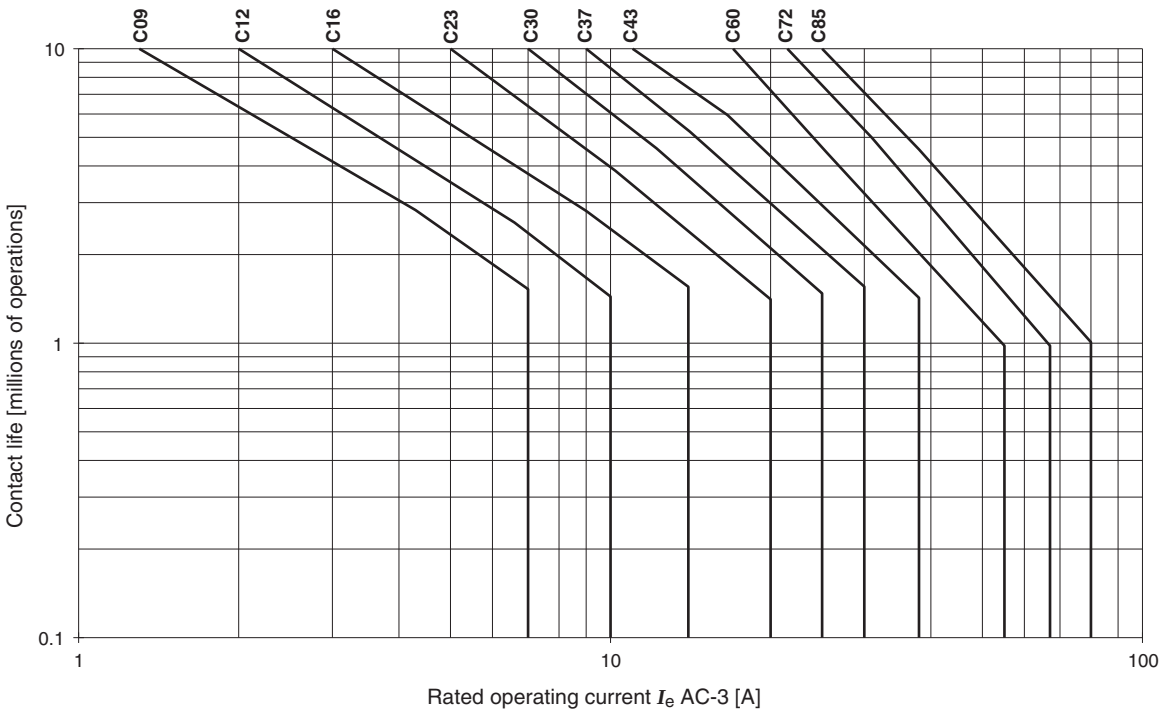
Life-Load Curves

AC-3

Switching of squirrel-cage motors while starting; U_e = 230…400…460V



Switching of squirrel-cage motors while starting; U_e = 500…575V

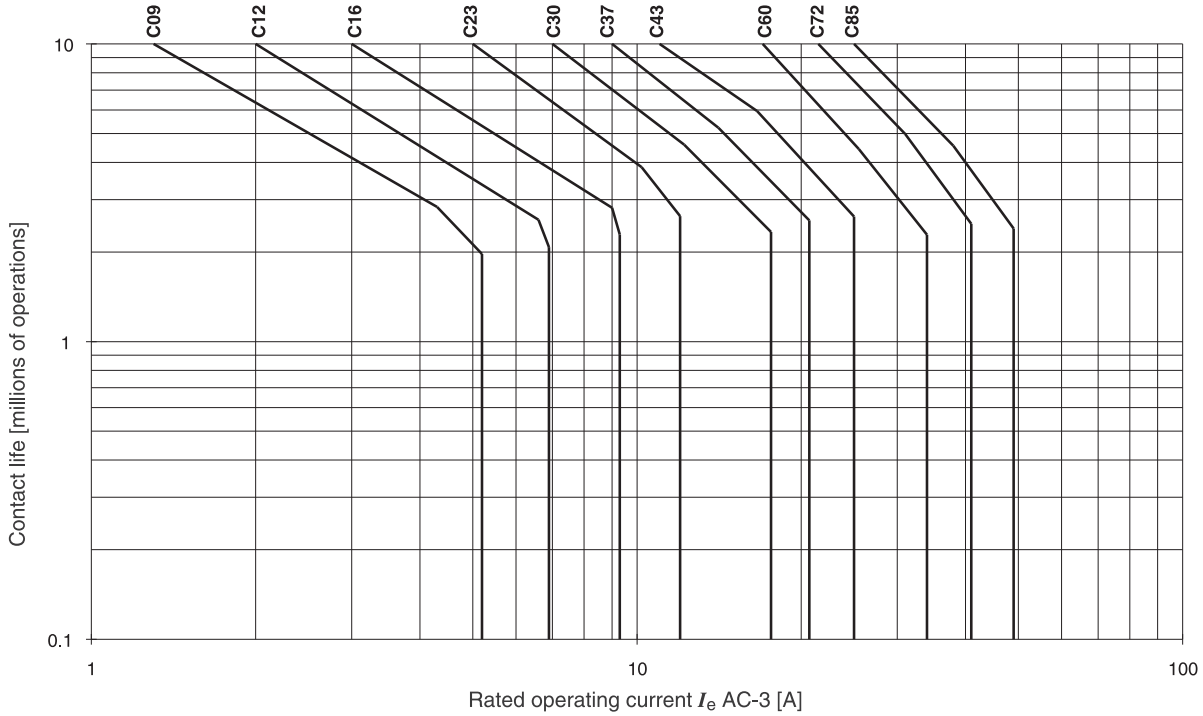


2

Life-Load Curves

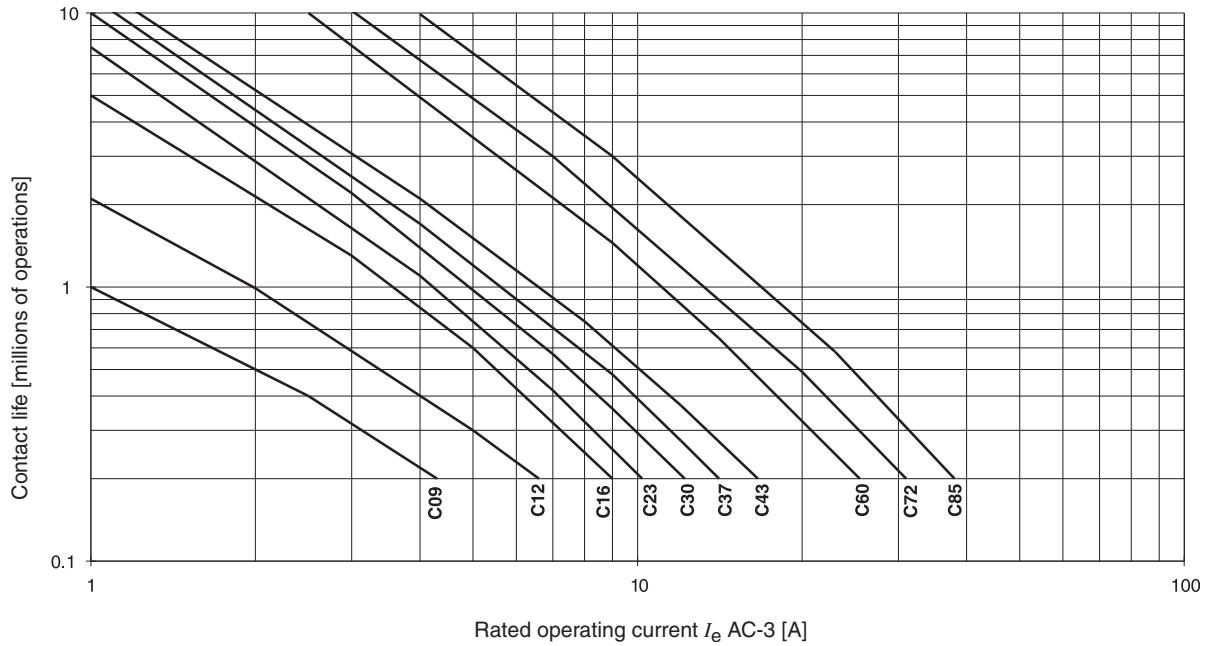
AC-3

Switching of squirrel-cage motors while starting; U_e = 690V



AC-4

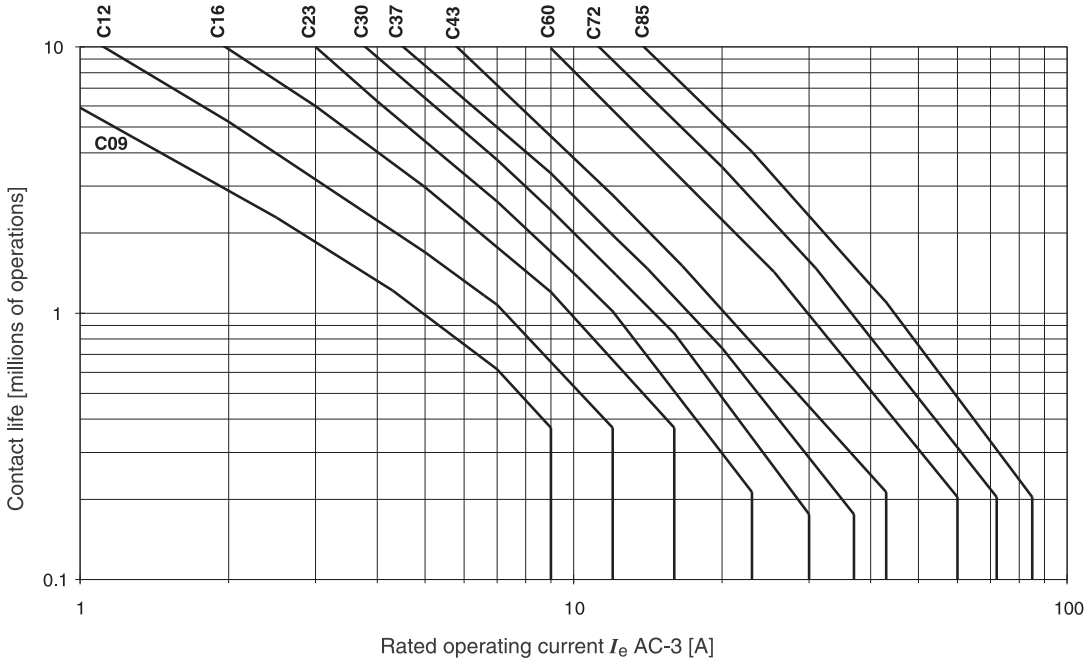
Switching of squirrel-cage motors; U_e = 230...690V



Life-Load Curves

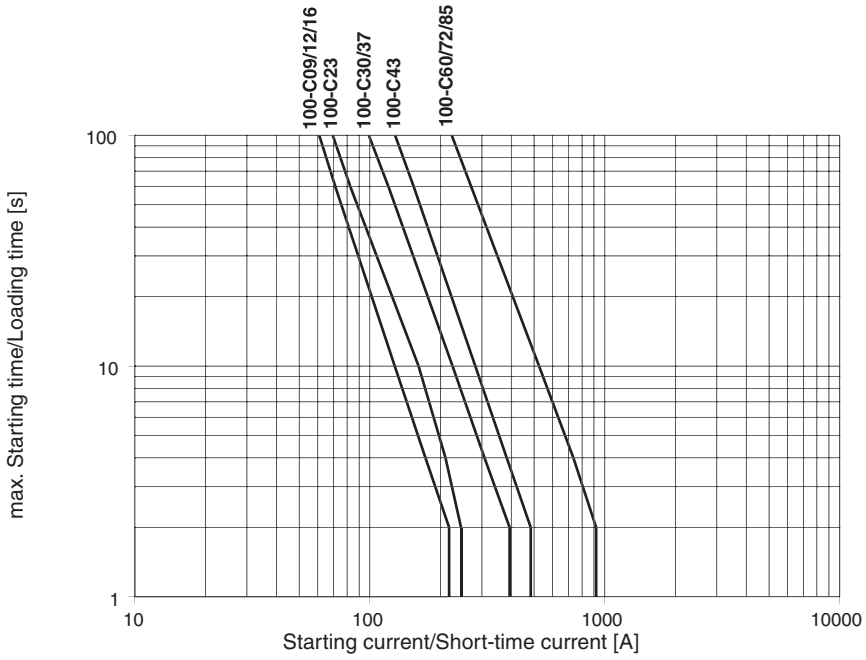
AC-3 & AC-4

10% AC-4 Mixed operation of squirrel-cage motors; U_e = 230…400…460V



Heavy Duty Starting and Regular Short-time Operation

Bulletin 100-C Contactors

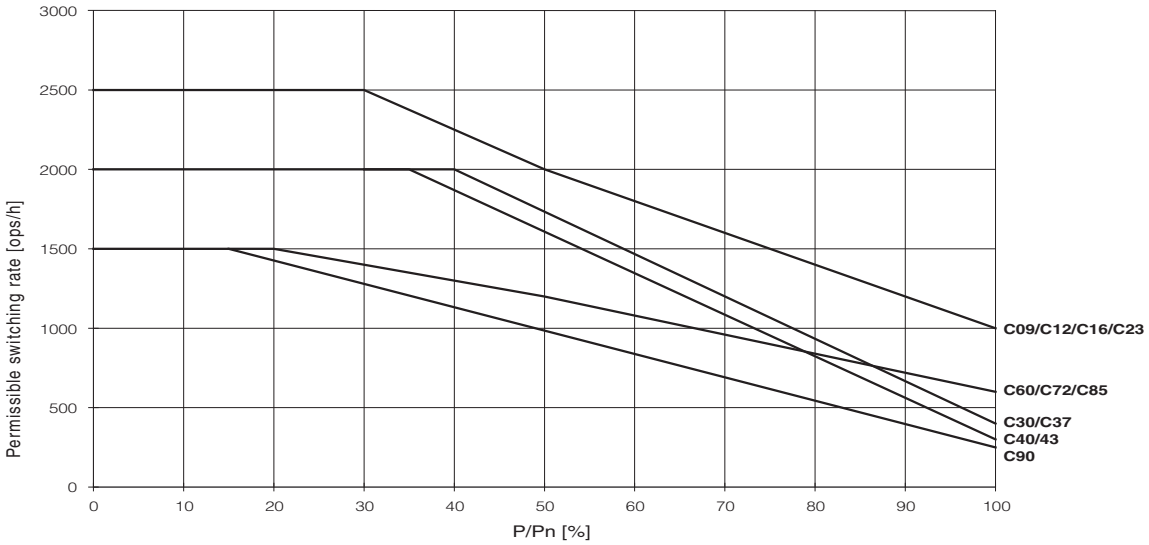


2

Maximum Operating Rates

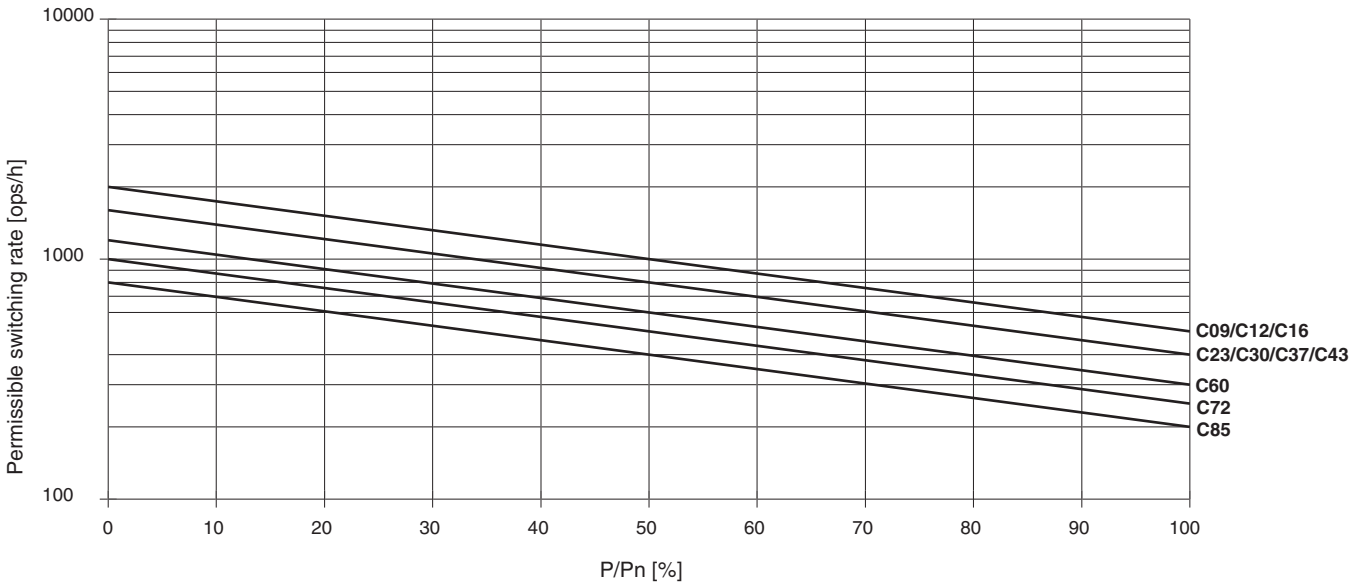
AC-1

40 °C Non- or slilghtly inductive loads, resistance furnaces; U_e = 230…690V



AC-2

Stepping of slip-ring motors; U_e = 230…460V



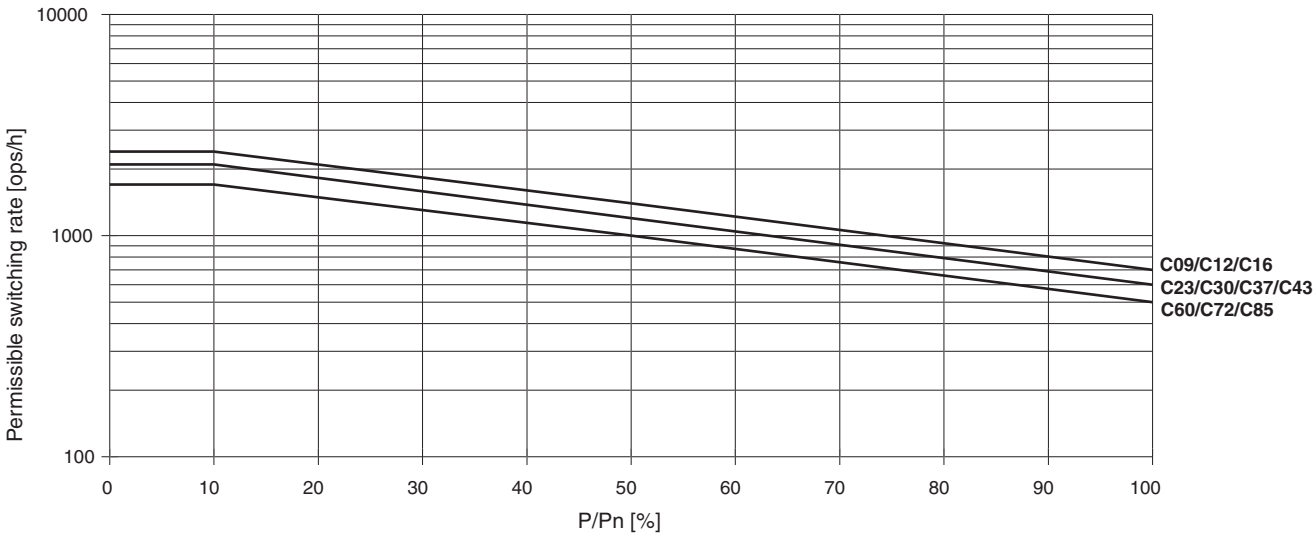
Visit our website: www.ab.com/catalogs
Preferred availability cat. nos. are printed in **bold**

Maximum Operating Rates

AC-3

Switching of squirrel-cage motors while starting; U_e = 230…460V

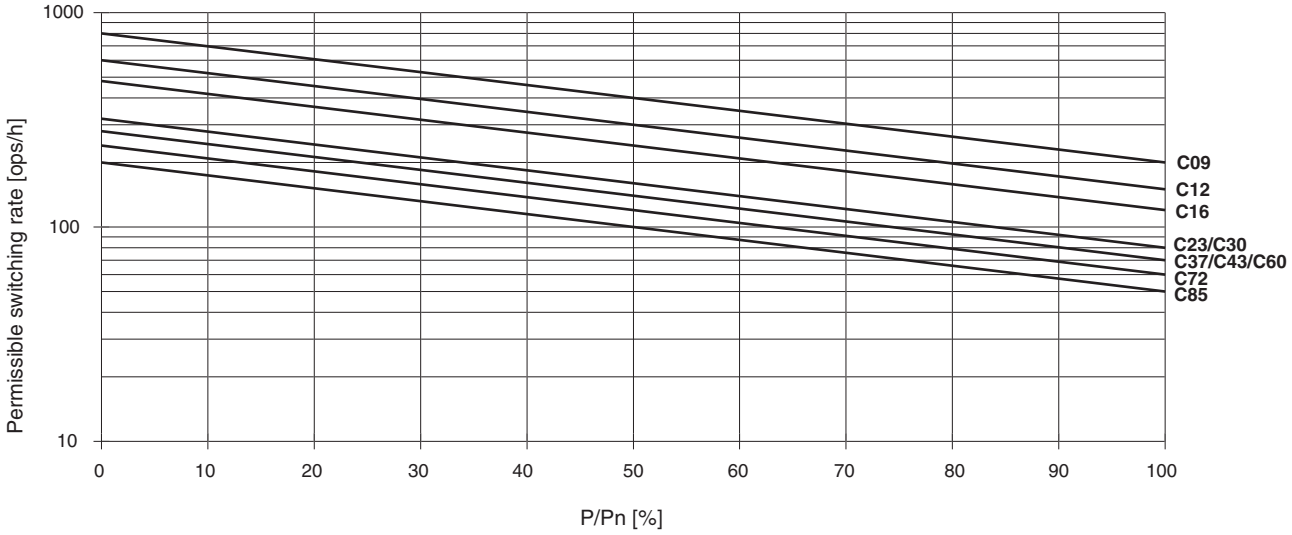
Relative operating time 40%, Starting time t_A = 0.25 s



AC-4

Stepping of squirrel-cage motors; U_e = 230…460V

Starting time t_A = 0.25 s



2

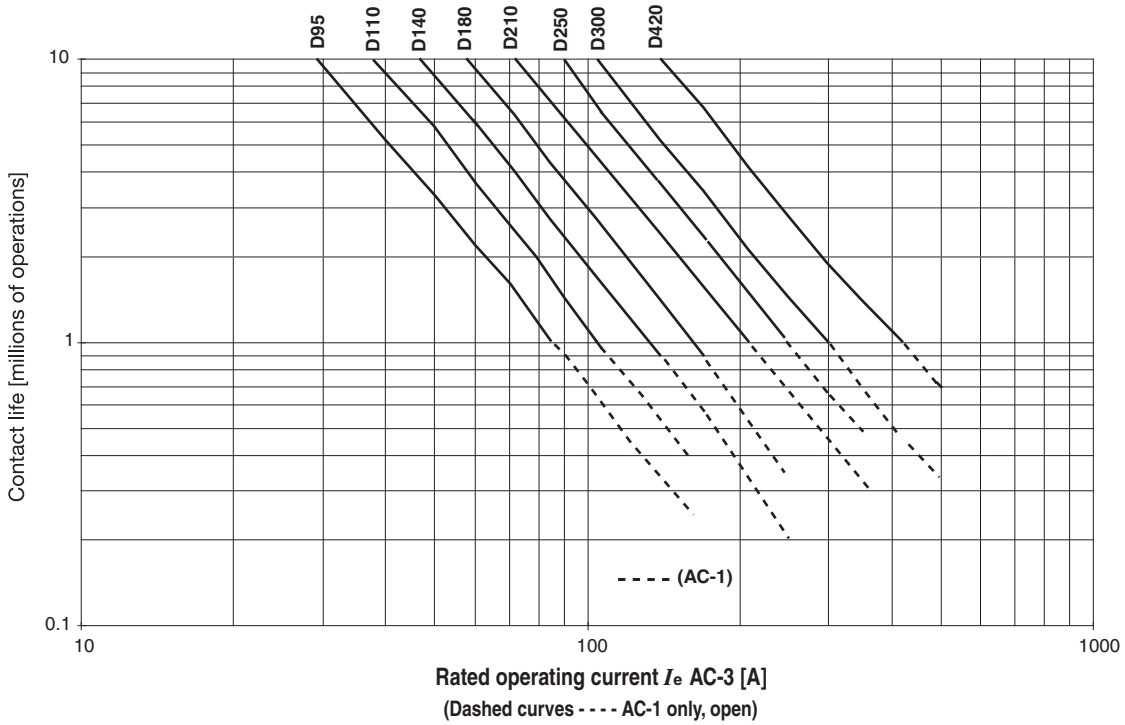
Bulletin 100-D/104-D Life-Load Curves

AC-3

Switching of squirrel-cage motors while starting

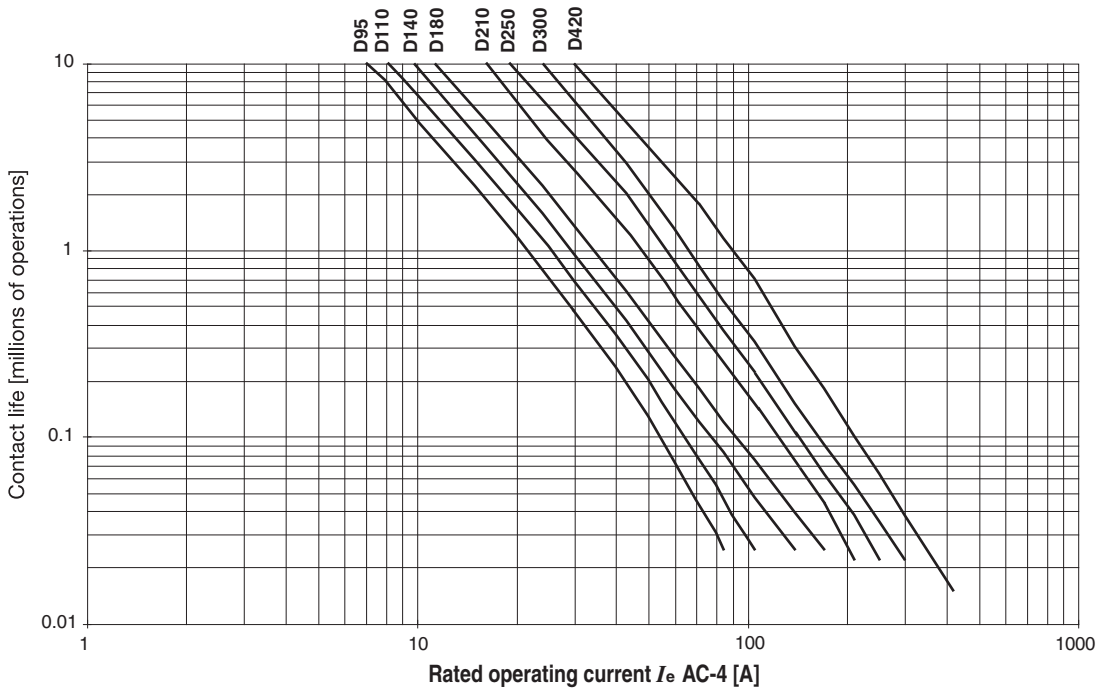
AC-1

Non- or slightly inductive loads, resistance furnaces; U_e = 400V



AC-4

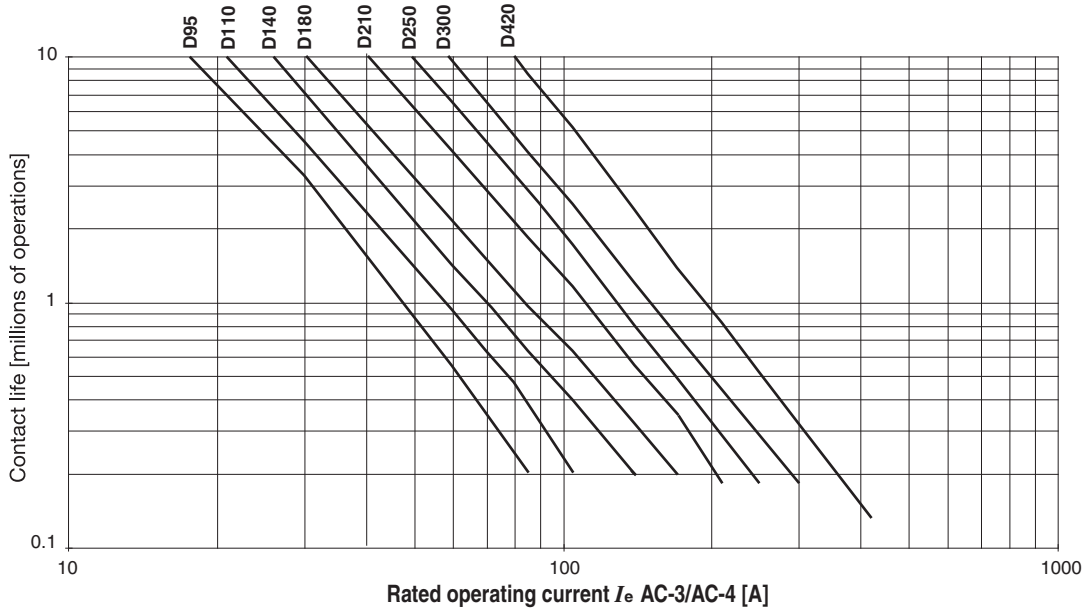
Stepping of squirrel-cage motors; U_e = 400V



Life-Load Curves

AC-3 90% & AC-4 10%

mixed operation of squirrel-cage motors; U_e = 400V

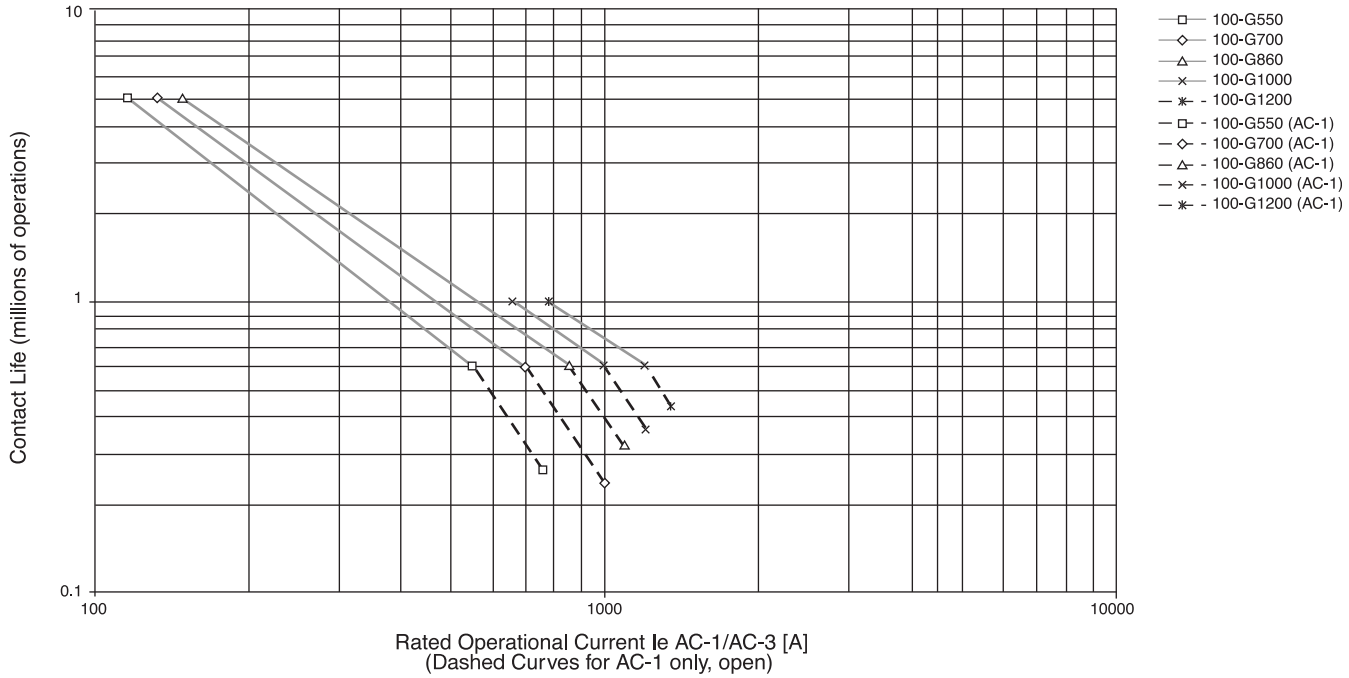


2

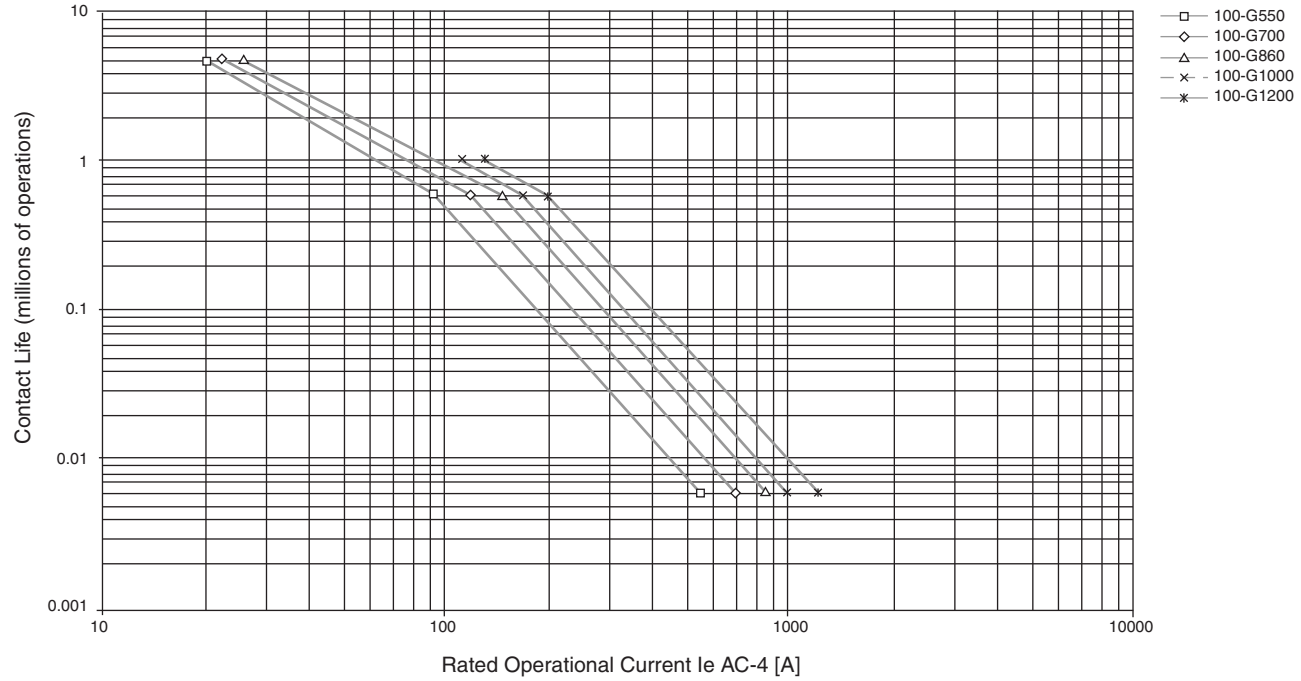
Life-Load Curves

100-G550...100-G1200

AC-3 Switching of Running Three-phase Motors, U_e = 380...460V AC
AC-1 Non or Slightly Inductive Loads, Resistance Furnaces



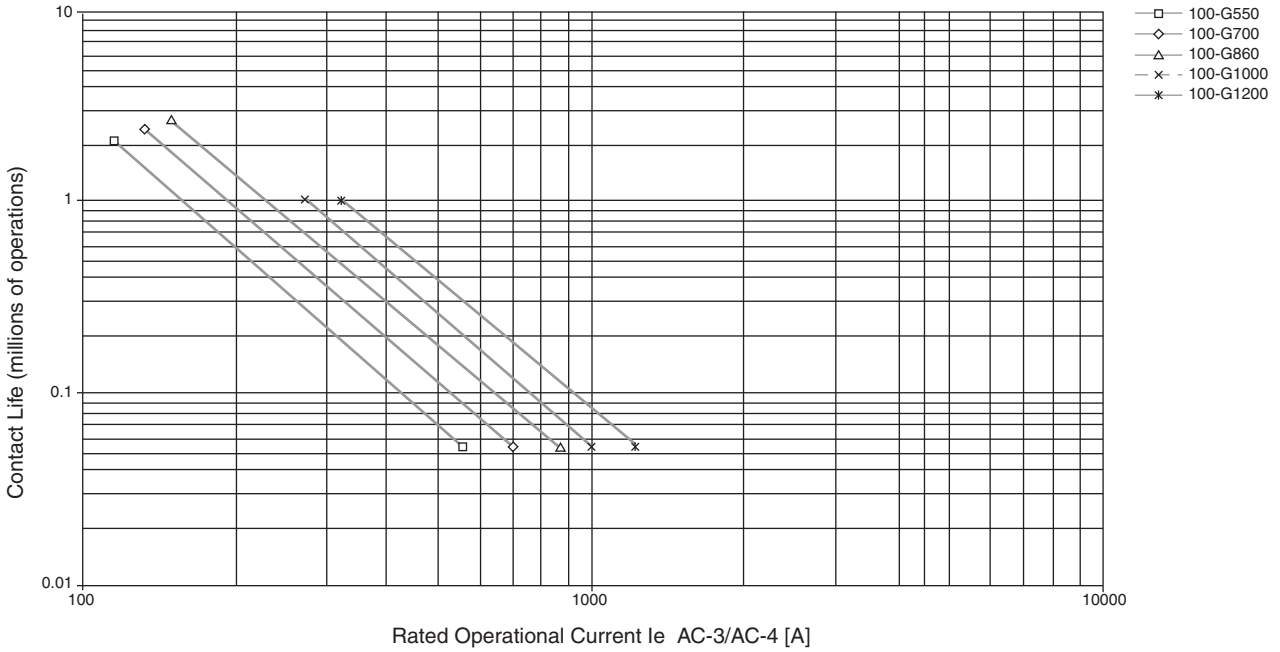
AC-4 Jogging of Squirrel-cage Motors, U_e = 380...460V AC



Life-Load Curves, Continued

100-G550…100-G1200

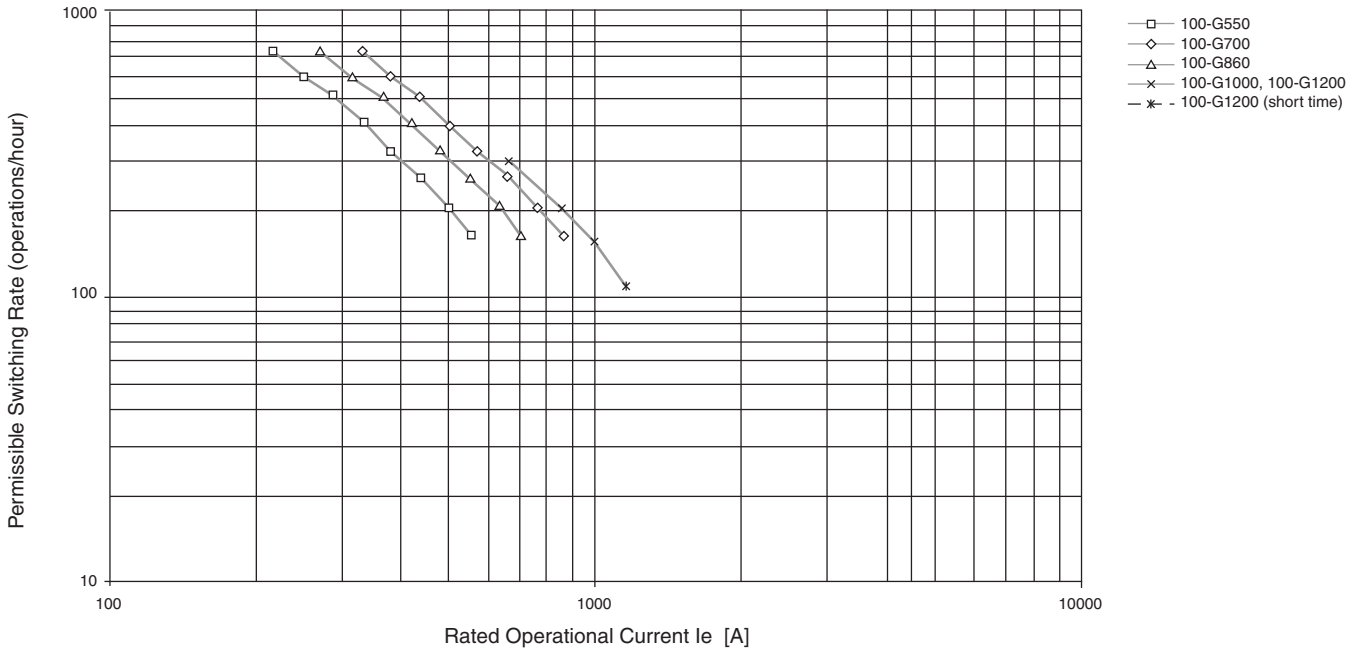
AC-3 90% Switching of Running Motors, U_e = 380…460V AC
AC-4 10% Jogging



Permissable Switching Rate

100-G550…100-G1200

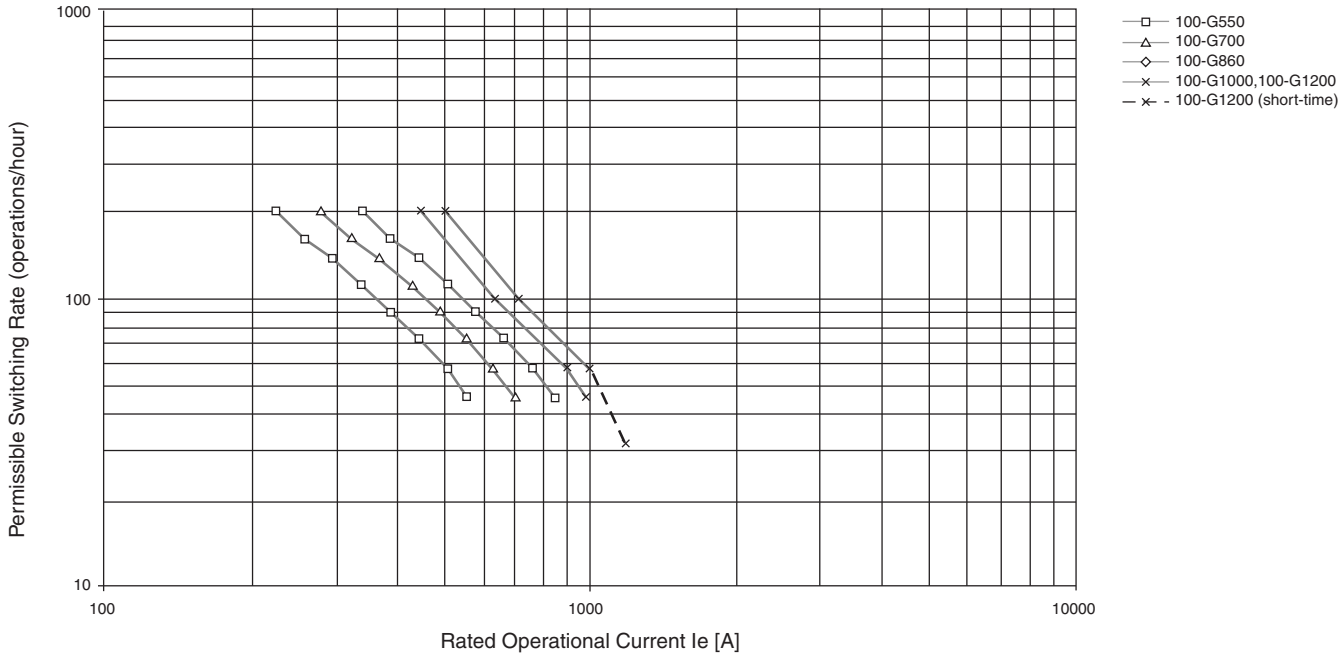
Switching of Running Squirrel-cage Motors AC-3, U_e = 380…460V AC
Starting Time t_s = 0.25 s, Relative Running Time 40%



Permissable Switching Rate, Continued

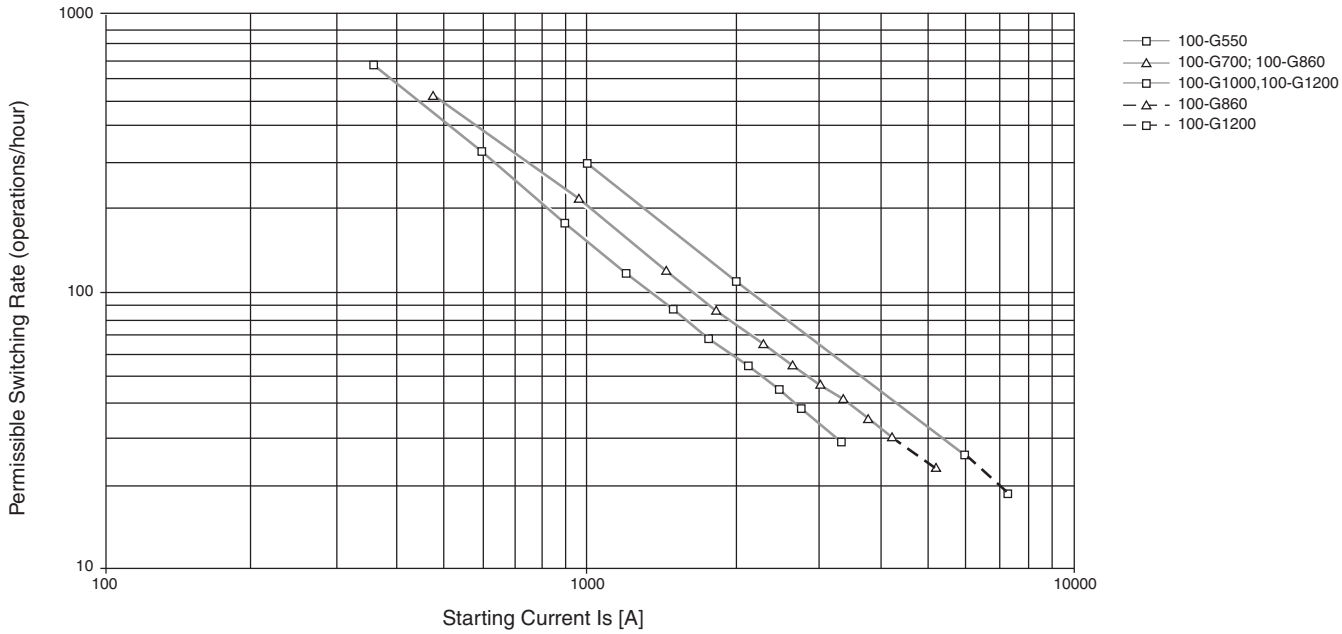
100-G550…100-G1200

Switching of Running Squirrel-cage Motors AC-3, U_e = 380…460V AC
Starting Time t_s = 1 s, Relative Running Time 40%



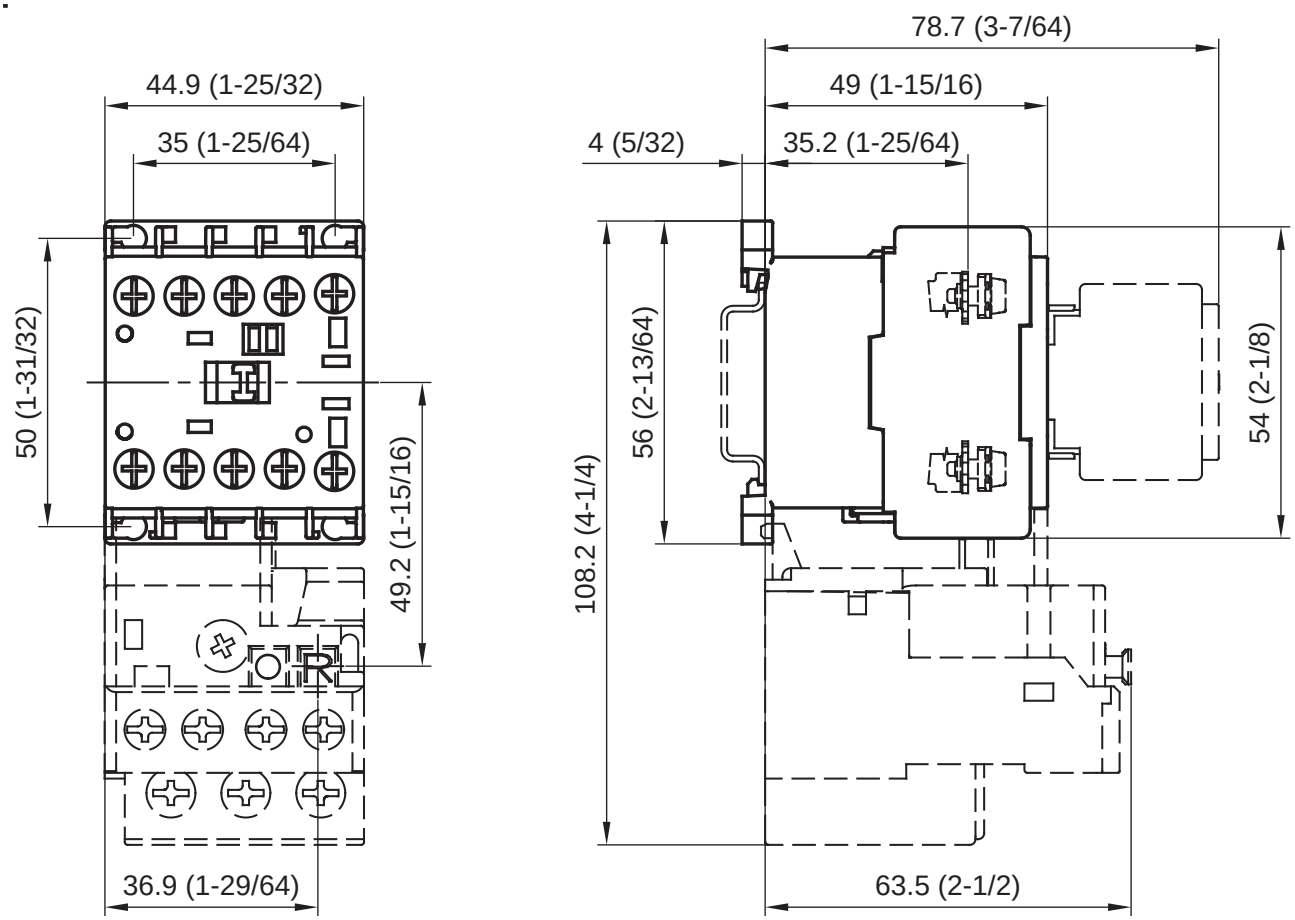
100-G550…100-G1200

Switching of Starting Motors (AC-2, and AC4) U_z = 380…460V AC
Starting Time t_{ed} = 1 s, (<t_s)



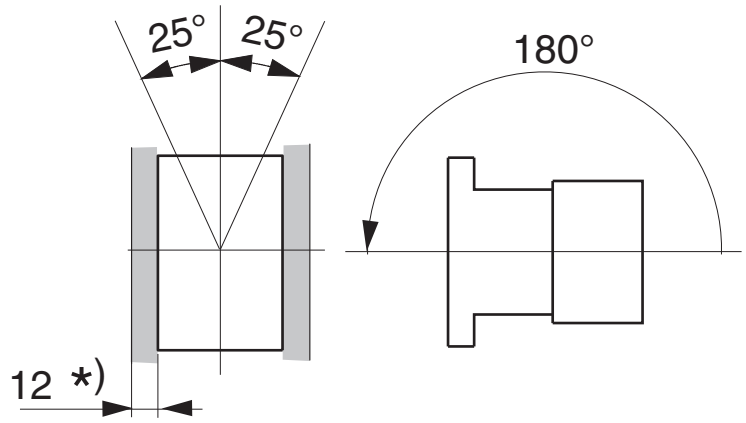
Bulletin 100-K Contactors and Accessories, Bulletin 193-K Overload Relays

Dimensions are shown in millimeters (inches). Dimensions are not intended for manufacturing purposes.



Mounting Position

With Accessories



*) -Minimum distance to grounded parts or walls

2

Bulletin 100-C Contactors and Accessories

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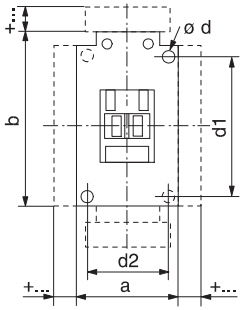
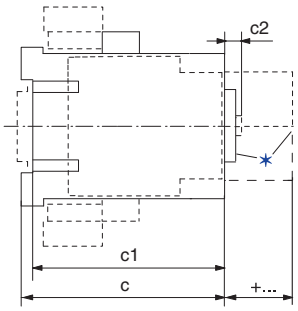
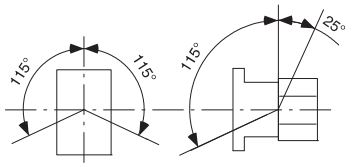
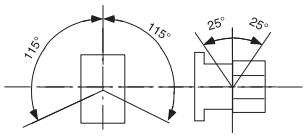




Mounting Position



AC contactors and DC contactors with electronic coils



DC contactors

AC Contactors and DC Contactors with Electronic Coils

Cat. No.	a	b	c	c1	c2	Ød	d1	d2
100-C09...100-C23	45 (1-25/32)	81 (3-3/16)	80.5 (3-11/64)	75.5 (2-31/32)	6 (15/64)	2 - 4.5 (2 - 3/16)	60 (2-23/64)	35 (1-3/8)
100-C30, 100-C37	45 (1-25/32)	81 (3-3/16)	97.5 (4)	92.5 (3-41/64)	6.5 (1/4)	2 - 4.5 (2 - 3/16)	60 (2-23/64)	35 (1-3/8)
100-C40	59 (2-21/64)	81 (3-3/16)	100.5 (3-61/64)	95.5 (3-49/64)	6.5 (1/4)	2 - 4.5 (2 - 3/16)	60 (2-23/64)	45 (1-25/32)
100-C43	54 (2-1/8)	81 (3-3/16)	100.5 (3-61/64)	95.5 (3-49/64)	6.5 (1/4)	2 - 4.5 (2 - 3/16)	60 (2-23/64)	45 (1-25/32)
100-C60...100-C85	72 (2-53/64)	122 (4-51/64)	117 (4-39/64)	111.5 (4-25/64)	8.5 (21/64)	4 - 5.4 (4 - 7/32)	100 (3-15/16)	55 (2-11/64)
100-C90	95 (3-47/64)	122 (4-51/64)	117 (4-39/64)	111.5 (4-25/64)	8.5 (21/64)	4 - 5.4 (4 - 7/32)	100 (3-15/16)	55 (2-11/64)

DC Contactors

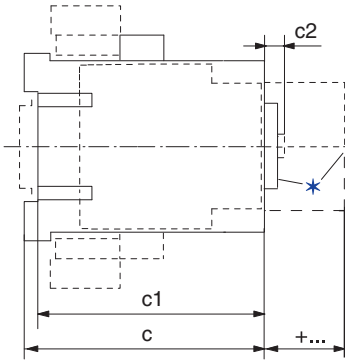
Cat. No.	a	b	c	c1	c2	Ød	d1	d2
100-C09Z...100-C16Z	45 (1-25/32)	81 (3-3/16)	106.5 (4-3/16)	101.5 (4)	6 (15/64)	2 - 4.5 (2 -3/16)	60 (2-23/64)	35 (1-3/8)
100-C23Z	45 (1-25/32)	81 (3-3/16)	123.5 (4-55/64)	119 (4-43/64)	6 (15/64)	2 - 4.5 (2 -3/16)	60 (2-23/64)	35 (1-3/8)
100-C30...100-C37	45 (1-25/32)	81 (3-3/16)	141.5 (5-37/64)	136.5 (5-3/8)	6.5 (1/4)	2 - 4.5 (2 -3/16)	60 (2-23/64)	35 (1-3/8)
100-C40Z	59 (2-21/64)	81 (3-3/16)	144.5 (5-11/16)	139.5 (5-1/2)	6.5 (1/4)	2 - 4.5 (2 -3/16)	60 (2-23/64)	45 (1-25/32)
100-C43Z	54 (2-1/8)	81 (3-3/16)	144.5 (5-11/16)	139.5 (5-1/2)	6.5 (1/4)	2 - 4.5 (2 -3/16)	60 (2-23/64)	45 (1-25/32)
100-C60D...100-C85D	72 (2-53/64)	122 (4-51/64)	117 (4-39/64)	111.5 (4-25/64)	8.5 (21/64)	4 - 5.4 (4 -7/32)	100 (3-15/16)	55 (2-11/64)
100-C90D	95 (3-47/64)	122 (4-51/64)	117 (4-39/64)	111.5 (4-25/64)	8.5 (21/64)	4 - 5.4 (4 - 7/32)	100 (3-15/16)	55 (2-11/64)

Accessories

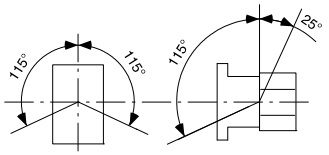
Contactors with		mm	(inches)
Auxiliary contact block for front mounting	2- or 4-pole	c/c1 + 39	(c/c1 + 1-37/64)
Auxiliary contact block for side mounting	1- or 2-pole	a + 9	(a + 23/64)
Pneumatic Timing Module		c/c1 + 58	(c/c1 + 2-23/64)
Electronic Timing Module	on coil terminal side	b + 24	(b + 15/16)
Mechanical Interlock	on side of contactor	a + 9	(a + 23/64)
Mechanical Latch		c/c1 + 61	(c/c1 + 2-31/64)
Interface Module	on coil terminal side	b + 9	(b + 23/64)
Surge Suppressor	on coil terminal side	b + 3	(b + 1/8)
Labeling with ✶	label sheet	+ 0	(+ 0)
	marking tag sheet with clear cover	+ 0	(+ 0)
	marking tag adapter for System V4 / V5	+ 5.5	(+ 7/32)
	marking tag adapter for System Bul. 1492W	+ 5.5	(+ 7/32)
Terminal Lug Kit	100-C09...C23	b + 53	(b + 2-3/32)
	100-C30...37	b + 44	(b + 1-47/64)
	100-C43	b + 52	(b+ 2-3/64)
	100-C60...C85	b + 99	(b + 3-7/8)
Paralleling Links	100-C09...C23	b + 78	(b + 3-1/16)
		c + 9/5	(c + 3/8)
	100-C30...C37	b + 85	(b + 3-11/32)

Bulletin 100S-C/104S-C Contactors and Accessories

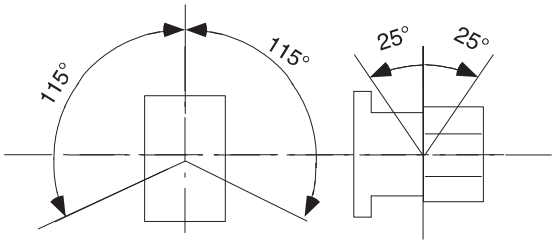
Dimensions are shown in millimeters (inches). Dimensions are not intended for manufacturing purposes.



Mounting Position



AC contactors and DC contactors with electronic coils



DC contactors

2

AC Contactors and DC Contactors with Electronic Coils

Cat. No.	a	b	c	c1	c2	Ød	d1	d2
100S-C09...100S-C23	45 (1-25/32)	81 (3-3/16)	119.5 (4-3/4)	114.5 (4-43/64)	6 (15/64)	2-4.5 (2-3/16)	60 (2-23/64)	35 (1-3/8)
100S-C30, 100S-C37	45 (1-25/32)	81 (3-3/16)	136.5 (5-37/64)	131.6 (5-11/32)	6.5 (1/4)	2-4.5 (2-3/16)	60 (2-23/64)	35 (1-3/8)
100S-C43	54 (2-1/8)	81 (3-3/16)	139.5 (5-11/16)	134.6 (5-29/64)	6.5 (1/4)	2-4.5 (2-3/16)	60 (2-23/64)	45 (1-25/32)
100S-C60...100S-C85	72 (2-53/64)	122 (4-51/64)	156 (6-11/32)	150.5 (6-1/8)	8.5 (21/64)	4-5.4 (4-7/32)	100 (3-15/16)	55 (2-11/64)

DC Contactors

Cat. No.	a	b	c	c1	c2	Ød	d1	d2
100S-C09Z...100S-C16Z	45 (1-25/32)	81 (3-3/16)	145.5 (5-49/64)	140.5 (5-37/64)	6 (15/64)	2 - 4.5 (2 -3/16)	60 (2-23/64)	35 (1-3/8)
100S-C23Z	45 (1-25/32)	81 (3-3/16)	162.5 (6-7/16)	158 (6-1/4)	6 (15/64)	2 - 4.5 (2 -3/16)	60 (2-23/64)	35 (1-3/8)
100S-C30Z...100S-C37Z	45 (1-25/32)	81 (3-3/16)	180.5 (7-5/32)	175.5 (6-61/64)	6.5 (1/4)	2 - 4.5 (2 -3/16)	60 (2-23/64)	35 (1-3/8)
100S-C43Z	54 (2-1/8)	81 (3-3/16)	183.5 (7-17/64)	179 (7-3/32)	6.5 (1/4)	2 - 4.5 (2 -3/16)	60 (2-23/64)	45 (1-25/32)
100S-C60D...100S-C85D	72 (2-53/64)	122 (4-51/64)	156 (6-11/32)	150.5 (6-1/8)	8.5 (21/64)	4 - 5.4 (4 -7/32)	100 (3-15/16)	55 (2-11/64)

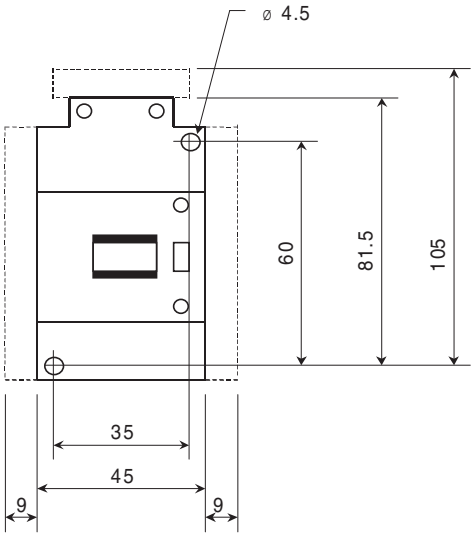
Accessories

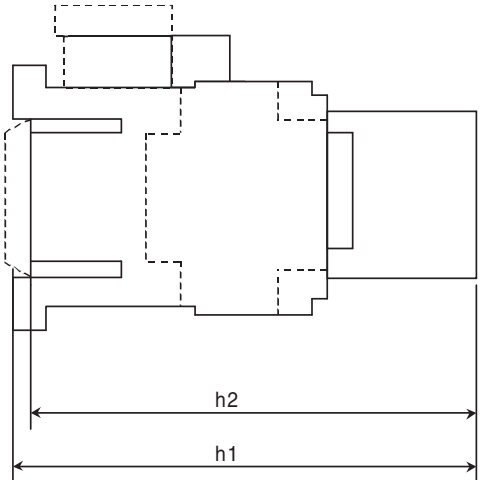
Contactors with		mm	(inches)
Auxiliary contact block for side mounting	1- or 2-pole	a + 9	(a + 23/64)
Electronic Timing Module	on coil terminal side	b + 24	(b + 15/16)
Mechanical Interlock	on side of contactor	a + 9	(a + 23/64)
Interface Module	on coil terminal side	b + 9	(b + 23/64)
Surge Suppressor	on coil terminal side	b + 3	(b + 1/8)
Labeling with ∗	label sheet marking tag sheet with clear cover marking tag adapter for System V4 / V5 marking tag adapter for System Bul. 1492W	+ 0 + 0 + 5.5 + 5.5	(+ 0) (+ 0) (+ 7/32) (+ 7/32)

2

Bulletin 100Q-C Contactors

Dimensions are in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

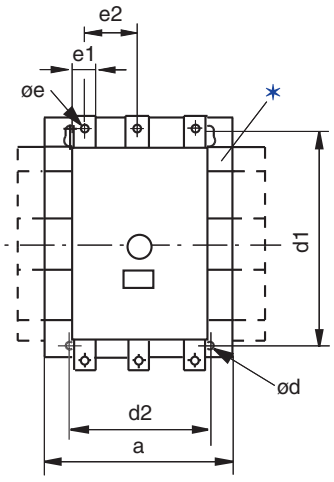


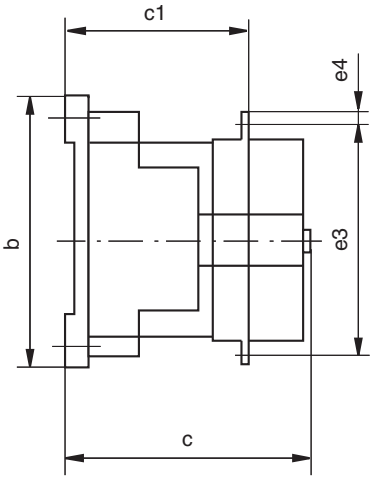


Cat No.	AC-Operated		DC-Operated	
	h1	h2	h1	h2
100Q-C16	120 (4-23/32)	115 (4-17/32)	146 (5-3/4)	141 (5-9/16)
100Q-C37	137 (5-3/8)	132 (5-3/16)	181 (7-1/8)	176 (6-15/16)

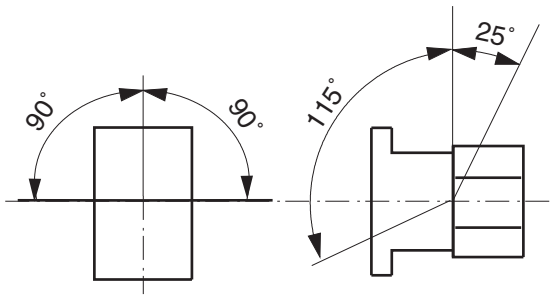
Bulletin 100-D Contactors and Accessories

Dimensions in millimeters. Dimensions are not intended to be used for manufacturing purposes.





Mounting Position



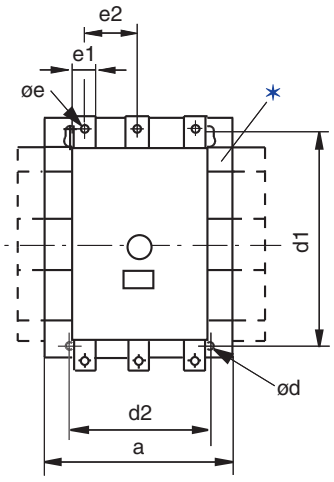
Cat. No.	a	b	c	c1	Ød	d1	d2	Øe	e1	e2	e3	e4
100-D95, 100-D110	120	170	156	110.5	5.2	145	100	M6	16	38.5	147	8
D100-D95E…100-D180E, 100-D140, 100-D180	120	170	156	110.5	5.2	145	100	M8	20	39	160	10
100-D120E…100-D420E	155	205	180	110.5	6.5	180	130	M10	25	48	193	12.5
100-D630E…100-D860E	255	310	265	110.5	10	230	225	M12	40	70	291	22

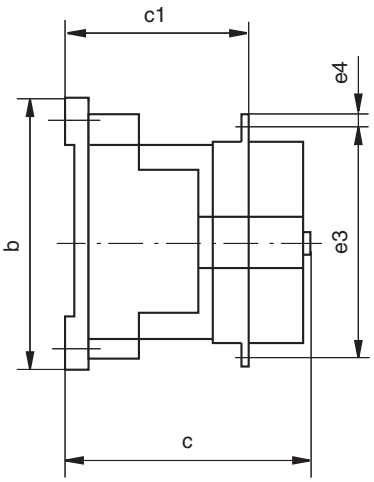
Contactor with		mm
Auxiliary contact block ∗	100-DS1… 100-DS2…	a a + 13.5 each
Mechanical Interlock	100-DM…	a + a
Frame terminal block	100-DTB110 100-DTB180 100-DTB420	b + 7 each b + 7 each b + 8.5 each
Label holder		c…+ 5

∗ Conventional DC coil contactors will have an additional auxiliary contact block that will add 13.5 mm to the “a” dimension on the right-hand side.

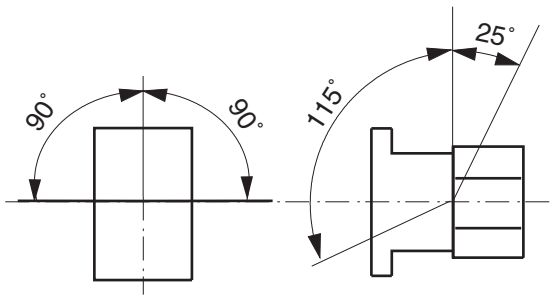
Bulletin 100S-D Contactors and Accessories

Dimensions are shown in millimeters (inches). Dimensions are not intended for manufacturing purposes.





Mounting Position



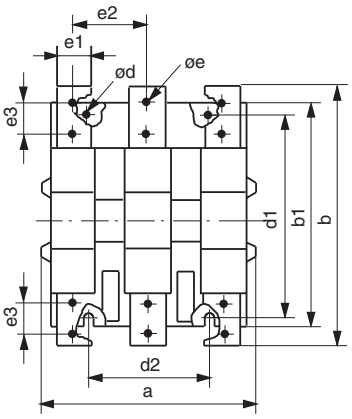
Cat. No.	a	b	c	c1	Ød	d1	d2	Øe	e1	e2	e3	e4
100S-D95, 100S-D110	120	170	156	110.5	5.2	145	100	M6	16	38.5	147	8
D100S-D95E…100S-D180E, 100S-D140, 100S-D180	120	170	156	110.5	5.2	145	100	M8	20	39	160	10
100S-D120E…100S-D420E	155	205	180	110.5	6.5	180	130	M10	25	48	193	12.5
100S-D630E…100S-D860E	255	310	265	110.5	10	230	225	M12	40	70	291	22

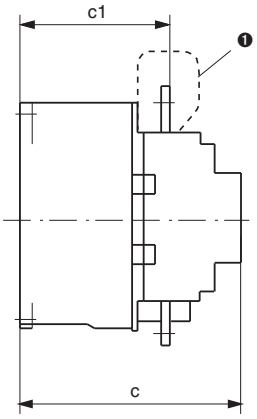
Contactor with		mm
Auxiliary contact block ∗	100-DS1… 100-DS2…	a a + 13.5 each
Mechanical Interlock	100-DM…	a + a
Frame terminal block	100-DTB110 100-DTB180 100-DTB420	b + 7 each b + 7 each b + 8.5 each
Label holder		c…+ 5

∗ Conventional DC coil contactors will have an additional auxiliary contact block that will add 13.5 mm to the “a” dimension on the right-hand side.

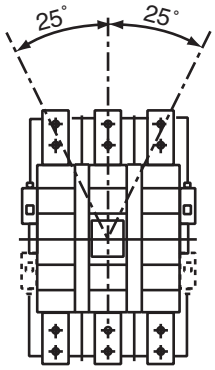
Bulletin 100-G Contactors and Accessories

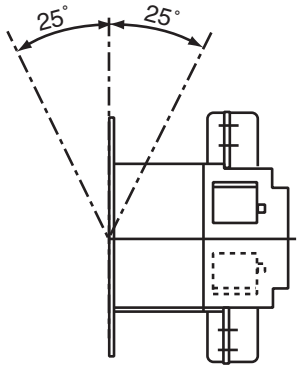
Dimensions are shown in millimeters (inches). Dimensions are not intended for manufacturing purposes.





Mounting Position





Cat. No.	a	b	b1	c	c1	Ød	d1	d2	Øe	e1	e2	e3
100-G550	220	258	228	225	164	9	220	110	12.5	40	79	—
100-G700	280	307	277	291	203	11	280	175	13	50	101	—
100-G860	280	361	325	291	203	11	280	175	15	50	101	—
100-G1000	334	490	434	345	231	13.5	380	120	2x13	50	100	40
100-G1200	334	490	434	345	231	13.5	380	120	2x13	60	100	40

Contactor with			mm
Auxiliary contact block			a
Mechanical Interlock	side by side	100-G550/100-G550 100-G700, -860/100-G700, -860 100-G1000, -1200/100-G1000, -1200 100-G550/100-G700, -860 100-G700, -860/100-G1000, -1200	a+42+a a+32+a a+46+a a+37+a a+73+a
	stacked vertically	100-G550/100-G550 100-G700, -860/100-G700, -860 100-G1000, -1200/100-G1000, -1200 100-G550/100-G700, -860 100-G700, -860/100-G1000, -1200	b+56 + b b/2+380…480+b/2 b+120…170+b b/2+400+b/2 b/2+570+b/2
4th add-on neutral switching pole		100-G550 100-G700, -860 100-G1000, -1200	a+74 a+68 a+76
Mechanical latch		100-G550 100-G700 100-G860	b+59 b+64 b+37

Coils

AC Standard Control Voltages [V]			AC Coil Code	100-C09…100-C16	100-C23…100-C37, 100L-C20	100-C40, -C43	100-C60…100-C85	100-C90
50 Hz	60 Hz	50/60 Hz		Cat. No.	Cat. No.	Cat. No.	Cat. No.	Cat. No.
—	12	—	Q	TA006	TC006	TD006	TE006	TF006
12	—	—	R	TA404	TC404	TD404	TE404	**TF404**
—	24	—	J	**TA013**	**TC013**	TD013	TE013	TF013
24	—	—	K	TA407	TC407	TD407	TE407	**TF407**
—	—	24	KJ	TA855	TC855	TD855	**TE855**	TF855
32	36	—	V	TA481	TC481	TD481	TE481	**TF481**
36	—	—	W	TA410	TC410	TD410	TE410	**TF410**
42	48	—	X	TA482	TC482	TD482	TE482	**TF482**
48	—	—	Y	TA414	TC414	TD414	TE414	**TF414**
—	—	48	KY	TA860	TC860	TD860	TE860	**TF860**
100	100…110	100	KP	TA861	TC861	TD861	TE861	TF861
110	120	—	D	**TA473**	**TC473**	**TD473**	**TE473**	TF473
—	—	110	KD	TA856	TC856	TD856	TE856	TF856
120	—	—	P	TA425	TC425	TD425	TE425	**TF425**
127	—	—	S	TA428	TC428	TD428	TE428	**TF428**
200	200…220	200	KG	TA862	TC862	TD862	TE862	**TF862**
—	208	—	H	**TA049**	**TC049**	TD049	TE049	**TF049**
200…220	208…240	—	L	**TA296**	TC296	TD296	**TE296**	TF296
—	—	200…230	KL	TA864	TC864	TD864	TE864	—
220	240	—	A	**TA474**	**TC474**	TD474	TE474	TF474
220…230	260	—	F	TA441	TC441	TD441	TE441	**TF441**
—	—	230	KF	TA851	TC851	TD851	TE851	**TF851**
230…240	—	—	VA	TA440	TC440	TD440	TE440	**TF440**
240	277	—	T	TA480	TC480	TD480	TE480	**TF480**
—	—	240	KA	TA858	TC858	TD858	TE858	TF858
—	347	—	I	TA065	TC065	TD065	TE065	**TF065**
—	380	—	E	TA067	TC067	TD067	TE067	**TF067**
380…400	440	—	N	TA071	TC071	TD071	TE071	TF071
—	—	400	KN	TA863	TC863	TD863	TE863	**TF863**
400…415	—	—	G	TA457	TC457	TD457	TE457	**TF457**
440	480	—	B	**TA475**	**TC475**	TD475	TE475	TF475
—	—	440	KB	TA859	TC859	TD859	TE859	**TF859**
500	—	—	M	TA479	TC479	TD479	TE479	**TF479**
550	600	—	C	TA476	TC476	TD476	TE476	**TF476**

Visit our website: www.ab.com/catalogs
Preferred availability cat. nos. are printed in **bold**

Coils, Continued

DC Standard Control Voltage [V]	DC Coil Code	100-C09...100-C16	100-C23...100-C37, 100L-C20	100-C40, -C43	100-C60...100-C85	100-C90
		Cat. No.	Cat. No.	Cat. No.	Cat. No.	Cat. No.
9∗	ZR	TA766	TC766	TD766	—	—
9V Diode∗	DR	—	—	—	TE766M	**TF766M**
12	ZQ	TA708	TC708	TD708	—	—
12V Diode	DQ	—	—	—	TE708M	TF708M
24❄	ZJ	**TA714**	TC714	TD714	—	—
24 Diode❄	DJ	TA714M	TC714M	TD714M	TE714M	TF714M
36	ZW	TA719	TC719	TD719	—	—
36V Diode	DW	—	—	—	TE719M	**TF719M**
48	ZY	TA724	TC724	TD724	—	—
48V Diode	DY	—	—	—	TE724M	**TF724M**
60	ZZ	TA774	TC774	TD774	—	—
60V Diode	DZ	—	—	—	TE774M	**TF774M**
64	ZB	TA727	TC727	TD727	—	—
64V Diode	DB	—	—	—	TE727M	**TF727M**
72	ZG	TA728	TC728	TD728	—	—
72V Diode	DG	—	—	—	TE728M	**TF728M**
80	ZE	TA729	TC729	TD729	—	—
80V Diode	DE	—	—	—	TE729M	**TF729M**
110	ZD	TA733	TC733	TD733	—	—
110V Diode	DD	—	—	—	TE733M	TF733M
115	ZP	TA734	TC734	TD734	—	—
115V Diode	DP	—	—	—	TE734M	**TF734M**
125	ZS	TA737	TC737	TD737	—	—
125V Diode	DS	—	—	—	TE737M	TF737M
220	ZA	TA747	TC747	TD747	—	—
220V Diode	DA	—	—	—	TE747M	**TF747M**
230	ZF	TA749	TC749	TD749	—	—
230V Diode	DF	—	—	—	TE749F	TF749F
250	ZT	TA751	TC751	TD751	—	—
250V Diode	DT	—	—	—	TE751F	TF751F

∗ Voltage operating range: 0.65...1.3 x Us.
❄ Voltage operating range: 0.7...1.25 x Us.

Bulletin 193 Overload Relays with Current Transformers

For Use With	Panel Adapter Assembly Cat. No.	Overload Relay Only Cat. No.
193-HPD110	40781-607-01	193-NX23
193-DPC88	40781-607-01	193-NX24
193-DPD120	40781-607-01	193-NX25
193-DPD200	40781-607-01	193-NX26
193-EPD180	40781-607-01	193-NX27
193-EPD300	40781-607-01	193-NX28
193-FPD240	40781-607-01	193-NX29
193-FPD40	40781-607-01	193-NX30
193-GPD378∗	40781-607-01	193-NX32
193-GPD630∗	40781-607-01	193-NX33

∗ Contact kits for Cat. Nos. 100-A09...100-A30 are not available as replacement parts.

AC Operating Coils Used with 193-GPD Devices		
Voltage	Frequency [Hz]	Cat. No.
24V AC	50	HA407
24V AC	60	HA013
110V AC	50	HA473
110 V AC	60	—
120 V AC	50	—
120V AC	60	HA473
208 V AC	50	—
208V AC	60	HA049
220V AC	50	HA474
220V AC	60	HA051
240V AC	50	HA442
240V AC	60	HA474
277V AC	60	HA060
380V AC	50	HA454
380 V AC	60	—
415V AC	50	HA457
440V AC	50	**HA475**
440V AC	60	HA071
480 V AC	50	—
480V AC	60	**HA475**
500V AC	50	HA464
500 V AC	60	—
600V AC	60	HA476

	Description	Coil Type	For Use With	Cat. No.
	Arc Chambers for Contactors For 3-pole 100-D Contactors	Conventional	100-D95	100-DA-95
			100-D110	100-DA-110
			100-D140	100-DA-140
			100-D180	100-DA-180
		Electronic	100-D95	100-DAE-95
			100-D110	100-DAE-110
			100-D140	100-DAE-140
			100-D180	100-DAE-180
			100-D210	**100-DAE-210**
			100-D250	100-DAE-250
			100-D300	100-DAE-300
			100-D420	100-DAE-420
	Main Contacts for Contactors Set for 3-pole 100-D Contactors	Conventional	100-D95	100-DC-95
			100-D110	**100-DC-110**
			100-D140	**100-DC-140**
			100-D180	**100-DC-180**
		Electronic	100-D95	**100-DCE-95**
			100-D110	**100-DCE-110**
			100-D140	**100-DCE-140**
			100-D180	**100-DCE-180**
			100-D210	**100-DCE-210**
			100-D250	**100-DCE-250**
			100-D300	**100-DCE-300**
			100-D420	**100-DCE-420**
			100-D630	100-DCE-630
			100-D860	100-DCE-860
	Terminal Hardware Set of 6	Conventional	100-D95…D110	100-DHF110
			100-D140…D180	100-DHF180
		Electronic	100-D95…D180	100-DHF180
			100-D210…D420	100-DHF420
			100-D630…D860	100-DHF860

Replacement coils for 100-D contactors

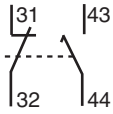
Conventional AC							Conventional DC				
AC Standard Control Voltages			AC Coil Code	100-D95…D180	100-D210…D420	100-D630…D860	DC Standard Control Voltages	DC Coil Code	100-D95…D180	100-D210…D420	100-D630…D860
50 Hz	60 Hz	50/60 Hz		Cat. No.	Cat. No.	Cat. No.			Cat. No.	Cat. No.	Cat. No.
24V	—	—	K	TG407	—	—	12V	ZQ	TG708	—	—
—	24V	—	J	TG013	—	—	24V	ZJ	TG714	—	—
32V	36V	—	V	TG481	—	—	36V	ZW	TG719	—	—
36V	42V	—	W	TG410	—	—	48V	ZY	TG724	—	—
48V	—	—	Y	TG414	—	—	60V	ZZ	TG774	—	—
42V	48V	—	X	TG482	—	—	110V	ZD	TG733	—	—
—	—	100V∗	KP	TG861	—	—	125V	ZS	TG737	—	—
110V	120V	—	D	TG473	—	—	130V	ZF	TG738	—	—
—	—	110V∗	KN	TG856	—	—	220V	ZA	TG761	—	—
—	208V	—	H	TG049	—	—	240V	ZL	TG750	—	—
—	—	200V∗	KG	TG862	—	—	250V	ZT	TG751	—	—
—	—	220V∗	KL	TG857	—	—					
220…230V	240V	—	A	TG441	—	—					
240V	277V	—	T	TG480	—	—					
—	—	277V∗	KT	TG060	—	—					
—	—	230V∗	KF	TG851	—	—					
—	—	240V∗	KA	TG858	—	—					
380…400V	440V	—	N	TG071	—	—					
415V	480V	—	B	TG475	—	—					
440V	—	—	G	TG478	—	—					
500V	—	—	M	TG479	—	—					
550V	600V	—	C	TG476	—	—					

Electronic AC							Electronic DC				
AC Standard Control Voltages			AC Coil Code	100-D95…D300	100-D420	100-D630…D860	DC Standard Control Voltage	DC Coil Code	100-D95…D300	100-D420	100-D630…D860
50 Hz	60 Hz	50/60 Hz		Cat. No.	Cat. No.	Cat. No.			Cat. No.	Cat. No.	Cat. No.
—	—	24V	EJ❄	TGE855	—	—	24V	EZJ	TGE708	—	—
—	—	42…64V	EY	TGE864	—	—	48…72V	EZY	TGE779	—	—
—	—	100V	EP	TGE861	THE861	TJE861	110…130V	EZD	TGE780	THE780	—
—	—	110…130V	ED	TGE865	THE865	TJE865		ED	—	—	TJE865
—	—	200V	EG	TGE862	THE862	TJE862	200…255V	EZA	TGE781	THE781	—
—	—	208…277V	EA	TGE866	THE866	TJE866		EA	—	—	TJE866
—	—	200…220V	EG	—	—	TJE878					
—	—	230…250V	EA	—	—	TJE879					
—	—	277V	ET	—	—	TJE880					
—	—	380…500V	EN	TGE867	THE867	—					
—	—	380…415V	EN	—	—	TJE867					
—	—	440…480V	EB	—	—	TJE868					
—	—	500V	EM	—	—	TJE869					
—	600V	—	EC	—	—	TJE870					

∗ Applies to 100-D95…-D110 contactors only. Not available with 100-D140…-D180 contactors.
❄ Not available on 100/104-D300.

IEC Renewal Parts

Renewal Parts, Continued

	Description	For Use With	Cat. No.
	Arcing Chamber For 3 poles	100-G550	100-AC550
		100-G700, 100-G860	100-AC860
	Arcing Chamber For 1 pole	100-G1000, 100-G1200	**100-AC1200**
	Main Contact Set Set for 1 pole	100-G550	100-CP550
		100-G700	100-CP700
		100-G860	**100-CP860**
		100-G1000	100-CP1000
		100-G1200	**100-CP1200**
	Auxiliary Contact Block Special 2-pole design: 1 N.O. delayed make, 1 N.C. contact N.O. delayed make contact used for operation of the Feeder/Group Coil mechanism One contact block supplied standard with contactor 	100-G1000, 100-G1200	100-EB11DC

Coils and Supply Modules

AC Standard Control Voltages 50/60 Hz	DC Standard Control Voltage	Coil Code	100-G550 Coil Cat. No.∗	100-G550 Supply Module Cat. No.	100-G700...100-G860 Coil Cat. No.∗	100-G700...100-G860 Supply Module Cat. No.
110…120V	100…110V	KD	TX734	TXS734	**TY734**	TYS734
220…240V	200…220V	KF	TX747	TXS747	TY747	TYS747
380…415V	345…380V	KN	TX779	TXS779	TY779	TYS779
440…480V	400…440V	KB	TX780	TXS780	TY780	TYS780

∗ Coils sold in pairs.

AC Standard Control Voltages 50/60 Hz	Coil Code	100-G1000...100-G1200 Coil Cat. No.∗	100-G1000...100-G1200 Supply Module Cat. No.
110…115V	KD	TZ734	TZS734
220…230V	KF	TZ747	TZS747
380…400V	KN	TZ779	TZS779
440V	KB	TZS780	TZS780

Electronic Overload Relay Code Selection

Bulletin 193 E1 Plus electronic overload relay for 3-phase applications: Selectable Trip Class 10, 15, 20, 30, selectable manual/auto reset

For use with: Bulletin 105, 106, 109, 112, 113, 120E, 132, and 133										Full Load Current Range [A]	3-Phase Overload Relay Code
					C30	C23	C16	C12	C09	0.10…0.5	E1A
										0.2…1.0	E1B
										1.0…5.0	E1C
										3.2…16	E1D
										5.4…27	E1E
			C43	C37	C30					5.4…27	E1E
										9.0…45	E1F
C85	C72	C60								18…90	E1G

Bulletin 193 E1 Plus electronic overload relay for 3-phase applications: Trip Class 10 only, manual reset

For use with: Bulletin 105, 106, 109, 112, 113, 120E, 132, and 133					Full Load Current Range [A]	3-Phase Overload Relay Code
C30	C23	C16	C12	C09	0.10…0.5	D1A
					0.2…1.0	D1B
					1.0…5.0	D1C
					3.2…16	D1D
					5.4…27	D1E

Bulletin 193 E1 Plus electronic overload relay for 1-phase applications: Selectable Trip Class 10, 15, 20, 30; selectable manual/auto reset

For use with: Bulletin 109										Full Load Current Range [A]	1-Phase Overload Relay Code
					C30∗	C23	C16	C12	C09	0.1…0.5	E1P
										3.2…16	E1R
										5.4…27	E1S
			C43	C37	C30					9.0…45	E1T
C85	C72	C60								18…90	E1U

∗ For Bulletin 113 combination starters and Bulletin 133 circuit breaker-type pump control panels only.

Consult your local Rockwell Automation sales office or Allen-Bradley distributor for availability and dimensions.

Bimetallic Overload Relay Code Selection

Bulletin 193-T1 Bimetallic Overload Relays: Auto/Manual Reset, Class 10

For use with: Bulletin 105, 106, 112, 113, 120E, 132, and 133 — Starter Size										Full Load Current Range [A]‡		Overload Relay Code
C85	C72	C60	C43	C37	C30	C23	C16	C12	C09	Min.	Max.	
										0.10	0.16	AA16
										0.16	0.25	AA25
										0.25	0.40	AA40
										0.35	0.50	AA50
										0.45	0.63	AA63
										0.55	0.80	AA80
										0.75	1.00	AB10
										0.90	1.30	AB13
										1.10	1.60	AB16
										1.40	2.00	AB20
										1.80	2.50	AB25
										2.30	3.20	AB32
										2.90	4.00	AB40
										3.50	4.80	AB48
										4.50	6.30	AB63
										5.50	7.50	AB75
										7.20	10.00	AC10
										9.00	12.50	AC12
										11.30	16.00	AC16
										15.00	20.00	AC20
										17.50	21.50	AC21
										21.00	25.00	AC25
										15.00	20.00	BC20
										17.50	21.50	BC21
										21.00	25.00	BC25
										24.50	30.00	BC30
										29.00	36.00	BC36
										33.00	38.00	BC38
										17.00	25.00	CC25
										24.50	36.00	CC36
										35.00	47.00	CC47
										35.00	47.00	DC47
										45.00	60.00	DC60
										58.00	75.00	DC75
										72.00	90.00	DC90
All sizes - No overload relay												XXX

∗ Not available on Bulletin 109 Molded Plastic Enclosed Starters.
‡ For motors with a service factor of 1.15 or greater, use the motor nameplate full load current. For motors with a service factor of 1.0, use 90% of the motor nameplate full load current.

Bulletin	**193-ED**	**193-EE**	**193-EC1**	**193-EC2/EC3**
Type	E1 Plus Electronic Overload Relay	E1 Plus Electronic Overload Relay	E3 Electronic Overload Relay	E3 Plus Electronic Overload Relay
Rated Current (Range)	0.1…27 A	0.1…800 A	0.4…5000 A	0.4…5000 A
NEMA Operating Voltage, Nominal	—	600V		
IEC Operating Voltage, Nominal	690V	690/1000V	690/1000V	
Overload Type	Solid-State	Solid-State	Microprocessor-Based	Microprocessor-Based
Trip Class (Fixed)	10	—	—	—
Trip Class (Adjustable)	—	10, 15, 20, 30	5…30	5…30
Ambient Temperature Compensated	✓	✓	✓	✓
Reset Type	Manual only	Automatic and Manual	Automatic and Manual	Automatic and Manual
Adjustment Range	5:1	5:1	5:1	5:1
Phase Loss	3 s	3 s	Adjustable Delay	Adjustable Delay
Ground (Earth) Fault	—	Optional	—	Sensitive
Overcurrent (Jam) Detection	—	Optional	✓	✓
Stall Detection	—	—	✓	✓
Underload Detection	—	—	✓	✓
Current Imbalance	—	—	✓	✓
PTC Thermistor Monitoring	—	Optional	—	✓
Warning Settings	—	—	✓	✓
N.C. Trip Contact	✓	✓	✓	✓
N.O. Alarm Contact	✓	✓	—	—
No. of Outputs	—	—	1	2
No. of Inputs	—	—	2	4
ODVA (DeviceNet) Conformance	—	Optional	✓	✓
Variable Frequency Drive (VFD) Compatible	—	—	✓	✓
Product Selection	**Page 2-174**	**Page 2-174**	**Page 2-187**	**Page 2-187**

Bulletin	**193-K**	**193-T1**	**825-P**
Type	Bimetallic Overload Relay		Modular Protection System
Rated Current (Range)	0.1…12.5 A	0.1…90 A	0.5…5000 A
Operating Voltage, Nominal	600V		120…240V AC/DC, 24…48V DC
Overload Type	Bimetallic		Microprocessor based
Trip Class (Fixed)	10	10	—
Ambient Temperature Compensated	✓	✓	✓
Reset Type	Automatic and Manual	Automatic and Manual	Automatic and Manual
Adjustment Range	1.5:1	1.5:1	—
Phase Loss	Normal Sensing	Normal Sensing	Adjustable delay
N.C. Trip Contact	✓	✓	✓
N.O. Alarm Contact	✓	✓	✓
Variable Frequency Drive (VFD) Compatible	—	—	✓
Product Selection	**Page 2-209**	**Page 2-204**	**Page 2-214**

E1 Plus Solid-State Overload Relays

Overview

E1 Plus Solid-State Overload Relays

- Self-powered
- Phase loss protection
- Wide adjustment range (5:1)
- Over-molded power connections
- 1 N.O. and 1 N.C. isolated auxiliary contacts (B600 Rated)
- Low energy consumption (150 mW)
- Ambient temperature compensation
- Visible trip indication

193-ED version offers:

- 0.1…27 A current range
- Fixed Trip Class 10
- Manual reset

193-EE version offers:

- 0.1…800 A current range
- Selectable Trip Class (10, 15, 20, or 30)
- Selectable manual/auto-manual reset
- Single- and three-phase devices
- Optional cage clamp control terminals (Bul. 193R-EE only)

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Standards Compliance

- IEC/EN 60947-4-1
- IEC/EN 60947-5-1
- CSA 22.2 No. 14
- UL 508

Certifications

- CE
- cULus Listed
- ATEX (pending)
- C-Tick
- CCC

Your order must include 1) the Cat. No. of overload relay selected, and 2) if required, Cat. No. of any accessories.

Product Overview

Accurate, Reliable Performance

Current measurement-based protection

While electromechanical overload relays pass motor current through heating elements to provide an indirect simulation of motor heating, the E1 Plus Overload Relay directly measures motor current. Current measurement-based overload protection more accurately models a motor's thermal condition. Furthermore, ambient temperature does not impact the performance of current measurement-based designs over the specified temperature operating range.

Electronic design

Thermal modeling is performed electronically with precision solid-state components, where at the heart of the E1 Plus Overload Relay is an application-specific integrated circuit (ASIC). The ASIC continually processes motor current data to accurately maintain the time-current status of the motor thermal capacity utilization value.

Thermal memory

A thermal memory circuit allows the E1 Plus Overload Relay to model the heating and cooling effects of motor on and off periods. This ensures accurate protection for both hot and cold motors.

Enhanced phase loss protection

A separate phase loss detection circuit incorporated into the E1 Plus Overload Relay allows it to respond quickly to phase loss conditions; typical reaction time is 3 seconds.

Easy to Select and Apply

Straightforward installation

The self-powered design means that the E1 Plus Overload Relay installs in the same manner as traditional overload relays. Device setup is accomplished by simply dialing the setting potentiometer to the motor FLA rating. The low energy consumption of the electronic design minimizes temperature rise issues inside control cabinets.

Wide adjustment range

A wide 5:1 adjustment range results in the need for half as many catalog numbers as the bimetallic alternative in order to cover the same current range. This helps to reduce inventory carrying costs and affords greater installation flexibility for dual voltage machines. Evenly spaced setting tick marks enhance the ease of installation setup.

Rugged Construction

Over-molded power connections

The unique line-side over-molded power connections make for a sturdy two-component starter assembly that is unmatched in the industry. The pre-formed power connections allow easy starter assembly — every time.

Current transformers

The current transformers are secured separately in the overload housing to ensure the greatest degree of resistance to shock and vibration conditions. Varnished laminations ensure consistent performance and provide additional protection against corrosion.

Latching relay

The robust design of the bi-polar latching relay provides reliable trip and reset performance for the most demanding of applications. The self-enclosed relay offers additional environmental protection for use in industrial applications.

Application Flexibility

Isolated Contacts

The isolated contact configuration allows the N.C. and N.O. contacts to be applied in circuits operating at different voltage levels and without polarity restrictions. The B600 contact rating affords application in circuits rated to 600V.

DIP switch settings

193-EE devices offer DIP switch settings to select the trip class (10, 15, 20 or 30) and the reset mode (manual or automatic), making these devices extremely versatile.

Side-Mount Expansion Modules

Through the use of optional side-mounted accessory modules, functionality of the E1 Plus overload relays can be cost effectively expanded and machine operation and protection enhanced. Direct mounting to the left side of the 193-EE and 592-EE E1 Plus overload relays means that only 18 mm is added to the overall product width. The side-mounted modules electronically interface with the E1 Plus overload relay so that all control circuit connections are made at the E1 Plus overload relay terminals.

E1 Plus DeviceNet™ Communication Module

The Bul. 193-EDN DeviceNet Communication Side-Mount Module provides a cost-effective, seamless deployment of motor starters onto the Integrated Architecture™ as an accessory for the E1 Plus electronic overload relay. The DeviceNet module provides Integrated I/O (2 inputs and 1 output) providing local connection of motor starter-related I/O. The DeviceNet module offers expanded protective functions including overload warning, jam protection, and underload warning. The DeviceNet module also allows access to average motor current (percentage of FLA setting), percentage of thermal capacity usage, device status, trip & warning identification, and trip history which allows continual monitoring of motor performance.

E1 Plus Remote Reset Module

The Bul. 193-ERR Remote Reset Module is available for applications that require remote reset of the E1 Plus overload relays after a trip occurs.

E1 Plus Jam Protection Module with Remote Reset

The Bul. 193-EJM Jam Protection Module provides front-accessible DIP switches which offers flexibility to provide jam protection to match application requirements. Selections are available for enabling or disabling the jam protection function and remote reset operation. Jam trip level settings are available at 150%, 200%, 300%, and 400% of full load current setting. Trip delay settings of 1/2, 1, 2, and 4 seconds are available to minimize nuisance tripping in applications where intermittent short-duration overloading is permissible.

E1 Plus Ground Fault Module with Remote Reset

The Bul. 193-EGF Ground Fault Protection Module offers front-accessible DIP switches providing flexibility to configure ground fault protection to match application requirements. Selections are available for enabling or disabling the ground fault protection function and remote reset operation. Ground fault trip level settings are available in four ranges: 20…100 mA (resistive loads only, for motor loads consult your local Allen-Bradley distributor), 100…500 mA, 0.2…1 A, and 1…5 A. Within each range, the specific ground fault trip level can be set (20%, 35%, 50%, 65%, 80%, 90%, or 100% of the maximum ground fault setting). Trip delay is fixed at 50 ms ± 20 ms.

E1 Plus Ground Fault/Jam Module with Remote Reset

The Bul. 193-EGJ Ground Fault/Jam Protection Module offers front-accessible DIP switches to provide flexibility to configure ground fault and jam protection to match application requirements. The ground fault selections are the same as the Bul. 193-EGF Ground Fault Protection Module. In addition to ground fault, this module offers selectable fixed jam protection. The user can enable or disable jam protection from the DIP switches. The jam protection is fixed at 400% of the full load current setting with a 0.5 second trip delay.

E1 Plus PTC Module with Remote Reset

The Bul. 193-EPT PTC Side-Mount Module provides two terminals for the connection of positive temperature coefficient (PTC) thermistor sensors. PTC sensors are commonly embedded in the motor stator windings to monitor winding temperature. PTC sensors react to actual temperature, so enhanced motor protection can be provided to address conditions like obstructed cooling and high ambient temperature.

E1 Plus Solid-State Overload Relays

Catalog Number Explanation/Product Selection

Catalog Number Explanation

193	–	EE	C	B
		a	*b*	*c*	*d*

a

Bulletin Number	
Code	Description
193	IEC Three-Phase
193R	IEC Three-Phase, Cage Clamp
193S	IEC Single-Phase
592	NEMA Three-Phase
592S	NEMA Single-Phase

b

Type	
Code	Description
ED1	Fixed Trip Class 10
EE	Selectable Trip Class

c

Adjustment Range [A]			
Three-Phase		Single-Phase	
Code	Description	Code	Description
A	0.1…0.5	P	1.0…5.0
B	0.2…1.0	R	3.2…16
C	1.0…5.0	S	5.4…27
D	3.2…16	T	9…45
E	5.4…27	U	18…90
F	9…45	—	—
G	18…90	—	—
H	30…150	—	—
J	40…200	—	—
K	60…300	—	—
L	100…500	—	—
M	120…600	—	—
N	160…800	—	—

d

Bulletin 100 Contactor Size	
Code	Description
B	C09…C23
D	C30…C43
E	C60…C85
F	D95…D180
G	D210…D420
H	D630…D860
Bulletin 500 NEMA Contactor Size	
Code	Description
T	Size 00
C	Size 0…2
D	Size 3
Panel/DIN Rail Mount	
Code	Description
P	Integrated panel mount and pass-through wiring
Z	Panel mount with external current transformers

Product Selection

Bulletin 193-ED – Three-Phase Devices

- Fixed Trip Class 10
- Manual reset
- Screw-type control terminals

Mounts to Contactor	Adjustment Range [A]	Cat. No.
100-C09…100-C23	0.1…0.5	**193-ED1AB**
	0.2…1.0	**193-ED1BB**
	1.0…5.0	**193-ED1CB**
	3.2…16	**193-ED1DB**
	5.4…27	**193-ED1EB**
Integrated panel/DIN Rail mount and pass-through wiring	1.0…5.0	**193-ED1CP**
	3.2…16	**193-ED1DP**
	5.4…27	**193-ED1EP**

Bulletin 193-EE – Three-Phase Devices

- Selectable Trip Class (10, 15, 20, 30)
- Selectable manual/auto-manual reset
- Screw-type control terminals

Mounts to Contactor	Adjustment Range [A]		Cat. No.
100-C09…100-C23	0.1…0.5	‡	**193-EEAB**
	0.2…1.0	‡	**193-EEBB**
	1.0…5.0	‡	**193-EECB**
	3.2…16	‡	**193-EEDB**
	5.4…27	‡	**193-EEEB**
100-C30…100-C43	5.4…27	‡	**193-EEED**
	9…45	‡	**193-EEFD**
100-C60…100-C85	18…90	‡	**193-EEGE**
100-D95…100-D180	18…90	❄	**193-EEGF**
	30…150	❄	**193-EEHF**
	40…200	❄	**193-EEJF**
	55…110	❄	**193-EEVF**
100-D210…100-D420	40…200	❄	193-EEJG
	60…300	❄	**193-EEKG**
	100…500	❄	193-EELG
100-D630…100-D860	120…600	❄	193-EEMH
	160…800	❄	193-EENH
Integrated panel/DIN Rail mount and pass-through wiring	1.0…5.0	‡	**193-EECP**
	3.2…16	‡	**193-EEDP**
	5.4…27	‡	**193-EEEP**

Bulletin 193S-EE – Single-Phase Devices

- Selectable Trip Class (10, 15, 20, 30)
- Selectable manual/auto-manual reset
- Screw-type control terminals

Mounts to Contactor	Adjustment Range [A]	Cat. No.
100-C09…100-C23	1.0…5.0	**193S-EEPB**
	3.2…16	**193S-EERB**
	5.4…27.0	**193S-EESB**
100-C30…100-C43	9…45	**193S-EETD**
100-C60…100-C85	18…90	**193S-EEUE**
Integrated panel/DIN Rail mount and pass-through wiring	1.0…5.0	**193S-EEPP**
	3.2…16	**193S-EERP**
	5.4…27.0	**193S-EESP**

Bulletin 193 Panel Mount Devices for use with External Current Transformers §♣

- Selectable Trip Class (10, 15, 20, 30)
- Selectable manual/auto-manual reset

CT Ratio	Adjustment Range [A]	Cat. No.
150:5	30…150	**193-EEHZ**
200:5	40…200	**193-EEJZ**
300:5	60…300	**193-EEKZ**
400:5	80…400	193-EEWZ
500:5	100…500	193-EELZ
600:5	120…600	193-EEMZ
800:5	160…800	193-EENZ

♣ Current Transformers supplied by customer.
§ Order panel adapter, **Cat. No. 193-EPB**, separately.

‡ **Cage Clamp Control Terminals** – To order, change the Bulletin number in the listed cat. no. from 193 to 193R (Example: **Cat. No. 193-EEFD** becomes **Cat. No. 193R-EEFD**).
❄ Does not include terminal lugs. See Accessories.

Visit our website: www.ab.com/catalogs
Preferred availability cat. nos. are printed in **bold**

Accessories

	Description	For Use With	Pkg. Quantity	Cat. No.
	DIN Rail/Panel Adapter For separate mounting – can be mounted to top-hat rail EN 50 022-35.	193-ED1_B, 193-EE_B, 193-EE_Z	1	**193-EPB**
		193-EE_D		**193-EPD**
		193-EE_E		**193-EPE**
	Current Adjustment Shield Prevents inadvertent adjustment of the current setting. Must be ordered in multiples of package quantities.	193-ED (all) 193-EE (all) 592-EE (all)	10	**193-BC8**
	External Reset Adapter For enclosed, through-the-door reset applications. Use with external reset button.	193-ED (all) 193-EE_B, 193-EE_D, 193-EE_E 193-EE_Z	1	**193-ERA**
	External Reset Button for Enclosed Devices	193-E all	1	**800FM-R611**Button
				800F-ATR08Rod
	Terminal Lugs Set of 2 Protection class IP2X per IEC 60529 and DIN 40050	100-D140, 100-D180, 100-D95E…D180E, 193-EC_F, 193-EE_F	2	**100-DTB180**
		100-D210...100-D420, 193-EC_G, 193-EF2C, 193-EE_G	2	**100-DTB420**
	Terminal Lugs, Copper Frame Set of 3	100-D95E, 100-D110E, 193-EC_F, 193-EE_F	3	**100-DLE110**
			3	**100-DL180**
		100-D210…100-D420, 193-EC_G, 193-EE_G	3	**100-DL420**
		100-D630, 100-D860, 193-EC_H, 193-EE_H	3	100-DL630
			3	100-DL860
	Terminal Covers Protection class IP20 per IEC 60529 and DIN 40 050 For direct-on-line, reversing, two-speed, and wye-delta/star-delta assemblies	100-D95…100-D180, 193-EC_F, 193-EE_F	1	**100-DTC180**
		100-D210...100-D420, 193-EC_G, 193-EE_G	1	**100-DTC420**
		100-D630…100-D860, 193-EC_H, 193-EE_H	1	100-DTC860
	Phase Barriers Set of 4	100-D630…D860, 193-EC_H, 193-EE_H	4	100-DPB860
	DeviceNet Configuration Terminal Used to interface with objects on a DeviceNet network. Includes 1 m communications cable (193-CB1).	193-EC (all), 592-EC (all); 280/281/283/284 ArmorStart	1	**193-DNCT**
	1 meter communication cable, color-coded bare leads	193-DNCT	1	**193-CB1**
	1 meter communication cable, microconnector (male)	193-DNCT	1	**193-CM1**
	Panel Mount Adapter/Door Mount Bezel Kit	193-DNCT	1	**193-DNCT-BZ1**

E1 Plus Solid-State Overload Relays

Accessories, Continued

	Description	Size	For Use With	Pkg. Quantity	Cat. No.
	Core Balanced Ground Fault Sensor • Required when using either an E1 Plus Ground Fault Protection or Ground Fault/Jam Module • Required for ground fault protection with the Cat. No. 193-EC3_ _ overload relay	20 mm (0.79 in.)	100-C09…100-C37 NEMA size 00…2	1	**193-CBCT1**
		40 mm (1.57 in.)	100-C09…100-C85 NEMA size 00…3	1	**193-CBCT2**
		63 mm (2.5 in.)	100-C09…100-C85, 100-D95…100-D180 NEMA size 00…4	1	193-CBCT3
		82 mm (3.25 in.)	100-C09…100-C85, 100-D95…100-D420 NEMA size 00…5	1	193-CBCT4

Side-Mount Expansion Modules∗

Function		E1 Plus‡ (Cat. No. 193/592-EE_)	E1 Plus w/ Jam Module (Cat. No. 193-EJM)	E1 Plus w/ Ground Fault Module∗ (Cat. No. 193-EGF)	E1 Plus w/ Ground Fault/Jam Module∗ (Cat. No. 193-EGJ)	E1 Plus w/ PTC Module (Cat. No. 193-EPT)	E1 Plus w/ Remote Reset Module (Cat. No. 193-ERR)
Manual/Automatic Reset		X	X	X	X	X	X
Selectable Trip Class		10	X	X	X	X	X
		15	X	X	X	X	X
		20	X	X	X	X	X
		30	X	X	X	X	X
Jam Protection	On or Off	—	X	—	X	—	—
	Trip Level	—	Adjustable 150/200/300/400%	—	Fixed @ 400%	—	—
	Trip Delay	—	Adjustable 0.5/1.0/2.0/4.0 s	—	Fixed @ 0.5 s	—	—
	Inhibit	—	Dynamic Inhibit‡	—	Dynamic Inhibit‡	—	—
Ground Fault Protection	Type	—	—	Core-Balanced Ground Fault Protection∗	Core-Balanced Ground Fault Protection∗	—	—
	On or Off	—	—	X	X	—	—
	Trip Level	—	—	Adjustable 20 mA…5 A§	Adjustable 20 mA…5 A§	—	—
	Trip Delay	—	—	Fixed @ 50 ms ± 20 ms	Fixed @ 50 ms ± 20 ms	—	—
	Inhibit	—	—	Dynamic Inhibit‡	Dynamic Inhibit‡	—	—
PTC Protection	PTC Overtemperature Trip	—	—	—	—	X	—
	PTC Open Circuit	—	—	—	—	X	—
	PTC Short Circuit	—	—	—	—	X	—
Remote Reset Capability		—	X	X	X	X	X
Fault Indication		—	—	X	X	X	—

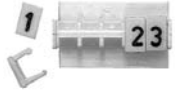
‡ Dynamic Inhibit: Protective function is enabled after the motor current goes above 150% and then falls to below 125%.
∗ Requires use of an external ground fault sensor, **Cat. No. 193-CBCT_**.
§ From 20…100 mA for resistive loads only.

	Description	For Use With	Pkg. Quantity	Cat. No.
	E1 Plus DeviceNet Module Provides motor diagnostics and device status information, as well as integrated I/O to allow the simplification of the network architecture.	193-EE (all), 592-EE (all), 193S-EE (all), 592S-EE (all)	1	**193-EDN**
	E1 Plus Jam Protection Module Provides Jam protection with adjustable trip level and trip delay setting. The module also provides an input to allow remote reset of a trip.∗	193-EE (all), 592-EE (all), 193S-EE (all), 592S-EE (all)	1	**193-EJM**
	E1 Plus Ground Fault Module Provides adjustable 20 mA…5 A ground fault protection. The module also provides an input to allow remote reset of a trip.	193-EE (all), 592-EE (all), 193S-EE (all), 592S-EE (all)	1	‡ 193-EGF
	E1 Plus Ground Fault/Jam Module Provides adjustable 20 mA…5 A ground fault and fixed jam protection. The module also provides an input to allow remote reset of a trip.	193-EE (all), 592-EE (all), 193S-EE (all), 592S-EE (all)	1	‡ 193-EGJ
	E1 Plus PTC Module Provides terminals for connection of up to 6 PTC thermistor sensors. These sensors react to actual temperature and therefore provide enhanced motor protection. The module also provides an input to allow remote reset of a trip.	193-EE (all), 592-EE (all), 193S-EE (all), 592S-EE (all)	1	193-EPT
	E1 Plus Remote Reset Module Provides an input to allow remote reset of a trip.	193-EE (all), 592-EE (all), 193S-EE (all), 592S-EE (all)	1	193-ERR
	Module Adjustment Cover Prevents inadvertent adjustment of setting. Must be ordered in multiples of package quantity.	193-EJM	25	193-EMC

∗ Only one module may be added at a time.
‡ Requires use of an external ground fault sensor (**Cat. No. 193-CBCT_**).

Marking Systems

Uniform labeling materials for contactors, motor starting equipment, timing relays and circuit breakers

	Description	Pkg. Qty.❄	Cat. No.
	Label Sheet 105 self-adhesive paper labels each, 6 x 17 mm	10	**100-FMS**
	Marking Tag Sheet 160 perforated paper labels each, 6 x 17 mm To be used with a transparent cover	10	**100-FMP**
	Transparent Cover To be used with marking tag sheets	100	**100-FMC**
	**Marking Tag Adapters** To be used with marking tag:	100	100-FMA2

❄ Must be ordered in multiples of package quantities.

E1 Plus Solid-State Overload Relays

Specifications

		Cat. No. 193-ED1_B, 193-EE_B, and 592-EE_T	Cat. No. 193-EE_D, and 592-EE_C	Cat. No. 193-EE_E, and 592-EE_D	Cat. No. 193-EE_F‡	Cat. No. 193-EE_G	Cat. No. 193-EE_H
Main Circuits							
Rated Insulation Voltage (U_i)		690V AC			1000V AC		
Rated Impulse Strength (U_{imp})		6 kV AC			6 kV AC		
Rated Operating Voltage (U_e) IEC/UL		690V AC/600V AC			1000V AC/600V AC		
Rated Operating Frequency		50/60 Hz (sinusoidal)			50/60 Hz (sinusoidal)		
Terminal Cross-Sections	Terminal Type						
	Terminal Screws	M5		M8	Lug		
Flexible-Stranded with Ferrule	Single Conductor Torque	2.5…16 mm² 2.5 N•m	2.5…16 mm² 2.5 N•m	4…35 mm² 24 N•m	—	—	—
	Two Conductor Torque	2.5…10 mm²❄ 3.4 N•m	2.5…10 mm²❄ 3.4 N•m	4…25 mm² 4 N•m	—	—	—
Coarse-Stranded/Solid	Single Conductor Torque	2.5…25 mm² 2.5 N•m	2.5…25 mm² 2.5 N•m	4…50 mm² 4 N•m	16…150 mm² 28 N•m	—	—
	Two Conductor Torque	6…16 mm²❄ 3.4 N•m	6…16 mm²❄ 3.4 N•m	4…35 mm² 4 N•m	—	25…185 mm2 28 N•m	70…240 mm2 45 N•m
	Four Conductor Torque	6…16 mm²❄ 3.4 N•m	6…16 mm²❄ 3.4 N•m	4…35 mm² 4 N•m	—	—	70…240 mm2 45 N•m
Stranded/Solid	Single Conductor Torque	14…6 AWG 22 lb-in.	14…6 AWG 22 lb-in.	12…1 AWG 35 lb-in.	6…300 MCM 250 lb-in.	—	—
	Two Conductor Torque	14…6 AWG❄ 30 lb-in.	14…6 AWG❄ 30 lb-in.	6…2 AWG 35 lb-in.	—	4…350 MCM 250 lb-in.	2/0…500 MCM 400 lb-in.
	Four Conductor Torque	14…6 AWG❄ 30 lb-in.	14…6 AWG❄ 30 lb-in.	6…2 AWG 35 lb-in.	—	—	2/0…500 MCM 400 lb-in.
Pozidriv Screwdriver Size		2	2	—	—	—	—
Slotted Screwdriver (mm)		1 x 6	1 x 6	—	—	—	—
Hexagon Socket Size (mm)		—	—	4	8	8	8
Control Circuits							
Rated Insulation Voltage (U_i)		690V AC					
Rated Impulse Strength (U_{imp})		6 kV AC					
Rated Operating Voltage (U_e) IEC/UL		690V AC / 600V AC					
Rating Designation		B600					
Rated Operating Current I_e		**N.O./N.C.**					
AC-15	12…120V	3/2					
	220…240V	1.5/1.5					
	380…480V	0.75/0.75					
	500…600V	0.6/0.6					
Thermal Current I_{the}		5 A					
Contact Reliability		17V, 5 mA					
Screw Terminal Cross Sections	Terminal Screw	M3					
Flexible-Stranded with Ferrule	Single Conductor Torque	0.5…2.5 mm² 0.55 N•m					
	Two Conductor Torque	0.25…1.5 mm² 0.55 N•m			0.2…0.75 mm² 0.55 N•m		
Coarse-Stranded/Solid	Single Conductor Torque	0.5…4 mm² 0.55 N•m					
	Two Conductor Torque	0.2…2.5 mm² 0.55 N•m			0.2…1.5 mm² 0.55 N•m		
Stranded/Solid	Single Conductor Torque	24…10 AWG 5 lb-in.					
	Two Conductor Torque	24…12 AWG 5 lb-in.			22…16 AWG 5 lb-in.		
Screwdriver Size (mm)		#1 Pozidriv/0.6 x 3.5 slotted					
Cage Clamp Cross-Sections							
Flexible-Stranded with Ferrule		0.25…1 mm²					
Coarse-Stranded/Solid		0.2…1.5 mm²					
Stranded/Solid		24…14 AWG					

❄ For multiple conductor applications, the same style and size of wire must be used.
‡ Cat. Nos. 193-EEGF and 193-EEVF follow Cat. No. 193-EE_E specifications.

3-Pole Terminal Blocks

Cat. No. 100-DTB180	Cat. No. 100-DTB420
(A) 6…1/0 AWG, 16…50 mm² (B) 6 AWG…250 MCM, 16…120 mm² 90…110 lb•in., 10…12 N•m	(2) 4 AWG…600 MCM, 25…240 mm² 180…220 lb•in., 20…25 N•m

Terminal Lug Kits

Cat. No. 100-DLE110	Cat. No. 100-DL180	Cat. No. 100-DL420	Cat. No. 100-DL630	Cat. No. 100-DL860
Lug: 6…2/0 AWG, 16…70 mm^2 90…110 lb•in., 10…12 N•m Terminal: 13/32 in., 10 mm 150 lb•in., 17 N•m	Lug: 6 AWG…250 MCM, 16…120 mm^2 90…110 lb•in., 10…12 N•m Terminal: 1/2 in., 13 mm 275 lb•in., 16 N•m	Lug: 2 AWG…350 MCM, 375 lb•in., 42 N•m Terminal: 11/16 in., 17 mm 140 lb•in., 16 N•m	Lug: 2/0 AWG…500 MCM, 70…240 mm^2 400 lb•in., 45 N•m Terminal: 3/4 in., 19 mm 600 lb•in., 68 N•m	Lug: 2/0 AWG…500 MCM, 70…240 mm2 400 lb•in., 45 N•m Terminal: 3/4 in., 19 mm 600 lb•in., 68 N•m

Environmental Ratings		
Ambient Temperature	Storage Operating	-40…+85 °C (-40…+185 °F) -20…+60 °C (-4…+140 °F)
Humidity	Operating Damp Heat	5…95% Non-condensing per IEC 68-2-3 and IEC 68-2-30
Vibration (per IEC 68-2-6)		3 G
Shock (per IEC 68-2-27)		30 G
Max. Altitude		2000 m
Pollution Environment		Pollution Degree 3
Degree of Protection		IP20
Protection		
Type of Relay		Ambient Compensated, Time Delay, Phase Loss Sensitive
Nature of Relay		Solid-State
Trip Rating		120% FLA
Trip Class	Type ED	10
	Type EE	10, 15, 20, 30
Reset Mode	Type ED	Manual
	Type EE	Automatic or Manual
Electromagnetic Compatibility		
Electrostatic Discharge Immunity	Test Level	8 kV Air Discharge, 6 kV Contact Discharge
	Performance Level	1 ‡❄
RF Immunity	Test Level	10 V/m
	Performance Level	1 ‡❄
Electrical Fast Transient/Burst Immunity	Test Level	4 kV
	Performance Level	1 ‡❄
Surge Immunity	Test Level	2 kV (L-E), 1 kV (L-L)
	Performance Level	1 ‡❄

‡ Performance Criteria 1 requires the device under test (DUT) to experience no degradation or loss of performance.
❄ Environment 2.

General

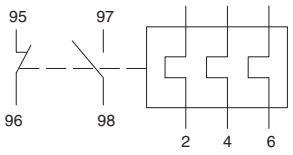
	Cat. No. 193-ED1_B, 193-EE_B	Cat. No. 193-EE_D	Cat. No. 193-EE_E
Standards	UL508, CSA C22.2 No. 14, NEMA ICS 2-1993 Part 4, EN 60947-4-1, EN 60947-5-1		
Certifications	CE, cULus, ATEX (pending), C-Tick, CCC		
Approximate Weights (unpackaged)	0.25 kg (0.55 lb)	0.25 kg (0.55 lb.)	0.52 kg (1.06 lb.)

External Current Transformers (for use with cat. nos. 193-EE_Z)

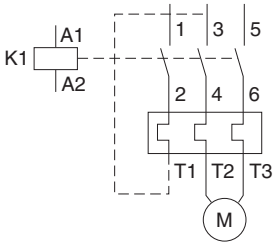
The user shall provide one current transformer (CT) for each motor phase,and shall connect the CT's secondary leads to the appropriate E1 Plus overload relay power terminals, as shown in current transformer's wiring diagrams. The CT shall have the appropriate ratio (refer to the product nameplate or product description). Additionally, the CT shall be selected to be capable of providing the required VA to the secondary load, which includes the E1 Plus overload relay burden at the rated secondary current and the wiring burden. Finally, the CT shall be rated for protective relaying to accomodate the high inrush currents associated with motor startup, and shall have an accuracy of <±2% over its normal operating range. Typical CT ratings include (Instrument Transformers, Inc. — Model #23 or equivalent):

ANSI (USA)	**Class C5B0.1**
CSA (Canada)	**Class 10L5**
IEC (Europe)	**5 VA Class 5P10**

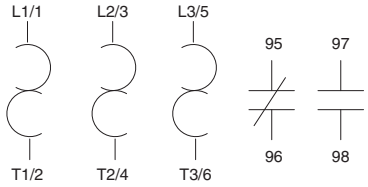
Wiring Schematic



Typical IEC Wiring Schematic



Typical Wiring for 1-Phase Applications

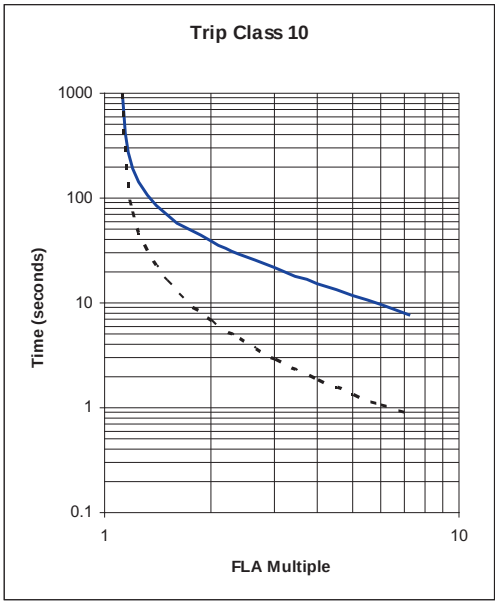


Typical NEMA Wiring Schematic

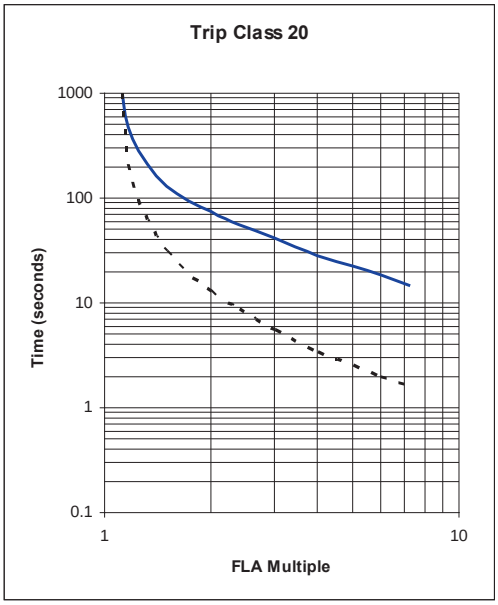
Trip Curves

Typical reset time for 193-EE devices set to automatic reset mode is 120 seconds.

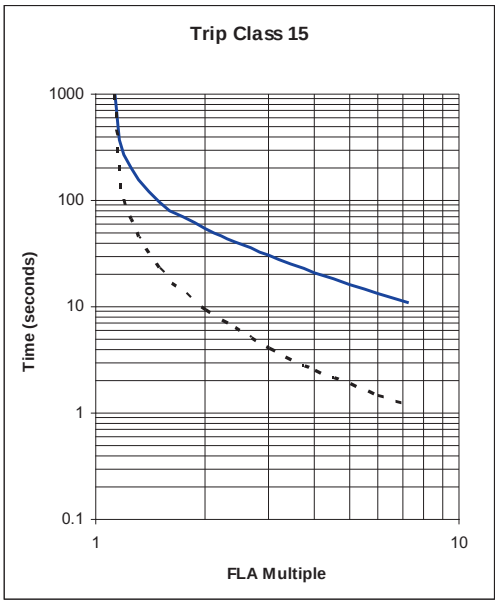
Trip Class 10



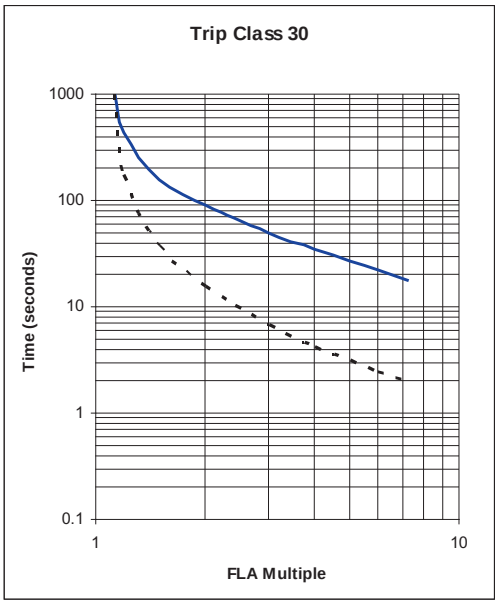
Trip Class 20



Trip Class 15



Trip Class 30



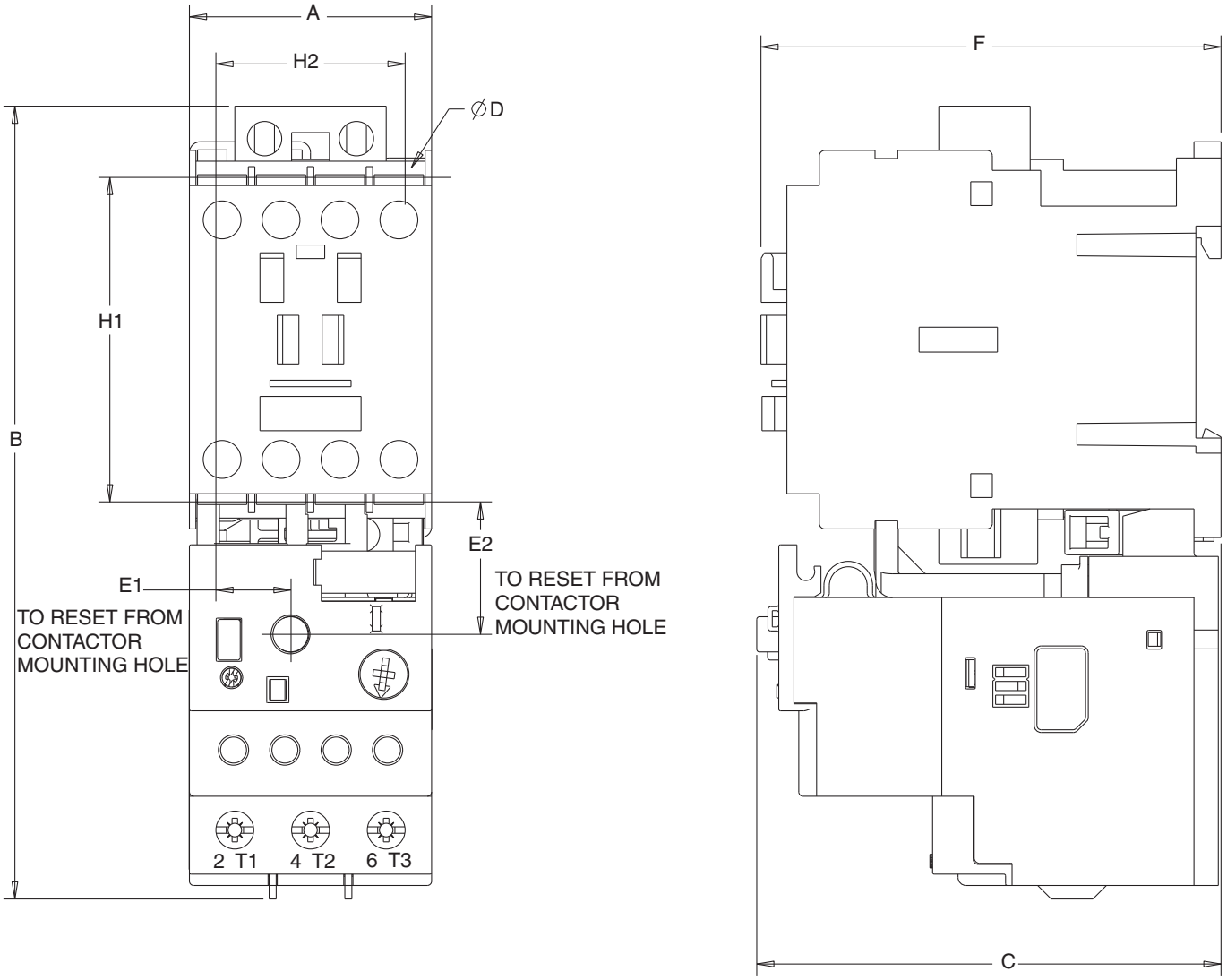
Trip Curve Legend: Cold Trip ——————
Hot Trip – – – – – – – – –

Visit our website: www.ab.com/catalogs

Preferred availability cat. nos. are printed in **bold**

Approximate dimensions are shown in millimeters (inches). Dimensions are not to be used for manufacturing purposes.

Bulletin 100-C Contactor Mounted



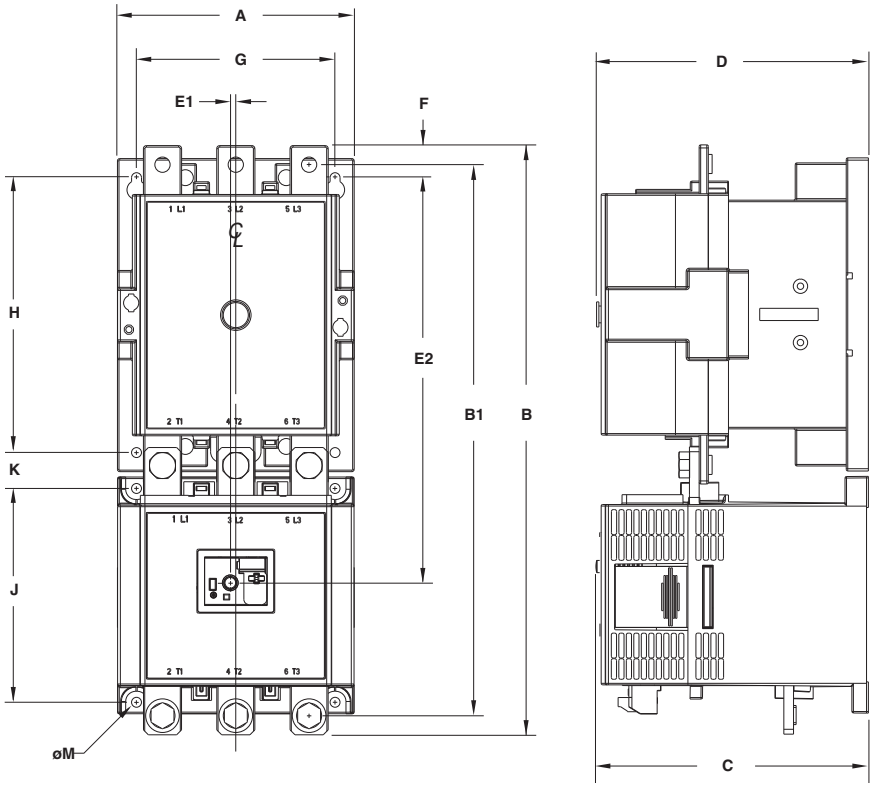
Overload Cat. No.	Contactor Cat. No.	Width A	Height B	Depth C	D	E1	E2	F	H1	H2
193-ED__B 193-EE__B 193R-EE__B 193S-EE__B	100-C09, -C12, -C16, -C23	45 (1-25/32)	146.6 (5-25/32)	85.2 (3-23/64)	4.5 (3/16)	13.9 (35/64)	24.5 (31/32)	86.5 (3-13/32)	60 (2-23/64)	35 (1-3/8)
193-EE__D 193R-EE__D 193S-EE__D	100-C30, -C37	45 (1-25/32	146.6 (5-25/32)	101.2 (3-63/64)	4.5 (3/16)	13.9 (35/64)	24.5 (31/32)	104 (4-3/32)	60 (2-23/64)	35 (1-3/8)
193-EE__D 193R-EE__D 193S-EE__D	100-C43	54 (2-1/8)	146.6 (5-25/32)	101.2 (3-63/64)	4.5 (3/16)	18.9 (3/4)	24.5 (31/32)	104 (4-3/32)	60 (2-23/64)	45 (1-25/32)
193-EE__E 193R-EE__E 193S-EE__E	100-C60, -C72, -C85	72 (2-53/64)	192.3 (7-37/64)	120.4 (4-3/4)	5.4 (7/32)	23.8 (15/16)	29 (1-9/64)	125.5 (4-15/16)	100 (3-15/16)	55 (2-11/64)

E1 Plus Solid-State Overload Relays

Approximate Dimensions, Continued

Approximate dimensions are shown in millimeters (inches). Dimensions are not to be used for manufacturing purposes.

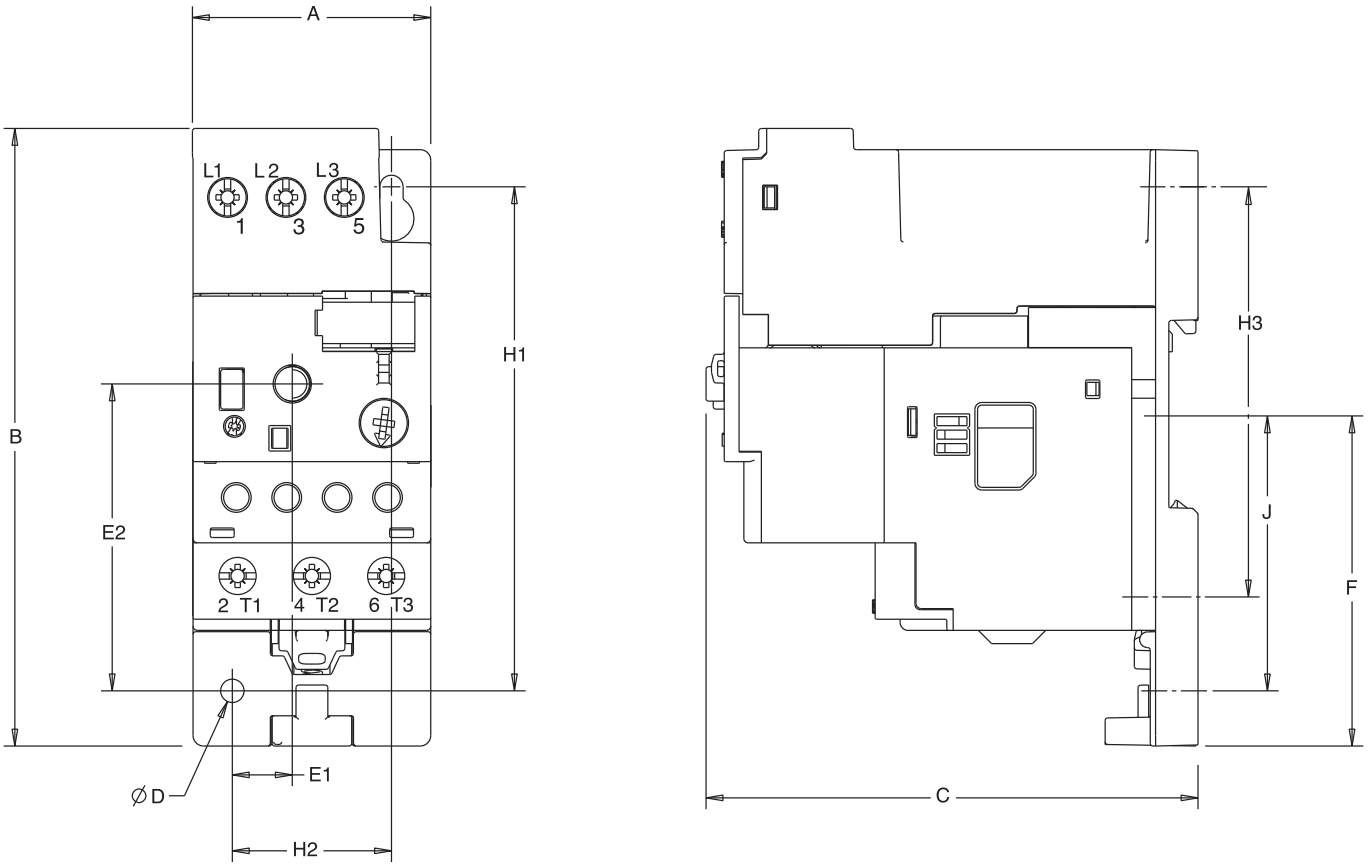
Bulletin 100-D Contactor Mounted



Overload Cat. No.	Contactor Cat. No.	Width A	Height B		Height B1	Depth C	D	E1	E2
			Without Terminal Covers	With Terminal Covers		(Reset)			
193-EE__F	100-D95, -D110	120 (4.72)	336.3 (13.24)	418 (16.46)	311.8 (12.27)	152.7 (6.01)	156 (6.14)	3.6 (0.14)	226.3 (8.91)
193-EE__F	100-D140, -D180	120 (4.72)	339.8 (13.38)	418 (16.46)	317.8 (12.51)	152.7 (6.01)	156 (6.14)	3.6 (0.14)	226.3 (8.91)
193-EE__G	100-D210, -D250, -D300, -D420	155 (6.10)	385.8 (15.19)	487.4 (19.19)	360.8 (14.2)	176.5 (6.95)	180 (7.09)	3.6 (0.14)	265.2 (10.44)
193-EE__H	100-D630, -D860	255 (10.04)	552 (21.73)	915 (36.02)	508 (20)	269.3 (10.6)	270.7 (10.66)	3.6 (0.14)	384.1 (15.12)

Overload Cat. No.	Contactor Cat. No.	F	G	H	J	K	øM
193-EE__F	100-D95, -D110	45 (1-25/32)	100 (3.94)	145 (5.71)	135 (5.31)	22.3 (0.88)	8 - 5.6 (8 - 0.22)
193-EE__F	100-D140, -D180	45 (1-25/32	100 (3.94)	145 (5.71)	135 (5.31)	22.3 (0.88)	8 - 5.6 (8 - 0.22)
193-EE__G	100-D210, -D250, -D300, -D420	54 (2-1/8)	130 (5.12)	180 (7.09)	140 (5.51)	23.5 (0.93)	8 - 6.5 (8 - 0.26)
193-EE__H	100-D630, -D860	52.5 (2.07)	226 (8.90)	230 (9.06)	108 (4.25)	109 (4.29)	8 - 13 (8 - 0.51)

Panel Adapter Mounted



Panel Adapter Cat. No.	Overload Cat. No.	Width A	Height B	Depth C	D	E1	E2	F	H1	H2	H3	J
193-EPB	193-ED__B 193-EE__B 193R-EE__B 193S-EE__B	45 (1-25/32	116.5 (4-19/16)	92.7 (3-21/32)	4.4 (11/64)	11.4 (0.45)	57.9 (2-9/32)	62.5 (2-15/32)	95 (3-3/4)	30 (1-3/16)	75 (2-31/32)	52.1 (2-3/64)
193-EPD	193-EE__D 193R-EE__D 193S-EE__D	45 (1-25/32	112.4 (4-7/16)	108.7 (4-9/32)	4.4 (11/64)	11.4 (0.45)	57.9 (2-9/32)	62.5 (2-15/32)	95 (3-3/4)	30 (1-3/16)	75 (2-31/32)	52.1 (2-3/64)
193-EPE	193-EE__E 193R-EE__E 193S-EE__E	72 (2-53/64)	107.4 (4-15/64)	127 (5/32)	5.5 (5/32)	26.4 (1-1/32)	54.5 (2-9/64)	48.3 (1-29/32)	90 (3-23/64)	60 (2-23/64)	—	43.3 (1-45/64)

DIN Rail / Panel Adapter - Terminal Cross Sections

		Cat. No. 193-EPB ❄	Cat. No. 193-EPD ❄	Cat. No. 193-EPE
Flexible-Stranded with Ferrule	Single Conductor	1.0…4.0 mm²	2.5…16 mm²	4.0…35 mm²
	Torque	1.8 N•m	2.3 N•m	4.0 N•m
	Two Conductor	1.0…4.0 mm²	2.5…10 mm²	4.0…25 mm²
	Torque	1.8 N•m	2.3 N•m	4.0 N•m
Coarse-Stranded/Solid	Single Conductor	1.5…6.0 mm²	2.5…25 mm²	4.0…50 mm²
	Torque	1.8 N•m	2.3 N•m	4.0 N•m
	Two Conductor	1.5…6.0 mm²	2.5…16 mm²	4.0…35 mm²
	Torque	1.8 N•m	2.3 N•m	4.0 N•m
Stranded/Solid	Single Conductor	14…8 AWG	16…6 AWG	12…1 AWG
	Torque	16 lb-in.	20 lb-in.	35 lb-in.
	Two Conductor	14…10 AWG	16…6 AWG	12…2 AWG
	Torque	16 lb-in.	20 lb-in.	35 lb-in.

❄ For multiple conductor applications, the same size and style wire must be used.

2

Bulletin 193-EC — E3 & E3 Plus Solid-State Overload Relays

Bul. 193/592-EC1 Overload Relays:
- 0.4…5000 A current range
- DeviceNet ready (ODVA Conformance Tested)
- LED indicators
- Test/Reset button
- Adjustable trip class 5…30
- Ambient temperature compensation
- True RMS current sensing (20…250 Hz)
- Protection for single- and three-phase motors
- Integrated I/O (2 In/1 Out)
- Programmable trip and warning settings
- Diagnostic functions (history of last 5 trips and warnings)
- Node address switches (series B)

Bul. 193/592-EC2/EC3 Overload Relays:
- Features of Bul. 193/592-EC1
- Integrated I/O (4 In/2 Out)
- EC2: Low-level (1…5 A) internal ground fault protection
- EC3:High-level (20 mA…5 A) external ground fault protection
- PTC thermistor monitoring
- DeviceLogix™ component technology (series B)
- Two-speed motor protection (series B)

Bul. 193/592-EC4 Current Monitor Relay:
- Current monitoring for three independent channels

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Standards Compliance

EN 60947-4-1
CSA C22.2 No. 14
UL 508, UL1053 (class 1)

Certifications

ABS
CE
cULus Listed (File No. E14840, Guide NKCR, NKCR7; File No. E53935, Guide KDAX)
ATEX
C-tick
CCC

Your order must include 1) the Cat. No. of overload relay selected, and 2) if required, Cat. No. of any accessories.

Product Overview

The E3 Overload Relay is available in two configurations: the E3 and E3 Plus. The following table illustrates the functional differences between the two:

Feature	E3	E3 Plus
Inputs*	2	4
Outputs	1	2
Thermistor Input	No	Yes
Ground Fault Protection	No	Yes
DeviceLogix	No	Yes

* Inputs are rated 24V DC.

Thermal Overload

Thermal Utilization

The E3 Overload Relay provides overload protection through true RMS current measurement of the individual phase currents of the connected motor. Based on this information, a thermal model that simulates the actual heating of the motor is calculated. Percent of thermal capacity utilization (%TCU) reports this calculated value and can be read via the DeviceNet network. An overload trip occurs when the value reaches 100%.

Adjustable Settings

Thermal overload protection setup is accomplished simply by programming the motor's full load current rating (FLA) and the desired trip class (5…30). Programming of the actual values through software programming ensures the accuracy of the protection.

Thermal Memory

The E3 Overload Relay includes a thermal memory circuit designed to approximate the thermal decay for a trip class 30 setting. This means that the thermal model of the connected motor is maintained at all times, even if the supply power is removed.

Reset Modes

Flexibility is afforded the end-user in the ability to select between manual and automatic reset for an overload trip, allowing for broad application. The point of reset is user adjustable from 1…100% TCU.

Time to Trip

During an overload condition, the E3 Overload Relay provides an estimated time to trip that is accessible via the DeviceNet network. This allows corrective action to be taken so that production may continue uninterrupted.

Time to Reset

Following an overload trip, the E3 Overload Relay will not reset until the calculated percentage of thermal capacity utilization falls below the reset level. As this value decays, the time to reset, which is accessible via the DeviceNet network, is reported.

Thermal Warning

The E3 Overload Relay provides the capability to alert in the event of an impending overload trip. A thermal warning bit is set in the Warning Status word when the calculated percentage of thermal capacity utilization exceeds the programmed thermal warning level, which has a setting range of 0…100% TCU.

Two-Speed Protection

The E3 Plus Overload Relay offers a second FLA setting for 2-speed motor protection. What used to require two separate overload relays, one for each set of motor windings, can now be accomplished with one device. Improved protection is delivered as thermal utilization is maintained in one device during operation in both speeds.

Phase Loss

The E3 Overload Relay offers configurable phase loss protection in allowing the installer to enable or disable the function plus set a time delay setting, adjustable from 0.1…25.0 seconds. The trip level is factory-set at a current imbalance measurement of 100%.

Ground (Earth) Fault

The E3 Plus Overload Relay incorporates zero sequence (core balance) sensing into its design through the 90 A rating for low level (arcing) ground fault detection. Trip and warning settings are adjustable from 20 mA…5.0 A. For devices rated greater than 90 A and for ground fault detection less than 1.0 A, the external core balance current transformer accessory is required. Class I protection is provided as defined by UL1053. Series B or later devices provide a trip inhibit setting, offering flexibility to prevent tripping when the ground fault current magnitude exceeds 10 A. This can be useful to guard against opening of the controller when the fault current could potentially exceed the controller's interrupting capacity rating. **Note:** The E3 Plus Overload Relay is not a Ground Fault Circuit-Interrupter for personnel protection as defined in article 100 of the U.S. National Electric Code.

Stall
Stall is defined as a condition where the motor is not able to reach full-speed operation in the appropriate amount of time required by the application. This can result in motor overheating as current draw is in excess of the motor's full load current rating.
The E3 Overload Relay provides user-adjustable stall protection. The trip setting has a range of 100…600% FLA, and the enable time is adjustable up to 250 seconds.

Jam (Overcurrent)
The E3 Overload Relay can respond quickly to take a motor off-line in the event of a mechanical jam, thereby reducing the potential for damage to the motor and the power transmission components. Trip adjustments include a trip setting adjustable from 50…600% FLA and a trip delay time with a range of 0.1…25.0 seconds. A separate warning setting is adjustable from 50…600% FLA.

Underload (Undercurrent)
A sudden drop in motor current can signal conditions such as
- Pump cavitation
- Tool breakage
- Belt breakage

For these instances, rapid fault detection can help minimize damage and aid in reducing production downtime.

Additionally, monitoring for an underload event can provide enhanced protection for motors that are coded by the medium handled (e.g., submersible pumps that pump water). Such motors can become overheated despite being underloaded. This can result from an absence or an insufficient amount of the medium (due to clogged filters, closed valves, etc.).

The E3 Overload Relay offers underload trip and warning settings adjustable from 10…100% FLA. The trip function also includes a trip delay time with a range of 0.1…25.0 seconds.

Over-temperature Protection
The E3 Plus Overload Relay provides motor over-temperature protection with the added provisions for terminating and monitoring of stator windingembedded positive temperature coefficient (PTC) thermistors. PTC thermistors are semiconductors that exhibit a large increase in resistance when the rated response temperature is exceeded. When the monitored PTC thermistor resistance exceeds the response level of the E3 Plus Overload Relay (3400 Ω), it can be set to trip immediately or programmed to set the PTC bit of the Warning Status word.

Current Imbalance (Asymmetry)
The E3 Plus Overload Relay offers current imbalance trip and warning settings adjustable from 10…100%. The trip function also includes a trip delay time with a range of 0.1…25.0 seconds.

Remote Trip
The remote trip function allows an external device such as a vibration sensor to induce the E3 Overload Relay to trip. External device relay contacts are wired to the E3 Overload Relay discrete iputs. The discrete inputs are configurable with an option for assigning the remote trip function.

Current Monitoring Functions
The E3 Overload Relay allows the user to monitor the following operational data over the DeviceNet network:
- Individual phase currents (in amperes)
- Individual phase currents (as a percentage of motor full load current)
- Average current (in amperes)
- Average current (as a percentage of motor full load current)
- Percentage of thermal capacity utilized
- Current imbalance percentage
- Ground fault current (E3 Plus)

Diagnostic Functions
The E3 Overload Relay allows the user to monitor the following diagnostic information over the DeviceNet network:
- Device status
- Trip status
- Warning status
- Time to an overload trip
- Time to reset after an overload trip
- History of past five trips
- History of positive warnings
- Hours of operation
- Number of starts

Status Indicators
The E3 Overload Relay provides the following LED indicators:

Network Status: This green/red LED indicates the status of the network connection.

TRIP/WARN: This LED flashes an amber code under a warning condition and a red code when tripped.

OUT A and B: These amber LEDs illuminate when the output contacts are commanded closed.

IN 1– 4: These amber LEDs illuminate when the user-connected device contact is closed.

Note: IN 3 and 4 and OUT B are available only on the E3 Plus Overload Relay.

Inputs/Outputs
Inputs allow the connection of such devices as contactor and disconnect auxiliary contacts, pilot devices, limit switches and float switches. Input status can be monitored via the network and mapped to a controller's input image table. Inputs are rated 24V DC and are current sinking. Power for the inputs is sourced from the DeviceNet network connection with convenient customer terminations at control terminals 5 and 6. Relay contact outputs can be controlled via the network or DeviceLogix function blocks for performing such tasks as contactor operation.

Test/Reset Button
The Test/Reset button located on the front of the E3 Overload Relay allows the user to perform the following:
Test: The trip relay contact will open if the E3 Overload Relay is in an untripped condition and the Test/Reset button is pressed for 2 seconds or longer.
Reset: The trip relay contact will close if the E3 Overload Relay is in a tripped condition, supply voltage is present, and the Test/Reset button is pressed.

Single/Three-Phase Operation
The E3 Overload Relay can be applied to three-phase as well as single-phase applications. A programming parameter is provided for selection between single- and three-phase operation. Straight-through wiring is afforded in both cases.

DeviceNet Communications
The E3 Overload Relay is a Group 2 "slave only" device and supports the following:
- UCMM (Unconnected Message Manager) messages
- Polled I/O messaging
- Change-of-state/cyclic messaging
- Explicit messaging
- Group 4 - Off-line node recovery messaging
- Full parameter object support
- Auto-baud network rate identification
- Configuration consistency value

For more information on operation and maintenance of this product, please reference the user manual, publication 193-UM002_-EN-P.

DeviceLogix

The E3 Plus offers increased control flexibility with DeviceLogix capabilities. Using RSNetWorx for DeviceNet (version 3.0 or later), function block programs can be configured and saved to an E3 Plus Overload Relay to operate single logic routines. The function blocks are programmed using standard Boolean operators such as AND, OR, XOR, and NOT, plus timers, counters, and latches. In addition to allowing the use of the integral discrete inputs, protection functions can also be used as inputs to trigger outputs. For example, the Ground Fault Protection function could be used to control Output A of the E3 Plus Overload Relay for operation of a circuit breaker short-trip mechanism.

DeviceNet™ Configuration Terminal

The DeviceNet Configuration Terminal (**Cat. No. 193-DNCT**) is a handheld device that can be used to commission, configure, program, and monitor devices on your DeviceNet network. The 193-DNCT allows you to increase productivity and ease troubleshooting with easy access to information and diagnostics of your system.

Network Who

The 193-DNCT can be used with any DeviceNet device and has DeviceLogix, metering, graphing, and auto-display capabilities which can help ease troubleshooting by commissioning devices online through your network. The terminal searches for all devices on the network and provides device address, device name, and status of a device.

Monitoring & Editing

The DeviceNet Configuration Terminal can be used to upload, store, and download device configurations and DeviceLogix™ programs for DeviceNet devices via your network. Easily replace and reconfigure scan lists of DeviceNet scanners (minus the Automatic Device Replacement configuration). Parameters can be accessed as either groups or as a numbered list of all parameters, and they can be monitored and edited.

Diagnostics

Ease troubleshooting using the DeviceNet Configuration Terminal. The 193-DNCT can present DeviceNet diagnostics, network utilization, and network statistics are available including baud rate, bus voltage, percentage of bus loading, and CAN errors.

DeviceLogix

The terminal allows you to enable, monitor, edit, or delete DeviceLogix programs.

AC Input Interface Module Accessory

The AC Input Interface Module conveniently allows the E3 overload relay to be retrofitted or applied in new applications that require 110/120V AC control circuitry. This new accessory simply plugs into the E3 overload relay's existing input terminals, optimizing panel space utilization. The module accepts termination of up to four external devices, making it compatible with the E3 and E3 Plus versions of the E3 overload relay. Optical isolation is provided between the AC input wiring and the E3's internal 24V circuitry.

Catalog Number Explanation

193 –	EC1	B	B
	a	*b*	*c*

a

Type	
Code	Description
EC1	E3
EC2	E3 Plus with internal ground fault sensor
EC3	E3 Plus with external ground fault sensor
EC4	E3 Plus current monitor relay with external ground fault sensor

b

Adjustment Rating [A]	
Code	Description
P	0.4…2.0
A	1…5
B	3…15
C	5…25
D	9…45
E	18…90
F	28…140
G	42…210
H	60…302
J	84…420
K	125…630
L	172…860
Z	9…5000

c

Bulletin 100 Contactor Size	
Code	Description
B	C09…C23
D	C30…C43
E	C60…C85
F	D95…D180
G	D210…D420
H	D630…D860
Z	Panel mount∗

∗ Only available for Cat. Nos. 193-EC1ZZ, 193-EC3ZZ, and 193-EC4ZZ. For all other cat. nos., order Cat. No. 193-ECPM_ separately.

Bulletin 193-EC1 Electronic Motor Protection Relays – Direct Contactor Mount

• 2 inputs • 1 output

Mounts to Contactor	Adjustment Range [A]	Cat. No.
100-C09…100-C23	0.4…2	**193-EC1PB**
	1…5	**193-EC1AB**
	3…15	**193-EC1BB**
	5…25	**193-EC1CB**
100-C30…100-C43	1…5	193-EC1AD
	3…15	193-EC1BD
	5…25	193-EC1CD
	9…45	**193-EC1DD**
100-C60…100-C85	9…45	193-EC1DE
	18…90	**193-EC1EE**
100-D95…100-D180	28…140	❄ **193-EC1FF**
	42…210	❄ 193-EC1GF
100-D210…100-D420	42…210	❄ 193-EC1GG
	60…302	❄ 193-EC1HG
	84…420	❄ 193-EC1JG
100-D630…100-D860	125…630	❄ 193-EC1KH
	172…860	❄ 193-EC1LH

❄ Does not include terminal lugs. See Accessories, page 2-218.

Bulletin 193-EC3 Electronic Motor Protection Relay – Direct Contactor Mount

• 4 inputs • 2 outputs
• PTC thermistor input • DeviceLogix (series B)
• External ground fault sensor input

Mounts to Contactor	Adjustment Range [A]	Cat. No.
100-C09…100-C23	0.4…2.0	193-EC3PB
	1…5	193-EC3AB
	3…15	193-EC3BB
	5…25	193-EC3CB
100-C30…100-C43	1…5	**193-EC3AD**
	3…15	**193-EC3BD**
	5…25	193-EC3CD
	9…45	193-EC3DD
100-C60…100-C85	9…45	193-EC3DE
	18…90	193-EC3EE
100-D95…100-D180	28…140	❄ 193-EC3FF
	42…210	❄ 193-EC3GF
100-D210…100-D420	42…210	❄ 193-EC3GG
	60…302	❄ 193-EC3HG
	84…420	❄ 193-EC3JG
100-D630…100-D860	125…630	❄ 193-EC3KH
	172…860	❄ 193-EC3LH

❄ Does not include terminal lugs. See Accessories, page 2-218.

Bulletin 193-EC2 Electronic Motor Protection Relay – Direct Contactor Mount

• 4 Inputs • 2 Outputs
• PTC thermistor input • DeviceLogix (series B)
• Internal ground fault sensor

Mounts to Contactor	Adjustment Range [A]	Cat. No.
100-C09…100-C23	0.4…2	**193-EC2PB**
	1…5	**193-EC2AB**
	3…15	**193-EC2BB**
	5…25	**193-EC2CB**
100-C30…100-C43	1…5	193-EC2AD
	3…15	**193-EC2BD**
	5…25	**193-EC2CD**
	9…45	**193-EC2DD**
100-C60…100-C85	9…45	193-EC2DE
	18…90	**193-EC2EE**

Bulletin 193-EC4 Current Monitor Relay – Direct Contactor Mount

• 4 inputs • 2 outputs
• PTC thermistor input • DeviceLogix (series B)
• External ground fault sensor input

Mounts to Contactor	Adjustment Range [A]	Cat. No.
100-C09…100-C23	0.4…2.0	193-EC4PB
	1…5	193-EC4AB
	3…15	193-EC4BB
	5…25	193-EC4CB
100-C30…100-C43	9…45	193-EC4DD
100-C60…100-C85	18…90	193-EC4EE
100-D95…100-D180	28…140	❄ 193-EC4FF
	42…210	❄ 193-EC4GF
100-D210…100-D420	42…210	❄ 193-EC4GG
	60…302	❄ 193-EC4HG
	84…420	❄ 193-EC4JG
100-D630…100-D860	125…630	❄ 193-EC4KH
	172…860	❄ 193-EC4LH

❄ Does not include terminal lugs. See Accessories, page 2-218.

Panel Mount Devices for use with External Current Transformers§

Description	Adjustment Range [A]	Cat. No.
• 2 Inputs • 1 Output	9…5000	**193-EC1ZZ**
• 4 Inputs • 2 Outputs • External Ground Fault Sensor Input • PTC Thermistor Input • DeviceLogix	9…5000	**193-EC3ZZ** **193-EC4ZZ**

§ Current transformers supplied by customer. Refer to Specifications, page 2-167, and CT Ratio to FLA chart below for proper current transformer selection.

CT Ratio to FLA Setting Range Correlation

CT Ratio	FLA Setting Range (A)	CT Ratio	FLA Setting Range (A)	CT Ratio	FLA Setting Range (A)
50:5	9…45	300:5	60…302	1200:5	240…1215
100:5	18…90	500:5	84…420	2500:5	450…2250
150:5	28…140	600:5	125…630	5000:5	1000…5000
200:5	42…210	800:5	172…860	—	—

2

Add-on Accessories

	Description	For Use With	Pkg. Qty.	Cat. No.
	DIN Rail/Panel Adapter♣	193-EC__B	1	**193-ECPM1**
		193-EC_D		**193-ECPM2**
		193-EC__E		**193-ECPM3**
	AC Input Interface Module rated 110/120V AC, 50/60 Hz	193-EC — all 592-EC — all	1	**193-EIMD**
	Core Balanced Ground Fault Sensor • Required when using either an E1 Plus Ground Fault Protection or Ground Fault/Jam Module • Required for ground fault protection with the Cat. No. 193-EC3_ _ overload relay	100-C09…100-C37 NEMA size 00…2	1	**193-CBCT1**
		100-C09…100-C85 NEMA size 00…3		**193-CBCT2**
		100-C09…100-C85, 100-D95…100-D180 NEMA size 00…4		193-CBCT3
		100-C09…100-C85, 100-D95…100-D420 NEMA size 00…5		193-CBCT4
	DeviceNet Configuration Terminal Used to interface with objects on a DeviceNet network. Includes 1 m communications cable (193-CB1).	193-EC (all), 592-EC (all); 280/281/283/284 ArmorStart	1	**193-DNCT**
	1 meter communication cable, color-coded bare leads	193-DNCT	1	**193-CB1**
	1 meter communication cable, microconnector (male)	193-DNCT	1	**193-CM1**
	Panel Mount Adapter/Door Mount Bezel Kit	193-DNCT	1	**193-DNCT-BZ1**

♣ The electronic motor protection relay can be mounted separately to top-hat rail EN 50 022-35.
‡ Intended only for point-to-point configurations.

	Description	For Use With	Pkg. Qty.	Cat. No.
	Terminal Lugs Set of 2 Protection class IP2X per IEC 60529 and DIN 40050	100-D140, 100-D180, 100-D95E…D180E, 193-EC_F, 193-EE_F	2	**100-DTB180**
		100-D210...100-D420, 193-EC_G, 193-EF2C, 193-EE_G		**100-DTB420**
	Terminal Lugs (UL/CSA), Copper Frame Set of 3	100-D95, 100-D110	3	100-DL110
		100-D140, 100-D180, 193-EC_F, 193-EE_F		**100-DL180**
		100-D210…100-D420, 193-EC_G, 193-EE_G		**100-DL420**
		100-D630, 100-D860, 193-EC_H, 193-EE_H		100-DL630
		100-D630, 100-D860, 193-EC_H, 193-EE_H		100-DL860
	Terminal Covers Protection class IP20 per IEC 60529 and DIN 40 050 For direct-on-line, reversing, two-speed, and wye-delta/star-delta assemblies	100-D95…100-D180, 193-EC_F, 193-EE_F	1	**100-DTC180**
		100-D210...100-D420, 193-EC_G, 193-EE_G		**100-DTC420**
		100-D630…100-D860, 193-EC_H, 193-EE_H		100-DTC860
	Phase Barriers Set of 4	100-D630…D860, 193-EC_H, 193-EE_H	4	100-DPB860

Marking Systems

Uniform labeling materials for contactors, motor starting equipment, timing relays and circuit breakers

	Description	Pkg. Qty.❄	Cat. No.
	Label Sheet 105 self-adhesive paper labels each, 6 x 17 mm	10	**100-FMS**
	Marking Tag Sheet 160 perforated paper labels each, 6 x 17 mm To be used with a transparent cover	10	**100-FMP**
	Transparent Cover To be used with marking tag sheets	100	**100-FMC**
	Marking Tag Adapters To be used with marking tag:	100	100-FMA2

❄ Must be ordered in multiples of package quantities.

Specifications

Main Circuits

	Cat. No. 193-EC_B, 193-EC_D, 193-EC_Z, 592-EC_T, 592-EC_C	Cat. No. 193-EC_E, 592-EC_D	Cat. No. 193-EC_F	Cat. No. 193-EC_G	Cat. No. 193-EC_H
Rated Insulation Voltage (U_i)	690V AC		1000V AC		
Rated Impulse Strength (U_{imp})	6 kV AC		6 kV AC		
Rated Operating Voltage (U_e) IEC/UL	690V AC/600V AC		1000V AC/600V AC		
Rated Frequency	20…250 Hz		50/60 Hz		
Terminal Cross-Sections			—	—	—
Terminal Type Terminal Screws	.M5	M8			
Flexible-Stranded with Ferrule Single Conductor Torque	2.5…16 mm² 2.5 N•m	4…35 mm² 4 N•m			
Flexible-Stranded with Ferrule Multiple Conductor Torque	6…10 mm² 3.4 N•m	4…25 mm² 4 N•m			
Coarse-Stranded/Solid Single Conductor Torque	2.5…25 mm² 2.5 N•m	4…50 mm² 4 N•m			
Coarse-Stranded/Solid Multiple Conductor Torque	6…16 mm² 3.4 N•m	4…35 mm² 4 N•m			
Stranded/Solid– Single Conductor Torque	#14…6 AWG 22 lb•in	#12…1 AWG 35 lb•in			
Stranded/Solid Multiple Conductor Torque	#10…6 AWG 30 lb•in	#6…2 AWG 35 lb•in			
Pozidriv Screwdriver Size	2	—			
Slotted Screwdriver (mm)	1 x 6	—			
Hexagon Socket Size SW (mm)	—	4			

3-Pole Terminal Blocks

Cat. No. 100-DTB180	Cat. No. 100-DTB420
(A) 6…1/0 AWG, 16…50 mm² B) 6 AWG…250 MCM, 16…120 mm² 90…110 lb•in., 10…12 N•m	(2) 4 AWG…600 MCM, 25…240 mm² 180…220 lb•in., 20…25 N•m

Terminal Lug Kits

Cat. No. 100-DL110	Cat. No. 100-DL180	Cat. No. 100-DL420	Cat. No. 100-DL630	Cat. No. 100-DL860
Lug: 6…2/0 AWG, 16…70 mm² 90…110 lb•in., 10…12 N•m Terminal: 13/32 in, 10 mm 150 lb•in., 17 N•m	Lug: 6 AWG…250 MCM, 16…120 mm² 90…110 lb•in., 10…12 N•m Terminal: 1/2 in, 13 mm 275 lb•in., 16 N•m	Lug: 2 AWG…350 MCM, 375 lb•in., 42 N•m Terminal: 11/16 in, 17 mm 140 lb•in., 16 N•m	Lug: 2/0 AWG…500 MCM, 70…240 mm² 400 lb•in., 45 N•m Terminal: 3/4 in, 19 mm 600 lb•in., 68 N•m	Lug: 2/0 AWG…500 MCM, 70…240 mm2 400 lb•in., 45 N•m Terminal: 3/4 in, 19 mm 600 lb•in., 68 N•m

Maximum Heat Dissipation (Watts)

	Cat. No. 193-EC_B, 193-EC_D	Cat. No. 193-EC_E	Cat. No. 193-EC_F	Cat. No. 193-EC_G	Cat. No. 193-EC_H
E3	3.83	4.43	10.67	22.52	35.36
E3 Plus	4.53	5.13	11.37	23.22	36.06

Control Circuits

Power Supply Ratings	
Rated Supply Voltage (U_s)	24V DC (supply via DeviceNet connection)
Operating Range	11…25V DC
Power Consumption	
E3	3.2 W
E3 Plus	3.9 W
Output Relay Ratings	
Type of Contacts	Form A SPDT–NO
Rated Insulation Voltage (U_i)	300V AC
Rated Operating Voltage (U_e)	250V AC
Rated Operating Current (I_e)	5 A
Minimum Operating Current	10 mA @ 5V DC
Switching Capacity	B300 AC-15
Resistive Load Rating (p.f. = 1.0)	5 A, 250V AC/5 A, 30V DC
Inductive Load Rating (p.f. = 0.4) (L/R = 7 ms)	2 A, 250V AC/2 A, 30V DC
Input Ratings	
Supply Voltage	24V DC ± 10% (provided by E3)
Input Type	Current Sinking
Thermistor/PTC Input Ratings	
Type of Control Unit	Mark A
Max. No. of Sensors in Series	6
Max. Cold Resistance of PTC Sensor Chain	1500 Ω
Trip Resistance	3400 Ω ± 150 Ω
Reset Resistance	1600 Ω ± 100 Ω
Short-Circuit Trip Resistance	25 Ω ± 10 Ω

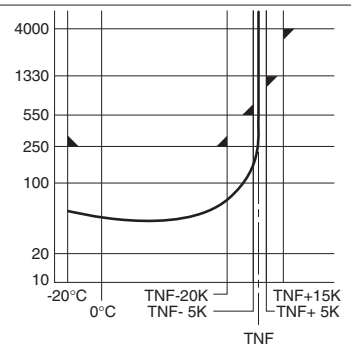
UL Short-Circuit Ratings

Cat. No.	Maximum Available Fault Current [A]	Maximum Voltage [V]
193-EC_B, 592-EC_T	5 000	600
193-EC_D, 592-EC_C	5 000	600
193-EC_E, 592-EC_D	10 000	600
193-EC_F	10 000	600
193-EC_G	18 000	600
193-EC_H	42 000	600
193-EC_Z	5 000	600

IEC Short-Circuit Ratings

Cat. No.	Maximum Available High Fault Current [A]	Maximum Voltage [V]
193-EC_B, 592-EC_T	100,000	690
193-EC_D, 592-EC_C	100,000	690
193-EC_E, 592-EC_D	100,000	690
193-EC_F	100,000	1000
193-EC_G	100,000	1000
193-EC_H	100,000	1000
193-EC_Z	100,000	690

Control Circuits, Continued

Thermistor/PTC Input Ratings, Continued	
Max. Voltage @ PTC Terminals (R_{PTC} = 4 kΩ)	7.5V DC
Max. Voltage @ PTC Terminals (R_{PTC} = open)	30V DC
Response Time	500 ms
Sensor Characteristic	

Per IEC 34-11-2

Control and DeviceNet Terminal Cross-Sections	
Terminal Screws	M3
Flexible-Stranded with Ferrule – Single Conductor Torque	0.25…2.5 mm² 0.55 N•m
Flexible-Stranded with Ferrule – Multiple Conductor Torque	0.5…0.75 mm² 0.55 N•m
Coarse-Stranded/Solid– Single Conductor Torque	0.2…4.0 mm² 0.55 N•m
Coarse-Stranded/Solid– Multiple Conductor Torque	0.2…1.5 mm² 0.55 N•m
Stranded/Solid– Single Conductor Torque	24…12 AWG 5 lb-in
Stranded/Solid– Multiple Conductor Torque	24…16 AWG 5 lb-in
Slotted Screwdriver (mm)	0.6 x 3.5

Electromagnetic Compatibility Ratings

Electrostatic Discharge Immunity Test Level	8kV Air Discharge, 6kV Contact Discharge
Performance Criteria	A ❄
RF Immunity Test Level	10V/m
Performance Criteria	A ❄
Electrical Fast Transient/Burst Immunity Test Level	4kV (Power), 2kV (Control & Comm)
Performance Criteria	A ❄
Surge Immunity Test Level	2kV (L-E), 1kV (L-L)
Performance Criteria	A ❄
Radiated Emissions	Class A
Conducted Emissions	Class A

❄ Performance Criteria A requires the device under test (DUT) to experience no degradation or loss of performance.

Environmental Ratings

Ambient Temperature Storage Operating	 -40…+85 °C (-40…+185 °F) -20…+55 °C (-4…+131 °F)
Humidity Operating Damp Heat – Steady-State (per IEC 68-2-3) Damp Heat – Cyclic (per IEC 68-2-30)	 5…95% Non-condensing 92% r.h., 40 °C(104 °F), 56 days 93% r.h., 25 °C/40 °C(77 °F/104 °F), 21 cycles
Vibration (per IEC 68-2-6)	3 G
Shock (per IEC 68-2-27)	30 G
Pollution Environment	Degree 2
Degree of Protection 193-ECxxx 592-ECxxx	 1P1X 1P0

Current Reporting Accuracy

Phase Currents: 100% min. FLA Setting Value … 720% max. FLA Setting Value 50%…100% min FLA Setting Value	 +/- 5% +/- 10%
Ground Current (0.5…9.0 A)	+/- 10%

External Current Transformers (for use with Cat. Nos. 193-EC1ZZ1, 193-EC3ZZ, and 193-EC4ZZ)

The user shall provide one current transformer (CT) for each motor phase,and shall connect the CT's secondary leads to the appropriate E3 overload relay power terminals, as shown in current transformer's wiring diagrams. The CT shall have the appropriate ratio (refer to the product nameplate or product description). Additionally, the CT shall be selected to be capable of providing the required VA to the secondary load, which includes the E3 overload relay burden of 0.1 VA at the rated secondary current and the wiring burden. Finally, the CT shall be rated for protective relaying to accomodate the high inrush currents associated with motor startup, and shall have an accuracy of <±2% over its normal operating range. Typical CT ratings include (Instrument Transformers, Inc. — Model #23 or equivalent):

ANSI (USA)	**Class C5B0.1**
CSA (Canada)	**Class 10L5**
IEC (Europe)	**5 VA Class 5P10**

General

	Cat. No. 193-EC_B, 193-EC_D, 193-EC_Z	Cat. No. 193-EC_E	Cat. No. 193-EC_F	Cat. No. 193-EC_G	Cat. No. 193-EC_H
Approximate Weights	0.80 kg (1.77 lb)	1.23 kg (2.71 lb)	2.95 kg (6.5 lb.)	4.43 kg (9.75 lb.)	8.63 kg (19.0 lb.)
Standards	CSA C22.2 No.14, DIN VDE 0660, EN 60 947, UL 508, UL 1053				
Certifications	CE, C-tick, cUL, ATEX (pending), CCC (pending)				

Protection and Warning Summary

	Trip Enable	Warning Enable	Trip Level Settings		Trip Delay Settings		Warning Level Settings		Inhibit Time Settings❄	
Protective Function	Factory Default	Factory Default	Range	Default	Range (s)	Default (s)	Range	Default	Range (s)	Default (s)
Thermal Overload	Enabled	Disabled	0.4…5000 A	—	Trip Class 5…30	Trip Class 10	0…100 %TCU	85%	—	—
Phase Loss	Enabled	—	‡	‡	0.1…25.0	1.0	—	—	0…250	0
Ground (Earth) Fault	Disabled	Disabled	1.0…5.0 A	2.5 A	0.1…25.0	0.5	1.0…5.0 A	2.0 A	0…250	10
Stall (High Overload During Start)	Disabled	—	100…600 % FLA §	600 % FLA §	0…250 §	10§	—	—	—	—
Jam (High Overload During Run)	Disabled	Disabled	50…600 % FLA	250 % FLA	0.1…25.0	5.0	50…600 % FLA	150 % FLA	0…250	10
Underload	Disabled	Disabled	10…100 % FLA	50 % FLA	0.1…25.0	5.0	10…100 % FLA	70 % FLA	0…250	10
PTC	Disabled	Disabled	—	—	—	—	—	—	—	—
Current Imbalance (Asymmetry)	Disabled	Disabled	10…100%	35%	0.1…25.0	5.0	10…100%	20%	0…250	10
Comm Fault	Enabled	Disabled	—	—	—	—	—	—	—	—
Comm Idle	Disabled	Disabled	—	—	—	—	—	—	—	—

§ Inhibit Time settings are used for both trip and warning functions.
‡ Phase loss trip level is set at a current imbalance greater than or equal to 100% and is not user adjustable.
❄ Stall Protection is only applicable to the motor starting sequence.

Programming and Control Terminal

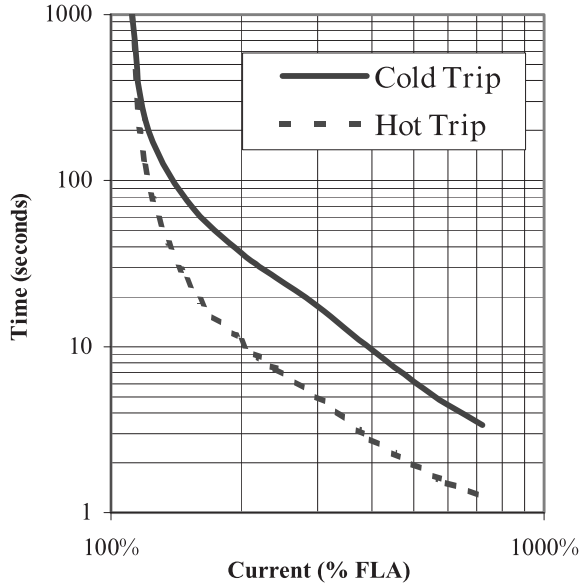
Display	
Display type	128x64 LCD with yellow-green backlighting
Viewing area	57 x 30 mm (2.24 x 1.18 in.)
Keypad	
Keypad type	Tactile embossed, domed keys, sealed membrane
Operation force	453 g (16 oz.)
Operational life	1 million operations
Communications	
Communication protocol	DeviceNet™ (125, 250, 500 Kbaud selectable)
Electrical	
Input voltage range	11…25V DC
Input power, typical	1.7 W
Input current	70 mA @ 24V DC
Environmental	
Operating temperature	0…50 °C (32…122 °F)
Storage temperature	-40…+85 °C (-40…+185 °F)
Humidity	5…95%, non-condensing
Operating shock	30 g
Non-operating shock	50 g
Operating vibration	2.5 g @ 5 Hz…2 kHz
Non-operating vibration	5 g @ 5 Hz…2 kHz
Dimensions	
Height	116 mm (4.57in.)
Width	70 mm (2.76 in.)
Depth	15.5 mm (0.67 in.)
Weight	85 g (3 oz.)
Certifications	
cULus	UL 508, C22.2, No. 14
CE	EN61000-6-2:2005 EN61000-6-4:2001
RoHS	This product meets the material restrictions of the European Union RoHS Directive

AC Input Interface Module

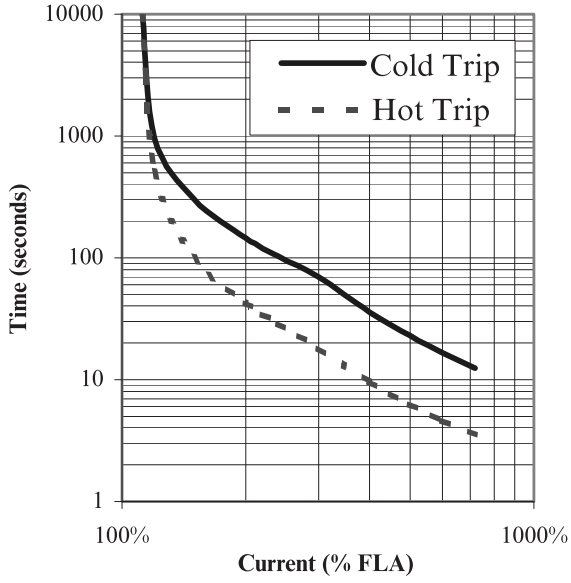
Electrical	
Number of inputs	4
Voltage category	110/120V AC
Operating voltage range	79…132V AC
Frequency range	47…63 Hz
Off-state voltage (max.)	20V AC
On-state voltage (min.)	79V AC
On-state current	2.0 mA @ 79V AC (min.), 10.0 mA @ 132V A (max.)
Inrush current (max.)	150 mA
Off-state current (max.)	1.0 mA
Heat dissipation (max.)	0.10 W/input
IEC input compatibility	Type 1
Environmental	
Operating temperature	-20…+55 °C (-4…+131 °F)
Storage temperature	-40…+85 °C (-40…+185 °F)
Humidity	5…95%, non-condensing
Vibration (IEC 68-2-6)	3 G
Shock (IEC 68-2-27)	30 G
Environmental	
Maximum altitude	2,000 m
Pollution environment	Pollution degree 2
Terminal marking	EN50012
Degree of protection	IP2LX
Electromagnetic Compatibility	
ESD Immunity (IEC 10000-4-2)	6 kV contact, 8 kV air
Radiated Immunity (IEC 10000-4-3)	10V/m
Fast transient burst (IEC 10000-4-4)	4 kV (Power), 2 kV (Control)
Surge immunity (IEC 10000-4-5)	2 kV common mode, 1 kV differential mode
Radiated and conducted emissions	Class A
Physical	
Weight	60 g (2.1 oz.)
Certifications	UR, cUR, CE

Trip Curves

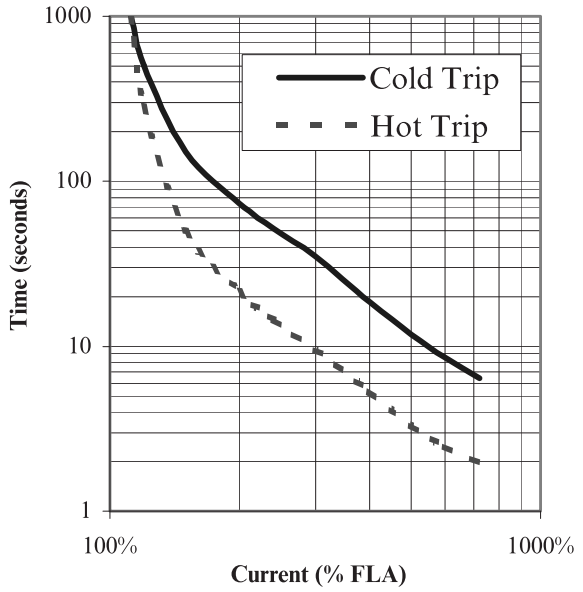
E3 & E3 Plus Overload Relay
Trip Class 5



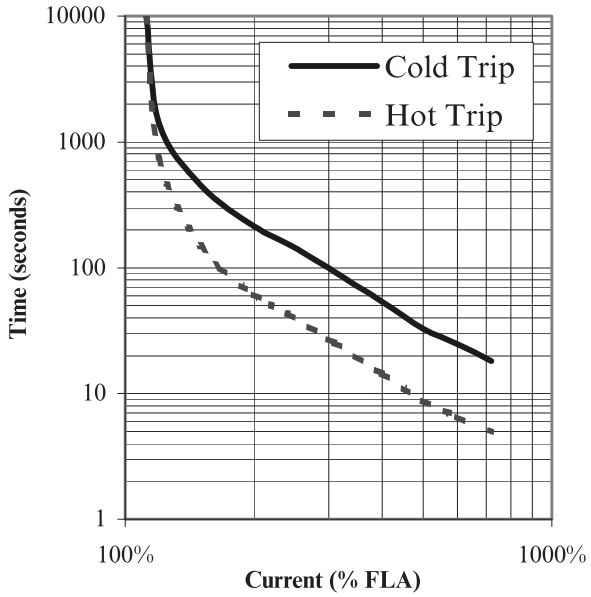
E3 & E3 Plus Overload Relay
Trip Class 20



E3 & E3 Plus Overload Relay
Trip Class 10

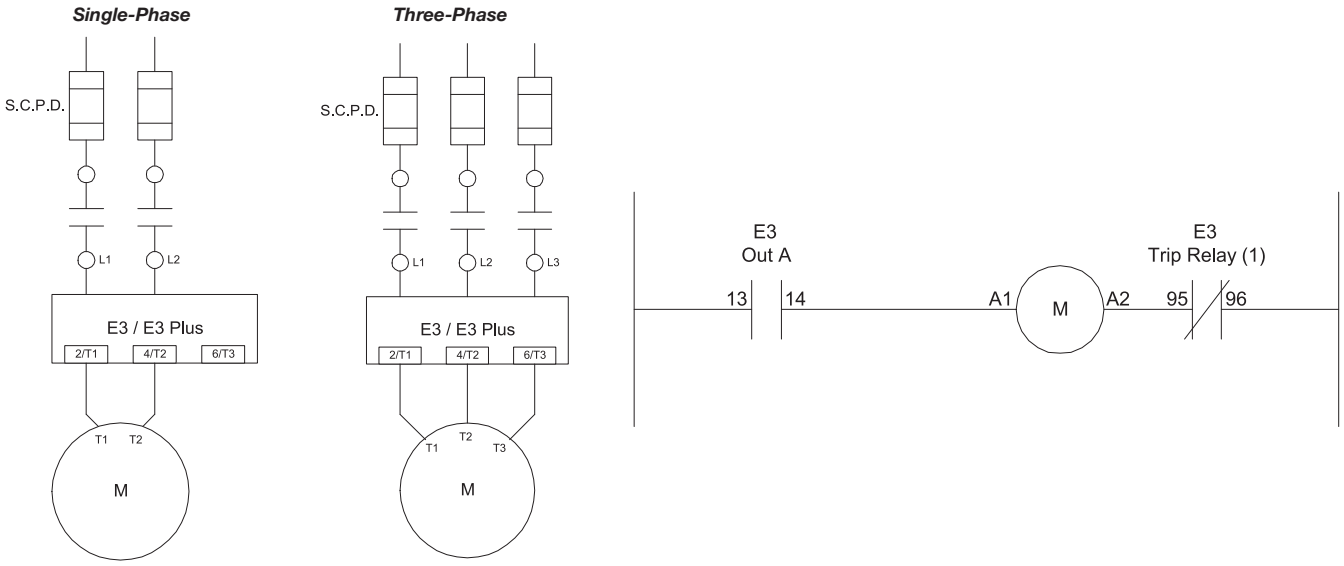


E3 & E3 Plus Overload Relay
Trip Class 30

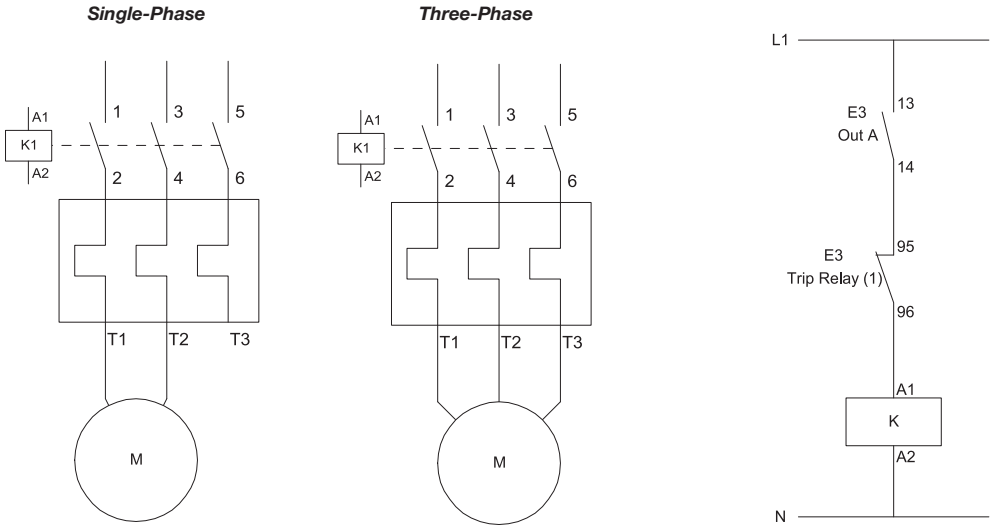


2

Typical Wiring Schematics – NEMA



Typical Wiring Schematics – IEC



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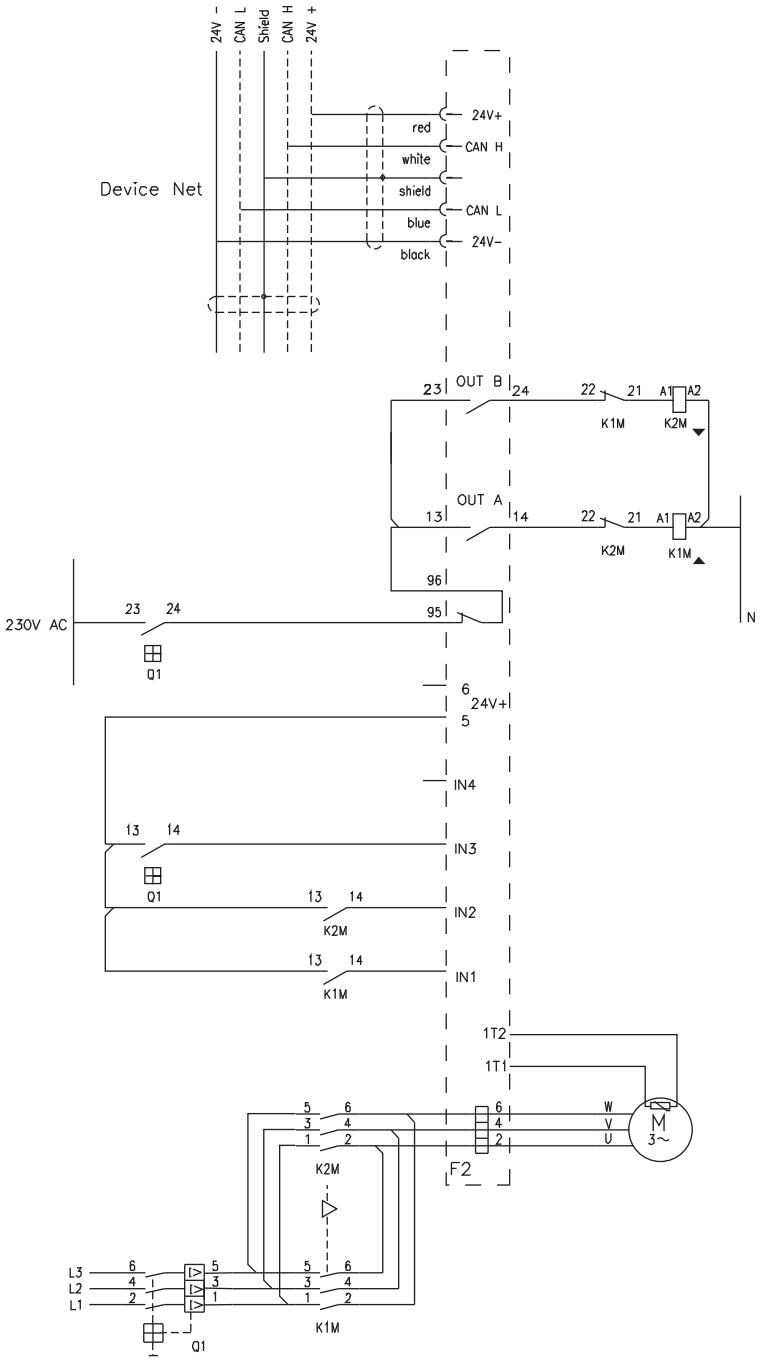
Allen-Bradley

Typical Wiring Schematics – IEC

Reversing Starter Application

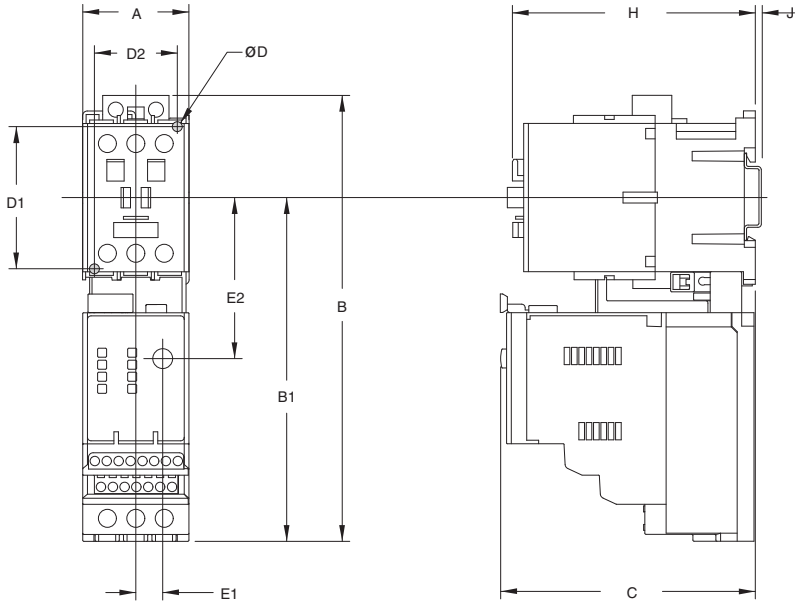


E3 and E3 Plus Solid-State Overload Relays

Approximate Dimensions

Approximate dimensions are shown in millimeters (inches). Dimensions are not to be used for manufacturing purposes.

Bulletin 109 Starter Approximate Dimensions

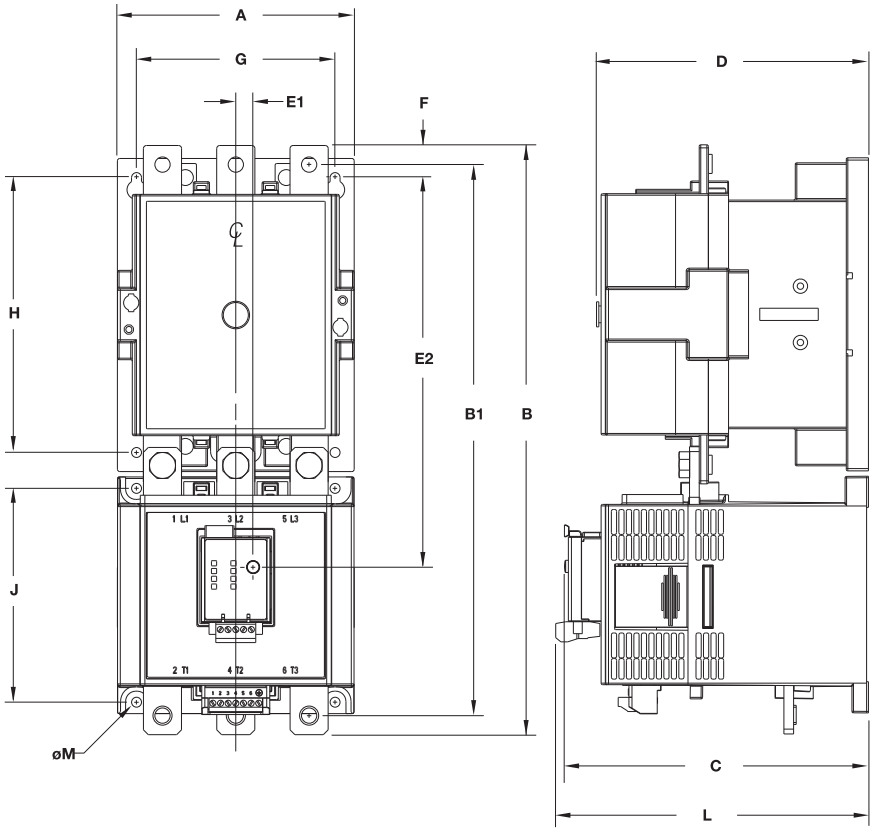


Overload Cat. No.	Contactor Cat. No.	Width A	Height B		B1	Depth C	E1	E2
			without 193-EIMD	with 193-EIMD				
193-EC_ _B	100-C09, -C12 -C16, -C23	45 (1-25/32)	188.3 (7-13/32)	207.7 (8-11/64)	145.1 (5-23/32)	107 (4-7/32)	11.4 (29/64)	67.9 (2-43/64)
193-EC_ _D	100-C30, -C37	45 (1-25/32	188.3 (7-13/32)	207.7 (8-11/64)	145.1 (5-23/32)	107 (4-7/32)	11.4 (29/64)	67.9 (2-43/64)
193-EC_ _D	100-C43	54 (2-1/8)	188.3 (7-13/32)	207.7 (8-11/64)	145.1 (5-23/32)	107 (4-7/32)	11.4 (29/64)	67.9 (2-43/64)
193-EC_ _E	100-C60, -C72, -C85	72 (2-53/64)	236.1 (9-19/64)	255.5 (10-1/16)	173.2 (6-13/16)	124.6 (4-29/32)	11.4 (29/64)	89.8 (3-17/32)

Overload Cat. No.	Contactor Cat. No.	D1	D2	H	J	ØD
193-EC_ _B	100-C09, -C12 -C16, -C23	60 (2-23/64)	35 (1-3/8)	85.1 (3-23/64)	2 (5/64)	Ø4.2 (11/64Ø)
193-EC_ _D	100-C30, -C37	60 (2-23/64)	35 (1-3/8)	104 (4-3/32)	2 (5/64)	Ø4.2 (11/64Ø)
193-EC_ _D	100-C43	60 (2-23/64)	45 (1-25/32)	107 (4-7/32)	2 (5/64)	Ø4.2 (11/64Ø)
193-EC_ _E	100-C60, -C72, -C85	100 (3-15/16)	55 (2-11/64)	125.5 (4-15/16)	2 (5/64)	Ø5.5 (7/32Ø)

Approximate dimensions are shown in millimeters (inches). Dimensions are not to be used for manufacturing purposes.

Bulletin 109 Starter Approximate Dimensions, Continued

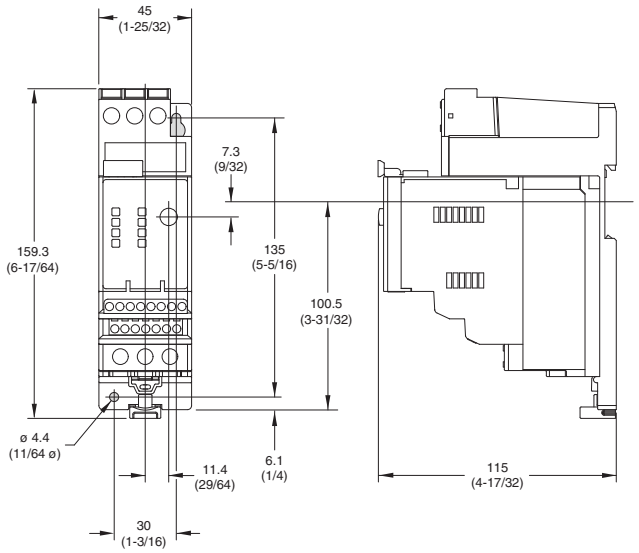


Overload Cat. No.	Contactor Cat. No.	A	Height B		B1	Depth C	D	E1	E2
			without Terminal Covers	with Terminal Covers					
193-EC_ _F	100-D95 100-D110	120 (4.72)	336.3 (13.24)	418 (16.45)	311.8 (12.27)	175.1 (6.89)	156 (5.14)	11.4 (0.45)	216.1 (8.51)
	100-D140 100-D182	120 (4.72)	339.8 (13.38)	418 (16.45)	317.8 (12.50)	175.1 (6.89)	156 (5.14)	11.4 (0.45)	216.1 (8.51)
193-EC_ _G	100-D210 100-D250 100-D300 100-D420	155 (6.10)	385.8 (15.19)	487.4 (19.19)	360.8 (14.2)	198.9 (7.83)	180 (7.09)	11.4 (0.45)	255 (10.04)
193-EC_ _H	100-D630 100-D850	255 (10.04)	552 (21.73)	915 (36.02)	508 (20)	291.7 (11.49)	270.7 (10.66)	11.4 (0.45)	373.9 (14.72)

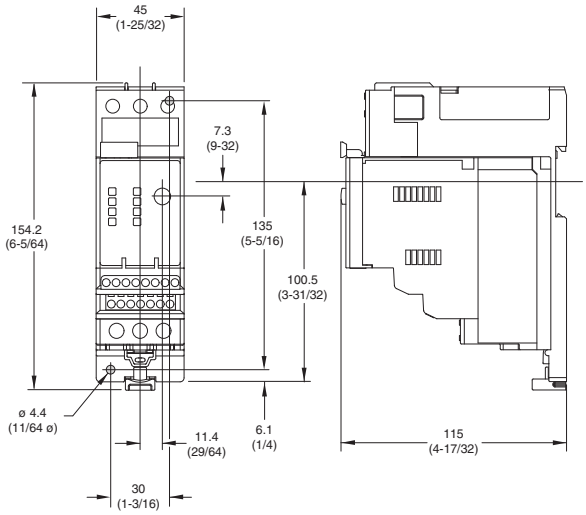
Overload Cat. No.	Contactor Cat. No.	F	G	H	J	K	L	M
193-EC_ _F	100-D95 100-D110	12.5 (0.49)	100 (3.94)	145 (5.71)	135 (5.31)	22.3 (0.88)	180.9 (7.12)	8 - 5.6 (8 - 0.22)
	100-D140 100-D182	16 (0.63)	100 (3.94)	145 (5.71)	135 (5.31)	22.3 (0.88)	180.9 (7.12)	8 - 5.6 (8 - 0.22)
193-EC_ _G	100-D210 100-D250 100-D300 100-D420	21 (0.83)	130 (5.12)	180 (7.09)	140 (5.51)	23.5 (0.93)	204.7 (8.06)	8 - 6.5 (8 - 0.26)
193-EC_ _H	100-D630 100-D850	52.5 (2.07)	226 (8.90)	230 (9.06)	108 (4.25)	109 (4.29)	297.5 (11.71)	8 - 13 (8 - 0.51)

Approximate dimensions are shown in millimeters (inches). Dimensions are not to be used for manufacturing purposes.

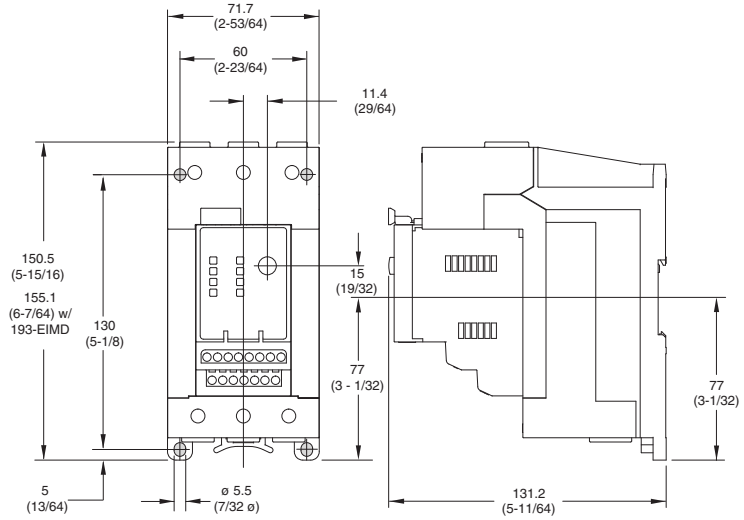
Panel Mount Adapters
(For Use With Cat. No. 193-EC_ _B)



(For Use With Cat. No. 193-EC_ _D, 193-EC_ZZ)



(For Use With Cat. No. 193-EC_ _E)



193-EF2B

193-EF2A

193-EF2C

Bulletin 193-EF

193-E1

- 0.5…400 A current range
- Phase loss/current imbalance protection
- LED indicators
- Digital (DIP switch) adjustments
- Adjustable Trip Class (2…30)

193-EF2 also includes:

- 0.5…630 A current range
- Overcurrent indication
- PTC thermistor monitoring

Bulletin 193-EF overload relays offer precise and reliable ambient compensated overload protection for the protection of three-phase squirrel cage motors. DIP switch settings allow the Bulletin 193-EF overload relays to be closely matched to the motor characteristics to safely obtain full utilization of the motor. The wide adjustment range of the trip class setting allows the Bulletin 193-EF overload relays to be applied in a wide variety of applications. The 193-EF2 version offers enhanced motor protection with additional circuitry for monitoring motor winding embedded thermistors.

Table of Contents

Product Selection 2-200
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Standards Compliance

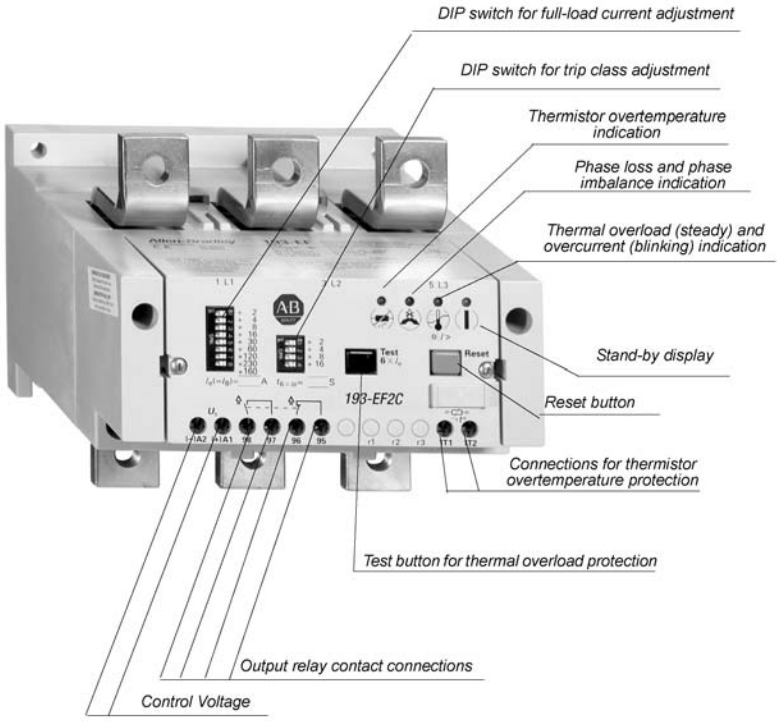
IEC 60947-4
CSA C22.2 No. 14
UL 508

Certifications

CE
CSA Certified (File No. LR13908)
UL Listed (File No. E33916, Guide NKCR)

2

Features



Catalog Number Explanation

193 – EF 1 A KP – R F L

a b c d e

a

Model	
Code	Description
EF	Bulletin 193-EF Solid-State Overload Relay

b

Version	
Code	Description
Basic	1
Advanced	2

c

Adjustment Range [A]	
Code	Description
A	20…180
B	160…400
C	160…630

d

Voltage	
Code	Description
KJ	24V AC
KV	36V AC
KY	48V AC
KD	110V AC
KP	120V AC
KF	230V AC
KA	240V AC
KN	400V AC
KG	415V AC
KB	440V AC
ZJ	24V DC
ZY	48V DC

e

Factory Modifications	
Code	Description
R	Automatic Reset
F	Remote Reset
L	External Indication

Solid-State Overload Relays

Product Selection/Accessories

Electronic Motor Protection Relays

Mounts to Contactor	Adjustment Range [A]	Cat. No.	Cat. No.§
100-D95…100-D180♣	20…180❄	**193-EF1A⊗**	**193-EF2A⊗**
100-D210…100-D420	160…400	**193-EF1B⊗**	**193-EF2B⊗**
100-D210…100-D420	160…630	—	**193-EF2C⊗**

♣ Contactor mounting requires the use of a bus bar mounting kit (**Cat. Nos. 825-MVS** or **825-MVS2**).
❄ 0.5…20 A can be achieved by looping the motor supply cables. (Refer to the Specifications section.) Use cable support **Cat. No. 193-HD**.
§ Device ships with the External Indication Module accessory (**Cat. No. 193-CB1**) included.

⊗ Coil Voltage Code

The catalog number as listed is incomplete. Select a coil voltage code from the table below for completion.
Example: **Cat. No. 193-EF1A⊗** becomes **Cat. No. 193-EF1AKP**.

Voltage [V]	24	36	48	110	120	230	240	400	415	440
50/60 Hz	KJ	KV	KY	KD	KP	KF	KA	KN	KG	KB
DC	ZJ	—	ZY	—	—	—	—	—	—	—

♣ Contactor mounting requires the use of a bus bar mounting kit (**Cat. Nos. 825-MVS** or **825-MVS2**).
❄ 0.5…20 A can be achieved by looping the motor supply cables. (Refer to the Specifications section.) Use cable support **Cat. No. 193-HD**.

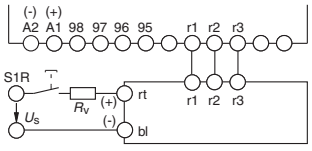
Factory Modification Options

Description	Suffix Code∗
Automatic Reset of overload and thermistor overtemperature protection	-R
Remote Reset‡	-F
External Indication§	-L

∗ Refer to the Catalog Number explanation section for the proper suffix code sequence.
‡ Device ships with the Remote Reset Module accessory (**Cat. No. 193-RB1**) included.
§ Device ships with the External Indication Module accessory (**Cat. No. 193-CB1**) included.

Accessories

Add-On Modules

	Description	Pkg. Qty.	Cat. No.
	External Indication Module For front mounting on a control panel or MCC 3 m connection cable with plug Function status indication Trips and alarms can be reset IP54 protection	1	**193-LB1**
	Remote Reset Module Trip reset from any location Operating voltage: 24…48V AC/DC with external burden resistor: - 8.2 kΩ, 4 W — 110…230V AC/DC - 22 kΩ, 10 W — 240…440V AC/DC 	1	**193-RB1**
	35 mm DIN Rail Mounting Adapter For easy mounting of timer modules on standard DIN Rail (EN 50 022-35) and G-Rail	10	**196-MTM**

Mounting Materials

	Description	For Use With	Pkg. Qty.	Cat. No.
	Transparent Front Cover	193-EF1, 139-EF2	1	193-PA
	Terminal Shields Set of 2 Protection class IP10 per IEC 60529 and DIN 40 050 For direct-on-line, reversing, two-speed, and wye-delta/star-delta assemblies	100-D95, 100-D110	2	**100-DTS110**
		100-D140, 100-D180, 100-D95-E…100-D180-E		**100-DTS180**
		100-D210...100-D420		**100-DTS420**
	Cable Support Set of 6 Includes terminal and fixing screws Provides support of cable end when looping through current evaluation ports	193-EF1A, 193-EF2A	6	**193-HD**
	Terminal Lugs Set of 2 Protection class IP2X per IEC 60529 and DIN 40 050	100-D95, 100-D110	2	**100-DTB110**
		100-D140, 100-D180, 100-D95E…D180E, 193-EC_F, 193-EE_F		**100-DTB180**
		100-D210...100-D420, 193-EC_G, 193-EF2C, 193-EE_G		**100-DTB420**

Connecting Components

	Description	For Use With	Pkg. Quantity	Cat. No.
	Terminal Lugs (UL/CSA), Copper Frame Set of 3	100-D95, 100-D110	3	100-DL110
		100-D140, 100-D180, 193-EC_F, 193-EE_F		**100-DL180**
		100-D210…100-D420, 193-EC_G, 193-EE_G		**100-DL420**

Mounting Materials — Bus Bars

Set of 3 busbars, includes terminal and fixing screws. Suitable for use with Cat. No. 193-EF1A and 193-EF2A overload relays.

	Description	Pkg. Qty.	Cat. No.
	M8 connections Set of 3 4 x 16 x 102 mm (1/8 x 5/8 x 4-1/64 in.) (125 A max.) Universally applicable Weight: 230 g	3	**825-MVM**
	M8 connections Set of 3 4 x 20 x 117 mm (1/8 x 25/32 x 4-39/64 in.) (180 A max.) Universally applicable	3	**825-MVM2**
	M6 lower connections Set of 3 For mounting on Bul. 100-D95 and 100-D110 contactors with conventional coil	3	**825-MVS**
	M8 lower connections Set of 3 For mounting on Bul. 100-D140, 100-D180 conventional and Bul. 100-D95E…100-D180E contactors with electronic coil	3	**825-MVS2**

Labeling Materials

Uniform labeling materials for contactors, motor starting equipment, timing relays and circuit breakers

	Description	Pkg. Qty.❄	Cat. No.
	Label Sheet 105 self-adhesive paper labels each, 6 x 17 mm	10	**100-FMS**
	Marking Tag Sheet 160 perforated paper labels each, 6 x 17 mm To be used with a transparent cover	10	**100-FMP**
	Transparent Cover To be used with marking tag sheets	100	**100-FMC**
	Marking Tag Adapters To be used with marking tag:	100	100-FMA2

❄ Must be ordered in multiples of package quantities.

2

Supply Voltage Failure
In the event of a supply voltage failure, the output relay resets and the stand-by indicator goes out. The actual status is stored for 30 minutes. When the supply voltage is restored, the output relay reverts to its original state.

Reset — Manual
The reset button resets all protection functions. Resetting from any location is possible with the 193-RB1 remote reset module.

Reset — Automatic
Automatic resetting of thermal overload and thermistor overtemperature functions is an optional feature. All other protection functions must be reset manually.

Test Button for Thermal Overload Protection
Pressing the test button will verify thermal tripping operation time at $6x/_e$ without the motor being connected. The test button must be held for longer than the set trip time $t_{6x/e}$.

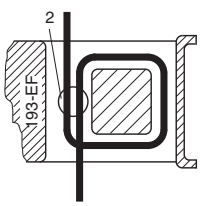
Device Installation and Commissioning
The operating instructions enclosed with the device provide all of the information necessary to set and commission it.

Surface Mounting
193-EF_A Snap-on fixing to standard DIN Rail or screw fixing
193-EF_B Screw fixing
193-EF_C Screw fixing
Mounting position: optional

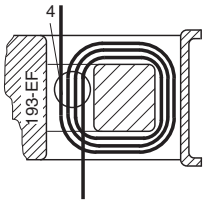
Setting the Rated Current (0.5…20 A) (193-EF1A and 193-EF2A Requires 193-HD)

The motor supply cables are looped through the current transformer twice, thereby doubling the rated motor current. The setting on the Bulletin 193-EF overload relay is the product of:

I_e [A] x…number of loops



Motor supply wire looped twice



Motor supply wire looped 4 times

Recommended for I_e [A]	Motor Supply Cables	Cable Cross Section (Flexible Strand)	
		IEC [mm²]	CSA, UL (AWG No.)
20…180	fed straight through	4…95	10…10 000
10…20	looped twice	2.5…25	14…10
5…10	looped 4 times	1…6	14
2.5…5	looped 8 times	0.75…2.5	14
0.5…2.5	looped 40 times	0.5…0.75	❄

❄ CSA, UL: for I_e = 0.5…2.5 A, only factory-assembled wound devices should be installed

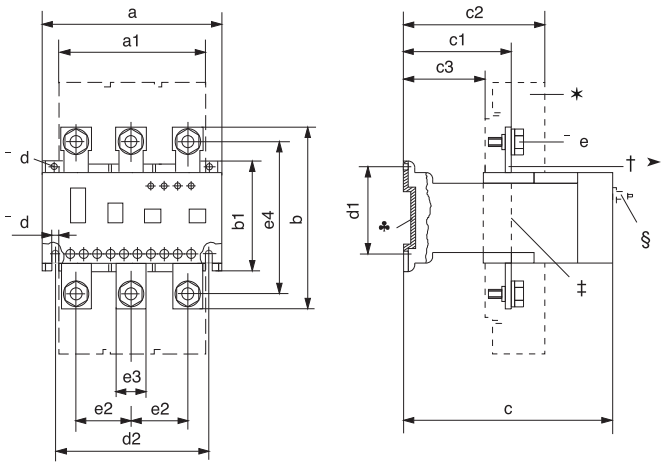
Rated Voltage Motor Circuit (primary circuit of current measuring device)					
IEC 947, EN 60947	[V]	1000			
CSA, UL	[V]	600			
Control Circuit					
IEC 947, EN 60947	[V]	440			
CSA, UL	[V]	240			
Rated Control Voltage U_S					
AC 50/60 Hz	[V]	24, 36, 48, 110, 120, 230, 240, 400, 415, 440, (0.8…1.1U_S)			
DC	[V]	24, 48 (0.9…1.2 U_S)			
Terminal Cross-section					
Control circuit	[mm²]	2 x 2.5			
Device Protection Fuse		10 A Type gG or 16 A Type gG			
Output Relay Contact Information					
Contact assembly		1 N.O. and 1 N.C., galvanically separated			
Rated operating voltage per UL/CSA: pilot duty 240V	[V]	24	110…125	220…250	380…440
Continuous Thermal current	[A]	4			
Rated AC operating current AC-15	[A]	3		3	1.2
Max. permissible switching current (cos = 0.3) AC-15	[A]	30		30	12
Rated DC operating current (L/R = 300 ms), no protective circuit needed DC-13	[A]	2	0.3	0.2	—
Max. rated back-up fuse current		10 A, 500V AC Type gG			
Ambient temperature Operation Storage Transport		-5…+60 °C -50…+60 °C -50…+85 °C			

Sensor Measurement Circuit			
Measurement circuit Cross section	[mm²]	0.5	1.5
Max. lead length❄	[m]	200	600
Max. cold resistance of PTC sensor chain	kΩ	1.5	
Max. number of PTC sensors per IEC 34-11-2		6	
Weights			
Overload Relay			
193-EF1A	[g]	1 070	
193-EF2A	[g]	1 090	
193-EF1B	[g]	2 510	
193-EF2B	[g]	2 530	
193-EF2C	[g]	5 550	
193-LB1 indication module	[g]	160	
193-RB1 Remote reset module	[g]	160	
196-MTM Adapter	[g]	5	
193-PA Front cover	[g]	3	
193-HD Terminal lug	[g]	40	
Bus bars			
825-MVM	[g]	230	
825-MVM2	[g]	290	
825-MVS	[g]	280	
825-MVS2	[g]	350	
Approvals			
CE, UL Listed, CSA, Bureau Veritas, Lloyd's Register of Shipping, Maritime Register of Shipping, RINA			

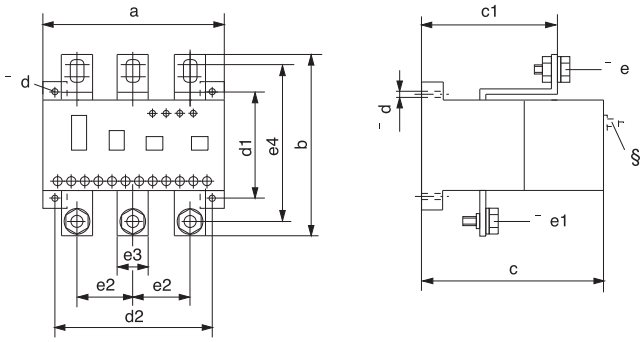
❄ Type of wiring: insulated control leads, screened > 200 m (shield connected with 1T1)

Dimensions in millimeters. Dimensions are not intended to be used for manufacturing purposes.

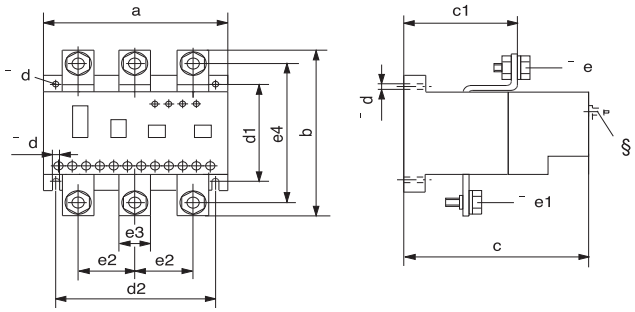
Cat. Nos. 193-EF1A, 193-EF2A (shown with cat. no. 825-MVM bus bar kit)



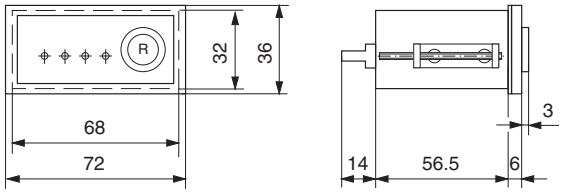
Cat. Nos. 193-EF1B, 193-EF2B



Cat. No. 193-EF2C



Cat. No. 193-LB1



Dimensions	193-EF1A 193-EF2A	193-EF1B 193-EF2B	193-EF2C
A	120	140	155
a1	105	—	—
b	100	142	143
b❄	100	—	—
b✦	117	—	—
b1	73	—	—
ϕd	5.4	5.8	6.5
d1	55…60	75	90…93
d2	100	125	135
ϕe	M8 x 12	M10 x 25	M10 x 25
ϕe1	—	M10 x 35	M10 x 25
e2	38.5	48	48
e3❄	16	25	25
e3✦	20	25	25
e4	82	117	118
e4❄	82	—	—
e4✦	97	—	—
c	143	148	178
c1	72	117	118
c2	93.5	—	—
c3	53.5	—	—

⌘ Terminal Cover
❄ Universally applicable busbars (825-MVM)
‡ Feed-through openings 19 x 19 mm
§ With 193-LB1 indication module: c = c + 29 mm
♣ Can be mounted to DIN Rail EN 50 022-35
✦ Universally applicable busbars (825-MVM2)

Bulletin 193-T1 — Bimetallic Overload Relays

- Overload protection Trip Class 10A
- Phase loss protection
- Ambient temperature compensation
- Auxiliary contact (1 N.O. and 1 N.C.)
- Manual/automatic reset
- Optional remote reset solenoid and external reset
- Stop button
- Test release
- Trip Indicator

Bulletin 193-T1 thermal overload relays are designed for use with Bulletin 100-C contactors and Bulletin 104-C reversing contactors. These class 10A ambient-compensated thermal overload relays include a differential mechanism for sensitivity to phase loss conditions. The trip setting is adjustable over the listed motor full load current range. The overload relay can be operated in a manual or automatic reset mode.

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Standards Compliance

IEC/EN 60497-1, -4-1, -5-1

UL508

CSA C22.2 No. 14

Certifications

cULus (File No. E33916, Guide NKCR, NKCR7)

Thermal Overload Relays

For Use With∗	Setting Range [A]❄‡	Max. Back-up fuse [A] gL/gG 50 kA, 690V AC IEC/EN 60947-4-1 Coordination Type 1	Max. Back-up fuse [A] gL/gG 50 kA, 690V AC IEC/EN 60947-4-1 Coordination Type 2	Max. Back-up fuse [A] UL Class K5 5 kA, 600V AC UL 508	Cat. No.
100-C09…100-C23	0.1…0.16	50	—	1	193-T1AA16
	0.16…0.25	50	—	1	193-T1AA25
	0.25…0.40	50	2	1	193-T1AA40
	0.35…0.50	50	2	2	193-T1AA50
	0.45…0.63	50	2	2	193-T1AA63
	0.55…0.80	50	4	3	193-T1AA80
	0.75…1.0	50	4	3	193-T1AB10
	0.90…1.3	50	6	4	193-T1AB13
	1.1…1.6	50	6	5	193-T1AB16
	1.4…2.0	50	1	8	193-T1AB20
	1.8…2.5	50	16	10	193-T1AB25
	2.3…3.2	50	16	12	193-T1AB32
	2.9…4.0	50	16	15	193-T1AB40
	3.5…4.8	50	16	15	193-T1AB48
	4.5…6.3	50	20	20	193-T1AB63
	5.5…7.5	50	25	25	193-T1AB75
	7.2…10	50	25	35	193-T1AC10
	9.0…12.5	50	35	50	193-T1AC12
	11.3…16	50	35	60	193-T1AC16
	15…20	80	40	80	193-T1AC20
	17.5…21.5	80	40	80	193-T1AC21
	21…25	80	40	100	193-T1AC25
100-C30…100-C37	15…20	80	40	80	193-T1BC20
	17.5…21.5	80	40	80	193-T1BC21
	21…25	80	40	100	193-T1BC25
	24.5…30	125	80	100	193-T1BC30
	29…36	125	80	125	193-T1BC36
	33…38	125	80	150	193-T1BC38
100-C43	17…25	160	100	100	193-T1CC25
	24.5…36	160	100	125	193-T1CC36
	35…47	160	100	175	193-T1CC47
100-C60…100-C85	35…47	250	160	175	193-T1DC47
	45…60	250	160	250§	193-T1DC60
	58…75	250	160	300§	193-T1DC75
	72…90	250	160	350§	193-T1DC90
Separate mounting required (Panel-mounted device)	35…47	250	160	175	193-T1DC47P
	45…60	250	160	250§	193-T1DC60P
	58…75	250	160	300§	193-T1DC75P
	72…90	250	160	350§	193-T1DC90P

∗Bulletin 193-T1 overload relays should not be used with conventional DC contactors. Use electronic DC versions.
❄ To select the setting range for use in Y-Δ Starters, multiply the rated operating current of the motor by a factor of 0.58.
‡ For motors with service factor of 1.15 or greater, use motor nameplate full load current. For motors with service factor of 1.0, use 90% of the motor nameplate full load current.
§ Max. Back-up fuse [A], UL Class K5, 10 kA, 600V AC

Add-On Modules

	Description	For Use With	Pkg. Quantity ✶	Cat. No.
	DIN Rail/Panel Mounting Adapter For separate mounting of overload relays Snaps on to 35 mm top hat rail	193-T1AA, 193-T1AB, 193-T1AC, 193-T1BC	1	193-T1APM
	Screw Adapter For screw fixing of the 193-T1APM panel adapter (2 required per adapter)	193-T1APM	10	**140M-C-N45**
	Remote Reset Solenoid For remote reset of 193-K and 193-T1 overload relays	193-K, 193-T1 (not for 193-T1DC_P)	1	193-T1R⊗
	External Reset Button For enclosed, through-the-door reset applications. Metal construction, IP66, non-illuminated. Refer to the 800F selection information for additional types.	All	1	**800FM-R611**
	Reset Rod Length 142 mm, adjustable range 141…159 mm	All	1	800F-ATR08
	Reset Adapter Expands the reset target area when using an external reset	All	1	193-RA3

✶ Must be ordered in multiples of package quantity.

⊗ Coil Voltage Codes for Remote Reset Solenoid

[V]	24	48	110	120	125	220…240
50 Hz	—	—	D	—	—	—
60 Hz	—	—	—	D	—	—
50/60 Hz	KJ	KY	—	—	—	KF
DC	ZJ	ZY	ZD	—	ZS	—

Marking System

Uniform labeling materials for contactors, motor starting equipment, timing relays, and circuit breakers

	Description	Pkg. Quantity✶	Cat. No.
	Label Sheet 105 self-adhesive paper labels each, 6 x 17 mm	10	**100-FMS**
	Marking Tag Sheet 160 perforated paper labels each, 6 x 17 mm To be used with a transparent cover	10	**100-FMP**
	Transparent Cover To be used with marking tag sheets	100	**100-FMC**

✶ Must be ordered in multiples of package quantities.

2

Thermal Overload Relays

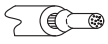
Main Circuits

Cat. No.			193-T1…
Rated isolation voltage U_i			690V AC
Rated impulse withstand voltage U_{imp} (between main poles and between main poles and auxiliary circuits)			6kV AC
Rated impulse withstand voltage U_{imp} (between auxiliary circuits)			4kV AC
Rated operating voltage U_e		IEC	690V AC
			440V DC
		UL, CSA	600V AC
Rated frequencies		[Hz]	50/60
Operational frequencies			DC…400 Hz
Power dissipation	193-T1A, 193-T1B	up to 0.4 A	7 W
		0.5…36 A	6 W
		38 A	12 W
	193-T1C	25…47 A	12 W
	193-T1D	47…90 A	18 W

Control Circuits

Cat. No.			193-T1…
Rated operating current Ie			
AC-15	24V	[A]	4
	240V	[A]	2
	400V	[A]	1.6
	690V	[A]	0.15
DC-13	24V	[A]	2
	110V	[A]	0.4
	220V	[A]	0.25
	440V	[A]	0.08
Thermal Current I_{th}			5
Short-circuit withstand, Fuse	IEC, gL/gG	[A]	6
Short-circuit withstand, circuit breaker ≤ 1 kA prospective short-circuit-current		[A]	4
Min. contact load for reliable operation			15V, 2 mA
UL Rating			A600/Q300

Terminations

Cat. Nos.			Main Circuits						Control Circuits	Remote Reset
			193-T1A…	193-T1BC20… T1BC25	193-T1BC30… T1BC38	193-T1C…	193-T1D…	193-T1APM	193-T1… all	193-T1R…
Wiring cross section Terminal type										
Terminal screws			M4	M4	M4	M5	M6	M4	M3.5	M3.5
	Fine stranded with ferrule	[mm²]	2 x (1.5…4)	2 x (1.5…4)	1 x (2.5…10)	1 x (2.5…16)	1 x (10…35)	1 x (1.5…10)	2 x (1…4)	1 x (1.5…4)
	Solid or coarse stranded	[mm²]	2 x (1.5…6)	2 x (1.5…6)	1 x (2.5…16)	1 x (2.5…25)	1 x (10…35)	1 x (1.5…16)	2 x (1…4)	1 x (1.5…4)
		[AWG]	2 x (16…10)	2 x (14…10)	1 x (10…6)	1 x (10…6)	1 x (8…1)	1 x (16…6)	2 x (18…12)	1 x (16…12)
Recommended torque		[N•m]	1.5 … 2.2	2.2 … 2.5	2.2 … 3.5	2.5 … 3.5	3.5 … 6	1.8…2.8	1.2	1.2
		[lb-in]	13 … 20	20 … 22	22 … 31	22 … 31	31 … 53	16…25	10.6	10.6
Pozidrive screwdriver		Size	2	2	2	3	3	2	2	2
Slotted screwdriver		[mm]	1 x 6	1 x 6	1 x 6	1 x 6.5	1 x 6.5	1 x 6	1 x 6	1 x 6

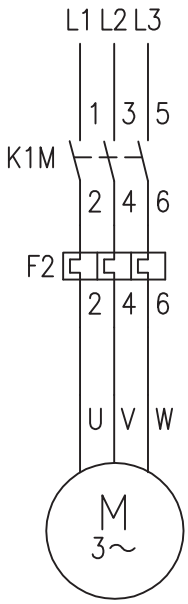
Visit our website: www.ab.com/catalogs
Preferred availability cat. nos. are printed in bold

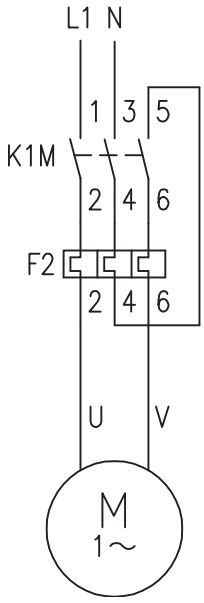
General

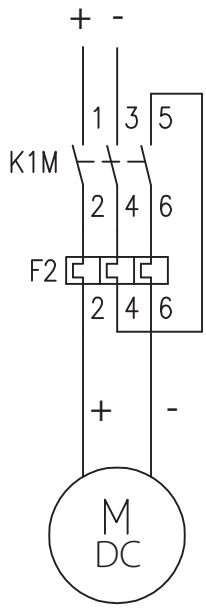
Cat. No.			193-T1…
Type of Overload Relay			Bimetallic, Ambient Compensated, Phase Loss Sensitive
Trip Rating (ultimate tripping current)			120% FLA
Phase loss sensitivity: Trip rating at phase loss			115% FLA
Trip Class		IEC/EN 60947-4-1	10A
		UL	10
Reset Mode			Automatic or Manual
Test release			Manual release of auxiliary contacts
Trip indication			By means of a flag visible through an opening in the relay front
Compensation temperature range			-20…+60 °C (-4…+140 °F)
Climatic Conditions	Release Tolerance at -20 °C		1.05…1.4 x I_n
	Storage Temperature Range		-55…+80 °C (-67…+176 °F)
	Operating Temperature Range		-20…+60 °C (-4…+140 °F)
	Air moisture (Storage/Operating)		5…95% rel.humidity, non-condensing
Vibration	(per IEC/EN 60068-2-6), service		3g
	IEC/EN 61373 (vibration railways)		category 1, class B
	IEC/EN 60092-504 (vibration ships), service		0.7 g, all axes, 2…200 Hz
Shock	(per IEC/EN 68000-2-27), transport		30 g
	IEC/EN 60068-2-27 (Shock half-sinus), service		11 ms > 5 g all axes
	IEC/EN 61373 (shock railways)		category 1, class B, 5g 30 ms
Max. Altitude			2000 m
Pollution Degree			3
Degree of Protection, with wires connected			IP2X
Materials			RoHS compliant
Flame resistivity (Outer housing parts)		UL-94	V0
Approximate Weight (unpackaged)	193-T1A, 193-T1B	0.16…25 A	0.115 kg
	193-T1B	30…38 A	0.155 kg
	193-T1C	25…47 A	0.330 kg
	193-T1D	47…90 A	0.360 kg
	193-T1….P	47…90 A	0.415 kg

2

Circuit Diagrams



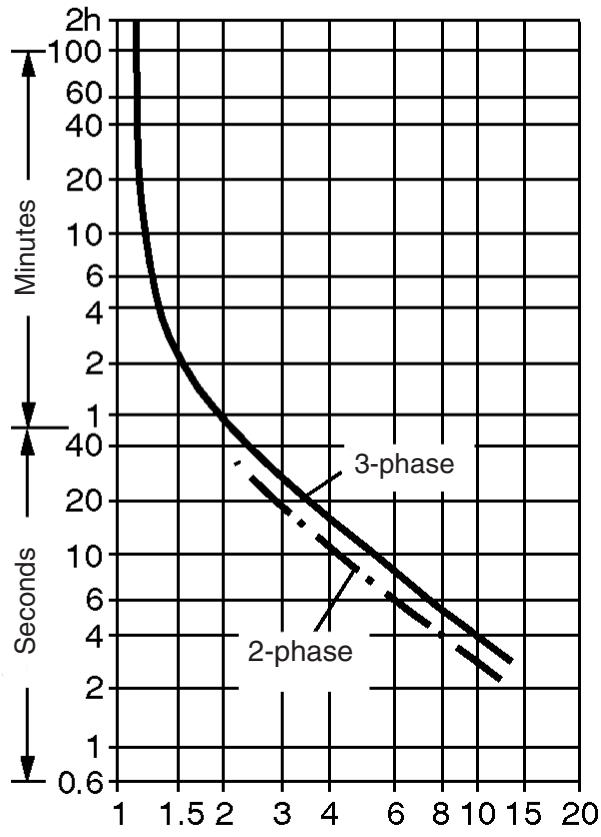




Trip Characteristics

These trip characteristics refer to IEC/EN 60947-4-1 and are average values from cold start at an ambient temperature of 20 °C. Trip time is pictured as a function of operating current. With the device at max. operating temperature, the trip time decreases to approximately 25% of the shown value.

Trip Class 10A



Bulletin 193-K — Miniature Bimetallic Overload Relays

- Standard motor protection for AC and DC motors
- Overload protection Trip Class 10A
- Auxiliary switch (1 N.O. and 1 N.C.)
- Phase loss sensitivity
- Manual/Auto reset button
- Test release
- Stop button
- Trip indicator

Bulletin 193-K bimetallic overload relays are designed for use with Bulletin 100-K contactors and Bulletin 104-K Reversing Contactors. These class 10A ambient temperature-compensated thermal overload relays include a differential mechanism for sensitivity to phase-loss conditions.

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Standards Compliance

IEC/EN 60947-1,-4-1,-5-1
UL 508
CSA 22.2. No. 14

Certifications

CE marked
cULus Listed (File No. E33916, Guide NKCR, NKCR7)

2

Miniature Bimetallic Overload Relays

Mounts to Contactor	Setting Range [A] ✶❄	Max. Current Rating of Backup Fuse [A] IEC Coordination Type 1	IEC Coordination Type 2	UL Class K5/5 kA, 600V AC UL 508	Cat. No.
100-K05...100-K12	0.10...0.16	35	—	1	193-KA16
	0.16...0.25	35	—	1	193-KA25
	0.25...0.40	35	2	1	193-KA40
	0.35...0.50	35	2	2	193-KA50
	0.45...0.63	35	2	2	193-KA63
	0.55...0.80	35	4	3	**193-KA80**
	0.75...1.0	35	4	3	**193-KB10**
	0.9...1.3	35	6	4	**193-KB13**
	1.1...1.6	35	6	5	**193-KB16**
	1.4...2.0	35	10	8	**193-KB20**
	1.8...2.5	35	20	10	**193-KB25**
	2.3...3.2	35	20	12	**193-KB32**
	2.9...4.0	35	20	15	**193-KB40**
	3.5...4.8	35	20	15	**193-KB48**
	4.5...6.3	35	20	20	**193-KB63**
100-K09...100-K12	5.5...7.5	35	20	25	193-KB75
	7.2...10.0	35	20	35	**193-KC10**
100-K12	9.0...12.5	35	20	50	193-KC12

✶ To select the setting range for use in Y-Δ Starters, multiply the rated operating current of the motor by a factor of 0.58.

❄ For motors with Service Factor of 1.15 or greater, use motor nameplate full load current. For motors with service factor of 1.0, use 90% of the motor nameplate full load current.

Accessories

	Description		Cat. No.
	Remote Reset Solenoid For remote reset of 193-K overload relay		193-T1R⊗
	Reset Adapter Expands the reset target area when using an external reset		193-RA3
	External Reset Button For enclosed, through-the-door reset applications. Metal construction IP66, non-illuminated with rod (length: 142 mm, adjustable range 141...159 mm). Refer to the 800F catalog pages for additional types.	Reset Button	**800FM-R611**
		Rod	800F-ATR08

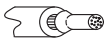
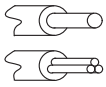
⊗ Coil Voltage Codes for Remote Reset Solenoid

[V]	24	48	110	120	125	220...240
50 Hz	—	—	D	—	—	—
60 Hz	—	—	—	D	—	—
50/60 Hz	KJ	KY	—	—	—	KF
DC	ZJ	ZY	ZD	—	ZS	—

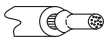
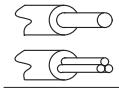
2

Specifications

Main Circuits

		193-K
Rated Isolation Voltage U_i		690V
Rated Impulse Strength U_{imp}		6 kV
Rated Operating Voltage U_e	IEC/UL	690V AC / 600V AC
Wiring cross section Terminal type		
Terminal screws		M3.5
 Fine stranded with ferrule	[mm²]	2 x (1.5…4)
 Solid or coarse stranded	[mm²] [AWG]	2 x (1.5…4) 2 x (16…12)
Recommended torque	[N•m] [lb•in.]	1.2 10.6
Pozidriv screwdriver	Size	2
Slotted screwdriver	[mm]	1 x 6

Control Circuits

			193-K
Rated Isolation Voltage U_i			690V AC
Rated Impulse Strength U_{imp}			4 kV AC
Rated Operating Voltage U_e		IEC/UL	690V AC/600V AC
Rating Designation **Rated Operating Current I_e**			A600/Q300 **N.O./N.C.**
AC-15	24V	[A]	4
	240V	[A]	2
	400V	[A]	1.6
	690V	[A]	0.15
DC-13	24V	[A]	2
	110V	[A]	0.4
	220V	[A]	0.25
	440V	[A]	0.08
Thermal Current I_{the}		[A]	5
Short-circuit withstand, fuse gG		[A]	6
Contact Reliability			15V, 2 mA
Wiring cross section Terminal type			
Terminal screw			M 3.5
 Fine stranded with ferrule		[mm²]	2 x (1…4)
 Solid or coarse stranded		[mm²] [AWG]	2 x (1…4) 2 x (18…12)
Recommended torque		[N•m] [lb•in.]	1.2 10.6
Pozidriv screwdriver		Size	2
Slotted screwdriver		[mm]	1 x 6

Environmental Ratings

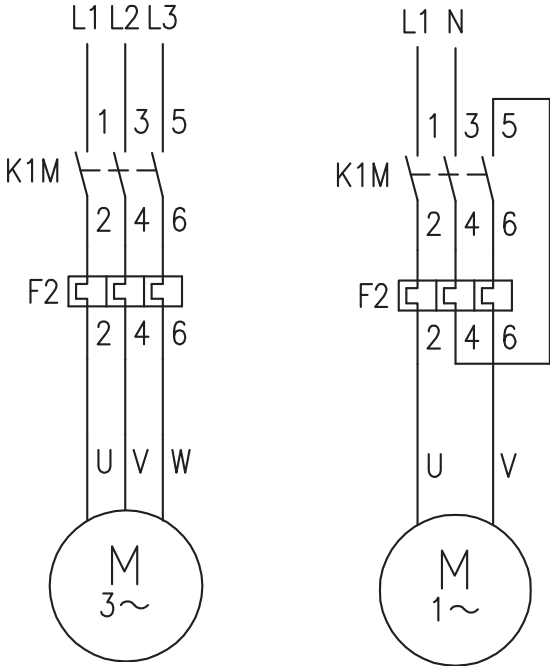
		193-K
Ambient Temperature	Storage	-55…+80 °C (-67…+176 °F)
	Operating	-20…+60 °C (-4…+140 °F)
Humidity	Operating Damp Heat	5…95% Non-condensing per IEC/EN 60068-2-3 and IEC/EN 60068-2-30
Vibration (per IEC/EN 60068-2-6)		3 G
Shock (per IEC/EN 60068-2-27)		30 G
Max. Altitude		2000 m
Pollution Environment		Pollution Degree 3
Degree of Protection		IP2X
Protection		
Type of Relay		Ambient Compensated, Time Delay, Phase Loss Sensitive
Nature of Relay		Bimetallic Overload Relay
Trip Rating		120% FLA
Trip Class		IEC: 10A, UL 10
Reset Mode		Automatic or Manual
Power dissipation	up to 0.4 A	7 W
	0.5…12.5 A	6 W

General Data

	193-K
Standards	IEC/EN 60947-1, -4-1, -5-1, UL 508, CSA 22.2. No. 14
Certifications	CE, cULus
Approximate Weights (unpackaged)	0.115 kg (0.25 lb)

Thermal Overload Relays

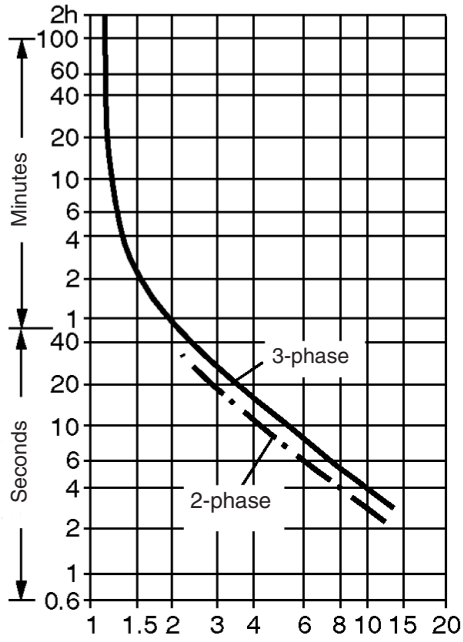
Circuit Diagrams



Trip Characteristics

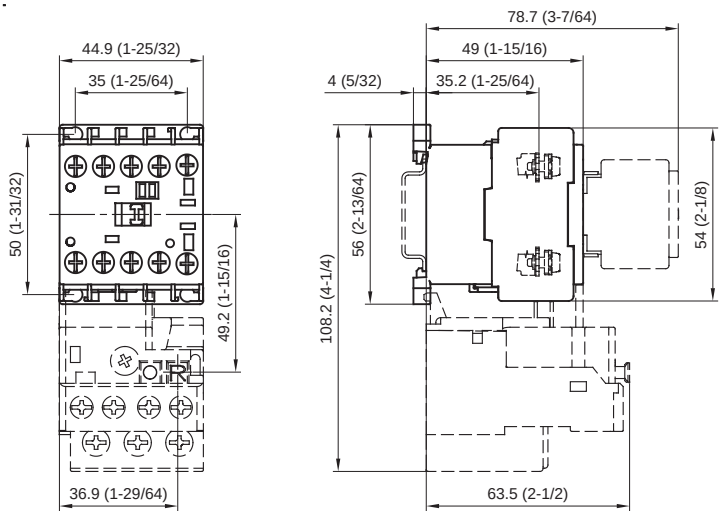
These trip characteristics refer to IEC 60947 and are average values from cold start at an ambient temperature of 20 °C. Trip time is pictured as a function of operating current. With the device at normal operating temperature, the trip time decreases to approximately 25% of the shown value.

Trip Class 10A



Bulletin 100-K, 193-K Approximate Dimensions

Dimensions are shown in millimeters (inches). Dimensions are not intended for manufacturing purposes.



Bulletin 825-P

- 0.5…5000 A current range
- Suitable for low- and medium-voltage applications
- Modular design with pluggable options
  - Voltage input card
  - Expansion I/O cards
  - Communications cards, including DeviceNet
  - RTD scanner module
- Comprehensive protection functions
- Built-in keypad and backlit 2-line LCD
- Test/Reset button
- Status LEDs
- Front accessible RS232 port
- 3 output relays
- 2 configurable inputs
- NEMA 12 (IP65) compatible

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Standards Compliance

IEC 60947-1
IEC 60947-4 Type 2 Coordination
CSA C22.2, No. 14
UL 508

Certifications

UL Listed (File No. E 14840, Guide NKCR)
CSA Certified (File No. LR1234)
CE
C-tick

Description

The Bulletin 825-P Modular Protection System for motors offers a compact, modular design that uniquely allows an installer to configure a device's functional capabilities to match the application requirements. Flexibility is also afforded by accommodating future expansion of the system as the application requirements grow. Finally, ease of installation is provided through pluggable options and accessories.

Comprehensive Protection

The 825-P Modular Protection System offers in-depth motor protection coverage by monitoring the critical elements of motor current, line voltage and temperature. High resolution settings allow the installer to configure a precise envelope of protection to achieve maximum motor utilization while avoiding damage and downtime.

ANSII No.	Function	ANSII No.	Function
Current Elements		**Temperature Elements**	
51	Thermal Overload	49	PTC Thermistor
46	Current Imbalance/Phase Loss	49	Stator RTD
50G/51G	Ground Fault	38	Bearing RTD
37	Undercurrent (Load Loss)	—	Ambient and Other RTD
48	Overcurrent (Load Jam)	**Power Elements**	
50	Short Circuit	37	Underpower
47	Phase Reversal	55/78	Power Factor
81	Frequency	—	Reactive Power
86	Overload Lockout	—	—
Voltage Elements		**Motor Starting Elements**	
27	Undervoltage	66	Starts/Hour
59	Overvoltage	—	Stall - Acceleration Time Monitoring
47	Phase Reversal	14	Speed Switch Monitoring
81	Frequency	19	Reduced Voltage Starting
—	—	48	Incomplete Start

Note: Voltage, power, and energy elements are only available with the installation of the voltage input option card.

Full Function Metering

Current Elements	Voltage Elements	Power Elements	Energy Elements	Thermal Elements
Phase Currents	Line-Line Voltages	Real Power (kW)	Real Energy (kWh)	% Thermal Capacity Utilization
Average Current	Avg. Line-Line Voltage	Reactive Power (kVAR)	Reactive Energy Forward (kVARh)	RTD Values
% Motor Load	Line-Neutral Voltages	Apparent Power (kVA)	Reactive Energy Reverse (kVARh)	—
Current Imbalance	Avg. Line-Neutral Voltage	Power Factor	Apparent Energy (kVAh)	—
Ground Fault Current	Voltage Imbalance	—	—	—
System Frequency	System Frequency	—	—	—

Note: Voltage and power elements are only available with the installation of the voltage input option card.

Statistical Values

The 825-P Modular Protection System provides the following valuable statistical values of motor operation:

- Elapsed time of operation
- Stopped time
- Percent of time running
- Number of starts
- Number of emergency starts
- Date and time of last trip reset

Historical Data

The 825-P Modular Protection System saves records for the five most recent trip events. Each trip event is summarized with record of the following prior to trip data capture:

- Event day and time
- Trip identification
- Phase and ground current values
- Voltage values

Function Overview

Description	Trip Level Setting Range	Trip Delay Setting Time	Warning Level Setting Range
Motor FLA I_e	0.5…5000 A	—	—
Locked Rotor Current	2.5…12 x I_e	—	50…100% TCU
Locked Rotor Time	1…600 s	—	—
Short Circuit	4…12 x I_e	0…5.00 s	4…12 x I_e
Ground Fault (Residual)	0.1…1.0 x I_e	0…5.00 s	0.1…1.0 x I_e
Ground Fault (Core balance)	0.01…25 A	0…5.00 s	0.01…25 A
Jam	1.0…6.0 x I_e	0…5.00 s	1.0…6.0 x I_e
Undercurrent	0.1…1.0 x I_e	0…120 s	0.1…1.0 x I_e
Current Imbalance	5…80%	0…240 s	5…80%
Start Monitoring	—	0…240 s	—
RTD Temp	0…250 °C	—	0…250 °C
Phase Reversal	Disable, Enable	—	—
Undervoltage	0.60…1.00 x V_{nom}	0…120 s	0.60…1.00 x V_{nom}
Overvoltage	1.00…1.20 x V_{nom}	0…120 s	1.00…1.20 x V_{nom}
Underpower	1…25000 kW	0…240 s	1…25000 kW
Power Factor	0.05…0.99	0…240 s	0.05…0.99
VAR	1…25000 kVAR	0…240 s	1…25000 kVAR
Frequency	45…55/55…65 Hz	0…240 s	45…55/55…65 Hz
Start Inhibit (Starts/hour)	1…15	—	—
Speed Switch	—	0…240 s	—

Modular Protection System

Product Selection

	Description		Cat. No.
	Basic Unit Note: The minimum requirements for a complete basic system are one basic unit and one converter module.	120…240V AC/DC	**825-PD**∗
		24…48V DC	**825-PZ**∗
	Converter Module	0.5…2.5 A	825-MCM2
		1.0…5.0	**825-MCM5**
		2.5…20 A	**825-MCM20**
		9…100 A	**825-MCM180**
		160…420	825-MCM420
		160…630 A	825-MCM630N
	Core Balance Ground Fault Sensor	100:1	**825-CBCT**
	RTD Scanner Module 12 RTD input channels with individual programming for 10 Ω copper, 100 Ω nickel, 120 Ω nickel, or 100 Ω platinum. Fiber optic connection to Basic Unit. Class I, Division 2, Group T48.	120 / 240V AC	**825-PR12D**
	Voltage Input Card Monitoring of V_A, V_B, V_C, and V_N	240V AC Max.	**825-PVS**∗
	Expansion I/O Card (3) Inputs (4) Output relays (1) 4…20 mA analog output	120V AC Rated Inputs	**825-PIOD**∗
		24V DC Rated Inputs	825-PIOR∗
	DeviceNet Communication Card DeviceLogix™ technology, Node address selection switches, ODVA conformance tested.	—	**825-PDN**∗
	Modbus RTU Communication Card	—	825-PMB∗
	MPS Explorer Software ‡	Windows-based configuration tool	
	Operation Instructions ❄	Quick Start Guide	825-QS001_-EN-P
		Basic Unit User Manual	825-UM004_-EN-P
		DeviceNet Card	825-UM005_-EN-P

∗ Factory modification available. For conformal coating add **CC** to the cat. no. Example: **Cat. No. 825-PZ** becomes **Cat. No. 825-PZ-CC**.

‡ Please contact your local Rockwell Automation sales office or Allen-Bradley distributor.

❄ Detailed operation instructions ship separately from the product. Please contact your local Rockwell Automation sales office or Allen-Bradley distributor to obtain printed copies.

Note: A no-charge download can be found at www.ab.com/industrialcontrols/products/iec_motor_controls/overload_relays/825p.html

Accessories

	Description		Cat. No.
	Bus Bars for 825-MCM180 Three-piece set includes terminals and screws	**M8 connections** Set of 3 4 x 16 x 102 mm (1/8 x 5/8 x 4-1/64 in.) (125 A max.) Universally applicable Weight: 230 g	**825-MVM**
		M8 connections Set of 3 4 x 20 x 117 mm (1/8 x 25/32 x 4-39/64 in.) (180 A max.) Universally applicable	**825-MVM2**
		M6 lower connections Set of 3 For mounting on Bul. 100-D95 and 100-D110 contactors with conventional coil	**825-MVS**
		M8 lower connections Set of 3 For mounting on Bul. 100-D140, 100-D180 conventional and Bul. 100-D95E…100-D180E contactors with electronic coil	**825-MVS2**
	Terminal Shields Set of 2 Protection class IP10 per IEC 60529 and DIN 40 050 For direct-on-line, reversing, two-speed, and wye-delta/star-delta assemblies	100-D95, 100-D110	**100-DTS110**
		100-D140, 100-D180, 100-D95-E…100-D180-E	**100-DTS180**
		100-D210...100-D420	**100-DTS420**
	Terminal Lugs Set of 2 Protection class IP2X per IEC 60529 and DIN 40 050	100-D95, 100-D110	**100-DTB110**
		100-D140, 100-D180, 100-D95E…D180E, 193-EC_F, 193-EE_F	**100-DTB180**
		100-D210...100-D420, 193-EC_G, 193-EF2C, 193-EE_G	**100-DTB420**
	Thermal Utilization Meter	For display of percent thermal capacity utilized Requires the use of an Expansion I/O Card	825-MTUM
—	**Connection Cable (Replacement)** Bul. 825-P to Bul. 825-MCM connection		**825-MCA**

Electrical Ratings

Main Circuits						
Rated Operating Voltage U_e	825-MCM2 825-MCM5		825-MCM20	825-MCM180 825-MCM420 825-MCM630N		
IEC CSA/UL	400V AC 240V AC		690V AC 600V AC	1000V AC 600V AC		
Rated Impulse Strength U_{imp}	2.5 kV		6 kV	8 kV		
Operating Current Range (A)	825-MCM2	825-MCM5	825-MCM20	825-MCM180	825-MCM420	825-MCM630N
	0.5…2.5	1…5	2.5…20	20…180	160…420	160…630
Rated Continuous Thermal Current (A)	3	6	24	216	504	756
Rated Saturation Current (A)	30	60	240	1350	3400	4600
Rated Frequency	50/60 Hz ±3 Hz					
Voltage Input Option Card						
Rated Operating Voltage U_e	250V AC Max					
Operating Range	0.8…1.1 U_e					
Rated Continuous Voltage	300V AC					
Rated Insulation Voltage U_i	300V AC					
Rated Impulse Strength U_{imp}	4kV					
Rated Frequency	50/60 Hz ±5 Hz					
Control Circuits						
Supply						
Rated Supply Voltage U_s	110…240V AC, 110…250V DC				24…48V DC	
Operating Range	0.8…1.1 U_e				0.8…1.1 U_e	
Rated Frequency (V AC)	50/60 Hz ±5 Hz				—	
Max. Power Consumption	40VA (AC) / 15W (DC)				15 W	
Output Relays						
Type of Contacts — Trip	Form C SPDT					
Type of Contacts — Aux1…Aux6	Form A SPST — N.O.					
Rated Insulation Voltage U_i	300V AC					
Rated Operating Voltage U_e	240V AC					
Rated Impulse Strength U_{imp}	4kV					
Rated Thermal Current I_{the}	5 A					
Rated Operating Current I_e — 120V AC	3 A					
Rated Operating Current I_e — 240V AC	1.5 A					
Contact Rating Designation	B300					
Utilization Category	AC15					
Contact Reliability	5 mA @ 17V					
Inputs						
Rated Operating Voltage U_e	IN1 and IN2			IN3, IN4, and IN5		
	24V AC/DC			120V AC/DC (825-PIOD), 24V AC/DC (825-PIOR)		
Operating Range	0.8…1.1 U_e					
Rated Insulation Voltage U_i	300V AC					
Rated Impulse Strength U_{imp}	4kV					
Rated Frequency (V AC)	50/60 Hz ±5 Hz					
On-State Voltage	15V			79V		
On-State Current (turn-on)	2 mA			2 mA		
Steady-State Current	15 mA			15 mA		
Off-State Voltage	5V			20V		
Off-State Current	0.5 mA			1 mA		
Transition Voltage	5…15V			20…79V		
PTC Thermistor Input						
Type of Control Unit	Mark A					
Max. No. of Sensors in Series	6					
Max. Cold Resistance of PTC Sensor Chain	1500 Ω					
Trip Resistance	3400 Ω ± 150 Ω					
Reset Resistance	1500…1650 Ω					
Short-Circuit Trip Resistance	25 Ω ± 10 Ω					

Mechanical Ratings

Environmental		
Ambient Temperature	Storage	-40…+85 °C (-40…+185 °F)
	Operation (open)	-20…+60 °C (-4…+140 °F)
Humidity (Operating)		5…95%, non-condensing
Max. Altitude		2000 m
Vibration (Per IEC 68-2-6)		3 G
Shock (per IEC 68-2-27)		30 G
Control Terminals		
Terminal Screw		M3
Cross Section (1 wire, stranded/solid)		0.14…2.5 mm² (#20…12 AWG)
Terminal Screw Torque		0.79 N•m (7 lb-in)

Electromagnetic Compatibility

Electrostatic Discharge Immunity	Test Level	8 kV Air Discharge, 6 kV Contact Discharge
	Performance Criteria	1 ‡❄
RF Immunity	Test Level	10V/m
	Performance Criteria	1 ‡❄
Electrical Fast Transient/Burst immunity	Test Level	4 kV (Power), 2 kV (Control and Comms)
	Performance Criteria	1 ‡❄
Surge Immunity	Test Level	2 kV L-E, 1 kV L-L
	Performance Criteria	1 ‡❄
Radiated Emissions		Class A
Conducted Emissions		Class A

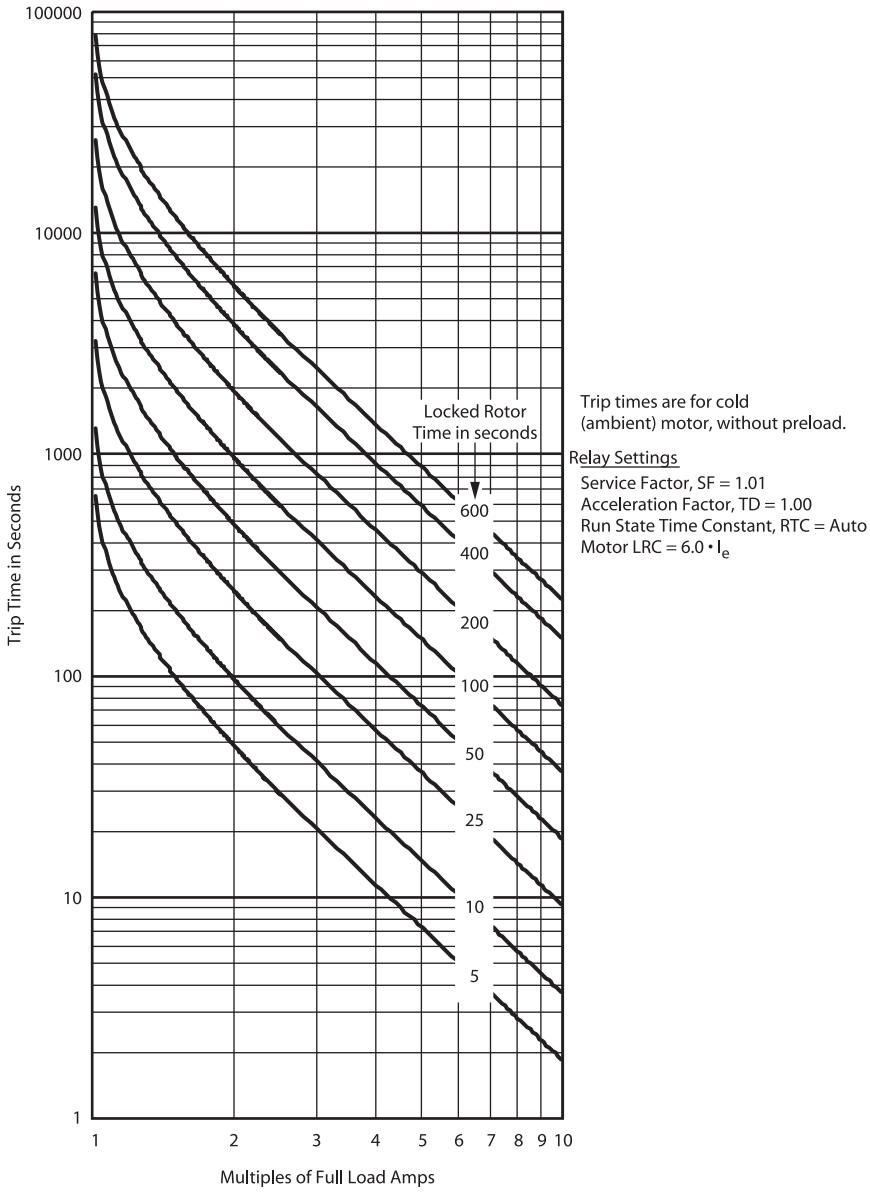
‡ Performance Criteria 1 requires the DUT to experience no degradation or loss of performance.
❄ Environment 2.

RTD Scanner Module

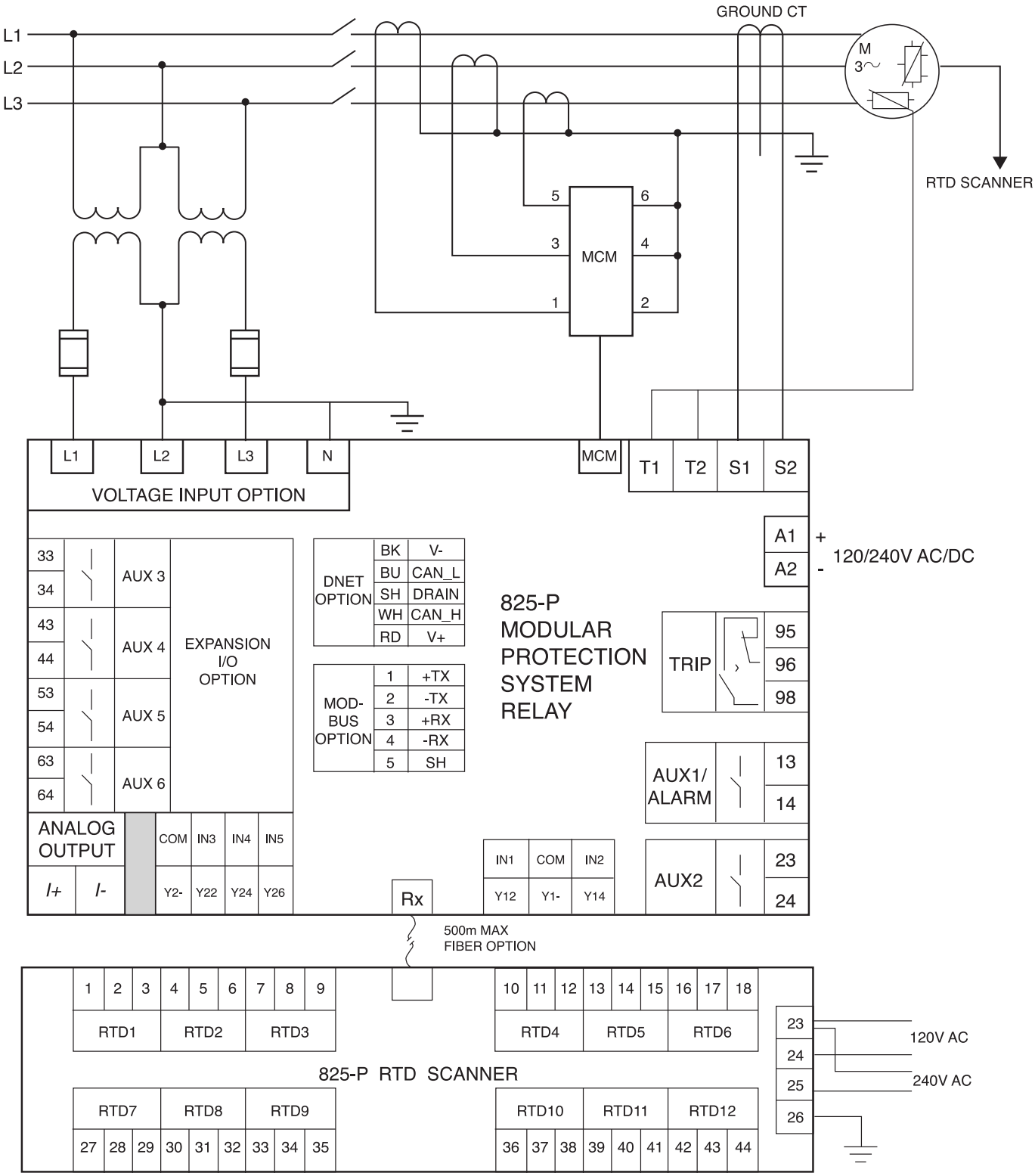
Supply		
Rated Supply Voltage U_s		110/240V AC
Operating Range		0.80…1.2 U_s
Rated Frequency		50/60 Hz ± 5 Hz
Max. Power Consumption		5VA
Rated Insulation Voltage U_i		300V AC
Rated Impulse Strength U_{imp}		4 kV
Pollution Degree		2
Environmental		
Ambient Temperature	Storage	-40…+85 °C (-40…+185 °F)
	Operation (open)	-20…+60 °C (-4…+140 °F)
Humidity (Operating)		5…95%, Non-condensing
Max. Altitude		2000 m
Vibration (per IEC 68-2-6)		3 G
Shock (per IEC 68-2-27)		30 G
Inputs		
No. of Input Channels		12
Type		3-wire
Compatibility		CU10, NI100, NI120, PT100 (per IEC 60751: 1983)
Range		-50…+250 °C
Accuracy		± 2 °C
Open Circuit Detection		>250 °C
Short-Circuit Detection		< -50 °C
Control Terminals		
Terminal Screw		M3
Cross Section (1 wire, stranded/solid)		0.25…2.5 mm² (#24…12 AWG)
Torque		0.4…0.6 N•m (3.5…5.3 lb•in.)
Degree of Protection		IP20

2

Trip Curves

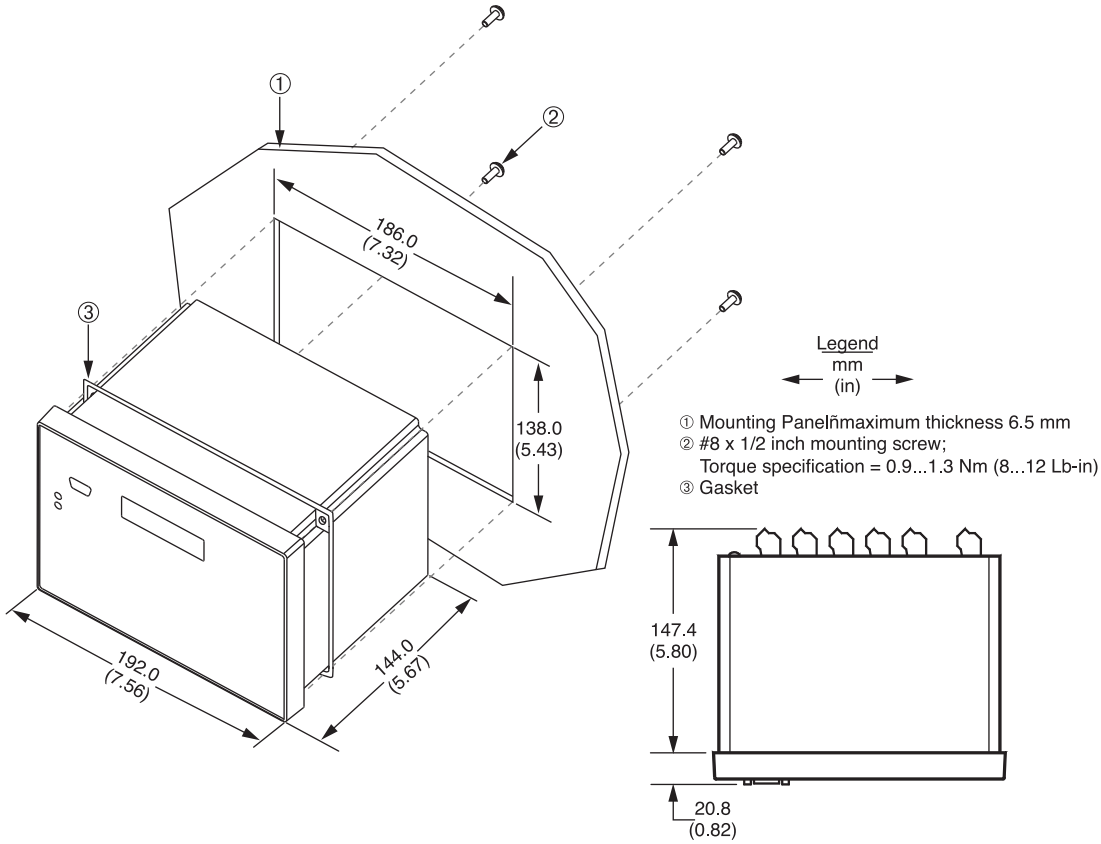


Wiring Schematic*

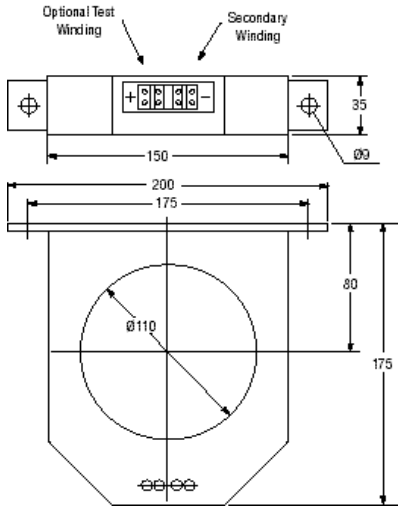


*Open Delta Voltage Connection

Dimensions are in millimeters. Dimensions are not intended to be used for manufacturing purposes.



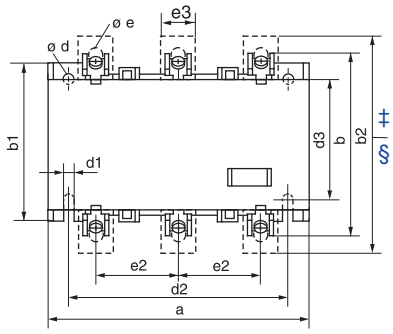
Core Balance Current Transformer

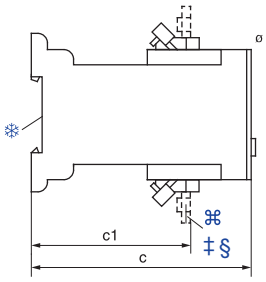


Cat. No. 825-CBCT

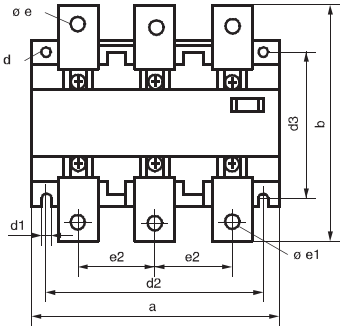
Dimensions are in millimeters. Dimensions are not intended to be used for manufacturing purposes.

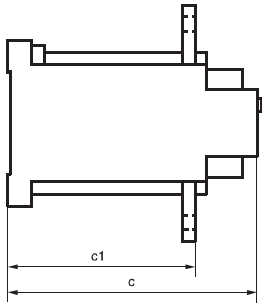
Bulletin 825-MCM Converter Module



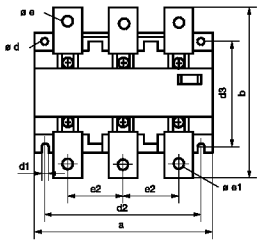


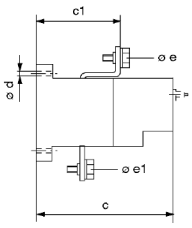
Cat. No. 825-MCM2...825-MCM180





Cat. No. 825-MCM420





Cat. No. 825-MCM630N

Dimensions													
Cat. No.	a	b	c	c1	ø d	d1	d2	d3	ø e	ø e1	e2	b1	b2
825-MCM2, -MCM5, -MCM20	120	85	102	66	5.3	5.3	100	55	2 x 2.5 mm²	—	38.5		
825-MCM180	120		102	72	5.3	5.3	100	55	♣	♣	38.5	75	‡/§ 100/118
825-MCM420	155	145	156	118	6.3	6.3	135	88	11	M10	48		
825-MCM630N	155	145	177	118	6.3	6.3	135	88	11	M10	48		

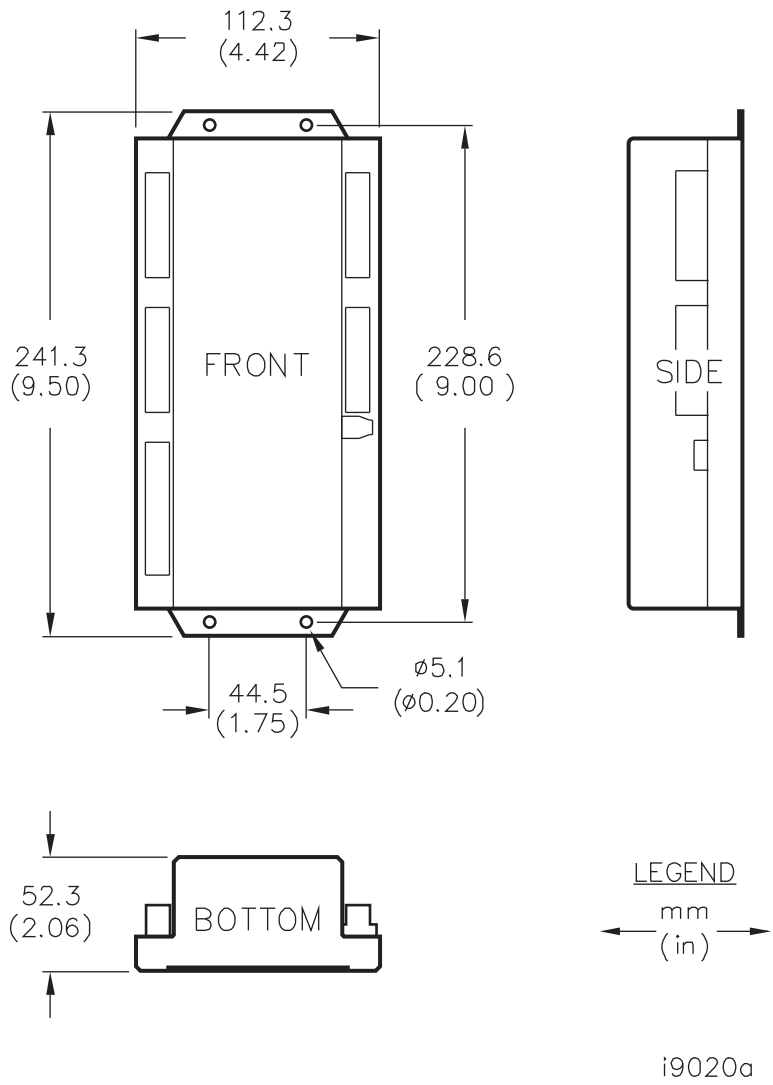
⌘ For snapping on to DIN Rail (EN 50 022-35 x 15 or 35 x 7.5).
❄ Cat. No. 825-MCM180; with bus bar or max. ø 19 mm aperture for looping the conductors.
‡ With Cat. No. 825-MVM.
§ Cat. No. 825-MVM2
♣ See below for bus bars for Cat. No. 825-MCM180.

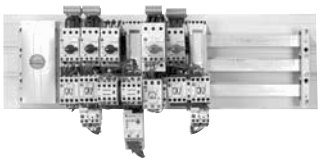
Bus Bars

Terminal Dimensions		
Cat. No.	Bottom	Top
825-MVM	M8	M8

Dimensions are in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

RTD Scanner





Bulletin 141A MCS Mounting System

- Modularity makes planning easy
- Factory-assembled starters
- Easy starter exchange
- Flexible field assembly of starters
  - DOL starters
  - Reversing starters
  - Star-Delta starters
  - Soft starters
  - Inverter
  - Complete range of accessories
- 3 mounting methods
  - On busbars
  - On 35 mm and 75 mm top hat rails
  - Screw fixing

Table of Contents

Product Selection .
ISO Busbar Modules..... 2-225
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Accessories..... 2-234
Specifications..... 2-235

Standards Compliance

UL 508
CSA 22.2 No. 14
EN 60947

Certifications

CE
cULus Recognized (File No. E 56639, Guide NMTR, NMTR8)

2

Examples given in this section are for reference purposes. This basic explanation should not be used for product selection; not all combinations will produce a valid catalog number.

141A – G S 45 R R 25 _____
a b c d e f g

a

Type	
Code	Description
G	Standard busbar module with wires

b

Length	
Code	Description
S	Short (200 mm)
M	Medium (260 mm)

c

Width	
Code	Description
45	45 mm
54	54 mm
63	63 mm
72	72 mm
81	81 mm
90	90 mm
180	180 mm
270	270 mm

d

Top Hat Rail	
Code	Description
R	RA-specific plastic rail
S	Standard plastic rail
M	Metal rail

e

Bottom Hat Rail	
Code	Description
R	RA-specific rail
S	Standard rail
H	Rail carrier
Blank	No bottom rail

f

Current Rating	
Code	Description
Blank	0 A (no wires)
16	16 A
25	25 A
45	45 A
125	125 A

g

Frame Size	
Code	Description
H	For 140U-H or 140M-H

141A – F S 45 R S 25 _____
a b c d e f g

a

Type	
Code	Description
F	Standard busbar module with terminals

b

Length	
Code	Description
S	Short (200 mm)
M	Medium (260 mm)
L	Long (320 mm)

c

Width	
Code	Description
45	45 mm
54	54 mm
63	63 mm
72	72 mm
81	81 mm
108	108 mm
110	110 mm

d

Top Hat Rail	
Code	Description
R	RA-specific plastic rail
S	Standard plastic rail
V	Screw mounting variable positions

e

Bottom Hat Rail	
Code	Description
S	Standard rail
Blank	No bottom rail

f

Current Rating	
Code	Description
25	25 A
63	63 A
200	200 A
250	250 A

g

Terminal Location	
Code	Description
Blank	Terminals on top
T	Terminals on top
B	Terminals on bottom

Examples given in this section are for reference purposes. This basic explanation should not be used for product selection; not all combinations will produce a valid catalog number.

141A – S S 45 R R 25

a b c d e f

a

Type	
Code	Description
S	ISO (isolation) busbar module with wires

b

Length	
Code	Description
S	Short (200 mm)
M	Medium (260 mm)

c

Width	
Code	Description
45	45 mm
54	54 mm
63	63 mm

d

Top Hat Rail	
Code	Description
R	RA-specific plastic rail
S	Standard plastic rail

e

Bottom Hat Rail	
Code	Description
R	RA-specific rail
S	Standard plastic rail

f

Current Rating	
Code	Description
Blank	0 A (no wires)
25	25 A
45	45 A

141A – W S 45 R R P

a b c d e f

a

Type	
Code	Description
W	Panel mounting modules

b

Length	
Code	Description
S	Short (200 mm)
M	Medium (260 mm)
L	Long (333 mm)

c

Width	
Code	Description
45	45 mm
54	54 mm

d

Top (Middle) Hat Rail	
Code	Description
R	RA-specific plastic rail

e

Bottom Hat Rail	
Code	Description
R	RA-specific plastic rail

f

Terminal Location	
Code	Description
P	With PE terminal

141A – C U H 125 B

a b c d e

a

Type	
Code	Description
C	Busbar module for specific devices

b

Length	
Code	Description
U	Universal — 140U or 140M

c

Width	
Code	Description
H	Frame size H
J	Frame size J
L	Frame sizes K and L

d

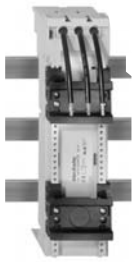
Current Rating	
Code	Description
125	125 A
250	250 A
600	600 A

e

Terminal Location	
Code	Description
Blank	Rear connecting studs (suitable for top or bottom)
T	Wires on top
B	Wires on bottom

ISO Busbar Modules

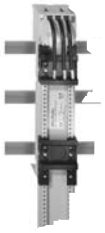
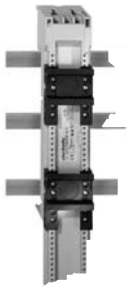
- 2-part construction
  - Device Adapter Plate (or DAP) (carrying the starter) snaps onto the base of the module
  - Base module remains on busbar when exchanging starters, providing isolation from live parts
- Test position with load circuit isolated
- Designed for use with control plug (order separately)
- Modules with current ratings supply the load current by means of wire connections matched to Bulletin 140-M motor protection circuit breakers
- Modules can form bigger platforms using the connection clips (see accessories)
- For plugging on 5 mm or 10 mm thick busbars
- Meets feeder circuit spacings per UL 508A

	Description	Rated Thermal Current I_{th} [A]	Width [mm]	Rails	Pkg. Qty.	Cat. No.
	**ISO Busbar Modules with Wires — Short Length** Wires on DAP for electrical connection 200 mm tall Top Hat Rails: R = MCS-Specific top hat rail	25	45	2R	1	**141A-SS45RR25**
			54			**141A-SS54RR25**
		45	54			**141A-SS54RR45**
			63			**141A-SS63RR45**
		Without electrical connections	45	1R	1	**141A-SS45R**
			54			141A-SS54R
	ISO Busbar Modules with Wires — Medium Length Wires on DAP for electrical connection 260 mm tall Top Hat Rails: R = MCS-Specific top hat rail; S = Standard top hat rail	25	45	1R+1S	1	**141A-SM45RS25**
			54			**141A-SM54RS25**
		45	54			**141A-SM54RS45**
			63			**141A-SM63RS45**
		Without electrical connections	45	1S	1	**141A-SM45S**
			54			**141A-SM54S**
			63			141A-SM63S

2

Standard Busbar Modules

- Modules plug directly onto the busbar
- Suitable for use with control plug
- Modules with current ratings supply the load current by means of wire or terminal connections
- Modules can form bigger platforms using the connection clips (see accessories)
- For plugging on 5 mm or 10 mm thick busbars
- Meets feeder circuit spacings per UL 508

	Description	Rated Thermal Current I_{th} [A]	Width [mm]	Rails	Pkg. Qty.	Cat. No.
	Standard Busbar Modules with Wires — Short Length With wires for electrical connection, 200 mm tall Top Hat Rails: R = MCS-Specific top hat rail M = Metal top hat rail S = Standard top hat rail	16	45	2R	1	**141A-GS45RR16**
			54			**141A-GS54RR16**
		25	45			**141A-GS45RR25**
			54			**141A-GS54RR25**
		45	54			**141A-GS54RR45**
			63			**141A-GS63RR45**
		125 (For 140-CMN)	90	1M		**141A-GS90M125**
			180			**141A-GS180M125**
			270			141A-GS270M125
		125 (For 140M-H)	180	1M		141A-GS180M125H
			270			141A-GS270M125H
		Without electrical connections (e.g., for reversing starters)	45	1R		**141A-GS45R**
			54			**141A-GS54R**
			72	1S		141A-GS72S
			81			**141A-GS81S**
	**Standard Busbar Modules with Wires — Medium Length** With wires for electrical connection 260 mm tall Top Hat Rails: R = MCS-Specific top hat rail S = Standard top hat rail	25	45	1R+1S	1	**141A-GM45RS25**
			54			141A-GM54RS25
		45	54			**141A-GM54RS45**
			63			**141A-GM63RS45**
		Without electrical connections (e.g., for reversing starters)	45	1S		**141A-GM45S**
			54			**141A-GM54S**
			63			**141A-GM63S**
	**Standard Busbar Modules with Terminals — Short Length** 200 mm tall With terminals for electrical connection S = Standard top hat rail	25	45	1S	1	**141A-FS45S25**
		63	54			**141A-FS54S63**
			63			141A-FS63S63
			72			141A-FS72S63
			81			**141A-FS81S63**
	Standard Busbar Modules with Terminals — Medium Length 260 mm tall With terminals for electrical connection S = Standard top hat rail	25	45	2S		**141A-FM45SS25**
		63	54			**141A-FM54SS63**
			63			141A-FM63SS63
			72			141A-FM72SS63
			81			**141A-FM81SS63**
	Standard Busbar Module with Terminals on Top 222 mm tall With box terminals on top for electrical connection Wire size 70 mm² (2/0 AWG) Universal mounting capability with sliding pocket nuts (M4)	200	108	—	1	**141A-FS108V200T**
	Standard Busbar Module with Terminals on Top 320 mm tall With box terminals on top for electrical connection Wire size 120 mm² (250 MCM) Universal mounting capability with sliding pocket nuts (M4)	250	110			**141A-FL110V250T**
	Standard Busbar Module with Terminals on Bottom 222 mm tall With box terminals on bottom for electrical connection Wire size 70 mm² (2/0 AWG) Universal mounting capability with sliding pocket nuts (M4)	200	108	—	1	**141A-FS108V200B**

Circuit Breaker Mounting Modules for Bulletin 140U and 140M Circuit Breakers

- Modules plug or clamp directly onto the busbar
- For plugging on 5 mm or 10 mm thick busbars

	Description	For Use With	Rated Thermal Current I_{th} [A]	Width [mm]	Pkg. Qty.	Cat. No.
	Standard Busbar Module with Flexible Connecting Wires for electrical connection For use with Bulletin 140U circuit breaker (H-Frame) For use with Bulletin 140M circuit breaker (H-Frame) Meets feeder circuit spacings per UL 508A	140U H-Frame 140M H-Frame (Top feed)	125	90	1	**141A-CUH125T**
		140U H-Frame 140M H-Frame (Bottom feed)	125	90		**141A-CUH125B**
	Standard Busbar Module with Rear Connecting Studs for electrical connection For use with Bulletin 140U circuit breakers (J-, K- or L-Frame) For use with Bulletin 140M circuit breakers (J-, K- or L-Frame) Meets feeder circuit spacings per UL 508A	140U J-Frame 140M J-Frame (Top or bottom feed)	250	105		**141A-CUJ250**
		140U K-Frame 140U L-Frame 140M L-Frame (Top or bottom feed)	630	140		**141A-CUL600**

Panel Mounting Modules

- Mounts on (2) 35 mm Top Hat Rails, (1) 75 mm Top Hat Rail, or screw mounts
- Suitable for use with control plug
- Versions with integrated PE terminal for direct motor connection

	Description	Width [mm]	Rails	Pkg. Qty.	Cat. No.	Cat. No. (with PE Terminal)
	Mounting Module — Short Length 228 mm tall Top hat rails: R = MCS-specific top hat rail For 2-component starters	45	2R	1	**141A-WS45RR**	**141A-WS45RRP**
		54			**141A-WS54RR**	141A-WS54RRP
	Mounting Module — Medium Length 283 mm tall Top hat rails: R = MCS-specific top hat rail For 3-component starters using 193-ED or -EE overload relays	45	2R	1	**141A-WM45RR**	141A-WM45RRP
		54			**141A-WM54RR**	141A-WM54RRP
	Mounting Module — Long Length 333 mm tall Top hat rails: R = MCS-specific top hat rail For 3-component starters using 193-EC, -ED or -EE overload relays	45	2R	1	**141A-WL45RR**	141A-WL45RRP
		54			141A-WL54RR	141A-WL54RRP

Busbar Components

	Description	Ampere Rating ✶	Height x Width (mm)	Pkg. Qty.	Cat. No.
	Busbar 800 mm length Tinned copper busbar❄	200	12 x 5	3	**141A-B125A**
		250‡	15 x 5		**141A-B155A**
		320	20 x 5		**141A-B205A**
		400‡	25 x 5		**141A-B255A**
		450	30 x 5		**141A-B305A**
		360	12 x 10		141A-B1210A
		520	20 x 10		**141A-B2010A**
		630	30 x 10		**141A-B3010A**
	Busbar 1600 mm length Tinned copper busbar❄	200	12 x 5		**141A-B125B**
		250‡	15 x 5		**141A-B155B**
		320	20 x 5		**141A-B205B**
		400‡	25 x 5		**141A-B255B**
		450	30 x 5		**141A-B305B**
		360	12 x 10		141A-B1210B
		520	20 x 10		**141A-B2010B**
		630	30 x 10		**141A-B3010B**
	Busbar 2400 mm length Tinned copper busbar❄	200	12 x 5	12	**141A-B125N**
		250‡	15 x 5		**141A-B155N**
		320	20 x 5		141A-B205N
		400‡	25 x 5		141A-B255N
		450	30 x 5		**141A-B305N**
		360	12 x 10	6	**141A-B1210N**
		520	20 x 10		**141A-B2010N**
		630	30 x 10		**141A-B3010N**
	Double-T Busbar 2400 mm length Tin-plated copper busbar	960	TT	1	**141A-BT11NZ**
		1250	TT	1	141A-BT12NZ

✶ Ratings shown are based upon tested conditions at an ambient temperature of 40 °C and a busbar temperature of 70 °C.
❄ Only available in North America.
‡ IEC applications only

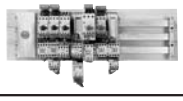
Busbar Components, Continued

	Description	Busbar [mm]	Pkg. Qty.	Cat. No.
	Busbar Support 60 mm pole center spacing 3-pole with inside mounting holes (meets feeder circuit spacings per UL508A)	12, 20, 30 x 5 or 12, 20, 30 x 10	10	**141A-TU3**
	Busbar Support 60 mm pole center spacing 3-pole with inside mounting holes (approved for branch circuit applications per UL508)	12…30 x 5 or 12…30 x 10	10	**141A-TR3**
	Busbar Support 60 mm pole center spacing 4-pole with inside mounting holes			**141A-TR4**
	Busbar Support 1-pole			**141A-TR1**
	Busbar Support with terminals 60 mm pole center spacing Terminals for electrical connections 16 mm² (#6 AWG) 3-pole	12…30 x 5 or 12…30 x 10	10	**141A-TR3F16**
	Double-T Busbar Support For double-T busbars 60 mm spacing (meets feeder circuit spacings per UL 508A)	3-pole	3	**141A-T13**
		1-pole	10	141A-T11
	Busbar End Cover Prevents contact with the busbar ends and prevents busbars from sliding. The end cover can easily be clipped on the busbar support.	3-pole (for use with Cat. Nos. 141A-TU3 or 141A-TR3)	10	**141A-TR3E**
		4-pole (for use with Cat. No. 141A-TR4)		**141A-TR4E**
		3-Pole (for use with Cat. No. 141A-T13 double T busbar supports)	4	**141A-T13E**

Busbar Components, Continued

	Description	Busbar [mm]	Pkg. Qty.	Cat. No.
	Supply Module 3-pole 6…50 mm² (10…1/0 AWG) 54 mm wide (meets feeder circuit spacings per UL 508A)	12…30 x 5 or 12…30 x 10	1	**141A-VN370**
	Supply Module 3-pole 35…120 mm² (2 AWG…250 MCM) 81 mm wide (meets feeder circuit spacings per UL 508A)			**141A-VN3120**
	Supply Module 3-pole 95…185 mm² (3/0 AWG…350 MCM) 135 mm wide			**141A-VN3185**
	Supply Module 3-pole for round conductors 150…300 mm² (300…600 MCM) 135 mm wide			**141A-VN3300R**
	Supply Module 3-pole for flat conductors up to 32 x 20 mm equivalent to 300 mm² (300…600 MCM) round conductor ampacity 135 mm wide			**141A-VN3300F**
	Supply Module 3-Pole (set of 3 terminals) for round conductors 120…300 mm² (250…600 MCM) 153 mm wide (3 single poles of 51 mm each) (meets feeder circuit spacings per UL 508A) Requires Cat. No. 141A-BK180, 141A-BK228 or 141A-BK250 terminal cover		1	**141A-VU3300R**
	Supply Module 3-Pole (set of 3 terminals) for flat conductors up to 32x20 mm equivalent to 300 mm² (600 MCM) 153 mm wide (3 single poles of 51 mm each) (meets feeder circuit spacings per UL 508A) Requires Cat. No. 141A-BK180, 141A-BK228 or 141A-BK250 terminal cover		1	141A-VU3300F
	Single Terminals Single terminals for supplying busbars 2.5…16 mm² (#14…6 AWG)	12…30 x 5	25	**141A-VS116**
		12…30 x 10		**141A-VS216**
	Single Terminals Single terminals for supplying busbars 4…35 mm² (#12…2 AWG)	12…30 x 5		**141A-VS135**
		12…30 x 10		**141A-VS235**
	Single Terminals Single terminals for supplying busbars 16…70 mm² (#6…2/0 AWG)	12…30 x 5		**141A-VS170**
		12…30 x 10		**141A-VS270**
	Single Terminals Single terminals for supplying busbars 16…120 mm² (#6…250 MCM)	12…30 x 10		**141A-VS2120**
	Profile Terminals For double-T busbars To connect with flat busbars and flexible copper busbars	400…800 mm²	3	141A-VS54136F
		500…750 mm²	3	141A-VS55121F
		600…900 mm²	3	141A-VS56421F
		600…1200 mm²	3	141A-VS56436F
		800…1600 mm²	3	141A-VS58136F
		1000…2000 mm²	3	141A-VS510136F

Busbar Components, Continued

	Description	Busbar [mm]	Pkg. Qty.	Cat. No.
	Terminal Cover Finger protection when busbars supplied with single terminals. Attaches directly to busbars. Height: 180 mm, Width: 54 mm	12…30 x 5 or 12…30 x 10	1	**141A-BK1**
	Terminal Cover Finger protection when bus bars are supplied by Cat. No. 141A-VU3300_ supply module Attaches directly to bus bars Height: 200 mm Depth: 90 mm	Width: 180 mm	1	**141A-BK180**
		Width: 228 mm	1	**141A-BK228**
		Width: 250 mm	1	**141A-BK250**
	Terminal Cover Kit Customized terminal cover width using end supports, front shroud and top/bottom shroud Shrouds can be cut to desired width Attaches directly to bus bars	Left and right support	1	**141A-BKH**
		Front shroud, 1100 mm	1	**141A-BKC**
		Top/bottom shroud, 1100 mm	1	**141A-BKS**
	Busbar Connector System distance: 5…10 mm	12…20 x 5 or 12…20 x 10	12	**141A-VC3A**
	Busbar Connector System distance: 13…20 mm	20…30 x 5 or 20…30 x 10	6	**141A-VC3B**
	Busbar Connector System distance: 50…60 mm		3	**141A-VC3C**
	Busbar Connector System distance: 100…110 mm		3	**141A-VC3D**
	Double-T Busbar Connectors For connection of double-T busbar racks with same dimensions, Width: 50 mm	Double-T	6	141A-VC5E
	Double-T Busbar Connectors For connection of double-T busbar racks with same dimensions, Width: 95 mm		3	141A-VC5F
	Double-T Busbar Connectors For connection of double-T busbar racks with same dimensions, Width: 150 mm		3	141A-VC5G
	Busbar Shroud Cover 200 x 1100 mm Covers all 3 busbars	12…30 x 5 or 12…30 x 10	2	**141A-BCF1**
	Busbar Shroud Holder 2 required per section of Busbar Shroud Cover		10	**141A-BCF1H**
	Single Pole Busbar Covers Snap-on profile for single busbars for protection against electric shock. Length: 1 m, can be cut to length.	12…30 x 5	10	**141A-BS5**
		12…30 x 10		**141A-BS10**
	Busbar Cover For double-T busbars Length: 1 m; can be cut to length	—	5	**141A-BCT1**
	Compartment Section Fits to 141A-T13 double-T busbar supports Adjusts the installation depth — 48 mm deep	Double-T	1	141A-BST48
	76 mm deep		1	141A-BST76
	**Panel Busbar Shroud** Provides isolation between busbar and panel (required for feeder-circuit applications per UL 508A) 230 x 810 mm	All	2	**141A-BCR**

Busbar Components, Continued

	Description				PQ	Cat. No.
	Busbar Fuse Switch 3-pole switch disconnector with fuses	For fuse links D02, for D01 fuses use reducer	400V AC	63 A∗	1	141A-NF0102
		For 10 x 38 NFC cylindrical fuses	690V AC	32 A	1	141A-NF1038
	Pilot Switch Pilot switch for signaling ON/OFF position of lid For 140-NF0102, 140-NF1038 and 140-NFH1038 250V AC/5 A; 30V DC/4 A				1	141A-NFASNF
	Spacer Module Connectable on both sides 9 mm wide				5	141A-NFAD
	Reducer D02 reducer for D01 fuses For 141A-NF0102				20	141A-NFAR
	Class J Busbar Fuse Base For mounting on 10 mm wide and double-T busbars Top or bottom connection For UL Class J fuses			61…100 A	1	**141A-NFJ100**
				101…200 A	1	**141A-NFJ200**
				201…400 A	1	**141A-NFJ400**

∗ The use of spacer module 141A-NFAD is recommended for a continuous load above 35 A.
PQ = Package Quantity

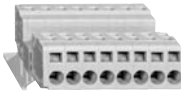
Busbar Components, Continued

	Description				PQ	Cat. No.
	NH Fuse Switch Disconnector Connection bottom or top Size 00 for plugging on 5, 10 mm thick and double-T busbars. Sizes 1 and 2 conversion kit 141A-NFAFR5 is required for plugging on 5 mm thick busbars. Size 3 only for plugging on 10 mm and double-T busbars.	Size 00 200 x 106 mm	M8 70 mm²	160 A	1	**141A-NFD160**
		Size 1 243 x 184 mm	M10 120 mm²	250 A	1	141A-NFD250
		Size 2 288 x 210 mm	M10 240 mm²	400 A	1	141A-NFD400
		Size 3 300 x 256 mm	M12 240 mm²	630 A	1	141A-NFD630
	Pilot Switch For NH-fuse switch disconnectors Signaling ON/OFF position of lid 250V AC/5 A 30V DC/4 A	Size 00…3			1	141A-NFASNFD
	Wedge Clamp Terminal For NH-fuse switch disconnectors Connection accessories	Size 1 18 x 10 mm	70…150 mm²		1	141A-NFVF1150
		Size 2 21 x 15 mm	120…240 mm²		1	141A-NFVF2240
		Size 3 25 x 20 mm	150…300 mm²		1	141A-NFVF3300
	Conversion Kit For NH-fuse switch disconnector to reduce size 1 and 2 on to 5 mm busbars	Size 1 and 2			1	141A-NFAFR5
	Cover for Cable Lugs For NH fuse switch disconnecor Can be clipped on bottom or top	Size 00			1	**141A-NFAC00A**
		Size 1			2	**141A-NFAC1A**
		Size 2			2	**141A-NFAC2A**
		Size 3			2	**141A-NFAC3A**

PQ = Package Quantity

2

Accessories

	Description	Width [mm]	Pkg. Qty.	Cat. No.
	Hat (DIN) Rails — MCS Top Hat Rail (Plastic) Slides onto mounting modules and is then fixed with screws. Has notches for MCS components (prevents movement of components when used with vertical busbar)	45	10	**141A-AHR45**
		54		**141A-AHR54**
		63		141A-AHR63
	Hat (DIN) Rails — Standard Top Hat Rail (Plastic) Slides onto mounting modules and is then fixed with screws	72	10	**141A-AHS72**
		81		141A-AHS81
	**Control Plug** Pull-apart terminal block allows fast and simple disconnection of control wiring Snaps on the support of the mobile device rail Composed of plug holder, male and female parts	8 Pole	1	**141A-APC8**
		10 Pole	1	**141A-APC10**
		12 Pole	1	**141A-APC12**
	Control Plug Holder Suitable for use with 8-, 10-, or 12-pole control plugs			**141A-APH**
 Cat. No. 141A-AS9S	**Spacer module — for ISO busbar modules** For 9 mm spacing of mounting modules. Connection clips (Cat. No. 141A-AK) are included for attaching the spacer module to the mounting modules.	200	10	**141A-AS9S**
 Cat. No. 141A-AS9B	**Spacer module — for Standard busbar modules** For 9 mm spacing of mounting modules. Connection clips (Cat. No. 141A-AK) are included for attaching the spacer module to the mounting modules.	200		**141A-AS9B**
	Spacer Module — for Mounting modules For spacing of load feeders by 9 mm e.g. for improved cooling. Including connection clips.	228		**141A-AS9W**
	Connection Clip For joining base of mounting modules		50	**141A-AK**
	Micro Switch N.C. Contact Only for ISO Modules. Automatically drops out the contactor when the DAP (Device Adapter Plate) (carrying the starter) is unplugged from the base of the ISO busbar module.		10	141A-AS

Module Data

			Iso Modules		Standard Modules with Wire Connections				Standard Modules with Box Terminals			
			141A-S		141A-G				141A-F			
Rated current at 60 °C I_{th}*		[A]	25	45	16	25	45	125	25	63	200	250
	stranded	[mm²] [AWG]	6 10	10 8	4 12	6 10	10 8	—	4 12	16 6	6…70 10…2/0	35…120 2…250 MCM
	solid	[mm²] [AWG]	—	—	—	—	—	—	4 12	16 6	6…70 10…2/0	35…120 2…250 MCM
		[mm²] [AWG]	—	—	—	—	—	43 1/0	—	—	—	—
Insulation rating of conductors		[°C]	105		105				—	—	—	

* The admissible load of a complete system depends on the system topography and the application parameters. Factors of influence are ambient temperature, air circulation, busbar load, distribution of busbar load, mix of modules and switchgear components.

Supply Modules

			Supply Modules							
			141A-TR3F16	141A-VN370	141A-VN3120	141A-VN3185	141A-VN3300R	141A-VN3300F	141A-VU3300R	141A-VU3300F
	stranded	[mm²] [AWG]	1.5…16 16…6	6…50 10…1/0	35…120 2…250 MCM	95…185 No. 3/0…350 MCM	150…300 300…600 MCM	—	120…300 250…600 MCM	—
	solid	[mm²] [AWG]	1.5…16 16…6	6…50 10…1/0	35…120 2…250 MCM	95…185 No. 3/0…350 MCM	150…300 300…600 MCM	—	120…300 250…600 MCM	—
	Laminated copper	[mm]	—	—	—	—	—	3 x 20 x 1… 10 x 32 x 1	—	3 x 20 x 1… 10 x 32 x 1
Tightening Torque		[N•m/ lb•in.]	—	8…10/71… 89	12…15/106 …133	30/266	30/266	30/266	30/266	30/266

Class J Bus Bar Fuse Bases

			Class J Bus Bar Fuse Bases		
			141A-NFJ100	141A-NFJ200	141A-NFJ400
	stranded	[mm²] [AWG]	6…70 10…2/0	10…150 8…300 MCM	16…300 4…600 MCM
	solid	[mm²] [AWG]	6…70 10…2/0	10…150 8…300 MCM	16…300 4…600 MCM
Tightening Torque		[N•m/ lb•in.]	14…16/125…142	16…18/142…160	38…40/336…355

Single Terminals

			Single Terminals		
			141A-VS116, 141A-VS216	141A-VS135, 141A-VS235	141A-VS170, 141A-VS270
	stranded	[mm²] [AWG]	2.5…16 14…6	4…35 12…2	16…70 6…2/0
	solid	[mm²] [AWG]	2.5…16 14…6	4…35 12…2	16…70 6…2/0
	Laminated copper 1. Conductor 2. Conductor	[mm] [mm]	— —	5 x 9 x 0.8 —	5 x 9 x 0.8 5 x 9 x 0.8
Clamping area	Width x Height	[mm]	7.5 x 7.5	10.5 x 11	14 x 14
Tightening Torque		[N•m/lb•in.]	4/35	6/53	10/120

Short-Circuit Current Ratings (support spacing at 800 mm)

Cat. No.	Description	Max. Circuit Bkr. Cat. No.	C. B. Rating	SCCR 480V	SCCR 600V	Max. Class CC, J or T Fuse	SCCR 480V	Max. Class CC, J or T Fuse	SCCR 600V
141A-B125*	12x5 Copper Bus Bar	140U-J6D3-D25	250 A	65 kA	25 kA	400 A	100 kA	400 A	100 kA
141A-B1210*	12x10 Copper Bus Bar	140U-J6D3-D25	250 A	65 kA	25 kA	400 A	100 kA	400 A	100 kA
141A-B205*	20x5 Copper Bus Bar	140U-K6D3-D40	400 A	65 kA	35 kA	500 A	100 kA	400 A	100 kA
141A-B2010*	20x10 Copper Bus Bar	140U-K6D3-D40	400 A	65 kA	35 kA	500 A	100 kA	400 A	100 kA
141A-B305*	30x5 Copper Bus Bar	140U-K6D3-D40	400 A	65 kA	35 kA	500 A	100 kA	500 A	100 kA
		140U-L6D3-D60		—	35kA	500 A	100 kA	500 A	100 kA
141A-B3010*	30x10 Copper Bus Bar	140U-K6D3-D40	400 A	65 kA	35 kA	600 A	100 kA	600 A	100 kA
		140U-L6D3-D60		50 kA	25 kA	600 A	100 kA	600 A	100 kA
141A-BT1*NZ	TT Copper Bus Bar	140U-M6D3-D80	800 A	65 kA	30 kA	800 A Class T	100 kA	600 A	100 kA
141A-TU3	Bus Bar Support	140U-K6D3-D40	400 A	65 kA	35 kA	600 A	100 kA	600 A	100 kA
		140U-L6D3-D60	600 A	50 kA	35kA	600 A	100 kA	600 A	100 kA
141A-T13	Bus Bar Support	140U-M6D3-D80	800 A	65 kA	30 kA	800 A Class T	100 kA	600 A	100 kA
141A-TR3E	BB Support End Cover	140U-K6D3-D40	400 A	65 kA	35 kA	600 A	100 kA	600 A	100 kA
		140U-L6D3-D60	600 A	50 kA	35kA	600 A	100 kA	600 A	100 kA
141A-T13E	BB Support End Cover	140U-M6D3-D80	800 A	65 kA	30 kA	800 A Class T	100 kA	600 A	100 kA
141A-VN370	Supply Module	140U-J6D3-D26	250 A	65 kA	25 kA	400 A	100 kA	400 A	100 kA
141A-VN3120	Supply Module	140U-K6D3-D40	400 A	65 kA	35 kA	600 A	100 kA	600 A	100 kA
		140U-L6D3-D60	600 A	50 kA	35kA	600 A	100 kA	600 A	100 kA
141A-VN3185	Supply Module	140U-K6D3-D40	400 A	65 kA	35 kA	500 A	100 kA	300 A	100 kA
141A-VN3300R	Supply Module	140U-K6D3-D40	400 A	65 kA	35 kA	500 A	100 kA	300 A	100 kA
141A-VU3300R	Supply Module	140U-K6D3-D40	400 A	65 kA	35 kA	500 A	100 kA	300 A	100 kA
141A-VS54136F	Profile Terminals	140U-M6D3-D80	800 A	65 kA	30 kA	800 A Class T	100 kA	600 A	100 kA
141A-CUH125B	Circuit Breaker Module	140U-H6C3-D12	125 A	65 kA	25 kA	N/A	N/A	N/A	N/A
141A-CUH125T	Circuit Breaker Module	140U-H6C3-D12	125 A	65 kA	25 kA	N/A	N/A	N/A	N/A
141A-CUJ250	Circuit Breaker Module	140U-J6D3-D25	250 A	65 kA	25 kA	N/A	N/A	N/A	N/A
141A-CUL600	Circuit Breaker Module	140U-K6D3-D40	400 A	65 kA	35 kA	N/A	N/A	N/A	N/A
		140U-L6D3-D60	600 A	50 kA	25 kA	N/A	N/A	N/A	N/A
141A-SS*25 141A-SM*25 141A-GS*25 141A-GM*25 141A-FS*25 141A-FM*25	Bus Bar Module	140M-C2E-B16	1.6 A	65 kA	47kA	30 A	100 kA	30 A	100 kA
		140M-C2E-C10	10 A	65 kA	30 kA	30 A	100 kA	30 A	100 kA
		140M-C2E-C25	25 A	30 kA	30 kA	30 A	100 kA	30 A	100 kA
		140M-D8E-C25	25 A	65 kA	30 kA	30 A	100 kA	30 A	100 kA
141A-SS*45 141A-SM*45 141A-GS*45 141A-GM*45	Bus Bar Module	140M-F8E-C32	32A	65 kA	30 kA	—	—	—	—
		140M-F8E-C45	45 A	65 kA	18kA	—	—	—	—

Busbars (required quality)

Material		E-CU blank or tinned
Busbar widths 5 or 10 mm thick	[mm]	12, 15, 20, 25, 30
Tolerance of thickness	[mm]	+0.1/-0.3
Corner radius	[mm]	0.5
Tolerance of center spacing	[mm]	60 +0.5/-0.5
Standard		DIN 46433

General Data

Main Circuits

Rated insulation voltage U_i		
Acc. to IEC, EN	[V]	690
Acc. to UL, NEMA, CSA, EEMAC	[V]	600
Rated impulse withstand voltage U_{imp}	[kV]	8
Rated frequency	[Hz]	50…60
Pollution degree		3
Ambient temperature		
Operation	[°C]	-25…+60
Transport and storage	[°C]	-50…+80

Protection class - Modules and busbars	IP00
- Modules and busbars mounted on plate, connected conductors and usage of busbar covers	IP20
- Iso-Modules with device adapter plate removed, from front	IP20 B (finger proof)
Standards and Norms	IEC/EN 60439-1
Certifications	CE, cULus Recognized

Control Circuits

Control plugs		
Rated insulation voltage U_i		
Acc. to IEC, EN	[V]	250
Acc. to UL, NEMA, CSA, EEMAC	[V]	300
Rated impulse withstand voltage U_{imp}	[kV]	4
Rated current at 40 °C ambient temperature I_{th}	[A]	12

Micro switch		
Rated insulation voltage U_i		
Acc. to IEC, EN	[V]	250
Acc. to UL, NEMA, CSA, EEMAC	[V]	300
Rated current		Suitable for switching contactors 100-C AC-coil-voltage ≤ 250 V DC-coil-voltage ≤ 120 V

Weight [g]

MCS Standard Busbar Module	[g]
141A-GS45RR25	302
141A-GS54RR25	347
141A-GS54RR45	358
141A-GS63RR45	379
141A-GS90M125	781
141A-GS180M125	1021
141A-GS270M125	1271
141A-GS45R	200
141A-GS54R	226
141A-GS72S	268
141A-GS81S	289
141A-GM45RS25	313
141A-GM54RS25	368
141A-GM54RS45	379
141A-GM63RS45	400
141A-GM45S	211
141A-GM54S	277
141A-GM63S	298
141A-FS45S25	272
141A-FS54S63	328
141A-FS63S63	349
141A-FS72S63	387
141A-FS81S63	408
141A-FM45SS25	293
141A-FM54SS63	349
141A-FM63SS63	370
141A-FM72SS63	408
141A-FM81SS63	429

MCS Iso Busbar Module	[g]
141A-SS45RR25	381
141A-SS54RR25	396
141A-SS54RR45	472
141A-SS63RR45	480
141A-SS45R	279
141A-SS54R	305
141A-SM45RS25	402
141A-SM54RS25	418
141A-SM54RS45	494
141A-SM63RS45	502
141A-SM45S	300
141A-SM54S	327
141A-SM63S	405

MCS Standard Busbar Module >100 A	[g]
141A-FS108V200T	1000
141A-FL110V250T	1200
141A-FS108V200B	1000

MCS Mounting Module	[g]
141A-WS45RR	163
141A-WS54RR	204
141A-WM45RR	189
141A-WM54RR	211
141A-WL45RR	211
141A-WL54RR	222
141A-WS45RRP	180
141A-WS54RRP	221
141A-WM45RRP	212
141A-WM54RRP	234
141A-WL45RRP	240
141A-WL54RRP	251

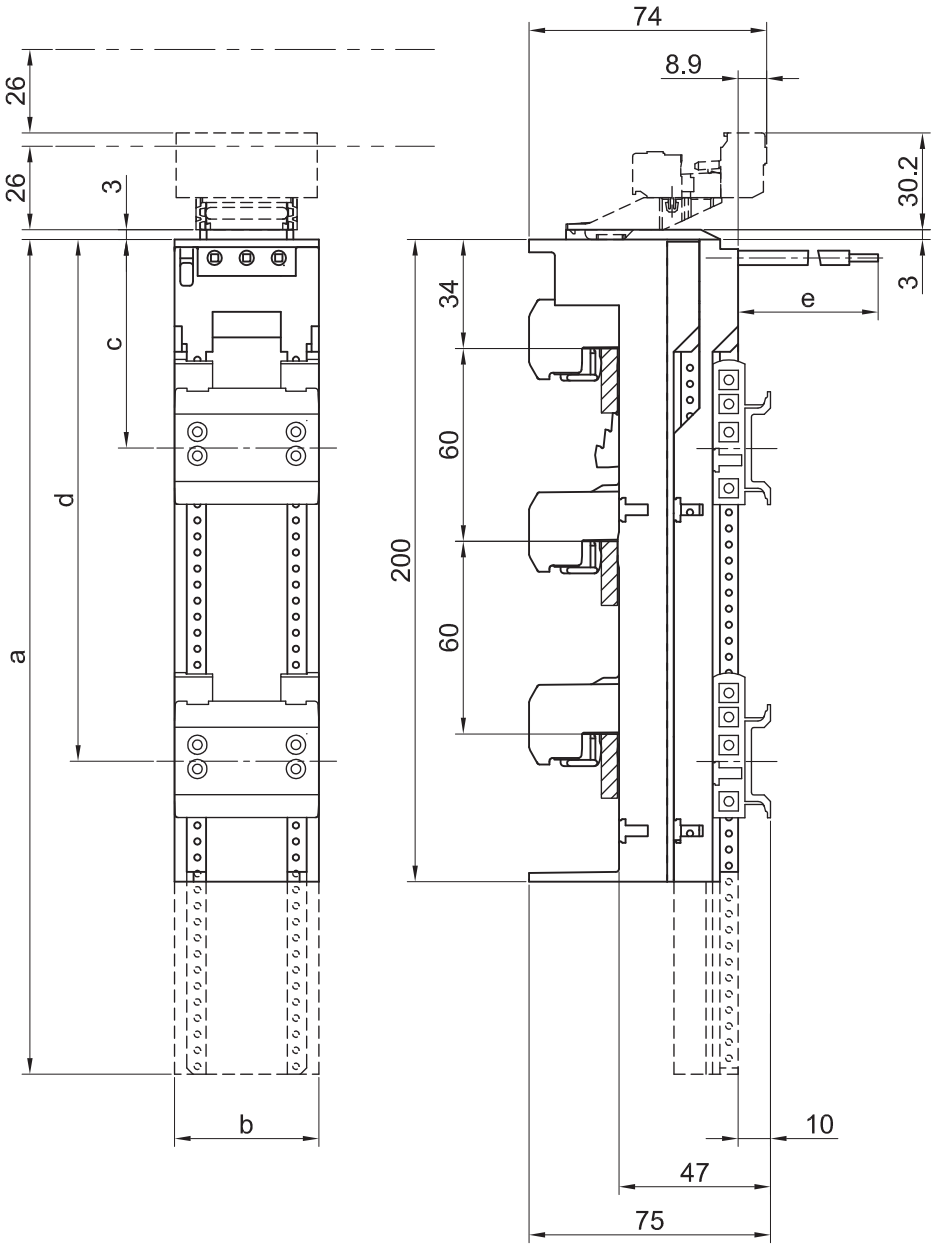
Busbar Components	[g]
141A-TR3	203
141A-TR4	256
141A-TR1	59
141A-TR3E	21
141A-TR4E	28
141A-TR3F16	285
141A-TU3	127
141A-T11	158
141A-T13	591
141A-T13E	20
141A-VN370	360
141A-VN3120	485
141A-VN3185	1140
141A-VN3300R	1540
141A-VN3300F	1619
141A-VU3300R	1550
141A-VU3300F	1325
141A-VS116	21
141A-VS216	23
141A-VS135	46
141A-VS235	47
141A-VS170	71
141A-VS270	74
141A-VS2120	109
141A-VS54136F	670
141A-VS55121F	705
141A-VS56421F	840
141A-VS56436F	859
141A-VS58136F	1011
141A-VS510136F	1137
141A-BK1	144
141A-VC3A	185
141A-VC3B	251
141A-VC3C	565
141A-VC3D	870
141A-VC5E	494
141A-VC5F	943
141A-VC5G	1461
141A-BCF1	750
141A-BCF1H	40
141A-BS5	87
141A-BS10	101

Busbar Components	[g]
141A-BCR	800
141A-BST48	700
141A-BST76	1050
141A-BCT1	380
141A-NF0102	759
141A-NF1038	760
141A-NFASNF	7
141A-NFAD	61
141A-NFAR	1
141A-NFJ100	3280
141A-NFJ200	4500
141A-NFJ400	6900
141A-NFD160	1300
141A-NFD250	3760
141A-NFD400	5500
141A-NFD630	7840
141A-NFASNFD	11
141A-NFVF1150	116
141A-NFVF2240	199
141A-NFVF3300	247
141A-NFAFR5	65
141A-NFAC00A	124
141A-NFAC1A	107
141A-NFAC2A	109
141A-NFAC3A	156
141A-BK180	395
141A-BK228	425
141A-BK250	440
141A-BKH	90
141A-BKC	420
141A-BKS	150

Accessories	[g]
141A-AHR45	15
141A-AHR54	16
141A-AHR63	16
141A-AHS72	17
141A-AHS81	18
141A-APC8	29
141A-APC10	35
141A-APC12	40
141A-APH	5
141A-AS9B	20
141A-AS9W	20
141A-AS9S	38
141A-AK	1
141A-AS	75

Dimensions are in millimeters. Dimensions are not intended for manufacturing purposes.

Cat. No. 141A-S...ISO Busbar Modules

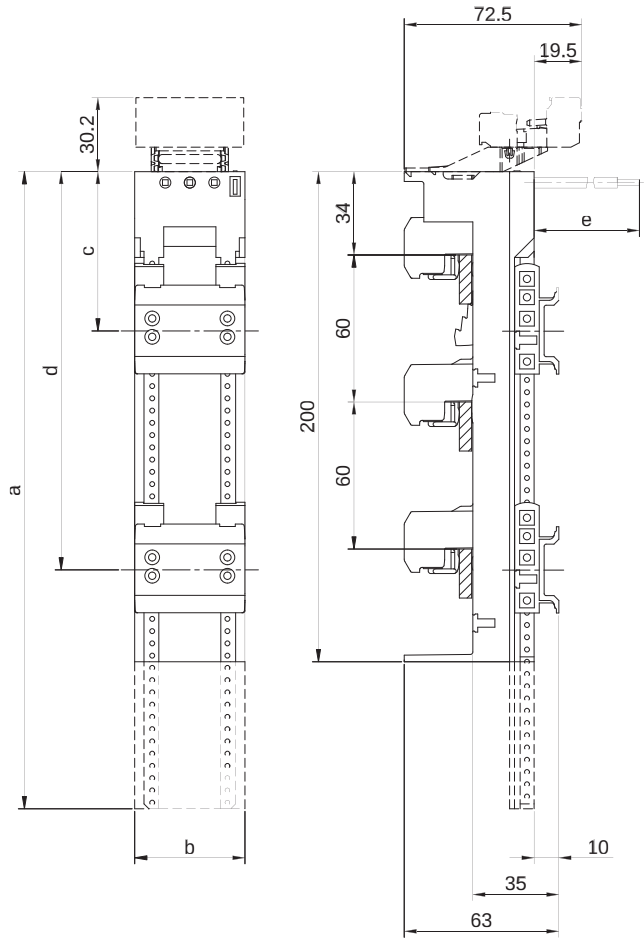


Cat. No.	A	B	C	D	E
141A-SS45RR25	200	45	65	162.5	73
141A-SS54RR25	200	54	65	162.5	73
141A-SS54RR45	200	54	65	170	95
141A-SS63RR45	200	63	65	170	95
141A-SS45R	200	45	—	162.5	—
141A-SS54R	200	54	—	170	—
141A-SM45RS25	260	45	65	170	73
141A-SM54RS25	260	54	65	170	73
141A-SM54RS45	260	54	65	170	95
141A-SM63RS45	260	63	65	170	95
141A-SM45S	260	45	—	170	—
141A-SM54S	260	54	—	170	—
141A-SM63S	260	63	—	170	—

NOTE:
1. FREE SPACE REQUIRED TO GET THE DEVICE ADAPTER PLATE IN PARKING POSITION.

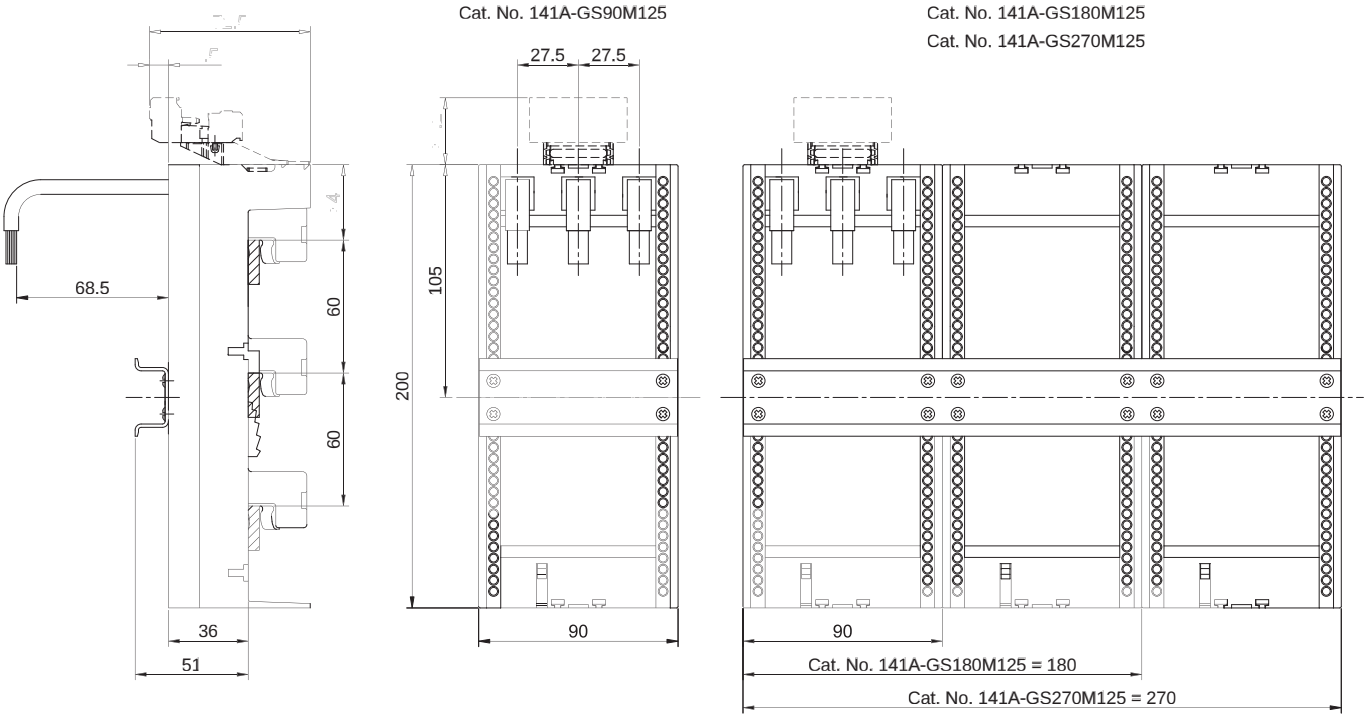
Dimensions are in millimeters (inches). Dimensions are not intended for manufacturing purposes.

Cat. No. 141A-GS, Standard Busbar Modules with Wires



Cat. No.	PER DETAIL	A	B	C	D	E
141A-GS45RR16	A	200	45	65	162.5	73
141A-GS54RR16	A	200	54	65	162.5	73
141A-GS45RR25	A	200	45	65	162.5	73
141A-GS54RR25	A	200	54	65	162.5	73
141A-GS54RR45	A	200	54	65	170	95
141A-GS63RR45	A	200	63	65	170	95
141A-GS45R	A	200	45	—	162.5	—
141A-GS54R	A	200	54	—	170	—
141A-GS72S	A	200	72	105	—	—
141A-GS81S	A	200	81	105	—	—
141A-GM45RS25	A	260	45	65	170	73
141A-GM54RS25	A	260	54	65	170	73
141A-GM54RS45	A	260	54	65	170	95
141A-GM63RS45	A	260	63	65	170	95
141A-GM45S	A	260	45	—	170	—
141A-GM54S	A	260	54	—	170	—
141A-GM63S	A	260	63	—	170	—

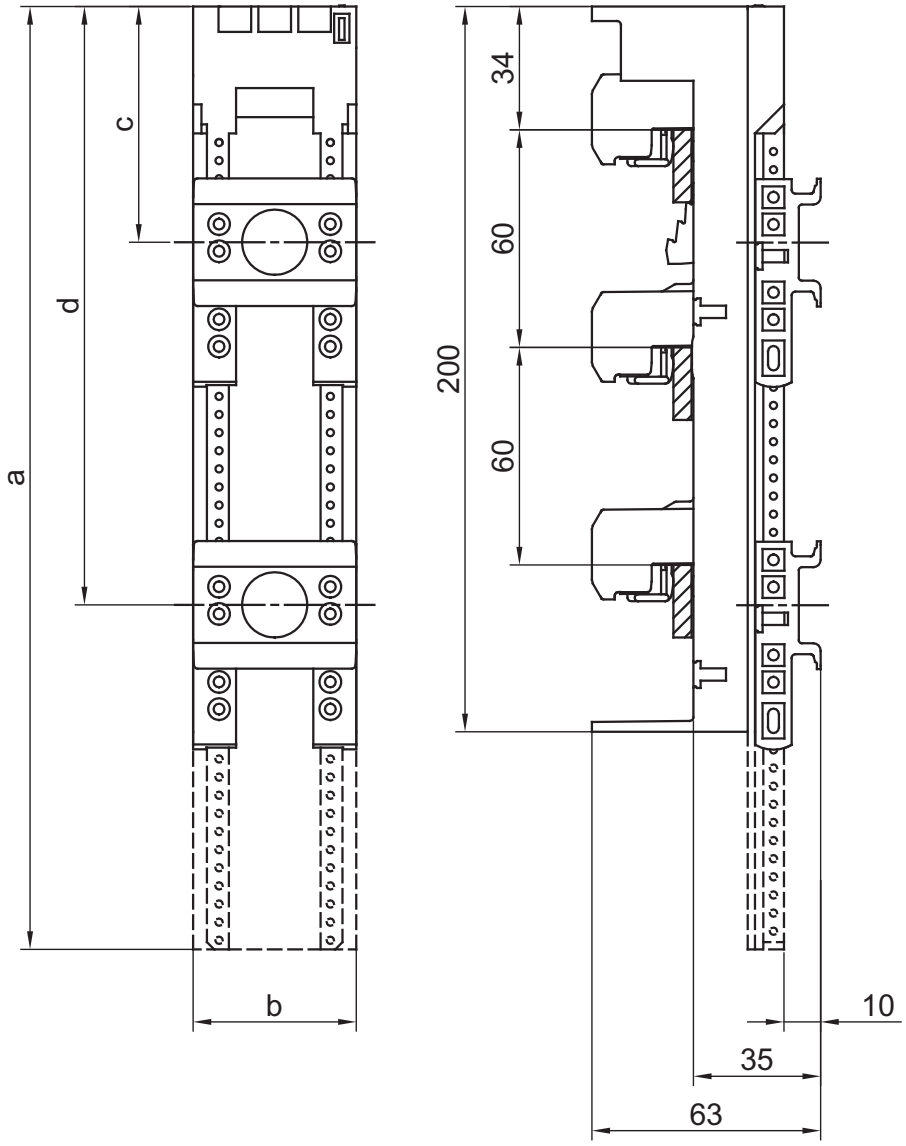
NOTE:
1. FREE SPACE REQUIRED TO PLUG/UNPLUG MODULE INTO THE BUSBARS.



2

Dimensions are in millimeters (inches). Dimensions are not intended for manufacturing purposes.

Cat. No. 141A-F… Standard Busbar Modules with Terminals

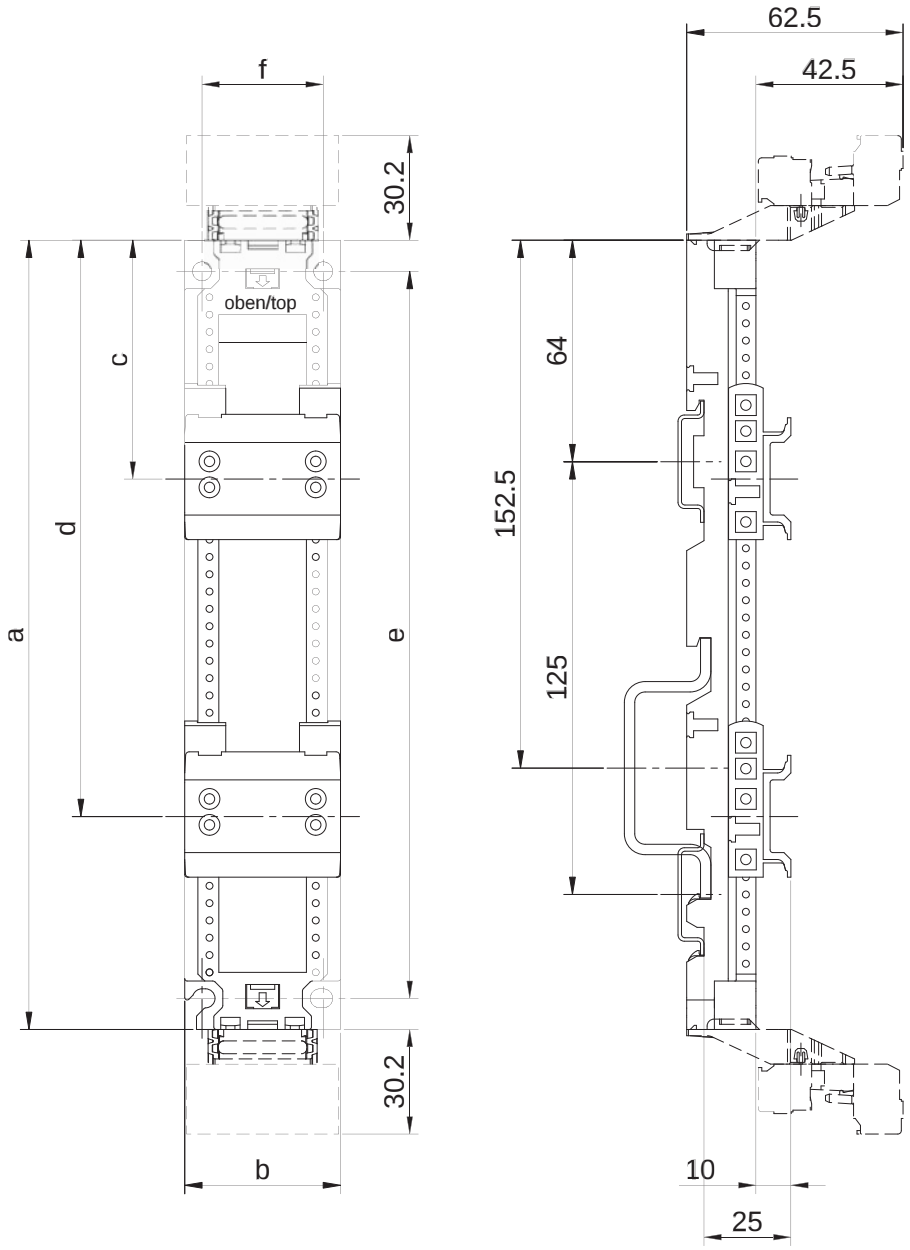


Cat. No.	A	B	C	D	WIRE SIZES	
					mm²	AWG
141A-FS45S25	200	45	65	—	6	#10
141A-FS54S63	200	54	65	—	16	#6
141A-FS63S63	200	63	65	—	16	#6
141A-FS72S63	200	72	65	—	16	#6
141A-FS81S63	200	81	65	—	16	#6
141A-FM45SS25	260	45	65	170	6	#10
141A-FM54SS63	260	54	65	170	16	#6
141A-FM63SS63	260	63	65	170	16	#6
141A-FM72SS63	260	72	65	170	16	#6
141A-FM81SS63	260	81	65	170	16	#6

NOTE:
1. FREE SPACE REQUIRED TO PLUG/UNPLUG MODULE INTO THE BUSBARS.

Dimensions are in millimeters. Dimensions are not intended for manufacturing purposes.

Cat. No. 141A-W… Panel Mount Modules

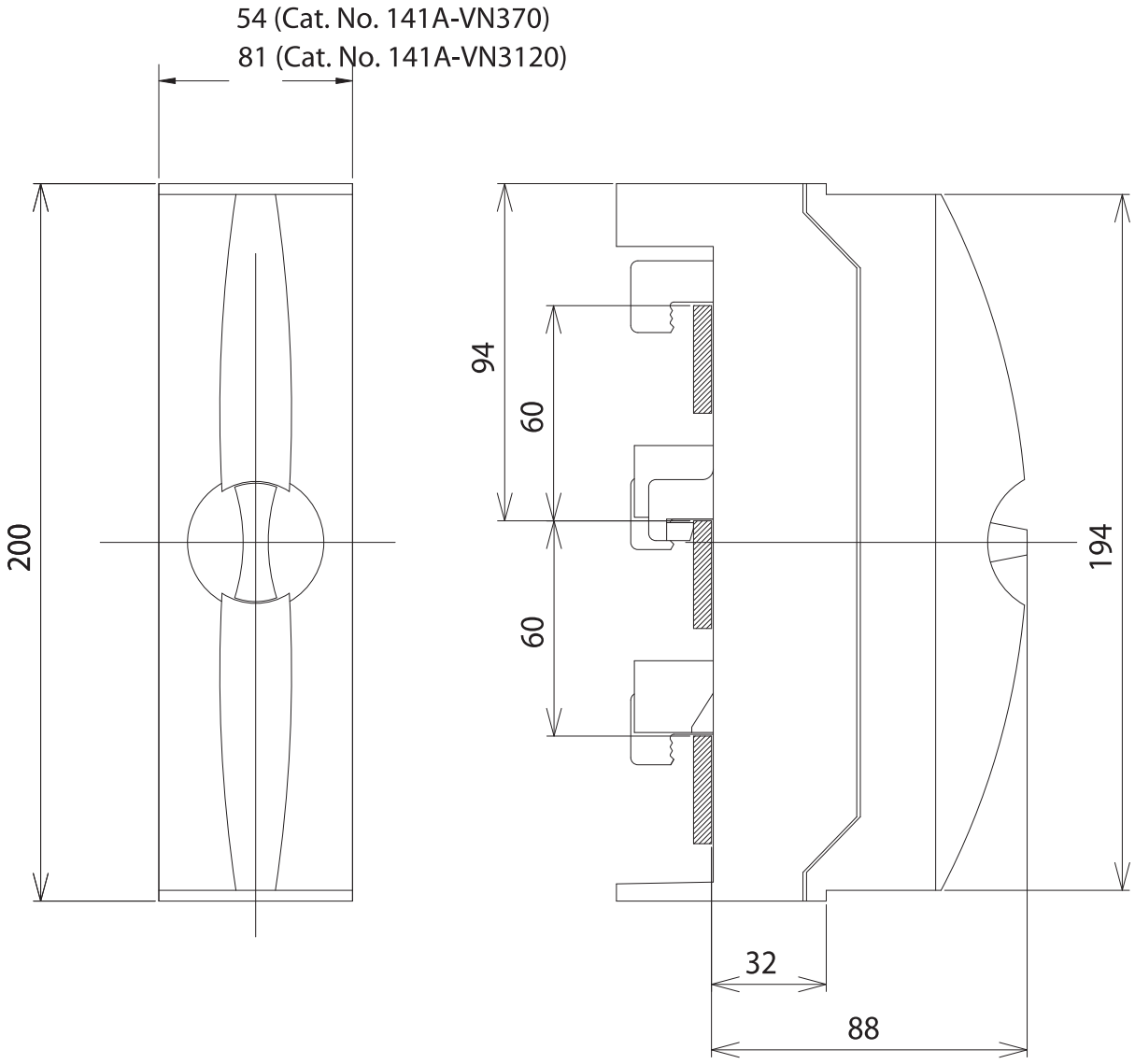


Cat. No.	A	B	C	D	E	F
141A-WS45RR(P)	228	45	69	166.5	210	35
141A-WS54RR(P)	228	54	69	174	210	40
141A-WM45RR(P)	283	45	69	166.5	265	35
141A-WM54RR(P)	283	54	69	174	265	40
141A-WL45RR(P)	333	45	69	166.5	315	35
141A-WL54RR(P)	333	54	69	174	315	40

Dimensions are in millimeters. Dimensions are not intended for manufacturing purposes.

Supply Modules

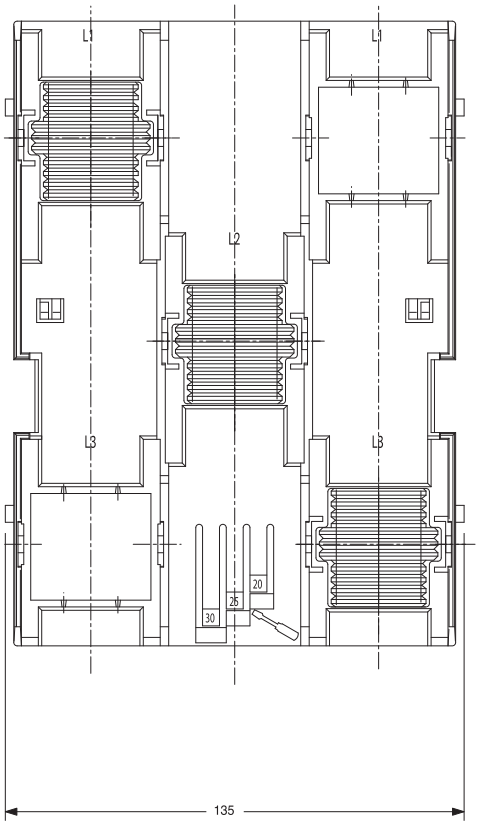
Cat. Nos. 141A-VN370 and 141A-VN3120

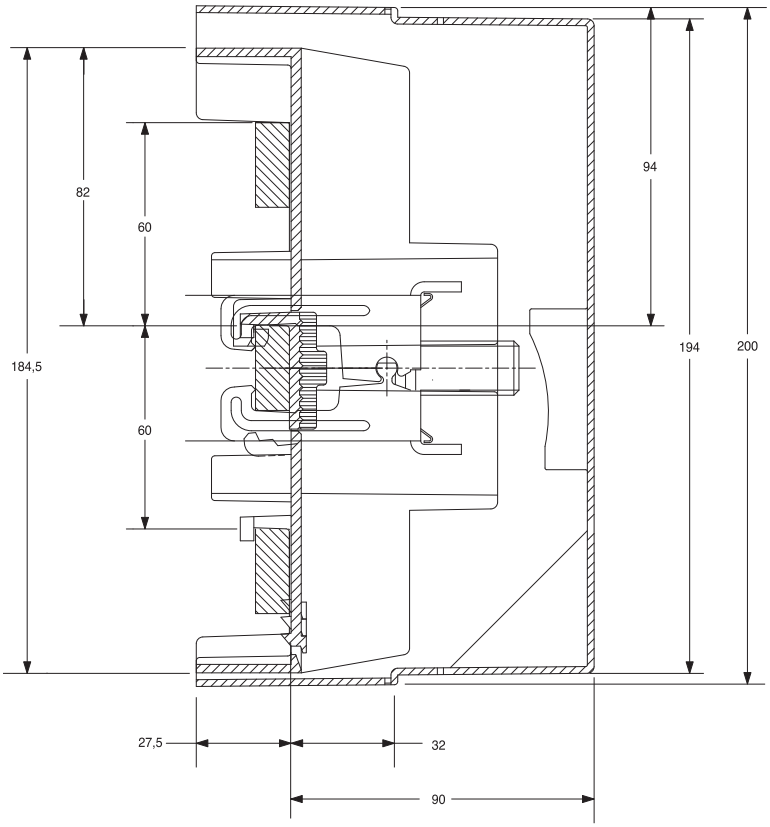


Dimensions are in millimeters. Dimensions are not intended for manufacturing purposes.

Supply Modules, Continued

Cat. Nos. 141A-VN3185, -VN3300R, and -VN3300F

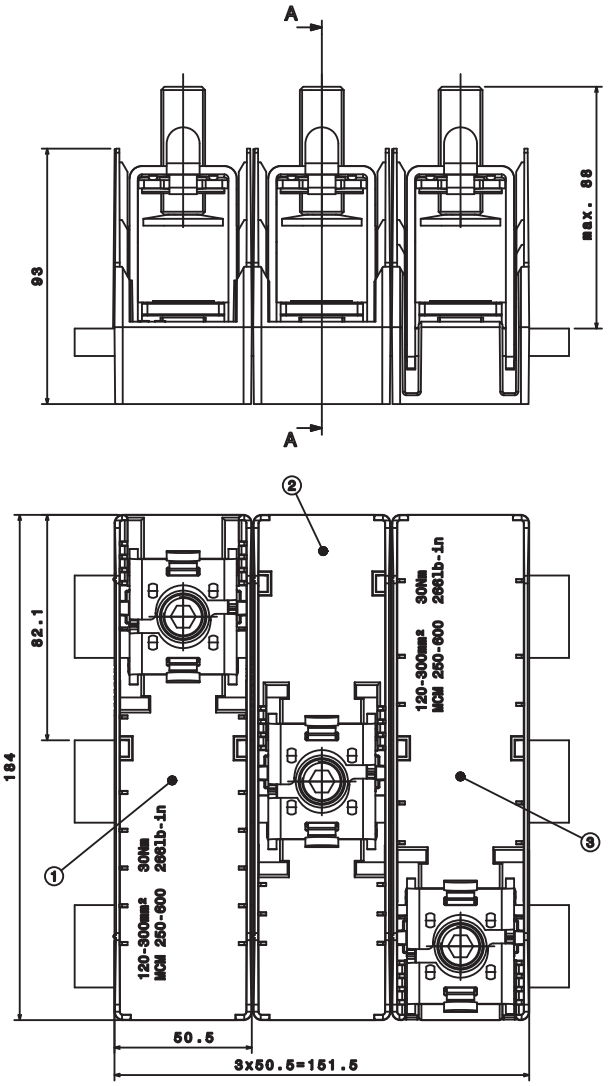


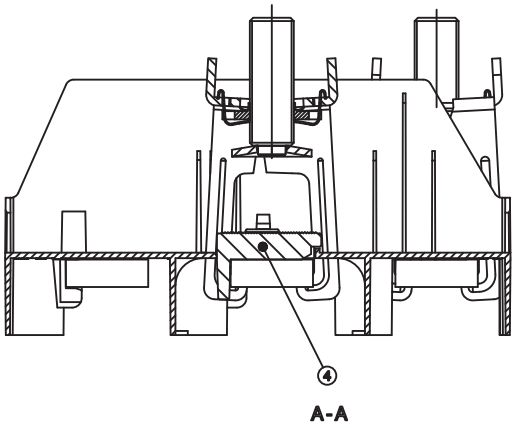


Dimensions are in millimeters. Dimensions are not intended for manufacturing purposes.

Supply Modules, Continued

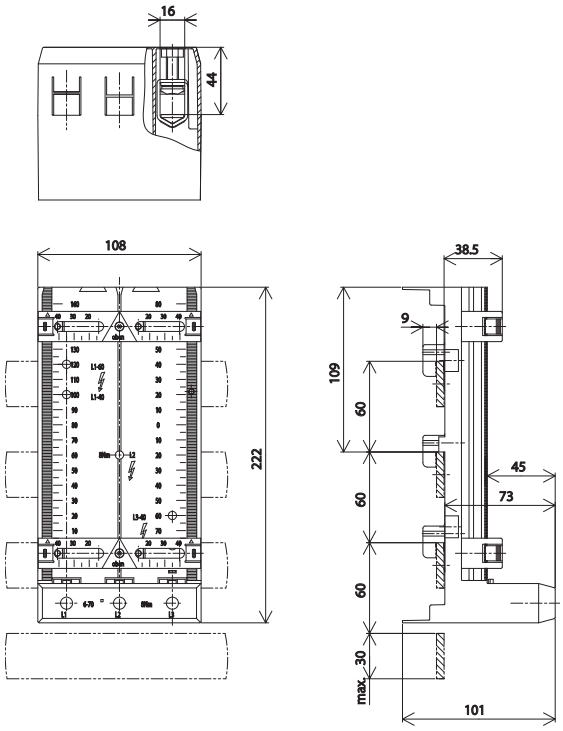
Cat. Nos. 141A-VU3300R and -VU3300F



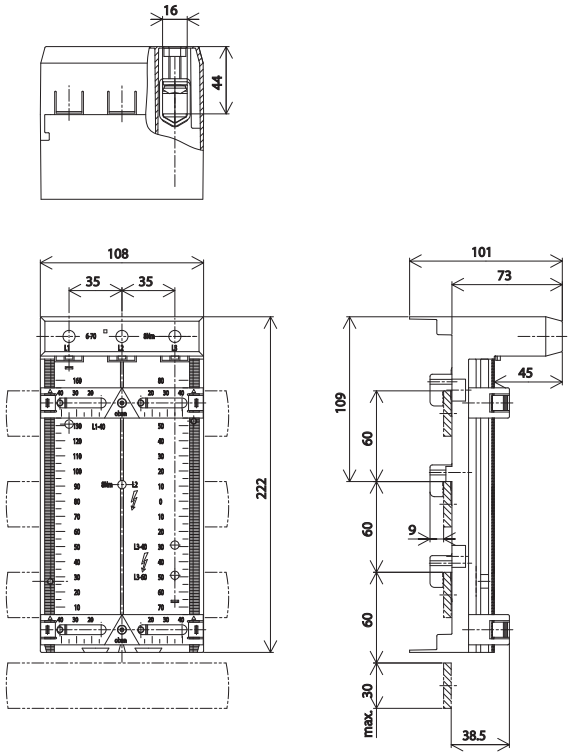


Dimensions are in millimeters. Dimensions are not intended for manufacturing purposes.

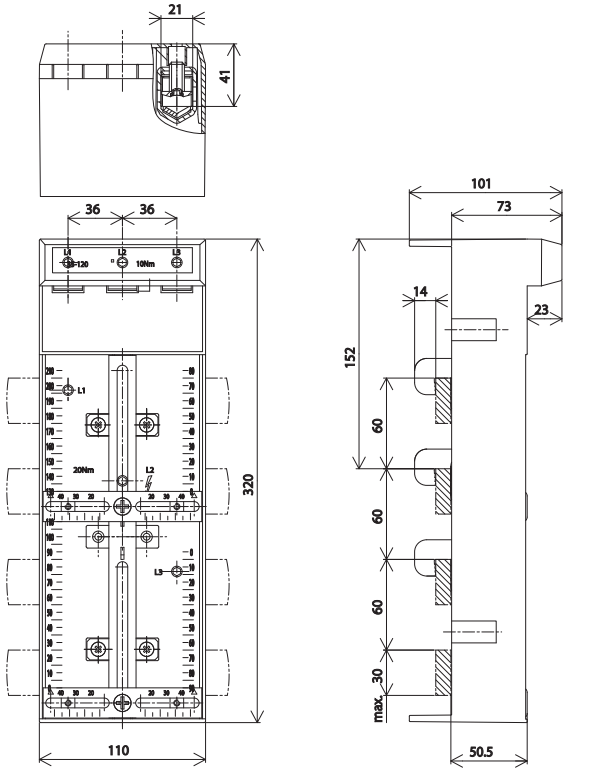
Standard Busbar Modules — Universal Adapters



Cat. No. 141A-FS108V200B



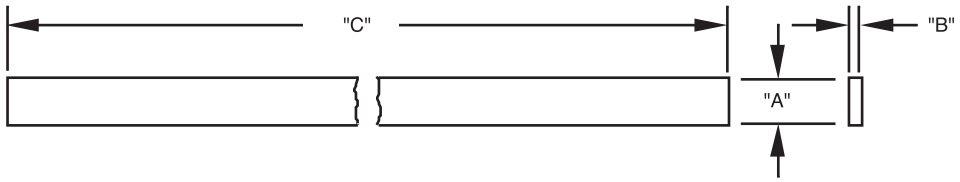
Cat. No. 141A-FS108V200T



Cat. No. 141A-FL110V250T

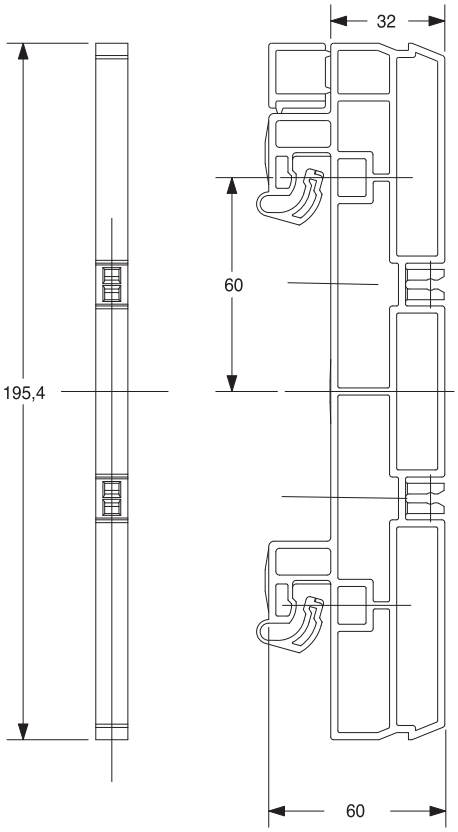
Dimensions are in millimeters. Dimensions are not intended for manufacturing purposes.

Busbars

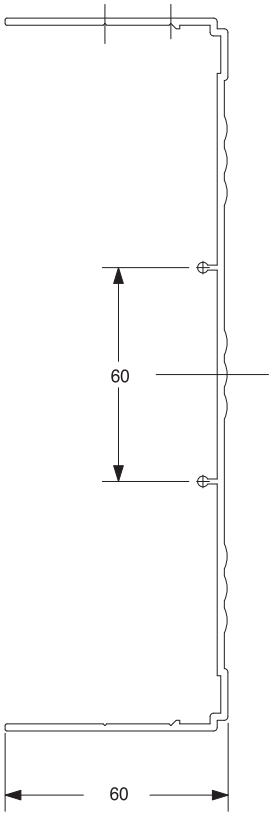


Cat. No.	A	B	C	Cat. No.	A	B	C
141A-B3010A	30	10	800	141A-B255B	25	5	1600
141A-B2010A	20	10	800	141A-B205B	20	5	1600
141A-B1210A	12	10	800	141A-B155B	15	5	1600
141A-B305A	30	5	800	141A-B125B	12	5	1600
141A-B255A	25	5	800	141A-B3010N	30	10	2400
141A-B205A	20	5	800	141A-B2010N	20	10	2400
141A-B155A	15	5	800	141A-B1210N	12	10	2400
141A-B125A	12	5	800	141A-B305N	30	5	2400
141A-B3010B	30	10	1600	141A-B255N	25	5	2400
141A-B2010B	20	10	1600	141A-B205N	20	5	2400
141A-B1210B	12	10	1600	141A-B155N	15	5	2400
141A-B305B	30	5	1600	141A-B125N	12	5	2400
				141A-BT11NZ	30	40	2400
				141A-BT12NZ	30	40	2400

Cat. Nos. 141A-BCF1, 141A-BCF1H Busbar Cover and Cover Holder



Cat. No. 141A-BCF1H

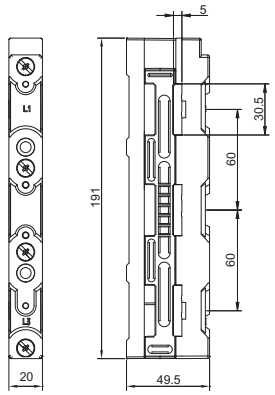


Cat. No. 141A-BCF1

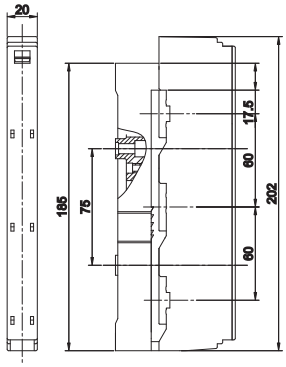
Dimensions are in millimeters. Dimensions are not intended for manufacturing purposes.

Cat. No. 141A-TR…Busbar Supports and End Covers

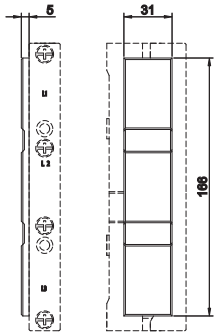
141A-TR3



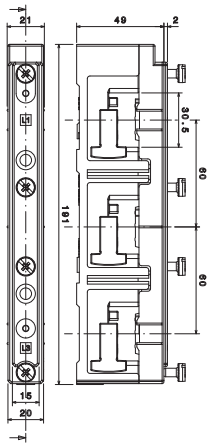
141A-TR3F16



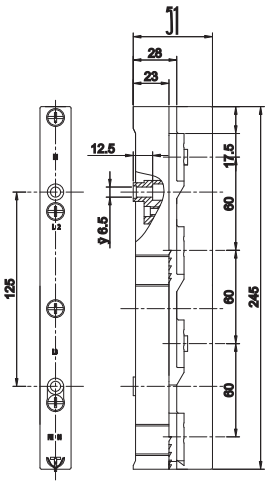
141A-TR3E



141A-TU3



141A-TR4



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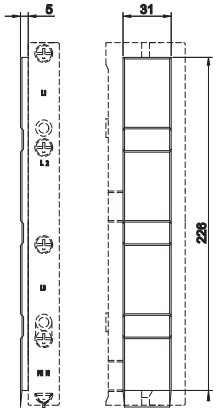
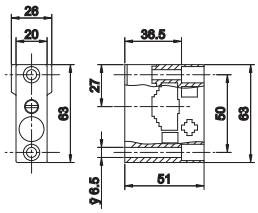


141A-TR1



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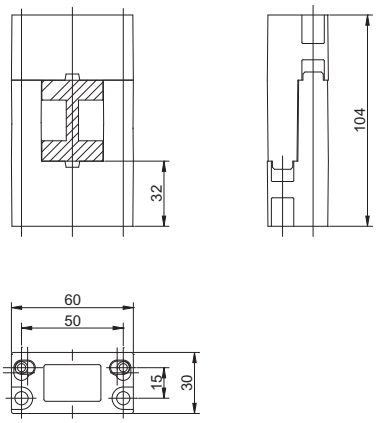
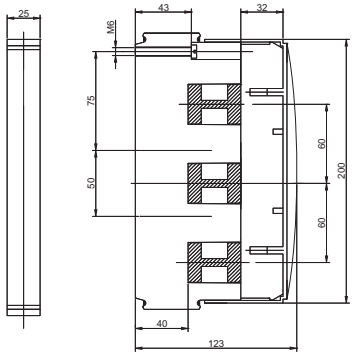
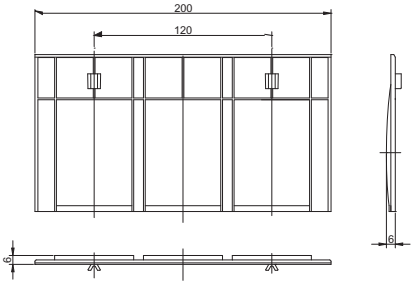


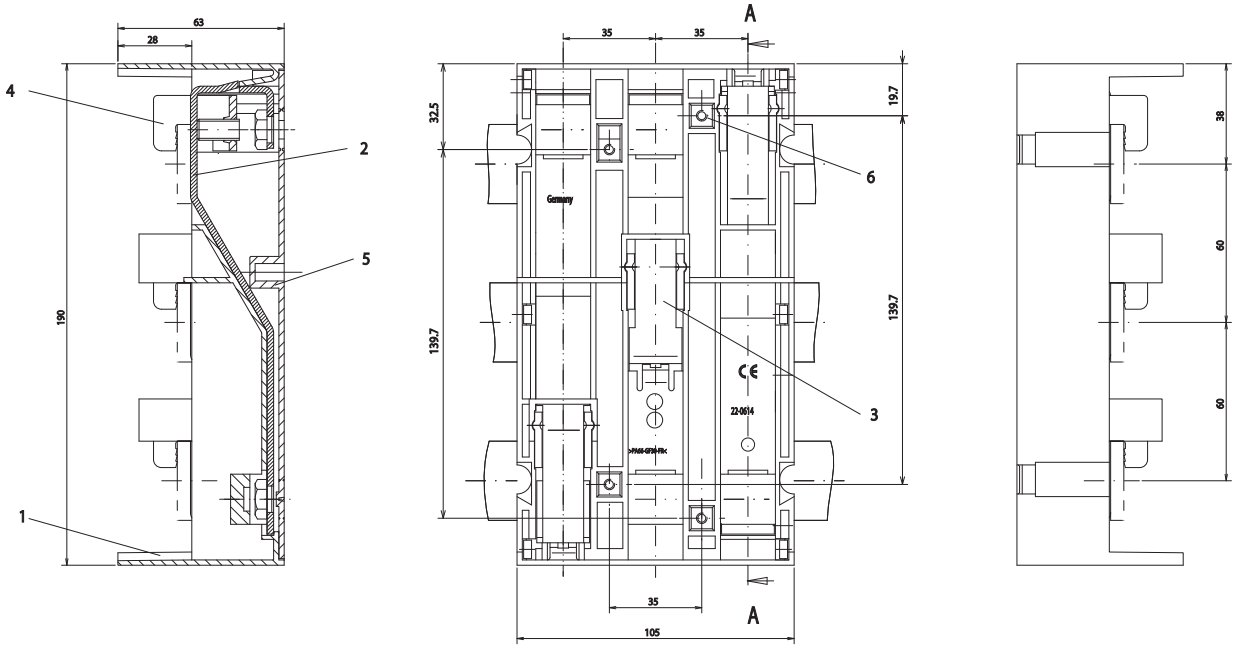
141A-T13



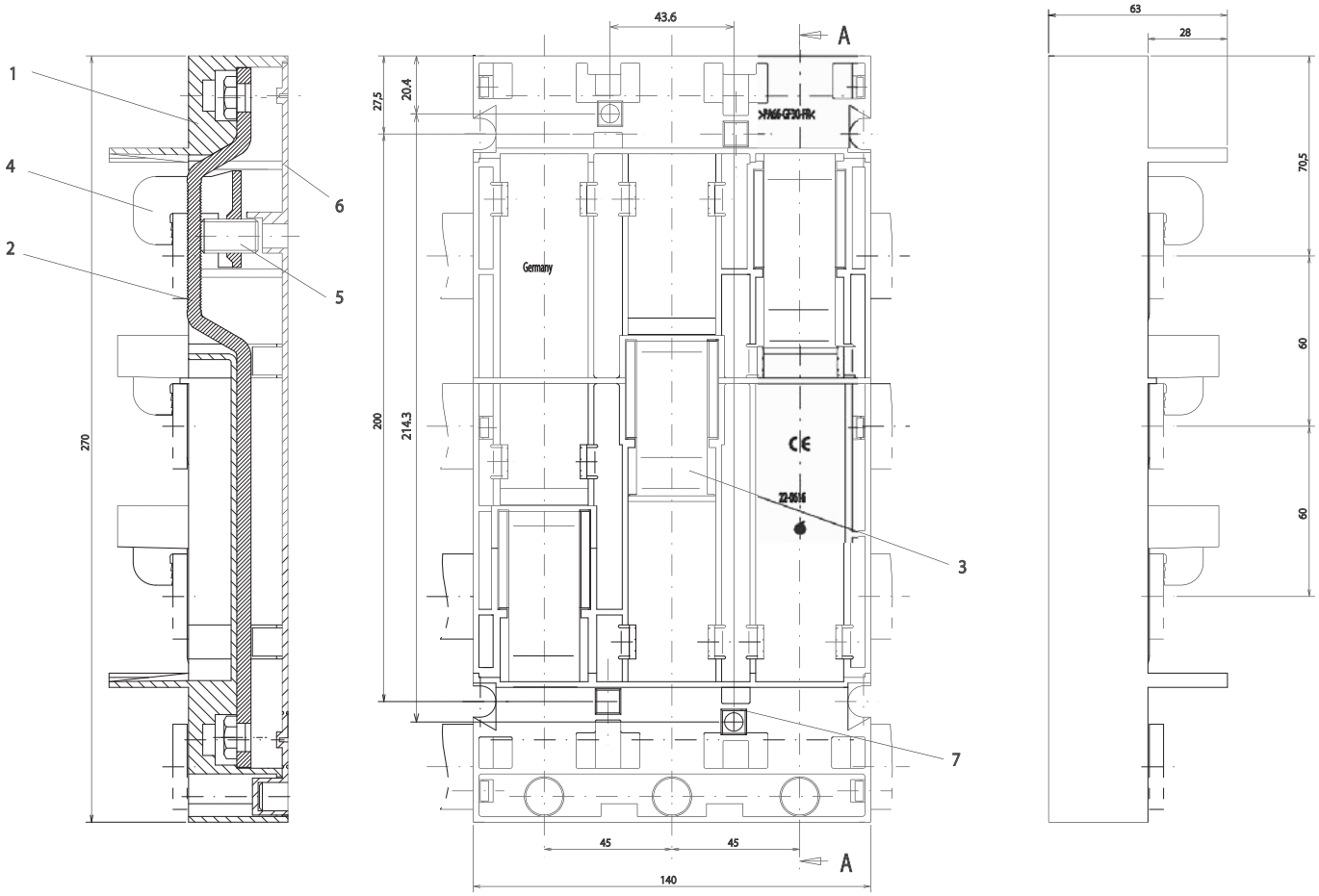
141A-T13E



Dimensions are in millimeters. Dimensions are not intended for manufacturing purposes.



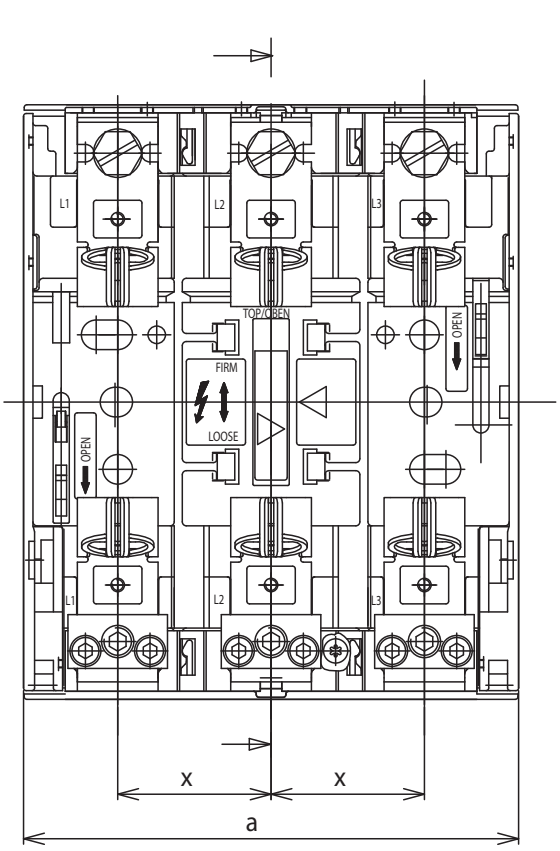
Cat. No. 141A-CUJ250

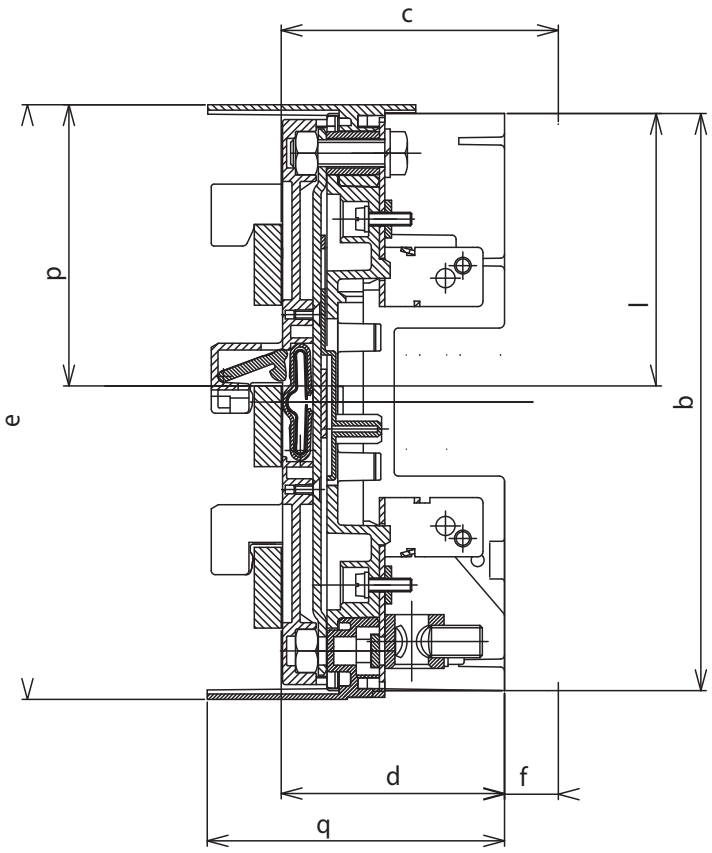


Cat. No. 141A-CUL600

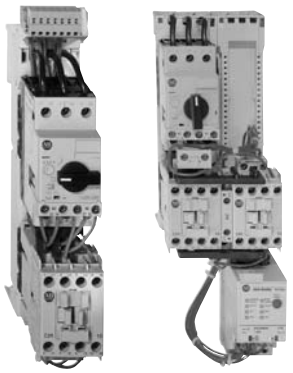
Dimensions are in millimeters. Dimensions are not intended for manufacturing purposes.

Cat. No. 141A-NFJ...





Cat. No.	a	b	c	d	e	f	l	p	q	x
141A-NFJ100	184	214.5	103	83	221	20	101	104.5	110.5	57
141A-NFJ200	210	255	117	97	268	20	118	128	124.5	65
141A-NFJ400	256	267	132.5	112.5	285	20	121.5	136.5	139	81



Bulletin 103S/107S and 103T/107T Combination Starters

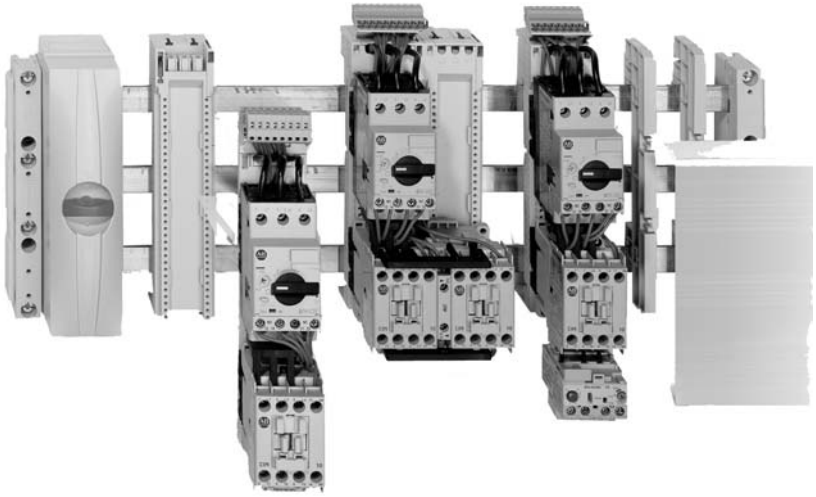
- Bulletin 103S/107S Combination Starters are 2-Component Starters
  - Bulletin 140M Motor Protection Circuit Breakers (MPCBs)
  - Bulletin 100-C/104-C Contactors
- Bulletin 103T/107T Combination Starters are 3-Component Starters
  - Bulletin 140M Motor Circuit Protectors (MCPs)
  - Bulletin 100-C/104-C Contactors
  - Bulletin 193-E Electronic Overload Relays
- Current range 0.1…90 A
- cULus Listed for control and protection of motor loads
- Factory-installed options include:
  - Lockable handles
  - Control plugs (pull-apart terminal blocks)
  - Auxiliary and trip indication contacts
  - Surge suppressors

Standards Compliance

UL 508
CSA 22.2, No. 14
IEC 60947 -2, -4

Certifications

cULus Listed (File No. E125316, Guide NKJH, NKJH7)
CE Marked



	Standard Busbar Mount		ISO Busbar Mount		Panel Mount	
	103S/107S	103T/107T	103S/107S	103T/107T	103S/107S	103T/107T
AC Coils	✓	✓	✓	✓	✓	✓
DC Coils	✓	✓	✓	✓	✓	✓
cULus	✓	✓	✓	✓	✓	✓
IEC/CE	✓	✓	✓	✓	✓	✓
Components						
140M (MPCB)	✓	—	✓	—	✓	—
140M (MCP)	—	✓	—	✓	—	✓
100-C Contactor	✓	✓	✓	✓	✓	✓
193 Overload Relay	—	✓	—	✓	—	✓
Max Current	90 A	45 A	45 A	45 A	45 A	45 A
Control Plug	Optional	Optional	Standard	Standard	Optional	Optional
Overload Protection						
140M (MPCB)	✓	—	✓	—	✓	—
193-E1 Plus/E3	—	✓	—	✓	—	✓
Busbar mount						
5/10 mm busbars	✓	✓	✓	✓	—	—
Panel Mount						
(2) Hat (DIN) Rail mount	—	—	—	—	✓	✓
(4) Screw mount	—	—	—	—	✓	✓

Coordination Ratings for Bulletin 103S and 103T Starters

Bulletin 103S starters consist of a Bulletin 140M Motor Protection Circuit Breaker (MPCB) and a Bulletin 100C Contactor. These starters are referred to as 2-Component Starters.

Bulletin 103T starters consist of a Bulletin 140M Motor Circuit Protector (MCP), a Bulletin 100C Contactor and a Bulletin 193 Overload Relay.
These staters are referred to as 3-Component Starters.

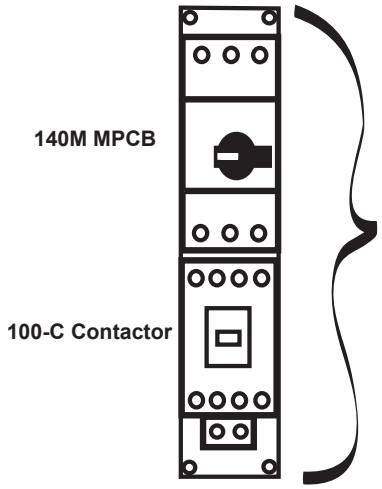
All of these combination starters may provide the branch-circuit, short-circuit protection, overload protection and magnetic control for each individual motor circuit. Additional short-circuit protection is not required for the protection of the individual motor circuits. Additionally, these starters are available with Type 1 or Type 2 coordination, as Type F Combination Motor Controllers (CMCs), or as Type E Self-Protected Combination Motor Controllers.These different coordination levels between the Bulletin 140M circuit breakers and the Bulletin 100C contactors are illustrated
below, along with the IEC and UL/CSA approvals for each type of starter.

IEC Type 1 coordination
* The contactor or starter may be inoperative and require replacement in the event of a short-circuit.

IEC Type 2 coordination
* No damage to the overload relay or other parts may occur in the event of a short-circuit, except welding of the contactor is permitted, as long as the contacts can be easily separated without significant deformation (such as with a screwdriver).

UL Type F Combination Motor Controller
* No damage to the motor protection circuit breaker is allowed in the event of a short-circuit. The contactor may be inoperative and require replacement.

UL Type E Self-Protected Combination Motor Controller
* No damage to the contactor, overload relay, or other parts may occur in the event of a short-circuit.



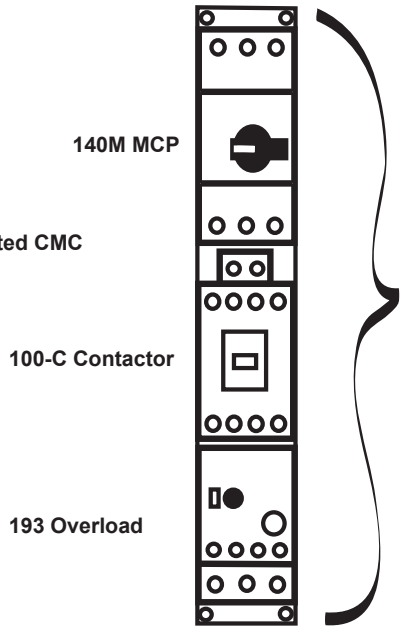
103S Starter
UL/CSA Approvals
* **Type F CMC**
* **Type E Self-Protected CMC**

IEC Approvals
* **Type 1**
* **Type 2**

Bulletin 103S

The 140M MPCBs (C..F frames) are UL/CSA listed as Type E Manual, Self-Protected Combination Motor Controllers. This allows for the Bulletin 103S starters to be UL/CSA listed as Combination Motor Controllers (Type F). Some of the Bulletin 103S starters are also available with Type 2 coordination between the 140M and the 100C.

Additionally, some of the Bulletin 103S starters have also been UL/CSA listed as Type E Self-Protected Combination Motor Controllers, providing an additional level of coordination between the 140M and the 100-C.



103T Starter
UL/CSA Approvals
* **Type E Self-Protected CMC**

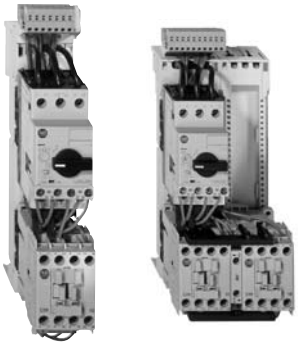
IEC Approvals
* **Type 1**
* **Type 2**

Bulletin 103T

The 140M MCPs (C..F frames) are UL/CSA listed as Manual Motor Controllers. This allows for the Bulletin 103T starters to be UL/CSA listed only as Type E Self-Protected Combination Motor Controllers.

This listing then allows for the Bulletin 103T starters to provide the short-circuit protection, overload protection and magnetic control for individual motor circuits and insures a high level of coordination between the 140M and the 100C.

2



Bulletin 103S/107S IEC Starters

- Non-reversing (Bul. 103S) and reversing (Bul. 107S) starters
- Current range 0.1…90 A
- cULus Listed Type F Combination Motor Controllers
  - Type 1 Coordination
  - Type 2 Coordination
- cULus Listed Type E Self-Protected Combination Motor Controllers
- Assemblies consist of Bulletin 140M MPCBs and Bulletin 100-C contactors mounted on Bulletin 141A busbar or panel mounting modules
- Installation and wiring of Control Plug for auxiliary contacts is standard on ISO Busbar Mount starters.
- Factory installed options include:
  - Installation of Lockable Twist Knob.
  - Installation of Spacing Adapter for Type E or Type F Starters.
  - Electronic Interface and Surge Suppressors for coil on 100-C.
  - Additional auxiliary contacts for 100-C.
  - Additional auxiliary or trip contacts on 140M.

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Aproximate Dimensions..... 2-270

Standards Compliance

UL 508
CSA 22.2, No. 14
IEC 60947 -2, -4

Certifications

cULus Listed (File No. E125316, Guide NKJH, NKJH7)
CE Marked

Bulletin 103S Panel Mount starter with front-mount auxiliary contacts and red/yellow lockable knob, as factory-installed options.

Bulletin 107S Standard Busbar Mount starter with front-mount auxiliary contacts and control plug, as factory-installed options.

Group Motor, Type E, and Type F Combination Motor Controllers (UL/CSA)

The Bulletin 103S/107S motor controllers can be used in a variety of applications. These starters can be used in group motor applications, or as a stand-alone product without any additional short-circuit protection in the motor branch circuits.

Most of the Bul. 140M-C/D motor protection circuit breakers used in the Bul. 103S/107S starters are cULus Listed as a manual **Type E** self-protected combination motor controller. Although there are many tests involved, one of the critical tests a self-protected combination motor controller must pass is to perform 6000 electrical operations and an additional 4000 mechanical operations after a short circuit.

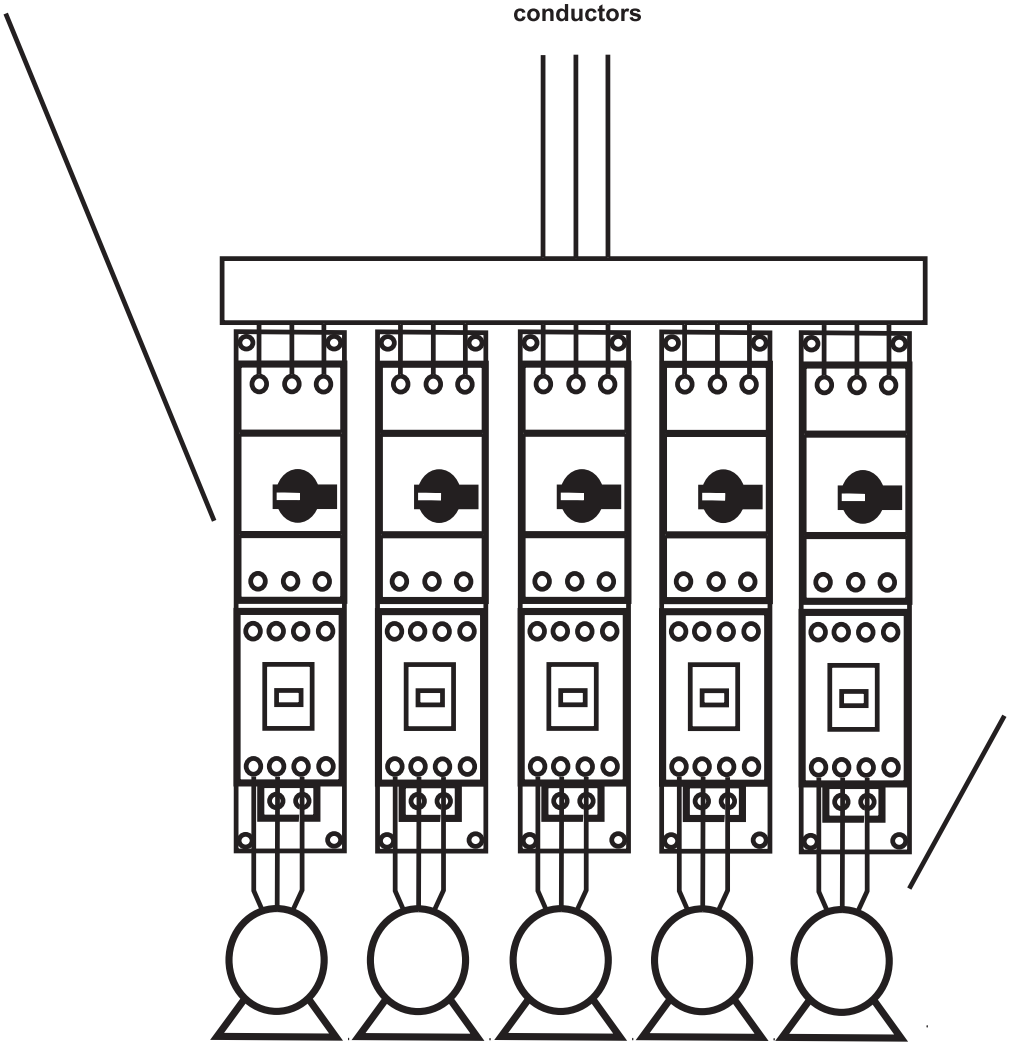
By definition, a **Type F** combination motor controller consists of a Type E manual self-protected combination motor controller and a magnetic or solid-state motor controller (such as a Bul. 100-C contactor or an SMC). As with a manual Type E self-protected combination motor controller, additional short-circuit protection for the individual motor circuits is not required.

A combination of a Bul. 140M manual self-protected combination motor controller and a 100-C contactor can be listed as a Type E self-protected combination motor controller. In this case, the 140M and 100-C must pass the additional 6000 electrical and 4000 mechanical operations test. In some cases, this may require oversizing of either component to achieve weld-free performance and meet the additional life requirements.

Multiple Motor Installation with 103S Combination Starters

Bulletin103S Combination Starters provide Individual Branch Circuit Protection for each motor.
They consist of a 140M Motor Protection Circuit Breaker and a 100C Contactor.
These combination starters may provide the branch-circuit, short-circuit protection, overload protection and magnetic control for each individual motor circuit. Additional short-circuit protection is not required for the protection of the individual motor circuits, leaving only the requirement for protection of the Feeder-Circuit conductors by an upstream protective device.
Below is an example that illustrates installations involving multiple motors using Bulletin 103S Combination Starters.

Bulletin 103S Combination Starters are UL/CSA listed as Type F Combination Motor Controllers or as Type E Self-Protected Combination Motor Controllers. These starters may provide the branch-circuit protection for each individual motor circuit.



Open Type Starters

Catalog Number Explanation

Cat. No. Explanation

Examples given in this section are for reference purposes. This basic explanation should not be used for product selection; not all combinations will produce a valid catalog number.

103S – A T D 2 – C A16 C – KN

a b c d e f g h i

a

Bulletin Number	
Code	Description
103S	DOL Starter with MPCB
107S	Rev. Starter with MPCB

b

Contactor Size	
Code	Description
A	100-C09
B	100-C12
C	100-C16
D	100-C23
E	100-C30
F	100-C37
G	100-C43
H	100-C60
J	100-C72
K	100-C85

c

Style	
Code	Description
S	On 141A ISO Busbar Module(s)
T	On 141A Standard Busbar Module(s)
W	On 141A Panel Mounting Module(s)

d

AC Coil Voltage	
Code	Description
Q	12V AC, 60 Hz
R	12V AC, 50 Hz
J	24V AC, 60 Hz
K	24V AC, 50 Hz
KJ	24V AC, 50/60 Hz
V	32V AC,50 Hz /36V AC,60 Hz
W	36V AC, 50 Hz
X	42V AC, 50 Hz /48V AC, 60 Hz
Y	48V AC, 50 Hz
KY	48V AC, 50/60 Hz
KP	100V AC, 50 Hz /100...110V AC, 60 Hz
D	110V AC, 50 Hz /120V AC, 60 Hz
KD	100V AC, 50/60 Hz
P	120V AC, 50 Hz
KL	200...230V AC, 50/60 Hz
H	208V AC, 60 Hz
L	208...240V AC, 60 Hz
A	220V AC, 50 Hz /240V AC, 60 Hz
F	220...230V AC, 50 Hz
KF	230V AC, 50/60 Hz
VA	230...240V AC, 50 Hz
T	240V AC, 50 Hz /277V AC, 60 Hz
E	380V AC, 60 Hz
N	380...400V AC, 50 Hz /440V AC, 60 Hz
KN	400V AC, 50/60 Hz
G	400...415V AC, 50 Hz
B	440V AC, 50 Hz /480V AC, 60 Hz
M	500V AC, 50 Hz
C	550V AC, 50 Hz /600V AC, 60 Hz

d, Continued

DC Coil Voltage		
Contactor Size A-G	Contactor Size H-J	
Code	Code	Description
ZR	DR	6...12V DC
ZQ	DQ	12V DC
ZJ	DJ	24V DC
DJ	DJ	24V DC with Diode
EJ	—	24V DC Electronic
ZW	DW	36V DC
ZY	DY	48V DC
ZZ	DZ	60V DC
ZB	DB	64V DC
ZG	DG	72V DC
ZE	DE	80V DC
ZD	DD	110V DC
ZP	DP	115V DC
ZS	DS	125V DC
ZA	DA	220V DC
ZF	DF	230V DC
ZT	DT	250V DC

e

Contactor Aux. Contacts	
Code	Description
2	1 N.O.
3	1 N.O. + 1 N.C.

f

Circuit Breaker Frame Size	
Code	Description
C	C Frame
D	D Frame
F	F Frame
G	CMN Frame

g

Circuit Breaker Current Range	
Code	Description
A16	0.1...0.16 A
A25	0.16...0.25 A
A40	0.25...0.4 A
A63	0.4...0.63 A
B10	0.63...1.0 A
B25	1.0...2.5 A
B40	2.5...4.0 A
B63	4.0...6.3 A
C10	6.3...10 A
C16	10...16 A
C20	16...20 A
C25	20...25 A
C32	25...32 A
C45	32...45 A
C63	45...63 A
C90	63...90 A

h

Circuit Breaker Aux. and Trip Contacts for 140M	
Select only one from each group	
Bottom Front	
Code	Description
X	Without Aux. Trip Contacts
A	1 N.C. Aux. Contact
B	1 N.O. Aux. Contact
C	1 N.O. + 1 N.C. Aux. Contact
D	2 N.O. Aux. Contacts
E	2 N.C. Aux. Contacts
R	1 N.O. (SC+OL) + 1 N.C. Aux. Contact
S	1 N.O. (SC+OL) + 1 N.O. Aux. Contact
Right Side	
Code	Description
K	1 N.C. (SC+OL) + 1 N.C. (SC)
L	1 N.O. (SC+OL) + 1 N.O. (SC)
M	1 N.C. (SC+OL) + 1 N.O. (SC)
N	1 N.O. (SC+OL) + 1 N.C. (SC)
Q	1 N.O. (SC) + 1 N.C. (SC)

Circuit Breaker Aux. and Trip Contacts for 140-CMN	
Select only one from each group	
Bottom Front	
Code	Description
X	Without Aux. and Trip Contacts
C	1 N.O. + 1 N.C. Aux. Contact
D	2 N.O. Aux. Contact
E	2 N.C. Aux. Contact
Top Front	
Code	Description
K	1 N.C. (OL) + 1 N.C. (SC)
L	1 N.O. (OL) + 1 N.O. (SC)
M	1 N.C. (OL) + 1 N.O. (SC)
N	1 N.O. (OL) + 1 N.C. (SC)

i

Modifications, Accessories	
Circuit Breaker Accessories	
Code	Description
TE	Type E Adder Module
KN	Lockable Twist Knob, Black
KY	Lockable Twist Knob, Red/Yellow
Coil Accessories	
Code	Description
JE	Electronic Interface(s)
D	Surge Suppressor Diode
R	Surge Suppressor RC
V	Surge Suppressor Varistor
Additional Contactor Auxiliaries (Side Mount)	
Code	Description
S01	1 N.C.
S10	1 N.O.
S11	1 N.O. + 1 N.C.
S20	2 N.O.
Additional Contactor Auxiliaries (Front Mount)	
Code	Description
F11	1 N.O. + 1 N.C.
F20	2 N.O.
F22	2 N.O. + 2 N.C.
Mounting System Accessories	
Code	Description
MS	Micro Switch (ISO Modules only)
SP	Top Mount Control Plug (pull-apart terminal block with spring clamp terminals) for control circuit ✶ (Standard Busbar and Panel Mounting Modules only)

✶ Standard for Starters on ISO Modules, no code required.

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Preferred availability cat. nos. are printed in **bold**

Bulletin 103S/107S Combination Starters

Product Selection and Coordination Ratings, UL/CSA in Group Motor Installation

Motor Current Adjustment Range [A]	UL/CSA Hp and Coordination Ratings (60 Hz)									DOL Starters	Reversing Starters
	Hp Ratings as a UL 508 Motor Controller in Group Motor Installations∗				Max. Fuse or Circuit Breaker per NEC	Max. Short-Circuit Current [kA]					
						Type 1 Coordination		Type 2 Coordination			
	200V AC	230V AC	460V AC	575V AC		480V AC	600V AC	480V AC	600V AC	Cat. No.	Cat. No.
C-Frame with 100-C/104-C Contactors on Standard Bus Bar Modules											
0.10…0.16	—	—	—	—	450	65	47	65	47	103S-AT⊗2-CA16C	**107S-AT⊗3-CA16C**
0.16…0.25	—	—	—	—	450	65	47	65	47	103S-AT⊗2-CA25C	**107S-AT⊗3-CA25C**
0.25…0.40	—	—	—	—	450	65	47	65	47	103S-AT⊗2-CA40C	**107S-AT⊗3-CA40C**
0.40…0.63	—	—	—	—	450	65	47	65	47	103S-AT⊗2-CA63C	**107S-AT⊗3-CA63C**
0.63…1.00	—	—	1/2	3/4	450	65	47	65	47	103S-AT⊗2-CB10C	107S-AT⊗3-CB10C
1.00…1.60	—	—	1/2…1	3/4…1	450	65	47	65	47	103S-AT⊗2-CB16C	107S-AT⊗3-CB16C
1.60…2.50	1/2	1/2…3/4	3/4…1-1/2	1…2	450	65	30	65	10	103S-AT⊗2-CB25C	107S-AT⊗3-CB25C
2.50…4.00	1/2…1	3/4…1	1-1/2…3	2…3	450	65	30	50	—	103S-AT⊗2-CB40C	107S-AT⊗3-CB40C
4.00…6.30	1…1-1/2	1…2	3…5	5	450	65	30	50	—	**103S-AT⊗2-CB63C**	107S-AT⊗3-CB63C
6.30…9.00	1-1/2…2	2	5	7-1/2	450	65	30	50	—	103S-AT⊗2-CC10C	107S-AT⊗3-CC10C
6.30…10.0	1-1/2…3	2…3	5…7-1/2	7-1/2…10	450	65	30	50	—	**103S-BT⊗2-CC10C**	**107S-BT⊗3-CC10C**
10.0…12.0	3	3	7-1/2	10	450	30	30	—	—	**103S-BT⊗2-CC16C**	**107S-BT⊗3-CC16C**
10.0…16.0	3…5	5	7-1/2…10	10	450	30	30	—	—	**103S-CT⊗2-CC16C**	**107S-CT⊗3-CC16C**
10.0…16.0	3…5	5	7-1/2…10	10…15	450	30	30	—	—	**103S-DT⊗2-CC16C**	**107S-DT⊗3-CC16C**
14.5…20.0	5	5…7-1/2	15	15	450	30	30	—	—	103S-DT⊗2-CC20C	**107S-DT⊗3-CC20C**
18.0…23.0	5	7-1/2	15	15	450	30	30	—	—	**103S-DT⊗2-CC25C**	**107S-DT⊗3-CC25C**
D-Frame with 100-C/104-C Contactors on Standard Bus Bar Modules											
1.60…2.50	1/2	1/2…3/4	3/4…1-1/2	1…2	450	65	30	65	10	**103S-AT⊗2-DB25C**	**107S-AT⊗3-DB25C**
1.60…2.50	1/2	1/2…3/4	3/4…1-1/2	1…2	450	65	30	65	30	103S-DT⊗2-DB25C	**107S-DT⊗3-DB25C**
2.50…4.00	1/2…1	3/4…1	1-1/2…3	2…3	450	65	30	65	—	**103S-AT⊗2-DB40C**	**107S-AT⊗3-DB40C**
2.50…4.00	1/2…1	3/4…1	1-1/2…3	2…3	450	65	30	65	30	103S-DT⊗2-DB40C	**107S-DT⊗3-DB40C**
4.00…6.30	1…1-1/2	1…2	3…5	5	450	65	30	65	—	103S-AT⊗2-DB63C	**107S-AT⊗3-DB63C**
4.00…6.30	1…1-1/2	1…2	3…5	5	450	65	30	65	30	**103S-ET⊗3-DB63C**	**107S-ET⊗3-DB63C**
6.30…9.00	1-1/2…2	2	5	7-1/2	450	65	30	65	—	**103S-AT⊗2-DC10C**	**107S-AT⊗3-DC10C**
6.30…10.0	1-1/2…3	2…3	5…7-1/2	7-1/2…10	450	65	30	65	—	**103S-BT⊗2-DC10C**	**107S-BT⊗3-DC10C**
6.30…10.0	1-1/2…3	2…3	5…7-1/2	7-1/2…10	450	65	30	65	—	**103S-CT⊗2-DC10C**	**107S-CT⊗3-DC10C**
6.30…10.0	1-1/2…3	2…3	5…7-1/2	7-1/2…10	450	65	30	65	30	**103S-ET⊗3-DC10C**	**107S-ET⊗3-DC10C**
10.0…12.0	3	3	7-1/2	10	450	65	30	65	—	**103S-BT⊗2-DC16C**	**107S-BT⊗3-DC16C**
10.0…16.0	3…5	5	7-1/2…10	10	450	65	30	65	—	**103S-CT⊗2-DC16C**	**107S-CT⊗3-DC16C**
10.0…16.0	3…5	5	7-1/2…10	10…15	450	65	30	65	—	103S-DT⊗2-DC16C	**107S-DT⊗3-DC16C**
10.0…16.0	3…5	5	7-1/2…10	10…15	450	65	30	65	30	**103S-ET⊗3-DC16C**	**107S-ET⊗3-DC16C**
14.5…20.0	5	5…7-1/2	15	15	450	65	30	65	—	**103S-DT⊗2-DC20C**	**107S-DT⊗3-DC20C**
14.5…20.0	5	5…7-1/2	15	20	450	65	30	65	—	**103S-ET⊗3-DC20C**	**107S-ET⊗3-DC20C**
18.0…23.0	5	7-1/2	15	15	450	65	30	65	—	**103S-DT⊗2-DC25C**	**107S-DT⊗3-DC25C**
18.0…25.0	7-1/2	7-1/2…10	15…20	20	450	65	30	65	—	**103S-ET⊗3-DC25C**	**107S-ET⊗3-DC25C**
F-Frame with 100-C/104-C Contactors on Standard Bus Bar Modules											
6.30…10.0	1-1/2…3	2…3	5…7-1/2	7-1/2…10	600	65	30	65	30	**103S-ET⊗3-FC10C**	**107S-ET⊗3-FC10C**
10.0…16.0	3…5	5	7-1/2…10	10…15	600	65	30	65	30	**103S-ET⊗3-FC16C**	**107S-ET⊗3-FC16C**
14.5…20.0	5	5…7-1/2	15	15…20	600	65	30	65	30	**103S-ET⊗3-FC20C**	**107S-ET⊗3-FC20C**
18.0…25.0	7-1/2	7-1/2…10	15…20	20	600	65	30	65	30	**103S-ET⊗3-FC25C**	**107S-ET⊗3-FC25C**
18.0…25.0	7-1/2	7-1/2…10	15…20	20…25	600	65	30	65	30	**103S-GT⊗3-FC25C**	**107S-GT⊗3-FC25C**
23.0…30.0	7-1/2	10	20	25	600	65	30	65	30	**103S-ET⊗3-FC32C**	107S-ET⊗3-FC32C
23.0…32.0	7-1/2…10	10	20…25	30	600	65	30	65	30	**103S-FT⊗3-FC32C**	**107S-FT⊗3-FC32C**
23.0…32.0	7-1/2…10	10	20…25	30	600	65	30	65	30	**103S-GT⊗3-FC32C**	**107S-GT⊗3-FC32C**
23.0…32.0	7-1/2…10	10	20…25	30	600	65	30	65	30	**103S-HT⊗3-FC32C**	**107S-HT⊗3-FC32C**
32.0…37.0	10	10	25	30	600	65	18	65	10	**103S-FT⊗3-FC45C**	**107S-FT⊗3-FC45C**
32.0…43.0	10	15	30	30	600	65	18	65	10	**103S-GT⊗3-FC45C**	**107S-GT⊗3-FC45C**
32.0…45.0	10	15	30	30…40	600	65	18	65	10	**103S-HT⊗3-FC45C**	**107S-HT⊗3-FC45C**
32.0…45.0	10	15	30	30…40	600	65	18	65	10	**103S-JT⊗3-FC45C**	**107S-JT⊗3-FC45C**
CMN-Frame with 100-C/104-C Contactors on Standard Bus Bar Modules											
40.0…60.0	15	15…20	30…40	40…50	1000	42	18	42	18	103S-HT⊗3-GC63C	**107S-HT⊗3-GC63C**
40.0…63.0	15…20	15…20	30…40	40…60	1000	42	18	42	18	**103S-JT⊗3-GC63C**	**107S-JT⊗3-GC63C**
40.0…63.0	15…20	15…20	30…40	40…60	1000	42	18	42	18	**103S-KT⊗3-GC63C**	**107S-KT⊗3-GC63C**
63.0…72.0	20	25	50	60	1000	35	10	35	10	**103S-JT⊗3-GC90C**	**107S-JT⊗3-GC90C**
63.0…85.0	25	30	50…60	60	1000	35	10	35	10	**103S-KT⊗3-GC90C**	**107S-KT⊗3-GC90C**

∗ Horsepower ratings shown in the table are for reference. Final selection of the starter depends upon the actual motor full-load current and service factor.

⊗Coil voltage code—see page 2-267

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Product Selection and Coordination Ratings, UL/CSA in Group Motor Installation, Continued

Motor Current Adjustment Range [A]	UL/CSA Hp and Coordination Ratings (60 Hz)									DOL Starters	Reversing Starters
	Hp Ratings as a UL 508 Motor Controller in Group Motor Installations∗				Max. Fuse or Circuit Breaker per NEC	Max. Short-Circuit Current [kA]				Cat. No.	Cat. No.
						Type 1 Coordination		Type 2 Coordination			
	200V AC	230V AC	460V AC	575V AC		480V AC	600V AC	480V AC	600V AC		
C-Frame with 100-C/104-C Contactors on ISO Bus Bar Modules											
0.10...0.16	—	—	—	—	450	65	47	65	47	**103S-AS⊗2-CA16C**	**107S-AS⊗3-CA16C**
0.16...0.25	—	—	—	—	450	65	47	65	47	**103S-AS⊗2-CA25C**	**107S-AS⊗3-CA25C**
0.25...0.40	—	—	—	—	450	65	47	65	47	**103S-AS⊗2-CA40C**	**107S-AS⊗3-CA40C**
0.40...0.63	—	—	—	—	450	65	47	65	47	**103S-AS⊗2-CA63C**	**107S-AS⊗3-CA63C**
0.63...1.00	—	—	1/2	3/4	450	65	47	65	47	**103S-AS⊗2-CB10C**	**107S-AS⊗3-CB10C**
1.00...1.60	—	—	1/2...1	3/4...1	450	65	47	65	47	**103S-AS⊗2-CB16C**	**107S-AS⊗3-CB16C**
1.60...2.50	1/2	1/2...3/4	3/4...1-1/2	1...2	450	65	30	65	10	**103S-AS⊗2-CB25C**	**107S-AS⊗3-CB25C**
2.50...4.00	1/2...1	3/4...1	1-1/2...3	2...3	450	65	30	50	—	**103S-AS⊗2-CB40C**	**107S-AS⊗3-CB40C**
4.00...6.30	1...1-1/2	1...2	3...5	5	450	65	30	50	—	**103S-AS⊗2-CB63C**	**107S-AS⊗3-CB63C**
6.30...9.00	1-1/2...2	2	5	7-1/2	450	65	30	50	—	**103S-AS⊗2-CC10C**	**107S-AS⊗3-CC10C**
6.30...10.0	1-1/2...3	2...3	5...7-1/2	7-1/2...10	450	65	30	50	—	**103S-BS⊗2-CC10C**	**107S-BS⊗3-CC10C**
10.0...12.0	3	3	7-1/2	10	450	30	30	—	—	**103S-BS⊗2-CC16C**	**107S-BS⊗3-CC16C**
10.0...16.0	3...5	5	7-1/2...10	10	450	30	30	—	—	**103S-CS⊗2-CC16C**	**107S-CS⊗3-CC16C**
10.0...16.0	3...5	5	7-1/2...10	10...15	450	30	30	—	—	**103S-DS⊗2-CC16C**	**107S-DS⊗3-CC16C**
14.5...20.0	5	5...7-1/2	15	15	450	30	30	—	—	**103S-DS⊗2-CC20C**	**107S-DS⊗3-CC20C**
18.0...23.0	5	7-1/2	15	15	450	30	30	—	—	103S-DS⊗2-CC25C	**107S-DS⊗3-CC25C**
D-Frame with 100-C/104-C Contactors on ISO Bus Bar Modules											
1.60...2.50	1/2	1/2...3/4	3/4...1-1/2	1...2	450	65	30	65	10	**103S-AS⊗2-DB25C**	**107S-AS⊗3-DB25C**
1.60...2.50	1/2	1/2...3/4	3/4...1-1/2	1...2	450	65	30	65	30	**103S-DS⊗2-DB25C**	**107S-DS⊗3-DB25C**
2.50...4.00	1/2...1	3/4...1	1-1/2...3	2...3	450	65	30	65	—	**103S-AS⊗2-DB40C**	**107S-AS⊗3-DB40C**
2.50...4.00	1/2...1	3/4...1	1-1/2...3	2...3	450	65	30	65	30	**103S-DS⊗2-DB40C**	**107S-DS⊗3-DB40C**
4.00...6.30	1...1-1/2	1...2	3...5	5	450	65	30	65	—	**103S-AS⊗2-DB63C**	**107S-AS⊗3-DB63C**
4.00...6.30	1...1-1/2	1...2	3...5	5	450	65	30	65	30	**103S-ES⊗3-DB63C**	**107S-ES⊗3-DB63C**
6.30...9.00	1-1/2...2	2	5	7-1/2	450	65	30	65	—	**103S-AS⊗2-DC10C**	**107S-AS⊗3-DC10C**
6.30...10.0	1-1/2...3	2...3	5...7-1/2	7-1/2...10	450	65	30	65	—	**103S-BS⊗2-DC10C**	**107S-BS⊗3-DC10C**
6.30...10.0	1-1/2...3	2...3	5...7-1/2	7-1/2...10	450	65	30	65	—	**103S-CS⊗2-DC10C**	**107S-CS⊗3-DC10C**
6.30...10.0	1-1/2...3	2...3	5...7-1/2	7-1/2...10	450	65	30	65	30	**103S-ES⊗3-DC10C**	**107S-ES⊗3-DC10C**
10.0...12.0	3	3	7-1/2	10	450	65	30	65	—	**103S-BS⊗2-DC16C**	**107S-BS⊗3-DC16C**
10.0...16.0	3...5	5	7-1/2...10	10	450	65	30	65	—	**103S-CS⊗2-DC16C**	**107S-CS⊗3-DC16C**
10.0...16.0	3...5	5	7-1/2...10	10...15	450	65	30	65	—	**103S-DS⊗2-DC16C**	**107S-DS⊗3-DC16C**
10.0...16.0	3...5	5	7-1/2...10	10...15	450	65	30	65	30	**103S-ES⊗3-DC16C**	**107S-ES⊗3-DC16C**
14.5...20.0	5	5...7-1/2	15	15	450	65	30	65	—	**103S-DS⊗2-DC20C**	**107S-DS⊗3-DC20C**
14.5...20.0	5	5...7-1/2	15	20	450	65	30	65	—	**103S-ES⊗3-DC20C**	**107S-ES⊗3-DC20C**
18.0...23.0	5	7-1/2	15	15	450	65	30	65	—	**103S-DS⊗2-DC25C**	**107S-DS⊗3-DC25C**
18.0...25.0	7-1/2	7-1/2...10	15...20	20	450	65	30	65	—	**103S-ES⊗3-DC25C**	**107S-ES⊗3-DC25C**
F-Frame with 100-C/104-C Contactors on ISO Bus Bar Modules											
6.30...10.0	1-1/2...3	2...3	5...7-1/2	7-1/2...10	600	65	30	65	30	**103S-ES⊗3-FC10C**	**107S-ES⊗3-FC10C**
10.0...16.0	3...5	5	7-1/2...10	10...15	600	65	30	65	30	**103S-ES⊗3-FC16C**	**107S-ES⊗3-FC16C**
14.5...20.0	5	5...7-1/2	15	15...20	600	65	30	65	30	**103S-ES⊗3-FC20C**	**107S-ES⊗3-FC20C**
18.0...25.0	7-1/2	7-1/2...10	15...20	20	600	65	30	65	30	**103S-ES⊗3-FC25C**	**107S-ES⊗3-FC25C**
18.0...25.0	7-1/2	7-1/2...10	15...20	20...25	600	65	30	65	30	**103S-GS⊗3-FC25C**	**107S-GS⊗3-FC25C**
23.0...30.0	7-1/2	10	20	25	600	65	30	65	30	**103S-ES⊗3-FC32C**	**107S-ES⊗3-FC32C**
23.0...32.0	7-1/2...10	10	20...25	30	600	65	30	65	30	**103S-FS⊗3-FC32C**	**107S-FS⊗3-FC32C**
23.0...32.0	7-1/2...10	10	20...25	30	600	65	30	65	30	**103S-GS⊗3-FC32C**	**107S-GS⊗3-FC32C**
32.0...37.0	10	10	25	30	600	65	18	65	10	**103S-FS⊗3-FC45C**	**107S-FS⊗3-FC45C**
32.0...43.0	10	15	30	30	600	65	18	65	10	**103S-GS⊗3-FC45C**	**107S-GS⊗3-FC45C**

∗ Horsepower ratings shown in the table are for reference. Final selection of the starter depends upon the actual motor full-load current and service factor.

⊗Coil voltage code—see page 2-267

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Product Selection and Coordination Ratings, UL/CSA in Group Motor Installation, Continued

Motor Current Adjustment Range [A]	UL/CSA Hp and Coordination Ratings (60 Hz)									DOL Starters	Reversing Starters
	Hp Ratings as a UL 508 Motor Controller in Group Motor Installations∗				Max. Fuse or Circuit Breaker per NEC	Max. Short-Circuit Current [kA]				Cat. No.	Cat. No.
						Type 1 Coordination		Type 2 Coordination			
	200V AC	230V AC	460V AC	575V AC		480V AC	600V AC	480V AC	600V AC		
C-Frame with 100-C/104-C Contactors on Panel Mounting Modules											
0.10...0.16	—	—	—	—	450	65	47	65	47	**103S-AW⊗2-CA16C**	**107S-AW⊗3-CA16C**
0.16...0.25	—	—	—	—	450	65	47	65	47	**103S-AW⊗2-CA25C**	**107S-AW⊗3-CA25C**
0.25...0.40	—	—	—	—	450	65	47	65	47	**103S-AW⊗2-CA40C**	**107S-AW⊗3-CA40C**
0.40...0.63	—	—	—	—	450	65	47	65	47	**103S-AW⊗2-CA63C**	**107S-AW⊗3-CA63C**
0.63...1.00	—	—	1/2	3/4	450	65	47	65	47	103S-AW⊗2-CB10C	**107S-AW⊗3-CB10C**
1.00...1.60	—	—	1/2...1	3/4...1	450	65	47	65	47	103S-AW⊗2-CB16C	107S-AW⊗3-CB16C
1.60...2.50	1/2	1/2...3/4	3/4...1-1/2	1...2	450	65	30	65	10	103S-AW⊗2-CB25C	107S-AW⊗3-CB25C
2.50...4.00	1/2...1	3/4...1	1-1/2...3	2...3	450	65	30	50	—	103S-AW⊗2-CB40C	107S-AW⊗3-CB40C
4.00...6.30	1...1-1/2	1...2	3...5	5	450	65	30	50	—	103S-AW⊗2-CB63C	**107S-AW⊗3-CB63C**
6.30...9.00	1-1/2...2	2	5	7-1/2	450	65	30	50	—	103S-AW⊗2-CC10C	**107S-AW⊗3-CC10C**
6.30...10.0	1-1/2...3	2...3	5...7-1/2	7-1/2...10	450	65	30	50	—	**103S-BW⊗2-CC10C**	**107S-BW⊗3-CC10C**
10.0...12.0	3	3	7-1/2	10	450	30	30	—	—	103S-BW⊗2-CC16C	**107S-BW⊗3-CC16C**
10.0...16.0	3...5	5	7-1/2...10	10	450	30	30	—	—	103S-CW⊗2-CC16C	**107S-CW⊗3-CC16C**
10.0...16.0	3...5	5	7-1/2...10	10...15	450	30	30	—	—	**103S-DW⊗2-CC16C**	**107S-DW⊗3-CC16C**
14.5...20.0	5	5...7-1/2	15	15	450	30	30	—	—	103S-DW⊗2-CC20C	**107S-DW⊗3-CC20C**
18.0...23.0	5	7-1/2	15	15	450	30	30	—	—	**103S-DW⊗2-CC25C**	**107S-DW⊗3-CC25C**
D-Frame with 100-C/104-C Contactors on Panel Mounting Modules											
1.60...2.50	1/2	1/2...3/4	3/4...1-1/2	1...2	450	65	30	65	10	103S-AW⊗2-DB25C	**107S-AW⊗3-DB25C**
1.60...2.50	1/2	1/2...3/4	3/4...1-1/2	1...2	450	65	30	65	30	**103S-DW⊗2-DB25C**	**107S-DW⊗3-DB25C**
2.50...4.00	1/2...1	3/4...1	1-1/2...3	2...3	450	65	30	65	—	**103S-AW⊗2-DB40C**	**107S-AW⊗3-DB40C**
2.50...4.00	1/2...1	3/4...1	1-1/2...3	2...3	450	65	30	65	30	**103S-DW⊗2-DB40C**	**107S-DW⊗3-DB40C**
4.00...6.30	1...1-1/2	1...2	3...5	5	450	65	30	65	—	103S-AW⊗2-DB63C	**107S-AW⊗3-DB63C**
4.00...6.30	1...1-1/2	1...2	3...5	5	450	65	30	65	30	**103S-EW⊗3-DB63C**	**107S-EW⊗3-DB63C**
6.30...9.00	1-1/2...2	2	5	7-1/2	450	65	30	65	—	**103S-AW⊗2-DC10C**	107S-AW⊗3-DC10C
6.30...10.0	1-1/2...3	2...3	5...7-1/2	7-1/2...10	450	65	30	65	—	**103S-BW⊗2-DC10C**	**107S-BW⊗3-DC10C**
6.30...10.0	1-1/2...3	2...3	5...7-1/2	7-1/2...10	450	65	30	65	—	103S-CW⊗2-DC10C	**107S-CW⊗3-DC10C**
6.30...10.0	1-1/2...3	2...3	5...7-1/2	7-1/2...10	450	65	30	65	30	**103S-EW⊗3-DC10C**	**107S-EW⊗3-DC10C**
10.0...12.0	3	3	7-1/2	10	450	65	30	65	—	**103S-BW⊗2-DC16C**	**107S-BW⊗3-DC16C**
10.0...16.0	3...5	5	7-1/2...10	10	450	65	30	65	—	103S-CW⊗2-DC16C	**107S-CW⊗3-DC16C**
10.0...16.0	3...5	5	7-1/2...10	10...15	450	65	30	65	—	103S-DW⊗2-DC16C	**107S-DW⊗3-DC16C**
10.0...16.0	3...5	5	7-1/2...10	10...15	450	65	30	65	30	**103S-EW⊗3-DC16C**	**107S-EW⊗3-DC16C**
14.5...20.0	5	5...7-1/2	15	15	450	65	30	65	—	103S-DW⊗2-DC20C	**107S-DW⊗3-DC20C**
14.5...20.0	5	5...7-1/2	15	20	450	65	30	65	—	**103S-EW⊗3-DC20C**	**107S-EW⊗3-DC20C**
18.0...23.0	5	7-1/2	15	15	450	65	30	65	—	**103S-DW⊗2-DC25C**	**107S-DW⊗3-DC25C**
18.0...25.0	7-1/2	7-1/2...10	15...20	20	450	65	30	65	—	**103S-EW⊗3-DC25C**	**107S-EW⊗3-DC25C**
F-Frame with 100-C/104-C Contactors on Panel Mounting Modules											
6.30...10.0	1-1/2...3	2...3	5...7-1/2	7-1/2...10	600	65	30	65	30	**103S-EW⊗3-FC10C**	**107S-EW⊗3-FC10C**
10.0...16.0	3...5	5	7-1/2...10	10...15	600	65	30	65	30	**103S-EW⊗3-FC16C**	**107S-EW⊗3-FC16C**
14.5...20.0	5	5...7-1/2	15	15...20	600	65	30	65	30	**103S-EW⊗3-FC20C**	**107S-EW⊗3-FC20C**
18.0...25.0	7-1/2	7-1/2...10	15...20	20	600	65	30	65	30	**103S-EW⊗3-FC25C**	**107S-EW⊗3-FC25C**
18.0...25.0	7-1/2	7-1/2...10	15...20	20...25	600	65	30	65	30	**103S-GW⊗3-FC25C**	**107S-GW⊗3-FC25C**
23.0...30.0	7-1/2	10	20	25	600	65	30	65	30	**103S-EW⊗3-FC32C**	**107S-EW⊗3-FC32C**
23.0...32.0	7-1/2...10	10	20...25	30	600	65	30	65	30	**103S-FW⊗3-FC32C**	**107S-FW⊗3-FC32C**
23.0...32.0	7-1/2...10	10	20...25	30	600	65	30	65	30	**103S-GW⊗3-FC32C**	**107S-GW⊗3-FC32C**
32.0...37.0	10	10	25	30	600	65	18	65	10	**103S-FW⊗3-FC45C**	**107S-FW⊗3-FC45C**
32.0...43.0	10	15	30	30	600	65	18	65	10	**103S-GW⊗3-FC45C**	107S-GW⊗3-FC45C

∗ Horsepower ratings shown in the table are for reference. Final selection of the starter depends upon the actual motor full-load current and service factor.

⊗Coil voltage code—see page 2-267

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Product Selection and Coordination Ratings, UL/CSA as a UL508 Type F Combination Motor Controller

Motor Current Adjustment Range [A]	UL/CSA Hp and Coordination Ratings (60 Hz)								DOL Starters	Reversing Starters
	Hp Ratings as a UL 508 Type F Combination Motor Controller✶				Max. Short-Circuit Current [kA]					
					Type 1 Coordination		Type 2 Coordination		Cat. No.	Cat. No.
	200V AC	230V AC	460V AC	575V AC	480Y/277V AC	600Y/347V AC	480Y/277V AC	600Y/347V AC		
C-Frame with 100-C/104-C Contactors on Standard Bus Bar Modules										
0.10...0.16	—	—	—	—	65	47	65	47	**103S-AT⊗2-CA16C-TE**	**107S-AT⊗3-CA16C-TE**
0.16...0.25	—	—	—	—	65	47	65	47	**103S-AT⊗2-CA25C-TE**	**107S-AT⊗3-CA25C-TE**
0.25...0.40	—	—	—	—	65	47	65	47	**103S-AT⊗2-CA40C-TE**	**107S-AT⊗3-CA40C-TE**
0.40...0.63	—	—	—	—	65	47	65	47	**103S-AT⊗2-CA63C-TE**	**107S-AT⊗3-CA63C-TE**
0.63...1.00	—	—	1/2	3/4	65	47	65	47	**103S-AT⊗2-CB10C-TE**	**107S-AT⊗3-CB10C-TE**
1.00...1.60	—	—	1/2...1	3/4...1	65	47	65	47	**103S-AT⊗2-CB16C-TE**	**107S-AT⊗3-CB16C-TE**
1.60...2.50	1/2	1/2...3/4	3/4...1-1/2	1...2	65	30	65	10	**103S-AT⊗2-CB25C-TE**	**107S-AT⊗3-CB25C-TE**
2.50...4.00	1/2...1	3/4...1	1-1/2...3	2...3	65	30	—	—	**103S-AT⊗2-CB40C-TE**	**107S-AT⊗3-CB40C-TE**
4.00...6.30	1...1-1/2	1...2	3...5	—	65	❖	—	❖	103S-AT⊗2-CB63C-TE	**107S-AT⊗3-CB63C-TE**
6.30...9.00	1-1/2...2	2	5	—	65	❖	—	❖	103S-AT⊗2-CC10C-TE	**107S-AT⊗3-CC10C-TE**
6.30...10.0	1-1/2...3	2...3	5...7-1/2	—	65	❖	50	❖	**103S-BT⊗2-CC10C-TE**	**107S-BT⊗3-CC10C-TE**
10.0...12.0	3	3	7-1/2	—	30	❖	—	❖	**103S-BT⊗2-CC16C-TE**	**107S-BT⊗3-CC16C-TE**
10.0...16.0	3...5	5	7-1/2...10	—	30	❖	—	❖	**103S-CT⊗2-CC16C-TE**	**107S-CT⊗3-CC16C-TE**
10.0...16.0	3...5	5	7-1/2...10	—	30	❖	—	❖	**103S-DT⊗2-CC16C-TE**	**107S-DT⊗3-CC16C-TE**
14.5...20.0	5	5...7-1/2	15	—	10	❖	—	❖	**103S-DT⊗2-CC20C-TE**	**107S-DT⊗3-CC20C-TE**
18.0...23.0	—	—	—	—	❖	❖	❖	❖	**103S-DT⊗2-CC25C-TE**	**107S-DT⊗3-CC25C-TE**
D-Frame with 100-C/104-C Contactors on Standard Bus Bar Modules										
1.60...2.50	1/2	1/2...3/4	3/4...1-1/2	1...2	65	30	65	10	**103S-AT⊗2-DB25C-TE**	**107S-AT⊗3-DB25C-TE**
1.60...2.50	1/2	1/2...3/4	3/4...1-1/2	1...2	65	30	65	30	**103S-DT⊗2-DB25C-TE**	**107S-DT⊗3-DB25C-TE**
2.50...4.00	1/2...1	3/4...1	1-1/2...3	2...3	65	30	65	—	**103S-AT⊗2-DB40C-TE**	**107S-AT⊗3-DB40C-TE**
2.50...4.00	1/2...1	3/4...1	1-1/2...3	2...3	65	30	65	30	**103S-DT⊗2-DB40C-TE**	**107S-DT⊗3-DB40C-TE**
4.00...6.30	1...1-1/2	1...2	3...5	5	65	30	65	—	**103S-AT⊗2-DB63C-TE**	**107S-AT⊗3-DB63C-TE**
4.00...6.30	1...1-1/2	1...2	3...5	5	65	30	65	30	**103S-ET⊗3-DB63C-TE**	**107S-ET⊗3-DB63C-TE**
6.30...9.00	1-1/2...2	2	5	7-1/2	65	30	65	—	**103S-AT⊗2-DC10C-TE**	**107S-AT⊗3-DC10C-TE**
6.30...10.0	1-1/2...3	2...3	5...7-1/2	7-1/2...10	65	30	65	—	**103S-BT⊗2-DC10C-TE**	**107S-BT⊗3-DC10C-TE**
6.30...10.0	1-1/2...3	2...3	5...7-1/2	7-1/2...10	65	30	65	—	**103S-CT⊗2-DC10C-TE**	**107S-CT⊗3-DC10C-TE**
6.30...10.0	1-1/2...3	2...3	5...7-1/2	7-1/2...10	65	30	65	30	**103S-ET⊗3-DC10C-TE**	**107S-ET⊗3-DC10C-TE**
10.0...12.0	3	3	7-1/2	10	65	30	65	—	**103S-BT⊗2-DC16C-TE**	**107S-BT⊗3-DC16C-TE**
10.0...16.0	3...5	5	7-1/2...10	10	65	30	65	—	**103S-CT⊗2-DC16C-TE**	**107S-CT⊗3-DC16C-TE**
10.0...16.0	3...5	5	7-1/2...10	10...15	65	30	65	—	**103S-DT⊗2-DC16C-TE**	**107S-DT⊗3-DC16C-TE**
10.0...16.0	3...5	5	7-1/2...10	10...15	65	30	65	30	**103S-ET⊗3-DC16C-TE**	**107S-ET⊗3-DC16C-TE**
14.5...20.0	5	5...7-1/2	15	—	65	❖	65	❖	103S-DT⊗2-DC20C-TE	**107S-DT⊗3-DC20C-TE**
14.5...20.0	5	5...7-1/2	15	—	65	❖	65	❖	**103S-ET⊗3-DC20C-TE**	**107S-ET⊗3-DC20C-TE**
18.0...23.0	5	7-1/2	15	—	65	❖	65	❖	**103S-DT⊗2-DC25C-TE**	**107S-DT⊗3-DC25C-TE**
18.0...25.0	7-1/2	7-1/2...10	15...20	—	65	❖	65	❖	**103S-ET⊗3-DC25C-TE**	**107S-ET⊗3-DC25C-TE**
F-Frame with 100-C/104-C Contactors on Standard Bus Bar Modules										
6.30...10.0	1-1/2...3	2...3	5...7-1/2	7-1/2...10	65	30	65	30	**103S-ET⊗3-FC10C-TE**	**107S-ET⊗3-FC10C-TE**
10.0...16.0	3...5	5	7-1/2...10	10...15	65	30	65	30	**103S-ET⊗3-FC16C-TE**	**107S-ET⊗3-FC16C-TE**
14.5...20.0	5	5...7-1/2	15	15...20	65	30	65	30	**103S-ET⊗3-FC20C-TE**	**107S-ET⊗3-FC20C-TE**
18.0...25.0	7-1/2	7-1/2...10	15...20	20	65	30	65	30	**103S-ET⊗3-FC25C-TE**	**107S-ET⊗3-FC25C-TE**
18.0...25.0	7-1/2	7-1/2...10	15...20	20...25	65	30	65	30	**103S-GT⊗3-FC25C-TE**	**107S-GT⊗3-FC25C-TE**
23.0...30.0	7-1/2	10	20	25	65	30	65	30	103S-ET⊗3-FC32C-TE	**107S-ET⊗3-FC32C-TE**
23.0...32.0	7-1/2...10	10	20...25	30	65	30	65	30	**103S-FT⊗3-FC32C-TE**	**107S-FT⊗3-FC32C-TE**
23.0...32.0	7-1/2...10	10	20...25	30	65	30	65	30	**103S-GT⊗3-FC32C-TE**	**107S-GT⊗3-FC32C-TE**
23.0...32.0	7-1/2...10	10	20...25	30	65	30	65	30	**103S-HT⊗3-FC32C-TE**	**107S-HT⊗3-FC32C-TE**
32.0...37.0	10	10	25	—	65	❖	65	❖	103S-FT⊗3-FC45C-TE	**107S-FT⊗3-FC45C-TE**
32.0...43.0	10	15	30	—	65	❖	65	❖	**103S-GT⊗3-FC45C-TE**	**107S-GT⊗3-FC45C-TE**
32.0...45.0	10	15	30	—	65	❖	65	❖	**103S-HT⊗3-FC45C-TE**	**107S-HT⊗3-FC45C-TE**
32.0...45.0	10	15	30	—	65	❖	65	❖	**103S-JT⊗3-FC45C-TE**	**107S-JT⊗3-FC45C-TE**

✶ Horsepower ratings shown in the table are for reference. Final selection of the starter depends upon the actual motor full-load current and service factor.

❖ This starter is not valid for application at this horsepower and voltage.

⊗Coil voltage code—see page 2-267

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Product Selection and Coordination Ratings, UL/CSA as a UL508 Type F Combination Motor Controller, Continued

Motor Current Adjustment Range [A]	UL/CSA Hp and Coordination Ratings (60 Hz)								DOL Starters	Reversing Starters
	Hp Ratings as a UL 508 Type F Combination Motor Controller✶				Max. Short-Circuit Current [kA]					
					Type 1 Coordination		Type 2 Coordination		Cat. No.	Cat. No.
	200V AC	230V AC	460V AC	575V AC	480Y/277V AC	600Y/347V AC	480Y/277V AC	600Y/347V AC		
C-Frame with 100-C/104-C Contactors on ISO Bus Bar Modules										
0.10...0.16	—	—	—	—	65	47	65	47	**103S-AS⊗2-CA16C-TE**	**107S-AS⊗3-CA16C-TE**
0.16...0.25	—	—	—	—	65	47	65	47	**103S-AS⊗2-CA25C-TE**	**107S-AS⊗3-CA25C-TE**
0.25...0.40	—	—	—	—	65	47	65	47	**103S-AS⊗2-CA40C-TE**	**107S-AS⊗3-CA40C-TE**
0.40...0.63	—	—	—	—	65	47	65	47	**103S-AS⊗2-CA63C-TE**	**107S-AS⊗3-CA63C-TE**
0.63...1.00	—	—	1/2	3/4	65	47	65	47	**103S-AS⊗2-CB10C-TE**	**107S-AS⊗3-CB10C-TE**
1.00...1.60	—	—	1/2...1	3/4...1	65	47	65	47	**103S-AS⊗2-CB16C-TE**	**107S-AS⊗3-CB16C-TE**
1.60...2.50	1/2	1/2...3/4	3/4...1-1/2	1...2	65	30	65	10	**103S-AS⊗2-CB25C-TE**	**107S-AS⊗3-CB25C-TE**
2.50...4.00	1/2...1	3/4...1	1-1/2...3	2...3	65	30	—	—	**103S-AS⊗2-CB40C-TE**	**107S-AS⊗3-CB40C-TE**
4.00...6.30	1...1-1/2	1...2	3...5	—	65	❖	—	❖	**103S-AS⊗2-CB63C-TE**	**107S-AS⊗3-CB63C-TE**
6.30...9.00	1-1/2...2	2	5	—	65	❖	—	❖	**103S-AS⊗2-CC10C-TE**	**107S-AS⊗3-CC10C-TE**
6.30...10.0	1-1/2...3	2...3	5...7-1/2	—	65	❖	50	❖	**103S-BS⊗2-CC10C-TE**	**107S-BS⊗3-CC10C-TE**
10.0...12.0	3	3	7-1/2	—	30	❖	—	❖	**103S-BS⊗2-CC16C-TE**	**107S-BS⊗3-CC16C-TE**
10.0...16.0	3...5	5	7-1/2...10	—	30	❖	—	❖	**103S-CS⊗2-CC16C-TE**	**107S-CS⊗3-CC16C-TE**
10.0...16.0	3...5	5	7-1/2...10	—	30	❖	—	❖	**103S-DS⊗2-CC16C-TE**	**107S-DS⊗3-CC16C-TE**
14.5...20.0	5	5...7-1/2	15	—	10	❖	—	❖	**103S-DS⊗2-CC20C-TE**	**107S-DS⊗3-CC20C-TE**
18.0...23.0	—	—	—	—	❖	❖	❖	❖	**103S-DS⊗2-CC25C-TE**	**107S-DS⊗3-CC25C-TE**
D-Frame with 100-C/104-C Contactors on ISO Bus Bar Modules										
1.60...2.50	1/2	1/2...3/4	3/4...1-1/2	1...2	65	30	65	10	**103S-AS⊗2-DB25C-TE**	**107S-AS⊗3-DB25C-TE**
1.60...2.50	1/2	1/2...3/4	3/4...1-1/2	1...2	65	30	65	30	**103S-DS⊗2-DB25C-TE**	**107S-DS⊗3-DB25C-TE**
2.50...4.00	1/2...1	3/4...1	1-1/2...3	2...3	65	30	65	—	**103S-AS⊗2-DB40C-TE**	**107S-AS⊗3-DB40C-TE**
2.50...4.00	1/2...1	3/4...1	1-1/2...3	2...3	65	30	65	30	**103S-DS⊗2-DB40C-TE**	**107S-DS⊗3-DB40C-TE**
4.00...6.30	1...1-1/2	1...2	3...5	5	65	30	65	—	**103S-AS⊗2-DB63C-TE**	**107S-AS⊗3-DB63C-TE**
4.00...6.30	1...1-1/2	1...2	3...5	5	65	30	65	30	**103S-ES⊗3-DB63C-TE**	**107S-ES⊗3-DB63C-TE**
6.30...9.00	1-1/2...2	2	5	7-1/2	65	30	65	—	**103S-AS⊗2-DC10C-TE**	**107S-AS⊗3-DC10C-TE**
6.30...10.0	1-1/2...3	2...3	5...7-1/2	7-1/2...10	65	30	65	—	**103S-BS⊗2-DC10C-TE**	**107S-BS⊗3-DC10C-TE**
6.30...10.0	1-1/2...3	2...3	5...7-1/2	7-1/2...10	65	30	65	—	**103S-CS⊗2-DC10C-TE**	**107S-CS⊗3-DC10C-TE**
6.30...10.0	1-1/2...3	2...3	5...7-1/2	7-1/2...10	65	30	65	30	**103S-ES⊗3-DC10C-TE**	**107S-ES⊗3-DC10C-TE**
10.0...12.0	3	3	7-1/2	10	65	30	65	—	**103S-BS⊗2-DC16C-TE**	**107S-BS⊗3-DC16C-TE**
10.0...16.0	3...5	5	7-1/2...10	10	65	30	65	—	**103S-CS⊗2-DC16C-TE**	**107S-CS⊗3-DC16C-TE**
10.0...16.0	3...5	5	7-1/2...10	10...15	65	30	65	—	**103S-DS⊗2-DC16C-TE**	**107S-DS⊗3-DC16C-TE**
10.0...16.0	3...5	5	7-1/2...10	10...15	65	30	65	30	**103S-ES⊗3-DC16C-TE**	**107S-ES⊗3-DC16C-TE**
14.5...20.0	5	5...7-1/2	15	—	65	❖	65	❖	**103S-DS⊗2-DC20C-TE**	**107S-DS⊗3-DC20C-TE**
14.5...20.0	5	5...7-1/2	15	—	65	❖	65	❖	**103S-ES⊗3-DC20C-TE**	**107S-ES⊗3-DC20C-TE**
18.0...23.0	5	7-1/2	15	—	65	❖	65	❖	**103S-DS⊗2-DC25C-TE**	**107S-DS⊗3-DC25C-TE**
18.0...25.0	7-1/2	7-1/2...10	15...20	—	65	❖	65	❖	**103S-ES⊗3-DC25C-TE**	**107S-ES⊗3-DC25C-TE**
F-Frame with 100-C/104-C Contactors on ISO Bus Bar Modules										
6.30...10.0	1-1/2...3	2...3	5...7-1/2	7-1/2...10	65	30	65	30	**103S-ES⊗3-FC10C-TE**	**107S-ES⊗3-FC10C-TE**
10.0...16.0	3...5	5	7-1/2...10	10...15	65	30	65	30	**103S-ES⊗3-FC16C-TE**	**107S-ES⊗3-FC16C-TE**
14.5...20.0	5	5...7-1/2	15	15...20	65	30	65	30	**103S-ES⊗3-FC20C-TE**	**107S-ES⊗3-FC20C-TE**
18.0...25.0	7-1/2	7-1/2...10	15...20	20	65	30	65	30	**103S-ES⊗3-FC25C-TE**	**107S-ES⊗3-FC25C-TE**
18.0...25.0	7-1/2	7-1/2...10	15...20	20...25	65	30	65	30	**103S-GS⊗3-FC25C-TE**	**107S-GS⊗3-FC25C-TE**
23.0...30.0	7-1/2	10	20	25	65	30	65	30	**103S-ES⊗3-FC32C-TE**	**107S-ES⊗3-FC32C-TE**
23.0...32.0	7-1/2...10	10	20...25	30	65	30	65	30	**103S-FS⊗3-FC32C-TE**	**107S-FS⊗3-FC32C-TE**
23.0...32.0	7-1/2...10	10	20...25	30	65	30	65	30	**103S-GS⊗3-FC32C-TE**	**107S-GS⊗3-FC32C-TE**
32.0...37.0	10	10	25	—	65	❖	65	❖	**103S-FS⊗3-FC45C-TE**	**107S-FS⊗3-FC45C-TE**
32.0...43.0	10	15	30	—	65	❖	65	❖	**103S-GS⊗3-FC45C-TE**	**107S-GS⊗3-FC45C-TE**

✶ Horsepower ratings shown in the table are for reference. Final selection of the starter depends upon the actual motor full-load current and service factor.

❖ This starter is not valid for application at this horsepower and voltage.

⊗Coil voltage code—see page 2-267

Product Selection and Coordination Ratings, UL/CSA as a UL508 Type F Combination Motor Controller, Continued

Motor Current Adjustment Range [A]	UL/CSA Hp and Coordination Ratings (60 Hz)								DOL Starters	Reversing Starters
	Hp Ratings as a UL 508 Type F Combination Motor Controller✶				Max. Short-Circuit Current [kA]				Cat. No.	Cat. No.
					Type 1 Coordination		Type 2 Coordination			
	200V AC	230V AC	460V AC	575V AC	480Y/277V AC	600Y/347V AC	480Y/277V AC	600Y/347V AC		
C-Frame with 100-C/104-C Contactors on Panel Mounting Modules										
0.10...0.16	—	—	—	—	65	47	65	47	**103S-AW⊗2-CA16C-TE**	**107S-AW⊗3-CA16C-TE**
0.16...0.25	—	—	—	—	65	47	65	47	**103S-AW⊗2-CA25C-TE**	**107S-AW⊗3-CA25C-TE**
0.25...0.40	—	—	—	—	65	47	65	47	**103S-AW⊗2-CA40C-TE**	**107S-AW⊗3-CA40C-TE**
0.40...0.63	—	—	—	—	65	47	65	47	**103S-AW⊗2-CA63C-TE**	**107S-AW⊗3-CA63C-TE**
0.63...1.00	—	—	1/2	3/4	65	47	65	47	**103S-AW⊗2-CB10C-TE**	**107S-AW⊗3-CB10C-TE**
1.00...1.60	—	—	1/2...1	3/4...1	65	47	65	47	**103S-AW⊗2-CB16C-TE**	**107S-AW⊗3-CB16C-TE**
1.60...2.50	1/2	1/2...3/4	3/4...1-1/2	1...2	65	30	65	10	**103S-AW⊗2-CB25C-TE**	**107S-AW⊗3-CB25C-TE**
2.50...4.00	1/2...1	3/4...1	1-1/2...3	2...3	65	30	—	—	**103S-AW⊗2-CB40C-TE**	**107S-AW⊗3-CB40C-TE**
4.00...6.30	1...1-1/2	1...2	3...5	—	65	❖	—	❖	**103S-AW⊗2-CB63C-TE**	**107S-AW⊗3-CB63C-TE**
6.30...9.00	1-1/2...2	2	5	—	65	❖	—	❖	**103S-AW⊗2-CC10C-TE**	**107S-AW⊗3-CC10C-TE**
6.30...10.0	1-1/2...3	2...3	5...7-1/2	—	65	❖	50	❖	**103S-BW⊗2-CC10C-TE**	**107S-BW⊗3-CC10C-TE**
10.0...12.0	3	3	7-1/2	—	30	❖	—	❖	**103S-BW⊗2-CC16C-TE**	**107S-BW⊗3-CC16C-TE**
10.0...16.0	3...5	5	7-1/2...10	—	30	❖	—	❖	**103S-CW⊗2-CC16C-TE**	**107S-CW⊗3-CC16C-TE**
10.0...16.0	3...5	5	7-1/2...10	—	30	❖	—	❖	**103S-DW⊗2-CC16C-TE**	**107S-DW⊗3-CC16C-TE**
14.5...20.0	5	5...7-1/2	15	—	10	❖	—	❖	**103S-DW⊗2-CC20C-TE**	**107S-DW⊗3-CC20C-TE**
18.0...23.0	—	—	—	—	❖	❖	❖	❖	**103S-DW⊗2-CC25C-TE**	**107S-DW⊗3-CC25C-TE**
D-Frame with 100-C/104-C Contactors on Panel Mounting Modules										
1.60...2.50	1/2	1/2...3/4	3/4...1-1/2	1...2	65	30	65	10	**103S-AW⊗2-DB25C-TE**	**107S-AW⊗3-DB25C-TE**
1.60...2.50	1/2	1/2...3/4	3/4...1-1/2	1...2	65	30	65	30	**103S-DW⊗2-DB25C-TE**	**107S-DW⊗3-DB25C-TE**
2.50...4.00	1/2...1	3/4...1	1-1/2...3	2...3	65	30	65	—	**103S-AW⊗2-DB40C-TE**	**107S-AW⊗3-DB40C-TE**
2.50...4.00	1/2...1	3/4...1	1-1/2...3	2...3	65	30	65	30	**103S-DW⊗2-DB40C-TE**	**107S-DW⊗3-DB40C-TE**
4.00...6.30	1...1-1/2	1...2	3...5	5	65	30	65	—	**103S-AW⊗2-DB63C-TE**	**107S-AW⊗3-DB63C-TE**
4.00...6.30	1...1-1/2	1...2	3...5	5	65	30	65	30	**103S-EW⊗3-DB63C-TE**	**107S-EW⊗3-DB63C-TE**
6.30...9.00	1-1/2...2	2	5	7-1/2	65	30	65	—	**103S-AW⊗2-DC10C-TE**	**107S-AW⊗3-DC10C-TE**
6.30...10.0	1-1/2...3	2...3	5...7-1/2	7-1/2...10	65	30	65	—	**103S-BW⊗2-DC10C-TE**	**107S-BW⊗3-DC10C-TE**
6.30...10.0	1-1/2...3	2...3	5...7-1/2	7-1/2...10	65	30	65	—	**103S-CW⊗2-DC10C-TE**	**107S-CW⊗3-DC10C-TE**
6.30...10.0	1-1/2...3	2...3	5...7-1/2	7-1/2...10	65	30	65	30	**103S-EW⊗3-DC10C-TE**	**107S-EW⊗3-DC10C-TE**
10.0...12.0	3	3	7-1/2	10	65	30	65	—	**103S-BW⊗2-DC16C-TE**	**107S-BW⊗3-DC16C-TE**
10.0...16.0	3...5	5	7-1/2...10	10	65	30	65	—	**103S-CW⊗2-DC16C-TE**	**107S-CW⊗3-DC16C-TE**
10.0...16.0	3...5	5	7-1/2...10	10...15	65	30	65	—	**103S-DW⊗2-DC16C-TE**	**107S-DW⊗3-DC16C-TE**
10.0...16.0	3...5	5	7-1/2...10	10...15	65	30	65	30	**103S-EW⊗3-DC16C-TE**	**107S-EW⊗3-DC16C-TE**
14.5...20.0	5	5...7-1/2	15	—	65	❖	65	❖	**103S-DW⊗2-DC20C-TE**	**107S-DW⊗3-DC20C-TE**
14.5...20.0	5	5...7-1/2	15	—	65	❖	65	❖	**103S-EW⊗3-DC20C-TE**	**107S-EW⊗3-DC20C-TE**
18.0...23.0	5	7-1/2	15	—	65	❖	65	❖	**103S-DW⊗2-DC25C-TE**	**107S-DW⊗3-DC25C-TE**
18.0...25.0	7-1/2	7-1/2...10	15...20	—	65	❖	65	❖	**103S-EW⊗3-DC25C-TE**	**107S-EW⊗3-DC25C-TE**
F-Frame with 100-C/104-C Contactors on Panel Mounting Modules										
6.30...10.0	1-1/2...3	2...3	5...7-1/2	7-1/2...10	65	30	65	30	**103S-EW⊗3-FC10C-TE**	**107S-EW⊗3-FC10C-TE**
10.0...16.0	3...5	5	7-1/2...10	10...15	65	30	65	30	**103S-EW⊗3-FC16C-TE**	**107S-EW⊗3-FC16C-TE**
14.5...20.0	5	5...7-1/2	15	15...20	65	30	65	30	**103S-EW⊗3-FC20C-TE**	**107S-EW⊗3-FC20C-TE**
18.0...25.0	7-1/2	7-1/2...10	15...20	20	65	30	65	30	**103S-EW⊗3-FC25C-TE**	**107S-EW⊗3-FC25C-TE**
18.0...25.0	7-1/2	7-1/2...10	15...20	20...25	65	30	65	30	**103S-GW⊗3-FC25C-TE**	**107S-GW⊗3-FC25C-TE**
23.0...30.0	7-1/2	10	20	25	65	30	65	30	**103S-EW⊗3-FC32C-TE**	**107S-EW⊗3-FC32C-TE**
23.0...32.0	7-1/2...10	10	20...25	30	65	30	65	30	**103S-FW⊗3-FC32C-TE**	**107S-FW⊗3-FC32C-TE**
23.0...32.0	7-1/2...10	10	20...25	30	65	30	65	30	**103S-GW⊗3-FC32C-TE**	**107S-GW⊗3-FC32C-TE**
32.0...37.0	10	10	25	—	65	❖	65	❖	**103S-FW⊗3-FC45C-TE**	**107S-FW⊗3-FC45C-TE**
32.0...43.0	10	15	30	—	65	❖	65	❖	**103S-GW⊗3-FC45C-TE**	**107S-GW⊗3-FC45C-TE**

✶ Horsepower ratings shown in the table are for reference. Final selection of the starter depends upon the actual motor full-load current and service factor.
❖ This starter is not valid for application at this horsepower and voltage.
⊗Coil voltage code—see page 2-267

Product Selection and Coordination Ratings, UL/CSA as a UL508 Self Protected Type E Combination Motor Controller

Motor Current Adjustment Range [A]	UL/CSA Hp and Coordination Ratings (60 Hz)						DOL Starters	Reversing Starters
	Hp Ratings as a UL 508 Self Protected Type E Combination Motor Controller✶				Max. Short-Circuit Current [kA]			
	200V AC	230V AC	460V AC	575V AC	480Y/277V AC	600Y/347V AC	Cat. No.	Cat. No.
C-Frame with 100-C/104-C Contactors on Standard Bus Bar Modules								
0.10...0.16	—	—	—	—	65	47	**103S-AT⊗2-CA16C-TE**	**107S-AT⊗3-CA16C-TE**
0.16...0.25	—	—	—	—	65	47	**103S-AT⊗2-CA25C-TE**	**107S-AT⊗3-CA25C-TE**
0.25...0.40	—	—	—	—	65	47	**103S-AT⊗2-CA40C-TE**	**107S-AT⊗3-CA40C-TE**
0.40...0.63	—	—	—	—	65	47	**103S-AT⊗2-CA63C-TE**	**107S-AT⊗3-CA63C-TE**
0.63...1.00	—	—	1/2	3/4	65	47	**103S-AT⊗2-CB10C-TE**	**107S-AT⊗3-CB10C-TE**
1.00...1.60	—	—	1/2...1	3/4...1	65	47	**103S-AT⊗2-CB16C-TE**	**107S-AT⊗3-CB16C-TE**
1.60...2.50	1/2	1/2...3/4	3/4...1-1/2	—	65	❖	**103S-AT⊗2-CB25C-TE**	**107S-AT⊗3-CB25C-TE**
2.50...4.00	—	—	—	—	❖	❖	**103S-AT⊗2-CB40C-TE**	**107S-AT⊗3-CB40C-TE**
4.00...6.30	—	—	—	—	❖	❖	103S-AT⊗2-CB63C-TE	**107S-AT⊗3-CB63C-TE**
6.30...9.00	—	—	—	—	❖	❖	103S-AT⊗2-CC10C-TE	**107S-AT⊗3-CC10C-TE**
6.30...10.0	—	—	—	—	❖	❖	**103S-BT⊗2-CC10C-TE**	**107S-BT⊗3-CC10C-TE**
10.0...12.0	—	—	—	—	❖	❖	**103S-BT⊗2-CC16C-TE**	**107S-BT⊗3-CC16C-TE**
10.0...16.0	—	—	—	—	❖	❖	**103S-CT⊗2-CC16C-TE**	**107S-CT⊗3-CC16C-TE**
10.0...16.0	—	—	—	—	❖	❖	**103S-DT⊗2-CC16C-TE**	**107S-DT⊗3-CC16C-TE**
14.5...20.0	—	—	—	—	❖	❖	**103S-DT⊗2-CC20C-TE**	**107S-DT⊗3-CC20C-TE**
18.0...23.0	—	—	—	—	❖	❖	**103S-DT⊗2-CC25C-TE**	**107S-DT⊗3-CC25C-TE**
D-Frame with 100-C/104-C Contactors on Standard Bus Bar Modules								
1.60...2.50	1/2	1/2...3/4	3/4...1-1/2	—	65	❖	**103S-AT⊗2-DB25C-TE**	**107S-AT⊗3-DB25C-TE**
1.60...2.50	1/2	1/2...3/4	3/4...1-1/2	1...2	65	30	**103S-DT⊗2-DB25C-TE**	**107S-DT⊗3-DB25C-TE**
2.50...4.00	—	—	—	—	❖	❖	**103S-AT⊗2-DB40C-TE**	**107S-AT⊗3-DB40C-TE**
2.50...4.00	1/2...1	3/4...1	1-1/2...3	2...3	65	30	**103S-DT⊗2-DB40C-TE**	**107S-DT⊗3-DB40C-TE**
4.00...6.30	—	—	—	—	❖	❖	**103S-AT⊗2-DB63C-TE**	**107S-AT⊗3-DB63C-TE**
4.00...6.30	1...1-1/2	1...2	3...5	5	65	30	**103S-ET⊗3-DB63C-TE**	**107S-ET⊗3-DB63C-TE**
6.30...9.00	—	—	—	—	❖	❖	**103S-AT⊗2-DC10C-TE**	**107S-AT⊗3-DC10C-TE**
6.30...10.0	—	—	—	—	❖	❖	**103S-BT⊗2-DC10C-TE**	**107S-BT⊗3-DC10C-TE**
6.30...10.0	—	—	—	—	❖	❖	**103S-CT⊗2-DC10C-TE**	**107S-CT⊗3-DC10C-TE**
6.30...10.0	1-1/2...3	2...3	5...7-1/2	7-1/2...10	65	30	**103S-ET⊗3-DC10C-TE**	**107S-ET⊗3-DC10C-TE**
10.0...12.0	—	—	—	—	❖	❖	**103S-BT⊗2-DC16C-TE**	**107S-BT⊗3-DC16C-TE**
10.0...16.0	—	—	—	—	❖	❖	**103S-CT⊗2-DC16C-TE**	**107S-CT⊗3-DC16C-TE**
10.0...16.0	—	—	—	—	❖	❖	**103S-DT⊗2-DC16C-TE**	**107S-DT⊗3-DC16C-TE**
10.0...16.0	3...5	5	7-1/2...10	10...15	65	30	**103S-ET⊗3-DC16C-TE**	**107S-ET⊗3-DC16C-TE**
14.5...20.0	—	—	—	—	❖	❖	103S-DT⊗2-DC20C-TE	**107S-DT⊗3-DC20C-TE**
14.5...20.0	5	5...7-1/2	15	—	65	❖	**103S-ET⊗3-DC20C-TE**	**107S-ET⊗3-DC20C-TE**
18.0...23.0	—	—	—	—	❖	❖	**103S-DT⊗2-DC25C-TE**	**107S-DT⊗3-DC25C-TE**
18.0...25.0	7-1/2	7-1/2...10	15...20	—	65	❖	**103S-ET⊗3-DC25C-TE**	**107S-ET⊗3-DC25C-TE**
F-Frame with 100-C/104-C Contactors on Standard Bus Bar Modules								
6.30...10.0	1-1/2...3	2...3	5...7-1/2	7-1/2...10	65	30	**103S-ET⊗3-FC10C-TE**	**107S-ET⊗3-FC10C-TE**
10.0...16.0	3...5	5	7-1/2...10	10...15	65	30	**103S-ET⊗3-FC16C-TE**	**107S-ET⊗3-FC16C-TE**
14.5...20.0	5	5...7-1/2	15	15...20	65	30	**103S-ET⊗3-FC20C-TE**	**107S-ET⊗3-FC20C-TE**
18.0...25.0	7-1/2	7-1/2...10	15...20	20	65	30	**103S-ET⊗3-FC25C-TE**	**107S-ET⊗3-FC25C-TE**
18.0...25.0	7-1/2	7-1/2...10	15...20	20...25	65	30	**103S-GT⊗3-FC25C-TE**	**107S-GT⊗3-FC25C-TE**
23.0...30.0	7-1/2	10	20	25	65	30	103S-ET⊗3-FC32C-TE	**107S-ET⊗3-FC32C-TE**
23.0...32.0	7-1/2...10	10	20...25	30	65	30	**103S-FT⊗3-FC32C-TE**	**107S-FT⊗3-FC32C-TE**
23.0...32.0	7-1/2...10	10	20...25	30	65	30	**103S-GT⊗3-FC32C-TE**	**107S-GT⊗3-FC32C-TE**
23.0...32.0	7-1/2...10	10	20...25	30	65	30	**103S-HT⊗3-FC32C-TE**	**107S-HT⊗3-FC32C-TE**
32.0...37.0	10	10	25	—	65	❖	103S-FT⊗3-FC45C-TE	**107S-FT⊗3-FC45C-TE**
32.0...43.0	10	15	30	—	65	❖	**103S-GT⊗3-FC45C-TE**	**107S-GT⊗3-FC45C-TE**
32.0...45.0	10	15	30	—	65	❖	**103S-HT⊗3-FC45C-TE**	**107S-HT⊗3-FC45C-TE**
32.0...45.0	10	15	30	—	65	❖	**103S-JT⊗3-FC45C-TE**	**107S-JT⊗3-FC45C-TE**

✶ Horsepower ratings shown in the table are for reference. Final selection of the starter depends upon the actual motor full-load current and service factor.
❖ This starter is not valid for application at this horsepower and voltage.
⊗Coil voltage code—see page 2-267

Product Selection and Coordination Ratings, UL/CSA as a UL508 Self Protected Type E Combination Motor Controller, Continued

Motor Current Adjustment Range [A]	UL/CSA Hp and Coordination Ratings (60 Hz)						DOL Starters	Reversing Starters
	Hp Ratings as a UL 508 Self Protected Type E Combination Motor Controller✶				Max. Short-Circuit Current [kA]			
	200V AC	230V AC	460V AC	575V AC	480Y/277V AC	600Y/347V AC	Cat. No.	Cat. No.
C-Frame with 100-C/104-C Contactors on ISO Bus Bar Modules								
0.10...0.16	—	—	—	—	65	47	**103S-AS⊗2-CA16C-TE**	**107S-AS⊗3-CA16C-TE**
0.16...0.25	—	—	—	—	65	47	**103S-AS⊗2-CA25C-TE**	**107S-AS⊗3-CA25C-TE**
0.25...0.40	—	—	—	—	65	47	**103S-AS⊗2-CA40C-TE**	**107S-AS⊗3-CA40C-TE**
0.40...0.63	—	—	—	—	65	47	**103S-AS⊗2-CA63C-TE**	**107S-AS⊗3-CA63C-TE**
0.63...1.00	—	—	1/2	3/4	65	47	**103S-AS⊗2-CB10C-TE**	**107S-AS⊗3-CB10C-TE**
1.00...1.60	—	—	1/2...1	3/4...1	65	47	**103S-AS⊗2-CB16C-TE**	**107S-AS⊗3-CB16C-TE**
1.60...2.50	1/2	1/2...3/4	3/4...1-1/2	—	65	❖	**103S-AS⊗2-CB25C-TE**	**107S-AS⊗3-CB25C-TE**
2.50...4.00	—	—	—	—	❖	❖	**103S-AS⊗2-CB40C-TE**	**107S-AS⊗3-CB40C-TE**
4.00...6.30	—	—	—	—	❖	❖	**103S-AS⊗2-CB63C-TE**	**107S-AS⊗3-CB63C-TE**
6.30...9.00	—	—	—	—	❖	❖	**103S-AS⊗2-CC10C-TE**	**107S-AS⊗3-CC10C-TE**
6.30...10.0	—	—	—	—	❖	❖	**103S-BS⊗2-CC10C-TE**	**107S-BS⊗3-CC10C-TE**
10.0...12.0	—	—	—	—	❖	❖	**103S-BS⊗2-CC16C-TE**	**107S-BS⊗3-CC16C-TE**
10.0...16.0	—	—	—	—	❖	❖	**103S-CS⊗2-CC16C-TE**	**107S-CS⊗3-CC16C-TE**
10.0...16.0	—	—	—	—	❖	❖	**103S-DS⊗2-CC16C-TE**	**107S-DS⊗3-CC16C-TE**
14.5...20.0	—	—	—	—	❖	❖	**103S-DS⊗2-CC20C-TE**	**107S-DS⊗3-CC20C-TE**
18.0...23.0	—	—	—	—	❖	❖	**103S-DS⊗2-CC25C-TE**	**107S-DS⊗3-CC25C-TE**
D-Frame with 100-C/104-C Contactors on ISO Bus Bar Modules								
1.60...2.50	1/2	1/2...3/4	3/4...1-1/2	—	65	❖	**103S-AS⊗2-DB25C-TE**	**107S-AS⊗3-DB25C-TE**
1.60...2.50	1/2	1/2...3/4	3/4...1-1/2	1...2	65	30	**103S-DS⊗2-DB25C-TE**	**107S-DS⊗3-DB25C-TE**
2.50...4.00	—	—	—	—	❖	❖	**103S-AS⊗2-DB40C-TE**	**107S-AS⊗3-DB40C-TE**
2.50...4.00	1/2...1	3/4...1	1-1/2...3	2...3	65	30	**103S-DS⊗2-DB40C-TE**	**107S-DS⊗3-DB40C-TE**
4.00...6.30	—	—	—	—	❖	❖	**103S-AS⊗2-DB63C-TE**	**107S-AS⊗3-DB63C-TE**
4.00...6.30	1...1-1/2	1...2	3...5	5	65	30	**103S-ES⊗3-DB63C-TE**	**107S-ES⊗3-DB63C-TE**
6.30...9.00	—	—	—	—	❖	❖	**103S-AS⊗2-DC10C-TE**	**107S-AS⊗3-DC10C-TE**
6.30...10.0	—	—	—	—	❖	❖	**103S-BS⊗2-DC10C-TE**	**107S-BS⊗3-DC10C-TE**
6.30...10.0	—	—	—	—	❖	❖	**103S-CS⊗2-DC10C-TE**	**107S-CS⊗3-DC10C-TE**
6.30...10.0	1-1/2...3	2...3	5...7-1/2	7-1/2...10	65	30	**103S-ES⊗3-DC10C-TE**	**107S-ES⊗3-DC10C-TE**
10.0...12.0	—	—	—	—	❖	❖	**103S-BS⊗2-DC16C-TE**	**107S-BS⊗3-DC16C-TE**
10.0...16.0	—	—	—	—	❖	❖	**103S-CS⊗2-DC16C-TE**	**107S-CS⊗3-DC16C-TE**
10.0...16.0	—	—	—	—	❖	❖	**103S-DS⊗2-DC16C-TE**	**107S-DS⊗3-DC16C-TE**
10.0...16.0	3...5	5	7-1/2...10	10...15	65	30	**103S-ES⊗3-DC16C-TE**	**107S-ES⊗3-DC16C-TE**
14.5...20.0	—	—	—	—	❖	❖	**103S-DS⊗2-DC20C-TE**	**107S-DS⊗3-DC20C-TE**
14.5...20.0	5	5...7-1/2	15	—	65	❖	**103S-ES⊗3-DC20C-TE**	**107S-ES⊗3-DC20C-TE**
18.0...23.0	—	—	—	—	❖	❖	**103S-DS⊗2-DC25C-TE**	**107S-DS⊗3-DC25C-TE**
18.0...25.0	7-1/2	7-1/2...10	15...20	—	65	❖	**103S-ES⊗3-DC25C-TE**	**107S-ES⊗3-DC25C-TE**
F-Frame with 100-C/104-C Contactors on ISO Bus Bar Modules								
6.30...10.0	1-1/2...3	2...3	5...7-1/2	7-1/2...10	65	30	**103S-ES⊗3-FC10C-TE**	**107S-ES⊗3-FC10C-TE**
10.0...16.0	3...5	5	7-1/2...10	10...15	65	30	**103S-ES⊗3-FC16C-TE**	**107S-ES⊗3-FC16C-TE**
14.5...20.0	5	5...7-1/2	15	15...20	65	30	**103S-ES⊗3-FC20C-TE**	**107S-ES⊗3-FC20C-TE**
18.0...25.0	7-1/2	7-1/2...10	15...20	20	65	30	**103S-ES⊗3-FC25C-TE**	**107S-ES⊗3-FC25C-TE**
18.0...25.0	7-1/2	7-1/2...10	15...20	20...25	65	30	**103S-GS⊗3-FC25C-TE**	**107S-GS⊗3-FC25C-TE**
23.0...30.0	7-1/2	10	20	25	65	30	**103S-ES⊗3-FC32C-TE**	**107S-ES⊗3-FC32C-TE**
23.0...32.0	7-1/2...10	10	20...25	30	65	30	**103S-FS⊗3-FC32C-TE**	**107S-FS⊗3-FC32C-TE**
23.0...32.0	7-1/2...10	10	20...25	30	65	30	**103S-GS⊗3-FC32C-TE**	**107S-GS⊗3-FC32C-TE**
32.0...37.0	10	10	25	—	65	❖	**103S-FS⊗3-FC45C-TE**	**107S-FS⊗3-FC45C-TE**
32.0...43.0	10	15	30	—	65	❖	**103S-GS⊗3-FC45C-TE**	**107S-GS⊗3-FC45C-TE**

✶ Horsepower ratings shown in the table are for reference. Final selection of the starter depends upon the actual motor full-load current and service factor.
❖ This starter is not valid for application at this horsepower and voltage.
⊗Coil voltage code—see page 2-267

Product Selection and Coordination Ratings, UL/CSA as a UL508 Self Protected Type E Combination Motor Controller, Continued

Motor Current Adjustment Range [A]	UL/CSA Hp and Coordination Ratings (60 Hz)						DOL Starters	Reversing Starters
	Hp Ratings as a UL 508 Self Protected Type E Combination Motor Controller✶				Max. Short-Circuit Current [kA]			
	200V AC	230V AC	460V AC	575V AC	480Y/277V AC	600Y/347V AC	Cat. No.	Cat. No.
C-Frame with 100-C/104-C Contactors on Panel Mounting Modules								
0.10...0.16	—	—	—	—	65	47	**103S-AW⊗2-CA16C-TE**	**107S-AW⊗3-CA16C-TE**
0.16...0.25	—	—	—	—	65	47	**103S-AW⊗2-CA25C-TE**	**107S-AW⊗3-CA25C-TE**
0.25...0.40	—	—	—	—	65	47	**103S-AW⊗2-CA40C-TE**	**107S-AW⊗3-CA40C-TE**
0.40...0.63	—	—	—	—	65	47	**103S-AW⊗2-CA63C-TE**	**107S-AW⊗3-CA63C-TE**
0.63...1.00	—	—	1/2	3/4	65	47	**103S-AW⊗2-CB10C-TE**	**107S-AW⊗3-CB10C-TE**
1.00...1.60	—	—	1/2...1	3/4...1	65	47	**103S-AW⊗2-CB16C-TE**	**107S-AW⊗3-CB16C-TE**
1.60...2.50	1/2	1/2...3/4	3/4...1-1/2	—	65	❖	**103S-AW⊗2-CB25C-TE**	**107S-AW⊗3-CB25C-TE**
2.50...4.00	—	—	—	—	❖	❖	**103S-AW⊗2-CB40C-TE**	**107S-AW⊗3-CB40C-TE**
4.00...6.30	—	—	—	—	❖	❖	**103S-AW⊗2-CB63C-TE**	**107S-AW⊗3-CB63C-TE**
6.30...9.00	—	—	—	—	❖	❖	**103S-AW⊗2-CC10C-TE**	**107S-AW⊗3-CC10C-TE**
6.30...10.0	—	—	—	—	❖	❖	**103S-BW⊗2-CC10C-TE**	**107S-BW⊗3-CC10C-TE**
10.0...12.0	—	—	—	—	❖	❖	**103S-BW⊗2-CC16C-TE**	**107S-BW⊗3-CC16C-TE**
10.0...16.0	—	—	—	—	❖	❖	**103S-CW⊗2-CC16C-TE**	**107S-CW⊗3-CC16C-TE**
10.0...16.0	—	—	—	—	❖	❖	**103S-DW⊗2-CC16C-TE**	**107S-DW⊗3-CC16C-TE**
14.5...20.0	—	—	—	—	❖	❖	**103S-DW⊗2-CC20C-TE**	**107S-DW⊗3-CC20C-TE**
18.0...23.0	—	—	—	—	❖	❖	**103S-DW⊗2-CC25C-TE**	**107S-DW⊗3-CC25C-TE**
D-Frame with 100-C/104-C Contactors on Panel Mounting Modules								
1.60...2.50	1/2	1/2...3/4	3/4...1-1/2	—	65	❖	**103S-AW⊗2-DB25C-TE**	**107S-AW⊗3-DB25C-TE**
1.60...2.50	1/2	1/2...3/4	3/4...1-1/2	1...2	65	30	**103S-DW⊗2-DB25C-TE**	**107S-DW⊗3-DB25C-TE**
2.50...4.00	—	—	—	—	❖	❖	**103S-AW⊗2-DB40C-TE**	**107S-AW⊗3-DB40C-TE**
2.50...4.00	1/2...1	3/4...1	1-1/2...3	2...3	65	30	**103S-DW⊗2-DB40C-TE**	**107S-DW⊗3-DB40C-TE**
4.00...6.30	—	—	—	—	❖	❖	**103S-AW⊗2-DB63C-TE**	**107S-AW⊗3-DB63C-TE**
4.00...6.30	1...1-1/2	1...2	3...5	5	65	30	**103S-EW⊗3-DB63C-TE**	**107S-EW⊗3-DB63C-TE**
6.30...9.00	—	—	—	—	❖	❖	**103S-AW⊗2-DC10C-TE**	**107S-AW⊗3-DC10C-TE**
6.30...10.0	—	—	—	—	❖	❖	**103S-BW⊗2-DC10C-TE**	**107S-BW⊗3-DC10C-TE**
6.30...10.0	—	—	—	—	❖	❖	**103S-CW⊗2-DC10C-TE**	**107S-CW⊗3-DC10C-TE**
6.30...10.0	1-1/2...3	2...3	5...7-1/2	7-1/2...10	65	30	**103S-EW⊗3-DC10C-TE**	**107S-EW⊗3-DC10C-TE**
10.0...12.0	—	—	—	—	❖	❖	**103S-BW⊗2-DC16C-TE**	**107S-BW⊗3-DC16C-TE**
10.0...16.0	—	—	—	—	❖	❖	**103S-CW⊗2-DC16C-TE**	**107S-CW⊗3-DC16C-TE**
10.0...16.0	—	—	—	—	❖	❖	**103S-DW⊗2-DC16C-TE**	**107S-DW⊗3-DC16C-TE**
10.0...16.0	3...5	5	7-1/2...10	10...15	65	30	**103S-EW⊗3-DC16C-TE**	**107S-EW⊗3-DC16C-TE**
14.5...20.0	—	—	—	—	❖	❖	**103S-DW⊗2-DC20C-TE**	**107S-DW⊗3-DC20C-TE**
14.5...20.0	5	5...7-1/2	15	—	65	❖	**103S-EW⊗3-DC20C-TE**	**107S-EW⊗3-DC20C-TE**
18.0...23.0	—	—	—	—	❖	❖	**103S-DW⊗2-DC25C-TE**	**107S-DW⊗3-DC25C-TE**
18.0...25.0	7-1/2	7-1/2...10	15...20	—	65	❖	**103S-EW⊗3-DC25C-TE**	**107S-EW⊗3-DC25C-TE**
F-Frame with 100-C/104-C Contactors on Panel Mounting Modules								
6.30...10.0	1-1/2...3	2...3	5...7-1/2	7-1/2...10	65	30	**103S-EW⊗3-FC10C-TE**	**107S-EW⊗3-FC10C-TE**
10.0...16.0	3...5	5	7-1/2...10	10...15	65	30	**103S-EW⊗3-FC16C-TE**	**107S-EW⊗3-FC16C-TE**
14.5...20.0	5	5...7-1/2	15	15...20	65	30	**103S-EW⊗3-FC20C-TE**	**107S-EW⊗3-FC20C-TE**
18.0...25.0	7-1/2	7-1/2...10	15...20	20	65	30	**103S-EW⊗3-FC25C-TE**	**107S-EW⊗3-FC25C-TE**
18.0...25.0	7-1/2	7-1/2...10	15...20	20...25	65	30	**103S-GW⊗3-FC25C-TE**	**107S-GW⊗3-FC25C-TE**
23.0...30.0	7-1/2	10	20	25	65	30	**103S-EW⊗3-FC32C-TE**	**107S-EW⊗3-FC32C-TE**
23.0...32.0	7-1/2...10	10	20...25	30	65	30	**103S-FW⊗3-FC32C-TE**	**107S-FW⊗3-FC32C-TE**
23.0...32.0	7-1/2...10	10	20...25	30	65	30	**103S-GW⊗3-FC32C-TE**	**107S-GW⊗3-FC32C-TE**
32.0...37.0	10	10	25	—	65	❖	**103S-FW⊗3-FC45C-TE**	**107S-FW⊗3-FC45C-TE**
32.0...43.0	10	15	30	—	65	❖	**103S-GW⊗3-FC45C-TE**	**107S-GW⊗3-FC45C-TE**

✶ Horsepower ratings shown in the table are for reference. Final selection of the starter depends upon the actual motor full-load current and service factor.
❖ This starter is not valid for application at this horsepower and voltage.
⊗Coil voltage code—see page 2-267

Product Selection and Coordination Ratings, IEC Type 1 and Type 2 Short-Circuit Coordination

Motor Current Adjustment Range [A]	IEC kW and Coordination Ratings (50 Hz)												DOL Starters	Reversing Starters
	kW Ratings*				Max. Short-Circuit Current [kA]									
					Type 1 Coordination				Type 2 Coordination					
	230V AC	400V AC	500V AC	690V AC	230V AC	400V AC	500V AC	690V AC	230V AC	400V AC	500V AC	690V AC	Cat. No.	Cat. No.
C-Frame with 100-C/104-C Contactors on Standard Bus Bar Modules														
0.10...0.16	—	—	0.06	0.06	65	65	65	50	65	65	65	50	103S-AT⊗2-CA16C	**107S-AT⊗3-CA16C**
0.16...0.25	0.02	0.06	0.06	0.12	65	65	65	50	65	65	65	50	103S-AT⊗2-CA25C	**107S-AT⊗3-CA25C**
0.25...0.40	0.06	0.09	0.12	0.18	65	65	65	50	65	65	65	50	103S-AT⊗2-CA40C	**107S-AT⊗3-CA40C**
0.40...0.63	0.09	0.18	0.18	0.37	65	65	65	50	65	65	65	50	103S-AT⊗2-CA63C	**107S-AT⊗3-CA63C**
0.63...1.00	0.12	0.25	0.37	0.55	65	65	65	50	65	65	65	50	103S-AT⊗2-CB10C	107S-AT⊗3-CB10C
1.00...1.60	0.25	0.55	0.75	1.1	65	65	65	50	65	65	65	50	103S-AT⊗2-CB16C	107S-AT⊗3-CB16C
1.60...2.50	0.55	0.75	1.1	1.8	65	65	50	8	65	50	50	8	103S-AT⊗2-CB25C	107S-AT⊗3-CB25C
2.50...4.00	0.75	1.5	2.2	3	65	50	50	8	50	50	—	—	103S-AT⊗2-CB40C	107S-AT⊗3-CB40C
4.00...6.30	1.5	2.2	3	4	65	50	50	4	50	50	—	—	**103S-AT⊗2-CB63C**	107S-AT⊗3-CB63C
6.30...9.00	2.2	4	4	—	65	65	50	—	50	50	—	—	103S-AT⊗2-CC10C	107S-AT⊗3-CC10C
6.30...10.0	2.2	4	5.5	5.5	65	65	50	4	50	50	50	—	**103S-BT⊗2-CC10C**	**107S-BT⊗3-CC10C**
6.30...10.0	2.2	4	5.5	7.5	65	65	50	4	50	50	50	—	**103S-CT⊗2-CC10C**	**107S-CT⊗3-CC10C**
10.0...12.0	4	5.5	—	—	65	65	—	—	50	50	—	—	**103S-BT⊗2-CC16C**	**107S-BT⊗3-CC16C**
10.0...16.0	4	7.5	7.5	—	65	50	10	—	50	—	—	—	**103S-CT⊗2-CC16C**	**107S-CT⊗3-CC16C**
10.0...16.0	4	7.5	10	10	65	50	10	3	50	50	—	—	**103S-DT⊗2-CC16C**	**107S-DT⊗3-CC16C**
14.5...20.0	4	10	11	—	50	15	6	—	15	—	—	—	103S-DT⊗2-CC20C	**107S-DT⊗3-CC20C**
18.0...23.0	6.3	11	13	—	50	15	6	—	15	—	—	—	**103S-DT⊗2-CC25C**	**107S-DT⊗3-CC25C**
D-Frame with 100-C/104-C Contactors on Standard Bus Bar Modules														
1.60...2.50	0.55	0.75	1.1	1.8	65	65	50	10	65	65	50	10	**103S-AT⊗2-DB25C**	**107S-AT⊗3-DB25C**
1.60...2.50	0.55	0.75	1.1	1.8	65	65	50	10	65	65	50	10	103S-DT⊗2-DB25C	**107S-DT⊗3-DB25C**
2.50...4.00	0.75	1.5	2.2	3	65	65	50	10	65	65	50	—	**103S-AT⊗2-DB40C**	**107S-AT⊗3-DB40C**
2.50...4.00	0.75	1.5	2.2	3	65	65	50	50	65	65	50	50	103S-DT⊗2-DB40C	**107S-DT⊗3-DB40C**
4.00...6.30	1.5	2.2	3	4	65	65	50	50	65	65	50	—	103S-AT⊗2-DB63C	**107S-AT⊗3-DB63C**
4.00...6.30	1.5	2.2	3	4	65	65	50	50	65	65	50	50	**103S-ET⊗3-DB63C**	**107S-ET⊗3-DB63C**
6.30...9.00	2.2	4	4	—	65	65	50	—	65	65	—	—	**103S-AT⊗2-DC10C**	**107S-AT⊗3-DC10C**
6.30...10.0	2.2	4	5.5	5.5	65	65	65	50	65	65	65	—	**103S-BT⊗2-DC10C**	**107S-BT⊗3-DC10C**
6.30...10.0	2.2	4	5.5	7.5	65	65	65	50	65	65	65	50	**103S-CT⊗2-DC10C**	**107S-CT⊗3-DC10C**
6.30...10.0	2.2	4	5.5	7.5	65	65	65	50	65	65	65	50	**103S-ET⊗3-DC10C**	**107S-ET⊗3-DC10C**
10.0...12.0	4	5.5	—	—	65	65	—	—	65	65	—	—	**103S-BT⊗2-DC16C**	**107S-BT⊗3-DC16C**
10.0...16.0	4	7.5	7.5	—	65	65	50	—	65	65	50	—	**103S-CT⊗2-DC16C**	**107S-CT⊗3-DC16C**
10.0...16.0	4	7.5	10	10	65	65	50	6	65	65	50	—	103S-DT⊗2-DC16C	**107S-DT⊗3-DC16C**
10.0...16.0	4	7.5	10	13	65	65	50	6	65	65	50	—	**103S-ET⊗3-DC16C**	**107S-ET⊗3-DC16C**
14.5...20.0	4	10	11	—	65	65	25	—	65	65	25	—	**103S-DT⊗2-DC20C**	**107S-DT⊗3-DC20C**
14.5...20.0	4	10	11	15	65	65	25	6	65	65	25	—	**103S-ET⊗3-DC20C**	**107S-ET⊗3-DC20C**
18.0...23.0	6.3	11	13	—	65	50	25	—	65	50	25	—	**103S-DT⊗2-DC25C**	**107S-DT⊗3-DC25C**
18.0...25.0	6.3	11	15	—	65	50	25	—	65	50	25	—	**103S-ET⊗3-DC25C**	**107S-ET⊗3-DC25C**
F-Frame with 100-C/104-C Contactors on Standard Bus Bar Modules														
6.30...10.0	2.2	4	5.5	7.5	65	65	50	50	65	65	50	50	**103S-ET⊗3-FC10C**	**107S-ET⊗3-FC10C**
10.0...16.0	4	7.5	10	13	65	65	50	50	65	65	50	50	**103S-ET⊗3-FC16C**	**107S-ET⊗3-FC16C**
14.5...20.0	4	10	11	15	65	65	50	50	65	65	50	50	**103S-ET⊗3-FC20C**	**107S-ET⊗3-FC20C**
18.0...25.0	6.3	11	15	—	65	65	50	—	65	65	50	—	**103S-ET⊗3-FC25C**	**107S-ET⊗3-FC25C**
18.0...25.0	6.3	11	15	22	65	65	50	50	65	65	50	50	**103S-GT⊗3-FC25C**	**107S-GT⊗3-FC25C**
23.0...30.0	7.5	15	15	—	65	65	50	—	65	65	50	—	**103S-ET⊗3-FC32C**	107S-ET⊗3-FC32C
23.0...32.0	7.5	15	20	—	65	65	50	—	65	65	50	—	**103S-FT⊗3-FC32C**	**107S-FT⊗3-FC32C**
23.0...32.0	7.5	15	20	22	65	65	50	50	65	65	50	50	**103S-GT⊗3-FC32C**	**107S-GT⊗3-FC32C**
23.0...32.0	7.5	15	20	25	65	65	50	50	65	65	50	50	**103S-HT⊗3-FC32C**	**107S-HT⊗3-FC32C**
32.0...37.0	11	18.5	—	—	65	65	—	—	65	65	—	—	**103S-FT⊗3-FC45C**	**107S-FT⊗3-FC45C**
32.0...43.0	13	22	25	—	65	65	50	—	65	65	50	—	**103S-GT⊗3-FC45C**	**107S-GT⊗3-FC45C**
32.0...45.0	13	22	30	—	65	65	50	—	65	65	50	—	**103S-HT⊗3-FC45C**	**107S-HT⊗3-FC45C**
32.0...45.0	13	22	30	—	65	65	50	—	65	65	50	—	**103S-JT⊗3-FC45C**	**107S-JT⊗3-FC45C**
CMN-Frame with 100-C/104-C Contactors on Standard Bus Bar Modules														
40.0...60.0	18.5	32	37	—	65	65	50	—	65	65	30	—	103S-HT⊗3-GC63C	**107S-HT⊗3-GC63C**
40.0...63.0	18.5	32	40	—	65	65	50	—	65	65	30	—	**103S-JT⊗3-GC63C**	**107S-JT⊗3-GC63C**
40.0...63.0	18.5	32	40	45	65	65	50	8	65	65	30	—	**103S-KT⊗3-GC63C**	**107S-KT⊗3-GC63C**
63.0...72.0	22	40	45	—	65	65	50	—	65	65	15	—	**103S-JT⊗3-GC90C**	**107S-JT⊗3-GC90C**
63.0...85.0	25	45	50	—	65	65	50	—	65	65	15	—	**103S-KT⊗3-GC90C**	**107S-KT⊗3-GC90C**

* kW ratings shown in the table are for reference. Final selection of the starter depends upon the actual motor full-load current and service factor.

⊗Coil voltage code—see page 2-267

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Preferred availability cat. nos. are printed in **bold**

Product Selection and Coordination Ratings, IEC Type 1 and Type 2 Short-Circuit Coordination, Continued

Motor Current Adjustment Range [A]	IEC kW and Coordination Ratings (50 Hz)												DOL Starters	Reversing Starters
	kW Ratings∗				Max. Short-Circuit Current [kA]									
					Type 1 Coordination				Type 2 Coordination					
	230V AC	400V AC	500V AC	690V AC	230V AC	400V AC	500V AC	690V AC	230V AC	400V AC	500V AC	690V AC	Cat. No.	Cat. No.
C-Frame with 100-C/104-C Contactors on ISO Bus Bar Modules														
0.10...0.16	—	—	0.06	0.06	65	65	65	50	65	65	65	50	**103S-AS⊗2-CA16C**	**107S-AS⊗3-CA16C**
0.16...0.25	0.02	0.06	0.06	0.12	65	65	65	50	65	65	65	50	**103S-AS⊗2-CA25C**	**107S-AS⊗3-CA25C**
0.25...0.40	0.06	0.09	0.12	0.18	65	65	65	50	65	65	65	50	**103S-AS⊗2-CA40C**	**107S-AS⊗3-CA40C**
0.40...0.63	0.09	0.18	0.18	0.37	65	65	65	50	65	65	65	50	**103S-AS⊗2-CA63C**	**107S-AS⊗3-CA63C**
0.63...1.00	0.12	0.25	0.37	0.55	65	65	65	50	65	65	65	50	**103S-AS⊗2-CB10C**	**107S-AS⊗3-CB10C**
1.00...1.60	0.25	0.55	0.75	1.1	65	65	65	50	65	65	65	50	**103S-AS⊗2-CB16C**	**107S-AS⊗3-CB16C**
1.60...2.50	0.55	0.75	1.1	1.8	65	65	50	8	65	50	50	8	**103S-AS⊗2-CB25C**	**107S-AS⊗3-CB25C**
2.50...4.00	0.75	1.5	2.2	3	65	50	50	8	50	50	—	—	**103S-AS⊗2-CB40C**	**107S-AS⊗3-CB40C**
4.00...6.30	1.5	2.2	3	4	65	50	50	4	50	50	—	—	**103S-AS⊗2-CB63C**	**107S-AS⊗3-CB63C**
6.30...9.00	2.2	4	4	—	65	65	50	—	50	50	—	—	**103S-AS⊗2-CC10C**	**107S-AS⊗3-CC10C**
6.30...10.0	2.2	4	5.5	5.5	65	65	50	4	50	50	50	—	**103S-BS⊗2-CC10C**	**107S-BS⊗3-CC10C**
6.30...10.0	2.2	4	5.5	7.5	65	65	50	4	50	50	50	—	**103S-CS⊗2-CC10C**	**107S-CS⊗3-CC10C**
10.0...12.0	4	5.5	—	—	65	65	—	—	50	50	—	—	**103S-BS⊗2-CC16C**	**107S-BS⊗3-CC16C**
10.0...16.0	4	7.5	7.5	—	65	50	10	—	50	—	—	—	**103S-CS⊗2-CC16C**	**107S-CS⊗3-CC16C**
10.0...16.0	4	7.5	10	10	65	50	10	3	50	50	—	—	**103S-DS⊗2-CC16C**	**107S-DS⊗3-CC16C**
14.5...20.0	4	10	11	—	50	15	6	—	15	—	—	—	**103S-DS⊗2-CC20C**	**107S-DS⊗3-CC20C**
18.0...23.0	6.3	11	13	—	50	15	6	—	15	—	—	—	103S-DS⊗2-CC25C	**107S-DS⊗3-CC25C**
D-Frame with 100-C/104-C Contactors on ISO Bus Bar Modules														
1.60...2.50	0.55	0.75	1.1	1.8	65	65	50	10	65	65	50	10	**103S-AS⊗2-DB25C**	**107S-AS⊗3-DB25C**
1.60...2.50	0.55	0.75	1.1	1.8	65	65	50	10	65	65	50	10	**103S-DS⊗2-DB25C**	**107S-DS⊗3-DB25C**
2.50...4.00	0.75	1.5	2.2	3	65	65	50	10	65	65	50	—	**103S-AS⊗2-DB40C**	**107S-AS⊗3-DB40C**
2.50...4.00	0.75	1.5	2.2	3	65	65	50	50	65	65	50	50	**103S-DS⊗2-DB40C**	**107S-DS⊗3-DB40C**
4.00...6.30	1.5	2.2	3	4	65	65	50	50	65	65	50	—	**103S-AS⊗2-DB63C**	**107S-AS⊗3-DB63C**
4.00...6.30	1.5	2.2	3	4	65	65	50	50	65	65	50	50	**103S-ES⊗3-DB63C**	**107S-ES⊗3-DB63C**
6.30...9.00	2.2	4	4	—	65	65	50	—	65	65	—	—	**103S-AS⊗2-DC10C**	**107S-AS⊗3-DC10C**
6.30...10.0	2.2	4	5.5	5.5	65	65	65	50	65	65	65	—	**103S-BS⊗2-DC10C**	**107S-BS⊗3-DC10C**
6.30...10.0	2.2	4	5.5	7.5	65	65	65	50	65	65	65	50	**103S-CS⊗2-DC10C**	**107S-CS⊗3-DC10C**
6.30...10.0	2.2	4	5.5	7.5	65	65	65	50	65	65	65	50	**103S-ES⊗3-DC10C**	**107S-ES⊗3-DC10C**
10.0...12.0	4	5.5	—	—	65	65	—	—	65	65	—	—	**103S-BS⊗2-DC16C**	**107S-BS⊗3-DC16C**
10.0...16.0	4	7.5	7.5	—	65	65	50	—	65	65	50	—	**103S-CS⊗2-DC16C**	**107S-CS⊗3-DC16C**
10.0...16.0	4	7.5	10	10	65	65	50	6	65	65	50	—	**103S-DS⊗2-DC16C**	**107S-DS⊗3-DC16C**
10.0...16.0	4	7.5	10	13	65	65	50	6	65	65	50	—	**103S-ES⊗3-DC16C**	**107S-ES⊗3-DC16C**
14.5...20.0	4	10	11	—	65	65	25	—	65	65	25	—	**103S-DS⊗2-DC20C**	**107S-DS⊗3-DC20C**
14.5...20.0	4	10	11	15	65	65	25	6	65	65	25	—	**103S-ES⊗3-DC20C**	**107S-ES⊗3-DC20C**
18.0...23.0	6.3	11	13	—	65	50	25	—	65	50	25	—	**103S-DS⊗2-DC25C**	**107S-DS⊗3-DC25C**
18.0...25.0	6.3	11	15	—	65	50	25	—	65	50	25	—	**103S-ES⊗3-DC25C**	**107S-ES⊗3-DC25C**
F-Frame with 100-C/104-C Contactors on ISO Bus Bar Modules														
6.30...10.0	2.2	4	5.5	7.5	65	65	50	50	65	65	50	50	**103S-ES⊗3-FC10C**	**107S-ES⊗3-FC10C**
10.0...16.0	4	7.5	10	13	65	65	50	50	65	65	50	50	**103S-ES⊗3-FC16C**	**107S-ES⊗3-FC16C**
14.5...20.0	4	10	11	15	65	65	50	50	65	65	50	50	**103S-ES⊗3-FC20C**	**107S-ES⊗3-FC20C**
18.0...25.0	6.3	11	15	—	65	65	50	—	65	65	50	—	**103S-ES⊗3-FC25C**	**107S-ES⊗3-FC25C**
18.0...25.0	6.3	11	15	22	65	65	50	50	65	65	50	50	**103S-GS⊗3-FC25C**	**107S-GS⊗3-FC25C**
23.0...30.0	7.5	15	15	—	65	65	50	—	65	65	50	—	**103S-ES⊗3-FC32C**	**107S-ES⊗3-FC32C**
23.0...32.0	7.5	15	20	—	65	65	50	—	65	65	50	—	**103S-FS⊗3-FC32C**	**107S-FS⊗3-FC32C**
23.0...32.0	7.5	15	20	22	65	65	50	50	65	65	50	50	**103S-GS⊗3-FC32C**	**107S-GS⊗3-FC32C**
32.0...37.0	11	18.5	—	—	65	65	—	—	65	65	—	—	**103S-FS⊗3-FC45C**	**107S-FS⊗3-FC45C**
32.0...43.0	13	22	25	—	65	65	50	—	65	65	50	—	**103S-GS⊗3-FC45C**	**107S-GS⊗3-FC45C**

∗ kW ratings shown in the table are for reference. Final selection of the starter depends upon the actual motor full-load current and service factor.

⊗Coil voltage code—see page 2-267

Product Selection and Coordination Ratings, IEC Type 1 and Type 2 Short-Circuit Coordination, Continued

Motor Current Adjustment Range [A]	IEC kW and Coordination Ratings (50 Hz)												DOL Starters	Reversing Starters
	kW Ratings*				Max. Short-Circuit Current [kA]									
					Type 1 Coordination				Type 2 Coordination					
	230V AC	400V AC	500V AC	690V AC	230V AC	400V AC	500V AC	690V AC	230V AC	400V AC	500V AC	690V AC	Cat. No.	Cat. No.
C-Frame with 100-C/104-C Contactors on Panel Mounting Modules														
0.10...0.16	—	—	0.06	0.06	100	100	65	50	65	65	65	50	**103S-AW⊗2-CA16C**	**107S-AW⊗3-CA16C**
0.16...0.25	0.02	0.06	0.06	0.12	100	100	65	50	65	65	65	50	**103S-AW⊗2-CA25C**	**107S-AW⊗3-CA25C**
0.25...0.40	0.06	0.09	0.12	0.18	100	100	65	50	65	65	65	50	**103S-AW⊗2-CA40C**	**107S-AW⊗3-CA40C**
0.40...0.63	0.09	0.18	0.18	0.37	100	100	65	50	65	65	65	50	**103S-AW⊗2-CA63C**	**107S-AW⊗3-CA63C**
0.63...1.00	0.12	0.25	0.37	0.55	100	100	65	50	65	65	65	50	103S-AW⊗2-CB10C	**107S-AW⊗3-CB10C**
1.00...1.60	0.25	0.55	0.75	1.1	100	100	65	50	65	65	65	50	103S-AW⊗2-CB16C	107S-AW⊗3-CB16C
1.60...2.50	0.55	0.75	1.1	1.8	100	65	50	8	65	50	50	8	103S-AW⊗2-CB25C	107S-AW⊗3-CB25C
2.50...4.00	0.75	1.5	2.2	3	100	50	50	8	50	50	—	—	103S-AW⊗2-CB40C	107S-AW⊗3-CB40C
4.00...6.30	1.5	2.2	3	4	100	50	50	4	50	50	—	—	103S-AW⊗2-CB63C	**107S-AW⊗3-CB63C**
6.30...9.00	2.2	4	4	—	100	65	50	—	50	50	—	—	103S-AW⊗2-CC10C	**107S-AW⊗3-CC10C**
6.30...10.0	2.2	4	5.5	5.5	100	65	50	4	50	50	50	—	**103S-BW⊗2-CC10C**	**107S-BW⊗3-CC10C**
6.30...10.0	2.2	4	5.5	7.5	100	65	50	4	50	50	50	—	**103S-CW⊗2-CC10C**	**107S-CW⊗3-CC10C**
10.0...12.0	4	5.5	—	—	100	65	—	—	50	50	—	—	103S-BW⊗2-CC16C	**107S-BW⊗3-CC16C**
10.0...16.0	4	7.5	7.5	—	100	50	10	—	50	—	—	—	103S-CW⊗2-CC16C	**107S-CW⊗3-CC16C**
10.0...16.0	4	7.5	10	10	100	50	10	3	50	50	—	—	**103S-DW⊗2-CC16C**	**107S-DW⊗3-CC16C**
14.5...20.0	4	10	11	—	50	15	6	—	15	—	—	—	103S-DW⊗2-CC20C	**107S-DW⊗3-CC20C**
18.0...23.0	6.3	11	13	—	50	15	6	—	15	—	—	—	**103S-DW⊗2-CC25C**	**107S-DW⊗3-CC25C**
D-Frame with 100-C/104-C Contactors on Panel Mounting Modules														
1.60...2.50	0.55	0.75	1.1	1.8	100	100	50	10	100	100	50	10	103S-AW⊗2-DB25C	**107S-AW⊗3-DB25C**
1.60...2.50	0.55	0.75	1.1	1.8	100	100	50	10	100	100	50	10	**103S-DW⊗2-DB25C**	**107S-DW⊗3-DB25C**
2.50...4.00	0.75	1.5	2.2	3	100	100	50	10	100	100	50	—	**103S-AW⊗2-DB40C**	**107S-AW⊗3-DB40C**
2.50...4.00	0.75	1.5	2.2	3	100	100	50	50	100	100	50	50	**103S-DW⊗2-DB40C**	**107S-DW⊗3-DB40C**
4.00...6.30	1.5	2.2	3	4	100	100	50	50	100	100	50	—	103S-AW⊗2-DB63C	**107S-AW⊗3-DB63C**
4.00...6.30	1.5	2.2	3	4	100	100	50	50	100	100	50	50	**103S-EW⊗3-DB63C**	**107S-EW⊗3-DB63C**
6.30...9.00	2.2	4	4	—	100	65	50	—	65	65	—	—	**103S-AW⊗2-DC10C**	107S-AW⊗3-DC10C
6.30...10.0	2.2	4	5.5	5.5	100	100	65	50	100	100	65	—	**103S-BW⊗2-DC10C**	**107S-BW⊗3-DC10C**
6.30...10.0	2.2	4	5.5	7.5	100	100	65	50	100	100	65	50	103S-CW⊗2-DC10C	**107S-CW⊗3-DC10C**
6.30...10.0	2.2	4	5.5	7.5	100	100	65	50	100	100	65	50	**103S-EW⊗3-DC10C**	**107S-EW⊗3-DC10C**
10.0...12.0	4	5.5	—	—	100	65	—	—	65	65	—	—	**103S-BW⊗2-DC16C**	**107S-BW⊗3-DC16C**
10.0...16.0	4	7.5	7.5	—	100	65	50	—	65	65	50	—	103S-CW⊗2-DC16C	**107S-CW⊗3-DC16C**
10.0...16.0	4	7.5	10	10	100	65	50	6	65	65	50	—	103S-DW⊗2-DC16C	**107S-DW⊗3-DC16C**
10.0...16.0	4	7.5	10	13	100	65	50	6	65	65	50	—	**103S-EW⊗3-DC16C**	**107S-EW⊗3-DC16C**
14.5...20.0	4	10	11	—	65	65	25	—	65	65	25	—	103S-DW⊗2-DC20C	**107S-DW⊗3-DC20C**
14.5...20.0	4	10	11	15	65	65	25	6	65	65	25	—	**103S-EW⊗3-DC20C**	**107S-EW⊗3-DC20C**
18.0...23.0	6.3	11	13	—	65	50	25	—	65	50	25	—	**103S-DW⊗2-DC25C**	**107S-DW⊗3-DC25C**
18.0...25.0	6.3	11	15	—	65	50	25	—	65	50	25	—	**103S-EW⊗3-DC25C**	**107S-EW⊗3-DC25C**
F-Frame with 100-C/104-C Contactors on Panel Mounting Modules														
6.30...10.0	2.2	4	5.5	7.5	100	100	50	50	100	100	50	50	**103S-EW⊗3-FC10C**	**107S-EW⊗3-FC10C**
10.0...16.0	4	7.5	10	13	100	100	50	50	100	100	50	50	**103S-EW⊗3-FC16C**	**107S-EW⊗3-FC16C**
14.5...20.0	4	10	11	15	100	100	50	50	100	100	50	50	**103S-EW⊗3-FC20C**	**107S-EW⊗3-FC20C**
18.0...25.0	6.3	11	15	—	100	100	50	—	100	100	50	—	**103S-EW⊗3-FC25C**	**107S-EW⊗3-FC25C**
18.0...25.0	6.3	11	15	22	100	100	50	50	100	100	50	50	**103S-GW⊗3-FC25C**	**107S-GW⊗3-FC25C**
23.0...30.0	7.5	15	15	—	100	100	50	—	100	100	50	—	**103S-EW⊗3-FC32C**	**107S-EW⊗3-FC32C**
23.0...32.0	7.5	15	20	—	100	100	50	—	100	100	50	—	**103S-FW⊗3-FC32C**	**107S-FW⊗3-FC32C**
23.0...32.0	7.5	15	20	22	100	100	50	50	100	100	50	50	**107S-GW⊗3-FC32C**	**107S-GW⊗3-FC32C**
32.0...37.0	11	18.5	—	—	100	100	—	—	100	100	—	—	**103S-FW⊗3-FC45C**	**107S-FW⊗3-FC45C**
32.0...43.0	13	22	25	—	100	100	50	—	100	100	50	—	**103S-GW⊗3-FC45C**	107S-GW⊗3-FC45C

* kW ratings shown in the table are for reference. Final selection of the starter depends upon the actual motor full-load current and service factor.

⊗Coil voltage code—see page 2-267

⊗ Coil Voltage Codes for AC Control

Voltage [V]	12	24	32	36	42	48	100	100-110	110	120	127	200	200-220	200-230	208	208-240
50 Hz	R	K	V	W	X	Y	KP	—	D	P	S	KG	—	—	—	—
60 Hz	Q	J	—	V	—	X	—	KP	—	D	—	—	KG	—	H	L
50/60 Hz	—	KJ	—	—	—	KY	KP	—	KD	—	—	KG	—	KL	—	—
Voltage [V]	**220-230**	**230**	**230-240**	**240**	**277**	**347**	**380**	**380-400**	**400**	**400-415**	**440**	**480**	**500**	**550**	**600**	
50 Hz	F	—	VA	T	—	—	—	N	—	G	B	—	M	C	—	
60 Hz	—	—	—	A	T	I	E	—	—	—	N	B	—	—	C	
50/60 Hz	—	KF	—	KA	—	—	—	—	KN	—	KB	—	—	—	—	

⊗ Coil Voltage Codes for DC Control

DC Voltages [V]		9	12	24	36	48	60	64	72	80	110	115	125	220	230	250
Contactor size A...G	Standard	ZR	ZQ	ZJ	ZW	ZY	ZZ	ZB	ZG	ZE	ZD	ZP	ZS	ZA	ZF	ZT
	with Integrated Diode	—	—	DJ	—	—	—	—	—	—	—	—	—	—	—	—
	with Electronic Coil	—	—	EJ	—	—	—	—	—	—	—	—	—	—	—	—
Contactor size H...J	with Integrated Diode	DR	DQ	DJ	DW	DY	DZ	DB	DG	DE	DD	DP	DS	DA	DF	DT

2

103S Factory-Installed Options

Change option code ① to desired auxiliary contact: 103S-AWD①-CA16C

Contactor Auxiliaries without "-SP" Control Plug									
		ISO Busbar Mount			Standard Busbar Mount			Panel Mount	
Option ①	Description	9…23 A	30…43 A	60…85 A	9…23 A	30…43 A	60…85 A	9…23 A	30…43 A
2	1 N.O.	NA	NA	NA	Standard	Standard	Standard	Standard	Standard
3	1 N.O. + 1 N.C.	NA	NA	NA	Available	Available	Available	Available	Available
4	2 N.O.	NA	NA	NA	Available	Available	Available	Available	Available
6	2 N.O. + 1 N.C.	NA	NA	NA	Available	NA	NA	Available	NA
7	2 N.O. + 2 N.C.	NA	NA	NA	NA	Available	Available	NA	Available
8	3 N.O. + 2 N.C.	NA	NA	NA	Available	NA	NA	Available	NA

Change option code ① to desired auxiliary contact: 103S-AWD①-CA16C

Contactor Auxiliaries with "-SP" Control Plug									
		ISO Busbar Mount			Standard Busbar Mount			Panel Mount	
Option ①	Description	9…23 A	30…43 A	60…85 A	9…23 A	30…43 A	60…85 A	9…23 A	30…43 A
2	1 N.O.	Standard	Standard	NA	Available	Available	Available	Available	Available
3	1 N.O. + 1 N.C.	Available	Available	NA	Available	Available	Available	Available	Available
4	2 N.O.	Available	Available	NA	Available	Available	Available	Available	Available
6	2 N.O. + 1 N.C.	NA	NA	NA	NA	NA	NA	NA	NA
7	2 N.O. + 2 N.C.	NA	NA	NA	NA	NA	NA	NA	NA
8	3 N.O. + 2 N.C.	NA	NA	NA	NA	NA	NA	NA	NA

Change option code ② to desired auxiliary contact: 103S-AWD2-CA16②

Circuit Breaker Aux/Trip Contacts									
		ISO Busbar Mount			Standard Busbar Mount			Panel Mount	
Option ②	Description	9…23 A	30…43 A	60…85 A	9…23 A	30…43 A	60…85 A	9…23 A	30…43 A
X∗	Without Aux/Trip Contacts	NA	NA	NA	Available	Available	Available	Available	Available
A∗	1 N.C. Aux.	NA	NA	NA	Available	Available	NA	Available	Available
B	1 N.O. Aux.	Available	Available	NA	Available	Available	NA	Available	Available
C	1 N.O. + 1 N.C. Aux.	Standard	Standard	NA	Standard	Standard	Standard	Standard	Standard
D	2 N.O. Aux.	Available	Available	NA	Available	Available	Available	Available	Available
E∗	2 N.C. Aux.	NA	NA	NA	Available	Available	Available	Available	Available
R∗	1 N.O. Trip + 1 N.C. Aux	NA	NA	NA	Available	Available	NA	Available	Available
S	1 N.O. Trip + 1 N.O. Aux	Available	Available	NA	Available	Available	NA	Available	Available

∗ Not available when an "-SP" Control Plug is selected.

Add option code ③ to desired auxiliary contact: 103S-AWD2-CA16C③

Additional Circuit Breaker Aux/Trip Contacts									
		ISO Busbar Mount			Standard Busbar Mount			Panel Mount	
Option ③	Description	9…23 A	30…43 A	60…85 A	9…23 A	30…43 A	60…85 A	9…23 A	30…43 A
Blank	Without Aux/Trip Contacts	Available	Available	Available	Available	Available	Available	Available	Available
C❄	1 N.O. + 1 N.C. Aux.	Available	Available	NA	Available	Available	NA	Available	Available
D❄	2 N.O. Aux.	Available	Available	NA	Available	Available	NA	Available	Available
E❄‡	2 N.C. Aux.	Available	Available	NA	Standard	Standard	NA	Standard	Standard
K	1 N.C. (OL) Trip + 1 N.C. (SC) Trip	Available	Available	NA	Available	Available	Available	Available	Available
L	1 N.O. (OL) Trip + 1 N.O. (SC) Trip	Available	Available	NA	Available	Available	Available	Available	Available
M‡	1 N.C. (OL) Trip + 1 N.O. (SC) Trip	Available	Available	NA	Available	Available	Available	Available	Available
N‡	1 N.O. (OL) Trip + 1 N.C. (SC) Trip	Available	Available	NA	Available	Available	Available	Available	Available
Q‡	1 N.O. (SC) Trip + 1 N.C. (SC) Trip	Available	Available	NA	Available	Available	NA	Available	Available

❄ Not available on 60…85 A starters.
‡ Not available when an "-SP" Control Plug is selected on 60…85 A starters.

Add option code ④ to desired auxiliary contact: 103S-AWD2-CA16C-④

Modifications/Accessories	
Option ④	Description
JE	Electronic Interface
R	Surge Suppressor, RC
V	Surge Suppressor, Varistor
D	Surge Suppressor, Diode
KN	Lockable Knob, Black
KY	Lockable Knob, Red/Yellow
TE	Spacing Adapter for UL508 Type E
SP	Control Plug, Top Mount

107S Factory-Installed Options

Change option code ① to desired auxiliary contact: 107S-AWD①-CA16C

Contactor Auxiliaries without "-SP" Control Plug									
		ISO Busbar Mount			Standard Busbar Mount			Panel Mount	
Option ①	Description	9…23 A	30…43 A	60…85 A	9…23 A	30…43 A	60…85 A	9…23 A	30…43 A
3	1 N.O. + 1 N.C.	NA	NA	NA	Standard	Standard	Standard	Standard	Standard
7	2 N.O. + 2 N.C.	NA	NA	NA	Available	Available	Available	Available	Available

Change option code ① to desired auxiliary contact: 107S-AWD①-CA16C

Contactor Auxiliaries with "-SP" Control Plug									
		ISO Busbar Mount			Standard Busbar Mount			Panel Mount	
Option ①	Description	9…23 A	30…43 A	60…85 A	9…23 A	30…43 A	60…85 A	9…23 A	30…43 A
3	1 N.O. + 1 N.C.	Standard	Standard	NA	Available	Available	Available	Available	Available
7	2 N.O. + 2 N.C.	Available	Available	NA	Available	Available	Available	Available	Available

Change option code ② to desired auxiliary contact: 107S-AWD2-CA16②

Circuit Breaker Aux/Trip Contacts									
		ISO Busbar Mount			Standard Busbar Mount			Panel Mount	
Option ②	Description	9…23 A	30…43 A	60…85 A	9…23 A	30…43 A	60…85 A	9…23 A	30…43 A
X✶	Without Aux/Trip Contacts	NA	NA	NA	Available	Available	Available	Available	Available
A✶	1 N.C. Aux.	NA	NA	NA	Available	Available	NA	Available	Available
B	1 N.O. Aux.	Available	Available	NA	Available	Available	NA	Available	Available
C	1 N.O. + 1 N.C. Aux.	Standard	Standard	NA	Standard	Standard	Standard	Standard	Standard
D	2 N.O. Aux.	Available	Available	NA	Available	Available	Available	Available	Available
E✶	2 N.C. Aux.	NA	NA	NA	Available	Available	Available	Available	Available
R✶	1 N.O. Trip + 1 N.C. Aux	NA	NA	NA	Available	Available	NA	Available	Available
S	1 N.O. Trip + 1 N.O. Aux	Available	Available	NA	Available	Available	NA	Available	Available

✶ Not available when an "-SP" Control Plug is selected.

Add option code ③ to desired auxiliary contact: 107S-AWD2-CA16C③

Additional Circuit Breaker Aux/Trip Contacts									
		ISO Busbar Mount			Standard Busbar Mount			Panel Mount	
Option ③	Description	9…23 A	30…43 A	60…85 A	9…23 A	30…43 A	60…85 A	9…23 A	30…43 A
Blank	Without Aux/Trip Contacts	Available	Available	Available	Available	Available	Available	Available	Available
C❄	1 N.O. + 1 N.C. Aux.	Available	Available	NA	Available	Available	NA	Available	Available
D❄	2 N.O. Aux.	Available	Available	NA	Available	Available	NA	Available	Available
E❄‡	2 N.C. Aux.	Available	Available	NA	Available	Available	NA	Available	Available
K	1 N.C. (OL) Trip + 1 N.C. (SC) Trip	Available	Available	NA	Available	Available	Available	Available	Available
L	1 N.O. (OL) Trip + 1 N.O. (SC) Trip	Available	Available	NA	Available	Available	Available	Available	Available
M‡	1 N.C. (OL) Trip + 1 N.O. (SC) Trip	Available	Available	NA	Available	Available	Available	Available	Available
N‡	1 N.O. (OL) Trip + 1 N.C. (SC) Trip	Available	Available	NA	Available	Available	Available	Available	Available
Q❄	1 N.O. (SC) Trip + 1 N.C. (SC) Trip	Available	Available	NA	Available	Available	NA	Available	Available

❄ Not available on 60…85 A starters.
‡ Not available when a "-SP" Control Plug is selected on 60…85 A starters.

Add option code ④ to desired auxiliary contact: 107S-AWD2-CA16C-④

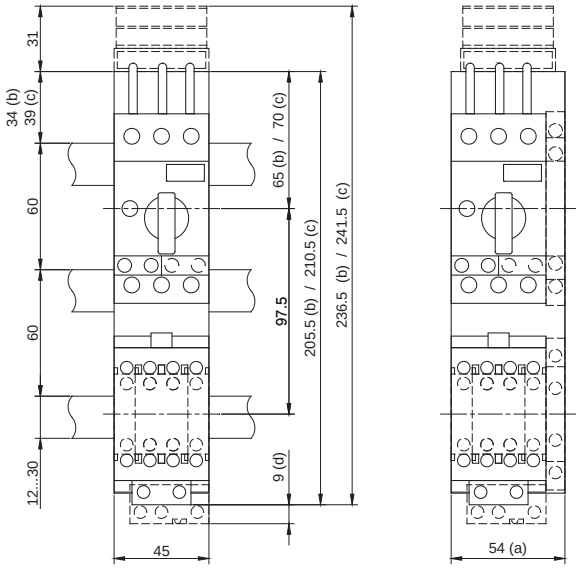
Modifications/Accessories	
Option ④	Description
JE	Electronic Interface
R	Surge Suppressor, RC
V	Surge Suppressor, Varistor
D	Surge Suppressor, Diode
KN	Lockable Knob, Black
KY	Lockable Knob, Red/Yellow
TE	Spacing Adapter for UL508 Type E
SP	Control Plug, Top Mount

Open Type Starters

Approximate Dimensions

Dimensions are shown in millimeters. Dimensions are not intended for manufacturing purposes.

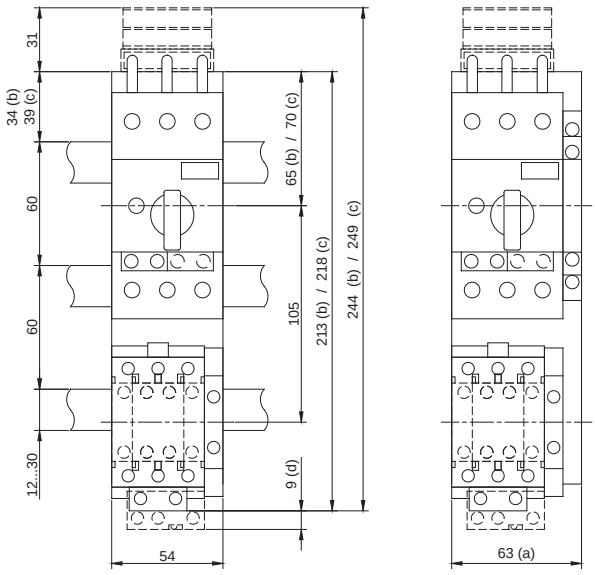
Standard and ISO Busbar Mount — Bulletin 103S Non-Reversing Starters



Circuit Breaker: 140M-C / -D
Contactor: 100-C09...23
Reference Print: D00GMD

(a) With additional side-mount aux. or trip contact(s)
(b) Standard busbar mount with control plug
(c) Iso busbar mount
(d) Electronic interface

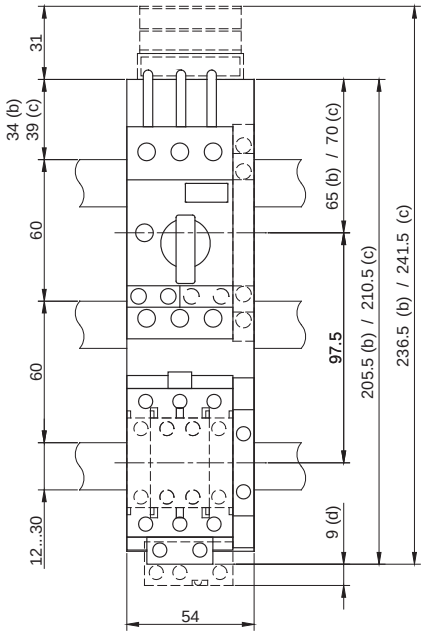
Bulletin 103S Busbar Mount



Circuit Breaker: 140M-F
Contactor: 100-C30...37
Reference Print: D10GMF

(a) With additional side-mount aux. or trip contact
(b) Standard busbar mount with control plug
(c) Iso busbar mount
(d) Electronic interface

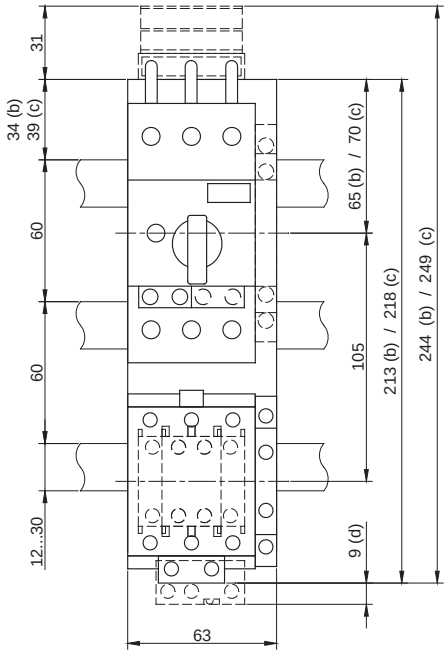
Bulletin 103S Busbar Mount



Circuit Breaker: 140M-D
Contactor: 100-C30...37
Reference Print: D10GMD

(b) Standard busbar mount with control plug
(c) Iso busbar mount
(d) Electronic interface

Bulletin 103S Busbar Mount



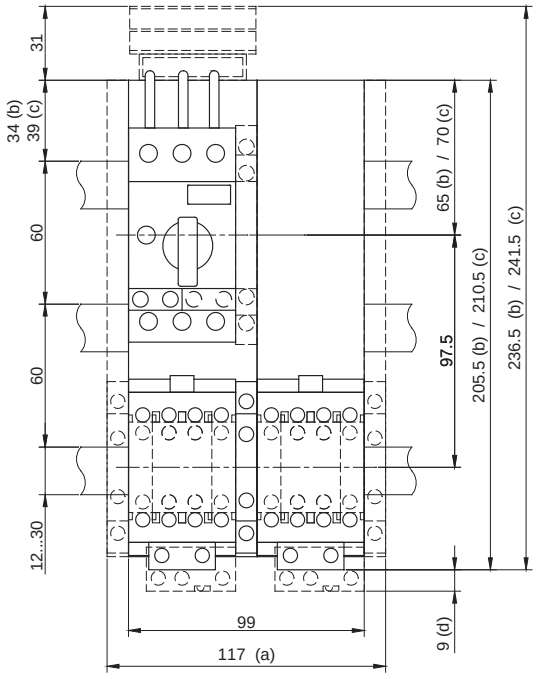
Circuit Breaker: 140M-F
Contactor: 100-C43
Reference Print: D20GMF

(b) Standard busbar mount with control plug
(c) Iso busbar mount
(d) Electronic interface

Bulletin 103S Busbar Mount

Dimensions are shown in millimeters. Dimensions are not intended for manufacturing purposes.

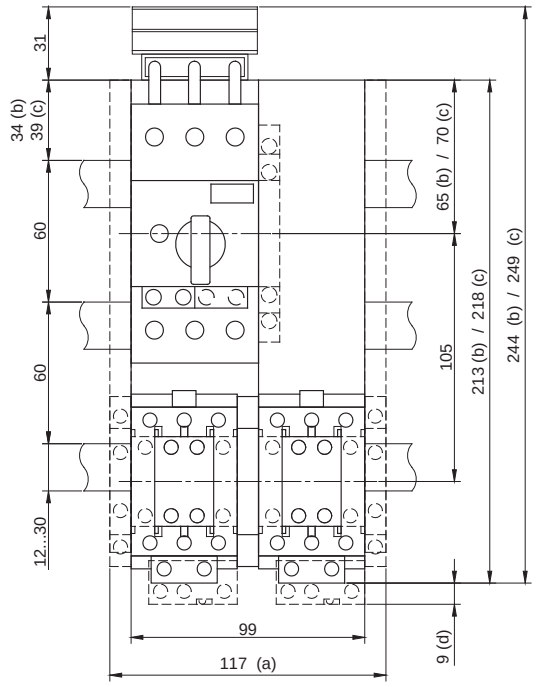
Standard and ISO Busbar Mount — Bulletin 107S Reversing Starters



Circuit Breaker: 140M-D
Contactors: 100-C09...23
Reference Print: R00GMD

(a) With additional side-mount aux. contacts
(b) Standard busbar mount with control plug
(c) Iso busbar mount
(d) Electronic interfaces

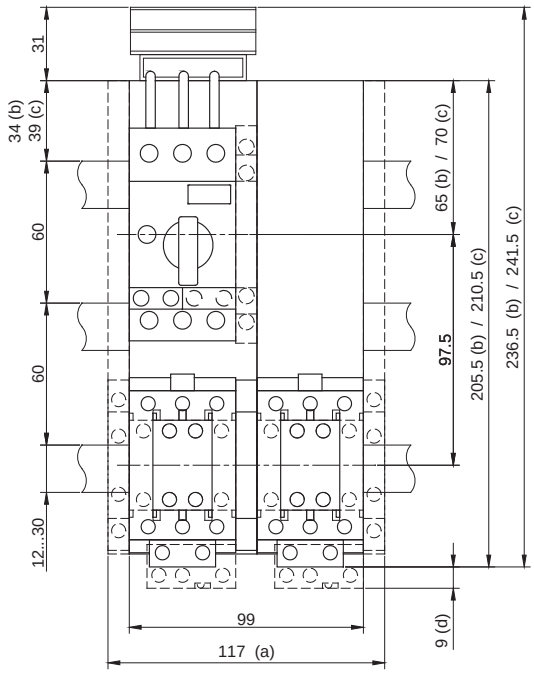
Bulletin 107S Busbar Mount



Circuit Breaker: 140M-F
Contactors: 100-C30...37
Reference Print: R10GMF

(a) With additional side-mount aux. contacts
(b) Standard busbar mount with control plug
(c) Iso busbar mount
(d) Electronic interface

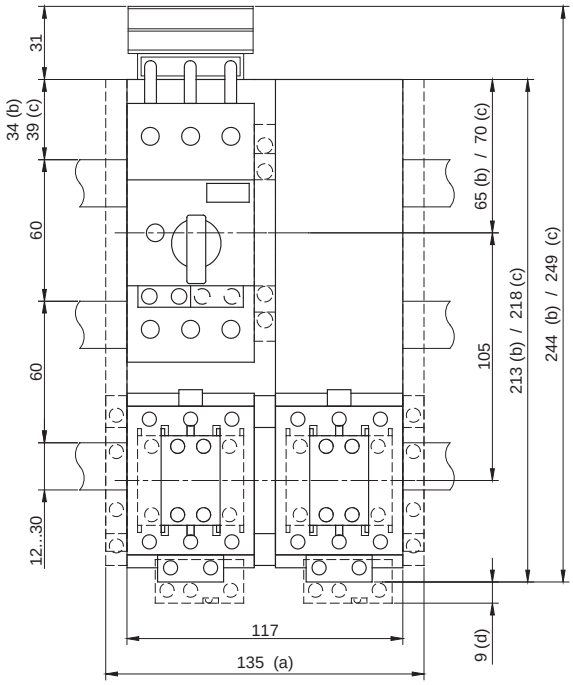
Bulletin 107S Busbar Mount



Circuit Breaker: 140M-D
Contactors: 100-C30...37
Reference Print: R10GMD

(a) With additional side-mount aux. contacts
(b) Standard busbar mount with control plug
(c) Iso busbar mount
(d) Electronic interface

Bulletin 107S Busbar Mount



Circuit Breaker: 140M-F
Contactors: 100-C43
Reference Print: R20GMF

(a) With additional side-mount aux. contacts
(b) Standard busbar mount with control plug
(c) Iso busbar mount
(d) Electronic interface

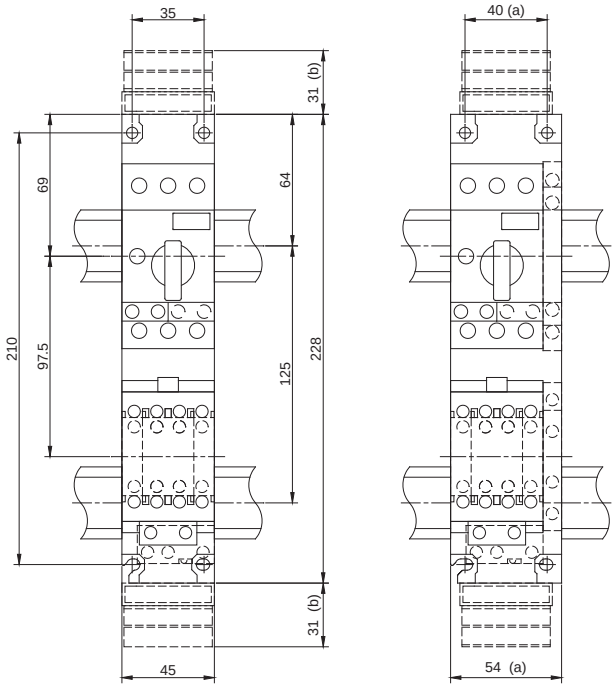
Bulletin 107S Busbar Mount

Open Type Starters

Approximate Dimensions, Continued

Dimensions are shown in millimeters. Dimensions are not intended for manufacturing purposes.

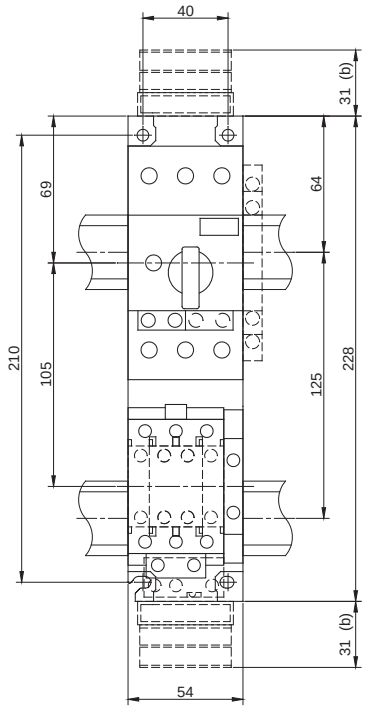
Panel Mount — Bulletin 103S Non-Reversing Starters



Circuit Breaker: 140M-C/D
Contactor: 100-C09...23
Reference Print: D00WMD

(a) With additional side-mount aux. or trip contact(s)
(b) Control plug on top OR bottom side optional

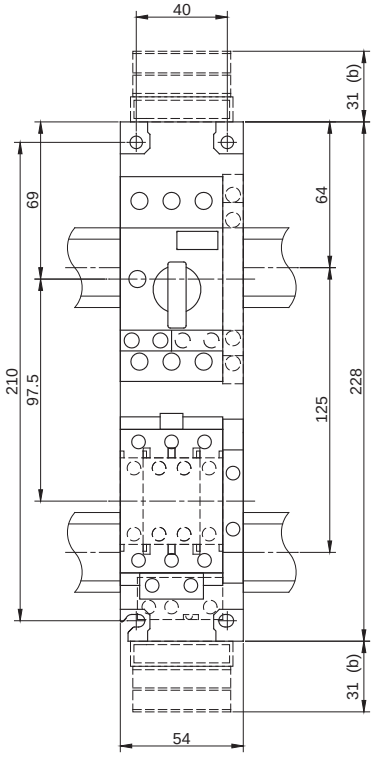
Bulletin 103S Panel Mount



Circuit Breaker: 140M-F
Contactor: 100-C30...37
Reference Print: D10WMF

(a) With additional side-mount aux. or trip contact
(b) Control plug on top OR bottom side optional

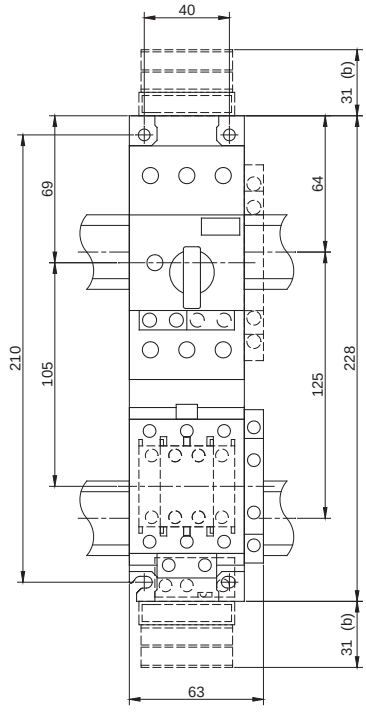
Bulletin 103S Panel Mount



Circuit Breaker: 140M-D
Contactor: 100-C30...37
Reference Print: D10WMD

(b) Control plug on top OR bottom side optional

Bulletin 103S Panel Mount



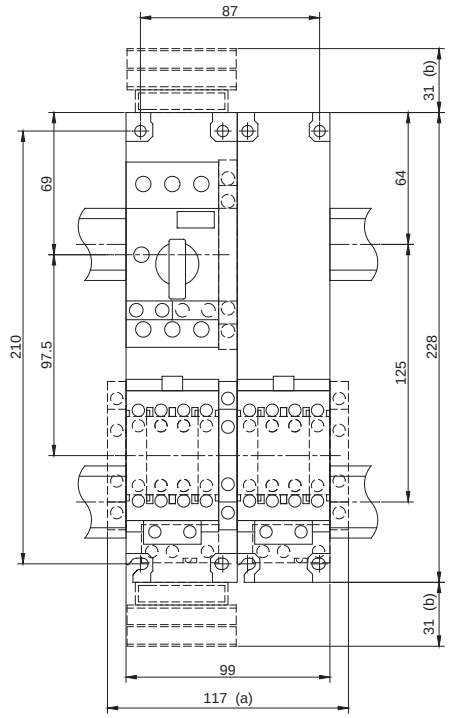
Circuit Breaker: 140M-F
Contactor: 100-C43
Reference Print: D20WMF

(a) With additional side-mount aux. or trip contact
(b) Control plug on top OR bottom side optional

Bulletin 103S Panel Mount

Dimensions are shown in millimeters. Dimensions are not intended for manufacturing purposes.

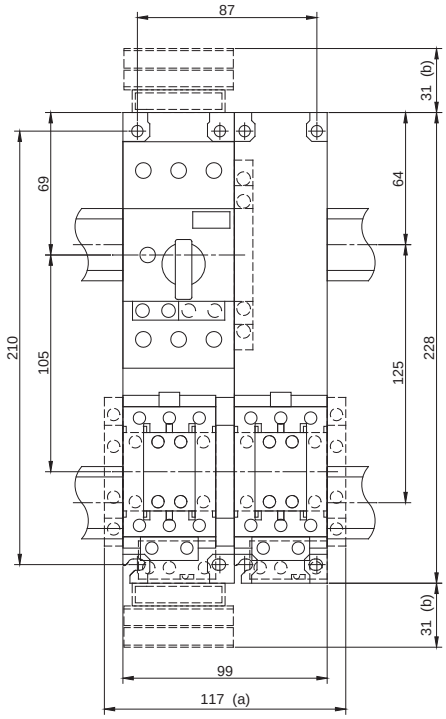
Panel Mount — Bulletin 107S Reversing Starters



Circuit Breaker: 140M-C/D
Contactors: 100-C09...23
Reference Print: R00WMD

(a) With additional side-mount aux. contacts
(b) Control plug on top OR bottom side optional

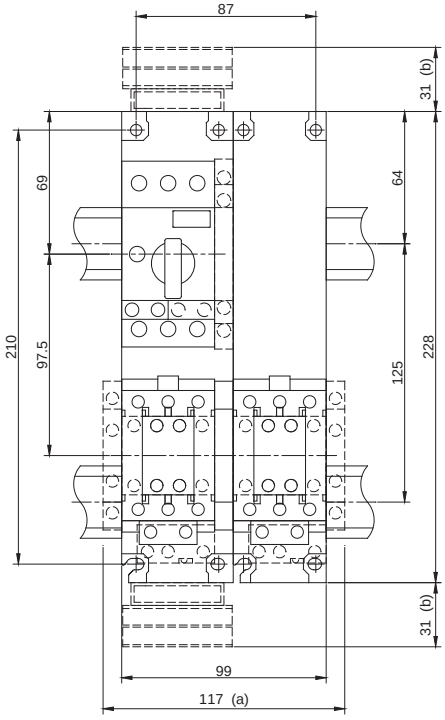
Bulletin 107S Panel Mount



Circuit Breaker: 140M-F
Contactors: 100-C30...37
Reference Print: R10WMF

(a) With additional side-mount aux. contacts
(b) Control plug on top OR bottom side optional

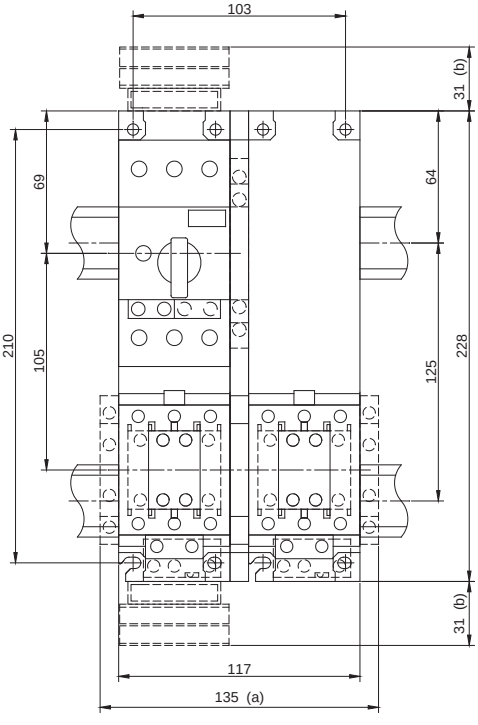
Bulletin 107S Panel Mount



Circuit Breaker: 140M-D
Contactors: 100-C30...37
Reference Print: R10WMD

(a) With additional side-mount aux. contacts
(b) Control plug on top OR bottom side optional

Bulletin 107S Panel Mount



Circuit Breaker: 140M-F
Contactors: 100-C43
Reference Print: R20WMF

(a) With additional side-mount aux. contacts
(b) Control plug on top OR bottom side optional

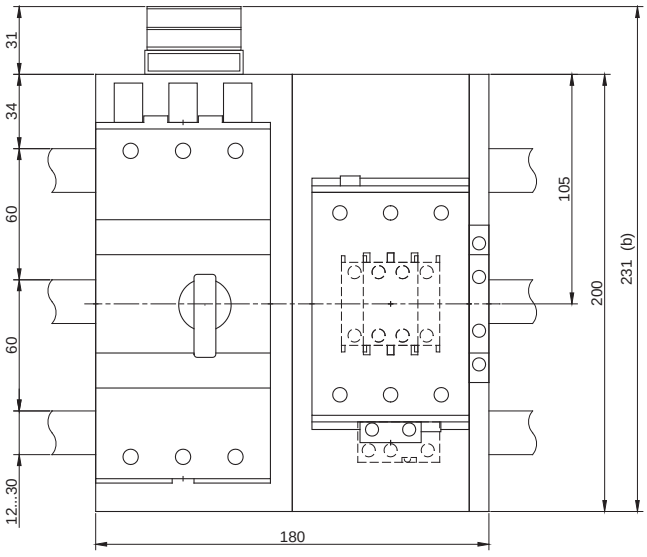
Bulletin 107S Panel Mount

Open Type Starters

Approximate Dimensions, Continued

Dimensions are shown in millimeters. Dimensions are not intended for manufacturing purposes.

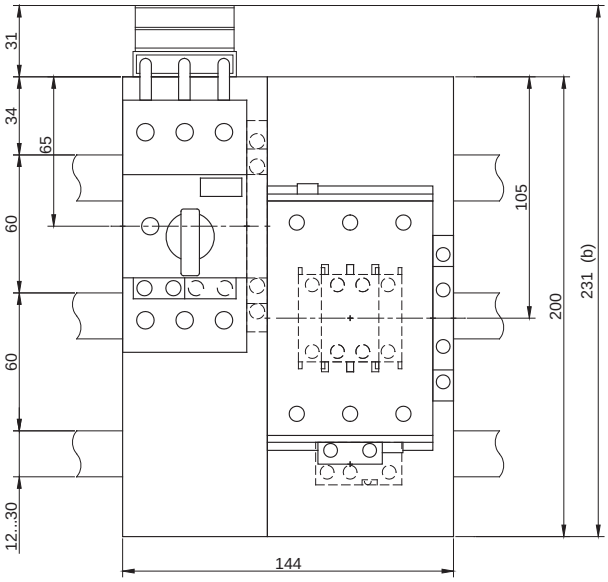
Standard Busbar Mount — Bulletin 103S Non-Reversing and Bulletin 107S Reversing Starters



Circuit Breaker: 140-CMN
Contactor: 100-C60...85
Reference Print: D30GCM

(b) Standard busbar mount with control plug

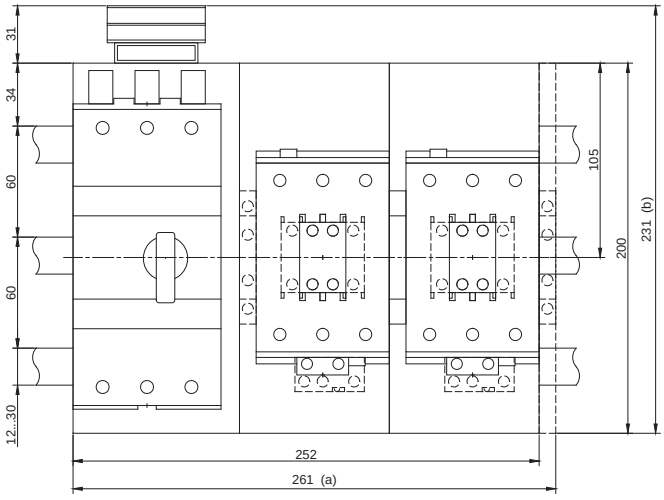
Bulletin 103S Busbar Mount



Circuit Breaker: 140M-F
Contactor: 100-C60...85
Reference Print: D30GMF

(b) Standard busbar mount with control plug

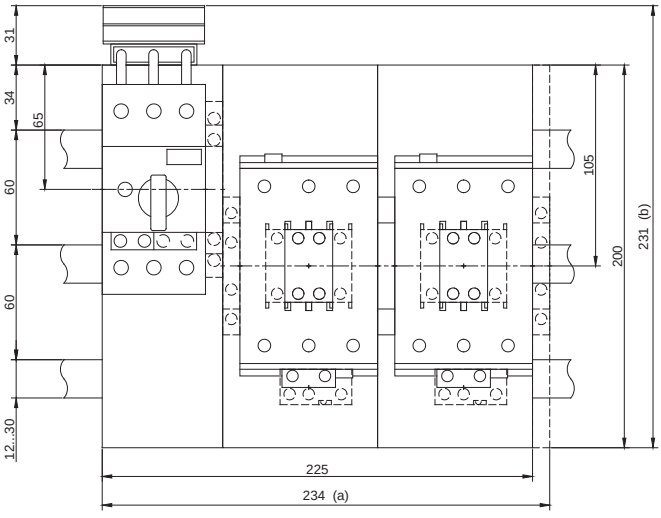
Bulletin 103S Busbar Mount



Circuit Breaker: 140-CMN
Contactors: 100-C60...85
Reference Print: R30GCM

(a) With additional side-mount aux. contacts
(b) Standard busbar mount with control plug

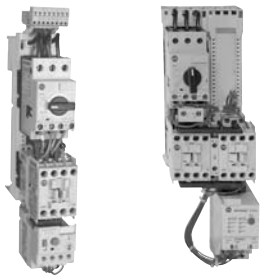
Bulletin 107S Busbar Mount



Circuit Breaker: 140M-F
Contactors: 100-C60...85
Reference Print: R30GMF

(a) With additional side-mount aux. contacts
(b) Standard busbar adapter with control plug

Bulletin 107S Busbar Mount



Bulletin 103T/107T IEC Starters

- Non-reversing (Bul. 103T) and reversing (Bul. 107T) starters
- Current Range 0.1…45 A
- cULus Listed Motor Controllers
  - Type 1 Coordination
  - Type 2 Coordination
- cULus Listed Type E Self-Protected Combination Motor Controllers
- Assemblies consist of Bulletin 140M MCPs or 140F fuse holders and Bulletin 100-C contactors and Bulletin 193-E overload relays mounted on Bulletin 141A busbar or panel mounting modules
- Factory installed options include:
  - Installation and wiring of Control Plug for auxiliary contacts.
  - Installation of Lockable Twist Knob.
  - Installation of Spacing Adapter for Type E Self-Protected Starters.
  - Electronic Interface and Surge Suppressors for coil on 100-C.
  - Additional auxiliary contacts for 100-C.
  - Additional auxiliary or trip contacts on 140M.

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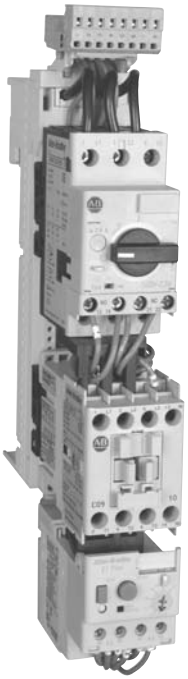
Standards Compliance

UL 508
CSA 22.2, No. 14
IEC 60947 -2, -4

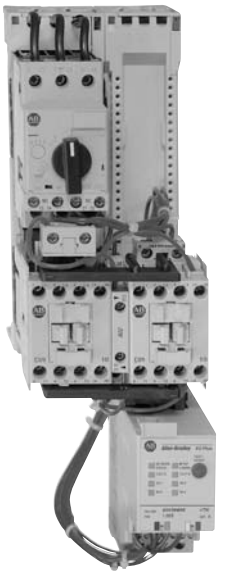
Certifications

cULus Listed (File No. E125316, Guide NKJH, NKJH7)
CE Marked



Bulletin 103T starter with Bulletin 193-ED overload relay and red/yellow lockable knob, as factory-installed option

Bulletin 103T starter with Bulletin 193-EC overload relay and red/yellow lockable knob, as factory-installed option



Bulletin 107T starter with Bulletin 193-EC overload relay with control plug option (factory-wired inputs and outputs)

Open Type Starters

Catalog Number Explanation

Cat. No. Explanation

Examples given in this section are for reference purposes. This basic explanation should not be used for product selection; not all combinations will produce a valid catalog number.

103T – A S D 2 – Q A16 C – C1P – TE

a b c d e f g h i j

a

Bulletin Number	
Code	**Description**
103T	DOL Starter with MCP
107T	Rev. Starter with MCP

b

Contactor Size	
Code	**Description**
A	100-C09
B	100-C12
C	100-C16
D	100-C23
E	100-C30
F	100-C37
G	100-C43

c

Style	
Code	**Description**
S	On 141A ISO Busbar Module(s)
T	On 141A Standard Busbar Module(s)
W	On 141A Panel Mounting Module(s)

d

AC Coil Voltage	
Code	**Description**
Q	12V AC, 60 Hz
R	12V AC, 50 Hz
J	24V AC, 60 Hz
K	24V AC, 50 Hz
KJ	24V AC, 50/60 Hz
V	32V AC, 50 Hz /36V AC, 60 Hz
W	36V AC, 50 Hz
X	42V AC, 50 Hz /48V AC, 60 Hz
Y	48V AC, 50 Hz
KY	48V AC, 50/60 Hz
KP	100V AC, 50 Hz /100...110V AC, 60 Hz
D	110V AC, 50 Hz /120V AC, 60 Hz
KD	100V AC, 50/60 Hz
P	120V AC, 50 Hz
KL	200...230V AC, 50/60 Hz
H	208V AC, 60 Hz
L	208...240V AC, 60 Hz
A	220V AC, 50 Hz /240V AC, 60 Hz
F	220...230V AC, 50 Hz
KF	230V AC, 50/60 Hz
VA	230...240V AC, 50 Hz
T	240V AC, 50 Hz /277V AC, 60 Hz
E	380V AC, 60 Hz
N	380...400V AC, 50 Hz /440V AC, 60 Hz
KN	400V AC, 50/60 Hz
G	400...415V AC, 50 Hz

d (cont'd)

DC Coil Voltage	
Code	**Description**
B	440V AC, 50 Hz /480V AC, 60 Hz
M	500V AC, 50 Hz
C	550V AC, 50 Hz /600V AC, 60 Hz
Contactor Size A…G	
Code	**Description**
ZR	6...12V DC
ZQ	12V DC
ZJ	24V DC
DJ	24V DC with Diode
EJ	24V DC Electronic
ZW	36 VDC
ZY	48V DC
ZZ	60V DC
ZB	64V DC
ZG	72V DC
ZE	80V DC
ZD	110V DC
ZP	115V DC
ZS	125V DC
ZA	220V DC
ZF	230V DC
ZT	250V DC

e

Contactor Aux. Contacts	
Code	**Description**
2	1 N.O.
3	1 N.O. + 1 N.C.

f

Circuit Breaker Frame Size	
Code	**Description**
Q	C Frame
R	D Frame
T	F Frame
F3	Bul. 140F fuse holder

g

Circuit Breaker Current Range	
Code	**Description**
A16	0.16 A
A25	0.25 A
A40	0.4 A
A63	0.63 A
B10	1.0 A
B25	2.5 A
B40	4.0 A
B63	6.3 A
C10	10 A
C16	16 A
C25	25 A
C32	32 A
C45	45 A

g (cont'd)

Bul. 140F Fuse Holder Type	
C	For 30 A Class CC fuses
F	For 32 A gL-gG fuses
M	For 30 A midget fuses
CL	For 30 A Class CC fuses w/ B.F.I.
FL	For 32 A gL-gG fuses w/ B.F.I.
ML	For 30 A midget fuses w/ B.F.I.

h

Circuit Breaker Aux. and Trip Contacts for 140M	
Select only one from each group	
Bottom Front	
Code	**Description**
X	Without Aux. Trip Contacts
A	1 N.C. Aux. Contact
B	1 N.O. Aux. Contact
C	1 N.O. + 1 N.C. Aux. Contact
D	2 N.O. Aux. Contact
E	2 N.C. Aux. Contact
R	1 N.O. (SC+OL) + 1 N.C. Aux. Contact
S	1 N.O. (SC+OL) + 1 N.O. Aux. Contact
Right Side	
Code	**Description**
K	1 N.C. (SC+OL) + 1 N.C. (SC)
L	1 N.O. (SC+OL) + 1 N.O. (SC)
M	1 N.C. (SC+OL) + 1 N.O. (SC)
N	1 N.O. (SC+OL) + 1 N.C. (SC)
Q	1 N.O. (SC) + 1 N.C. (SC)
Fuse Holder Aux.Contacts for 140F	
Bottom Front	
Code	**Description**
C	1 N.O. + 1 N.C. early break aux. contact

i

193-ED/EE O/L Relay	
Code	**Description**
D1	193-ED Cl.10, Man. Reset
E2	193-EE Cl.10…30, M./A. Reset
	Adjustment Range
Code	**Description**
..A	0.1...0.5 A
..B	0.2...1.0 A
..C	1.0...5.0 A
..D	3.2...16 A
..E	5.4...27 A
..F	9...45 A
..G	18...90 A

i (cont'd)

193-EC Electronic O/L Relay	
Code	**Description**
C1	193-EC1 (2 Input / 1 Output)
C2	193-EC2 (4 Input / 2 Output)
	Adjustment Range
Code	**Description**
..P	0.4...2.0 A
..A	1.0...5.0 A
..B	3.0...15 A
..C	5.0...25 A
..D	9.0...45 A
..E	18...90 A

j

Modifications, Accessories	
Circuit Breaker Accessories	
Code	**Description**
TE	Spacer Module
KN	Lockable Twist Knob, Black
KY	Lockable Twist Knob, Red/Yellow
Coil Accessories	
Code	**Description**
JE	Electronic Interface(s)
D	Surge Suppressor Diode
R	Surge Suppressor RC
V	Surge Suppressor Varistor
Additional Contactor Auxiliaries (Side Mount)	
Code	**Description**
S01	1 N.C.
S10	1 N.O.
S11	1 N.O. + 1 N.C.
S20	2 N.O.
Additional Contactor Auxiliaries (Front Mount)	
Code	**Description**
F11	1 N.O. + 1 N.C.
F20	2 N.O.
F22	2 N.O. + 2 N.C.
Mounting System Accessories	
Code	**Description**
MS	Micro Switch (ISO Modules only)
SP	Top Mount Control Plug (pull-apart terminal block with spring clamp terminals) for control circuit* (standard Bus bar and panel mounting modules only)

* Standard for Starters on ISO Adapters, no code required

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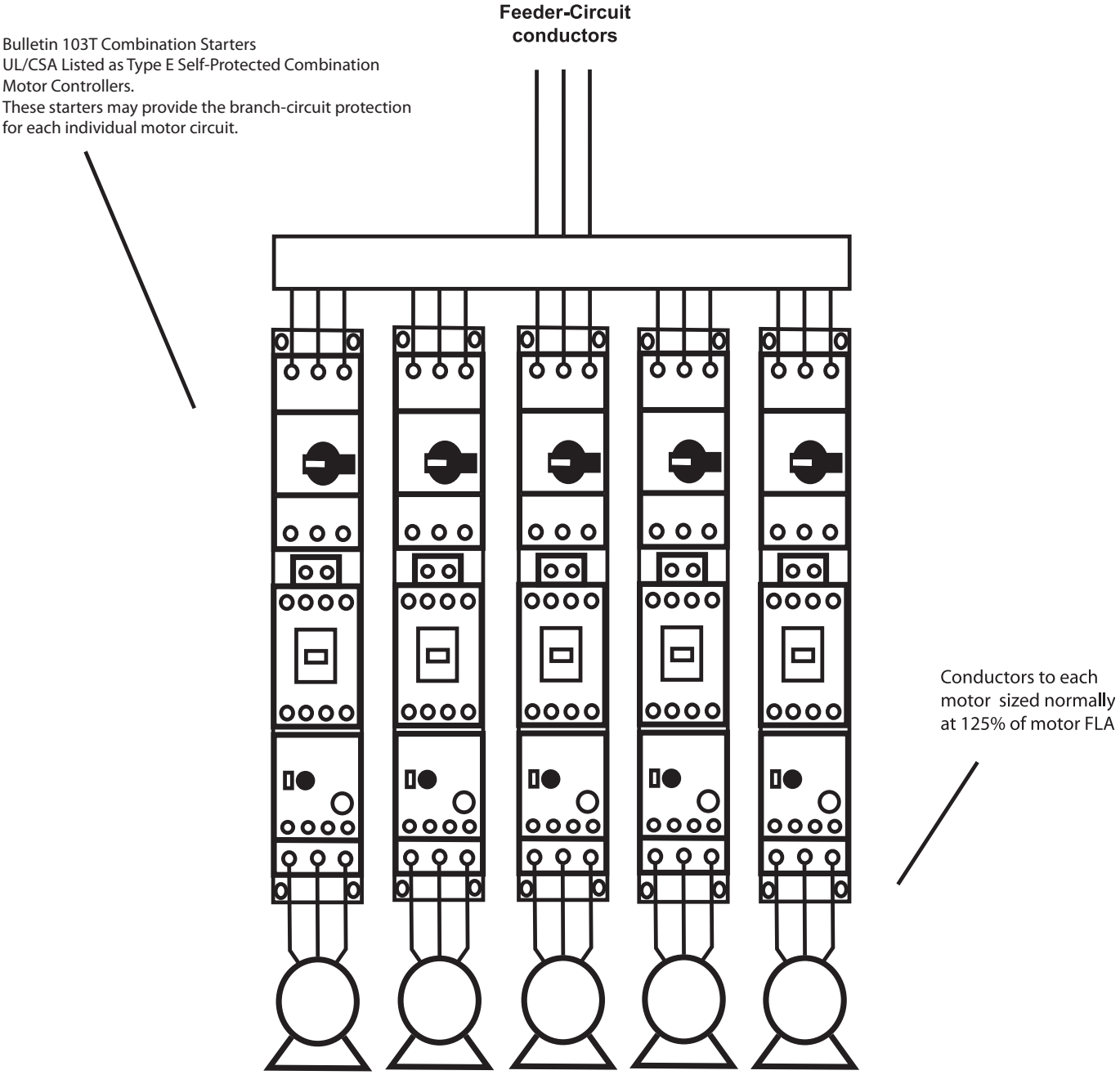
Preferred availability cat. nos. are printed in **bold**

Multiple Motor Installation with 103T Combination Starters

Each Motor has an Individual Branch Circuit Protective Device (BCPD)

Bulletin103T starters provide Individual Branch Circuit Protection for each motor.
They consist of a 140M Motor Circuit Protector, a 100C Contactor and a 193 Overload Relay.
These combination starters may provide the branch-circuit, short-circuit protection, overload protection and magnetic control for each individual motor circuit. Additional short-circuit protection is not required for the protection of the individual motor circuits, leaving only the requirement for protection of the Feeder-Circuit conductors by an upstream protective device.
Below is an example that illustrates installations involving multiple motors using Bulletin 103T Combination Starters.



Group Motor and Type E Combination Motor Controllers (UL/CSA)

The Bulletin 103T/107T motor controllers can be used in a variety of applications. These starters can be used in a group motor application or as a stand-alone product without any additional short-circuit protection in the motor branch circuits.

Most of the 140M-C/D motor protection circuit breakers used in the 103T/107T starters are UL listed as a manual motor controller with instantaneous trip short-circuit protection and is rated for group motor applications. Since there is no overload protection provded by these MCPs, a separate overload relay must be added to the motor branch circuit.

A combination of a 140M motor circuit protector, 100-C contactor and 193-E overload relay can be listed as a Type E self-protected combination motor controller. In this case, the 140M, 100-C and 193-E must pass an additional 6000 electrical and 4000 mechanical operational test after a short-circuit. In some cases, this may require over sizing of the 140M motor circuit protector or the 100-C contactor to achieve weld free performance and meet the additional life requirements.

Bulletin 103T/107T starters utilizing the 140F fuse holders must be used with a separate disconnecting means, as these fuse holders are not rated as a disconnect switch.

Product Selection and Coordination Ratings with Bulletin 193-EC, -ED, or EE Overload Relays—UL/CSA in Group Motor Installations

Motor Current Adjustment Range [A]	UL/CSA Hp and Coordination Ratings (60 Hz)									DOL Starters	Reversing Starters
	Hp Ratings as a UL 508 Motor Controller in Group Motor Installations*				Max. Fuse or C.B. per NEC	Max. Short-Circuit Current [kA]					
						Type 1 Coordination		Type 2 Coordination	Type 2 Coordination		
	200V AC	230V AC	460V AC	575V AC		480V AC	600V AC	480V AC	600V AC	Cat. No.	Cat. No.
C-Frame with 100-C/104-C Contactors on Standard Bus Bar Modules											
0.10...0.40	—	—	—	—	450	65	47	65	47	**103T-AT⊗2-QA40C-D1A**	**107T-AT⊗3-QA40C-D1A**
0.10...0.40	—	—	—	—	450	65	47	65	47	**103T-AT⊗2-QA40C-E1A**	**107T-AT⊗3-QA40C-E1A**
0.20...1.00	—	—	—	1/2	450	65	47	65	47	**103T-AT⊗2-QB10C-D1B**	**107T-AT⊗3-QB10C-D1B**
0.20...1.00	—	—	—	1/2	450	65	47	65	47	**103T-AT⊗2-QB10C-E1B**	**107T-AT⊗3-QB10C-E1B**
0.40...1.00	—	—	—	1/2	450	65	47	65	47	**103T-AT⊗2-QB10C-C1P**	—
0.40...1.00	—	—	—	1/2	450	65	47	65	47	**103T-AT⊗2-QB10C-C2P**	**107T-AT⊗3-QB10C-C2P**
0.4...2.0	—	—	1/2...1	1/2...1	450	65	30	65	—	**103T-AT⊗2-QB25C-C1P**	—
0.4...2.0	—	—	1/2...1	1/2...1	450	65	30	65	—	**103T-AT⊗2-QB25C-C2P**	**107T-AT⊗3-QB25C-C2P**
1.0...2.5	1/2	1/2...3/4	1/2...1-1/2	3/4...2	450	65	30	65	—	**103T-AT⊗2-QB25C-D1C**	**107T-AT⊗3-QB25C-D1C**
1.0...2.5	1/2	1/2...3/4	1/2...1-1/2	3/4...2	450	65	30	65	—	**103T-AT⊗2-QB25C-E1C**	**107T-AT⊗3-QB25C-E1C**
1.0...2.5	1/2	1/2...3/4	1/2...1-1/2	3/4...2	450	65	30	65	—	**103T-AT⊗2-QB25C-C1A**	—
1.0...2.5	1/2	1/2...3/4	1/2...1-1/2	3/4...2	450	65	30	65	—	**103T-AT⊗2-QB25C-C2A**	**107T-AT⊗3-QB25C-C2A**
D-Frame with 100-C/104-C Contactors on Standard Bus Bar Modules											
0.4...2.0	—	—	1/2...1	1/2...1	450	65	30	65	—	**103T-AT⊗2-RB25C-C1P**	—
0.4...2.0	—	—	1/2...1	1/2...1	450	65	30	65	—	**103T-AT⊗2-RB25C-C2P**	**107T-AT⊗3-RB25C-C2P**
1.0...2.5	1/2	1/2...3/4	1/2...1-1/2	3/4...2	450	65	30	65	—	**103T-AT⊗2-RB25C-D1C**	**107T-AT⊗3-RB25C-D1C**
1.0...2.5	1/2	1/2...3/4	1/2...1-1/2	3/4...2	450	65	30	65	—	**103T-AT⊗2-RB25C-E1C**	**107T-AT⊗3-RB25C-E1C**
1.0...2.5	1/2	1/2...3/4	1/2...1-1/2	3/4...2	450	65	30	65	—	**103T-AT⊗2-RB25C-C1A**	—
1.0...2.5	1/2	1/2...3/4	1/2...1-1/2	3/4...2	450	65	30	65	—	**103T-AT⊗2-RB25C-C2A**	**107T-AT⊗3-RB25C-C2A**
0.4...2.0	—	—	1/2...1	1/2...1	450	65	30	65	30	**103T-DT⊗2-RB25C-C1P**	—
0.4...2.0	—	—	1/2...1	1/2...1	450	65	30	65	30	**103T-DT⊗2-RB25C-C2P**	**107T-DT⊗3-RB25C-C2P**
1.0...2.5	1/2	1/2...3/4	1/2...1-1/2	3/4...2	450	65	30	65	30	**103T-DT⊗2-RB25C-D1C**	**107T-DT⊗3-RB25C-D1C**
1.0...2.5	1/2	1/2...3/4	1/2...1-1/2	3/4...2	450	65	30	65	30	**103T-DT⊗2-RB25C-E1C**	**107T-DT⊗3-RB25C-E1C**
1.0...2.5	1/2	1/2...3/4	1/2...1-1/2	3/4...2	450	65	30	65	30	**103T-DT⊗2-RB25C-C1A**	—
1.0...2.5	1/2	1/2...3/4	1/2...1-1/2	3/4...2	450	65	30	65	30	**103T-DT⊗2-RB25C-C2A**	**107T-DT⊗3-RB25C-C2A**
1.0...4.0	1/2...1	1/2...1	1/2...3	3/4...3	450	65	30	65	—	**103T-AT⊗2-RB40C-D1C**	**107T-AT⊗3-RB40C-D1C**
1.0...4.0	1/2...1	1/2...1	1/2...3	3/4...3	450	65	30	65	—	**103T-AT⊗2-RB40C-E1C**	**107T-AT⊗3-RB40C-E1C**
1.0...4.0	1/2...1	1/2...1	1/2...3	3/4...3	450	65	30	65	—	**103T-AT⊗2-RB40C-C1A**	—
1.0...4.0	1/2...1	1/2...1	1/2...3	3/4...3	450	65	30	65	—	**103T-AT⊗2-RB40C-C2A**	**107T-AT⊗3-RB40C-C2A**
1.0...4.0	1/2...1	1/2...1	1/2...3	3/4...3	450	65	30	65	30	**103T-DT⊗2-RB40C-D1C**	**107T-DT⊗3-RB40C-D1C**
1.0...4.0	1/2...1	1/2...1	1/2...3	3/4...3	450	65	30	65	30	**103T-DT⊗2-RB40C-E1C**	**107T-DT⊗3-RB40C-E1C**
1.0...4.0	1/2...1	1/2...1	1/2...3	3/4...3	450	65	30	65	30	**103T-DT⊗2-RB40C-C1A**	—
1.0...4.0	1/2...1	1/2...1	1/2...3	3/4...3	450	65	30	65	30	**103T-DT⊗2-RB40C-C2A**	**107T-DT⊗3-RB40C-C2A**
3.2...6.3	3/4...1-1/2	3/4...2	2...5	3...5	450	65	30	65	—	**103T-AT⊗2-RB63C-D1D**	**107T-AT⊗3-RB63C-D1D**
3.2...6.3	3/4...1-1/2	3/4...2	2...5	3...5	450	65	30	65	—	**103T-AT⊗2-RB63C-E1D**	**107T-AT⊗3-RB63C-E1D**
3.0...6.3	3/4...1-1/2	3/4...2	1-1/2...5	3...5	450	65	30	65	—	**103T-AT⊗2-RB63C-C1B**	—
3.0...6.3	3/4...1-1/2	3/4...2	1-1/2...5	3...5	450	65	30	65	—	**103T-AT⊗2-RB63C-C2B**	**107T-AT⊗3-RB63C-C2B**
3.2...10	3/4...3	3/4...3	2...7-1/2	3...10	450	65	30	65	—	**103T-BT⊗2-RC10C-D1D**	**107T-BT⊗3-RC10C-D1D**
3.2...10	3/4...3	3/4...3	2...7-1/2	3...10	450	65	30	65	—	**103T-BT⊗2-RC10C-E1D**	**107T-BT⊗3-RC10C-E1D**
3.0...10	3/4...3	3/4...3	1-1/2...7-1/2	3...10	450	65	30	65	—	**103T-BT⊗2-RC10C-C1B**	—
3.0...10	3/4...3	3/4...3	1-1/2...7-1/2	3...10	450	65	30	65	—	**103T-BT⊗2-RC10C-C2B**	**107T-BT⊗3-RC10C-C2B**
3.2...10	3/4...3	3/4...3	2...7-1/2	3...10	450	65	30	65	30	**103T-ET⊗3-RC10C-E1D**	**107T-ET⊗3-RC10C-E1D**
3.0...10	3/4...3	3/4...3	1-1/2...7-1/2	3...10	450	65	30	65	30	**103T-ET⊗3-RC10C-C1B**	—
3.0...10	3/4...3	3/4...3	1-1/2...7-1/2	3...10	450	65	30	65	30	**103T-ET⊗3-RC10C-C2B**	**107T-ET⊗3-RC10C-C2B**
3.2...16	3/4...5	3/4...5	2...10	3...10	450	65	30	65	—	**103T-CT⊗2-RC16C-D1D**	**107T-CT⊗3-RC16C-D1D**

Motor Current Adjustment Range [A]	UL/CSA Hp and Coordination Ratings (60 Hz)									DOL Starters	Reversing Starters
	Hp Ratings as a UL 508 Motor Controller in Group Motor Installations∗				Max. Fuse or C.B. per NEC	Max. Short-Circuit Current [kA]					
						Type 1 Coordination		Type 2 Coordination	Type 2 Coordination		
	200V AC	230V AC	460V AC	575V AC		480V AC	600V AC	480V AC	600V AC	Cat. No.	Cat. No.
D-Frame with 100-C/104-C Contactors on Standard Bus Bar Modules											
3.2...16	3/4...5	3/4...5	2...10	3...10	450	65	30	65	—	**103T-CT⊗2-RC16C-E1D**	**107T-CT⊗3-RC16C-E1D**
3.0...15	3/4...5	3/4...5	1-1/2...10	3...10	450	65	30	65	—	**103T-CT⊗2-RC16C-C1B**	—
3.0...15	3/4...5	3/4...5	1-1/2...10	3...10	450	65	30	65	—	**103T-CT⊗2-RC16C-C2B**	**107T-CT⊗3-RC16C-C2B**
3.2...16	3/4...5	3/4...5	2...10	3...10	450	65	30	65	30	**103T-ET⊗3-RC16C-E1D**	**107T-ET⊗3-RC16C-E1D**
3.0...15	3/4...5	3/4...5	1-1/2...10	3...10	450	65	30	65	30	**103T-ET⊗3-RC16C-C1B**	—
3.0...15	3/4...5	3/4...5	1-1/2...10	3...10	450	65	30	65	30	**103T-ET⊗3-RC16C-C2B**	**107T-ET⊗3-RC16C-C2B**
5.4...23	1-1/2...5	1-1/2...7-1/2	5...15	5...15	450	65	30	50	—	**103T-DT⊗2-RC25C-D1E**	**107T-DT⊗3-RC25C-D1E**
5.4...23	1-1/2...5	1-1/2...7-1/2	5...15	5...15	450	65	30	50	—	**103T-DT⊗2-RC25C-E1E**	**107T-DT⊗3-RC25C-E1E**
5.0...23	1-1/2...5	1-1/2...7-1/2	5...15	5...15	450	65	30	50	—	**103T-DT⊗2-RC25C-C1C**	—
5.0...23	1-1/2...5	1-1/2...7-1/2	5...15	5...15	450	65	30	50	—	**103T-DT⊗2-RC25C-C2C**	**107T-DT⊗3-RC25C-C2C**
5.4...25	1-1/2...5	1-1/2...7-1/2	5...15	5...20	450	65	30	65	—	**103T-ET⊗3-RC25C-E1E**	**107T-ET⊗3-RC25C-E1E**
5.0...25	1-1/2...5	1-1/2...7-1/2	5...15	5...20	450	65	30	65	—	**103T-ET⊗3-RC25C-C1C**	—
5.0...25	1-1/2...5	1-1/2...7-1/2	5...15	5...20	450	65	30	65	—	**103T-ET⊗3-RC25C-C2C**	**107T-ET⊗3-RC25C-C2C**
F-Frame with 100-C/104-C Contactors on Standard Bus Bar Modules											
5.4...25	1-1/2...7-1/2	1-1/2...10	5...20	5...20	600	65	30	65	30	**103T-ET⊗3-TC25C-E1E**	**107T-ET⊗3-TC25C-E1E**
5.0...25	1-1/2...7-1/2	1-1/2...10	5...20	5...20	600	65	30	65	30	**103T-ET⊗3-TC25C-C1C**	—
5.0...25	1-1/2...7-1/2	1-1/2...10	5...20	5...20	600	65	30	65	30	**103T-ET⊗3-TC25C-C2C**	**107T-ET⊗3-TC25C-C2C**
9.0...30	3...7-1/2	3...10	7-1/2...20	7-1/2...25	600	65	30	65	30	**103T-ET⊗3-TC32C-E1F**	**107T-ET⊗3-TC32C-E1F**
9.0...30	3...7-1/2	3...10	7-1/2...20	7-1/2...25	600	65	30	65	30	**103T-ET⊗3-TC32C-C1D**	—
9.0...30	3...7-1/2	3...10	7-1/2...20	7-1/2...25	600	65	30	65	30	**103T-ET⊗3-TC32C-C2D**	**107T-ET⊗3-TC32C-C2D**
9.0...32	3...10	3...10	7-1/2...25	7-1/2...30	600	65	30	65	30	**103T-FT⊗3-TC32C-E1F**	**107T-FT⊗3-TC32C-E1F**
9.0...32	3...10	3...10	7-1/2...25	7-1/2...30	600	65	30	65	30	**103T-FT⊗3-TC32C-C1D**	—
9.0...32	3...10	3...10	7-1/2...25	7-1/2...30	600	65	30	65	30	**103T-FT⊗3-TC32C-C2D**	**107T-FT⊗3-TC32C-C2D**
9.0...37	3...10	3...10	7-1/2...25	7-1/2...30	600	65	18	65	—	**103T-FT⊗3-TC45C-E1F**	**107T-FT⊗3-TC45C-E1F**
9.0...37	3...10	3...10	7-1/2...25	7-1/2...30	600	65	18	65	—	**103T-FT⊗3-TC45C-C1D**	—
9.0...37	3...10	3...10	7-1/2...25	7-1/2...30	600	65	18	65	—	**103T-FT⊗3-TC45C-C2D**	**107T-FT⊗3-TC45C-C2D**
9.0...43	3...10	3...15	7-1/2...30	7-1/2...30	600	65	18	65	—	**103T-GT⊗3-TC45C-E1F**	**107T-GT⊗3-TC45C-E1F**
9.0...43	3...10	3...15	7-1/2...30	7-1/2...30	600	65	18	65	—	**103T-GT⊗3-TC45C-C1D**	—
9.0...43	3...10	3...15	7-1/2...30	7-1/2...30	600	65	18	65	—	**103T-GT⊗3-TC45C-C2D**	**107T-GT⊗3-TC45C-C2D**
18...45	7-1/2...10	7-1/2...15	15...30	20...40	600	65	18	65	—	**103T-HT⊗3-TC45C-E1G**	**107T-HT⊗3-TC45C-E1G**
9.0...45	3...10	3...15	7-1/2...30	7-1/2...40	600	65	18	65	—	**103T-HT⊗3-TC45C-C1D**	—
9.0...45	3...10	3...15	7-1/2...30	7-1/2...40	600	65	18	65	—	**103T-HT⊗3-TC45C-C2D**	**107T-HT⊗3-TC45C-C2D**

∗ Hp ratings shown in the table are for reference. Final selection of the starter depends upon the actual motor full-load current and service factor.

⊗Coil voltage code—see page 2-295

Product Selection and Coordination Ratings with Bulletin 193-EC, -ED, or EE Overload Relays—UL/CSA in Group Motor Installations, Continued

Motor Current Adjustment Range [A]	UL/CSA Hp and Coordination Ratings (60 Hz)									DOL Starters	Reversing Starters
	Hp Ratings as a UL 508 Motor Controller in Group Motor Installations*				Max. Fuse or C.B. per NEC	Max. Short-Circuit Current [kA]					
						Type 1 Coordination		Type 2 Coordination	Type 2 Coordination		
	200V AC	230V AC	460V AC	575V AC		480V AC	600V AC	480V AC	600V AC	Cat. No.	Cat. No.
C-Frame with 100-C/104-C Contactors on ISO Bus Bar Modules											
0.10...0.40	—	—	—	—	450	65	47	65	47	**103T-AS⊗2-QA40C-D1A**	**107T-AS⊗3-QA40C-D1A**
0.10...0.40	—	—	—	—	450	65	47	65	47	**103T-AS⊗2-QA40C-E1A**	**107T-AS⊗3-QA40C-E1A**
0.20...1.00	—	—	—	1/2	450	65	47	65	47	**103T-AS⊗2-QB10C-D1B**	**107T-AS⊗3-QB10C-D1B**
0.20...1.00	—	—	—	1/2	450	65	47	65	47	**103T-AS⊗2-QB10C-E1B**	**107T-AS⊗3-QB10C-E1B**
0.40...1.00	—	—	—	1/2	450	65	47	65	47	**103T-AS⊗2-QB10C-C1P**	—
0.40...1.00	—	—	—	1/2	450	65	47	65	47	**103T-AS⊗2-QB10C-C2P**	**107T-AS⊗3-QB10C-C2P**
0.4...2.0	—	—	1/2...1	1/2...1	450	65	30	65	—	103T-AS⊗2-QB25C-C1P	—
0.4...2.0	—	—	1/2...1	1/2...1	450	65	30	65	—	**103T-AS⊗2-QB25C-C2P**	107T-AS⊗3-QB25C-C2P
1.0...2.5	1/2	1/2...3/4	1/2...1-1/2	3/4...2	450	65	30	65	—	**103T-AS⊗2-QB25C-D1C**	**107T-AS⊗3-QB25C-D1C**
1.0...2.5	1/2	1/2...3/4	1/2...1-1/2	3/4...2	450	65	30	65	—	**103T-AS⊗2-QB25C-E1C**	**107T-AS⊗3-QB25C-E1C**
1.0...2.5	1/2	1/2...3/4	1/2...1-1/2	3/4...2	450	65	30	65	—	**103T-AS⊗2-QB25C-C1A**	—
1.0...2.5	1/2	1/2...3/4	1/2...1-1/2	3/4...2	450	65	30	65	—	**103T-AS⊗2-QB25C-C2A**	**107T-AS⊗3-QB25C-C2A**
D-Frame with 100-C/104-C Contactors on ISO Bus Bar Modules											
0.4...2.0	—	—	1/2...1	1/2...1	450	65	30	65	—	**103T-AS⊗2-RB25C-C1P**	—
0.4...2.0	—	—	1/2...1	1/2...1	450	65	30	65	—	**103T-AS⊗2-RB25C-C2P**	**107T-AS⊗3-RB25C-C2P**
1.0...2.5	1/2	1/2...3/4	1/2...1-1/2	3/4...2	450	65	30	65	—	**103T-AS⊗2-RB25C-D1C**	**107T-AS⊗3-RB25C-D1C**
1.0...2.5	1/2	1/2...3/4	1/2...1-1/2	3/4...2	450	65	30	65	—	**103T-AS⊗2-RB25C-E1C**	**107T-AS⊗3-RB25C-E1C**
1.0...2.5	1/2	1/2...3/4	1/2...1-1/2	3/4...2	450	65	30	65	—	**103T-AS⊗2-RB25C-C1A**	—
1.0...2.5	1/2	1/2...3/4	1/2...1-1/2	3/4...2	450	65	30	65	—	**103T-AS⊗2-RB25C-C2A**	**107T-AS⊗3-RB25C-C2A**
0.4...2.0	—	—	1/2...1	1/2...1	450	65	30	65	30	**103T-DS⊗2-RB25C-C1P**	—
0.4...2.0	—	—	1/2...1	1/2...1	450	65	30	65	30	**103T-DS⊗2-RB25C-C2P**	**107T-DS⊗3-RB25C-C2P**
1.0...2.5	1/2	1/2...3/4	1/2...1-1/2	3/4...2	450	65	30	65	30	**103T-DS⊗2-RB25C-D1C**	**107T-DS⊗3-RB25C-D1C**
1.0...2.5	1/2	1/2...3/4	1/2...1-1/2	3/4...2	450	65	30	65	30	**103T-DS⊗2-RB25C-E1C**	**107T-DS⊗3-RB25C-E1C**
1.0...2.5	1/2	1/2...3/4	1/2...1-1/2	3/4...2	450	65	30	65	30	**103T-DS⊗2-RB25C-C1A**	—
1.0...2.5	1/2	1/2...3/4	1/2...1-1/2	3/4...2	450	65	30	65	30	**103T-DS⊗2-RB25C-C2A**	**107T-DS⊗3-RB25C-C2A**
1.0...4.0	1/2...1	1/2...1	1/2...3	3/4...3	450	65	30	65	—	**103T-AS⊗2-RB40C-D1C**	**107T-AS⊗3-RB40C-D1C**
1.0...4.0	1/2...1	1/2...1	1/2...3	3/4...3	450	65	30	65	—	**103T-AS⊗2-RB40C-E1C**	**107T-AS⊗3-RB40C-E1C**
1.0...4.0	1/2...1	1/2...1	1/2...3	3/4...3	450	65	30	65	—	**103T-AS⊗2-RB40C-C1A**	—
1.0...4.0	1/2...1	1/2...1	1/2...3	3/4...3	450	65	30	65	—	**103T-AS⊗2-RB40C-C2A**	**107T-AS⊗3-RB40C-C2A**
1.0...4.0	1/2...1	1/2...1	1/2...3	3/4...3	450	65	30	65	30	**103T-DS⊗2-RB40C-D1C**	**107T-DS⊗3-RB40C-D1C**
1.0...4.0	1/2...1	1/2...1	1/2...3	3/4...3	450	65	30	65	30	**103T-DS⊗2-RB40C-E1C**	**107T-DS⊗3-RB40C-E1C**
1.0...4.0	1/2...1	1/2...1	1/2...3	3/4...3	450	65	30	65	30	**103T-DS⊗2-RB40C-C1A**	—
1.0...4.0	1/2...1	1/2...1	1/2...3	3/4...3	450	65	30	65	30	**103T-DS⊗2-RB40C-C2A**	**107T-DS⊗3-RB40C-C2A**
3.2...6.3	3/4...1-1/2	3/4...2	2...5	3...5	450	65	30	65	—	**103T-AS⊗2-RB63C-D1D**	**107T-AS⊗3-RB63C-D1D**
3.2...6.3	3/4...1-1/2	3/4...2	2...5	3...5	450	65	30	65	—	**103T-AS⊗2-RB63C-E1D**	**107T-AS⊗3-RB63C-E1D**
3.0...6.3	3/4...1-1/2	3/4...2	1-1/2...5	3...5	450	65	30	65	—	**103T-AS⊗2-RB63C-C1B**	—
3.0...6.3	3/4...1-1/2	3/4...2	1-1/2...5	3...5	450	65	30	65	—	**103T-AS⊗2-RB63C-C2B**	**107T-AS⊗3-RB63C-C2B**
3.2...10	3/4...3	3/4...3	2...7-1/2	3...10	450	65	30	65	—	**103T-BS⊗2-RC10C-D1D**	**107T-BS⊗3-RC10C-D1D**
3.2...10	3/4...3	3/4...3	2...7-1/2	3...10	450	65	30	65	—	**103T-BS⊗2-RC10C-E1D**	**107T-BS⊗3-RC10C-E1D**
3.0...10	3/4...3	3/4...3	1-1/2...7-1/2	3...10	450	65	30	65	—	**103T-BS⊗2-RC10C-C1B**	—
3.0...10	3/4...3	3/4...3	1-1/2...7-1/2	3...10	450	65	30	65	—	**103T-BS⊗2-RC10C-C2B**	**107T-BS⊗3-RC10C-C2B**
3.2...10	3/4...3	3/4...3	2...7-1/2	3...10	450	65	30	65	30	**103T-ES⊗3-RC10C-E1D**	**107T-ES⊗3-RC10C-E1D**
3.0...10	3/4...3	3/4...3	1-1/2...7-1/2	3...10	450	65	30	65	30	**103T-ES⊗3-RC10C-C1B**	—
3.0...10	3/4...3	3/4...3	1-1/2...7-1/2	3...10	450	65	30	65	30	**103T-ES⊗3-RC10C-C2B**	**107T-ES⊗3-RC10C-C2B**
3.2...16	3/4...5	3/4...5	2...10	3...10	450	65	30	65	—	**103T-CS⊗2-RC16C-D1D**	**107T-CS⊗3-RC16C-D1D**
3.2...16	3/4...5	3/4...5	2...10	3...10	450	65	30	65	—	**103T-CS⊗2-RC16C-E1D**	**107T-CS⊗3-RC16C-E1D**
3.0...15	3/4...5	3/4...5	1-1/2...10	3...10	450	65	30	65	—	**103T-CS⊗2-RC16C-C1B**	—
3.0...15	3/4...5	3/4...5	1-1/2...10	3...10	450	65	30	65	—	**103T-CS⊗2-RC16C-C2B**	**107T-CS⊗3-RC16C-C2B**
3.2...16	3/4...5	3/4...5	2...10	3...10	450	65	30	65	30	**103T-ES⊗3-RC16C-E1D**	**107T-ES⊗3-RC16C-E1D**
3.0...15	3/4...5	3/4...5	1-1/2...10	3...10	450	65	30	65	30	**103T-ES⊗3-RC16C-C1B**	—
3.0...15	3/4...5	3/4...5	1-1/2...10	3...10	450	65	30	65	30	**103T-ES⊗3-RC16C-C2B**	**107T-ES⊗3-RC16C-C2B**
5.4...23	1-1/2...5	1-1/2...7-1/2	5...15	5...15	450	65	—	50	—	**103T-DS⊗2-RC25C-D1E**	**107T-DS⊗3-RC25C-D1E**
5.4...23	1-1/2...5	1-1/2...7-1/2	5...15	5...15	450	65	—	50	—	**103T-DS⊗2-RC25C-E1E**	**107T-DS⊗3-RC25C-E1E**
5.0...23	1-1/2...5	1-1/2...7-1/2	5...15	5...15	450	65	—	50	—	103T-DS⊗2-RC25C-C1C	—
5.0...23	1-1/2...5	1-1/2...7-1/2	5...15	5...15	450	65	—	50	—	**103T-DS⊗2-RC25C-C2C**	107T-DS⊗3-RC25C-C2C
5.4...25	1-1/2...5	1-1/2...7-1/2	5...15	5...20	450	65	30	65	—	**103T-ES⊗3-RC25C-E1E**	**107T-ES⊗3-RC25C-E1E**

Motor Current Adjustment Range [A]	UL/CSA Hp and Coordination Ratings (60 Hz)									DOL Starters	Reversing Starters
	Hp Ratings as a UL 508 Motor Controller in Group Motor Installations∗				Max. Fuse or C.B. per NEC	Max. Short-Circuit Current [kA]					
						Type 1 Coordination		Type 2 Coordination	Type 2 Coordination		
	200V AC	230V AC	460V AC	575V AC		480V AC	600V AC	480V AC	600V AC	Cat. No.	Cat. No.
D-Frame with 100-C/104-C Contactors on ISO Bus Bar Modules											
5.0…25	1-1/2…5	1-1/2…7-1/2	5…15	5…20	450	65	30	65	—	**103T-ES⊗3-RC25C-C1C**	—
5.0…25	1-1/2…5	1-1/2…7-1/2	5…15	5…20	450	65	30	65	—	**103T-ES⊗3-RC25C-C2C**	**107T-ES⊗3-RC25C-C2C**
F-Frame with 100-C/104-C Contactors on ISO Bus Bar Modules											
5.4…25	1-1/2…7-1/2	1-1/2…10	5…20	5…20	600	65	30	65	30	**103T-ES⊗3-TC25C-E1E**	**107T-ES⊗3-TC25C-E1E**
5.0…25	1-1/2…7-1/2	1-1/2…10	5…20	5…20	600	65	30	65	30	**103T-ES⊗3-TC25C-C1C**	—
5.0…25	1-1/2…7-1/2	1-1/2…10	5…20	5…20	600	65	30	65	30	**103T-ES⊗3-TC25C-C2C**	**107T-ES⊗3-TC25C-C2C**
9.0…30	3…7-1/2	3…10	7-1/2…20	7-1/2…25	600	65	30	65	30	**103T-ES⊗3-TC32C-E1F**	**107T-ES⊗3-TC32C-E1F**
9.0…30	3…7-1/2	3…10	7-1/2…20	7-1/2…25	600	65	30	65	30	**103T-ES⊗3-TC32C-C1D**	—
9.0…30	3…7-1/2	3…10	7-1/2…20	7-1/2…25	600	65	30	65	30	**103T-ES⊗3-TC32C-C2D**	107T-ES⊗3-TC32C-C2D
9.0…32	3…10	3…10	7-1/2…25	7-1/2…30	600	65	30	65	30	**103T-FS⊗3-TC32C-E1F**	**107T-FS⊗3-TC32C-E1F**
9.0…32	3…10	3…10	7-1/2…25	7-1/2…30	600	65	30	65	30	**103T-FS⊗3-TC32C-C1D**	—
9.0…32	3…10	3…10	7-1/2…25	7-1/2…30	600	65	30	65	30	**103T-FS⊗3-TC32C-C2D**	**107T-FS⊗3-TC32C-C2D**
9.0…37	3…10	3…10	7-1/2…25	7-1/2…30	600	65	18	65	—	**103T-FS⊗3-TC45C-E1F**	**107T-FS⊗3-TC45C-E1F**
9.0…37	3…10	3…10	7-1/2…25	7-1/2…30	600	65	18	65	—	**103T-FS⊗3-TC45C-C1D**	—
9.0…37	3…10	3…10	7-1/2…25	7-1/2…30	600	65	18	65	—	**103T-FS⊗3-TC45C-C2D**	107T-FS⊗3-TC45C-C2D
9.0…43	3…10	3…15	7-1/2…30	7-1/2…30	600	65	18	65	—	**103T-GS⊗3-TC45C-E1F**	**107T-GS⊗3-TC45C-E1F**
9.0…43	3…10	3…15	7-1/2…30	7-1/2…30	600	65	18	65	—	**103T-GS⊗3-TC45C-C1D**	—
9.0…43	3…10	3…15	7-1/2…30	7-1/2…30	600	65	18	65	—	**103T-GS⊗3-TC45C-C2D**	**107T-GS⊗3-TC45C-C2D**

∗ Hp ratings shown in the table are for reference. Final selection of the starter depends upon the actual motor full-load current and service factor.

⊗Coil voltage code—see page 2-295

Product Selection and Coordination Ratings with Bulletin 193-EC, -ED, or EE Overload Relays—UL/CSA in Group Motor Installations, Continued

Motor Current Adjustment Range [A]	UL/CSA Hp and Coordination Ratings (60 Hz)									DOL Starters	Reversing Starters
	Hp Ratings as a UL 508 Motor Controller in Group Motor Installations✶				Max. Fuse or C.B. per NEC	Max. Short-Circuit Current [kA]					
						Type 1 Coordination		Type 2 Coordination	Type 2 Coordination		
	200V AC	230V AC	460V AC	575V AC		480V AC	600V AC	480V AC	600V AC	Cat. No.	Cat. No.
C-Frame with 100-C/104-C Contactors on Panel Mounting Modules											
0.10...0.40	—	—	—	—	450	65	47	65	47	**103T-AW⊗2-QA40C-D1A**	**107T-AW⊗3-QA40C-D1A**
0.10...0.40	—	—	—	—	450	65	47	65	47	**103T-AW⊗2-QA40C-E1A**	**107T-AW⊗3-QA40C-E1A**
0.20...1.00	—	—	—	1/2	450	65	47	65	47	**103T-AW⊗2-QB10C-D1B**	**107T-AW⊗3-QB10C-D1B**
0.20...1.00	—	—	—	1/2	450	65	47	65	47	**103T-AW⊗2-QB10C-E1B**	**107T-AW⊗3-QB10C-E1B**
0.40...1.00	—	—	—	1/2	450	65	47	65	47	**103T-AW⊗2-QB10C-C1P**	—
0.40...1.00	—	—	—	1/2	450	65	47	65	47	**103T-AW⊗2-QB10C-C2P**	**107T-AW⊗3-QB10C-C2P**
0.4...2.0	—	—	1/2...1	1/2...1	450	65	30	65	—	**103T-AW⊗2-QB25C-C1P**	—
0.4...2.0	—	—	1/2...1	1/2...1	450	65	30	65	—	**103T-AW⊗2-QB25C-C2P**	**107T-AW⊗3-QB25C-C2P**
1.0...2.5	1/2	1/2...3/4	1/2...1-1/2	3/4...2	450	65	30	65	—	**103T-AW⊗2-QB25C-D1C**	**107T-AW⊗3-QB25C-D1C**
1.0...2.5	1/2	1/2...3/4	1/2...1-1/2	3/4...2	450	65	30	65	—	103T-AW⊗2-QB25C-E1C	**107T-AW⊗3-QB25C-E1C**
1.0...2.5	1/2	1/2...3/4	1/2...1-1/2	3/4...2	450	65	30	65	—	**103T-AW⊗2-QB25C-C1A**	—
1.0...2.5	1/2	1/2...3/4	1/2...1-1/2	3/4...2	450	65	30	65	—	**103T-AW⊗2-QB25C-C2A**	**107T-AW⊗3-QB25C-C2A**
D-Frame with 100-C/104-C Contactors on Panel Mounting Modules											
0.4...2.0	—	—	1/2...1	1/2...1	450	65	30	65	—	**103T-AW⊗2-RB25C-C1P**	—
0.4...2.0	—	—	1/2...1	1/2...1	450	65	30	65	—	**103T-AW⊗2-RB25C-C2P**	**107T-AW⊗3-RB25C-C2P**
1.0...2.5	1/2	1/2...3/4	1/2...1-1/2	3/4...2	450	65	30	65	—	**103T-AW⊗2-RB25C-D1C**	**107T-AW⊗3-RB25C-D1C**
1.0...2.5	1/2	1/2...3/4	1/2...1-1/2	3/4...2	450	65	30	65	—	**103T-AW⊗2-RB25C-E1C**	**107T-AW⊗3-RB25C-E1C**
1.0...2.5	1/2	1/2...3/4	1/2...1-1/2	3/4...2	450	65	30	65	—	**103T-AW⊗2-RB25C-C1A**	—
1.0...2.5	1/2	1/2...3/4	1/2...1-1/2	3/4...2	450	65	30	65	—	**103T-AW⊗2-RB25C-C2A**	**107T-AW⊗3-RB25C-C2A**
0.4...2.0	—	—	1/2...1	1/2...1	450	65	30	65	30	**103T-DW⊗2-RB25C-C1P**	—
0.4...2.0	—	—	1/2...1	1/2...1	450	65	30	65	30	**103T-DW⊗2-RB25C-C2P**	**107T-DW⊗3-RB25C-C2P**
1.0...2.5	1/2	1/2...3/4	1/2...1-1/2	3/4...2	450	65	30	65	30	**103T-DW⊗2-RB25C-D1C**	**107T-DW⊗3-RB25C-D1C**
1.0...2.5	1/2	1/2...3/4	1/2...1-1/2	3/4...2	450	65	30	65	30	**103T-DW⊗2-RB25C-E1C**	**107T-DW⊗3-RB25C-E1C**
1.0...2.5	1/2	1/2...3/4	1/2...1-1/2	3/4...2	450	65	30	65	30	**103T-DW⊗2-RB25C-C1A**	—
1.0...2.5	1/2	1/2...3/4	1/2...1-1/2	3/4...2	450	65	30	65	30	**103T-DW⊗2-RB25C-C2A**	**107T-DW⊗3-RB25C-C2A**
1.0...4.0	1/2...1	1/2...1	1/2...3	3/4...3	450	65	30	65	—	**103T-AW⊗2-RB40C-D1C**	**107T-AW⊗3-RB40C-D1C**
1.0...4.0	1/2...1	1/2...1	1/2...3	3/4...3	450	65	30	65	—	**103T-AW⊗2-RB40C-E1C**	**107T-AW⊗3-RB40C-E1C**
1.0...4.0	1/2...1	1/2...1	1/2...3	3/4...3	450	65	30	65	—	**103T-AW⊗2-RB40C-C1A**	—
1.0...4.0	1/2...1	1/2...1	1/2...3	3/4...3	450	65	30	65	—	**103T-AW⊗2-RB40C-C2A**	**107T-AW⊗3-RB40C-C2A**
1.0...4.0	1/2...1	1/2...1	1/2...3	3/4...3	450	65	30	65	30	**103T-DW⊗2-RB40C-D1C**	**107T-DW⊗3-RB40C-D1C**
1.0...4.0	1/2...1	1/2...1	1/2...3	3/4...3	450	65	30	65	30	**103T-DW⊗2-RB40C-E1C**	**107T-DW⊗3-RB40C-E1C**
1.0...4.0	1/2...1	1/2...1	1/2...3	3/4...3	450	65	30	65	30	**103T-DW⊗2-RB40C-C1A**	—
1.0...4.0	1/2...1	1/2...1	1/2...3	3/4...3	450	65	30	65	30	**103T-DW⊗2-RB40C-C2A**	**107T-DW⊗3-RB40C-C2A**
3.2...6.3	3/4...1-1/2	3/4...2	2...5	3...5	450	65	30	65	—	**103T-AW⊗2-RB63C-D1D**	**107T-AW⊗3-RB63C-D1D**
3.2...6.3	3/4...1-1/2	3/4...2	2...5	3...5	450	65	30	65	—	**103T-AW⊗2-RB63C-E1D**	**107T-AW⊗3-RB63C-E1D**
3.0...6.3	3/4...1-1/2	3/4...2	1-1/2...5	3...5	450	65	30	65	—	**103T-AW⊗2-RB63C-C1B**	—
3.0...6.3	3/4...1-1/2	3/4...2	1-1/2...5	3...5	450	65	30	65	—	**103T-AW⊗2-RB63C-C2B**	**107T-AW⊗3-RB63C-C2B**
3.2...10	3/4...3	3/4...3	2...7-1/2	3...10	450	65	30	65	—	**103T-BW⊗2-RC10C-D1D**	**107T-BW⊗3-RC10C-D1D**
3.2...10	3/4...3	3/4...3	2...7-1/2	3...10	450	65	30	65	—	**103T-BW⊗2-RC10C-E1D**	**107T-BW⊗3-RC10C-E1D**
3.0...10	3/4...3	3/4...3	1-1/2...7-1/2	3...10	450	65	30	65	—	**103T-BW⊗2-RC10C-C1B**	—
3.0...10	3/4...3	3/4...3	1-1/2...7-1/2	3...10	450	65	30	65	—	**103T-BW⊗2-RC10C-C2B**	**107T-BW⊗3-RC10C-C2B**
3.2...10	3/4...3	3/4...3	2...7-1/2	3...10	450	65	30	65	30	**103T-EW⊗3-RC10C-E1D**	**107T-EW⊗3-RC10C-E1D**
3.0...10	3/4...3	3/4...3	1-1/2...7-1/2	3...10	450	65	30	65	30	**103T-EW⊗3-RC10C-C1B**	—
3.0...10	3/4...3	3/4...3	1-1/2...7-1/2	3...10	450	65	30	65	30	**103T-EW⊗3-RC10C-C2B**	**107T-EW⊗3-RC10C-C2B**
3.2...16	3/4...5	3/4...5	2...10	3...10	450	65	30	65	—	**103T-CW⊗2-RC16C-D1D**	**107T-CW⊗3-RC16C-D1D**
3.2...16	3/4...5	3/4...5	2...10	3...10	450	65	30	65	—	**103T-CW⊗2-RC16C-E1D**	**107T-CW⊗3-RC16C-E1D**
3.0...15	3/4...5	3/4...5	1-1/2...10	3...10	450	65	30	65	—	**103T-CW⊗2-RC16C-C1B**	—
3.0...15	3/4...5	3/4...5	1-1/2...10	3...10	450	65	30	65	—	**103T-CW⊗2-RC16C-C2B**	**107T-CW⊗3-RC16C-C2B**
3.2...16	3/4...5	3/4...5	2...10	3...10	450	65	30	65	30	**103T-EW⊗3-RC16C-E1D**	**107T-EW⊗3-RC16C-E1D**
3.0...15	3/4...5	3/4...5	1-1/2...10	3...10	450	65	30	65	30	**103T-EW⊗3-RC16C-C1B**	—
3.0...15	3/4...5	3/4...5	1-1/2...10	3...10	450	65	30	65	30	**103T-EW⊗3-RC16C-C2B**	**107T-EW⊗3-RC16C-C2B**
5.4...23	1-1/2...5	1-1/2...7-1/2	5...15	5...15	450	65	—	50	—	**103T-DW⊗2-RC25C-D1E**	**107T-DW⊗3-RC25C-D1E**
5.4...23	1-1/2...5	1-1/2...7-1/2	5...15	5...15	450	65	—	50	—	**103T-DW⊗2-RC25C-E1E**	**107T-DW⊗3-RC25C-E1E**
5.0...23	1-1/2...5	1-1/2...7-1/2	5...15	5...15	450	65	—	50	—	**103T-DW⊗2-RC25C-C1C**	—
5.0...23	1-1/2...5	1-1/2...7-1/2	5...15	5...15	450	65	—	50	—	**103T-DW⊗2-RC25C-C2C**	**107T-DW⊗3-RC25C-C2C**
5.4...25	1-1/2...5	1-1/2...7-1/2	5...15	5...20	450	65	30	65	—	**103T-EW⊗3-RC25C-E1E**	**107T-EW⊗3-RC25C-E1E**
5.0...25	1-1/2...5	1-1/2...7-1/2	5...15	5...20	450	65	30	65	—	**103T-EW⊗3-RC25C-C1C**	—
5.0...25	1-1/2...5	1-1/2...7-1/2	5...15	5...20	450	65	30	65	—	**103T-EW⊗3-RC25C-C2C**	**107T-EW⊗3-RC25C-C2C**

Motor Current Adjustment Range [A]	UL/CSA Hp and Coordination Ratings (60 Hz)									DOL Starters	Reversing Starters
	Hp Ratings as a UL 508 Motor Controller in Group Motor Installations✶				Max. Fuse or C.B. per NEC	Max. Short-Circuit Current [kA]					
						Type 1 Coordination		Type 2 Coordination	Type 2 Coordination		
	200V AC	230V AC	460V AC	575V AC		480V AC	600V AC	480V AC	600V AC	Cat. No.	Cat. No.
F-Frame with 100-C/104-C Contactors on Panel Mounting Modules											
5.4...25	1-1/2...7-1/2	1-1/2...10	5...20	5...20	600	65	30	65	30	**103T-EW⊗3-TC25C-E1E**	**107T-EW⊗3-TC25C-E1E**
5.0...25	1-1/2...7-1/2	1-1/2...10	5...20	5...20	600	65	30	65	30	**103T-EW⊗3-TC25C-C1C**	—
5.0...25	1-1/2...7-1/2	1-1/2...10	5...20	5...20	600	65	30	65	30	**103T-EW⊗3-TC25C-C2C**	**107T-EW⊗3-TC25C-C2C**
9.0...30	3...7-1/2	3...10	7-1/2...20	7-1/2...25	600	65	30	65	30	**103T-EW⊗3-TC32C-E1F**	**107T-EW⊗3-TC32C-E1F**
9.0...30	3...7-1/2	3...10	7-1/2...20	7-1/2...25	600	65	30	65	30	**103T-EW⊗3-TC32C-C1D**	—
9.0...30	3...7-1/2	3...10	7-1/2...20	7-1/2...25	600	65	30	65	30	**103T-EW⊗3-TC32C-C2D**	**107T-EW⊗3-TC32C-C2D**
9.0...32	3...10	3...10	7-1/2...25	7-1/2...30	600	65	30	65	30	**103T-FW⊗3-TC32C-E1F**	**107T-FW⊗3-TC32C-E1F**
9.0...32	3...10	3...10	7-1/2...25	7-1/2...30	600	65	30	65	30	**103T-FW⊗3-TC32C-C1D**	—
9.0...32	3...10	3...10	7-1/2...25	7-1/2...30	600	65	30	65	30	**103T-FW⊗3-TC32C-C2D**	**107T-FW⊗3-TC32C-C2D**
9.0...37	3...10	3...10	7-1/2...25	7-1/2...30	600	65	18	65	—	**103T-FW⊗3-TC45C-E1F**	**107T-FW⊗3-TC45C-E1F**
9.0...37	3...10	3...10	7-1/2...25	7-1/2...30	600	65	18	65	—	**103T-FW⊗3-TC45C-C1D**	—
9.0...37	3...10	3...10	7-1/2...25	7-1/2...30	600	65	18	65	—	**103T-FW⊗3-TC45C-C2D**	**107T-FW⊗3-TC45C-C2D**
9.0...43	3...10	3...15	7-1/2...30	7-1/2...30	600	65	18	65	—	103T-GW⊗3-TC45C-E1F	**107T-GW⊗3-TC45C-E1F**
9.0...43	3...10	3...15	7-1/2...30	7-1/2...30	600	65	18	65	—	**103T-GW⊗3-TC45C-C1D**	—
9.0...43	3...10	3...15	7-1/2...30	7-1/2...30	600	65	18	65	—	103T-GW⊗3-TC45C-C2D	**107T-GW⊗3-TC45C-C2D**

✶ Hp ratings shown in the table are for reference. Final selection of the starter depends upon the actual motor full-load current and service factor.

⊗Coil voltage code—see page 2-295

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Product Selection and Coordination Ratings with Bulletin 193-EC, -ED, or EE Overload Relays— UL/CSA as a UL508 Self Protected Type E Combination Motor Controller

Motor Current Adjustment Range [A]	UL/CSA Hp and Coordination Ratings (60 Hz)						DOL Starters	Reversing Starters
	Hp Ratings as a UL 508 Self Protected Type E Combination Motor Controller✶				Max. Short-Circuit Current [kA]			
	200V AC	230V AC	460V AC	575V AC	480Y/277V AC	600Y/347V AC	Cat. No.	Cat. No.
C-Frame with 100-C/104-C Contactors on Standard Bus Bar Modules								
0.10...0.40	—	—	—	—	65	47	**103T-AT⊗2-QA40C-D1A-TE**	**107T-AT⊗3-QA40C-D1A-TE**
0.10...0.40	—	—	—	—	65	47	**103T-AT⊗2-QA40C-E1A-TE**	**107T-AT⊗3-QA40C-E1A-TE**
0.20...1.00	—	—	—	1/2	65	47	**103T-AT⊗2-QB10C-D1B-TE**	**107T-AT⊗3-QB10C-D1B-TE**
0.20...1.00	—	—	—	1/2	65	47	**103T-AT⊗2-QB10C-E1B-TE**	**107T-AT⊗3-QB10C-E1B-TE**
0.40...1.00	—	—	—	1/2	65	47	**103T-AT⊗2-QB10C-C1P-TE**	—
0.40...1.00	—	—	—	1/2	65	47	**103T-AT⊗2-QB10C-C2P-TE**	**107T-AT⊗3-QB10C-C2P-TE**
0.4...2.0	—	—	1/2...3/4	—	65	❖	**103T-AT⊗2-QB25C-C1P-TE**	—
0.4...2.0	—	—	1/2...3/4	—	65	❖	**103T-AT⊗2-QB25C-C2P-TE**	**107T-AT⊗3-QB25C-C2P-TE**
1.0...2.5	1/2	1/2	1/2...1	—	65	❖	**103T-AT⊗2-QB25C-D1C-TE**	**107T-AT⊗3-QB25C-D1C-TE**
1.0...2.5	1/2	1/2	1/2...1	—	65	❖	**103T-AT⊗2-QB25C-E1C-TE**	**107T-AT⊗3-QB25C-E1C-TE**
1.0...2.5	1/2	1/2	1/2...1	—	65	❖	**103T-AT⊗2-QB25C-C1A-TE**	—
1.0...2.5	1/2	1/2	1/2...1	—	65	❖	**103T-AT⊗2-QB25C-C2A-TE**	**107T-AT⊗3-QB25C-C2A-TE**
D-Frame with 100-C/104-C Contactors on Standard Bus Bar Modules								
0.4...2.0	—	—	1/2...3/4	—	65	❖	**103T-AT⊗2-RB25C-C1P-TE**	—
0.4...2.0	—	—	1/2...3/4	—	65	❖	**103T-AT⊗2-RB25C-C2P-TE**	**107T-AT⊗3-RB25C-C2P-TE**
1.0...2.5	1/2	1/2	1/2...1	—	65	❖	**103T-AT⊗2-RB25C-D1C-TE**	**107T-AT⊗3-RB25C-D1C-TE**
1.0...2.5	1/2	1/2	1/2...1	—	65	❖	**103T-AT⊗2-RB25C-E1C-TE**	**107T-AT⊗3-RB25C-E1C-TE**
1.0...2.5	1/2	1/2	1/2...1	—	65	❖	**103T-AT⊗2-RB25C-C1A-TE**	—
1.0...2.5	1/2	1/2	1/2...1	—	65	❖	**103T-AT⊗2-RB25C-C2A-TE**	**107T-AT⊗3-RB25C-C2A-TE**
0.4...2.0	—	—	1/2...3/4	1/2...1	65	30	**103T-DT⊗2-RB25C-C1P-TE**	—
0.4...2.0	—	—	1/2...3/4	1/2...1	65	30	**103T-DT⊗2-RB25C-C2P-TE**	**107T-DT⊗3-RB25C-C2P-TE**
1.0...2.5	1/2	1/2	1/2...1	3/4...1-1/2	65	30	**103T-DT⊗2-RB25C-D1C-TE**	**107T-DT⊗3-RB25C-D1C-TE**
1.0...2.5	1/2	1/2	1/2...1	3/4...1-1/2	65	30	**103T-DT⊗2-RB25C-E1C-TE**	**107T-DT⊗3-RB25C-E1C-TE**
1.0...2.5	1/2	1/2	1/2...1	3/4...1-1/2	65	30	**103T-DT⊗2-RB25C-C1A-TE**	—
1.0...2.5	1/2	1/2	1/2...1	3/4...1-1/2	65	30	**103T-DT⊗2-RB25C-C2A-TE**	**107T-DT⊗3-RB25C-C2A-TE**
1.0...4.0	1/2...3/4	1/2...3/4	1/2...2	3/4...3	65	30	**103T-DT⊗2-RB40C-D1C-TE**	**107T-DT⊗3-RB40C-D1C-TE**
1.0...4.0	1/2...3/4	1/2...3/4	1/2...2	3/4...3	65	30	**103T-DT⊗2-RB40C-E1C-TE**	**107T-DT⊗3-RB40C-E1C-TE**
1.0...4.0	1/2...3/4	1/2...3/4	1/2...2	3/4...3	65	30	**103T-DT⊗2-RB40C-C1A-TE**	—
1.0...4.0	1/2...3/4	1/2...3/4	1/2...2	3/4...3	65	30	**103T-DT⊗2-RB40C-C2A-TE**	**107T-DT⊗3-RB40C-C2A-TE**
3.2...10	3/4...2	3/4...3	2...5	3...7-1/2	65	30	**103T-ET⊗3-RC10C-E1D-TE**	**107T-ET⊗3-RC10C-E1D-TE**
3.0...10	3/4...2	3/4...3	1-1/2...5	3...7-1/2	65	30	**103T-ET⊗3-RC10C-C1B-TE**	—
3.0...10	3/4...2	3/4...3	1-1/2...5	3...7-1/2	65	30	**103T-ET⊗3-RC10C-C2B-TE**	**107T-ET⊗3-RC10C-C2B-TE**
3.2...16	3/4...3	3/4...5	2...10	3...10	65	30	**103T-ET⊗3-RC16C-E1D-TE**	**107T-ET⊗3-RC16C-E1D-TE**
3.0...15	3/4...3	3/4...5	2...10	3...10	65	30	**103T-ET⊗3-RC16C-C1B-TE**	—
3.0...15	3/4...3	3/4...5	2...10	3...10	65	30	**103T-ET⊗3-RC16C-C2B-TE**	**107T-ET⊗3-RC16C-C2B-TE**
5.4...25	1-1/2...5	1-1/2...7-1/2	5...15	—	65	❖	**103T-ET⊗3-RC25C-E1E-TE**	**107T-ET⊗3-RC25C-E1E-TE**
5.0...25	1-1/2...5	1-1/2...7-1/2	5...15	—	65	❖	**103T-ET⊗3-RC25C-C1C-TE**	—
5.0...25	1-1/2...5	1-1/2...7-1/2	5...15	—	65	❖	**103T-ET⊗3-RC25C-C2C-TE**	**107T-ET⊗3-RC25C-C2C-TE**
F-Frame with 100-C/104-C Contactors on Standard Bus Bar Modules								
5.4...25	1-1/2...5	1-1/2...7-1/2	5...15	5...20	65	30	**103T-ET⊗3-TC25C-E1E-TE**	**107T-ET⊗3-TC25C-E1E-TE**
5.0...25	1-1/2...5	1-1/2...7-1/2	5...15	5...20	65	30	**103T-ET⊗3-TC25C-C1C-TE**	—
5.0...25	1-1/2...5	1-1/2...7-1/2	5...15	5...20	65	30	**103T-ET⊗3-TC25C-C2C-TE**	**107T-ET⊗3-TC25C-C2C-TE**
9.0...30	3...7-1/2	3...10	7-1/2...20	7-1/2...20	65	30	**103T-ET⊗3-TC32C-E1F-TE**	**107T-ET⊗3-TC32C-E1F-TE**
9.0...30	3...7-1/2	3...10	7-1/2...20	7-1/2...20	65	30	**103T-ET⊗3-TC32C-C1D-TE**	—
9.0...30	3...7-1/2	3...10	7-1/2...20	7-1/2...20	65	30	**103T-ET⊗3-TC32C-C2D-TE**	**107T-ET⊗3-TC32C-C2D-TE**
9.0...32	3...7-1/2	3...10	7-1/2...20	7-1/2...25	65	30	**103T-FT⊗3-TC32C-E1F-TE**	**107T-ET⊗3-TC32C-E1F-TE**
9.0...32	3...7-1/2	3...10	7-1/2...20	7-1/2...25	65	30	**103T-FT⊗3-TC32C-C1D-TE**	—
9.0...32	3...7-1/2	3...10	7-1/2...20	7-1/2...25	65	30	**103T-FT⊗3-TC32C-C2D-TE**	**107T-ET⊗3-TC32C-C2D-TE**
9.0...37	3...10	3...10	7-1/2...25	—	65	❖	**103T-FT⊗3-TC45C-E1F-TE**	**107T-FT⊗3-TC45C-E1F-TE**
9.0...37	3...10	3...10	7-1/2...25	—	65	❖	**103T-FT⊗3-TC45C-C1D-TE**	—
9.0...37	3...10	3...10	7-1/2...25	—	65	❖	**103T-FT⊗3-TC45C-C2D-TE**	**107T-FT⊗3-TC45C-C2D-TE**
9.0...43	3...10	3...15	7-1/2...30	—	65	❖	**103T-GT⊗3-TC45C-E1F-TE**	**107T-GT⊗3-TC45C-E1F-TE**
9.0...43	3...10	3...15	7-1/2...30	—	65	❖	**103T-GT⊗3-TC45C-C1D-TE**	—
9.0...43	3...10	3...15	7-1/2...30	—	65	❖	**103T-GT⊗3-TC45C-C2D-TE**	**107T-GT⊗3-TC45C-C2D-TE**
18...45	7-1/2...10	7-1/2...15	15...30	—	65	❖	**103T-HT⊗3-TC45C-E1G-TE**	**107T-HT⊗3-TC45C-E1G-TE**
9.0...45	3...10	3...15	7-1/2...30	—	65	❖	**103T-HT⊗3-TC45C-C1D-TE**	—
9.0...45	3...10	3...15	7-1/2...30	—	65	❖	**103T-HT⊗3-TC45C-C2D-TE**	**107T-HT⊗3-TC45C-C2D-TE**

✶ Horsepower ratings shown in the table are for reference. Final selection of the starter depends upon the actual motor full-load current and service factor.

❖ This starter is not valid for application at this horsepower and voltage.

⊗Coil voltage code—see page 2-295

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Product Selection and Coordination Ratings with Bulletin 193-EC, -ED, or EE Overload Relays— UL/CSA as a UL508 Self Protected Type E Combination Motor Controller, Continued

Motor Current Adjustment Range [A]	UL/CSA Hp and Coordination Ratings (60 Hz)						DOL Starters	Reversing Starters
	Hp Ratings as a UL 508 Self Protected Type E Combination Motor Controller✶				Max. Short-Circuit Current [kA]			
	200V AC	230V AC	460V AC	575V AC	480Y/277V AC	600Y/347V AC	Cat. No.	Cat. No.
C-Frame with 100-C/104-C Contactors on ISO Bus Bar Modules								
0.10...0.40	—	—	—	—	65	47	**103T-AS⊗2-QA40C-D1A-TE**	**107T-AS⊗3-QA40C-D1A-TE**
0.10...0.40	—	—	—	—	65	47	**103T-AS⊗2-QA40C-E1A-TE**	**107T-AS⊗3-QA40C-E1A-TE**
0.20...1.00	—	—	—	1/2	65	47	**103T-AS⊗2-QB10C-D1B-TE**	**107T-AS⊗3-QB10C-D1B-TE**
0.20...1.00	—	—	—	1/2	65	47	**103T-AS⊗2-QB10C-E1B-TE**	**107T-AS⊗3-QB10C-E1B-TE**
0.40...1.00	—	—	—	1/2	65	47	**103T-AS⊗2-QB10C-C1P-TE**	—
0.40...1.00	—	—	—	1/2	65	47	**103T-AS⊗2-QB10C-C2P-TE**	**107T-AS⊗3-QB10C-C2P-TE**
0.4...2.0	—	—	1/2...3/4	—	65	❖	**103T-AS⊗2-QB25C-C1P-TE**	—
0.4...2.0	—	—	1/2...3/4	—	65	❖	**103T-AS⊗2-QB25C-C2P-TE**	**107T-AS⊗3-QB25C-C2P-TE**
1.0...2.5	1/2	1/2	1/2...1	—	65	❖	**103T-AS⊗2-QB25C-D1C-TE**	**107T-AS⊗3-QB25C-D1C-TE**
1.0...2.5	1/2	1/2	1/2...1	—	65	❖	**103T-AS⊗2-QB25C-E1C-TE**	**107T-AS⊗3-QB25C-E1C-TE**
1.0...2.5	1/2	1/2	1/2...1	—	65	❖	**103T-AS⊗2-QB25C-C1A-TE**	—
1.0...2.5	1/2	1/2	1/2...1	—	65	❖	**103T-AS⊗2-QB25C-C2A-TE**	**107T-AS⊗3-QB25C-C2A-TE**
D-Frame with 100-C/104-C Contactors on ISO Bus Bar Modules								
0.4...2.0	—	—	1/2...3/4	—	65	❖	**103T-AS⊗2-RB25C-C1P-TE**	—
0.4...2.0	—	—	1/2...3/4	—	65	❖	**103T-AS⊗2-RB25C-C2P-TE**	**107T-AS⊗3-RB25C-C2P-TE**
1.0...2.5	1/2	1/2	1/2...1	—	65	❖	**103T-AS⊗2-RB25C-D1C-TE**	**107T-AS⊗3-RB25C-D1C-TE**
1.0...2.5	1/2	1/2	1/2...1	—	65	❖	**103T-AS⊗2-RB25C-E1C-TE**	**107T-AS⊗3-RB25C-E1C-TE**
1.0...2.5	1/2	1/2	1/2...1	—	65	❖	**103T-AS⊗2-RB25C-C1A-TE**	—
1.0...2.5	1/2	1/2	1/2...1	—	65	❖	**103T-AS⊗2-RB25C-C2A-TE**	**107T-AS⊗3-RB25C-C2A-TE**
0.4...2.0	—	—	1/2...3/4	1/2...1	65	30	**103T-DS⊗2-RB25C-C1P-TE**	—
0.4...2.0	—	—	1/2...3/4	1/2...1	65	30	**103T-DS⊗2-RB25C-C2P-TE**	**107T-DS⊗3-RB25C-C2P-TE**
1.0...2.5	1/2	1/2	1/2...1	3/4...1-1/2	65	30	**103T-DS⊗2-RB25C-D1C-TE**	**107T-DS⊗3-RB25C-D1C-TE**
1.0...2.5	1/2	1/2	1/2...1	3/4...1-1/2	65	30	**103T-DS⊗2-RB25C-E1C-TE**	**107T-DS⊗3-RB25C-E1C-TE**
1.0...2.5	1/2	1/2	1/2...1	3/4...1-1/2	65	30	**103T-DS⊗2-RB25C-C1A-TE**	—
1.0...2.5	1/2	1/2	1/2...1	3/4...1-1/2	65	30	**103T-DS⊗2-RB25C-C2A-TE**	**107T-DS⊗3-RB25C-C2A-TE**
1.0...4.0	1/2...3/4	1/2...3/4	1/2...2	3/4...3	65	30	**103T-DS⊗2-RB40C-D1C-TE**	**107T-DS⊗3-RB40C-D1C-TE**
1.0...4.0	1/2...3/4	1/2...3/4	1/2...2	3/4...3	65	30	**103T-DS⊗2-RB40C-E1C-TE**	**107T-DS⊗3-RB40C-E1C-TE**
1.0...4.0	1/2...3/4	1/2...3/4	1/2...2	3/4...3	65	30	**103T-DS⊗2-RB40C-C1A-TE**	—
1.0...4.0	1/2...3/4	1/2...3/4	1/2...2	3/4...3	65	30	**103T-DS⊗2-RB40C-C2A-TE**	**107T-DS⊗3-RB40C-C2A-TE**
3.2...10	3/4...2	3/4...3	2...5	3...7-1/2	65	30	**103T-ES⊗3-RC10C-E1D-TE**	**107T-ES⊗3-RC10C-E1D-TE**
3.0...10	3/4...2	3/4...3	1-1/2...5	3...7-1/2	65	30	**103T-ES⊗3-RC10C-C1B-TE**	—
3.0...10	3/4...2	3/4...3	1-1/2...5	3...7-1/2	65	30	**103T-ES⊗3-RC10C-C2B-TE**	**107T-ES⊗3-RC10C-C2B-TE**
3.2...16	3/4...3	3/4...5	2...10	3...10	65	30	**103T-ES⊗3-RC16C-E1D-TE**	**107T-ES⊗3-RC16C-E1D-TE**
3.0...15	3/4...3	3/4...5	2...10	3...10	65	30	**103T-ES⊗3-RC16C-C1B-TE**	—
3.0...15	3/4...3	3/4...5	2...10	3...10	65	30	**103T-ES⊗3-RC16C-C2B-TE**	**107T-ES⊗3-RC16C-C2B-TE**
5.4...25	1-1/2...5	1-1/2...7-1/2	5...15	—	65	❖	**103T-ES⊗3-RC25C-E1E-TE**	**107T-ES⊗3-RC25C-E1E-TE**
5.0...25	1-1/2...5	1-1/2...7-1/2	5...15	—	65	❖	**103T-ES⊗3-RC25C-C1C-TE**	—
5.0...25	1-1/2...5	1-1/2...7-1/2	5...15	—	65	❖	**103T-ES⊗3-RC25C-C2C-TE**	**107T-ES⊗3-RC25C-C2C-TE**
F-Frame with 100-C/104-C Contactors on ISO Bus Bar Modules								
5.4...25	1-1/2...5	1-1/2...7-1/2	5...15	5...20	65	30	**103T-ES⊗3-TC25C-E1E-TE**	**107T-ES⊗3-TC25C-E1E-TE**
5.0...25	1-1/2...5	1-1/2...7-1/2	5...15	5...20	65	30	**103T-ES⊗3-TC25C-C1C-TE**	—
5.0...25	1-1/2...5	1-1/2...7-1/2	5...15	5...20	65	30	**103T-ES⊗3-TC25C-C2C-TE**	**107T-ES⊗3-TC25C-C2C-TE**
9.0...30	3...7-1/2	3...10	7-1/2...20	7-1/2...20	65	30	**103T-ES⊗3-TC32C-E1F-TE**	**107T-ES⊗3-TC32C-E1F-TE**
9.0...30	3...7-1/2	3...10	7-1/2...20	7-1/2...20	65	30	**103T-ES⊗3-TC32C-C1D-TE**	—
9.0...30	3...7-1/2	3...10	7-1/2...20	7-1/2...20	65	30	**103T-ES⊗3-TC32C-C2D-TE**	**107T-ES⊗3-TC32C-C2D-TE**
9.0...32	3...7-1/2	3...10	7-1/2...20	7-1/2...25	65	30	**103T-FS⊗3-TC32C-E1F-TE**	**107T-ES⊗3-TC32C-E1F-TE**
9.0...32	3...7-1/2	3...10	7-1/2...20	7-1/2...25	65	30	**103T-FS⊗3-TC32C-C1D-TE**	—
9.0...32	3...7-1/2	3...10	7-1/2...20	7-1/2...25	65	30	**103T-FS⊗3-TC32C-C2D-TE**	**107T-ES⊗3-TC32C-C2D-TE**
9.0...37	3...10	3...10	7-1/2...25	—	65	❖	**103T-FS⊗3-TC45C-E1F-TE**	**107T-FS⊗3-TC45C-E1F-TE**
9.0...37	3...10	3...10	7-1/2...25	—	65	❖	**103T-FS⊗3-TC45C-C1D-TE**	—
9.0...37	3...10	3...10	7-1/2...25	—	65	❖	**103T-FS⊗3-TC45C-C2D-TE**	**107T-FS⊗3-TC45C-C2D-TE**
9.0...43	3...10	3...15	7-1/2...30	—	65	❖	**103T-GS⊗3-TC45C-E1F-TE**	**107T-GS⊗3-TC45C-E1F-TE**
9.0...43	3...10	3...15	7-1/2...30	—	65	❖	**103T-GS⊗3-TC45C-C1D-TE**	—
9.0...43	3...10	3...15	7-1/2...30	—	65	❖	**103T-GS⊗3-TC45C-C2D-TE**	**107T-GS⊗3-TC45C-C2D-TE**

✶ Horsepower ratings shown in the table are for reference. Final selection of the starter depends upon the actual motor full-load current and service factor.
❖ This starter is not valid for application at this horsepower and voltage.
⊗Coil voltage code—see page 2-295

Product Selection and Coordination Ratings with Bulletin 193-EC, -ED, or EE Overload Relays— UL/CSA as a UL508 Self Protected Type E Combination Motor Controller, Continued

Motor Current Adjustment Range [A]	UL/CSA Hp and Coordination Ratings (60 Hz)						DOL Starters	Reversing Starters
	Hp Ratings as a UL 508 Self Protected Type E Combination Motor Controller✶				Max. Short-Circuit Current [kA]			
	200V AC	230V AC	460V AC	575V AC	480Y/277V AC	600Y/347V AC	Cat. No.	Cat. No.
C-Frame with 100-C/104-C Contactors on Panel Mounting Modules								
0.10...0.40	—	—	—	—	65	47	**103T-AW⊗2-QA40C-D1A-TE**	**107T-AW⊗3-QA40C-D1A-TE**
0.10...0.40	—	—	—	—	65	47	**103T-AW⊗2-QA40C-E1A-TE**	**107T-AW⊗3-QA40C-E1A-TE**
0.20...1.00	—	—	—	1/2	65	47	**103T-AW⊗2-QB10C-D1B-TE**	**107T-AW⊗3-QB10C-D1B-TE**
0.20...1.00	—	—	—	1/2	65	47	**103T-AW⊗2-QB10C-E1B-TE**	**107T-AW⊗3-QB10C-E1B-TE**
0.40...1.00	—	—	—	1/2	65	47	**103T-AW⊗2-QB10C-C1P-TE**	—
0.40...1.00	—	—	—	1/2	65	47	**103T-AW⊗2-QB10C-C2P-TE**	**107T-AW⊗3-QB10C-C2P-TE**
0.4...2.0	—	—	1/2...3/4	—	65	❖	**103T-AW⊗2-QB25C-C1P-TE**	—
0.4...2.0	—	—	1/2...3/4	—	65	❖	**103T-AW⊗2-QB25C-C2P-TE**	**107T-AW⊗3-QB25C-C2P-TE**
1.0...2.5	1/2	1/2	1/2...1	—	65	❖	**103T-AW⊗2-QB25C-D1C-TE**	**107T-AW⊗3-QB25C-D1C-TE**
1.0...2.5	1/2	1/2	1/2...1	—	65	❖	**103T-AW⊗2-QB25C-E1C-TE**	**107T-AW⊗3-QB25C-E1C-TE**
1.0...2.5	1/2	1/2	1/2...1	—	65	❖	**103T-AW⊗2-QB25C-C1A-TE**	—
1.0...2.5	1/2	1/2	1/2...1	—	65	❖	**103T-AW⊗2-QB25C-C2A-TE**	**107T-AW⊗3-QB25C-C2A-TE**
D-Frame with 100-C/104-C Contactors on Panel Mounting Modules								
0.4...2.0	—	—	1/2...3/4	—	65	❖	**103T-AW⊗2-RB25C-C1P-TE**	—
0.4...2.0	—	—	1/2...3/4	—	65	❖	**103T-AW⊗2-RB25C-C2P-TE**	**107T-AW⊗3-RB25C-C2P-TE**
1.0...2.5	1/2	1/2	1/2...1	—	65	❖	**103T-AW⊗2-RB25C-D1C-TE**	**107T-AW⊗3-RB25C-D1C-TE**
1.0...2.5	1/2	1/2	1/2...1	—	65	❖	**103T-AW⊗2-RB25C-E1C-TE**	**107T-AW⊗3-RB25C-E1C-TE**
1.0...2.5	1/2	1/2	1/2...1	—	65	❖	**103T-AW⊗2-RB25C-C1A-TE**	—
1.0...2.5	1/2	1/2	1/2...1	—	65	❖	**103T-AW⊗2-RB25C-C2A-TE**	**107T-AW⊗3-RB25C-C2A-TE**
0.4...2.0	—	—	1/2...3/4	1/2...1	65	30	**103T-DW⊗2-RB25C-C1P-TE**	—
0.4...2.0	—	—	1/2...3/4	1/2...1	65	30	**103T-DW⊗2-RB25C-C2P-TE**	**107T-DW⊗3-RB25C-C2P-TE**
1.0...2.5	1/2	1/2	1/2...1	3/4...1-1/2	65	30	**103T-DW⊗2-RB25C-D1C-TE**	**107T-DW⊗3-RB25C-D1C-TE**
1.0...2.5	1/2	1/2	1/2...1	3/4...1-1/2	65	30	**103T-DW⊗2-RB25C-E1C-TE**	**107T-DW⊗3-RB25C-E1C-TE**
1.0...2.5	1/2	1/2	1/2...1	3/4...1-1/2	65	30	**103T-DW⊗2-RB25C-C1A-TE**	—
1.0...2.5	1/2	1/2	1/2...1	3/4...1-1/2	65	30	**103T-DW⊗2-RB25C-C2A-TE**	**107T-DW⊗3-RB25C-C2A-TE**
1.0...4.0	1/2...3/4	1/2...3/4	1/2...2	3/4...3	65	30	**103T-DW⊗2-RB40C-D1C-TE**	**107T-DW⊗3-RB40C-D1C-TE**
1.0...4.0	1/2...3/4	1/2...3/4	1/2...2	3/4...3	65	30	**103T-DW⊗2-RB40C-E1C-TE**	**107T-DW⊗3-RB40C-E1C-TE**
1.0...4.0	1/2...3/4	1/2...3/4	1/2...2	3/4...3	65	30	**103T-DW⊗2-RB40C-C1A-TE**	—
1.0...4.0	1/2...3/4	1/2...3/4	1/2...2	3/4...3	65	30	**103T-DW⊗2-RB40C-C2A-TE**	**107T-DW⊗3-RB40C-C2A-TE**
3.2...10	3/4...2	3/4...3	2...5	3...7-1/2	65	30	**103T-EW⊗3-RC10C-E1D-TE**	**107T-EW⊗3-RC10C-E1D-TE**
3.0...10	3/4...2	3/4...3	1-1/2...5	3...7-1/2	65	30	**103T-EW⊗3-RC10C-C1B-TE**	—
3.0...10	3/4...2	3/4...3	1-1/2...5	3...7-1/2	65	30	**103T-EW⊗3-RC10C-C2B-TE**	**107T-EW⊗3-RC10C-C2B-TE**
3.2...16	3/4...3	3/4...5	2...10	3...10	65	30	**103T-EW⊗3-RC16C-E1D-TE**	**107T-EW⊗3-RC16C-E1D-TE**
3.0...15	3/4...3	3/4...5	2...10	3...10	65	30	**103T-EW⊗3-RC16C-C1B-TE**	—
3.0...15	3/4...3	3/4...5	2...10	3...10	65	30	**103T-EW⊗3-RC16C-C2B-TE**	**107T-EW⊗3-RC16C-C2B-TE**
5.4...25	1-1/2...5	1-1/2...7-1/2	5...15	—	65	❖	**103T-EW⊗3-RC25C-E1E-TE**	**107T-EW⊗3-RC25C-E1E-TE**
5.0...25	1-1/2...5	1-1/2...7-1/2	5...15	—	65	❖	**103T-EW⊗3-RC25C-C1C-TE**	—
5.0...25	1-1/2...5	1-1/2...7-1/2	5...15	—	65	❖	**103T-EW⊗3-RC25C-C2C-TE**	**107T-EW⊗3-RC25C-C2C-TE**
F-Frame with 100-C/104-C Contactors on Panel Mounting Modules								
5.4...25	1-1/2...5	1-1/2...7-1/2	5...15	5...20	65	30	**103T-EW⊗3-TC25C-E1E-TE**	**107T-EW⊗3-TC25C-E1E-TE**
5.0...25	1-1/2...5	1-1/2...7-1/2	5...15	5...20	65	30	**103T-EW⊗3-TC25C-C1C-TE**	—
5.0...25	1-1/2...5	1-1/2...7-1/2	5...15	5...20	65	30	**103T-EW⊗3-TC25C-C2C-TE**	**107T-EW⊗3-TC25C-C2C-TE**
9.0...30	3...7-1/2	3...10	7-1/2...20	7-1/2...20	65	30	**103T-EW⊗3-TC32C-E1F-TE**	**107T-EW⊗3-TC32C-E1F-TE**
9.0...30	3...7-1/2	3...10	7-1/2...20	7-1/2...20	65	30	**103T-EW⊗3-TC32C-C1D-TE**	—
9.0...30	3...7-1/2	3...10	7-1/2...20	7-1/2...20	65	30	**103T-EW⊗3-TC32C-C2D-TE**	**107T-EW⊗3-TC32C-C2D-TE**
9.0...32	3...7-1/2	3...10	7-1/2...20	7-1/2...25	65	30	**103T-FW⊗3-TC32C-E1F-TE**	**107T-EW⊗3-TC32C-E1F-TE**
9.0...32	3...7-1/2	3...10	7-1/2...20	7-1/2...25	65	30	**103T-FW⊗3-TC32C-C1D-TE**	—
9.0...32	3...7-1/2	3...10	7-1/2...20	7-1/2...25	65	30	**103T-FW⊗3-TC32C-C2D-TE**	**107T-EW⊗3-TC32C-C2D-TE**
9.0...37	3...10	3...10	7-1/2...25	—	65	❖	**103T-FW⊗3-TC45C-E1F-TE**	**107T-FW⊗3-TC45C-E1F-TE**
9.0...37	3...10	3...10	7-1/2...25	—	65	❖	**103T-FW⊗3-TC45C-C1D-TE**	—
9.0...37	3...10	3...10	7-1/2...25	—	65	❖	**103T-FW⊗3-TC45C-C2D-TE**	**107T-FW⊗3-TC45C-C2D-TE**
9.0...43	3...10	3...15	7-1/2...30	—	65	❖	**103T-GW⊗3-TC45C-E1F-TE**	**107T-GW⊗3-TC45C-E1F-TE**
9.0...43	3...10	3...15	7-1/2...30	—	65	❖	**103T-GW⊗3-TC45C-C1D-TE**	—
9.0...43	3...10	3...15	7-1/2...30	—	65	❖	**103T-GW⊗3-TC45C-C2D-TE**	**107T-GW⊗3-TC45C-C2D-TE**
18...45	7-1/2...10	7-1/2...15	15...30	—	65	❖	**103T-HW⊗3-TC45C-E1G-TE**	**107T-HW⊗3-TC45C-E1G-TE**
9.0...45	3...10	3...15	7-1/2...30	—	65	❖	**103T-HW⊗3-TC45C-C1D-TE**	—
9.0...45	3...10	3...15	7-1/2...30	—	65	❖	**103T-HW⊗3-TC45C-C2D-TE**	**107T-HW⊗3-TC45C-C2D-TE**

✶ Horsepower ratings shown in the table are for reference. Final selection of the starter depends upon the actual motor full-load current and service factor.

❖ This starter is not valid for application at this horsepower and voltage.

⊗ Coil voltage code—see page 2-295

Product Selection and Coordination Ratings with Bulletin 193-EC, -ED, or EE Overload Relays—UL/CSA as a Fused Motor Controller

Motor Current Adjustment Range [A]	UL/CSA Hp and Coordination Ratings (60 Hz)								DOL Starters	Reversing Starters
	Hp Ratings as a Fused Motor Controller∗				Type 1 Coordination		Type 2 Coordination			
	200V AC	230V AC	460V AC	575V AC	Max. Class CC Fuse	Max Short-Circuit Current [kA], 600V AC	Max. Class CC Fuse	Max Short-Circuit Current [kA], 600V AC	Cat. No.	Cat. No.
Bulletin 140F Fuse Holder with 100-C/104-C Contactors on Standard Bus Bar Modules										
0.10...0.50	—	—	—	—	3	100	3	100	**103T-AT⊗2-F3CC-D1A**	**107T-AT⊗3-F3CC-D1A**
0.10...0.50	—	—	—	—	3	100	3	100	**103T-AT⊗2-F3CC-E1A**	**107T-AT⊗3-F3CC-E1A**
0.20...1.00	—	—	—	1/2	6	100	6	100	**103T-AT⊗2-F3CC-D1B**	**107T-AT⊗3-F3CC-D1B**
0.20...1.00	—	—	—	1/2	6	100	6	100	**103T-AT⊗2-F3CC-E1B**	**107T-AT⊗3-F3CC-E1B**
0.40...1.00	—	—	—	1/2	6	100	6	100	**103T-AT⊗2-F3CC-C1P**	—
0.40...1.00	—	—	—	1/2	6	100	6	100	**103T-AT⊗2-F3CC-C2P**	**107T-AT⊗3-F3CC-C2P**
1.0...5.0	1/2...1	1/2...1	1/2...3	1/2...3	20	100	15	100	**103T-AT⊗2-F3CC-D1C**	**107T-AT⊗3-F3CC-D1C**
1.0...5.0	1/2...1	1/2...1	1/2...3	1/2...3	20	100	15	100	**103T-AT⊗2-F3CC-E1C**	**107T-AT⊗3-F3CC-E1C**
1.0...5.0	1/2...1	1/2...1	1/2...3	1/2...3	20	100	15	100	**103T-AT⊗2-F3CC-C1A**	—
1.0...5.0	1/2...1	1/2...1	1/2...3	1/2...3	20	100	15	100	**103T-AT⊗2-F3CC-C2A**	**107T-AT⊗3-F3CC-C2A**
3.2...9.0	3/4...2	3/4...2	2...5	3...7-1/2	20	100	15	100	**103T-AT⊗2-F3CC-D1D**	**107T-AT⊗3-F3CC-D1D**
3.2...9.0	3/4...2	3/4...2	2...5	3...7-1/2	20	100	15	100	**103T-AT⊗2-F3CC-E1D**	**107T-AT⊗3-F3CC-E1D**
3.0...9.0	3/4...2	3/4...2	2...5	3...7-1/2	20	100	15	100	**103T-AT⊗2-F3CC-C1B**	—
3.0...9.0	3/4...2	3/4...2	2...5	3...7-1/2	20	100	15	100	**103T-AT⊗2-F3CC-C2B**	**107T-AT⊗3-F3CC-C2B**
3.2...12.0	3/4...3	3/4...3	2...7-1/2	3...10	20	100	20	100	**103T-BT⊗2-F3CC-D1D**	**107T-BT⊗3-F3CC-D1D**
3.2...12.0	3/4...3	3/4...3	2...7-1/2	3...10	20	100	20	100	**103T-BT⊗2-F3CC-E1D**	**107T-BT⊗3-F3CC-E1D**
3.0...12.0	3/4...3	3/4...3	2...7-1/2	3...10	20	100	20	100	**103T-BT⊗2-F3CC-C1B**	—
3.0...12.0	3/4...3	3/4...3	2...7-1/2	3...10	20	100	20	100	**103T-BT⊗2-F3CC-C2B**	**107T-BT⊗3-F3CC-C2B**
3.2...16.0	3/4...3	3/4...5	2...10	3...15	30	100	30	100	**103T-CT⊗2-F3CC-D1D**	**107T-CT⊗3-F3CC-D1D**
3.2...16.0	3/4...3	3/4...5	2...10	3...15	30	100	30	100	**103T-CT⊗2-F3CC-E1D**	**107T-CT⊗3-F3CC-E1D**
3.0...15.0	3/4...3	3/4...5	2...10	3...15	30	100	30	100	**103T-CT⊗2-F3CC-C1B**	—
3.0...15.0	3/4...3	3/4...5	2...10	3...15	30	100	30	100	**103T-CT⊗2-F3CC-C2B**	**107T-CT⊗3-F3CC-C2B**
5.4...23.0	1-1/2...5	1-1/2...7-1/2	5...15	5...15	30	100	30	100	**103T-DT⊗2-F3CC-D1E**	**107T-DT⊗3-F3CC-D1E**
5.4...23.0	1-1/2...5	1-1/2...7-1/2	5...15	5...15	30	100	30	100	**103T-DT⊗2-F3CC-E1E**	**107T-DT⊗3-F3CC-E1E**
5.0...23.0	1-1/2...5	1-1/2...7-1/2	5...15	5...15	30	100	30	100	**103T-DT⊗2-F3CC-C1C**	—
5.0...23.0	1-1/2...5	1-1/2...7-1/2	5...15	5...15	30	100	30	100	**103T-DT⊗2-F3CC-C2C**	**107T-DT⊗3-F3CC-C2C**

∗ Horsepower ratings shown in the table are for reference. Final selection of the starter depends upon the actual motor full-load current and service factor.

⊗Coil voltage code—see page 2-295

Product Selection and Coordination Ratings with Bulletin 193-EC, -ED, or EE Overload Relays—UL/CSA as a Fused Motor Controller, Continued

Motor Current Adjustment Range [A]	UL/CSA Hp and Coordination Ratings (60 Hz)								DOL Starters	Reversing Starters
	Hp Ratings as a Fused Motor Controller∗				Type 1 Coordination		Type 2 Coordination			
	200V AC	230V AC	460V AC	575V AC	Max. Class CC Fuse	Max Short-Circuit Current [kA], 600V AC	Max. Class CC Fuse	Max Short-Circuit Current [kA], 600V AC	Cat. No.	Cat. No.
Bulletin 140F Fuse Holder with 100-C/104-C Contactors on ISO Bus Bar Modules										
0.10...0.50	—	—	—	—	3	100	3	100	**103T-AS⊗2-F3CC-D1A**	**107T-AS⊗3-F3CC-D1A**
0.10...0.50	—	—	—	—	3	100	3	100	**103T-AS⊗2-F3CC-E1A**	**107T-AS⊗3-F3CC-E1A**
0.20...1.00	—	—	—	1/2	6	100	6	100	**103T-AS⊗2-F3CC-D1B**	**107T-AS⊗3-F3CC-D1B**
0.20...1.00	—	—	—	1/2	6	100	6	100	**103T-AS⊗2-F3CC-E1B**	**107T-AS⊗3-F3CC-E1B**
0.40...1.00	—	—	—	1/2	6	100	6	100	**103T-AS⊗2-F3CC-C1P**	—
0.40...1.00	—	—	—	1/2	6	100	6	100	**103T-AS⊗2-F3CC-C2P**	**107T-AS⊗3-F3CC-C2P**
1.0...5.0	1/2...1	1/2...1	1/2...3	1/2...3	20	100	15	100	**103T-AS⊗2-F3CC-D1C**	**107T-AS⊗3-F3CC-D1C**
1.0...5.0	1/2...1	1/2...1	1/2...3	1/2...3	20	100	15	100	**103T-AS⊗2-F3CC-E1C**	**107T-AS⊗3-F3CC-E1C**
1.0...5.0	1/2...1	1/2...1	1/2...3	1/2...3	20	100	15	100	**103T-AS⊗2-F3CC-C1A**	—
1.0...5.0	1/2...1	1/2...1	1/2...3	1/2...3	20	100	15	100	**103T-AS⊗2-F3CC-C2A**	**107T-AS⊗3-F3CC-C2A**
3.2...9.0	3/4...2	3/4...2	2...5	3...7-1/2	20	100	15	100	**103T-AS⊗2-F3CC-D1D**	**107T-AS⊗3-F3CC-D1D**
3.2...9.0	3/4...2	3/4...2	2...5	3...7-1/2	20	100	15	100	**103T-AS⊗2-F3CC-E1D**	**107T-AS⊗3-F3CC-E1D**
3.0...9.0	3/4...2	3/4...2	2...5	3...7-1/2	20	100	15	100	**103T-AS⊗2-F3CC-C1B**	—
3.0...9.0	3/4...2	3/4...2	2...5	3...7-1/2	20	100	15	100	**103T-AS⊗2-F3CC-C2B**	**107T-AS⊗3-F3CC-C2B**
3.2...12.0	3/4...3	3/4...3	2...7-1/2	3...10	20	100	20	100	**103T-BS⊗2-F3CC-D1D**	**107T-BS⊗3-F3CC-D1D**
3.2...12.0	3/4...3	3/4...3	2...7-1/2	3...10	20	100	20	100	**103T-BS⊗2-F3CC-E1D**	**107T-BS⊗3-F3CC-E1D**
3.0...12.0	3/4...3	3/4...3	2...7-1/2	3...10	20	100	20	100	**103T-BS⊗2-F3CC-C1B**	—
3.0...12.0	3/4...3	3/4...3	2...7-1/2	3...10	20	100	20	100	**103T-BS⊗2-F3CC-C2B**	**107T-BS⊗3-F3CC-C2B**
3.2...16.0	3/4...3	3/4...5	2...10	3...15	30	100	30	100	**103T-CS⊗2-F3CC-D1D**	**107T-CS⊗3-F3CC-D1D**
3.2...16.0	3/4...3	3/4...5	2...10	3...15	30	100	30	100	**103T-CS⊗2-F3CC-E1D**	**107T-CS⊗3-F3CC-E1D**
3.0...15.0	3/4...3	3/4...5	2...10	3...15	30	100	30	100	**103T-CS⊗2-F3CC-C1B**	—
3.0...15.0	3/4...3	3/4...5	2...10	3...15	30	100	30	100	**103T-CS⊗2-F3CC-C2B**	**107T-CS⊗3-F3CC-C2B**
5.4...23.0	1-1/2...5	1-1/2...7-1/2	5...15	5...15	30	100	30	100	**103T-DS⊗2-F3CC-D1E**	**107T-DS⊗3-F3CC-D1E**
5.4...23.0	1-1/2...5	1-1/2...7-1/2	5...15	5...15	30	100	30	100	**103T-DS⊗2-F3CC-E1E**	**107T-DS⊗3-F3CC-E1E**
5.0...23.0	1-1/2...5	1-1/2...7-1/2	5...15	5...15	30	100	30	100	**103T-DS⊗2-F3CC-C1C**	—
5.0...23.0	1-1/2...5	1-1/2...7-1/2	5...15	5...15	30	100	30	100	**103T-DS⊗2-F3CC-C2C**	**107T-DS⊗3-F3CC-C2C**

∗ Horsepower ratings shown in the table are for reference. Final selection of the starter depends upon the actual motor full-load current and service factor.

⊗Coil voltage code—see page 2-295

Product Selection and Coordination Ratings—UL/CSA as a Fused Motor Controller, Continued

Motor Current Adjustment Range [A]	UL/CSA Hp and Coordination Ratings (60 Hz)								DOL Starters	Reversing Starters
	Hp Ratings as a Fused Motor Controller✶				Type 1 Coordination		Type 2 Coordination			
	200V AC	230V AC	460V AC	575V AC	Max. Class CC Fuse	Max Short-Circuit Current [kA], 600V AC	Max. Class CC Fuse	Max Short-Circuit Current [kA], 600V AC	Cat. No.	Cat. No.
Bulletin 140F Fuse Holder with 100-C/104-C Contactors on Panel Mounting Modules										
0.10...0.50	—	—	—	—	3	100	3	100	**103T-AW⊗2-F3CC-D1A**	**107T-AW⊗3-F3CC-D1A**
0.10...0.50	—	—	—	—	3	100	3	100	**103T-AW⊗2-F3CC-E1A**	**107T-AW⊗3-F3CC-E1A**
0.20...1.00	—	—	—	1/2	6	100	6	100	**103T-AW⊗2-F3CC-D1B**	**107T-AW⊗3-F3CC-D1B**
0.20...1.00	—	—	—	1/2	6	100	6	100	**103T-AW⊗2-F3CC-E1B**	**107T-AW⊗3-F3CC-E1B**
0.40...1.00	—	—	—	1/2	6	100	6	100	**103T-AW⊗2-F3CC-C1P**	—
0.40...1.00	—	—	—	1/2	6	100	6	100	**103T-AW⊗2-F3CC-C2P**	**107T-AW⊗3-F3CC-C2P**
1.0...5.0	1/2...1	1/2...1	1/2...3	1/2...3	20	100	15	100	**103T-AW⊗2-F3CC-D1C**	**107T-AW⊗3-F3CC-D1C**
1.0...5.0	1/2...1	1/2...1	1/2...3	1/2...3	20	100	15	100	**103T-AW⊗2-F3CC-E1C**	**107T-AW⊗3-F3CC-E1C**
1.0...5.0	1/2...1	1/2...1	1/2...3	1/2...3	20	100	15	100	**103T-AW⊗2-F3CC-C1A**	—
1.0...5.0	1/2...1	1/2...1	1/2...3	1/2...3	20	100	15	100	**103T-AW⊗2-F3CC-C2A**	**107T-AW⊗3-F3CC-C2A**
3.2...9.0	3/4...2	3/4...2	2...5	3...7-1/2	20	100	15	100	**103T-AW⊗2-F3CC-D1D**	**107T-AW⊗3-F3CC-D1D**
3.2...9.0	3/4...2	3/4...2	2...5	3...7-1/2	20	100	15	100	**103T-AW⊗2-F3CC-E1D**	**107T-AW⊗3-F3CC-E1D**
3.0...9.0	3/4...2	3/4...2	2...5	3...7-1/2	20	100	15	100	**103T-AW⊗2-F3CC-C1B**	—
3.0...9.0	3/4...2	3/4...2	2...5	3...7-1/2	20	100	15	100	**103T-AW⊗2-F3CC-C2B**	**107T-AW⊗3-F3CC-C2B**
3.2...12.0	3/4...3	3/4...3	2...7-1/2	3...10	20	100	20	100	**103T-BW⊗2-F3CC-D1D**	**107T-BW⊗3-F3CC-D1D**
3.2...12.0	3/4...3	3/4...3	2...7-1/2	3...10	20	100	20	100	**103T-BW⊗2-F3CC-E1D**	**107T-BW⊗3-F3CC-E1D**
3.0...12.0	3/4...3	3/4...3	2...7-1/2	3...10	20	100	20	100	**103T-BW⊗2-F3CC-C1B**	—
3.0...12.0	3/4...3	3/4...3	2...7-1/2	3...10	20	100	20	100	**103T-BW⊗2-F3CC-C2B**	**107T-BW⊗3-F3CC-C2B**
3.2...16.0	3/4...3	3/4...5	2...10	3...15	30	100	30	100	**103T-CW⊗2-F3CC-D1D**	**107T-CW⊗3-F3CC-D1D**
3.2...16.0	3/4...3	3/4...5	2...10	3...15	30	100	30	100	**103T-CW⊗2-F3CC-E1D**	**107T-CW⊗3-F3CC-E1D**
3.0...15.0	3/4...3	3/4...5	2...10	3...15	30	100	30	100	**103T-CW⊗2-F3CC-C1B**	—
3.0...15.0	3/4...3	3/4...5	2...10	3...15	30	100	30	100	**103T-CW⊗2-F3CC-C2B**	**107T-CW⊗3-F3CC-C2B**
5.4...23.0	1-1/2...5	1-1/2...7-1/2	5...15	5...15	30	100	30	100	**103T-DW⊗2-F3CC-D1E**	**107T-DW⊗3-F3CC-D1E**
5.4...23.0	1-1/2...5	1-1/2...7-1/2	5...15	5...15	30	100	30	100	**103T-DW⊗2-F3CC-E1E**	**107T-DW⊗3-F3CC-E1E**
5.0...23.0	1-1/2...5	1-1/2...7-1/2	5...15	5...15	30	100	30	100	**103T-DW⊗2-F3CC-C1C**	—
5.0...23.0	1-1/2...5	1-1/2...7-1/2	5...15	5...15	30	100	30	100	**103T-DW⊗2-F3CC-C2C**	**107T-DW⊗3-F3CC-C2C**

✶ Horsepower ratings shown in the table are for reference. Final selection of the starter depends upon the actual motor full-load current and service factor.

⊗Coil voltage code—see page 2-295

Product Selection and Coordination Ratings, IEC Type 1 and Type 2 Short-Circuit Coordination

Motor Current Adjustment Range [A]	IEC kW and Coordination Ratings (50 Hz)												DOL Starters	Reversing Starters
	kW Ratings*				Max. Short-Circuit Current [kA]									
					Type 1 Coordination				Type 2 Coordination					
	230V AC	400V AC	500V AC	690V AC	230V AC	400V AC	500V AC	690V AC	230V AC	400V AC	500V AC	690V AC	Cat. No.	Cat. No.
C-Frame with 100-C/104-C Contactors on Standard Bus Bar Modules														
0.10...0.40	0.06	0.09	0.12	0.18	65	65	65	50	65	65	50	50	**103T-AT⊗2-QA40C-D1A**	**107T-AT⊗3-QA40C-D1A**
0.10...0.40	0.06	0.09	0.12	0.18	65	65	65	50	65	65	50	50	**103T-AT⊗2-QA40C-E1A**	**107T-AT⊗3-QA40C-E1A**
0.20...1.00	0.12	0.25	0.37	0.55	65	65	65	50	65	65	50	50	**103T-AT⊗2-QB10C-D1B**	**107T-AT⊗3-QB10C-D1B**
0.20...1.00	0.12	0.25	0.37	0.55	65	65	65	50	65	65	50	50	**103T-AT⊗2-QB10C-E1B**	**107T-AT⊗3-QB10C-E1B**
0.40...1.00	0.12	0.25	0.37	0.55	65	65	65	50	65	65	50	50	**103T-AT⊗2-QB10C-C1P**	—
0.40...1.00	0.12	0.25	0.37	0.55	65	65	65	50	65	65	50	50	**103T-AT⊗2-QB10C-C2P**	**107T-AT⊗3-QB10C-C2P**
0.4 ... 2.0	0.37	0.75	0.75	1.1	65	65	50	8	65	50	50	8	**103T-AT⊗2-QB25C-C1P**	—
0.4 ... 2.0	0.37	0.75	0.75	1.1	65	65	50	8	65	50	50	8	**103T-AT⊗2-QB25C-C2P**	**107T-AT⊗3-QB25C-C2P**
1.0 ... 2.5	0.55	0.75	1.1	1.8	65	65	50	8	65	50	50	8	**103T-AT⊗2-QB25C-D1C**	**107T-AT⊗3-QB25C-D1C**
1.0 ... 2.5	0.55	0.75	1.1	1.8	65	65	50	8	65	50	50	8	**103T-AT⊗2-QB25C-E1C**	**107T-AT⊗3-QB25C-E1C**
1.0 ... 2.5	0.55	0.75	1.1	1.8	65	65	50	8	65	50	50	8	**103T-AT⊗2-QB25C-C1A**	—
1.0 ... 2.5	0.55	0.75	1.1	1.8	65	65	50	8	65	50	50	8	**103T-AT⊗2-QB25C-C2A**	**107T-AT⊗3-QB25C-C2A**
D-Frame with 100-C/104-C Contactors on Standard Bus Bar Modules														
0.4 ... 2.0	0.37	0.75	0.75	1.1	65	65	50	10	65	65	50	10	**103T-AT⊗2-RB25C-C1P**	—
0.4 ... 2.0	0.37	0.75	0.75	1.1	65	65	50	10	65	65	50	10	**103T-AT⊗2-RB25C-C2P**	**107T-AT⊗3-RB25C-C2P**
1.0 ... 2.5	0.55	0.75	1.1	1.8	65	65	50	10	65	65	50	10	**103T-AT⊗2-RB25C-D1C**	**107T-AT⊗3-RB25C-D1C**
1.0 ... 2.5	0.55	0.75	1.1	1.8	65	65	50	10	65	65	50	10	**103T-AT⊗2-RB25C-E1C**	**107T-AT⊗3-RB25C-E1C**
1.0 ... 2.5	0.55	0.75	1.1	1.8	65	65	50	10	65	65	50	10	**103T-AT⊗2-RB25C-C1A**	—
1.0 ... 2.5	0.55	0.75	1.1	1.8	65	65	50	10	65	65	50	10	**103T-AT⊗2-RB25C-C2A**	**107T-AT⊗3-RB25C-C2A**
0.4 ... 2.0	0.37	0.75	0.75	1.1	65	65	50	10	65	65	50	10	**103T-DT⊗2-RB25C-C1P**	—
0.4 ... 2.0	0.37	0.75	0.75	1.1	65	65	50	10	65	65	50	10	**103T-DT⊗2-RB25C-C2P**	**107T-DT⊗3-RB25C-C2P**
1.0 ... 2.5	0.55	0.75	1.1	1.8	65	65	50	10	65	65	50	10	**103T-DT⊗2-RB25C-D1C**	**107T-DT⊗3-RB25C-D1C**
1.0 ... 2.5	0.55	0.75	1.1	1.8	65	65	50	10	65	65	50	10	**103T-DT⊗2-RB25C-E1C**	**107T-DT⊗3-RB25C-E1C**
1.0 ... 2.5	0.55	0.75	1.1	1.8	65	65	50	10	65	65	50	10	**103T-DT⊗2-RB25C-C1A**	—
1.0 ... 2.5	0.55	0.75	1.1	1.8	65	65	50	10	65	65	50	10	**103T-DT⊗2-RB25C-C2A**	**107T-DT⊗3-RB25C-C2A**
1.0 ... 4.0	0.75	1.5	2.2	3	65	50	50	10	65	65	50	—	**103T-AT⊗2-RB40C-D1C**	**107T-AT⊗3-RB40C-D1C**
1.0 ... 4.0	0.75	1.5	2.2	3	65	50	50	10	65	65	50	—	**103T-AT⊗2-RB40C-E1C**	**107T-AT⊗3-RB40C-E1C**
1.0 ... 4.0	0.75	1.5	2.2	3	65	50	50	10	65	65	50	—	**103T-AT⊗2-RB40C-C1A**	—
1.0 ... 4.0	0.75	1.5	2.2	3	65	50	50	10	65	65	50	—	**103T-AT⊗2-RB40C-C2A**	**107T-AT⊗3-RB40C-C2A**
1.0 ... 4.0	0.75	1.5	2.2	3	65	50	50	50	65	65	50	50	**103T-DT⊗2-RB40C-D1C**	**107T-DT⊗3-RB40C-D1C**
1.0 ... 4.0	0.75	1.5	2.2	3	65	50	50	50	65	65	50	50	**103T-DT⊗2-RB40C-E1C**	**107T-DT⊗3-RB40C-E1C**
1.0 ... 4.0	0.75	1.5	2.2	3	65	50	50	50	65	65	50	50	**103T-DT⊗2-RB40C-C1A**	—
1.0 ... 4.0	0.75	1.5	2.2	3	65	50	50	50	65	65	50	50	**103T-DT⊗2-RB40C-C2A**	**107T-DT⊗3-RB40C-C2A**
3.2 ... 6.3	1.5	2.2	3	4	65	65	50	50	65	65	50	—	**103T-AT⊗2-RB63C-D1D**	**107T-AT⊗3-RB63C-D1D**
3.2 ... 6.3	1.5	2.2	3	4	65	65	50	50	65	65	50	—	**103T-AT⊗2-RB63C-E1D**	**107T-AT⊗3-RB63C-E1D**
3.0 ... 6.3	1.5	2.2	3	4	65	65	50	50	65	65	50	—	**103T-AT⊗2-RB63C-C1B**	—
3.0 ... 6.3	1.5	2.2	3	4	65	65	50	50	65	65	50	—	**103T-AT⊗2-RB63C-C2B**	**107T-AT⊗3-RB63C-C2B**
3.2 ... 10	2.2	4	5.5	5.5	65	65	65	50	65	65	65	—	**103T-BT⊗2-RC10C-D1D**	**107T-BT⊗3-RC10C-D1D**
3.2 ... 10	2.2	4	5.5	5.5	65	65	65	50	65	65	65	—	**103T-BT⊗2-RC10C-E1D**	**107T-BT⊗3-RC10C-E1D**
3.0 ... 10	2.2	4	5.5	5.5	65	65	65	50	65	65	65	—	**103T-BT⊗2-RC10C-C1B**	—
3.0 ... 10	2.2	4	5.5	5.5	65	65	65	50	65	65	65	—	**103T-BT⊗2-RC10C-C2B**	**107T-BT⊗3-RC10C-C2B**
3.2 ... 10	2.2	4	5.5	7.5	65	65	65	50	65	65	65	50	**103T-ET⊗3-RC10C-E1D**	**107T-ET⊗3-RC10C-E1D**
3.0 ... 10	2.2	4	5.5	7.5	65	65	65	50	65	65	65	50	**103T-ET⊗3-RC10C-C1B**	—
3.0 ... 10	2.2	4	5.5	7.5	65	65	65	50	65	65	65	50	**103T-ET⊗3-RC10C-C2B**	**107T-ET⊗3-RC10C-C2B**
3.2 ... 16	4	7.5	7.5	—	65	65	50	—	65	65	50	—	**103T-CT⊗2-RC16C-D1D**	**107T-CT⊗3-RC16C-D1D**
3.2 ... 16	4	7.5	7.5	—	65	65	50	—	65	65	50	—	**103T-CT⊗2-RC16C-E1D**	**107T-CT⊗3-RC16C-E1D**
3.0 ... 15	4	7.5	7.5	—	65	65	50	—	65	65	50	—	**103T-CT⊗2-RC16C-C1B**	—
3.0 ... 15	4	7.5	7.5	—	65	65	50	—	65	65	50	—	**103T-CT⊗2-RC16C-C2B**	**107T-CT⊗3-RC16C-C2B**
3.2 ... 16	4	7.5	10	13	65	65	50	6	65	65	50	—	**103T-ET⊗3-RC16C-E1D**	**107T-ET⊗3-RC16C-E1D**
3.0 ... 15	4	7.5	10	13	65	65	50	6	65	65	50	—	**103T-ET⊗3-RC16C-C1B**	—
3.0 ... 15	4	7.5	10	13	65	65	50	6	65	65	50	—	**103T-ET⊗3-RC16C-C2B**	**107T-ET⊗3-RC16C-C2B**
5.4 ... 23	6.3	11	13	—	65	50	25	—	65	50	25	—	**103T-DT⊗2-RC25C-D1E**	**107T-DT⊗3-RC25C-D1E**
5.4 ... 23	6.3	11	13	—	65	50	25	—	65	50	25	—	**103T-DT⊗2-RC25C-E1E**	**107T-DT⊗3-RC25C-E1E**
5.0 ... 23	6.3	11	13	—	65	50	25	—	65	50	25	—	**103T-DT⊗2-RC25C-C1C**	—
5.0 ... 23	6.3	11	13	—	65	50	25	—	65	50	25	—	**103T-DT⊗2-RC25C-C2C**	**107T-DT⊗3-RC25C-C2C**
5.4 ... 25	6.3	11	15	—	65	50	25	—	65	50	25	—	**103T-ET⊗3-RC25C-E1E**	**107T-ET⊗3-RC25C-E1E**
5.0 ... 25	6.3	11	15	—	65	50	25	—	65	50	25	—	**103T-ET⊗3-RC25C-C1C**	—
5.0 ... 25	6.3	11	15	—	65	50	25	—	65	50	25	—	**103T-ET⊗3-RC25C-C2C**	**107T-ET⊗3-RC25C-C2C**

Motor Current Adjustment Range [A]	IEC kW and Coordination Ratings (50 Hz)												DOL Starters	Reversing Starters
	kW Ratings∗				Max. Short-Circuit Current [kA]									
					Type 1 Coordination				Type 2 Coordination					
	230V AC	400V AC	500V AC	690V AC	230V AC	400V AC	500V AC	690V AC	230V AC	400V AC	500V AC	690V AC	Cat. No.	Cat. No.
F-Frame with 100-C/104-C Contactors on Standard Bus Bar Modules														
5.4 ... 25	6.3	11	15	—	65	65	50	—	65	65	50	—	**103T-ET⊗3-TC25C-E1E**	**107T-ET⊗3-TC25C-E1E**
5.0 ... 25	6.3	11	15	—	65	65	50	—	65	65	50	—	**103T-ET⊗3-TC25C-C1C**	—
5.0 ... 25	6.3	11	15	—	65	65	50	—	65	65	50	—	**103T-ET⊗3-TC25C-C2C**	**107T-ET⊗3-TC25C-C2C**
5.4 ... 25	6.3	11	15	18.5	65	65	50	50	65	65	50	50	**103T-FT⊗3-TC25C-E1E**	**107T-FT⊗3-TC25C-E1E**
5.0 ... 25	6.3	11	15	18.5	65	65	50	50	65	65	50	50	**103T-FT⊗3-TC25C-C1C**	—
5.0 ... 25	6.3	11	15	18.5	65	65	50	50	65	65	50	50	**103T-FT⊗3-TC25C-C2C**	**107T-FT⊗3-TC25C-C2C**
9.0 ... 30	7.5	15	15	—	65	65	50	—	65	65	50	—	**103T-ET⊗3-TC32C-E1F**	**107T-ET⊗3-TC32C-E1F**
9.0 ... 30	7.5	15	15	—	65	65	50	—	65	65	50	—	**103T-ET⊗3-TC32C-C1D**	—
9.0 ... 30	7.5	15	15	—	65	65	50	—	65	65	50	—	**103T-ET⊗3-TC32C-C2D**	**107T-ET⊗3-TC32C-C2D**
9.0 ... 32	7.5	15	20	—	65	65	50	—	65	65	50	—	**103T-FT⊗3-TC32C-E1F**	**107T-FT⊗3-TC32C-E1F**
9.0 ... 32	7.5	15	20	—	65	65	50	—	65	65	50	—	**103T-FT⊗3-TC32C-C1D**	—
9.0 ... 32	7.5	15	20	—	65	65	50	—	65	65	50	—	**103T-FT⊗3-TC32C-C2D**	**107T-FT⊗3-TC32C-C2D**
9.0 ... 32	7.5	15	20	22	65	65	50	50	65	65	50	50	**103T-GT⊗3-TC32C-E1F**	**107T-GT⊗3-TC32C-E1F**
9.0 ... 32	7.5	15	20	22	65	65	50	50	65	65	50	50	**103T-GT⊗3-TC32C-C1D**	
9.0 ... 32	7.5	15	20	22	65	65	50	50	65	65	50	50	**103T-GT⊗3-TC32C-C2D**	**107T-GT⊗3-TC32C-C2D**
9.0 ... 37	11	18.5	—	—	65	65	—	—	65	65	—	—	**103T-FT⊗3-TC45C-E1F**	**107T-FT⊗3-TC45C-E1F**
9.0 ... 37	11	18.5	—	—	65	65	—	—	65	65	—	—	**103T-FT⊗3-TC45C-C1D**	—
9.0 ... 37	11	18.5	—	—	65	65	—	—	65	65	—	—	**103T-FT⊗3-TC45C-C2D**	**107T-FT⊗3-TC45C-C2D**
9.0 ... 43	13	22	25	—	65	65	50	—	65	65	50	—	**103T-GT⊗3-TC45C-E1F**	**107T-GT⊗3-TC45C-E1F**
9.0 ... 43	13	22	25	—	65	65	50	—	65	65	50	—	**103T-GT⊗3-TC45C-C1D**	=2
9.0 ... 43	13	22	25	—	65	65	50	—	65	65	50	—	**103T-GT⊗3-TC45C-C2D**	**107T-GT⊗3-TC45C-C2D**
18 ... 45	13	22	30	—	65	65	50	—	65	65	50	—	**103T-HT⊗3-TC45C-E1G**	**107T-HT⊗3-TC45C-E1G**
9.0 ... 45	13	22	30	—	65	65	50	—	65	65	50	—	**103T-HT⊗3-TC45C-C1D**	=2
9.0 ... 45	13	22	30	—	65	65	50	—	65	65	50	—	**103T-HT⊗3-TC45C-C2D**	**107T-HT⊗3-TC45C-C2D**

∗ kW ratings shown in the table are for reference. Final selection of the starter depends upon the actual motor full-load current and service factor.

⊗Coil voltage code—see page 2-295

Product Selection and Coordination Ratings, IEC Type 1 and Type 2 Short-Circuit Coordination, Continued

Motor Current Adjustment Range [A]	IEC kW and Coordination Ratings (50 Hz)												DOL Starters	Reversing Starters
	kW Ratings*				Max. Short-Circuit Current [kA]									
					Type 1 Coordination				Type 2 Coordination					
	230V AC	400V AC	500V AC	690V AC	230V AC	400V AC	500V AC	690V AC	230V AC	400V AC	500V AC	690V AC	Cat. No.	Cat. No.
C-Frame with 100-C/104-C Contactors on ISO Bus Bar Modules														
0.10...0.40	0.06	0.09	0.12	0.18	65	65	65	50	65	65	50	50	**103T-AS⊗2-QA40C-D1A**	**107T-AS⊗3-QA40C-D1A**
0.10...0.40	0.06	0.09	0.12	0.18	65	65	65	50	65	65	50	50	**103T-AS⊗2-QA40C-E1A**	**107T-AS⊗3-QA40C-E1A**
0.20...1.00	0.12	0.25	0.37	0.55	65	65	65	50	65	65	50	50	**103T-AS⊗2-QB10C-D1B**	**107T-AS⊗3-QB10C-D1B**
0.20...1.00	0.12	0.25	0.37	0.55	65	65	65	50	65	65	50	50	**103T-AS⊗2-QB10C-E1B**	**107T-AS⊗3-QB10C-E1B**
0.40...1.00	0.12	0.25	0.37	0.55	65	65	65	50	65	65	50	50	**103T-AS⊗2-QB10C-C1P**	—
0.40...1.00	0.12	0.25	0.37	0.55	65	65	65	50	65	65	50	50	**103T-AS⊗2-QB10C-C2P**	**107T-AS⊗3-QB10C-C2P**
0.4 ... 2.0	0.37	0.75	0.75	1.1	65	65	50	8	65	50	50	8	**103T-AS⊗2-QB25C-C1P**	—
0.4 ... 2.0	0.37	0.75	0.75	1.1	65	65	50	8	65	50	50	8	**103T-AS⊗2-QB25C-C2P**	**107T-AS⊗3-QB25C-C2P**
1.0 ... 2.5	0.55	0.75	1.1	1.8	65	65	50	8	65	50	50	8	**103T-AS⊗2-QB25C-D1C**	**107T-AS⊗3-QB25C-D1C**
1.0 ... 2.5	0.55	0.75	1.1	1.8	65	65	50	8	65	50	50	8	**103T-AS⊗2-QB25C-E1C**	**107T-AS⊗3-QB25C-E1C**
1.0 ... 2.5	0.55	0.75	1.1	1.8	65	65	50	8	65	50	50	8	**103T-AS⊗2-QB25C-C1A**	—
1.0 ... 2.5	0.55	0.75	1.1	1.8	65	65	50	8	65	50	50	8	**103T-AS⊗2-QB25C-C2A**	**107T-AS⊗3-QB25C-C2A**
D-Frame with 100-C/104-C Contactors on ISO Bus Bar Modules														
0.4 ... 2.0	0.37	0.75	0.75	1.1	65	65	50	10	65	65	50	10	**103T-AS⊗2-RB25C-C1P**	—
0.4 ... 2.0	0.37	0.75	0.75	1.1	65	65	50	10	65	65	50	10	**103T-AS⊗2-RB25C-C2P**	**107T-AS⊗3-RB25C-C2P**
1.0 ... 2.5	0.55	0.75	1.1	1.8	65	65	50	10	65	65	50	10	**103T-AS⊗2-RB25C-D1C**	**107T-AS⊗3-RB25C-D1C**
1.0 ... 2.5	0.55	0.75	1.1	1.8	65	65	50	10	65	65	50	10	**103T-AS⊗2-RB25C-E1C**	**107T-AS⊗3-RB25C-E1C**
1.0 ... 2.5	0.55	0.75	1.1	1.8	65	65	50	10	65	65	50	10	**103T-AS⊗2-RB25C-C1A**	—
1.0 ... 2.5	0.55	0.75	1.1	1.8	65	65	50	10	65	65	50	10	**103T-AS⊗2-RB25C-C2A**	**107T-AS⊗3-RB25C-C2A**
0.4 ... 2.0	0.37	0.75	0.75	1.1	65	65	50	10	65	65	50	10	**103T-DS⊗2-RB25C-C1P**	—
0.4 ... 2.0	0.37	0.75	0.75	1.1	65	65	50	10	65	65	50	10	**103T-DS⊗2-RB25C-C2P**	**107T-DS⊗3-RB25C-C2P**
1.0 ... 2.5	0.55	0.75	1.1	1.8	65	65	50	10	65	65	50	10	**103T-DS⊗2-RB25C-D1C**	**107T-DS⊗3-RB25C-D1C**
1.0 ... 2.5	0.55	0.75	1.1	1.8	65	65	50	10	65	65	50	10	**103T-DS⊗2-RB25C-E1C**	**107T-DS⊗3-RB25C-E1C**
1.0 ... 2.5	0.55	0.75	1.1	1.8	65	65	50	10	65	65	50	10	**103T-DS⊗2-RB25C-C1A**	—
1.0 ... 2.5	0.55	0.75	1.1	1.8	65	65	50	10	65	65	50	10	**103T-DS⊗2-RB25C-C2A**	**107T-DS⊗3-RB25C-C2A**
1.0 ... 4.0	0.75	1.5	2.2	3	65	50	50	10	65	65	50	—	**103T-AS⊗2-RB40C-D1C**	**107T-AS⊗3-RB40C-D1C**
1.0 ... 4.0	0.75	1.5	2.2	3	65	50	50	10	65	65	50	—	**103T-AS⊗2-RB40C-E1C**	**107T-AS⊗3-RB40C-E1C**
1.0 ... 4.0	0.75	1.5	2.2	3	65	50	50	10	65	65	50	—	**103T-AS⊗2-RB40C-C1A**	—
1.0 ... 4.0	0.75	1.5	2.2	3	65	50	50	10	65	65	50	—	**103T-AS⊗2-RB40C-C2A**	**107T-AS⊗3-RB40C-C2A**
1.0 ... 4.0	0.75	1.5	2.2	3	65	50	50	50	65	65	50	50	**103T-DS⊗2-RB40C-D1C**	**107T-DS⊗3-RB40C-D1C**
1.0 ... 4.0	0.75	1.5	2.2	3	65	50	50	50	65	65	50	50	**103T-DS⊗2-RB40C-E1C**	**107T-DS⊗3-RB40C-E1C**
1.0 ... 4.0	0.75	1.5	2.2	3	65	50	50	50	65	65	50	50	**103T-DS⊗2-RB40C-C1A**	—
1.0 ... 4.0	0.75	1.5	2.2	3	65	50	50	50	65	65	50	50	**103T-DS⊗2-RB40C-C2A**	**107T-DS⊗3-RB40C-C2A**
3.2 ... 6.3	1.5	2.2	3	4	65	65	50	50	65	65	50	—	**103T-AS⊗2-RB63C-D1D**	**107T-AS⊗3-RB63C-D1D**
3.2 ... 6.3	1.5	2.2	3	4	65	65	50	50	65	65	50	—	**103T-AS⊗2-RB63C-E1D**	**107T-AS⊗3-RB63C-E1D**
3.0 ... 6.3	1.5	2.2	3	4	65	65	50	50	65	65	50	—	**103T-AS⊗2-RB63C-C1B**	—
3.0 ... 6.3	1.5	2.2	3	4	65	65	50	50	65	65	50	—	**103T-AS⊗2-RB63C-C2B**	**107T-AS⊗3-RB63C-C2B**
3.2 ... 10	2.2	4	5.5	5.5	65	65	65	50	65	65	65	—	**103T-BS⊗2-RC10C-D1D**	**107T-BS⊗3-RC10C-D1D**
3.2 ... 10	2.2	4	5.5	5.5	65	65	65	50	65	65	65	—	**103T-BS⊗2-RC10C-E1D**	**107T-BS⊗3-RC10C-E1D**
3.0 ... 10	2.2	4	5.5	5.5	65	65	65	50	65	65	65	—	**103T-BS⊗2-RC10C-C1B**	—
3.0 ... 10	2.2	4	5.5	5.5	65	65	65	50	65	65	65	—	**103T-BS⊗2-RC10C-C2B**	**107T-BS⊗3-RC10C-C2B**
3.2 ... 10	2.2	4	5.5	7.5	65	65	65	50	65	65	65	50	**103T-ES⊗3-RC10C-E1D**	**107T-ES⊗3-RC10C-E1D**
3.0 ... 10	2.2	4	5.5	7.5	65	65	65	50	65	65	65	50	**103T-ES⊗3-RC10C-C1B**	—
3.0 ... 10	2.2	4	5.5	7.5	65	65	65	50	65	65	65	50	**103T-ES⊗3-RC10C-C2B**	**107T-ES⊗3-RC10C-C2B**
3.2 ... 16	4	7.5	7.5	—	65	65	50	—	65	65	50	—	**103T-CS⊗2-RC16C-D1D**	**107T-CS⊗3-RC16C-D1D**
3.2 ... 16	4	7.5	7.5	—	65	65	50	—	65	65	50	—	**103T-CS⊗2-RC16C-E1D**	**107T-CS⊗3-RC16C-E1D**
3.0 ... 15	4	7.5	7.5	—	65	65	50	—	65	65	50	—	**103T-CS⊗2-RC16C-C1B**	—
3.0 ... 15	4	7.5	7.5	—	65	65	50	—	65	65	50	—	**103T-CS⊗2-RC16C-C2B**	**107T-CS⊗3-RC16C-C2B**
3.2 ... 16	4	7.5	10	13	65	65	50	6	65	65	50	—	**103T-ES⊗3-RC16C-E1D**	**107T-ES⊗3-RC16C-E1D**
3.0 ... 15	4	7.5	10	13	65	65	50	6	65	65	50	—	**103T-ES⊗3-RC16C-C1B**	—
3.0 ... 15	4	7.5	10	13	65	65	50	6	65	65	50	—	**103T-ES⊗3-RC16C-C2B**	**107T-ES⊗3-RC16C-C2B**
5.4 ... 23	6.3	11	13	—	65	50	25	—	65	50	25	—	**103T-DS⊗2-RC25C-D1E**	**107T-DS⊗3-RC25C-D1E**
5.4 ... 23	6.3	11	13	—	65	50	25	—	65	50	25	—	**103T-DS⊗2-RC25C-E1E**	**107T-DS⊗3-RC25C-E1E**
5.0 ... 23	6.3	11	13	—	65	50	25	—	65	50	25	—	**103T-DS⊗2-RC25C-C1C**	—
5.0 ... 23	6.3	11	13	—	65	50	25	—	65	50	25	—	**103T-DS⊗2-RC25C-C2C**	**107T-DS⊗3-RC25C-C2C**
5.4 ... 25	6.3	11	15	—	65	50	25	—	65	50	25	—	**103T-ES⊗3-RC25C-E1E**	**107T-ES⊗3-RC25C-E1E**
5.0 ... 25	6.3	11	15	—	65	50	25	—	65	50	25	—	**103T-ES⊗3-RC25C-C1C**	—
5.0 ... 25	6.3	11	15	—	65	50	25	—	65	50	25	—	**103T-ES⊗3-RC25C-C2C**	**107T-ES⊗3-RC25C-C2C**

Motor Current Adjustment Range [A]	IEC kW and Coordination Ratings (50 Hz)												DOL Starters	Reversing Starters
	kW Ratings✶				Max. Short-Circuit Current [kA]									
					Type 1 Coordination				Type 2 Coordination					
	230V AC	400V AC	500V AC	690V AC	230V AC	400V AC	500V AC	690V AC	230V AC	400V AC	500V AC	690V AC	Cat. No.	Cat. No.
F-Frame with 100-C/104-C Contactors on ISO Bus Bar Modules														
5.4 ... 25	6.3	11	15	—	65	65	50	—	65	65	50	—	**103T-ES⊗3-TC25C-E1E**	**107T-ES⊗3-TC25C-E1E**
5.0 ... 25	6.3	11	15	—	65	65	50	—	65	65	50	—	**103T-ES⊗3-TC25C-C1C**	—
5.0 ... 25	6.3	11	15	—	65	65	50	—	65	65	50	—	**103T-ES⊗3-TC25C-C2C**	**107T-ES⊗3-TC25C-C2C**
5.4 ... 25	6.3	11	15	18.5	65	65	50	50	65	65	50	50	**103T-FS⊗3-TC25C-E1E**	**107T-FS⊗3-TC25C-E1E**
5.0 ... 25	6.3	11	15	18.5	65	65	50	50	65	65	50	50	**103T-FS⊗3-TC25C-C1C**	—
5.0 ... 25	6.3	11	15	18.5	65	65	50	50	65	65	50	50	**103T-FS⊗3-TC25C-C2C**	**107T-FS⊗3-TC25C-C2C**
9.0 ... 30	7.5	15	15	—	65	65	50	—	65	65	50	—	**103T-ES⊗3-TC32C-E1F**	**107T-ES⊗3-TC32C-E1F**
9.0 ... 30	7.5	15	15	—	65	65	50	—	65	65	50	—	**103T-ES⊗3-TC32C-C1D**	—
9.0 ... 30	7.5	15	15	—	65	65	50	—	65	65	50	—	**103T-ES⊗3-TC32C-C2D**	**107T-ES⊗3-TC32C-C2D**
9.0 ... 32	7.5	15	20	—	65	65	50	—	65	65	50	—	**103T-FS⊗3-TC32C-E1F**	**107T-FS⊗3-TC32C-E1F**
9.0 ... 32	7.5	15	20	—	65	65	50	—	65	65	50	—	**103T-FS⊗3-TC32C-C1D**	—
9.0 ... 32	7.5	15	20	—	65	65	50	—	65	65	50	—	**103T-FS⊗3-TC32C-C2D**	**107T-FS⊗3-TC32C-C2D**
9.0 ... 32	7.5	15	20	22	65	65	50	50	65	65	50	50	**103T-GS⊗3-TC32C-E1F**	**107T-GS⊗3-TC32C-E1F**
9.0 ... 32	7.5	15	20	22	65	65	50	50	65	65	50	50	**103T-GS⊗3-TC32C-C1D**	—
9.0 ... 32	7.5	15	20	22	65	65	50	50	65	65	50	50	**103T-GS⊗3-TC32C-C2D**	**107T-GS⊗3-TC32C-C2D**
9.0 ... 37	11	18.5	—	—	65	65	—	—	65	65	—	—	**103T-FS⊗3-TC45C-E1F**	**107T-FS⊗3-TC45C-E1F**
9.0 ... 37	11	18.5	—	—	65	65	—	—	65	65	—	—	**103T-FS⊗3-TC45C-C1D**	—
9.0 ... 37	11	18.5	—	—	65	65	—	—	65	65	—	—	**103T-FS⊗3-TC45C-C2D**	**107T-FS⊗3-TC45C-C2D**
9.0 ... 43	13	22	25	—	65	65	50	—	65	65	50	—	**103T-GS⊗3-TC45C-E1F**	**107T-GS⊗3-TC45C-E1F**
9.0 ... 43	13	22	25	—	65	65	50	—	65	65	50	—	**103T-GS⊗3-TC45C-C1D**	—
9.0 ... 43	13	22	25	—	65	65	50	—	65	65	50	—	**103T-GS⊗3-TC45C-C2D**	**107T-GS⊗3-TC45C-C2D**

✶ kW ratings shown in the table are for reference. Final selection of the starter depends upon the actual motor full-load current and service factor.

⊗Coil voltage code—see page 2-295

Product Selection and Coordination Ratings, IEC Type 1 and Type 2 Short-Circuit Coordination, Continued

Motor Current Adjustment Range [A]	IEC kW and Coordination Ratings (50 Hz)												DOL Starters	Reversing Starters
	kW Ratings*				Max. Short-Circuit Current [kA]									
					Type 1 Coordination				Type 2 Coordination					
	230V AC	400V AC	500V AC	690V AC	230V AC	400V AC	500V AC	690V AC	230V AC	400V AC	500V AC	690V AC	Cat. No.	Cat. No.
C-Frame with 100-C/104-C Contactors on Panel Mounting Modules														
0.10...0.40	0.06	0.09	0.12	0.18	100	100	65	50	65	65	50	50	**103T-AW⊗2-QA40C-D1A**	**107T-AW⊗3-QA40C-D1A**
0.10...0.40	0.06	0.09	0.12	0.18	100	100	65	50	65	65	50	50	**103T-AW⊗2-QA40C-E1A**	**107T-AW⊗3-QA40C-E1A**
0.20...1.00	0.12	0.25	0.37	0.55	100	100	65	50	65	65	50	50	**103T-AW⊗2-QB10C-D1B**	**107T-AW⊗3-QB10C-D1B**
0.20...1.00	0.12	0.25	0.37	0.55	100	100	65	50	65	65	50	50	**103T-AW⊗2-QB10C-E1B**	**107T-AW⊗3-QB10C-E1B**
0.40...1.00	0.12	0.25	0.37	0.55	100	100	65	50	65	65	50	50	**103T-AW⊗2-QB10C-C1P**	—
0.40...1.00	0.12	0.25	0.37	0.55	100	100	65	50	65	65	50	50	**103T-AW⊗2-QB10C-C2P**	**107T-AW⊗3-QB10C-C2P**
0.4 ... 2.0	0.37	0.75	0.75	1.1	100	65	50	8	65	50	50	8	**103T-AW⊗2-QB25C-C1P**	—
0.4 ... 2.0	0.37	0.75	0.75	1.1	100	65	50	8	65	50	50	8	**103T-AW⊗2-QB25C-C2P**	**107T-AW⊗3-QB25C-C2P**
1.0 ... 2.5	0.55	0.75	1.1	1.8	100	65	50	8	65	50	50	8	**103T-AW⊗2-QB25C-D1C**	**107T-AW⊗3-QB25C-D1C**
1.0 ... 2.5	0.55	0.75	1.1	1.8	100	65	50	8	65	50	50	8	103T-AW⊗2-QB25C-E1C	**107T-AW⊗3-QB25C-E1C**
1.0 ... 2.5	0.55	0.75	1.1	1.8	100	65	50	8	65	50	50	8	**103T-AW⊗2-QB25C-C1A**	—
1.0 ... 2.5	0.55	0.75	1.1	1.8	100	65	50	8	65	50	50	8	**103T-AW⊗2-QB25C-C2A**	**107T-AW⊗3-QB25C-C2A**
D-Frame with 100-C/104-C Contactors on Panel Mounting Modules														
0.4 ... 2.0	0.37	0.75	0.75	1.1	100	100	50	10	100	100	50	10	**103T-AW⊗2-RB25C-C1P**	—
0.4 ... 2.0	0.37	0.75	0.75	1.1	100	100	50	10	100	100	50	10	**103T-AW⊗2-RB25C-C2P**	**107T-AW⊗3-RB25C-C2P**
1.0 ... 2.5	0.55	0.75	1.1	1.8	100	100	50	10	100	100	50	10	**103T-AW⊗2-RB25C-D1C**	**107T-AW⊗3-RB25C-D1C**
1.0 ... 2.5	0.55	0.75	1.1	1.8	100	100	50	10	100	100	50	10	**103T-AW⊗2-RB25C-E1C**	**107T-AW⊗3-RB25C-E1C**
1.0 ... 2.5	0.55	0.75	1.1	1.8	100	100	50	10	100	100	50	10	**103T-AW⊗2-RB25C-C1A**	—
1.0 ... 2.5	0.55	0.75	1.1	1.8	100	100	50	10	100	100	50	10	**103T-AW⊗2-RB25C-C2A**	**107T-AW⊗3-RB25C-C2A**
0.4 ... 2.0	0.37	0.75	0.75	1.1	100	100	50	10	100	100	50	10	**103T-DW⊗2-RB25C-C1P**	—
0.4 ... 2.0	0.37	0.75	0.75	1.1	100	100	50	10	100	100	50	10	**103T-DW⊗2-RB25C-C2P**	**107T-DW⊗3-RB25C-C2P**
1.0 ... 2.5	0.55	0.75	1.1	1.8	100	100	50	10	100	100	50	10	**103T-DW⊗2-RB25C-D1C**	**107T-DW⊗3-RB25C-D1C**
1.0 ... 2.5	0.55	0.75	1.1	1.8	100	100	50	10	100	100	50	10	**103T-DW⊗2-RB25C-E1C**	**107T-DW⊗3-RB25C-E1C**
1.0 ... 2.5	0.55	0.75	1.1	1.8	100	100	50	10	100	100	50	10	**103T-DW⊗2-RB25C-C1A**	—
1.0 ... 2.5	0.55	0.75	1.1	1.8	100	100	50	10	100	100	50	10	**103T-DW⊗2-RB25C-C2A**	**107T-DW⊗3-RB25C-C2A**
1.0 ... 4.0	0.75	1.5	2.2	3	100	100	50	10	100	100	50	—	**103T-AW⊗2-RB40C-D1C**	**107T-AW⊗3-RB40C-D1C**
1.0 ... 4.0	0.75	1.5	2.2	3	100	100	50	10	100	100	50	—	**103T-AW⊗2-RB40C-E1C**	**107T-AW⊗3-RB40C-E1C**
1.0 ... 4.0	0.75	1.5	2.2	3	100	100	50	10	100	100	50	—	**103T-AW⊗2-RB40C-C1A**	—
1.0 ... 4.0	0.75	1.5	2.2	3	100	100	50	10	100	100	50	—	**103T-AW⊗2-RB40C-C2A**	**107T-AW⊗3-RB40C-C2A**
1.0 ... 4.0	0.75	1.5	2.2	3	100	100	50	50	100	100	50	50	**103T-DW⊗2-RB40C-D1C**	**107T-DW⊗3-RB40C-D1C**
1.0 ... 4.0	0.75	1.5	2.2	3	100	100	50	50	100	100	50	50	**103T-DW⊗2-RB40C-E1C**	**107T-DW⊗3-RB40C-E1C**
1.0 ... 4.0	0.75	1.5	2.2	3	100	100	50	50	100	100	50	50	**103T-DW⊗2-RB40C-C1A**	—
1.0 ... 4.0	0.75	1.5	2.2	3	100	100	50	50	100	100	50	50	**103T-DW⊗2-RB40C-C2A**	**107T-DW⊗3-RB40C-C2A**
3.2 ... 6.3	1.5	2.2	3	4	100	100	50	50	100	100	50	—	**103T-AW⊗2-RB63C-D1D**	**107T-AW⊗3-RB63C-D1D**
3.2 ... 6.3	1.5	2.2	3	4	100	100	50	50	100	100	50	—	**103T-AW⊗2-RB63C-E1D**	**107T-AW⊗3-RB63C-E1D**
3.0 ... 6.3	1.5	2.2	3	4	100	100	50	50	100	100	50	—	**103T-AW⊗2-RB63C-C1B**	—
3.0 ... 6.3	1.5	2.2	3	4	100	100	50	50	100	100	50	—	**103T-AW⊗2-RB63C-C2B**	**107T-AW⊗3-RB63C-C2B**
3.2 ... 10	2.2	4	5.5	5.5	100	100	65	50	100	100	65	—	**103T-BW⊗2-RC10C-D1D**	**107T-BW⊗3-RC10C-D1D**
3.2 ... 10	2.2	4	5.5	5.5	100	100	65	50	100	100	65	—	**103T-BW⊗2-RC10C-E1D**	**107T-BW⊗3-RC10C-E1D**
3.0 ... 10	2.2	4	5.5	5.5	100	100	65	50	100	100	65	—	**103T-BW⊗2-RC10C-C1B**	—
3.0 ... 10	2.2	4	5.5	5.5	100	100	65	50	100	100	65	—	**103T-BW⊗2-RC10C-C2B**	**107T-BW⊗3-RC10C-C2B**
3.2 ... 10	2.2	4	5.5	7.5	100	100	65	50	100	100	65	50	**103T-EW⊗3-RC10C-E1D**	**107T-EW⊗3-RC10C-E1D**
3.0 ... 10	2.2	4	5.5	7.5	100	100	65	50	100	100	65	50	**103T-EW⊗3-RC10C-C1B**	—
3.0 ... 10	2.2	4	5.5	7.5	100	100	65	50	100	100	65	50	**103T-EW⊗3-RC10C-C2B**	**107T-EW⊗3-RC10C-C2B**
3.2 ... 16	4	7.5	7.5	—	100	65	50	—	65	65	50	—	**103T-CW⊗2-RC16C-D1D**	**107T-CW⊗3-RC16C-D1D**
3.2 ... 16	4	7.5	7.5	—	100	65	50	—	65	65	50	—	**103T-CW⊗2-RC16C-E1D**	**107T-CW⊗3-RC16C-E1D**
3.0 ... 15	4	7.5	7.5	—	100	65	50	—	65	65	50	—	**103T-CW⊗2-RC16C-C1B**	—
3.0 ... 15	4	7.5	7.5	—	100	65	50	—	65	65	50	—	**103T-CW⊗2-RC16C-C2B**	**107T-CW⊗3-RC16C-C2B**
3.2 ... 16	4	7.5	10	13	100	65	50	6	65	65	50	—	**103T-EW⊗3-RC16C-E1D**	**107T-EW⊗3-RC16C-E1D**
3.0 ... 15	4	7.5	10	13	100	65	50	6	65	65	50	—	**103T-EW⊗3-RC16C-C1B**	—
3.0 ... 15	4	7.5	10	13	100	65	50	6	65	65	50	—	**103T-EW⊗3-RC16C-C2B**	**107T-EW⊗3-RC16C-C2B**
5.4 ... 23	6.3	11	13	—	65	50	25	—	65	50	25	—	**103T-DW⊗2-RC25C-D1E**	**107T-DW⊗3-RC25C-D1E**
5.4 ... 23	6.3	11	13	—	65	50	25	—	65	50	25	—	**103T-DW⊗2-RC25C-E1E**	**107T-DW⊗3-RC25C-E1E**
5.0 ... 23	6.3	11	13	—	65	50	25	—	65	50	25	—	**103T-DW⊗2-RC25C-C1C**	—
5.0 ... 23	6.3	11	13	—	65	50	25	—	65	50	25	—	**103T-DW⊗2-RC25C-C2C**	**107T-DW⊗3-RC25C-C2C**
5.4 ... 25	6.3	11	15	—	65	50	25	—	65	50	25	—	**103T-EW⊗3-RC25C-E1E**	**107T-EW⊗3-RC25C-E1E**
5.0 ... 25	6.3	11	15	—	65	50	25	—	65	50	25	—	**103T-EW⊗3-RC25C-C1C**	—
5.0 ... 25	6.3	11	15	—	65	50	25	—	65	50	25	—	**103T-EW⊗3-RC25C-C2C**	**107T-EW⊗3-RC25C-C2C**

Motor Current Adjustment Range [A]	IEC kW and Coordination Ratings (50 Hz)												DOL Starters	Reversing Starters
	kW Ratings✶				Max. Short-Circuit Current [kA]									
					Type 1 Coordination				Type 2 Coordination					
	230V AC	400V AC	500V AC	690V AC	230V AC	400V AC	500V AC	690V AC	230V AC	400V AC	500V AC	690V AC	Cat. No.	Cat. No.
F-Frame with 100-C/104-C Contactors on Panel Mounting Modules														
5.4 ... 25	6.3	11	15	—	100	100	50	—	100	100	50	—	**103T-EW⊗3-TC25C-E1E**	**107T-EW⊗3-TC25C-E1E**
5.0 ... 25	6.3	11	15	—	100	100	50	—	100	100	50	—	**103T-EW⊗3-TC25C-C1C**	—
5.0 ... 25	6.3	11	15	—	100	100	50	—	100	100	50	—	**103T-EW⊗3-TC25C-C2C**	**107T-EW⊗3-TC25C-C2C**
5.4 ... 25	6.3	11	15	18.5	100	100	50	50	100	100	50	50	**103T-FW⊗3-TC25C-E1E**	**107T-FW⊗3-TC25C-E1E**
5.0 ... 25	6.3	11	15	18.5	100	100	50	50	100	100	50	50	**103T-FW⊗3-TC25C-C1C**	—
5.0 ... 25	6.3	11	15	18.5	100	100	50	50	100	100	50	50	**103T-FW⊗3-TC25C-C2C**	**107T-FW⊗3-TC25C-C2C**
9.0 ... 30	7.5	15	15	—	100	100	50	—	100	100	50	—	**103T-EW⊗3-TC32C-E1F**	**107T-EW⊗3-TC32C-E1F**
9.0 ... 30	7.5	15	15	—	100	100	50	—	100	100	50	—	**103T-EW⊗3-TC32C-C1D**	—
9.0 ... 30	7.5	15	15	—	100	100	50	—	100	100	50	—	**103T-EW⊗3-TC32C-C2D**	**107T-EW⊗3-TC32C-C2D**
9.0 ... 32	7.5	15	20	—	100	100	50	—	100	100	50	—	**103T-FW⊗3-TC32C-E1F**	**107T-FW⊗3-TC32C-E1F**
9.0 ... 32	7.5	15	20	—	100	100	50	—	100	100	50	—	**103T-FW⊗3-TC32C-C1D**	—
9.0 ... 32	7.5	15	20	—	100	100	50	—	100	100	50	—	**103T-FW⊗3-TC32C-C2D**	**107T-FW⊗3-TC32C-C2D**
9.0 ... 32	7.5	15	20	22	100	100	50	50	100	100	50	50	**103T-GW⊗3-TC32C-E1F**	**107T-GW⊗3-TC32C-E1F**
9.0 ... 32	7.5	15	20	22	100	100	50	50	100	100	50	50	**103T-GW⊗3-TC32C-C1D**	—
9.0 ... 32	7.5	15	20	22	100	100	50	50	100	100	50	50	**103T-GW⊗3-TC32C-C2D**	**107T-GW⊗3-TC32C-C2D**
9.0 ... 37	11	18.5	—	—	100	100	—	—	100	100	—	—	**103T-FW⊗3-TC45C-E1F**	**107T-FW⊗3-TC45C-E1F**
9.0 ... 37	11	18.5	—	—	100	100	—	—	100	100	—	—	**103T-FW⊗3-TC45C-C1D**	—
9.0 ... 37	11	18.5	—	—	100	100	—	—	100	100	—	—	**103T-FW⊗3-TC45C-C2D**	**107T-FW⊗3-TC45C-C2D**
9.0 ... 43	13	22	25	—	100	100	50	—	100	100	50	—	103T-GW⊗3-TC45C-E1F	**107T-GW⊗3-TC45C-E1F**
9.0 ... 43	13	22	25	—	100	100	50	—	100	100	50	—	**103T-GW⊗3-TC45C-C1D**	—
9.0 ... 43	13	22	25	—	100	100	50	—	100	100	50	—	103T-GW⊗3-TC45C-C2D	**107T-GW⊗3-TC45C-C2D**

✶ kW ratings shown in the table are for reference. Final selection of the starter depends upon the actual motor full-load current and service factor.

⊗ Coil Voltage Codes for AC Control

Voltage [V]	12	24	32	36	42	48	100	100-110V	110V	120	127	200	200-220	200-230	208	208-240
50 Hz	R	K	V	W	X	Y	KP	—	D	P	S	KG	—	—	—	—
60 Hz	Q	J	—	V	—	X	—	KP	—	D	—	—	KG	—	H	L
50/60 Hz	—	KJ	—	—	—	KY	KP	—	KD	—	—	KG	—	KL	—	—
Voltage [V]	**220-230**	**230**	**230-240**	**240**	**277**	**347**	**380**	**380-400**	**400**	**400-415**	**440**	**480**	**500**	**550**	**600**	
50 Hz	F	—	VA	T	—	—	—	N	—	G	B	—	M	C	—	
60 Hz	—	—	—	A	T	I	E	—	—	—	N	B	—	—	C	
50/60 Hz	—	KF	—	KA	—	—	—	—	KN	—	KB	—	—	—	—	

⊗ Coil Voltage Codes for DC Control

DC Voltages [V]	9	12	24	36	48	60	64	72	80	110	115	125	220	230	250
Standard	ZR	ZQ	ZJ	ZW	ZY	ZZ	ZB	ZG	ZE	ZD	ZP	ZS	ZA	ZF	ZT
with Integrated Diode	—	—	DJ	—	—	—	—	—	—	—	—	—	—	—	—
with Electronic Coil	—	—	EJ	—	—	—	—	—	—	—	—	—	—	—	—

2

103T Factory-Installed Options

Change option code ① to desired auxiliary contact: 103T-AWD①-CA16C

Contactor Auxiliaries without "-SP" Control Plug									
		ISO Busbar Mount			Standard Busbar Mount			Panel Mount	
Option ①	Description	9…23 A	30…43 A	60…85 A	9…23 A	30…43 A	60…85 A	9…23 A	30…43 A
2	1 N.O.	NA	NA	NA	Standard	Standard	Standard	Standard	Standard
3	1 N.O. + 1 N.C.	NA	NA	NA	Available	Available	Available	Available	Available
4	2 N.O.	NA	NA	NA	Available	Available	Available	Available	Available
6	2 N.O. + 1 N.C.	NA	NA	NA	Available	NA	NA	Available	NA
7	2 N.O. + 2 N.C.	NA	NA	NA	NA	Available	Available	NA	Available
8	3 N.O. + 2 N.C.	NA	NA	NA	Available	NA	NA	Available	NA

Change option code ① to desired auxiliary contact: 103T-AWD①-CA16C

Contactor Auxiliaries with "-SP" Control Plug									
		ISO Busbar Mount			Standard Busbar Mount			Panel Mount	
Option ①	Description	9…23 A	30…43 A	60…85 A	9…23 A	30…43 A	60…85 A	9…23 A	30…43 A
2	1 N.O.	Standard	Standard	NA	Available	Available	Available	Available	Available
3	1 N.O. + 1 N.C.	Available	Available	NA	Available	Available	Available	Available	Available
4	2 N.O.	Available	Available	NA	Available	Available	Available	Available	Available
6	2 N.O. + 1 N.C.	NA	NA	NA	NA	NA	NA	NA	NA
7	2 N.O. + 2 N.C.	NA	NA	NA	NA	NA	NA	NA	NA
8	3 N.O. + 2 N.C.	NA	NA	NA	NA	NA	NA	NA	NA

Change option code ② to desired auxiliary contact: 103T-AWD2-CA16②

Circuit Breaker Aux/Trip Contacts									
		ISO Busbar Mount			Standard Busbar Mount			Panel Mount	
Option ②	Description	9…23 A	30…43 A	60…85 A	9…23 A	30…43 A	60…85 A	9…23 A	30…43 A
X∗	Without Aux/Trip Contacts	NA	NA	NA	Available	Available	Available	Available	Available
A∗	1 N.C. Aux.	NA	NA	NA	Available	Available	NA	Available	Available
B	1 N.O. Aux.	Available	Available	NA	Available	Available	NA	Available	Available
C	1 N.O. + 1 N.C. Aux.	Standard	Standard	NA	Standard	Standard	Standard	Standard	Standard
D	2 N.O. Aux.	Available	Available	NA	Available	Available	Available	Available	Available
E∗	2 N.C. Aux.	NA	NA	NA	Available	Available	Available	Available	Available
R∗	1 N.O. Trip + 1 N.C. Aux	NA	NA	NA	Available	Available	NA	Available	Available
S	1 N.O. Trip + 1 N.O. Aux	Available	Available	NA	Available	Available	NA	Available	Available

∗ Not available when an "-SP" Control Plug is selected.

Add option code ③ to desired auxiliary contact: 103T-AWD2-CA16C③

Additional Circuit Breaker Aux/Trip Contacts									
		ISO Busbar Mount			Standard Busbar Mount			Panel Mount	
Option ③	Description	9…23 A	30…43 A	60…85 A	9…23 A	30…43 A	60…85 A	9…23 A	30…43 A
Blank	Without Aux/Trip Contacts	Available	Available	Available	Available	Available	Available	Available	Available
C❄	1 N.O. + 1 N.C. Aux.	Available	Available	NA	Available	Available	NA	Available	Available
D❄	2 N.O. Aux.	Available	Available	NA	Available	Available	NA	Available	Available
E❄‡	2 N.C. Aux.	Available	Available	NA	Standard	Standard	NA	Standard	Standard
K	1 N.C. (OL) Trip + 1 N.C. (SC) Trip	Available	Available	NA	Available	Available	Available	Available	Available
L	1 N.O. (OL) Trip + 1 N.O. (SC) Trip	Available	Available	NA	Available	Available	Available	Available	Available
M‡	1 N.C. (OL) Trip + 1 N.O. (SC) Trip	Available	Available	NA	Available	Available	Available	Available	Available
N‡	1 N.O. (OL) Trip + 1 N.C. (SC) Trip	Available	Available	NA	Available	Available	Available	Available	Available
Q‡	1 N.O. (SC) Trip + 1 N.C. (SC) Trip	Available	Available	NA	Available	Available	NA	Available	Available

❄ Not available on 60…85 A starters.
‡ Not available when an "-SP" Control Plug is selected on 60…85 A starters.

Add option code ④ to desired auxiliary contact: 103T-AWD2-CA16C-④

Modifications/Accessories	
Option ④	Description
R	Surge Suppressor, RC
V	Surge Suppressor, Varistor
D	Surge Suppressor, Diode
KN	Lockable Knob, Black
KY	Lockable Knob, Red/Yellow
TE	Spacing Adapter for UL508 Type E
SP	Control Plug, Top Mount

107T Factory-Installed Options

Change option code ① to desired auxiliary contact: 107T-AWD①-CA16C

Contactor Auxiliaries without "-SP" Control Plug									
		ISO Busbar Mount			Standard Busbar Mount			Panel Mount	
Option ①	Description	9…23 A	30…43 A	60…85 A	9…23 A	30…43 A	60…85 A	9…23 A	30…43 A
3	1 N.O. + 1 N.C.	NA	NA	NA	Standard	Standard	Standard	Standard	Standard
7	2 N.O. + 2 N.C.	NA	NA	NA	Available	Available	Available	Available	Available

Change option code ① to desired auxiliary contact: 107T-AWD①-CA16C

Contactor Auxiliaries with "-SP" Control Plug									
		ISO Busbar Mount			Standard Busbar Mount			Panel Mount	
Option ①	Description	9…23 A	30…43 A	60…85 A	9…23 A	30…43 A	60…85 A	9…23 A	30…43 A
3	1 N.O. + 1 N.C.	Standard	Standard	NA	Available	Available	Available	Available	Available
7	2 N.O. + 2 N.C.	Available	Available	NA	Available	Available	Available	Available	Available

Change option code ② to desired auxiliary contact: 107T-AWD2-CA16②

Circuit Breaker Aux/Trip Contacts									
		ISO Busbar Mount			Standard Busbar Mount			Panel Mount	
Option ②	Description	9…23 A	30…43 A	60…85 A	9…23 A	30…43 A	60…85 A	9…23 A	30…43 A
X✶	Without Aux/Trip Contacts	NA	NA	NA	Available	Available	Available	Available	Available
A✶	1 N.C. Aux.	NA	NA	NA	Available	Available	NA	Available	Available
B	1 N.O. Aux.	Available	Available	NA	Available	Available	NA	Available	Available
C	1 N.O. + 1 N.C. Aux.	Standard	Standard	NA	Standard	Standard	Standard	Standard	Standard
D	2 N.O. Aux.	Available	Available	NA	Available	Available	Available	Available	Available
E✶	2 N.C. Aux.	NA	NA	NA	Available	Available	Available	Available	Available
R✶	1 N.O. Trip + 1 N.C. Aux	NA	NA	NA	Available	Available	NA	Available	Available
S	1 N.O. Trip + 1 N.O. Aux	Available	Available	NA	Available	Available	NA	Available	Available

Add option code ③ to desired auxiliary contact: 107T-AWD2-CA16C③

Additional Circuit Breaker Aux/Trip Contacts									
		ISO Busbar Mount			Standard Busbar Mount			Panel Mount	
Option ③	Description	9…23 A	30…43 A	60…85 A	9…23 A	30…43 A	60…85 A	9…23 A	30…43 A
Blank	Without Aux/Trip Contacts	Available	Available	Available	Available	Available	Available	Available	Available
C❄	1 N.O. + 1 N.C. Aux.	Available	Available	NA	Available	Available	NA	Available	Available
D❄	2 N.O. Aux.	Available	Available	NA	Available	Available	NA	Available	Available
E❄‡	2 N.C. Aux.	Available	Available	NA	Available	Available	NA	Available	Available
K	1 N.C. (OL) Trip + 1 N.C. (SC) Trip	Available	Available	NA	Available	Available	Available	Available	Available
L	1 N.O. (OL) Trip + 1 N.O. (SC) Trip	Available	Available	NA	Available	Available	Available	Available	Available
M‡	1 N.C. (OL) Trip + 1 N.O. (SC) Trip	Available	Available	NA	Available	Available	Available	Available	Available
N‡	1 N.O. (OL) Trip + 1 N.C. (SC) Trip	Available	Available	NA	Available	Available	Available	Available	Available
Q❄	1 N.O. (SC) Trip + 1 N.C. (SC) Trip	Available	Available	NA	Available	Available	NA	Available	Available

❄ Not available on 60…85 A starters.
‡ Not available when a "-SP" Control Plug is selected on 60…85 A starters.

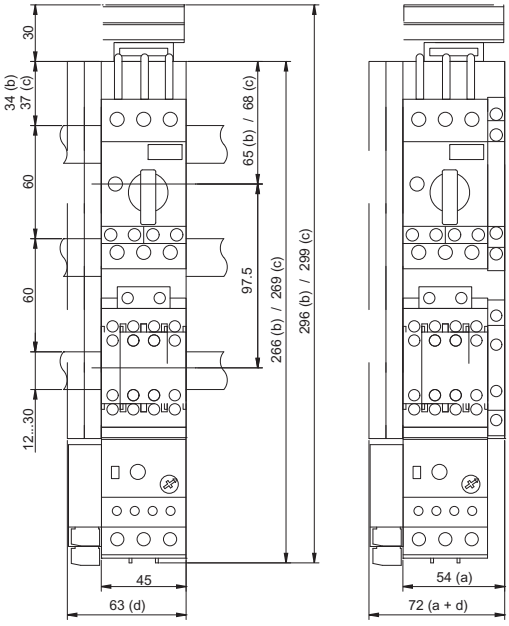
Add option code ④ to desired auxiliary contact: 107T-AWD2-CA16C-④

Modifications/Accessories	
Option ④	Description
R	Surge Suppressor, RC
V	Surge Suppressor, Varistor
D	Surge Suppressor, Diode
KN	Lockable Knob, Black
KY	Lockable Knob, Red/Yellow
TE	Spacing Adapter for UL508 Type E
SP	Control Plug, Top Mount

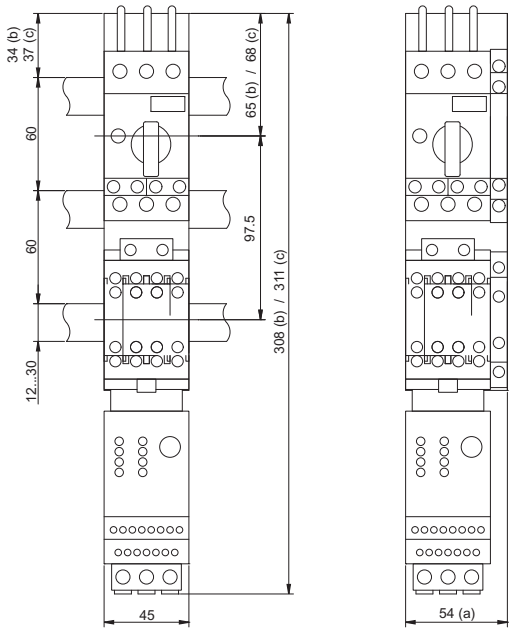
Open Type Starters

Approximate Dimensions

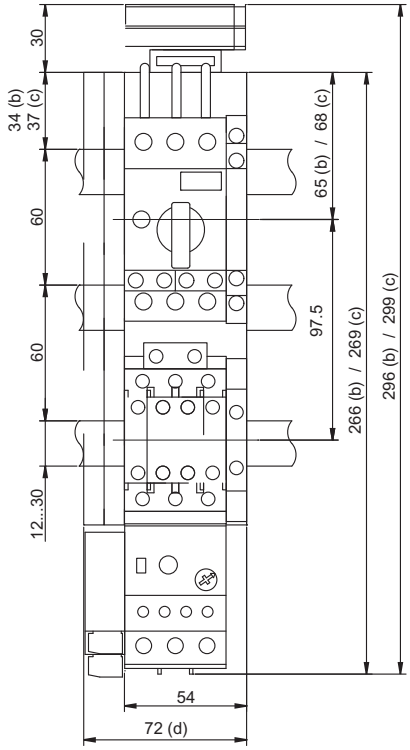
Dimensions are shown in millimeters. Dimensions are not intended for manufacturing purposes.



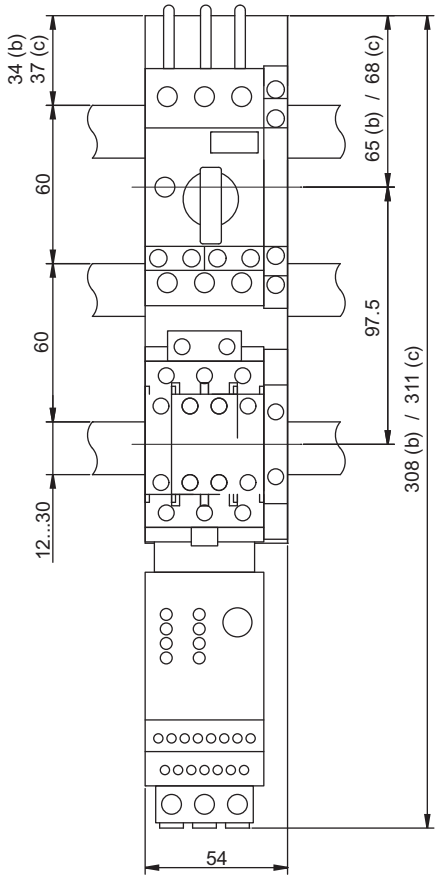
Circuit Breaker:	140M-C / -D	(a) With additional side-mount aux. or trip contact(s)
Contactor:	100-C09...23	(b) Standard busbar adapter with control plug
Motor Protection Relay:	193-ED / -EE	(c) Iso busbar adapter with control plug
		(d) With 193-E* side-mount module



Circuit Breaker:	140M-C / -D	(a) With additional side-mount aux. or trip contact(s)
Contactor:	100-C09...23	(b) Standard busbar adapter
Motor Protection Relay:	193-EC...	(c) Iso busbar adapter

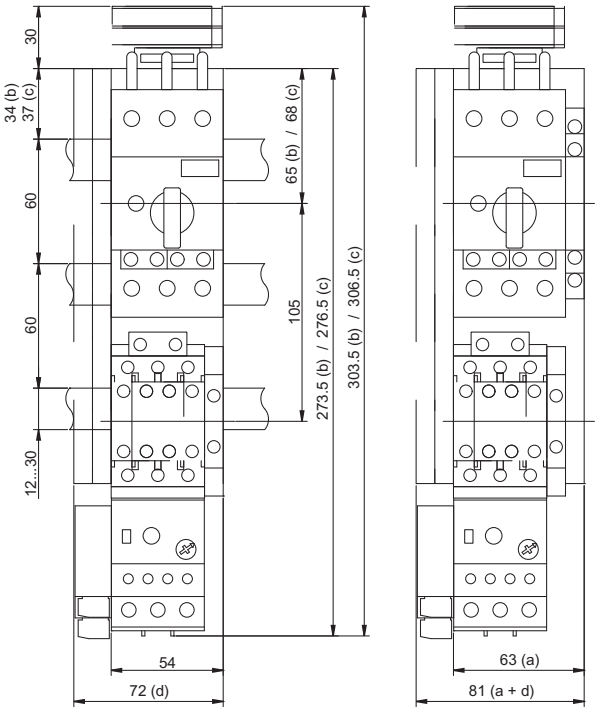


Circuit Breaker:	140M-D	(b) Standard busbar adapter with control plug
Contactor:	100-C30...37	(c) Iso busbar adapter with control plug
Motor Protection Relay:	193-EE	(d) With 193-E* side-mount module



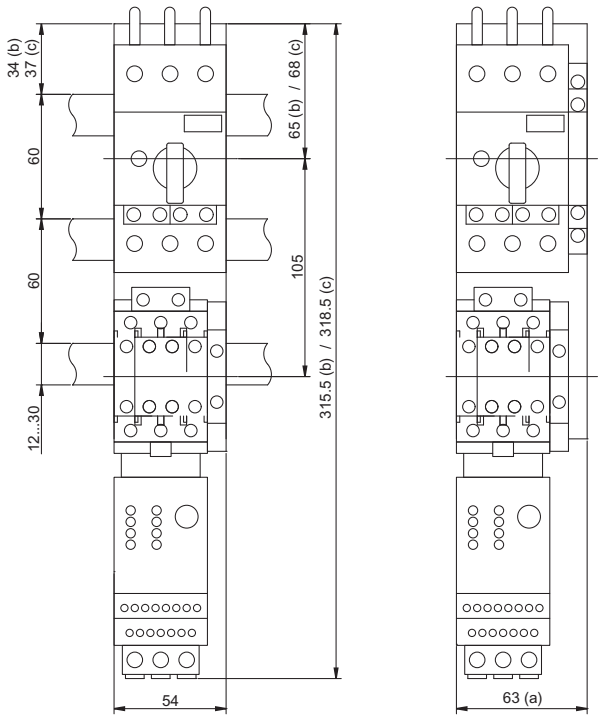
Circuit Breaker:	140M-D	(b) Standard busbar adapter
Contactor:	100-C30...37	(c) Iso busbar adapter
Motor Protection Relay:	193-EC...	

Dimensions are shown in millimeters. Dimensions are not intended for manufacturing purposes.



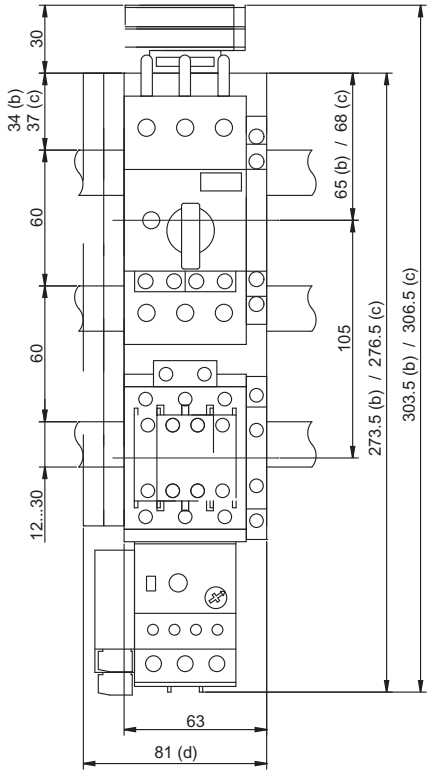
Circuit Breaker: 140M-F
Contactor: 100-C30...37
Motor Protection Relay: 193-EE

(a) With additional side-mount aux. or trip contact
(b) Standard busbar adapter with control plug
(c) Iso busbar adapter with control plug
(d) With 193-E* side-mount module



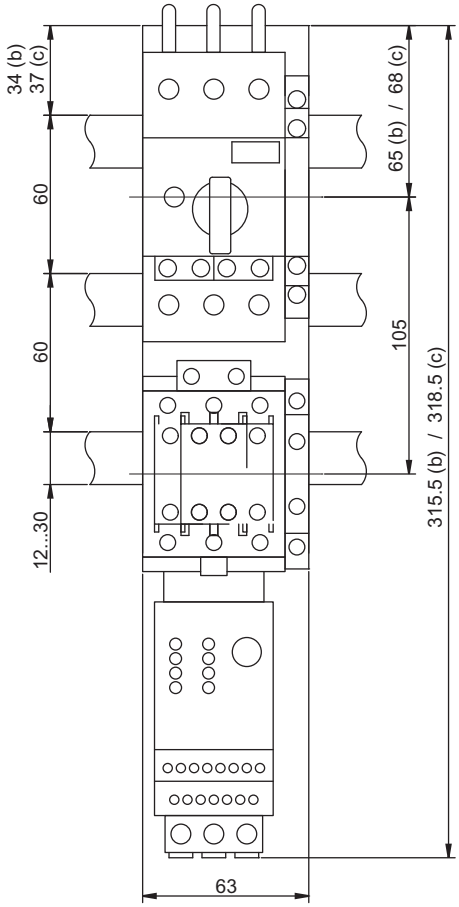
Circuit Breaker: 140M-F
Contactor: 100-C30...37
Motor Protection Relay: 193.EC...

(a) With additional side-mount aux. or trip contact
(b) Standard busbar adapter
(c) Iso busbar adapter



Circuit Breaker: 140M-F
Contactor: 100-C43
Motor Protection Relay: 193-EE

(b) Standard busbar adapter with control plug
(c) Iso busbar adapter with control plug
(d) With 193-E* side-mount module



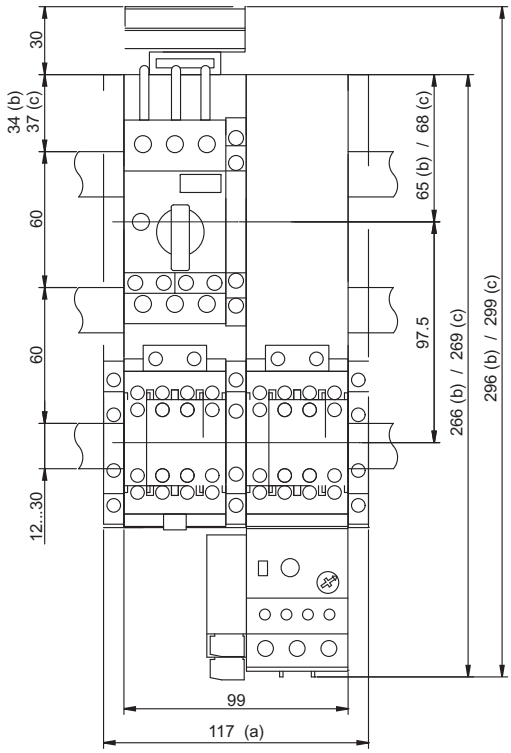
Circuit Breaker: 140M-F
Contactor: 100-C43
Motor Protection Relay: 193-EC...

(b) Standard busbar adapter
(c) Iso busbar adapter

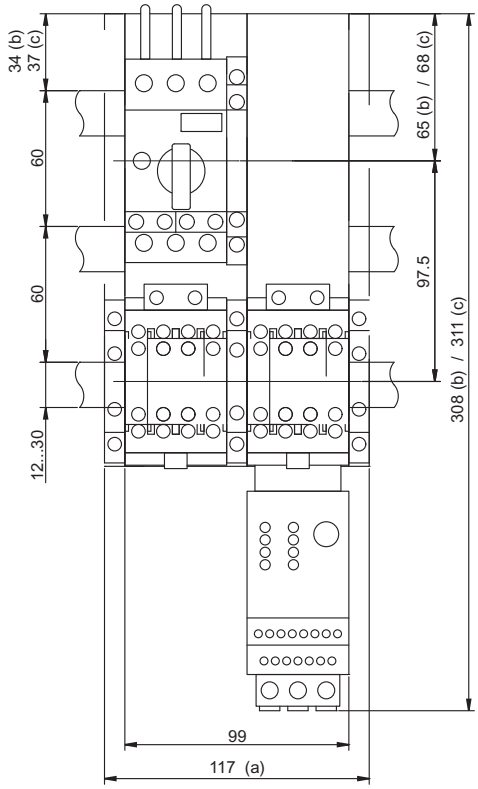
Open Type Starters

Approximate Dimensions, Continued

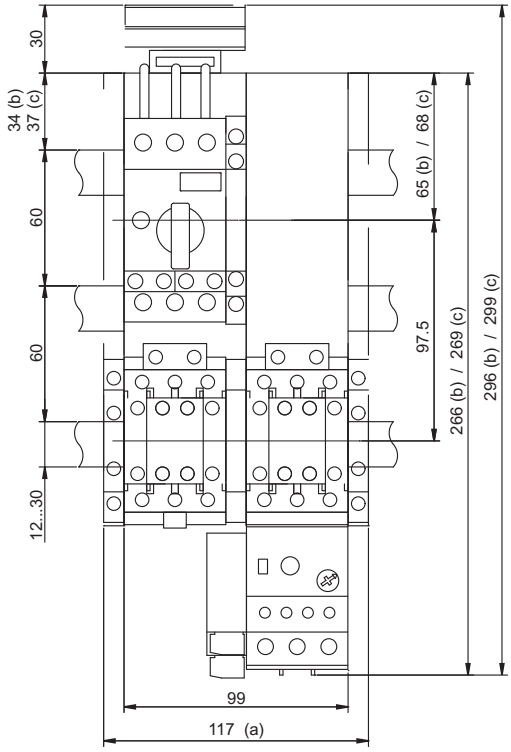
Dimensions are shown in millimeters. Dimensions are not intended for manufacturing purposes.



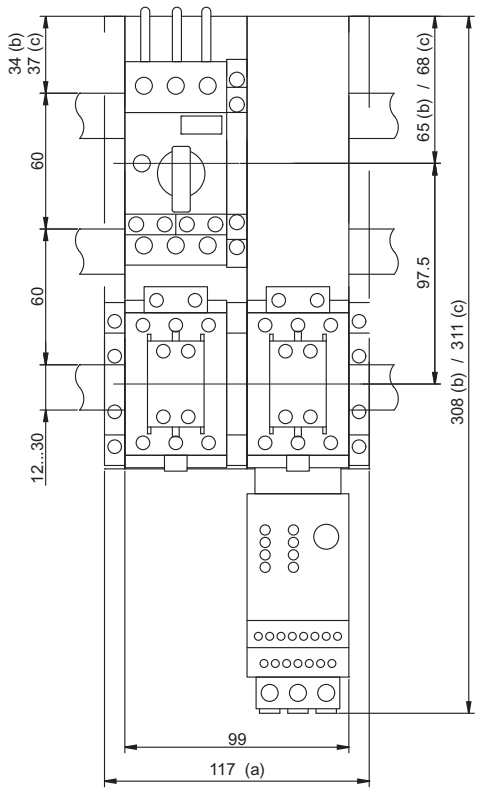
Circuit Breaker:	140M-C / -D	(a) With additional side-mount aux. contacts
Contactors:	100-C09...23	(b) Standard busbar adapter with control plug
Motor Protection Relay:	193-ED / -EE	(c) Iso busbar adapter with control plug



Circuit Breaker:	140M-C / -D	(a) With additional side-mount aux. contacts
Contactors:	100-C09...23	(b) Standard busbar adapter
Motor Protection Relay:	193-EC...	(c) Iso busbar adapter

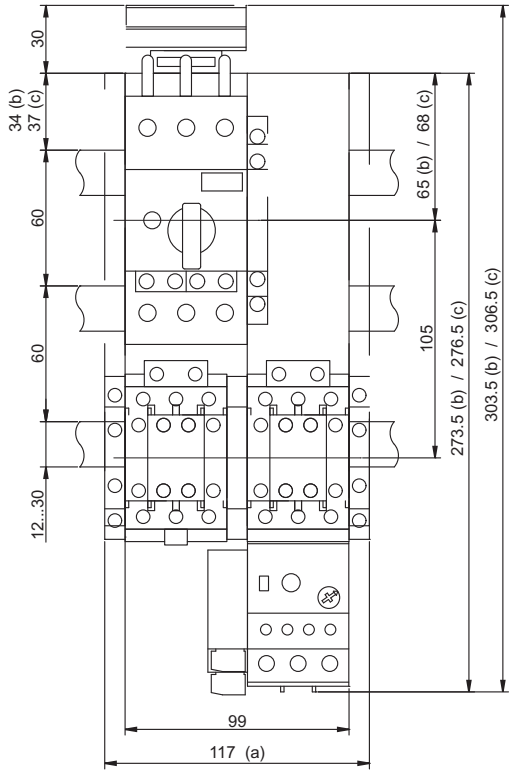


Circuit Breaker:	140M-D	(a) With additional side-mount aux. contacts
Contactors:	100-C30...37	(b) Standard busbar adapter with control plug
Motor Protection Relay:	193-EE	(c) Iso busbar adapter with control plug



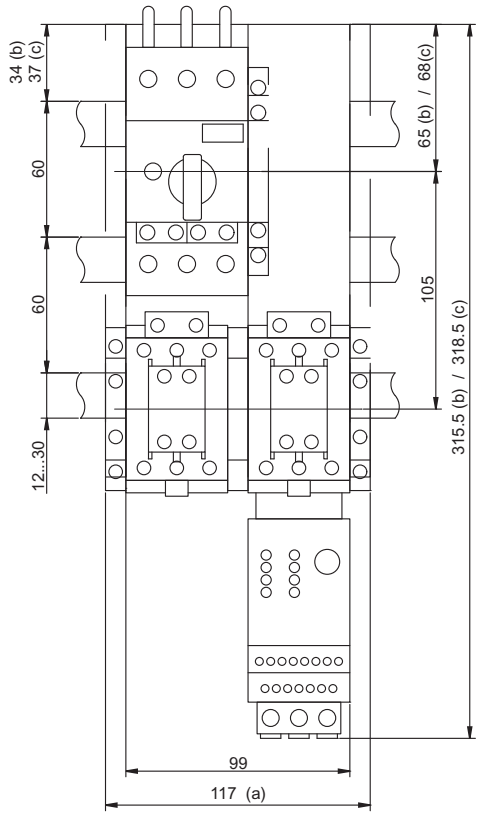
Circuit Breaker:	140M-D	(a) With additional side-mount aux. contacts
Contactors:	100-C30...37	(b) Standard busbar adapter
Motor Protection Relay:	193-EC...	(c) Iso busbar adapter

Dimensions are shown in millimeters. Dimensions are not intended for manufacturing purposes.



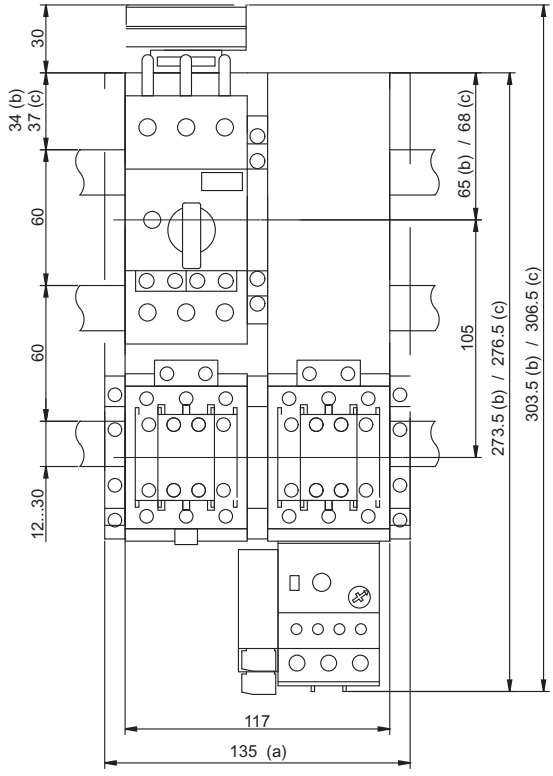
Circuit Breaker: 140M-F
Contactors: 100-C30...37
Motor Protection Relay: 193-EE

(a) With additional side-mount aux. contacts
(b) Standard busbar adapter with control plug
(c) Iso busbar adapter with control plug



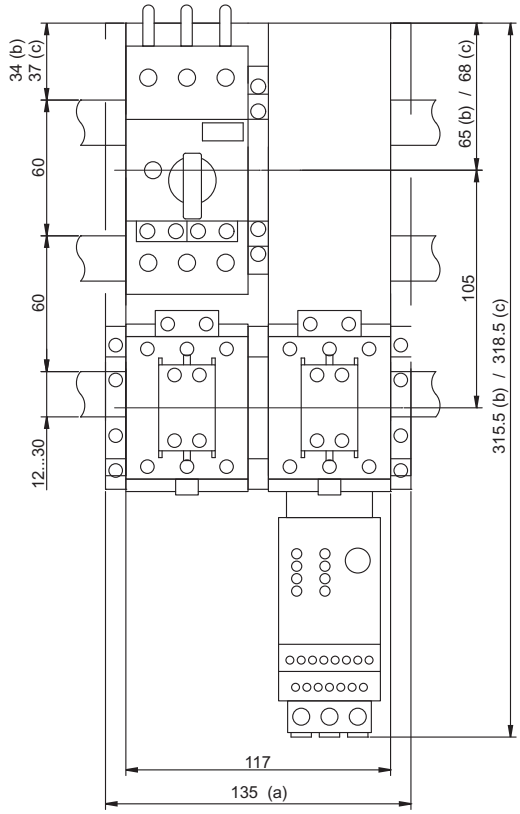
Circuit Breaker: 140M-F
Contactors: 100-C30...37
Motor Protection Relay: 193-EC...

(a) With additional side-mount aux. contacts
(b) Standard busbar adapter
(c) Iso busbar adapter



Circuit Breaker: 140M-F
Contactors: 100-C43
Motor Protection Relay: 193-EE

(a) With additional side-mount aux. contacts
(b) Standard busbar adapter with control plug
(c) Iso busbar adapter with control plug



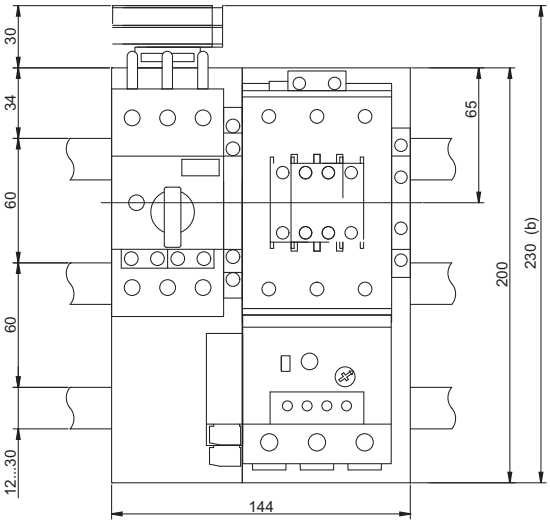
Circuit Breaker: 140M-F
Contactors: 100-C43
Motor Protection Relay: 193-EC...

(a) With additional side-mount aux. contacts
(b) Standard busbar adapter
(c) Iso busbar adapter

Open Type Starters

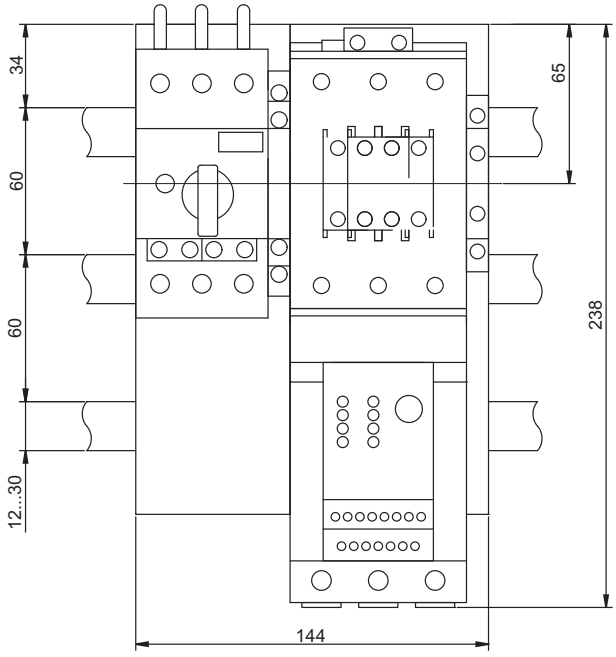
Approximate Dimensions, Continued

Dimensions are shown in millimeters. Dimensions are not intended for manufacturing purposes.

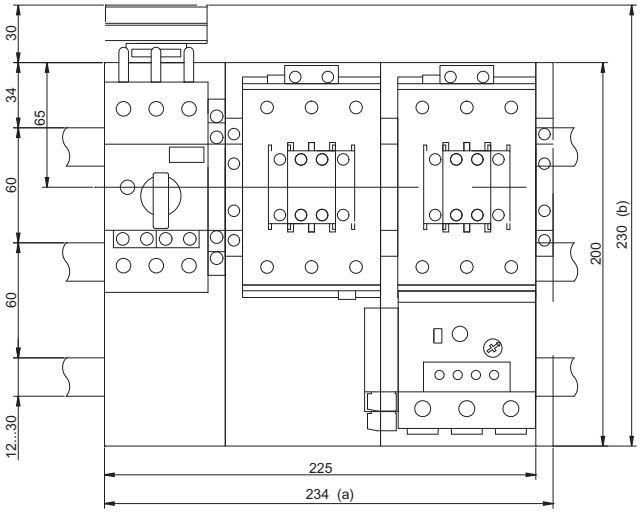


Circuit Breaker: 140M-F
Contactor: 100-C60...85
Motor Protection Relay: 193-EE

(b) Standard busbar adapter with control plug

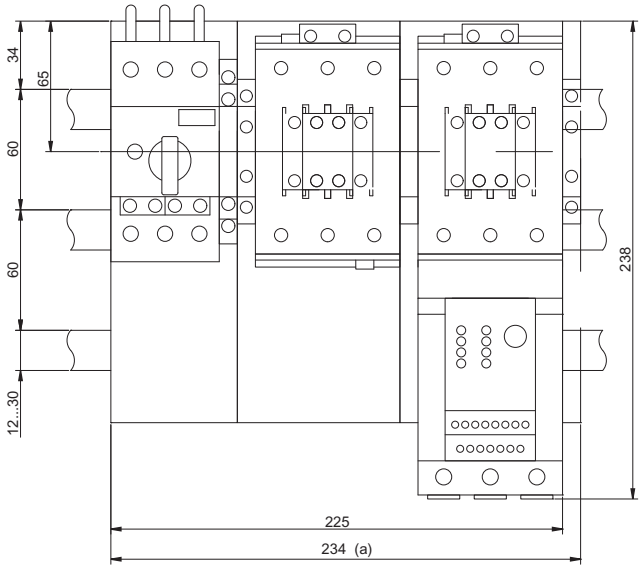


Circuit Breaker: 140M-F
Contactor: 100-C60...85
Motor Protection Relay: 193-EC...



Circuit Breaker: 140M-F
Contactors: 100-C60...85
Motor Protection Relay: 193-EE

(a) With additional side-mount aux. contacts
(b) Standard busbar adapter with control plug



Circuit Breaker: 140M-F
Contactors: 100-C60...85
Motor Protection Relay: 193-EC...

(a) With additional side-mount aux. contacts

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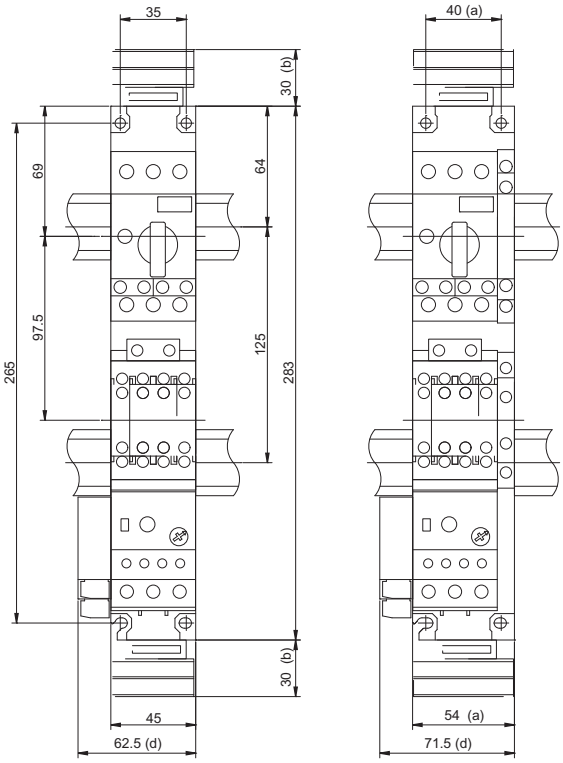
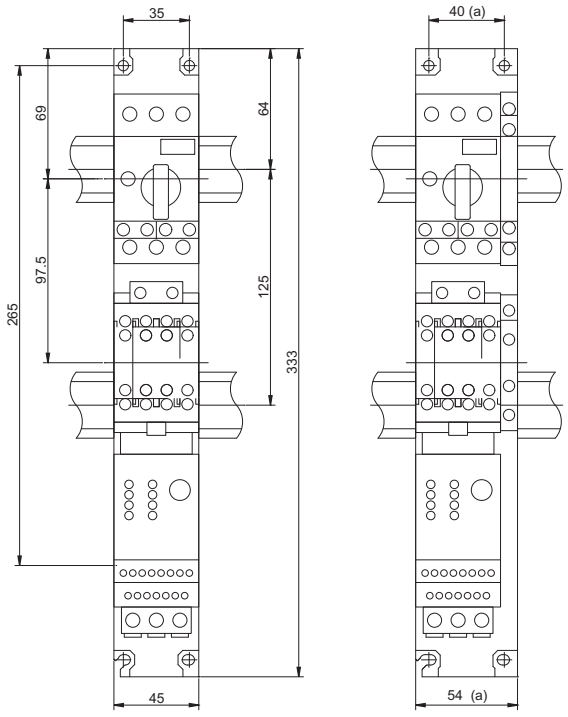
Preferred availability cat. nos. are printed in **bold**

Dimensions are shown in millimeters. Dimensions are not intended for manufacturing purposes.



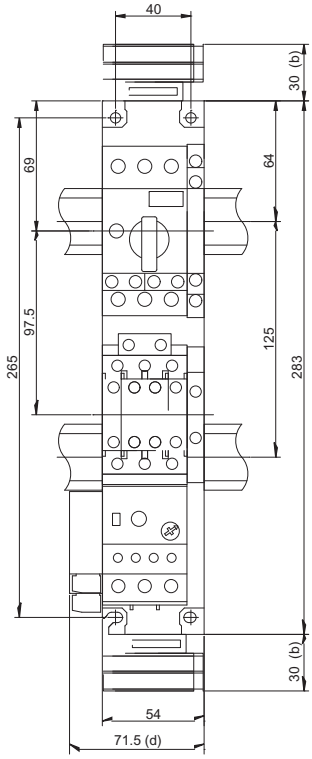
Circuit Breaker: 140M-C / -D
Contactors: 100-C09...23
Motor Protection Relay: 193-ED / -EE

(a) With additional side-mount aux. or trip contact(s)
(b) Control plug on top OR bottom side optional
(d) With 193-E* side-mount module



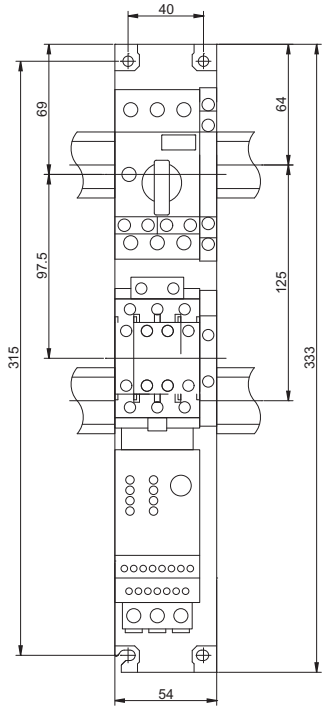
Circuit Breaker: 140M-C / -D
Contactors: 100-C09...23
Motor Protection Relay: 193-EC...

(a) With additional side-mount aux. or trip contact(s)



Circuit Breaker: 140M-D
Contactor: 100-C30...37
Motor Protection Relay: 193-EE

(b) Control plug on top OR bottom side optional
(d) With 193-E* side-mount module

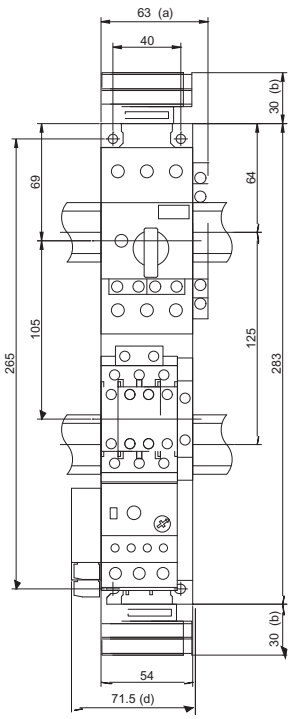


Circuit Breaker: 140M-D
Contactor: 100-C30...37
Motor Protection Relay: 193.EC...

Open Type Starters

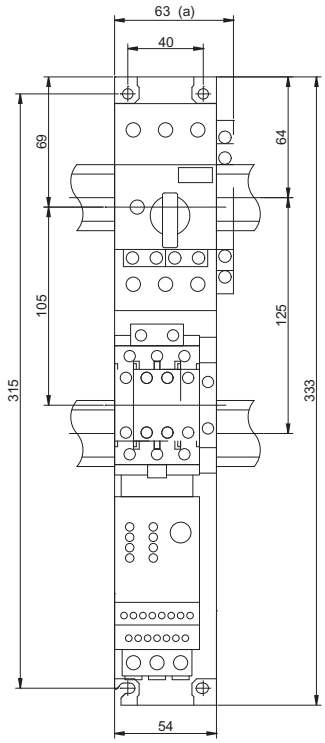
Approximate Dimensions, Continued

Dimensions are shown in millimeters. Dimensions are not intended for manufacturing purposes.



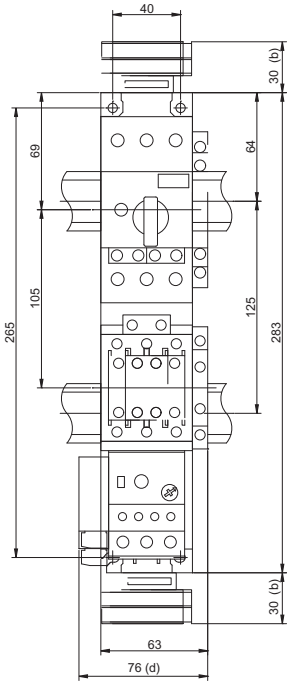
Circuit Breaker: 140M-F
Contactor: 100-C30...37
Motor Protection Relay: 193-EE

(a) With additional side-mount aux. or trip contact
(b) Control plug on top OR bottom side optional
(d) With 193-E* side-mount module



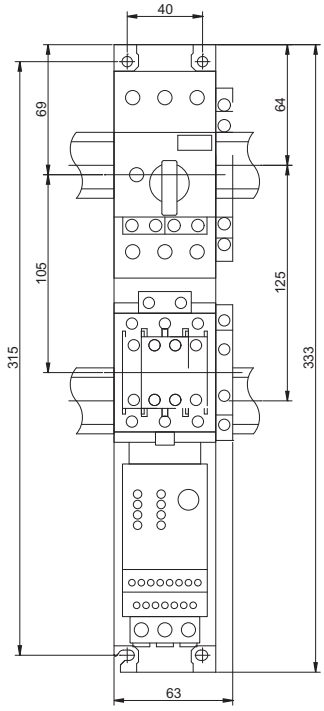
Circuit Breaker: 140M-F
Contactor: 100-C30...37
Motor Protection Relay: 193.EC...

(a) With additional side-mount aux. or trip contact



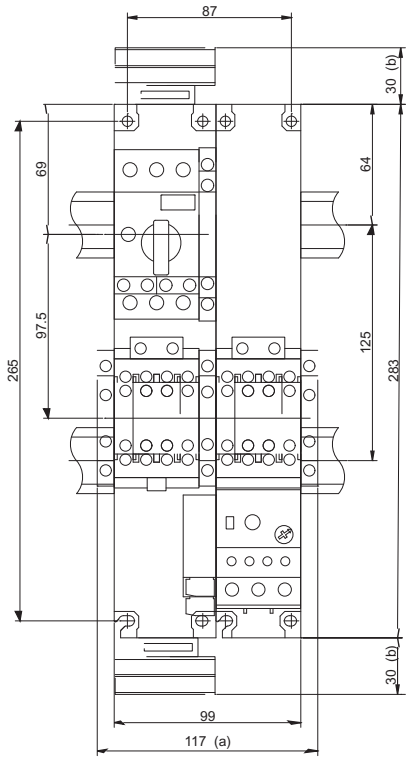
Circuit Breaker: 140M-F
Contactor: 100-C43
Motor Protection Relay: 193-EE

(b) Control plug on top OR bottom side optional
(d) With 193-E* side-mount module



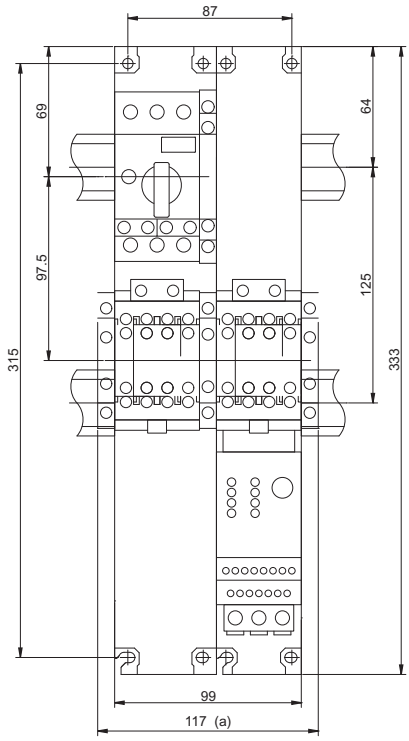
Circuit Breaker: 140M-F
Contactor: 100-C43
Motor Protection Relay: 193-EC...

Dimensions are shown in millimeters. Dimensions are not intended for manufacturing purposes.



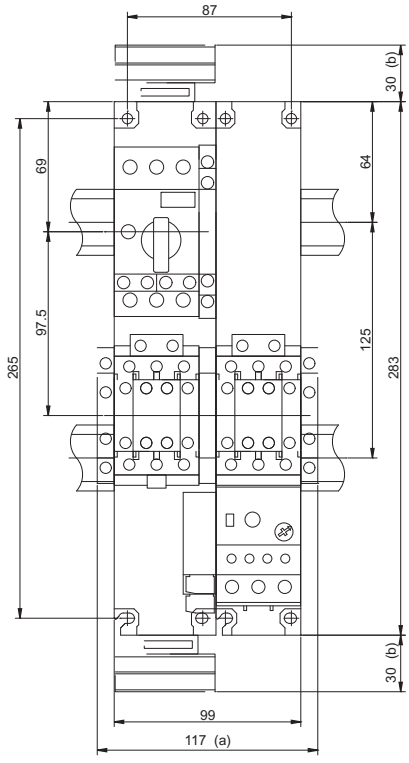
Circuit Breaker: 140M-C / -D
Contactors: 100-C09...23
Motor Protection Relay: 193-ED / -EE

(a) With additional side-mount aux. contacts
(b) Control plug on top OR bottom side optional



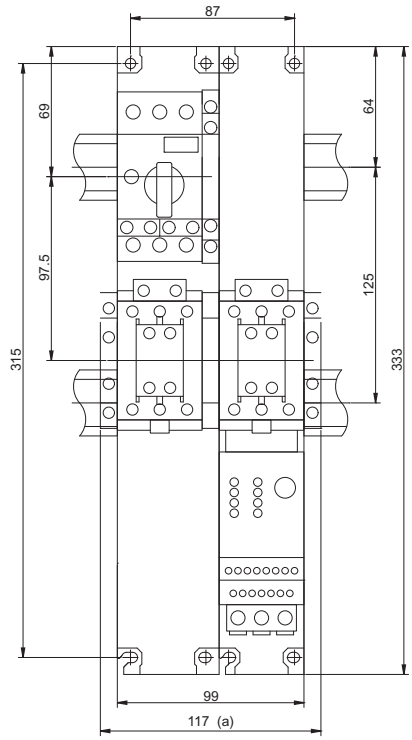
Circuit Breaker: 140M-C / -D
Contactors: 100-C09...23
Motor Protection Relay: 193-EC...

(a) With additional side-mount aux. contacts



Circuit Breaker: 140M-D
Contactors: 100-C30...37
Motor Protection Relay: 193-EE

(a) With additional side-mount aux. contacts
(b) Control plug on top OR bottom side optional



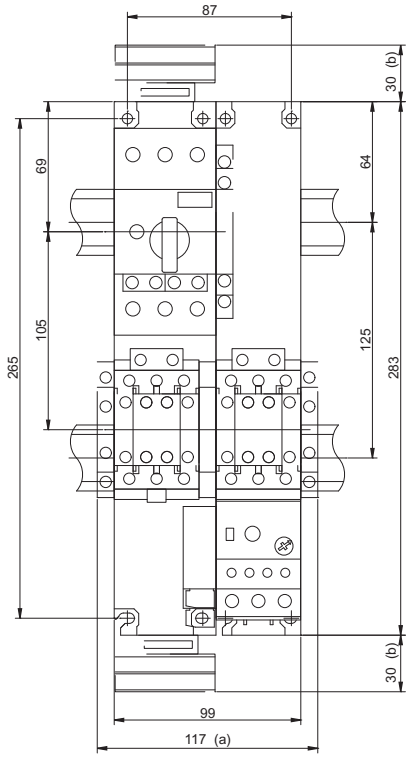
Circuit Breaker: 140M-D
Contactors: 100-C30...37
Motor Protection Relay: 193-EC...

(a) With additional side-mount aux. contacts

Open Type Starters

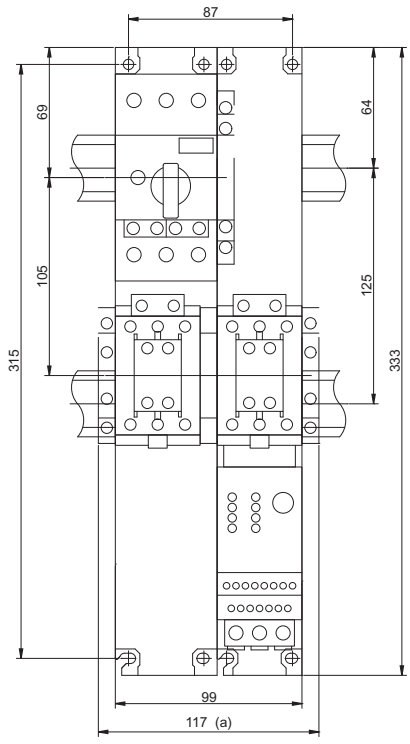
Approximate Dimensions, Continued

Dimensions are shown in millimeters. Dimensions are not intended for manufacturing purposes.



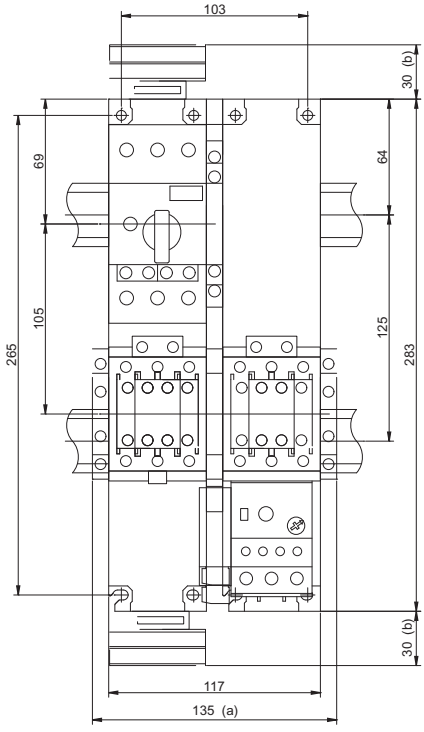
Circuit Breaker: 140M-F
Contactors: 100-C30...37
Motor Protection Relay: 193-EE

(a) With additional side-mount aux. contacts
(b) Control plug on top OR bottom side optional



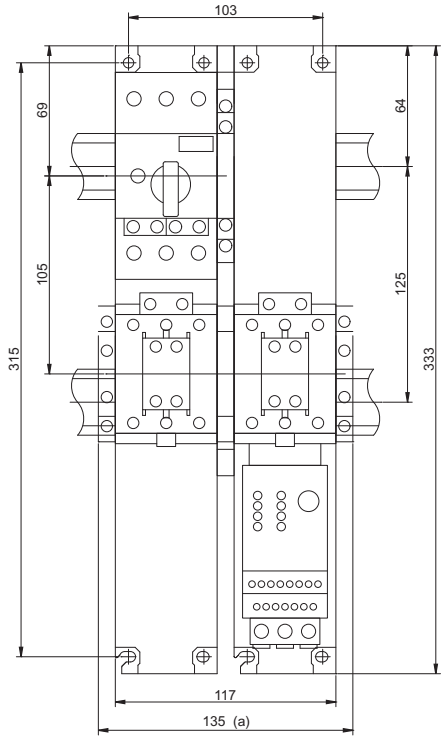
Circuit Breaker: 140M-F
Contactors: 100-C30...37
Motor Protection Relay: 193-EC...

(a) With additional side-mount aux. contacts



Circuit Breaker: 140M-F
Contactors: 100-C43
Motor Protection Relay: 193-EE

(a) With additional side-mount aux. contacts
(b) Control plug on top OR bottom side optional



Circuit Breaker: 140M-F
Contactors: 100-C43
Motor Protection Relay: 193-EC...

(a) With additional side-mount aux. contacts

Bulletin 190 Eco and Compact Combination Starters

- Current range: 0.1...43 A
- Bulletin 190E/191E modular Eco starters
- Bulletin 190S/191S Pre-wired compact starters
- Uses Bulletin 140M motor protection circuit breakers (MPCBs) and Bulletin 100-C or 100-K contactors
- cULus Listed for control and protection of motor loads
- Type 1 or Type 2 Coordination
- Mounts to top hat rail(s) or screw mounts

Your order must include: cat. no. of the starter selected and, if required, cat. no. of any accessories.

Table of Contents

Product Selection 2-310
Factory-Installed Modifications 2-322

Standards Compliance

IEC/EN 60947-1, -2, -4-1, -5
IEC/EN 60204-1
CSA 22.2, No. 14
UL 508

Certifications

cULus Listed (File No. E125316, Guide NKJH, NKJH7)
CE Marked

2

	Eco Starter with 100-K Miniature Contactor	**Eco Starter with 100-C IEC Contactor**	**Reversing Eco Starter with 100-K Miniature Contactor**	**Reversing Eco Starter with 100-C IEC Contactor**	**Compact Combination Starter (25 A)**	**Compact Combination Starter (45 A)**	**Reversing Compact Combination Starter (25 A)**
AC Coils	✓	✓	✓	✓	✓	✓	✓
DC Coils	✓	24V DC only	✓	24V DC only	✓	✓	24V DC only
Standards Compliance	See this page						
cULus Listed							
CE	✓	✓	✓	✓	✓	✓	✓
IEC 60947	✓	✓	✓	✓	✓	✓	✓
Type 2 Coordination	See pages 2-314 and page 2-320						
Components	140M-C	140M-C,-D	140M-C	140M-C,-D	140M-C,-D	140M-F	140M-C,-D
MPCB							
Contactor	100-K	100-C	104-K	104-C	100-C	100-C	104-C

Eco and Compact Combination Starters

Catalog Number Explanation

Cat. No. Explanation

Examples given in this section are for reference purposes. This basic explanation should not be used for product selection; not all combinations will produce a valid catalog number.

190E – A N D 2 – C A16 X – TE

a b c d e f g h i

a

Bulletin Number	
Starter Type	
Code	Description
190E	DOL Starter with MPCB
191E	Rev Starter with MPCB

b

Contactor Size	
Code	Description
A	100-C09
B	100-C12
C	100-C16
D	100-C23
KM	100-K05
KN	100-K09
KP	100-K12

c

Style	
Code	Description
N	Open Style — 35 mm top hat rail mount (1)

d

AC Coil Voltages for Contactor Size A-D	
Code	Description
Q	12V AC, 60 Hz
R	12V AC, 50 Hz
J	24V AC, 60 Hz
K	24V AC, 50 Hz
KJ	24V AC, 50/60 Hz
V	32V AC, 50 Hz/36V AC, 60 Hz
W	36V AC, 50 Hz
X	42V AC, 50 Hz/48V AC, 60 Hz
Y	48V AC, 50 Hz
KY	48V AC, 50/60 Hz
KP	100V AC, 50 Hz/100...110V AC, 60 Hz
D	110V AC, 50 Hz/120V AC, 60 Hz
KD	100V AC, 50/60 Hz
P	120V AC, 50 Hz
KL	200...230V AC, 50/60 Hz
H	208V AC, 60 Hz
L	208...240V AC, 60 Hz
A	220V AC, 50 Hz /240V AC, 60 Hz
F	220...230V AC, 50 Hz
KF	230V AC, 50/60 Hz
VA	230...240V AC, 50 Hz
T	240V AC, 50 Hz/277V AC, 60 Hz
E	380V AC, 60 Hz
N	380...400V AC, 50 Hz/440V AC, 60 Hz
KN	400V AC, 50/60 Hz
G	400...415V AC, 50 Hz
B	440V AC, 50 Hz/480V AC, 60 Hz
M	500V AC, 50 Hz
C	550V AC, 50 Hz/600V AC, 60 Hz

d, continued

DC Coil Voltages for Contactor Size A...D	
Code	Description
EJ	24V DC electronic
AC Coil Voltages for Contactor Size KM...KP	
Code	Description
KJ	24V AC, 50/60 Hz
D	110V AC, 50 Hz/120V AC, 60 Hz
KF	230V AC, 50/60 Hz
KA	240V AC, 50/60 Hz
KN	400V AC, 50/60 Hz
B	440V AC, 50 Hz/480V AC, 60 Hz
VC	525V AC, 50 Hz/600V AC, 60 Hz
DC Coil Voltage for Contactor Sizes KM...KP	
Code	Description
ZQ	12V DC
ZJ	24V DC
DJ	24V DC with integrated diode
ZD	110V DC
ZS	125V DC
ZA	220V DC
ZT	250V DC

e

Contactor Aux. Contacts	
Code	Description
1	1 N.C. (190E, or 191E-KM...KP)
2	1 N.O. (190E, or 191E-KM...KP)
3	1 N.O. + 1 N.C. (191E-A...D)

f

Circuit Breaker Frame Size	
Code	Description
C	C Frame
D	D Frame

g

Circuit Breaker Current Range	
Code	Description
A16	0.1...0.16 A
A25	0.16...0.25 A
A40	0.25...0.4 A
A63	0.4...0.63 A
B10	0.63...1.0 A
B25	1.0...2.5 A
B40	2.5...4.0 A
B63	4.0...6.3 A
C10	6.3...10 A
C16	10...16 A
C20	16...20 A
C25	20...25 A

h

Circuit Breaker Aux. and Trip Contacts for 140M	
Bottom Front	
Code	Description
X	Without Aux. Trip Contacts
A	1 N.C. Aux. Contact
B	1 N.O. Aux. Contact
C	1 N.O. + 1 N.C. Aux. Contact
D	2 N.O. Aux. Contact
R	1 N.O. (SC+OL) + 1 N.C. Aux. Contact
S	1 N.O. (SC+OL) + 1 N.O. Aux. Contact

i

Modifications, Accessories	
Circuit Breaker Accessories	
Code	Description
TE	Spacing Adapter
KN	Lockable Twist Knob, Black
KY	Lockable Twist Knob, Red/Yellow
Additional CB Auxiliaries (Side Mount)	
Code	Description
A02	2 N.C.
A20	2 N.O.
A11	1 N.O. + 1 N.C.
Additional CB Trip Contacts (Side Mount)	
Code	Description
R00	1 N.O. Thermal-Mag + 1 N.O. Mag Only
R01	1 N.O. Thermal-Mag + 1 N.C. Mag Only
R10	1 N.C. Thermal-Mag + 1 N.O. Mag Only
R11	1 N.C. Thermal-Mag + 1 N.C. Mag Only
M11	1 N.O. Mag Only + 1 N.C. Mag Only
Coil Accessories	
Code	Description
JE	Electronic Interface(s)
D	Surge Suppressor Diode
R	Surge Suppressor RC
V	Surge Suppressor Varistor
Additional Contactor Auxiliaries (Side Mount)	
Code	Description
S01	1 N.C.
S10	1 N.O.
S11	1 N.O. + 1 N.C.
S20	2 N.O.
Additional Contactor Auxiliaries (Front Mount)	
Code	Description
F11	1 N.O. + 1 N.C.
F20	2 N.O.
F22	2 N.O. + 2 N.C.

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Preferred availability cat. nos. are printed in **bold**

Cat. No. Explanation

Examples given in this section are for reference purposes. This basic explanation should not be used for product selection; not all combinations will produce a valid catalog number.

190S – A N D 2 – C A16 C – TE

a b c d e f g h i

a

Bulletin Number	
Starter Type	
Code	Description
190S	DOL Starter with MPCB
191S	Rev Starter with MPCB

b

Contactor Size	
Code	Description
A	100-C09
B	100-C12
C	100-C16
D	100-C23
E	100-C30
F	100-C37
G	100-C43

c

Style	
Code	Description
N	Open Style — Screw mount (4), 35 mm top hat rail mount (2) or 75 mm top hat rail mount (1)

d

AC Coil Voltage	
Code	Description
Q	12V AC, 60 Hz
R	12V AC, 50 Hz
J	24V AC, 60 Hz
K	24V AC, 50 Hz
KJ	24V AC, 50/60 Hz
V	32V AC, 50 Hz /36V AC, 60 Hz
W	36V AC, 50 Hz
X	42V AC, 50 Hz /48V AC, 60 Hz
Y	48V AC, 50 Hz
KY	48V AC, 50/60 Hz
KP	100V AC, 50 Hz /100...110V AC, 60 Hz
D	110V AC, 50 Hz /120V AC, 60 Hz
KD	100V AC, 50/60 Hz
P	120V AC, 50 Hz
KL	200...230V AC, 50/60 Hz
H	208V AC, 60 Hz
L	208...240V AC, 60 Hz
A	220V AC, 50 Hz /240V AC, 60 Hz
F	220...230V AC, 50 Hz
KF	230V AC, 50/60 Hz
VA	230...240V AC, 50 Hz
T	240V AC, 50 Hz /277V AC, 60 Hz
E	380V AC, 60 Hz
N	380...400V AC, 50 Hz /440V AC, 60 Hz
KN	400V AC, 50/60 Hz
G	400...415V AC, 50 Hz
B	440V AC, 50 Hz /480V AC, 60 Hz
M	500V AC, 50 Hz
C	550V AC, 50 Hz /600V AC, 60 Hz

d, continued

DC Coil Voltage — Bul. 190S only	
Code	Description
ZR	6...12V DC
ZQ	12V DC
ZJ	24V DC
DJ	24V DC with Diode
EJ	24V DC electronic*
ZW	36V DC
ZY	48V DC
ZZ	60V DC
ZB	64V DC
ZG	72V DC
ZE	80V DC
ZD	110V DC
ZP	115V DC
ZS	125V DC
ZA	220V DC
ZF	230V DC
ZT	250V DC

* Also available for Bulletin 191S

e

Contactor Aux. Contacts	
Code	Description
2	1 N.O. (190S only)
3	1 N.O. + 1 N.C. (Bul. 191S and 190S, contactor sizes E…G only)

f

Circuit Breaker Frame Size	
Code	Description
C	C Frame
D	D Frame
F	F Frame

g

Circuit Breaker Current Range	
Code	Description
A16	0.1...0.16 A
A25	0.16...0.25 A
A40	0.25...0.4 A
A63	0.4...0.63 A
B10	0.63...1.0 A
B25	1.0...2.5 A
B40	2.5...4.0 A
B63	4.0...6.3 A
C10	6.3...10 A
C16	10...16 A
C20	16...20 A
C25	20...25 A
C32	25...32 A
C45	32...45 A

h

Circuit Breaker Aux. and Trip Contacts for 140M	
Bottom Front	
Code	Description
C	1 N.O. + 1 NC Aux. Contact
D	2 N.O. Aux. Contact
R	1 N.O. (SC+OL) + 1 NC Aux. Contact
S	1 N.O. (SC+OL) + 1 N.O. Aux. Contact

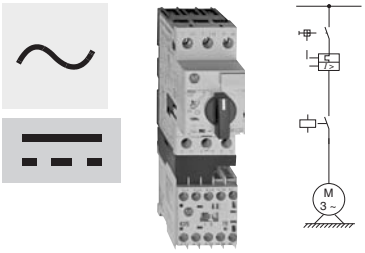
i

Modifications, Accessories	
Circuit Breaker Accessories	
Code	Description
TE	Spacer Module
KN	Lockable Twist Knob, Black
KY	Lockable Twist Knob, Red/Yellow
Additional CB Auxiliaries (Side Mount)	
Code	Description
A02	2 N.C.
A20	2 N.O.
A11	1 N.O. + 1 N.C.
Additional CB Trip Contacts (Side Mount)	
Code	Description
R00	1 N.O. Thermal-Mag + 1 N.O. Mag Only
R01	1 N.O. Thermal-Mag + 1 N.C. Mag Only
R10	1 N.C. Thermal-Mag + 1 N.O. Mag Only
R11	1 N.C. Thermal-Mag + 1 N.C. Mag Only
M11	1 N.O. Mag Only + 1 N.C. Mag Only
Coil Accessories	
Code	Description
JE	Electronic Interface(s)
D	Surge Suppressor Diode
R	Surge Suppressor RC
V	Surge Suppressor Varistor
Additional Contactor Auxiliaries (Side Mount)	
Code	Description
S01	1 N.C.
S10	1 N.O.
S11	1 N.O. + 1 N.C.
S20	2 N.O.
Additional Contactor Auxiliaries (Front Mount)	
Code	Description
F11	1 N.O. + 1 N.C.
F20	2 N.O.
F22	2 N.O. + 2 N.C.

Bulletin 190E Direct On-Line Eco Starters

Note: Verify that the motor protection circuit breaker can be set to the rated motor current!

- 190E/191E Modular Eco Starter using Bulletin 140M Motor Protection Circuit Breaker and Bulletin 100-K/104-K Mini Contactors and Bulletin 100-C/104-C MCS Contactors
- Mounting Options:
  Snap Fixing on (1) 35 mm top hat rail



Group Motor, Type E and Type F Combination Motor Controllers (UL/CSA)

The 190E/191E motor controllers can be used in a variety of applications. These starters can be used in a group motor application or as a stand-alone product without any additional short-circuit protection in the motor branch circuits.

Most of the 140M-C/D motor protection circuit breakers used in the 190E/191E starters are UL Listed as a manual Type E self-protected combination motor controller. Although there are many tests involved, one of the critical tests a self-protected combination motor controller must pass is to perform 6000 electrical ops. and an additional 4000 mechanical ops. after a short circuit.

By definition, a Type F combination motor controller consists of a Type E manual self protected combination motor controller and a magnetic or solid-state motor controller (such as a 100-C contactor or an SMC). As with a manual Type E self-protected combination motor controller, additional short-circuit protection is not required for the individual motor circuits.

A combination of a 140M manual self protected combination motor controller and 100-C contactor can be listed as a Type E self-protected combination motor controller. In this case, the 140M and 100-C must pass the additional 6000 electrical and 4000 mechanical operational test. In some cases, this may require over sizing of the 140M motor protection circuit breaker or the 100-C contactor to achieve weld-free performance and meet the additional life requirements.

Product Selection and Coordination Ratings — UL/CSA in Group Motor Installations

Motor Current Adjustment Range [A]	UL/CSA Hp Ratings (60 Hz)				Max. Fuse or Circuit Breaker per NEC [A]	Max. Short-Circuit Current [kA]				DOL Starter	Reversing Starter
	Hp Ratings as a UL508 Motor Controller in Group Motor Installations♣					Type 1 Coordination		Type 2 Coordination			
	200V	230V	460V	575V		480V	600V	480V	600V	Cat. No.	Cat. No.
C-Frame with 100-K/104-K Mini Contactors											
0.10…0.16	—	—	—	—	450	65	47	65	—	190E-KMN⊗2-CA16X	191E-KMN⊗1-CA16X
0.16…0.25	—	—	—	—	450	65	47	65	—	190E-KMN⊗2-CA25X	191E-KMN⊗1-CA25X
0.25…0.40	—	—	—	—	450	65	47	65	—	190E-KMN⊗2-CA40X	191E-KMN⊗1-CA40X
0.40…0.63	—	—	—	—	450	65	47	65	—	190E-KMN⊗2-CA63X	191E-KMN⊗1-CA63X
0.63…1.00	—	—	—	1/2	450	65	47	65	—	190E-KMN⊗2-CB10X	191E-KMN⊗1-CB10X
1.00…1.60	—	—	1/2	3/4	450	65	47	65	—	190E-KMN⊗2-CB16X	191E-KMN⊗1-CB16X
1.60…2.50	1/2	1/2	1/2…1	1...1-1/2	450	65	30	—	—	190E-KMN⊗2-CB25X	191E-KMN⊗1-CB25X
2.50…4.00	1/2…3/4	3/4	3/4…2	2…3	450	65	30	—	—	190E-KMN⊗2-CB40X	191E-KMN⊗1-CB40X
4.00…6.30	1	1...1-1/2	1-1/2…3	5	450	65	30	—	—	190E-KNN⊗2-CB63X	191E-KNN⊗1-CB63X
6.30…8.50	1-1/2…2	2	5	5	450	65	30	—	—	190E-KNN⊗2-CC10X	191E-KNN⊗1-CC10X
6.30…10.0	1-1/2…2	2...3	5	7-1/2	450	65	30	—	—	190E-KPN⊗2-CC10X	191E-KPN⊗1-CC10X
10.0…11.0	3	3	7-1/2	7-1/2	450	30	30	—	—	190E-KPN⊗2-CC16X	191E-KPN⊗1-CC16X
C-Frame with 100-C/104-C Contactors											
0.10…0.16	—	—	—	—	450	65	47	65	47	190E-AN⊗2-CA16X	**191E-AN⊗3-CA16X**
0.16…0.25	—	—	—	—	450	65	47	65	47	**190E-AN⊗2-CA25X**	**191E-AN⊗3-CA25X**
0.25…0.40	—	—	—	—	450	65	47	65	47	190E-AN⊗2-CA40X	**191E-AN⊗3-CA40X**
0.40…0.63	—	—	—	—	450	65	47	65	47	190E-AN⊗2-CA63X	**191E-AN⊗3-CA63X**
0.63…1.00	—	—	1/2	3/4	450	65	47	65	47	190E-AN⊗2-CB10X	**191E-AN⊗3-CB10X**
1.00…1.60	—	—	1/2…1	3/4...1	450	65	47	65	47	190E-AN⊗2-CB16X	**191E-AN⊗3-CB16X**
1.60…2.50	1/2	1/2...3/4	3/4…1-1/2	1…2	450	65	30	65	10	190E-AN⊗2-CB25X	**191E-AN⊗3-CB25X**
2.50…4.00	1/2…1	3/4...1	1-1/2…3	2…3	450	65	30	50	—	190E-AN⊗2-CB40X	**191E-AN⊗3-CB40X**
4.00…6.30	1...1-1/2	1…2	3...5	5	450	65	30	50	—	190E-AN⊗2-CB63X	**191E-AN⊗3-CB63X**
6.30…9.00	1-1/2…2	2	5	7-1/2	450	65	30	50	—	190E-AN⊗2-CC10X	**191E-AN⊗3-CC10X**
6.30…10.0	1-1/2…3	2...3	5...7-1/2	7-1/2...10	450	65	30	50	—	190E-BN⊗2-CC10X	**191E-BN⊗3-CC10X**
10.0…12.0	3	3	7-1/2	10	450	30	30	30	—	190E-BN⊗2-CC16X	**191E-BN⊗3-CC16X**
10.0…16.0	3...5	5	7-1/2…10	10...15	450	30	30	30	—	190E-DN⊗2-CC16X	**191E-DN⊗3-CC16X**
14.5…20.0	5	5...7-1/2	15	15	450	30	30	30	—	190E-DN⊗2-CC20X	**191E-DN⊗3-CC20X**
18.0…23.0	5	7-1/2	15	15	450	30	30	30	—	190E-DN⊗2-CC25X	**191E-DN⊗3-CC25X**
D-Frame with 100-C/104-C Contactors											
1.60…2.50	1/2	1/2...3/4	3/4…1-1/2	1…2	450	65	30	65	10	190E-AN⊗2-DB25X	**191E-AN⊗3-DB25X**
1.60…2.50	1/2	1/2...3/4	3/4…1-1/2	1…2	450	65	30	65	30	**190E-DN⊗2-DB25X**	**191E-DN⊗3-DB25X**
2.50…4.00	1/2…1	3/4...1	1-1/2…3	2…3	450	65	30	65	—	190E-AN⊗2-DB40X	**191E-AN⊗3-DB40X**
2.50…4.00	1/2…1	3/4...1	1-1/2…3	2…3	450	65	30	65	30	**190E-DN⊗2-DB40X**	**191E-DN⊗3-DB40X**
4.00…6.30	1…1-1/2	1…2	3…5	5	450	65	30	65	—	190E-AN⊗2-DB63X	**191E-AN⊗3-DB63X**
6.30…9.00	1-1/2…2	2	5	7-1/2	450	65	30	65	—	190E-AN⊗2-DC10X	**191E-AN⊗3-DC10X**
6.30…10.0	1-1/2…3	2...3	5…7-1/2	7-1/2…10	450	65	30	65	—	**190E-BN⊗2-DC10X**	**191E-BN⊗3-DC10X**
6.30…10.0	1-1/2…3	2...3	5…7-1/2	7-1/2…10	450	65	30	65	—	**190E-CN⊗2-DC10X**	**191E-CN⊗3-DC10X**
10.0…12.0	3	3	7-1/2	10	450	65	30	65	—	**190E-BN⊗2-DC16X**	**191E-BN⊗3-DC16X**
10.0…16.0	3…5	5	7-1/2…10	10	450	65	30	65	—	190E-CN⊗2-DC16X	**191E-CN⊗3-DC16X**
10.0…16.0	3…5	5	7-1/2…10	10…15	450	65	30	65	—	**190E-DN⊗2-DC16X**	**191E-DN⊗3-DC16X**
14.5…20.0	5	5...7-1/2	15	15	450	65	30	65	—	**190E-DN⊗2-DC20X**	**191E-DN⊗3-DC20X**
18.0…23.0	5	7-1/2	15	15	450	65	30	65	—	190E-DN⊗2-DC25X	**191E-DN⊗3-DC25X**

♣ Hp ratings shown in the table are for reference. Final selection of the starter depends upon the actual motor full-load current and service factor.

⊗Coil voltage code—see page 2-315

2

Product Selection and Coordination Ratings — UL/CSA as a UL508 Type F Combination Motor Controller

Motor Current Adjustment Range [A]	UL/CSA Hp Ratings (60 Hz)				Max. Short-Circuit Current [kA]				DOL Starter	Reversing Starter
	Hp Ratings as a UL508 Type F Combination Motor Controller♣				Type 1 Coordination		Type 2 Coordination			
	200V	230V	460V	575V	480Y/277V	600Y/347V	480Y/277V	600Y/347V	Cat. No.	Cat. No.
C-Frame with Bulletin 100-K/104-K Mini Contactors										
0.10…0.16	—	—	—	—	65	47	—	—	190E-KMN⊗2-CA16X-TE	191E-KMN⊗1-CA16X-TE
0.16…0.25	—	—	—	—	65	47	—	—	190E-KMN⊗2-CA25X-TE	191E-KMN⊗1-CA25X-TE
0.25…0.40	—	—	—	—	65	47	—	—	190E-KMN⊗2-CA40X-TE	191E-KMN⊗1-CA40X-TE
0.40…0.63	—	—	—	—	65	47	—	—	190E-KMN⊗2-CA63X-TE	191E-KMN⊗1-CA63X-TE
0.63…1.00	—	—	—	1/2	65	47	—	—	190E-KMN⊗2-CB10X-TE	191E-KMN⊗1-CB10X-TE
1.00…1.60	—	—	1/2	3/4	65	47	—	—	190E-KMN⊗2-CB16X-TE	191E-KMN⊗1-CB16X-TE
1.60…2.50	1/2	1/2	1/2…1	3/4...1-1/2	65	30	—	—	190E-KMN⊗2-CB25X-TE	191E-KMN⊗1-CB25X-TE
2.50…4.00	1/2…3/4	3/4	3/4…2	2…3	65	30	—	—	190E-KMN⊗2-CB40X-TE	191E-KMN⊗1-CB40X-TE
4.00…6.30	1	1...1-1/2	1-1/2…3	—	65	❖	—	❖	190E-KNN⊗2-CB63X-TE	191E-KNN⊗1-CB63X-TE
6.30…8.50	1-1/2…2	2	5	—	65	❖	—	❖	190E-KNN⊗2-CC10X-TE	191E-KNN⊗1-CC10X-TE
6.30…10.0	1-1/2…2	2...3	5	—	65	❖	—	❖	190E-KPN⊗2-CC10X-TE	191E-KPN⊗1-CC10X-TE
10.0…11.0	3	3	7-1/2	—	30	❖	—	❖	190E-KPN⊗2-CC16X-TE	191E-KPN⊗1-CC16X-TE
C-Frame with Bulletin 100-C/104-C Contactors										
0.10…0.16	—	—	—	—	65	47	65	47	**190E-AN⊗2-CA16X-TE**	**191E-AN⊗3-CA16X-TE**
0.16…0.25	—	—	—	—	65	47	65	47	**190E-AN⊗2-CA25X-TE**	**191E-AN⊗3-CA25X-TE**
0.25…0.40	—	—	—	—	65	47	65	47	**190E-AN⊗2-CA40X-TE**	**191E-AN⊗3-CA40X-TE**
0.40…0.63	—	—	—	—	65	47	65	47	**190E-AN⊗2-CA63X-TE**	**191E-AN⊗3-CA63X-TE**
0.63…1.00	—	—	1/2	3/4	65	47	65	47	**190E-AN⊗2-CB10X-TE**	**191E-AN⊗3-CB10X-TE**
1.00…1.60	—	—	1/2…1	3/4...1	65	47	65	47	**190E-AN⊗2-CB16X-TE**	**191E-AN⊗3-CB16X-TE**
1.60…2.50	1/2	1/2...3/4	3/4…1-1/2	1…2	65	30	65	10	**190E-AN⊗2-CB25X-TE**	**191E-AN⊗3-CB25X-TE**
2.50…4.00	1/2…1	3/4...1	1-1/2…3	2…3	65	30	—	—	**190E-AN⊗2-CB40X-TE**	**191E-AN⊗3-CB40X-TE**
4.00…6.30	1...1-1/2	1…2	3...5	—	65	❖	—	❖	**190E-AN⊗2-CB63X-TE**	**191E-AN⊗3-CB63X-TE**
6.30…9.00	1-1/2…2	2	5	—	65	❖	—	❖	**190E-AN⊗2-CC10X-TE**	**191E-AN⊗3-CC10X-TE**
6.30…10.0	1-1/2…3	2...3	5...7-1/2	—	65	❖	—	❖	**190E-BN⊗2-CC10X-TE**	**191E-BN⊗3-CC10X-TE**
10.0…12.0	3	3	7-1/2	—	30	❖	—	❖	**190E-BN⊗2-CC16X-TE**	**191E-BN⊗3-CC16X-TE**
10.0…16.0	3...5	5	7-1/2…10	—	30	❖	—	❖	**190E-CN⊗2-CC16X-TE**	**191E-CN⊗3-CC16X-TE**
10.0…16.0	3...5	5	7-1/2…10	—	30	❖	—	❖	**190E-DN⊗2-CC16X-TE**	**191E-DN⊗3-CC16X-TE**
14.5…20.0	5	5...7-1/2	15	—	10	❖	—	❖	**190E-DN⊗2-CC20X-TE**	**191E-DN⊗3-CC20X-TE**
18.0…23.0	—	—	—	—	❖	❖	❖	❖	**190E-DN⊗2-CC25X-TE**	**191E-DN⊗3-CC25X-TE**
D-Frame with Bulletin 100-C/104-C Contactors										
1.60…2.50	1/2	1/2...3/4	3/4…1-1/2	1…2	65	30	65	10	**190E-AN⊗2-DB25X-TE**	**191E-AN⊗3-DB25X-TE**
1.60…2.50	1/2	1/2...3/4	3/4…1-1/2	1…2	65	30	65	30	**190E-DN⊗2-DB25X-TE**	**191E-DN⊗3-DB25X-TE**
2.50…4.00	1/2…1	3/4...1	1-1/2…3	2…3	65	30	65	—	**190E-AN⊗2-DB40X-TE**	**191E-AN⊗3-DB40X-TE**
2.50…4.00	1/2…1	3/4...1	1-1/2…3	2…3	65	30	65	30	**190E-DN⊗2-DB40X-TE**	**191E-DN⊗3-DB40X-TE**
4.00…6.30	1…1-1/2	1…2	3…5	5	65	30	65	—	**190E-AN⊗2-DB63X-TE**	**191E-AN⊗3-DB63X-TE**
6.30…9.00	1-1/2…2	2	5	7-1/2	65	30	65	—	**190E-AN⊗2-DC10X-TE**	**191E-AN⊗3-DC10X-TE**
6.30…10.0	1-1/2…3	2...3	5…7-1/2	7-1/2…10	65	30	65	—	**190E-BN⊗2-DC10X-TE**	**191E-BN⊗3-DC10X-TE**
6.30…10.0	1-1/2…3	2...3	5…7-1/2	7-1/2…10	65	30	65	—	**190E-CN⊗2-DC10X-TE**	**191E-CN⊗3-DC10X-TE**
10.0…12.0	3	3	7-1/2	10	65	30	65	—	**190E-BN⊗2-DC16X-TE**	**191E-BN⊗3-DC16X-TE**
10.0…16.0	3…5	5	7-1/2…10	10	65	30	65	—	**190E-CN⊗2-DC16X-TE**	**191E-CN⊗3-DC16X-TE**
10.0…16.0	3…5	5	7-1/2…10	10…15	65	30	65	—	**190E-DN⊗2-DC16X-TE**	**191E-DN⊗3-DC16X-TE**
14.5…20.0	5	5...7-1/2	15	—	65	❖	65	❖	**190E-DN⊗2-DC20X-TE**	**191E-DN⊗3-DC20X-TE**
18.0…23.0	5	7-1/2	15	—	65	❖	65	❖	**190E-DN⊗2-DC25X-TE**	**191E-DN⊗3-DC25X-TE**

♣ Hp ratings shown in the table are for reference. Final selection of the starter depends upon the actual motor full-load current and service factor.

❖ This starter is not valid for application at this horsepower and voltage.

⊗Coil voltage code—see page 2-315

Product Selection and Coordination Ratings — UL/CSA as a UL508 Self-Protected Type E Combination Motor Controller

Motor Current Adjustment Range [A]	UL/CSA Hp Ratings (60 Hz) Hp Ratings as a UL508 Self-Protected Type E Combination Motor Controller♣				Max. Short-Circuit Current [kA]		DOL Starter	Reversing Starter
	200V	230V	460V	575V	480Y/277V	600Y/347V	Cat. No.	Cat. No.
C-Frame with Bulletin 100-K/104-K Mini Contactors								
0.10…0.16	—	—	—	—	❖	❖	190E-KMN⊗2-CA16X-TE	191E-KMN⊗1-CA16X-TE
0.16…0.25	—	—	—	—	❖	❖	190E-KMN⊗2-CA25X-TE	191E-KMN⊗1-CA25X-TE
0.25…0.40	—	—	—	—	❖	❖	190E-KMN⊗2-CA40X-TE	191E-KMN⊗1-CA40X-TE
0.40…0.63	—	—	—	—	❖	❖	190E-KMN⊗2-CA63X-TE	191E-KMN⊗1-CA63X-TE
0.63…1.00	—	—	—	—	❖	❖	190E-KMN⊗2-CB10X-TE	191E-KMN⊗1-CB10X-TE
1.00…1.60	—	—	—	—	❖	❖	190E-KMN⊗2-CB16X-TE	191E-KMN⊗1-CB16X-TE
1.60…2.50	—	—	—	—	❖	❖	190E-KMN⊗2-CB25X-TE	191E-KMN⊗1-CB25X-TE
2.50…4.00	—	—	—	—	❖	❖	190E-KMN⊗2-CB40X-TE	191E-KMN⊗1-CB40X-TE
4.00…6.30	—	—	—	—	❖	❖	190E-KNN⊗2-CB63X-TE	191E-KNN⊗1-CB63X-TE
6.30…8.50	—	—	—	—	❖	❖	190E-KNN⊗2-CC10X-TE	191E-KNN⊗1-CC10X-TE
6.30…10.0	—	—	—	—	❖	❖	190E-KPN⊗2-CC10X-TE	191E-KPN⊗1-CC10X-TE
10.0…11.0	—	—	—	—	❖	❖	190E-KPN⊗2-CC16X-TE	191E-KPN⊗1-CC16X-TE
C-Frame with Bulletin 100-C/104-C Contactors								
0.10…0.16	—	—	—	—	65	47	**190E-AN⊗2-CA16X-TE**	**191E-AN⊗3-CA16X-TE**
0.16…0.25	—	—	—	—	65	47	**190E-AN⊗2-CA25X-TE**	**191E-AN⊗3-CA25X-TE**
0.25…0.40	—	—	—	—	65	47	**190E-AN⊗2-CA40X-TE**	**191E-AN⊗3-CA40X-TE**
0.40…0.63	—	—	—	—	65	47	**190E-AN⊗2-CA63X-TE**	**191E-AN⊗3-CA63X-TE**
0.63…1.00	—	—	1/2	3/4	65	47	**190E-AN⊗2-CB10X-TE**	**191E-AN⊗3-CB10X-TE**
1.00…1.60	—	—	1/2…1	3/4...1	65	47	**190E-AN⊗2-CB16X-TE**	**191E-AN⊗3-CB16X-TE**
1.60…2.50	1/2	1/2...3/4	3/4…1-1/2	—	65	❖	**190E-AN⊗2-CB25X-TE**	**191E-AN⊗3-CB25X-TE**
2.50…4.00	—	—	—	—	❖	❖	**190E-AN⊗2-CB40X-TE**	**191E-AN⊗3-CB40X-TE**
4.00…6.30	—	—	—	—	❖	❖	**190E-AN⊗2-CB63X-TE**	**191E-AN⊗3-CB63X-TE**
6.30…9.00	—	—	—	—	❖	❖	**190E-AN⊗2-CC10X-TE**	**191E-AN⊗3-CC10X-TE**
6.30…10.0	—	—	—	—	❖	❖	**190E-BN⊗2-CC10X-TE**	**191E-BN⊗3-CC10X-TE**
10.0…12.0	—	—	—	—	❖	❖	**190E-BN⊗2-CC16X-TE**	**191E-BN⊗3-CC16X-TE**
10.0…16.0	—	—	—	—	❖	❖	**190E-CN⊗2-CC16X-TE**	**191E-CN⊗3-CC16X-TE**
10.0…16.0	—	—	—	—	❖	❖	**190E-DN⊗2-CC16X-TE**	**191E-DN⊗3-CC16X-TE**
14.5…20.0	—	—	—	—	❖	❖	**190E-DN⊗2-CC20X-TE**	**191E-DN⊗3-CC20X-TE**
18.0…23.0	—	—	—	—	❖	❖	**190E-DN⊗2-CC25X-TE**	**191E-DN⊗3-CC25X-TE**
D-Frame with Bulletin 100-C/104-C Contactors								
1.60…2.50	1/2	1/2...3/4	3/4…1-1/2	—	65	❖	**190E-AN⊗2-DB25X-TE**	**191E-AN⊗3-DB25X-TE**
1.60…2.50	1/2	1/2...3/4	3/4…1-1/2	1…2	65	30	**190E-DN⊗2-DB25X-TE**	**191E-DN⊗3-DB25X-TE**
2.50…4.00	—	—	—	—	❖	❖	**190E-AN⊗2-DB40X-TE**	**191E-AN⊗3-DB40X-TE**
2.50…4.00	1/2…1	3/4...1	1-1/2…3	2…3	65	30	**190E-DN⊗2-DB40X-TE**	**191E-DN⊗3-DB40X-TE**
4.00…6.30	—	—	—	—	❖	❖	**190E-AN⊗2-DB63X-TE**	**191E-AN⊗3-DB63X-TE**
6.30…9.00	—	—	—	—	❖	❖	**190E-AN⊗2-DC10X-TE**	**191E-AN⊗3-DC10X-TE**
6.30…10.0	—	—	—	—	❖	❖	**190E-BN⊗2-DC10X-TE**	**191E-BN⊗3-DC10X-TE**
6.30…10.0	—	—	—	—	❖	❖	**190E-CN⊗2-DC10X-TE**	**191E-CN⊗3-DC10X-TE**
10.0…12.0	—	—	—	—	❖	❖	**190E-BN⊗2-DC16X-TE**	**191E-BN⊗3-DC16X-TE**
10.0…16.0	—	—	—	—	❖	❖	**190E-CN⊗2-DC16X-TE**	**191E-CN⊗3-DC16X-TE**
10.0…16.0	—	—	—	—	❖	❖	**190E-DN⊗2-DC16X-TE**	**191E-DN⊗3-DC16X-TE**
14.5…20.0	—	—	—	—	❖	❖	**190E-DN⊗2-DC20X-TE**	**191E-DN⊗3-DC20X-TE**
18.0…23.0	—	—	—	—	❖	❖	**190E-DN⊗2-DC25X-TE**	**191E-DN⊗3-DC25X-TE**

♣ Hp ratings shown in the table are for reference. Final selection of the starter depends upon the actual motor full-load current and service factor.

❖ This starter is not valid for application at this horsepower and voltage.

⊗Coil voltage code—see page 2-315

2

Product Selection and Coordination Ratings (IEC Type 1 and Type 2 Short-Circuit Coordination)

Motor Current Adjustment Range [A]	IEC kW Ratings for Standard Motors, 1500 rpm Max. kW, 50 Hz♣				Max. Short-Circuit Current [kA] Type 1 Coordination				Max. Short-Circuit Current [kA] Type 2 Coordination				DOL Starter	Reversing Starter
	230V	400V	500V	690V	230V	400V	500V	690V	230V	400V	500V	690V	Cat. No.	Cat. No.
C-Frame with Bulletin 100-K/104-K Mini Contactors														
0.10…0.16	—	0.02	—	—	100	65	65	65	65	65	—	—	190E-KMN⊗2-CA16X	191E-KMN⊗1-CA16X
0.16…0.25	0.02	0.06	0.06	—	100	65	65	65	65	65	—	—	190E-KMN⊗2-CA25X	191E-KMN⊗1-CA25X
0.25…0.40	0.06	0.09	0.12	—	100	65	65	65	65	65	—	—	190E-KMN⊗2-CA40X	191E-KMN⊗1-CA40X
0.40…0.63	0.09	0.18	0.18	—	100	65	65	65	65	65	—	—	190E-KMN⊗2-CA63X	191E-KMN⊗1-CA63X
0.63…1.00	0.12	0.25	0.37	—	100	65	65	65	65	65	—	—	190E-KMN⊗2-CB10X	191E-KMN⊗1-CB10X
1.00…1.60	0.25	0.55	0.75	—	100	65	65	10	65	65	—	—	190E-KMN⊗2-CB16X	191E-KMN⊗1-CB16X
1.60…2.50	0.55	0.75	1.1	—	100	65	65	8	50	50	—	—	190E-KMN⊗2-CB25X	191E-KMN⊗1-CB25X
2.50…4.00	0.75	1.5	2.2	—	100	65	65	8	—	—	—	—	190E-KMN⊗2-CB40X	191E-KMN⊗1-CB40X
4.00…6.30	1.5	2.2	2.2	—	100	65	65	4	—	—	—	—	190E-KNN⊗2-CB63X	191E-KNN⊗1-CB63X
6.30…9.00	2.2	4	4	—	100	65	65	4	—	—	—	—	190E-KNN⊗2-CC10X	191E-KNN⊗1-CC10X
6.30…10.0	2.2	4	4	—	100	65	65	4	—	—	—	—	190E-KPN⊗2-CC10X	191E-KPN⊗1-CC10X
10.0…11.0	4	5.5	—	—	100	50	50	3	—	—	—	—	190E-KPN⊗2-CC16X	191E-KPN⊗1-CC16X
C-Frame with Bulletin 100-C/104-C Contactors														
0.10…0.16	—	—	0.06	0.06	100	100	65	50	100	100	65	50	190E-AN⊗2-CA16X	**191E-AN⊗3-CA16X**
0.16…0.25	0.02	0.06	0.06	0.12	100	100	65	50	100	100	65	50	**190E-AN⊗2-CA25X**	**191E-AN⊗3-CA25X**
0.25…0.40	0.06	0.09	0.12	0.18	100	100	65	50	100	100	65	50	190E-AN⊗2-CA40X	**191E-AN⊗3-CA40X**
0.40…0.63	0.09	0.18	0.18	0.37	100	100	65	50	100	100	65	50	190E-AN⊗2-CA63X	**191E-AN⊗3-CA63X**
0.63…1.00	0.12	0.25	0.37	0.55	100	100	65	50	100	100	65	50	190E-AN⊗2-CB10X	**191E-AN⊗3-CB10X**
1.00…1.60	0.25	0.55	0.75	1.1	100	100	65	50	100	100	65	50	190E-AN⊗2-CB16X	**191E-AN⊗3-CB16X**
1.60…2.50	0.55	0.75	1.1	1.8	100	65	50	8	65	50	50	8	190E-AN⊗2-CB25X	**191E-AN⊗3-CB25X**
2.50…4.00	0.75	1.5	2.2	3	100	50	50	8	50	50	—	—	190E-AN⊗2-CB40X	**191E-AN⊗3-CB40X**
4.00…6.30	1.5	2.2	3	4	100	50	50	4	50	50	—	—	190E-AN⊗2-CB63X	**191E-AN⊗3-CB63X**
6.30…9.00	2.2	4	4	—	100	65	50	—	50	50	—	—	190E-AN⊗2-CC10X	**191E-AN⊗3-CC10X**
6.30…10.0	2.2	4	5.5	5.5	100	65	50	4	50	50	50	—	190E-BN⊗2-CC10X	**191E-BN⊗3-CC10X**
6.30…10.0	2.2	4	5.5	7.5	100	65	50	4	50	50	50	—	**190E-CN⊗2-CC10X**	**191E-CN⊗3-CC10X**
10.0…12.0	4	5.5	—	—	100	65	—	—	50	50	—	—	190E-BN⊗2-CC16X	**191E-BN⊗3-CC16X**
10.0…16.0	4	7.5	7.5	—	100	50	10	—	50	—	—	—	190E-CN⊗2-CC16X	**191E-CN⊗3-CC16X**
10.0…16.0	4	7.5	10	10	100	50	10	3	50	50	—	—	190E-DN⊗2-CC16X	**191E-DN⊗3-CC16X**
14.5…20.0	4	10	11	—	50	15	6	—	15	—	—	—	190E-DN⊗2-CC20X	**191E-DN⊗3-CC20X**
18.0…23.0	6.3	11	13	—	50	15	6	—	15	—	—	—	190E-DN⊗2-CC25X	**191E-DN⊗3-CC25X**
D-Frame with Bulletin 100-C/104-C Contactors														
1.60…2.50	0.55	0.75	1.1	1.8	100	100	50	10	100	100	50	10	190E-AN⊗2-DB25X	**191E-AN⊗3-DB25X**
1.60…2.50	0.55	0.75	1.1	1.8	100	100	50	10	100	100	50	10	**190E-DN⊗2-DB25X**	**191E-DN⊗3-DB25X**
2.50…4.00	0.75	1.5	2.2	3	100	100	50	10	100	100	50	—	190E-AN⊗2-DB40X	**191E-AN⊗3-DB40X**
2.50…4.00	0.75	1.5	2.2	3	100	100	50	50	100	100	50	50	**190E-DN⊗2-DB40X**	**191E-DN⊗3-DB40X**
4.00…6.30	1.5	2.2	3	4	100	100	50	50	100	100	50	—	190E-AN⊗2-DB63X	**191E-AN⊗3-DB63X**
6.30…9.00	2.2	4	4	—	100	65	50	—	100	65	—	—	190E-AN⊗2-DC10X	**191E-AN⊗3-DC10X**
6.30…10.0	2.2	4	5.5	5.5	100	100	65	50	100	100	65	—	**190E-BN⊗2-DC10X**	**191E-BN⊗3-DC10X**
6.30…10.0	2.2	4	5.5	7.5	100	100	65	50	100	100	65	50	**190E-CN⊗2-DC10X**	**191E-CN⊗3-DC10X**
10.0…12.0	4	5.5	—	—	100	65	—	—	65	65	—	—	**190E-BN⊗2-DC16X**	**191E-BN⊗3-DC16X**
10.0…16.0	4	7.5	7.5	—	100	65	50	—	65	65	50	—	190E-CN⊗2-DC16X	**191E-CN⊗3-DC16X**
10.0…16.0	4	7.5	10	10	100	65	50	6	65	65	50	—	**190E-DN⊗2-DC16X**	**191E-DN⊗3-DC16X**
14.5…20.0	4	10	11	—	65	65	25	—	65	65	25	—	**190E-DN⊗2-DC20X**	**191E-DN⊗3-DC20X**
18.0…23.0	6.3	11	13	—	65	50	25	—	65	50	25	—	190E-DN⊗2-DC25X	**191E-DN⊗3-DC25X**

♣ kW ratings shown in the table are for reference. Final selection of the starter depends upon the actual motor full-load current and service factor.

⊗Coil voltage code—see page 2-315

Bulletin 190E/191E Eco Starters with Bulletin 100-K/104-K Mini Contactors

⊗ Coil Voltage Codes for AC or DC Control

Voltage [V]	24	110	120	230	240	400	480	600
50 Hz	—	D	—	—	—	—	—	—
60 Hz	—	—	**D**	—	—	—	B	VC
50/60 Hz	KJ	—	—	KF	KA	KN	—	—

Voltage [V]	12	24	110	125	220	250
DC	ZQ	ZJ	ZD	ZS	ZA	ZT
DC w/ Diode	—	DJ	—	—	—	—

Bulletin 190E/191E Eco Starters with Bulletin 100-C/104-C MCS Contactors

⊗ Coil Voltage Codes for AC or DC Control

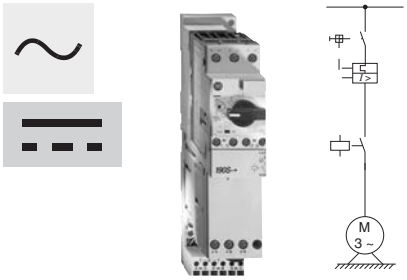
Voltage [V]	12	24	32	36	42	48	100	100... 110	110	120	127	200	200... 220	200... 230	208	208... 240
50 Hz	R	**K**	V	W	X	Y	KP	—	**D**	P	S	KG	—	—	—	—
60 Hz	Q	**J**	—	V	—	X	—	KP	—	**D**	—	—	KG	—	**H**	L
50/60 Hz	—	**KJ**	—	—	—	KY	KP	—	KD	—	—	KG	—	KL	—	—

Voltage [V]	220... 230	230	230... 240	240	277	347	380	380... 400	400	400... 415	440	480	500	550	600
50 Hz	F	—	VA	T	—	—	—	N	—	G	B	—	M	C	—
60 Hz	—	—	—	**A**	T	I	E	—	—	—	N	**B**	—	—	**C**
50/60 Hz	—	**KF**	—	**KA**	—	—	—	—	KN	—	KB	—	—	—	—

Voltage [V]	24
DC	EJ

Bulletin 190S Direct On-Line Compact Starters

- 190S Compact Starter using Bulletin 140M Motor Protection Circuit Breaker and Bulletin 100-C Contactor
- Short-Circuit Coordination Type "1" and "2" according to IEC 60947-4-1
- Complete unit, ready for connection with internal wiring
- Accessories: Bulletin 140M Circuit Breakers and 100-C Contactors
- Removable cover
- IEC and cULus Certified
- Auxiliary Contacts Wired to Terminal Block at Bottom of Starter Assembly
- Mounting Versions:
  - Screw Fixing
  - Snap Fixing on (1) or (2) 35 mm top hat rails
  - Snap Fixing on (1) 75 mm top hat rail



Group Motor, Type E and Type F Combination Motor Controllers (UL/CSA)

The 190S/191S motor controllers can be used in a variety of applications. These starters can be used in a group motor application or as a stand alone product without any additional short-circuit protection in the motor branch circuits.

Most of the 140M-C/D motor protection circuit breakers used in the 190S/191S starters are UL Listed as a manual Type E self-protected combination motor controller. Although there are many tests involved, one of the critical tests a self-protected combination motor controller must pass, is to perform 6000 electrical ops. and an additional 4000 mechanical ops. after a short circuit.

By definition, a Type F combination motor controller consists of a Type E manual self protected combination motor controller and a magnetic or solid-state motor controller (such as a 100-C contactor or an SMC). As with a manual Type E self-protected combination motor controller, additional short-circuit protection is not required for the individual motor circuits.

A combination of a 140M manual self protected combination motor controller and 100-C contactor can be listed as a Type E self-protected combination motor controller. In this case, the 140M and 100-C must pass the additional 6000 electrical and 4000 mechanical operational test. In some cases, this may require over sizing of the 140M motor protection circuit breaker or the 100-C contactor to achieve weld-free performance and meet the additional life requirements.

Note: Verify that the motor protection circuit breaker can be set to the rated motor current.

Product Selection and Coordination Ratings — UL/CSA in Group Motor Installations

Motor Current Adjustment Range [A]	UL/CSA Hp Ratings (60 Hz) Hp Ratings as a UL508 Motor Controller in Group Motor Installations♣ 200V	230V	460V	575V	Max. Fuse or Circuit Breaker per NEC [A]	Max. Short-Circuit Current [kA] Type 1 Coordination 480V	600V	Type 2 Coordination 480V	600V	DOL Starter Cat. No.	Reversing Starter (AC coils only) Cat. No.
C-Frame with Bulletin 100-C/104-C Contactors											
0.10…0.16	—	—	—	—	450	65	47	65	47	190S-AN⊗2-CA16C	191S-AN⊗3-CA16C
0.16…0.25	—	—	—	—	450	65	47	65	47	190S-AN⊗2-CA25C	191S-AN⊗3-CA25C
0.25…0.40	—	—	—	—	450	65	47	65	47	190S-AN⊗2-CA40C	191S-AN⊗3-CA40C
0.40…0.63	—	—	—	—	450	65	47	65	47	190S-AN⊗2-CA63C	191S-AN⊗3-CA63C
0.63…1.00	—	—	1/2	3/4	450	65	47	65	47	190S-AN⊗2-CB10C	191S-AN⊗3-CB10C
1.00…1.60	—	—	1/2…1	3/4...1	450	65	47	65	47	190S-AN⊗2-CB16C	191S-AN⊗3-CB16C
1.60…2.50	1/2	1/2...3/4	3/4…1-1/2	1…2	450	65	30	65	10	190S-AN⊗2-CB25C	191S-AN⊗3-CB25C
2.50…4.00	1/2…1	3/4...1	1-1/2…3	2…3	450	65	30	50	—	190S-AN⊗2-CB40C	191S-AN⊗3-CB40C
4.00…6.30	1...1-1/2	1…2	3...5	5	450	65	30	50	—	190S-AN⊗2-CB63C	191S-AN⊗3-CB63C
6.30…9.00	1-1/2…2	2	5	7-1/2	450	65	30	50	—	190S-AN⊗2-CC10C	191S-AN⊗3-CC10C
6.30…10.0	1-1/2…3	2...3	5...7-1/2	7-1/2...10	450	65	30	50	—	**190S-BN⊗2-CC10C**	**191S-BN⊗3-CC10C**
10.0…12.0	3	3	7-1/2	10	450	30	30	—	—	**190S-BN⊗2-CC16C**	191S-BN⊗3-CC16C
10.0…16.0	3...5	5	7-1/2…10	10	450	30	30	—	—	**190S-CN⊗2-CC16C**	191S-CN⊗3-CC16C
10.0…16.0	3...5	5	7-1/2…10	10...15	450	30	30	—	—	**190S-DN⊗2-CC16C**	**191S-DN⊗3-CC16C**
14.5…20.0	5	5...7-1/2	15	15	450	30	30	—	—	**190S-DN⊗2-CC20C**	**191S-DN⊗3-CC20C**
18.0…23.0	5	7-1/2	15	15	450	30	30	—	—	**190S-DN⊗2-CC25C**	**191S-DN⊗3-CC25C**
D-Frame with Bulletin 100-C/104-C Contactors											
1.60…2.50	1/2	1/2...3/4	3/4…1-1/2	1…2	450	65	30	65	10	190S-AN⊗2-DB25C	**191S-AN⊗3-DB25C**
1.60…2.50	1/2	1/2...3/4	3/4…1-1/2	1…2	450	65	30	65	30	**190S-DN⊗2-DB25C**	**191S-DN⊗3-DB25C**
2.50…4.00	1/2…1	3/4...1	1-1/2…3	2…3	450	65	30	65	—	190S-AN⊗2-DB40C	191S-AN⊗3-DB40C
2.50…4.00	1/2…1	3/4...1	1-1/2…3	2…3	450	65	30	65	30	**190S-DN⊗2-DB40C**	**191S-DN⊗3-DB40C**
4.00…6.30	1…1-1/2	1…2	3…5	5	450	65	30	65	—	190S-AN⊗2-DB63C	191S-AN⊗3-DB63C
6.30…9.00	1-1/2…2	2	5	7-1/2	450	65	30	65	—	190S-AN⊗2-DC10C	191S-AN⊗3-DC10C
6.30…10.0	1-1/2…3	2...3	5…7-1/2	7-1/2…10	450	65	30	65	—	**190S-BN⊗2-DC10C**	**191S-BN⊗3-DC10C**
6.30…10.0	1-1/2…3	2...3	5…7-1/2	7-1/2…10	450	65	30	65	—	190S-CN⊗2-DC10C	**191S-CN⊗3-DC10C**
10.0…12.0	3	3	7-1/2	10	450	65	30	65	—	**190S-BN⊗2-DC16C**	191S-BN⊗3-DC16C
10.0…16.0	3…5	5	7-1/2…10	10	450	65	30	65	—	**190S-CN⊗2-DC16C**	191S-CN⊗3-DC16C
10.0…16.0	3…5	5	7-1/2…10	10…15	450	65	30	65	—	190S-DN⊗2-DC16C	**191S-DN⊗3-DC16C**
14.5…20.0	5	5...7-1/2	15	15	450	65	30	65	—	**190S-DN⊗2-DC20C**	191S-DN⊗3-DC20C
18.0…23.0	5	7-1/2	15	15	450	65	30	65	—	**190S-DN⊗2-DC25C**	191S-DN⊗3-DC25C
F-Frame with Bulletin 100-C/104-C Contactors											
6.30…10.0	1-1/2…3	2...3	5…7-1/2	7-1/2…10	600	65	30	65	30	**190S-EN⊗3-FC10C**	—
10.0…16.0	3…5	5	7-1/2…10	10…15	600	65	30	65	30	**190S-EN⊗3-FC16C**	—
14.5…20.0	5	5…7-1/2	15	15…20	600	65	30	65	30	**190S-EN⊗3-FC20C**	—
18.0…25.0	7-1/2	7-1/2...10	15...20	20	600	65	30	65	30	**190S-EN⊗3-FC25C**	—
18.0…25.0	7-1/2	7-1/2...10	15...20	20...25	600	65	30	65	30	190S-GN⊗3-FC25C	—
23.0…30.0	7-1/2	10	20	25	600	65	30	65	30	**190S-EN⊗3-FC32C**	—
23.0…32.0	7-1/2...10	10	20...25	30	600	65	30	65	30	**190S-FN⊗3-FC32C**	—
23.0…32.0	7-1/2...10	10	20...25	30	600	65	30	65	30	190S-GN⊗3-FC32C	—
32.0…37.0	10	10	25	30	600	65	18	65	10	**190S-FN⊗3-FC45C**	—
32.0…43.0	10	15	30	30	600	65	18	65	10	**190S-GN⊗3-FC45C**	—

♣ Hp ratings shown in the table are for reference. Final selection of the starter depends upon the actual motor full-load current and service factor.

⊗Coil voltage code—see page 2-321

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Product Selection and Coordination Ratings — UL/CSA as a UL508 Type F Combination Motor Controller

Motor Current Adjustment Range [A]	UL/CSA Hp Ratings (60 Hz)				Max. Short-Circuit Current [kA]				DOL Starter	Reversing Starter
	Hp Ratings as a UL508 Type F Combination Motor Controller♣				Type 1 Coordination		Type 2 Coordination			
	200V	230V	460V	575V	480Y/277V	600Y/347V	480Y/277V	600Y/347V	Cat. No.	Cat. No.
C-Frame with Bulletin 100-C/104-C Contactors and Spacing Adapter										
0.10…0.16	—	—	—	—	65	47	65	47	190S-AN⊗2-CA16C-TE	**191S-AN⊗3-CA16C-TE**
0.16…0.25	—	—	—	—	65	47	65	47	190S-AN⊗2-CA25C-TE	**191S-AN⊗3-CA25C-TE**
0.25…0.40	—	—	—	—	65	47	65	47	190S-AN⊗2-CA40C-TE	**191S-AN⊗3-CA40C-TE**
0.40…0.63	—	—	—	—	65	47	65	47	190S-AN⊗2-CA63C-TE	**191S-AN⊗3-CA63C-TE**
0.63…1.00	—	—	1/2	3/4	65	47	65	47	190S-AN⊗2-CB10C-TE	**191S-AN⊗3-CB10C-TE**
1.00…1.60	—	—	1/2…1	3/4...1	65	47	65	47	190S-AN⊗2-CB16C-TE	**191S-AN⊗3-CB16C-TE**
1.60…2.50	1/2	1/2...3/4	3/4…1-1/2	1…2	65	30	65	10	190S-AN⊗2-CB25C-TE	**191S-AN⊗3-CB25C-TE**
2.50…4.00	1/2…1	3/4...1	1-1/2…3	2…3	65	30	—	—	190S-AN⊗2-CB40C-TE	**191S-AN⊗3-CB40C-TE**
4.00…6.30	1...1-1/2	1…2	3...5	—	65	❖	—	❖	190S-AN⊗2-CB63C-TE	**191S-AN⊗3-CB63C-TE**
6.30…9.00	1-1/2…2	2	5	—	65	❖	—	❖	190S-AN⊗2-CC10C-TE	**191S-AN⊗3-CC10C-TE**
6.30…10.0	1-1/2…3	2...3	5...7-1/2	—	65	❖	—	❖	190S-BN⊗2-CC10C-TE	**191S-BN⊗3-CC10C-TE**
10.0…12.0	3	3	7-1/2	—	30	❖	—	❖	190S-BN⊗2-CC16C-TE	**191S-BN⊗3-CC16C-TE**
10.0…16.0	3...5	5	7-1/2…10	—	30	❖	—	❖	190S-CN⊗2-CC16C-TE	**191S-CN⊗3-CC16C-TE**
10.0…16.0	3...5	5	7-1/2…10	—	30	❖	—	❖	190S-DN⊗2-CC16C-TE	**191S-DN⊗3-CC16C-TE**
14.5…20.0	5	5...7-1/2	15	—	10	❖	—	❖	190S-DN⊗2-CC20C-TE	**191S-DN⊗3-CC20C-TE**
18.0…23.0	—	—	—	—	❖	❖	❖	❖	190S-DN⊗2-CC25C-TE	**191S-DN⊗3-CC25C-TE**
D-Frame with Bulletin 100-C/104-C Contactors and Spacing Adapter										
1.60…2.50	1/2	1/2...3/4	3/4…1-1/2	1…2	65	30	65	10	190S-AN⊗2-DB25C-TE	**191S-AN⊗3-DB25C-TE**
1.60…2.50	1/2	1/2...3/4	3/4…1-1/2	1…2	65	30	65	30	190S-DN⊗2-DB25C-TE	**191S-DN⊗3-DB25C-TE**
2.50…4.00	1/2…1	3/4...1	1-1/2…3	2…3	65	30	65	—	190S-AN⊗2-DB40C-TE	**191S-AN⊗3-DB40C-TE**
2.50…4.00	1/2…1	3/4...1	1-1/2…3	2…3	65	30	65	30	190S-DN⊗2-DB40C-TE	**191S-DN⊗3-DB40C-TE**
4.00…6.30	1…1-1/2	1…2	3…5	5	65	30	65	—	190S-AN⊗2-DB63C-TE	**191S-AN⊗3-DB63C-TE**
6.30…9.00	1-1/2…2	2	5	7-1/2	65	30	65	—	190S-AN⊗2-DC10C-TE	**191S-AN⊗3-DC10C-TE**
6.30…10.0	1-1/2…3	2...3	5...7-1/2	7-1/2…10	65	30	65	—	190S-BN⊗2-DC10C-TE	**191S-BN⊗3-DC10C-TE**
6.30…10.0	1-1/2…3	2...3	5...7-1/2	7-1/2…10	65	30	65	—	190S-CN⊗2-DC10C-TE	**191S-CN⊗3-DC10C-TE**
10.0…12.0	3	3	7-1/2	10	65	30	65	—	190S-BN⊗2-DC16C-TE	**191S-BN⊗3-DC16C-TE**
10.0…16.0	3…5	5	7-1/2…10	10	65	30	65	—	190S-CN⊗2-DC16C-TE	**191S-CN⊗3-DC16C-TE**
10.0…16.0	3…5	5	7-1/2…10	10…15	65	30	65	—	190S-DN⊗2-DC16C-TE	**191S-DN⊗3-DC16C-TE**
14.5…20.0	5	5...7-1/2	15	—	65	❖	65	❖	190S-DN⊗2-DC20C-TE	**191S-DN⊗3-DC20C-TE**
18.0…23.0	5	7-1/2	15	—	65	❖	65	❖	190S-DN⊗2-DC25C-TE	**191S-DN⊗3-DC25C-TE**
F-Frame with Bulletin 100-C/104-C Contactors and Spacing Adapter										
6.30…10.0	1-1/2…3	2...3	5...7-1/2	7-1/2…10	65	30	65	30	190S-EN⊗3-FC10C-TE	—
10.0…16.0	3…5	5	7-1/2…10	10…15	65	30	65	30	190S-EN⊗3-FC16C-TE	—
14.5…20.0	5	5…7-1/2	15	15…20	65	30	65	30	190S-EN⊗3-FC20C-TE	—
18.0…25.0	7-1/2	7-1/2...10	15...20	20	65	30	65	30	190S-EN⊗3-FC25C-TE	—
18.0…25.0	7-1/2	7-1/2...10	15...20	20...25	65	30	65	30	190S-GN⊗3-FC25C-TE	—
23.0…30.0	7-1/2	10	20	25	65	30	65	30	190S-EN⊗3-FC32C-TE	—
23.0…32.0	7-1/2...10	10	20...25	30	65	30	65	30	190S-FN⊗3-FC32C-TE	—
23.0…32.0	7-1/2...10	10	20...25	30	65	30	65	30	190S-GN⊗3-FC32C-TE	—
32.0…37.0	10	10	25	—	65	❖	65	❖	190S-FN⊗3-FC45C-TE	—
32.0…43.0	10	15	30	—	65	❖	65	❖	190S-GN⊗3-FC45C-TE	—

♣ Hp ratings shown in the table are for reference. Final selection of the starter depends upon the actual motor full-load current and service factor.

❖ This starter is not valid for application at this horsepower and voltage.

⊗Coil voltage code—see page 2-321

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Product Selection and Coordination Ratings — UL/CSA as a UL508 Self-Protected Type E Combination Motor Controller

Motor Current Adjustment Range [A]	UL/CSA Hp Ratings (60 Hz) Hp Ratings as a UL508 Self-Protected Type E Combination Motor Controller♣ 200V	230V	460V	575V	Max. Short-Circuit Current [kA] 480Y/277V	600Y/347V	DOL Starter Cat. No.	Reversing Starter Cat. No.
C-Frame with Bulletin 100-C/104-C Contactors and Spacing Adapter								
0.10…0.16	—	—	—	—	65	47	190S-AN⊗2-CA16C-TE	**191S-AN⊗3-CA16C-TE**
0.16…0.25	—	—	—	—	65	47	190S-AN⊗2-CA25C-TE	**191S-AN⊗3-CA25C-TE**
0.25…0.40	—	—	—	—	65	47	190S-AN⊗2-CA40C-TE	**191S-AN⊗3-CA40C-TE**
0.40…0.63	—	—	—	—	65	47	190S-AN⊗2-CA63C-TE	**191S-AN⊗3-CA63C-TE**
0.63…1.00	—	—	1/2	3/4	65	47	190S-AN⊗2-CB10C-TE	**191S-AN⊗3-CB10C-TE**
1.00…1.60	—	—	1/2…1	3/4...1	65	47	190S-AN⊗2-CB16C-TE	**191S-AN⊗3-CB16C-TE**
1.60…2.50	1/2	1/2...3/4	3/4…1-1/2	—	65	❖	190S-AN⊗2-CB25C-TE	**191S-AN⊗3-CB25C-TE**
2.50…4.00	—	—	—	—	❖	❖	190S-AN⊗2-CB40C-TE	**191S-AN⊗3-CB40C-TE**
4.00…6.30	—	—	—	—	❖	❖	190S-AN⊗2-CB63C-TE	**191S-AN⊗3-CB63C-TE**
6.30…9.00	—	—	—	—	❖	❖	190S-AN⊗2-CC10C-TE	**191S-AN⊗3-CC10C-TE**
6.30…10.0	—	—	—	—	❖	❖	190S-BN⊗2-CC10C-TE	**191S-BN⊗3-CC10C-TE**
10.0…12.0	—	—	—	—	❖	❖	190S-BN⊗2-CC16C-TE	**191S-BN⊗3-CC16C-TE**
10.0…16.0	—	—	—	—	❖	❖	190S-CN⊗2-CC16C-TE	**191S-CN⊗3-CC16C-TE**
10.0…16.0	—	—	—	—	❖	❖	190S-DN⊗2-CC16C-TE	**191S-DN⊗3-CC16C-TE**
14.5…20.0	—	—	—	—	❖	❖	190S-DN⊗2-CC20C-TE	**191S-DN⊗3-CC20C-TE**
18.0…23.0	—	—	—	—	❖	❖	190S-DN⊗2-CC25C-TE	**191S-DN⊗3-CC25C-TE**
D-Frame with Bulletin 100-C/104-C Contactors and Spacing Adapter								
1.60…2.50	1/2	1/2...3/4	3/4…1-1/2	—	65	❖	190S-AN⊗2-DB25C-TE	**191S-AN⊗3-DB25C-TE**
1.60…2.50	1/2	1/2...3/4	3/4…1-1/2	1…2	65	30	190S-DN⊗2-DB25C-TE	**191S-DN⊗3-DB25C-TE**
2.50…4.00	—	—	—	—	❖	❖	190S-AN⊗2-DB40C-TE	**191S-AN⊗3-DB40C-TE**
2.50…4.00	1/2…1	3/4...1	1-1/2…3	2…3	65	30	190S-DN⊗2-DB40C-TE	**191S-DN⊗3-DB40C-TE**
4.00…6.30	—	—	—	—	❖	❖	190S-AN⊗2-DB63C-TE	**191S-AN⊗3-DB63C-TE**
6.30…9.00	—	—	—	—	❖	❖	190S-AN⊗2-DC10C-TE	**191S-AN⊗3-DC10C-TE**
6.30…10.0	—	—	—	—	❖	❖	190S-BN⊗2-DC10C-TE	**191S-BN⊗3-DC10C-TE**
6.30…10.0	—	—	—	—	❖	❖	190S-CN⊗2-DC10C-TE	**191S-CN⊗3-DC10C-TE**
10.0…12.0	—	—	—	—	❖	❖	190S-BN⊗2-DC16C-TE	**191S-BN⊗3-DC16C-TE**
10.0…16.0	—	—	—	—	❖	❖	190S-CN⊗2-DC16C-TE	**191S-CN⊗3-DC16C-TE**
10.0…16.0	—	—	—	—	❖	❖	190S-DN⊗2-DC16C-TE	**191S-DN⊗3-DC16C-TE**
14.5…20.0	—	—	—	—	❖	❖	190S-DN⊗2-DC20C-TE	**191S-DN⊗3-DC20C-TE**
18.0…23.0	—	—	—	—	❖	❖	190S-DN⊗2-DC25C-TE	**191S-DN⊗3-DC25C-TE**
F-Frame with Bulletin 100-C/104-C Contactors and Spacing Adapter								
6.30…10.0	1-1/2…3	2...3	5…7-1/2	7-1/2…10	65	30	190S-EN⊗3-FC10C-TE	—
10.0…16.0	3…5	5	7-1/2…10	10…15	65	30	190S-EN⊗3-FC16C-TE	—
14.5…20.0	5	5…7-1/2	15	15…20	65	30	190S-EN⊗3-FC20C-TE	—
18.0…25.0	7-1/2	7-1/2...10	15...20	20	65	30	190S-EN⊗3-FC25C-TE	—
18.0…25.0	7-1/2	7-1/2...10	15...20	20...25	65	30	190S-GN⊗3-FC25C-TE	—
23.0…30.0	7-1/2	10	20	25	65	30	190S-EN⊗3-FC32C-TE	—
23.0…32.0	7-1/2...10	10	20...25	30	65	30	190S-FN⊗3-FC32C-TE	—
23.0…32.0	7-1/2...10	10	20...25	30	65	30	190S-GN⊗3-FC32C-TE	—
32.0…37.0	10	10	25	—	65	❖	190S-FN⊗3-FC45C-TE	—
32.0…43.0	10	15	30	—	65	❖	190S-GN⊗3-FC45C-TE	—

♣ Hp ratings shown in the table are for reference. Final selection of the starter depends upon the actual motor full-load current and service factor.

❖ This starter is not valid for application at this horsepower and voltage.

⊗Coil voltage code—see page 2-321

Product Selection and Coordination Ratings—IEC Type 1 and Type 2 Short-Circuit Coordination

Motor Current Adjustment Range [A]	IEC kW Ratings for Standard Motors, 1500 rpm Max. kW, 50 Hz♣				Max. Short-Circuit Current [kA] Type 1 Coordination				Type 2 Coordination				DOL Starter	Reversing Starter
	230V	400V	500V	690V	230V	400V	500V	690V	230V	400V	500V	690V	Cat. No.	Cat. No.
C-Frame with Bulletin 100-C/104-C Contactors														
0.10…0.16	—	—	0.06	0.06	100	100	65	50	100	100	65	50	190S-AN⊗2-CA16C	191S-AN⊗3-CA16C
0.16…0.25	0.02	0.06	0.06	0.12	100	100	65	50	100	100	65	50	190S-AN⊗2-CA25C	191S-AN⊗3-CA25C
0.25…0.40	0.06	0.09	0.12	0.18	100	100	65	50	100	100	65	50	190S-AN⊗2-CA40C	191S-AN⊗3-CA40C
0.40…0.63	0.09	0.18	0.18	0.37	100	100	65	50	100	100	65	50	190S-AN⊗2-CA63C	191S-AN⊗3-CA63C
0.63…1.00	0.12	0.25	0.37	0.55	100	100	65	50	100	100	65	50	190S-AN⊗2-CB10C	191S-AN⊗3-CB10C
1.00…1.60	0.25	0.55	0.75	1.1	100	100	65	50	100	100	65	50	190S-AN⊗2-CB16C	191S-AN⊗3-CB16C
1.60…2.50	0.55	0.75	1.1	1.8	100	65	50	8	65	50	50	8	190S-AN⊗2-CB25C	191S-AN⊗3-CB25C
2.50…4.00	0.75	1.5	2.2	3	100	50	50	8	50	50	—	—	190S-AN⊗2-CB40C	191S-AN⊗3-CB40C
4.00…6.30	1.5	2.2	3	4	100	50	50	4	50	50	—	—	190S-AN⊗2-CB63C	191S-AN⊗3-CB63C
6.30…9.00	2.2	4	4	—	100	65	50	—	50	50	—	—	190S-AN⊗2-CC10C	191S-AN⊗3-CC10C
6.30…10.0	2.2	4	5.5	5.5	100	65	50	4	50	50	50	—	**190S-BN⊗2-CC10C**	**191S-BN⊗3-CC10C**
6.30…10.0	2.2	4	5.5	7.5	100	65	50	4	50	50	50	—	**190S-CN⊗2-CC10C**	**191S-BN⊗3-CC10C**
10.0…12.0	4	5.5	—	—	100	65	—	—	50	50	—	—	**190S-BN⊗2-CC16C**	191S-BN⊗3-CC16C
10.0…16.0	4	7.5	7.5	—	100	50	10	—	50	—	—	—	**190S-CN⊗2-CC16C**	191S-CN⊗3-CC16C
10.0…16.0	4	7.5	10	10	100	50	10	3	50	50	—	—	**190S-DN⊗2-CC16C**	**191S-DN⊗3-CC16C**
14.5…20.0	4	10	11	—	50	15	6	—	15	—	—	—	**190S-DN⊗2-CC20C**	**191S-DN⊗3-CC20C**
18.0…23.0	6.3	11	13	—	50	15	6	—	15	—	—	—	**190S-DN⊗2-CC25C**	**191S-DN⊗3-CC25C**
D-Frame with Bulletin 100-C/104-C Contactors														
1.60…2.50	0.55	0.75	1.1	1.8	100	100	50	10	100	100	50	10	190S-AN⊗2-DB25C	**191S-AN⊗3-DB25C**
1.60…2.50	0.55	0.75	1.1	1.8	100	100	50	10	100	100	50	10	**190S-DN⊗2-DB25C**	**191S-DN⊗3-DB25C**
2.50…4.00	0.75	1.5	2.2	3	100	100	50	10	100	100	50	—	190S-AN⊗2-DB40C	191S-AN⊗3-DB40C
2.50…4.00	0.75	1.5	2.2	3	100	100	50	50	100	100	50	50	**190S-DN⊗2-DB40C**	**191S-DN⊗3-DB40C**
4.00…6.30	1.5	2.2	3	4	100	100	50	50	100	100	50	—	190S-AN⊗2-DB63C	191S-AN⊗3-DB63C
6.30…9.00	2.2	4	4	—	100	65	50	—	100	65	—	—	190S-AN⊗2-DC10C	191S-AN⊗3-DC10C
6.30…10.0	2.2	4	5.5	5.5	100	100	65	50	100	100	65	—	**190S-BN⊗2-DC10C**	**191S-BN⊗3-DC10C**
6.30…10.0	2.2	4	5.5	7.5	100	100	65	50	100	100	65	50	190S-CN⊗2-DC10C	**191S-CN⊗3-DC10C**
10.0…12.0	4	5.5	—	—	100	65	—	—	65	65	—	—	**190S-BN⊗2-DC16C**	191S-BN⊗3-DC16C
10.0…16.0	4	7.5	7.5	—	100	65	50	—	65	65	50	—	**190S-CN⊗2-DC16C**	191S-CN⊗3-DC16C
10.0…16.0	4	7.5	10	10	100	65	50	6	65	65	50	—	190S-DN⊗2-DC16C	**191S-DN⊗3-DC16C**
14.5…20.0	4	10	11	—	65	65	25	—	65	65	25	—	**190S-DN⊗2-DC20C**	191S-DN⊗3-DC20C
18.0…23.0	6.3	11	13	—	65	50	25	—	65	50	25	—	**190S-DN⊗2-DC25C**	191S-DN⊗3-DC25C
F-Frame with Bulletin 100-C/104-C Contactors														
6.30…10.0	2.2	4	5.5	7.5	100	100	50	50	100	100	50	50	**190S-EN⊗3-FC10C**	—
10.0…16.0	4	7.5	10	13	100	100	50	50	100	100	50	50	**190S-EN⊗3-FC16C**	—
14.5…20.0	4	10	11	15	100	100	50	50	100	100	50	50	**190S-EN⊗3-FC20C**	—
18.0…25.0	6.3	11	15	—	100	100	50	—	100	100	50	—	**190S-EN⊗3-FC25C**	—
18.0…25.0	6.3	11	15	22	100	100	50	50	100	100	50	50	190S-GN⊗3-FC25C	—
23.0…30.0	7.5	15	15	—	100	100	50	—	100	100	50	—	**190S-EN⊗3-FC32C**	—
23.0…32.0	7.5	15	20	—	100	100	50	—	100	100	50	—	**190S-FN⊗3-FC32C**	—
23.0…32.0	7.5	15	20	22	100	100	50	50	100	100	50	50	190S-GN⊗3-FC32C	—
32.0…37.0	11	18.5	—	—	100	100	—	—	100	100	—	—	**190S-FN⊗3-FC45C**	—
32.0…43.0	13	22	25	—	100	100	50	—	100	100	50	—	**190S-GN⊗3-FC45C**	—

♣ kW ratings shown in the table are for reference. Final selection of the starter depends upon the actual motor full-load current and service factor.

⊗Coil voltage code—see page 2-321

Bulletin 190S/191S Compact Combination Starters

⊗ Coil Voltage Codes for AC Control

[V]	12	24	32	36	42	48	100	100-110	110	120	127	200	200-220	200-230	208	208-240
AC, 50 Hz	R	**K**	V	W	X	Y	KP	—	**D**	P	S	KG	—	—	—	—
AC, 60 Hz	Q	**J**	—	V	—	X	—	KP	—	**D**	—	—	KG	—	**H**	**L**
AC, 50/60 Hz	—	**KJ**	—	—	—	KY	KP	—	KD	—	—	KG	—	KL	—	—
[V]	220-230	230	230-240	240	277	347	380	380-400	400	400-415	440	480	500	550	600	
AC, 50 Hz	F	—	VA	T	—	—	—	N	—	G	B	—	M	C	—	
AC, 60 Hz	—	—	—	**A**	T	I	E	—	—	—	N	**B**	—	—	**C**	
AC, 50/60 Hz	—	**KF**	—	**KA**	—	—	—	—	KN	—	KB	—	—	—	—	

⊗ Coil Voltage Codes for DC Control (Bulletin 190S only)

[V]		9	12	24	36	48	60	64	72	80	110	115	125	220	230	250
Standard	DC	ZR	ZQ	**ZJ**	ZW	ZY	ZZ	ZB	ZG	ZE	ZD	ZP	ZS	ZA	ZF	ZT
with Integrated Diode		—	—	**DJ**	—	—	—	—	—	—	—	—	—	—	—	—
Electronic∗		—	—	EJ	—	—	—	—	—	—	—	—	—	—	—	—

∗ Also available for Bulletin 191S starters.

Bulletin 190E/191E/190S/191S Factory Installed Modifications

Note: For modifications change **(option code ✳)** and — add **(option code ❄)** for desired features to cat. no.

✳ Change option code **X** to desired auxiliary contact: 190E-KMND2-CA16**X**

Bulletin 140M Auxiliary and Trip Contacts		190E	191E	190S	191S
X	Without Auxiliary and Trip Contacts	Standard	Standard	NA	NA
A	Auxiliary Contact 1 N.C.	Available	Available	NA	NA
B	Auxiliary Contact 1 N.O.	Available	Available	NA	NA
C	Auxiliary Contact 1 N.O. + 1 N.C.	Available	Available	Standard	Standard
D	Auxiliary Contact 2 N.O.	Available	Available	Available	Available
E	Auxiliary Contact 2 N.C.	Available	Available	Available	Avaiable
R	1 N.O. Trip + 1 N.C. Auxiliary Contact	Available	Available	Available	Available
S	1 N.O. Trip + 1 N.O. Auxiliary Contact	Available	Available	Available	Available

❄ Add desired option codes AFTER auxiliary contact option code: 190S-AND2-CA16X-**KY**

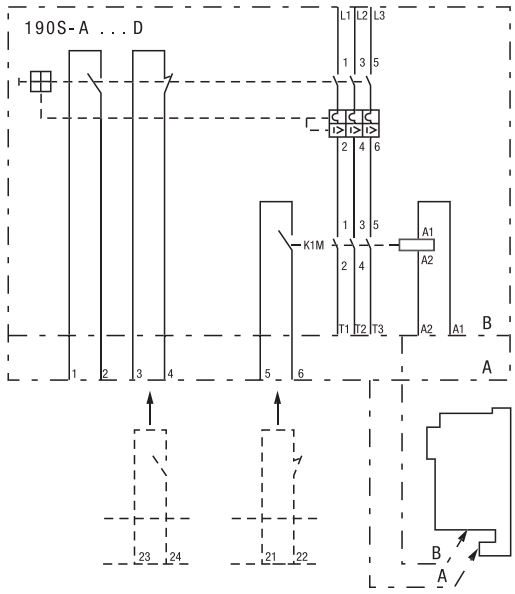
Modifications, Accessories		190E	191E	190S	191S
JE ‡	Electronic Interfaces (100-C)	Available	Available	Available	Available
R ‡	Surge Suppressor RC (100-C)	Available	Available	Available	Available
V ‡	Surge Suppressor Varistor (100-C)	Available	Available	Available	Available
D ‡	Surge Suppressor Diode (100-C)	Available	Available	Available	Available
KN	Lockable Twist Knob (140M) - Black	Available	Available	Available	Available
KY	Lockable Twist Knob (140M) - Red/Yellow	Available	Available	Available	Available
TE	Spacing Adapter for UL508 Type E and Type F	Available	Available	Available	Available
Additional Contactor Auxiliaries (Side Mount) §					
S01 ‡	1 N.C.	Available	Available	Available	Available
S10 ‡	1 N.O.	Available	Available	Available	Available
S11 ‡	1 N.O. + 1 N.C.	Available	Available	Available	Available
S20 ‡	2 N.O.	Available	Available	Available	Available
Additional Contactor Auxiliaries (Front Mount)					
F11 ‡	1 N.O. + 1 N.C.	Available	Available	NA	NA
F20 ‡	2 N.O.	Available	Available	NA	NA
F22 ‡	2 N.O. + 2 N.C.	Available	Available	NA	NA
Additional Bulletin 140M Auxiliaries (Side Mount)					
A02	2 N.C.	Available	Available	Available	Available
A20	2 N.O.	Available	Available	Available	Available
A11	1 N.O. + 1 N.C.	Available	Available	Available	Available
Additional Bulletin 140M Trip Contacts (Side Mount)					
R00	1 N.O. Thermal-Mag + 1 N.O. Mag Only	Available	Available	Available	Available
R01	1 N.O. Thermal-Mag + 1 N.C. Mag Only	Available	Available	Available	Available
R10	1 N.C. Thermal-Mag + 1 N.O. Mag Only	Available	Available	Available	Available
R11	1 N.C. Thermal-Mag + 1 N.C. Mag Only	Available	Available	Available	Available
M11	1 N.O. Mag Only + 1 N.C. Mag Only	Available	Available	Available	Available

‡ 191E and 191S Reversing Eco Starters will have two of these accessories installed (one on each contactor).

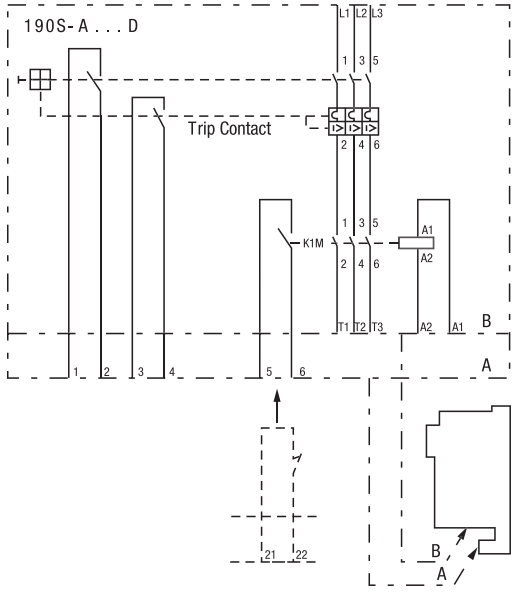
§ Not available on 190E/191E Eco starters with 100-K/104-K mini contactors.

Wiring Diagrams

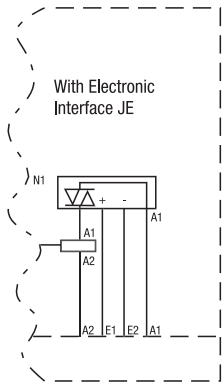
IEC Wiring Diagram Cat. No. 190S-A...D



190S-___2-____ C

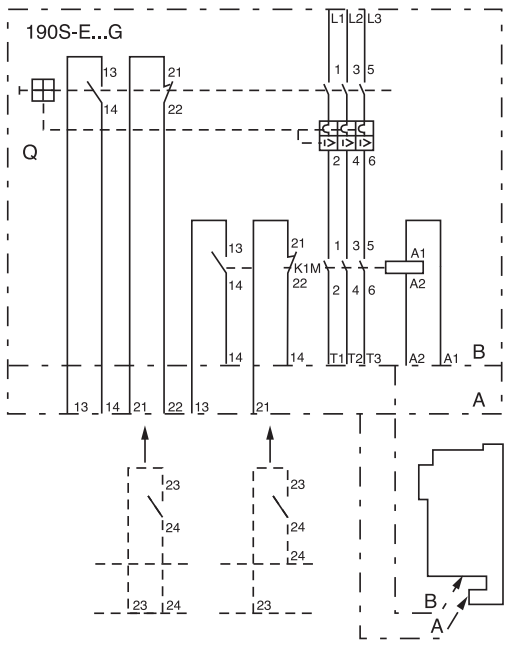


190S-___2-____ S

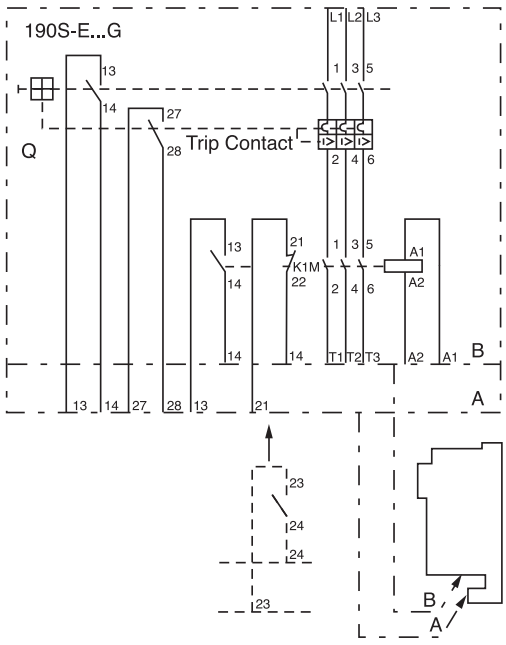


- JE Option

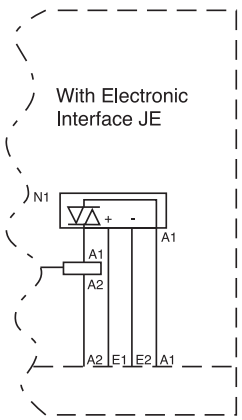
IEC Wiring Diagram Cat. No. 190S-E...G



190S-___2-____ C



190S-___2-____ S



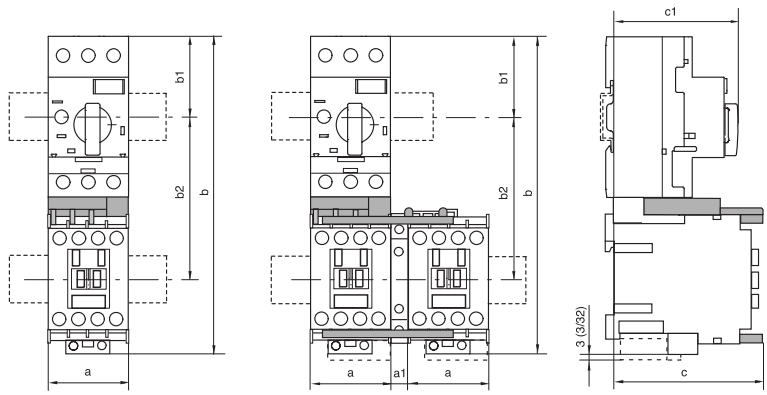
- JE Option

Eco and Compact Combination Starters

Approximate Dimensions

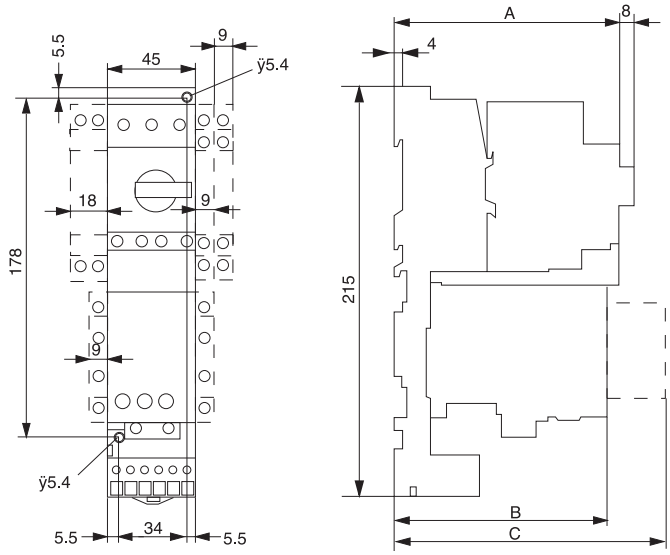
Dimensions are shown in millimeters. Dimensions are not intended to be used for manufacturing purposes.

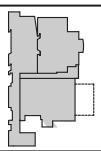
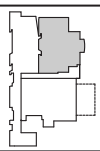
190E/191E

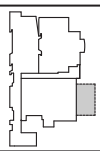


Cat. No.	a	a1	b	b1	b2	c	c1
190E Eco Starters							
190E-KMN…190E-KPN	45 (1-25/32)	0	171 (6-3/4)	45 (1-25/32)	—	49 (1-15/16)	70 (2-49/64)
190E-AN…190E-DN			178 (7)			83.5 (3-19/64)	
191E Reversing Eco Starters							
191E-KMN…191E-KPN	45 (1-25/32)	0	164 (6-15/32)	45 (1-25/32)	—	49 (1-15/16)	70 (2-49/64)
191E-AN…191E-DN		9 (23/64)	178 (7)			83.5 (3-19/64)	

190S-A…D



		A [mm]	B [mm]
190S-AN, -ANEJ	140M-C	112	107
190S-BN, -BNEJ			
190S-CN, -CNEJ	140M-D	122	
190S-DN, -DNEJ			
190S-ANZ, -ANDJ	140M-C	134.5	132.5
190S-BNZ, -BNDJ			
190S-CNZ, -CNDJ	140M-D	144.5	
190S-DNZ, -DNDJ	140M-C	157	150
	140M-D	167	

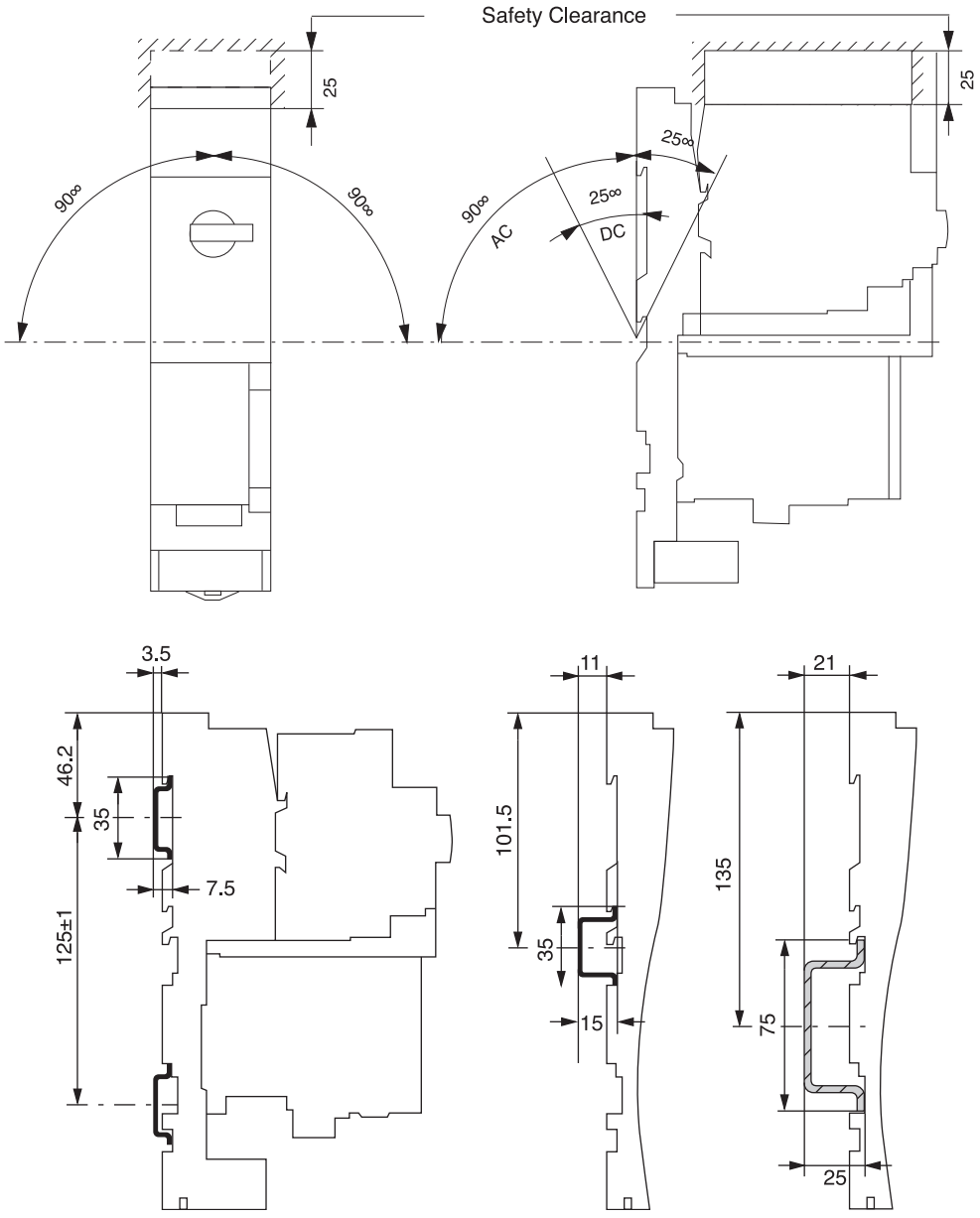
	C [mm]
100-FA, 100-FC 100-FPT 100-FL	138 157 160
100-FA, 100-FC	163.5
100-FA, 100-FC	181

Visit our website: www.ab.com/catalogs

Preferred availability cat. nos. are printed in **bold**

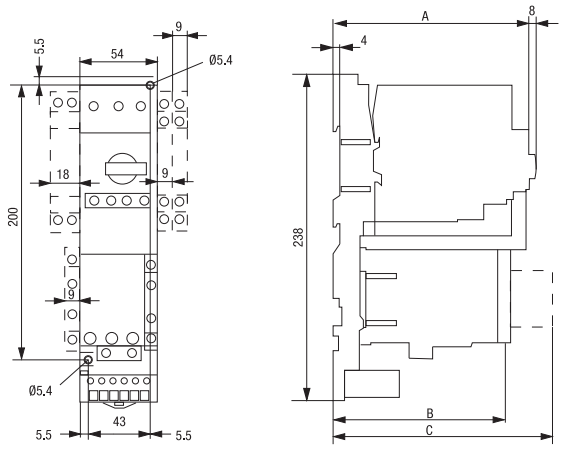
Dimensions are shown in millimeters. Dimensions are not intended to be used for manufacturing purposes.

190S-A...D



Dimensions are shown in millimeters. Dimensions are not intended to be used for manufacturing purposes.

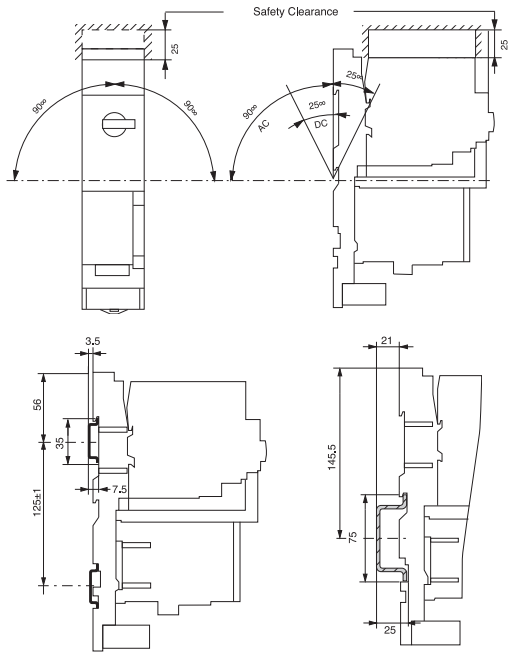
190S-E and 190S-F Approximate Dimensions



		A [mm]	B [mm]
190S-EN, -ENEJ	140M-F	135	124
190S-FN, -FNEJ			
190S-ENZ, -ENDJ		179	168
190S-FNZ, -FNDJ			

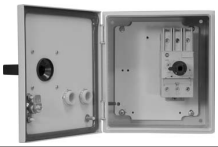
	C [mm]
100-FB 100-FPT 100-FL	154.5 173.5 176.5
100-FB	198.5

190S-G Approximate Dimensions



		A [mm]	B [mm]
190S-GN	140M-F	135	118.5
190S-GNZ, -GNDJ		179	162.5

	C [mm]
100-FB 100-FPT 100-FL	157 176 179
100-FB	201

					
	103H/107H	**140M**	**105-C**	**106-C**	**109-C**
Starter Type	Reversing (103H)/ non-reversing (107H)	Motor protection circuit breaker only	Reversing	Reversing combination	Non-reversing
AC Coils	✓	—	✓	✓	✓
DC Coils	—	—	—	—	—
UL/CSA	✓	✓	✓	✓	✓
IEC/CE	✓	✓	✓	✓	✓
Components					
140M (MPCB)	✓	✓	—	—	—
100-C Contactor	✓	—	✓	✓	✓
193 Overload Relay	—	—	✓	✓	✓
194R Disconnect	—	—	—	✓	—
Max. Current*	43 A	45 A	85 A	85 A	85 A
Enclosure Material	Metal	Metal	Metal	Standard	Molded plastic or metal
Enclosure Type	IP66 (Type 3/4/12)	IP66 (Type 3/4/12)	IP42 (Type 1) and IP66 (Type 3/4/12)	IP42 (Type 1) and IP66 (Type 3/4/12)	IP42 (Type 1) and IP66 (Type 3/4/12)—metal IP66 (Type 4/4X/12)—plastic
Product Selection	**page 2-329**	**page 2-331**	**page 2-336**	**page 2-337**	**page 2-339**

	112-C	**113-C**	**120E-C**	**132/133-C**
Starter Type	Non-reversing combination	Non-reversing combination	Multi-speed	Pump control panel
AC Coils	✓	✓	✓	✓
DC Coils	—	—	—	—
UL/CSA	✓	✓	✓	UL only
IEC/CE	✓	✓	✓	—
Components				
Motor Circuit Protector	—	✓	—	—
100-C Contactor	✓	✓	✓	✓
193 Overload Relay	✓	✓	✓	✓
194R Disconnect	✓	—	—	✓
Max. Current*	72 A	72 A	85 A	72 A
Enclosure Material	Metal	Metal	Metal	Molded plastic or metal
Enclosure Type	IP42 (Type 1) and IP66 (Type 3/4/12)	IP42 (Type 1) and IP66 (Type 3/4/12)	IP42 (Type 1) and IP66 (Type 3/4/12)	IP32 (Type 3R)
Product Selection	**page 2-340**	**page 2-341**	**page 2-342**	**page 2-343**

* For IEC enclosed starter solutions from 95…860 A, contact your local Rockwell Automation sales office or Allen-Bradley distributor.

Bulletin 103H starter in enclosure size A

Bulletin 107H starter in enclosure size C

Bulletin 103H/107H/140M Enclosed Combination Starters and Motor Protectors

Bulletin 103H/107H enclosed combination starters consist of a Bulletin 140M motor protection circuit breaker and a Bulletin 100C/104C contactor in a metallic Type 3/4/12 enclosure.

Bulletin 140M enclosed motor protection circuit breakers consist of a Bulletin 140M motor protection circuit breaker in a metallic Type 3/4/12 enclosure.

Features

- Current range 0.1…45 A
- cULus Listed for control and protection of motor loads
  - – Motor disconnect
  - – Short-circuit and overload protection
  - – Motor switching (magnetic)
- Factory-installed options include
  - – Pushbuttons, selector switches, and pilot lights
  - – Control transformer
  - – Auxiliary and trip indication contacts

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Wiring Diagram 2-333
Enclosure Dimensions 2-335

Standards Compliance

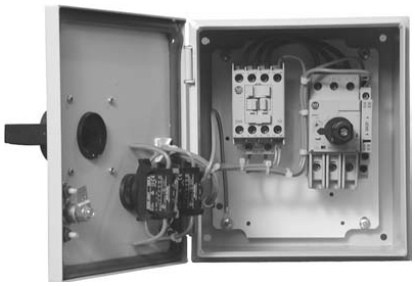
UL 508
CSA 22.2 No. 14

Certifications

cULus Listed (File No. E 125316, Guide NKJH, NKJH7)

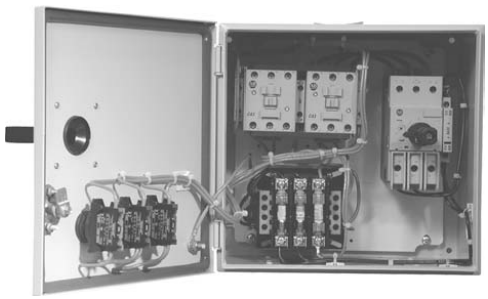
Product Selection

Reversing and Non-reversing Starters



The "A" size box accommodates:
-103H Non-Reversing Starters
-Motors up to 15 Hp/480V (23 A)
-2 pilot devices

The "B" size box accommodates:
-103H Non-Reversing Starters AND 107H Reversing Starters
-Motors up to 15 Hp/480V (23 A)
-Control Transformer and 3 pilot devices



The "C" size box accommodates:
103H Non-Reversing Starters AND 107H Reversing Starters
-Motors up to 30 Hp/480V (43 A)
-Control Transformer and 3 pilot devices

Type E and Type F Combination Motor Controllers (UL/CSA)

Most of the 140M-C/D motor protection circuit breakers used in the 103H/107H starters are UL Listed as a manual **Type E** self-protected combination motor controller. Although there are many tests involved, one of the critical tests a self-protected combination motor controller must pass is to perform 6000 electrical ops. and an additional 4000 mechanical ops. after a short circuit.

By definition, a **Type F** combination motor controller consists of a Type E manual self protected combination motor controller and a magnetic or solid-state motor controller (such as a 100-C contactor or an SMC). As with a manual Type E self-protected combination motor controller, additional short-circuit protection is not required for the individual motor circuits.

A combination of a Bulletin 140M manual self-protected combination motor controller and 100-C contactor can be listed as a **Type E** self-protected combination motor controller. In this case, the 140M and 100-C must pass the additional 6000 electrical and 4000 mechanical operational test. In some cases, this may require oversizing of the 140M motor protection circuit breaker or the 100-C contactor to achieve weld-free performance and meet the additional life requirements.

Product Selection and Coordination Ratings (UL/CSA as a UL508 Type F Combination Motor Controller)

Motor Current Adjustment Range [A]	Hp Ratings as a UL508 Type F Combination Motor Controller✶				Max. Short-Circuit Current [kA]				Non-Reversing Starter Cat. No.	Enclosure Size	Reversing Starter Cat. No.	Enclosure Size
					Type 1 Coordination		Type 2 Coordination					
	200V	230V	460V	575V	480Y/ 277V	600Y/ 347V	480Y/ 277V	600Y/ 347V				
25 A Frame Size												
0.10…0.16	—	—	—	—	65	47	65	47	**103H-AF✪⊗2-CA16X**	A	**107H-AF✪⊗3-CA16X**	B
0.16…0.25	—	—	—	—	65	47	65	47	**103H-AF✪⊗2-CA25X**	A	**107H-AF✪⊗3-CA25X**	B
0.25…0.40	—	—	—	—	65	47	65	47	**103H-AF✪⊗2-CA40X**	A	**107H-AF✪⊗3-CA40X**	B
0.40…0.63	—	—	—	—	65	47	65	47	**103H-AF✪⊗2-CA63X**	A	**107H-AF✪⊗3-CA63X**	B
0.63…1.00	—	—	1/2	3/4	65	47	65	47	**103H-AF✪⊗2-CB10X**	A	**107H-AF✪⊗3-CB10X**	B
1.00…1.60	—	—	1/2…1	3/4...1	65	47	65	47	103H-AF✪⊗2-CB16X	A	**107H-AF✪⊗3-CB16X**	B
1.60…2.50	1/2	1/2...3/4	3/4… 1-1/2	1…2	65	30	65	10	103H-AF✪⊗2-DB25X	A	107H-AF✪⊗3-DB25X	B
2.50…4.00	1/2…1	3/4...1	1-1/2… 3	2…3	65	30	65	—	103H-AF✪⊗2-DB40X	A	**107H-AF✪⊗3-DB40X**	B
2.50…4.00	1/2…1	3/4...1	1-1/2… 3	2…3	65	30	65	30	**103H-DF✪⊗2-DB40X**	A	**107H-DF✪⊗3-DB40X**	B
4.00…6.30	1… 1-1/2	1…2	3…5	5	65	30	65	—	103H-AF✪⊗2-DB63X	A	**107H-AF✪⊗3-DB63X**	B
4.00…6.30	1… 1-1/2	1…2	3…5	5	65	30	65	30	**103H-EF✪⊗2-DB63X**	C	**107H-EF✪⊗3-DB63X**	C
6.30…10.0	1-1/2… 3	2...3	5… 7-1/2	7-1/2… 10	65	30	65	—	103H-BF✪⊗2-DC10X	A	**107H-BF✪⊗3-DC10X**	B
6.30…10.0	1- 1/2…3	2...3	5… 7-1/2	7-1/2… 10	65	30	65	30	**103H-EF✪⊗2-DC10X**	C	**107H-EF✪⊗3-DC10X**	C
10.0…16.0	3…5	5	7-1/2… 10	10…15	65	30	65	—	103H-CF✪⊗2-DC16X	A	**107H-CF✪⊗3-DC16X**	B
10.0…16.0	3…5	5	7-1/2… 10	10…15	65	30	65	30	**103H-EF✪⊗2-DC16X**	C	**107H-EF✪⊗3-DC16X**	C
14.5…20.0	5	5	10	—	65	❖	65	❖	103H-DF✪⊗2-DC20X	A	**107H-DF✪⊗3-DC20X**	B
18.0…23.0	5	7-1/2	15	—	65	❖	65	❖	**103H-DF✪⊗2-DC25X**	A	**107H-DF✪⊗3-DC25X**	C
45 A Frame Size												
6.30…10.0	1-1/2… 3	2...3	5… 7-1/2	7-1/2… 10	65	30	65	10	**103H-EF✪⊗2-FC10X**	C	**107H-EF✪⊗3-FC10X**	C
10.0…16.0	3…5	5	7-1/2… 10	10…15	65	30	65	10	**103H-EF✪⊗2-FC16X**	C	**107H-EF✪⊗3-FC16X**	C
14.5…20.0	5	5… 7-1/2	15	15…20	65	30	65	10	**103H-EF✪⊗2-FC20X**	C	**107H-EF✪⊗3-FC20X**	C
18.0…25.0	7-1/2	7-1/2... 10	15...20	20	65	30	65	10	**103H-EF✪⊗2-FC25X**	C	**107H-EF✪⊗3-FC25X**	C
23.0…32.0	7-1/2... 10	10	20...25	30	65	30	65	10	**103H-FF✪⊗2-FC32X**	C	**107H-FF✪⊗3-FC32X**	C
32.0…43.0	10	15	30	—	65	❖	65	❖	**107H-GF✪⊗3-FC45X**	C	**107H-GF✪⊗3-FC45X**	C

✪ Line Voltage Codes — see page 2-332
⊗ Coil Voltage Codes — see page 2-332
✶ Hp ratings shown in the table are for reference. Final selection of the starter depends upon the actual motor full-load current and service factor.
❖ This starter is not valid for application at this horsepower and voltage.

2

Product Selection and Coordination Ratings (UL/CSA as a UL508 Self-Protected Type E Combination Motor Controller)

Motor Current Adjustment Range [A]	UL/CSA Hp and Coordination Ratings (60 Hz)						Non-Reversing Starter Cat. No.	Enclosure Size	Reversing Starter Cat. No.	Enclosure Size
	Hp Ratings as a UL508 Self-Protected Type E Combination Motor Controller✶				Max. Short-Circuit Current [kA]					
	200V	230V	460V	575V	480Y/ 277V	600Y/ 347V				
25 A Frame Size										
0.10…0.16	—	—	—	—	65	47	**103H-AF✪⊗2-CA16X**	A	**107H-AF✪⊗3-CA16X**	B
0.16…0.25	—	—	—	—	65	47	**103H-AF✪⊗2-CA25X**	A	**107H-AF✪⊗3-CA25X**	B
0.25…0.40	—	—	—	—	65	47	**103H-AF✪⊗2-CA40X**	A	**107H-AF✪⊗3-CA40X**	B
0.40…0.63	—	—	—	—	65	47	**103H-AF✪⊗2-CA63X**	A	**107H-AF✪⊗3-CA63X**	B
0.63…1.00	—	—	1/2	3/4	65	47	**103H-AF✪⊗2-CB10X**	A	**107H-AF✪⊗3-CB10X**	B
1.00…1.60	—	—	1/2…1	3/4...1	65	47	103H-AF✪⊗2-CB16X	A	**107H-AF✪⊗3-CB16X**	B
1.60…2.50	1/2	1/2...3/4	3/4…1-1/2	—	65	❖	103H-AF✪⊗2-DB25X	A	107H-AF✪⊗3-DB25X	B
1.60…2.50	1/2	1/2...3/4	3/4…1-1/2	1…2	65	30	**103H-DF✪⊗2-DB25X**	A	**107H-DF✪⊗3-DB25X**	B
2.50…4.00	—	—	—	—	❖	❖	103H-AF✪⊗2-DB40X	A	**107H-AF✪⊗3-DB40X**	B
2.50…4.00	1/2…1	3/4...1	1-1/2…3	2…3	65	30	**103H-DF✪⊗2-DB40X**	A	**107H-DF✪⊗3-DB40X**	B
4.00…6.30	—	—	—	—	❖	❖	103H-AF✪⊗2-DB63X	A	**107H-AF✪⊗3-DB63X**	B
4.00…6.30	1…1-1/2	1…2	3…5	5	65	30	**103H-EF✪⊗2-DB63X**	C	**107H-EF✪⊗3-DB63X**	C
6.30…10.0	—	—	—	—	❖	❖	103H-BF✪⊗2-DC10X	A	**107H-BF✪⊗3-DC10X**	B
6.30…10.0	1-1/2…3	2...3	5…7-1/2	7-1/2…10	65	30	**103H-EF✪⊗2-DC10X**	C	**107H-EF✪⊗3-DC10X**	C
10.0…16.0	—	—	—	—	❖	❖	103H-CF✪⊗2-DC16X	A	**107H-CF✪⊗3-DC16X**	B
10.0…16.0	3…5	5	7-1/2…10	10…15	65	30	**103H-EF✪⊗2-DC16X**	C	**107H-EF✪⊗3-DC16X**	C
14.5…20.0	—	—	—	—	❖	❖	103H-DF✪⊗2-DC20X	A	**107H-DF✪⊗3-DC20X**	B
14.5…20.0	5	5	10	—	65	❖	**103H-EF✪⊗2-DC20X**	C	**107H-EF✪⊗3-DC20X**	C
18.0…23.0	—	—	—	—	❖	❖	**103H-DF✪⊗2-DC25X**	A	**107H-DF✪⊗3-DC25X**	B
18.0…23.0	5	7-1/2	15	—	65	❖	**103H-EF✪⊗2-DC25X**	C	**107H-EF✪⊗3-DC25X**	C
45 A Frame Size										
6.30…10.0	1-1/2…3	2...3	5…7-1/2	7-1/2…10	65	30	**103H-EF✪⊗2-FC10X**	C	**107H-EF✪⊗3-FC10X**	C
10.0…16.0	3…5	5	7-1/2…10	10…15	65	30	**103H-EF✪⊗2-FC16X**	C	**107H-EF✪⊗3-FC16X**	C
14.5…20.0	5	5…7-1/2	15	15…20	65	30	**103H-EF✪⊗2-FC20X**	C	**107H-EF✪⊗3-FC20X**	C
18.0…25.0	7-1/2	7-1/2...10	15...20	20	65	30	**103H-EF✪⊗2-FC25X**	C	**107H-EF✪⊗3-FC25X**	C
23.0…32.0	7-1/2...10	10	20...25	30	65	30	**103H-FF✪⊗2-FC32X**	C	**107H-FF✪⊗3-FC32X**	C
32.0…43.0	10	15	30	—	65	❖	**103H-GF✪⊗2-FC45X**	C	**107H-GF✪⊗3-FC45X**	C

✪ Line Voltage Codes — see page 2-332
⊗ Coil Voltage Codes — see page 2-332
✶ Hp ratings shown in the table are for reference. Final selection of the starter depends upon the actual motor full-load current and service factor.
❖ This starter is not valid for application at this horsepower and voltage.

Enclosed Motor Protectors

- Self-protected UL Type E manual combination motor controller
- 65 kA at 480V
- 30 kA at 600V
- AC control

Rated Operational Current [A]	Motor Current Adjustment Range [A]	Magnetic Trip Current [A]	Maximum Hp, 3-phase				Cat. No.	Enclosure Size
			200V	230V	460V	575V		
25 A Frame Size								
0.16	0.10…0.16	2.1	—	—	—	—	**140M-F-CA16X**	A
0.25	0.16…0.25	3.3	—	—	—	—	**140M-F-CA25X**	A
0.4	0.25…0.40	5.2	—	—	—	—	**140M-F-CA40X**	A
0.63	0.40…0.63	8.2	—	—	—	—	**140M-F-CA63X**	A
1	0.63…1.0	13	—	—	0.5	0.75‡	140M-F-CB10X	A
1.6	1.0…1.6	21	—	—	1	1‡	140M-F-CB16X	A
2.5	1.6…2.5	33	0.5	0.75	1.5	2	140M-F-DB25X	A
4	2.5…4.0	52	1	1	3	3	140M-F-DB40X	A
6.3	4.0…6.3	82	1.5	2	5	5	140M-F-DB63X	A
10	6.3…10	130	3	3	7.5	10	140M-F-DC10X	A
16	10…16	208	3	5	10	15	140M-F-DC16X	A
20	14.5…20	260	5	7.5	15	—	140M-F-DC20X	A
25	18…25	325	7.5	7.5	15∗	—	140M-F-DC25X	A
45 A Frame Size								
10	6.3…10	130	3	3	7.5	10	**140M-F-FC10X**	C
16	10…16	208	3	5	10	15	**140M-F-FC16X**	C
20	14.5…20	260	5	7.5	15	20	140M-F-FC20X	C
25	18…25	325	7.5	10	20	25	**140M-F-FC25X**	C
32	23…32	416	10	10	25	30	140M-F-FC32X	C
45	32…45	585	15	15	30	—	140M-F-FC45X	C

∗ 30 kA
‡ 47 kA

2

Bulletin 103H/107H Factory Installed Modifications

Note: For modifications add (**option code** §) for desired features to cat. no.

§ Add desired option codes. Example: 103H-AND2-CA16**X-KY**

Coil Options	
JE✶	Electronic Interfaces (100-C)
R✶	Surge Suppressor RC (100-C)
V✶	Surge Suppressor Varistor (100-C)
D✶	Surge Suppressor Diode (100-C)
Additional Contactor Auxiliaries (Side Mount)	
S01✶	1 N.C.
S10✶	1 N.O.
S11✶	1 N.O. + 1 N.C.
S20✶	2 N.O.
Additional 140M Auxiliaries (Side Mount)	
A02	2 N.C.
A20	2 N.O.
A11	1 N.O. + 1 N.C.
Additional 140M Trip Contacts (Side Mount)	
R00	1 N.O. Thermal-Mag + 1 N.O. Mag Only
R01	1 N.O. Thermal-Mag + 1 N.C. Mag Only
R10	1 N.C. Thermal-Mag + 1 N.O. Mag Only
R11	1 N.C. Thermal-Mag + 1 N.C. Mag Only
M11	1 N.O. Mag Only + 1 N.C. Mag Only
Control Options	
1	Push Button — 103H Start-Stop / 107H For-Rev-Stop
1M	Multifunction Push Button — 103H Start-Stop / 107H For-Rev-Stop
14RM	Multifunction Push Button — 103H Start-Stop-Pilot Light
3	Selector Switch — 103H Hand-Off-Auto / 107H For-Off-Rev
4R	Pilot Light (red, ON)
4RW	Pilot Light (red—FOR, White — REV)
6P❄‡	Control Transformer‡ (not available with enclosure size A)
KY	External Handle — Red/Yellow

✶ 107H - One per contactor, for a total of two per option code.

❄ Starters in enclosure size "A" will change to enclosure size "B" when a control transformer is factory installed.

‡ Auxiliary contacy option "A20" is required when seelcting this control transformer.

140M Factory Installed Modifications (Enclosed)

Note: For modifications add (option code §) for desired features to cat. no.

§ Add desired option codes. Example: 140M-F-CA16X-UVB

Modifications	
UV⊗	Undervoltage Trip
SN⊗	Shunt Trip
Additional 140M Auxiliaries (Side Mount)	
A02	2 N.C.
A20	2 N.O.
A11	1 N.O. + 1 N.C.
Additional 140M Trip Contacts (Side Mount)	
R00	1 N.O. Thermal-Mag + 1 N.O. Mag Only
R01	1 N.O. Thermal-Mag + 1 N.C. Mag Only
R10	1 N.C. Thermal-Mag + 1 N.O. Mag Only
R11	1 N.C. Thermal-Mag + 1 N.C. Mag Only
M11	1 N.O. Mag Only + 1 N.C. Mag Only

Line and Coil Voltage Codes

✪ Line Voltage Codes

The Cat. No. as listed is incomplete. Select a line voltage code from the table below to complete the Cat. No.
Example: 208V 60 Hz: **Cat. No. 103H-AF✪⊗2-CA16X** becomes **Cat. No. 103H-AFH⊗2-CA16X.**

Line Voltages [V]	208	230	240	380	400	415	480	600
60 Hz	H	—	A	—	—	—	B	C
50 Hz	—	F	—	N	KN	G	—	—

⊗ Coil Voltage Codes

The Cat. No. as listed is incomplete. Select a coil voltage code from the table below to complete the Cat. No.
Example: 120V 60 Hz: **Cat. No. 103H-AFH⊗-CA16X** becomes **Cat. No. 103H-AFHD2-CA16X.**

Standard Coil Voltages [V]	24	110	120	208	220…230	240…260	277	380…400	415	480	600
50 Hz	K	C	—	—	F	—	—	N	B	—	—
60 Hz	J	—	D	H	—	A	T	—	—	B	UB

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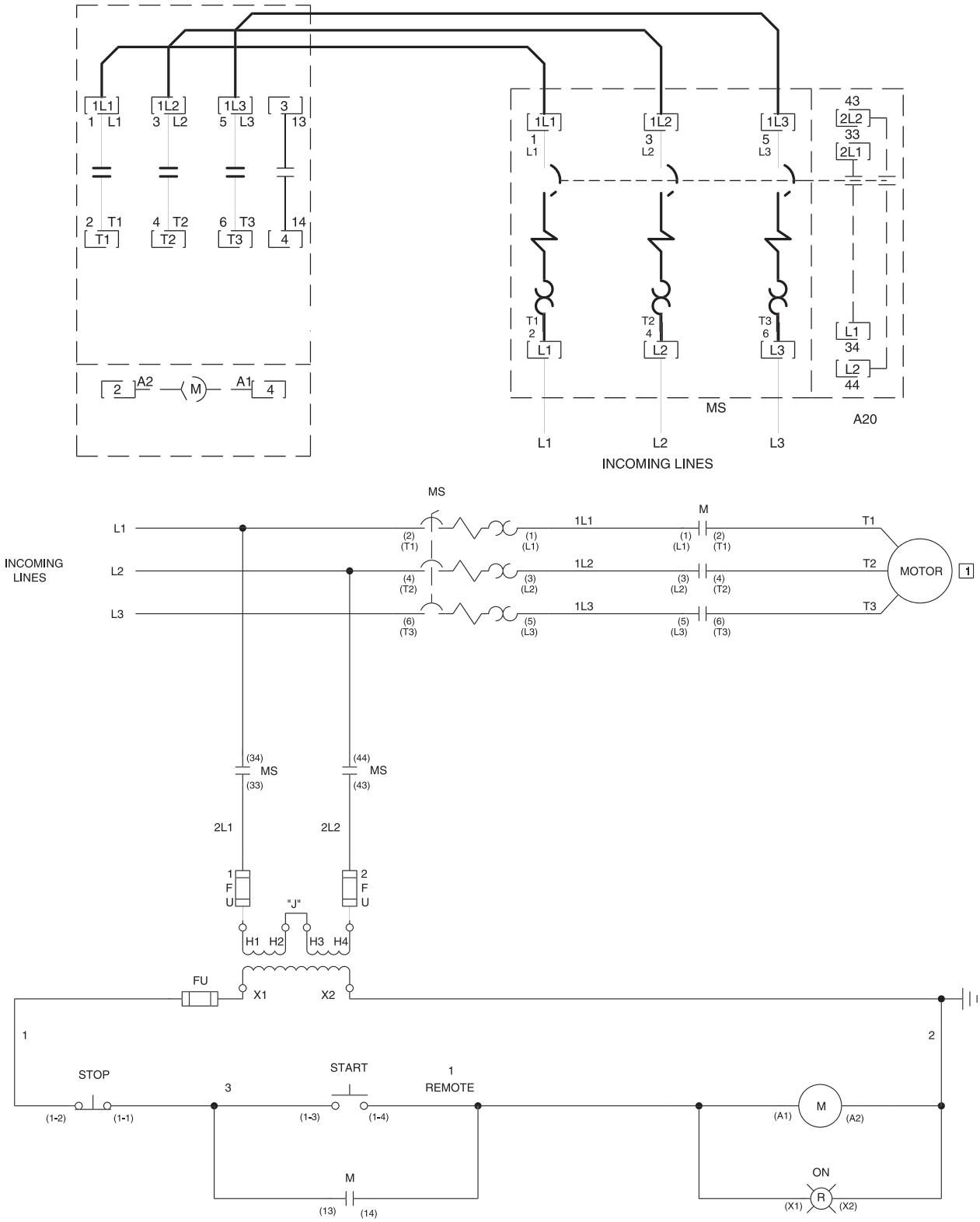
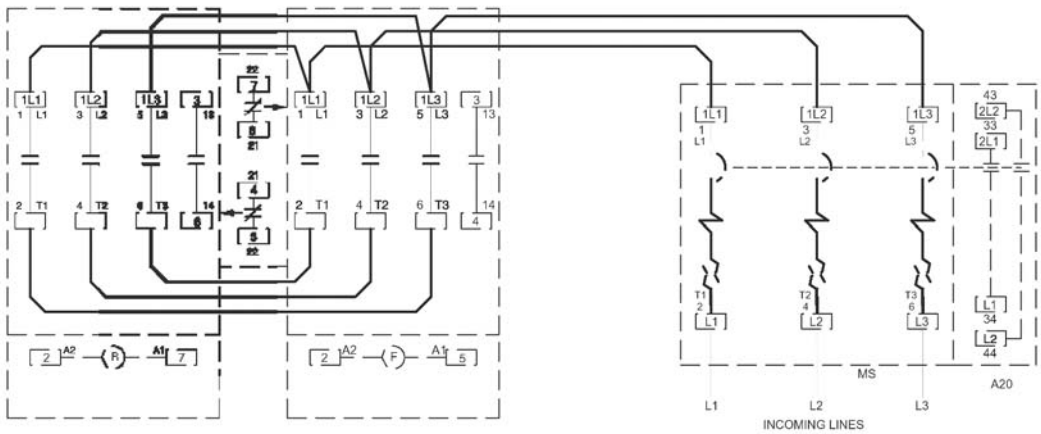
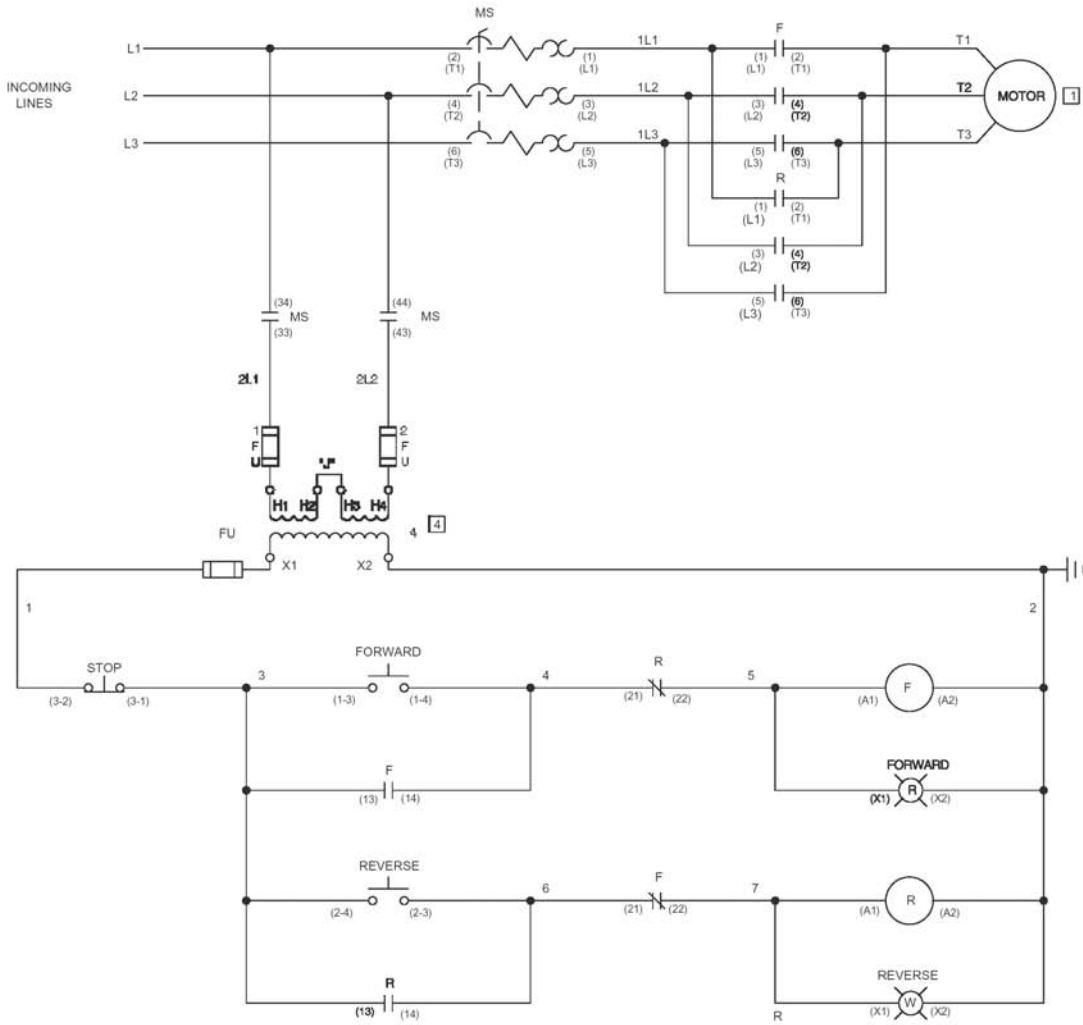
Cat. No. 103H-AFBD2-DB40X-1-4R-6P



2

Cat. No. 107H-AFBD3-CA16X-1M-4RW-6P





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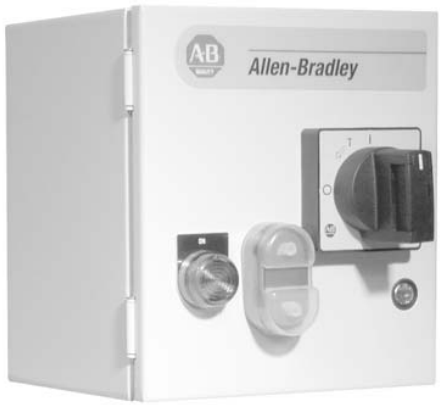
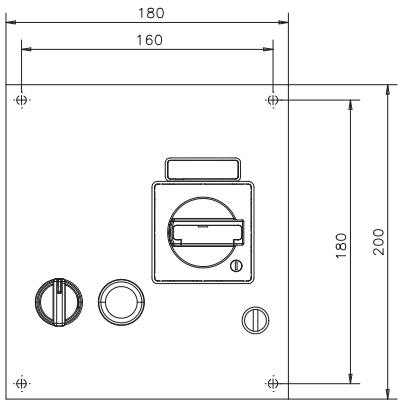
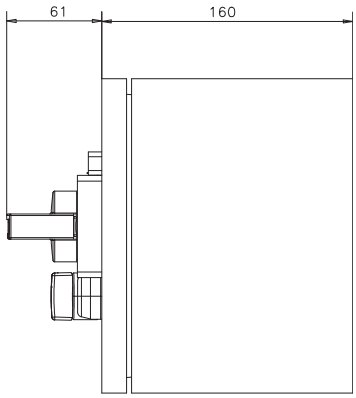
Allen-Bradley

Dimensions in mm. Dimensions are not intended to be used for manufacturing purposes.

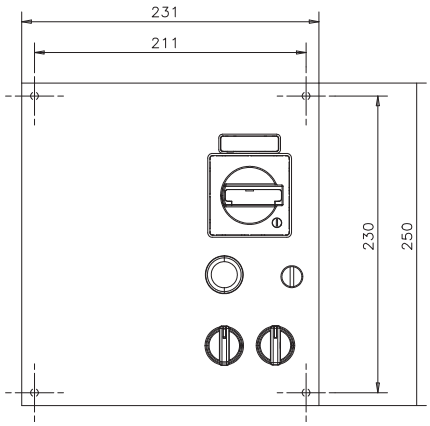
Enclosure Style A

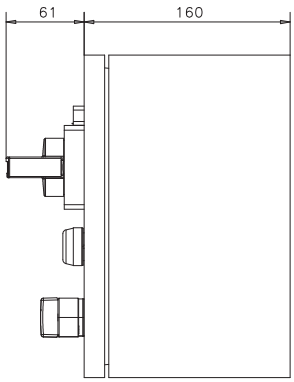




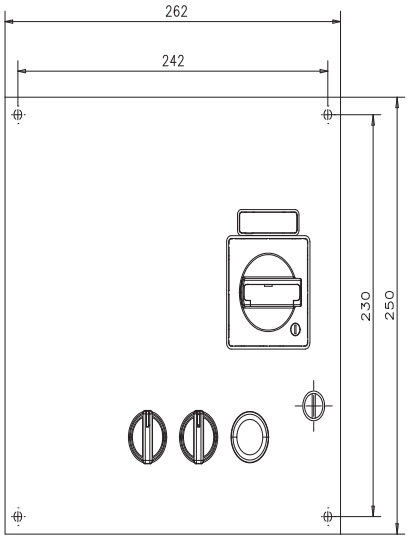


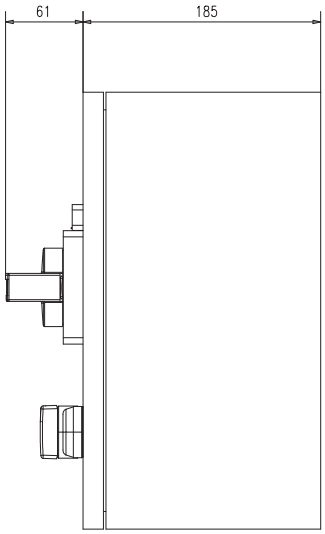
Enclosure Style B





Enclosure Style C





Cat. No. 105-C09ABA1F-1-6P Type 1 Metal Enclosure with Lift-off Cover

Bulletin 105 IEC Reversing Starters

- Selection of metal enclosures IP42 (Type 1) and IP66 (Type 3/4/12)
- Bimetallic Class 10 overload relays
- Solid-state overload relays
- Compact design
- Meets international standards

Bulletin 105 enclosed starters use Bulletin 104 reversing contactors and Bulletin 193 solid-state overload relays. These reversing starters (9…85 A) incorporate a "dual" interlock that provides both mechanical and electrical interlocking in a single unit. A normally open auxiliary contact is also included on each contactor.

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Modifications 2-348
Approximate Dimensions 2-351

Standards Compliance

EN/IEC 60947-4-1
VDE 0660
CSA C22.2 No. 14
UL 508

Certifications

cULus Listed (File E3125, Guide NLDX, NLDX7)

Your order must include: Cat. No. of the reversing starter selected, coil voltage code, overload relay suffix code, and, if required, factory-installed modifications suffix code and/or Cat. No. of any accessories.

Product Selection

AC-Operated

Ratings (AC3, AC4)								IP42 (Type 1) General Purpose Sheet Metal Enclosure (Lift-off cover through 105-C72)	IP66 (Type 3/4/12) Watertight, Dusttight Sheet Metal Enclosure (Hinged Cover)
	kW	Hp							
	3Ø	1Ø ✶		3Ø					
Max I_e [A]	380V/ 415V	115V	230V	200V	230V	460V	575V	Cat. No.	Cat. No.
9	4	1/2	1-1/2	2	2	5	7-1/2	105-C09A⊗✪	**105-C09F⊗✪**
12	5-1/2	1/2	2	3	3	7-1/2	10	**105-C12A⊗✪**	**105-C12F⊗✪**
16	7-1/2	1	3	5	5	10	15	**105-C16A⊗✪**	**105-C16F⊗✪**
23	11	2	3	5	7-1/2	15	15	**105-C23A⊗✪**	**105-C23F⊗✪**
30	15	2	5	7-1/2	10	20	25	**105-C30A⊗✪**	**105-C30F⊗✪**
37	18-1/2	3	5	10	10	25	30	**105-C37A⊗✪**	**105-C37F⊗✪**
43	22	3	7-1/2	10	15	30	30	**105-C43A⊗✪**	**105-C43F⊗✪**
60	30	5	10	15	20	40	50	**105-C60A⊗✪**	**105-C60F⊗✪**
72	37	5	15	20	25	50	60	**105-C72A⊗✪**	**105-C72F⊗✪**
85	45	7-1/2	15	25	30	60	60	**105-C85A⊗✪**	**105-C85F⊗✪**

⊗ Coil Voltage Code

The Cat. No. as listed is incomplete. Select a Coil Voltage Code from the table below to complete the Cat. No. Example: **Cat. No. 105-C09A⊗✪** becomes **Cat. No. 105-C09AB✪**.

AC Voltage		24	48	110	120	208	208… 240	220	240	277	380… 400	400… 415	440	480	500	600
Common Control❄ Coil Voltage Code	50 Hz	—	—	—	—	—	—	A	T	—	N	G	B	—	M	—
	60Hz	—	—	—	—	H	L	—	A	—	—	—	N	B	—	C
Separate Control (without transformer) Coil Voltage Code	50 Hz	K	Y	D	—	—	—	—	—	—	—	—	—	—	—	—
	60Hz	J	X	—	D	—	—	—	—	T	—	—	—	—	—	—

✪ Overload Relay Code

The Cat. No. as listed is incomplete. Select an overload relay code from page 2-169 to complete the Cat. No.

✶ For single-phase (1Ø) applications, consult your local Rockwell Automation sales office or Allen-Bradley distributor.

❄ When selecting a factory-installed control circuit transformer (**see** Modifications page 2-348), use the Common Control Coil Voltage Code to denote the transformer primary voltage. The starter coil and transformer secondary voltage will both be 120V by default. Example: **Cat. No. 105-C09FB✪-6P** will have a transformer with a 480V primary/120V secondary and a 120V starter coil. If a starter coil voltage other than 120V is desired, a second Coil Voltage Code must be added to denote the coil/transformer secondary voltage. Example: **Cat. No. 105-C09FBJ✪-6P** will have a transformer with a 480V primary/24V secondary and a 24V starter coil.

Cat. No. 106-C30FBA1H-4RW-6P
IP66 (Type 3,4,12)
Metal Enclosure with Hinged Cover

Bulletin 106 IEC Reversing Combination Starters

- Selection of metal enclosures IP42 (Type 1) and IP66 (Type 3/4/12)
- Bimetallic Class 10 overload relay
- Solid-state overload relays
- Compact design
- Meets international standards
- Can be modified in the field
- Handle with defeater mechanism
- Padlockable handle (up to three padlocks)

Bulletin 106 Combination starters use a Bulletin 104 reversing contactor, a Bulletin 193 bimetallic (Class 10) or solid-state overload relay, and a Bulletin 194R rotary disconnect switch. Reversing starters (9 A…72 A) incorporate a "dual" interlock that provides both mechanical and electrical interlocking in a single unit. A normally open auxiliary contact is also included on each contactor.

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EN/IEC 60947-4-1
VDE 0660
CSA C22.2 No. 14
UL 508

Certifications

cULus Listed (File E3125, Guide NLDX, NLDX7)

2

Your order must include: Cat. No. of the reversing combination starter selected, coil voltage code, overload relay suffix code, and, if required, factory-installed modifications suffix code and/or Cat. No. of any accessories.

Product Selection

Fusible Disconnect Type
AC Operated

Ratings (AC3, AC4)							IP42 (Type 1) General-Purpose Sheet Metal Enclosure (Hinged Cover)	IP66 (Type 3, 4, 12) Watertight, Dusttight Sheet Metal Enclosure (Hinged Cover)
Max I_e [A]	kW 3Ø 380…415V	Hp 3Ø 200V	Hp 3Ø 230V	Hp 3Ø 460V	Hp 3Ø 575V	Fuse Clip Rating Amperes/UL Class	Cat. No.	Cat. No.
9	4	2	2	5	7-1/2	30 A/Class CC	106-C09AÄ✪	**106-C09F⊗✪**
12	5-1/2	3	3	7-1/2	10	30 A/Class J	**106-C12A⊗✪**	**106-C12F⊗✪**
23	11	5	7-1/2	15	15	30 A/Class J	**106-C23A⊗✪**	**106-C23F⊗✪**
30	15	7-1/2	10	20	25	60 A/Class J	**106-C30A⊗✪**	106-C30FÄ✪
43	22	10	15	30	30	60 A/Class J	**106-C43A⊗✪**	**106-C43F⊗✪**
60	30	15	20	40	50	100 A/Class J	**106-C60A⊗✪**	**106-C60F⊗✪**
72	37	20	25	50	60	100 A/Class J	**106-C72A⊗✪**	**106-C72F⊗✪**

⊗ Coil Voltage Code

The Cat. No. as listed is incomplete. Select a Coil Voltage Code from the table below to complete the Cat. No. Example: **Cat. No. 106-C09A⊗✪** becomes **Cat. No. 106-C09AB✪**.

Voltage		208V	230…240V	460…480V	575…600V
Common Control ∗ Coil Voltage Code	60 Hz	H	A	B	C
120V — Separate Control (without transformer) Coil Voltage Code		AD	AD	CD	CD

✪ Overload Relay Code

The Cat. No. as listed is incomplete. Select an overload relay code from page 2-169 to complete the Cat. No.

∗ When selecting a factory-installed control circuit transformer (**see** Modifications page 2-348), use the Common Control Coil Voltage Code to denote the transformer primary voltage. The starter coil and transformer secondary voltage will both be 120V by default. Example: **Cat. No. 106-C09FB✪-6P** will have a transformer with a 480V primary/120V secondary and a 120V starter coil. If a starter coil voltage other than 120V is desired, a second Coil Voltage Code must be added to denote the coil/transformer secondary voltage. Example: **Cat. No. 106-C09FBJ✪-6P** will have a transformer with a 480V primary/24V secondary and a 24V starter coil.

IEC Non-Reversing Starters

Overview/Catalog Number Explanation

Cat. No. 109-C09ABA1F-1-4R-6P IP42 (Type 1) Metal Enclosure with Lift-off Cover

Cat. No. 109-CAKD2-E1A-7 Molded Plastic Enclosure

Bulletin 109 IEC Non-Reversing Starters

- Impact-resistant molded enclosures (9…23 A)
  IP66 (Type 4/4X/12)
- Selection of metal enclosures (9…85 A)
  IP42 (Type 1)
  IP66 (Type 3/4/12)
- Bimetallic Class 10 overload relays
- Solid-state overload relays
- Compact design
- Meets international standards

Bulletin 109 enclosed starters are designed using Bulletin 100 contactors (9…85 A) and Bulletin 193 bimetallic (Class 10) or solid-state overload relays in a metal or molded plastic enclosure.

Your order must include: Cat. No. of the starter selected, coil voltage code, overload relay suffix code, and, if required, factory-installed modifications suffix code and/or cat. no. of any accessories.

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UL 508

Certifications

cULus Listed (File E3125, Guide NLDX, NLDX7)

Catalog Number Explanation

Examples given in this section are for reference purposes. This basic explanation should not be used for product selection; not all combinations will produce a valid cat. no. Refer to the tables on the following pages for descriptions of options.

IEC Non-Reversing Starters in Plastic Enclosures

109	–	CA	K	D	2	–	E1P	–	4G	–	7
a		*b*	*c*	*d*	*e*		*f*		*g*		*g*

a

Bulletin No.	
Code	Description
109	IEC Non-reversing starter

b

Contactor Size	
Code	Description
CA	100-C09
CB	100-C12
CC	100-C16
CD	100-C23

c

Enclosure	
Code	Description
K	Plastic Encl. PC, IP66, Type 12K/4/4X

d

Coil Voltage Code — AC Voltage	
Code	Description
Q	12V, 60 Hz
R	12V, 50 Hz
J	24V, 60 Hz
K	24V, 50 Hz
KJ	24V, 50/60 Hz
V	32V, 50 Hz / 36V, 60 Hz
W	36V, 50 Hz
X	42V, 50 Hz / 48V, 60 Hz
Y	48V, 50 Hz
KY	48V, 50/60 Hz
KP	100V, 50 Hz / 100...110V, 60 Hz
D	110V, 50 Hz / 120V, 60 Hz
KD	110V, 50/60 Hz
P	120V, 50 Hz
S	127V, 50 Hz
KG	200V, 50 Hz / 200…220V, 60 Hz
KL	200…230V, 50/60 Hz
L	208...240V, 60 Hz
F	220...230V, 50 Hz
KF	230V, 50/60 Hz
A	240V, 60 Hz
T	240V, 50 Hz / 277V, 60 Hz
E	380V, 60 Hz
N	380...400V, 50 Hz / 440V, 60 Hz
KN	400V, 50/60 Hz
G	400...415V, 50 Hz
KB	440V, 50/60 Hz
B	440V, 50 Hz / 480V, 60 Hz
M	500V, 50 Hz
C	550V, 50/60 Hz0V, 60 Hz

e

Auxiliary Contacts	
Code	Description
0	N.O. Aux.Contact used in Start/Stop Circuit
2	N.O. for Customer Use with Reset Option only

f

Overload Relay	
193-ED/ -EE 3-phase Electronic Overload Relay	
Code	Description
D1_	Cl.10, Man. Reset (add additional code suffix below)
E1_	Aut./Man.Reset, Adj. Class (add additional code suffix below)
Adj. Range/Contactor Size	
Code	Description
_A	0.1…0.5 A, 100-C09…C23
_B	0.2…1.0 A, 100-C09…C23
_C	1.0…5.0 A, 100-C09…C23
_D	3.2…16 A, 100-C09…C23
_E	5.4…27 A, 100-C16…C23
193-EE Single-phase Electron. Overload Relay	
Code	Description
E1P	1.0...5.0 A, 100-C09…C23
E1R	3.2...16 A, 100-C09…C23
E1S	5.4…27 A, 100-C16…C23

g

Modifications and Accessories	
Code	Description
R	Surge Suppressor RC
V	Surge Suppressor Varistor
2	Push Buttons, START/raised STOP (green/red)
7	Push Button, RESET (blue)
MC	With Pushbutton Latch for Maintained Control
Pilot Lights IP66, Type 4/4X/12K	
Code	Description
4G	Pilot Light "RUN", Green
4R	Pilot Light "RUN", Red
4Y	Pilot Light "Failure", Yellow

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Preferred availability cat. nos. are printed in **bold**

Product Selection — AC-Operated Starters
Enclosed Type — Molded Plastic

Max I_e [A]	Ratings (AC3, AC4) kW 3Ø	Hp 1Ø		Hp 3Ø				IP66 (Type 4, 4X, 12) Watertight, Dusttight Corrosion Resistant Molded Plastic Enclosure	
								With integral Start/Stop Push Butotn	With integral Reset Push Butotn
	380V/415V	115V	230V	200V	230V	460V	575V	Cat. No.∗	Cat. No.∗
9	4	1/2	1-1/2	2	2	5	7-1/2	109-CAK⊗0-✪-2	109-CAK⊗0-✪-7
12	5-1/2	1/2	2	3	3	7-1/2	10	109-CBK⊗0-✪-2	109-CBK⊗0-✪-7
16	7-1/2	1	3	5	5	10	15	**109-CCK⊗0-✪-2**	**109-CCK⊗0-✪-7**
23	11	2	3	5	7-1/2	15	15	**109-CDK⊗0-✪-2**	**109-CDK⊗0-✪-7**

∗ N.O. auxiliary contact is used as holding contact with the START/STOP option.
N.O. auxiliary contact is available for customer use with RESET option.

Enclosed Type — Sheet Metal

Max I_e [A]	Ratings (AC3, AC4) kW 3Ø	Hp 1Ø		Hp 3Ø				IP42 (Type 1) General Purpose Sheet Metal Enclosure (Liftoff Cover)	IP66 (Type 3, 4, 12) Watertight, Dusttight Sheet Metal Enclosure (Hinged Cover)
	380V/415V	115V	230V	200V	230V	460V	575V	Cat. No.	Cat. No.
9	4	1/2	1-1/2	2	2	5	7-1/2	109-C09A⊗✪	109-C09F⊗✪
12	5-1/2	1/2	2	3	3	7-1/2	10	109-C12A⊗✪	109-C12F⊗✪
16	7-1/2	1	3	5	5	10	15	**109-C16A⊗✪**	**109-C16F⊗✪**
23	11	2	3	5	7-1/2	15	15	**109-C23A⊗✪**	**109-C23F⊗✪**
30	15	2	5	7-1/2	10	20	25	109-C30A⊗✪	**109-C30F⊗✪**
37	18-1/2	3	5	10	10	25	30	**109-C37A⊗✪**	109-C37F⊗✪
43	22	3	7-1/2	10	15	30	30	**109-C43A⊗✪**	**109-C43F⊗✪**
60	30	5	10	15	20	40	50	**109-C60A⊗✪**	**109-C60F⊗✪**
72	37	5	15	20	25	50	60	**109-C72A⊗✪**	**109-C72F⊗✪**
85	45	7-1/2	15	25	30	60	60	**109-C85A⊗✪**	**109-C85F⊗✪**

⊗ Coil Voltage Code

The Cat. No. as listed is incomplete. Select a Coil Voltage Code from the table below to complete the Cat. No. Example: **Cat. No. 109-C09A⊗✪** becomes **Cat. No.109-C09AB✪**.

AC Voltage [V]		24	48	110	120	208	208… 240	220	240	277	380… 400	400… 415	440	480	500	600
Common Control‡ Coil Voltage Code	50 Hz	—	—	—	—	—	—	A	T	—	N	G	B	—	M	—
	60 Hz	—	—	—	—	H	L	—	A	—	—	—	N	B	—	C
Separate Control (without transformer) Coil Voltage Code	50 Hz	K	Y	D	—	—	—	—	—	—	—	—	—	—	—	—
	60 Hz	J	X	—	D	—	—	—	—	T	—	—	—	—	—	—

✪ Overload Relay Code

The Cat. No. as listed is incomplete. Select an overload relay code from page 2-169 to complete the Cat. No. Select an overload relay code from E1 Plus Overload Relay for 3Ø Applications: Phase Loss Protection, Class 10 or 20 to complete the Cat. No. Bimetal overload relays are not available in molded plastic enclosed starters.

‡ When selecting a factory-installed control circuit transformer (see Modifications page 2-348), use the Common Control Coil Voltage Code to denote the transformer primary voltage. The starter coil and transformer secondary voltage will both be 120V by default. Example: **Cat. No. 109-C09FB✪-6P** will have a transformer with a 480V primary/120V secondary and a 120V starter coil. If a starter coil voltage other than 120V is desired, a second Coil Voltage Code must be added to denote the coil/transformer secondary voltage. Example: **Cat. No. 109-C09FBJ✪-6P** will have a transformer with a 480V primary/24V secondary and a 24V starter coil. Control Circuit transformers are not available in molded plastic enclosures

IEC Fused Combination Starters

Overview/Product Selection

Cat. No. 112-C09FBA1F-1-7 IP66 (Type 3,4,12) Metal Enclosure with Hinged Cover

Bulletin 112 IEC Combination Starters

- Compact design
- Can be modified in the field
- Selection of enclosures
  - IP42 (Type 1)
  - IP66 (Type 3/4/12)
- Bimetallic Class 10 overload relays
- Solid-state overload relays
- Fusible or non-fusible versions
- Handle with defeater mechanism
- Padlockable handle with up to three padlocks

Bulletin 112 is the first true IEC combination starter on the market, in that the enclosure and components have been designed to specific IEC standard requirements. The Bulletin 112 combination starter consists of a Bulletin 100 Contactor, Bulletin 193 bimetallic (Class 10) or solid-state overload relay and Bulletin 194R fused disconnect switch installed in a common enclosure. These full-voltage combination starters are designed to provide the disconnecting means, short-circuit protection (with suitable fuses), control and overload protection for three-phase squirrel-cage motors. All starters include a normally open auxiliary contact as standard.

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Certifications

cULus Listed (File E125316, Guide NKJH, NKJH7)

Your order must include: Cat. No. of the combination starter selected, coil voltage code, overload relay suffix code, and, if required, factory-installed modifications suffix code and/or Cat. No. of any accessories.

Product Selection — AC-Operated Starters

Fusible Disconnect Type

Ratings (AC3, AC4)						IP42 (Type 1) General Purpose Sheet Metal Enclosure (Hinged Cover)	IP66 (Type 3/4/12) Watertight, Dusttight Sheet Metal Enclosure (Hinged Cover)
Max I_e [A]	Hp 3Ø 200V	Hp 3Ø 230V	Hp 3Ø 460V	Hp 3Ø 575V	Fuse Clip Rating Amperes/ UL Class	Cat. No.	Cat. No.
9	2	2	5	7-1/2	30 A/Class CC	**112-C09A⊗✪**	**112-C09F⊗✪**
12	3	3	7-1/2	10	30 A/Class J	**112-C12A⊗✪**	**112-C12F⊗✪**
23	5	7-1/2	15	15	30 A/Class J	**112-C23A⊗✪**	**112-C23F⊗✪**
30	7-1/2	10	20	25	60 A/Class J	**112-C30A⊗✪**	**112-C30F⊗✪**
43	10	15	30	30	60 A/Class J	**112-C43A⊗✪**	**112-C43F⊗✪**
60	15	20	40	50	100 A/Class J	**112-C60A⊗✪**	**112-C60F⊗✪**
72	20	25	50	60	100 A/Class J	**112-C72A⊗✪**	**112-C72F⊗✪**

Non-Fusible Disconnect Type

Ratings (AC3, AC4)					IP42 (Type 1) General Purpose Sheet Metal Enclosure (Hinged Cover)	IP66 (Type 3/4/12) Watertight, Dusttight Sheet Metal Enclosure (Hinged Cover)
Max I_e [A]	Hp 3Ø 200V	Hp 3Ø 230V	Hp 3Ø 460V	Hp 3Ø 575V	Cat. No.	Cat. No.
9	2	2	5	7-1/2	**112-C09A⊗✪-DNF**	112-C09F⊗✪-DNF
12	3	3	7-1/2	10	**112-C12A⊗✪-DNF**	**112-C12F⊗✪-DNF**
23	5	7-1/2	15	15	**112-C23A⊗✪-DNF**	**112-C23F⊗✪-DNF**
30	7-1/2	10	20	25	**112-C30A⊗✪-DNF**	**112-C30F⊗✪-DNF**
43	10	15	30	30	**112-C43A⊗✪-DNF**	**112-C43F⊗✪-DNF**
60	15	20	40	50	**112-C60A⊗✪-DNF**	**112-C60F⊗✪-DNF**
72	20	25	50	60	**112-C72A⊗✪-DNF**	**112-C72F⊗✪-DNF**

⊗ Coil Voltage Code

The Cat. No. as listed is incomplete. Select a Coil Voltage Code from the table below to complete the Cat. No. Example: **Cat. No. 112-C09A⊗✪** becomes **Cat. No. 112-C09AB✪**.

Voltage [V]		208	230…240	460…480	575…600
Common Control∗ Coil Voltage Code	60 Hz	H	A	B	C
120V — Separate Control (without transformer) Coil Voltage Code	60 Hz	AD	AD	CD	CD

✪ Overload Relay Code

The Cat. No. as listed is incomplete. Select an overload relay code from page 2-169 to complete the Cat. No.

∗ When selecting a factory-installed control circuit transformer (see Modifications page 2-348), use the Common Control Coil Voltage Code to denote the transformer primary voltage. The starter coil and transformer secondary voltage will both be 120V by default. Example: **Cat. No. 112-C09FB-✪-6P** will have a transformer with a 480V primary/120V secondary and a 120V starter coil. If a starter coil voltage other than 120V is desired, a second Coil Voltage Code must be added to denote the coil/transformer secondary voltage. Example: **Cat. No. 112-C09FBJ-✪-6P** will have a transformer with a 480V primary/24V secondary and a 24V starter coil.

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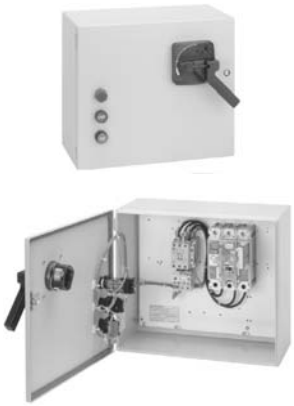
Preferred availability cat. nos. are printed in **bold**



Cat. No. 113-C30FBA1H-4R-43 IP66 (Type 3,4,12) Metal Enclosure with Hinged Cover

Bulletin 113 IEC Combination Starters

- Compact design
- Can be modified in the field
- Selection of enclosures
  IP42 (Type 1)
  IP66 (Type 3/4/12)
- Bimetallic Class 10 overload relays
- Solid-state overload relays
- Handle defeater mechanism
- Padlockable handle with up to three padlocks
- Adjustable instantaneous trip circuit breaker

Bulletin 113 combination starter consists of a Bulletin 100 contactor, Bulletin 193 bimetallic (Class 10) or solid-state overload relay and a motor circuit protector installed in a common enclosure. These full-voltage combination starters are designed to provide the disconnecting means, short-circuit protection, control and overload protection for three-phase squirrel-cage motors. All starters include a normally open auxiliary contact as standard.

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cULus Listed (File E125316, Guide NKJH, NKJH7)

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Your order must include: Cat. No. of the combination starter selected, coil voltage code, overload relay suffix code, and, if required, factory-installed modifications suffix code and/or Cat. No. of any accessories.

Product Selection

Circuit Breaker Type - AC Operated

Ratings (AC3, AC4)					IP42 (Type 1) General Purpose Sheet Metal Enclosure (Hinged Cover)	IP66 (Type 3/4/12) Watertight, Dusttight Sheet Metal Enclosure (Hinged Cover)
Max I_e [A]	Hp∗ 3Ø 200V	230V	460V	575V	Cat. No.∗	Cat. No.∗
30	1/2	1/2	—	—	**113-C30A⊗✪-33**	**113-C30F⊗✪-33**
	3/4…1	3/4…1	1/2…1	—	**113-C30A⊗✪-35**	**113-C30F⊗✪-35**
	—	—	—	1/2…1-1/2	**113-C30A⊗✪-36**	**113-C30F⊗✪-36**
	1-1/2…3	1-1/2…3	1-1/2…3	2…3	**113-C30A⊗✪-38**	**113-C30F⊗✪-38**
	5	—	—	—	**113-C30A⊗✪-39**	**113-C30F⊗✪-39**
	7-1/2	5…7-1/2	5…7-1/2	—	**113-C30A⊗✪-40**	**113-C30F⊗✪-40**
	—	10	—	5…10	**113-C30A⊗✪-41**	**113-C30F⊗✪-41**
	—	—	10	—	**113-C30A⊗✪-42**	**113-C30F⊗✪-42**
	—	—	20	15…20	**113-C30A⊗✪-43**	**113-C30F⊗✪-43**
	—	—	—	25	**113-C30A⊗✪-44**	**113-C30F⊗✪-44**
43	7-1/2…10	10	—	—	**113-C43A⊗✪-41**	**113-C43F⊗✪-41**
	—	15	—	—	**113-C43A⊗✪-42**	**113-C43F⊗✪-42**
	—	—	20…25	—	**113-C43A⊗✪-44**	**113-C43F⊗✪-44**
	—	—	30	25…30	**113-C43A⊗✪-45**	**113-C43F⊗✪-45**
60	15	—	—	—	**113-C60A⊗✪-42**	**113-C60F⊗✪-42**
	—	15…20	—	—	**113-C60A⊗✪-43**	**113-C60F⊗✪-43**
	—	—	40	40	**113-C60A⊗✪-46**	**113-C60F⊗✪-46**
72	15…20	—	—	—	**113-C72A⊗✪-43**	**113-C72F⊗✪-43**
	—	20…25	—	—	**113-C72A⊗✪-44**	**113-C72F⊗✪-44**
	—	—	40…50	—	**113-C72A⊗✪-47**	**113-C72F⊗✪-47**
	—	—	—	40…60	**113-C72A⊗✪-48**	**113-C72F⊗✪-48**

⊗ Coil Voltage Code

The Cat. No. as listed is incomplete. Select a Coil Voltage Code from the table below to complete the Cat. No. Example: **Cat. No. 113-C30A⊗✪-33** becomes **Cat. No. 113-C30AB✪-33**.

Voltage [V]		208	230…240	460…480	575…600
Common Control❄ Coil Voltage Code	60 Hz	H	A	B	C
120V — Separate Control (without transformer) Coil Voltage Code		HD	AD	BD	CD

✪ Overload Relay Code

The Cat. No. as listed is incomplete. Select an overload relay code from page 2-169 to complete the Cat. No.

∗ For design "E" motor applications, consult your local Rockwell Automation sales office or Allen-Bradley distributor.

❄ When selecting a factory-installed control circuit transformer (see Modifications page 2-348), use the Common Control Coil Voltage Code to denote the transformer primary voltage. The starter coil and transformer secondary voltage will both be 120V by default. Example: **Cat. No. 113-C30FB3✪-6P** will have a transformer with a 480V primary/120V secondary and a 120V starter coil. If a starter coil voltage other than 120V is desired, a second Coil Voltage Code must be added to denote the coil/transformer secondary voltage. Example: **Cat. No. 113-C30FBJ✪-6P** will have a transformer with a 480V primary/24V secondary and a 24V starter coil.

Cat. No. 120E-C09FDA1FA1D-3-4RW-7
IP66 (Type 3,4,12)
Metal Enclosure with Hinged Cover

Bulletin 120E IEC Multi-Speed Starters

- Compact design
- Selection of enclosures
  IP42 (Type 1) and
  IP66 (Type 3/4/12)
- Bimetallic Class 10 overload relays
- Solid-state overload relays

Bulletin 120E multi-speed starters are designed to control "two-speed, separate-winding" AC squirrel-cage induction motors. These starters are available for constant torque, variable torque, or constant horsepower three-phase motors. Multi-speed motors are commonly used on machine tools, fans, blowers, pumps, conveyors and many other types of equipment.

Bulletin 120E multi-speed motor starters use Bulletin 100 contactors and Bulletin 193 bimetallic (Class 10) or solid-state overload relays. A normally open auxiliary contact is also included on each contactor. A wide variety of factory- and field-installed options are available.

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Standards Compliance

EN/IEC 60947-4-1
VDE 0660
CSA C22.2 No. 14
UL 508

Certifications

cULus Listed (File E3125, Guide NLDX, NLDX7)

Your order must include: Cat. No. of the starter selected, coil voltage code, and, if required, factory-installed modifications suffix code and/or Cat. No. of any accessories.

Product Selection

Enclosed Type — AC Operated

2-Speed Separate Winding, Constant or Variable Torque (Constant Horsepower—Consult your local Rockwell Automation sales office or Allen-Bradley distributor)

Ratings (AC3, AC4)								IP42 (Type 1) General Purpose Sheet Metal Enclosure (Lift-off Cover through 120E-C72)	IP66 (Type 3/4/12) Watertight, Dusttight Sheet Metal Enclosure (Hinged Cover)
Max I_e [A]	kW	Hp							
	3Ø	1Ø∗		3Ø					
	380V/415V	115V	230V	200V	230V	460V	575V	Cat. No.	Cat. No.
9	4	1/2	1-1/2	2	2	5	7-1/2	**120E-C09A⊗✪✪**	**120E-C09F⊗✪✪**
12	5-1/2	1/2	2	3	3	7-1/2	10	**120E-C12A⊗✪✪**	**120E-C12F⊗✪✪**
16	7-1/2	1	3	5	5	10	15	**120E-C16A⊗✪✪**	**120E-C16F⊗✪✪**
23	11	2	3	5	7-1/2	15	15	**120E-C23A⊗✪✪**	**120E-C23F⊗✪✪**
30	15	2	5	7-1/2	10	20	25	**120E-C30A⊗✪✪**	**120E-C30F⊗✪✪**
37	18-1/2	3	5	10	10	25	30	**120E-C37A⊗✪✪**	**120E-C37F⊗✪✪**
43	22	3	7-1/2	10	15	30	30	**120E-C43A⊗✪✪**	**120E-C43F⊗✪✪**
60	30	5	10	15	20	40	50	**120E-C60A⊗✪✪**	**120E-C60F⊗✪✪**
72	37	5	10	20	25	50	60	**120E-C72A⊗✪✪**	**120E-C72F⊗✪✪**
85	45	7-1/2	15	25	30	60	60	**120E-C85A⊗✪✪**	**120E-C85F⊗✪✪**

⊗ Coil Voltage Code

The Cat. No. as listed is incomplete. Select a Coil Voltage Code from the table below to complete the Cat. No. Example: **Cat. No. 120E-C09A⊗✪✪✪** becomes **Cat. No. 120E-C09AB✪✪**.

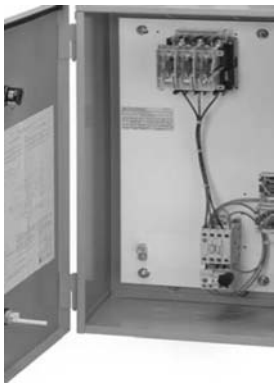
AC Voltage [V]		24	48	110	120	208	208…240	220	240	277	380…400	400…415	440	480	500	600
Common Control❄ Coil Voltage Code	50 Hz	—	—	—	—	—	—	A	T	—	N	G	B	—	M	—
	60 Hz	—	—	—	—	H	L	—	A	—	—	—	N	B	—	C
Separate Control (without transformer) Coil Voltage Code	50 Hz	K	Y	D	—	—	—	—	—	—	—	—	—	—	—	—
	60 Hz	J	X	—	D	—	—	—	—	T	—	—	—	—	—	—

✪ Overload Relay Code

The Cat. No. as listed is incomplete. Select two overload relay codes from page 2-169 to complete the Cat. No. The first code will denote the high speed overload relay, and the second code will denote the low speed overload relay.

∗ For single-phase (1Ø) applications, consult your local Rockwell Automation sales office or Allen-Bradley distributor.

❄ When selecting a factory-installed control circuit transformer (see Modifications page 2-348), use the Common Control Coil Voltage Code to denote the transformer primary voltage. The starter coil and transformer secondary voltage will both be 120V by default. Example: **Cat. No. 120E-C09FB✪✪-6P** will have a transformer with a 480V primary/120V secondary and a 120V starter coil. If a starter coil voltage other than 120V is desired, a second Coil Voltage Code must be added to denote the coil/transformer secondary voltage. Example: **Cat. No. 12E-C09FBJ✪✪-6P** will have a transformer with a 480V primary/24V secondary and a 24V starter coil.



Cat. No. 132-C09MBA1F

Bulletins 132 and 133 IEC Pump Control Panel Starters

- IP32 (Type 3R)
- Bimetallic Class 10 overload relays
- Solid-state overload relays
- Enclosure with extra panel space for mounting accessory devices
- Factory-installed disconnect switch or circuit breaker
- Handle with defeater mechanism
- Service entrance rated

Bulletin 132 and 133 pump control panels are specifically designed for irrigation and similar outdoor pumping applications.
The Bulletin 132 pump control panel includes a Bulletin 194R IEC fusible rotary disconnect switch, a Bulletin 100 IEC contactor, a Bulletin 193 bimetallic overload relay or solid-state overload relays, a HAND-OFF-AUTO selector switch, and a START button. All starters include a normally open auxiliary contact as standard. The Bulletin 133 pump control panels are supplied with a motor circuit protector instead of a fusible disconnect switch. IEC pump control panels include an IP32 (Type 3R) weather-resistant enclosure with a rugged, outdoor finish and brackets for pole or cross-bar mounting. Conduit knockouts are located at the bottom of the enclosure. Padlock provisions are furnished on the door latches and the handle (both the ON and OFF positions).

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UL 508

Certifications

cULus Listed (File No. E 125316, Guide NKJH, NKJH7)

2

Your order must include: Cat. No. of the pump control panel, coil voltage code, overload relay suffix code, and, if required, factory-installed modifications suffix code and/or Cat. No. of any accessories.

Product Selection

Fusible Disconnect Type

Ratings (AC3, AC4)						Fuse Clip Rating Amperes/UL Class	IP32 (Type 3R) Sleet Resistant, Outdoor Sheet Metal Enclosure (Hinged Cover)
Max. I_e [A]	kW 3Ø 380/415V	Hp 3Ø 200V	230V	460V	575V		Cat. No.
9	4	2	2	5	7-1/2	30 A/Class CC	**132-C09M⊗✪**
12	5-1/2	3	3	7-1/2	10	30 A/Class J	**132-C12M⊗✪**
23	11	5	7-1/2	15	15	30 A/Class J	**132-C23M⊗✪**
30	15	7-1/2	10	20	25	60 A/Class J	**132-C30M⊗✪**
43	22	10	15	30	30	60 A/Class J	**132-C43M⊗✪**
60	30	15	20	40	50	100 A/Class J	**132-C60M⊗✪**
72	37	20	25	50	60	100 A/Class J	**132-C72M⊗✪**

⊗ Coil Voltage Code—see page 2-344
✪ Overload Relay Code—see page 2-344

Circuit Breaker Type

Max. I_e [A]	Ratings (AC3, AC4) Hp∗ 3Ø 200V	230V	460V	575V	IP32 (Type 3R) Sleet Resistant, Outdoor Sheet Metal Enclosure (Hinged Cover) Cat. No.
30	1/2	1/2	—	—	**133-C30M⊗✪-33**
	3/4…1	3/4…1	1/2…1	—	**133-C30M⊗✪-35**
	—	—	—	1/2…1-1/2	**133-C30M⊗✪-36**
	1-1/2…3	1-1/2…3	1-1/2…3	2…3	**133-C30M⊗✪-38**
	5	—	—	—	**133-C30M⊗✪-39**
	7-1/2	5…7-1/2	5…7-1/2	—	**133-C30M⊗✪-40**
	—	10	—	5…10	**133-C30M⊗✪-41**
	—	—	10	—	**133-C30M⊗✪-42**
	—	—	20	15…20	**133-C30M⊗✪-43**
	—	—	—	25	**133-C30M⊗✪-44**
43	7-1/2…10	10	—	—	**133-C43M⊗✪-41**
	—	15	—	—	**133-C43M⊗✪-42**
	—	—	20…25	—	**133-C43M⊗✪-44**
	—	—	30	25…30	**133-C43M⊗✪-45**
60	15	—	—	—	**133-C60M⊗✪-42**
	—	15…20	—	—	**133-C60M⊗✪-43**
	—	—	40	40	**133-C60M⊗✪-46**
72	15…20	—	—	—	**133-C72M⊗✪-43**
	—	20…25	—	—	**133-C72M⊗✪-44**
	—	—	40…50	—	**133-C72M⊗✪-47**
	—	—	—	40…60	**133-C72M⊗✪-48**

⊗ Coil Voltage Code

The Cat. No. as listed is incomplete. Select a Coil Voltage Code from the table below to complete the Cat. No. Example: **Cat. No. 132-C12M⊗✪** becomes **Cat. No. 132-C12MB✪**

Voltage [V]		208	230…240	460…480	575…600
Common Control❄ Coil Voltage Suffix Code	60 Hz	H	A	B	C
120V Separate Control (without transformer) Coil Voltage Suffix Code		AD	AD	CD	CD

✪ Overload Relay Code

The Cat. No. as listed is incomplete. Select an overload relay code from page 2-169 to complete the Cat. No.

∗ For horsepower ratings less than those shown, consult your local Rockwell Automation sales office or Allen-Bradley distributor.

❄ When selecting a factory-installed control circuit transformer (see Modifications page 2-348), use the Common Control Coil Voltage Code to denote the transformer primary voltage. The starter coil and transformer secondary voltage will both be 120V by default. Example: **Cat. No. 132-C09MB✪-6P** will have a transformer with a 480V primary/120V secondary and a 120V starter coil. If a starter coil voltage other than 120V is desired, a second Coil Voltage Code must be added to denote the coil/transformer secondary voltage. Example: **Cat. No. 132-C09MBJ✪-6P** will have a transformer with a 480V primary/24V secondary and a 24V starter coil.

For Bulletins 105, 106, 109, 112, 113, 120E, 132, and 133

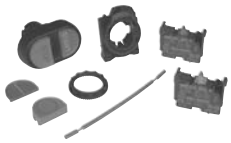
	Description		For Use With	Enclosure Type	Cat. No.
	Red "ON" Pilot Light∗ Transformer Type	120V	All	Metal Lift-off and Metal Hinged	❄ 198-PL21R
		208V			❄ 198-PL25R
		240V			❄ 198-PL22R
	Dual "ON" Pilot Light∗ Forward — Red Reverse — White	120V	105, 106	Metal Hinged	198-PL21RW
		240V			198-PL22RW
	Pilot Device Mounting Bracket (required when mounting pilot devices in metal lift-off enclosures)		105, 109, 120E	Metal Lift-off	198-BR1
	Control Circuit Fuse Block For Class CC Rejection Type Fuses (Fuses Not Included)		All	Metal Lift-off and Metal Hinged	**1491-R162**
	Grounding Bushing Adapts to 1/2 in. N.P.T., PG 16.5 & BS20 mm threads		109	Molded Plastic	198-GR1
	Single Pole N.O. Auxiliary Contact for Disconnect Switch		106, 112	Metal Hinged	‡ **195-GA10**
	Fuse Cover for Disconnect Switch		106,112,132-C09…C23	Metal Hinged	**194R-FCA2**
			106,112,132-C30…C43		**194R-FCJ60**
			106,112,132-C60…C72		§ **194R-FCC1**
	Closing Button For 22.5mm Round Panel Hole		All	All	198-N1
	"OFF-ON" Selector Switch 2-Position Maintained		All	Metal Lift-off and Metal Hinged	❄ 198-MT3

∗ Does not include legend plate. See page 10-111 for Bulletin 800F Legend Plate. Legend Plates for use on metal-hinged enclosures only.
❄ Requires mounting bracket **Cat. No. 198-BR1** when using metal lift-off enclosures.
‡ An auxiliary contact adaptor, **Cat. No. 194R-AA**, is required when installing auxiliary contact, **Cat. No. 195-GA10**.
§ 3 required for disconnect switch.

Accessories — Field Installed

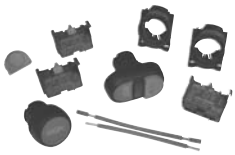
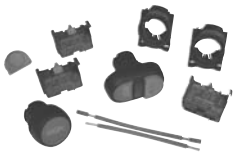
Accessories, Continued

For Bulletins 105, 106, 109, 112, 113, 120E, 132, and 133

	Description	For Use With	Enclosure Type		Cat. No.
	"HAND-OFF-AUTO" Selector Switch 3-Position Maintained, Includes Legend Plate	All	Metal Lift-off and Metal Hinged	✶	198-MT1
	"FORWARD-OFF-REVERSE" Selector Switch 3-Position Maintained	105, 106	Metal Lift-off and Metal Hinged	✶	198-MT2
	**"START-STOP" Push Button** Flush green "I/START" Extended red "O/STOP"	105, 109, 120E	Metal Lift-off	✶	198-MS3
	"START" Push Button Flush green "START"	All	Metal Hinged		198-MS13
	"ON-OFF" Push Button	105, 109, 120E	Metal Lift-off		198-MS6
	"FORWARD, REVERSE-STOP" Push Button	105	Metal Lift-off	✶	198-MS7

✶ Requires mounting bracket Cat. No. 198-BR1 when using metal lift-off enclosures.

For Bulletins 105, 106, 109, 112, 113, 120E, 132, and 133

	Description	For Use With	Enclosure Type	Cat. No.	
	**"HIGH, LOW-STOP" Push Button**	120E	Metal Lift-off	*	198-MS8
	**"FAST, SLOW-STOP" Push Button**	120E	Metal Lift-off	*	198-MS9
	"STOP" Push Button Extended red "STOP"	All	Metal Hinged		198-MS14
	"ON" Push Button Flush green "ON"	All	Metal Hinged		198-MS15
	"OFF" Push Button Extended red "OFF"	All	Metal Hinged		198-MS16
	"FORWARD, REVERSE-STOP" Push Buttons	105, 106	Metal Hinged		198-MS17
	"HIGH, LOW-STOP" Push Buttons	120E	Metal Hinged		198-MS18
	"RESET" Push Button	All	Metal Hinged		198-MR6
	"RESET" Push Button	105, 109, 120E	Metal Lift-off		**198-MR3**

* Requires mounting bracket **Cat. No. 198-BR1** when using metal lift-off enclosures.

Accessories — Factory Installed

Modifications

Full Voltage Non-Reversing Starters and Lighting Contactors (Bulletins 109, 100L)

Listed on this and the following pages are factory-installed modifications and special features which are available for the low voltage (600V maximum) starters listed in this catalog. To order, add a dash followed by the suffix number listed in these tables to the end of the product Cat. No. Example: **Cat. No. 109-C09ADA1E-1**

Description of Modification	Suffix Code	Enclosure Design	C09/ CA	C12/ CB	C16/ CC	100L- C20	C23/ CD	C30	C37	C43	C60	C72	C85
START-STOP Push Button	1	Metal Lift-off	A	A	A	NA	A	A	A	A	A	A	A
		Metal Hinged	A	A	A	NA	A	A	A	A	A	A	A
ON-OFF Push Button	1E	Metal Lift-off	A	A	A	A	A	A	A	A	A	A	A
		Metal Hinged	A	A	A	A	A	A	A	A	A	A	A
HAND-OFF-AUTO Selector Switch	3	Metal Lift-off	A	A	A	A	A	A	A	A	A	A	A
		Metal Hinged	A	A	A	A	A	A	A	A	A	A	A
OFF-ON Selector Switch	3E	Metal Lift-off	A	A	A	A	A	A	A	A	A	A	A
		Metal Hinged	A	A	A	A	A	A	A	A	A	A	A
RUN-Red Pilot Light∗	4R	Plastic Lift-off	A	A	A	NA	A	A	A	A	A	A	A
RUN-Green Pilot Light∗	4G		A	A	A	NA	A	A	A	A	A	A	A
RUN-Yellow Pilot Light∗	4Y		A	A	A	NA	A	A	A	A	A	A	A
Red LED Pilot Light (120V)	4R1	Plastic Lift-off	A	A	A	NA	A	NA	NA	NA	NA	NA	NA
Red LED Pilot Light (240V)	4R2	Plastic Lift-off	A	A	A	NA	A	NA	NA	NA	NA	NA	NA
Control Circuit Transformer 2 Primary and 1 Secondary Fuse Provided (Standard Capacity)	6P❄	Metal Lift-off	A	A	A	A	A	A	A	A	A	A	A
		Metal Hinged	A	A	A	A	A	A	A	A	A	A	A
External Reset	7	Plastic Lift-off	A	A	A	NA	A	NA	NA	NA	NA	NA	NA
		Metal Lift-off	A	A	A	NA	A	A	A	A	A	A	A
		Metal Hinged	A	A	A	NA	A	A	A	A	A	A	A
Control Circuit Fuse Block 2 Fuses Provided	22	Metal Lift-off	A	A	A	A	A	A	A	A	A	A	A
		Metal Hinged	A	A	A	A	A	A	A	A	A	A	A
Additional 1 N.O. – 1 N.C. (Side Mount) Auxiliary Contact on Contactor (100L only)	90	Metal Lift-off	NA	NA	NA	A	NA	NA	NA	NA	NA	NA	NA
		Metal Hinged	NA	NA	NA	A	NA	NA	NA	NA	NA	NA	NA
Additional 1 N.O. – 1 N.C. (Side Mount) Auxiliary Contact on Contactor	901	Metal Lift-off	A	A	A	A	A	A	A	A	A	A	A
		Metal Hinged	A	A	A	A	A	A	A	A	A	A	A
Additional 1 N.O. – 1 N.C. (Front Mount) Auxiliary Contact on Contactor	901T	Metal Lift-off	A	A	A	A	A	A	A	A	A	A	A
		Metal Hinged	A	A	A	A	A	A	A	A	A	A	A

∗ With Bulletin 800F Integrated LED Module. Pilot light is available for control voltages of 240Vor less. If applicable, seelct a transformer. For starters with molded plastic lift-off enclosures, the voltage of the LED module must equal the starter's coil voltage.

Non-Reversing Circuit Breaker Combination Starters (Bulletin 113, 133)

Description of Modification	Suffix Code	Enclosure Design	C09	C12	C16	C23	C30	C37	C43	C60	C72	C85
START-STOP Push Button (113 Only)	1	ALL	NA	NA	NA	NA	A	NA	A	A	A	NA
HAND-OFF-AUTO (113 Only)	3	ALL	NA	NA	NA	NA	A	NA	A	A	A	NA
Red Pilot Light∗	4R	ALL	NA	NA	NA	NA	A	NA	A	A	A	NA
Control Circuit Transformer 2 Primary and 1 Secondary Fuse Provided (Standard Capacity)	6P❄	ALL	NA	NA	NA	NA	A	NA	A	A	A	NA
External Reset	7	ALL	NA	NA	NA	NA	A	NA	A	A	A	NA
Control Circuit Fuse Block 2 Fuses Provided	22	ALL	NA	NA	NA	NA	A	NA	A	A	A	NA
Additional 1 N.O. - 1 N.C. (Side Mount) Auxiliary Contact on Contactor	901	ALL	NA	NA	NA	NA	A	NA	A	A	A	NA
Additional 1 N.O. - 1 N.C. (Front Mount) Auxiliary Contact on Contactor	901T	ALL	NA	NA	NA	NA	A	NA	A	A	A	NA

A=Available Option
NA=Not Available
∗ Transformer Type.
❄ When ordering in Canada, use suffix 6. Primary fusing is not required by the Canadian Electrical Code.

Full Voltage Reversing and Multi-Speed Starters (Bulletins 105, 120E)

Description of Modification	Suffix Code	Enclosure Design	C09	C12	C16	C23	C30	C37	C43	C60	C72	C85
FOR-REV-STOP Push Buttons (105 Only)	1	Metal Lift-off	A	A	A	A	A	A	A	A	A	NA
		Metal Hinged	A	A	A	A	A	A	A	A	A	A
HIGH-LOW-STOP Push Buttons (120E Only)	1	Metal Lift-off	A	A	A	A	A	A	A	A	A	NA
		Metal Hinged	A	A	A	A	A	A	A	A	A	A
FOR-OFF-REV Selector Switch (105 Only)	3	Metal Lift-off	A	A	A	A	A	A	A	A	A	NA
		Metal Hinged	A	A	A	A	A	A	A	A	A	A
HIGH-OFF-LOW Selector Switch (120E Only)	3	Metal Lift-off	A	A	A	A	A	A	A	A	A	NA
		Metal Hinged	A	A	A	A	A	A	A	A	A	A
Red FOR/ White REV Pilot Lights∗ (105 Only)	4RW	Metal Hinged	A	A	A	A	A	A	A	A	A	A
			A	A	A	A	A	A	A	A	A	A
Red HIGH/White LOW Pilot Lights∗ (120E Only)	4RW	Metal Hinged	A	A	A	A	A	A	A	A	A	A
			A	A	A	A	A	A	A	A	A	A
Control Circuit Transformer 2 Primary and 1 Secondary Fuse Provided (Standard Capacity)	6P❄	ALL	A	A	A	A	A	A	A	A	A	A
1 External Reset (105 Only)	7	ALL	A	A	A	A	A	A	A	A	A	A
2 External Resets (120E Only)	7	ALL	A	A	A	A	A	A	A	A	A	A
Control Circuit Fuse Block 2 Fuses Provided	22	ALL	A	A	A	A	A	A	A	A	A	A
Additional 1 N.O. – 1 N.C. (Side Mount) Auxiliary Contact on Each Contactor	901	ALL	A	A	A	A	A	A	A	A	A	A
Additional 1 N.O. – 1 N.C. (Front Mount) Auxiliary Contact on Each Contactor	901T	ALL	A	A	A	A	A	A	A	A	A	A

Reversing and Non-Reversing Fusible Combination Starters (Bulletins 106, 112, 132)

Description of Modification	Suffix Code	Enclosure Design	C09	C12	C16	C23	C30	C37	C43	C60	C72	C85
START-STOP Push Button (112 Only)	1	ALL	A	A	NA	A	A	NA	A	A	A	NA
FOR-REV-STOP Push Buttons (106 Only)	1	ALL	A	A	NA	A	A	NA	A	A	A	NA
HAND-OFF-AUTO Selector Switch (112 Only)	3	ALL	A	A	NA	A	A	NA	A	A	A	NA
FOR-REV-STOP Selector Switch (106 Only)	3	ALL	A	A	NA	A	A	NA	A	A	A	NA
Red Pilot Light∗	4R	ALL	A	A	NA	A	A	NA	A	A	A	NA
Red FOR/ White REV Pilot Lights∗ (106 Only)	4RW	ALL	A	A	NA	A	A	NA	A	A	A	NA
Control Circuit Transformer 2 Primary and 1 Secondary Fuse Provided (Standard Capacity)	6P❄	ALL	A	A	NA	A	A	NA	A	A	A	NA
External Reset	7	ALL	A	A	NA	A	A	NA	A	A	A	NA
Fuse Cover For Disconnect Switch	8	ALL	A	A	NA	A	A	NA	A	A	A	NA
Control Circuit Fuse Block 2 Fuses Provided	22	ALL	A	A	NA	A	A	NA	A	A	A	NA
N.O. Auxiliary Contact On Disconnect Switch	98	ALL	A	A	NA	A	A	NA	A	A	A	NA
Additional 1 N.O. – 1 N.C. (Side Mount) Auxiliary Contact on Contactor (112 and 132 Only)	901	ALL	A	A	NA	A	A	NA	A	A	A	NA
Additional 1 N.O. – 1 N.C. (Side Mount) Auxiliary Contact on each Contactor (106 Only)	901	ALL	A	A	NA	A	A	NA	A	A	A	NA
Additional 1 N.O. – 1 N.C. (Front Mount) Auxiliary Contact on Contactor (112 and 132 Only)	901T	ALL	A	A	NA	A	A	NA	A	A	A	NA
Additional 1 N.O. – 1 N.C. (Front Mount) Auxiliary Contact on each Contactor (106 Only)	901T	ALL	A	A	NA	A	A	NA	A	A	A	NA

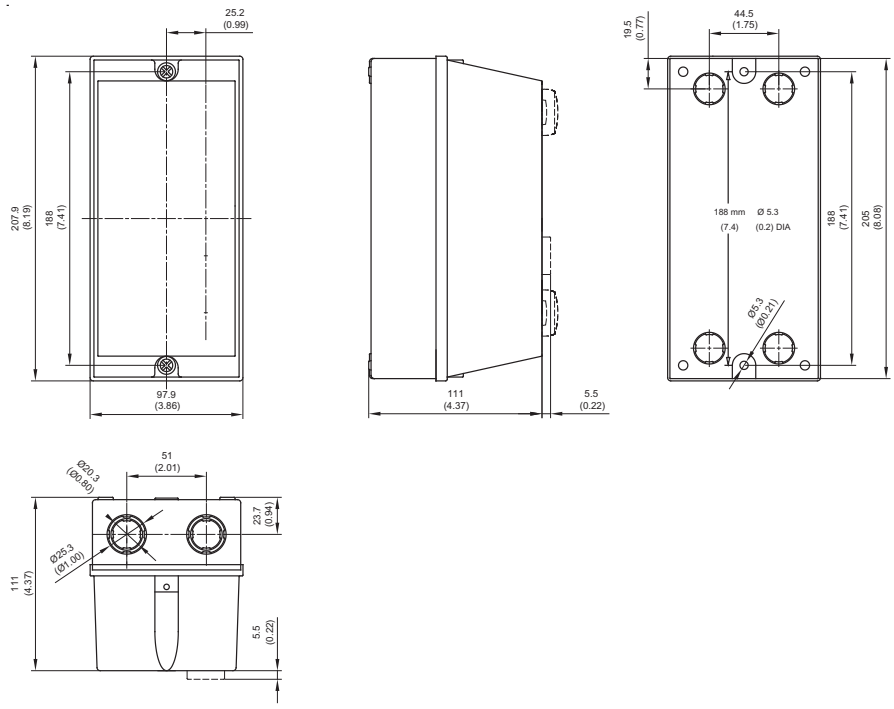
A=Available Option
NA=Not Available
∗ Transformer Type.
❄ When ordering in Canada, use suffix 6. Primary fusing is not required by the Canadian Electrical Code.

Accessories — Field Installed

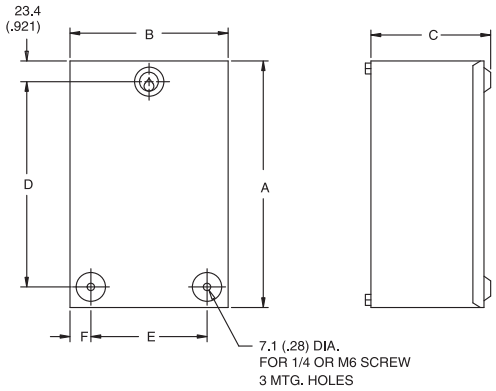
Approximate Dimensions

Dimensions are shown in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

Bulletin 109 Plastic Lift-Off Enclosure



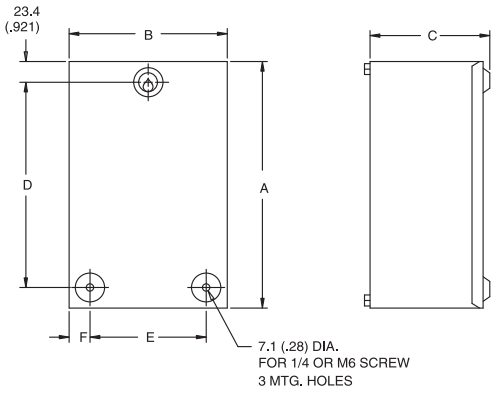
Bulletin 109 Metal Lift-Off Enclosures Type 1 (IP42)



Contactor Size	A Height	B Width	C Depth	D	E	F
IP42 (Type 1) General Purpose Metal Lift-Off Enclosure for Bulletin 109 (Without Transformer)						
C09…C23	220 (8-21/32)	140 (5-33/64)	152 (5-31/32)	175 (6-57/64)	95 (3-3/4)	22.5 (57/64)
C30…C43	290 (11-27/64)	188 (7-23/64)	152 (5-31/32)	245 (9-41/32)	140 (5-33/64)	24 (15/16)
C60…C72	305 (12)	178 (7)	203 (8)	270 (10-5/8)	140 (5-33/64)	24 (15/16)
C85	585 (23-1/32)	257 (10-7/64)	203 (8)	540 (21-17/64)	210 (8-17/64)	23.5 (59/64)
IP42 (Type 1) General Purpose Metal Lift-Off Enclosure for Bulletin 109 (With Transformer)						
C09…C23	305 (12)	178 (7)	203 (8)	245 (9-41/64)	140 (5-33/64)	24 (15/16)
C30…C43	290 (11-27/64)	270 (10-5/8)	152 (5-31/32)	245 (9-41/64)	225 (8-55/64)	22.5 (57/64)
C60…C72	315 (12-27/64)	325 (12-51/64)	203 (8)	270 (10-5/8)	280 (11-1/64)	22.5 (57/64)
C85	585 (23-1/32)	257 (10-7/64)	203 (8)	540 (21-17/64)	210 (8-17/64)	23.5 (59/64)

Dimensions are shown in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

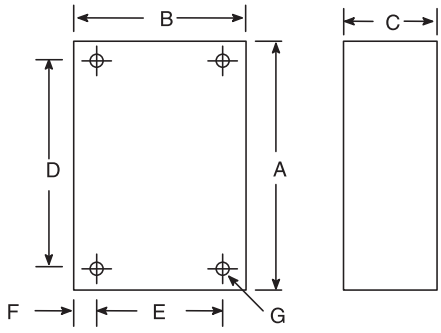
Bulletins 105 and 120E Metal Lift-Off Enclosures Type 1 (IP42)



Metal Lift-Off

Contactor Size	A Height	B Width	C Depth	D	E	F	G (dia)
IP42 (Type 1) General Purpose Metal Lift-off Enclosure for Bulletin 105 and 120E (Without Transformer)							
C09…C23	220 (8-21/32)	235 (9-1/4)	152 (5-31/32)	175 (6-57/64)	190 (7-31/64)	22.5 (57/64)	—
C30…C43	290 (11-27/64)	270 (10-5/8)	152 (5-31/32)	245 (9-41/32)	225 (8-55/64)	22.5 (57/64)	—
C60…C72	315 (12-27/64)	325 (12-51/64)	203 (8)	270 (10-5/8)	280 (11-1/64)	22.5 (57/64)	—
C85	610 (24)	406 (16)	230 (9-1/16)	572 (22-1/2)	368 (14-1/2)	19 (3/4)	11 (7-16)
IP42 (Type 1) General Purpose Metal Lift-Off Enclosure for Bulletin 105 and 120E (With Transformer)							
C09…C23	290 (11-27/64)	270 (10-5/8)	152 (5-31/32)	245 (9-41/64)	225 (8-55/64)	22.5 (57/64)	—
C30…C43	315 (12-27/64)	325 (12-51/64)	203 (8)	270 (10-5/8)	280 (11-1/64)	22.5 (57/64)	—

Bulletins 106, 112, and 113 Metal Hinged Enclosures Type 1 (IP42)



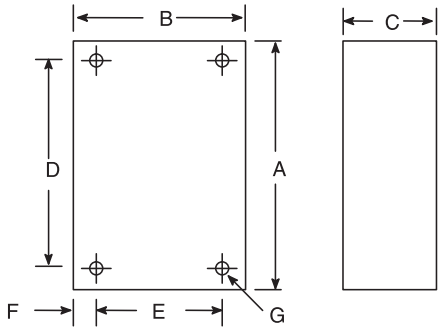
Contactor Size	A Height	B Width	C Depth	D	E	F	G (dia)
IP42 (Type 1) General Purpose Metal Hinged Enclosure for Bulletin 106 (With and Without Transformer)							
C30…C43	350 (13-25/32)	400 (15-3/4)	210 (8-9/32)	315 (12-13/32)	178 (7)	111 (4-3/8)	5.5 (7/32)
C60…C72	610 (24)	406 (16)	230 (9-1/06)	572 (22-1/2)	368 (14-1/2)	19 (3/4)	11 (7/16)
IP42 (Type 1) General Purpose Metal Hinged Enclosure for Bulletin 112 (With and Without Transformer)							
C09…C23	350 (13-25/32)	200 (7-7/8)	210 (8-9/32)	315 (12-13/32)	76 (3)	64 (2-1/2)	5.5 (7/32)
C30…C43	350 (13-25/32)	400 (15-3/4)	210 (8-9/32)	315 (12-13/32)	178 (7)	111 (4-3/8)	5.5 (7/32)
C60…C72	610 (24)	406 (16)	230 (9-1/06)	572 (22-1/2)	368 (14-1/2)	19 (3/4)	11 (7/16)
IP42 (Type 1) General Purpose Metal Hinged Enclosure for Bulletin 113 (With and Without Transformer)							
C30…C72	610 (24)	406 (16)	230 (9-1/06)	572 (22-1/2)	368 (14-1/2)	19 (3/4)	11 (7/16)

Accessories — Field Installed

Approximate Dimensions, Continued

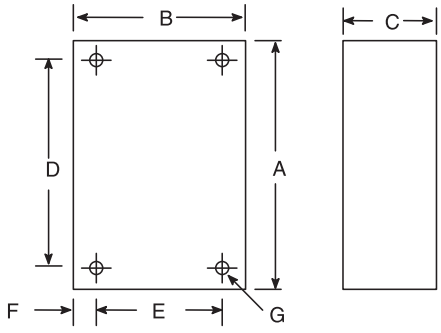
Dimensions are shown in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

Bulletin 109 Metal Hinged Enclosures Type 3/4/12 (IP66)



Contactor Size	A Height	B Width	C Depth	D	E	F	G (dia)
IP66 (Type 3/4/12) Metal Hinged Enclosure for Bulletin 109 (Without Transformer)							
C09…C43	300 (11-13/16)	200 (7-7/8)	160 (6-5/16)	265 (10-7/16)	76 (3)	62 (2-7/16)	5.5 (7/32)
C60…C72	350 (13/25/32)	200 (7-7/8)	210 (8-9/32)	315 (12-13/32)	76 (3)	62 (2-7/16)	5.5 (7/32)
C85	762 (30)	305 (12)	276 (10-7/8)	724 (28-1/2)	267 (10-1/2)	19 (3/4)	11 (7/16)
IP66 (Type 3/4/12) Metal Hinged Enclosure for Bulletin 109 (With Transformer)							
C09…C23	300 (11-13/16)	200 (7-7/8)	160 (6-5/16)	265 (10-7/16)	76 (3)	62 (2-7/16)	5.5 (7/32)
C30…C43	300 (11-13/16)	300 (11-13/16)	160 (6-5/16)	236 (9-5/16)	178 (7)	61 (2-13/32)	5.5 (7/32)
C60…C72	350 (13-25/32)	400 (15-3/4)	210 (8-9/32)	315 (12-13/32)	178 (7)	111 (4-3/8)	5.5 (7/32)
C85	610 (24)	406 (16)	230 (9-1/16)	572 (22-1/2)	368 (14-1/2)	19 (3/4)	11 (7/16)

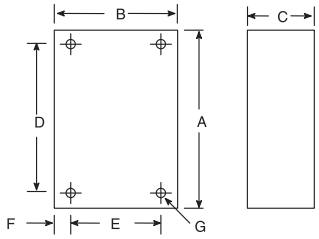
Bulletins 105 and 120E Metal Hinged Enclosures Type 3/4/12 (IP66)



Contactor Size	A Height	B Width	C Depth	D	E (Mtg.)	F	G (dia)
IP66 (Type 3/4/12) Metal Hinged Enclosure for Bulletins 105 and 120E (Without Transformer)							
C09…C23	250 (9-13/16)	250 (9-13/16)	160 (6-5/16)	186 (7-5/16)	76 (3)	87 (3-13/32)	5.5 (7/32)
C30…C43	300 (11-13/16)	300 (11-13/16)	160 (6-5/16)	236 (9-5/16)	178 (7)	61 (2-13/32)	5.5 (7/32)
C60…C72	350 (13/25/32)	400 (15-3/4)	210 (8-9/32)	315 (12-13/32)	178 (7)	111 (4-3/8)	5.5 (7/32)
C85	610 (24)	406 (16)	230 (9-1/06)	572 (22-1/2)	368 (14-1/2)	19 (3/4)	11 (7/16)
IP66 (Type 3/4/12) Metal Hinged Enclosure for Bulletins 105 and 120E (With Transformer)							
C09…C23	300 (11-13/16)	300 (11-13/16)	160 (6-5/16)	236 (9-5/16)	178 (7)	61 (2-13/32)	5.5 (7/32)
C30…C43	350 (13-25/32)	400 (15-3/4)	210 (8-9/32)	315 (12-13/32)	178 (7)	111 (4-3/8)	5.5 (7/32)
C60…C72	610 (24)	406 (16)	230 (9-1/06)	572 (22-1/2)	368 (14-1/2)	19 (3/4)	11 (7/16)
C85	762 (30)	610 (24)	281 (11-1/16)	724 (28-1/2)	572 (22-1/2)	19 (3/4)	11 (7/16)

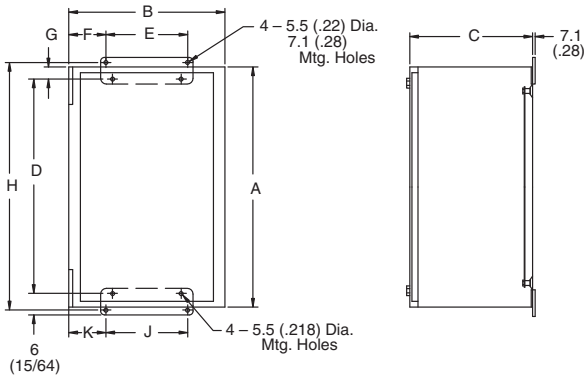
Dimensions are shown in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

Bulletins 106, 112 and 113 Metal Hinged Enclosures Type 3/4/12 (IP66)



Contactor Size	A Height	B Width	C Depth	D	E	F	G (dia)
IP66 (Type 3/4/12) Metal Hinged Enclosure for Bulletin 106 (With and Without Transformer)							
C30…C43	350 (13-25/32)	400 (15-3/4)	210 (8-9/32)	315 (12-13/32)	178 (7)	111 (4-3/8)	5.5 (7/32)
C60…C72	610 (24)	406 (16)	230 (9-1/06)	572 (22-1/2)	368 (14-1/2)	19 (3/4)	11 (7/16)
IP42 (Type 1) General Purpose Metal Hinged Enclosure for Bulletin 112 (With and Without Transformer)							
C09…C23	350 (13-25/32)	200 (7-7/8)	210 (8-9/32)	315 (12-13/32)	76 (3)	64 (2-1/2)	5.5 (7/32)
C30…C43	350 (13-25/32)	400 (15-3/4)	210 (8-9/32)	315 (12-13/32)	178 (7)	111 (4-3/8)	5.5 (7/32)
C60…C72	610 (24)	406 (16)	230 (9-1/06)	572 (22-1/2)	368 (14-1/2)	19 (3/4)	11 (7/16)
IP42 (Type 1) General Purpose Metal Hinged Enclosure for Bulletin 113 (With and Without Transformer)							
C30…C72	610 (24)	406 (16)	230 (9-1/06)	572 (22-1/2)	368 (14-1/2)	19 (3/4)	11 (7/16)

Bulletins 132 and 133 Metal Hinged Enclosures with Extra Space Type 3R (IP32)



Contactor Size	A Height	B Width	C Depth	D	E	F	G	H	J	K
IP 32 (Type 3R) Rainproof Metal Hinged Enclosure for Bulletins 132 and 133 (With and Without Transformer)										
C09…C43	584 (23)	320 (12-19/32)	187 (7-5/16)	711 (28)	105 (4-1/8)	108 (4-1/4)	679 (26-3/4)	667 (26-1/4)	105 (4-1/8)	105 (4-1/8)
C60…C72	864 (34)	447 (17-19/32)	238 (9-5/16)	991 (39)	105 (4-1/8)	171 (6-3/4)	959 (37-3/4)	946 (37-1/4)	105 (4-1/8)	169 (6-12/32)
B110	1067 (42)	762 (30)	305 (12)	1118 (44)	686 (27)	38 (1-1/2)	1092 (43)	1092 (43)	—	—
B180…B250	1219 (48)	914 (36)	305 (12)	1270 (50)	686 (27)	114 (4-1/2)	1245 (49)	1245 (49)	—	—

2

Molded Plastic Lift-Off

Metal Lift-Off

Metal Hinged Enclosure

IP42 (Type 1) — General Purpose Molded Plastic Lift-off Enclosure

Bulletin No.						Enclosure Cat. No.	Mounting Plate Cat. No.
105	106	109	112	113	120E		
—	—	C09…C23	—	—	—	**198E-AAC845**	—

IP66 (Type 4, 4X, 12) — Raintight, Dusttight, Corrosion-Resistant Molded Plastic Enclosure

Bulletin No.						Enclosure Cat. No.	Mounting Plate Cat. No.
105	106	109	112	113	120E		
—	—	C09…C23	—	—	—	**198E-AKC845**	—

IP42 (Type 1) — General Purpose Metal Lift-off Enclosure

Bulletin No.						Enclosure Cat. No.	Mounting Plate Cat. No.
105	106	109	112	113	120E		
—	—	C09…C23✶	—	—	—	**198E-BA966**	—
C09…C23✶	—	—	—	—	C09…C23✶	**198E-BA996**	—
—	—	C09…C23,❄ C30, C37, C43✶	—	—	—	**198E-BA1176**	—
C09…C23,❄ C30, C37, C43✶	—	C30, C37, C43❄	—	—	C09…C23,❄ C30, C37, C43✶	**198E-BA11116**	—
—	—	C60…C72✶	—	—	—	**198E-BA1278**	—
C30, C37, C43,❄ C60…C72✶	—	C60…C72❄	—	—	C30, C37, C43,❄ C60…C72✶	**198E-BA12138**	—
—	—	C85✶❄	—	—	—	**198E-BA23108**	198E-P2310

✶ Without control circuit transformer.
❄ With control circuit transformer.

IP42 (Type 1) — General Purpose Metal Hinged Enclosure

Bulletin No.						Enclosure Cat. No.	Mounting Plate Cat. No.
105	106	109	112	113	120E		
—	—	—	C09…C23‡§	—	—	198E-DA1488T	198E-P148T
—	C09…C43‡§	—	C30…C43‡§	—	—	198E-DA14168T	198E-P1416T

IP66 (Type 4, 4X, 12) — Raintight, Dusttight, Metal Hinged Enclosure

Bulletin No.						Enclosure Cat. No.	Mounting Plate Cat. No.
105	106	109	112	113	120E		
C09…C23‡	—	—	—	—	C09…C23‡	**198E-DF10106**	198E-P1010
—	—	C09…C23‡	—	—	—	**198E-DF1286**	198E-P128
		C09…C23§					
C09…C23§	—	C30…C43§	—	—	C09…C23§	198E-DF12126	198E-P1212
C09…C23‡					C09…C23‡		
—	—	C60…C72‡	—	—	—	**198E-DF1488**	198E-P148
C60…C72§	—	C60…C72§	—	—	C60…C72§	**198E-DF14168**	198E-P1416
C60…C72‡					C60…C72‡		
—	—	—	C09…C23‡§	—	—	198E-DF1488T	198E-P148T
—	C09…C43‡§	—	C30…C43‡§	—	—	198E-DF14168T	198E-P1416T

‡ Without control circuit transformer.
§ With control circuit transformer.

Visit our website: www.ab.com/catalogs
Preferred availability cat. nos. are printed in **bold**

Bulletin 194 Line Overview

	Bulletin 194E	**Bulletin 194L**	**Bulletin 194R Next Generation**
Product Type	Inductive load-rated load switch	Inductive load-rated control/load switch	Fused and non-fused rotary disconnects
Current Range	16…315 A	12…40 A	30 A, 60 A
Main Applications	• UL, CSA ratings "suitable as at-motor disconnect"	• UL, CSA ratings "suitable as at-motor disconnect"	• UL 98 ratings "suitable as service entrance disconnecting means" • UL 508, CSA ratings "suitable as at-motor disconnect"
Functionality	• 3- or 6-pole switch configurations for OFF-ON or changeover applications (16…100 A switches) • 3- or 4-pole switch configurations for OFF-ON or changeover applications (125…315 A switches)	• 1- to 6-pole multifunction switch control configurations for OFF-ON, changeover, Star-Delta (Wye-Delta), reversing, ammeter, voltmeter, and step switch applications • Also available in custom control configurations up to 16 circuits for any unique control switching application.	• 3- or 4-pole fusible or non-fusible disconenct for standard OFF-ON or emergency stop in a main panel disconnect application • 4th pole available as modular accessory • Test mode switch position
Mounting Styles	Front/door or base/DIN Rail mounting	Front/door or base/DIN Rail mounting	Base/DIN Rail mounting
Handles	• Handle colors in grey/black and red/yellow and padlockable versions • Legend plates available in 0-I international markings and text styles	• Uniformly styled handles: selector knob, disk style, rectangular style, and key-operated versions (Type 1/12/3R, IP66) • Handle colors in grey/black and red/yellow and padlockable versions • Legend plates available in 0-I international markings and text styles	• Available in rotary styles, UL Type 1/3R/4/4X/12, IP66, standard, or test mode versions • Handle colors in black and red/yellow and padlockable versions • 30 A/60 A legend markers (optional) — uses Cat. No. 1492-MS6X12 markers
Open Switch or Enclosed	• Open switch (large frame Bul. 194E — open style only) • Enclosed: IP66 thermoplastic enclosure or UL/CSA rated enclosure	• Open switch	• Open switch • Enclosed: UL/CSA rated enclosure
UL/CSA Electrical Ratings: Rated Voltage U_e	600V AC	600V AC	600V AC
Rated Current I_e	16…315 A @ 600V	12…40 A @ 600V	30 A, 60 A @ 600V
Rated Power P_e [FLA]	Varies w/ 1- or 3-phase switch, voltage	Varies w/ 1- or 3-phase switch, voltage	Varies w/ 1- or 3-phase switch, voltage
Short-Circuit Ratings	5 kA	5 kA	200 kA
Switching Rate [ops/h]	120	120	180
Mechanical Life [ops]	• 0.2 million (16…100 A switches) • 0.1 million (125 A and 160 A switches) • 0.075 million (250 A and 315 A switches)	• 1 million	• 10 000
IEC Rated Current I_e AC-1	16…315 A @ 600V	12…40 A @ 600V	20…63 A @ 690V
AC-21A	16…315 A @ 600V	12…40 A @ 600V	Varies w/ 1- or 3-phase switch, voltage
AC-22A	16…315 A @ 600V	12…40 A @ 600V	Varies w/ 1- or 3-phase switch, voltage
Ambient Operational Temp.	-25…+60 °C (-13…+140 °F)	-25…+60 °C (-13…+140 °F)	-20…+60 °C (-4…+140 °F)
Ambient Enclosed Temp.	-20…+60 °C (-4…+140 °F)	-20…+60 °C (-4…+140 °F)	-20…+60 °C (-4…+140 °F)
Ambient Storage Temp.	-40…+80 °C (-40…+176 °F)	-40…+80 °C (-40…+176 °F)	-40…+65 °C (-40…+149 °F)
Protection class per IEC 529	• Switch bodies: IP2	• Switch bodies: IP2	• Switch bodies: IP2 • Fuse carriers: IP30
Optional Accessories	• IP66 handles • Multi-length shafts and shaft extension kits • Terminal covers	• IP66 handles • Multi-length shafts and shaft extension kits • Terminal covers	• IP66 handles • Multi-length shafts • Auxiliary contacts • Terminal covers • NFPA 79 internal handle
Standards/Certifications	• UL 508 • CSA C22.2, No. 14 • IEC 60947-3 Low Voltage Switchgear and Controlgear part 3 • CE	• UL 508 • CSA C22.2, No. 14 • IEC 60947-3 Low Voltage Switchgear and Controlgear part 3 • CE	• UL 98, UL 508 • CSA C22.2, No. 14 • IEC 60947-3 Low Voltage Switchgear and Controlgear part 3 • CE
Product Selection	**Page 2-357**	**Page 2-387**	**Page 2-407**

Bulletin 194E IEC Load Switches

- Suitable as At-Motor Disconnect Switch (UL508)
- 16, 25, 32, 40, 63, 80, 100 A Inductive Load-Rated Switches
- IP66/ UL Type 1/3/3R/12 Operating Handles
- IP2LX Finger-Safe Terminals
- 3- and 6-Pole Versions; Add-on Accessory Poles to Make 4-, 5-, 7- and 8-Pole Units
- Front/Door or DIN/Base Mounting Configurations
- Available in OFF-ON and Changeover Configurations
- 3- and 6-Pole Enclosed Switches
- Optional Thermoplastic Enclosures
- Positive-Guided Actuation
- Padlockable Handles Available (up to 3 padlocks)

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Accessories 2-361
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Approximate Dimensions 2-370

Standards Compliance

IEC 60947-1
IEC 60947-3 Low-voltage switchgear and control gear part 3
UL 508
CSA: C22.2 No. 14

Certifications

UL Listed (File No. E14841, Guide NLRV)
CSA Certified (LR 13908)
IEC, VDE and BS
CE
RINA — Italian Naval Registry

Description

Bulletin 194E load switches are designed for use as local motor isolation and disconnect switch applications. Available with 3- and 6-pole versions with add-on additional poles, grounding and neutral terminals and auxiliary contacts, Bulletin 194Es share the same operating handles as the Bulletin 194L Control and Load Switches.
Bulletin 194E switches are offered in two mounting styles, Front/Door and Base/DIN configurations for a variety of installations. Switch body styles for Bulletin 194E base-mounted switches include standard interlock shaft; Bulletin 194E front-mounted switches include standard shaft. Two-position OFF-ON switch is used to connect or disconnect a variety of inductive loads, including solenoids, valves, magnetic starters, relays, and motors. Handles featuring marked legend plates are available in Selector-Knob, Disk-Style, Rectangular-Style and Key-Operated versions. Selector-Knob versions are available in three sizes. Most handles are available in colors of Grey/Black or Red/Yellow and have padlockable versions.

Cat. No. Explanation

194E 16...100 A Small-Frame Switches (Handles listed on page 2-358)

3-Pole Base Mount

3-Pole Front Mount

6-Pole Base Mount

6-Pole Front Mount

194E – A 32 –1753

a b c

a

Installation Type	
Code	Description
A	Base/DIN Mounting
E	Front/Door Mounting

b

Load Size	
Code	Description
16	16 A
25	25 A
32	32 A
40	40 A
63	63 A
80	80 A
100	100 A

c

Function/Circuit Diagram Ref. #			
Code	Function	Description	Circuit Diagram Ref. #
1753	OFF/ON	3-Pole, 2-Position (90°)	1753
1756	OFF/ON	6-Pole, 2-Position (90°)	1756
1783	OFF/ON	3-Pole, 2-Position (90° - inverted)	1783
3753	Changeover	3-Pole, 3-Position (90°)	3753

Frequently Ordered* OFF-ON 3-Pole Switch (includes operating shaft) (Handles listed on page 2-358)

Function Switching Angle	Contact Target Configuration X = Contact Closed O = Contact Open			Rated Current [A]	AC23A Rated Power [kW] at 690V AC 50 Hz	Hp @ 480V AC 60 Hz 3 Ø	OFF-ON 3-Pole Switch (includes operating shaft)	
		Handle Position					Base-Mounted	Front-Mounted
	No. of Circuits	OFF/0	ON/1				Cat. No.	Cat. No.
ON 1 OFF 0 90°	1 2 3	O O O	X X X	16	7.5	7.5	**194E-A16-1753**	**194E-E16-1753**
				25	11	10	**194E-A25-1753**	**194E-E25-1753**
				32	15	15	**194E-A32-1753**	**194E-E32-1753**
				40	18.5	20	**194E-A40-1753**	**194E-E40-1753**
				63	22	25	**194E-A63-1753**	**194E-E63-1753**
				80	37	40	**194E-A80-1753**	**194E-E80-1753**
				100	45	50	**194E-A100-1753**	**194E-E100-1753**

Frequently Ordered* OFF-ON 6-Pole Switch (includes operating shaft) (Handles listed on page 2-358)

Function Switching Angle	Contact Target Configuration X = Contact Closed O = Contact Open			Rated Current [A]	AC23A Rated Power [kW] at 690V AC 50 Hz	Hp @ 480V AC 60 Hz 3 Ø	OFF-ON 6-Pole Switch (includes operating shaft)	
		Handle Position					Base-Mounted	Front-Mounted
	No. of Circuits	OFF/0	ON/1				Cat. No.	Cat. No.
ON 1 OFF 0 90°	1 2 3 4 5 6	O O O O O O	X X X X X X	16	7.5	7.5	**194E-A16-1756**	**194E-E16-1756**
				25	11	10	**194E-A25-1756**	**194E-E25-1756**
				32	15	15	**194E-A32-1756**	**194E-E32-1756**
				40	18.5	20	**194E-A40-1756**	**194E-E40-1756**
				63	22	25	**194E-A63-1756**	**194E-E63-1756**
				80	37	40	**194E-A80-1756**	**194E-E80-1756**
				100	45	50	**194E-A100-1756**	**194E-E100-1756**

* See Catalog No. Explanation for more load size and change-over switch options.

2

Bulletin 194E/194L Handles (for use with Bulletin 194E Switches)

Color	Handles (Includes Legend Plate and Control Knob)			
Red/Yellow (Emergency Stop colors)	*Type I (IP66, UL Type 3/3R/12)*	*Type L (IP66, UL Type 3/3R/12) With Locking For One Padlock (Padlock Not Included)*	*Type N (IP66, UL Type 3/3R/12)*	**Bulletin 194L handles are available in both screw fixing and 22.5 mm mounting hole style.**
Black/Grey (Standard Operation colors)	*Type A (IP66, UL Type 3/3R/12)*	*Type E (IP66, UL Type 3/3R/12) With Locking For One Padlock (Padlock Not Included)*	*Type G (IP66, UL Type 3/3R/12)*	*Type S (IP66, UL Type 3/3R/12)*

Cat. No. Explanation

194L – HE 6 N – 175

a *b* *c* *d*

a

Code	Installation Type
HC	22.5 mm Mounting Hole Style Handle∗ (for use with front-mounted switches)
HE	Screw-Mounting Handle (for use with front- and base-mounted switches)

b

Code	Use with Handle Type	Handle Legend Plate Size	Use With 194E Switch Size
4	A, E, I, L❄	48 mm x 48 mm (1-57/64 in. x 1-57/64 in.)	194E-16…63 A
	S	48 mm x 62 mm (1-57/64 in. x 2-7/16 in.)	194E-25…63 A
6	A, E, I, L	64 mm x 64 mm (2-33/64 in. x 2-33/64 in.)	194E-25…100 A
	G, N❄‡	67 mm x 67 mm (2-41/64 in. x 2-41/64 in.)	194E-25…100 A
	S	64 mm x 78 mm (2-33/64 in. x 3-5/64 in.)	194E-25…100 A
8	A, I	88 mm x 88 mm (3-15/32 in. x 3-15/32 in.)	194E-40…100 A
	G, N	90 mm x 90 mm (3-35/64 in. x 3-35/64 in.)	194E-40…100 A

c

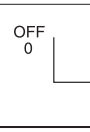
Code	Legend Plate Type	Color
A	Square	Grey/Black
I	Square	Red/Yellow
E	Square/Lockable	Grey/Black
L	Square/Lockable	Red/Yellow
G	Disc/Lockable (up to 3 locks)	Grey/Black
N	Disc/Lockable (up to 3 locks)	Red/Yellow
S	Large Square with extra legend area	Grey/Black

∗ For 22.5 mm mounting hole style handle (code HC), select either handle type A, E, I, or L with 48 x 48 mm legend plate size (code 4) only or handle type G or N with 64 x 64 mm legend plate size (code 6) only.

❄ Order 194E- 16A Type G and N handles as Cat. No. 194**E**-HE4N-175 or 194**E**-HE4G-175

‡ Use Type G and N with ON-OFF function only (selection "d", code -175)

d

Code	Description	Legend Marking
175	O-I	
175I	OFF-ON	
350	1-0-2 (Reversing)	
375	0-1-2 (90 degrees) (Changeover)	
178	O-I	
178I	OFF-ON	

Frequently Ordered 194L Handles — OFF-ON Base/Front-Mounted 3- and 6-Pole Switch Handles (Switch Body listed on page 2-357)

Handle Type	Degree of Protection	Handle Color	Bezel Plate Size	For Use With	Legend Plate Marking	Cat. No.
E	IP66 (UL Type 1) (UL Type 3/3R/12)	Black/Grey	48 mm x 48 mm (1-57/64 in. x 1-57/64 in.)	194E-16…63 A 194L-E12…40 A, -1753 194L-A12…40 A, -1753	0-1	**194L-HE4E-175**
					OFF-ON	**194L-HE4E-175I**
L		Red/Yellow	48 mm x 48 mm (1-57/64 in. x 1-57/64 in.)	194E-16…63 A 194L-E12…40 A, -1753 194L-A12…40 A, -1753	0-1	**194L-HE4L-175**
					OFF-ON	**194L-HE4L-175I**
G	IP66 (UL Type 3/3R/12)	Black/Grey	54 mm x 54 mm (2-1/8 in. x 2-1/8 in.)	194E-16 A	0-1 OFF-ON	**194E-HE4G-175**
			67 mm x 67 mm (2-41/64 in. x 2-41/64 in.)	194E-25…100 A 194L-E12…40 A, -1753 194L-A12…40 A, -1753	0-1 OFF-ON	**194L-HE6G-175**
			88 mm x 88 mm (3-15/32 in. x 3-15/32 in.)	194E-40…100 A	0-1 OFF-ON	**194L-HE8G-175**
N		Red/Yellow	54 mm x 54 mm (2-1/8 in. x 2-1/8 in.)	194E-16 A	0-1 OFF-ON	**194E-HE4N-175**
			67 mm x 67 mm (2-41/64 in. x 2-41/64 in.)	194E-25…100 A 194L-E12…40 A, -1753 194L-A12…40 A, -1753	0-1 OFF-ON	**194L-HE6N-175**
			88 mm x 88 mm (3-15/32 in. x 3-15/32 in.)	194E-40…100 A	0-1 OFF-ON	**194L-HE8N-175**
L	IP66 (UL Type 3/3R/12)	Red/Yellow	48 mm x 48 mm (1-57/64 in. x 1-57/64 in.)	194L-E12…40 A, -1753	0-1	**194L-HC4L-175**
					OFF-ON	**194L-HC4L-175I**

Visit our website: www.ab.com/catalogs

Preferred availability cat. nos. are printed in **bold**

Bulletin 194E Open and Enclosed Switch Kits

Cat. No. Explanation

194E – Y 32 – 1753 – 6N

a b c d

a

Code	Installation Type
A	Base/DIN Mounting, open type switch
E	Front/Door Mounting, open type switch
Y	Enclosed Base Mounting Switch With Handle (Uses IP66 ABS thermoplastic enclosure)

b

Code	Load Size
16	16 A∗
25	25 A
32	32 A
40	40 A
63	63 A
80	80 A
100	100 A

c

Code	Configuration
1753	3-Pole OFF/ON (90°)
1756	6-Pole OFF/ON (90°)

d

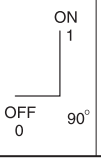
Code	Handle Style
4N	194E-HE4N-175 (use with 16 A Switch)
4G	194E-HE4G-175 (use with 16 A Switch)
4A	194L-HE4A-175 (use with 16…100 A Switch)
6N	194L-HE6N-175 (use with 25…100 A Switch)
6G	194L-HE6G-175 (use with 25…100 A Switch)
6A	194L-HE6A-175 (use with 25…100 A Switch)

∗ For 16 A Enclosed Switch: use "16M" (3-pole enclosure has M16/20 knockouts, 6-pole 16 A enclosure has M25/32 knockouts). For 25/32 A Enclosed Switch with M20/25 metric knockouts: use “25M” or “32M”.

Frequently Ordered Switch Kits — OFF-ON Front- and Base-Mounted 3-Pole Switch With Cat. No. 194L-HE6N-175 Red/Yellow Handle

	Function Switching Angle	Rated Current [A]	AC23A Rated Power [kW] at 690V AC	HP @ 480V AC 60 Hz, 3 Ø	Base-Mounted Cat. No.	Front-Mounted Cat. No.
		25	7.5	10	**194E-A25-1753-6N**	**194E-E25-1753-6N**
		32	11	15	**194E-A32-1753-6N**	**194E-E32-1753-6N**
		63	18.5	25	**194E-A63-1753-6N**	**194E-E63-1753-6N**

Base-Mounting Distribution Switches (handles are pre-assembled to switch)

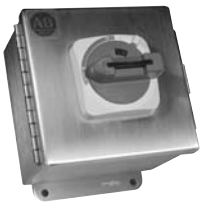
	Function Switching Angle	No. of Circuits	Contact Target OFF/0	Contact Target ON/1	Handle Color	Legend Plate Marking	Lockable (One Padlock)	Rated Current [A]	AC23A Rated Power [kW] at 690V AC	Hp @ 480V AC 60 Hz, 3 Ø	Cat. No.
		1 2 3	O O O	X X X	Red/Yellow	0-1	Yes	25	11	—	**194E-A25-1753-R**
					Black/Grey	0-1	No			—	**194E-A25-1753-Q**
					Red/Yellow	0-1	Yes	32	15	—	**194E-A32-1753-R**
					Black/Grey	0-1	No			—	**194E-A32-1753-Q**

Frequently Ordered Enclosures — 3- and 6-Pole Enclosed Switches With Cat. No. 194L-HE6N-175 Red/Yellow Operating Handles

	No. of Poles	Function Switching Angle	Rated Current [A]	Handle Color	Cat. No.
Uses Base-Mounted Switches	3		16	Red/Yellow	**194E-Y16-1753-4N**
			25		**194E-Y25-1753-6N**
			32		**194E-Y32-1753-6N**
			40		**194E-Y40-1753-6N**
	6		25	Red/Yellow	**194E-Y25-1756-6N**

2

Bulletin 194E Enclosed Disconnect Load Switches with 194R Handles (with Defeater, suitable for 3 padlocks)

194E-FA Painted Steel Enclosure UL Type 3/4/12, IP66	194E-CA Stainless Steel Enclosure UL Type 4/4X, IP66	194E-KA Non-Metallic Enclosure UL Type 3/4/4X, IP66	194E-AA Metallic Enclosure UL Type 1, IP54	194E-GA Painted Steel Enclosure UL Type 3/4/12, IP66	194E-DA Stainless Steel Enclosure UL Type 4/4X, IP66
					

Cat. No. Explanation ∗❄

194E – FA 32 E – P11 – P11 – 6

a b c d d e

a

Code	Enclosure Type
FA	UL Type 3/4/12, IP66 Painted Steel, Hinged, for 16…100 A switches
GA	UL Type 3/4/12, IP66 Painted Steel, Hinged, in 6 x 6 x 4 in. size, for 16…32 A 3-pole switches ‡
CA	UL Type 4/4X, IP66 Stainless Steel, Hinged, for 16…100 A switches
DA	UL Type 4/4X, IP66 Stainless Steel, Hinged, in 6 x 6 x 4 in. size, for 16…32 A 3-pole switches ‡
KA	UL Type 3/4/4X, IP66 Non-Metallic, for 16…100 A switches
AA	UL Type 1, IP54 Painted Steel, Hinged, for 16…100 A switches (Same enclosure as FA without gasketing)

b

Code	Load Size
16	16 A
20	25 A
32	32 A
40	40 A
63	63 A
80	80 A
00	100 A

c

Code	Handle Color (194R-HS _ _)
Blank	Grey/Black
E	Red/Yellow

d

Code	Left Side + Right Side Modifications∗
Blank	No Option
-P11	1 N.O. + 1 N.C. Auxiliary Contacts
-PL11	1 N.O. + 1 N.C.L.B. Auxiliary Contacts
-P22	2 N.O. + 2 N.C. Auxiliary Contacts
-PD10	1 N.O. E.B.
-NP	Additional Pole
-PE	Grounding Pole
-TN	Neutral Pole

e

Code	Switch Type
Blank	3-pole switch
-6	6 Pole switch§

∗ Modifications: Up to two suffix codes may be added to an enclosed disconnect load switch. See Guidelines, page 6-73. If only one accessory is chosen, it is mounted on the left side of the switch.
❄ To order the cat. no. 194E-FA40/FA63 or 194E-CA40/CA63 in the larger 80/100A sized enclosure, add an "X" after the handle color. For example, Cat. No. **194E-FA40E** becomes Cat. No. **194E-FA40**EX.
‡ GA and DA type enclosures: use with 3-pole 16…32 A switches only.
§ Special order; allow for longer delivery time.

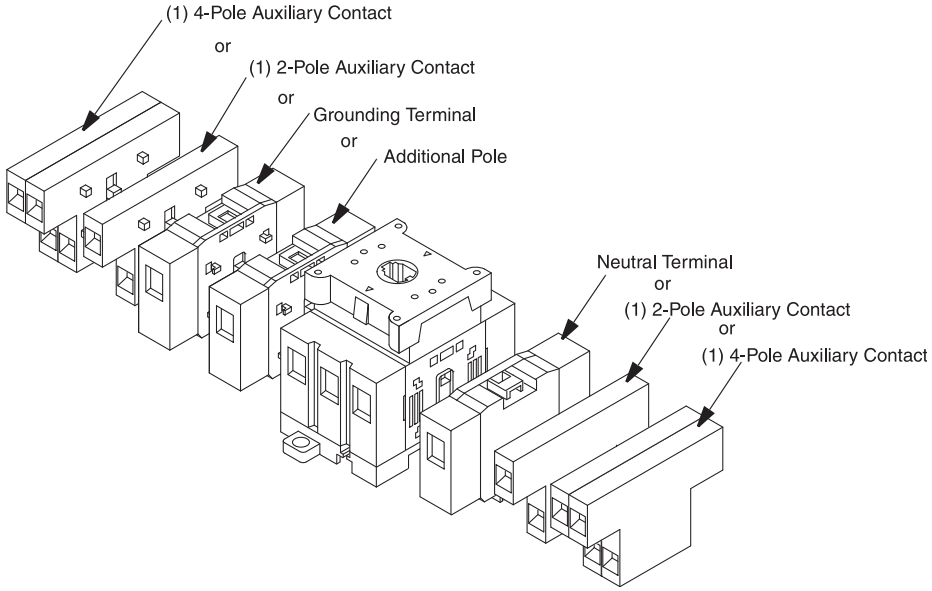
Frequently Ordered Bulletin 194E Enclosed Switches with Bulletin 194R Handle

Description	Rated Current (A)	Dimension Reference	Handle Color	Cat. No.∗
Stainless steel enclosure, IP66/Type 4/4X	25	A1	Black	194E-CA20
			Red/Yellow	194E-CA20E
	32	A1	Black	194E-CA32
			Red/Yellow	194E-CA32E
	63	A1	Black	194E-CA63
			Red/Yellow	194E-CA63E
	25	A1	Black	194E-FA20
			Red/Yellow	194E-FA20E
	32	A1	Black	194E-FA32
			Red/Yellow	194E-FA32E
	40	A1	Black	194E-FA40
			Red/Yellow	194E-FA40E
	25	C1	Black	194E-KA20
			Red/Yellow	194E-KA20E

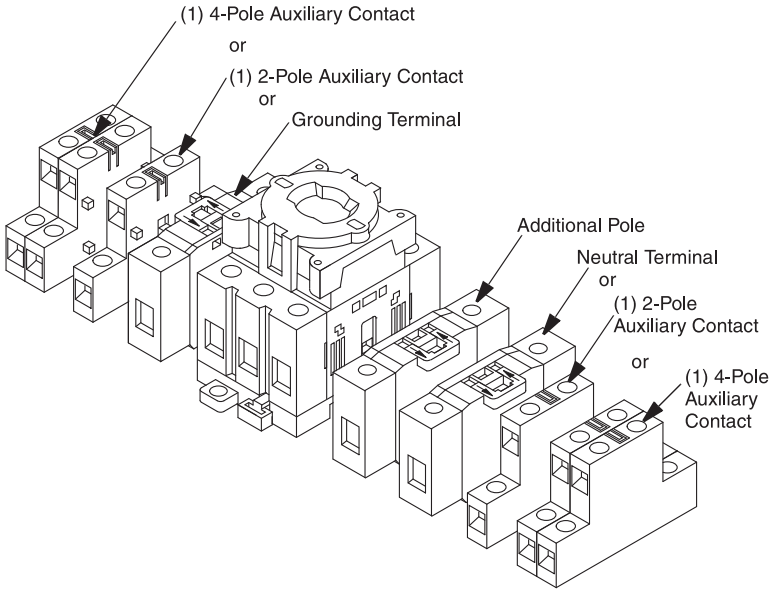
∗ Modifications: Up to two suffix codes may be added to an enclosed disconnect load switch. See Guidelines, page 2-361. If only one accessory is chosen, it is mounted on the left side of the switch.

IEC Load Switch Accessories

194E-E16...100 A, Front/Door Mounting



194E-A16...100 A, Base/DIN Rail Mounting



Accessory Configuration Guidelines

Accessory drawings represent modular, snap-on features of Bulletin 194E accessories. They are not suggesting possible accessory configurations. Use the following guidelines for choosing 194E accessory configurations.

- Up to two accessories may be added to the Bulletin 194E switch body.
- For the 194E 25, 32, 40, or 63 A switches, the early break auxiliary contact (-PD10) may only be used in the following configurations:
  As a single unit on either side of the switch
  As a single unit on a side when used with a switch + 4th pole (-NP)
  As a single unit on a side when used with a switch + ground terminal (-PE)
  As a single unit on a side when used with a switch + neutral terminal (-TN)
  No other auxiliary contact may be used in combinations with an early break auxiliary contact (-PD10)
- Other combinations of auxiliary contacts are permissable.
- For the 194E 80 and 100 A switches, any combination of auxiliary contacts, 4th pole, ground terminal, neutral terminal, and -PD10 is permissable.

2

Auxiliary Contacts	No. of Auxiliary Contacts	For Use With	Cat. No.*
	1 N.O. + 1 N.C.	194E-A16...100	**194E-A-P11**
		194E-E16...100	**194E-E-P11**
	1 N.O. + 1 N.C.L.B.	194E-A16...100	**194E-A-PL11**
		194E-E16...100	**194E-E-PL11**
	2 N.O. + 2 N.C.	194E-A16...100	**194E-A-P22**
		194E-E16...100	**194E-E-P22**
	1 N.O.E.B.	194E-A16	**194E-A16-PD10**
		194E-A25...100	**194E-A-PD10**
		194E-E16	**194E-E16-PD10**
		194E-E25...100	**194E-E-PD10**

Additional Pole, 1 N.O.	For Use With	Cat. No.*
	194E-A16	**194E-A16-NP**
	194E-A25	**194E-A25-NP**
	194E-A32	**194E-A32-NP**
	194E-A40	**194E-A40-NP**
	194E-A63	**194E-A63-NP**
	194E-A80	**194E-A80-NP**
	194E-A100	**194E-A100-NP**
	194E-E16	**194E-E16-NP**
	194E-E25	**194E-E25-NP**
	194E-E32	**194E-E32-NP**
	194E-E40	**194E-E40-NP**
	194E-E63	**194E-E63-NP**
	194E-E80	**194E-E80-NP**
	194E-E100	**194E-E100-NP**

Earthing/Grounding Terminal	For Use With	Cat. No.*
	194E-A16	**194E-A16-PE**
	194E-A25/32	**194E-A32-PE**
	194E-A40/63	**194E-A63-PE**
	194E-A80/100	**194E-A100-PE**
	194E-E16	**194E-E16-PE**
	194E-E25/32	**194E-E32-PE**
	194E-E40/63	**194E-E63-PE**
	194E-E80/100	**194E-E100-PE**

Neutral Terminal	For Use With	Cat. No.*
	194E-A16	194E-A16-TN
	194E-A25/32	**194E-A32-TN**
	194E-A40/63	**194E-A63-TN**
	194E-A80/100	194E-A100-TN
	194E-E16	194E-E16-TN
	194E-E25/32	**194E-E32-TN**
	194E-E40/63	**194E-E63-TN**
	194E-E80/100	**194E-E100-TN**

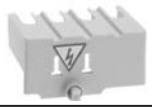
* A maximum of two side-mount accessories may be added to a 194E switch (one on each side).

6-Pole Mechanical Coupling∗❄	For Use With	Cat. No.
	194E-16	**194E-G3821**
	194E-25/32	194E-G3660
	194E-40/63	194E-G3661
	194E-80/100	**194E-G3662**

ABS Thermoplastic Enclosure — IP66, For High-Impact Applications (grounding screw included)	No. of Poles	For Use With	Cat. No.
	3…4	194EA-25/32	**194L-G3572**
	3…4	194EA-40/63	**194E-G3663**
	6	194EA-25/32	
	6	194EA-40/63	**194E-G3665**
	3…4	194EA-80/100	

Noryl Thermoplastic Enclosures — IP66, For Corrosion-Prone Applications (grounding screw included)	No. of Poles	For Use With	Cat. No.
	3…4	194EA-25/32	**194L-G3576**
	6	194EA-25/32	**194E-G3664**
	3…4	194EA-40/63	
	6	194EA-40/63	**194E-G3666**
	3…4	194EA-80/100	

Description	For Use With	Pkg. Qty.	Cat. No.
Additional Earth/Ground and Neutral Terminals — For Thermoplastic Enclosure	194L-G3663, G3664, G3665, G3666	5	**194E-G3673**
	194L-G3572 and G3676	5	**194E-G3653**

Terminal Covers	No. of Poles	For Use With	Cat. No.
	1	194E-16	194E-16-C1
	3	194E-16	**194E-16-C3**
		194E-25/32	**194E-25-C3**
		194E-40/63	**194E-40-C3**
		194E-80/100	**194E-80-C3**
	4	194E-25/32	**194E-25-C4**
		194E-40/63	**194E-40-C4**
		194E-80/100	**194E-80-C4**

∗ User must order (2) Bulletin 194E 3-Pole Switches separately.

❄ Coupling for changeover switch not available. Changeover switch must be ordered as a factory-assembled device (e.g., 194E-A25-3753).

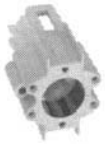
Operating Shafts

	Length	Construction	Pkg. Qty.	Cat. No.
Standard Shaft (for front-mount switches)	34 mm (1-11/32 in.)	Plastic	5	**194L-G3380**
		Metal	5	**194E-G3688**
Interlock Shaft (for base-mount switches)	44 mm (1-47/64 in.) (Standard Length)	Plastic	5	**194L-G2830**
		Metal		**194E-G3687**
	52 mm (2-3/64 in.)	Plastic		**194L-G3194**
		Metal		**194E-G3707**
	57 mm (2-15/64 in.)	Plastic		**194L-G3195**

Bulletin 194E Load Switch Cat. No. Shaft Selection for use with 194E and 194L Thermoplastic Enclosures

Rated Current [A]	3-Pole Switches (-1753 suffix)		6-Pole Switches (-1756 suffix)		Changeover Switches (-3753 suffix)	
	194E-E…	194E-A…	194E-E…	194E-A…	194E-E…	194E-A…
16	plastic shaft (Cat. No. 194L-G3380)	plastic shaft (Cat. No. 194L-G2830)	metallic shaft (Cat. No. 194E-G3688)	metallic shaft (Cat. No. 194E-G3687)	metallic shaft (Cat. No. 194E-G3688)	metallic shaft (Cat. No. 194E-G3687)
25	plastic shaft (Cat. No. 194L-G3380)	plastic shaft (Cat. No. 194L-G2830)	metallic shaft (Cat. No. 194E-G3688)	metallic shaft (Cat. No. 194E-G3687)	metallic shaft (Cat. No. 194E-G3688)	metallic shaft (Cat. No. 194E-G3687)
32	plastic shaft (Cat. No. 194L-G3380)	plastic shaft (Cat. No. 194L-G2830)	metallic shaft (Cat. No. 194E-G3688)	metallic shaft (Cat. No. 194E-G3687)	metallic shaft (Cat. No. 194E-G3688)	metallic shaft (Cat. No. 194E-G3687)
40	plastic shaft (Cat. No. 194L-G3380)	plastic shaft (Cat. No. 194L-G2830)	metallic shaft (Cat. No. 194E-G3688)	metallic shaft (Cat. No. 194E-G3687)	metallic shaft (Cat. No. 194E-G3688)	metallic shaft (Cat. No. 194E-G3687)
63	plastic shaft (Cat. No. 194L-G3380)	plastic shaft (Cat. No. 194L-G2830)	metallic shaft (Cat. No. 194L-G3688)	metallic shaft (Cat. No. 194E-G3687)	metallic shaft (Cat. No. 194E-G3688)	metallic shaft (Cat. No. 194E-G3687)
80	metallic shaft (Cat. No. 194E-G3688)	metallic shaft (Cat. No. 194E-G3687)	metallic shaft (Cat. No. 194E-G3688)	metallic shaft (Cat. No. 194E-G3687)	metallic shaft (Cat. No. 194E-G3688)	metallic shaft (Cat. No. 194E-G3687)
100	metallic shaft (Cat. No. 194E-G3688)	metallic shaft (Cat. No. 194E-G3687)	metallic shaft (Cat. No. 194E-G3688)	metallic shaft (Cat. No. 194E-G3687)	metallic shaft (Cat. No. 194E-G3688)	metallic shaft (Cat. No. 194E-G3687)

Shaft Extension Kits

	Length	For Use With	Pkg. Qty.	Cat. No.
 *Shaft Extension*	24 mm (15/16 in.) Per Extension	194E-A…	10	**194L-G2853**

Metal Shaft Extensions — With Padlock Provision in OFF Position

	Length	For Use With	Pkg. Qty.	Cat. No.
	110…235 mm (4-21/64…9-1/4 in.)	194E-A…	1	**194L-G3393**
	230…350 mm (9-3/64…13-51/64 in.)			**194L-G3394**

Metal Shaft Adaptor Kits — For use with 194R Type 4/4X Handles

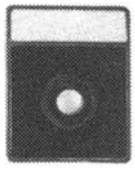
		For Use With	Pkg. Qty.	Cat. No.
	Metal shaft adaptor kits — for use with 194R Type 4/4X handles kit includes bezel adapter and 194R-R1 operating shaft. Operating handle (Cat. No. 194R-HS4) must be ordered separately.	194E-A…	1	**194E-G3675**
	Metal Shaft Extension For modification of Cat. No. 194L-G3393/ G3394 when used with any switches other than 2-position, 90° rotation.	194E-A…	10	**194L-G3399**

Other Accessories

194L/194E 22.5 mm Mounting Hole Style Handles (Type B, D) (For Front-Mounted Switches)

	Description		Cat. No.
Type B	22.5 mm Mounting Hole Style Handles (IP65) Handle Style: Knob Lever with Latch (For Use With 194E-E25…100 A, -1753) or 194L-E12…40 A		**194L-HCB-001**
Type D	22.5 mm Mounting Hole Style Handles Key Removal Position (Includes Latch) For Use With 194L-E 12…40 A, 194E-E16…63 A, -1753		**194L-HCDC-001**
	22.5 mm Mounting Hole Style Handles Key Removal Position (Includes Latch) For Use With 194L-E 12…40 A, 194E-E16…63 A, -1753		**194L-HCDD-001**
	22.5 mm Mounting Hole Style Handles Key Removal Position (Includes Latch) For Use With 194L-E 12…40 A, 194E-E16…63 A, -1753		**194L-HCDG-001**

Accessory Description		Pkg. Qty.	Cat. No.
	Locking Ring Wrench For 22.5 mm Mounting Hole Style Handles (For use with front-mounted switches)	1	**800E-AW2**
	Control Knob, Black, with Locking Facility (Use 1/4 in. max. hasp lock.) (Locks in 0°, 90°, 180°, and 270° positions)	10	**194L-G2864N**
	Control Knob, Red, with Locking Facility (Use 1/4 in. max. hasp lock)		**194L-G2864R**

Accessory Description			Pkg. Qty.	Cat. No.
		Control Knob, Type P Control Knob, Black, 31 mm (1-7/32 in.) Diameter	5	**194L-G2888N**
		Control Knobs, Type P Control Knob, Red, 31 mm (1-7/32 in.) Diameter		194L-G2888R
Standard Black Control Knob	 *Rectangular Front Frame*	Control Knob, Black, L = 37.5 mm (1-31/64 in.)	5	**194L-G3154N**
		Control Knob, Black, L = 48 mm (1-57/64 in.)		**194L-G3155N**
		Control Knob, Red, L = 37.5 mm (1-31/64 in.)		194L-G3154R
		Control Knob, Red, L = 48 mm (1-57/64 in.)		**194L-G3155R**
		Rectangular front frame with blank nameplate L = 48 mm x 62 mm (1-57/64 in. x 2-7/16 in.)	10	**194L-G3196**
		Rectangular front frame with blank nameplate L = 64 mm x 78 mm (2-33/64 in. x 3-5/64 in.)		**194L-G3197**

Additional Legend Plates/Frames

Color	Legend Size	For Use With	Pkg. Quantity	Legend Plate Marking	Cat. No.
Black/Grey	19.2 mm x 49 mm 3/4 in. x 1-59/64 in.	Size 6 Type G and N style handles, Cat. Nos. 194L-HE6G/N	5	(Blank)	**194L-G3667**
				MAIN SWITCH	**194L-G3667A**
				HAUPSCHALTER	194L-G3667B
				INTERR. PRINCIPALE	194L-G3667C
				INTERR. PRINCIPAUX	194L-G3667D
				INTERR. PRINCIPAL	194L-G3667E
				HUVUDBRYTARE	194L-G3667F
				WAHLSCHALTER	194L-G3667G
				EMERGENCY OFF	194L-G3667H
Black/Grey	18 mm x 84 mm 11/16 in. x 3-5/16 in.	Size 8 Type G and N style handles, Cat. Nos. 194L-HE8G/N	5	(Blank)	194L-G3515
				MAIN SWITCH	**194L-G3515A**
				HAUPTSCHALTER	194L-G3515B
				INTERR. PRINCIPALE	194L-G3515C
				INTERR. PRINCIPAUX	194L-G3515D
				INTERR. PRINCIPAL	194L-G3515E
				HUVUDBRYTARE	194L-G3515F
				WAHLSCHALTER	194L-G3515G
				EMERGENCY OFF	194L-G3515H

Legend Plates with Bezel	Legend Plate Color	Pkg. Quantity	Legend Plate Marking ∗		
			0-1	OFF-ON	Blank Legend Plate
			Cat. No.	Cat. No.	Cat. No.
	Silver	10	194L-A4-175	**194L-A4-175I**	194L-A4-000
			194L-A6-175	194L-A6-175I	194L-A6-000
			194L-A8-175	194L-A8-175I	194L-A8-000
	Yellow		**194L-I4-175**	**194L-I4-175I**	194L-I4-000
			194L-I6-175	**194L-I6-175I**	194L-I6-000
			194L-I8-175	194L-I8-175I	194L-I8-000

∗ Custom-Engraved legend plates available. To order, use publication 194L-PP002_-EN-P.

Shaft for Enclosures

Enclosure Type	Suitable For			Suitable For		
	194L (Base-Mounted Switches)	No. of Contacts	Shaft	Use with 194E Switch	No. of Poles	Shaft Required
194L-G3572	194L-A12(16)	1/2	194L-G3195	194E-A25(32)	3 and 4	194L-G3194
194L-G3576	194L-A12(16)	3/4	Standard			
	194L-A20(25)	1/2	194L-G3194			
(95 x 150 x 86 mm)	194L-A20(25)	3/4	Standard			
194L-G3573	194L-A12(16)	5/6	194L-G3195			
194L-G3577	194L-A12(16)	7/8	194L-G3194			
	194L-A12(16)	9/10	Standard	—	—	—
	194L-A20(25)	5/6	194L-G3194			
(95 x 150 x 111 mm)	194L-A20(25)	7/8	Standard			
194E-G3663				194E-A40(63)	3 and 4	194L-G3194
194E-G3664	—	—	—	194E-A25(32)	6	Standard
(125 x 180 x 105 mm)						
194E-G3665				194E-A80(100)	3 and 4	194E-G3707
194E-G3666	—	—	—	194E-A40(63)	6	Standard
(175 x 230 x 120 mm)						

Accessory Combinations in Enclosure

Enclosure Type	Switch	No. of Poles	Shaft	Aux. Contacts (single or double)	Additional Pole Block	On Switch		On Enclosure	
						Neutral Terminal Block	Ground Terminal Block	Neutral Terminal Block	Ground Terminal Block
194L-G3572 (ABS) 194L-G3576 (Noryl)	194E-A25(32)	3	194L-G3194	X	X				
				X		X			
				X			X		
					X		X		
						X	X		
				X				X	
				X					X
(95 x 150 x 86 mm)								X	X
194E-G3663 (ABS) 194E-G3664 (Noryl)	194E-A40(63)	3	194L-G3194	X	X			X	X
				X		X		X	X
				X			X	X	X
					X		X	X	X
						X	X	X	X
					X		X	X	X
(125 x 180 x 105 mm)	194E-A25(32)	6	194E-G3707					X	X
194E-G3665 (ABS) 194E-G3666 (Noryl)	194E-A80(100)	3	194E-G3707	X	X			X	X
				X		X		X	X
				X			X	X	X
					X		X	X	X
						X	X	X	X
					X		X	X	X
(175 x 230 x 120 mm)	194E-A40(63)	6	194E-G3707	1L+1R				X	X

2

Electrical Ratings

Performance Data				16 A	25 A	32 A	40 A	63 A	80 A	100 A	Aux. Contacts
IEC Applications											
Rated operational voltage (U_e): IEC∗			[V]	690	690	690	690	690	690	690	690
Rated operational voltage (U_e): UL, CSA			[V]	600	600	600	600	600	600	600	600
Rated isolation voltage (U_i): IEC/UL, CSA			[V]	690/600	690/600	690/600	690/600	690/600	690/600	690/600	690/600
Rated impulse voltage (U_{imp}): UL, CSA			[kV]	8	8	8	8	8	8	8	8
Test voltage, (U_i) 1 minute			[kV]	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Lost power per pole			[W]	0.58	1.0	1.5	1.6	2.4	3.6	5.5	0.4
Rated frequency			[Hz]	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60
Conventional free air thermal current I_{th}∗			[A]	25	40	50	63	75	100	120	12
Conventional enclosed thermal current I_e∗			[A]	20	32	40	50	63	80	100	10
Rated current I_e∗											
AC-1/ Non-inductive or only slightly inductive loads **AC-21A** Switching of resistive loads with slight overload			[A]	16	25	32	40	63	80	100	10
Rated power P_e											
AC-23A Occasional switching of 3Ø motors and other highly inductive loads (criterion for selecting main switches)		230V	[kW]	5.5	7.5	7.5	15	18.5	22	30	—
		400V	[kW]	7.5	11	15	22	30	37	55	—
		690V	[kW]	7.5	11	15	18.5	22	37	45	—
AC-3 Squirrel-cage motors; starting and stopping of running motors		230V	[kW]	4	5.5	7.5	11	15	18.5	22	—
		400V	[kW]	5.5	7.5	11	15	18.5	30	37	—
		690V	[kW]	5.5	7.5	11	15	18.5	30	22	—
Short circuit current (co-ordination type 2)			[kA]	20	20	15	20	15	30	25	—
Rated conditional short-circuit current Maximum fuse rating of circuit (type g,G)		400/415V	[A]	20	25	35	50	63	80	100	—
Rated short-time current I_{cw} (1 s)			[A]	800	900	900	1300	1300	2500	2500	—
Rated breaking capacity AC23A (cosϕ 0.45)		230V	[A]	156	296	296	484	484	780	780	—
		400V	[A]	120	256	256	504	504	800	800	—
		690V	[A]	70	136	136	196	196	376	376	—
DC switching capacity											
Rated current I_e	1 pole	48V	[A]	20	25	32	40	63	80	100	—
		110V	[A]	5	5	6	8	10	16	20	
		220V	[A]	1	1	1	1.5	15	3	3	
		440V	[A]	0.5	0.5	0.5	0.6	0.6	0.7	0.7	
DC-21A For resistive loads, T ≤ 1 ms, U_e max = 660V	2 poles in series	96V	[A]	20	25	32	40	63	80	100	—
		110V	[A]	20	23	25	32	50	70	80	
		220V	[A]	5	5	6	8	10	16	20	
		440V	[A]	1	1	1	1.5	1.5	3	3	
		600V	[A]	0.6	0.6	0.6	0.8	0.8	1	1	
	3 poles in series	110V	[A]	20	25	32	40	63	80	100	—
		220V	[A]	13	13	15	20	28	50	63	
		440V	[A]	2.2	2.2	2.2	3.6	3.6	6.5	6.5	
		600V	[A]	1.3	1.5	1.5	2	2	3	3	
Rated power P_e											
DC-23A, DC-3, DC-5 For inductive loads, T ≤ 15 ms	3 poles in series	90V	[kW]	1	1.3	1.5	2.9	4.1	5.1	7.2	—
		110V	[kW]	1	1.1	1.3	2.2	3.3	5.5	7	
		220V	[kW]	0.8	0.9	1.1	1.7	2	3.5	4.4	
		440V	[kW]	0.6	0.6	0.6	0.9	0.9	1.1	1.1	
		600V	[kW]	0.4	0.4	0.4	0.5	0.5	0.9	0.9	

∗ See standards compliance listed on page 2-356.
❄ Suitable also for SEV 500.

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Allen-Bradley

Electrical Ratings, Continued

Performance Data			16 A	25 A	32 A	40 A	63 A	80 A	100 A	Aux. Contacts
UL/CSA Applications										
Continuous current		[A]	16	25	32	40	63	80	100	—
Heavy Pilot Duty		[AC]	A600	A600	A600	—	—	—	—	A600
Standard Duty		[DC]	—	—	—	—	—	—	—	Q600
Motor rating 60 Hz	120V, 1P	FLA	16	16	16	24	34	56	80	
		Hp	1	1	1	2	3	5	7.5	
	240V, 1P	FLA	12	12	17	17	28	50	68	
		Hp	2	2	3	3	5	10	15	
Single-phase (2 poles)	480V, 1P	FLA	8.5	8.5	14	21	26	34	68	—
		Hp	3	3	5	7.5	10	15	30	
	600V, 1P	FLA	11.2	11.2	11.2	16	20	27	44	
		Hp	5	5	5	7.5	10	15	25	
Three-phase	120V, 3P	FLA	13.6	13.6	19.2	30.4	40	56	84	
		Hp	2	2	3	5	7.5	10	15	
	240V, 3P	FLA	9.6	15.2	22	28	42	68	80	
		Hp	3	5	7.5	10	15	25	30	
	480V, 3P	FLA	11	14	21	27	34	52	65	—
		Hp	7.5	10	15	20	25	40	50	
	600V, 3P	FLA	11	11	17	22	27	52	52	
		Hp	10	10	15	20	25	50	50	

Mechanical Data

Performance Data			16 A	25…32 A	40…63 A	80…100 A	Aux. Contacts
Protection class according to IEC 529							
Motor rating 60 Hz							
handles			IP66	IP66	IP66	IP66	IP66
switch bodies			IP20	IP20	IP20	IP20	IP20
Mechanical life		[million operations]	0.2	0.2	0.2	0.2	0.2
Max wire gauges							
Terminal size per IEC 947-1			A4	A6	A7	A9	2xA2
rigid wire	1/2 conductor	AWG	(1)16…10/(2)16…12	(1)14…8/(2)14…10	(1)12…4/(2)12…8	(1)10…1/(2)10…4	18…14
		mm^2	(1)1…10/(2)1…4	(1)1.5…16/(2)1.5…6	(1)2.5…25/(2)2.5…16	(1)4…50/(2)4…25	0.75…2.5
fine strands	1/2 conductor	AWG	(1)16…8/(2)16…12	(1)14…8/(2)14…10	(1)12…4/(2)12…8	(1)10…1/(2)10…6	18…14
		mm^2	(1)1.5…6/(2)1.5…4	(1)1.5…10/(2)1…6	(1)2.5…16/(2)2.5…10	(1)4…35/(2)4…16	0.5…2.5

Environmental Data

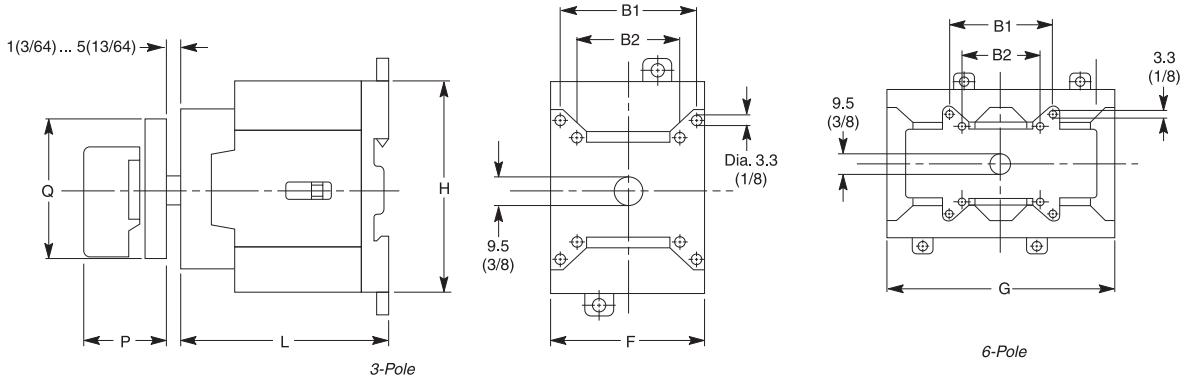
Storage	–40…+80 °C (–40…+176 °F)
Operation	–25…+60 °C (–13…+140 °F)

IEC Load Switches

Approximate Dimensions

Dimensions are shown in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

Front Installation Cat. No. 194E-E...

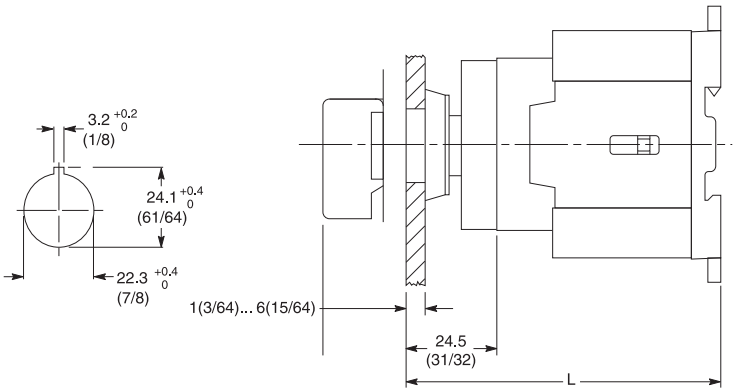


Handles		
Cat. No.	P	Q
194L-HE4A	28 (1-7/64)	48 x 48 (1-57/64 x 1-57/64)
194L-HE4I	28 (1-7/64)	48 x 48 (1-57/64 x 1-57/64)
194L-HE4S	28 (1-7/64)	48 x 62 (1-57/64 x 2-7/16)
194E-HE4N	34 (1-11/32)	54 x 54 (2-1/8 x 2-1/8)
194E-HE4G	34 (1-11/32)	54 x 54 (2-1/8 x 2-1/8)
194L-HE6A	28 (1-7/64)	64 x 64 (2-33/64 x 3-5/64)
194L-HE6I	28 (1-7/64)	64 x 64 (2-33/64 x 3-5/64)
194L-HE6S	28 (1-7/64)	64 x 78 (2-33/64 x 3-5/64)
194L-HE6N	34 (1-11/32)	67 x 67 (2-41/64 x 2-41/64)
194L-HE6G	34 (1-11/32)	67 x 67 (2-41/64 x 2-41/64)

Switch Body						
Use with Cat. No.	B1∗	B2	F	H	L ❄	G
194E-E16	28 (1-7/64)	N/A	36 (1-37/64)	63 (2-31/64)	51 (2)	90 (3-35/64)
194E-E25/32	36 (1-27/64)	N/A	45 (1-25/32)	64 (2-33/64)	60 (2-3/8)	90 (3-1/2)
194E-E40/63	48 (1-57/64)	36 (1-27/64)	54 (2-1/8)	72 (2-27/32)	74 (2-29/32)	108 (4-1/4)
194E-E80/100	48 (1-57/64)	36 (1-27/64)	72 (2-27/32)	90 (3-35/64)	90 (3-35/64)	144 (5-11/16)

∗ Does not apply to 194E-40/63A, 6-Pole Switches. Use B2 dimensions for 6-pole devices.
❄ For 6-pole switches, add 1 in. to the "L" dimension.

Cat. No. 194E-E Switch Body with Cat. No. 194L-HC4A Handle for 22.5 mm Hole Mounting Style



Type	L
194E-E16	76 (3)
194E-E25/32	84.5 (3-21/64)
194E-E40/63	98.5 (3-7/8)
194E-E80/100	114.5 (4-33/64)

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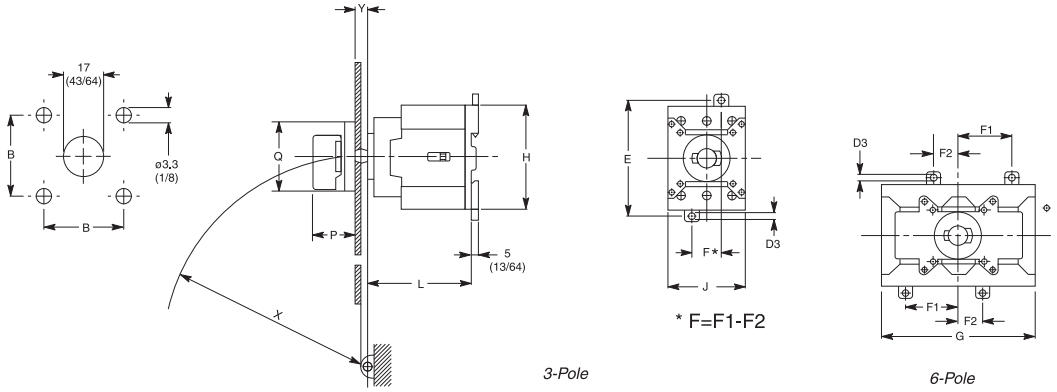
Preferred availability cat. nos. are printed in **bold**

Allen-Bradley

Dimensions are shown in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

Base Mounting Cat. No. 194E-A...



3-Pole *6-Pole*

Handles

Cat. No.	P	Q
194L-HE4A	28 (1-7/64)	48 x 48 (1-57/64 x 1-57/64)
194L-HE4I	28 (1-7/64)	48 x 48 (1-57/64 x 1-57/64)
194L-HE4S	28 (1-7/64)	48 x 62 (1-57/64 x 2-7/16)
194E-HE4N	34 (1-11/32)	54 x 54 (2-1/8 x 2-1/8)
194E-HE4G	34 (1-11/32)	54 x 54 (2-1/8 x 2-1/8)
194L-HE6A	28 (1-7/64)	64 x 64 (2-33/64 x 3-5/64)
194L-HE6I	28 (1-7/64)	64 x 64 (2-33/64 x 3-5/64)
194L-HE6S	28 (1-7/64)	64 x 78 (2-33/64 x 3-5/64)
194L-HE6N	34 (1-11/32)	67 x 67 (2-41/64 x 2-41/64)
194L-HE6G	34 (1-11/32)	67 x 67 (2-41/64 x 2-41/64)

Cover Requirements

For Use With	Y min.	X ≥	Y max.	X ≥
194E-A16	5 (13/64)	142 (5-19/32)	9.5 (3/8)	90 (3-35/64)
194E-A25/32	5 (13/64)	142 (5-19/32)	9.5 (3/8)	90 (3-35/64)
194E-A40/63	2.5 (7/64)	150 (5-29/32)	9.5 (3/8)	90 (3-35/64)
194E-A80/100	2.5 (7/64)	150 (5-29/32)	9.5 (3/8)	90 (3-35/64)

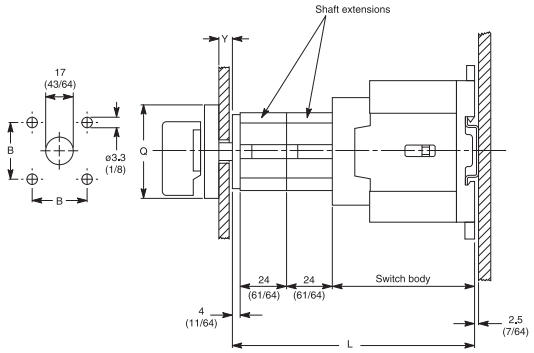
Switch Body

Use With Cat. No.	D3	E	F1	F2	G	H	L ❄	J
194E-A16	4.5 (3/16)	70 (2-49/64)	45 (1-25/32)	12.5 (31/64)	90 (3-35/64)	63 (2-31/64)	80 (3-5/32)	36 (1-27/64)
194E-A25/32	4.5 (3/16)	70 (2-49/64)	30 (1-3/16)	15 (19/32)	90 (3-1/2)	64 (2-33/64)	59 (2-5/16)	45 (1-25/32)
194E-A40/63	4.5 (3/16)	80 (3-5/32)	37 (1-15/32)	17 (43/64)	108 (4-1/4)	72 (2-27/32)	73 (2-55/64)	54 (2-1/8)
194E-A80/100	5.6 (7/32)	95 (3-3/4)	48.5 (1-29/32)	23.5 (59/64)	144 (5-11/16)	90 (3-35/64)	89 (3-1/2)	72 (2-27/32)

❄ For 6-pole switches, add 1 in. to the "L" dimension.

Base Mounting Cat. No. 194E-A...

Cat. No. 194E-A... Switch Body with Cat. No. 194L-G2853 Shaft Extension



Switch Body				
	Cat. No.			
L ∗	194E-A 16	194E-A 25/32	194E-A 40/63	194E-A 80/100
With 1 shaft extension	79 (3-7/64)	88 (3-15/32)	102 (4-1/32)	118 (4-21/32)
With 2 shaft extensions	103 (4-37/64)	112 (4-27/64)	126 (4-31/32)	142 (5-19/32)
With 3 shaft extensions	127 (5)	136 (5-23/64)	150 (5-29/32)	166 (6-35/64)
With 4 shaft extensions	151 (6-61/64)	160 (6-5/16)	174 (6-55/64)	190 (7-31/64)
With 5 shaft extensions	175 (7-57/64)	184 (7-1/4)	198 (7-51/64)	214 (8-7/16)
With 6 shaft extensions	199 (8-27/32)	208 (8-13/64)	222 (8-3/4)	238 (9-3/8)

∗ For 6-pole switches, add 1 in. to the "L" dimension.

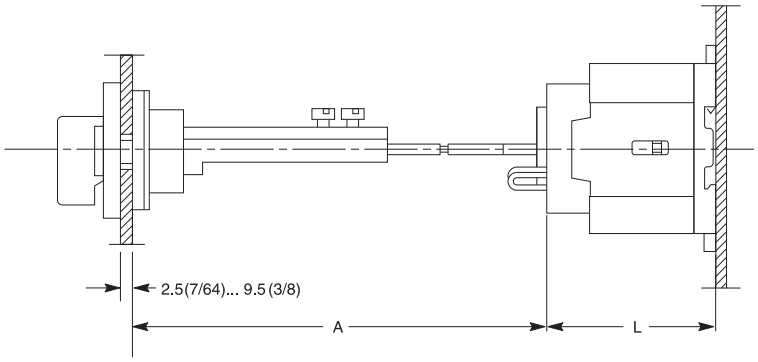
Shaft	Y
194L-G2830	2.5...9.5 (7/64...3/8)
194L-G3194	9...18 (23/64...23/32)
194L-G3195	14...23 (9/16)...(29/32)

Handles			
Type	B	Q	P
194L-HE4A	36 (1-27/64)	48 x 48 (1-57/64 x 1-57/64)	28 (1-7/64)
194L-HE4I	36 (1-27/64)	48 x 48 (1-57/64 x 1-57/64)	28 (1-7/64)
194E-HE4G	28 (1-7/64)	54 x 54 (2-1/8 x 2-1/8)	34 (1-11/32)
194E-HE4N	28 (1-7/64)	54 x 54 (2-1/8 x 2-1/8)	34 (1-11/32)
194L-HE6A	48 (1-57/64)	64 x 64 (2-33/64 x 2-33/64)	28 (1-7/64)
194L-HE6I	48 (1-57/64)	64 x 64 (2-33/64 x 2-33/64)	28 (1-7/64)
194L-HE6N	48 (1-57/64)	67 x 67 (2-41/64 x 2-41/64)	34 (1-11/32)
194L-HE6G	48 (1-57/64)	67 x 67 (2-41/64 x 2-41/64)	34 (1-11/32)

Dimensions are shown in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

Base Installation Cat. No. 194E-A...

Cat. No. 194E-A Switch Body with Metal Shaft Extension



Cat. No.	A
194L-G3393	110...235 (4-11/32...9-1/4)
194L-G3394	230...350 (9-1/16...13-25/32)

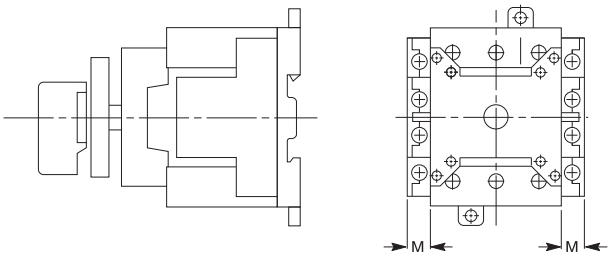
Cat. No.	L*
194E-A16	51 (2)
194E-A25/32	60 (2-3/8)
194E-A40/63	74 (2-59/64)
194E-A80/100	90 (3-35/64)

* For 6-pole switches, add 1 in. to the "L" dimension.

Base and Front Installation

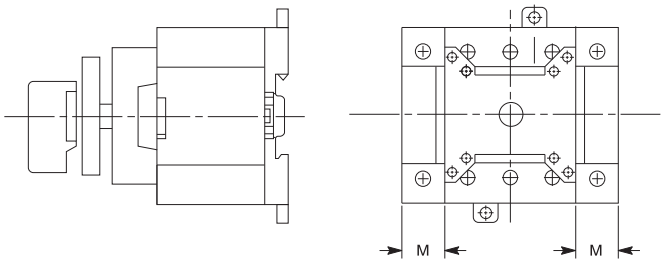
Cat. No. 194E... with Auxiliary Contact Block Installed

Contacts	M
1 N.O. + 1 N.C.	9 (23/64)
2 N.O. + 2 N.C.	18 (23/32)



Cat. No. 194E... with 4-Pole, Ground and Neutral Terminals

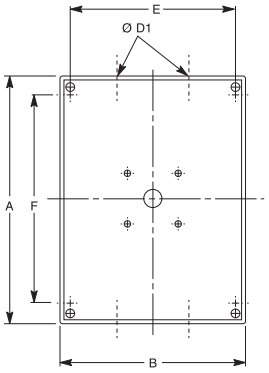
Cat. No.	M
194E-16	12.5 (31/64)
194E-25/32	14 (9/16)
194E-40/63	17.5 (11/16)
194E-80/100	22 (7/8)



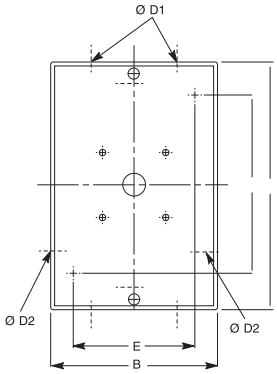
Dimensions are shown in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

Base Mounting Cat. No. 194E-A...

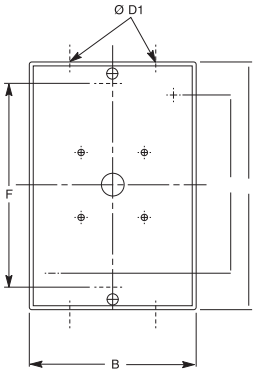
Thermoplastic Enclosures



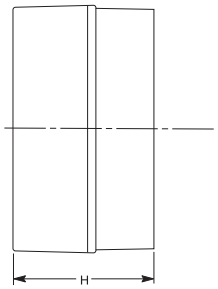
Cat. No. 194L-3665



Cat. No. 194L-3572



Cat. No. 194L-3563



Enclosure Base View

Complete Switches		Enclosures		Height A	Width B	Knockouts❄ ØD1		Mounting Holes‡ E	Mounting Holes‡ F	Depth H
Cat. No.	Poles	ABS Cat. No.	Noryl Cat. No.							
194E-Y16	3 and 4	∗	∗	118 (4-21/32)	66 (2-19/32)	M16/M20 16/20 mm	PG11/PG16 18.5/22.5 mm	50 (1-31/32)	105 (4-9/65)	70 (2-49/65)
	6	194E-G3663	194E-G3664	180 (7-3/32)	125 (4-59/64)	M25/M30 25/30 mm	PG21/PG29 28.5/37.5 mm	On Center	145 (5-23/32)	105 (4-1/8)
194E-Y25/32	3 and 4	194L-G3572	194L-G3576	150 (5-29/32)	95 (3-3/4)	PG16/PG21 22.5/28.5 mm		60 (2-3/8)	115 (4-17/32)	86 (3-3/8)
	6	194E-G3663	194E-G3664	180 (7-3/32)	125 (4-59/64)	PG21/PG29 28.5/37.5 mm		On Center	145 (5-23/32)	105 (4-1/8)
194E-Y40/63	3 and 4	194E-G3663	194E-G3664	180 (7-3/32)	125 (4-59/64)	PG21/PG29 28.5/37.5 mm		On Center	145 (5-23/32)	105 (4-1/8)
	6	194E-G3665	194E-G3666	230 (9-1/16)	175 (6-57/64)	PG29/PG36 37.5/47.5 mm		155 (6-3/32)	195 (4-11/16)	120 (4-47/64)
194E-Y80/100	3 and 4	194E-G3665	194E-G3666	230 (9-1/16)	175 (6-57/64)	PG29/PG36 37.5/47.5 mm		155 (6-3/32)	195 (4-11/16)	120 (4-47/64)

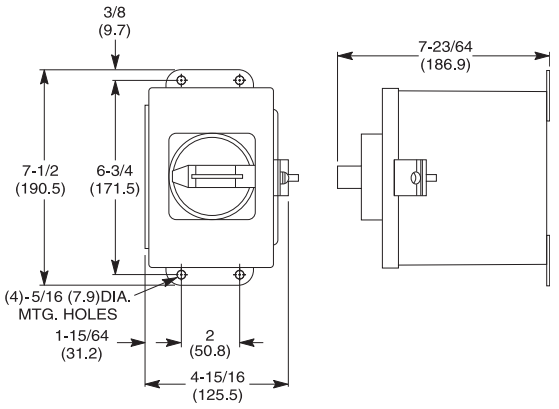
∗ Empty enclosures not available for purchase.
❄ Cat. No. 194E-A16 units have 1 knockout on each end. all others have 2 knockouts on each end. A letter "M" in the catalog number indicates metric knockouts; the unit is otherwise supplied with PG knockouts.
‡ All mounting holes have a 4.2 mm (5/32 in.) diameter.

No. of Extensions	Cat. No. 194E-A 20/32...	Cat. No. 194E-A 40/63...	Cat. No. 194E-A 80/00...
With 1 extension	96 (3-25/32)	107 (4-7/32)	114 (4-31/64)
With 2 extensions	120 (4-23/32)	131 (5-5/32)	138 (5-7/16)
With 3 extensions	144 (5-43/64)	155 (6-7/64)	162 (6-3/8)
With 4 ∗ extensions	168 (6-39/64)	179 (7-3/64)	186 (7-21/64)
With 5 ∗ extensions	192 (7-9/16)	203 (8)	210 (8-17/64)
With 6 ∗ extensions	216 (8-1/2)	227 (8-15/16)	234 (9-7/32)

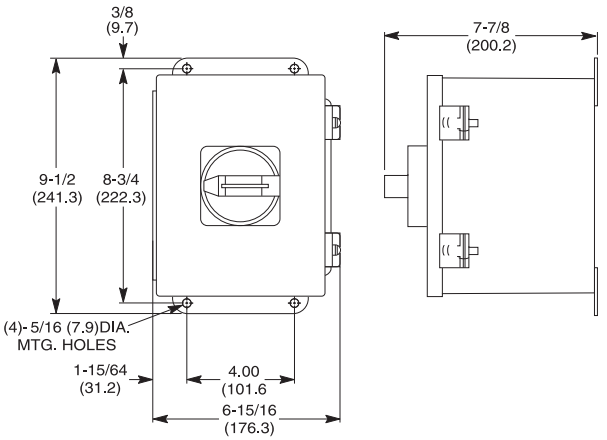
∗ When more than 4 modules are used, attach the first one to the switch body using the screws supplied with the extension (Cat. No. 194L-G2853).

Dimensions are shown in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

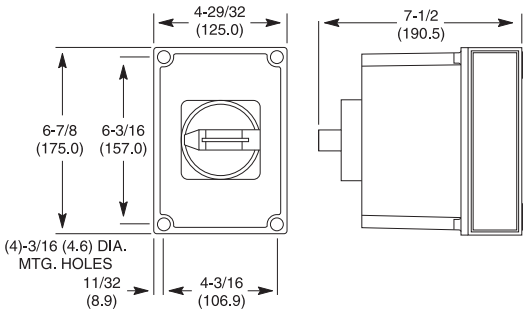
194E Enclosed Switches with 194R Handles



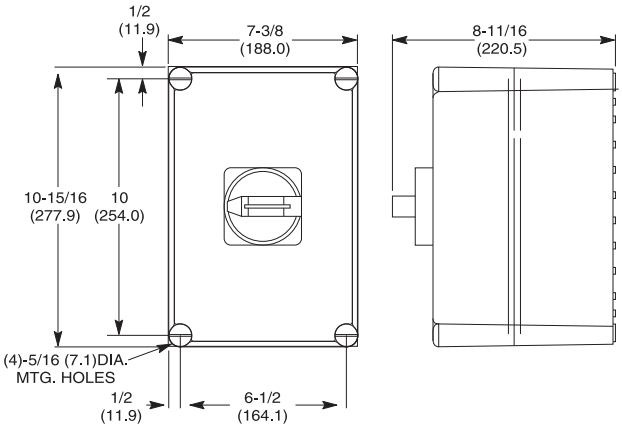
Cat. Nos. 194E-CA16...63, 194E-FA16...63, 194E-AA16...63



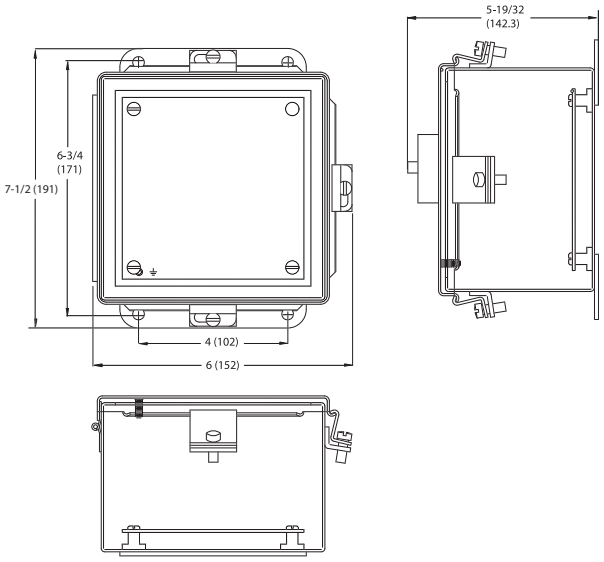
Cat. Nos. 194E-CA80...00, 194E-FA80...00, 194E-AA80...00
Cat. Nos. 194E-CA40X...63X, 194E-FA40X...63X, 194E-AA40X...63X



Cat. No. 194E-KA16...63



Cat. No. 194E-KA80...00



Cat. No. 194E-DA16...32, 194E-GA16...32

Bulletin 194E IEC Load Switches

- At-Motor Disconnect Switch (UL508)
- 125, 160, 250, 315 A Versions of Inductive Load-Rated Switches
- IP66/UL Type 1/3/3R/12 Operating Handles
- IP2LX Finger-Safe Terminals
- 3- and 4-Pole Versions
- Front/Door or DIN/Base Mounting Configurations
- OFF-ON Configurations
- Box Lug and Bolt-on Terminals Available
- Switches Include Operating Shaft
- Suitable as Motor Disconnect

Bulletin 194E load switches are designed for use as local motor isolation and for disconnect switch applications. They are available in 3- and 4-pole versions with add-on grounding and neutral terminals and auxiliary contacts.
Bulletin 194E switches are offered in two mounting styles, Front/Door and Base/DIN configurations, for a variety of installations. Switch body styles for Bulletin 194E base-mounted switches include standard interlock shaft; Bulletin 194E front-mounted switches include standard shaft.

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Approximate Dimensions..... 2-381

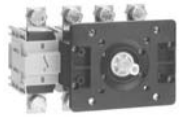
Standards Compliance

IEC 207
IEC 60947-1
IEC 60947-3 Low-voltage switchgear and control gear part 3
UL 508
CSA C22.2, No. 14

Certifications

cULus Listed (Box Lug Version) (UL File No. E14841, Guide NLRV, NLRV7)
UR Recognized (Bolt-on Version) (UL File No. E 14841 NLRV2, NLRV8)
CE

Bulletin 194E Switches — 125…315 A

OFF-ON Switch — with Box Lugs (UL Listed)		OFF-ON Switch — with Bolt-on Wiring (UR Recognized))	
3-pole Base Mounted	*3-pole Front Mounted*	*3-pole Base Mounted*	*3-pole Front Mounted*
4-pole Base Mounted	*4-pole Front Mounted*	*4-pole Base Mounted*	 *4-pole Front Mounted*

Cat. No. Explanation

194E – A 125 – 1753
a *b* *c*

a

Installation Type	
Code	Description
A	Base Mounting w/Box Lugs — UL Listed∗
B	Base Mounting w/Bolt-on Wiring — UR Recognized∗
E	Front Mounting w/Box Lugs — UL Listed
F	Front Mounting w/Bolt-on Wiring — UR Recognized

b

Load Size	
Code	Description
125	125 A
160	160 A
250	250 A
315	315 A

c

Configuration			
Code	Function	Description	Circuit Diagram Ref. No.
1753	OFF-ON	3-Pole, 2-position (90 degrees)	1753
1754	OFF-ON	4-Pole, 2-position (90 degrees)	1754

Frequently Ordered 194E Switches

(see Cat. No. Explanation for additional load sizes in 3- and 4-pole configurations)

Description	No. of Poles	Rated Current	AC23 Rated kw 690V AC 50 Hz	Hp @ 480V AC 60 Hz 3 Ø	Cat. No.	
Base-mounting switch w/ box lugs — 125 A	3	125	45	60	∗	**194E-A125-1753**
Base-mounting switch w/ box lugs — 160 A		160	55	60	∗	**194E-A160-1753**
Base-mounting switch w/ box lugs — 250 A		250	90	75	∗	**194E-A250-1753**
Base-mounting switch w/ box lugs — 315 A	4	315	110	100	∗	194E-A315-1754
Base-mounting switch w/ bolt-on wiring — 250 A	3	250	45	75	∗	**194E-B250-1753**
Base-mounting switch w/ bolt-on wiring — 315 A		315	45	100	∗	194E-B315-1753
Front-mounting switch w/ box lugs — 160 A		160	37	60		**194E-E160-1753**
Front-mounting switch w/ bolt-on wiring — 160 A	4	160	37	60		194E-F160-1754
Front-mounting switch w/ bolt-on wiring — 250 A		250	45	75		194E-F250-1754
Front-mounting switch w/ bolt-on wiring — 315 A		315	45	100		**194E-F315-1754**

∗ 20 cm shaft included with switch.

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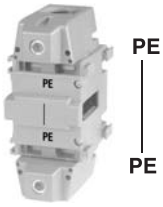
Preferred availability cat. nos. are printed in **bold**

Accessories
Handles 194E - 125...315 A

Handles with Screw Fixing (Includes Legend Plate and Control Knob)	Degree of Protection	Color	Legend Plate Size	For Use With	Legend Marking	Cat. No.
Type A	IP65 (UL Type 3/3R/12)	Black/Grey	88 mm x 88 mm 3-15/32 in. x 3-15/32 in.	194E-125…315 A		**194E-HE8A-175**
			130 mm x 130 mm 5-1/8 in. x 5-1/8 in.			**194E-HE13A-175**
Type I		Red/Yellow	88 mm x 88 mm 3-15/32 in. x 3-15/32 in.			**194E-HE8I-175**
			130 mm x 130 mm 5-1/8 in. x 5-1/8 in.			**194E-HE13I-175**
Type G		Black/Grey	90 mm x 90 mm 3-35/64 in. x 3-35/64 in.	194E-125…315 A		**194E-HE8G-175**
			135 mm x 135 mm 5-5/16 in. x 5-5/16 in.			**194E-HE13G-175**
Type N		Red/Yellow	90 mm x 90 mm 3-35/64 in. x 3-35/64 in.			**194E-HE8N-175**
			135 mm x 135 mm 5-5/16 in. x 5-5/16 in.			**194E-HE13N-175**

Accessories 194E - 125...315 A

Auxiliary Contacts - 2 N.O. / 1 N.C.	For Use With	Cat. No.
	194E-A125-160,194E-B125-160	**194E-AB-P21-160**
	194E-A250-315,194E-B250-315	**194E-AB-P21-315**
	194E-E125-160,194E-F125-160	**194E-EF-P21-160**
	194E-E250-315,194E-F250-315	**194E-EF-P21-315**

Earthing/Grounding Terminal	For Use With	Cat. No.
	194E-A125-160,194E-E125-160	**194E-AE160-PE**
	194E-A250-315,194E-E250-315	**194E-AE315-PE**
	194E-B125-160,194E-F125-160	194E-BF160-PE
	194E-B250,194E-F250	**194E-BF250-PE**
	194E-B315,194E-F315	194E-BF315-PE

Neutral Terminal	For Use With	Cat. No.
	194E-A125-160,194E-E125-160	194E-AE160-TN
	194E-A250-315,194E-E250-315	194E-AE315-TN
	194E-B125-160,194E-F125-160	194E-BF160-TN
	194E-B250,194E-F250	194E-BF250-TN
	194E-B315,194E-F315	194E-BF315-TN

Shaft Extension	Length	For Use With	Cat. No.
	40 cm	194E-A or 194E-B 125…315 A Base-Mounted Switches	**194E-AB40**

Terminal Cover	For Use With		Cat. No.
	194E-A125-160 194E-E125-160	2 covers per pole	**194E-AE125-C1**
	194E-A250-315 194E-E250-315	2 covers per pole	**194E-AE250-C1**
	194E-B125-160 194E-F125-160	2 covers per pole	194E-BF125-C1
	194E-B250-315 194E-F250-315	2 covers per pole	**194E-BF250-C1**

Legend

Additional Name Plate and Frame

	Color	Legend Size	For Use With	Legend Marking	Pkg. Qty.	Cat. No.
	Black/Grey	18 mm x 84 mm 11/16 in. x 3-5/16 in.	Size 8 Type G and N Style Handles, Cat. Nos. 194L-HE8G/N 88 mm x 88 mm 90 mm x 90 mm 130 mm x 130 mm 135 mm x 135 mm legend frames	MAIN SWITCH	5	**194L-G3515A**
				HAUPTSCHALTER		194L-G3515B
				INTERR. PRINCIPALE		194L-G3515C
				INTERR. PRINCIPAUX		194L-G3515D
				INTERR. PRINCIPAL		194L-G3515E
				HUVUDBRYTARE		194L-G3515F
				WAHLSCHALTER		194L-G3515G
	Red/Yellow			EMERGENCY OFF		194L-G3515H

Specifications

IEC Performance Data for 194E

				194E-125	194E-160	194E-250	194-315
Rated insulation voltage U_i: ✶			[V]	1000	1000	1000	1000
Rated impulse withstand voltage U_{imp}			[kV]	8	8	8	8
Test voltage 1 min			[kV]	3.5	3.5	3.5	3.5
Rated voltage U_e ✶❄			[V]	1000	1000	1000	1000
Rated frequency			[Hz]	50/60	50/60	50/60	50/60
Rated thermal current I_{th} open			[A]	125	160	250	315
Rated thermal current I_{the} enclosed			[A]	125	160	250	315
Rated current I_e							
AC-1 / AC-21A	Non-inductive or slightly induc. load / Switching of resistive loads with slight overload		[A]	125	160	250	315
Rated power P_e							
AC-23A	Occasional switching of motor and other highly inductive loads	230V	[kW]	30	30	37	55
		400V	[kW]	45	55	90	110
		690V	[kW]	37	37	45	45
AC-3	Squirrel-cage motors: starting and stopping of running motors	230V	[kW]	22	30	37	45
		400V	[kW]	37	45	55	75
		690V	[kW]	30	37	45	45
Conditional rated short-circuit current		400/415V	[kA]	30	30	30	30
Max. fuse rating of circuit (type gG)			[A]	125	160	250	315
Rated short-time current I_{cw} 1S			[A]	2500	3000	4600	5800
Rated breaking capacity		230V	[A]	800	900	1600	1800
AC-23A (cos ϕ 0.45)		400V	[A]	750	850	1380	1650
		690V	[A]	340	340	400	400

✶ Valid for line with grounded common neutral termination, overvoltage category III, pollution degree 3. Other values on request.
❄ Not suitable for load-switching applications (AC-20A) above 690V.

DC Switching Capacity							
				194E-125	194E-160	194E-250	194E-315
Rated current I_e							
	Rated voltage [V]	No. Poles in series					
DC-21A	60	3	[A]	125	160	250	315
For resistive loads T≤1 ms	110	3	[A]	110	140	220	280
	220	3	[A]	45	55	85	110
	Rated voltage [V]	No. Poles in series					
	110	4	[A]	125	160	250	315
	220	4	[A]	80	100	150	200
	440	4	[A]	16	20	32	40
Rated power P_e							
	Rated voltage [V]	No. Poles in series					
DC-22A, DC-3	24	4	[kW]	3	3.8	6	7.5
For Inductive loads T≤2.5 ms	48	4	[kW]	6	7.5	12	15
	60	4	[kW]	7.5	9.5	15	19
	110	4	[kW]	10	12.5	20	25
	220	4	[kW]	4.5	5.5	8	10
Rated Power P_e							
	Rated voltage [V]	No. Poles in series					
DC-23A, DC-5	24	4	[kW]	3	3.8	6	7.5
For Inductive loads T≤15 ms	48	4	[kW]	6	7.5	12	15
	60	4	[kW]	7.5	9.5	15	19
	110	4	[kW]	8.8	11	17.5	22
	220	4	[kW]	2.5	3.5	5.5	7

UL CSA Performance Data for 194E

			194E-125	194E-160	194E-250	194E-315
Rated Insulation Voltage		[V]	600	600	600	600
Rated voltage		[V]	600	600	600	600
Continuous current		[A]	150	200	250	300
Ampere rating for general use		[A]	150	200	250	300
Heavy Pilot Duty		[AC]				
Standard Duty		[DC]				
Motor rating 60Hz						
1-phase (2 poles)	120V, 1 P	[FLA]	80	100	135	180
		[Hp]	7.5	10	15	20
	240V, 1 P	[FLA]	88	110	136	155
		[Hp]	20	25	30	35
	480V, 1 P	[FLA]	78	88	99	108
		[Hp]	35	40	45	50
	600V, 1 P	[FLA]	62	70	86	104
		[Hp]	35	40	50	60
3-Phase	120V, 3 P	[FLA]	84	108	160	208
		[Hp]	15	20	30	40
	240V, 3 P	[FLA]	8	104	154	192
		[Hp]	30	40	60	75
	480V, 3 P	[FLA]	77	77	96	124
		[Hp]	60	60	75	100
	600V, 3 P	[FLA]	62	62	77	99
		[Hp]	60	60	75	100

Mechanical Data

				194E-125	194E-160	194E-250	194E-315
Handles				IP66	IP66	IP66	IP66
Protection class according to IEC 529				—	—	—	—
Front side Front unit				IP66	IP66	IP66	IP66
Box lugs*				IP20	IP20	IP20	IP20
Bolt-on	straight version*			IP20	IP20	IP20	IP20
	bent version			—	—	—	—
Mechanical life			[Million operations]	0.1	0.1	0.075	0.075
Box lugs — max. wire gauges				—	—	—	—
Terminal sizes according to IEC 947-1		Gauge No.		B11	B11	B14	B14
Fine strands, 1 conductor		Max.	mm^2	70	70	150	150
		Min.	mm^2	16	16	25	25
Rigid wire, 1 conductor		Max.	mm^2	95	95	185	185
		Min.	mm^2	10	10	16	16
Wire gauges according to UL/CSA		Max.	AWG	3/0	3/0	—	—
			MCM	—	—	350	350
		Min.	AWG	8	8	4	4

* When provided with terminal covers.

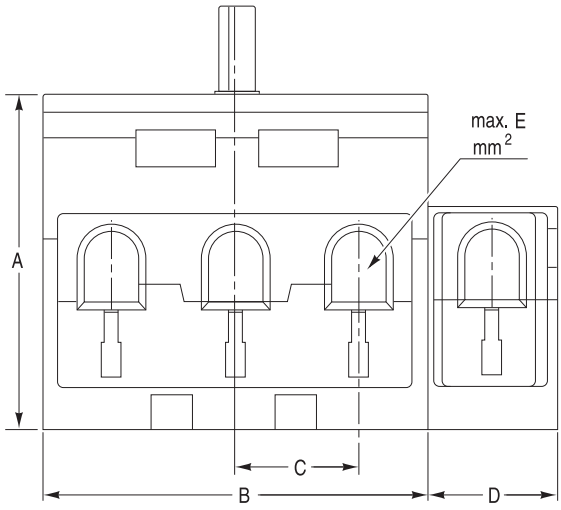
Certifications

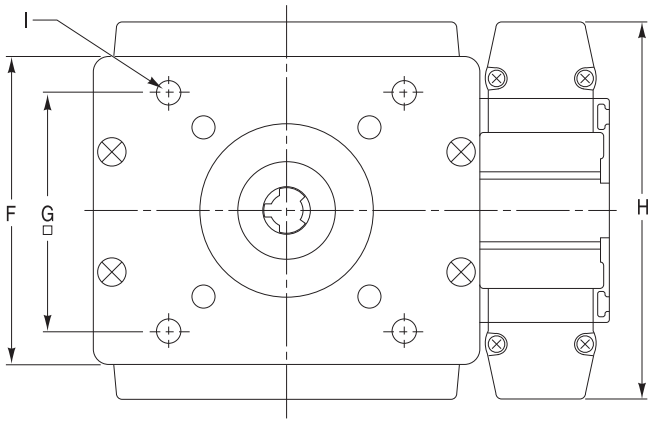
Catalog No. or Designation		UL-Listed (marked with UL)	UR-Recognized (marked with UR)	UL-Listed for Canada (marked with cUL)	UR-Recognized for Canada (marked with cUR)	CE
194E-A125	194E-E125	A	—	A	—	A
194E-A160	194E-E160	A	—	A	—	A
194E-A250	194E-E250	A	—	A	—	A
194E-A315	194E-E315	A	—	A	—	A
194E-B125	194E-F125	—	A	—	A	A
194E-B160	194E-F160	—	A	—	A	A
194E-B250	194E-F250	—	A	—	A	A
194E-B315	194E-F315	—	A	—	A	A
Aux. switch blocks		Z	Z	Z	Z	Z
Ground terminal		Z	Z	Z	Z	Z
Neutral terminal		Z	Z	Z	Z	Z

A = Certified
Z = accessories are covered by the approval for the switch

Dimensions are shown in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

Front-Installation Box Lugs, 3- and 4-Pole



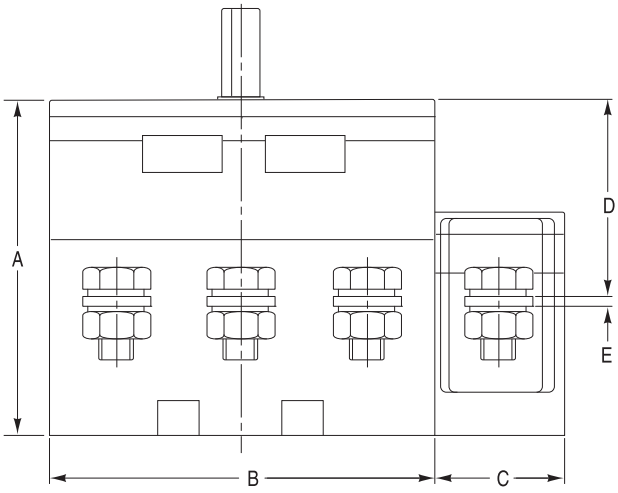


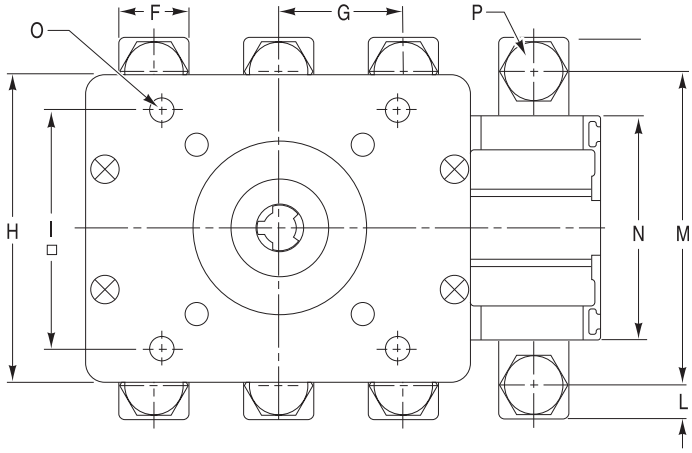
Switch Body 194E-E

[A]	A	B	C	D	E	F	G	H	I∗
125	91 (3-19/32)	112 (4-13/32)	36 (1-13/32)	38 (1-1/2)	95 (3-23/64)	88 (3-7/16)	68 (2-11/16)	108 (4-1/4)	M5∗
160	91 (3-19/32)	112 (4-13/32)	36 (1-13/32)	38 (1-1/2)	95 (3-23/64)	88 (3-7/16)	68 (2-11/16)	108 (4-1/4)	M5∗
250	103 (4-3/64)	145 (5-23/32)	44 (1-23/32)	52.5 (2-1/16)	185 (7-9/32)	88 (3-7/16)	68 (2-11/16)	120 (4-11/16)	M5∗
315	103 (4-3/64)	145 (5-23/32)	44 (1-23/32)	52.5 (2-1/16)	185 (7-9/32)	88 (3-7/16)	68 (2-11/16)	120 (4-11/16)	M5∗

∗ M5 x 0.8 bolts supplied with switch. Threaded hole.

Front-Installation Bolt-on Terminals, 3- and 4-Pole





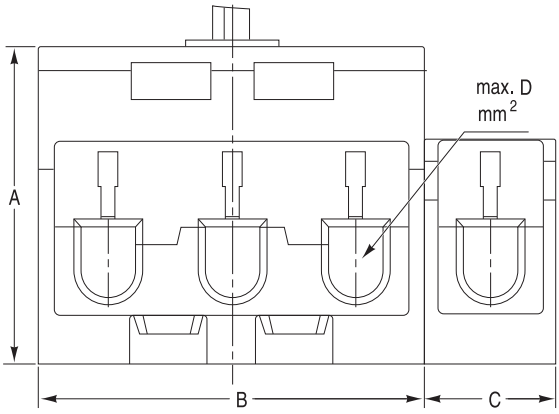
Switch Body 194E-F

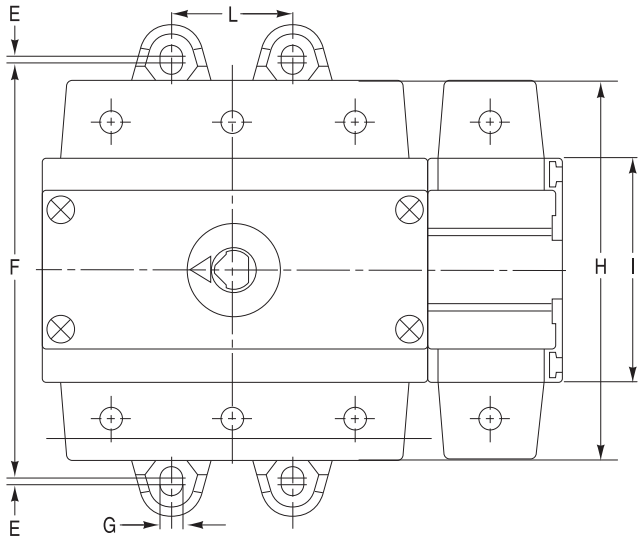
[A]	A	B	C	D	E	F	G	H	I	L	M	N	O∗	P❄
125	91 (3-19/32)	112 (4-3/32)	38 (1-1/2)	65.5 (2-9/16)	3 (1/8)	2 (3/32)	36 (1-13/32)	88 (3-7/16)	68 (2-11/16)	10 (13/32)	90 (3-17/32)	64 (2-17/32)	M5∗	M10❄
160	91 (3-19/32)	112 (4-3/32)	38 (1-1/2)	65.5 (2-9/16)	3 (1/8)	2 (3/32)	36 (1-13/32)	88 (3-7/16)	68 (2-11/16)	10 (13/32)	90 (3-17/32)	64 (2-17/32)	M5∗	M10❄
250	103 (4-3/64)	145 (5-23/32)	52.5 (1-22/32)	60.4 (2-3/8)	4 (5/32)	2 (3/32)	44 (1-23/32)	88 (3-7/16)	68 (2-11/16)	13 (1/2)	100 (3-15/16)	70 (2-3/4)	M5∗	M12❄
315	103 (4-3/64)	145 (5-23/32)	52.5 (1-22/32)	60.4 (2-3/8)	4 (5/32)	2 (3/32)	52 (2-1/16)	88 (3-7/16)	68 (2-11/16)	13 (1/2)	100 (3-15/16)	70 (2-3/4)	M5∗	M12❄

∗ M5 x 0.8 bolts supplied with switch. Threaded hole.
❄ Bolts and nuts supplied with switch. Through-hole.

Dimensions are shown in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

Base-Mounting Box Lugs, 3- and 4-Pole

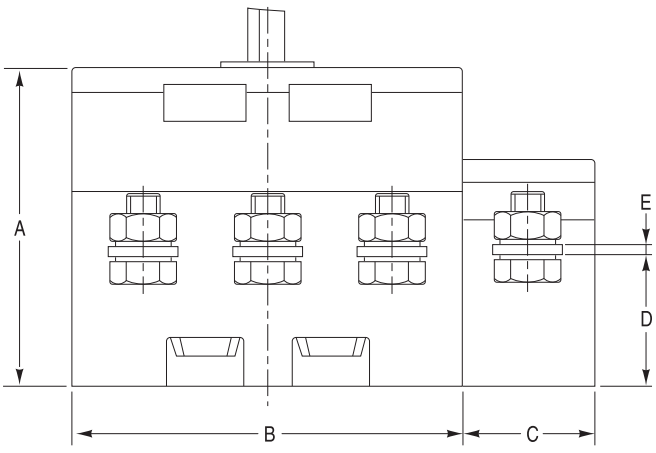


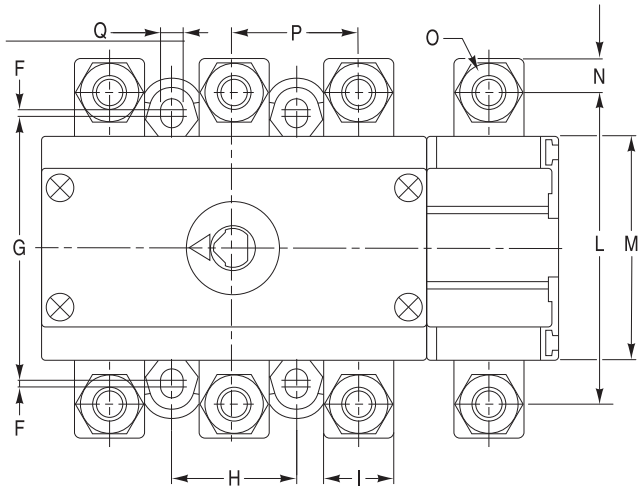


Switch Body 194E-A

[A]	A	B	C	D	E	F	G	H	I	L
125	91 (3-19/32)	112 (4-13/32)	38 (1-1/2)	95 (3-23/64)	2 (3/32)	118 (4-5/8)	6.4 (1/4)	108 (4-1/4)	64 (2-17/32)	36 (1-13/32)
160	91 (3-19/32)	112 (4-13/32)	38 (1-1/2)	95 (3-23/64)	2 (3/32)	118 (4-5/8)	6.4 (1/4)	108 (4-1/4)	64 (2-17/32)	36 (1-13/32)
250	98 (3-27/32)	145 (5-23/32)	52.5 (1-23/32)	185 (7-9/32)	2 (3/32)	140 (5-1/2)	6.4 (1/4)	126 (4-15/16)	70 (2-3/4)	44 (2-1/16)
315	98 (3-27/32)	145 (5-23/32)	52.5 (1-23/32)	185 (7-9/32)	2 (3/32)	140 (5-1/2)	6.4 (1/4)	126 (4-15/16)	70 (2-3/4)	44 (2-1/16)

Base-Mounting Bolt-on Terminals, 3- and 4-Pole



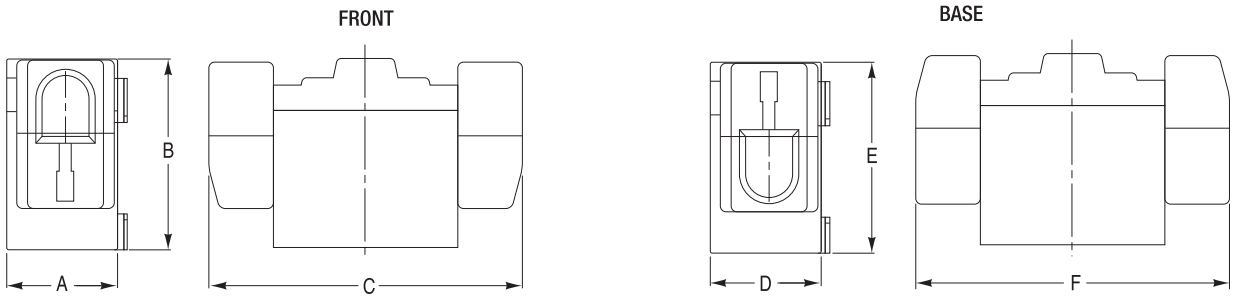


Switch Body 194E-B

[A]	A	B	C	D	E	F	G	H	I	L	M	N	O	P	Q
125	91 (3-19/32)	112 (4-3/32)	38 (1-1/2)	36.5 (1-7/16)	3 (1/8)	2 (3/32)	76 (3)	36 (1-13/32)	20 (3/4)	90 (3-17/32)	64 (2-17/32)	10 (13/32)	M10 (3/8)	36 (1-13/32)	6.4 (1/4)
160	91 (3-19/32)	112 (4-3/32)	38 (1-1/2)	36.5 (1-7/16)	3 (1/8)	2 (3/32)	76 (3)	36 (1-13/32)	20 (3/4)	90 (3-17/32)	64 (2-17/32)	10 (13/32)	M10 (3/8)	36 (1-13/32)	6.4 (1/4)
250	98 (3-27/64)	145 (5-23/32)	52.5 (1-22/32)	38.6 (1-1/2)	4 (5/32)	2 (3/32)	80 (3-1/8)	44 (1-23/32)	26 (1-1/64)	100 (3-15/16)	70 (2-3/4)	13 (1/2)	M12 (15/32)	44 (1-23/32)	6.4 (1/4)
315	98 (3-27/64)	145 (5-23/32)	52.5 (1-22/32)	38.6 (1-1/2)	4 (5/32)	2 (3/32)	80 (3-1/8)	44 (1-23/32)	26 (1-1/64)	100 (3-15/16)	70 (2-3/4)	13 (1/2)	M12 (15/32)	52 (2-1/16)	6.4 (1/4)

Dimensions are shown in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

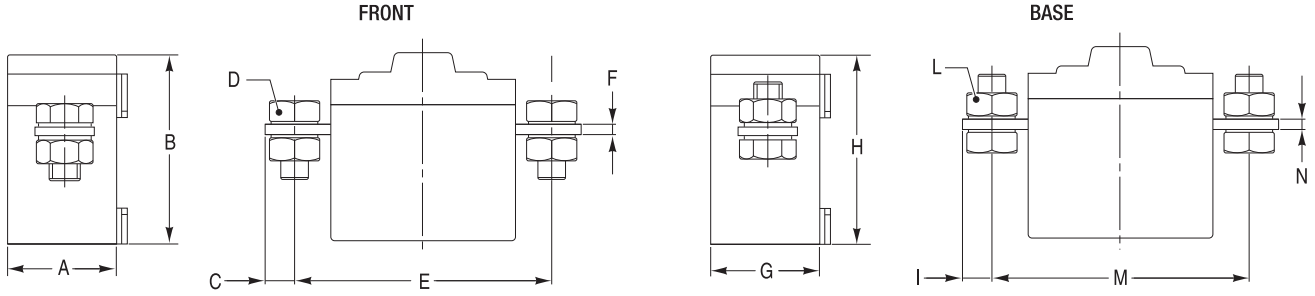
Box Ground and Neutral Terminal



Switch Body 194E-F

[A]	A	B	C	D	E	F
125	37.8 (1-1/2)	64 (2-17/32)	108 (4-1/4)	37.8 (1-1/2)	64 (2-17/32)	108 (4-1/4)
160	37.8 (1-1/2)	64 (2-17/32)	108 (4-1/4)	37.8 (1-1/2)	64 (2-17/32)	108 (4-1/4)
250	52.3 (2-1/16)	71.1 (2-25/32)	126 (4-15/16)	52.3 (2-1/16)	80.6 (3-1/8)	126 (4-15/16)
315	52.3 (2-1/16)	71.1 (2-25/32)	126 (4-15/16)	52.3 (2-1/16)	80.6 (3-1/8)	126 (4-15/16)

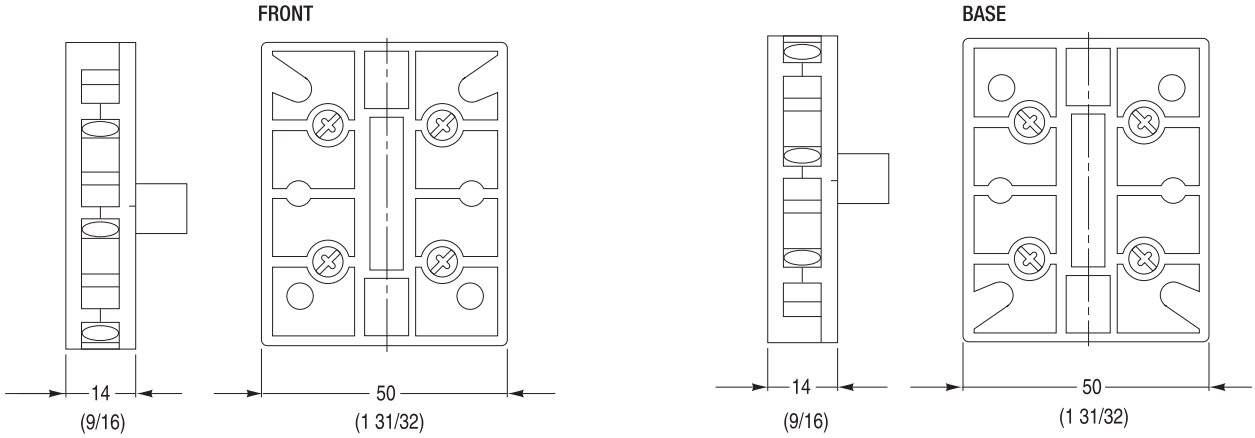
Bolt Ground and Neutral Terminal



Switch Body 194E-F

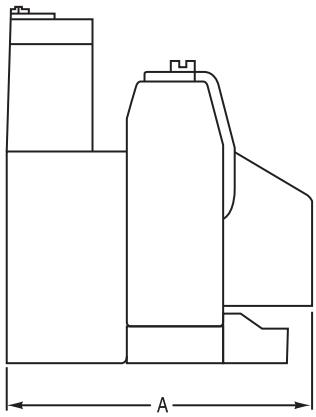
[A]	A	B	C	D	E	F	G	H	I	L	M	N
125	37.8 (1-1/2)	64 (2-17/32)	10 (13/32)	M10 (13/32)	90 (3-17/32)	3 (1/8)	37.8 (1-1/2)	64 (2-17/32)	10 (13/32)	M10 (13/32)	90 (3-17/32)	3 (1/8)
160	37.8 (1-1/2)	64 (2-17/32)	10 (13/32)	M10 (13/32)	90 (3-17/32)	3 (1/8)	37.8 (1-1/2)	64 (2-17/32)	10 (13/32)	M10 (13/32)	90 (3-17/32)	3 (1/8)
250	52.3 (2-1/16)	68 (2-21/32)	13 (1/2)	M12 (15/32)	100 (3-15/16)	4 (5/32)	52.3 (2-1/16)	68 (2-21/32)	13 (1/2)	M12 (15/32)	100 (3-15/16)	4 (5/32)
315	52.3 (2-1/16)	68 (2-21/32)	13 (1/2)	M12 (15/32)	100 (3-15/16)	4 (5/32)	52.3 (2-1/16)	68 (2-21/32)	13 (1/2)	M12 (15/32)	100 (3-15/16)	4 (5/32)

Auxiliary Contacts

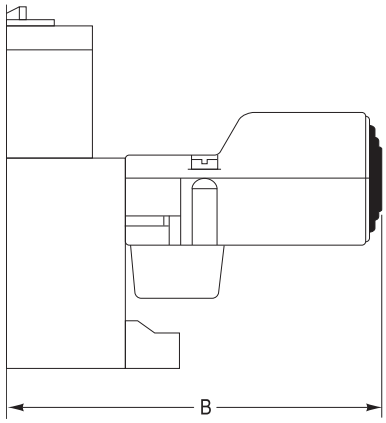


Dimensions are shown in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

Terminal Cover

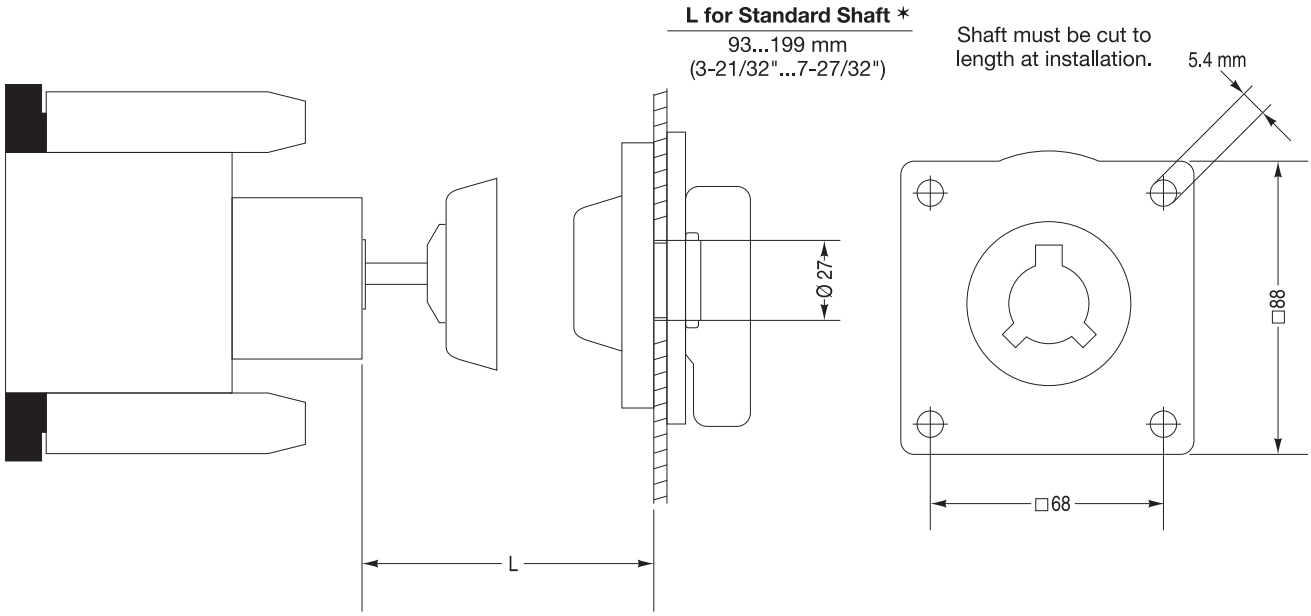


Switch Body 194E-F



[A]	A	B
125	76.2 (3)	95 (3-3/4)
160	76.2 (3)	95 (3-3/4)
250	88 (3-15/32)	109.5 (4-5/16)
315	88 (3-15/32)	109.5 (4-5/16)

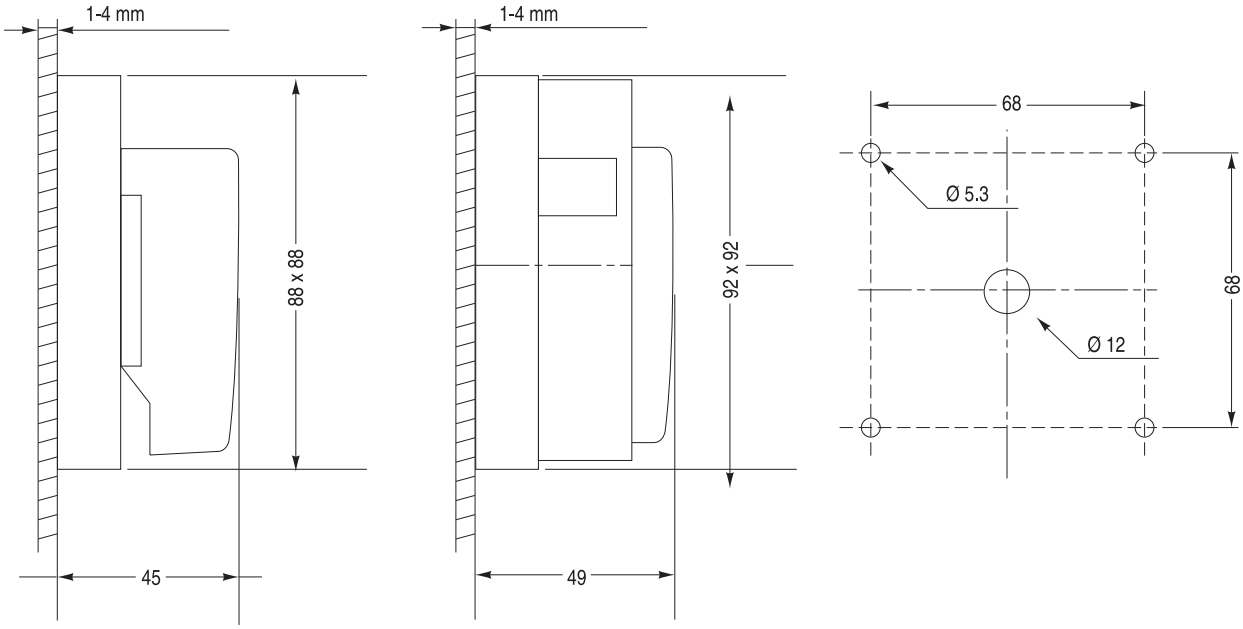
Door Clutches



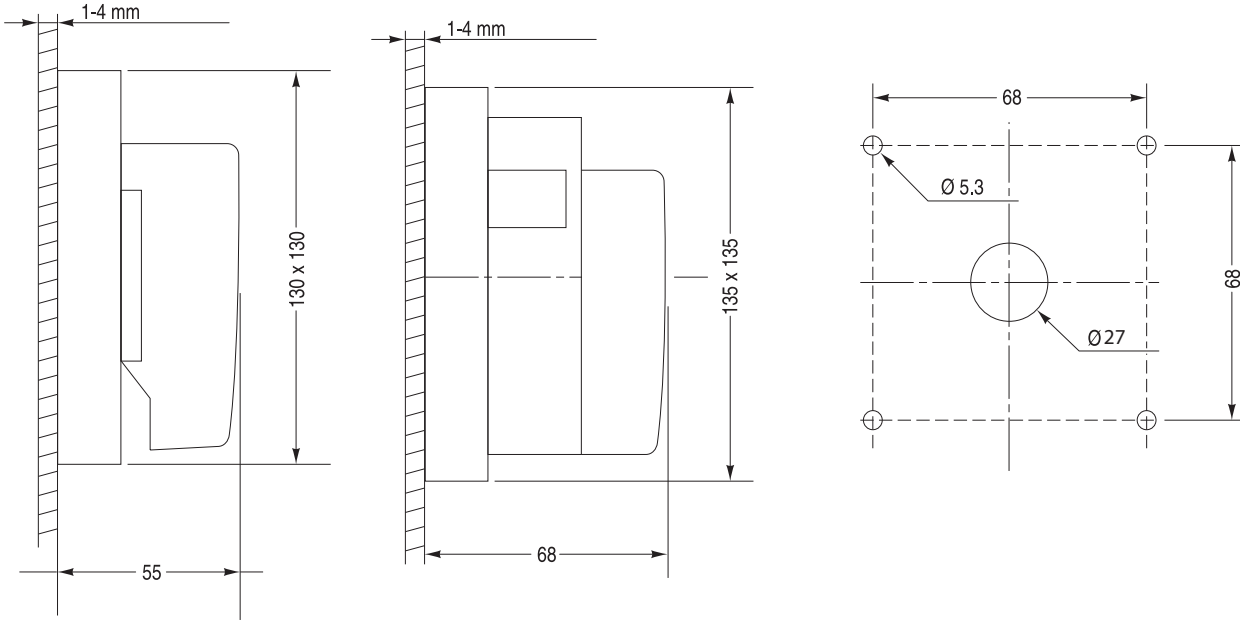
* Use Cat. No. 194E-AB40 shaft extension accessory to extend beyond the standard shaft length.

Dimensions are shown in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

Handles (Type 194E-HE-8A-8I-8G-8N)



Handles (Type 194E-HE-13A-13I-13G-13N)

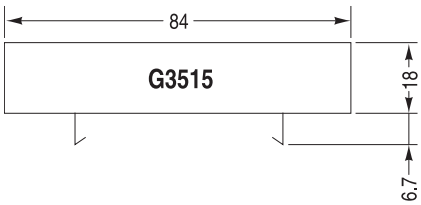


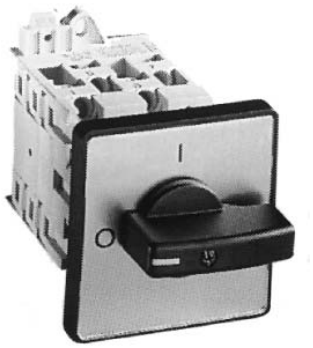
Type A and I

Type G and N

Additional Name Plate

Frame and legend snaps on to handle bezel. Fits size 8 and 13 handles.





Bulletin 194L IEC Control and Load Switches

- 12, 16, 20, 25, 32, and 40 A inductive load-rated switch
- IP66 water spray and dustproof handles
- IP20 finger-safe terminals
- Switches available for OFF-ON, changeover, star-delta (wye-delta), reversing, ammeter, voltmeter and step switch configurations
- 1…6-Pole versions
- Front/door- or base/ DIN Rail-mounting configurations
- Thermoplastic enclosures IP66
- Suitable as motor disconnect (UL 508)

Bulletin 194L control and load switches are flexible, adaptable, time- and space-saving devices. Switches are available as front/door- or Base/DIN rail-mounting versions. Uniformly styled handles, featuring marked legend plates, are available in Selector-Knob, Disk-Style, Rectangular-Style and Key-Operated versions. Selector-Knob versions are available in three sizes. Most handles are available in Grey/Black or Red/Yellow and have padlockable versions.

A new thermoplastic enclosure features constructions of impact-resistant ABS or corrosion resistant NORYL materials. Both shallow and deep versions include 35 mm DIN mounting rail, grounding and neutral terminals, and captive cover screws. Enclosures may be ordered with or without cover openings for handle mounting. Enclosures are rated for use in IP66 (UL Type 1, 3, 3R, 12) environments.

Table of Contents

Product Overview ..... this page
Product Selection 2-387
Accessories 2-393
Switching Diagrams .. 2-395
Specifications 2-399
Approximate Dimensions 2-402

Standards Compliance

IEC 60947-3 Low-voltage switchgear and control gear part 3
UL 508
CSA: C22.2 No. 14

Certifications

UL Listed (File No. E14841 NLRV)
CSA Certified (LR 13908)
Meets IEC, VDE and BS Standard requirements
CE

Product Overview

OFF-ON Switch

OFF-ON Switch

Two-position switch used to connect or disconnect a variety of inductive loads including: solenoids, handles, valves, magnetic starters and relays.

Ammeter Switch

Ammeter Switch

Multi-position switch used to connect one or more phases of an electrical supply to an ammeter, so that the current in each phase can be displayed on one ammeter.

Changeover Switch

Changeover Switch

Two-position switch used in control applications to change between alternate power supplies. This device can typically be used to manually switch power supplies from a primary source to a stand-by/emergency supply in the event of a power outage.

Voltmeter Switch

Voltmeter Switch

Multi-position switch used to connect two lines of the electrical supply system to a voltmeter so that the voltage between the lines (phase-to-phase or phase-to-neutral) can be displayed on one voltmeter.

Star-Delta (Wye-Delta) Switch

Star-Delta (Wye-Delta) Switch

Three-position (Off-Wye-Delta) switch used to manually control reduced-voltage motor starting. Operating the switch manually changes the wiring configuration of the motor from a star configuration to delta configuration after the controller operator has determined that the motor is up to operating speed.

Step Switch

Step Switch

Multi-position switch used to connect a variety of loads to an electrical supply in a pre-determined logical sequence. A typical application would be temperature control of a heating oven or furnace.

Reversing Switch

Reversing Switch

Three-phase, three-position (Forward-Off-Reverse) switch used to manually control a motor's direction of rotation. Operating the switch changes the wiring configuration of the motor to operate in the forward or reverse direction.

Bulletin 194L Control and Load Switches

Base/DIN Rail Mounting	Front/Door Mounting	Base/DIN Rail Mounting	Front/Door Mounting	Front/Door Mounting
12…25 A Base Mount	12…25 A Front Mount	32 A and 40 A Base Mount	32 A and 40 A Front Mount	32 A and 40 A Front Mount, for use with 22.5 mm mounting hole style handle

2

Cat. No. Explanation

194L – A 16 – 175 3
a b c d

a

Installation Type	
Code	Description
A	Base/DIN Mounting
E	Front/Door Mounting
C	Front/Door Mounting (For use with 32 A and 40 A switches only. Use when selecting 22.5 mm hole-mounting style handle.)

b

Load Size			
Code	Description	Code	Description
12	12 A	25	25 A
16	16 A	32	32 A
20	20 A	40	40 A

c

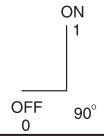
Code	Function	Configuration	Use with Switch Style∗❄:	Circuit Diagram Ref. No.
150	On/Off	2-Position (60 degrees)	194L-E, 12…40 A, 1…6 poles	1501…1506
175		2-Position (90 degrees)	194L-E or 194L-A, 12…40 A, 1…6 poles	1751…1756
178		2-Position (90 degrees-inverted)	194L-E or 194L-A, 12…40 A, 1…4 poles	1781…1784
225	Change-Over	1-2 (without 0, 45 degrees)	194L-E, 12…40 A, 1…5 poles or 194L-A, 12…40 A, 1…2 poles	2251…2255
250		1-2 (without 0, 60 degrees)	194L-E, 12…40 A, 1…5 poles	2501…2505
300		1-0-2 (with 0, 30 degrees, spring return)	194L-E, 12 A, 1…3 poles	3001…3003
325		1-0-2 (with 0, 45 degrees)	194L-E or 194L-A, 12…40 A, 1…4 poles	3251…3254
326		1-0-2 (with 0, 45 degrees, spring return)	194L-E, 12 A, 1…3 poles	3261…3263
350		1-0-2 (with 0, 60 degrees)	194L-E, 12…40 A, 1…4 poles	3501…3504
375		1-0-2 (with 0, 90 degrees)		3751…3754
425	Step Switch	1-2-3 (45 degrees)	194L-E or 194L-A, 12…40 A, 1 pole 194L-E, 12…40 A, 2…3 poles	4251…4253
426		1-2-3-4 (45 degrees)	194L-E, 12…40 A, 1…3 poles 194L-A, 12…40 A, 2 poles	4261…4263
427		1-2-3-4-5 (45 degrees)	194L-E or 194L-A, 12…40 A, 1 pole	4271
428		1-2-3-4-5-6 (45 degrees)		4281
450		1-2-3 (60 degrees)	194L-E, 12…40 A, 1…3 poles	4501…4503
451		1-2-3-4 (60 degrees)		4511…4513
452		1-2-3-4-5 (60 degrees)	194L-E, 12…40 A, 1 pole	4521
453		1-2-3-4-5-6 (60 degrees)		4531
500		0-1-2-3-4 (30 degrees)	194L-E, 12…40 A, 1…3 poles	5001…5003
501		0-1-2-3-4-5 (30 degrees)		5011…5013
525		0-1-2 (45 degrees)		5251…5253
526		0-1-2-3 (45 degrees)	194L-E or 194L-A, 12…40 A, 1 pole 194L-E, 12…40 A, 2…3 poles	5261…5263
527		0-1-2-3-4 (45 degrees)		5271…5273
528		0-1-2-3-4-5 (45 degrees)		5281…5283
550		0-1-2 (60 degrees)	194L-E, 12…40 A, 1…3 poles	5501…5503
551		0-1-2-3 (60 degrees)		5511…5513
552		0-1-2-3-4 (60 degrees)		5521…5523
553		0-1-2-3-4-5 (60 degrees)		5531…5533
725	Star-Delta (Wye-Delta)	0-Y-Δ (45/90 degrees)	194L-E or 194L-A, 12…40 A, 3 poles	7253
732		0-Y-Δ (45/90 degrees)		7323
750		0-Y-Δ (60 degrees)	194L-E, 12…40 A, 3 poles	7503
730	Reversing	1-0-2 (45 degrees)	194L-E or 194L-A, 12…40 A, 3 poles	7303
754		1-0-2 (60 degrees)	194L-E, 12…40 A, 3 poles	7543
825	Voltmeter	0-RN-SN-TN-TR-ST-RS (45 degrees)	194L-E or 194L-A, 12 A, 1 pole	8251
827		0-RS-ST-TR (45 degrees)		8271
875	Ammeter	0-1-2-3 (90 degrees)		8751
876		0-1-2-3-4 (90 degrees)		8761
877		0-1 (90 degrees inverted)		8771

d

No. of Poles	
Code	Description
1	1 Pole
2	2 Poles
3	3 Poles
4	4 Poles
5	5 Poles
6	6 Poles

∗ Not all possible configurations are available as standard. Some configurations are custom orders with longer delivery times.
❄ When choosing front mount style 194L-E for 32 A or 40 A, use the 194L-C code.

Frequently Ordered 194L Switches — Base/Front-Mounted Switches
(Switch Handles listed on page 2-389)

ON-OFF Switch Body (Includes Shaft) 	No. of Poles	Contact Target Configuration X = Contact Closed O = Contact Open: No. of Circuits	Control Knob Position: OFF/0	Control Knob Position: ON/1	Rated Current [A]	Mounting Type	Cat. No.
1-Circuit ON-OFF Switch	1	1	O	X	20	Front/Door	**194L-E20-1751**
					25	Base/DIN	**194L-A25-1751**
						Front/Door	**194L-E25-1751**
2-Circuit ON-OFF Switch	2	1 2	O O	X X	12	Base/DIN	**194L-A12-1752**
						Front/Door	**194L-E12-1752**
					16	Front/Door	**194L-E16-1752**
					20	Base/DIN	**194L-A20-1752**
						Front/Door	**194L-E20-1752**
					25	Front/Door	**194L-E25-1752**
3-Circuit ON-OFF Switch	3	1 2 3	O O O	X X X	12	Base/DIN	**194L-A12-1753**
						Front/Door	**194L-E12-1753**
					16	Base/DIN	**194L-A16-1753**
						Front/Door	**194L-E16-1753**
					20	Base/DIN	**194L-A20-1753**
						Front/Door	**194L-E20-1753**
					25	Base/DIN	**194L-A25-1753**
						Front/Door	**194L-E25-1753**
4-Circuit ON-OFF Switch	4	1 2 3 4	O O O O	X X X X	12	Base/DIN	**194L-A12-1754**
					20	Base/DIN	**194L-A20-1754**
						Front/Door	**194L-E20-1754**
					25	Base/DIN	**194L-A25-1754**
						Front/Door	**194L-E25-1754**
6-Circuit ON-OFF Switch	6	1 2 3 4 5 6	O O O O O O	X X X X X X	16	Front/Door	**194L-E16-1756**
					20	Base/DIN	**194L-A20-1756**
						Front/Door	**194L-E20-1756**
					25	Base/DIN	**194L-A25-1756**
						Front/Door	**194L-E25-1756**

Reversing Switch Body (Includes Shaft)	No. of Poles	Contact Target Configuration X = Contact Closed O = Contact Open: No. of Circuits	Control Knob Position: 1	Control Knob Position: 0	Control Knob Position: 2	Rated Current [A]	Mounting Type	Cat. No.
5-Circuit Reversing Switch	3	1 2 3 4 5	O X X O X	O O O O O	X O O X X	25	Front/Door	**194L-E25-7543**

Visit our website: www.ab.com/catalogs

Preferred availability cat. nos. are printed in **bold**

Bulletin 194L Handles (for use with Bulletin 194L Switches)

Color	Handles (Includes Legend Plate and Control Knob)			
Red/Yellow (Emergency Stop colors)	*Type I*	*Type L With Locking For One Padlock (Padlock Not Included)*	*Type N*	**Bulletin 194L handles are available in both screw fixing and 22.5 mm mounting hole style.** IP66, UL Type 3/3R/12 for all 194L Handles
Black/Grey (Standard Operation colors)	*Type A*	*Type E With Locking For One Padlock (Padlock Not Included)*	*Type G*	*Type S*

Cat. No. Explanation

194L – HE 6 N – 175

a *b* *c* *d*

a

Code	Installation Type
HC	22.5 mm Mounting Hole Style Handle (for use with front-mounted switches)
HE	Screw-Mounting Handle (for use with front- and base-mounted switches)

b

Code	Use with Handle Type	Handle Legend Plate Size	Use With 194L Switch Size
4	A, E, I, L	48 mm x 48 mm (1-57/64 in. x 1-57/64 in.)	194L-A12…A25 194L-E12…E25 194L-C32…C40
	S	48 mm x 62 mm (1-57/64 in. x 2-7/16 in.)	
6	A, E, I, L	64 mm x 64 mm (2-33/64 in. x 2-33/64 in.)	194L-A12…40 A 194L-E12…40 A
	G, N∗	67 mm x 67 mm (2-41/64 in. x 2-41/64 in.)	
	S	64 mm x 78 mm (2-33/64 in. x 3-5/64 in.)	

∗ Use Type G and N with ON-OFF function only (selection "d").

c

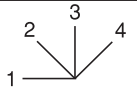
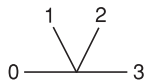
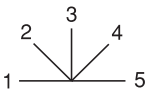
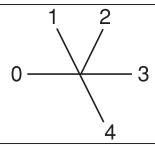
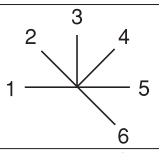
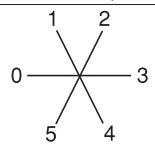
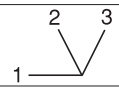
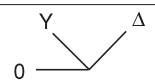
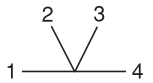
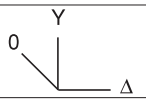
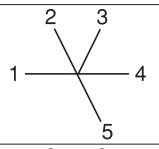
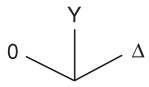
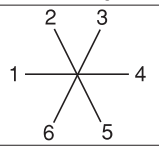
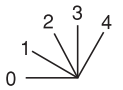
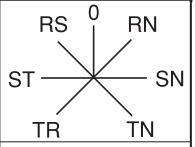
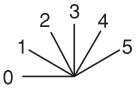
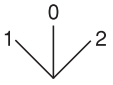
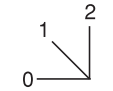
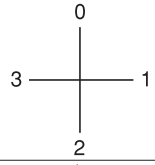
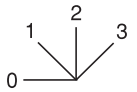
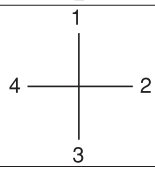
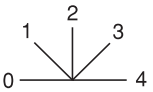
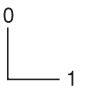
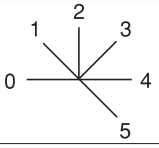
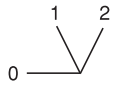
Code	Legend Plate Type	Color
A	Square	Grey/Black
I	Square	Red/Yellow
E	Square/Lockable	Grey/Black
L	Square/Lockable	Red/Yellow
G	Disc/Lockable (up to 3 locks)	Grey/Black
N	Disc/Lockable (up to 3 locks)	Red/Yellow
S	Large Square with extra legend area	Grey/Black

d

See Table on the next page.

2

d

Code	Description	Legend Marking	Code	Description	Legend Marking	Code	Description	Legend Marking
150	O-I		426	1-2-3-4 (45° Step Switch)		551	0-1-2-3 (60° Step Switch)	
150I	OFF-ON		427	1-2-3-4-5 (45° Step Switch)		552	0-1-2-3-4 (60° Step Switch)	
175	O-I		428	1-2-3-4-5-6 (45° Step Switch)		553	0-1-2-3-4-5 (60° Step Switch)	
175I	OFF-ON		450	1-2-3 (60° Step Switch)		725	0-Y-Δ (45°/90° Star-Delta Switch)	
178	O-I		451	1-2-3-4 (60° Step Switch)		732	0-Y-Δ (45°/90° Star-Delta Switch)	
178I	OFF-ON		452	1-2-3-4-5 (60° Step Switch)		750	0-Y-Δ (60° Star-Delta Switch)	
225	1-2 (45° Changeover without O)		453	1-2-3-4-5-6 (60° Step Switch)		754	Same as Code 350. Use order code 350.	
250	1-2 (60° Changeover without O)		500	0-1-2-3-4 (30° Step Switch)		825	0-RN-SN-TN-TR-ST-RS (45° Voltmeter Switch)	
300	1-0-2 (30° Changeover with spring return)		501	0-1-2-3-4-5 (30° Step Switch)		827	0-RS-ST-TR (45° Voltmeter Switch)	
325	1-0-2 (45° Changeover with O)		525	0-1-2 (45° Step Switch)		875	0-1-2-3 (90° Ammeter Switch — 3 c.t.'s)	
326	Same as Code 325. Use order code 325.		526	0-1-2-3 (45° Step Switch)		876	1-2-3-4 (90° Ammeter Switch — 4 c.t.'s)	
350	1-0-2 (Reversing 45° Changeover with O)		527	0-1-2-3-4 (45° Step Switch)		877	0-1 (90° Ammeter Switch — 1 c.t.)	
375	1-0-2 (90° Changeover with O)		528	0-1-2-3-4-5 (45° Step Switch)				
425	1-2-3 (45° Step Switch)		550	0-1-2 (60° Step Switch)				

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Allen-Bradley

Frequently Ordered 194L Handles — Base/Front-Mounted Switch Handles (Switch Body listed on page 2-387)

Handle Type	Degree of Protection	Handle Color	Legend Plate Size	For Use With	Legend Plate Marking	Cat. No.*
A	IP66	Black/Grey	48 mm x 48 mm (1-57/64 in. x 1-57/64 in.)	194L-E12…40 A, -7543	1-0-2	**194L-HC4A-350**
			48 mm x 48 mm (1-57/64 in. x 1-57/64 in.)	194L-E12…40 A, -7543 194L-A12…40 A, -7543		**194L-HE4A-350**
			64 mm x 64 mm (2-33/64 in. x 2-33/64 in.)	194L-E12…40 A, -7543 194L-A12…40 A, -7543		**194L-HE6A-350**
E		Black/Grey	48 mm x 48 mm (1-57/64 in. x 1-57/64 in.)	194E-16…63 A 194L-E12…40 A, -1753 194L-A12…40 A, -1753	0-1	**194L-HE4E-175**
					OFF-ON	**194L-HE4E-175I**
L		Red/Yellow	48 mm x 48 mm (1-57/64 in. x 1-57/64 in.)	194E-16…63 A 194L-E12…40 A, -1753 194L-A12…40 A, -1753	0-1	**194L-HE4L-175**
					OFF-ON	**194L-HE4L-175I**
G	IP66 (UL Type 3/3R/12)	Black/Grey	67 mm x 67 mm (2-41/64 in. x 2-41/64 in.)	194E-25…100 A 194L-E12…40 A, -1753 194L-A12…40 A, -1753	0-1 OFF-ON	**194L-HE6G-175**
N		Red/Yellow	67 mm x 67 mm (2-41/64 in. x 2-41/64 in.)	194E-25…100 A 194L-E12…40 A, -1753 194L-A12…40 A, -1753	0-1 OFF-ON	**194L-HE6N-175**
L	IP66 (UL Type 3/3R/12)	Red/Yellow	48 mm x 48 mm (1-57/64 in. x 1-57/64 in.)	194L-E12…40 A, -1753	0-1	**194L-HC4L-175**
					OFF-ON	**194L-HC4L-175I**

* For 22.5 mm mounting hole style (code HC), select either handle type A, E, I, or L with 48 x 48 mm legend plate size (code 4) only or handle type G or N with 64 x 64 mm legend plate size (code 6) only.

Rectangular Knob Handle (Includes Legend Plate and Control Knob)	Color	Locking Provision	Legend Plate Size	For Use With	Fixing	Legend Marking	Cat. No.
	Black/Grey	None	48 mm x 48 mm (1-57/64 in. x 1-57/64 in.)	194L-A 12…40 A switches ONLY	Screw	0-1	194L-HE4P-175
						OFF-ON	**194L-HE4P-175I**

22.5 mm Mounting Hole Style Knob and Keyed Type Handles

	Description	Fixing	Pkg. Qty.	Cat. No.
Type B	22.5 mm Mounting Hole Style Handles (IP65) Handle Style: Knob Lever with Latch (For Use With 194E-E25…100 A, -1753) or 194L-E12…40 A	22.5 mm Mounting Hole Style	1	**194L-HCB-001**
Type D	22.5 mm Mounting Hole Style Handles Key Removal Position (Includes Latch) For Use With 194L-E 12…40 A, 194E-E16…63 A, -1753	22.5 mm Mounting Hole Style	1	**194L-HCDC-001**
	22.5 mm Mounting Hole Style Handles Key Removal Position (Includes Latch) For Use With 194L-E 12…40 A, 194E-E16…63 A, -1753			**194L-HCDD-001**
	22.5 mm Mounting Hole Style Handles Key Removal Position (Includes Latch) For Use With 194L-E 12…40 A, 194E-E16…63 A, -1753			**194L-HCDG-001**
	22.5 mm Mounting Hole Style Handles Key Removal Position (Includes Latch) For Use With 194L-E 12…40 A, 194E-E16…63 A -1753			**194L-HCDH-001**

2

Custom Motor-Rated Cam Switches

Switch Specifications for Special Versions of Bulletin 194L Switches

Bulletin 194L switches are offered in 12, 16, 20, or 25 A load sizes. Switches may be configured for up to 16 inductive load 32 and 40 A rated circuits. Handle operation may be specified for up to 12 positions, with 30, 60, 45 or 90 degrees of positional rotation. Maintained and some spring return functions may be specified. Custom legend markings are also available.

Key Features

- Motor rated/HP rated to switch inductive loads
- Same appearance as standard 194L devices
- Suitable as Motor Disconnect
- Suitable for Across-the-Line motor starting applications
- Gold flashed contacts for Auxiliary load switching
- UL Listed, CSA Certified, CE compliant
- Lockout/Tagout compliant (when using lockable handles)
- Mounts to many competitive panel drilling patterns

Instructions to receive your price and availability quotation

- Complete the following layout form.
- Fill in distributor name, date, telephone/fax, quantity required and end user name. To locate your nearest Allen-Bradley distributor, go to www.ab.com.
- Select all the following options:
  Switch load size and mounting style
  Target table, # positions, spring returned/maintained operation
  Handle type
  Special wiring & terminal markings (optional)
- In the U.S. and Canada, send the completed Custom Switch form to your local Allen-Bradley distributor

If you are outside the US or Canada, or if you have technical questions about filling out this form, please call our Technical Response Center at 440-646-5800 and select the "Allen-Bradley Industrial Controls" option.

Special Switches

Switching specification for special versions of 194-L switches (sample for copy)

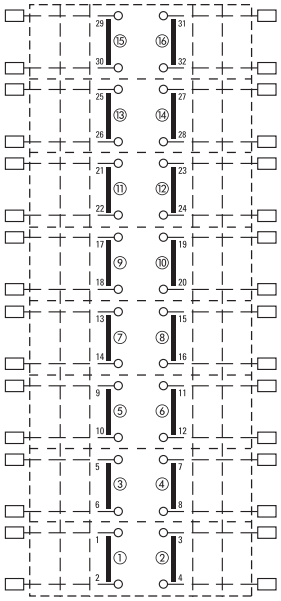
Distributor	Location	Date
Quantity	Phone No.	Fax No.
End User Name		

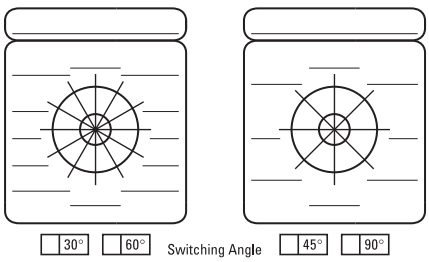
Switch Load Size & Mounting (choose 1)

194L-A12	194L-A16	194L-A20	194L-A25	**Base Mount Switching (8 Circuit Max.)**
194L-E12	194L-E16	194L-E20	194L-E25	**Door Mount Switching (16 Circuit Max.)**

Switch Level	Circuit No.	Terminal Markings	Target Table											
8	16	31-32												
	15	29-30												
7	14	27-28												
	13	25-26												
6	12	23-24												
	11	21-22												
5	10	19-20												
	9	17-18												
4	8	15-16												
	7	13-14												
3	6	11-12												
	5	9-10												
2	4	7-8												
	3	5-6												
1	2	3-4												
	1	1-2												
Position #/ Function **X** Contact Closed Spring Return **X-X** Contact Closed in several positions														

Special Wiring or Terminal Markings

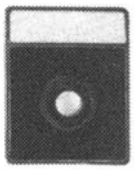
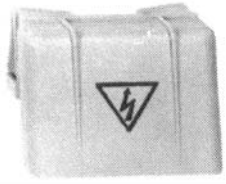




Handle and Legend Selection

Handle Type: 194L-H__ __ __ (See page 2-389 for handle styles.)
Quantity: _____
Note: _____

Accessories

	Description	Pkg. Qty.	Cat. No.
 ***Standard Black Control Knob*** ***Rectangular Front Frame***	Control Knob, Black, L = 37.5 mm (1-31/64 in.)	5	**194L-G3154N**
	Control Knob, Black, L = 48 mm (1-57/64 in.)	5	**194L-G3155N**
	Control Knob, Red, L = 37.5 mm (1-31/64 in.)	5	194L-G3154R
	Control Knob, Red, L = 48 mm (1-57/64 in.)	5	**194L-G3155R**
	Rectangular front frame with blank nameplate L = 48 mm x 62 mm (1-57/64 in. x 2-7/16 in.)	10	**194L-G3196**
	Rectangular front frame with blank nameplate L = 64 mm x 78 mm (2-33/64 in. x 3-5/64 in.)	10	**194L-G3197**
Control Knob, With Locking Facility	Control Knob, Black, with Locking Facility (Use 1/4 in. max. hasp lock.) (Locks in 0°, 90°, 180°, and 270° positions)	10	**194L-G2864N**
	Control Knob, Red, with Locking Facility (Use 1/4 in. max. hasp lock)		**194L-G2864R**
	Control Knob, Type P Control Knob, Black, 31 mm (1-7/32 in.) Diameter	5	**194L-G2888N**
	Control Knobs, Type P Control Knob, Red, 31 mm (1-7/32 in.) Diameter		194L-G2888R
	Large Control Knob, 41 mm (1-5/8 in.) Diameter; IP40, Black	5	194L-G2851N
	Control Knob, 41 mm (1-5/8 in.) Diameter; IP65, Black	5	194L-G2854N
	Use Bulletin 800F Legend Frames and Inserts	—	—
	Blank Legend Plate, 48 mm x 48 mm (1-57/64 in. x 1-57/64 in.)	10	**194L-B4**
	Blank Legend Plate, 64 mm x 64 mm (2-33/64 in. x 2-33/64 in.)		**194L-B6**
	Locking Ring Wrench For 22.5 mm Mounting Hole Style Handles (For use with front-mounted switches)	1	**800E-AW2**
	Terminal Cover — Base/DIN For Cat. No. 194L-A12…16	10	**194L-A12-C34**
	Terminal Cover — Front (Door) For Cat. No. 194L-E12…16		**194L-E12-C34**
	Terminal Cover — Base/DIN For Cat. No. 194L-A20…25	10	**194L-A20-C34**
	Terminal Cover — Front (Door) For Cat. No.194L-E20…25		**194L-E20-C34**

	Use With Switch	Number of Contacts❄	ABS Cat. No.	Required Shaft Cat. No.	Noryl Material Cat. No.	Required Shaft Cat. No.
Use With Size 6 Handles	194L-A12/16	1…2	**194L-G3572**	**194L-G3195**	**194L-G3576**	**194L-G3195**
		3…4	**194L-G3572**	**194L-G2830**	**194L-G3576**	**194L-G2830**
		5…6	**194L-G3573**	**194L-G3195**	194L-G3577	**194L-G3195**
	194L-A20/25	1…2	**194L-G3572**	**194L-G3194**	**194L-G3576**	**194L-G3194**
		3…4	**194L-G3572**	**194L-G2830**	**194L-G3576**	**194L-G2830**
		5…6	**194L-G3573**	**194L-G3194**	194L-G3577	**194L-G3194**
	194L-E12/16	1…4	✶ **194L-G3574**	**194L-G3380**	**194L-G3578**✶	**194L-G3380**
		5…8	✶ **194L-G3575**	**194L-G3380**	194L-G3579✶	**194L-G3380**
	194L-E20/25	1…4	✶ **194L-G3574**	**194L-G3380**	**194L-G3578**✶	**194L-G3380**
		5…8	✶ **194L-G3575**	**194L-G3380**	194L-G3579✶	**194L-G3380**

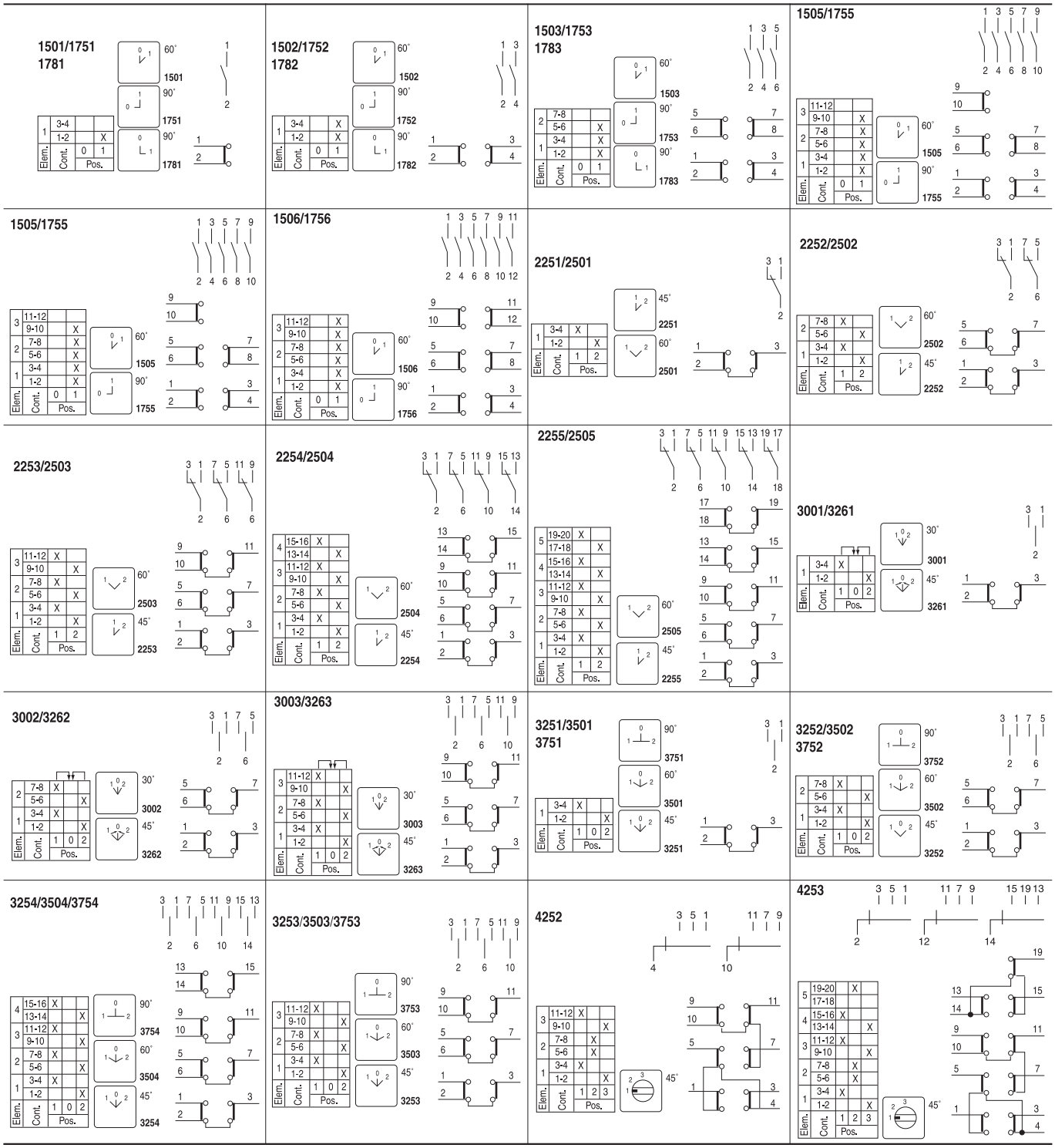
✶ Covers must be drilled for operating handle by user. Does not include earth/ground — neutral terminal.
❄ Refer to the switching diagrams that follow to determine the number of switch contacts.

	Description	Pkg. Qty.	Cat. No.
	Metal Shaft Extension with Padlock Provision ON Switch in OFF Position L = 110 mm…235 mm (4-21/64 in.…9-1/4 in.)	1	**194L-G3393**
	Metal Shaft Extension with Padlock Provision ON Switch in OFF Position L = 230 mm…350 mm (9-3/64 in.…13-51/64 in.)	1	**194L-G3394**
	Metal Shaft Extension For modification of Cat. No. 194L-G3393/ G3394 when used with any switches other than 2-position, 90° rotation.	10	**194L-G3399**
	Standard Interlock Shaft For Use With 194L-A12…40 = 44 mm (1-47/64 in.)	5	**194L-G2830**❄
	Interlock Shaft For Use With 194L-A12…40 = 52 mm (2-3/64 in.)		**194L-G3194**❄
	Interlock Shaft For Use With 194L-A12…40 = 57 mm (2-15/64 in.)		**194L-G3195**❄
	Shaft Extension Including Coupling For Use With 194L-A12…40 = 24 mm (15/16 in.)	10	**194L-G2853**
	Standard Shaft For Use With 194L-E12…40 = 34 mm (1-11/32 in.)	5	**194L-G3380**

❄ For Use With **194L-A**… Base-Mounted switches only.

Contact target tables: X = Contact Closed
[Blank] = Contact Open

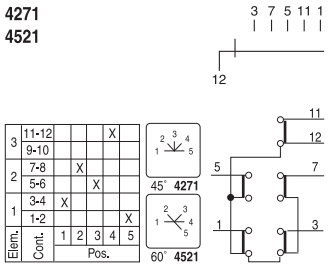
Circuit Diagram Nos. 1501…4253



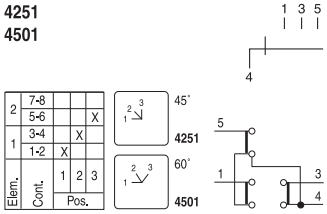
2

Circuit Diagram Nos. 4271…5531

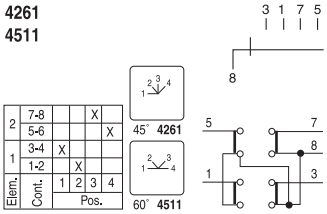
4271
4521



4251
4501



4261
4511



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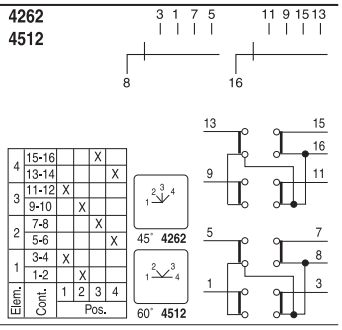
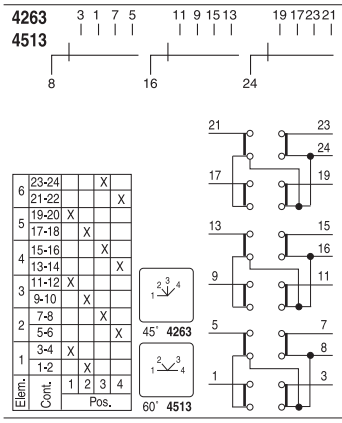
4512



4263
4513



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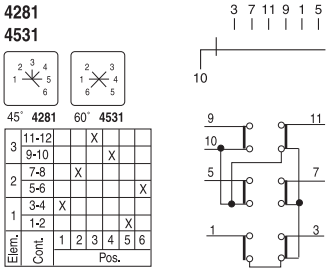

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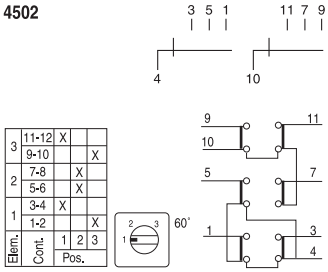
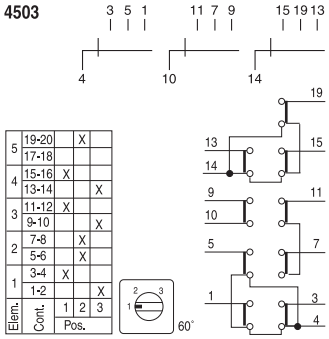
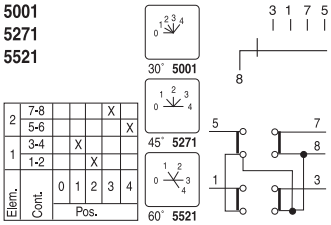


4503



5001
5271
5521



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5272
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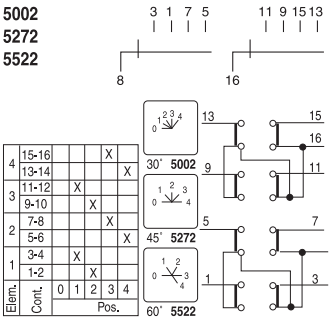
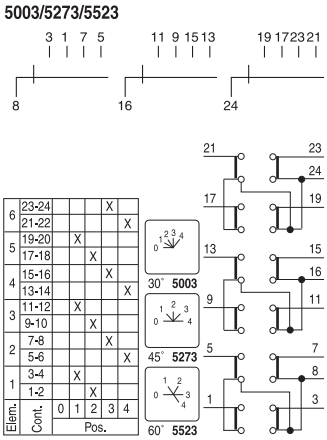
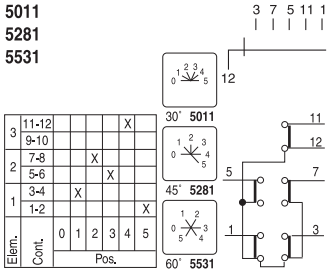


5003/5273/5523



5011
5281
5531



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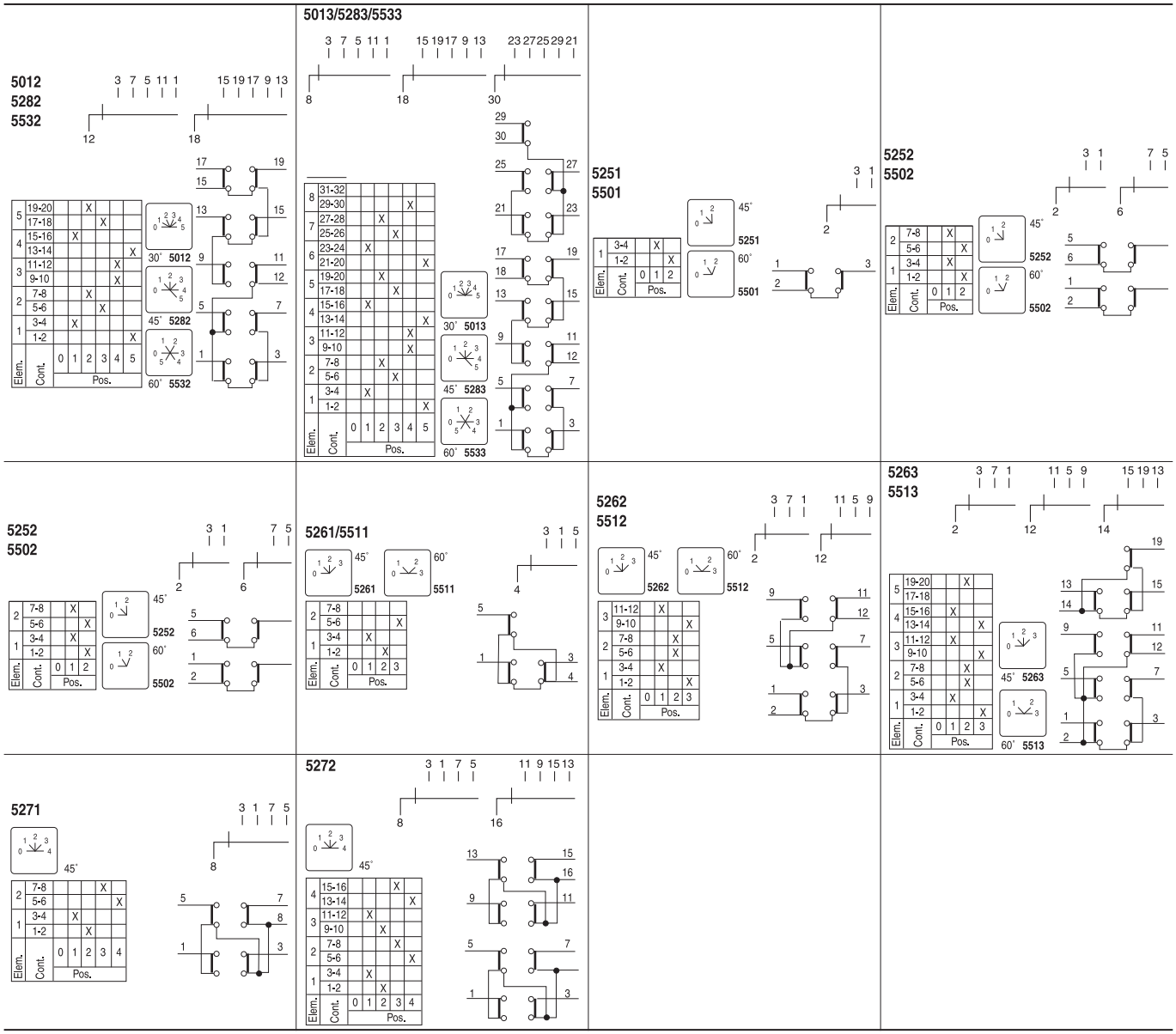
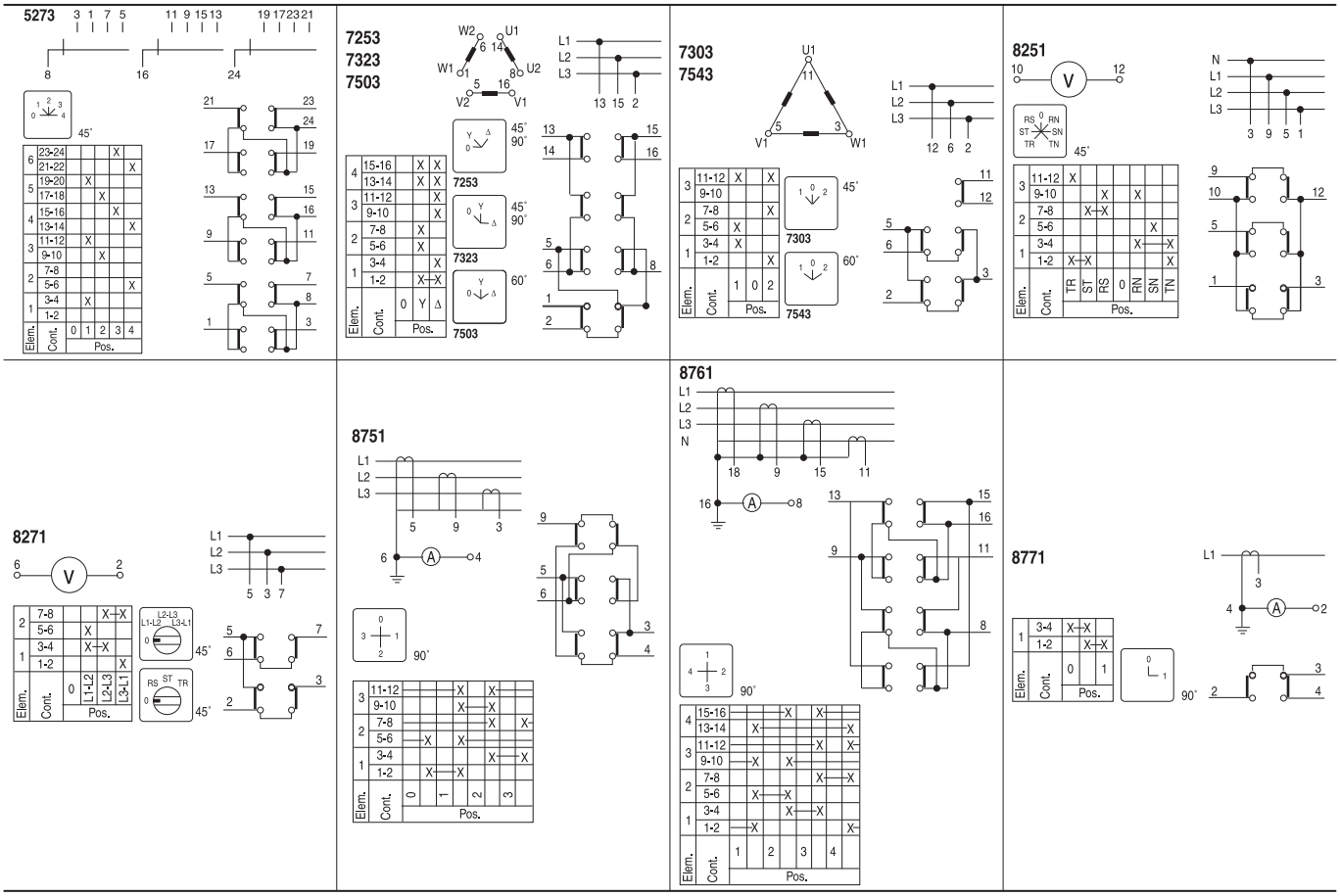
Circuit Diagram Nos. 5012...5272



Circuit Diagram Nos. 5273...8771



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Allen-Bradley

Electrical Ratings

Performance Data											12 A	16 A	20 A	25 A	32 A	40 A
IEC Applications																
Rated voltage U_e ✶		IEC-947								[V]	690	690	690	690	690	690
Isolating conditions acc. to VDE fulfilled up to rated impulse voltage *U*imp										[kV]	6	6	6	6	8	8
Thermal rated current I_{th}✶	40 °C	IEC-947								[A]	16	20	25	30	32	45
Thermal rated current I_{the}	60 °C	IEC-947								[A]	12	16	20	25	32	45
Rated current I_e✶																
AC-1/ AC-21A	Non-inductive or slightly inductive loads/ switching of resistive loads with slight overload	IEC-947							690V	[A]	12	16	20	25	32	40
AC-1	Non-inductive or slightly inductive loads	SEV							660V	[A]	12	16	20	25	32	40
AC22A	Switching of mixed resistive and inductive loads with slight overload	IEC-947							220…500V 690V	[A] [A]	12 12	16 16	20 20	25 25	32 32	40 40
AC-15	Switching of inductive drives, motors, valves, and electromagnets.	IEC-947							220…240V 380…415V 500V	[A] [A] [A]	5 3 2	6 4 2.5	7 5 3	8 6 4	—	—
DC switching capacity Rated current I_e		Contacts in series														
	Rated Voltage [V]	1	2	3	4	5	6	8								
		24	48	72	96	120	144	192		[A]	12	16	20	22	—	—
		48	96	144	192	240	288	384		[A]	10	12	16	18	—	—
		60	120	180	240	300	360	450		[A]	8	10	12	14	32	40
DC-21A	For resistive loads, T ≤ 1ms	110	220	330	440	550	660	—		[A]	2	2.5	4	5	—	—
		220	440	660	—	—	—	—		[A]	0.5	0.6	0.7	0.8	—	—
	U_e max = 600V	440	—	—	—	—	—	—		[A]	0.4	0.4	0.5	0.5	—	—
Rated making/breaking capacity (= 1.5 x I_e)																
		25.2	50.4	75.6	100.8	126	151.2	201.6		[A]	18	24	30	33	—	—
	1.05 x Rated voltage [V]	50.4	100.8	151.2	201.6	252	302.4	403.2		[A]	15	21	24	27	—	—
	For resistive loads, T I_{th} 1ms	63	126	189	252	315	378	504		[A]	12	18	18	21	48	60
		115.5	231	346.5	462	577.5	—	—		[A]	3	4.5	6	7.5	—	—
	U_e max = 600V	231	462	—	—	—	—	—		[A]	0.75	1.12	1.05	1.2	—	—
		462	—	—	—	—	—	—		[A]	0.52	0.78	0.47	0.75	—	—
Rated current I_e																
	Rated voltage [V]	24	48	72	96	120	144	192		[A]	8	10	12	14	16	16
		30	60	90	120	150	180	240		[A]	4.5	5.5	7	8	—	—
	For inductive loads T = 50 ms	48	96	144	192	240	288	384		[A]	1.5	2	2.5	3	8	8
	Rated voltage [V]	60	120	180	240	300	360	450		[A]	1	1.2	1.5	1.8	4.8	4.8
		110	220	330	440	550	660	—		[A]	0.4	0.5	0.6	0.7	2	2
		220	—	—	—	—	—	—		[A]	—	—	—	—	0.6	0.6
Rated making/breaking capacity (= 1.1 x I_e)																
	1.1 x Rated voltage [V]	26.4	52.8	79.2	105.6	132	158.4	184.8		[A]	8.8	11	13.2	1.54	—	17.6
		33	66	99	132	165	198	231		[A]	4.95	6.05	7.7	8.8	—	—
	For inductive loads T = 50 ms	52.8	105.6	158.4	211.2	264	316.8	369.6		[A]	1.65	2.2	2.75	3.3	8.8	8.8
	U_e max = 600V	66	132	198	264	330	396	462		[A]	1.1	1.32	1.65	1.98	5.28	5.28
		121	242	363	484	605	—	—		[A]	4.95	6.05	7.7	8.8	2.2	2.2
Power Lost										[W]	0.3	0.5	0.6	0.9	0.8	1.4
Rated power P_e		Contacts in series														
		24				1				[kW]	0.12	0.15	0.20	0.25	0.30	0.30
		24				2				[kW]	0.20	0.25	0.30	0.37	—	—
		48				2				[kW]	0.25	0.30	0.37	0.50	0.50	0.50
		48				3				[kW]	0.30	0.37	0.50	0.75	—	—
Rated voltage [V] DC-23A, DC-3, DC-5 For inductive loads, T ≤1 ms		60				2				[kW]	0.25	0.30	0.37	0.50	1.00	1.00
		60				4				[kW]	0.37	0.50	0.75	1.00	—	—
		110				4				[kW]	0.50	0.75	1.00	1.20	—	—
		110				6				[kW]	1.00	1.20	1.40	1.60	—	—
		220				4				[kW]	0.37	0.50	0.75	1.00	—	—
		220				6				[kW]	1.00	1.20	1.40	1.50	—	—

✶ See standards compliance listed on page page 2-386.

❄ 32 and 40 A data for one contact in series.

Performance Data, Continued					12 A	16 A	20 A	25 A	32 A	40 A
IEC Applications, Continued										
Rated making/breaking capacity (= 4 x I_e)		Contacts in series								
Rated Voltage [V]	25.2	1		[A]	20.0	25.0	33.3	41.6	50.0	50.0
	25.2	2		[A]	33.3	41.6	50.0	61.6	—	—
DC-23A, DC-3, DC-5	50.4	2		[A]	21.0	25.0	30.8	41.6	41.6	41.6
For inductive loads, T ≤ 7.5 ms	50.4	3		[A]	25.0	30.8	42.0	62.4	—	—
	63	2		[A]	16.6	20.0	24.6	33.2	66.6	66.6
	63	4		[A]	24.6	33.3	50.0	66.4	—	—
	115.5	4		[A]	18.1	27.2	36.4	44.0	—	—
	115.5	6		[A]	36.4	43.6	51.0	58.2	—	—
	231	4		[A]	6.7	9.1	13.6	18.2	—	—
	231	6		[A]	18.1	21.8	25.2	27.2	—	—
Rated breaking capacity			at 220V 0.45 [cos j]	[A]	72	96	128	176	296	296
			at 380V 0.45 [cos j]	[A]	72	96	128	176	280	336
			at 660V 0.45[cos j]	[A]	53	72	86	112	196	196
Rated power P_e*	IEC-947									
AC-2 Slip-ring motors: starting, reversing and electric braking; star/delta starting	3 Ø 3-pole		240V	[kW]	3	4	5.5	5.5	—	—
			380V	[kW]	5.5	7.5	9	13	—	—
			415V	[kW]	5.5	7.5	9	13	—	—
			440V	[kW]	5.5	7.5	9	13	—	—
			500V	[kW]	7.5	10	11	15	—	—
			660V	[kW]	7.5	10	11	15	—	—
AC-3 Squirrel-cage motors: starting and stopping of running motors	IEC-947									
	3 Ø 3-pole		220…240V	[kW]	2.2	3	4.5	5.5	7.5	7.5
			380…440V	[kW]	4	5.5	7.5	11	15	18.5
			500V	[kW]	5.5	7.5	10	13	—	—
			660V	[kW]	5.5	7.5	8	11	18.5	18.5
	1 Ø 2-pole		110V	[kW]	0.75	1.1	1.2	1.6	—	—
			220…240V	[kW]	1.3	2.2	2.5	3.2	4	4
			380…440V	[kW]	2.2	3.7	4.5	5.5	8	16
AC-4 Squirrel-cage motors: starting, reversing, electric braking, inching	IEC-947									
	3 Ø 3-pole		220…240V	[kW]	0.75	1.5	3	4	5.5	5.5
			380…415V	[kW]	1.5	2.2	3.7	5.5	7.5	7.5
			440…550V	[kW]	1.5	2.2	3.7	5.5	7.5	11
	1 Ø 2-pole		110V	[kW]	0.18	0.37	0.55	0.75	—	—
			240V	[kW]	0.37	0.75	1.5	2.2	—	—
			380V	[kW]	0.75	1.1	1.8	3	—	—
			440V	[kW]	0.75	1.1	1.8	3	—	—

* See standards compliance listed on page page 2-386.

Performance Data, Continued					12 A	16 A	20 A	25 A	32 A	40 A
IEC Applications, Continued										
AC-23A	Occasional switching of motors and other highly inductive loads (criterion for selecting main switches)	IEC-947 3Ø 3-pole	220…240V 380…440V 500V 660V	[kW] [kW] [kW] [kW]	2.2 4 5.5 5.5	3 5.5 7.5 7.5	4.5 7.5 10 8	5.5 11 13 11	11 18.5 — 22	11 22 — 22
		1Ø 2-pole	110V 220…240V 380…440V	[kW] [kW] [kW]	0.75 1.3 2.2	1.1 2.2 3.7	1.2 2.5 4.5	1.6 3.2 5.5	— 5.5 11	— 5.5 11
Short-circuit ratings										
	Rated short-time current (1s)			[kA_{rms}]	0.48	0.48	0.6	0.75	0.8	0.8
	Strongest series fuse, not in enclosure	(gL characteristic)		[A]	20∗	20∗	20∗	25∗	35	40
	Conditional rated short-circuit			[kA]	6	6	5	5	5	5
Switch Rate		electrical		[ops/h]	120	120	120	120	120	120
CSA and UL Applications										
Rated Voltage U_e				[V AC]	600	600	600	600	600	600
Ampere Rating	Pilot Duty General Use	Contact class Non-inductive or slightly inductive load❄		[A]	A600 12	A600 16	— 20	— 25	— 32	— 40
Rated power P_e‡		UL (CSA)			(FLA)	(FLA)	(FLA)	(FLA)		
Standard motor DOL rating (similar to AC-3)		3Ø 3-pole	120V 240V 480V 600V	[Hp] [Hp] [Hp] [Hp]	1 (7.2) 2 (6.8) 5 (7.6) 5 (6.1)	1.5 (12) 3 (9.6) 7.5 (11) 7.5 (9)	2 (13.6) 4 (12.4) 8 (11.6) 10 (11)	3 (19.2) 6 (18) 12 (17) 15 (17)	5 (30.4) 7.5 (22) 20 (27) 20 (22)	5 (30.4) 10 (28) 25 (34) 25 (27)
		1Ø 2-pole	120V 240V 480V 600V	[Hp] [Hp] [Hp] [Hp]	0.5 (9.8) 1 (8.0) 2 (6.0) 3 (6.8)	.75 (13.8) 1.5 (10.0) 3 (8.5) 3 (6.8)	1 (16) 2 (12) 4 (11.2) 5 (11.2)	1.5 (20) 3 (17) 6 (17) 7.5 (16)	2 (24) 5 (28) 7.5 (21) 10 (20)	2 (24) 5 (28) 10 (26) 15 (27)
Heavy motor load, reversing Rating (similar to AC-4) Max. back-up fuse		3Ø 3-pole (gG characteristic)	120V 240V	[Hp] [Hp] [A]	— — 35	— — 55	— — 60	— — 80		
Short Circuit Ratings	Maximum Short Circuit Prospective Fault Current			[kA]	5	5	5	5		
	Maximum Fuse Size			[A]	35	55	60	80		
Switching Rate		electrical		[ops/h]	120	120	120	120	120	120

Mechanical Data

Performance Data			12/16 A	20/25 A	32/40 A
Protection class acc. to IEC 529	Handles Switch Bodies		IP66 IP20	IP66 IP20	IP66 IP20
Mechanical Endurance		[mil.ops]	1	1	1
Switching rate	mechanical	[ops/h]	1200	1200	1200
Maximum Wire Gauges					
	rigid wire	AWG [mm^2]	(2)18…12 (2)1…2.5	(2)16…10 (2)1.5…6	(2)12…8 (2)4…10
	fine strands	AWG [mm^2]	(2)18…12 (2)1…2.5	(2)16…10 (2)1.5…4	(2)14…10 (2)2.5…6

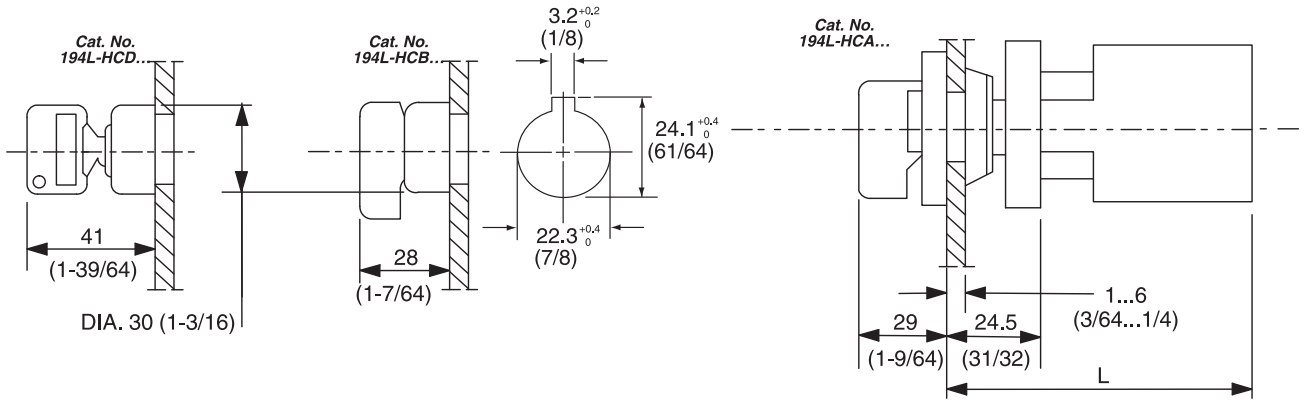
Environmental Data

Performance Data		12/16/20/25 A	32/40 A
Ambient temperature			
	Operation	–25…+60 °C (–13…+140 °F)	–25…+60 °C (–13…+140 °F)
	Storage	–40…+80 °C (–40…+176 °F)	–40…+80 °C (–40…+176 °F)

∗ Does not apply to switches in enclosure.
❄ Suitable for switching off-load (AC-20) above 660V, but only up to 660V for switches with screws at the rear.
‡ See standards compliance listed on page page 2-386.

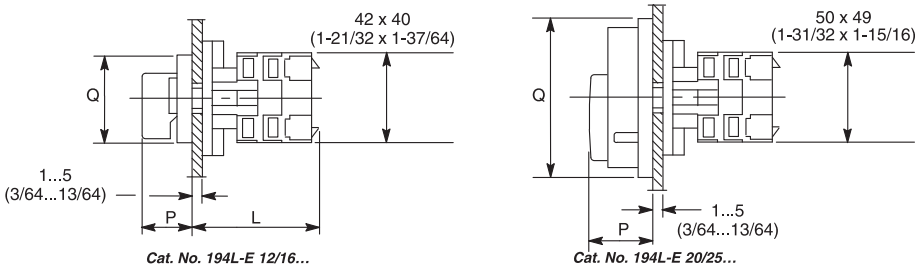
Dimensions are shown in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

***Cat. No. 194L-E**... for Central Fixing (**194L-HC**...)*

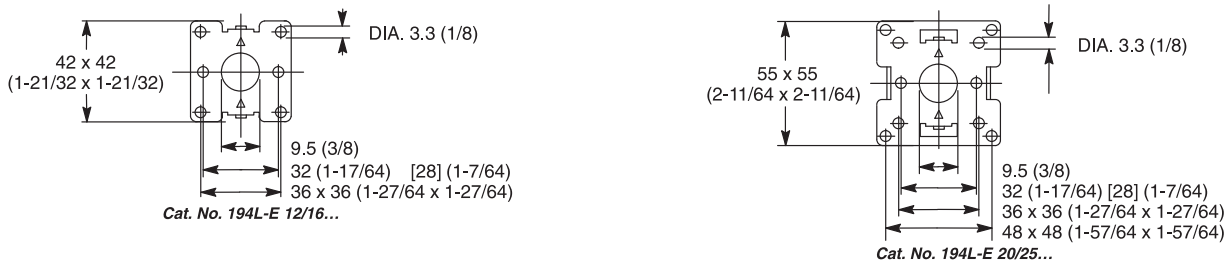


Cat. No.	L				
	No. of Contacts				
	1...2	3...4	5...6	7...8	9...10
194L-E12/16...	67.5 (2-21/32)	77.5 (3-3/64)	87.5 (3-7/16)	97.5 (3-27/32)	107.5 (4-15/64)
194L-E20/25...	69 (2-23/32)	81.5 (3-7/32)	94 (3-45/64)	106.5 (4-3/16)	119 (4-11/16)
194L-E32/40...	86 (3-25/64)	103.5 (4-5/64)	121 (4-49/64)	138.5 (5-29/64)	156 (6-9/64)

Cat. No. 194L... for Front (Door) Installation



Mounting Dimensions



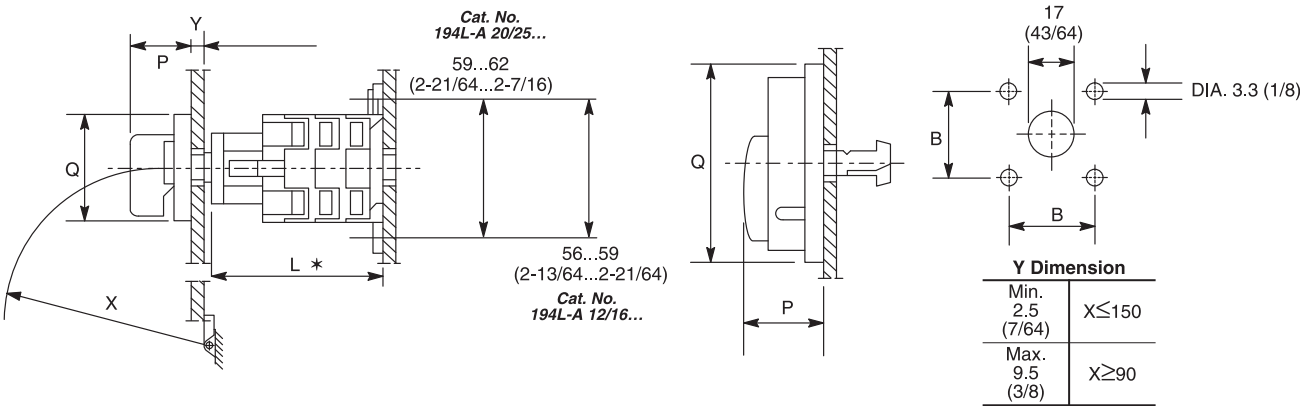
Cat. No.	L				
	No. of Contacts				
	1...2	3...4	5...6	7...8	9...10
194L-E12/16...	44 (1-47/64)	54 (2-1/8)	64 (2-33/64)	74 (2-29/32)	84 (3-5/16)
194L-E20/25...	44.5 (1-3/4)	57 (2-1/4)	69.5 (2-3/4)	82 (3-15/64)	94.5 (3-23/32)
194L-E32/40...	43 (1-11/16)	58.5 (2-5/16)	76 (2-63/64)	93.5 (3-11/16)	111 (4-3/8)

Control Knob

Cat. No.	P	Q
194L-HE4A...	28 (1-7/64)	48 (1-57/64) x 48 (1-57/64)
194L-HE4I...		
194L-HE4S...		48 (1-57/64) x 62 (2-7/16)
194L-HE6A...		64 (2-33/64) x 64 (2-33/64)
194L-HE6I...		
194L-HE6S...		64 (2-33/64) x 78 (3-5/64)
194L-HE6N...		67 (2-41/64) x 67 (2-41/64)
194L-HE6G...	34 (1-11/32)	

Dimensions are shown in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

***Cat. No. 194L-A**... for Base/DIN Rail Installation*



Cat. No.	L ✶ No. of Contacts			
	1...2	3...4	5...6	7...8
194L-A12/16...	58 (2-9/32)	68 (2-11/16)	78 (3-5/64)	88 (3-15/32)
194L-A20/25...	58 (2-9/32)	71.5 (2-13/16)	84 (3-5/16)	96.5 (3-51/64)
194L-A32/40...	67.5 (2-21/32)	85 (3-11/32)	102.5 (4-1/32)	120 (4-47/64)

Control Knob

Cat. No.	P	B	Q
194L-HE4A...	28 (1-7/64)	36 (1-27/64)	48 (1-57/64) x 48 (1-57/64)
194L-HE4I...			
194L-HE4S...			48 (1-57/64) x 62 (2-7/16)
194L-HE6A...		48 (1-57/64)	64 (2-33/64) x 64 (2-33/64)
194L-HE6I...			
194L-HE6S...			64 (2-33/64) x 78 (3-5/64)
194L-HE6N...	34 (1-11/32)		67 (2-41/64) x 67 (2-41/64)
194L-HE6G...			

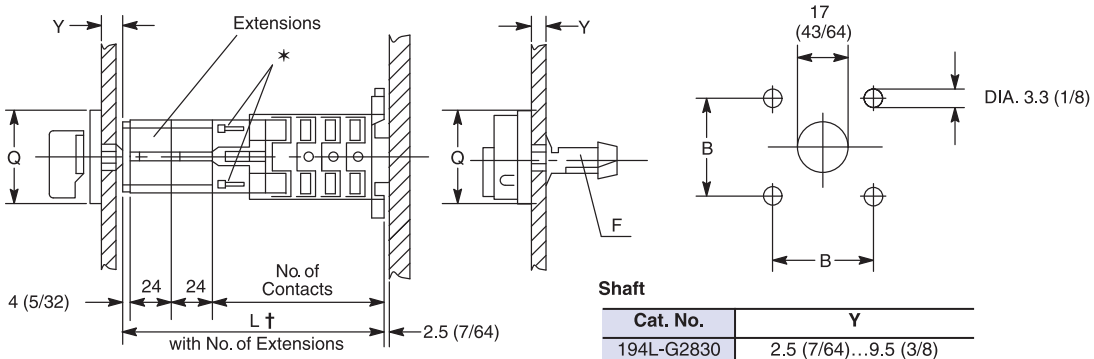
✶ With DIN 46 277 (35) Rail + 2.5 mm (7/64)

IEC Control and Load Switches

Approximate Dimensions, Continued

Dimensions are shown in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

Cat. No. 194L-A**... With Shaft Extension **Cat. No. 194L-G2853



Shaft

Cat. No.	Y
194L-G2830 194L-G3194 194L-G3195	2.5 (7/64)...9.5 (3/8) 9 (23/64)...18 (23/32) 14 (35/64)...23 (29/32)

	Cat. No. 194L-A12/16... 10mm (0.39)				Cat. No. 194L-A20/25... 12.5mm (0.49)				Cat. No. 194L-A32/40			
	L											
	No. of Contacts											
No. of Extensions	1...2	3...4	5...6	7...8	1...2	3...4	5...6	7...8	1...2	3...4	5...6	7...8
With 1 extension	82 (3-15/64)	92 (3-5/8)	102 (4-1/64)	112 (4-13/32)	83 (3-17/64)	95.5 (3-49/64)	108 (4-1/4)	120.5 (4-3/4)	91.5 (3-15/64)	108 (4-1/4)	126.5 (5-63/64)	144 (6-43/64)
With 2 extensions	106 (4-11/64)	116 (4-37/64)	126 (4-31/32)	136 (5-23/64)	107 (4-7/32)	119.5 (4-45/64)	132 (5-13/64)	144.5 (5-11/16)	115.5 (5-35/64)	133 (5-15/64)	150.5 (6-5/16)	168 (7-5/8)
With 3 extensions	130 (5-1/8)	140 (5-33/64)	150 (5-29/32)	160 (6-19/64)	131 (5-5/32)	143.5 (5-21/32)	156 (6-9/64)	168.5 (6-5/8)	135.5 (5-11/32)	157 (6-3/16)	174.5 (7-7/8)	182 (8-9/16)
With 4 * extensions	154 (6-1/16)	164 (6-15/32)	174 (6-55/64)	184 (7-15/64)	155 (6-7/64)	167.5 (6-19/32)	180 (7-3/32)	192.5 (7-37/64)	163.5 (6-7/16)	181 (7-1/8)	198.5 (8-53/64)	216 (9-33/64)
With 5 * extensions	178 (7-1/64)	188 (7-13/32)	198 (7-51/64)	208 (8-3/16)	179 (7-3/64)	191.5 (7-35/64)	204 (8-1/32)	216.5 (8-33/64)	187.5 (7-3/8)	205 (8-5/64)	222.5 (9-49/64)	240 (9-29/64)
With 6 * extensions	202 (7-61/64)	212 (8-23/64)	222 (8-3/4)	232 (9-1/8)	203 (7-63/64)	215.5 (8-31/64)	228 (8-63/64)	240.5 (9-15/32)	211.5 (8-21/64)	229 (12)	246.5 (10-23/32)	264 (10-13/32)

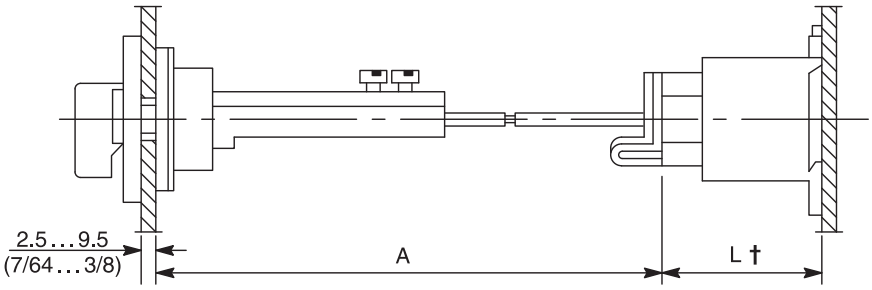
Control Knob

Cat. No.	Q	B
194L-HE4A...	48 (1-57/64) x 48 (1-57/64)	36 (1-27/64)
194L-HE4I...		
194L-HE6A...	64 (2-33/64) x 64 (2-33/64)	48 (1-57/64)
194L-HE6I...		
194L-HE6N...	67 (2-41/64) x 67 (2-41/64)	
194L-HE6G...		

* When more than 4 modules are used, attach the first one to the switch body using the screws supplied with the extension **(Cat. No. 194L-G2853)**.
❄ Mounting on DIN 46 277 (35) Rails.

Dimensions are shown in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

***Cat. No. 194L-A**... With Metal Shafts*



Cat. No.	A
194L-G3393...	110 (4-21/64)...235(9-1/4)
194L-G3394...	230 (9-1/16)...350 (13-25/32)

Cat. No.	L* No. of Contacts			
	1...2	3...4	5...6	7...8
194L-A12/16...	54 (2-1/8)	64 (2-33/64)	74 (2-29/32)	84 (3-5/16)
194L-A20/25...	55 (2-11/64)	67.5 (2-21/32)	80 (3-5/32)	92.5 (3-41/64)
194L-A32/40...	63.5 (2-31/64)	81 (3-3/16)	88.5 (3-7/8)	116 (4-9/16)

Modular Shaft Extensions (Cat. No. 194L-G2853)

Select No. of Extension Modules and Shaft for use with enclosures.

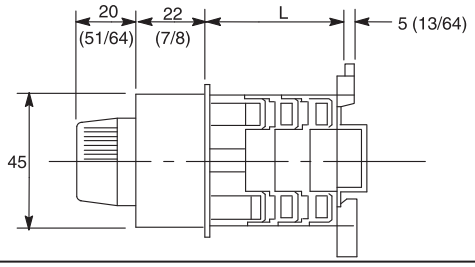
No. of Extension Modules	Required End Shaft	Enclosure Mounting Depth‡	
		Cat. No. 194L-A12/16...	Cat. No. 194L-A20/25...
0	44 (1-47/64) §	71.5...77.5 (2-13/16...3-1/16)	75...80.5 (2-61/64...3-11/64)
	52 (2-3/64)	77...87 (3-1/32...3-27/64)	80...90 (3-5/32...3-35/64)
	57 (2-1/4)	82...92 (3-15/64...3-5/8)	85...95 (3-11/32...3-3/4)
1	44 (1-47/64) §	95.5...101.5 (3-49/64...4)	99...105 (3-29/32...4-9/64)
	52 (2-3/64)	97.5...111 (3-27/32...4-3/8)	101...114.5 (3-63/64...4-33/64)
	57 (2-1/4)	102.5...116 (4-3/64...4-37/64)	106...119.5 (4-11/64...4-45/64)
2	44 (1-47/64) §	119.5...125.5 (4-45/64...4-61/64)	123...129 (4-27/32...5-5/64)
	52 (2-3/64)	121.5...135 (4-51/64...5-5/16)	125...138.5 (4-59/64...5-29/64)
	57 (2-1/4)	126.5...140 (4-63/64...5-33/64)	130...143.5 (5-1/8...5-21/32)
3	44 (1-47/64) §	143.5...149.5 (5-21/32...5-57/64)	147...153 (5-51/64...6-1/32)
	52 (2-3/64)	145.5...159 (5-47/64...6-17/64)	149...162.5 (5-7/8...6-13/32)
	57 (2-1/4)	150.5...164 (5-15/16...6-15/32)	154...167.5 (6-1/16...6-19/32)
4	44 (1-47/64) §	167.5...173.5 (6-19/32...6-27/32)	171...177 (6-47/64...6-31/32)
	52 (2-3/64)	169.5...183 (6-43/64...7-13/64)	173...186.5 (6-13/16...7-11/32)
	57 (2-1/4)	174.5...188 (6-7/8...7-13/32)	178...191.5 (7-1/64...7-35/64)
5	44 (1-47/64) §	191.5...197.5 (7-35/64...7-25/32)	195...201 (7-43/64...7-59/64)
	52 (2-3/64)	193.5...207 (7-5/8...8-5/32)	197...210.5 (7-49/64...8-19/64)
	57 (2-1/4)	198.5...212 (7-53/64...8-23/64)	202...215.5 (7-61/64...8-31/64)
6	44 (1-47/64) §	215.5...221.5 (8-31/64...8-23/32)	219...225 (8-5/8...8-55/64)
	52 (2-3/64)	217.5...231 (8-37/64...9-3/32)	221...234.5 (8-45/64...9-15/64)
	57 (2-1/4)	222.5...236 (8-49/64...9-19/64)	226...239.5 (8-29/32...9-7/16)

* When more than 4 modules are used, attach the first one to the switch body using the screws supplied with the extension **(Cat. No. 194L-G2853)**.
❄ With DIN 46 277 (35) Rail + 2.5 mm (7/64)
‡ For DIN Rail-mounted devices, remember to deduct the offset distance provided by the rail. For example, deduct 2.5 mm (7/64 in.) from the mounting depth for Bulletin 194L switch body mounted on DIN 46277 rail.
§ One 44 mm (1-47/64 in) end shaft is supplied with all Bulletin 194L Switch Bodies.

Dimensions are shown in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

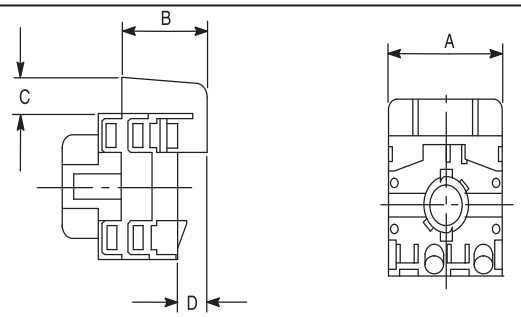
Cat. No. 194L-A... With Cat. No. 194L-HE4P-...

Installation on DIN 46277 (35) Rails + 2.5 mm (7/64)



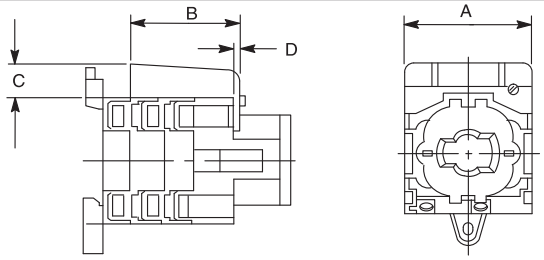
Cat. No.	L			
	No. of Contacts			
	1...2	3...4	5...6	7...8
194L-A12/16...	35 (1-3/8)	45 (1-49/64)	55 (2-11/64)	65 (2-9/16)
194L-A20/25...	33.5 (1-21/64)	48 (1-57/64)	60.5 (2-3/8)	73 (2-7/8)
194L-A32/40...	43 (1-11/16)	61 (2-13/32)	79 (3-7/64)	97 (3-53/64)

Cat. No. 194L-E... With Terminal Cover



Cat. No.	A	B	C	D
194L-E12/16...	40 (1-37/64)	42.5 (1-43/64)	12 (15/32)	2.5 (7/64)
194L-E20/25...	49 (1-15/16)	37.5 (1-31/64)	12 (15/32)	2.5 (7/64)
194L-E32/40...	59 (2-21/64)	50 (1-31/32)	15 (19/32)	2.5 (7/64)

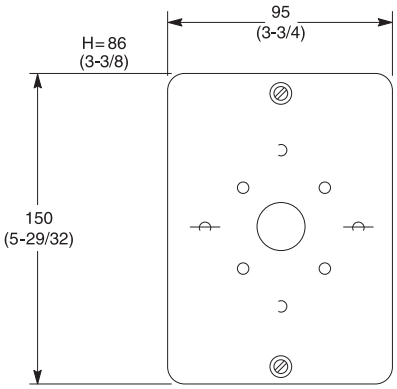
Cat. No. 194L-A... With Terminal Cover



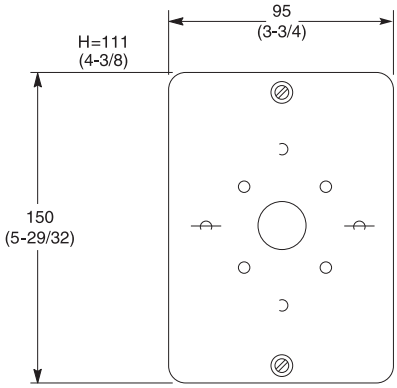
Cat. No.	A	B	C	D
194L-A12/16...	40 (1-37/64)	42.5 (1-43/64)	12 (15/32)	2.5 (7/64)
194L-A20/25...	49 (1-15/16)	37.5 (1-31/64)	12 (15/32)	2.5 (7/64)
194L-A32/40...	63.5 (2-1/2)	49 (1-53/64)	12 (15/32)	2 (5/64)

Enclosure

Cat. No. 194L-G3572...Cat. No. 194L-G3579



Cat. No. 194L-G3572/G3576
G3574/G3578



Cat. No. 194L-G3573/G3577
G3575/G3579

Bulletin 194R Next Generation Global Fused and Non-Fused Disconnects

- 20 A…63 A Sizes
- Fused switch versions:
  - BS88 - DIN
  - CSA HRCII-C - CSA HRCI-MISC
  - UL Class J - UL Class CC
  - NFC
- Non-fused switches
- Operating handle ingress ratings:
  - IP42 (Type 1)
  - IP66 (Type 3R, 3, 12, 4, 4X)
- Handle with or without test mode
- Padlockable handle for up to three padlocks
- Up to 6 auxiliary contacts can be added per switch
- Suitable as service entrance disconnecting means (UL 98)
- Suitable as at-motor disconnecting means (UL 508)

Certifications

UL Listed (File No. E 14841, Guide NLRV; File No. E 47426, Guide WHTY)
CSA Certified (File No. LR1234)
CE

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Specifications..... 2-414
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Standards Compliance

IEC 60947/EN60947-3
BS EN60947-3
VDE 0660
CSA 22.2 No. 4
NEMA KS-1
UL 98
UL 508

The Bulletin 194R line of fused and non-fused global disconnect switches provides the flexibility to meet worldwide applications. These rod-operated disconnect switches incorporate removable fuse carriers that have high short circuit protection ratings. The disconnect switches are UL Listed and CSA Certified and are designed to meet IEC 60947-3, VDE, DIN, BS and applicable NEMA requirements.

Product Selection — Open Switches

Cat. No. Explanation

194R-J30-1753

194R – J 30 – 1753 S
a b c d

a

Fuse Type	
Code	Description
C	UL Class CC, CSA Type HRCI-MISC (30 A)
J	UL Class J, CSA Type HRCI-J (30 A or 60 A)
H	CSA Type HRCII-C (30 A or 60 A)
B	BS88 (20 A, 32 A, or 63 A)
D	DIN (32 A or 63 A)
F	NFC (25 A, 32 A, or 63 A)
N	Non-fused (30 A or 60 A)

b

Load Size		
Code	Description	Dimensional Ref.
20	20 A (BS88)	A1
25	25 A (NFC)	A1
30	30 A (CC, J, HRCI-J)	A1
	30 A (Non-Fused) ❄	A2
	30 A (HRCII-C)	B1
32	32 A (BS88, NFC)	A1
	32 A (DIN)	B1
60	60 A (J, HRCI-J, HRCII-C)	B1
60	60 A (Non-Fused) ❄	B2
63	63 A (BS88, DIN, NFC)	B1

✶ See page 2-420 for dimensional reference data.
❄ Non-fused disconnect switches must use separately installed fuses for upstream short-circuit protection

c

No. of Poles	
Code	Description
1753	3-pole switch

d

Fuse Indication	
Code	Configuration
Blank	No fuse status indication
S	Fuse status indication

Limit of 6 total auxiliary contact blocks total for test and standard positions.
Fourth pole, additional auxiliary contacts and handle options available in accessory section.

UL/CSA Fused Disconnect Switches

Cat. No. 194R-J30-1753

Rated Current [A]	Maximum Hp Ratings ✶							Fuse	Dim. Ref.	Cat. No.
	1Ø (60 Hz)		3Ø (60 Hz)			DC				
	120V	240V	240V	480V	600V	125V	250V			
UL Class CC and CSA HRCI-MISC Fuses										
30	2	3	7.5	15	20	3	5	30 A CC, HRCI-Misc	A1	**194R-C30-1753**
UL Class J and CSA HRCI-J Fuses										
30	2	3	7.5	15	20	3	5	30 A Class J, HRCI-J	A1	**194R-J30-1753**
60	3	10	15	30	50	5	10	60 A Class J, HRCI-J	B1	**194R-J60-1753**
CSA HRCII-C Fuses										
30	2	3	7.5	15	20	3	5	30A HRCII-C	B1	194R-H30-1753
60	3	10	15	30	50	5	10	60A HRCII-C	B1	194R-H60-1753

✶ Time delay fuses may be required to utilize the disconnect switch at its maximum horsepower rating.

Non-Fused Disconnect Switches

194R-N30-1753

Fuse Description	Rated Current✶ [A]	Non-Fused Maximum Hp Ratings							Dim. Ref.	Cat. No.
		1Ø (60 Hz)		3Ø (60 Hz)			DC			
		120V	240V	240V	480V	600V	125V	250V		
Non-fused disconnect switches must use separately installed fuses for upstream short circuit protection.	30	2	3	7.5	15	20	3	5	A2	194R-N30-1753
	60	3	10	15	30	40	5	10	B2	**194R-N60-1753**

✶ 30 A UL-rated device has I_{the} of 40 A per IEC. 60 A UL-rated device has I_{the} of 80 A per IEC.

IEC Fused Disconnect Switches

194R-F32-1753

194R-F63-1753

BS88 Fused Disconnect Switches

Load Rating I_e [A]	Ratings (AC23) With Fuse Links 3Ø Maximum kW (50 Hz) 200/230V	380/400/415V	660/690V	Fuse	Dim. Ref.	Cat. No.
20	5.5	11	15	BS88 A1	A1	194R-B20-1753
32	9	18.5	30	BS88 A2	A1	194R-B32-1753
63	18.5	30	55	BS88 A3	B1	194R-B63-1753

DIN Fused Disconnect Switches

Load Rating I_e [A]	Ratings (AC23) With Fuse Links 3Ø Maximum kW (50 Hz) 200/230V	380/400/415V	660/690V	Fuse	Dim. Ref.	Cat. No.
32	9	18.5	30	NH 000	B1	194R-D32-1753
63	18.5	30	55	NH 000	B1	194R-D63-1753

NFC Fused Disconnect Switches

Load Rating I_e [A]	Ratings (AC23) With Fuse Links 3Ø Maximum kW (50 Hz) 200/230V	380/400/415V	660/690V	Fuse	Dim. Ref.	Cat. No.
25	7.5	11	22	NFC 14x51 mm	A1	194R-F25-1753
32	9	18.5	30	NFC 14x51 mm	A1	194R-F32-1753
63	18.5	30	55	NFC 22x58 mm	B1	194R-F63-1753

2

Accessories

4th Pole Modules

Rated Current [A]	Maximum Hp Ratings∗ 1Ø (60 Hz) 120V	1Ø (60 Hz) 240V	3Ø (60 Hz) 240V	3Ø (60 Hz) 480V	3Ø (60 Hz) 600V	DC 125V	DC 250V	Fuse	Dim. Ref.	Cat. No.
Non-Fused										
30❄	2	3	7.5	15	20	3	5	—	A2	**194R-30-NN**
60‡	3	10	15	30	40	5	10	—	B2	**194R-60-NN**
UL Class CC and CSA HRCI-MISC Fuses										
30	2	3	7.5	15	20	3	5	30 A CC, HRCI-Misc	A1	**194R-30-NC**
UL Class J and CSA HRCI-J Fuses										
30	2	3	7.5	15	20	3	5	30 A J, HRCI-J	A1	**194R-30-NJ**
60	3	10	15	30	50	5	10	60 A J, HRCI-J	B1	**194R-60-NJ**
CSA HRCII-C Fuses										
30	2	3	7.5	15	20	—	—	30A HRCII-C	B1	194R-30-NH
60	3	10	15	30	50	—	—	60A HRCII-C	B1	194R-60-NH

∗ Time delay fuses may be required to utilize the disconnect at its maximum horsepower rating.
❄ 30 A UL, 40 A IEC
‡ 60 A UL, 80 A IEC

BS88 Fuses

Load Rating I_e [A]	Ratings (AC23) With Fuse Links 3Ø Maximum kW (50 Hz) 200/230V	380/400/415V	660/690V	Fuse	Dim. Ref.	Cat. No.
20	5.5	11	15	BS88 A1	A1	194R-20-NB
32	9	18.5	30	BS88 A2	A1	194R-32-NB
63	18.5	30	55	BS88 A3	B1	194R-63-NB

DIN Fuses

Load Rating I_e [A]	Ratings (AC23) With Fuse Links 3Ø Maximum kW (50 Hz) 200/230V	380/400/415V	660/690V	Fuse	Dim. Ref.	Cat. No.
32	9	18.5	30	NH 000	B1	194R-32-ND
63	18.5	30	55	NH 000	B1	194R-63-ND

NFC Fuses

Load Rating I_e [A]	Ratings (AC23) With Fuse Links 3Ø Maximum kW (50 Hz) 200/230V	380/400/415V	660/690V	Fuse	Dim. Ref.	Cat. No.
25	7.5	11	22	NFC 14 x 51 mm	A1	194R-25-NF
32	9	18.5	30	NFC 14 x 51 mm	A1	194R-32-NF
63	18.5	30	55	NFC 22 x 58 mm	B1	194R-63-NF

Operating Handles (Accepts 3 Padlocks)

For Use With	Description	Color	Degree of Protection	Cat. No.
A1, A2, B1, B2	Test mode handle **with** defeater	Black	(Type 3R, 3, 12, 4, 4X) IP66	194R-HST4
		Red/Yellow	(Type 3R, 3, 12, 4, 4X) IP66	194R-HST4E
A1, A2, B1, B2	Standard handle test mode **with** defeater	Black	(Type 1) IP42	**194R-HS1**
			(Type 3R, 3, 12, 4, 4X) IP66	**194R-HS4**
		Red/Yellow	(Type 1) IP42	**194R-HS1E**
			(Type 3R, 3, 12, 4, 4X) IP66	**194R-HS4E**
	Standard handle **without** defeater	Black	(Type 1) IP42	**194R-HS1-N2**
			(Type 3R, 3, 12, 4, 4X) IP66	**194R-HS4-N2**
		Red/Yellow	(Type 1) IP42	**194R-HS1E-N2**
			(Type 3R, 3, 12, 4, 4X) IP66	**194R-HS4E-N2**

OSHA Lockout/Tag Out Compliance (LOTO)

OSHA CFR36 Section 1910 mandates that disconnects be able to be locked out while in the OFF position during servicing. All Bulletin 194R handles comply with this important safety requirement.

(Please see NFPA Article 430 for disconnect requirements of motor applications)

Operating Shafts

Disconnect Switch Dim. Ref.	Operating Shaft Type	Operating Shaft Length Approx. Dim. mm (in.)	Enclosure Working Depth			Cat. No.
			Disconnect Switch Dim. Ref.	Minimum Approx. Dim. mm (in.)	Maximum Approx. Dim. mm (in.)	
A1, A2, B1, B2	Standard Length	263 (10.3)	A1, B1	148 (5.8)	260 (10.2)	**194R-R1**
			A2, B2	111 (4.4)	260 (10.2)	
	Extended Length	457 (18.0)	A1, B1	148 (5.8)	454 (17.8)	**194R-R2**
			A2, B2	111 (4.4)	454 (17.8)	

NFPA 79 Operating Shaft/Handle Kits

An internal handle that permits operation of the disconnect switch when the panel door is open, in compliance with NFPA 79.

	Description	Shaft Length [mm (in.)]	Disconnect Switch Dim Ref.	Pkg. Qty.	Cat. No.
	NFPA 79 Handle Kit Includes NFPA 79 handle, operating shaft, and Cat. No. 194R-PLA1 padlocking attachment	305 (12)	A1, A2, B1, B2	1	**194R-NHR1**
		533 (21)	A1, A2, B1, B2	1	**194R-NHR2**

Other Accessories

	Description	Disconnect Switch Dim Ref.	Pkg. Qty.	Cat. No.
	Operating Shaft Guide — Allows easier coupling of shaft to operating handle if misalignment occurs between switch and enclosure after assembly installation	A1, A2, B1, B2	1	**194R-HSG1**
	Shaft Guard — Provides extra protection against contact with shaft	A1, A2, B1, B2	1	194R-R1G
	Operating Shaft Coupler — Used with Cat. Nos. 194R-R1 and 194R-R2 shafts to extend shaft length an additional 4.75 in.	A1, A2, B1, B2	1	**194R-SC1**
	Operating Handle Instruction Label — Describes the function of the operating handle for opening the enclosure door with the disconnect switch in the ON and OFF position	ALL	10	**194R-L1**

Replacement Mounting Hardware

	Pkg. Qty.	Description	For Use With	Cat. No.
	2	1 set screw, 1 shaft clip, and 2 #8 M4 screws	A1, A2	**194R-30-HDWR**
	4	1 set screw, 1 shaft clip, and 4 #8 M4 screws	B1, B2	**194R-60-HDWR**

Replacement Fuse Hardware

Description	For Use With	Pkg. Qty.	Cat. No.
M4 x .7 Fuse screws	194R BS88 Fuse Types	2	**194R-BS88-M4**
M5 x .6 Fuse screws	194R BS88 Fuse Types	2	**194R-BS88-M5**

Terminal Shields

	Description	Disconnect Switch Dim Ref.	Quantity Required Per Disconnect Switch	Pkg. Qty.	Cat. No.
	30 A Terminal Shield (3 terminals)	A1, A2	2	2	**194R-30-C3**
	60 A Terminal Shield (3 terminal)	B1, B2	2	2	**194R-60-C3**
	30 A Terminal Shield (1 terminal)	A1, A2	2	2	**194R-30-C1**
	60 A Terminal Shield (1 terminal)	B1, B2	2	2	**194R-60-C1**

✶ For use on either Line or Load Side of Disconnect Switch.

Disconnect Switch Padlock Accessory

	Disconnect Switch Dim Ref.	Pkg. Qty.	Cat. No.
	A1, A2, B1, B2	1	**194R-PLA1**

Replacement Fuse Carriers

	Description	Pkg. Quantity	Cat. No.❄
194R-J30-FC	**30 A CC Fuse Carrier**	1	**194R-C30-FC**
	30 A J Fuse Carrier	1	**194R-J30-FC**
	60 A J Fuse Carrier	1	**194R-J60-FC**
	20 A BS88 Fuse Carrier	1	**194R-B20-FC**
	32 A BS88 Fuse Carrier	1	**194R-B32-FC**
	63 A BS88 Fuse Carrier	1	**194R-B63-FC**
	30 A CSA HRCII-C Fuse Carrier	1	**194R-H30-FC**
	60 A CSA HRCII-C Fuse Carrier	1	**194R-H60-FC**
194R-J30-FCS	**32 A DIN Fuse Carrier**	1	**194R-D32-FC**
	63 A DIN Fuse Carrier	1	**194R-D63-FC**
	25 A NFC Fuse Carrier	1	**194R-F25-FC**
	32 A NFC Fuse Carrier	1	**194R-F32-FC**
	63 A NFC Fuse Carrier	1	**194R-F63-FC**
	30 A Non-Fuse Carrier	1	**194R-N30-FC**
	60 A Non-Fuse Carrier	1	**194R-N60-FC**

❄ For fuse status indication add "S" to catalog number, example: 194R-J30-FC becomes 194R-J30-FCS

Auxiliary Contact Blocks❄

	Description	Contact Material	Pkg. Quantity	Cat. No.
Cat. No. 800F-X10	**Contact Block** **Note:** Sold only in multiples of 10. Order (quantity of) 10 to receive one package of 10 pieces. Latch not included.	N.O.	10	**800F-X10**
		N.C.		**800F-X01**
		N.O.E.M.		**800F-X10E**
		N.C.L.B.		**800F-X01L**
		N.O. with stab terminals		**800F-X10T**
		N.C. with stab terminals		**800F-X01T**
		N.O. spring-clamp		**800F-Q10**
		N.C. spring-clamp		**800F-Q01**

❄ Also used for test mode function.

Fused Disconnect Switches For UL Class Fuses and CSA HRCI-J

Electrical Ratings								
Cat. No.		194R-C30-1753		194R-J30-1753		194R-J60-1753	
CSA Fuse Type/UL Fuse Type		Class CC/HRCI-MISC ❄		Class J/HRCI-J		Class J/HRCI-J	
Maximum Fuse Cartridge Size	(A)	30		30		60	
Maximum Voltage AC DC	(V) (V)	600 250		600 250		600 250	
Ampere Rating	(A)	30		30		60	
Maximum Short Circuit Prospective Fault Current	(kA)	200		200		200	
Fuse Operating Characteristics		Time Delay	Non-Time Delay	Time Delay	Non-Time Delay	Time Delay	Non-Time Delay
Maximum Hp, 3Ø AC							
200V, 60 Hz	(Hp)	5	3	7.5	3	15	7.5
240V, 60 Hz	(Hp)	5	3	7.5	3	15	7.5
480V, 60 Hz	(Hp)	10	5	15	5	30	15
600V, 60 Hz	(Hp)	10	7.5	20	7.5	50	15
Maximum Hp, 1Ø AC							
120V, 60 Hz	(Hp)	0.75	0.5	2	0.5	3	1.5
240V, 60 Hz	(Hp)	2	1.5	3	1.5	10	3
Maximum Hp, DC							
125V DC	(Hp)	2	3	3	2	5	5
250V DC	(Hp)	3	5	5	5	10	10

Mechanical Data			
Cat. No.		194R-C30-1753, 194R-J30-1753	194R-J60-1753
Degree of Protection (per IEC 60947-3) Switch Only Switch with Terminal Shield & Fuse Carriers		 IP20 IP20	 IP20 IP20
Mechanical Endurance‡	Operations	10 000	10 000
Operating Torque (Maximum)	N•m lb•in.	2 12	3.5 35
Terminal Capacity Power Terminals	mm^2 AWG	2.5…10 #14…#8	2.5…25 #14…#4
Auxiliary Contact Terminals	mm^2 AWG	2.5…4 #14…#12	2.5…4 #14…#12
Maximum Number of Auxiliary Circuits		6	6
Approximate Weight	kg. lbs.	0.92 2.03	1.32 2.9
Minimum Enclosure Size Approximate dimensions in millimeters (inches)	Height Width Depth	248 (9-3/4) 171 (6-3/4) 148 (5-13/16)	248 (9-3/4) 197 (7-3/4) 148 (5-13/16)
Switch Dimension Reference (See dimension drawings.)		A1	B1

❄ CSA HRCI-MISC fuses must also be UL Listed as Class CC fuses.

‡ Based on Rockwell Automation tests in accordance with the requirements as defined in CSA C22.2 No. 4, IEC 60947-3 and UL 98.

Non-Fused Disconnect Switches For CSA and UL Class Applications§

Electrical Ratings						
Cat. No.		194R-N30-1753		194R-N60-1753		
Maximum Fuse Cartridge Size		30♣		60♣		
Maximum Voltage	AC [V] DC [V]	600 250		600 250		
Ampere Rating	[A]	30		60		
Maximum Short Circuit Prospective Fault Current	[kA]	200		200		
Fuse Operating Characteristics➢		Time Delay	Non-Time Delay	Time Delay	Non-Time Delay	
Maximum Hp, 3Ø AC	200V, 60 Hz [Hp] 240V, 60 Hz [Hp] 480V, 60 Hz [Hp] 600V, 60 Hz [Hp]	7.5 7.5 15 20	3 3 5 7.5	15 15 30 50	7.5 7.5 15 15	
Maximum Hp, 1Ø AC	120V, 60 Hz [Hp] 240V, 60 Hz [Hp]	2 3	0.5 1.5	3 10	1.5 3	
Maximum Hp, DC	125V DC [Hp] 250V DC [Hp]	3 5	2 5	5 10	5 10	
Power Lost	[W]	2		6		

§ Non-fused disconnect switches must be used with separately installed fuses.
♣ When using CSA HRCI-J, HRCI-MISC (also UL Listed as Class CC) or HRCI-T fuses, and UL Class J, CC or T fuses.
➢ Based on Rockwell Automation tests in accordance with the requirements as defined in CSA C22.2 No. 4, IEC 60947-3, UL 1087 and UL 98.

Mechanical Data			
Cat. No.		194R-N30-1753	194R-N60-1753
Degree of Protection (per IEC 60947-3) Switch Only Switch with Terminal Shield & Fuse Carriers		IP20 IP20	IP20 IP20
Mechanical Endurance‡	Operations	10 000	10 000
Operating Torque (Maximum)	N•m lb•in.	2 12	3.5 35
Terminal Capacity Power Terminals	mm^2 AWG	2.5…10 #14…#8	2.5…25 #14…#4
Auxiliary Contact Terminals	mm^2 AWG	2.5…10 #14…#8	2.5…25 #14…#4
Maximum Number of Auxiliary Circuits		6	6
Approximate Weight	kg lbs.	0.81 1.78	1.14 2.52
Minimum Enclosure Size Approximate dimensions in millimeters (inches)	Height Width Depth	248 (9-3/4) 171 (6-3/4) 111 (4-3/8)	248 (9-3/4) 197 (7-3/4) 111 (4-3/8)
Switch Dimension Reference (See dimension drawings)		A2	B2

∗ Non-fused disconnect switches must be used with separately installed fuses.

All Bulletin 194R Disconnect Switch Cat. Nos., 20 A…63 A Range

Environmental Data	
Ambient Temperature	
Open .....°C (°F) Enclosed .....°C (°F) Storage .....°C (°F)	–2…+55 (–4…+131) –20…+40 (–4…+104) –40…+65 (–40…+149)
Altitude (per IEC 60947-1)	2,000
Relative Humidity (per IEC 60947-1)	90% @ +20 °C (+68 °F) 50% @ +40 °C (+104 °F)

Fused Disconnect Switches For CSA HRCII-C Fuses

Electrical Ratings				
Cat. No.			194R-H30-1753	194R-H60-1753
CSA Fuse Type			HRCII-C	HRCII-C
Maximum Fuse Cartridge Size		[A]	30	60
Maximum Voltage	AC	[V]	600	600
Ampere Rating		[A]	30	60
Maximum Short Circuit Prospective Fault Current		[kA]	200	200
Maximum Hp, 3Ø AC				
	200V, 60 Hz	[Hp]	7.5	15
	240V, 60 Hz	[Hp]	7.5	15
	480V, 60 Hz	[Hp]	15	30
	600V, 60 Hz	[Hp]	20	50
Maximum Hp, 1Ø AC				
	120V, 60 Hz	[Hp]	2	3
	240V, 60 Hz	[Hp]	3	10

Mechanical Data			
Cat. No.		194R-H30-1753	194R-H60-1753
Degree of Protection (per IEC 60947-3) Switch Only Switch with Terminal Shield & Fuse Carriers		IP 20 IP 20	IP 20 IP 20
Mechanical Endurance∗	Operations	10 000	10 000
Operating Torque (Maximum)	N•m lb•in.	2 12	3.5 35
Terminal Capacity			
Power Terminals	mm^2 AWG	2.5…10 #14…#8	2.5…25 #14…#4
Auxiliary Contact Terminals	mm^2 AWG	2.5…4 #14…#12	2.5…4 #14…#12
Maximum Number of Auxiliary Circuits		6	6
Approximate Weight	kg lbs.	1.18 2.60	1.18 2.60
Minimum Enclosure Size Approximate dimensions in millimeters (inches)	Height Width Depth	248 (9-3/4) 171 (6-3/4) 148 (5-13/16)	248 (9-3/4) 197 (7-3/4) 148 (5-13/16)
Switch Dimension Reference (See dimension drawings.)		B1	B1

∗ Based on Rockwell Automation tests in accordance with the requirements as defined in CSA C22.2 No. 4 and IEC 60947-3.

Fused Disconnect Switches For BS88 Fuses

Note: Table continued on pages 2-435…2-439.

Electrical Ratings						
Cat. No.		194R-B20-1753		194R-B32-1753	194R-B63-1753	
Fuse Type	BS88 Dimension	A1		A2	A2, A3	
Rated Insulation Voltage (U_i)	[V]	1000		1000	1000	
Rated Conditional Short-Circuit Current (r.m.s.) at 415V	[kA]	100		100	100	
Rated Operational Current AC-22A (I_e)		Fuse Links	Shorting Links	Fuse Links	Fuse Links	Shorting Links
200/230V 50 Hz	[A]	20	32	32	63	63
380/400/415V 50 Hz	[A]	20	32	32	63	63
500V 50 Hz	[A]	20	32	32	63	63
660/690V 50 Hz	[A]	20	32	32	63	63
Rated Operational Current AC-23A (I_e)						
200/230V 50 Hz	[A]	20	32	31	60.5	60
380/400/415V 50 Hz	[A]	22	32	35	57	57
500V 50 Hz	[A]	20	32	32.5	57	57
660/690V 50 Hz	[A]	17	32	32.5	57	57
Rated Thermal Current (I_{the})	[A]	20	32	32	63	63
Maximum kW, AC-23A 3Ø						
200/230V 50 Hz	[kW]	5.5	9	9	18.5	18.5
380/400/415V 50 Hz	[kW]	11	18.5	18.5	30	30
500V 50 Hz	[kW]	11	18.5	18.5	30	30
660/690V 50 Hz	[kW]	15	30	30	55	55
Maximum Fuse Rating	[A]	20	—	32	63	—
Maximum Motor Circuit Fuse Link		20M32	—	32M63	63M100	—
Maximum Fuse Cut-off Current*	[kA]	7.5	7.5	7.5	10	10
Rated Short Time Current, 1 Second	[kA]	1		1	1	

Mechanical Data				
Cat. No.		194R-B20-1753	194R-B32-1753	194R-B63-1753
Degree of Protection (per IEC 60947-3) Switch Only Switch with Terminal Shield & Fuse Carriers		 IP20 IP20	 IP20 IP20	 IP20 IP20
Mechanical Endurance Operations ‡		10 000	10 000	10 000
Operating Torque (Maximum)	N•m lb•in.	2 12	2 12	3.5 35
Terminal Capacity Power Terminals	mm^2	2.5…10 #14…#8	2.5…10 #14…#8	2.5…25 #14…#4
Auxiliary Contact Terminals	mm^2 AWG	2.5…4 #14…#12	2.5…4 #14…#12	2.5…4 #14…#12
Maximum Number of Auxiliary Circuits		6	6	6
Approximate Weight	kg lbs.	0.83 1.84	0.83 1.84	1.18 2.60
Minimum Enclosure Size Approximate dimensions in millimeters (inches)	Height Width Depth	248 (9-3/4) 171 (6-3/4) 148 (5-13/16)	248 (9-3/4) 171 (6-3/4) 148 (5-13/16)	248 (9-3/4) 197 (7-3/4) 148 (5-13/16)
Switch Dimension Reference (See dimension drawings.)		A1	A1	B1

* Fuses must be selected with regard to the maximum prospective fault current of the system and the maximum cut-off current of the fuse when subjected to that maximum fault current. The maximum fuse cut-off current as specified for each disconnect switch must not be exceeded.

‡ Based on Rockwell Automation tests in accordance with the requirements as defined in IEC 60947-3.

Fused Disconnect Switches For DIN Fuses

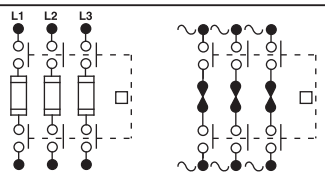
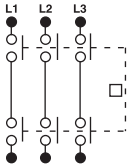
Electrical Ratings			
Cat No.		194R-D32-1753	194R-D63-1753
Fuse Type	DIN Dimension	00	0, 00
Rated Insulation Voltage (U_i)	(V)	1000	1000
Rated Conditional Short-Circuit Current (r.m.s.) at 415V	(kA)	100	100
Rated Operational Current AC-22A (I_e)		Fuse Links	Fuse Links
200/230V 50 Hz	(A)	32	63
380/400/415V 50 Hz	(A)	32	63
500V 50 Hz	(A)	32	63
660/690V 50 Hz	(A)	32	63
Rated Operational Current AC-23A (I_e)			
200/230V 50 Hz	(A)	31	60.5
380/400/415V 50 Hz	(A)	35	57
500V 50 Hz	(A)	32.5	57
660/690V 50 Hz	(A)	32.5	57
Rated Thermal Current (I_{the})	(A)	40	63
Maximum kW, AC-23A 3Ø			
200/230V 50 Hz	(kW)	9	18.5
380/400/415V 50 Hz	(kW)	18.5	30
500V 50 Hz	(kW)	18.5	30
660/690V 50 Hz	(kW)	30	55
Maximum Fuse Rating	(A)	32	63
Maximum Motor Circuit Fuse Link		—	—
Maximum Fuse Cut-off Current∗	(kA)	14	20
Rated Short Time Current, 1 Second	(kA)	1	1

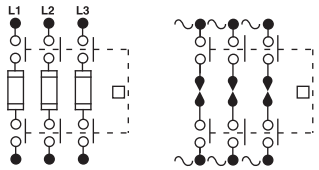
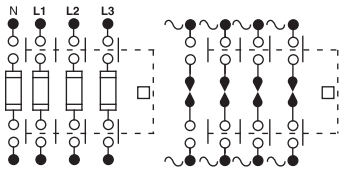
Mechanical Data			
Cat. No.		194R-D32-1753	194R-D63-1753
Degree of Protection (per IEC 60947-3) Switch Only Switch with Terminal Shield & Fuse Carriers		 IP20 IP20	 IP20 IP20
Mechanical Endurance❄	Operations	10 000	8 000
Operating Torque (Maximum)	N•m lb•in.	2 35	3.5 35
Terminal Capacity Power Terminals	mm^2 AWG	2.5…25 #14…#4	2.5…25 #14…#4
Auxiliary Contact Terminals	mm^2 AWG	2.5…4 #14…#12	2.5…4 #14…#12
Maximum Number of Auxiliary Circuits		6	6
Approximate Weight	kg lbs.	1.18 2.60	1.18 2.60
Minimum Enclosure Size Approximate dimensions in millimeters (inches)	Height Width Depth	248 (9-3/4) 197 (7-3/4) 148 (5-13/16)	248 (9-3/4) 197 (7-3/4) 148 (5-13/16)
Switch Dimension Reference (See dimension drawings.)		B1	B1

∗ Fuses must be selected with regard to the maximum prospective fault current of the system and the maximum cut-off current of the fuse when subjected to that maximum fault current. The maximum fuse cut-off current as specified for each disconnect switch must not be exceeded.

❄ Based on Rockwell Automation tests in accordance with the requirements as defined in IEC 60947-3.

Wiring Schematic

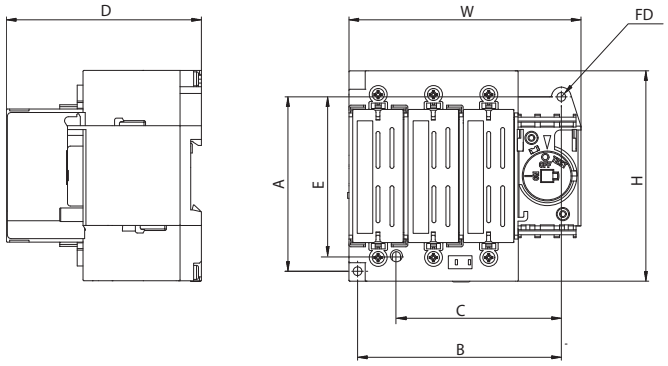
UL LISTED, CSA CERTIFIED	DIMENSION REFERENCE	CIRCUIT
Cat. No.		
194R-C30-1753 194R-J30-1753 194R-J60-1753 194R-H30-1753 194R-H60-1753	A1 A1 B1 B1 B1	
194R-N30-1753 194R-N60-1753	A2 B2	

IEC SWITCHES	DIMENSION REFERENCE	CIRCUIT
Cat. No.		
194R-B20-1753 194R-B32-1753 194R-B63-1753 194R-D32-1753 194R-D63-1753 194R-F25-1753 194R-F32-1753 194R-F63-1753	A1 A1 B1 B1 B1 A1 A1 B1	
194R-∗-1754	(See 3-pole Dimension Reference) for Fused Switches	

2

Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

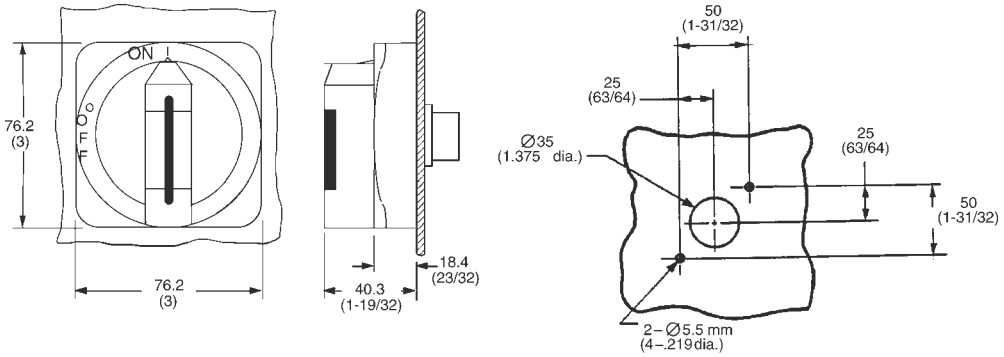
Disconnect Switch Dimension References A1, A2, B1 and B2 (30 A and 60 A)



Disconnect Switch Dimension Reference	Approximate Dimensions mm (in)							
	H	W	D	A	B	C❄	E❄	FD
A1	108 (4-1/4)	120 (4-3/4)	101 (4)	90 (3-9/16)	105 (4-1/8)	85 (3-11/32)	82 (3-15/64)	2-M4, 2-#8
A2	108 (4-1/4)	120 (4-3/4)	80 (3-1/8)	90 (3-9/16)	105 (4-1/8)	85 (3-11/32)	82 (3-15/64)	2-M4, 2-#8
B1	113 (4-29/64)	142 (5-19/32)	114 (4-31/64)	100 (3-15/16)	120 (4-23/32)	N/A	N/A	4-M4, 4-#8
B2	113 (4-29/64)	142 (5-19/32)	93 (3-43/64)	100 (3-15/16)	120 (4-23/32)	N/A	N/A	4-M4,4-#8

❄ Mounting holes for backward compatibility with Bulletin 194R legacy switches.

Operating Handles — Cat. No. 194R-HS.../HST



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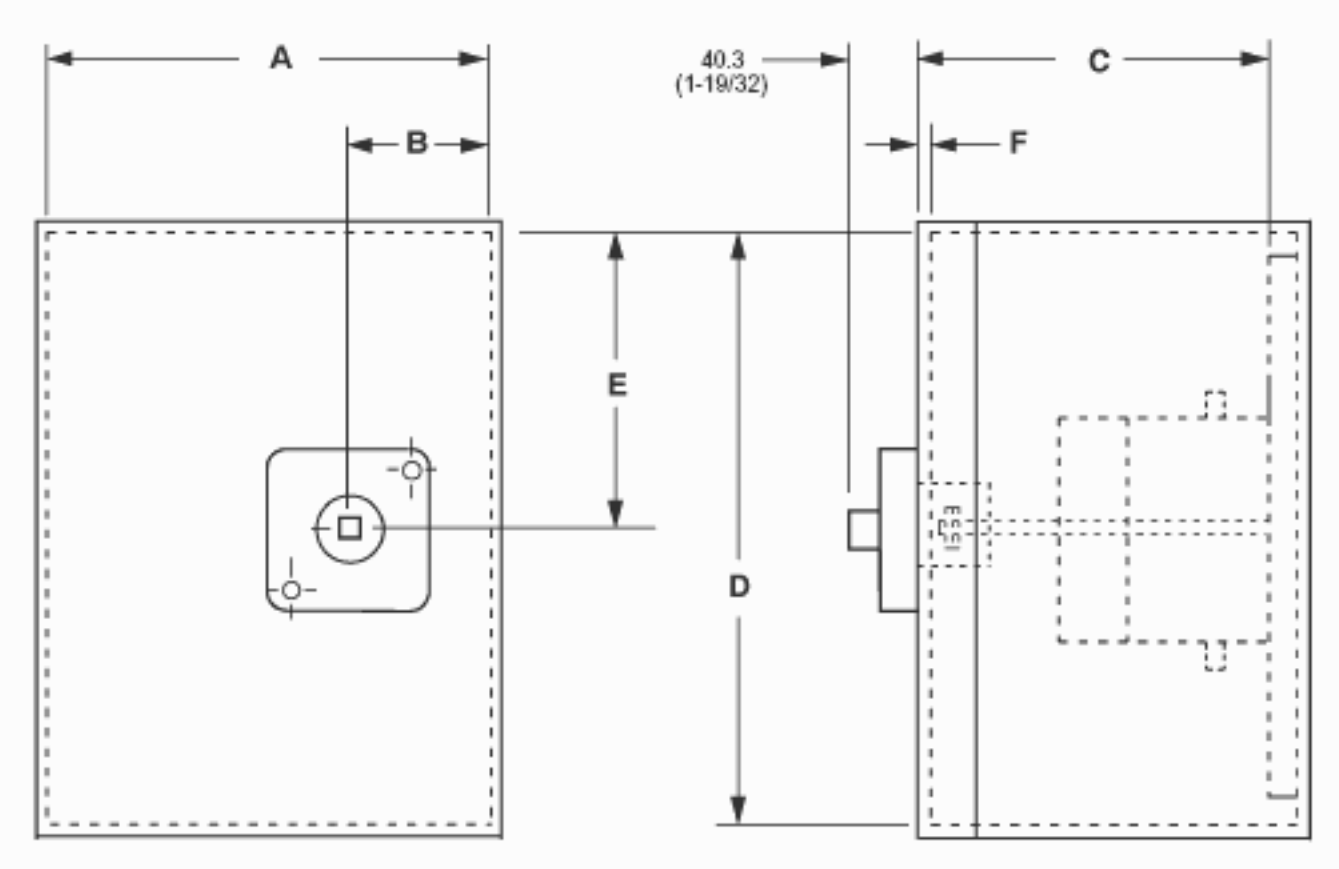
Disconnect Switch Dim. Ref.: A1, A2, B1, B2 (30 A and 60 A) Enclosure and Operating Handle

Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

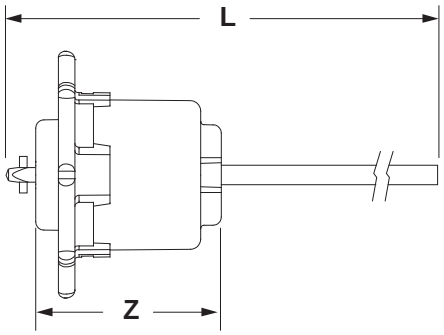


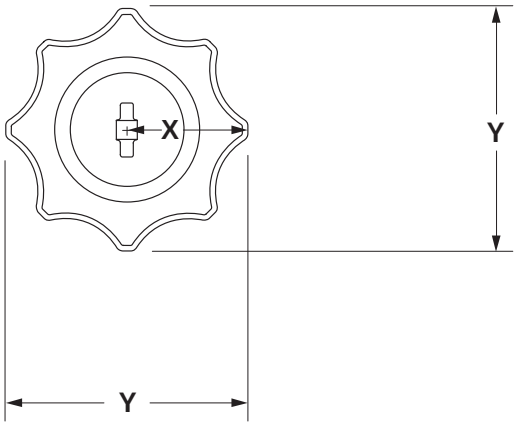
Enclosure Installation Dimensions

Cat. No.	Dimension Reference	A	B	C		D	E	F	
		Maximum	Minimum	Minimum	Maximum	Minimum	Minimum	Minimum	Maximum
194R-B20-1753	A1	171 (6-3/4)	45 (1-49/64)	147.6 (5-13/16)	454 (17-7/8)	248 (9-3/4)	89 (3-1/2)	1.4 (1/16)	4/78 (3/16)
194R-B32-1753									
194R-C30-1753									
194R-F32-1753									
194R-J30-1753									
194R-N30-1753	A2	171 (6-3/4)	45 (1-49/64)	111 (4-3/8)	454 (17-7/8)	248 (9-3/4)	89 (3-1/2)	1.4 (1/16)	4/78 (3/16)
194R-B63-1753	B1	197 (7-3/4)	45 (1-49/64)	147.6 (5-13/16)	454 (17-7/8)	248 (9-3/4)	105 (4-9/64)	1.4 (1/16)	4/78 (3/16)
194R-D32-1753									
194R-D63-1753									
194R-F63-1753									
194R-H30-1753									
194R-H60-1753									
194R-J60-1753									
194R-N60-1753	B2	197 (7-3/4)	45 (1-49/64)	111 (4-3/8)	454 (17-7/8)	248 (9-3/4)	105 (4-9/64)	1.4 (1/16)	4/78 (3/16)

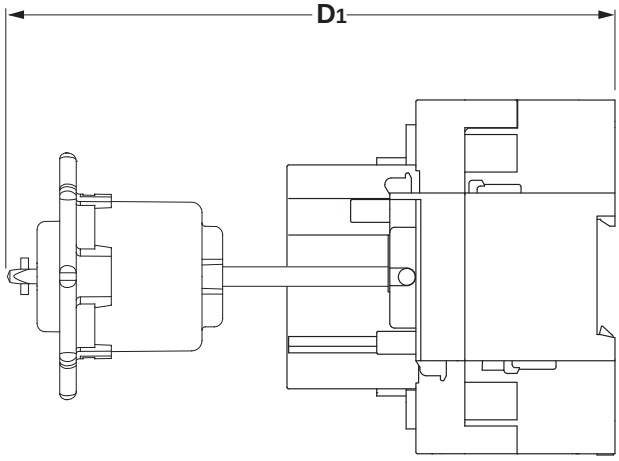
Universal Internal Handle Dimensions

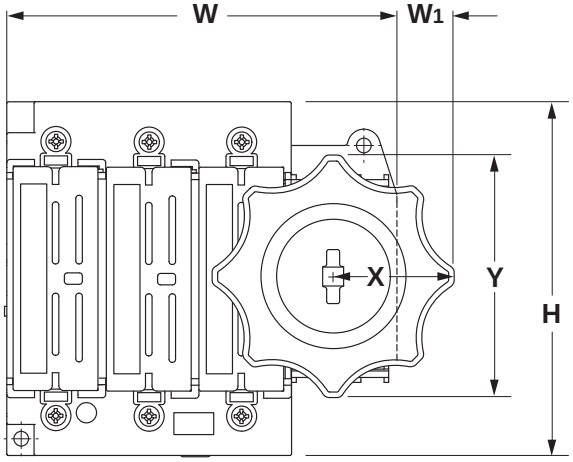
Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.





Catalog No.		$L_{(max)}$	X	Y	Z
194R -NHR1	mm (in.)	305 (12)	38 (1-1/2)	76 (3)	57 (2-1/4)
194R -NHR2	mm (in.)	533 (21)	38 (1-1/2)	76 (3)	57 (2-1/4)

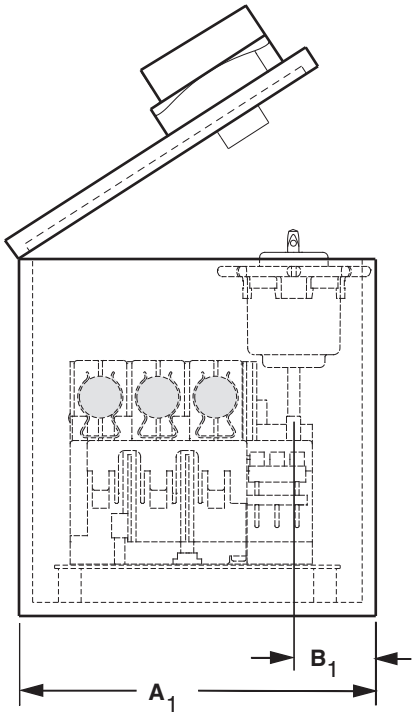


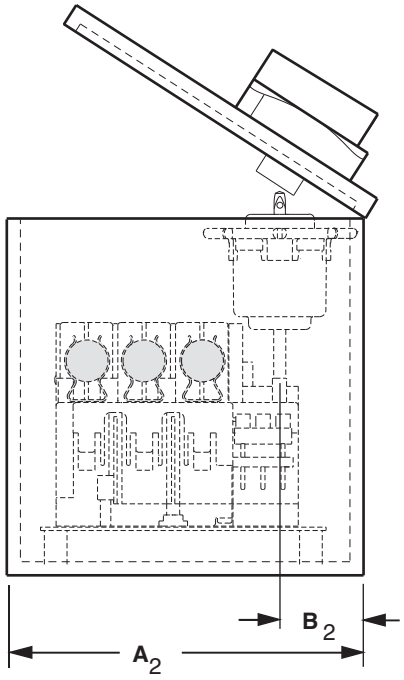


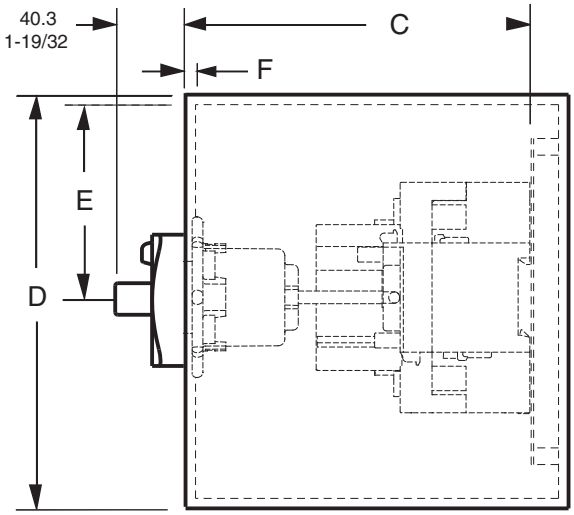
Catalog No.	Dim. Ref.		H	W	W_1	$D_{1(min)}$	X	Y
194R-B20-* 194R-F25-* 194R-B32-* 194R-F32-* 194R-C30-* 194R-J30-*	A1	mm (in.)	108 (4-1/4)	120 (4-3/4)	19 (3/4)	184 (7-1/4)	38 (1-1/2)	76 (3)
194R-N30-*	A2	mm (in.)	108 (4-1/4)	120 (4-3/4)	19 (3/4)	160 (6-5/16)	38 (1-1/2)	76 (3)
194R-B63-* 194R-H30-* 194R-D32-* 194R-H60-* 194R-D63-* 194R-J60-* 194R-F63-*	B1	mm (in.)	113 (4-29/64)	142 (5-19/32)	19 (3/4)	196 (7-49/64)	38 (1-1/2)	76 (3)
194R-N60-*	B2	mm (in.)	113 (4-29/64)	142 (5-19/32)	19 (3/4)	176 (6-59/64)	38 (1-1/2)	76 (3)

Enclosure Installation Dimensions

Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.







ENCLOSURE INSTALLATION DIMENSIONS

CAT.	DIM. REF.		A_{112} MINIMUM	A_2 MINIMUM	B MINIMUM	B MINIMUM	C MINIMUM	C MAXIMUM	D MINIMUM	E MINIMUM	F MINIMUM	F MAXIMUM
194R-B20-* 194R-F25-* 194R-C30-* 194R-B32-* 194R-J30-* 194R-F32-*	A1	mm	171	203	45	76	178	454	248	89	1.4	4.78
		in.	6-3/4	7-63/64	1-49/64	3	7	17-7/8	9-3/4	3-1/2	1/16	3/16
194R-N30-*	A2	mm	171	203	45	76	178	454	248	89	1.4	4.78
		in.	6-3/4	7-63/64	1-49/64	3	7	17-7/8	9-3/4	3-1/2	1/16	3/16
194R-D32-* 194R-B63-* 194R-H60-* 194R-D63-* 194R-H30-* 194R-F63-* 194R-J60-*	B1	mm	197	228	45	76	178	454	248	105	1.4	4.78
		in.	7-3/4	8-63/64	1-49/64	3	7	17-7/8	9-3/4	4-9/64	1/16	3/16
194R-N60-*	B2	mm	197	228	45	76	178	454	248	105	1.4	4.78
		in.	7-3/4	8-63/64	1-49/64	3	7	17-7/8	9-3/4	4-9/64	1/16	3/16

***Dimensions common for R1 or R2 shaft lengths**

Proper Selection of Disconnect Switches
Applications Within Canada and the United States

General

The requirements for disconnect switches used in motor branch circuits rated 600V and less are defined in Article 430, Part J of the U.S. National Electrical Code (NEC), NFPA70. Canadian Electrical Code (CEC) requirements are very similar in the area of motor branch circuit disconnect requirements. For simplicity, we will treat the NEC and CEC requirements as being the same — and reference specific sections of the U.S. National Electrical Code.
The requirements for properly sizing a disconnect switch are dependent on the type of application. The NEC refers to two types of applications: single motor and combination loads. A combination load consists of an application where two or more motors are used together or where one or more motors are used in combination with other loads, such as resistance heaters.

Single Motor Applications

Section 430-110 Paragraph (a) states that the disconnect switch must have an ampere rating of at least 115% of the full-load current rating of the motor.
Example 1: For a motor with a full-load current of 22 A, the disconnect switch must be rated at least 25.3 A (22 x 1.15).
If the disconnecting means under evaluation is rated in horsepower, the selection of the disconnect switch is even more straightforward; a disconnect switch must have a horsepower rating equal to, or greater than the horsepower rating of the motor at the applicable voltage.
Example 2: For a motor with a 10 Hp rating at 460V AC, the disconnect switch must be rated at least 10 Hp at 460V AC.
If the disconnect switch is rated in horsepower, and UL Listed, UL Component Recognized, or CSA Certified, it will meet the requirements for the 115% full load current rating stipulated by the NEC.

Combination Load Applications

Section 430-110 Paragraph (c) addresses the rating of the disconnecting means for combination loads. This paragraph essentially requires that the loads that "may be simultaneous on a single disconnecting means" be combined to provide equivalent full-load and locked-rotor currents for what is then to be considered as a single motor for the purpose of selecting the appropriate disconnecting means. This means that it is necessary to identify the particular combination of connected loads which can be operating simultaneously and will result in the maximum full-load and locked-rotor current sums.
The individual full-load current values are to be selected from Tables 430-148, 430-149, or 430-150 and the locked-rotor values are to be from Table 430-151.
The equivalent single motor full-load current is the sum of the simultaneously operating motor full-load currents and the rating in amperes of other loads operating at the same time. The equivalent locked-rotor current is the sum of the simultaneously started motors' locked-rotor currents and the full-load currents of the remaining operating motor and non-motor loads.
The disconnecting means shall have a current rating equal to or greater than 115% of the equivalent single motor full-load current and have a horsepower rating equal to or greater than the horsepower rating determined from the equivalent locked-rotor summation.
Consider the following 460V application:

Load	Hp	Full-Load Current [A]
Motor 1	5	7.6 (simultaneous)
Motor 2	10	14.0 (not included)∗
Motor 3	15	21.0 (simultaneous)
Motor 4	20	27.0 (simultaneous)
Other		7.0 (simultaneous)
Total Equivalent		62.6 (simultaneous)

∗ Motor 2 is not included in the total since it cannot operate simultaneously with the other motors, therefore, the disconnect switch must be rated at least 72 A (1.15 x 62.6).
Consider now the locked-rotor current analysis for the same application:

Load	Hp	Full-Load Current [A]
Motor 1	5	(7.6FLA) 45.6 (simultaneous)
Motor 2	10	84.0 (not included)∗
Motor 3	15	126.0 (simultaneous)❄
Motor 4	20	162.0 (simultaneous)❄
Other		7.0 (simultaneous)
Total Equivalent		302.6 (simultaneous)

∗ Note again that Motor 2 cannot operate simultaneously with the other loads.
❄ The largest equivalent locked-rotor current occurs when motors 3 and 4 start together while the other loads marked "simultaneous" are already operating. Since Motor 1 is not starting with Motors 3 and 4, its full-load current will be added to the total instead of its locked-rotor current.

Table 430-151, which provides the correlation between locked-rotor currents and Hp ratings, shows that a 40 Hp rating is the equivalent for 302.6 locked-rotor amperes.
Therefore, the disconnect selected for this application must have a current rating of at least 72 A and a Hp rating of at least 40 Hp. In this case a Bulletin 194R rated for 100 A and 60 Hp at 460V would be an appropriate choice. What can be seen from this analysis is that, depending upon the number of motors that can start simultaneously, the actual size of the required disconnect is sometimes determined by the equivalent full load current (72 A) and other times by the equivalent horsepower determined from the locked rotor analysis (40 Hp).

Applications Outside the United States and Canada

General

Disconnect switches designed to IEC Standards and used in applications outside of North America are selected based on the ampere, horsepower, or kilowatt rating of the disconnect switch, under various utilization categories. Utilization categories for disconnect switches are as follows:

Nature of Current	Utilization Category		Typical Applications
	Frequent Operation	Infrequent Operation	
AC	AC-20A∗	AC-20B∗	Connecting and disconnecting under no load conditions
	AC-21A	AC-21B	Switching of resistive loads including moderate overloads
	AC-22A	AC-22B	Switching of mixed resistive and inductive loads, including moderate overloads
	AC-23A	AC-23B	Switching of motor loads or other highly inductive loads

∗ The use of these utilization categories is not permitted in the U.S.

For any application, the disconnect switch rating (A. Hp, or kW) must be greater than or equal to the application full-load current or power (Hp or kW), in the appropriate utilization category.
Example 1: For a 380V 50 Hz distribution application (AC-22A), with a 63 A full load current, the disconnect switch must be rated at least 63 A at 380V 50 Hz for use in AC-22A applications.
Example 2: For a 415V 50 Hz motor application (AC-23A), with a 75 kW rating, the disconnect switch must be rated at least 75 kW at 415V 50 Hz for use in AC-23A applications.

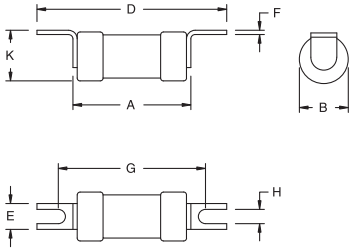
Fuse Description

With Bulletin 194R Fused Disconnect Switches

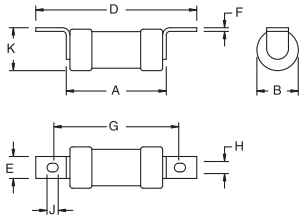
Bulletin 194R Fused Disconnect Switches have been designed to accept a variety of fuses for worldwide application flexibility. Following is a brief summary of typical fuse specifications, where the fuses are typically used, and which Bulletin 194R disconnect switches will accommodate each fuse type. Fuse manufacturers should be contacted for more specific information about each fuse type. **Fuses are not available from Rockwell Automation. BS88 Fuses (63 A shown)**

Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

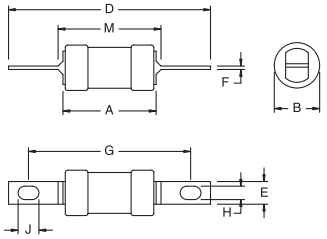
- IEC fuse type: Fuse-link for bolted connection
- Voltage rating: 660/690V AC
- Interrupting rating: 80 kA
- Standard cartridge sizes: A1, A2, A3, A4, B1, B2, B3, B4
- Typical ampere ratings: 2…400 A
- Construction: Blade type for bolted connection
- Can be installed on Bulletin 194R disconnect switch **Cat. Nos: 194RNA100P3, NA200P3, NA300P3, NA380P3, NA400P3, NB200P3, NB300P3**
- Where used: United Kingdom, Australia, New Zealand, Asia



Standard cartridge size A1



Standard cartridge sizes A2, A3, A4



Standard cartridge sizes B1, B2, B3, B4

Dim. Ref.	Ampere Range [A]	A	B	D	E	F	G	H	K
A1	2…20	36.50 (1-7/16)	13.90 (35/64)	55.60 (2-3/16)	11.10 (7/16)	0.80 (1/32)	4.50 (1-3/4)	4.40 (11/64)	14.30 (9/16)

Dim. Ref.	Ampere Range [A]	A	B	D	E	F	G	H	J	K
A2	2…20	56.40 (2-7/32)	23.80 (15/16)	85.80 (3-3/8)	8.70 (11/32)	1.20 (3/64)	73.00 (2-7/8)	5.20 (13/64)	7.10 (9/32)	23.80 (15/16)
A3	35…63	56.40 (2-7/32)	23.80 (15/16)	85.80 (3-3/8)	8.70 (11/32)	1.20 (3/64)	73.00 (2-7/8)	5.20 (13/64)	7.10 (9/32)	23.80 (15/16)
A4	80…100	70.00 (2-3/4)	34.90 (1-3/8)	111.00 (4-3/8)	19.10 (3/4)	2.40 (3/32)	93.70 (3-11/	8.70 (11/32)	10.30 (13/32)	34.90 (1-3/8)

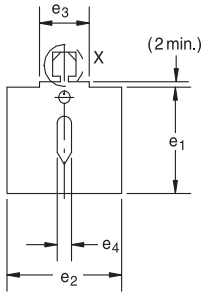
Dim. Ref.	Ampere Range [A]	A	B	D	E	F	G	H	J	M
B1	2…20	70.00 (2-3/4)	34.90 (1-3/8)	136.50 (5-3/8)	19.10 (3/4)	3.20 (1/8)	111.00 (4-3/8)	8.70 (11/32)	11.90 (15/32)	79.40 (3-1/8)
B2	125…200	77.00 (3-1/32)	41.30 (1-5/8)	136.50 (5-3/8)	19.10 (3/4)	3.20 (1/8)	111.00 (4-3/8)	8.70 (11/32)	11.90 (15/32)	79.40 (3-1/8)
B3	250…315	83.00 (3-9/32)	54.00 (2-1/8)	136.50 (5-3/8)	25.40 (1)	3.20 (1/8)	111.00 (4-3/8)	8.70 (11/32)	11.90 (15/32)	82.00 (3-1/4)
B4	355…400	70.00 (2-3/4)	61.10 (2-13/32)	136.50 (5-3/8)	25.40 (1)	6.30 (1/4)	111.00 (4-3/8)	8.70 (11/32)	11.90 (15/32)	85.80 (3-3/8)

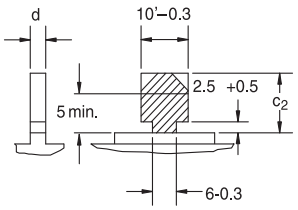
2

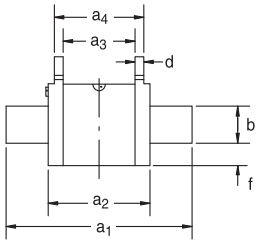
DIN Fuses (100 A shown)

Dimensions in millimeters only.
Dimensions are not intended to be used for manufacturing purposes.

- IEC fuse type: Fuse-link with blade contacts
- Voltage rating: 660/690V AC
- Interrupting rating: 120,000 A
- Standard cartridge sizes: 00, 0, 1 and 2
- Typical ampere ratings: 2…400 A
- Construction: Blade type
- Can be installed on Bulletin 194R disconnect switch Cat. Nos: 194RND072P3, ND138P3, ND250P3, ND300P3
- Where used: Europe, South America, Middle East and India







Size	Max. rated current (A)	a1	a2	a3	a4	b (min.)	d	e1 (max.)	e2 (max.)	e3	e4 ±0.2	f
00	100	78.5 ± 1.5	53	45 ± 1.5	49 ±1.5	15	2 ±0.5	48	30	20 ±5	6	12.5
0	160	125 ±2.5	67	62 +3 –1.5	68 +1.5 –3	15	2 +1.5 –0.5	48	40	20 ±5	6	11.5
1	250	135 ±2.5	71	62 ±2.5	68 ±2.5	20	2.5 +1.5 –0.5	53	52	20 +5 –2	6	10
2	400	150 ±2.5	72	62 ±2.5	68 ±2.5	25	2.5 +1.5 –0.5	61	60	20 +5 –2	6	10

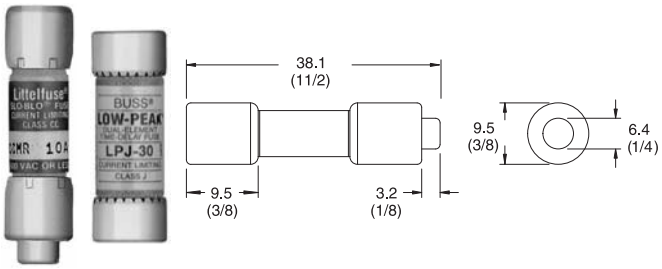
With Bulletin 194R Fused Disconnect Switches, Continued

CSA HRCI and UL Class Fuses (10 A shown)

CSA HRCI and UL Class Fuses (10 A shown)

Dimensions in millimeters (inches).
Dimensions are not intended to be used for manufacturing purposes.

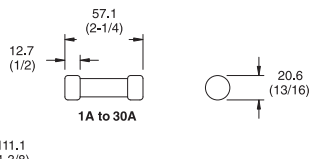
- UL fuse type: Class CC
- CSA fuse type: HRCI-MISC
- Voltage rating: 600V AC
- Interrupting rating: 200 000 A
- Standard cartridge sizes: 30 A
- Typical ampere ratings: 1…30 A
- Construction: Ferrule type
- Can be installed on Bulletin 194R disconnect switch **Cat. No: 194R-NC030P3**
- Where used: North America

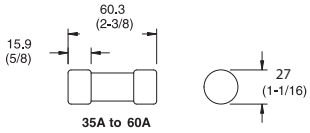


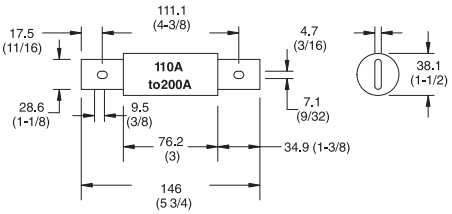
CSA HRCI and UL Class Fuses (30 A shown)

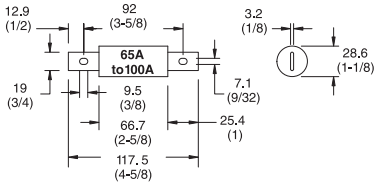
Dimensions in millimeters (inches).
Dimensions are not intended to be used for manufacturing purposes.

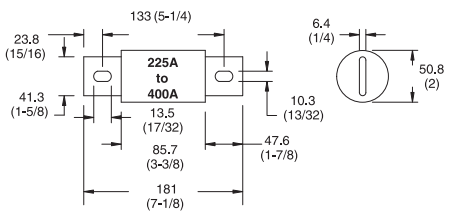
- CSA fuse type: HRCI-J
- UL fuse type: Class J
- Voltage rating: 600V AC
- Interrupting rating: 200 000 A
- Standard cartridge sizes: 30, 60, 100, 200, and 400 A
- Typical ampere ratings: 1…600 A; Blade type for bolted connection
- Can be installed on Bulletin 194R disconnect switch **Cat. Nos: 194R-NJ030P3, NJ060P3, NJ100P3, NJ200P3, NJ400P3**
- Where used: North America







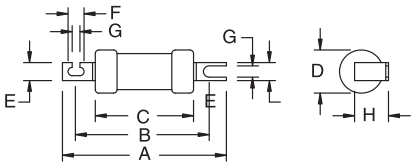




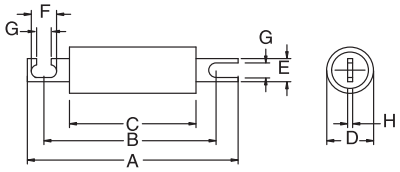
CSA HRCII Fuses (100 A shown)

Dimensions in millimeters (inches).
Dimensions are not intended to be used for manufacturing purposes.

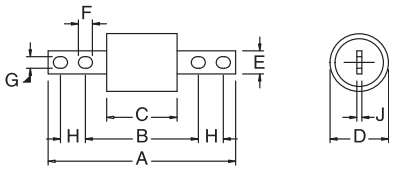
- CSA fuse type: HRCII-C
- Voltage rating: 600V AC
- Interrupting rating: 200 000 A
- Standard cartridge sizes: 30, 60, 100, 200, and 400 A
- Typical ampere ratings: 1…400 A
- Construction: Blade type for bolted connection
- Can be installed on Bulletin 194R disconnect switch **Cat. Nos: 194R-NA200P3, NA300P3, NH100P3, NH200P3, NH400P3**
- Where used: Canada



Standard Cartridge Sizes 30, 60, and 100 A



Standard Cartridge Size 200 A



Standard Cartridge Size 400 A

Current Range [A]	A	B	C	D	E	F	G	H	J
0…30	84.14 (3-5/16)	71.04 (2-51/64)	50.8 (2)	20.64 (13/16)	8.73 (11/32)	7.54 (19/64)	5.56 (7/32)	23.81 (15/16)	1.59 (1/16)
31…60	88.9 (3-1/2)	71.04 (2-51/64)	50.8 (2)	20.64 (13/16)	12.7 (1/2)	7.54 (19/64)	5.56 (7/32)	26.99 (1-1/16)	1.59 (1/16)
61…100	109.54 (4-5/16)	92.47 (3-41/64)	60.72 (2-25/64)	34.13 (1-11/32)	19.05 (3/4)	11.91 (15/32)	8.73 (11/32)	34.93 (1-3/8)	2.38 (3/32)
101…200	134.94 (5-5/16)	109.14 (4-19/64)	76.2 (3)	38.1 (1-1/2)	19.05 (3/4)	11.91 (15/32)	8.73 (11/32)	3.18 (1/8)	—
201…400	207.96 (8-3/16)	133.35 (5-1/4)	76.2 (3)	60.33 (2-3/8)	25.4 (1)	12.7 (1/2)	9.53 (3/8)	25.4 (1)	4.76 (3/16)
401…600	207.96 (8-3/16)	133.35 (5-1/4)	76.2 (3)	76.2 (3)	25.4 (1)	15.08 (19/32)	10.32 (13/32)	25.4 (1)	9.53 (3/8)

Bulletin 194R Global Fused and Non-Fused Disconnects

- 100 A…400 A sizes
- Open or enclosed switches
- Fused switch versions:
  - BS88 - DIN
  - CSA HRCII-C - CSA HRCI-J
  - UL Class J - UL Class CC
- Non-fused switches
- Operating handle ingress ratings:
  - IP42 (Type 1)
  - IP66 (Type 3R, 3, 12, 4, 4X)
- Handle with or without defeater mechanism
- Padlockable handle with up to three padlocks
- Up to 8 auxiliary contacts can be added per switch
- Suitable as service entrance disconnecting means (UL 98)

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Standards Compliance

IEC 60947-4-1/EN60947-3
BS EN60947-3
VDE 0660
CSA 22.2 No. 4
NEMA KS-1
UL 98

Certifications

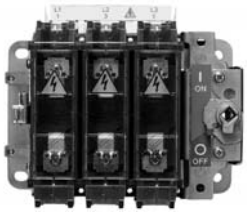
UL Listed (File No. E 47426, Guide WHTY)
CSA Certified (File No. LR1234)
CE
ASTA Certified
LOVAG Certified

The Bulletin 194R line of fused and non-fused global disconnect switches provides the flexibility to meet worldwide applications. These rod-operated disconnect switches incorporate onboard fuse carriers thus reducing panel space requirements and have high short circuit protection ratings. The disconnect switches are UL Listed, CSA, ASTA and LOVAG Certified and are designed to meet IEC 60947-3, VDE, DIN, BS and applicable NEMA requirements.

Your order must include: 1) the desired disconnect switch Cat. No. Note the disconnect switch dimension reference, 2) the appropriate operating handle and operating shaft Cat. No. corresponding to the dimension reference of the disconnect switch, 3) if required, Cat. No. of any accessories.

Product Selection

UL/CSA Fused Disconnect Switches



Cat. No. 194R-NJ100P3

Rated Current [A]	Maximum Hp Ratings ∗ 1Ø (60 Hz) 115V	1Ø (60 Hz) 230V	3Ø (60 Hz) 200V	3Ø (60 Hz) 230V	3Ø (60 Hz) 460V	3Ø (60 Hz) 575V	DC 125V	DC 250V	Fuse	Dim. Ref.	Cat. No.∗
CSA HRCII-C FUSES											
100	—	15	25	30	60	75	—	—	100 A HRCII-C	D1	194R-NH100P3
200	—	30	50	60	125	150	—	—	200 A HRCII-C	E1	194R-NH200P3
400	—	50	100	125	250	300	—	—	400 A HRCII-C	F1	194R-NH400P3
UL CLASS J AND CSA HRCI-J FUSES ‡											
100	7-1/2	15	25	30	60	75	—	20	100 A CLASS J	C1	§ **194R-NJ100P3**
200	—	25	50	60	125	150	—	40	200 A CLASS J	D1	**194R-NJ200P3**
400	—	50	100	125	250	300	—	50	400 A CLASS J	F1	**194R-NJ400P3**

∗ Time delay fuses may be required to utilize the disconnect switch at its maximum horsepower rating.
‡ Only CSA Certified HRCI-J and UL Listed Class J fuses are suitable for use with these disconnect switches.
§ Line and load terminals use 4 mm Allen-type wrench; will not accept terminal lugs.

UL/CSA Non-Fused Disconnect Switches

Non-Fused											
Fuse Description	Rated Current [A]	Maximum Hp Ratings								Dim. Ref.	Cat. No.
		1Ø (60 Hz)		3Ø (60 Hz)				DC			
		115V	230V	200V	230V	460V	575V	125V	250V		
Non-fused disconnect switches must use separately installed fuses for upstream short circuit protection.	100	7-1/2	15	25	30	60	75	—	20	C1	‡ **194R-NN100P3**
	200	—	25	50	60	125	150	—	40	D1	**194R-NN200P3**
	400	—	—	100	125	250	300	—	50	F1	**194R-NN400P3**

‡ Line and Load Terminals use 4 mm Allen-type wrench; will not accept terminal lugs.

BS88 Fused Disconnect Switches

Ratings (AC23)											
With Fuse Links					With Shorting Links						
	3Ø Maximum kW (50 Hz)					3Ø Maximum kW (50 Hz)					
Load Rating I_e [A]	200/ 230V	380/ 400/ 415V	500V	660/ 690V	Load Rating I_e [A]	200/ 230V	380/ 400/ 415V	500V	660/ 690V	Fuse	Dim. Ref.	Cat. No.
75	22	37	45	55	75	22	37	45	55	BS88 A3	C1	194R-NA380P3
138	37	75	90	110	138	37	75	90	110	BS88 A4	D1	194R-NA400P3
245	75	132	160	160	245	75	132	160	160	BS88 B1, B2	E1	194R-NB200P3
300	90	160	200	200	300	40	160	200	200	BS88 B1, B2 B3, B4	F1	194R-NB300P3

DIN Fused Disconnect Switches

Ratings (AC23)							
Load Rating I_e [A]	With Fuse Links 3Ø Maximum kW (50 Hz) 200/230V	380/400/415V	500V	660/690V	Fuse	Dim. Ref.	Cat. No.
75	22	37	45	55	DIN 00	C2	194R-ND072P3
138	37	75	90	110	DIN 0, 00❄	D2	194R-ND138P3
245	75	132	160	160	DIN 1	E2	194R-ND250P3
300	90	160	200	200	DIN 1, 2	F1	194R-ND300P3

❄ Series C only.

Operating Handles (Accepts 3 Padlocks)

	For Use With	Description	Color	Degree of Protection	Cat. No.
	C1, C2, D1, D2, E1, E2, F1	Standard orientation **with** defeater	Black/Grey	IP42 (Type 1)	**194R-HM1**
				IP66 (Type 3R, 3, 12, 4, 4X)	**194R-HM4**
			Red/Yellow	IP42 (Type 1)	**194R-HM1E**
				IP66 (Type 3R, 3, 12, 4, 4X)	**194R-HM4E**
		Standard orientation **without** defeater	Black/Grey	IP42 (Type 1)	194R-HM1-N2
				IP66 (Type 3R, 3, 12, 4, 4X)	**194R-HM4-N2**
			Red/Yellow	IP42 (Type 1)	**194R-HM1E-N2**
				IP66 (Type 3R, 3, 12, 4, 4X)	**194R-HM4E-N2**
		90° Rotated orientation **with** defeater	Black/Grey	IP42 (Type 1)	**194R-HM1-N1**
				IP66 (Type 3R, 3, 12, 4, 4X)	**194R-HM4-N1**
			Red/Yellow	IP42 (Type 1)	**194R-HM1E-N1**
				IP66 (Type 3R, 3, 12, 4, 4X)	**194R-HM4E-N1**
		90° Rotated orientation **without** defeater	Black/Grey	IP42 (Type 1)	**194R-HM1-N3**
				IP66 (Type 3R, 3, 12, 4, 4X)	**194R-HM4-N3**
			Red/Yellow	IP42 (Type 1)	194R-HM1E-N3
				IP66 (Type 3R, 3, 12, 4, 4X)	194R-HM4E-N3

NFPA 79 Operating Shaft/Handle Kits

An internal handle that permits operation of the disconnect switch when the panel door is open, in compliance with NFPA 79.

Description	Disconnect Switch Dim. Ref.	Operating Shaft Type	Operating Shaft Length [mm (in.)]	Cat. No.
NFPA 79 Handle Kit Includes NFPA 79 handle and operating shaft	C1, C2, D1, D2	8 mm square size	305 (12)	194R-NHR3
			533 (21)	194R-NHR4
	E1, E2, F1	9.5 mm square size	305 (12)	194R-NHR5
			533 (21)	194R-NHR6

2

Operating Shafts

Disconnect Switch Dim. Ref.	Operating Shaft Type	Operating Shaft Length Approx. Dim. [mm (in.)]	Enclosure Working Depth			Cat. No.
			Disconnect Switch Dim. Ref.	Minimum Approx. Dim. [mm (in.)]	Maximum Approx. Dim. [mm (in.)]	
C1, C2, D1, D2	Standard Length	200 (7.9)	C1, C2 D1, D2	183 (7.2)	254 (10.0)	**194R-R3**
	Extended Length	403 (15.9)		183 (7.2)	457 (18.0)	**194R-R4**
E1, E2, F1	Standard Length	278 (10.9)	E1, E2, F1	243 (9.6)	356 (14.0)	**194R-R5**
	Extended Length	532 (20.9)		243 (9.6)	610 (24.0)	**194R-R6**

Complete UL/CSA Disconnect Switch Kits

Includes Disconnect Switch, Operating Handle with Defeater Mechanism and Operating Shaft

Rated Current [A]	Maximum Horsepower Ratings✶ 3Ø (60 Hz) 200V	230V	460V	575V	Disconnect Switch❄ Fuse	Dim. Ref.	Operating Shaft Type	Operating Handle Degree of Protection	Handle Color	Cat. No.
100	25	30	60	75	None	C1	Standard Length	!P66 (Type 3, 3R, 4, 4X, 12)	Black/Grey	194R-NN100P34R3
									Red/Yellow	194R-NN100P34ER3
	25	30	60	75	100 A Class J	C1			Black/Grey	**194R-NJ100P34R3**
									Red/Yellow	**194R-NJ100P34ER3**
200	50	60	125	150	None	D1			Black/Grey	194R-NN200P34R3
									Red/Yellow	194R-NN200P34ER3
	50	60	125	150	200 A Class J	D1			Black/Grey	194R-NJ200P34R3
									Red/Yellow	**194R-NJ200P34ER3**
400	100	125	250	300	None	F1			Black/Grey	194R-NN400P34R5
									Red/Yellow	194R-NN400P34ER5
	100	125	250	300	400 A Class J	F1			Black/Grey	194R-NJ400P34R5
									Red/Yellow	194R-NJ400P34ER5

✶ Time delay fuses may be required to utilize the disconnect switch at its maximum horsepower ratings.
❄ Only UL Listed Class J and CSA Certified HRCI-J fuses are suitable for use with these disconnect switches.

UL Enclosed Disconnect Switches (Fused and Non-Fused)

Stainless Steel Enclosure

Rated Current [A]	Maximum Horsepower Ratings						Fuse Type	Dim. Ref.	IP66 (Type 3/4/12) Watertight Dusttight Sheet Metal Enclosure	IP66 (Type 4/4X) Watertight, Corrosion-Resistant Stainless Steel Enclosure	IP66 (Type 4/4X) Watertight, Corrosion-Resistant Non-Metallic Enclosure
	1Ø (60Hz)		3Ø (60Hz)								
	115V	230V	200V	230V	460V	575V			Cat. No.∗	Cat. No.∗	Cat. No.∗
100	7-1/2	15	25	30	60	75	Class J Fused	C1	194R-FJ100P3	194R-CJ100P3	194R-KJ100P3
							None	C1	194R-FN100P3	194R-CN100P3	194R-KN100P3
200	—	25	50	60	125	150	Class J Fused	D1	194R-FJ200P3	194R-CJ200P3	194R-KJ200P3
							None	D1	194R-FN200P3	194R-CN200P3	194R-KN200P3
400	—	50	100	125	250	300	Class J Fused	F1	194R-FJ400P3	194R-CJ400P3	194R-KJ400P3
							None	F1	194R-FN400P3	194R-CN400P3	194R-KN400P3

∗ Black operating handles supplied as standard. To order Red/Yellow Handles, add string suffix **"E"** to the Cat. No. Example: **Cat. No. 194R-FJ100P3E.**

Accessories

Modifications for Enclosed Bulletin 194R Switches (max. 4 contact blocks/8 auxiliary contacts per switch)

Description	Uses Cat. No.	Suffix Code
Auxiliary Contact (1 N.O. + 1 N.C.)	195-GA11	-989
Auxiliary Contact (1 N.O.)	195-GA10	-98
Auxiliary Contact (1 N.C.)	195-GA01	-99

Accessories

	Description	Disconnect Switch Dim Ref.	Pkg. Qty.	Cat. No.
	Shaft Guard — Provides extra protection against contact with shaft	C1, C2, D1, D2, E1, E2, F1	1	194R-R3G

Fuse Covers

Cat. No. 194R-FCD1

Disconnect Switch Dim Ref.	Quantity Required Per Disconnect Switch	Cat. No.
C1	3	**194R-FCC1**
C2		**194R-FCC2**
D1, D2		**194R-FCD1**
E1, E2		**194R-FCE1**
F1		**194R-FCF1**

Terminal Shields*

Disconnect Switch Dim Ref.	Quantity Required Per Disconnect Switch	Cat. No.
C1, C2	2	**194R-LNC3**
D1, D2	2	**194R-LNC4**
E1, E2	2	**194R-LNC5**
F1	2	**194R-LNC6**

* For use on either Line or Load Side of Disconnect Switch. Disconnect switch **Cat. Nos: 194R-NN**P3** and **194R-NJ**P3** are provided as standard with a line side terminal shield.

Terminal Lugs

Disconnect Switch Dim Ref.	Conductor Range	Pkg. Qty.	Cat. No.
D1 (Cat. No. 194R-NH100P3 only)	#8…1/0 AWG 10 mm²…50 mm²	3	**199-LE1**
D1 (Cat. No. 194R-NJ200P3, -NN200P3, -NA400P3) D2	#6…250 MCM AWG 16 mm²…120 mm²		**199-LF1**
E1, E2, F1	#4…500 MCM AWG 25 mm²…240 mm²		**199-LG1**
F1	Two 1/0…350 MCM AWG Two 50 mm²…150 mm²		**199-LH1**

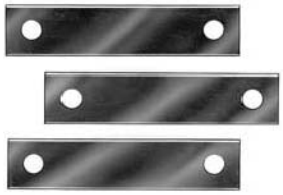
Auxiliary Contacts∗

Cat. No. 195-GA10

Disconnect Switch Dim Ref.	Description	No. of Auxiliary Contacts	Cat. No.
C1, C2, D1, D2, E1, E2, F1, F2	Auxiliary contact (side-mounted)‡	1 N.O.	**195-GA10**
		1 N.C.	**195-GA01**
C1, C2, D1, D2, E1, E2, F1, F2	Two-pole auxiliary contact for disconnect switch‡	1 N.O./1 N.C.	**195-GA11**
C1, C2, D1, D2, E1, E2, F1, F2	Two-pole N.O. auxiliary contact for disconnect switch 2 N.O.‡	2 N.O.	**195-GA20**
C1, C2, D1, D2, E1, E2, F1, F2	Two-pole N.C. auxiliary contact for disconnect switch‡	2 N.C.	**195-GA02**
C1, C2, D1, D2, E1, E2, F1, F2	Auxiliary support for 5…8 circuits per switch	—	**194R-A1**

∗ See page 2-439 for contact ratings.
‡ A maximum of four (4) contact blocks (8 auxiliary contacts) can be installed on each disconnect switch. When more than two (2) contact blocks are used, a support kit **Cat. No. 194R-A1** must be used.

Shorting Links For BS Switches Only



Disconnect Switch Dim Ref.	Description	For Use with Cat. No.	Cat. No.
D1	BS88 Size A4	194R-NA400P3	**194R-SLA4**
E1	BS88 Size B1, B2	194R-NB200P3	**194R-SLB2**
F1	BS88 Size B3, B4	194R-NB300P3	

Fused Disconnect Switches For BS88 Fuses

Electrical Ratings									
Cat. No.		194R-NA380P3		194R-NA400P3		194R-NB200P3		194R-NB300P3	
Fuse Type	BS88 Dimension	A3		A4		B1, B2		B1, B2, B3, B4	
Rated Insulation Voltage (U_i)	[V]	660		660		660		660	
Maximum Short Circuit Prospective Fault Current	[kA]	80		80		80		80	
Rated Operational Current AC-22A (I_e)		Fuse Links	Shorting Links	Fuse Links	Shorting Links	Fuse Links	Shorting Links	Fuse Links	Shorting Links
200/230V 50 Hz	[A]	100	100	200	160	250	250	400	400
380/400/415V 50 Hz	[A]	100	100	200	160	250	250	400	400
500V 50 Hz	[A]	100	100	200	160	250	250	400	400
660/690V 50 Hz	[A]	100	100	200	160	250	250	400	400
Rated Operational Current AC-23A (I_e)									
200/230V 50 Hz	[A]	75	75	130	130	240	240	300	300
380/400/415V 50 Hz	[A]	75	75	138	138	245	245	300	300
500V 50 Hz	[A]	65	65	130	130	220	220	290	290
660/690V 50 Hz	[A]	61	61	118	118	170	170	220	220
Rated Thermal Current (I_{the})	[A]	100	100	160	160	200	250	400	400
Maximum kW, AC-23A 3Ø									
200/230V 50 Hz	[kW]	22	22	37	37	75	75	90	90
380/400/415V 50 Hz	[kW]	37	37	75	75	132	132	160	160
500V 50 Hz	[kW]	45	45	90	90	160	160	200	200
660/690V 50 Hz	[kW]	55	55	110	110	160	160	200	200
Maximum Fuse Rating	[A]	100	—	200	—	200	—	400	—
Maximum Motor Circuit Fuse Link		100M125	—	200M250	—	ED355	—	400M450	—
Maximum Fuse Cut-off Current✶	[kA]	14	14	20	20	33	33	40	40
Rated Short Time Current, 1 Second	[kA]	2		4		7.5		12	

Mechanical Data					
Cat. No.		194R-NA380P3	194R-NA400P3	194R-NB200P3	194R-NB300P3
Degree of Protection (per IEC 947) Switch Only Switch with Terminal Shield & Fuse Cover(s)		 IP00 IP20	 IP00 IP20	 IP00 IP20	 IP00 IP20
Mechanical Endurance❄	Operations	10 000	8 000	8 000	8 000
Operating Torque (Maximum)	N•m lb•in.	17.5 155	20.3 180	31.4 275	31.4 275
Terminal Capacity Power Terminals	mm^2 AWG	2.5…35 #14…#2	16…120 #6-250MCM	25…240 #4-500MCM	Two 50…150 Two 1/0…350MCM
Auxiliary Contact Terminals	mm^2 AWG	2.5…4 #14…#12	2.5…4 #14…#12	2.5…4 #14…#12	2.5…4 #14…#12
Maximum Number of Auxiliary Circuits		8	8	8	8
Approximate Weight	kg lbs.	4.03 8.88	6.16 13.59	9.30 20.50	23.83 30.50
Minimum Enclosure Size Approximate dimensions in millimeters (inches)	Height Width Depth	330 (13) 301 (11-27/32) 162 (6-3/8)	560 (22) 344 (13-17/32) 178 (7)	610 (24) 394 (15-33/64) 227 (8-15/16)	762 (30) 424 (16-45/64) 243 (9-9/16)
Switch Dimension Reference (See dimension drawings on pages 2-441 and 2-443…2-444.)		C1	D1	E1	F1

✶ Fuses must be selected with regard to the maximum prospective fault current of the system and the maximum cut-off current of the fuse when subjected to that maximum fault current. The maximum fuse cut-off current as specified for each disconnect switch must not be exceeded.

❄ Based on Rockwell Automation tests in accordance with the requirements as defined in IEC 60947-3.

Fused Disconnect Switches For DIN Fuses

Electrical Ratings					
Cat No.		194R-ND072P3	194R-ND138P3	194R-ND250P3	194R-ND300P3
Fuse Type	DIN Dimension	00	0, 00❄	1	1, 2
Rated Insulation Voltage (U_i)	[V]	660	660	660	660
Maximum Short Circuit Prospective Fault Current	[kA]	100	100	100	100
Rated Operational Current AC-22A (I_e)		Fuse Links	Fuse Links	Fuse Links	Fuse Links
200/230V 50 Hz	[A]	85	160	250	400
380/400/415V 50 Hz	[A]	85	160	250	400
500V 50 Hz	[A]	85	160	250	400
660/690V 50 Hz	[A]	85	160	250	400
Rated Operational Current AC-23A (I_e)					
200/230V 50 Hz	[A]	75	130	240	300
380/400/415V 50 Hz	[A]	72	138	245	300
500V 50 Hz	[A]	65	130	220	290
660/690V 50 Hz	[A]	61	118	170	220
Rated Thermal Current (I_{the})	[A]	85	160	250	400
Maximum kW, AC-23A 3Ø					
200/230V 50 Hz	[kW]	22	37	75	90
380/400/415V 50 Hz	[kW]	37	75	132	160
500V 50 Hz	[kW]	45	90	160	200
660/690V 50 Hz	[kW]	55	110	160	200
Maximum Fuse Rating	[A]	100	200	250	400
Maximum Motor Circuit Fuse Link		100	200	250	400
Maximum Fuse Cut-off Current∗	[kA]	14	20	33	40
Rated Short Time Current, 1 Second	[kA]	2	4	7.5	12

Mechanical Data					
Cat. No.		194R-ND072P3	194R-ND138P3	194R-ND250P3	194R-ND300P3
Degree of Protection (per IEC 947) Switch Only Switch with Terminal Shield & Fuse Cover(s)		 IP00 IP20	 IP00 IP20	 IP00 IP20	 IP00 IP20
Mechanical Endurance❄	Operations	10 000	8 000	8 000	8 000
Operating Torque (Maximum)	N•m lb•in.	17.5 155	20.3 180	31.4 275	31.4 275
Terminal Capacity Power Terminals	mm^2 AWG	2.5…35 #14…#2	16…120 #6…250MCM	25…240 #4…500MCM	Two 50…150 Two 1/0…350MCM
Auxiliary Contact Terminals	mm^2 AWG	2.5…4 #14…#12	2.5…4 #14…#12	2.5…4 #14…#12	2.5…4 #14…#12
Maximum Number of Auxiliary Circuits		8	8	8	8
Approximate Weight	kg lbs.	4.15 9.16	6.17 13.61	9.41 20.75	14.06 31.00
Minimum Enclosure Size Approximate dimensions in millimeters (inches)	Height Width Depth	330 (13) 301 (11-27/32) 168 (6-5/8)	560 (22) 344 (13-17/32) 183 (7-7/32)	712 (28) 394 (15-33/64) 227 (8-15/16)	762 (30) 424 (16-45/64) 243 (9-9/16)
Switch Dimension Reference (See dimension drawings on pages 2-441 and 2-443…2-444.)		C2	D2	E2	F1

∗ Fuses must be selected with regard to the maximum prospective fault current of the system and the maximum cut-off current of the fuse when subjected to that maximum fault current. The maximum fuse cut-off current as specified for each disconnect switch must not be exceeded.

❄ Based on Rockwell Automation tests in accordance with the requirements as defined in IEC 60947-3.

Fused Disconnect Switches For CSA HRCII-C Fuses

Electrical Ratings				
Cat. No.		**194R-NH100P3**	**194R-NH200P3**	**194R-NH400P3**
CSA Fuse Type		HRCII-C	HRCII-C	HRCII-C
Maximum Fuse Cartridge Size	[A]	100	200	400
Maximum Voltage AC	[V]	600	600	600
Ampere Rating	[A]	100	200	400
Maximum Short Circuit Prospective Fault Current	[kA]	100	100	100
Maximum Hp, 3Ø AC				
200V 60 Hz	[Hp]	25	50	100
230V 60 Hz	[Hp]	30	60	125
460V 60 Hz	[Hp]	60	125	250
575V 60 Hz	[Hp]	75	150	300
Maximum Hp, 1Ø AC				
115V 60 Hz	[Hp]	—	—	—
230V 60 Hz	[Hp]	15	30	50

Mechanical Data				
Cat. No.		**194R-NH100P3**	**194R-NH200P3**	**194R-NH400P3**
Degree of Protection (per IEC 947) Switch Only Switch with Terminal Shield & Fuse Cover(s)		 IP00 IP20	 IP00 IP20	 IP00 IP20
Mechanical Endurance∗	Operations	10 000	8 000	8 000
Operating Torque (Maximum)	N•m lb•in.	20.3 180	31.4 275	31.4 275
Terminal Capacity				
Power Terminals	mm^2 AWG	10…50 #8…#1/0	25…240 #4…500MCM	Two 50…150 Two 1/0…350MCM
Auxiliary Contact Terminals	mm^2 AWG	2.5…4 #14…#12	2.5…4 #14…#12	2.5…4 #14…#12
Maximum Number of Auxiliary Circuits		8	8	8
Approximate Weight	kg lbs.	6.16 13.59	9.30 20.50	13.83 30.50
Minimum Enclosure Size Approximate dimensions in millimeters (inches)	Height Width Depth	384 (15-1/8) 344 (13-17/32) 178 (7)	610 (24) 394 (15-33/64) 227 (8-15/16)	762 (30) 424 (16-45/64) 243 (9-9/16)
Switch Dimension Reference (See dimension drawings on 2-441, 2-442, and 2-443.)		D1	E1	F1

∗ Based on Rockwell Automation tests in accordance with the requirements as defined in CSA C22.2 No. 4 and IEC 60947-3.

IEC Fused and Non-Fused Disconnects

Specifications, Continued

Fused Disconnect Switches For CSA HRCI-J and UL Class Fuses❄

Electrical Ratings							
Cat. No.		194R-NJ100P3		194R-NJ200P3		194R-NJ400P3	
CSA Fuse Type/UL Fuse Type		HRCI-J/Class J		HRCI-J/Class J		HRCI-J/Class J	
Maximum Fuse Cartridge Size	[A]	100		200		400	
Maximum Voltage AC DC	[V] [V]	600 250		600 250		600	
Ampere Rating	[A]	100		200		400	
Maximum Short Circuit Prospective Fault Current	[kA]	100		100		100	
Fuse Operating Characteristics		Time Delay	Non-Time Delay	Time Delay	Non-Time Delay	Time Delay	Non-Time Delay
Maximum Hp, 3Ø AC							
200V 60 Hz	[Hp]	25	15	50	25	100	50
230V 60 Hz	[Hp]	30	15	60	25	125	50
460V 60 Hz	[Hp]	60	25	125	50	250	100
575V 60 Hz	[Hp]	75	30	150	60	300	125
Maximum Hp, 1Ø AC							
115V 60 Hz	[Hp]	7.5	—	—	—	—	—
230V 60 Hz	[Hp]	15	7.5	25	15	50	25
Maximum Hp, DC							
125V DC	[Hp]	—	—	—	—	—	—
250V DC	[Hp]	20	20	40	40	50	50

❄ Only CSA Certified HRCI-J and HRCI-MISC (also UL Listed as Class CC) fuses and UL Listed Class J and CC fuses are suitable for use with these disconnect switches.

Fused Disconnect Switches For CSA HRCI-J and UL Class Fuses∗, Continued

Mechanical Data				
Cat. No.		194R-NJ100P3	194R-NJ200P3	194R-NJ400P3
Degree of Protection (per IEC 947) Switch Only Switch with Terminal Shield & Fuse Cover(s)		 IP00 IP20	 IP00 IP20	 IP00 IP20
Mechanical Endurance‡	Operations	10 000	8 000	8 000
Operating Torque (Maximum)	N•m lb•in.	17.5 155	20.3 180	31.4 275
Terminal Capacity Power Terminals	mm^2 AWG	2.5…35 #14…#2	16…120 #6…250MCM	Two 50…150 Two 1/0…350MCM
Auxiliary Contact Terminals	mm^2 AWG	2.5…4 #14…#12	2.5…4 #14…#12	2.5…4 #14…#12
Maximum Number of Auxiliary Circuits		8	8	8
Approximate Weight	kg. lbs.	4.12 9.08	6.16 13.59	13.83 30.50
Minimum Enclosure Size Approximate dimensions in millimeters (inches)	Height Width Depth	330 (13) 301 (11-27/32) 162 (6-3/8)	560 (22) 344 (13-17/32) 178 (7)	762 (30) 424 (16-45/64) 243 (9-9/16)
Switch Dimension Reference (See dimension drawings on 2-441, 2-443 and 2-443.)		C1	D1	F1

∗ Only CSA Certified HRCI-J) fuses and UL Listed Class J fuses are suitable for use with these disconnect switches.

‡ Based on Rockwell Automation tests in accordance with the requirements as defined in CSA C22.2 No. 4, IEC 60947-3 and UL 98.

Non-Fused Disconnect Switches For CSA and UL Class Applications§

Electrical Ratings								
Cat. No.			194R-NN100P3		194R-NN200P3		194R-NN400P3	
Maximum Fuse Cartridge Size			100♣		200♣		400♣	
Maximum Voltage	AC DC	[V] [V]	600 250		600 250		600 250	
Ampere Rating		[A]	100		200		400	
Maximum Short Circuit Prospective Fault Current		[kA]	100		100		100	
Fuse Operating Characteristics➢			Time Delay	Non-Time Delay	Time Delay	Non-Time Delay	Time Delay	Non-Time Delay
Maximum Hp, 3Ø AC	200V 60 Hz 230V 60 Hz 460V 60 Hz 575V 60 Hz	[Hp] [Hp] [Hp] [Hp]	25 30 60 75	15 15 25 30	50 60 125 150	25 25 50 60	100 125 250 300	50 50 100 125
Maximum Hp, 1Ø AC	115V 60 Hz 230V 60 Hz	[Hp] [Hp]	— 15	— 15	— 25	— 15	— 50	— 25
Maximum Hp, DC	125V DC 250V DC	[Hp] [Hp]	— 20	— 20	— 40	— 40	— 50	— 50
Power Lost		[W]	20		40		80	

§ Non-fused disconnect switches must be used with separately installed CSA Certified HRCI-J or HRCI-T fuses; or UL Listed Class J or T fuses.
♣ When using CSA HRCI-J or HRCI-T fuses, and UL Class J or T fuses.
➢ Based on Rockwell Automation tests in accordance with the requirements as defined in CSA C22.2 No. 4, IEC 947-3 and UL 98.

Non-Fused Disconnect Switches For CSA and UL Class Applications*, Continued

Mechanical Data				
Cat. No.		194R-NN100P3	194R-NN200P3	194R-NN400P3
Degree of Protection (per IEC 947) Switch Only Switch with Terminal Shield & Fuse Cover(s)		IP00 IP20	IP00 IP20	IP00 IP20
Mechanical Endurance‡	Operations	10 000	8 000	8 000
Operating Torque, Max.	N•m (lb•in.)	17.5 (155)	20.3 (180)	31.4 (275)
Terminal Capacity Power Terminals	mm^2 AWG	2.5…35 #14…#2	16…120 #6…250MCM	Two 50…150 Two 1/0…350MCM
Auxiliary Contact Terminals	mm^2 AWG	2.5…4 #14…#12	2.5…4 #14…#12	2.5…4 #14…#12
Maximum Number of Auxiliary Circuits		8	8	8
Approximate Weight	kg lbs.	4.31 9.50	6.56 14.47	14.97 33.00
Minimum Enclosure Size Approximate dimensions in millimeters (inches)	Height Width Depth	330 (13) 301 (11-27/32) 162 (6-3/8)	560 (22) 344 (13-17/32) 178 (7)	762 (30) 424 (16-45/64) 243 (9-9/16)
Switch Dimension Reference (See dimension drawings on 2-441, 2-443 and 2-443.)		C1	D1	F1

* Non-fused disconnect switches must be used with separately installed CSA Certified HRCI-J, HRCI-T fuses; or UL Listed Class J or T fuses.
‡ Based on Rockwell Automation tests in accordance with the requirements as defined in CSA C22.2 No. 4, IEC 60947-3, and UL 98.

All Bulletin 194R Disconnect Switches, 100 A, 200 A, 400 A Range

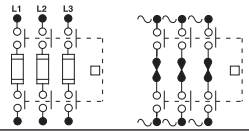
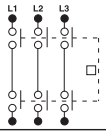
Environmental Data	
Ambient Temperature	
Open Enclosed Storage	–2…+55 °C (–4…+131 °F) –20…+40 °C (–4…+104 °F) –40…+65 °C (–40…+149 °F)
Altitude (per IEC 947-1)	2,000
Relative Humidity (per IEC 947-1)	90% @ +20 °C (+68 °F) 50% @ +40 °C (+104 °F)

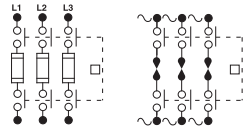
Auxiliary Contact Ratings for Cat. No. 195-GA

AC11 Rating		DC11 Rating	
U_e [V]	I_e [A]	U_e [V]	I_e [A]
12…120	6	28	5.0
220…240	3	110	1.25
380…480	1.5	220	0.62
500…600	1.2	440	0.27
		600	0.20

Thermal Current — 10 Amperes. EEMAC/NEMA A600, P300.
Insulation Voltage IEC (U_i) — 660.

Wiring Schematic

U.L. CSA LISTED SWITCHES	DIMENSION REFERENCE	CIRCUIT
Cat. No.		
194R-NH100P3 194R-NH200P3 194R-NH400P3	D1 E1 F1	
194R-NJ100P3 194R-NJ100P3 194R-NJ100P3	C1 D1 F1	
194R-NN100P3 194R-NN200P3 194R-NN400P3	C1 D1 F1	

OTHER SWITCHES	DIMENSION REFERENCE	CIRCUIT
Cat. No.		
194R-NA380P3 194R-NA400P3 194R-NB200P3 194R-NB300P3	C1 D1 E1 F1	

Renewal Parts

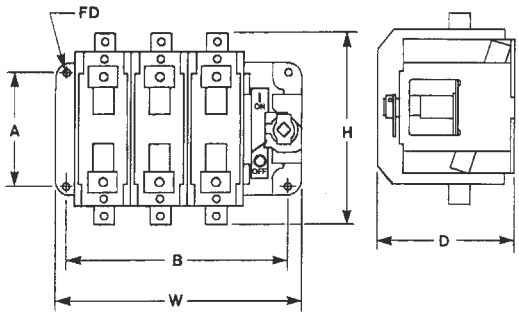
Hardware Kits (Includes switch/fuse mounting hardware and operating rod cotter pin)

Disconnect Switch		Hardware Kit Part No.
Cat. No.	Dim. Ref.	
194R-NA380P3 194R-NN100P3 194R-NJ100P3	C1, C2	41022-800-03 41022-800-02 41022-800-01
194R-NA400P3 194R-NN200P3 194R-NJ200P3 194R-ND072P3	D1, D2	41022-800-07 41022-800-06 41022-800-05 41022-800-04

Disconnect Switch		Hardware Kit Part No.
Cat. No.	Dim. Ref.	
194R-NH200P3 194R-ND250P3 194R-NB200P3 194R-NH100P3 194R-ND138P3	E1, E2	41022-800-12 41022-800-11 41022-800-10 41022-800-09 41022-800-08
194R-NH400P3 194R-ND300P3 194R-NB300P3 194R-NN400P3 194R-NJ400P3	F1	41022-800-17 41022-800-16 41022-800-15 41022-800-14 41022-800-13

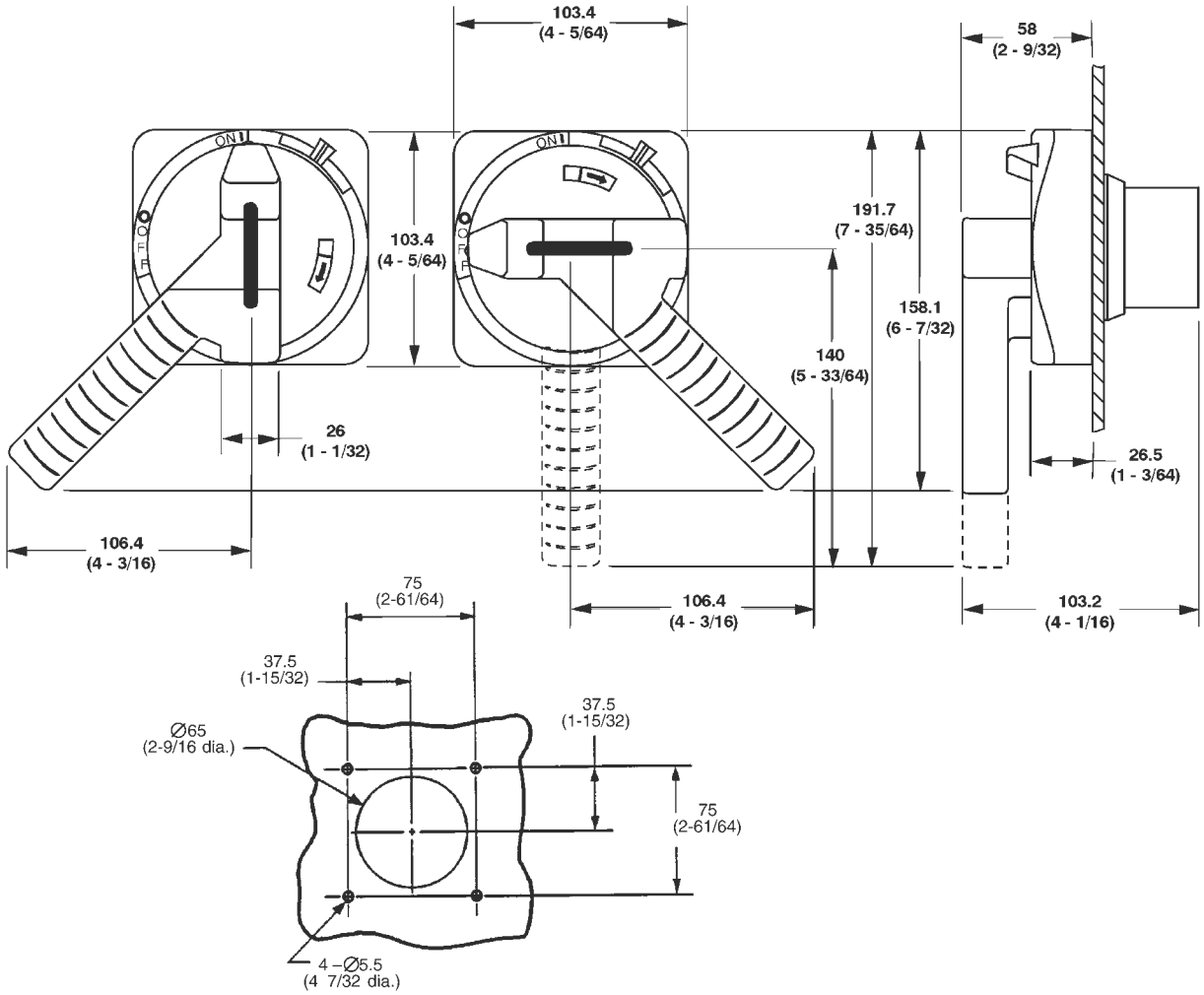
Disconnect Switch Dimension References C1, C2, D1, D2, E1, E2 and F1 (100, 200, and 400 A)

Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.



Disconnect Switch Dimension Reference	Approximate Dimensions					
	H	W	D	A	B	FD
C1	148 (5-53/64)	194 (7-41/64)	130 (5-7/64)	106 (4-11/64)	170 (6-11/16)	4-M6 (4-1/4)
C2	148 (5-53/64)	194 (7-41/64)	136 (5-23/64)	106 (4-11/64)	170 (6-11/16)	4-M6 (4-1/4)
D1	184 (7-1/4)	236 (9-19/64)	148 (5-53/64)	106 (4-11/64)	212 (8-11/32)	4-M6 (4-1/4)
D2	184 (7-1/4)	236 (9-19/64)	153 (6-1/64)	106 (4-11/64)	212 (8-11/32)	4-M6 (4-1/4)
E1	220 (8-21/32)	278 (10-15/16)	213 (8-25/64)	150 (5-29/32)	252 (9-59/64)	4-M8 (4-5/16)
E2	220 (8-21/32)	278 (10-15/16)	213 (8-25/64)	150 (5-29/32)	252 (9-59/64)	4-M8 (4-5/16)
F1	250 (9-27/32)	308 (12-1/8)	213 (8-25/64)	150 (5-29/32)	282 (11-7/64)	4-M8 (4-5/16)

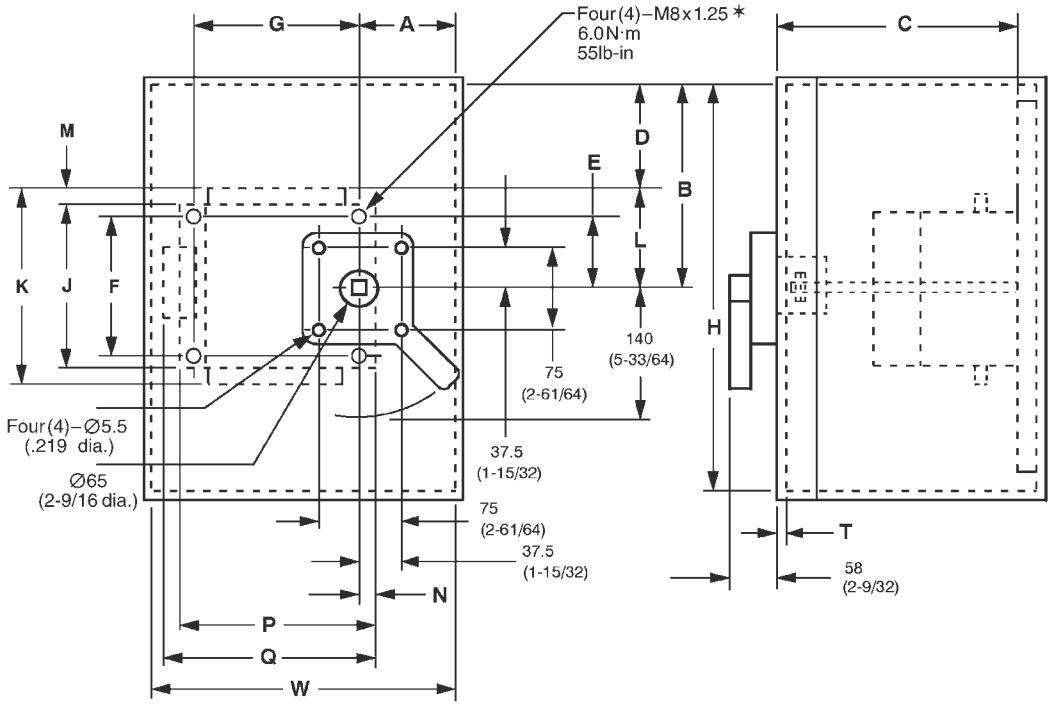
Operating Handles — Cat. No. 194R-HM…/190-HM



2

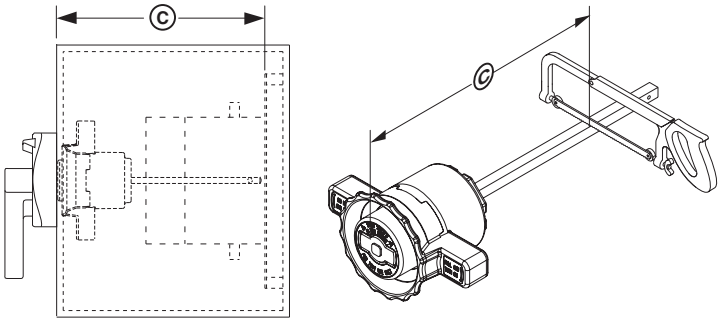
Disconnect Switch Dim. Ref.: C1, C2, D1, D2 (100 A and 200 A)

Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.



✶The switch is capable of accepting four (4)Ø 6.4 (1/4 dia.) screws for mounting.

NFPA 79 Operating Handles/Shafts Cat. Nos. 194R-NHR...



Disconnect			Ⓒ
194R-NH100_ _ **194R-NJ100_ _** **194R-NN100_ _**	**194R-NJ200_ _** **194R-NN200_ _** **194R-NA400_ _**	**194R-NA380_ _** **194R-ND072_ _** **194R-ND138_ _**	**≥ 216 mm** **8.5 in**
194R-NB200_ _ **194R-NB300_ _** **194R-ND250_ _**	**194R-ND300_ _** **194R-NH200_ _** **194R-NH400_ _**	**194R-NJ400_ _** **194R-NN400_ _**	**≥ 305 mm** **12.0 in**

Enclosure Installation Dimensions

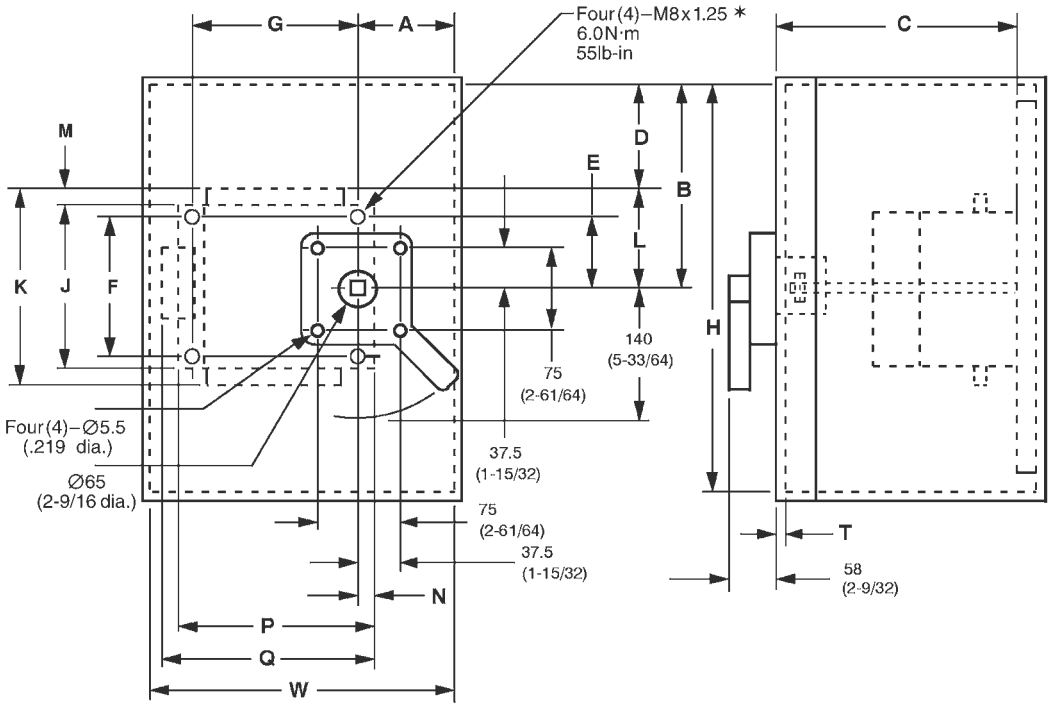
Dimension Reference	A	B	C		H	T		W	
								Minimum	
	Minimum	Minimum	Minimum	Maximum	Minimum	Minimum	Maximum	Single Pole Aux. Cont.	Two Pole Aux. Cont.
C1	108 (4-1/4)	162 (6-3/8)	162 (6-3/8)	457 (18)	330 (13)	1.6 (1/16)	4.8 (3/16)	301 (11-27/32)	313 (12-5/16)
C2	108 (4-1/4)	162 (6-3/8)	168 (6-5/8)	457 (18)	330 (13)	1.6 (1/16)	4.8 (3/16)	301 (11-27/32)	313 (12-5/16)
D1	108 (4-1/4)	280 (11)	178 (7)	457 (18)	560 (22)	1.6 (1/16)	4.8 (3/16)	344 (13-17/32)	356 (14)
D2	108 (4-1/4)	280 (11)	183 (7-7/32)	457 (18)	560 (22)	1.6 (1/16)	4.8 (3/16)	344 (13-17/32)	356 (14)

Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

Disconnect Switch and Operating Handle Installation Dimensions

Dimension Reference	D	E	F	G	J	K	L	M	N	P	Q
C1, C2	74 (2-29/32)	53 (2-3/32)	106 (4-3/16)	170 (6-11/16)	148 (5-53/64)	176 (6-15/16)	88 (3-15/32)	13.5 (17/32)	12.7 (1/2)	194 (7-41/64)	206 (8-7/64)
D1, D2	162 (6-23/64)	53 (2-3/32)	106 (4-3/16)	212 (8-11/32)	184 (7-1/4)	236 (9-9/32)	118 (4-41/64)	26 (1-1/32)	12.7 (1/2)	236 (9-19/64)	248 (9-49/64)

Disconnect Switch Dim. Ref.: E1, E2, F1 (200 and 400 A)



✶ The switch is capable of accepting four (4)Ø 7.9 (5/16 dia.) screws for mounting.

Enclosure Installation Dimensions

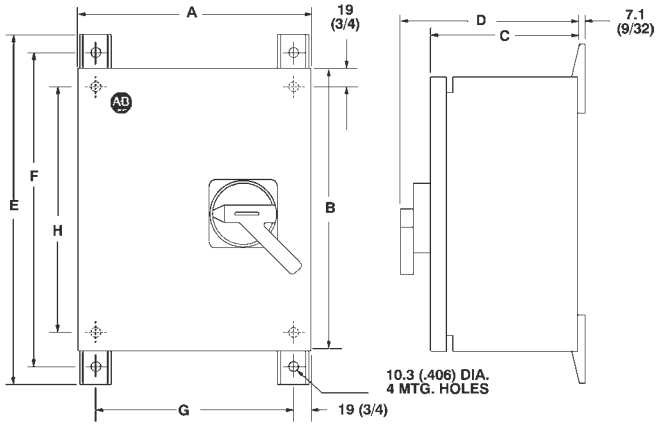
Dimension Reference	A	B	C		H	T		W	
								Minimum	
	Minimum	Minimum	Minimum	Maximum	Minimum	Minimum	Maximum	Single Pole Aux. Cont.	Two Pole Aux. Cont.
E1	108 (4-1/4)	305 (12)	227 (8-15/16)	610 (24)	610 (24)	1.6 (1/16)	4.8 (3/16)	394 (15-33/64)	406 (16)
E2	108 (4-1/4)	356 (14)	227 (8-15/16)	610 (24)	712 (28)	1.6 (1/16)	4.8 (3/16)	394 (15-33/64)	406 (16)
F1	108 (4-1/4)	381 (15)	243 (9-9/16)	610 (24)	762 (30)	1.6 (1/16)	4.8 (3/16)	606 (23-7/8)	606 (23-7/8)

Disconnect Switch and Operating Handle Installation Dimensions

Dimension Reference	D	E	F	G	J	K	L	M	N	P	Q
E1	158 (6-7/32)	75 (2-61/64)	150 (5-29/32)	252 (9-59/64)	220 (8-21/32)	294 (11-37/64)	147 (5-25/32)	37 (1-29/64)	14 (35/64)	278 (10-15/16)	290 (11-13/32)
E2	209 (8-7/32)	75 (2-61/64)	150 (5-29/32)	252 (9-59/64)	220 (8-21/32)	294 (11-37/64)	147 (5-25/32)	37 (1-29/64)	14 (35/64)	278 (10-15/16)	290 (11-13/32)
F1	202 (7-61/64)	75 (2-61/64)	150 (5-29/32)	282 (11-7/64)	250 (9-27/32)	358 (14-3/32)	179 (7-3/64)	54 (2-1/8)	14 (35/64)	308 (12-1/8)	320 (12-19/32)

IP66 (Type 3/4/12) Watertight, Dusttight Sheet Metal Enclosure

Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

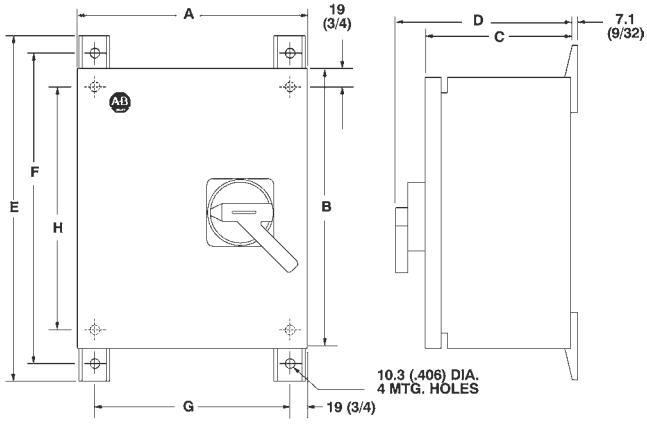


External Mounting Feet Optional Cat. No. 198-F3

[A]	Type	Dim. Ref.	A	B	C	D	E	F	G	H
200	Non-Fused & Fused	D1	406 (16)	610 (24)	224 (8-51/64)	282 (11-5/64)	688 (27-5/64)	648 (25-1/2)	368 (14-1/2)	572 (22-1/2)
400	Non-Fused & Fused	F1	610 (24)	762 (30)	326 (12-51/64)	384 (15-5/64)	840 (33-5/64)	800 (31-1/2)	572 (22-1/2)	724 (28-1/2)

Type 4/4X Watertight, Corrosion-Resistant Stainless Steel Enclosure

Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

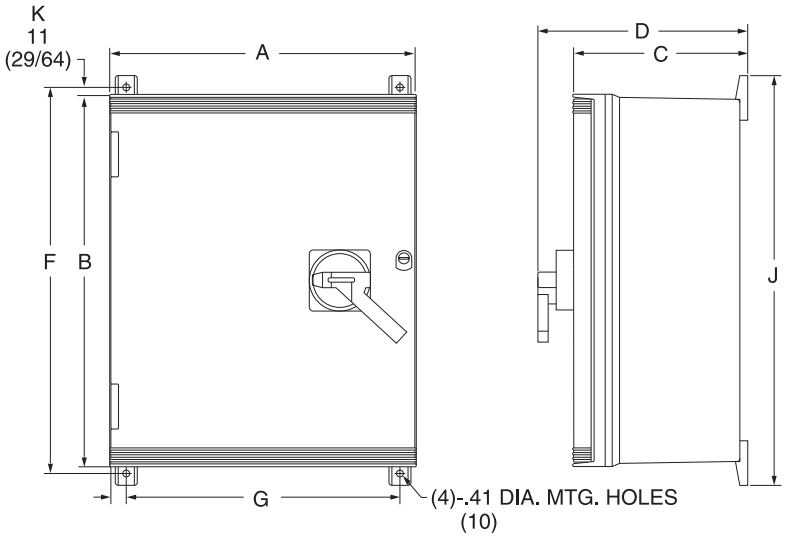


External Mounting Feet Optional Cat. No. 198-F3

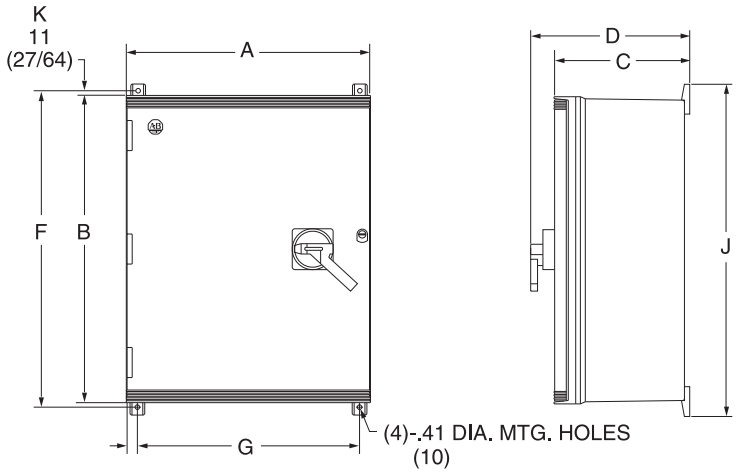
[A]	Type	Dim. Ref.	A	A1	B	C	D	E	F	G	H
100	Non-Fused & Fused	C1	508 (20)	—	406 (16)	224 (8-51/64)	282 (11-7/64)	484 (19-5/64)	444 (17-1/2)	470 (18-1/2)	368 (14-1/2)
200	Non-Fused & Fused	D1	406 (16)	—	610 (24)	224 (8-51/64)	282 (11-5/64)	484 (19-5/64)	444 (17-1/2)	572 (22-1/2)	368 (14-1/2)
400	Non-Fused & Fused	F1	610 (24)	—	762 (30)	326 (12-51/64)	384 (15-5/64)	840 (33-5/64)	800 (31-1/2)	572 (22-1/2)	724 (28-1/2)

IP66 (Type 3/4/4X/12) Corrosion Resistant, Non-Metallic Enclosure

Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.



Cat. No. 194R-K_200P3 200 A Switch



Cat. No. 194R-K_400P3 400 A Switch

Switch Size [A]	A	B	C	D	F	G	J	K
200	513 (20-13/64)	625 (24-5/8)	292 (11-31/64)	350 (13-25/32)	648 (25-1/2)	457 (18)	686 (27)	11 (7/16)
400	612 (24-1/8)	775 (30-33/64)	342 (13-31/64)	401 (15-25/32)	796 (31-11/32)	555 (21-7/8)	834 (32-27/32)	11 (27/64)

Bulletin 194RS Preassembled Side-Mount Disconnect Switch

Bulletin 194RS NFPA 79 Compliant IEC Fused and Non-Fused Disconnects, Side-Mounted Style

- 30/60 A sizes
- Open switches
- Fused switch versions:
  – UL Class J, UL Class CC
- Non-fused switches
- Operating handle ingress ratings:
  – IP66 (Type 3R, 3, 12, 4, 4X)
- Pre-assembled, side-mounting bracketed disconnect interlock
- Padlockable handle

The Bulletin 194RS side-mount handle provides NFPA 79 compliancy with a bracketed switch and interlock system that is another Allen-Bradley exclusive. The 194R rotary handle is mounted to the side of the enclosure and attaches to the 194R bracketed disconnect and interlock mechanism. The side handle remains connected to the switch and interlock mechanism at all times. This solution provides the single, side handle design with the NFPA 79 compliancy of the secondary interlock.

Table of Contents

Cat. No. Explanation this page
Approximate Dimensions..... 2-447

Standards Compliance for Disconnect Switch

IEC 60947-4-1/EN60947-3
BS EN60947-3
VDE 0660
CSA 22.2 No. 4
NEMA KS-1
UL 489

Standards Compliance for Pre-Assembled Side-Mount Handle Mechanism with Disconnect Switch

UL 98
CSA 22.2 No. 4

Standards Compliance for Enclosed Pre-Assembled Side-Mount Handle Mechanism with Disconnect Switch

UL 98
CSA 22.2 No. 4

Certifications

UL Listed (File No. E119349, Guide WJAZ)
CSA Certified (File No. LR1234)
CE
ASTA Certified
LOVAG Certified

Certifications for Pre-Assembled Side-Mount Handle Mechanism with Disconnect Switch

UL Listed (File No. E47426, Guide WHTY)
CSA Certified (File No. LR1234)

Certifications for Enclosed Pre-Assembled Side-Mount Handle Mechanism with Disconnect Switch

UL Listed (File No. E 227497, Guide WIAX)
CSA Certified (File No. LR1234)

Cat. No. Explanation

194RS	–	N	J	060	4E
		a	*b*	*c*	*d*	*f*

a

Code	Description
194RS	Side-Mounted Disconnect Switch with interlock

b

Code	Enclosure Type
N	Open

c

Code	Fuse Type
C	CC Fuse (30 A)
J	J Fuse (30…400 A)
N	Non-Fused

d

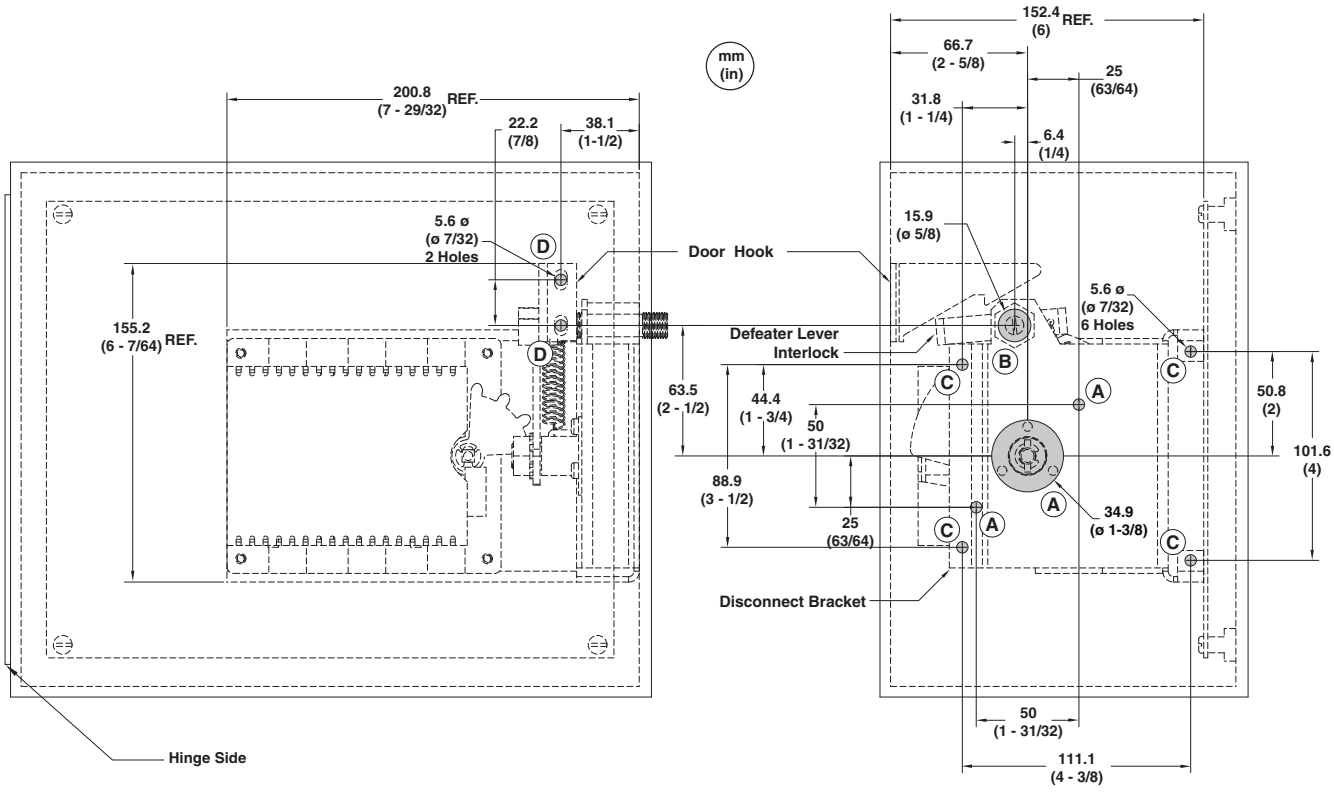
Code	Load Size (Class CC, J, Non-Fused)
030	30 A
060	60 A

e ∗

Code	Handle Type
4	Type 4/4X Black
4E	Type 4/4X, Red/Yellow

∗ Side-mounted mechanism assembly and component gaskets meet UL Type 1/12 enclosure ratings at this time, even though handle meets UL 4/4X.

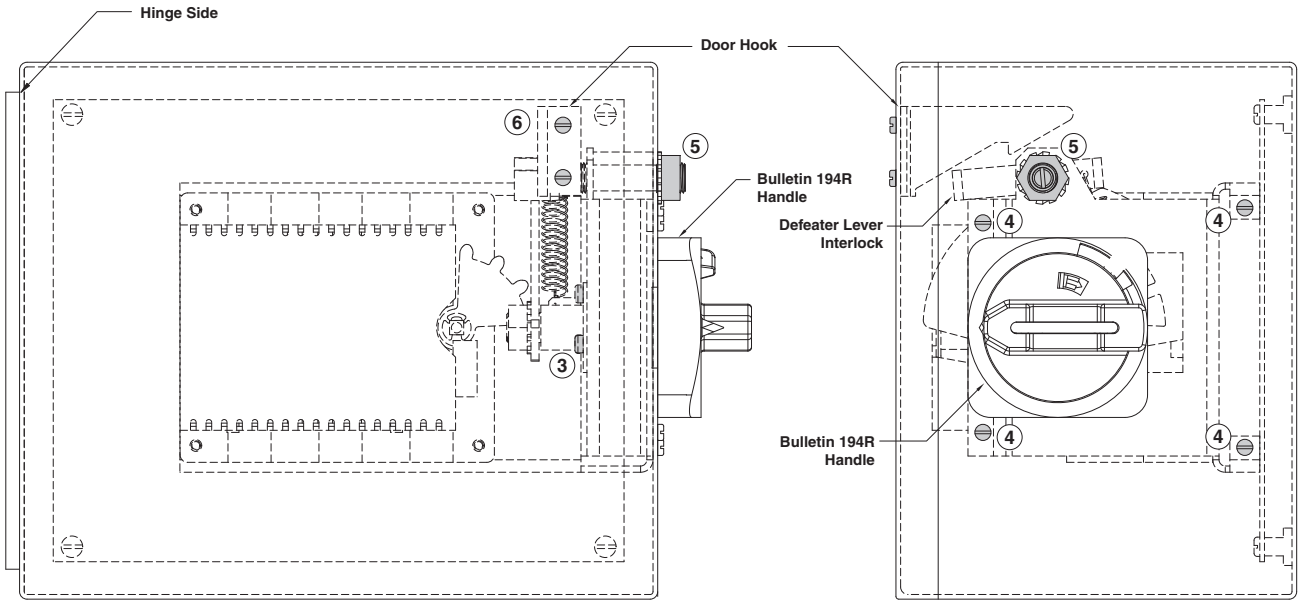
Dimensions in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.



FRONT VIEW

RIGHT SIDE VIEW

NOTE: 1) All dimensions reference inside wall.
2) Assembly and component gaskets meet UL Type 1/12 enclosure ratings.



FRONT VIEW

RIGHT SIDE VIEW

IEC Fused and Non-Fused Disconnects

Overview/Catalog Number Explanation

Bulletin 194RC NFPA 79 Compliant IEC Fused and Non-Fused Disconnects with Cable-Operated Handle for Flange-Style Enclosures

- 30 A size
- Open switches
- Fused switch versions:
  - – UL Class J, UL Class CC
- Non-fused switches
- Uses Bulletin 1494F handles
  - – IP66 (Type 3R, 3, 12, 4, 4X)
- Pre-assembled cable-operated disconnect with interlock
- Padlockable handle mounts to flange-styled enclosures
- Cable options available in 3…10 ft. lengths
- NFPA 2002 Compliant

Table of Contents

Cat. No. Explanation this page
Bulletin 194RC
Installation 2-449

Standards Compliance for Disconnect Switch

IEC 60947-4-1/EN60947-3
BS EN60947-3
VDE 0660
CSA 22.2 No. 4
NEMA KS-1
UL 98

Certifications

UL Listed (File No. E 47426, Guide WHTY)
CSA Certified (File No. LR1234)
CE
ASTA Certified
LOVAG Certified

The Bulletin 194RC cable-operated disconnect with interlock is another Rockwell Automation Allen-Bradley exclusive, providing a fully compliant solution to the 2002 changes in the National Fire Protection Association 79 (NFPA 79).

The new 194RC combines the small size of the 194R IEC disconnect with the flexibility of a cable-operated mechanism to provide an NFPA 79 IEC solution for flange style enclosures. The 194RC bracketed mechanism for 194R 30 A devices attaches to the current 194R disconnect switch base and operates the ON-OFF action via cable to a standard 1494F handle.

The 194RC handle/interlock mechanism provides the 'no-tools' operation and the secondary interlock as required by NFPA 79 2002 changes. The 194RC cable-operated disconnect is offered in 3…10 ft cable lengths, allowing a variety of placement options for the 194R disconnect within the enclosure. The handle is available in 3 different styles: plastic, stainless steel, or painted metal.

Cat. No. Explanation

194RC	–	N	J	030	P	4
a		*b*	*c*	*d*	*e*	*f*

a

Bulletin Number	
Code	Description
194RC	Cable-Operated Disconnect Switch with handle

b

Enclosure Type	
Code	Description
N	Open

c

Fuse Type	
Code	Description
C	CC Fuse (30 A)
J	J Fuse (30 A or 60 A)*
N	Non-Fused

d

Load Size	
Code	Description (Class CC, J, Non-Fused)
030	30 A
060	60 A

e

Handle Type	
Code	Description
P	Type 4/4X Black Plastic
M	Type 12 Metal
S	Type 4/4X Stainless Steel

f

Cable Length	
Code	Description
3	3 ft.
4	4 ft.
6	6 ft.
10	10 ft.

* 194RC 60 A version is under development at this time.

Visit our website: www.ab.com/catalogs
Preferred availability cat. nos. are printed in **bold**

Bulletin 194RC Installation

1. Install disconnect switch with four #10-32 screws (see ***Figure 1***).

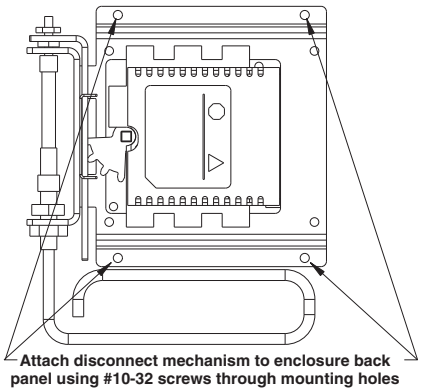


Figure 1 *Attaching Disconnect to Enclosure Back Panel*

2. Install handle to enclosure by placing the outer handle mechanism with the attached gasket over the enclosure cutout. Insert the top mounting screw with lockwasher through the enclosure and thread it into the outer handle mechanism for a few turns but not all the way (see ***Figure 2***).
3. Slide the toggle mechanism assembly over the top handle mounting screw. Insert the bottom handle mounting screw and lockwasher through the toggle mechanism assembly, through the enclosure and into the handle. Tighten both mounting screws to specified torque (see ***Figure 2***).
4. Assemble adapter link to actuator link. Tighten to specified torque (see ***Figure 3***).
5. Align adapter link with the bell crank. Attach bell crank to adapter link with shoulder bolt and nut. Tighten to specified torque (see ***Figure 4***).
6. Mount door hasp to handle using the two screws provided with the handle (see ***Figure 2***).
7. Operate handle mechanism to ensure functionality. To operate either close door or defeat door interlock.
8. If minor adjustments are necessary, refer to adjustment checklist (page 2-450).
9. Install appropriate door hardware (supplied).

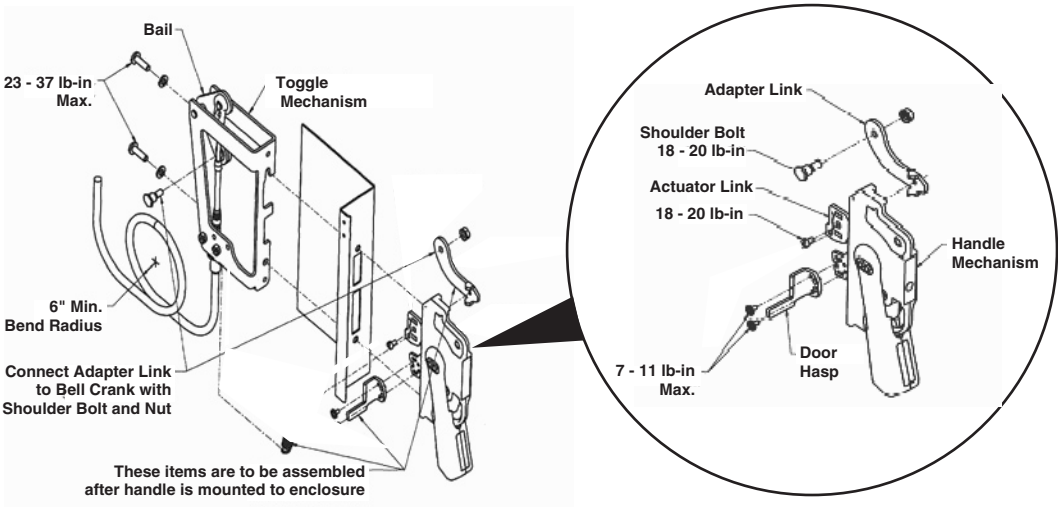


Figure 2 *Securing Toggle Mechanism and Handle to Flange*

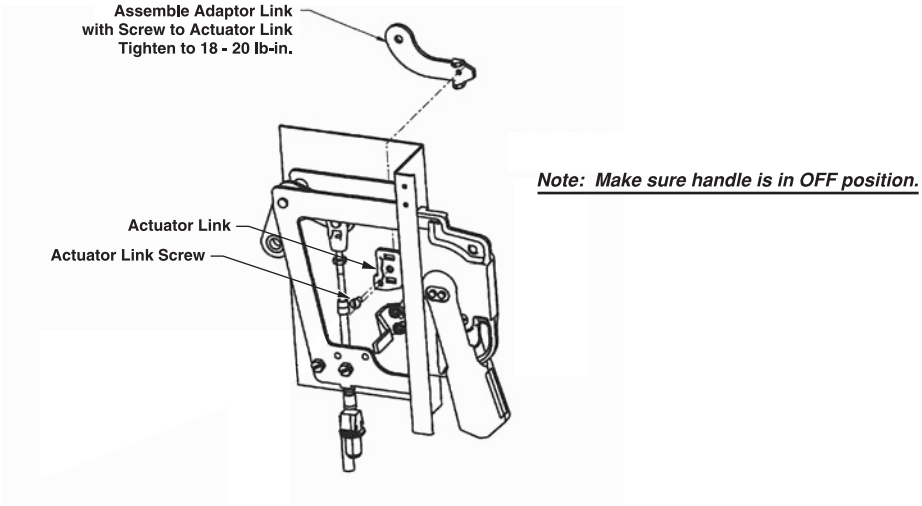


Figure 3 *Assembly of Adapter Link to Actuator Link*

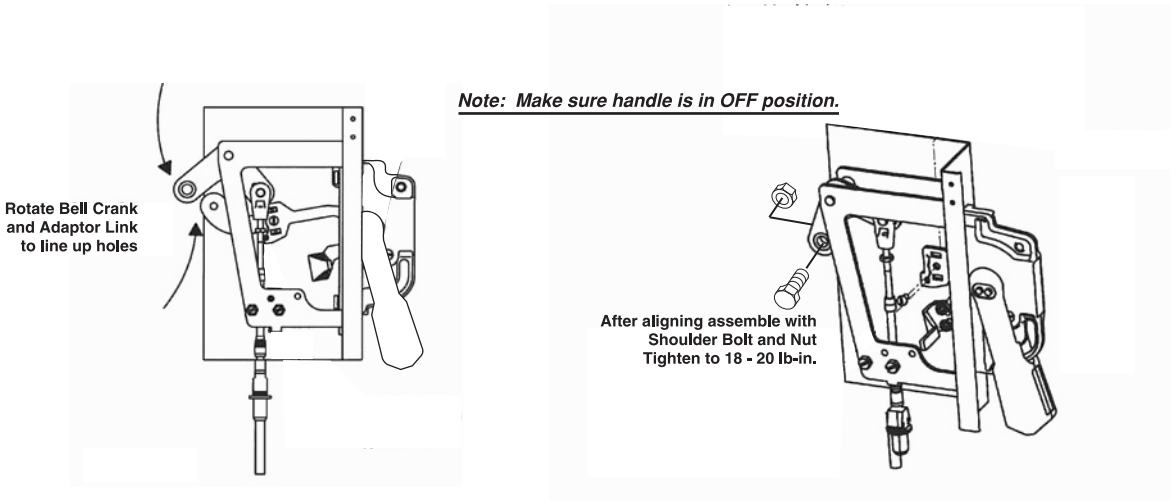


Figure 4 *Assembly of Adapter Link to Bell Crank Using Shoulder Bolt*

ATTENTION

Before any installation or maintenance is performed, make sure that the disconnect switch is not energized.

Adjustment Checklist

Situation:
Handle and Cable Operated Mechanism turns **ON**, but disconnect switch does not transition to **ON**.

Adjustment:
Loosen the lifting washer/nut while tightening the washer/lockwasher/nut, two or three turns should be sufficient (see ***Figure 5***).

➲ **NOTICE**
Check the OFF position of the actuator mechanism, that the lifting nut and sleeve of cable do not come into contact with the bulkhead connector (***Figure 5***). If they do, move the bulkhead connectors accordingly.

Situation:
Handle and Cable Operated Mechanism turns **OFF**, but disconnect switch does not transition to **OFF**.

Adjustment:
For the Cable Operated Disconnect Mechanism, loosen the washer/lockwasher/nut until the Disconnect Switch turns **OFF** with positive action. Tighten both nuts and recheck for **ON** and **OFF** positions (***Figure 5***).

NOTICE
Be certain after adjustment to have a minimum of 1 thread past the washer/lockwasher/nut assembly (***Figure 5***). If any other adjustment problems should arise, contact your local Allen-Bradley representative.

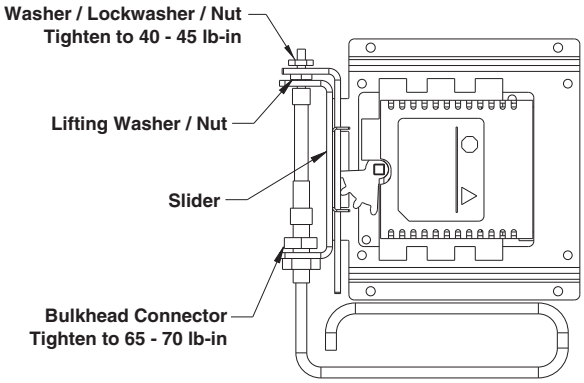
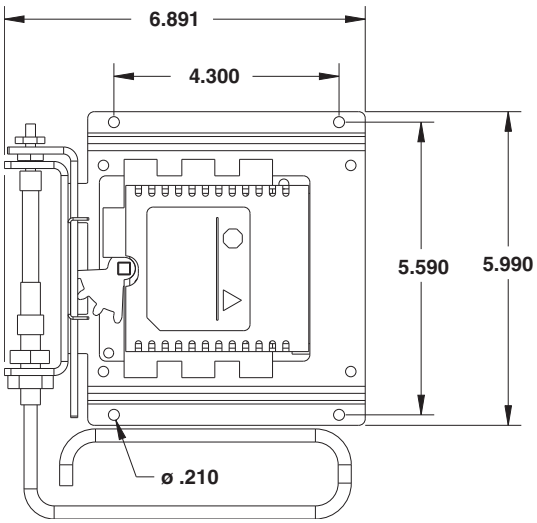


Figure 5 *Cable Operated Disconnect Mechanism*

Dimensions

Dimensions in inches. Dimensions are not intended to be used for manufacturing purposes.



2

Installation Instructions for Door Interlock

Dimensions in inches. Dimensions are not intended to be used for manufacturing purposes.

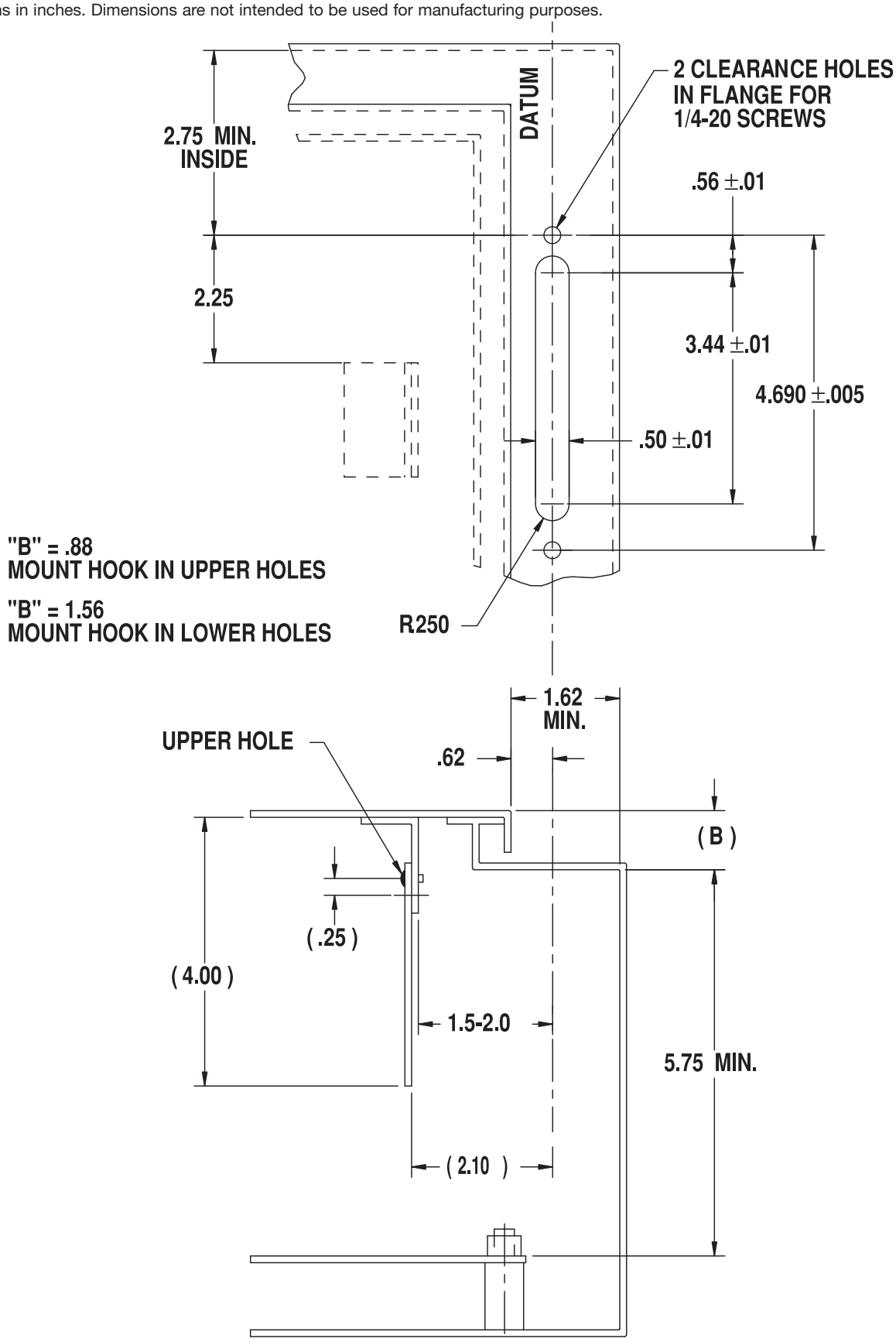


Figure 6 *Flange Drilling Plan for Handle and Interlock Blade Mounting Dimensions*

To obtain a complete Rotary Circuit Breaker Operating Mechanism, order the following:

Rotary Circuit Breaker Operating Mechanism (Circuit Breaker is shown but not supplied with Operating Mechanisms)

Operating Shaft

Operating Handle

Bulletin 198-H Rotary Circuit Breaker Operating Mechanisms

- Rotary circuit breaker operating mechanisms available up to 400 A
- Adaptable to enclosures:
  - IP42 (Type 1)
  - IP66 (Type 3, 3R, 4, 4X, 12)
- Color coded on/off/reset handle indication

The Bulletin 198-H Rotary Circuit Breaker Operating Mechanism permits door-mounted, rotary-operated circuit breaker disconnection of motor loads using Bulletin 190 Disconnect Handles and Cutler-Hammer/Westinghouse G and H frame motor protectors in industrial applications. Operating handles are adaptable to IP42 (Type 1) and IP66 (Type 3, 3R, 4, 4X, 12) enclosures for door-mounted operation. A complete installation consists of operating mechanism, operating handle, operating shaft, plus ***user-supplied circuit breaker and enclosure.***

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Product Selection ..... this page
Accessories..... 2-454

Standards Compliance

IEC 60947-3
CSA 22.2 No. 5
UL 489

Certifications

UL Recognized (File no. E 300325, Guide D1HS2)
CSA Certified

2

Your order must include: 1) Cat. No. of the rotary circuit breaker operating mechanism, 2) Cat. No. of the operating handle and operating shaft

Product Selection — Circuit Breaker Type

Rotary Circuit Breaker Operating Mechanisms

Cat. No. 198-H1

Cat. No. 198-H2, 198-H3

Circuit Breaker			Cat. No.
Manufacturer	Frame Size	Frame Designation	
Cutler-Hammer/Westinghouse	63 A	GMCP	**198-H1**
	150 A	EDH, FD, FDB, FBC, HFD, HMCP	**198-H2**
	250 A, 400 A	JD, JDB, JDC, HJD, HMCP (250 A Frame) KD, KDB, KDC, HKD, HMCP (400 A Frame)	**198-H3**

Operating Shafts

Cat. No. 194R-R3

Description	Circuit Breaker Frame Size	Enclosure Working Depth∗ [mm (in.)]		Cat. No.
		Minimum	Maximum	
Standard	63 A	153 (6-1/32)	369 (14-17/32)	**194R-R1**
Extended		153 (6-1/32)	563 (22-5/32)	**194R-R2**
Standard	150 A	203 (8)	305 (12)	**194R-R3**
Extended		203 (8)	508 (20)	**194R-R4**
Standard	250/400 A	225 (8-7/8)	327 (12-7/8)	**194R-R3**
Extended		225 (8-7/8)	530 (20-7/8)	**194R-R4**

∗ Dimensions are shown in millimeters (inches). For handle dimensions, see Bulletin 194R, page 2-428.

Operating Handle

Handle Type	Frame Size	Degree of Protection	Handle Color	Cat. No.
Standard — Cat. No. 190-HS4E	63 A	IP66 (Type 3, 3R, 4, 4X, 12)	Black/Grey	**190-HS4**
			Red/Yellow	**190-HS4E**
		IP55 (Type 1)	Black/Grey	**190-HS1**
			Red/Yellow	**190-HS1E**
Long — Cat. No. 190-HM4E	150, 200, 400 A	IP66 (Type 3/3R/4/4X/12)	Black/Grey	**190-HM4**
			Red/Yellow	**190-HM4E**
		IP55 (Type 1)	Black/Grey	**190-HM1**
			Red/Yellow	**190-HM1E**

Accessories

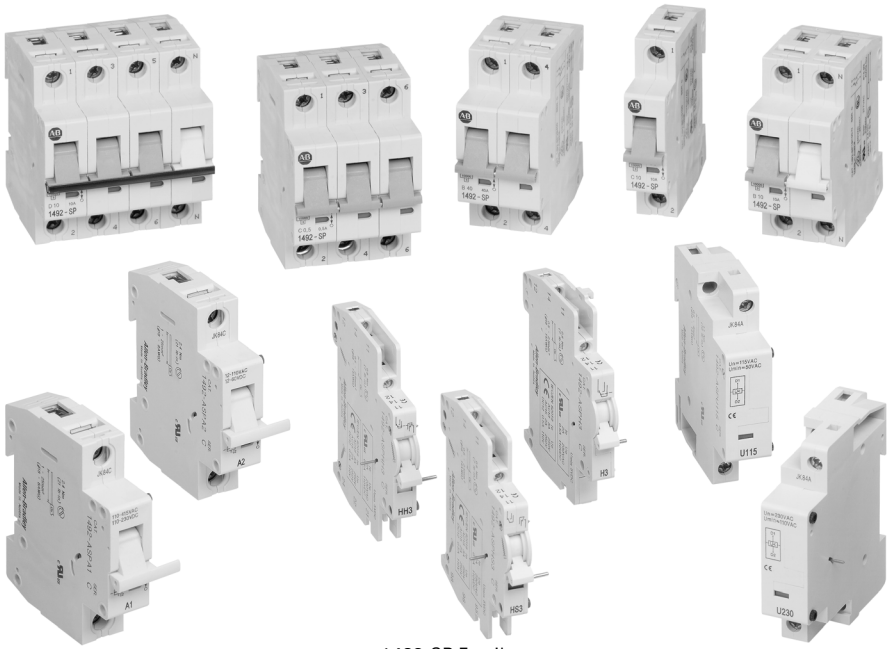
	Description	Cat. No.
Cat. No. 198-H4	**Mounting Bracket Extension** — Provides added support for extended length operating shafts (194R-R2, 194R-R4).	**198-H4**

Allen-Bradley

Supplementary Protectors/Miniature Circuit Breaker

Bulletin 1492-SP Series C

Technical Data



1492-SP Family

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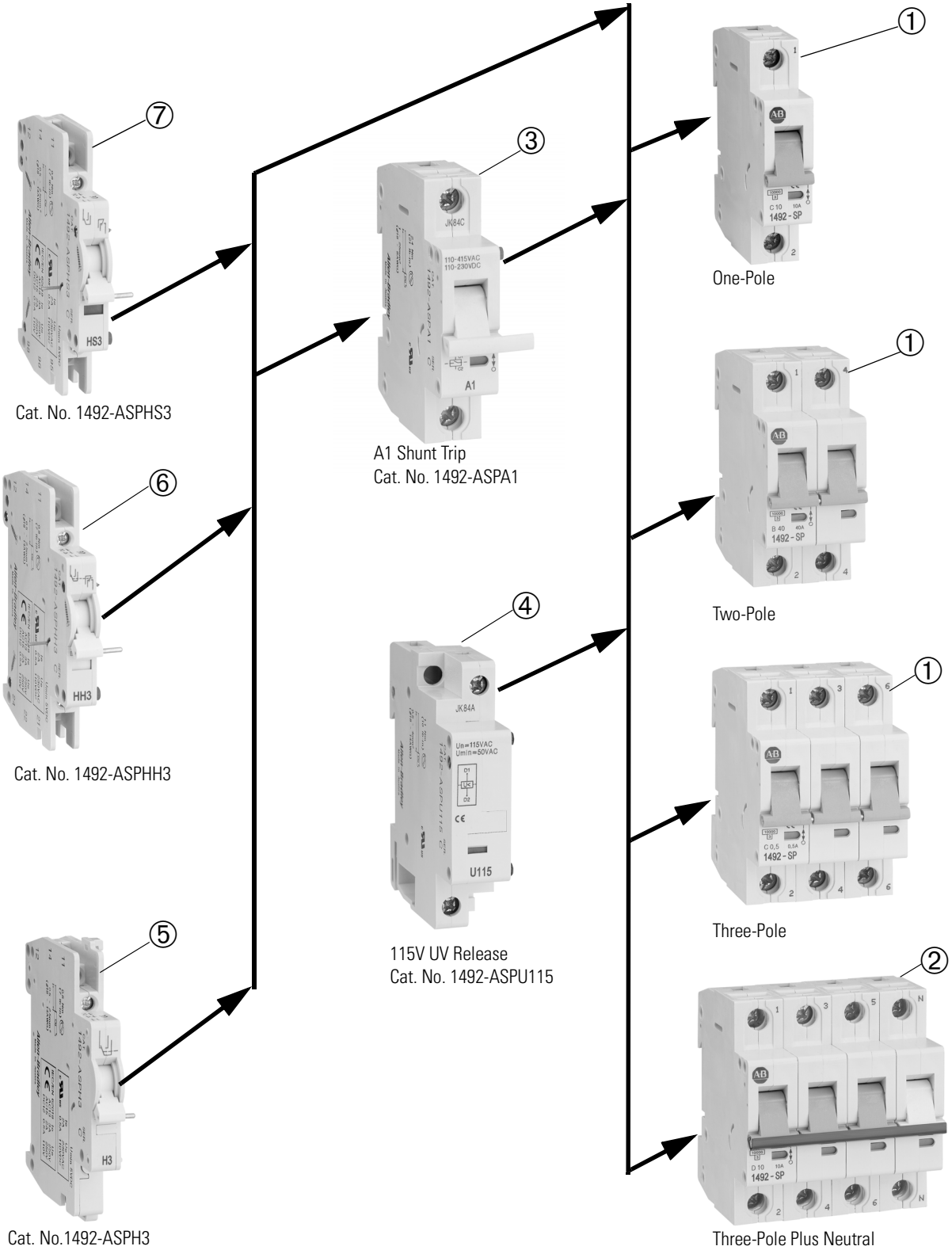
International Approvals	5	Technical Information	19
Features	5	Energy Limiting Characteristics	20
Selection Tables	10	Specifications	23

Rockwell Automation

Bulletin 1492-SP Supplementary Protectors and Accessories



Introduction

① Supplementary Protector/ Miniature Circuit Breaker

- Available in single or multi-pole. Meets UL 1077/CSA 22.2 No. 235. In conformity with IEC/EN 60 898. CE Marked

  B-trip: Trip Characteristic for resistive or slightly inductive loads
  C-trip: Trip Characteristic for inductive loads
  D-trip Trip Characteristic for highly inductive loads ❶

  ❶ UL/CSA pending.

② Switched Neutral Protector (Not Field Mountable)

- Switched neutral pole closes before the adjacent protected pole (i.e. early make)
- Instantaneous/magnetic release provided but no overload thermal release

③ Shunt Trip

- Field installable
- Mounts to side
- Module width is equal to that of a single pole

④ Undervoltage Release

- Field installable
- Mounts to side
- Module width is equal to that of a single pole

⑤ Auxiliary Contact Module

- Field installable
- Changeover contact
- Switches when protective device is operated manually or is tripped electrically
- 1 Form C

⑥ Dual Auxiliary Contact Module

- Field installable
- (2) auxiliary contacts
- Changeover contact
- Switches when protective device is operated manually or is tripped electrically
- 2 Form C

⑦ Auxiliary/Signal Alarm

- Field installable
- Auxiliary contacts

  Auxiliary Contact switches when protective device is operated manually or is tripped electrically
- Signal alarm

  Signal alarm contact switches only when protective device is tripped electrically
- Changeover contact
- 2 Form C
- Front indicator indicates when device is tripped electrically

Description

Bulletin 1492 "Energy Limiting" devices are thermal magnetic type overcurrent protective devices meeting UL 1077/CSA 22.2 No. 235, IEC/EN 60898 and IEC 947-2. These devices are designed for the protection of a wide variety of products including:

- Solenoids
- Test Equipment
- Controller I/O Points
- Relay and Contractor Coils
- Computers
- Transformers
- Automotive Systems
- Power Supplies
- Medical Equipment
- Control Instrumentation

The Bulletin 1492-SP supplementary protectors/miniature circuit breakers are available in one-, one-pole plus neutral, two-, three-, and three-pole plus neutral units. One- and two- pole AC units also have limited DC ratings. Two and three pole units are connected at the handle for simultaneous operation.

Screw termination is standard on all 1492-SP units. Both line and load side terminals accept #16…4 AWG (1.5…25 mm^2) copper wire.

Important: UL 1077, CSA C22.2 No. 235– In North America, miniature circuit breakers are recognized as supplementary protectors and are intended for use as overcurrent protection within an appliance or other electrical equipment where branch circuit protection is already provided or not required. Internationally, these products are rated to IEC standards as miniature circuit breakers for equipment.

International Approvals

The Bulletin 1492-SP supplementary protectors/miniature circuit breakers are designed to comply with standards for world-wide customer acceptance. They meet the following standards:

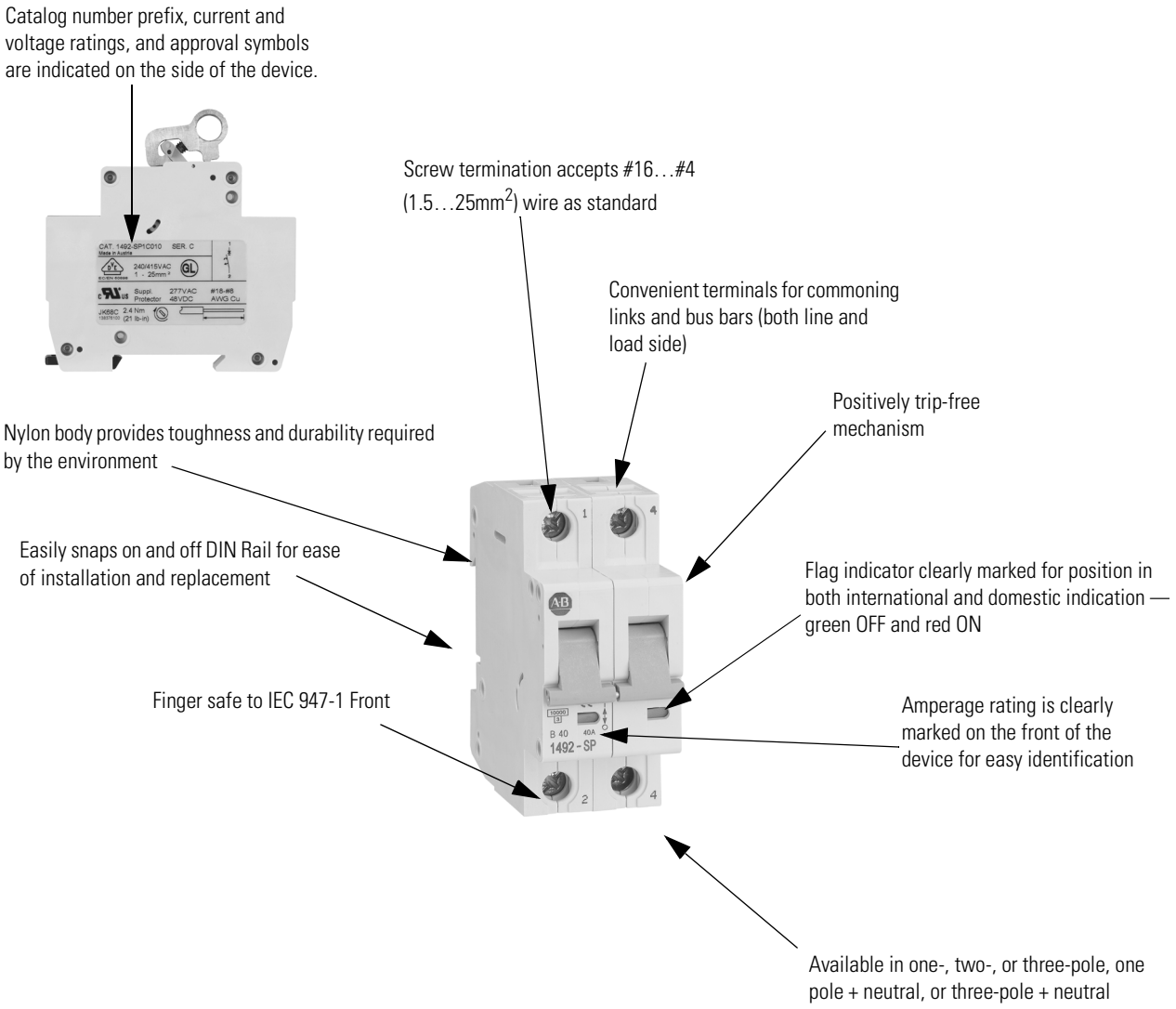
Certifying Agency	Certification Marks	Country	Standard
Underwriters Laboratory	c UL us	USA	UL 1077
		Canada	CSA 22.2 No. 235
Verband Deutscher Electrotechniker	DVE	Germany	IEC/EN 60 898
Germanischer Lloyd	GL	Germany	IEC/EN 60 947-2
per Conformite European	CE	European Union	LVD Directives
per International Electrotechnical Commission	IEC	Global	IEC 60 898 IEC 60 947-2

Features

- Energy Limiting Design—protects downstream components better than conventional breakers during short circuits
- Field mountable options for selective applications
- True IP2X finger safe design (front)
- International approvals—CE Marked, and meets UL, CSA, and IEC (VDE, GL) standards for worldwide acceptance
- Ratings to 480Y/277V AC
  @ 240/415V AC — 10,000 A Interrupt Rating
- AC and DC voltage ratings—in one convenient device
- A positively trip-free mechanism (breaker operation cannot be defeated by holding the handle in the ON position)
- 3 trip curves: B, C, and D
- Time delay (D characteristic) for high inrush currents during inductive start-ups such as transformers and power supplies
- Superior shock and vibration resistance capabilities—helps to prevent nuisance tripping
- Mounts on DIN Rail
- Line and load connections may be reversed

Construction

The following design features provide superior performance



Switched Neutral Module (Not Field Mountable)

The switched neutral module opens the neutral line of the circuit when the protected poles are tripped. Use this module as a safety measure (required by some standards) when protecting networks with a grounded neutral system. The switched neutral pole closes before the adjacent protected pole (i.e. early make). Provided with instantaneous/magnetic trip. Manual actuation is through the linked handles.

Switched neutral modules are always mounted on the right side of the protected poles. These modules are not field installable.

How to Order

Ordering Information

To order the proper device, you need to know:

- Maximum rated current of equipment to be protected
- 1-, 2-, or 3- phase system
- Maximum startup (inrush) current
- If accessories are required

Using the Catalog Number Selection Chart

Use the charts on pages 10…15 determine the catalog number.

1. Select a 1-, 2-, or 3- pole device.
2. If needed, select the Switched Neutral Module. The Switched Neutral Module is mounted on the right side of the breaker. This module must be mounted at the factory. It cannot be installed in the field.
3. If applicable, consider derating factors as noted on pages 8 and 9.
4. Order accessory contacts or modules as separate items. Accessory modules are always mounted on the left side of the supplemental protector/miniature circuit breaker. A maximum of two accessory modules can be mounted on a single device. See table on page 17 for possible combinations.

Determining Ratings

The standard tripping characteristic for Bulletin 1492-SP is Type C. Type C has a magnetic trip activated at 5…10 times the rated current of the circuit breaker. The reference temperature for the thermal tripping characteristics is 30° C. The Type C characteristic will suit most applications. Use the following steps to determine the current rating for the breaker.

1. Take the rated current of the equipment. For example, 10 A.
2. Take the ambient temperature of the 1492-SP location. For example, 50°C (122°F).
3. Refer to the table below which rerates the 1492-SP for the given ambient.

Rerated current at higher ambients

Influence of the ambient temperature on the thermal tripping characteristic

Note: The table shows the corrected values of the rated current dependent on the ambient temperature.

Device Marked Current Rating	**Rated heat dissipation/pole**	**I_n [A] at Higher Ambient Temperature**					
I_n [A] @ 30°C	[W]	35° C	40° C	45° C	50° C	55° C	60° C
0.5	1.2	0.5	0.5	0.5	0.5	0.5	0.4
1	1.3	1.0	1.0	0.9	0.9	0.9	0.9
2	1.4	2.0	1.9	1.9	1.8	1.8	1.8
3	1.2	2.9	2.9	2.8	2.8	2.7	2.6
4	1.2	3.9	3.8	3.8	3.7	3.6	3.5
6	1.8	5.9	5.8	5.6	5.5	5.4	5.3
10	2.1	9.8	9.6	9.4	9.2	9.0	8.8
13	2.3	12.7	12.5	12.2	12.0	11.7	11.4
16	2.0	15.7	15.4	15.0	14.7	14.4	14.1
20	2.9	19.6	19.2	18.8	18.4	18.0	17.6
25	3.1	24.5	24.0	23.5	23.0	22.5	22.0
32	3.1	31.4	30.7	30.1	29.4	28.8	28.2
40	4.2	39.2	38.4	37.6	36.8	36.0	35.2
50	4.6	49.0	48.0	47.0	46.0	45.0	44.0
63	5.3	61.7	60.5	59.2	58.0	56.7	55.4

Determining Ratings, Continued

4. Select the 1492-SP with the next available rating at the given ambient. In this example it would be 13 A. With this selection, adequate overload protection is provided and nuisance tripping by thermal influences is avoided.
5. Check that transients of the system do not exceed the "must hold" value of the trip characteristic. This will eliminate nuisance tripping by magnetic influences. The Type C characteristic will be adequate for most applications. See page 22 for tripping characteristics.

   In rare occurrences when the Type C characteristic does not fully meet the application, the following additional magnetic trip characteristics are available:

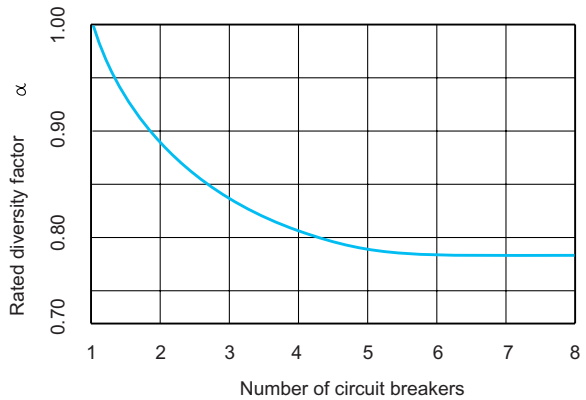
   Type D allows for transients approximately twice as high as the standard Type C. See page 22 for tripping characteristics.

   Type B achieves instantaneous tripping at current levels approximately half as high as Type D. See Page 22 for tripping characteristics.

6. When multiple supplementary protectors are mounted side by side, they must be derated to determine the load carrying capacity.

   Adjusted current rating = Rated current multiplied by α.

Rated diversity factor, where miniature circuit breakers mounted side by side influence one another thermally at rated load.



Selection Tables

B-Trip Characteristics—Resistive or slightly inductive loads

Tripping characteristics 3…5 I_n

	One-Pole			One-Pole Plus Neutral		
	Continuous Current Rating (*I*n)	**Cat. No.**	**3rd Party Certification**	**Continuous Current Rating (*I*n)**	**Cat. No.**	**3rd Party Certification**
	1	1492-SP1B010		1	1492-SP1B010-N	
	2	1492-SP1B020		2	1492-SP1B020-N	
	3	1492-SP1B030		3	1492-SP1B030-N	
	4	1492-SP1B040		4	1492-SP1B040-N	
	5 ❶	1492-SP1B050		5 ❶	1492-SP1B050-N	
	6	1492-SP1B060		6	1492-SP1B060-N	
	7❶	1492-SP1B070		7 ❶	1492-SP1B070-N	
	8	1492-SP1B080		8	1492-SP1B080-N	
	10	1492-SP1B100		10	1492-SP1B100-N	
	13	1492-SP1B130		13	1492-SP1B130-N	
	15 ❶	1492-SP1B150		15 ❶	1492-SP1B150-N	
	16	1492-SP1B160		16	1492-SP1B160-N	
	20	1492-SP1B200		20	1492-SP1B200-N	
	25	1492-SP1B250		25	1492-SP1B250-N	
	30 ❶	1492-SP1B300		30 ❶	1492-SP1B300-N	
	32	1492-SP1B320		32	1492-SP1B320-N	
	40	1492-SP1B400		40	1492-SP1B400-N	
	50	1492-SP1B500		50	1492-SP1B500-N	
	63	1492-SP1B630		63	1492-SP1B630-N	
	One-Pole			**One-Pole Plus Neutral**		
Operational Voltage	IEC 240/415V AC			IEC 240V AC		
	UL/CSA 277V AC/48V DC			UL/CSA 277V AC		
Pieces per package	12			1		
Diagram	1-pole			1-pole +N		

❶Current rating commonly used in North America.

Selection Tables, Continued

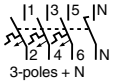
B-Trip Characteristics—Resistive or slightly inductive loads

Tripping characteristics 3…5 I_n

Two-Pole

Three-Pole

Three-Pole Plus Neutral

Continuous Current Rating (*I*n)	Cat. No.	3rd Party Certification	Continuous Current Rating (*I*n)	Cat. No.	3rd Party Certification	Continuous Current Rating (*I*n)	Cat. No.	3rd Party Certification
1	1492-SP2B010		1	1492-SP3B010		1	1492-SP3B010-N	
2	1492-SP2B020		2	1492-SP3B020		2	1492-SP3B020-N	
3	1492-SP2B030		3	1492-SP3B030		3	1492-SP3B030-N	
4	1492-SP2B040		4	1492-SP3B040		4	1492-SP3B040-N	
5 ❶	1492-SP2B050		5 ❶	1492-SP3B050		5 ❶	1492-SP3B050-N	
6	1492-SP2B060		6	1492-SP3B060		6	1492-SP3B060-N	
7 ❶	1492-SP2B070		7 ❶	1492-SP3B070		7 ❶	1492-SP3B070-N	
8	1492-SP2B080		8	1492-SP3B080		8	1492-SP3B080-N	
10	1492-SP2B100		10	1492-SP3B100		10	1492-SP3B100-N	
13	1492-SP2B130		13	1492-SP3B130		13	1492-SP3B130-N	
15 ❶	1492-SP2B150		15 ❶	1492-SP3B150		15 ❶	1492-SP3B150-N	
16	1492-SP2B160		16	1492-SP3B160		16	1492-SP3B160-N	
20	1492-SP2B200		20	1492-SP3B200		20	1492-SP3B200-N	
25	1492-SP2B250		25	1492-SP3B250		25	1492-SP3B250-N	
30 ❶	1492-SP2B300		30 ❶	1492-SP3B300		30 ❶	1492-SP3B300-N	
32	1492-SP2B320		32	1492-SP3B320		32	1492-SP3B320-N	
40	1492-SP2B400		40	1492-SP3B400		40	1492-SP3B400-N	
50	1492-SP2B500		50	1492-SP3B500		50	1492-SP3B500-N	
63	1492-SP2B630		63	1492-SP3B630		63	1492-SP3B630-N	
Two Pole			**Three Pole**			**Three Pole Plus Neutral**		
Operational Voltage	IEC 415V AC		IEC 415V AC			IEC 415V AC		
	UL/CSA 480Y/277V AC, 125V DC		UL/CSA 480Y/277V AC			UL/CSA 480Y/277V AC		
Pieces per package	6		4			1		
Diagram	2-poles	DC + -	3-poles			 3-poles + N		

❶Current rating commonly used in North America.

Selection Tables, Continued

C-Trip Characteristics—Inductive Loads

Tripping Characteristics 5…10 I_n

One-Pole

One-Pole Plus Neutral

	Continuous Current Rating (In)	Cat. No.	3rd Party Certification	Continuous Current Rating (In)	Cat. No.	3rd Party Certification
	0.5	1492-SP1C005		0.5	1492-SP1C005-N	
	1	1492-SP1C010		1	1492-SP1C010-N	
	2	1492-SP1C020		2	1492-SP1C020-N	
	3	1492-SP1C030		3	1492-SP1C030-N	
	4	1492-SP1C040		4	1492-SP1C040-N	
	5 ❶	1492-SP1C050		5 ❶	1492-SP1C050-N	
	6	1492-SP1C060		6	1492-SP1C060-N	
	7 ❶	1492-SP1C070		7 ❶	1492-SP1C070-N	
	8	1492-SP1C080		8	1492-SP1C080-N	
	10	1492-SP1C100		10	1492-SP1C100-N	
	13	1492-SP1C130		13	1492-SP1C130-N	
	15 ❶	1492-SP1C150		15 ❶	1492-SP1C150-N	
	16	1492-SP1C160		16	1492-SP1C160-N	
	20	1492-SP1C200		20	1492-SP1C200-N	
	25	1492-SP1C250		25	1492-SP1C250-N	
	30 ❶	1492-SP1C300		30 ❶	1492-SP1C300-N	
	32	1492-SP1C320		32	1492-SP1C320-N	
	40	1492-SP1C400		40	1492-SP1C400-N	
	50	1492-SP1C500		50	1492-SP1C500-N	
	63	1492-SP1C630		63	1492-SP1C630-N	
	One Pole			**One Pole Plus Neutral**		
Operational Voltage	IEC 240/415V AC			IEC 240V AC		
	UL/CSA 277V AC/48V DC			UL/CSA 277V AC		
Pieces per package	12			1		
Diagram	1-pole			1-pole +N		

❶Current rating commonly used in North America.

Selection Tables, Continued

C-Trip Characteristics—Inductive Loads

Tripping Characteristics 5…10 I_n

Two-Pole

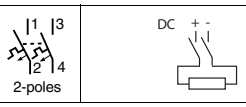
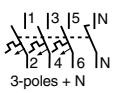
Continuous Current Rating (In)	Cat. No.	3rd Party Certification
0.5	1492-SP2C005	
1	1492-SP2C010	
2	1492-SP2C020	
3	1492-SP2C030	
4	1492-SP2C040	
5 ❶	1492-SP2C050	
6	1492-SP2C060	
7 ❶	1492-SP2C070	
8	1492-SP2C080	
10	1492-SP2C100	
13	1492-SP2C130	
15 ❶	1492-SP2C150	
16	1492-SP2C160	
20	1492-SP2C200	
25	1492-SP2C250	
30 ❶	1492-SP2C300	
32	1492-SP2C320	
40	1492-SP2C400	
50	1492-SP2C500	
63	1492-SP2C630	

Three-Pole

Continuous Current Rating (In)	Cat. No.	3rd Party Certification
0.5	1492-SP3C005	
1	1492-SP3C010	
2	1492-SP3C020	
3	1492-SP3C030	
4	1492-SP3C040	
5 ❶	1492-SP3C050	
6	1492-SP3C060	
7 ❶	1492-SP3C070	
8	1492-SP3C080	
10	1492-SP3C100	
13	1492-SP3C130	
15 ❶	1492-SP3C150	
16	1492-SP3C160	
20	1492-SP3C200	
25	1492-SP3C250	
30 ❶	1492-SP3C300	
32	1492-SP3C320	
40	1492-SP3C400	
50	1492-SP3C500	
63	1492-SP3C630	

Three-Pole Plus Neutral

Continuous Current Rating (In)	Cat. No.	3rd Party Certification
0.5	1492-SP3C005-N	
1	1492-SP3C010-N	
2	1492-SP3C020-N	
3	1492-SP3C030-N	
4	1492-SP3C040-N	
5 ❶	1492-SP3C050-N	
6	1492-SP3C060-N	
7 ❶	1492-SP3C070-N	
8	1492-SP3C080-N	
10	1492-SP3C100-N	
13	1492-SP3C130-N	
15 ❶	1492-SP3C150-N	
16	1492-SP3C160-N	
20	1492-SP3C200-N	
25	1492-SP3C250-N	
30 ❶	1492-SP3C300-N	
32	1492-SP3C320-N	
40	1492-SP3C400-N	
50	1492-SP3C500-N	
63	1492-SP3C630-N	

	Two-Pole	Three-Pole	Three-Pole Plus Neutral
Operational Voltage	IEC 415V AC	IEC 415V AC	IEC 415V AC
	UL/CSA 480Y/277V AC, 125V DC	UL/CSA 480Y/277V AC	UL/CSA 480Y/277V AC
Pieces per package	6	4	1
Diagram			

❶Current rating commonly used in North America.

Selection Tables, Continued

D-Trip Characteristics—Highly Inductive Loads

Tripping Characteristics 10…20 I_n

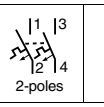
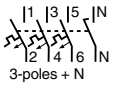
	One-Pole			One-Pole Plus Neutral		
	Continuous Current Rating (*I*n)	**Cat. No.**	**3rd Party Certification**	**Continuous Current Rating (*I*n)**	**Cat. No.**	**3rd Party Certification**
	0.5	1492-SP1D005		0.5	1492-SP1D005-N	
	1	1492-SP1D010		1	1492-SP1D010-N	
	2	1492-SP1D020		2	1492-SP1D020-N	
	3	1492-SP1D030		3	1492-SP1D030-N	
	4	1492-SP1D040		4	1492-SP1D040-N	
	5 ❶	1492-SP1D050		5 ❶	1492-SP1D050-N	
	6	1492-SP1D060		6	1492-SP1D060-N	
	7 ❶	1492-SP1D070		7 ❶	1492-SP1D070-N	
	8	1492-SP1D080		8	1492-SP1D080-N	
	10	1492-SP1D100		10	1492-SP1D100-N	
	13	1492-SP1D130		13	1492-SP1D130-N	
	15 ❶	1492-SP1D150		15 ❶	1492-SP1D150-N	
	16	1492-SP1D160		16	1492-SP1D160-N	
	20	1492-SP1D200		20	1492-SP1D200-N	
	25	1492-SP1D250		25	1492-SP1D250-N	
	30 ❶	1492-SP1D300		30 ❶	1492-SP1D300-N	
	32	1492-SP1D320		32	1492-SP1D320-N	
	40	1492-SP1D400		40	1492-SP1D400-N	
	One Pole			**One Pole Plus Neutral**		
Operational Voltage	IEC 240/415V AC			IEC 240V AC		
	UL/CSA 277V AC/48V DC			UL/CSA 277V AC		
Pieces per package	12			1		
Diagram	1-pole			1-pole +N		

❶Current rating commonly used in North America.

Selection Tables, Continued

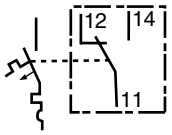
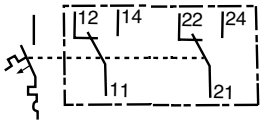
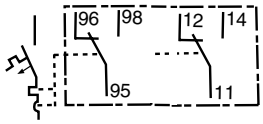
D-Trip Characteristics — Highly Inductive Loads

Tripping Characteristics 10…20 I_n

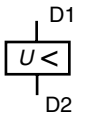
	Two-Pole			Three-Pole			Three-Pole Plus Neutral		
	Continuous Current Rating (*I*n)	**Cat. No.**	**3rd Party Certification**	**Continuous Current Rating (*I*n)**	**Cat. No.**	**3rd Party Certification**	**Continuous Current Rating (*I*n)**	**Cat. No.**	**3rd Party Certification**
	0.5	1492-SP2D005		0.5	1492-SP3D005		0.5	1492-SP1D005-N	
	1	1492-SP2D010		1	1492-SP3D010		1	1492-SP1D010-N	
	2	1492-SP2D020		2	1492-SP3D020		2	1492-SP1D020-N	
	3	1492-SP2D030		3	1492-SP3D030		3	1492-SP1D030-N	
	4	1492-SP2D040		4	1492-SP3D040		4	1492-SP1D040-N	
	5 ❶	1492-SP2D050		5 ❶	1492-SP3D050		5 ❶	1492-SP1D050-N	
	6	1492-SP2D060		6	1492-SP3D060		6	1492-SP1D060-N	
	7 ❶	1492-SP2D070		7 ❶	1492-SP3D070		7 ❶	1492-SP1D070-N	
	8	1492-SP2D080		8	1492-SP3D080		8	1492-SP1D080-N	
	10	1492-SP2D100		10	1492-SP3D100		10	1492-SP1D100-N	
	13	1492-SP2D130		13	1492-SP3D130		13	1492-SP1D130-N	
	15 ❶	1492-SP2D150		15 ❶	1492-SP3D150		15 ❶	1492-SP1D150-N	
	16	1492-SP2D160		16	1492-SP3D160		16	1492-SP1D160-N	
	20	1492-SP2D200		20	1492-SP3D200		20	1492-SP1D200-N	
	25	1492-SP2D250		25	1492-SP3D250		25	1492-SP1D250-N	
	30 ❶	1492-SP2D300		30 ❶	1492-SP3D300		30 ❶	1492-SP3D300-N	
	32	1492-SP2D320		32	1492-SP3D320		32	1492-SP3D320-N	
	40	1492-SP2D400		40	1492-SP3D400		40	1492-SP3D400-N	
	Two-Pole			**Three-Pole**			**Three-Pole Plus Neutral**		
Operational Voltage	IEC 415V AC			IEC 415V AC			IEC 415V AC		
	UL/CSA 480Y/277V AC, 125V DC			UL/CSA 480Y/277V AC			UL/CSA 480Y/277V AC		
Pieces per package	6			4			1		
Diagram	 2-poles			3-poles			 3-poles + N		

❶Current rating commonly used in North America.

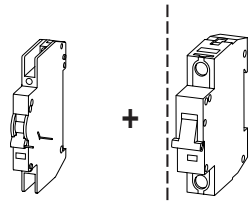
Accessories

Auxiliary Contacts	Description	Approvals	Diagrams	Cat. No.
	Auxiliary Contact Module • Changeover contact • 1 Form C • Switches when protective device is operated manually or tripped electrically	c UL us IEC CE		1492-ASPH3
	Dual Auxiliary Contact Module • (2) Auxiliary Contacts • Changeover contact • 2 Form C • Switches when protective device is operated manually or tripped electrically	c UL us IEC CE		1492-ASPHH3
	Auxiliary/Signal Alarm Module • (1) Auxiliary Contacts Auxiliary Contact—Switches when protective device is operated manually or tripped electrically • (1) Signal Alarm contact Signal Alarm—Trip indicating contact switches only when protective device is tripped electrically • Changeover contact • 2 Form C • Front indicator indicates when device is tripped electronically	c UL us IEC CE		1492-ASPHS3

Accessories, Continued

Voltage Trips	Description	Approvals	Diagrams	Voltage	Cat. No.
	Undervoltage Release Module • Use the Undervoltage Release Module to trip the adjacent breaker poles when the applied voltage is less than the nominal voltage. • Undervoltage trip is often used when loss of power and eventual restoration of power creates an unsafe or unknown set of conditions.	cULus IEC CE		50…115V AC	1492-ASPU115
				110…240V AC	1492-ASPU230
	Shunt Trip Module • Use the Shunt Trip Module to trip the adjacent breaker poles from a remote location. The module is actuated by applying a voltage (Pickup Voltage) to the trip terminals. • Shunt Trip Modules are often used in emergency shutdown circuits where multiple power circuits must be switched off from a single location.	cULus IEC CE		110…415V AC 110…230V DC	1492-ASPA1
				12…110V AC 12…60V DC	1492-ASPA2

Allowable combinations of field added modules ❶



1492-ASPH3	1492-ASPHH3	1492-ASPHS3	1492-ASPA…	1492-ASPU…	1492-SP…
X					X
	X				X
		X			X
			X		X
				X	X
X			X		X
	X		X		X
		X	X		X

(1) Auxiliary Contact Module
(1) Dual Auxiliary Contact Module
(1) Auxiliary/Signal Alarm Contact Module
(1) Shunt Trip Module
(1) Undervoltage Release Module
(1) Auxiliary Contact Module + (1) Shunt Trip Module
(1) Dual Auxiliary Contact Module + (1) Shunt Trip Module
(1) Auxiliary/Signal Alarm Module + (1) Shunt Trip Module

❶ All modules are added to left side of supplementary protector/miniature circuit breaker.

Accessories, Continued

Accessories used with all 1492-SP Miniature Circuit Breakers

Accessories	Cat. No.	Pieces/Package
Mounting Rails		
1 m Symmetrical DIN	199-DR1	10
1 m Hi-Rise Symmetrical DIN	1492-DR6	2
1 m Angled Hi-Rise Symmetrical DIN	1492-DR7	2
End Anchor	1492-EAH35	50
Lockout Attachment	1492-ASPLOA	10

Pin Style Commoning Links (may be cut to length, not for use with accessories)	Number of 1492-SPs	Rated Operational Current (I_e) (A)	Approvals	Cat. No.	Pieces/ Package
One-Pole	1 m (56 devices/m)	40	CE	1492-ACBCL1	1
Two-Pole(1p + N)	1 m (29 devices/m)	30	CE	1492-ACBCL2	1
Three-Pole	1 m (19 devices/m)	30	CE	1492-ACBCL3	1
End Cap for two and three pole	—	—	CE	1492-ACBEC1	10
Fork style Commoning Links (may be cut to length, not for use with accessories)					
One-Pole	1 m (56 devices/m)	40	CE	1492-ASPCL1	1
Three-Pole	1 m (19 devices/m)	30	CE	1492-ASPCL3	1
End Cap for one and three pole	—	—	CE	1492-ASPEC1	10
Protective Covers for unused fork termination	—	—	CE	1492-ASPCLPS	10 sets (5/set)

Accessories, Continued

Fork Style Commoning Links (may not be cut)	Number of 1492-SPs	Rated Operational Current (I_e) (A)	Approvals	Cat. No.	Pieces/ Package
Four-Pole	2	120	CE	1492-ASPCL408	5
Four-Pole	3	120	CE	1492-ASPCL412	5
For 1492-SP with an Auxillary Contact or Auxiliary/Signal Module					
One-Pole	2	85	CE	1492-ASPCL1A02	1
One-Pole	6	85	CE	1492-ASPCL1A06	1
One-Pole	9	85	CE	1492-ASPCL1A09	1
Two-Pole (1p + N)	2	120	CE	1492-ASPCL2A04	1
Two-Pole (1p + N)	3	120	CE	1492-ASPCL2A06	1
Two-Pole (1p + N)	5	120	CE	1492-ASPCL2A10	1
Three-Pole	2	120	CE	1492-ASPCL3A06	1
Three-Pole	4	120	CE	1492-ASPCL3A12	1
For multiple single pole 1492-SP, each with one Auxiliary Contact or one Auxiliary/Signal Alarm Module					
—	2 x 3 (1P)	120	CE	1492-ASPCL3AP06	1
—	2 x 3 (1P) + 2(1P)	120	CE	1492-ASPCL3AP08	1
—	3 x 3 (1P)	120	CE	1492-ASPCL3AP09	1
Incoming Terminals for fork style commoning links (IP20 Protection)					
For max 25 mm2 wire, #4 AWG	—	—	CE	1492-ASPCLT25	20
For max 35 mm2 wire, #2 AWG	—	—	CE	1492-ASPCLT35	10
Fork Style Commoning Links (may not be cut)					
For 1492-SP without Auxillary Contacts					
One-Pole	2	85	CE	1492-ASPCL102	20
One-Pole	6	85	CE	1492-ASPCL106	20
One-Pole	12	85	CE	1492-ASPCL112	20
Two-Pole (1p + N)	2	120	CE	1492-ASPCL204	10
Two-Pole (1p + N)	3	120	CE	1492-ASPCL206	10
Two-Pole (1p + N)	6	120	CE	1492-ASPCL212	10
Three-Pole	2	120	CE	1492-ASPCL306	10
Three-Pole	4	120	CE	1492-ASPCL312	10

Technical Information

The Benefits of Limiting Let-Through-Energy

Bulletin 1492-SP vs. Conventional Breakers

The 1492-SP line features the unique ability to achieve short circuit interruptions far more effectively than conventional breakers.

In *conventional circuit breakers*, the short circuit interruption time required is approximately one or two half cycles of an AC sine wave. When the contacts open, the resulting arc continues to burn until the current level passes through zero. The arc may re-ignite because of the insufficient width of the contact gap. The current that flows until the arc is extinguished produces a heating effect proportional to the I^2t value *(let-through-energy)* of the fault current.

The 1492-SP device is designed to substantially reduce the amount of *let-through-current* and the resulting *let-through-energy* that can damage protected components. The Bulletin 1492-SP has the ability to interrupt short circuit current within the first half cycle of the fault.

Limiting let-through-energy will protect against the harmful effects of overcurrent and is focused primarily on avoiding the following:

- Excessive Heat
- Mechanical Damage

Both of these factors are proportional to the square of the current. Thermal energy is proportional to the square of the RMS value and magnetic forces are proportional to the square of the peak value. The most effective way to provide protection is to substantially limit *let-through-energy*. This provides the following advantages:

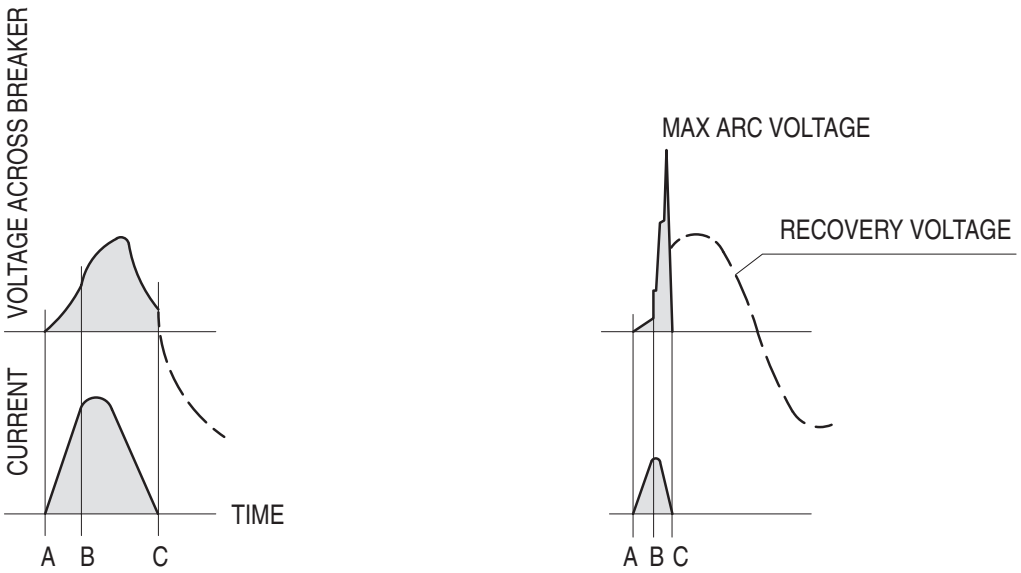
- Far less damage at the location of the short circuit.
- Fast electric separation of a faulty unit from the system, especially power supplies connected in parallel that are switched off when the voltage of the power bus drops below a certain level.
- Far less wear on the miniature circuit breaker itself. This means more safe interruptions.
- Better protection of all components in the short circuit path.
- Far wider range of selective action when used with an upstream protective device. (No nuisance shut downs from feeder line interruptions, causing a blackout in all connected branches.)

Technical Information, Continued

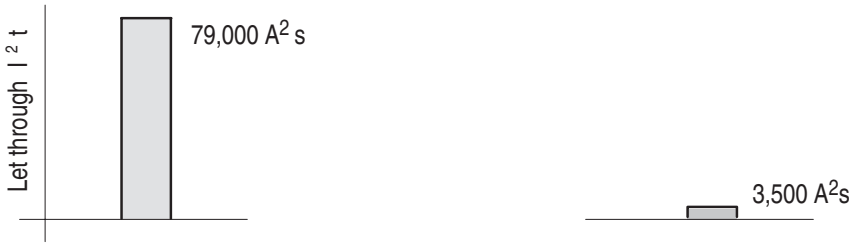
Short Circuit Interruption Diagrams

Short Circuit Interruption 10 kA — 120V AC
Instant of initiation: 15° after voltage zero

CONVENTIONAL BREAKERS **ALLEN-BRADLEY Bulletin 1492-SP**



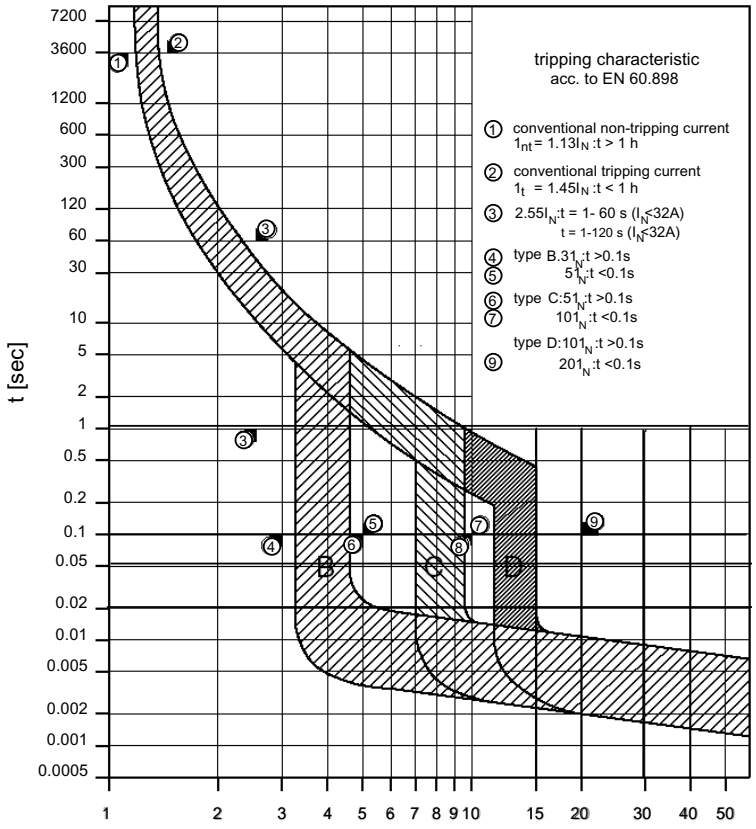
A = Instant when the short is initiated
B = Instant when the contacts open and the arc is initiated
C = Instant when the arc extinguishes and the current ceases to flow



Energy Limiting Characteristics, Continued

Tripping Characteristics

Tripping Characteristics
1492-SP_ at 30 ° C



Specifications

	B Curve Resistive or Slightly Inductive Loads	C Curve Inductive Loads	D Curve Highly Inductive Loads
Tripping Characteristic	3…5 I_n	5…10 I_n	10…20 I_n
Approvals	See Selection Tables		
Maximum Voltage Ratings			
Dielectric Strength	1960V AC		
Shock	25 G Half Sine Wave for 11 ms (3 Axis)		
Vibration	Frequency Range: 10…2000 Hz Max. Amplitude (p - p) = 0.30 in. Max. Acceleration = 5 G 2 hours each of 3 axis		
Operating Temperature Range	23…+104°F (–5…+40°C)		
Shipment and Short Term Temperature Limits	–40…+185°F (–40…+85°C)		
Housing Material	Nylon		
Wire Size	#18…#8 AWG (1.0…25 mm^2)		
Recommended Wire Strip Length	0.51" (13 mm)		
Electromechanical Life	6000 operations (1 operation = 2 switching events) ON/OFF		
Switched Neutral Rating	277V AC		
Supplementary Protector			
Approvals	UL 1077, CSA 22.2 No. 235 UL File Number E65138		
Current Range	1…40 A	.5 … 40 A	.5 … 25 A
Withstand Rating One-pole without series fuse	5 kA @ 277V AC U1		
Withstand Rating, Multi-pole with series fuse	5 kA @ 480Y/277V AC C1		
Withstand Rating, all poles without series fuse	1 pole 10 kA @ 48V DC U1 2 pole in series 10 kA @ 125V DC U1		
Miniature Circuit Breaker			
Approvals	IEC/EN 60 898 (VDE) IEC/EN 60 947-2 (GL)		
Current Range	1…63 A	.5 … 63 A	.5 … 40 A
Interrupt Rating One-pole	10 kA @ 240V AC		
Interrupt Rating, Multi-pole	10 kA @ 415V AC		
Rated Impulse Withstand Voltage U_{imp}	4000 V		
Rated Insulation Voltage U_i	440V AC		
Overload Category/Pollution Degree	III/3		
Rated Operation Voltage U_e	240/415V AC		
Approval	IEC/EN 60 947-2 (GL)		
Rated Ultimate Short Circuit Breaking Capacity I_{cu}	15 kA 0.5 cos @ 240/415V AC		

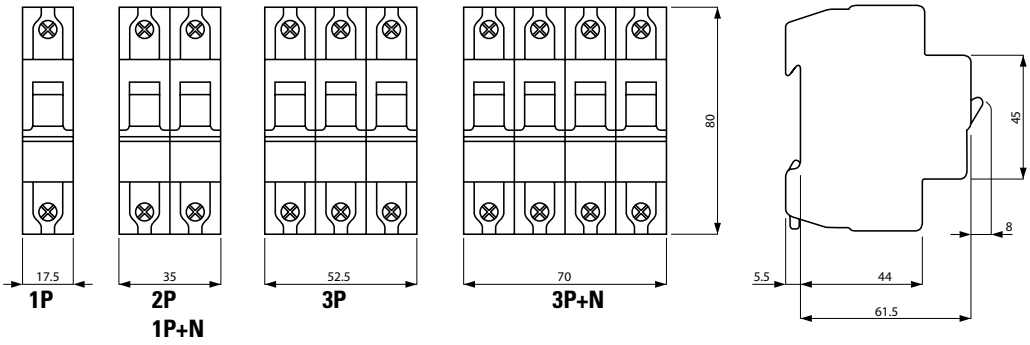
Specifications, Continued Auxiliary Specifications

		Auxiliary Contact Module Dual Auxiliary Contact Module Auxiliary/Signal Alarm Module Cat. Nos. 1492-ASPH3 1492-ASPHH3 1492-ASPHS3	Undervoltage Release Module Cat. Nos. 1492-ASPU115 1492-ASPU230		Shunt Trip Module Cat. Nos. 1492-ASPA1 1492-ASPA2	
Degree of Protection		IP 20 (IP 00)				
Dimensions		see page 25				
Weight		0.045 kg	0.155 kg		0.155 kg	
Mechanical Lifespan		6000 operations	10,000 operations		4000 operations	
Minimum Impulse Duration		—	—		> 15 ms	
Minimum Command Time		—	—		≤ 200 ms	
Operating Voltage		—	1492-ASPU115	U_n - 115V AC U_{min} - 50V AC	1492-ASPA1	110 … 415V AC 110 … 230V DC
		—	1492-ASPU230	U_n - 230/240V AC U_{min} - 110V AC	1492-ASPA2	12 … 110V AC 12 … 60V DC
Inrush Current		—	3.6/44 mA (AC/DC)		25/12 mA (AC) 15/2 mA DC	
Dropout		—	0.7 … 0.35 x U_s		—	
Voltage Range		—	—		0.7 … 1.1 x Us	
IEC	Max. Operating Current	AC13 @ 250V AC 3 A AC15 @ 250V AC 0.5 A DC12 @ 110V DC 0.5 A U_{min} - 5V AC	—		—	
	Terminal Capacity IEC Rigid, CU	0.5…2.5 mm^2 2 x 0.5…2 x 2.5 mm^2	0.5…4.0 mm^2 2 x 0.5…2 x 2.5 mm^2		1.0…25 mm^2 2 x 1.0…2 x 4.0 mm^2	
	Tightening Torque	0.8 Nm	1.1 Nm		2.4 Nm	
UL 1077 CSA 22.2 No. 235	Max. Operating Current	@ 230V AC 2 A @ 110V DC 0.5 A U_{min} - 5 V DC	—		—	
	Terminal Capacity CU	#18…#14 AWG 2 x #18 …2x #14 AWG	#18…#14 AWG 2 x #18 …2x #14 AWG		#18…#8 AWG 2 x #18…2x #12 AWG	
	Tightening Torque	7 lb-in.	10 lb-in.		21 lb-in.	

Dimensions

Dimensions are shown in millimeters. Dimensions are not intended for manufacturing purposes.

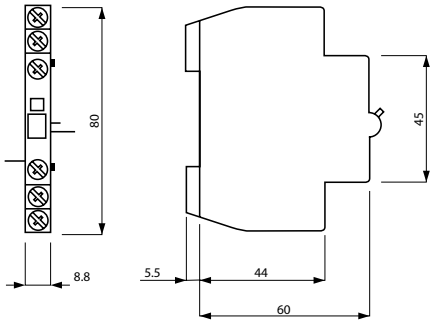
1492-SP Series C



1P **2P** **3P** **3P+N**

1P+N

Accessories



Cat. No.
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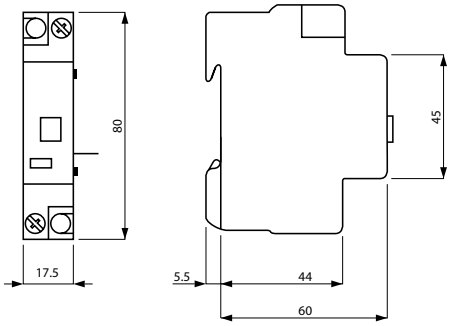
1492-ASPHS3
1492-ASPH3



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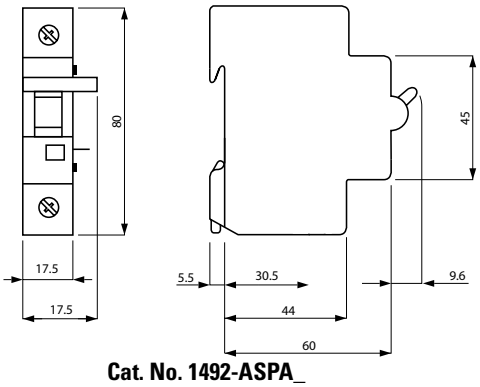

Cat. No. 1492-ASPA_

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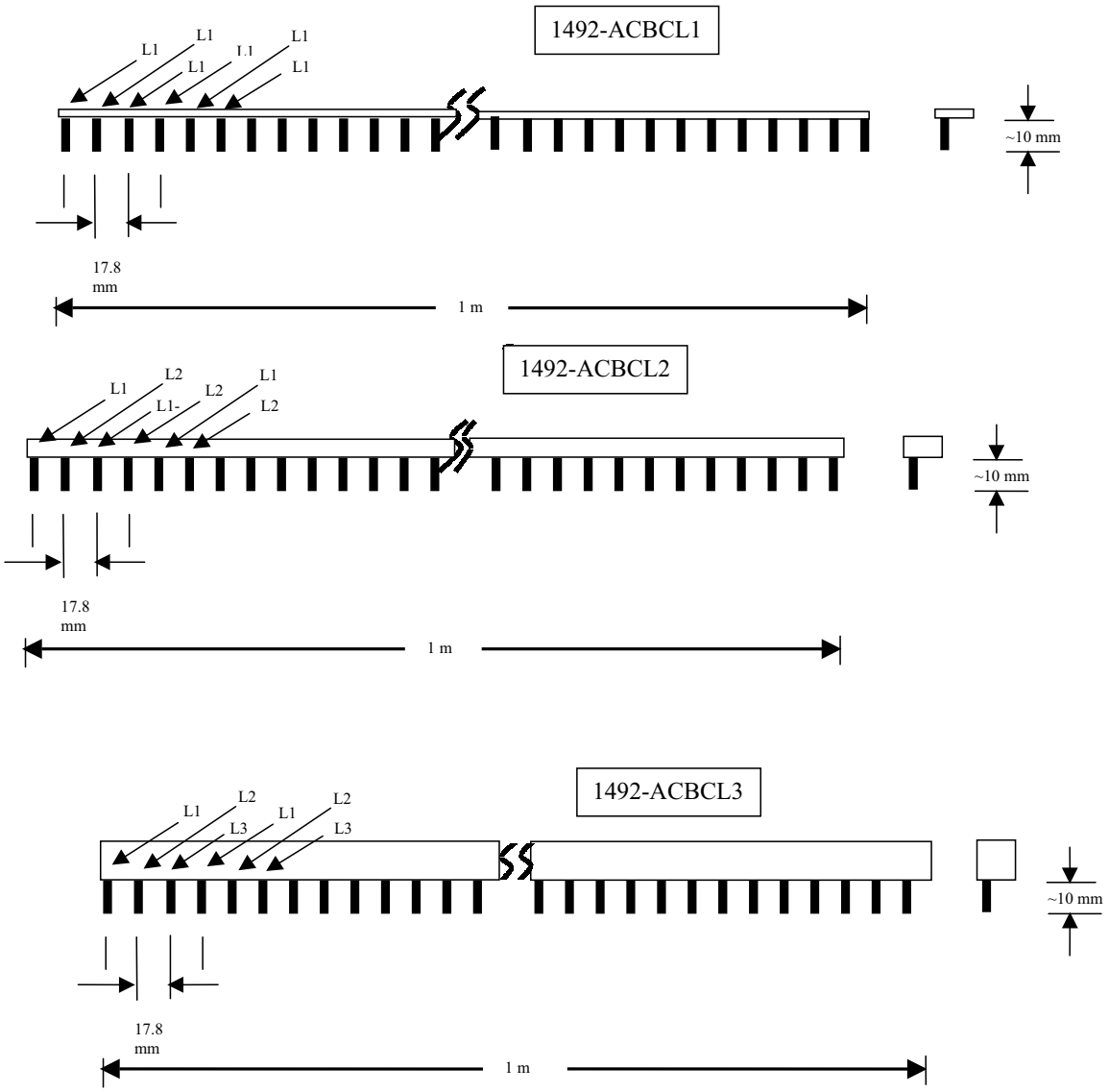

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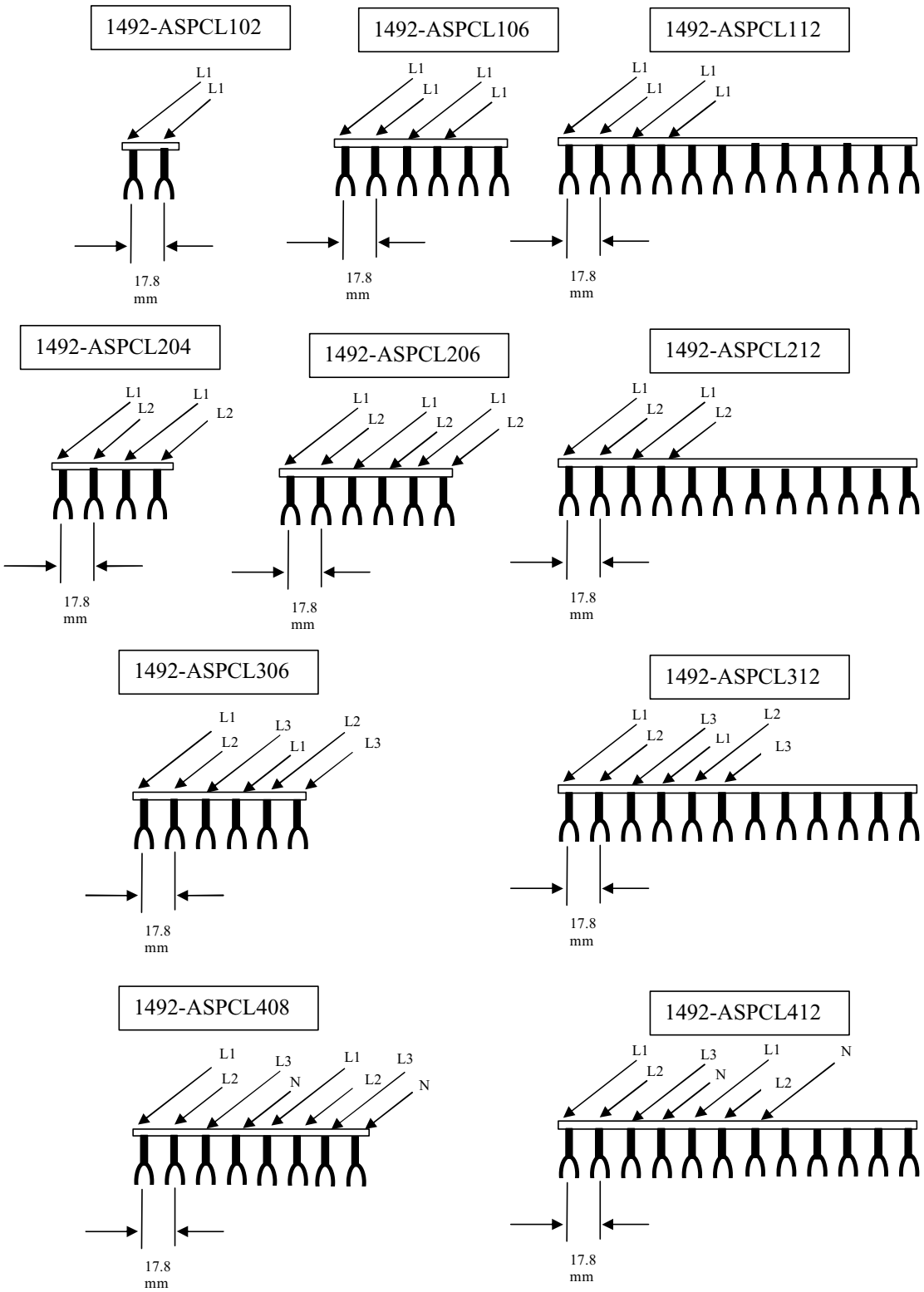

Dimensions, Continued

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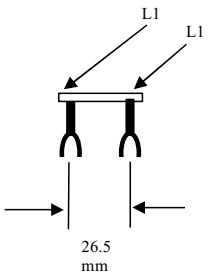

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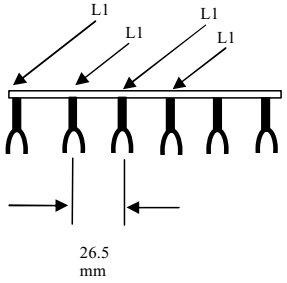

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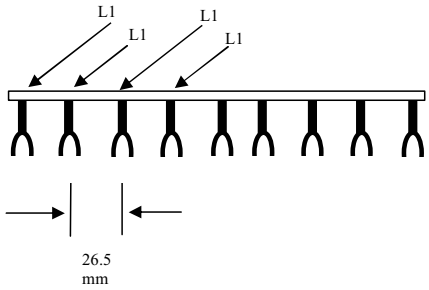

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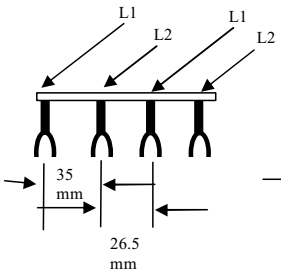

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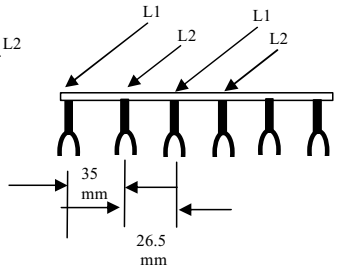

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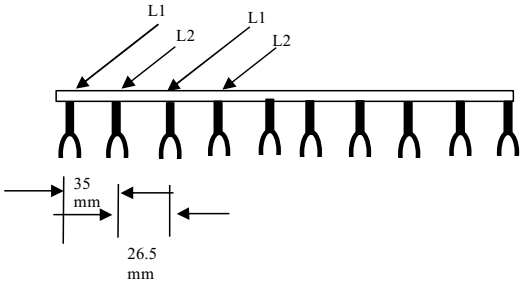

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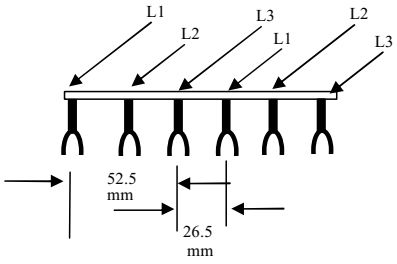

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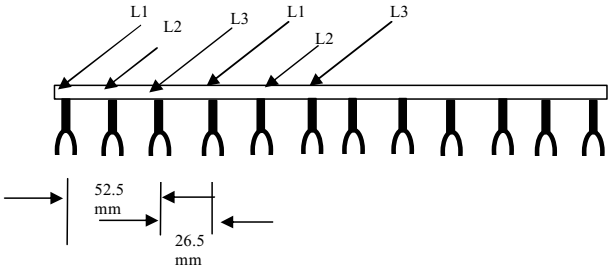

Dimensions, Continued

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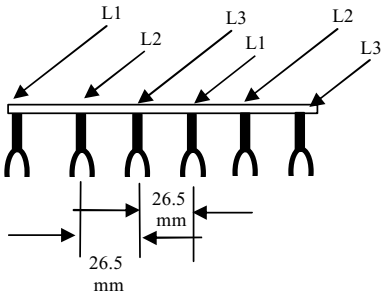

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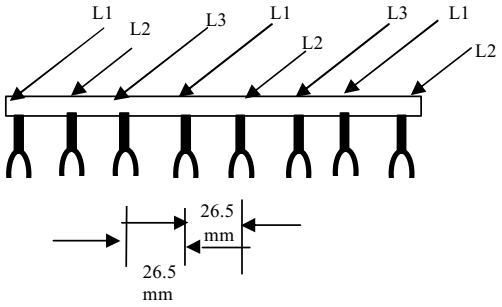

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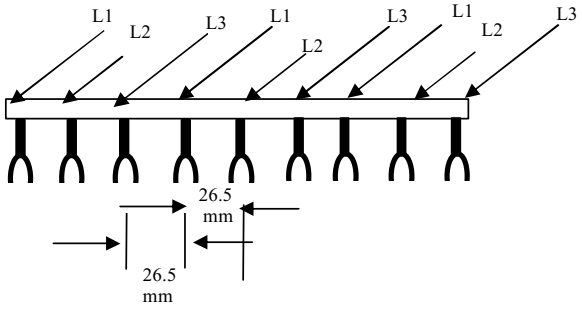

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Allen-Bradley

PowerFlex® 70

Adjustable Frequency AC Drive

Standard and Enhanced Control

Firmware Versions
Standard Control: 2.xxx
Enhanced Control: 2.xxx-3.xxx

User Manual

Rockwell Automation

Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. *Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls* (Publication SGI-1.1 available from your local Rockwell Automation sales office or online at **http://www.rockwellautomation.com/literature**) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

Reproduction of the contents of this manual, in whole or in part, without written permission of Rockwell Automation, Inc. is prohibited.

Throughout this manual, when necessary we use notes to make you aware of safety considerations.

WARNING: Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.

Important: Identifies information that is critical for successful application and understanding of the product.

ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you:

- identify a hazard
- avoid the hazard
- recognize the consequences

Shock Hazard labels may be located on or inside the equipment (e.g., drive or motor) to alert people that dangerous voltage may be present.

Burn Hazard labels may be located on or inside the equipment (e.g., drive or motor) to alert people that surfaces may be at dangerous temperatures.

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DriveExplorer, DriveExecutive, and SCANport are trademarks of Rockwell Automation, Inc.
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The information below summarizes the changes to the PowerFlex 70 User Manual since the February 2005 release.

Parameter Updates

The following parameters have been added or updated with firmware version 3.002.

Parameter	Number	Description	Page
[Torque Estimate]	015	New	3-12
[Motor OL Mode]	050	New	3-14
[Mtr OL Trip Time]	221	New	3-42
[Drive Status 3]	222	New	3-42
[Status 3 @ Fault]	223	New	3-42
[Spd Err Filt BW]	448	New	3-28
[Fiber Control]	620	New	3-59
[Fiber Status]	621	New	3-59
[Sync Time]	622	New	3-59
[Traverse Inc]	623	New	3-59
[Traverse Dec]	624	New	3-59
[Max Traverse]	625	New	3-59
[P Jump]	626	New	3-59
[Motor NP RPM]	044	Updated	3-13
[Stop/Brk Mode A/B]	155, 156	Updated	3-30
[Start Inhibits]	214	Updated	3-40
[Last Stop Source]	215	Updated	3-41
[Digital Inx Sel]	361-366	Updated	3-55
[Digital Outx Sel]	380, 384	Updated	3-57

Additional Manual Updates

Description of New or Updated Information	Page
Catalog number explanation updated	P-5
External filter information added	1-24
Parameters 140 [Accel Time 1] and 141 [Accel Time 2] minimum value corrected to 0.0 Secs.	3-29
Parameters 142 [Decel Time 1] and 143 Decel Time 2] minimum value corrected to 0.0 Secs.	3-29
Conversion formula added to description of parameter 244-250 [Fault x Time].	3-45
Fast Brake application note added.	C-6

Notes:

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Overview

The purpose of this manual is to provide you with the basic information needed to install, start-up and troubleshoot the PowerFlex 70 Adjustable Frequency AC Drive.

For information on...	See page...
Who Should Use this Manual?	P-1
What Is Not in this Manual	P-1
Reference Materials	P-2
Manual Conventions	P-2
Drive Frame Sizes	P-3
General Precautions	P-3
Catalog Number Explanation	P-5

Who Should Use this Manual?

This manual is intended for qualified personnel. You must be able to program and operate Adjustable Frequency AC Drive devices. In addition, you must have an understanding of the parameter settings and functions.

What Is Not in this Manual

The *Power*Flex 70 User Manual is designed to provide only basic start-up information. For detailed drive information, please refer to the *PowerFlex Reference Manual*, publication PFLEX-RM001…. The reference manual is included on the CD supplied with your drive or is also available online at **http://www.rockwellautomation.com/literature**.

Reference Materials

The following manuals are recommended for general drive information:

Title	Publication	Available Online at …
Wiring and Grounding Guidelines for Pulse Width Modulated (PWM) AC Drives	DRIVES-IN001…	**www.rockwellautomation.com/literature**
Preventive Maintenance of Industrial Control and Drive System Equipment	DRIVES-TD001…	
Safety Guidelines for the Application, Installation and Maintenance of Solid State Control	SGI-1.1	
A Global Reference Guide for Reading Schematic Diagrams	100-2.10	
Guarding Against Electrostatic Damage	8000-4.5.2	

For detailed PowerFlex 70 information:

Title	Publication	Available …
PowerFlex Reference Manual	PFLEX-RM001…	on the CD supplied with the drive or at **www.rockwellautomation.com/literature**

For Allen-Bradley Drives Technical Support:

Title	Online at …
Allen-Bradley Drives Technical Support	**www.ab.com/support/abdrives**

Manual Conventions

- In this manual we refer to the PowerFlex 70 Adjustable Frequency AC Drive as; drive, PowerFlex 70 or PowerFlex 70 Drive.
- To help differentiate parameter names and LCD display text from other text, the following conventions will be used:
  - Parameter Names will appear in [brackets].
    For example: [DC Bus Voltage].
  - Display Text will appear in “quotes.” For example: “Enabled.”
- The following words are used throughout the manual to describe an action:

Word	Meaning
Can	Possible, able to do something
Cannot	Not possible, not able to do something
May	Permitted, allowed
Must	Unavoidable, you must do this
Shall	Required and necessary
Should	Recommended
Should Not	Not recommended

Drive Frame Sizes

Similar PowerFlex 70 drive sizes are grouped into frame sizes to simplify spare parts ordering, dimensioning, etc. A cross reference of drive catalog numbers and their respective frame size is provided in Appendix A.

General Precautions

ATTENTION: This drive contains ESD (Electrostatic Discharge) sensitive parts and assemblies. Static control precautions are required when installing, testing, servicing or repairing this assembly. Component damage may result if ESD control procedures are not followed. If you are not familiar with static control procedures, reference A-B publication 8000-4.5.2, "Guarding Against Electrostatic Damage" or any other applicable ESD protection handbook.

ATTENTION: An incorrectly applied or installed drive can result in component damage or a reduction in product life. Wiring or application errors, such as, undersizing the motor, incorrect or inadequate AC supply, or excessive ambient temperatures may result in malfunction of the system.

ATTENTION: Only qualified personnel familiar with adjustable frequency AC drives and associated machinery should plan or implement the installation, start-up and subsequent maintenance of the system. Failure to comply may result in personal injury and/or equipment damage.

ATTENTION: To avoid an electric shock hazard, verify that the voltage on the bus capacitors has discharged before performing any work on the drive. Measure the DC bus voltage at the +DC terminal of the Power Terminal Block and the -DC test point (refer to Chapter 1 for locations). The voltage must be zero.

ATTENTION: Risk of injury or equipment damage exists. DPI or SCANport host products must not be directly connected together via 1202 cables. Unpredictable behavior can result if two or more devices are connected in this manner.

ATTENTION: A risk of injury or equipment damage exists in firmware version 1.011 and earlier. When there is a combination of long shielded motor cables, high source impedance, low speed, light motor load and parameter 190 [Direction Mode] is set to "Unipolar" or "Bipolar," an unexpected change in motor direction may occur. If these conditions exist, choose one of the following corrective actions:

- Set parameter 190 to "Reverse Dis"
- Set parameters 161 and 162 to "Disabled"
- Install a properly sized Dynamic Brake resistor

ATTENTION: Nuisance tripping may occur in Standard Control firmware version 1.011 and earlier due to unstable currents. When using a motor that is connected for a voltage that is different from the drive (e.g., using a 230V connected motor with a 460V drive) the following adjustment must be made to "Stability Gain" using DriveExplorer software and a personal computer.

$$\frac{\text{Motor Nameplate Voltage}}{\text{Drive Rated Voltage}} \times 128$$

Any adjustment made to "Stability Gain" must be manually restored if the drive is reset to defaults or is replaced.

If unstable currents are still present after making the adjustment, contact the factory for assistance.

ATTENTION: The "adjust freq" portion of the bus regulator function is extremely useful for preventing nuisance overvoltage faults resulting from aggressive decelerations, overhauling loads, and eccentric loads. It forces the output frequency to be greater than commanded frequency while the drive's bus voltage is increasing towards levels that would otherwise cause a fault; however, it can also cause either of the following two conditions to occur.

1. Fast positive changes in input voltage (more than a 10% increase within 6 minutes) can cause uncommanded positive speed changes; however an "OverSpeed Limit" fault will occur if the speed reaches [Max Speed] + [Overspeed Limit]. If this condition is unacceptable, action should be taken to 1) limit supply voltages within the specification of the drive and, 2) limit fast positive input voltage changes to less than 10%. Without taking such actions, if this operation is unacceptable, the "adjust freq" portion of the bus regulator function must be disabled (see parameters 161 and 162).
2. Actual deceleration times can be longer than commanded deceleration times; however, a "Decel Inhibit" fault is generated if the drive stops decelerating altogether. If this condition is unacceptable, the "adjust freq" portion of the bus regulator must be disabled (see parameters 161 and 162). In addition, installing a properly sized dynamic brake resistor will provide equal or better performance in most cases.

Note: These faults are not instantaneous and have shown test results that take between 2 and 12 seconds to occur.

Catalog Number Explanation

Position Number

1-3	4	5-7	8	9	10	11	12	13	14	15	16
20A	B	2P2	A	3	A	Y	Y	N	N	C	0
a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*	*k*	*l*

a

Drive

Code	Type
20A	PowerFlex 70

b

Voltage Rating

Code	Voltage	Ph.
B	240V ac	3
C	400V ac	3
D	480V ac	3
E	600V ac	3

c1

ND Rating

208V, 60 Hz Input

Code	Amps	kW (Hp)
2P2	2.5	0.37 (0.5)
4P2	4.8	0.75 (1.0)
6P8	7.8	1.5 (2.0)
9P6	11	2.2 (3.0)
015	17.5	4.0 (5.0)
022	25.3	5.5 (7.5)
028	32.2	7.5 (10)
042	43	11 (15)
054	62.1	15 (20)
070	78.2	18.5 (25)

c2

ND Rating

240V, 60 Hz Input

Code	Amps	kW (Hp)
2P2	2.2	0.37 (0.5)
4P2	4.2	0.75 (1.0)
6P8	6.8	1.5 (2.0)
9P6	9.6	2.2 (3.0)
015	15.3	4.0 (5.0)
022	22	5.5 (7.5)
028	28	7.5 (10)
042	42	11 (15)
054	54	15 (20)
070	70	18.5 (25)

c3

ND Rating

400V, 50 Hz Input

Code	Amps	kW (Hp)
1P3	1.3	0.37 (0.5)
2P1	2.1	0.75 (1.0)
3P5	3.5	1.5 (2.0)
5P0	5.0	2.2 (3.0)
8P7	8.7	4.0 (5.0)
011	11.5	5.5 (7.5)
015	15.4	7.5 (10)
022	22	11 (15)
030	30	15 (20)
037	37	18.5 (25)
043	43	22 (30)
060	60	30 (40)
072	72	37 (50)

c4

ND Rating

480V, 60 Hz Input

Code	Amps	kW (Hp)
1P1	1.1	0.37 (0.5)
2P1	2.1	0.75 (1.0)
3P4	3.4	1.5 (2.0)
5P0	5.0	2.2 (3.0)
8P0	8.0	3.7 (5.0)
011	11	5.5 (7.5)
014	14	7.5 (10)
022	22	11 (15)
027	27	15 (20)
034	34	18.5 (25)
040	40	22 (30)
052	52	30 (40)
065	65	37 (50)

c5

ND Rating

600V, 60 Hz Input

Code	Amps	kW (Hp)
0P9	0.9	0.37 (0.5)
1P7	1.7	0.75 (1.0)
2P7	2.7	1.5 (2.0)
3P9	3.9	2.2 (3.0)
6P1	6.1	4.0 (5.0)
9P0	9.0	5.5 (7.5)
011	11	7.5 (10)
017	17	11 (15)
022	22	15 (20)
027	27	18.5 (25)
032	32	22 (30)
041	41	30 (40)
052	52	37 (50)

d

Enclosure

Code	Enclosure
A	Panel Mount - IP 20, NEMA Type 1
C	Wall/Machine Mount = IP66, NEMA Type 4X/12 for indoor use only
F	Flange Mount - Front Chassis = IP 20, NEMA Type 1; Rear Heatsink = IP66, UL Type 4X/12 for indoor/outdoor use
G	Wall/Machine Mount - IP54, NEMA Type 12

e

HIM ✶

Code	Interface Module
0	Blank Cover
2	Digital LCD
3	Full Numeric LCD
5	Prog. Only LCD
8 ❄	Wireless Interface Module

✶ IP66, NEMA Type 4X/12 (Enclosure Code C) is available only with HIM Codes 0, 3, 5, or 8.

❄ HIM Code 8 is available only with IP66, NEMA Type 4X/12 enclosures.

Position Number

1-3	*4*	*5-7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*
20A	B	2P2	A	3	A	Y	Y	N	N	C	0
a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*	*k*	*l*

f

Documentation	
Code	**Type**
A	English User Manual and Multi-Language Quick Start
N	No Manual

g

Brake IGBT	
Code	**w/Brake IGBT**
Y	Yes

h

Internal Brake Resistor	
Code	**w/Resistor**
Y	Yes
N	N o

i

Emission Class	
Code	**Rating**
A	Filtered⁎ A⊕ & B Frames (Optional) C, D, & E Frames (Standard)
N	Not Filtered⁎ A & B Frames (Optional) C, D, & E Frames

⁎ 600V Frames A through D available only without filter (Cat. Code N). 600V Frame E available only with filter (Cat. Code A).

⊕ Increases size to Frame B.

j

Comm Slot	
Code	**Version**
C	ControlNet (Coax)
D	DeviceNet
E	EtherNet/IP
R	RIO
S	RS485 DF1
N	None

k

Control & I/O		
Code	**Control**	**Safe-Off**
N	Standard	N/A
C	Enhanced	No
G ⁎	Enhanced	Yes

⁎ Not available as factory installed option for 600V ratings.

l

Feedback	
Code	**Feedback**
N	N/A
0	None
1	5V/12V Encoder

Installation/Wiring

This chapter provides information on mounting and wiring the PowerFlex 70 Drive.

For information on...	See page
Opening the Cover	1-1
Mounting Considerations	1-2
AC Supply Source Considerations	1-3
General Grounding Requirements	1-4
Fuses and Circuit Breakers	1-5
Power Wiring	1-5
Using Input/Output Contactors	1-10

For information on...	See page
Disconnecting MOVs and Common Mode Capacitors	1-11
I/O Wiring	1-12
Speed Reference Control	1-19
Auto/Manual Examples	1-20
EMC Instructions	1-21

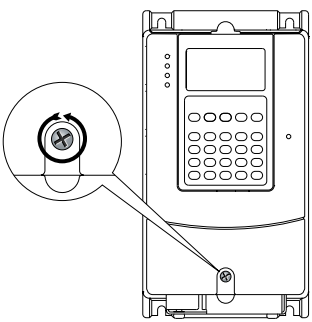
Most start-up difficulties are the result of incorrect wiring. Every precaution must be taken to assure that the wiring is done as instructed. All items must be read and understood before the actual installation begins.

ATTENTION: The following information is merely a guide for proper installation. Rockwell Automation, Inc. cannot assume responsibility for the compliance or the noncompliance to any code, national, local or otherwise for the proper installation of this drive or associated equipment. A hazard of personal injury and/or equipment damage exists if codes are ignored during installation.

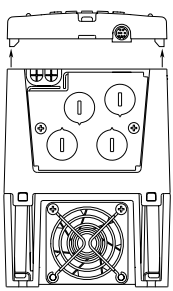
Opening the Cover

IP 20 (NEMA Type 1)

1. Loosen cover screw.

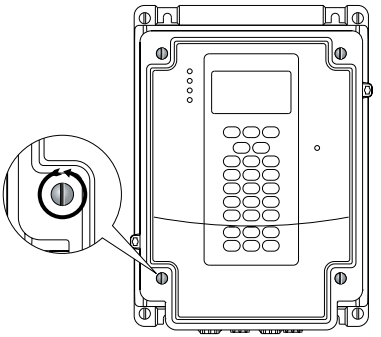


2. Pull cover straight off chassis to avoid damaging connector pins.

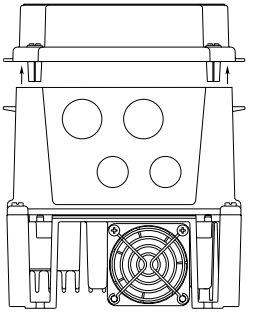


IP 66 (NEMA Type 4X/12)

1. Loosen the cover screws.



2. Pull cover straight off chassis.



Important: Torque cover screws to 0.79 N-m (7 lb.-in.).

Mounting Considerations

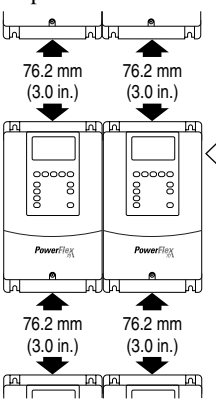
Maximum Surrounding Air Temperature

Enclosure Rating	Temperature Range
Open Type, IP 20, NEMA Type 1 & Flange Mount	0 to 50 degrees C (32 to 122 degrees F)
IP 66 & NEMA Type 4X/12	0 to 40 degrees C (32 to 104 degrees F)
IP 54 & NEMA Type 12	0 to 40 degrees C (32 to 104 degrees F)

Important: Some drives are equipped with an adhesive label on the top of the chassis. Removing the adhesive label from the drive changes the NEMA enclosure rating from Type 1 Enclosed to Open Type.

Minimum Mounting Clearances

Specified vertical clearance requirements are intended to be from drive to drive. Other objects can occupy this space; however, reduced airflow may cause protection circuits to fault the drive. In addition, inlet air temperature must not exceed the product specification.



Clearances apply to all PowerFlex 70 Drives:

- Panel Mount
- Flange Mount
- NEMA Type 4X/12

AC Supply Source Considerations

PowerFlex 70 drives are suitable for use on a circuit capable of delivering up to a maximum of 200,000 rms symmetrical amperes, and a maximum of 600 volts.

ATTENTION: To guard against personal injury and/or equipment damage caused by improper fusing or circuit breaker selection, use only the recommended line fuses/circuit breakers specified in Appendix A.

If a system ground fault monitor (RCD) is to be used, only Type B (adjustable) devices should be used to avoid nuisance tripping.

Unbalanced, Ungrounded, Resistive or B Phase Grounded Distribution Systems

If phase to ground voltage will exceed 125% of normal line to line voltage or the supply system is ungrounded, refer to the *Wiring and Grounding Guidelines for AC Drives* (publication DRIVES-IN001).

ATTENTION: PowerFlex 70 drives contain protective MOVs and common mode capacitors that are referenced to ground. These devices must be disconnected if the drive is installed on an ungrounded, resistive or B phase grounded distribution system. See page 1-11 for jumper locations.

Input Power Conditioning

Certain events on the power system supplying a drive can cause component damage or shortened product life. These conditions are divided into 2 basic categories:

1. **All drives**
   - The power system has power factor correction capacitors switched in and out of the system, either by the user or by the power company.
   - The power source has intermittent voltage spikes in excess of 6000 volts. These spikes could be caused by other equipment on the line or by events such as lightning strikes.
   - The power source has frequent interruptions.
2. **5 HP or Less Drives (in addition to "1" above)**
   - The nearest supply transformer is larger than 100kVA or the available short circuit (fault) current is greater than 100,000A.
   - The impedance in front of the drive is less than 0.5%.

If any or all of these conditions exist, it is recommended that the user install a minimum amount of impedance between the drive and the

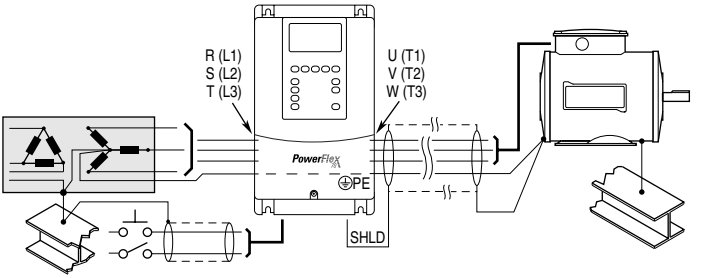
source. This impedance could come from the supply transformer itself, the cable between the transformer and drive or an additional transformer or reactor. The impedance can be calculated using the information supplied in the *Wiring and Grounding Guidelines for Pulse Width Modulated (PWM) AC Drives*, publication DRIVES-IN001….

General Grounding Requirements

The drive Safety Ground - PE must be connected to system ground. Ground impedance must conform to the requirements of national and local industrial safety regulations and/or electrical codes. The integrity of all ground connections should be periodically checked.

For installations within a cabinet, a single safety ground point or ground bus bar connected directly to building steel should be used. All circuits including the AC input ground conductor should be grounded independently and directly to this point/bar.

Figure 1.1 Typical Grounding



Safety Ground - PE

This is the safety ground for the drive that is required by code. This point must be connected to adjacent building steel (girder, joist), a floor ground rod or bus bar (see above). Grounding points must comply with national and local industrial safety regulations and/or electrical codes.

Shield Termination - SHLD

The Shield terminal (see Figure 1.2 on page 1-8) provides a grounding point for the motor cable shield. The **motor cable** shield should be connected to this terminal on the drive (drive end) and the motor frame (motor end). A shield terminating cable gland may also be used.

When shielded cable is used for **control and signal wiring**, the shield should be grounded at the source end only, not at the drive end.

RFI Filter Grounding

Using an optional RFI filter may result in relatively high ground leakage currents. Therefore, the **filter must only be used in installations with grounded AC supply systems and be permanently installed and solidly grounded** (bonded) to the building power distribution ground. Ensure that the incoming supply neutral is solidly connected (bonded) to the same building power distribution ground. Grounding must not rely on flexible cables and should not include any form of plug or socket that would permit inadvertent disconnection. Some local codes may require redundant ground connections. The integrity of all connections should be periodically checked. Refer to the instructions supplied with the filter.

Fuses and Circuit Breakers

The PowerFlex 70 can be installed with either input fuses or an input circuit breaker. National and local industrial safety regulations and/or electrical codes may determine additional requirements for these installations. Refer to Appendix A for recommended fuses/circuit breakers.

ATTENTION: The PowerFlex 70 does not provide branch short circuit protection. Specifications for the recommended fuse or circuit breaker to provide protection against short circuits are provided in Appendix A.

Power Wiring

ATTENTION: National Codes and standards (NEC, VDE, BSI etc.) and local codes outline provisions for safely installing electrical equipment. Installation must comply with specifications regarding wire types, conductor sizes, branch circuit protection and disconnect devices. Failure to do so may result in personal injury and/or equipment damage.

Cable Types Acceptable for 200-600 Volt Installations

A variety of cable types are acceptable for drive installations. For many installations, unshielded cable is adequate, provided it can be separated from sensitive circuits. As an approximate guide, allow a spacing of 0.3 meters (1 foot) for every 10 meters (32.8 feet) of length. In all cases, long parallel runs must be avoided. Do not use cable with an insulation thickness less than 15 mils (0.4 mm/0.015 in.). Use copper wire only. Wire gauge requirements and recommendations are based on 75 degree C. Do not reduce wire gauge when using higher temperature wire.

Unshielded

THHN, THWN or similar wire is acceptable for drive installation in dry environments provided adequate free air space and/or conduit fill rates limits are provided. **Do not use THHN or similarly coated wire in wet areas**. Any wire chosen must have a minimum insulation thickness of 15 mils and should not have large variations in insulation concentricity.

Shielded/Armored Cable

Shielded cable contains all of the general benefits of multi-conductor cable with the added benefit of a copper braided shield that can contain much of the noise generated by a typical AC Drive. Strong consideration for shielded cable should be given in installations with sensitive equipment such as weigh scales, capacitive proximity switches and other devices that may be affected by electrical noise in the distribution system. Applications with large numbers of drives in a similar location, imposed EMC regulations or a high degree of communications / networking are also good candidates for shielded cable.

Shielded cable may also help reduce shaft voltage and induced bearing currents for some applications. In addition, the increased impedance of shielded cable may help extend the distance that the motor can be located from the drive without the addition of motor protective devices such as terminator networks. Refer to Reflected Wave in *Wiring and Grounding Guidelines for PWM AC Drives*, publication DRIVES-IN001.

Consideration should be given to all of the general specifications dictated by the environment of the installation, including temperature, flexibility, moisture characteristics and chemical resistance. In addition, a braided shield should be included and be specified by the cable manufacturer as having coverage of at least 75%. An additional foil shield can greatly improve noise containment.

A good example of recommended cable is Belden® 295xx (xx determines gauge). This cable has four (4) XLPE insulated conductors with a 100% coverage foil and an 85% coverage copper braided shield (with drain wire) surrounded by a PVC jacket.

Other types of shielded cable are available, but the selection of these types may limit the allowable cable length. Particularly, some of the newer cables twist 4 conductors of THHN wire and wrap them tightly with a foil shield. This construction can greatly increase the cable charging current required and reduce the overall drive performance. Unless specified in the individual distance tables as tested with the drive, these cables are not recommended and their performance against the lead length limits supplied is not known.

Table 1.A Recommended Shielded Wire

Location	Rating/Type	Description
Standard (Option 1)	600V, 90°C (194°F) XHHW2/RHW-2 Anixter B209500-B209507, Belden 29501-29507, or equivalent	• Four tinned copper conductors with XLPE insulation. • Copper braid/aluminum foil combination shield and tinned copper drain wire. • PVC jacket.
Standard (Option 2)	Tray rated 600V, 90°C (194°F) RHH/RHW-2 Anixter OLF-7xxxxx or equivalent	• Three tinned copper conductors with XLPE insulation. • 5 mil single helical copper tape (25% overlap min.) with three bare copper grounds in contact with shield. • PVC jacket.
Class I & II; Division I & II	Tray rated 600V, 90°C (194°F) RHH/RHW-2 Anixter 7V-7xxxx-3G or equivalent	• Three bare copper conductors with XLPE insulation and impervious corrugated continuously welded aluminum armor. • Black sunlight resistant PVC jacket overall. • Three copper grounds on #10 AWG and smaller.

EMC Compliance

Refer to EMC Instructions on page 1-21 for details.

Cable Trays and Conduit

If cable trays or large conduits are to be used, refer to guidelines presented in *Wiring and Grounding Guidelines for Pulse Width Modulated (PWM) AC Drives*, publication DRIVES-IN001.

ATTENTION: To avoid a possible shock hazard caused by induced voltages, unused wires in the conduit must be grounded at both ends. For the same reason, if a drive sharing a conduit is being serviced or installed, all drives using this conduit should be disabled. This will help minimize the possible shock hazard from “cross coupled” motor leads.

Motor Cable Lengths

Typically, motor lead lengths less than 30 meters (approximately 100 feet) are acceptable. However, if your application dictates longer lengths, refer to *Wiring and Grounding Guidelines for Pulse Width Modulated (PWM) AC Drives* for details.

Single-Phase Input Power

The PowerFlex 70 drive is typically used with a three-phase input supply. The drive has been listed by U.L. to operate on single-phase input power with the following requirement:

- Output current is derated by 50% of the three-phase ratings identified in Tables A.B through A.D.

Power Terminal Block

Figure 1.2 Typical Power Terminal Block Location (B Frame Shown)

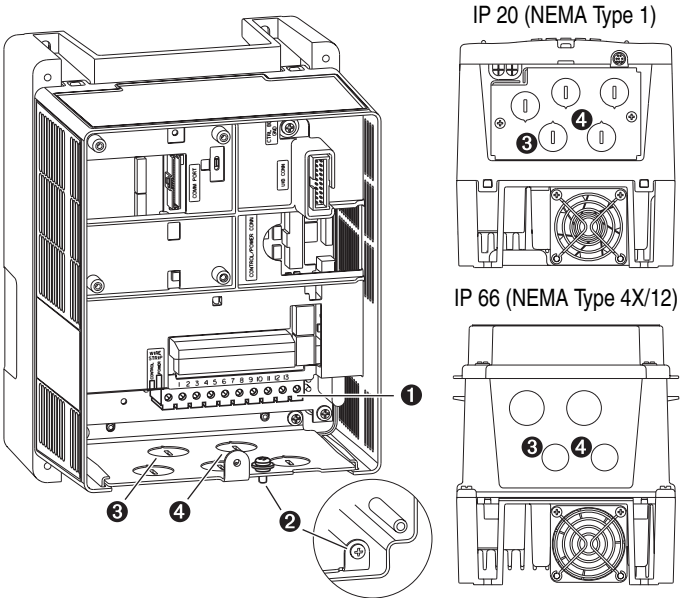


Table 1.B Power Terminal Block Specifications

No.	Name	Description	Frame	Wire Size Range[1] Maximum	Wire Size Range[1] Minimum	Torque Maximum	Torque Recommended
❶	Power Terminal Block	Input power and motor connections	A, B, & C	3.5 mm^2 (12 AWG)	0.3 mm^2 (22 AWG)	0.66 N-m (5.5 lb.-in.)	0.6 N-m (5 lb.-in.)
			D	8.4 mm^2 (8 AWG)	0.8 mm^2 (18 AWG)	1.7 N-m (15 lb.-in.)	1.4 N-m (12 lb.-in.)
			E	25.0 mm^2 (3 AWG)	2.5 mm^2 (14 AWG)	2.71 N-m (24 lb.-in.)	2.71 N-m (24 lb.-in.)
❷	SHLD terminal	Terminating point for wiring shields	All	—	—	1.6 N-m (14 lb.-in.)	1.6 N-m (14 lb.-in.)

(1) Maximum/minimum sizes that the terminal block will accept - these are not recommendations.

Table 1.C Wire Routing Recommendations

No.	Description
❸	Suggested entry for incoming line wiring.
❹	Suggested entry for motor wiring.

Cable Entry Plate Removal

If additional wiring access is needed, the Cable Entry Plate on all drive Frames can be removed. Simply loosen the screws securing the plate to the heat sink and slide the plate out.

Figure 1.3 Frames A-D Power Terminal Block and DC Bus Test Points

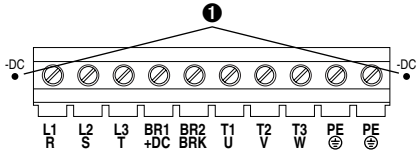
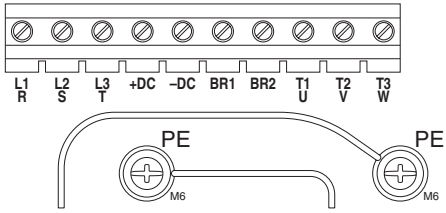
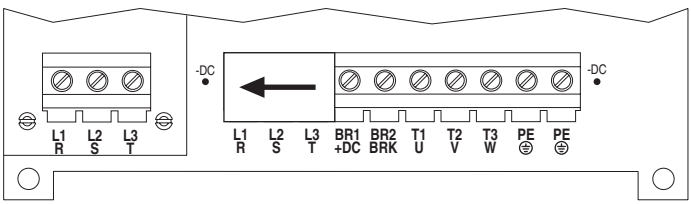


Figure 1.4 Frame E Power Terminal Block



Terminal	Description	Notes
R	R (L1)	AC Line Input Power
S	S (L2)	AC Line Input Power
T	T (L3)	AC Line Input Power
BR1	DC Brake	DB Resistor Connection - **Important:** Do not connect both an internal and external DB resistor at the same time. This may violate the minimum allowed DB resistance and cause drive damage.
BR2	DC Brake	
U	U (T1)	To Motor
V	V (T2)	To Motor
W	W (T3)	To Motor
PE	PE Ground	
PE	PE Ground	
-DC	DC Bus (–)	❶ Test point on Frames A-D located to the left or right of the Power Terminal Block. Frame E has a dedicated terminal.
+DC	DC Bus (+)	

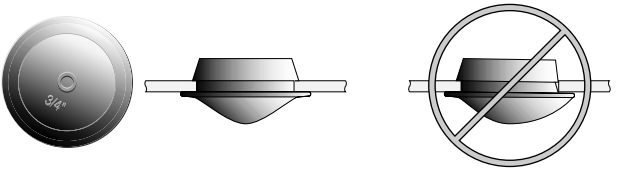
Figure 1.5 Power Input Terminals on Frame B with Internal RFI Filter Option



IP66 (NEMA Type 4X/12) Installations

Use the plugs supplied with IP66 (NEMA Type 4X/12) rated drives to seal unused holes in the conduit entry plate.

Important: Completely seat the plug inner rim for the best seal.



Using Input/Output Contactors

Input Contactor Precautions

ATTENTION: A contactor or other device that routinely disconnects and reapplies the AC line to the drive to start and stop the motor can cause drive hardware damage. The drive is designed to use control input signals that will start and stop the motor. If an input device is used, operation must not exceed one cycle per minute or drive damage will occur.

ATTENTION: The drive start/stop/enable control circuitry includes solid state components. If hazards due to accidental contact with moving machinery or unintentional flow of liquid, gas or solids exist, an additional hardwired stop circuit may be required to remove the AC line to the drive. An auxiliary braking method may be required.

Output Contactor Precaution

ATTENTION: To guard against drive damage when using output contactors, the following information must be read and understood. One or more output contactors may be installed between the drive and motor(s) for the purpose of disconnecting or isolating certain motors/loads. If a contactor is opened while the drive is operating, power will be removed from the respective motor, but the drive will continue to produce voltage at the output terminals. In addition, reconnecting a motor to an active drive (by closing the contactor) could produce excessive current that may cause the drive to fault. If any of these conditions are determined to be undesirable or unsafe, an auxiliary contact on the output contactor should be wired to a drive digital input that is programmed as “Enable.” This will cause the drive to execute a coast-to-stop (cease output) whenever an output contactor is opened.

Disconnecting MOVs and Common Mode Capacitors

PowerFlex 70 drives contain protective MOVs and common mode capacitors that are referenced to ground. To guard against drive damage, these devices should be disconnected if the drive is installed on an ungrounded distribution system where the line-to-ground voltages on any phase could exceed 125% of the nominal line-to-line voltage. To disconnect these devices, remove all the jumper(s) shown in the figure and table below. See the *Wiring and Grounding Guidelines for Pulse Width Modulated (PWM) AC Drives*, publication DRIVES-IN001, for more information on ungrounded system installation.

ATTENTION: To avoid an electric shock hazard, verify that the voltage on the bus capacitors has discharged before removing/installing jumpers. Measure the DC bus voltage at the +DC terminal of the Power Terminal Block and the -DC test point. The voltage must be zero.

Figure 1.6 Typical Jumper Locations (C Frame Shown)

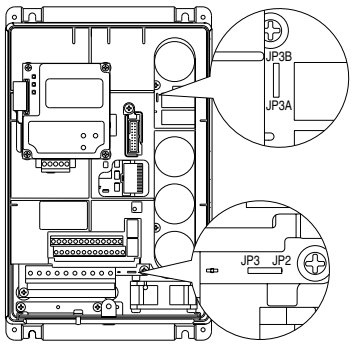
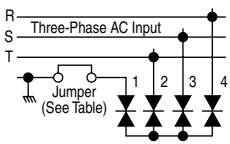
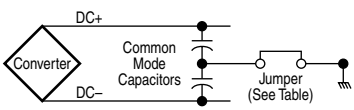


Figure 1.7 Phase to Ground MOV Removal



Frame	Jumper	Removes
A, B, C and D	JP3 – JP2	MOV to Ground
E	JP2 – JP1	MOV and Line to Line Capacitors to Ground

Figure 1.8 Common Mode Capacitors to Ground Removal



Frame	Jumper	Removes
A	N/A	
B	JP6 – JP5	Common Mode Capacitors to Ground
C and D	JP3B – JP3A	Common Mode Capacitors to Ground
E	JP3 – JP4	Common Mode Capacitors to Ground

I/O Wiring

Important points to remember about I/O wiring:

- Use copper wire only. Wire gauge requirements and recommendations are based on 75 degree C. Do not reduce wire gauge when using higher temperature wire.
- Wire with an insulation rating of 600V or greater is recommended.
- Control and signal wires should be separated from power wires by at least 0.3 meters (1 foot).

Important: I/O terminals labeled "(–)" or "Common" are not referenced to earth ground and are designed to greatly reduce common mode interference. Grounding these terminals can cause signal noise.

ATTENTION: Configuring an analog input for 0-20mA operation and driving it from a voltage source could cause component damage. Verify proper configuration prior to applying input signals.

ATTENTION: Hazard of personal injury or equipment damage exists when using bipolar input sources. Noise and drift in sensitive input circuits can cause unpredictable changes in motor speed and direction. Use speed command parameters to help reduce input source sensitivity.

Signal and Control Wire Types

Table 1.D Recommended Signal Wire

Signal Type	Wire Type(s)	Description	Minimum Insulation Rating
Analog I/O	Belden 8760/9460 (or equiv.)	0.750 mm^2 (18 AWG), twisted pair, 100% shield with drain(1).	300V, 75-90 degrees C (167-194 degrees F)
	Belden 8770 (or equiv.)	0.750 mm^2 (18 AWG), 3 conductor, shielded for remote pot only.	
Encoder	Belden 9728 (or equiv.)	0.196 mm^2 (24 AWG), individually shielded.	
EMC Compliance	Refer to EMC Instructions on page 1-21 for details.		

(1) If the wires are short and contained within a cabinet which has no sensitive circuits, the use of shielded wire may not be necessary, but is always recommended.

Table 1.E Recommended Control Wire for Digital I/O

	Wire Type(s)	Description	Minimum Insulation Rating
Unshielded	Per US NEC or applicable national or local code	—	300V, 60 degrees C (140 degrees F)
Shielded	Multi-conductor shielded cable such as Belden 8770 (or equiv.)	0.750 mm^2 (18 AWG), 3 conductor, shielded.	

I/O Terminal Block

Figure 1.9 Typical I/O Terminal Block Location (B Frame Shown)

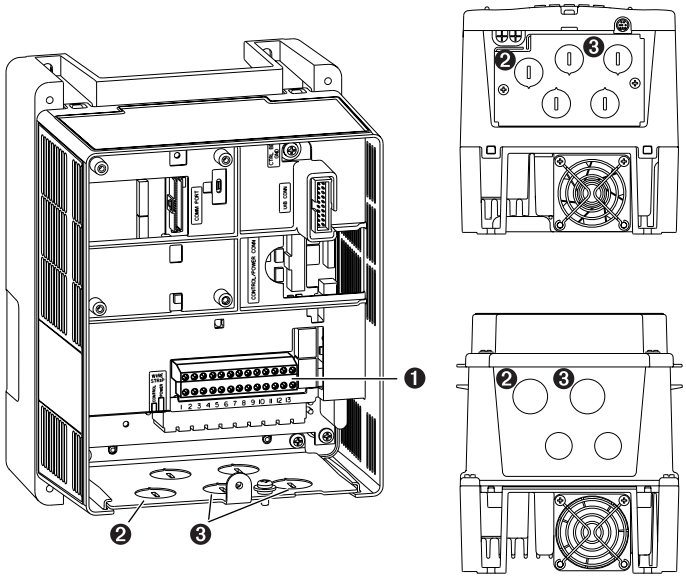


Table 1.F I/O Terminal Block Specifications

No.	Name	Description	Wire Size Range(1)		Torque	
			Maximum	Minimum	Maximum	Recommended
❶	I/O Terminal Block	Signal & control connections	1.5 mm^2 (16 AWG)	0.05 mm^2 (30 AWG)	0.55 N-m (4.9 lb.-in.)	0.5 N-m (4.4 lb.-in.)

(1) Maximum / minimum that the terminal block will accept - these are not recommendations.

Table 1.G Wire Routing Recommendations

No.	Description
❷	Suggested entry for communication wiring.
❸	Suggested entry for I/O and control wiring.

Figure 1.10 I/O Terminal Positions

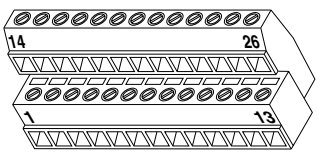


Table 1.H I/O Terminal Designations – Standard and Enhanced Control

No.	Signal	Factory Default	Description	Related Param.
1	Digital In 1	Stop – CF (CF = Clear Fault)	11.2 mA @ 24V DC 19.2V minimum on state 3.2V maximum off state Important: Use only 24V DC, not suitable for 115V AC circuitry. Inputs can be wired as sink or source.	361 - 366
2	Digital In 2	Start		
3	Digital In 3	Auto/Man		
4	Digital In 4	Speed Sel 1		
5	Digital In 5	Speed Sel 2		
6	Digital In 6	Speed Sel 3		
7	24V Common	–	Drive supplied power for Digital In1-6 inputs. See examples on page 1-18. 150mA maximum load.	
8	Digital In Common	–		
9	+24V DC	–		
10	+10V Pot Reference	–	2 k ohm minimum load.	
11	Digital Out 1 – N.O.(1)	NOT Fault	Max Resistive Load: 250V AC / 30V DC, 50 VA / 60 Watts Max Inductive Load: 250V AC / 30V DC, 25 VA / 30 Watts Minimum DC Load: 10 µA, 10 mV DC	380 - 387
12	Digital Out 1 Common			
13	Digital Out 1 – N.C.(1)	Fault		
14	Analog In 1 (– Volts)	(2) Voltage – Reads value at 14 & 15	Non-isolated, 0 to +10V, 10 bit, 100k ohm input impedance.(3)	320 - 327
15	Analog In 1 (+ Volts)			
16	Analog In 1 (– Current)		Non-isolated, 4-20mA, 10 bit, 100 ohm input impedance.(3)	
17	Analog In 1 (+ Current)			
18	Analog In 2 (– Volts)	(2) Voltage – Reads value at 18 & 19	Isolated, bipolar, differential, 0 to +10V unipolar (10 bit) or ±10V bipolar (10 bit & sign), 100k ohm input impedance.(4)	
19	Analog In 2 (+ Volts)			
20	Analog In 2 (– Current)		Isolated, 4-20mA, 10 bit & sign, 100 ohm input impedance.(4)	
21	Analog In 2 (+ Current)			
22	10V Pot Common Analog Out (– Volts) Analog Out (– Current)	(2) Output Freq	0 to +10V, 10 bit, 10k ohm (2k ohm minimum) load. 0 to 20mA, 10 bit, 400 ohm maximum load.(5) Referenced to chassis ground.	340 - 344
23	Analog Out (+ Volts) Analog Out (+ Current)		Common if internal 10V supply (terminal 10) is used.	
24	Digital Out 2 – N.O.(1)	Run	See description at No.s 11-13.	380 - 387
25	Digital Out 2 Common			
26	Digital Out 2 – N.C.(1)	NOT Run		

(1) Contacts shown in unpowered state. Any relay programmed as Fault or Alarm will energize (pick up) when power is applied to drive and deenergize (drop out) when fault or alarm exists. Relays selected for other functions will energize only when that condition exists and will deenergize when condition is removed.

(2) These inputs/outputs are dependent on a number of parameters. See “Related Parameters.”

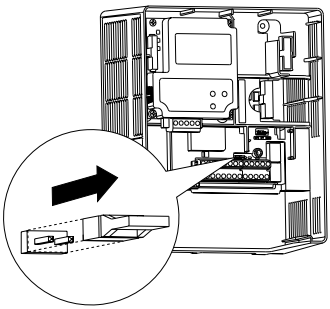
(3) Differential Isolation - External source must be less than 10V with respect to PE.

(4) Differential Isolation - External source must be maintained at less than 160V with respect to PE. Input provides high common mode immunity.

(5) Analog output current is only available with Enhanced Control drives.

Hardware Enable Circuitry (Enhanced Control Only)

By default, the user can program a digital input as an Enable input. The status of this input is *interpreted by drive software*. If the application requires the drive to be disabled *without* software interpretation, a hardware enable configuration can be utilized. This is done by removing the enable jumper (ENBL JMP) and wiring the enable input to "Digital In 6" (see below).



1.Remove drive cover as described on pages 1-1 and 1-2.

2.Locate and remove the Enable Jumper on the Main Control Board (see diagram).

3.Wire Enable to "Digital In 6" (see Table 1.H).

4.Verify that 366 [Digital In6 Sel] is set to option 1 "Enable".

Safe Off Board (Enhanced Control Only)

The PowerFlex Safe-Off board, when used with suitable safety components, provides protection according to EN 954-1:1997; Category 3 for safe off and protection against restart. The PowerFlex safe off option is just one safety control system. All components in the system must be chosen and applied correctly, to achieve the desired level of operator safeguarding.

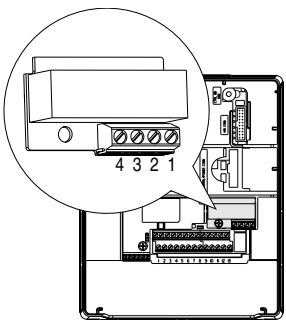


Table 1.I Terminal Description

No.	Signal	Description
1	Monitor - N.C.	Normally closed contacts for monitoring relay status. Maximum Resistive Load: 250V AC / 30V DC / 50 VA / 60 Watts Maximum Inductive Load: 250V AC / 30V DC / 25 VA / 30 Watts
2	Common - N.C.	
3	+24V DC	Connections for user supplied power to energize coil.
4	24V Common	

For detailed information on installing and wiring a safety relay system, refer to the *DriveGuard® Safe-Off Option for PowerFlex AC Drives User Manual*, publication PFLEX-UM001….

Important: If the Safe-Off board is removed from the drive, pins 3 and 4 of the Safe-Off Connector must be jumpered for the drive to run. If the Safe-Off board or the jumper is not installed, and the drive is commanded to run, an F111 "Enable Hardware" fault will occur.

Encoder Interface (Enhanced Control Only)

The PowerFlex Encoder Interface can source 5 or 12 volt power and accept 5 or 12 volt single ended differential inputs.

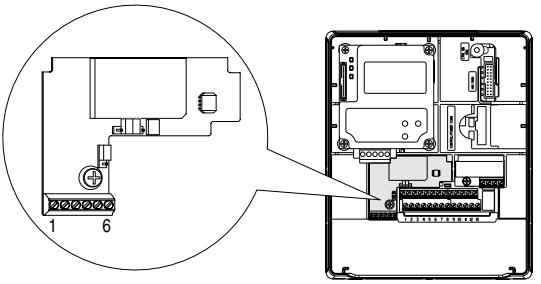


Table 1.J Terminal Description

No.	Signal	Description
1	5-12V Power	Internal power source 250 mA (isolated).
2	Power Return	
3	Encoder B (NOT)	Single channel or quadrature B input.
4	Encoder B	
5	Encoder A (NOT)	Single channel or quadrature A input.
6	Encoder A	

Figure 1.11 Jumper Settings

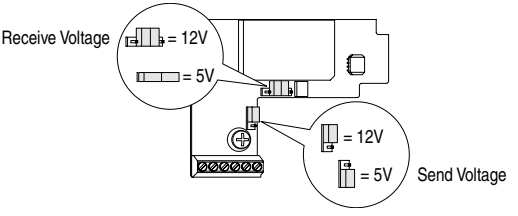
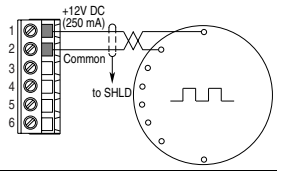
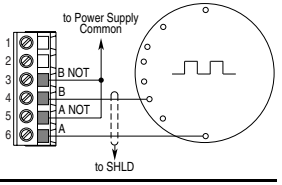
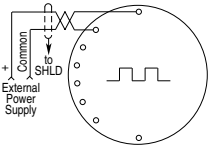
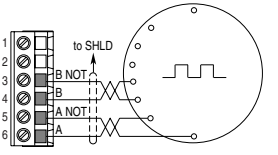
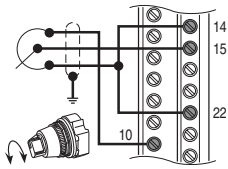
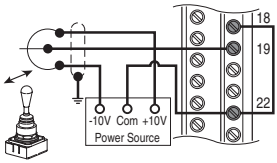
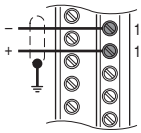
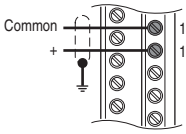
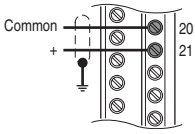
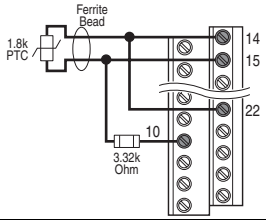
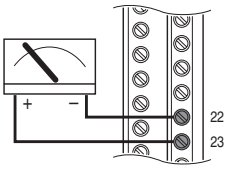


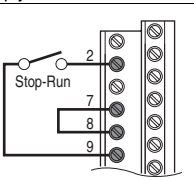
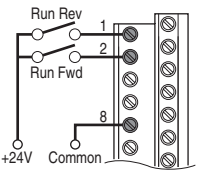
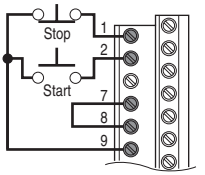
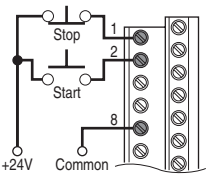
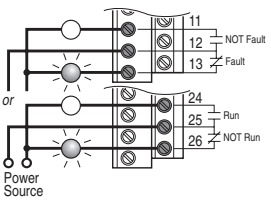
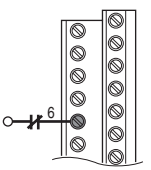
Figure 1.12 Sample Encoder Wiring

I/O	Connection Example
Encoder Power – Internal Drive Power Internal (drive) 12V DC, 250mA	
Encoder Signal – Single-Ended, Dual Channel	

I/O	Connection Example
Encoder Power – External Power Source	
Encoder Signal – Differential, Dual Channel	

I/O Wiring Examples

Input/Output	Connection Example	Required Parameter Settings
Potentiometer Unipolar Speed Reference 10k Ohm Pot. Recommended (2k Ohm minimum)		Select Speed Reference source: Param. 090 = 1 “Analog In 1” Adjust Scaling: Param. 091, 092, 322, 323 Check Results: Param. 016
Joystick Bipolar Speed Reference ±10V Input		Set Direction Mode: Param. 090 = 2 “Analog In 2” Param. 190 = 1 “Bipolar” Adjust Scaling: Param. 091, 092, 325, 326 Check Results: Param. 017
Analog Input Bipolar Speed Reference ±10V Input		Adjust Scaling: Param. 091, 092, 325, 326 Check Results: Param. 017
Analog Input Unipolar Speed Reference 0 to +10V Input		Adjust Scaling: Param. 091, 092, 325, 326 Check Results: Param. 017
Analog Input Unipolar Speed Reference 4-20 mA Input		Configure Input for Current: Param. 320, Bit #1 = 1 “Current” Adjust Scaling: Param. 091, 092, 325, 326 Check Results: Param. 017
Analog Input, PTC PTC OT set > 5V PTC OT cleared < 4V PTC Short < 0.2V		Set Fault Config 1: Param. 238, Bit #7 = 1 “Enabled” Set Alarm Config 1: Param. 259, Bit #11 = 1 “Enabled”
Analog Output Unipolar 0 to +10V Output. Can Drive a 2k Ohm load (25 mA short circuit limit) 0-20 mA Output. 400 Ohm maximum load.		Select Source Value: Param. 342 Adjust Scaling: Param. 343, 344

Input/Output	Connection Example	Required Parameter Settings
2 Wire Control Non-Reversing	Internal Supply 	Disable Digital Input 1: Param. 361 = 0 “Not Used” Set Digital Input 2: Param. 362 = 7 “Run”
2 Wire Control Reversing	External Supply 	Set Digital Input 1: Param. 361 = 9 “Run Reverse” Set Digital Input 2: Param. 362 = 8 “Run Forward”
3 Wire Control	Internal Supply 	Use factory default parameter settings.
3 Wire Control	External Supply 	Use factory default parameter settings.
Digital Output Form C Relays Energized in Normal State.		Select Source: Param. 380, 384
Enable Input Shown in enabled state.		Standard Control Configure with parameter 366 Enhanced Control Configure with parameter 366 For dedicated hardware Enable: Remove Enable Jumper (see page 1-15)

Speed Reference Control

"Auto" Speed Sources

The drive speed command can be obtained from a number of different sources. The source is determined by drive programming and the condition of the Speed Select digital inputs, Auto/Manual digital inputs or reference select bits of a command word.

The default source for a command reference (all speed select inputs open or not programmed) is the selection programmed in [Speed Ref A Sel]. If any of the speed select inputs are closed, the drive will use other parameters as the speed command source.

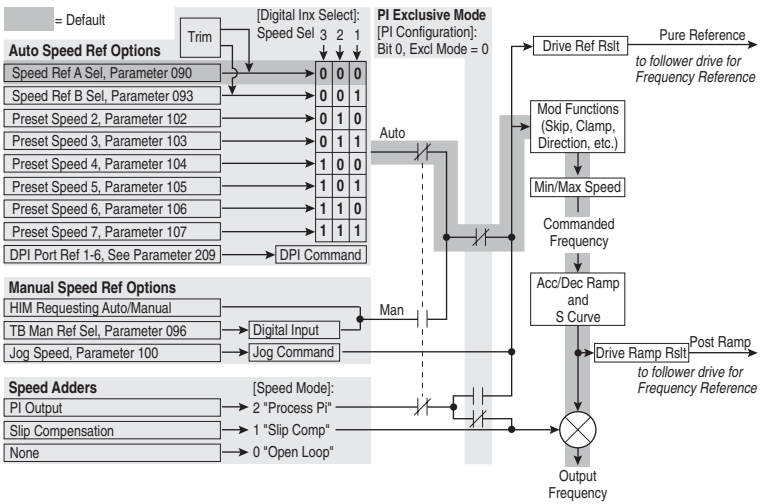
"Manual" Speed Sources

The manual source for speed command to the drive is either the HIM requesting manual control (see ALT Functions on page B-2) or the control terminal block (analog input) if a digital input is programmed to "Auto/Manual".

Changing Speed Sources

The selection of the active Speed Reference can be made through digital inputs, DPI command, jog button or Auto/Manual HIM operation.

Figure 1.13 Speed Reference Selection Chart (1)



(1) To access Preset Speed 1, set [Speed Ref A Sel] or [Speed Ref B Sel] to "Preset Speed 1".

Auto/Manual Examples

PLC = Auto, HIM = Manual

A process is run by a PLC when in Auto mode and requires manual control from the HIM during set-up. The Auto speed reference is issued by the PLC through a communications module installed in the drive. Since the internal communications is designated as Port 5, [Speed Ref A Sel] is set to “DPI Port 5” with the drive running from the Auto source.

Attain Manual Control

- Press ALT then Auto/Man on the HIM.
  When the HIM attains manual control, the drive speed command comes from the HIM speed control keys or analog potentiometer.

Release to Auto Control

- Press ALT then Auto/Man on the HIM again.
  When the HIM releases manual control, the drive speed command returns to the PLC.

PLC = Auto, Terminal Block = Manual

A process is run by a PLC when in Auto mode and requires manual control from an analog potentiometer wired to the drive terminal block. The auto speed reference is issued by the PLC through a communications module installed in the drive. Since the internal communications is designated as Port 5, [Speed Ref A Sel] is set to “DPI Port 5” with the drive running from the Auto source. Since the Manual speed reference is issued by an analog input (“Analog In 1 or 2”), [TB Man Ref Sel] is set to the same input. To switch between Auto and Manual, [Digital In4 Sel] is set to “Auto/ Manual”.

Attain Manual Control

- Close the digital input.
  With the input closed, the speed command comes from the potentiometer.

Release to Auto Control

- Open the digital input.
  With the input open, the speed command returns to the PLC.

Auto/Manual Notes

1. Manual control is exclusive. If a HIM or Terminal Block takes manual control, no other device can take manual control until the controlling device releases manual control.
2. If a HIM has manual control and power is removed from the drive, the drive will return to Auto mode when power is reapplied.

EMC Instructions

CE Conformity[1]

Conformity with the Low Voltage (LV) Directive and Electromagnetic Compatibility (EMC) Directive has been demonstrated using harmonized European Norm (EN) standards published in the Official Journal of the European Communities. PowerFlex Drives comply with the EN standards listed below when installed according to the instructions in this manual and the *Wiring and Grounding Guidelines for Pulse Width Modulated (PWM) AC Drives*, publication DRIVES-IN001.

CE Declarations of Conformity are available online at: **http://www.ab.com/certification/ce/docs**.

Low Voltage Directive (73/23/EEC)

- EN50178 Electronic equipment for use in power installations

EMC Directive (89/336/EEC)

- EN61800-3 Adjustable speed electrical power drive systems Part 3: EMC product standard including specific test methods.

General Notes

- If the adhesive label is removed from the top of the drive, the drive must be installed in an enclosure with side openings less than 12.5 mm (0.5 in.) and top openings less than 1.0 mm (0.04 in.) to maintain compliance with the LV Directive.
- The motor cable should be kept as short as possible in order to avoid electromagnetic emission as well as capacitive currents.
- Use of line filters in ungrounded systems is not recommended.
- PowerFlex drives may cause radio interference if used in a residential or domestic environment. The installer is required to take measures to prevent interference, in addition to the essential requirements for CE compliance provided in this section, if necessary.
- Conformity of the drive with CE EMC requirements does not guarantee an entire machine or installation complies with CE EMC requirements. Many factors can influence total machine/installation compliance.
- PowerFlex drives generate conducted low frequency disturbances (harmonic emissions) on the AC supply system.

[1] CE Certification testing has not been completed for 600 Volt class drives.

General Notes (continued)

- When operated on a public supply system, it is the responsibility of the installer or user to ensure, by consultation with the distribution network operator and Rockwell Automation if necessary, that applicable requirements have been met.

Essential Requirements for CE Compliance

Conditions 1-6 listed below **must be** satisfied for PowerFlex drives to meet the requirements of **EN61800-3**.

1. Standard PowerFlex 70 CE compatible Drive.
2. Review important precautions/attention statements throughout this manual before installing the drive.
3. Grounding as described on page 1-5.
4. Output power, control (I/O) and signal wiring must be braided, shielded cable with a coverage of 75% or better, metal conduit, or equivalent attenuation.
5. All shielded cables should terminate with the proper shielded connector.
6. Conditions in Table 1.K or 1.L.

Table 1.K PowerFlex 70 EN61800-3 EMC Compatibility

Frame	Drive Description	Second Environment				First Environment Restricted Distribution
		Restrict Motor Cable to 40 m (131 ft.)	*Internal Filter Option*	*External Filter*	*Input Ferrite (1)*	
A	Drive Only	✔		✔		Refer to *Table 1.L*
	with any Comm Option	✔		✔		
	with Remote I/O	✔		✔	✔	
B	Drive Only	✔	✔			
	with any Comm Option	✔	✔			
	with Remote I/O	✔	✔		✔	
C	Drive Only	✔				
	with any Comm Option	✔				
	with Remote I/O	✔			✔	
D	Drive Only	✔				
	with any Comm Option	✔				
	with Remote I/O	✔			✔	
E	Drive Only	✔				
	with any Comm Option	✔				
	with Remote I/O	✔			✔	

(1) Input cables through a Ferrite Core (Frames A, B and C Fair-Rite #2643102002 or equivalent, Frames D and E Fair-Rite #2643251002 or equivalent).

Table 1.L PowerFlex 70 EN61800-3 First Environment Restricted Distribution

Frame	Drive Description	First Environment Restricted Distribution				
		Restrict Motor Cable to:	*Internal Filter Option*	*External Filter (1)*	*Comm Cable Ferrite (2)*	*Common Mode Core (3)*
A	Drive Only	40 m (131 ft.)	–	✔	–	–
	Drive with any Comm Option	40 m (131 ft.)	–	✔	–	–
	Drive with Remote I/O	40 m (131 ft.)	–	✔	✔	–
B	Drive Only	12 m (40 ft.)	✔	–	–	–
	Drive with any Comm Option	12 m (40 ft.)	✔	–	–	–
	Drive with Remote I/O	12 m (40 ft.)	✔	–	✔	–
C	Drive Only	12 m (40 ft.)	–	–	–	✔
	Drive with any Comm Option	12 m (40 ft.)	–	–	–	✔
	Drive with Remote I/O	12 m (40 ft.)	–	–	✔	✔
D	Drive Only	12 m (40 ft.)	–	–	–	–
	Drive with any Comm Option	12 m (40 ft.)	–	–	–	–
	Drive with Remote I/O	12 m (40 ft.)	–	–	✔	–
E	Drive Only	30 m (98 ft.)	–	✔	–	–
	Drive with any Comm Option	30 m (98 ft.)	–	✔	–	–
	Drive with Remote I/O	30 m (98 ft.)	–	✔	✔	–

(1) External filters for First Environment installations and increasing motor cable lengths in Second Environment installations are available. Roxburgh models KMFA (RF3 for UL installations) and MIF or Schaffner FN3258 and FN258 models are recommended. Refer to Table 1.M and **http://www.deltron-emcon.com** and **http://www.mtecorp.com** (USA) or **http://www.schaffner.com**, respectively.

(2) Two turns of the blue comm option cable through a Ferrite Core (Frames A, B, C Fair-Rite #2643102002, Frame D Fair-Rite #2643251002 or equivalent).

(3) Refer to the 1321 Reactor and Isolation Transformer Technical Data publication, 1321-TD001x for 1321-Mxxx selection information.

Table 1.M PowerFlex 70 Recommended Filters

Manufacturer	Frame	Manufacturer Part Number(1)	Class A (Meters)	Class B (Meters)	Manufacturer Part Number(1)	Class A (Meters)	Class B (Meters)
Deltron	A	KMF306A	25	25	–	–	–
	B w/o Filter	KMF310A	50	25	–	–	–
	B w/Filter	KMF306A	100	50	MIF306	–	100
	C	KMF318A	–	150	–	–	–
	D	KMF336A	150	5	MIF330	–	150
	D w/o DC CM Capacitor	KMF336A	–	50	–	–	–
	E	–	–	–	MIF3100	–	30
Schaffner	A	FN3258-7-45	–	50	–	–	–
	B w/o Filter	FN3258-7-45	100	50	–	–	–
	B w/Filter	FN3258-7-45	–	100	–	–	–
	C	FN3258-16-45	–	150	–	–	–
	D	FN3258-30-47	0	0	FN258-30-07	–	150
	D w/o DC CM Capacitor	FN3258-30-47	–	150	–	–	–
	0	FN3258-16-45	–	150	–	–	–
	1	FN3258-30-47	–	150	–	–	–
	2	FN3258-42-47	50	50	–	–	–
	2 w/o DC CM Capacitor	FN3258-42-47	150	150	–	–	–
	3	FN3258-75-52	100	100	–	–	–
	3 w/o DC CM Capacitor	FN3258-75-52	150	150	–	–	–

(1) Use of these filters assumes that the drive is mounted in an EMC enclosure.

Start Up

This chapter describes how you start up the PowerFlex 70 Drive. Refer to Appendix B for a brief description of the LED and LCD HIM (Human Interface Module).

For information on...	See page
Prepare For Drive Start-Up	2-1
Status Indicators	2-2
Start-Up Routines	2-3

For information on...	See page
Running S.M.A.R.T. Start	2-4
Running an Assisted Start Up	2-4

ATTENTION: Power must be applied to the drive to perform the following start-up procedure. Some of the voltages present are at incoming line potential. To avoid electric shock hazard or damage to equipment, only qualified service personnel should perform the following procedure. Thoroughly read and understand the procedure before beginning. If an event does not occur while performing this procedure, **Do Not Proceed**. **Remove Power** including user supplied control voltages. User supplied voltages may exist even when main AC power is not applied to the drive. Correct the malfunction before continuing.

Prepare For Drive Start-Up

Before Applying Power to the Drive

❑ **1.** Confirm that all inputs are connected to the correct terminals and are secure.

❑ **2.** Verify that AC line power at the disconnect device is within the rated value of the drive.

❑ **3.** Verify that control power voltage is correct.

The remainder of this procedure requires that a HIM be installed. If an operator interface is not available, remote devices should be used to start up the drive.

Important: When power is first applied, the HIM may require approximately 5 seconds until commands are recognized (including the Stop key).

Applying Power to the Drive

❑ **4.** Apply AC power and control voltages to the drive.

If any of the six digital inputs are configured to "Stop – CF" (CF = Clear Fault) or "Enable," verify that signals are present or the drive will not start. Refer to Alarm Descriptions on page 4-7 for a list of potential digital input conflicts.

If a fault code appears, refer to Chapter 4.

If the STS LED is not flashing green at this point, refer to Status Indicators and their indications below.

❑ **5.** Proceed to Start-Up Routines.

Status Indicators

Figure 2.1 Drive Status Indicators (Typical)

#	Name	Color	State	Description
❶	STS (Status)	Green	Flashing	Drive ready, but not running and no faults are present.
			Steady	Drive running, no faults are present.
		Yellow See page 4-7	Flashing, Drive Stopped	An inhibit condition exists, the drive cannot be started. Check parameter 214 [Start Inhibits].
			Flashing, Drive Running	An intermittent type 1 alarm condition is occurring. Check parameter 211 [Drive Alarm 1].
			Steady, Drive Running	A continuous type 1 alarm condition exists. Check parameter 211 [Drive Alarm 1].
		Red See page 4-3	Flashing	A fault has occurred.
			Steady	A non-resetable fault has occurred.
❷	PORT	Refer to the Communication Adapter User Manual.		Status of DPI port internal communications (if present).
	MOD			Status of communications module (when installed).
	NET A			Status of network (if connected).
	NET B			Status of secondary network (if connected).

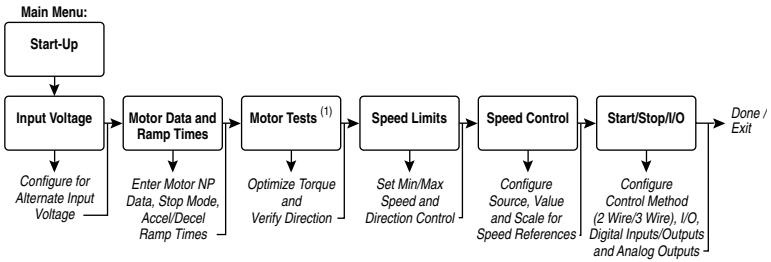
Start-Up Routines

The PowerFlex 70 is designed so that start up is simple and efficient. If you have an LCD HIM, two start-up methods are provided, allowing the user to select the desired level needed for the application.

- **S.M.A.R.T. Start**
  This routine allows you to quickly set up the drive by programming values for the most commonly used functions (see below).

- **Assisted Start Up**
  This routine prompts you for information that is needed to start up a drive for most applications, such as line and motor data, commonly adjusted parameters and I/O. With Enhanced Control, two levels of Assisted Start Up are provided; Basic and Detailed.

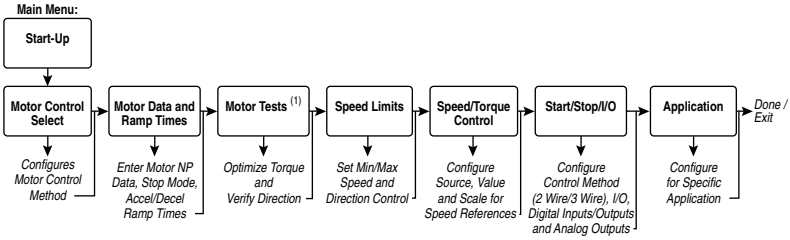
Figure 2.2 Standard Control Start Up Menu



If you do not have an LCD HIM, you must set parameters individually using the LED HIM or other configuration tools, Refer to Chapter 3 for parameters.

Important: Power must be applied to the drive when viewing or changing parameters. Previous programming may affect the drive status when power is applied.

Figure 2.3 Enhanced Control Start Up Menu



(1) During "Motor Tests" the drive may modify some parameter values. It may be necessary to review previously set values.

Running S.M.A.R.T. Start

During a Start Up, the majority of applications require changes to only a few parameters. The LCD HIM on a PowerFlex 70 drive offers S.M.A.R.T. start, which displays the most commonly changed parameters. With these parameters, you can set the following functions:

S - Start Mode and Stop Mode
M - Minimum and Maximum Speed
A - Accel Time 1 and Decel Time 1
R - Reference Source
T - Thermal Motor Overload

To run a S.M.A.R.T. start routine:

Step	Key(s)	Example LCD Displays
1. Press ALT and then Esc (S.M.A.R.T). The S.M.A.R.T. start screen appears. 2. View and change parameter values as desired. For HIM information, see Appendix B. 3. Press Esc to exit the S.M.A.R.T. start.	ALT Esc Esc	F-> Stopped Auto SMART List: Digital In2 Sel Stop Mode A Minimum Speed

Running an Assisted Start Up

Important: This start-up routine requires an LCD HIM.

The Assisted start-up routine asks simple yes or no questions and prompts you to input required information. Access Assisted Start Up by selecting “Start Up” from the Main Menu.

To perform an Assisted Start-Up

Step	Key(s)	Example LCD Displays
1. In the Main Menu, press the Up Arrow or Down Arrow to scroll to “Start Up”. 2. Press Enter.	▲ ▼ ↵	F-> Stopped Auto 0.0 Hz Main Menu: Memory Storage Start Up Preferences

Programming and Parameters

Chapter 3 provides a complete listing and description of the PowerFlex 70 parameters. The parameters can be programmed (viewed/edited) using an LED or LCD HIM (Human Interface Module). As an alternative, programming can also be performed using DriveExplorer™ or DriveExecutive™ software and a personal computer. Refer to Appendix B for brief descriptions of the LED and LCD Human Interface Modules.

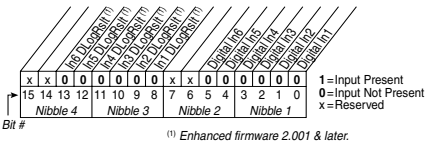
For information on...	See page...
About Parameters	3-1
How Parameters are Organized	3-3
Monitor File (File A)	3-11
Motor Control File (File B)	3-13
Speed Command File (File C)	3-20
Dynamic Control File (File D)	3-29
Utility File (File E)	3-36
Communication File (File H)	3-47
Inputs & Outputs File (File J)	3-52
Applications File (File K)	3-59
Parameter Cross Reference – by Name	3-60

About Parameters

To configure a drive to operate in a specific way, drive parameters may have to be set. Three types of parameters exist:

- **ENUM Parameters**
  ENUM parameters allow a selection from 2 or more items. The LCD HIM will display a text message for each item. The LED HIM will display a number for each item.
- **Bit Parameters**
  Bit parameters have individual bits associated with features or conditions. If the bit is 0, the feature is off or the condition is false. If the bit is 1, the feature is on or the condition is true.
- **Numeric Parameters**
  These parameters have a single numerical value (i.e. 0.1 Volts).

The example on the following page shows how each parameter type is presented in this manual.

❶ File	❷ Group	❸ No.	❹ Parameter Name & Description	❺ Values	❻ Related
UTILITY (File E)	Drive . . .	198	**[Load Frm Usr Set]** Loads a previously saved set of parameter values from a selected user set location in drive nonvolatile memory to active drive memory.	Default: 0 "Ready" Options: 0 "Ready" 1 "User Set 1" 2 "User Set 2" 3 "User Set 3"	199
	Diagnostics	216	**[Dig In Status]** Status of the digital inputs.  (1) *Enhanced firmware 2.001 & later.*	
MOTOR . . .	Torq . . .	059	E C **[SV Boost Filter]** Sets the amount of filtering used to boost voltage during Sensorless Vector operation.	Default: 500 Min/Max: 0/32767 Units: 1	

No.	Description
❶	**File** – Lists the major parameter file category.
❷	**Group** – Lists the parameter group within a file.
❸	**No.** – Parameter number. = Parameter value can not be changed until drive is stopped. 32 = 32 bit parameter. E C 32 = 32 bit parameter in Enhanced Control drives only. FV = Parameter only displayed when [Motor Cntl Sel] is set to "4."
❹	**Parameter Name & Description** – Parameter name as it appears on an LCD HIM, with a brief description of the parameters function. Standard = This parameter is specific to Standard Control drives. E C = This parameter will only be available with Enhanced Control drives.
❺	**Values** – Defines the various operating characteristics of the parameter. Three types exist.

ENUM	Default:	Lists the value assigned at the factory. "Read Only" = no default.
	Options:	Displays the programming selections available.
Bit	Bit #:	Lists the bit place holder and definition for each bit.
Numeric	Default:	Lists the value assigned at the factory. "Read Only" = no default.
	Min/Max: Units:	The range (lowest and highest setting) possible for the parameter. Unit of measure and resolution as shown on the LCD HIM.
	Important: Some parameters will have two unit values: • Analog inputs can be set for current or voltage with 320 [Anlg In Config]. • Values that pertain to Enhanced Control drives only will be indicated by "E C."	
	Important: When sending values through DPI ports, simply remove the decimal point to arrive at the correct value (i.e. to send "5.00 Hz," use "500").	

❻	**Related** – Lists parameters (if any) that interact with the selected parameter. The symbol "i" indicates that additional parameter information is available in Appendix C.

How Parameters are Organized

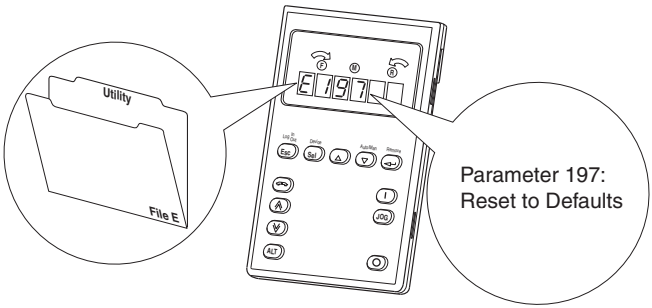
LED HIM (Human Interface Module)

The LED HIM displays parameters in **Numbered List** order. Parameters are accessed by first selecting the file letter then a parameter number.

Important: The PowerFlex 70 Enhanced Control drive does not support the LED HIM.

File Letter Designations

The LED HIM identifies each parameter by File Letter and Parameter Number.



LCD HIM (Human Interface Module)

The LCD HIM displays parameters in a **File-Group-Parameter** or **Numbered List** view order. To switch display mode, access the Main Menu, press ALT then Sel while cursor is on the parameter selection. In addition, using 196 [Param Access Lvl], the user has the option to display *all* parameters, commonly used parameters or diagnostic parameters.

Control Options

Two different control options are available for the PowerFlex 70; Standard and Enhanced. Standard Control drives provide Volts per Hertz and Sensorless Vector operation. Enhanced Control drives support the addition of FVC Vector Control, DriveGuard Safe Off option and more.

File-Group-Parameter View

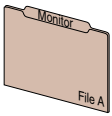
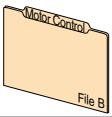
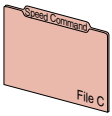
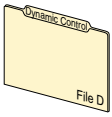
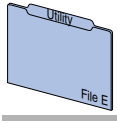
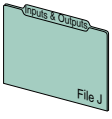
This simplifies programming by grouping parameters that are used for similar functions. The parameters are organized into 6 files in Basic Parameter view or 7 files in Advanced Parameter view. Each file is divided into groups, and each parameter is an element in a group. By default, the LCD HIM displays parameters by File-Group-Parameter view.

Numbered List View

All parameters are in numerical order.

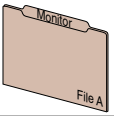
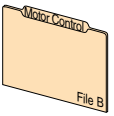
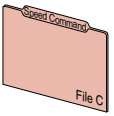
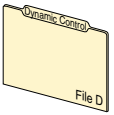
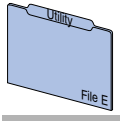
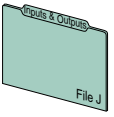
Basic Parameter View – Standard Control

Parameter 196 [Param Access Lvl] set to option 0 "Basic."

File	Group	Parameters					
Monitor 	Metering	Output Freq Commanded Freq Output Current DC Bus Voltage	001 002 003 012				
Motor Control 	Motor Data	Motor NP Volts Motor NP FLA Motor NP Hertz	041 042 043	Motor NP RPM Motor NP Power Mtr NP Pwr Units	044 045 046	Motor OL Hertz	047
	Torq Attributes	Torque Perf Mode Maximum Voltage	053 054	Maximum Freq Autotune	055 061		
Speed Command 	Spd Mode & Limits	Minimum Speed Maximum Speed	081 082				
	Speed References	Speed Ref A Sel Speed Ref A Hi Speed Ref A Lo	090 091 092	Speed Ref B Sel Speed Ref B Hi Speed Ref B Lo	093 094 095	TB Man Ref Sel TB Man Ref Hi TB Man Ref Lo	096 097 098
	Discrete Speeds	Jog Speed Preset Speed 1-7	100 101-107				
Dynamic Control 	Ramp Rates	Accel Time 1 Accel Time 2	140 141	Decel Time 1 Decel Time 2	142 143	S Curve %	146
	Load Limits	Current Lmt Sel Current Lmt Val	147 148				
	Stop/Brake Modes	Stop Mode A Stop Mode B	155 156	DC Brk Lvl Sel DC Brake Level DC Brake Time	157 158 159	Bus Reg Mode A Bus Reg Mode B DB Resistor Type	161 162 163
	Restart Modes	Start At PowerUp	168	Auto Rstrt Tries	174	Auto Rstrt Delay	175
	Power Loss	Power Loss Mode	184	Power Loss Time	185		
Utility 	Direction Config	Direction Mode	190				
	Drive Memory	Param Access Lvl Reset To Defalts	196 197	Load Frm Usr Set Save To User Set	198 199	Language	201
	Diagnostics	Start Inhibits	214	Dig In Status	216	Dig Out Status	217
	Faults	Fault Config 1	238				
Inputs & Outputs 	Analog Inputs	Anlg In Config	320	Analog In1 Hi Analog In1 Lo	322 323	Analog In2 Hi Analog In2 Lo	325 326
	Analog Outputs	Analog Out1 Sel Analog Out1 Hi Analog Out1 Lo	342 343 344				
	Digital Inputs	Digital In1-6 Sel	361-366				
	Digital Outputs	Digital Out1 Sel Dig Out1 Level	380 381	Digital Out2 Sel Dig Out2 Level	384 385		

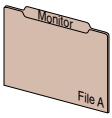
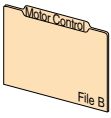
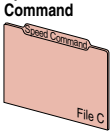
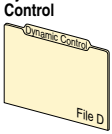
Basic Parameter View – Enhanced Control

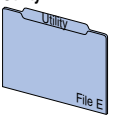
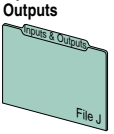
Parameter 196 [Param Access Lvl] set to option 0 “Basic.”

File	Group	Parameters					
Monitor 	Metering	Output Freq Commanded Freq Output Current Torque Current DC Bus Voltage Commanded Torque**	001 002 003 004 012 024				
Motor Control 	Motor Data	Motor NP Volts Motor NP FLA Motor NP Hertz	041 042 043	Motor NP RPM Motor NP Power Mtr NP Pwr Units	044 045 046	Motor OL Hertz Motor Poles	047 049
	Torq Attributes	Motor Cntl Sel Maximum Voltage Maximum Freq	053 054 055	Autotune Autotune Torque** Inertia Autotune**	061 066 067	Torque Ref A Sel** Torque Ref A Hi** Torque Ref A Lo** Pos Torque Limit** Neg Torque Limit**	427 428 429 436 437
	Speed Feedback	Motor Fdbk Type** Encoder PPR**	412 413				
Speed Command 	Spd Mode & Limits	Feedback Select	080	Minimum Speed Maximum Speed	081 082		
	Speed References	Speed Ref A Sel Speed Ref A Hi Speed Ref A Lo	090 091 092	Speed Ref B Sel Speed Ref B Hi Speed Ref B Lo	093 094 095	TB Man Ref Sel TB Man Ref Hi TB Man Ref Lo	096 097 098
	Discrete Speeds	Jog Speed 1	100	Preset Speed 1-7	101-107	Jog Speed 2	108
Dynamic Control 	Ramp Rates	Accel Time 1 Accel Time 2	140 141	Decel Time 1 Decel Time 2	142 143	S Curve %	146
	Load Limits	Current Lmt Sel	147	Current Lmt Val	148		
	Stop/Brake Modes	Stop/Brk Mode A Stop/Brk Mode B	155 156	DC Brake Lvl Sel DC Brake Level DC Brake Time	157 158 159	Bus Reg Mode A Bus Reg Mode B DB Resistor Type	161 162 163
	Restart Modes	Start At PowerUp	168	Auto Rstrt Tries	174	Auto Rstrt Delay	175
	Power Loss	Power Loss Mode	184	Power Loss Time	185		
Utility 	Direction Config	Direction Mode	190				
	Drive Memory	Param Access Lvl Reset To Defalts	196 197	Load Frm Usr Set Save To User Set	198 199	Language	201
	Diagnostics	Start Inhibits	214	Dig In Status	216	Dig Out Status	217
	Faults	Fault Config 1	238				
Inputs & Outputs 	Analog Inputs	Anlg In Config	320	Analog In 1 Hi Analog In 2 Hi	322 325	Analog In 1 Lo Analog In 2 Lo	323 326
	Analog Outputs	Analog Out1 Sel	342	Analog Out1 Hi Analog Out1 Lo	343 344		
	Digital Inputs	Digital In1-6 Sel	361-366				
	Digital Outputs	Digital Out1 Sel Digital Out2 Sel	380 384	Dig Out1 Level Dig Out2 Level	381 385		

Advanced Parameter View – Standard Control

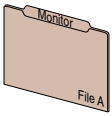
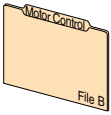
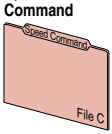
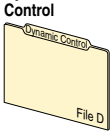
Parameter 196 [Param Access Lvl] set to option 1 “Advanced.”

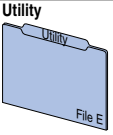
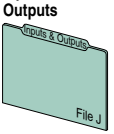
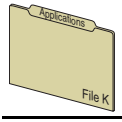
File	Group	Parameters					
Monitor 	Metering	Output Freq	001	Output Voltage	006	MOP Frequency	011
		Commanded Freq	002	Output Power	007	DC Bus Voltage	012
		Output Current	003	Output Powr Fctr	008	DC Bus Memory	013
		Torque Current	004	Elapsed MWh	009	Analog In1 Value	016
		Flux Current	005	Elapsed Run Time	010	Analog In2 Value	017
	Drive Data	Rated kW	026	Rated Amps	028		
		Rated Volts	027	Control SW Ver	029		
Motor Control 	Motor Data	Motor Type	040	Motor NP RPM	044	Motor OL Factor	048
		Motor NP Volts	041	Motor NP Power	045		
		Motor NP FLA	042	Mtr NP Pwr Units	046		
		Motor NP Hertz	043	Motor OL Hertz	047		
	Torq Attributes	Torque Perf Mode	053	Compensation	056	Autotune	061
		Maximum Voltage	054	Flux Up Mode	057	IR Voltage Drop	062
		Maximum Freq	055	Flux Up Time	058	Flux Current Ref	063
	Volts per Hertz	StAcc Boost	069	Break Voltage	071		
		Run Boost	070	Break Frequency	072		
Speed Command 	Spd Mode & Limits	Speed Mode	080	Overspeed Limit	083	Skip Frequency 3	086
		Minimum Speed	081	Skip Frequency 1	084	Skip Freq Band	087
		Maximum Speed	082	Skip Frequency 2	085		
	Speed References	Speed Ref A Sel	090	Speed Ref B Sel	093	TB Man Ref Sel	096
		Speed Ref A Hi	091	Speed Ref B Hi	094	TB Man Ref Hi	097
		Speed Ref A Lo	092	Speed Ref B Lo	095	TB Man Ref Lo	098
	Discrete Speeds	Jog Speed	100				
		Preset Speed 1-7	101-107				
	Speed Trim	Trim In Select	117	Trim Hi	119		
		Trim Out Select	118	Trim Lo	120		
	Slip Comp	Slip RPM @ FLA	121	Slip RPM Meter	123		
		Slip Comp Gain	122				
	Process PI	PI Configuration	124	PI Integral Time	129	PI Status	134
		PI Control	125	PI Prop Gain	130	PI Ref Meter	135
		PI Reference Sel	126	PI Lower Limit	131	PI Fdback Meter	136
		PI Setpoint	127	PI Upper Limit	132	PI Error Meter	137
		PI Feedback Sel	128	PI Preload	133	PI Output Meter	138
Dynamic Control 	Ramp Rates	Accel Time 1	140	Decel Time 1	142	S Curve %	146
		Accel Time 2	141	Decel Time 2	143		
	Load Limits	Current Lmt Sel	147	Drive OL Mode	150		
		Current Lmt Val	148	PWM Frequency	151		
		Current Lmt Gain	149				
	Stop/Brake Modes	Stop Mode A	155	DC Brake Level	158	Bus Reg Mode A	161
		Stop Mode B	156	DC Brake Time	159	Bus Reg Mode B	162
		DC Brake Lvl Sel	157	Bus Reg Gain	160	DB Resistor Type	163
	Restart Modes	Start At PowerUp	168	Flying StartGain	170	Auto Rstrt Delay	175
		Flying Start En	169	Auto Rstrt Tries	174		
	Power Loss	Power Loss Mode	184				
		Power Loss Time	185				

File	Group	Parameters					
Utility 	Direction Config	Direction Mode	190				
	HIM Ref Config	Save HIM Ref Man Ref Preload	192 193				
	MOP Config	Save MOP Ref MOP Rate	194 195				
	Drive Memory	Param Access Lvl Reset To Defalts Load Frm Usr Set	196 197 198	Save To User Set Reset Meters Language	199 200 201	Voltage Class Drive Checksum	202 203
	Diagnostics	Drive Status 1 Drive Status 2 Drive Alarm 1 Drive Alarm 2 Speed Ref Source Start Inhibits Last Stop Source Dig In Status	209 210 211 212 213 214 215 216	Dig Out Status Drive Temp Drive OL Count Motor OL Count Fault Frequency Fault Amps Fault Bus Volts Status 1 @ Fault	217 218 219 220 224 225 226 227	Status 2 @ Fault Alarm 1 @ Fault Alarm 2 @ Fault Testpoint 1 Sel Testpoint 1 Data Testpoint 2 Sel Testpoint 2 Data	228 229 230 234 235 236 237
	Faults	Fault Config 1 Fault Clear	238 240	Fault Clear Mode Power Up Marker	241 242	Fault 1-4 Code Fault 1-4 Time	243-249 244-250
	Alarms	Alarm Config 1	259				
Communication	Comm Control	DPI Data Rate Drive Logic Rslt	270 271	Drive Ref Rslt Drive Ramp Rslt	272 273		
	Masks & Owners	Logic Mask Start Mask Jog Mask Direction Mask Reference Mask Accel Mask Decel Mask	276 277 278 279 280 281 282	Fault Clr Mask MOP Mask Local Mask Stop Owner Start Owner Jog Owner Direction Owner	283 284 285 288 289 290 291	Reference Owner Accel Owner Decel Owner Fault Clr Owner MOP Owner Local Owner	292 293 294 295 296 297
	Datalinks	Data In A1-D2 Data Out A1-D2	300-307 310-317				
Inputs & Outputs 	Analog Inputs	Anlg In Config Anlg In Sqr Root	320 321	Analog In 1 Hi Analog In 1 Lo Anlg In 1 Loss	322 323 324	Analog In 2 Hi Analog In 2 Lo Anlg In 2 Loss	325 326 327
	Analog Outputs	Anlg Out Absolut Analog Out1 Sel	341 342	Analog Out1 Hi Analog Out1 Lo	343 344		
	Digital Inputs	Digital In1-6 Sel	361-366				
	Digital Outputs	Digital Out1 Sel Dig Out1 Level Dig Out1 OnTime Dig Out1 OffTime	380 381 382 383	Digital Out2 Sel Dig Out2 Level Dig Out2 OnTime Dig Out2 OffTime	384 385 386 387		

Advanced Parameter View – Enhanced Control

Parameter 196 [Param Access Lvl] set to option 1 "Advanced."

File	Group	Parameters					
Monitor 	Metering	Output Freq	001	Output Powr Fctr	008	Torque Estimate	015[3.x]
		Commanded Freq	002	Elapsed MWh	009	Analog In1 Value	016
		Output Current	003	Elapsed Run Time	010	Analog In2 Value	017
		Torque Current	004	MOP Frequency	011	Ramped Speed	022
		Flux Current	005	DC Bus Voltage	012	Speed Reference	023
		Output Voltage	006	DC Bus Memory	013	Commanded Torque**	024
		Output Power	007	Elapsed kWh	014	Speed Feedback	025
	Drive Data	Rated kW	026	Rated Amps	028		
		Rated Volts	027	Control SW Ver	029		
Motor Control 	Motor Data	Motor Type	040	Motor NP RPM	044	Motor OL Factor	048
		Motor NP Volts	041	Motor NP Power	045	Motor Poles	049
		Motor NP FLA	042	Mtr NP Pwr Units	046	Motor OL Mode	050[3.x]
		Motor NP Hertz	043	Motor OL Hertz	047		
	Torq Attributes	Motor Cntl Sel	053	Autotune	061	Torque Ref A Hi**	428
		Maximum Voltage	054	IR Voltage Drop	062	Torque Ref A Lo**	429
		Maximum Freq	055	Flux Current Ref	063	Torque Setpoint1**	435
		Compensation	056	Ixo Voltage Drop	064	Pos Torque Limit**	436
		Flux Up Mode	057	Autotune Torque**	066	Neg Torque Limit**	437
		Flux Up Time	058	Inertia Autotune**	067	Control Status**	440
		SV Boost Filter	059	Torque Ref A Sel**	427	Torq Current Ref**	441
	Volts per Hertz	StAcc Boost*	069	Break Voltage*	071		
		Run Boost*	070	Break Frequency*	072		
	Speed Feedback	Motor Fdbk Type	412	Enc Pos Feedback	414	Fdbk Filter Sel**	416
		Encoder PPR	413	Encoder Speed	415	Notch FilterFreq**	419
						Notch Filter K**	420
Speed Command 	Spd Mode & Limits	Feedback Select	080	Skip Frequency 1	084	Skip Freq Band	087
		Minimum Speed	081	Skip Frequency 2	085	Speed/Torque Mod**	088
		Maximum Speed	082	Skip Frequency 3	086	Rev Speed Limit	454
		Overspeed Limit	083				
	Speed References	Speed Ref A Sel	090	Speed Ref B Sel	093	TB Man Ref Sel	096
		Speed Ref A Hi	091	Speed Ref B Hi	094	TB Man Ref Hi	097
		Speed Ref A Lo	092	Speed Ref B Lo	095	TB Man Ref Lo	098
	Discrete Speeds	Jog Speed 1	100	Preset Speed 1-7	101-107	Jog Speed 2	108
	Speed Trim	Trim % Setpoint	116	Trim In Select	117	Trim Hi	119
				Trim Out Select	118	Trim Lo	120
	Slip Comp	Slip RPM @ FLA	121	Slip Comp Gain*	122	Slip RPM Meter	123
	Process PI	PI Configuration	124	PI Lower Limit	131	PI Output Meter	138
		PI Control	125	PI Upper Limit	132	PI BW Filter	139
		PI Reference Sel	126	PI Preload	133	PI Deriv Time	459
		PI Setpoint	127	PI Status	134	PI Reference Hi	460
		PI Feedback Sel	128	PI Ref Meter	135	PI Reference Lo	461
		PI Integral Time	129	PI Fdback Meter	136	PI Feedback Hi	462
		PI Prop Gain	130	PI Error Meter	137	PI Feedback Lo	463
	Speed Regulator	Ki Speed Loop**	445	Spd Err Filt BW	448[3.x]	Total Inertia**	450
		Kp Speed Loop**	446	Speed Desired BW**	449	Speed Loop Meter**	451
		Kf Speed Loop**	447				
Dynamic Control 	Restart Modes	Powerup Delay	167	Auto Rstrt Tries	174	Wake Level	180
		Start At PowerUp	168	Auto Rstrt Delay	175	Wake Time	181
		Flying Start En	169	Sleep Wake Mode	178	Sleep Level	182
		Flying StartGain	170	Sleep Wake Ref	179	Sleep Time	183
	Power Loss	Gnd Warn Level	177	Power Loss Time	185	Load loss Time	188
		Power Loss Mode	184	Load Loss Level	187		
	Ramp Rates	Accel Time 1	140	Decel Time 1	142	S Curve %	146
		Accel Time 2	141	Decel Time 2	143		
	Load Limits	Current Lmt Sel	147	Drive OL Mode	150	Regen Power Lim**	153
		Current Lmt Val	148	PWM Frequency	151	Current Rate Lim**	154
		Current Lmt Gain	149	Droop RPM@FLA	152	Shear Pin Time*	189

File	Group	Parameters					
Dynamic Control *continued*	Stop/Brake Modes	DB While Stopped	145	DC Brake Time	159	Bus Reg Kp*	164
		Stop/Brk Mode A	155	Bus Reg Ki*	160	Bus Reg Kd*	165
		Stop/Brk Mode B	156	Bus Reg Mode A	161	Flux Braking	166
		DC Brake Lvl Sel	157	Bus Reg Mode B	162		
		DC Brake Level	158	DB Resistor Type	163		
Utility 	Direction Config	Direction Mode	190				
	HIM Ref Config	AutoMan Cnfg	192				
	MOP Config	Save MOP Ref	194	MOP Rate	195		
	Drive Memory	Param Access Lvl	196	Reset Meters	200	Dyn UsrSet Cnfg	204
		Reset To Defalts	197	Language	201	Dyn UserSet Sel	205
		Load Frm Usr Set	198	Voltage Class	202	Dyn UserSet Actv	206
		Save To User Set	199	Drive Checksum	203		
	Diagnostics	Drive Status 1	209	Drive Temp	218	Status 1 @ Fault	227
		Drive Status 2	210	Drive OL Count	219	Status 2 @ Fault	228
		Drive Alarm 1	211	Motor OL Count	220	Alarm 1 @ Fault	229
		Drive Alarm 2	212	Mtr OL Trip Time	221[3.x]	Alarm 2 @ Fault	230
		Speed Ref Source	213	Drive Status 3	222[3.x]	Testpoint 1 Sel	234
		Start Inhibits	214	Status 3 @ Fault	223[3.x]	Testpoint 1 Data	235
		Last Stop Source	215	Fault Frequency	224	Testpoint 2 Sel	236
		Dig In Status	216	Fault Amps	225	Testpoint 2 Data	237
		Dig Out Status	217	Fault Bus Volts	226		
	Faults	Fault Config 1	238	Fault Clear Mode	241	Fault 1-4 Code	243-249
		Fault Clear	240	Power Up Marker	242	Fault 1-4 Time	244-250
	Alarms	Alarm Config 1	259				
Communication	Comm Control	DPI Data Rate	270	Drive Ramp Rslt	273	DPI Ref Select	298
		Drive Logic Rslt	271	DPI Port Select	274		
		Drive Ref Rslt	272	DPI Port Value	275		
	Masks & Owners	Logic Mask	276	Fault Clr Mask	283	Reference Owner	292
		Start Mask	277	MOP Mask	284	Accel Owner	293
		Jog Mask	278	Local Mask	285	Decel Owner	294
		Direction Mask	279	Stop Owner	288	Fault Clr Owner	295
		Reference Mask	280	Start Owner	289	MOP Owner	296
		Accel Mask	281	Jog Owner	290	Local Owner	297
		Decel Mask	282	Direction Owner	291		
	Datalinks	Data In A1-D2	300-307	HighRes Ref	308	Data Out A1-D2	310-317
	Security	PortMask Act	595	Write Mask Act	597	Logic Mask Act	598
		Write Mask Cfg	596	Logic Mask	276		
Inputs & Outputs 	Analog Inputs	Anlg In Config	320	Analog In 1 Lo	323	Analog In 2 Lo	326
		Anlg In Sqr Root	321	Analog In 1 Loss	324	Analog In 2 Loss	327
		Analog In 1 Hi	322	Analog In 2 Hi	325		
	Analog Outputs	Anlg Out Config	340	Analog Out1 Hi	343	Anlg Out1 Setpt	377
		Anlg Out Absolut	341	Analog Out1 Lo	344		
		Analog Out1 Sel	342	Anlg Out Scale	354		
	Digital Inputs	Digital In1-6 Sel	361-366	DigIn DataLogic	411		
	Digital Outputs	Dig Out Setpt	379	Dig Out1 OnTime	382	Dig Out2 Level	385
		Digital Out1 Sel	380	Dig Out1 OffTime	383	Dig Out2 OnTime	386
		Dig Out1 Level	381	Digital Out2 Sel	384	Dig Out2 OffTime	387
Applications[3.x] 	Fiber Functions[3.x]	Fiber Control	620[3.x]	Traverse Inc	623[3.x]	P Jump	626[3.x]
		Fiber Status	621[3.x]	Traverse Dec	624[3.x]		
		Sync Time	622[3.x]	Max Traverse	625[3.x]		

* These parameters will only be displayed when parameter 053 [Motor Cntl Sel] is set to option "2 or 3."

** These parameters will only be displayed when parameter 053 [Motor Cntl Sel] is set to option "4."

[3.x] Firmware 3.002 & later only.

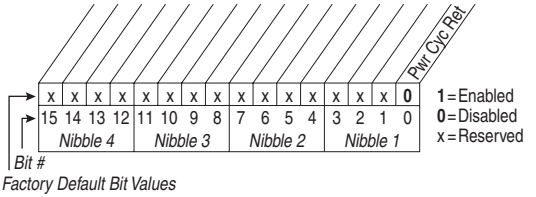
Monitor File (File A)

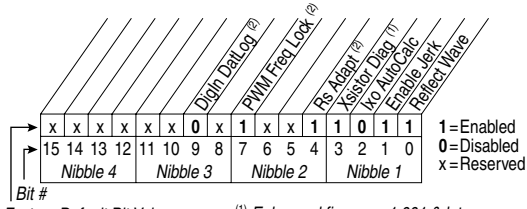
File A	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
MONITOR (File A)	Metering	001	**[Output Freq]** Output frequency present at T1, T2 & T3 (U, V & W)	Default: Read Only Min/Max: –/+[Maximum Freq] Units: 0.1 Hz	
		002	**[Commanded Freq]** Value of the active frequency command.	Default: Read Only Min/Max: –/+[Maximum Speed] Units: 0.1 Hz	
		003	**[Output Current]** EC 32 The total output current present at T1, T2 & T3 (U, V & W).	Default: Read Only Min/Max: 0.0/Drive Rated Amps × 2 Units: 0.1 Amps 0.01 Amps EC	
		004	**[Torque Current]** EC 32 The amount of current that is in phase with the fundamental voltage component.	Default: Read Only Min/Max: Drive Rating × –2/+2 Units: 0.1 Amps 0.01 Amps EC	
		005	**[Flux Current]** EC 32 The amount of current that is out of phase with the fundamental voltage component.	Default: Read Only Min/Max: Drive Rating × –2/+2 Units: 0.1 Amps 0.01 Amps EC	
		006	**[Output Voltage]** Output voltage present at terminals T1, T2 & T3 (U, V & W).	Default: Read Only Min/Max: 0.0/Drive Rated Volts Units: 0.1 VAC	
		007	**[Output Power]** EC 32 Output power present at T1, T2 & T3 (U, V & W).	Default: Read Only Min/Max: 0.0/Drive Rated kW × 2 Units: 0.1 kW 0.01 kW EC	
		008	**[Output Powr Fctr]** Output power factor.	Default: Read Only Min/Max: 0.00/1.00 Units: 0.01	
		009	**[Elapsed MWh]** 32 Accumulated output energy of the drive.	Default: Read Only Min/Max: 0.0/429496729.5 MWh Units: 0.1 MWh	
		010	**[Elapsed Run Time]** 32 Accumulated time drive is outputting power.	Default: Read Only Min/Max: 0.0/429496729.5 Hrs Units: 0.1 Hrs	
		011	**[MOP Frequency]** Value of the signal at MOP (Motor Operated Potentiometer).	Default: Read Only Min/Max: –/+[Maximum Frequency] Units: 0.1 Hz	
		012	**[DC Bus Voltage]** Present DC bus voltage level.	Default: Read Only Min/Max: 0.0/Drive Rating Based Units: 0.1 VDC	
		013	**[DC Bus Memory]** 6 minute average of DC bus voltage level.	Default: Read Only Min/Max: 0.0/Drive Rating Based Units: 0.1 VDC	

File A	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
MONITOR (File A)	Metering	014 32	E C **[Elapsed kWh]** Accumulated output energy of the drive.	Default: Read Only Min/Max: 0.0/429496729.5 kWh Units: 0.1 kWh	
		015	E C v3 **[Torque Estimate]** Estimated motor torque output as percent of motor rated torque.	Default: Read Only Min/Max: –/+800.0 % Units: 0.1 %	
		016 017	**[Analog In1 Value]** **[Analog In2 Value]** Value of the signal at the analog inputs.	Default: Read Only Min/Max: 0.000/20.000 mA –/+10.000V Units: 0.001 mA 0.001 Volt	
		022	E C **[Ramped Speed]** The value shown is the value after the accel/decel ramp but prior to any corrections supplied by slip comp, PI, etc.	Default: Read Only Min/Max: –/+500.0 Hz Units: 0.1 Hz	
		023	E C **[Speed Reference]** Summed value of ramped speed and Process PI.	Default: Read Only Min/Max: –/+500.0 Hz Units: 0.1 Hz	
		024 FV	E C v2 **[Commanded Torque]** Final torque reference value after limits & filtering are applied. % motor rated torque.	Default: Read Only Min/Max: –/+800.0% Units: 0.1%	053
		025	E C v2 **[Speed Feedback]** Value of actual motor speed, measured by encoder feedback or estimated.	Default: Read Only Min/Max: –/+500.0 Hz Units: 0.1 Hz	053
	Drive Data	026 32	**[Rated kW]** Drive power rating.	Default: Read Only Min/Max: 0.37/15.0 kW 0.00/300.00 kW E C Units: 0.01 kW	
		027	**[Rated Volts]** The drive input voltage class (208, 240, 400 etc.).	Default: Read Only Min/Max: 208/600 Volt 0.0/6553.5 Volt E C Units: 0.1 VAC	
		028	**[Rated Amps]** The drive rated output current.	Default: Read Only Min/Max: 1.1/32.2 Amps 0.0/6553.5 Amps E C Units: 0.1 Amps	
		029	**[Control SW Ver]** Main Control Board software version.	Default: Read Only Min/Max: 0.000/65.256 0.0/65.535 E C Units: 0.001	196

Motor Control File (File B)

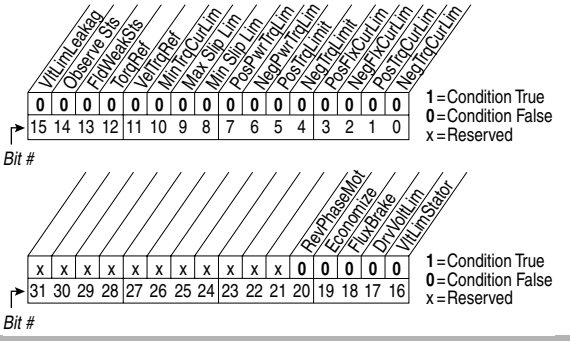
File B	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
MOTOR CONTROL (File B)	Motor Data	040	**[Motor Type]** Set to match the type of motor connected.	Default: 0 "Induction" Options: 0 "Induction" 1 "Synchr Reluc" 2 "Synchr PM"	
		041	**[Motor NP Volts]** Set to the motor nameplate rated volts.	Default: Drive Rating Based Min/Max: 0.0/[Rated Volts] Units: 0.1 VAC	
		042	**[Motor NP FLA]** Set to the motor nameplate rated full load amps.	Default: Drive Rating Based Min/Max: 0.0/[Rated Amps] × 2 Units: 0.1 Amps	047 048
		043	**[Motor NP Hertz]** Set to the motor nameplate rated frequency.	Default: Drive Rating Based Min/Max: 5.0/400.0 Hz 5.0/500.0 Hz EC Units: 0.1 Hz	
		044	**[Motor NP RPM]** Set to the motor nameplate rated RPM.	Default: Drive Rating Based Min/Max: 60/30000 RPM Units: 1 RPM	
		045	**[Motor NP Power]** Set to the motor nameplate rated power. 32 (1) See [Mtr NP Pwr Units]	Default: Drive Rating Based Min/Max: 0.00/100.00 0.00/412.48 EC Units: 0.01 kW/HP(1)	046
		046	**[Mtr NP Pwr Units]** Selects the motor power units to be used.	Default: Drive Rating Based Options: 0 "Horsepower" 1 "kiloWatts"	
		047	**[Motor OL Hertz]** Selects the output frequency below which the motor operating current is derated. The motor thermal overload will generate a fault at lower levels of current.	Default: Motor NP Hz/3 Min/Max: 0.0/500.0 Hz Units: 0.1 Hz	042 220
		048	**[Motor OL Factor]** Sets operating level for motor overload. Motor FLA x OL Factor = Operating Level	Default: 1.00 Min/Max: 0.20/2.00 Units: 0.01	042 220
		049	EC **[Motor Poles]** Defines the number of poles in the motor.	Default: 4 Min/Max: 2/40 Units: 2 Pole	

File B	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
MOTOR CONTROL (File B)	Motor Data	050	E C v3 **[Motor OL Mode]** If "0," [Drive OL Count], P219 is reset to zero by a drive reset or a power cycle. If "1," the value is maintained. A "1" to "0" transition resets [Drive OL Count] to zero.  *Factory Default Bit Values*		219
	Torq Attributes	053	Standard **[Torque Perf Mode]** Sets the method of motor torque production.	Default: 0 "Sensrls Vect" Options: 0 "Sensrls Vect" 1 "SV Economize" 2 "Custom V/Hz" 3 "Fan/Pmp V/Hz"	062 063 069 070
			E C **[Motor Cntl Sel]** Sets the method of motor control used in the drive. **Important:** "FVC Vector" mode requires autotuning of the motor, both coupled and uncoupled to the load. (1) Enhanced firmware 2.001 & later.	Default: 0 "Sensrls Vect" Options: 0 "Sensrls Vect" 1 "SV Economize" 2 "Custom V/Hz" 3 "Fan/Pmp V/Hz" 4 "FVC Vector"(1)	
		054	**[Maximum Voltage]** Sets the highest voltage the drive will output.	Default: Drive Rated Volts Min/Max: Rated Volts × 0.25/Rated Volts Units: 0.1 VAC	
		055	**[Maximum Freq]** Sets the highest frequency the drive will output. Refer to parameter 083 [Overspeed Limit].	Default: 110.0 or 130.0 Hz Min/Max: 5.0/400.0 Hz 5.0/500.0 Hz E C Units: 0.1 Hz	083

File B	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
MOTOR CONTROL (File B)	Torq Attributes	056	**[Compensation]** Enables/disables correction options.  *Factory Default Bit Values* (1) *Enhanced firmware 1.001 & later.* (2) *Enhanced firmware 2.001 & later.* Option Descriptions Reflect Wave — Disables reflected wave overvoltage protection for long cable lengths. (typically enabled). Enable Jerk — In non-FVC Vector modes, disabling jerk removes a short S-curve at the start of the accel/decel ramp. Ixo AutoCalc — Not functional – reserved for future enhancements. Xsistor Diag — Disables power transistor power diagnostic tests which run at each start command. Rs Adapt — FVC w/Encoder Only - Disabling may improve torque regulation at lower speeds (typically not needed). Mtr Lead Rev — Reverses the phase rotation of the applied voltage, effectively reversing the motor leads. PWM Freq Lock — Keeps the PWM frequency from decreasing to 2 kHz at low operating frequencies in FVC Vector mode without encoder.		411
		057	**[Flux Up Mode]** Auto = Flux is established for a calculated time period based on motor nameplate data. [Flux Up Time] is not used. Manual = Flux is established for [Flux Up Time] before acceleration.	Default: 0 "Manual" Options: 0 "Manual" 1 "Automatic"	053 058
		058	**[Flux Up Time]** Sets the amount of time the drive will use to try and achieve full motor stator flux. When a Start command is issued, DC current at current limit level is used to build stator flux before accelerating.	Default: 0.00 Secs Min/Max: 0.00/5.00 Secs Units: 0.01 Secs	053 058
		059	E C **[SV Boost Filter]** Sets the amount of filtering used to boost voltage during Sensorless Vector operation.	Default: 500 Min/Max: 0/32767 Units: 1	

File B	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
MOTOR CONTROL (File B)	Torq Attributes	061	**[Autotune]** Provides a manual or automatic method for setting [IR Voltage Drop] and [Flux Current Ref], which affect sensorless vector performance. Valid only when parameter 53 is set to "Sensrls Vect," "SV Economize" or "FVC Vector"	Default: 3 "Calculate" Options: 0 "Ready" 1 "Static Tune" 2 "Rotate Tune" 3 "Calculate"	053 062
			"Ready" (0) = Parameter returns to this setting following a "Static Tune" or "Rotate Tune." It also permits manually setting [IR Voltage Drop] and [Flux Current Ref]. "Static Tune" (1) = A temporary command that initiates a non-rotational motor stator resistance test for the best possible automatic setting of [IR Voltage Drop]. A start command is required following initiation of this setting. The parameter returns to "Ready" (0) following the test, at which time another start transition is required to operate the drive in normal mode. Used when motor cannot be rotated. "Rotate Tune" (2) = A temporary command that initiates a "Static Tune" followed by a rotational test for the best possible automatic setting of [Flux Current Ref]. A start command is required following initiation of this setting. The parameter returns to "Ready" (0) following the test, at which time another start transition is required to operate the drive in normal mode. **Important:** Used when motor is uncoupled from the load. Results may not be valid if a load is coupled to the motor during this procedure. **ATTENTION:** Rotation of the motor in an undesired direction can occur during this procedure. To guard against possible injury and/or equipment damage, it is recommended that the motor be disconnected from the load before proceeding. "Calculate" (3) = This setting uses motor nameplate data to automatically set [IR Voltage Drop] and [Flux Current Ref].		
		062	**[IR Voltage Drop]** Value of voltage drop across the resistance of the motor stator at rated motor current. Used only parameter 53 is set to "Sensrls Vect", "SV Economize" or "FVC Vector."	Default: Drive Rating Based Min/Max: 0.0/[Motor NP Volts]×0.5 Units: 0.1 VAC	053 061
		063	**[Flux Current Ref]** Value of amps for full motor flux. Used only when parameter 53 is set to "Sensrls Vect", "SV Economize" or "FVC Vector."	Default: Drive Rating Based Min/Max: [Motor NP FLA] × 0.05/ [Motor NP FLA] × 0.9 Units: 0.01 Amps	053 061
		064	E C v2 **[IXo Voltage Drop]** Value of voltage drop across the leakage inductance of the motor at rated motor current. Used only when parameter 53 is set to "FVC Vector."	Default: Based on Drive Rating Min/Max: 0.0/Motor NP Volts Units: 0.1 VAC	
		066	E C v2 **[Autotune Torque]** Specifies motor torque applied to the motor during the flux current and inertia tests performed during an autotune.	Default: 50.0% Min/Max: 0.0/150.0% Units: 0.1%	053

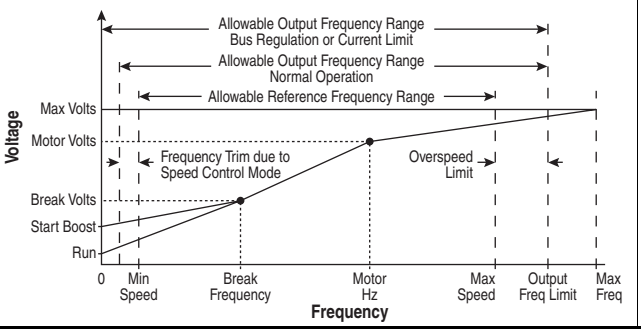
File B	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
MOTOR CONTROL (File B)	Torq Attributes	067	E C v2 **[Inertia Autotune]** Provides an automatic method of setting [Total Inertia]. This test is automatically run during Start-Up motor tests. **Important:** Use when motor is coupled to the load. Results may not be valid if the load is not coupled to the motor during this procedure. "Ready" = Parameter returns to this setting following a completed inertia tune. "Inertia Tune" = A temporary command that initiates an inertia test of the motor/load combination. The motor will ramp up and down, while the drive measures the amount of inertia.	Default: 0 "Ready" Options: 0 "Ready" 1 "Inertia Tune"	053 450
		427	E C v2 **[Torque Ref A Sel]** Selects the source of the external torque reference to the drive. How this reference is used is dependent upon [Speed/Torque Mod]. (1) See *Appendix B* for DPI port locations.	Default: 0 "Torque Setpt" Options: 0 "Torque Setpt" 1 "Analog In 1" 2 "Analog In 2" 3-17 "Reserved" 18-22 "DPI Port 1-5"(1) 23 "Reserved" 24 "Disabled"	053
		428	E C v2 **[Torque Ref A Hi]** Scales the upper value of the [Torque Ref A Sel] selection when the source is an analog input.	Default: 100.0% Min/Max: –/+800.0% Units: 0.1%	053
		429	E C v2 **[Torque Ref A Lo]** Scales the lower value of the [Torque Ref A Sel] selection when the source is an analog input.	Default: 0.0% Min/Max: –/+800.0% Units: 0.1%	053
		435	E C v2 **[Torque Setpoint1]** Provides an internal fixed value for Torque Setpoint when [Torque Ref Sel] is set to "Torque Setpt."	Default: 0.0% Min/Max: –/+800.0% Units: 0.1%	053
		436	E C v2 **[Pos Torque Limit]** Defines the torque limit for the positive torque reference value. The reference will not be allowed to exceed this value.	Default: 200.0% Min/Max: 0.0/800.0% Units: 0.1%	053
		437	E C v2 **[Neg Torque Limit]** Defines the torque limit for the negative torque reference value. The reference will not be allowed to exceed this value.	Default: –200.0% Min/Max: –800.0/0.0% Units: 0.1%	053

File B	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
MOTOR CONTROL (File B)	Torq Attributes	440	E C v2 **[Control Status]** FV Displays a summary status of any condition that may be limiting either the current or the torque reference.  	Read Only	053
		441	E C v2 **[Torq Current Ref]** FV Displays the torque current reference value that is present at the output of the current rate limiter (parameter 154).	Default: Read Only Min/Max: –/+3276.7 Amps Units: 0.1 Amps	053
	Volts per Hertz	069	**[Start/Acc Boost]** Sets the voltage boost level for starting and acceleration when “Custom V/Hz” mode is selected. Refer to parameter 083 [Overspeed Limit].	Default: Drive Rating Based Min/Max: 0.0/[Motor NP Volts] × 0.25 Units: 0.1 VAC	053 070
		070	**[Run Boost]** Sets the boost level for steady state or deceleration when “Fan/Pmp V/Hz” or “Custom V/Hz” modes are selected. Refer to the diagram at parameter 083.	Default: Drive Rating Based Min/Max: 0.0/[Motor NP Volts] × 0.25 Units: 0.1 VAC	053 069
		071	**[Break Voltage]** Sets the voltage the drive will output at [Break Frequency]. Refer to parameter 083 [Overspeed Limit].	Default: [Motor NP Volts] × 0.25 Min/Max: 0.0/[Motor NP Volts] Units: 0.1 VAC	053 072
		072	**[Break Frequency]** Sets the frequency the drive will output at [Break Voltage]. Refer to parameter 083 [Overspeed Limit].	Default: [Motor NP Hertz] × 0.25 Min/Max: 0.0/[Maximum Freq] Units: 0.1 Hz	053 071

File B	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
MOTOR CONTROL (File B)	Speed Feedback	412	E C v2 **[Motor Fdbk Type]** Selects the encoder type; single channel or quadrature. Options 1 & 3 detect a loss of encoder signal (when using differential inputs) regardless of the [Feedback Select], param. 080 setting. For FVC Vector mode, use a quadrature encoder only (option 0/1). If a single channel encoder is used (option 2/3) in sensorless vector or V/Hz mode, select "Reverse Dis" (option 2) in param. 190.	Default: 0 "Quadrature" Options: 0 "Quadrature" 1 "Quad Check" 2 "Single Chan" 3 "Single Check"	
		413	E C v2 **[Encoder PPR]** Contains the encoder pulses per revolution. For improved operation in FVC Vector mode, PPR should be ≥ (64 x motor poles).	Default: 1024 PPR Min/Max: 1/20000 PPR Units: 1 PPR	
		414	E C v2 **[Enc Pos Feedback]** Displays raw encoder pulse count. For single channel encoders, this count will increase (per rev.) by the amount in [Encoder PPR]. For quadrature encoders this count will increase by 4 times the amount defined in [Encoder PPR].	Default: Read Only Min/Max: –/+2147483647 Units: 1	
		415	E C v2 **[Encoder Speed]** Provides a monitoring point that reflects speed as seen from the feedback device.	Default: Read Only Min/Max: –/+500.0 Hz Units: 0.1 Hz	
		416	E C v2 **[Fdbk Filter Sel]** Selects the type of feedback filter desired. "Light" uses a 35/49 radian feedback filter. "Heavy" uses a 20/40 radian feedback filter.	Default: 0 "None" Options: 0 "None" 1 "Light" 2 "Heavy"	
		419	E C v2 **[Notch FilterFreq]** FV Sets the center frequency for an optional 2-pole notch filter. Filter is applied to the torque command. "0" disables this filter.	Default: 0.0 Hz Min/Max: 0.0/500.0 Hz Units: 0.1 Hz	053
		420	E C v2 **[Notch Filter K]** FV Sets the width for the 2-pole notch filter.	Default: 0.3 Min/Max: 0.1/0.9 Units: 0.1	053

Speed Command File (File C)

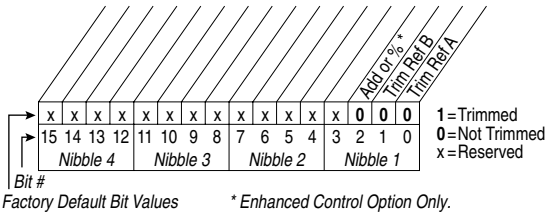
File C	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
SPEED COMMAND (File C)	Spd Mode & Limits	080	Standard **[Speed Mode]** Sets the method of speed regulation.	Default: 0 "Open Loop" Options: 0 "Open Loop" 1 "Slip Comp" 2 "Process PI"	121 thru 138
			EC **[Feedback Select]** Selects the source for motor speed feedback. Note that all selections are available when using Process PI. "Open Loop" (0) - no encoder is present, and slip compensation is not needed. "Slip Comp" (1) - tight speed control is needed, and encoder is not present. "Encoder" (3) - an encoder is present. "Simulator" (5) - Simulates a motor for testing drive operation & interface check.	Default: 0 "Open Loop" Options: 0 "Open Loop" 1 "Slip Comp" 2 "Reserved" 3 "Encoder" 4 "Reserved" 5 "Simulator"	
		081	**[Minimum Speed]** Sets the low limit for speed reference after scaling is applied. Refer to parameter 083 [Overspeed Limit].	Default: 0.0 Hz Min/Max: 0.0/[Maximum Speed] Units: 0.1 Hz	092 095
		082	**[Maximum Speed]** Sets the high limit for speed reference after scaling is applied. Refer to parameter 083 [Overspeed Limit].	Default: 50.0 or 60.0 Hz (Dependent on voltage class) Min/Max: 5.0/400.0 Hz 5.0/500.0 Hz EC Units: 0.1 Hz	055 083 091 094 202
		083	**[Overspeed Limit]** Sets the incremental amount of the output frequency (above [Maximum Speed]) allowable for functions such as slip compensation. [Maximum Speed] + [Overspeed Limit] must be ≤ [Maximum Freq]	Default: 10.0 Hz Min/Max: 0.0/20.0 Hz Units: 0.1 Hz	055 082

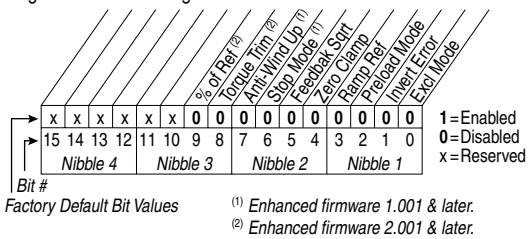
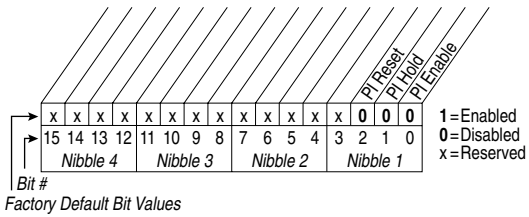


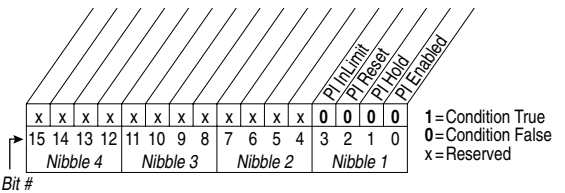
File C	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
SPEED COMMAND (File C)	Spd Mode & Limits	084 085 086	**[Skip Frequency 1]** **[Skip Frequency 2]** **[Skip Frequency 3]** Sets a frequency at which the drive will not operate.	Default: 0.0 Hz Default: 0.0 Hz Default: 0.0 Hz Min/Max: –/+500.0 Hz Units: 0.1 Hz	087
		087	**[Skip Freq Band]** Determines the bandwidth around a skip frequency. [Skip Freq Band] is split, applying 1/2 above and 1/2 below the actual skip frequency. The same bandwidth applies to all skip frequencies.	Default: 0.0 Hz Min/Max: 0.0/30.0 Hz Units: 0.1 Hz	084
		088 FV	E C v2 **[Speed/Torque Mod]** Selects the torque reference source. "Zero Torque" (0) - torque command = 0. "Speed Reg" (1) - drive operates as a speed regulator. "Torque Reg" (2) - an external torque reference is used for the torque command. "Min Torq/Spd" (3) - selects the smallest algebraic value to regulate to when the torque reference and torque generated from the speed regulator are compared. "Max Torq/Spd" (4) - selects the largest algebraic value when the torque reference and the torque generated from the speed regulator are compared. "Sum Torq/Spd" (5) - selects the sum of the torque reference and the torque generated from the speed regulator. **ATTENTION:** The speed of the drive could reach [Maximum Speed] + [Overspeed Limit] to meet required torque when any of the torque modes have been selected. Equipment damage and/or personal injury may result.	Default: 1 "Speed Reg" Options: 0 "Zero Torque" 1 "Speed Reg" 2 "Torque Reg" 3 "Min Torq/Spd" 4 "Max Torq/Spd" 5 "Sum Torq/Spd"	053
		454	E C **[Rev Speed Limit]** Sets a limit on speed in the negative direction. A value of zero disables this parameter and uses [Min Speed] for minimum speed.	Default: 0.0 Hz Min/Max: –[Max Speed]/0.0 Hz Units: 0.1 Hz	

File C	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
SPEED COMMAND (File C)	Speed References	090	**[Speed Ref A Sel]** Selects the source of the speed reference to the drive unless [Speed Ref B Sel] or [Preset Speed 1-7] is selected. For more information on selecting a speed reference source, see Figure 1.13 on page 1-19. (1) See Appendix B for DPI port locations. (2) Enhanced Control Drives Only.	Default: 2 "Analog In 2" Options: 1 "Analog In 1" 2 "Analog In 2" 3-7 "Reserved" 8 "Encoder" 9 "MOP Level" 10 "Reserved" 11 "Preset Spd1" 12 "Preset Spd2" 13 "Preset Spd3" 14 "Preset Spd4" 15 "Preset Spd5" 16 "Preset Spd6" 17 "Preset Spd7" 18 "DPI Port 1"(1) 19 "DPI Port 2"(1) 20 "DPI Port 3"(1) 21 "Reserved" 22 "DPI Port 5"(1) 23-29 "Reserved" 30 "HighRes Ref"(2)	002 091 thru 093 101 thru 107 117 thru 120 192 thru 194 213 272 273 320 361 thru 366
		091	**[Speed Ref A Hi]** Scales the upper value of the [Speed Ref A Sel] selection when the source is an analog input.	Default: [Maximum Speed] Min/Max: –/+[Maximum Speed] Units: 0.1 Hz	082
		092	**[Speed Ref A Lo]** Scales the lower value of the [Speed Ref A Sel] selection when the source is an analog input.	Default: 0.0 Hz Min/Max: –/+[Maximum Speed] Units: 0.1 Hz	081
		093	**[Speed Ref B Sel]** See [Speed Ref A Sel].	Default: 11 "Preset Spd1" Options: See [Speed Ref A Sel]	See 090
		094	**[Speed Ref B Hi]** Scales the upper value of the [Speed Ref B Sel] selection when the source is an analog input.	Default: [Maximum Speed] Min/Max: –/+[Maximum Speed] Units: 0.1 Hz	093
		095	**[Speed Ref B Lo]** Scales the lower value of the [Speed Ref B Sel] selection when the source is an analog input.	Default: 0.0 Hz Min/Max: –/+[Maximum Speed] Units: 0.1 Hz	090 093

File C	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
SPEED COMMAND (File C)	Speed References	096	**[TB Man Ref Sel]** Sets the manual speed reference source when a digital input is configured for "Auto/Manual." (1) "Analog In 2" is not a valid selection if it was selected for any of the following: - [Trim In Select] - [PI Feedback Sel] - [PI Reference Sel] - [Current Lmt Sel]	Default: 1 "Analog In 1" Options: 1 "Analog In 1" 2 "Analog In 2"(1) 3-8 "Reserved" 9 "MOP Level"	097 098
		097	**[TB Man Ref Hi]** Scales the upper value of the [TB Man Ref Sel] selection when the source is an analog input.	Default: [Maximum Speed] Min/Max: –/+[Maximum Speed] Units: 0.1 Hz	096
		098	**[TB Man Ref Lo]** Scales the lower value of the [TB Man Ref Sel] selection when the source is an analog input.	Default: 0.0 Hz Min/Max: –/+[Maximum Speed] Units: 0.1 Hz	096
	Discrete Speeds	100	Standard **[Jog Speed]** Sets the output frequency when a jog command is issued.	Default: 10.0 Hz Min/Max: –/+[Maximum Speed] Units: 0.1 Hz	
			E C **[Jog Speed 1]** Sets the output frequency when Jog Speed 1 is selected.	Default: 10.0 Hz Min/Max: –/+[Maximum Speed] Units: 0.1 Hz	
		101 102 103 104 105 106 107	**[Preset Speed 1]** **[Preset Speed 2]** **[Preset Speed 3]** **[Preset Speed 4]** **[Preset Speed 5]** **[Preset Speed 6]** **[Preset Speed 7]** Provides an internal fixed speed command value. In bipolar mode direction is commanded by the sign of the reference.	Default: 5.0 Hz 10.0 Hz 20.0 Hz 30.0 Hz 40.0 Hz 50.0 Hz 60.0 Hz Min/Max: –/+[Maximum Speed] Units: 0.1 Hz	090 093
		108	E C **[Jog Speed 2]** Sets the output frequency when Jog Speed 2 is selected.	Default: 10.0 Hz Min/Max: –/+[Maximum Speed] Units: 0.1 Hz	

File C	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
SPEED COMMAND (File C)	Speed Trim	116	EC **[Trim % Setpoint]** Adds or subtracts a percentage of the speed reference or maximum speed. Dependent on the setting of [Trim Out Select], parameter 118.	Default: 0.00% Min/Max: –/+200.00% Units: 0.01%	090 093
		117	**[Trim In Select]** Specifies which analog input signal is being used as a trim input.	Default: 2 "Analog In 2" Options: See [Speed Ref A Sel]	090 093
		118	**[Trim Out Select]** Specifies which speed references are to be trimmed.  *Factory Default Bit Values* * Enhanced Control Option Only.	117 119 120
		119	**[Trim Hi]** Scales the upper value of the [Trim In Select] selection when the source is an analog input.	Default: 60.0 Hz Min/Max: –/+[Maximum Speed] Units: 0.1 Hz 1 % EC	082 117
		120	**[Trim Lo]** Scales the lower value of the [Trim In Select] selection when the source is an analog input.	Default: 0.0 Hz Min/Max: –/+[Maximum Speed] Units: 0.1 Hz 1 % EC	117
	Slip Comp		**Important:** Parameters in the Slip Comp Group are used to enable and tune the Slip Compensation Regulator. In order to allow the Slip Compensation Regulator to control drive operation, parameter 080 must be set to 1 "Slip Comp".		
		121	**[Slip RPM @ FLA]** Sets the amount of compensation to drive output at motor FLA. If the value of parameter 061 [Autotune] = 3 "Calculate" changes made to this parameter will not be accepted.	Default: Based on [Motor NP RPM] Min/Max: 0.0/1200.0 RPM Units: 0.1 RPM	061 080 122 123
		122	**[Slip Comp Gain]** Sets the response time of slip compensation.	Default: 40.0 Min/Max: 1.0/100.0 Units: 0.1	080 121 122
		123	**[Slip RPM Meter]** Displays the present amount of adjustment being applied as slip compensation.	Default: Read Only Min/Max: 0.0/300.0 RPM –/+300.0 RPM EC Units: 0.1 RPM	080 121 122

File C	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
SPEED COMMAND (File C)	Process PI		**Important:** Parameters in the Process PI Group are used to enable and tune the PI Loop. Standard To allow the PI Loop to control drive operation, parameter 080 must be set to 2 "Process PI".		
		124	**[PI Configuration]** Sets configuration of the PI regulator.  *Factory Default Bit Values* (1) *Enhanced firmware 1.001 & later.* (2) *Enhanced firmware 2.001 & later.*		124 thru 138
		125	**[PI Control]** Controls the PI regulator.  *Factory Default Bit Values*		080
		126	**[PI Reference Sel]** Selects the source of the PI reference. (1) Enhanced Control Drives Only.	Default: 0 "PI Setpoint" Options: 0 "PI Setpoint" 1 "Analog In 1" 2 "Analog In 2" 3-7 "Reserved" 8 "Encoder" 9 "MOP Level" 10 "Master Ref" 11-17 "Preset Spd1-7" 18-20 "DPI Port 1-3" 21 "Reserved" 22 "DPI Port 5" 23-29 "Reserved" 30 "HighRes Ref"(1)	124 thru 138
		127	**[PI Setpoint]** Provides an internal fixed value for process setpoint when [PI Reference Sel] is set to "PI Setpoint."	Default: 50.00% Min/Max: –/+100.00% of Maximum Process Value Units: 0.01%	124 thru 138

File C	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
SPEED COMMAND (File C)	Process PI	128	**[PI Feedback Sel]** Selects the source of the PI feedback.	Default: 2 "Analog In 2" Options: See [PI Reference Sel].	124 thru 138
		129	**[PI Integral Time]** Time required for the integral component to reach 100% of [PI Error Meter]. Not functional when the PI Hold bit of [PI Control] = "1" (enabled). A value of zero disables this parameter	Default: 2.00 Secs Min/Max: 0.00/100.00 Secs Units: 0.01 Secs	124 thru 138
		130	**[PI Prop Gain]** Sets the value for the PI proportional component. PI Error × PI Prop Gain = PI Output	Default: 1.00 Min/Max: 0.00/100.00 Units: 0.01	124 thru 138
		131	**[PI Lower Limit]** Sets the lower limit of the PI output.	Default: –[Maximum Freq] –100% EC Min/Max: –/+400.0 Hz –/+800% EC Units: 0.1 Hz 0.1% EC	124 thru 138
		132	**[PI Upper Limit]** Sets the upper limit of the PI output.	Default: +[Maximum Freq] 100% EC Min/Max: –/+400.0 Hz –/+800.0% EC Units: 0.1 Hz 0.1% EC	124 thru 138
		133	**[PI Preload]** Sets the value used to preload the integral component on start or enable.	Default: 0.0 Hz 100.0% EC Min/Max: [PI Lower Limit]/ [PI Upper Limit Units: 0.1 Hz 0.1% EC	124 thru 138
		134	**[PI Status]** Status of the Process PI regulator.  	Read Only	124 thru 138
		135	**[PI Ref Meter]** Present value of the PI reference signal.	Default: Read Only Min/Max: –/+100.00% Units: 0.01%	124 thru 138

File C	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
SPEED COMMAND (File C)	Process PI	136	**[PI Fdback Meter]** Present value of the PI feedback signal.	Default: Read Only Min/Max: –/+100.00% Units: 0.01%	124 thru 138
		137	**[PI Error Meter]** Present value of the PI error.	Default: Read Only Min/Max: –/+100.00% Units: 0.01%	124 thru 138
		138	**[PI Output Meter]** Present value of the PI output.	Default: Read Only Min/Max: –/+100.0 Hz –/+800.0% EC Units: 0.1 Hz 0.1% EC	124 thru 138
		139	EC v2 **[PI BW Filter]** *Firmware 2.001 & later* – Provides filter for Process PI error signal. The output of this filter is displayed in [PI Error Meter]. Zero will disable the filter.	Default: 0.0 R/s Min/Max: 0.0/240.0 R/s Units: 0.1 R/s	137
		459	EC v2 **[PI Deriv Time]** Refer to formula below: $PI_{Out} = KD\ (Sec) \times \frac{d_{PI\ Error}\ (\%)}{d_t\ (Sec)}$	Default: 0.00 Secs Min/Max: 0.00/100.00 Secs Units: 0.01 Secs	
		460	EC **[PI Reference Hi]** Scales the upper value of [PI Reference Sel] of the source.	Default: 100.0% Min/Max: –/+100.0% Units: 0.1%	
		461	EC **[PI Reference Lo]** Scales the lower value of [PI Reference Sel] of the source.	Default: –100.0% Min/Max: –/+100.0% Units: 0.1%	
		462	EC **[PI Feedback Hi]** Scales the upper value of [PI Feedback] of the source.	Default: 100.0% Min/Max: –/+100.0% Units: 0.1%	
		463	EC **[PI Feedback Lo]** Scales the lower value of [PI Feedback] of the source.	Default: 0.0% Min/Max: –/+100.0% Units: 0.1%	
	Speed Regulator	445	EC v2 **[Ki Speed Loop]** FV Controls the integral error gain of the speed regulator. The drive automatically adjusts [Ki Speed Loop] when a non-zero value is entered for [Speed Desired BW] or an autotune is performed. Typically, manual adjustment of this parameter is needed only if system inertia cannot be determined through an autotune. [Speed Desired BW] is set to "0" when a manual adjustment is made to this parameter.	Default: 7.8 Min/Max: 0.0/4000.0 Units: 0.1	053

File C	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
SPEED COMMAND (File C)	Speed Regulator	446 FV	E C v2 **[Kp Speed Loop]** Controls the proportional error gain of the speed regulator. The drive automatically adjusts [Kp Speed Loop] when a non-zero value is entered for [Speed Desired BW] or an auto-tune is performed. Typically, manual adjustment of this parameter is needed only if system inertia cannot be determined through an autotune. [Speed Desired BW] is set to "0" when a manual adjustment is made to this parameter.	Default: 6.3 Min/Max: 0.0/200.0 Units: 0.1	053
		447 FV	E C v2 **[Kf Speed Loop]** Controls the feed forward gain of the speed regulator. Setting the Kf gain greater than zero reduces speed feedback overshoot in response to a step change in speed reference.	Default: 0.0 Min/Max: 0.0/0.5 Units: 0.1	053
		448 FV	E C v3 **[Spd Err Filt BW]** Sets the bandwidth of a speed error filter used in FVC Vector mode. A setting of 0.0 disables the filter.	Default: 200.0 R/s Min/Max: 0.0/2000.0 R/s Units: 0.1 R/s	053
		449 FV	E C v2 **[Speed Desired BW]** Sets the speed loop bandwidth and determines the dynamic behavior of the speed loop. As bandwidth increases, the speed loop becomes more responsive and can track a faster changing speed reference. Adjusting this parameter will cause the drive to calculate and change [Ki Speed Loop] and [Kp Speed Loop] gains.	Default: 0.0 Radians/Sec Min/Max: 0.0/250.0 Radians/Sec Units: 0.1 Radians/Sec	053
		450 FV	E C v2 **[Total Inertia]** Represents the time in seconds, for a motor coupled to a load to accelerate from zero to base speed, at rated motor torque. The drive calculates Total Inertia during the autotune inertia procedure. Adjusting this parameter will cause the drive to calculate and change [Ki Speed Loop] and [Kp Speed Loop] gains.	Default: 0.10 Secs Min/Max: 0.01/600.0 Secs Units: 0.01 Secs	053
		451 FV	E C v2 **[Speed Loop Meter]** Value of the speed regulator output. When in FVC mode, units are in percent.	Default: Read Only Min/Max: –/+800.0%/Hz Units: 0.1%/Hz	053 121

Dynamic Control File (File D)

File D	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
DYNAMIC CONTROL (File D)	Ramp Rates	140 141	**[Accel Time 1]** **[Accel Time 2]** Sets the rate of accel for all speed increases. $\frac{\text{Max Speed}}{\text{Accel Time}}$ = Accel Rate	Default: 10.0 Secs 10.0 Secs Min/Max: 0.0/3600.0 Secs Units: 0.1 Secs	142 143 146 361 thru 366
		142 143	**[Decel Time 1]** **[Decel Time 2]** Sets the rate of decel for all speed decreases. $\frac{\text{Max Speed}}{\text{Decel Time}}$ = Decel Rate	Default: 10.0 Secs 10.0 Secs Min/Max: 0.0/3600.0 Secs Units: 0.1 Secs	140 141 146 361 thru 366
		146	**[S Curve %]** Sets the percentage of accel or decel time that is applied to the ramp as S Curve. Time is added, 1/2 at the beginning and 1/2 at the end of the ramp.	Default: 0.0% Min/Max: 0.0/100.0% Units: 0.1%	140 thru 143
	Load Limits	147	**[Current Lmt Sel]** Selects the source for the adjustment of current limit (i.e. parameter, analog input, etc.).	Default: 0 "Cur Lim Val" Options: 0 "Cur Lim Val" 1 "Analog In 1" 2 "Analog In 2"	146 149
		148	**[Current Lmt Val]** Defines the current limit value when [Current Lmt Sel] = "Cur Lim Val."	Default: [Rated Amps] × 1.5 (Equation approximates default value.) Min/Max: Drive Rating Based Units: 0.1 Amps	147 149
		149	**[Current Lmt Gain]** Sets the responsiveness of the current limit.	Default: 250 Min/Max: 0/5000 Units: 1	147 148
		150	**[Drive OL Mode]** Selects the drive's response to increasing drive temperature.	Default: 3 "Both–PWM 1st" Options: 0 "Disabled" 1 "Reduce CLim" 2 "Reduce PWM" 3 "Both–PWM 1st"	219
		151	**[PWM Frequency]** Sets the carrier frequency for the PWM output. Drive derating may occur at higher carrier frequencies. For derating information, refer to the *PowerFlex Reference Manual*, publication PFLEX-RM001….	Default: 4 kHz Min/Max: 2, 3, 4, 5, 6, 7, 8, 9, 10 kHz 2, 4, 8, 12 kHz EC Units: 1 kHz	

File D	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
DYNAMIC CONTROL (File D)	Load Limits	152	E C v2 **[Droop RPM @ FLA]** Selects amount of droop that the speed reference is reduced when at full load torque. Zero disables the droop function. Setting parameter 080 to 0 is recommended when using the Droop function.	Default: 0.0 RPM Min/Max: 0.0/200.0 RPM Units: 0.1 RPM	
		153	E C v2 **[Regen Power Lim]** FV Sets the maximum power limit allowed to transfer from the motor to the DC bus. When using an external dynamic brake, set this parameter to its maximum value.	Default: –50.0% Min/Max: –800.0/0.0% Units: 0.1%	053
		154	E C v2 **[Current Rate Lim]** FV Sets the largest allowable rate of change for the current reference signal. This number is scaled in percent of maximum motor current every 250 microseconds.	Default: 400.0% Min/Max: 1.0/800.0% Units: 0.1%	053
		189	E C **[Shear Pin Time]** Sets the time that the drive is at or above current limit before a fault occurs. Zero disables this feature.	Default: 0.0 Secs Min/Max: 0.0/30.0 Secs Units: 0.1 Secs	
	Stop/Brake Modes	145	E C **[DB While Stopped]** Enables/disables dynamic brake operation. Disabled = DB will only operate when drive is running. Enable = DB operates whenever drive is energized.	Default: 0 "Disabled" Options: 0 "Disabled" 1 "Enabled"	
		155 156	Standard **[Stop Mode A]** Standard **[Stop Mode B]** Active stop mode. [Stop Mode A] is active unless [Stop Mode B] is selected by digital inputs programmed for "Stop Mode B." (1) When using options 1 or 2, refer to the Attention statements at [DC Brake Level].	Default: 1 "Ramp" Default: 0 "Coast" Options: 0 "Coast" 1 "Ramp"(1) 2 "Ramp to Hold"(1) 3 "DC Brake"	157 158 159 361 thru 366
			E C v2 **[Stop/Brk Mode A]** E C v2 **[Stop/Brk Mode B]** See description above.	Default: 1 "Ramp" Default: 0 "Coast" Options: 0 "Coast" 1 "Ramp"(1) 2 "Ramp to Hold"(1) 3 "DC Brake" 4 "Fast Brake" E C v3	
		157	**[DC Brake Lvl Sel]** Selects the source for [DC Brake Level].	Default: 0 "DC Brake Lvl" Options: 0 "DC Brake Lvl" 1 "Analog In 1" 2 "Analog In 2"	155 156 158 159

File D	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
DYNAMIC CONTROL (File D)	Stop/Brake Modes	158	**[DC Brake Level]** Defines the DC brake current level injected into the motor when "DC Brake" is selected as a stop mode. The DC braking voltage used in this function is created by a PWM algorithm and may not generate the smooth holding force needed for some applications. Refer to the *PowerFlex Reference Manual*, publication PFLEX-RM001…. **Important:** Frame E drives may be limited to less than 150% depending on the setting of parameter 151 [PWM Frequency].	Default: [Rated Amps] Min/Max: 0/[Rated Amps] × 1.5 (Equation yields approximate maximum value.) Units: 0.1 Amps	
			ATTENTION: If a hazard of injury due to movement of equipment or material exists, an auxiliary mechanical braking device must be used. **ATTENTION:** This feature should not be used with synchronous or permanent magnet motors. Motors may be demagnetized during braking.		
		159	**[DC Brake Time]** Sets the amount of time DC brake current is "injected" into the motor.	Default: 0.0 Secs Min/Max: 0.0/90.0 Secs Units: 0.1 Secs	155 thru 158
		160	Standard **[Bus Reg Gain]** E C **[Bus Reg Ki]** Sets the responsiveness of the bus regulator.	Default: 450 Min/Max: 0/5000 Units: 1	161 162
		161 162	**[Bus Reg Mode A]** **[Bus Reg Mode B]** Active bus regulation mode. Choices are dynamic brake, frequency adjust or both. Sequence is determined by programmed value or digital input programmed for "Bus Reg Md B." Dynamic Brake Setup If a dynamic brake resistor is connected to the drive, both these parameters must be set to either option 2, 3 or 4. Refer to the Attention statement on page P-4 for important information on bus regulation.	Default: 1 "Adjust Freq" 4 "Both-Frq 1st" Options: 0 "Disabled" 1 "Adjust Freq" 2 "Dynamic Brak" 3 "Both-DB 1st" 4 "Both-Frq 1st"	160 163 361 thru 366
			ATTENTION: The drive does not offer protection for externally mounted brake resistors. A risk of fire exists if external braking resistors are not protected. External resistor packages must be self-protected from over temperature or the protective circuit shown in Figure C.1 on page C-1 (or equivalent) must be supplied.		

File D	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
DYNAMIC CONTROL (File D)	Stop/Brake Modes	163	**[DB Resistor Type]** Selects whether the internal or an external DB resistor will be used. If a dynamic brake resistor is connected to the drive, [Bus Reg Mode x], A, B or Both (if used), must be set to either option 2, 3 or 4. **ATTENTION:** The drive does not offer protection for externally mounted brake resistors. A risk of fire exists if external braking resistors are not protected. External resistor packages must be self-protected from over temperature or the protective circuit shown in Figure C.1 on page C-1, or equivalent, must be supplied. **ATTENTION:** Equipment damage may result if a drive mounted (internal) resistor is installed and this parameter is set to "External Res." Thermal protection for the internal resistor will be disabled, resulting in possible device damage.	Default: 0 "Internal Res" 2 "None" E C Options: 0 "Internal Res" 1 "External Res" 2 "None"	161 162
		164	E C **[Bus Reg Kp]** Proportional gain for the bus regulator. Used to adjust regulator response.	Default: 1500 Min/Max: 0/10000 Units: 1	
		165	E C **[Bus Reg Kd]** Derivative gain for the bus regulator. Used to control regulator overshoot.	Default: 1000 Min/Max: 0/10000 Units: 1	
		166	E C v2 **[Flux Braking]** Set to use an increase in the motor flux current to increase the motor losses, and allow a faster deceleration time when a chopper brake or regenerative capability is not available. Can be used as a stopping or fast deceleration method.	Default: 0 "Disabled" Options: 0 "Disabled" 1 "Enabled"	

File D	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
DYNAMIC CONTROL (File D)	Restart Modes	167	E C **[Powerup Delay]** Defines the programmed delay time, in seconds, before a start command is accepted after a power up.	Default: 0.0 Secs Min/Max: 0.0/30.0 Secs Units: 0.1 Secs	
		168	**[Start At PowerUp]** Enables/disables a feature to issue a Start or Run command and automatically resume running at commanded speed after drive input power is restored. Requires a digital input configured for Run or Start and a valid start contact. **ATTENTION:** Equipment damage and/or personal injury may result if this parameter is used in an inappropriate application. Do not use this function without considering applicable local, national and international codes, standards, regulations or industry guidelines.	Default: 0 "Disabled" Options: 0 "Disabled" 1 "Enabled"	
		169	**[Flying Start En]** Enables/disables the function which reconnects to a spinning motor at actual RPM when a start command is issued.	Default: 0 "Disabled" Options: 0 "Disabled" 1 "Enabled"	170
		170	**[Flying StartGain]** Sets the response of the flying start function.	Default: 4000 Min/Max: 20/32767 Units: 1	169
		174	**[Auto Rstrt Tries]** Sets the maximum number of times the drive attempts to reset a fault and restart. **ATTENTION:** Equipment damage and/or personal injury may result if this parameter is used in an inappropriate application. Do not use this function without considering applicable local, national and international codes, standards, regulations or industry guidelines.	Default: 0 Min/Max: 0/9 Units: 1	175
		175	**[Auto Rstrt Delay]** Sets the time between restart attempts when [Auto Rstrt Tries] is set to a value other than zero.	Default: 1.0 Secs Min/Max: 0.5/30.0 Secs Units: 0.1 Secs	174

File D: DYNAMIC CONTROL (File D) | Group: Restart Modes | No. 178

Parameter Name and Description — *See page 3-2 for symbol descriptions*

[Sleep Wake Mode] E C v2

Enables/disables the Sleep/Wake function. **Important:** When enabled, the following conditions must be met:

- A proper value must be programmed for [Sleep Level] & [Wake Level].
- A speed reference must be selected in [Speed Ref A Sel].
- At least one of the following must be programmed (and input closed) in [Digital Inx Sel]; "Enable," "Stop=CF," "Run," "Run Forward," "Run Reverse."

Values

Default: 0 "Disabled"

Options: 0 "Disabled"
1 "Direct" (Enabled)
2 "Invert" (Enabled)(7)

Related

ATTENTION: Enabling the Sleep-Wake function can cause unexpected machine operation during the Wake mode. Equipment damage and/or personal injury can result if this parameter is used in an inappropriate application. Do Not use this function without considering the information below and in Appendix C. In addition, all applicable local, national & international codes, standards, regulations or industry guidelines must be considered

Conditions Required to Start Drive(1)(2)(3)

Input	After Power-Up	After a Drive Fault		After a Stop Command
		Reset by Stop-CF, HIM or TB	*Reset by Clear Faults (TB)*	*HIM or TB*
Stop	Stop Closed Wake Signal	Stop Closed Wake Signal New Start or Run Cmd.(4)	Stop Closed Wake Signal	Stop Closed Direct Mode Analog Sig. > Sleep Level(6) Invert Mode Analog Sig. < Sleep Level(6) New Start or Run Cmd.(4)
Enable	Enable Closed Wake Signal(4)	Enable Closed Wake Signal New Start or Run Cmd.(4)	Enable Closed Wake Signal	Enable Closed Direct Mode Analog Sig. > Sleep Level(6) Invert Mode Analog Sig. < Sleep Level(6) New Start or Run Cmd.(4)
Run Run For. Run Rev.	Run Closed Wake Signal	New Run Cmd.(5) Wake Signal	Run Closed Wake Signal	New Run Cmd.(5) Wake Signal

(1) When power is cycled, if all of the above conditions are present after power is restored, restart will occur.

(2) If all of the above conditions are present when [Sleep-Wake Mode] is "enabled," the drive will start.

(3) The active speed reference is determined as explained in Speed Reference Control on page 1-19. The Sleep/Wake function and the speed reference may be assigned to the same input.

(4) Command must be issued from HIM, TB or network.

(5) Run Command must be cycled.

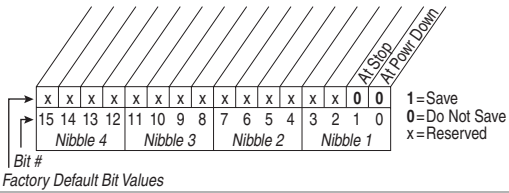
(6) Signal does not need to be greater than wake level.

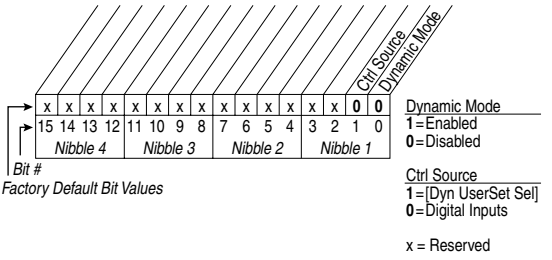
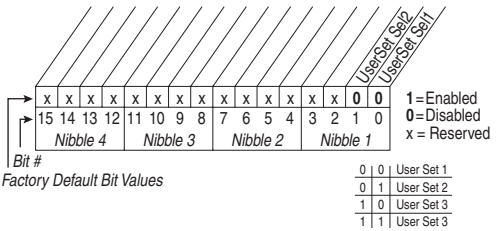
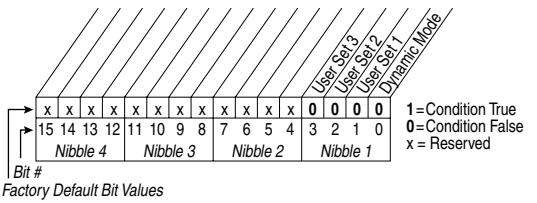
(7) Enhanced firmware 2.001 & later. For Invert function, refer to [Analog In x Loss].

File D	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
DYNAMIC CONTROL (File D)	Restart Modes	179	E C v2 **[Sleep Wake Ref]** Selects the source of the input controlling the Sleep-Wake function.	Default: 2 "Analog In 2" Options: 1 "Analog In 1" 2 "Analog In 2"	
		180	E C v2 **[Wake Level]** Defines the analog input level that will start the drive.	Default: 6.000 mA, 6.000 Volts Min/Max: [Sleep Level]/20.000 mA [Sleep Level]/10.000 Volts Units: 0.001 mA 0.001 Volts	181
		181	E C v2 **[Wake Time]** Defines the amount of time at or above [Wake Level] before a Start is issued.	Default: 1.0 Secs Min/Max: 0.0/1000.0 Secs Units: 0.1 Secs	180
		182	E C v2 **[Sleep Level]** Defines the analog input level that will stop the drive.	Default: 5.000 mA, 5.000 Volts Min/Max: 4.000 mA/[Wake Level] 0.000 Volts/[Wake Level] Units: 0.001 mA 0.001 Volts	183
		183	E C v2 **[Sleep Time]** Defines the amount of time at or below [Sleep Level] before a Stop is issued.	Default: 1.0 Secs Min/Max: 0.0/1000.0 Secs Units: 0.1 Secs	182
	Power Loss	177	E C v2 **[Gnd Warn Level]** Sets the level at which a ground warning fault will occur. Configure with [Alarm Config 1].	Default: 3.0 Amps Min/Max: 1.0/5.0 Amps Units: 0.1 Amps	259
		184	**[Power Loss Mode]** Sets the reaction to a loss of input power. Power loss is recognized when: • DC bus voltage is ≤ 73% of [DC Bus Memory] and [Power Loss Mode] is set to "Coast". • DC bus voltage is ≤ 82% of [DC Bus Memory] and [Power Loss Mode] is set to "Decel".	Default: 0 "Coast" Options: 0 "Coast" 1 "Decel" 2 "Continue" E C	013 185
		185	**[Power Loss Time]** Sets the time that the drive will remain in power loss mode before a fault is issued.	Default: 0.5 Secs Min/Max: 0.0/60.0 Secs Units: 0.1 Secs	184
		187	E C v2 **[Load Loss Level]** Sets the percentage of motor nameplate torque at which a load loss alarm will occur.	Default: 200.0% Min/Max: 0.0/800.0% Units: 0.1%	211 259
		188	E C v2 **[Load Loss Time]** Sets the time that current is below the level set in [Load Loss Level] before a fault occurs.	Default: 0.0 Secs Min/Max: 0.0/300.0 Secs Units: 0.1 Secs	187

Utility File (File E)

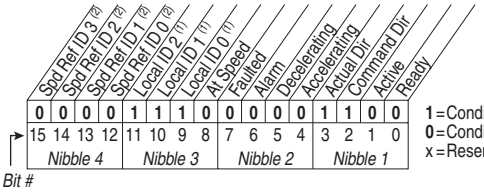
File E	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
UTILITY (File E)	Direction Config	190	**[Direction Mode]** Selects the method for changing drive direction. **Mode** / **Direction Change** Unipolar — Drive Logic Bipolar — Sign of Reference Reverse Dis — Not Changable	Default: 0 "Unipolar" Options: 0 "Unipolar" 1 "Bipolar" 2 "Reverse Dis"	320 thru 327 361 thru 366
	HIM Ref Config	192	**Standard** **[Save HIM Ref]** Enables a feature to save the present frequency reference value issued by the HIM to Drive memory on power loss. Value is restored to the HIM on power up. Bit # 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 — At Powr Down Nibble 4 / Nibble 3 / Nibble 2 / Nibble 1 Factory Default Bit Values: x x x x x x x x x x x x x x x 1 1 = Save at Power Down 0 = Do Not Save x = Reserved		
			E C **[AutoMan Cnfg]** Bit # 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 — HIM Disable / ManRefPrld / Manual Mode / Save HIM Ref Nibble 4 / Nibble 3 / Nibble 2 / Nibble 1 Factory Default Bit Values: x x x x x x x x x x x x 0 1 0 1 Save HIM Ref 1 = Saves HIM reference, Reloads HIM reference at power-up. **0** = Disabled Manual Mode **1** = HIM has exclusive Start & Jog control in Manual mode. **0** = Disabled ManRefPrld **1** = Preloads auto reference into HIM upon Auto to Manual transition. **0** = Disabled HIM Disable **1** = HIM does not start drive. **0** = HIM starts drive x = Reserved	
		193	**Standard** **[Man Ref Preload]** Enables/disables a feature to automatically load the present "Auto" frequency reference value into the HIM when "Manual" is selected. Allows smooth speed transition from "Auto" to "Manual."	Default: 0 "Disabled" Options: 0 "Disabled" 1 "Enabled"	

File E	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
UTILITY (File E)	MOP Config	194	**[Save MOP Ref]** Enables/disables the feature that saves the present MOP frequency reference at power down or at stop.  *Factory Default Bit Values*		
		195	**[MOP Rate]** Sets rate of change of the MOP reference in response to a digital input.	Default: 1.0 Hz/s Min/Max: 0.2/[Maximum Freq] Units: 0.1 Hz/s	
	Drive Memory	196	**[Param Access Lvl]** Selects the parameter display level. Basic = Reduced param. set Advanced = Full param. set	Default: 0 "Basic" Options: 0 "Basic" 1 "Advanced" 2 "Reserved" EC	
		197	**[Reset To Defalts]** Resets all parameter values (except parameters 196, 201 & 202) to defaults. Option 1 resets drive to factory settings. Options 2 and 3 will reset drive to alternate voltage and current rating.	Default: 0 "Ready" Options: 0 "Ready" 1 "Factory" 2 "Low Voltage" 3 "High Voltage"	
		198	**[Load Frm Usr Set]** Loads a previously saved set of parameter values from a selected user set location in drive nonvolatile memory to active drive memory.	Default: 0 "Ready" Options: 0 "Ready" 1 "User Set 1" 2 "User Set 2" 3 "User Set 3"	199
		199	**[Save To User Set]** Saves the parameter values in active drive memory to a user set in drive nonvolatile memory.	Default: 0 "Ready" Options: 0 "Ready" 1 "User Set 1" 2 "User Set 2" 3 "User Set 3"	198
		200	**[Reset Meters]** Resets selected meters to zero.	Default: 0 "Ready" Options: 0 "Ready" 1 "MWh" 2 "Elapsed Time"	
		201	**[Language]** Selects the display language when using an LCD HIM. This parameter is not functional with an LED HIM.	Default: 0 "Not Selected" Options: 0 "Not Selected" 1 "English" 2 "Français" 3 "Español" 4 "Italiano" 5 "Deutsch" 6 "Reserved" 7 "Português" 8-9 "Reserved" 10 "Nederlands"	

File E	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
UTILITY (File E)	Drive Memory	202	**[Voltage Class]** Configures the drive current rating and associates it with the selected voltage (i.e. 400 or 480V). This parameter is normally used when downloading parameter sets.	Default: Based on Drive Cat. No. Options: 2 "Low Voltage" 3 "High Voltage"	
		203	**[Drive Checksum]** Provides a checksum value that indicates whether or not a change in drive programming has occurred.	Default: Read Only Min/Max: 0/65535 Units: 1	
		204	E C v2 **[Dyn UsrSet Cnfg]** Enables/Disables dynamic selection of user parameter sets. **Important:** In dynamic mode, changes to the parameters are not saved to nonvolatile storage. Switching user sets restores the values last saved before enabling dynamic mode. 	
		205	E C v2 **[Dyn UsrSet Sel]** Selects user set if [Dyn UsrSet Cnfg] = xxx xx11. 	
		206	E C v2 **[Dyn UserSet Actv]** Read Only Indicates the active user set and if the operation is dynamic or normal. 	

File E	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
UTILITY (File E)	Diagnostics	209	**[Drive Status 1]**	Read Only	210

Present operating condition of the drive.

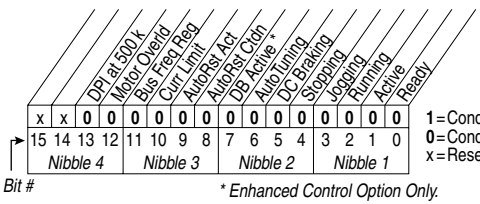


Bits (2)				
15	14	13	12	Description
0	0	0	0	Ref A Auto
0	0	0	1	Ref B Auto
0	0	1	0	Preset 2 Auto
0	0	1	1	Preset 3 Auto
0	1	0	0	Preset 4 Auto
0	1	0	1	Preset 5 Auto
0	1	1	0	Preset 6 Auto
0	1	1	1	Preset 7 Auto
1	0	0	0	TB Manual
1	0	0	1	Port 1 Manual
1	0	1	0	Port 2 Manual
1	0	1	1	Port 3 Manual
1	1	0	0	Port 4 Manual
1	1	0	1	Port 5 Manual
1	1	1	0	Port 6 Manual
1	1	1	1	Jog Ref

Bits (1)			
11	10	9	Description
0	0	0	Port 0 (TB)
0	0	1	Port 1
0	1	0	Port 2
0	1	1	Port 3
1	0	0	Port 4
1	0	1	Port 5
1	1	0	Port 6
1	1	1	No Local Control

210	**[Drive Status 2]**													Read Only		209

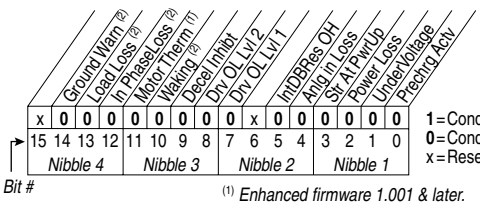
Present operating condition of the drive.



* *Enhanced Control Option Only.*

211	**[Drive Alarm 1]**													Read Only		212

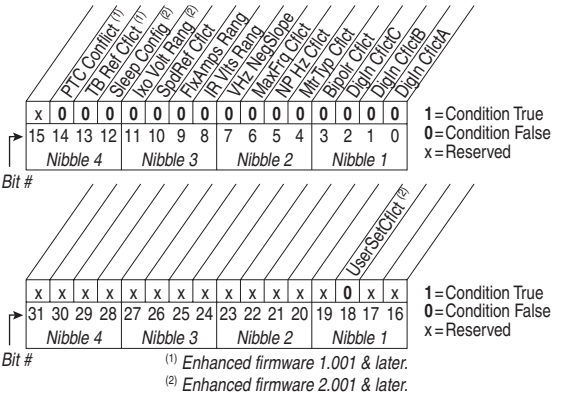
Alarm conditions that currently exist in the drive.



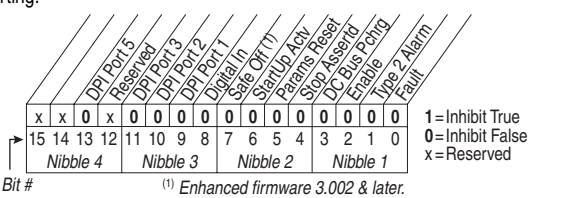
(1) *Enhanced firmware 1.001 & later.*

(2) *Enhanced firmware 2.001 & later.*

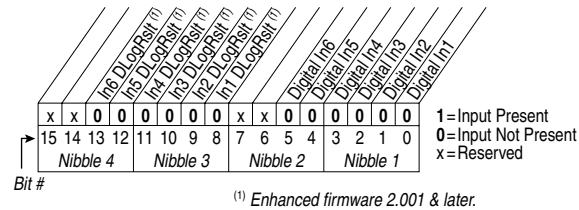
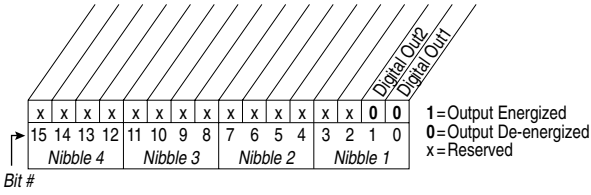
File E	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
UTILITY (File E)	Diagnostics	212	**[Drive Alarm 2]** Alarm conditions that currently exist in the drive.	Read Only	211
		213	**[Speed Ref Source]** Displays the source of the speed reference to the drive. (1) Enhanced Control Drives Only.	Default: Read Only Options: 0 "PI Output" 1 "Analog In 1" 2 "Analog In 2" 3-7 "Reserved" 8 "Encoder" 9 "MOP Level" 10 "Reserved" 11 "Preset Spd1" 12 "Preset Spd2" 13 "Preset Spd3" 14 "Preset Spd4" 15 "Preset Spd5" 16 "Preset Spd6" 17 "Preset Spd7" 18 "DPI Port 1" 19 "DPI Port 2" 20 "DPI Port 3" 21 "Reserved" 22 "DPI Port 5" 23-29 "Reserved" 30 "HighRes Ref"(1)	090 093 096 101
		214	**[Start Inhibits]** Displays the inputs currently preventing the drive from starting.	Read Only	

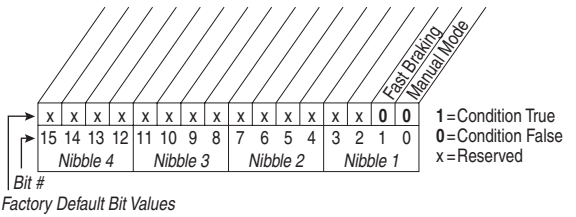
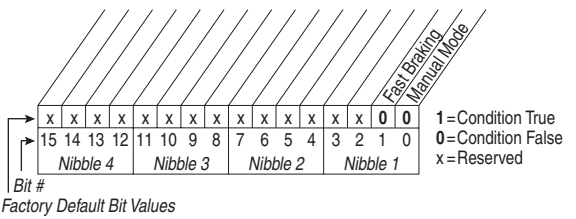


(1) *Enhanced firmware 1.001 & later.*
(2) *Enhanced firmware 2.001 & later.*

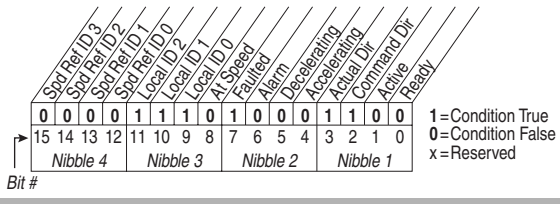


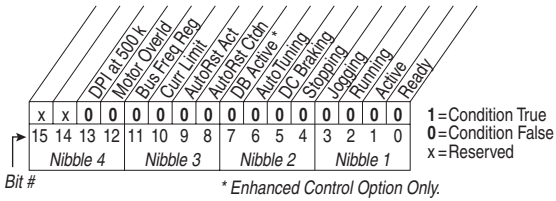
(1) *Enhanced firmware 3.002 & later.*

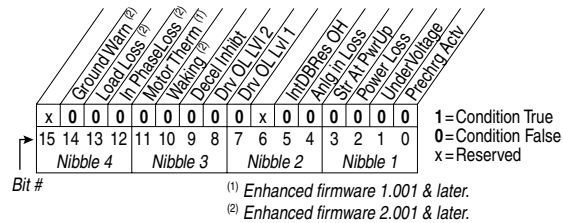
File E	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
UTILITY (File E)	Diagnostics	215	**[Last Stop Source]** Displays the source that initiated the most recent stop sequence. It will be cleared (set to 0) during the next start sequence.	Default: Read Only Options: 0 "Pwr Removed" 1 "DPI Port 1" 2 "DPI Port 2" 3 "DPI Port 3" 4 "Reserved" 5 "DPI Port 5" 6 "Reserved" 7 "Digital In" 8 "Fault" 9 "Not Enabled" 10 "Sleep" 11 "Jog" 12 "Autotune" EC 13 "Precharge" EC 14 "Safe Off" EC v3	361 362 363 364 365 366
		216	**[Dig In Status]** Status of the digital inputs.  (1) *Enhanced firmware 2.001 & later.*	Read Only	361 thru 366 411
		217	**[Dig Out Status]** Status of the digital outputs.  	Read Only	380 thru 384
		218	**[Drive Temp]** Present operating temperature of the drive power section.	Default: Read Only Min/Max: –/+100 degC 0.0/100.0% EC Units: 1.0 degC 0.1% EC	

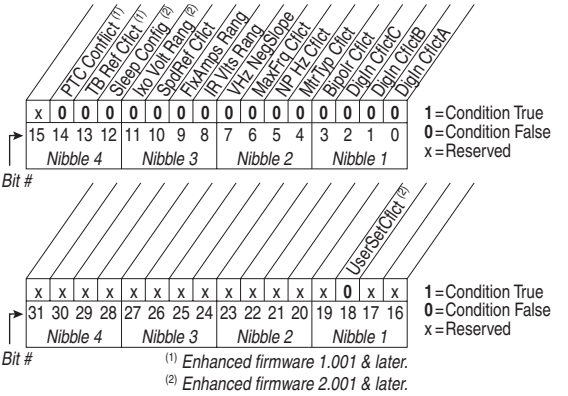
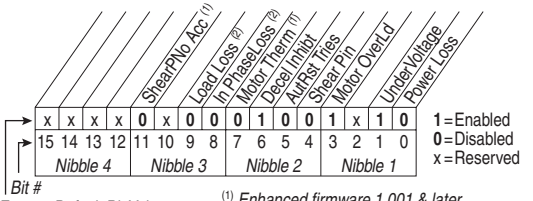
File E	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
UTILITY (File E)	Diagnostics	219	**[Drive OL Count]** Accumulated percentage of drive overload. Continuously operating the drive over 100% of its rating will increase this value to 100% and cause a drive fault or foldback depending on the setting of [Drive OL Mode].	Default: Read Only Min/Max: 0.0/100.0% Units: 0.1%	150
		220	**[Motor OL Count]** Accumulated percentage of motor overload. Continuously operating the motor over 100% of the motor overload setting will increase this value to 100% and cause a drive fault.	Default: Read Only Min/Max: 0.0/100.0% Units: 0.1%	047 048
		221	E C v3 **[Mtr OL Trip Time]** Amount of time before a drive Overload fault(F64) occurs if the load condition remains constant. A value of 99999 means that the drive is operating under the overload level.	Default: Read Only Min/Max: 0/99999 Units: 1	220
		222	E C v3 **[Drive Status 3]** Present operating condition of the drive. Manual Mode - See *Manual Speed Sources* on page 1-19. Fast Braking - Fast Braking is active, see [Stop/Brk Mode A] on page 3-30.  *Factory Default Bit Values*	Read Only	
		223	E C v3 **[Status 3 @ Fault]** Captures and displays [Drive Status 3] bit pattern at the time of the last fault.  *Factory Default Bit Values*	Read Only	

File E	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
UTILITY (File E)	Diagnostics	224	**[Fault Frequency]** Captures and displays the output speed of the drive at the time of the last fault.	Default: Read Only Min/Max: 0.0/+[Maximum Freq] Units: 0.1 Hz	225 thru 230
		225	**[Fault Amps]** Captures and displays motor amps at the time of the last fault.	Default: Read Only Min/Max: 0.0/[Rated Amps] × 2 Units: 0.1 Amps	224 thru 230
		226	**[Fault Bus Volts]** Captures and displays the DC bus voltage of the drive at the time of the last fault.	Default: Read Only Min/Max: 0.0/Max Bus Volts Units: 0.1 VDC	224 thru 230
		227	**[Status 1 @ Fault]** Captures and displays [Drive Status 1] bit pattern at the time of the last fault.	Read Only	209 224 thru 230
		228	**[Status 2 @ Fault]** Captures and displays [Drive Status 2] bit pattern at the time of the last fault.	Read Only	210 224 thru 230
		229	**[Alarm 1 @ Fault]** Captures and displays [Drive Alarm 1] at the time of the last fault.	Read Only	211 224 thru 230



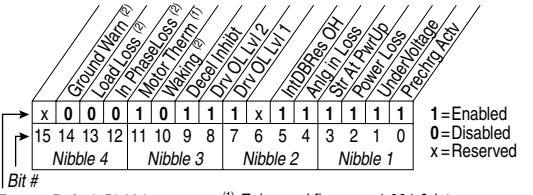




File E	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
UTILITY (File E)	Diagnostics	230	**[Alarm 2 @ Fault]** Captures and displays [Drive Alarm 2] at the time of the last fault.  (1) *Enhanced firmware 1.001 & later.* (2) *Enhanced firmware 2.001 & later.*	Read Only	212 224 thru 230
		234 236	**[Testpoint 1 Sel]** **[Testpoint 2 Sel]** Selects the function whose value is displayed value in [Testpoint x Data]. These are internal values that are not accessible through parameters. See Testpoint Codes and Functions on page 4-11 for a listing of available codes and functions.	Default: 499 Min/Max: 0/999 0/65535 EC Units: 1	
		235 237 EC 32	**[Testpoint 1 Data]** **[Testpoint 2 Data]** The present value of the function selected in [Testpoint x Sel].	Default: Read Only Min/Max: 0/65535 –/+2147483647 EC Units: 1	
	Faults	238	**[Fault Config 1]** Enables/disables annunciation of the listed faults.  (1) *Enhanced firmware 1.001 & later.* (2) *Enhanced firmware 2.001 & later.*		
		240	**[Fault Clear]** Resets a fault and clears the fault queue.	Default: 0 "Ready" Options: 0 "Ready" 1 "Clear Faults" 2 "Clr Flt Que"	

File E	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
UTILITY (File E)	Faults	241	**[Fault Clear Mode]** Enables/disables a fault reset (clear faults) attempt from any source. This does not apply to fault codes which are cleared indirectly via other actions.	Default: 1 "Enabled" Options: 0 "Disabled" 1 "Enabled"	
		242 32	**[Power Up Marker]** Elapsed hours since initial drive power up. This value will rollover to 0 after the drive has been powered on for more than the max value shown. For relevance to most recent power up see [Fault x Time].	Default: Read Only Min/Max: 0.0000/429496.7295 Hrs Units: 0.0001 Hrs	246
		243 245 247 249	**[Fault 1 Code]** **[Fault 2 Code]** **[Fault 3 Code]** **[Fault 4 Code]** A code that represents the fault that tripped the drive. The codes will appear in these parameters in the order they occur ([Fault 1 Code] = the most recent fault).	Default: Read Only Min/Max: 0/9999 0/65535 EC Units: 0	
		244 246 248 250	**[Fault 1 Time]** **[Fault 2 Time]** **[Fault 3 Time]** **[Fault 4 Time]**	Default: Read Only Min/Max: 0.0000/429496.7295 Hrs Units: 0.0001 Hrs	242
		32	The time between **initial** drive power up and the occurrence of the associated trip fault. Can be compared to [Power Up Marker] for the time from the most recent power up. [Fault x Time] – [Power Up Marker] = Time difference to the most recent power up. A negative value indicates fault occurred before most recent power up. A positive value indicates fault occurred after most recent power up. To convert this value to the number days, hours, minutes and seconds, the following formula may be used: Fault x Time / 24 hours = (# of days).(remaining time) Remaining Time x 24 hours = (# of hours).(remaining time) Remaining Time x 60 minutes = (# of minutes).(remaining seconds) Remaining Time x 60 seconds = (# of seconds) Result = (# of days).(# of hours).(# of minutes).(# of seconds) Example: 1909.2390 Hrs / 1 Day/24 Hrs = 79.551625 Days 0.551625 Days x 24 Hrs/Day = 13.239 Hrs 0.239 Hrs x 60 Min/Hr = 14.34 Min 0.34 Min x 60 Sec/Min = 20.4 Secs	

File E	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
UTILITY (File E)	Alarms	259	**[Alarm Config 1]** Enables/disables alarm conditions that will initiate an active drive alarm.		



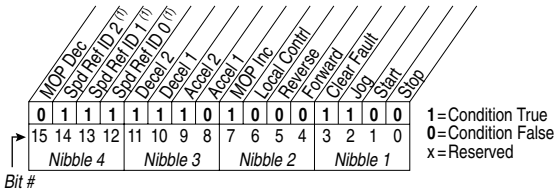
Factory Default Bit Values

(1) *Enhanced firmware 1.001 & later.*

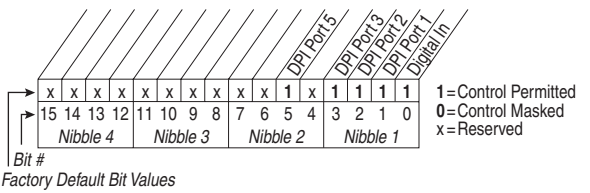
(2) *Enhanced firmware 2.001 & later.*

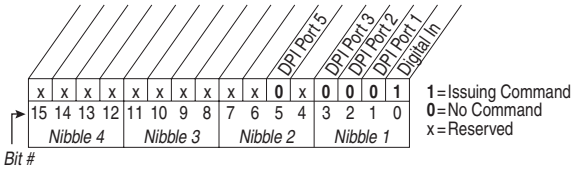
Communication File (File H)

File H	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
COMMUNICATION (File H)	Comm Control	270	**[DPI Data Rate]** Sets the baud rate for attached drive peripherals. When changing this value the drive must be reset for the change to take affect.	Default: 0 "125 kbps" Options: 0 "125 kbps" 1 "500 kbps"	
		271	**[Drive Logic Rslt]** The final logic command resulting from the combination of all DPI and discrete inputs. This parameter has the same structure as the product-specific logic command received via DPI and is used in peer to peer communications.	Read Only	
		272	**[Drive Ref Rslt]** Present frequency reference scaled as a DPI reference for peer to peer communications. The value shown is the value prior to the accel/decel ramp and any corrections supplied by slip comp, PI, etc.	Default: Read Only Min/Max: –/+32767 Units: 1	
		273	**[Drive Ramp Rslt]** Present frequency reference scaled as a DPI reference for peer to peer communications. The value shown is the value after the accel/decel ramp but prior to any corrections supplied by slip comp, PI, etc.	Default: Read Only Min/Max: –/+32767 Units: 1	

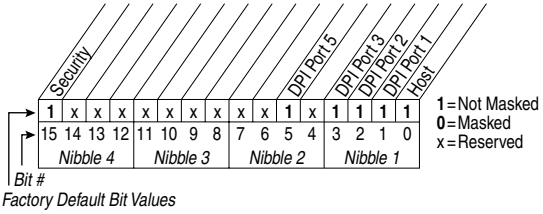
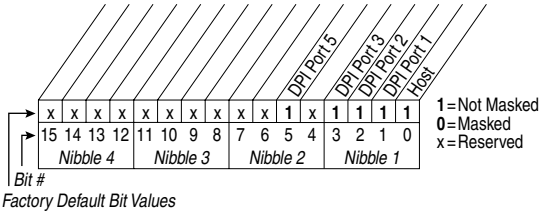
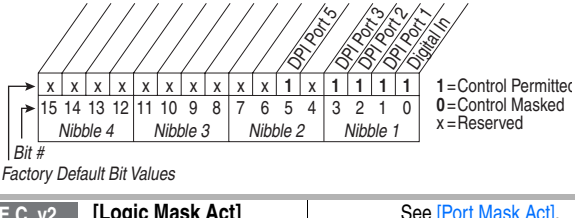


Bits(1)			
14	13	12	Description
0	0	0	No Command - Man. Mode
0	0	1	Ref A Auto
0	1	0	Ref B Auto
0	1	1	Preset 3 Auto
1	0	0	Preset 4 Auto
1	0	1	Preset 5 Auto
1	1	0	Preset 6 Auto
1	1	1	Preset 7 Auto

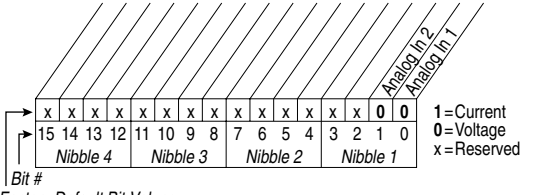
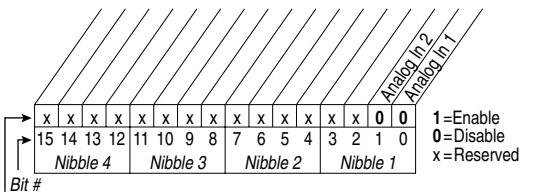
File H	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
COMMUNICATION (File H)	Comm Control	274	E C **[DPI Port Select]** Selects which port reference value will appear in [DPI Port Value].	Default: 0 "Not Used" Options: 0 "Not Used" 1 "DPI Port 1" 2 "DPI Port 2" 3 "DPI Port 3" 4 "Reserved" 5 "DPI Port 5"	
		275	E C **[DPI Port Value]** Value of the DPI reference selected in [DPI Port Sel].	Default: Read Only Min/Max: –/+32767 Units: 1	
		298	E C **[DPI Ref Select]** Scales DPI on [Maximum Freq] or [Maximum Speed]. This will adjust the resolution of the DPI reference.	Default: 0 "Max Freq" Options: 0 "Max Freq" 1 "Max Speed"	
	Masks & Owners	276	**[Logic Mask]** Determines which adapters can control the drive when 598, bit 15 is set to "1." If the bit for an adapter is "0," the adapter will have no control functions except for stop.  *Factory Default Bit Values*	288 thru 297
		277	**[Start Mask]** Controls which adapters can issue start commands.	See [Logic Mask].	288 thru 297
		278	**[Jog Mask]** Controls which adapters can issue jog commands.	See [Logic Mask].	288 thru 297
		279	**[Direction Mask]** Controls which adapters can issue forward/reverse direction commands.	See [Logic Mask].	288 thru 297
		280	**[Reference Mask]** Controls which adapters can select an alternate reference; [Speed Ref A, B Sel] or [Preset Speed 1-7].	See [Logic Mask].	288 thru 297
		281	**[Accel Mask]** Controls which adapters can select [Accel Time 1, 2].	See [Logic Mask].	288 thru 297
		282	**[Decel Mask]** Controls which adapters can select [Decel Time 1, 2].	See [Logic Mask].	288 thru 297
		283	**[Fault Clr Mask]** Controls which adapters can clear a fault.	See [Logic Mask].	288 thru 297

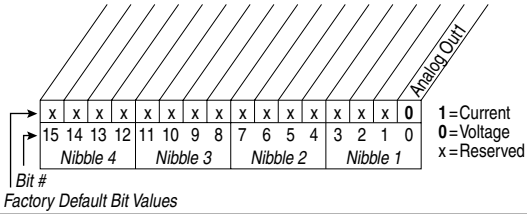
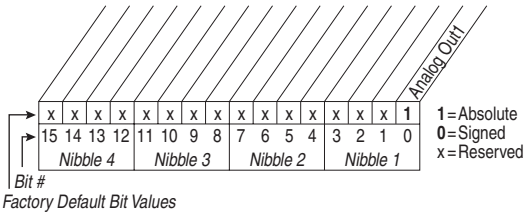
File H	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
COMMUNICATION (File H)	Masks & Owners	284	**[MOP Mask]** Controls which adapters can issue MOP commands to the drive.	See [Logic Mask].	288 thru 297
		285	**[Local Mask]** Controls which adapters are allowed to take exclusive control of drive logic commands (except stop). Exclusive "local" control can only be taken while the drive is stopped.	See [Logic Mask].	288 thru 297
		288	**[Stop Owner]** Adapters that are presently issuing a valid stop command.  	Read Only	276 thru 285
		289	**[Start Owner]** Adapters that are presently issuing a valid start command.	See [Stop Owner].	276 thru 285
		290	**[Jog Owner]** Adapters that are presently issuing a valid jog command.	See [Stop Owner].	276 thru 285
		291	**[Direction Owner]** Adapter that currently has exclusive control of direction changes.	See [Stop Owner].	276 thru 285
		292	**[Reference Owner]** Adapter that has the exclusive control of the command frequency source selection.	See [Stop Owner].	276 thru 285
		293	**[Accel Owner]** Adapter that has exclusive control of selecting [Accel Time 1, 2].	See [Stop Owner].	140 276 thru 285
		294	**[Decel Owner]** Adapter that has exclusive control of selecting [Decel Time 1, 2].	See [Stop Owner].	142 276 thru 285
		295	**[Fault Clr Owner]** Adapter that is presently clearing a fault.	See [Stop Owner].	276 thru 285
		296	**[MOP Owner]** Adapters that are currently issuing increases or decreases in MOP command frequency.	See [Stop Owner].	276 thru 285

File H	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
COMMUNICATION (File H)	Masks & Owners	297	**[Local Owner]** Adapter that has requested exclusive control of all drive logic functions. If an adapter is in local lockout, all other functions (except stop) on all other adapters are locked out and non-functional. Local control can only be obtained when the drive is not running.	See [Stop Owner].	276 thru 285
	Datalinks	300 301 ◯	**[Data In A1] -** Link A Word 1 **[Data In A2] -** Link A Word 2 Parameter number whose value will be written from a communications device data table. Parameters that can only be changed while drive is stopped cannot be used as Datalink inputs. Entering a parameter of this type will "Disable" the link. Refer to your communications option manual for datalink information.	Default: 0 (0 = "Disabled") Min/Max: 0/387 0/545 EC 0/598 EC v2 Units: 1	
		302 303 ◯	**[Data In B1] -** Link B Word 1 **[Data In B2] -** Link B Word 2	See [Data In A1] - Link A Word 1.	
		304 305 ◯	**[Data In C1] -** Link C Word 1 **[Data In C2] -** Link C Word 2	See [Data In A1] - Link A Word 1.	
		306 307 ◯	**[Data In D1] -** Link D Word 1 **[Data In D2] -** Link D Word 2	See [Data In A1] - Link A Word 1.	
		310 311	**[Data Out A1] -** Link A Word 1 **[Data Out A2] -** Link A Word 2 Parameter number whose value will be written to a communications device data table.	Default: 0 (0 = "Disabled") Min/Max: 0/387 0/545 EC 0/598 EC v2 Units: 1	
		312 313	**[Data Out B1] -** Link B Word 1 **[Data Out B2] -** Link B Word 2	See [Data Out A1] - Link A Word 1.	
		314 315	**[Data Out C1] -** Link C Word 1 **[Data Out C2] -** Link C Word 2	See [Data Out A1] - Link A Word 1.	
		316 317	**[Data Out D1] -** Link D Word 1 **[Data Out D2] -** Link D Word 2	See [Data Out A1] - Link A Word 1.	
		308 32	EC **[HighRes Ref]** Used as a high resolution, 32 bit reference with Datalinks. –/+[Maximum Freq] or –/+[Maximum Speed] = 2147418112	Default: 0 Min/Max: –/+2147483647 Units: 1	090 093 126 128 213 298

File H	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
COMMUNICATION (File H)	Security	595	E C v2 **[Port Mask Act]** Active status for port communication.  *Factory Default Bit Values*		
		596	E C v2 **[Write Mask Cfg]** Enables/disables write access (parameters, etc.) for ports. Changes to this parameter only become affective upon power cycle, drive reset or when 597, bit 15 transitions from “1” to “0.”  *Factory Default Bit Values*		
		597	E C v2 **[Write Mask Act]** Active status of write access for ports. Bit 15 determines if network security is controlling the write mask instead of 596.	See [Port Mask Act].	
		276	**[Logic Mask]** Determines which adapters can control the drive when 597, bit 15 is set to “1”. If the bit for a port is set to “0,” the port will have no control functions except for stop.  *Factory Default Bit Values*		288 thru 297
		598	E C v2 **[Logic Mask Act]** Active status of logic mask for ports. Bit 15 determines if network security is controlling the logic mask instead of 276.	See [Port Mask Act].	

Inputs & Outputs File (File J)

File J	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
INPUTS & OUTPUTS (File J)	Analog Inputs	320	**[Anlg In Config]** Selects the mode for the analog inputs.  *Factory Default Bit Values*		322 323
		321	**[Anlg In Sqr Root]** Enables/disables the square root function for each input.  *Factory Default Bit Values*		
		322 325	**[Analog In 1 Hi]** **[Analog In 2 Hi]** Sets the highest input value to the analog input x scaling block.	Default: 10.000 Volt 10.000 Volt Min/Max: 4.000/20.000 mA Standard, 0.000/20.000 mA EC, –/+10.000V, Units: 0.000/10.000V 0.001 mA, 0.001 Volt	091 092
		323 326	**[Analog In 1 Lo]** **[Analog In 2 Lo]** Sets the lowest input value to the analog input x scaling block.	Default: 0.000 Volt 0.000 Volt Min/Max: 4.000/20.000 mA, 0.000/10.000V (No. 323), –/+10.000V (No. 326) Units: 0.000/10.000V, 0.001 mA, 0.001 Volt	091 092
		324 327	**[Analog In 1 Loss]** **[Analog In 2 Loss]** Selects drive action when an analog signal loss is detected. Signal loss is defined as an analog signal less than 1V or 2mA. The signal loss event ends and normal operation resumes when the input signal level is greater than or equal to 1.5V or 3mA.	Default: 0 "Disabled" 0 "Disabled" Options: 0 "Disabled" 1 "Fault" 2 "Hold Input" 3 "Set Input Lo" 4 "Set Input Hi" 5 "Goto Preset1" 6 "Hold OutFreq"	091 092

File J	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
INPUTS & OUTPUTS (File J)	Analog Outputs	340	**E C [Anlg Out Config]** Selects the mode for the analog outputs.  *Factory Default Bit Values*		
		341	**[Anlg Out Absolut]** Selects whether the signed value or absolute value of a parameter is used before being scaled to drive the analog output.  *Factory Default Bit Values*		342
		342	**[Analog Out1 Sel]** Selects the source of the value that drives the analog output.	Default: 0 "Output Freq" Options: See Table	001 002 003 004 005 007 006 012 135 136 137 138 220 219 024 441 023 025 015 377

Options		[Analog Out1 Lo] Value *Param. 341= Signed*	 *Param. 341 = Absolute*	[Analog Out1 Hi] Value
0	"Output Freq"	–[Maximum Speed]	0 Hz	+[Maximum Speed]
1	"Command Freq"	–[Maximum Speed]	0 Hz	+[Maximum Speed]
2	"Output Amps"	0 Amps	0 Amps	200% Drive Rated
3	"Torque Amps"	–200%	0 Amps	200% Drive Rated
4	"Flux Amps"	0 Amps	0 Amps	200% Drive Rated
5	"Output Power"	0 kW	0 kW	200% Drive Rated
6	"Output Volts"	0 Volts	0 Volts	120% Drive Rated
7	"DC Bus Volts"	0 Volts	0 Volts	200% Drive Rated
8	"PI Reference" (1)	–100%	0%	100%
9	"PI Feedback"	–100%	0%	100%
10	"PI Error"	–100%	0%	100%
11	"PI Output"	–800%	0%	800%
12	"%Motor OL"	0%	0%	100%
13	"%Drive OL"	0%	0%	100%
14	"CommandedTrq:" (3)	–800%	0%	800% Motor Rated
15	"MtrTrqCurRef" (1)(3)	–200%	0 Amps	200% Motor Rated
16	"Speed Ref" (3)	–[Maximum Speed]	0 Hz	[Maximum Speed]
17	"Speed Fdbk" (3)	–[Maximum Speed]	0 Hz	[Maximum Speed]
19	"Torque Est" (1)(3)	–800%	0%	800% Motor Rated
24	"Param Cntl" (1)(2)			
25	"SpdFdBk NoFilt" (1)	–[Maximum Speed]	0 Hz	[Maximum Speed]

(1) Refer to Option Definitions on page 3-58.
(2) Enhanced firmware 1.001 & later.
(3) Enhanced firmware 2.002 & later.

File J	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
INPUTS & OUTPUTS (File J)	Analog Outputs	343	**[Analog Out1 Hi]** Sets the analog output value when the source value is at maximum.	Default: 10.00 Volts Min/Max: 0.00/10.00 Volts 0.00/20.00 mA EC Units: 0.01 Volt 0.01 mA EC	340 342
		344	**[Analog Out1 Lo]** Sets the analog output value when the source value is at minimum.	Default: 0.00 Volts Min/Max: 0.00/10.00 Volts 0.00/20.00 mA EC Units: 0.01 Volt 0.01 mA EC	340 342
		354	EC **[Anlg Out1 Scale]** Sets the high value for the range of analog out scale. Entering 0.0 will disable this scale and max scale will be used. Example: If [Analog Out Sel] = "Commanded Trq," a value of 150 = 150% scale in place of the default 800%.	Default: 0.0 Min/Max: [Analog Out1 Sel] Units: 0.01	
		377	EC **[Anlg Out1 Setpt]** Controls the analog output value from a communication device. Example Set [Data In A1] to "377" which will be the value from the communication device.	Default: 0.00 Volts Min/Max: 0.00/10.00 Volts 0.00/20.00 mA EC Units: 0.01 Volt 0.01 mA EC	340

File J	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
INPUTS & OUTPUTS (File J)	Digital Inputs	361 362 363 364 365 366	**[Digital In1 Sel]** **[Digital In2 Sel]** **[Digital In3 Sel]** **[Digital In4 Sel]** **[Digital In5 Sel]** **[Digital In6 Sel]**(7)	Default: 4 "Stop – CF"(1) Default: 5 "Start" Default: 18 "Auto/ Manual" Default: 15 "Speed Sel 1" Default: 16 "Speed Sel 2" Default: 17 "Speed Sel 3"	
			Selects the function for the digital inputs.	Options: 0 "Not Used" 1 "Enable"(6) 2 "Clear Faults"(1) 3 "Aux Fault" 4 "Stop – CF"(1) 5 "Start"(9)(11) 6 "Fwd/ Reverse"(9) 7 "Run"(10) 8 "Run Forward"(10) 9 "Run Reverse"(10) 10 "Jog"(9) "Jog1"(4) 11 "Jog Forward" 12 "Jog Reverse" 13 "Stop Mode B" 14 "Bus Reg Md B" 15-17 "Speed Sel 1-3"(2) 18 "Auto/ Manual"(8) 19 "Local" 20 "Acc2 & Dec2" 21 "Accel 2" 22 "Decel 2" 23 "MOP Inc"(12) 24 "MOP Dec"(12) 25 "Excl Link"(12) 26 "PI Enable" 27 "PI Hold" 28 "PI Reset" 29 "Reserved" 30 "Precharge En"(4)(12) 31-33 "Spd/Trq Sel1-3"(3)(13) 34 "Jog 2"(4) 35 "PI Invert"(4) 36-40 "Reserved" 41-42 "UserSet Sel1-2"(5) 43 "Run Level"(5)(12) 44 "RunFwd Level"(5)(12) 45 "RunRev Level"(5)(12) 46 "Run w/Comm"(5)(12) 47-57 "Reserved" 58 "Sync Enable"(13) 59 "Traverse Ena"(13)	100 156 162 096 140 194 380 125 088 108 124 205 620

(1) When [Digital Inx Sel] is set to option 2 "Clear Faults" the Stop button cannot be used to clear a fault condition.

(2)

3	2	1	"Speed Sel 1-3"
0	0	0	Reference A
0	0	1	Reference B
0	1	0	Preset Speed 2
0	1	1	Preset Speed 3
1	0	0	Preset Speed 4
1	0	1	Preset Speed 5
1	1	0	Preset Speed 6
1	1	1	Preset Speed 7

To access Preset Speed 1, set [Speed Ref A Sel] or [Speed Ref B Sel] to "Preset Speed 1".

(3)

3	2	1	"Spd/Trq Sel1-3"
0	0	0	Zero Torque
0	0	1	Spd Reg
0	1	0	Torque Reg
0	1	1	Min Spd/Trq
1	0	0	Max Spd/Trq
1	0	1	Sum Spd/Trq
1	1	0	Absolute
1	1	1	Zero Trq

(4) Enhanced Control Drives Only.

(5) Enhanced Firmware V2.001 and later.

(6) Opening an "Enable" input will cause the motor to coast-to-stop, ignoring any programmed Stop modes.

(7) A dedicated hardware enable input is available via a jumper selection. Refer to page 1-15 for further information.

(8) Auto/Manual - Refer to Figure 1.13 on page 1-19 for details.

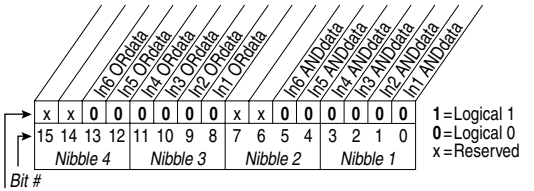
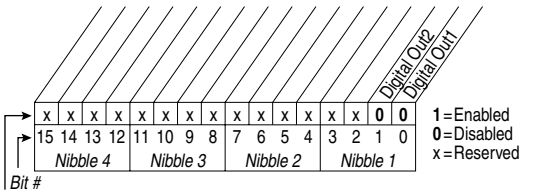
(9) Typical 3-Wire Inputs - Requires that only 3-wire functions are chosen. Including 2-wire selections will cause a type 2 alarm.

(10) Typical 2-Wire Inputs - Requires that only 2-wire functions are chosen. Including 3-wire selections will cause a type 2 alarm.

(11) A "Dig In ConflictB" alarm will occur if a "Start" input is programmed without a "Stop" input. Type 2 Alarms - Some digital input programming may cause conflicts that will result in a Type 2 alarm. Example: [Digital In1 Sel] set to 5 "Start" in 3-wire control and [Digital In2 Sel] set to 7 "Run" in 2-wire. Refer to Alarm Descriptions on page 4-7 for information on resolving this type of conflict.

(12) Refer to Option Definitions on page 3-58.

(13) Enhanced Firmware V3.002 and later.

File J	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
INPUTS & OUTPUTS (File J)	Digital Inputs	411	E C **[DigIn DataLogic]** Provides data to the logical operations that will be done with the digital inputs when parameter 056 is set to option 9 “DigIn DatLog”.  *Factory Default Bit Values*	056
	Digital Outputs	379	E C **[Dig Out Setpt]** Controls output relays (CRx) when parameter 380 or 384 is set to option 30 “Param Cntl”.  *Factory Default Bit Values*	

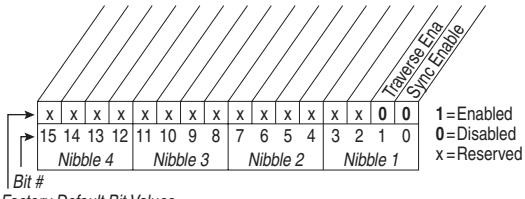
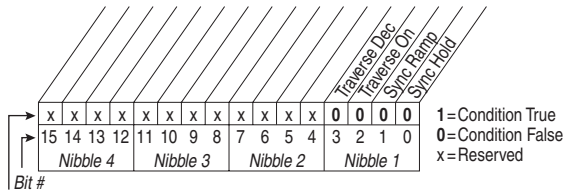
File J	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values			Related
INPUTS & OUTPUTS (File J)	Digital Outputs	380 384	**[Digital Out1 Sel]** **[Digital Out2 Sel]** Selects the drive status that will energize a (CRx) output relay. (1) Any relay programmed as Fault or Alarm will energize (pick up) when power is applied to drive and deenergize (drop out) when a fault or alarm exists. Relays selected for other functions will energize only when that condition exists and will deenergize when condition is removed. Refer to page 1-14. (2) Activation level is defined in [Dig Outx Level] below. (3) Enhanced Control Drives Only. (4) Enhanced Firmware V3.002 and later.	Default: Options:	1 4 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31-57 58 59	"Fault" "Run" "Fault"(1) "Alarm"(1) "Ready" "Run" "Forward Run" "Reverse Run" "Auto Restart" "Powerup Run" "At Speed" "At Freq"(2) "At Current"(2) "At Torque"(2) "At Temp"(2) "At Bus Volts"(2) "At PI Error"(2) "DC Braking" "Curr Limit" "Economize" "Motor Overld" "Power Loss" "Input 1 Link" "Input 2 Link" "Input 3 Link" "Input 4 Link" "Input 5 Link" "Input 6 Link" "PI Enabled"(3) "PI Hold"(3) "Drive Overld"(3) "Param Cntl"(3) ""Reserved" "Manual Mode"(4) "Fast Braking"(4)	381 385 382 383 002 001 003 004 218 012 137 157 147 053 048 184
		381 385	**[Dig Out1 Level]** **[Dig Out2 Level]** Sets the relay activation level for options 10 – 15 in [Digital Outx Sel]. Units are assumed to match the above selection (i.e. "At Freq" = Hz, "At Torque" = Amps).	Default: Min/Max: Units:	0.0 0.0 0.0/819.2 0.1		380
		382 386	**[Dig Out1 OnTime]** **[Dig Out2 OnTime]** Sets the "ON Delay" time for the digital outputs. This is the time between the occurrence of a condition and activation of the relay.	Default: Min/Max: Units:	0.0 Secs 0.0 Secs 0.0/600.0 Secs 0.1 Secs		380

File J	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
INPUTS & OUTPUTS (File J)	Digital Outputs	383 387	**[Dig Out1 OffTime]** **[Dig Out2 OffTime]** Sets the "OFF Delay" time for the digital outputs. This is the time between the disappearance of a condition and de-activation of the relay.	Default: 0.0 Secs 0.0 Secs Min/Max: 0.0/600.0 Secs Units: 0.1 Secs	380

Selected Option Definitions – [Analog Outx Sel], [Digital Inx Sel], [Digital Outx Sel]

Option	Description	Related
At Speed	Relay changes state when drive has reached commanded speed.	380
Excl Link	Links digital input to a digital output if the output is set to "Input 1-6 Link."	361
Input 1-6 Link	When Digital Output 1 is set to of these (i.e. Input 3 Link) in conjunction with Digital Input 3 set to "Excl Link," the Digital Input 3 state (on/off) is echoed in the Digital Output 1.	380
Manual Mode	Either the HIM or I/O Terminal Block (analog input) has control of the speed reference.	380
MOP Dec	Decrements speed reference as long as input is closed.	361
MOP Inc	Increments speed reference as long as input is closed.	361
MtrTrqCurRef	Torque producing current reference.	342
Param Cntl	Parameter controlled analog output allows PLC to control analog outputs through data links. Set in [AnlgX Out Setpt], parameters 377-378.	342
Param Cntl	Parameter controlled digital output allows PLC to control digital outputs through data links. Set in [Dig Out Setpt], parameter 379.	342
PI Reference	Reference for PI block (see Process PI for Standard Control on page C-11).	342
Precharge En	Forces drive into precharge state. Typically controlled by auxiliary contact on the disconnect at the DC input to the drive.	361
Run Level RunFwd Level RunRev Level	Provides a run level input. They do not require a transition for enable or fault, but a transition is still required for a stop.	
Run w/Comm	Allows the comms start bit to operate like a run with the run input on the terminal block. Ownership rules apply.	
SpdFdBk NoFilt	Provides an unfiltered value to an analog output. The filtered version "Speed Fdbk" includes a 125 ms filter.	342
Sync Enable	The fiber feature Synchronized Speed Change has been enabled. Allows a coordinated change in drive speeds to change machine speed.	622
Torque Est	Calculated percentage of rated motor torque.	342
Traverse Enable	The Traverse function has been enabled. This adds a triangle wave and square wave modulation to the speed reference.	623 624 625 626

Applications File (File K)

File K	Group	No.	Parameter Name & Description *See page 3-2 for symbol descriptions*	Values	Related
APPLICATIONS (File K)	Fiber Functions	620	E C v3 **[Fiber Control]** Controls the Sync and Traverse functions.  *Factory Default Bit Values*		
		621	E C v3 **[Fiber Status]** Read Only Status of Sync and Traverse functions.  *Factory Default Bit Values*		
		622	E C v3 **[Sync Time]** The time to ramp from the "held speed reference" to the current speed reference, after the Sync input is de-energized.	Default: 0.0 Secs Min/Max: 0.0/3600.0 Secs Units: 0.1 Secs	
		623	E C v3 **[Traverse Inc]** Sets the time period of increasing frequency.	Default: 0.00 Secs Min/Max: 0.00/30.00 Secs Units: 0.01 Secs	
		624	E C v3 **[Traverse Dec]** Sets the time period of decreasing frequency.	Default: 0.00 Secs Min/Max: 0.00/30.00 Secs Units: 0.01 Secs	
		625	E C v3 **[Max Traverse]** Sets the amplitude of the triangle wave speed modulation.	Default: 0.00 Hz Min/Max: 0.00/Maximum Speed Units: 0.01 Hz	
		626	E C v3 **[P Jump]** Sets the amplitude of the square wave speed modulation.	Default: 0.00 Hz Min/Max: 0.00/Maximum Speed Units: 0.01 Hz	

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Troubleshooting

Chapter 4 provides information to guide you in troubleshooting the PowerFlex 70. Included is a listing and description of drive faults (with possible solutions, when applicable) and alarms.

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Faults and Alarms

A fault is a condition that stops the drive. There are three fault types.

Type	Fault Description	
①	Auto-Reset Run	When this type of fault occurs, and [Auto Rstrt Tries] (see page 3-33) is set to a value greater than "0," a user-configurable timer, [Auto Rstrt Delay] (see page 3-33) begins. When the timer reaches zero, the drive attempts to automatically reset the fault. If the condition that caused the fault is no longer present, the fault will be reset and the drive will be restarted.
②	Non-Resettable	This type of fault normally requires drive or motor repair. The cause of the fault must be corrected before the fault can be cleared. The fault will be reset on power up after repair.
③	User Configurable	These faults can be enabled/disabled to annunciate or ignore a fault condition.

An alarm is a condition that, if left untreated, may stop the drive. There are two alarm types.

Type	Alarm Description	
①	User Configurable	These alarms can be enabled or disabled through [Alarm Config 1] on page 3-46.
②	Non-Configurable	These alarms are always enabled.

Drive Status

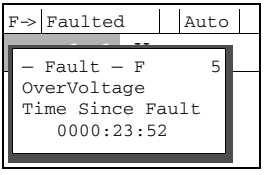
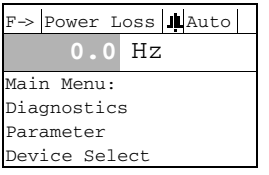
The condition or state of your drive is constantly monitored. Any changes will be indicated through the LEDs and/or the HIM (if present).

LED Indications

See page 2-2 for information on LED status indicators.

HIM Indication

The LCD and LED HIMs also provide visual notification of a fault or alarm condition.

Condition	Display
Drive is indicating a fault. The LCD HIM immediately reports the fault condition by displaying the following. • "Faulted" appears in the status line • Fault number • Fault name • Time that has passed since fault occurred Press Esc to regain HIM control. The LED HIM reports the fault condition by displaying the specific fault code.	LCD HIM  LED HIM
Drive is indicating an alarm. The LCD HIM immediately reports the alarm condition by displaying the following. • Alarm name (Type 2 alarms only) • Alarm bell graphic	LCD HIM  LED HIM No indication.

Manually Clearing Faults

Step	Key(s)
1. Press Esc to acknowledge the fault. The fault information will be removed so that you can use the HIM.	Esc
2. Address the condition that caused the fault. The cause must be corrected before the fault can be cleared.	
3. After corrective action has been taken, clear the fault by one of these methods. • Press Stop • Cycle drive power • Set parameter 240 [Fault Clear] to "1." • "Clear Faults" on the HIM Diagnostic menu.	

Fault Descriptions

Table 4.A Fault Types, Descriptions and Actions

Fault	No.	Type(1)	Description	Action
Analog In Loss	29	① ③	An analog input is configured to fault on signal loss. A signal loss has occurred. Configure with [Anlg In 1, 2 Loss] on page 3-52.	1. Check parameters. 2. Check for broken/loose connections at inputs.
Anlg Cal Chksum	108		The checksum read from the analog calibration data does not match the checksum calculated.	Replace drive.
Auto Rstrt Tries	33	③	Drive unsuccessfully attempted to reset a fault and resume running for the programmed number of [Flt RstRun Tries]. Enable/Disable with [Fault Config 1] on page 3-44.	Correct the cause of the fault and manually clear.
AutoTune Aborted	80		Autotune function was canceled by the user or a fault occurred.	Restart procedure.
Auxiliary Input	2	①	Auxiliary input interlock is open.	Check remote wiring.
Decel Inhibit	24	③	The drive is not following a commanded deceleration because it is attempting to limit bus voltage.	1. Verify input voltage is within drive specified limits. 2. Verify system ground impedance follows proper grounding techniques. 3. Disable bus regulation and/or add dynamic brake resistor and/or extend deceleration time.
Drive OverLoad	64		Drive rating of 110% for 1 minute or 150% for 3 seconds has been exceeded.	Reduce load or extend Accel Time.

Fault	No.	Type(1)	Description	Action
Drive Powerup E C v2	49		No fault displayed. Used as a Power Up Marker in the Fault Queue indicating that the drive power has been cycled.	
Enable Hardware E C	111		Safe-Off board is not installed and pins 3 and 4 of the Safe-Off Connector are not jumpered.	Install Safe-Off board or jumper pins 3 and 4.
			Safe-Off board has failed.	Replace Safe-Off board.
			Hardware enable circuitry failed.	Replace control board.
Encoder Loss E C v2	91		One or both encoder channel signals is missing.	1. Check Wiring. 2. Replace encoder.
Excessive Load	79		Motor did not come up to speed in the allotted time during autotune.	1. Uncouple load from motor. 2. Repeat Autotune.
Faults Cleared E C v2	52		No fault displayed. Used as a marker in the Fault Queue indicating that the fault clear function was performed.	
Flt QueueCleared E C v2	51		No fault displayed. Used as a marker in the Fault Queue indicating that the clear queue function was performed.	
FluxAmpsRef Rang	78		The value for flux amps determined by the Autotune procedure exceeds the programmed [Motor NP FLA].	1. Reprogram [Motor NP FLA] with the correct motor nameplate value. 2. Repeat Autotune.
Heatsink OvrTemp	8	①	Heatsink temperature exceeds 100% of [Drive Temp].	1. Verify that maximum ambient temperature has not been exceeded. 2. Check fan. 3. Check for excess load.
HW OverCurrent	12	①	The drive output current has exceeded the hardware current limit.	Check programming. Check for excess load, improper DC boost setting, DC brake volts set too high or other causes of excess current.
Incompat MCB-PB	106	②	Drive rating information stored on the power board is incompatible with the main control board.	Load compatible version files into drive.
Input Phase Loss E C v2	17		The DC bus ripple has exceeded a preset level.	Check incoming power for a missing phase/blown fuse.
IR Volts Range	77		"Calculate" is the autotune default and the value determined by the autotune procedure for IR Drop Volts is not in the range of acceptable values.	Re-enter motor nameplate data.
IXo VoltageRange E C v2	87		Voltage calculated for motor inductive impedance exceeds 25% of [Motor NP Volts].	1. Check for proper motor sizing. 2. Check for correct programming of [Motor NP Volts], parameter 41. 3. Additional output impedance may be required.
Load Loss E C v2	15		Drive output torque current is below [Load Loss Level] for a time period greater than [Load Loss time].	1. Verify connections between motor and load. 2. Verify level and time requirements.

Fault	No.	Type(1)	Description	Action
Motor OverLoad	7	① ③	Internal electronic overload trip. Enable/Disable with [Fault Config 1] on page 3-44.	An excessive motor load exists. Reduce load so drive output current does not exceed the current set by [Motor NP FLA].
Motor Thermistor E C	16		Thermistor output is out of range.	1. Verify that thermistor is connected. 2. Motor is overheated. Reduce load.
Overspeed Limit	25	①	Functions such as Slip Compensation or Bus Regulation have attempted to add an output frequency adjustment greater than that programmed in [Overspeed Limit].	Remove excessive load or overhauling conditions or increase [Overspeed Limit].
OverVoltage	5	①	DC bus voltage exceeded maximum value.	Monitor the AC line for high line voltage or transient conditions. Bus overvoltage can also be caused by motor regeneration. Extend the decel time or install dynamic brake option.
Parameter Chksum	100	②	The checksum read from the board does not match the checksum calculated.	1. Restore defaults. 2. Reload User Set if used.
Params Defaulted	48		The drive was commanded to write default values to EEPROM.	1. Clear the fault or cycle power to the drive. 2. Program the drive parameters as needed.
Phase U to Grnd	38		A phase to ground fault has been detected between the drive and motor in this phase.	1. Check the wiring between the drive and motor. 2. Check motor for grounded phase. 3. Replace drive.
Phase V to Grnd	39			
Phase W to Grnd	40			
Phase UV Short	41		Excessive current has been detected between these two output terminals.	1. Check the motor and drive output terminal wiring for a shorted condition. 2. Replace drive.
Phase VW Short	42			
Phase UW Short	43			
Port 1-5 DPI Loss	81-85		DPI port stopped communicating. A SCANport device was connected to a drive operating DPI devices at 500k baud.	1. If adapter was not intentionally disconnected, check wiring to the port. Replace wiring, port expander, adapters, Main Control Board or complete drive as required. 2. Check HIM connection. 3. If an adapter was intentionally disconnected and the [Logic Mask] bit for that adapter is set to “1”, this fault will occur. To disable this fault, set the [Logic Mask] bit for the adapter to “0.”
Port 1-5 Adapter	71-75		The communications card has a fault.	Check DPI device event queue and corresponding fault information for the device.

Fault	No.	Type[1]	Description	Action
Power Loss	3	① ③	DC bus voltage remained below 85% of nominal for longer than [Power Loss Time]. Enable/ Disable with [Fault Config 1] on page 3-44.	Monitor the incoming AC line for low voltage or line power interruption.
Pwr Brd Chksum1	104		The checksum read from the EEPROM does not match the checksum calculated from the EEPROM data.	Clear the fault or cycle power to the drive.
Pwr Brd Chksum2	105	②	The checksum read from the board does not match the checksum calculated.	1. Cycle power to the drive. 2. If problem persists, replace drive.
Replaced MCB-PB	107	②	Main Control Board was replaced and parameters were not programmed.	1. Restore defaults. 2. Reprogram parameters.
Shear Pin	63	③	Programmed [Current Lmt Val] has been exceeded. Enable/ Disable with [Fault Config 1] on page 3-44.	Check load requirements and [Current Lmt Val] setting.
SW OverCurrent	36	①	Drive output current has exceeded the 1ms current rating. This rating is greater than the 3 second current rating and less than the hardware overcurrent fault level. It is typically 200-250% of the drive continuous rating.	Check for excess load, improper DC boost setting. DC brake volts set too high.
Trnsistr OvrTemp	9	①	Output transistors have exceeded their maximum operating temperature.	1. Verify that maximum ambient temperature has not been exceeded. 2. Check fan. 3. Check for excessive load.
UnderVoltage	4	① ③	DC bus voltage fell below the minimum value of 509V DC at 600V input, 407V DC at 400/ 480V input or 204V DC at 200/ 240V input. Enable/Disable with [Fault Config 1] on page 3-44.	Monitor the incoming AC line for low voltage or power interruption.
UserSet1 Chksum	101	②	The checksum read from the user set does not match the checksum calculated.	Re-save user set.
UserSet2 Chksum	102	②		
UserSet3 Chksum	103	②		

(1) See page 4-1 for a description of fault types.

Table 4.B Fault Cross Reference

No.(1)	Fault
2	Auxiliary Input
3	Power Loss
4	UnderVoltage
5	OverVoltage
7	Motor Overload
8	Heatsink OvrTemp
9	Trnsistr OvrTemp
12	HW OverCurrent
15	Load Loss
16	Motor Thermistor
17	Input Phase Loss
24	Decel Inhibit
25	OverSpeed Limit
29	Analog In Loss
33	Auto Rstrt Tries
36	SW OverCurrent

No.(1)	Fault
38	Phase U to Grnd
39	Phase V to Grnd
40	Phase W to Grnd
41	Phase UV Short
42	Phase UW Short
43	Phase VW Short
48	Params Defaulted
49	Drive Powerup
51	Flt QueueCleared
52	Faults Cleared
63	Shear Pin
64	Drive Overload
71-75	Port 1-5 Adapter
77	IR Volts Range
78	FluxAmpsRef Rang

No.(1)	Fault
79	Excessive Load
80	AutoTune Aborted
81-85	Port 1-5 DPI Loss
87	IXo VoltageRange
91	Encoder Loss
100	Parameter Chksum
101	UserSet1 Chksum
102	UserSet2 Chksum
103	UserSet3 Chksum
104	Pwr Brd Chksum1
105	Pwr Brd Chksum2
106	Incompat MCB-PB
107	Replaced MCB-PB
108	Anlg Cal Chksum
111	Enable Hardware

(1) Fault numbers not listed are reserved for future use.

Clearing Alarms

Alarms are automatically cleared when the condition that caused the alarm is no longer present.

Alarm Descriptions

Table 4.C Alarm Descriptions and Actions

Alarm	No.	Type(1)	Description
Analog in Loss	5	①	An analog input is configured for “Alarm” on signal loss and signal loss has occurred.
Bipolar Conflict	20	②	Parameter 190 [Direction Mode] is set to “Bipolar” or “Reverse Dis” and one or more of the following digital input functions is configured: “Fwd/Reverse”, “Run Forward”, “Run Reverse”, “Jog Forward”, or “Jog Reverse”.
Decel Inhibit	10	①	Drive is being inhibited from decelerating.

Alarm	No.	Type(1)	Description
Dig In ConflictA	17	②	Digital input functions are in conflict. Combinations marked with a "●" will cause an alarm.

	Acc2/Dec2	Accel 2	Decel 2	Jog	Jog Fwd	Jog Rev	Fwd/Rev
Acc2 / Dec2		●	●				
Accel 2	●						
Decel 2	●						
Jog					●	●	
Jog Fwd				●			●
Jog Rev				●			●
Fwd / Rev					●	●	

Dig In ConflictB	18	②	A digital Start input has been configured without a Stop input or other functions are in conflict. Combinations that conflict are marked with a "●" and will cause an alarm.						

	Start	Stop–CF	Run	Run Fwd	Run Rev	Jog	Jog Fwd	Jog Rev	Fwd/ Rev
Start			●	●	●		●	●	
Stop–CF									
Run	●			●	●		●	●	
Run Fwd	●		●			●			●
Run Rev	●		●			●			●
Jog				●	●				
Jog Fwd	●		●						
Jog Rev	●		●						
Fwd / Rev				●	●				

Dig In ConflictC	19	②	More than one physical input has been configured to the same input function. Multiple configurations are not allowed for the following input functions.			
			Forward/Reverse	Run Reverse	Bus Regulation Mode B	
			Speed Select 1	Jog Forward	Acc2 / Dec2	
			Speed Select 2	Jog Reverse	Accel 2	
			Speed Select 3	Run	Decel 2	
			Run Forward	Stop Mode B		
Drive OL Level 1	8	①	The calculated IGBT temperature requires a reduction in PWM frequency. If [Drive OL Mode] is disabled and the load is not reduced, an overload fault will eventually occur.			
Drive OL Level 2	9	①	The calculated IGBT temperature requires a reduction in Current Limit. If [Drive OL Mode] is disabled and the load is not reduced, an overload fault will eventually occur.			
FluxAmpsRef Rang	26	②	The calculated or measured Flux Amps value is not within the expected range. Verify motor data and rerun motor tests.			
Ground Warn E C v2	15	①	Ground current has exceeded the level set in [Gnd Warn Level].			
In Phase Loss E C v2	13	①	The DC bus ripple has exceeded the level in [Phase Loss Level].			
IntDBRes OvrHeat	6	①	The drive has temporarily disabled the DB regulator because the resistor temperature has exceeded a predetermined value.			

Alarm	No.	Type(1)	Description
IR Volts Range	25	②	The drive auto tuning default is “Calculate” and the value calculated for IR Drop Volts is not in the range of acceptable values. This alarm should clear when all motor nameplate data is properly entered.
IXo VoltageRange E C v2	28	②	Motor leakage inductance is out of range.
Load Loss E C v2	14		Output torque current is below [Load Loss Level] for a time period greater than [Load Loss time].
MaxFreq Conflict	23	②	The sum of [Maximum Speed] and [Overspeed Limit] exceeds [Maximum Freq]. Raise [Maximum Freq] or lower [Maximum Speed] and/or [Overspeed Limit] so that the sum is less than or equal to [Maximum Freq].
Motor Thermistor E C	12		[Fault Config 1] or [Alarm Config 1] Bit 7 “Motor Therm” is enabled and the analog Input voltage is <0.2 Volts or >5.0 Volts.
Motor Type Cflct	21	②	[Motor Type] has been set to “Synchr Reluc” or “Synchr PM” and one or more of the following exist: • [Torque Perf Mode] = “Sensrls Vect,” “SV Economize” or “Fan/Pmp V/Hz.” • [Flux Up Time] is greater than 0.0 Secs. • [Speed Mode] is set to “Slip Comp.” • [Autotune] = “Static Tune” or “Rotate Tune.”
NP Hz Conflict	22	②	Fan/pump mode is selected in [Torq Perf Mode] and the ratio of [Motor NP Hertz] to [Maximum Freq] is greater than 26.
Power Loss	3	①	Drive has sensed a power line loss.
Precharge Active	1	①	Drive is in the initial DC bus precharge state.
PTC Conflict E C	31		[Fault Config 1] or [Alarm Config 1] Bit 7 “Motor Therm” is enabled and Analog In 1 is set to milliamperes.
Sleep Config E C v2	29	②	Sleep/Wake configuration error. With [Sleep-Wake Mode] = “Direct,” possible causes include: drive is stopped and [Wake Level] < [Sleep Level]. “Stop=CF,” “Run,” “Run Forward,” or “Run Reverse.” is not configured in [Digital Inx Sel].
Speed Ref Cflct	27	②	[Speed Ref x Sel] or [PI Reference Sel] is set to “Reserved”.
Start At PowerUp	4	①	[Start At PowerUp] is enabled. Drive may start at any time within 10 seconds of drive powerup.

Alarm	No.	Type(1)	Description
TB Man Ref Cflct E C	30		Occurs when: • "Auto/Manual" is selected (default) for [Digital In3 Sel], parameter 363 *and* • [TB Man Ref Sel], parameter 96 has been reprogrammed. No other use for the selected analog input may be programmed. Example: If [TB Man Ref Sel] is reprogrammed to "Analog In 2," all of the factory default uses for "Analog In 2" must be reprogrammed (such as parameters 90, 117, 128 and 179). See also Auto/Manual Examples on page 1-20. To correct: • Verify/reprogram the parameters that reference an analog input *or* • Reprogram [Digital In3] to another function or "Unused."
UnderVoltage	2	①	The bus voltage has dropped below a predetermined value.
UserSet Conflict E C v2	51	②	[Digital Inx Sel] values differ in different user sets.
VHz Neg Slope	24	②	[Torq Perf Mode] = "Custom V/Hz" and the V/Hz slope is negative.
Waking E C v2	11	①	The Wake timer is counting toward a value that will start the drive.

(1) See page 4-1 for a description of alarm types.

Table 4.D Alarm Cross Reference

No.(1)	Alarm
1	Precharge Active
2	UnderVoltage
3	Power Loss
4	Start At PowerUp
5	Analog in Loss
6	IntDBRes OvrHeat
8	Drive OL Level 1
9	Drive OL Level 2
10	Decel Inhibit
11	Waking

No.(1)	Alarm
12	Motor Thermistor
13	In Phase Loss
14	Load Loss
15	Ground Warn
17	Dig In ConflictA
18	Dig In ConflictB
19	Dig In ConflictC
20	Bipolar Conflict
21	Motor Type Cflct
22	NP Hz Conflict

No.(1)	Alarm
23	MaxFreq Conflict
24	VHz Neg Slope
25	IR Volts Range
26	FluxAmpsRef Rang
27	Speed Ref Cflct
28	Ixo Vlt Rang
29	Sleep Config
30	TB Man Ref Cflct
31	PTC Conflict
51	UserSet Conflict

(1) Alarm numbers not listed are reserved for future use.

Testpoint Codes and Functions

Code Selected in [Testpoint x Sel]	Function Whose Value is Displayed in [Testpoint x Data]
1	DPI Error Status
2	Heatsink Temperature
3	Active Current Limit
4	Active PWM Frequency
5	Lifetime MegaWatt Hours(1)
6	Lifetime Run Time
7	Lifetime Powered Up Time
8	Lifetime Power Cycles
9	Life MegaWatt Hours Fraction(1)
10	Life MegaWatt Hours Fraction Units(1)
11-99	Reserved for Factory Use

(1) Use the equation below to calculate total Lifetime MegaWatt Hours.

$$\left(\frac{\text{Value of Code 9}}{\text{Value of Code 10}} \times 0.1\right) + \text{Value of Code 5} = \text{Total Lifetime MegaWatt Hours}$$

Common Symptoms and Corrective Actions

Drive does not Start from Start or Run Inputs wired to the terminal block.

Cause(s)	Indication	Corrective Action
Drive is Faulted	Flashing red status light	Clear fault. • Press Stop • Cycle power • Set [Fault Clear] to 1 (See page 3-44) • "Clear Faults" on the HIM Diagnostic menu
Incorrect input wiring. See page 1-17 for wiring examples. • 2 wire control requires Run, Run Forward, Run Reverse or Jog input. • 3 wire control requires Start and Stop inputs • Jumper from terminal 7 to 8 is required.	None	Wire inputs correctly and/or install jumper.
Incorrect digital input programming. • Mutually exclusive choices have been made (i.e., Jog and Jog Forward). • 2 wire and 3 wire programming may be conflicting. • Exclusive functions (i.e, direction control) may have multiple inputs configured. • Stop is factory default and is not wired.	None	Program [Digital Inx Sel] for correct inputs. (See page 3-55) Start or Run programming may be missing.
	Flashing yellow status light and "DigIn CflctB" indication on LCD HIM. [Drive Status 2] shows type 2 alarm(s).	Program [Digital Inx Sel] to resolve conflicts. (See page 3-55) Remove multiple selections for the same function. Install stop button to apply a signal at stop terminal.

Drive does not Start from HIM.

Cause(s)	Indication	Corrective Action
Drive is programmed for 2 wire control. HIM Start button is disabled for 2 wire control.	None	If 2 wire control is required, no action is necessary. If 3 wire control is required, program [Digital Inx Sel] for correct inputs. (See page 3-55)

Drive does not respond to changes in speed command.

Cause(s)	Indication	Corrective Action
No value is coming from the source of the command.	LCD HIM Status Line indicates “At Speed” and output is 0 Hz.	1. If the source is an analog input, check wiring and use a meter to check for presence of signal. 2. Check [Commanded Freq] for correct source. (Param #002, page 3-11)
Incorrect reference source has been programmed.	None	3. Check [Speed Ref Source] for the source of the speed reference. (Param #213, page 3-40) 4. Reprogram [Speed Ref A Sel] for correct source. (Param #090, page 3-22)
Incorrect Reference source is being selected via remote device or digital inputs.	None	5. Check [Drive Status 1], bits 12 and 13 for unexpected source selections. (Param #209, page 3-39) 6. Check [Dig In Status] to see if inputs are selecting an alternate source. (Param #216, page 3-41) 7. Reprogram digital inputs to correct “Speed Sel x” option. (See page 3-55)

Motor and/or drive will not accelerate to commanded speed.

Cause(s)	Indication	Corrective Action
Acceleration time is excessive.	None	Reprogram [Accel Time x]. (See page 3-29)
Excess load or short acceleration times force the drive into current limit, slowing or stopping acceleration.	None	Check [Drive Status 2], bit 10 to see if the drive is in Current Limit. (See page 3-39) Remove excess load or reprogram [Accel Time x]. (See page 3-29)
Speed command source or value is not as expected.	None	Check for the proper Speed Command using Steps 1 through 7 above.
Programming is preventing the drive output from exceeding limiting values.	None	Check [Maximum Speed] (Param #082, page 3-20) and [Maximum Freq] (Param #055, page 3-14) to assure that speed is not limited by programming.

Motor operation is unstable.

Cause(s)	Indication	Corrective Action
Motor data was incorrectly entered or Autotune was not performed.	None	1. Correctly enter motor nameplate data. 2. Perform “Static” or “Rotate” Autotune procedure. (Param #061, page 3-16)

Drive will not reverse motor direction.

Cause(s)	Indication	Corrective Action
Digital input is not selected for reversing control.	None	Check [Digital Inx Sel] (See page 3-55). Choose correct input and program for reversing mode.
Digital input is incorrectly wired.	None	Check input wiring. (See page 1-14)
Direction mode parameter is incorrectly programmed.	None	Reprogram [Direction Mode] for analog "Bipolar" or digital "Unipolar" control. (Param #190, page 3-36)
Motor wiring is improperly phased for reverse.	None	Switch two motor leads.
A bipolar analog speed command input is incorrectly wired or signal is absent.	None	1. Use meter to check that an analog input voltage is present. 2. Check wiring. (See page 1-17) Positive voltage commands forward direction. Negative voltage commands reverse direction.

Stopping the drive results in a Decel Inhibit fault.

Cause(s)	Indication	Corrective Action
The bus regulation feature is enabled and is halting deceleration due to excessive bus voltage. Excess bus voltage is normally due to excessive regenerated energy or unstable AC line input voltages. Internal timer has halted drive operation.	Decel Inhibit fault screen. LCD Status Line indicates "Faulted".	1. See Attention statement on Preface-4. 2. Reprogram bus regulation (parameters 161 and 162) to eliminate any "Adjust Freq" selection. 3. Disable bus regulation (parameters 161 and 162) and add a dynamic brake. 4. Correct AC input line instability or add an isolation transformer. 5. Reset drive.

Supplemental Drive Information

For information on…	See page…
Specifications	A-1
Communication Configurations	A-4
Dimensions	A-7
Output Devices	A-14
Drive, Fuse & Circuit Breaker Ratings	A-14

Specifications

Category	Specification						
Protection	**Drive**	**200-208V**	**240V**	**380/400**	**480V**	**600V**	**690V**
	AC Input Overvoltage Trip:	247VAC	285VAC	475VAC	570VAC	690VAC	
	AC Input Undervoltage Trip:	120VAC	138VAC	233VAC	280VAC	345VAC	
	Bus Overvoltage Trip:	405VDC	405VDC	810VDC	810VDC	1013VDC	
	Bus Undervoltage Output Shutoff:	300VDC	300VDC	407V DC	407V DC	508V DC	
	Bus Undervoltage Fault Level:	160VDC	160VDC	300VDC	300VDC	375VDC	
	Nominal Bus Voltage:	281VDC	324VDC	540VDC	648VDC	810VDC	
	All Drives						
	Heat Sink Thermistor:	Monitored by microprocessor overtemp trip					
	Drive Overcurrent Trip Software Current Limit: Hardware Current Limit: Instantaneous Current Limit:	 20-160% of rated current 200% of rated current (typical) 220-300% of rated current (dependent on drive rating)					
	Line transients:	up to 6000 volts peak per IEEE C62.41-1991					
	Control Logic Noise Immunity:	Showering arc transients up to 1500V peak					
	Power Ride-Thru:	15 milliseconds at full load					
	Logic Control Ride-Thru:	0.5 seconds minimum, 2 seconds typical					
	Ground Fault Trip:	Phase-to-ground on drive output					
	Short Circuit Trip:	Phase-to-phase on drive output					
Environment	Altitude:	1000 m (3300 ft) max. without derating					
	Maximum Surrounding Air Temperature without derating: IP20, NEMA Type 1: Flange Mount: IP66, NEMA Type 4X/12:	 0 to 50 degrees C (32 to 122 degrees F) 0 to 50 degrees C (32 to 122 degrees F) 0 to 40 degrees C (32 to 104 degrees F)					
	Storage Temperature (all const.):	–40 to 70 degrees C (–40 to 158 degrees F)					
	Atmosphere	**Important:** Drive **must not** be installed in an area where the ambient atmosphere contains volatile or corrosive gas, vapors or dust. If the drive is not going to be installed for a period of time, it must be stored in an area where it will not be exposed to a corrosive atmosphere.					
	Relative Humidity:	5 to 95% non-condensing					
	Shock:	15G peak for 11ms duration (±1.0 ms)					
	Vibration:	0.152 mm (0.006 in.) displacement, 1G peak					

Category	Specification				
Agency Certification	**Type 1, IP30**	**Flange Type**	**Type 4X/12, IP66**		
	✔	✔	✔	c UL us	Listed to UL508C and CAN/CSA-C2.2 No. 14-M91
		✔			Listed to UL508C for plenums (Rear heatsink only)
	✔	✔	✔	CE	Marked for all applicable European Directives (1) EMC Directive (89/336/EEC) EN 61800-3 Adjustable Speed electrical power drive systems Low Voltage Directive (73/23/EEC) EN 50178 Electronic Equipment for use in Power Installations
	✔	✔	✔	N223	Certified to AS/NZS, 1997 Group 1, Class A
			✔	NSF	Certified to Criteria C-2, 1983.
	✔	✔	✔	EMC TÜV EN 50178 TÜV Rheinland FS	Certified to EN 954-1, Category 3 for 240V, 400V, and 480V ratings of PowerFlex 70 Enhanced Control with DriveGuard Safe-Off option.
	✔	✔	✔		TUV Approved to EN 954-1, Category 3 for 600V ratings of PowerFlex 70 Enhanced Control with DriveGuard Safe-Off option.
	The drive is also designed to meet the appropriate portions of the following specifications: NFPA 70 - US National Electrical Code NEMA ICS 3.1 - Safety standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems. IEC 146 - International Electrical Code.				
Electrical	Voltage Tolerance:				–10% of minimum, +10% of maximum. See page C-14 for Full Power and Operating Range.
	Frequency Tolerance:				47-63 Hz.
	Input Phases:				Three-phase input provides full rating for all drives. Single-phase operation provides 50% of rated current.
	Displacement Power Factor (all drives):				0.98 across speed range.
	Efficiency:				97.5% at rated amps, nominal line volts.
	Maximum Short Circuit Rating:				200,000 Amps symmetrical.
	Max. Short Circuit Current Rating: Using Recommended Fuse or Circuit Breaker Type				Maximum short circuit current rating to match specified fuse/circuit breaker capability.
Control	Method:				Sine coded PWM with programmable carrier frequency. Ratings apply to all drives.
	Carrier Frequency:				2, 3, 4, 5, 6, 7, 8, 9 & 10 kHz Standard. 2, 4, 8 & 12 kHz EC. Drive rating based on 4 kHz.
	Output Voltage Range:				0 to rated motor voltage
	Output Frequency Range:				0 to 400 Hz Standard. 0 to 500 Hz EC.
	Frequency Accuracy Digital Input: Analog Input:				 Within ±0.01% of set output frequency. Within ±0.4% of maximum output frequency.

Category	Specification	
Control *(continued)*	Frequency Control - Speed Regulation	with Slip Compensation (V/Hz Mode) 0.5% of base speed across 40:1 speed range 40:1 operating range 10 rad/sec bandwidth
		with Slip Compensation (Sensorless Vector Mode) 0.5% of base speed across 80:1 speed range 80:1 operating range 20 rad/sec bandwidth
		with feedback (Sensorless Vector Mode) EC 0.1% of base speed across 80:1 speed range 80:1 operating range 20 rad/sec bandwidth
	Speed Control - Speed Regulation	without feedback (Vector Control Mode) EC 0.1% of base speed across 120:1 speed range 120:1 operating range 30 rad/sec bandwidth
		with feedback (Vector Control Mode) EC 0.001% of base speed across 120:1 speed range 1000:1 operating range 125 rad/sec bandwidth
	Torque Regulation	without feedback +/-10% EC
		with feedback +/-5% EC
	Selectable Motor Control:	Sensorless Vector with full tuning. Standard V/Hz with full custom capability and vector control.
	Stop Modes:	Multiple programmable stop modes including - Ramp, Coast, DC-Brake, Ramp-to-Hold and S-curve.
	Accel/Decel:	Two independently programmable accel & decel times. Each time may be programmed from 0-3600 seconds in 0.1 sec. increments
	Intermittent Overload:	110% Overload capability for up to 1 minute 150% Overload capability for up to 3 seconds
	Current Limit Capability:	Proactive Current Limit programmable from 20 to 160% of rated output current. Independently programmable proportional and integral gain.
	Electronic Motor Overload Protection:	Class 10 protection with speed sensitive response. Investigated by U.L. to comply with N.E.C. Article 430. U.L. File E59272, volume 12.
Encoder	Type:	Incremental, dual channel
	Supply:	5V/12V Configurable +/-5%
	Quadrature:	90° +/-27° at 25° C.
	Duty Cycle:	50% +10%
	Requirements	Encoders must be line driver type, quadrature (dual channel) or pulse (single channel), single-ended or differential and capable of supplying a minimum of 10 mA per channel. The Encoder Interface Board accepts 5V or 12V DC square-wave with a minimum high state voltage of 3.5V DC (5V mode) and 7.0V DC (12V mode). Maximum low state voltage is 1V DC (for both 5V and 12V modes). Maximum input frequency is 250 kHz.

(1) Applied noise impulses may be counted in addition to the standard pulse train causing erroneously high [Pulse Freq] readings.

Communication Configurations

Typical Programmable Controller Configurations

Important: If block transfers are programmed to continuously write information to the drive, care must be taken to properly format the block transfer. If attribute 10 is selected for the block transfer, values will be written only to RAM and will not be saved by the drive. This is the preferred attribute for continuous transfers. If attribute 9 is selected, each program scan will complete a write to the drives non-volatile memory (EEprom). Since the EEprom has a fixed number of allowed writes, continuous block transfers will quickly damage the EEprom. Do Not assign attribute 9 to continuous block transfers. Refer to the individual communications adapter User Manual for additional details.

Logic Command/Status Words

Figure A.1 Logic Command Word

Logic Bits																
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	**Command**	**Description**
															x	Stop[1]	0 = Not Stop 1 = Stop
														x		Start[1][2]	0 = Not Start 1 = Start
													x			Jog	0 = Not Jog 1 = Jog
												x				Clear Faults	0 = Not Clear Faults 1 = Clear Faults
										x	x					Direction	00 = No Command 01 = Forward Command 10 = Reverse Command 11 = Hold Present Direction
									x							Local Control	0 = No Local Control 1 = Local Control
								x								MOP Increment	0 = Not Increment 1 = Increment
						x	x									Accel Rate	00 = No Command 01 = Use Accel Time 1 10 = Use Accel Time 2 11 = Use Present Time
				x	x											Decel Rate	00 = No Command 01 = Use Decel Time 1 10 = Use Decel Time 2 11 = Use Present Time
	x	x	x													Reference Select[3]	000 = No Command 001 = Ref. 1 (Ref A Select) 010 = Ref. 2 (Ref B Select) 011 = Ref. 3 (Preset 3) 100 = Ref. 4 (Preset 4) 101 = Ref. 5 (Preset 5) 110 = Ref. 6 (Preset 6) 111 = Ref. 7 (Preset 7)
x																MOP Decrement	0 = Not Decrement 1 = Decrement

(1) A “0 = Not Stop” condition (logic 0) must first be present before a “1 = Start” condition will start the drive. The Start command acts as a momentary Start command. A “1” will start the drive, but returning to “0” will not stop the drive.

(2) This Start will not function if a digital input (parameters 361-366) is programmed for 2-Wire Control (option 7, 8 or 9).

(3) This Reference Select will not function if a digital input (parameters 361-366) is programmed for “Speed Sel 1, 2 or 3” (option 15, 16 or 17). When using the Logic Command Word for the speed reference selection, always set Bit 12, 13 or 14. Note that Reference Selection is “Exclusive Ownership” see [Reference Owner] on page 3-49.

Figure A.2 Logic Status Word

Logic Bits															Status	Description
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
															x	Ready	0 = Not Ready 1 = Ready
														x		Active	0 = Not Active 1 = Active
													x			Command Direction	0 = Reverse 1 = Forward
												x				Actual Direction	0 = Reverse 1 = Forward
											x					Accel	0 = Not Accelerating 1 = Accelerating
										x						Decel	0 = Not Decelerating 1 = Decelerating
									x							Alarm	0 = No Alarm 1 = Alarm
								x								Fault	0 = No Fault 1 = Fault
							x									At Speed	0 = Not At Reference 1 = At Reference
				x	x	x										Local Control[1]	000 = Port 0 (TB) 001 = Port 1 010 = Port 2 011 = Port 3 100 = Port 4 101 = Port 5 110 = Port 6 111 = No Local
x	x	x	x													Reference Source	0000 = Ref A Auto 0001 = Ref B Auto 0010 = Preset 2 Auto 0011 = Preset 3 Auto 0100 = Preset 4 Auto 0101 = Preset 5 Auto 0110 = Preset 6 Auto 0111 = Preset 7 Auto 1000 = Term Blk Manual 1001 = DPI 1 Manual 1010 = DPI 2 Manual 1011 = DPI 3 Manual 1100 = DPI 4 Manual 1101 = DPI 5 Manual 1110 = DPI 6 Manual 1111 = Jog Ref

(1) See “Owners” on page 3-49 for further information.

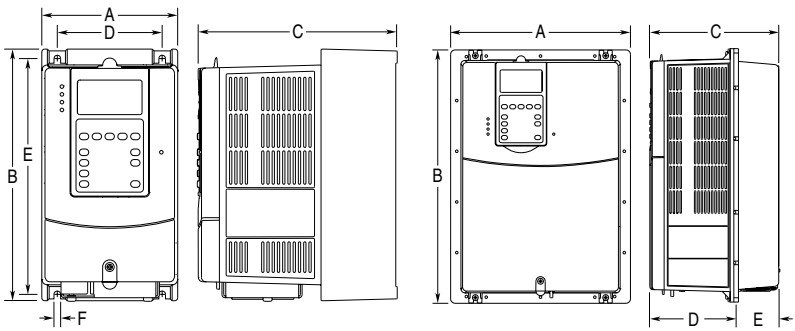
Dimensions

Table A.A PowerFlex 70 Frames

Output Power		Frame Size								
		208-240V AC Input			400-480V AC Input			600V AC Input		
kW ND (HD)	HP ND (HD)	*Not Filtered*	*Filtered*	*IP66 (4X/12)*	*Not Filtered*	*Filtered*	*IP66 (4X/12)*	*Not Filtered*	*Filtered*	*IP66 (4X/12)*
0.37 (0.25)	0.5 (0.33)	A	B	B	A	B	B	A	–	B
0.75 (0.55)	1 (0.75)	A	B	B	A	B	B	A	–	B
1.5 (1.1)	2 (1.5)	B	B	B	A	B	B	A	–	B
2.2 (1.5)	3 (2)	B	B	B	B	B	B	B	–	B
4 (3)	5 (3)	–	C	D	B	B	B	B	–	B
5.5 (4)	7.5 (5)	–	D	D	–	C	D	C	–	D
7.5 (5.5)	10 (7.5)	–	D	D	–	C	D	C	–	D
11 (7.5)	15 (10)	–	D	D	–	D	D	D	–	D
15 (11)	20 (15)	–	E	E	–	D	D	D	–	D
18.5 (15)	25 (20)	–	E	E	–	D	D	–	–	–
22 (18.5)	30 (25)	–	–	–	–	D	D	–	–	–
30 (22)	40 (30)	–	–	–	–	E	E	–	–	–
37 (30)	50 (40)	–	–	–	–	E	E	–	–	–

Figure A.3 PowerFlex 70 Frames A-E

IP20/66 (NEMA Type 1/4X/12) **Flange Mount**



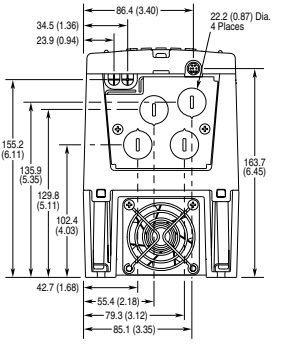
Dimensions are in millimeters and (inches).

Frame	A	B	C	D	E	F	Weight [1] *kg (lbs.)*
IP20 / NEMA Type 1							
A	122.4 (4.82)	225.7 (8.89)	179.8 (7.08)	94.2 (3.71)	211.6 (8.33)	5.8 (0.23)	2.71 (6.0)
B	171.7 (6.76)	234.6 (9.24)	179.8 (7.08)	122.7 (4.83)	220.2 (8.67)	5.8 (0.23)	3.60 (7.9)
C	185.0 (7.28)	300.0 (11.81)	179.8 (7.08)	137.6 (5.42)	285.6 (11.25)	5.8 (0.23)	6.89 (15.2)
D	219.9 (8.66)	350.0 (13.78)	179.8 (7.08)	169.0 (6.65)	335.6 (13.21)	5.8 (0.23)	9.25 (20.4)
E	280.3 (11.04)	555.8 (21.88)	207.1 (8.15)	200.0 (7.87)	491.0 (19.33)	6.9 (0.27)	18.60 (41.0)
IP66 / NEMA Type 4X/12							
B	171.7 (6.76)	239.8 (9.44)	203.3 (8.00)	122.7 (4.83)	220.2 (8.67)	5.8 (0.23)	3.61 (8.0)
D	219.9 (8.66)	350.0 (13.78)	210.7 (8.29)	169.0 (6.65)	335.6 (13.21)	5.8 (0.23)	9.13 (20.1)
E	280.3 (11.04)	555.8 (21.88)	219.8 (8.65)	200.0 (7.87)	491.0 (19.33)	6.9 (0.27)	18.60 (41.0)
Flange Mount							
A	156.0 (6.14)	225.8 (8.89)	178.6 (7.03)	123.0 (4.84)	55.6 (2.19)	–	2.71 (6.0)
B	205.2 (8.08)	234.6 (9.24)	178.6 (7.03)	123.0 (4.84)	55.6 (2.19)	–	3.60 (7.9)
C	219.0 (8.62)	300.0 (11.81)	178.6 (7.03)	123.0 (4.84)	55.6 (2.19)	–	6.89 (15.2)
D	248.4 (9.78)	350.0 (13.78)	178.6 (7.03)	123.0 (4.84)	55.6 (2.19)	–	9.25 (20.4)
E	280.3 (11.04)	555.8 (21.88)	207.1 (8.15)	117.2 (4.61)	89.9 (3.54)	–	18.60 (41.0)

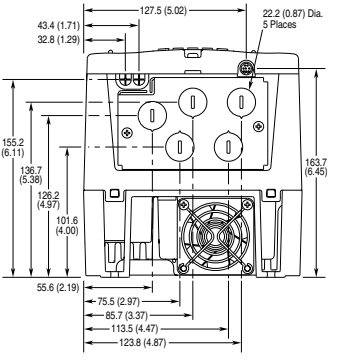
(1) Weights include HIM and Standard I/O.

Figure A.4 PowerFlex 70 IP20 / NEMA Type 1 Bottom View Dimensions

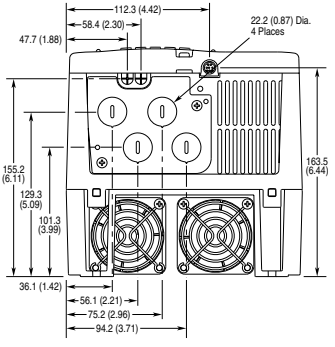
Frame A



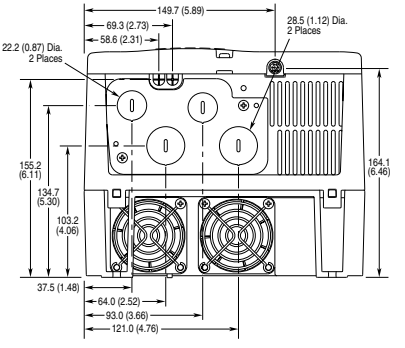
Frame B



Frame C



Frame D



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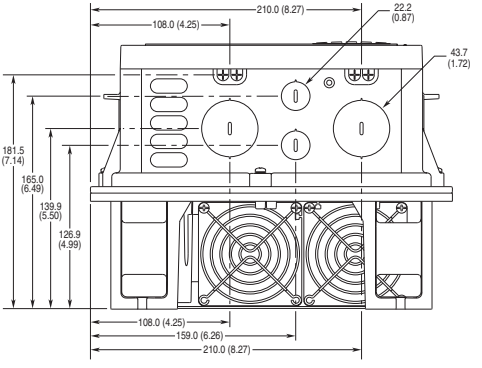
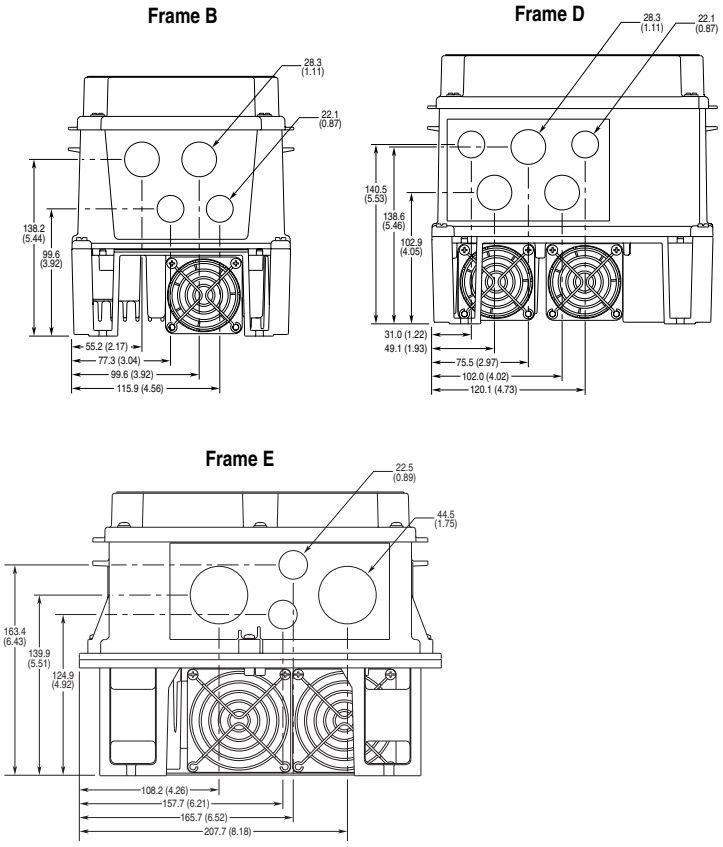


Dimensions are in millimeters and (inches).

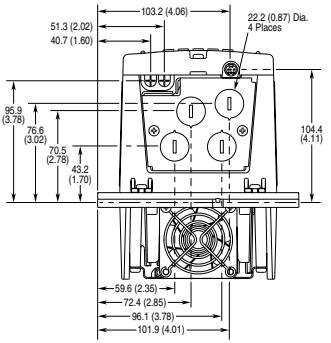
Figure A.5 PowerFlex 70 IP 66 (NEMA Type 4X/12) Bottom View Dimensions



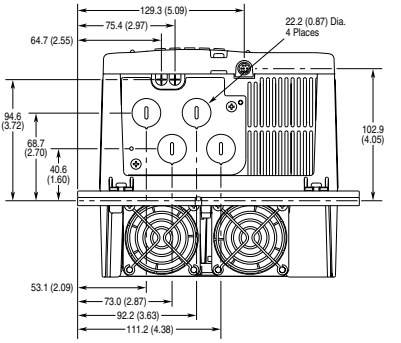
Dimensions are in millimeters and (inches).

Figure A.6 PowerFlex 70 Flange Mount Bottom View Dimensions

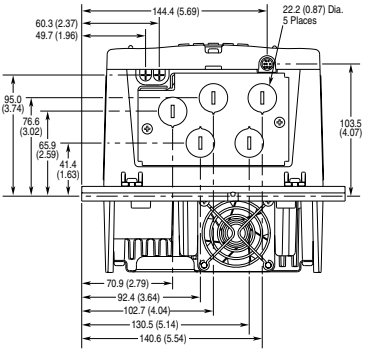
Frame A



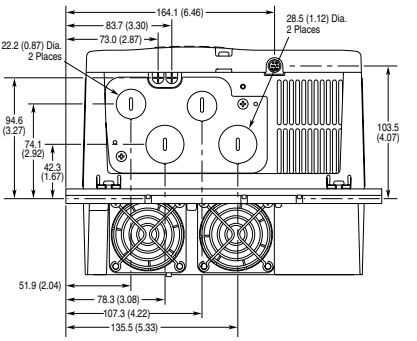
Frame C



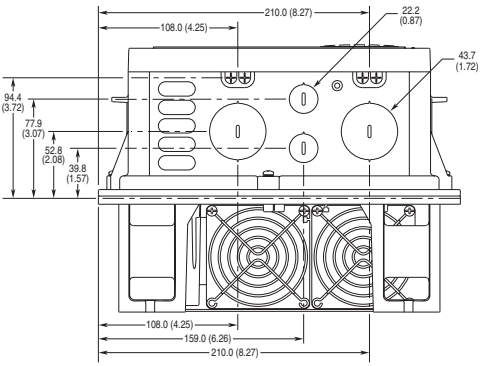
Frame B



Frame D



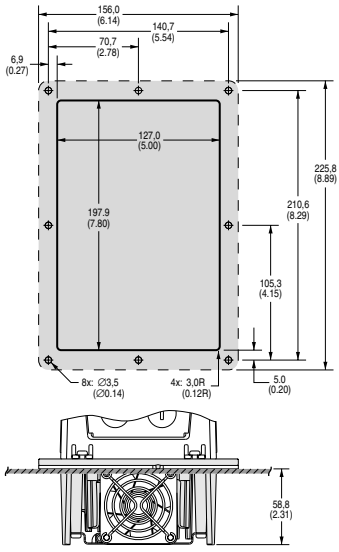
Frame E



Dimensions are in millimeters and (inches).

Figure A.7 PowerFlex 70 Cutout Dimensions

Frame A



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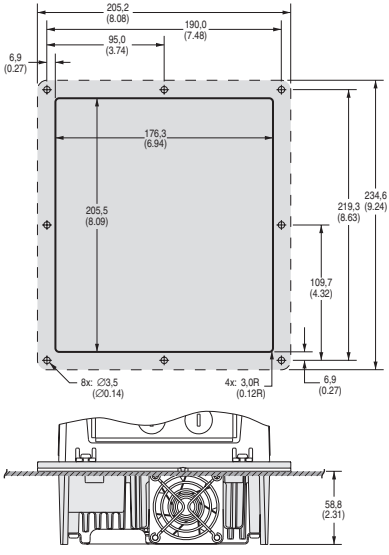
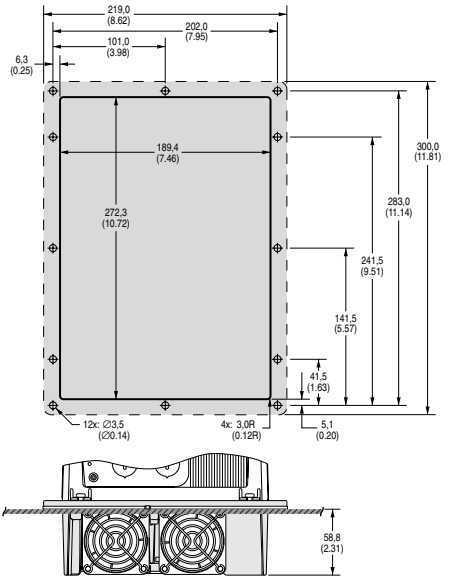
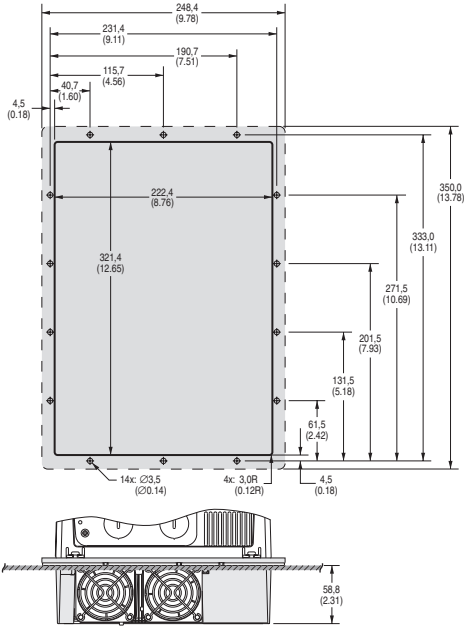


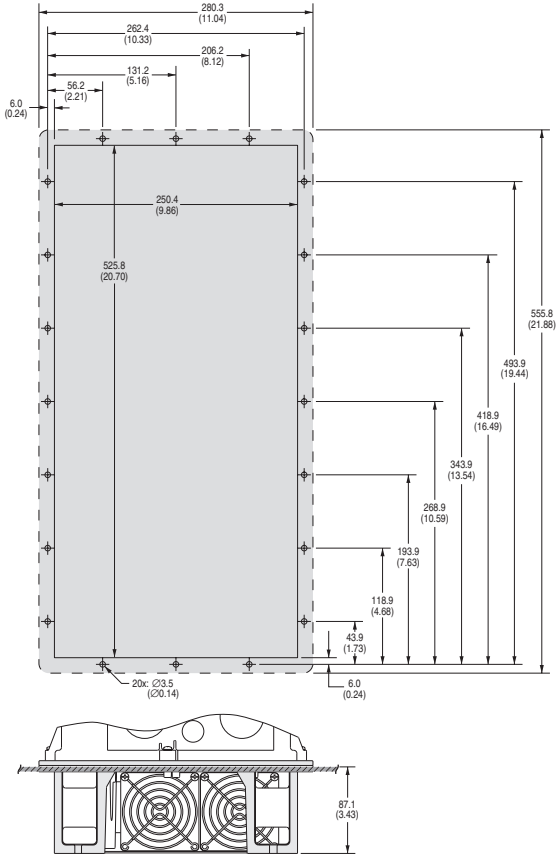
Frame C



Frame D



Frame E


280.3
(11.04)
262.4
(10.33)
206.2
(8.12)
131.2
(5.16)
56.2
(2.21)
6.0
(0.24)
250.4
(9.86)
525.8
(20.70)
555.8
(21.88)
493.9
(19.44)
418.9
(16.49)
343.9
(13.54)
268.9
(10.59)
193.9
(7.63)
118.9
(4.68)
43.9
(1.73)
20x: Ø3.5
(Ø0.14)
6.0
(0.24)
87.1
(3.43)

Output Devices

For information on output devices such as output contactors, cable terminators and output reactors refer to the *PowerFlex Reference Manual*, publication PFLEX-RM001….

Drive, Fuse & Circuit Breaker Ratings

The tables on the following pages provide drive ratings (including continuous, 1 minute and 3 second) and recommended AC line input fuse and circuit breaker information. Both types of short circuit protection are acceptable for UL and IEC requirements. Sizes listed are the recommended sizes based on 40 degree C and the U.S. N.E.C. Other country, state or local codes may require different ratings.

Fusing

If fuses are chosen as the desired protection method, refer to the recommended types listed below. If available amp ratings do not match the tables provided, the closest fuse rating that exceeds the drive rating should be chosen.

- IEC – BS88 (British Standard) Parts 1 & 2 [1], EN60269-1, Parts 1 & 2, type gG or equivalent should be used.
- UL – UL Class CC, T, RK1 or J must be used.

Circuit Breakers

The “non-fuse” listings in the following tables include both circuit breakers (inverse time or instantaneous trip) and 140M Self-Protecting Motor Starters. **If one of these is chosen as the desired protection method**, the following requirements apply.

- IEC and UL – Both types of devices are acceptable for IEC and UL installations.

[1] Typical designations include, but may not be limited to the following; Parts 1 & 2: AC, AD, BC, BD, CD, DD, ED, EFS, EF, FF, FG, GF, GG, GH.

Table A.B 208/240 Volt AC Input Protection Devices (See page A-17 for Notes)

Drive Catalog Number	Frame[1]	HP Rating		Input Ratings		Output Amps			Dual Element Time Delay Fuse		Non-Time Delay Fuse		Circuit Breaker[4]	Motor Circuit Protector[6]	140M Motor Starter with Adjustable Current Range[7] [8]			
		ND	HD	Amps	kVA	Cont.	1 Min.	3 Sec.	Min.[2]	Max.[3]	Min.[2]	Max.[3]	Max.[5]	Max.[5]	Available Catalog Numbers[9]			
208 Volt AC Input																		
20AB2P2	A	0.5	0.33	2.9	1.1	2.5	2.7	3.7	6	6	6	10	15	7	140M-C2E-B40	140M-D8E-B40	–	–
20AB4P2	A	1	0.75	5.6	2	4.8	5.5	7.4	10	10	10	17.5	15	7	140M-C2E-B63	140M-D8E-B63	–	–
20AB6P8	B	2	1.5	10	3.6	7.8	10.3	13.8	15	15	15	30	30	15	140M-C2E-C10	140M-D8E-C10	140M-F8E-C10	–
20AB9P6	B	3	2	14	5.1	11	12.1	16.5	20	25	20	40	40	30	140M-C2E-C16	140M-D8E-C16	140M-F8E-C16	–
20AB015	C	5	3	16	5.8	17.5	19.2	26.6	20	35	20	70	70	30	140M-C2E-C20	140M-D8E-C20	140M-F8E-C20	–
20AB022	D	7.5	5	23.3	8.3	25.3	27.8	37.9	30	50	30	100	100	30	140M-C2E-C25	140M-D8E-C25	140M-F8E-C25	140-CMN-2500
20AB028	D	10	7.5	29.8	10.7	32.2	37.9	50.6	40	70	40	125	125	50	–	–	140M-F8E-C32	140-CMN-4000
20AB042	D	15	10	39.8	14.3	43	55.5	74	60	100	60	175	175	70	–	–	140M-F8E-C45	140-CMN-6300
20AB054	E	20	15	57.5	20.7	62.1	72.4	96.6	80	125	80	200	200	100	–	–	–	140-CMN-6300
20AB070	E	25	20	72.3	26.0	78.2	93.1	124	90	175	90	300	300	100	–	–	–	140-CMN-9000
240 Volt AC Input																		
20AB2P2	A	0.5	0.33	2.5	1.1	2.2	2.4	3.3	3	4.5	3	8	15	3	140M-C2E-B25	140M-D8E-B25	–	–
20AB4P2	A	1	0.75	4.8	2	4.2	4.8	6.4	6	9	6	15	15	7	140M-C2E-B63	140M-D8E-B63	–	–
20AB6P8	B	2	1.5	8.7	3.6	6.8	9	12	15	15	15	25	25	15	140M-C2E-C10	140M-D8E-C10	140M-F8E-C10	–
20AB9P6	B	3	2	12.2	5.1	9.6	10.6	14.4	20	20	20	35	35	15	140M-C2E-C16	140M-D8E-C16	140M-F8E-C16	–
20AB015	C	5	3	13.9	5.8	15.3	17.4	23.2	20	30	20	60	60	30	140M-C2E-C16	140M-D8E-C16	140M-F8E-C16	–
20AB022	D	7.5	5	19.9	8.3	22	24.4	33	25	45	25	80	80	30	140M-C2E-C25	140M-D8E-C25	140M-F8E-C25	140-CMN-2500
20AB028	D	10	7.5	25.7	10.7	28	33	44	35	60	35	110	110	50	–	–	140M-F8E-C32	140-CMN-4000
20AB042	D	15	10	38.7	16.1	42	46.2	63	50	90	50	150	150	50	–	–	140M-F8E-C45	140-CMN-6300
20AB054	E	20	15	49.8	20.7	54	63	84	60	100	60	200	200	100	–	–	–	140-CMN-6300
20AB070	E	25	20	64.5	26.8	70	81	108	90	150	90	275	275	100	–	–	–	140-CMN-9000

Table A.C 400/480 Volt AC Input Protection Devices (See page A-17 for Notes).

Drive Catalog Number	Frame[1]	kW *(400V)* HP *(480V)* Rating		Input Ratings		Output Amps			Dual Element Time Delay Fuse		Non-Time Delay Fuse		Circuit Breaker[4]	Motor Circuit Protector[6]	140M Motor Starter with Adjustable Current Range[7] [8]			
		ND	*HD*	*Amps*	*kVA*	*Cont.*	*1 Min.*	*3 Sec.*	*Min.[2]*	*Max.[3]*	*Min.[2]*	*Max.[3]*	*Max.[5]*	*Max.[5]*	*Available Catalog Numbers[9]*			
400 Volt AC Input																		
20AC1P3	A	0.37	0.25	1.6	1.1	1.3	1.4	1.9	3	3	3	5	15	3	140M-C2E-B16	–	–	–
20AC2P1	A	0.75	0.55	2.5	1.8	2.1	2.4	3.2	4	6	4	8	15	7	140M-C2E-B25	140M-D8E-B25	–	–
20AC3P5	A	1.5	1.1	4.3	3	3.5	4.5	6	6	6	6	12	15	7	140M-C2E-B63	140M-D8E-B63	–	–
20AC5P0	B	2.2	1.5	6.5	4.5	5	5.5	7.5	10	10	10	20	20	15	140M-C2E-C10	140M-D8E-C10	140M-F8E-C10	–
20AC8P7	B	4	3	11.3	7.8	8.7	9.9	13.2	15	17.5	15	30	30	15	140M-C2E-C16	140M-D8E-C16	140M-F8E-C16	–
20AC011	C	5.5	4	11	7.6	11.5	13	17.4	15	25	15	45	40	15	140M-C2E-C16	140M-D8E-C16	140M-F8E-C16	–
20AC015	C	7.5	5.5	15.1	10.4	15.4	17.2	23.1	20	30	20	60	60	20	140M-C2E-C16	140M-D8E-C16	140M-F8E-C16	–
20AC022	D	11	7.5	21.9	15.2	22	24.2	33	30	45	30	80	80	30	140M-C2E-C25	140M-D8E-C25	140M-F8E-C25	140-CMN-2500
20AC030	D	15	11	30.3	21	30	33	45	40	60	40	120	120	50	–	–	140M-F8E-C32	140-CMN-4000
20AC037	D	18.5	15	35	24.3	37	45	60	50	80	50	125	140	50	–	–	140M-F8E-C45	140-CMN-4000
20AC043	D	22	18.5	40.7	28.2	43	56	74	60	90	60	150	160	70	–	–	–	140-CMN-6300
20AC060	E	30	22	56.8	39.3	60	66	90	80	125	80	225	240	80	–	–	–	140-CMN-6300
20AC072	E	37	30	68.9	47.8	72	90	120	90	150	90	250	280	100	–	–	–	140-CMN-9000
480 Volt AC Input																		
20AD1P1	A	0.5	0.33	1.3	1.1	1.1	1.2	1.6	3	3	3	4	15	3	140M-C2E-B16	–	–	–
20AD2P1	A	1	0.75	2.4	2	2.1	2.4	3.2	3	6	3	8	15	3	140M-C2E-B25	140M-D8E-B25	–	–
20AD3P4	A	2	1.5	3.8	3.2	3.4	4.5	6	6	6	6	12	15	7	140M-C2E-B40	140M-D8E-B40	–	–
20AD5P0	B	3	2	5.6	4.7	5	5.5	7.5	10	10	10	20	20	15	140M-C2E-B63	140M-D8E-B63	–	–
20AD8P0	B	5	3	9.8	8.4	8	8.8	12	15	15	15	30	30	15	140M-C2E-C10	140M-D8E-C10	140M-F8E-C10	–
20AD011	C	7.5	5	9.5	7.9	11	12.1	16.5	15	20	15	40	40	15	140M-C2E-C16	140M-D8E-C16	140M-F8E-C16	–
20AD014	C	10	7.5	12.5	10.4	14	16.5	22	20	30	20	50	50	20	140M-C2E-C16	140M-D8E-C16	140M-F8E-C16	–
20AD022	D	15	10	19.9	16.6	22	24.2	33	25	45	25	80	80	30	140M-C2E-C25	140M-D8E-C25	140M-F8E-C25	–
20AD027	D	20	15	24.8	20.6	27	33	44	35	60	35	100	100	50	–	–	140M-F8E-C32	140-CMN-2500
20AD034	D	25	20	31.2	25.9	34	40.5	54	40	70	40	125	125	50	–	–	140M-F8E-C45	140-CMN-4000
20AD040	D	30	25	36.7	39.7	40	51	68	50	90	50	150	150	50	–	–	140M-F8E-C45	140-CMN-4000
20AD052	E	40	30	47.7	39.7	52	60	80	60	110	60	200	200	70	–	–	–	140-CMN-6300
20AD065	E	50	40	59.6	49.6	65	78	104	80	125	80	250	250	100	–	–	–	140-CMN-9000

Table A.D 600 Volt AC Input Protection Devices

Drive Catalog Number	Frame[1]	HP Rating		Input Ratings		Output Amps			Dual Element Time Delay Fuse		Non-Time Delay Fuse		Circuit Breaker[4]	Motor Circuit Protector[6]	140M Motor Starter with Adjustable Current Range[7] [8]			
		ND	HD	Amps	kVA	Cont.	1 Min.	3 Sec.	Min.[2]	Max.[3]	Min.[2]	Max.[3]	Max.[5]	Max.[5]	Available Catalog Numbers[9]			
600 Volt AC Input																		
20AE0P9	A	0.5	0.33	1.3	1.3	0.9	1.1	1.4	3	3	3	3.5	15	3	140M-C2E-B16	–	–	–
20AE1P7	A	1	0.75	1.9	2	1.7	2	2.6	3	6	3	6	15	3	140M-C2E-B25	140M-D8E-B25	–	–
20AE2P7	A	2	1.5	3	3.1	2.7	3.6	4.8	4	6	4	10	15	7	140M-C2E-B40	140M-D8E-B40	–	–
20AE3P9	B	3	2	4.4	4.5	3.9	4.3	5.9	6	8	6	15	15	7	140M-C2E-B63	140M-D8E-B63	–	–
20AE6P1	B	5	3	7.5	7.8	6.1	6.7	9.2	10	12	10	20	20	15	140M-C2E-C10	140M-D8E-C10	140M-F8E-C10	–
20AE9P0	C	7.5	5	7.7	8	9	9.9	13.5	10	20	10	35	35	15	140M-C2E-C10	140M-D8E-C10	140M-F8E-C10	–
20AE011	C	10	7.5	9.8	10.1	11	13.5	18	15	20	15	40	40	15	140M-C2E-C16	140M-D8E-C16	140M-F8E-C16	–
20AE017	D	15	10	15.3	15.9	17	18.7	25.5	20	35	20	60	60	30	140M-C2E-C20	140M-D8E-C20	140M-F8E-C20	–
20AE022	D	20	15	20	20.8	22	25.5	34	25	45	25	80	80	30	140M-C2E-C25	140M-D8E-C25	140M-F8E-C25	140-CMN-2500
20AE027	D	25	20	24.8	25.7	27	33	44	35	60	35	100	100	50	–	–	140M-F8E-C25	140-CMN-2500
20AE032	D	30	25	29.4	30.5	32	40.5	54	40	70	40	125	125	50	–	–	140M-F8E-C32	140-CMN-4000
20AE041	E	40	30	37.6	39.1	41	48	64	50	90	50	150	150	100	–	–	140M-F8E-C45	140-CMN-4000
20AE052	E	50	40	47.7	49.6	52	61.5	82	60	110	60	200	200	100	–	–	–	140-CMN-6300

(1) For IP 66 (NEMA Type 4X/12) enclosures, drives listed as Frame A increase to Frame B and drives listed as Frame C increase to Frame D.

(2) Minimum protection device size is the lowest rated device that supplies maximum protection without nuisance tripping.

(3) Maximum protection device size is the highest rated device that supplies drive protection. For US NEC, minimum size is 125% of motor FLA. Ratings shown are maximum.

(4) Circuit Breaker - inverse time breaker. For US NEC, minimum size is 125% of motor FLA. Ratings shown are maximum.

(5) Maximum allowable rating by US NEC. Exact size must be chosen for each installation.

(6) Motor Circuit Protector - instantaneous trip circuit breaker. For US NEC, minimum size is 125% of motor FLA. Ratings shown are maximum.

(7) Bulletin 140M with adjustable current range should have the current trip set to the minimum range that the device will not trip.

(8) Manual Self-Protected (Type E) Combination Motor Controller, UL listed for 208 Wye or Delta, 240 Wye or Delta, 480Y/277 or 600Y/347. Not UL listed for use on 480V or 600V Delta/Delta systems.

(9) The AIC ratings of the Bulletin 140M Motor Protector may vary. See publication 140M-SG001B-EN-P.

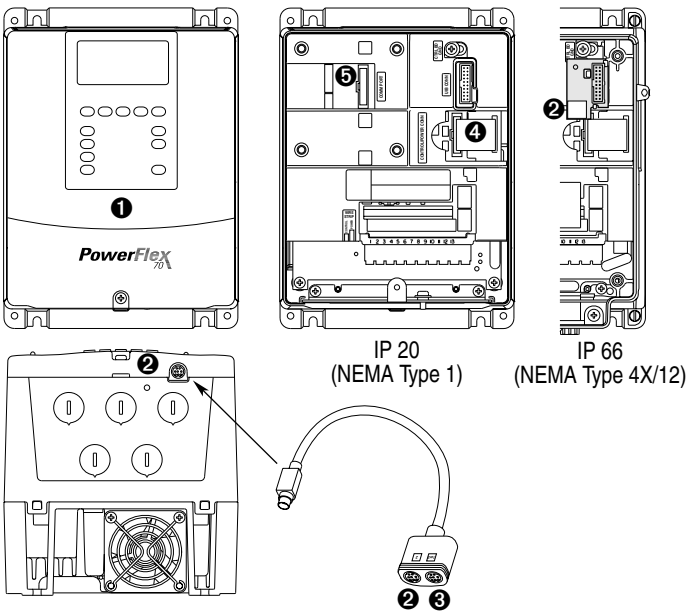
Notes:

HIM Overview

For information on…	See page	For information on…	See page
External and Internal Connections	B-1	Menu Structure	B-3
LCD Display Elements	B-2	Viewing and Editing Parameters	B-5
ALT Functions	B-2	Removing the HIM	B-2

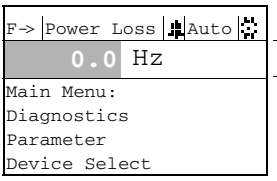
External and Internal Connections

The PowerFlex 70 provides a number of cable connection points (B Frame shown).



No.	Connector	Description
1	DPI Port 1	HIM connection when installed in cover.
2	DPI Port 2	Cable connection for handheld and remote options.
3	DPI Port 3	Splitter cable connected to DPI Port 2 provides additional port.
4	Control / Power Connection	Connection between control and power boards.
5	DPI Port 5	Cable connection for communications adapter.

LCD Display Elements

Display	Description
	Direction | Drive Status | Alarm | Auto/Man | Information Commanded or Output Frequency Programming / Monitoring / Troubleshooting

ALT Functions

To use an ALT function, press the ALT key, release it, then press the programming key associated with one of the following functions:

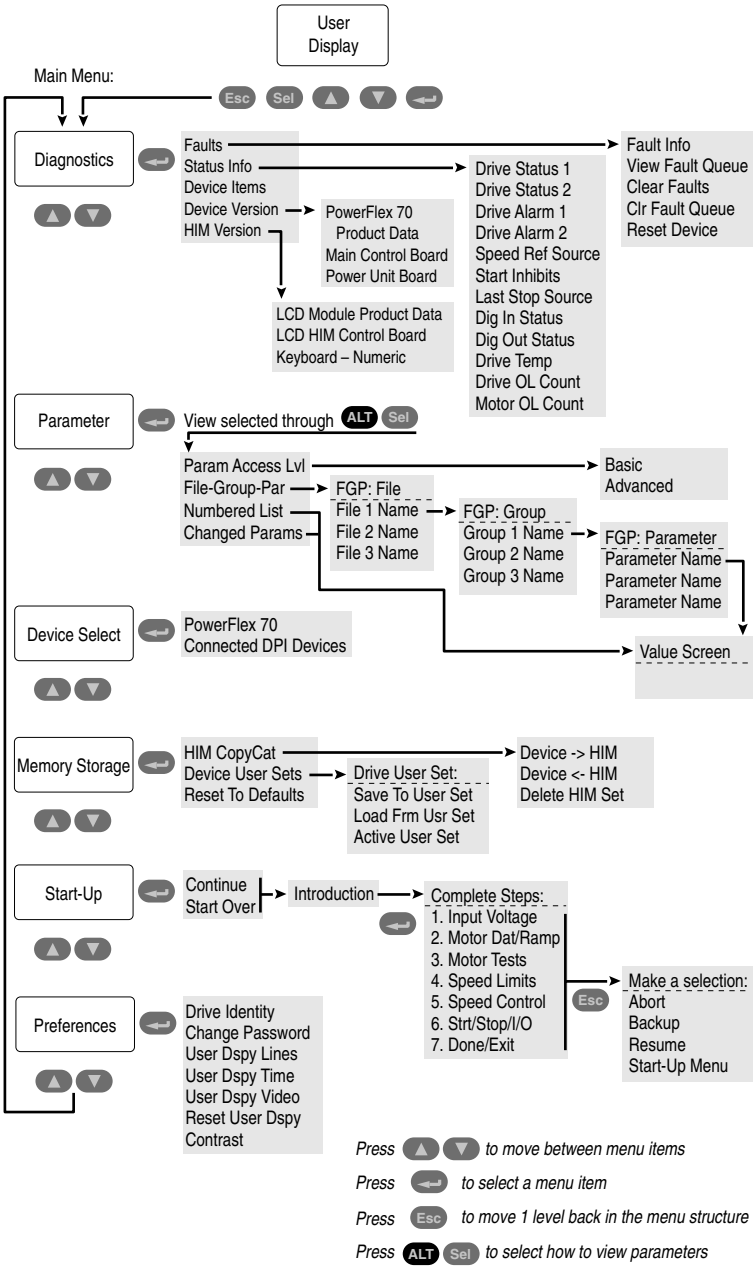
ALT Key and then ...			Performs this function ...	HIM Type
ALT	Esc	S.M.A.R.T.	Displays the S.M.A.R.T. screen.	LCD only
	Esc	Log In/Out	Log in to change parameter settings. Log out to protect parameter settings. Change a password.	LED only
	Sel	View	Allows the selection of how parameters will be viewed or detailed information about a parameter or component.	LCD only
	Sel	Device	Select a connected adapter for editing.	LED only
	▲	Lang	Displays the language selection screen.	LCD only
	▼	Auto / Man	Switches between Auto and Manual Modes.	LCD and LED
	↵	Remove	Allows HIM removal without causing a fault if the HIM is not the last controlling device and does not have Manual control of the drive.	LCD and LED
	.	Exp	Allows value to be entered as an exponent. (Not available on PowerFlex 70.)	LCD only
	+/–	Param #	Allows entry of a parameter number for viewing/ editing.	LCD only

Removing the HIM

The HIM can be removed while the drive is powered. Normally, the drive issues a fault when the HIM is removed because it detects that a device is missing.

Important: HIM removal is only permissible in Auto mode. If the HIM is removed while in Manual mode or the HIM is the only remaining control device, a fault will occur.

Menu Structure



Diagnostics Menu

When a fault trips the drive, use this menu to access detailed data about the drive.

Option	Description
Faults	View fault queue or fault information, clear faults or reset drive.
Status Info	View parameters that display status information about the drive.
Device Version	View the firmware version and hardware series of components.
HIM Version	View the firmware version and hardware series of the HIM.

Parameter Menu

Refer to Viewing and Editing Parameters on page B-5.

Device Select Menu

Use this menu to access parameters in connected peripheral devices.

Memory Storage Menu

Drive data can be saved to, or recalled from, User and HIM sets.
User sets are files stored in permanent nonvolatile drive memory.
HIM sets are files stored in permanent nonvolatile HIM memory.

Option	Description
HIM Copycat Device -> HIM Device <- HIM	Save data to a HIM set, load data from a HIM set to active drive memory or delete a HIM set.
Device User Sets	Save data to a User set, load data from a User set to active drive memory or name a User set.
Reset To Defaults	Restore the drive to its factory-default settings.

Start Up Menu

See Chapter 2.

Preferences Menu

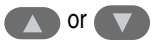
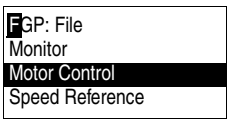
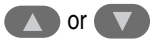
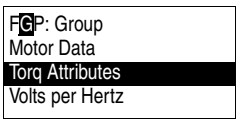
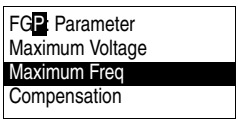
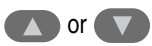
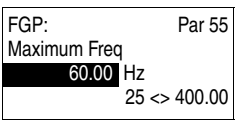
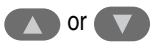
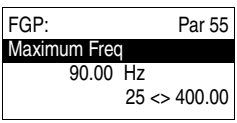
The HIM and drive have features that you can customize.

Option	Description
Drive Identity	Add text to identify the drive.
Change Password	Enable/disable or modify the password.
User Dspy Lines	Select the display, parameter, scale and text for the User Display. The User Display is two lines of user-defined data that appears when the HIM is not being used for programming.
User Dspy Time	Set the wait time for the User Display or enable/disable it.
User Dspy Video	Select Reverse or Normal video for the Frequency and User Display lines.
Reset User Dspy	Return all the options for the User Display to factory default values.

Viewing and Editing Parameters

The PowerFlex 70 drive is initially set to Basic Parameter View. To view all parameters, set parameter 196 [Param Access Lvl] to option 1 "Advanced". Parameter 196 is not affected by the Reset to Defaults function.

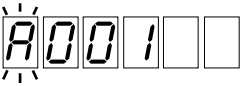
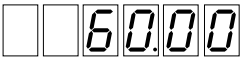
LCD HIM

Step	Key(s)	Example Displays
1. In the Main Menu, press the Up Arrow or Down Arrow to scroll to "Parameter."		
2. Press Enter. "FGP File" appears on the top line and the first three files appear below it.		
3. Press the Up Arrow or Down Arrow to scroll through the files.		
4. Press Enter to select a file. The groups in the file are displayed under it.		
5. Repeat steps 3 and 4 to select a group and then a parameter. The parameter value screen will appear.		
6. Press Enter to edit the parameter.		
7. Press the Up Arrow or Down Arrow to change the value. If desired, press Sel to move from digit to digit, letter to letter, or bit to bit. The digit or bit that you can change will be highlighted.		
8. Press Enter to save the value. If you want to cancel a change, press Esc.		
9. Press the Up Arrow or Down Arrow to scroll through the parameters in the group, or press Esc to return to the group list.		

Numeric Keypad Shortcut

If using a HIM with a numeric keypad, press the ALT key and the +/– key to access the parameter by typing its number.

LED HIM - Standard Control Only

Step	Key(s)	Example Displays
1. Press Esc until the Output Frequency screen appears. This screen displays the frequency of the drive if it is running. If the drive is stopped, it will display 0.	Esc	
2. Press Enter. The parameter that was last viewed appears. Its file letter will flash.	Enter	
3. Press the Up Arrow or Down Arrow to scroll through the files.	Up or Down	
4. Press Enter to enter a file. The right digit will then flash.	Enter	
5. Press the Up Arrow or Down Arrow to scroll through the parameters that are in the file. An "n" appears after a number if a parameter is a bit parameter that is divided into nibbles.	Up or Down	
6. Press Enter to view the value of a parameter or nibble. Its value will be displayed. If you do not want to edit the value, press Esc to return to the parameter list.	Enter	
7. Press Enter to enter edit mode. The right digit will flash if it can be edited.	Enter	
8. Press the Up Arrow or Down Arrow to change the value. If desired, press Sel to move from digit to digit or bit to bit. The digit or bit that you can change will flash. To change a sign in a signed value, press Sel to move the cursor to the left-most digit. Then, press the Up Arrow or Down Arrow to scroll to the desired sign.	Up or Down Sel	
9. Press Enter to save the value. If you want to cancel a change, press Esc. The value will stop flashing to indicate that you are no longer in edit mode.	Enter	
10. Press Esc to return to the parameter list.	Esc	

Application Notes

For information on…	See page…
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Skip Frequency	C-2
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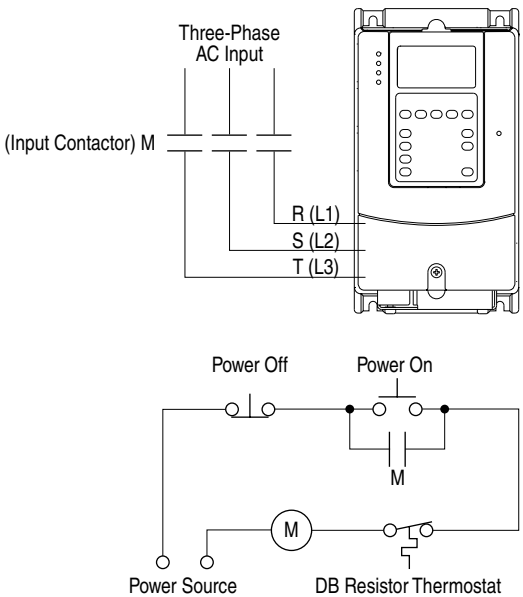
Motor Overload	C-7

For information on…	See page…
Start At PowerUp	C-9
Overspeed	C-10
Process PI for Standard Control	C-11

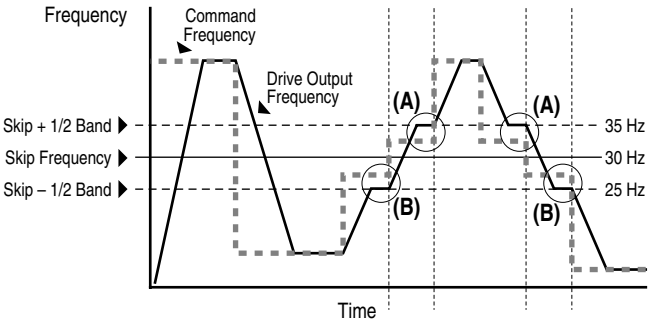
External Brake Resistor

Figure C.1 External Brake Resistor Circuitry



Skip Frequency

Figure C.2 Skip Frequency



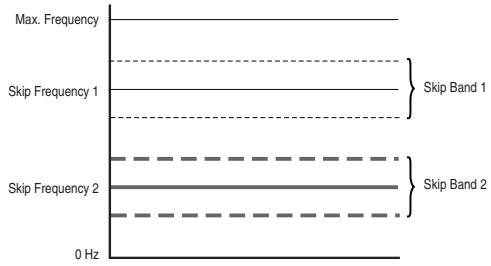
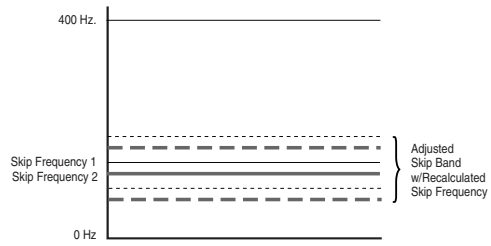
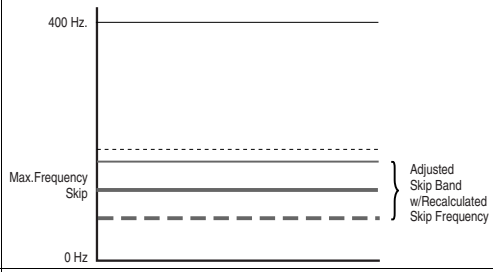
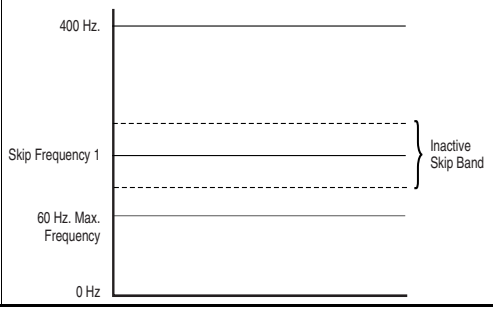
Some machinery may have a resonant operating frequency that must be avoided to minimize the risk of equipment damage. To assure that the motor cannot continuously operate at one or more of the points, skip frequencies are used. Parameters 084-086, ([Skip Frequency 1-3]) are available to set the frequencies to be avoided.

The value programmed into the skip frequency parameters sets the center point for an entire “skip band” of frequencies. The width of the band (range of frequency around the center point) is determined by parameter 87, [Skip Freq Band]. The range is split, half above and half below the skip frequency parameter.

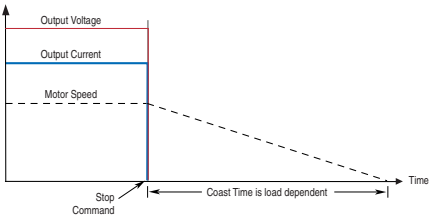
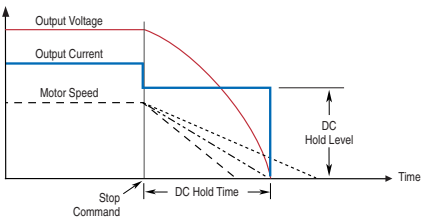
If the commanded frequency of the drive is greater than or equal to the skip (center) frequency and less than or equal to the high value of the band (skip plus 1/2 band), the drive will set the output frequency to the high value of the band. See (A) in Figure C.2.

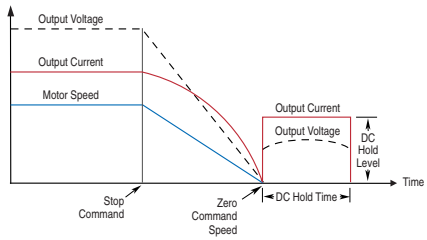
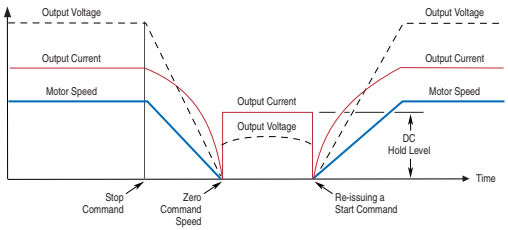
If the commanded frequency is less than the skip (center) frequency and greater than or equal to the low value of the band (skip minus 1/2 band), the drive will set the output frequency to the low value of the band. See (B) in Figure C.2.

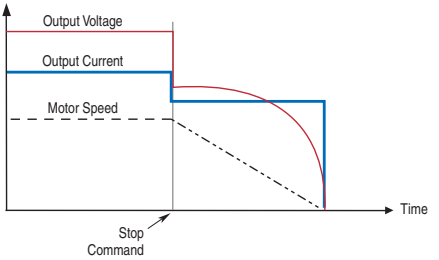
Acceleration and deceleration are not affected by the skip frequencies. Normal accel/decel will proceed through the band once the commanded frequency is greater than the skip frequency. See (A) & (B) in Figure C.2. This function affects only continuous operation within the band.

Skip Frequency Examples	
The skip frequency will have hysteresis so the output does not toggle between high and low values. Three distinct bands can be programmed. If none of the skip bands touch or overlap, each band has its own high/low limit.	
If skip bands overlap or touch, the center frequency is recalculated based on the highest and lowest band values.	
If a skip band(s) extend beyond the max frequency limits, the highest band value will be clamped at the max frequency limit. The center frequency is recalculated based on the highest and lowest band values.	
If the band is outside the limits, the skip band is inactive.	

Stop Mode

Mode	Description
Coast to Stop	 This method releases the motor and allows the load to stop by friction. 1. On Stop, the drive output goes immediately to zero (off). 2. No further power is supplied to the motor. The drive has released control. 3. The motor will coast for a time that is dependent on the mechanics of the system (inertia, friction, etc).
Brake to Stop	 This method uses DC injection of the motor to Stop and/or hold the load. 1. On Stop, 3 phase drive output goes to zero (off) 2. Drive outputs DC voltage on the last used phase at the level programmed in [DC Brake Level] Par 158. This voltage causes a “stopping” brake torque. If the voltage is applied for a time that is longer than the actual possible stopping time, the remaining time will be used to attempt to hold the motor at zero speed. 3. DC voltage to the motor continues for the amount of time programmed in [DC Brake Time] Par 159. Braking ceases after this time expires. 4. After the DC Braking ceases, no further power is supplied to the motor. The motor may or may not be stopped. The drive has released control. 5. The motor, if rotating, will coast from its present speed for a time that is dependent on the mechanics of the system (inertia, friction, etc).

Mode	Description
Ramp to Stop	 This method uses drive output reduction to stop the load. 1. On Stop, drive output will decrease according to the programmed pattern from its present value to zero. The pattern may be linear or squared. The output will decrease to zero at the rate determined by the programmed [Maximum Freq] and the programmed active [Decel Time x] 2. The reduction in output can be limited by other drive factors such as bus or current regulation. 3. When the output reaches zero the output is shut off. 4. The motor, if rotating, will coast from its present speed for a time that is dependent on the mechanics of the system (inertia, friction, etc).
Ramp to Hold	 This method combines two of the methods above. It uses drive output reduction to stop the load and DC injection to hold the load at zero speed once it has stopped. 1. On Stop, drive output will decrease according to the programmed pattern from its present value to zero. The pattern may be linear or squared. The output will decrease to zero at the rate determined by the programmed [Maximum Freq] and the programmed active [Decel Time x] 2. The reduction in output can be limited by other drive factors such as bus or current regulation. 3. When the output reaches zero 3 phase drive output goes to zero (off) and the drive outputs DC voltage on the last used phase at the level programmed in [DC Brake Level] Par 158. This voltage causes a “holding” brake torque. 4. DC voltage to the motor continues until a Start command is reissued or the drive is disabled. 5. If a Start command is reissued, DC Braking ceases and the drive returns to normal AC operation. If an Enable command is removed, the drive enters a “not ready” state until the enable is restored.

Mode	Description
Fast Brake	 This method uses drive output reduction to stop the load. 1. On Stop, the drive output will decrease according to the programmed pattern from its present value to zero at the rate determined by the programmed active [Decel Time x]. This is accomplished by lowering the output frequency below the motor speed where regeneration will not occur. This causes excess energy to be lost in the motor. 2. The reduction in output can be limited by other drive factors such as bus or current regulation. 3. When the output reaches very near zero, DC brake will automatically be used to complete the stop then the output is shut off.

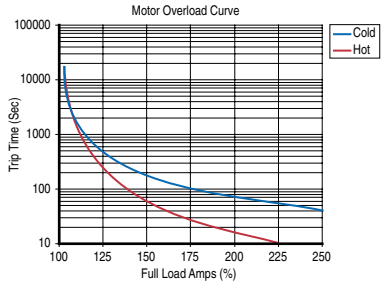
Motor Overload

For single motor applications the drive can be programmed to protect the motor from overload conditions. An electronic thermal overload I^2T function emulates a thermal overload relay. This operation is based on three parameters; [Motor NP FLA], [Motor OL Factor] and [Motor OL Hertz] (parameters 042, 048 and 047, respectively).

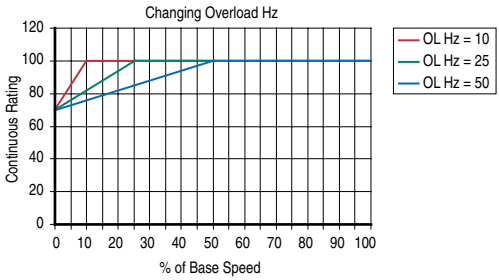
[Motor NP FLA] is multiplied by [Motor OL Factor] to allow the user to define the continuous level of current allowed by the motor thermal overload. [Motor OL Hertz] is used to allow the user to adjust the frequency below which the motor overload is derated.

The motor can operate up to 102% of FLA continuously. If the drive had just been activated, it will run at 150% of FLA for 180 seconds. If the motor had been operating at 100% for over 30 minutes, the drive will run at 150% of FLA for 60 seconds. These values assume the drive is operating above [Motor OL Hertz], and that [Motor OL Factor] is set to 1.00.

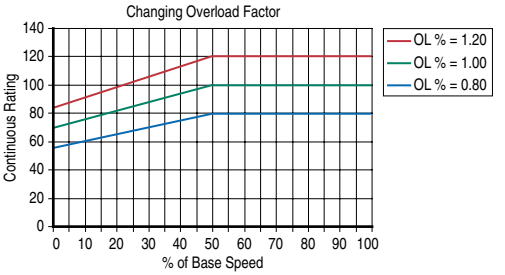
Operation below 100% current causes the temperature calculation to account for motor cooling.



[Motor OL Hertz] defines the frequency where motor overload capacity derate should begin. The motor overload capacity is reduced when operating below [Motor OL Hertz]. For all settings of [Motor OL Hertz] other than zero, the overload capacity is reduced to 70% at an output frequency of zero.



[Motor NP FLA] is multiplied by [Motor OL Factor] to select the rated current for the motor thermal overload. This can be used to raise or lower the level of current that will cause the motor thermal overload to trip. The effective overload factor is a combination of [Motor OL Hertz] and [Motor OL Factor].



Motor Overload Memory Retention Per 2005 NEC

The PowerFlex 70 EC (Firmware Revision 3.002 or greater) has the ability to retain the motor overload count at power down per the 2005 NEC motor overtemp requirement. A parameter has been added to provide this functionality. To Enable/Disable this feature, refer to the information below.

File B	Group	No.	Parameter Name and Description *See page 3-2 for symbol descriptions*	Values	Related
MOTOR CONTROL (File B)	Motor Data	050	E C v3 **[Motor OL Mode]** If "0," [Drive OL Count], P219 is reset to zero by a drive reset or a power cycle. If "1," the value is maintained. A "1" to "0" transition resets [Drive OL Count] to zero. Pwr Cyc Rst x x x x x x x x x x x x x x x **0** 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 *Nibble 4* *Nibble 3* *Nibble 2* *Nibble 1* *Bit #* *Factory Default Bit Values* **1** = Enabled **0** = Disabled x = Reserved		219

Start At PowerUp

When Start At Powerup in 2 wire control is configured, the drive will start if all start permissive conditions are met (within 10 seconds of drive power being applied), and the terminal block start input (Run, Run Forward or Run Reverse for 2-wire) is closed. An alarm will be annunciated from application of power until the drive actually starts, indicating the powerup start attempt is in progress.

The powerup start attempt will be aborted if any of the following occurs anytime during the 10-second start interval:

- A fault condition occurs
- A Type 2 alarm condition occurs
- The terminal block programmed enable input is opened
- All terminal block run, run forward, or run reverse, inputs are canceled
- A Stop request (from any source) is received

If the drive has not started within the 10 second interval, the powerup start attempt will be terminated.

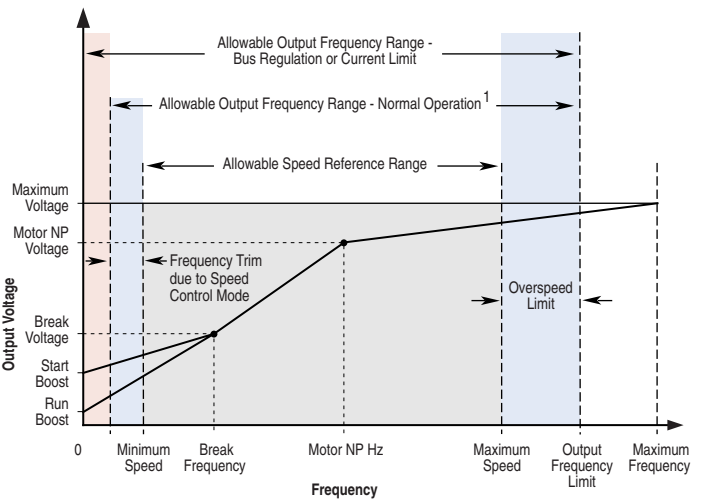
Overspeed

Overspeed Limit is a user programmable value that allows operation at maximum speed, but also provides an “overspeed band” that will allow a speed regulator such as encoder feedback or slip compensation to increase the output frequency above maximum speed in order to maintain maximum motor speed.

The figure below illustrates a typical Custom V/Hz profile. Minimum Speed is entered in Hertz and determines the lower speed reference limit during normal operation. Maximum Speed is entered in Hertz and determines the upper speed reference limit. The two “Speed” parameters only limit the speed reference and not the output frequency.

The actual output frequency at maximum speed reference is the sum of the speed reference plus “speed adder” components from functions such as slip compensation.

The Overspeed Limit is entered in Hertz and added to Maximum Speed and the sum of the two (Speed Limit) limit the output frequency. This sum (Speed Limit) must is compared to Maximum Frequency and an alarm is initiated which prevents operation if the Speed Limit exceeds Maximum Frequency.



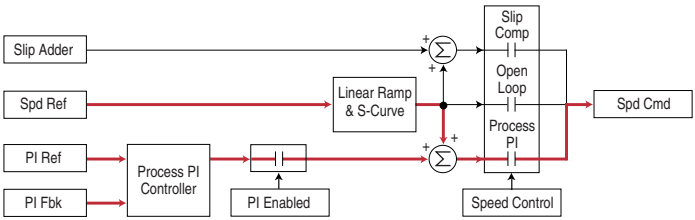
Note 1: The lower limit on this range can be 0 depending on the value of Speed Adder

Process PI for Standard Control

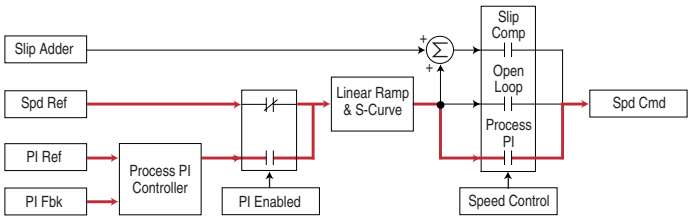
The internal PI function of the PowerFlex 70 provides closed loop process control with proportional and integral control action. The function is designed for use in applications that require simple control of a process without external control devices. The PI function allows the microprocessor of the drive to follow a single process control loop.

The PI function reads a process variable input to the drive and compares it to a desired setpoint stored in the drive. The algorithm will then adjust the output of the PI regulator, changing drive output frequency to try and make the process variable equal the setpoint.

It can operate as trim mode by summing the PI loop output with a master speed reference.

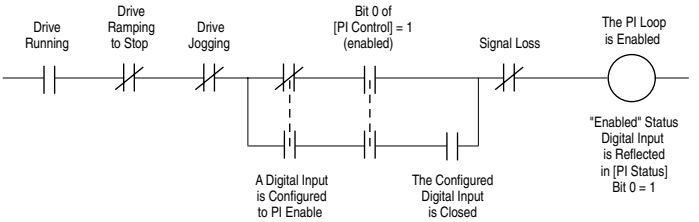


Or, it can operate as control mode by supplying the entire speed reference. This method is identified as “exclusive mode”



PI Enable

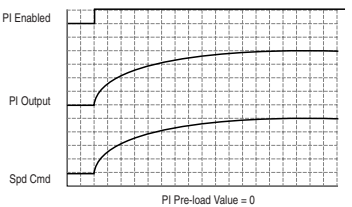
The output of the PI loop can be turned on (enabled) or turned off (disabled). This control allows the user to determine when the PI loop is providing part or all of the commanded speed. The logic for enabling the PI loop is shown in below.

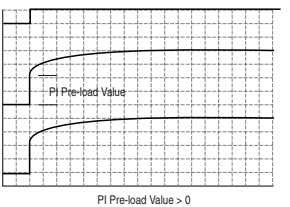


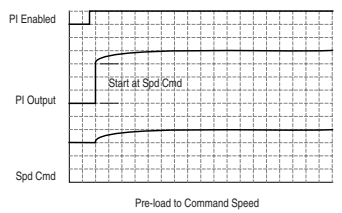
The drive must be running for the PI loop to be enabled. The loop will be disabled when the drive is ramping to a stop, jogging or the signal loss protection for the analog input(s) is sensing a loss of signal.

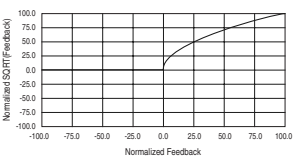
If a digital input has been configured to “PI Enable,” two events are required to enable the loop: the digital input must be closed AND bit 0 of the PI Control parameter must be = 1.

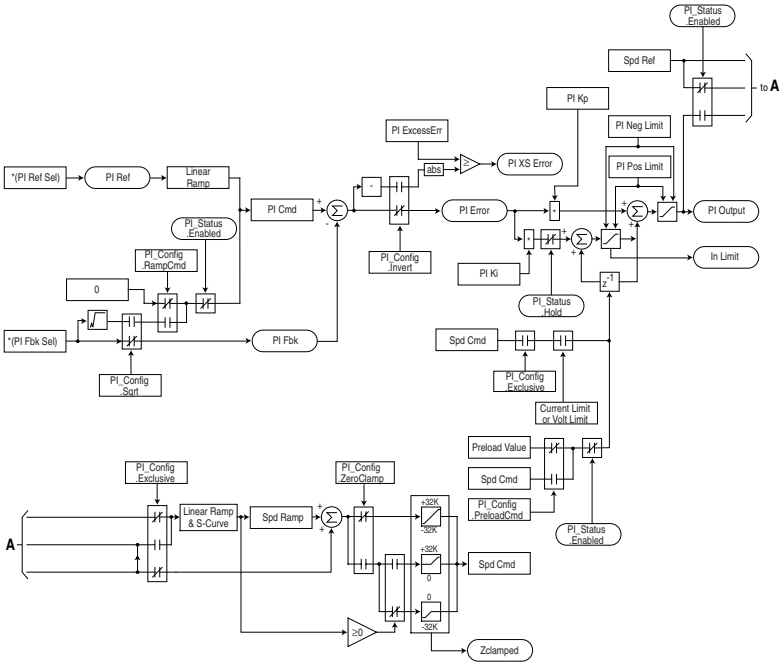
If no digital input is configured to “PI Enable,” then only the Bit 0 = 1 condition must be met. If the bit is permanently set to a “1”, then the loop will become enabled as soon as the drive goes into “run”.







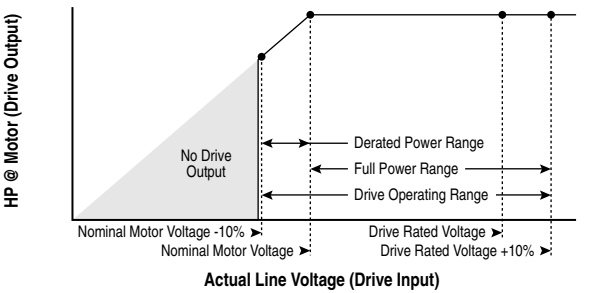



PI_Status Enabled
Spd Ref
to A
PI Kp
PI Neg Limit
PI ExcessErr
PI Pos Limit
*(PI Ref Sel)
PI Ref
Linear Ramp
PI Cmd
PI XS Error
PI Error
PI Output
PI_Status Enabled
PI_Config RampCmd
PI_Config Invert
In Limit
PI Ki
0
PI_Status Hold
*(PI Fbk Sel)
PI Fbk
Spd Cmd
PI_Config Sqrt
PI_Config Exclusive
Current Limit or Volt Limit
Preload Value
PI_Config Exclusive
PI_Config ZeroClamp
Linear Ramp & S-Curve
Spd Ramp
PI_Config PreloadCmd
PI_Status Enabled
A
Spd Cmd
Zclamped

Voltage Tolerance

Drive Rating	Nominal Line Voltage	Nominal Motor Voltage	Drive Full Power Range	Drive Operating Range
200-240	200	200†	200-264	180-264
	208	208	208-264	
	240	230	230-264	
380-400	380	380†	380-528	342-528
	400	400	400-528	
	480	460	460-528	
500-600	600	575†	575-660	432-660

Drive Full Power Range =	Nominal Motor Voltage to Drive Rated Voltage + 10%. Rated current is available across the entire Drive Full Power Range
Drive Operating Range =	Lowest† Nominal Motor Voltage - 10% to Drive Rated Voltage + 10%. Drive Output is linearly derated when Actual Line Voltage is less than the Nominal Motor Voltage

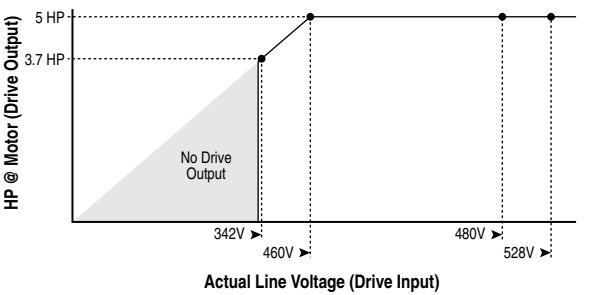


Example:

Calculate the maximum power of a 5 HP, 460V motor connected to a 480V rated drive supplied with 342V Actual Line Voltage input.

- Actual Line Voltage / Nominal Motor Voltage = 74.3%
- 74.3% × 5 HP = 3.7 HP
- 74.3% × 60 Hz = 44.6 Hz

At 342V Actual Line Voltage, the maximum power the 5 HP, 460V motor can produce is 3.7 HP at 44.6 Hz.



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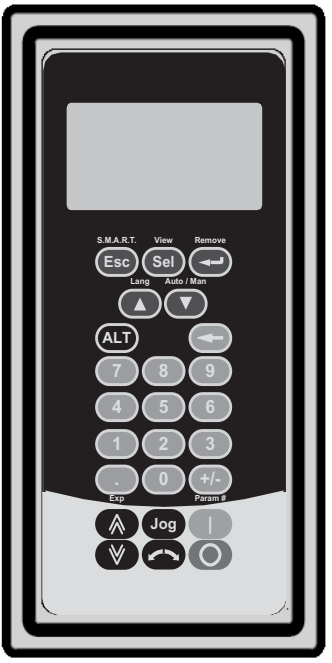
Installation Instructions
Installationsanleitung
Installation
Installazione
Instalación
Instructies
Instalação

PowerFlex® 7-Class Remote Small HIM
Kleine PowerFlex® HIM
Petite HIM PowerFlex® décentralisée
Modulo interfaccia operatore PowerFlex® remoto di piccole dimensioni
Módulo Remoto PowerFlex® Compacto de Interface de Operador
Kleine PowerFlex® Remote HIM
Pequena HIM remota PowerFlex®

20-HIM-C3S



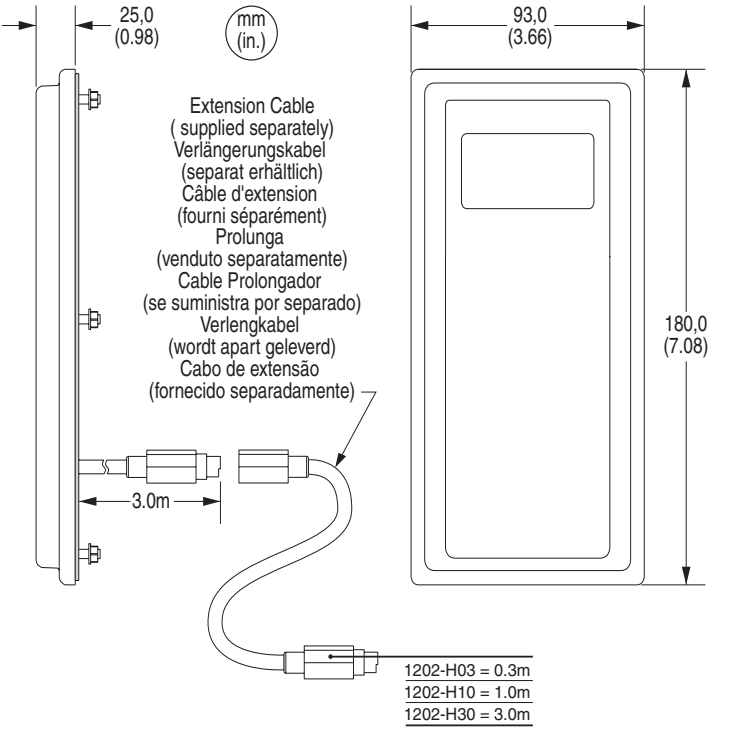
20-HIM-C5S

IP66 (NEMA Type 4X/12)
Indoor / Innenraum / Usage Intérieur / Interno / Interior / Indoor / Interno

Important: Adhesive coated gasket designed for one time installation.
Wichtig: Dichtung ist nur für den einmaligen Einbau anwendbar.
Important : Joint adhésif à usage unique.
Importante: Guarnizione adesiva valida per una sola installazione. Smontando e rimontando la stessa non sara' piu' garantita la protezione IP66.
ATENCIÓN: Junta con capa adhesiva diseñada para solo una fijación– no reutilizable.
Belangrijk: De zelfklevende dichtingsring is voor éénmalig gebruik.
Importante: Vedação adesiva foi projetada para ser instalada uma vez.

Dimensions
Abmessungen
Dimensions
Dimensioni

Dimensiones
Afmetingen
Dimensões



Note: The 20-HIM-C3S and 20-HIM-C5S are respectively smaller than the 20-HIM-C3 and 20-HIM-C5, and cannot be used as a direct field replacement.

Hinweis: Die 20-HIM-C3S und die 20-HIM-C5S sind jeweils kleiner als die 20-HIM-C3 und 20-HIM-C5 und können nicht direkt vor Ort ausgewechselt werden.

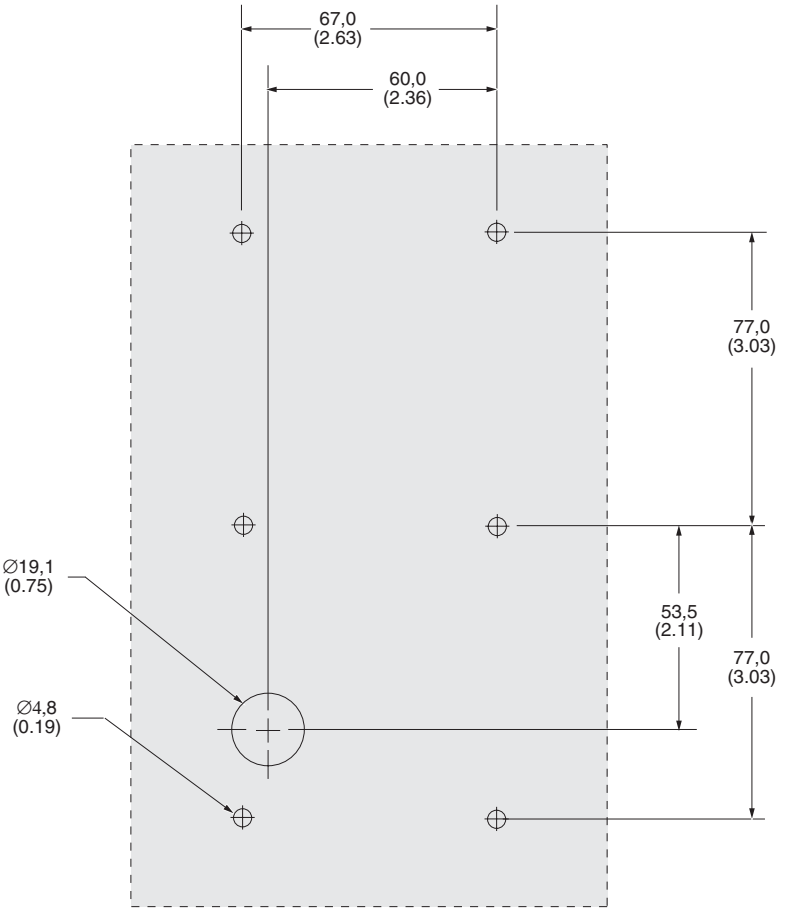
Remaque : Les 20-HIM-C3S et 20-HIM-C5S sont respectivement plus petites que les 20-HIM-C3 et 20-HIM-C5 et ne peuvent pas être utilisées directement comme pièces de rechange.

Nota: I modelli 20-HIM-C3S e 20-HIM-C5S sono di dimensioni inferiori ai modelli 20-HIM-C3 e 20-HIM-C5 e non possono sostituire i dispositivi applicati direttamente su campo.

Nota: Los módulos 20-HIM-C3S y 20-HIM-C5S son más compactos que los modelos 20-HIM-C3 y 20-HIM-C5 respectivamente, y no se los puede utilizar como reemplazo directo en el campo.

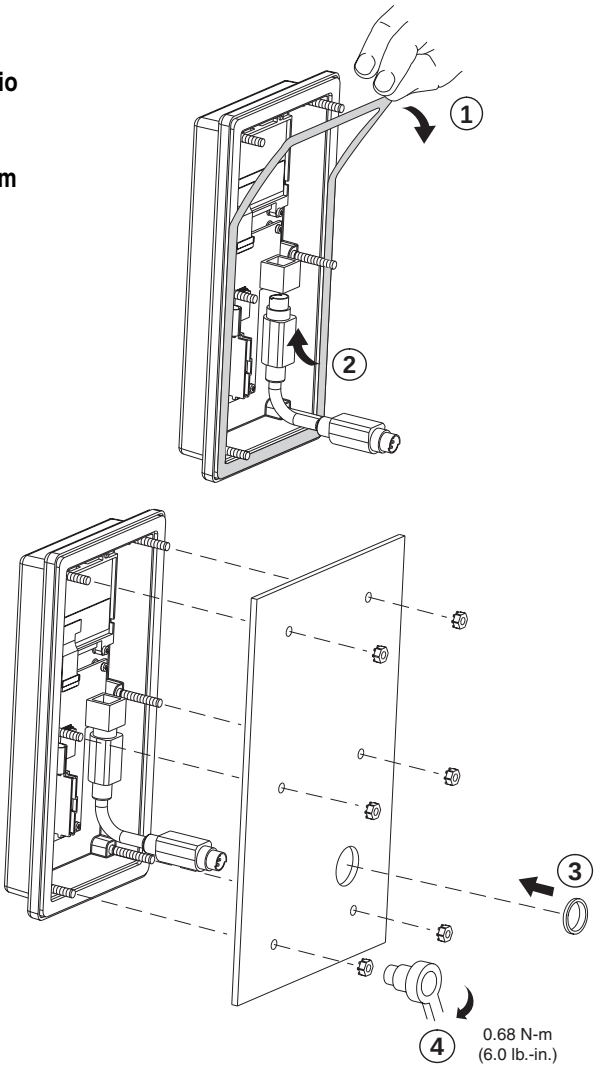
Opmerking: De 20-HIM-C3S en 20-HIM-C5S zijn kleiner dan resp. de 20-HIM-C3 en 20-HIM-C5 en kunnen niet als directe vervanging in het veld worden gebruikt.

Nota: A 20-HIM-C3S e 20-HIM-C5S são, respectivamente, menores do que a 20-HIM-C3 e a 20-HIM-C5 e não podem ser usadas como substitutas diretas no campo.



Front View
Frontansicht
Vue Frontale
Vista anteriore
Vista Frontal
Vooraanzicht
Vista anterior

Mount
Montage
Montage
Montaggio
Montado
Montage
Montagem



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General Information

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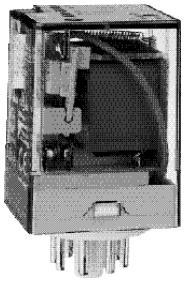
- Contact Switching Data — Web/CD
- Surge Suppression Solutions — Web/CD
- Low Energy Selection Criteria — Web/CD

NOTE: This information is available on the Industrial Controls Catalog CD-ROM (pub. no. A115-CA002A-EN-C) or on the industrial Controls Catalog Web site www.ab.com/catalogs.



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- Bulletin 700-HD Flange Mount Square Base Relay — Page 9-33
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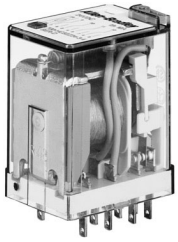

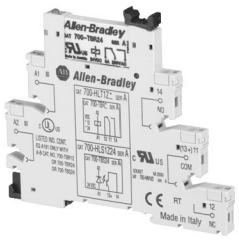

Interposing/Isolation Relays

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- Bulletin 700-HK “Slim Line” Relay — Page 9-46
- Bulletin 700-HL Terminal Block Relay — Page 9-50
- Bulletin 700-HP PCB “Pin” Style Relay — Page 9-55

Latching Relay

- Bulletin 700-HJ Magnetic Latching Relay — Web/CD

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Power Relays

- Bulletin 700-HG Power Relay — Web/CD
- Bulletin 700-HHF Flange Mount Power Relay — Web/CD

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DIN Rail Mounted Timing Relays

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Socket Mounted Timing Relays

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- Bulletin 700-HT Timing Relay — Web/CD
- Bulletin 700-HV Timing Relay — Web/CD

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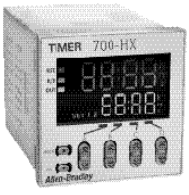

Digital Timing/Counting Relays

- Bulletin 700-HX Multifunction Digital Timing Relay — Page 9-94
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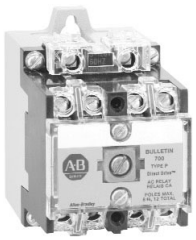
NEMA Heavy-Duty Industrial Relays



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Solid-State Relays

- Bulletin 700-SA Tube Base Relay — Page 9-171
- Bulletin 700-SC “Ice Cube” Relay — Page 9-175
- Bulletin 700-SE Flat Pack Relay — Page 9-180
- Bulletin 700-SF Square Base Relay — Page 9-185
- Bulletin 700-SH “Hockey Puck” Relay — Page 9-188
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Single-Loop Temperature Heater Controllers

- Bulletin 900-TC Digital Temperature Controller — Page 9-199
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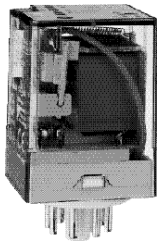
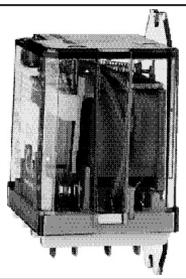
General Information

Quick Selection Table For Relays

				
Bulletin No.	**700-HA**	**700-HB**	**700-HD**	**700-HF**
Type	General Purpose Relay	General Purpose Relay	General Purpose Relay	General Purpose Relay
Features	Pin Style Terminals,Standard ON/OFF Flag Indicator, Electrical Schematic on Face, Clear Cover for Visual Inspection, Optional Push-to-test and Manual Override, Optional LED	Blade Style Quick Connect Terminals, Standard ON/OFF Flag Indicator, Electrical Schematic on Face, Clear Cover for Visual Inspection, Optional Push-to-test and Manual Override, Optional LED	Flange-mounted, Blade-style Quick Connection Terminals, Clear Cover for Visual Inspection	Square Base, Plug-in Quick Connect Solder Terminals, Optional Push-to-test and LED
Contact Ratings				
Contact Form	DPDT, 3PDT	DPDT, 3PDT	DPDT, 3PDT	DPDT, 3PDT, 4PDT
Contact Type	Single, Bifurcated	Single	Single	Single
Contact Material	AgNi, AgNi + Gold	AgCdO	AgCdO	AgCdO
Max. operating current under resistive load	10 A	15 A	15 A	10 A
Min. permissible load	700-HA 10V 50mA 700-HAB 6V 30mA 700-HAX 6V 1mA	10V 50 mA	10V 50 mA	10V 50 mA
Coil Ratings				
Coil Voltage	**AC:** 6V, 12V, 24V, 48V, 110V, 120V, 208V, 230V, 240V, 277V **DC:** 6V, 12V, 24V, 36V, 48V, 60V, 80V 110V, 125V, 140V, 220V	**AC:** 6V, 12V, 24V, 120V, 240V **DC:** 6V, 12V, 24V, 48V, 110V	**AC:** 6V, 12V, 24V, 120V, 208V, 240V **DC:** 6V, 12V, 24V, 48V, 110V	**AC:** 6V, 12V, 24V, 120V, 240V **DC:** 6V, 12V, 24V, 48V, 110V
Permissible Coil Voltage Variation	80…110% of Nominal Voltage at 50 Hz 80…110% of Nominal Voltage at 60 Hz 80…110% of Nominal Voltage at DC	80…110% of Nominal Voltage at 50 Hz 80…110% of Nominal Voltage at 60 Hz 80…110% of Nominal Voltage at DC	80…110% of Nominal Voltage at 50 Hz 80…110% of Nominal Voltage at 60 Hz 80…110% of Nominal Voltage at DC	85…110% of Nominal Voltage at 50 Hz 85…110% of Nominal Voltage at 60 Hz 80…110% of Nominal Voltage at DC
Electrical Ratings				
Dielectric Withstand Voltage	Pole-to-pole: 2000V Contact-to-coil: 2000V Contact-to-frame: 2000V	Pole-to-pole: 2500V Contact-to-coil: 4000V Contact-to-frame: 2500V	Pole-to-pole: 1500V Contact-to-coil: 1500V Contact-to-frame: 1500V	Pole-to-pole: 1500V AC Contact-to-coil: 1500V AC Contact-to-frame: 1500V AC
Electric Service Life (cycles)	100,000 minimum	100,000 minimum	100,000 minimum	200,000 minimum, 500,000 minimum (DPDT)
Reference				
Certifications	CE, cULus, cURus, ABS, IMQ, RINA	CE, cULus, cURus, ABS, IMQ, RINA	CE, UR, CSA, ABS, IMQ, RINA	CE, UR, CSA
Socket Cat. No(s).	700-HN100, 700-HN101, 700-HN125, 700-HN126	700-HN153 700-HN154	—	700-HN116, 700-HN138, 700-HN139
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	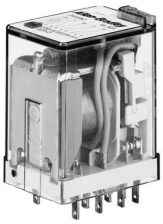	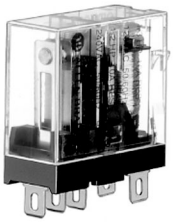	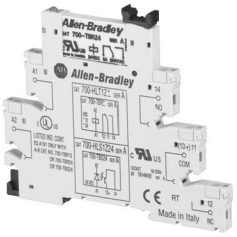	
Bulletin No.	700-HC	700-HK	700-HL	700-HP
Type	Interposing/Isolation Relay	Interposing/Isolation Relay	Interposing/Isolation Relay	Interposing/Isolation Relay
Features	Pin Style Terminals,Standard ON/OFF Flag Indicator, Electrical Schematic on Face, Clear Cover for Visual Inspection, Optional Push-to-test and Manual Override, Optional LED	Optional Pilot Light, Built-in Retainer Clip, Low Switching Capacity	Ideal for PLC Interfaces, Built-in Coil Surge Protection, Fully Assembled Relay/Sockets, Standard LED, Relay or Solid-state Output Optional: Leakage Current Suppression Solution	PCB “Pin Style” Mounting, 5 mm Pin spacing
Contact Ratings				
Contact Form	2PDT, 4PDT	SPDT, DPDT	SPDT (1 c/o) 1 N.O. (SSR)	2PDT
Contact Type	Single	Single	Single	Single
Contact Material	AgNi, AgNi + Gold	AgCdO, AgCd+Gold	AgSnO	AgNi, AgNi + Gold
Max. operating current under resistive load	10 A (2PDT) 7 A (4PDT)	5 A (DPDT), 10 A (SPDT)	6 A (SPDT), 2 A (SSR)	8 A
Min. permissible load	10V 1 mA (Gold), 10V 10 mA (Silver)	10V 50 mA (Silver), 5V 10 mA (Gold)	12V 6 mA (72 mW) Silver 8V, 2.5 mA (20 mW) Gold	5V 5 mA (50 mW) Gold, 5V 5 mA (300 mW) Silver
Coil Ratings				
Coil Voltage	**AC:** 6V, 12V, 24V, 120V, 240V **DC:** 6V, 12V, 24V, 48V, 110V	**AC:** 6V, 12V, 24V, 120V, 240V **DC:** 6V, 12V, 24V, 48V, 110V	**AC:** 12V, 24V, 48V, 110V, 120V, 230V, 240V **DC:** 12V, 24V, 48V, 125V, 230V, 240V	**AC:** 6V, 12V, 24V, 120V, 240V **DC:** 6V, 12V, 24V, 48V, 110V
Permissible Coil Voltage Variation	80…110% of Nominal Voltage at 50 Hz 80…110% of Nominal Voltage at 60 Hz 80…110% of Nominal Voltage at DC	85…110% of Nominal Voltage at 50 Hz 85…110% of Nominal Voltage at 60 Hz 80…110% of Nominal Voltage at DC	85…110% of Nominal Voltage at 50 Hz 85…110% of Nominal Voltage at 60 Hz 80…110% of Nominal Voltage at DC	80…110% of Nominal Voltage at 50 Hz 80…110% of Nominal Voltage at 60 Hz 73…150% of Nominal Voltage at DC
Electrical Ratings				
Dielectric Withstand Voltage	Pole-to-pole: 1600V Contact-to-coil: 1600V Contact-to-frame: 1600V	Pole-to-pole: 1500V AC Contact-to-coil: 1500V AC Contact-to-frame: 1500V AC	Pole-to-pole: — Contact-to-coil: 4000V Contact-to-frame: 1500V	Pole-to-pole: 2000V Contact-to-coil: 5000V
Electric Service Life (cycles)	100,000 minimum	100,000 minimum	100,000 minimum	100,000 minimum
Reference				
Approvals	CE, cULus, cURus, IMQ, ABS, RINA	CE, UL, UR, CSA	CE, cURus, cULus, ABS, IMQ	CE, cULus, cURus, IMQ, ABS, RINA
Socket Type	700-HN103, 700-HN128, 700-HN104	700-HN121 700-HN122	—	700-HN123
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General Information

Quick Selection Table For Relays

Bulletin No.	**700-HG**	**700-HHF**	**700-HJ**
Type	Power Relay	Power Relay	Magnetic Latching Relay
Features	Panel Mount with Screw Terminals, Optional Magnetic Blowouts for Switching DC Loads, Optional Snap Action Switch	Flange Mounted, Optional LED	Socket Mounted, Ideal for Lighting Applications
Contact Ratings			
Contact Form	SPST-N.O.-DM, SPDT, DPST-N.O., DPDT	SPST-NO-DM, DPDT, 3PDT	SPDT, DPDT (Single or Dual Coil)
Contact Type	Single	Single	Single
Contact Material	AgCdO	AgCdO	AgCdO
Max. operating current under resistive load	30 A	20 A (3PDT), 25 A (DPDT), 30 A (SPDT)	10 A
Min. permissible load	10V 50 mA	10V 50 mA 10V 100 mA (3PDT)	10V 50 mA
Coil Ratings			
Coil Voltage	**AC:** 24V, 120V, 240V, 277V, 480V **DC:** 12V, 24V, 48V, 110V, 220V, 250V	**AC:** 24V, 120V, 240V **DC:** 6V,12V, 24V	**AC:** 24V, 120V, 240V **DC:** 12V, 24V
Permissible Coil Voltage Variation	85…110% of Nominal Voltage at 50 Hz 85…110% of Nominal Voltage at 60 Hz 80…110% of Nominal Voltage at DC	85…110% of Nominal Voltage at 50 Hz 85…110% of Nominal Voltage at 60 Hz 80…110% of Nominal Voltage at DC	85…110% of Nominal Voltage at 50 Hz 85…110% of Nominal Voltage at 60 Hz 80…110% of Nominal Voltage at DC
Electrical Ratings			
Dielectric Withstand Voltage	Pole-to-pole: 2200V AC Contact-to-coil: 2200V AC Contact-to-frame: 2200V AC	Pole-to-pole: 2200V AC Contact-to-coil: 2200V AC Contact-to-frame: 2200V AC	Pole-to-pole: 1500V AC Contact-to-coil: 1500V AC Contact-to-frame: 1500V AC
Electric Service Life (cycles)	100,000 minimum	100,000 minimum	100,000 minimum
Reference			
Certifications	CE, UL, CSA	CE, UR, CSA	CE, UR, CSA
Socket Cat. No(s).	—	—	700-HN153 700-HN154
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✶ Information for these product lines are available on the Industrial Control Catalog CD-ROM (pub. no. A115-CA002A-EN-C) or on the Industrial Controls catalog Web site www.ab.com/catalogs.

Bulletin No.	700-FE	700-FS	700-HR52, -HRP, -HRS, -HRT, -HRV	700-HRM/-HRC	700-HRF
Type	DIN Rail Timer	DIN Rail Timer	Multifunction Timer	On-Delay Timer	Twin Timer
Features	Only 17.5 mm wide, 5 A Contact Rating, Multifunction or Single Function	Electronic Timing Relay	Dial Timing Relays 5 A Contact Rating Multiple Programmable Timing Ranges Tube Base Pin Style Terminals Multi-Voltage Inputs Timed Contacts and Instantaneous Contacts Transistor Outputs Single Function and Multi-Function 7 Different Operating Modes	Dial Timing Relays 5 A Contact Rating Multiple Programmable Timing Ranges Tube Base Pin Style Terminals Multi-Voltage Inputs Timed Contacts and Instantaneous Contacts Transistor Outputs Single Function and Multi-Function	Independent ON and OFF settings 14 time ranges 8-pin models available Dial Timing Relays UL508
Control Outputs: Time Limit Instantaneous	1 N.O. or SPDT Timed	SPDT, DPDT, 2 N.O. + 1 common	DPDT Timed, Transistor SPDT Timed/Instantaneous	DPDT Timed, Transistor SPDT Timed/Instantaneous	DPDT Timed
Operation Modes:	On-Delay Off-Delay One Shot Repeat Cycle-Pulse Fleeting Off-Delay Pulse Converter Star Delta	11 Different Timing Modes	On-Delay Off-Delay One Shot Repeat Cycle Off Start Repeat Cycle On Start Signal On/Off-Delay On-Delay One Shot	On-Delay	Repeat Cycle Off Start Repeat Cycle On Start
Time Range	0.05 s…10 h	0.05s…60 h	0.05 s…300 h	0.05 s…300 h	0.05 s…300 h
Supply Voltage	24V AC/DC 110…240V AC 24V…48V AC/DC 24V…240V AC	12V DC 24V…48V DC 24V…240V AC	12…48V DC 24…48V AC 100…240V AC 100…125V DC	12…48V DC 24…48V AC 100…240V AC 100…125V DC	12V DC 24V AC/DC 48…125V DC 100…240V AC
Contact Rating at 120V AC	6 A	8 A	5 A	5 A	5 A
Certifications	cUR, UL, CE	cUR, UL, CE	cURus, CE, ACA	cURus, CE, ACA	cURus, CE, ACA
Socket Cat. No(s).	—	—	700-HN100 OR 700-HN101 700-HN125 OR 700-HN126	700-HN100 700-HN125	700-HN100 700-HN125
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General Information

Quick Selection Table For Timing Relays

Bulletin No.	**700-HRY**	**700-HRQ**	**700-HNC**	**700-HNK**
Type	Star-Delta Timer	True Off-Delay Timer	Miniature Timer	Ultra-Slim Timer
Features	A wide star-time range (up to 120 s) Star-delta transfer time range (up to 0.5 s) UL Recognized	Dial Timing Relays Long power Off-Delay Times 11-pin and 8-pin models are available UL Recognized	Four Different Operating Modes DIN Rail Mount with Socket Pin Configuration Same as Bulletin 700-HC Relay	Ultra-Slim Timing Relay 4 Different Operating Modes Three Operating Voltages DIN Rail Mount with Socket Pin Configuration Same as 700-HK Relay
Control Outputs: Time Limit Instantaneous	SPST (Star, Delta) Timed SPST - NO Instantaneous	DPDT Timed	4PDT	SPDT, DPST-NO
Operation Modes:	Star-Delta	True OFF-delay Timer True OFF-delay Timer w/reset	On-Delay One Shot Repeat Cycle Off Start Repeat Cycle On Start	On-Delay One Shot Repeat Cycle Off Start Repeat Cycle On Start
Time Range	0.5 s…120 s	0.05 s…12 min.	0.1 s…10 h	0.1 s…10 h
Supply Voltage	100…120V AC 200…240V AC	48V DC 24V AC/DC 100…240V AC 100…125V DC	12V DC 24V AC/DC 48…125V DC 100…240V AC	12V DC 24V DC 24V AC
Contact Rating at 120V AC	5 A	5 A	5 A	5 A
Certifications	cURus, CE, ACA	cURus, CE, ACA	cURus, CE, ACA	cURus, CE, VDE, ACA
Socket Cat. No(s).	700-HN100 700-HN125	700-HN100 OR 700-HN101 700-HN125 OR 700-HN126	700-HN103 700-HN128	700-HN121 700-HN122
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			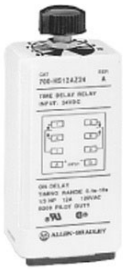		
Bulletin No.	**700-HT**	**700-HV**	**700-HS**	**700-HX**	**700-HXM**
Type	Tube Base Timing Relay	Repeat Cycle Timing Relay	Square Base Timing Relay	Digital Timer	Digital Counter/Timer
Features	Pin Style Terminals Single Range or Fixed Timers Available as -ON or -OFF Delays	Pin Style Terminals, Single Range Timer, Repeat Cycle	Blade Style Terminals, Single Range or Fixed Timers Available as -ON or Off-Delay	Digital Timer 5 A Contact Rating Negative Transmissive LCD Display 10 Functions or Modes Environmentally Friendly—Flash Memory, No Battery NEMA B300 Rated NEMA 4/ IP66 DIN or Panel Mount Capable	World's Smallest Compact Preset Timer Built-in Prescaling for Counter Operation Finger Protection Terminal Block to Meet VDE0106/P100 Panel Surface Compatible with NEMA 4/IP66 Six-language Instruction Manual Provided Environmentally Friendly—Flash Memory, No Battery Negative Transmissive LCD Display
Control Outputs: Time Limit Instantaneous	DPDT	DPDT	DPDT	SPDT	SPDT
Timing Operation Modes:	On-Delay Off-Delay	Repeat Cycle	On-Delay Off-Delay	Signal On-Delay 1 and 2 Signal Off-Delay One Shot Repeat Cycle Off Start Repeat Cycle On Start Signal On/Off-Delay Power On-Delay 1 and 2 Twin Timer Cumulative	On-Delay Repeat Cycle Signal Off-Delay One Shot Accumulative On/Off-duty Adjustable-Repeat Cycle Counter Multi Mode
Time Range	0.1 s…30 min.	0.1 s…30 min.	0.1 s…180 s	0.05 s…300 h	0…9999 h
Supply Voltage	12V DC 24V DC 24V AC 120V AC 240V AC	24V DC 24V AC 120V AC 240V AC	12V DC 24V AC 24V DC 120V AC	12…24V DC 24V AC 100…240V AC	24V DC
Contact Rating at 120V AC	10 A	10 A	12 A	5 A	5 A
Certifications	UR, CSA, CE	UR, CSA, CE	UR, CSA, CE	cURus, CE, NEMA 4/IP66, ACA	cURus, CE, NEMA 4/IP66, ACA
Socket Cat. No(s).	700-HN100 OR 700-HN101 700-HN125 OR 700-HN126	700-HN100 700-HN125	700-HN153 700-HN154	700-HN100 700-HN125	—
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* Information for these product lines are available on the Industrial Control Catalog CD-ROM (pub. no. A115-CA002A-EN-C) or on the Industrial Controls catalog Web site www.ab.com/catalogs.

General Information

Quick Selection Table For Relays

Bulletin No.	700-CF and 700-S-CF	700-M/MB	700-P and 700S-P	700-PK	700-R
Type	Control Relay	Miniature Control Relay	Heavy-Duty Control Relay	Heavy-Duty Control Relay	Sealed Switch
Features	Mechanically Linked Contacts, Timer and Latch Operations, Switch up to 600V AC and DC 700S-CF for Safety Circuits	Smallest Size, Long Life, Low Power Consumption, Mechanically Linked Contacts, Switch up to 600V AC and DC	Five Contact Styles, Mechanically Linked Contacts, Timer and Latch Options, Switch up to 600V AC and DC 700S-P for Safety Circuits	Five Contact Styles, Mechanically Linked Contacts, Timer and Latch Options, Switch up to 600V AC and DC	Hazardous Location Ratings, Long Life in Dirty Environment, Timer and Latch Options, Switch 600V AC, 300V DC
Contact Form	4-12 Poles Double Break	4-8 Poles Double Break	2-12 Poles Double Break	2-12 Poles Double Break	2-8 Poles
Contact Type	Cross Stamp, Bifurcated	X-Mark and Bifurcated	Bifurcated Double Break	Double Break	Sealed Switch
Contact Material	Silver, Gold	Silver-Copper	Silver-Nickel	Silver-Cadmium Oxide	Sealed Switch
Electrical					
Max. Current AC Resistive	25 A (Relay) 10 A (Adder Deck)	15 A	10 A	20 A	5 A
Min. load	24V 10 mA (Silver) 12V 8 mA (Gold)	17V, 30 mA (700-M) 17V 5 mA (700-MB)	10V, 50 mA 5V 1 mA (sealed switch)	1 mA, 5V with Bulletin 700-CPR	1 mA, 5V
Coil Voltage	12…600V AC 9…250V DC	24…480V AC 12…220V DC	24…600V AC 6…600V DC	24…600V AC 6…600V DC	24…240V AC 24…250V DC
Coil Voltage Pickup	85…110% AC Coils, 80…110% DC Coils	85…110% AC Coils, 80…110% DC Coils	85…110% AC Coils, 80…110% DC Coils	85…110% AC Coils, 80…110% DC Coils	85…110% AC Coils, 80…110% DC Coils
Dielectric Withstand	2640V	2640V	2640V	2640V	2640V
Reference					
Electric Service Life (cycles)	1.2 million at 10 A 120V AC	800K at 10 A 120V AC	1.5 million at 10 A 120V AC	1.5 million at 10 A 120V AC	1.5 million at 5 A 120V AC
Certifications	UL, CSA, CE	UL, CSA, CE	UL, CSA, CE	UL, CSA, CE	UL, CSA, CE
Sockets	DIN Rail or Panel Mount	DIN Rail or Panel Mount	Panel or Rail Mount	Panel or Rail Mount	Panel or Rail Mount
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Bulletin No.	**100-ETA**	**196-MT3**	**700-RTC**	**700-PS**
Type	Solid-state Timing Module (for 700-CF relays)	Solid-State Timing Module (for 700-M relays)	Solid-state Timing Relay	Solid-state Timer
Features	Changes all contacts on Bulletin 100-C contactors and Bulletin 700-CF control relays into timed contacts	35 mm DIN Rail Mounting Adapter	Timed and instantaneous contacts. Sealed contacts for harsh environments and hazardous locations.	Self-contained or external potentiometer. Continuous carrying current of 5 A AC or DC. Stand alone or mount on 700-P or &00-R.
Control Outputs: Time Limit Instantaneous	4 timed contacts on relay	4 instantaneous to timed contacts	8 output contacts	3 output contacts
Timing Operation Modes:	On-Delay Off-Delay	On-Delay	On-Delay Off-Delay	On-Delay Off-Delay
Time Range	0.1…180 s	0.1…30 s	0.05 s…64 min.	0.1 …120 s
Supply Voltage	110…240V 50/60 Hz 24V DC 110…250V DC	110…250V AC/DC 50/60 Hz	24V AC 110…120V AC 220…240V AC 24V DC 120V DC 240V DC	110…120V 50/60 Hz
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Bulletin No.	100-FPT	700-PT
Type	Penumatic Timing Module (for 700-CF relays)	Pneumatic Time-Delay Timer
Features	Timing function works independently of the supply voltage. Relay contact operates instantaneously. Continuous adjustment type.	Continuous carrying current of 10 A, Contacts of N.O. and N.C. Open Type Without Enclosure. Mounts on 700-P relay.
Control Outputs: Time Limit Instantaneous	2 timed contacts	1 open, 1 closed
Timing Operation Modes:	On-Delay Off-Delay	On-Delay Off-Delay
Time Range	0.3…180 s	0.1…60 s
Supply Voltage	110…240V 50/60 Hz 110…250V DC	24…600V AC 6…600V DC
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			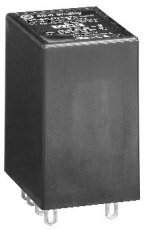	
Bulletin No.	**700-SH**	**700-SE**	**700-SC**	
Type	Hockey Puck	Flat Pack	Miniature, Ice Cube Socketed	
Features	Panel/DIN Mount, High Current, Protective Cover, LED Status	Panel/DIN Mount, Low Profile	Compatible w/700-HN103 or 128 socket, LED Status & Zero-cross AC Switching Options	
Load Type	AC (47…63 Hz)	AC (47…63 Hz)	AC (47…63 Hz)	DC
Load Voltage Range	19…264V AC, 180…528V AC*	75…264V AC	75…264V AC	3…52.8V DC or 3…125V DC
Load Current Max. (Continuous)	6 A/40 A†	5 A/20 A†	3 A	3A @ 48V DC, or 2A @ 110V DC
Max Leakage Current to Load	5 mA @ 100V, 10 mA @ 200V, 20 mA @ 400V	5 mA @ 100V, 10 mA @ 200V	5 mA @ 100V AC	10 mA @ 200V AC5 mA @ 50V DC, or 0.1mA @ 100V DC
Zero Cross Load Switching	Yes	Yes (optional)	Yes (optional)	N/A
Equivalent Electromechanical Relay Contact Arrangement	Form A	Form A	Form A	
Rated Control (Input) Voltage	5…24V DC, 100…120V AC, 200…240V AC	5V DC, 12V DC, 24V DC	5…24V DC, 100…110V AC, 200/220V AC	5...24V DC
LED Indicator	Yes	No	Yes (optional)	Yes (optional for 48V DC)
Mounting Method	Panel w/o heat sink, Panel or DIN w/heat sink	Panel w/o heat sink, Panel or DIN w/heat sink	Panel or DIN w/socket	
Dielectric Strength	2500V AC, 50/60 Hz, 1 min.	2000V AC, 50/60 Hz, 1 min.	1500V AC, 50/60 Hz, 1 min.	
Certification	cURus, CE , TÜV*	cURus, CE, TÜV	cURus, CE, VDE	
Max. Ambient Operating Temperature	-30…80 °C (no condensation)	-30…80 °C (no condensation)	-30…80 °C (no condensation)	
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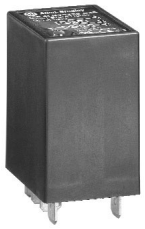
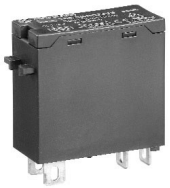
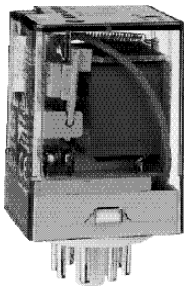
* 180…528V load voltage range units do not have CE approval.
† With heat sink.

								
Bulletin No.	**700-SF**		**700-SA**		**700-SK**			
Type	Square Base, Socketed		Tube Base, Socketed		Slim Line, Socketed			
Features	Compatible w/700-HN116 socket, LED status, zero-cross AC switching		Compatible w/700-HN100, 125,108, and 202 socket, LED status, zero-cross switching		Compatible w/700-HN121 socket. Supports Input (sensor) module or Output (SSR) module			
Load Type	AC (47…63 Hz)	DC	AC (47…63 Hz)	DC	Output Module		Input Module	
					AC 47…63 Hz)	DC	AC (47…63 Hz)	DC
Load Voltage Range	75…264V AC	3 … 52.8V DC	75…264V AC	3 …125V DC	75 … 264V AC	4 … 60V DC, 40 … 200V DC	Field Input: 60… 264V AC	Field Input: 6.6… 32V DC
Load Current Max. (Continuous)	3 A		5 A	3 A	2 A	2A @ 60V, 1.5A @ 200V	Supply Current: 0.1 … 100 mA	Supply Current: 0.1 … 100 mA
Max Leakage Current to Load	5mA @ 100V AC, 10mA @ 200V AC	5mA @ 50V DC	5 mA @ 100V, 10 mA @ 200V	5 mA @ 125V	1.5 mA	1 mA	5 µA	5 µA
Zero Cross Load Switching	Yes	N/A	Yes	N/A	Yes (optional)	N/A	No	N/A
Equivalent Electromechanical Relay Contact Arrangement	Form A		Form A		Form A			
Rated Control (Input) Voltage	4V DC or 24V DC		5…24V DC		5 … 24 V DC	5 … 24 V DC	5 … 24V DC	5 … 24V DC
LED Indicator	Yes		Yes		Yes			
Mounting Method	Panel or DIN w/socket		Panel or DIN w/socket		Panel or DIN w/socket			
Dielectric Strength	1500V AC, 50/60 Hz, 1 min.		1500V AC, 50/60 Hz, 1 min.		4000V AC, 50/60 Hz, 1 min.			
Certification	cURus, CE, VDE		cURus, CE, VDE		cURus, CE, TÜV			
Max. Ambient Operating Temperature	-30…80 °C (no condensation)		-30 … 80 °C, (no condensation)		-30 … 80 °C (no condensation)			
Page Number	page 9-185		page 9-171		page 9-195			



Bulletin 700-HA

- 10 A Contact Rating
- DPDT, 3PDT
- Pin Style Terminals
- Standard ON/OFF Flag Indicator
- Options: LED, Push-to-Test and Manual Override, Socket Mounted Surge Suppressor Module, or Multifunction Timer
- Contact Choices: Standard Silver Nickel, Bifurcated Silver Nickel, or Bifurcated with Gold Plating

Table of Contents

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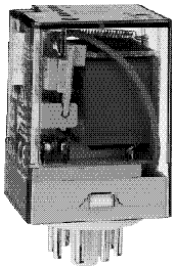
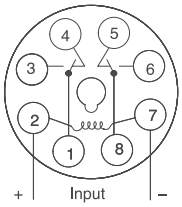
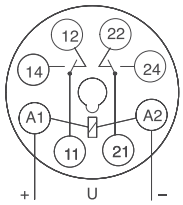
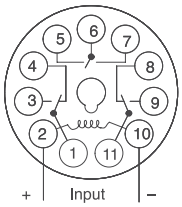
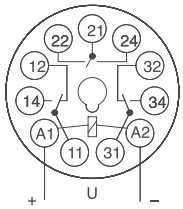
Accessories 9-18
Specifications 9-21
Approximate Dimensions 9-24

Standards Compliance and Certifications

See Specification Table In This Section.

Bulletin 700-HA Tube Base Relay with PIN Terminals (Single Contact) — Mechanical ON/OFF Indicator included*

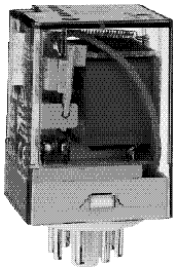
	Description	Contact Rating	Wiring Diagrams U.S./Canada	Wiring Diagrams International	Coil Voltage	Cat. No.†‡§
	DPDT 2-pole 2 Form C Single AgNi Contact	10 A B300			6V AC	700-HA32A06
					12V AC	700-HA32A12
					24V AC	700-HA32A24
					120V AC	700-HA32A1
					240V AC	700-HA32A2
					277V AC	700-HA32A27➤
					6V DC	700-HA32Z06
					12V DC	700-HA32Z12
					24V DC	700-HA32Z24
					36V DC	700-HA32Z36
					48V DC	700-HA32Z48
					60V DC	700-HA32Z60
					80V DC	700-HA32Z80
					110V DC	700-HA32Z1
					125V DC	700-HA32Z01
	Sockets		*700-HN125*	*700-HN100* *700-HN204*	140V DC	700-HA32Z3
					220V DC	700-HA32Z2➤
	3PDT 3-pole 3 Form C Single AgNi Contact	10 A B300			6V AC	700-HA33A06
					12V AC	700-HA33A12
					24V AC	700-HA33A24
					120V AC	700-HA33A1
					240V AC	700-HA33A2
					6V DC	700-HA33Z06
					12V DC	700-HA33Z12
					24V DC	700-HA33Z24
					48V DC	700-HA33Z48
					60V DC	700-HA33Z60
					80V DC	700-HA33Z80
					110V DC	700-HA33Z1
					125V DC	700-HA33Z01
	Sockets		*700-HN126*	*700-HN101* *700-HN205*	140V DC	700-HA33Z3
					220V DC	700-HA33Z2➤

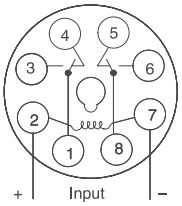
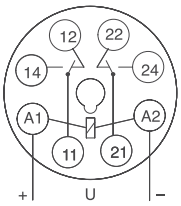
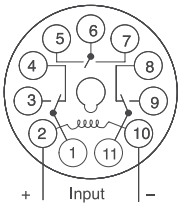
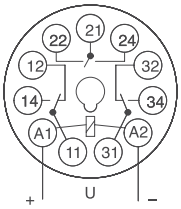
* For Time Module and Surge Suppressor Module, see page 9-19.
† LED Option: Add suffix (**-4**) to the selected Bulletin 700-HA Relay Cat. No., except for the 240V AC Units, add (**-4L**).
‡ Push-to-test, Manual Override, and LED Option: Add suffix (**-3-4**) to the selected Bulletin 700-HA Relay Cat. No., except for the 240V AC units, add (**-3-4L**).
§ Push-to-test and Manual Override option: Add suffix (**-3**) to the selected Bulletin 700-HA relay.
➤ LED not available for 220V DC and 277V AC coils.

General Purpose Relays

Product Selection, Continued

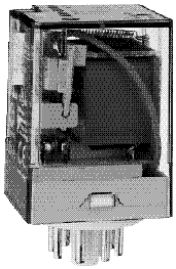
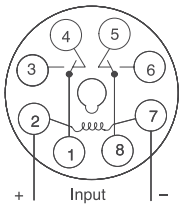
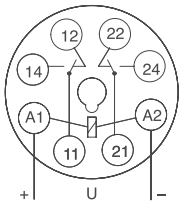
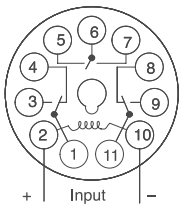
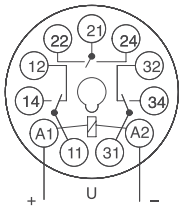
Bulletin 700-HAB Tube Base Relay with PIN Terminals (Bifurcated Contacts) — Mechanical ON/OFF Indicator included*



Description	Contact Rating	Wiring Diagrams		Coil Voltage	Cat. No.†‡§
		U.S./Canada	International		
DPDT 2-Pole 2 Form C Bifurcated AgNi Contacts	6 A			6V AC	700-HAB2A06
				12V AC	700-HAB2A12
				24V AC	700-HAB2A24
				120V AC	700-HAB2A1
				240V AC	700-HAB2A2
				277V AC	700-HAB2A27➤
				6V DC	700-HAB2Z06
				12V DC	700-HAB2Z12
				24V DC	700-HAB2Z24
				36V DC	700-HAB2Z36
				48V DC	700-HAB2Z48
				110V DC	700-HAB2Z1
Sockets		*700-HN125*	*700-HN100* *700-HN204*	125V DC	700-HAB2Z01
				140V DC	700-HAB2Z3
3PDT 3-Pole 3 Form C Bifurcated AgNi Contacts	6 A			6V AC	700-HAB3A06
				12V AC	700-HAB3A12
				24V AC	700-HAB3A24
				120V AC	700-HAB3A1
				240V AC	700-HAB3A2
				6V DC	700-HAB3Z06
				12V DC	700-HAB3Z12
				24V DC	700-HAB3Z24
				48V DC	700-HAB3Z48
				110V DC	700-HAB3Z1
Sockets		*700-HN126*	*700-HN101* *700-HN205*	125V DC	700-HAB3Z01
				140V DC	700-HAB3Z3

* For Time Module and Surge Suppressor Module, see page 9-19.
† LED Option: Add suffix (**-4**) to the selected Bulletin 700-HAB Relay Cat. No., except for the 240V AC Units, add (**-4L**).
‡ Push-to-test, Manual Override & Pilot Light Option: Add suffix (**-3 -4**) to the selected Bulletin 700-HAB Relay Cat. No., except for the 240V AC units, add (**-3 -4L**).
§ Push-to-test and Manual Override option: Add suffix (**-3**) to theselected Bulletin 700-HA relay.
➤ LED not available.

Bulletin 700-HAX Tube Base Relay with PIN Terminals (Bifurcated Contacts with Gold Overlay) — Mechanical ON/OFF Indicator Included∗

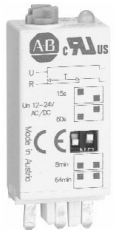
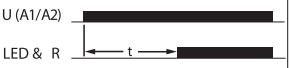
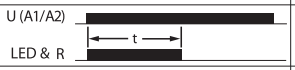
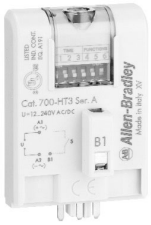
	Description	Contact Rating	Wiring Diagrams U.S./Canada	Wiring Diagrams International	Coil Voltage	Cat. No.†‡§
	DPDT 2-Pole 2 Form C Bifurcated AgNi Contacts with Gold Overlay Sockets	6 A			6V AC	700-HAX2A06
					12V AC	700-HAX2A12
					24V AC	700-HAX2A24
					120V AC	700-HAX2A1
					240V AC	700-HAX2A2
					277V AC	700-HAX2A27♣
					6V DC	700-HAX2Z06
					12V DC	700-HAX2Z12
					24V DC	700-HAX2Z24
					36V DC	700-HAX2Z36
					48V DC	700-HAX2Z48
					110V DC	700-HAX2Z1
	Sockets		*700-HN125*	*700-HN100* *700-HN204*	125V DC	700-HAX2Z01
					140V DC	700-HAX2Z3
	3PDT 3-Pole 3 Form C Bifurcated AgNi Contacts with Gold Overlay Sockets	6 A			6V AC	700-HAX3A06
					12V AC	700-HAX3A12
					24V AC	700-HAX3A24
					120V AC	700-HAX3A1
					240V AC	700-HAX3A2
					6V DC	700-HAX3Z06
					12V DC	700-HAX3Z12
					24V DC	700-HAX3Z24
					48V DC	700-HAX3Z48
					110V DC	700-HAX3Z1
	Sockets		*700-HN126*	*700-HN101* *700-HN205*	125V DC	700-HAX3Z01
					140V DC	700-HAX3Z3

∗ For Time Module and Surge Suppressor Module, see page 9-19.
† LED Option: Add suffix (**-4**) to the selected Bulletin 700-HAX Relay Cat. No., except for the 240V AC Units, add (**-4L**).
‡ Push-to-test and LED Option: Add suffix (**-3-4**) to the selected Bulletin 700-HAX Relay Cat. No., except for the 240V AC units, add (**-3-4L**).
§ Push-to-test and Manual Override option: Add suffix (**-3**) to the selected Bulletin 700-HA relay.
♣ LED not available.

General Purpose Relays

Accessories

	Description	Pkg. Qty.	Cat. No.
Cat. No. 700-HN100	**Screw Terminal Tube Base Socket — Panel or DIN Rail Mounting; Guarded Terminal Construction.** 8-Pin for use with DPDT Bulletin 700-HA Relays, -HX Timing Relays, -HT (On-Delay) and -HRM, -HRC and -HV (Repeat Cycle) Timing Relays. Order ten or multiples of ten	10	700-HN100
Cat. No. 700-HN125	**Screw Terminal Tube Base Socket — Panel or DIN Rail Mounting; Open Style Construction.** 8-Pin for use with DPDT Bulletin 700-HA Relays, -HT (On-Delay) and -HRM, -HRC and -HV (Repeat Cycle) Timing Relays. Order must be for 10 sockets or multiples of 10. No retainer clip required.	10	700-HN125
Cat. No. 700-HN101	**Screw Terminal Tube Base Sockets — Panel or DIN Rail Mounting. Guarded Terminal Construction** 11-pin for use with 3PDT Bulletin 700-HA relays, -HR and -HT (Off-Delay) timing relays. Order must be for 10 sockets or multiples of 10.	10	700-HN101
Cat. No. 700-HN126	**Screw Terminal Tube Base Sockets — Panel or DIN Rail Mounting. Open Style Terminal Construction** 11-pin for use with 3PDT Bulletin 700-HA relays, -HR and -HT (Off-Delay) timing relays. Order must be for 10 sockets or multiples of 10.	10	700-HN126
Cat. No. 700-HN205	**8-Pin Socket — Can Be Used With or Without Timing Attachment or Surge Suppressor** Screw Terminal Tube Base Sockets — panel or DIN Rail mounting. Guarded terminal construction. Used with DPDT Bulletin 700-HA Relays. Order must be for 10 sockets or multiples of 10.	10	700-HN204
	11-Pin Socket — Can Be Used With or Without Timing Attachment or Surge Suppressor Screw Terminal Tube Base Sockets — panel or DIN Rail mounting. Guarded terminal construction. Used with 3PDT Bulletin 700-HA relays. Order must be for 10 sockets or multiples of 10.	10	700-HN205
Cat. No. 199-DR1	**DIN (#3) Symmetrical Rail** 35 mm x 7.5 mm x 1 m long Zinc-plated, yellow chromated	10	199-DR1

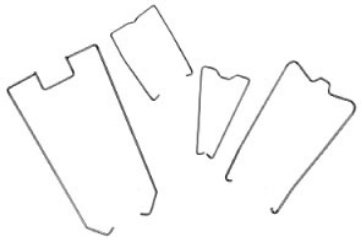
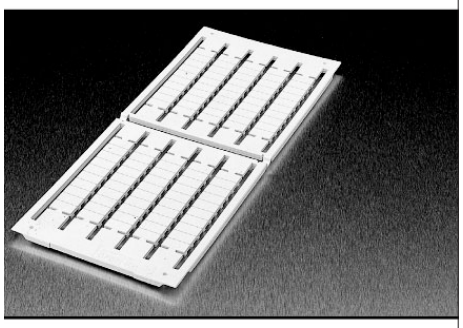
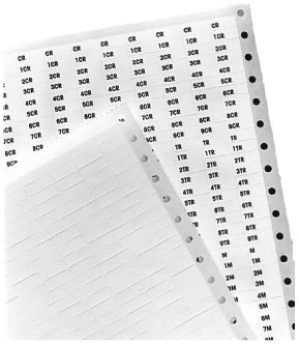
	Description	Pkg. Qty.	Cat. No.
	Diode Surge Suppressor∗ Voltage Range: 6…220V DC used with 700-HN204 and 700-HN205 socket	10	700-ADR
	Diode with LED Surge Suppressor∗ Voltage Range: 6…24V DC used with 700-HN204 and 700-HN205 socket	10	700-ADL1R
	Diode with LED Surge Suppressor∗ Voltage Range: 28…60V DC used with 700-HN204 and 700-HN205 socket	10	700-ADL2R
	Diode with LED Surge Suppressor∗ Voltage Range: 110…220V DC used with 700-HN204 and 700-HN205 socket	10	700-ADL3R
	Varistor with LED Surge Suppressor∗ Voltage Range: 6…24V AC used with 700-HN204 and 700-HN205 socket	10	700-AV1R
	Varistor with LED Surge Suppressor∗ Voltage Range: 110…240V AC used with 700-HN204 and 700-HN205 socket	10	700-AV3R
	RC Surge Suppressor∗ Voltage Range: 6…24V AC/DC used with 700-HN204 and 700-HN205 socket	10	700-AR1
	RC Surge Suppressor∗ Voltage Range: 110…240V AC/DC used with 700-HN204 and 700-HN205 socket	10	700-AR2
	**On-Delay Time Module**∗ Voltage Range: 12…24V AC/DC used with 700-HN204 and 700-HN205 socket 	1	700-AT1
Cat. No. 700-AT2	**One Shot Timing Module**∗ Voltage Range: 12…24V AC/DC used with 700-HN204 and 700-HN205 socket 	1	700-AT2
	**Multi-Function Multi-Range Time Module**∗ Voltage range 12…240V AC 50/60 Hz and 12…240V DC, with a voltage variation of 85…110%. Repeat accuracy of ±1%. Reset time <50 ms. Refer to page 9-23 for Specifications.	1	700-HT3
	Eight (8) Timing Modes Eight (7) Timing Ranges: 1. 1 s — 0.05 s…1 s 2. 10 s — 0.5 s…10 s 3. 100 s — 5 s…100 s 4. 10 min — 0.5 min…10 min 5. 100 min — 5 min…100 min 6. 10 hours — 0.5 h…10 h 7. 100 hours — 5 h…100 h 		
Cat. No. 700-HT3	LED Indicator		

∗ Suppressors and Time Modules easily plug into sockets (Cat. Nos. 700-HN204 and 700-HN205). For use with Bulletin 700-HA relays.

ATTENTION: Cat. No. 700-HT3 is wired with signal “S” connected to “A1”. See wiring diagram marked on the timer module.

General Purpose Relays

Accessories, Continued

	Description	Pkg. Qty.	Cat. No.
 *Sample Retainer Clips*	**Retainer Clip for Cat. Nos. 700-HN100, -HN101, -HN200, -HN201, -HN204, and -HN205 Sockets with Bulletin 700-HA Relays**∗ Secures relay in socket. Order must be for 10 clips or multiples of 10.	10	700-HN157
 *Snap-in markers*	**Relay Identification Snap-in Markers**‡ Snap-in markers fit on top of Bulletin 700-HA relay covers. The following are blank cards. Squares slip into molded slot on top of Bulletin 700-HA or 700-HB relay cover.	100	1492-MS5X12 1492-MS6X9 1492-MS6X12 1492-MS8X9 1492-MS8X12 1492-MP-Blank
	**Pre-printed identification tags —** contains 10 sheets of pre-printed and blank tags. Each sheet contains 13 sets of the markings CR…9CR, TR…9TR, M…9M, F, R, 1S, and 117 blank tags. Tags are peel-off with sticky backing for easy placement on relays.	10	700-N40
	Blank identification tags — contains 10 sheets of blank identification tags for customer specialized printing. Each sheet contains 546 blank tags. Tags are peel-off with sticky backing for easy placement on relays.	10	700-N41

∗ See Bulletin 700-HA Relay, Socket, and Retainer Clip Reference Chart below.
‡ For pre-printed marker cards, turn to the following 1492 sections: 1492-SM5X12_, 1492-SM6X9_,1492-SM8X9_,1492-SM8X12_,1492-MP_

Relay Type	Socket	Retainer Clip
700-HA32 700-HAB2 700-HAX2	700-HN100 700-HN125 700-HN204 700-HN200	700-HN157 Not Required§ 700-HN157 700-HN157
700-HA33 700-HAB3 700-HAX3	700-HN201 700-HN101 700-HN126 700-HN205	700-HN157 700-HN157 Not Required§ 700-HN157

§ Design of these sockets holds the relays securely and does not require retainer clips.

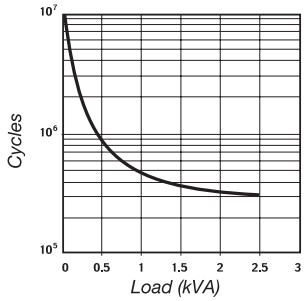
Cat. No. 700-HA…				
Electrical Ratings				
Pilot Duty Rating†		NEMA B300		
Rated Thermal Current (I_{th})		HA = 10 A – 120V, 240V HAB/HAX = 6 A – 120V, 240V		
Rated Insulation Voltage (U_i)		250V IEC – 300V UL/CSA		
Contacts	Inductive	**Make**	**Break**	**Hp**
		►][◄	◄][►	
	120V AC	30 A	3 A	1/3
	240V AC	15 A	1.5 A	1
	General Purpose	10 A, 240V AC		
	Resistive	10 A, 30V DC		
Min. Low Energy Permissible Load		HA = 10V, 50 mA HAB= 6V, 30 mA HAX = 6V, 1 mA		
Permissible Coil Voltage Variation		Pickup: 80…110% of Nominal Voltage at 50 Hz 80…110% of Nominal Voltage at 60 Hz 80…110% of Nominal Voltage at DC		
Coil Consumption ±10%	AC Coils	**50 Hz**	**60 Hz**	
	Inrush	3.3 VA	2.85 VA	
	Sealed	2.2 VA	1.9 VA	
	DC Coils	1.3 W		
Must Dropout Voltage		20% of nominal V AC 10% of nominal V DC		
Max. Contact Resistance		50 MΩ (700-HA and 700-HAB) 30 MΩ (700-HAX)		
Design Specification/Test Requirements				
Electrical				
Dielectric Withstand Voltage				
Pole-to-Pole		1000V		
Contact to Coil		3600V		
Contact to Frame		4000V		
Electrical Life (Operating)		100,000 min.		
Mechanical				
Degree of Protection (Open Type) IEC 529		IP 40		
Mechanical Life Cycles (AC/DC)		> 20 x 10^6/ 50 x 10^6		
Switching Frequency Operations		3600/HR		
Coil Voltages		See Product Selection		
Operating Time	Max. Pickup	10 ms		
	Max. Dropout	10 ms		
Maximum Operating Rate		4 Ops/s		
Vibration	Endurance	5 G		
	Operational	2.5 G		
Shock	Endurance	50 G		
	Operational	9 G		
Environmental				
Temperature	Operating	AC/DC	–40…+70 °C	
	Storage	AC/DC	–40…+100 °C	
Altitude		2000 m (6560 ft)		
Construction				
Insulating Material		Molded High Dielectric Material		
Enclosure		Transparent Dust Cover		
Contact Material		700-HA:	10 A– AgNi	
		700-HAB:	6 A–Bifurcated AgNi	
		700-HAX:	6 A–Bifurcated/Gold Plating AgNi	
Terminal Markings on Socket		In accordance with EN50 0005		
Sockets		8-Pin Socket — 700-HN100, -HN125, -HN204 11-Pin Socket — 700-HN101, -HN126, -HN205		
Certifications		CE, cULus listed, IMQ, RINA, ABS		

✶ Performance Data – See page Important 2, Industrial Controls Catalog.
† NEMA Rating Chart is on page 19 of publication 700-SG003B-EN-P.

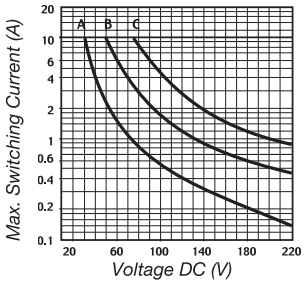
General Purpose Relays

Specifications, Continued*

700-HA Relay Performance Graphs

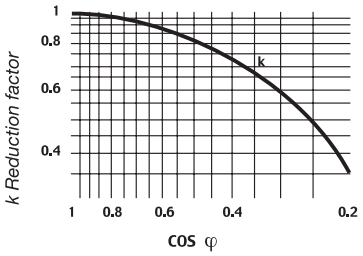


Contact life vs. AC1 load at 1,800 cycles/h



Breaking capacity for DC1 load at 1,800 cycles/h.

***A** = load applied to 1 contact*
***B** = load applied to 2 contacts in series*
***C** = load applied to 3 contacts in series*



Load reduction factor vs. cos ϕ

Time Module Cat. No. 700-HT3		
Electrical Ratings		
Operating Voltage Range		12…240V AC (50/60 Hz) 12…240V DC
Power Consumption		0.1 W (12V) 1.0 W (230V)
Mechanical		
Degree of Protection of Input (B1) Terminal		IP 20 (Guarded Terminal)
Input Terminal Wire Range		1.0 x 0.2 mm²…2.5 mm² (24 AWG…14 AWG) 2.0 x 0.2 mm²…1.5 mm² (24 AWG…16 AWG)
Input Terminal Torque Range		0.45…0.8 Nm (4…7 lb-in.)
LED Indicator		Red
Repeat Accuracy†		±1%
Recovery Time		<50 ms
Selectable Timing Ranges		3 DIP Switches, 7 Ranges (set from 5…100% of range): 1 s, 10 s, 100 s, 10 min, 100 min, 10 h, 100 h
Selectable Timing Modes		3 DIP Switches, 8 Modes: 1. Power On–Delay 2. Power On One-Shot 3. Power On Repeat Cycle, On Start 4. Signal On-Delay and Signal Off-Delay 5. Signal Off-Delay 6. Signal On-One-Shot 7. Signal Off-One-Shot 8. Signal On and Signal Off Watchdog Monster
Adjustable Trimmer Scale Accuracy		±5% of Time Range
Environmental		
Temperature	Operating	–20 °C…+50 °C (–4 °F…+122 °F)
	Storage	–55 °C…+85 °C (–67…+185 °F)
Altitude		2000 m (6560 ft)
Construction		
Enclosure		Gray Plastic Housing
Mounting with Socket Only		8- or 11-Pin Socket with Module Plug
Sockets		700-HN204 (8-Pin with Plug) 700-HN205 (11-Pin with Plug)
Certifications		CE, UL listed, CSA, CE-Marked (per EU Low Voltage Directive 73/23 EEC 93/68 EEC)
Standards		EN 60947-4-1, EN 60947-5-1, CSA 22.2, UL 508, Nema/EE MAC compliant, ICS-2 compliant

* Performance Data - See page Important-2, publication A115.
† At constant voltage and temperature.

Timing Charts, Cat. No. 700-HT3 Multi-Function Time Module (t = Time Range 0.05 s...100 h)

Cat. No. 700-HT3 Timing Modes, Time Description, Timing Charts, and DIP Switch Selections

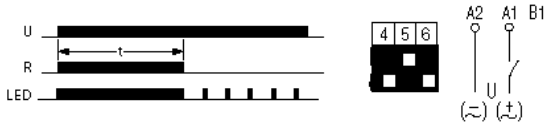
Terms:
U is Power Input
R is Relay Output
S Signal, **+A1** Socket, **B1** Timer
t is the resulting Time Delay (Red LED)

1. Power On-Delay

Apply power (U) to timer. Relay contacts (R) change state after time delay (t) is complete. Contacts return to their shelf state when power is removed. Terminal B1 is not used in this mode.

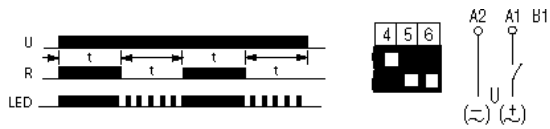
2. Power On One-Shot

Apply power (U) to timer. Relay contacts (R) change state immediately and the time delay begins. When the time delay (t) is complete, contacts return to their shelf state. Contacts return to their shelf state when power is removed. Terminal B1 is not used in this mode.



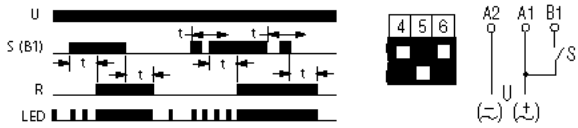
3. Power On Repeat Cycle, On Start

Apply power (U) to timer. Relay contacts (R) change state immediately and the time delay (t) begins. When the time delay is complete, the contacts return to their shelf state for time delay (t) (time on = time off). This cycle will repeat until the power is removed. Terminal B1 is not used in this mode.



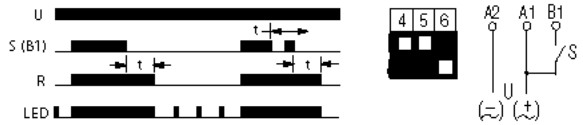
4. Signal On-Delay and Signal Off-Delay

Apply power (U) to timer. When the signal (S) is closed the time delay (t) begins, after the time delay is complete the relay contacts (R) change state. Opening the signal starts the time delay, after the time delay is complete the contacts return to their shelf state. If the signal is closed or opened before the time delay is complete, the time delay is reset. Contacts return to their shelf state when power is removed.



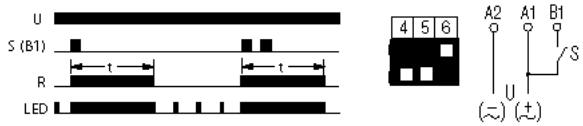
5. Signal Off-Delay

Apply power (U) to timer. When the signal (S) is closed, the relay contacts (R) change state immediately. When the signal is opened, the time delay (t) begins. If the signal is closed before the time delay is complete, the time delay is reset and the relay remains energized. When the time delay is complete, the contacts return to their shelf state. Contacts return to their shelf state when power is removed.



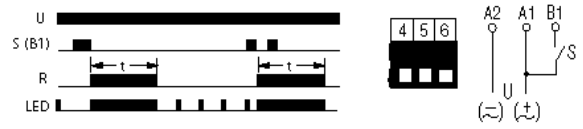
6. Signal On One-Shot

Apply power (U) to timer. When the signal (S) is closed, the relay contacts (R) change state immediately and the time delay (t) begins. After the time delay begins, opening or closing the signal will not reset the time delay. When the time delay is complete, the contacts return to their shelf state. Contacts return to their shelf state when power is removed.



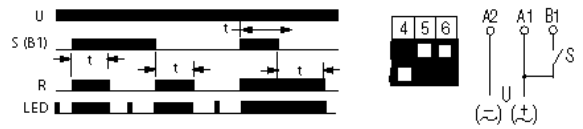
7. Signal Off One-Shot

Apply power (U) to timer. When the signal (S) is closed and then opened, the relay contacts (R) change state immediately and the time delay (t) begins. After the time delay begins, opening or closing the signal will not reset the time delay. When the time delay is complete, the contacts return to their shelf state. Contacts return to their shelf state when power is removed.



8. Signal On and Signal Off Watchdog Monitor

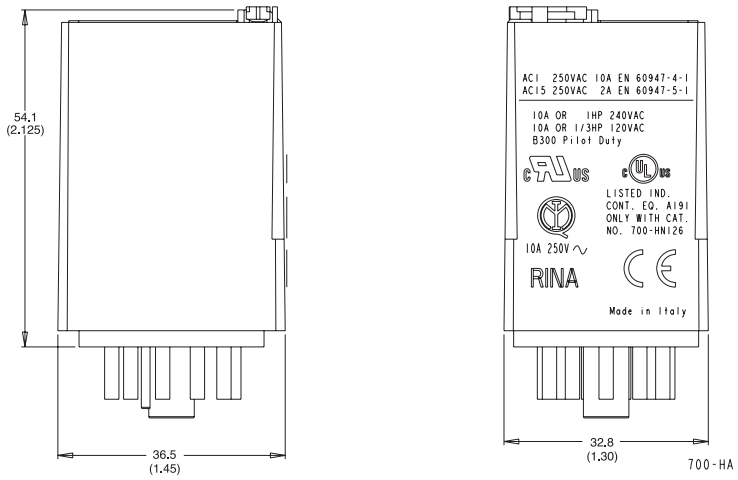
Apply power (U) to timer. When the signal (S) is closed, the relay contacts (R) energize immediately and the time delay (t) begins. If the signal is opened before the time delay is complete, the relay remains energized and the time delay is reset. When the time delay is complete the contacts return to their shelf state. If the signal is opened after the time delay is complete, the relay contacts energize immediately and the same time delay begins. Continuous cycling of the signal at a rate that is faster than the time delay will cause the relay contacts to remain energized. Contacts return to their shelf state when power is removed.



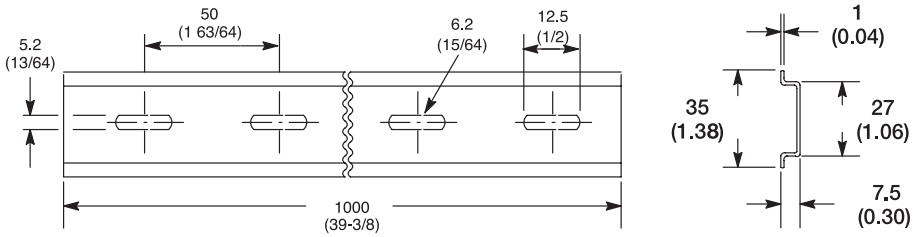
General Purpose Relays

Approximate Dimensions

Approximate Dimensions are shown in millimeters (inches). Approximate Dimensions are not intended to be used for manufacturing purposes.



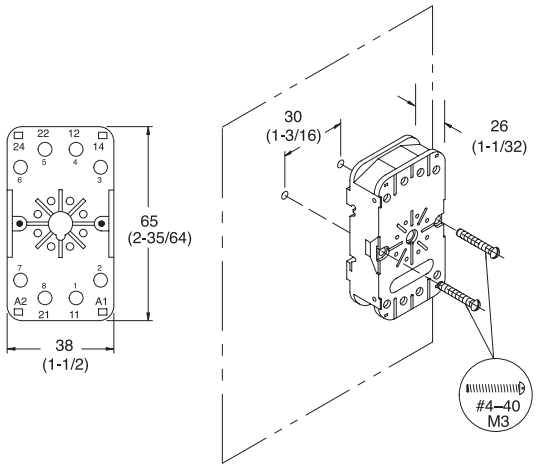
Bulletin 700-HA Relay



Cat. No. 199-DR1 DIN Mounting Rail Series B
Cat. No. 199-DR4 DIN Mounting Rail Series B Has No Mounting Holes

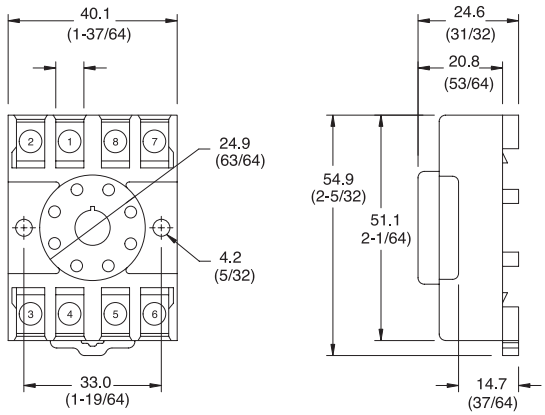
Cat. No.	A	B	C	D	Approx. Shipping Wt.
199-DR1	35 (1-3/8)	27 (1-1/16)	7.5 (19/64)	1.02 (1/64)	1.85 kg (4.07 lbs.) (10/pkg)
199-DR4	35 (1-3/8)	27 (1-1/16)	15 (19/32)	2.3 (3/32)	3.68 kg (8 lbs.) (5/pkg)

Approximate Dimensions are shown in millimeters (inches). Approximate Dimensions are not intended to be used for manufacturing purposes.



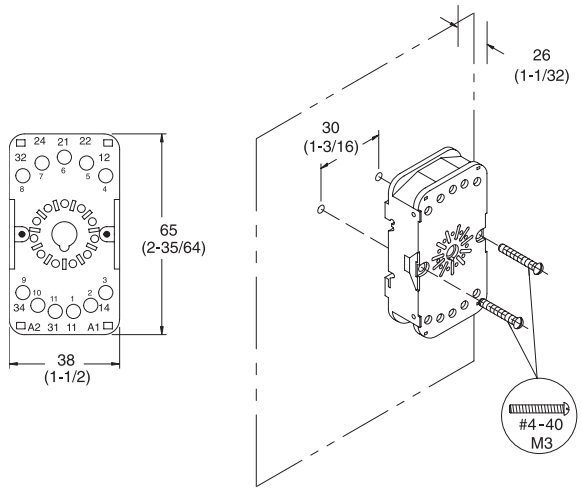
Cat. No. 700-HN100 *Panel Mounting*

Wire Size: 2 x 2.5 mm²
Single Wire – Up to #12 AWG
Double Wire – 2 x 2.5 mm² (#2–14 AWG… #2–20 AWG)
(Either Solid or Stranded)
Strip Length: 9 mm (3/8 in) – Torque: 0.8 Nm (7 lb•in)



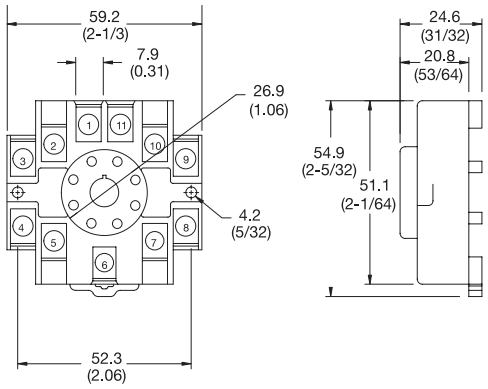
Cat. No. 700-HN125

Wire Size: 2 x 2.5 mm²
Single Wire – Up to 12 AWG
Double Wire – 2 x 2.5 mm² (#2–14 AWG…#2–20 AWG)
(Either Solid or Stranded)
Strip Length: 9 mm (3/8 in) – Torque: 0.8 Nm (7 lb•in)



Cat. No. 700-HN101 *Panel Mounting* *Panel Mounting*

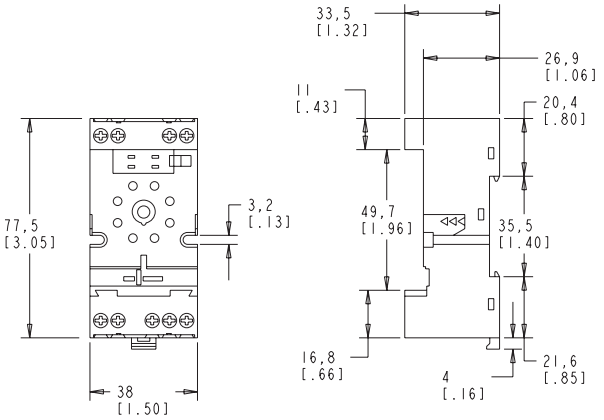
Wire Size: 2 x 2.5 mm²
Single Wire – Up to #12 AWG
Double Wire – 2 x 2.5 mm² (#2–14 AWG…#2–20 AWG)
(Either Solid or Stranded)
Strip Length: 9 mm (3/8 in) – Torque: 0.8 Nm (7 lb•in)



Cat. No. 700-HN126

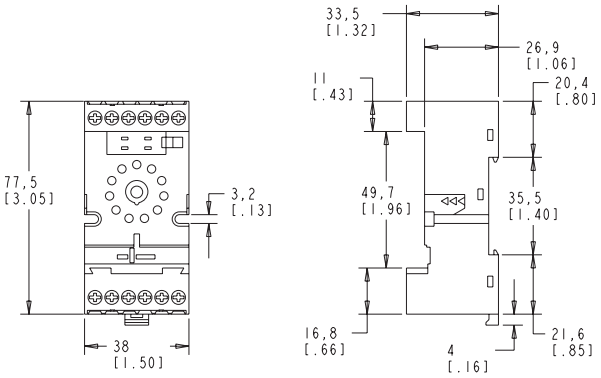
Wire Size: 2 x 2.5 mm²
Single Wire – Up to #12 AWG
Double Wire – 2 x 2.5 mm² (#2–#14 AWG…#2–20 AWG)
(Either Solid or Stranded)
Strip Length: 9 mm (3/8 in) – Torque: 0.8 Nm (7 lb•in)

Approximate Dimensions are shown in millimeters (inches). Approximate Dimensions are not intended to be used for manufacturing purposes.



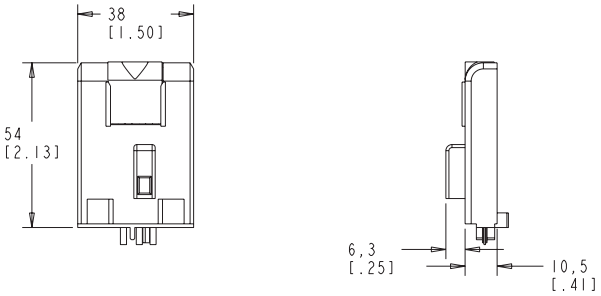
Cat. No. 700-HN204

Wire Size: 2 x 2.5 mm²
Single Wire – Up to #12 AWG
Double Wire – 2 x 2.5 mm² (#2–14 AWG… #2–20 AWG)
(Either Solid or Stranded)
Strip Length: 9 mm (3/8 in) – Torque: 0.8 Nm (7 lb•in)



Cat. No. 700-HN205

Wire Size: 2 x 2.5 mm²
Single Wire – Up to #12 AWG
Double Wire – 2 x 2.5 mm² (#2–14 AWG …#2–20 AWG)
(Either Solid or Stranded)
Strip Length: 9 mm (3/8 in) – Torque: 0.8 Nm (7 lb•in)



Cat. No. 700-HT3

Wire Size: 2 x 1.5 mm² (#2 – 16 AWG…#1–20 AWG)
(Either Solid or Stranded)
Strip Length: 9 mm (3/8 in) – Torque: 0.8 Nm (7 lb•in)

Bulletin 700-HB

- 15 A Contact Rating
- DPDT, 3PDT
- Blade Style Quick Connect Terminals
- Standard ON/OFF Flag Indicator
- Options: LED, Push-to-Test, and Manual Override
- Faston 187 (4.8 x 0.5 mm)

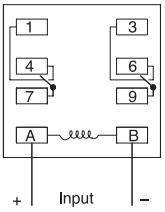
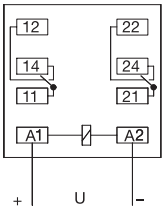
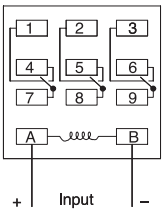
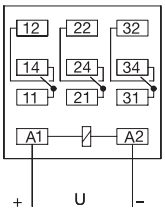
Table of Contents

Product Selection . . . this page
Accessories 9-28
Specifications 9-30
Approximate Dimensions 9-32

Standards Compliance and Certifications

See Specification Table In This Section.

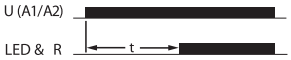
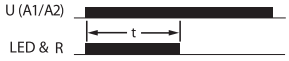
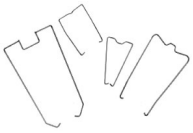
Bulletin 700-HB Square Base Relay with Blade Style Quick Connect/Solder Terminations — Mechanical ON/OFF Indicator Included

	Description	Contact Rating	Wiring Diagrams U.S./Canada	Wiring Diagrams International	Coil Voltage	Cat. No.∗†§
	DPDT 2-Pole 2 Form C Single AgCdO Contact	15 A B300			6V AC	700-HB32A06
					12V AC	700-HB32A12
					24V AC	700-HB32A24
					120V AC	700-HB32A1
					240V AC	700-HB32A2
					6V DC	700-HB32Z06
					12V DC	700-HB32Z12
					24V DC	700-HB32Z24
					48V DC	700-HB32Z48
	Sockets		*700-HN154*	*700-HN153*	110V DC	700-HB32Z1
	3PDT 3-Pole 3 Form C Single AgCdO Contact	15 A B300			6V AC	700-HB33A06
					12V AC	700-HB33A12
					24V AC	700-HB33A24
					120V AC	700-HB33A1
					240V AC	700-HB33A2
					6V DC	700-HB33Z06
					12V DC	700-HB33Z12
					24V DC	700-HB33Z24
					48V DC	700-HB33Z48
Cat. No 700-HB...	Sockets		*700-HN154*	*700-HN153*	110V DC	700-HB33Z1

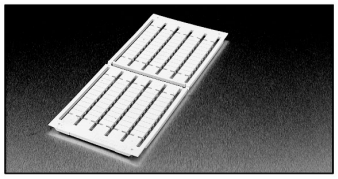
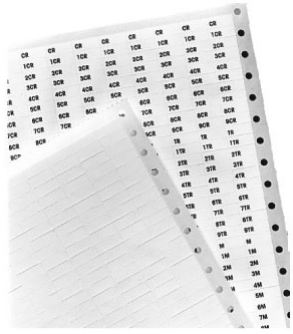
∗ LED Option: Add suffix **(-4)** to the selected Bulletin 700-HB Relay Cat. No., except for the 240V AC Units, add **(-4L)**.
† Push-to-test, Manual Override, and LED Option: Add suffix **(-3-4)** to the selected Bulletin 700-HB Relay Cat. No., except for the 240V AC units, add **(-3-4L)**.
§ Push-to-test and Manual Override option: Add suffix **(-3)** to the selected Bulletin 700-HB relay.

General Purpose Relays

Accessories

	Description	Pkg. Qty.	Cat. No.
	Diode Surge Suppressor Voltage Range: 6…220V DC used with 700-HN153 socket	10	700-ADR
	Diode with LED Surge Suppressor Voltage Range: 6…24V DC used with 700-HN153 socket	10	700-ADL1R
	Diode with LED Surge Suppressor Voltage Range: 28…60V DC used with 700-HN153 socket	10	700-ADL2R
	Diode with LED Surge Suppressor Voltage Range: 110…220V DC used with 700-HN153 socket	10	700-ADL3R
	Varistor with LED Surge Suppressor Voltage Range: 6…24V AC used with 700-HN153 socket	10	700-AV1R
	Varistor with LED Surge Suppressor Voltage Range: 110…240V AC used with 700-HN153 socket	10	700-AV3R
	RC Surge Suppressor Voltage Range: 6…24V AC/DC used with 700-HN153 socket	10	700-AR1
	RC Surge Suppressor Voltage Range: 110…240V AC/DC used with 700-HN153 socket	10	700-AR2
	On-Delay Time Module Voltage Range: 12…24V AC/DC used with 700-HN153 socket 	1	700-AT1
Cat. No. 700-AT2	**One Shot Timing Module** Voltage Range: 12…24V AC/DC used with 700-HN153 socket 	1	700-AT2
	Multi-Function Multi-Range Time Module Voltage range 12…240V AC 50/60 Hz and 12…240V DC, with a voltage variation of 85…110%. Repeat accuracy of ±1%. Reset time <50 ms. For use with 700-HN153 socket. Refer to page 9-30 for Specifications. Eight (8) Timing Modes Seven (7) Timing Ranges: 1. 1 s — 0.05 s…1 s 2. 10 s — 0.5 s…10 s 3. 100 s — 5 s…100 s 4. 10 min. — 0.5 min…10 min 5. 100 min. — 5 min…100 min 6. 10 hours — 0.5 hr…10 hr 7. 100 hours — 5 hr…100 hr 	1	700-HT3
Cat. No. 700-HT3			
	Screw Terminal Socket — Panel or DIN Rail Mounting. Guarded Terminal Construction 11-blade socket for use with Bulletin 700-HB and -HJ relays and -HS timing relays. Order must be for 10 sockets or multiples of 10. Safe separation between coil and contacts.	10	700-HN153
Cat. No. 700-HN153			
	Screw Terminal Base Socket — Panel or DIN Rail Mounting. Open Style Construction 11-blade for use with Bulletin 700-HB and -HJ relays and -HS timing relays. Order must be for 10 sockets or multiples of 10.	10	700-HN154
Cat. No. 700-HN154			
	DIN (#3) Symmetrical Rail 35 mm x 7.5 mm x 1 m long Zinc-plated, yellow chromated	10	199-DR1
Cat. No. 199-DR1			
	**Retainer Clip for Cat. No. -HN154 open terminal socket with 700-HB relays**✶ Secures relay in socket. Order must be for 10 clips or multiples of 10.	10	700-HN156
Sample Retainer Clips	**Retainer Clip for Cat. No. 700-HN153** Sockets with 700-HB Relays✶. Secures relay in socket. Order must be for 10 clips or multiples of 10.	10	700-HN158

✶ Bulletin 700-HB square base relay socket and rotation clip reference chart (see page 9-29).

	Description	Pkg. Qty.	Cat. No.
 *Snap-in markers*	**Relay Identification Snap-in Markers**‡ Snap-in markers fit on top of product covers. The following are blank cards. Squares slip into molded slot on top of product covers.	100	1492-MS5X12 1492-MS6X9 1492-MS6X12 1492-MS8X9 1492-MS8X12 1492-MP-Blank
	**Pre-printed identification tags —** contains 10 sheets of pre-printed and blank tags. Each sheet contains 13 sets of the markings CR…9CR, TR…9TR, M…9M, F, R, 1S, and 117 blank tags. Tags are peel-off with sticky backing for easy placement on relays.	10	700-N40
	Blank identification tags — contains 10 sheets of blank identification tags for customer specialized printing. Each sheet contains 546 blank tags. Tags are peel-off with sticky backing for easy placement on relays.	10	700-N41

‡ For pre-printed marker cards, turn to the following 1492 sections of publication A115: 1492-MS5X12_, 1492-MS6X9_, 1492-MS8X9_ , 1492-MS8X12_, 1492-MP_.

Relay Type	Socket Cat. No.	Retainer Clip Cat. No.
700-HB	700-HN153 700-HN154	700-HN158 700-HN156

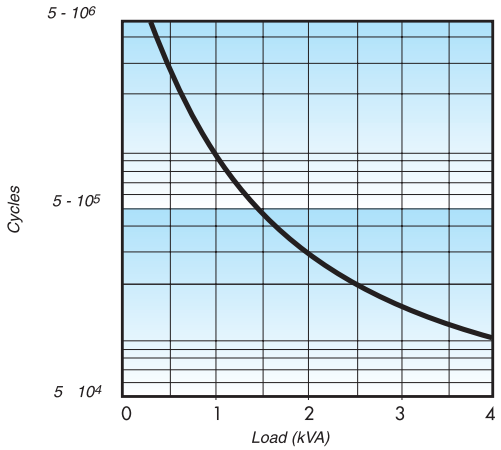
General Purpose Relays

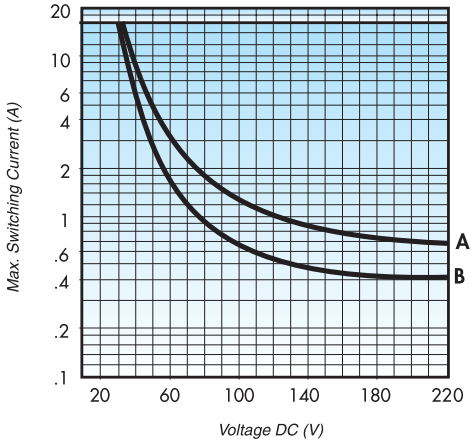
Specifications*

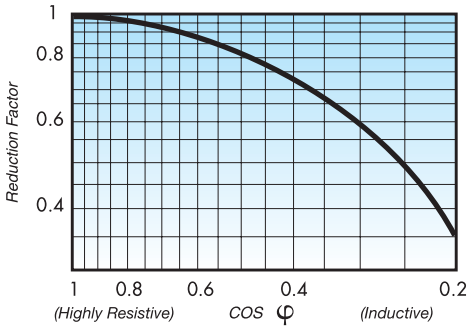
Cat. No. 700-HB…						
Electrical Ratings						
Pilot Duty Rating†		NEMA B300				
Rated Thermal Current (I_{th})		15 A – 120V, 240V				
Rated Insulation Voltage (U_i)		250V IEC-300V UL/CSA				
Contacts	Inductive	**Make**		**Break**		**Hp**
		►][◄		◄][►		
		2 -Pole	3 -Pole	2 -Pole	3 -Pole	
	120V AC	60 A	30 A	6 A	3 A	3/4
	240V AC	30 A	15 A	3 A	1.5 A	2
	General Purpose	15 A, 240V AC				
	Resistive	15 A, 30V DC				
Min. Low Energy Permissible Load		1000 mW (10V, 10 mA)				
Permissible Coil Voltage Variation		80…110% of Nominal Voltage at 50 Hz				
		80…110% of Nominal Voltage at 60 Hz				
		80…110% of Nominal Voltage at DC				
Coil Consumption ±10%	AC Coils	**50 Hz**		**60 Hz**		
	Inrush	3.3 VA		2.85 VA		
	Sealed	2.2 VA		1.9 VA		
	DC Coils	1.3 W				
Max. Allowable Leakage		25% of VA				
		10% of W				
Max. Contact Resistance		50 mΩ				
Design Specification/Test Requirements						
Electrical						
Dielectric Withstand Voltage						
Pole-to-Pole		1500V				
Contact to Coil		6000V				
Contact to Frame		4000V				
Mechanical						
Degree of Protection (Open Type) IEC 529		IP 40				
Mechanical Life Cycles (AC/DC)		> 10 x 10^6/30 x 10^6				
Switching Frequency Operations		3600/HR				
Coil Voltages		See Overview/Product Selection				
Operating Time (ms)	Pickup	20 ms				
	Dropout	4 ms				
Maximum Operating Rate		4 Ops/s				
Vibration	Endurance	5 G				
	Operational	1.5 G				
Shock	Endurance	50 G				
	Operational	15 G				
Environmental						
Temperature	Operating	AC/DC		–40…+70 °C		
	Storage	AC/DC		–40…+100 °C		
Altitude		2000 m (6560 ft)				
Construction						
Insulating Material		Molded High Dielectric Material				
Enclosure		Transparent Dust Cover				
Contact Material		AgCdO				
Terminal Markings on Socket		In accordance with EN50 0005				
Sockets		700-HN153, -HN154				
Certifications		CE, cULus, cURus, IMQ, RINA, ABS, File E3125Guide NLDX 2, cULus Listed, with Allen-Bradley socket, CE Marked (per EU Low Voltage Directive 73/23 EEC 93/68 EEC), ABS (American Bureau of Shipping), File 00-GE 195140-PDA, RINA listed, IMQ listed				
Standards		EN 60947-4-1, EN 60947-5-1, IEC 947CSA 22.2, UL 508, NEMA/EEMAC, ICS2 compliant				

* Performance Data – See Important 2, publication A115.
† NEMA Rating Chart is on page 19 of publication 700-SG003B-EN-P.

Technical Data



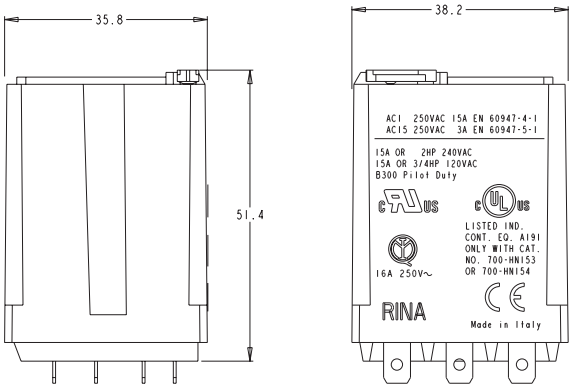




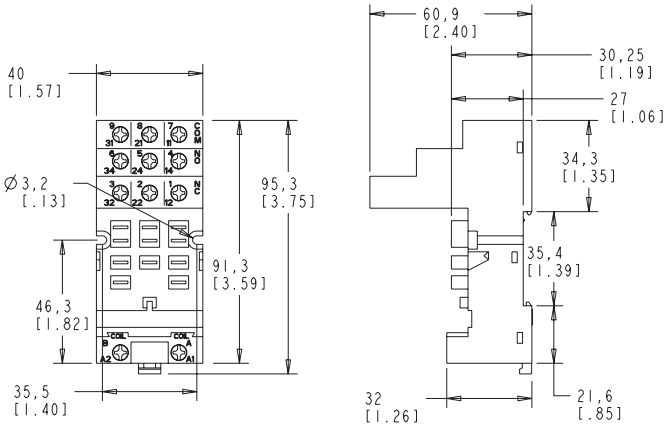
General Purpose Relays

Approximate Dimensions

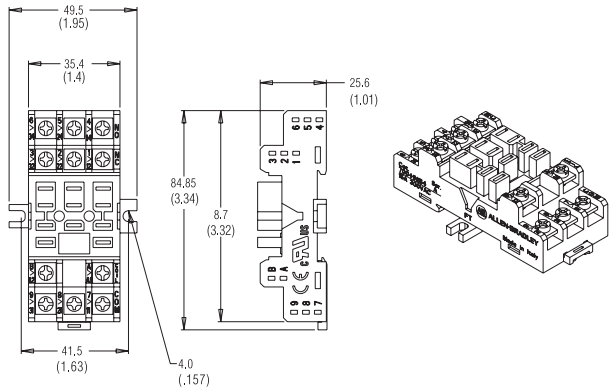
Approximate Dimensions are shown in millimeters (inches). Approximate Dimensions are not intended to be used for manufacturing purposes.



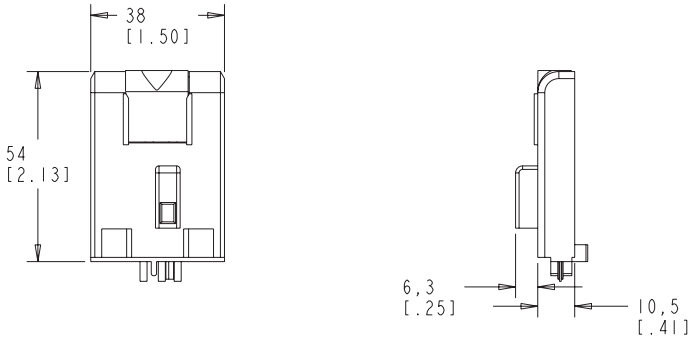
Bulletin 700-HB Relay



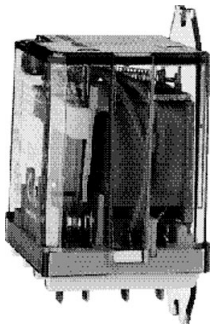
Cat. No. 700-HN153
Wire Size: 2 x 2.5 mm²
Single Wire – Up to #12 AWG
Double Wire – 2 x 2.5 mm² (#2–14 AWG... #2–20 AWG)
(Either Solid or Stranded)
Strip Length: 9 mm (3/8 in) – Torque: 0.8 Nm (7 lb•in)



Cat. No. 700-HN154
Wire Size: 2 x 2.5 mm²
Single Wire – Up to #12 AWG
Double Wire – 2 x 2.5 mm² (#2–14 AWG... #2–20 AWG)
(Either Solid or Stranded)
Strip Length: 9 mm (3/8 in) – Torque: 0.8 Nm (7 lb•in)



Cat. No. 700-HT3
Wire Size: 2 x 1.5 mm² (#2 – 16 AWG...#1–20 AWG)
(Either Solid or Stranded)
Strip Length: 9 mm (3/8 in) – Torque: 0.8 Nm (7 lb•in)



Bulletin 700-HD

- Flange Mounted/Panel Mounted
- 15 A Contact Rating
- DPDT, 3PDT
- Blade Style Quick Connect Terminals (0.187 x 0.020)
- Solder Terminals (no socket required)

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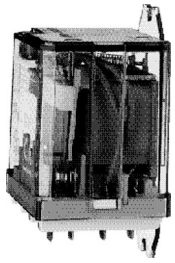
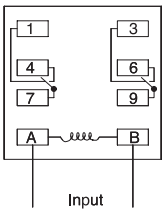
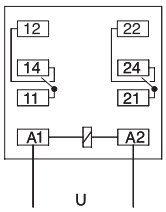
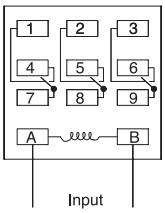
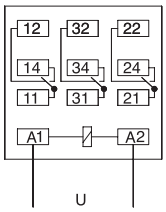
Standards Compliance and Certifications

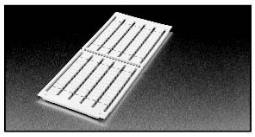
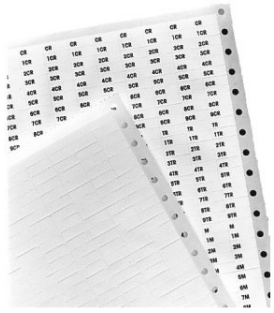
See Specification Table In This Section.



Description	Contact Rating	Wiring Diagrams		Coil Voltage	Cat. No.
		U.S./Canada	International		
DPDT 2-Pole 2 Form C AgCdO Contacts	15 A			6V AC	700-HD32A06
				12V AC	700-HD32A12
				24V AC	700-HD32A24
				120V AC	700-HD32A1
				208V AC	700-HD32A20
				240V AC	700-HD32A2
				6V DC	700-HD32Z06
				12V DC	700-HD32Z12
				24V DC	700-HD32Z24
				48V DC	700-HD32Z48
				110V DC	700-HD32Z1
3PDT 3-Pole 3 Form C AgCdO Contacts	15 A			6V AC	700-HD33A06
				12V AC	700-HD33A12
				24V AC	700-HD33A24
				120V AC	700-HD33A1
				208V AC	700-HD33A20
				240V AC	700-HD33A2
				6V DC	700-HD33Z06
				12V DC	700-HD33Z12
				24V DC	700-HD33Z24
				48V DC	700-HD33Z48
				110V DC	700-HD33Z1

General Purpose Relays

Accessories

	Description	Pkg. Quantity	Cat. No.
	**Relay Identification Snap-in Markers**∗ Snap-in markers fit on top of product covers. The following are blank cards. Squares slip into molded slot on top of product covers.	100	1492-MS5X12† 1492-MS6X9† 1492-MS6X12† 1492-MS8X9† 1492-MS8X12† 1492-MP-Blank†
	**Pre-printed identification tags —** contains 10 sheets of pre-printed and blank tags. Each sheet contains 13 sets of the markings CR…9CR, TR…9TR, M…9M, F, R, 1S, and 117 blank tags. Tags are peel-off with sticky backing for easy placement on relays.	10	700-N40
	Blank identification tags — contains 10 sheets of blank identification tags for customer specialized printing. Each sheet contains 546 blank tags. Tags are peel-off with sticky backing for easy placement on relays.	10	700-N41

∗ Refer to terminal block marking systems within the Industrial Control Catalog.
† For pre-printed marker cards, turn to the following 1492 sections of publication A115: 1492-MS5X12_, 1492-MS6X9_, 1492-MS8X9_, 1492-MS8X12_, 1492-MP_.

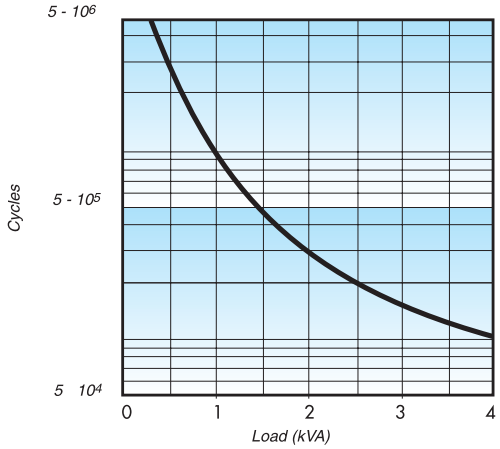
Cat. No. 700-HD…						
Electrical Ratings						
Pilot Duty Rating†		NEMA B300				
Rated Thermal Current I_{th}		15 A‡ – 120V 15 A‡ – 240V				
Rated Insulation Voltage (U_i)		250V IEC-300V UL/CSA				
Contacts	Inductive	**Make** ►][◄		**Break** ◄][►		**Hp**
		2-Pole	3-Pole	2-Pole	3-Pole	
	120V AC	60 A	30 A	6 A	3 A	3/4
	240V AC	30 A	15 A	3 A	1.5 A	2
	General Purpose	15 A, 240V AC				
	Resistive	15 A, 30V DC				
Permissible Coil Voltage Variation		80…110% of Nominal Voltage at 50 Hz 80…110% of Nominal Voltage at 60 Hz 80…110% of Nominal Voltage at DC				
Coil Consumption ±10%	AC Coils	**50 Hz**		**60 Hz**		
	Inrush	3.3 VA		2.85 VA		
	Sealed	2.2 VA		1.9 VA		
	DC Coils	1.3 W				
Maximum Contact Resistance		50 mΩ				
Must Dropout Voltage		20% of Nominal V AC 10% of Nominal V DC				
Design Specification/Test Requirements						
Electrical						
Dielectric Withstand Voltage						
Pole-to-Pole		1500V				
Contact to Coil		6000V				
Contact to Frame		4000V				
Mechanical						
Degree of Protection (Open Type) IEC 529		IP 40				
Mechanical Life Cycles (AC/DC)		> 10 x 10^6 / 30 x 10^6				
Switching Frequency Operations		3600/HR				
Coil Voltages		See Overview/Product Selection				
Operating Time	Pickup	20 ms				
	Dropout	4 ms				
Maximum Operating Rate		4 Ops/s				
Minimum Low Energy Permissible Load		1000 mN (10V, 10mA)				
Environmental						
Temperature	Operating	–40…+70 °C				
	Storage	–40…+100 °C				
Altitude		2000 m (6560 ft)				
Construction						
Insulating Material		Molded High Dielectric Material				
Enclosure		Transparent Dust Cover				
Contact Material		Silver Cad. Ox.				
Terminal Markings		In accordance with EN50 0005				
Certifications and Approvals		CE, cURus, IMQ, RINA, ABS, File E3125, Guide NLDX 2, CE Marked (per EU Low Voltage Directive 73/23 EEC 93/68 EEC), ABS (American Bureau of Shipping), File 00-GE 195140-PDA, RINA listed, IMQ listed				
Conformity to Standards		EN 60947-4-1,EN 60947-5-1,IEC 947,CSA 22.2,UL 508,NEMA/EEMAC ICS2 compliant				

✶ Performance Data – See Important 2, publication A115
† NEMA Rating Chart is on page 19 of publication 700-SG003B-EN-P.
‡ 3-pole relays have a 20 A maximum total current rating for all three poles.

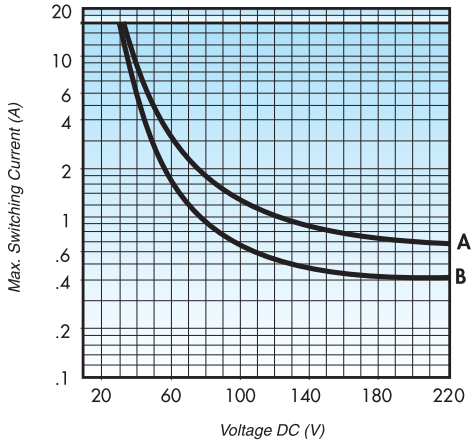
Note: Bulletin 700-HD wiring terminals are the quick connect/solder type 4.7mm x 0.5mm (0.187 in x 0.020 in) termination.

General Purpose Relays

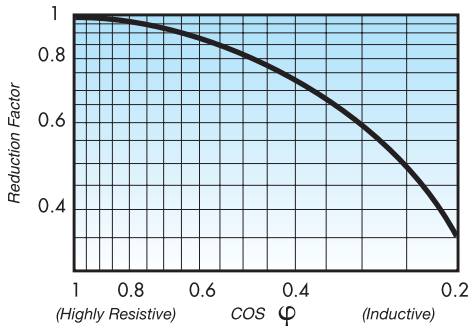
Specifications, Continued



Contact life vs AC1 load at 600 cycles/h.



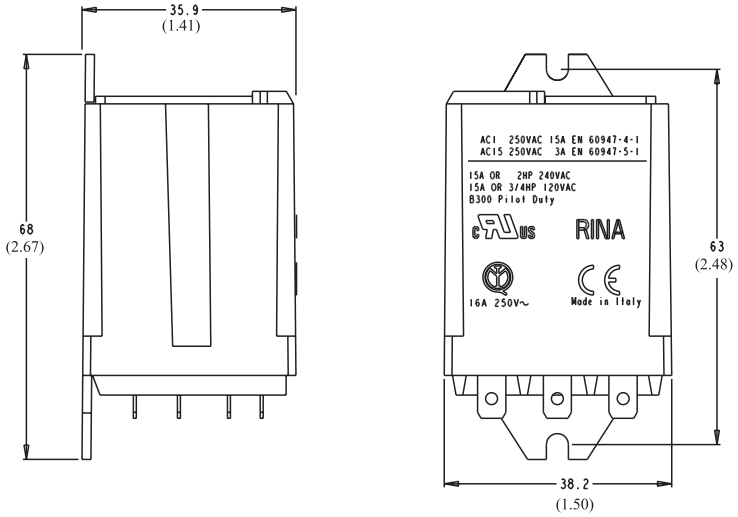
Breaking capacity for DC1 load at 600 cycles/h.
Load applied to 1 contact.
A = for N.O. types
B= other types

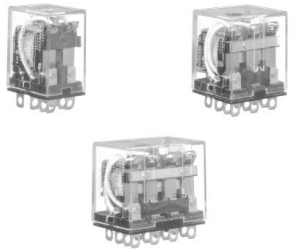


Load Reduction factor vs cos ϕ

Approximate Dimensions

Approximate Dimensions are shown in millimeters (inches). Approximate Dimensions are not intended to be used for manufacturing purposes.





Bulletin 700-HF

- 10 A Contact Rating
- DPDT, 3PDT, 4PDT
- Plug-in Quick Connect Solder Terminals
- Options: LED, Push-to-Test Operator

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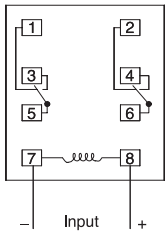
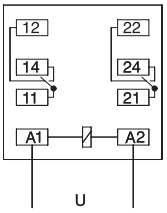
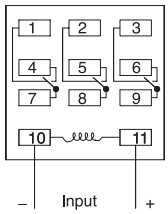
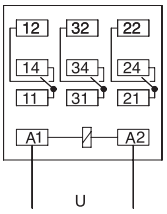
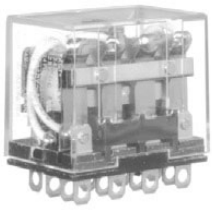
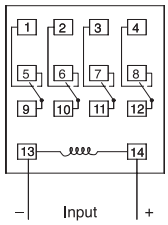
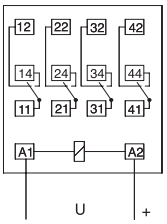
Standards Compliance and Certifications

See Specification Table In This Section.

Square Base with Quick Connect/Solder Style Terminations

	Description	Contact Rating	Wiring Diagrams U.S./Canada	Wiring Diagrams International	Coil Voltage	Cat. No. ∗†
	DPDT 2-pole 2 Form C AgCdO Contacts Socket	10 A	 *700-HN116*	 *700-HN116*	6V AC	700-HF32A06
					12V AC	700-HF32A12
					24V AC	700-HF32A24
					120V AC	700-HF32A1
					240V AC	700-HF32A2
					6V DC	700-HF32Z06
					12V DC	700-HF32Z12
					24V DC	700-HF32Z24
					48V DC	700-HF32Z48
					110V DC	700-HF32Z1
	3PDT 3-pole 3 Form C AgCdO Contacts Socket	10 A	 *700-HN138*	 *700-HN138*	6V AC	700-HF33A06
					12V AC	700-HF33A12
					24V AC	700-HF33A24
					120V AC	700-HF33A1
					240V AC	700-HF33A2
					6V DC	700-HF33Z06
					12V DC	700-HF33Z12
					24V DC	700-HF33Z24
					48V DC	700-HF33Z48
					110V DC	700-HF33Z1
	4PDT 4-pole 4 Form C AgCdO Contact Socket	10 A	 *700-HN139*	 *700-HN139*	6V AC	700-HF34A06
					12V AC	700-HF34A12
					24V AC	700-HF34A24
					120V AC	700-HF34A1
					240V AC	700-HF34A2
					6V DC	700-HF34Z06
					12V DC	700-HF34Z12
					24V DC	700-HF34Z24
					48V DC	700-HF34Z48
					110V DC	700-HF34Z1

∗ Pilot Light Option: Add suffix (**-4**) to the selected Bulletin 700-HF Relay Cat. No. except for the 240V AC units, add (**-4L**).
† Manual Operator and LED Option: Add suffix (**-1-4**) to the selected Bulletin 700-HF Relay Cat. No., except for the 240V AC units, add (**-1-4L**).

General Purpose Relays

Accessories

	Description	Pkg. Qty.	Cat. No.
Cat. No 700-HN116	**Screw Terminal Socket — Panel or DIN Rail Mounting** 8-blade miniature socket for use with DPDT HF relays. Order must be for 10 sockets or multiples of 10.	10	700-HN116
Cat. No. 700-HN138	**Screw Terminal Socket — Panel or DIN Rail Mounting** 11-blade socket for use with 3PDT Bulletin 700-HF relays.	1	700-HN138
Cat. No. 700-HN139	**Screw Terminal Socket — Panel or DIN Rail Mounting, Guarded Terminal Construction** 14-blade socket for use with 4PDT Bulletin 700-HF relays.	1	700-HN139
Cat. No 199-DR1	**DIN (#3) Symmetrical Rail** 35 mm x 7.5 mm x 1 m long Zinc-plated, yellow chromated	10	199-DR1
Sample Retainer Clips	**Retainer Clip for Cat. Nos. 700-HN103, -HN104 and -HN128 Sockets with 700-HC Relays and Cat. Nos. 700-HN116 Sockets with Bulletin 700-HF DPDT Relays**∗ Secures relay in socket. Order must be for 10 clips or multiples of 10.	10	700-HN114
	Retainer Clip for Cat. Nos. 700-HN138 and -HN139 Sockets with Bulletin 700-HF 3PDT and 4PDT Relays∗ Secures relay in socket. Order must be for 10 clips or multiples of 10.	10	700-HN140

∗ Bulletin 700-HF Square Base Relay, Socket, and Retainer Clip Reference

Relay Type	Cat. No. Socket	Cat. No. Retainer Clip
700-HF32	700-HN116	700-HN114
700-HF33	700-HN138	700-HN140
700-HF34	700-HN139	700-HN140

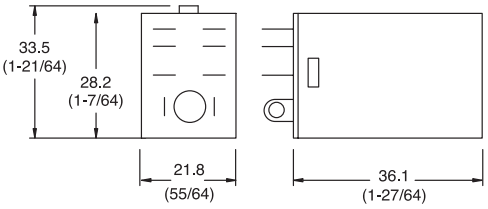
Cat. No. 700-HF…					
Electrical Ratings					
Pilot Duty Rating			C300		
Rated Thermal Current (I_{th})			10 A		
Rated Insulation Voltage (U_i)			250V IEC, 300 UL/CSA		
Contacts		Inductive	**Make**	**Break**	**Hp**
			▶][◀	◀][▶	
		120V AC	29 A	2.9 A	1/2
		240V AC	14 A	1.4 A	1/3
		General Purpose	10 A, 240V AC		
		Resistive	10 A, 30V DC		
Permissible Coil Voltage Variation			85…110% of Nominal Voltage at 50 Hz 85…110% of Nominal Voltage at 60 Hz 80…110% of Nominal Voltage at DC		
Coil Consumption ±10%	AC Coils		**50 Hz**	**60 Hz**	
		Inrush	2.4 VA	2.1 VA	
		Sealed	1.6 VA	1.4 VA	
	DC Coils		0.9 W		
Max. Allowable Leakage			25% of VA		
			10% of W		
Design Specification/Test Requirements					
Dielectric Withstand Voltage		Pole-to-Pole	1500V AC		
		Contact to Pole	1500V AC		
		Contact to Frame	1500V AC		
Mechanical					
Degree of Protection			Open Type (Sockets)		
Mechanical Life Operations			30 x 10^6		
Switching Frequency Operations			3600/hr		
Coil Voltages			See Product Selection		
Operating Time at Nominal Voltage at 20 °C		Pickup	15 ms		
		Dropout	15 ms		
Maximum Operating Rate			4 Ops/s		
Shock (Mechanical Durability)			100 G		
Shock (Malfunction Durability)			20 G		
Environmental					
Temperature		Operating	–30…+55 °C (–22…+131 °F)		
		Storage	–55…+85 °C (–67…+185 °F)		
Altitude			2000 m (6560 ft)		
Construction					
Insulating Material			Molded High Dielectric Material		
Enclosure			Transparent Dust Cover		
Contact Material			Silver Cad. Ox.		
Terminal Markings on Socket			In accordance with EN50 0005		
Sockets			8-Blade Socket (DPDT) Cat. No. 700-HN116 11-Blade Socket (3PDT) Cat. No. 700-HN138 14-Blade Socket (4PDT) Cat. No. 700-HN139		
Certifications			CSA Certified, File LR75088, UL Recognized, File E3125,Guide NLDX 2, CE Marked (per EU Low Voltage Directive 73/23 EEC 93/68 EEC)		
Standards			CSA 22.2, UL 508, pr EN 60255-1-0, IEC 255-1-00, IEC 255-0-20		

✶ Performance Data – See page Important-2.

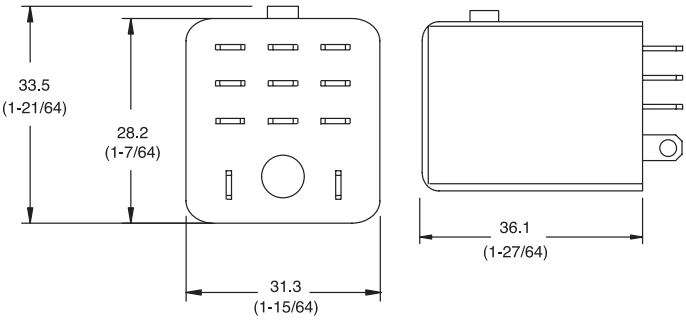
General Purpose Relays

Approximate Dimensions

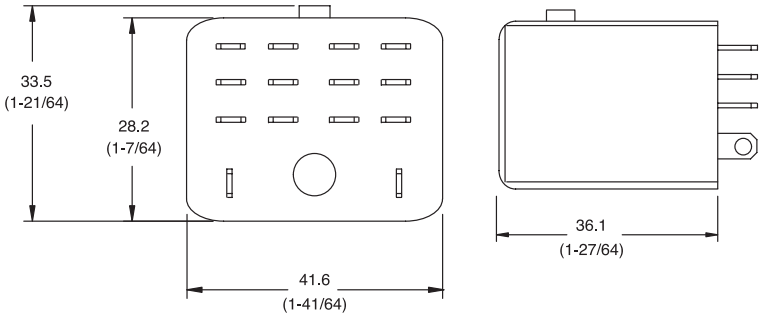
Approximate Dimensions are shown in millimeters (inches). Approximate Dimensions are not intended to be used for manufacturing purposes.



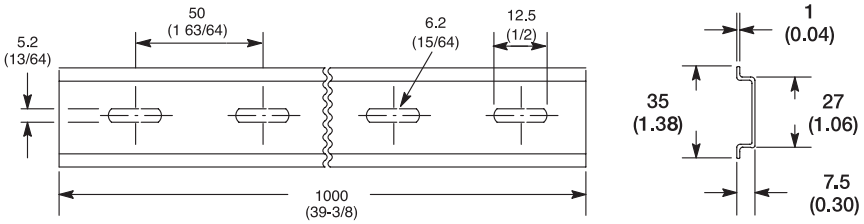
Bulletin 700-HF Relay (DPDT)



Bulletin 700-HF (3PDT)



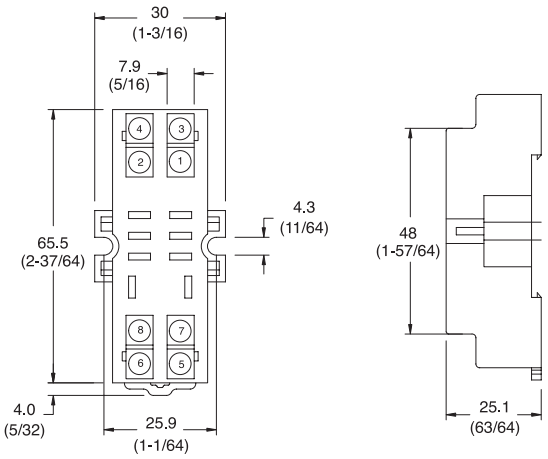
Bulletin 700-HF (4PDT)



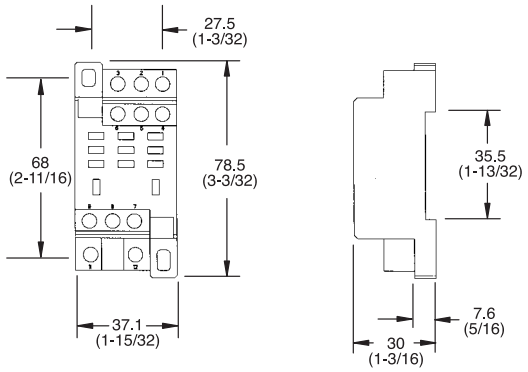
Cat. No. 199-DR1 DIN Mounting Rail Series B
Cat. No. 199-DR4 DIN Mounting Rail Series B Has No Mounting Holes

Cat. No.	A	B	C	D	Approx. Shipping Wt.
199-DR1	35 (1-3/8)	27 (1-1/16)	7.5 (19/64)	1.02 (1/64)	1.85 kg (4.07 lbs.) (10/pkg)
199-DR4	35 (1-3/8)	27 (1-1/16)	15 (19/32)	2.3 (3/32)	3.68 kg (8 lbs.) (5/pkg)

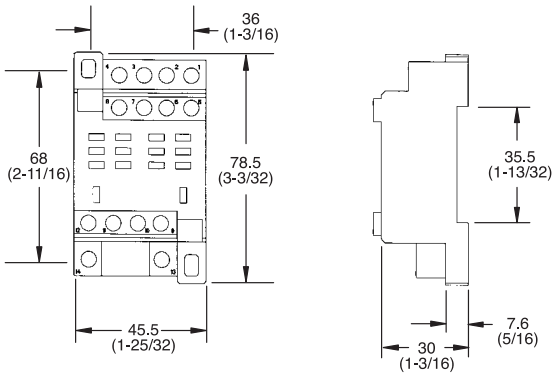
Approximate Dimensions are shown in millimeters (inches). Approximate Dimensions are not intended to be used for manufacturing purposes.



Cat. No. 700-HN116
Wire Size: 2 x 2.5 mm²
Single Wire – Up to #12 AWG
Double Wire – 2 x 2.5 mm² (#2–14 AWG… #2–20 AWG)
(Either Solid or Stranded)
Strip Length: 9 mm (3/8 in) – Torque: 0.8 Nm (7 lb.in)



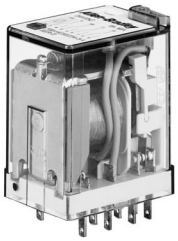
Cat. No. 700-HN138
Wire Size: 2 x 2.5 mm²
Single Wire – Up to #12 AWG
Double Wire – 2 x 2.5 mm² (#2–14 AWG… #2–20 AWG)
(Either Solid or Stranded)
Strip Length: 9 mm (3/8 in) – Torque: 0.8 Nm (7 lb.in)



Cat. No. 700-HN139
Wire Size: 2 x 2.5 mm²
Single Wire – Up to #12 AWG
Double Wire – 2 x 2.5 mm² (#2–14 AWG… #2–20 AWG)
(Either Solid or Stranded)
Strip Length: 9 mm (3/8 in) – Torque: 0.8 Nm (7 lb.in)

Interposing/Isolation Relays

Overview/Product Selection



Bulletin 700-HC

- 7 A or 10 A Contact Ratings
- 2PDT or 4PDT
- Standard ON/OFF Flag Indicator
- Blade Style Terminals
- Choice of Standard Silver Nickel Contacts, or Silver Nickel With Gold Plated Contacts for Low Energy Applications
- Options: LED, Push-to-Test with Manual Override Option
- Tungsten UL Approvals
  4-Pole: 5A @ 24V DC
  2-Pole: 10A @ 24V DC

Table of Contents

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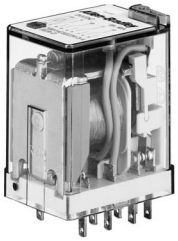
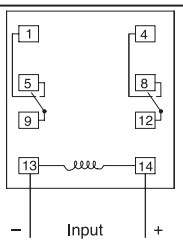
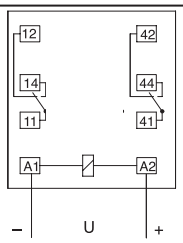
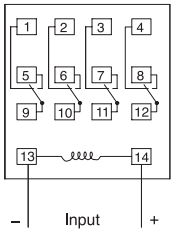
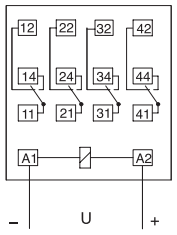
Approximate Dimensions 9-45

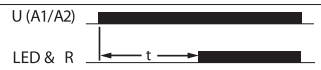
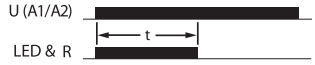
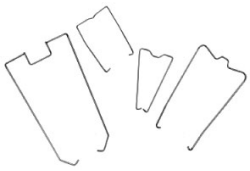
Standards Compliance and Certifications

See Specification Table In This Section.

Bulletin 700-HC Miniature Square Base with Blade Terminals

	Description	Contact Rating	Wiring Diagrams U.S./Canada	Wiring Diagrams International	Coil Voltage	Cat. No. ∗ †
	2PDT 2-Pole 2 Form C Contacts: 10 A = AgNi Contacts	10 A C300 R300 Low energy rating; (10V, 10 mA)	 *700-HN128*	 *700-HN103* *700-HN104*	12V DC	700-HC22Z12
					24V DC	700-HC22Z24
					24V AC	700-HC22A24
					120V AC	700-HC22A1
					240V AC	700-HC22A2
	4PDT 4-Pole 4 Form C Contacts: 7A = AgNiAu Gold Plated Contacts	7 A Low energy rating; (10V, 1 mA)	 *700-HN128*	 *700-HN103* *700-HN104*	6V AC	700-HC14A06
					12V AC	700-HC14A12
					24V AC	700-HC14A24
					120V AC	700-HC14A1
					240 AC	700-HC14A2
					6V DC	700-HC14Z06
					12V DC	700-HC14Z12
					24V DC	700-HC14Z24
					48V DC	700-HC14Z48
					110V DC	700-HC14Z1
	4PDT 4-Pole 4 Form C Contacts: 7A = AgNi Silver Contacts	7 A C300 R300 Low energy rating; (10V, 10 mA)			6V AC	700-HC24A06
					12V AC	700-HC24A12
					24V AC	700-HC24A24
					120V AC	700-HC24A1
					240V AC	700-HC24A2
					6V DC	700-HC24Z06
					12V DC	700-HC24Z12
					24V DC	700-HC24Z24
					48V DC	700-HC24Z48
					110V DC	700-HC24Z1

∗ LED Option: Add suffix **(-4)** to the selected Bulletin 700-HC Relay Cat. No. except for the 240V AC units, add **(-4L)**.
† Push-to-Test and LED Option: Add suffix **(-3-4)** to the selected Bulletin 700-HC Relay Cat. No., except for the 240V AC units, add **(-3-4L)**.

	Description	Pkg. Qty.	Cat. No.
	Diode with LED Surge Suppressor Voltage Range: 6…24V DC used with 700-HN104 socket	10	700-ADL1
	Diode with LED Surge Suppressor Voltage Range: 28…60V DC used with 700-HN104 socket	10	700-ADL2
	Diode with LED Surge Suppressor Voltage Range: 110…220V DC used with 700-HN104 socket	10	700-ADL3
	Varistor with LED Surge Suppressor Voltage Range: 6…24V AC used with 700-HN104 socket	10	700-AV1R
	Varistor with LED Surge Suppressor Voltage Range: 110…240V AC used with 700-HN104 socket	10	700-AV3R
	RC Surge Suppressor Voltage Range: 6…24V AC/DC used with 700-HN104 socket	10	700-AR1
	RC Surge Suppressor Voltage Range: 110…240V AC/DC used with 700-HN104 socket	10	700-AR2
 Cat. No. 700-AT2	**On-Delay Time Module** Voltage Range: 12…24V AC/DC used with 700-HN104 socket 	1	700-AT1
	One Shot Timing Module Voltage Range: 12…24V AC/DC used with 700-HN104 socket 	1	700-AT2
 Cat. No. 700-HN103	**Screw Terminal Socket — Panel or DIN Rail Mounting; Guarded Terminal Construction.** I_{th} = 10 A per pole. 14-Blade miniature socket for use with Bulletin 700-HC Relays. Order must be in ten or multiples of ten	10	700-HN103
 Cat. No. 700-HN104	**Screw Terminal Socket – Panel or DIN Rail Mounting. Guarded Terminal Construction** I_{th} = 10 A per pole. 14-blade miniature socket for use with Bulletin 700-HC relays. This socket has coil and contact separation as well as the ability to plug in optional plug in modules (700-A** accessories: LED, Surge Suppression, Timing Modules)	10	700-HN104
 Cat. No. 700-HN128	**Screw Terminal Base Socket — Panel or DIN Rail Mounting; Open Style Construction** I_{th} = 10 A per pole. 14-Blade miniature socket for use with Bulletin 700-HC Relays. Order must be in multiples of ten	10	700-HN128
 Cat. No. 199-DR1	**DIN (#3) Symmetrical Rail** 35 mm x 7.5 mm x 1 m long Zinc-plated, yellow chromated	10	199-DR1
 *Sample Retainer Clips*	**Retainer Clip for Cat. Nos. 700-HN103, -HN104 and -HN128 Sockets with 700-HC Relays and Cat. Nos. 700-HN116 Sockets with Bulletin 700-HF DPDT Relays**✶ Secures relay in socket. Order must be for 10 clips or multiples of 10.	10	700-HN114
	Plastic Retainer and Ejection Lever For use with the 700-HN104 Sockets for 700-HC relays. Built-in ability to accept 1492 Snap-in Markers	10	700-HN124

✶ Bulletin 700-HC Miniature Square Base Relay, Socket, and Retainer Clip Reference Chart

Relay Type	Socket Cat. No.	Retainer Clip Cat. No.
700-HC	700-HN103	700-HN114
	700-HN128	700-HN114
	700-HN104	700-HN114 or 700-HN124

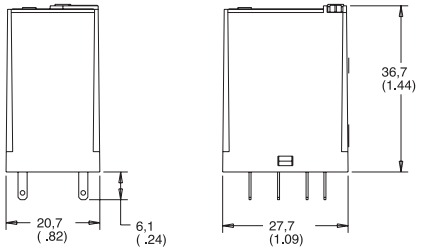
Interposing/Isolation Relays

Specifications*

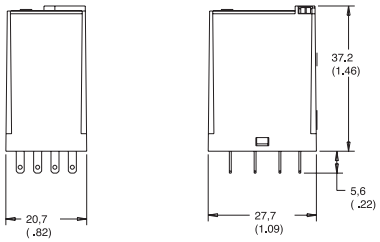
Cat. No. 700-HC…							
Electrical Ratings							
Pilot Duty Rating †		NEMA C300, R300					
Rated Thermal Current (I_{th})		7 A and 10 A					
Rated Insulation Voltage (U_i)		250V IEC – 300V UL/CSA					
Contacts	Inductive	**700-HC_4**		**Hp**	**700-HC22**		**Hp**
		►][◄	◄][►		►][◄	◄][►	
	120V AC	15 A	1.5 A	1/8	15 A	1.5 A	1/3
	240V AC	7.5 A	0.75 A	1/3	7.5 A	0.75 A	3/4
	General Purpose	7 A, 277V AC			10 A, 277V AC		
	Resistive	7 A, 30V DC			10 A, 24V DC		
Permissible Coil Voltage Variation		Pickup:	80…110% of Nominal Voltage at 50 Hz 80…110% of Nominal Voltage at 60 Hz 80…110% of Nominal Voltage at DC		Must Dropout Voltage:	20% of Nominal Voltage at AC 10% of Nominal Voltage at DC	
		50 Hz			**60 Hz**		
Coil Consumption ±10%	AC Coils – Inrush	2.2 VA			1.6 VA		
	AC Coils – Sealed	1.3 VA			1.1 VA		
	DC Coils	1.0 W					
Max. Allowable Leakage		20% of VA (AC)					
		10% of W (DC)					
Design Specification/Test Requirements							
Electrical							
Dielectric Withstand Voltage	Pole-to-Pole	1000V					
	Contact to Coil	3600V					
	Contact to Frame	3600V					
Electrical Life (Cycles)		100,000 minimum					
Mechanical							
Degree of Protection (Open Type) IEC 529		IP 20 (Guarded Terminal Sockets)					
Mechanical Life Cycles		20 x 10^6 (AC) 50 x 10^6 (DC)					
Switching Frequency Operations		1800/HR					
Coil Voltages		See Product Selection					
Operating Time (ms)	Max. Pickup	10					
	Max. Dropout	3					
Maximum Operating Rate		8 cycles/s					
Environmental							
Temperature	Operating	–30…+55 °C					
		(–22…+131 °F)					
	Storage	–55…+85 °C					
		(–67…+185 °F)					
Altitude		2000 m (6560 ft)					
Insulating Material		Molded High Dielectric Material					
Enclosure		Transparent Dust Cover					
Contact Material		AgNi (700-HC2) AgNi + 5 µm All (700-HC1)					
Terminal Markings on Socket		In accordance with EN50 0005					
Sockets		700-HN103, -HN128, -HN104					
Certifications		cULus Listed, cURus recognized, IMQ, ABS, RINA, CE Marked					
Standards		EN 60947-4-1, EN 60947-5-1,IEC 947,CSA 22.2, UL 508					

* Performance Data – See Important 2, publication A115.
† NEMA Rating Chart is on page 19 of publication 700-SG003B-EN-P.

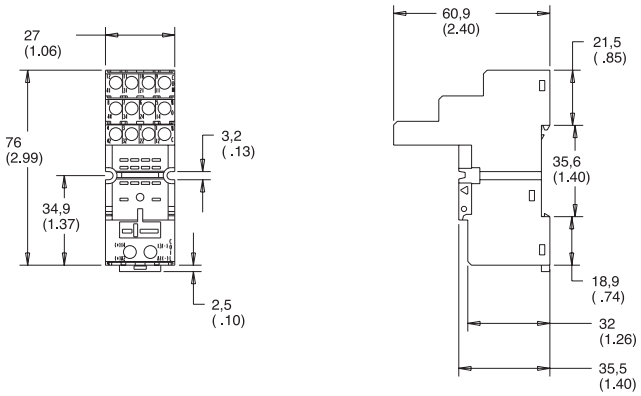
Approximate Dimensions are shown in millimeters (inches). Approximate Dimensions are not intended to be used for manufacturing purposes.



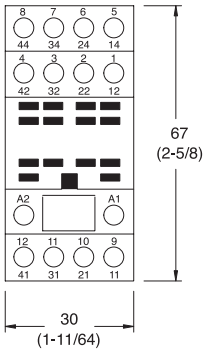
Bulletin 700-HC Relay (Two-Pole)

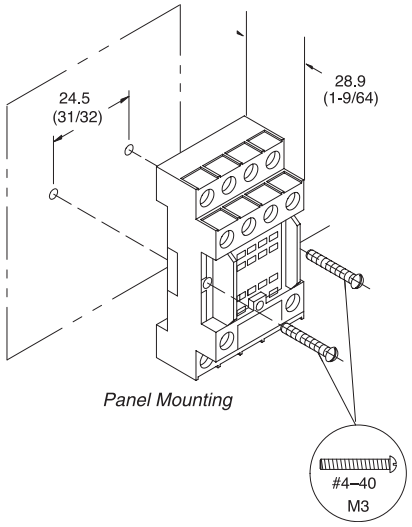


Bulletin 700-HC Relay (Four-Pole)



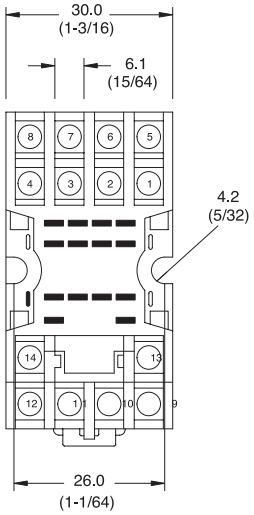
Cat. No. 700-HN104
Single Wire: 0.2 mm²…2.5 mm² (#24 AWG…14 AWG)
Double Wire: 2 x 0.2 mm²…2 x2.5 mm² (2 x 24 AWG…2 x 14 AWG)
Wire Type: solid or stranded, copper only
Strip Length: 7 mm (9/32 in), Torque: 0.5 Nm (4.4 lb•in)

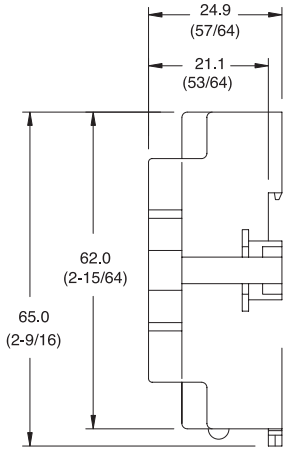




Panel Mounting

Cat. No. 700-HN103
Single Wire: 0.2 mm²…2.5 mm² (#24 AWG…14 AWG)
Double Wire: 2 x 0.2 mm²…2 x 1.5 mm² (2 x 24 AWG…2 x 16 AWG)
Wire Type: Solid or Stranded, Copper only
Strip Length: 8 mm (5/16 in), Torque: 0.5 Nm (4.4 lb•in)





Cat. No. 700-HN128
Wire Size: 2 x 1.5mm² (#2-16 AWG…#1-20 AWG)
(Either Solid or Stranded)
Strip Length: 9 mm (3/8 in) – Toque: 0.8 Nm (7 lb•in)

Interposing/Isolation Relays

Overview/Product Selection

Bulletin 700-HK "Slim Line" Relay

- 5 A/10 A Contact Ratings
- DPDT/SPDT
- Plug-in Blade Style Terminals
- Built-in Retainer Clip in Sockets
- Choice of Standard Silver Cadmium Contacts, or Silver With Gold Plated Contacts
- Options: LED

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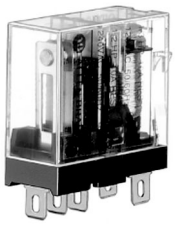
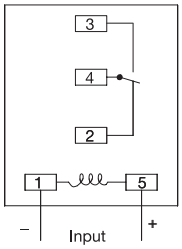
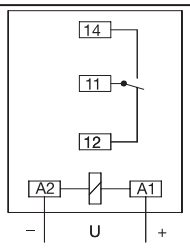
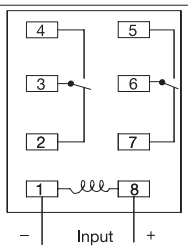
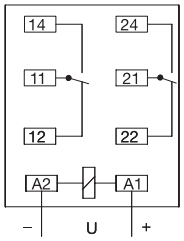
Standards Compliance and Certifications

See Specification Table In This Section.

Slim Line Relay with Plug-in Quick Connect Terminations

	Description	Contact Rating	Wiring Diagrams U.S./Canada	Wiring Diagrams International	Coil Voltage	Cat. No.*†
 *Bulletin 700-HK SPDT*	SPDT 1-Pole 1 Form C AgCdO Contacts	10 A			6V AC	700-HK36A06
					12V AC	700-HK36A12
					24V AC	700-HK36A24
					120V AC	700-HK36A1
					240V AC	700-HK36A2
					6V DC	700-HK36Z06
					12V DC	700-HK36Z12
					24V DC	700-HK36Z24
					48V DC	700-HK36Z48
	Socket		*700-HN121*	*700-HN121*	110V DC	700-HK36Z1
Bulletin 700-HK DPDT	DPDT 2-Pole 2 Form C AgCdO Contacts	5 A			6V AC	700-HK32A06
					12V AC	700-HK32A12
					24V AC	700-HK32A24
					120V AC	700-HK32A1
					240V AC	700-HK32A2
					6V DC	700-HK32Z06
					12V DC	700-HK32Z12
					24V DC	700-HK32Z24
					48V DC	700-HK32Z48
	Socket		*700-HN122*	*700-HN122*	110V DC	700-HK32Z1

∗ LED Option: Add suffix (**-4**) to the selected Bulletin 700-HK relay Cat. No. except for the 240V AC units, add (**-4L**).

† For AgCdO Contact with Gold Overlay: Replace "3" with "X" in Cat. No. For example, if Cat. No. 700-HK36A1 is required with Gold Overlay, the new catalog number is 700-HKX6A1.

	Description	Pkg. Qty.	Cat. No.	
Cat. No. 700-HN121	**Screw Terminal Socket — Panel or DIN Rail Mounting** 5-blade miniatue socket. For use with 1-pole, Bulletin 700-HK Relays. Socket includes a retainer clip. Order must be in multiples of ten	10	700-HN121	
Cat. No. 700-HN122	**Screw Terminal Socket — Panel or DIN Rail Mounting** 8-blade miniature socket for use with 2-pole, Bulletin 700-HK relays. This socket includes a retainer clip. Order must be for 10 sockets or multiples of 10.	10	700-HN122	
Cat. No. 700-HN108	8-Way Jumper can be cut to required length. Rated 10 A – 250V	1	Color	Cat. No.
			Red	700-HN180R
			Gray	700-HN180G
			Blue	700-HN180B
Cat. No. 199-DR1	**DIN (#3) Symmetrical Rail** 35 mm x 7.5 mm x 1 m long Zinc-plated, yellow chromated	10	199-DR1	

Bulletin 700-HK Slim Line Relay, Socket, and Retainer Clip Reference Chart

Relay Type	Socket Cat. No.	Retainer Clip Cat. No.
700-HK32	700-HN122	Provided
700-HK36	700-HN121	

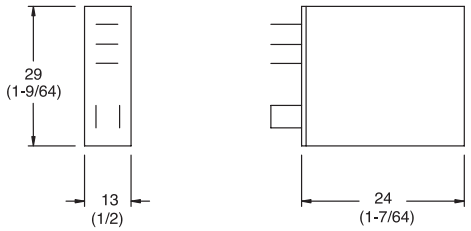
Interposing/Isolation Relays

Specifications*

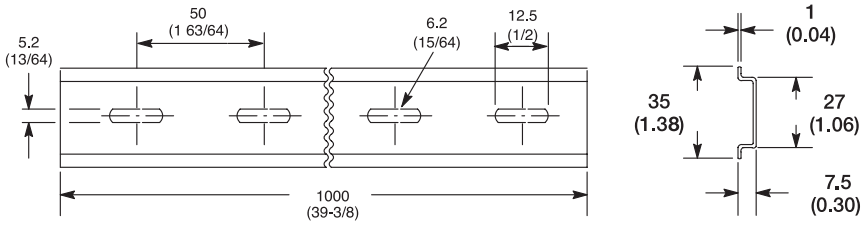
		Cat. No. 700-HK...					
Electrical Ratings							
Pilot Duty Rating†		B300					
Rated Thermal Current (I_{th})		1-Pole — 10 A			2-Pole — 5 A		
Rated Insulation Voltage (U_i)		250V IEC, 300V UL/CSA					
Contacts	Inductive	1-Pole		HP	2-Pole		HP
		▶][◀	◀][▶		▶][◀	◀][▶	
	120V AC, 1-phase	30 A	3 A	1/3	30 A	3 A	1/6
	240V AC, 1-phase	15 A	1.5 A	1/2	15 A	1.5 A	1/3
	General Purpose	10 A, 240V AC			5 A, 240V AC		
	Resistive	10 A, 30V DC			5 A, 30V DC		
Min. Permissible Contact Ratings		700-HK = 500 mW, 700-HKX = 50 mW					
Permissible Coil Voltage Variation		80…110% of Nominal Voltage at 50 Hz 85…110% of Nominal Voltage at 60 Hz 80…110% of Nominal Voltage at DC					
Sealed Power Consumption ±10%	AC Coils	Max. Allowable Leakage OFF 25% of VA‡					
		1.1 VA 50 Hz 0.9 VA 60 Hz					
	DC Coils	Max. Allowable Leakage of 10% of W 0.53 W					
Design Specification/Test Requirements							
Dielectric Withstand Voltage	Pole to Pole (VRMS)	1500V AC					
	Contact to Coil (VRMS)	1500V AC					
Mechanical							
Degree of Protection		Open Type (Sockets)					
Mechanical Life Operations		5 x 10^6					
Switching Frequency Operations		1800/hr.					
Coil Voltages		See Overview/Product Selection					
Operating Time at Nominal Voltage at 20 °C (ms)	Pickup	15					
	Dropout	15					
Maximum Operating Rate		3 Ops/s					
Vibration	Mechanical	10…55 Hz, 1.50 mm (0.6 in.) double amplitude					
	Malfunction	10…55 Hz, 1.50 mm (0.6 in.) double amplitude					
Shock	Mechanical	100 G					
	Malfunction	20 G (energized) 10 G (de-energized)					
Max. Socket Torque		0.8 Nm (7 lb. - in.)					
Environmental							
Temperature	Operating	–30…+55 °C (–22…+131 °F)					
	Storage	–55…+85 °C (–67…+185 °F)					
Altitude		2000 m (6560 ft)					
Construction							
Insulating Material		Molded High Dielectric Material					
Enclosure		Transparent Dust Cover					
Contact Material		Silver Cad. Ox., (AgCdO), Silver Cad. + Gold (AgCd + Au)					
Terminal Markings on Socket		In accordance with EN50 0005					
Sockets		**1-Pole**			**2-Pole**		
		700-HN121			700-HN122		
Approvals							
Certifications		CSA Certified, File LR75088, UL Recognized, File E3125 Guide NLDX 2,UL Listed, with Allen-Bradley Sockets, CE-Marked (per EU Low Voltage Directive 73/23 EEC 93/68 EEC)					
Standards		IEC 255-1-00, IEC 255-23, CSA 22.2, UL 508					

* Performance Data - See Important 2, publication A115.
† NEMA Rating Chart is on page 19 of publication 700-SG003B-EN-P.
‡ The inrush VA equals 1.5 times the sealed VA.

Approximate Dimensions are shown in millimeters (inches). Approximate Dimensions are not intended to be used for manufacturing purposes.

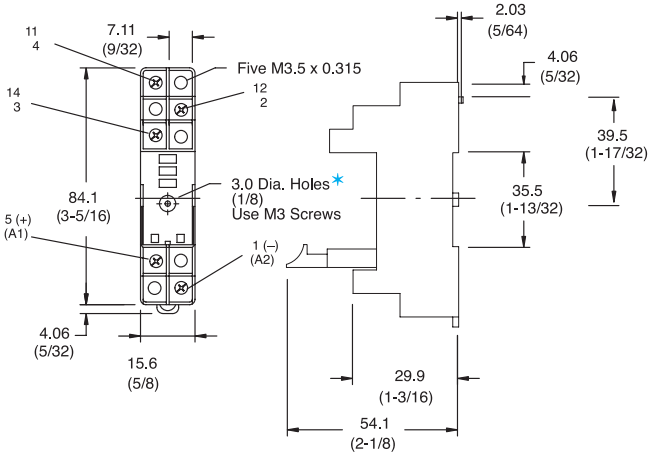


Bulletin 700-HK Relay
SPDT and DPDT Relays

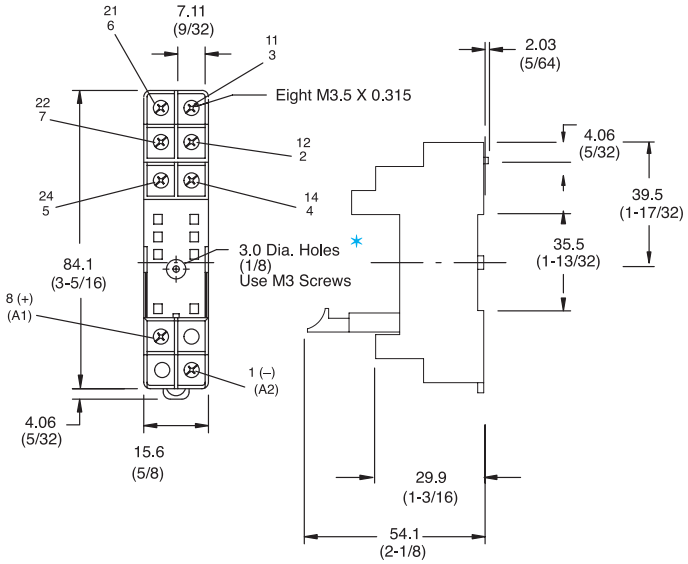


Cat. No. 199-DR1 DIN Mounting Rail Series B
Cat. No. 199-DR4 DIN Mounting Rail Series B Has No Mounting Holes

Cat. No.	A	B	C	D	Approx. Shipping Wt.
199-DR1	35 (1-3/8)	27 (1-1/16)	7.5 (19/64)	1.02 (1/64)	1.85 kg (4.07 lbs.) (10/pkg)
199-DR4	35 (1-3/8)	27 (1-1/16)	15 (19/32)	2.3 (3/32)	3.68 kg (8 lbs.) (5/pkg)



Cat. No. 700-HN121
Wire Size: 2 x 2.5 mm²
Single Wire – Up to #14 AWG
Double Wire – 2 x 2.5 mm² (#2–14 AWG… #2–20 AWG)
(Either Solid or Stranded)
Strip Length: 9 mm (3/8 in) – Torque: 0.8 N•m (7 lb•in)



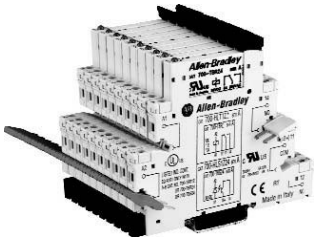
Cat. No. 700-HN122
Wire Size: 2 x 2.5 mm²
Single Wire – Up to #14 AWG
Double Wire – 2 x 2.5 mm² (#2–14 AWG… #2–20 AWG)
(Either Solid or Stranded)
Strip Length: 9 mm (3/8 in) – Torque: 0.8 N•m (7 lb•in)

* Holes required for mounting [3 mm (1/8 in) diameter].

* Holes required for mounting [3 mm (1/8 in) diameter].

Interposing/Isolation Relays

Overview/Product Selection



Bulletin 700-HL "Terminal Block Relay"

- Relay and Socket Assembled Interface Modules For High Density Interposing or Isolation Applications
- Screw Terminal and Spring Clamp Bases
- 6 A Relay, Choice of Silver or Gold Contacts
- 2 A Solid-State Relay
- SPDT (Relay), 1 N.O. (Solid-State)
- Built-in Retainer Clip and Snap-in Marker Lever
- Standard LED, Reverse Polarity Protection, and Surge Protection
- Externally Replaceable Relay Modules
- Unique Leakage Current Suppression Version to Address Industry Concerns of Nuisance Coil Turn-on or Contact Non-Drop Out when Connecting to PLCs with Leakage Current

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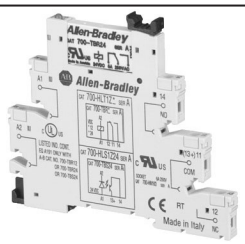
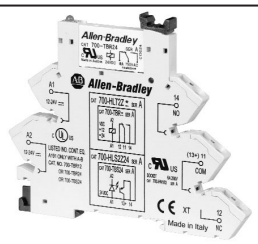
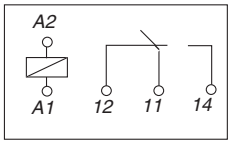
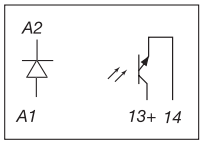
Standards Compliance and Certifications

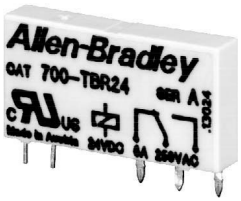
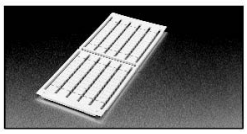
See Specification Table In This Section.

Product Selection

Standard built-in Features: • LED • Reverse Polarity Protection for DC Inputs • Coil Surge Protection	 *Cat. No. 700-HLT1Z24*	 *Cat. No. 700-HLT2Z24*	 *Cat. No. 700-HLS1Z24*	 *Cat. No. 700-HLS2Z24*
Specifications			 *	
Output Type	SPDT (1 C/O); I_{th} = 6A‡		1 N.O. solid-state; I_{th} = 2 A, 24V DC	
Recommended Tightening Torque	0.5 Nm max. (4.4 lb.–in.)			
Wire Range	Screw Terminal: 0.14 mm²…2.5 mm² (#26…#14 AWG), Spring Terminal: 0.2 mm²…2.5 mm² (#24…#14 AWG)			
Approvals	cULus, cURus, ABS, CE			

Assembled Devices	Pkg. Quantity	Cat. No. (Screw Terminals)	Cat. No. (Spring Clamp Terminals)	Pkg. Quantity	Cat. No. (Screw Terminals)	Cat. No. (Spring Clamp Terminals)
Input Voltage						
12V DC	10	700-HLT1Z12†	700-HLT2Z12	—	—	—
24V DC	10	700-HLT1Z24†	700-HLT2Z24	10	700-HLS1Z24†	700-HLS2Z24
48V DC	10	700-HLT1Z48†	700-HLT2Z48	10	700-HLS1Z48†	700-HLS2Z48
12V AC/DC	10	700-HLT1U12	700-HLT2U12	—	—	—
24V AC/DC	10	700-HLT1U24	700-HLT2U24	—	—	—
48V AC/DC	10	700-HLT1U48	700-HLT2U48	—	—	—
110/125V AC/DC	10	700-HLT1U1	700-HLT2U1	10	700-HLS1U1†	700-HLS2U1
220…240V AC/DC	10	700-HLT1U2	700-HLT2U2	10	700-HLS1U2†	700-HLS2U2
Built-in LCSC (leakage current suppression circuit) 120V AC and 125V DC§	10	700-HLT1L1†	—	10	700-HLS1L1†	—
Built-in LCSC (leakage current suppression circuit) 240V AC§	10	700-HLT1L2†	—	10	700-HLS1L2†	—

* Reverse polarity on the output terminals of the solid-state relay will result in the output being "On" regardless of the state of the input voltage.
† Electromechanical relay to solid-state relay interchangeability is possible.
‡ For Gold-plated contacts: Add the letter "X" at the end of the catalog number. For example: if Cat. No. 700-HLT1Z24 is required with gold plating, the new cat. no. is 700-HLT1Z24X.
§ Leakage current suppression up to 2.2 mA off state current.

	Description	Pkg. Quantity	Socket Input Voltage	Cat. No.
 *Cat. No. 700-TBR24*	**Replacement Relays** Order must be for 20 relays or multiples of 20.	20	12V	700-TBR12∗
			24V	700-TBR24∗
			48V	700-TBR48∗
			110/125V 220…240V 120V…125V 240V	700-TBR60∗
Cat. No. 700-TBS24	**Replacement SSR** 4-blade miniature relay for use with 1 N.O. SSR output. Order must be for 20 relays or multiples of 20.	20	24V	700-TBS24
			48V 110/125V 220…240V 120V…125V 240V 120/125V	700-TBS60
Cat. No. 700-TBJ20B	**20-Way Jumper** Can be cut to required length. *Ith* =36 A max per 20-way jumper.	1	Color	
			Red	700-TBJ20R
			Gray	700-TBJ20G
			Blue	700-TBJ20B
Cat. No. 700HN177	**End Barrier** Used for visual inspection of groups, safe separation of neighboring 700-HL modules that end with jumpers. Order must be for 10 or multiples of 10.	10	Black	700-HN177
	**Snap-in Marker** These snap-in markers have a 6 x 10 mm surface and snap into the ejection lever for the relay.	100	Blank	1492-MC6X10
			Standard 1492-MC6X10	www.ab.com/catalogs for information
			Custom	†

∗ For gold-plated contacts: Add the letter "X" at the end of the catalog number. For example: if Cat. No. 700-TBR24 is required with gold plating, the new cat. no. is 700-TBR24X. Also add $1 (US) to the price per relay.

† Go to http://www.ab.com/software/termblock/index.html and download software. Create custom text, save file, and e-mail to your local Allen-Bradley distributor.

Note: Terminal block relay bases are not sold separately.

Interposing/Isolation Relays

Specifications✶

Cat. No. 700-HLT… (Relay Output)							
Electrical Ratings							
Pilot Duty Rating	6 A NEMA B 300, R 300						
Rated Thermal Current (I_{th})	1-Pole — 6 A						
Rated Insulation Voltage (U_i)	250V IEC, 300V UL/CSA						
Contacts	Inductive	1-Pole					
	24V AC, 1-phase	30 A	►][◄	5 A	◄][►		
	120V AC, 1-phase	30 A		3 A			
	240V AC, 1-phase	15 A		1.5 A			
	Make, Break & Continuous V DC	24V DC			1.0 A		
		120V DC			0.2 A		
		240V DC			0.1 A		
Min. Permissible Contact Ratings	12V, 6 mA (72 mW) for Silver Contacts, 8V, 2.5 mA (20 mW) for Gold Contacts						
Permissible Coil Voltage Variation	Pickup:	85…110% of Nominal Voltage at 50 Hz 85…110% of Nominal Voltage at 60 Hz 80…110% of Nominal Voltage at DC			Must Dropout Voltage:	10% of Nominal Voltage at AC 5% of Nominal Voltage at DC	
Power Consumption ±10%	AC	0.3 VA					
	DC	0.2 W					
Design Specification/Test Requirements							
Dielectric Withstand Voltage	Pole to Pole (VRMS)	1000V					
	Contact to Coil (VRMS)	4000V					
Input Voltage	12V AC/DC	24V AC/DC	48V AC/DC	120V AC/DC	240V AC/DC	120V LCSC	240V LCSC
Impedance (Ohms)	1 K	2 K	6 K	26 K	56 K	16 K	35 K
Mechanical							
Degree of Protection	IP20						
Mechanical Life Operations	1 x 10^7						
Electrical Life Operations	6 A Resistive: 100,000 min. 24V DC, 1 A Inductive: 200, 000 min. 120V AC 1 A Inductive: 300,000 min.						
Switching Frequency Operations (no-load)	10 cycles/sec						
Coil Voltages	See Overview/Product Selection						
Operating Time at Nominal Voltage at 20°C (ms)	Pickup	7 ms					
	Dropout	3 ms					
Maximum Operating Rate (full load = 6 A)	6 cycles/min.						
Coil Surge Protection	Per EN 61000-4.5; Surge Immunity (801-5) Class III: 2 kV common and 1 kV differential mode						
Environmental							
Temperature	Operating	–40…+55 °C					
	Storage	–40…100 °C					
Altitude	2000 m (6560 ft)						
Construction							
Insulating Material	Molded High Dielectric Material						
Enclosure	Relay IP67						
Contact Material	Silver Tin Ox., AgSnO or Silver with Gold Plating, AgSnO + Au						
Terminal Markings on Socket	In accordance with EN50 0005						
Certifications	cURus Recognized, File E3125,Guide NLDX 2,cULus Listed, with Allen-Bradley socket, CE Marked (per EU Low Voltage Directive 73/23 EEC 93/68 EEC), ABS (American Bureau of Shipping)						
Standards	EN60947-4-1,EN60947-5-1,IEC 947CSA 22.2,UL 508,NEMA IEE MAC Compliant, ICS-2 Compliant						

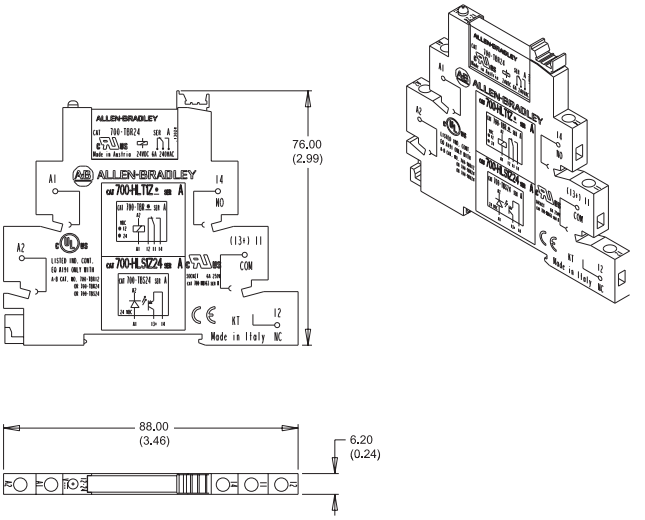
✶ Performance Data – See Important 2, publication A115.

Cat. No. 700-HLS… (Solid State Output)						
Electrical						
Rated Thermal Current (I_{th})	2 A					
Rated Insulation Voltage (U_i)	250V IEC, 300V UL/CSA					
Control Circuit	Min. Control Voltage	80% nominal voltage				
	Maximum Control Voltage	110% nominal voltage				
	Control Current	9 mA ±10% (24V) 4 mA ±10% (120/240V)				
	Release Voltage	0.4 x nominal voltage (24V), 0.35 x nominal voltage (120/240V)				
	Min. Control Circuit Resistance	3200 ohms (24V), 16k ohms (120V), 32k ohms (240V)				
Outputs	Load Voltage Range	0…24V DC				
	Max. Repetitive Blocking Voltage	33V				
	Max. Switching Current	2 A DC				
	On State Voltage Drop @ Max. Switching Current	<120 mV DC				
	Leakage Current	max. 100 µA (@U = 24V)				
Power Consumption ±10%	AC	0.3 VA				
	DC	0.2 W				
Design Specification/Test Requirements						
Dielectric Withstand Voltage	Pole to Pole (VRMS)	2500V				
	Contact to Coil (VRMS)	2500V				
Input Voltage	24V DC	48V DC	120V AC/DC	240V AC/DC	120V LCSC	240V LCSC
Impedance (Ohms)	2K	9 K	26 K	58 K	16 K	35 K
Mechanical						
Degree of Protection	IP20					
Input Voltages	See Overview/Product Selection					
Operating Time at Nominal Voltage at 20°C (ms)	Turn on Time	30 µs (DC only input voltage), 7 ms (AC/DC input voltage)				
	Drop Off Time	350 µs (DC only input voltage), 10 ms (AC/DC input voltage)				
Maximum Operating Rate	300 Hz					
Environmental						
Temperature	Operating	–20…+55 °C				
	Storage	–40…70 °C				
Altitude	2000 m (6560 ft)					
Construction						
Insulating Material	Molded High Dielectric Material					
Enclosure	Relay IP67					
Terminal Markings on Socket	In accordance with EN50 0005					
Certifications	cULus, cURus, ABS, CE					

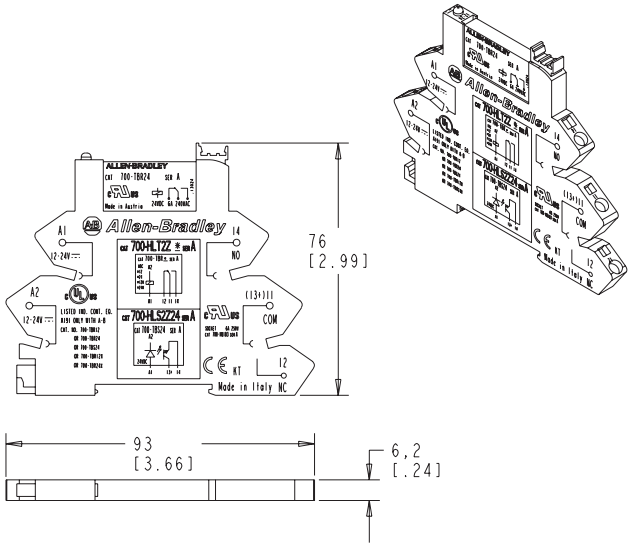
Interposing/Isolation Relays

Approximate Dimensions

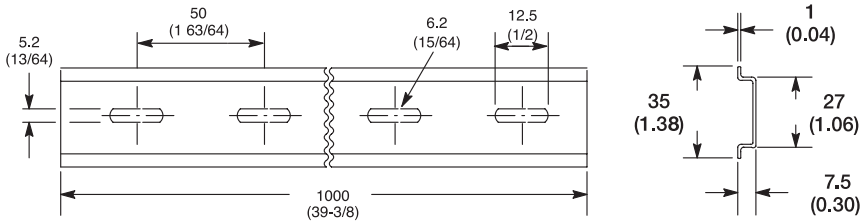
Approximate Dimensions are shown in millimeters (inches). Approximate Dimensions are not intended to be used for manufacturing purposes.



Bulletin 700-HL Screw Terminal Design
Single Wire: 0.14 mm²…2.5 mm² (#26 AWG…14 AWG)
Double Wire: 2 x 0.14 mm²…2 x 1.5 mm² (2 x #26 AWG…2 x 16 AWG)
Wire Type: Solid or stranded, copper only
Strip Length: 9 mm (11/32). Torque: 0.5 Nm (4.4 lb•in)



Bulletin 700-HL Spring Terminal Design
Single Wire: 0.2 mm²…2.5 mm² (#24 AWG…#14 AWG)
Wire Type: Solid or stranded, copper only
Strip Length: 9 mm (11/32)



Cat. No. 199-DR1 DIN Mounting Rail Series B
Cat. No. 199-DR4 DIN Mounting Rail Series B Has No Mounting Holes

Cat. No.	A	B	C	D	Approx. Shipping Wt.
199-DR1	35 (1-3/8)	27 (1-1/16)	7.5 (19/64)	1.02 (1/64)	1.85 kg (4.07 lbs.) (10/pkg)
199-DR4	35 (1-3/8)	27 (1-1/16)	15 (19/32)	2.3 (3/32)	3.68 kg (8 lbs.) (5/pkg)

Bulletin 700-HP (PCB) "Pin Style" Relay

- 8 A Contact Ratings
- DPDT/ (2 c/o) Contacts
- Plug-in PIN Style (PCB) Terminals (5 mm Pinning)
- Choice of Standard Silver Nickel Contacts, or Silver Nickel with Gold Plated Contacts
- Options: None

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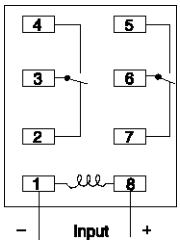
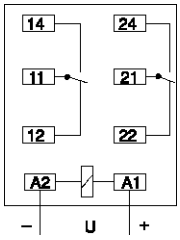
Standards Compliance and Certifications

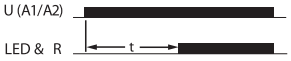
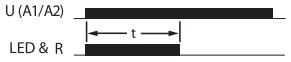
See Specification Table In This Section.

Slim Line Relay with "PIN Style" Terminations

	Description	Contact Rating	Wiring Diagrams U.S./Canada	Wiring Diagrams International	Coil Voltage	Package Quantity	Cat. No.
	DPDT 2-Pole 2 Form C AgNi + Au Gold Plated Contacts	8 A			6V AC	10	700-HPX2A06
					12V AC	10	700-HPX2A12
					24V AC	10	700-HPX2A24
					120V AC	10	700-HPX2A1
					240V AC	10	700-HPX2A2
					6V DC	10	700-HPX2Z06
					12V DC	10	700-HPX2Z12
					24V DC	10	700-HPX2Z24
					48V DC	10	700-HPX2Z48
	Sockets				110V DC	10	700-HPX2Z1
	DPDT 2-Pole 2 Form C AgNi Contacts				6V AC	10	700-HP32A06
					12V AC	10	700-HP32A12
					24V AC	10	700-HP32A24
					120V AC	10	700-HP32A1
					240V AC	10	700-HP32A2
					6V DC	10	700-HP32Z06
					12V DC	10	700-HP32Z12
					24V DC	10	700-HP32Z24
					48V DC	10	700-HP32Z48
Bulletin 700-HP DPDT	Sockets		*700-HN123*	*700-HN123*	110V DC	10	700-HP32Z1

Interposing/Isolation Relays

Assessories

	Description	Pkg. Quantity	Cat. No.
	Diode Surge Suppressor Voltage Range: 6…220V DC used with 700-HN123 socket	10	700-ADR
	Diode with LED Surge Suppressor Voltage Range: 6…24V DC used with 700-HN123 socket	10	700-ADL1R
	Diode with LED Surge Suppressor Voltage Range: 28…60V DC used with 700-HN123 socket	10	700-ADL2R
	Diode with LED Surge Suppressor Voltage Range: 110…220V DC used with 700-HN123 socket	10	700-ADL3R
	Diode with LED Surge Suppressor Voltage Range: 6…24V AC used with 700-HN123 socket	10	700-AV1R
	Varistor with LED Surge Suppressor Voltage Range: 110…240V AC used with 700-HN123 socket	10	700-AV3R
	RC Surge Suppressor Voltage Range: 6…24V AC/DC used with 700-HN123 socket	10	700-AR1
	RC Surge Suppressor Voltage Range: 110…240V AC/DC used with 700-HN123 socket	10	700-AR2
 Cat. No. 700-AT2	**On-Delay Time Module** Voltage Range: 12…24V AC/DC used with 700-HN123 socket 	1	700-AT1
	One Shot Timing Module Voltage Range: 12…24V AC/DC used with 700-HN123 socket 	1	700-AT2
 Cat. No. 700-HN123	**Screw Terminal Socket — Panel or DIN Rail Mounting** 8-pin miniature socket for use with 2-pole, Bulletin 700-HP relays. Incorporates coil and contact separation. Order must be for 10 sockets or multiples of 10.	10	700-HN123
 Cat. No. 700-HN180	8-Way Jumper can be cut to required length. Rated 10 A – 250V	1	Color / Cat. No. Red 700-HN180R Gray 700-HN180G Blue 700-HN180B
 Cat. No. 199-DR1	**DIN (#3) Symmetrical Rail** 35 mm x 7.5 mm x 1 m long Zinc-plated, yellow chromated	10	199-DR1
Cat. No. 700-HN119	**Plastic Retainer and Ejection Lever** For use with the 700-HN123 Sockets Built-in ability to accept 1492 Snap-in Markers Order must be in multiples of 10	10	700-HN119

Bulletin 700-HP Pin Style (PCB) Slim Line Relay, Socket, and Retainer Clip Reference Chart

Relay Type	Socket Cat. No.	Retainer Clip Cat. No.
700-HPX2	700-HN123	700-HN119
700-HP32	700-HN123	700-HN119

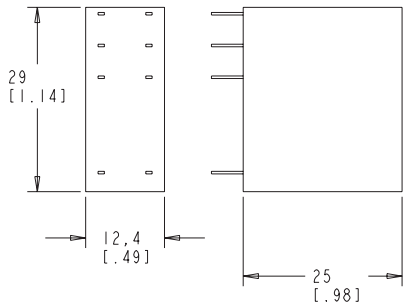
Cat. No. 700-HP…				
Electrical Ratings				
Pilot Duty Rating†		C300, R300		
Rated Thermal Current (I_{th})		2-Pole — 8A		
Rated Insulation Voltage (U_i)		250V IEC, 300V UL/CSA		
Contacts	Inductive	2-Pole		Hp
		▶][◀	◀][▶	
	120V AC, 1-phase	15 A	1.5 A	1/6
	240V AC, 1-phase	7.5 A	0.75 A	1/3
	General Purpose	8 A, 277V AC		
	Resistive	8 A, 30V DC		
Min. Permissible Contact Ratings		700-HP32 = 300 mW (5V, 5 mA) 700-HPX = 50 mW (5V, 5 mA)		
Permissible Coil Voltage Variation		Pickup: 80…110% of Nominal Voltage at 50 Hz 80…110% of Nominal Voltage at 60 Hz 73…150% of Nominal Voltage at DC		Must Drop-out Voltage: 20% of Nominal Coil Voltage AC 10% of Nominal Coil Voltage DC
Sealed Power Consumption ±10%	AC Coils	Max. Allowable Leakage OFF 25% of VA‡ 1.2 VA 50 Hz 1.0 VA 60 Hz		
	DC Coils	Max. Allowable Leakage of 10% of W 0.5 W		
Design Specification/Test Requirements				
Dielectric Withstand Voltage for One Minute	Pole to Pole (VRMS)	1000V AC		
	Contact to Coil (VRMS)	5000V AC		
Mechanical				
Degree of Protection		Open Type (Sockets)		
Mechanical Life Cycles		10 x 10^6 (AC Coils), 20 x 10^6 (DC coils)		
Switching Frequency Operations		1800/hr (no load)		
Coil Voltages		See Overview/Product Selection		
Operating Time at Nominal Voltage at 20 °C (ms)	Pickup	12		
	Dropout	4		
Maximum Operating Rate		16 Ops/s (full load)		
Vibration	Enclosure	5 G		
	Fragility	2.5 G		
Shock	Endurance	50 G		
	Fragility	15 G		
Max. Socket Torque		0.5 Nm (4.4 lb.in)		
Environmental				
Temperature	Operating	–40…+85 °C		
	Storage	–45…+100 °C		
Altitude		2000 m (6560 ft)		
Construction				
Insulating Material		Molded High Dielectric Material		
Enclosure		Transparent Dust Cover		
Contact Material		Silver Nickel, (AgNi) (700-HP3), Silver Nickel + Gold Plating (AgNi + Au) (700-HPX)		
Terminal Markings on Socket		In accordance with EN50 0005		
Sockets		2-Pole		
		700-HN123		
Approvals				
Certifications		CSA certified, UL recognized, UL listed with AB socket, CE		
Standards		IEC 255-1-00, IEC 255-23, CSA 22.2, UL508		

* Performance Data – See Important 2, publication A115.
† NEMA Rating Chart is on page 19 of publication 700-SG003B-EN-P.
‡ The inrush VA equals 1.5 times the sealed VA.

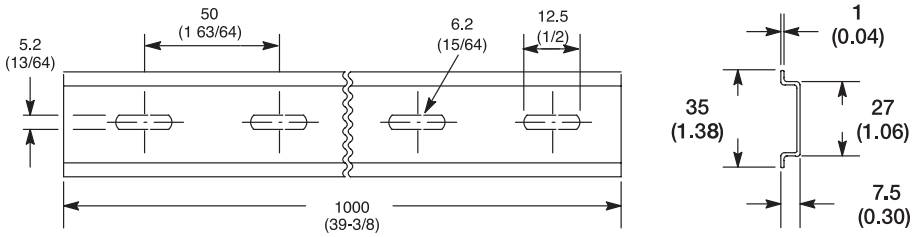
Interposing/Isolation Relays

Approximate Dimensions

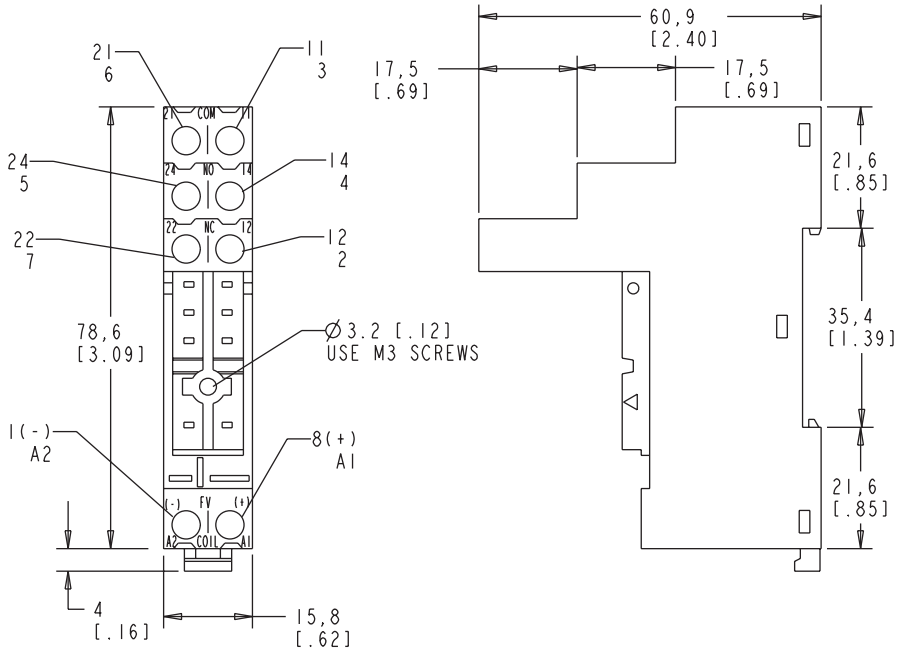
Approximate Dimensions are shown in millimeters (inches). Approximate Dimensions are not intended to be used for manufacturing purposes.



Bulletin 700-HP Relay



Cat. No.	A	B	C	D	Approx. Shipping Wt.
199-DR1	35 (1-3/8)	27 (1-1/16)	7.5 (19/64)	1.02 (1/64)	1.85 kg (4.07 lbs.) (10/pkg)
199-DR4	35 (1-3/8)	27 (1-1/16)	15 (19/32)	2.3 (3/32)	3.68 kg (8 lbs.) (5/pkg)



Cat. No. 700-HN123
Single Wire: 0.2 mm2.....2.5 mm2 (#24 AWG.....14 AWG)
Double Wire: 2 X 0.2 mm2.....2 X 2.5 mm2 (2 X 24 AWG....#.2 X 14 AWG)
Wire Type: solid or stranded, copper only
Strip Length: 7 mm (9/32 in), Torque: 0.5Nm (4.4 lb.in)

Bulletin 700-FE

- Adjustable Function and Timing Range Timing Relays
- DIN Rail Mounted Without Cost of Socket
- 17.5 mm wide, Multi-Function or Single Function
- Available as 1 N.O. or SPDT Contact Output, 5A
- Timing Ranges From 0.05s…10.0h

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See Specification Table In This Section.

Multi-Function

This device offers you the flexibility of selecting one of 4 single timing functions.

Operating Mode	Contact Output	Timing Range	Input Voltage	Cat. No.
ON-delay, OFF-delay, One Shot, Flasher (repeat cycle starting with pulse)	1 N.O.	0.75 s…1 h (4 settings)†	24V AC/DC 110…240V AC 50/60 Hz*	700-FEM1RU22
ON-delay, OFF-delay, One Shot, Flasher (repeat cycle starting with pulse)	SPDT (l C/O)	0.05 s…10 h (6 settings)†	24V…48V AC/DC 24…240V AC 50/60 Hz	700-FEM3TU23

Single-Function

This device offers you one specific timing function.

Operating Mode	Contact Output	Timing Range	Input Voltage	Cat. No.
ON-delay	1 N.O.	0.75 s…1 h (4 settings)§	24V AC/DC 110…240V AC 50/60 Hz*	700-FEA1SU22
	SPDT (1 C/O)	0.05 s…10 h (6 settings)‡	24V…48V AC/DC 24…240V AC 50/60 Hz	700-FEA3TU23
OFF-delay	1 N.O.	0.75 s…1 h (4 settings)§	24V AC/DC 110…240V AC 50/60 Hz*	700-FEB1SU22
	SPDT (1 C/O)	0.05 s…10 h (6 settings)‡	24V…48V AC/DC 24…240V AC 50/60 Hz	700-FEB3TU23
One Shot	1 N.O.	0.75 s…1 h (4 settings)§	24V AC/DC 110…240V AC 50/60 Hz*	700-FED1SU22
	SPDT (1 C/O)	0.05 s…10 h (6 settings)‡	24V…48V AC/DC 24…240V AC 50/60 Hz	700-FED3TU23
Fleeting OFF-delay	SPDT (1 C/O)	0.05 s…10 h (6 settings)‡	24V…48V AC/DC 24…240V AC 50/60 Hz	700-FEE3TU23
Flasher (repeat cycle starting with pulse)	1 N.O.	0.75 s…1 h (4 settings)§	24V AC/DC 110…240V AC 50/60 Hz*	700-FEF1SU22
	SPDT (1 C/O)	0.05 s…10 h (6 settings)‡	24V…48V AC/DC 24…240V AC 50/60 Hz	700-FEF3TU23
Pulse Converter	SPDT (1 C/O)	0.05 s…10 h (6 settings)‡	24V…48V AC/DC 24…240V AC 50/60 Hz	700-FEL3TU23

* Voltage is either 24V AC 50/60 Hz or 24V DC.
† Time ranges: 0.5 s…10 s, 3…60 s, 0.5 s…10 min., 3…60 min.
‡ Time ranges: 0.05 s…1 s, 0.5…10 s, 0.05…1 min., 0.5…10 min, 0.05…1 h, 0.5…10 h.
§ Time ranges: 0.75…15 s, 3…60 s, 0.4…8 min., 3…60 min.

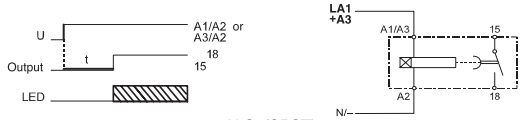
Special Functions

Operating Mode	Contact Output	Timing Range	Input Voltage	Cat. No.
Star-delta	2 N.O. with 1 Common	0.15 s…10 min. (4 settings)*	24V…48V AC/DC 24…240V AC 50/60 Hz	700-FEY2QU23

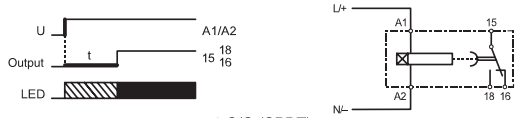
* Time ranges: 0.15…3 s, 0.5…10 s, 3 s…1 min., 30 s…10 min.

700-FE Function and Connection Diagrams

(A) On-Delay

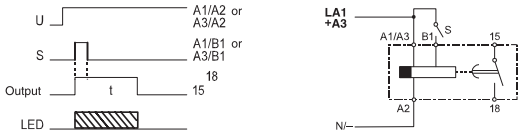


1 N.O. (SPST)

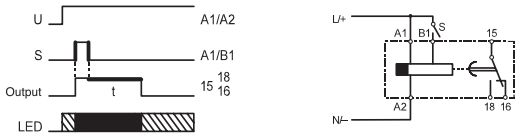


1 C/O (SPDT)

(B) Off-Delay

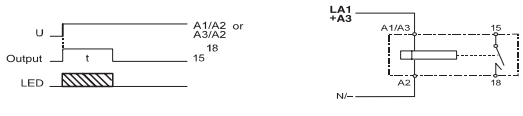


1 N.O. (SPST)

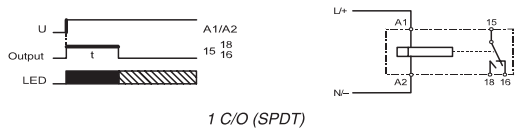


1 C/O (SPDT)

(D) One Shot

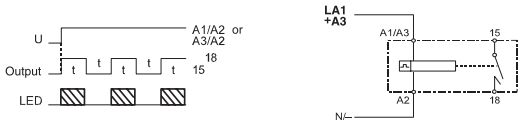


1 N.O. (SPST)

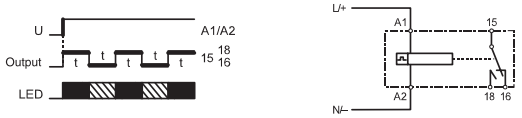


1 C/O (SPDT)

(F) Flasher (Repeat Cycle Starting with Pulse)

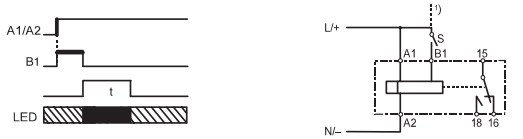


1 N.O. (SPST)



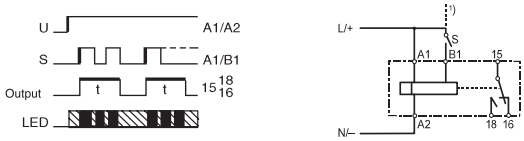
1 C/O (SPDT)

(E) Fleeting Off-delay



1 C/O (SPDT)

(L) Pulse Converter



(Y) Star-delta timing relay

Bi-Color LED: 1 C/O (SPDT) Contact Timers

LED U = green:Supply voltage available
LED Relay = red:Output is energized

LED: 1 N.O. Contact Timers

ON = green
OFF = no color

Single Color LED: 2 N.O. with Common

ON = green
OFF = red

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Allen-Bradley

	Description	Pkg. Quantity	Cat. No.
	Panel Mounting Adapter For surface mounting according to drilling plan EN 50 002	5	199-FSA
	Label Sheet 10 sheets with 105 self-adhesive paper labels each, 6 x 17 mm	10	100-FMS

Specifications*

Time Characteristics (according to VDE 0435, part 2021)

		1 N.O.	SPDT
Setting Accuracy		±5% of full scale	
Repeatability		±1% of setting (typical)	
Tolerance		By voltage: ±0.01%/%ΔU By temperature: ±0.25%/°C	By voltage: ±0.001%/%ΔU By temperature: ±0.025%/°C
Supply			
Supply Voltage		24V AC/DC† and 110…240V AC, 50/60 Hz	24…48V DC and 24…240V AC, 50/60 Hz
Voltage Tolerance	AC	–15%/+10%	
	DC	–15%/+20%	
Power Consumption		0.5 W at 24V DC, 9 VA at 240V AC	0.5 W at 24V DC, 5 VA at 240V AC
Time Energized		100%	
Reset Time		250 ms	100 ms
Cable Length (Supply Voltage Control)		Max. 100 m (300 feet)	Max. 250 m (750 feet)
Pulse Control (B1)			
Impulse Duration		≥ 250 ms	≥ 50 ms (AC), ≥ 30 ms (DC)
Input Voltage		supply voltage range	
Input Current		1 mA	
Cable Length		Max. 250 m without parallel load between B1 and A2 Max. 50 m with load (< 3 kΩ) between B1 and A2	
Outputs			
Contact Type		1 N.O. contact	1 Form C – SPDT contact
Dielectric Withstand Voltage	Contact-to-coil	4000 V	
Switching Capacity	Power	1250 VA	
	According to IEC 947-5-1	AC-1	5 A /250V AC (resistive load)
		AC-14	1 A/250V AC (inductive load)
		DC-13	1 A/24V DC (inductive load)
	According to UL 508	NEMA D300 - 1 A/300V AC	
Short-Circuit Resistance		6 A gL (Fast Blow Fuse)	
Life	Mechanical	20 million operations	
	Electrical	0.4 million at 1 A/250V AC, resistive 0.4 million at 0.5 A/250V AC, cos ϕ = 0.4 0.4 million at 1 A/24V DC, resistive	
State Indicator		1 LED	1 Bi-Color LED (Supply; Relay)
Certifications		cUL Recognized, File E14840, cULus Listed, File E14840, Guide NKCR,CE Marked (per EU Low Voltage Directive 73/23 EEC 93/68 EEC: per Electromagnetic Compatibility Directive 89/336 EEC 92/31 EEC 93/681 EEC)	
Standards		EN 60947-1,EN 60947-5-1,EN 50081-1,IEC 947,UL 508, CSA 22.2	

* Performance Data - See Important 2, publication A115.
† Voltage is either 24V DC or AC 50/60 Hz.

DIN Rail Timing Relays

Specifications, Continued

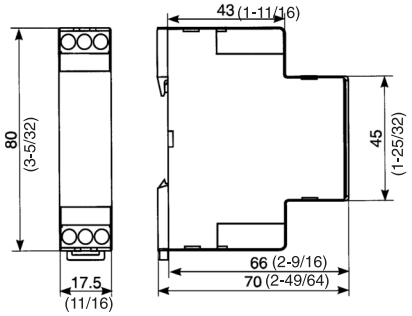
General Specifications

	1 N.O.	SPDT
Insulation Characteristics	2 kV AC/50 Hz test voltage according to VDE 0435 and 4 kV 1.2/50 µs surge voltage according to IEC 947-1 between all inputs and outputs	
EMC/Interference Immunity	The following requirements are fulfilled: Surge capacity of the supply voltage according to IEC 1000-4-5: Level 3 (A1-A2) 110...240V AC according to IEC 1000-4-5: Level 2 (A3-A2) 24V AC/DC* Burst according to IEC 1000-4-4: Level 3 ESD discharge according to IEC 1000-4-2: Level 3	The following requirements are fulfilled: Surge capacity of the supply voltage according to IEC 1000-4-5: Level 3 Burst according to IEC 1000-4-4: Level 3 ESD discharge according to IEC 1000-4-2: Level 3
EMC/Emmission	electromagnetical fields according to EN 55 022: Class B	
Safe Isolation	according to VDE 106, Part 101	
Climatic Withstand	56 cycles (24 h) at 25…40 °C and 95% relative humidity according to IEC 68-2-30 and IEC 68-2-3	
Vibration Resistance	4 g in 3 axes at 10…500 Hz, test FC according to IEC 68-2-6	
Shock Resistance	50 g according to IEC 68-2-27	
Protection Class IEC 947-1	Enclosure:IP 40 Terminal:IP 20	
Weight	60 g	60 g
Certifications	cULus, CE Certified	cULus, Germanischer Lloyd, CE Certified
Ambient Temperature	Open:–25…+60 °C Enclosed:–25…+45 °C Storage:–40…+85 °C	
Connections	Screw terminal M3 for Pozidriv No.1, Philips and slotted screws No.2. suitable for power screw-driver. Rated tightening torque 8.8 lb.-in. (max. 1.0 Nm) For terminal cross-sections of 1 x 0.5 mm²…2 x 1.5 mm² (solid) or 2 x 1.5 mm² (stranded with sleeve), #20…14 AWG. Finger protection according to VDE 0106	
Mounting	For surface mounting in any position; snap-on mounting on 35 mm DIN Rail or by adapter and 2 screws (M4 type)	
Disposal	Synthetic materials without dioxin according to EC/EFTA-Notification No. 93/0141/D electrical contacts are AgCdO	

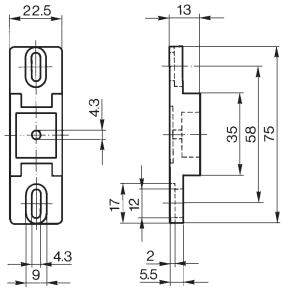
* Voltage is either 24V DC or AC 50/60 Hz.

Approximate Dimensions

Approximate Dimensions are shown in millimeters (inches). Approximate Dimensions are not intended to be used for manufacturing purposes.



Cat. No. 700-FE...



Cat. No. 199-FSA...

Bulletin 700-FS

- Adjustable Function and Timing Range Timing Relays
- DIN Rail Mounted without Cost of Socket
- 22.5 mm Wide Multifunction or Single Functions
- Available as SPDT or DPDT Contact Output, 8 A
- Timing Ranges From 0.05s…60h

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Standards Compliance and Certifications

See Specification Table In This Section.

Catalog Number Explanation

700	–	FS	H	3	U	U23
Bulletin Number		Type of Relay	Operating Mode	Contact Output	Timing Range	Input Voltage

Single-Function (With SPDT 1 C/O contacts)

700–FS	A	3	A	U23
	a	*b*	*c*	*d*

a

Operating Mode	
Code	Description
A	On-delay∗
B	Off-delay∗
C	On- and off-delay∗
D	One shot∗
E	Fleeting off-delay∗
F	Flasher (repeat cycle starts with pulse)∗
G	Flasher (repeat cycle starts with pulse)∗
I	On-delay pulse generator∗
J	On-delay (pulse controlled)∗
K	One shot/watch dog (pulse controlled)∗
L	Pulse converter∗

b

Contact Output	
All functions:	
3 1 Changeover contact (SPDT)	1 C/O

c

Timing Range	
Code	Description
A	0.05…1 s
B	0.15…3 s
C	0.5…10 s
D	1.5…30 s
E	0.05…1 min
F	0.15…3 min
G	0.5…10 min
H	1.5…30 min
I	0.05…1 h
J	0.15…3 h
K	0.5…10 h
L	3.0…60 h
U	0.05 s…60 h†

d

Input Voltage	
Code	Description
Z12	12V DC
U23	24…48V DC 24…240V AC 50/60 Hz

∗ Preferred availability item.
† Valid for functions “A” and “B” only.

Single Function (With 2PDT 2 C/O contacts)

Operating Mode	Contact Output	Timing Range	Input Voltage	Cat. No.
On-Delay	(DPDT) 2 C/O	0.05 s…60 h‡	12V DC	700-FSA4UZ12
On-Delay	(DPDT) 2 C/O		24…48V DC 24…240V AC 50/60 Hz	700-FSA4UU23
Off-Delay	(DPDT) 2 C/O		12V DC	700-FSB4UZ12
Off-Delay	(DPDT) 2 C/O		24…48V DC 24…240V AC 50/60 Hz	700-FSB4UU23

‡ The time range of “0.05 s…60 h” is selectable in 12 smaller ranges plus an ON and OFF function for maintenance needs.

DIN Rail Timing Relays

Product Selection

Multi-Function (This device offers you the flexibility of selecting one of 8 single timing functions.)

Operating Mode	Contact Output	Timing Range	Input Voltage	Cat. No.
M Multi-function timing relays 8 Single-functions: A, B, C, D, E, F, I, and L ON and OFF function additional (for installation and maintenance) note: See connection diagrams for further description.	(SPDT) 1 C/O	0.05 s…60 h∗	12V DC	700-FSM3UZ12
	(SPDT) 1 C/O		24…48V DC 24…240V AC 50/60 Hz	700-FSM3UU23
	(DPDT) 2 C/O		12V DC	700-FSM4UZ12
	(DPDT) 2 C/O		24…48V DC 24…240V AC 50/60 Hz	700-FSM4UU23

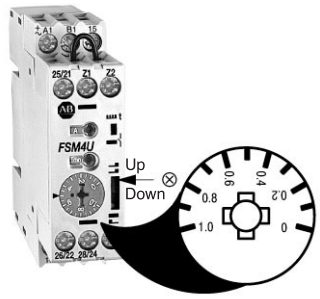
Special Function

Operating Mode	Contact Output	Timing Range	Input Voltage	Cat. No.
Flasher (Repeat cycle starting with pulse or pause)	(SPDT) 1 C/O	0.05 s…60 h∗	12V DC	700-FSH3UZ12
			24…48V DC 24…240V AC 50/60 Hz	700-FSH3UU23
		2 x 0.05 s…60 h (2 ranges)	12V DC	700-FSH3VZ12
			24…48V DC 24…240V AC 50/60 Hz	700-FSH3VU23
OFF-delay without supply voltages (True OFF-delay)‡	(SPDT) 1 C/O	0.15 s…10 m†	24…48V DC 24…240V AC 50/60 Hz	700-FSQ3QU18
	(DPDT) 2 C/O			700-FSQ4QU18
Star-Delta	2 N.O. + 1 Common	0.5 s…10 s	24…48V DC	700-FSY2CU23
		1.5…30 s	24…240V AC 50/60 Hz	700-FSY2DU23
		0.05 s…1 min.		700-FSY2EU23
		0.15…3 min.		700-FSY2FU23
		0.5…10 min.		700-FSY2GU23

∗ The time range of “0.05 s…60 h” is selectable in 12 smaller ranges plus an ON and OFF function for maintenance needs.
† This time range is selectable in four smaller ranges: 0.15 s…2.5 s, 0.5 s…10 s, 4 s…80 s, 30 s…10 min.
‡ Due to shock during shipment, the state of the contacts should be verified before initial use.

Multi-Function Timing Relay Function and Time Range Settings

Description	SPDT	DPDT
	Multi-Time Setting Range 0.05 s…60 h	

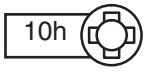


Multi-function timing relays 700-FSM3U includes 10 setting functions:

(A)On-Delay
(B)Off-Delay
(C)On- and Off-Delay
(D)One shot
(E)Fleeting Off-Delay
(F)Flasher (repeat cycle starts with pulse)
(I)On-Delay pulse generator
(L)Pulse converter
(On)ON-Function§
(Off)OFF-Function§

Note: Switch ⊗ is on DPDT relays only. When switch is down, one contact is instantaneous and one is timed. When switch is up, both contacts are timed.

(1 s)0.05…1 s
(3 s)0.15…3 s
(10 s)0.5…10 s
(1 min)0.05…1 min
(3 min)0.15…3 min
(10 min)0.5…10 min
(1 h)0.05…1 h
(3 h)0.15…3 h
(10 h)0.5…10 h
(60 h)3….60 h



§ For installation and maintenance.

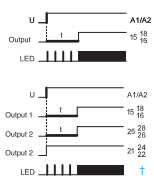
	Description	Pkg. Quantity	Cat. No.
	Setting Knob with Scale (for time setting without tools)	10	700-FSK
	Panel Mounting Adapter For surface mounting according to drilling plan EN 50 002	5	199-FSA
	Label Sheet 10 sheets with 105 self-adhesive paper labels each, 6 x 17 mm	10	100-FMS
	Marking Tag Sheet 10 sheets with 160 perforated paper labels each, 6 x 17 mm To be used with a transparent cover	10	100-FMP
	Transparent Cover 100 each To be used with marking tag sheets	100	100-FMC
	Marking Tag Adapters 100 each To be used with marking tag:	100	100-FMA2*

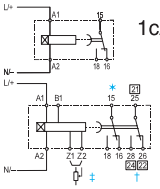
* Cat. No. 100-FMA2 is only a marking tag carrier. Please refer to the Terminal Block Accessories section for appropriate marker cards to be used with this carrier.

DIN Rail Timing Relays

700-FS Function and Connection Diagrams

(A) On-Delay

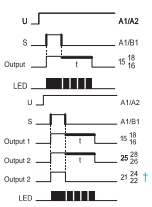


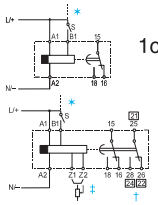


1c/o (SPST)

2 c/o (DPDT)

(B) Off-Delay (Min. Pulse AC 50 ms…DC 30 ms)

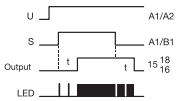


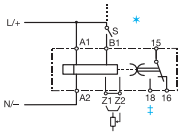


1c/o (SPST)

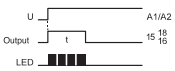
2 c/o (DPDT)

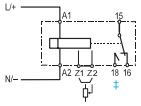
(C) On- and Off-Delay



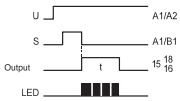


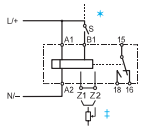
(D) One Shot



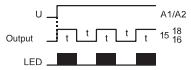


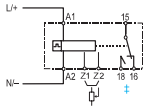
(E) Fleeting Off-Delay (Min. Pulse AC 50 ms…DC 30 ms)



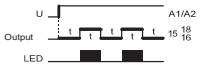


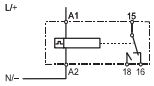
(F) Flasher (Repeat Cycle Starts with Pulse)



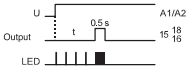


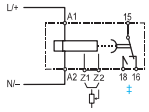
(G) Flasher (Repeat Cycle Starts with Pause)



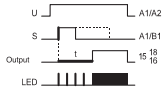


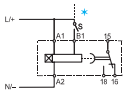
(I) On-Delay Pulse Generator



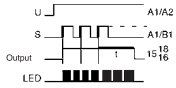


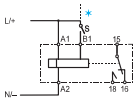
(J) On-Delay (Pulse Controlled)



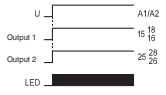


(K) One Shot/ Watch Dog (Pulse Controlled)

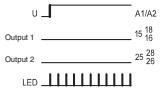




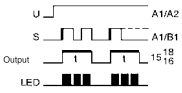
(Off) OFF-Function

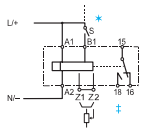


(On) ON-Function



(L) Pulse Converter (Min. Pulse AC 50 ms…DC 30 ms)





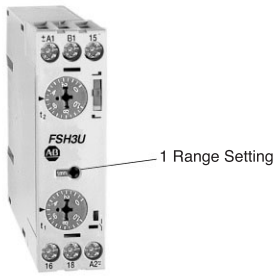
Cleverly Designed Function Display LED (Green)

- Output in rest position, no timing
- Output in rest position, time running
- Output in operation position, no timing
- Output in operation position, time running

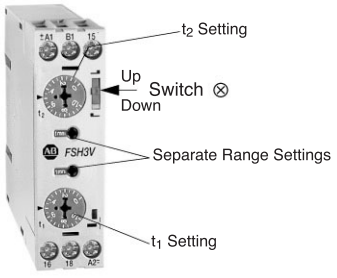
∗ A voltage other than the supply voltage can be used at B1, but must be within voltages specified on timer.
† Output 2 is selectable as instantaneous contact with sliding switch (⊗) on front panel (instantaneous when switch is down, timed when switch is up).
‡ Available on multifunction “M,” and single function “A” or “B” option timing relays along with code “4” (2PDT contacts). Bridge or potentiometer 10 kΩ, min. 0.25 W (low voltage) for external time setting. Set timer dial to 0.0.

Special Function Flasher (Repeat Cycle Starting with Pulse or Pause) Timing Relays

Description



700-FSH3U



700-FSH3V

Supply Voltages (A1/A2)

Z12 12V DC

U23 24…48V DC,

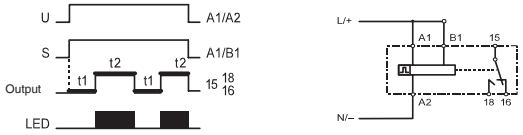
24…240V AC, 50/60 Hz

Function Diagram / Connection Diagram

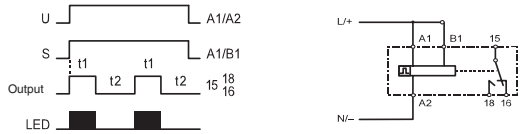
(H) Flasher (Repeat Cycle Starting with Pulse or Pause)
The repeat cycle timer permits different settings for on and off times.
The following operating modes are possible:

- Oscillating mode; repeat cycle starts with voltage applied at A1 and B1, and continues to repeat until voltage is off.
- One cycle mode; started by energizing B1 with voltage on A1 and A2.
- Output starts with pulse or pause (switch ⊗ Up or Down).
- 700-FSH3U provides (1) range setting for t_1 and t_2.
  700-FSH3V provides (2) range settings for t_1 and t_2.

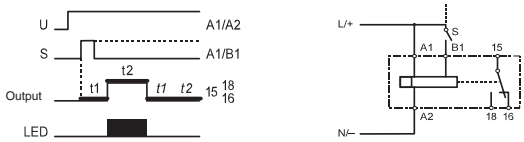
Supply Voltage Controlled, Oscillating Mode Starting with Pause — Switch ⊗ is Up



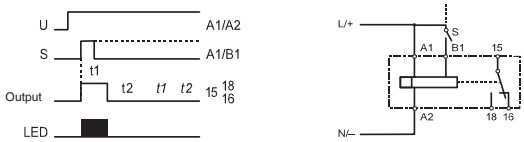
Supply Voltage Controlled, Oscillating Mode Starting with Pulse — Switch ⊗ is Down



Pulse Controlled, Output Starts With Pause (Min. Pulse AC 50 ms — DC 30 ms) — Switch ⊗ is Up One Cycle Mode — Voltage Supplied at A1 and A2, then Pulsing "s" to Energize B1 will Initiate One Cycle.



Pulse Controlled, Output Starts with Pulse (Min. Pulse AC 50 ms — DC 30 ms) — Switch ⊗ is Down One Cycle Mode — Voltage Supplied at A1 and A2, then Pulsing "s" to Energize B1 will Initiate One Cycle.



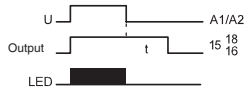
Note: If B1 is pulsed, a one full time cycle consisting of t_1 and t_2 is completed.

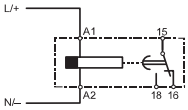
LED Operation Chart Green LED

LED ———	Output at Shelf State, No Timing – LED Off
LED _ _ _ _	Output at Shelf State, Time is Running – LED Flashing
LED ▬▬▬	Output NO Contact is Closed, No Timing – LED On
LED ▬ ▬ ▬	Output NO Contact is Closed, Time is Running – LED Long Flashing

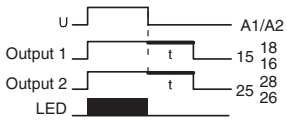
Function Diagram / Connection Diagram

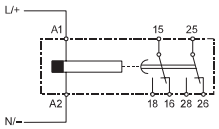
(Q) Off-Delay without Supply Voltage (True Off-Delay) — When input power is turned on, the output contact changes state. When the power is removed, the time delay begins. The output contact returns to shelf state at the end of the time delay.



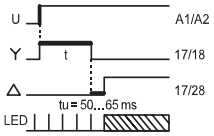


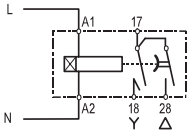
Note: Min. pulse (t) required:
24V DC: 200 ms
24V AC: 325 ms
240V DC: 200 ms
240V AC: 175 ms





(Y) Star-Delta Timing Relay — When power is applied, the output contact 17/18(Y) changes state. After the time setting, the output contact 17/18(Y) returns to shelf state. After the fixed time (50… 60 ms), the output contact 17/28Δ changes state. Both output contacts return to shelf state whenever the power is removed.





Time Characteristics (according to VDE 0435, Part 2021)

Setting Accuracy	±5% of full scale
Repeatability	±0.2% of the setting values
Tolerance	Voltage: ±0.001%/%ΔU Temperature: ±0.025%/°C

Supply

Supply Voltages	24…48V DC and 24…240V AC, 50/60 Hz (multi voltage)
Voltage Tolerance	–20…+20% (DC), –15…+10% (AC)
Power Consumption	0.5 W at 24V DC, 5 VA at 240V AC
Time Energized	100%
Reset Time	50 ms
Voltage Interruption	≤20 ms without reset (supply voltage)
Input Impedance	Relay ON: 3K-13K ohms Relay OFF: 0.7K-4K ohms
Cable Length (Supply Voltage Control)	Max. 250 m (800 ft)

Pulse Control (B1)

Pulse Duration	≥50 ms (AC), ≥30 ms (DC)
Input Voltage	Supply voltage range
Input Current	1 mA
Max. Leakage Current	400 micro Amps
Cable Length	Max. 250 m (800 ft) without parallel load between B1 and A2 Max. 50 m (160 ft) with load (<3 kΩ) between B1 and A2

Outputs

Contact Type	Relay as changeover switch
Dielectric Coil to Contact Withstand Voltage	5,000 V
Switching Capacity	Voltage: 440V AC
	Current Ith (AC-1): 8 A (5 A for 700-FSQ)
	Power: 2000 VA
	According to IEC 947-5-1:
	3 A/440V AC (inductive load, AC 14)
	3 A/250V AC (inductive load, AC 15)
	1 A/24V DC (inductive load, DC 13)
	According to UL 508:
	1.5 A/250V AC (B300)
	3 A/120V AC (B300)
Short-Circuit Resistance	10 A gL
Life	Mechanical: 30 million operations
	Electrical operations:
	4 Mil. at 1 A/250V AC, cos ϕ = 1
	0.2 Mil. at 6 A/250V AC, cos ϕ = 1
	1.5 Mil. at 1 A/250V AC, cos ϕ = 0.3
	0.3 Mil. at 3 A/250V AC, cos ϕ = 0.3
	0.5 Mil. at 6 A/24V DC, resistive
	2 Mil. at 4 A/24V DC, resistive
	2 Mil. at 0.2 A/230V DC, resistive
	1 Mil. at 0.4 A/24V DC, L/R = 20 ms
	1 Mil. at 0.2 A/110V DC, L/R = 20 ms
	1 Mil. at 0.1 A/230V DC, L/R = 20 ms
State Indicator	1 LED, combination signal

* Performance Data — See page important-2, publication A115.

General Data

Insulation Characteristics	2 kVAC/50 Hz test voltage according to VDE 0435 and 6 kV 1.2/50 µs surge voltage according to IEC 947-1 between all inputs and outputs
EMC/Interference Immunity	Performance of following requirements: Surge capacity of the supply voltage according to IEC 1000-4-5: 4 kV 1.2/50 µs Burst according to IEC 1000-4-4: 6 kV 6/50 ns ESD discharge according to IEC 1000-4-2: Contact 8 kV, air 8 kV Electromagnetic HF field according to IEC 801-3 and conducted electromagnetic HF signal according to IEC 801-6: Level 3
EMC/Emission	Electromagnetic fields according to EN 55 022: class B
Safe Isolation	According to VDE 106, part 101
Climatic Withstand	56 Cycles (24 h) at 25…40 °C and 95% relative humidity according to IEC 68-2-30 and IEC 68-2-3
Vibration Resistance	4 g in 3 axes at 10…500 Hz, test FC according to IEC 68-2-6
Shock Resistance	50 g according to IEC 68-2-27
Protection Class	Enclosure:IP 40 IP 30 (Single-function) Terminal:IP 20 according to IEC 947-1
Weight	100 g
Approval	UL, C-UL
Ambient Temperature	Open: –25…+60 °C Enclosed: –25…+45 °C Storage: –40…+85 °C
Terminals	Screw terminal M3.5 for Number 2 Posidrive, Philips, and slotted screws. Suitable for power screwdriver. Rated tightening torque 8.8 lb.-in. (0.8 N•m, max. 1.2 N•m). Dual-chamber system for terminal cross-sections of 1 x 0.5 mm^2…2 x 2.5 mm^2 (solid) or stranded 2 x 2.5 mm^2 (flexible with sleeve), #20…14 AWG. Finger protection according to VDE 0106.
Mounting	Front mounting; For snap-on mounting on 35 mm DIN Rail or screw fixing by adapter and 2 screws (M4 type)
Disposal	Synthetic material without dioxin according to EC/EFTA notification Number 93/0141/D electrical contacts with cadmium
Certifications	cUL Recognized, File E14840, cULus Listed, File E14840, Guide NKCR, CE Marked (per EU Low Voltage Directive 73/23 EEC 93/68 EEC: per Electromagnetic Compatibility Directive 89/336 EEC 92/31 EEC 93/681 EEC)
Standards	EN 60947-1, EN 60947-5-1, EN 50081-1, IEC 947, UL 508, CSA 22.2

* Performance Data — See page important-2, publication A115.

Bulletin 700-HNC

- Miniature Timer, Perfect for Converting 700-HC "Ice Cube" Relays Into Timing Relay
- 4 Operating Modes
- 4PDT Contact Output
- Timing Range From 0.1 s...10 h
- Socket Mounted

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Approximate Dimensions 9-75

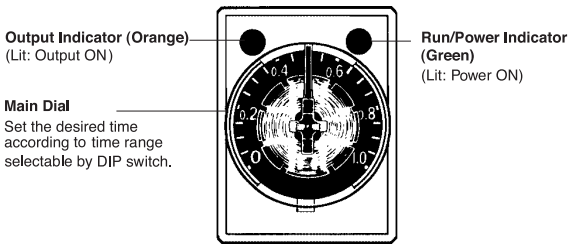
Standards Compliance and Certifications

See Specification Table In This Section.

Bulletin 700-HNC Miniature Timer with Multiple Time Ranges

Model	Timing Mode	Contact Output	Input Voltages	Timing Range	Socket Type	Cat. No.
Cat. No. 700-HNC	On-Delay One Shot Repeat cycle, OFF-start Repeat cycle, ON-start	4PDT	12V DC	.1 s...10 min.	700-HN103 700-HN128	700-HNC44AZ12
				.1 min...10 h		700-HNC44BZ12
			24V DC	.1 s...10 min.		700-HNC44AZ24
				.1 min...10 h		700-HNC44BZ24
			48V DC	.1 s...10 min.		700-HNC44AZ48
				.1 min....10 h		700-HNC44BZ48
			100...110V DC	.1 s...10 min.		700-HNC44AZ11
				.1 min....10 h		700-HNC44BZ11
			125V DC	.1 s...10 min.		700-HNC44AZ25
				.1 min....10 h		700-HNC44BZ25
			24V AC	.1 s...10 min.		700-HNC44AA24
				.1 min....10 h		700-HNC44BA24
			100...120V AC	.1 s...10 min.		700-HNC44AA12
				.1 min....10 h		700-HNC44BA12
			200...230V AC	.1 s...10 min.		700-HNC44AA23
				.1 min....10 h		700-HNC44BA23

General Timer Functions



Accessories

	Description	Pkg. Quantity	Cat. No.
Cat. No. 700-HN103	**Screw Terminal Socket — Panel or DIN Rail Mounting. Guarded Terminal Construction** 14-Blade miniature socket for use with Bulletin 700-HNC timers.	10	700-HN103
Cat. No. 700-HN128	**Screw Terminal Base Sockets — Panel or DIN Rail Mounting. Open Style Construction** 14-blade miniature socket for use with Bulletin 700-HNC timers. Order must be for 10 sockets or multiples of 10.	10	700-HN128

	Description	Pkg. Quantity	Cat. No.
Cat. No. 700-HN104	**Screw Terminal Socket – Panel or DIN Rail Mounting. Guarded Terminal Construction** 14-blade miniature socket for use with Bulletin 700-HNC timers. This socket has coil and contact separation. Orders must be for ten or multiples of ten	10	700-HN104
Cat. No. 700-HN163	Retainer Clip for Cat. Nos. 700-HN103, -HN104 and -HN128 Sockets with Bulletin 700-HNC Timers. Secures Timer in Socket. Orders must be for ten clips or multiples of ten	10	700-HN163

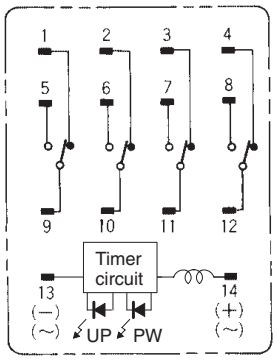
Ratings				
Item		700-HNC		
Pilot Duty Rating		NEMA B300		
Pin type		Plug-in		
Operating voltage range		85%…110% of rated supply voltage (12V DC: 90%…110% of rated supply voltage)†		
Reset voltage		10% min. of rated supply voltage‡		
Power consumption		24V AC:	Relay ON: Relay OFF:	1.5 VA (1.1 W) (at 24V AC, 60 Hz) 0.2 VA (0.1 W) (at 24V AC, 60 Hz)
		100…120V AC:	Relay ON: Relay OFF:	1.5 VA (1.3 W) (at 120V AC, 60 Hz) 0.8 VA (0.5 W) (at 120V AC, 60 Hz)
		200…230V AC:	Relay ON: Relay OFF:	1.8 VA (1.5 W) (at 230V AC, 60 Hz) 1.2 VA (0.9 W) (at 230V AC, 60 Hz)
		12V DC:	Relay ON: Relay OFF:	0.9 W (at 12V DC) 0.07 W (at 12V DC)
		24V DC:	Relay ON: Relay OFF:	0.9 W (at 24V DC) 0.07 W (at 24V DC)
		48V DC:	Relay ON: Relay OFF:	1.0 W (at 48V DC) 0.2 W (at 48V DC)
		100…110V DC:	Relay ON: Relay OFF:	1.3 W (at 110V DC) 0.3 W (at 110V DC)
		125V DC:	Relay ON: Relay OFF:	1.3 W (at 125V DC) 0.3 W (at 125V DC)
Control outputs		4PDT: 5 A at 250V AC, resistive load ($\cos\phi$ = 1)		
Characteristics				
►][◄ Make	120V AC	30 A		
	240V AC	15 A		
◄][► Break	120V AC	3 A		
	240V AC	1.5 A		
Hp at 120V AC		1/6 Hp		
Hp at 240V AC		1/6 Hp		
Accuracy of operating time		±1% FS max. (1 s range: ±1%±10 ms max.)		
Setting error		±10%±50 ms FS max.		
Reset time		Min. power-opening time: 0.1 s max. (including halfway reset)		
Influence of voltage		±2% FS max.		
Influence of temperature		±2% FS max.		
Insulation resistance		100 mΩ min. (at 500V DC)		
Dielectric strength		2,000V AC, 50/60 Hz for 1 min. (between current-carrying terminals and exposed non-current-carrying metal parts)*		
		2,000V AC, 50/60 Hz for 1 min. (between operating power circuit and control output)		
		2,000V AC, 50/60 Hz for 1 min. (between different pole contacts; 2-pole model)		
		1,500V AC, 50/60 Hz for 1 min. (between different pole contacts; 4-pole model)		
		1,000V AC, 50/60 Hz for 1 min. (between non-continuous contacts)		
Vibration resistance		Malfunction:10…55 Hz, 0.5 mm single amplitude		
Shock resistance		Malfunction:100 m/s² (approx. 10G)		
Ambient temperature		Operating:-10 °C…50 °C (with no icing)		
		Storage:-25 °C…65 °C (with no icing)		
Ambient humidity		Operating:35%…85%		
Life expectancy		Mechanical:10,000,000 operations min. (under no load at 1,800 operations/h)		
		Electrical:4PDT: 200,000 operations min. (3 A at 250V AC, resistive load at 1,800 operations/h)		

* Single-phase, full-wave-rectified power supplies can be used.
† When using the 700-HNC continuously in any place where the ambient temperature is in a range of 45 °C…50 °C, supply 90%…110% of the rated supply voltages supply 95%…110% with 12V DC type).
‡ Set the reset voltage as follows to ensure proper resetting.
100…120V AC:10V AC max.
200…230V AC:20V AC max.
100…110V DC:10V DC max.

Characteristics, Continued	
Noise immunity	±1.5 kV, square-wave noise by noise simulator (pulse width: 100 ns/1 µs, 1-ns rise)
Static immunity	Destruction:8 kV Malfunction:4 kV
Enclosure rating	IP40
Weight	Approx. 50 g
EMC	Emission Enclosure:EN55011 Group 1 class A
	Emission AC Mains:EN55011 Group 1 class A
	Immunity ESD:EN61000-4-2:4 kV contact discharge (level 2) 8 kV air discharge (level 3)
	Immunity RF-interference:ENV50140:10 V/m (amplitude modulated, 80 MHz to 1 GHz) (level 3) 10 V/m (pulse modulated, 900 MHz)
	Immunity Conducted Disturbance:ENV50141:10 V (0.15…80 MHz) (level 3)
	Immunity Burst:EN61000-4-4:2 kV power-line (level 3) 2 kV I/O signal-line (level 4)
Standards	UL508, CSA 22.2 No. 14
	Conforms to VDE0435/P2021, VDE0110 (for in-panel use)
	Conforms to EN50081-2, EN50082-2

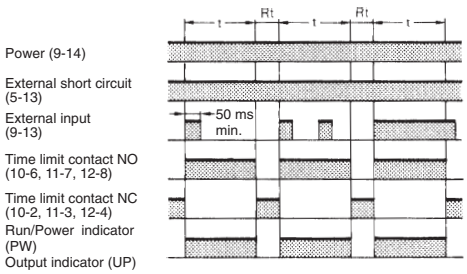
Note:t:Set time
Rt:Reset time

Operating Mode	Timing Charts / Wiring Diagram
ON-Delay Power t Output	Power (13-14) Time limit contact NC (9-1, 10-2, 11-3, 12-4) Time limit contact NO (9-5, 10-6, 11-7, 12-8) Run/Power indicator (PW) Output indicator (UP)
One Shot Power t Output	Power (13-14) Time limit contact NC (9-1, 10-2, 11-3, 12-4) Time limit contact NO (9-5, 10-6, 11-7, 12-8) Run/Power indicator (PW) Output indicator (UP)
Repeat Cycle OFF-Star t Power Output	Power (13-14) Time limit contact NC (9-1, 10-2, 11-3, 12-4) Time limit contact NO (9-5, 10-6, 11-7, 12-8) Run/Power indicator (PW) Output indicator (UP)
Repeat Cycle ON-Start Power Output	Power (13-14) Time limit contact NC (9-1, 10-2, 11-3, 12-4) Time limit contact NO (9-5, 10-6, 11-7, 12-8) Run/Power indicator (PW) Output indicator (UP)

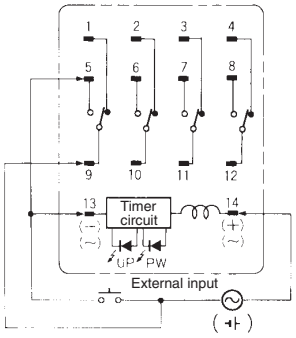


Pulse Operation

A pulse output for a certain period can be obtained with a random external input signal. Use the 700-HNC timing relay in interval mode as shown in the following timing charts.



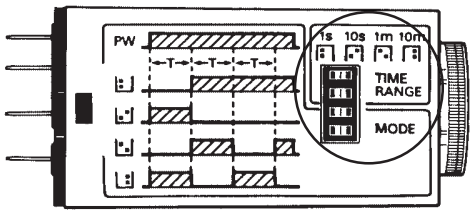
Note: t: Set time
Rt: Reset time



Time Ranges

Cat. No.	Time Range	Time Setting Range	Setting	Factory-Set
700-HNC44AZ12 700-HNC44AZ24 700-HNC44AZ48 700-HNC44AZ11 700-HNC44AZ25 700-HNC44AA24 700-HNC44AA12 700-HNC44AA23	1 s	0.1 s...1 s		Yes
	10 s	1 s...10 s		No
	1 min.	0.1 s...1 min.		No
	10 min.	1 min....10 min.		No
700-HNC44BZ12 700-HNC44BZ24 700-HNC44BZ48 700-HNC44BZ11 700-HNC44BZ25 700-HNC44BA24 700-HNC44BA12 700-HNC44BA23	1 min.	0.1 min....1 min.		Yes
	10 min.	1 min....10 min.		No
	1 h	0.1 h...1 h		No
	1 0 h	1 h...10 h		No

Note: The top two DIP switch pins are used to select the time ranges.



Operating Modes

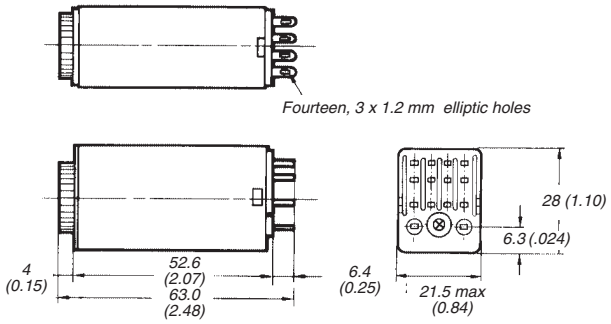
Operating Mode	Setting	Factory-set
ON-delay		Yes
One Shot		No
Repeat Cycle OFF-start		No
Repeat Cycle ON-start		No

Note: The bottom two DIP switch pins are used to select the time ranges.

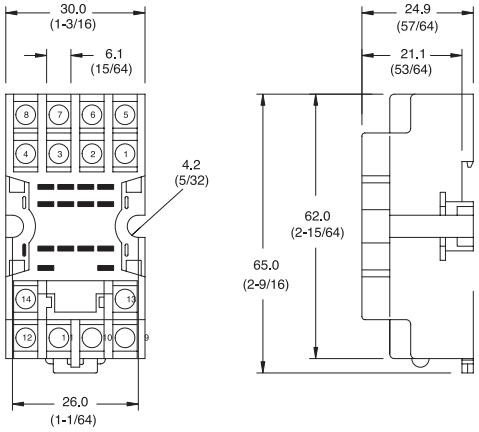
Approximate Dimensions are shown in millimeters (inches) where not specified. Approximate Dimensions are not intended to be used for manufacturing purposes.

Timers

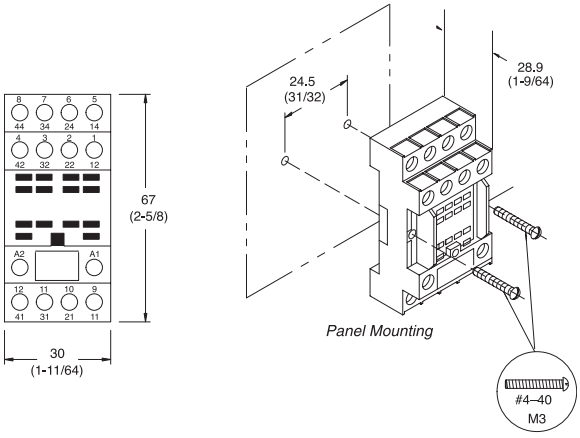
Front Mounting



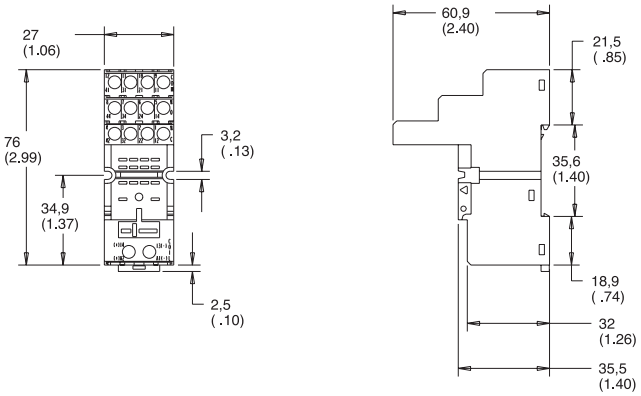
Approximate Dimensions for cat. no. 700-HNC



Cat. No. 700-HN128∗
Wire Size: 2 x 1.5 mm² (#2-16 AWG…#1-20 AWG)
(Either Solid or Stranded)
Strip Length: 9 mm (3/8 in) - Torque: 0.8 N . m (7 lb•in)



Cat. No. 700-HN103
Single wire: 0.2mm²…2.5mm² (#24 AWG…14 AWG)
Double wire: 2 x 0.2mm²…2 x 1.5mm² (2 x 24 AWG…2 x 16 AWG)
Wire type: solid or stranded, copper only
Strip length: 8 mm (5/16 in), Torque: 0.5 Nm (4.4 lb•in)



Cat. No. HN-104
Single Wire: 0.2 mm²…2.5 mm² (#24 AWG…14 AWG)
Double Wire: 2 x 0.2 mm²…2 x2.5 mm² (2 x 24 AWG…2 x 14 AWG)
Wire Type: solid or stranded, copper only
Strip Length: 7 mm (9/32 in), Torque: 0.5 Nm (4.4 lb•in)

∗ Total height of 700-HN128 + 700-HNC is 82.5 mm.

Bulletin 700-HNK

- The Ultra-Slim Timing Relay is The Smallest Relay Available
- It is Perfect for Converting 700-HK Relays Into a Timing Relay
- SPDT and DPST-NO Contact Output
- Socket Mounted
- Timing Range From 0.1 s...10 h

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Standards Compliance and Certifications

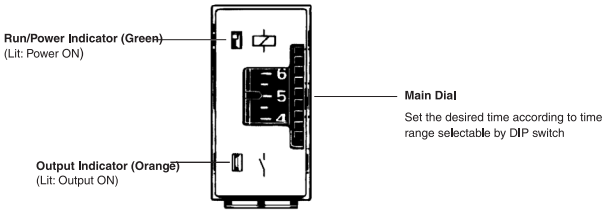
See Specification Table In This Section.

Bulletin 700-HNK Miniature Timer with Multiple Time Ranges

	Timing Mode	Socket Type	Contact Output	Timing Range	Input Voltage	Cat. No.
Cat. No. 700-HNK SPDT, DPST-NO	On-Delay One Shot Repeat Cycle, OFF-start Repeat Cycle, ON-start	700-HN121	SPDT✶	0.1 s...10 min.	12V DC	700-HNK41AZ12
					24V DC	700-HNK41AZ24
					24V AC	700-HNK41AA24
				0.1 min...10 h	12V DC	700-HNK41BZ12
					24V DC	700-HNK41BZ24
					24V AC	700-HNK41BA24
		700-HN122	DPST-NO†	0.1 s...10 min.	12V DC	700-HNK42AZ12
					24V DC	700-HNK42AZ24
					24V AC	700-HNK42AA24
				0.1 min...10 h	12V DC	700-HNK42BZ12
					24V DC	700-HNK42BZ24
					24V AC	700-HNK42BA24

✶ 5-blade terminal type only.
† 8-blade terminal type only.

General Timer Functions



Accessories

	Description	Pkg. Quantity	Cat. No.
Cat. No. 700-HN121	**Screw Terminal Socket — Panel or DIN Rail Mounting** 5-blade miniatue socket. For use with 1-pole type 700-HNK41 timers. Socket includes a retainer clip. Order must be in multiples of ten	10	700-HN121
Cat. No. 700-HN122	**Screw Terminal Socket — Panel or DIN Rail Mounting** 8-blade miniature socket for use with 2-pole, Bulletin 700-HNK42 timers. This socket includes a retainer clip. Order must be for 10 sockets or multiples of 10.	10	700-HN122

Timing Relay, Socket, Retainer Clip Reference Chart

Timer Type	Socket Cat. No.	Retainer Clip Cat. No.
700-HNK	700-HN121	Provided
	700-HN122	Provided

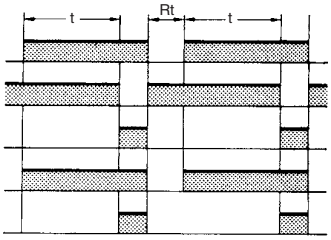
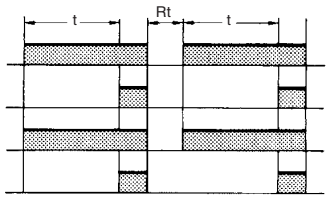
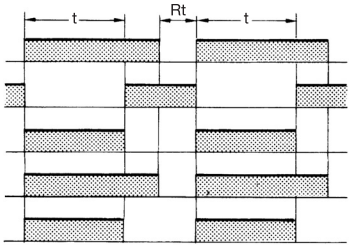
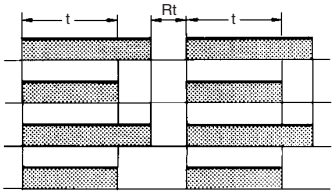
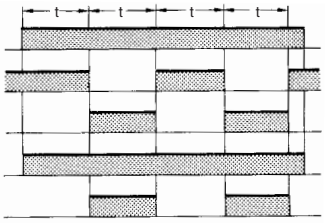
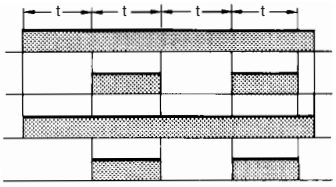
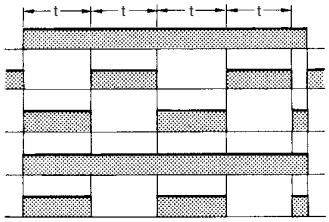
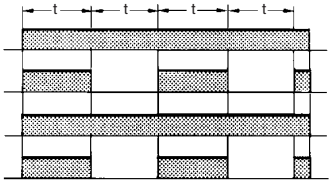
Ratings			
Item			
Pilot Duty Rating		NEMA B300	
Rated supply voltage		24V AC; 12, 24V DC	
Pin type		Plug-in	
Operating mode		ON-delay, One Shot, Repeat Cycle OFF start, or Repeat Cycle ON start selectable with DIP switch.	
Operating voltage range		85%…110% of rated supply voltage (12 VDC: 90%…110% of rated supply voltage)*	
Power consumption		24V AC:Relay ON:approx. 0.8 VA (at 24 VAC, 60 Hz) Relay OFF:0.5 VA (at 24V AC, 60 Hz) 12V DC:Relay ON:approx. 0.4 W (at 12V DC) Relay OFF:0.1 W (at 12V DC) 24V DC:Relay ON:approx. 0.5 W (at 24V DC) Relay OFF:0.2 W (at 24V DC)	
Control outputs		5 A at 250V AC, resistive load (cosϕ = 1) The minimum applicable load is 10 mA at 5 VDC (P reference value).	
Characteristics			
►][◄ Make	120V AC	30 A	
	240V AC	15 A	
◄][► Break	120V AC	3 A	
	240V AC	1.5 A	
Hp at 240V AC		1/6 Hp	
Accuracy of operating time		±1% FS max. (1 s range: +1%±10 ms max.)	
Setting error		±15%+50 ms FS max.	
Reset time		Min. power-opening time:	12, 24V DC: 0.1 s max. (including halfway reset) 24V AC: 0.5 s max. (including halfway reset)
Influence of voltage		±2% FS max.	
Influence of temperature		±2% FS max.	
Insulation resistance		100 mΩ min. (at 500V DC)	
Dielectric strength		2,000V AC, 50/60 Hz for 1 min. (between operating circuit and control output, or contacts of different poles) 1,000V AC, 50/60 Hz for 1 min. (between non-continuous contacts)	
Vibration resistance		Malfunction:10…55 Hz, 0.5 mm single amplitude	
Shock resistance		Malfunction:100 m/s² (approx. 10G)	
Ambient temperature		Operating:-10 °C…50 °C (with no icing) Storage:-25 °C…65 °C (with no icing)	
Ambient humidity		Operating:35%…85%	
Life expectancy		Mechanical:10,000,000 operations min. (under no load at 1,800 operations/h) Electrical:100,000 operations min. (3 A at 250V AC, resistive load at 1,800 operations/h)	
Impulse withstand voltage		Between power terminals: 1 kV	
Noise immunity		±1.5 kV, square-wave noise by noise simulator (pulse width: 100 ns/1 µs, 1-ns rise)	
Static immunity		Destruction:8 kV Malfunction:4 kV	
Enclosure rating		IP20	
Weight		Approx. 18 g	
EMC		Emission Enclosure:EN55011 Group 1 class A Emission AC Mains:EN55011 Group 1 class A Immunity ESD:EN61000-4-2:4 kV contact discharge (level 2) 8 kV air discharge (level 3) Immunity RF-interference:ENV50140:10 V/m (amplitude modulated, 80 MHz…1GHz) (level 3) 10 V/m (pulse modulated, 900 MHz) Immunity Conducted Disturbance:ENV50141:10 V (0.15…80 MHz) (level 3) Immunity Burst:EN61000-4-4:2 kV power-line (level 3) 2 kV I/O signal-line (level 4)	
Approved standards		UL508, CSA 22.2 No. 14 Conforms to VDE 0435/P2021 (for built-in use) Conforms to EN50081-2, EN50082-2, ACA, CE-certified	

* When using 700-HNK timer in any place where the ambient temperature is more than 50 °C, supply 90 %…110 % of the rated voltages (12V DC: 95 %…110 % of the rated voltage).

Plug-in Timing Relays

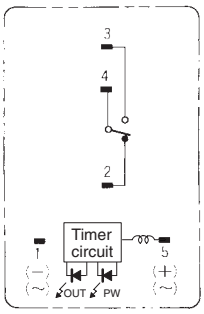
Timing Charts

Note: t: Set time
Rt: Reset time

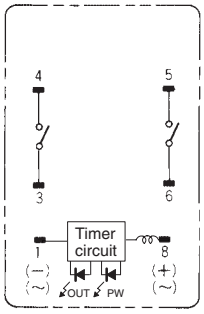
Operating Mode	Timing Chart	
	700-HNK41…	700-HNK42…
ON-Delay Power t Output	Power (1-5) Time limit contact NC (4-2) Time limit contact NO (4-3) Run/Power Indicator (PW) Output Indicator (OUT) 	Power (1-8) Time limit contact NO 4-3, 5-6 Run/Power indicator (PW) Output indicator (OUT) 
One shot Power t Output	Power (1-5) Time limit contact NC (4-2) Time limit contact NO (4-3) Run/Power indicator (PW) Output indicator (OUT) 	Power (1-8) Time limit contact NO (4-3, 5-6) Run/Power indicator (PW) Output indicator (OUT) 
Repeat Cycle OFF-Start Power t t t Output	Power (1-5) Time limit contact NC (4-3) Time limit contact NO (4-3) Run/Power indicator (PW) Output indicator (OUT) 	Power (1-8) Time limit contact NO (4-3, 5-6) Run/Power indicator (PW) Output indicator (OUT) 
Repeat Cycle ON-Start Power t t t Output	Power (1-5) Time limit contact NC (4-2) Time limit contact NO (4-3) Run/Power indicator (PW) Output indicator (OUT) 	Power (1-8) Time limit contact NO (4-3, 5-6) Run/Power indicator (PW) Output indicator (OUT) 

Wiring Diagrams

Cat. No. 700-HNK41...

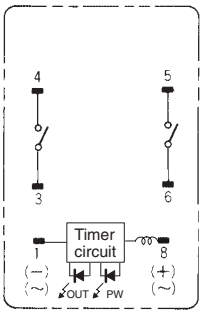


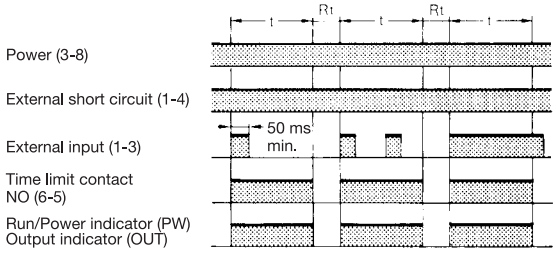
Cat. No. 700-HNK42...



A pulse output for a certain period can be obtained with a random external input signal. Use the 700-HNK in interval mode as shown in the following timing chart.

Cat. No. 700-HNK42...





Note: t: Set time
Rt: Reset time

Mode	Terminals
Pulse Operation	Power supply between 3 and 8 Short-circuit between 4 and 1 Input signal between 3 and 1
Operating mode; One shot and all other modes	Power supply between 1 and 8

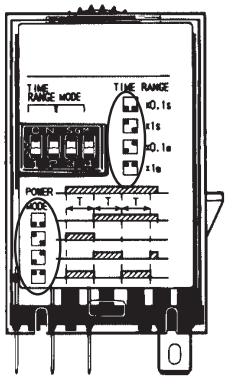
Plug-in Timing Relays

DIP Switch Settings

Time Ranges

Cat. No.	Time Range	Time Setting Range	Setting	Factory-Set
700-HNK41AZ12 700-HNK41AZ24 700-HNK41AA24 700-HNK42AZ12 700-HNK42AZ24 700-HNK42AA24	1 s	0.1 s...1 s		Yes
	10 s	1 s...10 s		No
	1 min.	0.1 s...1 min.		No
	10 min.	1 min...10 min.		No
700-HNK41BZ12 700-HNK41BZ24 700-HNK41BA24 700-HNK42BZ12 700-HNK42BZ24 700-HNK42BA24	1 min.	0.1 min...1 min.		Yes
	10 min.	1 min...10 min.		No
	1 h	0.1 h...1 h		No
	10 h	1 h...10 h		No

Note: The left two DIP switch pins are used to select the time ranges.

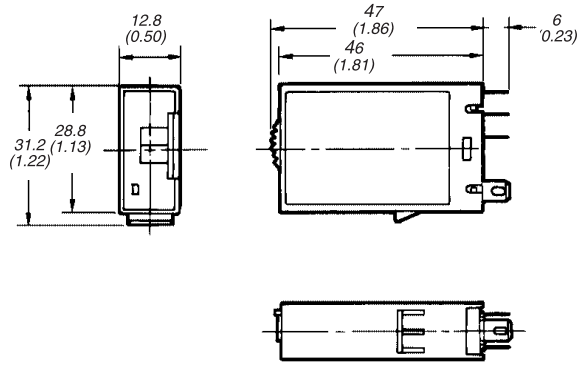


Operating Modes

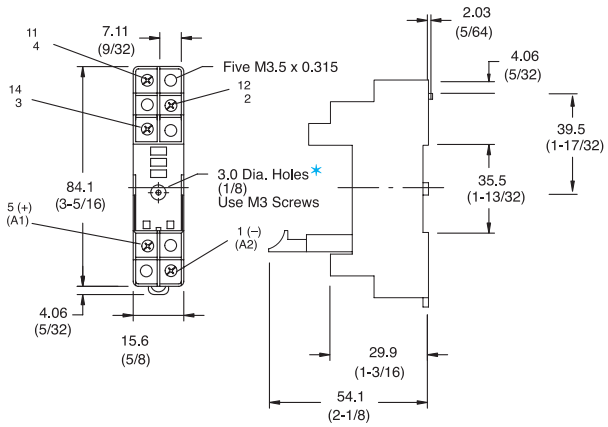
Operating Mode	Setting	Factory-set
On-delay		Yes
One Shot		No
Repeat Cycle Off-start		No
Repeat Cycle On-start		No

Note: The right two DIP switch pins are used to select the operating modes.

Approximate Dimensions are shown in millimeters (inches). Approximate Dimensions are not intended to be used for manufacturing purposes.

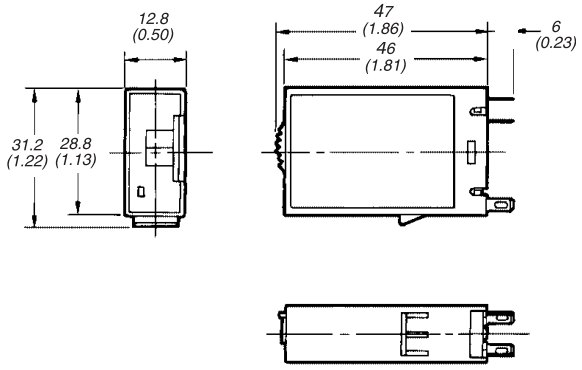


Bulletin 700-HNK41 SPDT Contact
Approximate Dimensions

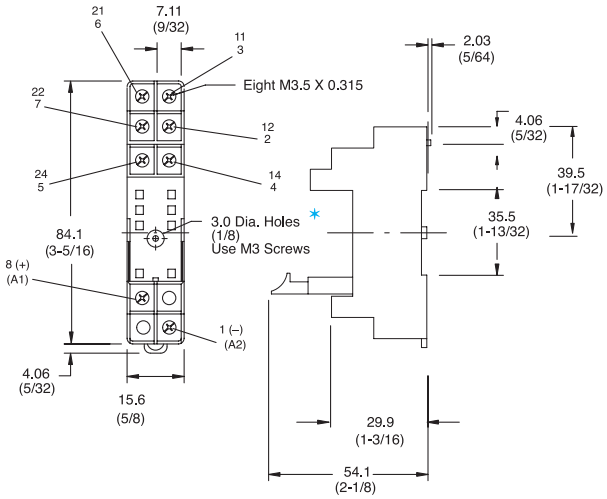


Cat No. 700-HN121
Wire Size: 2 x 2.5 mm²
Single Wire – Up to #12 AWG
Double Wire – 2 x 2.5 mm² (#2–14 AWG... #2–20 AWG)
(Either Solid or Stranded)
Strip Length: 9 mm (3/8 in) – Torque: 0.8 N•m (7 lb•in)
Total height: 700-HN121 + 700-HNK41 is 78.0 mm.

* Holes required for mounting [3 mm (1/8 in) diameter].



Bulletin 700-HNK42 DPST-NO Contact
Approximate Dimensions



Cat No. 700-HN122
Wire Size: 2 x 2.5 mm²
Single Wire – Up to #12 AWG
Double Wire – 2 x 2.5 mm² (#2–14 AWG... #2–20 AWG)
(Either Solid or Stranded)
Strip Length: 9 mm (3/8 in) – Torque: 0.8 N•m (7 lb•in)
Total height: 700-HN122 + 700-HNK42 is 78.0 mm.

* Holes required for mounting [3 mm (1/8 in) diameter].

Plug-in Timing Relays

Overview/Product Selection

Bulletin 700-HR

- Dial Timing Relays
- Socket or Panel Mounted
- 5 A Contact Ratings or Transistor Outputs
- Single Function or Multi-Function
- Timing Range From 0.05 s...300 h
- Multi-voltage Inputs

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See Specification Table In This Section.

Bulletin 700 Multi-Function, Multi-Range Dial Timing Relays with Pin Style Terminations

	Operating Mode	Timing Range	Socket Type	No. of Pins	Input Voltage	Contact Output	Cat. No.
Multifunction Timer *Cat. No. 700-HR, -HRP, -HRS, -HRT, -HRV*	A,D,E, B,B2,C	0.05 s....300 h	700-HN101 700-HN126 700-HN129	11	24...48V AC 12...48V DC	DPDT	700-HR52TU24
							700-HRV52TU24∗
						Transistor	700-HRT6TTU24†
					100...240V AC 100...125V DC	DPDT	700-HR52TA17†
							700-HRV52TA17∗
	A, E, B2, J		700-HN100 700-HN125 700-HN108	8	24...48V AC 12...48V DC	DPDT	700-HRS42TU24
						Transistor	700-HRT4TTU24∗
					24...48V AC/DC	SPDT Timed + Instantaneous Contact	700-HRP42TU24∗
					100...240V AC 100...125V DC	SPDT Timed + Instantaneous Contact	700-HRP42TA17
						DPDT	700-HRS42TA17
On-Delay Timer *Cat. No. 700-HRM, -HRC*	A	0.05 s....300 h	700-HN100 700-HN125 700-HN108	8	24...48V AC/DC	SPDT Timed +Instantaneous Contact	700-HRC12TU24
					24...48V AC 12...48V DC	DPDT	700-HRM12TU24
					100...240V AC	DPDT	700-HRM12TA17
						SPDT Timed + Instantaneous Contact	700-HRC12TA17

∗ Voltage Input: Connection to high signal instead of OV signal.
† Compatible with connections to 3-wire sensors.

Operating mode description

A	D	E	B	B2	C	J
ON-delay	OFF-delay	One Shot	Repeat Cycle OFF-start	Repeat Cycle ON- start	Signal ON/OFF-delay	One Shot

	Operating Mode	Timing Range	Socket Type	No. of Pins	Input Voltage	Contact Output	Cat. No.
Twin Timer	B	0.05 s...30 h	700-HN100 700-HN125 700-HN108	8	12V DC	DPDT	700-HRF72DZ12
		0.05 s...30 h	700-HN100 700-HN125 700-HN108	8	24V AC/DC	DPDT	700-HRF72DU25
		0.05 s...30 h	700-HN100 700-HN125 700-HN108	8	48...125V DC	DPDT	700-HRF72DZ45
		0.05 s...30 h	700-HN100 700-HN125 700-HN108	8	100...240V AC	DPDT	700-HRF72DA18
	B2	0.05 s...30 h	700-HN100 700-HN125 700-HN108	8	12V DC	DPDT	700-HRF82DZ12
		0.05 s...30 h	700-HN100 700-HN125 700-HN108	8	24V AC/DC	DPDT	700-HRF82DU25
		0.05 s...30 h	700-HN100 700-HN125 700-HN108	8	48...125V DC	DPDT	700-HRF82DZ45
Cat. No. 700-HRF...		0.05 s...30 h	700-HN100 700-HN125 700-HN108	8	100...240V AC	DPDT	700-HRF82DA18
Star-Delta Timer	Star-Delta	0.5 s...120 s	700-HN100 700-HN125 700-HN108	8	100...120V AC	SPDT Timed + Instantaneous Contact	700-HRYY6FA12
Cat. No. 700-HRY...					200...240V AC		700-HRYY6FA22

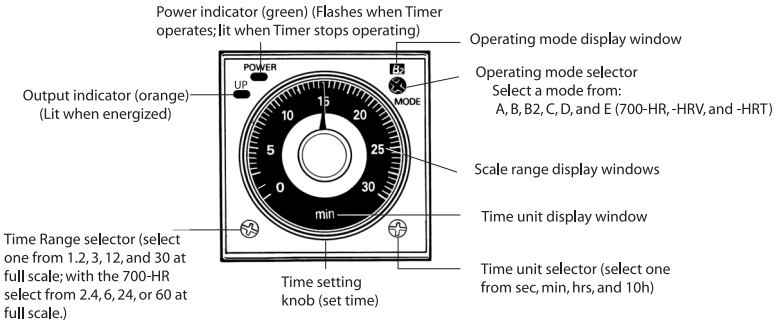
Plug-in Timing Relays

Product Selection, Continued

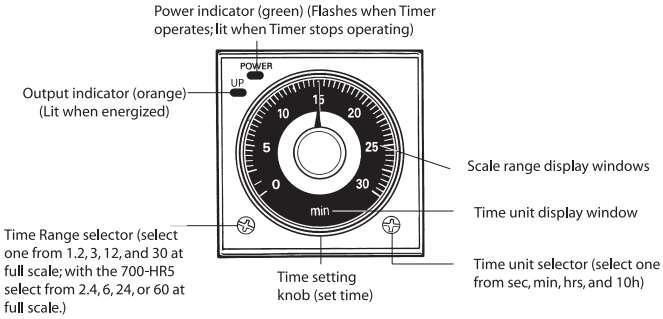
	Operating Mode	Timing Range	Socket Type	No. of Pins	Input Voltage	Contact Output	Cat. No.
True Off-Delay Timer	True Off-Delay	0.05 s…12 s	700-HN100 700-HN125 700-HN108	8	100…120V AC	DPDT	700-HRQN2GA12
					200…240V AC	DPDT	700-HRQN2GA22
			700-HN101 700-HN126 700-HN129	11	100…120V AC	DPDT	700-HRQR2GA12✶
					200…240V AC	DPDT	700-HRQR2GA22✶
		0.05 min…12 min.	700-HN100 700-HN125 700-HN108	8	100…120V AC	DPDT	700-HRQN2HA12
					200…240V AC	DPDT	700-HRQN2HA22
			700-HN101 700-HN126 700-HN129	11	100…120V AC	DPDT	700-HRQR2HA12✶
					200…240V AC	DPDT	700-HRQR2HA22✶
		0.05 s…12 s	700-HN100 700-HN125 700-HN108	8	24V AC/DC	DPDT	700-HRQN2GU25
			700-HN101 700-HN126 700-HN129	11	24V AC/DC	DPDT	700-HRQR2GU25✶
	True Off-Delay	0.05 min…12 min.	700-HN100 700-HN125 700-HN108	8	24V AC/DC	DPDT	700-HRQN2HU25
			700-HN101 700-HN126 700-HN129	11	24V AC/DC	DPDT	700-HRQR2HU25✶
		0.05 s…12 s	700-HN100 700-HN125 700-HN108	8	48V DC	DPDT	700-HRQN2GZ48
			700-HN101 700-HN126 700-HN129	11	48V DC	DPDT	700-HRQR2GZ48✶
		0.05 min…12 min.	700-HN100 700-HN125 700-HN108	8	48V DC	DPDT	700-HRQN2HZ48
			700-HN101 700-HN126 700-HN129	11	48V DC	DPDT	700-HRQR2HZ48✶
		0.05 s…12 s	700-HN100 700-HN125 700-HN108	8	100…125V DC	DPDT	700-HRQN2GZ11
			700-HN101 700-HN126 700-HN129	11	100…125V DC	DPDT	700-HRQR2GZ11✶
		0.05 min…12 min.	700-HN100 700-HN125 700-HN108	8	100…125V DC	DPDT	700-HRQN2HZ11
Cat. No. 700-HRQ…			700-HN101 700-HN126 700-HN129	11	100…125V DC	DPDT	700-HRQRHZ11✶

✶ Indicates True Off-Delay timer with reset

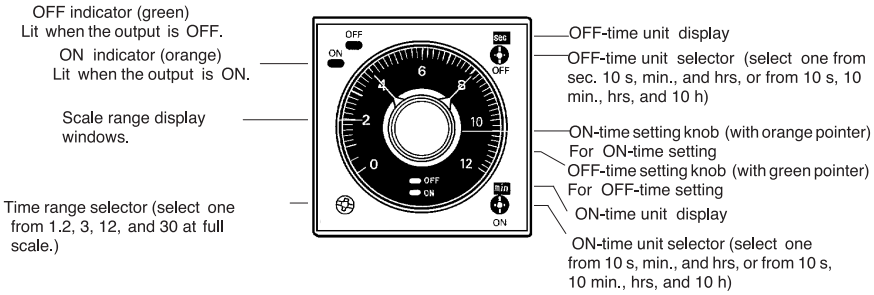
700-HR Multifunction Timer



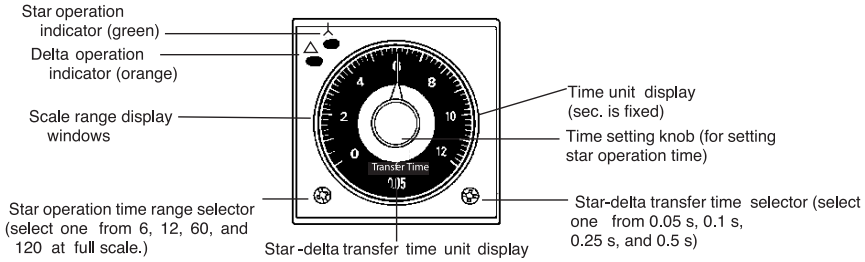
700-HRC -HRM On-Delay Timer



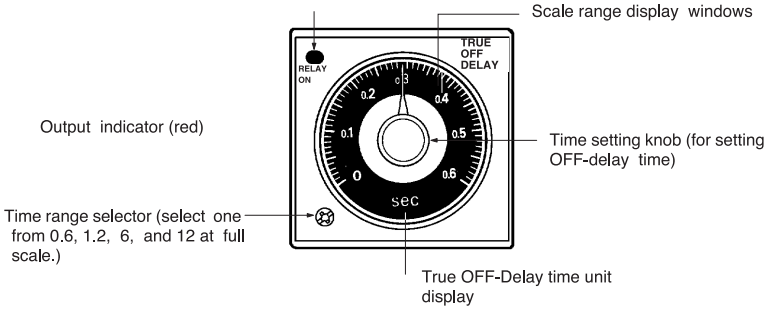
700-HRF Twin Timer



700-HRY Star-Delta Timer



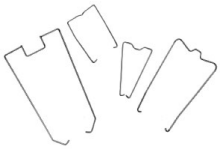
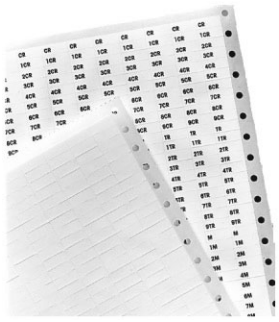
700-HRQ True Off-Delay Timer



Plug-in Timing Relays

Accessories

	Description	Pkg. Qty.	Cat. No.
Cat. No. 700-HN100	**Screw Terminal Tube Base Socket — Panel or DIN Rail Mounting; Guarded Terminal Construction.** 8-Pin for use with Bulletin 700-HR and -HX timing relays. Order ten or multiples of ten	10	700-HN100
Cat. No. 700-HN125	**Screw Terminal Tube Base Socket — Panel or DIN Rail Mounting; Open Style Construction.** 8-Pin for use with Bulletin 700-HR and -HX timing relays. Order must be for 10 sockets or multiples of 10. No retainer clip required.	10	700-HN125
Cat. No. 700-HN101	**Screw Terminal Tube Base Sockets — Panel or DIN Rail Mounting. Guarded Terminal Construction** 11-pin for use with 3PDT Bulletin 700-HA relays, -HR and -HT (Off-Delay) timing relays. Order must be for 10 sockets or multiples of 10.	10	700-HN101
Cat. No. 700-HN126	**Screw Terminal Tube Base Sockets — Panel or DIN Rail Mounting. Open Style Terminal Construction** 11-pin for use with 3PDT Bulletin 700-HA relays, -HR and -HT (Off-Delay) timing relays. Order must be for 10 sockets or multiples of 10.	10	700-HN126
Cat. No. 199-DR1	**DIN (#3) Symmetrical Rail** 35 mm x 7.5 mm x 1 m long Zinc-plated, yellow chromated	10	199-DR1
Cat. No. 700-HN108	**Specialty Socket** 8-pin backwired socket with solder terminals for use with 700-HR timing relays. Order ten or multiples of ten	10	700-HN108
Cat. No. 700-HN129	**Specialty Socket** 11-pin backwired socket with solder terminals for use with Bulletin 700-HR timing relays. Order must be for 10 sockets or multiples of 10.	10	700-HN129

	Description	Pkg. Qty.	Cat. No.
Cat. No. 700-HN130	**Frame Adapter** For flush or door mounting of all Bulletin 700-HR timers.	1	700-HN130
 *Sample Retainer Clips*	**Retainer Clip for Cat. Nos. 700-HN100 and -HN101 Sockets with all 700-HR Timing Relays** Secures timer in socket. Order must be for 10 clips or multiples of 10. Note: Not required for installation	10	700-HN131
Cat. No. 700-HN122	**Protective Cover** Helps prevent tampering of timing and mode settings. Provides a degree of protection against water and dirt from entering the front of the relay. For use with all Bulletin 700-HRs and -HX timing relays.	1	700-HN132
	**Pre-printed identification tags —** contains 10 sheets of pre-printed and blank tags. Each sheet contains 13 sets of the markings CR…9CR, TR…9TR, M…9M, F, R, 1S, and 117 blank tags. Tags are peel-off with sticky backing for easy placement on relays.	10	700-N40
	Blank identification tags — contains 10 sheets of blank identification tags for customer specialized printing. Each sheet contains 546 blank tags. Tags are peel-off with sticky backing for easy placement on relays.	10	700-N41

Bulletin 700-HR Multi-function, Multi-Range Dial Timing Relay, Socket, Retainer Clip Reference Chart

Timer Type	Socket Cat. No.	Retainer Clip Cat. No.
700-HR, HRQR2, HRV HRT6	700-HN101†	700-HN131
	700-HN126†	Not Required*
	700-HN129†	Not Applicable
700-HRC/HRF/HR5, HRT4, HRM, HRP	700-HN100‡	700-HN131(See note above)
	700-HN108‡	Not Applicable
	700-HN125‡	Not Required*

* Design of these sockets holds the timing relays securely and does not require retainer clips.
† 11 pins.
‡ 8 pins.

Plug-in Timing Relays

Specification

		700-HR, -HRS, -HRV	700-HRP	700-HRC	700-HRM	700-HRF	700-HRY	700-HRQ	700-HRT (Transistor Outputs)
Electrical Ratings									
Pilot Duty Rating		NEMA B300							—
Thermal Current (I_{th})		5 A							100 mA
►][◄	120V AC	30 A							—
Make	240V AC	15 A							—
◄][►	120V AC	3 A							—
Break	240V AC	1.5 A							—
Hp at 120V		1/6 Hp	1/4 Hp		1/6 Hp		1/4 Hp	1/6 Hp	—
Hp at 240V		1/3 Hp							—
Accuracy of operating time		±0.2 % FS max. (±0.2 %±10 ms max. in a range of 1.2 s)							
Setting error		±5 % FS ±50 ms (The value is ±5 % FS +100 ms to -0 ms max. when the C, D, or G mode signal of the 700-HRVs are OFF.)							
Reset time		Min. power-opening time: 0.1 s max. Min. pulse width: 0.05 s (cat nos. 700-HR52TA17, 700-HR52TU24, 700-HRT6TTU24)							
Reset voltage		10 % max. of rated voltage							
Influence of voltage		±0.2 % FS max. (±0.2 %±10 ms max. in a range of 1.2 s)							
Permissible leakage current to switch a gate, signal or reset		10 µA max. (3 wire solid-state)							
Influence of temperature		±1 % FS max. (±1 %±10 ms max. in a range of 1.2 s)							
Design Specifications									
Dielectric strength		2,000V AC (1,000V AC for 700-HRT), 50/60 Hz for 1 min. (contact to frame) 2,000V AC (1,000V AC for 700-HRT), 50/60 Hz for 1 min. (between control output terminals and operating circuit) 2,000V AC, 50/60 Hz for 1 min. (pole-to-pole) 1,000V AC, 50/60 Hz for 1 min. (between contacts not located next to each other) 2,000V AC, 50/60 Hz for 1 min. (contact to coil)							
Mechanical									
Vibration resistance		Malfunction: 10…55 Hz with 0.5 mm double amplitude each in three directions for ten minutes each							
Shock resistance		Malfunction: 100 m/s^2 (10 G)				98 m/s^2 (10 G)	294 m/s^2 (10 G)	98 m/s^2 (10 G)	100 m/s^2 (10 G)
Environmental									
Noise immunity		±1.5 kV for ±600V DC				±400V for 12V DC		±1kV for 48V DC	±1.5 kV for ±600 V DC
Static immunity		Malfunction: 8 kV							
Ambient temperature		Operating: -10 °…55 °C (with no icing) Storage: -25 °…65 °C (with no icing)							
Ambient humidity		Operating: 35…85 %							
Construction									
Life expectancy (operations min.)		Mechanical:20,000,000. (under no load at 1,800 operations/h Electrical: 100,000 (5 A at 250V AC, resistive load at 1,800 operations/h)						Mech: 10^7 Electrical: 10^4	Mech: 20^7 Electrical: 10^4
EMC		(EMI)EN50081-2 Emission Enclosure:EN55011 Group 1 class A Emission AC Mains: EN55011 Group 1 class A (EMS)EN50082-2 Immunity ESD:EN61000-4-2:4 kV contact discharge (level 2) 8 kV air discharge (level 3) Immunity RF-interference from AM Radio Waves: ENV50140:10 V/m (80 MHz…1 GHz) (level 3) Immunity RF-interference from Pulse-modulated Radio Waves:ENV50204:10 V/m (900±5 MHz) (level 3) Immunity Conducted Disturbance:ENV50141:10 V (0.15…80 MHz) (level 3) Immunity Burst:EN61000-4-4:2 kV power-line (level 3) Immunity Surge:EN61000-4-52 kV I/O signal-line (level 4) 1 kV line to line 2 kV line to ground (level 3)							
Degree of protection		IP40 (panel surface)							
Weight		Approx. 90 g							
Certifications		CSA Certified, File LR60859, UL Recognized, File E14840, Guide NKCR 2,CE Marked (per EU Low Voltage Directive 73/23 EEC 93/68 EEC: per Electromagnetic Compatibility Directive 89/336 EEC 92/31 EEC 93/681 EEC), ACA							
Standards		EN 60947-5-1, EN 50081-2, EN 50082-2,IEC 947, VDE 0435, CSA 22.2,UL 508							

Multifunction and ON-Delay Timer

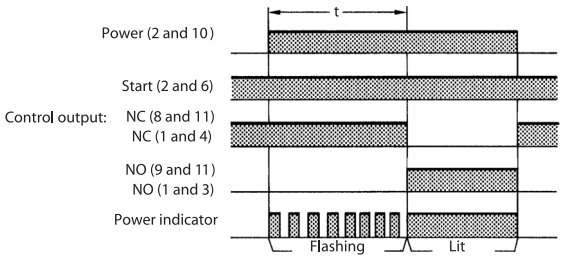
Application Examples

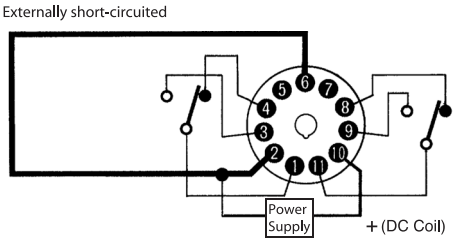
A Mode: Signal ON-Delay

On-delay operation (A mode) is a basic mode.

1. Power-ON Start/Power-OFF Reset*

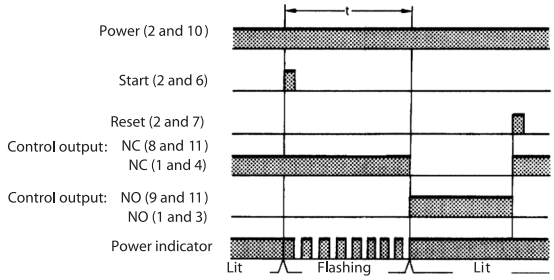
The Power-ON start/Power-OFF reset operation is a standard operating method.

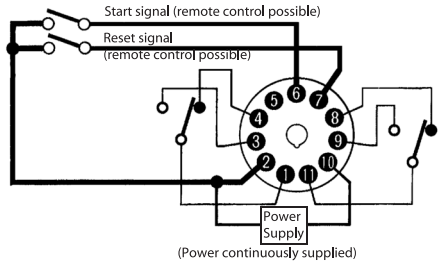




2. Signal Start/Signal Reset*

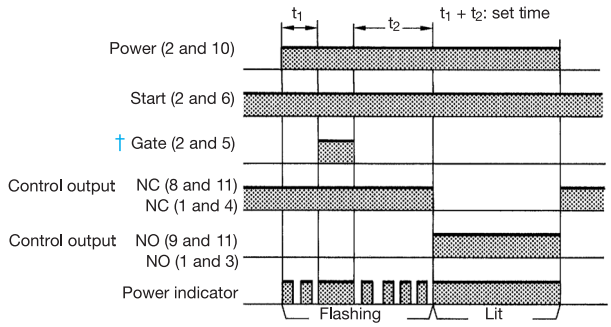
The Signal start/Signal reset operation is useful for remote control of the Timer.



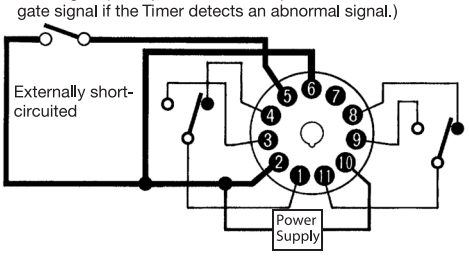


3. Control of Integrated Time with Gate Signal*

With a gate signal, the Power-ON start operation and Signal start operation can be controlled (the operation can be interrupted).



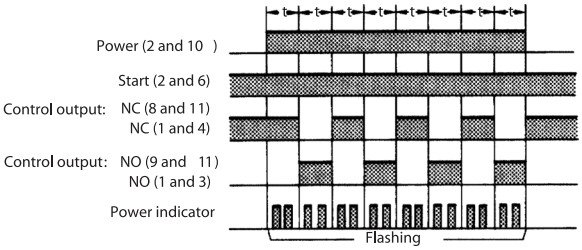
Gate signal (The operation is interrupted with the gate signal if the Timer detects an abnormal signal.)

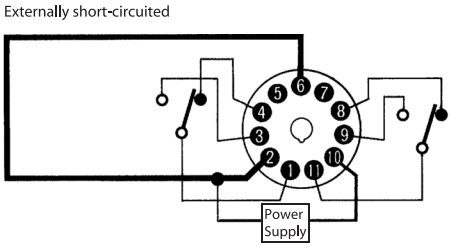


B/B2 Mode: Repeat Cycle

The Repeat Cycle operation in the B and B2 modes can be effectively applied to lamp or buzzer (ON and OFF) alarms or the monitoring of an intermittent operation with a display.

1. Power-ON Start/Power-OFF Reset (in B Mode)*



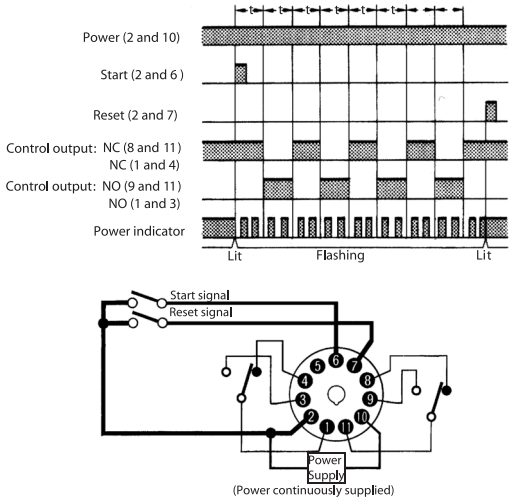


* If using a voltage input, connect pin 6 and 10 for DPDT devices.
† Gate Signal: A maintained connection is required to allow the timing sequence to complete.

Multifunction and On-Delay Timer, Continued

2. Signal Start/Signal Reset (in B Mode)*

If there is an abnormal signal, flashing starts. When the abnormal condition is restored, a reset signal stops the display flashing.

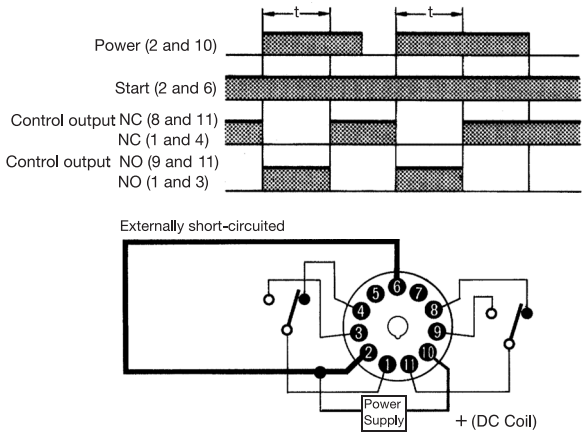


C Mode: Signal On/Off-Delay

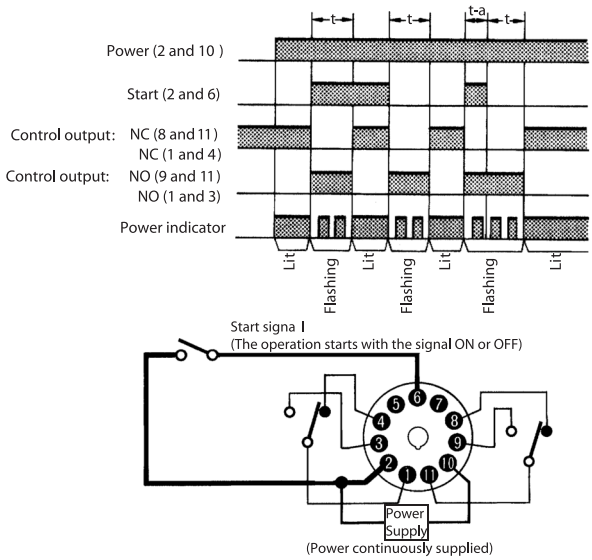
The Signal On-/Off-delay operation (C mode) is useful for the control of distribution of products on a production line into boxes by the specified number or time.

1. Power-ON Start/Instantaneous Operation/Time-Limit Reset*

A set of these functions is useful for the operation of a machine for a specified period when power is ON.



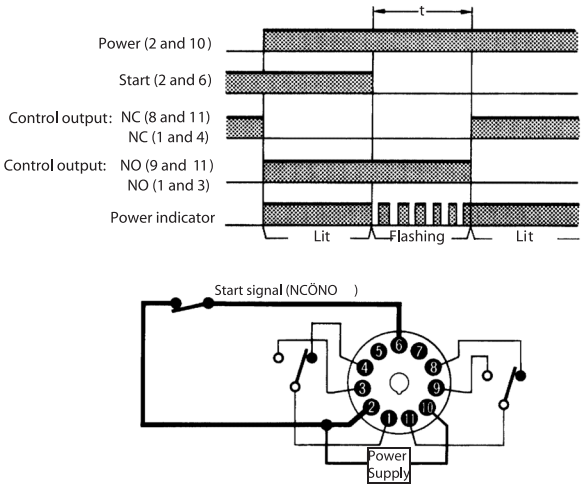
2. Signal-ON-OFF Start/Instantaneous Operation/Time-Limit Reset*



D Mode: Signal Off-Delay

Signal Off-delay operation (D mode) can be effectively used to keep a load operating for a certain period. For example, this function enables the cooling fan for a lamp or heater to operate for a certain period after the lamp or heater is switched OFF.

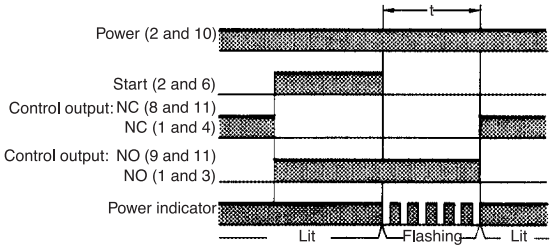
1. Power-ON Start/Instantaneous Operation/Time-Limit Reset*

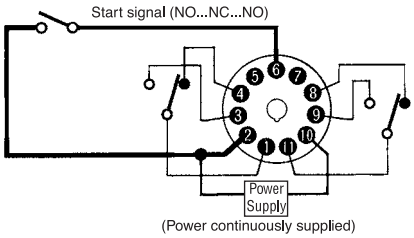


* If using a voltage input, connect pin 6 and 10 for DPDT devices.

Multifunction and On-Delay Timer, Continued

2. Signal Start/Instantaneous Operation/Time-Limit Reset

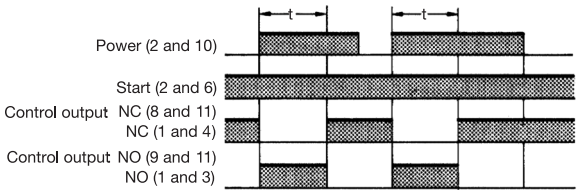


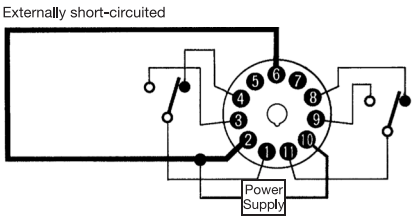


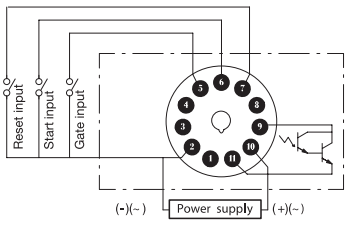
E Mode: One Shot

1. Power-ON Start/Instantaneous Operation/Time-Limit Reset

This function is useful for the operation of a machine for a specified period after power is ON.



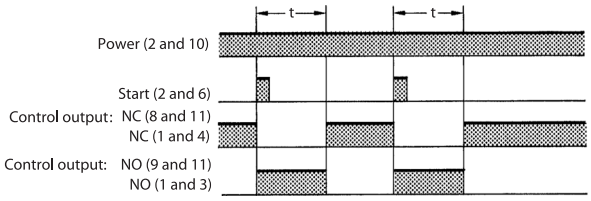


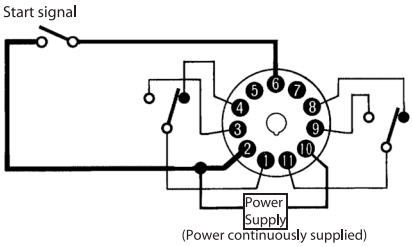


Note: Start input is valid and retriggerable while the timer is in operation.

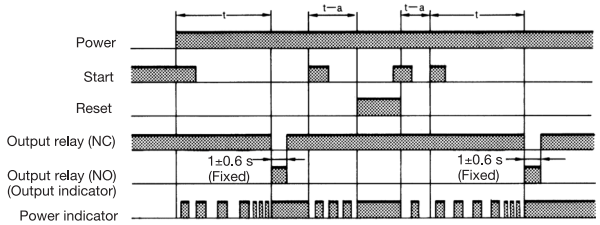
2. Signal Start/Instantaneous Operation/Time-Limit Reset

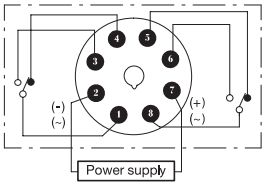
This function is useful for the repetitive control such as the filling of liquid for a specified period after each Signal start input.

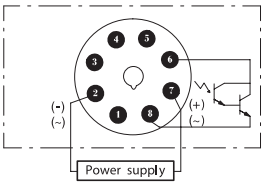


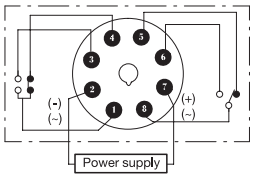


J Mode: On-Delay One Shot









Plug-in Timing Relays

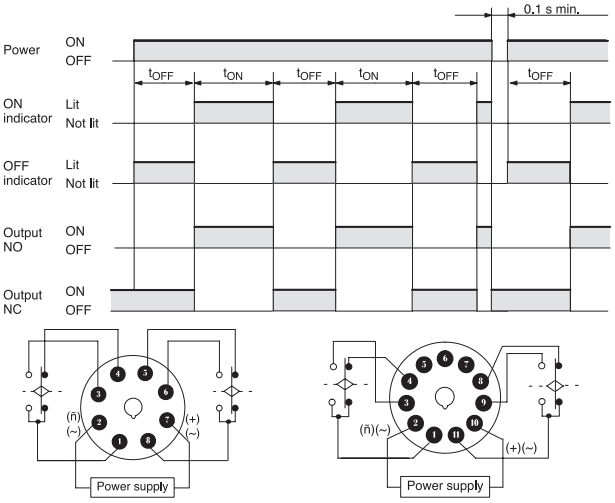
Bulletin 700-HR Timer Wiring Diagrams and Timing Charts, Continued

700-HRF Twin Timer, 700-HRY Star-Delta Timer, and 700-HRQ Off-Delay Timer

B Mode: Repeat Cycle Off-start (700-HRF)

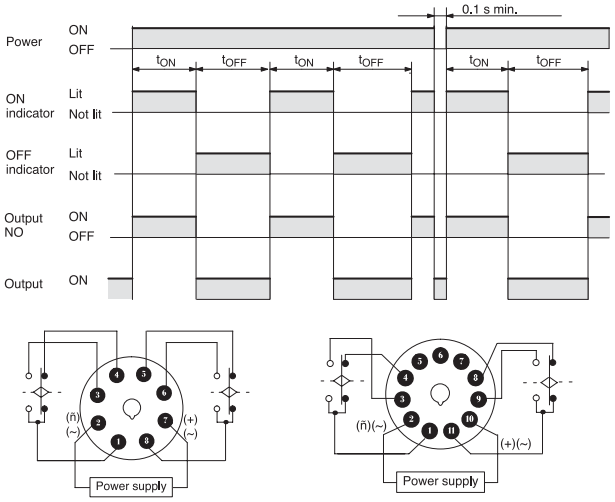
The Repeat Cycle operation in the B mode can be effectively applied to lamp or buzzer (ON and OFF) alarms or the monitoring of an intermittent operation with a display.

1. Power-ON Start/Power-OFF Reset (in B Mode)



B2 Mode: Repeat Cycle On-start (700-HRF)

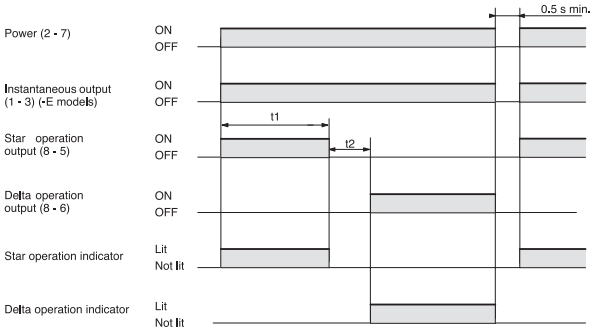
The Repeat Cycle operation in the B2 mode can be effectively applied to lamp or buzzer (ON and OFF) alarms or the monitoring of an intermittent operation with a display



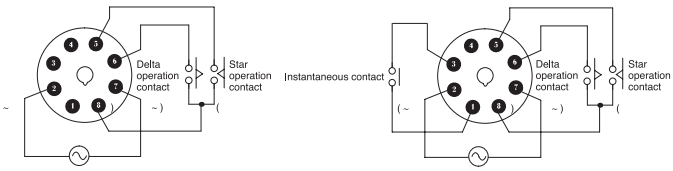
Star-Delta (700-HRY)

1. Power-ON Start/Instantaneous Operation/Time-Limit Reset

This function is useful for the operation of a machine for a specified period after power is ON.



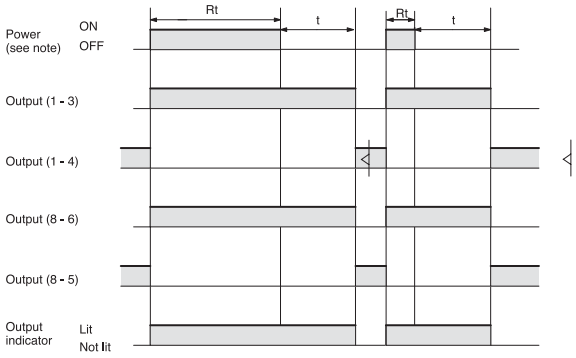
t1: Star operation time setting
t2: Star-delta transfer time



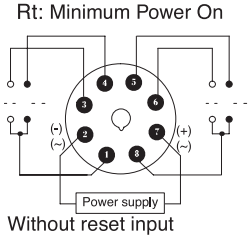
True OFF-Delay (700-HRQ)

Signal OFF-delay operation (D mode) can be effectively used to keep a load operating for a certain period. For example, this function enables the cooling fan for a lamp or heater to operate for a certain period after the lamp or heater is switched OFF.

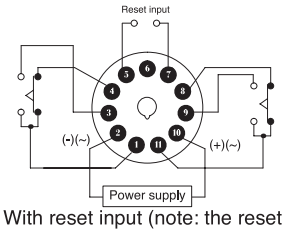
1. Power-ON Start/Instantaneous Operation/Time-Limit Reset



t: Set time
Rt: Minimum Power On

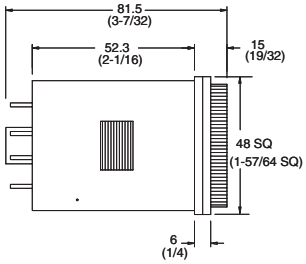


Without reset input

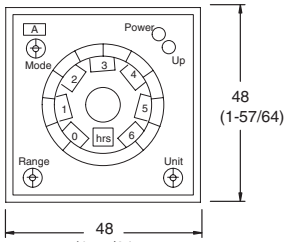


With reset input (note: the reset brings coil to shelf state)

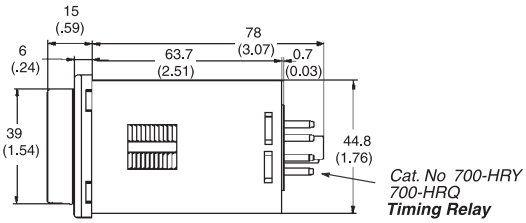
Approximate Dimensions are shown in millimeters (inches). Approximate Dimensions are not intended to be used for manufacturing purposes.



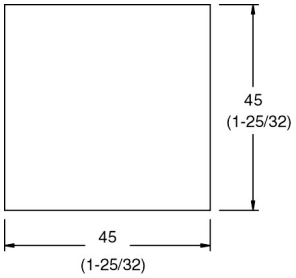
Cat. No. 700-HR, -HRM, -HRC, -HRF, -HRS, -HRV, -HRP
Timing Relay



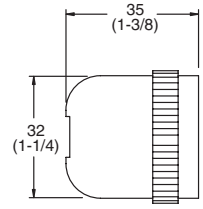
Cat. No. 700-HR…/-HRM…/-HRC…/-HRF…/-HRS…/-HRV…/ -HRP…/-HRY…/-HRQ
Timing Relays



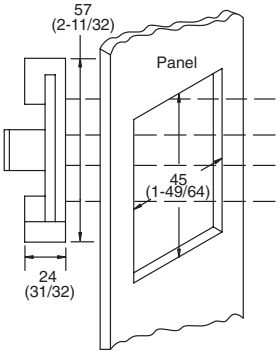
Cat. No 700-HRY
700-HRQ
Timing Relay



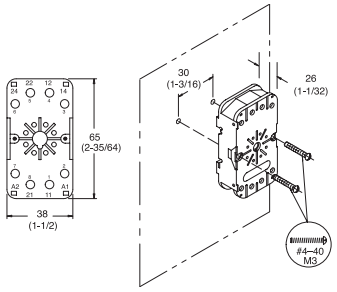
Cat. No. 700-HR…
Panel Cutout



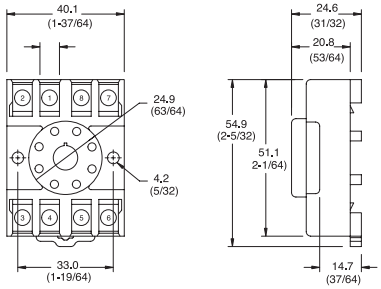
Cat. No. 700-HN129 — 11-Pin
Cat. No. 700-HN108 — 8-Pin
Socket



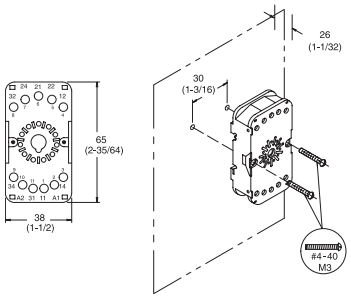
700-HN130
Retainer



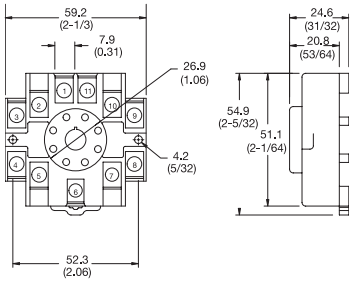
Panel Mounting Cat. No. 700-HN100
Wire Size: 2 x 2.5 mm²
Single Wire – Up to #12 AWG
Double Wire – 2 x 2.5 mm² (#2–14 AWG… #2–20 AWG)
(Either Solid or Stranded)
Strip Length: 9 mm (3/8 in) – Torque: 0.8 N•m (7 lb•in)



Cat. No. 700-HN125
Wire Size: 2 x 2.5 mm²
Single Wire – Up to #12 AWG
Double Wire – 2 x 2.5 mm² (#2–14 AWG… #2–20 AWG)
(Either Solid or Stranded)
Strip Length: 9 mm (3/8 in) – Torque: 0.8 N•m (7 lb•in)



Panel Mounting Cat. No. 700-HN101
Wire Size: 2 x 2.5 mm²
Single Wire – Up to #12 AWG
Double Wire – 2 x 2.5 mm² (#2–14 AWG… #2–20 AWG)
(Either Solid or Stranded)
Strip Length: 9 mm (3/8 in) – Torque: 0.8 N•m (7 lb•in)



Cat. No. 700-HN126
Wire Size: 2 x 2.5 mm²
Single Wire – Up to #12 AWG
Double Wire – 2 x 2.5 mm² (#2–14 AWG… #2–20 AWG)
(Either Solid or Stranded)
Strip Length: 9 mm (3/8 in) – Torque: 0.8 N•m (7 lb•in)

Bulletin 700-HX

- Digital Timing Relay with LCD Display
- Socket or Panel Mounted (NEMA 4X/IP66)
- 5A, B300, SPDT Contact Ratings
- 10 Functions or Modes
- Environmentally Friendly — Flash Memory, No Battery
- User Manual 700-UM002A-EN-D Available at the Automation Bookstore web site http://www.theautomationbookstore.com

Table of Contents

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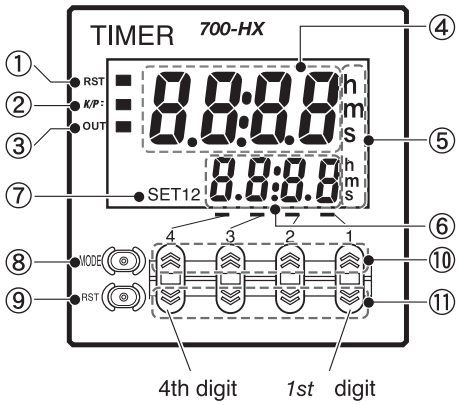
Accessories 9-95
Specifications 9-96
Approximate Dimensions 9-102

Standards Compliance and Certifications

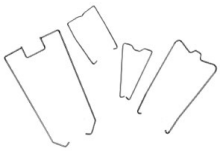
See Specification Table In This Section.

Model	Operating Mode	Timing Range	Socket Type	Contact Output	No. of Pins	Input Voltage	Cat. No.
Cat. No. 700-HX...	A mode: Signal On-Delay 1 A-1 mode: Signal On-Delay 2 A-2 mode: Power On-Delay 1 A-3 mode: Power On-Delay 2 B mode: Repeat Cycle 1 B-1 mode: Repeat Cycle 2 D mode: Signal OFF-delay E mode: One Shot F mode: Cumulative Twin Timer	0.000…9.999 s 0.000…99.99 s 0.000…999.9 s 0.000…9999 s 0.000…99 min. 59 s 0.000…999.9 min. 0.000…9999 min. 0.000…99 h 59 min. 0.000…999.9 h 0.000…9999 h	700-HN100 700-HN125	SPDT	8	100…240V AC	700-HX86SA17
						24V AC 12…24V DC	700-HX86SU24

General Timer Functions



① Reset indicator
② Key protect indicator (Orange)
③ Output indicator (Orange)
④ Present value (11.5-mm character height, Red)
⑤ Time unit display (Orange)
⑥ Set value (6-mm character height, Green)
⑦ Set Values 1 and 2 display
⑧ Mode key
Mode conversion and switching of setting items are carried out.
⑨ Reset key
⑩ Up key
⑪ Down key

	Description	Pkg. Quantity	Cat. No.
Cat. No. 700-HN100	**Screw Terminal Tube Base Socket — Panel or DIN Rail Mounting; Guarded Terminal Construction.** 8-Pin for use with Bulletin 700-HX Timing Relays. Order ten or multiples of ten	10	700-HN100
Cat. No. 700-HN125	**Screw Terminal Tube Base Socket — Panel or DIN Rail Mounting; Open Style Construction.** 8-Pin for use with Bulletin 700-HX Timing Relays. Order must be for 10 sockets or multiples of 10. No retainer clip required.	10	700-HN125
Cat. No. 199-DR1	**DIN (#3) Symmetrical Rail** 35 mm x 7.5 mm x 1 m long Zinc-plated, yellow chromated	10	199-DR1
Cat. No. 700-HN108	**Specialty Socket** 8-pin backwired socket with solder terminals. For use with 700-HX Timing Relays. Order ten or multiples of ten	10	700-HN108
 *Sample Retainer Clips*	**Retainer Clip for Cat. Nos. 700-HN100 Sockets with all 700-HX Timing Relays** Secures timer in socket. Order must be for 10 clips or multiples of 10. Note: Not required for installation	10	700-HN131
Cat. No. 700-HN130	**Frame Adapter** For flush or door mounting of all Bulletin 700-HR timers.	1	700-HN130
Cat. No. 700-HN132	**Protective Cover** Helps prevent tampering of timing and mode settings. Provides a degree of protection against water and dirt from entering the front of the relay. For use with all Bulletin 700-HRs and -HX timing relays.	1	700-HN132

Timing Relay, Socket, Retainer Clip Reference Chart

Timer Type	Socket Cat. No.	Retainer Clip Cat. No.
700-HX	700-HN100	700-HN131
	700-HN108	Not Required*
	700-HN125	Not Required*

* Design of socket holds the relay securely and does not require retainer clips.

Plug-in Timing Relays

Specifications

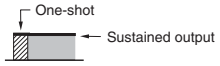
Electrical Ratings		
Pilot Duty Rating		NEMA B300
Rated supply voltage		100 to 240V AC, 24V AC/12 to 24V DC (50/60Hz) (permissible ripple: 20%(p-p) max.)
Operating voltage range		85%…110% of rated supply voltage
Power consumption	100…240V AC	4.3 VA
	24V AC/12…24V DC	3.4 VA/1.7 W
Inrush Current	100…240V AC	3 A
	24V AC/12…24V DC	5 A
►][◄ Make	120V AC	30 A
	240V AC	15 A
◄][► Break	120V AC	3 A
	240V AC	1.5 A
Hp at 120V AC		1/4 Hp
Hp at 240V AC		1/3 Hp
Mechanical		
Mounting method		Flush mounting, surface mounting, DIN mounting
Display		7-segment, negative transmissive LCD; Present value (red, 8 mm high characters); Set value (green, 4 mm high characters)
Digits		4 digits
Timer	Time ranges	0.000…9.999 s, 0.00…99.99 s, 0.0…999.9 s, 0…9999 s, 0 min. 00 s…99 min. 59 s, 0.0…999.9 min., 0 h 00 min.…99 h 59 min., 0.0 h…999.9 h, 0 h…9999 h
	Timer modes	Elapsed time (Up), remaining time (Down), selectable
	Output modes	A, A-1, A-2, A-3, B, B-1, D, E, F, Z, ton or toff
Inputs	Input signals	Start, reset
	Input method	No-voltage input via:NPN transistor or switching of contact
	Start, reset, gate	Minimum input signal width: 1 or 20 ms (selectable)
	Power reset	Minimum power-opening time: 0.5 s (Except for A-3, B-1, and F mode)
Control output		SPDT contact output: 5 A at 250V AC, resistive load (cosine=1) Minimum applied load: 10 mA at 5 V DC (failure level: P, reference value)
External Power Supply		No
Key Protect		Yes
Memory backup		EEP-ROM (overwritten 200,000 times min.), which can store data for 20 years min.
Accuracy of Operating Time and Setting Error*		Power-ON start: ±0.01% ±50 ms max. * to be rated against set value Signal start: ±0.005 ±30 ms max. * to be rated against set value Signal start at transistor output model: ±0.005% ±3 ms max.† If the set value is within the sensor waiting time (250 ms max.)

* The values are based on the set value.
† The value is applied for a minimum pulse width of 1 ms.

		Characteristics*
Insulation resistance		100 mΩ min. (at 500V DC)
Dielectric strength		2000V AC, 50/60Hz for 1 min. between current-carrying terminals and non-current-carrying metal parts (1000V AC for 24V AC/12 to 24V DC type), 1000 VAC, 50/60 Hz for 1 min. between non-continuous contacts
Noise immunity		' ±1.5 kV (between power terminals) for 100 to 240 VAC, ±480V for 24VAC/12 to 24VDC, and ± 600V (between input terminals), square-wave noise by noise simulator (pulse width: 100 ns/1 µs, 1-ns rise)
Static immunity		±8 kV (malfunction), ±15 kV (destruction)
Vibration resistance	Malfunction	10…55 Hz with 0.35 mm single amplitude each in three directions for 10 min.
Shock resistance	Malfunction	98 m/s² (approx. 10 G) each in three directions
Life expectancy	Mechanical	10 million operations min. (under no load at 18,000 operation/hr)
	Electrical	100,000 operations min. (5 A at 250V AC, resistive load at 1,800 operation/hr)
EMC	(EMI)	EN61812-1
	Emission Enclosure:	EN55011 Group1 class A
	Emission AC mains:	EN55011 Group1 class A
	(EMS)	EN61812-1
	Immunity ESD:	EN61000-4-2: 6 kV contact discharge (level2) 8 kV air discharge (level3)
	Immunity RF-interference:	EN61000-4-3: 10 V/m
Approved standards		UL508, CSA C22.2 No.14 Conforms to EN61812-1 (Pollution degree 2/overvoltage category III) Conforms to VDE0106/P 100 (Finger Protection), conforms to NEMA output rating (N/F)
Enclosure ratings		Panel surface:IP66 and NEMA Type 4X (indoors)†
Weight		Approx. 100 g
Certifications		CE Certified; UL508; CSA, C22.2 No. 14; ACA
Standards		EN61010-1; IEC61010-1; VDE0106/P 100; NEMA 4X/IP66

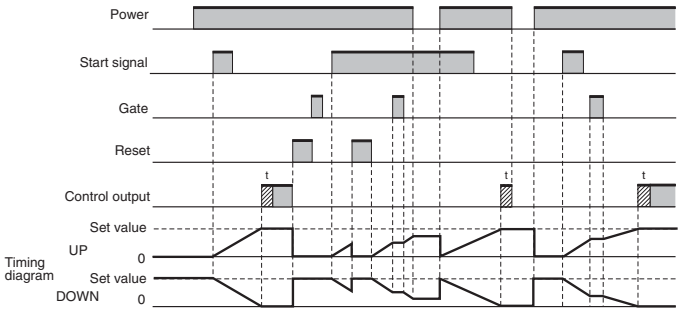
* 700-HX User Manual, pub. number 700-UM002A-EN-D, available at: the Automation Bookstore web site http://www.theautomationbookstore.com
† An attached waterproof packing is necessary to ensure IP66 waterproofing between the 700-HX and installation pan.

Timing Charts



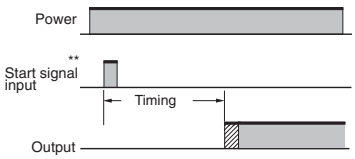
One-shot outputs can be to set to 0.1 s, 0.5 s, 1s, 5 s, 10 s, 20 s.

Output mode A Mode: Signal ON-Delay (Timer resets when power comes ON.)



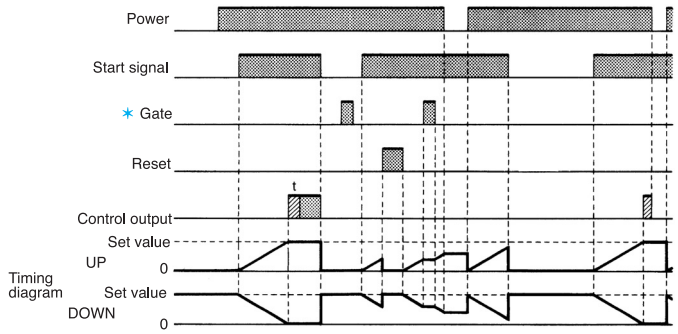
Timing starts when the start signal goes ON.
While the start signal is ON, the timer starts when power comes ON or when the reset input goes OFF.
The control output is controlled using a sustained or one-shot rime period.

Basic Operation



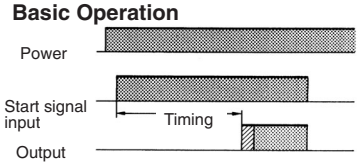
* Output is instantaneous when setting is 0.
** Start signal input is enabled during timing.

Output Mode A-1: Signal ON-Delay 2 (Timer resets when power comes ON.)



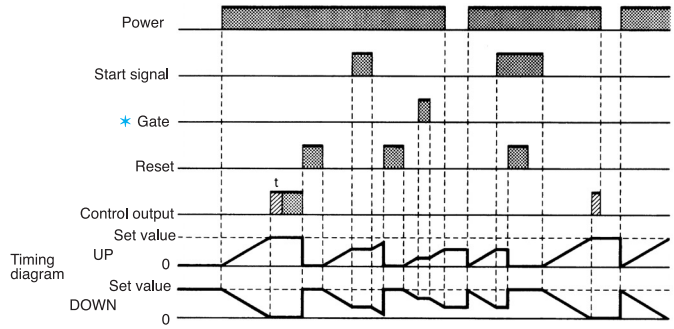
Timing starts when the start signal goes ON, and is reset when the start signal goes OFF.
While the start signal is ON, the timer starts when the power comes ON or when the reset input goes OFF.
The control output is controlled using a sustained or one-shot time period.

Basic Operation



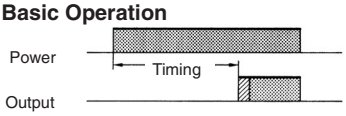
*Output is instantaneous when setting is 0.

Output mode A-2: Power ON Delay 1 (Timer resets when power comes ON)



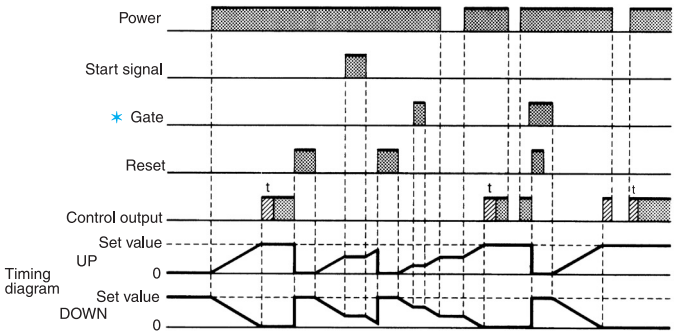
Timing starts when the reset input goes OFF.
The start signal disables the timing function (i.e., same function as the gate input).
The control output is controlled using a sustained or one-shot time period.

Basic Operation



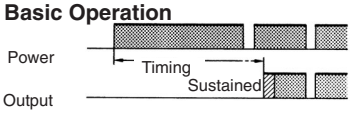
*Output is instantaneous when setting is 0.

Output mode A-3 Power ON Delay 2 (Timer does not reset when power comes ON)



Timing starts when the reset input goes OFF.
The start signal disables the timing function (i.e., same function as the gate input).
The control output is controlled using a sustained or one-shot time period.

Basic Operation

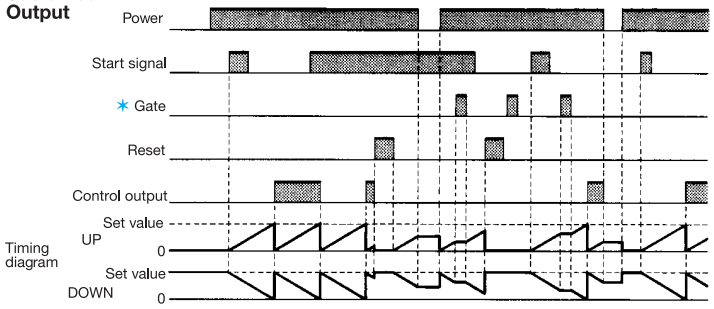


*Output is instantaneous when setting is 0.

✶ Gate not included on any mode of this relay.

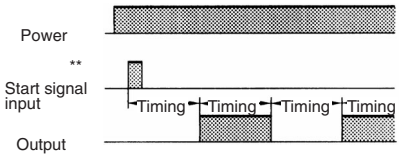
Output mode B: Repeat Cycle (Timer resets when power comes ON.)

Sustained Output



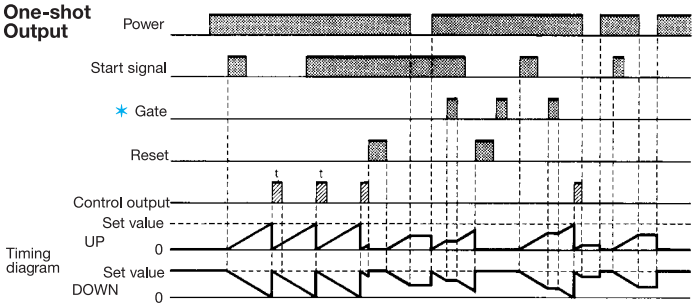
Timing starts when the start signal goes ON.
The status of the control output is reversed when time is up (OFF at start).
While the start signal is ON, the timer starts when the power comes ON or when the reset input goes OFF.

Basic Operation



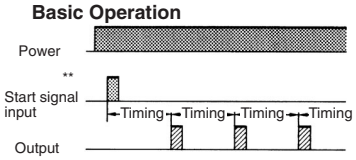
* Normal output operation will not be possible if the set time is too short.
Set the value to at least 100 ms (contact output type).
** Start signal input is disabled during timing.

One-shot Output



Timing starts when the start signal goes ON.
The control output is turned ON when time is up.
While the start signal is ON, the timer starts when the power comes ON or when the reset input goes OFF.

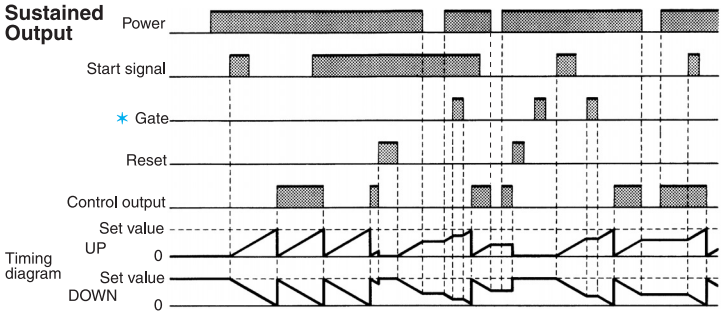
Basic Operation



* Normal output operation will not be possible if the set time is too short.
Set the value to at least 100 ms (contact output type).
** Start signal input is disabled during timing.

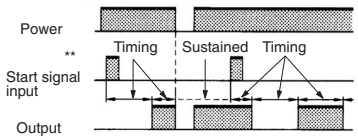
Output Mode B-1: Repeat Cycle 2 (Timer does not reset when power comes ON)

Sustained Output



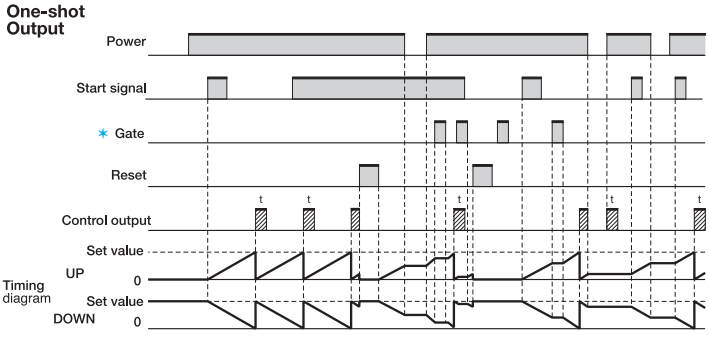
Timing starts when the start signal goes ON.
The status of the control output is reversed when time is up (OFF at start).
While the start signal is ON, the timer starts when the power comes ON or when the reset input goes OFF.

Basic Operation



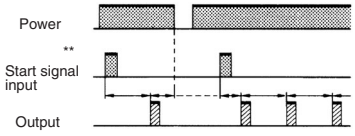
* Normal output operation will not be possible if the set time is too short.
Set the value to at least 100 ms (contact output type).
** Start signal input is disabled during timing.

One-shot Output



Timing starts when the start signal goes ON.
The control output comes ON when time is up..
While the start signal is ON, the timer starts when power comes ON or when the reset input goes OFF.

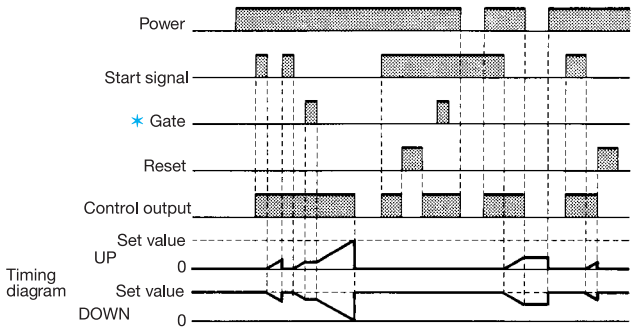
Basic Operation



* Normal output operation will not be possible if the set time is too short.
Set the value to at least 100 ms (contact output type).
** Start signal input is disabled during timing.

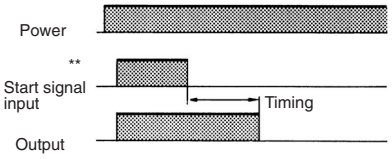
✶ Gate not included on any mode of this relay.

Output mode D: Signal OFF-delay (Timer resets when power comes ON.)



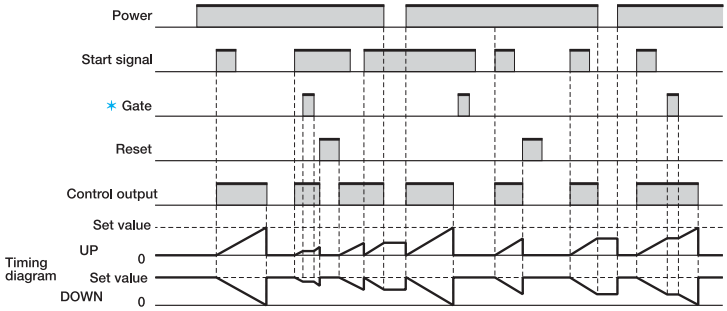
The control output is ON when the start signal is ON (except when the power is OFF or the reset is ON).
The timer is reset when the time is up.

Basic Operation



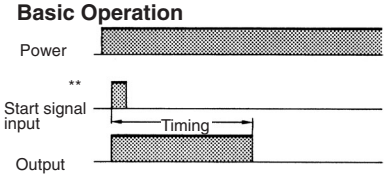
* Output functions only during start signal input when setting is 0.
** Start signal input is enabled during timing.

Output mode E: Interval (Timer resets when power comes ON.)



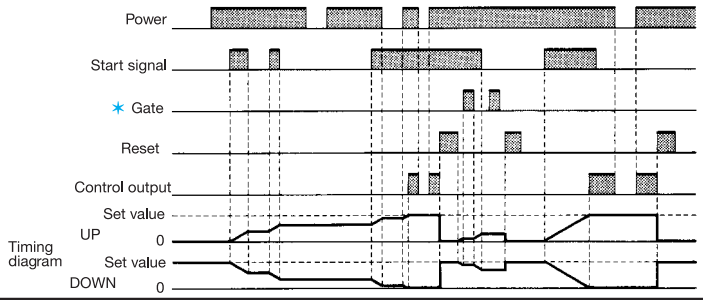
Timing starts when the start signal comes ON.
The control output is reset when time is up.
While the start signal is ON, the timer starts when power comes ON or when the reset input goes OFF.

Basic Operation



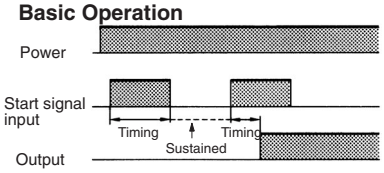
* Output is disabled when the setting is 0.
** Start signal input is enabled during timing.

Output Mode F: Cumulative (Timer does not reset when power comes ON)



Start signal enables timing (timing is stopped when the start signal is OFF or when the power is OFF).
A sustained control output is used.

Basic Operation



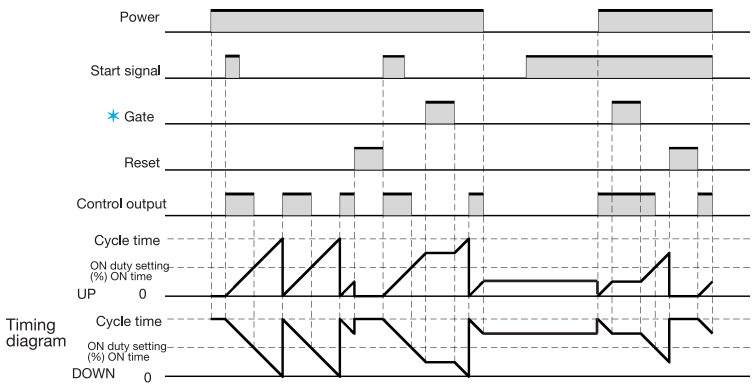
*Output is instantaneous when setting is 0.

✶ Gate not included on any mode of this relay.

Z Mode

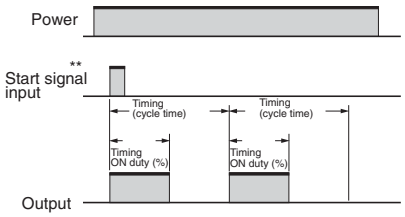
Output quantity can be adjusted by changing the cycle time set in the adjustment level to 1 and by changing the ON duty (%) set value. The set value shows the ON duty (%) and can be set to a value between 0 and 100 (%). When the cycle time is 0, the output will always be OFF. When the cycle time is not 0 and when ON duty has been set to 0 (%), the output will always be OFF. When ON duty has been set to 100 (%), the output will always be ON.

Z mode: ON/OFF-duty Adjustable Repeat Cycle



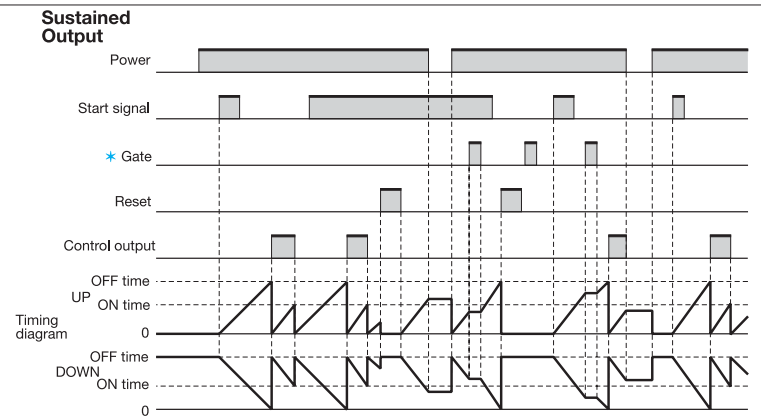
Timing starts when the start signal goes ON.
The status of the control output is reversed when time is up (ON at start).
While the start signal is ON, the timer starts when power comes ON or when the reset input goes OFF.

Basic Operation



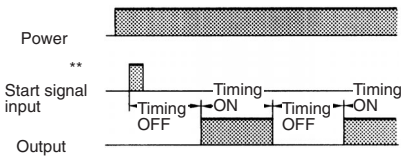
* Normal output operation will not be possible if the set time is too short.
Set the value to at least 100 ms (contact output type).
** Start signal input is enabled during timing.

Output mode T OFF: Twin Timer OFF start



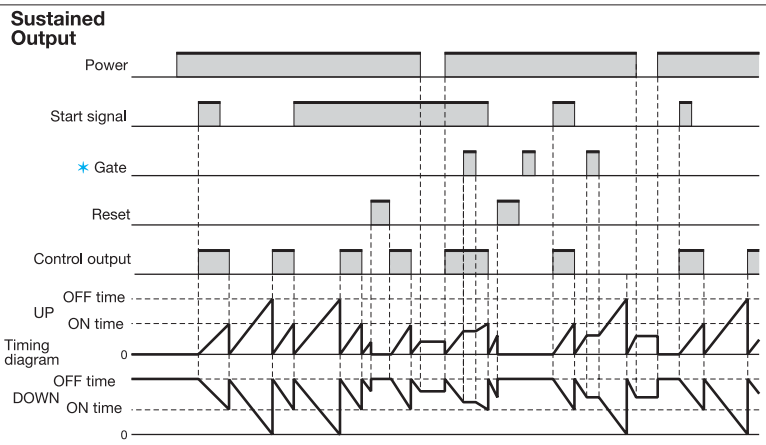
Timing starts when the start signal goes ON.
The status of the control output is reversed when time is up (OFF at start).
While the start signal is ON, the timer starts when the power comes ON or when the reset input goes OFF.

Basic Operation



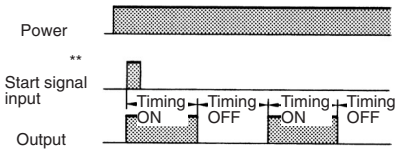
* Normal output operation will not be possible if the ON/OFF set time is too short.
Set the value to at least 100 ms (contact output type).
** Start signal input is disabled during timing.

Output mode T ON: Twin Timer ON start



Timing starts when the start signal goes ON.
The status of the control output is reversed when time is up (ON at start).
While the start signal is ON, the timer starts when the power comes ON or when the reset input goes OFF.

Basic Operation



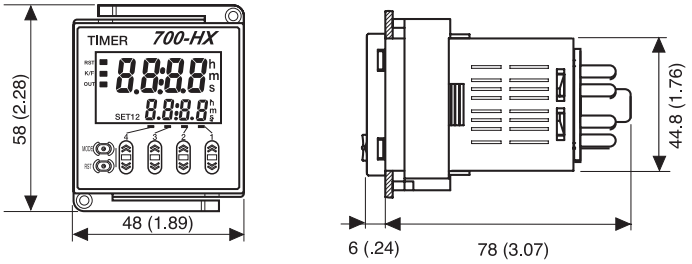
* Normal output operation will not be possible if the ON/OFF set time is too short.
Set the value to at least 100 ms (contact output type).
** Start signal input is disabled during timing.

* Gate not included on any mode of this Relay.

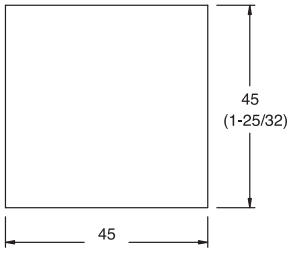
Plug-in Timing Relays

Approximate Dimensions

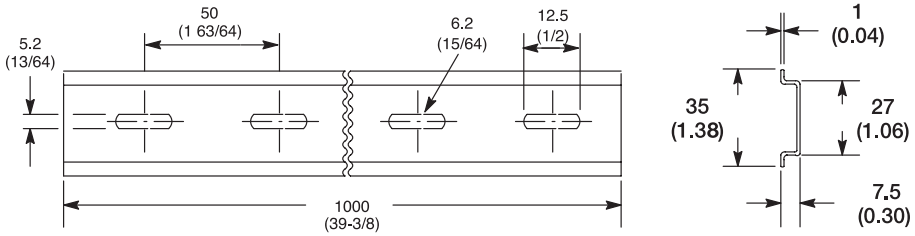
Approximate Dimensions are shown in millimeters (inches). Approximate Dimensions are not intended to be used for manufacturing purposes.



Cat. No. 700-HX...

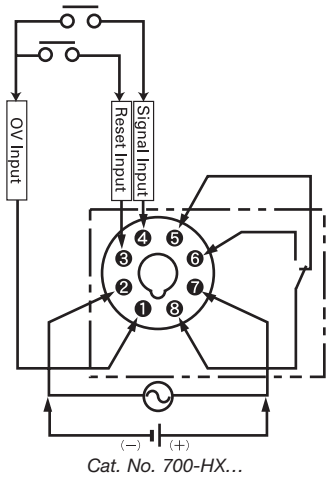


Cat. No. 700-HX...
Panel Cutout



Cat. No. 199-DR1 DIN Mounting Rail Series B
Cat. No. 199-DR4 DIN Mounting Rail Series B Has No Mounting Holes

Terminal Arrangement



Cat. No. 700-HX...

Bulletin 700-HXM

- One of the World's Smallest Preset Digital Timers
- Panel Mounted (1/32 DIN Cut Out)
- Built-in Prescaling for Counter Operation
- Finger Protection Terminal Block (VDE0106/P100)
- NEMA 4 / IP66
- User Manual 700-UM001A-EN-D Available at http://www.theautomationbookstore.com

Table of Contents

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Standards Compliance and Certifications

See Specification Table In This Section.

Model	Operating Modes	Counter Modes*		Timing Range	Counter Range	Input Voltage	Cat. No.
		Input	Output				
Cat. No 700-HXM...	A mode: Signal ON-delay B mode: Repeat Cycle D mode: Signal OFF-delay E mode: One Shot F mode: Accumulative Z mode: ON/OFF-duty Adjustable Repeat Cycle	Increment Decrement Individual Quadrature	N, F, C, K	0.000…9999 h	-999…9999	24V DC	700-HXM66SZ24

* For counter mode explanation, see page 9-106.

General Timer Functions

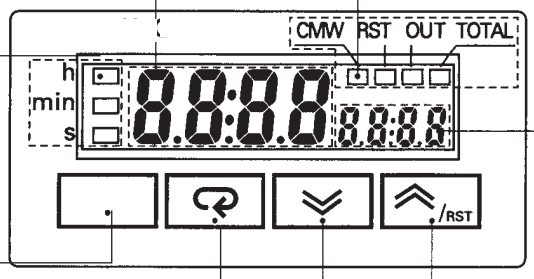
NO. 1 Display
Displays the present value or parameter type. When totalizing count is displayed, the leftmost 4 digits of the 8-digit totalizing count will be displayed (Zeros suppressed)

Operation Display 2

Indicator	Meaning
RST	*Lit during reset using reset input or Reset Key.*
OUT	*Lit when control output is ON.*
TOTAL	*Lit when totalizing value is displayed.*

Operation display 1
Displays the time unit when the timer function has been selected

Example
5 h 30 min
123.4 s
5:30
123.4



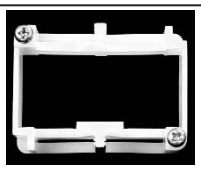
No. 2 Display
Displays set value or set value of the parameter. Displays the rightmost 4 digits of the count value when the 700-HXM is used as a totalizing counter (Zeros suppressed)

Level Key
Displays the present value or parameter type. When totalizing count is displayed, the leftmost 4 digits of the 8-digit totalizing count will be displayed (Zeros suppressed)

Mode Key
Press this key to select parameters within each level.

Down Key
Each press of this key decreases values displayed on the No. 2 display. Hold down this key continuously to decrease values quickly. Also returns setting items.

Up/Reset Key
Each press of this key increases values displayed on the No. 2 display. Hold down this key continuously to increase values quickly. Also advances setting items. To reset the present value, press this key while the present value is displayed. If this key is pressed while the totalizing count value is displayed, the totalizing count value and the present value will be reset.

	Description	Pkg. Quantity	Cat. No.
 *Cat. No. 700-HN141*	**Replacement Flush Mounting Adapter** (One shipped with each 700-HXM66Z24)	1	700-HN141

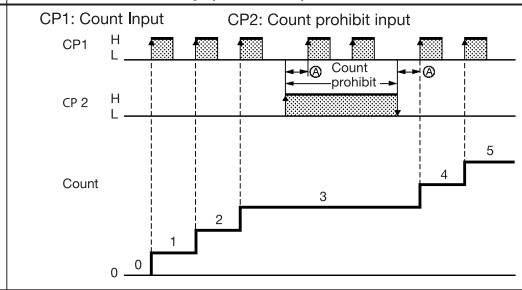
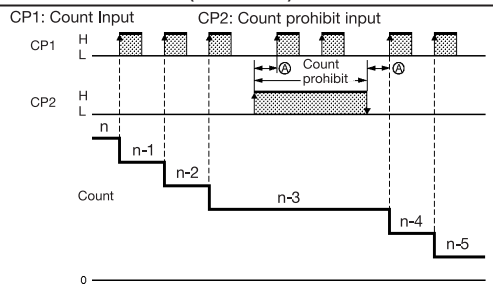
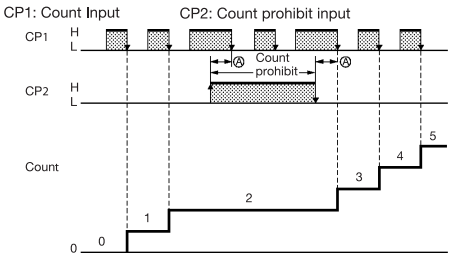
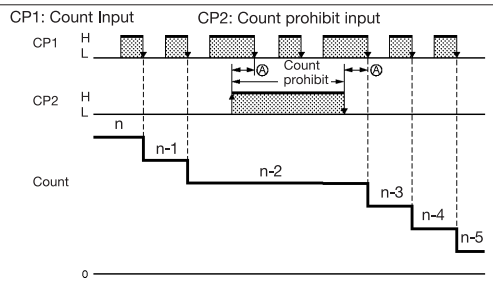
Electrical Ratings		
Pilot Duty Rating		NEMA B300
Rated supply voltage		24 VDC
Operating voltage range		85%…110% of rated supply voltage
Power consumption		1.5 W max. (for max. DC load) (Inrush current: 15 A max.)
►][◄ Make	120V AC	30 A
	240V AC	15 A
◄][► Break	120V AC	3 A
	240V AC	1.5 A
Hp at 120V AC		1/4 Hp
Hp at 240V AC		1/3 Hp
Mechanical		
Mounting method		Flush mounting (Panel or door)
Terminal screw tightening torque		0.5 N•m max.
Display		7-segment, negative transmissive LCD; time display (h, min., s); CMW, OUT, RST, TOTAL Present value (red, 7 mm high characters); Set value (green, 3.4 mm high characters)
Digits		PV: 4 digits SV: 4 digits When total count value is displayed: 8 digits (Zeros suppressed)
Memory backup		EEPROM (non-volatile memory) (number of writes: 100,000 times)
Counter	Maximum counting speed	30 Hz or 5 kHz∗
	Counting range	-999…9,999
	Input modes	Increment, decrement, individual, quadrature inputs
	Output modes	N, F, C, or K
Timer	Time ranges	0.000…9.999 s, 0.00…99.99 s, 0.0…999.9 s, 0…9999 s, 0 min. 00 s…99 min. 59 s, 0.0…999.9 min., 0 h 00 min.…99 h 59 min., 0.0 h…999.9 h, 0 h…9999 h
	Timer modes	Elapsed time (Up), remaining time (Down)
	Output modes	A, B, D, E, F, or Z
Inputs (OV input)	Input signals	For Counter: CP1, CP2, and reset For Timer: Start, gate, and reset
	Input method	No-voltage input (contact short-circuit and open input) Short-circuit (ON) impedance: 1 KΩ max. (Approx. 2 mA runoff current at 0Ω) Short-circuit (ON) residual voltage: 2V DC max. Open (OFF) impedance: 100 kΩ min. Applied voltage: 30V DC max.
	Start, reset, gate	Minimum input signal width: 1 or 20 ms (selectable)
	Power reset	Minimum power-opening time: 0.5 s
Control output		SPDT contact output: 5 A at 250V AC/30V DC, resistive load (cos ϕ = 1)
Minimum applied load		10 mA at 5 VDC (failure level: P, reference value)
Reset system		External, manual, and power supply resets (for timer in A, B, D, E, or Z modes)
Sensor waiting time		260 ms max. (Inputs cannot be received during sensor wait time if control outputs are turned OFF.)

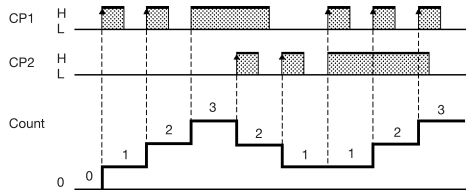
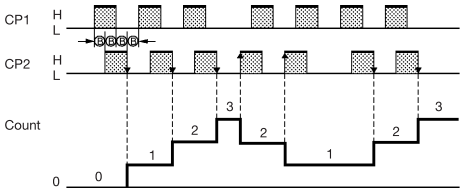
∗ The figures given for maximum counting speed are for incrementing or decrementing operation with a prescale value of x1. If prescaling is used and 5 kHz is set, the maximum counting speed will be reduced to about half. The non-prescaling maximum counting speed will also be reduced to about half when the up/down mode is selected.

† "700-HXM User Manual" pub. no. 700-UM001A-EN-D, available at: http://www.theautomationbookstore.com.

Characteristics		
Timer function		Signal start: ±0.03% ±30 ms max. Power-ON start: ±0.03% ±50 ms max.
Insulation resistance		100 mΩ min. (at 500V DC)
Dielectric strength		1,500V AC, 50/60 Hz for 1 min. between output terminals and non-current-carrying metal parts 510V AC, 50/60 Hz for 1 min. between current-carrying terminals (except output terminals) and non-current-carrying metal parts 1,500V AC, 50/60 Hz for 1 min. between output terminals and current-carrying terminals (except output terminals) 500V AC, 50/60 Hz for 1 min. between communications terminals and current-carrying terminals (except output terminals) 1,000V AC, 50/60 Hz for 1 min. between contacts not located next to each other
Noise immunity		Square-wave noise by noise simulator; ±480V (between power terminals), ±600 V (between input terminals)
Static immunity		±8 kV (malfunction), ±15 kV (destruction)
Vibration resistance	Malfunction	10…55 Hz with 0.35 mm single amplitude each in three directions for 10 min.
Shock resistance	Malfunction	100 m/s^2 (approx. 10 G), 3 times each in six directions
Life expectancy	Mechanical	10 million operations
	Electrical	100,000 operations min. (3 A at 250V AC, resistive load)
Ambient temperature	Operating	-10 °C…55 °C (with no icing or condensation)
	Storage	-25 °C…65 °C (with no icing or condensation)
Ambient humidity		25%…85%
EMC		(EMI): Emission Enclosure: EN61326 Class A (EMS): EN61326 Immunity ESD:EN61000-4-2:4 kV contact discharge (level 2) 8 kV air discharge (level 3) Immunity RF-interference:EN61000-4-3:10 V/m (Amplitude-modulated, 80 MHz…1 GHz) (level 3); 10 V/m (Pulse-modulated, 900 MHz ±5 MHz) (level 3) Immunity Conducted Disturbance:EN61000-4-6:3 V (0.15…80 MHz) (level 2) Immunity Burst:EN61000-4-4:2 kV power-line (level 3); 1 kV I/O signal-line (level 4); 1 kV communications-line (level 3) Immunity Surge:EN61000-4-5:1 kV between lines (power and output lines) (level 3); 2 kV between grounds (power and output lines) (level 3)
Approved standards		UL508, CSA C22.2 No.14 Conforms to EN61010-1/IEC61010-1 (Pollution degree 2/overvoltage category II) Conforms to VDE0106/P 100 (Finger Protection)
Enclosure ratings		Panel surface: IP66 and NEMA Type 4 (indoors) Rear case: IP20 Terminal block: IP20
Weight		Approx. 80 g
Certifications		CE Certified; UL508; CSA C22.2 No. 14; ACA
Standards		EN61010-1; IEC61010-1; VDE0106/P 100; NEMA 4/IP66; VDE0106/P100

Input/Output Modes and Count Values

		Up (Increment) Mode ✶	Down (Decrement) Mode ✶
Input edge	UP		
	DOWN		

Up/Down B Individual Input	Up/Down C Quadrature Input✶
	

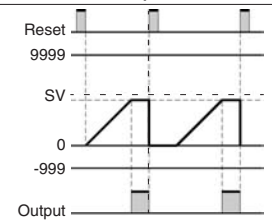
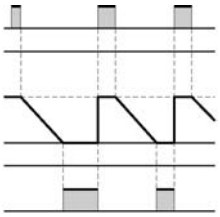
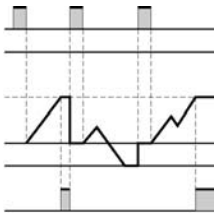
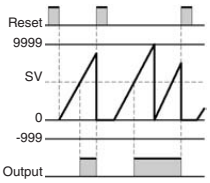
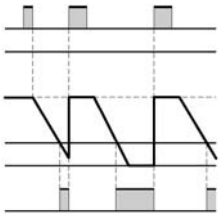
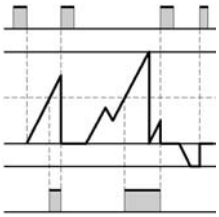
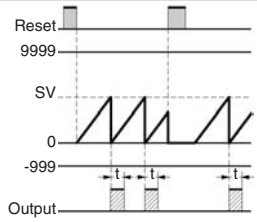
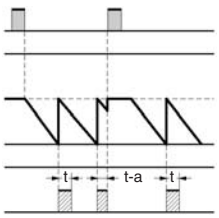
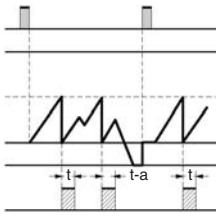
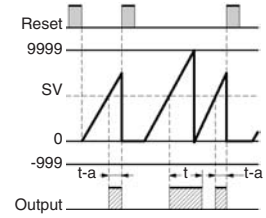
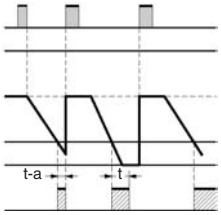
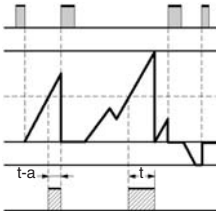
Note: H = Short-circuited
L = Open

✶ (A) indicates the minimum signal width and (B) requires at least 1/2 the minimum signal width. If these conditions are not met, a counting error (+1 or -1) may occur.

Input/Output Mode Settings

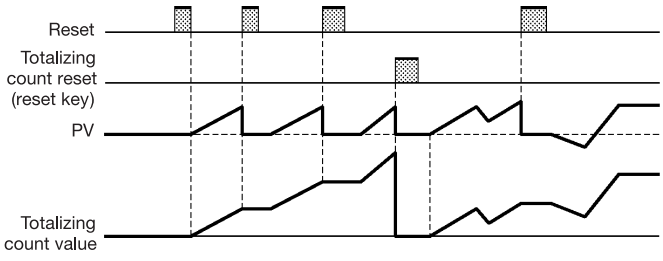
Counter Function

If there is a power failure during output ON, output will turn ON again when the power supply has recovered. For one-shot output, an output will be made again for the duration of the output time setting once the power supply has resumed.
Output timing restarted during one-shot outputs is ignored.

		Input Mode		
		Up	Down	Up/Down B.C
Output mode	N			
	F			
	C			
	K			

Note: t-a: Less than the output time
t: Output time

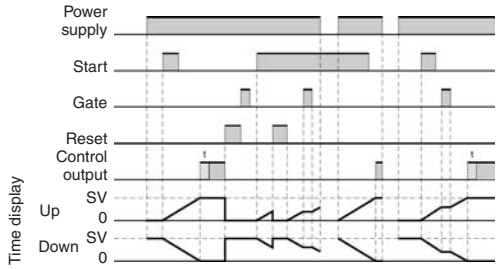
Totalizing Counter Operation



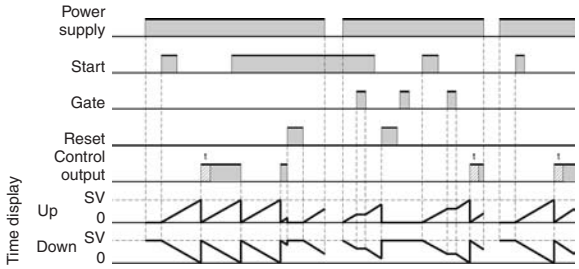
- Totalizing counter continues to count the present value, regardless of whether an reset input (by the reset key) has been made to reset the PV.
- When totalizing count value has reset, the PV is reset at the same time.
- The totalizing count range is 0…99999999. If the totalizing count exceeds 99999999, the count returns to 0. If the count drops below 0, it becomes 99999999.

Timer Function

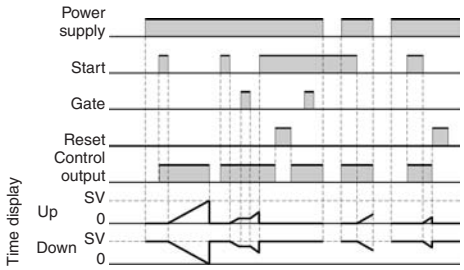
A Mode: Signal ON-Delay*



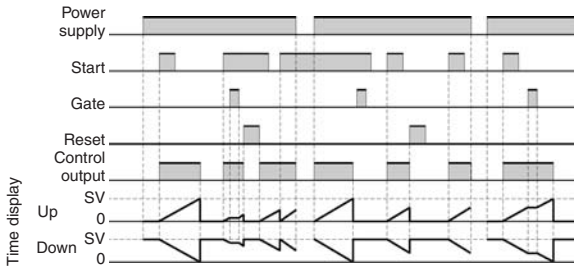
B Mode: Repeat Cycle*



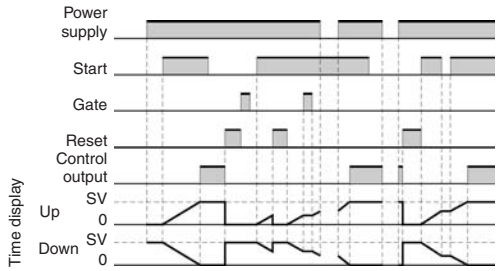
D Mode: Signal OFF-Delay



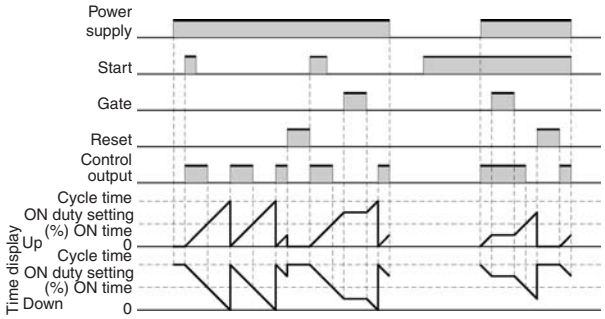
E Mode: One Shot



F Mode: Accumulative

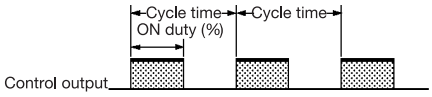


Z Mode: ON/OFF-Duty Adjustable Repeat Cycle



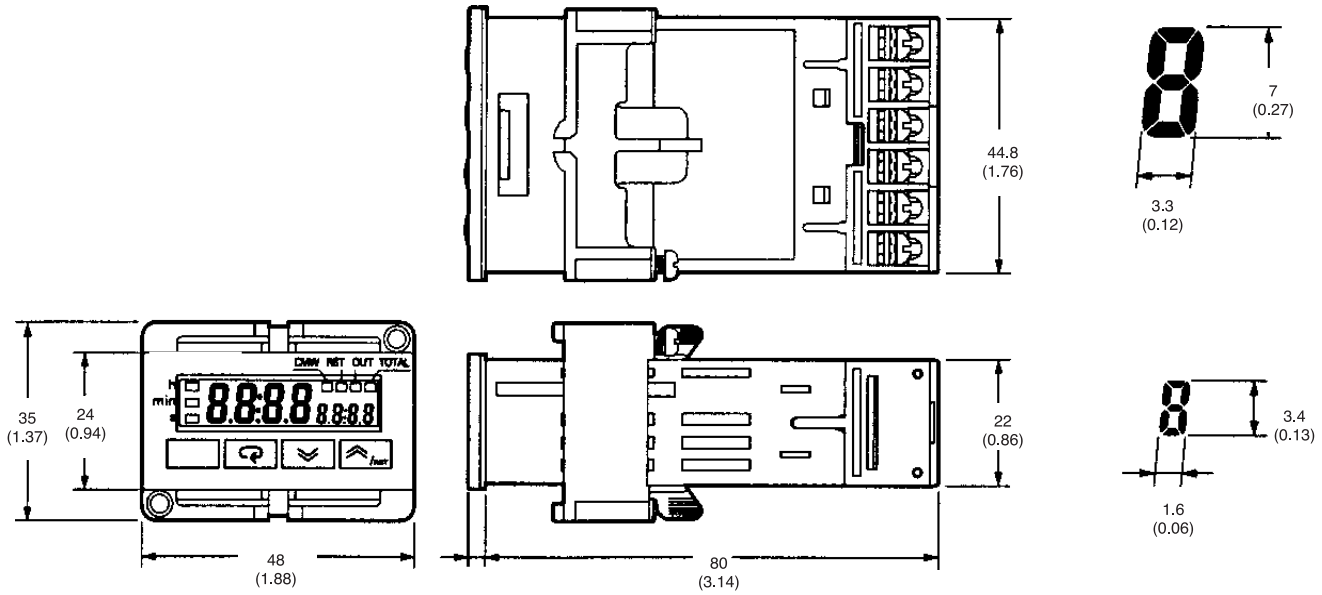
Z Mode

Output quantity can be adjusted by changing the cycle time set in the adjustment level to 1 and by changing the ON duty (%) set value. The set value shows the ON duty (%) and can be set to a value between 0 and 100 (%). When the cycle time is 0, the output will always be OFF. When the cycle time is not 0 and when ON duty has been set to 0 (%), the output will always be OFF. When ON duty has been set to 100 (%), the output will always be ON.



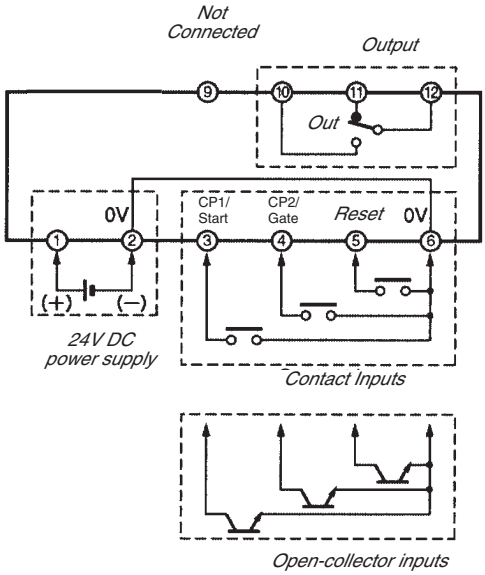
* One-shot output or HOLD output can be selected for output:

Approximate Dimensions are shown in millimeters (inches). Approximate Dimensions are not intended to be used for manufacturing purposes.



Cat. No. 700-HXM...

Terminal Arrangement



Cat. No. 700-HXM...

Heavy-Duty Industrial Relays

Overview/Product Selection

Bulletin 700-P Direct Drive™ Convertible Contact Cartridge Relays

- NEMA and IEC Ratings
- 600V Maximum AC/DC
- Accessories for Field Installation: Adder Decks, Time Delay, Latching, Surge Suppressors, Mounting Strip
- Contact Ratings: (10A) 700-CP1, (20A) 700-CPM, (35A) 700-CPH, (Low Power) 700-CPR
- For Machine Tool and Other Heavy Duty Applications
- Can Accommodate Ring Tongue Terminals
- Expands Safety Relay Outputs

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Approximate Dimensions 9-123

Certifications

- UL Listed (File No. E14840) (Guide No. NKCR) per UL 508
- CSA Certified (File No. LR1234) per CSA C22.2 No. 14
- CE Certified

Description

The Bulletin 700-P family of relays has 4 types of contact cartridges to meet your specific switching requirements. Different cartridges can be combined into one relay to yield a custom-tailored application solution. Time delay, latching attachments, overlapping and logic reed contacts are available.

Bulletin 700-P relays use standard (10A) contact cartridges with a double-break and bifurcated design. Bifurcation provides excellent contact reliability and low contact bounce, while the double-break contact design reduces the possibility of contacts welding and enhances the relay's ability to break DC circuits. These relays are supplied with a max. of 12 contacts (max. 8 N.C.).

Bulletin 700-PK master control relays contain (20A) master contact cartridges with large single-contact pads on each side of the spanner for twice the current rating to control heavy loads and for master control of a system. The Bulletin 700-PK relay also has the same doublebreak design as the 700-P relay. These relays are supplied with a max. of 12 contacts (max. 8 N.C.). Time delay and latching attachments are available.

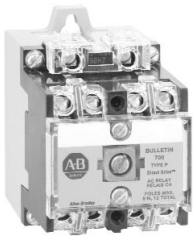
Bulletin 700-P and **-PK** relays combine the advantages of convertible contacts with **Direct Drive**, a construction designed to maintain non-overlap operation between N.O. and N.C. contacts (within published ratings).

Bulletin 700-PH relays contain (35A) tandem contact cartridges. A jumper kit (Cat No. 700-CPH) allows two (20A) master contact cartrridges to be connected in parallel. A maximum of six poles are supplied, up to four of which can be normally closed. Time delay and latch attachments are available.

Electrically Held Relays

Bulletin 700-P Standard Contact Cartridge✶†

AC-Operated Relays



Contacts N.O.	Contacts N.C.	Contact Arrangement and Markings	Open Type Relay Rail Mount Cat. No.	Open Type DIN Rail Mount Cat. No.	Type 1➤ General Purpose Cat. No.
2	—	4-Pole Relay: K1, A1X ‡, A2X, A3X, A4X ‡ / K2, A1Y, A2Y, A3Y, A4Y	700-P200⊗	700-P200D⊗	700-P201⊗
4	—		700-P400⊗	700-P400D⊗	700-P401⊗
6	—	8-Pole Relay: B1X §, B2X, B3X, B4X § / B1Y, B2Y, B3Y, B4Y	700-P600⊗	700-P600D⊗	700-P601⊗
8	—		700-P800⊗	700-P800D⊗	700-P801⊗
10	—	12-Pole Relay: C1X ♣, C2X, C3X, C4X ♣ / C1Y, C2Y, C3Y, C4Y	700-P1000⊗	700-P1000D⊗	700-P1001⊗
12	—		700-P1200⊗	700-P1200D⊗	700-P1201⊗

⊗AC Voltage Suffix Code

The Cat. No. as listed is incomplete. Select a voltage suffix code from the table below to complete the Cat. No. Example: **Cat. No. 700-P200⊗** becomes **Cat. No. 700-P200A48**. For other coil voltages, consult your local Allen-Bradley distributor.

Hz	24	48	110	110-115	115-120	120	127	200-208	220-230	230-240	277	347	380	415	440-480	460-480	500	575-600
50	B24	B48	A1⌘	B11✦	—	—	B27	—	B22	B2	—	—	B3	B41	B44	—	B50	—
60	A24	A48	—	—	A1⌘	B11✦	—	A20	A22	A2	A27	A35	—	—	—	A4	—	A6

⌘ Optimized for 115…120V, 60 Hz. Operates satisfactorily at 110V, 50 Hz.
✦ Optimized for 110…115V, 50 Hz. Operates satisfactorily at 120V, 60 Hz.

DC-Operated Relays

Contacts N.O.	Contacts N.C.	Contact Arrangement and Markings	Open Type Relay Rail Mount Cat. No.	Open Type DIN Rail Mount Cat. No.	Type 1➤ General Purpose Cat. No.
2	—	4-Pole Relay: K1, A1X ‡, A2X, A3X, A4X ‡ / K2, A1Y, A2Y, A3Y, A4Y	700DC-P200⊗	700DC-P200D⊗	700DC-P201⊗
4	—		700DC-P400⊗	700DC-P400D⊗	700DC-P401⊗
6	—	8-Pole Relay: B1X §, B2X, B3X, B4X § / B1Y, B2Y, B3Y, B4Y	700DC-P600⊗	700DC-P600D⊗	700DC-P601⊗
8	—		700DC-P800⊗	700DC-P800D⊗	700DC-P801⊗
10	—	12-Pole Relay: C1X ♣, C2X, C3X, C4X ♣ / C1Y, C2Y, C3Y, C4Y	700DC-P1000⊗	700DC-P1000D⊗	—
12	—		700DC-P1200⊗	700DC-P1200D⊗	—

⊗DC Voltage Suffix Code

The Cat. No. as listed is incomplete. Select a voltage suffix code from the table below to complete the Cat. No. Example: **Cat. No. 700DC-P200⊗** becomes **Cat. No. 700DC-P200Z48**. For other coil voltages, consult your local Allen-Bradley distributor.

6	12	18	24	32	48	64	72	90	115-125	230-250	500-550	575-600
Z06	Z12	Z18	Z24	Z32	Z48	Z64	Z72	Z90	Z1	Z2	Z5	Z6

✶ **Normally closed contacts**: The normally open contacts can easily be changed to normally closed in the field. Relays can be supplied with N.C. contacts.
† **Overlap contacts**: To order a relay containing one pair: Use **Cat. No. 700-PZ110**. To order a relay containing two pairs: Use **Cat. No. 700-PZ2220**. N.O. contact closes before N.C. contact opens. AC Ratings: NEMA A600, DC Ratings: P161.
‡ Location of contacts in 2-pole relays.
§ Location of contacts in 6-pole relays: 4-pole relay plus the 2 contacts indicated.
♣ Location of contacts in 10-pole relays: 8-pole relay plus the 2 contacts indicated.
➤ For Type 4/4X Enclosure replace 1 with 4, for Type 7 & 9 Enclosure replace 1 with 7 (Example, 700-P401 becomes 700-P404).

Heavy-Duty Industrial Relays

Product Selection, Continued

Electrically Held Relays

Bulletin 700-PK Master Contact Cartridges*†

AC-Operated Relays

Contacts N.O.	Contacts N.C.	Contact Arrangement and Markings	Open Type Relay Rail Mount Cat. No.	Open Type DIN Rail Mount Cat. No.	Type 1➤ General Purpose Cat. No.
2	—	4-Pole Relay: K1, K2; A1X‡, A2X, A3X, A4X‡; A1Y, A2Y, A3Y, A4Y	700-PK200⊗	700-PK200D⊗	700-PK201⊗
4	—		700-PK400⊗	700-PK400D⊗	700-PK401⊗
6	—	8-Pole Relay: B1X§, B2X, B3X, B4X§; B1Y, B2Y, B3Y, B4Y	700-PK600⊗	700-PK600D⊗	700-PK601⊗
8	—		700-PK800⊗	700-PK800D⊗	700-PK801⊗
10	—	12-Pole Relay: C1X♣, C2X, C3X, C4X♣; C1Y, C2Y, C3Y, C4Y	700-PK1000⊗	700-PK1000D⊗	700-PK1001⊗
12	—		700-PK1200⊗	700-PK1200D⊗	700-PK1201⊗

⊗AC Voltage Suffix Code

The Cat. No. as listed is incomplete. Select a voltage suffix code from the table below to complete the Cat. No. Example: **Cat. No.700-PK200⊗** becomes **Cat. No.700-PK200A48** for 48V 60 Hz. For other coil voltages, consult your local Allen-Bradley distributor.

Hz	24	48	110	110-115	115-120	120	127	200-208	220-230	230-240	277	347	380	415	440-480	460-480	500	575-600
50	B24	B48	A1⌘	B11✦	—	—	B27	—	B22	B2	—	—	B3	B41	B44	—	B50	—
60	A24	A48	—	—	A1⌘	B11✦	—	A20	A22	A2	A27	A35	—	—	—	A4	—	A6

⌘ Optimized for 115…120V, 60 Hz. Operates satisfactorily at 110V, 50 Hz.
✦ Optimized for 110…115V, 50 Hz. Operates satisfactorily at 120V, 60 Hz.

DC-Operated Relays

Contacts N.O.	Contacts N.O.	Contact Arrangement and Markings	Open Type Relay Rail Mount Cat. No.	Open Type DIN Rail Mount Cat. No.	Type 1➤ General Purpose Cat. No.
2	—	4-Pole Relay: K1, K2; A1X‡, A2X, A3X, A4X‡; A1Y, A2Y, A3Y, A4Y	700DC-PK200⊗	700DC-PK200D⊗	700DC-PK201⊗
4	—		700DC-PK400⊗	700DC-PK400D⊗	700DC-PK401⊗
6	—	8-Pole Relay: B1X§, B2X, B3X, B4X§; B1Y, B2Y, B3Y, B4Y	700DC-PK600⊗	700DC-PK600D⊗	700DC-PK601⊗
8	—		700DC-PK800⊗	700DC-PK800D⊗	700DC-PK801⊗
10	—	12-Pole Relay: C1X♣, C2X, C3X, C4X♣; C1Y, C2Y, C3Y, C4Y	700DC-PK1000⊗	700DC-PK1000D⊗	—
12	—		700DC-PK1200⊗	700DC-PK1200D⊗	—

⊗DC Voltage Suffix Code

The Cat. No. as listed is incomplete. Select a voltage suffix code from the table below to complete the Cat. No. Example: **Cat. No. 700DC-PK200⊗** becomes **Cat. No. 700DC-PK200Z12** for 12V DC. For other coil voltages, consult your local Allen-Bradley distributor.

6	12	18	24	32	48	64	72	90	115-125	230-250	500-550	575-600
Z06	Z12	Z18	Z24	Z32	Z48	Z64	Z72	Z90	Z1	Z2	Z5	Z6

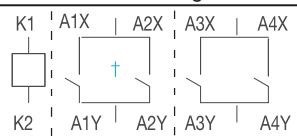
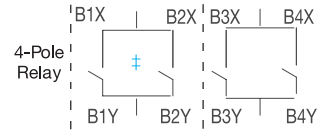
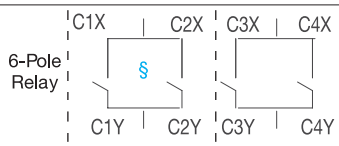
* **Normally closed contacts**: The normally open contacts can easily be changed to normally closed in the field. Relays can be supplied with N.C. contacts.
† **Overlap contacts**: To order a relay containing one pair: Use **Cat. No. 700-PZ110**. To order a relay containing two pairs: Use **Cat. No. 700-PZ2220**. N.O. contact closes before N.C. contact opens. AC Ratings: NEMA A600, DC Ratings: P161.
‡ Location of contacts in 2-pole relays.
§ Location of contacts in 6-pole relays: 4-pole relay plus the 2 contacts indicated.
♣ Location of contacts in 10-pole relays: 8-pole relay plus 2 contacts indicated
➤ For Type 4/4X Enclosure replace 1 with 4, for Type 7 & 9 Enclosure replace 1 with 7 (Example, 700-PK401⊗ becomes 700-PK404).

Electrically Held Relays

Bulletin 700-PH 35A Tandem Contact Cartridges✶

AC-Operated Relays

Cat. No. 700-PH200

Contacts N.O.	Contacts N.C.	Contact Arrangement and Markings	Open Type Relay Rail Mount Cat. No.	Open Type DIN Rail Mount Cat. No.	Type 1➤ General Purpose Cat. No.
1	—		700-PH100⊗	700-PH100D⊗	700-PH101⊗
2	—		700-PH200⊗	700-PH200D⊗	700-PH201⊗
3	—		700-PH300⊗	700-PH300D⊗	700-PH301⊗
4	—		700-PH400⊗	700-PH400D⊗	700-PH401⊗
5	—		700-PH500⊗	700-PH500D⊗	700-PH501⊗
6	—		700-PH600⊗	700-PH600D⊗	700-PH601⊗

⊗AC Voltage Suffix Code

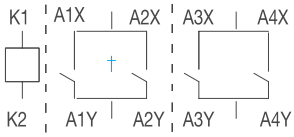
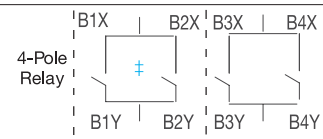
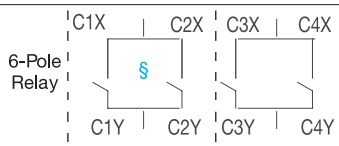
The Cat. No. as listed is incomplete. Select a voltage suffix code from the table below to complete the Cat. No. Example: **Cat. No. 700-PH100⊗** becomes **Cat. No. 700-PH100A48**. For other coil voltages, consult your local Allen-Bradley distributor.

Hz	24	48	110	110-115	115-120	120	127	200-208	220-230	230-240	277	347	380	415	440-480	460-480	500	575-600
50	B24	B48	A1⌘	B11✦	—	—	B27	—	B22	B2	—	—	B3	B41	B44	—	B50	—
60	A24	A48	—	—	A1⌘	B11✦	—	A20	A22	A2	A27	A35	—	—	—	A4	—	A6

⌘ Optimized for 115…120V, 60 Hz. Operates satisfactorily at 110V, 50 Hz.
✦ Optimized for 110…115V, 50 Hz. Operates satisfactorily at 120V, 60 Hz.

DC-Operated Relays

Cat. No. 700DC-PH200

Contacts N.O.	Contacts N.C.	Contact Arrangement and Markings	Open Type Relay Rail Mount Cat. No.	Open Type DIN Rail Mount Cat. No.	Type 1➤ General Purpose Cat. No.
1	—		700DC-PH100⊗	700DC-PH100D⊗	700DC-PH101⊗
2	—		700DC-PH200⊗	700DC-PH200D⊗	700DC-PH201⊗
3	—		700DC-PH300⊗	700DC-PH300D⊗	700DC-PH301⊗
4	—		700DC-PH400⊗	700DC-PH400D⊗	700DC-PH401⊗
5	—		700DC-PH500⊗	700DC-PH500D⊗	700DC-PH501⊗
6	—		700DC-PH600⊗	700DC-PH600D⊗	—

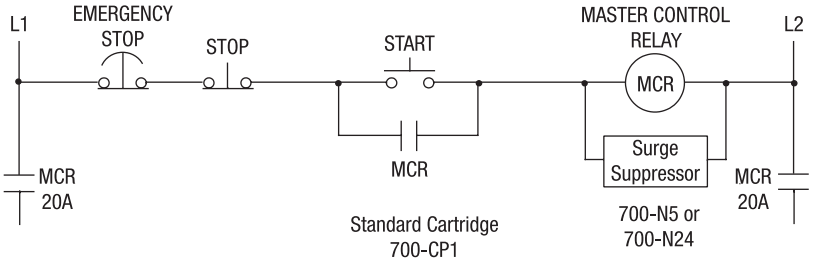
⊗DC Voltage Suffix Code

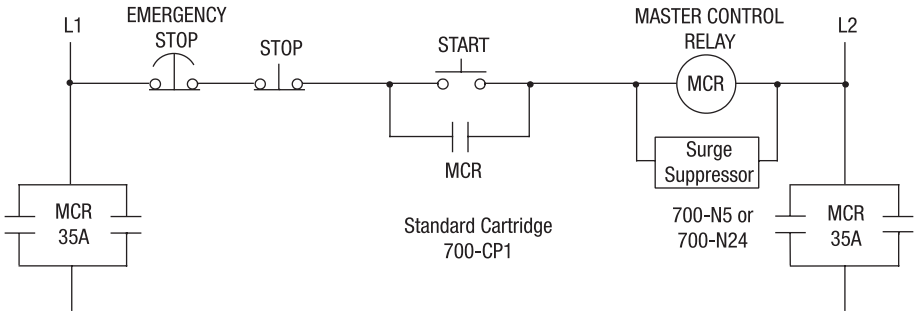
The Cat. No. as listed is incomplete. Select a voltage suffix code from the table below to complete the Cat. No. Example: **Cat. No. 700DC-PH200⊗** becomes **Cat. No. 700DC-PH200Z12**. For other coil voltages, consult your local Allen-Bradley Sales Office.

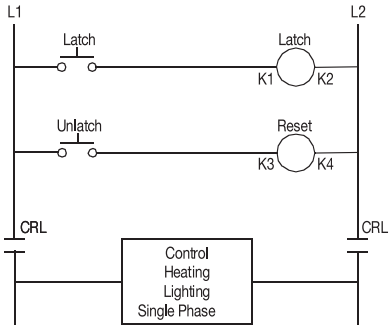
6	12	18	24	32	48	64	72	90	115-125	230-250	500-550	575-600
Z06	Z12	Z18	Z24	Z32	Z48	Z64	Z72	Z90	Z1	Z2	Z5	Z6

✶ **Normally closed contacts**: The normally open contacts can easily be changed to normally closed in the field. Relays can be supplied with N.C. contacts.
† Location of contacts in 1-pole relays.
‡ Location of contacts in 3-pole relays: 2-pole relay plus the contact indicated.
§ Location of contacts in 5-pole relays: 4-pole relay plus the contact indicated.
➤ For Type 4/4X Enclosure replace 1 with 4, for Type 7 & 9 Enclosure replace 1 with 7 (Example, 700-PH401⊗ becomes 700-PH404).

Electrically Held Relays — Typical Wiring Diagrams



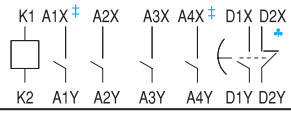
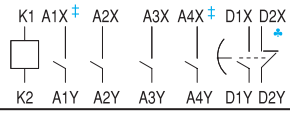




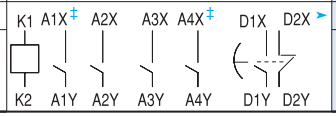
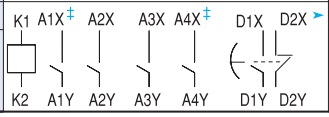
Time Delay Relays — Open Type With Pneumatic Time-Delay Attachment

- Factory-Assembled Bulletin 700-PT and PKT Timing Relays
  - – Timing Range — 0.1…60 s
  - – 0, 2, or 4 instantaneous contacts
  - – 2 timed contacts — both ON Delay or both OFF Delay
  - – Convertible from ON Delay to OFF Delay and vice versa
  - – Standard contact cartridges rated NEMA A600 (AC) and P600 (DC)
  - – Master contact cartridges rated 2X NEMA A600 (AC) and 2X P600 (DC)

Bulletin 700-P Standard Contact Cartridge✶†

AC-Operated Relays					DC-Operated Relays		
Contacts			Open Type Relay Rail Mount	Open Type DIN Rail Mount		Open Type Relay Rail Mount	Open Type DIN Rail Mount
N.O.	N.C.	Contact Arrangement and Markings	Cat. No.	Cat. No.	Contact Arrangement and Markings	Cat. No.	Cat. No.
0	—	Relay with only time delay contacts	700-PPT⊗	700-PPTD⊗	Relay with only time delay contacts	700DC-PPT⊗	700DC-PPTD⊗
2	—		700-PT200⊗	700-PT200D⊗		700DC-PT200⊗	700DC-PT200D⊗
4	—		700-PT400⊗	700-PT400D⊗		700DC-PT400⊗	700DC-PT400D⊗

Bulletin 700-PK Master Contact Cartridges✶

AC-Operated Relays					DC-Operated Relays		
Contacts			Open Type Relay Rail Mount	Open Type DIN Rail Mount		Open Type Relay Rail Mount	Open Type DIN Rail Mount
N.O.	N.C.	Contact Arrangement	Cat. No.	Cat. No.	Contact Arrangement	Cat. No.	Cat. No.
0	—	Relay with only time delay contacts	700-PPKT⊗	700-PPKTD⊗	Relay with only time delay contacts	700DC-PPKT⊗	700DC-PPKTD⊗
2	—		700-PKT200⊗	700-PKT200D⊗		700DC-PKT200⊗	700DC-PKT200D⊗
4	—		700-PKT400⊗	700-PKT400D⊗		700DC-PKT400⊗	700DC-PKT400D⊗

⊗AC Voltage Suffix Code

The Cat. No. as listed is incomplete. Select a voltage suffix code from the table below to complete the Cat. No. Example: **Cat. No. 700-PKT200⊗** becomes **Cat. No. 700-PKT200A48** for 48V 60 Hz. For other coil voltages, consult your local Allen-Bradley distributor.

Hz	24	48	110	110-115	115-120	120	127	200-208	220-230	230-240	277	347	380	415	440-480	460-480	500	575-600
50	B24	B48	A1⌘	B11✦	—	—	B27	—	B22	B2	—	—	B3	B41	B44	—	B50	—
60	A24	A48	—	—	A1⌘	B11✦	—	A20	A22	A2	A27	A35	—	—	—	A4	—	A6

⌘ Optimized for 115…120V, 60 Hz. Operates satisfactorily at 110V, 50 Hz.
✦ Optimized for 110…115V, 50 Hz. Operates satisfactorily at 120V, 60 Hz.

⊗DC Voltage Suffix Code

The Cat. No. as listed is incomplete. Select a voltage suffix code from the table below to complete the Cat. No. Example: **Cat. No. 700DC-PKT200⊗** becomes **Cat. No. 700DC-PKT200Z12** for 12V DC. For other coil voltages, consult your local Allen-Bradley Sales Office.

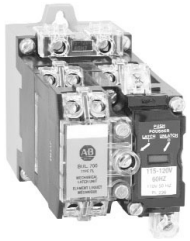
6	12	18	24	32	48	64	72	90	115-125	230-250	500-550	575-600
Z06	Z12	Z18	Z24	Z32	Z48	Z64	Z72	Z90	Z1	Z2	Z5	Z6

✶ **Normally closed contacts**: The normally open contacts can easily be changed to normally closed in the field. Relays can be supplied with N.C. contacts.
† **Overlap contacts**: N.O. contact closes before N.C. contact opens. To order a relay containing one pair: Use **Cat. No. 700-PTZ110**. To order a relay containing two pairs: Use **Cat. No. 700-PTZ2220**. AC Ratings: NEMA A600, DC Ratings: P161.
‡ Location of contacts in 2-pole relays.
♣ Timer has 1 N.O. and 1 N.C. convertible cartridge in addition to the instantaneous cartridges on the relay. Timer is supplied as On-Delay. Convertible to Off-Delay in the field.
➤ The timer has 1 N.O. and 1 N.C convertible master cartridge in addition to the instantaneous master cartridges on the relay. Timer is supplied as On-Delay. It is convertible to Off-Delay in the field.

Heavy-Duty Industrial Relays

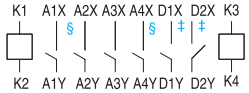
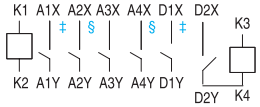
Product Selection, Continued

Mechanical Latching Relays



- Factory-Assembled Bulletin 700-PL Latching Relays
- Converts all poles to latching
- AC latch coil — max. 6 poles latching
- DC latch coil — max. 5 poles latching
- Latching relays have 2 coils — latch coil is the relay coil, reset coil is on the latch attachment
- Latch/reset coils can have 2 AC coils, 2 DC coils, or 1 AC and 1 DC coil (e.g., latch with AC power, unlatch with DC battery)

Bulletin 700-P Standard Contact Cartridge*†

AC-Operated Relays					DC-Operated Relays		
Contacts			Open Type Relay Rail Mount with Mechanical Latch Attachment (Read ATTENTION Below)	Open Type DIN Rail Mount with Mechanical Latch Attachment (Read ATTENTION Below)		Open Type Relay Rail Mount with Mechanical Latch Attachment (Read ATTENTION Below)	Open Type DIN Rail Mount with Mechanical Latch Attachment (Read ATTENTION Below)
N.O.	N.C.	Contact Arrangement and Markings	Cat. No.	Cat. No.	Contact Arrangement and Markings	Cat. No.	Cat. No.
0	—	—	—	—	—	—	—
2	—		700-PL200⊗	700-PL200D⊗		700DC-PL200⊗	700DC-PL200D⊗
4	—		700-PL400⊗	700-PL400D⊗		700DC-PL400⊗	700DC-PL400D⊗
6	—		700-PL600⊗	700-PL600D⊗		700DC-PL500⊗	700DC-PL500D⊗

6-pole Relay

5-pole Relay

⊗AC Voltage Suffix Code

The Cat. No. as listed is incomplete. Select a voltage suffix code from the table below to complete the Cat. No. Example: **Cat. No. 700-PL200⊗** becomes **Cat. No. 700-PL200A48**. For other coil voltages, consult your local Allen-Bradley Sales Office.
Relays with latch attachments: if the latch attachment coil is to be a different voltage other than the relay coil, add a second coil code suffix. Example: **Cat. No. 700-PL400A1A24**. Only one suffix is required if both coils are the same voltage.

Hz	24	48	110	110-115	115-120	120	127	200-208	220-230	230-240	277	347	380	415	440-480	460-480	500	575-600
50	B24	B48	A1⌘	B11✦	—	—	B27	—	B22	B2	—	—	B3	B41	B44	—	B50	—
60	A24	A48	—	—	A1⌘	B11✦	—	A20	A22	A2	A27	A35	—	—	—	A4	—	A6

⌘ Optimized for 115…120V, 60 Hz. Operates satisfactorily at 110V, 50 Hz.
✦ Optimized for 110…115V, 50 Hz. Operates satisfactorily at 120V, 60 Hz.

⊗DC Voltage Suffix Code

The Cat. No. as listed is incomplete. Select a voltage suffix code from the table below to complete the Cat. No. Example: **Cat. No. 700DC-PL200⊗** becomes **Cat. No. 700DC-PL200Z12**. For other coil voltages, consult your local Allen-Bradley Sales Office.

6	12	18	24	32	48	64	72	90	115-125	230-250	500-550	575-600
Z06	Z12	Z18	Z24	Z32	Z48	Z64	Z72	Z90	Z1	Z2	Z5	Z6

ATTENTION – An open or failed unlatch control circuit will fail to unlatch the relay. For this reason, a mechanical latch unit should not be used where protection is needed against automatic restart after a power failure or where reliability to a control function is critical to safety.
* **Normally closed contacts**: The normally open contacts can easily be changed to normally closed in the field. Relays can be supplied with N.C. contacts.
† **Overlap contacts**: To order a relay containing one pair: Use **Cat. No. 700-PTZ110**. To order a relay containing two pairs: Use **Cat. No. 700-PTZ2220**. N.O. contact closes before N.C. contact opens. AC Ratings: NEMA A600, DC Ratings: P161.
‡ Location of contacts in 2-pole relays.
§ Location of contacts in 4-pole relays: 2-pole relay plus the 2 contacts indicated.

Adder Decks

Second Deck
Cat. No. 700-PB40

Description	No. of N.O. Contacts	No. of N.C. Contacts	Continuous Carrying Current (A)	Arrangement	Cat. No.
Second Deck (2-pole)	2	—	10	B1X B4X / B1Y B4Y	700-PB20
	2	—	20		700-PKB20
Second Deck (4-pole)	4	—	10	B1X B2X B3X B4X / B1Y B2Y B3Y B4Y	700-PB40
	4	—	20		700-PKB40
Third Deck (2-pole)	2	—	10	C1X C4X / C1Y C4Y	700-PC20
	2	—	20		700-PKC20
Third Deck (4-pole)	4	—	10	C1X C2X C3X C4X / C1Y C2Y C3Y C4Y	700-PC40
	4	—	20		700-PKC40

Third Deck
Cat. No. 700-PC40

Contact Cartridges (Convertible from N.O. to N.C. and N.C. to N.O.)

Standard Contact Cartridge
Cat. No. 700-CP1, -CP11Z

Master Contact Cartridge
Cat. No. 700-CPM

Logic Reed Cartridge
Cat. No. 700-CPR

Description		Continuous Carrying Current (A)	Arrangement	Pkg. Quantity	Cat. No.
Standard Contact Cartridge AC Rating NEMA A600 DC Rating NEMA P600		10	OR	1	700-CP1
Overlap Contact Cartridges Overlapping Used in pairs. N.O. contact closes before N.C. contact opens on pick-up and vice versa on drop-out.♣	AC Rating NEMA A600	10	OR	2	700-CP11Z
	DC Rating NEMA P150 125V DC, 138 VA Make and Break	5			
Master Contact Cartridge AC Rating Twice NEMA A600 DC Rating Twice NEMA P600		20	OR	1	700-CPM
Logic Reed Cartridge for Low Energy Circuits 150V AC 500 mA 25 VA Max. 30V DC 200 mA 6 W Max.	Maximum 150V AC	500 mA	OR	1	700-CPR
	Maximum 30V DC	200 mA			
Safety Contact Cartridge 10 A cartridge meeting IEC 947-5 Note: Use this cartridge when full compliance to IEC 947-5 is required. 700-P relays equipped with CPS cartridges fully meet the IEC 947-5 spec for mechanically linked contacts.		10	OR	1	700-CPS

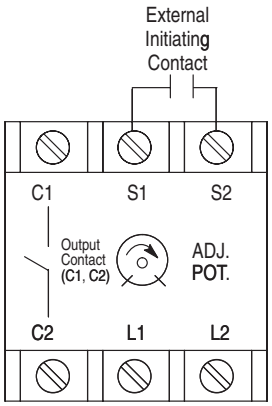
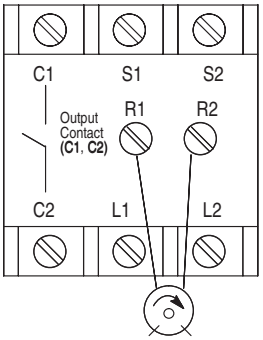
♣ Not Direct Drive.

International Symbol for Mechanically Linked Contacts	

Heavy-Duty Industrial Relays

Accessories, Continued

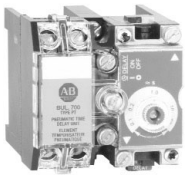
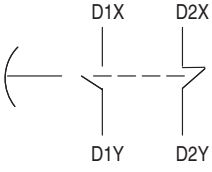
Bulletin 700-PS and -PSR Solid-State Timers*

	Description	Continuous Carrying Current (A)	Arrangement	Timing Range†	Cat. No.
	Self-Contained Potentiometer On-Delay	5	 110/120V, 50/60 Hz Power	0.1…2 s	700-PSAA1
				0.4…8 s	700-PSBA1
				1.5…30 s	700-PSCA1
				6…120 s	700-PSDA1
	Off-Delay			0.1…2 s	700-PSPA1
				0.4…8 s	700-PSRA1
				1.5…30 s	700-PSTA1
				6…120 s	700-PSUA1
	External Potentiometer On-Delay	5	 Remote Pot. Max. Shielded Cable Length 50 FT UL Style #2517 or Equivalent	0.1…2 s	700-PSRAA1
				0.4…8 s	700-PSRBA1
				1.5…30 s	700-PSRCA1
				6…120 s	700-PSRDA1
	Off-Delay			0.1…2 s	700-PSRPA1
				0.4…8 s	700-PSRRA1
				1.5…30 s	700-PSRTA1
				6…120 s	700-PSRUA1

Remote Potentiometers for Cat. No. 700-PSR…

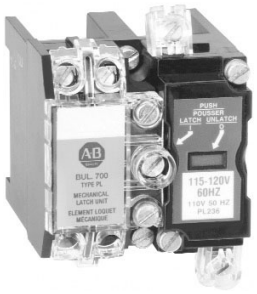
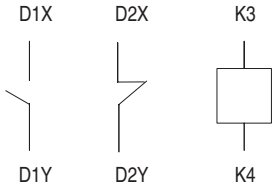
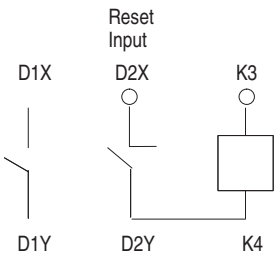
Timing Range (s)	Resistance (mΩ)	Cat. No.
0.1…2	0.75	700-N35
0.4…8	0.75	700-N35
1.5…30	2.0	700-N36
6…120	3.5	700-N37

Pneumatic Time-Delay Unit – 1 N.O. and 1 N.C. Convertible Contact Cartridge*

	Description			Continuous Carrying Current (A)	Arrangement	Timing Range	Open Type Without Enclosure
	Operating Mode	No. of N.O. Contacts	No. of N.C. Contacts				Cat. No.
 *Pneumatic Time-Delay*	On-Delay Off-Delay	1	1	10		0.1…60 s	700-PT
				20			700-PKT

* Mounts on 4-pole Bulletin 700-P or -PK relay or 2-pole Bulletin 700-PH relay.
† Maximum time may be 50% greater and the minimum time may be 50% less than the value specified.

Mechanical Latch Units

	Description	Arrangement	Continuous Carrying Current (A)	Cat. No.
	AC-Operated Latch Units		No cartridge	700-PLL⊗
			10	700-PLL11⊗
			20	700-PKLL11⊗
	DC-Operated Latch Units		No cartridge	700DC-PLL⊗
			10	700DC-PLL10⊗
			20	700DC-PKLL10⊗

⊗AC Voltage Suffix Code

The Cat. No. as listed is incomplete. Select a voltage suffix code from the table below to complete the Cat. No. Example: **Cat. No. 700-PLL⊗** becomes **Cat. No. 700-PLLA1**. For other coil voltages, consult your local Allen-Bradley distributor.

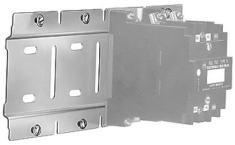
Hz	24	48	110	110-115	115-120	120	127	200-208	220-230	230-240	277	347	380	415	440-480	460-480	500	575-600
50	B24	B48	A1∗	B11†	—	—	B27	—	B22	B2	—	—	B3	B41	B44	—	B50	—
60	A24	A48	—	—	A1∗	B11†	—	A20	A22	A2	A27	A35	—	—	—	A4	—	A6

∗ Optimized for 115…120V, 60 Hz. Operates satisfactorily at 110V, 50 Hz.
† Optimized for 110…115V, 50 Hz. Operates satisfactorily at 120V, 60 Hz.

⊗DC Voltage Suffix Code

The Cat. No. as listed is incomplete. Select a voltage suffix code from the table below to complete the Cat. No. Example: **Cat. No. 700DC-PLL⊗** becomes **Cat. No. 700DC-PLLZ12**. For other coil voltages, consult your local Allen-Bradley Sales Office.

6	12	18	24	32	48	64	72	90	115-125	230-250	500-550	575-600
Z06	Z12	Z18	Z24	Z32	Z48	Z64	Z72	Z90	Z1	Z2	Z5	Z6

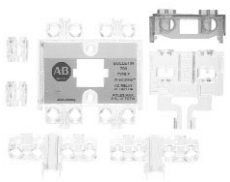
	Description	Relays per Strip	Pkg. Quantity	Cat. No.
 *Mounting Strip Cat. No. 700-MP4*	**Relay Rail** Simplifies panel layout. These indexed strips are easily cut to the required length and bolted, riveted, or spot-welded in place. Relays are installed adjacent to one another on the mounting strip with the captive mounting screws provided. Rows of relays on Relay Rail form their own wiring trough. Can be used with the following relays: 700P, 700-PK, 700PH, 700S-P, 700N, 700-R, 700-RTC	4 Relays per Strip	5	700-MP4
		8 Relays per Strip	5	700-MP8
		12 Relays per Strip	5	700-MP12
		16 Relays per Strip	5	700-MP16
Cat. No. 700-DRA	**DIN Rail Adapter** Can be used with the following relays: 700P, 700-PK, 700-PH, 700S-P, 700-N, 700-R, 700-RTC		1	700-DRA
199-DR1	**DIN (#3) Symmetrical Rail** 35 mm x 7.5 mm x 1 m long Zinc-plated, yellow chromated EN 50022		10	199-DR1
Cat. No. 700-N31	**Type 1 Enclosure –** Use for all Bulletin 700-P, -PH and -PK relays except 10- and 12-pole DC relays or 5- and 6-pole DC Bulletin 700-PH relays.		1	700-N31
	Type 4/4X Enclosure – For 2- and 4-pole Bulletin 700-P, -PH, -N and -R relays and 2-pole Bulletin 700-PH relays.		1	700-N39
	Type 7 & 9 Enclosure – For 2- and 4-pole Bulletin 700-P, -PK, -N and -R relays and 2-pole Bulletin 700-PH relays. 1 conduit hub; top and bottom.		1	700-N33

Heavy-Duty Industrial Relays

Accessories, Continued

	Description		Pkg. Quantity	Cat. No.
Surge Suppressor ***Cat. No. 700-N5***	**Surge Suppressors (RC Circuit) —** Surge suppressors reduce the high transient voltages generated when the coil circuit is opened. These suppressors can be used with Bulletin 700-P, -PH, -PK and -N relays, and other electromechanical devices. They contain a resistor and capacitor. Maximum ratings: 150V, AC or DC, 35 VA. Cat. No. 700-N5 requires 1 in. additional depth of enclosure.	Mounting behind relay	1	700-N5
Surge Suppressor ***Cat. No. 700-N24***		Mounting on coil terminal	1	700-N24
Surge Suppressor ***Cat. No. 199-FSMA1***	**Surge Suppressor** When the circuit to a DC operating coil is opened, the inductive energy stored in the coil can generate very high transient voltages. With the addition of the appropriate surge suppressor, the stored energy is absorbed and dissipated limiting the voltage spikes. A surge suppressor is not required with AC 700-R or -RM relays because the AC operating coil transients are suppressed by a full wave rectifier connected to the coil.	24…48V AC/DC	1	199-FSMA9
		50…120V AC/DC	1	199-FSMA10
		130…250V AC/DC	1	199-FSMA11
	Diode Surge Suppressor – for 6…300V DC voltage coils. Used on Bulletin 700-P, -PH, -PK, -N, -F, and -R relays.		1	199-FSMZ-1
35A Jumper Kit ***Cat. No. 700-CPH***	**35 A Jumper Kit –** CSA Approved, UL Listed This 35 A Jumper Kit can be used with any Bulletin 700-P and -PK AC or DC relay, Time-Delay relay or Latch Unit equipped with 20 A Master Cartridges. It does not require any additional panel space. Jumper Kit terminals are designed for one #8 AWG wire or two #10 AWG wires. When connecting the two 20 A Master Cartridges in parallel, it is important that they be the same configuration (Normally Open or Normally Closed). Jumpers can be added to any contact cartridge location on a relay except the two center poles because of the wide spacing. An adhesive label is included with each kit listing the contact ratings.		1	700-CPH
Jumper ***Cat. No. 700-N3*** *Jumper* ***Cat. No. 700-N4***	**Jumpers** (Not applicable for Bulletin 700-PH or -PK relays) – For connection between a middle pole and an outer pole on the left or right side of the relay	**Jumper** – For outer poles	50	700-N3
	Jumpers (Not applicable for Bulletin 700-PH or -PK relays) – For connection between two middle poles.	**Jumper** – For middle poles		700-N4
Check Out Tool ***Cat. No. 700-N23***	**Check Out Tool —** Mechanically maintains the Bulletin 700-P, -PH or -PK relay in the energized position for troubleshooting purposes.		1	700-N23
	Adapter Plate — Simplified relay conversion. Allows you to use the existing mounting holes when you replace a Bulletin 700-B, -BR, -BX or -D relay with a Bulletin 700-P, -PH, or -PK relay.			700-N34
	Protective Cover — For 700-PT Timing Adjustment Knob. Helps prevent tampering with time setting.		5	700-N38

IP 2x Finger-Safe Cover Accessories



Description	Pkg. Quantity	Cat. No.
Top Covers (Covering Top Level Contact Screws)		
IP2X Top Cover for 700-P, (AC Standard Relays)	5	700-PFSACT
IP2X Top Cover for 700-P, (DC Standard Relays)	5	700-PFSDCT
IP2X Top Cover for 700PK, (AC Master Control Relays)	5	700-PFSAPKT
IP2X Top Cover for 700PK, (DC Master Control Relays)	5	700-PFSDPKT
Timer Top Cover Kit, (for Relays with Pneumatic Latch Attachment)	5	700-PFSTC
Timer Top Cover Kit (for Relays with Mechanical Latch Attachment)	5	700-PFSLCK
Timer Top Cover Kit, (for Master Cont. Relays with Pneumatic Timer)	5	700-PFSKTC
Latch Top Cover Kit (for Master Cont. Relays with Mechanical Latch)	5	700-PFSKLCK
Deck Covers (Covering all terminals not on top deck, only for multi-deck relays)		
IP2X Deck Cover for all AC & DC Relays in the 700P Range	10	700-PFSDEK
Coil Covers		
IP2X Coil Cover for all AC Relays in the 700P Range	5	700-PFSACC
IP2X Coil Cover for all DC Relays in the 700P Range	5	700-PFSDCC

Type			700-P, PLL, PT						700-PK, PKLL, PKT						700-PH					
Electrical																				
Contact Rating Continuous			10 A @ 600V AC 5 A @ 600V DC						20 A @ 600V AC 10 A @ 600V DC						35 A @ 600V AC 20 A @ 600V DC					
Ratings Make/Break		AC	NEMA A600						2 x NEMA A600						2 x NEMA A600					
		DC	NEMA P600						2 x NEMA P600						2 x NEMA P600					
Additional Contact Ratings for AC single-phase loads			—						3 Hp @ 240V AC - N.O. 2 Hp @ 240V AC - N.O./N.C. 1 Hp @ 120V AC - N.O./N.C. 20 A Resistive Heating to 600V AC 20 A Tungsten Lighting Load to 480V AC						5 Hp @ 240V AC - N.O. 3 Hp @ 240V AC - N.O./N.C. 2 Hp @ 120V AC - N.O./N.C. 35 A General Use At 0.75 PF to 600V AC 35 A Tungsten Lighting Load to 480V AC					
DC Current Ratings Make/Break			Cartridge Cat. No. 700-CP1						Cartridge Cat. No. 700-CPM						Cartridge Cat. No. 700-CPH					
DC Switching		Contacts in Series	Volts DC																	
			24	64	125	250	500	600	24	64	125	250	500	600	24 480W	64 480W	125 275W	250 138W	500 135W	600 120W
		1	5 A	2.2 A	1.1 A	.55 A	.24 A	.2 A	10 A	5 A	2.2 A	.55 A	.24 A	.2 A	10 A	5 A	2.2 A	.55 A	.24 A	.2 A
		2	10 A	10 A	5 A	2 A	.7 A	.5 A	20 A	10 A	5 A	2 A	.7 A	.5 A	20 A	10 A	5 A	2 A	.7 A	.5 A
		3	—	—	7 A	3 A	1.5 A	1.0 A	—	15 A	7 A	3 A	1.5 A	1.0 A	—	15 A	7 A	3 A	1.5 A	1.0 A
		4	—	—	10 A	5 A	2.5 A	1.5 A	—	20 A	10 A	5 A	2.5 A	1.5 A	—	20 A	10 A	5 A	2.5 A	1.5 A
Coil Voltage Range		AC	85…110%						85…110%						85…110%					
		DC	80…110%						80…110%						80…110%					
		Battery Charging	85…115%						85…115%						85…115%					
Coil Consumption P-PH-PK			50 Hz			60 Hz			50 Hz			60 Hz			50 Hz			60 Hz		
	A C	Inrush	132 VA†			138 VA†			132 VA†			138 VA†			132 VA†			138 VA†		
	A C	Sealed	19.3 VA†			19 VA†			19.3 VA†			19 VA†			19.3 VA†			19 VA†		
	D C	Inrush	12.7 VA†						12.7 VA†						12.7 VA†					
	D C	Sealed	12.7 VA†						12.7 VA†						12.7 VA†					
PLL - PKLL AC Latch Unit		Inrush	15 VA†			15.6 VA†			5 VA†			15.6 VA†			15 VA†			15.6 VA†		
		Sealed	5.4 VA†			5.5 VA†			5.4 VA†			5.5 VA†			5.4 VA†			5.5 VA†		
PLL - PKLL DC Latch Unit		Unlatch	35 VA†						35 VA†						—					
		Intermittent	35 W†						35 W†						—					
Reset Time		PT – PKT	75 ms						75 ms						—					
Minimum Pulse		PLL–PKLL	75 ms						75 ms						—					
Mechanical																				
Operating Time		Pickup	AC – 10…20 ms DC – 30…50 ms						AC – 10…20 ms DC – 30…50 ms						AC – 10…20 ms DC – 30…50 ms					
		Dropout	AC – 10…20 ms DC – 20…33 ms						AC – 10…20 ms DC – 20…33 ms						AC – 10…20 ms DC – 20…33 ms					
Mechanical Life			10 million operations																	
Construction																				
Contact Arrangement			Up to 12 Poles, Convertible to N.O. or N.C. (8 N.C. Maximum)						Up to 12 Poles, Convertible to N.O. or N.C. (8 N.C. Maximum)						Up to 6 Poles, Convertible to N.O. or N.C. (4 N.C. Maximum)					
Contact Material			Nickel Silver						Silver Cadmium Oxide						Silver Cadmium Oxide					
Mounting			Panel or Strip Mount Horizontal Mounting Recommended						Panel or Strip Mount Horizontal Mounting Recommended						Panel or Strip Mount Horizontal Mounting Recommended					
Environmental																				
Temperature		Operating*	–20…+65 °C (–4…149 °F)						–20…+65 °C (–4…149 °F)						–20…+65 °C (–4…149 °F)					
		Storage	–40…+65 °C (–40…149 °F)						–40…+65 °C (–40…149 °F)						–40…+65 °C (–40…149 °F)					
Certifications			CSA Certified, CSA File #LR1234, UL Listed, UL File #E14840, Guide NKCR, CE Certified																	
Standards			IEC 947-5-1, IEC 337-1 CENELEC, BS 4794, VDE 0660, Listed: U.S. Coast Guard and American Bureau of Shipping, UL508, CSA 22.2																	
Wire Terminations																				
Wire size per UL/CSA			#18 AWG…(2) #12 AWG																	
Tightening Torque			8…12 lb-in. (0.9…1.4 N•m)																	

* Temperature inside the panel.
† Average value for all coils within range. For values on a specific coil voltage, contact your local Allen-Bradley distributor.

Heavy-Duty Industrial Relays

Specifications, Continued

Operating Coils

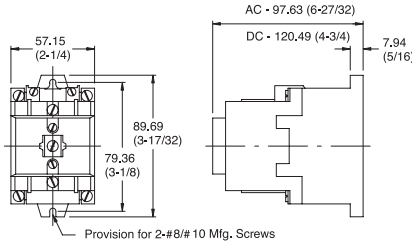
Bulletin 700 Bulletin 700-P-PH-PK Relays — Bulletin 700-PLL-PKLL Mechanical Latch Attachments*

	Coil Volts*	Bulletin 700-P, -PK 2…12-pole, Bulletin 700-PH 1…6-pole AC		Bulletin 700-PLL–PKLL AC Mechanical Latch Attachment		Bulletin 700-P-PK …12-pole, Bulletin 700-PH …6-pole DC
		60 Hz	50 Hz	60 Hz	50 Hz	—
Bulletin 700-P Operating Coil	24	PA013	PA407	PL013	PL407	PD714
	32	—	—	—	—	PD718
	48	PA222	PA314	PL222	PL314	PD724
	110†	—	PA236	—	PL236	PD733 § (100…110)
	115…120†	PA236	—	PL236	—	—
	110…115‡	—	PA322	—	PL322	—
	115…125	—	—	—	—	PD735
	120‡	PA322	—	PL322	—	—
	130…140	—	—	—	—	PD738
Bulletin 700-PL Unlatch Coil and Magnet Assembly	200…208	PA249	—	PL249	—	—
	220…230	PA251	PA339	—	PL339	—
	230…240	PA254	PA342	PL254	PL342	—
	230…250	—	—	PD748	—	PD748
	277	PA260	—	—	—	—
	380	—	PA354	—	PL354	—
	415	—	PA357	—	PL357	—
	440…460	—	PA360	—	PL360	—
	460…480	PA273	—	PL273	—	—
	500	—	PA364	—	PL364	PD759
	575…600	PA278	—	PL278	—	PD758

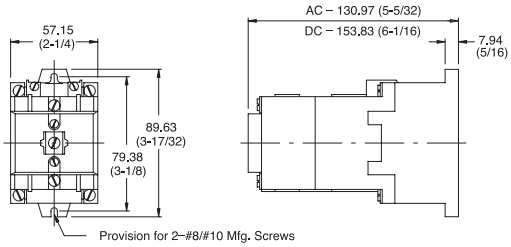
* Coils for AC relays cannot be used in DC relays and vice versa.
† This coil is optimized for 115…120V, 60 Hz applications and will operate satisfactorily at 110V, 50 Hz.
‡ This coil is optimized for 110…115V, 50 Hz applications and will operate satisfactorily at 120V, 60 Hz.
§ This coil is designed and marked for use at 100…110V DC.

Dimensions are shown in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

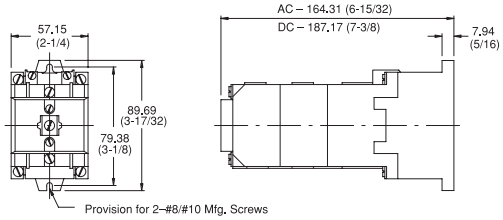
Bulletin 700-P, -PH and -PK Relays



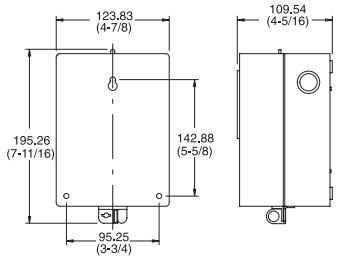
2- and 4-pole Bulletin 700-P, -PK Relay — 2-pole Bulletin 700-PH Relay
Approximate Shipping Weight AC – 0.68 kg (1.5 lbs.),
DC – 1.34 kg (2.95 lbs.)



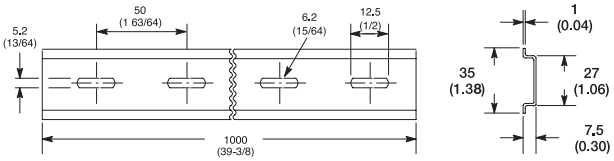
6- and 8-pole Bulletin 700-P, or -PK Relay — 4-pole Bulletin 700-PH Relay
Approximate Shipping Weight AC – 0.79 kg (1.75 lbs.),
DC – 1.45 kg (3.20 lbs.)



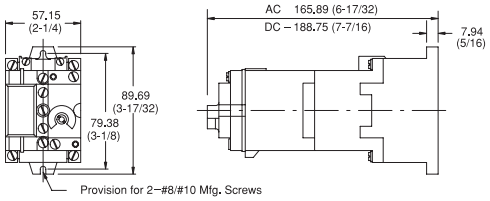
10- and 12-pole Bulletin 700-P, DIN Rail Adapter or -PK Relay — 6-pole
Bulletin 700-PH Relay Approximate Shipping Weight
AC – 1.02 kg (2.25 lbs.), DC – 1.68 kg (3.7 lbs.)



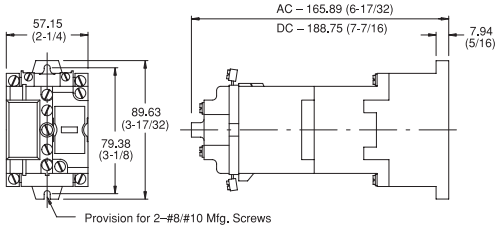
Type 1 Enclosure (Approximate Shipping Weight 1.04 kg (2.3 lb.)
for Bulletin 700-P or -PK Relay (2…4-pole);
Bulletin 700-PH Relay (1…2-pole only);
Cat. No. 700-N31 NEMA Type 1 Enclosure for other Bulletin 700-P, -PH, -PK, -RTC Relays has
same Approximate Dimensions except the depth is 178 mm (7”).
Approximate Shipping Weight 1.26 kg (2.8 lb.)



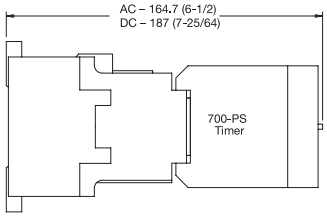
Cat. No. 199-DR1 DIN Mounting Rail Series B
Cat. No. 199-DR4 DIN Mounting Rail Series B Has No Mounting Holes



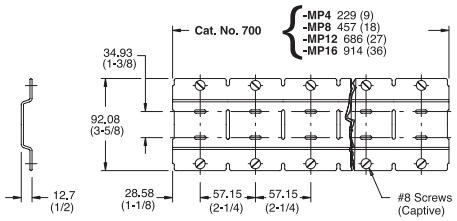
2- and 4-pole Bulletin 700-P or -PK Relay or 2-pole Bulletin 700-PH Relay with Pneumatic Time Delay Attachment
Approximate Shipping Weight AC – 0.85 kg (1.88 lbs.),
DC – 1.5 kg (3.33 lbs.)



2- and 4-pole Bulletin 700-P or -PK Relay or 2-pole Bulletin 700-PH Relay with Mechanical Latch Attachment
Approximate Shipping Weight AC – 0.97 kg (2.13 lbs.),
DC – 1.62 kg (3.58 lbs.)



Bulletin 700-PS Timer Mounted on a 4-pole Bulletin 700 Bulletin 700-P or -PK Relay or 2-pole Bulletin 700-PH Relay.
Approximate Shipping Weight AC – 0.68 kg (1.5 lbs.) without 700-PS,
eDC – 1.34 kg (2.9 lbs.) without 700-PS



Relay Rail for Bulletin 700-P, -PH, -PK, -N, -NM, -R, -RM, -RT, -RTA Relays

Secure the mounting strip with 2 screws at each end relay position.
Use a minimum of one screw at the 3rd, 5th, 7th, etc., relay positions.
Alternate between upper and lower horizontal slots.

Heavy-Duty Industrial Safety Relays

Product Selection/Overview

Bulletin 700S-P

- Mechanically Linked Contacts meet IEC 947-5-1-L
- 2...12 poles – all Mechanically Linked
- Red Faceplate for Easy Identification of Safety Circuits
- IEC Mechanically linked Contacts Symbol Displayed on Front
- Double-break Contacts to Reduce Probability of Welded Contacts
- Visual Indication of Contact State
- Tamper Resistant Cover Helps Prevent Changes Which Could Jeopardize Safety
- Complete Catalog Number Displayed on Front
- Ideal for use in Safety Circuits

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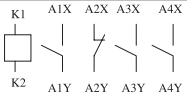
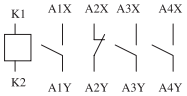
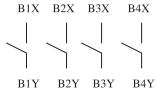
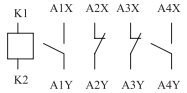
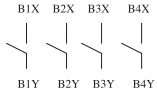
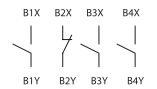
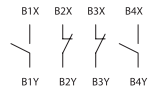
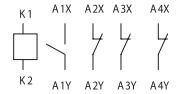
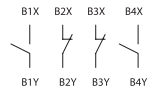
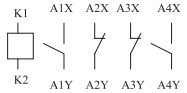
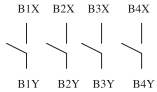
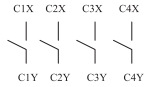
Approximate Dimensions 9-126

Certifications

- UL Listed (File No. E14840) (Guide No. NKCR) per UL 508
- CSA Certified (File No. LR1234) per CSA C22.2 No. 14
- CE Certified

Type S-P Safety Control Relays — AC and DC Coil Voltages

Connection Diagrams and terminal markings			Contacts		AC Coils	24V DC Coils
Coil and Main Contacts	Additional Contacts	Additional Contacts	N.O.	N.C.	Cat. No.∗	Cat. No.∗
	—	—	3	1	700S-P310⊗	700S-DCP310Z24
	—	—	2	2	700S-P220⊗	700S-DCP220Z24
		—	7	1	700S-P710⊗	700S-DCP710Z24
		—	6	2	700S-P620⊗	700S-DCP620Z24
		—	5	3	700S-P530⊗	700S-DCP530Z24
		—	4	4	700S-P440⊗	700S-DCP440Z24
		—	3	5	700S-P350⊗	700S-DCP350Z24
			10	2	700S-P1020⊗	700S-DCP1020Z24

⊗AC Voltage Suffix Code

The Cat. No. as listed is incomplete. Select a voltage suffix code from the table below to complete the Cat. No.
Example: Cat. No. 700S-P310 becomes Cat. No. 700S-P310A1 for a 120V AC coil.

Hz	24	115-120	230-240	277	460-480
60	A24	A1	A2	A27	A4

∗ For other coil voltages, consult your local Allen-Bradley Distributor.

IEC 947-5-1 Annex L has 2 requirements for a relay to meet for mechanically linked contacts:
1.) If a N.O. contact welds, all the N.C. contacts will remain open and meet a 2500V impulse test.
2.) If a N.C. contact welds, all the N.O. contacts will remain open and meet a 2500V impulse test.
700S-P and 700S-DCP relays meet these requirements including the 2500V impulse test.
The relays shown on this page are shipped from the factory with the 700-CPS cartridge installed and can not be converted to N.O. or N.C. in the Field.

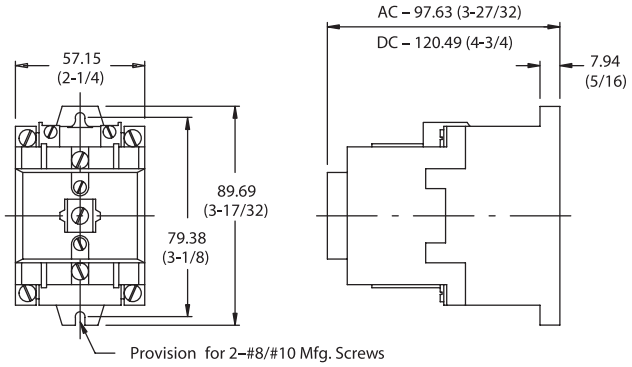
Type			700S-P					
Electrical								
Contact Rating Continuous			10 A @ 600V AC 5 A @ 600V DC					
Ratings Make/Break		AC	NEMA A600					
		DC	NEMA P600					
Minimum Contact Switching Ratings			10V, 50 mA					
DC Switching		Contacts in Series	Volts DC					
			24V	64V	125V	250V	500V	600V
		1	5 A	2.2 A	1.1 A	0.55 A	0.24 A	0.2 A
		2	10 A	10 A	5 A	2 A	0.7 A	0.5 A
		3	—	—	7 A	3 A	1.5 A	1.0 A
		4	—	—	10 A	5 A	2.5 A	1.5 A
Contact Electrical Life—Resistive Loads			1.5 million operations at 10A break at 120V AC 14 million operations at 1A break at 120V AC 6 million operations at 1A break at 24V DC					
Coil Voltage Range*		AC	85…110%					
		DC	80…110%					
		Battery Charging	85…115%					
Coil Consumption			50 Hz			60 Hz		
	AC	Inrush	132 VA			138 VA		
		Sealed	19.3 VA			19 VA		
	DC	Inrush	12.7 W					
		Sealed	12.7 W					
Mechanical								
Mechanically Linked Contacts			All contacts are mechanically linked per IEC 947-5-1 annex L for 2 to 12 poles					
Operating Time		Pickup	AC – 10…20 ms DC – 30…50 ms					
		Dropout	AC – 10…20 ms DC – 20…33 ms					
Mechanical Life			12.5 million operations†					
Construction								
Contact Arrangement			2 to 12 Poles, Double Break Contacts N.O. or N.C. (8 N.C. Maximum)					
Contact Material/Design			Silver Nickel/Bifurcated					
Mounting			Panel mount or mount on 700-MP Relay or DIN Rail Horizontal Mounting Recommended					
Environmental								
Temperature		Operating‡	–20…+65 °C (–4…149 °F)					
		Storage	–40…+65 °C (–40…149 °F)					
Wire Terminations								
Wire size per UL/CSA			#18 AWG…(2) #12 AWG					
Tightening Torque			8…12 lb-in. (0.9…1.4 N•m)					

* Coil voltage required for proper operation (percent of rated coil voltage).
† 90% of devices are expected to meet or exceed 12.5 million operations, and 50% of devices are expected to meet 20 million operations.
‡ Temperature inside the panel.

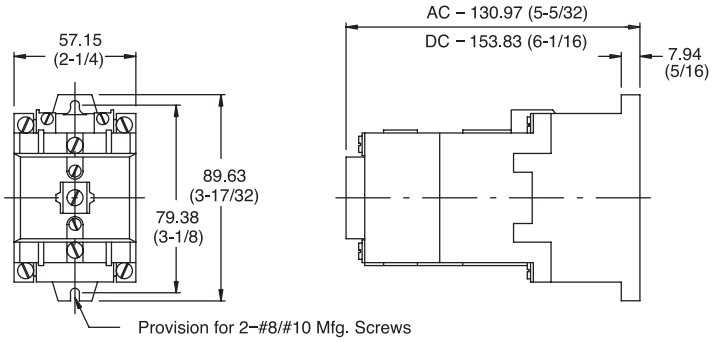
Heavy-Duty Industrial Safety Relays

Approximate Dimensions

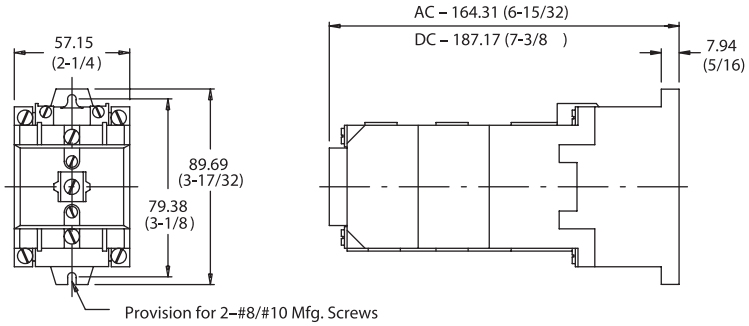
Dimensions are shown in millimeters (inches). Dimensions are not intended for manufacturing purposes.



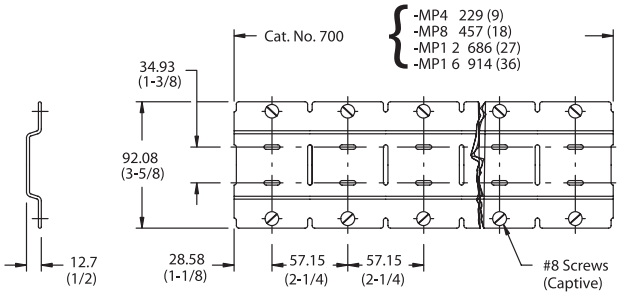
2-pole and 4-pole Bulletin 700S-P Relay
Approximate Weight AC – 0.68 kg (1.5 lbs.), DC – 1.34 kg (2.95 lbs.)



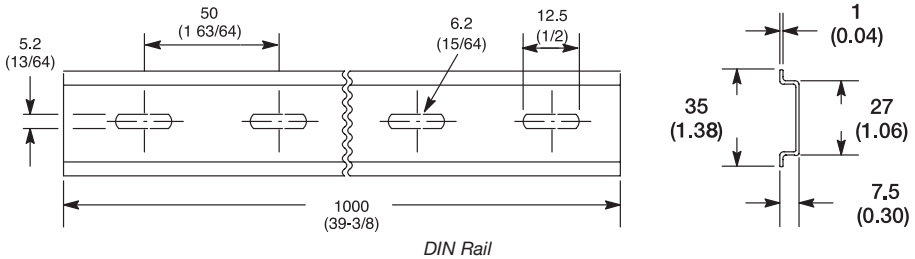
6- and 8-pole Bulletin 700S-P Relay
Approximate Weight AC – 0.79 kg (1.75 lbs.),
DC – 1.45 kg (3.20 lbs.)



10- and 12-pole Bulletin 700S-P Relay
Approximate Weight AC – 1.02 kg (2.25 lbs.),
DC – 1.68 kg (3.7 lbs.)



Relay Rail



DIN Rail

Bulletin 700-N Industrial Relay

- Contact Cartridges Convertible from N.O. to N.C. and Vice Versa
- NEMA A300 AC
- 24…250V AC Coils
- Pneumatic Timing Unit
- Solid State Timing Unit
- Overlap Contacts
- Logic Reed Contacts
- 2…8-pole

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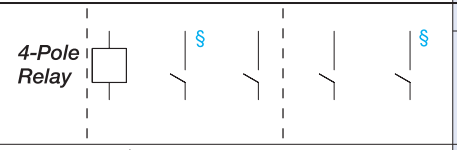
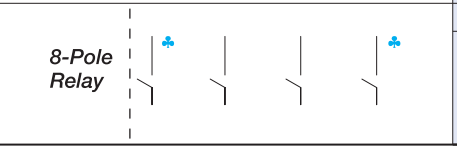
Certifications

- UL Listed (File No. E14840) (Guide No. NKCR) per UL 508
- CSA Certified (File No. LR1234) per CSA C22.2 No. 14

AC-Operated Relays

Contacts ✶ † ‡		Contact Arrangement	Open Type	Type 1 General Purpose
N.O.	N.C.		Cat. No.	Cat. No.
2	—		700-N200⊗	700-N201⊗
4	—		700-N400⊗	700-N401⊗
6	—		700-N600⊗	700-N601⊗
8	—		700-N800⊗	700-N801⊗

⊗ AC Voltage Suffix Code

The Cat. No. as listed is incomplete. Select a voltage suffix code from the table below to complete the Cat. No. Example: **Cat. No.700-N200**⊗ becomes **Cat. No. 700-N200A24** for 24V 60 Hz. For other coil voltages, contact your local Allen-Bradley Distributor.

Voltage	24V	32V	48V	64V	110V	120V	208V	220V	240V
50	B24	B32	B48	B64	A1	—	B20	A2	—
60	A24	A32	A48	A64	—	A1	A20	—	A2

✶ **NORMALLY CLOSED CONTACTS:** Listed relays are supplied with all contacts normally open. These contacts can be readily converted to normally closed in the field. Relays having combinations of normally open and normally closed contacts can be supplied.

† **OVERLAP CONTACTS:** Overlap contacts (normally open contact closes before the normally closed contact opens) can be supplied. See page 9-119 for information on kits for field installation of overlap contact cartridges.

‡ **BIFURCATED CONTACTS:** To order a relay with bifurcated contacts, add the letter "B" after the letter "N" in the Cat. No. Example: **Cat. No. 700-N200A1** becomes **Cat. No. 700-NB200A1**.

§ Location of contacts in 2-pole relays.

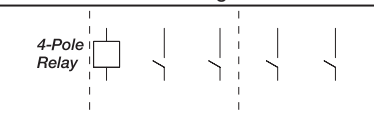
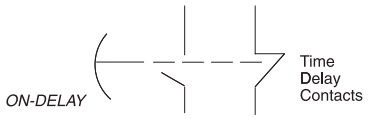
♣ Location of contacts in 6-pole relays: 4-pole relay plus the two contacts indicated.

Operating Coils

Bulletin 700-N Operating Coil

Coil Voltage	Bulletin 700-N Relay • 2…8-Pole	
	60 Hz	50 Hz
24	84AB27	84AB28
110	84AB01	84AB86
120	84AB86	—
208	84AB113	—
220	84AB06	84AB83
240	84AB83	—

AC-Operated Relays with Pneumatic Timing Unit*†‡

Description	Instantaneous Contacts		Contact Arrangement	Open Type
	N.O.	N.C.		Cat. No.
Electrically Held AC Relay	2	—		700-NT200⊗
	4	—		700-NT400⊗

⊗ AC Voltage Suffix Code

The Cat. No. as listed is incomplete. Select a voltage suffix code from the table below to complete the Cat. No. Example: **Cat. No. 700-NT200** ⊗ becomes **Cat. No. 700-NT200A24**. For other coil voltages, contact your local Allen-Bradley Distributor.

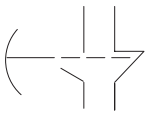
Voltage	24V	32V	48V	64V	110V	115…125V	120V	208V	220V	230…250V	240V
50 Hz	B24	B32	B48	B64	A1	—	—	B20	A2	—	—
60 Hz	A24	A32	A48	A64	—	—	A1	A20	—	—	A2

* **NORMALLY CLOSED CONTACTS:** Listed relays are supplied with all contacts normally open. These contacts can be readily converted to normally closed in the field. Relays having combinations of normally open and normally closed contacts can be supplied.

† **OVERLAP CONTACTS:** Overlap contacts (normally open contact closes before the normally closed contact opens) can be supplied. See page page 9-130 for information on kits for field installation of overlap contact cartridges.

‡ **BIFURCATED CONTACTS:** To order a relay with bifurcated contacts, add the letter "B" after the letter "T" in the Cat. No. Example: **Cat. No. 700-NT200A1** becomes **Cat. No. 700-NTB200A1**.

Bulletin 700-NT Pneumatic Timing Unit

	Description	Timed Contacts N.O.	Timed Contacts N.C.	Contact Arrangement	Open Type Cat. No.
Cat. No. 700-NT	**Timing Unit Only** (for Bulletin 700-N, 2…4-pole)	1	1	 *ON-Delay mode is standard. Timer is easily converted to OFF-Delay mode.*	700-NT
Cat. No. 700-NPTA1	**Timing Unit Mounted on 700-N Relay** (Relay supplied without contacts)	1	1		700-NPT⊗

⊗ AC Voltage Suffix Code

The Cat. No. as listed is incomplete. Select a voltage suffix code from the table below to complete the Cat. No. Example: **Cat. No. 700-NPT⊗** becomes **Cat. No. 700-NPTA24** for 24V 60 Hz. For other coil voltages, contact your local Allen-Bradley Sales Office.

Voltage	24V	32V	48V	64V	110V	115…125V	120V	208V	220V	230…250V	240V
50 Hz	B24	B32	B48	B64	A1	—	—	B20	A2	—	—
60 Hz	A24	A32	A48	A64	—	—	A1	A20	—	—	A2

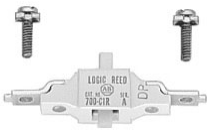
Bulletin 852S Solid-State Timing Unit for Mounting on Bulletin 700-N Relays⁎

(Supplied as On-Delay. Easily Converted to Off-Delay Mode) Input: 110V/50 Hz, 120V/60 Hz; Output: NEMA B300, Sealed Contacts

Timing Unit with Self-Contained Potentiometer		
Minimum Time (s)	Maximum Time (s)	Cat. No.
0.1	5.0	852S-NSA
0.5	30.0	852S-NSB
1.0	60.0	852S-NSC

Timing Unit Only			External Potentiometer†	
Minimum Time (s)	Maximum Time (s)	Cat. No.	Resistance	Cat. No.
0.1	0.21	852S-A†	15 kΩ	800T-U34
	0.35		25 kΩ	800T-U37
	0.70		50 kΩ	800T-U41
	1.10		75 kΩ	800T-U46
	1.50		100 kΩ	800T-U49
	2.10		150 kΩ	800T-U50
	5.6		400 kΩ	800T-U54
	7.0		500 kΩ	800T-U55
	14.0		1 MΩ	800T-U57
	29.0		2 MΩ	800T-U59
1.0	2.0	852S-C	50 kΩ	800T-U41
	4.0		100 kΩ	800T-U49
	8.0		200 kΩ	800T-U51
	16.0		400 kΩ	800T-U54
	32.0		800 kΩ	800T-U56
	40.0		1 MΩ	800T-U57
	80.0		2 MΩ	800T-U59
	120.0		3 MΩ	800T-U62
	160.0		4 MΩ	800T-U64

⁎ The maximium time is fixed by component characteristics and may be up to 70% greater than listed
† These timing relays require an external potentiometer. To order an external potentiometer, refer to right side of table.

	Description		Cat. No.
Universal Mounting Strip	**Relay Rail** Simplifies panel layout. These indexed strips are easily cut to the required length and bolted, riveted, or spot-welded in place. Relays are installed adjacent to one another on the mounting strip with the captive mounting screws provided. Rows of relays on Relay Rail form their own wiring trough. Can be used with the following relays: 700P, 700-PK, 700PH, 700S-P, 700N, 700-R, 700-RTC	Relays per strip 4	700-MP4
		8	700-MP8
		12	700-MP12
		16	700-MP16
Cat. No. 700-DRA	DIN Rail Adapter	—	700-DRA
Cat. No. 700-NA40	**Front Deck** Front decks can be attached to Bulletin 700 4-pole relays. Provides up to 4 additional convertible poles – without changing the mounting area.	Front Deck with 2 Contact Cartridges	700-NA20
		Front Deck with 4 Contact Cartridges	700-NA40
	Standard Contact Cartridges Available for adding to both rear deck and front deck.	Rear Deck Contact Cartridge	700-C1∗
		Front Deck Contact Cartridge	700-C2∗
	Gold-Plated Contact Cartridges May be used in low power circuits to improve reliability. Good for long term storage, because gold resists corrosion.	Rear Deck Contact Cartridge	700-C1X∗
		Front Deck Contact Cartridge	700-C2X∗
	**Logic Reed Cartridges** Cartridges are hermetically sealed contact for low energy switching.	Rear Deck Contact Cartridge (150V AC, 150 mA, 8VA Max.) (30V DC, 60 mA Max.)	700-C1R∗
	Bifurcated Contact Cartridges Cartridges are less apt to open because of vibration and shock.	Rear Deck Contact Cartridge	700-C1B∗
		Front Deck Contact Cartridge	700-C2B∗
Cat. No. 700-C11Z	**Overlap Contact Cartridges** Cartridges are available in pairs. The N.O. contact closes before the N.C. contact opens. 300V AC max. 125V DC max.	Rear Deck Contact Cartridge (1 pair in a package)	700-C11Z∗
		Front Deck Contact Cartridge (1 pair in a package)	700-C22Z∗
	Timing Unit Replacement (Bifurcated) Contact Cartridge for Bulletin 700-NT relay	Timing Unit Deck Contact Cartridge	X-457011∗
Cat. No. 700-N4,-N3	**Jumpers** (Not applicable for Bulletin 700-PH or -PK relays) – For connection between a middle pole and an outer pole on the left or right side of the relay	Jumper for middle pole to outer poles	700-N3
		Jumper for middle poles	700-N4
	Gold-Plated Contact Timing Unit Replacement Cartridge	—	40163-447-03∗
Cat. No. 700-N5 *Cat. No. 700-N24*	**Surge Suppressors (RC Circuit) —** Surge suppressors reduce the high transient voltages generated when the coil circuit is opened. These suppressors can be used with Bulletin 700-P, -PH, -PK and -N relays, and other electromechanical devices. They contain a resistor and capacitor. Maximum ratings: 150V, AC or DC, 35 VA. Cat. No. 700-N5 requires 1 in. additional depth of enclosure.	For mounting behind relay (1 in. additional depth needed)	700-N5
		For mounting on coil terminal	700-N24
Cat. No. 700-N21	**Check Out Tool** Mechanically maintains the Bulletin 700-N relay in operated position.	Check Out Tool for Bulletin 700-N AC relay	700-N21

∗ **Note:** All contact cartridges are convertible (N.O. or N.C.).

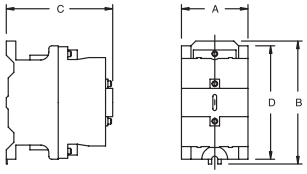
		Type 700-N		Type 700-NT
Electrical Ratings				
Rated Thermal Current I_{th}		10 A		
Rated Insulation Voltage		300V		
Contact Rating		10 A @ 300V AC, NEMA A300		
Coil Voltage Range	AC	85…110%		
	DC	80…110%		
Coil Consumption				
		50 Hz	**60 Hz**	—
AC	Inrush	120 VA	133 VA	—
	Sealed	24 VA	20 VA	—
Mechanical				
		AC		—
Max. Operating Time	Pickup	14 ms		—
	Drop Out	13 ms		—
Timing Range		—		0.2…60 s
Repeat Accuracy		—		±15% of setting
Reset Time		—		75 ms
Timing Mode		—		On-Delay — convertible to OFF Delay, up to 2 poles convertible to N.O. or N.C.
Construction				
Contact Arrangement		Up to 8 Poles, Convertible to N.O. or N.C.		—
Contact Material		Silver		Silver
Mounting		Panel or strip mount Horizontal mounting recommended		On relay only
Environmental				
Ambient Temperature (Outside Enclosure)	Operating	–20…+40 °C (–4…+104 °F)		
	Storage	–40…+60 °C (–40…+140 °F)		
Operating Temperature Rise (Inside Enclosure)		+25 °C Max		—
Wire Terminations				
Wire size per UL/CSA		#18 AWG…(2) #12 AWG		
Tightening Torque		8…12 lb-in. (0.9…1.4 N•m)		

Industrial Relays

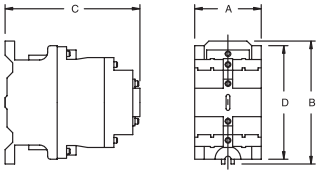
Approximate Dimensions and Shipping Weights

Dimensions are shown in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

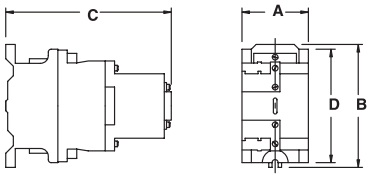
Type of Relay		No. of Poles	Open Type Without Enclosure					Approx. Ship. Wt. kg (lbs.)	Type 1 General Purpose Enclosure					Approx. Ship. Wt. kg (lbs.)
			Drawing Number	A Wide	B High	C Deep	D		A Wide	B High	C Deep	D	E	
N	Bulletin 700	2…4	1	57.15 (2-1/4)	88.90 (3-1/2)	82.55 (3-1/4)	79.38 (3-1/8)	0.68 (1-1/2)	107.95 (4-1/4)	185.74 (7-5/16)	103.19 (4-1/16)	146.05 (5-3/4)	85.73 (3-3/8)	1.59 (3-1/2)
	Bulletin 700	6…8	2	57.15 (2-1/4)	88.90 (3-1/2)	106.36 (4-3/16)	79.38 (3-1/8)	0.79 (1-3/4)	112.71 (4-7/16)	228.60 (9)	120.65 (4-3/4)	206.38 (8-1/8)	92.08 (3-5/8)	2.27 (5)
N with Pneumatic Timer	Bulletin 700	2…4	3	57.15 (2-1/4)	88.90 (3-1/2)	138.11 (5-7/16)	79.38 (3-1/8)	0.91 (2)	—	—	—	—	—	—
N with Solid-State Timer	Bulletin 700	2…4	3	57.15 (2-1/4)	88.90 (3-1/2)	160.34 (6-5/16)	79.38 (3-1/8)	1.02 (2-1/4)	—	—	—	—	—	—



Drawing Number 1



Drawing Number 2



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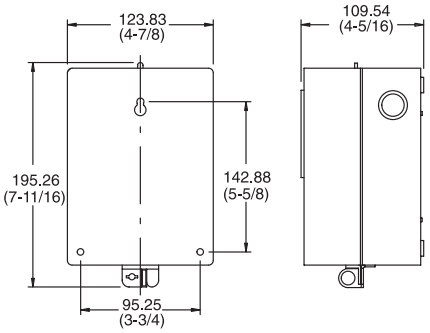

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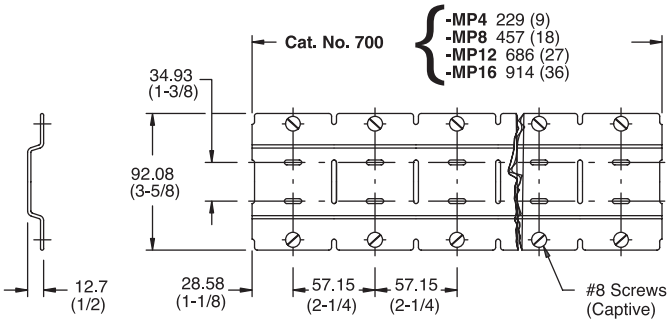
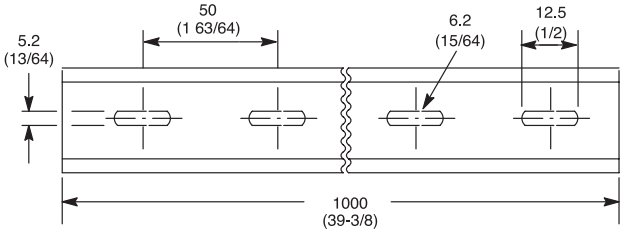
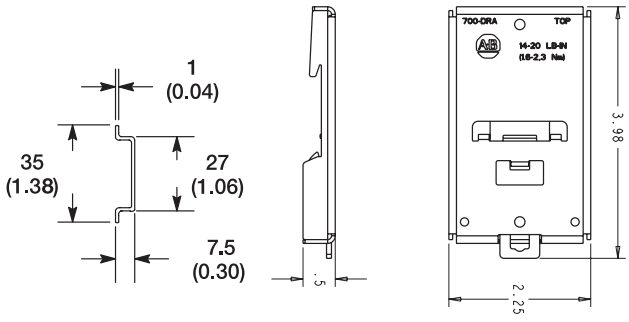


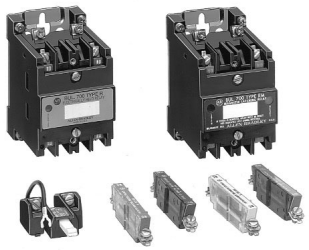
Relay Rail for Bulletin 700-P, -PH, -PK, -N, -NM, -R, -RM, -RT, -RTA Relays

Secure the mounting strip with 2 screws at each end relay position. Use a minimum of one screw at the 3rd, 5th, 7th, etc. relay positions. Alternate between upper and lower horizontal slots.





DIN Rail Adapter



Bulletin 700-R -RM

- Sealed Contacts
- Extremely Long Mechanical and Electrical Life
- Hazardous Locations Class 1, Div 2 Groups A, B, C, D
- Harsh Environments
- Suitable for Applications with Shock and Vibration
- High Reliability Circuit Integrity

Table of Contents

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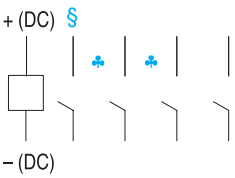
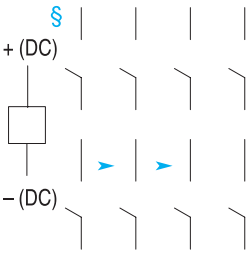
Specifications 9-136
Approximate Dimensions 9-137

Certifications

- UL Listed (File No. E10314) (Guide No. NOIV) per UL 508
- CSA Certified (File No. LR11924)
- CE Certified

No. of Poles	Electrically Held						
	Contacts		Contact Arrangement and Markings†	AC-Operated Relay Only		DC-Operated Relay Only	
				Open Type	Type 1 General Purpose	Open Type	Type 1 General Purpose
	N.O.	N.C.		Cat. No.	Cat. No.	Cat. No.	Cat. No.
0	0	0	Relay without Contact	700-R000⊗	700-R001⊗	700DC-R000⊗	700DC-R001⊗
2	2	0		700-R200⊗	700-R201⊗	700DC-R200⊗	700DC-R201⊗
	1	1		700-R110⊗	700-R111⊗	700DC-R110⊗	700DC-R111⊗
	0	2		700-R020⊗	700-R021⊗	700DC-R020⊗	700DC-R021⊗
4	4	0		700-R400⊗	700-R401⊗	700DC-R400⊗	700DC-R401⊗
	3	1		700-R310⊗	700-R311⊗	700DC-R310⊗	700DC-R311⊗
	2	2		700-R220⊗	700-R221⊗	700DC-R220⊗	700DC-R221⊗
	1	3		700-R130⊗	700-R131⊗	700DC-R130⊗	700DC-R131⊗
	0	4		700-R040⊗	700-R041⊗	700DC-R040⊗	700DC-R041⊗
6	6	0		700-R600⊗	700-R601⊗	700DC-R600⊗	700DC-R601⊗
	5	1		700-R510⊗	700-R511⊗	700DC-R510⊗	700DC-R511⊗
	4	2		700-R420⊗	700-R421⊗	700DC-R420⊗	700DC-R421⊗
	3	3		700-R330⊗	700-R331⊗	700DC-R330⊗	700DC-R331⊗
	2	4		700-R240⊗	700-R241⊗	700DC-R240⊗	700DC-R241⊗
	1	5		700-R150⊗	700-R151⊗	700DC-R150⊗	700DC-R151⊗
	0	6		700-R060⊗	700-R061⊗	700DC-R060⊗	700DC-R061⊗
8	8	0		700-R800⊗	700-R801⊗	700DC-R800⊗	700DC-R801⊗
	7	1		700-R710⊗	700-R711⊗	700DC-R710⊗	700DC-R711⊗
	6	2		700-R620⊗	700-R621⊗	700DC-R620⊗	700DC-R621⊗
	5	3		700-R530⊗	700-R531⊗	700DC-R530⊗	700DC-R531⊗
	4	4		700-R440⊗	700-R441⊗	700DC-R440⊗	700DC-R441⊗
	3	5		700-R350⊗	700-R351⊗	700DC-R350⊗	700DC-R351⊗
	2	6		700-R260⊗	700-R261⊗	700DC-R260⊗	700DC-R261⊗
	1	7		700-R170⊗	700-R171⊗	700DC-R170⊗	700DC-R171⊗
	0	8		700-R080⊗	700-R081⊗	700DC-R080⊗	700DC-R081⊗

⊗ Voltage Suffix Code

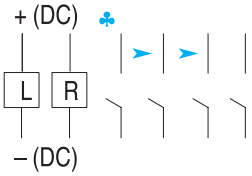
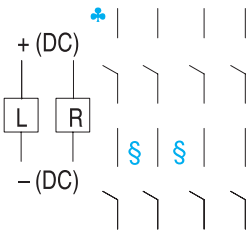
The Cat. No. as listed is incomplete. Select a voltage code from the table below to complete the Cat. No. Example: **Cat. No. 700-R000⊗** becomes **Cat. No. 700-R000A24**. For other coil voltages, contact your local Allen-Bradley Sales Office.

Type of Relay	Hz	Coil Volts							
		24V	48V	110V	115-125V	120V	220V	230-250V	240V
AC	25	—	—	C11	—	C1	—	—	C2
	50	B24	B48	A1	—	—	A2	—	—
	60	A24	A48	—	—	A1	—	—	A2
DC	—	Z24	Z48	—	Z1	—	—	Z2	—

✶ 3-, 5- and 7-pole relays are available. Refer to your local Allen-Bradley Distributor.
† Arrangement displays all N.O. contacts.
§ Polarity must be observed for DC voltage (700 DC) relays.
♣ Location of contacts in 2-pole relays.
➤ Location of contacts in 6-pole relays.

Sealed Switch Relays

Product Selection, Continued

No. of Poles	Magnetic Latch						
	Contacts		Contact Arrangement and Markings †	AC-Operated Relay Only		DC-Operated Relay Only	
				Open Type	Type 1 General Purpose	Open Type	Type 1 General Purpose
	N.O.	N.C.		Cat. No.	Cat. No.	Cat. No.	Cat. No.
0	0	0	Relay without Contact	700-RM000⊗	700-RM001⊗	700DC-RM000⊗	700DC-RM001⊗
2	2	0		700-RM200⊗	700-RM201⊗	700DC-RM200⊗	700DC-RM201⊗
	1	1		700-RM110⊗	700-RM111⊗	700DC-RM110⊗	700DC-RM111⊗
	0	2		700-RM020⊗	700-RM021⊗	700DC-RM020⊗	700DC-RM021⊗
4	4	0		700-RM400⊗	700-RM401⊗	700DC-RM400⊗	700DC-RM401⊗
	3	1		700-RM310⊗	700-RM311⊗	700DC-RM310⊗	700DC-RM311⊗
	2	2		700-RM220⊗	700-RM221⊗	700DC-RM220⊗	700DC-RM221⊗
	1	3		700-RM130⊗	700-RM131⊗	700DC-RM130⊗	700DC-RM131⊗
	0	4		700-RM040⊗	700-RM041⊗	700DC-RM040⊗	700DC-RM041⊗
6	6	0		700-RM600⊗	700-RM601⊗	700DC-RM600⊗	700DC-RM601⊗
	5	1		700-RM510⊗	700-RM511⊗	700DC-RM510⊗	700DC-RM511⊗
	4	2		700-RM420⊗	700-RM421⊗	700DC-RM420⊗	700DC-RM421⊗
	3	3		700-RM330⊗	700-RM331⊗	700DC-RM330⊗	700DC-RM331⊗
	2	4		700-RM240⊗	700-RM241⊗	700DC-RM240⊗	700DC-RM241⊗
	1	5		700-RM150⊗	700-RM151⊗	700DC-RM150⊗	700DC-RM151⊗
	0	6		700-RM060⊗	700-RM061⊗	700DC-RM060⊗	700DC-RM061⊗
8	8	0		700-RM800⊗	700-RM801⊗	700DC-RM800⊗	700DC-RM801⊗
	7	1		700-RM710⊗	700-RM711⊗	700DC-RM710⊗	700DC-RM711⊗
	6	2		700-RM620⊗	700-RM621⊗	700DC-RM620⊗	700DC-RM621⊗
	5	3		700-RM530⊗	700-RM531⊗	700DC-RM530⊗	700DC-RM531⊗
	4	4		700-RM440⊗	700-RM441⊗	700DC-RM440⊗	700DC-RM441⊗
	3	5		700-RM350⊗	700-RM351⊗	700DC-RM350⊗	700DC-RM351⊗
	2	6		700-RM260⊗	700-RM261⊗	700DC-RM260⊗	700DC-RM261⊗
	1	7		700-RM170⊗	700-RM171⊗	700DC-RM170⊗	700DC-RM171⊗
	0	8		700-RM080⊗	700-RM081⊗	700DC-RM080⊗	700DC-RM081⊗

⊗ Voltage Suffix Code

The Cat. No. as listed is incomplete. Select a voltage code from the table below to complete the Cat. No. Example: **Cat. No. 700-RM000⊗** becomes **Cat. No. 700-RM000A24**. For other coil voltages, contact your local Allen-Bradley Distributor.

Type of Relay	Hz	Coil Volts							
		24V	48V	110V	115-125V	120V	220V	230-250V	240V
AC	25	—	—	C11	—	C1	—	—	C2
	50	B24	B48	A1	—	—	A2	—	—
	60	A24	A48	—	—	A1	—	—	A2
DC	—	Z24	Z48	—	Z1	—	—	Z2	—

✶ 3-, 5- and 7-pole relays are available. Refer to your local Allen-Bradley Distributor.
† Arrangement displays all N.O. contacts.
§ Location of contacts in 6-pole relays.
♣ Polarity must be observed for DC voltage (700 DC) relays.
➤ Location of contacts in 2-pole relays.

Modifications

Description	Letter Designation	Manual Actuator Addition for Relay	Actuation Qty.
Manual Actuator A factory-installed manual actuator is available for manual energization of the relay coils. To order, replace the letters **"R"** or **"RM"** after the dash in the listed catalog number with the letters listed at right. Ratings 150V AC or DC maximum. Example: **Cat. No. 700-RM300A1** becomes **Cat. No. 700-RMLR300A1**.	RL	Type R	1
	RML	Type RM on Latch Coil	1
	RMR	Type RM on Reset Coil	1
	RMLR	Type RM on Latch and Reset Coil (2 manual actuators required)	2

Accessories for Bulletin 700-R, -RM Relays

	Description		Pkg. Quantity	Cat. No.
	Relay Rail Simplifies panel layout. These indexed strips are easily cut to the required length and bolted, riveted, or spot-welded in place. Relays are installed adjacent to one another on the mounting strip with the captive mounting screws provided. Rows of relays on Relay Rail form their own wiring trough. Can be used with the following relays: 700P, 700-PK, 700PH, 700S-P, 700N, 700-R, 700-RTC	4 Relays per Strip Relays per Strip	5	700-MP4
		8 Relays per Strip Relays per Strip	5	700-MP8
		12 Relays per Strip Relays per Strip	5	700-MP12
		16 Relays per Strip Relays per Strip	5	700-MP16
 Cat. No. 199-DR1	**DIN (#3) Symmetrical Rail** 35 mm x 7.5 mm x 1 m long Zinc-plated, yellow chromated		10	199-DR1
	DIN Rail Adapter Can be used with the following relays: 700P, 700-PK, 700-PH, 700S-P, 700-N, 700-R, 700-RTC		1	700-DRA
	Front Deck A front deck can be attached to Bulletin 700 2-, 3-, or 4-pole AC and DC Type R or RM relays.	Front Deck with one N.O. Contact Cartridge (700-R Relay)	1	700-RA10
		Front Deck with one N.C. Contact Cartridge (700-R Relay)	1	700-RA01
		Front Deck with one N.O. Contact Cartridge (700-RM Relay)	1	700-RB10
		Front Deck with one N.C. Contact Cartridge (700-RM Relay)	1	700-RB01
 Cat. No. 700-CR5 *Cat. No. 700-CR6* *Cat. No. 700-CR9*	**Contact Cartridges** These cartridges are used to increase the number of poles of a relay. A dummy cartridge is also available to fill empty space not occupied by a contact cartridge. N.O. N.C.	N.O. Contact Cartridge - Green (700-R Relay)	1	700-CR5
		N.C. Contact Cartridge - Yellow (700-R Relay)	1	700-CR6
		N.O. Contact Cartridge - Blue (700-RM Relay)	1	700-CR7
		N.C. Contact Cartridge - Red (700-RM Relay)	1	700-CR8
		"DUMMY" Cartridge - Black (700-R and -RM Relays)	1	700-CR9
	Surge Suppressor When the circuit to a DC operating coil is opened, the inductive energy stored in the coil can generate very high transient voltages. With the addition of the appropriate surge suppressor, the stored energy is absorbed and dissipated limiting the voltage spikes. A surge suppressor is not required with AC 700-R or -RM relays because the AC operating coil transients are suppressed by a full wave rectifier connected to the coil.	12V DC (700-R Relay)	1	199-FSMA9
		12V DC (700-RM Relay)	2	
		24V DC (700-R Relay)	1	
		24V DC (700-RM Relay)	2	
		48V DC (700-R Relay)	1	
		48V DC (700-RM Relay)	2	
		115…125V DC (700-R Relay)	1	199-FSMA10
		115…125V DC (700-RM Relay)	2	
		230…250V DC (700-R Relay)	1	199-FSMA11
		230…250V DC (700-RM Relay)	2	
	Bulletin 700-PS Solid-State Timing Unit You can attach a Bulletin 700-PS solid-state timing unit to 4-pole 700-R or -RM relays. An adaptor kit, **Cat. No. 700-N26**, is required. See page 9-142 for description.			
	Bulletin 852S Solid-State Timing Unit You can attach a Bulletin 852S solid-state timing unit to 4-pole 700-R or -RM relays.			

Sealed Switch Relays

Specifications

Application Data – Because of the inherent characteristics of this device, the normally open contacts may close before the normally closed contacts open on energization and the normally closed contacts may close before the normally open contacts open on de-energization.

Note: For Type 700-RM, energizing both the latch and unlatch coil together will cause the relay to be energized and both latch and unlatch coils can be operated together continuously.

Ratings

AC Voltage						DC Voltage			
NEMA Rating Designation	Voltage		Make	Break	Continuous Carrying Current (A)	NEMA Rating Designation	Volts DC	Make/Break	Continuous Carrying Current (A)
B300	Up to 300V AC	120V	30	3	5	NEMA P300	46…300	138 VA	5
		240V	15	1.5					
C600	Above 300V AC	480V	7.5	0.75	2.5		5…46	3 A	5
		600V	6.0	0.60					

Maximum Allowable Off-State Leakage Current

Voltage	Maximum Off-State Leakage Current (mA) Type R	Maximum Off-State Leakage Current (mA) Type RM
24V DC	23	8
24V AC	23	8
120V AC	5	2

Relay Data

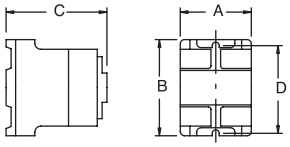
Type		700-R	700-RM
Contact Arrangement		Up to 8 Poles, available in any combination of N.O. or N.C. contacts	Up to 8 Poles, available in any combination of N.O. or N.C. contacts
Contact Material		W (tungsten in a controlled gas atmosphere)	W (tungsten in a controlled gas atmosphere)
Coil Voltage Range		24…250V AC 24…250V DC	24…250V AC 24…250V DC
Coil Power	Sealed Voltage Range: –15… +10%	5.5 VA, 50/60 Hz 5.5 W DC	1.7 VA, 50/60 Hz (Latch or Unlatch) 1.7 W DC
	Inrush	5.5 VA, 50/60 Hz 5.5 W DC	1.7 VA, 50/60 Hz (Latch or Unlatch) 1.7 W DC
Pickup Time		30 ms	75 ms Min. Latch Pulse
Dropout Time		30 ms	75 ms Min. Unlatch Pulse
Operating Temperature		–40…+60 °C (–40…+140 °F)	–40…+60 °C (–40…+140 °F)
Mounting		Panel Mount	Panel Mount

Bulletin 700-R Operating Coils

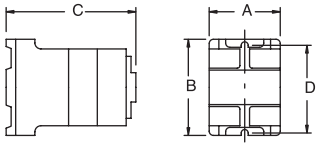
Bulletin 700-R Operating Coil

Coil Volts	Bulletin 700-R 2-…8-Pole AC 60 Hz	Bulletin 700-R 2-…8-Pole AC 50 Hz	Bulletin 700-R 2-…8-Pole DC
24	77AB27	77AB27	77D152
48	77AB134	77AB134	77D166
110	77AB86	77AB86	—
115…125	—	—	77D155
120	77AB86	77AB86	—
208	—	—	—
220	77AB83	77AB83	—
240	77AB83	77AB83	—
230…250	—	—	77D156

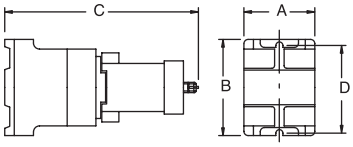
Dimensions are shown in millimeters (inches) shown. Dimensions are not intended to be used for manufacturing purposes.
Secure the mounting strip with 2 screws at each end relay position. Use a minimum of one screw at the 3rd, 5th, 7th, etc., relay positions. Alternate between upper and lower horizontal slots.



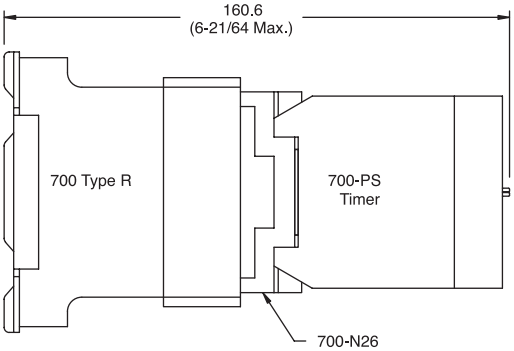
Bulletin 700-R400..., -RM400...



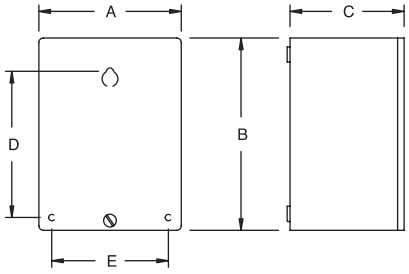
Bulletin 700-R800, -RM800...



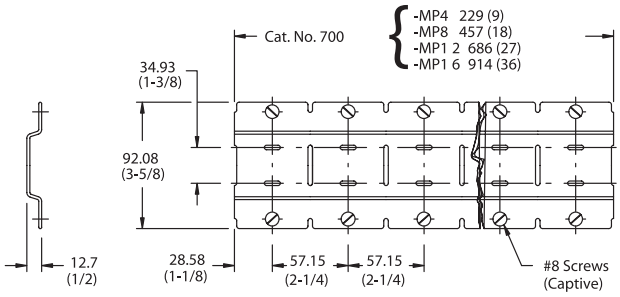
Bulletin 700-R with 852s timer



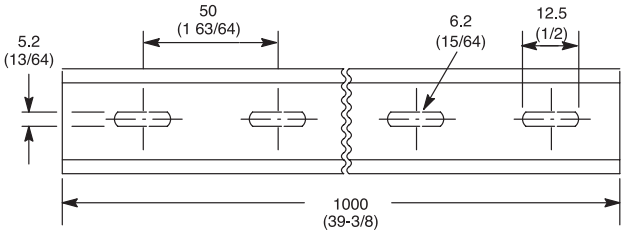
Bulletin 700-PS Timer Mounted on a 4-Pole Bulletin 700-R Relay Approximate Shipping Wt. 1.25 kg (2.75 lbs.)



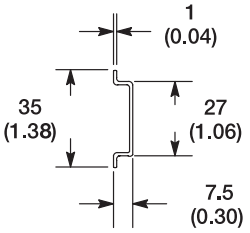
Type 1 Enclosure

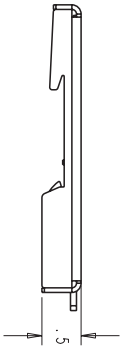


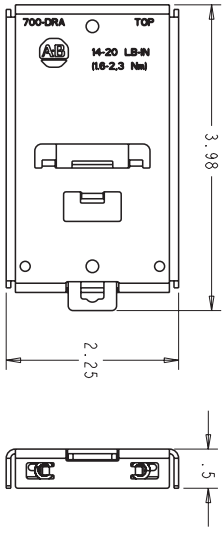
Relay Rail



Cat. No. 199-DR1 DIN Mounting Rail Series B





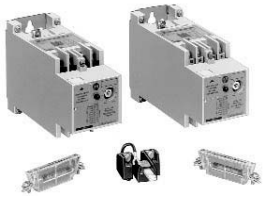


Bulletin 700-R, -RM Relays

Type of Relay		No. of Poles	Open Type Without Enclosures					Approx. Ship Wt. (kg) lbs.	Type 1 General Purpose Enclosure					Approx. Ship Wt. kg (lbs.)
			Drawing Number	A Wide	B High	C Deep	D		A Wide	B High	C Deep	D	E	
R	Bulletin 700 and Bulletin 700DC	2...4	1	55.56 (2-3/16)	88.90 (3-1/2)	92.25 (3-3/8)	79.38 (3-1/8)	0.91 (2)	104.78 (4-1/8)	185.74 (7-5/16)	103.19 (4-1/16)	146.05 (5-3/4)	85.73 (3-3/8)	1.81 (4)
		5...8	2	55.56 (2-3/16)	88.90 (3-1/2)	111.13 (4-3/8)	79.38 (3-1/8)	1.02 (2-1/4)	112.71 (4-7/16)	228.60 (9)	120.65 (4-3/4)	206.38 (8-1/8)	92.08 (3-5/8)	2.49 (5)
R with Bulletin 852S Timer	Bulletin 700 and Bulletin 700DC	2...4	3	55.56 (2-3/16)	88.90 (3-1/2)	165.1 (6-1/2)	79.38 (3-1/8)	1.25 (2-3/4)	—	—	—	—	—	—
RM	Bulletin 700 and Bulletin 700DC	2...4	1	55.56 (2-3/16)	88.90 (3-1/2)	95.25 (3-3/8)	79.38 (3-1/8)	0.91 (2)	104.78 (4-1/8)	185.74 (7-5/16)	103.19 (4-1/16)	146.05 (5-3/4)	85.73 (3-3/8)	1.81 (4)
		5...8	2	55.56 (2-3/16)	89.90 (3-1/2)	111.13 (4-3/8)	79.38 (3-1/8)	1.02 (2-1/4)	112.71 (4-7/16)	228.60 (9)	120.65 (4-3/4)	206.38 (8-1/8)	92.08 (3-5/8)	2.49 (5)
RM with Bulletin 852S Timer	Bulletin 700 and Bulletin 700DC	2...4	3	55.56 (2-3/16)	88.90 (3-1/2)	165.1 (6-1/2)	79.38 (3-1/8)	1.25 (2-3/4)	—	—	—	—	—	—

Sealed Switch Timing Relays

Overview



Bulletin 700-RTC

- Timing Functions
- 8 ON-Delay
- 8 OFF-Delay
- Timing Ranges
- Seconds: 0.05…2, 0.2…8, 0.4…30, 2…120
- Minutes: 0.015…1, 0.06…4, 0.25…16 and 1…64
- AC, 50/60 Hz or DC
- 600V AC Maximum
- 300V DC Maximum
- Relays with Fixed Time Delay
- Sealed Contacts
- Harsh Environments
- Hazardous Locations Class I, Div. 2, Groups A, B, C and D

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Certifications

- UL Listed (File No. E10314) (Guide No. NOIV) per UL 508
- CSA Certified (File No. LR11924)
- CE Certified

Bulletin 700-RTC Relay – Relays with Provision for Instantaneous Contacts

Relays listed below have slots for two timed contacts and two instantaneous contacts. Unused slots are equipped with removable dummy cartridges.

Number of Contact Cartridges					Open Type Without Enclosure
	Instantaneous		Timed		
Total	N.O.	N.C.	N.O.	N.C.	Cat. No.
0	0	0	0	0	700-RTC00000⊗
1	0	0	1	0	700-RTC00100⊗
	0	0	0	1	700-RTC00010⊗
2	0	0	2	0	700-RTC00200⊗
	1	0	1	0	700-RTC10100⊗
	0	1	1	0	700-RTC01100⊗
	0	0	1	1	700-RTC00110⊗
	1	0	0	1	700-RTC10010⊗
	0	1	0	1	700-RTC01010⊗
	0	0	0	2	700-RTC00020⊗
3	1	0	2	0	700-RTC10200⊗
	2	0	1	0	700-RTC20100⊗
	0	1	2	0	700-RTC01200⊗
	1	1	1	0	700-RTC11100⊗
	1	0	1	1	700-RTC10110⊗
	2	0	0	1	700-RTC20010⊗
	0	2	1	0	700-RTC02100⊗
	0	1	1	1	700-RTC01110⊗
	1	1	0	1	700-RTC11010⊗
	1	0	0	2	700-RTC10020⊗
	0	2	0	1	700-RTC02010⊗
	0	1	0	2	700-RTC01020⊗
4	2	0	2	0	700-RTC20200⊗
	1	1	2	0	700-RTC11200⊗
	2	0	1	1	700-RTC20110⊗
	0	2	2	0	700-RTC02200⊗
	1	1	1	1	700-RTC11110⊗
	2	0	0	2	700-RTC20020⊗
	1	1	0	2	700-RTC11020⊗
	0	2	1	1	700-RTC02110⊗
	0	2	0	2	700-RTC02020⊗

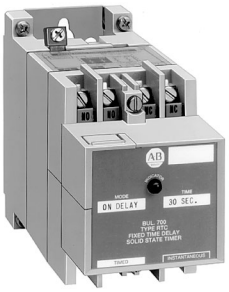
⊗ Voltage Suffix Code

The Cat. No. as listed is not complete. Select a voltage suffix code from the table below to complete the Cat. No. Example: **Cat. No. 700-RTC00100⊗** becomes **Cat. No. 700-RTC00100U24**. For other voltages consult your local Allen-Bradley Distributor.

Voltage	24V DC 24V AC, 50/60 Hz	120V DC 110/120V AC, 50/60 Hz	240V DC 220/240V AC, 50/60 Hz
Coil Code	U24	U1	U2

Bulletin 700-RTC Relays with Fixed Time Delay— Relays with Provision for Instantaneous Contacts

Relays listed below have slots for two timed and two instantaneous contacts. Unused slots are equipped with removable dummy cartridges.



Number of Contact Cartridges					Open Type Without Enclosure
	Timed		Instantaneous		
Total	N.O.	N.C.	N.O.	N.C.	Cat. No.✶
0	0	0	0	0	700-RTC00#0⊗
1	1	0	0	0	700-RTC10#0⊗
	0	1	0	0	700-RTC20#0⊗
2	2	0	0	0	700-RTC40#0⊗
	1	0	1	0	700-RTC11#0⊗
	1	0	0	1	700-RTC12#0⊗
	1	1	0	0	700-RTC30#0⊗
	0	1	1	0	700-RTC21#0⊗
	0	1	0	1	700-RTC22#0⊗
	0	2	0	0	700-RTC50#0⊗
3	2	0	1	0	700-RTC41#0⊗
	1	0	2	0	700-RTC14#0⊗
	2	0	0	1	700-RTC42#0⊗
	1	0	1	1	700-RTC13#0⊗
	1	1	1	0	700-RTC31#0⊗
	0	1	2	0	700-RTC24#0⊗
	1	0	0	2	700-RTC15#0⊗
	1	1	0	1	700-RTC32#0⊗
	0	1	1	1	700-RTC23#0⊗
	0	2	1	0	700-RTC51#0⊗
	0	1	0	2	700-RTC25#0⊗
	0	2	0	1	700-RTC52#0⊗
4	2	0	2	0	700-RTC44#0⊗
	2	0	1	1	700-RTC43#0⊗
	1	1	2	0	700-RTC34#0⊗
	2	0	0	2	700-RTC45#0⊗
	1	1	1	1	700-RTC33#0⊗
	0	2	2	0	700-RTC54#0⊗
	1	1	0	2	700-RTC35#0⊗
	0	2	1	1	700-RTC53#0⊗
	0	2	0	2	700-RTC55#0⊗

✶ # Operating Mode
Replace the # in the Cat. No. with the appropriate letter and numbers to indicate the operating mode and the fixed time delay value. Refer to operating mode table.

Digit	Operating Mode	Fixed Time Delay
S	On-Delay – s	**Seconds** –Two digits indicating the fixed time delay in seconds. Three digits indicating the fixed time delay (first digit indicates seconds, next two digits indicate 1/100 seconds).
Z	Off-Delay – s	
Y	On-Delay – Min.	**Minutes** –Two digits indicating the fixed time delay in minutes. Three digits indicating the fixed time delay (first digit indicates minutes, next two digits indicate 1/100 minutes).
I	Off-Delay – Min.	

Examples: **Cat. No. 700-RTC00Y200**U1 is for a relay without contact cartridges. **"Y20"** indicates an On-Delay timer with a 20 minute fixed time delay. This is a "standard relay." Order the contact cartridges separately. **Cat. No. 700-RTC42S020**U1 is for a relay with 2 N.O. cartridges in the timed position and 1 N.C. cartridge in the instantaneous position. **"S02"** indicates an On-Delay timer with a 2 second fixed time delay.

⊗ Voltage Suffix Code

The Cat. No. as listed is not complete. To complete the Cat. No., add a coil code selected from the table below.

Voltage	24V DC—24V AC, 50/60 Hz	120V DC—110/120V AC, 50/60 Hz	240V DC—220/240V AC, 50/60 Hz
Coil Code	U24	U1	U2

Sealed Switch Timing Relays

Accessories

	Description	Cartridge Type	Color	Cat. No.
Cat. No. 700-CRT5 *Cat. No. 700-CRT6* *Cat. No. 700-CR9*	**Contact Cartridges –** These cartridges are used to add contacts to timing relays having unused slots. The N.O., N.C., and "Dummy" cartridges are interchangeable and can be used in timed or instantaneous contact slots. "Dummy" cartridges should be placed in unused cartridge slots to guard against entrance of foreign material.	N.O.	Gray	700-CRT5
		N.C.	Orange	700-CRT6
		Dummy Cartridge	Black	700-CR9
Cat. No. 800MR-N37	**External Potentiometer** – The potentiometer units listed are recommended for timers with remote potentiometer provision. Refer to catalog section on Bulletin 800T or 800M for general construction features. **Connection Cable** – Use shielded twisted pair cable, maximum of 50 feet. Recommended cable (or equivalent): UL style 2517, having two #18 stranded conductors with aluminum mylar foil shield and #20 drain wire. Rated 150 °C, FR-1, 300 volts.	Oiltight∗		800T-U90
		Small Oiltight – Round†‡		800MR-N37
		Small Oiltight – Square†§		800MS-N37
	ATTENTION – If the recommended potentiometer and cable are not used, be certain that the potentiometer and cable wiring is insulated from ground and circuit common for 300V RMS or greater.			
	Type 1 Enclosure – Use for all Bulletin 700-P, -PH and -PK relays except 10- and 12-pole DC relays or 5- and 6-pole DC Bulletin 700-PH relays.			700-N31
	Relay Rail Simplifies panel layout. These indexed strips are easily cut to the required length and bolted, riveted, or spot-welded in place. Relays are installed adjacent to one another on the mounting strip with the captive mounting screws provided. Rows of relays on Relay Rail form their own wiring trough.	Relays per Strip	Pkg. Quantity	
		4	5	700-MP4
		8	5	700-MP8
		12	5	700-MP12
		16	5	700-MP16
	DIN Rail Adapter		1	700-DRA
Cat. No. 199-DR1	**DIN (#3) Symmetrical Rail** 35 mm x 7.5 mm x 1 m long Zinc-plated, yellow chromated EN 50022		5	199-DR1

∗ Legend plate, Cat. No. 800T-X609, must be specified when ordering.
† Add suitable 400 KΩ potentiometer.
‡ Does not include legend plate. Refer to publication A115.
§ Does not include legend plate. Contact your local Allen-Bradley Distributor.

Voltage and Power Requirements

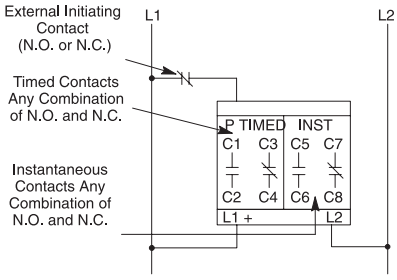
AC Voltage +10% –15% 50/60 Hz	Total Power Required	Initiate Terminal (P) Power	Maximum Allowable Leakage Current	Coil Code
24V AC	8 VA	4 VA	10 mA	U24
110/120V AC	9 VA	4 VA	2.4 mA	U1
220/240V AC	11 VA	5 VA	2.4 mA	U2

DC Voltage +10% –20%	Total Power Required	Initiate Terminal (P) Power	Maximum Allowable Leakage Current	Coil Code
24V DC	10 W	5 W	10 mA	U24
120V DC	11 W	5 W	2.4 mA	U1
240V DC	12 W	5 W	2.4 mA	U2

Type	700-RTC	
Contact Rating (See page 19, pub. 700-SG003B-EN-P)	NEMA B600 600V AC, 5 A NEMA P300 300V DC, 5 A	
Contact Arrangement	1…4 poles. Max. of 2 timed and 2 instantaneous. Available in any combination of N.O. and N.C. contacts	
Contact Material	W (tungsten in a controlled gas atmosphere)	
Operating Mode	Convertible to On-Delay or Off-Delay	
Timing Range	0.05…64 min.	
Reset Time	25 ms	
Repeat Accuracy	±1% (or ±50 ms) at constant voltage and temperature	
Mounting	Panel or Strip Mount	
Surge Suppression	Not required. Timers have internal suppression	
Standards	NEMA B600, NEMA P300	
Certifications	UL Listed, File E10314, Guide NOIV Suitable for use in Class I, Division 2, Groups A, B, C, and D CSA Certified, File LR11924	
Maximum Allowable Leakage Current	24V AC/DC	10 mA
	110/120V AC, 220/240V AC, 120/240V DC	2.4 mA
Ambient Temperature*		
Operating:	–20…+60 °C (–4…+140 °F)	
Storage:	–20…+60 °C (–4…+140 °F)	

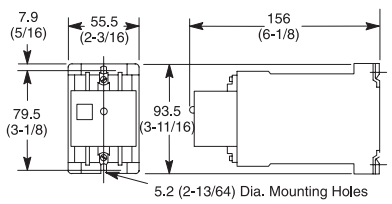
* Continuous duty units placed close to each other (3 in a row) have a temperature range of –20…+45 °C (–4…+113 °F) or should have air circulated around the units. Approximate space of 3/4 in (mm) on all sides is needed.

Typical Wiring Diagram

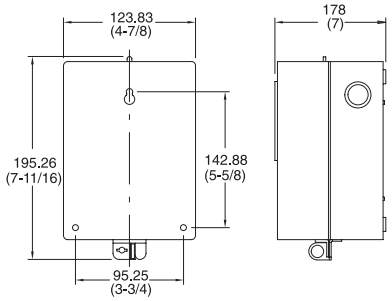


Approximate Dimensions

Approximate Dimensions are shown in millimeters (inches). Approximate Dimensions are not intended to be used for manufacturing purposes.



Approximate Shipping Weight 0.92 kg (2.1 lb.)



NEMA Type 1 Enclosure for RTC Relays
Approximate Shipping Weight 1.26 kg (2.8 lb.)

Solid-State Timer
Cat. No. 700-PSPA1

Bulletin 700-PS

- Solid-State Timer
- 600V AC Maximum, 300V DC Maximum
- Time Range 0.1…120 sec
- Can be attached to a Bulletin 700 Type P, PK, R and RM relay
- Convertable to ON Delay or OFF Delay

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Certifications

- UL Listed (File No. E10319) (Guide No. NOIV) per UL508
- CSA Certified (File No. LR11924)

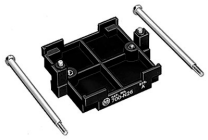
Bulletin 700-PS

Solid-State Timer
Cat. No. 700-PSPA1

Operating Mode	Timing Range*	Timing Relay with Self-Contained Potentiometer Unit Cat. No.	Timing Relay for Use with External Potentiometer Unit Cat. No.
On-Delay	0.1…2 s	700-PSAA1	700-PSRAA1
	0.4…8 s	700-PSBA1	700-PSRBA1
	1.5…30 s	700-PSCA1	700-PSRCA1
	6…120 s	700-PSDA1	700-PSRDA1
Off-Delay	0.1…2 s	700-PSPA1	700-PSRPA1
	0.4…8 s	700-PSRA1	700-PSRRA1
	1.5…30 s	700-PSTA1	700-PSRTA1
	6…120 s	700-PSUA1	700-PSRUA1

Bulletin 700-PS — Accessories

Cat. No. 700-N25



Cat. No. 700-N26

Description			Cat. No.
Adapter Plate — For mounting Bulletin 700-PS timers directly on a panel or on Bulletin 700-MP universal mounting strips.			700-N25
Adapter for Bulletin 700-R, -RM Relays Allows you to mount the Bulletin 700-PS timer on a 1…4 pole Bulletin 700-R or -RM relay.			700-N26
	Timing Range*	Resistance (mΩ)	
	0.1…2 (0.4…8)	0.75	700-N35†
	0.1…2 (0.4…8)	0.75	700-N35†
	1.5…30	2.0	700-N36†
	6…120	3.5	700-N37†

* The maximum range may be 50% greater and the minimum range may be 50% less than the values specified.
† This Cat. No. includes only the potentiometer. Order **Cat. No. 800T-N37** for the potentiometer operator and housing.

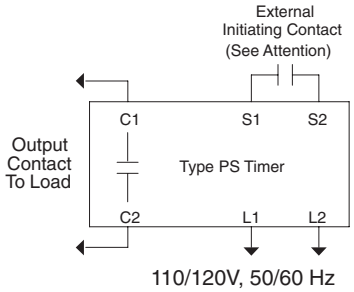
Bulletin 700-PS

Supply Voltage	110…120V AC, 50/60 Hz
Power Requirement	4 VA, 2.5 W
Output Contact Ratings	NEMA B600 and P300. See page 19, pub. 700-SG003B-EN-P.
Operating Temperature Range	–20…+60 °C ambient (–4…+140 °F)
Reset Time	20 ms
Repeat Accuracy, Constant Voltage and Temperature	±2% of setting or ±0.004 s, whichever is greater
Standards	NEMA B600, NEMA P300
Certifications	UL Listed, Class I, Division 2, Groups A, B, C, and D, CSA Certified

Operation

The timer must be energized continuously (L1-L2). ON-Delay: When the initiating contact closes, timing begins. At time-out, the output contact closes. OFF-Delay: When the initiating contact closes, the output contact closes instantly. When the initiating contact re-opens, timing begins. At time-out, the output contact re-opens.

Typical Wiring Diagram*



➲ **Attention** — To avoid damage to timer, do not switch any load in addition to timing relay at terminals S1–S2. Do not apply an external voltage to terminals S1–S2.

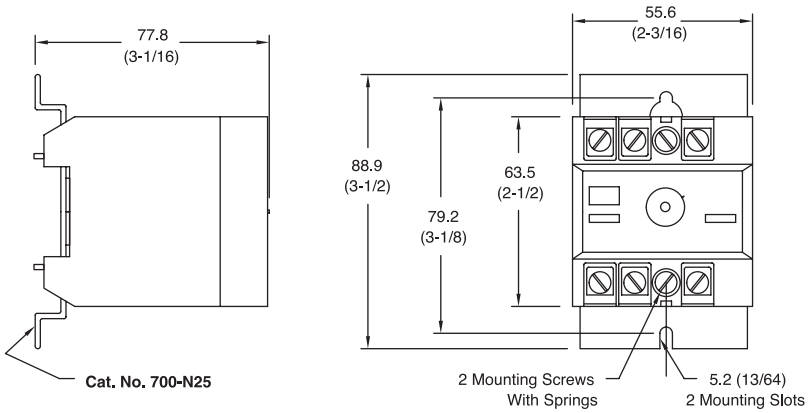
* Note: External Potentiometer units have R1, R2 terminals for connecting the potentiometer.

Industrial Timing Relays

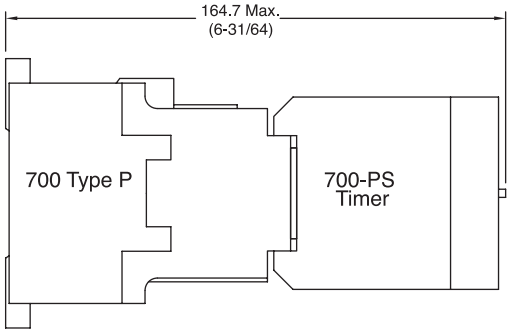
Approximate Dimensions

Dimensions are shown in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

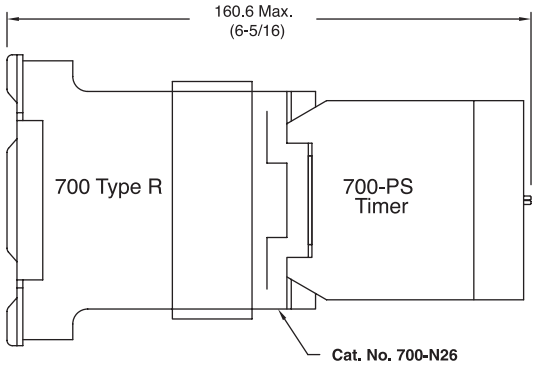
Bulletin 700-PS



Bulletin 700-PS Timer Mounted on the Adapter Plate
Cat. No. 700-N25
Approximate Shipping Wt. 0.45 kg (1 lb.)

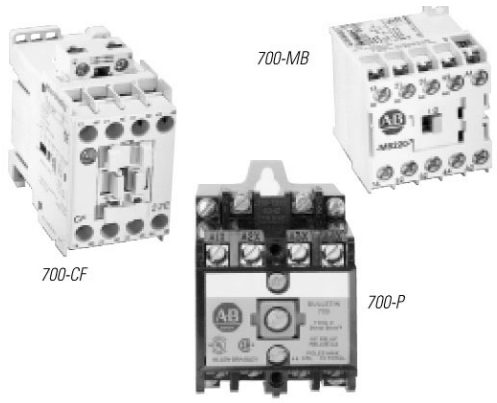


Bulletin 700-PS Timer Mounted on a 4-Pole
Bulletin 700-P or -PK, or 2-Pole Bulletin 700-PH Relay
Approximate Shipping Wt. 1.02 kg (2.3 lbs.)



Bulletin 700-PS Timer Mounted on a 4-Pole
Bulletin 700-R or -RM Relay
Approximate Shipping Wt. 1.25 kg (2.8 lbs.)

Industrial Relays



This portion of the selection guide covers industrial relays. Industrial relays are used for:

- Safety applications
- Applications requiring long life
- Hazadous Areas and Difficult Environments
- Latch and Pneumatic Timers

Safety Features

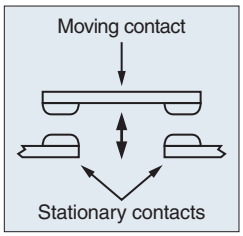
Industrial relays have important features that provide safe, more reliable design of control systems.

- Mechanically linked contacts (positive-guided contacts)
- Double-break contacts make it possible to detect a welded contact and also reduce the posibility of welding a contact.
- Break before make contacts (non-overlapping)

Importance of Mechanically Linked Contacts

This feature allows detection of a welded contact condition. In most relays, each contact opens and closes independently of the other contacts. Mechanically linked (also known as positively guided and Direct Drive™) contacts are linked together, thereby preventing the reclosing of the N.C. contacts if a N.O. contact has welded.

Importance of Double-Break Contacts



This design provides better protection against contact welding than single break design. Other benefits include greater DC load breaking capability and better isolation. It also provides separation of N.O. and N.C. circuits, unlike standard “Form C” contacts. Double-break contacts open the circuit in two places, creating two air gaps. It is analogous to having two contacts in series.

Long Life

Allen-Bradley industrial relays and contacts are designed for long life. Each component is engineered for millions of operations, without compromising peformance. Contact life is often 3 to 5 times greater than plug-in relays.

Safety Applications:

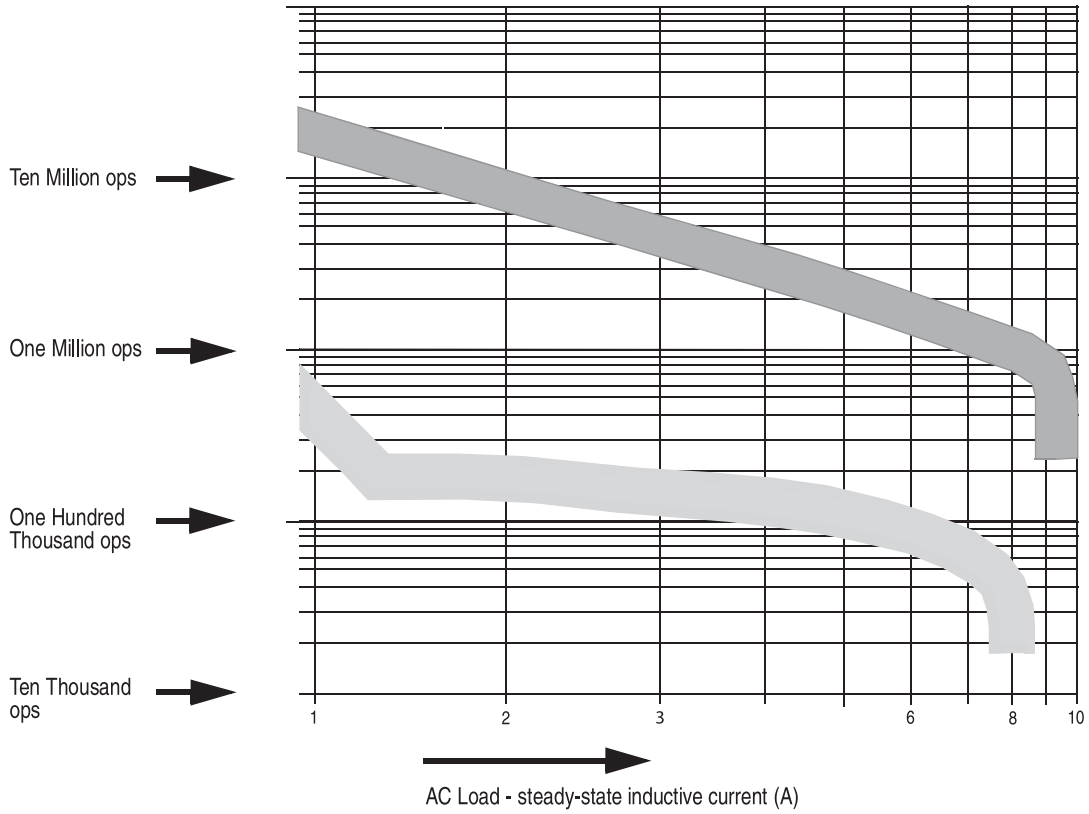
Allen-Bradley industrial relays are frequently used in safety circuits for:

- Safety relay output to expand the current rating or contact life of a safety relay
- Master Control Relays (switching PLC power supplies)
- E-Stop Relays
- Directing course of action when a safety condition occurs
- Light curtain monitoring
- Press control

Additional Features and Options

- Switch up to 12 circuits with one relay
- Sealed contacts for dirty enviroments and low-energy switching
- Coil voltages from 12…600V AC and 6…600V DC
- Switch from 5…600V AC and DC
- Switch from 1 mA…35 A
- Pneumatic timers to maintain timing even if power is lost

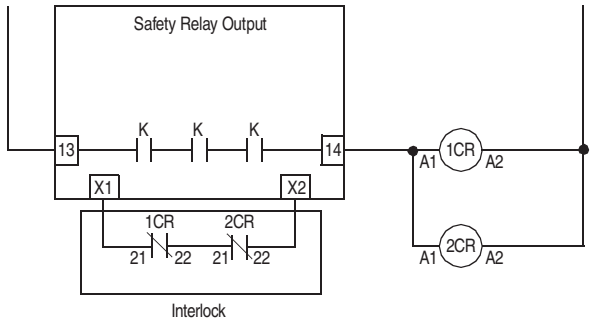
Relay Load Life Comparison—Pilot Duty Loads (solenoid valve, contactor coil, relay coil)

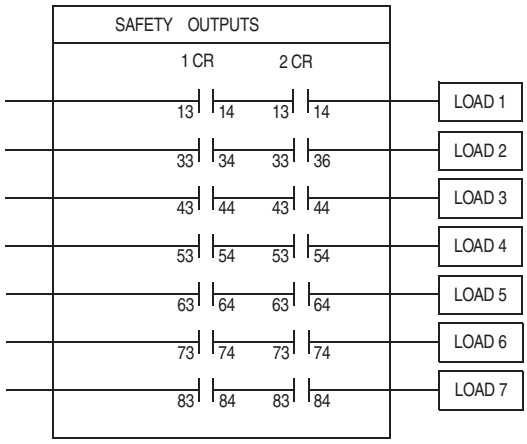


Does not change conditions of sales or warranty.

Safety Relay Output Block Diagram

This diagram illustrates how 2 industrial relays can be used to expand safety relay outputs.





CR = Industrial Relay (700S-P, 700S-CF)

Note: 1 CR and 2 CR are Allen-Bradley Industrial relays with mechanically linked contacts (Bulletins 700-P, 700-CF, and 700-M)

Bulletin. No.	**700-M/MB**	**700-CF**	**700S-CF**	**700-P**	**700S-P**	**700-R**
Mechanically Linked contacts∗	Y†	Y	Y	Y‡	Y‡	N
Double-break contacts	Y	Y	Y	Y	Y	—
Switch millions of operations at >1 A	Y	Y	Y	Y	Y	Y
Low-energy switching	Y	Y	Y	Y	Y	Y
Marine certification—vibration applications	Y	Y	Y	Y	Y	Y
Relay Differences						
Number of circuits to switch (number of poles)	4…8	4…10 (AC) 4…8 (DC)	8	2…12	2…12	2…8
Current ratings at 120V AC	10 A	10 A	10 A	10…35 A	10 A	5 A
Pneumatic timer option	N	Y	N	Y	N	Y
Electronic timer option	Y	Y	Y	Y	N	Y
Latch option	N	Y	N	Y	N	Y
Built-in surge suppression for 24V DC coil option	Y	Y	Y	N	N	Y§
Convertible and replaceable contacts	N	N	N	Y	N	Y
Switch 20…35 A on 6…12 poles	N	N	N	Y	N	N
DIN Rail Mounting	Y	Y	Y	N	N	N
Finger-Safe Terminals	Y	Y	Y	N	N	N
Poles permanently attached	N	N	Y	Y	Y	Y

∗ If a N.O. contact welds, the N.C. contacts will remain open and if a N.C. contact welds, the N.O. contacts will remain open.
† Yes for main poles only.
‡ Bulletins 700-P and 700S-P meet the component requirements for relays of ANSI B11.19 section 5.5.1 (Control Reliability).
§ Y for AC coil.

Bulletin 700-CF

- IEC Industrial Relays (Finger Safe Design)
- Positively-Guided/Mechanically-Linked Contacts per IEC 947-5-1 Annex L on Main and Auxiliary Contacts
- Gold Plated, Bifurcated Version for Low Level Switching Applications
- Master Control Relay Version rated 15 A (AC-15)
- Solid-State and Pneumatic Timing Modules
- 4...10 Poles
- 12...600V Coils

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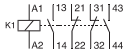
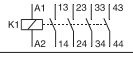
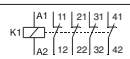
Standards Compliance and Certifications

- IEC 60947-5-1
- UL 508
- CSA C22.2 No. 14

4-Pole AC Coil Voltage

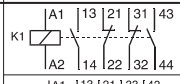
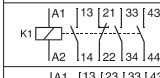
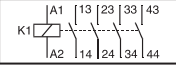
AC-12		AC-15								Contacts				
I_{th} [A]		I_{th} [A]												
40 °C	60 °C	24/48V	120V	240V	400V	500V	600V	690V	Connection Diagrams	N.O.	N.C.	Standard Contacts Cat. No.	Gold Plated Bifurcated Contacts Cat. No.	Master Contacts Cat. No.
20	20	10	10	10	6	2.5	1	1		2	2	700-CF220⊗	700-CFB220⊗	700-CFM220⊗
										3	1	700-CF310⊗	700-CFB310⊗	700-CFM310⊗
										4	0	700-CF400⊗	700-CFB400⊗	700-CFM400⊗
										0	4	700-CF040⊗	700-CFB040⊗	—

⊗ AC Coil Voltage Code

The Cat. No. as listed is incomplete. Select a Coil Voltage Code from the table below to complete the Cat. No. Example: **Cat. No. 700-CF220⊗** becomes **Cat. No. 700-CF220D** for 120V, 60 Hz

Voltage	12	24	32	36	42	48	100	100 - 110	110	120	127	200	200 - 220	208	208 - 240	220 - 230	230	230 - 240	240	277	347	380	380 - 400	400	400 - 415	440	480	500	550	600
50 Hz	R	K	V	W	X	Y	KP	—	D	P	S	KG	L	—	—	F	—	VA	T	—	—	—	N	—	G	B	—	M	C	—
60 Hz	Q	J	—	V	—	X	—	KP	—	D	—	—	KG	H	L	—	—	—	A	T	I	E	—	—	—	N	B	—	—	C
50/60 Hz	—	KJ	—	—	—	KY	KP	—	KD	—	—	KG	KL	—	—	KL	KF	—	KA	—	—	—	—	KN	—	KB	—	—	—	—

4-Pole DC Coil Voltage

AC-12		AC-15								Contacts				
I_{th} [A]		I_{th} [A]												
40 °C	60 °C	24/48V	120V	240V	400V	500V	600V	690V	Connection Diagrams	N.O.	N.C.	Standard Contacts Cat. No.	Gold Plated Bifurcated Contacts Cat. No.	Master Contacts Cat. No.
20	20	10	10	10	6	2.5	1	1		2	2	700-CF220⊗	700-CFB220⊗	700-CFM200⊗
										3	1	700-CF310⊗	700-CFB310⊗	700-CFM310⊗
										4	0	700-CF400⊗	700-CFB400⊗	700-CFM400⊗

⊗ DC Coil Voltage Code⁎

The Cat. No. as listed is incomplete. Select a Coil Voltage Code from the table below to complete the Cat. No. Example: **Cat. No. 700-CF220⊗** becomes Cat. No. **700-CF220ZJ for 24V DC**

Voltage	9	12	24	36	48	60	64	72	80	110	115	125	220	230	250
Standard	ZR	ZQ	ZJ	ZW	ZY	ZZ	ZB	ZG	ZE	ZD	ZP	ZS	ZA	ZF	ZT
With diode suppressor	—	—	DJ	—	—	—	—	—	—	—	—	—	—	—	—

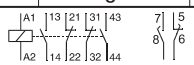
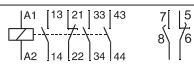
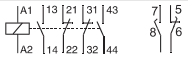
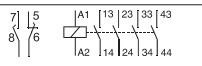
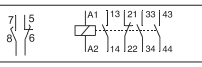
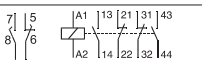
⁎ When ordering DJ coil with built-in surge suppression, the DJ is not polarity sensitive. Drop out time: 14...20 ms.

6- and 8-Pole Relays

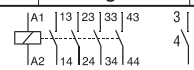
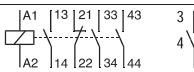
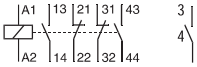
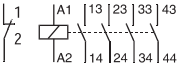
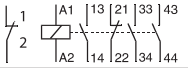
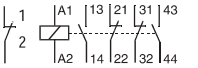
Cat. No. 700-CFZ 1420

Cat. No. 700-CFZ 0530

Control Relays with Overlapping Side-Mounted Contacts

AC-12 I_{th} [A]			AC-15 I_{th} [A]							Left Aux.	Relay Arrangement	Right Aux.	Contacts		Overlapping Side-Mounted Contacts		Cat. No.
	40 °C	60 °C	24/48V	120V	240V	400V	500V	600V	690V				N.O.	N.C.	N.O.	N.C.	
Main Relay	20	20	10	10	10	6	2.5	1	1				4	0	1	1	700-CFZ1510⊗
													3	1	1	1	700-CFZ1420⊗
Side Contacts :	10	10	6	6	5	3	1.6	1	1				2	2	1	1	700-CFZ1330⊗
													4	0	2	2	700-CFZ2620⊗
													3	1	2	2	700-CFZ2530⊗
													2	2	2	2	700-CFZ2440⊗

Control Relays with Standard Side-Mounted Contacts

AC-12 I_{th} [A]			AC-15 I_{th} [A]							Left Aux.	Relay Arrangement	Right Aux.	Contacts		Standard Side-Mounted Contacts		Cat. No.
	40 °C	60 °C	24/48V	120V	240V	400V	500V	600V	690V				N.O.	N.C.	N.O.	N.C.	
Main Relay	20	20	10	10	10	6	2.5	1	1				4	0	1	1	700-CFZ0510⊗
													3	1	1	1	700-CFZ0420⊗
													2	2	1	1	700-CFZ0330⊗
Side Contacts :	10	10	6	6	5	3	1.6	1	1				4	0	2	2	700-CFZ0620⊗
													3	1	2	2	700-CFZ0530⊗
													2	2	2	2	700-CFZ0440⊗

⊗ AC Coil Voltage Code

The Cat. No. as listed is incomplete. Select a Coil Voltage Code from the table below to complete the Cat. No. Example: **Cat. No. 700-CFZ0510⊗** becomes **Cat. No. 700-CFZ0510F**.

Voltage	12	24	32	36	42	48	100	100 - 110	110	120	127	200	200 - 220	208	208 - 240	220 - 230	230	230 - 240	240	277	347	380	380 - 400	400	400 - 415	440	480	500	550	600
50 Hz	R	K	V	W	X	Y	KP	—	D	P	S	KG	L	—	—	F	—	VA	T	—	—	—	N	—	G	B	—	M	C	—
60 Hz	Q	J	—	V	—	X	—	KP	—	D	—	—	KG	H	L	—	—	—	A	T	I	E	—	—	—	N	B	—	—	C
50/60 Hz	—	KJ	—	—	—	KY	KP	—	KD	—	—	KG	KL	—	—	KL	KF	—	KA	—	—	—	—	KN	—	KB	—	—	—	—

Auxiliary Contacts

	Description	N.O.	N.C.	Connection Diagrams	For Use With	Standard Contacts Cat. No.	Bifurcated Contacts Cat. No.
	Auxiliary Contact Blocks for Front Mounting∗† 2- and 4-pole Quick and easy mounting without tools Electronic-compatible contacts down to 17V, 5 mA Mechanically linked performance between N.O. and N.C. poles and to the main contactor poles (except for L types) Models with equal function with several terminal numbering choices 1L = Late break N.C./early make N.O. Bifurcated version for switching down to 8V, 5 mA	0	2	-FA02 -FA11	700-CF	100-FA02	100-FAB02
		1	1			100-FA11	100-FAB11
		2	0			100-FA20	100-FAB20
		1L	1L			100-FAL11	—
		0	4	-FA20 -FAL11		100-FA04	100-FAB04
		1	3			100-FA13	100-FAB13
		2	2			100-FA22	100-FAB22
		3	1	-FA04 -FA13		100-FA31	100-FAB31
		4	0			100-FA40	100-FAB40
		1+ 1L	1+ 1L	-FA22 -FB22 -FA31 -FA40 -FAL22		100-FAL22	—

	Description	N.O.	N.C.	Connection Diagrams	For Use With	Cat. No.
	Auxiliary Contact Blocks for Side Mounting without Sequence Terminal Designations†‡ 1- and 2-pole Two-way numbering for right or left mounting on the contactor Quick and easy mounting without tools Electronic-compatible contacts down to 17V, 10 mA Mirror contact performance to the main contactor poles 1L = Late break N.C./early make N.O.	0	1	-SA01 -SA10	700-CF	100-SA01
		1	0			100-SA10
		0	2			100-SA02
		1	1			100-SA11
		2	0			100-SA20
		1L	1L	-SA02 -SA11 -SA20 -SAL11		100-SAL11

∗ Control Relay and Auxiliary Contact.
† Up to 6 auxiliary contacts may be mounted (a maximum of 4 N.C. contacts and a maximum of 2 N.O. contacts).
‡ Maximum No. of Contacts: Refer to the following tables.

700CF (AC coils), vertical mounting, 60 °C

Cat. No. 700…	Max. N.O. Side Aux.	Max. N.C. Side Aux.	Max. N.O. Front + Side Aux.	Max. N.C. Front + Side Aux.	Max. N.O. + N.C. Front + Side Aux.
CF400	2	4	6	4	6
CF310	2	4	6	4♣	6
CF220	2	4	6	4♣	6
CF040	2	3	4	4♣	6

♣ Side mounted auxiliary contacts only.
➤ Side or front mounted auxiliary contacts only, not both.

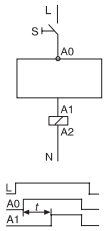
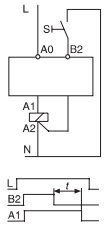
700CF (DC coils), vertical mounting, 40 °C➤

Cat. No. 700…	Max. N.O. Side Aux.	Max. N.C. Side Aux.	Max. N.O. + N.C. Side Aux.	Max. N.O. Front Aux.	Max. N.C. Front Aux.
CF400	2	2	2	4	4
CF310	2	2	2	4	3
CF220	2	2	2	4	2

700CF (DC coils), vertical mounting, 60 °C➤

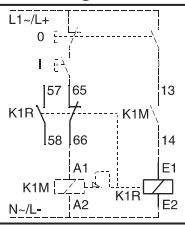
Cat. No. 700…	Max. N.O. Side Aux.	Max. N.C. Side Aux.	Max. N.O. + N.C. Side Aux.	Max. N.O. Front Aux.	Max. N.C. Front Aux.
CF400	2	2	4	4	2
CF310	2	2	4	4	2
CF220	2	2	4	4	2

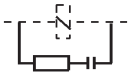
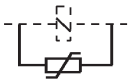
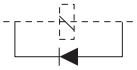
Control Modules

	Description	Connection Diagrams	Reset Time	Repeat Accuracy	Delay	For Use With	Cat. No.
	Pneumatic Timing Modules✶ Pneumatic timing element contacts switch after the delay time. The contacts on the main control relay continue to operate without delay.		25…90 ms for AC Coils 47…85 ms for DC coils	+/-10%	**On-Delay** 0.3…30 s	700-CF all✶	100-FPTA30
					1.8…180 s	700-CF all	100-FPTA180
	Pneumatic Timing Modules Pneumatic timing element contacts switch after the delay time. The contacts on the main control relay continue to operate without delay.				**Off-Delay** 0.3…30 s	700-CF all	100-FPTB30
					1.8…180 s	700-CF all	100-FPTB180
	Electronic Timing Modules — On-Delay Delay of the control relay coil assembly. The control relay is energized at the end of the delay time.		100 ms	+/-1%	**On-Delay** 0.1…3 s	700-CF 110…240V AC 110…250V DC coils	100-ETA3
					1…30 s	700-CF 110…240V AC 110…250V DC coils	100-ETA30
					10…180 s	700-CF 110…240V AC 110…250V DC coils	100-ETA180
					On-Delay 0.1…3 s	700-CF 24…48V DC coils	100-ETAZJ3
					1…30 s	700-CF 24…48V DC coils	100-ETAZJ30
					10…180 s	700-CF 24…48V DC coils	100-ETAZJ180
 Cat. No. 100-ETB30	**Electronic Timing Modules — Off-Delay** Delay of the control relay coil assembly. After interruption of the control signal, the control relay is deenergized at the end of the delay time.				**Off-Delay** 0.3…3 s	700-CF 110…240V AC coils	100-ETB3
					1…30 s	700-CF 110…240V AC coils	100-ETB30
					10…180 s	700-CF 110…240V AC coils	100-ETB180
					Off-Delay 0.3…3 s	700-CF 24V AC coils	100-ETBKJ3
					1…30 s	700-CF 24V AC coils	100-ETBKJ30
					10…180 s	700-CF 24V AC coils	100-ETBKJ180

✶ Cannot be used with side-mounted auxiliary contacts on DC coil relays.

Control Modules, Continued

	Description	Connection Diagrams	For Use With	Cat. No.
Cat. No. 100-FL⊗	**Mechanical Latch** Following relay latching, the relay coil is immediately de-energized (off) by the N.C. auxiliary contact (65-66). Electrical or manual release 1 N.O. + 1 N.C. auxiliary contacts		700-CF with AC coils	100-FL11⊗

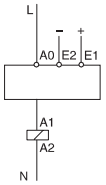
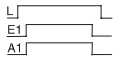
	Description			Connection Diagrams	For Use With	Cat. No.
	Surge Suppressors For limitation of coil switching transients. Plug-in, coil mounted	**RC Module** AC Operating Mechanism	24…48V 50/60 Hz		700-CF with AC coils	100-FSC48
			110…280V 50/60 Hz			100-FSC280
			380…480V 50/60 Hz			100-FSC480
		Varistor Module AC/DC Operating Mechanism	12…55V AC/ 12…77V DC		700-CF all	100-FSV55
			56…136V AC/ 78…180V DC			100-FSV136
			137…277V AC/ 181…350V DC			100-FSV277
			278…575V AC			100-FSV575
		Diode Module DC Operating Mechanism Dropout Time 70…95 ms	12…250V DC		700-CF with DC coils	100-FSD250

⊗ Coil Voltage Code

The Cat. No. as listed is incomplete. Select a Coil Voltage Code from the table below to complete the Cat. No. Example: **Cat. No. 100-FL11⊗** becomes **Cat. No. 100-FL11J**.∗

Voltage	24	48	100	110	120	230-240	240	277	380-400	400-415	440	480
50 Hz	K	Y	KP	D	—	VA	T	—	N	G	B	—
60 Hz	J	—	—	—	D	—	A	T	—	—	N	B

∗ For special voltages, consult your local Allen-Bradley Distributor.

	Description (Relays)		Connection Diagrams	For Use With (Relays)	Cat. No.
Cat. No. 100-JE	**DC Interface** (electronic) Interface between the DC control signal (PLC) and the AC operating mechanism of the control relay. Control (input) voltage 12V DC 18…30V DC (24V nominal) 48V DC Requires no additional surge suppression on the relay coils	Input: 18…30V DC Output: 110…240V AC		700-CF with 110…240V AC coils	100-JE
		Input: 12V DC Output: 110…240V AC			100-JE12
		Input: 48V DC Output: 110…240V AC	 *E1, E2 = DC Signal*		100-JE48

		100-JE	100-JE12	100-JE48
Electrical				
Input Voltage		24V DC	12V DC	48V DC
Input Voltage Range		18…30V DC	6…12V DC	35…48V DC
Output Voltage		110…240V DC	110…240V DC	110…240V DC
Power Consumption		0.1…0.4 W	0.02…0.12 W	0.2…0.5 W
Minimum Actuation		5V DC, 2 mA DC	5V DC, 2 mA DC	5V DC, 2 mA DC
Mechanical				
Finger Protection		IP20	IP20	IP20
Pickup Time		0…10 ms + pickup time of the contactor	0…10 ms + pickup time of the contactor	0…10 ms + pickup time of the contactor
Dropout Time		0…10 ms + dropout time of the contactor	0…10 ms + dropout time of the contactor	0…10 ms + dropout time of the contactor
Max. Cycles Per Second		2∗	2∗	2∗
Isolation/Breakdown Voltage		In: 50V, Out: 250V	In: 50V, Out: 250V	In: 50V, Out: 250V
Rated Impulse Withstand Voltage		4 kV	4 kV	4 kV
Environmental				
Ambient Temperature Range		-25…60 °C	-25…60 °C	-25…60 °C
Storage Temperature Range		-50…+80 °C	-50…80 °C	-50…80 °C
Life		100+ million ops	100+ million ops	100+ million ops
Construction				
Wire Size Range	1 Wire	0.5…2.5 mm² (flexible wire)	0.5…2.5 mm² (flexible wire)	0.5…2.5 mm² (flexible wire)
	2 Wire	0.75…2.5 mm² (flexible wire)	0.75…2.5 mm² (flexible wire)	0.75…2.5 mm² (flexible wire)
	1 Wire	1.0…2.5 mm² (solid wire)	1.0…2.5 mm² (solid wire)	1.0…2.5 mm² (solid wire)
	2 Wire	1.0…2.5 mm² (solid wire)	1.0…2.5 mm² (solid wire)	1.0…2.5 mm² (solid wire)
	Solid and Stranded	18…14 AWG	18…14 AWG	18…14 AWG
Tightening Torque		1…1.5 Nm/7…15 lb-in	1…1.5 Nm/7…15 lb-in	1…1.5 Nm/7…15 lb-in
Type of Light		LED	LED	LED

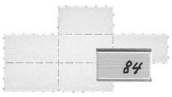
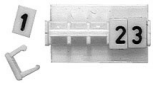
∗ To consider the maximum ops/hour of the relays.

Assembly Components

	Description	For Use With	Pkg. Quantity*	Cat. No.
Cat. No. 100-SCCA	**Protective Covers** Provides protection against unintended manual operation	700-CF all	1	100-SCCA
Cat. No. 100-SCFA	**Protective Covers** Provides protection against unintended manual operation For front mounted auxiliary contacts, pneumatic timers and latches	100-FA, -FB, -FC, -FP, -FL;	10	100-SCFA

Marking Systems

Uniform labelling materials for contactors, motor startup equipment, relays and circuit breakers.

	Description	Pkg. Quantity*	Cat. No.
	Label Sheet 10 sheets with 105 self-adhesive paper labels each, 6 x 17 mm	10	100-FMS
	**Marking Tag Sheet** 10 sheets with 160 perforated paper labels each, 6 x 17 mm To be used with a transparent cover	10	100-FMP
	Transparent Cover 100 each To be used with marking tag sheets	100	100-FMC
	**Marking Tag Adapters** 100 each To be used with marking tag:	100	100-FMA1
	System 1492 W		100-FMA2

* Must be ordered in multiples of package quantities.

Coils

	AC Coil Code	AC Voltages 50Hz	AC Voltages 60Hz	AC Voltages 50/60Hz	Cat. No. 700-CF	DC Coil Code	DC Voltages	Cat. No. 700-CF
	Q	—	12V	—	TA006	ZR	9V	TA766
	R	12V	—	—	TA404	ZQ	12V	TA708
	J	—	24V	—	TA013	DJ	24V Diode	TA714M
	K	24V	—	—	TA407	ZJ	24V	TA714
	KJ	—	—	24V	TA855	ZW	36V	TA719
	V	32V	36V	—	TA481	ZY	48V	TA724
	W	36V	—	—	TA410	ZZ	60V	TA774
	X	42V	48V	—	TA482	ZB	64V	TA727
	Y	48V	—	—	TA414	ZG	72V	TA728
	KY	—	—	48V	TA860	ZE	80V	TA729
	KP	100V	100 - 110V	100V	TA861	ZD	110V	TA733
	D	110V	120V	—	TA473	ZP	115V	TA734
	KD	—	—	110V	TA856	ZS	125V	TA737
	P	120V	—	—	TA425	ZA	220V	TA747
	S	127V	—	—	TA428	ZF	230V	TA749
	KG	200V	200 - 220V	200V	TA862	ZT	250V	TA751
	H	—	208V	—	TA049	—	—	—
	L	200 - 220V	208 - 240V	—	TA296	—	—	—
	KL	—	—	200 - 230V	TA864	—	—	—
	A	220V	240V	—	TA474	—	—	—
	F	220 - 230V	—	—	TA441	—	—	—
	KF	—	—	230V	TA851	—	—	—
	VA	230 - 240V	—	—	TA440	—	—	—
	T	240V	277V	—	TA480	—	—	—
	KA	—	—	240V	TA858	—	—	—
	I	—	347V	—	TA065	—	—	—
	E	—	380V	—	TA067	—	—	—
	N	380 - 400V	440V	—	TA071	—	—	—
	KN	—	—	400V	TA863	—	—	—
	G	400-415V	—	—	TA457	—	—	—
	B	440V	480V	—	TA475	—	—	—
	KB	—	—	440V	TA859	—	—	—
	M	500V	—	—	TA479	—	—	—
	C	550V	600V	—	TA476	—	—	—

General

			Mounted Standard Auxiliary	Main Relay Cat. No. 700-CF‡	Front Mounted Standard Auxiliary Contacts	Main Relay Cat. No. 700-CFB	Front Mounted Bifurcated Auxiliary Contacts	Master Relay Cat. No. 700-CFM	Side-mounted Contacts
Contact Ratings — NEMA				A600, P600	A600, Q600			2 x A600, P600	A600, Q600
Min. Contact Rating				17V, 10 mA	17V, 5 mA	5V, 3 mA		—	17V, 10 mA
Contact Ratings — IEC AC-15 (solenoids, contactors) at rated voltage IEC 60947-5-1			24V	10 A	6 A	3 A	3 A	15 A	6 A
			48V	10 A	6 A	3 A	3 A	15 A	6 A
			120V	10 A	6 A	3 A	3 A	15 A	6 A
			240V	10 A	5 A	3 A	3 A	15 A	5 A
			400V	6 A	3 A	2 A	2 A	7.5 A	3 A
			480V/500V	2.5 A	1.6 A	1.2 A	1.2 A	5 A	1.6 A
			600V	1 A	1 A	0.7 A	0.7 A	2 A	1 A
			690V	1 A	1 A	0.7 A	0.7 A	2 A	1 A
AC-12 (Control of resistive loads) IEC 60947-5-1		**40 °C I_{th}**		20 A	10 A	10 A	10 A	20 A	10 A
			230V	8 kW					
			400V	14 kW					
			690V	24 kW					
		60 °C I_{th}		20 A	6 A	6 A	6 A	20 A	6 A
			230V	8 kW					
			400V	14 kW					
			690V	24 kW					
DC-12 Switching DC Loads L/R < 1ms, Resistive Loads IEC 60947-5-1			24V	12 A	12 A	6 A	6 A	20 A	6 A
			48V	9 A	9 A	3.2 A	3.2 A	20 A	3.2 A
			110V	3.5 A	3.5 A	0.45 A	0.45 A	8 A	0.45 A
			220V	0.55 A	0.55 A	0.18 A	0.18 A	1.5 A	0.18 A
			440V	0.2 A	0.2 A	0.1 A	0.1 A	0.4 A	0.1 A
DC-13 IEC 60947-5-1, Solenoids and contactors			24V	5 A	5 A	2.5 A	2.5 A	5 A	5 A
			48V	3 A	3 A	1.5 A	1.5 A	3 A	3 A
			110V	1.2 A	1.2 A	0.6 A	0.6 A	1.2 A	1.2 A
			220V	0.6 A	0.6 A	0.3 A	0.3 A	0.6 A	0.6 A
			440V	0.3 A	0.15 A	0.15 A	0.15 A	0.3 A	0.15 A
	Location of welded N.O. contacts	State of N.C. Contacts if N.O. contact welds							
		Main	Front aux.	Side aux.					
Mechanically Linked Contacts†	Main	Open	Open∗	Open‡					
	Front aux.	Open	Open∗						

∗ If the accessory is a pneumatic timer or latch, there is no mechanically linked performance; the accessory contacts are independent.
† Defined in IEC 947-5-1 annex L. Mechanically linked is a relationship between contacts of opposite types (i.e., N.O. and N.C.).
‡ Side mounted auxiliary contacts provide “mirror contact” performance with main poles only.

				Cat. No. 700-CF	Aux./Pneumatic Timer Contact (Front-mounted)
Mechanical Life			[Mil]	15	5
Electrical Life	AC-15 (240V, 3 A)		[Mil]	1.5	1.5
Weight	AC Coil		[g]	390	—
Terminal Cross-Sections					
Terminal Type					
Terminal Size per IEC 947-1				2 x A4	2 x A4
	Solid/Stranded	1 Conductor	[mm²]	1.5…6	0.5…2.5
	§	2 Conductor	[mm²]	1.5…6	0.75…2.5
Max. Wire Size per UL/CSA			[AWG]	16…10	18…14
Tightening Torque			[lb.-in.]	8.9…22	8.9…13.3
Tightening Torque			[N-m]	1…2.5	1…1.5

§ For 16 or more strands, end ferrule is required.

DC Switching Ratings for 700-CF Main Poles in Series (Resistive Load at 60 °C)			
	1 pole	2 poles	3 poles
24/48 V	25/20 A	25 A	25 A
125 V	6 A	25 A	25 A
220 V	1.5 A	8 A	25 A
440 V	0.4 A	1 A	3 A

Control Circuit

			Cat. No. 700-CF
Operating Voltage			
AC 50/60 Hz	Pickup	[x U_s]	0.85…1.1
	Dropout	[x U_s]	0.3…0.6
DC✶	Pickup	[x U_s]	0.8…1.1
	Dropout	[x U_s]	0.1…0.6
Coil Consumption			
AC 50/60 Hz	Inrush	[VA/W]	70/50
	Seal	[VA/W]	8/2.6
DC	Inrush/Seal	[W]	6.00
Operating Times			
AC 50/60 Hz	Pickup Time	[ms]	15…30
	Dropout Time	[ms]	10…60
DC	Pickup Time	[ms]	40…70
	Dropout Time	[ms]	7…15
Latch Attachment Release, 100-FL			
Coil Consumption	AC	[VA/W]	45 VA/40W
	DC	[W]	25 W
Contact Signal Duration		[min./max]	0.03…15 s
Timing Attachment			
Reset Time, 100ETA, 100-ETB			
at min. time setting	[ms]		10
at max. time setting	[ms]		70
	Repeat Accuracy		± 10%

✶ For 9V DC, code ZR, use operating voltage 0.65…1.3 x U_s.
For 24V DC, code ZJ or DJ, use operating voltage 0.7…1.25 x U_s.

General

	Cat. No. 700-CF
Rated Insulation Voltage U_i	
IEC	690 V
UL; CSA	600 V
Rated Impulse Strength U_{imp}	8 kV
High Test Voltage 1 minute (per IEC 60947-4)	2500V
Rated Voltage U_e	
AC	115, 230, 400, 500, 690V
DC	24, 48, 110, 220, 440V
Short-Circuit Protection gG Fuse 10 A	
Rated Frequency	50/60 Hz, DC
Ambient Temperature	
Storage	–55…+80 °C (–67…176 °F)
Operation at nominal current	–25…+60 °C (–13…140 °F)
Conditioned 15% current reduction after AC-1 at > 60 °C	–25…+70 °C (–13…158 °F)
Corrosion Resistance	humid-alternating climate, cyclic, per IEC 68-2-30 and DIN 50 016, 56 cycles
Altitude	2000 m above mean sea level, per IEC 947-4
Type of Protection	
IP2X (IEC 60529 and DIN 40050)	in connected state
Shock Resistance	IEC 68-2: Half sinusoidal shock 11 ms, 30 G (in 3 directions)
Vibration Resistance	IEC 68-2: Static >2 G, in normal position no malfunction <5 G

Utilization Category Table from EN 947-5-1

Verification of Making and Breaking Capacities of Switching Elements Under Normal Conditions Corresponding to the Utilization Categories†

Utilization Category	Normal Condition of Use								
	Make‡			Break‡			Number and Rate of Making and Breaking operations		
	I/I_e	U/U_e	cos ψ	I/I_e	U/U_e	cos ψ	No. operating cycles§	Operating cycles per minute	ON time (s)➤
AC-12⌘	1	1	0.9	1	1	0.9	6050	6	0.05
AC-13⌘	2	1	0.65	1	1	0.65	6050	6	0.05
AC-14⌘	6	1	0.3	1	1	0.3	6050	6	0.05
AC-15⌘	10	1	0.3	1	1	0.3	6050	6	0.05
DC	—	—	$T_{0.95}$	—	—	$T_{0.95}$	—	—	—
DC-12	1	1	1 ms	1	1	1	6050	6	0.05➤
DC-13	1	1	6 x P♣	1	1	6 x P♣	6050	6	0.05➤
DC-14⌘	10	1	15 ms	1	1	15	6050		0.05➤

I_e Rated operational current
U_e Rated operational voltage I Current to be made or broken
PU_eI_e Steady-state power consumption (W)
$T_{0.95}$ Time to reach 95% of the steady-state current (ms) U Voltage before make
† See sub-clause 8.3.3.5.2.
‡ For tolerances on test quantities, see sub-clause 8.3.2.2.
§ The first 50 operating cycles shall be run at U/U_e=1.1 with the loads set at U_e.
♣ The value "6 x P" results from an empirical relationship which is found to represent most DC magnetic loads to an upper limit of P = 50 W, e.g., 6 x P= 300 W.
➤ The ON time shall be at least equal to $T_{0.95}$.
⌘ Where the break current differs from the make current value, the ON time refers to the make current value after which the current is reduced to the break current value for a suitable period e.g., 0.05 s.

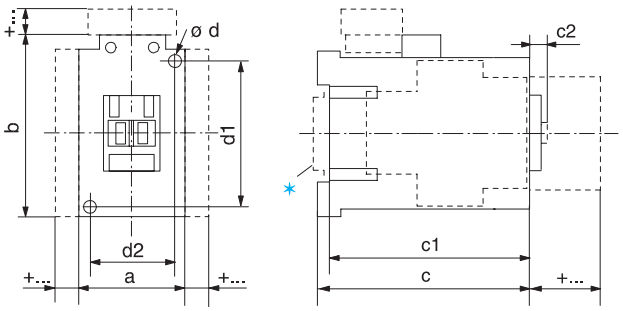
Contact Rating Table from EN 60947-5-1

Examples of Contact Rating Designation Based on Utilization Categories

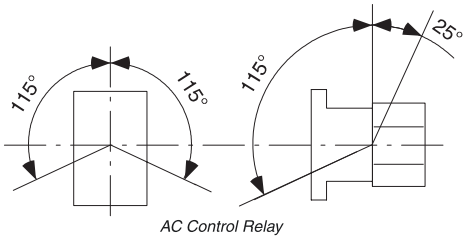
NEMA Designation *	IEC Utilization Category	Conventional Thermal Current I_{the} (A)	Rated Operational Current I_e (A) at Rated Operational Voltage U_e						VA Rating	
AC			120V	240V	380V	480V	500V	600V	Make	Break
A150	AC-15	10	6	—	—	—	—	—	7200	720
A300	AC-15	10	6	3	—	—	—	—	7200	720
A600	AC-15	10	6	3	1.9	1.5	1.4	1.2	7200	720
B150	AC-15	5	3	—	—	—	—	—	3600	360
B300	AC-15	5	3	1.5	—	—	—	—	3600	360
B600	AC-15	5	3	1.5	0.95	0.75	0.72	0.6	3600	360
C150	AC-15	2.5	1.5	—	—	—	—	—	1800	180
C300	AC-15	2.5	1.5	0.75	—	—	—	—	1800	180
C600	AC-15	2.5	1.5	0.75	0.47	0.375	0.35	0.3	1800	180
D150	AC-14	1.0	0.6	—	—	—	—	—	432	72
D300	AC-14	1.0	0.6	0.3	—	—	—	—	432	72
E150	AC-14	0.5	0.3	—	—	—	—	—	216	36
DC			125V	250V	440V	500V	600V	—	—	—
N150	DC-13	10	2.2	—	—	—	—	—	275	275
N300	DC-13	10	2.2	1.1	—	—	—	—	275	275
N600	DC-13	10	2.2	1.1	0.63	0.55	0.4	—	275	275
P150	DC-13	5	1.1	—	—	—	—	—	138	138
P300	DC-13	5	1.1	0.55	—	—	—	—	138	138
P600	DC-13	5	1.1	0.55	0.31	0.27	0.2	—	138	138
Q150	DC-13	2.5	0.55	—	—	—	—	—	69	69
Q300	DC-13	2.5	0.55	0.27	—	—	—	—	69	69
Q600	DC-13	2.5	0.55	0.27	0.15	0.13	0.1	—	69	69
R150	DC-13	1.0	0.22	—	—	—	—	—	28	28
R300	DC-13	1.0	0.22	0.1	—	—	—	—	28	28

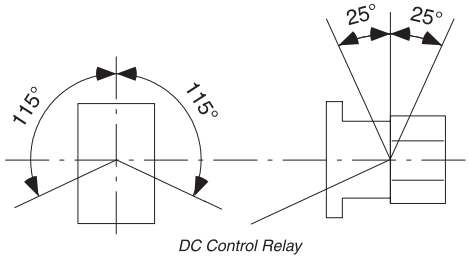
* This letter stands for the conventional thermal current and identifies AC or DC: e.g., B = 5 A AC. The number that follows is the rated insulation voltage.

Approximate Dimensions are shown in millimeters (inches). Approximate Dimensions are not intended for manufacturing purposes.



Mounting Position





AC Control Relays

Type	a	b	c	c1	c2	Ød	d1	d2
700-CF, CFB	45 (1-25/32)	81 (3-3/16)	80.5 (3-11/64)	75.5 (3-3/32)	6 (1/4)	2 screws 4.5 (3/16)	60 (2-23/64)	35 (1-25/64)

* May be mounted to 35 mm EN 50 022 DIN Rail.

DC Safety Control Relays

Type	a	b	c	c1	c2	Ød	d1	d2
700-CF___Z	45 (1-25/32)	81 (3-3/16)	106.5 (4-3/16)	101.5 (4)	6 (1/4)	2 screws 4.5 (3/16)	60 (2-23/64)	35 (1-25/64)

Accessories

Relay with		AC Control Relay		DC Control Relay	
		mm	(inches)	mm	(inches)
Auxiliary Contact for Front Mounting	2- or 4-pole	c/c1 + 39	(c/c1 + 1 – 37/64)	c/c1 + 39	c/c1 + 1 – 37/64)
Auxiliary Contact for Side Mounting	1- or 2-pole	a + 9	(a + 23/64)	a + 9	(a + 23/64)
Pneumatic Timing Module	—	c/c1 + 58	(c/c1 + 2 – 23/64)	—	—
Solid-state Timing Module	on coil terminal side	b + 24	(b + 15/16)	b + 24	(b + 15/16)
Mechanical Latching	—	c/c1 + 61	(c/c1 + 2 – 31/64)	—	—
Interface	on coil terminal side	b + 9	(b + 23/64)	—	—
Protective Element	on coil terminal side	b + 3	(b + 1/8)	b + 3	(b + 1/8)
Labelling with:	label sheet	+0	(+0)	+0	(+0)
—	marking tag with cover	+0	(+0)	+0	(+0)
—	marking tag carrier for System V4/V5	+5.5	(+7/32)	+5.5	(+7/32)
—	marking tag carrier for System Bull. 1492W	+5.5	(+7/32)	+5.5	(+7/32)

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Accessories — page 9-151
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Bulletin 700S-CF

- IEC Industrial Safety Relay
- Positively Guided/Mechanically Linked Contacts as Per IEC 947-5-1 Annex L
- Third Party Certification By SUVA
- Red Cover and Mechanically Linked Contact Symbol on Front Face
- Gold Plated, Bifurcated Version for Low Level Switching Applications

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Standards Compliance

- IEC 60947-5-1
- UL 508
- CSA C22.2 No. 14

Type CF and CFB Safety Control Relays — 8-Pole AC Coil Voltage

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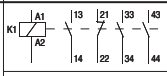
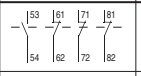
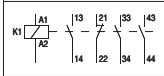
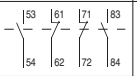
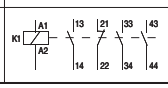
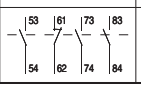
AC-12			AC-15							Connection Diagrams		Contacts		Standard Contacts Cat. No.	Gold Plated Bifurcated Contacts Cat. No.
I_e [A]			I_e [A]												
	40 °C	60 °C	24/48V	120V	240V	400V	500V	600V	690V	Main Contacts	Auxiliary Contacts	N.O.	N.C.		
Main Contacts	20	20	10	10	10	6	2.5	1	1			4	4	700S-CF440⊗C	700S-CFB440⊗C
												5	3	700S-CF530⊗C	700S-CFB530⊗C
Adder Deck Contacts	10	6	6	6	5	3	1.6	1	1			6	2	700S-CF620⊗C	700S-CFB620⊗C

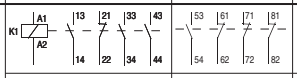
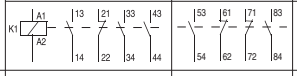
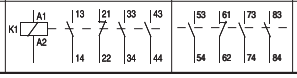
⊗ AC Coil Voltage Code

The Cat. No. as listed is incomplete. Select a Coil Voltage Code from the table below to complete the Cat. No. Example: **Cat. No. 700S-CF440⊗C** becomes **Cat. No. 700S-CF440DC** for 120V, 60 Hz.

Voltage	12	24	32	36	42	48	100	100-110	110	120	127	200	200-220	208	208-240	220-230
50 Hz	R	K	V	W	X	Y	KP	—	D	P	S	KG	L	—	—	F
60 Hz	Q	J	—	V	—	X	—	KP	—	D	—	—	KG	H	L	—
50/60 Hz	—	KJ	—	—	—	KY	KP	—	KD	—	—	KG	KL	—	—	KL

Voltage	230	230-240	240	277	347	380	380-400	400	400-415	440	480	500	550	600
50 Hz	—	VA	T	—	—	—	N	—	G	B	—	M	C	—
60 Hz	—	—	A	T	I	E	—	—	—	N	B	—	—	C
50/60 Hz	KF	—	KA	—	—	—	—	KN	—	KB	—	—	—	—

Ordering Details
Type CF and CFB Safety Control Relays — 8-Pole DC Coil Voltage

AC-12			AC-15							Connection Diagrams		Contacts			
I_e [A]			I_e [A]												
	40 °C	60 °C	24/48V	120 V	240 V	400 V	500 V	600 V	690 V	Main Contacts	Auxiliary Contacts	No. of N.O. Contacts	No. of N.C. Contacts	Standard Contacts Cat. No.✶	Gold Plated Bifurcated Contacts Cat. No.✶
Main Contacts	20	20	10	10	10	6	2.5	1	1			4	4	700S-CF440⊗C	700S-CFB440⊗C
												5	3	700S-CF530⊗C	700S-CFB530⊗C
Adder Deck Contacts	10	6	6	6	5	3	1.6	1	1			6	2	700S-CF620⊗C	700S-CFB620⊗C

✶ See table below for coil voltage selection information.

⊗ DC Coil Voltage Code

The Cat. No. as listed is incomplete. Select a Coil Voltage Code from the table below to complete the Cat. No. Example: **700S-CF440⊗C** becomes **Cat. No. 700S-CF440ZJC** for 24V DC.

Voltage	9	12	24	36	48	60	64	72	80	110	115	125	220	230	250
Standard	ZR	ZQ	ZJ	ZW	ZY	ZZ	ZB	ZG	ZE	ZD	ZP	ZS	ZA	ZF	ZT
With diode suppressor	—	—	DJ	—	—	—	—	—	—	—	—	—	—	—	—

General

			Main Relay Cat. No. 700S-CF	Front Mounted Standard Auxiliary Contacts	Main Relay Cat. No. 700S-CFB	Front Mounted Bifurcated Auxiliary Contacts	Side-mounted Auxiliary Contacts
Contact Ratings — NEMA			A600, P600	A600, Q600	A600, Q600	A600, Q600	A600, Q600
Min. Contact Rating			17V, 10 mA	17V, 5 mA	8V, 5 mA	5V, 3 mA	17V, 10 mA
Contact Ratings — IEC AC-15 (solenoids, contactors) at rated voltage IEC 60947-5-1		24V	10 A	6 A	3 A	3 A	6 A
		48V	10 A	6 A	3 A	3 A	6 A
		120V	10 A	6 A	3 A	3 A	6 A
		240V	10 A	5 A	3 A	3 A	5 A
		400V	6 A	3 A	2 A	2 A	3 A
		480V/500V	2.5 A	1.6 A	1.2 A	1.2 A	1.6 A
		600V	1 A	1 A	0.7 A	0.7 A	1 A
		690V	1 A	1 A	0.7 A	0.7 A	1 A
AC-12 (Control of resistive loads) IEC 60947-5-1	**40 °C**	**I_{th}**	20 A	10 A	10 A	10 A	10 A
		230 V	8 kW				
		400 V	14 kW				
		690 V	24 kW				
	60 °C	**I_{th}**	20 A	6 A	6 A	6 A	6 A
		230V	8 kW				
		400V	14 kW				
		690V	24 kW				
DC-12 Switching DC Loads L/R < 1ms, Resistive Loads IEC 60947-5-1		24V	12 A	12 A	6 A	6 A	6 A
		48V	9 A	9 A	3.2 A	3.2 A	3.2 A
		110V	3.5 A	3.5 A	0.45 A	0.45 A	0.45 A
		220V	0.55 A	0.55 A	0.18 A	0.18 A	0.18 A
		440V	0.2 A	0.2 A	0.1 A	0.1 A	0.1 A
DC-13 IEC 60947-5-1, Solenoids and contactors		24V	5 A	5 A	2.5 A	2.5 A	5 A
		48V	3 A	3 A	1.5 A	1.5 A	3 A
		110V	1.2 A	1.2 A	0.6 A	0.6 A	1.2 A
		220V	0.6 A	0.6 A	0.3 A	0.3 A	0.6 A
		440V	0.3 A	0.15 A	0.15 A	0.15 A	0.15 A
	Location of welded N.O. contacts	State of N.C. Contacts if N.O. contact welds					
		Main	Front aux.	Side aux.			
	Main	Open	Open	Open*			
Mechanically Linked Contacts†	Front aux.	Open	Open	—			

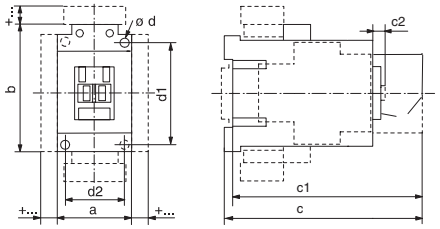
* Side mounted auxiliary contacts provide “mirror contact” performance with main poles only.
† Defined in IEC 947-5-1 annex L. Mechanically linked is a relationship between contacts of opposite types (i.e., N.O. and N.C.).

				Cat. No. 700S-CF	Aux. Contact (Front-mounted)
Mechanical Life			[Mil]	15	15
Electrical Life	AC-15 (240V, 3 A)		[Mil]	1.5	1.5
Weight	AC Coil		[g]	390	—
Terminal Cross-Sections					
Terminal Type					
Terminal Size per IEC 947-1				2 x A4	2 x A4
	Solid/ Stranded‡	1 Conductor	[mm²]	1.5…6	0.5…2.5
		2 Conductor	[mm²]	1.5…6	0.75…2.5
Max. Wire Size per UL/CSA			**[AWG]**	16…10	18…14
Tightening Torque			[lb.-in.]	8.9…22	8.9…13.3
Tightening Torque			[N-m]	1…2.5	1…1.5

‡ For 16 or more strands, end ferrule is required

DC Switching Ratings for 700S-CF Main Poles in Series (Resistive Load at 60 °C)			
	1 pole	2 poles	3 poles
24/48 V	25/20 A	25 A	25 A
125 V	6 A	25 A	25 A
220 V	1.5 A	8 A	25 A
440 V	0.4 A	1 A	3 A

Approximate Dimensions are shown in millimeters (inches). Approximate Dimensions are not intended for manufacturing purposes.



AC Safety Control Relays

Cat. No.	a	b	c	c1	c2	Ød	d1	d2
700S-CF	45	81	119.5	114.5	6	2 - 4.5	60	35
	(1-25/32)	(3-3/16)	(4-3/4)	(4-43/64)	(1/4)	(2 - 3/16)	(2-23/64)	(1-25/64)

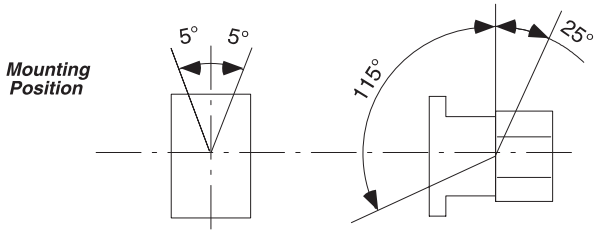
DC Safety Control Relays

Cat. No.	a	b	c	c1	c2	Ød	d1	d2
700S-CF	45	81	145.5	140.5	6	2 - 4.5	60	35
	(1-25/32)	(3-3/16)	(5-49/64)	(5-37/64)	(1/4)	(2 - 3/16)	(2-23/64)	(1-25/64)

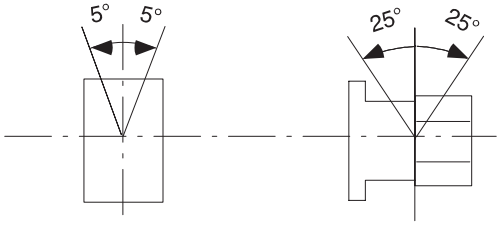
Accessories

Safety Control Relays with	mm.	(inches)
Auxiliary contact block for side mounting 1- or 2-pole	a + 9	(a + 23/64)
Electronic Timing Module on coil terminal side	b + 24	(b + 15/16)
Interface Module on coil terminal side	b + 9	(b + 23/64)
Surge Suppressor on coil terminal side	b + 3	(b + 1/8)
Labeling with label sheet	+ 0	(+ 0)
marking tag sheet with clear cover	+ 0	(+ 0)
marking tag adapter for System Bul. 1492W	+ 5.5	(+ 7/32)

Mounting Positions



AC Safety Control Relays



DC Safety Control Relays

Safety Relay Circuit With 5 Safety Outputs

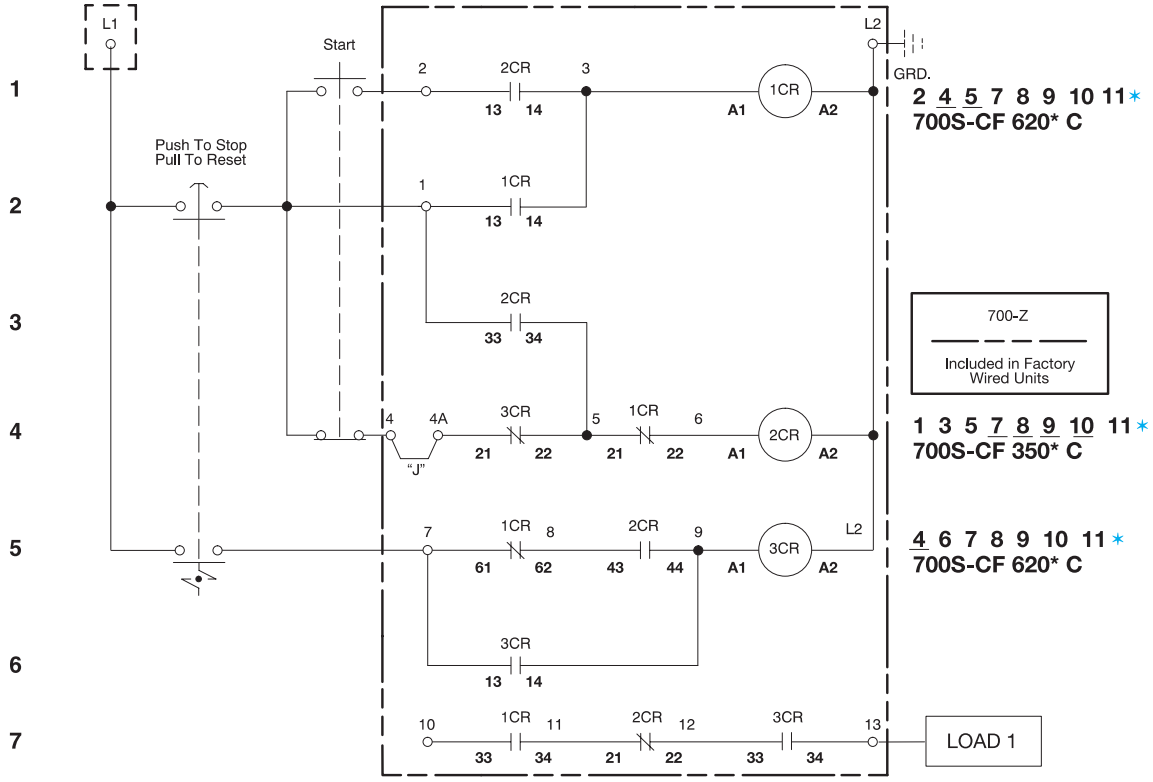
- Use for E-stop control. E-stop will work properly if any one fault occurs (a fault could be one welded contact or one undesired open connection such as a loose wire).
- High output switching capability and long contact life.
- Circuit complies with EN 954 categories 1, 2, 3, 4.
- Prevents restart of the 5 safety outputs if there is a single fault anywhere in the system.

Use (3) 700S-CF relays and this diagram to construct the circuit, or contact your local Allen Bradley sales office for pre-assembled module

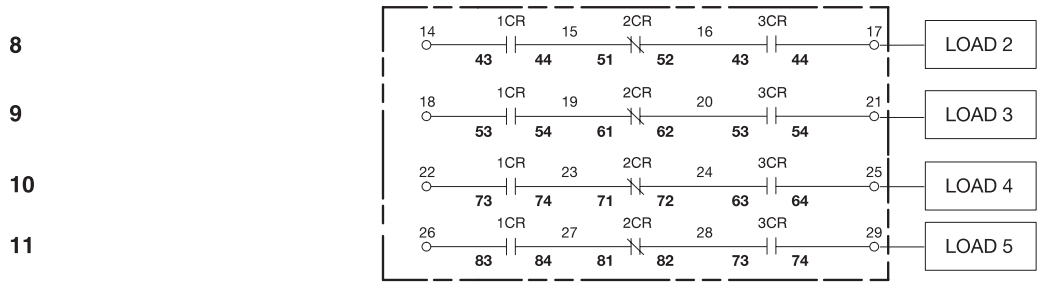
Basic Circuit
(1) Output Circuit (3 Relays, 9 Terminal Blocks)

Basic Circuit

(1) Output Circuit (3 Relays, 9 Terminal Blocks)



(5) Output Circuit (3 Relays, 17 Terminal Blocks)



* Numbers shown are the line numbers where the contacts for this relay appear.

Bulletin 700-M

- IEC Compact Industrial Relay
- 700-M Standard Contacts (10 A)
- 700-MB Bifurcated Contacts For Low Energy Loads
- Positively Guided/Mechanically Linked Contacts Per IEC 60947-5-1 on All 700-M Relays

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- IEC 60947-5-1
- UL 508
- CSA C22.2 No. 14

AC Coil VoltageControl Relays (700-M) and Control Relays with Bifurcated Contacts (700-MB)*

Contact Configuration		Pkg. Quantity†	Cat. No.†
No. of N.O. Contacts	No. of N.C. Contacts		
2	2	1	700-M220⊗S
3	1	1	700-M310⊗S
4	—	1	700-M400⊗S
2	2	1	700-MB220⊗S
3	1	1	700-MB310⊗S
4	—	1	700-MB400⊗S

⊗ AC Coil Voltage Code

The Cat. No. as listed is incomplete. Select a coil voltage code from the table below to complete the Cat. No. Example: **Cat. No. 700-MB400⊗S** becomes **Cat. No. 700-MB400A24S** for 24V, 50-60 Hz. For other voltages, consult your local Allen-Bradley Distributor.

Voltage	24	48	100	110…120	220…230	230…240	380	440	440…480
50 Hz	A24	A48	A1	—	A2	—	A3	A4	—
60 Hz	A24	A48	—	A1	—	A2	A3	—	A4

DC Control Relays (700DC-M) and Control Relays with Bifurcated Contacts (700DC-MB)*

Contact Configuration		Pkg. Quantity	Cat. No.†
No. of N.O. Contacts	No. of N.C. Contacts		
2	2	1	700DC-M220⊗S
3	1	1	700DC-M310⊗S
4	—	1	700DC-M400⊗S
2	2	1	700DC-MB220⊗S
3	1	1	700DC-MB310⊗S
4	—	1	700DC-MB400⊗S

⊗ DC Coil Voltage Code

The Cat. No. as listed is incomplete. Select a coil voltage code from the table below to complete the **Cat. No. Example: Cat. No. 700DC-MB400⊗S** becomes **Cat. No. 700DC-MB400Z24S** for 24V DC.

Voltage	12	24	24 with Diode	48	80	110	125	220
DC	Z12	Z24	D24‡	Z48	Z80	Z11	Z3	Z2

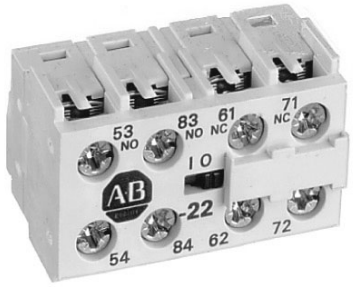
* Mechanically Linked Contacts — Summary:
700-M, 700-MB, 700DC-M, and 700DC-MB relays are positively guided for 4 main poles. Restrictions apply when using auxiliary contacts.

† 10-packs can be ordered for the following voltage codes: A1, A2, A24, Z24, D24. To order a 10-pack, specify quantity in multiples of 10 and drop the final "S" from the catalog number.

‡ To determine whether a 700DC-M relay has a diode, check the voltage label above the A1 terminal. A green background indicated that the relay has a built-in diode; a white background indicates that there is no diode.

Accessories

Auxiliary Contact Adder Decks

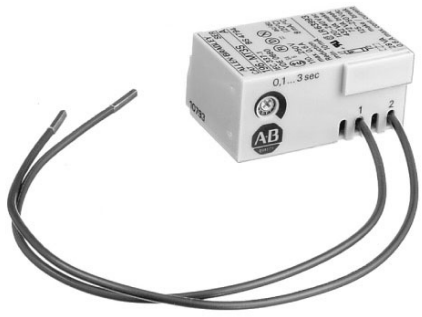


For Use with 700-M and 700-MB Relays		
Description	Pkg. Quantity	Cat. No.
1 N.O.–1 N.C.	10	195-MA11
2 N.O.	10	195-MA20
2 N.C.	10	195-MA02
2 N.O.–2 N.C.	10	195-MA22
4 N.O.	10	195-MA40
1 N.O.–3 N.C.	10	195-MA13
4 N.C.	10	195-MA04

Surge Suppressors

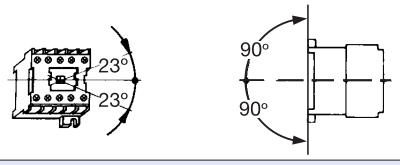
Description		Pkg. Quantity	Cat. No.
R-C Suppressor	24…48V AC	10	199-MSMA48
	110…240V AC	10	199-MSMA1
MOV Suppressor	12…55V AC/12…77V DC	10	199-MSMV1
	56…125V AC/78…178V DC	10	199-MSMV2
	126…277V AC/181…350V DC	10	199-MSMV3
Diode Suppressor	12…250V DC	10	199-MSMD1

Timers

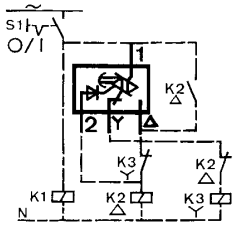


Description		Pkg. Quantity	Cat. No.
Solid-State Timing Element	0.1…3 s On–Delay	10	196-MT3S
	1…30 s On–Delay	10	196-MT30S
Star-Delta Timer 110V AC	220…250V 50/60Hz	10	196-MTSDA2
	110…120V 50/60 Hz	10	196-MTSDA1
35 mm DIN Rail Mounting Adapter For easy mounting of timer modules on standard DIN Rail (EN 50 022-35) and G-Rail		10	196-MTM

Mini-Relays

			Cat. Nos. 700-M… and 700-MB…
Electrical			
Operating Range	AC	Pick-Up	85…110% nominal coil voltage
		Drop-Out	35…65% nominal coil voltage
	DC	Pick-Up	80…110% nominal coil voltage
		Drop-Out	10…25% nominal coil voltage
Coil Consumption	AC	Inrush	22 VA
		Sealed	4 VA
	DC	Inrush	2.5 W
		Sealed	2.5 W
Mechanical			
Operating Time	AC	Pick-Up	15…40 ms
		Drop-Out	15…25 ms
	DC	Pick-Up	18…40 ms
		Drop-Out	6…12 ms
Environmental			
Ambient Temperature	In storage, transport		–55…+80 °C (–67…176 °F)
	At rated operational current		–25…+60 °C (–13…140 °F)
	At 85% rated operational current		–25…+70 °C (–13…158 °F)
Resistance to Climatic Change	Humid heat		40 °C (104 °F), 95% relative humidity, 56 days
	Alternating climatic conditions		23 °C (73.4 °F), 83%/40 °C (104 °F), 93%, 56 cycles
Mounting Position			
Construction			
Protection Class			IP20
Protection Against Accidental Contact			Finger and back-of-hand proof according to VDE 0106, part 100
Terminals	Wire		2 x 0.75…2.5 mm² (#18…14 AWG)
	Stranded lead without connector sleeve		2 x 0.75…2.5 mm² (#18…14 AWG)
	Stranded lead with connector sleeve		2 x 0.75…2.5 mm² (#18…14 AWG)
Weight			700-M = 153 g, 700-MB = 153 g

Timers

Cat. No.		196-MT	196-MTSD
Electrical			
Operational Voltage		AC and DC 110V –23%…250V +10%	AC only, 50/60 Hz 110V –23%…120V +10% 220V –20%…240V +10%
Voltage Drop		5V maximum	5V maximum
Load current for reliable function		10 mA minimum	10 mA minimum
Load current at 20 °C (68 °F)		600 mA	600 mA
40 °C (104 °F)		440 mA	440 mA
55 °C (131 °F)		320 mA	320 mA
Leakage current at 220V		5 mA	Y 17 mA, Δ 6 mA
Time range (delayed operation)		0.1…3 s 1…30 s	1…30 s
Transition time Y/Δ		—	90 ms ± 30 ms
Reset time		≥200 ms	≥200 ms
Voltage failure duration having no influence on time sequence		≤15 ms	≥20 ms
Repeat accuracy At fixed temperature		±1%	±1%
With temperature range of –5…+55 °C (+23…+131 °F)		±5%	±5%
Time interval for start commands		1.4 X set time	2 X set time
General			
Functional description		After the set time has expired, the timer completes the circuit and switches on the series connected relay or contactor.	After the set time has expired, contactor KY is switched off, and after the fixed switching interval 90 ± 30 ms, contactor KΔ is switched on.
Circuit diagrams			
Time setting		The 0.1…3 s and 1…30 s delay period is preset by means of the seconds marking and then corrected according to the process sequence or by checking with a stop watch.	
Environmental			
Ambient temperature	Operation	–20…+55 °C (–40…+131 °F)	–20…+55 °C (–40…+131 °F)
	Storage	–40…+80 °C (–4…+176 °F)	–40…+80 °C (–40…+176 °F)
Construction			
Terminals:0.8 mm² (AWG 18)		2 free cable ends, each 250 mm long	4 free cable ends, each 250 mm long

Surge Suppressors

Electrical	
Cat. No.	**199-MSM**
Overvoltage factor	n = U_{max}/U_n = 0.8…2.5

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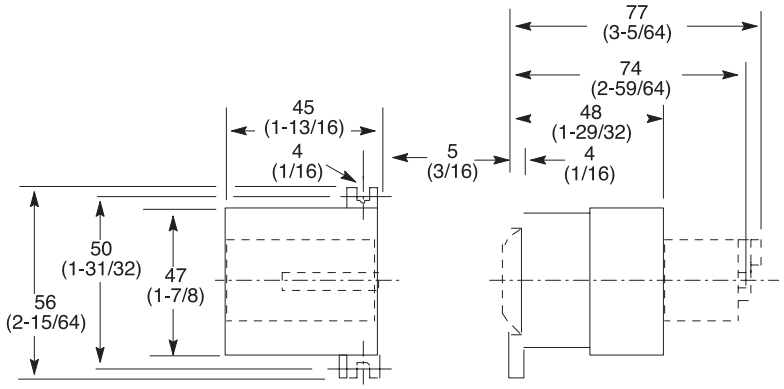
Allen-Bradley

Contact Ratings

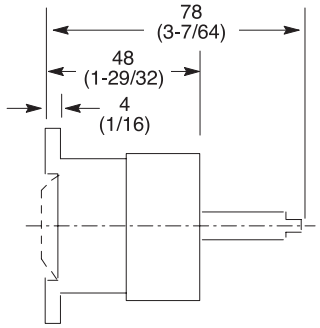
Description						
Cat. No.		700-MB… and Auxiliary Contacts		700-M…		
Rated Thermal Current	I_{th} Open*	10 A		16 A		
	I_{th} Enclosed*	6 A		12 A		
Contact Ratings Continuous		10 A @ 300V AC NEMA A300† 2.5 A @ 300V DC NEMA Q300†		10 A @ 600V AC NEMA A600† 2.5 A @ 600V DC NEMA Q600†		
Make/Break IEC 60947 AC-15 (Switching Solenoid)		12…120V 220…240V — —	2.5 A 2.5 A	12…230V 240V 400V 500V	6.0 A 5.0 A 2.5 A 1.25 A	
Make/Break IEC 60947 DC-13		24V 48V 110V 220V	5.0 A 0.6 A 0.45 A 0.1 A	24V 48V 110V 220V 440V	5.0 A 4.0 A 0.6 A 0.2 A 0.04 A	
Minimum Switching Recommendation		17V, 5 mA		17V, 25 mA		
Rated Voltage	IEC 60947-5-1	300V		500V		
	UL, NEMA, CSA, EEMAC	600V		600V		
Back-Up Fuse IEC 60947-5-1		10 A		16 A		
Life	Mechanical	10 million operations		10 million operations		
	AC-1 Electrical (230V/6 A)	0.7 million operations		0.7 million operations		
Continuous Rating		300V 600V	10 A 10 A	300V 600V	10 A 10 A	
DC Switching (DC-1 Slightly Inductive Loads at 60 °C)		—			1 pole	2 poles	3 poles
				24/48V	6/4	6.0 A	6.0 A
				110V	0.6 A	4.0 A	6.0 A
				220V	0.2 A	0.8 A	3.0 A
				440V	0.08 A	0.2 A	0.4 A
Certifications		Bureau Veritas, CSA Certified, UL Listed, File E14840				
Standards		IEC 60947-5-1, CSA C22.2 No. 14; UL 508				

* "Open" values refer to 40 °C (104 °F) ambient temperature. "Enclosed" values refer to 60 °C (140 °F) ambient temperature.
† Refer to publication 700-SG003B-EN-P for NEMA Contact Rating information.

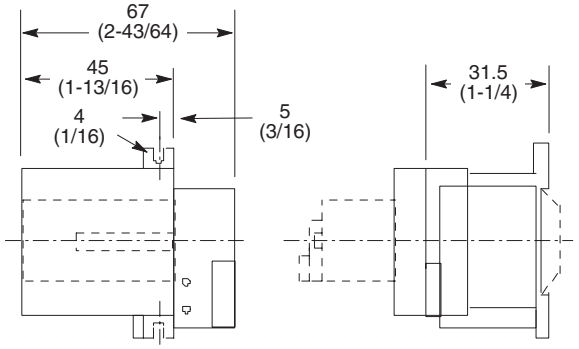
Approximate Dimensions are shown in millimeters (inches). Approximate Dimensions are not intended to be used for manufacturing purposes.



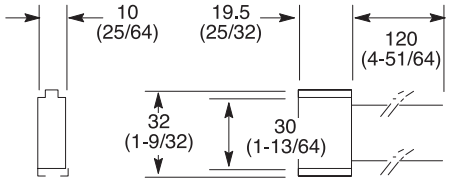
Mini-relay with auxiliary contact adder deck or timer mounted to front.
Cat. No. 700-M and 700-MB



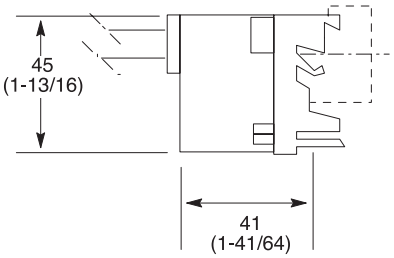
Mini-relay with surge suppressor mounted to front. Cat. No. 700-M and 700-MB



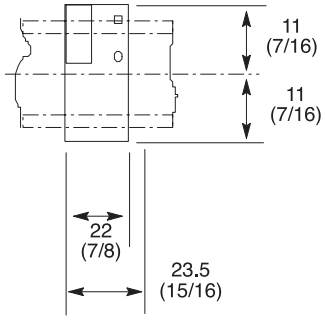
Mini-relay with auxiliary contact adder deck mounted to front and timer mounted to side
Cat No. 700-M and 700-MB



Surge Suppressor
Cat No. 199-MSM



Timer with DIN Rail mounting adapter on 35 mm DIN Rail
Cat. No. 196-MT



Timer with DIN Rail mounting adapter on 35 mm DIN Rail
Cat. No. 196-MT

Bulletin 700-SA

- 5 A (resistive) Max. Continuous Load (Output) Current
- 264V AC or 125V DC Max. Load Voltage Options
- Photocoupler Isolation Between Control and Load Voltage
- LED Indicator (Standard) for Input/Logic ON/OFF Status Monitoring
- 700-HN100, -HN125, -HN 202, or -HN108 Specialty Socket Compatible
- 700-HT2 Timing Module

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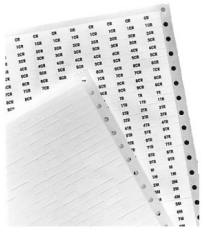
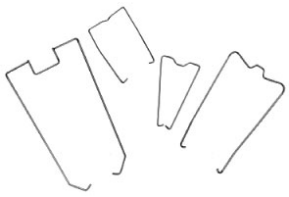
Certifications

- UL 508
- CSA C22.2
- CE
- TÜV*

* Cat. No. 700-SH_ _ H225 not CE or TÜV approved.

Product Selection

	Input-to-Output Isolation Method	Zero Cross Function	LED Indicator	Output (Load) Max. Continuous Current and Rated Voltage Range	Rated Input (Control) Voltage	Cat. No.
	Photocoupler	Yes	Yes	5 A @ 100…240V AC (47…63 Hz)	5…24V DC	700-SAZY5Z25
		Not Applicable		3 A @ 5…110V DC		700-SANY3Z25

	Description	Pkg. Quantity	Cat. No.
Cat. No. 700-HN100	**Screw Terminal Tube Base Socket — Panel or DIN Rail Mounting; Guarded Terminal Construction.** Order ten or multiples of ten	10	700-HN100
Cat. No. 700-HN108	**Specialty Socket** 8-pin backwired socket with solder terminals Order ten or multiples of ten	10	700-HN108
Cat. No. 700-HN125	**Screw Terminal Tube Base Socket — Panel or DIN Rail Mounting; Open Style Construction.** Order must be for 10 sockets or multiples of 10. No retainer clip required.	10	700-HN125
Cat No. 199-DR1	**DIN (#3) Symmetrical Rail** 35 mm x 7.5 mm x 1 m long Zinc-plated, yellow chromated	10	199-DR1
	**Pre-printed identification tags —** contains 10 sheets of pre-printed and blank tags. Each sheet contains 13 sets of the markings CR…9CR, TR…9TR, M…9M, F, R, 1S, and 117 blank tags. Tags are peel-off with sticky backing for easy placement on relays.	10	700-N40
	Blank identification tags — contains 10 sheets of blank identification tags for customer specialized printing. Each sheet contains 546 blank tags. Tags are peel-off with sticky backing for easy placement on relays.	10	700-N41
 *Sample Retainer Clips*	**Retainer Clip for Cat. No. 700-HN153** Sockets with 700-SA AND 700-HB Relays. Secures relay in socket. Order must be for 10 clips or multiples of 10.	10	700-HN158
	8-Pin Socket—Screw Terminal Tube Base Sockets — panel or DIN Rail mounting. Order must be for 10 sockets or multiples of 10.	10	700-HN204

Control/Input Ratings

Cat. No.	Rated Control Voltage	Max. Operating Control Voltage Range	Max. Reverse Control Voltage	Impedance	Control Voltage Levels	
					Pick-up Voltage	Drop-out Voltage
700-SAZY5Z25	5…24V DC	4…32V DC	-32V DC	15 mA max.∗	4V DC max.	1V DC min.
700-SANY3Z25		4…30V DC	-30V DC	1.5 kΩ (+20% -10%)		

Load/Output Ratings

Cat. No.	Rated Load Voltage	Maximum Load Voltage Range	Continuous Load Current (Resistive)		Max. Inrush Current‡
			Min.	Max†	
700-SAZY5Z25	100…240V AC	75…264V AC	0.1 A	5.0 A	80 A, @ 50/60 Hz for 1 cycle
700-SANY3Z25	5…110V DC	3…125V DC	0.1 A	3.0 A	12 A (10 ms)

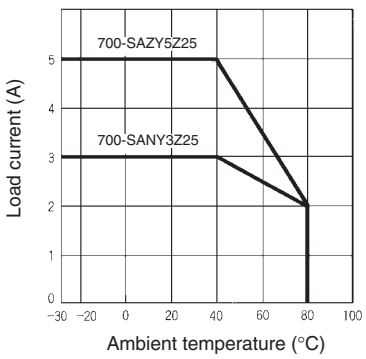
Characteristics

Item		700-SAZY5Z25	700-SANY3Z25
Load Switching Method/Device		Triac	Transistor
Pick-up time		1/2 cycle of load power source cycle time§ + 1 ms max.	0.5 ms max.
Drop-out time		1/2 cycle of load power source cycle time§ + 1 ms max.	2.5 ms max.
Output ON voltage drop		1.6 V (RMS) max.	1.5 V max.
Output Leakage current		5 mA max. (at 100V AC); 10 mA max. (at 200V AC)	5 mA max. (at 125V DC)
Output V_{DRM} V_{CEO} (V)		600	150
Output di/dt (A/uS)		50	—
Output dv/dt (V/uS)		500	—
Output I^2t (A^2S)		41.6	—
Output Tj (°C) Max.		125	150
Insulation resistance		100 MΩ min. (at 500V DC)	
Dielectric strength		1,500V AC, 50/60 Hz for 1 min.	
Vibration resistance (max.)		10…55 Hz, 1.5 mm double amplitude (10 G)	
Shock resistance (max.)		1,000 m/s^2 (100 G)	
Ambient temperature	Operating	–30…80 °C (–22…176 °F) with no icing or condensation	
	Storage	–30…100 °C (–22…212 °F) with no icing or condensation	
Ambient humidity		45…85% (no condensation)	
Standards Compliance		UL508, CSA C22.2 , CE, VDE	
Weight		Approx. 70 g	

∗ With constant current input system. SSR input impedance varies with a change in input (control) voltage.
† Refer to the following graph “Load Current Vs. Ambient Temperature Characteristics” for additional load current details.
‡ If the SSR operation is continuous ON/OFF, this value should be reduced by 50%. Refer to “Inrush Current Resistivity” graphs below.
§ 60 Hz full cycle time = 16.6 ms, 50 Hz full cycle time = 20 ms

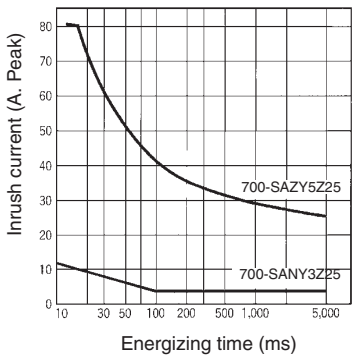
Load Current vs. Ambient Temperature Characteristics

700-SA



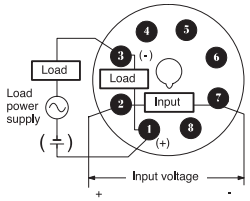
Inrush Current Resistivity♣

700-SA



♣ Inrush current resistivity is the ability of an SSR to withstand a large surge current for a short period of time. Surges are considered non-repetitive (max. repeatability once every 5 seconds). Keep the inrush current to half the rated value if it occurs repetitively. Exceeding the non-repetitive inrush current will damage the SSR.

Terminal Arrangement (Bottom View)



Note: The plus and minus symbols shown in parentheses are for DC loads.

Basic Application Considerations

High Density Mounting of Multiple SSRs

If multiple SSRs are installed side by side be aware that the outer case wall of the SSR serves to dissipate heat. Install the relays so that they are adequately ventilated. If poor ventilation is unavoidable, reduce the load current to half.

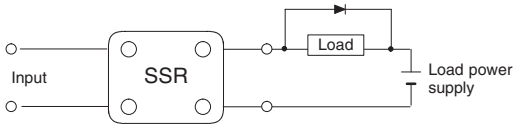
Protective Component

When controlling AC inductive loads, connect an inrush/surge absorbing device (varistor) across the SSR load terminals. If the SSR has built-in surge suppression (Bulletins 700-SE and 700-SH) and additional surge suppression is required, connect the varistor across the terminals of the load device. Select a varistor that meets the conditions of the load voltage outlined in the table below.

Load Voltage	Varistor Voltage	Varistor Surge Resistance
100…120V AC	240…270 V	1000 A min.
200…240V AC	440…470 V	
380…480V AC	820…1000 V	

For additional details applying solid-state relays, refer to pub. 700-AT001A-EN-E, “Solid-State Relay Application Guide” available at The Automation Bookstore http://www.theautomationbookstore.com.

For a DC inductive load, a diode should be connected parallel to the load to absorb the counter electromotive force (OFF) of the load.

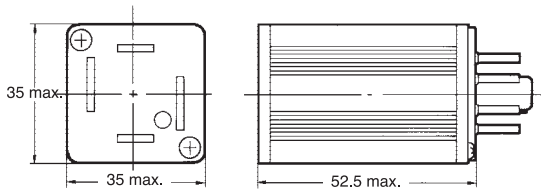


Note: For additional details when using Solid-State Relays, refer to pub. 700-AT001A-EN-E, “Solid-State Relay Application Guide” available at the Automation Bookstore web site http://www.theautomationbookstore.com.

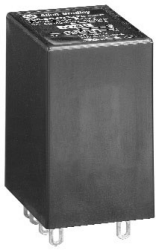
Approximate Dimensions

Note: All units in millimeters unless otherwise indicated. To convert millimeters to inches multiply by 0.0394. Dimensions are not intended to be used for manufacturing purposes.

700-SA∗



∗ Bulletin 700-SA is compatible with cat. nos. 700-HN100, -108, -125, and -204 (sockets).



Bulletin 700-SC

- 3 A (resistive) Max. Continuous Load (Output) Current
- 264V AC, 48V DC or 125V DC Max. Load Voltage Options
- 5…24V DC or 110/220V AC Control (Input) Voltage Options
- LED Indicator (Optional) For Input/Logic On/Off Status Monitoring
- 700-HN103, 700-HN104, or 700-HN128 Socket Compatible
- Compatible with 700-AT1 or 700-AT2 Timer Module

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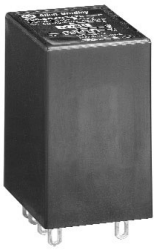
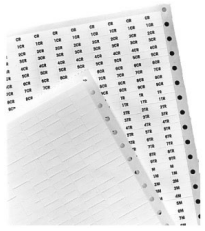
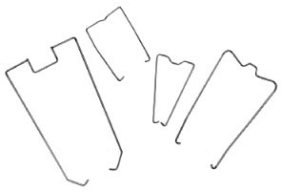
Certifications

- UL 508
- CSA C22.2
- VDE, CE

Product Selection

	Input-to-Output Isolation Method	Zero Cross Function	LED Indicator	Output (Load) Max. Continuous Current and Rated Voltage Range	Rated Input (Control) Voltage	Cat. No.
	Photocoupler	Yes	Yes	3 A @ 100…240V AC✶	5…24V DC	700-SCZY3Z25
				2 A @ 100…240V AC✶	100/110V AC	700-SCZY2A1
					200/220V AC	700-SCZY2A2
	Phototriac	No		3 A @100…240V AC✶	24V DC	700-SCTY3Z24
	Photocoupler	Not Applicable		3 A @ 4…48V DC	5…24V DC	700-SCNY3Z25
		Yes	No	3 A @ 100…240V AC✶	4…24V DC	700-SCZN3Z26
	Phototriac	No			24V DC	700-SCTN3Z24
	Photocoupler	Not Applicable		3 A @ 4…48V DC	4…24V DC	700-SCNN3Z26
				2 A @ 5…110V DC	5…24V DC	700-SCNN2Z25

✶ 47…63 Hz

	Description	Pkg. Quantity	Cat. No.
Cat. No. 700-HN103	**Screw Terminal Socket — Panel or DIN Rail Mounting; Guarded Terminal Construction.** I_{th} = 10 A per pole. 14-Blade miniature socket for use with Bulletin 700-HC Relays. Order must be in ten or multiples of ten	10	700-HN103
Cat. No. 700-HN104	**Screw Terminal Socket – Panel or DIN Rail Mounting. Guarded Terminal Construction** I_{th} = 10 A per pole. 14-blade miniature socket for use with Bulletin 700-HC relays. This socket has coil and contact separation as well as the ability to plug in optional plug in modules (700-A** accessories: LED, Surge Suppression, Timing Modules)	10	700-HN104
Cat. No. 700-HN128	**Screw Terminal Base Socket — Panel or DIN Rail Mounting; Open Style Construction** I_{th} = 10 A per pole. 14-Blade miniature socket for use with Bulletin 700-HC Relays. Order must be in multiples of ten	10	700-HN128
Cat. No. 700-DR1	**DIN (#3) Symmetrical Rail** 35 mm x 7.5 mm x 1 m long Zinc-plated, yellow chromated	10	199-DR1
	**Pre-printed identification tags —** contains 10 sheets of pre-printed and blank tags. Each sheet contains 13 sets of the markings CR…9CR, TR…9TR, M…9M, F, R, 1S, and 117 blank tags. Tags are peel-off with sticky backing for easy placement on relays.	10	700-N40
	Blank identification tags — contains 10 sheets of blank identification tags for customer specialized printing. Each sheet contains 546 blank tags. Tags are peel-off with sticky backing for easy placement on relays.	10	700-N41
 *Sample Retainer Clips*	**Retainer Clip — Secures relay in socket.** Order must be for 10 clips or multiples of 10.	10	700-HN114B*
	On-Delay Time Module Voltage Range: 12…24V AC/DC used with 700-HN104 socket	1	700-AT1
	One Shot Timing Module Voltage Range: 12…24V AC/DC used with 700-HN104 socket	1	700-AT2

* Series B retainer clip must be used with Bulletin 700-SC

Control/Input Ratings

Cat. No.	Rated Control Voltage	Max. Operating Control Voltage Range	Max. Reverse Control Voltage	Impedance	Control Voltage Levels	
					Pick-up Voltage	Drop-out Voltage
700-SCZY3Z25	5…24V DC	4…28V DC	-28.8	15 mA max. ∗	4V DC max.	1V DC min.
700-SCZY2A1	100/110V AC	75…125V AC	NA	41 kΩ± 20%	75V AC max.	20V AC min.
700-SCZY2A2	200/220V AC	150…250V AC	NA	72 kΩ± 20%	150V AC max.	40V AC min.
700-SCTY3Z24	24V DC	19.2…28.8V DC	-28.8	2 kΩ± 20%	19.2V DC max.	1V DC min.
700-SCNY3Z25	5…24V DC	4…28V DC	-28	1.5 kΩ +20%/ -10% †	4V DC max.	
700-SCZN3Z26	4…24V DC	3…28V DC	-28.8	15 mA max. ∗	3V DC max.	
700-SCTN3Z24	24V DC	19.2…28.8V DC	-28.8	2 kΩ± 20%	19.2V DC max.	
700-SCNN3Z26	4…24V DC	3…28V DC	-28	1.5 kΩ +20%/ -10% †	3V DC max.	
700-SCNN2Z25	5…24V DC		-28.8			

Load/Output Ratings

Cat. No.	Rated Control Voltage	Max. Load Voltage Range	Continuous Load Current (Resistive)		Max. Inrush Current‡
			Min.	Max.§	—
700-SCZY3Z25	100…240V AC	75…264V AC	0.1 A	3 A	45 A (@50/60 Hz, 1 cycle)
700-SCTY3Z24					
700-SCZN3Z26					
700-SCTN3Z24					
700-SCZY2A1			0.1 A	2 A	
700-SCZY2A2					
700-SCNN3Z26	4…48V DC	3…52.8V DC	0.1 A	3 A	18 A (10 ms)
700-SCNY3Z25					
700-SCNN2Z25	5…110V DC	3…125V DC	0.1 A	2 A	10 A (10 ms)

† Input impedance attains its maximum at the operating voltage.
‡ If the SSR operation is continuous ON/OFF, this value should be reduced by 50%. Refer to “Inrush Current Resistivity” graphs on page 40 for details.
§ Refer to the following “Load Current Versus Ambient Temperature Characteristics” graphs on page 40 for additional load current details.
∗ With constant current input circuit system. SSR impedance varies with a change in input (control) voltage.
† Input impedance attains its maximum at the operating voltage.
‡ If the SSR operation is continuous On/Off, this value should be reduced by 50%. Refer to “Inrush Current Resistivity” graphs on page [T-499344] for details.
§ Refer to the following “Load Current Versus Ambient Temperature Characteristics” graphs on page [T-499342] for additional load current details.

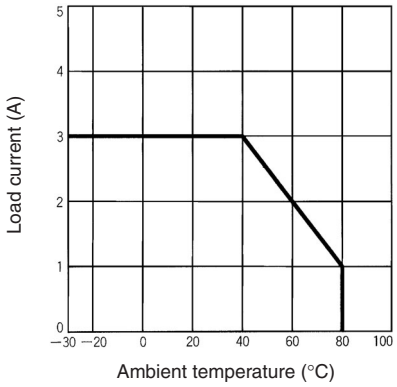
Characteristics

Cat. No.	700-SCZ…	700-SCT	700-SCNY, 700-SCNN3…	700-SCNN2…
Load Switching Method/Device	Triac		Transistor	
Pick-up time	1/2 of load power source cycle time ♣+ 1 ms max. (DC input)	1 ms max	0.5 ms max.	0.5 ms max.
	3/2 of load power source cycle time ♣+ 1 ms max. (AC input)			
Drop-out time	1/2 of load power source cycle time♣ + 1 ms max. (DC input)	1/2 of load power source cycle time♣ + 1 ms max	2 ms max.	2.5 ms max.
	3/2 of load power source cycle time♣ + 1 ms max. (AC input)			
Output On Voltage Drop	1.6 V (RMS) max.	1.6 V (RMS)	1.5 V max.	1.5 V max.
Output Leakage Current	5 mA max (@ 100 V AC) 10 mA max (@ 200 V AC)	2.5 mA max (@ 100 V AC) 5 mA max (at 200 V AC)	5 mA max (@ 50 V DC)	0.1 mA max (@ 100 V DC)
Output V_{DRM}, V_{CEO} (V)	600	600	80	80
Output di/dt (A/uS)	50	50	—	—
Output dv/dt (V/uS)	250	250	—	—
Output I^2t (A^2S)	18	18	—	—
Output Tj (°C) Max.	125	125	150	150
Insulation Resistance	100 MΩ min (@500V DC)			
Dielectric Strength	1,500V AC, 50/60 Hz for 1 minute			
Vibration Resistance (max.)	10…55 Hz, 1.5 mm double amplitude (10 G)			
Shock Resistance (max.)	1,000 m/s² (100 G)			
Ambient Temperature	Operating: -30 °C…80 °C (-22...176 °F) with no icing or condensation Storage: -30 °C…100 °C (-22...212 °F) with no icing or condensation			
Standards Compliance	UL508, CSA C22.2, CE, VDE			
Ambient Humidity	Operating: 45%…85% (no condensation)			
Weight	Approx. 50 g			

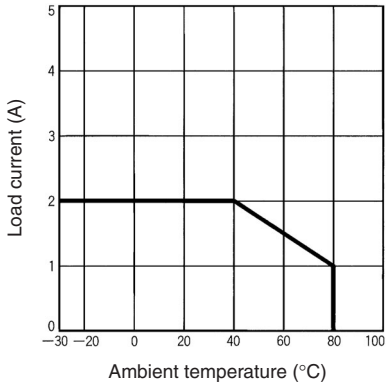
♣ 60 Hz full cycle time = 16.6 ms, 50 Hz full cycle time = 20 ms

Load Current Versus Ambient Temperature Characteristics

700-SC_ _3...

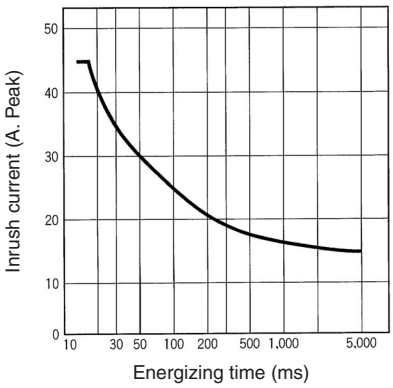


700-SC_ _2...

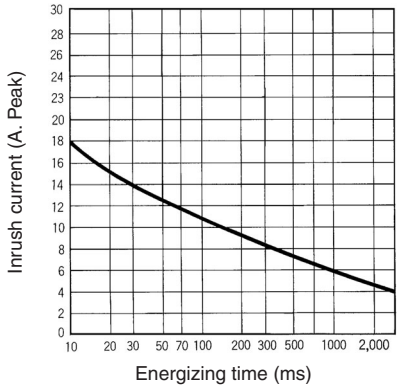


Inrush Current Resistivity*

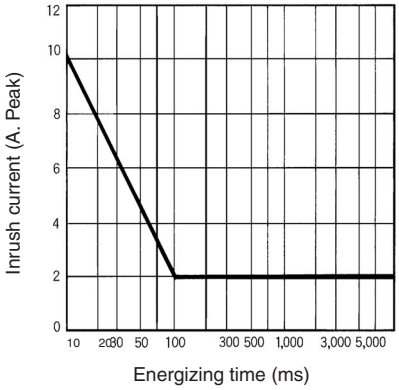
700-SCZ.... **700-SCT...**



700-SCNN3... **700-SCNY3**

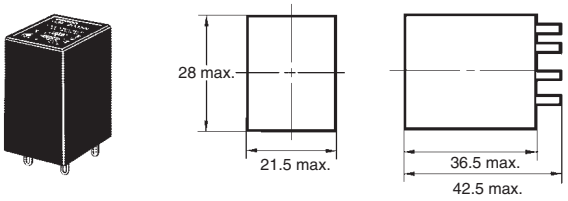


700-SCNN2...



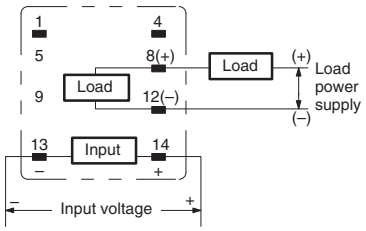
* Inrush current resistivity is the ability of an SSR to withstand a large surge current for a short period of time. Surges are considered non-repetitive (max. repeatability once every 2…5 seconds). Keep the inrush current to half the rated value if it occurs repetitively. Exceeding the non-repetitive inrush current will damage the SSR.

Note: Bulletin 700-SC is compatible with the 700-HN103, 700-HN104, and 700-HN128 sockets. All units in millimeters unless otherwise indicated. To convert to inches multiply by 0.0394. Dimensions are not intended for manufacturing purposes.



Cat. No 700-SC...∗

Terminal Arrangement/ Internal Connections (Bottom View)



Note: The plus and minus symbols shown in parentheses are for DC loads.

∗ Bulletin 700-SC is compatible with cat. nos. 700-HN103, -HN104, and -HN128 socket.

Basic Application Considerations For Bulletin 700-SC

Connection

For DC Load Switching, Bulletin 700-SC will operate properly if the load is connected to either the positive or negative SSR load terminal.

High-density Mounting of Multiple SSRs

If multiple relays are mounted side by side, be aware that the outer wall of each SSR works as a radiator.

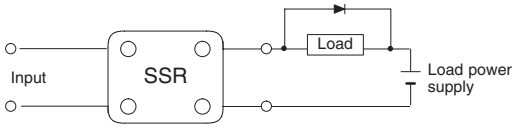
The SSR casing serves to dissipate heat. Install the relays so that they are adequately ventilated. If poor ventilation is unavoidable, reduce the load current by half.

Protective Component

When controlling AC inductive loads, connect an inrush/surge absorbing device (varistor) across the SSR load terminals. If the SSR has built-in surge suppression (Bulletins 700-SE and 700-SH) and additional surge suppression is required, connect the varistor across the terminals of the load device. Select a varistor that meets the conditions of the load voltage outlined in the table below. Note: For additional details applying solid-state relays, refer to pub. number 700-AT001A-EN-E, "Solid-State Relay Application Guide." Document available at http://www.theautomationbookstore.com

Load Voltage	Varistor Voltage	Varistor Surge Resistance
100...120V AC	240...270 V	1000 A min.
200...240V AC	440...470 V	
380...480V AC	820...1000 V	

For a DC inductive load, a diode should be connected parallel to the load to absorb the counter electromotive force (OFF) of the load.



Note: For additional details when using Solid-State Relays, refer to pub. 700-AT001A-EN-E, "Solid-State Relay Application Guide" available at the Automation Bookstore web site http://www.theautomationbookstore.com.

Bulletin 700-SE

- 20 A (resistive) Max. Continuous Load (Output) Current with Heat Sink
- 264V AC Max. Load Voltage
- 5,12, or 24V DC Control/Input Voltage Options
- Built-in Varistor Helps Absorb Most Electrical Surges
- Low Profile (Flat Pack) Design
- Quick-Connect #110 Input and #250 Output Terminals

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Certifications

- UL 508
- CSA C22.2
- CE
- TÜV

Product Selection

	Input-to-Output Isolation Method	Zero Cross Function	LED Indicator	Output (Load) Max. Continuous Current and Rated Voltage Range*	Rated Input (Control) Voltage	Cat. No.
	Phototriac	Yes	No	5 A @ 100…240V AC (47…63 Hz)	5V DC	700-SE05GZZ05
					12V DC	700-SE05GZZ12
					24V DC	700-SE05GZZ24
				10 A @ 100…240V AC (47…63 Hz)	5V DC	700-SE10GZZ05
					12V DC	700-SE10GZZ12
					24V DC	700-SE10GZZ24
				20 A @ 100…240V AC (47…63 Hz)	5V DC	700-SE20GZZ05
					12V DC	700-SE20GZZ12
					24V DC	700-SE20GZZ24
		No		5 A @ 100…240V AC (47…63 Hz)	5V DC	700-SE05GNZ05
					12V DC	700-SE05GNZ12
					24V DC	700-SE05GNZ24
				10 A @ 100…240V AC (47…63 Hz)	5V DC	700-SE10GNZ05
					12V DC	700-SE10GNZ12
					24V DC	700-SE10GNZ24
				20 A @ 100…240V AC (47…63 Hz)	5V DC	700-SE20GNZ05
					12V DC	700-SE20GNZ12
					24V DC	700-SE20GNZ24

* Maximum load current when mounted on the appropriate heat sink. Refer to page 9-172.

	Description	Pkg. Quantity	Cat. No.
Cat. No. 700-S10	**Heat Sink— Panel or DIN Rail Mount**✶	1	700-S10
Cat. No. 700-S20	**Heat Sink— Panel or DIN Rail Mount**✶	1	700-S20
Cat. No. 700-DR1	DIN Symmetrical Rail, 1 m 35 mm x 7.5 mm Zinc-plated, yellow chromated	10	199-DR1
	Thermally (heat) conductive grease, non-silicon based	1	46801-010-01

✶ Refer to “Load Current Vs. Ambient Temperature Characteristics” page 9-183 for information about how to select the correct size of heat sink for your application (cat. no. 700-S10, 700-S20). For additional heat sink information refer to pub. 700-AT001A—EN-E, “Solid-State Relay Application Guide”. Document available at the Automation Bookstore web site http://www.theautomationbookstore.com

Control/Input Ratings*

Cat. No.	Rated Control Voltage	Max. Operating Control Voltage Range	Max. Reverse Control Voltage	Impedance		Control Voltage Levels	
				With Zero Cross Function	Without Zero Cross Function	Pick-up Voltage	Drop-out Voltage
700-SE_ _ _Z05	5V DC	4…6V DC	–6	250 Ω ± 20%	300 Ω ± 20%	4V DC max.	1V DC min.
700-SE_ _ _Z12	12V DC	9.6…14.4V DC	–14.4	600 Ω ± 20%	800 Ω ± 20%	9.6V DC max.	
700-SE_ _ _Z24	24V DC	19.2…28.8V DC	–28.8	1.6k Ω ± 20%		19.2V DC max.	

Load/Output Ratings

Cat. No.	Rated Load Voltage	Max. Load Voltage Range	Continuous Load Current (Resistive)				Max. Inrush Current‡
			With Heat Sink†		Without Heat Sink†		
			Min.	Max.	Min.	Max.	
700-SE05…	100…240V AC	75…264V AC	0.1 A	5 A	0.1 A	5 A	60 A (@50/60 Hz, 1 cycle)
700-SE10…			0.1 A	10 A	0.1 A	5 A	150 A (@50/60 Hz, 1 cycle)
700-SE20…			0.1 A	20 A	0.1 A	5 A	220 A (@50/60 Hz, 1 cycle)

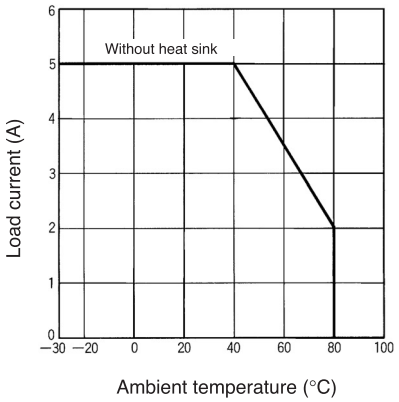
Characteristics

Item	700-SE_ _ _Z…	700-SE_ _ _N…
Load Switching Method/Device	Triac	
Pick-up time	1/2 of load power source cycle time§ + 1 ms max.	1 ms max.
Drop-out time	1/2 of load power source cycle time§ + 1 ms max.	
Output ON voltage drop	1.6 V (RMS) max.	
Output Leakage current	5 mA max (at 100 V AC) 10 mA max (at 200 V AC)	
Output V_{DRM}, V_{CEO} (V)	600	
Output di/dt (A/uS)	SE05GZ = 100 SE10GZ & SE20 GZ = 50	SE05GN = 100 SE10 GN & SE20GN = 50
Output dv/dt (V/uS)	SE05GZ = 200, SE10GZ = 500, SE20GZ = 100	SE05GN = 200, SE10GN = 500, SE20GN = 100
Output I^2t (A^2S)	SE05GZ = 24.5, SE10GZ = 60, SE20GZ = 260	SE05GN = 24.5, SE10GN = 60, SE20GN = 260
Output Tj (°C) Max.	125	
Insulation resistance	100 MΩ min (at 500V DC)	
Dielectric strength	2,000V AC, 50/60 Hz for 1 min.	
Vibration resistance (max.)	10…55 Hz, 1.5 mm double amplitude (10 G)	
Shock resistance (max.)	1,000 m/s^2 (100 G)	
Ambient temperature	Operating: –30…80 °C (–22…176 °F) with no icing or condensation Storage: –30…100 °C (–22…212 °F) with no icing or condensation	
Ambient humidity Operating	45…85% (no condensation)	
Standards Compliance	UL 508, CSA C22.2 , CE, TÜV	
Weight	Approx. 37 g	

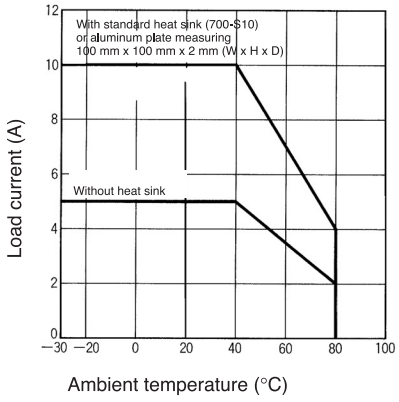
* Each 5 A, 10 A, and 20 A model has 5V DC, 12V DC, and 24V DC input versions.
† Refer to “Load Current Vs. Ambient Temperature Characteristics” graphs page page 9-183 regarding maximum load current with and without heat sinks.
‡ If the SSR operation is continuous ON/OFF, this value should be reduced by 50%. Refer to the “Inrush Curent Resistivity” graphs on page page 9-183 for more details.
§ 60 Hz full cycle time = 16.6 ms, 50 Hz full cycle time = 20 ms

Load Current vs. Ambient Temperature Characteristics*

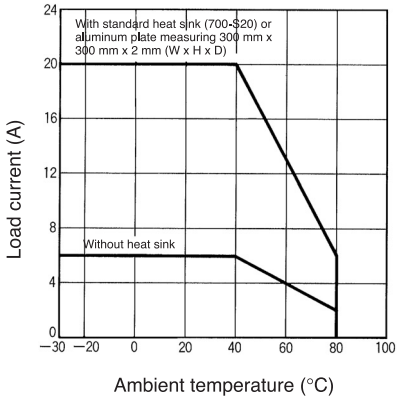
700-SE05...



700-SE10...

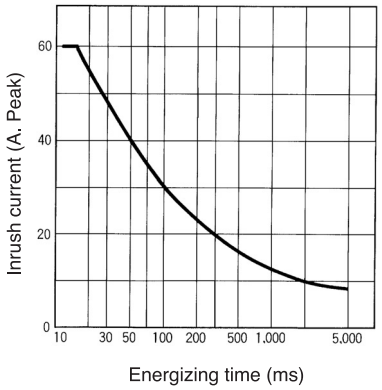


700-SE20...

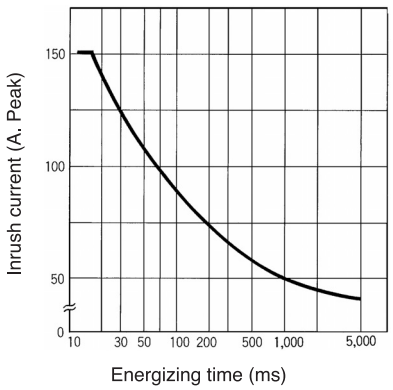


Inrush Current Resistivity†

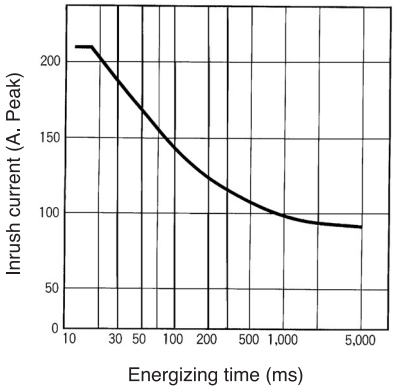
700-SE05...



700-SE10...



700-SE20...



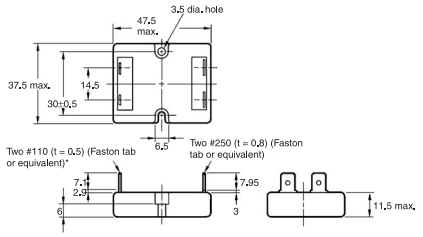
* All graphs assume conductive grease (A-B repair part number W46801-010) is being used.
† Inrush current resistivity is the ability of an SSR to withstand a large surge current for a short period of time. Surges are considered non-repetitive (max. repeatability once every 2…5 seconds). Keep the inrush current to half the rated value if it occurs repetitively. Exceeding the non-repetitive inrush current will damage the SSR.

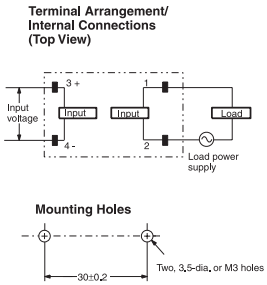
Solid-State Relays

Approximate Dimensions

Mounting Considerations*†‡

Note: All units are in millimeters unless otherwise indicated. To convert to inches multiply by 0.0394. Dimensions are not intended for manufacturing purposes.





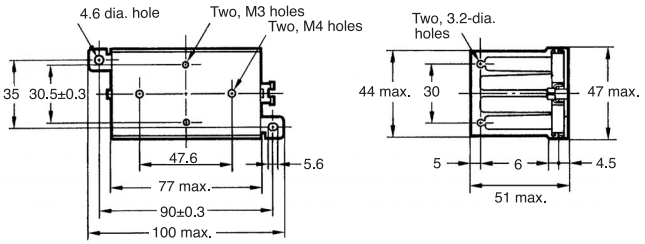
* The proper mounting orientation of the heat sink is so the heat fins run perpendicular to the floor (vertical) to maximize ventilation flow. If the fins do not run perpendicular to the floor, a 30% current derating is required.

† When attaching a heat sink to Bulletin 700-SE, apply a thin layer of heat conductive grease (approximately 0.002in. thick) on the heat sink to maximize heat transfer between the SSR and the heat sink. Recommended types: Silicon based, Dow Corning 340, Toshiba YG6240; Non-silicon based, AOS company type 53300 (Cat No. 46801-010-01).

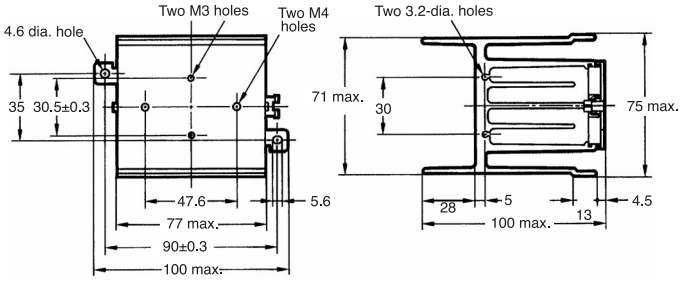
‡ Tighten the SSR's panel/heat sink mounting screws to a torque of 0.78…0.98 N•m (6.9…8.7 lb.-in.)

Heat Sinks

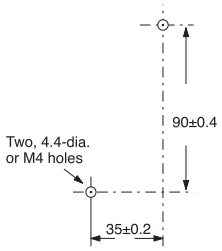
Cat. No. 700-S10



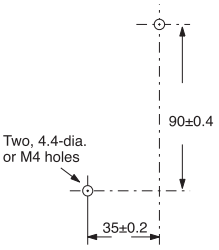
Cat. No. 700-S20



Mounting Holes§

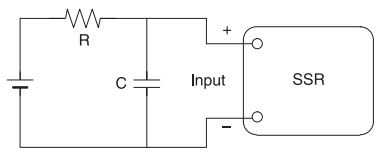


Mounting Holes



§ Tighten the heat sink's panel mounting screws (M4) to a torque of 0.59…0.98 N•m (5.22…8.67 lb.-in.).

Basic Application Considerations



- Because the operation time of Bulletin 700-SE is extremely short, take measures to suppress noise induced between the input terminals. If generation of strong noise is expected, connect an external noise absorber such as an RC circuit.
- Do not apply excessive force to the terminals. Exercise care when pulling or inserting the terminal clips.
- Bulletin 700-SE has a built-in varistor to absorb most inrush/surge currents when operating AC inductive loads If additional suppression is required, connect an external varistor across the load device terminals. Select a varistor that meets the load voltage outlined in the table below.
- For additional details on applying solid-state relays, refer to pub. 700-AT001A-EN-E, "Solid-State Relay Application Guide." Document available at www.theautomationbookstore.com.

Load Voltage	Varistor Voltage	Varistor Surge Resistance
100…120V AC	240…270 V	1000 A min.
200…240V AC	440…470 V	
380…480V AC	820…1000 V	

Bulletin 700-SF

- 3 A (resistive) Max. Continuous Load (Output) Current
- 264V AC or 52.8V DC Max. Load Voltage Options
- 4…24V DC Control/Input Voltage
- Photocoupler or Phototriac Isolation Option Between Control and Output Voltage
- LED Indicator for Input/Logic ON/OFF Status Monitoring
- 700-HN116 Socket Compatible

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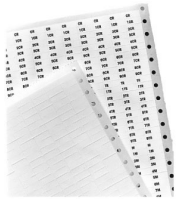
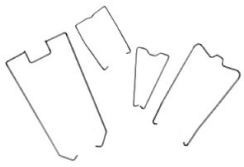
Certifications

- UL 508
- CSA C22.2
- CE

Product Selection

	Input-to-Output Isolation Method	Zero Cross Function	LED Indicator	Output (Load) Max. Continuous Current and Rated Voltage Range	Rated Input Control Voltage	Cat. No.
	Photocoupler	Yes	Yes	3 A @ 100…240V AC (47 to 63 Hz)	5…24V DC	700-SFZY3Z25
	Phototriac	No			24V DC	700-SFTY3Z24
	Photocoupler	Not Applicable		3 A @ 4…48V DC	4…24V DC	700-SFNY3Z25

Accessories

	Description	Pkg. Quantity	Cat. No.
Cat. No. 700-HN116	**Screw Terminal Socket — Panel or DIN Rail Mounting** 8-blade miniature socket for use with DPDT HF relays. Order must be for 10 sockets or multiples of 10.	10	700-HN116
Cat. No. 199-DR1	DIN Symmetrical Rail, 1 m 35 mm x 7.5 mm Zinc-plated, yellow chromated	10	199-DR1
	**Pre-printed identification tags —** contains 10 sheets of pre-printed and blank tags. Each sheet contains 13 sets of the markings CR…9CR, TR…9TR, M…9M, F, R, 1S, and 117 blank tags. Tags are peel-off with sticky backing for easy placement on relays.	10	700-N40
	Blank identification tags — contains 10 sheets of blank identification tags for customer specialized printing. Each sheet contains 546 blank tags. Tags are peel-off with sticky backing for easy placement on relays.	10	700-N41
 *Sample Retainer Clips*	**Retainer Clip — Secures relay in socket.** Order must be for 10 clips or multiples of 10.	10	700-HN114B∗

∗ Bulletin 700-SF must use 700-HN114 series B retainer clip.

Solid-State Relays

Specifications

Control/Input Ratings

Cat. No.	Rated Control Voltage	Max. Operating Control Voltage Range	Max. Reverse Control Voltage	Impedance	Control Voltage Levels	
					Pick-up Voltage	Drop-out Voltage
700-SFZY3Z25	5…24V DC	4…28V DC	–32	15 mA max.∗	4V DC max.	1V DC min.
700-SFTY3Z24	24V DC	19.2…28.8V DC	–28.8	2 kΩ ± 20%	19.2V DC max.	1V DC min.
700-SFNY3Z25	5…24V DC	4…28V DC	–28.8	1.5 kΩ + 20%/–10%†	4V DC max.	1V DC min.

Load/Output Ratings

Cat. No.	Rated Load Voltage	Max. Load Voltage Range	Continuous Load Current (Resistive)		Max. Inrush Current‡
			Min.	Max.§	
700-SFZY3Z25	100…240V AC	75…264V AC	0.1 A	3 A	45 A @50/60 Hz, 1 cycle
700-SFTY3Z24			0.1 A	3 A	
700-SFNY3Z25	4…48V DC	3…52.8V DC	0.1 A	3 A	18 A (10 ms)

Characteristics

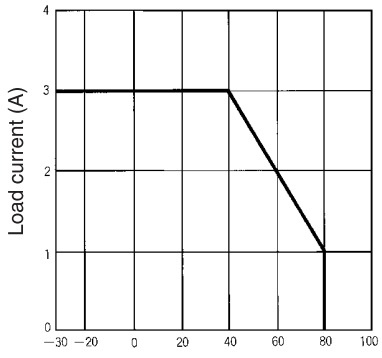
Cat. No.	700-SFZY3Z25	700-SFTY3Z24	700-SFNY3Z25
Load Switching Method/Device	Triac	Transistor	
Pick-up time	1/2 cycle of load power source cycle time ♣ + 1 ms max.	1 ms max.	0.5 ms max.
Drop-out time	1/2 cycle of load power source cycle time♣ + 1 ms max.		2 ms max.
Output ON voltage drop	1.6 V (RMS) max.		1.5V max.
Output Leakage current	5 mA max. (at 100 V AC); 10 mA max. (at 200 V AC)	2.5 mA max. (at 100V AC); 5 mA max. (at 200V AC)	5 mA max. (at 50V DC)
Output V_{DRM}, V_{CEO} (V)	600	600	80
Output di/dt (A/uS)	50	50	—
Output dv/dt (V/uS)	250	250	—
Output I^2t (A^2S)	18	18	—
Output Tj (°C) Max.	125	125	150
Insulation resistance	100 MΩ min. (at 500V DC)		
Dielectric strength	1,500V AC, 50/60 Hz for 1 min.		
Vibration resistance (max.)	10…55 Hz, 1.5 mm double amplitude (10 G)		
Shock resistance (max.)	1,000 m/s^2 (100 G)		
Ambient temperature	Operating: –30…80 °C (–22…176 °F) with no icing or condensation Storage: –30…100 °C (–22…212 °F) with no icing or condensation		
Ambient humidity	45…85% (no condensation)		
Standards Compliance	UL508, CSA C22.2, CE, VDE		
Weight	Approx. 50 g		

∗ With constant curent input circuit system, SSR impedance varies with a change in input voltage.
† Input impedance reaches its maximum at the operating voltage.
‡ If the SSR operation is continuous ON/OFF, this value should be reduced by 50%. Refer to the “Inrush Current Resistivity” graphs on page 9-187 for more details.
§ Refer to “Load Current vs. Ambient Temperature Characteristics” on page 9-176 for additional load current details.
♣ 60 Hz full cycle time = 16.6 ms, 50 Hz full cycle time 20 ms

Note: These data are non-repetitive. Keep the inrush current to half the rated value if it occurs repetitively. Inrush current resistivity is the ability of an SSR to withstand a large surge current for a short period of time. Surges are considered non-repetitive (max. repeatability once every 2…5 seconds). Keep the inrush current to half the rated value if it occurs repetitively. Exceeding the non-repetitive inrush current will damage the SSR.

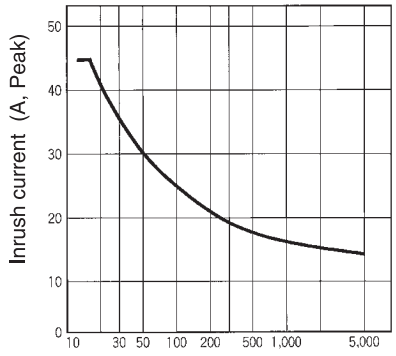
Load Current vs. Ambient Temperature Characteristics

700-SF…



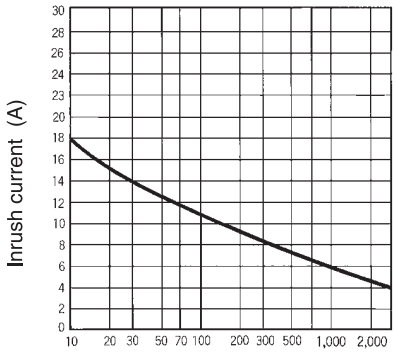
Inrush Current Resistivity*

700-SFZ… 700SFT…



Inrush Current Resistivity*

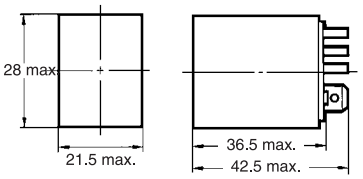
700-SFN…



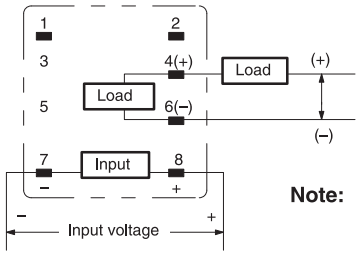
* Inrush current resistivity is the ability of an SSR to withstand a large surge current for a short period of time. Surges are considered non-repetitive (max. repeatability once every 2…5 seconds). Keep the inrush current to half the rated value if it occurs repetitively. Exceeding the non-repetitive inrush current will damage the SSR.

Approximate Dimensions

All units are in millimeters unless otherwise indicated. To convert to inches multiply by 0.0394. Dimensions are not intended for manufacturing purposes.



Terminal Arrangement/ Internal Connections (Bottom View)



Note:
1. The plus and minus symbols shown in the parentheses are for DC loads.
2. The coil has no polarity.

Note: The 700-SF is compatible with the 700-HN116 socket.

Basic Application Considerations of Bulletin 700-SF

High Density Mounting of Multiple SSRs

If multiple SSRs are mounted side by side be aware that the outer case wall of the SSR acts as a radiator. The SSR case serves to dissipate heat. Install the relays so that they are adequately ventilated. If poor ventilation is unavoidable, reduce the load current by half.

Connection

For DC load switching, the 700-SF SSR will operate properly if the load is connected to either the positive or negative load terminals.

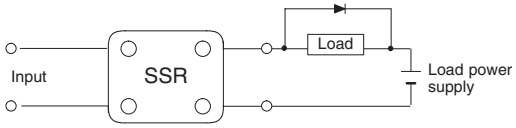
Protective Component To Extend SSR Life

When controlling AC inductive loads, connect an inrush/surge absorbing device (varistor) across the SSR load terminals. If the SSR has built-in surge suppression (Bulletins 700-SE and 700-SH) and additional surge suppression is required, connect the varistor across the terminals of the load device. Select a varistor that meets the conditions of the load voltage outlined in the table below.

Load Voltage	Varistor Voltage	Varistor Surge Resistance
100…120V AC	240…270 V	1000 A min.
200…240V AC	440…470 V	
380…480V AC	820…1000 V	

Note: For additional details applying solid-state relays, refer to pub. number 700-AT001A-EN-E, Solid-State Relay Application Guide. Document available at http://www.theautomationbookstore.com.

For a DC inductive load, a diode should be connected parallel to the load to absorb the counter electromotive force (OFF) of the load.



Note: For additional details when using Solid-State Relays, refer to pub. 700-AT001A—EN-E, “Solid-State Relay Application Guide” available at the Automation Bookstore web site http://www.theautomationbookstore.com.

Bulletin 700-SH

- 40 A (resistive) Max. Continuous Load (Output) Current with Appropriate Heat Sink
- 264V AC or 528V AC Max. Load Voltage Options
- 5…24V DC, 100…120V AC, 200…240V AC Control (Input) Voltage Options
- LED Indicator for Input/Logic ON/OFF Status Monitoring
- Built-in Varistor to Absorb Most Surges
- Protective Cover for Added Safety (Meets VDE 106 Finger Safe Standard)

Table of Contents

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Approximate Dimensions 9-193
Basic Application Considerations 9-194

Certifications

- UL 508
- CSA C22.2
- CE
- TÜV∗

∗ Cat. No. 700-SH_ _ H225 not CE or TÜV approved.

Product Selection

Input-to-Output Isolation Method	Zero Cross Function	LED Indicator	Output (Load) Max. Continuous Current and Rated Voltage Range†	Rated Input Control Voltage	Cat. No.
Phototriac	Yes	Yes	5 A @ 24…240V AC‡	5…24V DC	700-SH05GZ25
Photocoupler				100…120V AC	700-SH05GA12
				200…240V AC	700-SH05GA22
Phototriac			10 A @ 24…240V AC‡	5…24V DC	700-SH10GZ25
Photocoupler				100…120V AC	700-SH10GA12
				200…240V AC	700-SH10GA22
			10 A @ 200…480V AC‡	5…24V DC	700-SH10HZ25
Phototriac			25 A @ 24…240V AC‡	5…24V DC	700-SH25GZ25
Photocoupler				100…120V AC	700-SH25GA12
				200…240V AC	700-SH25GA22
Photocoupler			25 A @ 200…480V AC‡	5…24V DC	700-SH25HZ25
Phototriac			40 A @ 24…240V AC‡	5…24V DC	700-SH40GZ25
Photocoupler				100…120V AC	700-SH40GA12
				200…240V AC	700-SH40GA22
			40 A @ 200…480V AC‡	5…24V DC	700-SH40HZ25

† Maximum load current when mounted on the appropriate heat sink. Refer to [S-497952].
‡ 47…63 Hz

	Description	Pkg. Quantity	Cat. No.
Cat. No. 700-S10	**Heat Sink— Panel or DIN Rail Mount***	1	700-S10
Cat. No. 700-S20	**Heat Sink— Panel or DIN Rail Mount***	1	700-S20
Cat. No. 700-S30	**Heat Sink— Panel or DIN Rail Mount***	1	700-S30
Cat. No. 199-DR1	DIN Symmetrical Rail, 1 m 35 mm x 7.5 mm Zinc-plated, yellow chromated	10	199-DR1
	Thermally (heat) conductive grease, non-silicon based	1	46801-010-01

* For information regarding selection of the proper heat sink for your application, refer to “Heat Sink Size Vs. Load Current” graph on page page 9-191 or “Load Current Vs. Ambient Temperature Characteristics” on page 9-192. For additional heat sink information refer to pub. 700-AT001A-EN-E, “Solid-State Relay Application Guide”. Document available at: the Automation Bookstore web site http://www.theautomationbookstore.com

Control/Input Ratings

Cat. No.	Rated Control Voltage	Max. Operating Control Voltage Range	Max. Reverse Control Voltage	Impedance∗	Control Voltage Levels	
					Pick-up Voltage	Drop-out Voltage
700-SH_ _G…	5...24V DC	4...32V DC	-32V DC	15 mA max†	4V DC max.	1V DC min.
	100...120V AC	75...132V AC	NA	36 kΩ +/-20%	75V AC max.‡	20V AC min.‡
	200...240V AC	150…264V AC	NA	72 kΩ +/-20%	150V AC max.‡	40V AC min.‡
700-SH_ _ H…	5…24V DC	4…32V DC	-32V DC	5 mA max.†	4V DC max.	1V DC min.

Load/Output Ratings

Cat. No.	Rated Load Voltage	Max. Load Voltage Range	Continuous Load Current (Resistive)				Max. Inrush Current♣
			With Heat Sink (A)§		Without Heat Sink (A)§		
			Min.	Max.	Min.	Max.	
700-SH05G…	24…240V AC	19 …264V AC	0.1 A	5 A	0.1 A	3 A	60 A (@50/60 Hz, 1 cycle)
700-SH10G…			0.1 A	10 A	0.1 A	4 A	150 A (@50/60 Hz, 1 cycle)
700-SH10H…	200…480V AC	180…528 VAC	0.2 A	10 A	0.2 A	4 A	
700-SH25G…	24…240V AC	19…264V AC	0.1 A	25 A	0.1 A	4 A	220 A (@ 50/60 Hz, 1 cycle)
700-SH25H…	200…480V AC	180…528V AC	0.2 A	25 A	0.2 A	4 A	
700-SH40G…	24…240V AC	19…264V AC	0.1 A	40 A	0.1 A	6 A	440 A (@ 50/60 Hz, 1 cycle)
700-SH40H…	200…480V AC	180…528V AC	0.2 A	40 A	0.2 A	6 A	

∗ The input impedance is measured at the maximum value of the rated supply voltage.
† With a constant current input system, SSR impedance varies with a change in input voltage.
‡ Refer to graphs, “Temperature Characteristics…” and “Must Release Voltage” on page 9-191 for further details.
§ When specified heat sink is used. Refer to accessories, page 9-189 for applicable heat sinks. For more details, refer to graphs “Load Current Vs. Ambient Temperature Characteristics” on page 9-192, and the “Heat Sink vs. Load Current” graph on page 9-191.
♣ If the SSR operation is continuous ON/OFF, this value should be reduced by 50%. Refer to “Inrush Current Resistivity” graphs on page 9-191 for more details.

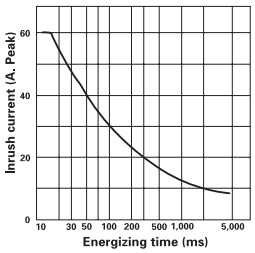
Characteristics

Cat. No.	700-SH05G, -SH10G, SH25G	700-SH40G	700-SH10H, -SH25H, SH40H
Load Switching Method/Device	Triac		Thyristor
Pick-up time	1/2 of load power source cycle time§+ 1 ms max. (DC input) 3/2 of load power source cycle time§ + 1 ms max. (AC input)		
Drop-out time	1/2 of load power source cycle time§+ 1 ms max. (DC input) 3/2 of load power source cycle time§ + 1 ms max. (AC input)		
Output ON voltage drop	1.6 V (RMS) max.		1.8 V (RMS) max
Output Leakage current	5 mA max (at 100V AC)		10 mA max. (@ 200V AC)
	10 mA max (at 200V AC)		20 mA max. (@ 400V AC)
Output V_{DRM}, V_{CEO} (V)	600	600	1200
Output di/dt (A/uS)	-SHO5G = 100, -SHO10G, -SH25G = 50	50	100
Output dv/dt (V/uS)	-SHO5G = 200, -SHO10G, -SH25G = 100	100	300
Output I^2t (A^2S)	-SHO5G = 24.5, -SHO10G = 112.5 -SH25G = 260	1260	SH10H, SH25H = 260, SH40H = 1800
Output Tj (°C) Max.	125		
Insulation Resistance	100 MΩ min. (at 500V DC)		
Dielectric Strength	2,500V AC, 50/60 Hz for 1 minute		
Vibration Resistance (max.)	10…55 Hz, 1.5 mm double amplitude (10 G)		
Shock Resistance (max.)	1,000 m/s^2 (100 G)		
Ambient Temperature	Operating: –30…80 °C (–22…176 °F) with no icing or condensation		
	Storage: –30…100 °C (–22…212 °F) with no icing or condensation		
Ambient Humidity	Operating: 45%…85% (no condensation)		
Standards Compliance*	UL508, CSA C22.2, CE, TÜV		
Weight	Approx. 60 g	Approx. 70 g	Approx. 80 g

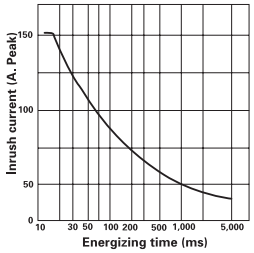
* Cat. No. 700-SH_ _ _HZ25 not CE or TÜV approved.
§ 60 Hz cycle time = 16.6 ms, 50 Hz cycle time = 20 ms

Inrush Current Resistivity†

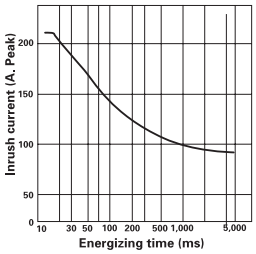
700-SH05G...



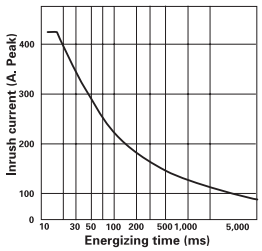
700-SH10G... SH10H...



700-SH25G... SH25H...

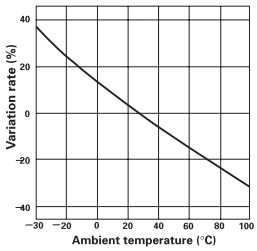


700-SH40G... SH40H...



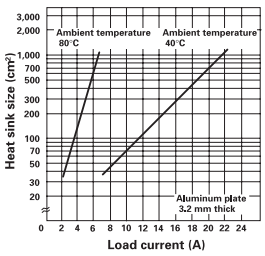
Temperature Characteristics (with Must Operate Voltage and Must Release Voltage)

700-SH_ _G...



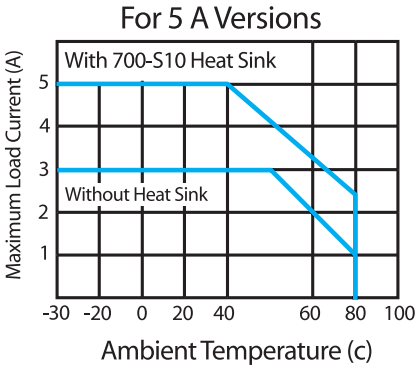
Heat Sink Size vs. Load Current

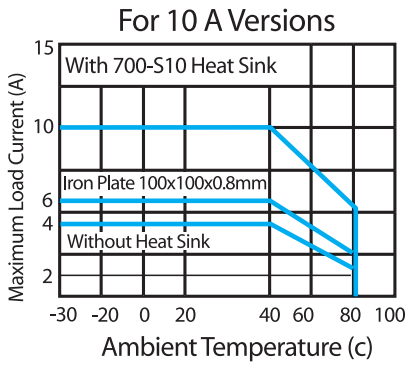
700-SH 25G... ‡

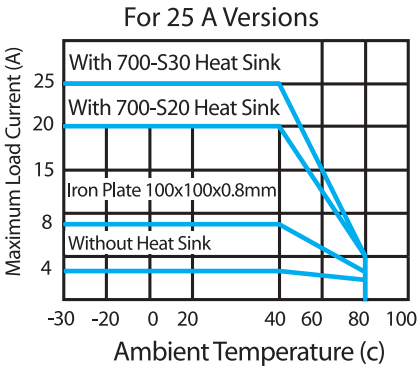


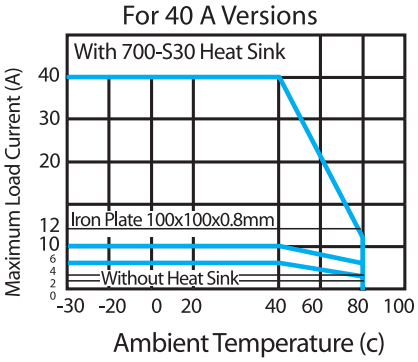
† Inrush current resistivity is the ability of an SSR to withstand a large surge current for a short period of time. Surges are considered non-repetitive (max. repeatability once every 2…5 seconds). Keep the inrush current to half the rated value if it occurs repetitively. Exceeding the non-repetitive inrush current will damage the SSR.
‡ The heat sink size refers to the combined area of the sides of the heat sink that radiate heat. For example, when a current of 18 A is allowed to flow through the SSR at 40 °C, the graph shows that the heat sink size is about 450 cm^2 . Therefore, if the heat sink is square, one side of the heat sink must be 15 cm (15^2 x 2 = 450) or longer.

Load Current vs. Ambient Temperature Characteristics*†





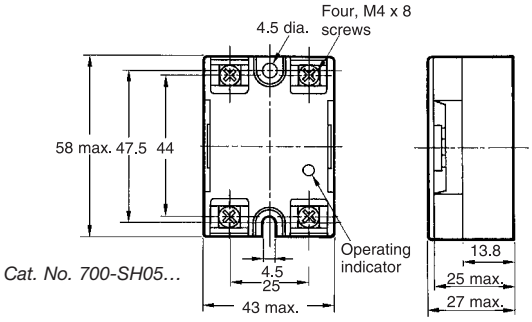


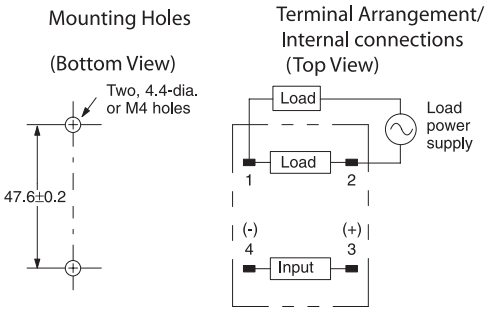


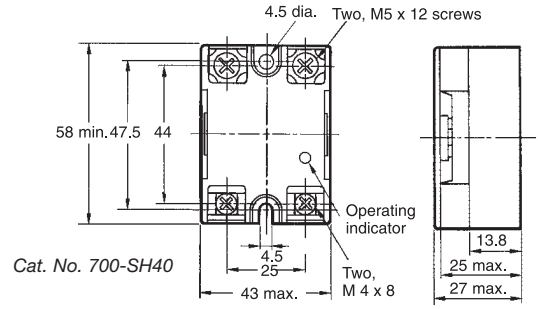
* For the above 4 graphs, the line "with iron plate measuring 100 x 100 x 0.8 in means the SSR is mounted directly to an iron plate of at least this size.
† All graphs assume thermally conductive grease is applied to the solid-state relay.

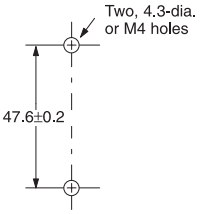
Mounting Considerations*†‡§♣

All units are in mm's unless otherwise indicated. To convert to inches multiply by 0.0394. Dimensions are not intended for manufacturing purposes.



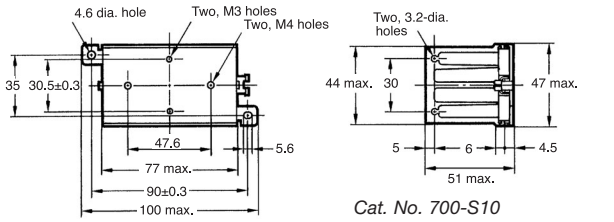


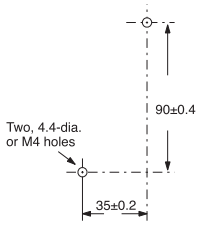


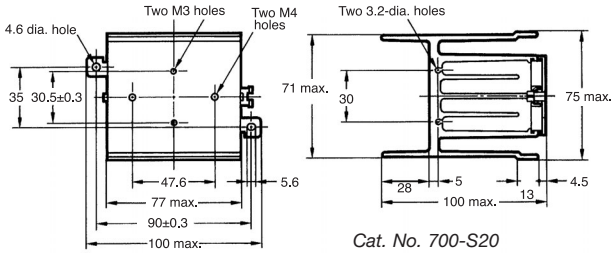


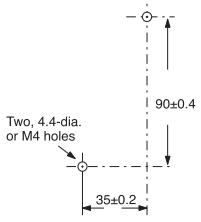
* The proper mounting orientation of the heat sink is so the heat fins run perpendicular to the floor (vertical) to maximize ventilation flow.
† If the fins do not run perpendicular to the floor, a 30% current derating is required.
‡ When attaching a heat sink to Bulletin 700-SH, apply a thin layer of heat conductive grease (approximately 0.002in. thick) on the heat sink to maximize heat transfer between the SSR and the heat sink. Recommended types: Silicon based, Dow Corning 340, Toshiba YG6240; Non-silicon based, AOS company type 53300 (Cat. No. 46801-010-01).
§ Tighten the SSR panel/heat sink mounting screws to a torque of 0.78…0.98 N•m (6.9…8.7 lb•in).
♣ Tighten the SSR terminal wiring screws as follows M4: 0.98…1.37 N•m (8.67…12.12 lb•in), M5: 1.57…2.35 Nm (13.89…20.8 lb•in).

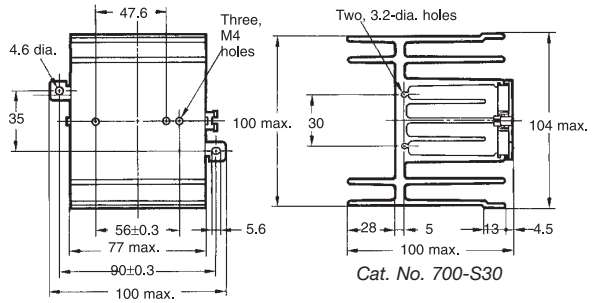
Heat Sinks➢⌘

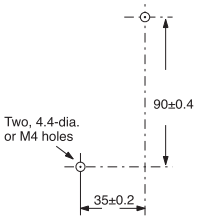












➢ Tighten the heat sink mounting screws (M4) to a torque of 0.98…1.37 N•m (8.67…12.12 lb•in).
⌘ Heat sink weight: cat. nos. 700-S10 = 200 g, 700-S20 = 400 g, 700-S30 = 560 g.

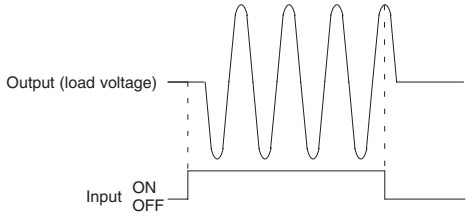
Load Connection

- For an AC load, use a power supply rated at 50 or 60 Hz. The maximum operating frequency is 10 Hz.
- The Bulletin 700-SH has a built-in varistor for surge/inrush protection of AC loads. If additional suppression is required, connect an external varistor across the load device terminals. Select a varistor which meets the load voltage condition outlined in the table below.

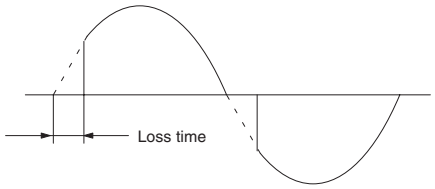
Load Voltage	Varistor Voltage	Varistor Surge Resistance
100…120V AC	240…270 V	1000 A min.
200…240V AC	440…470 V	
380…480V AC	820…1000 V	

Zero Cross Function

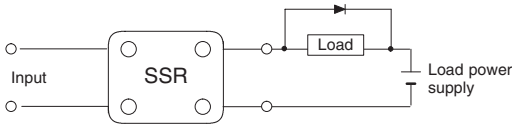
A SSR with a zero cross function operates when an AC load voltage reaches the zero point or its vicinity. This reduces clicking noises when the load is switched, and minimizes the influence of an inductive load, such as a lamp, heater, or motor, on the power supply because the inrush current of the load is reduced. This can also minimize the scale of the inrush current protection circuit.



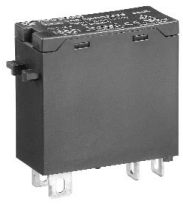
At a low applied voltage, such as 24V AC, the load current is not fully supplied. When the unit is switched ON, the voltage required to power the unit deprives the output signal of the necessary voltage level and thus creates loss time. The lower the load voltage is, the greater the loss time is. This condition, however, will not create any serious problems.



For a DC inductive load, a diode should be connected parallel to the load to absorb the counter electromotive force (OFF) of the load.



Note: For additional details when using Solid-State Relays, refer to pub. 700-AT001A-EN-E, “Solid-State Relay Application Guide” available at the Automation Bookstore web site http://www.theautomationbookstore.com.



Bulletin 700-SK

- High Response Speed Models
- Input Sensor Module to Allow High Voltage 100…240V AC or 12…24V DC Sensor
- Interface to Low Voltage (Logic) Device Such as a PC Output Module For Typical SSR Applications
- LED Indicator
- Input Modules and Output Modules Can Be Used With the 700-HN121 Socket

Bulletin 100S-D safety contactors provide mechanically linked, positively guided contacts, which are required in feedback circuits for modern safety applications. The positively guided N.C. auxiliary contacts will not change state when a power contact welds.

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Product Selection . . . this page
Accessories . . . . . this page
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Approximate Dimensions 9-198

Certifications

- UL 508
- CSA C22.2
- CE
- TÜV

Product Selection

Input/Sensor Module

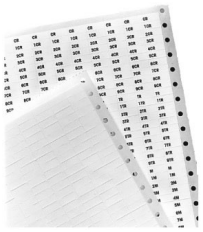
Input-to-Output Isolation Method	LED Indicator	Response Speed	Logic Level		Rated Input Sensor Voltage	Cat. No.
			Supply Voltage	Supply Current		
Photocoupler	Yes	10 Hz	4…32V DC	0.1…100 mA	100…240V AC✶	700-SKICA18
		High-speed (1 kHz)			12…24V DC	700-SKICZ24

Output/SSR Module

Input-to-Output Isolation Method	Zero Cross Function	LED Indicator	Output (Load) Max. Continuous Current and Rated Voltage Range	Rated Input Control Voltage	Cat. No.
Phototriac	Yes	Yes	2 A @ 100…240V AC✶	5…24V DC	700-SKOZ2Z25
	No				700-SKON2Z25
Photocoupler	Not Applicable		2 A @ 5…48V DC		700-SKOC2Z25
			1.5 A @ 48…200V DC		700-SKOC1Z25

✶ 47…63 Hz

Accessories

	Description	Pcs./Pkg.	Cat. No.
Cat. No. 700-HN121	**Screw Terminal Socket — Panel or DIN Rail Mounting** 5-blade miniatue socket. Socket includes a retainer clip. Order must be in multiples of ten ✶	10	700-HN121
Cat. No. 199-DR1	DIN Symmetrical Rail, 1 m 35 mm x 7.5 mm Zinc-plated, yellow chromated	10	199-DR1
	**Pre-printed identification tags —** contains 10 sheets of pre-printed and blank tags. Each sheet contains 13 sets of the markings CR…9CR, TR…9TR, M…9M, F, R, 1S, and 117 blank tags. Tags are peel-off with sticky backing for easy placement on relays.	10	700-N40
	Blank identification tags — contains 10 sheets of blank identification tags for customer specialized printing. Each sheet contains 546 blank tags. Tags are peel-off with sticky backing for easy placement on relays.	10	700-N41

Input Sensor Module

Input Sensor Ratings

Cat. No.	Rated Input Voltage	Max. Operating Input Voltage Range	Input Current	Pick-up Voltage	Drop-out Voltage
700-SKICZ24	12…24V DC	6.6…32V DC	8 mA max.	6.6V DC max.	3.6V DC min.
700-SKICA18	100…240V AC	60…264V AC	15 mA max.	60V AC max.	20V AC min.

Output Logic Ratings

Cat. No.	Logic Level Supply Voltage	Logic Level Supply Current Draw
700-SKICZ24	4…32V DC	0.1…100 mA
700-SKICA18		

Characteristics

Cat. No.		700-SKICA18	700-SKICZ24
Pick-up time		20 ms max.	0.1 ms max.
Drop-out time		20 ms max.	0.1 ms max.
Response frequency		10 Hz	1 kHz
Output ON voltage drop		1.6 V max.	
Leakage current		5 µA max.	
Output V_{DRM}, V_{CEO} (V)		80 (ref. value)	80 (ref. value)
Output di/dt (A/uS)		—	—
Output dv/dt (V/uS)		—	—
Output I^2t (A^2S)		—	—
Output Tj (°C) Max.		150	150
Insulation resistance		100 MΩ min. between input and output	
Dielectric strength		4,000V AC, 50/60 Hz for 1 min. between input and output	
Vibration resistance (max.)		10…55 Hz, 1.5 mm double amplitude (10 G)	
Shock resistance (max.)		1,000 m/s^2 (100 G)	
Ambient temperature	Operating	–30…80 °C (–22…176 °F) with no icing or condensation	
	Storage	–30…100 °C (–22…212 °F) with no icing or condensation	
Standards Compliance		UL 508, CSA C22.2, CE, TÜV	
Ambient humidity	Operating	45…85% (no condensation)	
Weight		Approx. 18 g	

Output SSR Module

Control/Input Ratings

Cat. No.	Rated Control Voltage	Max. Operating Control Voltage Range	Max. Reverse Control Voltage	Impedance*	Pick-up Voltage	Drop-out Voltage
700-SKOZ2Z25	5…24V DC	4…32V DC	-32V DC	15 mA max. at 25 °C (77 °F)	4V DC max.	1V DC min.
700-SKON2Z25						
700-SKOC2Z25				8 mA max.		
700-SKOC1Z25						

Load/Output Ratings

Cat. No.	Rated Load Voltage	Maximum Load Voltage Range	Continuous Load Current (Resistive)		Max. Inrush Current†
			Min.	Max.‡	
700-SKOZ2Z25	100…240V AC	75…264V AC	0.05 A	2 A	30 A (@50/60 Hz, 1 cycle)
700-SKON2Z25					
700-SKOC2Z25	5…48V DC	4…60V DC	0.1 A	2 A	8 A (10 ms)
700-SKOC1Z25	48…200V DC	40…200V DC	0.1 A	1.5 A	8 A (10 ms)

* With a constant current input system. SSR impedance varies with a change in input voltage.
† If the SSR operation is continuous ON/OFF, this value should be reduced by 50%. Refer to the “Inrush Current Resistivity” graphs on page 9-197 for more details.
‡ Refer to “Load Current Versus Ambient Temperature Characteristics” graphs onpage 9-197 for additional details.

Output Module, Continued

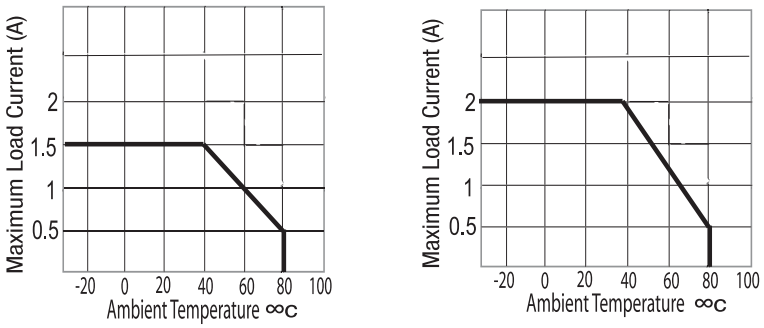
Characteristics

Cat. No.		700-SKOZ2Z25	700-SKON2Z25	700-SKOC2Z25	700-SKOC1Z25
Load Switching Method/Device		Triac		Transistor	
Pick-up time		1/2 cycle of load power source cycle time∗ + 1 ms max.		1 ms max.	
Drop-out time		1/2 of load power source cycle time∗ + 1 ms max.		2 ms max.	
Response frequency		20 Hz		100 kHz	
Output ON voltage drop		1.6V max.			2.5V max.
Leakage current		1.5 mA max.		1 mA max.	
Output V_{DRM}, V_{CEO} (V)		600 (ref.value)	600 (ref.value)	80 (ref.value)	400 (ref.value)
Output di/dt (A/uS)		30	30	—	—
Output dv/dt (V/uS)		300	300	—	—
Output I^2t (A^2S)		10.4	10.4	—	—
Output Tj (°C) Max.		125	125	150	150
Insulation resistance		100 MΩ min. between input and output			
Dielectric strength		4,000V AC, 50/60 Hz for 1 min. between input and output			
Vibration resistance (max.)		10…55 Hz, 1.5 mm double amplitude (10 G)			
Shock resistance (max.)		1,000 m/s² (100 G)			
Ambient temperature	Operating	–30…80 °C (–22…176 °F) with no icing or condensation			
	Storage	–30…100 °C (–22…212 °F) with no icing or condensation			
Standards Compliance		UL 508, CSA C22.2, CE, TÜV			
Ambient humidity	Operating	45…85% (no condensation)			
Weight		Approx. 18 g			

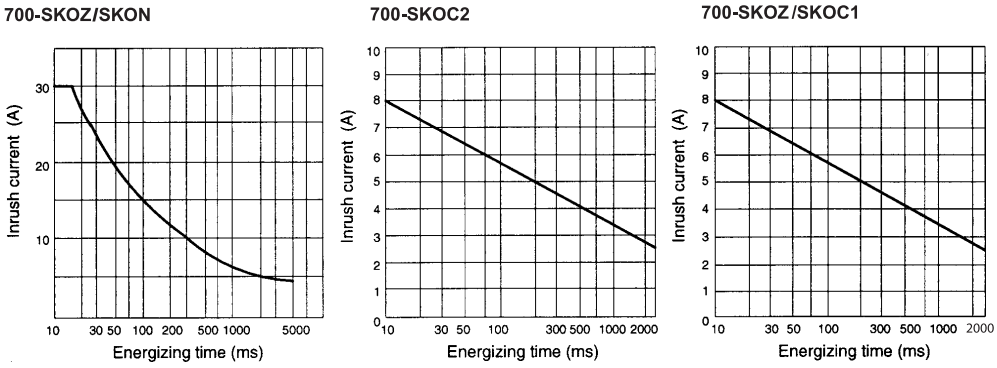
∗ 60 Hz cycle time = 16.6 ms, 50 Hz cycle time = 20 ms

Load Current vs. Ambient Temperature Characteristics

For 2 A Versions



Inrush Current Resistivity†

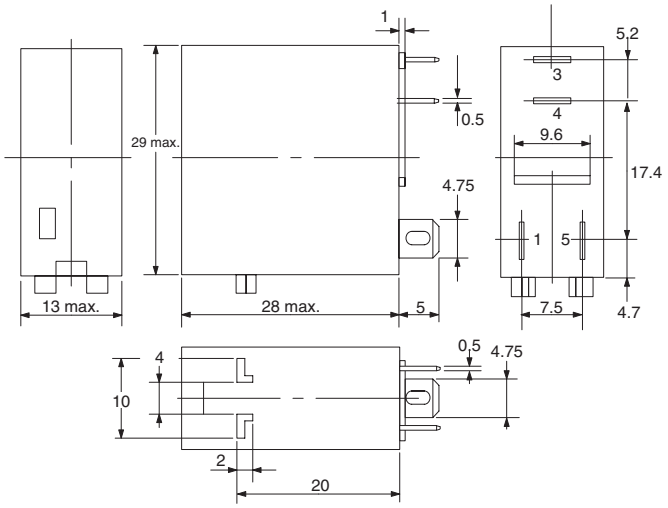


† Inrush current resistivity is the ability of an SSR to withstand a large surge current for a short period of time. Surges are considered non-repetitive (max. repeatability once every 2…5 seconds). Keep the inrush current to half the rated value if it occurs repetitively. Exceeding the non-repetitive inrush current will damage the SSR.

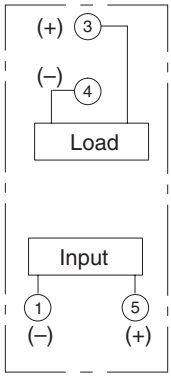
Solid-State Relays

Approximate Dimensions

All units are in millimeters unless otherwise indicated. To convert to inches multiply by 0.0394. Dimensions are not to be used for manufacturing purposes.
Note: The input module (700-SKI) and output module (700-SKO) are compatible with the 700-HN121 socket.



Terminal Arrangement/ Internal Connections (Bottom View)



Application Considerations of Bulletin 700-SK

Connection

For DC load switching, Bulletin 700-SK SSR will operate properly if the load is connected to either the positive or negative SSR load terminal. The load can be connected to either positive or negative output terminals of the SSR.

Protective Element (to extend SSR life)

Since the SSR does not incorporate a surge absorption component, be sure to connect a surge absorption component when using the SSR to control an inductive load.
For additional details applying solid-state relays, refer to pub. number 700-AT001A-EN-E, “Solid-State Relay Application Guide.” Document available at the Automation Bookstore web site http://www.theautomationbookstore.com.

Bulletin 900-TC32

Bulletin 900-TC16

Bulletin 900-TC8

Bulletin 900 — Single-Loop Electronic Digital Temperature/Heater Controllers

- Single-Loop, High Value, ON/OFF, or Analog Output Controllers
- 1/8 DIN (Bulletin 900-TC8), 1/16 DIN (Bulletin 900-TC16), and 1/32 DIN (Bulletin 900-TC32) Sizes
- Various Sensor Inputs
  - Thermocouple
  - Platinum RTD
  - Non-Contact Temperature Sensor
  - Analog Input (0...50 mV)
- Auto-Tuning and Self-tuning Available to Simplify Startup
- Heating, Cooling, or Heating/Cooling Control Available
- High Visibility 4-digit LED Displays, Easy to See in High Levels of Ambient Light
- Integral Keypad with Tactile Feedback for Setup and Modification of Parameters
- Optional 900Builder™ Personal Computer (PC) Software Simplifies Configuration, File Save/Recall, Graphics, and Trending
- Water-Resistant Construction UL Type 4X or IP66 for Indoor Use (except 900-TC8)
- cULus, CE

Product Selection . . . 9-200
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Installation 9-210
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Standards Compliance and Certifications

- NEMA/EEMAC ICS 2 (Industrial Controls and Systems)
- UL, CSA, IEC

Quick Selection

Bulletin 900-TCx Quick Selection

Item		Bulletin No.		
		900-TC8	900-TC16	900-TC32
Dimensions		48 mm (W) x 96 mm (H) x 78 mm (D)	48 mm (W) x 48 mm (H) x 78 mm (D)	48 mm (W) x 24 mm (H) x 100 mm (D)
Sample Rate		500 ms		
Indication Accuracy		±0.5% PV +1 digit max.		
Heating/Cooling Control Mode		Yes	Yes	Yes
Control Method		ON/OFF or 2-PID (auto-tune and self-tune) with time proportioning ON/OFF outputs		
Inputs	Thermocouple Input	Yes	Yes	Yes
	Platinum Resistance Temperature Sensor	Yes	Yes	Yes
	Analog Input (0...50 mV)	Yes	Yes	Yes
	Non-Contact Temperature Sensor	Yes	Yes	Yes
Outputs	Relay Output	Yes	Yes	Yes
	Voltage Output for Solid-State Relay	Yes	Yes	Yes
	4...20 mA (DC) Analog	Yes	Yes	No
Alarms	None	No	No	Yes
	1 Point	No	No	Yes
	2 Points	No	Yes	No
	3 Points	Yes	No	No
RS-232C Communications Function		Yes	No	No
RS-485 Communications Function		Yes	Yes	Yes
Event Input		Yes	Yes	No
Run/Stop via Keypad or Interrupts		Yes	Yes	Keypad
Multiple SP Selection via Keypad or Interrupts		Yes	Yes	Keypad
Heater Burnout Alarm		Yes	Yes	No

Digital Temperature Controller

Product Selection

Standard Controller Models

Bulletin No.	DIN Size (DImensions) (mm)	Power Supply Voltage	Max No. of Alarms Supported	Control Output Type	Supports Heater Burnout Alarm Output	Controller Cat. No. with Thermocouple Support	Controller Cat. No. with Platinum RTD Support
900-TC8 ∗†	1/8 DIN 48 mm (W) x 96 mm (H) x 78 mm (D)	100…240V AC	3	Relay Output	No	900-TC8RTZ25	900-TC8RPZ25
					Yes	900-TC8RTHZ25	900-TC8RPHZ25
				Voltage output (for driving SSR)	No	900-TC8VTZ25	900-TC8VPZ25
					Yes	900-TC8VTHZ25	900-TC8VPHZ25
				4...20 mA Analog Output	No	900-TC8ACTZ25	900-TC8ACPZ25
		24 V AC/ V DC	3	Relay Output	No	900-TC8RTU25	900-TC8RPU25
					Yes	900-TC8RTHU25	900-TC8RPHU25
				Voltage output (for driving SSR)	No	900-TC8VTU25	900-TC8VPU25
					Yes	900-TC8VTHU25	900-TC8VPHU25
				4...20 mA Analog Output	No	900-TC8ACTU25	900-TC8ACPU25
900-TC16 ∗†	1/16 DIN 48 mm (W) x 48 mm (H) x 78 mm (D)	100…240V AC	2	Relay Output	Yes‡	900-TC16RTZ25	900-TC16RPZ25
				Voltage output (for driving SSR)	Yes‡	900-TC16VTZ25	900-TC16VPZ25
				4...20 mA Analog Output	No	900-TC16ACTZ25	900-TC16ACPZ25
		24 V AC/ V DC	2	Relay Output	Yes‡	900-TC16RTU25	900-TC16RPU25
				Voltage output (for driving SSR)	Yes‡	900-TC16VTU25	900-TC16VPU25
				4...20 mA Analog Output	No	900-TC16ACTU25	900-TC16ACPU25
900-TC32 §♣	1/32 DIN 48 mm (W) x 24 mm (H) x 100 mm (D)	100…240V AC	1	Relay Output	No	900-TC32RTZ25	900-TC32RPZ25
				Voltage output (for driving SSR)		900-TC32VTZ25	900-TC32VPZ25
		24 V AC/ V DC	1	Relay Output	No	900-TC32RTU25	900-TC32RPU25
				Voltage output (for driving SSR)		900-TC32VTU25	900-TC32VPU25
		100…240V AC	RS485	Relay Output	No	900-TC32CRTZ25	900-TC32CRPZ25
				Voltage output (for driving SSR)		900-TC32CVTZ25	900-TC32CVPZ25
		24 V AC/ V DC	RS485	Relay Output	No	900-TC32CRTU25	900-TC32CRPU25
				Voltage output (for driving SSR)		900-TC32CVTU25	900-TC32CVPU25

∗ A current transformer (CT) is not provided with the unit.
† When the heating and cooling function or the heater burnout alarm is used, one of the relay alarm outputs will be disabled for each function used.
‡ The heater burnout alarm is available by mounting the Cat. No. 900-TC16EIM or the Cat. No. 900-TC16COM in the 900-TC16RTZ25, RPZ25, VTZ25, VPZ25, RTU25, RPU25, VTU25, or VPU25. Heater burnout does not apply to analog output style controllers.
§ If the heating/cooling function is used, ALM1 will be used for the cooling control output and so the alarm output relay will not be available.
♣ Cat. Nos. with a C designator (e.g., Cat. No. 900-TC32C___) include RS-485 communications, but do not have an alarm (or cooling) output.

Option Units (Bulletins 900-TC8 and 900-TC16 — Only One Option Unit per Controller)

The unit provides communications or event input functionality.

Bulletin No.	Name	Function	Cat. No.
900-TC8	Communications Unit	RS-232C communications➤	900-TC8232
		RS-485 communications	900-TC8COM
	Event Input Unit	Event input⌘	900-TC8EIM
900-TC16	Communications and Heater Burnout Unit	RS-485 communications and heater burnout alarm✦	900-TC16COM
	Event Input Unit and Heater Burnout	Event input and heater burnout alarm⌘✦	900-TC16EIM
	Event Input Unit	Event Input⌘	900-TC16ACEIM
	Communications Unit	RS-485 Communications	900-TC16ACCOM

➤ Enables direct RS-232 connection to personal computer using 900Builder software. A Cat. No. 900-CP1X cable or equivalent is also required.
⌘ Provides two event inputs.
✦ Heater burnout is not available for 4…20 mA analog output style 900-TC16 controllers such as the 900-TC16ACTU25

Current Transformer (Use with Bulletins 900-TC8 and 900-TC16 Only for Heater Burnout)

For Use With Bulletin No.	Hole Diameter*	Cat. No.
900-TC8, 900-TC16	5.8 dia.	900-CT1
	12.0 dia.	900-CT2

* The hole diameter is the only functional difference between the Cat. No. 900-CT1 and the Cat. No. 900-CT2. Current output to controller is the same.

Interface Converter (RS-232/USB to RS-485) Model

Converts personal computer RS-232 or USB (Ser. B or later) communications to RS-485. Use for interface with a single Bulletin 900-TC8, or Bulletin 900-TC16 with a Cat. No. 900-TCxxCOM unit installed or a single Cat. No. 900-TC32C_ designated controller. Also allows interface to up to 31 controllers connected on a RS-485 link/network. See page 9-203 for additional details.

Bulletin No.	Size	Power Supply Voltage	Cat. No.
900-CONV	30 mm (W) x 80 mm (H) x 78 mm (D)	100…240V AC	900-CONVZ25
		24V AC/DC	900-CONVU25

RS-232 Interface Cable

Allows connection between a 900-TC8 with a 900-TC8232 option unit and a PC using 900Builder software (see page 9-209) or PC with 900Builder and a 900-CONV RS232-to-RS485 converter (see page 9-205).

Accessory	Cat. No.
RS-232 cable with 9-pin female D shell and 3 flying leads (3 m)	900-CP1X

900Builder Personal Computer Configuration Software

Allows graphical configuration and monitoring of controller parameters with data-logging and trending, plus program upload/download capability for any Bulletin 900-TCx controller.

Accessory	Cat. No.
900Builder™ Personal Computer Configuration Software for Bulletin 900-TCx Temperature Controllers (available in CD format only)	900-BLDSW1

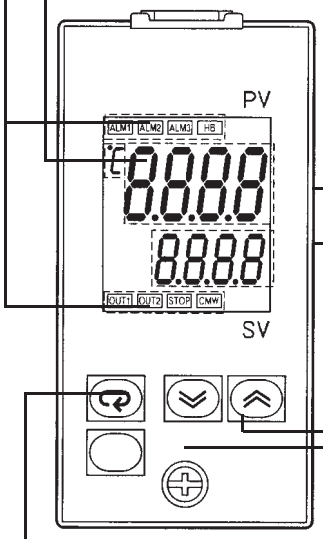
General Functions

Bulletin 900-TC8

Operation Indicators

1. ALM1 (red alarm 1) — Lights when alarm 1 output is ON.
   ALM2 (red alarm 2) — Lights when alarm 2 output is ON.
   ALM3 (red alarm 3) — Lights when alarm 3 output is ON.
2. HB (red heater burnout alarm display)—Lights when a heater burnout is detected. The heater burnout alarm remains ON by setting the heater burnout latch. To reset, turn the power supply OFF and then ON or set the heater burnout alarm value to 0.0 A.
3. OUT1, OUT2 (amber control output 1, control output 2) — Lights when control output 1 and/or control output 2 are ON.
4. STOP (amber stop) — Lights when control of the Bulletin 900-TC8 has been stopped. During control, this indicator lights when an event or the run/stop function has become stopped. Otherwise, this indicator is out.
5. CMW (amber communications writing control) – Lights when communications writing is enabled and is out when it is disabled.

Temperature Unit
Temperature units are displayed when the display unit parameter is configured for temperature. Indication is determined by the currently selected temperature unit parameter set value. When this parameter is set to °C, c is displayed, and when set to °F, F is displayed.



No. 1 Display (Red)
Displays the process value or parameter type.

No. 2 Display (Green)
Displays the set point, manipulated variable, or set value (setup) of the parameter.

Up Key
Each press of this key increases values displayed on the No. 2 display. Holding down this key continuously increases values.

Down Key
Each press of this key decreases values displayed on the No. 2 display. Holding down this key continuously decreases values.

Function Group Selection Key
Press this key to select the setup function group. The setup function group is selected in order operation function group ←→ adjustment function group, initial setting function group ←→ communications setting function group.

Mode Key
Press this key to select parameters within each function group.

Function Group + Mode Keys
This key combination sets the Bulletin 900-TC8 to the protect function group.

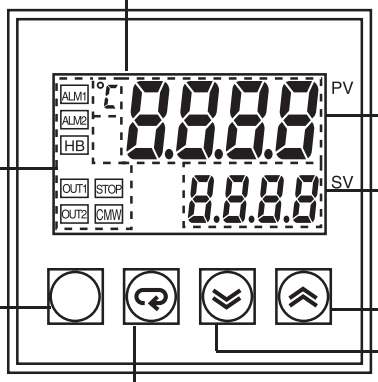
Bulletin 900-TC16

Operation Indicators
1. ALM1 (red alarm 1) — Lights when alarm 1 output is ON. ALM2 (red alarm 2) — Lights when alarm 2 output is ON.
2. HB (red heater burnout alarm display) — Lights when a heater burnout is detected. The heater burnout alarm remains ON by setting the heater burnout latch. To reset, turn the power supply OFF and then ON or set the heater burnout alarm value to 0.0 A.
3. OUT1, OUT2 (amber control output 1, control output 2) — Lights when control output 1 and/or control output 2 (cool) are ON.
4. STOP (amber stop) — Lights when control of the Bulletin 900-TC16 has been stopped. During control, this indicator lights when an event or the run/stop function has become stopped. Otherwise, this indicator is out.
5. CMW (amber communications writing control) — Lights when communications writing is enabled and is out when it is disabled.

Temperature Unit
Temperature units are displayed when the display unit parameter is configured for temperature. Indication is determined by the currently selected temperature unit parameter set value. When this parameter is set to °C, c is displayed, and when set to °F, F is displayed.

No. 1 Display (Programmable Red or Green)
Displays the process value or parameter type.

No. 2 Display (Green)
Displays the set point, manipulated variable, or set value (setup) of the parameter.



Up Key
Each press of this key increases values displayed on the No. 2 display. Holding down this key continuously increases values.

Down Key
Each press of this key decreases values displayed on the No. 2 display. Holding down this key continuously decreases values.

Function Group Selection Key
Press this key to select the setup function group. The setup function group is selected in order operation function group ←→ adjustment function group, initial setting function group ←→ communications setting function group.

Mode Key
Press this key to select parameters within each function group.

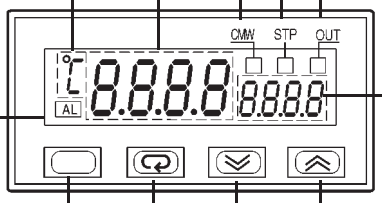
Function Group + Mode Keys
This key combination sets the Bulletin 900-TC16 to the protect function group.

Bulletin 900-TC32

Operation Indicators
1. AL (red alarm) — Lights when alarm output is ON.
2. CMW (amber communications writing control) — Lights when communications writing is enabled and is out when it is disabled.
3. STP (amber stop) — Lights when control of the Bulletin 900-TC32 has been stopped. During control, this indicator lights when an event or the run/stop function has become stopped. Otherwise, this indicator is out.
4. OUT (amber control output) — Lights when control output is ON.

Temperature Unit
Temperature units are displayed when the display unit parameter is configured for temperature. Indication is determined by the currently selected temperature unit parameter set value. When this parameter is set to °C, c is displayed, and when set to °F, F is displayed.

No. 1 Display (Red)
Displays the process value or parameter type.



No. 2 Display (Green)
Displays the set point, manipulated variable, or set value (setup) of the parameter.

Up Key
Each press of this key increases values displayed on the No. 2 display. Holding down this key continuously increases values.

Down Key
Each press of this key decreases values displayed on the No. 2 display. Holding down this key continuously decreases values.

Function Group + Mode Keys
This key combination sets the Bulletin 900-TC32 to the protect function group.

Function Group Selection Key
Press this key to select the setup function group. The setup function group is selected in order operation function group ←→ adjustment function group, initial setting function group ←→ communications setting function group.

Mode Key
Press this key to select parameters within each function group.

		Platinum Resistance Thermometer Input					Thermocouple Input																	Analog Input
Input Type		Platinum Resistance Thermometer †					Thermocouple ✶													Non-Contact Temperature Sensor ‡				
Name		Pt100			JPt100		K		J		T		E	L	U		N	R	S	B	K10… 70°C	K60… 120°C	K115… 165°C	K160… 260°C	0… 50 mV
Temperature Range	1800																			1800					Usable in the following ranges by scaling: -1999… 9999 or -199.9… 999.9
	1700																	1700	1700						
	1600																								
	1500																								
	1400																								
	1300						1300										1300								
	1200																								
	1100																								
	1000																								
	900	850							850					850											
	800																								
	700																								
	600												600												
	500		500.0		500.0			500																	
	400									400	400	400			400	400.0									
	300																							260	
	200																					120	165		
	100			100		100														100	70				
	0			0		0		-20		-20			0					0	0		0	0	0	0	
	-100								-100					-100											
	-200																								
		-200	-199.9		-199.9		-200				-200	-199.9			-200	-199.9	-200								
Set Value		0	1	2	3	4	0	1	2	3	4	17	5	6	7	18	8	9	10	11	12	13	14	15	16

✶ Applicable standards by input type are as follows:
K, J, T, E, N, R, S, B: JIS C1602-1995
L: Fe-CuNi, DIN 43710-1985
U: Cu-CuNi, DIN 43710-1985

† JPt100: JIS C1604-1989, JIS C1606-1989
Pt100: JIS C1604-1997, IEC 751
Shaded ranges indicate default settings.

‡ The non-contact temperature sensor must be configurable for type K thermocouple output within either of the four specified ranges. For example, an OMRON ES1A infrared sensor.

Digital Temperature Controller

Specifications*

Bulletins 900-TC8, 900-TC16, and 900-TC32

Technical/Control Ratings				
Supply Voltage (Line)			100…240V AC, 50/60 Hz	24 V AC, 50/60 Hz or, 24 V DC
Operating Voltage Range (Line)			85…110% of rated supply voltage	
Power Consumption	900-TC8		5.4 VA @120V AC, 9 VA @ 240V AC	5 VA @ 24 V AC, 4 W @ 24 V DC
	900-TC16		4.7 VA @120V AC, 7 VA @ 240V AC	4 VA @ 24 V AC, 3 W @ 24 V DC
	900-TC32		4.3 VA @ 120V AC, 7 VA @ 240V AC	4 VA @ 24 V AC, 2.5 W @ 24 V DC
Sensor Input	Thermocouple		K, J, T, E, L, U, N, R, S, B (controller applies cold junction compensation)	
	Platinum Resistance Thermometer		Pt100, JPt100 (controller RTD excitation current: approx. 1 mA) 2- or 3-wire configuration	
	Non-Contact Temperature Sensor		10…70 °C, 60…120 °C, 115…165 °C, 160…260 °C	
	Voltage Input		0…50 mV	
Control Output	Electro-mechanical Relay output	900-TC8	SPST-NO, 250V AC @ 5 A, 30V DC @ 10 A (max. resistive load), electrical life: 100 000 operations	
		900-TC16	SPST-NO, 250V AC @ 3 A, 30V DC @ 10 A (max. resistive load), electrical life: 100 000 operations	
		900-TC32	SPST-NO, 250V AC @ 2 A, 30V DC @ 2 A (max. resistive load), electrical life: 100 000 operations	
	Voltage output (SSR compatible)	900-TC8	12V DC (PNP), max. load current: 40 mA, with current limit protection	
		900-TC16	12V DC (PNP), max. load current: 21 mA, with current limit protection	
		900-TC32	12V DC (PNP), max. load current: 21 mA, with current limit protection	
	Analog	900-TC8	DC: 4...20 mA, max. load 600 ohms, resolution 2,600	
		900-TC16	DC: 4...20 mA, max. load 600 ohms, resolution 2,600	
		900-TC32	NA	
Alarm Output	900-TC8		SPST-NO, 250V AC @ 3 A, 30V DC @ 5 A (max. resistive load), electrical life: 100 000 operations	
	900-TC16, 900-TC32		SPST-NO, 250V AC @ 1 A, 30V DC @ 2 A (max. resistive load), electrical life: 100 000 operations	
Event Input ‡	Contact		ON: 1K Ω (max.) OFF: 100K Ω (min.)	
	Non-contact		ON: Voltage Drop 1.5V (max.) OFF: Leakage current 0.1 mA (max.)	
Control Method			ON/OFF control or 2-PID (auto-tune and self-tune)	
Setting Method			Digital setting using front panel keys or 900Builder software	
Indication Method			7-segment digital display and single-lighting indicator	
Character height	900-TC8		Process Value Display: 14.0 mm; Set Point Display: 9.5 mm	
	900-TC16		Process Value Display: 9.9 mm; Set Point Display: 6.4 mm	
	900-TC32		Process Value Display: 7.0 mm; Set Point Display: 3.5 mm	
Indication Accuracy	Thermocouple		(±0.5% of indicated value or ±1°C, whichever greater) ±1 digit max. †	
	Platinum Resistance Thermometer (RTD)		(±0.5% of indicated value or ±1°C, whichever greater) ±1 digit max.	
	Analog Input (0…50 mV)		±0.5% FS±1 digit max.	
	CT Input (900-TC8, 900-TC16)		±5% FS±1 digit max.	
Hysteresis			0.1…999.9 EU (in units of 0.1 EU)	
Proportional Band (P)			0.1…999.9 EU (in units of 0.1 EU)	
Integral Time (I)			0…3999 s (in units of 1 s)	
Derivative Time (D)			0…3999 s (in units of 1 s)	
Control Period			1…99 s (in units of 1 s)	
Manual Reset Value			0.0…100.0% (in units of 0.1%)	
Alarm Setting Range			–1999…+9999 (decimal point position depends on input type)	
Sampling Period			500 ms	
Other Functions			According to Controller model	

* Unless noted, specifications apply to Bulletins 900-TC8, 900-TC16, and 900-TC32.

† The indication of K thermocouples in the –200…+1300 °C range, and T and N thermocouples at a temperature of –100 °C or less, and U and L thermocouples at any temperature is ±2 °C ±1 digit maximum. The indication of B thermocouples at a temperature of 400 °C or less is unrestricted. The indication of R and S thermocouples at a temperature of 200 °C or less is ±3 °C ±1 digit maximum.

‡ Applies to 900-TC8 or 900-TC16.

Bulletins 900-TC8, 900-TC16, and 900-TC32, Continued

General/Environmental Ratings		
Weight (includes carton)	900-TC8	Approx. 390 g (13.8 ounces)
	900-TC16	Approx. 215 g (7.6 ounces)
	900-TC32	Approx. 160 g (5.6 ounces)
	900-TC8232, COM, EIM	Approx. 20 g (0.7 ounces)
	900-TC16COM, EIM	Approx. 35 g (1.2 ounces)
Ambient Temperature		–10…+55 °C (with no condensation or icing)
Ambient Humidity		25…85%
Storage Temperature		–25…+65 °C (with no condensation or icing)
Insulation Resistance		20 MΩ min. (at 500V DC)
Dielectric Strength		2000V AC, 50 or 60 Hz for 1 min. (between different charging terminals)
Maximum Vibration		10…55 Hz, 10 m/s² (1 G) for 10 minutes each in X, Y, and Z directions
Maximum Shock		200 m/s² (20 G), 3 times each in 3 axes, 6 directions (when using a relay: 100 m/s² [10 G])
Protective Structure		Front panel: UL Type 4X for indoor use (equivalent to IP66), rear case: IP20, terminals: IP00 VDE 0106
Installation Environment		Installation category II, pollution class 2 (IEC 61010-1 compliant)
Memory Protection		EEPROM (non-volatile memory) (number of writes: 100 000)
EMC	Emission Enclosure	EN55011 Group 1 class A
	Emission AC Mains	EN55011 Group 1 class A
	Immunity ESD	EN61000-4-2: 4 kV contact discharge (level 2); 8 kV air discharge (level 3)
	Immunity RF-Interference	EN61000-4-3: 10V/m (amplitude modulated, 80 MHz…1 GHz) (level 3) 10V/m (pulse modulated, 900 MHz)
	Immunity Conducted Disturbance	EN61000-4-6: 10V (0.15…80 MHz) (level 3)
	Immunity Burst	EN61000-4-4: 2 kV power-line (level 3); 2 kV I/O signal-line (level 4)
	Surge Immunity	EN61000-4-5: 1 kV line to line (level 2), 2 kV line to ground (level 3)
	Voltage DIPs/Short Interruptions	EN61000-4-11: 100%/0.5 period
Conformity to Standards		UL3121-1, CSA C22.2 No. 14-95, E.B.1402C; conforms to EN50081-2, EN50082-2, EN61010-1 (IEC 61010-1); conforms to VDE 0106/part 100 (finger protection) when the terminal cover is mounted.
Communications		
Transmission Path Connection		Multiple points
Communications Method ∗	900-TC8	RS-232C or RS-485 (2-wire, half duplex)
	900-TC16	RS-485 (2-wire, half duplex)
	900-TC32	RS-485 (2-wire, half duplex)
Synchronization Method		Start-stop synchronization
Baud Rate		1200/2400/4800/9600/19 200 bps
Transmission Code		ASCII
Data Bit Length †		7 or 8 bits
Stop Bit Length †		1 or 2 bits
Error Detection, Vertical Parity		None, even, odd
Flow Control		Not available
Interface	900-TC8 ∗	RS-485/RS-232C
	900-TC16 †	RS-485
	900-TC32 †	RS-485
Retry Function		Not available
Communications Buffer		40 bytes
Heater Burnout Alarm (Use with Bulletins 900-TC8 and 900-TC16 Only)		
Max. Heater Current	Single-Phase AC	50 A
Input Current Readout Accuracy		±5%FS ±1 digit max.
Heater Burnout Alarm Setting Range		0.0…50.0 A (0.1 A units) ‡
Min. Detection ON Time		190 ms §
Current Transformer (Sold Separately) Ratings (Use with Bulletins 900-TC8 and 900-TC16 Only)		
Dielectric Strength		1000V AC (1 min.)
Vibration Resistance		50 Hz 98 m/s² (10 G)
Weight (includes carton)	900-CT1	Approx. 19 g (0.67 ounces)
	900-CT2	Approx. 65 g (2.3 ounces)
Conformity to Standards		
Standards		NEMA/EEMAC ICS 2 (Industrial Controls and Systems) UL, CSA, IEC

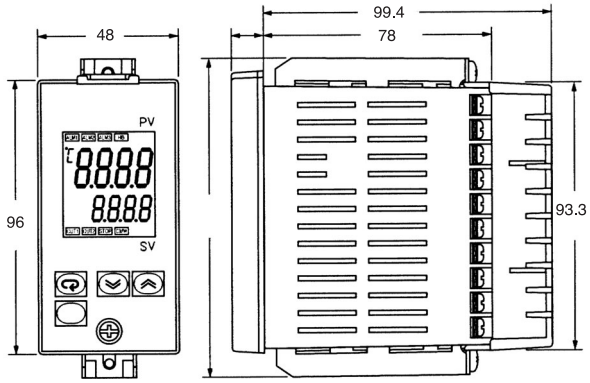
∗ RS-232C communications is only supported for Bulletin 900-TC8 (Cat. No. 900-TC8232 option board installed). All controllers support RS-485 communications (32 linked/networked devices) by appropriate option unit or correct controller catalog number.
† The baud rate, data bit length, stop bit length, or vertical parity can be individually set using the communications configuration function group.
‡ When the configured value of the heater burnout alarm is 00 A, the heater burnout alarm will always be OFF. When the configured value is 50.0 A, the heater burnout alarm will always be ON.
§ When the heater ON time is less than 190 ms, heater burnout detection and heater current measurement will not be carried out.

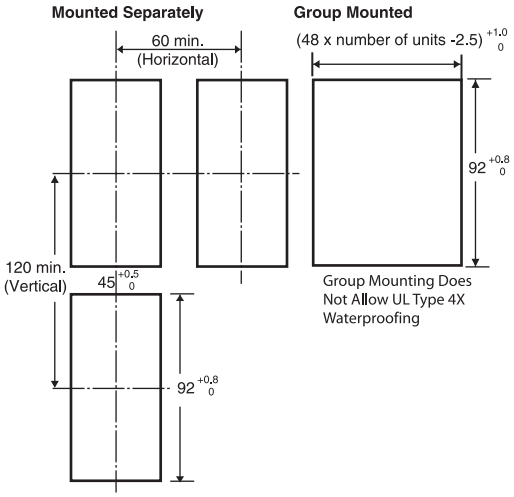
Digital Temperature Controller

Approximate Dimensions

Approximate dimensions are shown in millimeters unless otherwise indicated (to convert to inches, multiply by 0.0394). Dimensions are not to be used for manufacturing purposes.

Bulletin 900-TC8

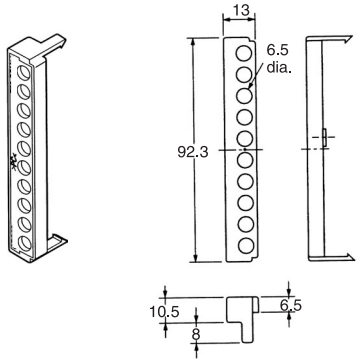




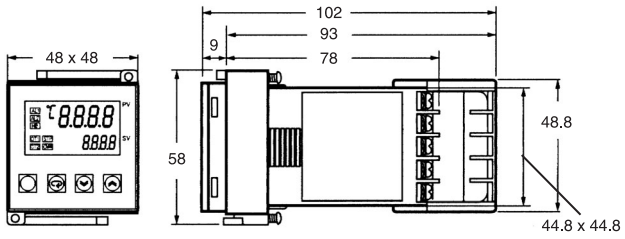
Panel Cutouts

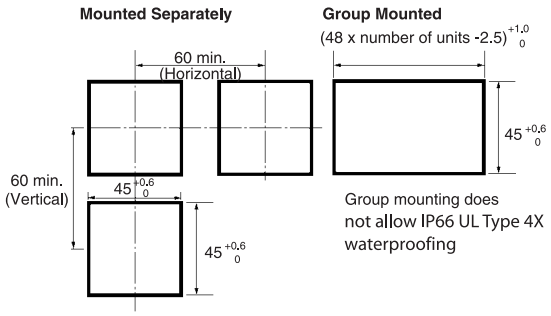
- Recommended panel thickness is 1…8 mm.
- Group mounting is not possible in the vertical direction. (Maintain the specified mounting space between controllers when they are group mounted. UL Type 4X is not possible when group mounting.)
- To mount the unit so that it is waterproof, apply the waterproof gasket to the unit
- When two or more units are mounted together, make sure that the surrounding ambient temperature does not exceed the allowable operating temperature specification.

Safety Terminal Cover*



Bulletin 900-TC16

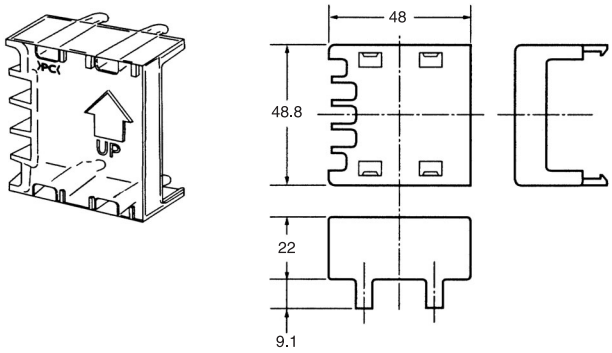




Panel Cutouts

- Recommended panel thickness is 1…5 mm.
- Group mounting is not possible in the vertical direction. (Maintain the specified mounting space between Controllers when they are group mounted. IP66 UL Type 4X is not possible when group mounting.)
- To mount the unit so that it is waterproof, apply the waterproof gasket to the unit.
- When two or more units are mounted together, make sure that the surrounding ambient temperature does not exceed the allowable operating temperature specification.

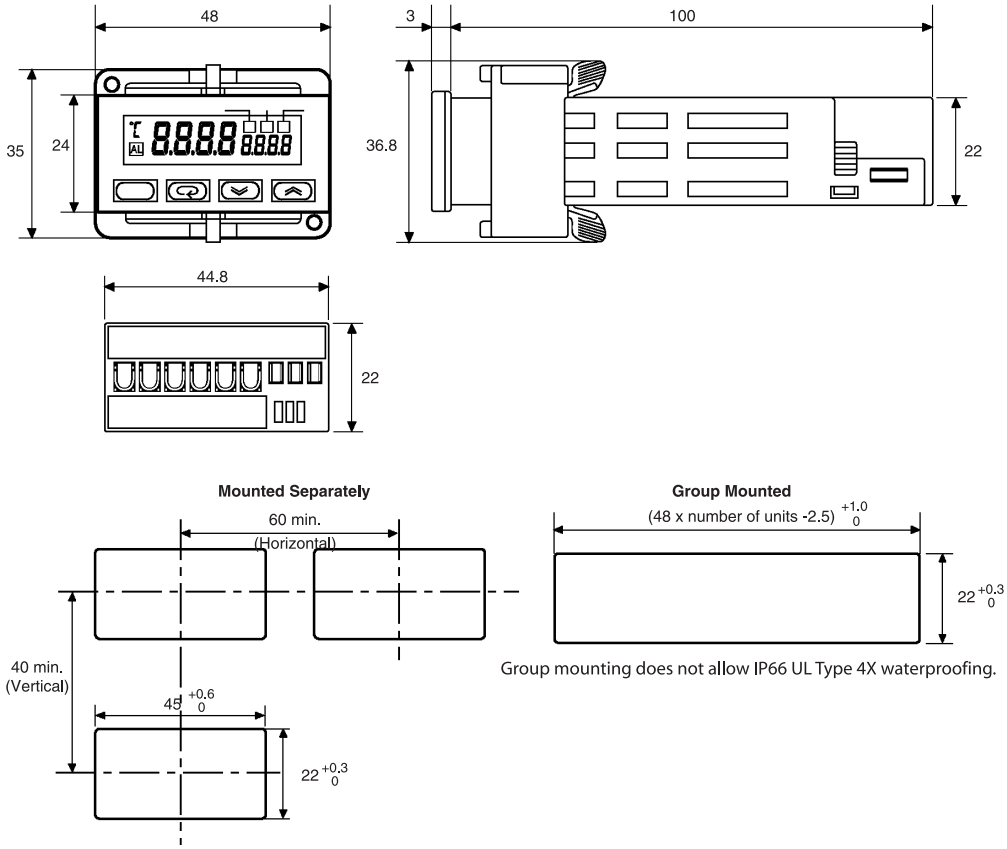
Safety Terminal Cover*



* Conforms to VDE 0106 (finger protection) when installed on the controller.

Approximate dimensions are shown in millimeters unless otherwise indicated (to convert to inches, multiply by 0.0394). Dimensions are not to be used for manufacturing purposes.

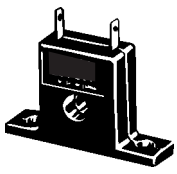
Bulletin 900-TC32

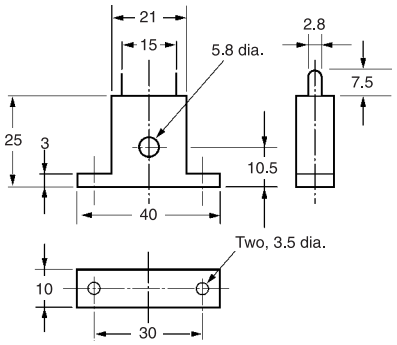


Panel Cutouts

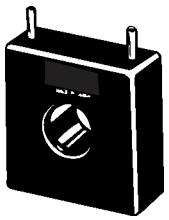
- Recommended panel thickness is 1…5 mm.
- When carrying out maintenance on the unit, the I/O wiring terminal block can be removed from the module with the terminal leads still attached.
- Group mounting is not possible in the vertical direction. (Maintain the specified mounting space between controllers when they are group mounted. IP66 UL Type 4X is not possible when group mounting.)
- To mount the unit so that it is waterproof, apply the waterproof gasket to the unit.
- When two or more units are mounted together, make sure that the surrounding ambient temperature does not exceed the allowable operating temperature specification.

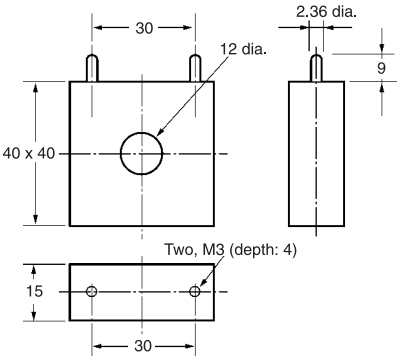
Current Transformer (Sold Separately) (Bulletins 900-TC8 and 900-TC16 Only)





Cat. No. 900-CT1





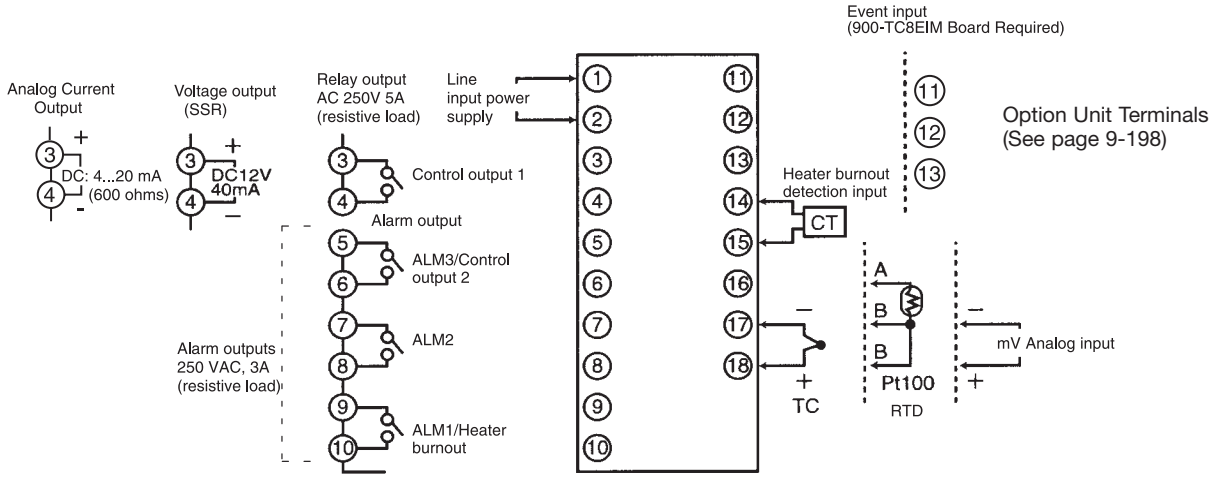
Cat. No. 900-CT2

Note: The hole diameter is the major functional difference between the Cat. No. 900-CT1 and the Cat. No. 900-CT2. The current output signal is the same.

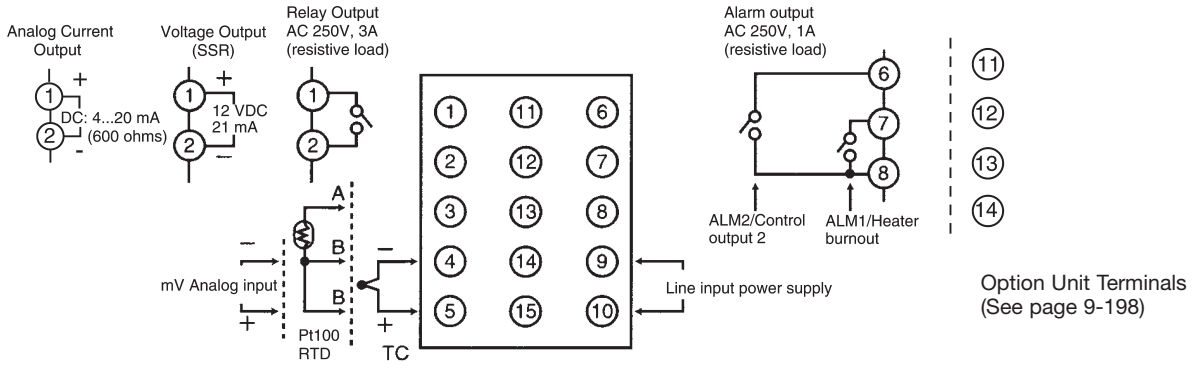
- The voltage output (SSR control output) is not electrically isolated from the controller's internal circuits. When using a grounded thermocouple, do not connect the control output terminals to earth ground. If the control output terminals are connected to earth ground, errors will occur in the measured temperature values as a result of ground loop leakage current.
- Standard insulation is applied to the power supply I/O sections. If reinforced insulation is required, connect the input and output terminals to a device without any exposed current-carrying parts or to a device with standard insulation suitable for the maximum operating voltage of the power supply I/O section.

Note: Input power supply available: 100…240 V AC, or 24 V AC/DC

Bulletin 900-TC8

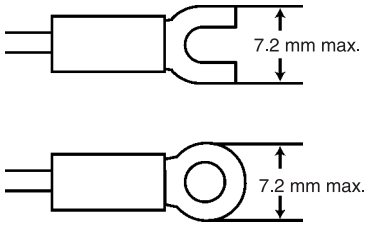


Bulletin 900-TC16



Bulletins 900-TC8 and 900-TC16

- Separate input leads and power lines to protect the Bulletin 900-TC8/900-TC16 and its lines from external noise.
- We recommend using solderless lugs when wiring to the Bulletin 900-TC8/900-TC16 wire terminals. However, if lugs are not used, the controller's screw terminals will accept two solid or stranded wires (no mixing) 14…24 AWG.
- Tighten the terminal screws using a torque 1.13…1.36 Nm (10…12 lb-in).
- Use the following type of solderless lugs for M3.5 screws.

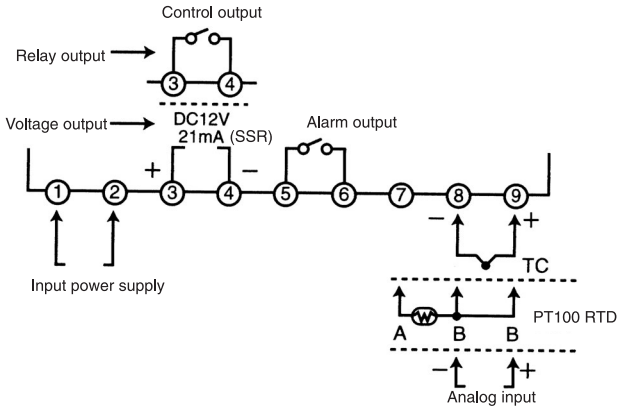


Wiring Terminals, Continued

- The voltage output (SSR control output) is not electrically isolated from the controller's internal circuits. When using a grounded thermocouple, do not connect the control output terminals to earth ground. If the control output terminals are connected to earth ground, errors will occur in the measured temperature values as a result of ground loop leakage current.
- Standard insulation is applied to the power supply I/O sections. If reinforced insulation is required, connect the input and output terminals to a device without any exposed current-carrying parts or to a device with standard insulation suitable for the maximum operating voltage of the power supply I/O section.

Note: Input power supply available: 100…240 V AC, or 24 V AC/DC

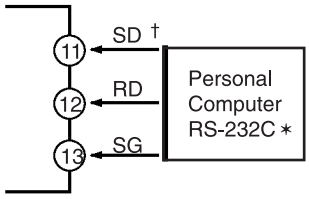
Bulletin 900-TC32



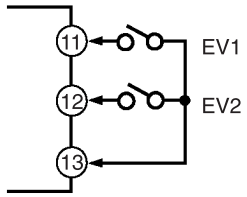
Option Units

Bulletin 900-TC8

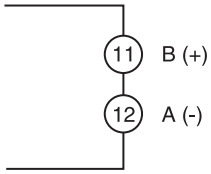
Cat. No. 900-TC8232 RS-232C Communications Unit



Cat. No. 900-TC8EIM Event Input Unit



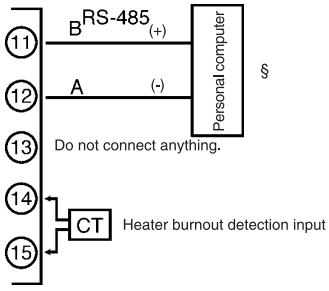
Cat. No. 900-TC8COM RS-485 Communications Unit‡



∗ With 900Builder Software
† 900-CP1x or equivalent cable provides the physical connection between the PC and controller.
‡ Typically, an RS-232 to RS-485 converter such as the Cat. No. 900-CONVZ25 (see page 9-203) will be required between the personal computer (with 900Builder software) and the Bulletin 900-TCx controller. In that case, a 900-CPx or equivalent cable provides the physical connection between the converter and the PC. RS-485 allows linking up to 31 controllers with a single personal computer.

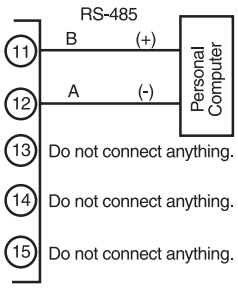
Bulletin 900-TC16

Cat. No. 900-TC16COM RS-485 Communications/ Heater Burnout Alarm Unit

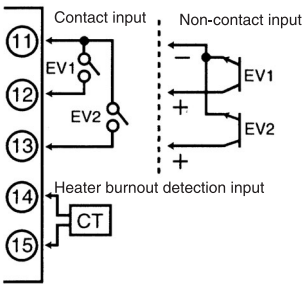


Communications Heater Burnout

Cat. No. 900-TC16ACCOM RS-485 Communications/ Unit

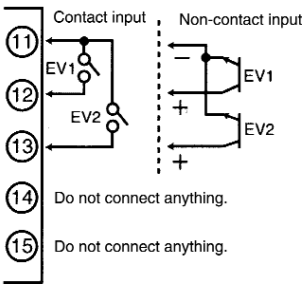


Cat. No. 900-TC16EIM Event Input/ Heater Burnout Alarm Unit



Event Input/Heater Burnout Detection

Cat. No. 900-TC16ACEIM Event Input Unit

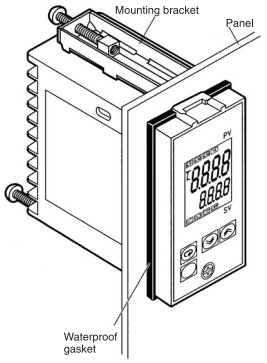


§ Typically, an RS-232 to RS-485 converter such as the Cat. No. 900-CONVZ25 (see page 9-203) will be required between the personal computer (with 900Builder software) and the Bulletin 900-TCx controller. RS-485 allows linking up to 31 controllers with a single personal computer.

Bulletin 900-TC8

Panel Mounting

1. Insert the Bulletin 900-TC8 into the mounting hole in the panel from the front. Ensure the waterproof gasket is in place if this is a UL Type 4X enclosure.
2. Push the mounting bracket along the Bulletin 900-TC8 body from the rear terminals up to the panel, and secure it temporarily.
3. Tighten the screw on each mounting bracket alternately until the ratchet stops tightening.

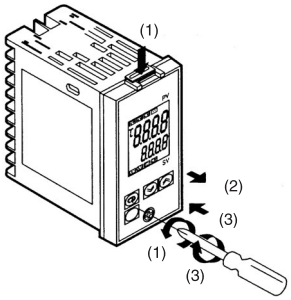


Bulletin 900-TC8

Removing the Unit from its Case

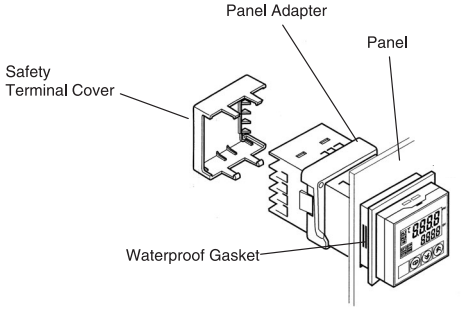
To remove the Bulletin 900-TC8 unit from its case whether it is mounted in a panel or not, use a suitable Phillips screwdriver for the screw located at the bottom on the front of the case.

1. While pressing down on the hook located at the top of the case front, turn the screw (located at the bottom on the front) counterclockwise using a Phillips screwdriver.
2. Hold both sides of the front case and draw out the unit towards you. With the unit removed, option boards can be installed or replaced.
3. When replacing/inserting the unit into the case/panel, confirm that the waterproof gasket is in place. While pressing down on the hook located at the top of the front case, turn the screw (located at the bottom on the front) clockwise using a Phillips screwdriver and tighten to a torque of 0.3…0.5 N•m (2.66…4.43 lb•in). Make sure that electronic parts do not come in contact with the case.



Bulletin 900-TC16

Panel Mounting



Mounting the Bulletin 900-TC16 in a Panel/Enclosure

1. Insert the Bulletin 900-TC16 into the mounting hole in the panel. Ensure the waterproof gasket is in place if this is a IP66 UL Type 4X enclosure.
2. Push the panel adapter along the Bulletin 900-TC16 body from the rear terminals up to the panel, and secure it temporarily.
3. Tighten the two screws on the adapter. When tightening the two screws, tighten them alternately, keeping the torque to 0.29…0.39 N•m (2.57…3.45 lb•in).

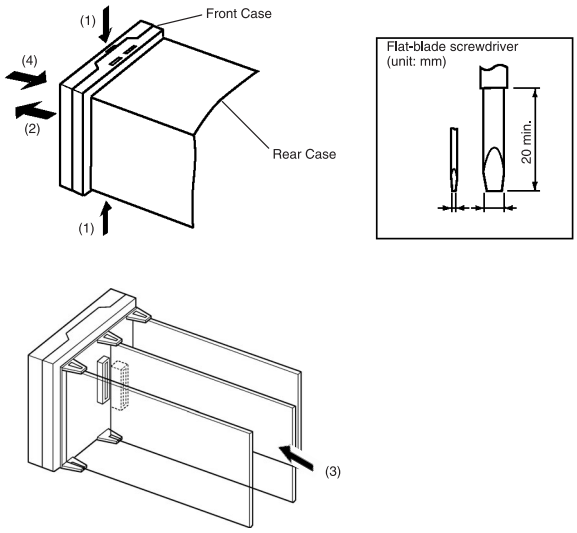
Attaching the Safety Terminal Cover

Make sure that the UP arrow mark is facing up, and then fit the terminal cover into the holes on the top and bottom of the controller. All Bulletin 900-TC16 controllers are provided with a terminal cover.

Installing the Option Units

If communications, event input, or heater burnout functions are required, mount the applicable option unit into the controller. The heater burnout function is supported on either the 900-TC16EIM or 900-TC16COM units. One option unit (max.) per controller.

Assembly Directions

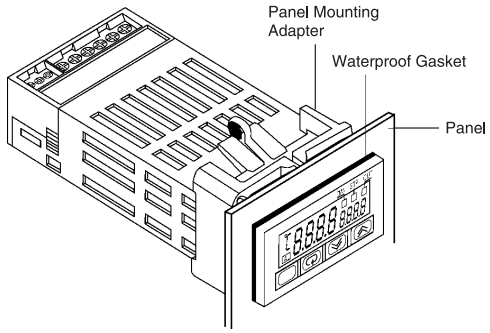


1. Insert the tools (see drawing above) into the slots (one on the top and one on the bottom) and release the case hooks.
2. Insert the tool in the space between the front and rear case selections and slightly pull out the front case. Hold the top and bottom of the front case and pull it toward yourself to remove it.
3. Mount the option unit in the center position. Match the upper and lower option unit (board) retaining claws with the connection points and insert/lock the option unit in place.
4. Before inserting the unit into the panel/enclosure, confirm that the waterproof gasket is in place. Insert the front case into the rear case until you hear a click. When inserting the front case, press down the hooks on the top and bottom of the rear case so that they firmly hook together. Make sure that electronic parts do not come in contact with the case.

Bulletin 900-TC32

Panel Mounting

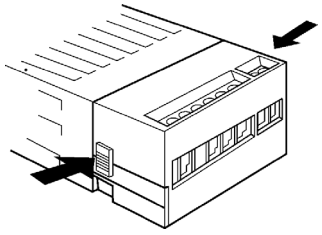
1. Insert the Bulletin 900-TC32 into the mounting hole in the panel from the front. Ensure the waterproof gasket is in place if this is a IP66 UL Type 4X enclosure.
2. Push the panel mounting adapter along the Bulletin 900-TC32 body from the rear terminals up to the panel, and secure it temporarily.
3. Tighten the two screws on the adapter. When tightening the two screws, tighten them alternately, keeping the torque to within approximately 0.29…0.39 N•m (2.57…3.45 lb•in).



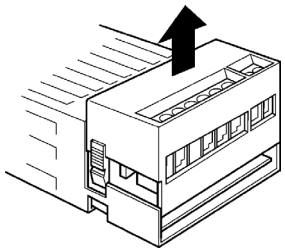
Removing and Attaching the Wiring Terminal Cover Plate

A damaged Bulletin 900-TC32 can quickly be replaced by removing the field terminal plate.

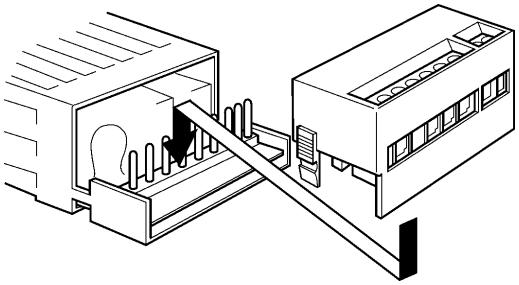
1. Press in firmly on the fasteners at both sides of the terminals to unlock the terminal plate and pull it upwards.



2. Remove the terminal plate with the field wires attached.



3. Before you replace/insert the terminal plate on the replacement Bulletin 900-TC32, make sure that the pins match the positions of the holes in the terminal plate, and press it into place on the controller.



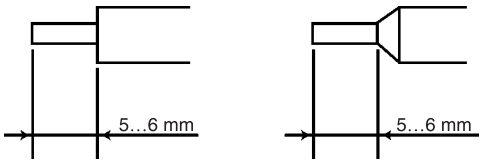
Wiring Precautions

Bulletin 900-TC32

Connect the terminals as specified below.

Terminal No.	Cables	Pin Terminals
1…6	AWG24…14	2.1 dia. max.
7…9	AWG28…22	1.3 dia. max.

The exposed current-carrying part to be inserted into terminals must be 5…6 mm.



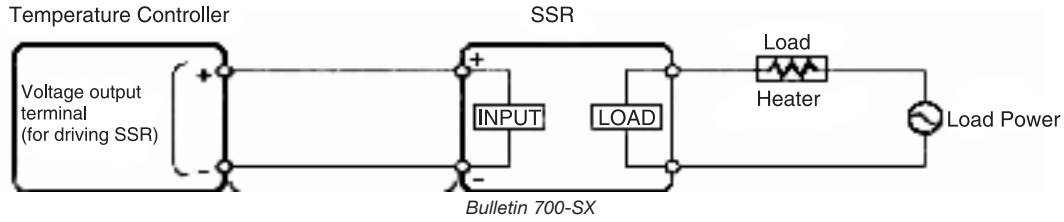
Electrical wire Pin terminal

Tighten the terminal screws to the torque specified below.

Terminal No.	Screw	Maximum Tightening Torque
1…6	M2.6	0.23…0.25 N•m (2.04…2.21 lb•in)
7…9	M2	0.12…0.14 N•m (1.06…1.24 lb•in)

Temperature Controller Connection to a Solid-State Relay (SSR)

The 12V DC output of a temperature controller is typically used to interface to an SSR, such as the Allen-Bradley Bulletin 700-Sx line. An SSR provides high current (e.g., 40 A) switching capability plus longer life than a mechanical relay. See the Relays and Timers Selection Guide (Publication 700-SG003B-EN-P) for additional information.



Bulletin 700-SX

Controller Configuration from Keypad

Controller configuration of parameters can be done using the four keys on the bottom of the controller along with the two LED displays. The configuration system is structured, which means a set path must be followed to get from one parameter to another.
User manuals, which provide details about configuring the Bulletin 900-TCx controllers, are available on-line at the Automation Bookstore web site http://www.ab.theautomationbookstore.com:

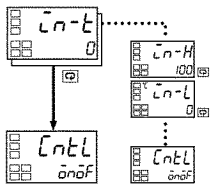
- Bulletin 900-TC8: Publication 900-UM002B-EN-E
- Bulletin 900-TC16: Publication 900-UM001B-EN-E
- Bulletin 900-TC32: Publication 900-UM003B-EN-E

Initial Setup, ON/OFF Control

The following is an example of the structure to alter the configuration of a controller parameter.
Note: On the Bulletin 900-TC8/900-TC32, the ⊙ key is the ⇦ M key.

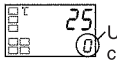
Typical Application Example

Changing Parameters



Indicates that there is a parameter. Keep on pressing the mode key until the desired parameter is selected.

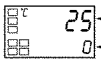
Changing Set Values



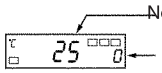
Use the ⩔ or ⩓ keys to change the set value displayed in the setup menu.

Display

No. 1 display
No. 2 display
900-TC8



No. 1 display
No. 2 display
900-TC16

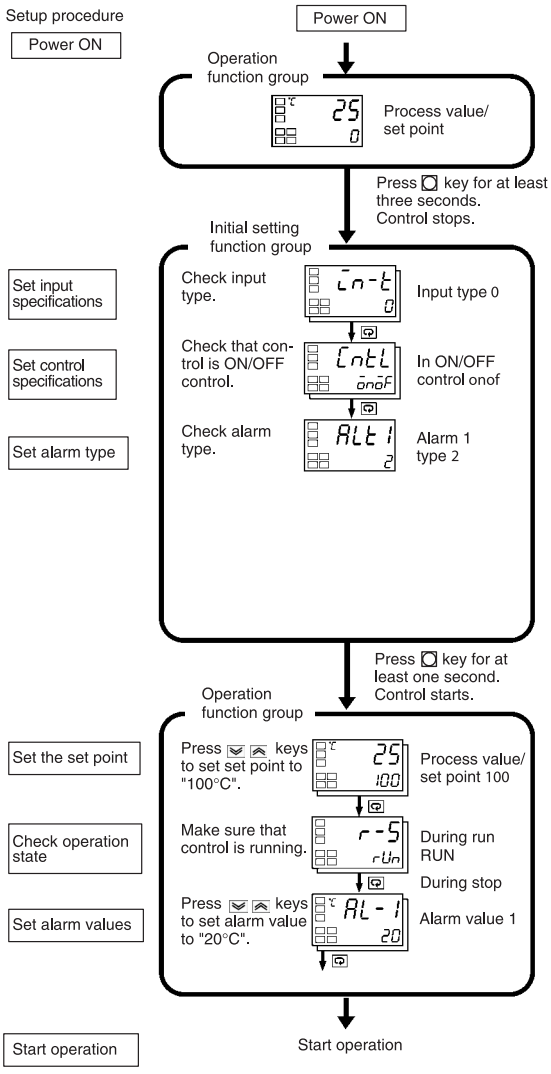


No. 1 display
No. 2 display
900-TC32

Typical Example

Input type:	0 K thermocouple -200…1300°C
Control method:	ON/OFF control
Alarm type:	2 upper limit
Alarm value 1:	20°C (For setting deviation)
Set point:	100°C

Change only the alarm value 1 and set point.
The rest must be left as default settings.



Interface Converter

Product Overview/Specifications

Bulletin 900 — Interface Converter

- Enables RS-232 or USB ∗ (ser. B or later converter) to RS-485 Communications between a Personal Computer (PC) using 900Builder™ Software and up to 31 Bulletin 900-TCx Controllers — Ideal for Industrial Applications
- All Signal Lines have 1500V AC Insulation at the RS-232C (USB: 500 V AC) and RS-485 Sides Using Opto-Couples; Power Supply Lines have 1500V AC Insulation Using a Transformer
- Diagnostic LEDs Indicate Power Available and Active Data Transmission
- On-Board Wiring and Data Configuration Diagrams Simplify Startup
- DIN Rail or Panel Mountable
- cURus, CE

∗ Requires loading free software into PC. Available at the Allen-Bradley web site http://www.ab.com/industrialcontrols/products/Temp_controls/index.html.

Table of Contents

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Standard Models

Bulletin No.	Size	Power Supply Voltage	Cat. No.
900-CONV†	30 mm (W) x 80 mm (H) x 78 mm (D)	100…240V AC	900-CONVZ25
		24V AC/DC	900-CONVU25

† Converts personal computer RS-232/USB communications to RS-485. Use for interface with a single Bulletin 900-TCx, or multiple (up to 31) controllers with RS-485 communications.

Specifications

Technical/Control Ratings				
Communications Method	Master Device (PC)		RS-232C	
	Slave Device (900-TCx Controller)		RS-485 (2-wire, half duplex) (selectable)	
Synchronization Method			Start-stop synchronization	
Master Device (PC)	RS-232C Interface	Max. transmission distance	15 m	
		Max. number of connectable units	1 unit	
	USB Interface	Max. transmission distance	5 m or when the total time (hub delay time plus the cable delay time) is less than or equal to 70 ns	
		Max. number of connectable slave units	1 unit	
		USB Standard	V1.1	
Slave Device (900-TCx) RS-485 Interface		Max. transmission distance	500 m	
		Max. number of connectable slave units	31 units (for multi-drop connection)	
Baud Rate			1200/2400/4800/9600/19 200/38 400 bps (Default setting: 9600)	
Data Bit Length			7 or 8 bits (Default setting: 7)	
Stop Bit Length			1 or 2 bits (Default setting: 2)	
Communications Parity			None, even, odd (Default setting: Even)	
Echoback Selection			Echoback: With/without (Default setting: Without)	
Selection Switch Response Delay			Approx. 30 ms	
General/Environmental Ratings				
Supply Voltage			100…240V AC, 50/60 Hz	24 V AC, 50/60 Hz or 24 V DC
Operating Voltage Range			85…110% of rated supply voltage	
Power Consumption			5 VA max.	24 V AC: 3 VA max., 24 V DC: 3 W max.
Ambient Temperature		RS-232C	–10…+55 °C (with no icing)	
		USB	0...+55 °C (with no icing)	
Ambient Humidity			25…85% (with no condensation)	
Storage Temperature			–20…+65 °C	

Specifications, Continued

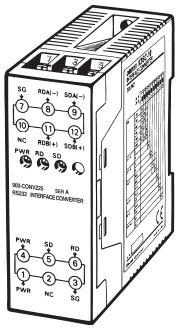
General/Environmental Ratings			
Insulation Resistance			20 MΩ min. measured at 500V DC between the following: External terminals ↔ casing RS-232C terminals ↔ RS-485 terminals power supply terminals
	Isolation Method	Communications	Phototransistor coupler
		Power supply	Isolating transformer
Dielectric Strength			1,500 V AC for 1 min. between the external terminal and case, and between the RS-232C RS-485 block power supply terminal
Noise Immunity			500 V AC for 1 min. between the RS-232C/USB block and RS-485 block
Vibration (Max.)			10…55 Hz, 0.5 mm single amplitude for 10 min. each in X, Y, and Z directions (1 G)
Shock (Max.)			98 m/s² (10 G), 3 times each in X, Y, and Z directions
Weight			Approx. 150 g
Enclosure Rating	Front Panel Operation Parts		Conforms to IEC standards, equivalent to IP20 (when terminal cover mounted) ∗
	Terminals		Equivalent to VDE 0106/100 (when terminal cover mounted) ∗
Memory Protection			No protective functions (communications data is not protected for power interruptions during communications)
EMC	Radiated Emission		EN61326 class A
	Conducted Emission		EN61326 class A
	Immunity ESD		EN61000-4-2: 4 kV contact discharge (level 2); 8 kV air discharge (level 3)
	Immunity RF-Interference		EN61000-4-3: 10V/m (amplitude modulated, 80 MHz…1 GHz) (level 3) 10V/m (pulse modulated, 900 MHz)
	Immunity Conducted Disturbance		EN61000-4-6: 10V (0.15…80 MHz) (level 3)
	Immunity Burst		EN61000-4-3: 2 kV power-line (level 3); 2 kV I/O signal-line (level 4)
Conformity to Standards			UL508, CSA C22.2 No. 14-95 Conforms to EN50081-2, EN50082-2, EN61010-1 (IEC 61010-1) Conforms to VDE 0106/part 100 (Finger Protection), when the terminal cover is mounted.

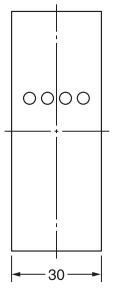
∗ When USB communication is used, the cover must be removed

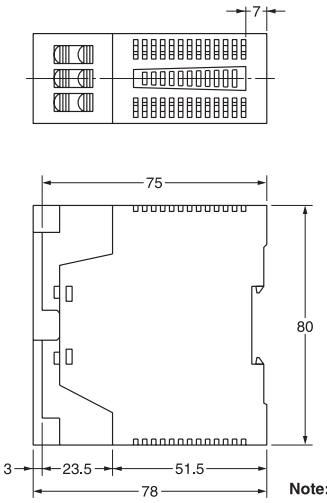
Approximate Dimensions

Approximate dimensions are shown in millimeters unless otherwise indicated (to convert to inches, multiply by 0.0394). Dimensions are not to be used for manufacturing purposes.

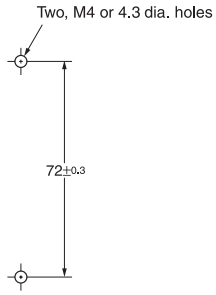
Cat. No. 900-CONVZ25





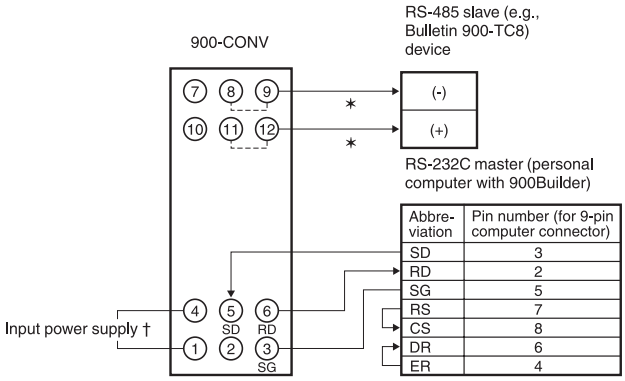


Mounting Hole Dimensions (For Direct Mounting)



Note: DIN rail mounting is also possible.

RS-485 Connection



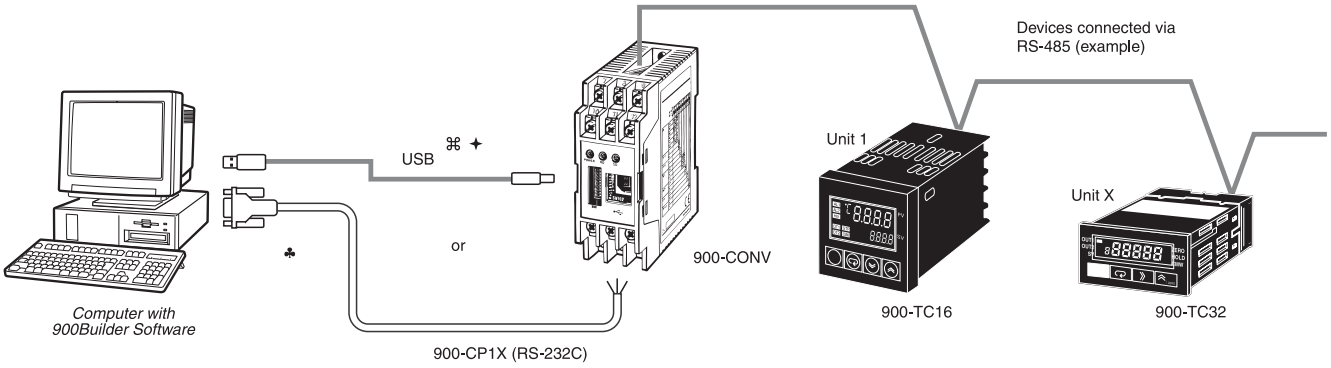
∗ If RS-485 is selected as the communications method (i.e., pin 9 of the DIP switch is set to OFF), terminals 8 and 9, and terminals 11 and 12 are connected internally.
† A 100…240 V AC, 24 V AC, or 24 V DC (not polarity sensitive) input power supply is required.

Function	Terminal Number	Name	Signal Direction	Explanation
For connecting the operating power supply	1 and 4	PWR	—	100…240V AC or 24 V AC/DC model
Connection terminals for RS-232C communications with master device (DIP switch pin 8: OFF)	3	SG	—	Connect to signal ground.
	5	SD	Input	Receives data from SD of the master device.
	6	RD	Output	Sends data to RD of the master device.
Used for RS-485 communications with slave device (DIP switch pin 9: OFF)	8	RDA (–)	Input/ output	SD and RD for RS-485 (cold side) Terminals 8 and 9 are connected internally when pin 9 of the DIP switch is set to OFF.
	9	SDA (–)		
	11	RDB (+)	Input/ output	SD and RD for RS-485 (hot side) Terminals 11 and 12 are connected internally when pin 9 of the DIP switch is set to OFF.
	12	SDB (+)		

Note: Terminals 2 and 10 are not used.

Connection to an RS-232C Master Device

Set the same communications conditions (baud rate, stop bits, data length, and parity) for the master device, the Interface Converter, and slave devices.



‡ With RS-485 communications, connect a terminating resistance (120Ω, 1/2 W recommended) to both ends of the communications link/network.
§ The Bulletin 900-TCx communications number must be set.
♣ A pre-fabricated 3 m RS-232 cable with a 9-pin female D-shell connector on one end and three flying leads at the other is available from Allen-Bradley (Cat. No. 900-CP1X).
➤ RS-485 allows connecting 32 devices.
⌘ Use a commercially available USB cable
✦ To use the USB mode requires the download of “free” software into your PC. This software can be found at the following website:
the Allen-Bradley web site http://www.ab.com/industrialcontrols/temp_control/index.html
Once at this site, go to “Get Software” (upper right of screen) and click on “Virtual Communications Port USB Driver” and follow the instructions.

Terminal Specifications

Make sure to check the input and output specifications for the signal pins of connected devices before connecting the terminals.

Bulletin 900-CONV Front Display

Terminal Cover

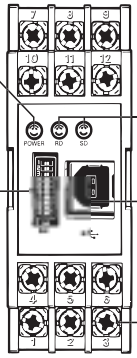
Note: Cover the terminals to prevent electric shock.

Power Indicator
Lights (green) when line power is supplied.

Communications Setting Switch
Used to set the communications conditions for connected devices.

Switch	Setting
1	Baud Rate
2	
3	
4	Data Length
5	
6	Parity
7	
8	Master Device
9	Slave Device
10	Echoback

Bulletin 900-CONVx without Terminal Cover



Communications Status Indicators
RD: Amber lights when receiving RS-485 communications.
SD: Amber lights when sending RS-485 communications.

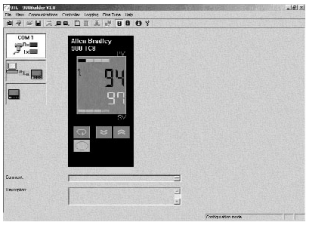
USB Port
(Use a commercially available USB cable)

M3.5 Terminal Screw

Caution: Make sure to use the Bulletin 900-CONV with the terminal cover mounted when using in machinery that must conform to EN/IEC standards.

900Builder™ Software

Product Overview/Product Selection



Bulletin 900 — 900Builder™ Personal Computer (PC) Configuration Software for Bulletin 900-TCx Temperature Controllers

- Provides a Graphic Configuration Option to Using the Controller's On-Board Keypad and Displays
- Simplifies Controller Configuration by Use of Fill-in-the-Blank Menus
- On-Line Monitoring of Parameters by Controller Simulated Graphic or Bar Chart Faceplates
- Provides Data-Logging and Graphic Trending Feature
- Uses Microsoft® Windows® Environment to Allow Viewing Multiple Applications Simultaneously
- ActiveX Feature Allows Saving Parameters for Use by Other Windows® Applications Such as Excel
- RS-232 Direct Connection to Bulletin 900-TC8 with Bulletin 900-TC8232 Option Unit
- RS-485 Connection with up to 31 Controllers via Bulletin 900-CONV RS-232/RS-485 Converter Module
- Rev. 1.1 supports analog output and 24 V AC/DC controllers

Table of Contents

Additional Features . 9-219

Product Selection

Product Name/Description	Cat. No.
900Builder™ Personal Computer Configuration Software for Bulletin 900-TCx Temperature Controllers (available in CD format only)	900-BLDSW1

Computer Hardware Requirements

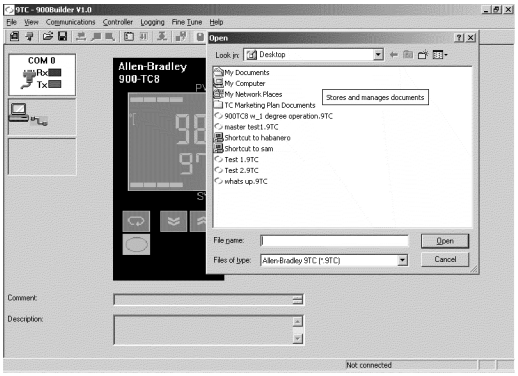
The 1.0 release requires a PC with the following minimum specification:

- Pentium® P90
- 16MB RAM, 32 recommended
- 15MB free disk space
- CD-ROM Drive (4x speed, with 32 bit device driver) (optional)
- SVGA resolution monitor (800 x 600)
- Microsoft® Windows®-supported mouse
- Microsoft® Windows®-supported printer (optional)
- Free serial 9-pin COM Port for connection to controller or RS-232 to RS-485 converter (Bulletin 900-CONV) (required for configuration)

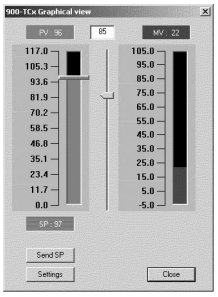
Computer Operating System Requirements

Either of the following operating systems can be used with 900Builder

- Microsoft® Windows® 95
- Microsoft® Windows® 98
- Microsoft® Windows NT® 4.0 (service pack 6)
- Microsoft® Windows® 2000



- Store parameters to PC memory or disk
- Retrieve parameters from PC memory or disk
- On-line help
- Communications active display

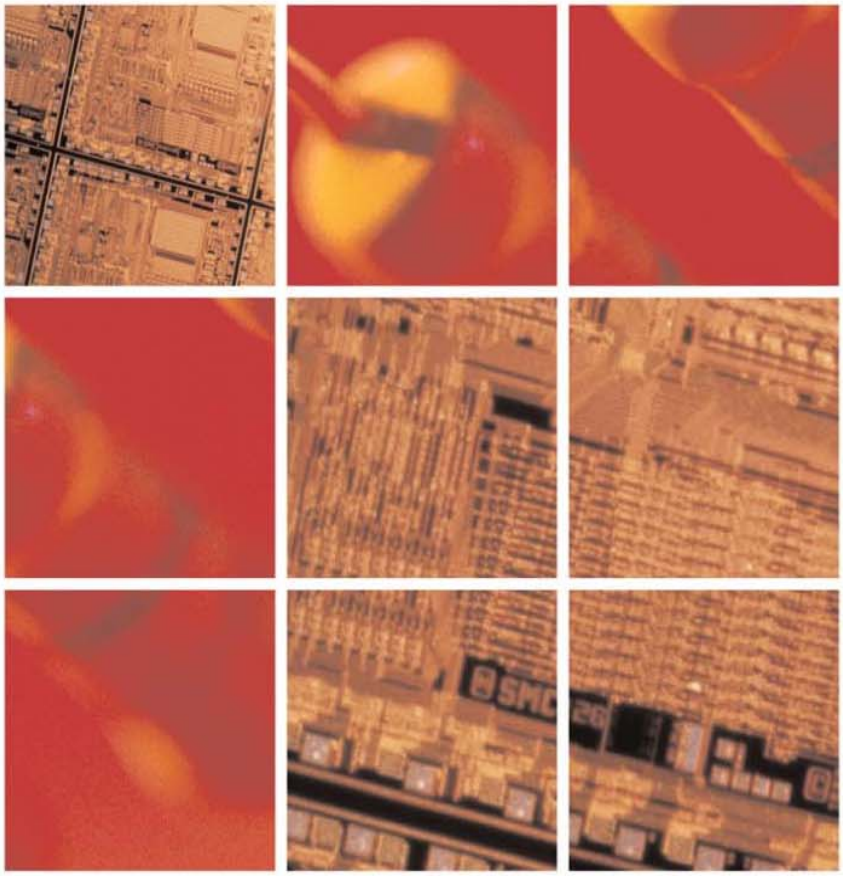


- Faceplate display with active bar graph for real-time monitoring
- Parameters also displayed data value format for precise indication
- Colors can be modified to meet the application
- Slider tool (center of graphic) allows on-line set point change

in complete control of power

Electrical Power Products

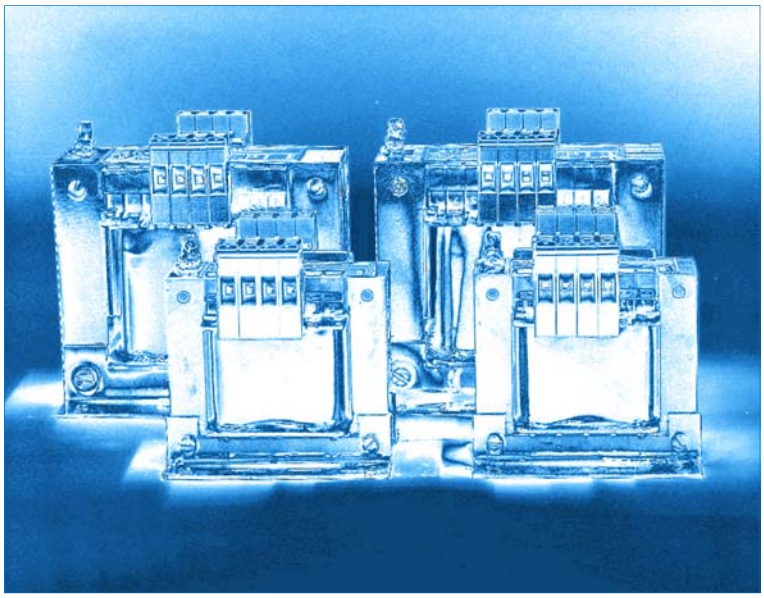
•transformers...•stock•custom built 1ph & 3ph•toroidal•PCB & chassis mounted
•chokes & reactors•AC/DC & DC/DC power supplies•RFI filters



•DC UPS systems•constant voltage transformers•battery chargers for electric power vehicles
•DIN rail terminals & interface modules•power & braking resistors•AC & DC cooling fans

ETE

Catalogue reference
EPP 0506



Eastern Transformers and Equipment Ltd
Unit H1 Overland Business Park
Sudbury Road
Great Welnetham
Bury St Edmunds
Suffolk
England
IP30 0UL

If you require technical assistance, delivery times or prices please contact us on….

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Fax +44 (0) 1284 386969

Email info@ete.co.uk
Web www.ete.co.uk

In the interest of continuous improvement ETE reserves the right to alter designs and specifications without notice.

Where data is critical please check with our technical sales

INTRODUCTION AND CATALOGUE INDEX

Since our establishment in 1984 ETE has constantly strived to match the fast pace of technical and commercial changes in the UK controls ,automation, and machine building markets.We have designed and developed distinctive ranges of transformers for these prime markets. At the forefront of our thinking are products that are technically advanced and competitively priced.

We offer over 150 standard 'stock transformer lines' and we back this up with rapid delivery options for bespoke units that require special design criteria.

To enhance our appeal to our widening customer base ETE has introduced complementary power products to add to our port folio.

We now stock one of the most comprehensive and competitive ranges of DIN rail power supplies in the whole UK.

These and other important power products are listed below.

Page 1 Stock range of single phase transformers from 25VA to 7.5kVA
Page 2 Custom built range of single phase transformers up to 30kVA open or enclosed
Page 3 Custom built range of three phase transformers up to 100kVA open or enclosed
Page 4 Heat loss data for Class F,E and A 1ph transformers and IP65/Ex single phase transformers
Page 5 Custom built 3 phase, auto wound, motor starting transformers open or enclosed
Page 6 Custom built dry type, cast resin type and oil cooled 3 phase transformers up to 10MVA
Page 7 Custom built toroidal transformers from 30VA to 1.5kVA + Slimtran toroidals from 50VA to 500VA
Page 8 Custom built PCB transformers 1VA- 43.5VA and chassis mounted transformers 6VA to 300VA
Page 9 Custom built single and three phase enclosed transformers with accessories
Page 10 Stock range of portable transformers, single and 3 phase site range and custom built units
Page 11 Current transformers standard ranges and custom built types
Page 12 Single and 3 phase variable auto transformers open or enclosed types
Page 13 Custom built 1ph and 3 phase auto transformers in Classes A,E,F and IP65/Ex,open and enclosed
Page 14 Custom built inductive reactors for AC motor controllers and DC chokes & AC reactors
Page 15 Single output AC/DC DIN rail mounted switched mode PSUs from 20W-500W in various voltages
Page 16 Stock range of AC/DC DIN rail mounted switched mode PSUs 20W-500W in various voltages
Page 17 Single/multi output switched mode PSUs, open or enclosed, chassis mounted in various voltages
Page 18 DC to DC converters, PCB and enclosed types for chassis mounting
Page 19 Stock range of unregulated 24V DC PSUs with both single and 3 phase inputs
Page 20 Stock range of single output 24V DC switched mode PSUs with 1 phase or 3 phase inputs
Page 21 DC UPS systems for battery back up of 12V DC and 24V DC
Page 22 Custom built power supplies with either 1phase or 3 phase inputs
Page 23 Constant voltage, ultra isolation, medical isolation transformers and transient voltage suppressors
Page 24 Battery chargers for electric vehicles and DC powered mobile and fixed equipment
Page 25 Single and three phase EMC filters, standard ranges and custom built types
Page 26 Stock ranges of single and 3 phase EMC filters
Page 27 DIN rail mounted terminals and accessories
Page 28 DIN rail mounted interface modules
Page 29 Resistors for power applications from 2 watts to over 6000 watts
Page 30 Braking resistors from 150 watts to 3000 watts
Page 31 AC and DC cooling fans, cross flow fans and accessories
Page 32 Sheet steel ventilated enclosures to IP22 for transformers and power supplies

STOCK RANGE OF SINGLE PHASE TRANSFORMERS
RATINGS FROM 25VA TO 7.5kVA

Ex stock for next day delivery

Multi voltage and single voltage options
High specification

Easy to install and with a DIN rail mounting option up to 150VA

Designed to EN 60 742

A comprehensive range of single phase stock transformers from 25VA to 7.5KVA.
The MV multi- voltage range is designed to meet various voltage requirements .
The SV simplified range is designed for applications requiring only a single input voltage and a single output voltage and can be supplied fitted with either integral input or output fuses.
All transformers are air cooled to class E (120 deg C) and are fully varnish impregnated with a class F polyester varnish .
Connections are via high specification touch proof terminals giving both a compact design and ease of installation .
Fixing centres are designed to give easy access to fixing slots .
A full range of ventilated enclosures is available for all sizes.

Reference	VA rating	L (mm)	W	H	FC L	FC W	DIAM	Weight (kg)	Enclosure Ref. Page 16	Contactor information Inr VA 95%V	Inr VA 90%V
SV 25	25VA	67	60	75	50	40	5	0.80	SP1	35	60
SV & MV 50	50VA	77	75	82	54	43	5	1.10	SP1	60	85
SV & MV 100	100VA	87	75	89	72	48	5	1.60	SP2	150	225
SV & MV 150	150VA	96	82	98	84	59	5	2.30	SP2	250	400
SV & MV 200	200VA	96	95	95	84	67	5	2.80	SP2	350	600
SV & MV 250	250VA	120	95	116	100	65	5	3.90	SP3	400	750
SV & MV 300	300VA	120	105	116	100	76	5	4.70	SP3	650	1K
SV & MV 400	400VA	120	125	116	100	84	5	5.90	SP3	900	1.5K
SV & MV 500	500VA	135	105	125	105	88	5	6.20	SP4	1.2K	1.75K
SV & MV 750	750VA	150	108	130	105	78	6	8.20	SP5	2.2K	3.8K
SV & MV 1000	1.0kVA	150	125	130	105	95	6	10.1	SP5	3.0K	5.5K
MV 1500	1.5kVA	150	151	130	105	121	6	14.2	SP5	3.6K	6.2K
MV 2000	2.0kVA	212	160	190	180	104	8	21.0	SP6	4.0K	7.5K
MV 2500	2.5kVA	212	185	190	180	130	8	29.0	SP6	5.8K	9.0K
MV 3000	3.0kVA	230	165	205	195	107	8	31.0	SP6	7.2K	10.2K
MV 4000	4.0kVA	230	190	205	195	132	8	26.0	SP6	9.5K	12.0K
MV 5000	5.0kVA	270	220	240	220	153	8	49.0	SP7	12K	15K
MV 6250	6.25kVA	270	250	240	220	178	8	65.0	SP7		
MV 7500	7.5kVA	270	270	240	220	202	8	76.0	SP7		

Multi-voltage input	MV code	Multi-voltage output	MV code	Single voltage input	SV code	Single voltage output	SV code
10/0/220/240V 50/60Hz	P1	0/55/110V	S1	0/240V 50/60Hz	P4	0/110V	S4
20/0/380/420V 50/60Hz	P2	10/0/220/240V	S2	0/415V 50/60Hz	P5	0/240V	S5
0/120V 0/120V 50/60Hz	P3	0/12V 0/12V	S3			0/24V	S6

Stock units available	25 VA	50 VA	100 VA	150 VA	200 VA	250 VA	300 VA	400 VA	500 VA	750 VA	1.0 kVA	1.5 kVA	2.0 kVA	3.0 kVA	4.0 kVA	5.0 kVA	6.0 kVA	7.5 kVA
P1 S1		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
P1 S3		■	■	■	■	■	■	■	■	■	■							
P2 S1		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
P2S2		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
P2 S3		■	■	■	■	■	■	■	■	■	■							
P3 S3		■	■	■	■	■	■	■	■	■	■							
P4 S4		■	■	■	■	■	■	■	■	■	■							
P4 S6		■	■	■	■	■	■	■	■	■	■							
P5 S4		■	■	■	■	■	■	■	■	■	■							
P5 S6		■	■	■	■	■	■	■	■	■	■							

Example of orders
Transformer 100VA Input 0/380/440V Output 0/55/100V:Reference is MV 100 P2S1
Transformer 300VA Input 240V Output 24V: Reference is SV 300 P4 S6

CUSTOM BUILT RANGE OF SINGLE PHASE TRANSFORMERS FROM 25VA TO 30KVA OPEN OR ENCLOSED

Fast delivery for urgent requirements

Two day, within five working days and standard delivery options

Designed to EN 60 742

Easy to install with DIN rail option up to 150VA

Enclosures available for all sizes

A comprehensive range of custom built single phase transformers designed specifically to customer own requirements.
Any quantity can be produced, from single units to regular call-off orders.
Sizes from 25VA to 15KVA (SE 25-SE 15000) are designed with Class E (120 deg C) materials with an additional option of Class F (155 deg C) designs from 500VA to 30KVA (SF 500 -SF 30000).
All transformers are air cooled and are fully varnish impregnated with an aesthetically appealing polyester varnish .Connections are via high specification touch proof terminals giving both a compact design and ease of wiring.Fixing centres are designed to give easy access to fixing slots to speed installation.
A full range of ventilated enclosures is available for all sizes with IP 65 enclosures available on request.
Sizes from 25VA to 150VA can be fitted with 'easy fit' DIN rail fixing brackets if required.
Variations include specific input and output voltages , multiple input and output windings and in-built overload and short circuit protection using in-built fuses and/or thermal protectors.
Special customised designs can be produced to meet various international standards.
Please contact our sales and design department to discuss your requirements or for more information .

Reference	VA rating	L (mm)	W	H	FC L	FC W	DIAM	Weight (kg)	Enclosure reference	Enclosure size L x W x H
SE 25	25VA	67	60	75	50	40	5	0.80	SP1	120 x 95 x 90
SE 50	50VA	77	75	82	54	43	5	1.10	SP1	120 x 95 x 90
SE 100	100VA	87	75	89	72	48	5	1.60	SP2	140 x 120 x 115
SE 150	150VA	96	82	98	84	59	5	2.30	SP2	140 x 120 x 115
SE 200	200VA	96	95	98	84	67	5	2.80	SP2	140 x 120 x 115
SE 250	250VA	120	95	116	100	65	5	3.90	SP3	165 x 140 x 150
SE 300	300VA	120	105	116	100	76	5	4.70	SP3	165 x 140 x 150
SE 400 & SF 500	400VA & 500VA	120	125	116	100	84	5	5.90	SP3	165 x 140 x 150
SE 500 & SF 600	500VA & 600VA	135	105	125	105	88	5	6.20	SP4	180 x 160 x 140
SE 600 & SF 750	600VA & 750VA	135	115	125	105	98	5	7.30	SP4	180 x 160 x 140
SE 750 & SF 1000	750VA & 1kVA	150	108	150	105	78	6	8.20	SP5	340 x 220 x 270
SE 1000 & SF 1250	1kVA & 1.25kVA	150	125	130	105	95	6	10.1	SP5	340 x 220 x 270
SE 1500 & SF 2000	1.5kVA & 2.0kVA	150	151	130	105	121	6	14.2	SP5	340 x 220 x 270
SE 2000 & SF 2500	2.0kVA & 2.5kVA	212	160	190	180	104	8	21.0	SP6	350 x 250 x 360
SE 2500 & SF 3000	2.5kVA & 3.0kVA	212	185	190	180	130	8	29.0	SP6	350 x 250 x 360
SE 3000 & SF 4000	3.0kVA & 4.0kVA	230	165	205	195	107	8	31.0	SP6	350 x 250 x 360
SE 4000 & SF 5000	4.0kVA & 5.0kVA	230	190	205	195	132	8	36.0	SP6	350 x 250 x 360
SE 5000 & SF 6250	5.0kVA & 6.25kVA	270	220	240	220	153	8	49.0	SP7	385 x 310 x 460
SE 6250 & SF 7500	6.25kVA & 7.5kVA	270	250	240	220	178	8	65.0	SP7	385 x 310 x 460
SE 7500 & SF 10000	7.5kVA & 10kVA	270	270	240	220	202	8	76.0	SP7	385 x 310 x 460
SE 10000 & SF 12500	10kVA & 12.5kVA	320	200	460	150	160	12	90.0	SP8	400 x 400 x 550
SE 12500 & SF 15000	12.5kVA & 15kVA	320	220	460	150	180	12	110.0	SP8	400 x 400 x 550
SE 15000 & SF 20000	15kVA & 20kVA	320	260	460	150	220	12	130.0	SP8	400 x 400 x 550
SF25000	25kVA	320	390	480	150	250	12	160.0	SP9	450 x 500 x 650
SF30000	30kVA	320	420	480	150	280	12	190.0	SP9	450 x 500 x 650

STANDARD SPECIFICATION
Ambient temperature range from -10 deg C to + 35 deg C
Generally to EN 60 742
Double wound air cooled

CUSTOM BUILT RANGE OF THREE PHASE TRANSFORMERS FROM 120VA TO 100KVA OPEN OR ENCLOSED

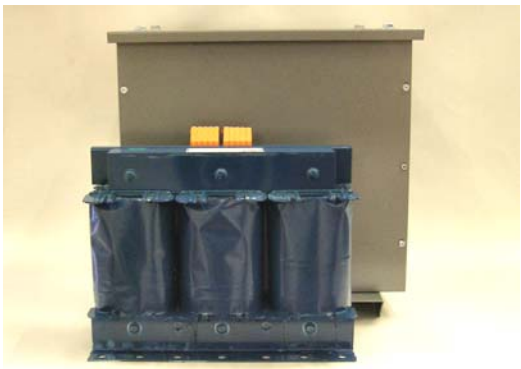
Fast delivery for urgent requirements

Two day, within five working days and standard delivery options

Designed to EN 60 742

Low profile option available on request

Enclosures available for all sizes



A comprehensive range of custom built three phase transformers designed specifically to customer own requirements.
Any quantity can be produced from single units to regular call-off orders.
Sizes from 120VA to 50KVA (TE 120-TE 50000) are designed with Class E (120 deg C) materials with an additional option of Class F (155 deg C) designs from 2KVA to 100KVA (TF 2000-TF 100000).
All transformers are air cooled and are fully varnish impregnated with an aesthetically appealing polyester varnish. Connections are via high specification touch proof terminals giving both a compact design and ease of wiring. DIN rail mounted terminals are used for currents exceeding 50 amps.
Fixing brackets are secured through the transformer core giving a compact and robust design .Fixing centres are designed to give easy access to fixing slots for ease of installation.
A low profile range of units are also available where height restrictions are necessary. Dimensions are available on request.
All windings are wound on robust glass reinforced bobbins to DIN 41 305 to give both a high electrical strength and a high quality construction.
A full range of ventilated enclosures is available for all sizes , as shown, with IP65 enclosures available on request.
Variations include specific input and output voltages , multiple input and output windings and in-built overload and short circuit protection using in-built fuses and/or thermal protectors. Special customised designs can be produced to meet various international standards.
Please contact our sales and design department to discuss your requirements or for more information .

Reference	VA rating	L (mm)	W	H	FC L	FC W	DIAM	Weight (kg)	Enclosure Ref: page 16	Enclosure size L x W x H
TE 120	120VA	120	80	125	70	44	5	2	SP4	180 x 160 x 140
TE 200	200VA	120	90	125	70	44	5	3	SP4	180 x 160 x 140
TE 350	350VA	150	115	165	90	50	6	4	SP5	340 x 190 x 270
TE 500	500VA	150	130	165	90	64	6	6	SP5	340 x 190 x 270
TE 650	650VA	180	120	190	100	62	6	8	SP5	340 x 190 x 270
TE 900	900VA	180	140	190	100	82	6	10	SP5	340 x 190 x 270
TE 1200	1.2kVA	200	130	210	120	65	6	13	SP6	350 x 250 x 360
TE 1500 & TF2000	1.5kVA & 2.0kVA	225	130	230	130	70	6	16	SP6	350 x 250 x 360
TE 2000 & TF 2800	2.0kVA & 2.8kVA	225	165	230	130	94	6	20	SP6	350 x 250 x 360
TE 2800 & TF 3500	2.8kVA & 3.5kVA	260	150	250	150	82	8	25	SP6	350 x 250 x 360
TE 3500 & TF 4000	3.5kVA & 4.0kVA	260	170	250	150	96	8	30	SP6	350 x 250 x 360
TE 4000 & TF 4750	4.0kVA & 4.75kVA	300	160	280	170	88	8	35	TP2	400 x 200 x 400
TE 4750 & TF 5250	4.75kVA & 5.25kVA	300	190	280	170	100	8	40	TP2	400 x 200 x 400
TE 5250 & TF 6600	5.25kVA & 6.6kVA	330	180	310	190	98	10	50	TP2	400 x 200 x 400
TE 6600 & TF 8000	6.6kVA & 8.0kVA	360	190	340	210	104	10	60	TP2	400 x 200 x 400
TE 8000 & TF 10000	8.0kVA & 10kVA	360	210	340	210	124	10	70	TP3	450 x 300 x 500
TE 10000 & TF 12500	10kVA & 12.5kVA	420	200	400	250	122	10	80	TP3	450 x 300 x 500
TE 12500 & TF 16000	12.5kVA & 16kVA	420	220	400	250	142	10	95	TP3	450 x 300 x 500
TE 16000 & TF 20000	16kVA & 20kVA	480	250	450	280	152	12	110	TP3	450 x 300 x 500
TE 20000 & TF 25000	20kVA & 25kVA	480	270	450	280	172	12	150	TP4	600 x 400 x 600
TE 25000 & TF 31500	25kVA & 31.5kVA	480	310	450	280	214	12	190	TP4	600 x 400 x 600
TE 31500 & TF 40000	31.5kVA & 40kVA	600	300	600	400	175	12	220	TP5	740 x 485 x 760
TE 40000 & TF 50000	40kVA & 50kVA	600	325	600	400	195	12	270	TP5	740 x 485 x 760
TE 50000 & TF 63000	50kVA & 63kVA	600	350	600	400	225	12	320	TP5	740 x 485 x 760
TF 75000	75KVA	600	400	600	400	275	12	390	TP5	740 x 485 x 760
TF100000	100KVA	600	450	600	400	325	12	460	TP5	740 x 485 x 760

STANDARD SPECIFICATION
Ambient temperature range from -10 deg C to + 35 deg C
Generally to EN 60 742
Double wound air cooled

HEAT LOSS DATA FOR SINGLE PHASE TRANSFORMERS IN CLASSES F, E & A & HIGH EFFICIENCY SINGLE PHASE TRANSFORMERS FOR IP65 AND Ex ENCLOSURES

Losses for Class F (155 deg C) transformers

Losses for Class E (120 deg C) transformers

Losses for Class A (105 deg C) transformers
With frame size data

Losses for IP65 or for Ex enclosed transformers
With frame size data

The data shown is provided to help design engineers select the correct insulation classification for transformers. The heat loss data is important when transformers are fully enclosed or housed in confined control panel situations.

Standard stock transformers are Class E insulation (shown on page 1).
Standard custom built single and three phase transformers are either Class E or Class F insulation (shown on pages 2-3).

Non standard Class A insulation (105 deg C) transformers are for lower watts loss per VA.
Class A designs are suitable for UL requirements utilising all approved UL registered and approved materials.

To allow transformers to be enclosed in IP65 or Ex rated cabinets high grade Grain Oriented core materials are used.
Selection of enclosure must be based on the heat loss data provided.

Definitions and data

Insulation class	Coding	Temperature rating	Maximum temperature rise	Maximum ambient temperature
Class F	SF	155 deg C	115 deg C	35 deg C
Class E	SE	120 deg C	85 deg C	35 deg C
Class A	SA	105 deg C	70 deg C	35 deg C

High efficiency types for IP65 or Ex enclosure (Ex,IP65) For guidance only, for specific applications contact our sales

C– Core losses are at nominal input voltage **W– Winding losses (approximate) are at full load**

Rating Class F	Losses C	Losses W	Frame size	Rating Class E	Losses C	Losses W	Frame size	Rating Class A	Losses C	Losses W	Frame size	Rating Ex,IP65	Losses C	Losses W	Frame size
30VA	5W	8W	SE 25	25VA	5W	6W	SE 25	20VA	4W	4W	SE 25	20VA	0.6W	4W	SE 25
60VA	6W	12W	SE 50	50VA	6W	8W	SE 50	40VA	5W	5W	SE 50	40VA	0.8W	5W	SE 50
120VA	7W	23W	SE 100	100VA	7W	15W	SE 100	80VA	6W	8W	SE 100	80VA	1.0W	8W	SE 100
180VA	10W	30W	SE 150	150VA	10W	20W	SE 150	125VA	8W	12W	SE 150	125VA	1.5W	12W	SE 150
225VA	13W	35W	SE 200	200VA	13W	25W	SE 200	150VA	10W	13W	SE 200	150VA	2.0W	13W	SE 200
280VA	18W	40W	SE 250	250VA	18W	30W	SE 250	200VA	13W	18W	SE 250	200VA	3.2W	18W	SE 250
300VA	24W	56W	SE 250	300VA	24W	40W	SE 300	250VA	18W	21W	SE 300	250VA	4.0W	21W	SE 300
400VA	26W	60W	SE 300	400VA	26W	45W	SE 400	300VA	21W	30W	SE 400	300VA	5.0W	30W	SE 400
500VA	28W	67W	SE 400	500VA	28W	52W	SE 500	400VA	23W	38W	SE 500	400VA	6.0W	38W	SE 500
600VA	32W	85W	SE 500	600VA	32W	68W	SE 600	500VA	25W	45W	SE 600	500VA	6.0W	45W	SE 600
700VA	35W	95W	SE 600	750VA	35W	74W	SE 750	600VA	28W	56W	SE 750	600VA	6.5W	56W	SE 750
1.0KVA	38W	110W	SE 750	1.0KVA	38W	90W	SE 1000	750VA	31W	65W	SE 1000	750VA	6.0W	65W	SE 1000
1.5KVA	53W	155W	SE 1000	1.5KVA	53W	120W	SE 1500	1.25KV	45W	90W	SE 1500	1.0KVA	11W	90W	SE 1500
2.0KVA	62W	180W	SE 1500	2.0KVA	62W	150W	SE 2000	1.5KVA	55W	100W	SE 2000	1.25KVA	13W	100W	SE 2000
2.5KVA	77W	205W	SE 2000	2.5KVA	77W	170W	SE 2500	2.0KVA	63W	110W	SE 2500	1.5KVA	15W	110W	SE 2500
3.0KVA	103W	250W	SE 2500	3.0KVA	103W	190W	SE 3000	2.5KVA	85W	140W	SE 3000	2.0KVA	21W	140W	SE 3000
4.0KVA	116W	280W	SE 3000	4.0KVA	116W	220W	SE 4000	3.0KVA	95W	165W	SE 4000	2.5KVA	24W	165W	SE 4000
5.0KVA	160W	360W	SE 4000	5.0KVA	160W	305W	SE 5000	4.0KVA	125W	190W	SE 5000	3.0KVA	33W	190W	SE 5000
6.25KV	200W	430W	SE 5000	6.25KVA	200W	320W	SE 6250	5.0KVA	160W	230W	SE 6250	4.0KVA	42W	230W	SE 6250
7.5KVA	248W	490W	SE 6250	7.5KVA	248W	360W	SE 7500	6.25KV	200W	280W	SE 7500	5.0KVA	51W	280W	SE 7500

Heat loss data for single phase transformers from 7.kVA to 30kVA
and
Heat loss data for 3 phase transformers from 120VA to 100kVA
on request

CUSTOM BUILT 3 PHASE AUTO WOUND MOTOR STARTING TRANSFORMERS OPEN OR ENCLOSED TYPES

Class E or Class F options

2-6 starts per hour,7-15 starts per hour and 16-40 starts per hour

Maximum run up/start time 45 seconds
Minimum tapping 40%

Open type or enclosed types

Two ranges of either Class E (120 deg C) or Class F (155 deg C) auto wound motor starting transformers. These units are custom built and can be supplied as open or enclosed units.All transformers are air cooled and are fully varnish impregnated with a class F varnish finish.Connections are via high current, non rotating stud terminals.These connections are shrouded with a cover plate . Fixing centres are designed to give easy access to fixing slots to speed installation. Heat sensors or thermal cut outs can be fitted to each winding. A full range of ventilated enclosures is available, see page 32 for details.

Please contact our sales and design department to discuss your specific requirements.

Class E ref 2-6 starts per hour	Class E size Page 3 *	HP rating	KW rating	Class E ref 7-15 starts per hour	Class E size Page 3 *	HP rating	KW rating	Class E ref 16-40 starts per hour	Class E size Page 3 *	HP rating	KW rating	Enclosure reference
MS20/2-6/E	TE2800	20	15	MS13/7-15/E	TE2800	13	10	MS/9/16-40/E	TE2800	9	7	SP6
MS27/2-6/E	TE3500	27	20	MS20/7-15/E	TE3500	20	15	MS/12/16-40/E	TE3500	12	9	SP6
MS34/2-6/E	TE4000	34	25	MS27/7-15/E	TE4000	27	20	MS/13/16-40/E	TE4000	13	10	TP2
MS40/2-6/E	TE4750	40	30	MS34/7-15/E	TE4750	34	25	MS/16/16-40/E	TE4750	16	12	TP2
MS47/2-6/E	TE5250	47	35	MS40/7-15/E	TE5250	40	30	MS/18/16-40/E	TE5250	18	13	TP2
MS60/2-6/E	TE6600	60	45	MS47/7-15/E	TE6600	47	35	MS/22/16-40/E	TE6600	22	16	TP2
MS74/2-6/E	TE8000	74	55	MS53/7-15/E	TE8000	53	40	MS/27/16-40/E	TE8000	27	20	TP3
MS107/2-6/E	TE10000	107	80	MS67/7-15/E	TE10000	67	50	MS/32/16-40/E	TE10000	32	24	TP3
MS134/2-6/E	TE12500	134	100	MS80/7-15/E	TE12500	80	60	MS/40/16-40/E	TE12500	40	30	TP3
MS175/2-6/E	TE16000	175	130	MS107/7-15/E	TE16000	107	80	MS/51/16-40/E	TE16000	51	38	TP4
MS215/2-6/E	TE20000	215	160	MS134/7-15/E	TE20000	134	100	MS/65/16-40/E	TE20000	65	48	TP4
MS270/2-6/E	TE25000	270	200	MS160/7-15/E	TE25000	160	120	MS/80/16-40/E	TE25000	80	60	TP4
MS335/2-6/E	TE31500	335	250	MS200/7-15/E	TE31500	200	150	MS/100/16-40/E	TE31500	100	75	TP5
MS430/2-6/E	TE40000	430	320	MS255/7-15/E	TE40000	255	190	MS/134/16-40/E	TE40000	134	100	TP5
MS540/2-6/E	TE50000	540	400	MS320/7-15/E	TE50000	320	240	MS/160/16-40/E	TE50000	160	120	TP5

Class F ref 2-6 starts per hour	Class E size Page 3 *	HP rating	KW rating	Class F ref 7-15 starts per hour	Class E size Page 3 *	HP rating	KW rating	Class F ref 16-40 starts per hour	Class E size Page 3 *	HP rating	KW rating	Enclosure reference
MS/134/2-6/F	TE10000	134	100	MS/80/7-15/F	TE10000	80	60	MS/40/16-40/F	TE10000	40	30	TP3
MS/175/2-6/F	TE12500	175	130	MS/107/7-15/F	TE12500	107	80	MS/51/16-40/F	TE12500	51	38	TP3
MS/215/2-6/F	TE16000	215	160	MS/134/7-15/F	TE16000	134	100	MS/65/16-40/F	TE16000	65	48	TP4
MS/270/2-6/F	TE20000	270	200	MS/160/7-15/F	TE20000	160	120	MS/80/16-40/F	TE20000	80	60	TP4
MS/335/2-6/F	TE25000	335	250	MS/200/7-15/F	TE25000	200	150	MS/100/16-40/F	TE25000	100	75	TP4
MS/430/2-6/F	TE31500	430	320	MS/255/7-15/F	TE31500	255	190	MS/134/16-40/F	TE31500	134	100	TP5
MS/540/2-6/F	TE40000	540	400	MS/320/7-15/F	TE40000	320	240	MS/160/16-40/F	TE40000	160	120	TP5
MS/670/2-6/F	TE50000	670	500	MS/400/7-15/F	TE50000	400	300	MS/174/16-40/F	TE50000	174	130	TP5

*** To allow for maximum height including stud terminals add 120mm**

Information required when ordering

Line/line voltage, frequency and HP or KW rating
Class of insulation (E or F) and open or enclosed type
Number of starts per hour and % voltage tappings
Thermistor or auto reset cut out fitted
Run up time if in excess of 45 seconds

CUSTOM BUILT RANGE OF DRY TYPE,CAST RESIN TYPE AND OIL COOLED THREE PHASE TRANSFORMERS UP TO 10MVA

Low and medium voltage
custom built three phase transformers

Dry type from 100kVA to 1600kVA : Up to 10kV

Cast resin type from 25kVA to 4MVA : Up to 22kV

Cast resin type from 100kVA to 4MVA : Up to 35kV

Cast resin type from 5kVA to 630kVA: Up to 22kV
Ecological design for indoor installation

Oil cooled type from 25kVA to 2500kVA : Up to 35kV

Oil cooled type from 4MVA to 10MVA : Up to 35kV

Oil cooled type from 250kVA to 630kVA : Up to 22kV
Using amorphous core material for high efficiency

To IEC 60076 and IEC 60726

A comprehensive range of low to medium voltage dry type, cast resin type and oil cooled three phase transformers from 25kVA up to 10MVA.

Dry and cast resin types are manufactured in accordance with IEC 60076 and IEC 60726. Cast resin transformers are environmentally friendly and require the minimum of maintenance.
Fire resistance is to class F1 and climatic protection is to C2. The normal ambient temperature range is up to 60 deg C. They are for indoor use and can be manufactured to IP 00 and IP 23.

Oil cooled transformers are produced in either hermetically sealed corrugated enclosures or as a non hermetically sealed construction. The coolant medium is either mineral oil, silicone oil or an ecological dielectric medium. The core material is high grade grain oriented electrical steel for optimum efficiency. A high efficiency range of transformers is also available using amorphous core materials.

Based on a long term experience in the design and testing of low to medium voltage transformers special applications can be accommodated. These include regulation transformers, furnace transformers, transformers with forced cooling , seismic resistant transformers for nuclear installations and a comprehensive range of high powered single phase units.

Transformer type	Ratings available	Construction	Voltage range
Three phase dry type	100kVA to 1600kVA	Open type to IP 00 or IP 23	Up to 10kV
Three phase cast resin type	25kVA to 4MVA	Open type to IP 00 or IP 23	Up to 22kV
Three phase cast resin type	100kVA to 4MVA	Open type to IP 00 or IP 23	Up to 35kV
Three phase cast resin type	5kVA to 630kVA	Open type to IP 00 or IP 23 : Ecological designed	Up to 22kV
Three phase oil cooled type	25kVA to 2500kVA	Hermetically or non hermetically sealed	Up to 35kV
Three phase oil cooled type	4MVA to 10MVA	Hermetically or non hermetically sealed	Up to 35kV
Three phase oil cooled type	250kVA to 630kVA	As above using amorphous core material	Up to 22kV

For more information and detailed specifications please contact our sales department

CUSTOM BUILT RANGE OF TOROIDAL TRANSFORMERS FROM 30VA TO 1.5KVA AND SLIMTRAN RANGE OF CUSTOM BUILT TOROIDAL TRANSFORMERS FROM 50VA TO 500VA

Custom built range of low profile toroidal transformers

High efficiency and low radiated magnetic field

Low profile and high VA to weight ratio

A comprehensive range of custom built toroidal transformers. All are designed and manufactured to customers' own requirements using top grade materials and employing the most advanced winding technology.
Standard designs are based around the sizes listed below but where units are required to fit into a specific area special units can be produced, all units can be fully encapsulated using a flame retardant polyester resin.

Please contact our sales department for more information.

Reference	VA	Maximum	Height	Fixing bolt	Weight
TD 30	30VA	80	30	M5	0.50
TD 50	50VA	90	40	M5	0.70
TD 100	100VA	100	30	M5	0.80
TD 150	150VA	100	40	M5	1.20
TD 200	200VA	110	50	M6	1.90
TD 250	250VA	130	40	M6	2.20
TD 300	300VA	120	50	M6	2.40
TD 400	400VA	135	45	M6	2.80
TD 500	500VA	150	60	M6	3.50
TD 625	625VA	150	70	M8	4.00
TD 1000	1KVA	170	70	M8	6.00
TD 1500	1.5KVA	185	80	M8	8.00

Custom built range of SlimTRAN toroidal transformers

Up to half the weight and width of conventional units

High efficiency and low radiated magnetic field

Low temperature rise

A revolutionary new range of single phase transformers from 50VA to 500VA, which are up to half the width and weight of conventional transformers.
Units from 50VA-160VA are designed for both DIN rail mounting or chassis mounting and larger units are designed for chassis mounting only. The revolutionary design combines efficiencies from over 90%, low radiated magnetic fields and low temperature rises.To the systems engineer this means the SlimTRANrange can be used along side more heat sensitive electronics.They occupy less space per VA and radiate less heat. Integral fuses can be fitted to both the input and the output windings. All units are encapsulated in high impact moulded enclosures using a polyester resin and are fitted with touch proof terminals.

For more information please contact our sales department.

Reference	VA	L	W	H	FC L	FC W	DIAM	Weight	Temp.	Efficiency	Typical
ST 50	50VA	95	42	130	80	25	5	0.90	<60deg C	>85%	15%
ST 80	80VA	95	42	130	80	25	5	1.00	<60deg C	>85%	12%
ST 120	120VA	115	58	145	100	40	5	1.40	<60deg C	>90%	10%
ST 160	160VA	115	58	145	100	40	5	2.10	<60deg C	>90%	10%
ST 225	225VA	125	70	155	110	55	6	2.40	<55 deg C	>92%	8%
ST 250	250VA	125	70	155	110	55	6	2.60	<55 deg C	>92%	8%
ST 300	300VA	125	70	155	110	55	6	3.00	<55 deg C	>94%	6%
ST 400	400VA	150	75	175	130	55	6	4.00	<45 deg C	>94%	6%
ST 500	500VA	150	75	175	130	55	6	4.50	<45 deg C	>95%	5%

STANDARD SPECIFICATION
From class A to class F insulation systems
To EN 60 742

CUSTOM BUILT RANGE OF PRINTED CIRCUIT BOARD MOUNTING TRANSFORMERS AND CUSTOM BUILT RANGE OF CHASSIS MOUNTED TRANSFORMERS FROM 6VA TO 300VA

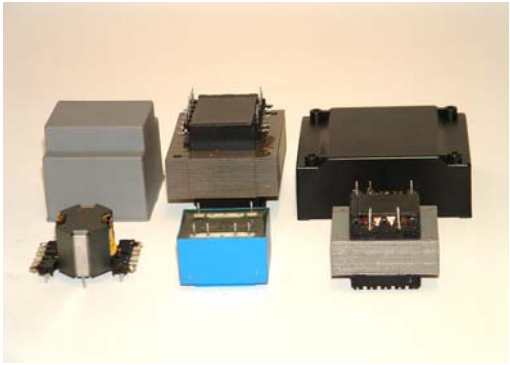
Custom built range of PCB mounting transformers

Designed for low cost volume applications

Open and fully encapsulated types

Conventional and low profile options

Ferrite cored transformers and inductors



A comprehensive range of custom built printed circuit board mounting transformers.All are designed and manufactured to customers' own requirements using top grade materials and employing the most advanced production technology.Power ratings start at 0.35VA and go up over 40VA. Approvals include EN 60742 and EN 61558. Open transformers are from 1VA to 40VA and encapsulated units are from 0.35VA to 43.5VA in conventional formats. Low profile designs are from 3VA up to 30VA.
A variety of high frequency 'ferrite core' transformers and inductors are also available upon request.

Description	Types	VA ratings	Quantity requirements
Open type PCB mounted (Imperial)	Using 5.08mm & 7.62mm grid pitch	From 1VA to 30VA	50pcs to 1000pcs
Open type PCB mounted (Metric)	Using 5.00mm grid pitch	From 1VA to 40VA	50pcs to 1000pcs
Fully encapsulated conventional PCB mounted (Metric)	Using 5.00mm grid pitch	From 0.35VA to 43.5VA	100 to over 5000 pcs
Fully encapsulated low profile PCB mounted (Metric)	Using 5.00mm grid pitch	From 3VA to 30VA	100 to over 5000 pcs
Ferrite cored switched mode transformers PCB mounted	To customer design	To customer requirements	250pcs and over
Ferrite cored inductors PCB mounted	To customer design	To customer requirements	250pcs and over
Toroidal ferrite cored inductors PCB mounted	To customer design	To customer requirements	250pcs and over
Custom design windings for PCB mounting	To customer design	To customer requirements	250pcs and over

Custom built range of chassis mounted transformers from 6VA to 300VA

Designed for low cost volume applications

Open types with solder tag or amp tag connections

Encapsulated type from 28VA to 120VA with solder tags

A comprehensive range of custom built chassis mounting transformers.All are designed and manufactured to customers' own requirements using top grade materials and employing the most advanced manufacturing technology.Ratings start at 6VA and go up to 300VA. Approvals include EN 60742 and EN 61558. Open transformers are from 6VA to 300VA and encapsulated units are from 28VA to 300VA. Various connection options are available including solder tags and push-on amp tag connections.
A variety of high frequency 'ferrite core' transformers and inductors are also available upon request.

Description	Types	VA ratings	Typical volumes
Open type with solder tags	Using two fixing wrap over clamping bracket	From 6VA to 90VA	50pcs to 1000pcs
Open type with solder tags	Using four fixing universal frames or base clamps	From 25VA to 300VA	50pcs to 1000pcs
Open type with amp tags	Using four fixing universal frames or base clamps	From 25VA to 300VA	50pcs to 1000pcs
Encapsulated type	Using multi fixing moulded cases	From 28VA to 120VA	250pcs to 5000pcs

CUSTOM BUILT SINGLE AND THREE PHASE ENCLOSED TRANSFORMERS WITH ACCESSORIES

Custom built single phase enclosed transformers with accessories

Wall/floor or portable enclosures from IP20 to IP65

With fuse, MCB or thermal protection

Accessories include: input/output plugs and sockets, wheels, cooling fans, indicator lamps, meters and mains isolator switches.

A range of custom built, single phase transformers with accessories. These can be enclosed in a variety of fixed or portable enclosures from IP20 to IP65. Transformers with non ventilated enclosures are designed with low loss cores and reduced losses in the windings. Fuse, MCB and thermal protection can be incorporated.

A wide range of accessories can be fitted including input and output plugs and sockets to many international standards, wheels for ease of movement, cooling fans, indicator lamps, a variety of metering and mains isolators switches.

To discuss your specific requirements please contact our sales department.

Custom built three phase enclosed transformers with accessories

Wall/floor or portable enclosures from IP20 to IP65

With fuse, MCB or thermal protection

Accessories include: input/output plugs and sockets, wheels, cooling fans, indicator lamps, meters and mains isolator switches.

A range of custom built, three phase transformers with accessories. These can be enclosed in a variety of fixed or portable enclosures from IP20 to IP65. Transformers with non ventilated enclosures are designed with low loss cores and reduced losses in the windings. Fuse, MCB or thermal protection can be incorporated.

A wide range of accessories can be fitted including input and output plugs and sockets to many international standards, wheels for ease of movement, cooling fans, indicator lamps, a variety of metering and mains isolators switches.

To discuss your specific requirements please contact our sales department.

Special requirements	Typical options available
Enclosed	IP 20 fixed or portable types with or without fan ventilation. Up to IP65 fixed or portable Enclosure materials include metal or polyester
Input or output protection	Fuse or MCB protection on input and/or outputs mounted inside or outside the enclosure Thermal protection of input and output windings where practical
Indicator lamps	From miniature neon or LED to 22mm panel indicators or LEDs
Metering	Digital or analogue, including voltage and current Multifunction meters for high powered, enclosed 3 ph transformers
Mains isolators	From single pole on/of switches to high current multi-pole isolator switches

A wide variety of additional accessories can be fitted on request
as well as customised designs to meet bespoke applications

PORTABLE TRANSFORMERS INCLUDING SINGLE PHASE STOCK RANGE SINGLE PHASE AND THREE PHASE SITE RANGE AND CUSTOM BUILT UNITS

Single phase stock range of portable tool transformers from 750VA to 5kVA

To EN 60 742

Full MCB protection

Double wound 230-240V input with earth screen and 110V output with centre tap taken to earth

A comprehensive stock range of single phase portable tool transformers which cover ratings from 750VA up to 5kVA.

All units are designed to EN60 742 (BS 3535) and socket outlets are to BS 4343. Input voltages are 230~240V 50Hz 1ph and the output voltage is 110V with a centre tap taken to earth. M.C.B protection is standard on all sizes.The PT range incorporates high impact, glass reinforced polyester enclosures and are supplied with a 2 metre input cable.All units up to 4kVA are fitted with a moulded 13 Amp plug for the input connection.

Reference	Tool rating	Input voltage	Protection	No.of sockets and ratings
PT 750/1	750VA	230-240V 1ph 50/60Hz	M.C.B	1 x 110V 16Amp
PT 1000/1	1kVA	230-240V 1ph 50/60Hz	M.C.B	1 x 110V 16Amp
PT 1000/2	1kVA	230-240V 1ph 50/60Hz	M.C.B	2 x 110V 16Amp
PT 1500/1	1.5kVA	230-240V 1ph 50/60Hz	M.C.B	1 x 110V 16Amp
PT 1500/2	1.5kVA	230-240V 1ph 50/60Hz	M.C.B	2 x 110V 16Amp
PT 2250/2	2.25kVA	230-240V 1ph 50/60Hz	M.C.B	2 x 110V 16Amp
PT 3300/2	3.3kVA	230-240V 1ph 50/60Hz	M.C.B	2 x 110V 16Amp
PT 4000/2	4.0kVA	230-240V 1ph 50/60Hz	M.C.B	2 x 110V 16Amp
PT 5000/2	5kVA	230-240V 1ph 50/60Hz	M.C.B	1 x 110V 16Amp and 1 x 110V 32Amp
PT 5000/3	5kVA	230-240V 1ph 50/60Hz	M.C.B	2 x 110V 16Amp and 1 x 110V 32Amp

Site transformers from 5kVA to 10kVA both 1ph and 3ph

To EN 60 742

Full MCB protection

Single and three phase double wound with earth screen and 110V centre tap taken to earth

The SES and TES ranges incorporate high quality powder coated metal enclosures with carrying handles and skid mountings for ease of movement.
A comprehensive range of site electric products, accessories and safety electric equipment is available to compliment the above transformer ranges.

Reference	Tool rating	Input voltage	Protection	No.of sockets and ratings
SES 5000/5	5kVA	230-240V 1 ph 50/60Hz	M.C.B	4 x 110V 16Amp and 1 x 110V 32Amp
SES 7500/6	7.5kVA	230-240V 1ph 50/60Hz	M.C.B	4 x 110V 16Amp and 2 x 110V 32Amp
SES 10000/6	10kVA	230-240V 1ph 50/60Hz	M.C.B	4 x 110V 16Amp and 2 x 110V 32Amp
TES 5000/5	5kVA	400-415V 3ph 50/60Hz	M.C.B	4 x 110V 16Amp and 1 x 110V 32Amp
TES 10000/6	10kVA	400-415V 3ph 50/60Hz	M.C.B	4 x 110V 16Amp and 2 x 110V 32Amp

Custom built portable transformers can be produced to order in both single and three phase options
Please contact our sales for more information

CURRENT TRANSFORMERS
STANDARD RANGES AND CUSTOM BUILT TYPES

Moulded case current transformers for DIN rail and chassis mounting
With cable and bus bar primary

To IEC 185, VDE 0414 and CEI 38-1

Range to BS 3938 with non combustible plastic case

Chassis mounted cast resin CTs

Taped CTs with screw terminals

Custom built CTs

A comprehensive range of AC current transformers in both standard and custom built formats.

Moulded case units are available in several ranges in both DIN rail and chassis mounting types. These can be used for current measurement via either cables or bus bars. The construction is in accordance with IEC 185, VDE 0414 and CEI 38-1.

A full range of units is available to BS 3938 utilising a non combustible plastic casing. Chassis mounted, cast resin CTs and taped CTs with screw connections are also available.

To complement the standard ranges bespoke units can be produced to customer own requirements.

Series	Range	Primary	Class	Fixing	Terminals	Construction
TAF series	From 5A to 1000A	Cable and bus bar	0.5 to 1.0	DIN rail and chassis mounted	Push on amp tags	Moulded case
TAC series	From 5A to 150A	Cable and bus bar	0.5 to 1.0	DIN rail and chassis mounted	Push on amp tags	Moulded case
TAB series	From 5A to 1000A	Cable and bus bar	0.5 to 1.0	DIN rail and chassis mounted	Screw terminals	Moulded case
CTP series	From 50A to 2000A	Bus bar	0.5 to 1.0	Chassis mounted and bus bar mounted	Screw terminals	Moulded case
SCT series	From 50A to 3000A	Bus bar	0.5 to 1.0	Chassis mounted	Screw terminals	Moulded case
MFO series	From 50A to 3000A	Bus bar	1.0	Chassis mounted and bus bar mounted	Screw terminals	Moulded case
ECT series	From 30A to 300A	Cable or cable with tags	0.2, 0.5s, 0.5 and 1.0	Chassis mounted	Screw terminals	Cast resin
RCT series	From 20A to 3000A	Cable	1.0	Chassis mounted	Screw terminals	Moulded case
MR series	From 30A to 5000A	Cable or bus bar	0.5, 1.0 and 3.0	None	Screw terminals	Taped

Custom built current transformers can be designed to special requirements

 For detailed information or data sheets on standard ranges please contact our sales department

SINGLE AND THREE PHASE VARIABLE AUTO TRANSFORMERS
OPEN AND ENCLOSED TYPES

Standard single & 3 phase ranges from 1 amp to 28 amps

Standard input 240V 50Hz, output 0….270V 50Hz 1ph
& 415V 50Hz, output 0….470V 50Hz 3ph

High efficiency with no output voltage distortion
Ambient temperature rating up to 45 deg C

Long life, high quality wiper design
Open or enclosed versions

A comprehensive range of single and 3 phase phase variable auto transformers covering ratings from 1 amp to 28 amps per phase. Used for the variable control of voltages from 0 to 270V 1ph and 0 to 470V 3ph with low power losses.Units can be supplied as either open or enclosed types with the option of double wound transfomers to give total isolation.
Also units can be supplied to give a variable DC output via a bridge rectifier and motor drive options are also available.Larger units can be supplied by paralleling two or more stacked versions and all types can be fully protected from overload and short circuits. They can also be fitted with full metering if required.
The unique silver or nickle plated wiper path design gives high reliability and long life. All windings are wound on high quality low loss toroidal cores giving efficiencies up to 98%.

Standard range Reference	Description Enclosed type	Input Voltage	Output Voltage	Output current per phase	Maximum VA rating	L	W	H	Shaft diam	Shaft L	Kg	Enclosure Reference (Page 32)
1F-1	Panel mounted 1 ph	240V	0….270V	1 Amp	270VA	83	99	75	4	25	1.60	SP5
2F-1	Panel mounted 1 ph	240V	0….270V	2 Amps	540VA	110	110	95	7.5	31	2.90	SP5
3F-1	Panel mounted 1 ph	240V	0….270V	3 Amps	810VA	110	110	115	7.5	31	3.30	SP5
4F-1	Panel mounted 1 ph	240V	0….270V	4 Amps	1080VA	175	175	102	10	41	5.90	SP5
6F-1	Panel mounted 1 ph	240V	0….270V	6 Amps	1620VA	175	175	110	10	41	6.80	SP5
8F-1	Panel mounted 1 ph	240V	0….270V	8 Amps	2160VA	175	175	130	10	41	8.00	SP5
10F-1	Panel mounted 1 ph	240V	0….270V	10 Amps	2700VA	175	175	135	10	41	9.00	SP5
15F-1	Panel mounted 1 ph	240V	0….270V	15 Amps	4050VA	225	225	135	10	41	13.5	SP5
20F-1	Panel mounted 1 ph	240V	0….270V	20 Amps	5400VA	225	225	145	10	41	15.0	SP6
28F-1	Panel mounted 1 ph	240V	0….270V	28 Amps	7560VA	300	300	160	10	41	22.0	SP6
1F-3	Floor mounted 3 ph	415V	0…470V	1 Amp	814VA	90	90	270	4	30	5.40	
2F-3	Floor mounted 3 ph	415V	0…470V	2 Amps	1628VA	110	110	330	7.5	30	9.70	
3F-3	Floor mounted 3 ph	415V	0…470V	3 Amps	2442VA	110	110	330	7.5	30	10.9	
4F-3	Floor mounted 3 ph	415V	0…470V	4 Amps	3256VA	175	175	410	10	50	19.4	
6F-3	Floor mounted 3 ph	415V	0…470V	6 Amps	4884VA	175	175	410	10	50	22.0	
8F-3	Floor mounted 3 ph	415V	0…470V	8 Amps	6512VA	175	175	410	10	50	26.0	
10F-3	Floor mounted 3 ph	415V	0…470V	10 Amps	8140VA	175	175	410	10	50	29.1	
15F-3	Floor mounted 3 ph	415V	0…470V	15 Amps	12210VA	225	225	425	10	50	41.0	
20F-3	Floor mounted 3 ph	415V	0…470V	20 Amps	16280VA	225	225	425	10	50	49.0	
28F-3	Floor mounted 3 ph	415V	0…470V	28 Amps	22790VA	300	300	525	10	50	75.0	

Standard range Reference	Description Open type	Input Voltage	Output Voltage	Output current per phase	Maximum VA rating	L	W	H	Kg
1P-1	Test bench mounted-enclosed 1ph	240V	0….270V	1 Amp	270VA	125	130	130	2.30
2P-1	Test bench mounted-enclosed 1ph	240V	0….270V	2 Amps	540VA	130	130	155	4.20
3P-1	Test bench mounted-enclosed 1ph	240V	0….270V	3 Amps	810VA	130	130	155	4.60
4P-1	Test bench mounted-enclosed 1ph	240V	0….270V	4 Amps	1080VA	175	175	160	6.90
6P-1	Test bench mounted-enclosed 1ph	240V	0….270V	6 Amps	1620VA	175	175	160	7.80
8P-1	Test bench mounted-enclosed 1ph	240V	0….270V	8 Amps	2160VA	175	175	180	8.90
10P-1	Test bench mounted-enclosed 1ph	240V	0….270V	10 Amps	2700VA	175	175	180	10.10
15P-1	Test bench mounted-enclosed 1ph	240V	0….270V	15 Amps	4050VA	225	225	190	15.50
20P-1	Test bench mounted-enclosed 1ph	240V	0….270V	20 Amps	5400VA	225	225	190	17.00
28P-1	Test bench mounted-enclosed 1ph	240V	0….270V	28 Amps	7560VA	300	300	225	25.00
1P-3	Fully enclosed free standing 3ph	415V	0…470V	1 Amp	814VA	120	150	270	7.30
2P-3	Fully enclosed free standing 3ph	415V	0…470V	2 Amps	1628VA	150	200	330	13.80
3P-3	Fully enclosed free standing 3ph	415V	0…470V	3 Amps	2442VA	200	200	330	15.00
4P-3	Fully enclosed free standing 3ph	415V	0…470V	4 Amps	3256VA	200	250	425	26.50
6P-3	Fully enclosed free standing 3ph	415V	0…470V	6 Amps	4884VA	200	250	425	29.10
8P-3	Fully enclosed free standing 3ph	415V	0…470V	8 Amps	6512VA	200	250	425	31.50
10P-3	Fully enclosed free standing 3ph	415V	0…470V	10 Amps	8140VA	200	250	425	34.50
15P-3	Fully enclosed free standing 3ph	415V	0…470V	15 Amps	12210VA	250	300	445	54.70
20P-3	Fully enclosed free standing 3ph	415V	0…470V	20 Amps	16280VA	250	300	445	59.25
28P-3	Fully enclosed free standing 3ph	415V	0…470V	28 Amps	22790VA	250	400	545	86.00

Wide ranges of other non standard voltages, currents and power ratings available
Motor drive option available

OPEN OR ENCLOSED CUSTOM BUILT SINGLE & 3PH PHASE AUTO TRANSFORMERS IN CLASSES A, E, F AND FOR IP65/Ex ENCLOSURES

Custom built single and three phase auto transformers
Either open or enclosed types

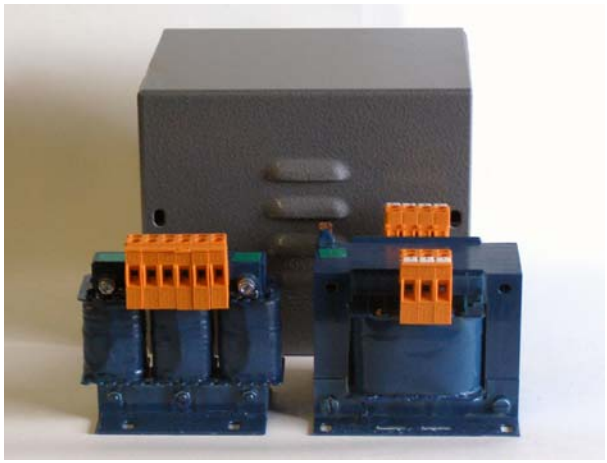
Non safety isolating

In insulation classes A, E and F
and special designs for IP65 or Ex enclosures

Ideal where output voltage (s) are similar to input voltage (s) and where safety isolation is not required

With fuse or MCB or thermal protection

With accessories including plugs and sockets, wheels, cooling fans, indicator lamps, meters and mains isolator switches.



A comprehensive range of custom built single or three phase auto transformers in either open or enclosed types.

Major reductions in both size and cost can be achieved using auto transformers. They should only be used in applications where an isolated output is not a safety consideration. Auto transformers are single winding units and offer no isolation between input and output voltages.

Standard insulation classes include A, E and F and special designs for IP65 or Ex enclosures can be produced.

They are frequently used to adjust voltages for exported or imported machines or equipment.

Our sales department will calculate the size and cost reductions if auto transformers can be utilised.

Customised units can be produced with full fuse, MCB or thermal protection and a variety of accessories can be fitted including plugs and sockets, indicator lamps, meters and mains isolator switches.

For quotes against specific requirements please contact our sales department.

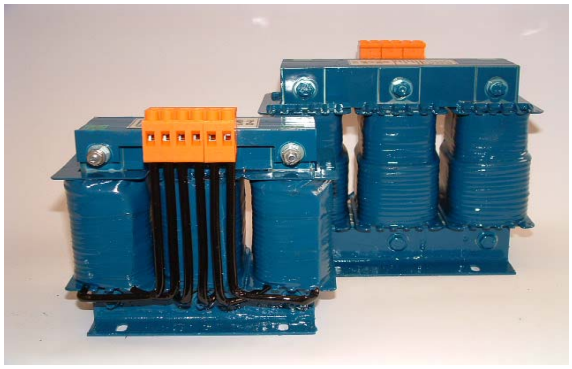
Auto transformer types available	Design and specification criteria
Single phase open type	Up to 1000V and less than 500A Naturally air cooled
Three phase open types	Up to 1000V and less than 500A per phase Naturally air cooled
Single phase enclosed In standard IP22 enclosures as shown on page 32	Up to 1000V and less than 500A per phase Naturally air cooled or fan cooled
Three phase enclosed In standard IP22 enclosures as shown on page 32	Up to 1000V and less than 500A per phase Naturally air cooled or fan cooled
Single phase enclosed In IP65 or Ex enclosures	Up to 1000V and less than 500A dependant on enclosure size Naturally air cooled utilising high grade Grain Oriented core materials
Three phase enclosed In IP65 or Ex enclosures	Up to 1000V and less than 500A per phase dependant on enclosure size Naturally air cooled utilising high grade Grain Oriented core materials

CUSTOM BUILT INDUCTIVE REACTORS FOR AC MOTOR CONTROLLERS AND CUSTOM BUILT RANGE OF DC CHOKES AND AC REACTORS

Custom built range of inductive reactors for AC motor controllers

Designed to customer specification

Using either our standard format
or to customers' own drawings or requirements



A comprehensive range of custom built inductive reactors used in conjunction with AC motor controllers.

They are connected in differential mode configuration and are used in the following three applications:
The reactor is installed between the input mains filter and the motor controller and in this application the low frequency electromagnetic interference is improved by levelling the input current drawn. This will cause a typical volt drop of between 2-4% of the nominal mains voltage.
The reactor is installed between the inverter and the motor and enables the correct de-coupling of the two devices. Where the reactor is used in a system with a single power supply for multi-axis or mandrel control devices, the reactor is installed between the mains filter and the power supply to de-couple it from the mains supply.

These reactors are custom built or can be designed to customer drawings or requirements. Where dimensions are not critical these units are designed around the SE/SF and TE/TF range of frame sizes as shown on pages 2 and 3 of this catalogue.

Information required

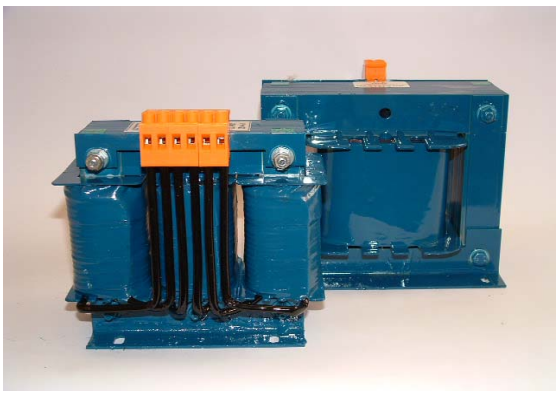
Inductance and current rating

Dimensions, if critical

Custom built range of DC chokes
and AC reactors in both single and three phase options

Designed to customer specification

Using either our standard format
or to customers' own drawings or requirements



A comprehensive range of custom built DC chokes and AC reactors in both single and three phase options.

These chokes and reactors are custom built or can be designed to customer drawings or requirements. Where dimensions are not critical these units are desined around the SE/SF and TE/TF range of frame sizes as shown on pages 2 and 3 of this catalogue.
Alternatively units can be produced to customer drawings or customer own requirements.

Information required

Inductance , current rating and frequency range

Dimensions, if critical

STANDARD SPECIFICATION
Ambient temperature range from -10 deg C to + 35 deg C
Class E or class F construction (see pages 2 and 3)
Easy access fixing centres with touch proof terminations

SINGLE OUTPUT RANGE OF AC TO DC DIN RAIL MOUNTED SWITCHED MODE POWER SUPPLIES FROM 20W TO 500W IN VARIOUS VOLTAGES WITH 20~24W AND 45W EX STOCK

Competitive prices

High quality, approved to UL,CUL and CE

From 20~24 Watt up to 500 Watt versions
Ex stock : 20~24W unit only 45mm wide, 45W unit only 49mm wide optimising the space on the DIN rail

Wide input range from less than 100V~240V AC 1 phase
Output voltages of 5V, 12V , 24V and 48V DC

EMC standards EN55022 class B,EN61000-3-2,3(All) EN55024

A high quality, highly cost effective range of DIN rail mounted switched mode power supplies from 20~24W up to 500W. The 20~24W unit is 45mm wide and the 45W unit is 49mm wide, optimises the space on the DIN rail. Both these types are ex stock. All units are available in a variety of output voltages and are approved to UL,CUL and are CE marked.They have universal inputs and all units are fully protected against overload, short circuit and over voltage and have an LED 'power on' indicator. Each unit is subjected to a 100% full load burn-in test.
EMC standards are as stated above and all units have a DC output adjuster to provide +/-10% of rated output voltage.
Safety standard are to UL 60950, CSA 60950 and CE 60950 (marking).
All units have a full 2 years warranty and are designed for an ambient temperature range from –15 to 50 deg C.

Reference	Watts	Input voltage	Output voltage and current	Load & Line regulation	Ripple & noise	O.V.P Trip	Efficiency	Dimensions WxDxH
RP1020D-05F	20W	100~240V AC 1 ph 127~380VDC	5V DC +/-10% 4.0A	+/-1%	50mV p-p	11V DC	68% Min	45x76x90
RP1024D-12F	24W	100~240V AC 1 ph 127~380VDC	12V DC +/-10% 2.0A	+/-1%	100mV p-p	22V DC	70% Min	45x76x90
RP1024D-24F	24W	100~240V AC 1 ph 127~380VDC	24V DC +/-10% 1.0A	+/-1%	150mV p-p	44V DC	71% Min	45x76x90
RP1045D-05F	45W	100~240V AC 1 ph 127~380VDC	5V DC +/-10% 9.0A	+/-1%	50mV p-p	5.8~7.0V	69% Min	49x83x100
RP1045D-12F	45W	100~240V AC 1 ph 127~380VDC	12V DC +/-10% 3.75A	+/-1%	100mV p-p	15~18V	70% Min	49x83x100
RP1045D-24F	45W	100~240V AC 1 ph 127~380VDC	24V DC +/-10% 1.875A	+/-1%	150mV p-p	27.6~31V	75% Min	49x83x100
RP1072D-05F	72W	100~240V AC 1 ph 127~380VDC	5V DC +/-10% 14.4A	+/-1%	70mV p-p	5.8~7.0V	70% Min	60x110x100
RP1072D-12F	72W	100~240V AC 1 ph 127~380VDC	12V DC +/-10% 6.0A	+/-1%	100mV p-p	15~18V	73% Min	60x110x100
RP1072D-24F	72W	100~240V AC 1 ph 127~380VDC	24V DC +/-10% 3.0A	+/-1%	150mV p-p	27.6~31V	75% Min	60x110x100
RP1072D-48F	72W	100~240V AC 1 ph 127~380VDC	48V DC +/-10% 1.5A	+/-1%	250mV p-p	52~58V	75% Min	60x110x100
RP1120D-12C	120W	100~240V AC 1 ph 127~380VDC	12V DC +/-10% 10.0A	+/-1%	100mV p-p	15~18V	73% Min	90x110x100
RP1120D-24C	120W	100~240V AC 1 ph 127~380VDC	24V DC +/-10% 5.0A	+/-1%	150mV p-p	27.6~31V	75% Min	90x110x100
RP1120D-12C	120W	100~240V AC 1 ph 127~380VDC	48V DC +/-10% 2.5A	+/-1%	250mV p-p	52~58V	76% Min	90x110x100
RP1200D-12M	200W	110/220V AC 1ph +/-15%	12V DC +/-10% 16.6A	+/-1%	100mV p-p	15~18V	78% Min	90x110x100
RP1200D-24M	200W	110/220V AC 1ph +/-15%	24V DC +/-10% 8.3A	+/-1%	250mV p-p	27.6~31V	80% Min	90x110x100
RP1200D-48M	200W	110/220V AC 1ph +/-15%	48V DC +/-10% 4.2A	+/-1%	250mV p-p	52~58V	80% Min	90x110x100
RP1240D-12C	240W	100~240V AC 1 ph 127~380VDC	12V DC +/-10% 20A	+/-1%	100mV p-p	15~18V	78% Min	90x110x100
RP1240D-12C	240W	100~240V AC 1 ph 127~380VDC	24V DC +/-10% 10A	+/-1%	150mV p-p	27.6~31V	80% Min	90x110x100
RP1240D-12C	240W	100~240V AC 1 ph 127~380VDC	48V DC +/-10% 5A	+/-1%	250mV p-p	52~58V	80% Min	90x110x100
RP1500D-12C	500W	100~240V AC 1 ph 127~380VDC	12V DC +/-10% 41.6A	+/-1%	100mV p-p	15~18V	80% Min	210x110x110
RP1500D-24C	500W	100~240V AC 1 ph 127~380VDC	24V DC +/-10% 20.8A	+/-1%	150mV p-p	27.6~31V	81% Min	210x110x110
RP1500D-48C	500W	100~240V AC 1 ph 127~380VDC	48V DC +/-10% 10.4A	+/-1%	250mV p-p	52~58V	82% Min	210x110x110

Additional Data

- Hold up time 16ms
- Short circuit protection - Auto recovery
- Over load protection - Automatic power limited
- Over voltage protection - Auto recovery
- MOSFET designed
- Operating humidity 5~95% RH, no condensing
- Storage temperature –20 to +85 deg C
- Vibration 2G 10~500Hz, 3 axes
- Convection cooled
- 350,000 Hrs MTBF per MIL-HDBK-217K

Fully detailed technical data sheets on request

STOCK RANGE OF SINGLE OUTPUT AC TO DC DIN RAIL MOUNTED SWITCHED MODE POWER SUPPLIES FROM 30W TO 960W IN VARIOUS VOLTAGES

Competitive prices and ex stock deliveries

High quality, approved to UL,CUL,TUV,CB and CE

From 30 Watt to 480 Watt with a wide input range from less than 88V up to 264V AC single phase
From 240 Watt to 960 Watt with an input range from 340~550V three phase

Output voltages of 5V, 12V, 15V, 24V and 48V DC

EMC standards EN55022 class B,EN61000-3-2,3 EN61000-4-2,3,4,5,6,8,11, ENV50204

A high quality, highly cost effective ex stock range of DIN rail mounted switched mode power supplies from 30W to 960W. These units are available in a variety of output voltages and are fully approved to UL,CUL,TUV,CB and are CE marked. They have universal inputs of 85~264V AC 1ph in 30W,45W,60W,75W,240W, the 120W range is from 88~264V AC 1ph selected by a switch and the 480W units have inputs of either 180~264V AC 1pH or 90~264V AC 1ph. Three phase units are available in 240W,480W and 960W with an input range of 340~550V AC 3ph .All units are fully protected against overload, short circuit, over voltage and over temperature and have an LED 'power on' indicator. Each unit is subjected to a 100% full load burn-in test.
EMC standards are as stated above and all units have a DC output adjuster to provide +10% of rated output voltage.
All units have a full 2 years warranty and are designed for an ambient temperature range from 0 to 45 deg C.

Reference	Watts	Input voltage	Output	Output V	Ripple &	Efficiency	Dimensions WxDxH:KG
DR-30-05	30 Watt	85~264V AC 1ph 120~370V DC	5V DC 3.0A	+/- 2%	80mV	74%	78 x 56 x 93 :0.27
DR-30-12	30 Watt	85~264V AC 1ph 120~370V DC	12V DC 2.0A	+/- 1%	120mV	81%	78 x 56 x 93 :0.27
DR-30-15	30 Watt	85~264V AC 1ph 120~370V DC	15V DC 2.0A	+/- 1%	120mV	82%	78 x 56 x 93 :0.27
DR-30-24	30 Watt	85~264V AC 1ph 120~370V DC	24V DC 1.5A	+/- 1%	150mV	83%	78 x 56 x 93 :0.27
DR-45-05	45 Watt	85~264V AC 1ph 120~370V DC	5V DC 5.0A	+/- 2%	100mV	72%	78 x 67 x 93 :0.28
DR-45-12	45 Watt	85~264V AC 1ph 120~370V DC	12V DC 3.5A	+/- 1%	200mV	77%	78 x 67 x 93 :0.28
DR-45-15	45 Watt	85~264V AC 1ph 120~370V DC	15V DC 2.8A	+/- 1%	240mV	77%	78 x 67 x 93 :0.28
DR-45-24	45 Watt	85~264V AC 1ph 120~370V DC	24V DC 2.0A	+/- 1%	480mV	80%	78 x 67 x 93 :0.28
DR-60-05	60 Watt	85~264V AC 1ph 120~370V DC	5V DC 6.5A	+/- 2%	80mV	76%	78 x 56 x 93 :0.30
DR-60-12	60 Watt	85~264V AC 1ph 120~370V DC	12V DC 4.5A	+/- 1%	120mV	83%	78 x 56 x 93 :0.30
DR-60-15	60 Watt	85~264V AC 1ph 120~370V DC	15V DC 4.0A	+/- 1%	120mV	84%	78 x 56 x 93 :0.30
DR-60-24	60 Watt	85~264V AC 1ph 120~370V DC	24V DC 2.5A	+/- 1%	150mV	86%	78 x 56 x 93 :0.30
DR-75-12	75 Watt	85~264V AC 1ph 120~370V DC	12V DC 6.3A	+/- 2%	100mV	76%	55.5 x 100 x 25.2 :0.55
DR-75-24	75 Watt	85~264V AC 1ph 120~370V DC	24V DC 3.2A	+/- 1%	150mV	80%	55.5 x 100 x 125.2 :0.55
DR-75-48	75 Watt	85~264V AC 1ph 120~370V DC	48V DC 1.6A	+/- 1%	240mV	81%	55.5 x 100 x 125.2 :0.55
DR-120-12	120 Watt	85~264V AC 1ph 120~370V DC	12V DC 10A	+/- 2%	80mV	80%	65.5 x 100 x 125.2 :0.72
DR-120-24	120 Watt	85~264V AC 1ph 120~370V DC	24V DC 5.0A	+/- 1%	80mV	84%	65.5 x 100 x 125.2 :0.72
DR-120-48	120 Watt	85~264V AC 1ph 120~370V DC	48V DC 2.5A	+/- 1%	100mV	85%	65.5 x 100 x 125.2 :0.72
DRP-240-24	240 Watt	85~264V AC 1ph 120~370V DC	24V DC 10A	+/- 1%	80mV	84%	125.5 x 100 x 125.2 :1.08
DRP-240-48	240 Watt	85~264V AC 1ph 120~370V DC	48V DC 5A	+/- 1%	150mV	85%	125.5 x 100 x 125.2 :1.08
DRT-240-24	240 Watt	340~550V AC 3ph 480~780V DC	24V DC 10A	+/- 1%	80mV	89%	125.5 x 100 x 125.2 :1.08
DRT-240-48	240 Watt	340~550V AC 3ph 480~780V DC	48V DC 5A	+/- 1%	80mV	89%	125.5 x 100 x 125.2 :1.08
DRP-480-24	480 Watt	180~264V AC 1ph 250~370V DC	24V DC 20A	+/- 1%	120mV	89%	227 x 100 x 125.2:2.10
DRP-480S-24	480 Watt	90~132V/180~264V AC 254~370V	24V DC 20A	+/- 1%	120mV	89%	227 x 100 x 125.2:2.10
DRP-480S-48	480 Watt	90~132V/180~264V AC 254~370V	48V DC 10A	+/- 1%	120mV	89%	227 x 100 x 125.2:2.10
DRT-480-24	480 Watt	340~550V AC 3ph 480~780V DC	24V DC 20A	+/- 1%	80mV	89%	227 x 100 x 125.2:2.10
DRT-480-48	480 Watt	340~550V AC 3ph 480~780V DC	48V DC 10A	+/- 1%	80mV	89%	227 x 100 x 125.2:2.10
DRT-960-24	960 Watt	340~550V AC 3ph	24V DC 40A	+/- 1%	80mV	91%	275 x 100 x 125.2:3.30
DRT-960-48	960 Watt	340~550V AC 3ph	48V DC 20A	+/- 1%	80mV	92%	275 x 100 x 125.2:3.30

Fully detailed technical brochure on request or in PDF format on www.ete.co.uk

SINGLE AND MULTI OUTPUT SWITCHED MODE POWER SUPPLIES OPEN AND ENCLOSED TYPES IN VARIOUS VOLTAGES

Competitive prices

Comprehensive ranges from 5W to 2kW

Open type and enclosed types with DIN Rail and chassis mounted options

Single and multi output up to four DC output voltages

Power Factor Correction function available

Various approval options and EMC standards

Desktop and battery charger types

A wide variety of highly cost effective ranges of open and enclosed switched mode power supplies from 5W to 2kW.

These ranges are available in a variety of output voltages from single output to quadruple output options. The open PCB types are supplied for direct fitting into customers own equipment and the enclosed units can be supplied for chassis mounting. Most units can be adapted for DIN rail mounting.

Various additional options include PFC functions , battery charger types, enclosed desktop types and medical types.

For more information please contact our sales department.

Ranges available	Specification
Single output enclosed switched mode power supplies	From 15W to 350W and from 3V DC to 48V DC
Single output enclosed switched mode power supplies with power factor correction	From 75W to 500W and from 3.3V to 48V DC
Parallel enclosed switched mode power supplies with power factor correction	From 300W to 2kW and from 5V to 48V DC
Dual output switched mode power supplies	From 30W to 155W with duel outputs from 5V to 24V DC
Dual output switched mode power supplies with battery charging option and/or power factor correction	From 55W to 155W from 5V to 54V (and 53.5V charger options)
Triple output switched mode power supplies	From 30W to 115W with triple outputs from 5V to 24V DC
Triple output switched mode power supplies with power factor correction functions	From 75W to 150W from 5V to 24V DC
Quad output switched mode power supplies some units with power factor correction	From 60W to 375 W from in various voltage options
Open type modular switched mode power supplies Single and multi-output and with power factor correction	From 5W to 150W in a variety of voltage options
Open medical type power supplies	From 30W to 65W in various voltage options
Desktop power supplies or charges	From 108W to 216W and from 13.5V to 54V DC
Desktop power supplies with single outputs	From 12W to 80W and from 5V to 48V DC
Desktop power supplies with duel or triple outputs	From 25W to 50W in various voltage options
Plug-in power supplies	Up to 24W in various voltage options
Video game and PC power supplies	Up to 250W in various voltage options

DC TO DC CONVERTERS
PCB MOUNTING TYPES AND ENCLOSED TYPE FOR CHASSIS MOUNTING

For PCB mounting

Power ratings from 0.5W to 30W

Single and dual output options

2:1 and 4:1 wide input ranges

High reliability with 100% burn-in test

A comprehensive range of PCB mounted DC to DC converters from 0.5W to 30W ratings. Options include both single or dual output voltages and a wide input range.

They have full overload and short circuit protection and some units also have over voltage protection . All units offer high reliability and low cost and have a full 100% burn-in test.

For more detailed specifications and PCB pin configurations please contact our sales department.

Ranges available	Specification
0.5W DC-DC regulated single output	Inputs from 5V to 48V DC +/- 10% and outputs from 5V to 15V DC
1W DC-DC regulated and unregulated single output	Inputs from 5V to 48V DC +/- 10% and outputs from 5V to 15V DC
3W DC-DC regulated single and dual output	Variety of inputs and outputs from 5V to 15V and +/-5V to +/-15V DC
5W regulated & 10W single and dual output	Variety of inputs and outputs from 5V to 24V and +/-5V to +/-24V DC
15W single and dual outputs and 30W single output	Variety of inputs and outputs from 3.3V to 24V and +/-5V to +/-24V DC
10W and 15W regulated single and dual outputs	Variety of inputs and outputs from 3.3V to 15V and +/-5V to +/-15V DC

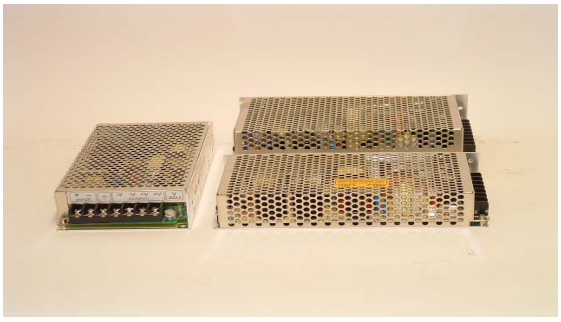
Enclosed types for chassis mounting

Power ratings from 25W to 150W

Single outputs from 5V to 24V DC

2:1 wide input ranges

Adjustable DC outputs



A comprehensive range of enclosed chassis mounting DC to DC converters from 25W to 150W ratings. Outputs range from 5V to 24V DC and have a variety of input options.

They have full overload and over voltage protection and an ambient temperature range of –10 deg C to +60 deg C.
EMC tests are to EN55022 class B and EN61000-4-2,3,4,6,8.

For more detailed specifications and sizes please contact our sales department..

Ranges available	Specification
25W DC-DC regulated single output	Variety of inputs and outputs from 5V to 24V
50W DC-DC regulated single output	Variety of inputs and outputs from 5V to 24V
100W DC-DC regulated single output	Variety of inputs and outputs from 5V to 24V
150W DC-DC regulated single output	Variety of inputs and outputs from 5V to 24V

STOCK RANGE OF UNREGULATED 24V DC POWER SUPPLIES WITH BOTH SINGLE AND THREE PHASE INPUTS

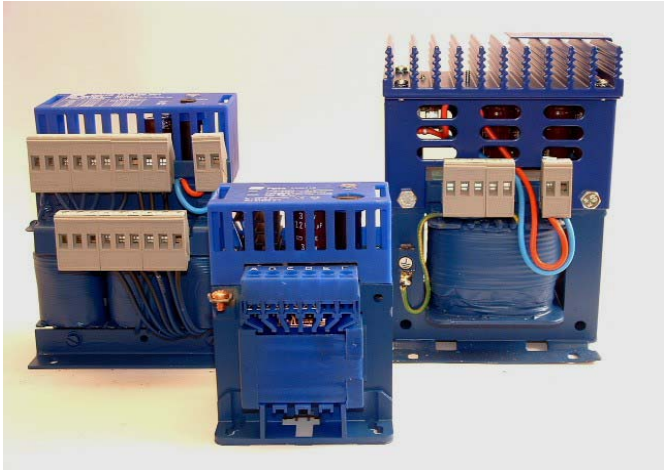
Unregulated and smoothed DC outputs

Single and three phase inputs with 24V DC output

Single phase input with from 1A to 16A DC output with a ripple of less than 5%
Three phase input with from 6A to 40A DC output with ripples of less than 6% and less than 3%

Off load voltage <30.2V with 6% line over voltage
Full load voltage >20.4V with 10% line under voltage

DIN rail mounting option from 1A-2.5A DC.



Three ranges of unregulated 24V DC conventional power supplies.

A single phase range with either 230V +/- 5% or 400V +/- 5% inputs and a 24V DC output from 1A to 6A with 5% ripple.
A single phase range with dual inputs of 230/400V +/- 5% and a 24V DC output from 10A to 16A with 5% ripple.
A three phase range with 400V +/- 5% inputs and a 24V DC output from 6A to 40A with either 6% or 3% ripple.

The transformers are to VDE 0551 class 1 construction and are suitable for ambient temperatures of up to 60 deg C. The connections are touch protected screw terminals and all units are designed for chassis mounting. Also single phase units up to 2.5A DC are suitable for DIN rail mounting with the use of an easy fit adaptor.

Reference: Input voltage 230V 1ph +/- 5%	Reference: Input voltage 400V 1ph +/- 5%	Output	L	W	H	FC L	FC W	DIAM	KG
145-113	145-113.001	24V DC 1.0A	78	70	112	65	52	4.8	1.3
145-114	145-114.001	24V DC 1.6A	78	70	112	65	52	4.8	1.3
145-125	145-125.001	24V DC 2.5A	84	86	120	70	70	4.8	2.2
145-116	145-116.001	24v DC 3.15A	84	86	120	70	70	4.8	2.2
145-117	145-117.001	24V DC 4.0A	105	96	140	88	71	5.3	3.0
145-119	145-119.001	24V DC 6.0A	105	96	140	88	71	5.3	3.6

Reference: Input voltage 230/400V 1ph +/- 5%	Output	L	W	H	FC L	FC W	DIAM	KG
148-110	24V DC 10.0A	126	105	186	90	86	5.8	6.0
148-116	24V DC 16.0A	195	112	210	123	90	7.0	14.8

Reference: Input voltage 400V 3ph +/- 5% 6% ripple	Reference: Input voltage 400V 3ph +/- 5% 3% ripple	Output	L	W	H	FC L	FC W	DIAM	KG
137-106	137-106.200	24V DC 6.0A	125	80	154	100	56	5	3.1
137-110	137-110.200	24V DC 10.0A	156	140	105	140	112	4.3	5.5
137-116	137-116.200	24V DC 16.0A	185	165	120	167	132	7	8.1
137-125	137-125.200	24v DC 25.0A	185	165	190	167	132	7	12.1
137-140	137-140.200	24V DC 40.0A	215	212	185	194	157	7	18.1

Reference: Input voltage 200/230/400/415/440/460/480/500V 3ph 3% ripple	Output	L	W	H	FC L	FC W	DIAM	KG
137-106.201	24V DC 6.0A	125	80	154	100	56	5	3.6
137-110.201	24V DC 10.0A	156	140	105	140	112	4.3	6.0
137-116.202	24V DC 16.0A	185	165	120	167	132	7	8.5
137-125.201	24V DC 25.0A	185	165	190	167	132	7	12.7
137-140.201	24V DC 40.0A	215	212	185	194	157	7	19.0

STOCK RANGE OF SINGLE OUTPUT 24V DC SWITCHED MODE POWER SUPPLIES WITH BOTH SINGLE OR THREE PHASE INPUTS

Competent COSMO slim line series
Slim construction to maximise space on the DIN rail
Covered input connections and range of 5A -20A at 24V DC
Power factor correction to EN 61000-3-2
Extended output voltage range
Balanced load sharing when wired in parallel
Low ripple < 50mV
Overload indicator
Approvals include UL and CUL
Special optional functions

The Competent COSMO slim line series offers the design engineer the optimum in design excellence for a comprehensive range of 24V DC applications.
The slim construction maximises the space on the DIN rail and units from 24V DC 5A to 20A have a unique termination cover to protect the connections and the wiring. The terminations are a cage clamp type for ease of wiring and consistent reliability. All units comply with EN 61000-3-2 for the latest power factor correction requirements. The DC output voltage is adjustable as shown in the table below and when they are wired in parallel the load is balanced automatically between the units. The output ripple is below 50mV and in the event of an overload a red LED indicator is activated. Special optional functions include remote ON/OFF control, overload signalling, power failure signalling and has the option of either hicc-up mode or turn-off mode for the output overload protection.
The units are fully approved to the highest standards including UL,CUL and LGA.

Reference	Input range 47-63Hz	Output	W (mm)	D from rail	H	Weight (kg)	Typical efficiency	Output adjustment range
149002-21001	94-265V 1ph	24V DC 1.25A	45	105	72	0.20	85%	23.3V to 24.7V DC
149001-31001	94-265V 1ph	24V DC 2.0A	45	105	72	0.20	89%	23.3V to 24.7V DC
149001-51056	94-265V 1ph	24V DC 5.0A	70	139	132	0.90	89%	22V to 30V DC (30V max.4A)
149001-51111	93-132V & 187-265V 1ph	24V DC 10A	70	164	147	1.2	90%	22V to 30V DC (30V max.8A)
149001-61114	190-265V 1ph	24V DC 20A	86	173	227	2.0	89%	22V to 29V DC (29V max.16A)
149001-61116	340-550V 3ph	24V DC 20A	86	173	227	2.0	89%	22V to 29V DC (29V max.16.5A)

Competent COSMO conventional series
High quality and reliability with proven track record

From 2.5A to 40A at 24V DC
In both single and 3 phase inputs
Overload indicator
Safety standard to IEC 950, EN 60950 and VDE 0805
RFI suppression to EN 55011/ EN 55022 class B
Noise immunity to EN 50082-1/-2

The Competent Cosmo conventional series of 24V DC range offer high specification and proven reliability.
The range has been extensively used throughout the world and has a proven track record for long term reliability and high quality. Units are available from 24V DC 2.5A to 40A and are available in both 1 ph and 3 ph inputs. RFI suppression is to EN 55011/ EN 55022 class B and noise immunity is to EN 50082-1/-2. They are fully protected against overload and short circuit and are in accordance to IEC 950, EN 60950 and VDE 0805 safety requirements . All units have an inbuilt 'on' indicator.

Reference	Input range 47-63Hz	Output	W (mm)	D from rail	H	Weight (kg)	Typical efficiency	Output adjustment range
149001-41001	94-265V 1ph	24V DC 2.5A	108	65	123	0.60	86%	22.5V to 27.5V DC
149001-51051	94-265V 1ph	24V DC 5.0A	147	86	123	0.80	86%	22.5V to 27.5V DC
149001-51101	97-132V & 195-265V 1ph	24V DC 10A	205	86	123	1.20	89%	22.5V to 27.5V DC
149001-51301	340-550V 3ph	24V DC 10A	81	160	153	1.40	90%	23V to 30V DC
149001-61103	195-265V 1ph	24V DC 20A	240	86	153	1.90	88%	22.5V to 27.5V DC
149001-61101	340-550V 3ph	24V DC 20A	240	86	153	1.90	90%	22.5V to 27.5V DC
149001-71101	340-550V 3ph	24V DC 40A	292	130	195	3.60	90%	22.5 to 27.5V DC

DC UPS SYSTEMS FOR BATTERY BACK-UP OF 12V AND 24V DC

DC-UPS systems and components

For both 12V and 24V DC applications to support equipment from a few seconds up to many hours

Switch automatically to battery supply in case of mains failure

DC output currents from 5A DC to 75A DC

Can be supplied as UPS, UPS plus battery pack or UPS plus battery pack and power supply or charger

A comprehensive range of uninterruptible power supply modules for 12V DC and 24V DC systems.

Used to support DC systems in the event of a mains failure or to bridge momentary voltage breaks. A variety of system options are available from UPS, UPS with battery pack, to UPS with battery pack and power supply or charger. Systems can switch automatically to the battery supply in the event of a mains failure and output currents from 5A to 75A DC can be supported.

Associated equipment can also be supplied to complement these ranges including diode de-coupling modules, contact accessory modules and complete sealed lead battery modules.

To discuss specific applications and system requirements please contact our sales department.

System description	Ratings available
Regulated battery charger for 24V DC systems	From 1ph input,0.2A DC output to 3ph input, 40A DC output
Regulated battery charger for 12V DC systems	From 1ph input,1.25A DC output to 3ph input, 20A DC output
DC-UPS mains failure modules	From 24V DC 5A to 20A, from a few seconds up to many hours Powered by the Competent Cosmo series of power supplies (Page 15)
DC-UPS mains failure and voltage break modules	From 24V DC 20A to 40A, from a few seconds up to many hours Powered by the Competent Cosmo series of power supplies (Page 15)
DC-UPS mains failure and voltage break modules	From 24V DC 20A to 75A, from a few seconds up to many hours Powered by the Competent Cosmo series of power supplies (Page 15)
DC-UPS mains failure and voltage break modules	From 12V DC 10A to 40A, from two minutes up to many hours Powered by 12V DC regulated battery charger
DC-UPS mains failure and voltage break module	From 24V DC 30A, from 3 to 230 minutes Powered by the unregulated range of 24V DC power supplies (page 14)
Complete DC-UPS module	19.5V-26.5V 4.5A DC with battery power Complete system with power supply, charger, DC-UPS and battery for 15 minutes bridging time
Maintenance-free lead acid sealed battery modules	From 12V DC 5Ah to 65Ah, for 24V DC 2 x 12V batteries Can be supplied loose or fitted to a mounting plate for easy installation

For more information or detailed specifications please contact our sales department

CUSTOM BUILT POWER SUPPLIES WITH EITHER 1PH OR 3PH INPUTS

Custom built power supplies with single phase inputs
Custom built power supplies with 3 phase inputs

DC outputs from below 1A up to 500A

Open type or enclosed, portable or fixed
Naturally air cooled or forced air cooled

With accessories such as metering, indicators, mains isolators, with input fuse or MCB or output semi conductor fuse protection

Output smoothing available on some types

A comprehensive range of custom built power supply units with either single or three phase inputs.

Single phase units have a high output ripple of 48% with conventional full wave bridge rectifiers. Three phase units have a much lower output ripple of 6% with conventional full wave bridge rectifiers. These values of ripple can be reduced to lower levels with output smoothing, where practical.

Units can be open or enclosed and can be supplied with separate transformers and bridge rectifiers with suitable heat sinks. Cooling can be either naturally air cooled or forced air cooled with the use of AC or DC fans.

Fully customised units can be produced with accessories such as AC and DC metering, status indicators, mains isolators switches and input and output protection.

To discuss specific applications and system requirements please contact our sales department.

PSU type	Description
Open type single phase input with DC output	Single phase transformer and bridge rectifier with no output smoothing From below 1A up to 500A – ripple 48%
Open type three phase input with DC output	Three phase transformer and 3ph bridge rectifier with no output smoothing From 5A up to 500A – ripple 6%
Open type single phase input with smoothed DC output	Single phase transformer and bridge rectifier with output smoothing From below 1A up to 500A – ripple 5% to 48% as required
Open type three phase input with smoothed DC output	Three phase transformer and 3ph bridge rectifier with output smoothing From 5A up to 500A – ripple 3% to 6%
Enclosed type single phase input with DC output	Single phase transformer and bridge rectifier with no output smoothing From below 1A up to 500A – ripple 48%
Enclosed type three phase input with DC output	Three phase transformer and 3ph bridge rectifier with no output smoothing From 5A up to 500A – ripple 6%
Enclosed type single phase input with smoothed DC output	Single phase transformer and bridge rectifier with output smoothing From below 1A up to 500A – ripple 5% to 48% as required
Enclosed type three phase input with smoothed DC output	Three phase transformer and 3ph bridge rectifier with output smoothing From 5A up to 500A – ripple 3% to 6%

CONSTANT VOLTAGE TRANSFORMERS,ULTRA-ISOLATION TRANSFORMERS MEDICAL ISOLATION TRANSFORMERS & TRANSIENT VOLTAGE SUPPRESSORS

Constant voltage transformers from 100VA to 45kVA at unity power factor (1.0pf)

Ultra-isolation transformers from 250VA to 10kVA
Larger units available on request

Medical isolation transformers from 250VA to 1.0kVA
Larger units available on request

Transient voltage suppressors
For zone C-Factory floor/industrial
For zone B-Engineering and communications

A comprehensive range of mains conditioning and load protection units.

Constant voltage transformers are ideal maintenance free solutions for loads that can suffer erratic operation or be damaged by electrical noise, local transients, mains power sags, surges or brownouts.

Ultra isolation transformers provide a clean electrical supply that is noise and spike free. They help prevent data processing errors and the type of damage caused by lightening strikes.

Medical isolation transformers are for loads that require complete isolation due to high leakage or transient generation in medical applications. They offer protection to loads that can be damaged or suffer erratic operation by electrical noise and local transients.

Transient voltage suppressors offer protection from mains borne transients or the effects of local lightening strikes. They are designed to satisfy the requirements for zone protection defined in BS EN6651 and UL 1449.

For full technical data on any of the above products please contact our sales department.

Products	Description and application
Constant voltage transformers	From 100VA to 45kVA For medical equipment, industrial PLCs, process control, weighbridges, grid link applications Rail signalling and critical systems, sensitive electronic test systems.
Ultra-isolation transformers	From 250VA to 10kVA with larger units available on request For telecoms switches, modems, hubs and routers, retail EPoS terminals and work stations Sensitive laboratory test gear
Medical isolation transformers	From 250VA to 1kVA with larger units available on request For medical equipment requiring separation from the mains supply (BS EN 60601) For medical computer terminals and workstations
Transient voltage suppressors	Zone C-office applications for protection of mains incomer, mains distribution points, 3ph sub distribution points and high current distribution Zone B-engineering and communications applications for protection of sub distribution and sensitive single and three phase loads Zone A-Factory floor applications for transient protection of consumer units, OEM design and protection and sensitive single and three phase loads

BATTERY CHARGERS FOR ELECTRIC VEHICLES AND DC POWERED MOBILE AND FIXED EQUIPMENT

Comprehensive ranges of battery chargers

Some units in stock for immediate despatch

For the charging of lead acid, gel and inner recombination batteries in 12V, 24V, 36V, 48v, 72V, 80V, 96V and 120V

Charging currents from 5 Amps through to 320 Amps

With either single phase or three phase inputs

Using the latest charging technology including high frequency switched mode designs

A comprehensive range of high technology battery charging units for charging electric vehicles and mobile or fixed DC equipment.
All common battery types can be accommodated including lead acid, gel and inner recombination types. These are available from battery voltage combinations from 12V , 24V, 36V, 48V, 72V, 80V, 96V to 120V with charging currents from 5 Amps through to 320 Amps dependant on the vehicle, machine or equipment.
Both single and three phase input units are available. All types utilise the latest in battery charging technology including the latest innovations in low weight and compact high frequency switched mode technology.
Due to the importance in matching the equipment with the correct charger, technical assistance must be obtained from our sales department.

Charger range Reference	Description
Micro - Logic A	Automatic single phase inputs for small lead acid batteries Input from 100V to 240V AC Outputs 12V,24V,36V in 10A,15A,20A,30A & 40A
Micro - Tech A	Automatic single phase and 3ph inputs for lead acid batteries Inputs 230~240V 1ph or 400~415V 3ph AC Outputs 24V,36V, 48V, 72V & 80V in 30A ,40A ,50A, 60A, 80A, 100A, 120A & 140A
Micro - Digital A	Automatic single phase and 3ph inputs for lead acid batteries Inputs 230~240V 1ph or 400~415V 3ph AC Outputs 12V,24V,36V,48V,60V,72V,80V,96V & 120V in 15A,20A,30A ,40A ,50A, 60A, 80A, 100A, 120A ,140A,160A,180Z,200A,200A,240A280A & 320A
Micro Golf A	Automatic single phase inputs for small capacity sealed batteries Input from 115V to 230V AC +/-15% Outputs 12V,24V,36V & 48V in 5A,7.5A,10A,15A,20A & 25A
Power Switch	High frequency battery charger with universal input from 185V to 265V AC 50/60Hz Outputs 24V,36V & 48V with rechargeable capacity from 60Ah/C5 to 720Ah/C5
Power Switch single phase with P.F.C	High frequency battery charger with universal input from 185V to 265V AC 50/60Hz and with PFC Outputs 24V,36V,48V,72V & 80V 3000W with rechargeable capacity from 180Ah/C5 to 960Ah/C5
Power Switch 3 phase	High frequency battery charger with universal 3ph input from 340V to 460V AC 50/60Hz Outputs 24V,36V,48V,72V & 80V with rechargeable capacity from 240Ah/C5 to 840Ah/C5
Extreme	Automatic single phase inputs for extreme applications to IP 65 Input from 180v to 265V AC Outputs 24V,36V & 48V in 25/30A from 90Ah/C5 to 360Ah/C5
Easy - Golf	Automatic single phase chargers for small sealed (gel or inner recombination) batteries Input from 115V to 230V AC +/-15% AC Outputs 24V in 4A,6A,8A & 10A
Easy - Log	Automatic single phase chargers 12V 10A for small lead acid batteries Input 230V AC 50/60Hz Outputs 12V 10A
MGX m	Automatic single phase chargers with data memory for both lead acid and gel batteries Input 185V~265V AC 50/60Hz Outputs 12V,24V,36V & 48V 30Ah/C5 to 480Ah/C5
Custom built designs	Bespoke designs to customer own specification on request

 The above information is listed to show the wide range of standard battery charging units available

For more information and recommendations regarding the choice of charger please contact our sales department

SINGLE AND THREE PHASE EMC FILTERS
STANDARD RANGES AND CUSTOM BUILT UNITS

Single phase filters from 5 Amps to 100 Amps

Three phase filters from 4 Amps to 2500 Amps
VPE 'compact' series from 180 Amps to 2500Amps

Three phase and neutral range with UL approval

Full compliance testing to IEC and EN standards with on site testing for large machines or installations

Full range of compatible components including output chokes, common mode chokes and surge arresters.

Comprehensive ranges of both single and three phase RFI filters are available to assist design engineers to meet the various requirements of the relevant EMC legislation. These can be standard ranges or custom built.

Single phase units are from 5 Amps to 100 Amps and are available in a variety of case and termination options. Three phase units are from 4 Amps up to 2500 Amps in 'bookend', 'shoebox' and 'footprint' styles'. Termination options include terminal blocks, terminal blocks and flying leads, and high current copper bus bar connections . Standard voltage options are up to 760V AC . Footprint filters are designed around the specific requirements of the inverter, servo motor or motor control system. The VPE range (*), from 180A-2500A , is one of the most compact ranges of high current filters in the whole EMC market.
A full range of PCB mounted and IEC inlet filters is also available.

Full compliance testing to IEC and EN standards can be performed by our accredited EMC test facility either in-house or on site.

To compliment the extensive range of filter options there are full ranges of compatible components which include output chokes, common mode chokes and surge arresters. For more information please contact our sales department.

Range	Current rating	Voltage & ph	Terminations	Description	Style
EMK 1	10A to 65A	250V AC 1ph	Terminal blocks	High attenuation and low leakage current	Shoebox
EMK 3	6A to 180A	480V AC 3ph	Terminal blocks	High attenuation and low leakage current	Shoebox
EMK 3	220A to 1000A	480V AC 3ph	Screw terminals	High attenuation and low leakage current	Shoebox
EMK 4	6A to 170A	480V AC 3ph & N	Terminal blocks	High attenuation and low leakage current	Shoebox
EMK 251	4A to 24A	480V AC 3ph	Input terminal blocks & output flying leads	High attenuation and low leakage current	Shoebox
*VPE 3/A or /B	180A to 2500A	DC to 760V AC	Bus bars	High attenuation and low leakage current	Shoebox
EMS 1	20A to 100A	250V AC 1ph	Terminal blocks or flying leads (C)	High attenuation and low leakage current	Shoebox
EMS 3	20A to 210A	480V AC 3ph	Terminal blocks or flying leads (C)	High attenuation and low leakage current	Shoebox
EMS 4	20A to 100A	480V AC 3ph & N	Terminal blocks or flying leads (C)	High attenuation and low leakage current	Shoebox
DLC 1	10 to 35A	250V AC 1ph	Terminal blocks or flying leads	High attenuation and low leakage current	Bookend
DLC 3	7A to 210A	480V AC 3ph	Terminal blocks or flying leads	High attenuation and low leakage current	Bookend
SLC 1	10 to 35A	250V AC 1ph	Terminal blocks or flying leads	High attenuation and low leakage current	Bookend
SLC 3	7A to 210A	480V AC 3ph	Terminal blocks or flying leads	High attenuation and low leakage current	Bookend
VEB 3	12A to 130A	480V AC 3ph	Terminal blocks or flying leads	High attenuation and low leakage current	Bookend
MLC 3	7A to 180A	480V AC 3ph	Terminal blocks or flying leads	High attenuation and low leakage current	Bookend
Footprint 1	5A to 35A	250V AC 1ph	To requirements	Designed to requirements	Footprint
Footprint 3	3A to 180A	220V-480V 3ph	To requirements	Designed to requirements	Footprint
SF /2	4A to 9A	230V-260V 3ph	Terminal blocks	Sine wave filter	Shoebox
SF /4	4A to 24A	400V-510V 3ph	Terminal blocks	Sine wave filter	Shoebox
FIN 1700	7A to 25A	440V AC 3ph	Terminal blocks	High attenuation with UL approval	Bookend

Our ranges of RFI filters and EMC components are extensive

Page 25 For more detailed information or for a fully comprehensive catalogue please contact our sales department

To cross reference existing suppliers' filters or for advice on suitable equivalent units please contact our sales department

STOCK RANGES OF
SINGLE AND THREE PHASE EMC FILTERS

Ranges of single and three phase EMC filters for immediate despatch on a next day delivery

Single phase filters from 6A to 65A, in both single and two stage configurations

Three phase filters from 6A to 180A 520V AC50/60Hz Bookend style with terminal block connections

DIN rail mounted 3ph filters from 5A to 25A 500V AC 50/60Hz

Comprehensive ranges of both single and three phase EMC filters that are held in stock for immediate despatch on a next day delivery service.

Single phase units are from 6A to 65A with push on amp tag or terminal block connections. Medium and high performance single phase filters are available in both single and two stage configurations.

There are two options for 3 phase filters:

A conventional bookend range of filters from 6A to 180A with a small footprint and high performance. These are designed to meet UL standard 1283 and EN 133200 and have terminal block connections.

A DIN rail mounted range of filters from 5A to 25A with terminal block connections.

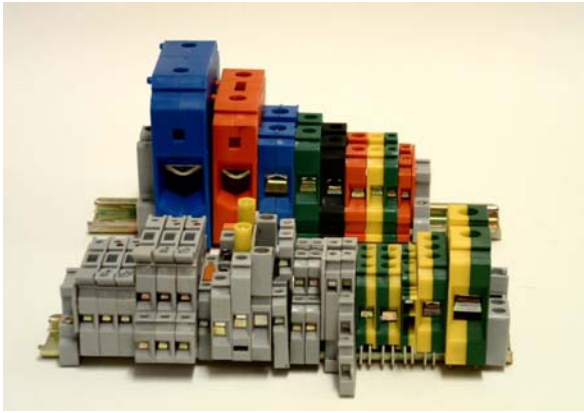
Standard , special or custom built filters can be held in stock for immediate despatch against specific call off orders.

To discuss your specific delivery requirements please contact our sales department.

Reference	Current rating	Voltage & ph	Terminations	Description	Leakage current
FIN 33.006F	6A	250V AC 1ph	Amp tags	Single stage general purpose filter	<1.5mA
FIN 35 F/M range	From 5A to 24A	250V AC 1ph	Up to 16A amp tags 24A terminal blocks	Two stage general purpose filter	<1.5mA
FIN 40 F/M range	From 5A to 24A	250V AC 1ph	Up to 16A amp tags 24A terminal blocks	Two stage general purpose filter	<1.5mA
FIN 50 F/M range	From 6A to 24A	250V AC 1ph	Up to 16A amp tags 24A terminal blocks	High attenuation two stage filter	<2.2mA
EMK 1 range	From 10A to 30A	250V AC 1ph	Terminal blocks	High attenuation filter	<3.2mA
6-3000 range	From 6A to 180A	520V AC 3ph	Terminal blocks	High performance With small footprint	< 4mA nominal
FIN 538 range	From 5A to 25A	440V AC 3ph	Terminal blocks	DIN rail mounted in polyester enclosure	<35mA

DIN RAIL MOUNTED TERMINALS AND ACCESSORIES

Feed through range of DIN rail mounted terminals
Multi-level terminals (double deck and triple deck)
Disconnecting terminals: fused and non fused
Fused feed through terminals
Distribution blocks
Earth terminals
Bus bar power terminals
Micro terminals
“U” series terminals
Spring clamp terminals
PCB connectors
DIN rail mounted melamine terminals



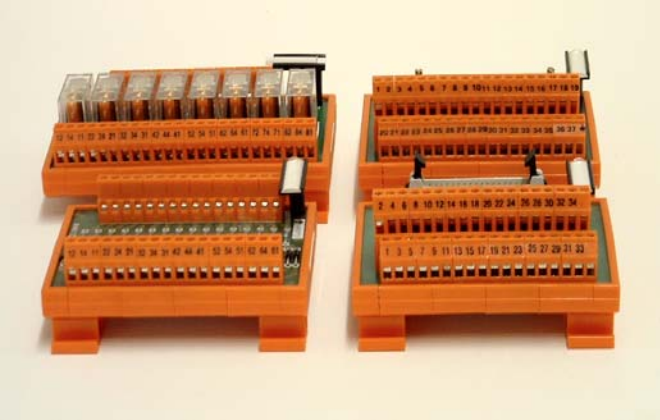
A comprehensive range of DIN rail mounted terminal blocks and associated accessories.
Feed through terminals from KUT 2.5 (2.5mm sq mm) to KUT 95 (95mm sq mm) and accessories are standard .
Where wiring space is at a premium multi-level terminals in both double deck and triple deck are available in 2.5 sq mm.
A range of disconnect terminals are available where fault finding without removing the cables is necessary. These are from 2.5 sq mm to 6 sq mm and also come with a fused terminal option.
Fused feed through terminals with built in safety fuse levers that take 5mm x 20mm or 5mm x 25mm fuses are available and these can be fitted with LED ‘fuse blown’ indication.
Distribution blocks can be used where a single wire connection is split to give multiple output connections.
A full range of rail mounted earth terminals from 6 sq mm to 35 sq mm is available.
Bus bar power terminals from 70 sq mm to 120 sq mm can be used for high power applications.
A wide range of compact micro terminals from 1.5 sq mm to 4 sq mm can be used where space is extremely limited.
A “U” range of terminals is available where a high reliability contact is required and can be used to connect cables from 0.2 sq mm to 10 sq mm. These terminals also come with fused, twin and double deck options as well as an earthed range from 2.5 sq mm to 10 sq mm.
Where ease of wiring is necessary the spring clamp terminals can be used from 2.5 sq mm to 6 sq mm. These terminals provide a reliable, fast and maintenance free connection without the use of tools.
A comprehensive range of PCB connectors is available in a wide variety of mounting options, these include 1,2 and 3 way connectors, single and double deck connectors, fuse connectors and disconnecting types.
To complement the above types a comprehensive range of accessories is available. This includes end and barrier plates, marking accessories, inter-connecting accessories, end clamps and DIN mounting rails.
For comprehensive information please contact our sales department.

Series	Description	Rating(IEC)/ size
KUT	Feed through terminals	From 25A to 232A
KUDD,KU2D,DU3D & DUSD	Multi-level double and triple deck	500V 24A 4 sq mm
KUDT,KUTSD & KSTD	Disconnecting terminals	From 10A to 41A 4mm sq to 10 sq mm
KUTD & KUDF,	Disconnecting fuse terminals	From 6.3A to 61A 4mm sq to 16mm sq
KUDF & KUDDF	Fuse feed through terminals	6.3A 4mm sq
DBK & FDBK	Distribution blocks	1x 2 to 1 x 8 way 32A to 114A
ET	Earth terminals	From 6 sq mm to 35 sq mm
DPBB & DPBC	Power (bus bar) terminals	From 192A to 269A 70 sq mm to 120 sq mm
SUT, CET, NET, MBT MBET & PET	Micro terminals	From 18A to 32A 1.5 sq mm to 4 sq mm
UBT , UBDD & UBDF EBT	U series terminals & U series earth terminals	From 24A to 57A 2.5 sq mm to 10 sq mm
DCC	Spring clamp terminals	From 24A to 41A 2.5 sq mm to 6 sq mm
PUT,ECM,ECD,ECDD,ECDS,ECDF ECDT & ECC	PCB connectors	From 6.3A to 15A 0.5 sq mm to 2.5 sq mm
ACCESSORIES	End/barrier plates,markers, Interconnecting,end clamps & DIN rail	Also melamine terminals Available on request

For more information and a special short form brochure please contact our sales department

DIN RAIL MOUNTED
INTERFACE MODULES

Passive interface modules
Relay interface modules
Relay modules with fuse at poles
Relay modules with IDC/D-Sub connectors
Diode modules
Signal distribution modules
Resistor modules
LED-Resistor modules
Solid state relay modules
DIN rail mounted switched mode power supplies



A comprehensive range of DIN rail mounted interface modules for the automation, controls and machine tool markets.
Passive interface modules can be supplied having sub miniature D(Sub-D) male and female connectors from 9 pin to 50 pin. Also a range with IDC or FRC (Header) connectors from 10 pin to 64 pin is available.
Relay interface modules are in both 1 pole and 2 pole double throw with both AC and DC coils. They are available in 1 to 16 channel and have LED indication and a freewheeling diode is provided for relay coil protection. Four pole double throw units can be supplied in 1 to 8 channel.
Fused relay modules with 5 x 20mm fuse holders in 1 pole and 2 pole versions are available. These have fuses at the poles to protect from overloads and short circuits and can be supplied with or without fuse blown indication.
Relay modules with IDC/D-Sub connectors on the contact side provide an input or output interface to PLC/DSC/CNC or any other dedicated computer system in the control, automation, machine tool and process industries. They are available in 1N/O, 1 C/O and 2 C/O configurations.
Diode modules are available in series, O ring and other configurations. They are used for reverse DC polarity protection, freewheeling and DC inductive kick suppression from 4 to 16 diode.
Signal distribution modules are for the distribution of both AC and DC signals. Special configurations are available on request.
Resistor modules are available in series and parallel configurations with from 4 to 16 resistors. Resistors are 4700 Ohms/0.25 Watt and resistor current is 5mA at 24V DC.
LED resistor modules are available in series, common cathode and common anode types. These modules are used to monitor control functions and sequences to detect problems quickly and efficiently.
Solid state relay modules are widely used in automation for potential separation between control and field signals. They range fro, 1 to 16 channels .
DIN rail mounted switched mode power supplies are available in DC power ratings from 5V 1A to 5V 10A, 12V 1A to 12V 10A and 24V 1A to 24V 10A.
For a detailed short form brochure please contact our sales department.

Series	Description
RMI 9,15,25,37,50DM RMI 9,15,25,37,50DF	9,15,25.37,50 PIN male connector passive interface modules 9,15,25.37,50 PIN female connector passive interface modules
RMI 10 1,14 1,16 1,20 1,26 1,34 1,40 1, 50 1,64,1 RMI 10 1M,14 1M,16 1M,20 1M,26 1M,34 1M,40 1M, 50 1,64,1M	10 ,14 ,16 ,20 ,26 ,34 ,40 , 50 ,64, PIN standard interface modules 10 M,14 M,16 M,20 M,26 M,34 M,40 M, 50 M,64,M PIN matrix interface modules
RMIR 122,123,124,125,126,247 RMIR 104,158,105,159,081,268	1,2,4,6,8,16 channel, single pole changeover relay modules 1,2,4,6,8,16 channel, double pole changeover relay modules
RMIR 177,367,368,369,370 RMIR 083,105,382X,383X,380X,381X	1,2,4,6,8 channel four pole changeover relay module Relay modules with fuse at pole and with/without fuse blown indication
RMIR 293X,387X,384X,385X,007X,147X,388X,389X RMIR 293TX,387TX,384TX,385TX,007TX,147TX,388TX,389TX	Relay modules with IDC/D-Sub connectors O/E/N module type Relay modules with IDC/D-Sub connectors Omron type
RMSM 007,008,009	Diode modules in series configuration
RMIC 196,197 RMIC 198,199	40 point 3 channel ,2 channel 20 point 3 channel, 2 channel
RMSM 001,002,003 RMSM 004,005,006	Resistor modules in series configuration Resistor modules in parallel configuration
RMSM 016,017,018	LED resistor modules in series configuration
RMSR 100,101,102,103,104,105	Solid state relay modules from 1-16 channel
RMPS 51,53,55,5,10,	Switched mode power supplies 5V 1A,3A,5A,10A

RESISTORS FOR POWER APPLICATIONS
FROM 2 WATTS TO 6000 WATTS

Ceramic cased wire wound resistors from 2-20 Watts
Aluminium housed, chassis mounted, wire wound resistors from 5-300 Watts
Aluminium housed, chassis mounted, wire wound resistors with a large creepage distance in 25 Watt and 50 Watt
Thick film power resistors from 100 Watts to 250 Watts
Silicone & vitreous coated wire wound resistors in both fixed and adjustable types from 25-1500 Watts
Fibre glass resistor assemblies from 500-3000 Watts in free air to 850-6000 Watts with fan cooling.

A comprehensive range of power resistors from 2 Watts to over 6000 Watts.

Ceramic cased wire wound resistors are from 2-20 Watts with Ohmic values from 0.01E-50K.
Aluminium housed, wire wound resistors for chassis mounted range from 5 Watts to 300 Watts. An alternative range with of units with a large creepage from 25-50 Watts is also available. Both types offer a light weight, compact size and low cost with non-inductive models available as well as custom built types.
Thick film power resistors are from 100 Watts to 250 Watts and have the advantage of a good power to volume ratio.
Silicone and vitreous coated wire wound resistors are available from 25-1500 Watts in both fixed and adjustable types. The fixed types are from 0.1 ohms to 1000K ohms and the adjustable types are from 0.10 ohms to 130K ohms.
For high power applications a range of fibre glass resistor assemblies is available with ratings of 500-3000 Watts in free air to 850-6000 Watts with fan cooling. These units offer low cost , low weight, low operating temperature and extremely high efficiency when fan cooled.

For detailed technical advise and a comprehensive brochure please contact our sales department.

Type	Power ratings	Description	Applications
CER	2W, 3W, 5W, 7W, 10W, 15W, 20W	Ceramic encased wire wound resistors Fire proof ceramic case Tolerances +/-5% , +/-10% Non inductive types available	General power applications
TFR	100W to 250W	Thick film power resistors Good power/volume ratio Suited to UL94-VO applications Non inductive performance for high frequency applications	General power applications
AHCR	25W & 50W	Fixed power wire wound resistors Aluminium housed With large creepage distance Chassis mounted	General power applications
AHR	5W, 10W, 25W, 50, 100W 150/200W & 250/300W	Fixed power wire wound resistors Aluminium housed Chassis mounted Screw or solder tag connections	General power applications Induction furnaces Medical equipment Humidity chambers
SVR	25W, 30W,40W,50W,75W, 100W,150W,200W,250W, 300W,400W,500W,600W, 75OW,1000W,125OW,1500W	Fixed type silicone & vitreous coated wire wound resistors Adjustable type silicone & vitreous coated wire wound resistors Non inductive types available Various mounting options	Educational modelling Load testing Machinery and power distribution Instruments and automation control
VHWR	1000W, 1500W, 2000W, 2500W, 3000W	High wattage wire wound resistors Current ratings from 4A to 27A Variable resistors available Can be supplied enclosed	Load banks Capacitor discharge Neutral grounding
GR & GRA	In free air 500W,600W,2000W,3000W Fan cooled 850W,1000W,4000W,6000W	Wound on fibre glass cord Can be assembled to form high wattages Can be supplied enclosed	Load banks Inverters General power applications

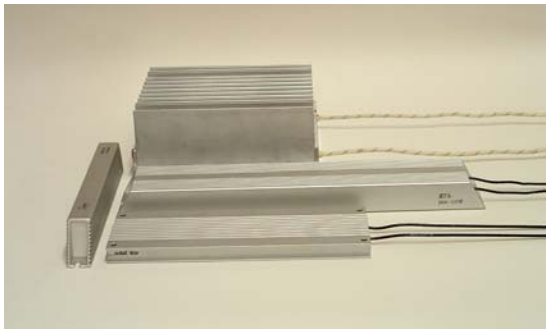
BRAKING RESISTORS
FROM 60 WATTS TO 3000 WATTS

Aluminium housed metal clad braking resistors
Bookend and low profile options from 60W to 1000W

Stackable slim type aluminium housed braking resistors
From 100W to 500W

Edge wound resistors in 800W, 1000W and 1200W

High wattage wire wound resistor from 1000W to 3000W



The EMCV and EMCH ranges of aluminium housed metal clad braking resistors in both upright 'bookend' style and 'flat 'low profile' styles. The full range is from 60 Watts to 1000 Watts in 11 standard ratings. These units offer low price with a small overall size , they are high power with excellent load life stability. They are moulded within a self extinguishing , solvent and moisture resistant material. Non inductive types are available and custom built units can be produced for special requirements.

The SLR range of high power, slim-type aluminium housed resistors from 100 Watts to 500 Watts in 7 standard ratings offer an excellent space factor to power ratio. They are low cost and light weight with good heat conduction. Non inductive types, modules with thermal switches and high or low resistance values are available. Multiple resistors can be assembled together for higher power ratings.

The OER range of edge wound resistors, in 800 Watts, 1000 Watts and 1200 Watts, are constructed by coiling the resistor around ceramic insulators on a steel strip. The resistor element is made of stainless steel, fecral or nickel chromium. The ceramic core is resistant against shock or vibration and the edge wise helical design offers efficient cooling with an extended life. These units are industry standards for easy replacements for other major brands. They can be easily assembled in multiple banks and can be supplied fully enclosed. Custom built units are available on request.

The VHWR range of wire wound resistors are high wattage from 1000 Watts to 3000 Watts in 5 standard sizes. They are available in current ratings from 4 amps to 27 Amps. They are constructed from continuously wound resistance wire on a high strength and high temperature ceramic core over a steel frame. Non inductive and custom built resistors are available on request. They can be supplied as variable types, assembled in multiple banks and can be fully enclosed.

For detailed technical advise and a comprehensive brochure please contact our sales department.

Type	Power ratings	Description	Applications
EMCV & EMCH	60W, 80W,100W,120W, 150W,200W,300W,400W, 500W,750W and 100W	Aluminium housed, metal clad Filled with self extinguishing material Amp tag terminations or flying leads Operating temperature from –55 deg c to +275 deg C	Braking resistors
SLR	100W, 150W, 200W 250W ,300W,400W and 500W	Aluminium housed, metal clad Filled with self extinguishing material Flying lead connections Temperature from –55 deg c to +275 deg C @ 40 deg C ambient Temperature from –55 deg c to +250 deg C @ 20 deg C ambient	Charging resistors, dynamic braking resistors, cranes, snubber resistors, hoists, CNC machines, electric cars, power sources for industrial instruments
OER	800W, 1000W and 1200W	Edge wound on ceramic insulators over a steel strip Strong end terminations in stainless steel Low temperature coefficient elements Can be assembled as a bank of resistors Enclosed units available	To accelerate, dynamic braking of motors, neutral grounding resistors, AC and DC dynamic load banks, current limiting, blast for mercury vapour lamps
VHWR	1000W, 1500W, 2000W 2500W and 3000W	Wire wound on strong ceramic insulators over a steel frame Turns separated by a groove on the ceramic core Variable resistors available Can be assembled as a bank of resistors Enclosed units available	Load banks, dynamic braking, capacitor discharge, neutral grounding

AC & DC COOLING FANS, CROSS FLOW FANS AND FAN ACCESSORIES

AC cooling fans from 80mm to 250mm
In 120V & 230V 50/60Hz with sleeve and ball bearing

DC cooling fans from 25mm to 170mm
In 5V, 12V, 24V and 48V with sleeve and ball bearing

AC and DC cross flow fans from 25mm to 110mm diameter
In 120V & 230V 50/60Hz with sleeve and ball bearing
In 12V, 24V and 48V DC with sleeve and ball bearing

All in various air flows

Offering low noise, low power consumption,
low temperature rise and greater air flow

A comprehensive range of AC and DC cooling fans, cross flow fans and accessories.

The ranges of AC fans are from 80mm to 250mm and are available in both 115V and 230V options. They have either sleeve or ball bearings, flying leads or terminal connections and come in a variety of air flow speeds. Both AC axial and AC blower types are offered.

The DC ranges of cooling fans are from 25mm to 170mm and are available in 5V, 12V, 24V and 48V version. They have either sleeve or ball bearings, flying leads or terminal connections and come in a variety of air flow speeds. Both DC cooling and DC blower types are offered.

A variety of construction materials are used for all the housings with thermoplastic and metal impeller options.

AC and DC cross flow fans are from 25mm to 110mm impeller diameter and are available in 115V and 230V AC and 12V, 24V and 48V DC options. Impeller lengths are from 98mm to 300mm and the motor can be positioned at either end of the fan. Air flow can be forwards or upwards and air flow speeds are from extra low to super speed with a duel speed option also available.

Fan accessories include thermo plastic fan guards, filter media and media retainers as well as circular metal wire formed guards and various plug and connection cords.

AC series	Description or size	DC series	Description or size
25089	254mm diameter x 89mm	D17251	172 x 151 x 81mm
20872	208 x 208 x 72mm	D12038 & -03	120 x 120 x 38mm
18065	180 x 180 x 65mm	D12032	120 x 120 x 32mm
17051	170mm diameter x 51mm	D12025	120 x 120 x 25mm
17251	172 x 151 x 51mm	D9225	92 x 92 x 25mm
17238	172 x 151 x 38mm	D8025 & -03	80 x 80 x 25mm
16062	160 x 160 x 62mm	D8015	80 x 80 x 15mm
15055	150 x 172 x 55mm	D7025	70 x 70 x 25mm
12738	127 x 127 x 38mm	D7015	70 x 70 x 15mm
12038	119 x 119 x 38mm	D6025 & -03	60 x 60 x 25mm
12025	119 x 119 x 25mm	D6020	60 x 60 x 20mm
9238	92 x 92 x 38mm	D6015	60 x 60 x 15mm
9225	92 x 92 x 25mm	D6010	60 x 60 x 10mm
8038	80 x 80 x 38mm	D5015	50 x 50 x 15mm
8025	80 x 80 x 25mm	D5010	50 x 50 x 10mm
		D4020	40 x 40 x 20mm
12137	Blower 121 x 121 x 37mm	D4010	40 x 40 x 10mm
		D4007	40 x 40 x 7mm
		D3010	30 x 30 x 10mm
		D2510	25 x 25 x 10mm
		DB12032	Blower 120 x 120 x 32mm
		DB7630	Blower 75.7 x 75.7 x 30mm

For a full technical catalogue, information or data sheets please contact our sales department

SHEET STEEL VENTILATED ENCLOSURES TO IP22 FOR TRANSFORMERS AND POWER SUPPLIES

Sheet steel ventilated enclosures to IP22 for stock transformers, custom built transformers and power supply units

SP1-SP4 enclosures with base mounting fixings and 20mm cable entries

SP5-SP7 wall and floor mounted enclosures with 20mm cable entries

SP8-SP9 and T2-T5 floor mounted enclosures with cable gland plates

Sheet steel construction with epoxy powder finish

A comprehensive range of standard ventilated enclosures to IP22 for stock transformers, custom built transformers and power supply units.

The smaller units from SP1-SP4 are designed with base mounting fixings and have 20mm cable entries for ease of wiring. Units from SP5-SP7 are designed for either floor or wall mounting and have 20mm cable entries on either side of the enclosure for ease of wiring. The larger units SP8-SP9 and T2-T5 are designed for floor mounting and are fitted with removable gland plates.

The construction is sheet steel with a durable epoxy powder paint finish in hammer grey.
Special enclosures can be made to order, please contact our sales department for details.

Reference	L	W	H	Fixing	Wiring
SP1	120	95	90	Base mounting	20 mm cable entries
SP2	140	120	115	Base mounting	20 mm cable entries
SP3	165	140	150	Base mounting	20 mm cable entries
SP4	180	160	140	Base mounting	20 mm cable entries
SP5	340	220	270	Floor or wall mounting	20 mm cable entries
SP6	350	250	360	Floor or wall mounting	20 mm cable entries
SP7	385	310	460	Floor or wall mounting	20 mm cable entries
SP8	400	400	550	Floor mounting	Via gland plate
SP9	450	500	650	Floor mounting	Via gland plate
TP2	450	300	400	Floor mounting	Via gland plate
TP3	525	450	500	Floor mounting	Via gland plate
TP4	625	500	600	Floor mounting	Via gland plate
TP5	850	600	800	Floor mounting	Via gland plate

Special enclosures can be produced to order
This includes designs to IP23, IP44 , IP54 and IP65
Special paint colours and finishes are also available
SP8-SP9 and TP2-TP5 enclosures can be fitted with wheels for mobility
For more information please contact our sales department

GENERAL

Ambient temperature range
The specified temperature range within which the device is designed to operate
Efficiency
The ratio of output power to input power expressed as a percentage
Power de-rating
The required reduction in output power of a device where the specified ambient temperature range is exceeded
Power factor: cos-phi
The ratio of real power to apparent power due to the non sinusoidal shape of the input current

TRANFORMERS

VA rating
The combination of output voltage and output current. Where multiple outputs occur the overall VA rating is the total VA of all the output windings, kVA is kilovolt amperes
Double wound transformer or isolation transformer
A transformer with at least two windings providing isolation between the input and output circuits
Auto transformer
A single winding transformer with no isolation between input and output circuits. These transformers can be used where input and output voltages are very close and space is at a premium.
Input voltage
The supply voltage to the transformer
Output voltage(s)
The output or load voltage(s) from the transformer
Off load and full load
Off load is the where the input to the transformer is powered but no load is being taken. Full load is where the full rated power of the transformer is being taken.
Insulation class
Class A– 105 deg C rating
Class E– 120 deg C rating
Class F– 155 deg C rating

POWER SUPPLIES

Transformer rectifier
A combination of conventional transformer and rectifier to covert AC to DC
Switched mode power supply
A power supply that switches the power to a high frequency to reduce size and weight. AC-DC takes AC power and converts it to DC power. DC-DC takes DC power of one voltage and coverts it to DC power of another voltage.

RFI FILTERS

EMC
Electro magnetic compatibility
RFI
Radio frequency interference
Residential standard and industrial standard
Residential standard to EN 50081-1, industrial standard to EN 50081-2

Fuse holder terminal blocks

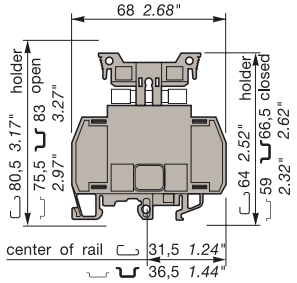
for 8,5 x 31,5 mm *11/32 x 1 1/4 in.* fuses

Screw clamp

DIN 1 - DIN 3

M 10/16.SF1

Spacing 16 mm *(.630")*

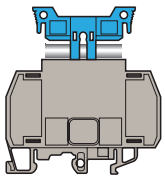


16 mm block without fusion indicator.

Colour	Type	Part numbers
Grey	**M 10/16.SF1**	1SNA **115 375** R**2200**

M 10/16.SN1

Spacing 16 mm *(.630")*



16 mm block with disconnect link bar locked on blue holder.

Colour	Type	Part numbers
Grey / Blue	**M 10/16.SN1**	1SNA **115 376** R**2300**

End stop	th. 9 mm	**BADL**	V0	1SNA **399 903** R**0200**
End stop	th. 10 mm	**BAM2**	V2	1SNA **206 351** R**1600**
End stop	th. 10 mm	**BAM2 V0**	V0	1SNA **296 351** R**0000**
Rail	35 x 7,5 x 1	**PR3.Z2**		1SNA **174 300** R**1700**
Rail	35 x 15 x 2,3	**PR4**		1SNA **168 500** R**1200**
Rail	35 x 15 x 1,5	**PR5**		1SNA **168 700** R**2200**
Rail	32 x 15 x 1,5	**PR1.Z2**		1SNA **163 050** R**0400**

Other end stops, rails and accessories : see section on accessories.

Notes

The use of some accessories may decrease the block's voltage rating. For more information, consult us.

Characteristics

Wire size		NFC DIN	UL	CSA
Screw clamp	Rigid	0,5-10 mm²		20-8 AWG
	Flexible	0,5-6 mm²		20-8 AWG

Voltage			
Rated	750 V Gr.C (1)		600 V (1)
Impulse withstand			
Pollution degree			

Current			
Rated	20 A		20 A

Wire size			
Rated / Gauge	10 mm²		8 AWG

Wire stripping length	Recomm. screwdriver	Recomm. torque	Protection
11 mm *.433"*	5,5 mm *.217"*	0,8-1 Nm *7.1-8.9 lb.in*	

Characteristics

Wire size		NFC DIN	UL	CSA
Screw clamp	Rigid	0,5-10 mm²		20-8 AWG
	Flexible	0,5-6 mm²		20-8 AWG

Voltage			
Rated	750 V Gr.C (1)		600 V (1)
Impulse withstand			
Pollution degree			

Current			
Rated	20 A		20 A

Wire size			
Rated / Gauge	10 mm²		8 AWG

Wire stripping length	Recomm. screwdriver	Recomm. torque	Protection
11 mm *.433"*	5,5 mm *.217"*	0,8-1 Nm *7.1-8.9 lb.in*	

Accessories

		Type		Part numbers	Type		Part numbers
1	**1** Fuse 8,5 x 31,5	FU853	2 A	1SNA **163 847** R**2400**			
			4 A	1SNA **163 848** R**0500**			
			6 A	1SNA **163 849** R**0600**			
			10 A	1SNA **163 850** R**0300**			
			16 A	1SNA **163 851** R**2000**			
			20 A	1SNA **163 852** R**2100**			
2, 3	**2** Comb-type jumper bar 70 A	PC16	2 poles	1SNA **116 729** R**2600**	PC16	2 poles	1SNA **116 729** R**2600**
	70 A	PC16	3 poles	1SNA **116 733** R**1200**	PC16	3 poles	1SNA **116 733** R**1200**
	70 A	PC16	4 poles	1SNA **116 734** R**1300**	PC16	4 poles	1SNA **116 734** R**1300**
	70 A	PC16	10 poles	1SNA **116 735** R**1400**	PC16	10 poles	1SNA **116 735** R**1400**
	3 Insulating tip	EIP		1SNA **113 550** R**2400**	EIP		1SNA **113 550** R**2400**
R	**R** See section on markers marking method	RC65 - RC610	RC810	Sides of block RC1010	RC65 - RC610	RC810	Sides of block RC1010

Note : (1) Insulation voltage of terminal block - operating voltage : according to fuse.

Multi-Contact

STÄUBLI GROUP

Steckverbinder
für die Einschubtechnik

Modulares
Rundsteckverbindersystem
bis 600V, 300A

Gabelstecker
bis 600V, 1490A

Connectors
for plug-in systems

Modular
round connector systems
up to 600V, 300A

Fork plugs
up to 600V, 1490A

Connecteurs
pour tiroirs embrochables

Systèmes modulaires
de connecteurs cylindriques
jusqu'à 600V, 300A

Fourches de contact
jusqu'à 600V, 1490A

Industrie-Steckverbinder
Industrial Connectors
Connecteurs industriels

Slide-in*line*

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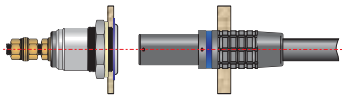	Was ist bei der Planung eines Steckverbinders zu beachten!	Points that must be observed when planning the use of an Connector!	Facteurs à prendre en compte dans le cadre de la mise en oeuvre d'un connecteur!	5
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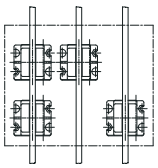
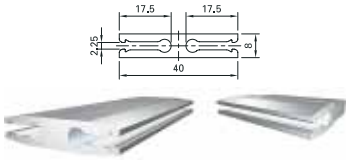
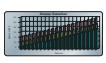
63A 	4-pol. Buchsen- und Steckerleiste P4/50... und P4/63... mit Schraubanschluss	4-pole socket and plug blocks P4/50... and P4/63... with screw termination	Barrettes 4-pôles femelle et mâle P4/50... et P4/63... avec raccordement à visser	14 – 15
100A 	Buchsen- und Steckerleiste-Element P1/100-... mit Crimp- oder Schraubanschluss	Socket and plug modules P1/100-... with crimp or screw termination	Connecteurs modulaires femelle et mâle P1/100-... avec raccordement à sertir ou à visser	16 – 19
	Befestigungsmaterial für 2 bis 10 Buchsen- und Steckerleiste Elemente Montageanordnung für Bemessungsspannungen 500V und 600V	Fixing material for 2 up to 10 socket and plug modules Mounting for rated voltage 500V and 600V	Matériel de fixation pour 2 à 10 connecteurs modulaires Montage pour tension assignée 500V et 600V	20 – 21
160 – 300A 	Einschubbuchsen EBB... Einschubstecker EBS...	Slide-in socket EBB... Slide-in plug EBS...	Connecteurs mâle et femelle EBB..., EBS...	22 – 25

	MC-Gabelstecker für Stromschienen Einführung	**MC-Fork plugs for busbars** Introduction	**Fourches de contact MC pour jeux de barres** Introduction	26 – 27
80 – 250A 	Gabelstecker GSR5/... mit Crimpanschluss für Stromschienendicken von 5mm	Fork plug GSR5/... with crimp termination for busbar thicknesses of 5mm	Fourche de contact GSR5/... avec fût à sertir pour barres d'épaisseur 5mm	28
80 – 400A 	Gabelstecker GSR5/B-M10x50 mit Schraubanschluss für Stromschienendicken von 5mm	Fork plug GSR5/B-M10x50 with screw termination for busbar thicknesses of 5mm	Fourche de contact GSR5/B-M10x50 avec embout fileté pour barres d'épaisseur 5mm	29
	Isoliergehäuse I-GSR5 zu Gabelstecker G-GSR5/... Anschlussvarianten und Strombelastbarkeit für G-GSR5/B-M10x50	Insulating housing I-GSR5 for fork plugs G-GSR5/... Terminations and current carrying capacity for fork plugs G-GSR5/B-M10x50	Boîtier isolant I-GSR5 pour fourche de contact G-GSR5/... Raccordements et intensités pour fourche de contact G-GSR5/B-M10x50	30 – 31
	Anordnung und Befestigungsvarianten für Gabelstecker GSR5/...	Arrangement and fastening for fork plugs GSR5/...	Arrangement et fixation des fourches de contact GSR5/...	32 – 34
	Doppelgabelstecker GSRD...	**Double fork plugs GSRD...**	**Fourche double de contact GSRD...**	35 – 37
	MC-Spezialgabelstecker für Stromschienendicken von 1,57 – 10mm Beispiele von Spezialanfertigungen	MC-Special fork plugs for busbar thicknesses of 1,57 – 10mm Examples of special versions	Fourches de contact MC spéciales (pour barres d'épaisseur 1,57 – 10mm) Exemples d'exécutions spéciales	38 – 40
	Derating Diagramme	Derating diagrams	Diagrammes de derating	41 – 42

info	Technische Hinweise Technische Anforderungen laut UL Underwriters Laboratories Inc.	Technical information Engineering considerations of UL Underwriters Laboratories Inc.	Informations techniques Spécifications techniques selon UL Underwriters Laboratories Inc.	43 – 46
	Anwendungsbeispiele der Einschubtechnik	Application examples of Slide-in technology	Exemples d'applications de la technique pour tiroirs	47 – 52
info	Aphabetischer Index	Alphabetic index	Index alphabétique	53
	MC-Kontaktlamellen das unübertroffene Kontaktsystem	MC-Multilam® the unsurpassed contact system	Contacts à lamelles MC le système de contact inégalé	54 – 55

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www.multi-contact.com

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www.multi-contact.com

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Piktogramme

*Für diese Teile besteht eine Montageanleitung mit einer Nummer, **z.B. MA001***
Download:
www.multi-contact.com

Technische Hinweise
Allgemeine Hinweise
Bestellhinweise

Pictograms

*These parts have assembly instructions with a number, **e.g. MA001***
Download:
www.multi-contact.com

Technical information
General information
Ordering information

Pictogrammes

*Ces articles ont une notice de montage identifiée par un code, **par ex. MA001***
A télécharger:
www.multi-contact.com

Informations techniques
Généralités
Pour vos commandes

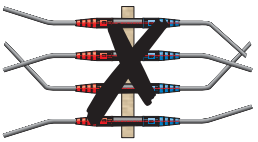
Was ist bei der Planung eines MC®-Steckverbinders zu beachten!

1. Während dem Stecken oder Trennen dürfen keine Querkräfte auftreten.
2. Die Leitungen oder Kabel müssen die richtige Länge haben.

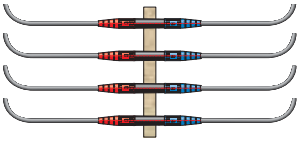
falsch / wrong / faux

richtig / correct

3. Wenn mehrere Steckverbinder nebeneinander liegen, sollte wenn immer möglich eine Kreuzung der Leitungen vermieden werden. Die Leitungen oder Kabel müssen genügend lang sein.

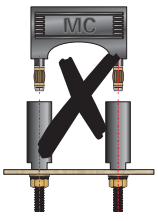


falsch / wrong / faux

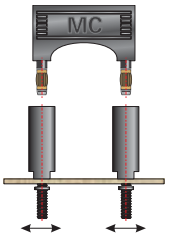


richtig / correct

4. Im Falle von mehrpoligen Steckverbindern sollte immer eine Seite (Stecker- oder Buchsenseite) oder beide Seiten "schwimmend" befestigt sein um alle Konstruktionstoleranzen zu absorbieren.

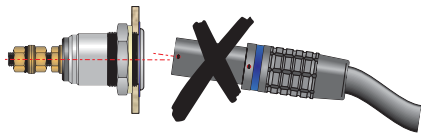


falsch / wrong / faux



richtig / correct

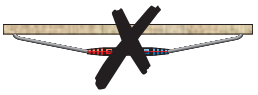
5. Schwere Steckverbinder erfordern eine Abstützung, oder die Steckseite muss "schwimmend" befestigt sein.



falsch / wrong / faux

Points that must be observed when planning the use of an MC®-Connector!

1. No transverse forces must be exerted during connection and disconnection.
2. The leads or cables must be of adequate length.



falsch / wrong / faux

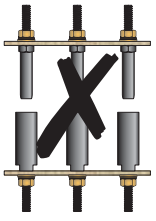
richtig / correct

3. If a number of plug connectors are located side by side, crossing of the leads should be avoided as far as possible. The leads and cables must be of adequate length.

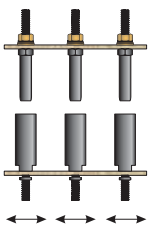
falsch / wrong / faux

richtig / correct

4. In the case of multi-pole plug connectors, at least one side (socket or plug side) or both sides must be provided with a "floating" mounting that is capable of absorbing all design tolerances.

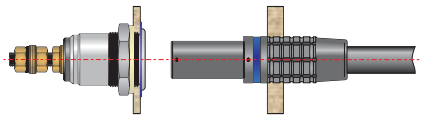


falsch / wrong / faux

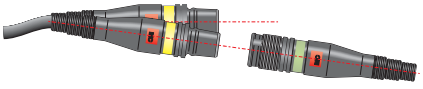


richtig / correct

5. Heavy connectors need to be supported or the plugged side must be float mounted.



richtig mit Abstützung
correct with support
correct avec guidage



richtig mit "schwimmender" Steckseite
correct with "floating mounting"
correct avec montage flottant

Facteurs à prendre en compte dans le cadre de la mise en œuvre d'un connecteur MC®!

1. Lors des phases d'embrochage et débrochage, les efforts radiaux ne sont pas tolérés.
2. Les cordons ou les câbles doivent avoir une longueur appropriée.

falsch / wrong / faux

richtig / correct

3. Lorsque plusieurs connecteurs sont mis côte à côte, le croisement de câbles doit être évité. Les cordons et câbles doivent être de longueur suffisante.

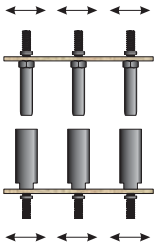
falsch / wrong / faux

richtig / correct

4. Dans le cas de connecteurs multipolaires, afin d'absorber les tolérances de construction, un côté (douille ou broche) ou les deux côtés devrai(en)t être monté(s) flottant(s).

falsch / wrong / faux

richtig / correct



richtig / correct

5. Les connecteurs lourds requièrent un guidage ou un montage flottant.

Rundsteckverbinder für Einschubtechnik

Einführung

Round connectors for plug-in systems

Introduction

Connecteurs cylindriques pour tiroirs embrochables

Introduction

P1/...

P4/...

Ø 4mm

Kompakte 4-polige Einheit
Compact 4-pole unit
Barrette 4-pôles

Auswahl aus 3 modularen Grössen
Range of 3 modular sizes
Choisir entre 3 groupes modulaires

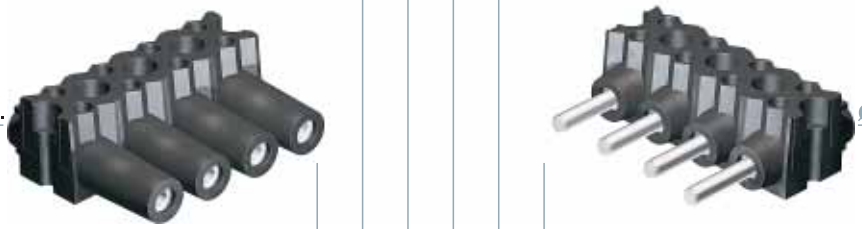
P1/30...
30A

Ø 2mm

P1/63...
63A

Ø 4mm

P1/100...
100A



Ø 6mm

mit Crimpanschluss
with crimp termination
avec fût à sertir

mit Schraubklemmenanschluss
with screw termination
avec raccordement à visser

mit Crimpanschluss
with crimp termination
avec fût à sertir

Bis zu 10 Elemente können aneinander gereiht werden

Up to 10 modules can be joined together

Jusqu'à 10 connecteurs peuvent être regroupés ensemble

2 Steckerlängen für voreilende Kontakte

Long version of plug for leading contact

2 longueurs de broches pour contacts avancés

Die Buchsen (P1/63..., P1/100...) sind mit den bewährten MC-Kontaktlamellen ausgerüstet

The sockets (P1/63..., P1/100...) are fitted with the proven MC-Multilams®

Les douilles (P1/63..., P1/100...) sont équipées des fameux contacts à lamelles MC

Kodiermöglichkeit bei gleichem Nenndurchmesser

Provision for coding if modules of the same nominal diameter are mixed

Possibilité d'alterner des contacts mâles avec des contacts femelles pour réaliser un détrompage avec un même Ø nominal

Das Kontaktteil ist in der Isolation mittels Gewindestift schwimmend befestigt

The floating contact part is mounted in the insulation by means of a threaded pin

La pièce de contact est retenue dans l'isolant par une vis sans tête

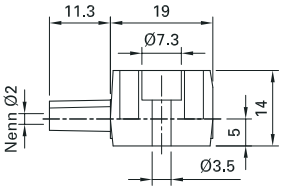
Buchsen- und Steckerleisteelement P1/30... mit Schraubklemmenanschluss

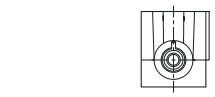
Socket and plug modules P1/30... with screw termination

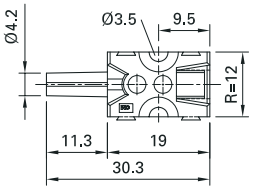
Connecteurs modulaires femelle et mâle P1/30... avec raccordement à visser

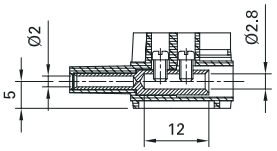
P1/30-BS

Buchse
Socket
Douille



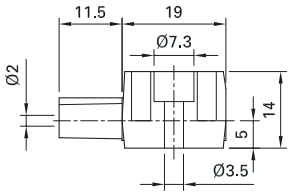


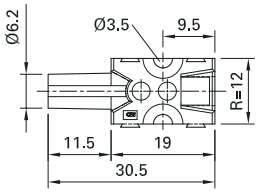


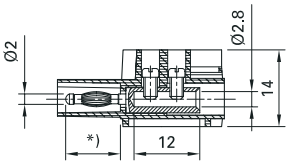


P1/30-SS...

Stecker
Plug
Broche







Montagehinweise Assembly advices Conseils de montage	Seiten / Pages 20 – 21

*) Ausführung lang = 12 / kurz = 10
Long version = 12 / short = 10
Version longue = 12 / courte = 10

R = Rastermass / Raster dimension / Entraxe

Technische Daten / Technical data

für Leiterquerschnitt for conductor cross section pour section du conducteur	2,5mm² / 14 AWG
Bemessungsstrom Rated current Intensité assignée	30A Derating diagram Seite/Page 41
Bemessungsspannung Rated voltage Tension assignée	500V
Kurzschlussstrom Short-circuit current Intensité de court-circuit	0,29kA / 1s 0,17kA / 3s
Prüfspannung (50Hz, 1min.) Test voltage (50Hz, 1min.) Tension d'essai (50Hz, 1min.)	2,21kV (: 2kV) [1]
Überschlagspannung (50Hz) Flashover voltage (50Hz) Tension de claquage (50Hz)	5kV
Kontaktwiderstand Contact resistance Résistance de contact	500µΩ

Caractéristiques techniques

Kontaktmaterial Contact material Matériau conducteur	Messing, versilbert brass, silver plated laiton, argenté
Isolationskoordination [2] Insulation coordination [2] Coordination de l'isolement [2]	4kV/2
Isolationsmaterial / Flammklasse Insulation material / Flame rating Matériau isolant / Classe d'inflammabilité	PC / UL94-V0
Anzugsdrehmom. / Anschlussschrauben Tightening torque / Termination screws Couple de serrage / Vis de raccordement	max. 0,2Nm
Auszugskraft Withdrawal force Force d'extraction	4N
Maximale Erwärmung Maximum temperature rise Echauffement maximal	45K (UL 1977 – Section 16)
Temperaturbereich Temperature range Plage de températures	-40°C...+125°C

[1] Siehe Seite 45: UL Engineering considerations
[2] Gilt zwischen den spannungsführenden Teilen und der Befestigungsebene

[1] See page 45: UL Engineering considerations
[2] Valid between live parts and mounting surface

[1] Voir page 45: UL Engineering considerations
[2] S'applique entre les parties conductrices et le plan de fixation

Beschriftung (z.B. mit Dekafix DEK5 (www.weidmueller.de)

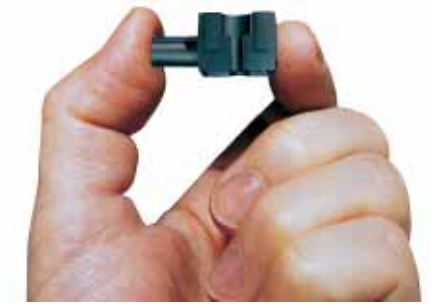
Marking facility (e.g. with Dekafix DEK5 (www.weidmueller.de)

Marquage (par exemple avec Dekafix DEK5 (www.weidmueller.de)

Führungsnut verhindert 180° Verdrehung

Keyed to protect against wrong insertion

Rainure de guidage pour détrompage à 180°

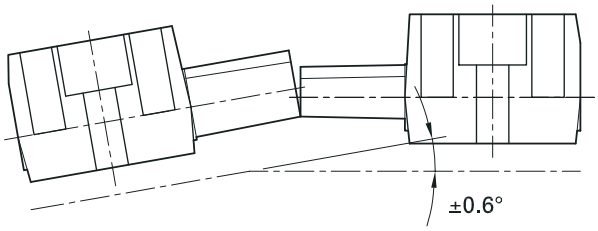


P1/30-BS und P1/30-SSK sind berührgeschützt in ungestecktem Zustand

P1/30-BS and P1/30-SSK are touch protected in unmated condition

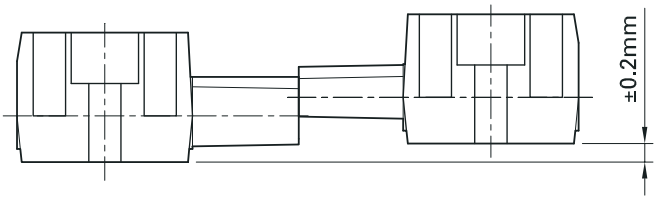
P1/30-BS et P1/30-SSK sont protégés au toucher à l'état débroché.

Maximaler Versatz beim Einbau



Maximum mounting offset

Rattrapage de jeu maxi



Typ Type Type	Bestell-Nr. Order No. No. de Cde	Bezeichnung Description Description	Zulassung UL UL Approval Approbation UL	Lieferform Delivered Livré
P1/30-BS	**15.0188**	Buchse / Socket / Douille	1)	montiert / assembled / monté
P1/30-SSK	**15.0186**	Stecker / Plug / Broche	1)	montiert / assembled / monté
P1/30-SSL 2)	**15.0187**	Stecker / Plug / Broche	1)	montiert / assembled / monté

1) Siehe Seite 45: UL Engineering considerations
2) Mit voreilendem Stift

1) See page 45: UL Engineering considerations
2) With leading pin

1) Voir page 45: UL Engineering considerations
2) Avec broche avancée

Hinweis:
Flexible Anschlussleitungen sind mit handelsüblichen Aderendhülsen zu versehen.

Note:
Commercial wire-end ferrules are to be used when connecting flexible leads.

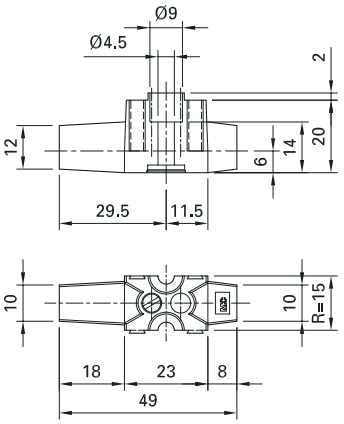
Remarque:
Les conducteurs souples doivent être munis d'embouts de câbles.

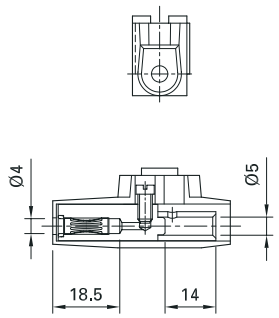
Buchsen- und Steckerleisteelement P1/63... mit Crimpanschluss

Socket and plug modules P1/63... with crimp termination

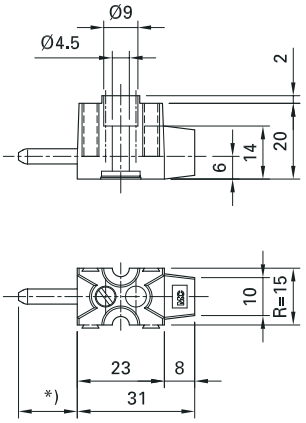
Connecteurs modulaires femelle et mâle P1/63... avec raccordement à sertir

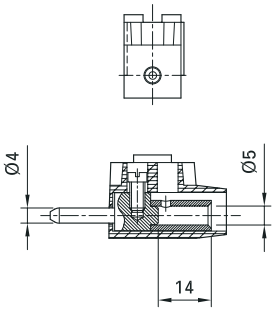
P1/63-B10





P1/63-S10...





Montagehinweise Assembly advices Conseils de montage	Seiten / Pages 20 – 21

*) Ausführung lang = 17,5 / kurz = 15,5
Long version = 17,5 / short = 15,5
Version longue = 17,5 / courte = 15,5

R = Rastermass / Raster dimension / Entraxe

Technische Daten / Technical data

für Leiterquerschnitt for conductor cross section pour section du conducteur	10mm² / 8 AWG
Bemessungsstrom Rated current Intensité assignée	63A Derating diagram Seite/Page 41
Bemessungsspannung Rated voltage Tension assignée	500V / 600V [1] [2]
Kurzschlussstrom Short-circuit current Intensité de court-circuit	1,2kA / 1s 0,85kA / 3s
Prüfspannung (50Hz, 1min.) Test voltage (50Hz, 1min.) Tension d'essai (50Hz, 1min.)	2,21kV, 3,51kV [1] (UL: 2kV) [3]
Überschlagspannung (50Hz) Flashover voltage (50Hz) Tension de claquage (50Hz)	6kV / 9kV [1]
Kontaktwiderstand Contact resistance Résistance de contact	250µΩ

Caractéristiques techniques

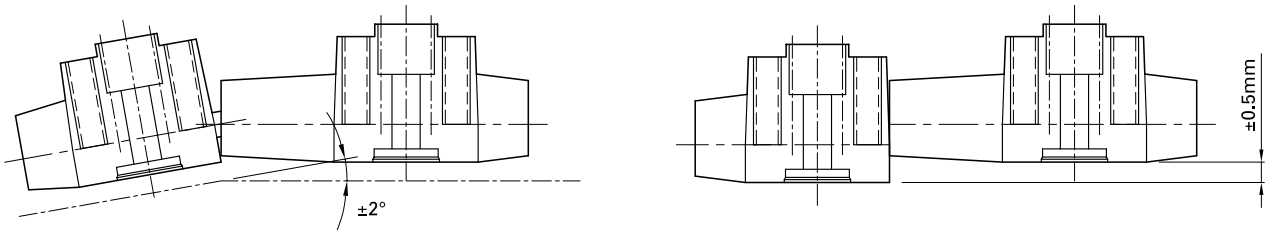
Kontaktmaterial Contact material Matériau conducteur	Messing, versilbert brass, silver plated laiton, argenté
Isolationskoordination [4] Insulation coordination [4] Coordination de l'isolement [4]	6kV/2 [5] / 6kV/3 [6]
Isolationsmaterial / Flammklasse Insulation material / Flame rating Matériau isolant / Classe d'inflammabilité	PC / UL94-V0
Anschlussart Termination Système de raccordement	Crimpen Crimping Sertir
Auszugskraft Withdrawal force Force d'extraction	5N
Maximale Erwärmung Maximum temperature rise Echauffement maximal	49K (UL 1977 – Section 16)
Temperaturbereich Temperature range Plage de températures	-40°C...+125°C

[1] Mit Distanzkörper D-P4/50PC, siehe Seiten 20/21
[2] Beinhaltet 400V / 690V (IEC 60038)
[3] Siehe Seite 45: UL Engineering considerations
[4] Gilt zwischen den spannungsführenden Teilen und der Befestigungsebene
[5] Bei Befestigung mit Metallzylinderschrauben
[6] Bei Befestigung mit Kunststoffschrauben

[1] With spacer D-P4/50PC, see pages 20/21
[2] Includes 400V / 690V (IEC 60038)
[3] See page 45: UL Engineering considerations
[4] Valid between live parts and mounting surface
[5] To attachment with metal cheese headed screws
[6] To attachment with plastic cheese headed screws

[1] Avec entretoise D-P4/50PC, voir pages 20/21
[2] Y compris 400V / 690V (CEI 60038)
[3] Voir page 45: UL Engineering considerations
[4] S'applique entre les parties conductrices et le plan de fixation
[5] Fixation avec des vis métalliques à tête cyl.
[6] Fixation avec des vis en matière plastique

Maximaler Versatz beim Einbau **Maximum mounting offset** **Rattrapage de jeu maxi**



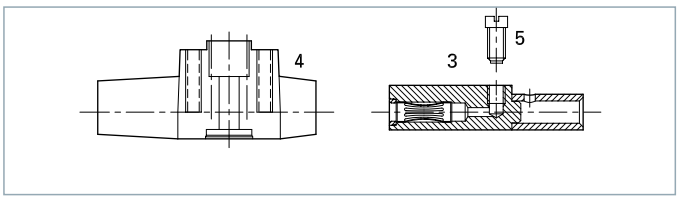
Nr. No. No.	Typ Type Type	Bestell-Nr. Order No. No. de Cde	Bezeichnung Description Description	Zulassung UL UL approval Approbation UL	Lieferform Delivered Livré
1	**P1/63-B10**	**15.0184**	Buchse / Socket / Douille	1)	unmontiert / unassembled / non monté
2	**P1/63-B10**	**15.0184**	Buchse / Socket / Douille	1)	unmontiert 2) / unassembled 2) / non monté 2)
Einzelteile			**Individual parts**		**Pièces détachées**
3	BP4-P1/63-10	01.0414	Buchse / Socket / Douille		
4	I-P1/63-B	15.5256	Isolation, schwarz / Insulation, black / Isolant, noir		
5	SCH-P4/50	15.5032	Zylinderschraube / Cheese headed screw / Vis à tête cylindrique		
6	D-P4/50PC	15.5035	Distanzkörper, schwarz / Spacer, black / Entretoise, noire		
7	**P1/63-S10K**	**15.0180**	Stecker / Plug / Broche	1)	unmontiert / unassembled / non monté
7	**P1/63-S10L** 3)	**15.0182**	Stecker / Plug / Broche	1)	unmontiert / unassembled / non monté
8	**P1/63-S10K**	**15.0180**	Stecker / Plug / Broche	1)	unmontiert 2) / unassembled 2) / non monté 2)
8	**P1/63-S10L** 3)	**15.0182**	Stecker / Plug / Broche	1)	unmontiert 2) / unassembled 2) / non monté 2)
Einzelteile			**Individual parts**		**Pièces détachées**
9	SP4-P1/63-10K	05.0403	Stift / Pin / Broche		
10	SP4-P1/63-10L	05.0404	Stift voreilend / Leading pin / Broche avancée		
11	I-P1/63-S	15.5255	Isolation, schwarz / Insulation, black / Isolant, noir		
5	SCH-P4/50	15.5032	Zylinderschraube / Cheese headed screw / Vis à tête cylindrique		
6	D-P4/50PC	15.5035	Distanzkörper, schwarz / Spacer, black / Entretoise, noire		

1) Siehe Seite 45: UL Engineer considerations
2) Distanzkörper 600V D-P4/50PC (Pos.-Nr. 6) bitte separat bestellen. Siehe Seiten 20 – 21
3) Mit voreilendem Stift

1) See page 45: UL Engineering considerations
2) Please order the spacer 600V D-P4/50PC (Pos. No. 6) separately. See pages 20 – 21
3) With leading pin

1) Voir page 45: UL Engineer considerations
2) L'entretoise 600V D-P4/50P (Pos. No. 6) doit être commandée séparément. Voir pages 20 – 21
3) Avec broche avancée

1



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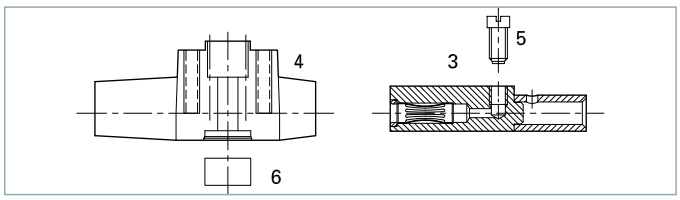

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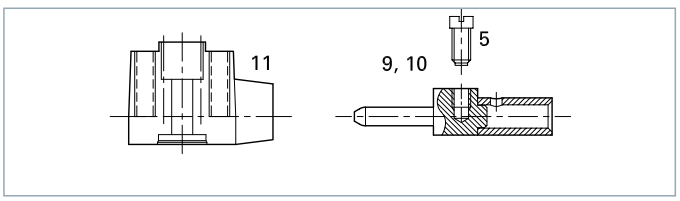

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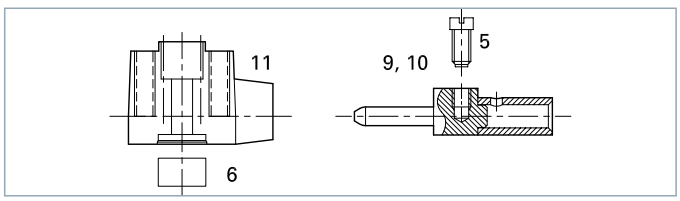
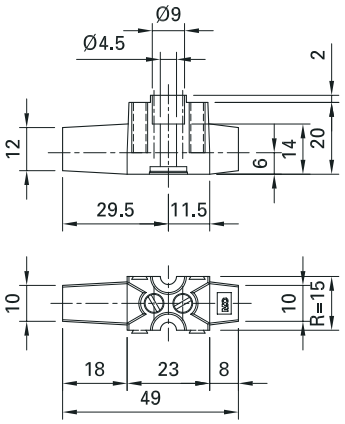


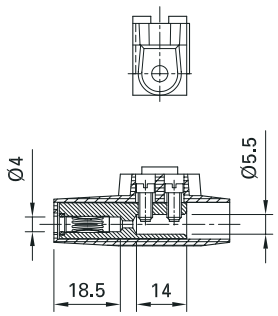
Buchsen- und Steckerleisteelement P1/63... mit Schraubklemmenanschluss

Socket and plug modules P1/63... with screw termination

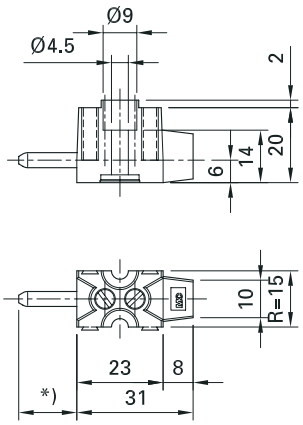
Connecteurs modulaires femelle et mâle P1/63... avec raccordement à visser

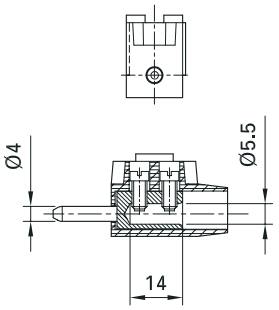
P1/63-BS





P1/63-SS...





Montagehinweise Assembly advices Conseils de montage	Seiten / Pages 20 – 21

*) Ausführung lang = 17,5 / kurz = 15,5
Long version = 17,5 / short = 15,5
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R = Rastermass / Raster dimension / Entraxe

Technische Daten / Technical data / Caractéristiques techniques

für Leiterquerschnitt for conductor cross section pour section du conducteur	10mm² / 8 AWG
Bemessungsstrom Rated current Intensité assignée	63A Derating diagram Seite/Page 41
Bemessungsspannung Rated voltage Tension assignée	500V / 600V [1] [2]
Kurzschlussstrom Short-circuit current Intensité de court-circuit	1,2kA / 1s 0,85kA / 3s
Prüfspannung (50Hz, 1min.) Test voltage (50Hz, 1min.) Tension d'essai (50Hz, 1min.)	2,21kV, 3,51kV [1] (: 2kV) [3]
Überschlagspannung (50Hz) Flashover voltage (50Hz) Tension de claquage (50Hz)	6kV / 9kV [1]
Kontaktwiderstand Contact resistance Résistance de contact	250µΩ

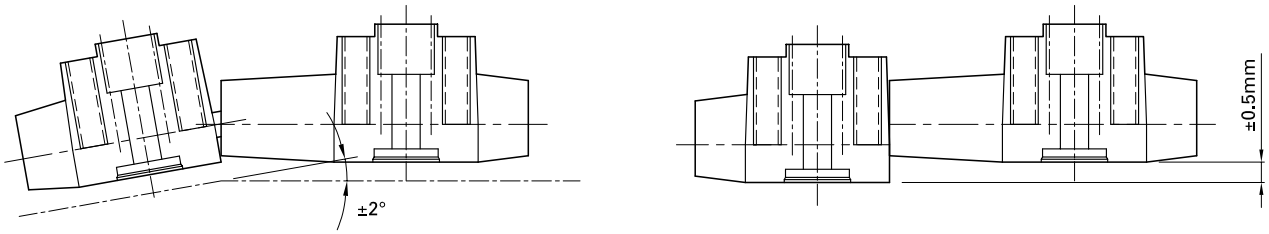
Kontaktmaterial Contact material Matériau conducteur	Messing, versilbert brass, silver plated laiton, argenté
Isolationskoordination [4] Insulation coordination [4] Coordination de l'isolement [4]	6kV/2 [5] / 6kV/3 [6]
Isolationsmaterial / Flammklasse Insulation material / Flame rating Matériau isolant / Classe d'inflammabilité	PC / UL94-V0
Anzugsdrehmom. / Anschlussschrauben Tightening torque / Termination screws Couple de serrage / Vis de raccordement	max. 1Nm
Auszugskraft Withdrawal force Force d'extraction	5N
Maximale Erwärmung Maximum temperature rise Echauffement maximal	49K (UL 1977 – Section 16)
Temperaturbereich Temperature range Plage de températures	-40°C...+125°C

[1] Mit Distanzkörper D-P4/50PC, siehe Seiten 20/21
[2] Beinhaltet 400V / 690V (IEC 60038)
[3] Siehe Seite 45: UL Engineering considerations
[4] Gilt zwischen den spannungsführenden Teilen und der Befestigungsebene
[5] Bei Befestigung mit Metallzylinderschrauben
[6] Bei Befestigung mit Kunststoffschrauben

[1] With spacer D-P4/50PC, see pages 20/21
[2] Includes 400V / 690V (IEC 60038)
[3] See page 45: UL Engineering considerations
[4] Valid between live parts and mounting surface
[5] To attachment with metal cheese headed screws
[6] To attachment with plastic cheese headed screws

[1] Avec entretoise D-P4/50PC, voir pages 20/21
[2] Y compris 400V / 690V (CEI 60038)
[3] Voir page 45: UL Engineering considerations
[4] S'applique entre les parties conductrices et le plan de fixation
[5] Fixation avec des vis métalliques à tête cyl.
[6] Fixation avec des vis en matière plastique

Maximaler Versatz beim Einbau **Maximum mounting offset** **Rattrapage de jeu maxi**



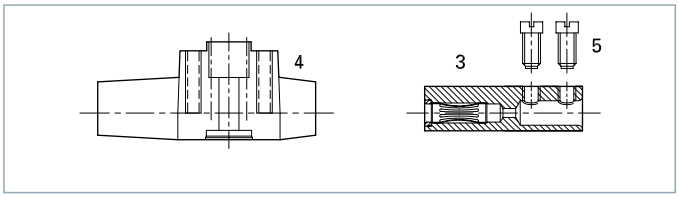
Nr. No. No.	Typ Type Type	Bestell-Nr. Order No. No. de Cde	Bezeichnung Description Description	Zulassung UL UL approval Approbation UL	Lieferform Delivered Livré
1	**P1/63-BS**	**15.0164**	Buchse / Socket / Douille	1)	montiert / assembled / monté
2	**P1/63-BS**	**15.0164**	Buchse / Socket / Douille	1)	montiert 2) / assembled 2) / monté 2)
Einzelteile			**Individual parts**		**Pièces détachées**
3	B4-P4/50-B	01.0410	Buchse / Socket / Douille		
4	I-P1/63-B	15.5256	Isolation, schwarz / Insulation, black / Isolant, noir		
5	SCH-P4/50	15.5032	Zylinderschraube / Cheese headed screw / Vis à tête cylindrique		
6	D-P4/50PC	15.5035	Distanzkörper, schwarz / Spacer, black / Entretoise, noire		
7	**P1/63-SSK**	**15.0160**	Stecker / Plug / Broche	1)	montiert / assembled / monté
7	**P1/63-SSL** 3)	**15.0162**	Stecker / Plug / Broche	1)	montiert / assembled / monté
8	**P1/63-SSK**	**15.0160**	Stecker / Plug / Broche	1)	montiert 2) / assembled 2) / monté 2)
8	**P1/63-SSL** 3)	**15.0162**	Stecker / Plug / Broche	1)	montiert 2) / assembled 2) / monté 2)
Einzelteile			**Individual parts**		**Pièces détachées**
9	S4-P4/50-S17	04.0410	Stift / Pin / Broche		
10	S4-P4/50-S19	04.0413	Stift voreilend / Leading pin / Broche avancée		
11	I-P1/63-S	15.5255	Isolation, schwarz / Insulation, black / Isolant, noir		
5	SCH-P4/50	15.5032	Zylinderschraube / Cheese headed screw / Vis à tête cylindrique		
6	D-P4/50PC	15.5035	Distanzkörper, schwarz / Spacer, black / Entretoise, noire		

1) Siehe Seite 45: UL Engineer considerations
2) Distanzkörper 600V D-P4/50PC (Pos.-Nr. 6) bitte separat bestellen. Siehe Seiten 20 – 21
3) Mit voreilendem Stift

1) See page 45: UL Engineering considerations
2) Please order the spacer 600V D-P4/50PC (Pos. No. 6) separately. See pages 20 – 21
3) With leading pin

1) Voir page 45: UL Engineer considerations
2) L'entretoise 600V D-P4/50P (Pos. No. 6) doit être commandée séparément. Voir pages 20 – 21
3) Avec broche avancée

1



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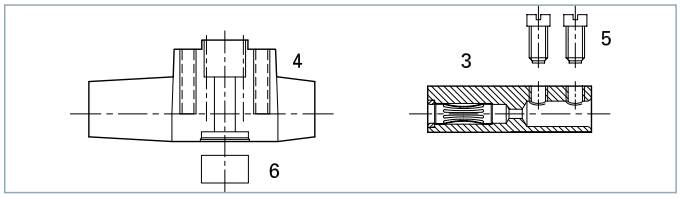

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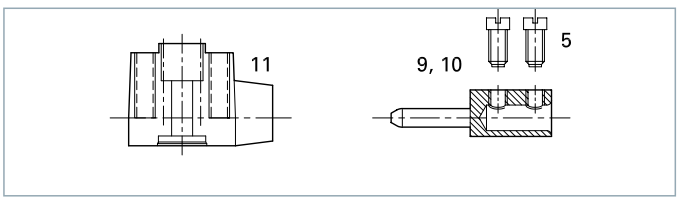

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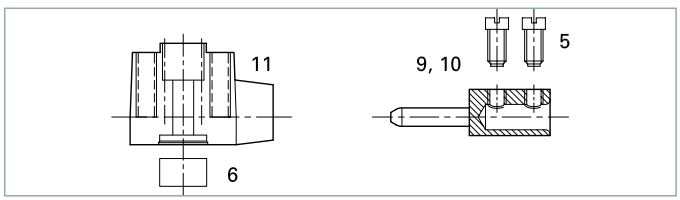
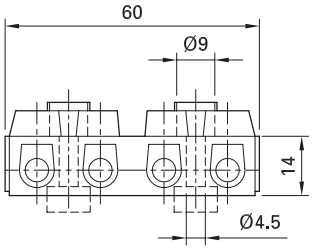


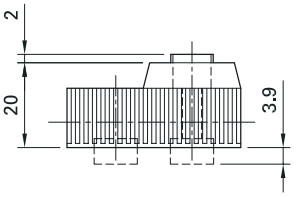
4-polige Buchsen- und Steckerleiste mit Schraubanschluss P4/50... und P4/63...

4-pole socket and plug blocks with screw termination P4/50... und P4/63...

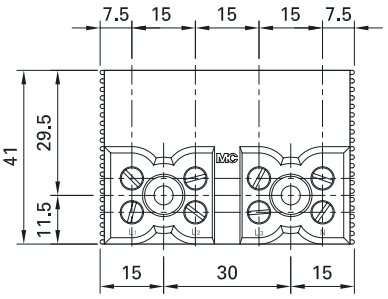
Barrettes 4-pôles femelle et mâle avec raccordement à visser P4/50... und P4/63...

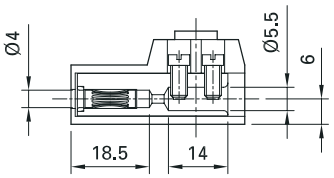
P4/50-B
P4/63-B-PC





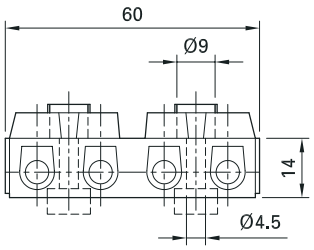
P4/50-B-D
P4/63-B-PCD

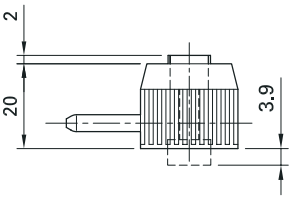




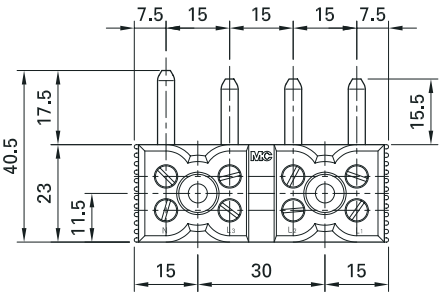
Inkl. 4 Distanzkörper D-P4/50PC
With 4 spacers D-P4/50PC
Avec 4 entretoises D-P4/50PC

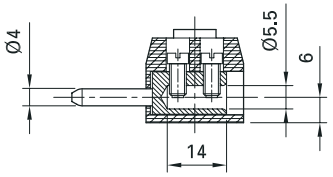
P4/50-S
P4/63-S-PC





P4/50-S-D
P4/63-S-PCD





Inkl. 2 Distanzkörper D-P4/50PC
With 2 spacers D-P4/50PC
Avec 2 entretoises D-P4/50PC

Montagehinweise Assembly advices Conseils de montage	Seiten / Pages 21

Mechanische Daten / Mechanical data / Caractéristiques mécaniques

für Leiterquerschnitt Cu for conductor cross section Cu pour section du conducteur Cu	10mm² / 8 AWG
Kontaktmaterial Contact material Matériau conducteur	Messing, versilbert brass, silver plated laiton, argenté
Isolationsmaterial schwarz Insulation material black Matériau isolant noir	P4/50..., ABS P4/63..., PC
Flammklasse Flame class Classe d'inflammabilité	UL94-V0

Anzugsdrehmom. / Anschlussschrauben Tightening torque / Termination screws Couple de serrage / Vis de raccordement	max. 1Nm
Auszugskraft Withdrawal force Force d'extraction	20N
Maximale Erwärmung Maximum temperature rise Echauffement maximal	59,7K (UL 1977 – Section 16)
Temperaturbereich Temperature range Plage de températures	P4/50..., -40°C...+90°C P4/63..., -40°C...+120°C

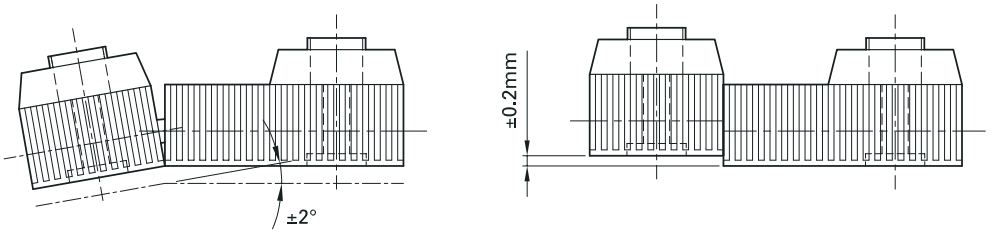
Elektrische Daten / Electrical data

Bemessungsstrom Rated current Intensité assignée	P4/50... , 50A P4/63..., 63A Derating diagram Seite/Page 41
Bemessungsspannung Rated voltage Tension assignée	500V / 600V [1] [2]
Kurzschlussstrom Short-circuit current Intensité de court-circuit	1,2kA / 1s 0,85kA / 3s
Prüfspannung (50Hz, 1min.) Test voltage (50Hz, 1min.) Tension d'essai (50Hz, 1min.)	2,2kV, 3,3kV [1] (: 2kV) [3]

Caractéristiques électriques

Überschlagspannung (50Hz) Flashover voltage (50Hz) Tension de claquage (50Hz)	3kV, 4kV [1]
Kontaktwiderstand Contact resistance Résistance de contact	250µΩ
Isolationskoordination ohne Distanzkörper [4] Insulation coordination without spacer [4] Coordination de l'isolement sans entretoise [4]	 P4/50..., 4kV/2 P4/63..., 4kV/1
Isolationskoordination mit Distanzkörper [4] Insulation coordination with spacer [4] Coordination de l'isolement avec entretoise [4]	 6kV/2 [5] 6kV/3 [6]

Maximaler Versatz beim Einbau / Maximum mounting offset / Rattrapage de jeu maxi



Typ Type Type	Bestell-Nr. Order No. No. de Cde	Bezeichnung Description Description	Zulassung UL UL Approval Approbation UL	Lieferform Delivered Livré
P4/50-B	**15.0112**	Buchse / Socket / Douille	[3]	montiert / assembled / monté
P4/63-B-PC	**15.0114**	Buchse / Socket / Douille	[3]	montiert / assembled / monté
P4/50-B-D	**15.0116**	Buchse / Socket / Douille	[3]	montiert / assembled / monté
P4/63-B-PCD	**15.0118**	Buchse / Socket / Douille	[3]	montiert / assembled / monté
P4/50-S	**15.0111**	Stecker / Plug / Broche	[3]	montiert / assembled / monté
P4/63-S-PC	**15.0113**	Stecker / Plug / Broche	[3]	montiert / assembled / monté
P4/50-S-D	**15.0115**	Stecker / Plug / Broche	[3]	montiert / assembled / monté
P4/63-S-PCD	**15.0117**	Stecker / Plug / Broche	[3]	montiert / assembled / monté

[1] Mit Distanzkörper D-P4/50PC, siehe Seiten 20 – 21
[2] Beinhaltet 400V / 690V (IEC 60038)
[3] Siehe Seite 45: UL Engineering considerations
[4] Gilt zwischen spannungsführenden Teilen und der Befestigungsebene
[5] Bei Montage mit 2 Metallzylinderschrauben
[6] Bei Montage mit 2 Kunststoffzylinderschrauben

[1] With spacer D-P4/50PC, see pages 20 – 21
[2] Includes 400V / 690V (IEC 60038)
[3] See page 45: UL Engineering considerations
[4] Valid between live parts and mounting surface
[5] To attachment with 2 metal cheese headed screws
[6] To attachment with 2 plastic cheese headed screws

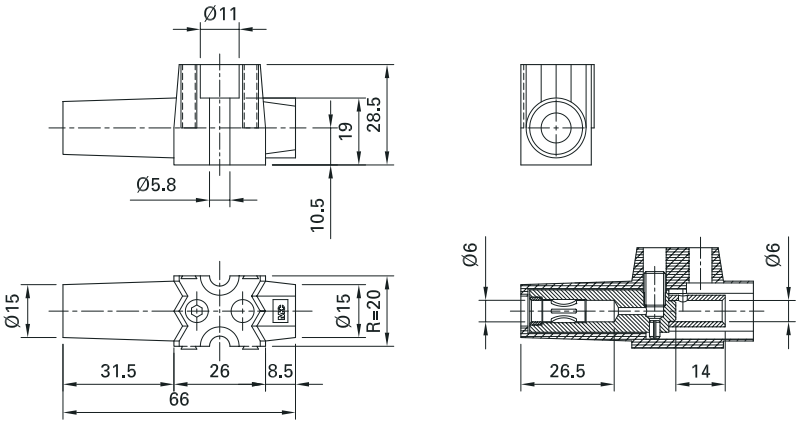
[1] Avec entretoise D-P4/50PC, voir pages 20 – 21
[2] Y compris 400V / 690V (CEI 60038)
[3] Voir page 45: UL Engineering considerations
[4] S'applique entre les parties conductrices et le plan de fixation
[5] Fixation avec 2 vis métalliques à tête cyl.
[6] Fixation avec 2 vis en matière plastique à tête cyl.

Buchsen- und Steckerleisteelement P1/100... mit Crimpanschluss

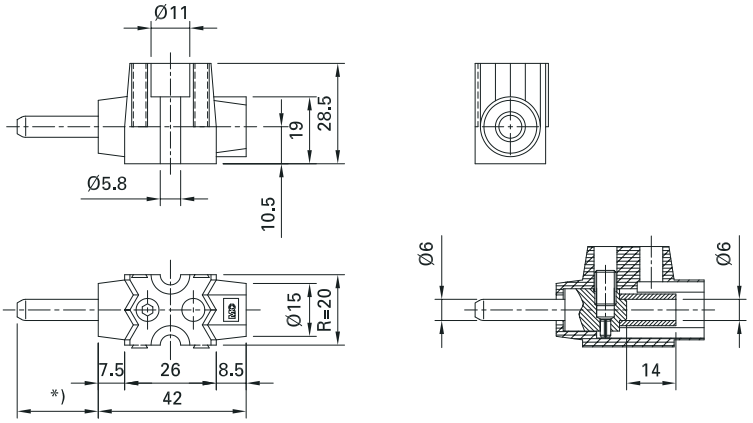
Socket and plug modules P1/100... with crimp termination

Connecteurs modulaires femelle et mâle P1/100... avec raccordement à sertir

P1/100-B16



P1/100-S16...



Montagehinweise Assembly advices Conseils de montage	Seiten / Pages 20 – 21

*) Ausführung lang = 26 / kurz = 23
Long version = 26 / short = 23
Version longue = 26 / courte = 23

R = Rastermass / Raster dimension / Entraxe

Technische Daten / Technical data / Caractéristiques techniques

für Leiterquerschnitt for conductor cross section pour section du conducteur	16mm² / 6 AWG
Bemessungsstrom Rated current Intensité assignée	100A Derating diagram Seite/Page 41
Bemessungsspannung Rated voltage Tension assignée	600V [1]
Kurzschlussstrom Short-circuit current Intensité de court-circuit	2,2kA / 1s 1,3kA / 3s
Prüfspannung (50Hz, 1min.) Test voltage (50Hz, 1min.) Tension d'essai (50Hz, 1min.)	3,51kV (: 2,2kV) [2]
Überschlagspannung (50Hz) Flashover voltage (50Hz) Tension de claquage (50Hz)	9kV
Kontaktwiderstand Contact resistance Résistance de contact	150µΩ

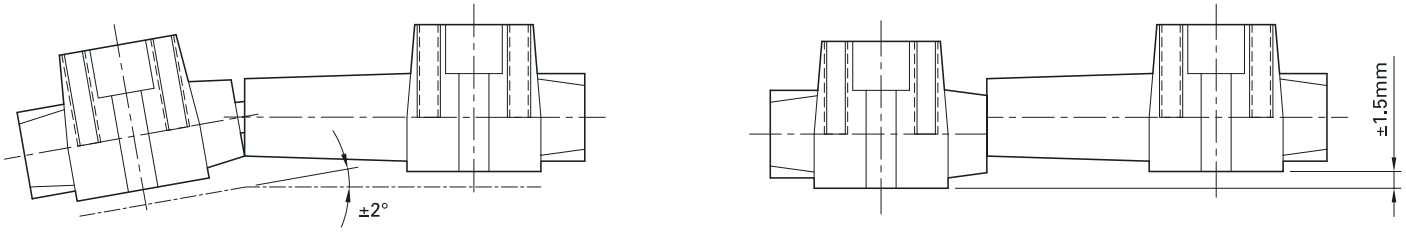
Kontaktmaterial Contact material Matériau conducteur	Messing, versilbert brass, silver plated laiton, argenté
Isolationskoordination Insulation coordination Coordination de l'isolement	6kV / 2 [3]
Isolationsmaterial / Flammklasse Insulation material / Flame rating Matériau isolant / Classe d'inflammabilité	PC / UL94-V0
Anschlussart Termination Système de raccordement	Crimpen Crimping Sertir
Auszugskraft Withdrawal force Force d'extraction	25N
Maximale Erwärmung Maximum temperature rise Echauffement maximal	49K
Temperaturbereich Temperature range Plage de températures	-40°C...+125°C

[1] Beinhaltet 400V / 690V (IEC 60038)
[2] Siehe Seite 45: UL Engineering considerations
[3] Gilt zwischen den spannungsführenden Teilen und der Befestigungsebene

[1] Includes 400V / 690V (IEC 60038)
[2] See page 45: UL Engineering considerations
[3] Valid between live parts and mounting surface

[1] Y compris 400V / 690V (CEI 60038)
[2] Voir page 45: UL Engineering considerations
[3] S'applique entre les parties conductrices et le plan de fixation

Maximaler Versatz beim Einbau **Maximum mounting offset** **Rattrapage de jeu maxi**



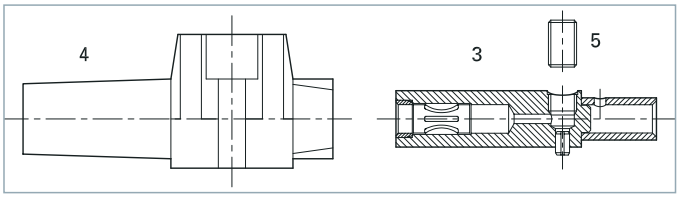
Nr. No. No.	Typ Type Type	Bestell-Nr. Order No. No. de Cde	Bezeichnung Description Description	Zulassung UL UL approval Approbation UL	Lieferform Delivered Livré
1	**P1/100-B16**	**15.0172**	Buchse / Socket / Douille	1)	unmontiert / unassembled / non monté
Einzelteile			**Individual parts**		**Pièces détachées**
3	BP6-P1/100-16	01.0406	Buchse / Socket / Douille		
4	I-P1/100-B	15.5252	Isolation, schwarz / Insulation, black / Isolant, noir		
5	GS-P1/100	15.5253	Gewindestift, M6x12 / Grub screw, M6x12 / Vis sans tête, M6x12		
2	**P1/100-S16K**	**15.0170**	Stecker / Plug / Broche	1)	unmontiert / unassembled / non monté
2	**P1/100-S16L** 2)	**15.0171**	Stecker / Plug / Broche	1)	unmontiert / unassembled / non monté
Einzelteile			**Individual parts**		**Pièces détachées**
6	SP6-P1/100-16K	05.0400	Stecker / Plug / Broche		
7	SP6-P1/100-16L	05.0401	Stecker, voreilender Stift / Plug, leading pin / Broche avancée		
8	I-P1/100-S	15.5251	Isolation, schwarz / Insulation, black / Isolant, noir		
5	GS-P1/100	15.5253	Gewindestift, M6x12 / Grub screw, M6x12 / Vis sans tête, M6x12		

1) Siehe Seite 45: UL Engineering considerations
2) Mit voreilendem Stift

1) See page 45: UL Engineering considerations
2) With leading pin

1) Voir page 45: UL Engineering considerations
2) Avec broche avancée

1



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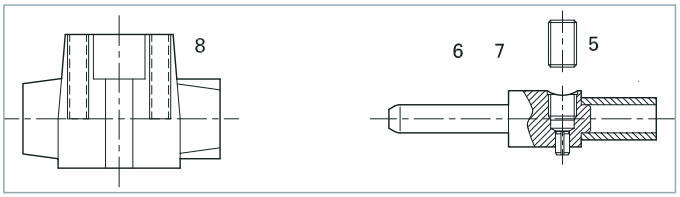
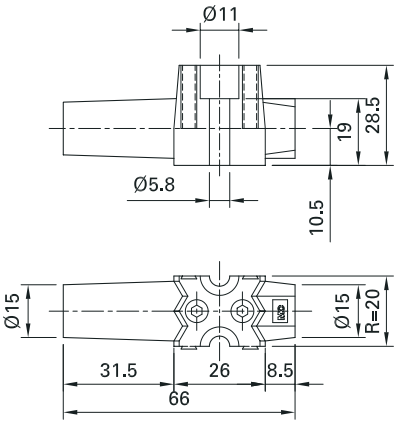


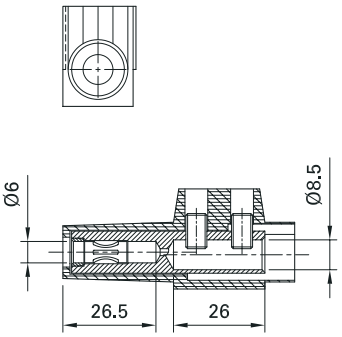
Buchsen- und Steckerleisteelement P1/100... mit Schraubklemmenanschluss

Socket and plug modules P1/100... with screw termination

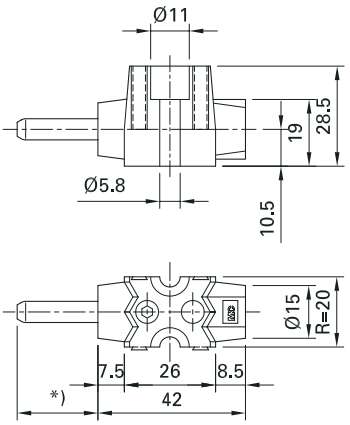
Connecteurs modulaires femelle et mâle P1/100... avec raccordement à visser

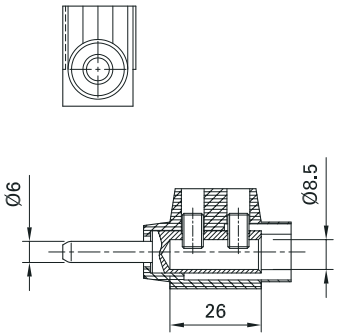
P1/100-BS





P1/100-SS...





Montagehinweise Assembly advices Conseils de montage	Seiten / Pages 20 – 21

*) Ausführung lang = 26 / kurz = 23
Long version = 26 / short = 23
Version longue = 26 / courte = 23

R = Rastermass / Raster dimension / Entraxe

Technische Daten / Technical data / Caractéristiques techniques

für Leiterquerschnitt for conductor cross section pour section du conducteur	16mm², 25mm² 6 AWG, 4 AWG
Bemessungsstrom Rated current Intensité assignée	100A, 130A Derating diagram Seite/Page 41
Bemessungsspannung Rated voltage Tension assignée	600V [1]
Kurzschlussstrom Short-circuit current Intensité de court-circuit	2,2kA / 1s 1,3kA / 3s
Prüfspannung (50Hz, 1min.) Test voltage (50Hz, 1min.) Tension d'essai (50Hz, 1min.)	3,51kV (UL: 2,2kV) [2]
Überschlagspannung (50Hz) Flashover voltage (50Hz) Tension de claquage (50Hz)	9kV
Kontaktwiderstand Contact resistance Résistance de contact	150µΩ

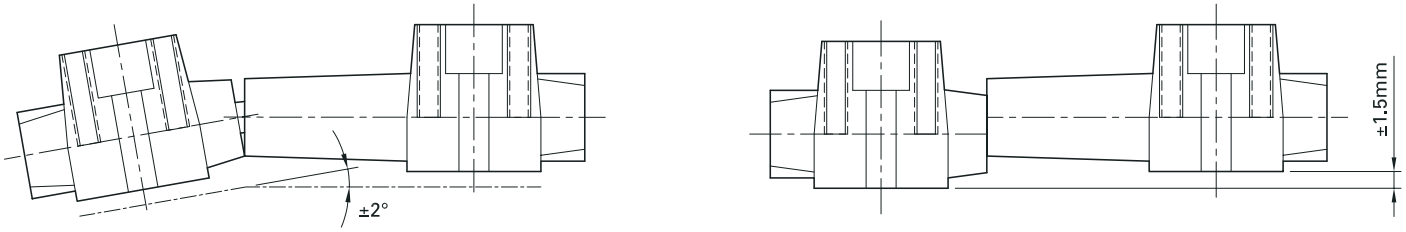
Kontaktmaterial Contact material Matériau conducteur	Messing, versilbert brass, silver plated laiton, argenté
Isolationskoordination Insulation coordination Coordination de l'isolement	6kV / 2 [3]
Isolationsmaterial / Flammklasse Insulation material / Flame rating Matériau isolant / Classe d'inflammabilité	PC / UL94-V0
Anzugsdrehmom. / Anschlussschrauben Tightening torque / Termination screws Couple de serrage / Vis de raccordement	max. 3Nm
Auszugskraft Withdrawal force Force d'extraction	25N
Maximale Erwärmung Maximum temperature rise Echauffement maximal	49K (UL 1977 – Section 16)
Temperaturbereich Temperature range Plage de températures	-40°C...+125°C

[1] Beinhaltet 400V / 690V (IEC 60038)
[2] Siehe Seite 45: UL Engineering considerations
[3] Gilt zwischen den spannungsführenden Teilen und der Befestigungsebene

[1] Includes 400V / 690V (IEC 60038)
[2] See page 45: UL Engineering considerations
[3] Valid between live parts and mounting surface

[1] Y compris 400V / 690V (CEI 60038)
[2] Voir page 45: UL Engineering considerations
[3] S'applique entre les parties conductrices et le plan de fixation

Maximaler Versatz beim Einbau | **Maximum mounting offset** | **Rattrapage de jeu maxi**



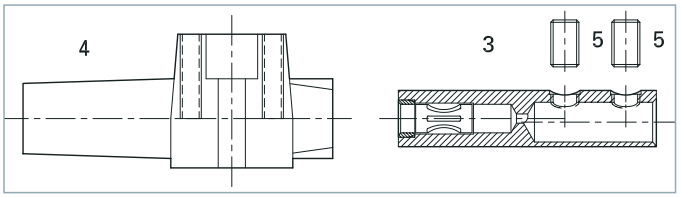
Nr. No. No.	Typ Type Type	Bestell-Nr. Order No. No. de Cde	Bezeichnung Description Description	Zulassung UL UL approval Approbation UL	Lieferform Delivered Livré
1	**P1/100-BS**	**15.0152**	Buchse / Socket / Douille	1)	montiert / assembled / monté
Einzelteile			**Individual parts**		**Pièces détachées**
3	BP6-P1/100-S	01.0405	Buchse / Socket / Douille		
4	I-P1/100-B	15.5252	Isolation, schwarz / Insulation, black / Isolant, noir		
5	GS-P1/100	15.5253	Gewindestift, M6x12 / Grub screw, M6x12 / Vis sans tête, M6x12		
2	**P1/100-SSK**	**15.0150**	Stecker / Plug / Broche	1)	montiert / assembled / monté
2	**P1/100-SSL** 2)	**15.0151**	Stecker / Plug / Broche	1)	montiert / assembled / monté
Einzelteile			**Individual parts**		**Pièces détachées**
6	SP6-P1/100-SK	04.0401	Stecker / Plug / Broche		
7	SP6-P1/100-SL	04.0402	Stecker, voreilender Stift / Plug, leading pin / Broche avancée		
8	I-P1/100-S	15.5251	Isolation, schwarz / Insulation, black / Isolant, noir		
5	GS-P1/100	15.5253	Gewindestift, M6x12 / Grub screw, M6x12 / Vis sans tête, M6x12		

1) Siehe Seite 45: UL Engineering considerations
2) Mit voreilendem Stift

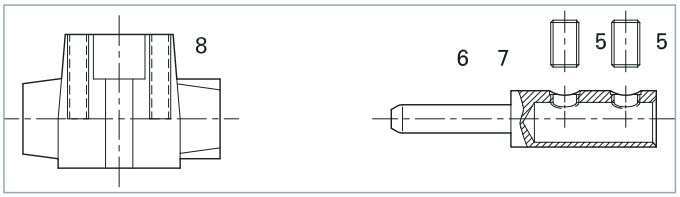
1) See page 45: UL Engineering considerations
2) With leading pin

1) Voir page 45: UL Engineering considerations
2) Avec broche avancée

1



2



Befestigungsmaterial

für 2 bis 10 Buchsen- und Steckerleisteelemente P1/30..., P1/63... und P1/100...

Hinweis: Das Befestigungsmaterial gehört nicht zum Lieferumfang

Fixing material

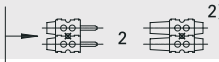
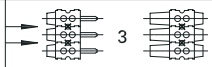
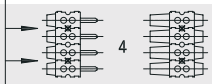
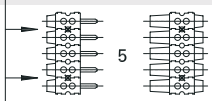
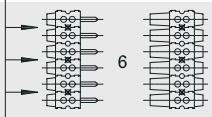
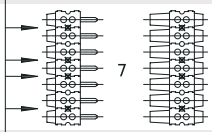
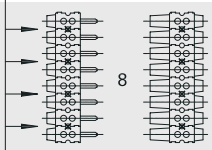
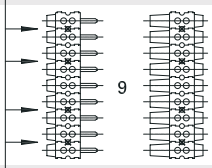
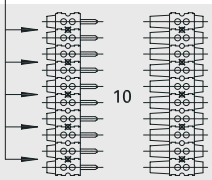
for 2 up to 10 socket and plug modules P1/30..., P1/63... and P1/100...

Note: Fixing material is not suplied

Matériel de fixation

pour 2 à 10 connecteurs modulaires P1/30..., P1/63... et P1/100...

Remarque: Le matériel de fixation est hors fourniture

Empfohlene Befestigungsstellen Recommended fixing points Points de fixations recommandés	Anzahl Elemente Number of modules Nombre de connecteurs	P1/30-BS P1/30-SS...	P1/63-S... **(500V)** P1/63-B... **(500V)**	P1/63-S... mit / with / avec D-P4/50PC **(600V)** P1/63-B... mit / with / avec D-P4/50PC **(600V)**		P1/100-S... P1/100-B...
		Zylinderschraube M3 DIN 84A Unterlegscheibe M3 DIN 125A Cheese headed screw M3 DIN 84A Brass washer M3 DIN 125A Vis à tête cylindrique M3 DIN 84A Rondelle en laiton M3 DIN 125A	Zylinderschraube M4 DIN 84A Cheese headed screw M4 DIN 84A Vis à tête cylindrique M4 DIN 84A	Distanzkörper D-P4/50PC Bestell-Nr. 15.5035 Spacer D-P4/50PC Order No. 15.5035 Entretoise D-P4/50PC No. de Cde 15.5035	Zylinderschraube M4 DIN 84A Cheese headed screw M4 DIN 84A Vis à tête cylindrique M4 DIN 84A	Zylinderschraube M4 DIN 84A Unterlegscheibe M5 DIN 125A Cheese headed screw M4 DIN 84A Brass washer M5 DIN 125A Vis à tête cylindrique M4 DIN 84A Rondelle en laiton M5 DIN 125A
					[1]	
	2 [2]	1	1	1	1	1
	3	2	2	2	2	2
	4	2	2	3	2	2
	5	2	2	4	2	2
	6	3	3	5	3	3
	7	4	4	6	4	4
	8	4	4	7	4	4
	9	4	4	8	4	4
	10	5	5	9	5	5

[1] **Isolationskoordination**
– 6 kV/2 mit Metallzylinderschrauben
– 6 kV/3 mit Kunststoffzylinderschrauben

[2] Bei 2-poligen Elementen ist eine Verdrehsicherung vorzusehen (Kunststoffstift oder Kunststoffschraube

[1] **Insulation coordination**
– 6 kV/2 with metal cheese headed screws
– 6 kV/3 with plastic cheese headed screws

[2] In case of the 2-pole module it is recommended that a plastic pin or screw be used to prevent rotation

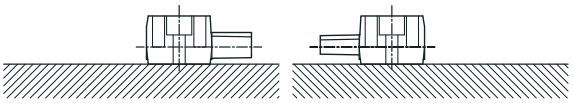
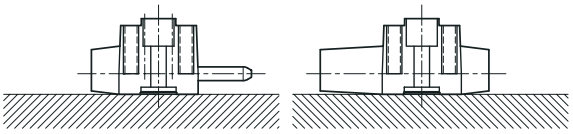
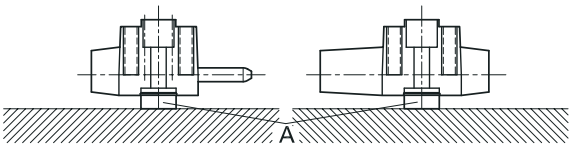
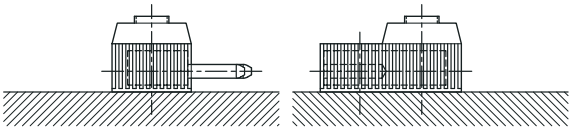
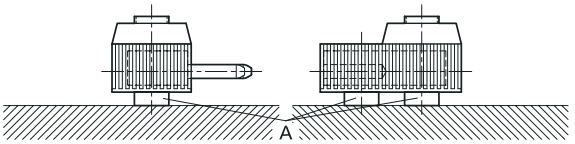
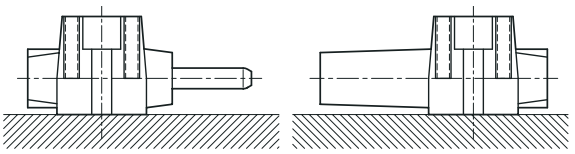
[1] **Coordination de l'isolement**
– 6 kV/2 avec des vis métalliques à tête cylindrique
– 6 kV/3 avec des vis à tête cyl. en matière plastique

[2] Pour les élements à 2 pôles, prévoir une fiche ou une vis en matière plastique pour assurer l'anti-rotation

Montageanordnung für Bemessungsspannungen von 500V und 600V
Für P1/30..., P1/63..., P4/50..., P4/63..., P1/100...

Mounting for rated voltage 500V and 600V
For P1/30..., P1/63..., P4/50..., P4/63..., P1/100...

Montage pour tension assignée 500V et 600V
Pour P1/30..., P1/63..., P4/50..., P4/63..., P1/100...

Typ Type Type	500V	600V
P1/30...		
P1/63...		
P4/50... P4/63		
P1/100...		

= Befestigungsebene / Mounting surface / Plan de fixation

A = Distanzkörper / Spacer / Entretoise

D-P4/50PC (15.5035)

Einschubbuchsen EBB...
Einschubstecker EBS...

Slide-in sockets EBB...
Slide-in plugs EBS...

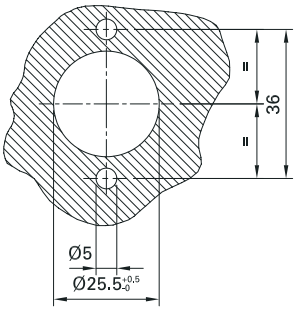
Douilles EBB... et broches EBS... pour tiroirs embrochables

EBB8-V0
EBB10-V0

EBB14-V0

Bohrplan
Drilling plan
Plan de perçage

EBB8-V0, EBS8-V0
EBB10-V0, EBS10-V0

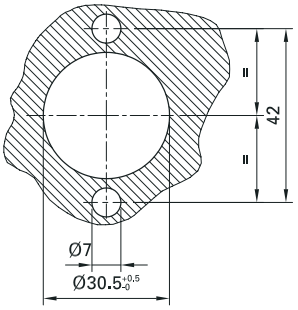


EBS8-V0
EBS10-V0

EBS14-V0

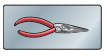
Bohrplan
Drilling plan
Plan de perçage

EBB14-V0, EBS14-V0



Technische Daten / Technical data / Caractéristiques techniques

Bemessungsspannung Rated voltage Tension assignée	500V
Prüfspannung (50Hz, 1min.) Test voltage (50Hz, 1min.) Tension d'essai (50Hz, 1min.)	3,3kV
Überschlagspannung (50Hz) Flashover voltage (50Hz) Tension de claquage (50Hz)	> 4kV

Isolationskoordination Insulation coordination Coordination de l'isolement	6kV / 2
Isolationsmaterial Insulation material Matériau isolant	EB...8... / EB...10..., PA66 [1] EB...14..., PA66 [2]
Montageanleitung Assembly instructions Instructions de montage	 MA020 www.multi-contact.com

Type Type Type	Bestell-Nr. Order No. No. de Cde	Gewindeanschluss Threaded bolt connection Connexion sur tige filetée	Leiterquerschnitt Cu Conductor cross section Cu Section du conducteur Cu	Nenn-Ø Stift / Buchse Nominal-Ø pin / socket Ø nominal broche / douille	Auszugskraft Withdrawal force Force d'extraction	Max. Anzugsdrehmoment [3] Max. tightening torque [3] Couple de serrage max. [3]	Bemessungsstrom Rated current Intensité assignée	Kontaktwiderstand Contact resistance Résistance de contact	Kurzschlussstrom (1s) Short circuit current (1s) Intensité de court-circuit (1s)	Kurzschlussstrom (3s) Short circuit current (3s) Intensité de court-circuit (3s)
			mm²	mm	N	Nm	A	µΩ	kA	kA
EBB8-V0	01.0474	M8	35	8	20	6	160	60	3	1,5
EBS8-V0	04.0427	M8	35	8		6	160		3	1,5
EBB10-V0	01.0475	M10	50	10	30	10	200	50	5,5	3
EBS10-V0	04.0428	M10	50	10		10	200		5,5	3
EBB14-V0	01.0431	M16	120	14	50	22	300	50	12	8
EBS14-V0	04.0431	M16	120	14		22	300		12	8

Bestellangaben und Einzelteile, siehe Seiten 24 – 25.

[1] Farbe schwarz
[2] Farbe rot
[3] Der Leitungsanschlussmuttern

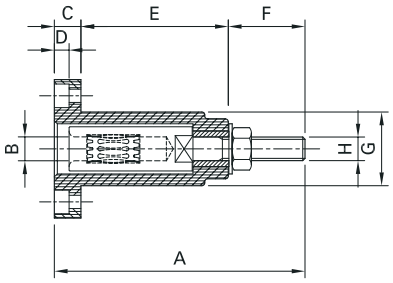
Ordering information and individual parts, see pages 24 – 25.

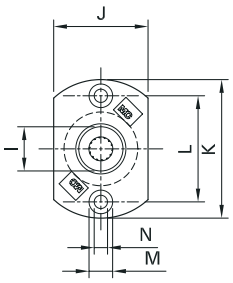
[1] Colour black
[2] Colour red
[3] Of the cable connection nut

Pour vos commandes et pièces détachées, voir pages 24 – 25.

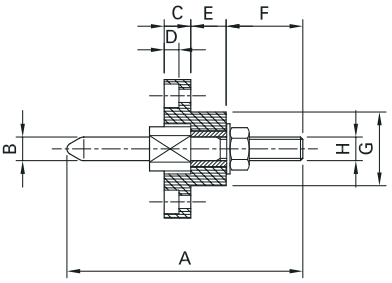
[1] Couleur noire
[2] Couleur rouge
[3] Des écrous de raccordement

Typ Type Type	Bestell-Nr. Order No. No. de Cde	Abmessungen (mm) Dimensions (mm) Dimensions (mm)													
		A	B	C	D	E	F	G	H	I	J	K	L	M	N
EBB8-V0	01.0474	85	8	9	5	50	26	25	M8	15	32	47	36	8,5	4,7
EBS8-V0	04.0427	80	8	9	5	12	26	25	M8	15	32	47	36	8,5	4,7
EBB10-V0	01.0475	90	10	9	5	50	31	25	M10	16	32	47	36	8,5	4,7
EBS10-V0	04.0428	85	10	9	5	12	31	25	M10	16	32	47	36	8,5	4,7
EBB14-V0	01.0431	120,5	14	12	7	53	55,5	30	M16	24	40	60	42	11	7
EBS14-V0	04.0431	132,5	14	12	7	20	55,5	30	M16	24	40	60	42	11	7





Plattenabstand = 2 x C



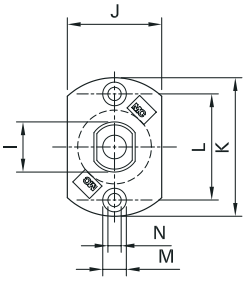


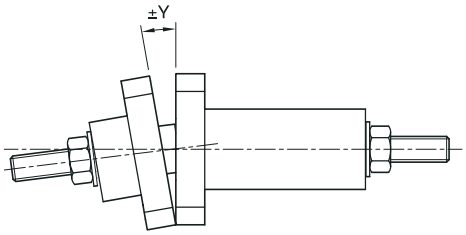
Plate spacing = 2 x C

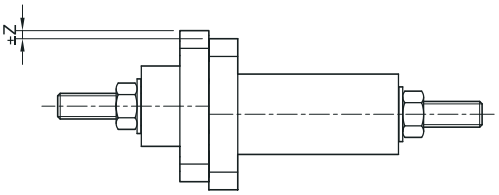
Ecartement des plaques = 2 x C

Maximaler Versatz beim Einbau

Maximum mounting offset

Rattrapage de jeu maxi



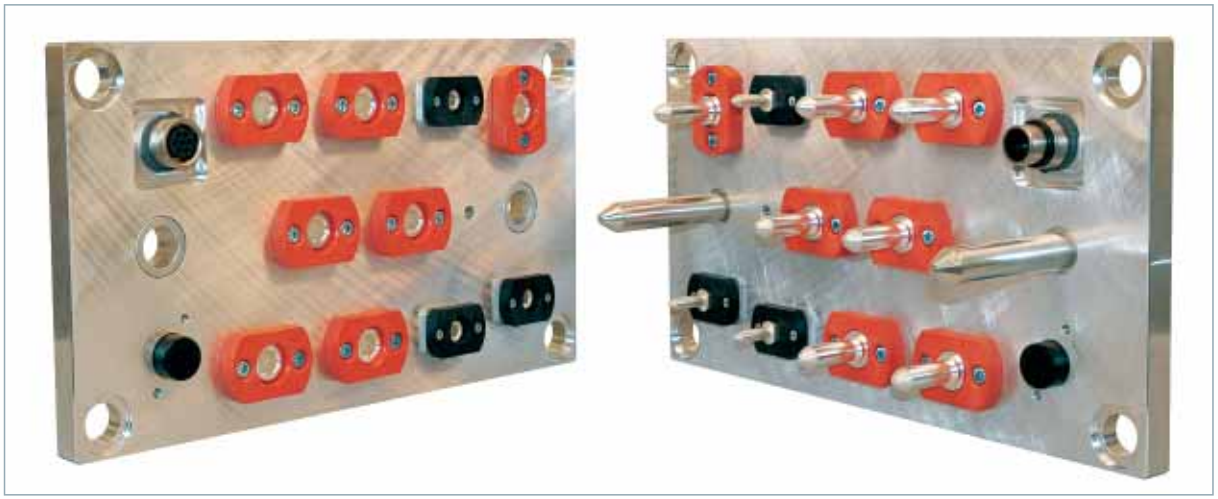


Typ Type Type	Y	Z	Max. Frontplattendicke Max. panel thickness Epaisseur max. du panneau	Min. Abstand zwischen 2 Elementen Min. distance between 2 elements Distance min. entre 2 éléments
EBB8... / EBS8...	2,5°	± 1mm	5mm	35mm
EBB10... / EBS10...	1,5°	± 1mm	5mm	35mm
EBB14... / EBS14...	1°	± 1mm	10mm	45mm

Applikation mit Einschubbuchsen und Stecker auf einer Dockingplatte

Application with slide-in sockets and plugs on a docking plate

Application: douilles et broches montées sur des plaques multi-raccords

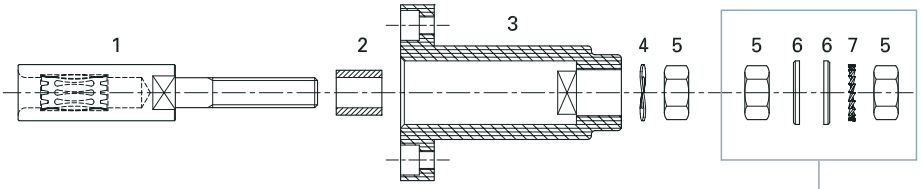


Bestellangaben				Ordering information	Pour vos commandes
Nr. No. No.	Typ Type Type	Bestell-Nr. Order No. No. de Cde	Ø mm	Bezeichnung Description Description	Lieferform Delivered Livré
	EBB8-V0	**01.0474**	8	Buchsen / Socket / Douille	montiert / assembled / monté
	EBB10-V0	**01.0475**	10	Buchsen / Socket / Douille	montiert / assembled / monté
	EBB14-V0	**01.0431**	14	Buchsen / Socket / Douille	montiert / assembled / monté
Einzelteile				**Individual parts**	**Pièces détachées**
1	B-EBB8	01.0411	8	Buchseneinsatz, Ms, versilbert / Socket insert, brass, silver-plat. / Douille en laiton, argentée	
1	B-EBB10	01.0419	10	Buchseneinsatz, Ms, versilbert / Socket insert, brass, silver-plat. / Douille en laiton, argentée	
1	B-EBB14	01.0470	14	Buchseneinsatz, Ms, versilbert / Socket insert, brass, silver-plat. / Douille en laiton, argentée	
2	D-EBB/S8	01.0413	8	Distanzrohr [1] / Spacer tube [1] / Entretoise [1]	
2	D-EBB/S10	01.0418	10	Distanzrohr [1] / Spacer tube [1] / Entretoise [1]	
3	I-EBB8-V0	01.0466	8 +10	Isolierkörper PA66, schwarz / Insulation PA66, black / Fourreau isolant PA66, noir	
3	I-EBB14-V0	01.0471	14	Isolierkörper PA66, rot / Insulation PA66, red / Fourreau isolant PA66, rouge	
4	FS/M8	08.0721	8	Federscheibe DIN 137, Bronze / Lock washer DIN137, bronze / Rondelle frein DIN 137, bronze	
4	FS/M10	08.0722	10	Federscheibe DIN 137, Bronze / Lock washer DIN137, bronze / Rondelle frein DIN 137, bronze	
4	U/M16	08.0309	14	U-Scheibe / Washer / Rondelle	
5	MU0,5D/M8	08.0005	8	6 kt. Mutter M8 / Hex. nut M8 / Ecrou hex. M8	
5	MU0,5D/M10	08.0006	10	6 kt. Mutter M10 / Hex. nut M10 / Ecrou hex. M10	
5	MU0,5D/M16	08.0009	14	6 kt. Mutter M16 / Hex. nut M16 / Ecrou hex. M16	
	EBS8-V0	**04.0427**	8	Stecker / Plug / Broche	montiert / assembled / monté
	EBS10-V0	**04.0428**	10	Stecker / Plug / Broche	montiert / assembled / monté
	EBS14-V0	**04.0431**	14	Stecker / Plug / Broche	montiert / assembled / monté
Einzelteile				**Individual parts**	**Pièces détachées**
8	S-EBS8	04.0411	8	Steckereinsatz, Ms, versilbert / Plug insert, brass, silver-plat. / Broche en laiton, argentée	
8	S-EBS10	04.0417	10	Steckereinsatz, Ms, versilbert / Plug insert, brass, silver-plat. / Broche en laiton, argentée	
8	S-EBS14	04.0432	14	Steckereinsatz, Ms, versilbert / Plug insert, brass, silver-plat. / Broche en laiton, argentée	
9	D-EBB/S8	01.0413	8	Distanzrohr [1] / Spacer tube [1] / Entretoise [1]	
9	D-EBB/S10	01.0418	10	Distanzrohr [1] / Spacer tube / Entretoise [1]	
10	I-EBS8-V0	04.0435	8 + 10	Isolierkörper PA66, schwarz / Insulation PA66, black / Fourreau isolant PA66, noir	
10	I-EBS14-V0	04.0433	14	Isolierkörper PA66, rot / Insulation PA66, red / Fourreau isolant PA66, rouge	
4	FS/M8	08.0721	8	Federscheibe DIN 137, Bronze / Lock washer DIN137, bronze / Rondelle frein DIN 137, bronze	
4	FS/M10	08.0722	10	Federscheibe DIN 137, Bronze / Lock washer DIN137, bronze / Rondelle frein DIN 137, bronze	
4	U/M16	08.0309	14	U-Scheibe / Washer / Rondelle	
5	MU0,5D/M8	08.0005	8	6 kt. Mutter M8 / Hex. nut M8 / Ecrou hex. M8	
5	MU0,5D/M10	08.0006	10	6 kt. Mutter M10 / Hex. nut M10 / Ecrou hex. M10	
5	MU0,5D/M16	08.0009	14	6 kt. Mutter M16 / Hex. nut M16 / Ecrou hex. M16	

[1] Nur bei EBB8-V0, EBB10-V0, EBS8-V0, EBS10-V0

[1] Only with EBB8-V0, EBB10-V0, EBS8-V0, EBS10-V0

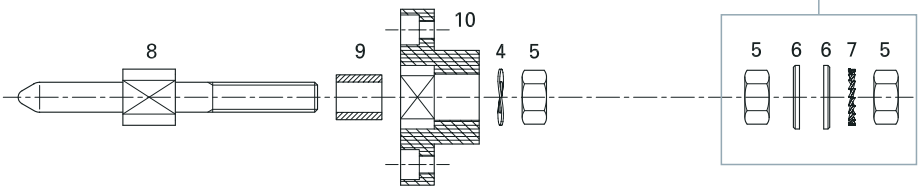
[1] Uniquement pour EBB8-V0, EBB10-V0, EBS8-V0, EBS10-V0



Leitungsbefestigungsmaterial
bitte separat bestellen

Cable fixing material,
please order separately

Matériel de fixation du câble,
à commander séparément



Nr. No. No.	Typ Type Type	Bestell-Nr. Order No. No. de Cde	Ø mm	Bezeichnung Description Description
Leitungsbefestigungsmaterial [1]				**Cable fixing material** [1] **Matériel de fixation du câble** [1]
5	MU0,5D/M8	08.0005	8	6kt. Mutter M8 / Hex. nut M8 / Ecrou hex. M8
6	U/M8	08.0305	8	U-Scheibe, Ms, versilbert / Washer, brass, silver-plated / Rondelle en laiton, argentée
7	F/M8	08.0705	8	Fächerscheibe / Serrated lock washer / Rondelle éventail
5	MU0,5D/M10	08.0006	10	6kt. Mutter M10 / Hex. nut M10 / Ecrou hex. M10
6	U/M10	08.0306	10	U-Scheibe, Ms, versilbert / Washer, brass, silver-plated / Rondelle en laiton, argentée
7	F/M10	08.0706	10	Fächerscheibe / Serrated lock washer / Rondelle éventail
5	MU0,5D/M16	08.0009	14	6kt. Mutter M16 / Hex. nut M16 / Ecrou hex. M16
6	U/M16	08.0309	14	U-Scheibe, Ms, versilbert / Washer, brass, silver-plated / Rondelle en laiton, argentée
7	F/M16	08.0709	14	Fächerscheibe / Serrated lock washer / Rondelle éventail

[1] Bitte separat bestellen

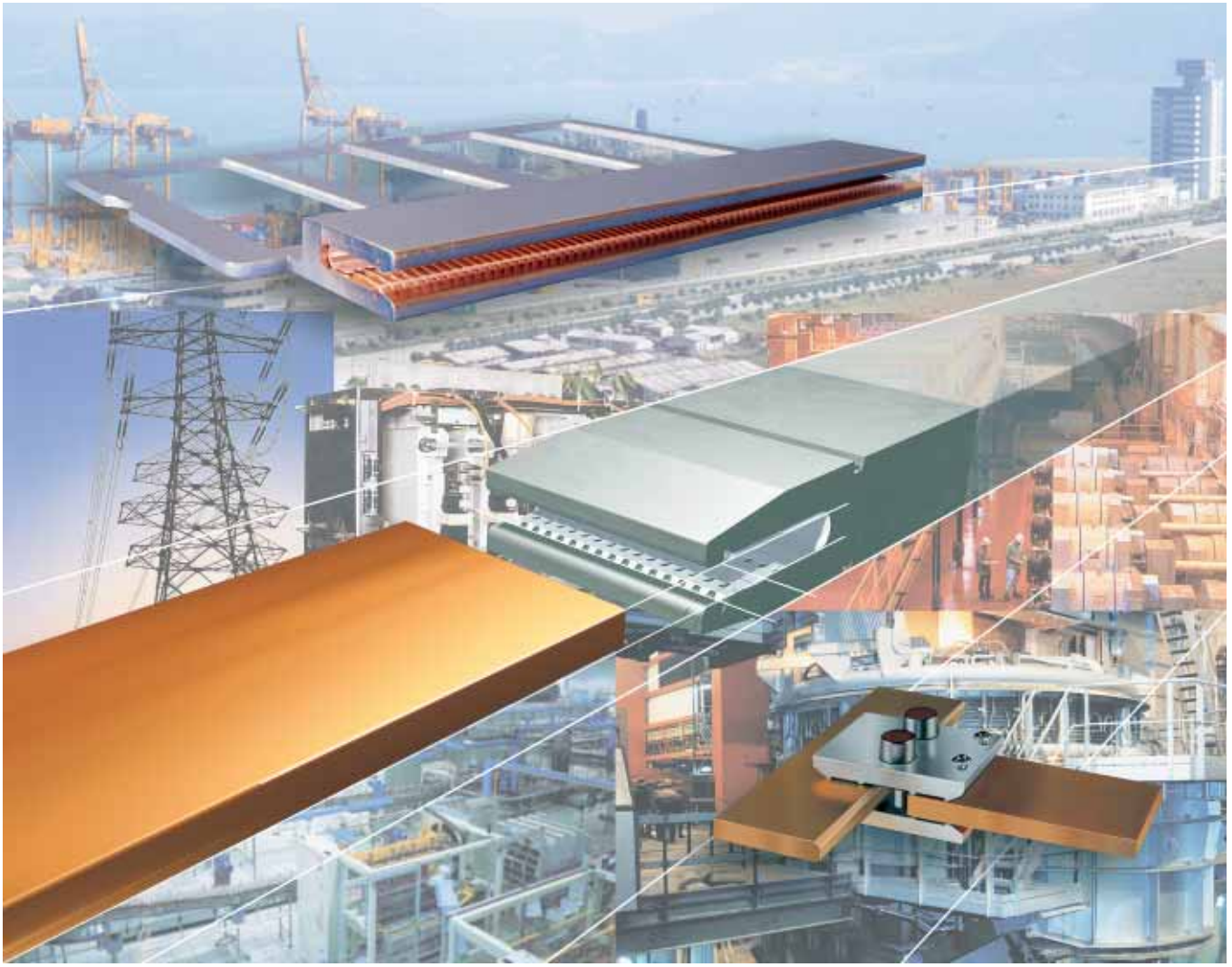
[1] Please order separately

[1] A commander séparément s.v.p.

MC-Gabelstecker für Stromschienen

MC-Fork plugs for busbars

Fourches de contact MC pour jeux de barres



Bemessungsstrom bis 1490A

Bemessungsspannung bis 600V

Standardausführungen oder Spezialanfertigungen nach Ihren Vorgaben

Rated current up to 1490A

Rated voltage up to 600V

Standard units or specially designed plugs according to your requirements

Intensité assignée jusqu'à 1490A

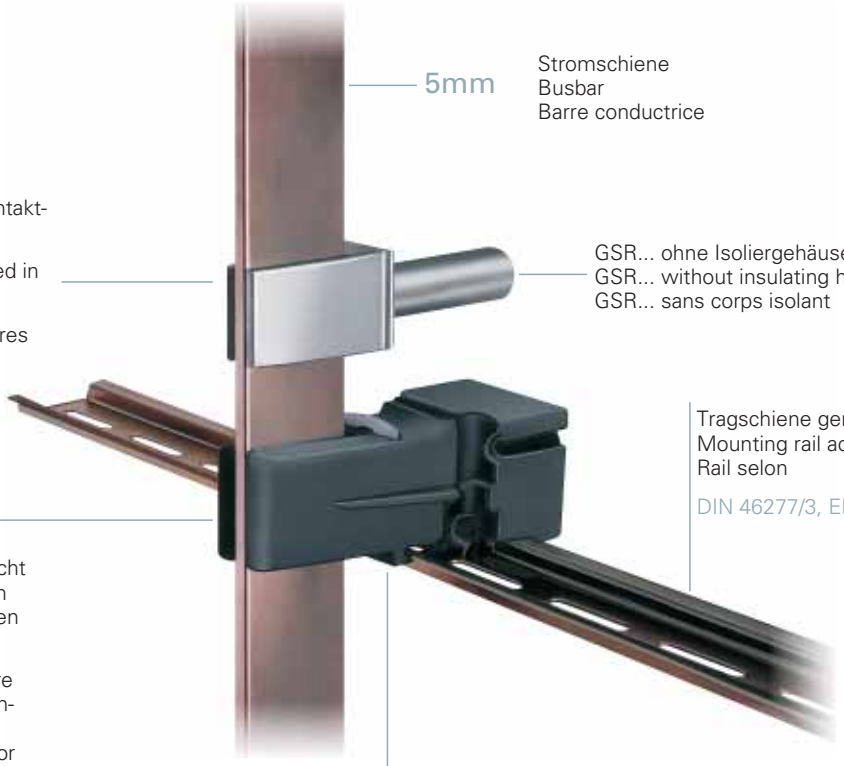
Tension assignée jusqu'à 600V

Pièces standard ou réalisations spéciales selon vos spécifications

Gabelstecker GSR5/... Einführung

Fork plugs GSR5/... Introduction

Fourche de contact GSR5/... Introduction



Stromschienen sollten im Kontaktbereich versilbert sein.

Busbars should be silver-plated in the contact areas.

Les zones de contact des barres doivent être argentées.

Die Gabelstecker GSR... sind geeignet für den Einsatz in nicht korrosiver Atmosphäre, z.B. in Innenanlagen oder geschützten Aussenanlagen.

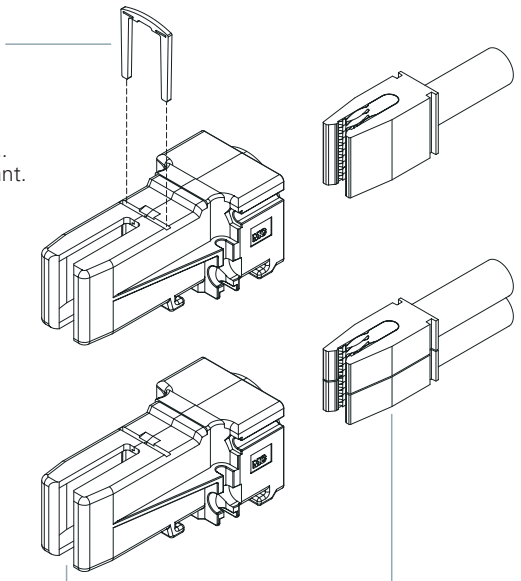
The GSR... fork connectors are suitable for applications in non-corrosive atmospheres, e.g. indoors or in protected outdoor installations.

La fourche de contact GSR... convient aux applications en atmosphères non corrosives, par. ex. en intérieur ou dans des installations extérieures protégées.

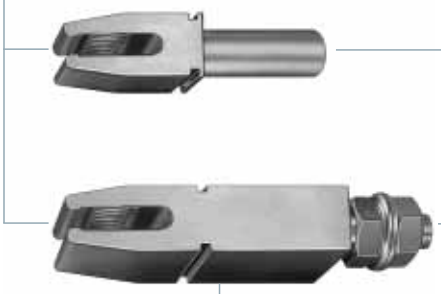
Sicherungsbügel hält GSR... in schwimmender Lagerung.

Securing clip holding the GSR... in a floating support.

L'etrier de sécurité maintenant le GSR... de manière à garantir un montage flottant.



Kontaktlamelle LAI, versilbert
MC-Multilam® LAI, silver-plated
Contact à lamelles LAI, argenté



Crimpanschluss
Crimp termination
Raccordement à sertir

Schraubanschluss
Screw termination
Raccordement à visser

Material: Aluminium, versilbert
Material: Aluminium, silver-plated
Matière: Aluminium, argenté

Gehäuse aus PPO (nach UL 94-HB).

Housing made of PPO (to UL 94-HB).

Le Boîtier est en PPO (selon la norme UL 94-HB).

In einem Gehäuse können zwei Gabelstecker mit Breite 12,5mm eingesetzt werden.

Two fork plugs 12,5mm wide can be inserted in one housing.

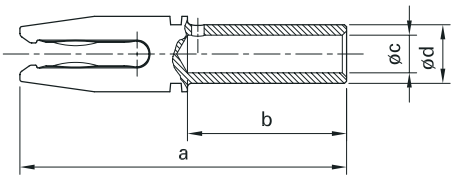
Deux fourches de largeur 12,5mm peuvent être insérées dans un même boîtier.

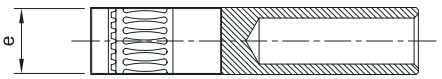
Gabelstecker G-GSR5/... mit Crimpanschluss

Fork plug G-GSR5/... with crimp termination

Fourche de contact G-GSR5/... avec fût à sertir

G-GSR5/...





Technische Daten / Technical data / Caractéristiques techniques

Bemessungsspannung Rated voltage Tension assignée	600V [1]
Prüfspannung (50Hz, 1min.) Test voltage (50Hz, 1min.) Tension d'essai (50Hz, 1min.)	3,5kV [1]

Isolationskoordination Insulation coordination Coordination de l'isolement	6kV/3 [1]
Material Material Matériel	Al, versilbert Al, silver-plated Al, argenté

Typ Type Type	Bestell-Nr. Order No. No. de Cde	Leiterquerschnitt Conductor cross section Section du conducteur	Masse (mm) Sizes (mm) Dimensions (mm)					Steckkraft [2] Insertion force [2] Force d'embrochage [2]	Auszugskraft [2] Withdrawal force [2] Force d'extraction [2]	Bemessungsstrom [3] Rated current [3] Intensité assignée [3]	Stosskurzschlussstrom Rated peak withstand current Courant de crête	Kurzschlussstrom (1s) Short-circuit current (1s) Intensité de court-circuit (1s)	Kurzschlussstrom (3s) Short-circuit current (3s) Intensité de court-circuit (3s)
		mm²	a	b	Ø c	Ø d	e	N	N	A	kA	kA	kA
G-GSR5/10	**10.5005**	10	55	15	5	10	12,5	24	20	80	5,5	1	0,6
G-GSR5/16	**10.5006**	16	65	25	6	11	12,5	24	20	100	8,5	1,5	1
G-GSR5/25	**10.5007**	25	65	25	6,7	12	12,5	24	20	130	14,0	2,5	1,5
G-GSR5/35	**10.5008**	35	78	38	9	14	25	48	40	160	19,5	3,5	2
G-GSR5/50	**10.5009**	50	78	38	11	16	25	48	40	200	28	5	3
G-GSR5/70	**10.5010**	70	78	38	12,5	18	25	48	40	250	42	7,5	4

[1] Gilt zwischen dem Gabelstecker im Isoliergehäuse und der Normprofilschiene
[2] Richtgrössen gemessen mit Kupferschienen, versilbert
[3] Siehe auch Derating Diagramm, Seiten 41 – 42

[1] Only valid between fork plug in the insulating housing and the standard mounting rail
[2] Typical ratings, measured with silver plated copper busbars
[3] See derating diagrams, pages 41 – 42

[1] Valable uniquement entre la fourche de contact avec son boîtier isolant et le rail profilé
[2] Valeurs indicatives, mesurées avec des barres en cuivre argentées
[3] Voir diagrammes de derating, pages 41 – 42

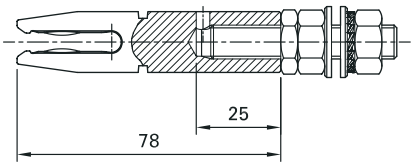
Passendes Isoliergehäuse I-GSR5 und Sicherungsbügel S-GSR5, siehe Seite 30
Suitable insulating housing I-GSR5 with securing clip S-GSR5, see page 30
Boîtier isolant convenable I-GSR5 avec clip de sécurité S-GSR5, voir page 30

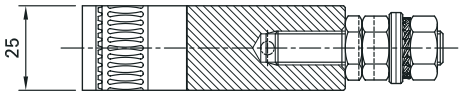
Gabelstecker G-GSR5/B-M10x50 mit Schraubanschluss

Fork plug G-GSR5/B-M10x50 with screw termination

Fourche de contact G-GSR5/B-M10x50 avec embout fileté

GSR5/B-M10x50



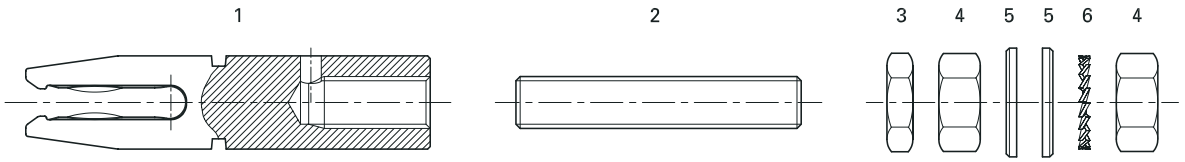


Technische Daten	Technical data	Caractéristiques techniques
Bemessungsspannung Rated voltage Tension assignée	600V [1]	
Prüfspannung (50Hz, 1min.) Test voltage (50Hz, 1min.) Tension d'essai (50Hz, 1min.)	3,5kV [1]	
Isolationskoordination Insulation coordination Coordination de l'isolement	6kV/3 [1]	
		Steckkraft Insertion force Force d'embrochage: 48N [2]
		Auszugskraft Withdrawal force Force d'extraction: 40N [2]
		Strombelastbarkeit und Anschlussvarianten Current carrying capacity and terminations Intensités et types de raccordements: siehe Seite 31 / see page 31 / voir page 31

[1] Gilt zwischen dem Gabelstecker im Isoliergehäuse und der Normprofilschiene
[2] Richtgrössen gemessen mit Kupferschienen, versilbert

[1] Only valid between fork plug in the insulating housing and the standard mounting rail
[2] Typical ratings, measured with silver plated copper busbars

[1] Valable uniquement entre la fourche de contact avec son boîtier isolant et le rail profilé
[2] Valeurs indicatives, mesurées avec des barres en cuivre argentées



Pos.	Typ Type Type	Bestell-Nr. Order No. No. de Cde	Bezeichnung Description Description
1 – 6	**G-GSR5/B-M10x50**	**10.5012**	Gabelstecker mit Schraubanschluss, komplett / Fork plug with screw termination, complete / Fourche de contact avec embout fileté, complète

Einzelteile / **Individual parts** / **Pièces détachées**

1	G-GSR5/M10	10.5011	Gabelstecker mit Innengewinde M10 / Fork plug with internal thread M10 / Fourche de contact avec taraudage M10
2	B-GSR	10.5023	Gewindebolzen / Threaded bolt / Embout fileté
3	MU0,5D/M10	08.0006	Spannmutter / Fastening nut / Ecrou de fixation
4	MU0,8D/M10	08.0106	Anschlussmutter / Termination nut / Ecrou de raccordement
5	U/M10	08.0306	U-Scheibe / Washer / Rondelle
6	F/M10	08.0716	Fächerscheibe / Serrated lock washer / Rondelle éventail

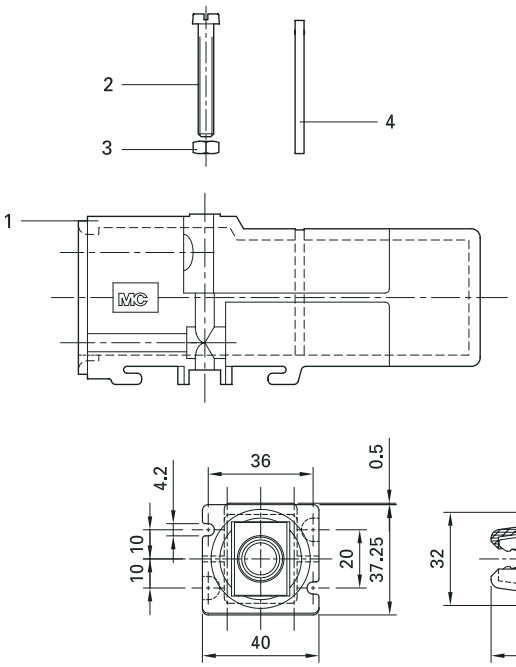
Passendes Isoliergehäuse I-GSR5 und Sicherungsbügel S-GSR5, siehe Seite 30
Suitable insulating housing I-GSR5 with securing clip S-GSR5, see page 30
Boîtier isolant convenable I-GSR5 avec clip de sécurité S-GSR5, voir page 30

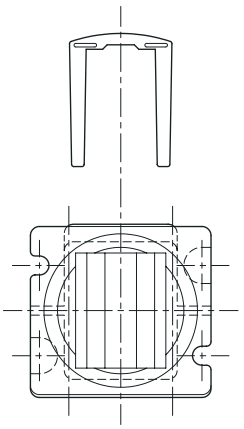
Isoliergehäuse I-GSR5 zu Gabelstecker G-GSR5/...

Insulating housing I-GSR5 for fork plug G-GSR5/...

Boîtier isolant I-GSR5 pour fourche de contact G-GSR5/...

I-GSR5





Technische Daten

Prüfspannung (50Hz, 1min.) Test voltage (50Hz, 1min.) Tension d'essai (50Hz, 1min.)	3,5kV [1]
Isolationskoordination Insulation coordination Coordination de l'isolement	6kV/3 [1]

[1] Gilt zwischen dem Gabelstecker im Isoliergehäuse und der Normprofilschiene

Technical data

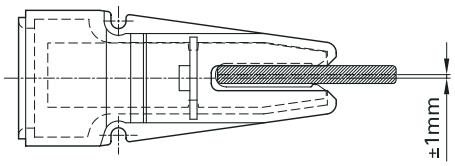
Isolation Insulation Isolation	PPO
Anzugsdrehmom. / Befestigungsschrauben Tightening torque / Fixing screws Couple de serrage / Vis de fixation	max. 1,3Nm

[1] Only valid between fork plug in the insulating housing and the standard mounting rail

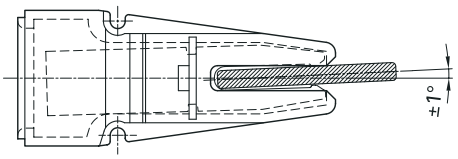
Caractéristiques techniques

[1] Valable uniquement entre la fourche de contact avec son boîtier isolant et le rail profilé

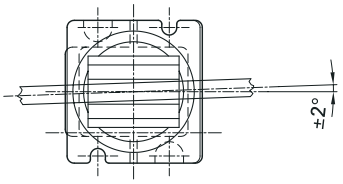
Maximaler Versatz beim Einbau



Maximum mounting offset



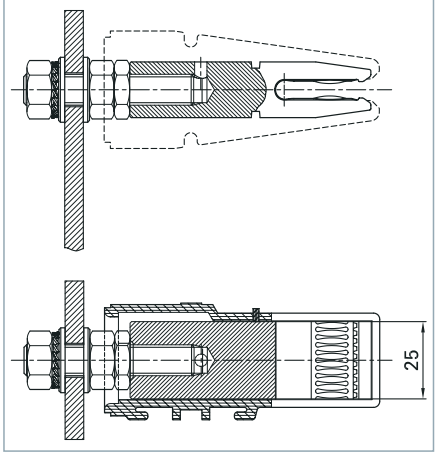
Rattrapage de jeu maxi



Pos.	Typ Type Type	Bestell-Nr. Order No. No. de Cde	Bezeichnung Description Description
1	**I-GSR5**	**10.5020**	Isoliergehäuse für Gabelstecker G-GSR5/... / Insulating housing for fork plugs G-GSR5/... / Corps isolant pour fourches de contact G-GSR5/...
2	**SCH-GSR5**	**10.5022**	Zylinderschraube M4x25 / Cheese head. screw M4x25 / Vis à tête cylindrique M4x25
3	**MU-GSR5**	**10.5024**	6 kt. Mutter M4 DIN 84 / Hex. nut M4 DIN 84 / Ecrou hex. M4 DIN 84
4	**S-GSR5**	**10.5021**	Sicherungsbügel für Gabelstecker G-GSR5/... / Securing clip for fork plug G-GSR5/... / Etrier de sécurité pour fourches de contact G-GSR5/...

Anschlussvarianten und Strombelastbarkeit für Gabelstecker G-GSR5/B-M10x50

Cu Stromschiene
Cu-Busbar
Barre en Cu



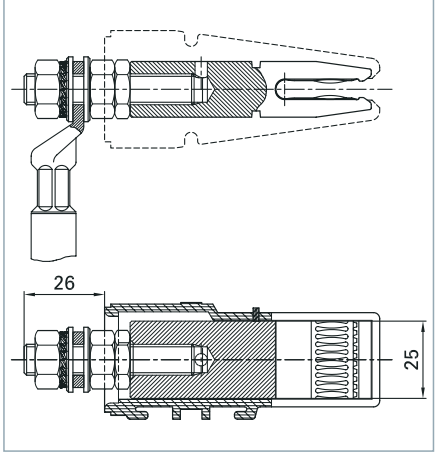
Leiterquerschnitt Cu Conductor cross section Cu Section du conducteur Cu	Bemessungsstrom Rated current Intensité assignée	Stosskurzschlussstrom Rated peak withstand current Intensité de crête	Kurzschlussstrom (1s) Short-circuit current (1s) Intensité de court-circuit (1s)	Kurzschlussstrom (3s) Short-circuit current (3s) Intensité de court-circuit (3s)
mm²	A	kA	kA	kA
15x5	200	27	7	5,2
20x5	260	27	7	5,2
25x5	280	27	7	5,2
30x5	350	54	12	10
40x5	400	54	12	10
50x5	400	54	12	10
60x5	400	54	12	10
80x5	400	54	12	10

[1] Siehe Derating Diagramm, Seite 42
[2] Leiterquerschnitt
[3] Bohrung

info *Siehe Technische Hinweise, Seite 43 für weitere Informationen zur Gabelsteckermontage*

Terminations and current carrying capacity for fork plug G-GSR5/B-M10x50

Kabelschuh
Cable lug
Cosse à sertir



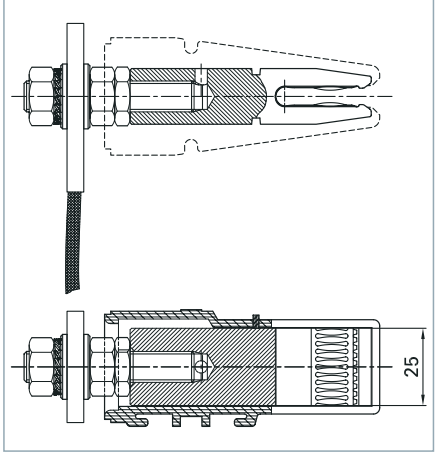
Typ Kabelschuh Cable lug type Type cosse à sertir	Leiterquerschnitt Cu Conductor cross section Cu Section du conducteur Cu	Bemessungsstrom [1] Rated current [1] Intensité assignée [1]	Stosskurzschlussstrom Rated peak withstand current Intensité de crête	Kurzschlussstrom (1s) Short-circuit current (1s) Intensité de court-circuit (1s)	Kurzschlussstrom (3s) Short-circuit current (3s) Intensité de court-circuit (3s)
[2] [3]	mm²	A	kA	kA	kA
10 10	10	80	5,5	1	0,6
16 10	16	100	8,5	1,5	1
25 10	25	130	14	2,5	1,5
35 10	35	160	19,5	3,5	2
50 10	50	200	28	5	3
70 10	70	250	42,5	7,5	4
95 10	95	300	54	10	6

[1] See derating diagram, page 42
[2] Conductor cross section
[3] Drill hole

info *See technical information, on page 43 for further information about fork plug assembly*

Types de raccordements et intensités pour fourche de contact G-GSR5/B-M10x50

Cu Litzenband
Cu stranded ribbon cable
Tresse en Cu



Leiterquerschnitt Cu Conductor cross section Cu Section du conducteur Cu	Bemessungsstrom Rated current Intensité assignée	Stosskurzschlussstrom Rated peak withstand current Intensité de crête	Kurzschlussstrom (1s) Short-circuit current (1s) Intensité de court-circuit (1s)	Kurzschlussstrom (3s) Short-circuit current (3s) Intensité de court-circuit (3s)
mm²	A	kA	kA	kA
10	80	5,5	1	0,6
16	110	8,5	1,5	1
25	140	14,5	2,5	1,5
35	180	19,5	3,5	2
50	220	28	5	3
70	275	42,5	7,5	4
95	330	54	10	6
120	400	54	12	9

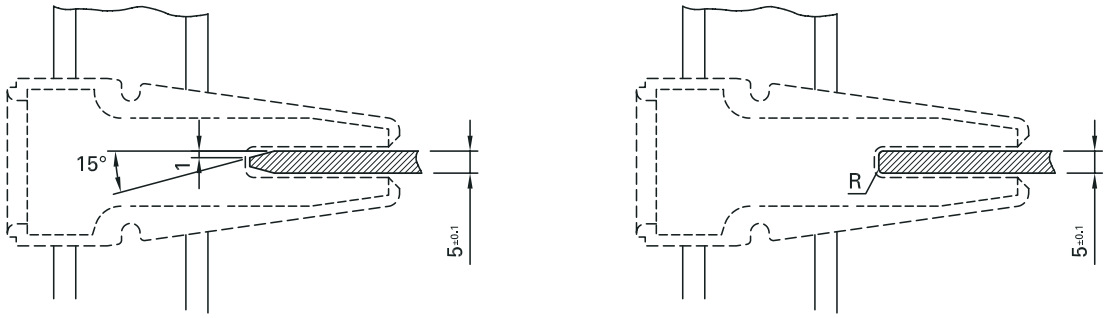
[1] Voir diagrammes de derating, page 42
[2] Section du conducteur
[3] Bornage

info *Voir informations techniques, page 43, pour de plus amples informations sur le montage des fourches de contact*

Stromschiene nach
DIN EN 13601
Kupfer oder Kupferlegierung

Busbar according to
DIN EN 13601
Copper or copper alloy

Barre conductrice selon
DIN EN 13601
Cuivre ou cuivre allié

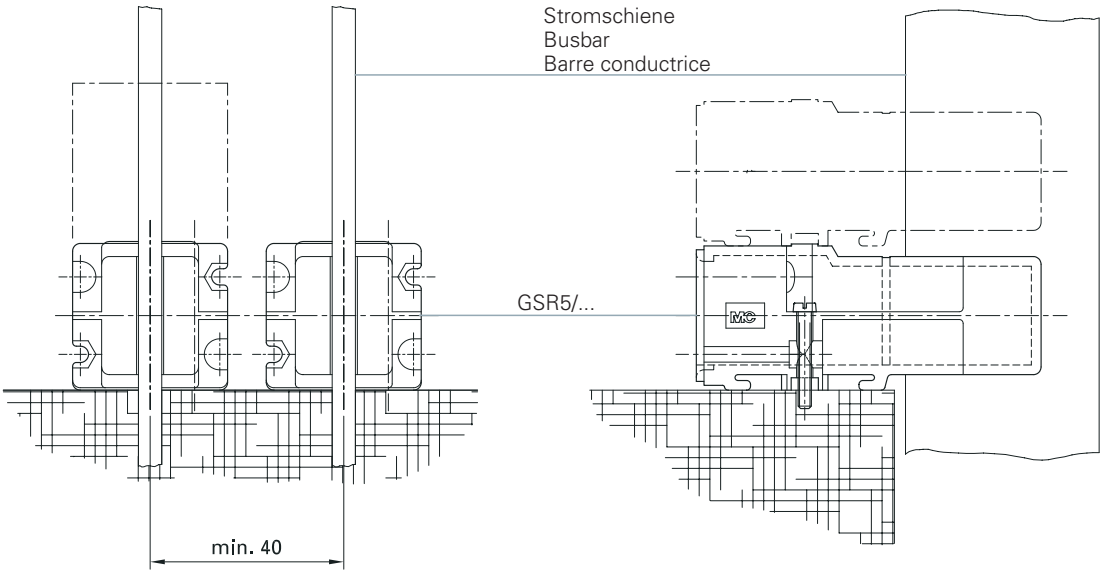


Anordnung und
Befestigungsvarianten für
Gabelstecker GSR5/...

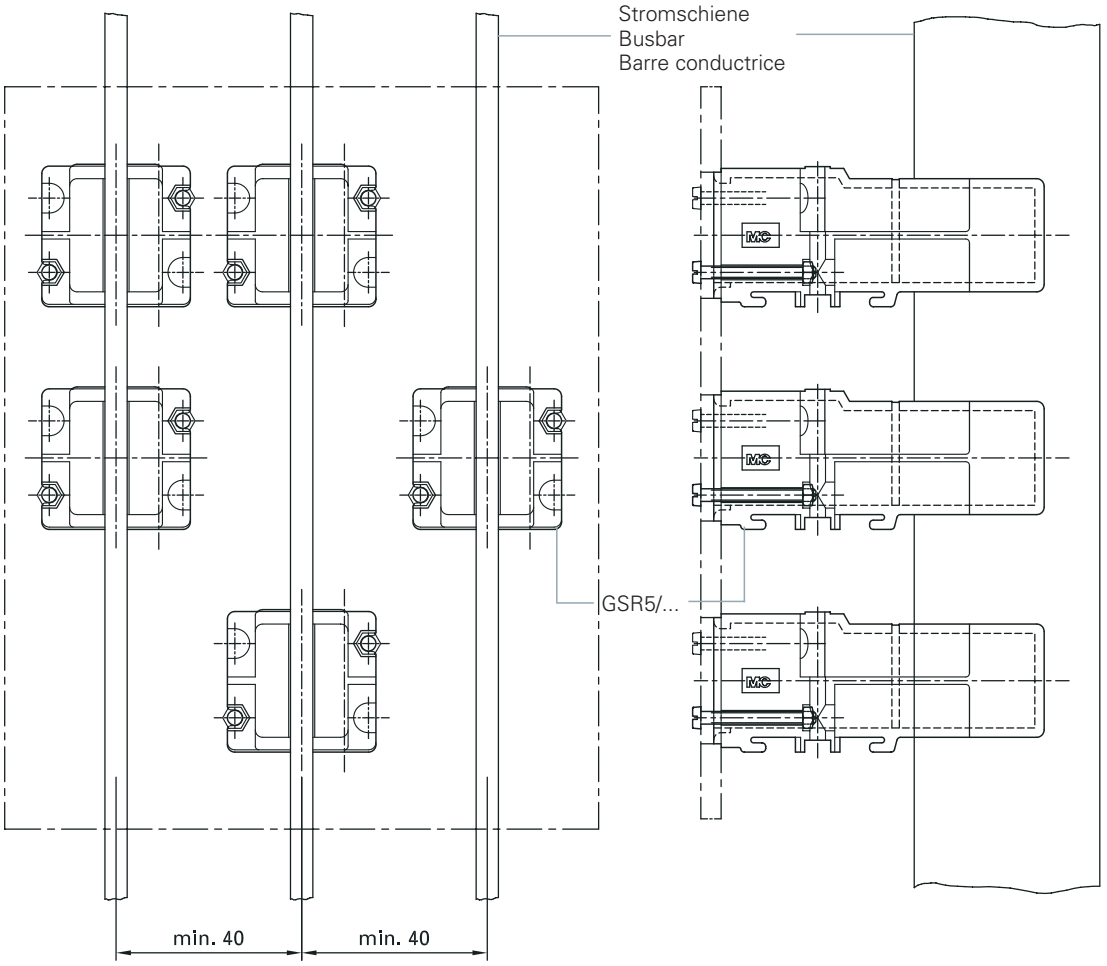
Arrangement and
fastening for
fork plugs GSR5/...

Arrangement et
fixation des
fourches de contact GSR5/...

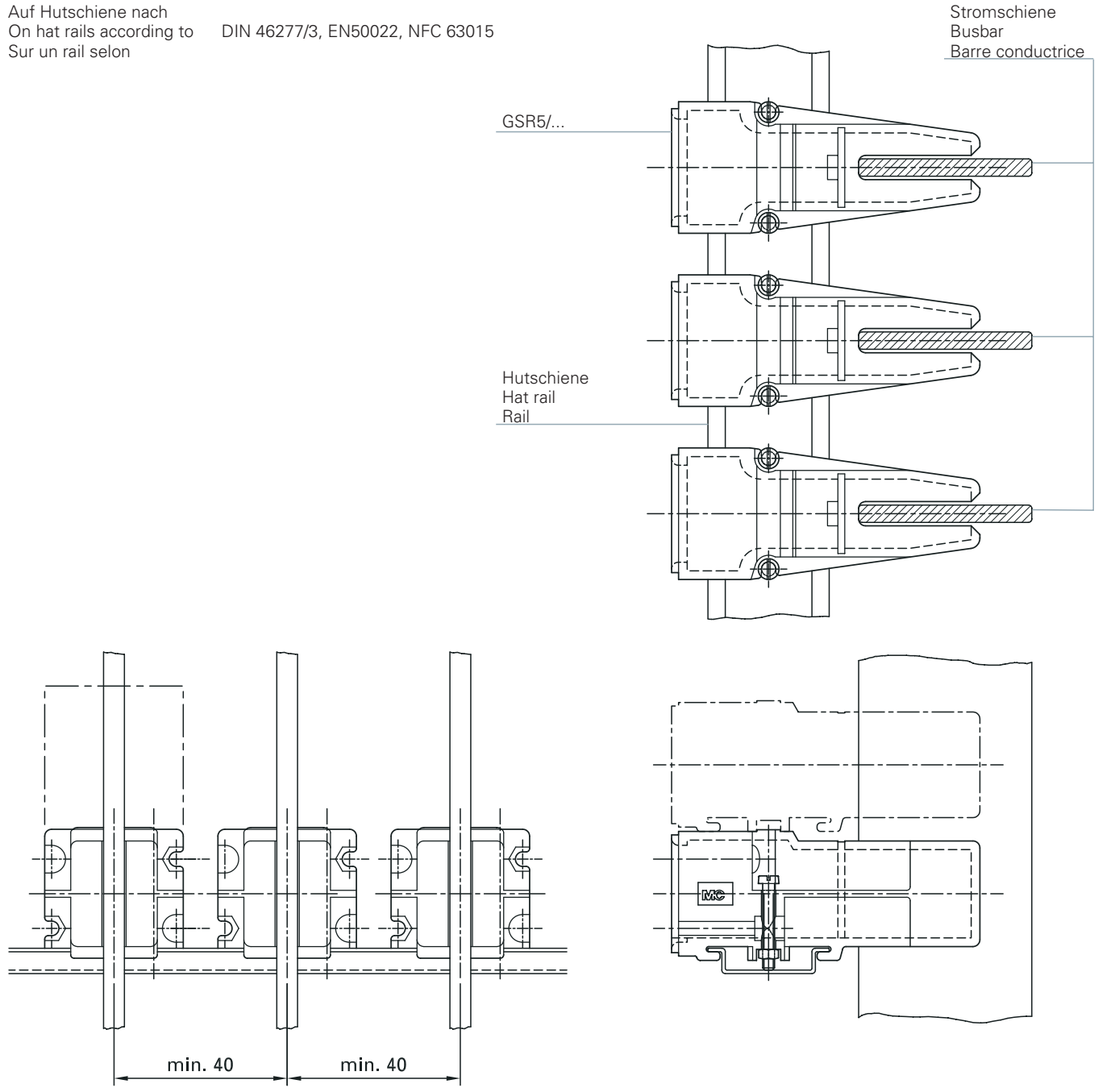
Direkt auf Sockel
Direct on foundation
Directement sur un socle



Auf Tafel nach Montagezeichnung des Kunden
On panel according to customer's assembly drawing
Sur un panneau d'après un plan client



Auf Hutschiene nach
On hat rails according to DIN 46277/3, EN50022, NFC 63015
Sur un rail selon



info *Siehe Technische Hinweise, Seite 43 für weitere Informationen zur Gabelsteckermontage*

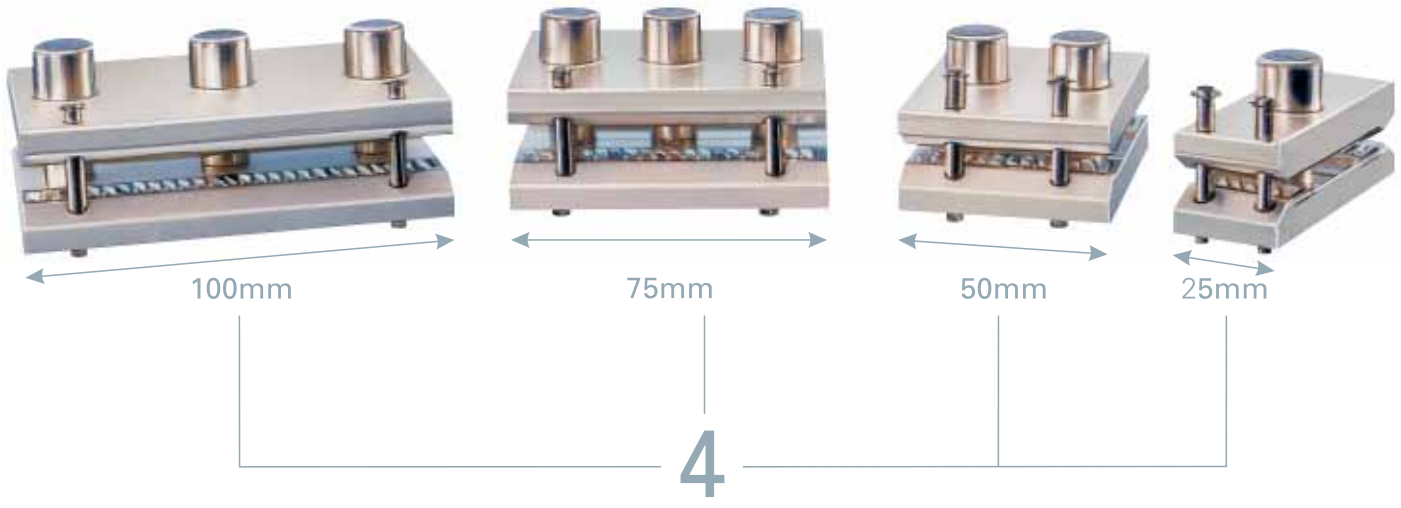
info *See technical information on page 43 for further information about fork plug assembly*

info *Voir informations techniques, page 43, pour de plus amples informations sur le montage des fourches de contact*

Doppelgabelstecker GSRD... Einführung

Double fork plug GSRD... Introduction

Fourche double de contact GSRD... Introduction

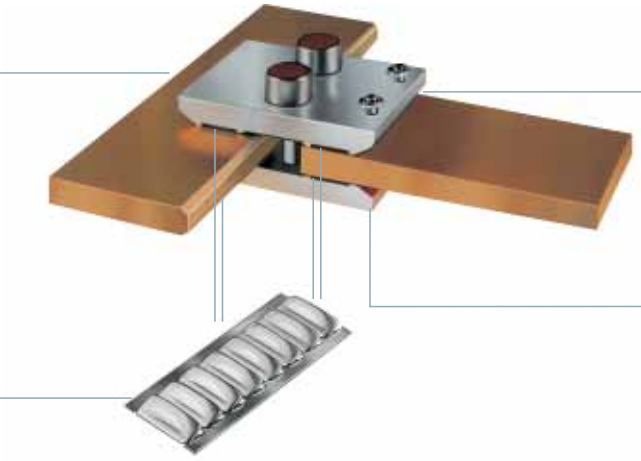


Standardtypen [1] / Standard versions [1] / Largeurs standard [1]

Mehr als 1000 Steckzyklen [2]

More than 1000 plugging cycles [2]

Plus de 1000 cycles d'embrochage-débrochage [2]



Stromschienen aus Al oder Cu sollten im Kontaktbereich versilbert sein.

Busbars from Al or Cu should be silver-plated in the contact areas.

Les zones de contact des barres Al ou Cu doivent être argentées.

Federnde Kontaktplatten [3]

Spring-loaded contact plates [3]

Profilés montés sur ressort [3]

MC-Kontaktlamelle

MC-Multilam®

Contact à lamelles MC

Für Stromschienendicken von

For busbar thicknesses of

Pour barres conductrices d'épaisseur

10mm [1]

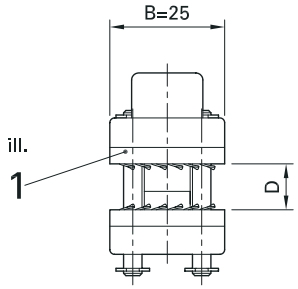
6,35mm (1/4") [1]

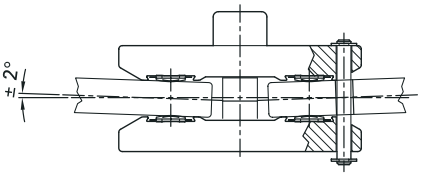
5mm [1]

[1] Andere Breiten und Dicken, auf Anfrage
[2] Bei leicht gefetteten Stromschienen, Schmiermittel, siehe Seite 43
[3] Aus Aluminium, versilbert

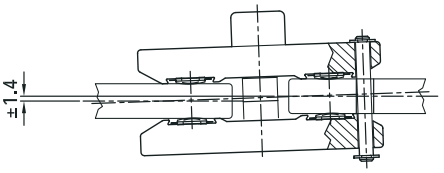
[1] Special double fork plugs can be suplied in non-standard widths and thicknesses on request
[2] With slightly greased busbars. Lubricants see page 43
[3] Aluminium, silver plated

[1] Autres largeurs et épaisseurs, sur demande
[2] Avec des barres légèrement graissées. Lubrifiants, voir page 43
[3] En aluminium, argenté

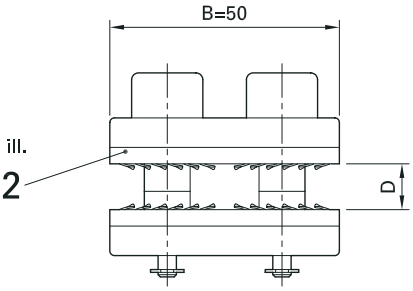


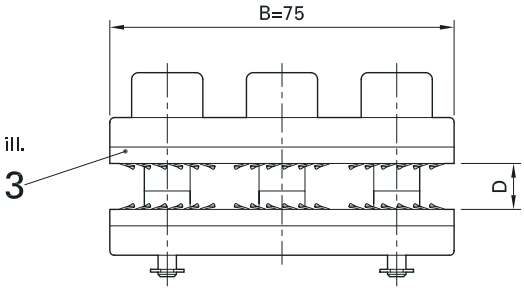


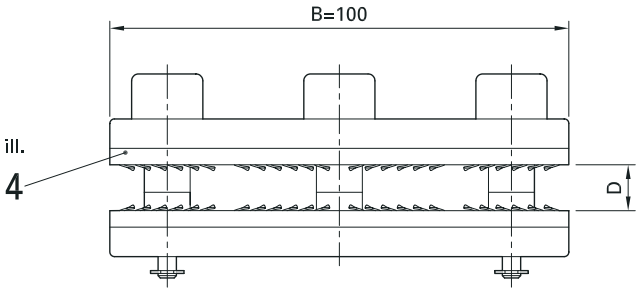
Winkeltoleranz / Angular tolerance
Défaut angulaire

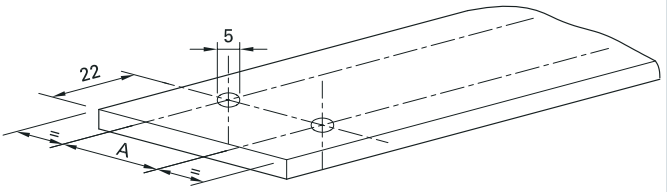


Fluchtungstoleranz / Alignment tolerance
Défaut d'alignement



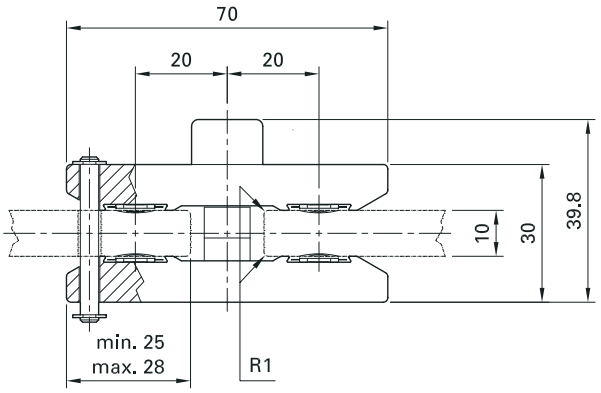






Bohrplan / Drilling plan / Plan de perçage

Typ Type Type	Masse (mm) Sizes (mm) Dimensions (mm)
	A
GSRD...25	15
GSRD...50	25
GSRD...75	50
GSRD...100	75



Anwendungsbeispiel
Verbindung zwischen den Stromschienen eines Verdampferwagens (im Bild nicht sichtbar) und einer Hochstromdurchführung eines Vakuumzylinders mit Doppelgabelsteckern.

Application example
Connection between the busbars of a vaporizer (not visible in the illustration) and the high-current feed through of a vacuum cylinder with double fork plugs.

Exemple d'application
Connexion avec des fourches de contact entre les jeux de barres d'un vaporiseur (non représenté) et une traversée de puissance dans un cylindre sous vide.

Technische Daten und Bestellangaben

Technical data and ordering information

Caractéristiques techniques Pour vos commandes

ill.	Type Type Type	Bestell Nr. Order No. No. de Cde	für Stromschienendicke D for thickness of busbar D pour épaisseur de barre D	Gabelstecker-Breite B Fork plug width B Largeur de fourche de contact B	Schiebekraft Insertion force Force d'embrochage	Auszugskraft Withdrawal force Force d'extraction	Kontaktwiderstand [1] Contact resistance [1] Résistance de contact [1]	Bemessungsstrom [2] Cu [3] Rated current [2] Intensité assignée [2]	Bemessungsstrom [2] Al [4] Rated current [2] Intensité assignée [2]	Kurzschlussstrom Cu [3] Short-circuit current Intensité de court-circuit	Kurzschlussstrom Cu [3] Short-circuit current Intensité de court-circuit	Kurzschlussstrom Al [4] Short-circuit current Intensité de court-circuit	Kurzschlussstrom Al [4] Short-circuit current Intensité de court-circuit	Stosskurzschlussstrom Rated peak withstand current Courant de crête
			mm	mm	N	N	µΩ	A	A	kA (1s)	kA (3s)	kA (1s)	kA (3s)	kA
1	**GSRD5-25**	**10.0031**	5	25	40	80	40	325	255	9,5	7,5	9,5	6,5	36
2	**GSRD5-50**	**10.0032**	5	50	80	160	20	580	455	19	15,5	19	13	72
3	**GSRD5-75**	**10.0033**	5	75	120	240	13,5	885	685	28,5	23,5	28,5	20,8	108
4	**GSRD5-100**	**10.0034**	5	100	160	320	10	1080	845	38	31,3	38	26	144
1	**GSRD6/6,35-25**	**10.0035**	6 – 6,35	25	40	80	40	385	285	9,5	7,5	9,5	7,5	36
2	**GSRD6/6,35-50**	**10.0036**	6 – 6,35	50	80	160	20	645	505	19	15,5	19	15,5	72
3	**GSRD6/6,35-75**	**10.0037**	6 – 6,35	75	120	240	13,5	965	760	28,5	23,5	28,5	23,5	108
4	**GSRD6/6,35-100**	**10.0038**	6 – 6,35	100	160	320	10	1170	920	38	31,5	38	31,2	144
1	**GSRD10-25**	**10.0039**	10	25	40	80	40	480	375	9,5	7,5	9,5	7,5	36
2	**GSRD10-50**	**10.0040**	10	50	80	160	20	850	665	19	15,5	19	15,5	72
3	**GSRD10-75**	**10.0041**	10	75	120	240	13,5	1240	980	28,5	23,5	28,5	23,5	108
4	**GSRD10-100**	**10.0042**	10	100	160	320	10	1490	1190	38	31,5	31,5	31,5	144

[1] Werte gelten mit versilberten Kontaktbereichen auf Kupfer- und Aluminiumstromschienen
[2] Bemessungsstrom nach DIN 43671, siehe Derating Diagramme, Seite 42
[3] Werte gelten für Kupferstromschienen
[4] Werte gelten für Aluminiumstromschienen

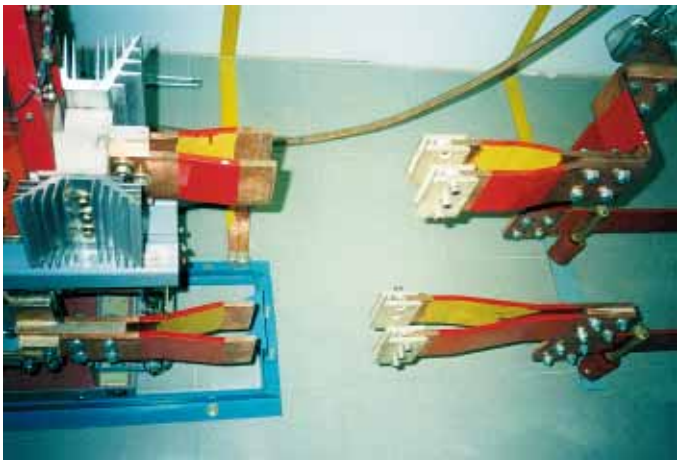
[1] Data valid with silver plated contact areas on copper and aluminium busbars
[2] Rated current according to standard DIN 43670, see derating diagrams, page 42
[3] Data valid for copper busbars
[4] Data valid for aluminium busbars

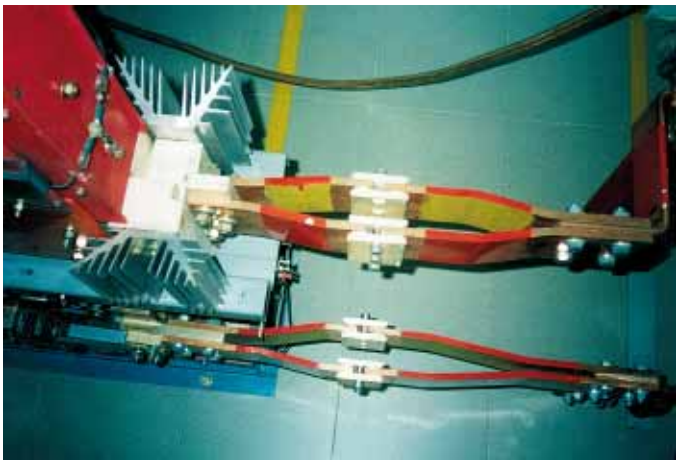
[1] Ces valeurs sont valables avec des surfaces de contact argentées de jeux de barres en cuivre et aluminium
[2] Intensité assignée selon norme DIN 43670, voir diagrammes de derating, page 42
[3] Ces valeurs sont valables pour des jeux de barres en cuivre
[4] Ces valeurs sont valables pour des jeux de barres en aluminium

Anwendungsbeispiel
Verbindung zwischen festen und beweglichen Stromschienen.

Application example
Connection between fixed and movable busbars.

Exemple d'application
Connexion entre des jeux de barres fixes et mobiles





MC-Spezialgabelstecker

Gabelstecker werden aus Profilstangen geschnitten, nach der Weiterbearbeitung in der Regel versilbert und dann mit der Kontaktlamelle ausgerüstet. Dadurch sind beliebige Gabelsteckerbreiten herstellbar.
Im Anschlussbereich sind im Rahmen der Profilabmessungen alle Befestigungs- und Anschlussvarianten möglich, z.B. Schraub- oder Crimpanschluss, Absätze, Nuten, Bohrungen, Gewinde usw.
Auf den Seiten 39 und 40 sind einige Beispiele von Spezialanfertigungen zu sehen, für die bereits Werkzeuge bestehen und woraus Gabelstecker herstell- und lieferbar sind.

MC-Special fork plugs

Fork plugs are cut from section rods and after further machining they are as a rule silver-plated and then fitted with an MC Multilam®. This allows fork plugs to be made in any desired width.
In the terminal part of the plug, all types of lead attachment are possible within the limits of the section dimensions, e.g. screw or crimp connection, slots, drilled holes, screw threads etc.
See pages 39 and 40 for some examples of special versions for which tools for the manufacture and supply of fork plugs already exist.

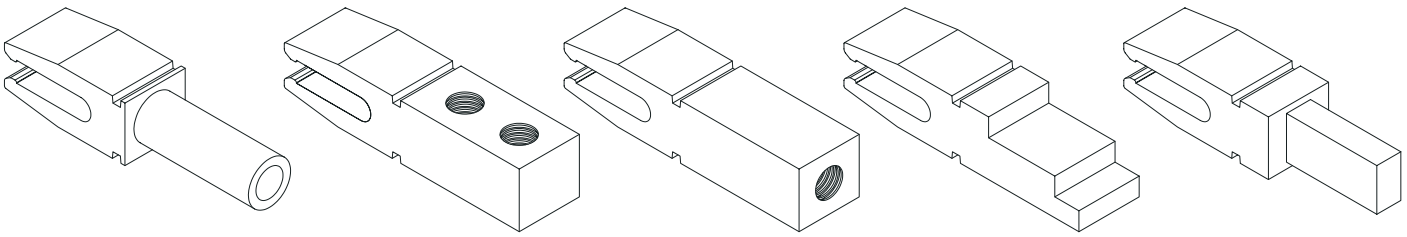
Fourches de contact spéciales

Les fourches de contact sont réalisées à partir d'un profilé, coupé à longueur, argenté, avant d'être équipé d'un contact à lamelles MC. Cette technique de fabrication permet de réaliser des fourches de largeur variable.
De plus, différentes techniques de raccordement peuvent être proposées: sertissage (fût à sertir), vissage (embout fileté ou taraudage), soudure etc.
Les pages 39 et 40 montrent un certain nombre de fabrications spéciales, réalisées par le passé, et pour lesquelles les outillages existent. Ces produits peuvent donc être fabriqués sans difficulté.

Verschiedene Anschluss- und Befestigungsmöglichkeiten

Various termination and fixing possibilities

Diverses possibilités de montage et de raccordement



Multi-Contact hat jahrelange Erfahrung mit Gabelsteckern und ist für solche Kontaktsysteme der ideale Partner.
Fragen Sie uns, unsere Konstrukteure und Techniker beraten Sie gerne.

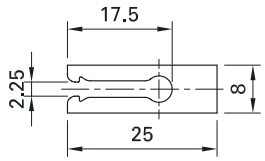
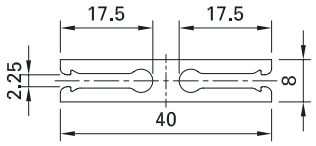
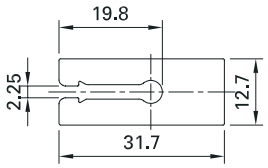
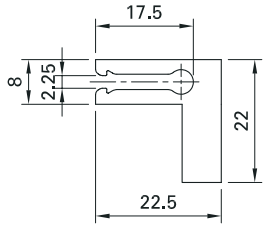
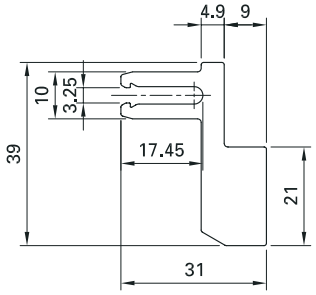
Multi-Contact has many years of experience with fork plugs, and is the ideal address for such contact systems.
Ask us, our designers and engineers will be pleased to advise you

Multi-Contact dispose d'une longue expérience en matière de fourches de contact et, est pour ce type de système de connexion, votre interlocuteur idéal.
Consultez-nous, nos techniciens vous conseilleront volontiers

Beispiele von Gabelstecker Spezialanfertigungen

Examples of special versions of fork plugs

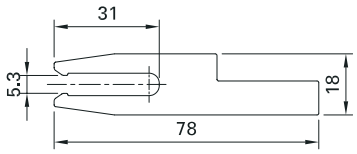
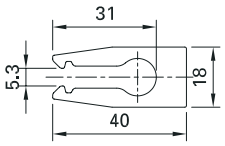
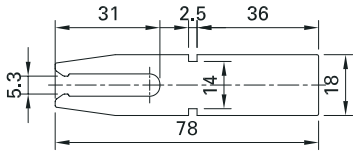
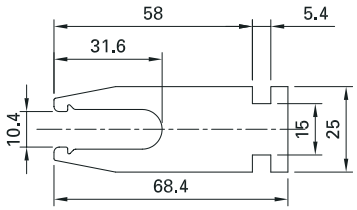
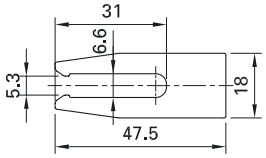
Exemples de fourches de contact spéciales

Profilzeichnung Profile drawing Plan du profilé	Referenz Reference Référence	Nennmass = Schienen Abmessung Rated size = Size of the busbar Dimension nominale = épaisseur des barres	Lamellen-Typ Typ of Multilam® Contact à lamelles	Bemessungsstrom pro 10mm Profillänge Rated current per 10mm busbar length Intensité assignée pour 10mm de long. de profilé	Anschlussmöglichkeiten Connection system Raccordement	Profilmaterial Material of profile Matière du profilé
	**P-GSR2** **11000443**	1,57 – 2mm [1] 2mm [2]	LAspez. LAIII/0,2	≈ 100 A	S [3] + C [3]	CuZn
	**P-GS2-D** **11000437**	1,57 – 2mm [1] 2mm [2]	LAspez. LAIII/0,2	≈ 100 A	–	CuZn
	**P-GSR1,57** **11000438**	1,57 – 2mm [1] 2mm [2]	LAspez. LAIII/0,2	≈ 100 A	–	Al
	**P-GS2-W** **11000441**	1,57 – 2mm [1] 2mm [2]	LAspez. LAIII/0,2	≈ 100 A	S [3]	CuZn
	**P-GSR3** **3W7.131.00**	3mm [2]	LAIII/0,2	≈ 100 A	S [3]	CuZn

[1] Mit Spezial Kontaktlamelle LA Spez.
[2] Entspricht Stromschienendicke gemäss DIN 46433 oder ±0,1 mm.
[3] C = Crimpanschluss
S = Schraubanschluss

[1] With special Multilam® LA spec.
[2] Corresponds to busbar thickness according to DIN 46433 or ±0,1 mm.
[3] C = Crimp connection
S = Screw connection

[1] Avec contact à lamelles spécial (LA spec.)
[2] Correspond à l'épaisseur de la barre selon DIN 46433 ou ±0,1 mm.
[3] C = Raccordement à sertir
S = Raccordement à visser

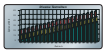
Profilzeichnung Profile drawing Plan du profilé	Referenz Reference Référence	Nennmass = Schienen Abmessung Rated size = Size of the busbar Dimension nominale = épaisseur des barres	Lamellen-Typ Typ of Multilam® Contact à lamelles	Bemessungsstrom pro 10mm Profillänge Rated current per 10mm busbar length Intensité assignée pour 10mm de long. de profilé	Anschlussmöglichkeiten Connection system Raccordement	Profilmaterial Material of profile Matière du profilé
	**P-GSR5** **11003537**	5mm [2]	LAl/0,2	≈ 200 A	S [3]	CuZn
	**P-GSR5** **11003524**	5mm [2]	LAl/0,2	≈ 200 A	S [3]	CuZn
	**P-GSR5N** **10.5309**	5mm [2]	LAl/0,2	≈ 200 A	S [3] + C [3]	Al
	**P-GSR10** **3W7.089.00**	10mm [2]	LAl/0,2	≈ 200 A	S [3]	Al
	**P-GSR5** **11006003**	5mm [2]	LAl/0,2	≈ 200 A	S [3]	CuZn

[1] Mit Spezial Kontaktlamelle LA Spez.
[2] Entspricht Stromschienendicke gemäss DIN 46433 oder ±0,1 mm.
[3] C = Crimpanschluss
S = Schraubanschluss

[1] With special Multilam® LA spec.
[2] Corresponds to busbar thickness according to DIN 46433 or ±0,1 mm.
[3] C = Crimp connection
S = Screw connection

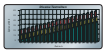
[1] Avec contact à lamelles spécial (LA spec.)
[2] Correspond à l'épaisseur de la barre selon DIN 46433 ou ±0,1 mm.
[3] C = Raccordement à sertir
S = Raccordement à visser

Derating Diagramme



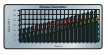
Beispiele für 2 und 6 stromführende Leiter (gebündelt) gemäss DIN VDE 0298, Teil 4 für 1,5mm², 2,5mm², 10mm², 16mm² und 25mm² Cu Draht, PVC isoliert mit erhöhter Wärmebelastbarkeit (90°C).

Derating diagrams

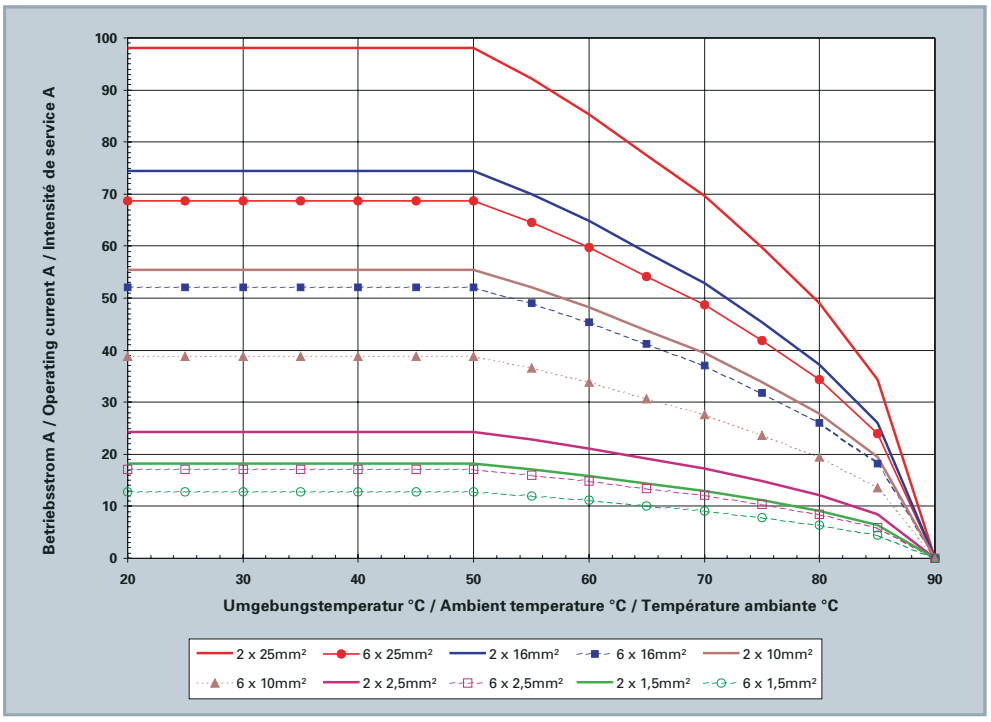


Examples of 2 and 6 current-carrying conductors (bundled) according to DIN VDE 0298, part 4 for 1,5mm², 2,5mm², 10mm², 16mm² und 25mm² Cu wire, PVC insulated for higher temperatures (90°C).

Diagrammes de derating



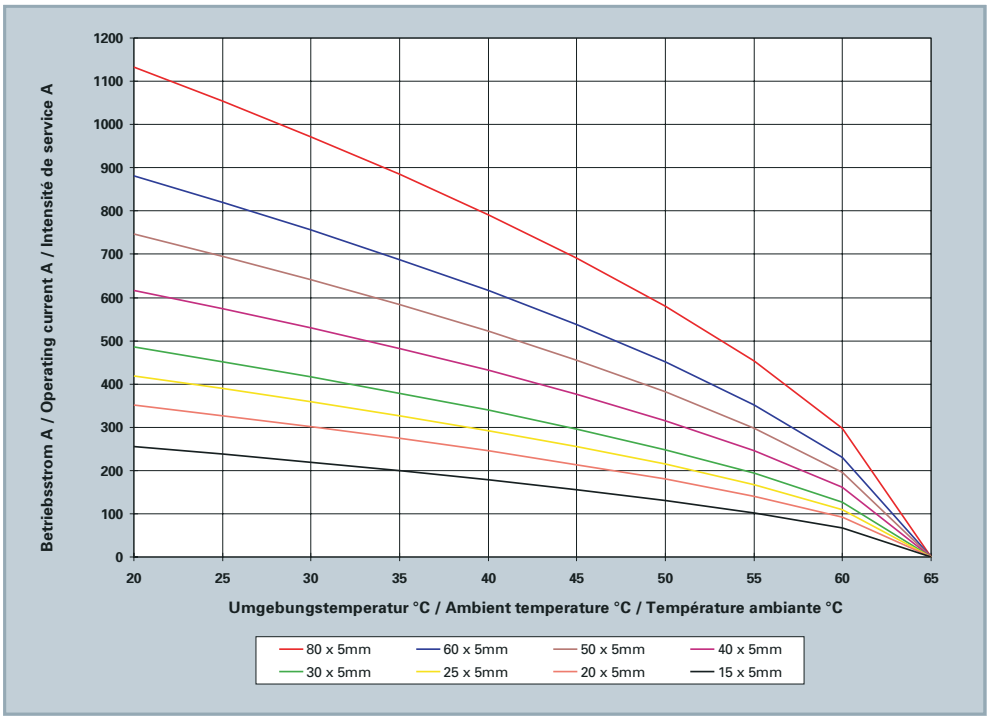
Exemples pour des câbles en torons de 2 et 6 conducteurs, selon DIN VDE 0298, partie 4 pour des conducteurs Cu 1,5mm², 2,5mm², 10mm², 16mm² et 25mm² , isolés PVC à haute tenue en température (90°C).



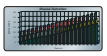
Rechteckige Kupferschienen gem. DIN 43671. Mögliche Kontaktierung mit Gabelsteckern GSR5/... Mit Crimp- oder Kabelschuhanschluss.

Rectangular section copper busbars according to DIN 43671. Possibility to contact with fork plugs GSR5/... with crimp or cable lug termination.

Jeux de barres en cuivre de section rectangulaire selon DIN 43671. Possibilité de contacter des fourches de contact GSR5/... avec raccordement par sertissage ou par cosse.

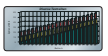


Derating Diagramme



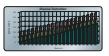
Cu-Anschlussleitung von 10mm² – 95mm², PVC isoliert (70°C) frei in Luft nach DIN VDE 0298, Teil 4. Mögliche Kontaktierung mit Gabelsteckern GSR5/... mit Crimp- oder Kabelschuhanschluss.

Derating diagrams

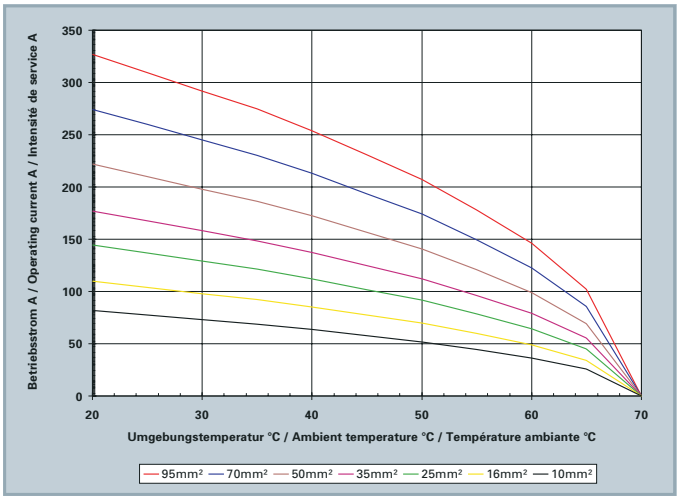


PVC insulated Cu conductors 10mm² – 95mm², (type 70°C) free in air, according to DIN VDE 0298, part 4. Possibility to contact with fork plugs GSR5/... with crimp or cable lug termination.

Diagrammes de derating



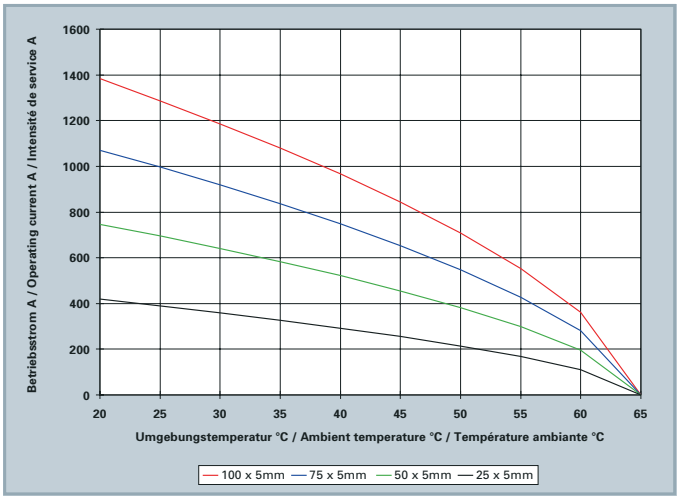
Câble Cu de 10mm² – 95mm², à isolation PVC (70°C) à l'air libre, selon DIN VDE 0298, partie 4. Possibilité de contacter des fourches de contact GSR5/... avec raccordement par sertissage ou par cosse.

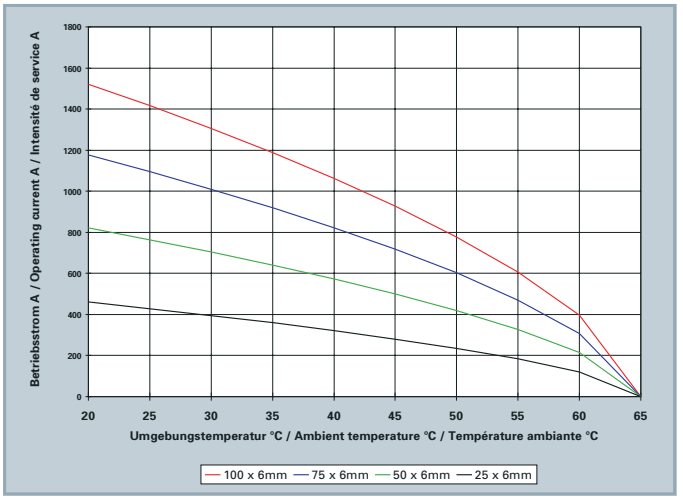


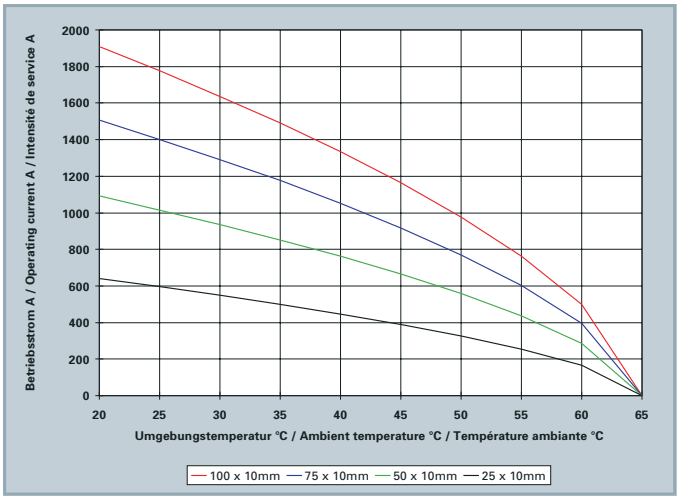
Rechteckige Kupferschienen gemäss DIN 43671. Mögliche Kontaktierung mit Gabelsteckern GSRD...

Rectangular section copper busbars acc. to DIN 43671. Possibility to contact with fork plugs GSRD...

Jeux de barres en cuivre de section rectangulaire selon DIN 43671. Possibilité de contacter des fourches de contact GSRD.







Technische Hinweise

Gabelstecker-Anschlüsse
sind flexibel auszuführen, um die schwimmende Lagerung des Gabelsteckerkörpers nicht zu beeinträchtigen. Beim Einsatz des Gabelsteckers ohne Isoliergehäuse ist mindestens ein Teil schwimmend anzuschliessen und zu befestigen (Stromschiene oder Gabelstecker)

Galvanik
Die zu kontaktierenden Cu- oder Al-Schienen sollten mit einer dünnen Schicht Silber über Nickel überzogen werden.

Schmierung
der Kontaktbereiche (Schiene) mit Kontaktfett wird empfohlen.

Schmiermittel
Von MC empfohlene Schmiermittel:
Metalon HT-1,5 (73.1052)
Kontasynth BA100 Spray (73.1051)*
Gleitfett in SF6-Gas:
Barrierta I EL-102*
Einpress- und Abdichtfett:
Barrierta IS-402 oder IMI-402*
* von Klüber Lubrication, München

Berührungsschutz
Da eine allgemeine Berührungssicherheit der Gabelstecker nicht gegeben ist, sind bei der Montage am Gabelstecker die 5 Sicherheitsregeln nach EN 50110-1 einzuhalten.

Auszugs- und Steckkraft
Angegebene Werte sind Kräfte nach 20 bis 30maliger Betätigung bei dünnem Schmiermittelfilm.

Technical information

Fork plug terminations
have to be made flexible so that the floating mounting of the fork plug body in the insulating housing is not impaired. When the fork plug is used without insulating housing, at least one part must be terminated and fastened in a floating manner (busbar or fork plug).

Plating
The copper and aluminium busbars should be plated with a thin layer of silver over nickel.

Lubrication
of the contact area (busbar) with contact grease is recommended.

Lubricant
MC recommends the following lubricants:
Metalon HT-1,5 (73.1052)
Kontasynth BA100 Spray (73.1051)*
Sliding grease in SF6-gas:
Barrierta I EL-102*
Assembly and sealing grease:
Barrierta IS-402 or IMI-402*
* from Klüber Lubrication, München

Touch protection
The fork plug is not a touchproof safety plug, therefore the 5 safety rules according to EN 50110-1 must be observed when working with it.

Withdrawal and mating forces
The stated figures refer to forces after 20 – 30 mating cycles with a thin film of lubricant present. Forces are greater in the new condition.

Informations techniques

Les raccordements des fourches de contact
doivent être exécutés de façon souple pour ne pas compromettre le montage flottant de la fourche de contact dans son boîtier isolant. En cas de mise en oeuvre d'une fourche de contact sans boîtier isolant, un élément au moins doit être raccordé et fixé de façon flottante (barre conductrice ou fourche de contact).

Traitement de surface
Les barres de connexion en cuivre ou aluminium connectées doivent être argentées (sous-couche de nickel).

La lubrification
des zones de contacts (barres) à l'aide d'une graisse de contact est conseillée.

Lubrifiants
Recommandés par MC:
Metalon HT-1,5 (73.1052)
Kontasynth BA100 Spray (73.1051)*
Graisse pour contact sous gaz SF6:
Barrierta I EL-102*
Graisse d'emmanchement et d'étanchéité:
Barrierta IS-402 ou IMI-402*
* de la société Klüber Lubrication à Munich.

Protection au toucher
Une protection généralisée contre un contact direct de la fourche ne peut être garantie. Lors des manipulations, les 5 directives de sécurité selon EN 50110-1 doivent être respectées impérativement.

Efforts d'embrochage et de débrochage
Les valeurs indiquées sont celles obtenues après 20 à 30 cycles d'embrochage-débrochage, les contacts étant légèrement graissés.

Verwendete Kunststoffe / **Employed plastic materials** / **Matériaux isolants utilisés**

Kurzzeichen Symbol Symbole	Werkstoffbezeichnung Material description Désignation de matière	Temperatur °C Temperature °C Température °C
PC	Polycarbonat / Polycarbonate / Polycarbonat	-80°C...+125°C
ABS	Acrylnitril-Butadien-Styrol-Copolymere	-40°C...+ 90°C
PA66	Polyamid 66 / Polyamide 66 / Polyamide 66	-40°C...+140°C
PPO	Polyphenyloxid / Polyphenylene oxide / Polyphénylène oxyde	-40°C...+140°C

Bemessungsstrom
(IEC 61984) Ströme und Temperaturen wurden bei 20°C Umgebungstemperatur nach 2 Stunden Belastung gemessen. (Endtemperatur: 70°C – 80°C).

Bemessungsspannung (IEC 61984)
Für Steckverbinder von MC festgelegter Wert der Spannung, auf den Betriebs- und Leistungskennwerte bezogen werden.
Anmerkung: Ein Steckverbinder darf mehr als einen Wert der Bemessungsspannung haben.

Rated rurrent
(IEC 61984) Amperages and temperatures were measured at 20°C ambient temperature after 2 hours load. (Final temperature about 70°C – 80°C).

Rated voltage (IEC 61984)
Voltage assigned by MC to the connector and to which the operation and performance characteristics refer.
Note: A connector may have more than one voltage value.

Intensité assignée
(CEI 61984) Les courants et les températures ont été mesurés à une température ambiante de 20°C après 2 heures de charge. (Température finale environ 70°C – 80°C).

La tension assignée (CEI 61984)
Valeur de la tension assignée par MC au connecteur, et à laquelle on se réfère pour le fonctionnement et pour les caractéristiques fonctionnelles.
Note: Un connecteur peut avoir plusieurs tensions assignées.

Kontaktwiderstand
ist der an der Berührungsstelle zweier Kontaktflächen auftretende Widerstand. Sein Wert wird über den gemessenen Spannungsabfall beim Bemessungsstrom berechnet.

Prüfspannung
ist die Spannung, der ein Steckverbinder bei festgelegten Bedingungen ohne Durch- oder Überschlag standhält.

Überschlagspannung
ist die Steh-Wechselspannung, bei der Überschläge entstehen können. Die Werte in den Tabellen gelten zwischen aktiven Teilen und der Befestigungsebene.

Stosskurzschlussstrom
Definition gem. DIN VDE 0102/1.90 (IEC 60909:1988).

Isolationskoordination
gemäss IEC 60664-1, DIN VDE 0110-1. Sie wird mit der Bemessungs-Stossspannung in kV und dem Verschmutzungsgrad angegeben.

Steckzyklen
Die maximale Steckhäufigkeit der Standardsteckverbindung beträgt 1000 bis 5000 je nach Einsatzbedingungen.
Voraussetzung ist ein dünner Schmiermittelfilm auf den Kontakten vor dem ersten Steckvorgang.
Höhere Steckzyklen stellen besondere Anforderungen an die Oberfläche, die Führung und die Schmierung und bedingen immer spezielle Abklärungen und Sonderausführungen.

Schutz gegen elektrischen Schlag
Bei einem ungekapselten Steckverbinder muss der Schutz gegen elektrischen Schlag durch das Endprodukt gegeben sein, in das der Steckverbinder montiert wird.

Crimpanschlüsse
Für die Leiteranschlüsse empfehlen wir für unsere Crimphülsen Sechskantcrimpung. Dornkerbung ist möglich. Unsere Crimphülsen sind ausgelegt für hochflexible Cu-Leitungen. Für andere Leitungen sind spezielle Crimphülsen erforderlich. MC empfiehlt Elpress für alle hochflexiblen Cu-Leiter.

Schraubklemmenanschluss
Bei Anschlüssen von flexiblen oder hochflexiblen Leitern sind Aderendhülsen zu verwenden.

Contact resistance
is the resistance occuring at the contact point of two contact surfaces. Its value is calculated from the measured voltage drop at the rated current.

Test voltage
is the voltage withstood by a plug connector under predetermined test conditions, without breakdown or flashover.

Flashover voltage
is the withstand alternating voltage at which flashover can arise.
The values in the tables apply between active parts and the attachment plane.

Rated peak withstand current
As defined by IEC 60909:1988.

Insulation coordination
according to IEC 60664-1. Indicate the rated surge voltage in kV and the degree of pollution.

Mating cycles
The maximum number of mating cycles of the standard plug-in connections is between 1000 and 5000, depending on duty conditions. Precondition is a thin film of lubricant on the contacts prior to initial mating.
Because higher cycle numbers call for special surface treatment, guiding and lubrication measures, each case must be individually investigated to establish the required measures.

Protection against electric shock
For an unenclosed connector, protection against electric shock must be provided by the enclosure of the end-use-product, in which the connector is installed.

Crimp terminations
For conductor terminations, we recommend hexagonal crimping for our crimp sleeves. Afterwards the sleeve can be notched with a drift. Our crimp sleeves are designed for highly flexible Cu conductors. Special crimp sleeves are required for other types of conductors. MC recommends Elpress for all highly flexible conductors.

Screw clamping terminals
When flexible or highly flexible leads are connected, use wire sleeves.

La résistance de contact
est la résistance qui se crée au point de contact de deux surfaces. Sa valeur est calculée à partir de la chute de tension mesurée sous intensité assignée.

La tension d'essai
est la tension que supporte un connecteur dans des conditions prédéfinies sans que prenne naissance un arc électrique perforant ou de surface.

La tension de claquage
est la tension alternative crête à laquelle des claquages peuvent avoir lieu. Les valeurs mentionnées dans les tableaux sont valables entre les éléments actifs et le plan de fixation.

Intensité de crête
Définition selon CEI 60909:1988.

La coordination de l'isolement
d'après CEI 60664-1. Les valeurs indiques la tension de crête assignée en kV et le degré de pollution.

Cycle d'embrochage-débrochage
Le nombre maximal de cycles d'une connexion standard est de 1000 à 5000 en fonction des conditions d'utilisation, sous réserve de graisser légèrement les contacts avant le premier embrochage.
Des valeurs plus importantes peuvent être atteintes dans certaines conditions: état de surface, guidage, graissage spéciaux. Chaque cas implique une réalisation particulière selon des critères à définir.

Protection contre les chocs électriques
La protection contre les chocs électriques des connecteurs à enveloppe ouverte doit être garantie par le produit fini, dans lequel vient se monter le connecteur.

Raccordements par fût à sertir
Pour le raccordement de conducteurs à ses cosses, MC préconise un sertissage six pans, un poinçonnage étant toutefois possible. Les fûts à sertir sont prévues pour des câbles extra-souples en cuivre. Pour d'autres types de conducteurs, ils est nécessaire d'adapter des fûts spéciaux. MC recommande le système Elpress pour tous ses câbles en cuivre extra souples.

Raccordements à visser
Pour les raccordements de conducteurs souples ou extra-souples, utiliser des embouts de câble.

Technische Anforderungen laut UL Underwriters Laboratories Inc.
zutreffend auf Steckverbinder der Serien
P1/30 (Seiten 8 – 9)
P1/63 (Seiten 10 – 13)
P1/100 (Seiten16 – 19)
P4/50 (Seiten 14– 15)
P4/63 (Seiten 14 – 15).
Technische Daten und Nennwerte: Siehe Seiten mit der allgemeinen Beschreibung der jeweiligen Typen.

Diese Elemente sind mehrpolige oder einpolige Steckverbinder mit Crimp- oder Schraubanschluss, zur Anwendung in elektrischen Geräten.

- Anwendung
  Diese Elemente sind ausschliesslich für die Verwendung in kompletten Geräten bei denen die Annehmbarkeit der Kombination von Underwriters Laboratories Inc. bestätigt wird.
- Untersucht gemäss United States Standard UL 1977, erste Ausgabe, Standard für Komponenten Steckverbinder für den Gebrauch bei Daten, Signal, Steuerungs- und Leistungsanwendungen (und gemäss Canadian National Standard CSA C22.2 No. 182.3-M1).
- Annahmebedingungen
  Um als Bauteil für ein elektrisches Gerät bewertet zu werden, müssen die folgenden Bedingungen erfüllt werden:

1. Diese Elemente sollten nur da eingesetzt werden, wo sie den Strom nicht unterbrechen.
2. Die Eignung der Befestigungsart soll durch die Endnutzung bestimmt werden.
3. Die dielektrische Stehspannungsprüfung (AC) wurde wie in den Tabellen aufgelistet, zwischen benachbarten Polen durchgeführt, siehe unter Prüfspannung.
4. Die Betriebstemperatur dieser Elemente sollte den Temperaturbereich der Isoliermaterialien – wie in der Tabelle angegeben – nicht übersteigen. (Siehe unter Temperaturbereich).
5. Diese Elemente sind nicht geeignet Zugbelastungen von den Leitern aufzunehmen.

Engineering considerations per UL Underwriters Laboratories Inc.
applicable for connectors of series
P1/30 (pages 8 – 9)
P1/63 (pages 10 – 13)
P1/100 (pages16 – 19)
P4/50 (pages 14 – 15)
P4/63 (pages 14 – 15).
Technical data and ratings: See pages with the general description of each type.

These devices are multi-pole or single-pole connectors with contacts employing crimp and screw type terminations intended for use in electrical equipment.

- Use
  These devices are for use only in complete equipment where the acceptability of the combination is confirmed by Underwriters Laboratories Inc.
- Tested according to United States Standard UL 1977, First Edition, Standard for Component Connectors for Use in Data, Signal, Control, and Power Applications. (and Canadian National Standard CSA C22.2 No. 182.3-M1).

- Conditions of Acceptability - In order to be judged acceptable as a component of electrical equipment, the following conditions shall be met:

1. These devices should be used only where they will not interrupt current.
2. The suitability of the mode of installation shall be determined in the end use.
3. The dielectric Voltage Withstand Test (AC) has been conducted between adjacent poles at a potential as stated in the tables, (see under Test voltage).
4. The operating temperature of these devices should not exceed the temperature ratings of the insulating materials as stated in the tables (see under Temperature range).
5. These devices are not intended to absorb any strain from the conductors.

Spécifications techniques selon UL Underwriters Laboratories Inc.
applicables aux connecteurs des séries
P1/30 (pages 8 – 9)
P1/63 (pages 10 – 13)
P1/100 (pages16 – 19)
P4/50 (pages 14 – 15)
P4/63 (pages 14 – 15).
Caractéristiques techniques et valeurs nominales: voir les pages contenant la description générale des types concernés.

Ces éléments sont des connecteurs multipolaires ou unipolaires à raccord serti ou vissé, destinés à être utilisés dans des équipements électriques.

- Application
  Ces éléments sont exclusivement destinés à être utilisés dans des appareils complets dont l'acceptabilité de la combinaison est confirmée par Underwriters Laboratories Inc.
- Contrôle selon United States Standard UL 1977, première édition, norme pour composants de connecteurs destinés à être utilisés dans des applications de transmission de données, de signaux, de commande et de puissance (et selon Canadian National Standard CSA C22.2 No. 182.3-M1).
- Conditions d'acceptation. Pour qu'un composant soit jugé apte à être utilisé dans un appareil électrique, les conditions suivantes doivent être remplies:

1. Ces éléments ne doivent être utilisés que là où ils ne coupent pas le courant.
2. L'adéquation du mode d'installation doit être déterminée par l'utilisation finale.
3. Le contrôle de la tension de tenue diélectrique (AC) a été effectué entre des pôles voisins, comme indiqué dans les tableaux (voir sous tension d'essai).
4. La température de fonctionnement de ces éléments ne doit pas dépasser la plage de température des matériaux isolants comme indiqué dans le tableau (voir sous plage de température).
5. Ces éléments ne sont pas conçus pour reprendre des efforts de traction des conducteurs.

6. Abstände – in Luft und über Oberflächen zwischen stromführenden Metallteilen mit entgegengesetzter Polarität, zwischen stromführenden Teilen und exponierten nicht stromführenden Metallteilen. Diese Elemente eignen sich für Spannungen
   – ≤ 250V basierend auf einem Minimum von 3/64 inch (1,2mm), oder
   – 600V basierend auf einem Minimum von 1/8 inch (3,2mm) Abstände, gemäss UL 1977.

UL 1977:
Abschnitt 17:
Dielektrische Stehspannungsprüfung

Abschnitt 14:
Mech. Spannungsprüfung

Abschnitt 16:
Temperaturtest, untersucht unter Strom auf jedem Kontakt

Abschnitt 19:
Zugentlastungsversuch

UL 498:
Abschnitt 62:
Isolationswiderstands-Test

Abschnitt 63:
Zugentlastungsversuch.

Zusammenfassung der Testergebnisse:
Die Ergebnisse der Untersuchung zeigen, dass die geprüften Steckverbinder den jeweiligen Anforderungen entsprechen und somit als qualifiziert bewertet werden, das -Zeichen zu tragen.

Allgemeine Hinweise

info

Die Überprüfung, ob in speziellen, von uns nicht vorhersehbaren Anwendungsbereichen, die in diesem Katalog gezeigten Produkte anderen als den angegebenen Vorschriften entsprechen, obliegt dem Anwender.

Änderungen / Vorbehalte
Alle Daten, Abbildungen und Zeichnungen in diesem Katalog sind das Resultat sorgfältiger Prüfungen. Sie entsprechen dem Stand unserer Erfahrungen. Irrtum vorbehalten. Ebenfalls vorbehalten sind Änderungen aus konstruktions- bzw. sicherheitstechnischen Gründen. Es ist deshalb ratsam, bei Konstruktionen, in die unsere Bauteile einfliessen, nicht alleine auf die Katalogdaten abzustellen, sondern mit uns Rücksprache zu nehmen, um sicherzustellen, dass die neuesten Daten zur Anwendung kommen. Wir beraten Sie gerne.

6. Spacings provided through air and over surface between live metal parts of opposite polarity, between live parts and exposed non current carrying metal parts. These devices may be used at potentials
   – ≤ 250V based on a minimum of 3/64 inch (1,2mm), or
   – 600V based on a minimum of 1/8 inch (3,2mm). Spacings specified by UL 1977.

UL 1977:
Section 17:
Dielectric Voltage Withstand Test

Section 14:
Mold Stress Test

Section 16:
Temperature Test, investigated for a current test with metric wires carried by each contact)

Section 19:
Conductor Secureness Test

UL 498:
Section 62:
Insulation Resistance Test

Section 63:
Conductor Secureness Test

Test record summary:
The results of the investigation indicate that the connectors evaluated comply with the applicable requirements, and are judged eligible to bear Marking.

General information

info

Users wishing to employ products listed in this catalogue for applications we have not considered are themselves responsible for making certain that the products comply with standards other than those stated.

Changes / Provisos
All data, illustrations and drawings in the catalogue have been carefully checked. They are in accordance with our experience to date, but no responsibility can be accepted for errors.
We also reserve the right to make modifications for design and safety reasons. When designing equipment incorporating our components, it is therefore advisable not to rely solely on the data in the catalogue but to consult us to make sure this information is up to date. We shall be pleased to advise you.

6. Distances dans l'air et lignes de fuite entre des pièces métalliques actives de polarité opposée entre des pièces actives et des pièces métalliques exposées, non actives. Ces éléments peuvent être utilisés à des tensions
   – ≤ 250V sur la base d'un minimum de 3/64 pouce (1,2mm) ou
   – 600V sur la base d'un minimum de 1/8 pouce (3,2mm). Distances selon UL 1977.

UL1977:
Chapitre 17:
Contrôle de la tension de tenue diélectrique

Chapitre 14:
Essai de relaxation

Chapitre 16:
Essai thermique, contrôlé sous charge sur chaque contact

Chapitre 19:
Essai de tenue à la traction

UL 498:
Chapitre 62:
Essai de résistance d'isolement

Chapitre 63:
Essai de tenue à la traction

Résumé des résultats d'essai:
Les résultats des essais montrent que les connecteurs testés sont conformes aux différentes spécifications et donc qualifiés pour porter la marque .

Généralités

info

Dans le cas d'une application spéciale, non-prévue par le constructeur, l'utilisateur se chargera de vérifier la conformité aux normes et prescriptions en vigueur des produits référencés dans ce catalogue.

Modifications / Réserves
Les données, illustrations et dessins figurant dans ce catalogue ont fait l'objet de contrôles rigoureux. Ces informations correspondent à l'état actuel de notre expérience, et vous sont communiquées sous réserve d'erreurs et sous réserve également de modifications apportées pour des raisons constructives ou techniques. Il est donc conseillé, pour les conceptions faisant appel à nos composants, de ne pas seulement se référer aux données du catalogue, mais de faire appel à nos services pour vous assurer de la validité des données et pour vous permettre de disposer des informations les plus récentes. Nous nous tenons volontiers à votre service.

Anwendungsbeispiele der Einschubtechnik

Multi-Contact ist nicht nur Lieferant von hochwertigen Steckverbindern, sondern auch Anbieter von Gesamtlösungen für Kontaktsysteme.

Application examples of Slide-in technology

Multi-Contact is not only a supplier of high-quality plug connectors, but also offers complete contact system solutions

Exemples d'applications des connecteurs pour tiroirs embrochables

Multi-Contact est non seulement un fabricant de connecteurs embrochables de haute qualité, mais offre également des solutions complètes de systèmes de connexion.

Wir beraten Sie in Sachen

**Kontakttechnik,
Anschlusstechnik
Isolations- und
Kontaktträgertechnik**

unter Berücksichtigung Ihrer speziellen Bedürfnisse.

Auf den folgenden Seiten sind einige Beispiele aufgeführt.

We advise you on

**contact technology
connection technology
insulation and
contact carrier technology**

in accordance with your special needs.

The following pages show some examples

Nous sommes en mesure de vous conseiller dans le choix des

**techniques de contact
techniques de raccordement
techniques d'isolation et de
supports de contact**

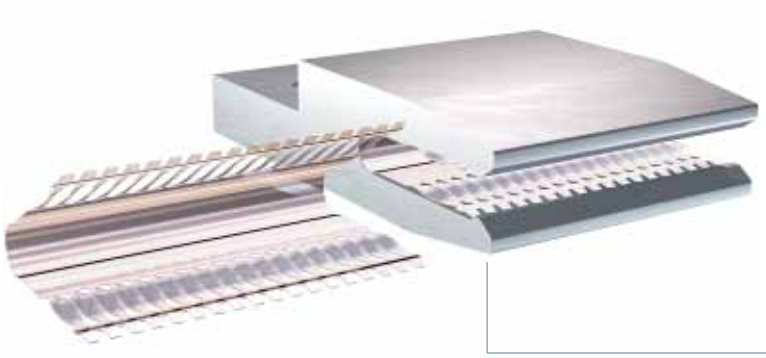
à partir de vos contraintes et spécifications.

Les exemples qui suivent présentent notre savoir-faire.

Spezial Gabelstecker für flüssigkeitsgekühlte Traktions- und Antriebsanwendungen

Special fork connector for liquid cooled devices for traction and drive applications

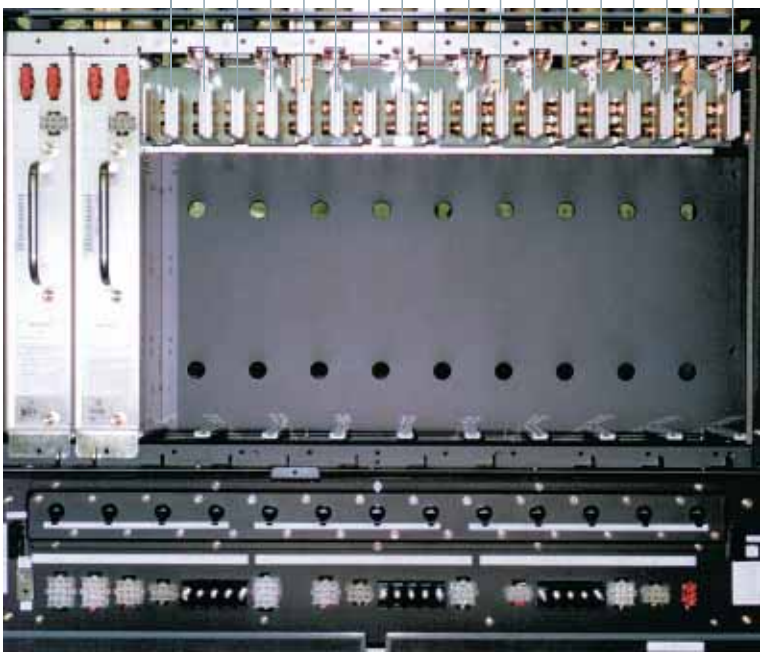
Fourche spéciale pour éléments à refroidissement liquide dans des modules de traction et de propulsion



MC-Kontakte sind langzeitstabil

MC contacts for enduring stability

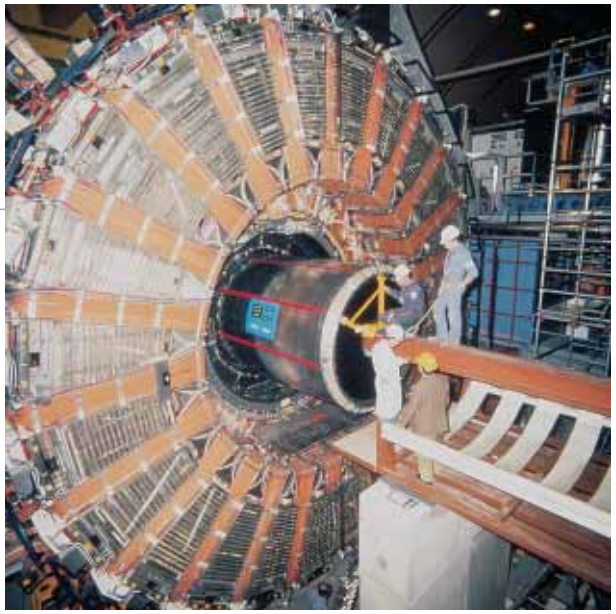
Contacts MC, stables à long terme

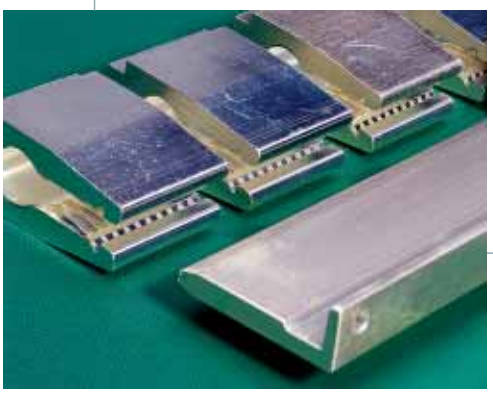


Gabelstecker, die ideale Lösung für die Einschubtechnik

Fork plugs, the perfect solution for slide-in rack connections

Les fourches de contact, la technique de connexion idéale pour les tiroirs embrochables





Noch eine praktische Lösung mit Gabelstecker für die Einschubtechnik

Another practical solution with fork plugs for slide-in rack connection

Encore une bonne solution de connexion pour tiroirs embrochables basée sur l'utilisation de fourches de contact

MC-Kontakte sind zuverlässig

MC contacts are reliable

Les contacts MC sont fiables

Gabelstecker (Gussteil mit Lötanschluss) für die Leistungselektronik

Fork plug (cast part for solder termination) for power electronics

Fourche de contact pour l'électronique de puissance (à souder sur CI)

Gabelstecker mit Anschlussbuchse

Fork plug with connection socket

Fourche de contact avec douille de raccordement

Gabelstecker-Drehkontakt für einen Schiffsruder-Antrieb

Fork plug rotating contact for a ship's steering gear

Fourche pour contact tournant (principe disque/fourche) pour des propulsions de navires de type POD

MC Kontakte haben niedrige Übergangwiderstände

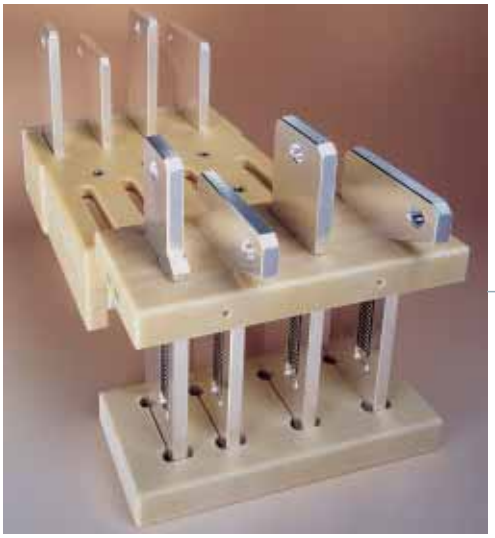
MC contacts have low contact resistances

Les Contacts MC ont de faibles résistances de contact

Gabelstecker-Einheit zur Rührspulenkontaktierung in einer Stranggussanlage (800A)

Fork plug unit in a connector for agitation coils in a continuous casting plant (800A)

Module de connexion composé de plusieurs fourches de contact pour brasseur magnétique de haut-fourneau (800A)



Gabelstecker mit Kunststoffführungen und der besonders leistungsstarken Kontaktlamelle LA-CU für einen Drehkontakt

Fork plug with plastic guides and the extra heavy-duty high-power Multilam® LA-CU for rotary connection

Fourches équipées de patins de guidage en matière plastique et des contacts à lamelles particulièrement performants du type LA-CU pour un contact tournant

MC-Kontakte haben einen hohen Qualitätsstandard

MC contacts have a high quality standard

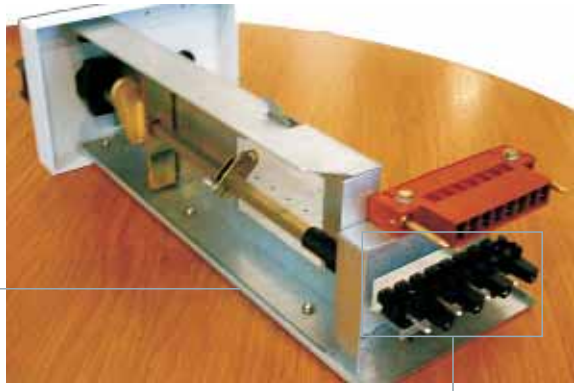
Contacts MC de qualité supérieure

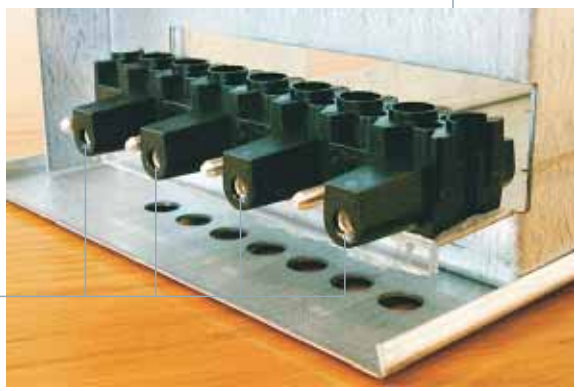
Gabelstecker mit abgedichtetem Kontaktmodul MC-SEALconTACT welches eine Kontaktierung von blanken unbearbeiteten Stromschienen ermöglicht

Fork plug with a sealed contact module (MC-SEALconTACT) which allows contact on the connection side with unplated, unmachined busbars

Fourche de contact équipée au niveau du socle de raccordement d'un module de contact étanche (MC-SEALconTACT) pour un montage direct sur des jeux de barres à l'état brut (non reprises et non traitées)

SEALconTACT





P1/63... in einem Einschub

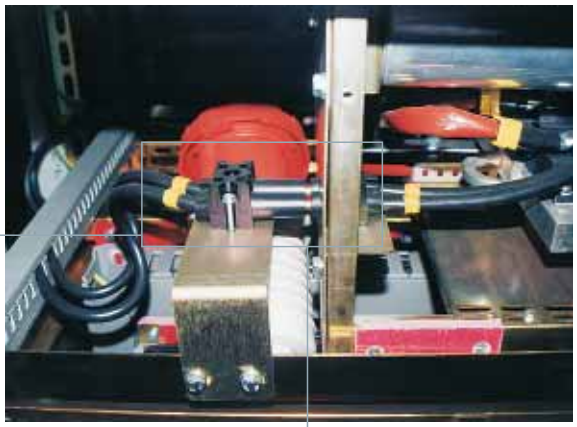
P1/63... in a slide-in rack

P1/63... dans un tiroir

MC Kontakte sind effizient

MC contacts are efficient

Les contacts MC sont efficaces



Buchsen- und Steckerleiste-Element P1/100... in einem Einschub

Socket and plug modules P1/100... in a slide-in rack

Connecteurs modulaires P1/100... dans un tiroir

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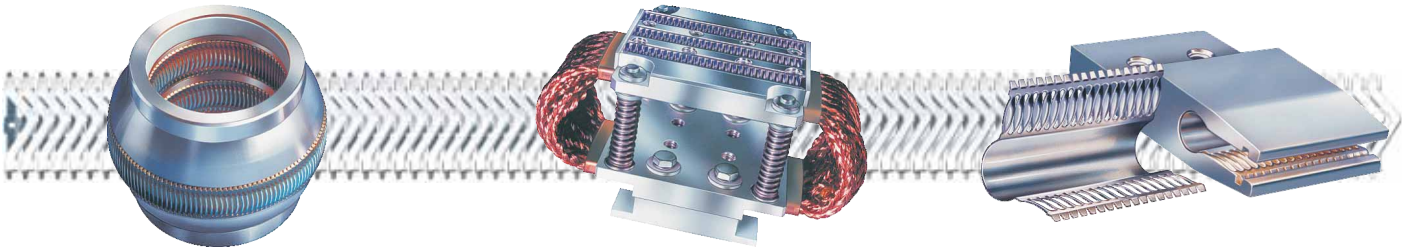
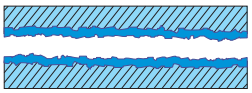
MC®-Kontaktlamellen
Das unübertroffene Kontaktsystem



Kontaktlamellen sind speziell geformte Hartkupferblechstreifen.
Multi-Contact bietet ein ganzes System von Kontaktlamellen, das laufend, anhand neuer Projekte erweitert wird.



Kontaktteile mit Fremdschicht

Contact pieces with pollution film

Pièces de contact avec une couche d'oxydation

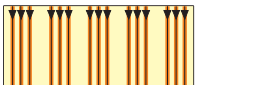
Die Kontaktlamellen sind auf Bändern angeordnet und erlauben damit eine Kontaktgabe über eine Vielzahl von definierten stromführenden Pfaden.
Jeder Lamellensteg bildet eine unabhängige Strombrücke und die vielen parallel angeordneten Lamellenstege vermindern damit den Kontaktwiderstand des Gesamtkontaktes erheblich.

Eigenschaften:
- Minimaler Kontaktwiderstand
- Minimaler Spannungsabfall
- Erlaubt hohe spezifische Stromdichte
- Grosse Anzahl Kontaktpunkte
- Selbstreinigungseffekt im Kontaktbereich
- Minimaler Leistungsverlust

Vorteile:
- Minimale Erwärmung
- Energiesparend
- Weniger Materialkosten
- Hohe Stromtragfähigkeit
- Geringe Wartungskosten
- Tausende von Steckzyklen möglich
- Lange Lebensdauer der Produkte

MC®-Multilam®
The unsurpassed contact system

MC-Multilams® are specially formed strips of hard copper.
Multi-Contact can supply a complete range of these Multilams® that is being continually expanded to meet the needs of new projects.



Der Idealfall: viele Kontaktpunkte

The ideal case: many contact points

Le cas idéal: de nombreux points de contacts

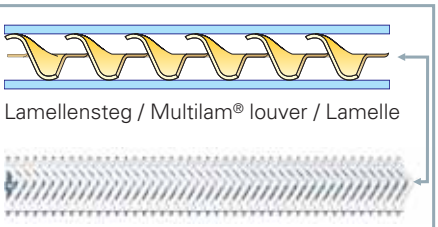
The contact louvers are arranged on strips, thus allowing contact to be made over a large number of defined current-carrying contact surfaces.
Each louver forms an independent current bridge and the many parallel louvers considerably reduce the overall contact resistance.

Features:
- Minimal contact resistance
- Minimal voltage drop
- Allows high specific current density
- Large number of contact points
- Self-cleaning in contact area
- Minimal power loss

Benefits:
- Minimal heat build-up
- Energy savings
- Lower material costs
- High specific current capacity
- Low maintenance costs
- Perfect function over thousands of mating operations
- Longer product life

Contacts à lamelles MC®
Le système de contact inégalé

Les contacts à lamelles sont des interfaces de contact spécialement formées en alliage de cuivre. Multi-Contact propose une large gamme de contacts à lamelles, qui s'étoffe régulièrement au travers de nouveaux projets.



MC-Kontaktlamellen mit vielen Kontaktpunkten

MC-Multilam® with many contact points

Contact à lamelles MC avec de nombreux points de contact

Les lamelles de contact sont disposées en parallèle sur une bande, permettant ainsi la réalisation d'un contact au travers d'une multitude de points de contact, parfaitement définis.
Chaque lamelle forme une ligne de courant indépendante, de sorte que la multiplication de ces lignes en parallèle conduit à une diminution sensible de la résistance du contact complet.

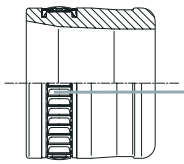
Caractéristiques:
- Résistance de contact minimale
- Chute de tension minimale
- Forte densité de courant
- Grand nombre de points de contact
- Effet autonettoyant dans la zone de contact
- Perte de puissance minimale

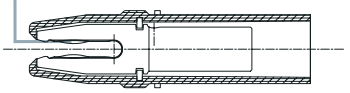
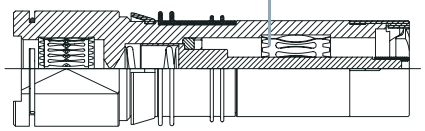
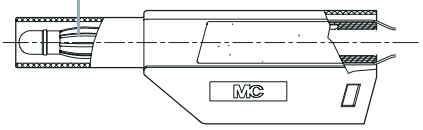
Avantages:
- Réduction de l'échauffement
- Economies d'énergie
- Economies de coûts de matière
- Haute conductibilité électrique
- Coûts de maintenance réduits
- Endurance: des milliers de cycles d'embrochage possibles
- Durée de vie prolongée

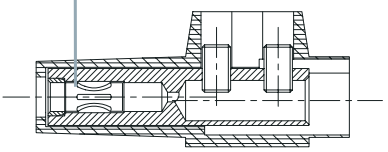
MC®-Kontaktlamellen
Vielseitige Grundlage neuer Entwicklungen

MC®-Multilam®
The versatile basis for new developments

Contacts à lamelles MC®
La base de multiples nouveaux développements





In unserer Schrift **Multilam***Technology*, die Sie bei uns anfordern können, finden Sie zusätzlich viele nützliche Informationen.

You will find much more useful information in our publication **Multilam***Technology*, which we will supply on request.

Vous trouverez de nombreuses informations complémentaires dans notre brochure **Multilam***Technology*.

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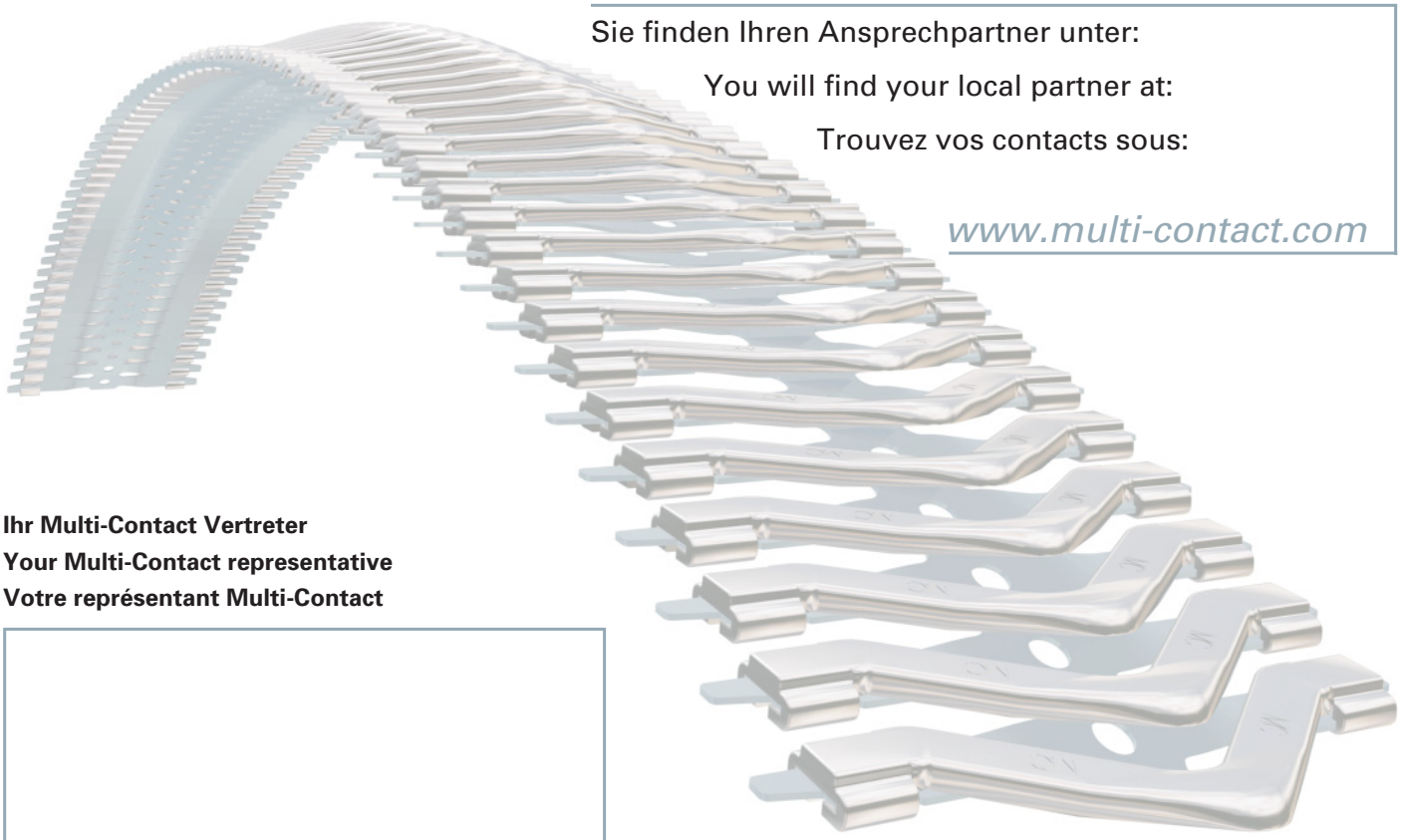

Ihr Multi-Contact Vertreter
Your Multi-Contact representative
Votre représentant Multi-Contact

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Catalogue 31

www.fascinating-future.com

FRIEDHELM LOH GROUP

RITTAL®

We look to the future

Rittal is already working enthusiastically on the solutions of the future. This is our tradition, and is the key to our **innovativeness** in the field of technology packaging. Experience the future of **communications technology and automation** with Rittal, trendsetters in holistic solutions. Setting trends means understanding customers, creating future-safe solutions, and being very forward-thinking. Industrial Ethernet, nano-spray-finishing and Rittal Liquid Cooling Systems are just some of the examples which impressively underscore our commitment to this principle.

With **fascinating future,** progress becomes possible – this is our mission.

The Rittal corporate principle
We are aware of our responsibility to the environment and the world in which we live. We want to help structure and improve them!

RITTAL®

It is only through **intelligent production techniques** that pioneering ideas acquire a clear added value. Mindful of this fact, Rittal has always chosen innovative paths and produced modern products in superb quality, whilst exploiting the cost benefits of mass production.

We produce the future

For example, the patented section in the TS 8 frame is **16-fold profiled** in a special technique. All 12 frame parts are linked together in a combined **seam and welding robot system.** Exceptionally smooth enclosure seams are achieved with the **powder plasma welding technique.** In order to achieve highly practical paint structures and enhanced corrosion protection, Rittal uses **electrophoretic dipcoat-priming** developed for the automotive industry, as an outstanding feature of Rittal surface quality! In addition, the techniques of **zinc phosphating** and **aluminization** ensure exceptional longevity and resistance. A state-of-the-art powder coating technique enables us to realise **customised colour changes in next to no time.** In this way, we produce a decisive, lasting added value for your application.

The Rittal corporate principle

We concentrate all our efforts on perfect, cost-effective production of our products, professional marketing, and reliable delivery!

RITTAL®

We offer forward-thinking information

Rittal offers product selection support from a number of information platforms which systematically complement one another: Our comprehensive Catalogue, the compact CD-ROM with useful links, and the Rittal website, which is always up-to-date. This enables you to compile your own individual system solution very easily, selectively and quickly.

Navigation through the Catalogue is now even easier, because it is structured into three parts:

– **Range overview (A)** with the relevant product group at a glance,

– **Order information (B)** containing full details, and

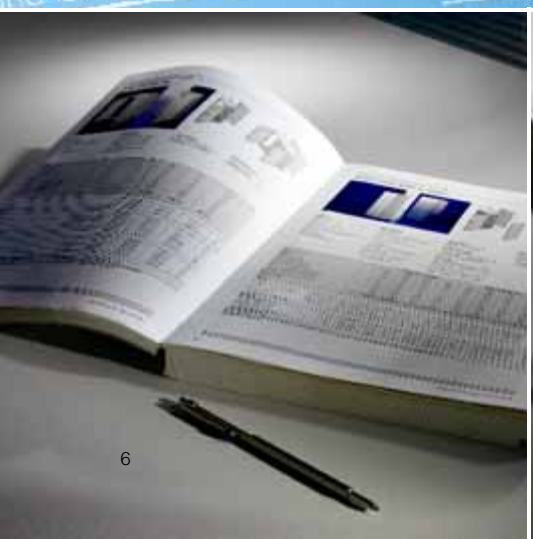
– **The technical part (C)** containing detailed dimensional drawings.

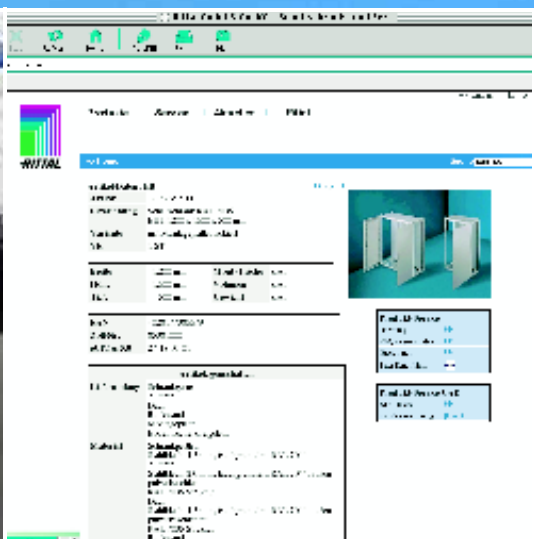
The CD-ROM features cross-references to take you, for example, straight to the matching system accessories at the click of a mouse, while Model Numbers offer direct links to the Internet for standardised CAD files, precise assembly instructions, and up-to-date approvals.

We call it the **Triple C:**

Complete,
Compact,
Comfortable.

All three information platforms from Rittal – Catalogue, CD-ROM and Internet – will guide you swiftly to the appropriate solution for your particular task. In this way, you benefit from forward-thinking information and navigation.





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The Rittal corporate principle

We view our customers as partners who determine the success of our company:

- We must find solutions to our customers' requests and problems, because our customers are our livelihood and our safeguard for the future!
- Our products must offer clear benefits and advantages for the customer, particularly in terms of quality, technical execution, product selection and deliverability.

Dialogue with us offers exciting prospects

Your application demands solutions for specific tasks. As such, **dialogue with our customers** is always our primary source of information when devising new products and services. To this end, we utilise all the major platforms to forge long lasting relationships with our customers – national and international trade fairs, competence days, and the new media.
We continue this dialogue throughout every phase of the process, from the initial idea, to development of a solution, through to the use of our products.

Pre-sales service: Information, advice, planning aids, analyses.

Sales service: Online shops, project planning, prototype construction, tests, assembly, warehousing and delivery service.

After-sales service: Training, commissioning, maintenance, repair and spare parts service.

Constructive dialogue creates shared prospects for all of us.

RITTAL®

There is a demand for the **holistic solutions** of modern technology packaging **in all segments of industry.**

All areas of the system, such as enclosures, climate control, power distribution, racks and monitoring, are expertly coordinated with one another. Synergies are utilised to perfection. Rittal provides you with intelligent product packaging when technologies become merged, such as **communications technology** and **automation.**

The provision of cross-industry, complete solutions, e.g. for industrial automation, mechanical engineering, electronics, networks and servers, fixed network and mobile communications, transport technology and facility management, is our mission.

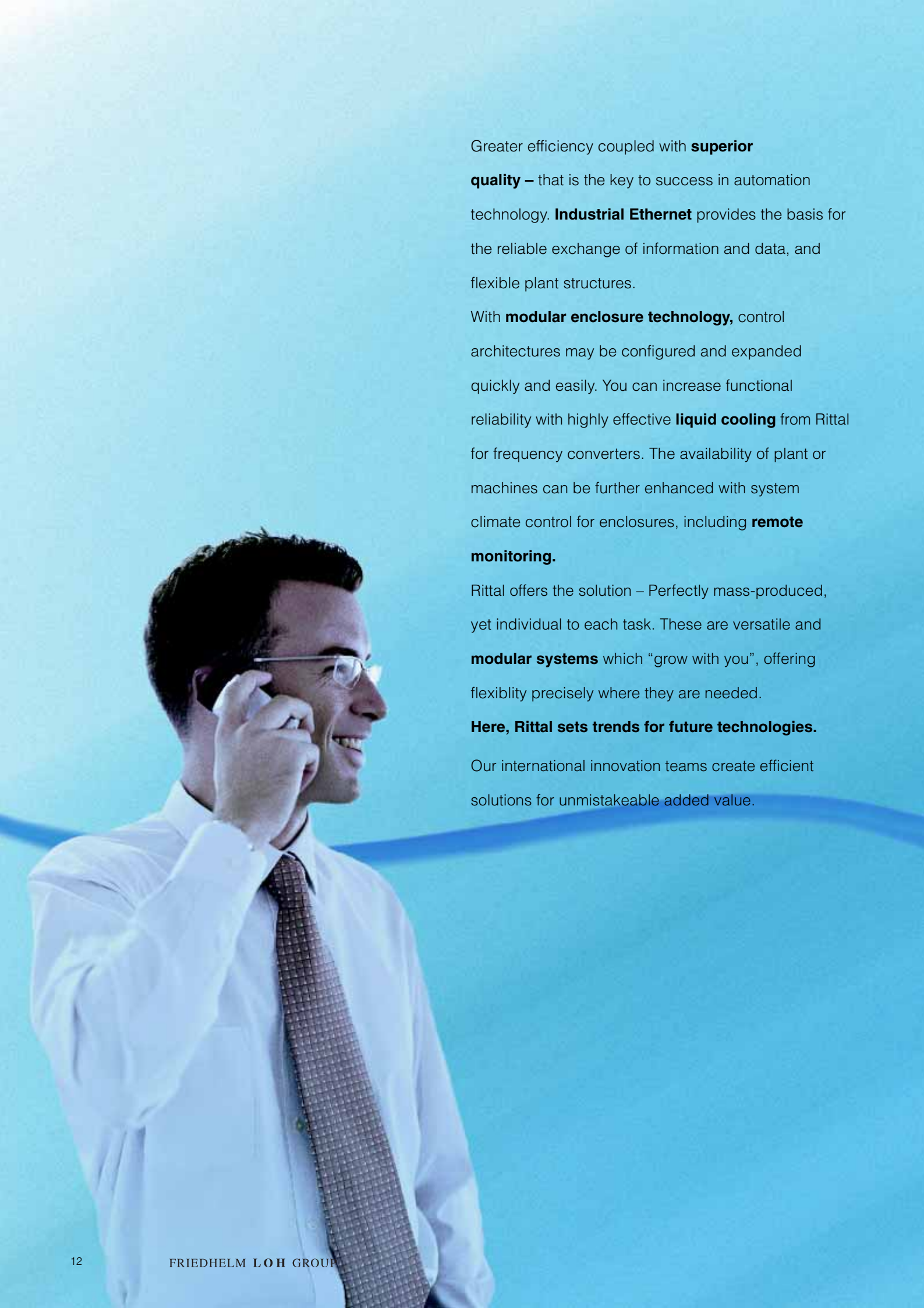
Thanks to perfect interplay between the many different facets, solutions become complete.

We say, “Complete is better!”

The Rittal corporate principle

Perfect mastery of our day-to-day business safeguards our existence and enables us to master the requirements of the future!

RITTAL®



Greater efficiency coupled with **superior quality –** that is the key to success in automation technology. **Industrial Ethernet** provides the basis for the reliable exchange of information and data, and flexible plant structures.

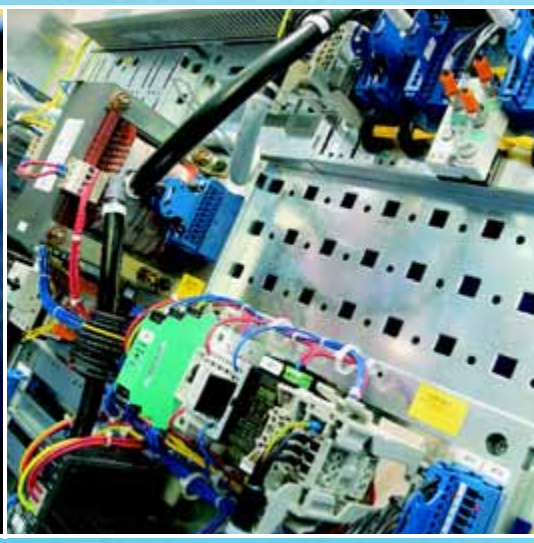
With **modular enclosure technology,** control architectures may be configured and expanded quickly and easily. You can increase functional reliability with highly effective **liquid cooling** from Rittal for frequency converters. The availability of plant or machines can be further enhanced with system climate control for enclosures, including **remote monitoring.**

Rittal offers the solution – Perfectly mass-produced, yet individual to each task. These are versatile and **modular systems** which “grow with you”, offering flexiblity precisely where they are needed.

Here, Rittal sets trends for future technologies.

Our international innovation teams create efficient solutions for unmistakeable added value.

We safeguard efficiency



The Rittal corporate principle
We need to be faster and better than the competition.
We must prove this competitive lead to our customers on a daily basis.

We open up new horizons full of opportunities

Innovative information technologies with an **extremely high data throughput** – in the mobile communications, network and server sectors, as well as in biotechnology and medical engineering – demand holistic enclosure solutions. Rittal offers enclosures with a modern layout, **integral power modules, effective cooling** and **super-fast backplanes.** AdvancedTCA Shelves from Rittal are one such example.

Our dynamic **Liquid Cooling technology** facilitates maximum blade server performance – with a flexible choice of several cooling systems. With Rittal, you can always be sure of getting the right solution, from a matching 482.6 mm (19″) rack, to an efficient IT rack, through to modular components for the modern IT infrastructure. Take advantage of **Rittal's expertise as a complete provider** for packaging tasks in information technology and automation – including a comprehensive service concept. We offer expert advice, planning support and test services in accredited Rittal laboratories, through to CFD analyses – take advantage of our know-how, and ensure maximum availability in all areas.

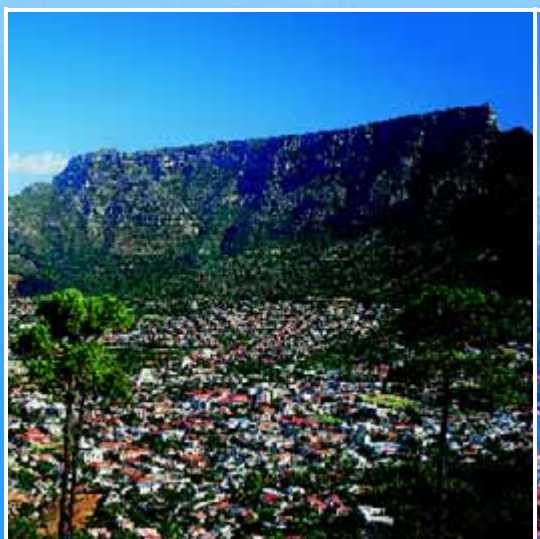
High technological demands reveal new opportunities, which are transformed into solutions with clear benefits.

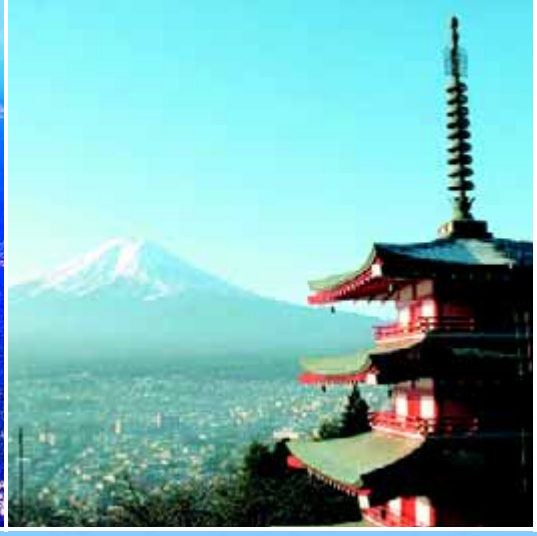
The Rittal corporate principle

We are aware of the correlation between qualification, motivation and company success; in other words, we encourage our employees to participate in training, and involve them in our overall success.

The Rittal corporate principle

Our aim is to establish long-term partnerships with our suppliers; the pre-requisite for this is to remain competitive in terms of quality, delivery service and price, and optimum problem-solving!





Worldwide, we are on your doorstep

Customer proximity is a key Rittal philosophy:

With global solutions, with local advisors, and with **100 % availability** of our products and services.

19 production sites, 50 subsidiaries, 70 agents and 150 distribution and logistic centres – around the globe – are testimony to our consistent customer orientation.

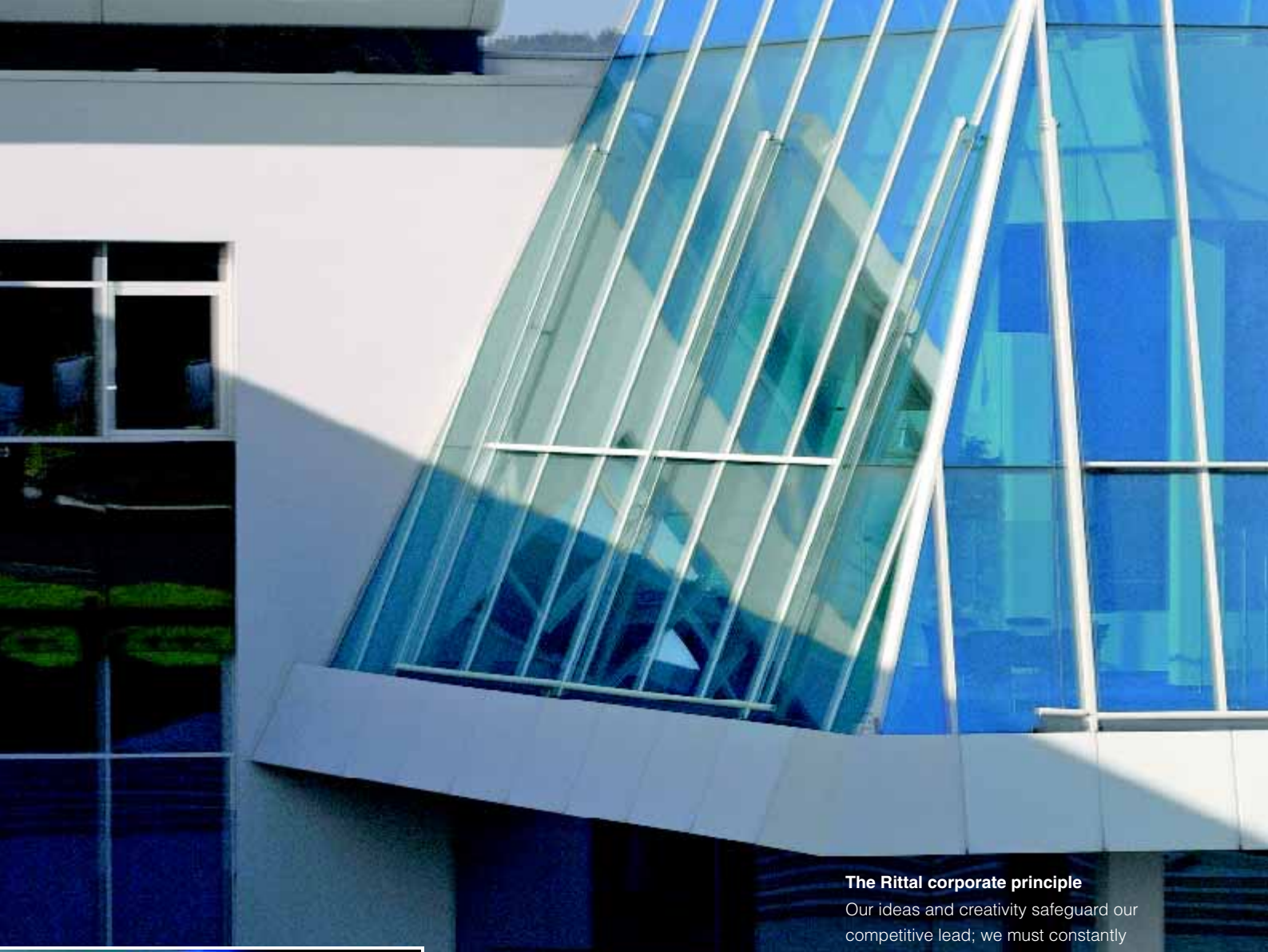
When it comes to technical applications, quality and reliability, Rittal is your first choice.

All our products meet the very latest technical findings, globally recognised quality standards with certifications, and **internationally valid approvals.**

Our comprehensive Total Quality Management system ensures consistently high product quality worldwide.

We meet all your requirements, globally and locally, in close partnership with our customers – our advantage, your value-added benefit.

RITTAL®



The Rittal corporate principle
Our ideas and creativity safeguard our competitive lead; we must constantly search for new inspiration and ideas, and implement these in a consistent and professional manner!

In the IT sector, transport technology, automation industry and beyond, **Rittal solves all tasks for a wide variety of application areas – always with an eye on the future.**

Over 8,000 employees worldwide are thinking and acting on your behalf, with precise knowledge of the industry, practical expertise, curiosity and far-sightedness.

Progress is possible – with Rittal, in all sectors and for all applications.

Over 8,000 employees committed to a fascinating future

For experts and beginners alike, the product overview facilitates **fast selection of individual product groups within the range.**

For example, the appropriate dimensions of an enclosure or the correct cooling output of a climate control component are easily ascertained.

For all Rittal components of technology packaging, power supply, climate control and monitoring technology, a comprehensive pre-selection is provided.

Product overview

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Industrial Enclosures

Industrial enclosures – reap the benefits of the extensive Rittal enclosure range:
Perfect, cost-effective solutions to suit every application. All in all, the wide range of sizes, the application-oriented choice of materials, the tailoring to specific application areas, the modular range of system accessories and compatibility with all other Rittal lines gives Rittal customers a competitive lead from a single source.

Holistic solutions to perfection:
- Small enclosures
- Compact enclosures
- Compact system enclosures
- Large enclosures
- Industrial workstations
- PC enclosure systems
- Console systems

Detailled information may be found on Catalogue pages 96 – 295 and on our website at www.rittal.com

1.1 Polycarbonate enclosures PK

Dimensions mm			Model No. PK		Page
Width	Height	Depth	Cover grey	Cover transp.	
50	52	35	**9530.000**[1)]	–	100
50	65	35	**9531.000**[1)]	–	100
65	65	57	**9500.000**	–	100
65	65	81	**9501.000**	–	100
94	65	57	**9502.000**	–	100
94	65	81	**9503.000**	–	100
94	94	57	**9504.000**	**9504.100**	100
94	94	81	**9505.000**	–	100
110	110	66	**9506.000**	**9506.100**	100
110	110	90	**9507.000**	**9507.100**	100
130	94	57	**9508.000**	**9508.100**	100
130	94	81	**9509.000**	**9509.100**	100
130	130	75	**9510.000**	**9510.100**	100
130	130	99	**9511.000**	**9511.100**	100

[1)] With cable gland

Dimensions mm			Model No. PK		Page
Width	Height	Depth	Cover grey	Cover transp.	
180	94	57	**9512.000**	**9512.100**	100
180	94	81	**9513.000**	**9513.100**	100
180	110	90	**9514.000**	**9514.100**	101
180	110	111	**9515.000**	**9515.100**	101
180	110	165	**9516.000**	**9516.100**	101
182	180	90	**9517.000**	**9517.100**	101
182	180	111	**9518.000**	**9518.100**	101
182	180	165	**9519.000**	**9519.100**	101
254	180	90	**9520.000**	**9520.100**	101
254	180	111	**9521.000**	**9521.100**	101
254	180	165	**9522.000**	**9522.100**	101
360	254	111	**9523.000**	**9523.100**	101
360	254	165	**9524.000**	**9524.100**	101

Approvals:
- Bureau Veritas

1.1 Cast aluminium enclosures GA

Dimensions mm			Model No. GA	Page
Width	Height	Depth		
50	45	30	**9100.210**	104
58	64	36	**9101.210**	104
75	80	57	**9104.210**	104
98	64	36	**9102.210**	104
125	80	57	**9105.210**	104
122	120	80	**9108.210**	104
150	64	36	**9103.210**	104
160	160	90	**9112.210**	104
175	80	57	**9106.210**	104
200	230	110	**9116.210**	104

Dimensions mm			Model No. GA	Page
Width	Height	Depth		
220	120	90	**9110.210**	104
250	80	57	**9107.210**	104
260	160	90	**9113.210**	104
280	230	110	**9117.210**	104
330	230	110	**9118.210**	104
330	230	180	**9119.210**	104
360	122	80	**9111.210**	104
360	160	90	**9114.210**	104

1.1 Terminal boxes KL

Dimensions mm			Model No. KL				Model No. KL	
			Sheet steel				Stainless steel	
Width	Height	Depth	**with gland plate**	Page	**without gland plate**	Page	**without gland plate**	Page
150	150	80	–		**1514.510**	107	**1521.010**	270
150	150	120	–		**1500.510**	108	–	
200	150	80	–		**1528.510**	107	–	
200	150	120	–		**1529.510**	108	–	
200	200	80	–		**1516.510**	107	**1523.010**	270
200	200	120	–		**1502.510**	108	–	
300	150	80	–		**1515.510**	107	**1522.010**	270
300	150	120	**1530.510**	109	**1501.510**	108	–	
300	200	80	–		**1517.510**	107	**1524.010**	270
300	200	120	**1531.510**	109	**1503.510**	108	–	
300	300	120	**1535.510**	109	**1507.510**	108	**1526.010**	270
400	150	120	–		**1589.510**	108	–	
400	200	80	–		**1518.510**	107	–	
400	200	120	**1532.510**	109	**1504.510**	108	**1525.010**	270
400	300	120	**1536.510**	109	**1508.510**	108	–	
400	400	120	**1539.510**	109	**1511.510**	108	–	
500	200	120	**1533.510**	109	**1505.510**	108	–	
500	300	120	**1537.510**	109	**1509.510**	108	–	
600	200	80	–		**1519.510**	107	–	
600	200	120	**1534.510**	109	**1506.510**	108	–	
600	300	120	**1538.510**	109	**1510.510**	108	–	
600	400	120	**1540.510**	109	**1512.510**	108	–	
800	200	120	**1542.510**	109	**1527.510**	108	–	
800	400	120	**1541.510**	109	**1513.510**	108	–	

Approvals:
- UL
- CSA
- TÜV
- Germanischer Lloyd
- Norske Veritas
- Russian Maritime Register of Shipping
- Lloyds Register of Shipping
- Bureau Veritas
- VDE

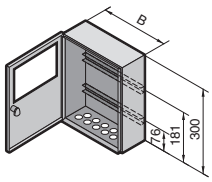
1.1 E-Box EB

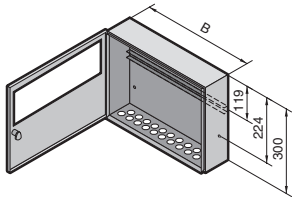
Dimensions mm			Model No. EB	Page
Width	Height	Depth		
150	150	80	**1551.500**	110
150	150	120	**1553.500**	110
150	300	80	**1545.500**	110
150	300	120	**1548.500**	110
200	200	80	**1546.500**	110
200	200	120	**1549.500**	110
200	300	80	**1552.500**	110
200	300	120	**1554.500**	110

Dimensions mm			Model No. EB	Page
Width	Height	Depth		
200	400	80	**1547.500**	110
200	400	120	**1550.500**	110
200	500	120	**1557.500**	110
300	300	120	**1555.500**	110
300	400	120	**1556.500**	110
300	400	155	**1577.500**	110
300	600	155	**1578.500**	110
300	800	155	**1579.500**	110

Approvals:
- UL
- CSA
- TÜV
- Germanischer Lloyd
- Norske Veritas
- Russian Maritime Register of Shipping
- Lloyds Register of Shipping
- Bureau Veritas
- VDE

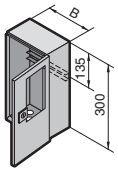
1.1 Bus enclosures BG





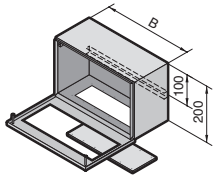
Dimensions mm			Version PG		Version metric	
Width	Height	Depth	**Model No. BG**	Page	**Model No. BG**	Page
200	300	80	**1583.510**	111	**1583.520**	111
300	300	80	**1584.510**	111	**1584.520**	111
400	300	80	**1585.510**	111	**1585.520**	111
500	300	80	**1586.510**	111	**1586.520**	111

Approvals:
- TÜV
- Lloyds Register of Shipping
- VDE
- UL
- C-UL



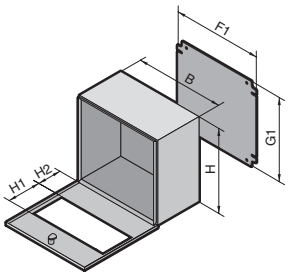
Dimensions mm			PG version						Metric version					
			Number of PG holes				**Model No. BG**	Page	Number of metric holes				**Model No. BG**	Page
Width	Height	Depth	9	13.5	29	36			M12	M20	M32	M50		
200	300	120	2	–	5	–	**1605.510**	112	2	–	5	–	**1605.520**	112
400	300	120	–	2	9	1	**1606.510**	112	–	2	9	1	**1606.520**	112

Approvals:
- TÜV
- Lloyds Register of Shipping
- VDE
- UL
- C-UL



Dimensions mm			**Model No. BG**	Page
Width	Height	Depth		
400	200	125	**1558.510**	112
600	200	125	**1559.510**	112

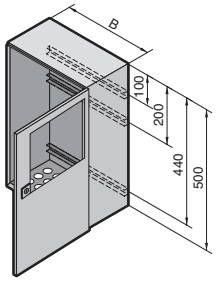
Approvals:
- TÜV
- Lloyds Register of Shipping
- VDE
- UL
- C-UL



1.1 Bus enclosures BG

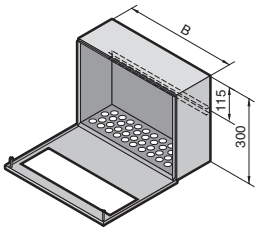
Dimensions mm			Model No. BG	Page
Width	Height	Depth		
400	300	155	**1577.500**	113
600	300	155	**1578.500**	113
800	300	155	**1579.500**	113

Approvals:
- TÜV
- Lloyds Register of Shipping
- VDE
- UL
- C-UL



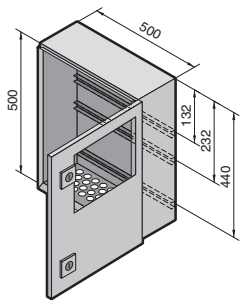
Dimensions mm			Model No. BG	Page
Width	Height	Depth		
400	500	160	**1611.510**	113

Approvals:
- TÜV
- Lloyds Register of Shipping
- VDE
- UL
- C-UL



Dimensions mm			Model No. BG	Page
Width	Height	Depth		
500	300	120	**1609.510**	114

Approvals:
- TÜV
- Lloyds Register of Shipping
- VDE
- UL
- C-UL



Dimensions mm			Model No. BG	Page
Width	Height	Depth		
500	500	210	**1050.900**	114

Approvals:
- TÜV
- Lloyds Register of Shipping
- VDE
- UL
- C-UL

1.2 Compact enclosures AE

Dimensions mm			Model No. AE	Page	Model No. AE	Page
Width	Height	Depth	Sheet steel		Stainless steel	
Single-door						
200	300	120	**1032.500**	118	–	
200	300	155	**1035.500**	118	**1002.600**	273
300	300	210	**1033.500**	118	–	
300	380	210	–		**1005.600**	273
300	400	210	**1034.500**	118	–	
380	300	155	**1030.500**	118	**1004.600**	273
380	300	210	**1031.500**	118	–	
380	380	210	**1380.500**	118	**1006.600**	273
380	600	210	**1038.500**	119	**1008.600**	273
380	600	350	**1338.500**	119	–	
400	500	210	**1045.500**	119	–	
500	500	210	**1050.500**	119	**1007.600**	273
500	500	300	**1350.500**	119	**1013.600**	273
500	700	250	**1057.500**	119	–	
600	380	210	**1039.500**	118	**1009.600**	273
600	380	350	**1339.500**	118	–	
600	600	210	**1060.500**	119	**1010.600**	273
600	600	350	**1360.500**	119	–	
600	760	210	**1076.500**	119	**1012.600**	273
600	760	350	**1376.500**	119	–	
600	800	250	**1058.500**	119	–	
600	1000	250	**1090.500**	119	–	
600	1200	300	**1260.500**	120	–	
760	760	210	**1077.500**	119	–	
760	760	300	**1073.500**	119	**1014.600**	273
800	1000	300	**1180.500**	119	**1016.600**	273
800	1200	300	**1280.500**	120	**1017.600**	273
Double-door						
1000	760	210	**1100.500**	120	–	
1000	760	300	**1130.500**	120	–	
1000	1000	300	**1110.500**	120	**1018.600**	273
1000	1200	300	**1213.500**	120	**1019.600**	273
1000	1400	300	**1114.500**	120	–	

Approvals:
- UL
- CSA
- TÜV
- Germanischer Lloyd
- Norske Veritas
- Russian Maritime Register of Shipping
- Lloyds Register of Shipping
- Bureau Veritas
- VDE

Compact enclosures AE, protection category IP 69K

Dimensions mm			Model No. AE	Page
Width	Height	Depth		
Single-door				
230	330	155	**1101.010**	121
400	400	250	**1101.020**	121
400	650	250	**1101.030**	121
650	650	250	**1101.040**	121

1.2 Compact enclosures AK

Dimensions mm			Model No. AK	Page
Width	Height	Depth		
Single-door				
600	1200	400	**1646.500**	122
800	1200	400	**1648.500**	122

Dimensions mm			Model No. AK	Page
Width	Height	Depth		
Double-door				
1000	1200	400	**1650.500**	122
1000	1400	400	**1647.500**	122
1200	1200	400	**1652.500**	122

Approvals:
- UL
- CSA
- TÜV
- Germanischer Lloyd
- Norske Veritas
- Russian Maritime Register of Shipping
- Lloyds Register of Shipping
- Bureau Veritas
- VDE

1.2 Plastic enclosures KS

Dimensions mm			Door(s)	Model No. KS		Page
Width	Height	Depth		Viewing window		
				without	with	
200	300	150	1	**1423.600**	–	123
250	350	150	1	**1432.600**	–	123
300	400	200	1	**1434.600**	–	123
400	400	200	1	**1444.600**	**1448.600**	123
400	600	200	1	**1446.600**	**1449.600**	123
500	500	300	1	**1453.600**	**1454.600**	123
600	600	200	1	**1466.600**	**1467.600**	123
600	800	300	1	**1468.600**	**1469.600**	124
800	1000	300	1	**1480.600**	**1479.600**	124
1000	1000	300	2	**1400.600**	–	124

Approvals:
- UL (without viewing window)
- CSA (without viewing window)
- TÜV
- Germanischer Lloyd
- Norske Veritas
- Russian Maritime Register of Shipping
- Lloyds Register of Shipping
- Bureau Veritas
- VDE

1.3 Compact system enclosures Rittal CM

Dimensions mm			Model No. CM	Page
Width	Height	Depth		
Single-door				
600	800	400	**5110.500**	128
600	1000	400	**5111.500**	128
600	1200	300	**5112.500**	128
600	1200	400	**5113.500**	128
800	1000	300	**5114.500**	128
800	1000	400	**5115.500**	128
800	1200	300	**5116.500**	128
800	1200	400	**5117.500**	129

Dimensions mm			Model No. CM	Page
Width	Height	Depth		
Double-door				
1000	1000	300	**5118.500**	129
1000	1200	300	**5119.500**	129
1000	1200	400	**5120.500**	129
1000	1400	300	**5121.500**	129
1000	1400	400	**5122.500**	129
1200	1200	400	**5123.500**	129

1.3 Compact system enclosures Rittal CL

Dimensions mm			Model No. CL	Page
Width	Height	Depth		
Single-door				
600	1600	500	**5150.500**	130
600	1800	400	**5151.500**	130
600	2000	500	**5152.500**	130
800	1600	500	**5153.500**	130
800	1800	400	**5154.500**	130
800	2000	500	**5155.500**	130
1000	1800	400	**5156.500**	130

Dimensions mm			Model No. CL	Page
Width	Height	Depth		
Double-door				
1000	1800	400	**5157.500**	131
1200	1600	500	**5158.500**	131
1200	1800	400	**5159.500**	131
1200	2000	500	**5160.500**	131

1.4 Free-standing enclosure ES 5000

Dimensions mm			Model No. ES	Page	Model No. ES	Page
Width	Height	Depth	Sheet steel		Stainless steel	
Single-door						
600	1600	400	–		**5450.600**	285
600	1600	500	**5665.500**	136	–	
600	1800	400	**5684.500**	136	–	
600	1800	500	–		**5451.600**	285
600	2000	500	**5605.500**	136	–	
800	1600	500	**5865.500**	136	–	
800	1800	400	**5884.500**	136	–	
800	1800	500	–		**5452.600**	285
800	2000	500	**5805.500**	136	–	
800	2000	600	–		**5453.600**	285
1000	1800	400	**5084.500**	136	**5454.600**	285
Double-door						
1000	1800	400	**5080.500**	136	–	
1200	1600	500	**5265.500**	137	–	
1200	1800	400	**5284.500**	137	–	
1200	2000	500	**5205.500**	137	**5455.600**	285
1600	1800	400	**5784.500**	137	–	
1800	2000	500	**5905.500**	137	–	

Approvals:
- UL
- CSA
- TÜV
- Germanischer Lloyd
- Norske Veritas
- Russian Maritime Register of Shipping
- Lloyds Register of Shipping
- Bureau Veritas
- VDE

1.4 Baying system TS 8

Dimensions mm			Model No. TS	Page	Model No. TS	Page
Width	Height	Depth	Sheet steel		Stainless steel	
Single-door						
400	1800	500	**8485.510**[1)]	141	–	
400	1800	600	**8486.510**[1)]	142	–	
400	2000	500	**8405.510**[1)]	144	–	
400	2000	600	**8406.510**[1)]	145	–	
600	1400	500	**8645.500**	138	–	
600	1600	500	**8665.500**	139	–	
600	1800	400	**8684.500**	140	–	
600	1800	500	**8685.500**	141	**8457.600**	284
600	1800	600	**8686.500**	142	–	
600	2000	400	**8604.500**	143	–	
600	2000	500	**8605.500**	144	–	
600	2000	600	**8606.500**	145	**8452.600**	284
600	2000	800	**8608.500**	146	–	
600	2200	600	**8626.500**	147	–	
800	1400	500	**8845.500**	138	–	
800	1600	500	**8865.500**	139	–	
800	1800	400	**8884.500**	140	**8454.600**	284
800	1800	500	**8885.500**	141	**8455.600**	284
800	1800	600	**8886.500**	142	–	
800	2000	400	**8804.500**	143	–	
800	2000	500	**8805.500**	144	–	
800	2000	600	**8806.500**	145	**8450.600**	284
800	2000	800	**8808.500**	146	–	
800	2200	600	**8826.500**	147	–	
1000	1800	400	**8084.500**	140	–	
Double-door						
800	1800	500	**8880.500**	141	–	
800	1800	600	**8881.500**	142	–	
1000	1800	400	**8080.500**	140	–	
1000	2000	500	**8005.500**	144	–	
1000	2000	600	**8006.500**	145	–	
1200	1400	500	**8245.500**	138	–	
1200	1600	500	**8265.500**	139	–	
1200	1800	400	**8284.500**	140	**8456.600**	284
1200	1800	500	**8285.500**	141	**8453.600**	284
1200	1800	600	**8286.500**	142	–	
1200	2000	400	**8204.500**	143	–	
1200	2000	500	**8205.500**	144	–	
1200	2000	600	**8206.500**	145	**8451.600**	284
1200	2000	800	**8208.500**	146	–	
1200	2200	600	**8226.500**	147	–	

[1)] Without tubular door frame, mounting plate and gland plates.

Approvals:
- UL
- CSA
- TÜV
- Russian Maritime Register of Shipping
- TÜV Mark
- Lloyds Register of Shipping
- Bureau Veritas
- VDE
- Germanischer Lloyd

1.4 Baying system TS 8

Electronic enclosure

Dimensions mm			Model No. TS	Page
Width	Height	Depth	Enclosure	
600	1600	600	**8410.510**	148
600	1600	800	**8418.510**	148
600	2000	600	**8430.510**	148
600	2000	800	**8438.510**	148

Approvals:
- UL
- C-UL

For modular front design

Dimensions mm			Model No. TS	Page
Width	Height	Depth	Enclosure	
600	2000	600	**8606.512**	149
800	2000	600	**8806.512**	149

For isolator door locking

Dimensions mm			Model No. TS	Page
Width	Height	Depth	Enclosure	
800	1800	400	**8984.500**	150
800	1800	500	**8985.500**	150
800	2000	500	**8905.500**	150
800	2000	600	**8906.500**	150

Approvals:
- UL
- C-UL

IP 65/NEMA 4x, NEMA 4

Dimensions mm			Model No. TS	Page
Width	Height	Depth	Enclosure	
NEMA 4x, stainless steel				
600	1800	600	**8458.640**	151
800	1800	600	**8459.640**	151
600	2000	600	**8452.640**	151
800	2000	600	**8450.640**	151
NEMA 4, sheet steel				
600	1800	600	**8686.540**	151
800	1800	600	**8886.540**	151
600	2000	600	**8606.540**	151
800	2000	600	**8806.540**	151

Approvals:
- UL
- C-UL

1.4 Baying system TS 8

prepared for EX pressurisation

Dimensions mm			Model No. TS	Page	Model No. TS	Page
Width	Height	Depth	Sheet steel		Stainless steel	
600	1400	500	**8645.560**	152	–	
800	1400	500	**8845.560**	152	–	
600	1600	500	**8665.560**	152	–	
800	1600	500	**8865.560**	152	–	
600	1800	400	**8684.560**	152	–	
800	1800	400	**8884.560**	152	**8454.660**	152
1000	1800	400	**8084.560**	152	**8461.660**	152
600	1800	500	**8685.560**	152	**8457.660**	152
800	1800	500	**8885.560**	152	**8455.660**	152
600	1800	600	**8686.560**	152	**8458.660**	152
800	1800	600	**8886.560**	152	–	
600	2000	400	**8604.560**	152	–	
800	2000	400	**8804.560**	152	–	
600	2000	500	**8605.560**	152	–	
800	2000	500	**8805.560**	152	–	
600	2000	600	**8606.560**	152	**8452.660**	152
800	2000	600	**8806.560**	152	**8450.660**	152
600	2000	800	**8608.560**	152	–	
800	2000	800	**8808.560**	152	**8460.660**	152
600	2200	600	**8626.560**	152	–	
800	2200	600	**8826.560**	152	–	

1.5 VIP 6000

Selection of operating/keyboard housings see page 154 – 169.

Approvals:
- UL
- CSA
- TÜV
- DNV
- Lloyds Register of Shipping
- BV
- VDE

1.5 Optipanel

Selection of operating/keyboard housings see page 170 – 177.

1.5 Optipanel

Standard sizes

To fit front panels mm	To fit TFT monitor Model No. SM	Dimensions mm			Model No. CP	Page	Rear panel, hinged		Support arm connection
		Width	Height	Depth			Quick-release fastener for screwdriver	Cam with double-bit insert	
270 x 234	–	314	278	60	**6380.100**	178	–	■	CP-S VESA 75
482.6 x 310.3	–	527	354	110	**6380.000**	178	–	■	CP-L[1)]
430 x 343	6450.010/.030	475	387	60	**6380.010**	178	■	–	CP-L[1)] , rear
430 x 343	6450.010/.030	475	387	110	**6380.020**	178	–	■	CP-L[1)]
482.6 x 354.8	6450.020/.040	527	399	60	**6380.030**	178	■	–	CP-L[1)] , rear
482.6 x 354.8	6450.020/.040	527	399	110	**6380.040**	178	–	■	CP-L[1)]

[1)] ▭ 120 x 65 mm

1.5 Compact Panel

Dimensions mm			To fit		Model No. CP			Page
Width	Height	Depth	Front panel width mm	Front panel height mm	with support arm connection CP-S	with support arm connection CP-L[1)]	without support arm connection	
241	238	87	178	200	**6340.000**	**6340.010**	**6340.020**	183
241	388	87	178	350	**6340.100**	**6340.110**	**6340.120**	183
241	521	87	178/4 U	482.6/19″	**6340.200**	**6340.210**	**6340.220**	183
315	238	87	252	200	**6340.300**	**6340.310**	**6340.320**	183
315	388	87	252	350	**6340.400**	**6340.410**	**6340.420**	183

[1)] ▭ 120 x 65 mm

1.5 Command panel housing with door

based on AE

Dimensions mm			Model No. CP	Page	Model No. CP	Page
Width	Height	Depth	Sheet steel		Stainless steel	
300	200	180	**6534.000**	184	–	
300	300	150	–		**6535.010**	276
300	300	180	**6535.000**	184	–	
300	400	180	**6537.000**	184	–	
400	300	150	–		**6536.010**	276
400	300	180	**6536.000**	184	–	
400	400	150	–		**6538.010**	276
400	400	180	**6538.000**	184	–	
500	500	180	**6544.000**	184	–	
600	400	150	–		**6539.010**	276

Approvals:
- UL
- C-UL

1.5 Operating housing

based on AE

Dimensions mm			Model No. CP	Page
Width	Height	Depth		
300	200	155	**6540.200**	185
380	300	210	**6531.200**	185
380	380	210	**6530.200**	185
500	500	210	**6532.200**	185
600	380	210	**6533.200**	185

Approvals:
- UL
- C-UL

1.5 Operating housing

based on AE with display panel front

Dimensions mm			Model No. CP	Page
Width	Height	Depth		
380	380	249	**6442.500**	186
380	600	249	**6462.500**	186
500	500	249	**6552.500**	186
600	600	249	**6662.500**	186

Operating housing based on AE with wide VIP 6000 frame see page 187.

Approvals:
- UL
- C-UL

1.5 Support arm systems

Fast selection of CP-S see page 191.

Fast selection of CP-L see page 200.

Fast selection of CP-XL see page 218.

Support arm system CP-S, stainless steel see page 277.

1.5 Stand systems

Selection see from page 228.

1.5 Industrial workstations

Fast selection see page 240.

Approvals,
may be found on our website: www.rittal.com

1.5 PC enclosure systems

Dimensions mm			Model No. PC	Page	Model No. PC	Page	Model No. PC	Page	Model No. PC	Page	Model No. PC	Page
Width	Height	Depth	with keyboard drawer, glazed door, top		with keyboard drawer, glazed door, top, mounting compartment, small		with keyboard drawer, mounting compartment, large		with folding keyboard, glazed door, top		with desk section, glazed door, top	
Based on TS 8												
600	1600	636	**8366.000**	257	**8366.300**	257	**8366.400**	257	**8366.100**	258	**8366.200**	258
600	1600	836	**8368.000**	257	–		–		**8368.100**	258	–	
Based on ES												
600	1600	650	**4603.703**	259	**4603.913**	259	**4603.603**	259	**4603.920**	260	**4603.704**	260
600	1600	850	**4609.703**	259	–		–		**4609.920**	260	–	
Stainless steel												
600	1600	620	**4650.000**	283	–		–		–		**4650.704**	283

Approvals:
- UL
- CSA
- TÜV
- Germanischer Lloyd
- Russian Maritime Register of Shipping
- Lloyds Register of Shipping
- VDE

1.5 Console systems AP

Combination options of the modules

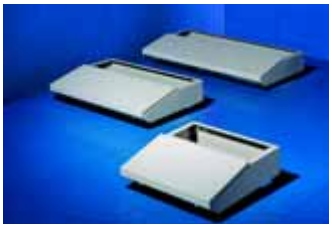
see page 262.

Approvals:

- UL
- CSA
- TÜV
- Germanischer Lloyd
- Russian Maritime Register of Shipping
- Lloyds Register of Shipping
- VDE

1.5 Consoles

Dimensions mm			Model No. AP	Page
Width	Height	Depth		
Cover, front				
800	430	400	**2612.500**	264
1200	430	400	**2642.500**	264
1600	430	400	**2652.500**	264
Cover, front and rear				
800	430	500	**2614.500**	264
1200	430	500	**2644.500**	264
1600	430	500	**2654.500**	264
800	630	500	**2647.500**	264
1200	630	500	**2648.500**	264
1600	630	500	**2649.500**	264



1.5 Desk units

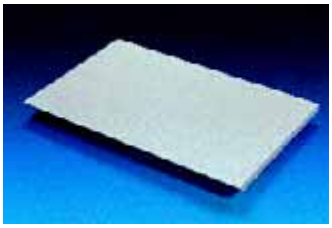
Dimensions mm			Model No. AP	Page
Width	Height	Depth		
For depth 400 mm (consoles)				
800	200	850	**2611.500**	264
1200	200	850	**2641.500**	264
1600	200	850	**2651.500**	264

Dimensions mm			Model No. AP	Page
Width	Height	Depth		
For depth 500 mm (consoles)				
800	200	950	**2613.500**	264
1200	200	950	**2643.500**	264
1600	200	950	**2653.500**	264

1.5 Pedestals

Dimensions mm			Model No. AP	Page
Width	Height	Depth		
Door(s) front				
800	670	400	**2600.500**	265
1200	670	400	**2620.500**	265
1600	670	400	**2630.500**	265

Dimensions mm			Model No. AP	Page
Width	Height	Depth		
Door(s) front and rear				
800	670	500	**2610.500**	265
1200	670	500	**2640.500**	265
1600	670	500	**2650.500**	265



1.5 Trim panel

For console, desk unit and pedestal

To fit		Model No. AP	Page
Width mm	Depth mm		
800	400	**2615.500**	265
1200	400	**2645.500**	265
1600	400	**2655.500**	265
800	500	**2616.500**	265
1200	500	**2646.500**	265
1600	500	**2656.500**	265

1.5 One-piece consoles AP

Dimensions mm			Model No. AP	Page	Model No. AP	Page
Width	Height	Depth	Sheet steel		Stainless steel	
Single-door						
600	960	400/480	**2666.500**	266	**2683.600**	282
800	960	400/480	**2668.500**	266	**2684.600**	282
Double-door						
1000	960	400/480	**2670.500**	266	**2685.600**	282
1200	960	400/480	**2672.500**	266	**2686.600**	282

Approvals:
- UL
- CSA
- TÜV
- Germanischer Lloyd
- Russian Maritime Register of Shipping
- Lloyds Register of Shipping
- VDE

1.5 Universal consoles AP

Dimensions mm			Model No. AP	Page
Width	Height	Depth		
with short front door				
600	1300	500	**2694.500**	267
with tall front door				
600	1300	500	**2695.500**	267

Approvals:
- UL
- CSA
- TÜV
- Germanischer Lloyd
- Russian Maritime Register of Shipping
- Lloyds Register of Shipping
- VDE

1.6 Stainless steel

Terminal boxes KL see page 23
Compact enclosures AE see page 26
Command panel housing with door see page 32
Support arm system CP-S see page 277
Stand systems see page 281
One-piece consoles AP see page 36
PC enclosure systems see page 34
Baying systems TS 8 see page 29
Free-standing enclosure ES 5000 see page 28

1.6 Premium Line KL, protection category IP 69K, stainless steel

Dimensions mm			Model No. KL	Page
Width	Height	Depth		
150	150	80	**1024.010**	271
150	150	120	**1024.020**	271
300	200	120	**1024.030**	271
400	300	120	**1024.040**	271

1.6 Bus enclosures BG, stainless steel

Dimensions mm			Model No. BG	Page
Width	Height	Depth		
200	300	80	**1583.010**	272
300	300	80	**1584.010**	272
400	300	80	**1585.010**	272
400	200	123	**1558.010**	272
600	200	123	**1559.010**	272

Approvals:
- TÜV
- Lloyds Register of Shipping
- VDE
- UL
- C-UL

1.6 Premium Panel, protection category IP 69K, stainless steel

Dimensions mm								Support arm connection	Model No. CP	Page
Width	Height		Depth	For installation panel W x H		Installation depth:				
	Operating housing	Keyboard housing	Operating housing	Operating housing	Keyboard housing	Operating housing	Keyboard housing			
With keyboard housing										
530	460	200	120	482.6 mm (19″) x 354.8 mm (8 U)	482.6 mm (19″) x 177 mm (4 U)	115	front 58 rear 63	top	**6680.000**	274
530	460	200	120			115	front 58 rear 63	bottom	**6680.010**	274
530	460	200	220			215	front 58 rear 63	top	**6680.100**	274
530	460	200	220			215	front 58 rear 63	bottom	**6680.110**	274
Without keyboard housing										
530	360	–	120	482.6 mm (19″) x 310 mm (7 U)	–	115	–	top, or bottom by rotating the enclosure	**6681.000**	274
530	360	–	220			215	–		**6681.100**	274

1.6 Operating housing, stainless steel

Dimensions mm			Model No. CP	Page
Width	Height	Depth		
320	240	160	**6670.000**	275
400	320	160	**6672.000**	275

Approvals:
- CSA
- UL
- C-UL

1.7 Ex enclosures, stainless steel

with screw fastened lid

Dimensions mm			Model No. KEL	Page
Width	Height	Depth		
150	150	80	**9301.000**	287
200	200	80	**9303.000**	287
300	150	80	**9302.000**	287
300	200	80	**9304.000**	287
300	300	120	**9306.000**	287
400	200	120	**9305.000**	287

with hinged door

Dimensions mm			Number of fasteners	Model No. KEL	Page
Width	Height	Depth			
200	300	155	1	**9401.600**	287
300	380	210	1	**9409.600**	287
380	300	155	1	**9402.600**	287
380	380	210	1	**9403.600**	287
380	600	210	2	**9404.600**	287
600	600	210	2	**9405.600**	287
600	760	210	2	**9406.600**	287
760	760	300	2	**9407.600**	287
800	1000	300	2	**9408.600**	287

Approvals:
- PTB

1.7 Ex enclosures, plastic

Dimensions mm			Model No. KEL	Page
Width	Height	Depth		
200	300	150	**9201.600**	288
250	350	150	**9202.600**	288
300	400	200	**9203.600**	288
400	400	200	**9204.600**	288
400	600	200	**9205.600**	288
500	500	300	**9207.600**	288
600	600	200	**9206.600**	288
600	800	300	**9208.600**	288
800	1000	300	**9209.600**	288

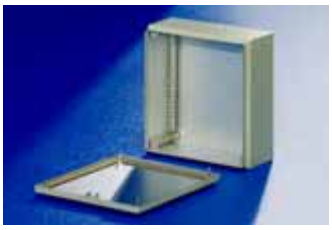
Approvals:
- PTB

1.8 EMC enclosures

EMC baying systems TS 8 see page 291

EMC E-Box EB see page 290

EMC free-standing enclosure ES 5000 see page 291



1.8 EMC terminal boxes KL

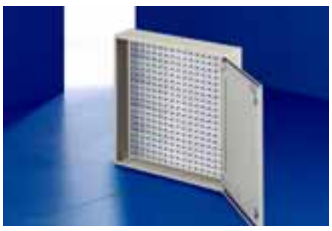
Dimensions mm			Model No. KL	Page
Width	Height	Depth		
300	300	120	**1507.710**	290

Approvals:
- UL
- CSA
- TÜV
- Norske Veritas
- Lloyds Register of Shipping
- VDE

1.8 EMC compact enclosures AE

Dimensions mm			Model No. AE	Page
Width	Height	Depth		
380	380	210	**1380.700**	290
600	380	210	**1039.700**	290
600	600	210	**1060.700**	290
800	1000	300	**1180.700**	290

Approvals:
- UL
- CSA
- TÜV
- Norske Veritas
- Lloyds Register of Shipping
- VDE



1.9 Modular enclosure technology

Compact enclosures AE (mounting plate with modular pitch pattern of holes) see page 295

Approvals:
- UL
- CSA
- TÜV
- Germanischer Lloyd
- Norske Veritas
- Russian Maritime Register of Shipping
- Lloyds Register of Shipping
- Bureau Veritas
- VDE

1.9 Modular enclosure technology

Baying systems TS 8 (mounting plate with modular pitch pattern of holes) see page 295

Approvals:
- UL
- CSA
- TÜV
- Russian Maritime Register of Shipping
- TÜV Mark
- Lloyds Register of Shipping
- Bureau Veritas
- VDE
- Germanischer Lloyd

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- ISV distribution enclosures

Detailed information may be found on Catalogue pages 298 – 420 or refer to our website: www.rittal.com

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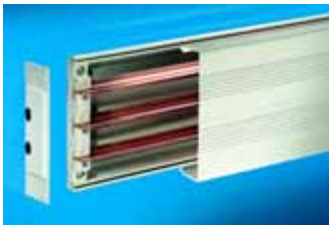


2.1 Busbar systems up to 250 A (40 mm)

Rittal Mini-PLS

Description	Length mm	Packs of	**Model No. SV**	Page
Mini-PLS busbar supports up to 250 A, 690 V~, 3-pole, 40 mm bar centre distance	–	4	**9600.000**	302
Mini-PLS end cover	–	2	**9610.000**	302
Mini-PLS special busbars E-Cu 250 A, 120 mm²	500	3	**9601.000**	302
	700	3	**9602.000**	302
	1100	3	**9603.000**	302
	1500	3	**9624.000**	302
Mini-PLS busbar connectors	–	3	**9611.000**	302
Mini-PLS base tray sections	250	1	**9604.000**	302
	500	1	**9605.000**	302
	700	1	**9606.000**	302
	1100	1	**9607.000**	302
Mini-PLS cover sections	250	1	**9608.000**	302
	500	1	**9609.000**	302

Mini-PLS busbar connection adaptor

Version	Packs of	**Model No. SV**	Page
63 A, 690 V~, connection top/bottom for round conductors 1.5 – 35 mm² and for laminated copper bars, clamping area 10 x 8 mm	1	**9613.000**	303
250 A, 690 V~, connection top/bottom for round conductors 10 – 120 mm² and for laminated copper bars, clamping area 17 x 15 mm	1	**9612.000**	303

2.1 Busbar systems up to 250 A (40 mm)

Mini-PLS component adaptor
Cable outlet at the top

Construction width mm	Rated current up to	Rated operating voltage	Connection cables[1)]	Support rails		Packs of	**Model No. SV**	Page
				Height mm	Number			
45	12 A	690 V~	AWG 14	7.5	1	1	**9614.110**	304
45	25 A	690 V~	AWG 12	7.5	1	1	**9614.100**	304
45	25 A	690 V~	AWG 12	15	1	1	**9615.100**	304
54	25 A	690 V~	AWG 12	7.5	1	1	**9614.000**	304
54	25 A	690 V~	AWG 12	15	1	1	**9615.000**	304
72	25 A	690 V~	AWG 12	7.5	1	1	**9625.000**	304
72	25 A	690 V~	AWG 12	15	1	1	**9626.000**	304
90	25 A	690 V~	AWG 12	7.5	1	1	**9629.010**	304
99	25 A	690 V~	AWG 12	15	1	1	**9629.020**	304
108	25 A	690 V~	AWG 12	7.5	1	1	**9629.030**	304
54	40 A	690 V~	AWG 10	7.5	1	1	**9616.000**	306
54	40 A	690 V~	AWG 10	15	1	1	**9617.000**	306
72	40 A	690 V~	AWG 10	7.5	1	1	**9627.000**	306
72	40 A	690 V~	AWG 10	15	1	1	**9628.000**	306
90	100 A	690 V~	35 mm²	Mounting plate		1	**9629.000**	306

[1)] AWG = American Wire Gauges
AWG 14 = 2.08 mm² ≙ 2.5 mm²
AWG 12 = 3.31 mm² ≙ 4 mm²
AWG 10 = 5.26 mm² ≙ 6 mm²

Note:
For allocation of "power circuit-breakers/starter combinations",
see page 1128/1129.

Mini-PLS quick-fit component adaptor

Construction width mm	Rated current up to[1)]	Rated operating voltage	For power circuit-breakers	Packs of	**Model No. SV**	Page
54	25 A (32 A)	690 V~	AEG, General Electric, Schiele	1	**9618.000**	305
54	25 A (32 A)	690 V~	Moeller Electric	1	**9619.000**	305
54	25 A (32 A)	690 V~	Allen Bradley, Moeller	1	**9620.000**	305
54	25 A (32 A)	690 V~	Telemecanique	1	**9621.000**	305
54	25 A (32 A)	690 V~	ABB, Siemens, Telemecanique	1	**9622.000**	305

[1)] Rated current 25 A at 35°C and 32 A at 25°C ambient temperature

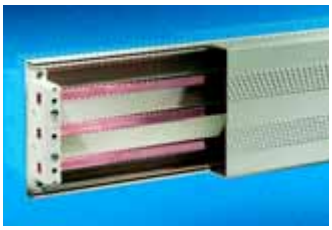
Note:
For allocation of "power circuit-breakers/starter combinations",
see page 1128.

Mini-PLS bus-mounting fuse base

Version	Packs of	**Model No. SV**	Page
D 02-E 18, 63 A, 400 V~, terminal for round conductors 1.5 – 16 mm²	1	**9630.000**	307

NH on-load isolators

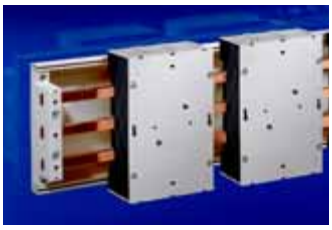
Version	Packs of	**Model No. SV**	Page
Size 000, 100 A, 690 V~, cable outlet top/bottom, terminal up to 50 mm²	1	**3431.000**	307
Mini-PLS busbar adaptor for SV 3431.000	1	**9629.100**	307



2.1 Busbar systems up to 360 A (40 mm)

System components

Description		Dimensions mm	Length mm	Packs of	Model No. SV	Page
Busbar support up to 360 A, 690 V~, 3-pole, 40 mm bar centre distance, for E-Cu busbars 12 x 5 mm to 15 x 10 mm		–	–	4	**9350.000**	308
End cover		–	–	2	**9610.000**	308
Busbars E-Cu		12 x 5	2400	6	**3580.000**	308
		12 x 10	2400	6	**3580.100**	308
		15 x 5	2400	6	**3581.000**	308
		15 x 10	2400	6	**3581.100**	308
Base tray sections		–	250	1	**9604.000**	309
		–	500	1	**9605.000**	309
		–	700	1	**9606.000**	309
		–	1100	1	**9607.000**	309
Cover sections		–	250	1	**9608.000**	309
		–	500	1	**9609.000**	309
Busbar cover sections for busbars	12/15 x 5 mm	–	1000	4	**9350.010**	309
	12/15 x 10 mm	–	1000	4	**9350.060**	309
Busbar connectors		–	–	3	**9350.070**	309



Busbar connection adaptor

Version	For busbars mm	Packs of	Model No. SV	Page
360 A, 690 V AC, for round conductors 10 – 120 mm² (max. 250 A) and laminated copper bars (max. 360 A), clamping area 17 x 15 mm	12 x 5/10	1	**9350.020**	310
	15 x 5/10	1	**9350.030**	310

Bus-mounting fuse base

Version	For busbars mm	Packs of	Model No. SV	Page
D 02-E 18, 63 A, 400 V~, terminal for round conductors 1.5 – 16 mm²	12 x 5/10	1	**9350.050**	311
	15 x 5/10	1	**9350.500**	311

NH on-load isolators

Version	For busbars mm	Packs of	Model No. SV	Page
Size 000, 100 A, 690 V~, cable outlet top/bottom, terminal up to 50 mm²	–	1	**3431.000**	311
Busbar adaptor for SV 3431.000	12 x 5/10	1	**9350.400**	311
	15 x 5/10	1	**9350.410**	311

2.1 Busbar systems up to 360 A (40 mm)

Multi-functional component adaptor

Con-struc-tion width mm	Rated current up to	Rated operating voltage	Connec-tion cables[1)]	Connection of round conductors up to	Cable outlet	Support rails		For bar thickness mm	Packs of	**Model No. SV**	Page
						Height mm	Number				
45	12 A	690 V~	AWG 14	–	top	10	1	5	1	**9350.080**	312
45	12 A	690 V~	AWG 14	–	top	10	1	10	1	**9350.090**	312
45	25 A	690 V~	AWG 12	–	top	10	1	5	1	**9350.100**	312
45	25 A	690 V~	AWG 12	–	top	10	1	10	1	**9350.110**	312
45	25 A	690 V~	AWG 12	–	top	10	2	5	1	**9350.120**	312
45	25 A	690 V~	AWG 12	–	top	10	2	10	1	**9350.130**	312
45	25 A	690 V~	AWG 12	–	top	10	2	5	1	**9350.260**	312
45	25 A	690 V~	AWG 12	–	top	10	2	10	1	**9350.270**	312
45	25 A	690 V~	AWG 12	–	top	10	2 (1 var.)	5	1	**9350.140**	312
45	25 A	690 V~	AWG 12	–	top	10	2 (1 var.)	10	1	**9350.150**	312
90	25 A	690 V~	AWG 12	–	top	10	1	5	1	**9350.280**	313
90	25 A	690 V~	AWG 12	–	top	10	1	10	1	**9350.290**	313
99	25 A	690 V~	AWG 12	–	top	10	2	5	1	**9350.300**	313
99	25 A	690 V~	AWG 12	–	top	10	2	10	1	**9350.310**	313
108	25 A	690 V~	AWG 12	–	top	10	2	5	1	**9350.320**	313
108	25 A	690 V~	AWG 12	–	top	10	2	10	1	**9350.330**	313
45	25 A	690 V~	–	16 mm²	top	10	2 (1 var.)	5	1	**9350.160**	314
45	25 A	690 V~	–	16 mm²	top	10	2 (1 var.)	10	1	**9350.170**	314
45	25 A	690 V~	–	16 mm²	top/bottom	10	2	5	1	**9350.180**	314
45	25 A	690 V~	–	16 mm²	top/bottom	10	2	10	1	**9350.190**	314
54	40 A	690 V~	–	16 mm²	top	10	2	5	1	**9350.220**	314
54	40 A	690 V~	–	16 mm²	top	10	2	10	1	**9350.230**	314
54	40 A	690 V~	–	16 mm²	top/bottom	10	2	5	1	**9350.240**	314
54	40 A	690 V~	–	16 mm²	top/bottom	10	2	10	1	**9350.250**	314
54	40 A	690 V~	AWG 10	–	top	10	2	5	1	**9350.200**	315
54	40 A	690 V~	AWG 10	–	top	10	2	10	1	**9350.210**	315
54	40 A	690 V~	AWG 10	–	top	15	1	5	1	**9350.340**	315
54	40 A	690 V~	AWG 10	–	top	15	1	10	1	**9350.350**	315

[1)] AWG = American Wire Gauges
AWG 14 = 2.08 mm² ≙ 2.5 mm²
AWG 12 = 3.31 mm² ≙ 4 mm²
AWG 10 = 5.26 mm² ≙ 6 mm²

Note:
For allocation of “power circuit-breakers/starter combinations”,
see page 1129/1130.

Component adaptor

Version	For busbars mm	Packs of	**Model No. SV**	Page
100 A, 690 V~, construction width 90 mm, connection cables 35 mm², cable outlet at the top	12 x 5/10	1	**9350.420**	315
	15 x 5/10	1	**9350.430**	315

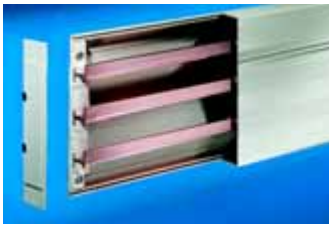
Note:
For allocation of “power circuit-breakers/starter combinations”,
see page 1130.

2.2 Busbar systems up to 800 A (60 mm)

System components

Description	Number of poles	Bar centre distance mm	For busbars mm	Packs of	**Model No. SV**	Page
Busbar supports up to 800 A, 1000 V~	3-pole	60	12 x 5 – 30 x 10[1)]	4	**3000.000**	318
	2-pole	60	12 x 5 – 30 x 10[1)]	4	**3050.000**	318
	1-pole	–	12 x 5 – 30 x 10[1)]	4	**3078.000**	318
	4-pole	60	12 x 5 – 30 x 10[1)]	3	**3064.000**	318
Busbar supports up to 450 A, 1000 V~	3-pole	60	30 x 5	4	**3066.000**	318
Inserts for SV 3000.000 SV 3050.000 SV 3064.000 SV 3078.000	–	–	12 x 5	12	**3009.000**	319
	–	–	12 x 10	24	**3008.000**	319
	–	–	15 x 5	12	**3007.000**	319
	–	–	20 x 5	12	**3004.000**	319
	–	–	20 x 10	24	**3003.000**	319
	–	–	25 x 5	12	**3002.000**	319
	–	–	30 x 5	12	**3001.000**	319
End covers						319
Support cover						319
Busbars of E-Cu						319
Busbar cover sections						319

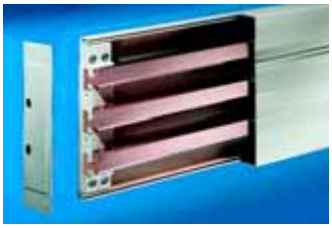
[1)] Max. busbar accommodation without inserts 30 x 10 mm



2.2 Busbar systems up to 800 A/1600 A (60 mm)

Rittal PLS

Description	Rated current up to	For PLS bar cross-section (bar thickness)	Packs of	**Model No. SV**	Page
PLS busbar supports, 3-pole, 60 mm bar centre distance, rated operating voltage 1000 V~.	800 A	300 mm² (5 mm)	4	**3500.000**	320
	1600 A	900 mm² (10 mm)	4	**3510.000**	320



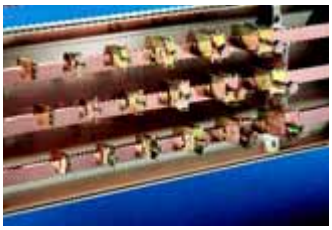
Description	Length mm	For enclosure width mm	Packs of	**Model No. SV**		Page
				for PLS 800 A	for PLS 1600 A	
PLS end covers	–	–	2	**3501.000**	**3511.000**	320
PLS special busbars E-Cu[1)]	2400	variable	1	**3509.000**	**3516.000**	320
	495	600	3	**3524.000**	**3527.000**	320
	695	800	3	**3525.000**	**3528.000**	320
	1095	1200	3	**3526.000**	**3529.000**	320
PLS base tray sections	500	–	2	**3502.000**	**3512.000**	321
	700	–	1	**3503.000**	**3513.000**	321
	1100	–	1	**3518.000**	**3519.000**	321
PLS cover sections	250	–	2	**3506.000**	**3506.000**	321
	500	–	2	**3507.000**	**3507.000**	321
	700	–	1	**3508.000**	**3508.000**	321

[1)] Bar cross-section (bar thickness)
PLS 800 A: 300 mm² (5 mm)
PLS 1600 A: 900 mm² (10 mm)

Busbar connection adaptor

Rated current up to	Rated operating voltage	Connection	Connection of round conductors up to	Clamping area for laminated copper bars mm	Packs of	**Model No. SV**	Page
63 A	690 V~	bottom	10 mm²/2 x 6 mm²	–	1	**3443.000**	322
125 A	690 V~	bottom	35 mm²	11 x 14	1	**3444.000**	322
250 A	690 V~	bottom	70 mm²	16 x 15	1	**3442.000**	322
400 A	690 V~	bottom	150 mm²	–	1	**3440.000**	322
600 A	690 V~	top/bottom	35 to 240 mm²	24 x 21	1 set	**3439.010**	323
800 A	690 V~	bottom	185 mm²	30 x 25	1	**3441.000**	322
800 A	690 V~	top/bottom	–	34 x 21 (16)	1 set	**3439.000**	323
1600 A	690 V~	top/bottom	–	65 x 21	1 set	**3517.000[1)]**	323

[1)] Only suitable for Rittal PLS 1600 A



2.2 Busbar systems up to 800 A/1600 A (60 mm)

Connection clamps/system covers

Description	Page
Conductor connection clamps	324
Plate clamp	324
System covers	324

Multi-functional component adaptor

Construction width mm	Rated current up to	Rated operating voltage	Connection cables[1)]	Connection of round conductors up to	Cable outlet	Support rails		For bar thickness mm	Packs of	**Model No. SV**	Page
						Height mm	Number				
45	12 A	690 V~	AWG 14	–	top	10	1	5	1	**9320.160**	325
45	12 A	690 V~	AWG 14	–	top	10	1	10	1	**9320.170**	325
45	25 A	690 V~	AWG 12	–	top	10	1	5	1	**9320.180**	325
45	25 A	690 V~	AWG 12	–	top	10	1	10	1	**9320.190**	325
45	25 A	690 V~	AWG 12	–	top	10	2	5	1	**9320.200**	325
45	25 A	690 V~	AWG 12	–	top	10	2	10	1	**9320.210**	325
45	25 A	690 V~	AWG 12	–	top	10	2	5	1	**9320.440**	325
45	25 A	690 V~	AWG 12	–	top	10	2	10	1	**9320.450**	325
45	25 A	690 V~	AWG 12	–	top	10	2 (1 var.)	5	1	**9320.220**	325
45	25 A	690 V~	AWG 12	–	top	10	2 (1 var.)	10	1	**9320.230**	325
45	25 A	690 V~	AWG 12	–	bottom	10	2	5	1	**9320.240**	325
45	25 A	690 V~	AWG 12	–	bottom	10	2	10	1	**9320.250**	325
90	25 A	690 V~	AWG 12	–	top	10	2	5	1	**9320.380**	326
90	25 A	690 V~	AWG 12	–	top	10	2	10	1	**9320.390**	326
99	25 A	690 V~	AWG 12	–	top	10	2	5	1	**9320.400**	326
99	25 A	690 V~	AWG 12	–	top	10	2	10	1	**9320.410**	326
108	25 A	690 V~	AWG 12	–	top	10	2	5	1	**9320.420**	326
108	25 A	690 V~	AWG 12	–	top	10	2	10	1	**9320.430**	326
45	25 A	690 V~	–	16 mm²	top	10	2 (1 var.)	5	1	**9320.260**	326
45	25 A	690 V~	–	16 mm²	top	10	2 (1 var.)	10	1	**9320.270**	326
45	25 A	690 V~	–	16 mm²	top/bottom	10	2	5	1	**9320.280**	326
45	25 A	690 V~	–	16 mm²	top/bottom	10	2	10	1	**9320.290**	326
54	40 A	690 V~	AWG 10	–	top	10	2	5	1	**9320.300**	327
54	40 A	690 V~	AWG 10	–	top	10	2	10	1	**9320.310**	327
54	40 A	690 V~	AWG 10	–	top	15	1	5	1	**9320.460**	327
54	40 A	690 V~	AWG 10	–	top	15	1	10	1	**9320.470**	327
54	40 A	690 V~	AWG 10	–	bottom	10	2	5	1	**9320.320**	327
54	40 A	690 V~	AWG 10	–	bottom	10	2	10	1	**9320.330**	327
54	40 A	690 V~	–	16 mm²	top	10	2	5	1	**9320.340**	327
54	40 A	690 V~	–	16 mm²	top	10	2	10	1	**9320.350**	327
54	40 A	690 V~	–	16 mm²	top/bottom	10	2	5	1	**9320.360**	327
54	40 A	690 V~	–	16 mm²	top/bottom	10	2	10	1	**9320.370**	327

[1)] AWG = American Wire Gauges
AWG 14 = 2.08 mm² ≙ 2.5 mm²
AWG 12 = 3.31 mm² ≙ 4 mm²
AWG 10 = 5.26 mm² ≙ 6 mm²

Note:
For allocation of “power circuit-breakers/starter combinations”,
see page 1130/1131.

2.2 Busbar systems up to 800 A/1600 A (60 mm)

Component adaptor
Cable outlet at the top

Construction width mm	Rated current up to	Rated operating voltage	Connection cables[1]	Connection of round conductors mm²	Support rails		For bar thickness mm	Packs of	**Model No. SV**	Page
					Height mm	Number				
54	50 A	690 V~	AWG 10 (32 A)	1.5 – 10	7.5	1	5	1	**3540.000**	328
54	50 A	690 V~	AWG 10 (32 A)	1.5 – 10	7.5	1	10	1	**3541.000**	328
54	50 A	690 V~	AWG 10 (32 A)	1.5 – 10	7.5	2	5	1	**3040.000**	328
54	50 A	690 V~	AWG 10 (32 A)	1.5 – 10	7.5	2	10	1	**3041.000**	328
72	50 A	690 V~	AWG 10 (32 A)	1.5 – 10	7.5	1	5	1	**3544.000**	328
72	50 A	690 V~	AWG 10 (32 A)	1.5 – 10	7.5	1	10	1	**3545.000**	328
108	50 A	690 V~	AWG 10 (32 A)	1.5 – 10	7.5	2	5	1	**3042.000**	329
108	50 A	690 V~	AWG 10 (32 A)	1.5 – 10	7.5	2	10	1	**3043.000**	329
126	50 A	690 V~	AWG 10 (32 A)	1.5 – 10	7.5	2	5	1	**3069.000**	329
126	50 A	690 V~	AWG 10 (32 A)	1.5 – 10	7.5	2	10	1	**3070.000**	329
144	50 A	690 V~	AWG 10 (32 A)	1.5 – 10	15	2	5	1	**3044.000**	329
144	50 A	690 V~	AWG 10 (32 A)	1.5 – 10	15	2	10	1	**3045.000**	329
54	63 A	690 V~	AWG 8	1.5 – 10	7.5	1	5	1	**3036.000**	330
54	63 A	690 V~	AWG 8	1.5 – 10	7.5	1	10	1	**3037.000**	330
72	63 A	690 V~	AWG 8	1.5 – 10	7.5	2	5	1	**3038.000**	330
72	63 A	690 V~	AWG 8	1.5 – 10	7.5	2	10	1	**3039.000**	330
72	63 A	690 V~	AWG 8	1.5 – 10	15	1	5	1	**3067.000**	330
72	63 A	690 V~	AWG 8	1.5 – 10	15	1	10	1	**3068.000**	330
72	63 A	690 V~	AWG 8	1.5 – 10	15	2	5	1	**3046.000**	330
72	63 A	690 V~	AWG 8	1.5 – 10	15	2	10	1	**3047.000**	330
144	63 A	690 V~	AWG 8	1.5 – 10	15	2	5	1	**3048.000**	330
144	63 A	690 V~	AWG 8	1.5 – 10	15	2	10	1	**3049.000**	330
54	63 A	690 V~	AWG 10	1.5 – 10	7.5	1	5 – 10	1	**3445.000**	331
54	63 A	400 V~	–	1.5 – 16	7.5	1	5 – 10	1	**3446.000**[2]	331
90	100 A	690 V~	35 mm²	–	Mounting plate		5	1	**9320.000**	332
90	100 A	690 V~	35 mm²	–	Mounting plate		10	1	**9320.010**	332
110	160 A	690 V~	–	6 – 70	Mounting plate		5 – 10	1	**3438.000**	332
110	160 A	690 V~	–	6 – 70	Mounting plate		5 – 10	1	**3539.000**	332
110	250 A	690 V~	–	50 – 120	–		5 – 10	1	**3437.000**	333
110	250 A	690 V~	–	50 – 120	–		5 – 10	1	**3437.010**	333

[1] AWG = American Wire Gauges
AWG 10 = 5.26 mm² ≙ 6 mm²
AWG 8 = 8.37 mm² ≙ 10 mm²
[2] with pre-fuse unit D 02-E 18

Note:
For allocation of “power circuit-breakers/starter combinations”,
see page 1131.

Component support (without contact system)

Construction width mm	Support rails		For bar thickness mm	Packs of	**Model No. SV**	Page
	Height mm	Number				
54	7.5	1	5	1	**3542.000**	333
54	7.5	1	10	1	**3543.000**	333
72	7.5	1	5	1	**3546.000**	333
72	7.5	1	10	1	**3547.000**	333

2.2 Busbar systems up to 800 A/1600 A (60 mm)

Bus-mounting fuse bases

Type	Rated current	Rated operating voltage	For bar thickness mm	Packs of	Model No. SV				Page
					Bus-mounting fuse base	Contact hazard protection cover	End caps	Side cover	
For clamping screw attachment									
D 02-E 18[1)]	63 A	400 V~	5 – 10	10	**3418.000**	**3419.000**	**3420.000**	**3093.000**	334
D II-E 27[2)]	25 A	500 V~	5 – 10	10	**3427.000**	**3428.000**	**3429.000**	**3093.000**	334
D III-E 33[2)]	63 A	690 V~	5 – 10	10	**3433.000**	**3434.000**	**3435.000**	**3093.000**	334
For snap-on mounting									
D 02-E 18[1)]	63 A	400 V~	5	10	**3422.000**	**3424.000**	**3425.000**	**3093.000**	335
D 02-E 18[1)]	63 A	400 V~	10	10	**3423.000**	**3424.000**	**3425.000**	**3093.000**	335
D II-E 27[3)]	25 A	500 V~	5	10	**3520.000**	**3522.000**	**3429.000**	**3093.000**	335
D II-E 27[3)]	25 A	500 V~	10	10	**3521.000**	**3522.000**	**3429.000**	**3093.000**	335
D III-E 33[3)]	63 A	690 V~	5	10	**3530.000**	**3532.000**	**3435.000**	**3093.000**	335
D III-E 33[3)]	63 A	690 V~	10	10	**3531.000**	**3532.000**	**3435.000**	**3093.000**	335

[1)] Adaptor sleeve
[2)] Adaptor screw
[3)] Gauge ring

NH fused isolators/NH on-load isolators

Description	Cable outlet	Type of connection	For bar thickness mm	Packs of	Model No. SV	Page
NH fused isolators size 00 160 A, 690 V~	top	Screw M8	5 – 10	1	**3591.020**	336
	bottom	Screw M8	5 – 10	1	**3591.030**	336
NH on-load isolators size 000 100 A, 690 V~	top/bottom	Terminal up to 50 mm²	–	1	**3431.000**	337
Busbar adaptor for SV 3431.000	–	–	5	1	**9320.040**	337
	–	–	10	1	**9320.050**	337

NH bus-mounting on-load isolator

Version	Cable outlet	Type of connection	Packs of	Model No. SV	with fuse monitoring		Page
					Model No. SV[1)]	Model No. SV[2)]	
Size 00, 160 A, 690 V~	top	Screw M8 up to 95 mm²	1	**3400.000**	**3490.000**	**3490.210**	338
Size 00, 160 A, 690 V~	bottom	Screw M8 up to 95 mm²	1	**3401.000**	**3491.000**	**3491.210**	338
Size 00, 160 A, 690 V~	top	Clamp-type terminal connection up to 70 mm²	1	**3402.000**	**3492.000**	**3492.210**	338
Size 00, 160 A, 690 V~	bottom	Clamp-type terminal connection up to 70 mm²	1	**3403.000**	**3493.000**	**3493.210**	338
Size 1, 250 A, 690 V~	top	Screw M10 up to 150 mm²	1	**3411.000**	**3495.000**	**3495.210**	339
Size 1, 250 A, 690 V~	bottom	Screw M10 up to 150 mm²	1	**3410.000**	**3494.000**	**3494.210**	339
Size 2, 400 A, 690 V~	top	Screw M10 up to 240 mm²	1	**3415.020**	**3415.120**	**3415.210**	340
Size 2, 400 A, 690 V~	bottom	Screw M10 up to 240 mm²	1	**3415.030**	**3415.130**	**3415.230**	340
Size 3, 630 A, 690 V~	top	Screw M10 up to 240 mm²	1	**3095.020**	**3095.120**	**3095.210**	341
Size 3, 630 A, 690 V~	bottom	Screw M10 up to 240 mm²	1	**3095.030**	**3095.130**	**3095.230**	341

[1)] Electromechanical fuse monitoring
[2)] Electronic fuse monitoring and LED display

2.3 Busbar systems up to 1250 A (100 mm)

System components

Description	For busbars mm	Packs of	Model No. SV	Page
Busbar supports up to 1250 A, 1000 V~, 3-pole, 100 mm bar centre distance	–	4	**3073.000**	343
Inserts for SV 3073.000	30 x 10	24	**3074.000**	343
	40 x 10	24	**3075.000**	343
	50 x 10	24	**3076.000**	343
Busbars E-Cu				343
End cover	–	10	**3083.000**	343
Busbar cover sections				343

Connection clamps/system covers

Description	Page
Plate clamps	344
Conductor connection clamps	344
System covers	344

NH bus-mounting on-load isolator

Version	Cable outlet	Type of connection	Packs of	Model No. SV	with fuse monitoring		Page
					Model No. SV[1]	Model No. SV[2]	
Size 00, 160 A, 690 V~	top	Screw M8 up to 95 mm²	1	**3400.000**	**3490.000**	**3490.210**	345
Size 00, 160 A, 690 V~	bottom	Screw M8 up to 95 mm²	1	**3401.000**	**3491.000**	**3491.210**	345
Size 00, 160 A, 690 V~	top	Clamp-type terminal connection up to 70 mm²	1	**3402.000**	**3492.000**	**3492.210**	345
Size 00, 160 A, 690 V~	bottom	Clamp-type terminal connection up to 70 mm²	1	**3403.000**	**3493.000**	**3493.210**	345
Size 1, 250 A, 690 V~	top	Screw M10 up to 150 mm²	1	**3411.000**	**3495.000**	**3495.210**	346
Size 1, 250 A, 690 V~	bottom	Screw M10 up to 150 mm²	1	**3410.000**	**3494.000**	**3494.210**	346
Size 2, 400 A, 690 V~	top/bottom	Screw M10 up to 240 mm²	1	**3415.010**	**3415.110**	**3415.310**	347
Size 3, 630 A, 690 V~	top/bottom	Screw M10 up to 240 mm²	1	**3095.010**	**3095.110**	**3095.310**	348
Busbar adaptor for NH isolators		Size 00, Size 1	1	**3412.000**			345
		Size 2	1	**3499.020**			347
		Size 3	1	**3499.030**			348

[1] Electromechanical fuse monitoring
[2] Electronic fuse monitoring and LED display

NH fused isolator

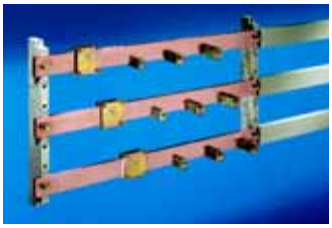
Version	Cable outlet	Type of connection	Packs of	Model No. SV	Page
Size 00, 160 A, 690 V~	top/bottom	Screw M8	1	**3591.010**	349

2.4 Busbar systems up to 1600 A (185 mm)

System components

Description	For busbars mm	Packs of	Model No. SV	Page
Busbar supports up to 1600 A, 1000 V~, 3-pole, 185 mm bar centre distance	50 – 80 x 10[1]	2	**3052.000**	351
Inserts for SV 3052.000	50 x 10	24	**3074.000**	351
	60 x 10	24	**3075.000**	351
Busbars E-Cu				351
Busbar cover sections				351

[1] Max. busbar accommodation without inserts 80 x 10 mm.
The base component of the busbar support may also be used as a single-pole support.



2.4 Busbar systems up to 1600 A (185 mm)

Connection clamps

Description	Page
Plate clamps	352
Conductor connection clamps	352

NH fused isolators

Version	Cable outlet	Type of connection	Packs of	**Model No. SV**	Page
Size 00, 160 A, 690 V~	top/bottom	Screw M8	1	**3591.040**[1)]	353
			2	**3591.050**[2)]	353
Size 1, 250 A, 690 V~	top/bottom	Screw M12	1	**3485.000**	353
Size 2, 400 A, 690 V~	top/bottom	Screw M12	1	**3486.000**	353
Size 3, 630 A, 690 V~	top/bottom	Screw M12	1	**3487.000**	353

[1)] Including busbar adaptor
[2)] Including busbar adaptor (double adaptor)

2.5 Busbar systems up to 2500 A/3000 A (150 mm)

System components

Description	Rated current up to	Max. bar accommodation without spacing pieces	Packs of	**Model No. SV**	Page
Busbar support, 3-pole, 150 mm bar centre distance, rated operating voltage 1000 V~	2500 A	2 x 80 x 10 mm	2	**3055.000**	355
	3000 A	2 x 100 x 10 mm	2	**3057.000**	355
Spacing pieces			12	**3056.000**	355
Busbars E-Cu					355
Connection plates					356
Bar insulation					356

2.6 Mounting plate assembly

NH on-load isolators

Version	Cable outlet	Type of connection	Packs of	**Model No. SV**	with fuse monitoring		Page
					Model No. SV[1)]	**Model No. SV**[2)]	
Size 000, 100 A, 690 V~	top/bottom	Terminal up to 50 mm²	1	**3431.000**	–	–	358
Size 00, 160 A, 690 V~	top/bottom	Screw M8 up to 95 mm²	1	**3488.000**	–	–	358
Size 00, 160 A, 690 V~	bottom	Screw M8 up to 95 mm²	1	–	–	**3488.310**	358
Size 00, 160 A, 690 V~	top/bottom	Clamp-type terminal up to 70 mm²	1	**3489.000**	–	–	358
Size 00, 160 A, 690 V~	bottom	Clamp-type terminal up to 70 mm²	1	–	–	**3489.310**	358
Size 1, 250 A, 690 V~	top/bottom	Screw M10 up to 150 mm²	1	**3409.000**	–	–	358
Size 1, 250 A, 690 V~	bottom	Screw M10 up to 150 mm²	1	–	–	**3409.310**	358
Size 2, 400 A, 690 V~	top/bottom	Screw M10 up to 240 mm²	1	**3415.010**	–	–	359
Size 2, 400 A, 690 V~	top/bottom	Screw M10 up to 240 mm²	1	–	**3415.110**	–	359
Size 2, 400 A, 690 V~	bottom	Screw M10 up to 240 mm²	1	–	–	**3415.310**	359
Size 3, 630 A, 690 V~	top/bottom	Screw M10 up to 240 mm²	1	**3095.010**	–	–	359
Size 3, 630 A, 690 V~	top/bottom	Screw M10 up to 240 mm²	1	–	**3095.110**	–	359
Size 3, 630 A, 690 V~	bottom	Screw M10 up to 240 mm²	1	–	–	**3095.310**	359

[1)] Electromechanical fuse monitoring
[2)] Electronic fuse monitoring and LED display

2.8 Rittal Maxi-PLS up to 2000 A/3200 A

Description	up to 2000 A page	up to 3200 A page
Connection kits (3-pole)	368 – 369	378 – 381
Connection kits for coupling sets (3-pole)	370 – 371	382 – 383
Connection kits for rear section (3-pole)	372 – 373	384 – 387
Connection kits for coupling sets – rear section (3-pole)	374 – 375	388 – 389
System components		
Busbar support	376	390
Busbar support, suitable for top mounting	376	390
End supports	376	390
System attachment	376	390
Maxi-PLS busbars, E-Cu 57	376	390
Cover section	376	390
Longitudinal connector E-Cu	376	390
End cover	376	390
Stabiliser	–	390
Connection components		
Connection bracket E-Cu	377	391
Isolator chassis	377	391
U contact maker E-Cu	377	391
Connection clamp	377	391
Connection plates	377	391
Terminal studs	377	391
Sliding blocks	377	391
Sliding nuts	377	391
Threaded bolts	377	391

2.8 Rittal Maxi-PLS SV-TS 8 enclosures

for incoming/outgoing

Dimensions mm			Model No. SV		Model No. TS					Page
						Base/plinth Packs of 1 set				
						Components front and rear		Trim panels sides		
Width	Height	Depth	For Maxi-PLS	Enclosure	Side panels Packs of 2	100 mm	200 mm	100 mm	200 mm	
3-pole										
600	2000	600	2000 A	**9660.665**[1]	8106.235	8601.600	8602.600	8601.060	8602.060	392
600	2000	600	2000 A	**9660.675**[2]	8106.512	8601.600	8602.600	8601.060	8602.060	392
800	2000	600	3200 A	**9660.865**[1]	8106.235	8601.800	8602.800	8601.060	8602.060	392
800	2000	600	3200 A	**9660.875**[2]	8106.512	8601.800	8602.800	8601.060	8602.060	392
4-pole										
800	2000	600	2000 A	**9649.625**[1]	8106.235	8601.800	8602.800	8601.060	8602.060	393
800	2000	600	2000 A	**9649.635**[2]	8106.512	8601.800	8602.800	8601.060	8602.060	393
800	2000	800	3200 A	**9659.625**[1]	8108.235	8601.800	8602.800	8601.080	8602.080	393
800	2000	800	3200 A	**9659.635**[2]	8108.512	8601.800	8602.800	8601.080	8602.080	393

[1] 1-door
[2] 3-door

2.8 Rittal Maxi-PLS SV-TS 8 enclosures

for Rittal NH fused isolators

Dimensions mm			Model No. TS						Page
Width	Height	Depth	Enclosure[1]	Side panels Packs of 2	Base/plinth Packs of 1 set				
					Components front and rear		Trim panels sides		
					100 mm	200 mm	100 mm	200 mm	
3-pole/4-pole (2000 A/3200 A)									
600	2000	500	**9660.505**[2]	8105.235	8601.600	8602.600	8601.050	8602.050	394
600	2000	600	**9660.605**[2]	8106.235	8601.600	8602.600	8601.060	8602.060	394
600	2000	800	**9660.805**[2]	8108.235	8601.600	8602.600	8601.080	8602.080	394
800	2000	500	**9660.535**[2]	8105.235	8601.800	8602.800	8601.050	8602.050	394
800	2000	600	**9660.635**[2]	8106.235	8601.800	8602.800	8601.060	8602.060	394
800	2000	800	**9660.835**[2]	8108.235	8601.800	8602.800	8601.080	8602.080	394
1000	2000	500	**9660.595**[3]	8105.235	8601.000	8602.000	8601.050	8602.050	395
1000	2000	600	**9660.695**[3]	8106.235	8601.000	8602.000	8601.060	8602.060	395
1200	2000	500	**9660.555**[3]	8105.235	8601.200	8602.200	8601.050	8602.050	395
1200	2000	600	**9660.655**[3]	8106.235	8601.200	8602.200	8601.060	8602.060	395
1200	2000	800	**9660.855**[3]	8108.235	8601.200	8602.200	8601.080	8602.080	395

[1] Without mounting plate
[2] 1-door
[3] 2-door

for NH fused isolators

Dimensions mm			Model No. SV	Model No. TS					Page
Width	Height	Depth	Enclosure 1-door	Side panels Packs of 2	Base/plinth Packs of 1 set				
					Components front and rear		Trim panels sides		
					100 mm	200 mm	100 mm	200 mm	
3-pole (2000 A/3200 A)									
1000	2000	600	**9660.515**[1]	8106.512	8601.000	8602.000	8601.060	8602.060	396
1200	2000	600	**9660.545**[1]	8106.512	8601.200	8602.200	8601.060	8602.060	396
1000	2000	600	**9660.415**[2]	8106.512	8601.000	8602.000	8601.060	8602.060	396
1200	2000	600	**9660.445**[2]	8106.512	8601.200	8602.200	8601.060	8602.060	396
4-pole (2000 A)									
1000	2000	600	**9649.665**[1]	8106.512	8601.000	8602.000	8601.060	8602.060	397
1200	2000	600	**9649.675**[1]	8106.512	8601.200	8602.200	8601.060	8602.060	397
1000	2000	600	**9649.645**[2]	8106.512	8601.000	8602.000	8601.060	8602.060	397
1200	2000	600	**9649.655**[2]	8106.512	8601.200	8602.200	8601.060	8602.060	397
4-pole (3200 A)									
1000	2000	800	**9659.665**[1]	8108.512	8601.000	8602.000	8601.080	8602.080	397
1200	2000	800	**9659.675**[1]	8108.512	8601.200	8602.200	8601.080	8602.080	397
1000	2000	800	**9659.645**[2]	8108.512	8601.000	8602.000	8601.080	8602.080	397
1200	2000	800	**9659.655**[2]	8108.512	8601.200	8602.200	8601.080	8602.080	397

[1] For NH fused isolators, brand ABB SlimLine
[2] For NH fused isolators, brand Jean Müller SASIL

System components for NH fused isolator panels

For NH fused isolator brands ABB SlimLine/Jean Müller SASIL

Description	Page
T-bar support 800 A/1600 A	398
T-busbars E-Cu 800 A/1600 A	398
T-connector kits 800 A/1600 A	398

2.8 Rittal Maxi-PLS SV-TS 8 enclosures

for coupling sets

Dimensions mm			Model No. SV		Model No. TS					Page
						Base/plinth Packs of 1 set				
						Components front and rear		Trim panels sides		
Width	Height	Depth	For Maxi-PLS	Enclosure	Side panels Packs of 2	100 mm	200 mm	100 mm	200 mm	
3-pole										
800	2000	600	2000 A	**9660.305**	8106.512	8601.800	8602.800	8601.060	8602.060	399
1000	2000	600	3200 A	**9660.355**	8106.512	8601.000	8602.000	8601.060	8602.060	399
4-pole										
1000	2000	600	2000 A	**9649.685**	8106.512	8601.000	8602.000	8601.060	8602.060	399
1000	2000	800	3200 A	**9659.695**	8108.512	8601.000	8602.000	8601.080	8602.080	399

System components for coupling sets

Description	Page
Coupling sets, vertical	400
System attachment for vertical coupling set	400

2.9 ISV distribution enclosures

ISV-TS 8 enclosures for distribution enclosures up to 630 A

Dimensions mm			Model No. SV	Model No. TS					Page
					Base/plinth Packs of 1 set				
					Components front and rear		Trim panels sides		
Width	Height	Depth	Enclosure	Side panels Packs of 2	100 mm	200 mm	100 mm	200 mm	
600	2000	400	**9665.945**[1)]	8104.235	8601.600	8602.600	8601.040	8602.040	409
600	2000	600	**9665.905**[1)]	8106.235	8601.600	8602.600	8601.060	8602.060	409
850	2000	400	**9665.955**[1)]	8104.235	8601.850	8602.850	8601.040	8602.040	409
850	2000	600	**9665.915**[1)]	8106.235	8601.850	8602.850	8601.060	8602.060	409
1100	2000	400	**9665.965**[2)]	8104.235	8601.300	8602.100	8601.040	8602.040	409
1100	2000	600	**9665.925**[2)]	8106.235	8601.300	8602.100	8601.060	8602.060	409

[1)] 1-door
[2)] 2-door

ISV-TS 8 enclosures for distribution enclosures up to 1600 A

Dimensions mm			Model No. SV	Model No. TS					Page
					Base/plinth Packs of 1 set				
					Components front and rear		Trim panels sides		
Width	Height	Depth	Enclosure	Side panels Packs of 2	100 mm	200 mm	100 mm	200 mm	
600	2000	600	**9665.975**[1)]	8106.235	8601.600	8602.600	8601.060	8602.060	410
850	2000	600	**9665.985**[1)]	8106.235	8601.850	8602.850	8601.060	8602.060	410

[1)] 1-door

2.9 ISV distribution enclosures

Installation modules

Description	Page
Contact hazard protection modules	411
Mounting plate modules	411
Support rail modules	412
Support modules	412
Connection modules	413
DIN rail mounted device modules	413
NH on-load isolator modules	414
Power circuit-breaker modules	414
Busbar support	415
Contact hazard protection cover for conductor connection clamps and plate clamps	416/418
Contact hazard protection covers for bus-mounting fuse bases	416
Contact hazard protection covers for NH bus-mounting on-load isolator size 00	416
NH fused isolator modules	417
Contact hazard protection covers for NH fused isolator size 00	417
Busbar modules, 2-pole	418
Meter mounting board module	418

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3.1 ATCA

AdvancedTCA Shelf VA-1 (Rittal ShMC connectable from rear)

U	Slots	Backplane	IPMI	Rittal ShMC[1)]	Switch slots	PC	PEM	PEM-Amp	RiCool-2	Model No. RP	Page
13	14	Dual Star	bussed	2 x kernels	centre	2 x	2 x	90 A each	4 x 48 V-IPMI	**3688.306**	426
13	14	Dual Star	bussed	2 x kernels	centre	2 x	4 x	50 A each	4 x 48 V-IPMI	**On request**	426
13	14	Full Mesh	bussed	2 x kernels	1 + 2	2 x	2 x	90 A each	4 x 48 V-IPMI	**3688.305**	426
13	14	Full Mesh	bussed	2 x kernels	1 + 2	2 x	4 x	50 A each	4 x 48 V-IPMI	**3688.463**	426

[1)] ShMC not included with the supply.

AdvancedTCA Shelf VB-1 (Intel ShMC connectable from front)

U	Slots	Backplane	IPMI	Intel ShMC[1)]	Switch slots	PC	PEM[2)]	PEM-Amp	RiCool-2	Model No. RP	Page
13	14	Dual Star	radial	2 x CMM	centre	2 x	2 x	90 A each	4 x 48 V-IPMI	**3688.303**	427
13	14	Dual Star	radial	2 x CMM	centre	2 x	4 x	50 A each	4 x 48 V-IPMI	**On request**	427
13	14	Full Mesh	radial	2 x CMM	1 + 2	2 x	2 x	90 A each	4 x 48 V-IPMI	**3688.301**	427
13	14	Full Mesh	radial	2 x CMM	1 + 2	2 x	4 x	50 A each	4 x 48 V-IPMI	**3688.466**	427

[1)] ShMC not included with the supply.
[2)] PEM-IPMI included with the supply.

AdvancedTCA Shelf version VB-2 (Pigeon Point ShMC connectable from front)

U	Slots	Backplane	IPMI	Pigeon Point ShMC[1)]	Switch slots	PC	PEM[2)]	PEM-Amp	RiCool-2	Model No. RP	Page
13	14	Dual Star	bussed	2 x CMM	centre	2 x	2 x	90 A each	4 x 48 V-IPMI	**3688.304**	427
13	14	Dual Star	bussed	2 x CMM	centre	2 x	4 x	50 A each	4 x 48 V-IPMI	**3688.469**	427
13	14	Full Mesh	bussed	2 x CMM	1 + 2	2 x	2 x	90 A each	4 x 48 V-IPMI	**3688.302**	427
13	14	Full Mesh	bussed	2 x CMM	1 + 2	2 x	4 x	50 A each	4 x 48 V-IPMI	**3688.470**	427

[1)] ShMC not included with the supply.
[2)] PEM-IPMI included with the supply.

3.2 CPCI

Rack-mount systems, Slim-Box

U	Depth mm	Installation space for		Model No. RP			Page
		Boards mm	Rear I/O boards mm	with CPCI backplane and power supply	with CPCI backplane without power supply	without backplane with power supply	
1	300	160	80	**9907.475**	**3689.177**	**9907.479**	433
1	300	160	–	**9907.471**	**–**	**–**	433
2	300	160	80	**9907.476**	**3689.178**	**9907.480**	433
2	300	160	–	**9907.472**	**–**	**–**	433
3	300	160	80	**9907.477**	**3689.179**	**9907.481**	433
3	300	160	–	**9907.473**	**–**	**–**	433
4	300	160	80	**9907.478**	**3689.180**	**9907.482**	433
4	300	160	–	**9907.474**	**–**	**–**	433

Rack-mount systems, Ripac

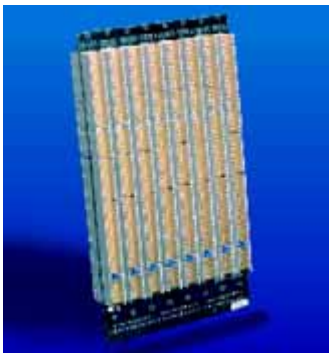
Slots (version)	U	Depth mm	Wiring space depth mm	For PCB	Model No. RP	Page
					MPS system	
5 horizontal	3	405	210	6 U x 160 mm	**3687.717**	434
7 horizontal	4	405	210	6 U x 160 mm	**3687.718**	434
8	4 (3 + 1)	405	210	3 U/6 U x 160 mm	**3687.719**	435
8	7 (6 + 1)	405	210	3 U/6 U x 160 mm	**3687.720**	435
8	7 (6 + 2 x $^1/_2$)	405	210	6 x U 160 mm	**3687.721**	436
8 (with radial fan)	9 (6 + 2 x $1^1/_2$)	290.5	85.5	6 U x 160 mm	**3687.723**	437

3.2 CPCI

Backplanes 3.5 U

Slots	Version	Model No. RP		Page
		32-bit	64-bit	
2	SE	**–**	**3687.864**	440
3	SBE	**3687.865**	**3686.578**	440
4	SBE	**3687.863**	**3686.576**	440
5	SBE	**3687.862**	**3686.575**	440
6	SBME	**3687.861**	**3686.548**	440
7	SBE	**3687.860**	**3686.547**	440
8	S	**3687.859**	**3686.546**	440

S = Stand alone
B = Beginning segment
M = Middle segment
E = Ending segment

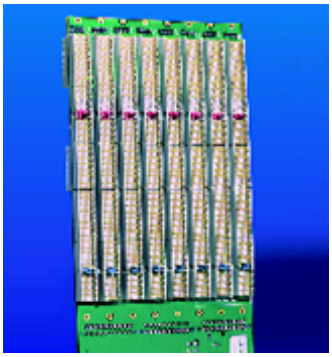


3.2 CPCI

Backplanes 6.5 U

Slots	Version	Model No. RP		Page
		32-bit	64-bit	
Backplanes[1)]				
2	SBE	–	**3686.581**	440
3	SBE	**3687.871**	**3686.580**	440
4	SBE	**3687.870**	**3686.579**	440
5	SBE	**3687.869**	**3686.552**	440
6	SBME	**3687.868**	**3686.551**	440
7	SBE	**3687.867**	**3686.550**	440
8	S	**3687.866**	**3686.549**	440
Backplanes for low profile bridge[2)]				
3	SBE	–	**3689.209**	440
4	SBE	–	**3689.208**	440
5	SBE	–	**3689.207**	440
6	SBME	–	**3689.206**	440
7	SBE	–	**3689.205**	440

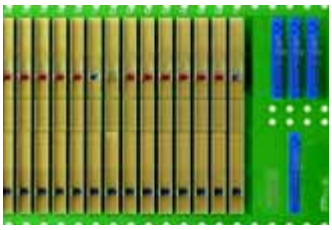
[1)] Cannot be used when rear connection of 80 mm boards is required.
[2)] May be used when rear connection of 80 mm boards is required.
S = Stand alone
B = Beginning segment
M = Middle segment
E = Ending segment



Backplanes 7 U with H.110

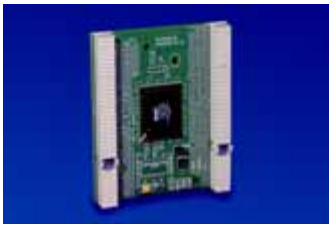
Slots	Version	Model No. RP		Page
		H.110 connected to system slot	H.110 not connected to system slot	
3	S	**3688.508[1)]**	–	441
4	SE	**3688.507[2)]**	–	441
5	SB	**3687.875[2)]**	**3688.506[2)]**	441
6	SBME	**3687.874[2)]**	**3688.505[2)]**	441
7	SBE	**3687.873[2)]**	**3688.504[2)]**	441
8	S	**3687.877**	**9805.494**	441

[1)] Extendible with low profile bridges
[2)] Extendible with bridges RP 3686.571
S = Stand alone
B = Beginning segment
M = Middle segment
E = Ending segment



Backplanes 7 U, Switch Fabric to PICMG 2.16

Width	Number of slots	Description of slots	Model No. RP	Page
32 HP	8	1 fabric slot 6 node slots with CPCI and H.110 1 host slot	**3689.188**	442
32 HP	8	see RP 3689.188, but without H.110	**3686.414**	442
84 HP	16	1 fabric slot 6 node slots with CPCI and H.110 1 host slot 1 fabric slot 6 node slots with CPCI and H.110 1 host slot 3 slots for power supplies	**3686.396**	442
84 HP	16	see RP 3686.396, but without H.110	**3689.186**	442
84 HP	21	7 node slots with CPCI and H.110 1 host slot 1 node slot with H.110, without CPCI 1 fabric slot 7 node slots with CPCI and H.110 1 host slot 1 node slot with H.110, without CPCI 1 fabric slot 1 alarm slot	**3686.397**	442
84 HP	21	see RP 3686.397, but without H.110	**3689.190**	442
84 HP	21	see RP 3686.397, but without CPCI	**3689.191**	442



3.2 CPCI

Modular CPCI bridge

Description	Model No. RP	Page
64-bit CPCI bridge	**3686.571**	443

Modular low profile bridge

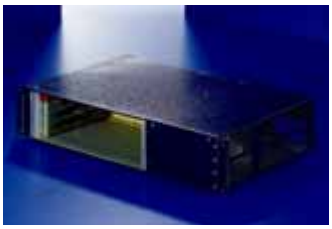
Version	Bits	Model No. RP	Page
left-right	32	**3689.210**	443
right-left	32	**3689.211**	443
left-right	64	**9810.637**	443
right-left	64	**9812.625**	443

Only suitable for use in conjunction with low profile backplanes.

Power supply board

Description	Model No. RP	Page
3.5 U, 16 HP		
Board for pluggable power supply with Positronic connector, 47 pin	**3688.603**	444
ATX (12″) cable harness	**9810.337**	444
ATX (16″) cable harness	**3686.570**	444
ATX (20″) cable harness	**9810.338**	444
6.5 U, 8 HP[1)]		
Board for pluggable power supply with Positronic connector, 47 pin	**3688.607**	445
ATX (12″) cable harness	**9810.337**	445
ATX (16″) cable harness	**3686.570**	445
ATX (20″) cable harness	**9810.338**	445
6.5 U, 16 HP[1)]		
Board for 2 x pluggable power supplies with Positronic connector, 47 pin	**3688.608**	446
ATX (12″) cable harness	**9810.337**	446
ATX (16″) cable harness	**3686.570**	446
ATX (20″) cable harness	**9810.338**	446

[1)] Extended delivery times.



3.2 VME

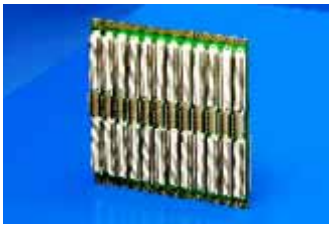
Rack-mount systems, Slim-Box

U	Depth mm	Installation space for		Model No. RP		Page
		Boards mm	Rear I/O boards mm	with VME backplane and power supply	without backplane with power supply	
1	300	160	80	–	**9907.479**	447
1	360	160	160	**9907.467**	–	447
1	300	160	–	**9907.463**	–	447
2	300	160	80	–	**9907.480**	447
2	360	160	160	**9907.468**	–	447
2	300	160	–	**9907.464**	–	447
3	300	160	80	–	**9907.481**	447
3	360	160	160	**9907.469**	–	447
3	300	160	–	**9907.465**	–	447
4	300	160	80	–	**9907.482**	447
4	360	160	160	**9907.470**	–	447
4	300	160	–	**9907.466**	–	447

3.2 VME/VME64x

Rack-mount systems, Ripac

Slots (version)	U	For	Depth mm	Wiring space depth mm	For PCB	Model No. RP MPS system	Page
5 horizontal	3	VME	405	210	6 U x 160 mm	**3687.698**	448
5 horizontal	3	VME64x	405	210	6 U x 160 mm	**3687.699**	448
7 horizontal	4	VME	405	210	6 U x 160 mm	**3687.700**	448
7 horizontal	4	VME64x	405	210	6 U x 160 mm	**3687.696**	448
12	4 (3 + 1)	VME	405	210	3 U x 160 mm	**3687.702**	449
12	7 (6 + 1)	VME	405	210	3/6 U x 160 mm	**3687.703**	449
12	7 (6 + 1)	VME64x	405	210	3/6 U x 160 mm	**3687.704**	449
12	7 (6 + 2 x 1/2)	VME	405	210	6 U x 160 mm	**3687.705**	450
12	7 (6 + 2 x 1/2)	VME64x	405	210	6 U x 160 mm	**3687.706**	450
12 (with radial fan)	9 (6 + 2 x 1 1/2)	VME64x	290.5	85.5	6 U x 160 mm	**3687.708**	451

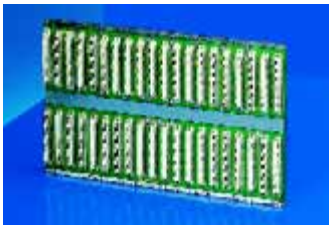


3.2 VME

Backplanes VME64x

Slots	Dimensions in mm Width	Height	Model No. RP without P0 connector	with P0 connector	Page
6 U					
5	100	261.6	**3687.608**	**3687.609**	454
7	161.5	261.6	**3687.610**	**3687.611**	454
9	181.5	261.6	**9904.930**	**9904.932**	454
10	202	261.6	**9904.931**	**9904.933**	454
12	242.5	261.6	**3686.634**	**3686.473**	454
21	425.5	261.6	**3686.635**	**3686.474**	454

Slots	Dimensions in mm Width	Height	Model No. RP without P0 connector	with P0 connector	Page
6.5 U					
5	100	283.7	**9910.012**	**9910.007**	454
7	161.5	283.7	**9910.013**	**9910.008**	454
9	181.5	283.7	**9910.014**	**9910.009**	454
10	202	283.7	**9904.928**	**9904.929**	454
12	242.5	283.7	**9910.015**	**9910.010**	454
21	425.5	283.7	**9910.016**	**9910.011**	454



Backplanes VME J1/J2 Monolithic

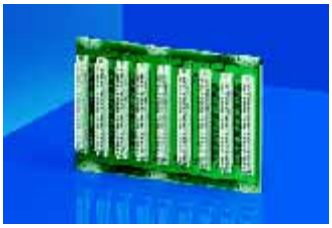
Slots	Dimensions in mm Width	Height	Model No. RP passive	active	Page
2	39.5	261.7	**3686.475**	**3686.495**	455
3	59.5	261.7	**3686.476**	**3686.496**	455
4	80	261.7	**3686.477**	**3686.497**	455
5	100	261.7	**3686.478**	**3686.498**	455
6	120.5	261.7	**3686.479**	**3686.499**	455
7	141	261.7	**3686.480**	**3686.500**	455
8	161.5	261.7	**3686.481**	**3686.501**	455
9	181.5	261.7	**3686.482**	**3686.502**	455
10	202	261.7	**3686.483**	**3686.503**	455
11	222.5	261.7	**3686.484**	**3686.504**	455

Slots	Dimensions in mm Width	Height	Model No. RP passive	active	Page
12	242.5	261.7	**3686.485**	**3686.505**	455
13	263	261.7	**3686.486**	**3686.506**	455
14	283	261.7	**3686.487**	**3686.507**	455
15	303.5	261.7	**3686.488**	**3686.508**	455
16	324	261.7	**3686.489**	**3686.509**	455
17	344	261.7	**3686.490**	**3686.510**	455
18	364.5	261.7	**3686.491**	**3686.511**	455
19	385	261.7	**3686.492**	**3686.512**	455
20	405	261.7	**3686.493**	**3686.513**	455
21	425.5	261.7	**3686.494**	**3686.514**	455

Backplanes VME J1 system bus

Slots	Dimensions in mm Width	Height	Model No. RP	Page
3	59.5	128.4	**3686.555**	456
4	80	128.4	**3686.556**	456
5	100	128.4	**3686.557**	456
6	120.5	128.4	**3686.558**	456
7	141	128.4	**3686.559**	456
8	161.5	128.4	**3686.560**	456
9	181.5	128.4	**3686.561**	456
10	202	128.4	**3686.562**	456

Slots	Dimensions in mm Width	Height	Model No. RP	Page
12	242.5	128.4	**3686.563**	456
13	263	128.4	**3686.564**	456
14	283	128.4	**3686.565**	456
15	303.5	128.4	**3686.566**	456
18	364.5	128.4	**3686.567**	456
20	405	128.4	**3686.568**	456
21	425.5	128.4	**3686.569**	456



3.2 VME

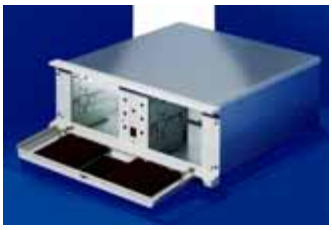
Backplanes VME J2 expansion bus

Slots	Dimensions in mm		Model No. RP	Page
	Width	Height		
3	59.5	128.4	**3686.585**	456
4	80	128.4	**3686.586**	456
5	100	128.4	**3686.587**	456
6	120.5	128.4	**3686.588**	456
7	161.5	128.4	**3686.589**	456
8	161.5	128.4	**3686.590**	456
9	181.5	128.4	**3686.591**	456
10	202	128.4	**3686.592**	456

Slots	Dimensions in mm		Model No. RP	Page
	Width	Height		
12	242.5	128.4	**3686.593**	456
13	263	128.4	**3686.594**	456
14	283	128.4	**3686.595**	456
15	303.5	128.4	**3686.596**	456
18	364.5	128.4	**3686.597**	456
20	405	128.4	**3686.598**	456
21	425.5	128.4	**3686.599**	456

3.3 Rack-mount systems for industrial PCs

U	Dimensions in mm			Packs of	Model No. RP	Page
	Width	Height Flanges/ Side panels	Depth			
ATX Ripac 4 U, aluminium						
4	482.6 (19″)	177	440	1	**3659.000**	462
ATX 1, 2 and 4 U, sheet steel						
1	482.6 (19″)	44	532.5/530	1	**3659.500**	463
2	482.6 (19″)	88	532.5/530	1	**3659.600**	464
4	482.6 (19″)	177/174	442.5/440	1	**3659.900**	465
ATX Economy with front door 4 U, sheet steel						
4	482.6 (19″)	177/174	430/415	1	**3659.100**	466
Modular system AT/ATX Vario Economy with front door, 4 U, sheet steel Expansion for AT/ATX power pack (PS/2) or redundant power pack (PS/2), ATX/AT 8 + 4 slots/AT 14 slots. Basic enclosure individually upgradable for AT or ATX applications.						
4	482.6 (19″)	177/174	430	1	**3659.400**	467
ATX with front connections for 482.6 mm (19″) installation, 4 U						
4	482.6 (19″)	177/174	442.5/440	1	**3659.700**	468
ATX with front connections for wall mounting						
	380	330	292.5/290	1	**3659.710**	469
ATX for PICMG backplane, 4 U, sheet steel						
4	482.6 (19″)	177/174	442.5/440	1	**3659.650**	470
ATX with alternative accommodation, 2 U, sheet steel						
2	482.6 (19″)	88	532/530	1	**3659.640**	471



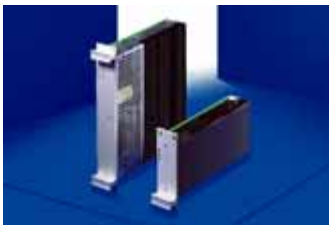
3.3 Rack-mount systems for storage devices

Version	Dimensions in mm			Packs of	Model No. RP	Page
	Width	Height Flanges/ Side panels	Depth			
19″ RAID subrack	482.6 (19″)	177 (4 U)	455/440	1	**3659.300**	472
19″ ATX RAID subrack, 6-drive	482.6 (19″)	177/174 (4 U)	450/435	1	**3659.420**	473
19″ ATX RAID subrack, 9-drive	482.6 (19″)	177 (4 U)	692.5/690	1	**3659.430**	474

3.4 Power supplies

Ripac power supplies – Open Frame

Watts	Output voltage/output current			Model No. RP				Page
	Output 1	Output 2	Output 3	35 A	60 A	85 A	110 A	
250	5 V/35 A	+12 V/8 A	–12 V/8 A	**3686.622**	–	–	–	479
400	5 V/60 A, 85 A	+12 V/8 A	–12 V/8 A	–	**3686.623**	**3686.629**	–	479
600	5 V/85 A	+12 V/8 A	–12 V/8 A	–	–	**3686.624**	–	479
1000	5 V/110 A	+12 V/16 A	–12 V/8 A	–	–	–	**3686.625**	479



Ripac power supplies, plug-in

Watts	Width (HP)	Height (U)	Output voltage/output current			Model No. RP		Page
			Output 1	Output 2	Output 3	Power supply	Font panel	
130	10	3	5 V/14 A	+12 V/5 A	–12 V/2 A	**3686.469**	**3685.304**	480
160	12	3	5 V/20 A	+12 V/5 A	–12 V/2 A	**3686.470**	**3685.305**	480
160	8	6	5 V/20 A	+12 V/5 A	–12 V/2 A	**3686.471**	**3686.472**	480
270	12	6	5 V/35 A	+12 V/6 A	–12 V/2 A	**3685.306**	**3685.307**	480

Ripac power supplies for CPCI, plug-in

Watts	Width (HP)	Height (U)	Output voltage/output current				Output current Output 1 + 2	Model No. RP		Page
			Output 1	Output 2	Output 3	Output 4		Power supply AC	Power supply DC	
175	8	3	5 V/25 A	3.3 V/20 A	12 V/5 A	–12 V/0.5 A	30 A max.	**3688.534**	**3688.537**	481
200	8	3	5 V/30 A	3.3 V/25 A	12 V/5 A	–12 V/0.5 A	38 A max.	**3688.694**	**3688.655**	481
250	8	3	5 V/33 A	3.3 V/33 A	12 V/6 A	–12 V/1.5 A	38 A max.	**3688.695**	**3688.696**	481
350	8	6	5 V/40 A	3.3 V/40 A	12 V/9 A	–12 V/1 A	80 A max.	**3688.528**	**3688.530**	481

CPCI open frame power supply

Watts	Dimensions in mm			Model No. RP	Page
	Height	Width	Depth		
400	126	63	279	**3687.695**	482

CPCI power supply, plug-in

Watts	Height (U)	Width (HP)	Model No. RP		Page
			Power supply	Front panel for power supply	
180	3	12	**3686.682**	**3685.330**	482

3.4 Power supplies

AT/ATX power supply

Version	Watts	PFC	Packs of	Model No. RP	Page
ATX power supply for external switch					
ATX	300	passive	1	**3687.793**	483
AT/ATX power supply					
AT	300	passive	1	**3688.118**	483
AT for RAID	300	passive	1	**3688.119**	483
ATX	300	passive	1	**3688.121**	483
ATX	250	active	1	**3688.127**	483
ATX	300	active	1	**3688.129**	483
ATX	400	active	1	**3688.128**	483
ATX power supply unit 1 U					
ATX	200	active	1	**3688.130**	484

Front panel for ATX power supply

U	HP	Model No. RP		Page
		EMC	Non-EMC	
3	42	**3685.331**	**3685.328**	483
6	21	**3685.332**	**3685.329**	483

Redundant power supply

Version	Watts	PFC	Packs of	Model No. RP	Page
for RAID					
RAID version	2 x 300	active	1	**3688.125**	484
Power pack module (spare)			1	**3688.126**	484
for ATX					
ATX version (1 connector)	2 x 300	active	1	**3688.123**	484
Power pack module (spare)			1	**3688.124**	484
ATX version (2 connector)	2 x 300	active	1	**3688.120**	485
Power pack module (spare)			1	**3688.122**	485

Uninterruptible power supply

Power	Input/output voltage	Input frequency	Output frequency	Model No. RP	Page
300 VA/180 W	220, 230, 240 V AC ±15 %	50 Hz ±5 %	50 Hz ±1 %	**3659.080**	482

3.5 Subrack

Ripac ECO 3 U, 6 U, sheet steel

Side panel depth mm	Maximum board depth mm	Model No. RP		Page
		3 U	6 U	
175	160	**3688.114**	**3688.116**	488
235	220	**3688.115**	**3688.117**	488

3.5 Subrack

Ripac Vario

3 U, 6 U, 9 U

Side panel depth mm	Max. card depth mm	Model No. RP						Page
		3 U		6 U		9 U		
		For backplane	For connector IEC 60 603-2	For backplane	For connector IEC 60 603-2	For backplane	For connector IEC 60 603-2	
185	160	**3684.020**	**3684.034**	**3684.043**	**3684.056**	–	–	489
225	160	**3684.021**	**3684.035**	**3684.044**	**3684.057**	–	–	489
245	220	**3684.022**	**3684.036**	**3684.045**	**3684.058**	–	–	489
285	220	**3684.023**	**3685.281**	**3684.046**	–	–	–	489
305	280	**3685.231**	**3685.233**	**3685.238**	**3685.240**	–	–	489
345	280	**3684.024**	–	**3684.047**	–	**3684.051**	**3684.059**	489
365	340	**3685.232**	**3685.234**	**3685.239**	–	–	–	489
405	340	**3684.025**	–	**3684.048**	–	**3684.052**	**3684.060**	489
465	400	**3684.026**	–	**3684.049**	–	**3684.053**	**3684.061**	489
525	400	**3684.027**	–	**3684.050**	–	**3684.054**	–	489
585	400	–	–	–	–	**3684.055**	–	489

4 U, 7 U

Side panel depth mm	Max. card depth mm	Model No. RP						Page
		4 U (3 + 1)		4 U (3 + 2 x 1/2)		7 U (6 + 1)	7 U (6 + 2 x 1/2)	
		For backplane	For connector IEC 60 603-2	For backplane	For connector IEC 60 603-2	For backplane	For backplane	
245	220	**3685.235**	–	–	–	–	–	490
285	220	**3684.028**	**3684.037**	**3684.031**	**3684.040**	–	–	490
305	280	**3685.236**	–	–	–	–	–	490
345	280	**3684.029**	**3684.038**	**3684.032**	**3684.041**	–	–	490
365	340	**3685.237**	–	–	–	–	–	490
405	340	**3684.030**	**3684.039**	**3684.033**	**3684.042**	**3684.064**	**3684.062**	490
465	400	–	–	–	–	**3684.065**	**3684.063**	490

Ripac Vario EMC

3 U, 6 U, 9 U

Side panel depth mm	Max. card depth mm	Model No. RP						Page
		3 U		6 U		9 U		
		For backplane	For backplane[1)]	For backplane	For backplane[1)]	For backplane	For backplane[1)]	
245	160	**3684.128**	**3684.142**	**3684.156**	**3684.169**	–	–	491
285	220	**3684.129**	**3684.143**	**3684.157**	**3684.170**	–	–	491
305	220	**3685.241**	**3685.243**	**3685.242**	**3685.244**	–	–	491
345	280	**3684.130**	**3684.144**	**3684.158**	**3684.171**	**3684.162**	**3684.175**	491
405	340	**3684.131**	**3684.145**	**3684.159**	**3684.172**	**3684.163**	**3684.176**	491
465	400	**3684.132**	**3684.146**	**3684.160**	**3684.173**	**3684.164**	**3684.177**	491
525	400	**3684.133**	**3684.147**	**3684.161**	**3684.174**	**3684.165**	**3684.178**	491
585	400	–	–	–	–	**3684.166**	**3684.179**	491

4 U

Side panel depth mm	Max. card depth mm	Model No. RP				Page
		4 U (3 + 1)		4 U (3 + 2 x 1/2)		
		For backplane	For backplane[1)]	For backplane	For backplane[1)]	
285	220	**3684.134**	**3684.148**	**3684.137**	**3684.151**	492
345	280	**3684.135**	**3684.149**	**3684.138**	**3684.152**	492
405	340	**3684.136**	**3684.150**	**3684.139**	**3684.153**	492

7 U

Side panel depth mm	Max. card depth mm	Model No. RP				Page
		7 U (6 + 1)		7 U (6 + 2 x 1/2)		
		For backplane	For backplane[1)]	For backplane	For backplane[1)]	
285	220	**3684.187**	**3684.192**	–	–	492
345	280	**3684.188**	**3684.193**	**3684.189**	**3684.196**	492
405	340	**3684.180**	**3684.194**	**3684.190**	**3684.197**	492
465	400	**3684.181**	**3684.195**	**3684.191**	**3684.198**	492

[1)] Front horizontal rails with 10 mm extension for injector/extractor handles.

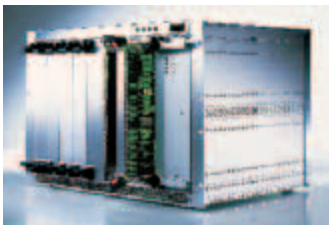
3.5 Subrack

Ripac Compact 3 U, 6 U

Side panel depth mm	Max. PCB depth mm	Model No. RP					Page
		3 U				6 U	
		21 HP		42 HP		42 HP	
		Top hat rail	Mounting plate	Top hat rail	Mounting plate	Mounting plate	
For backplane							
225	160	**3687.667**	**3687.669**	**3687.671**	**3687.673**	**3687.680**	493
285	220	**3687.668**	**3687.670**	**3687.672**	**3687.674**	**3687.681**	493
For backplane – EMC version							
225	160	**3687.682**	**3687.684**	**3687.686**	**3687.688**	**3687.690**	493
285	220	**3687.683**	**3687.685**	**3687.687**	**3687.689**	**3687.691**	493

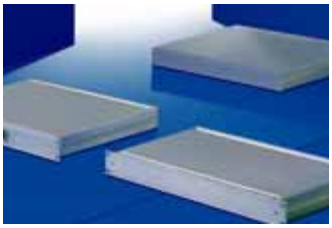
Ripac Vario Mobil 3 U, 6 U, for mobile use

Side panel depth mm	Max. card depth mm	Model No. RP						Page
		3 U			6 U			
		For backplane	For connector IEC 60 603-2	For backplane – EMC Version	For backplane	For connector IEC 60 603-2	For backplane – EMC Version	
245	220	**3687.782**	**3687.780**	**3687.784**	**3687.783**	**3687.781**	**3687.785**	494



Accessories for subracks

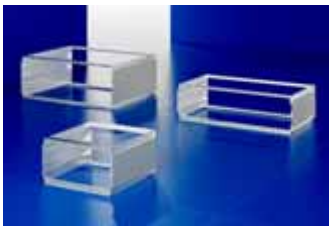
	Page
Subracks, individual components	
Side panels and flanges	495 – 497
Horizontal rails	498 – 505
Subrack, climate control	519 – 524
Subrack, accessories	
Components for EMC installation	506 – 507
Internal mounting kits	508 – 509
Guide rails	509 – 513
Keying/card ejectors	514
Top and bottom covers	515 – 518
Front panels, handles	525 – 540
Ripac box-type plug-in units – Type I	541
Ripac box type plug-in units – individual components	542 – 543
Ripac box-type plug-in units for drives	544
Ripac box-type plug-in units, covers and guides	545
Connectors	546 – 551
Assembly parts	576 – 577



3.6 Instrument cases/system enclosures

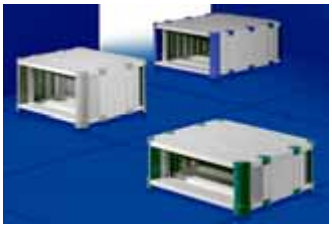
RiBox system enclosures 1 U

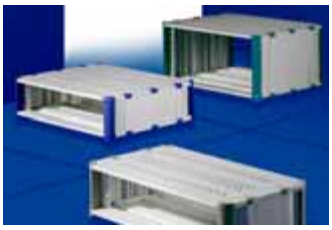
Dimensions in mm		Model No. RP	Page
Width	Depth		
Rack-mounted			
19″ (482.6)	150	**3687.814**	554
19″ (482.6)	200	**3687.815**	554
19″ (482.6)	250	**3687.816**	554
19″ (482.6)	300	**3687.817**	554
19″ (482.6)	350	**3687.818**	554
Rack mount including assembly kit for double Euroboards			
19″ (482.6)	250	**3684.072**	554
19″ (482.6)	350	**3684.073**	554
Instrument cases			
447	150	**3687.819**	554
447	200	**3687.820**	554
447	250	**3687.821**	554
447	300	**3687.822**	554
447	350	**3687.823**	554



Ripac Vario-Module, system enclosures

U	Installation width (HP)	Depth mm	Packs of	Model No. VM			
				Basic enclosure	Page	EMC basic enclosure	Page
3	42	250.4	1	**3982.040**	555	**3983.040**	556
3	42	310.4	1	**3982.070**	555	**3983.070**	556
3	63	250.4	1	**3982.050**	555	**3983.050**	556
3	63	310.4	1	**3982.080**	555	**3983.080**	556
3	84	250.4	1	**3982.060**	555	**3983.060**	556
3	84	310.4	1	**3982.090**	555	**3983.090**	556
3	84	370.4	1	**3982.100**	555	**3983.100**	556
4 (3 + 1)	84	250.4	1	**3982.110**	555	**3983.110**	556
4 (3 + 1)	84	310.4	1	**3982.120**	555	**3983.120**	556
4 (3 + 1)	84	370.4	1	**3982.130**	555	**3983.130**	556
6	84	310.4	1	**3982.140**	557	**3983.140**	558
6	84	370.4	1	**3982.150**	557	**3983.150**	558
6	84	430.4	1	**3982.160**	557	**3983.160**	558
7 (6 + 1)	84	310.4	1	**3982.170**	557	**3983.170**	558
7 (6 + 1)	84	430.4	1	**3982.190**	557	**3983.190**	558



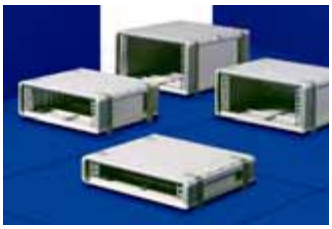


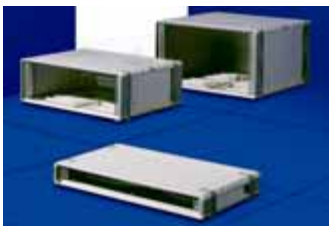
3.6 Instrument cases/system enclosures

Rittal RiCase, instrument case

U	Depth mm		Model No. RC						Page
	Vented	Unvented	Vented RAL 5018[1]	Unvented RAL 5018[1]	Vented RAL 5012[1]	Unvented RAL 5012[1]	Vented RAL 7030	Unvented RAL 7030	
Rittal RiCase 269.2 mm (1/2 19″)									
1	420	300	**3750.110**	**3750.100**	**3750.112**	**3750.102**	**3750.114**	**3750.104**	562
2	540	300	**3750.220**	**3750.200**	**3750.222**	**3750.202**	**3750.224**	**3750.204**	562
3	420	300	**3750.350**	**3750.210**	**3750.352**	**3750.212**	**3750.354**	**3750.214**	562
3	540	420	**3750.360**	**3750.300**	**3750.362**	**3750.302**	**3750.364**	**3750.304**	562
4	540	420	**3750.450**	**3750.400**	**3750.452**	**3750.402**	**3750.454**	**3750.404**	562
Rittal RiCase 482.6 mm (19″)									
3	300	300	**3750.330**	**3750.310**	**3750.332**	**3750.312**	**3750.334**	**3750.314**	563
3	420	420	**3750.340**	**3750.320**	**3750.342**	**3750.322**	**3750.344**	**3750.324**	563
4	300	300	**3750.430**	**3750.410**	**3750.432**	**3750.412**	**3750.434**	**3750.414**	563
4	420	420	**3750.440**	**3750.420**	**3750.442**	**3750.422**	**3750.444**	**3750.424**	563
6	300	300	**3750.630**	**3750.600**	**3750.632**	**3750.602**	**3750.634**	**3750.604**	563
6	420	420	**3750.640**	**3750.610**	**3750.642**	**3750.612**	**3750.644**	**3750.614**	563
6	540	540	**3750.650**	**3750.620**	**3750.652**	**3750.622**	**3750.654**	**3750.624**	563
7	420	420	**3750.720**	**3750.700**	**3750.722**	**3750.702**	**3750.724**	**3750.704**	563
7	540	540	**3750.730**	**3750.710**	**3750.732**	**3750.712**	**3750.734**	**3750.714**	563
9	420	420	**3750.920**	**3750.900**	**3750.922**	**3750.902**	**3750.924**	**3750.904**	563
9	540	540	**3750.930**	**3750.910**	**3750.932**	**3750.912**	**3750.934**	**3750.914**	563
12	540	540	**3750.030**	**3750.000**	**3750.032**	**3750.002**	**3750.034**	**3750.0004**	563

[1] Extended delivery times.
Packs of 1





Rittal Vario-Case iS, instrument case

U	Depth	Packs of	Model No. VC		Page
			without vent slots	with vent slots	
Rittal Vario-Case iS, 269.2 mm (1/2 19″)					
1	300	1	**3710.000**	–	569
2	300	1	**3720.000**	–	569
3	300	1	**3730.000**	–	569
3	400	1	**3731.000**	–	569
4	300	1	**3740.000**	–	569
4	400	1	**3741.000**	–	569
Rittal Vario-Case iS, 482.6 mm (19″)					
1	300	1	**3713.000[1]**	**3713.200[1]**	570
1	400	1	**3714.000**	**3714.200**	570
4	300	1	**3743.000[2]**	**3743.200**	570
4	400	1	**3744.000**	**3744.200**	570
4	500	1	**3745.000[1]**	**3745.200[1]**	570
7	400	1	**3774.000[2]**	**3774.200**	570
7	500	1	**3775.000**	**3775.200**	570
3	300	1	**3733.000[2]**	**3733.200**	571
3	400	1	**3734.000[2]**	**3734.200**	571
3	500	1	**3735.000**	**3735.200**	571
6	300	1	**3763.000**	**3763.200**	571
6	400	1	**3764.000[2]**	**3764.200**	571
6	500	1	**3765.000[2]**	**3765.200**	571
9	400	1	**3794.000**	**3794.200**	571
9	500	1	**3795.000[2]**	**3795.200**	571

[1] Extended delivery times.
[2] To order EMC version, please add extension .700 to the Model No.

System climate control creates the correct ambient conditions for every application, particularly for sensitive electronics.
A broad selection of cooling units, recooling systems, heat exchangers, fan-and-filter units and enclosure heaters protects against adverse physical and thermal influences.
This is supplemented by a versatile range of accessory components.

With a full advisory service and its PC software package Rittal Therm, Rittal will help you to select the correct climate control unit to suit your precise requirements.

Enhanced operational reliability and a longer service life for electronics

- Climate controlled enclosure systems
- Cooling units
- Recooling systems
- Heat exchangers
- Fan-and-filter units
- Roof-mounted fans
- Rack-mounted climate control
- Enclosure heaters
- Cooling

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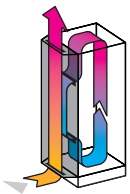
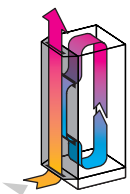
The current status of approvals may be found on our website: www.rittal.com



4.1 Climate controlled enclosures

Useful cooling output	Dimensions W x H x D mm	Voltage V, Hz	Model No. SK	Approvals UL	CUL	DIN	GS	Page
1100 W	600 x 1800 x 600	230, 50/60	**8687.100**	■	■		■	582
	600 x 2000 x 600		**8607.100**	■	■		■	582
	600 x 1800 x 600	400, 2~, 50/60	**8687.840**	■	■		■	582
	600 x 2000 x 600		**8607.840**	■	■		■	582
1500 W	800 x 1800 x 600	230, 50/60	**8887.150**	■	■	■	■	582
	800 x 2000 x 600		**8807.100**	■	■	■	■	582
	800 x 1800 x 600	400, 2~, 50/60	**8887.140**	■	■	■	■	582
	800 x 2000 x 600		**8807.140**	■	■	■	■	582
2000 W	1200 x 1800 x 600	230, 50/60	**8287.170**	■	■			583
			8807.180	■	■			583
	1200 x 2000 x 600		**8207.170**	■	■			583
			8207.180	■	■			583
2500 W	1200 x 1800 x 600	400, 3~, 50/60	**8807.260**					583
	1200 x 2000 x 600		**8807.250**					583

Delivery times available on request.

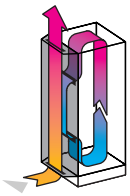


4.1 Climate control doors

for single-door TS 8 enclosures with thermostat

Useful cooling output	For enclosure dimensions W x H mm	Voltage V, Hz	Model No. SK	Approvals UL	CUL	DIN	GS	Page
1100 W	600 x 1800	230, 50/60	**3306.880**[1)]	■	■		■	584
	600 x 2000		**3306.800**[1)]	■	■		■	584
	600 x 1800	400, 2~, 50/60	**3306.884**[1)]	■	■		■	584
	600 x 2000		**3306.840**[1)]	■	■		■	584
1500 W	600 x 1800	230, 50/60	**3307.880**[1)]					584
	600 x 2000		**3307.800**[1)]					584
	600 x 1800	400, 2~, 50/60	**3307.890**[1)]					584
	600 x 2000		**3307.840**					584
	800 x 1800	230, 50/60	**3308.880**[1)]	■	■	■	■	585
	800 x 2000		**3308.800**[1)]	■	■	■	■	585
	800 x 1800	400, 2~, 50/60	**3308.884**[1)]	■	■	■	■	585
	800 x 2000		**3308.840**[1)]	■	■	■	■	585
2000 W	600 x 1800	230, 50/60	**3309.880**[1)]	■	■			586
	600 x 2000		**3309.800**	■	■			586
	600 x 1800	400, 2~, 50/60	**3309.884**[1)]	■	■			586
	600 x 2000		**3309.840**[1)]	■	■			586
2500 W	600 x 1800	400, 3~, 50/60	**3310.880**[1)]					586
	600 x 2000		**3310.800**					586

[1)] Delivery times available on request.

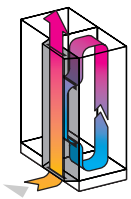


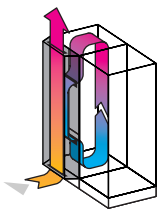
4.1 Climate control doors

for single-door TS 8 enclosures with microcontroller

Useful cooling output	For enclosure dimensions W x H mm	Voltage V, Hz	Model No. SK	Approvals				Page
				UL	CUL	DIN	GS	
1100 W	600 x 1800	230, 50/60	**3306.580**[1)]	■	■			584
	600 x 2000		**3306.500**[1)]	■	■			584
	600 x 1800	400, 2~, 50/60	**3306.590**[1)]	■	■			584
	600 x 2000		**3306.540**[1)]	■	■			584
1500 W	600 x 1800	230, 50/60	**3307.580**[1)]					584
	600 x 2000		**3307.500**[1)]					584
	600 x 1800	400, 2~, 50/60	**3307.590**[1)]					584
	600 x 2000		**3307.540**[1)]					584
	800 x 1800	230, 50/60	**3308.580**[1)]	■	■			585
	800 x 2000		**3308.500**	■	■			585
	800 x 1800	400, 2~, 50/60	**3308.590**[1)]	■	■			585
	800 x 2000		**3308.540**	■	■			585
2000 W	600 x 1800	230, 50/60	**3309.580**[1)]	■	■			586
	600 x 2000		**3309.500**	■	■			586
	600 x 1800	400, 2~, 50/60	**3309.590**[1)]					586
	600 x 2000		**3309.540**					586
2500 W	600 x 1800	400, 3~, 50/60	**3310.580**[1)]					586
	600 x 2000		**3310.500**[1)]					586

[1)] Delivery times available on request.





for two-door TS 8 enclosures

Useful cooling output	For enclosure dimensions W x H mm	Voltage V, Hz	Device position	Model No. SK		Approvals				Page
				with thermostat	with micro-controller	UL	CUL	DIN	GS	
1100 W	1200 x 1800	230, 50/60	right	**3306.250**	**3306.550**	■	■			587
		400, 2~, 50/60		**3306.450**	**3306.650**	■	■			587
	1200 x 2000	230, 50/60		**3306.210**	**3306.510**	■	■			587
		400, 2~, 50/60		**3306.410**	**3306.610**	■	■			587
	1200 x 1800	230, 50/60	left	**3306.270**	**3306.570**	■	■			587
		400, 2~, 50/60		**3306.470**	**3306.670**	■	■			587
	1200 x 2000	230, 50/60		**3306.230**	**3306.530**	■	■			587
		400, 2~, 50/60		**3306.430**	**3306.630**	■	■			587
1500 W	1200 x 1800	230, 50/60	right	**3307.250**	**3307.550**					587
		400, 2~, 50/60		**3307.450**	**3307.650**					587
	1200 x 2000	230, 50/60		**3307.210**	**3307.510**					587
		400, 2~, 50/60		**3307.410**	**3307.610**					587
	1200 x 1800	230, 50/60	left	**3307.270**	**3307.570**					587
		400, 2~, 50/60		**3307.470**	**3307.670**					587
	1200 x 2000	230, 50/60		**3307.230**	**3307.530**					587
		400, 2~, 50/60		**3307.430**	**3307.630**					587
2000 W	1200 x 1800	230, 50/60	right	**3309.170**	**3309.570**	■	■			588
		400, 2~, 50/60		**3309.470**	**3309.670**					588
	1200 x 2000	230, 50/60		**3309.120**	**3309.520**	■	■			588
		400, 2~, 50/60		**3309.420**	**3309.620**					588
	1200 x 1800	230, 50/60	left	**3309.210**	**3309.510**	■	■			588
		400, 2~, 50/60		**3309.410**	**3309.610**					588
	1200 x 2000	230, 50/60		**3309.140**	**3309.530**	■	■			588
		400, 2~, 50/60		**3309.440**	**3309.640**					588
2500 W	1200 x 1800	400, 3~, 50/60	right	**3310.250**	**3310.650**					588
	1200 x 2000			**3310.230**	**3310.630**					588
	1200 x 1800	400, 3~, 50/60	left	**3310.150**	**3310.550**					588
	1200 x 2000			**3310.130**	**3310.530**					588

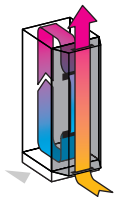
Delivery times available on request.

4.1 Climate control side panels

for TS 8 enclosures

Useful cooling output	For enclosure dimensions W x H mm	Voltage V, Hz	Model No. SK	Approvals				Page
				UL	CUL	DIN	GS	
1100 W	1800 x 600	230, 50/60	**3331.116**					589
	2000 x 600		**3331.316**					589
	1800 x 600	400, 2~, 50/60	**3331.140**[1)]					589
	2000 x 600		**3331.340**[1)]					589
1400 W	1800 x 600	230, 50/60	**3331.216**[1)]					589
	2000 x 600		**3331.416**					589
	1800 x 600	400, 2~, 50/60	**3331.240**[1)]					589
	2000 x 600		**3331.440**[1)]					589

[1)] Delivery times available on request.



4.1 TopTherm roof-mounted cooling units

Useful cooling output	For enclosure dimensions W x H x D mm	Voltage V, Hz	Model No. SK		Approvals				Page
			with Basic controller	with Comfort controller	UL	CUL	DIN	GS	
500 W	597 x 415 x 375	230, 50/60	**3382.100**	**3382.500**	■	■			590
		115, 50/60	**3382.110**	**3382.510**	■	■			590
750 W	597 x 415 x 375	230, 50/60	**3359.100**	**3359.500**	■	■			590
		115, 50/60	**3359.110**	**3359.510**	■	■			590
		400, 2~, 50/60	**3359.140**	**3359.540**	■	■			590
1000 W	597 x 415 x 475	230, 50/60	**3383.100**	**3383.500**	■	■			591
		115, 50/60	**3383.110**	**3383.510**	■	■			591
		400, 2~, 50/60	**3383.140**	**3383.540**	■	■			591
1500 W	597 x 415 x 475	230, 50/60	**3384.100**	**3384.500**	■	■			593
		115, 50/60	**3384.110**	**3384.510**	■	■			593
		400, 2~, 50/60	**3384.140**	**3384.540**	■	■			593
2000 W	597 x 415 x 475	230, 50/60	**3385.100**	**3385.500**	■	■			593
		115, 50/60	**3385.110**	**3385.510**	■	■			593
		400, 2~, 50/60	**3385.140**	**3385.540**	■	■			593
3000 W	796 x 470 x 580	400, 3~, 50 460, 3~, 60	**3386.140**	**3386.540**	■	■			594
4000 W	796 x 470 x 580	400, 3~, 50 460, 3~, 60	**3387.140**	**3387.540**	■	■			594

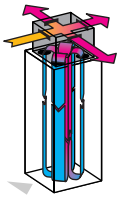
Roof-mounted cooling units in stainless steel version, see page 69.

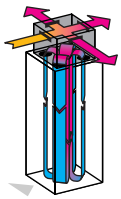
4.1 TopTherm roof-mounted cooling units

for the office sector

Useful cooling output	Dimensions W x H x D mm	Voltage V, Hz	Model No. SK	Approvals				Page
				UL	CUL	DIN	GS	
1100 W	597 x 415 x 510	115, 50/60	**3273.515**[1)]					592
		230, 50/60	**3273.500**					592

[1)] Delivery times available on request.



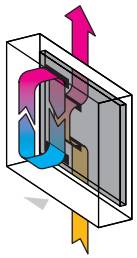


4.1 TopTherm roof-mounted cooling units

Stainless steel

Useful cooling output	Dimensions W x H x D mm	Voltage V, Hz	Model No. SK		Approvals				Page
			with Basic controller	with Comfort controller	UL	CUL	DIN	GS	
500 W	597 x 415 x 375	230, 50/60	**3382.200**	**3382.600**	■	■			590
		115, 50/60	**3382.210**	**3382.610**	■	■			590
750 W	597 x 415 x 375	230, 50/60	**3359.200**	**3359.600**					590
		115, 50/60	**3359.210**	**3359.610**					590
		400, 2~, 50/60	**3359.240**	**3359.640**					590
1000 W	597 x 415 x 475	230, 50/60	**3383.200**	**3383.600**	■	■			591
		115, 50/60	**3383.210**	**3383.610**	■	■			591
		400, 2~, 50/60	**3383.240**	**3383.640**	■	■			591
1500 W	597 x 415 x 475	230, 50/60	**3384.200**	**3384.600**	■	■			593
		115, 50/60	**3384.210**	**3384.610**	■	■			593
		400, 2~, 50/60	**3384.240**	**3384.640**	■	■			593
2000 W	597 x 415 x 475	230, 50/60	**3385.200**	**3385.600**	■	■			593
		115, 50/60	**3385.210**	**3385.610**	■	■			593
		400, 2~, 50/60	**3385.240**	**3385.640**	■	■			593
3000 W	796 x 470 x 580	400, 3~, 50 460, 3~, 60	**3386.240**	**3386.640**	■	■			594
4000 W	796 x 470 x 580	400, 3~, 50 460, 3~, 60	**3387.240**	**3387.640**	■	■			594

Delivery times available on request.



4.1 Wall-mounted cooling units

VIP small cooling units

Useful cooling output	Dimensions W x H x D mm	Voltage V, Hz	Condenser design	Model No. SK	Approvals				Page
					UL	CUL	DIN	GS	
225 W	526 x 353.5 x 105	230, 50/60	left	**3201.100**	■	■			595
			right	**3202.100**	■	■			595

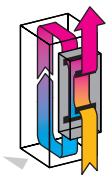
4.1 TopTherm wall-mounted cooling units

Mini cooling unit, in horizontal format

Useful cooling output	Dimensions W x H x D mm	Voltage V, Hz	Model No. SK	Approvals				Page
				UL	CUL	DIN	GS	
300 W	525 x 340 x 153	230, 50/60	**3302.300**			■		596
		115, 60	**3302.310**			■		596

4.1 TopTherm wall-mounted cooling units

Useful cooling output	Dimensions W x H x D mm	Voltage V, Hz	Model No. SK		Approvals				Page
			with Basic controller	with Comfort controller	UL	CUL	DIN	GS	
300 W	280 x 550 x 140	230, 50/60	**3302.100**	–	■	■			597
		115, 60	**3302.110**	–	■	■			597
500 W	280 x 550 x 200	230, 50/60	**3303.100**	**3303.500**	■	■			597
		115, 60	**3303.110**	**3303.510**	■	■			597
750 W	280 x 550 x 280	230, 50/60	**3361.100**	**3361.500**					598
		115, 60	**3361.110**	**3361.510**					598
		400, 2~, 50/60	**3361.140**	**3361.540**					598
1000 W	400 x 950 x 260	230, 50/60	**3304.100**	**3304.500**	■	■			599
		115, 50/60	**3304.110**	**3304.510**	■	■			599
		400, 3~, 50 460, 3~, 60	**3304.140**	**3304.540**	■	■			599
1500 W	400 x 950 x 260	230, 50/60	**3305.100**	**3305.500**	■	■			599
		115, 50/60	**3305.110**	**3305.510**	■	■			599
		400, 3~, 50 460, 3~, 60	**3305.140**	**3305.540**	■	■			599
2000 W	400 x 1580 x 290	230, 50/60	**3328.100**	**3328.500**	■	■			600
		115, 50/60	**3328.110**	**3328.510**	■	■			600
		400, 3~, 50 460, 3~, 60	**3328.140**	**3328.540**	■	■			600
2500 W	400 x 1580 x 290	230, 50/60	**3329.100**	**3329.500**	■	■			600
		115, 50/60	**3329.110**	**3329.510**	■	■			600
		400, 3~, 50 460, 3~, 60	**3329.140**	**3329.540**	■	■			600
4000 W	500 x 1580 x 340	400, 3~, 50 460, 3~, 60	**3332.140**	**3332.540**	■	■			601



Stainless steel

Useful cooling output	Dimensions W x H x D mm	Voltage V, Hz	Model No. SK		Approvals				Page
			with Basic controller	with Comfort controller	UL	CUL	DIN	GS	
300 W	280 x 550 x 140	230, 50/60	**3302.200**	–	■	■			597
		115, 60	**3302.210**	–	■	■			597
500 W	280 x 550 x 200	230, 50/60	**3303.200**	**3303.600**	■	■			597
		115, 60	**3303.210**	**3303.610**	■	■			597
750 W	280 x 550 x 280	230, 50/60	**3361.200**	**3361.600**					598
		115, 60	**3361.210**	**3361.610**					598
		400, 2~, 50/60	**3361.240**	**3361.640**					598
1000 W	400 x 950 x 260	230, 50/60	**3304.200**	**3304.600**	■	■			599
		115, 50/60	**3304.210**	**3304.610**	■	■			599
		400, 3~, 50 460, 3~, 60	**3304.240**	**3304.640**	■	■			599
1500 W	400 x 950 x 260	230, 50/60	**3305.200**	**3305.600**	■	■			599
		115, 50/60	**3305.210**	**3305.610**	■	■			599
		400, 3~, 50 460, 3~, 60	**3305.240**	**3305.640**	■	■			599
2000 W	400 x 1580 x 290	230, 50/60	**3328.200**	**3328.600**	■	■			600
		115, 50/60	**3328.210**	**3328.610**	■	■			600
		400, 3~, 50 460, 3~, 60	**3328.240**	**3328.640**	■	■			600
2500 W	400 x 1580 x 290	230, 50/60	**3329.200**	**3329.600**	■	■			600
		115, 50/60	**3329.210**	**3329.610**	■	■			600
		400, 3~, 50 460, 3~, 60	**3329.240**	**3329.640**	■	■			600
4000 W	500 x 1580 x 340	400, 3~, 50 460, 3~, 60	**3332.240**	**3332.640**	■	■			601

Delivery times available on request.

4.1 TopTherm wall-mounted cooling units

Slimline

Useful cooling output	Dimensions W x H x D mm	Voltage V, Hz	Model No. SK		Approvals				Page
			with Basic controller	with Comfort controller	UL	CUL	DIN	GS	
1500 W	450 x 1580 x 165	230, 50/60	**3377.100**[1)]	**3377.500**[1)]					602
		115, 50/60	**3377.110**[1)]	**3377.510**[1)]					602
		400/460, 3~, 50/60	**3377.140**[1)]	**3377.540**[1)]					602
1500 W	450 x 1580 x 195	230, 50/60	**3366.100**	**3366.500**					602
		115, 50/60	**3366.110**	**3366.510**					602
		400/460, 3~, 50/60	**3366.140**	**3366.540**					602

[1)] Delivery times available on request.

Slimline, stainless steel

Useful cooling output	Dimensions W x H x D mm	Voltage V, Hz	Model No. SK		Approvals				Page
			with Basic controller	with Comfort controller	UL	CUL	DIN	GS	
1500 W	450 x 1580 x 165	230, 50/60	**3377.200**	**3377.600**					602
		115, 50/60	**3377.210**	**3377.610**					602
		400/460, 3~, 50/60	**3377.240**	**3377.640**					602
1500 W	450 x 1580 x 195	230, 50/60	**3366.200**	**3366.600**					602
		115, 50/60	**3366.210**	**3366.610**					602
		400/460, 3~, 50/60	**3366.240**	**3366.640**					602

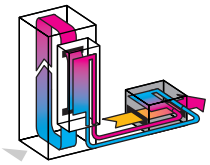
Delivery times available on request.

4.1 TopTherm wall-mounted cooling units

NEMA 4x version

Useful cooling output	Dimensions W x H x D mm	Voltage V, Hz	Model No. SK		Approvals				Page
			with Basic controller	with Comfort controller	UL	CUL	DIN	GS	
500 W	280 x 550 x 200	230, 50/60	**3303.104**	**3303.504**	■	■			603
		115, 50/60	**3303.114**	**3303.514**	■	■			603
1000 W	400 x 950 x 260	230, 50/60	**3304.104**	**3304.504**	■	■			603
		115, 50/60	**3304.114**	**3304.514**	■	■			603
		400, 3~, 50 460, 3~, 60	**3304.144**	**3304.544**	■	■			603
1500 W	400 x 950 x 260	230, 50/60	**3305.104**	**3305.504**	■	■			603
		115, 50/60	**3305.114**	**3305.514**	■	■			603
		400, 3~, 50 460, 3~, 60	**3305.144**	**3305.544**	■	■			603
2000 W	400 x 1580 x 290	230, 50/60	**3328.104**	**3328.504**	■	■			604
		115, 50/60	**3328.114**	**3328.514**	■	■			604
		400, 3~, 50 460, 3~, 60	**3328.144**	**3328.544**	■	■			604
2500 W	400 x 1580 x 290	230, 50/60	**3329.104**	**3329.504**	■	■			604
		115, 50/60	**3329.114**	**3329.514**	■	■			604
		400, 3~, 50 460, 3~, 60	**3329.144**	**3329.544**	■	■			604

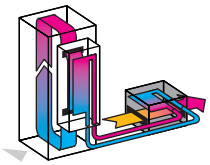
Delivery times available on request.



4.2 Recooling systems

Mini

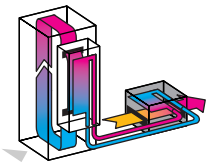
Cooling output	Dimensions W x H x D mm	Voltage V, Hz	Model No. SK		Approvals				Page
			Roof mounting	Wall mounting	UL	CUL	DIN	GS	
1000 W	400 x 950 x 310	400, 3~, 50/60/ 460, 3~, 60	–	**3360.100**					610
2500 W	400 x 1580 x 290	400, 3~, 50/60/ 460, 3~, 60	–	**3360.250**					610
4000 W	500 x 1580 x 340	400, 3~, 50/60/ 460, 3~, 60	–	**3360.400**					610
960 W	600 x 400 x 430	230, 50/60	**3318.600**	–					608
			3318.610	–					608
1490 W	600 x 400 x 430	230, 50/60	**3319.600**	–					608
			3319.610	–					608
3000 W	600 x 680 x 625	400, 3~, 50/60/ 460, 3~, 60	**3320.600**	–					609
4500 W	600 x 680 x 625	400, 3~, 50/60/ 460, 3~, 60	**3334.600**	–					609



In a floor standing enclosure

Cooling output	Dimensions W x H x D mm	Voltage V, Hz	Model No. SK	Approvals				Page
				UL	CUL	DIN	GS	
2100 W	470 x 725 x 540	400, 3~, 50	**3336.100**					611
2580 W	485 x 965 x 650	400, 3~, 50	**3336.200**					611
3360 W	485 x 965 x 650	400, 3~, 50	**3336.300**					611
5040 W	595 x 1180 x 800	400, 3~, 50	**3336.500**					611
6160 W	595 x 1180 x 800	400, 3~, 50	**3336.600**					611
7700 W	595 x 1180 x 800	400, 3~, 50	**3336.650**					611
10000 W	615 x 1178 x 1160	400, 3~, 50 460, 3~, 60	**3336.700**					612
14350 W	615 x 1178 x 1160	400, 3~, 50 460, 3~, 60	**3336.710**					612
16300 W	615 x 1178 x 1160	400, 3~, 50 460, 3~, 60	**3336.720**					612
18500 W	715 x 1178 x 1360	400, 3~, 50 460, 3~, 60	**3336.730**					612
20900 W	715 x 1178 x 1360	400, 3~, 50 460, 3~, 60	**3336.740**					612
25200 W	715 x 1178 x 1360	400, 3~, 50 460, 3~, 60	**3336.750**					612

Delivery times available on request.

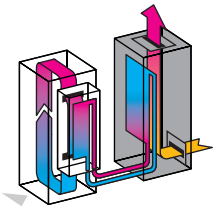


4.2 Recooling systems

In a floor standing enclosure for oil

Cooling output	Dimensions W x H x D mm	Voltage V, Hz	Model No. SK	Approvals				Page
				UL	CUL	DIN	GS	
2550 W	485 x 965 x 650	400, 3~, 50	**3337.200**					613
3400 W	485 x 965 x 650	400, 3~, 50	**3337.300**					613
5150 W	595 x 1180 x 800	400, 3~, 50	**3337.500**					613
6700 W	595 x 1180 x 800	400, 3~, 50	**3337.600**					613
7900 W	595 x 1180 x 800	400, 3~, 50	**3337.650**					613
10600 W	615 x 1178 x 1160	400, 3~, 50 460, 3~, 60	**3337.700**					614
15150 W	615 x 1178 x 1160	400, 3~, 50 460, 3~, 60	**3337.710**					614
17200 W	615 x 1178 x 1160	400, 3~, 50 460, 3~, 60	**3337.720**					614
19250 W	715 x 1178 x 1360	400, 3~, 50 460, 3~, 60	**3337.730**					614
21600 W	715 x 1178 x 1360	400, 3~, 50 460, 3~, 60	**3337.740**					614
26100 W	715 x 1178 x 1360	400, 3~, 50 460, 3~, 60	**3337.750**					614

Delivery times available on request.



In the TS 8 Top enclosure system

Cooling output	Dimensions W x H x D mm	Voltage V, Hz	Model No. SK	Approvals				Page
				UL	CUL	DIN	GS	
6000 W	600 x 2000 x 600	400, 3~, 50	**3335.060**					615
7500 W	600 x 2000 x 600	400, 3~, 50	**3335.075**					615
10000 W	800 x 2000 x 600	400, 3~, 50	**3335.100**					616
12000 W	800 x 2000 x 600	400, 3~, 50	**3335.120**					616
15000 W	800 x 2000 x 600	400, 3~, 50	**3335.150**					616
20000 W	1200 x 2000 x 600	400, 3~, 50	**3335.200**					616
25000 W	1200 x 2000 x 600	400, 3~, 50	**3335.250**					616

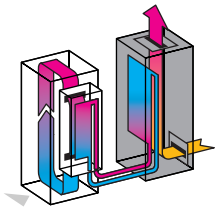
Delivery times available on request.

4.2 Recooling systems

In an industrial enclosure

Cooling output	Dimensions W x H x D mm	Voltage V, Hz	Model No. SK	Approvals				Page
				UL	CUL	DIN	GS	
32025 W	815 x 1400 x 1560	400, 3~, 50 460, 3~, 60	**3339.100**					617
36225 W	815 x 1400 x 1560	400, 3~, 50 460, 3~, 60	**3339.200**					617
66700 W	1550 x 2000 x 2500	400, 3~, 50	**3339.300**					617
75900 W	1550 x 2000 x 2500	400, 3~, 50	**3339.400**					617
172200 W	1630 x 2200 x 3400	400, 3~, 50	**3339.500**					617

Delivery times available on request.

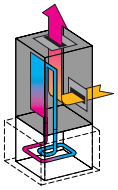


4.2 Immersible recooling systems

for oil

Cooling output	Dimensions W x H x D mm	Voltage V, Hz	Model No. SK	Approvals				Page
				UL	CUL	DIN	GS	
2400 W	785 x 1650 x 785	400, 3~, 50 460, 3~, 60	**3338.020**					618
3200 W	785 x 1650 x 785	400, 3~, 50 460, 3~, 60	**3338.040**					618
4600 W	785 x 1650 x 785	400, 3~, 50 460, 3~, 60	**3338.060**					618
5600 W	785 x 1650 x 785	400, 3~, 50 460, 3~, 60	**3338.080**					618
8500 W	785 x 1650 x 785	400, 3~, 50 460, 3~, 60	**3338.100**					619
10500 W	785 x 1650 x 785	400, 3~, 50 460, 3~, 60	**3338.120**					619
12000 W	785 x 1650 x 785	400, 3~, 50 460, 3~, 60	**3338.140**					619
13600 W	785 x 1650 x 785	400, 3~, 50 460, 3~, 60	**3338.160**					619
15300 W	785 x 1650 x 785	400, 3~, 50 460, 3~, 60	**3338.180**					619
17300 W	785 x 1650 x 785	400, 3~, 50 460, 3~, 60	**3338.200**					619
20700 W	785 x 1650 x 1830	400, 3~, 50 460, 3~, 60	**3338.220**					620
30800 W	785 x 1650 x 1830	400, 3~, 50 460, 3~, 60	**3338.240**					620
34900 W	785 x 1650 x 1830	400, 3~, 50 460, 3~, 60	**3338.260**					620
44500 W	1830 x 1650 x 1830	400, 3~, 50 460, 3~, 60	**3338.280**					620
48600 W	1830 x 1650 x 1830	400, 3~, 50 460, 3~, 60	**3338.300**					620
60600 W	1830 x 1650 x 1830	400, 3~, 50 460, 3~, 60	**3338.320**					620
72600 W	1830 x 1650 x 1830	400, 3~, 50 460, 3~, 60	**3338.340**					620
77900 W	1830 x 1650 x 1830	400, 3~, 50 460, 3~, 60	**3338.360**					620

Delivery times available on request.



4.2 Immersible recooling systems

for emulsion

Cooling output	Dimensions W x H x D mm	Voltage V, Hz	Model No. SK	Approvals				Page
				UL	CUL	DIN	GS	
2400 W	785 x 1650 x 785	400, 3~, 50 460, 3~, 60	**3338.500**					621
3200 W	785 x 1650 x 785	400, 3~, 50 460, 3~, 60	**3338.520**					621
4600 W	785 x 1650 x 785	400, 3~, 50 460, 3~, 60	**3338.540**					621
5600 W	785 x 1650 x 785	400, 3~, 50 460, 3~, 60	**3338.560**					621
8500 W	785 x 1650 x 785	400, 3~, 50 460, 3~, 60	**3338.580**					622
10500 W	785 x 1650 x 785	400, 3~, 50 460, 3~, 60	**3338.600**					622
12000 W	785 x 1650 x 785	400, 3~, 50 460, 3~, 60	**3338.620**					622
13600 W	785 x 1650 x 785	400, 3~, 50 460, 3~, 60	**3338.640**					622
15300 W	785 x 1650 x 785	400, 3~, 50 460, 3~, 60	**3338.660**					622
17300 W	785 x 1650 x 785	400, 3~, 50 460, 3~, 60	**3338.680**					622
20700 W	785 x 1650 x 1830	400, 3~, 50 460, 3~, 60	**3338.700**					623
30800 W	785 x 1650 x 1830	400, 3~, 50 460, 3~, 60	**3338.720**					623
34900 W	785 x 1650 x 1830	400, 3~, 50 460, 3~, 60	**3338.740**					623
44500 W	1830 x 1650 x 1830	400, 3~, 50 460, 3~, 60	**3338.760**					623
48600 W	1830 x 1650 x 1830	400, 3~, 50 460, 3~, 60	**3338.780**					623
60600 W	1830 x 1650 x 1830	400, 3~, 50 460, 3~, 60	**3338.800**					623
72600 W	1830 x 1650 x 1830	400, 3~, 50 460, 3~, 60	**3338.820**					623
77900 W	1830 x 1650 x 1830	400, 3~, 50 460, 3~, 60	**3338.840**					623

Delivery times available on request.

4.3 Air/water heat exchangers

Micro, for wall mounting

Useful cooling output	Dimensions W x H x D mm	Voltage V, Hz	Model No. SK	Approvals				Page
				UL	CUL	DIN	GS	
300 W	150 x 300 x 85	230, 50/60	**3212.230**					626
		115, 50/60	**3212.115**[1)]					626
		24 V (DC)	**3212.024**					626

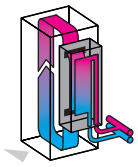
[1)] Delivery times available on request.

4.3 Air/water heat exchanger

Wall-mounted

Useful cooling output	Dimensions W x H x D mm	Voltage V, Hz	Model No. SK	Approvals				Page
			Wall mounting	UL	CUL	DIN	GS	
600 W	200 x 500 x 100	230, 50/60	**3214.100**					627
1000 W	298 x 520 x 135	230, 50/60	**3217.100**	■	■			627
1250 W	200 x 950 x 100	230, 50/60	**3215.100**					628
1540 W	380 x 825 x 105	230, 50/60	**3247.000**	■	■			628
2250 W	400 x 950 x 200	230, 50/60	**3218.104**[1)]					629
3000 W	400 x 950 x 200	230, 50/60	**3218.100**	■	■			629
4500 W	450 x 1400 x 250	230, 50/60	**3216.100**	■	■			629

[1)] Delivery times available on request.



4.3 TopTherm air/water heat exchanger

Roof-mounted

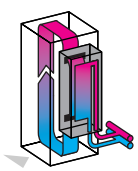
Useful cooling output	Dimensions W x H x D mm	Voltage V, Hz	Model No. SK		Approvals				Page
			with Basic controller	with Comfort controller	UL	CUL	DIN	GS	
1875 W	597 x 415 x 475	230, 50/60	**3209.104**[1)]	**3209.504**[1)]					630
		115, 50/60	**3209.114**[1)]	**3209.514**[1)]					630
		400, 2~, 50/60	**3209.144**[1)]	**3209.544**[1)]					630
2500 W	597 x 415 x 475	230, 50/60	**3209.100**	**3209.500**					630
		115, 50/60	**3209.110**	**3209.510**					630
		400, 2~, 50/60	**3209.140**[1)]	**3209.540**[1)]					630
3000 W	597 x 415 x 475	230, 50/60	**3210.104**[1)]	**3210.504**[1)]					631
		115, 50/60	**3210.114**[1)]	**3210.514**[1)]					631
		400, 2~, 50/60	**3210.144**[1)]	**3210.544**[1)]					631
4000 W	597 x 415 x 475	230, 50/60	**3210.100**	**3210.500**					631
		115, 50/60	**3210.110**	**3210.510**					631
		400, 2~, 50/60	**3210.140**[1)]	**3210.540**[1)]					631

[1)] Delivery times available on request.

4.3 Air/water heat exchanger

As a side panel for TS 8 enclosures

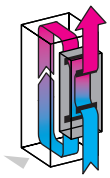
Useful cooling output	To fit enclosures H x D mm	Dimensions W x H x D mm	Voltage V, Hz	Model No. SK	Approvals				Page
					UL	CUL	DIN	GS	
700 W	1800 x 600	600 x 1800 x 95	230, 50/60	**3316.180**					632
700 W	2000 x 600	600 x 2000 x 95	230, 50/60	**3316.200**					632



4.3 TopTherm air/air heat exchanger

Wall mounting

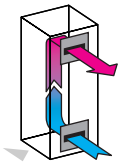
Specific thermal output	Dimensions W x H x D mm	Voltage V, Hz	**Model No. SK**	Approvals				Page
				UL	CUL	DIN	GS	
17.5 W/K	280 x 550 x 150	230, 50/60	**3126.100**	■	■			633
30.0 W/K	400 x 950 x 205	230, 50/60	**3127.100**	■	■			633
45.0 W/K	400 x 950 x 225	230, 50/60	**3128.100**	■	■			633
60.0 W/K	400 x 950 x 225	230, 50/60	**3129.100**	■	■			633
90.0 W/K	400 x 1580 x 215	230, 50/60	**3130.100**	■	■			634



4.4 Fan-and-filter unit

Air throughput, unimpeded air flow	Voltage V, Hz	**Model No. SK** RAL 7035	Approvals					Page
			UL	CUL	DIN	GS	CSA	
20/25 m³/h	230, 50/60	**3321.107**	■	■				636
	115, 50/60	**3321.117**	■	■				636
20 m³/h	24 (DC)	**3321.027**	■	■				636
	48 (DC)	**3321.047**[1)]	■	■				636
55/66 m³/h	230, 50/60	**3322.107**	■	■			■	636
	115, 50/60	**3322.117**	■	■			■	636
55 m³/h	24 (DC)	**3322.027**	■	■				636
	48 (DC)	**3322.047**[1)]	■	■				636
105/120 m³/h	230, 50/60	**3323.107**	■	■			■	637
	115, 50/60	**3323.117**	■	■			■	637
105 m³/h	24 (DC)	**3323.027**	■	■			■	637
	48 (DC)	**3323.047**[1)]	■	■				637
180/160 m³/h	230, 50/60	**3324.107**	■	■			■	637
	115, 50/60	**3324.117**	■	■			■	637
180 m³/h	24 (DC)	**3324.027**	■	■			■	637
	48 (DC)	**3324.047**[1)]	■	■				637
230/265 m³/h	230, 50/60	**3325.107**	■	■			■	638
	115, 50/60	**3325.117**	■	■			■	638
230 m³/h	24 (DC)	**3325.027**	■	■			■	638
	48 (DC)	**3325.047**[1)]	■	■				638
550/600 m³/h	230, 50/60	**3326.107**	■	■			■	639
	115, 50/60	**3326.117**	■	■			■	639
700/720 m³/h	230, 50/60	**3327.107**	■	■				639
	115, 50/60	**3327.117**	■	■				639
	400/460, 3~, 50/60	**3327.147**	■	■				639

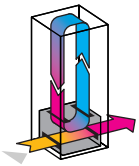
[1)] Delivery times available on request.



4.4 Fan-and-filter unit – EMC

Air throughput, unimpeded air flow	Voltage V, Hz	**Model No. SK** RAL 7035	Approvals					Page
			UL	CUL	DIN	GS	CSA	
20/25 m³/h	230, 50/60	**3321.607**	■	■				640
	115, 50/60	**3321.617**[1)]	■	■				640
55/66 m³/h	230, 50/60	**3322.607**	■	■				640
	115, 50/60	**3322.617**[1)]	■	■				640
105/120 m³/h	230, 50/60	**3323.607**	■	■				640
	115, 50/60	**3323.617**[1)]	■	■				640
180/160 m³/h	230, 50/60	**3324.607**	■	■				641
	115, 50/60	**3324.617**[1)]	■	■				641
230/265 m³/h	230, 50/60	**3325.607**	■	■				641
	115, 50/60	**3325.617**	■	■				641
550/600 m³/h	230, 50/60	**3326.607**	■	■				641
	115, 50/60	**3326.617**[1)]	■	■				641
700/720 m³/h	230, 50/60	**3327.607**	■	■				641
	115, 50/60	**3327.617**[1)]	■	■				641

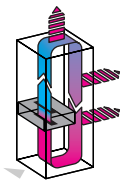
[1)] Delivery times available on request.



4.5 Rack-mounted cooling units

Useful cooling output	Dimensions W x H x D mm	Voltage V, Hz	**Model No. SK**	Approvals				Page
				UL	CUL	DIN	GS	
1000 W	445 x 265.9 x 542	115, 50/60	**3278.134**[1)]					644
		230, 50/60	**3292.134**					644

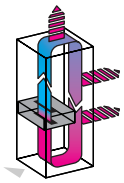
[1)] Delivery times available on request.



4.5 Rack-mounted fan

Air throughput, unimpeded air flow	No. of fans	Distance between axes mm	Voltage V, Hz	**Model No. SK**	Approvals					Page
					UL	CUL	DIN	GS	VDE	
250 m³/h	3	85	36 (DC) – 72 (DC)	**9769.002**[1)]						645
320 m³/h	2	85	24 (DC)	**3340.024**[1)]	■	■			■	645
	2	85	115 (AC), 50/60	**3340.115**[1)]	■	■			■	645
	2	85	230 (AC), 50/60	**3340.230**	■	■			■	645
480 m³/h	3	85	24 (DC)	**3341.024**[1)]	■	■			■	645
	3	105	24 (DC)	**3342.024**	■	■			■	645
	3	85	115 (AC), 50/60	**3341.115**	■	■			■	645
	3	105	115 (AC), 50/60	**3342.115**[1)]	■	■			■	645
	3	85	230 (AC), 50/60	**3341.230**	■	■			■	645
	3	105	230 (AC), 50/60	**3342.230**	■	■			■	645
	3	105	24 (DC) 115 – 230 (AC), 50/60	**3342.500**	■	■			■	645

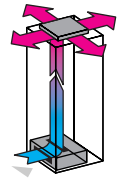
[1)] Delivery times available on request.



4.5 Vario rack-mounted fan

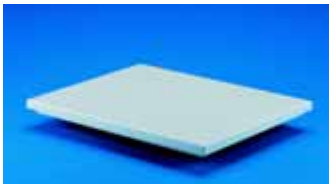
Air throughput, unimpeded air flow	No. of fans	Distance between axes mm	Voltage V, Hz	Model No. SK	Approvals					Page
					UL	CUL	DIN	GS	VDE	
320 m³/h	2	85	24 (DC)	**3350.024**[1)]	■	■			■	645
	2	85	115 (AC), 50/60	**3350.115**[1)]	■	■			■	645
	2	85	230 (AC), 50/60	**3350.230**	■	■			■	645
480 m³/h	3	85	24 (DC)	**3351.024**[1)]	■	■			■	645
	3	105	24 (DC)	**3352.024**[1)]	■	■			■	645
	3	85	115 (AC), 50/60	**3351.115**[1)]	■	■			■	645
	3	105	115 (AC), 50/60	**3352.115**[1)]	■	■			■	645
	3	85	230 (AC), 50/60	**3351.230**	■	■			■	645
	3	105	230 (AC), 50/60	**3352.230**	■	■			■	645
	3	105	24 (DC) 115 – 230 (AC), 50/60	**3352.500**[1)]	■	■			■	645

[1)] Delivery times available on request.



4.5 Centrifugal fan

Air throughput, unimpeded air flow	Dimensions W x H x D mm	Voltage V, Hz	Model No. SK	Approvals				Page
				UL	CUL	DIN	GS	
320 m³/h	482.6 x 87.2 x 158	115, 50/60	**3145.000**					646
		230, 50/60	**3144.000**					646



4.5 Roof-mounted fan and vent attachment

For TS 8

Air throughput, unimpeded air flow	Voltage V, Hz	Required mounting cutout W x D mm	Model No. SK	Approvals					Page
				UL	CUL	DIN	GS	CSA	
400 m³/h	115, 50/60	475 x 260	**3149.410**						647
	230, 50/60	475 x 260	**3149.420**						647
	400, 3~, 50/60 460, 3~, 60	475 x 260	**3149.440**						647
800 m³/h	115, 50/60	475 x 260	**3149.810**						647
	230, 50/60	475 x 260	**3149.820**						647
	400, 3~, 50/60 460, 3~, 60	475 x 260	**3149.840**						647
Without motor		490 x 390	**8801.380**						647

4.5 Roof-mounted fans

Air throughput, unimpeded air flow	Voltage V, Hz	Required mounting cutout W x D mm	Model No. SK	Approvals					Page
				UL	CUL	DIN	GS	CSA	
360 m³/h	230, 50/60	345 x 265	**3149.007**						647
	115, 50/60	345 x 265	**3169.007**						647
Without fan motor		345 x 265	**3148.007**						647

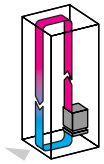
4.5 Roof-mounted fans

for TS/FR(i) for the office sector

Air throughput, unimpeded air flow	Voltage V, Hz	Version		Dimensions W x H x D mm	Model No. SK	Approvals					Page
		with roof plate	without roof plate			UL	CUL	DIN	GS	CSA	
1,500 m^3/h	115, 50/60	■		800 x 240 x 800	**3164.610**						648
	230, 50/60	■		800 x 240 x 800	**3164.620**						648
1,500 m^3/h	115, 50/60	■		800 x 240 x 900	**3164.810**						648
	230, 50/60	■		800 x 240 x 900	**3164.820**						648
1,500 m^3/h	115, 50/60		■	511 x 227 x 511	**3164.115**						648
	230, 50/60		■	511 x 227 x 511	**3164.230**						648

4.6 Enclosure heaters

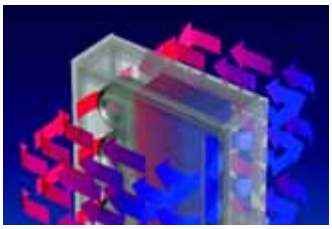
Continuous thermal output for T_u = 20°C	Voltage V, Hz	Model No. SK	Approvals					Page
			UL	CUL	DIN	GS	VDE	
10 W	110 – 240 (AC/DC)	**3105.000**	■	■			■	655
20 W	110 – 240 (AC/DC)	**3106.000**	■	■			■	655
30 W	110 – 240 (AC/DC)	**3115.000**	■	■			■	655
50 W	110 – 240 (AC/DC)	**3116.000**	■	■			■	655
130 W	110 – 240 (AC/DC)	**3107.000 + 3108.000**	■	■			■	655
300 W	230, 50/60	**3102.000 (incl. fan)**	■	■			■	655



4.6 Enclosure heaters

for CS outdoor enclosures

Continuous thermal output for T_u = 20°C	Voltage V, Hz	Installation		Dimensions W x H x D mm	Model No. CS	Approvals					Page
		in the enclosure	19″ mounting angles			UL	CUL	DIN	GS	VDE	
1000 W	230, 50/60	■	–	325 x 82 x 220	**9769.015**	■	■				656
600 W	230, 50/60	–	■	482.6 x 87.2 x 236	**9769.023**						656



4.8 Liquid Cooling Package

Cooling output	Dimensions W x H x D mm	Voltage V, Hz	Model No. SK	Approvals				Page
				UL	CUL	DIN	GS	
Enclosure + 3 modules								
4000 W	300 x 2000 x 1000	230, 50/60	**3301.230**					672
4000 W	300 x 2000 x 1000	115, 50/60	**3301.210**					672
Cooling module, single								
4000 W	250 x 550 x 950	230, 50/60	**3301.250**					672

4.8 Rack-mounted recooling system

Specific thermal output	Dimensions W x H x D mm	Voltage V, Hz	Model No. SK	Approvals				Page
				UL	CUL	DIN	GS	
1000 W	442 x 175 x 751	230, 50/60	**3301.260**					673

Delivery times available on request.

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- Networking
- Server racks
- Monitoring
- Terminals
- Telecom

Detailed information may be found on catalogue pages 676 – 811 or refer to our website: www.rittal.com The latest status of approvals may be found on the Internet at: www.rittal.com

5.1 Networking

Network enclosures based on TE 7000

Dimensions in mm				U	Model No. TE, RAL 7035		Page
Width	Height	Depth	19″ distance between levels as delivered Depth		Side panels with	Side panels without	
600	600	600	495	12	**7000.390**	–	682
600	600	800	495	12	**7000.410**	–	682
600	1200	600	495	24	**7000.430**	–	682
600	1200	800	495	24	**7000.440**	–	682
600	2000	600	495	42	**7000.500**[2)]	**7000.502**	682
600	2000	800	495	42	**7000.510**[3)]	–	682
600	2200	600	495	47	**7000.560**	**7000.562**	682
600	2200	800	495	47	**7000.570**	–	682
800	1200	600	495	24	**7000.450**	–	685
800	1200	800	495	24	**7000.460**[1)]	–	685
800	2000	600	495	42	**7000.520**[4)]	–	685
800	2000	800	495	42	**7000.530**[1) 5)]	**7000.532**[1)]	685
800	2200	600	495	47	**7000.580**	–	685
800	2200	800	495	47	**7000.590**	**7000.592**	685

[1)] Model No. TE preconfigured with base/plinth, earthing and accessory kit: Height 1200 mm: 7000.840, Height 2000 mm: wih side panel 7000.850, without side panel 7000.852
[2)] Model No. TE in RAL 9005: 7000.505 [3)] Model No. TE in RAL 9005: 7000.515
[4)] Model No. TE in RAL 9005: 7000.525 [5)] Model No. TE in RAL 9005: 7000.535

Network enclosures based on Rittal TS 8, pre-configured

Dimensions mm			U	Model No. DK		Page
Width	Height	Depth		Side panels with	Side panels without	
Enclosure type V1						
600	1200 + 100	600	24	**7830.100**	–	687
Enclolsure type V2						
800	1800 + 100	800	38	**7830.800**	**7830.850**	687
800	2000 + 100	800	42	**7830.200**	**7830.250**	687
800	2200 + 100	800	47	**7830.220**	**7830.270**	687
Enclosure type V3						
800	1200 + 100	900	24	**7830.120**	–	689
800	2000 + 100	900	42	**7830.300**	**7830.350**	689
800	2000 + 100	1000	42	**7830.330**	**7830.335**	689
800	2200 + 100	900	47	**7830.320**	**7830.370**	689
800	2200 + 100	1000	47	**7830.340**	**7830.380**	689
Enclosure type V4						
800	2000 + 100	800	42	**7830.400**	–	691
Enclosure type V5						
800	2000 + 100 + 25	800	42	**7830.500**	**7830.550**	691
Enclosure type V6						
800	2000 + 100 + 25	800	40	**7830.660**	**7830.670**	691

5.1 Networking

Network enclosures, based on Rittal TS 8, types 1 and 2

Dimensions mm			U	Model No. DK		Page
Width	Height	Depth		Type 1	Type 2	
600	800	600	15	**7820.100**	**7821.100**	693
600	1000	600	20	**7820.200**	**7821.200**	693
800	1000	600	20	**7820.240**	**7821.240**	693
600	1200	600	24	**7820.300**	**7821.300**	693
800	1200	600	24	**7820.340**	**7821.340**	693
800	1200	800	24	**7820.350**	**–**	693
800	1200	900	24	**7820.355**	**7821.355**	693
800	1200	1000	24	**7820.360**	**–**	693
600	1400	600	29	**7820.400**	**7821.400**	693
600	1400	800	29	**7820.410**	**7821.410**	693
800	1400	600	29	**7820.440**	**7821.440**	693
600	1600	600	33	**7820.500**	**7821.500**	693
600	1600	800	33	**7820.510**	**7821.510**	693
800	1600	600	33	**7820.540**	**7821.540**	693
600	1800	600	38	**7820.600**	**7821.600**	693
600	1800	800	38	**7820.610**	**7821.610**	693
600	1800	900	38	**7820.620**	**7821.620**	694
800	1800	600	38	**7820.640**	**7821.640**	694
800	1800	800	38	**7820.650**	**7821.650**	694
800	1800	1000	38	**7820.670**	**7821.670**	694
600	2000	600	42	**7820.700**	**7821.700**	694
600	2000	800	42	**7820.710**	**7821.710**	694
800	2000	600	42	**7820.740**	**7821.740**	694
800	2000	800	42	**7820.750**	**7821.750**	694
800	2000	900	42	**7820.760**	**7821.760**	694
800	2000	1000	42	**7820.770**	**7821.770**	694
600	2200	600	47	**7820.800**	**7821.800**	694
600	2200	800	47	**7820.810**	**7821.810**	694
800	2200	600	47	**7820.840**	**7821.840**	694
800	2200	800	47	**7820.850**	**7821.850**	694
800	2200	900	47	**7820.860**	**7821.860**	694
800	2200	1000	47	**7820.870**	**7821.870**	694

Approvals:
- UL
- C-UL

Network enclosures based on Rittal flexRack(i), pre-configured

Dimensions mm			U	Model No. FR(i)		Page
Width	Height	Depth[1)]		Side panels		
				with	without	
600	600	805	11	**7855.480**	**–**	703
600	600	1005	11	**7855.500**	**–**	703
600	1200	1005	25	**7855.510**	**–**	703
800	2000 + 100	805	42	**7855.550**	**7855.540**	703
800	2000 + 100	1005	42	**7855.570**	**7855.560**	703

[1)] Nominal size excluding lock system.

5.1 Networking

Network enclosures based on Rittal flexRack(i)

Dimensions mm			U	Model No. FR(i)	Page
Width	Height	Depth[1)]			
600	600	605	11	**7855.610**	705
600	600	1005	11	**7855.620**	705
600	1200	605	24	**7855.630**	705
600	1200	1005	24	**7855.640**	705
600	1800	605	38	**7855.650**	705
600	2000	605	42	**7855.660**	705
600	2000	1005	42	**7855.670**	705
600	2200	1005	47	**7855.680**	705
800	1200	805	24	**7855.690**	705
800	1800	805	38	**7855.700**	705
800	2000	805	42	**7855.710**	705
800	2000	1005	42	**7855.720**	705
800	2200	805	47	**7855.730**	705
800	2200	1005	47	**7855.740**	705

[1)] Nominal size excluding lock systems.

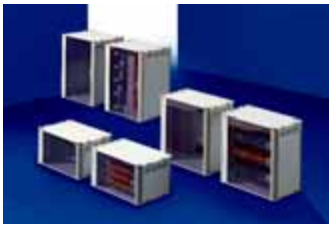
Distributor racks based on Rittal Data Rack

Dimensions mm			U	Model No. DK	Page
Width	Height	Depth			
550	1499.5	750	31	**7391.000**	708
550	1721.8	750	36	**7396.000**	708
550	1899.5	750	40	**7400.000**	708
550	2121.8	750	45	**7445.000**	708

Mobile workstation, Rittal RiLab

Dimensions mm			Model No. DK	Page
Width	Height	Depth		
Type 1				
714	820	625	**7600.100**	711
Type 2				
714	1108	625	**7600.200**	711
Type 3				
714	1428	625	**7600.300**	711

Approvals:
- TÜV tested safety



5.2 Networking

RNC enclosure

Dimensions mm			U	Mounting position	Model No. DK		Page
Width	Height	Depth			Single	Bulk pack	
342	255	280	4	horizontal	**7870.100**	**7870.500**	716
342	390	280	8	horizontal	**7870.200**	**7870.510**	716
342	490	400	6	vertical	**7870.300**	**7870.520**	716

RNC universal enclosure

Dimensions mm			U ½ 19″	U 19″	Model No. DK		Page
Width	Height	Depth			Single	Bulk pack	
350	500	350	10	5	**7870.350**	**7870.530**	717

Wall-mounted enclosure, based on Rittal QuickBox, 6 – 21 U

Dimensions mm			U/SU	Model No. DK		Page
Width	Height	Depth		With glazed door	With sheet steel door	
600	362	300	6/10	**7502.013**	–	718
600	362	400	6/10	**7502.014**	**7502.114**	718
600	362	600	6/10	**7502.016**	–	718
600	495	300	9/15	**7502.023**	**7502.123**	718
600	495	400	9/15	**7502.024**	**7502.124**	718
600	495	600	9/15	**7502.026**	**7502.126**	718
600	628	400	12/20	**7502.034**	**7502.134**	718
600	628	500	12/20	**7502.035**	–	718
600	628	600	12/20	**7502.036**	**7502.126**	718
600	762	400	15/26	**7502.044**	**7502.144**	719
600	762	500	15/26	**7502.045**	–	719
600	762	600	15/26	**7502.046**	**7502.146**	719
600	895	400	18/31	**7502.054**	–	719
600	895	500	18/31	**7502.055**	–	719
600	895	600	18/31	**7502.056**	–	719
600	1028	400	21/36	**7502.064**	–	719
600	1028	600	21/36	**7502.066**	**7502.166**	719

5.2 Networking

Wall-mounted enclosure, based on Rittal QuickBox with vertical 482.6 mm (19″) level

Dimensions mm			U vertical	Model No. DK	Page
Width	Height	Depth			
600	631	210	3	**7502.630**	720
600	631	360	6	**7502.660**	720

Wall-mounted enclosure, based on Rittal AE, with pull-out frame

Dimensions mm			U sides, vertical	U front	Model No. DK	Page
Width	Height	Depth				
600	600	350	4	10	**7644.000**	721

Wall-mounted enclosure, based on Rittal AE

Dimensions mm			U	Model No. DK	Page
Width	Height	Depth			
600	380	350	8	**7641.000**	722
600	600	350	13	**7643.000**	722
600	760	350	16	**7645.000**	722

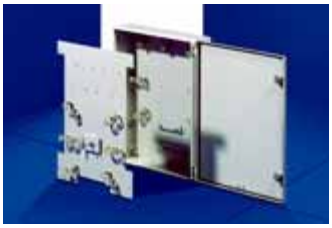
Approvals:
- UL
- CSA
- Lloyds Register of Shipping

Office distributor, 2 and 4 U, for fibre-optic and copper cables

Dimensions mm			U	Model No. DK	Page
Width	Height	Depth			
400	504	106	2	**7245.000**	723
400	504	195	4	**7245.400**	723

Small fibre-optic distributors

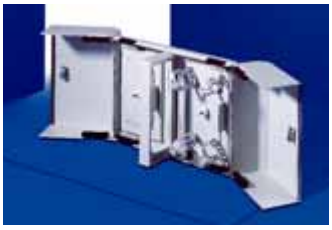
Dimensions mm			Number of fibres	Model No. DK	Page
Width	Height	Depth			
500	500	120	1 – 48	**7452.035**	724
500	900	120	1 – 96	**7453.035**	724



5.2 Networking

Small fibre-optic distributors, based on Rittal AE

Dimensions mm			Number of fibres	Model No. DK	Page
Width	Height	Depth			
400	500	155	1 – 48	**7454.000**	725



Fibre-optic marshalling enclosure

Dimensions mm			Number of fibres	Model No. DK	Page
Width	Height	Depth			
400	250	120	1 – 24	**7247.000**	726

Small fibre-optic distributor, polycarbonate

Dimensions mm			Number of fibres	Model No. DK	Page
Width	Height	Depth			
180	254	90	1 – 24	**7451.000**	727

Wall-mounted enclosure, based on Rittal EL, 3-part, pre-configured, depth 573

Dimensions mm			U	Model No. DK		Page
Width	Height	Depth		With glazed door	With slotted metal door[1)]	
600	478	572.5	9	**7709.735**	**7709.835**	728
600	746	572.5	15	**7715.735**	**7715.835**	728
600	1012	572.5	21	**7721.735**	**7721.835**	728

[1)] Extended delivery times.

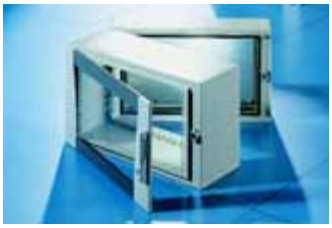
Additional features of the pre-configured wall-mounted enclosure:
Earth rail with star earthing, one outlet filter on both the left and right, 4 wall mounting brackets.

Approvals (for glazed doors only)
- UL
- C-UL

Wall-mounted enclosure, based on Rittal EL, 3-part, with punched rails, depth 473

Dimensions mm			U	Model No. DK	Page
Width	Height	Depth			
600	345	472.5	6	**7706.135**	729
600	478	472.5	9	**7709.135**	729
600	612	472.5	12	**7712.135**	729
600	746	472.5	15	**7715.135**	729
600	878	472.5	18	**7718.135**	729
600	1012	472.5	21	**7721.135**	729

Approvals:
- UL
- C-UL

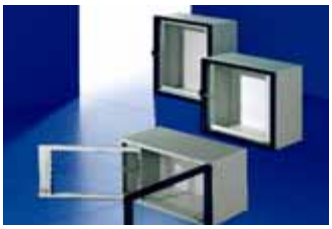


5.2 Networking

Wall-mounted enclosure, based on Rittal EL, 3-part, with mounting plate, depth 373 and 473

Dimensions mm		U	Model No. DK	Page	Model No. DK	Page
Width	Height		Depth 373 mm		Depth 473 mm	
600	212	3	**2243.605**	730	**2253.605**	731
600	345	6	**2246.605**	730	**2256.605**	731
600	478	9	**2249.605**	730	**2259.605**	731
600	612	12	**2252.605**	730	**2262.605**	731
600	746	15	**2255.605**	730	**2265.605**	731
600	878	18	**2258.605**	730	**2268.605**	731
600	1012	21	**2261.605**	730	**2271.605**	731

Approvals:
- UL
- C-UL



Wall-mounted enclosure, based on Rittal EL, 2-part, depth 369

Dimensions mm			U	Model No. EL	Page
Width	Height	Depth			
600	380	369	6	**1919.500**	732
600	600	369	11	**1920.500**	732
600	760	369	14	**1926.500**	732

Approvals:
- TÜV
- Russian Maritime Register of Shipping
- Lloyds Register of Shipping
- VDE

5.3 Server racks

Based on Rittal TS 8, pre-configured

Dimensions mm			U	Model No. DK		Page
Width	Height	Depth		RAL 7035	RAL 9005	
600	1200	900	24	**7831.431**	**7831.432**	737
600	1200	1000	24	**7831.433**	**7831.434**	737
600	2000	900	42	**7831.436**	**7831.437**	737
600	2000	1000	42	**7831.438**	**7831.439**	737
600	2200	900	47	**7831.440**	**7831.441**	737
600	2200	1000	47	**7831.442**	**7831.443**	737
800	2000	1000	42	**7831.446**	–	737

Based on Rittal TS 8, pre-configured, multi-door

Dimensions mm			U	SU	Number of front and rear doors	Model No. DK		Page
Width	Height	Depth				RAL 7035	RAL 9005	
600	2200	900	2 x 21	2 x 37	2	**7831.450**	**7831.451**	737
600	2200	900	2 x 21	2 x 37	2 (vertically divided)	**7831.457**	**7831.458**	737
600	2200	900	4 x 10	4 x 17	4	**7831.460**	**7831.461**	737

5.3 Server racks

Based on Rittal flexRack(i), pre-configured

Dimensions mm			U	Model No. FR(i)	Page
Width	Height	Depth[1)]			
600	1200	1000	24	**7855.310**	738
600	2000	1000	42	**7855.330**	738
600	1200	1200	24	**7855.312**	738
600	2000	1200	42	**7855.332**	738

[1)] **Nominal size** excluding lock systems.

5.3 Server racks

Based on Rittal TE 7000

Dimensions mm			U	Model No. TE		Page
Width	Height	Depth		RAL 7035	RAL 9005	
600	2000	1000	42	**7000.882**	**–**	736
600	2000	1000	42	**–**	**7000.885**	736
800	2000	1000	42	**7000.892**	**–**	736
800	2000	1000	42	**–**	**7000.895**	736

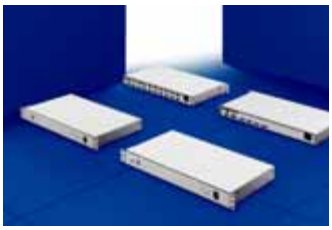
Monitor/keyboard unit, 1 U

		15″		17″		Page
		RAL 7035/ RAL 9006	RAL 9005/ RAL 9006	RAL 7035/ RAL 9006	RAL 9005/ RAL 9006	
Touchpad	German	**9050.100**	**9050.200**	**9050.300**	**9050.400[1)]**	739
	English	**9050.102**	**9050.202**	**9050.302[1)]**	**9050.402[1)]**	739
	French	**9050.103[1)]**	**9050.203[1)]**	**9050.303[1)]**	**9050.403[1)]**	739
Trackball	German	**9050.150**	**9050.250**	**9050.350**	**9050.450**	739
	International	**9050.151[2)]**	**9050.251[2)]**	**9050.351[2)]**	**9050.451[2)]**	739

[1)] Extended delivery times.
[2)] International version only available with trackball, without number pad.

Rittal SSC view 8/SSC view 32 Cat for monitor/keyboard unit, 1 U

Dimensions			No. of channels	Connections Video	Video resolution, maximum (depending on distance)	Bandwidth	Model No. DK	Page
Width	Height	Depth						
482.5 mm (19″)	1 U	140 mm	8	VGA/HD15	1280 x 1024 @ 85 Hz	200 MHz	**7552.000**	740
482.5 mm (19″)	1 U	140 mm	32	Cat 5	1920 x 1044 @ 75 Hz	250 MHz	**7552.100**	740



Rittal SSCmini/SSCmulti

Rittal Server Switch Control SSC	No. of computers in stand-alone mode	Number of local operator consoles	Video resolution, maximum (depending on distance) at 85 Hz	Bandwidth	Model No. DK	Page
SSCmini 4	4	1	1600 x 1200	250 MHz	**7551.000**	741
SSCmulti 4	4	1	1600 x 1200	250 MHz	**7551.010**	741
SSCmulti 8	8	1	1600 x 1200	250 MHz	**7551.020**	741
SSCmuti 16	16	1	1600 x 1200	250 MHz	**7551.030**	741

5.4 Power

	Page
Power Distribution Rack PDR	743
Power Distribution Module PDM	743
Power System Module PSM	744
Connection cable	745
Voltage supply	746

5.4 UPS systems

UPS, single-phase	U	Power kVA	**Model No. DK**	Page
UPS for 482.6 mm (19″) racks with integral battery	2	1	**7857.401**	753
UPS for 482.6 mm (19″) racks with integral battery	2	1.5	**7857.402**	753
UPS control unit for 482.6 mm (19″) racks (matching battery pack 2/3 kVA is always needed)	2 2	2	**7857.403** **7857.408**	753
UPS control unit for 482.6 mm (19″) racks (matching battery pack 2/3 kVA is always needed)	2 2	3	**7857.404** **7857.408**	753
UPS floor standing enclosure with integral battery	–	6	**7857.405**	753

5.6 Monitoring

Computer Multi Control Top Concept CMC-TC

CMC-TC main products	Packs of	**Model No. DK**	Page
CMC-TC monitoring system master	1	**7320.000**	769
CMC-TC monitoring system processing unit	1	**7320.100**	766
CMC-TC sensor unit I/O unit	1	**7320.210**	764
CMC-TC sensor unit access unit	1	**7320.220**	765
CMC-TC sensor unit climate unit	1	**7320.230**	765
CMC-TC display unit	1	**7320.490**	767
CMC-TC GSM unit	1	**7320.820**	767
CMC-TC ISDN unit	1	**7320.830**	768
CMC extension unit 3 x voltage 100 – 230 V AC	1	**7200.520**	776
Fan Control System FCS	1	**7320.810**	786
Fan Alarm System FAS	1	**7320.811**	787

Sensor unit	I/O unit	Access unit	Climate unit	Packs of	**Model No. DK**	Page
Sensors/actuators:						
Temperature sensor	■		■	1	**7320.500**	773
Smoke alarm	■		■	1	**7320.560**	773
Humidity sensor	■			1	**7320.510**	773
Airflow monitor	■		■	1	**7320.550**	774
Voltage monitor	■		■	1	**7320.600**	774
Voltage monitor with switch output	■			1	**7320.610**	774
Voltage monitor 48 V DC	■		■	1	**7320.620**	775
Vandalism sensor	■			1	**7320.540**	777
Access sensor (max. 5 sensors in series supported)	■	■	■	2	**7320.530**	777
CMC-TC motion detector	■		■	1	**7320.570**	778
Leakage sensor	■			1	**7320.630**	778
Analog sensor input module “4 – 20 mA”	■			1	**7320.520**	779
Digital sensor input module	■	■	■	1	**7320.580**	779
Digital relay output module	■			1	**7320.590**	779
Lock/reader:						
Electro-magnetic TS 8 handle with master key function		■		1	**7320.721**	781
Electro-magnetic Ergoform-S FR/PS/TC and TE		■		1	**7320.700**	781
Electro-magnetic Ergoform-S QR		■		1	**7320.710**	781
Smart card reader		■		1	**7320.750**	782
Magnetic card reader		■		1	**7320.760**	782
Coded lock		■		1	**7320.770**	782
Universal lock		■		1	**7320.730**	783
Relay output module for room door		■		1	**7320.740**	780
Lock FR(i)		■		1	**7320.900/.910/.920/.930**	783

5.7 Kiosks

ITS Arc-Line II

TFT display, 17″		Dimensions of kiosk enclosures approx. mm			Contact sensor (touchscreen) including controller	Keyboard recess for use of ITS keyboards	Model No. ITS	Page
		Width	Height	Depth				
Basic (sheet steel)	Rear door	550	1180	700	■	–	**9012.100**	792
		550	1180	700	–	■	**9012.110**	792
	Front door	550	1180	700	■	–	**9012.200**	792
		550	1180	700	–	■	**9012.210**	792
Classic (stainless steel)	Rear door	550	1180	700	■	–	**9012.300**	792
		550	1180	700	–	■	**9012.310**	792
	Front door	550	1180	700	■	–	**9012.400**	792
		550	1180	700	–	■	**9012.410**	792

Accessories see page 800.

ITS Opti-Line II

TFT display	Dimensions of kiosk enclosures approx. mm			Contact sensor (touchscreen) including controller	Keyboard support for use of ITS keyboards	Model No. ITS	Page
	Width	Height	Depth				
15″	560	1500	510	■	–	**9006.505**	793
15″	560	1500	580	–	■	**9006.605**	793
17″	560	1500	510	■	–	**9006.705**	793
17″	560	1500	580	–	■	**9006.805**	793

Accessories see page 800.

ITS Opti-Desk

TFT display	Dimensions approx. mm						Model No. ITS		Page
	With worktop			Base enclosure only with front door			Door and worktop curved inwards	Door and worktop curved outwards	
	Width	Height	Depth	Width	Height	Depth			
15″	1000	1500	800	435	1000	530	**9021.250**	**9021.255**	794
17″	1000	1500	800	435	1000	530	**9021.270**	**9021.275**	794

Accessories see page 800.

ITS Opti-Wall

TFT display	Enclosure dimensions approx. mm			Contact sensor (touchscreen) including controller	Keyboard support for use of ITS keyboards	Model No. ITS	Page
	Width	Height	Depth				
15″	560	1000	200	■	–	**9020.150**	795
15″	560	1000	400	–	■	**9020.250**	795
17″	560	1000	200	■	–	**9020.170**	795
17″	560	1000	400	–	■	**9020.270**	795

Accessories see page 800.

5.7 Kiosks

ITS Alpha-Line

	Dimensions including base plate and viewing guard approx. mm			TFT display 15″	Model No. ITS	Page
	Width	Height	Depth			
Touchscreen	580	1300	540	■	**9007.105**	796
Prepared for keyboard	580	1300	640	■	**9007.205**	796

Accessories see page 800.

ITS Out-Line Wall

	Enclosure dimensions approx. mm						TFT display (high brightness for outdoor applications)	Model No. ITS[1)]	Page
	Body			Including all projecting parts					
	Width	Height	Depth	Width	Height 2	Depth			
Touchscreen	480	1100	305	600	1360	305	15″	**9023.150**	797
	480	1100	305	600	1360	305	17″	**9023.170**	797
Prepared for keyboard	480	1100	365	600	1360	365	15″	**9023.250**	797
	480	1100	365	600	1360	365	17″	**9023.270**	797

Accessories see page 800.
[1)] Climate control needed.

ITS Out-Line Pro

TFT display (suitable for outdoor use with increased luminosity)	Dimensions approx. mm						Contact sensor (touchscreen) including controller	Keyboard support for use of ITS keyboards	Model No. ITS[1)]	Page
	Kiosk enclosures			Kiosk including roof						
	Width	Height	Depth	Width	Height	Depth				
15″	650	2000	400	1000	2400	1000	■	–	**9022.150**	798
15″	650	2000	400	1000	2400	1000	–	■	**9022.250**	798
17″	650	2000	400	1000	2400	1000	■	–	**9022.170**	798
17″	650	2000	400	1000	2400	1000	–	■	**9022.270**	798

Accessories see page 800.
[1)] Climate control needed.

ITS PC systems,
see page 799.

Keyboards,
see page 800/801.

5.8 Telecom

Rack system, based on Rittal TC-Rack

Dimensions mm			U	SU	Model No. DK	Page
Width	Height	Depth				
600	2200	300	46	82	**7723.035**	803
600	2200	600	46	82	**7726.035**	803

Small FM distributors

Dimensions mm			FM systems	Paired wires	Model No. DK	Page
Width	Height	Depth				
300	500	120	–	100	**7052.035**	806
500	500	120	–	200	**7053.035**	806
500	700	120	–	400	**7054.035**	806
900	700	120	–	800	**7055.035**	806

Modular FM wall-mounted distributor

Dimensions mm			FM systems	Paired wires	Model No. DK	Page
Width	Height	Depth				
600	600	350	2 sets	max. 340	**7011.535**	807
760	760	300	2 sets	max. 500	**7012.535**	807
800	1000	300	3 sets	max. 990	**7013.535**	807
800	1200	300	3 sets	max. 1170	**7014.535**	807

Approvals:
- UL
- CSA
- TÜV
- Lloyds Register of Shipping
- VDE

Modular FM distributor racks

Dimensions mm			FM systems	Paired wires	Model No. DK	Page
Width	Height	Depth				
600	2000	400	2	max. 1300	**7834.060**	808
800	2000	400	3	max. 1950	**7834.080**	808
1200	2000	400	5	max. 3250	**7834.120**	808

Approvals:
- UL
- CSA
- TÜV
- Lloyds Register of Shipping
- VDE

Communication Systems – Perfect protection for all weathers
Rittal's expertise in the fields of enclosure technology, climate control, security management and system integration is combined in standard solutions and customised outdoor systems. The specific requirements of mobile communications, IT technology, environmental technology and power distribution are accommodated on a project-specific basis.
High-quality materials such as aluminium and zinc-plated sheet steel combine corrosion resistance and protection from vandalism with UV stability and a high level of RF attenuation.

Individual complete solutions using mass-produced modules:
- CS Toptec (twin-walled)
- CS wall-mounted enclosure (enclosure within an enclosure)
- CS compact enclosure (single-walled)
- CS basic enclosure (single-walled)
- CS modular enclosure (twin-walled)
- CS Indoor Racks
- CS Outdoor climate control

Detailed information may be found on catalogue pages 812 – 831 or refer to our website: www.rittal.com

6.1 CS Toptec

Dimensions mm			Model No. CS		Page
Width	Height	Depth			
Without climate control module					
650	1200	650	**9774.100**		817
800	1200	650	**9774.200**		817
650	1600	650	**9774.300**		817
800	1600	650	**9774.400**		817
With heat exchanger			85 W/K	135 W/K	
800	1200	650	**9774.210**	**9774.230**[1)]	817
800	1600	650	**9774.410**	**9774.430**[1)]	817
With cooling unit			1000 W	1500 W	
800	1200	650	**9774.250**	**9774.270**[1)]	817
800	1600	650	**9774.450**	**9774.470**[1)]	817

[1)] Delivery times available on request.

6.1 CS wall-mounted enclosures

Dimensions external/internal mm			Model No. CS	Page
Width	Height	Depth		
370/300	522.5/400	210/170	**9791.015**	818
420/350	560.5/440	210/170	**9791.025**	818
530/460	700/565	265/220	**9791.035**	818
630/580	780/580	380/333	**9791.045**	818
with rotating frame, 5 U, instead of mounting plate				
630/580	780/580	380/333	**9791.145**	818

6.1 CS compact enclosures

Dimensions mm			Enclosure	Model No. CS	Page
Width	Height	Depth			
Aluminium AlMg3					
800	1100	320	single-door	**9771.115**	819
1100	1100	320	double-door	**9772.115**	819
Sheet steel, zinc-plated, passivated					
800	1100	320	single-door	**9771.111**	819
1100	1100	320	double-door	**9772.111**	819

6.1 Compact enclosures, Outdoor

Dimensions mm			Model No.		Page
Width	Height	Depth	Sheet steel	Stainless steel	
800	1200	350	**1620.000**	**1620.100**	820
1200	800	350	**1621.000**	**1621.100**	820
1200	1200	350	**1622.000**	**1622.100**	820

6.1 CS basic enclosures

Dimensions mm			Model No. CS		Page
Width	Height	Depth	without centre bar	with centre bar	
single-door					
600	800	400	**9783.040**	–	821
600	1200	400	**9783.050**	–	821
600	1400	400	**9783.060**	–	821
600	1200	500	**9783.030**	–	821
800	800	400	**9783.010**	–	821
800	1200	400	**9783.020**	–	821
800	1400	400	**9783.120**	–	821
800	1200	500	**9783.110**	–	821
double-door					
1200	800	400	**9784.110**	**9784.010**	822
1200	1200	400	**9784.120**	**9784.020**	822
1200	1200	500	**9784.140**	**9784.040**	822
1200	1400	400	**9784.130**	**9784.030**	822

6.1 CS modular enclosures

Dimensions mm			Model No. CS	Page
Width	Height	Depth		
600	1200	600	**9751.125**	823
800	1200	500	**9751.145**	823
800	1600	600	**9751.165**	823
1200	1200	600	**9752.125**	823

Other modules and size variants may be found on page 824.

6.1 CS Indoor Racks

Dimensions mm			Mounting angles	Model No. CS	Page
Width	Height	Depth			
600	2200	300	19″	**9790.042**	825
600	2200	300	Metric	**9790.043**	825

6.2 Heat exchanger for CS modular enclosures/ compact enclosures

Dimensions mm			Mounting situation	**Specific thermal output**	Heater[2)]	Rated operating voltage	**Model No. CS**	Page
Width	Height	Depth						
470	158	380	Roof mounting	**30 W/K**	without	48 V DC	**9764.040**	827
535	390	400	Roof mounting	**60 W/K**	400 W	48 V DC	**9764.012**	827
515	1170	151.5	Wall mounting	**60 W/K**	400 W	48 V DC	**9763.012**	827
480	1005	110	Door mounting	**40 W/K**	400 W	48 V DC	**9768.032**	828
510	1005	150	Door mounting	**60 W/K**	400 W	48 V DC	**9768.012**	828
445	1050	150	Door mounting	**85 W/K**	without	48 V DC	**9768.042**	828
575	1050	195	Door mounting	**120 W/K**	without	48 V DC	**9768.062**	828
855	95	240	Roof mounting[1)]	**15 W/K**	without	48 V DC	**9767.012**	828

[1)] For compact enclosures
[2)] Rated operating voltage 230 V AC, 50/60 Hz

Note:
Enclosure heaters for CS outdoor enclosures,
see page 80, 656.

6.2 Cooling units for CS modular enclosures

Dimensions mm			Mounting situation	**Useful cooling output EN 814**		Rated operating voltage	**Model No. CS**	Page
Width	Height	Depth		**L35 L35**	**L35 L50**			
535	390	400	Roof mounting	**900 W**	**750 W**	230 V AC, 50/60 Hz	**9762.012**	829
430	1170	210	Door mounting	**900 W**	**650 W**	230 V AC, 50/60 Hz	**9768.100**	829
515	1070	151.5	Wall mounting	**900 W**	**750 W**	230 V AC, 50/60 Hz	**9761.012**	829
695	1132	151.5	Wall mounting	**1400 W**	**1050 W**	230 V AC, 50/60 Hz	**9761.032**	829
776	1100	250	Wall mounting	**2500 W**	**2000 W**	230 V AC, 50/60 Hz	**9761.042**	829
400	1050	310	Universal built-in	**1500 W**	**1250 W**	230 V AC, 50/60 Hz	**9768.150**	829

Approvals CS 9761.032:
- UL
- C-UL

6.2 Climate control units for CS Toptec

Dimensions mm			Mounting situation	**Useful cooling output EN 814**		**Specific thermal output**	Rated operating voltage	**Model No. CS**	Page
Width	Height	Depth		**L35 L35**	**L35 L50**				
Heat exchanger									
500	1000	150	Universal built-in	–	–	**85 W/K**	48 V DC	**9776.100**	830
500	1000	260	Universal built-in	–	–	**135 W/K**	48 V DC	**9776.150**	830
Cooling unit									
500	1000	150	Universal built-in	**1000 W**	**680 W**	–	230 V AC, 50/60 Hz	**9776.500**	830
500	1000	260	Universal built-in	**1500 W**	**1150 W**	–	230 V AC, 50/60 Hz	**9776.550**	830

Rittal has all the elements of **packaging technology for the factory of the future,** even in the toughest ambient conditions. Current examples include: Compact, secure technologies for **Industrial Ethernet,** enabling simple modifications to production procedures.

Modular enclosure technology is advantageous in terms of the rapid assembly and adaptation of controllers.

At the human/machine interface, your ergonomic requirements are precisely realised with the **Command Panel and Industrial Workstations**.

High-quality products + matching accessories + modular assembly

= perfect solutions at an inexpensive price.

Industrial Enclosures

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Small enclosures

Features

This is application-oriented diversity:

6 enclosure types in 4 materials and more than 100 sizes.

With

- Fibreglass-reinforced polycarbonate
- Cast aluminium
- Sheet steel with high-quality coating
- Stainless steel

every aspect of your requirements is met.

It goes without saying that all this is achieved in Rittal's familiar high quality, and to suit every security requirement.

And for special requirements:

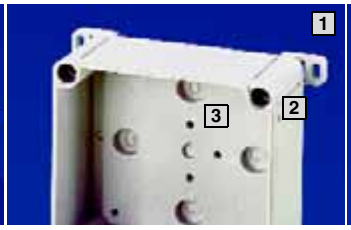
Stainless steel enclosures, see page 268 – 272.

Ex enclosures, see page 286 – 288.

EMC enclosures, see page 289 – 290.

Polycarbonate enclosures

Hinges available as accessories. Cover screw prepared for a lead seal.



3 attachment options:

1 Wall mounting brackets
2 Below the cover screws
3 Knockouts in the enclosure

Enclosures with knockouts for metric screw fastening and assembly are available on request.

Cast aluminium enclosures

Some holes tapped for the attachment of support rails, mounting plates or earthing systems.

Cover with captive screws.
Wall mounting optionally
- below the cover
- via wall mounting bracket (available as an accessory).

Hole drilling and assembly of the cable glands (see page 972) available on request.

Features

Terminal boxes KL with and without gland plate

NEW: Cover may be opened and securely locked in a flash, with the new quick-action screw. $^1/_4$ turn instead of thread ensures correct contact pressure of the seal.

Support rail TS 35/7.5 for better use of the depth, optionally attached at the bottom or via the profile strips on both sides with self-tapping screws.

Electrophoretic dipcoat priming and powder coating – reliable surface protection thanks to even coating in all the corners and edges.

E-Box

The “E-Box” supplied as standard with mounting plate, 180° hinge and double-bit lock system.

Lock insert exchangeable or prepared for a lead seal with lock cover as an accessory – see page 890.

The highly elastic foamed-in PU seal guarantees perfect sealing. High protection category IP 66 to EN 60 529/10.91.

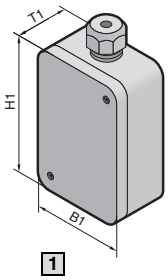
Bus enclosure

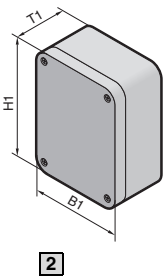
Door hinged at the bottom or side. Hinges with 180° opening angle, may be unscrewed from the inside.

Viewing window made from Macrolon with recess set flush into the metal.

Bus modules of virtually all makes may be attached via the built-in support rails. Upon request also with fitted cable glands, see page 972.

Polycarbonate enclosures PK





Material:
Grey enclosure and cover (version .000) from fibreglass-reinforced polycarbonate, transparent cover (version .100) from polycarbonate,
cover screws from polyamide,
insulating bungs from polyethylene.

Colour:
RAL 7035

Protection category:
IP 66 to EN 60 529/10.91

Supply includes:
Enclosure and cover,
cover screws,
insulating bung for wall mounting screws (not with 9530.000 and 9531.000),
all-round foamed-in PU seal.

Approvals,
see page 22.

Detailed drawing,
see page 1079.

Width (B1) in mm		50	50	65	65	94	94	94	94	Page
Height (H1) in mm		52	65	65	65	65	65	94	94	
Depth (T1) in mm		35	35	57	81	57	81	57	81	
1 **Model No. PK with cable gland**		**9530.000**	**9531.000**	**–**	**–**	**–**	**–**	**–**	**–**	
2 **Model No. PK with grey cover**		**–**	**–**	**9500.000**	**9501.000**	**9502.000**	**9503.000**	**9504.000**	**9505.000**	
Model No. PK with transparent cover		**–**	**–**	**–**	**–**	**–**	**–**	**9504.100**	**–**	
Packs of		10	10	12	12	8	8	6	6	
Accessories										
Mounting plate		9551.000	9552.000	9540.000		9541.000		9542.000		102
Packs of		10	10	12		12		12		
Support rail (Packs of 12)										
TS 15/5.5	Installation in the width	–	–	9560.000		9561.000		9561.000		103
	Installation in the height	–	–	–		9560.000		9561.000		103
TS 35/7.5	Installation in the width	–	–	–		–		9564.000		103
	Installation in the height	–	–	–		–		9564.000		103

Width (B1) in mm		110	110	130	130	130	130	180	180	Page
Height (H1) in mm		110	110	94	94	130	130	94	94	
Depth (T1) in mm		66	90	57	81	75	99	57	81	
2 **Model No. PK with grey cover**		**9506.000**	**9507.000**	**9508.000**	**9509.000**	**9510.000**	**9511.000**	**9512.000**	**9513.000**	
Model No. PK with transparent lid		**9506.100**	**9507.100**	**9508.100**	**9509.100**	**9510.100**	**9511.100**	**9512.100**	**9513.100**	
Packs of		6	6	4	4	4	4	2	2	
Accessories										
Mounting plate		9543.000		9544.000		9545.000		9546.000		102
Packs of		12		12		10		10		
Support rail (Packs of 12)										
TS 15/5.5	Installation in the width	9562.000		9563.000		9563.000		–		103
	Installation in the height	9562.000		9561.000		9563.000		9561.000		103
TS 35/7.5	Installation in the width	9564.000		9565.000		9565.000		9566.000		103
	Installation in the height	9564.000		9564.000		9565.000		9564.000		103

Cable gland, polyamide,
Model No. see page 972.

Wall mounting bracket,
Model No. see page 103.

External mounting bracket,
Model No. see page 102.

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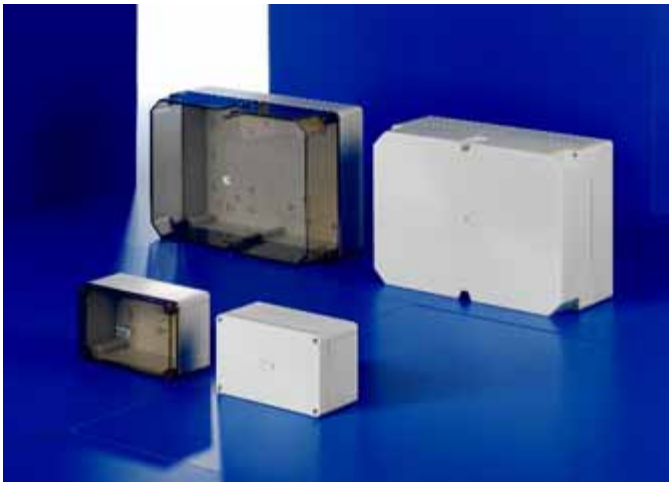
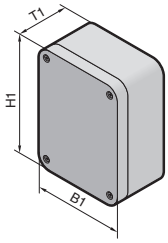




Material:
Grey enclosure and cover (version .000) from fibreglass-reinforced polycarbonate, transparent cover (version .100) from polycarbonate, cover screws from polyamide, insulating bungs from polyethylene.

Colour:
RAL 7035

Protection category:
IP 66 to EN 60 529/10.91

Supply includes:
Enclosure and cover,
cover screws,
insulating bungs for wall mounting screws,
all-round foamed-in PU seal.

Approvals,
see page 22.

Detailed drawing,
see page 1079.

Width (B1) in mm	180	180	180	182	182	182	Page
Height (H1) in mm	110	110	110	180	180	180	
Depth (T1) in mm	90	111	165	90	111	165	
Model No. PK with grey cover	**9514.000**	**9515.000**	**9516.000**	**9517.000**	**9518.000**	**9519.000**	
Model No. PK with transparent cover	**9514.100**	**9515.100**	**9516.100**	**9517.100**	**9518.100**	**9519.100**	
Packs of	2	2	2	1	1	1	
Accessories							
Mounting plate	9547.000			9548.000			102
Packs of	10			10			
Support rail TS 35/7.5 (Packs of 12)							
Installation in the width	9566.000			9566.000			103
Installation in the height	9564.000			9566.000			103

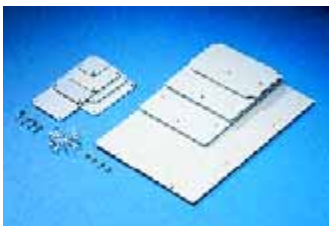
Width (B1) in mm	254	254	254	360	360	Page
Height (H1) in mm	180	180	180	254	254	
Depth (T1) in mm	90	111	165	111	165	
Model No. PK with grey cover	**9520.000**	**9521.000**	**9522.000**	**9523.000**	**9524.000**	
Model No. PK with transparent cover	**9520.100**	**9521.100**	**9522.100**	**9523.100**	**9524.100**	
Packs of	1	1	1	1	1	
Accessories						
Mounting plate	9549.000			9550.000		102
Packs of	8			4		
Support rail TS 35/7.5 (Packs of 12)						
Installation in the width	9567.000			9568.000		103
Installation in the height	9566.000			9567.000		103

Hinges,
Model No. see page 102.

Turn-lock fastener,
Model No. see page 102.

Accessories Page 832

Accessories



Mounting plate

For individual configuration of the enclosure interior, the mounting plate offers a stable, secure and flexible design option.

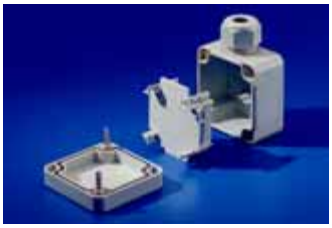
Design:
Melamine phenol-coated laminated paper, 2.5 mm thick.

Colour:
RAL 7035

Supply includes:
Self-tapping assembly screws.

To fit	Width mm	Height mm	Packs of	Model No. PK
PK 9500.000/PK 9501.000	45	45	12	**9540.000**[1)]
PK 9502.000/PK 9503.000	74	45	12	**9541.000**[1)]
PK 9504.000/PK 9505.000	74	74	12	**9542.000**[1)]
PK 9506.000/PK 9507.000	90	90	12	**9543.000**[1)]
PK 9508.000/PK 9509.000	110	74	12	**9544.000**[1)]
PK 9510.000/PK 9511.000	110	110	10	**9545.000**
PK 9512.000/PK 9513.000	160	74	10	**9546.000**
PK 9514.000/PK 9515.000/PK 9516.000	150	90	10	**9547.000**
PK 9517.000/PK 9518.000/PK 9519.000	150	150	10	**9548.000**
PK 9520.000/PK 9521.000/PK 9522.000	220	150	8	**9549.000**
PK 9523.000/PK 9524.000	331	220	4	**9550.000**

[1)] with spacers



Mounting plate

for polycarbonate enclosures
- PK 9530.000
- PK 9531.000

Via a 3-way depth-adjustable assembly component, the mounting plate may also be used as an inner cover for installed equipment.

Material:
Polycarbonate

For enclosure	Packs of	Model No. PK
9530.000	10	**9551.000**
9531.000	10	**9552.000**

Supply includes:
Assembly parts.

Turn-lock fastener

A quick, convenient screw fastening aid is obtained by clipping into the head of the lid screw.

Material:
Polyamide

Supply includes:
1 pack

	Packs of	Model No. PK
For all enclosures	100	**9582.000**

Hinges

For hinged attachment of lids.
The supplied drilling template ensures problem-free assembly.

Supply includes:
1 set =
2 hinges,
4 assembly screws,
3 polyethylene sealing bungs,
1 drilling template.

For enclosure	Material	Packs of	Model No. PK
PK 9500.000 – PK 9513.000	Polycarbonate	10 sets	**9580.000**
PK 9514.000 – PK 9524.000	Polystyrene	10 sets	**9581.000**

External mounting bracket

To fit enclosure
- PK 9530.000
- PK 9531.000

With moulded lug for cable tie.

Material:
Polyamide

Supply includes:
Assembly parts.

Packs of	Model No. PK
10	**9553.000**

Wall mounting brackets

The enclosure can be screwed to the wall using four wall mounting brackets. The bracket is securely attached to the enclosure by means of pins.

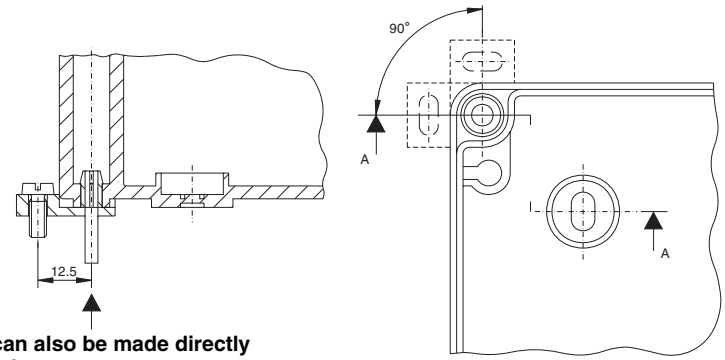
Material:
Polyamide, grey

Supply includes:
1 pack

	Packs of	Model No. PK
For all enclosures	40	**9583.000**

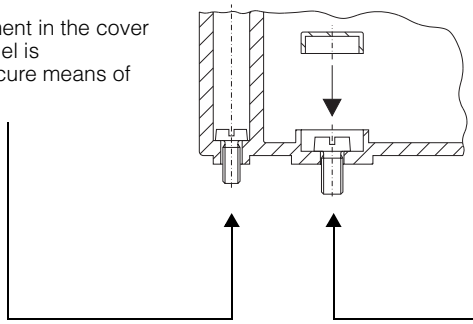
The assembly screw is located in the wall mounting bracket, making it accessible at all times.

The wall mounting bracket may be fitted to the side or top.



Wall attachment can also be made directly without the bracket:

Variant 1
Wall attachment in the cover screw channel is a simple, secure means of attachment.



Variant 2
By knocking out the hole in the enclosure base, mounting in the enclosure interior is also possible.
The screws must be concealed using the sealing bungs supplied with the enclosure. The spacing between the attachment holes is marked on the rear panel of the enclosure.

Support rail

The two support rail sections provide good flexibility for accommodating terminal blocks and installed components.

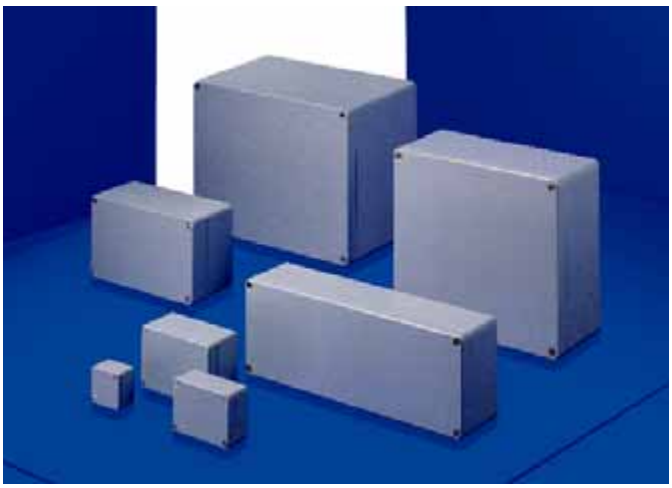
Design:
The support rails are designed in accordance with EN 50 045 (TS 15/5.5) or EN 50 022 (TS 35/7.5); the surface finish is zinc-plated.

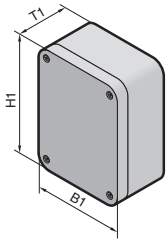
Supply includes:
Two self-tapping assembly screws.

Rail	Maximum number of terminals with the following terminal sizes			Bar length mm	Packs of	Model No. PK
	2.5 mm²	4 mm²	10 mm²			
TS 15/5.5	5	5	4	49.5	12	**9560.000**
	11	11	8	80	12	**9561.000**
	14	14	10	92	12	**9562.000**
	18	18	13	111	12	**9563.000**
TS 35/7.5	12	9	5	81	12	**9564.000**
	17	13	8	106	12	**9565.000**
	24	20	11	144	12	**9566.000**
	38	32	19	216	12	**9567.000**
	61	50	30	336	12	**9568.000**

Calculation of the maximum number of terminals is based on two end holders and a cover.

Cast aluminium enclosures GA





Material:
Enclosure and lid made from cast aluminium, lid with neoprene cord seal.

Surface finish:
Smooth spray finish similar to RAL 7001

Protection category:
IP 67 to EN 60 529/10.91, complies with NEMA 4.

Supply includes:
2 or 4 cover screws, captive mounted
2 or 4 screws for the attachment of support rails, mounting plates etc.
1 screw for connection of the PE conductor.

Rittal service:

Individual standard solutions for enclosures and covers
- Hole drilling
- Thread tapping
- Milling
- Screen printing
- Engraving
- Choice of RAL colours and other surface finishes available on request.

Detailed drawing,
see page 1080.

Width (B1) in mm		50	58	98	150	75	125	175	250	122	Page
Height (H1) in mm		45	64	64	64	80	80	80	80	120	
Depth (T1) in mm		30	36	36	36	57	57	57	57	80	
Model No. GA		**9100.210**	**9101.210**	**9102.210**	**9103.210**	**9104.210**	**9105.210**	**9106.210**	**9107.210**	**9108.210**	
Packs of		6	5	3	2	1	1	1	1	1	
Accessories											
Mounting plate		–	–	–	–	–	9105.700	9106.700	9107.700	9108.700	105
Packs of		–	–	–	–	–	10	10	5	2	
Support rail[1)]	TS 15/5.5 (Packs of 10)	–	–	–	–	–	9105.150	9106.150	9107.150	–	105
	TS 35/7.5 (Packs of 5)	–	–	–	–	–	–	–	–	9108.350	105
Wall mounting brackets (Packs of 2)		–	–	–	–	–	–	–	–	9121.122	106
Exterior hinge (Packs of 2)		–	–	–	–	–	9123.100	9123.100	9123.100	9123.000	106

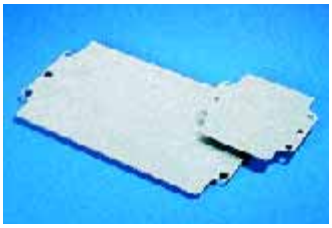
Width (B1) in mm		220	360	160	260	360	200	280	330	330	Page
Height (H1) in mm		120	122	160	160	160	230	230	230	230	
Depth (T1) in mm		90	80	90	90	90	110	110	110	180	
Model No. GA		**9110.210**	**9111.210**	**9112.210**	**9113.210**	**9114.210**	**9116.210**	**9117.210**	**9118.210**	**9119.210**	
Packs of		1	1	1	1	1	1	1	1	1	
Accessories											
Mounting plate		9110.700	9111.700	9112.700	9113.700	9114.700	9116.700	9117.700	9118.700	9119.700	105
Packs of		2	2	2	2	1	1	1	1	1	
Support rail[1)]	TS 35/7.5 (Packs of 5)	9110.350	9111.350	9112.350	9113.350	9111.350	9116.350	9117.350	9118.350	9118.350	105
Wall mounting brackets (Packs of 2)		9121.122	9121.122	9121.160	9121.160	9121.160	9121.230	9121.230	9121.230	9121.230	106
Exterior hinge (Packs of 2)		9123.000	9123.000	9123.000	9123.000	9123.000	9123.000	9123.000	9123.000	9123.000	106

[1)] Installation in the width

Cable gland, brass,
Model No. see page 972.

Cover screws prepared for a lead seal,
Model No. see page 106.

Accessories Page 832



Mounting plate

for universal interior installation.

Material:
Sheet steel, zinc-plated, passivated, with attachment holes.

Exterior dimensions (mm)		For enclosure	Packs of	**Model No. GA**
Width	Height			
114	69	GA 9105.210	10	**9105.700**
164	69	GA 9106.210	10	**9106.700**
239	69	GA 9107.210	5	**9107.700**
109	107	GA 9108.210	2	**9108.700**
207	107	GA 9110.210	2	**9110.700**
347	107	GA 9111.210	2	**9111.700**
144	142	GA 9112.210	2	**9112.700**
245	142	GA 9113.210	2	**9113.700**
346	142	GA 9114.210	1	**9114.700**
183	214	GA 9116.210	1	**9116.700**
264	214	GA 9117.210	1	**9117.700**
314	214	GA 9118.210/GA 9119.210	1	**9118.700**

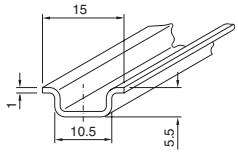
Support rail

To accommodate terminal blocks or other installed equipment.

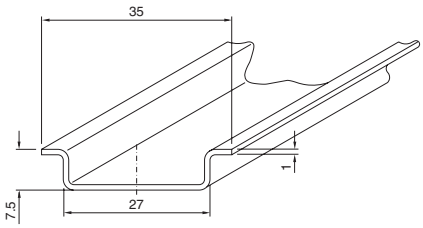
Material:
Sheet steel, zinc-plated, passivated, with attachment holes.

Rail	Maximum number of terminals with the following terminal sizes			Rail length available for population mm	For enclosure width mm	Packs of	**Model No. GA**
	2.5 mm²	4 mm²	10 mm²				
TS 15/5.5 to EN 50 045	15	15	12	95	125	10	**9105.150**
	27	22	19	145	175	10	**9106.150**
	42	35	29	220	250	10	**9107.150**
TS 35/7.5 to EN 50 022	12	12	9	80	122	5	**9108.350**
	18	18	14	115	160	5	**9112.350**
	25	25	18	155	200	5	**9116.350**
	29	29	21	180	220	5	**9110.350**
	34	34	26	215	260	5	**9113.350**
	37	37	28	230	280	5	**9117.350**
	46	46	35	290	330	5	**9118.350**
	51	51	39	320	360	5	**9111.350**

TS 15/5.5



TS 35/7.5



Accessories

Wall mounting bracket

For external mounting to surfaces – no need to dismantle the lid if pre-assembled.

Material:
Sheet steel, zinc-plated, passivated

For enclosure	Packs of	Model No. GA
GA 9108.210/ GA 9110.210/ GA 9111.210	2	**9121.122**
GA 9112.210/ GA 9113.210/ GA 9114.210	2	**9121.160**
GA 9116.210/ GA 9117.210/ GA 9118.210/ GA 9119.210	2	**9121.230**

Hinge, exterior

For fastening the lid to the enclosure base, complete with drilling template.

Material:
Die-cast aluminium

Colour:
RAL 7001

For enclosure	Packs of	Model No. GA
GA 9105.210/ GA 9106.210/ GA 9107.210	2 + 8 screws	**9123.100**
GA 9108.210/ GA 9110.210/ GA 9111.210/ GA 9112.210/ GA 9113.210/ GA 9114.210/ GA 9116.210/ GA 9117.210/ GA 9118.210/ GA 9119.210	2 + 8 screws	**9123.000**

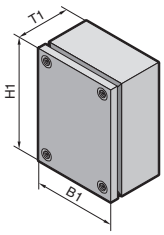
Cover screws, prepared for lead seal

to protect against unauthorised opening.
Two per cover are required.

Material:
Stainless steel

For enclosure	Packs of	Model No. GA
GA 9104.210/ GA 9105.210/ GA 9106.210/ GA 9107.210	6	**9122.424**

without gland plate, depth: 80



Material:
Enclosure: Sheet steel 1.25 mm
Cover: Sheet steel 1.25 mm

Surface finish:
Case and cover:
Dipcoat-primed,
powder-coated on the outside
in textured RAL 7035

Protection category:
IP 66 to EN 60 529/10.91,
Complies with NEMA 4.

Supply includes:
Enclosure, cover with all-round foamed-in PU seal and cover screws, including plastic bushes.

Approvals,
see page 23.

Detailed drawing,
see page 1081.

Width (B1) in mm	Packs of	150	200	200	300	300	400	600	Page
Height (H1) in mm		150	150	200	150	200	200	200	
Depth (T1) in mm		80	80	80	80	80	80	80	
Model No. KL	1	**1514.510**	**1528.510**	**1516.510**	**1515.510**	**1517.510**	**1518.510**	**1519.510**	
Weight (kg)		1.4	1.6	1.9	2.1	2.6	3.2	4.6	
Accessories									
Mounting plate	1	1560.700	1575.700	1562.700	1561.700	1563.700	1564.700	1566.700	909
Support rail TS 35/7.5	10	2314.000	2315.000	2315.000	2316.000	2316.000	2317.000	–	927
Support rail TS 35/15	10	–	–	–	–	–	–	2319.000	927
Cover retainer	3 pairs	1591.000	1591.000	1591.000	1591.000	1591.000	1591.000	1591.000	–
Cover hinge	6	1592.000	1592.000	1592.000	1592.000	1592.000	1592.000	1592.000	894

To order terminal boxes in textured RAL 7032 please add extension .210 to the Model No., and for primed terminal boxes use extension .310.
Delivery times available on request.

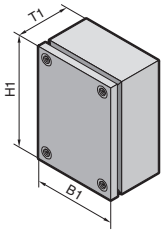
Double-membrane gland, stepped collar for cable entry, Model No. see page 973.

Cover retainer
The cover retainer KL 1591.000 is easily fitted without drilling, and allows the covers to be opened upwards, even when the terminal box below is bayed.

Accessories Page 832 **KL stainless steel** Page 270 **KL Premium Line stainless steel** Page 271 **KL EMC-shielded** Page 290 **KL Ex-proof** Page 287

Terminal boxes KL

without gland plate, depth: 120



Material:
Enclosure: Sheet steel 1.25 mm; 1.38 mm for KL 1507.510 to KL 1513.510
Cover: Sheet steel 1.25 mm

Surface finish:
Case and cover: Dipcoat-primed, powder-coated on the outside in textured RAL 7035

Protection category:
IP 66 to EN 60 529/10.91, Complies with NEMA 4.

Supply includes:
Enclosure, cover with all-round foamed-in PU seal and cover screws, including plastic bushes.

Approvals,
see page 23.

Detailed drawing,
see page 1081.

Width (B1) in mm	Packs of	150	200	200	300	300	300	400	400	400	400	Page
Height (H1) in mm		150	150	200	150	200	300	150	200	300	400	
Depth (T1) in mm		120	120	120	120	120	120	120	120	120	120	
Model No. KL	1	**1500.510**	**1529.510**	**1502.510**	**1501.510**	**1503.510**	**1507.510**	**1589.510**	**1504.510**	**1508.510**	**1511.510**	
Weight (kg)		1.6	1.8	2.3	2.6	3.0	4.0	3.2	3.6	4.8	6.2	
Accessories												
Mounting plate	1	1560.700	1575.700	1562.700	1561.700	1563.700	1567.700	1576.700	1564.700	1568.700	1571.700	909
Support rail TS 35/7.5	10	2314.000	2315.000	2315.000	2316.000	2316.000	2316.000	2317.000	2317.000	2317.000	2317.000	927

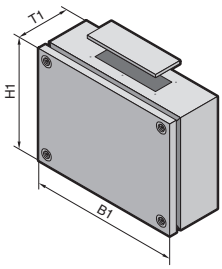
Width (B1) in mm	Packs of	500	500	600	600	600	800	800	Page
Height (H1) in mm		200	300	200	300	400	200	400	
Depth (T1) in mm		120	120	120	120	120	120	120	
Model No. KL	1	**1505.510**	**1509.510**	**1506.510**	**1510.510**	**1512.510**	**1527.510**	**1513.510**	
Weight (kg)		4.4	5.8	5.7	6.8	8.4	6.8	11.0	
Accessories									
Mounting plate	1	1565.700	1569.700	1566.700	1570.700	1572.700	1574.700	1573.700	909
Support rail TS 35/15	10	2318.000	2318.000	2319.000	2319.000	2319.000	–	–	927
Cover retainer	3 pairs	1591.000	1591.000	1591.000	1591.000	1591.000	1591.000	1591.000	107
Cover hinge	6	1592.000	1592.000	1592.000	1592.000	1592.000	1592.000	1592.000	894

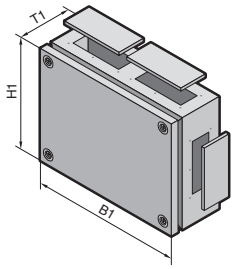
To order terminal boxes in textured RAL 7032 please add extension .210 to the Model No., and for primed terminal boxes use extension .310.
Delivery times available on request.

Cable gland and multi-seal inserts,
Model No. see page 972 – 973.

Accessories Page 832 **KL stainless steel** Page 270 **KL Premium Line stainless steel** Page 271 **KL EMC-shielded** Page 290 **KL Ex-proof** Page 287

with gland plate, depth 120





Material:
Enclosure: Sheet steel 1.38 mm; 1.25 mm for KL 1530.510 to KL 1534.510 and KL 1542.510
Cover: Sheet steel 1.25 mm

Surface finish:
Case and cover: Dipcoat-primed, powder-coated on the outside in in textured RAL 7035

Protection category:
IP 55 to EN 60 529/10.91, Complies with NEMA 12.

Supply includes:
Enclosures with gland apertures, cover with foamed-in special seal and cover screws including plastic bushes, sheet steel gland plates with seals and assembly parts.

Approvals,
see page 23.

Detailed drawing,
see page 1081.

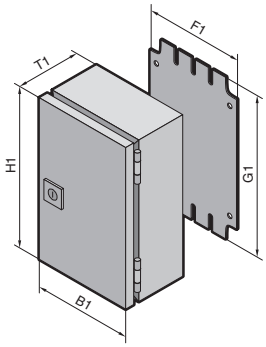
Width (B1) in mm	Packs of	300	300	300	400	400	400	Page
Height (H1) in mm		150	200	300	200	300	400	
Depth (T1) in mm		120	120	120	120	120	120	
Model No. KL	1	**1530.510**	**1531.510**	**1535.510**	**1532.510**	**1536.510**	**1539.510**	
Weight (kg)		2.7	3.3	4.5	4.0	5.2	6.7	
Accessories								
Mounting plate	1	1561.700	1563.700	1567.700	1564.700	1568.700	1571.700	909
Gland plate (top + bottom)		1 + 1	1 + 1	1 + 1	1 + 1	1 + 1	1 + 1	
Gland plate (left + right)		–	–	1 + 1	–	1 + 1	1 + 1	
Support rail TS 35/7.5	10	2316.000	2316.000	2316.000	2317.000	2317.000	2317.000	927

Width (B1) in mm	Packs of	500	500	600	600	600	800	800	Page
Height (H1) in mm		200	300	200	300	400	200	400	
Depth (T1) in mm		120	120	120	120	120	120	120	
Model No. KL	1	**1533.510**	**1537.510**	**1534.510**	**1538.510**	**1540.510**	**1542.510**	**1541.510**	
Weight (kg)		4.9	5.2	5.9	7.7	9.0	7.2	12.0	
Accessories									
Mounting plate	1	1565.700	1569.700	1566.700	1570.700	1572.700	1574.700	1573.700	909
Gland plate (top + bottom)		2 + 2	2 + 2	2 + 2	2 + 2	2 + 2	3 + 3	3 + 3	
Gland plate (left + right)		–	1 + 1	–	1 + 1	1 + 1	–	1 + 1	
Support rail TS 35/15	10	2318.000	2318.000	2319.000	2319.000	2319.000	–	–	927
Cover retainer	3 pairs	1591.000	1591.000	1591.000	1591.000	1591.000	1591.000	1591.000	107
Cover hinge	6	1592.000	1592.000	1592.000	1592.000	1592.000	1592.000	1592.000	894

To order terminal boxes in textured RAL 7032 please add extension .210 to the Model No., and for primed terminal boxes use extension .310.
Delivery times available on request.

Accessories Page 832 **KL stainless steel** Page 270 **KL Premium Line stainless steel** Page 271 **KL EMC-shielded** Page 290 **KL Ex-proof** Page 287

E-Box EB



Material:
Sheet steel
Enclosure: 1.25 mm
1.38 mm for
EB 1555.500, EB 1556.500,
EB 1577.500 to EB 1579.500

Surface finish:
Enclosure and door:
Dipcoat-primed,
powder-coated on the outside in
textured RAL 7035
Mounting plate: Zinc-plated

Protection category:
IP 66 to EN 60 529/10.91

Supply includes:
Enclosure with mounting plate, door including 180° hinges and cam lock with double-bit insert.

Approvals,
see page 23.

Detailed drawing,
see page 1082.

Depth 80 mm

Width (B1) in mm	Packs of	150	150	200	200	200
Height (H1) in mm		150	300	200	300	400
Depth (T1) in mm		80	80	80	80	80
Mounting plate width (F1) in mm		125	125	175	175	175
Mounting plate height (G1) in mm		135	285	185	285	385
Model No. EB	1	**1551.500**	**1545.500**	**1546.500**	**1552.500**	**1547.500**
Weight (kg)		1.7	2.6	2.4	3.2	4.4

Depth 120 mm

Width (B1) in mm	Packs of	150	150	200	200	200	300	300	200
Height (H1) in mm		150	300	200	300	400	300	400	500
Depth (T1) in mm		120	120	120	120	120	120	120	120
Mounting plate width (F1) in mm		125	125	175	175	175	275	275	175
Mounting plate height (G1) in mm		135	285	185	285	385	285	385	485
Model No. EB	1	**1553.500**	**1548.500**	**1549.500**	**1554.500**	**1550.500**	**1555.500**	**1556.500**	**1557.500**
Weight (kg)		2.0	3.0	2.8	3.6	5.0	5.0	6.4	6.2

Depth 155 mm

Width (B1) in mm	Packs of	300	300	300
Height (H1) in mm		400	600	800
Depth (T1) in mm		155	155	155
Mounting plate width (F1) in mm		275	275	275
Mounting plate height (G1) in mm		385	585	785
Model No. EB	1	**1577.500**	**1578.500**	**1579.500**
Weight (kg)		7.1	11.0	13.2

Lock systems

Standard double-bit lock insert may be exchanged for lock inserts, type A, see page 888,
lock cylinder inserts, plastic handles and T handles, type B, see page 886 – 889.

To order terminal boxes in textured RAL 7032 please add extension .600 to the Model No., and for primed terminal boxes use extension .310.
Delivery times available on request.

Accessories Page 832 **E-Box, EMC-shielded** Page 290

Bus enclosure

Material:
Sheet steel
Enclosure: 1.38 mm
Door: 1.5 mm
Viewing window made from polycarbonate, 4 mm

Surface finish:
Enclosure and door:
powder-coated in textured RAL 7035

Protection category:
IP 65 to EN 60 529/10.91

Supply includes:
Door hinged on the left,
1 cam lock with double-bit insert,
2 (1) support rail(s) TS 35/7.5 (for BG 1586.510).
Drilled holes for cable glands in the base.

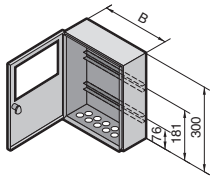
Approvals,
see page 24.

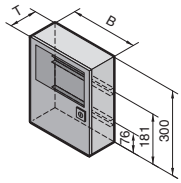
Dimensions mm			PG version						Metric version			
			Number of PG holes					Model No. BG	Number of metric holes			Model No. BG
W	H	D	9	11	13.5	16	21		M12	M20	M25	
200	300	80	1	8	–	1	1	**1583.510**	9	–	2	**1583.520**
300	300	80	1	14	–	1	1	**1584.510**	15	–	2	**1584.520**
400	300	80	1	18	–	1	2	**1585.510**	19	–	3	**1585.520**
500	300	80	3	–	24	–	–	**1586.510**	3	24	–	**1586.520**

Lock systems

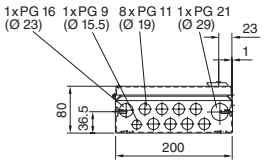
Standard double-bit lock insert may be exchanged for lock inserts, type A, see page 888 and plastic handles, type B, see page 886.

To order enclosures in RAL 7032, please add the extension .210 or .220 to the Model No.
Delivery times available on request.

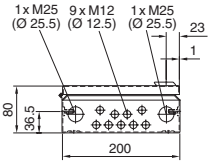


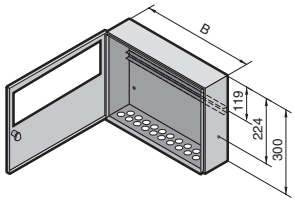


PG
BG 1583.510

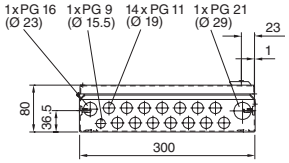


Metric
BG 1583.520

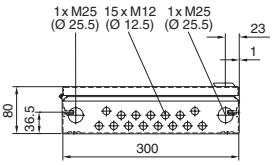


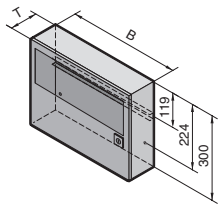


BG 1584.510

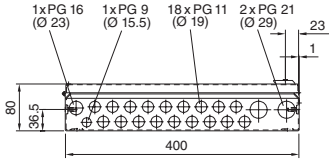


BG 1584.520

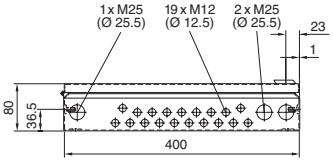




BG 1585.510

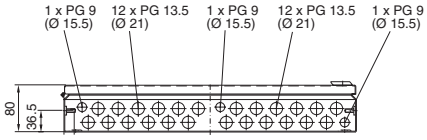


BG 1585.520

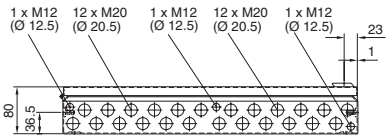


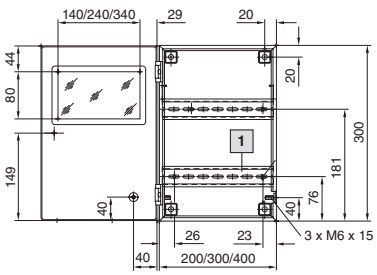
B = Width
T = Depth

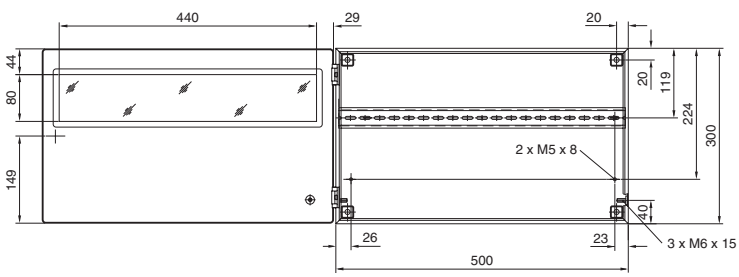
BG 1586.510



BG 1586.520







1 Not applicable to BG1586.510

Bus enclosure

Material:
Sheet steel
Enclosure: 1.38 mm
Door: 1.5 mm
Viewing window made from polycarbonate, 4 mm

Surface finish:
Enclosure and door:
Powder-coated in textured RAL 7035

Protection category:
IP 65 to EN 60 529/10.91

Supply includes:
Door with r/h hinge,
1 cam lock with double-bit insert,
1 support rail TS 35/7.5.
Drilled holes for cable glands in the base.

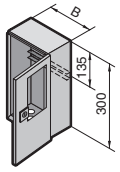
Approvals,
see page 24.

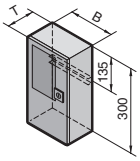
Dimensions mm			PG version					Metric version				
			Number of PG holes				Model No. BG	Number of metric holes				Model No. BG
W	H	D	9	13.5	29	36		M12	M20	M32	M50	
200	300	120	2	–	5	–	**1605.510**	2	–	5	–	**1605.520**
400	300	120	–	2	9	1	**1606.510**	–	2	9	1	**1606.520**

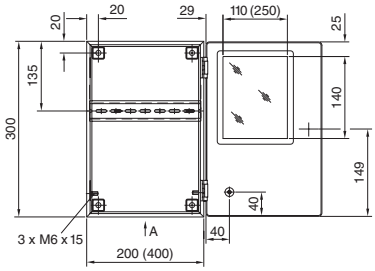
Lock systems

Standard double-bit lock insert may be exchanged for lock inserts, type A, see page 888 and plastic handles, type B, see page 886.

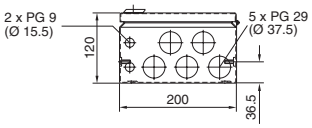
To order enclosures in RAL 7032, please add the extension .210 or .220 to the Model No.
Delivery times available on request.



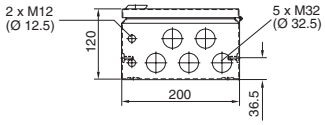




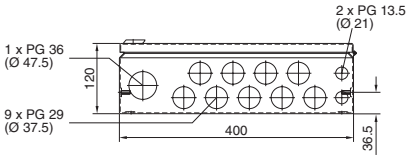
BG 1605.510



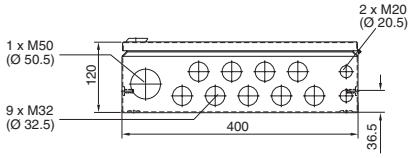
BG 1605.520



BG 1606.510



BG 1606.520



B = Width
T = Depth

Bus enclosure

Material:
Sheet steel
Enclosure: 1.38 mm
Door: 1.5 mm
Viewing window made from polycarbonate, 4 mm

Surface finish:
Enclosure and door:
Dipcoat-primed, powder-coated in textured RAL 7035

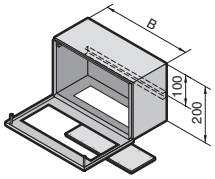
Protection category:
IP 65 to EN 60 529/10.91

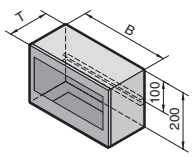
Dimensions in mm			Model No. BG
W	H	D	
400	200	125	**1558.510**
600	200	125	**1559.510**

To order enclosures in RAL 7032, please add the extension .210 to the Model No.
Delivery times available on request.

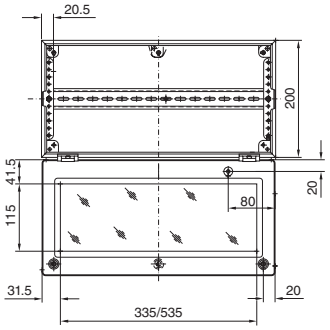
Supply includes:
Door with bottom hinge,
2 (3) quick-release fasteners for screwdrivers (with BG 1559.510),
1 support rail TS 35/7.5,
1 gland plate at bottom.
Holes for cable glands in the gland plate or directly in the enclosure available on request.

Approvals,
see page 24.

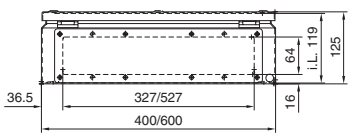




B = Width
T = Depth



i.L. = Clearance width



Bus enclosure

Material:
Sheet steel
Enclosure: 1.38 mm
Door: 1.5 mm
Polycarbonate viewing window
Zinc-plated mounting plate

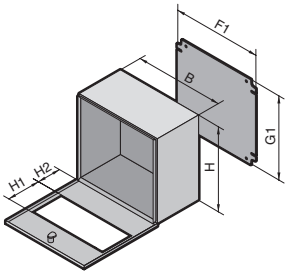
Surface finish:
Enclosure and door:
Powder-coated in textured RAL 7035

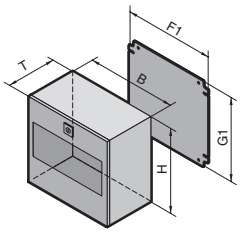
Supply includes:
Door with bottom hinge,
cam lock with double-bit insert
may be exchanged for lock inserts,
type A, page 888 and plastic handles, type B,
page 886.

Approvals,
see page 24.

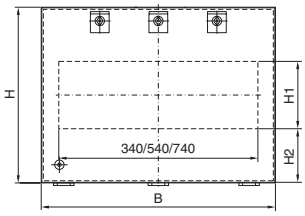
Dimensions in mm					Cam lock	Model No. BG
Enclosure			Mounting plate			
W	H	D	F1	G1		
400	300	155	385	275	1	**1577.500**
600	300	155	585	275	2	**1578.500**
800	300	155	785	275	2	**1579.500**

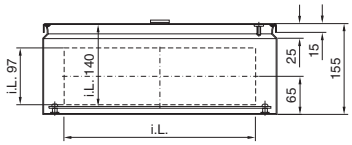
To order enclosures in RAL 7032, please add extension .600 to the Model No.
Delivery times available on request.





B = Width
T = Depth
i.L. = Clearance width



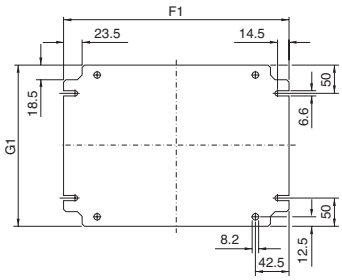


Bus enclosure modifications

Viewing window and gland plates – see table.

Height of viewing window mm		Gland plate cutout[2] at bottom (clearance width) mm	Model No. BG	
H1	H2		Basic	Extension
		327 x 97	**1577.**	
		527 x 97	**1578.**	
		2 off 327 x 97	**1579.**	
115	92	–		**.520[1]**
190	42	–		**.530[1]**
115	92	■		**.550[1]**
190	42	■		**.560[1]**
155	92	–		**.450[1]**

[1] Extended delivery times.
[2] Gland plates 14 mm larger all-round.



Bus enclosure

Material:
Sheet steel
Enclosure: 1.38 mm
Door: 1.5 mm
Viewing window made from polycarbonate, 4 mm

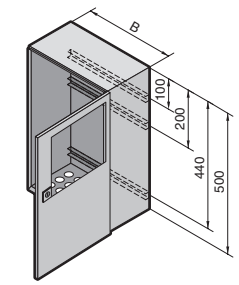
Surface finish:
Enclosure and door:
Powder-coated in textured RAL 7035

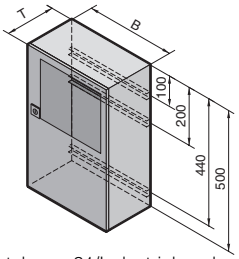
Approvals,
see page 24.

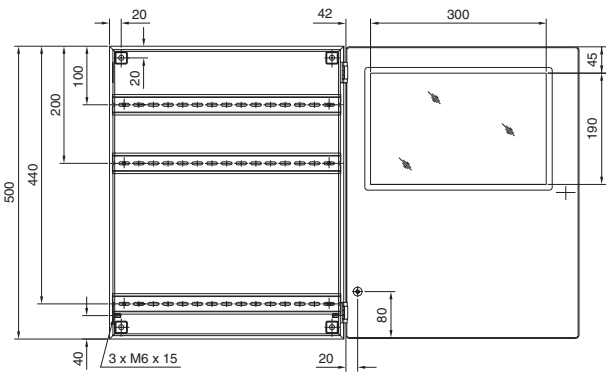
Dimensions in mm			Number of holes for PG 13.5 or M20	Model No. BG
W	H	D		
400	500	160	33	**1611.510**

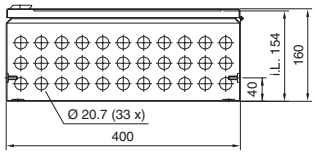
To order enclosures in RAL 7032, please add the extension .210 to the Model No.
Delivery times available on request.

Supply includes:
Door with r/h hinge,
1 cam lock with 3 mm double-bit insert, may be exchanged for type A lock inserts, page 888 and type B plastic handles, page 886.
3 support rails TS 35/7.5.
Drilled holes for cable glands in the base.









B = Width
T = Depth
i.L. = Clearance width

Bus enclosure

Material:
Sheet steel
Enclosure: 1.38 mm
Door: 1.5 mm
Viewing window made from polycarbonate, 4 mm

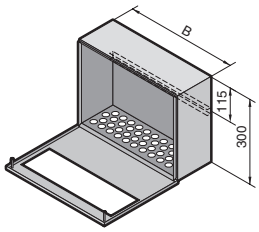
Surface finish:
Enclosure and door:
Powder-coated in textured RAL 7035

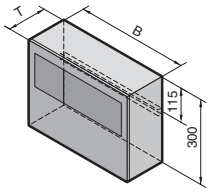
Approvals,
see page 24.

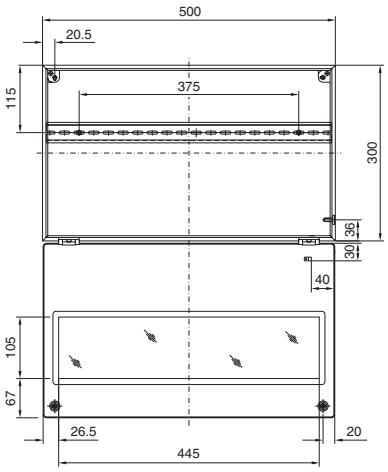
Dimensions in mm			Number of holes for PG 13.5 or M20	Model No. BG
W	H	D		
500	300	120	48	**1609.510**

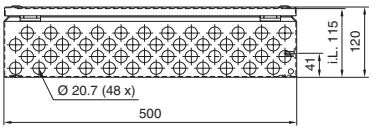
To order enclosures in RAL 7032, please add the extension .210 to the Model No.
Delivery times available on request.

Supply includes:
Door with bottom hinge,
2 quick-release fasteners for screwdrivers,
1 support rail TS 35/7.5.
Drilled holes for cable glands in the base.









B = Width
T = Depth
i.L. = Clearance width

Bus enclosure

for modular cable entry

Material:
Sheet steel
Enclosure: 1.38 mm
Door: 1.5 mm
Viewing window made from polycarbonate, 4 mm

Surface finish:
Enclosure and door:
Powder-coated in textured RAL 7035

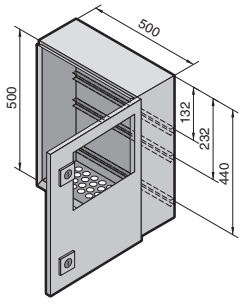
Protection category:
IP 55 to EN 60 529/10.91
(in conjunction with module plates)

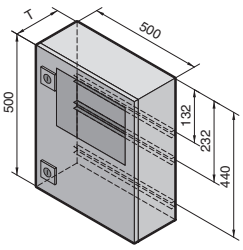
Approvals,
see page 24.

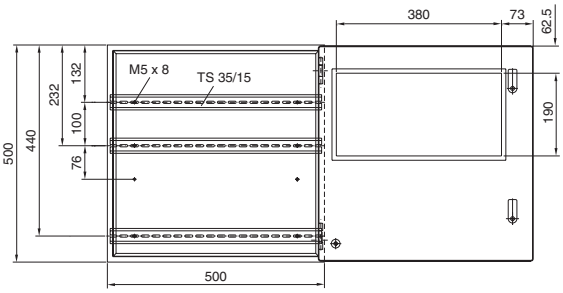
Width mm	Height mm	Depth mm	Model No. BG
500	500	210	**1050.900**

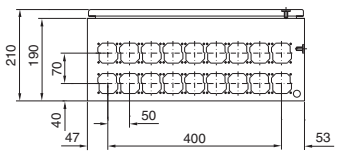
Supply includes:
18 cutouts in the base for module plates,
Pre-configured top-hat rail for bus systems (I/O modules, motor starters) and terminal blocks.
Door with viewing panel for visual monitoring of the installed components.

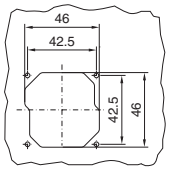
Also required:
Module plates,
see page 969.











B = Width
T = Depth

Compact enclosures

Features

The major success of Rittal compact enclosures is based on three key advantages:

1. Rittal mass-produced quality with triple surface treatment (phosphating, electrophoretic dipcoat-priming and powder coating).

2. Materials, sizes and variants are tailored to all major requirement profiles.

3. Superior value for money and virtually unlimited solution diversity thanks to Rittal system accessories.

Simply outstanding – everything fits for years to come: Rittal CM and Rittal CL compact system enclosures – compact-class enclosures which are fully compatible with the TS 8 range of system accessories.

For exceptional requirements:

Stainless steel compact enclosures, see page 273.

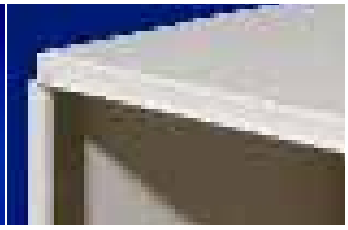
Ex enclosures, see page 286 – 288.

EMC enclosures, see page 289 – 290.

Compact enclosures AE

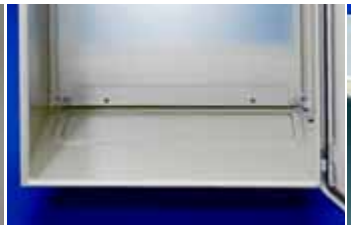
Perforated mounting strips in the door for fast attachment of support strips, cable conduit holders and covers.

Rear panel with holes, prepared for wall mounting bracket or direct wall mounting.



Multi-folded **enclosure protection channel** prevents the ingress of dirt and water when the door is opened.

PE conductor connection facilities on the enclosure, door and mounting plate. See system accessories.



Gland plates made from sheet steel for self-assembly may be exchanged for prepunched plates or plastic plates with membranes.

Triple surface treatment: Phosphating, electrophoretic dipcoat priming, powder coating.

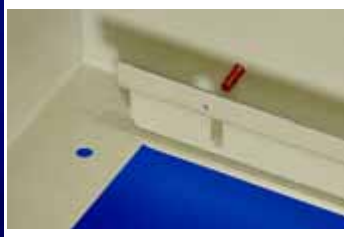
Compact enclosures AE IP 69K

Ideal for **mounting on vehicles:** Lock, hinges and mounting plate are all secured in a vibration-resistant manner.

Resistant to high-pressure cleaning
The silicone seal is protected from direct hosed water by the labyrinth seal of the door and enclosure return edge.

Secure, sealed **wall mounting** from the outside via press-fitted M8 nuts, either directly or using wall mounting brackets 1594.000 and 2433.000, see page 905.

Compact enclosures, Outdoor



Mounting plates
The enclosure is prepared for the installation of an MDF or sheet steel mounting plate. The MDF version is mounted via the mounting brackets.

Roof plate screw-fastened at the correct distance for permanent air circulation. The bonded insulating plate additionally helps to prevent the formation of drips.

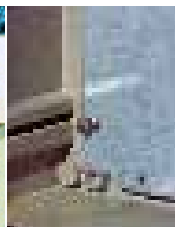
Plastic **handle**, prepared for the installation of semi-cylinders 40 or 45 mm to DIN 18 254.

Compact system enclosures Rittal CM and Rittal CL

Compact Medium Rittal CM
The alternative to large enclosures in the AE series, and a replacement for the AK series. See page 128 – 129.

Compact Large Rittal CL
The economical variant of free-standing enclosures ES 5000. See page 130 – 131.

Plastic enclosures KS



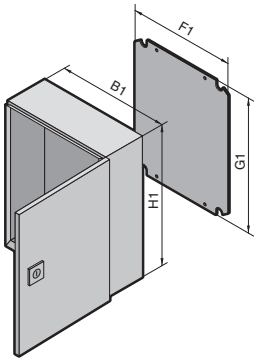
C-sections for infinitely variable mounting plate depth adjustment, and to create several mounting levels.

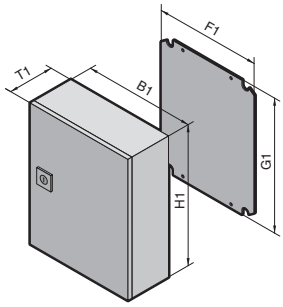
Twin seal on the top and bottom edges of the door in all enclosures, thanks to the integral rain protection strip.

Mounting inserts for threaded inserts in the door and in the rear panel of the enclosure, for simple installation.

Compact enclosures AE

Width: 200 – 600, height: 300 – 400





Material:
Sheet steel

Surface finish:
Enclosure and door:
Dipcoat-primed,
powder-coated on the outside in textured RAL 7035
Mounting plate: Zinc-plated

Protection category:
IP 66 to EN 60 529/10.91,
Complies with NEMA 12
(AE 1032.500, AE 1035.500),
Complies with NEMA 4
(AE 1030.500, AE 1031.500, AE 1380.500, AE 1039.500, AE 1339.500).

Supply includes:
Enclosure of all-round solid construction, single door,
1 gland plate in the enclosure base,
r/h door hinge, may be swapped to opposite side (except with AE 1032.500 and AE 1035.600),
with one cam lock,
foamed-in door seal, mounting plate.

Approvals,
see page 26.

Detailed drawing,
see page 1083.

Width (B1) in mm	Packs of	200	200	300	300	380	380	380	600	600
Height (H1) in mm		300	300	300	400	300	300	380	380	380
Depth (T1) in mm		120	155	210	210	155	210	210	210	350
Mounting plate width (F1) in mm		162	162	254	254	334	334	334	549	549
Mounting plate height (G1) in mm		275	275	275	375	275	275	355	355	355
Mounting plate thickness in mm		2.0	2.0	2.0	2.0	2,.0	2.0	2.0	2.5	2.5
Model No. AE	1	**1032.500**	**1035.500**	**1033.500**	**1034.500**	**1030.500**	**1031.500**	**1380.500**	**1039.500**	**1339.500**
Weight (kg)		4.0	4.5	7.0	8.8	7.4	7.5	9.8	15.4	20.0

Lock systems

Standard double-bit lock insert may be exchanged for 27 mm lock inserts, type A, see page 888, lock cylinder, plastic handles and T handles, type B, see page 886 – 889.

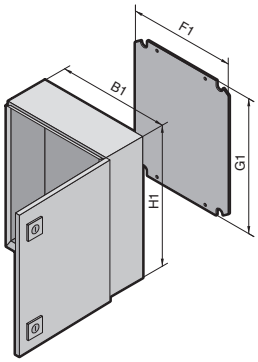
To order enclosures in textured RAL 7032 please add extension .600 to the Model No., and for primed enclosures use extension .800.
Delivery times available on request.

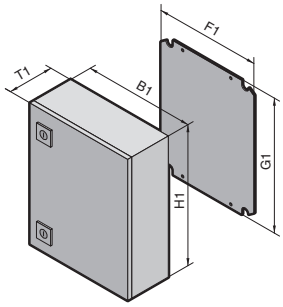
Cable glands
made from polyamide, brass, and multi-seal inserts,
Model No. see page 972/973.

Dust guard trim
for the gap between the door and the enclosure,
Model No. see page 899.

Accessories Page 832 **AE stainless steel** Page 273 **AE IP 69K** Page 121 **AE EMC shielded** Page 290 **AE Ex-proof** Page 287

Width: 380 – 800, height: 500 – 1000





Material:
Sheet steel

Surface finish:
Enclosure and door:
Dipcoat-primed,
powder-coated on the outside in textured RAL 7035
Mounting plate: Zinc-plated

Protection category:
to EN 60 529/10.91:
IP 56,
IP 66 for AE 1038.500, AE 1338.500, AE 1045.500, AE 1050.500, AE 1350.500, AE 1060.500, AE 1360.500,
Complies with NEMA 4.

Supply includes:
Enclosure of all-round solid construction, single door,
1 gland plate in the enclosure base,
r/h door hinge,
may be swapped to opposite side,
with 2 cam locks,
foamed-in door seal,
zinc-plated mounting plate.

Approvals,
see page 26.

Detailed drawing,
see page 1083.

Width (B1) in mm	Packs of	380	380	400	500	500	500	600	600
Height (H1) in mm		600	600	500	500	500	700	600	600
Depth (T1) in mm		210	350	210	210	300	250	210	350
Mounting plate width (F1) in mm		334	334	354	449	449	449	549	549
Mounting plate height (G1) in mm		570	570	475	470	470	670	570	570
Mounting plate thickness in mm		2.5	2.5	2.0	2.5	2.5	3.0	2.5	2.5
Model No. AE	1	**1038.500**	**1338.500**	**1045.500**	**1050.500**	**1350.500**	**1057.500**	**1060.500**	**1360.500**
Weight (kg)		15.6	19.4	13.0	16.8	19.6	31.2	22.8	28.4

Width (B1) in mm	Packs of	600	600	600	600	760	760	800
Height (H1) in mm		760	760	800	1000	760	760	1000
Depth (T1) in mm		210	350	250	250	210	300	300
Mounting plate width (F1) in mm		549	549	549	539	704	704	739
Mounting plate height (G1) in mm		730	730	770	955	730	730	955
Mounting plate thickness in mm		3.0	3.0	3.0	3.0	3.0	3.0	3.0
Model No. AE	1	**1076.500**	**1376.500**	**1058.500**	**1090.500**	**1077.500**	**1073.500**	**1180.500**
Weight (kg)		32.1	36.0	34.2	50.5	40.0	44.5	57.0

Lock systems

Standard double-bit lock insert may be exchanged for 27 mm lock inserts, type A, see page 888, lock cylinder, plastic handles and T handles, type B, see page 886 – 889.

To order enclosures in textured RAL 7032 please add extension .600 to the Model No., and for primed enclosures use extension .800.
Delivery times available on request.

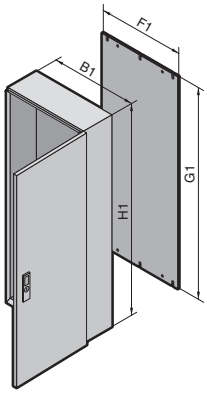
Metal gland plates,
pre-punched,
Model No. see page 968.

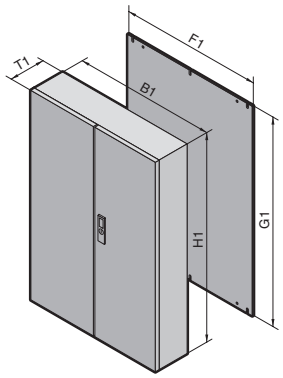
Plastic wiring plan pocket,
screw-fastened,
Model No. see page 897.

Accessories Page 832 **AE IP 69K** Page 121 **AE stainless steel** Page 273 **AE EMC-shielded** Page 290 **AE Ex-proof** Page 287

Compact enclosures AE

Width: 600 – 1000, height: 760 – 1400





Material:
Sheet steel
Enclosure: 1.5 mm
Door: 2.0 mm
Mounting plate: 3.0 mm

Surface finish:
Enclosure and door:
Dipcoat-primed,
powder-coated on the outside in textured RAL 7035
Mounting plate: Zinc-plated

Protection category:
IP 55 to EN 60 529/10.91,
Complies with NEMA 12.
IP 56 to EN 60 529/10.91 for AE 1260.500 and AE 1280.500.

Supply includes:
Enclosure of all-round solid construction, single door:
1 gland plate,
twin-door: 2 gland plates in the enclosure base,
3-point lock system,
prepared for use of the Ergoform-S lock system,
2 cam locks for 1100.500, 1130.500, 1110.500, foamed-in door seal, zinc-plated mounting plate.

Approvals,
see page 26.

Detailed drawing,
see page 1084.

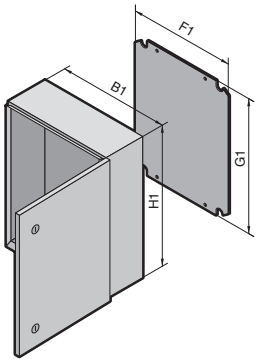
Possible alternative:
Compact system enclosures Rittal CM, see page 128 – 129.

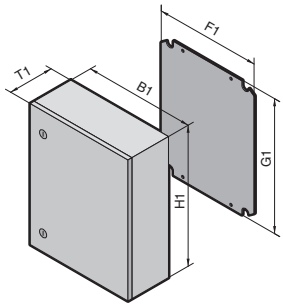
Width (B1) in mm		Packs of	600	800	1000	1000	1000	1000	1000	Page
Height (H1) in mm			1200	1200	760	760	1000	1200	1400	
Depth (T1) in mm			300	300	210	300	300	300	300	
Mounting plate width (F1) in mm			540	740	944	944	939	940	940	
Mounting plate height (G1) in mm			1155	1155	730	730	955	1155	1355	
Model No. AE		1	**1260.500**	**1280.500**	**1100.500**	**1130.500**	**1110.500**	**1213.500**	**1114.500**	
Door(s)			1	1	2	2	2	2	2	
Weight (kg)			55.0	70.0	52.0	56.0	71.0	85.0	97.0	
Accessories										
Self-tapping screws		300	2487.000							937
Base/plinth	Height 100 mm	1	2816.200	2818.200	–	–	2801.200	2801.200	2801.200	843
	Height 200 mm	1	2826.200	2828.200	–	–	2802.200	2802.200	2802.200	843
Stainless steel rain canopy		1	–	2475.000	–	2363.000	2363.000	2363.000	2363.000	899
Plastic cable gland plate		5	2563.000	2563.000	2562.000	2562.000	2562.000	2562.000	2562.000	966
Eyebolts		4	2509.000	2509.000	–	–	–	2509.000	2509.000	904
Lock systems										
Standard double-bit lock insert may be exchanged for 27 mm lock inserts, type A, see page 888 and Ergoform-S lock system (not for 1100.500, 1130.500, 1110.500), see page 885.										

To order enclosures in textured RAL 7032 please add extension .600 to the Model No., and for primed enclosures use extension .800.
Delivery times available on request.

Accessories Page 832 **AE IP 69K** Page 121 **AE stainless steel** Page 273 **AE EMC-shielded** Page 290 **AE Ex-proof** Page 287

Protection category IP 69K





Perfect protection in a tough environment
The compact enclosure AE in IP 69K is the ideal solution when a high protection category and corrosion resistance are needed.

- Resistant to high-pressure cleaning (protection category IP 69K). The interior seal is protected against direct hosed water.
- Ideal for mounting on vehicles: Lock, hinges and mounting plate are all vibration resistant.
- The enclosure and door have an aluminium zinc coating for a high level of corrosion protection.
- Foamed-in silicone seal, water-impermeable, with high resistance to temperature and chemicals.
- Prepared to accommodate the door stay 1101.800 and the interior door.
- Wall mounting

Material:
Sheet steel

Surface finish:
Enclosure and door:
Aluminium zinc coating, powder-coated in textured RAL 7035
Mounting plate: Zinc-plated

Protection category:
IP 69K to DIN 40 050-9/5.93

Supply includes:
Enclosure of all-round solid construction, single door,
door hinge may be swapped to opposite side by rotating the enclosure,
cam lock with double-bit insert, other inserts available on request.

Rittal service:
Other sizes available on request. Cutouts and drilled holes to your specifications.

Detailed drawing,
see page 1086.

Width (B1) in mm	Packs of	230	400	400	650	Page
Height (H1) in mm		330	400	650	650	
Depth (T1) in mm		155	250	250	250	
Mounting plate width (F1) in mm		–	334	334	549	
Mounting plate height (G1) in mm		–	355	570	570	
Mounting plate thickness in mm		2	2	2,5	2,5	
Model No. AE	1	**1101.010**	**1101.020**	**1101.030**	**1101.040**	
Weight (kg)		6.6	13.8	20	29.6	
Locks		1	2	2	2	
Accessories						
Interior door	1	1101.910	1101.920	1101.930	1101.940	873
Door stay	1	1101.800	1101.800	1101.800	1101.800	898

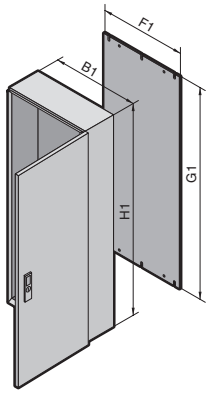
Interior door
with 4 (2 for 1101.010) studs for the installation of punched rails 23 x 23 (may be cut to required length) and universal installation accessories.

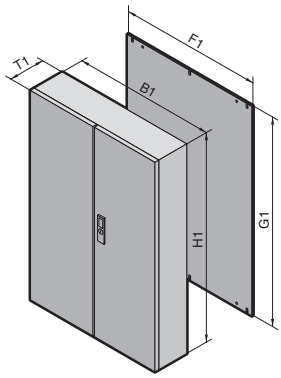
Wall mounting
directly from the rear via M8 nut or with wall mounting bracket, see page 905.

Accessories Page 832 **AE stainless steel** Page 273 **AE EMC-shielded** Page 290 **AE Ex-proof** Page 287

Compact enclosures AK

Depth: 400





Material:
Sheet steel
Enclosure: 1.5 mm
Door(s): 2.0 mm
Mounting plate: 3.0 mm

Surface finish:
Enclosure and door(s):
Dipcoat-primed, powder-coated in textured RAL 7035 on the outside
Mounting plate: Zinc-plated

Protection category:
IP 55 to EN 60 529/10.91,
Complies with NEMA 12.

Supply includes:
Enclosure of all-round solid construction,
r/h door hinge, may be swapped to opposite side, AK 1652.500, AK 1650.500, AK 1647.500:
Lockable door on right, foamed-in door seal, holes provided for eyebolts, mounting plate, two-part gland plates.

Approvals,
see page 27.

Detailed drawing,
see page 1086.

Possible alternative:
Compact system enclosures Rittal CL, see page 130 – 131.

NOTE: Discontinued item, please do not use for new designs.

Width (B1) in mm		Packs of	600	800	1000	1000	1200	Page
Height (H1) in mm			1200	1200	1200	1400	1200	
Depth (T1) in mm			400	400	400	400	400	
Mounting plate width (F1) in mm			514	714	914	914	1114	
Mounting plate height (G1) in mm			1125	1125	1125	1325	1125	
Model No. AK		1	**1646.500**	**1648.500**	**1650.500**	**1647.500**	**1652.500**	
Door(s)			1	1	2	2	2	
Weight (kg)			60.0	75.0	88.5	103.5	108.0	
Accessories								
Base/plinth	Height 100 mm	1	2911.200	2901.200	2891.200	2891.200	2921.200	843
	Height 200 mm	1	2912.200	2902.200	2892.200	2892.200	2922.200	843
Lock systems								
Standard double-bit lock insert may be exchanged for 27 mm lock inserts, type A, see page 888, and Ergoform-S lock system, see page 885.								

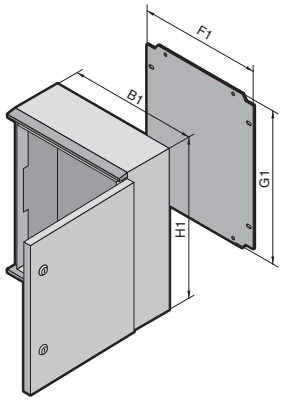
To order enclosures in textured RAL 7032 please add extension .600 to the Model No., and for primed enclosures use extension .800.
Delivery times available on request.

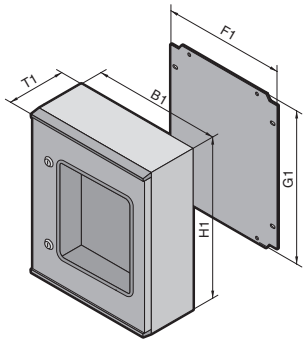
Cable gland
made from polyamide/brass, and multi-seal inserts,
Model No. see page 972/973.

Signal pillar LED compact,
Model No. see page 1041.

Accessories Page 832 **Console systems** Page 261

Width: 200 – 600, height: 300 – 600





Material:
Enclosure and door:
Fibreglass-reinforced unsaturated polyester
Mounting plate:
Sheet steel
For KS with viewing window:
Impact resistant glazed acrylic, 3.0 mm with all-round rubber cable clamp strip

Surface finish:
Enclosure and door:
No after-treatment,
dyed plastic,
similar to RAL 7032
Mounting plate: Zinc-plated

Protection category:
KS without viewing window:
IP 66 to EN 60 529/10.91, complies with NEMA 4x.
KS with viewing window:
IP 56 to EN 60 529/10.91, complies with NEMA 12.

Supply includes:
Enclosure of solid all-round construction,
r/h door hinge,
door hinge may be swapped to opposite site by rotating the enclosure,
mounting plate,
all-round foamed-in PU seal in the door,
twin seal on the top and bottom edges of the door (integral rain protection strip), press-fitted
C sections at the sides for infinitely variable mounting plate depth adjustment.

Note:
Under the influence of long-term UV radiation (sunlight) in conjunction with wind and rain, the surface finish may become visually impaired.
In other words, the fibreglass portions become visible on unprotected surfaces. This does not impair the protection of the installed electrical components in any way. All other surface finishes are likewise impaired by ultraviolet radiation.
If the enclosures cannot be protected from radiation, e.g. via a sun canopy, we recommend that they should be painted with a PUR paint. Older enclosures where the surface finish already reveals visible fibreglass portions can likewise be treated in this way after thorough cleaning.
Of course, all enclosures can also be supplied spray-finished in RAL colours. For outdoor siting, we recommend pale shades.

Approvals,
see page 27.

Detailed drawing,
see page 1087.

	Packs of	Without viewing window							With viewing window			
Width (B1) in mm		200	250	300	400	400	500	600	400	400	500	600
Height (H1) in mm		300	350	400	400	600	500	600	400	600	500	600
Depth (T1) in mm		150	150	200	200	200	300	200	200	200	300	200
Mounting plate width (F1) in mm		145	195	245	345	345	417	545	345	345	417	545
Mounting plate height (G1) in mm		250	300	350	350	550	450	550	350	550	450	550
Mounting plate thickness in mm		2.0	2.0	2.0	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Model No. KS	1	**1423.600**	**1432.600**	**1434.600**	**1444.600**	**1446.600**	**1453.600**	**1466.600**	**1448.600**	**1449.600**	**1454.600**	**1467.600**
Door(s)		1	1	1	1	1	1	1	1	1	1	1
Weight (kg)		3.0	4.1	6.0	7.9	11.5	12.9	15.9	8.0	11.5	13.4	15.9

Lock systems

Standard double-bit lock insert may be exchanged for lock inserts, type A, see page 888,
and plastic handle, type E, KS 1484.000, see page 886.

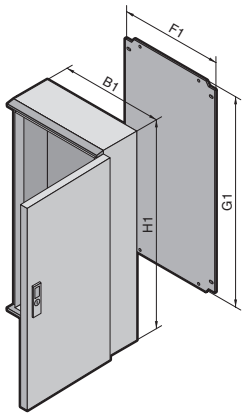
Cable gland, polyamide,
Model No. see page 972.

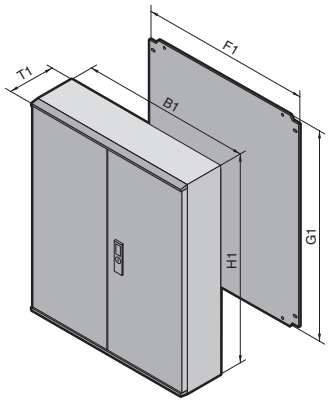
Double-membrane gland and stepped collar for cable entry,
Model No. see page 973.

Accessories Page 832 **KS Ex-proof** Page 288

Plastic enclosures KS

Width: 600 – 1000, height: 800 – 1000





Material:
Enclosure and door:
Fibreglass-reinforced unsaturated polyester
Mounting plate:
Sheet steel
For KS with viewing window:
Impact resistant glazed acrylic, 3.0 mm with all-round rubber cable clamp strip

Surface finish:
Enclosure and door:
No after-treatment,
dyed plastic,
Similar to RAL 7032
Mounting plate: Zinc-plated

Protection category:
IP 56
IP 66 for KS 1468.600

Supply includes:
Enclosure of solid all-round construction,
r/h door hinge, may be swapped to opposite side by rotating the enclosure (only with single-door models), mounting plate,
all-round foamed-in PU seal in the door,
twin seal on the top and bottom edges of the door (integral rain protection strip),
press-fitted C sections at the sides for infinitely variable mounting plate depth adjustment.
KS 1400.600 additionally with removable centre bar in the enclosure.

Note:
Under the influence of long-term UV radiation (sunlight) in conjunction with wind and rain, the surface finish may become visually impaired.
In other words, the fibreglass portions become visible on unprotected surfaces. This does not impair the protection of the installed electrical components in any way. All other surface finishes are likewise impaired by ultraviolet radiation.
If the enclosures cannot be protected from radiation, e.g. via a sun canopy, we recommend that they should be painted with a PUR paint. Older enclosures where the surface finish already reveals visible fibreglass portions can likewise be treated in this way after thorough cleaning.
Of course, all enclosures can also be supplied spray-finished in RAL colours. For outdoor siting, we recommend pale shades.

Approvals,
see page 27.

Detailed drawing,
see page 1088.

	Packs of	Without viewing window			With viewing window	
Width (B1) in mm		600	800	1000	600	800
Height (H1) in mm		800	1000	1000	800	1000
Depth (T1) in mm		300	300	300	300	300
Mounting plate width (F1) in mm		517	717	917	517	717
Mounting plate height (G1) in mm		750	950	950	750	950
Mounting plate thickness in mm		3.0	3.0	3.0	3.0	3.0
Model No. KS	1	**1468.600**	**1480.600**	**1400.600**	**1469.600**	**1479.600**
Door(s)		1	1	2	1	1
Weight (kg)		26.0	39.0	50.0	25.5	33.0

Lock systems

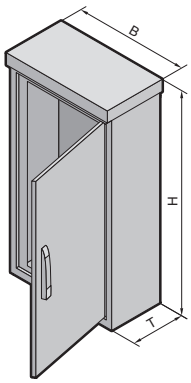
Standard double-bit lock insert may be exchanged for lock inserts, type A, see page 888,
and Ergoform-S lock system, KS 1490.000, see page 885.

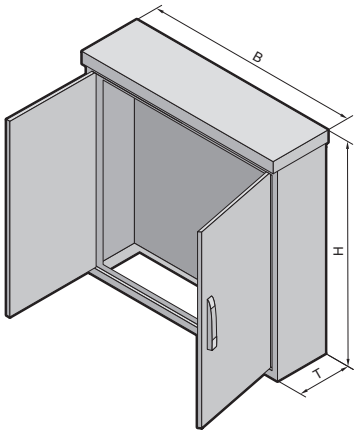
Cable ducts,
Model No. see page 978.

Signal pillar LED compact,
in protection category IP 65,
Model No. see page 1041.

Accessories Page 832 **KS Ex-proof** Page 288

Width: 800 – 1200, height: 800 – 1200





Material:
Optionally
Sheet steel, zinc-plated,
or
Stainless steel 1.4301

Colour:
RAL 7035

Supply includes:
Enclosure, closed back and sides,
interior door(s):
Swing handle prepared for semi-cylinder 40 or 45 mm, overall length to DIN 18 254.

Roof plate:
With bonded insulating plate to prevent the formation of drips, screw-fastened at a distance to prevent condensation.

Protection category:
IP 44 to 60 529/10.91

Detailed drawing,
see page 1185.

Width (B) in mm	Packs of	800	1200	1200	Page
Height (H) in mm		1200	800	1200	
Depth (T) in mm		350	350	350	
Model No. Sheet steel	1	**1620.000**	**1621.000**	**1622.000**	
Model No. Stainless steel	1	**1620.100**	**1621.100**	**1622.100**	
Doors		1	2	2	
Accessories					
Mounting plate sheet steel, 3 mm, zinc-plated, passivated	1	1616.200	1616.210	1616.220	916
Mounting plate MDF, 15 mm	1	1616.230	1616.230	1616.240	916
Concrete base/plinth	1	1616.300[1)]	1616.310[1)]	1616.310[1)]	842
Wiring plan pocket	1	4116.000	4115.000	4115.000	898
Door stay	1	1616.110	1616.110	1616.110	898

[1)] Delivery times available on request.

Accessories Page 832

Compact system enclosures

Features

Rittal CM and Rittal CL – the new compact class for the configuration of compact enclosures with a diverse range of opportunities for interior installation and cable entry.

Rittal Compact Medium, the alternative to large enclosures in the AE series and the replacement for the AK series. **Rittal Compact Large,** the economic variant of free-standing enclosures ES 5000.

Compatibility with TS 8 mounting components and Rittal system accessories make these enclosures the “unbeatable heroes” of your applications.

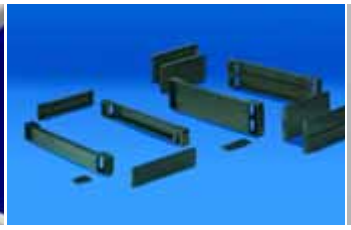
Key features of Rittal CM and Rittal CL

Solid sides with studs on the inside for the installation of adaptor rails for interior configuration with TS 8 accessories.

Automatic potential equalisation via earthing inserts on the attachments of the gland plates.

Earthing bolts with paint-free, corrosion-proof contact discs, on the hinge side of the enclosure at the bottom.

More space, greater stability, and more opportunities for cable entry, thanks to a large opening and a wide range of gland plate combinations,
see page 132.



Fewer parts, more opportunities, plus lower purchasing, storage and assembly costs – the formula for the new modular base/plinth system TS 8 – now also for Rittal CM and Rittal CL.

Enclosure slotted for interchangeable door hinge.

Roof with holes and bungs, prepared for the mounting of eyebolts.

The triple surface finish:
1. Phosphating,
2. Electrophoretic dipcoat priming,
3. Powder coating.

Corrosion protection and resistance to lubricants, machining products and cleaning agents.

Features

Compact Medium Rittal CM

Lock insert is protected from contamination by the inserted trim panel. There is space for your company logo behind the top plexiglass cover.

Enclosure top and bottom, with stud at front for installation of an adaptor rail for fast assembly of system light, door operated switch, door stay or covers.

Doors right and left with spot welded perforated mounting strips (25 mm pitch pattern) for universal interior installation.

Fast attachment: The mounting plate (folded over at the side) is inserted at the bottom, and secured at the top with clips.

Perfect seal, thanks to the twin edge of the enclosure and optimum compression of the foamed-in seal.

Fold rather than turn – this handle facilitates optimum use of the door space for internal and external mounting.

Compact Large Rittal CL

Mounting plate (identical to the TS 8) – with grid pattern print on the right and left for easy positioning of mounted equipment – depth-variable.

Enclosure perforated on a 25 mm pitch pattern at the front top for the installation of a system light, door operated switch, door stay etc.

Adjacent door with additional centre protection with a bar at the top, with interconnecting rods and handle at the bottom.

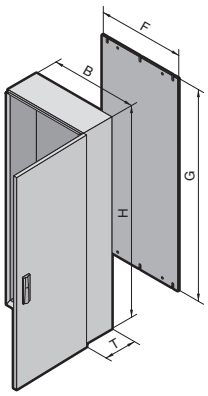
Doors (identical to TS 8) with square frame, perforations on a 25 mm pitch pattern.

The rods of the lock are locked from top to bottom. This is safe for transportation, and vibration-proof.

The welded rear panel facilitates direct screw fastening to a machine or wall.

Compact system enclosures Rittal CM

Width: 600 – 800, height: 800 – 1200



Material:
Sheet steel
Enclosure: 1.5 mm
Door: 2.0 mm
Mounting plate: 3.0 mm

Surface finish:
Enclosure and door:
Dipcoat-primed,
powder-coated on the outside in textured RAL 7035
Mounting plate: Zinc-plated

Protection category:
IP 55 with selection of the appropriate gland plates,
see page 132.

Supply includes:
Enclosure with one door, r/h door hinge, may be swapped to opposite side, mounting plate, open base for individual cable entry,
see page 132.

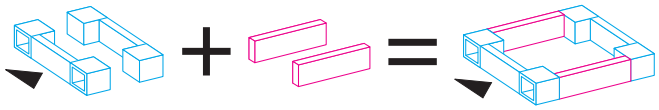
Available from October 2005.

Width (B) in mm		Packs of	600	600	600	600	800	800	800	800	Page
Height (H) in mm			800	1000	1200	1200	1000	1000	1200	1200	
Depth (T) in mm			400	400	300	400	300	400	300	400	
Mounting plate width (F) in mm			540	540	540	540	740	740	740	740	
Mounting plate height (G) in mm			755	955	1155	1155	955	955	1155	1155	
Model No. CM		1	**5110.500**	**5111.500**	**5112.500**	**5113.500**	**5114.500**	**5115.500**	**5116.500**	**5117.500**	
Door			1	1	1	1	1	1	1	1	
Base/plinth											
Components front and rear	Height 100 mm	1 set	8601.600	8601.600	8601.600	8601.600	8601.800	8601.800	8601.800	8601.800	835
	Height 200 mm	1 set	8602.600	8602.600	8602.600	8602.600	8602.800	8602.800	8602.800	8602.800	835
Trim panels (sides)	Height 100 mm	1 set	8601.040	8601.040	8601.030	8601.040	8601.030	8601.040	8601.030	8601.030	835
	Height 200 mm	1 set	8602.040	8602.040	8602.030	8602.040	8602.030	8602.040	8602.030	8602.030	835
Accessories											
Rail for interior installation	for height	4	5001.051	5001.052	5001.053	5001.053	5001.052	5001.052	5001.053	5001.053	133
	for width	4	5001.050	5001.050	5001.050	5001.050	5001.051	5001.051	5001.051	5001.051	133
Matching punched section with mounting flange	in depth	4	8612.140	8612.140	8612.130	8612.140	8612.130	8612.140	8612.130	8612.140	921
	in width	4	8612.060	8612.060	8612.060	8612.060	8612.080	8612.080	8612.080	8612.080	921
Support strips for door		20	4596.000	4596.000	4596.000	4596.000	4598.000	4598.000	4598.000	4598.000	895
Wiring plan pocket, sheet steel		1	4116.000	4116.000	4116.000	4116.000	4118.000	4118.000	4118.000	4118.000	898
Lock systems											
Standard double-bit lock insert may be exchanged for lock inserts, type A, see page 888, and folding lever handle, see page 133.											

To order primed enclosures, please add extension .800 to the Model No. Delivery times available on request.

Cable entry plates and grommets,
suitable for integration into the modular gland plate concept,
see page 964/965.

Base/plinth,
Model No. see page 835.



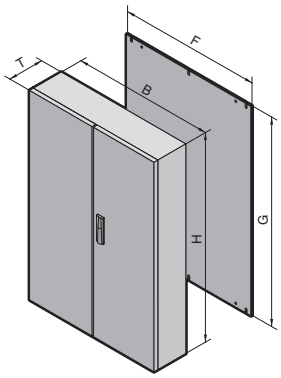
One Model No. for the **base/plinth components** front and rear.

One Model No. for the **base/plinth trim panels** at the sides.

One complete **base/plinth.**

Accessories Page 832

Width: 1000 – 1200, height: 1000 – 1400



Material:
Sheet steel
Enclosure: 1.5 mm
Door: 2.0 mm
Mounting plate: 3.0 mm

Surface finish:
Enclosure and door:
Dipcoat-primed,
powder-coated on the outside in textured RAL 7035
Mounting plate: Zinc-plated

Protection category:
IP 55 with selection of the appropriate gland plates,
see page 132.

Supply includes:
Enclosure with two doors, r/h door lockable, may be swapped to opposite side, mounting plate, open base for individual cable entry,
see page 132.

Available from October 2005.

Width (B) in mm		Packs of	1000	1000	1000	1000	1000	1200	Page
Height (H) in mm			1000	1200	1200	1400	1400	1200	
Depth (T) in mm			300	300	400	300	400	400	
Mounting plate width (F) in mm			940	940	940	940	940	1140	
Mounting plate height (G) in mm			955	1155	1155	1355	1355	1155	
Model No. CM		1	**5118.500**	**5119.500**	**5120.500**	**5121.500**	**5122.500**	**5123.500**	
Doors			2	2	2	2	2	2	
Base/plinth									
Components front and rear	Height 100 mm	1 set	8601.000	8601.000	8601.000	8601.000	8601.000	8601.200	835
	Height 200 mm	1 set	8602.000	8602.000	8602.000	8602.000	8602.000	8602.200	835
Trim panels (sides)	Height 100 mm	1 set	8601.030	8601.030	8601.040	8601.030	8601.040	8601.040	835
	Height 200 mm	1 set	8602.030	8602.030	8602.040	8602.030	8602.040	8602.040	835
Accessories									
Rail for interior installation	for height	4	5001.052	5001.053	5001.053	5001.054	5001.054	5001.053	133
	for width	4	5001.052	5001.052	5001.052	5001.052	5001.052	5001.053	133
Matching punched section with mounting flange	in depth	4	8612.130	8612.130	8612.140	8612.130	8612.140	8612.140	921
	in width	4	8612.000	8612.000	8612.000	8612.000	8612.000	8612.020	921
Support strips for door		20	4309.000	4309.000	4309.000	4309.000	4309.000	4596.000	895
Wiring plan pocket, sheet steel		1	4115.000	4115.000	4115.000	4115.000	4115.000	4116.000	898
Lock systems									
Standard double-bit lock insert may be exchanged for lock inserts, type A, see page 888, and folding lever handle, see page 133.									

To order primed enclosures, please add extension .800 to the Model No. Delivery times available on request.

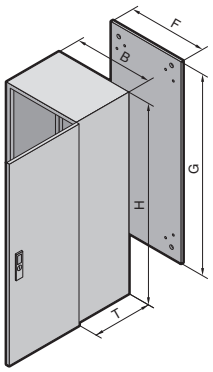
Sections for cable entry,
suitable for integration into the modular gland plate concept,
see page 965.

Punched section with mounting flange, 17 x 73 mm
Model No. see page 921.

Accessories Page 832

Compact system enclosures Rittal CL

Width: 600 – 1000, height: 1600 – 2000



Material:
Sheet steel
Enclosure: 1.5 mm
Door: 2.0 mm
Mounting plate: 3.0 mm

Surface finish:
Enclosure and door:
Dipcoat-primed, powder-coated in textured RAL 7035 on the outside
Mounting plate: Zinc-plated

Protection category:
IP 55 with selection of the appropriate gland plates,
see page 132.

Supply includes:
Enclosure with one door, r/h door hinge, may be swapped to opposite side,
mounting plate, open base for individual cable entry,
see page 132.

Available from the 2nd quarter 2006 on.

Width (B) in mm		Packs of	600	600	600	800	800	800	1000	Page
Height (H) in mm			1600	1800	2000	1600	1800	2000	1800	
Depth (T) in mm			500	400	500	500	400	500	400	
Mounting plate width (F) in mm			499	499	499	699	699	699	899	
Mounting plate height (G) in mm			1496	1696	1896	1496	1696	1896	1696	
Model No. CL		1	**5150.500**	**5151.500**	**5152.500**	**5153.500**	**5154.500**	**5155.500**	**5156.500**	
Door			1	1	1	1	1	1	1	
Base/plinth										
Components front and rear	Height 100 mm	1 set	8601.600	8601.600	8601.600	8601.800	8601.800	8601.800	8601.000	835
	Height 200 mm	1 set	8602.600	8602.600	8602.600	8602.800	8602.800	8602.800	8602.000	835
Trim panels (sides)	Height 100 mm	1 set	8601.050	8601.040	8601.050	8601.050	8601.040	8601.050	8601.040	835
	Height 200 mm	1 set	8602.050	8602.040	8602.050	8602.050	8602.040	8602.050	8602.040	835
Accessories										
Rail for interior installation	for height	4	5001.055	5001.056	5001.057	5001.055	5001.056	5001.057	5001.056	133
Matching punched section with mounting flange	in depth	4	8612.150	8612.140	8612.150	8612.150	8612.140	8612.150	8612.140	921
	in width	4	8612.060	8612.060	8612.060	8612.080	8612.080	8612.080	8612.000	921
Support strips for door		20	4596.000	4596.000	4596.000	4598.000	4598.000	4598.000	4599.000	895
Wiring plan pocket, sheet steel		1	4116.000	4116.000	4116.000	4118.000	4118.000	4118.000	4124.000	898
Lock systems										
Standard double-bit lock insert may be exchanged for other lock inserts and comfort handle, see page 881/888.										

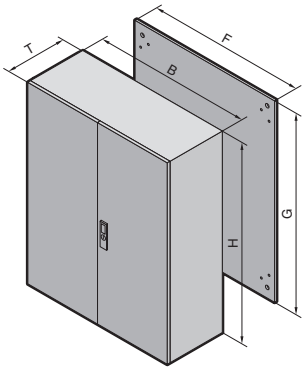
To order primed enclosures, please add extension .800 to the Model No. Delivery times available on request.

Cable entry plates,
suitable for integration into the modular gland plate concept,
see page 964.

Transport handles for mounting plates and doors,
Model No. see page 912/898.

Accessories Page 832

Width: 1000 – 1200, height: 1600 – 2000



Material:
Sheet steel
Enclosure: 1.5 mm
Door: 2.0 mm
Mounting plate: 3.0 mm

Surface finish:
Enclosure and door:
Dipcoat-primed,
powder-coated in textured
RAL 7035 on the outside
Mounting plate: Zinc-plated

Protection category:
IP 55 with selection of the appropriate gland plates,
see page 132.

Supply includes:
Enclosure with two doors,
Lockable door on r/h side,
mounting plate,
open base for individual cable entry,
see page 132.

Available from the 2nd quarter 2006 on.

Width (B) in mm		Packs of	1000	1200	1200	1200	Page
Height (H) in mm			1800	1600	1800	2000	
Depth (T) in mm			400	500	400	500	
Mounting plate width (F) in mm			899	1099	1099	1099	
Mounting plate height (G) in mm			1696	1496	1696	1896	
Model No. CL		1	**5157.500**	**5158.500**	**5159.500**	**5160.500**	
Doors			2	2	2	2	
Base/plinth							
Components front and rear	Height 100 mm	1 set	8601.000	8601.200	8601.200	8601.200	835
	Height 200 mm	1 set	8602.000	8602.200	8602.200	8602.200	835
Trim panels (sides)	Height 100 mm	1 set	8601.040	8601.050	8601.040	8601.050	835
	Height 200 mm	1 set	8602.040	8602.050	8602.040	8602.050	835
Accessories							
Rail for interior installation	for height	4	5001.056	5001.055	5001.056	5001.057	133
Matching punched section with mounting flange	in depth	4	8612.140	8612.150	8612.140	8612.150	921
	in width	4	8612.000	8612.200	8612.200	8612.000	921
Support strips for door		20	4309.000	4596.000	4596.000	4596.000	895
Wiring plan pocket, sheet steel		1	4115.000	4116.000	4116.000	4116.000	898
Lock systems							
Standard double-bit lock insert may be exchanged for other lock inserts and comfort handle, see page 881/888.							

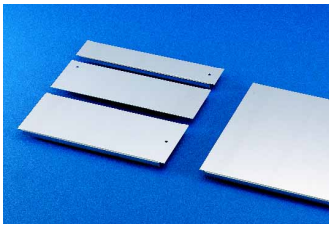
To order primed enclosures, please add extension .800 to the Model No. Delivery times available on request.

Cable duct, horizontal,
sized to the width of the mounting plate or in a fixed length of 2000 mm,
Model No. see page 978.

EMC gland plates,
suitable for integration into the modular gland plate concept,
see page 958.

Accessories Page 832

Accessories



Gland plates

Select suitable gland plates depending on the application. The following examples illustrate how individually cable entry may be organised. Potential equalisation is provided via assembly components and earthing points.

Design	For enclosure width mm			
	600	800	1000	1200
	Model No.			
1	5001.210	5001.211	5001.212	5001.213
2	5001.214	5001.215	5001.216	5001.217
3	5001.218	5001.219	5001.220	5001.221
4	5001.222	5001.223	5001.224	5001.225
6	5001.226[1)]	5001.227[1)]	5001.228[1)]	5001.229[1)]

[1)] Cable entry grommets, see Cat. 31, page 964 - 965
Packs of 1

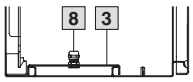
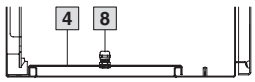
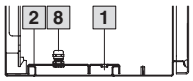
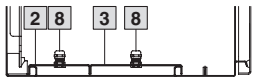
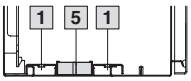
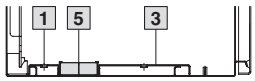
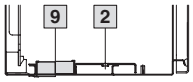
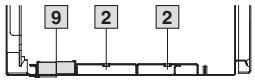
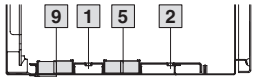
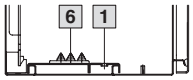
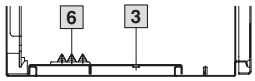
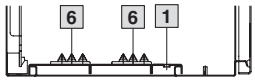
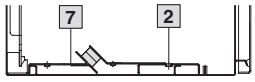
Material:
Sheet steel, zinc-plated, passivated

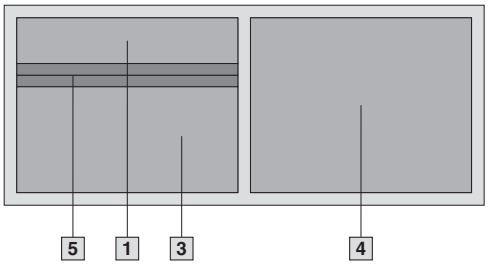
Supply includes:
Assembly parts.

Note:
For greater stability and universal cable entry, the base opening is divided in the width for 1000 and 1200 mm wide enclosures, and can be populated differently.

Order example:
CM 5120.500 (W/H/D 1000 x 1200 x 400 mm)
– On left, gland plates divided into two with cable clamp strip
– On right, one-piece gland plate

Combination options:

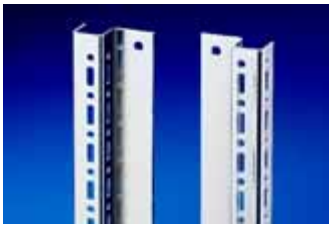
	Depth 300 mm	Depth 400 mm
One-piece/ Cable glands		
Divided/cable glands		
Divided/ Cable clamp strip, centre		
Divided/ Cable clamp strip, rear		
Divided/ Cable clamp strip on centre and rear		
Divided/ 1 grommet		
Divided/ 2 grommets		
EMC		



You will need:

- 5 2 sections for cable entry, centre, TS 8802.100, see Cat. 31, page 965 (Packs of 4)
- 1 1 gland plate, depth 50 mm, 5001.212
- 3 1 gland plate, depth 150 mm, 5001.220
- 4 1 gland plate, depth 250 mm, 5001.224

- 1 Gland plate, depth 50 mm
- 2 Gland plate, depth 100 mm
- 3 Gland plate, depth 150 mm
- 4 Gland plate, depth 250 mm
- 5 Section for cable entry, centre, see Catalogue 31, page 965.
- 6 Cable entry plates, 100 mm deep, see above, Grommets, see Catalogue 31, page 965.
- 7 EMC gland plate, see Catalogue 31, page 958.
- 8 Cable glands, see page 13.
- 9 Section for cable entry, rear, see page 9.



Rails for interior installation

For mounting in:
- Rittal CM
- Rittal CL

on the threaded bolts provided in the enclosure.

With TS system punchings for mounting:
- TS punched section with mounting flange, 17 x 73 mm
  – in the depth for outer mounting level,
  – in the width for inner mounting level
- TS punched rail 18 x 38 mm
- TS mounting bars for outer mounting level
- PS punched rail 23 x 23 mm, in conjunction with TS mounting bracket
- PS punched section without mounting flange, 23 x 73 mm, in conjunction with support bracket TS

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

For enclosure height mm	Packs of	Model No. SZ
600	4	**5001.050**
800	4	**5001.051**
1000	4	**5001.052**
1200	4	**5001.053**
1400	4	**5001.054**
1600	4	**5001.055**
1800	4	**5001.056**
2000	4	**5001.057**

Available from the 2nd quarter 2006 on.

Accessories:

TS punched section with mounting flange, 17 x 73 mm, see page 921.
TS punched rail 18 x 38 mm, see page 923.
TS support strips, see page 924.
PS punched rail 23 x 23 mm, see page 925.
PS punched section without mounting flange, 23 x 73 mm, see page 925.
TS mounting bracket, see page 932.
TS support bracket, see page 933.

Folding lever handle

Because the handle does not take up any swing space, due to its folding mechanism, the door surface area may be maximised to install equipment.

Prepared for the installation of:
- Semi-cylinders with an overall length of 40 or 45 mm (to DIN 18 254)
- All lock inserts
- As well as SZ lock and push-button inserts

Available from the 2nd quarter 2006 on.

Version	Model No. CM
Dark grey with light handle	**5001.060**

Accessories:

Lock inserts, see page 881.
SZ lock and push-button inserts, see page 882.

With security lock insert E1.
Only for applications in the VW, Audi, SEAT, Skoda Auto sector.
Supplied without key.
Other locks available on request.

Version	Model No. CM
Dark grey with light handle	**5001.061**

Enclosure systems

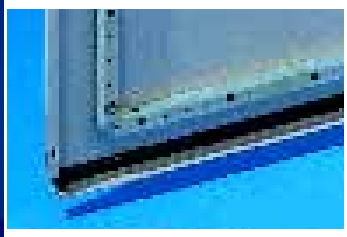
Features

ES, the free-standing enclosure with firmly linked side panels.

TS 8, the Top enclosure system, a system platform for individual tasks.

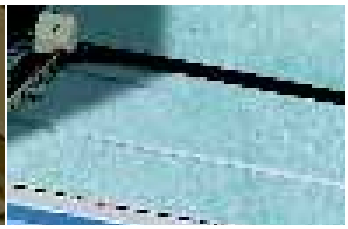
Every enclosure, with all-round accessibility, is a specialist – however particular the task in hand.

ES free-standing enclosures



Door frame with slots on a 25 mm pitch pattern for the mounting of ducts, utility lectern, cable harnesses, wiring plan pockets etc.

Enclosure, **with system slots** on a 25 mm pitch pattern all round, for interior installation with PS accessories.



Three-piece, interchangeable, movable **gland plates** for easier cable entry and machining.

Compact system enclosures

New:
Compact Large Rittal CL,
the cost-effective alternative.

Monobloc construction.

Doors, mounting plates and interior installation compatible with TS 8.

See page 130 – 131.

Baying systems TS 8

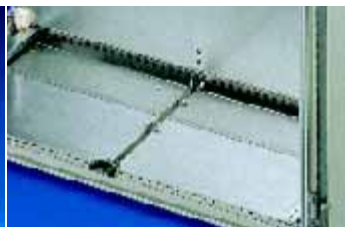
The system platform for

- Electronic enclosures, see page 148.
- Modular front design, see page 149.
- Isolator door locking, see page 150.
- Corner enclosures, see page 868.
- Climate controlled enclosures, see page 582 – 583.
- Ex pressurisation, see page 152.
- Higher protection categories, see page 151.
- Stainless steel enclosure systems, see page 284.
- EMC enclosures, see page 291.

Baying systems TS 8

Door frame with punchings on a 25 mm pitch pattern, for the attachment of ducts, utility lecterns, cable harnesses, wiring plan pockets etc.

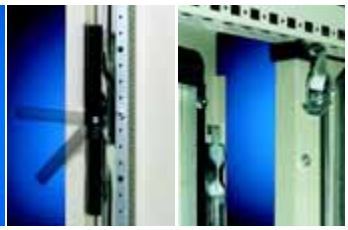
Mounting plate, zinc-plated, with C-fold at the side, **depth-variable** on a 25 mm pitch pattern. After installation, the slide rails may be used as mounting rails for the interior installation.



Maximum space for cable entry, thanks to multi-divided gland plates and accessory modules. With a square base area, cable entry may be installed rotated through 90°.

Universal interior installation: Frame sections, slotted on a 25 mm pitch pattern, with two mounting levels vertically with a TS hole pattern, and horizontally with a PS pitch pattern.

The roof plate is secured with **removable eyebolts.** The **all-round rain channel** prevents dirt and moisture from lying in contact with the seal.



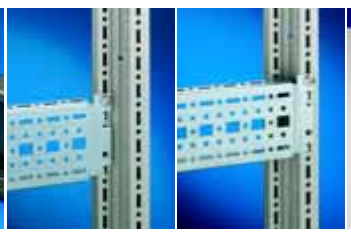
Adjacent door locked into position by bars top and bottom with interconnecting rods and handle.

It couldn't be any faster: With the gland plates, side panels, rear panel and cover, **potential equalisation occurs automatically via earthing points** during assembly.

Between bayed enclosures, the **cover** affords additional protection for the seal.
Cover see page 867.

Fastening of the rods on all lock pieces is **from top to bottom.** This means that the lock cannot be opened during transportation or as a result of vibrations.

Base/plinth components (front and rear) combined with **trim panels** (side) or used to link two base/plinths.

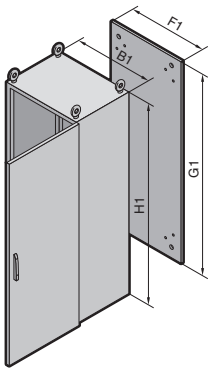


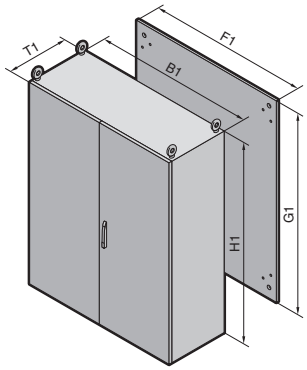
Two symmetrical levels for **maximum space utilisation** in the width and depth.

Potential equalisation is not necessary on the lock, because the lockable door latches onto the adjacent door outside of the sealing zone.

Free-standing enclosure ES 5000

Width: 600 – 1000





Material:
Sheet steel
Enclosure: 1.8 mm
Door: 2.0 mm
Rear panel and gland plates: 1.5 mm
Mounting plate: 3.0 mm

Surface finish:
Enclosure, door and rear panel: Dipcoat-primed, powder-coated in textured RAL 7035 on the outside
Mounting plate and gland plates: Zinc-plated

Protection category:
IP 56 to EN 60 529/10.91,
IP 55 to EN 60 529/10.91 for ES 5080.500,
Complies with NEMA 12.

Supply includes:
Enclosure with door(s), r/h door hinge, can be changed to opposite side (except 5080.500), mounting plate, gland plates and rear panel, detachable, 2 eyebolts, not fitted (ES 5080.500, ES 5084.500: 4 eyebolts, fitted).

Approvals,
see page 28.

Detailed drawing/ nominal dimensions,
see page 1089 – 1090.

Possible alternative:
Compact system enclosure Rittal CL, see page 130 – 131.

Width (B1) in mm		Packs of	600	800	600	800	1000	1000	600	800	Page
Height (H1) in mm			1600	1600	1800	1800	1800	1800	2000	2000	
Depth (T1) in mm			500	500	400	400	400	400	500	500	
Mounting plate width (F1) in mm			499	699	499	699	899	899	499	699	
Mounting plate height (G1) in mm			1496	1496	1696	1696	1696	1696	1896	1896	
Model No. ES		1	**5665.500**	**5865.500**	**5684.500**	**5884.500**	**5084.500**	**5080.500**	**5605.500**	**5805.500**	
Door(s)			1	1	1	1	1	2	1	1	
Weight (kg)			102.5	124.5	104.5	125.0	147.0	148.0	124.0	151.5	
Accessories											
Base/plinth	Height 100 mm	1	2807.200	2829.200	2804.200	2823.200	2909.200	2909.200	2807.200	2829.200	843
	Height 200 mm	1	2808.200	2830.200	2805.200	2824.200	2910.200	2910.200	2808.200	2830.200	843

Lock systems

Standard double-bit lock insert may be exchanged for 27 mm lock inserts, type A, see page 888 and Ergoform-S lock system, see page 885.

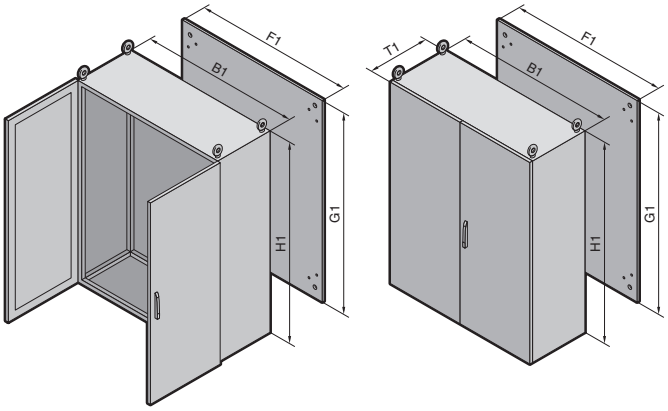
To order enclosures in textured RAL 7032 please add extension .600 to the Model No., and for primed enclosures use extension .800.
Delivery times available on request.

Fold-out tray for keyboard and mouse,
Model No. see page 1049.

Transport handles for mounting plates and doors,
Model No. see page 912/898.

Accessories Page 832 **ES 5000 stainless steel** Page 285 **ES 5000 EMC-shielded** Page 291

Width: 1200 – 1800



Material:
Sheet steel
Enclosure: 1.8 mm
Double door: 2.0 mm
Rear panel and gland plates: 1.5 mm
Mounting plate: 3.0 mm

Surface finish:
Enclosure, double door and rear panel: Dipcoat-primed, powder-coated on the outside in textured RAL 7035
Mounting plate and gland plates: Zinc-plated

Protection category:
IP 55 to EN 60 529/10.91, Complies with NEMA 12.

Supply includes:
Enclosure with doors, mounting plate, gland plates and rear panel (ES 5784.500, ES 5905.500 two-piece), detachable, 4 eyebolts, fitted.

Approvals,
see page 28.

Detailed drawing/ nominal dimensions,
see page 1089 – 1090.

Possible alternative:
Compact system enclosure Rittal CL, see page 130 – 131.

Width (B1) in mm		Packs of	1200	1200	1600	1200	1800	Page
Height (H1) in mm			1600	1800	1800	2000	2000	
Depth (T1) in mm			500	400	400	500	500	
Mounting plate width (F1) in mm			1099	1099	1499	1099	1699	
Mounting plate height (G1) in mm			1496	1696	1696	1896	1896	
Model No. ES		1	**5265.500**	**5284.500**	**5784.500**	**5205.500**	**5905.500**	
Doors			2	2	2	2	2	
Weight (kg)			175.5	180.0	222.0	210.0	300.0	
Accessories								
Base/plinth	Height 100 mm	1	2839.200	2836.200	2905.200	2839.200	2903.200	843
	Height 200 mm	1	2840.200	2837.200	2906.200	2840.200	2904.200	843

Lock systems

Standard double-bit lock insert may be exchanged for 27 mm lock inserts, type A, see page 888 and Ergoform-S lock system, see page 885.

To order enclosures in textured RAL 7032 please add extension .600 to the Model No., and for primed enclosures use extension .800.
Delivery times available on request.

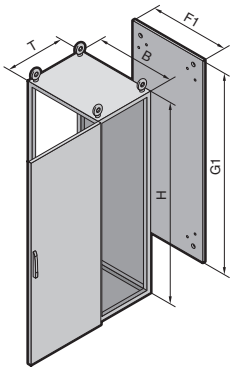
Cable duct, horizontal,
Model No. see page 978.

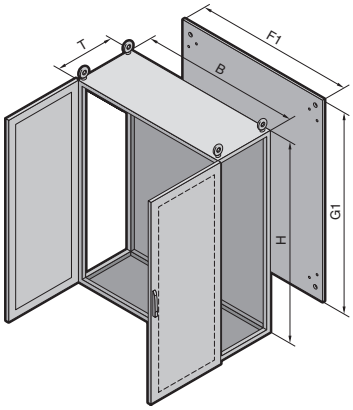
Viewing window
to protect against unauthorised access and preserve the protection category,
Model No. see page 878.

Accessories Page 832 **ES 5000 stainless steel** Page 285 **ES 5000 EMC-shielded** Page 291

Baying systems TS 8

Height: 1400, depth: 500





Material:
Sheet steel
Enclosure frame, roof, rear panel and gland plates: 1.5 mm
Door: 2.0 mm
Mounting plate: 3.0 mm

Surface finish:
Enclosure frame:
Dipcoat-primed
Door, roof and rear panel:
Dipcoat-primed, powder-coated in textured RAL 7035 on the outside
Mounting plate and gland plates: Zinc-plated

Supply includes:
Enclosure frame with doors, mounting plate, gland plates, rear panel and roof plate

Protection category:
IP 55 to EN 60 529,
Complies with NEMA 12.

Approvals,
see page 29.

Detailed drawing/ nominal dimensions,
see page 1091 – 1092.

Width (B) in mm		Packs of	600	800	1200	Page
Height (H) in mm			1400	1400	1400	
Depth (T) in mm			500	500	500	
Mounting plate width (F1) in mm			499	699	1099	
Mounting plate height (G1) in mm			1296	1296	1296	
Model No. TS		1	**8645.500**	**8845.500**	**8245.500**	
Door(s)			1	1	2	
Weight (kg)			86.0	107.5	163.5	
Walls						
Side panels		2	8145.235	8145.235	8145.235	853
Divider panel		1	8609.450	8609.450	8609.450	857
Divider panel for module plates		1	8609.180	8609.180	8609.180	858
Base/plinth						
Components front and rear	Height 100 mm	1 set	8601.600	8601.800	8601.200	835
	Height 200 mm	1 set	8602.600	8602.800	8602.200	835
Trim panels (sides)	Height 100 mm	1 set	8601.050	8601.050	8601.050	835
	Height 200 mm	1 set	8602.050	8602.050	8602.050	835
Accessories						
Cable clamp rails for cable clamps		2	4191.000	4192.000	4196.000	979
Cable clamp rails (C section) for cable clamps		6	4944.000	4945.000	4947.000	928
Support strips for door		20	4596.000	4598.000	4596.000	895
Wiring plan pocket, sheet steel		1	4116.000	4118.000	4116.000	898
Lock systems						
Standard double-bit lock insert may be exchanged for other lock inserts and comfort handle, see page 881 – 889.						

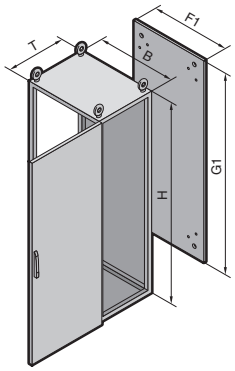
To order enclosures in textured RAL 7032 please add extension .600 to the Model No., and for primed enclosures use extension .800.
Delivery times available on request.

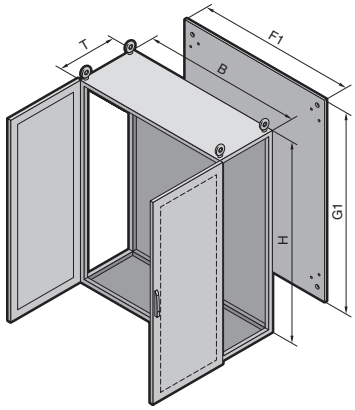
Signal pillar LED compact,
Model No. see page 1041.

Baying cover,
Model No. see page 867.

Accessories Page 832 **TS 8 stainless steel** Page 284 **TS 8 EMC-shielded** Page 291 **TS 8 climate controlled enclosure** Page 582 – 583
TS 8 climate control doors Page 584 – 588

Height: 1600, depth: 500





Material:
Sheet steel
Enclosure frame, roof, rear panel and gland plates: 1.5 mm
Door: 2.0 mm
Mounting plate: 3.0 mm

Surface finish:
Enclosure frame:
Dipcoat-primed
Door, roof and rear panel:
Dipcoat-primed, powder-coated in textured RAL 7035 on the outside
Mounting plate and gland plates: Zinc-plated

Supply includes:
Enclosure frame with doors, mounting plate, gland plates, rear panel and roof plate

Protection category:
IP 55 to EN 60 529,
Complies with NEMA 12.

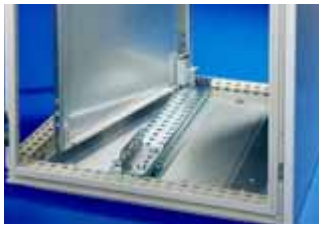
Approvals,
see page 29.

Detailed drawing/ nominal dimensions,
see page 1091 – 1092.

Width (B) in mm		Packs of	600	800	1200	Page
Height (H) in mm			1600	1600	1600	
Depth (T) in mm			500	500	500	
Mounting plate width (F1) in mm			499	699	1099	
Mounting plate height (G1) in mm			1496	1496	1496	
Model No. TS		1	**8665.500**	**8865.500**	**8265.500**	
Door(s)			1	1	2	
Weight (kg)			100.0	103.0	159.3	
Walls						
Side panels		2	8165.235	8165.235	8165.235	853
Divider panel		1	8609.650	8609.650	8609.650	857
Divider panel for module plates		1	8609.165	8609.165	8609.165	858
Base/plinth						
Components front and rear	Height 100 mm	1 set	8601.600	8601.800	8601.200	835
	Height 200 mm	1 set	8602.600	8602.800	8602.200	835
Trim panels (sides)	Height 100 mm	1 set	8601.050	8601.050	8601.050	835
	Height 200 mm	1 set	8602.050	8602.050	8602.050	835
Accessories						
Cable clamp rails for cable clamps		2	4191.000	4192.000	4196.000	979
Cable clamp rails (C section) for cable clamps		6	4944.000	4945.000	4947.000	928
Support strips for door		20	4596.000	4598.000	4596.000	895
Wiring plan pocket, sheet steel		1	4116.000	4118.000	4116.000	898
Lock systems						
Standard double-bit lock insert may be exchanged for other lock inserts and comfort handle, see page 881 – 889.						

To order enclosures in textured RAL 7032 please add extension .600 to the Model No., and for primed enclosures use extension .800.
Delivery times available on request.

Connector gland
for connecting a keyboard, mouse or scanner,
Model No. see page 975.

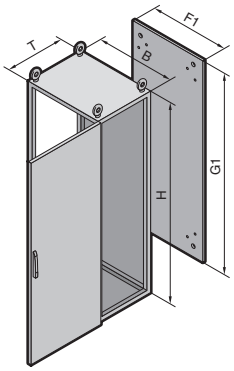


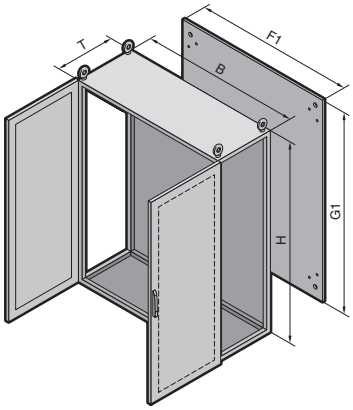
Hinge attachment
for partial mounting plates,
Model No. see page 911.

Accessories Page 832 **TS 8 stainless steel** Page 284 **TS 8 EMC-shielded** Page 291 **TS 8 climate controlled enclosure** Page 582 – 583
TS 8 climate control doors Page 584 – 588

Baying systems TS 8

Height: 1800, depth: 400





Material:
Sheet steel
Enclosure frame, roof, rear panel and gland plates: 1.5 mm
Door: 2.0 mm
Mounting plate: 3.0 mm

Surface finish:
Enclosure frame:
Dipcoat-primed
Door, roof and rear panel:
Dipcoat-primed, powder-coated in textured RAL 7035 on the outside
Mounting plate and gland plates: Zinc-plated

Supply includes:
Enclosure frame with doors, mounting plate, gland plates, rear panel and roof plate.

Protection category:
IP 55 to EN 60 529,
Complies with NEMA 12.

Approvals,
see page 29.

Detailed drawing/ nominal dimensions,
see page 1091 – 1092.

Accessories:
Corner enclosures,
see page 868.

Possible alternative:
A matching climate control door instead of the door or rear panel, see page 584 – 588.

Width (B) in mm		Packs of	600	800	1000	1000	1200	Page
Height (H) in mm			1800	1800	1800	1800	1800	
Depth (T) in mm			400	400	400	400	400	
Mounting plate width (F1) in mm			499	699	899	899	1099	
Mounting plate height (G1) in mm			1696	1696	1696	1696	1696	
Model No. TS		1	**8684.500**	**8884.500**	**8084.500**	**8080.500**	**8284.500**	
Door(s)			1	1	1	2	2	
Weight (kg)			91.3	113.5	136.4	140.0	170.6	
Walls								
Side panels		2	8184.235	8184.235	8184.235	8184.235	8184.235	853
Divider panel		1	8609.840	8609.840	8609.840	8609.840	8609.840	857
Base/plinth								
Components front and rear	Height 100 mm	1 set	8601.600	8601.800	8601.000	8601.000	8601.200	835
	Height 200 mm	1 set	8602.600	8602.800	8602.000	8602.000	8602.200	835
Trim panels (sides)	Height 100 mm	1 set	8601.040	8601.040	8601.040	8601.040	8601.040	835
	Height 200 mm	1 set	8602.040	8602.040	8602.040	8602.040	8602.040	835
Accessories								
Cable clamp rails for cable clamps		2	4191.000	4192.000	4336.000	4336.000	4196.000	979
Cable clamp rails (C section) for cable clamps		6	4944.000	4945.000	4946.000	4946.000	4947.000	928
Support strips for door		20	4596.000	4598.000	4599.000	4309.000	4596.000	895
Wiring plan pocket, sheet steel		1	4116.000	4118.000	4124.000	4115.000	4116.000	898
Lock systems								
Standard double-bit lock insert may be exchanged for other lock inserts and comfort handle, see page 881 – 889.								

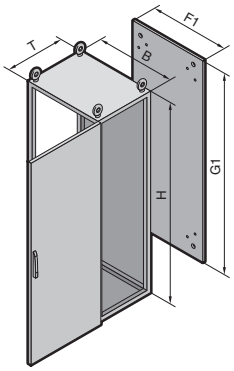
To order enclosures in textured RAL 7032 please add extension .600 to the Model No., and for primed enclosures use extension .800.
Delivery times available on request.

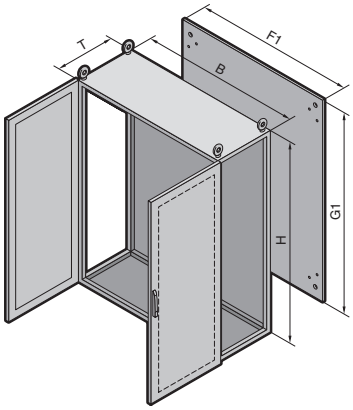
Snap-on nut
for screw-fastening to the vertical section with a thread,
Model No. see page 931.

System windows
to protect against unauthorised access and preserve the protection category,
Model No. see page 877.

Accessories Page 832 **TS 8 stainless steel** Page 284 **TS 8 EMC-shielded** Page 291 **TS 8 climate controlled enclosure** Page 582 – 583
TS 8 climate control doors Page 584 – 588

Height: 1800, depth: 500





Material:
Sheet steel
Enclosure frame, roof, rear panel and gland plates: 1.5 mm
Door: 2.0 mm
Mounting plate: 3.0 mm

Surface finish:
Enclosure frame:
Dipcoat-primed
Door, roof and rear panel:
Dipcoat-primed, powder-coated in textured RAL 7035 on the outside
Mounting plate and gland plates: Zinc-plated

Supply includes:
Enclosure frame with doors, mounting plate, gland plates, rear panel and roof plate.

Protection category:
IP 55 to EN 60 529,
Complies with NEMA 12 (apart from TS 8485.510).

Approvals,
see page 29.

Detailed drawing/ nominal dimensions,
see page 1091 – 1092.

Accessories:
Corner enclosures, see page 868.

Possible alternative:
A matching climate control door instead of the door or rear panel, see page 584 – 588.

Width (B) in mm		Packs of	400	600	800	800	1200	Page
Height (H) in mm			1800	1800	1800	1800	1800	
Depth (T) in mm			500	500	500	500	500	
Mounting plate width (F1) in mm			–	499	699	699	1099	
Mounting plate height (G1) in mm			–	1696	1696	1696	1696	
Model No. TS		1	**8485.510**[1)]	**8685.500**	**8885.500**	**8880.500**	**8285.500**	
Door(s)			1	1	1	2	2	
Weight (kg)			49.2	93.8	115.8	122.5	173.3	
Walls								
Side panels		2	8185.235	8185.235	8185.235	8185.235	8185.235	853
Divider panel		1	8609.850	8609.850	8609.850	8609.850	8609.850	857
Divider panel for module plates		1	8609.100	8609.100	8609.100	8609.100	8609.100	858
Base/plinth								
Components front and rear	Height 100 mm	1 set	8601.400	8601.600	8601.800	8601.800	8601.200	835
	Height 200 mm	1 set	8602.400	8602.600	8602.800	8602.800	8602.200	835
Trim panels (sides)	Height 100 mm	1 set	8601.050	8601.050	8601.050	8601.050	8601.050	835
	Height 200 mm	1 set	8602.050	8602.050	8602.050	8602.050	8602.050	835
Accessories								
Cable clamp rails for cable clamps		2	4193.000	4191.000	4192.000	4192.000	4196.000	979
Cable clamp rails (C section) for cable clamps		6	–	4944.000	4945.000	4945.000	4947.000	928
Support strips for door		20	–	4596.000	4598.000	4594.000	4596.000	895
Wiring plan pocket, sheet steel		1	–	4116.000	4118.000	4114.000	4116.000	898
Lock systems								
Standard double-bit lock insert may be exchanged for other lock inserts and comfort handle, see page 881 – 889.								

[1)] Without tubular door frame, mounting plate and gland plates.
To order enclosures in textured RAL 7032 please add extension .600 or .610 to the Model No., and for primed enclosures use extension .800 or .810. Delivery times available on request.

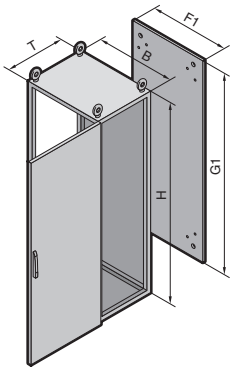
Interface flap
for the secure, lockable accommodation of sockets, ports or drives,
Model No. see page 1059.

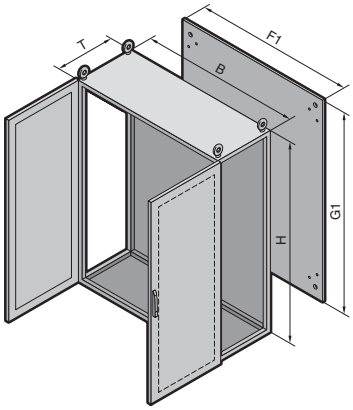
Keyboard, pull-out
with integral trackball,
Model No. see page 1048.

Accessories Page 832 **TS 8 stainless steel** Page 284 **TS 8 EMC-shielded** Page 291 **TS 8 climate controlled enclosure** Page 582 – 583
TS 8 climate control doors Page 584 – 588

Baying systems TS 8

Height: 1800, depth: 600





Material:
Sheet steel
Enclosure frame, roof, rear panel and gland plates: 1.5 mm
Door: 2.0 mm
Mounting plate: 3.0 mm

Surface finish:
Enclosure frame:
Dipcoat-primed
Door, roof and rear panel:
Dipcoat-primed, powder-coated in textured RAL 7035 on the outside
Mounting plate and gland plates: Zinc-plated

Supply includes:
Enclosure frame with doors, mounting plate, gland plates, rear panel, roof plate and 2 support strips (TS 4696.000, see page 924), fitted in the enclosure depth.

Protection category:
IP 55 to EN 60 529,
Complies with NEMA 12 (apart from TS 8486.510).

Accessories:

Corner enclosures, see page 868.
Climate controlled enclosure KTS single-door/two-door, see page 582 – 583.

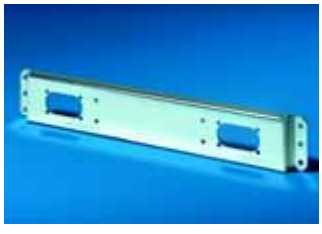
Approvals, see page 29.

Detailed drawing/ nominal dimensions, see page 1091 – 1092.

Width (B) in mm		Packs of	400	600	800	800	1200	Page
Height (H) in mm			1800	1800	1800	1800	1800	
Depth (T) in mm			600	600	600	600	600	
Mounting plate width (F1) in mm			–	499	699	699	1099	
Mounting plate height (G1) in mm			–	1696	1696	1696	1696	
Model No. TS		1	**8486.510**[1)]	**8686.500**	**8886.500**	**8881.500**	**8286.500**	
Door(s)			1	1	1	2	2	
Weight (kg)			51.7	96.8	120.3	125.8	179.9	
Walls								
Side panels		2	8186.235	8186.235	8186.235	8186.235	8186.235	853
Divider panel		1	8609.860	8609.860	8609.860	8609.860	8609.860	857
Divider panel for module plates		1	8609.110	8609.110	8609.110	8609.110	8609.110	858
Climate control side panel		1	3331.XXX	3331.XXX	3331.XXX	3331.XXX	3331.XXX	589
Base/plinth								
Components front and rear	Height 100 mm	1 set	8601.400	8601.600	8601.800	8601.800	8601.200	835
	Height 200 mm	1 set	8602.400	8602.600	8602.800	8602.800	8602.200	835
Trim panels (sides)	Height 100 mm	1 set	8601.060	8601.060	8601.060	8601.060	8601.060	835
	Height 200 mm	1 set	8602.060	8602.060	8602.060	8602.060	8602.060	835
Accessories								
Cable clamp rails for cable clamps		2	4193.000	4191.000	4192.000	4192.000	4196.000	979
Cable clamp rails (C section) for cable clamps		6	–	4944.000	4945.000	4945.000	4947.000	928
Support strips for door		20	–	4596.000	4598.000	4594.000	4596.000	895
Wiring plan pocket, sheet steel		1	–	4116.000	4118.000	4114.000	4116.000	898
Lock systems								
Standard double-bit lock insert may be exchanged for other lock inserts and comfort handle, see page 881 – 889.								

[1)] Without tubular door frame, mounting plate and gland plates.
To order enclosures in textured RAL 7032 please add extension .600 or .610 to the Model No., and for primed enclosures use extension .800 or .810. Delivery times available on request.

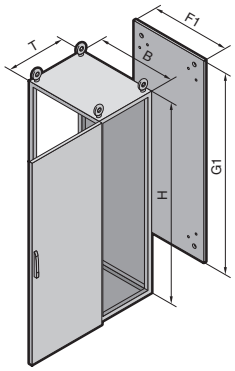
Enclosure surface connector and support for keyboards,
Model No. see page 1034/1048.

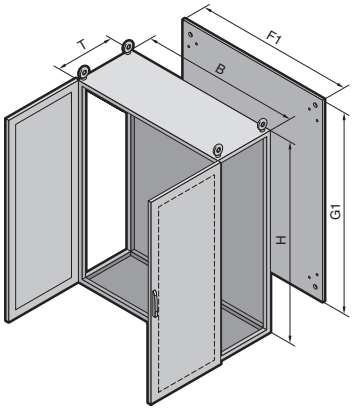


Cross-brace for door
to stabilise an externally mounted keyboard housing,
Model No. see page 895.

Accessories Page 832 **TS 8 stainless steel** Page 284 **TS 8 EMC-shielded** Page 291 **TS 8 climate controlled enclosure** Page 582 – 583
TS 8 climate control doors Page 584 – 588

Height: 2000, depth: 400





Material:
Sheet steel
Enclosure frame, roof, rear panel and gland plates: 1.5 mm
Door: 2.0 mm
Mounting plate: 3.0 mm

Surface finish:
Enclosure frame:
Dipcoat-primed
Door, roof and rear panel:
Dipcoat-primed, powder-coated in textured RAL 7035 on the outside
Mounting plate and gland plates: Zinc-plated

Supply includes:
Enclosure frame with doors, mounting plate, gland plates, rear panel and roof plate.

Protection category:
IP 55 to EN 60 529,
Complies with NEMA 12.

Accessories:
Corner enclosures,
see page 868.
Climate controlled enclosure KTS single-door/two-door,
see page 582 – 583.

Approvals,
see page 29.

Detailed drawing/ nominal dimensions,
see page 1091 – 1092.

Width (B) in mm		Packs of	600	800	1200	Page
Height (H) in mm			2000	2000	2000	
Depth (T) in mm			400	400	400	
Mounting plate width (F1) in mm			499	699	1099	
Mounting plate height (G1) in mm			1896	1896	1896	
Model No. TS		1	**8604.500**	**8804.500**	**8204.500**	
Door(s)			1	1	2	
Weight (kg)			99.0	124.0	184.5	
Walls						
Side panels		2	8104.235	8104.235	8104.235	853
Divider panel		1	8609.040	8609.040	8609.040	857
Climate control side panel		1	3331.XXX	3331.XXX	3331.XXX	589
Side panel with air/water heat exchangers		1	3316.200	3316.200	3316.200	632
Base/plinth						
Components front and rear	Height 100 mm	1 set	8601.600	8601.800	8601.200	835
	Height 200 mm	1 set	8602.600	8602.800	8602.200	835
Trim panels (sides)	Height 100 mm	1 set	8601.040	8601.040	8601.040	835
	Height 200 mm	1 set	8602.040	8602.040	8602.040	835
Accessories						
Cable clamp rails for cable clamps		2	4191.000	4192.000	4196.000	979
Cable clamp rails (C section) for cable clamps		6	4944.000	4945.000	4947.000	928
Support strips for door		20	4596.000	4598.000	4596.000	895
Wiring plan pocket, sheet steel		1	4116.000	4118.000	4116.000	898
Lock systems						
Standard double-bit lock insert may be exchanged for other lock inserts and comfort handle, see page 881 – 889.						

To order enclosures in textured RAL 7032 please add extension .600 to the Model No., and for primed enclosures use extension .800.
Delivery times available on request.

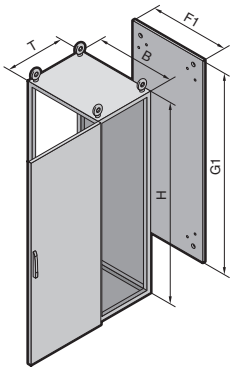
Vertical cable trunking,
sized to the section and horizontally on the mounting plate,
Model No. see page 977 – 978.

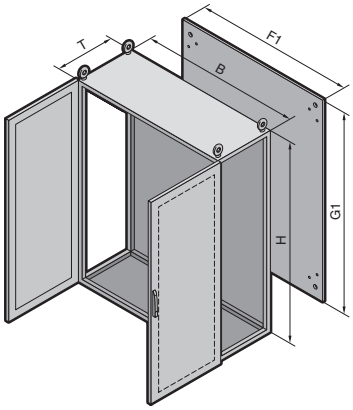
Bar
for EMC shielding brackets and cable clamps,
Model No. see page 957.

Accessories Page 832 **TS 8 stainless steel** Page 284 **TS 8 EMC-shielded** Page 291 **TS 8 climate controlled enclosure** Page 582 – 583
TS 8 climate control doors Page 584 – 588

Baying systems TS 8

Height: 2000, depth: 500





Material:
Sheet steel
Enclosure frame, roof, rear panel and gland plates: 1.5 mm
Door: 2.0 mm
Mounting plate: 3.0 mm

Surface finish:
Enclosure frame, door, roof and rear panel: RAL 7044
Dipcoat-primed, powder-coated in textured RAL 7035 on the outside
Mounting plate and gland plates: Zinc-plated

Supply includes:
Enclosure frame with doors, mounting plate, gland plates, rear panel and roof plate.

Protection category:
IP 55 to EN 60 529,
Complies with NEMA 12 (apart from TS 8405.510).

Possible alternative:
A matching climate control door instead of the door or rear panel, see page 584 – 588.

Accessories:
Corner enclosures, see p. 868.
Climate controlled enclosure KTS single-door/two-door, see page 582 – 583.

Approvals,
see page 29.

Detailed drawing/ nominal dimensions,
see page 1091 – 1092.

Width (B) in mm		Packs of	400	600	800	1000	1200	Page
Height (H) in mm			2000	2000	2000	2000	2000	
Depth (T) in mm			500	500	500	500	500	
Mounting plate width (F1) in mm			–	499	699	899	1099	
Mounting plate height (G1) in mm			–	1896	1896	1896	1896	
Model No. TS		1	**8405.510**[1)]	**8605.500**	**8805.500**	**8005.500**	**8205.500**	
Door(s)			1	1	1	2	2	
Weight (kg)			60.7	101.3	126.3	157.1	190.6	
Walls								
Side panels		2	8105.235	8105.235	8105.235	8105.235	8105.235	853
Divider panel		1	8609.050	8609.050	8609.050	8609.050	8609.050	857
Divider panel for module plates		1	8609.120	8609.120	8609.120	8609.120	8609.120	858
Base/plinth								
Components front and rear	Height 100 mm	1 set	8601.400	8601.600	8601.800	8601.000	8601.200	835
	Height 200 mm	1 set	8602.400	8602.600	8602.800	8602.000	8602.200	835
Trim panels (sides)	Height 100 mm	1 set	8601.050	8601.050	8601.050	8601.050	8601.050	835
	Height 200 mm	1 set	8602.050	8602.050	8602.050	8602.050	8602.050	835
Accessories								
Cable clamp rails for cable clamps		2	4193.000	4191.000	4192.000	4336.000	4196.000	979
Cable clamp rails (C section) for cable clamps		6	–	4944.000	4945.000	4946.000	4947.000	928
Support strips for door		20	–	4596.000	4598.000	4309.000	4596.000	895
Wiring plan pocket, sheet steel		1	–	4116.000	4118.000	4115.000	4116.000	898
Lock systems								
Standard double-bit lock insert may be exchanged for other lock inserts and comfort handle, see page 881 – 889.								

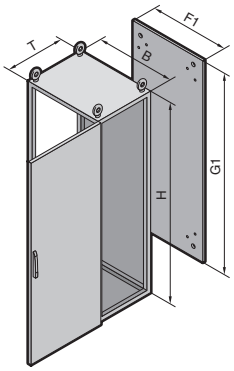
[1)] Without tubular door frame, mounting plate and gland plates.
To order enclosures in textured RAL 7032 please add extension .600 or .610 to the Model No., and for primed enclosures use extension .800 or .810. Delivery times available on request.

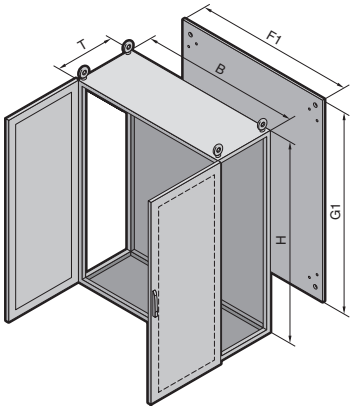
Cable glands
made from polyamide or brass,
Model No. see page 972.

Fold-out tray for keyboard and mouse,
Model No. see page 1049.

Accessories Page 832 **TS 8 stainless steel** Page 284 **TS 8 EMC-shielded** Page 291 **TS 8 climate controlled enclosure** Page 582 – 583
TS 8 climate control doors Page 584 – 588

Height: 2000, depth: 600





Material:
Sheet steel
Enclosure frame, roof, rear panel and gland plates: 1.5 mm
Door: 2.0 mm
Mounting plate: 3.0 mm

Surface finish:
Enclosure frame:
Dipcoat-primed
Door, roof and rear panel:
Dipcoat-primed, powder-coated in textured RAL 7035 on the outside
Mounting plate and gland plates: Zinc-plated

Supply includes:
Enclosure frame with doors, mounting plate, gland plates, rear panel, roof plate and 2 support strips (TS 4696.000, see page 924), fitted in the enclosure depth.

Protection category:
IP 55 to EN 60 529,
Complies with NEMA 12 (apart from TS 8406.510).

Accessories:

Corner enclosures,
see page 868.
Climate controlled enclosure KTS single-door/two-door,
see page 582 – 583.

Approvals,
see page 29.

Detailed drawing/ nominal dimensions,
see page 1091 – 1092.

Width (B) in mm		Packs of	400	600	800	1000	1200	Page
Height (H) in mm			2000	2000	2000	2000	2000	
Depth (T) in mm			600	600	600	600	600	
Mounting plate width (F1) in mm			–	499	699	899	1099	
Mounting plate height (G1) in mm			–	1896	1896	1896	1896	
Model No. TS		1	**8406.510**[1)]	**8606.500**	**8806.500**	**8006.500**	**8206.500**	
Door(s)			1	1	1	2	2	
Weight (kg)			55.7	104.0	130.5	161.2	194.6	
Walls								
Side panels		2	8106.235	8106.235	8106.235	8106.235	8106.235	853
Divider panel		1	8609.060	8609.060	8609.060	8609.060	8609.060	857
Divider panel for module plates		1	8609.130	8609.130	8609.130	8609.130	8609.130	858
Climate control side panel		1	3331.XXX	3331.XXX	3331.XXX	3331.XXX	3331.XXX	589
Base/plinth								
Components front and rear	Height 100 mm	1 set	8601.400	8601.600	8601.800	8601.000	8601.200	835
	Height 200 mm	1 set	8602.400	8602.600	8602.800	8602.000	8602.200	835
Trim panels (sides)	Height 100 mm	1 set	8601.060	8601.060	8601.060	8601.060	8601.060	835
	Height 200 mm	1 set	8602.060	8602.060	8602.060	8602.060	8602.060	835
Accessories								
Cable clamp rails for cable clamps		2	4193.000	4191.000	4192.000	4336.000	4196.000	979
Cable clamp rails (C section) for cable clamps		6	–	4944.000	4945.000	4946.000	4947.000	928
Support strips for door		20	–	4596.000	4598.000	4309.000	4596.000	895
Wiring plan pocket, sheet steel		1	–	4116.000	4118.000	4115.000	4116.000	898
Lock systems								
Standard double-bit lock insert may be exchanged for other lock inserts and comfort handle, see page 881 – 889.								

[1)] Without tubular door frame, mounting plate and gland plates.
To order enclosures in textured RAL 7032 please add extension .600 or .610 to the Model No., and for primed enclosures use extension .800 or .810. Delivery times available on request.

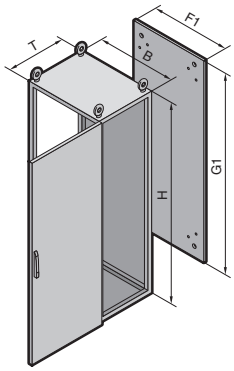
Section for cable entry
for top mounting on gland plates with routing of the cable clamp strip,
Model No. see page 965.

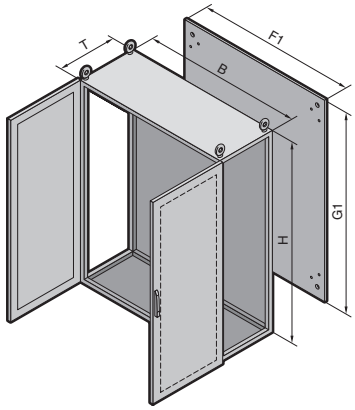
Module panel
for cable entry in divider panel,
Model No. see page 859.

Accessories Page 832 **TS 8 stainless steel** Page 284 **TS 8 EMC-shielded** Page 291 **TS 8 climate controlled enclosure** Page 582 – 583
TS 8 climate control doors Page 584 – 588

Baying systems TS 8

Height: 2000, depth: 800





Material:
Sheet steel
Enclosure frame, roof, rear panel and gland plates: 1.5 mm
Door: 2.0 mm
Mounting plate: 3.0 mm

Surface finish:
Enclosure frame:
Dipcoat-primed
Door, roof and rear panel:
Dipcoat-primed, powder-coated in textured RAL 7035 on the outside
Mounting plate and gland plates: Zinc-plated

Supply includes:
Enclosure frame with doors, mounting plate, gland plates, rear panel and roof plate.

Protection category:
IP 55 to EN 60 529,
Complies with NEMA 12.

Possible alternative:
A matching climate control door instead of the door or rear panel, see page 584 – 588.

Accessories:
Climate controlled enclosure KTS single-door/two-door, see page 582 – 583.

Approvals,
see page 29.

Detailed drawing/ nominal dimensions,
see page 1091 – 1092.

Width (B) in mm		Packs of	600	800	1200	Page
Height (H) in mm			2000	2000	2000	
Depth (T) in mm			800	800	800	
Mounting plate width (F1) in mm			499	699	1099	
Mounting plate height (G1) in mm			1896	1896	1896	
Model No. TS		1	**8608.500**	**8808.500**	**8208.500**	
Door(s)			1	1	2	
Weight (kg)			111.3	137.0	203.0	
Walls						
Side panels		2	8108.235	8108.235	8108.235	853
Divider panel		1	8609.080	8609.080	8609.080	857
TS 8 internal fan mounting panel		1	3348.200	3348.200	3348.200	653
Base/plinth						
Components front and rear	Height 100 mm	1 set	8601.600	8601.800	8601.200	835
	Height 200 mm	1 set	8602.600	8602.800	8602.200	835
Trim panels (sides)	Height 100 mm	1 set	8601.080	8601.080	8601.080	835
	Height 200 mm	1 set	8602.080	8602.080	8602.080	835
Accessories						
Cable clamp rails for cable clamps		2	4191.000	4192.000	4196.000	979
Cable clamp rails (C section) for cable clamps		6	4944.000	4945.000	4947.000	928
Support strips for door		20	4596.000	4598.000	4596.000	895
Wiring plan pocket, sheet steel		1	4116.000	4118.000	4116.000	898
Lock systems						
Standard double-bit lock insert may be exchanged for other lock inserts and comfort handle, see page 881 – 889.						

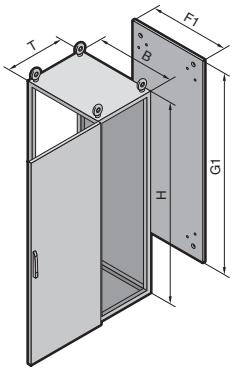
To order enclosures in textured RAL 7032 please add extension .600 to the Model No., and for primed enclosures use extension .800.
Delivery times available on request.

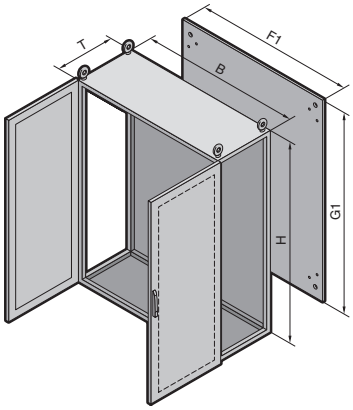
Punched section without mounting flange 45 x 88 mm
The universal installation solution with 11 rows of holes for heavy mounted equipment and for screw-fastening to the machine,
Model No. see page 922.

Mounting plate attachment
in conjunction with a mounting plate infill,
Model No.
see page 910.

Accessories Page 832 **TS 8 stainless steel** Page 284 **TS 8 EMC-shielded** Page 291 **TS 8 climate controlled enclosure** Page 582 – 583
TS 8 climate control doors Page 584 – 588

Height: 2200, depth: 600





Material:
Sheet steel
Enclosure frame, roof, rear panel and gland plates: 1.5 mm
Door: 2.0 mm
Mounting plate: 3.0 mm

Surface finish:
Enclosure frame:
Dipcoat-primed
Door, roof and rear panel:
Dipcoat-primed, powder-coated in textured RAL 7035 on the outside
Mounting plate and gland plates: Zinc-plated

Supply includes:
Enclosure frame with doors, mounting plate, gland plates, rear panel and roof plate.

Protection category:
IP 55 to EN 60 529,
Complies with NEMA 12.

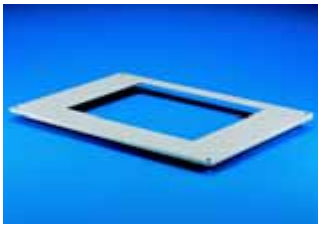
Accessories:
Corner enclosures,
see page 868.

Approvals,
see page 29.

Detailed drawing/ nominal dimensions,
see page 1091 – 1092.

Width (B) in mm		Packs of	600	800	1200	Page
Height (H) in mm			2200	2200	2200	
Depth (T) in mm			600	600	600	
Mounting plate width (F1) in mm			499	699	1099	
Mounting plate height (G1) in mm			2096	2096	2096	
Model No. TS		1	**8626.500**	**8826.500**	**8226.500**	
Door(s)			1	1	2	
Weight (kg)			113.1	139.3	208.0	
Walls						
Side panels		2	8126.235	8126.235	8126.235	853
Divider panel		1	8609.260	8609.260	8609.260	857
Base/plinth						
Components front and rear	Height 100 mm	1 set	8601.600	8601.800	8601.200	835
	Height 200 mm	1 set	8602.600	8602.800	8602.200	835
Trim panels (sides)	Height 100 mm	1 set	8601.060	8601.060	8601.060	835
	Height 200 mm	1 set	8602.060	8602.060	8602.060	835
Accessories						
Cable clamp rails for cable clamps		2	4191.000	4192.000	4196.000	979
Cable clamp rails (C section) for cable clamps		6	4944.000	4945.000	4947.000	928
Support strips for door		20	4596.000	4598.000	4596.000	895
Wiring plan pocket, sheet steel		1	4116.000	4118.000	4116.000	898
Lock systems						
Standard double-bit lock insert may be exchanged for other lock inserts and comfort handle, see page 881 – 889.						

To order enclosures in textured RAL 7032 please add extension .600 to the Model No., and for primed enclosures use extension .800.
Delivery times available on request.

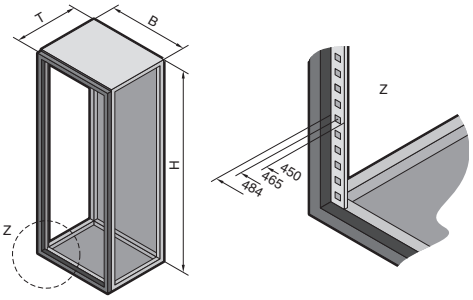


Roof plates
with cutout for cooling units,
Model No. see page 664.

Utility shelves
for external mounting on surfaces as a support e.g. for scanners or tools,
Model No. see page 1039.

Accessories Page 832 **TS 8 stainless steel** Page 284 **TS 8 EMC-shielded** Page 291 **TS 8 climate controlled enclosure** Page 582 – 583
TS 8 climate control doors Page 584 – 588

Electronic enclosure



Material:
Enclosure frame:
1.5 mm sheet steel
Front frame:
Extruded aluminium sections with die-cast corner pieces
Rear door: Sheet steel 2 mm
Roof and gland plates:
1.5 mm sheet steel
Adaptor sections: Aluminium

Surface finish:
Enclosure frame:
Dipcoat-primed
Front frame, rear door and roof:
Powder-coated in RAL 7035
Adaptor sections:
Conductive, corrosion-resistant coating
Gland plates: Zinc-plated

Supply includes:
Enclosure frame, front frame (r/h hinge, opening angle 130°, held via mechanical snap fasteners on left), rear door (r/h hinge, may be swapped to opposite side), roof, adaptor sections and gland plates.

Approvals,
see page 30.

Detailed drawing/nominal dimensions,
see page 1094.

U		Packs of	33	33	42	42	Page
Width (B) in mm			600	600	600	600	
Height (H) in mm			1600	1600	2000	2000	
Depth (T) in mm			600	800	600	800	
Model No. TS		1	**8410.510**	**8418.510**	**8430.510**	**8438.510**	
Door(s)			1	1	1	1	
Base/plinth							
Components front and rear	Height 100 mm	1 set	8601.600	8601.600	8601.600	8601.600	835
	Height 200 mm	1 set	8602.600	8602.600	8602.600	8602.600	835
Trim panels (sides)	Height 100 mm	1 set	8601.060	8601.080	8601.060	8601.080	835
	Height 200 mm	1 set	8602.060	8602.080	8602.060	8602.080	835
Accessories							
Side panels		2	8166.235	8168.235	8106.235	8108.235	853
Cable clamp rails for cable clamps		2	4191.000	4191.000	4191.000	4191.000	979
Cable clamp rails (C section) for cable clamps		6	4944.000	4944.000	4944.000	4944.000	928
Lock systems							
Standard double-bit lock insert (in rear door) may be exchanged for other lock inserts and comfort handle, see page 881 – 889.							

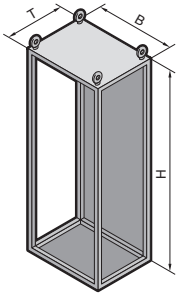
For primed enclosures, please add extension .810 to the Model No. Delivery times available on request.

Signal pillar LED compact,
Model No. see page 1041.

Earthing plate,
the central earthing point for up to eight flat-pin connectors.
Model No. see page 961.

Accessories Page 832 **482.6 mm (19″) mounting accessories** From page 993 **Subrack systems** Page 486 **482.6 mm (19″) climate control** Page 644 – 646

for modular front design



The basic enclosures without
- Mounting plate
  for universal interior installation with
  – Partial mounting plates
  – Component shelves and drawers
  – Punched sections and rails
- Doors
  Frame for the installation of
  – Partial doors with and without viewing panels
  – Completely glazed doors
  – Drawers and desk sections
  – Profile blanking frame
  – Vertically divided doors
  – Trim panels hinged at the top

Material:
Sheet steel
Enclosure frame, roof, rear panel and gland plates: 1.5 mm

Surface finish:
Enclosure frame:
Dipcoat-primed
Door and rear panel:
Dipcoat-primed
Powder-coated on the outside in Textured RAL 7035
Gland plates: Zinc-plated

Supply includes:
Enclosure frame, roof, rear panel, gland plates, three-piece.

Detailed drawing (TS basic enclosures without door),
see page 1094.

Width (B) in mm		Packs of	600	800	Page
Height (H) in mm			2000	2000	
Depth (T) in mm			600	600	
Model No. TS		1	**8606.512**	**8806.512**	
Weight (kg)			52.5	63.0	
Walls					
Side panels		2	8106.512	8106.512	876
Divider panel		1	8609.060	8609.060	857
Divider panel for module plates		1	8609.130	8609.130	858
Base/plinth					
Components front and rear	Height 100 mm	1 set	8601.600	8601.800	835
	Height 200 mm	1 set	8602.600	8602.800	835
Trim panels (sides)	Height 100 mm	1 set	8601.060	8601.060	835
	Height 200 mm	1 set	8602.060	8602.060	835

To order enclosures in textured RAL 7032 please add extension .612 to the Model No., and for primed enclosures use extension .812.
Delivery times available on request.

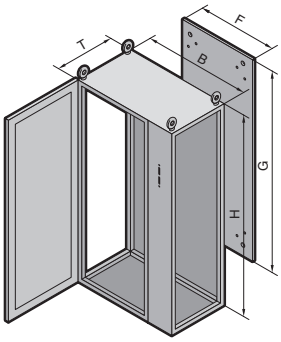
Trim panels TS
For height trim at the top and bottom,
Model No. see page 875.

Drawer tray
pull-out,
Model No. see page 942.

Accessories Page 832 **Partial doors** Page 875 **Partial mounting plates** Page 913

Baying systems TS 8

For isolator door locking



Material:
Sheet steel
Enclosure frame, roof, rear panel and gland plates:
1.5 mm
Door and trim panel: 2.0 mm
Mounting plate: 3.0 mm

Surface finish:
Enclosure frame:
Dipcoat-primed
Door, trim panel, roof and rear panel:
Dipcoat-primed
Powder-coated on the outside in textured RAL 7035
Mounting plate and gland plates: Zinc-plated

Protection category:
IP 55 to EN 60 529/10.91,
Complies with NEMA 12
(with fitted/sealed isolator switch actuation)

Supply includes:
Enclosure frame, door (l/h hinge), trim panel (r/h hinge, with a swing lever at the top and bottom, with cutout for isolator switch actuation), roof, rear panel, mounting plate, three-piece gland plates.

Approvals,
see page 30.

Detailed drawing/nominal dimensions,
see page 1093.

Width (B) in mm		Packs of	800	800	800	800	Page
Height (H) in mm			1800	1800	2000	2000	
Depth (T) in mm			400	500	500	600	
Mounting plate width (F) in mm			699	699	699	699	
Mounting plate height (G) in mm			1696	1696	1896	1896	
Model No. TS		1	**8984.500**	**8985.500**	**8905.500**	**8906.500**	
Door(s)			1	1	1	1	
Weight (kg)			113.5	115.8	126.3	130.5	
Base/plinth							
Components front and rear	Height 100 mm	1 set	8601.800	8601.800	8601.800	8601.800	835
	Height 200 mm	1 set	8602.800	8602.800	8602.800	8602.800	835
Trim panels (sides)	Height 100 mm	1 set	8601.040	8601.050	8601.050	8601.060	835
	Height 200 mm	1 set	8602.040	8602.050	8602.050	8602.060	835
Also required							
Latch for bayed suites							892
Accessories							
Isolator door locking (USA version)		1	8611.310	8611.310	8611.310	8611.310	892
Lock systems							
Standard double-bit lock insert may be exchanged for other lock inserts and comfort handle, see page 881 – 889.							

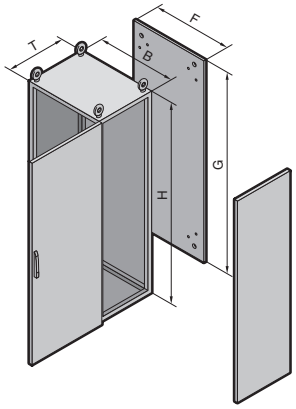
To order enclosures in RAL 7032 please add extension .600 to the Model No., and for primed enclosures use extension .800.
Delivery times available on request.

Cable gland
made from polyamide or brass,
Model No. see page 972.

Snap-on nut
for screw-fastening to the vertical section,
Model No. see page 931.

Accessories Page 832 **Adjacent cubicle latch mechanism** Page 883

IP 65/NEMA 4x, NEMA 4



Material:
NEMA 4x:
Stainless steel 1.4301

NEMA 4:
Sheet steel, spray-finished

Enclosure frame, roof, base/ plinth, rear panel, side panels: 1.5 mm
Door: 2.0 mm
Mounting plate: 3.0 mm (sheet steel)

Surface finish:
NEMA 4x:
Enclosure frame: Bare
Door, roof, base, rear panel, side panels: Brushed on the outside, grain size 240
Mounting plate: Zinc-plated

NEMA 4:
Enclosure frame:
Dipcoat-primed
Door, roof, base, rear panel, side panels:
Dipcoat-primed
and powder-coated
Textured RAL 7035
Mounting plate: Zinc-plated

Protection category:
IP 65 to EN 60 529/10.91
(NEMA 4x or NEMA 4 is met)

Supply includes:
NEMA 4x/NEMA 4:
Enclosure frame with door, roof/base plate, rear panel, side panels, mounting plate.

Approvals,
see page 30.

Detailed drawing (TS basic enclosures),
see page 1091.

		Packs of	NEMA 4x, stainless steel				NEMA 4, sheet steel				Page
Width (B) in mm			600	800	600	800	600	800	600	800	
Height (H) in mm			1800	1800	2000	2000	1800	1800	2000	2000	
Depth (T) in mm			600	600	600	600	600	600	600	600	
Mounting plate width (F) in mm			499	699	499	699	499	699	499	699	
Mounting plate height (G) in mm			1696	1696	1896	1896	1696	1696	1896	1896	
Model No. TS		1	**8458.640**	**8459.640**	**8452.640**	**8450.640**	**8686.540**	**8886.540**	**8606.540**	**8806.540**	
Door(s)			1	1	1	1	1	1	1	1	
Base/plinth											
Components front and rear	Height 100 mm	1 set	8701.600	8701.800	8701.600	8701.800	8601.600	8601.800	8601.600	8601.800	841/835
	Height 200 mm	1 set	8702.600	8702.800	8702.600	8702.800	8602.600	8602.800	8602.600	8602.800	841/835
Trim panels (sides)	Height 100 mm	1 set	8701.060	8701.060	8701.060	8701.060	8601.060	8601.060	8601.060	8601.060	841/835
	Height 200 mm	1 set	8702.060	8702.060	8702.060	8702.060	8602.060	8602.060	8602.060	8602.060	841/835
Base/plinth trim, modular SO		4	2913.000	2913.000	2913.000	2913.000	–	–	–	–	841
Accessories											
Cable clamp rails		2	4191.000	4192.000	4191.000	4192.000	4191.000	4192.000	4191.000	4192.000	979
System support rails		2	4361.000	4362.000	4361.000	4362.000	4361.000	4362.000	4361.000	4362.000	926
Support strips for door		20	4596.000	4598.000	4596.000	4598.000	4596.000	4598.000	4596.000	4598.000	895
Wiring plan pocket, sheet steel		1	4116.000	4118.000	4116.000	4118.000	4116.000	4118.000	4116.000	4118.000	898
Lock systems											
Standard double-bit lock insert may be exchanged for other lock inserts and comfort handle, see page 881 – 889.											

Delivery times available on request.

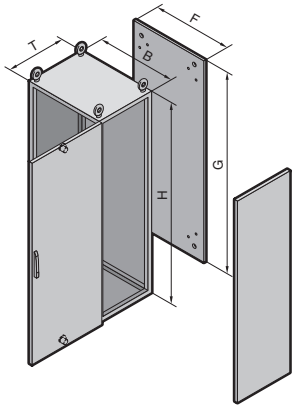
Cable glands IP 68
in polyamide and brass,
Model No. see page 972.

Punched rail
25 x 38 mm,
Model No. see page 923.

Accessories Page 832 **Cable entry** From page 964

Baying systems TS 8

prepared for EX pressurisation



In conjunction with an EX overpressure control, e.g. from Stahl (not included with the supply), conventional operating equipment may be used in explosion hazard areas. To this end, a permanent overpressure is applied to the enclosure which prevents the ingress of potentially explosive atmospheres. Economical operation is guaranteed, thanks to a minimal leakage rate of less than 20 l/min, at 2 mbar test pressure.

Design:
- Base as for roof
- Door with additional cams top and bottom, r/h hinge (l/h hinge on request)
- Side panels fitted

Surface finish:
Sheet steel:
Enclosure frame:
Dipcoat-primed door, roof, base, side panels and rear panel:
Dipcoat-primed, powder-coated on the outside
Textured RAL 7035
Mounting plate: Zinc-plated

Stainless steel:
Enclosure frame: Bare
Door, side panels, roof, base/plinth, and rear panel:
Brushed, grain 240
Mounting plate: Zinc-plated

Protection category:
IP 65 to EN 60 529/10.91

Supply includes:
Enclosure frame with door (with additional cam top and bottom), roof/base plate, rear panel, side panels, mounting plate.

Note:
According to ATEX an EExp empty enclosure cannot be certified.

Width (B) in mm	600	800	600	800	600	800	1000	600	800	600	–
Height (H) in mm	1400	1400	1600	1600	1800	1800	1800	1800	1800	1800	–
Depth (T) in mm	500	500	500	500	400	400	400	500	500	600	–
Mounting plate width (F) in mm	499	699	499	699	499	699	899	499	699	499	–
Mounting plate height (G) in mm	1296	1296	1496	1496	1696	1696	1696	1696	1696	1696	–
Model No. TS sheet steel	**8645.560**	**8845.560**	**8665.560**	**8865.560**	**8684.560**	**8884.560**	**8084.560**	**8685.560**	**8885.560**	**8686.560**	–

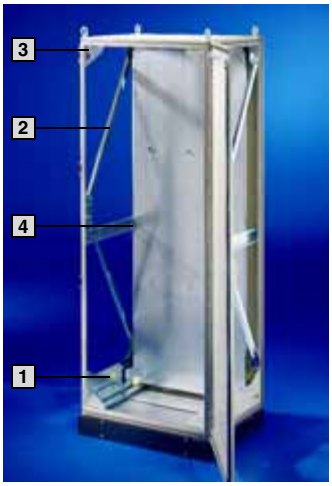
Width (B) in mm	800	600	800	600	800	600	800	600	800	600	800
Height (H) in mm	1800	2000	2000	2000	2000	2000	2000	2000	2000	2200	2200
Depth (T) in mm	600	400	400	500	500	600	600	800	800	600	600
Mounting plate width (F) in mm	699	499	699	499	699	499	699	499	699	499	699
Mounting plate height (G) in mm	1696	1896	1896	1896	1896	1896	1896	1896	1896	2096	2096
Model No. TS sheet steel	**8886.560**	**8604.560**	**8804.560**	**8605.560**	**8805.560**	**8606.560**	**8806.560**	**8608.560**	**8808.560**	**8626.560**	**8826.560**

Width (B) in mm	800	1000	600	800	600	600	800	800	–	–	–
Height (H) in mm	1800	1800	1800	1800	1800	2000	2000	2000	–	–	–
Depth (T) in mm	400	400	500	500	600	600	600	800	–	–	–
Mounting plate width (F) in mm	699	899	499	699	499	499	699	699	–	–	–
Mounting plate height (G) in mm	1696	1696	1696	1696	1696	1896	1896	1896	–	–	–
Model No. TS stainless steel	**8454.660**	**8461.660**	**8457.660**	**8455.660**	**8458.660**	**8452.660**	**8450.660**	**8460.660**	–	–	–

Delivery times available on request.

Accessories Page 832 **Cable entry** From page 964

For areas at risk from earthquakes



TS 8 for earthquake zone 1, 2 and 3 to Bellcore
TS 8806.500:
W x H x D 800 x 2000 x 600 mm

With base/plinth (base/plinth components front and rear and base/plinth trim, side, see page 835), 100 mm high, with weight load of 125 kg distributed evenly over the mounting plate.

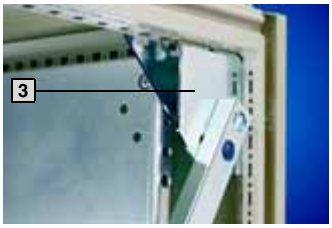
Note:
These versions have been tested and meet the requirements to Telcordia GR 63-CORE. They should be seen as a comparative variable to the customer's own plant, since the certification of empty enclosures is not possible.

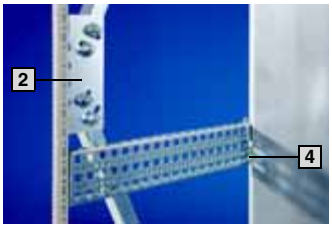
TS 8 for earthquake zone 4 to Bellcore
TS 8806.500:
W x H x D 800 x 2000 x 600 mm

Fitted with:
- Earthquake kit and
- Base/plinth, complete see page 153,

with weight load of 450 kg distributed evenly over the mounting plate.

Rittal service:
- Mounting on the enclosure available on request.





Earthquake kit

for TS 8806.500

Material:
Sheet steel

Surface finish:
Zinc-plated, passivated

Supply includes:

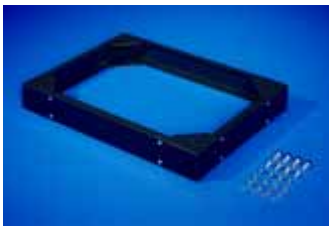
1 2 side reinforcements, bottom

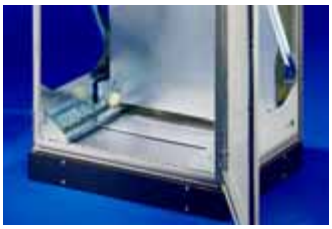
2 2 bracing struts each, sides

3 8 gusset plates

4 Mounting plate attachment and reinforcement including assembly parts

Packs of	Model No. TS
1 set	**8613.860**





Base/plinth, complete

for TS 8806.500

Material:
Sheet steel.
Corner pieces 5 mm
Trim panels 2 mm

Surface finish:
Powder-coated in RAL 7022

Supply includes:
1 set =
- 4 corner pieces
- 2 depth stays
- 1 trim panel each front and rear

fully assembled.

Base/plinth height	Packs of	Model No. TS
100 mm	1 set	**8601.860**

Accessories Page 832 **Base/plinth** Page 834

Command Panel VIP 6000

Diversity: Frame and front design

The VIP 6000 offers exceptionally diverse opportunities.

Each of the three frames conveys its own design line with special functions.

Each enclosure is manufactured to order and covers every conceivable requirement. Every operator panel is assembled quickly and precisely.

Should you have any queries, please contact your specialist Rittal advisor.

As we have said, there's always a solution!

Protective rights for frames:
German patent
No. 195 25 876
German patent
Nr. P 41 09 695
European patent no. 0 505 681
with validity for CH, FR, GB, IT
European patent no. 0 839 299
with validity for FR, GB, IT
Jap. patent no. 3199745
Jap. patent no. 3221506
South Korean patent
No. 97-70 77 12
US patent no. 5,921,050

German registered design
No. M 94 08 533
IR Reg. Des. No. DM/032 843
with validity for BE, CH, ES, FR, IT, NL
Austral. Reg. Des. No. 125352
Japan. registered design
No. 983 783
Austrian Registered Design
No. 17467
Swedish Registered Design
No. 58 996

South Korean Reg. Des.
No. 191148
UK Reg. Des. No. 2047055
US Design Patent No.
Des. 375,726
Brazilian design pattern
No. DI 5500 709-0

Approvals,
see page 31.

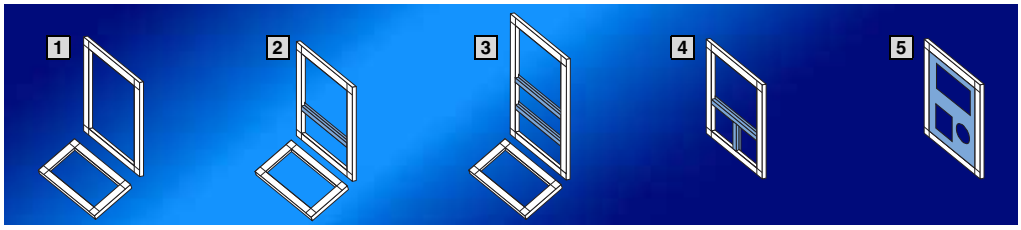
Three customised design lines

Wide frame
A frame and handle in one; the ideal choice where enclosures with fins all round are used for better heat dissipation.

Narrow frame
An eye-catching design with its stylish lines, particularly for small enclosures.

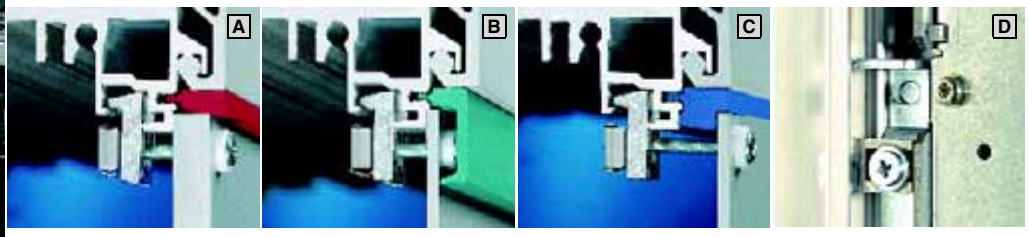
Combined handle
The soft-coated frame at the sides is particularly sympathetic to the touch. This is also suitable for use with enclosures with fins at the sides.

Individual front design



1 Without subdivision
2 With cross member or sealing bar
3 With two cross members or sealing bars, including combinations
4 Combined with horizontal/vertical cross member or sealing bar
5 Adaptor plate with individual cutouts

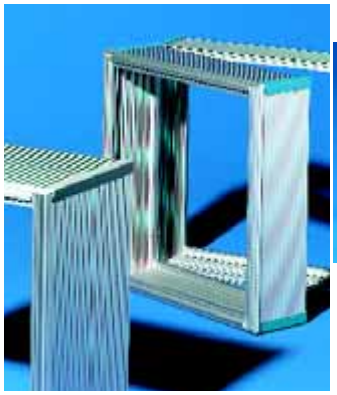
Attachment/trim



Each attachment point all round is achieved with sliding retaining claws.

The screw heads disappear stylishly beneath the cover trim (A).
Front panels with threaded bolts may also be combined with the end trim (B) or spacer trim (C).
Panels with screw clamp (D) are mounted with the end trim.

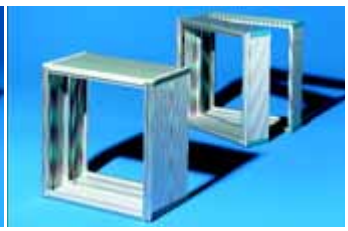
Diversity: Enclosures, rear panels, heat dissipation



Tailor-made operating housings

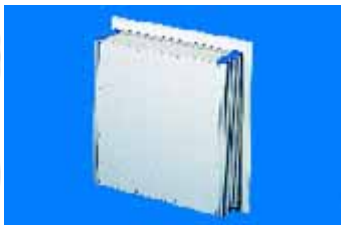
There is a choice of five installation depths (155, 185, 295, 328 and 438 mm) available. Either screw-fastened or hinged, depending on requirements.

They provide space e.g. for: industrial PCs, machine control panels, flat screens and monitors, keyboard drawers, drives, bus modules and every other conceivable application.



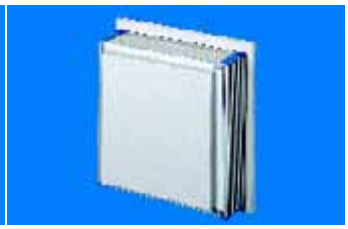
Versatile configuration is individual and easy, thanks to the internal screw channels.

Rear panels to order

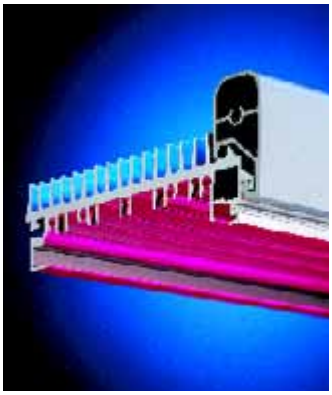


Screw-fastened/vertically or horizontally hinged –

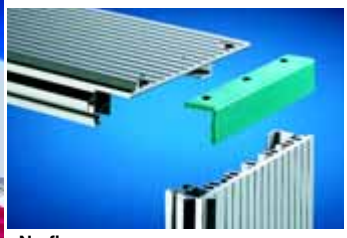
choose the rear panel according to your servicing requirements.



A depth extension of 45 or 245 mm can also be achieved using special rear panels.

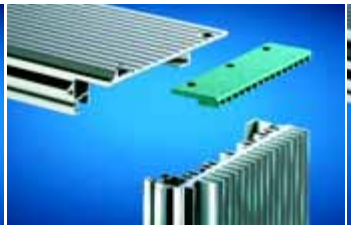


Effective heat dissipation



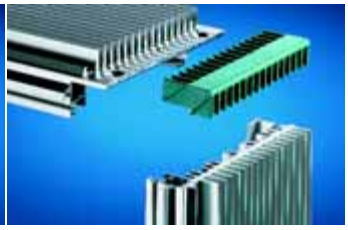
No fins

Because it is equipped with cooling fins, the VIP 6000 solution often eliminates the need for active cooling components. Even the VIP 6000 enclosure version without fins boasts excellent heat loss dissipation.



Fins at sides

For an installation depth of 155 mm, with all-round cooling fins the dissipatable heat loss is increased by approximately 30%. With air circulation inside the enclosure, the dissipatable heat loss is increased by up to



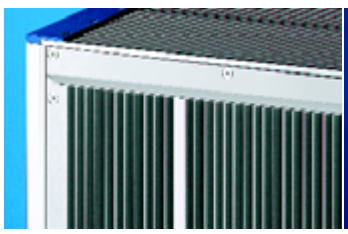
Fins all round

a further 15%. A further significant increase in heat dissipation can be achieved with the modular cooling rear panel.

Dissipatable heat loss[1)]				
Installation depth 155 mm	19″/ 7 U	Rear cooling panel, modular	19″/ 7 + 3.5 U	Rear cooling panel, modular
No fins	80 W	88 W	100 W	110 W
Fins at sides	95 W	105 W	115 W	127 W
Fins all round	110 W	121 W	130 W	148 W

[1)] P_v (W) at ΔT = 20 K

Enclosures with installation depth 185 mm and 328 mm are directly behind the front frame at a depth of 44 mm, without fins.



Cooling fins on the rear cooling panel considerably increase the dissipatable heat loss.

VIP SK small cooling unit
This cooling unit provides added peace of mind when cooling fins are not enough.

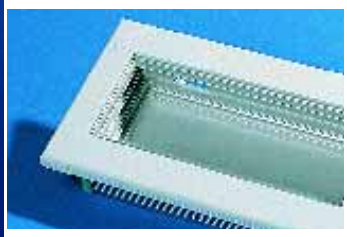
Command Panel VIP 6000

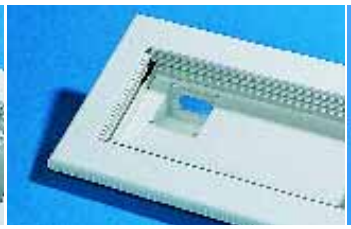
Diversity: Keyboard housing and ergonomics

Further diversity from the modular system:

Keyboard housing in three different depths.

The matching keyboard housing





For all three frame types, keyboard housings are available in the installation depths 105 and 44 mm. For the wide frame, a depth of 27 mm is additionally available in two variants. The width of the keyboard and operating housing is identical with the wide VIP 6000 frame. With narrow and combined VIP 6000 frames, different widths of keyboard and operating housings may also be used.

Keyboard housing connectors for wide frames and . . .

Wide frame

Combined frame

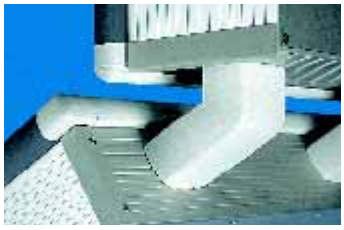
Narrow frame

Depending on the chosen VIP 6000 frame, rigid and adjustable connections between the operating housing and the keyboard housing are available.

Frame connector and cable tube, rigid
Tilting angle 120°.

Frame connector, adjustable and cable tube, flexible
Tilting angle adjustable from 75° – 120° in 7.5° increments.

. . . for narrow and combined frames



Enclosure duct connector
Tilting angle 120°, rigid, with integral cable tube, for enclosure installation depth 105 mm.

Enclosure bar connector
Tilting angle 120°, rigid, for enclosure installation depth 44 mm.

Hinged frame connector
Tilting angle 75° – 120° infinitely adjustable.

Diversity: Keyboard housing and ergonomics

Precisely the right position

Different viewing angles of the machine, whether the operating staff are tall or short, sitting or standing – with Rittal support arm systems, the command panel is always in the optimum position. Depending on the system configuration, jib length and enclosure weight, support arm systems CP-L or CP-XL are used. If you want to combine a high load capacity with a stylish look, system combinations provide the ideal solution.

Always within reach

Tailored precisely to the operator's requirements, various handle sets may be fitted in accordance with ergonomic requirements. "Steering" the enclosure becomes child's play.

Stationary or mobile

Floor-standing systems in a variety of designs – even height-adjustable – round off the application diversity of the VIP 6000 Command Panel.

Diversity: Configuration examples

Nothing's impossible . . .

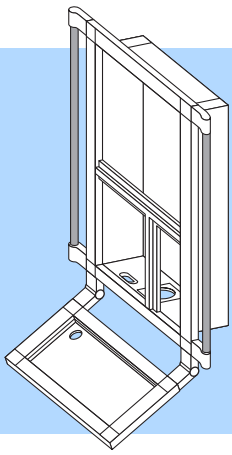
A kaleidoscope of incredible solution diversity. Configure your perfect enclosure.

Allow yourself to be inspired by these examples: e.g. by the front divisions, the handle arrangements, the enclosure depths, and much more besides.

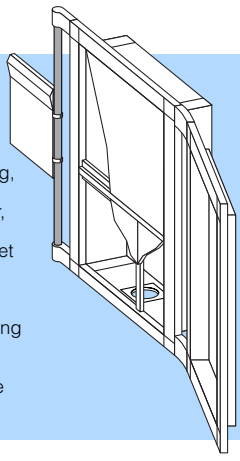
. . . with wide frame.

A small selection from the wide range of opportunities available.
For enclosures with cooling fins, the wide frame is important.

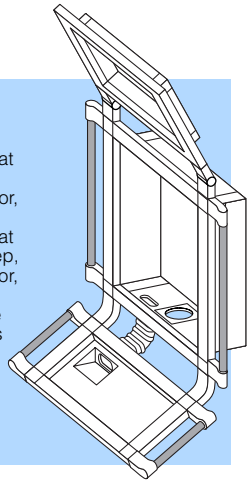
Example A
- Operating housing, 155 mm deep
- Keyboard housing, 27 mm deep, with cable entry grommet
- Frame connector, adjustable
- Vertical handle set
- With vertical and horizontal cross member
- Support arm connection at bottom



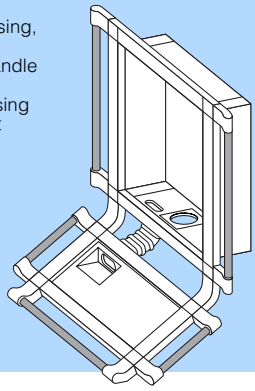
Example B
- Operating housing, 155 mm deep
- Side keyboard housing, 44 mm deep
- Frame connector, rigid
- Vertical handle set with clipboard
- With horizontal cross member and vertical sealing bar
- Support arm connection at the bottom



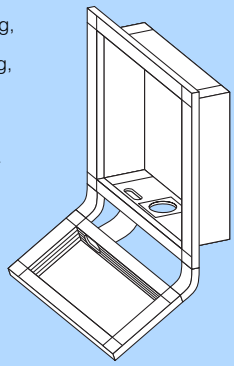
Example C
- Command panel, 155 mm deep
- Keyboard housing at top, 44 mm deep, with frame connector, adjustable
- Keyboard housing at bottom, 44 mm deep, with frame connector, rigid
- Cable tube, flexible
- Vertical handle sets
- Support arm connection bottom



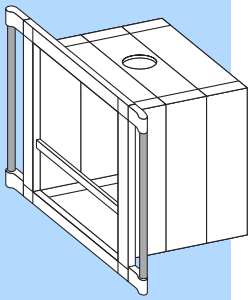
Example D
- Operating housing, 155 mm deep, with vertical handle set
- Keyboard housing with handle set horizontal and vertical
- Cable tube, flexible
- Support arm connection at bottom



Example E
- Operating housing, 155 mm deep
- Keyboard housing, 105 mm deep
- Frame connector and cable tube, rigid
- Support arm connection at bottom



Example F
- Operating housing, 438 mm deep, e.g. for colour screen
- With handle set vertical
- With horizontal sealing bar
- Support arm connection top

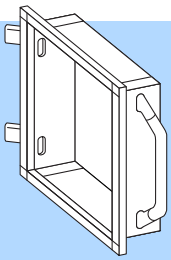


Diversity: Configuration examples

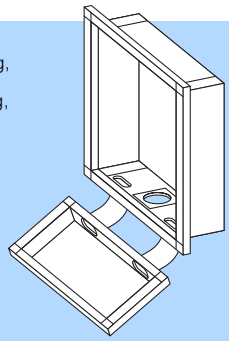
. . . with narrow frame.

Stylish lines for small enclosures and those without fins.

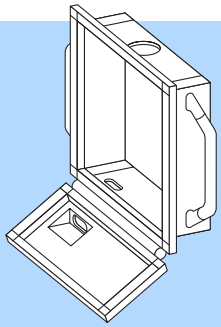
Example G
- Operating housing, 155 mm deep
- With U handle, vertical
- Enclosure connector, adjustable, on l/h side for vertically hinged wall mounting



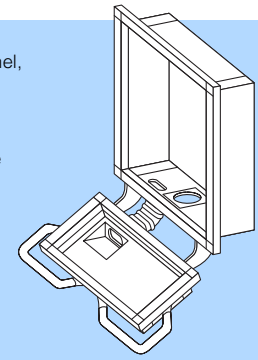
Example H
- Operating housing, 155 mm deep
- Keyboard housing, 105 mm deep
- Enclosure duct connector
- Support arm connection at the bottom



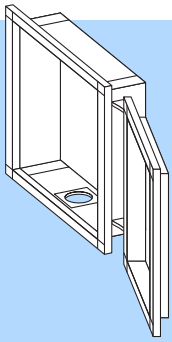
Example I
- Operating housing, 155 mm deep
- Keyboard housing, 44 mm deep
- Hinged frame connector
- U handles, vertical
- Cable tube, flexible
- Support arm connection, top



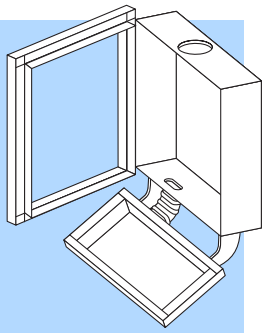
Example J
- Command panel, 155 mm deep
- Keyboard housing, 44 mm deep
- With enclosure bar connector
- With corner handles
- Cable tube, flexible
- Support arm connection at bottom



Example K
- Operating housing, 155 mm deep
- Keyboard housing, 44 mm deep
- Enclosure bar connector
- Support arm connection at bottom



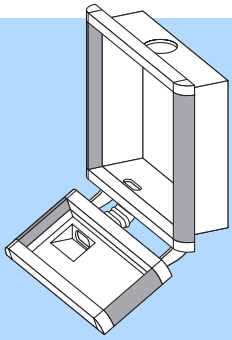
Example L
- Operating housing, 185 mm deep, hinged
- Keyboard housing, 44 mm deep
- Enclosure bar connector
- Cable tube, flexible
- Support arm connection top



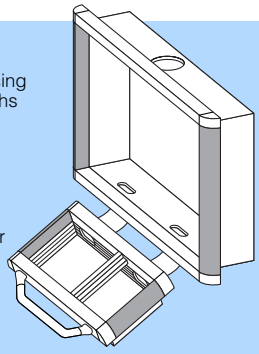
. . . with combined frame.

The soft-coated frame at the sides is particularly sympathetic to the touch.

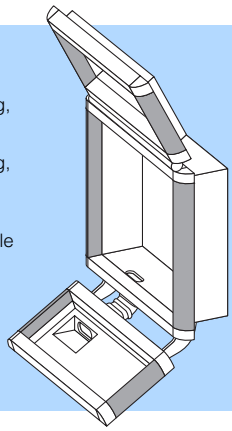
Example M
- Operating housing, 155 mm deep
- Keyboard housing, 44 mm deep
- Enclosure bar connector
- Cable tube, flexible
- Support arm connection top



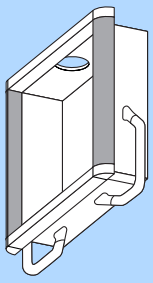
Example N
- Operating and keyboard housing in various widths
- Keyboard housing, 105 mm deep, with cross member
- Enclosure duct connector
- U handle horizontal
- Support arm connection top



Example O
- Command panel, 155 mm deep
- Keyboard housing, top, with hinged frame connector
- Keyboard housing, bottom, with enclosure bar connector
- Cable tube, flexible
- Support arm connection, top



Example P
- Operating housing, 155 mm deep
- Corner handles
- Support arm connection, top



Selection: Operating housing/keyboard housing

We need the following information in order to deal with your enquiry/order:
- Model No. front frame: CP 6392.X09
- The dimensions and number of panels/front panels to be installed in the operating/keyboard housing
- Design code number for the operating/keyboard housing

Protection category:
IP 65 (if the opening in the enclosure is covered or sealed in accordance with the protection category).

Order form, available on the Internet.

1. Front frame

Select the frame to match your requirements. It is used automatically for a keyboard housing as well.

Model No. CP Command panel

6	3	9	2	.		0	9

Model No. CP Keyboard housing

6	3	5	1	.		0	9

.009

Wide frame 0
Extruded aluminium section

Die-cast zinc corner pieces

Colour: RAL 7035[1]
finely textured

.109

Combined frame[2] 1
Extruded aluminium section

Soft-coated frame similar to RAL 7024 (sides), vertical

Die-cast zinc corner pieces

Note:
For visual reasons only enclosures without fins or with fins on the side should be mounted here.

.209

Narrow frame[2] 2
Extruded aluminium section

Die-cast zinc corner pieces

Note:
For visual reasons only enclosures without fins should be mounted here.

[1] Other RAL colours available on request.
[2] For keyboard housing depth 27 mm not possible (see selection 4.1).

2. Panel dimensions

2.1 For operating housings CP 6392.X09 and
2.2 For keyboard housings CP 6351.X09
On the order form, please state the width (B) x height (H) x depth (T) of the control components and the manufacturer/model, with due regard for the installation criteria (see below).

Checking the installation criteria

Please check whether your operator panel is installed directly into the VIP 6000. Otherwise, an adaptor panel is needed – cf. 3.2, design code number **6**, page 162.
The dimensions of the operating panel and keyboard housing are derived from the dimensions of your panel and the number of cross members.

1 **7 to 13 mm edge spacing** of the mounting hole or bolt.

2 **Front panel projection** on sides with mounting holes or bolts **at least 17 mm,** on sides without mounting holes at least 6 mm.

3 **Front panel thickness** depending on the type of trim section variable, see page 163, version 3.4.

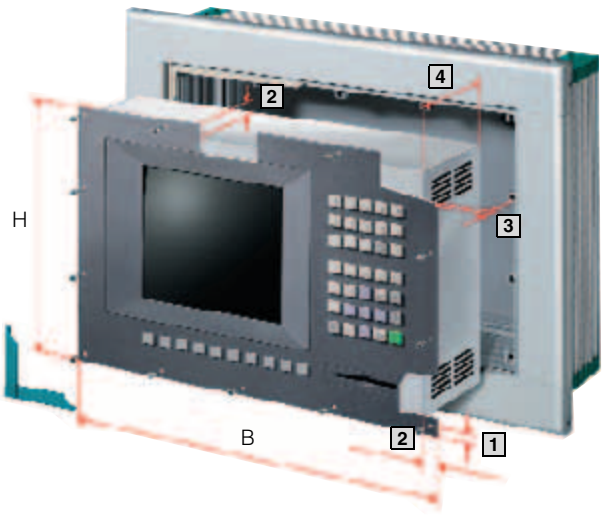
4 **Installation depths:**
Operating housing = 155 mm, 185 mm[1], 295 mm[1], 328 mm[1], 438 mm[1].
Command panel **with 45 mm deep rear panel**[2] = 200 mm, 230 mm[1], 340 mm[1], 373 mm[1], 483 mm[1].
Command panel **with 245 mm deep rear panel**[2] = 400 mm, 430 mm[1], 540 mm[1], 573 mm[1], 683 mm[1].

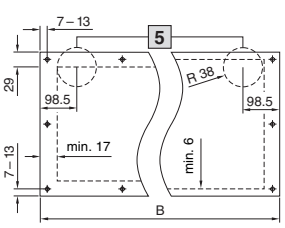
5 For versions with a hinged rear panel, the maximum installation depth is reduced by 27 mm in the vicinity of the lock.

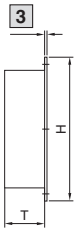
[1] Enclosure without fins with a 60 mm deeper rear section available on request.

[2] Other depths available on request.

Note:
Load information for installed equipment, see page 1186.







3.1 Installation depth

Material:
Enclosure:
Extruded aluminium section
Corner protectors:
Plastic, self-extinguishing

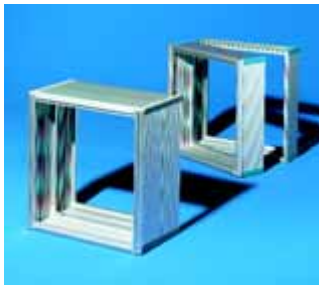
Surface finish:
Enclosure: Natural anodised

Note:
Support arm connection see 3.6.
Drawing view from above.
R/h hinge is also possible.

Detailed drawing,
see page 1095/1096.

Installation depth 155 mm

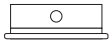
Installation depth 185 mm[1)]



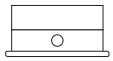
Installation depth 295 mm[1)]

Support arm system CP-L	prepared	prepared	prepared
Support arm system CP-XL	with adaptor CP 6528.500	with adaptor CP 6528.500	with adaptor CP 6528.500

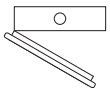
screw-fastened — 3.1 1



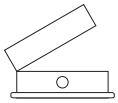
screw-fastened — 3.1 2



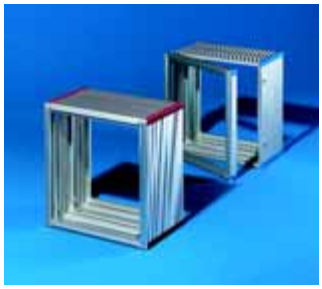
screw-fastened — 3.1 4



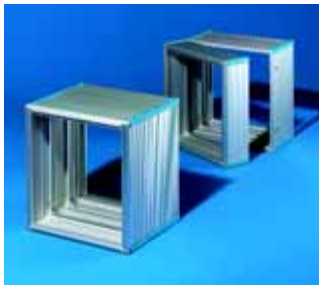
hinged[2)] — 3.1 3



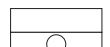
hinged[2)] — 3.1 5



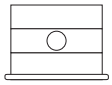
Installation depth 328 mm[1)]



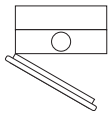
Installation depth 438 mm[1)]



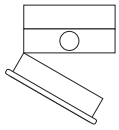
screw-fastened — 3.1 6



screw-fastened — 3.1 8

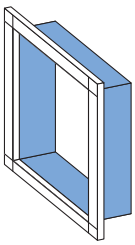


hinged[2)] — 3.1 7



hinged[2)] — 3.1 9

Support arm system CP-L		with adaptor CP 6528.000[3)]	with adaptor CP 6528.000[3)]
Support arm system CP-XL		prepared	prepared



3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8

[1)] Enclosure without fins with a 60 mm deeper rear section available on request.

[2)] Cam lock with double-bit lock insert, may be exchanged for 41 mm lock inserts, type C, see page 888.

[3)] Provided the admissible load capacity of the support arm system is adequate, see page 188.

Selection: Operating housings

3.2 Front design

Cross member
For horizontal and/or vertical division. With channel on both sides for mounting kits, see page 1037.

Material:
Extruded aluminium section, RAL 7035

Sealing bar
For horizontal and/or vertical division. The “slot-free” division produces a height gain of 28 mm.

Material:
Extruded aluminium section 8 x 20 mm, natural anodised

Adaptor plate

Material thickness:
3 mm aluminium, natural anodised.

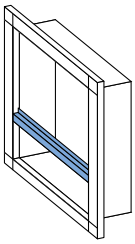
Please specify the dimensions for the front panel and the desired holes and cutouts.

Spacing and built-in trim panel
For additional space for cable entry and for installing switches/ indicator lights, emergency off/ key switches, CD-ROM drives, interfaces etc. With channel on one side for mounting kits, see page 1037.

Material:
Extruded aluminium section, natural anodised.

Detailed drawing,
see page 1038.

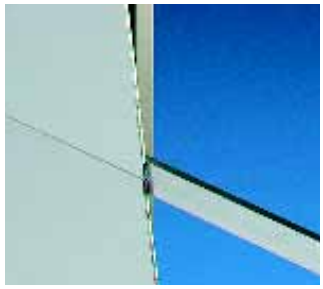
Also required:
Mounting kit for the installation of front panels, operating panels and keyboards in command panels and keyboard housings, see page 1037.



3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8

Without cross member 3.2 0

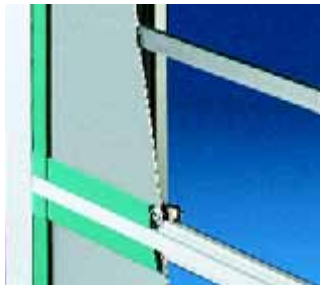
With one cross member 3.2 1



With one sealing bar[1)] 3.2 2

With two cross members 3.2 3

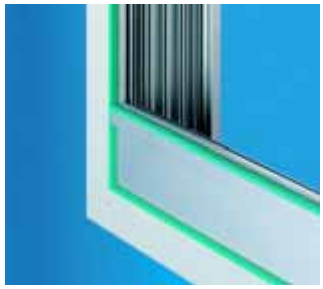
With two sealing bars[1)] 3.2 4



With one cross member and one sealing bar[1) 2)] 3.2 5

With one adaptor plate (to specifications) 3.2 6

With spacing and built-in trim panel at the top[3)] 3.2 7



With spacing and built-in trim panel at the bottom[3)] 3.2 8

With front panel hinged[4)] 3.2 9
If, for example, a disk drive built into the operator panel needs this free access.

Standard design
- Screw-fastened from the outside
- R/h hinge

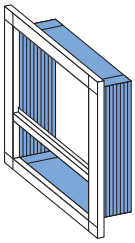
[1)] Not possible with spacer trim (cf. 3.4).

[2)] Unless otherwise specified: Sealing bar at the top, cross member at the bottom.

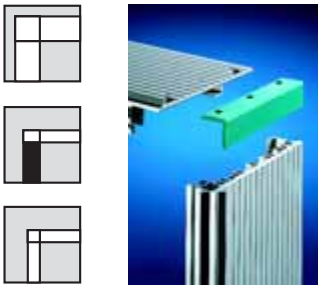
[3)] Only for use in conjunction with end trim.

[4)] Screw-fastened from the inside, with cam or l/h hinge on request.

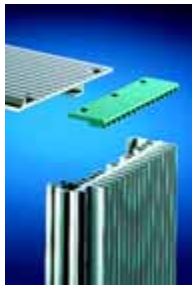
3.3 Cooling fins



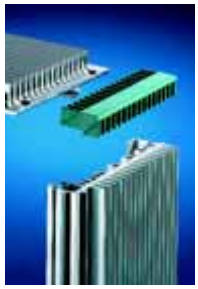
3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8
		■					



No fins 3.3 1



Fins at sides 3.3 2



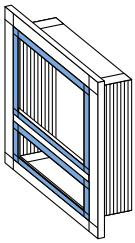
Fins all round 3.3 3

Fins are selected according to the heat loss to be dissipated, see page 155.

Enclosures in installation depth 185 mm and 328 mm are directly behind the front frame at a depth of 44 mm, without fins. The colour of the corner protectors matches the trim colour selected under 3.5.

3.4 Trim types

Detailed drawing, see page 1097.



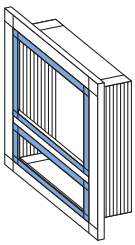
3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8
			■				

Cover trim 3.4 1
To conceal the front panel assembly screws. For front panel thickness up to 3.5 mm.

End trim 3.4 2
Attractively finishes off the space between the front panel and the frame section. For all front panel thicknesses.
Only this trim may be selected when installing drawers.

Spacer trim 3.4 3
For installed equipment flush with the frame section.
For front panel thickness approx. 3.5 mm.

3.5 Trim colours



3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8
				■			

Turqoise (similar to RAL 5018) 3.5 1

Bright blue (similar to RAL 5005) 3.5 2

Bright red (similar to RAL 3001) 3.5 3

Pebble grey (similar to RAL 7030) 3.5 5

Graphite grey (similar to RAL 7024) 3.5 6

Note:
Enclosure corner protectors are likewise supplied in the chosen colour.
Other colours available on request with larger orders.

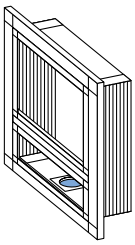
Selection: Operating housings

3.6 Support arm/ wall and pedestal connection

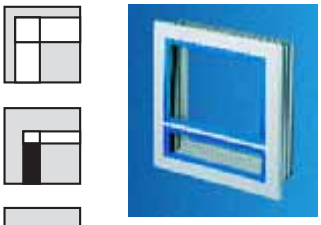
3 different support arm systems, see page 188 and various floor-standing systems, see page 228 are available.

Note:
Support arm connection CP-S for small enclosures with an installation depth of 155 mm are selected by adding an “S” after the design code number.

Detailed drawing,
see page 1102.



3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8



Without connection 3.6 0

Connection top 3.6 1

Wall connection rigid,
see page 1035

Connection bottom 3.6 2

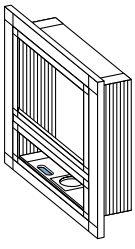
Connection top and bottom,
one cover plate included
3.6 3

Wall connection vertically hinged,
see page 907

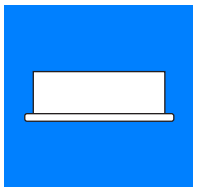
Examples showing the versatility for mounting on surfaces.

3.7 Preparation for mounting keyboard housings

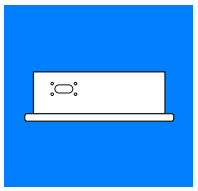
Detailed drawing,
see page 1098.



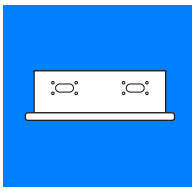
3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8



Without connection to the keyboard housing 3.7 0

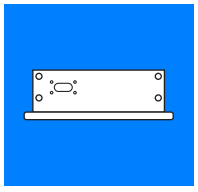


Connection with hinged frame connector, rigid or adjustable 3.7 1

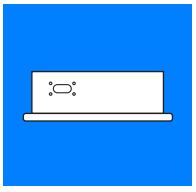


Connection with enclosure duct connector 3.7 2

To fit keyboard housing depth:	–	105	105
	–	44	–
	–	27	–
Connection of operating housing to keyboard housing: (Selection 4.4, page 168)	–	Frame connector, rigid/adjustable	Enclosure duct connector
Cable tube: (Selection 4.5, page 169)	–	rigid/flexible	Enclosure duct connector



Connection with enclosure bar connector 3.7 3



Connection with hinged frame connector 3.7 4

To fit keyboard housing depth:	–	44	105 44
Connection of operating housing to keyboard housing: (Selection 4.4, page 168)	–	Enclosure bar connector	Hinged frame connector
Cable tube: (Selection 4.5, page 169)	–	flexible	flexible

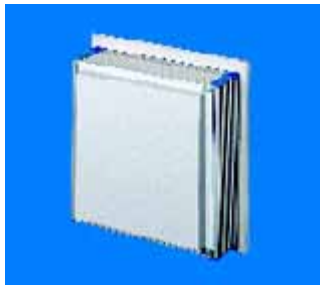
3.8 Rear panels

Screw-fastened 3.8 1

Material:
Aluminium,
natural anodised

Hinged[1] 3.8 2
For rapid
service access

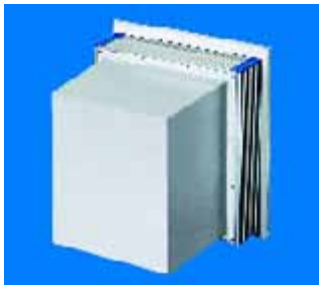
Material:
Aluminium,
natural anodised



Depth plus 45 mm 3.8 3
Hinged,
screw fastener

Material:
Sheet steel, RAL 7035

[1] On the longest side (right/bottom), cam with double-bit insert, may be exchanged for lock inserts 41 mm, type C, see page 888, plastic handles and T handles, type C, see page 886/887.



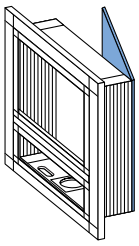
Depth plus 245 mm,
square[2], screw-fastened 3.8 4

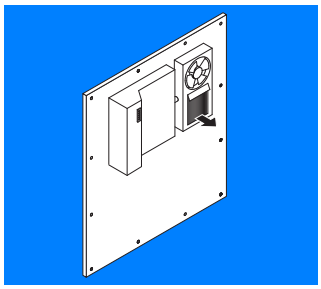
Material:
Sheet steel, RAL 7035

[2] For 482.6 mm (19″)/7 U concave

Hinged[1] 3.8 5
for heavy installed
equipment

Material:
Aluminium,
natural anodised

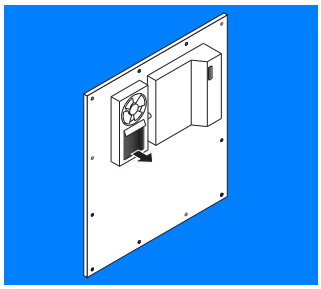




Screw-fastened with built-in VIP SK small cooling unit, condenser mounting top left 3.8 6
Recommendation for command panel design
(see 3.1 Installation depth, 3, 5, 7, 9)

Material:
Aluminium,
natural anodised

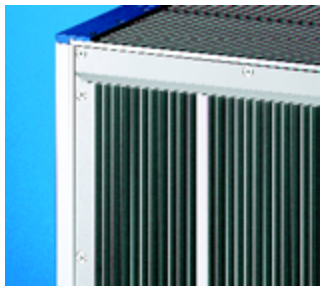
Detailed drawing,
see page 595.



Screw-fastened with built-in VIP SK small cooling unit, condenser mounting top right 3.8 7
Recommendation for command panel design
(see 3.1 Installation depth, 3, 5, 7, 9)

Material:
Aluminium,
natural anodised

Detailed drawing,
see page 595.



Rear cooling panel modular[3] 3.8 8
Significantly increases heat dissipation from the enclosure!

Material:
Extruded aluminium section, natural anodised

Detailed drawing and arrangement of the sections,
see page 1103.

3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8

[3] When installing the pull-out keyboard CP 6002.100 (see page 1048) in VIP 6000, design variant 3.1, no. 1, the 11 mm cooling fins protruding into the enclosure and screw channels in this area may be milled off.
Please state the installation position when ordering.

Selection: Keyboard housings

4.1 Keyboard housing

Without fins.

For installing or positioning keyboards on top (with a depth of 27 mm).

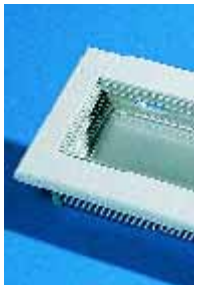
All keyboard housings are custom-produced to your dimensions. Where the wide front frame is selected, the width of the keyboard housing is dependent on the operating housing.

Material:
Extruded aluminium section

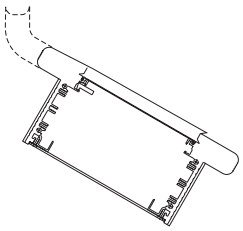
Detailed drawing,
see page 1098 – 1100.

Also required:

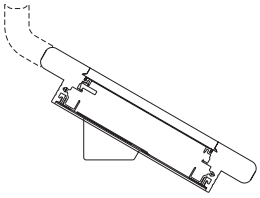
Mounting kit for installing front panels, operating panels and keyboards in command panels and keyboards housings,
see page 1037.

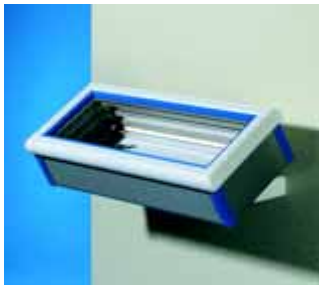


Installation depth 105 mm for built-in keyboards 4.1 1



Installation depth 44 mm for built-in keyboards 4.1 2



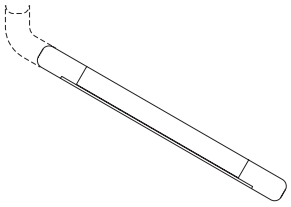


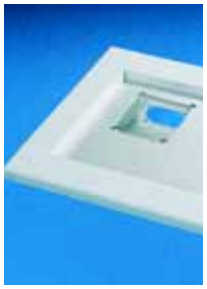
Example of the versatility of the keyboard housing: External mounting on doors
With all keyboard housings, on request the rear panel may be supplied prepared for external mounting on surfaces.

Also required:

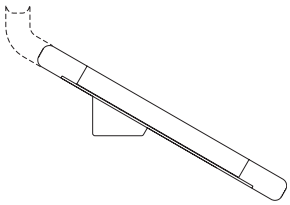
Enclosure duct connector CP 6006.000, see page 1035.
For mounting and cable entry.
Cross-brace for door TS 8800.960/TS 8800.980, see page 895,
when mounting on 600/800 mm wide doors TS, CM, CL, ES.

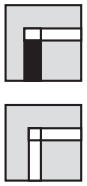
Depth 27 mm with cable entry grommet, for desktop enclosures 4.1 3



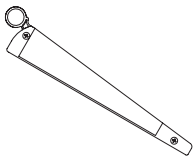


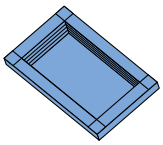
Depth 27 mm with cable tube, flexible, for desktop enclosures 4.1 4





Support for keyboards with cable entry grommet[1] 4.1 5





4.1	4.2	4.3	4.4	4.5

[1] Only for use in conjunction with hinged frame connector, see 4.4 design code number **5.**

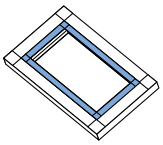
4.2 Trim types[1)]

Detailed drawing,
see page 1097.

Cover trim 4.2 1
To conceal the front panel assembly screws. For front panel thickness up to 3.5 mm.

End trim 4.2 2
Attractively finishes off the space between the front panel and the frame section. For all front panel thicknesses.

Spacer trim 4.2 3
For installed equipment flush with the frame section.
For front panel thickness approx. 3.5 mm.



4.1	4.2	4.3	4.4	4.5

[1)] Cannot be selected with keyboard housing depth 27 mm or support for keyboards. In such cases, please enter an **X.**

4.3 Trim colours[1)]

Note:
Enclosure corner protectors are likewise supplied in the chosen colour.
For larger orders, other colours are available on request.

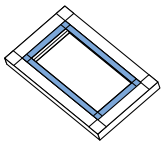
Turqoise (similar to RAL 5018) 4.3 1

Bright blue (similar to RAL 5005) 4.3 2

Bright red (similar to RAL 3001) 4.3 3

Pebble grey (similar to RAL 7030) 4.3 5

Graphite grey (similar to RAL 7024) 4.3 6



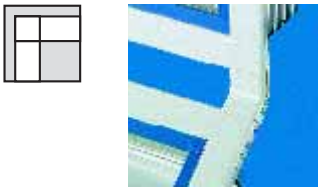
4.1	4.2	4.3	4.4	4.5

[1)] Cannot be selected with keyboard housing depth 27 mm or support for keyboards. In such cases, please enter an **X.**

Selection: Keyboard housings

4.4 Keyboard housing connector

With keyboard housing, supplied loose to connect operating and keyboard housings.



Frame connector (rigid) 4.4 1

Frame connector (adjustable) 4.4 2

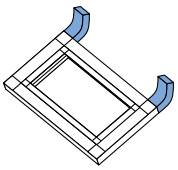
Enclosure duct connector 4.4 3

	Frame connector (rigid)	Frame connector (adjustable)	Enclosure duct connector
Keyboard housing depth:	105	105	105
	44	44	–
	27	27	–
Tilt angle:	120°, rigid	75 – 120°, adjustable in 7.5° increments	120°, rigid
Cable tube:	See 4.5	See 4.5	Integral
	To fit operating and keyboard housings with a wide frame in the same width.	To fit operating and keyboard housings with a wide frame in the same width.	To fit operating housings with keyboard housings 105 mm deep, also available in different widths.
	Material: Die-cast zinc, RAL 7035	**Material:** Die-cast zinc, RAL 7035	**Material:** Aluminium, RAL 7035

Enclosure bar connector 4.4 4

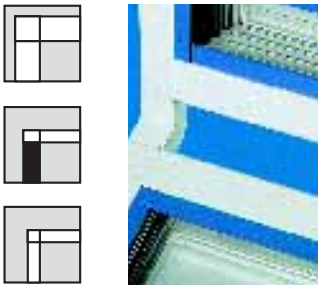
Hinged frame connector 4.4 5

	Enclosure bar connector	Hinged frame connector
Keyboard housing depth:	–	105
	44	44
Tilt angle:	120°, rigid	75 – 120°, infinitely adjustable
Cable tube:	See 4.5	See 4.5
	To fit operating housings with keyboard housings 44 mm deep, also available in different widths.	To fit operating housings with keyboard housings 105, 44 mm deep and support for keyboards, also available in different widths.
	Material: Sheet steel, RAL 7035	**Material:** Aluminium, RAL 7035



4.1	4.2	4.3	4.4	4.5

4.5 Cable tube



Without cable tube 4.5 0

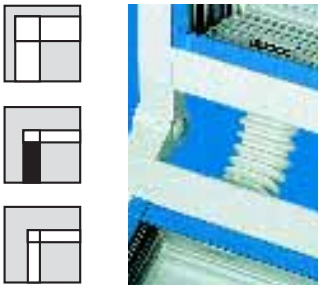
Cable tube, rigid 4.5 1

Suitable for cable entry when using the rigid frame connector (for wide frames) and keyboard housing with 105 mm installation depth.

Material:
Aluminium, RAL 7035

Note:
Not possible with:
3.1 Operating housing, design code numbers 3 and 7.

4.4 Keyboard housing connector, design code number 2.

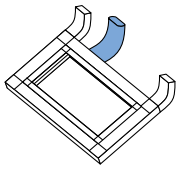


Cable tube, flexible 4.5 2

Suitable for cable entry when using the frame connector, adjustable, hinged frame connector or enclosure bar connector. Mounting on keyboard housings with 105, 44 or 27 mm deep.

Material:
Plastic, RAL 7035

Note:
Not possible with:
4.1 Keyboard housing, design code numbers 3 and 5.



4.1	4.2	4.3	4.4	4.5

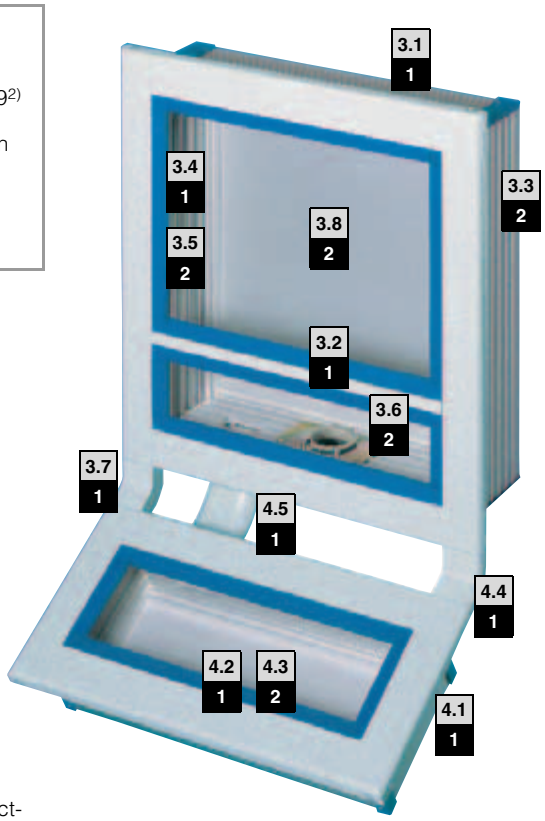
Examples

The picture opposite shows the solution we have chosen, together with its corresponding design code number.
The following key explains how the code number in our example is made up.

In order to deal with your enquiry/ order we will need the following information:

- Model No. front frame: CP 6392.X09[2)]
- The dimensions and number of panels/front panels to be installed in the operating/keyboard housing
- Design code number operating/keyboard housing

Order form, available on the Internet.



Operating housing

Model No.: CP 6392.009

Design code number:

3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8
1	1	2	1	2	2	1	2

- 3.1 1 Command panel, installation depth 155 mm
- 3.2 1 1 cross member
- 3.3 2 Cooling fins (sides)
- 3.4 1 Cover trim
- 3.5 2 Trim colour: bright blue
- 3.6 2 Support arm connection at the bottom
- 3.7 1 Connection with frame connector, rigid
- 3.8 2 Rear panel, hinged with double-bit fastener

Keyboard housing

Model No.: CP 6351.009

Design code number:

4.1	4.2	4.3	4.4	4.5
1	1	2	1	1

- 4.1 1 Keyboard housing, installation depth 105 mm
- 4.2 1 Cover trim
- 4.3 2 Trim colour: bright blue
- 4.4 1 Frame connector, rigid
- 4.5 1 Cable tube, rigid

[2)] Replace X with the number after selecting the front frame.

Note:
If the design code number does not cover your requirements, please enter an X here and enclose a written explanation.

Diversity: Enclosure, front design, attachment

The stylish, customised solution.

Three installation depths: 50 mm, 100 mm, 150 mm.

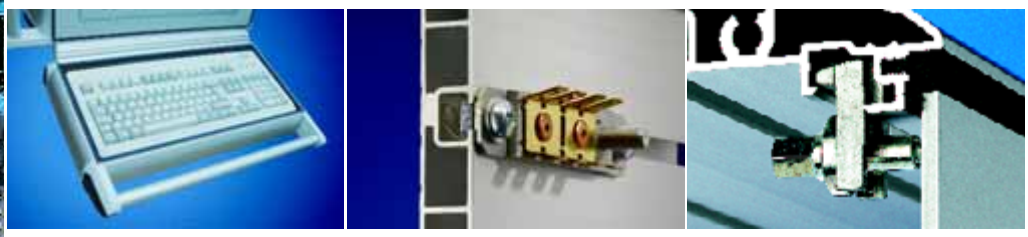
Hinged rear panels offer easy servicing.

Customised to order or in standard sizes

off the shelf.

Property rights:
German patent No. 41 09 695
European patent no. 0 505 681
with validity for CH, FR, GB, IT
Jap. patent no. 3221506
German patent
No. 199 02 174
German patent
No. 100 13 283
German registered design
no. 400 02 955
IR Reg. Design no. DM/053 168
with validity for CH, FR, IT
US Design Patent No. D 456,403

Always within reach



Tailored precisely to the operator's requirements, various handle sets may be fitted in accordance with ergonomic requirements. "Steering" the enclosure becomes child's play.

All-round spring groove channels for flexible interior installation and for mounting accessories.

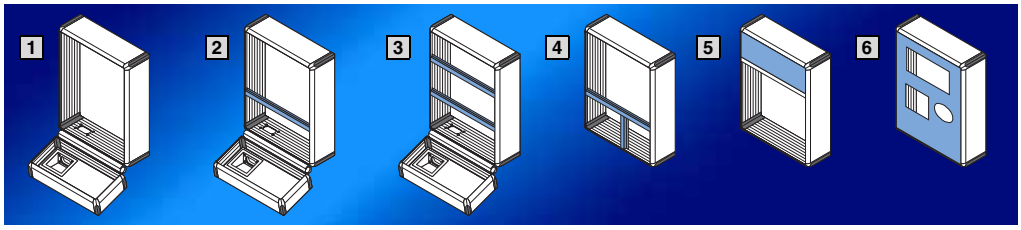
Superior seal helps to achieve protection category IP 65. For installations flush with the frame section with a front panel thickness of approx. 3.5 mm.

Individual front design

Subdivison of the operating level with Rittal standard modules covers every conceivable requirement. Individual cutouts may be achieved e.g. via the adaptor plate.

Should you have any queries, please contact your Rittal specialist advisor.

As we have said, there's always a solution!



1 Without subdivision
2 With cross member or sealing bar
3 With two cross members or sealing bars, including combinations
4 With combined horizontal/vertical cross member or sealing bar
5 With spacing panel and built-in trim panel. May be positioned at the top, bottom or side.
6 Adaptor plate with individual cutouts

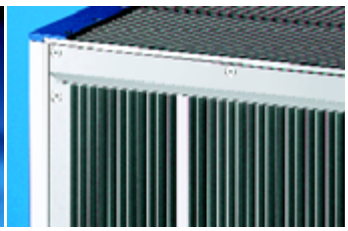
All-round attachment

Every attachment point is accessible on all sides!

Movable retaining claws create sufficient play to accommodate virtually all hole spacings (distance from the panel's outer edge 7 – 13 mm). Panels with screw fastening from the front, with studs or screw clamps, may be used.

Diversity: Rear panels, keyboard housings, ergonomics

Rear panels to order

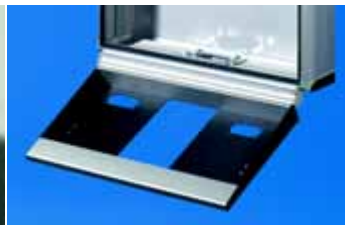


Choose the rear panel according to your servicing requirements:
- screw fastened
- hinged with cam fastener and double-bit insert
- hinged with quick-release fasteners

The modular rear cooling panel significantly increases dissipation of the heat loss from the enclosure!

This is achieved thanks to a combination of cooling fins on the outside and screw channels on the inside, which ensure optimum heat absorption and dissipation.

Keyboard housing



Select the most suitable keyboard housing, tailored to your requirements. Two installation depths are available. The keyboard housing with an installation depth of 50 or 100 mm and the keyboard support may be attached directly to the command panel or to the enclosure door.

Precisely the right position

Different viewing angles of the machine, whether the operating staff are tall or short, sitting or standing – with Rittal support arm systems, the Optipanel is always in the optimum position. All system components for rotating, tilting, swivelling, raising and lowering are combined with one another to create incredible diversity.
Depending on the system configuration, jib length and enclosure weight, support arm systems CP-S or CP-L are used.
If you want to combine a high load capacity with a stylish look, system combinations provide the ideal solution.

Stationary or mobile

Stand systems in a variety of designs – even height-adjustable – round off the application diversity of the Optipanel.

Selection: Operating housing/keyboard housing

It's so easy!

We need the following three pieces of information in order to deal with your enquiry/order:

- Model No.: CP 6382.009
- The dimensions and number of panels/front panels to be installed in the keyboard/operating housing
- Design code number

Order form,
available on the Internet.

Operating/keyboard housing

Model No. CP

6	3	8	2	.	0	0	9

Material:
Enclosure: Extruded aluminium section
Corner pieces: Die-cast zinc
Corner protectors:
Plastic, self-extinguishing
Sealing trim: Flexible plastic section

Surface finish:
Enclosure: Natural anodised
Corner pieces: Powder-coated in finely textured RAL 7035
Corner protectors and sealing trims:
Dyed similar to RAL 7024

For larger orders, other colours similar to RAL

- 5018 (turquoise)
- 5005 (bright blue)
- 3001 (bright red)
- 7030 (pebble grey)

are available.

Protection category:
IP 65 to EN 60 529
(if the openings in the enclosure are covered or sealed in accordance with the protection category).

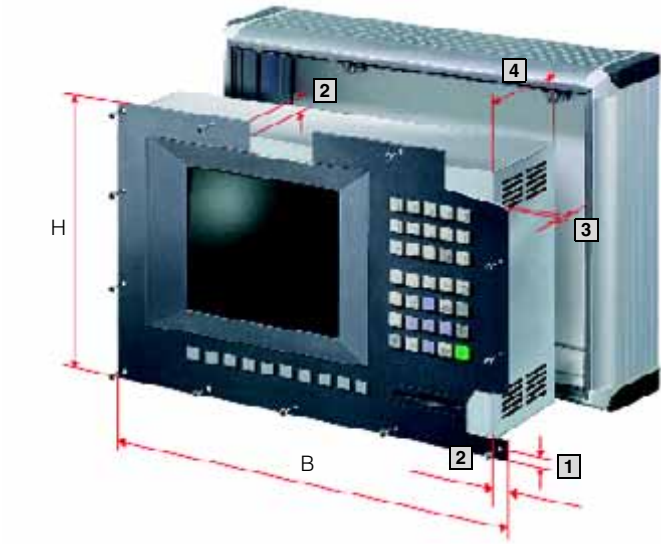
1. Panel dimensions

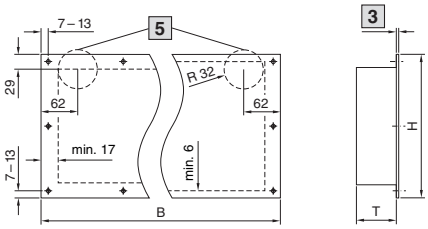
1.1 For operating housings and
1.2 For keyboard housings
On the order form, please state the width (B) x height (H) x depth (T) of the control components and the manufacturer/model.
(See installation criteria).

Checking the installation criteria

Please check whether your operator panel may be installed directly into the Optipanel. Otherwise, an adaptor panel is needed – cf. 2.2, design code number 2.
The dimensions of the operating and keyboard housing are derived from the dimensions of your panel and the number of cross members.

Note:
Different widths of operating and keyboard housings are possible (whereby only the keyboard housing may be wider than the operating housing).
For minimum size, refer to minimum front panel width under "Technical Details", page 1103.





1 **7 to 13 mm edge spacing** of the mounting hole or bolt.

2 **Front panel projection** on sides with mounting holes and bolts at least 17 mm, on sides without attachments at least 6 mm.

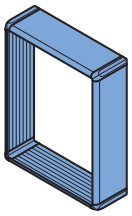
3 **Front panels up to 5 mm.** With a thickness of approximately 3.5 mm the front panel is flush with the sealing trim and the enclosure front.

4 **Installation depths:** Operating housing = 50 mm, 100 mm, 150 mm. Keyboard housing = 50 mm, 100 mm.

5 For versions with a hinged rear panel with cam fastener, the maximum installation depth is reduced by 25 mm in the vicinity of the lock.

2.1 Installation depth

Detailed drawing,
see page 1101.



2.1	2.2	2.3	2.4	2.5

50 mm 2.1 / 1

100 mm 2.1 / 2

150 mm 2.1 / 3

Note:
Installation depth > 150 mm over recessed rear panel on request (like VIP 6000, design variant 3.8, no. 3 and 4, see page 165).

2.2 Front design

Also required:

Mounting kit for installing front panels, operating panels and keyboards in command panels and keyboard housings,
see page 1037.

Detailed drawing,
see page 1101.

[1] Suitable quantity for sealing the individual separation points. Example: 3 front panels in operating housing = 2 separation points = 2 cross members/sealing bars included with the supply. Other combinations available on request.

[2] Screw-fastened from the inside, with cam or l/h hinge on request.

[3] **Detailed drawing,**
see page 1038.

Without cross member 2.2 0

With cross member[1] 2.2 1
For horizontal and/or vertical subdivision of the operating housing front.
With mounting channel on both sides to accommodate mounting kits,
see page 1037.

Material:
Extruded aluminium section, natural anodised

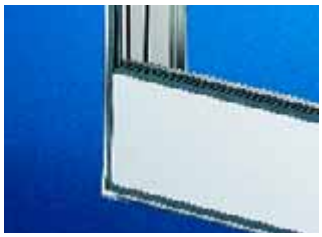
With an adaptor plate 2.2 2
(to specifications)

Material thickness:
3 mm aluminium, natural anodised.

Please specify the dimensions for the front panel and the desired holes and cutouts.

With spacing and built-in trim panel[3], top 2.2 3
For additional space for cable entry and for installing switches/indicator lights, emergency off/key switches, CD-ROM/disk drives, interfaces etc.

Material:
Extruded aluminium section, natural anodised



With spacing and built-in trim panel[3], bottom 2.2 4
For additional space for cable entry and for installing switches/indicator lights, emergency off/key switches, CD-ROM/disk drives, interfaces etc.

Material:
Extruded aluminium section, natural anodised

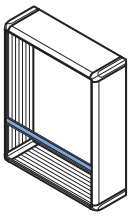
With sealing bar[1] 2.2 5
For horizontal and/or vertical subdivision of operating housings.
The “slot-free” division produces a height gain of 22 mm.

Material:
Extruded aluminium section 8 x 20 mm, natural anodised

With front panel, hinged[2] 2.2 6
For example, if a disk drive built into the operator panel needs this free access,
see page 1036.

Standard design:
- Screw-fastened from the outside
- R/h hinge

Material:
Front panel: 3 mm aluminium, natural anodised.
Extruded aluminium section: Natural anodised



2.1	2.2	2.3	2.4	2.5

2.3 Support arm wall and pedestal connection

Accessories:

Support arm components for connection of the Optipanel to the support arm system CP-S[1], CP-L see page 188 onwards. Pillars, see page 228 onwards.

Detailed drawing, see page 1102.

Without connection 2.3 0

Connection top 2.3 1

Connection bottom 2.3 2

Connection top and bottom[2)] 2.3 3

CP-L ▭ 120 x 65 mm for
Housing coupling CP 6525.1X0,
Enclosure attachment CP 6525.6X0,
Housing coupling CP-S, CP 6501.130
only applies to installation depth 100 and 150 mm

Connection top[1)] 2.3 4

Connection bottom[1)] 2.3 5

Connection top and bottom[1)2)] 2.3 6

CP-L, Ø 130 mm for
Housing coupling CP 6525.0X0,
Enclosure attachment CP 6525.5X0,
Angle coupling CP 6526.0X0
only applies to installation depth 150 mm

[1)] For support arm system CP-S, steel, for installation depth 50, 100 and 150 mm please add an **S** after the design code number.

[2)] Including a cover plate for sealing the unused section.

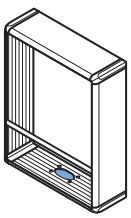
[3)] Unless otherwise specified, will be supplied in RAL 7024.

Note:
Wall mounting possible: hinged with CP 6016.200, see page 907.

Connection at rear, top[3)] 2.3 7

Connection at rear, bottom[3)] 2.3 8

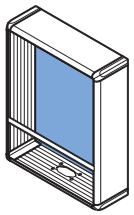
CP-L ▭ 120 x 65 mm for
Housing coupling CP 6525.1X0,
Enclosure attachment CP 6525.6X0,
Enclosure attachment, tilting CP 6902.640/.670,
Housing coupling CP-S, CP 6501.130

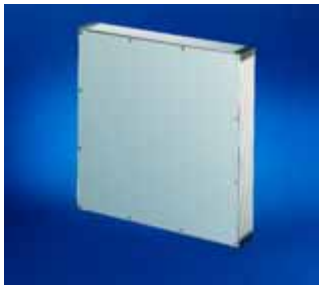


2.1	2.2	2.3	2.4	2.5

Selection: Operating housings

2.4 Rear panels





Rear panel screw-fastened

2.4 | 1

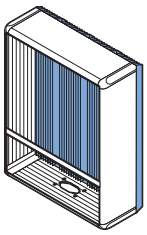
Rear panel hinged on longest side
Viewed from rear, hinged on the right or at the bottom[1) 2) 3) 4)].

2.4 | 2

Example of the versatility of the enclosure:
External mounting on doors
With all operating/keyboard housings, on request the rear panel may be supplied prepared for external mounting on flat surfaces.

! Also required:

Enclosure duct connector CP 6006.000, see page 1035. For mounting and cable entry.
Cross-brace for door TS 8800.960/TS 8800.980, see page 895, when mounting on 600/800 mm wide doors TS, CM, CL, ES.



Rear cooling panel, modular
Increases the dissipation of heat loss from the enclosure by approx. 10%.

2.4 | 3

Material:
Extruded aluminium section

Note:
When installing the pull-out keyboard CP 6002.100 (see page 1048) in an Optipanel, design variant 2.1, no. 3, the 11 mm cooling fins and screw channels protruding into the enclosure may be milled off in this area – please specify when ordering.

Detailed drawing,
see page 1103.

Rear panel hinged with quick-release fasteners[1)]

2.4 | 4

2.1	2.2	2.3	2.4	2.5

Note:
[1)] With a support arm connection at the rear, only possible on the side opposite the support arm connection.
[2)] Not for operating housings with an installation depth of 50 mm with keyboard housings.
[3)] Standard double-bit lock insert may be exchanged for 41 mm lock inserts, type C, see page 888, plastic handles and T handles, type C, see page 886/887.
[4)] With a hinged rear panel, the maximum installation depth in the vicinity of the lock is reduced by 25 mm (see page 173, drawing point **5**).

[1)]

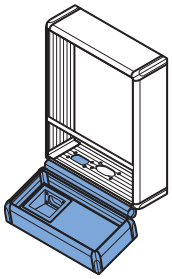
2.5 Keyboard housing

Width independent of operating housing.
The swivel bracket is infinitely adjustable from 80° to 155°.

Also required:

[1] Mounting kit for installing front panels, operating panels and keyboards in operating and keyboard housings, see page 1037.

Detailed drawing, see page 1102.



2.1	2.2	2.3	2.4	2.5

Without keyboard housing 2.5 0

With keyboard housing Installation depth 50 mm[1] 2.5 1

With keyboard housing Installation depth 100 mm[1] 2.5 2

With support for keyboards 2.5 3

Utility bars, vertically hinged with cable entry grommet[2] 2.5 4

[2] With a support bar connection at the bottom, from depth 150 mm, only in conjunction with: enclosure attachment CP-S (CP 6501.070), enclosure attachment CP-L for support arm connection ▭ 120 x 65 mm (CP 6525.6X0)

When mounting beneath surfaces, the bars may alternatively be pushed towards the rear.

Examples

The picture opposite shows the solution we have chosen, together with its corresponding design code number. The following key explains how the code number in our example is made up.

Operating/keyboard housing

Model No.: CP 6382.009

Design code number:

2.1	2.2	2.3	2.4	2.5
2	1	2	1	1

2.1 2 Command panel, installation depth 100 mm

2.2 1 With cross member

2.3 2 Support arm connection CP-L ▭ 120 x 65 mm, bottom

2.4 1 Rear panel, screw-fastened

2.5 1 With keyboard housing, installation depth 50 mm

We need the following three pieces of information in order to deal with your enquiry/order:

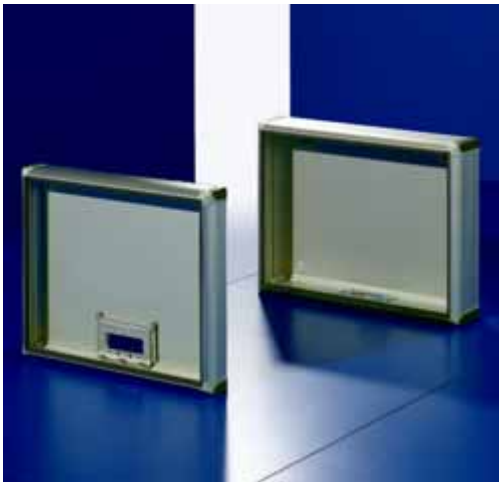
- Model No.: CP 6382.009
- The dimensions and number of panels/front panels to be installed in the keyboard/operating housing
- Design code number

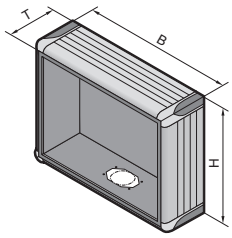
Order form, available on the Internet.

Note:
If the design code number does not cover your requirements, please enter an X here and enclose a written explanation.

Optipanel

Standard sizes





Material:
Enclosure:
Extruded aluminium section
Corner pieces:
Die-cast zinc
Corner protectors:
Plastic, self-extinguishing
Sealing trim:
Flexible plastic section

Surface finish:
Enclosure:
Natural anodised
Corner pieces:
Powder-coated in finely textured RAL 7035
Corner protectors and sealing trims:
Dyed similar to RAL 7024

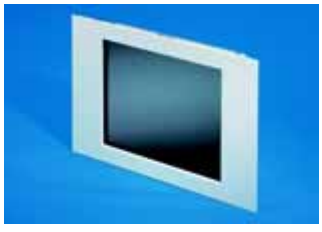
Protection category:
IP 65 to EN 60 529/10.91
(if the openings in the enclosure are covered or sealed in accordance with the protection category).

Detailed drawing,
see page 1104.

To fit front panels[1] Width x height mm		Packs of	270 x 234	482.6 x 310.3	430 x 343	430 x 343	482.6 x 354.8	482.6 x 354.8	Page
To fit TFT monitor[2]			–	–	SM 6450.010/ .030	SM 6450.010/ .030	SM 6450.020/ 0.040	SM 6450.020/ 0.040	1046
Width (B) in mm			314	527	475	475	527	527	
Height (H) in mm			278	354	387	387	399	399	
Depth (T) in mm			60	110	60	110	60	110	
Model No. CP		1	**6380.100**	**6380.000**	**6380.010[3]**	**6380.020**	**6380.030[3]**	**6380.040**	
Rear panel, hinged	Quick-release fastener for screwdriver				■		■		
	Cam with double-bit insert[3]		■	■		■		■	
Support arm connection[4]			CP-S VESA 75[5]	CP-L ▭ 120 x 65 mm	CP-L ▭ 120 x 65 mm, rear	CP-L ▭ 120 x 65 mm	CP-L ▭ 120 x 65 mm, rear	CP-L ▭ 120 x 65 mm	
Weight (kg)			2.8	6.2	4.08	5.28	4.41	4.86	

[1] Installation criteria required for direct mounting of the panels, see page 173.
[2] For depth 60 mm the power pack must be mounted externally for reasons of space, e.g. in IW Station.
[3] Standard double-bit lock insert may be exchanged for 41 mm lock inserts, type C, see page 888, plastic handles and T handles, type C, see page 886/887.
[4] Support arm connection at the top or bottom, by rotating the enclosure.
[5] Additional marked points for drilling holes, for the external mounting of:
Assembly components with drilling pattern to VESA 75 = Enclosure attachment, tilting IW 6902.670
Support arm system CP-L, ▭ 120 x 65 mm
Support arm system CP-S.

Utility bars, vertically hinged,
Model No. see page 1049.



TFT monitor,
Model No. see page 1046.

Accessories Page 832 **Industrial Workstations IW** Page 238 **Support arm systems** Page 188 **Stand systems** Page 228

Operating housings

Features

Modern, flexible production technology demands solutions which precisely meet the required standards of ergonomics, user-friendliness, hygiene or corrosion protection at the operating interface. The Rittal operating housing range is tailored to these requirements. Supplemented by a support arm or pedestal system, system accessories or system climate control, an enclosure becomes a complete solution. All this is achieved quickly and practically on your behalf.

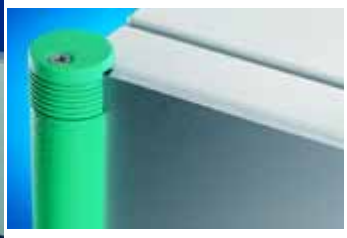
Compact Panel, aluminium

Front panels are inserted from the rear and secured with a screw clamp.

Rear door hinged optionally on the right or left by loosening the screws.

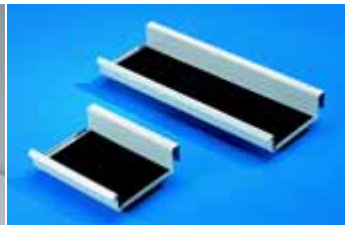
Mounting optionally on support arm system CP-S or directly with the wall attachment, vertically hinged, see page 908.

Command panel housing with door, with handle strips



For additional front panels of aluminium, the handle strips may be set forward by up to 5 mm.

Rear panel with welded nuts for the attachment of mounting plate or support rails.



Space for tools, measuring instruments or scanners with the utility shelf, screw connection, see page 1039.

Operating housing with handle strips

Interior installation of the enclosure via side mounting angles with system punchings.

Additional installation space is created by the perforated mounting strips on both sides in the rear door.

For external mounting of a terminal box as an additional keyboard housing, connectors CP 6005.100 may be used, see page 1034.

Operating housing with display panel front

For installation or servicing, the hinged display panel front may be opened from the inside by loosening the screws.

Interior installation of the enclosure via side mounting angles with system punchings.

For the support of keyboards. For programming and servicing work, the vertically hinged utility bars, CP 6514.200, may be externally mounted,
see page 1049.

Operating housing with wide VIP 6000 frame

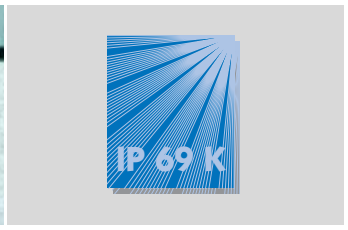
External mounting of VIP keyboard housings via frame connectors, rigid or adjustable,
see page 168.

Interior installation of the enclosure via side mounting angles with system punchings.

The interface flap SZ 2482.200 ensures secure accommodation of sockets, ports or drives,
see page 1059.

Premium Panel, stainless steel

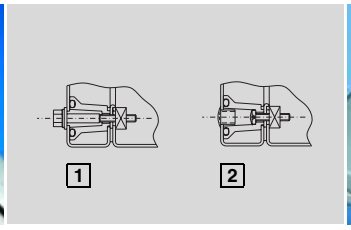
Exceptionally hygienic, thanks to easy-to-clean, external, highly resistant silicone seal.



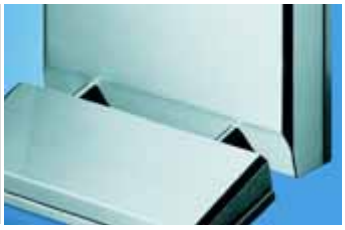
Pressure washer-resistant (protection category IP 69K) and high EMC shielding effect thanks to ideal shaping of the seal and all-round metallic contact between the enclosure and the rear panel.

Suitable for use in clean rooms to meet the most demanding requirements, certified by the Fraunhofer-Institut IPA.

Clear hygiene benefits compared with external hinges, rear panel bracket CP 6682.000,
see page 893.



Screw fastening of the rear panel optionally via external hex screws **1** or internal screws, concealed with plastic stoppers **2.**



Protected cable routing from the operating housing to the keyboard housing via a robust duct connector.

Features

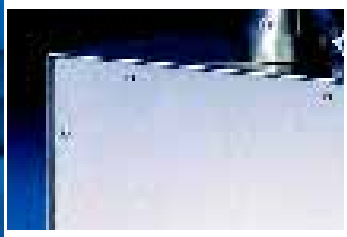
Command panel housing with door, stainless steel

Rear panel with welded studs for the attachment of mounting plate or support rails.

Simple mounting on the support arm system CP-S stainless steel by locating the pre-assembled screw in the cutout.

Safe handling when swivelling, thanks to side handle strips.

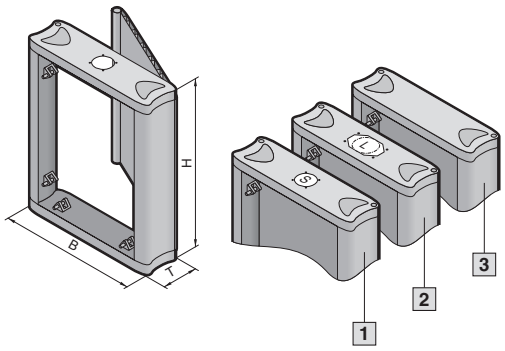
Operating housing, stainless steel



Perfect protection of keys or signal lamps thanks to internal front panel.

The operator panels and other command and indicator devices may also be fitted in the rotated enclosure.
In such cases, the front panel becomes a screw-fastened rear panel.

Simple mounting on the support arm system CP-S stainless steel by locating the pre-assembled screw in the cutout.



For small operating units built into front panels. The front panel is inserted from the rear and secured from the inside with screw clamps. Special front panels with a material thickness of between 2 and 6 mm are possible. Rear panel optionally hinged on the left or right.

Material:
Roof tray, base tray, rear panel:
Aluminium
Side parts:
Extruded aluminium section
Screw cover:
Plastic

Surface finish and colour:
Roof tray, base tray, side parts:
Powder-coated, RAL 7024
Rear panel: Natural anodised
Screw cover:
Similar to RAL 7024

Protection category:
IP 65 to EN 60 529

Supply includes:
Roof tray, base tray, rear panel, side parts, screw cover, including seal and screw clamp.

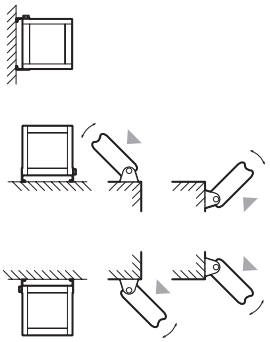
Rittal service:

- Other RAL colours
- Holes and cutouts in the roof and base tray

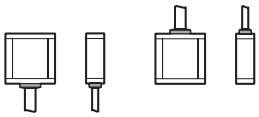
Detailed drawing,
see page 1105.

Property rights:
German patent
No. 102 16 448
German patent
No. 102 16 366

Assembly examples:
with wall mounting bracket



with support arm connection



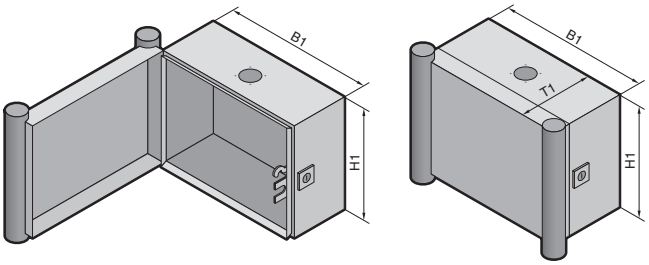
Width (B) in mm		Packs of	241	241	241	315	315	Page
Height (H) in mm			238	388	521	238	388	
Depth (T) in mm			87	87	87	87	87	
To fit	Front panel width mm		178	178	178/4U	252	252	
	Front panel height mm		200	350	482.6/19″	200	350	
1 **Model No. CP** (with support arm connection CP-S)		1	**6340.000**	**6340.100**	**6340.200**	**6340.300**	**6340.400**	
2 **Model No. CP**[1)] (with support arm connection CP-L, ▭ 120 x 65 mm)		1	**6340.010**	**6340.110**	**6340.210**	**6340.310**	**6340.410**	
3 **Model No. CP**[1)] (without support arm connection)		1	**6340.020**	**6340.120**	**6340.220**	**6340.320**	**6340.420**	
Weight (kg)			2.8	3.8	4.5	3.4	4.5	
Accessories								
Front panel, 3.0 mm aluminium, natural anodised		1	6028.500	6028.510	6028.520	6028.530	6028.540	1036
Wall mounting bracket, vertically hinged		1 set	6341.000	6341.000	6341.000	6341.000	6341.000	908
Cover plate for support arm connection CP-S		1	6505.200	6505.200	6505.200	6505.200	6505.200	1040
Spring nut M5		50	6108.000	6108.000	6108.000	6108.000	6108.000	937

[1)] Extended delivery times.
To order different heights for front panel width:
– 178 mm use Model No.: CP 6342.109
– 252 mm use Model No.: CP 6342.209
and additionally specify the front panel height. Extended delivery times.

Accessories Page 832 **Support arm systems** Page 188

Command panel housing with door

based on AE



Material and surface finish:
Enclosure and door:
Sheet steel, dipcoat-primed and powder-coated in textured RAL 7035
Handle strips:
Aluminium, powder-coated in RAL 5018
Cover caps:
Plastic, RAL 5018

Protection category:
IP 55 to EN 60 529

Supply includes:
Enclosure with cutout and reinforcement for support arm system CP-L[1], Ø 130 mm, with seal.
Door with sealing frame, side handle strips and end caps.

Note:
The support arm connection and door hinge may be swapped over by rotating the enclosure.

Rittal service:

- Other sizes
- Other RAL colours
- Modified support arm cutout or door hinge
- Holes and cutouts for key pads and operator panels
- Aluminium front panels (up to 5 mm thick may be placed between the side handle strips and door on the enclosure front)

available on request.

Detailed drawing,
see page 1105.

Approvals,
see page 32.

Width (B1) in mm		Packs of	300	300	300	400	400	500	Page
Height (H1) in mm			200	300	400	300	400	500	
Depth (T1) in mm			180	180	180	180	180	180	
Model No. CP[1)]		1	**6534.000**	**6535.000**	**6537.000**	**6536.000**	**6538.000**	**6544.000**	
Weight (kg)			5.5	7.1	8.4	8.4	10.6	14.5	
Accessories									
Matching mounting plate	AE type		1032.500	1033.500	1034.500	1030.500	1380.500	1050.500	118/119
	Model No.[3)]		0271.324	0271.926	0271.927	0274.131	0271.548	0271.333	
Support rails[2)]	Model No.	10	2316.000	2316.000	2316.000	2317.000	2317.000	2318.000	927
Lock systems									
Standard double-bit lock insert may be exchanged for 41 mm lock inserts, plastic handle and T handle, type C, see page 886 – 888.									

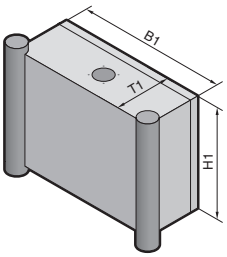
[1)] To order a command panel housing with door with mounting cutout CP-S, please use the extension number .080. Delivery times available on request.
[2)] Only with vertical attachment of punched rail 23 x 23 mm, see page 925.
[3)] Delivery times available on request.

Signal pillar LED compact.
Model No. see page 1041.

Utility bars, vertically hinged
for keyboards.
Model No. see page 1049.

Accessories Page 832 **Stand systems** Page 228 **Support arm systems** Page 188

based on AE



Material and surface finish:
Enclosure and door:
Sheet steel, dipcoat-primed and powder-coated in textured RAL 7035
Handle strips:
Aluminium in RAL 7030
Cover caps:
Plastic, RAL 7030

Protection category:
IP 55 to EN 60 529

Supply includes:
Enclosure with cutout and reinforcement for support arm system CP-L, Ø 130 mm and with mounting angles spot welded at the sides.
Front with maximum cutout, covered with easily machinable 3 mm aluminium front panel and side handle strips with end caps.
Rear with door.

Note:
The support arm connection and door hinge may be swapped over by rotating the enclosure.

Rittal service:
- Other sizes
- Other RAL colours
- Modified support arm cutout or door hinge
- Holes and cutouts for key pads and operator panels

available on request.

Property rights:
German patent no. 44 13 543
French Patent no. 95 04769
GB patent no. 2 288 971
Ital. patent no. 01273518
Jap. patent no. 2 820 637
US patent no. 5,662,397
German registered design no. M 94 03 156
IR reg. design no. DM/031 020 with validity for BE, DE, ES, FR, IT, LU, NL
U.K. reg. des. no. 2 042 639
Jap. reg. des. No. 955 950
US Design Patent no. Des 375,938

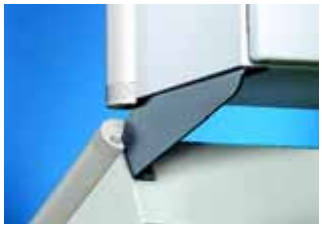
Detailed drawing,
see page 1106.

Approvals,
see page 33.

Width (B1) in mm	Packs of	300	380	380	500	600	Page
Height (H1) in mm		200	300	380	500	380	
Depth (T1) in mm		155	210	210	210	210	
Model No. CP	1	**6540.200**[1)]	**6531.200**	**6530.200**	**6532.200**	**6533.200**	
Weight (kg)		4.9	9.3	10.2	15.4	14.6	
Accessories							
Support strips for attaching to the mounting angles on the sides	20	–	–	4594.000	4309.000	4594.000	895
Lock systems							
Standard double-bit lock insert may be exchanged for 27 mm lock inserts, type A, plastic handles, T handles, type B, and lock cylinders, see page 886 – 888.							

[1)] Support arm connection and door hinge at the bottom.

Support arm bracket 90° CP-L
for the configuration of compact support arm systems.
Model No. see page 204.

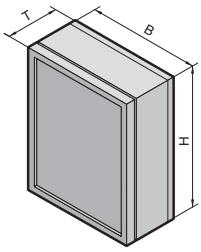


Connector for compact enclosures.
Model No. see page 1034.

Accessories Page 832 **Stand systems** Page 228 **Support arm systems** Page 188

Command panel

based on AE with display panel front



Material and surface finish:
Enclosure and door:
Sheet steel, dipcoat-primed and powder-coated in textured RAL 7035
Frame and front panel:
Aluminium, natural anodised.

Protection category:
IP 54 to EN 60 529

Supply includes:
Enclosure without support arm connection with mounting angles spot-welded at the sides. With maximum cutout at the front and fitted, easily machinable 3 mm front panel with aluminium frame, with r/h hinge, screw-fastened from the inside.
Rear door with r/h hinge, with two cam locks (for CP 6442.500 one lock).

Rittal service:

- Other sizes
- Other RAL colours
- With support arm cutout
- Holes and cutouts for key pads and operator panels

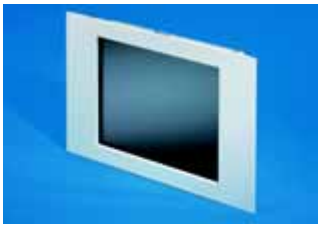
available on request.

Detailed drawing,
see page 1106.

Approvals,
see page 33.

Width (B) in mm	Packs of	380	380	500	600	Page
Height (H) in mm		380	600	500	600	
Depth (T) in mm		249	249	249	249	
Model No. CP	1	**6442.500**	**6462.500**	**6552.500**	**6662.500**	
Weight (kg)		9.5	13.4	18.0	19.6	
Accessories						
Reinforcement plate with support arm cutout CP-L	1	6143.210	6143.210	6143.210	6503.000	237
Lock systems						
Standard double-bit lock insert may be exchanged for 27 mm lock inserts, type A, lock cylinder, plastic handles and T handles, type B, see page 886 – 888.						

To order command panels in RAL 7032, please add extension .200 to the Model No. Delivery times available on request.

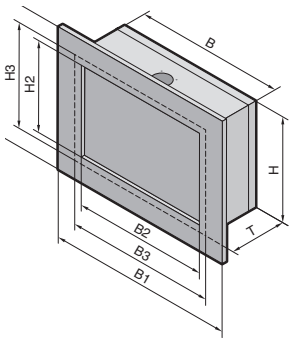


TFT monitor
for industrial use.
Model No. see page 1046.

Support for keyboards.
Model No. see page 1048.

Accessories Page 832 **Stand systems** Page 228 **Support arm systems** Page 188

based on AE with wide VIP 6000 frame



Width dimensions:
B = Enclosure width
B1 = B + 79 mm, overall width
B2 = B – 42 mm, clearance between the front frames
B3 = B – 5 mm, front panel width

Height dimensions:
H = Enclosure height
H1 + 79 mm, overall height
H2 = H – 42 mm, clearance between the front frames
H3 = H – 5 mm, front panel height

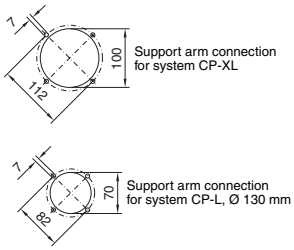
Depth dimensions:
T = Enclosure depth

The right frame, even for deeper operator panels.
On request, the compact enclosure AE can be equipped with a stylish VIP 6000 frame mounted on the rear panel. The large AE door provides easy access for servicing.

Material and surface finish:
Enclosure and door:
Sheet steel, dipcoat-primed and powder-coated in textured RAL 7035
Front panel:
3 mm aluminium, natural anodised
Frame section:
Aluminium, powder-coated in RAL 7035
Frame corner pieces:
Die-cast zinc, powder-coated in RAL 7035

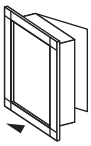
Protection category:
IP 56 to EN 60 529,
Complies with NEMA 12.

Supply includes:
Enclosure with integral roof or base reinforcement and connection for support arm system CP-L or CP-XL. Aluminium front panel and front frame supplied loose, rear door.



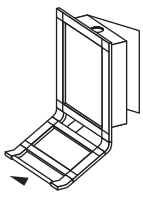
Command panel with wide VIP 6000 frame in the dimensions of compact enclosures AE or in individual sizes	Basic Model No. CP	Design code number		
	6541.009			
Support arm connection for support arm system				
without	6541.009	**0**		
CP-XL, top	6541.009	**1**		
CP-XL, bottom	6541.009	**2**		
CP-L, Ø 130 mm, top	6541.009	**3**		
CP-L, Ø 130 mm, bottom	6541.009	**4**		
Cable tube connection				
without	6541.009	X	**0**	
bottom	6541.009	X	**1**	
Dimensions				
Individual sizes mm	6541.009	X	X	W x H x D:
Like compact enclosure AE (see page 118)	6541.009	X	X	Model No. AE:
Lock systems				
Standard double-bit lock insert may be exchanged for 27 mm lock inserts, type A, lock cylinder, plastic handles and T handles, type B, see page 886 – 888.				

Order example	6541.009	**4**	**1**	W x H x D: 537 x 352 x 350 mm (or e.g AE 1050.600)



Order example

Model No. CP 6541.009
Design code numbers:
- **Support arm connection CP-L, Ø 130 mm, bottom (4)**
- **Cable tube connection at the bottom (1)**
- **Individual dimensions: W x H x D: 537 x 352 x 350 mm**



Additional mounting of a VIP 6000 keyboard housing is possible via the design code number (see page 166).
The front panel width refers to an enclosure width B – 54 mm and is achieved via a frame connector, which is included with the supply of the keyboard housing.

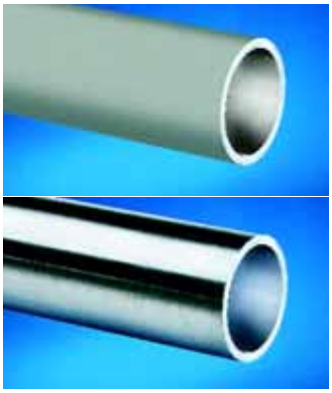
Accessories Page 832 **Stand systems** Page 228 **Support arm systems** Page 188 **VIP 6000 keyboard housing** Page 166

Support arm systems

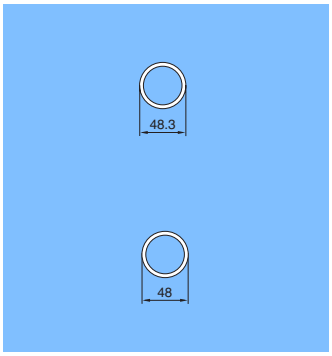
Features

Different viewing angles of the machine, tall or short operating staff, sitting or standing – with the support arm systems from Rittal, the interaction between monitoring and operating is achieved to perfection.

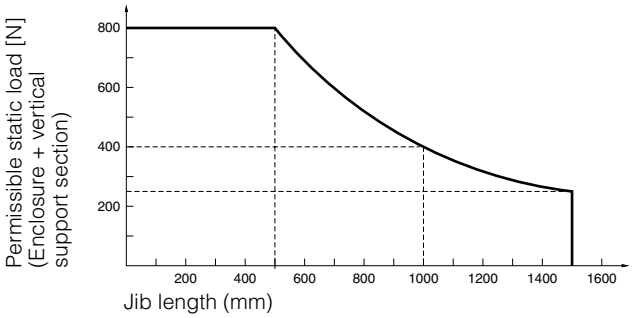
Three different systems are used, depending on the system configuration, jib length and enclosure weight.



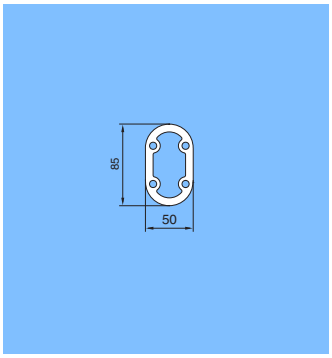
Load capacity CP-S steel/stainless steel



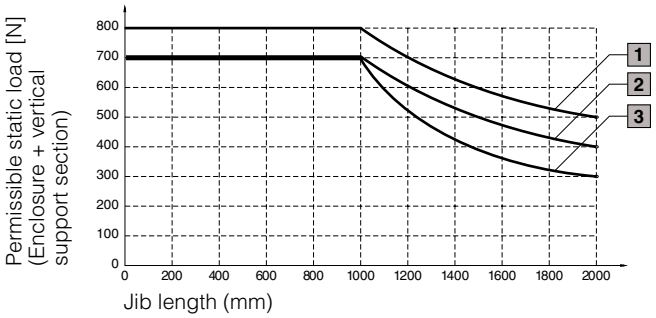
For use of CP-S in conjunction with CP-L (in the horizontal run of the system), the CP-L load diagram applies.



Load capacity CP-L

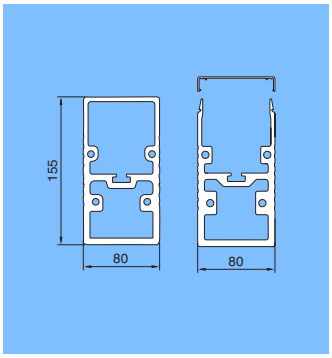


Permissible load depending on system assembly
Intermediate hinge CP 6523.0X0 should only be used once per system!

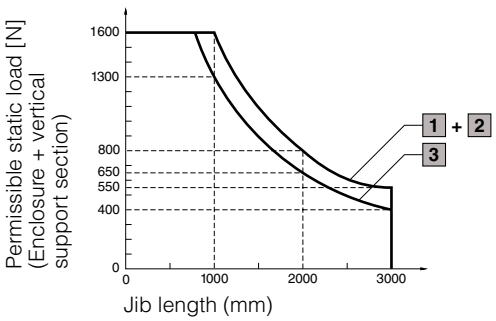


1 System assembly without joint
2 System assembly with one joint
3 System assembly with two joints

Load capacity CP-XL

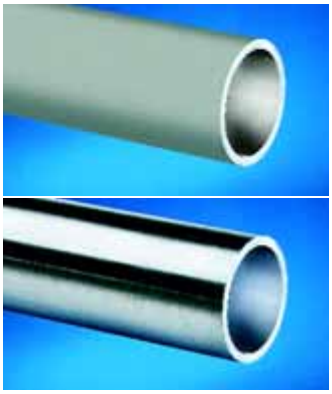


Permissible load depending on system assembly
Intermediate hinge CP 6120.000 should only be used once per system!

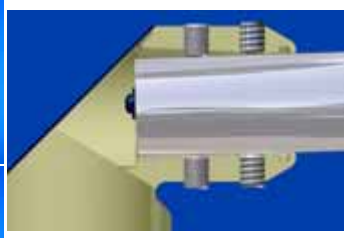


1 Open and solid support section
2 Solid support section with one joint
3 Open support section with one joint

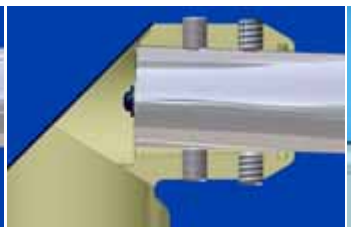
Features



CP-S steel and stainless steel



The angle coupling and angle piece, wall-mounted and top-mounted joint of the system from steel have an integral adjustment facility.



This means that deviations in the horizontal of ±2.5° may be balanced out in a flash.

The enclosures are easily located on the enclosure coupling of the stainless steel system with a pre-assembled screw.

Angle adaptor 90°
The ideal connection from a small to a medium-sized system.

Due to the differing requirements and slightly deviating attachment types, the support arm and enclosure should be made from the same material (steel or stainless steel).

CP-L aluminium

The alternative for the configuration of compact systems – the 90° support arm bracket.

Signal pillars may be mounted on many connecting elements of the systems using the mounting component,
see page 1045.

The height-adjustable support arm offers even better ergonomics.

Angle adaptor 90°
The ideal connection from a medium-sized to a large system.

CP-XL aluminium

With quadruple screw-fastening, the system offers a particularly high level of safety.

Two ducts allow the control cable and supply voltage to be separated.

A stable base point for the system – the custom-produced pillar,
see page 236.

Support arm systems

Getting from the enclosure to the matching support arm components

The diagrams show how the connection points of the Rittal enclosures may be continued with support arm systems, either directly or via adaptors.
There is a choice of four support arm systems, depending on your design, load and cabling requirements.

tiltable or rotatable components

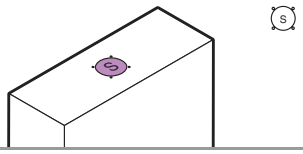
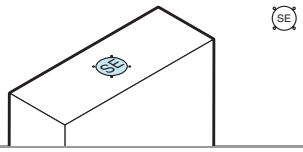
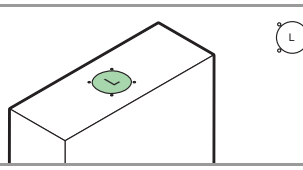
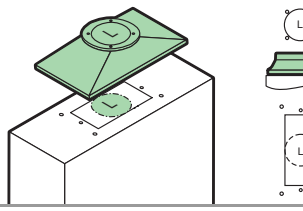
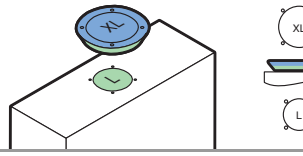
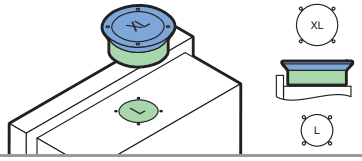
system end

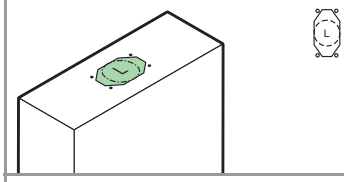
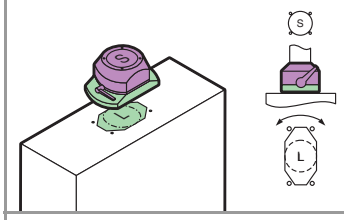
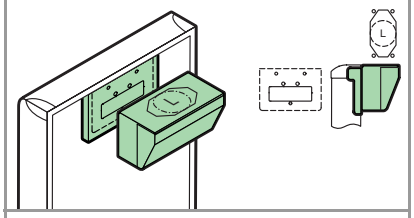
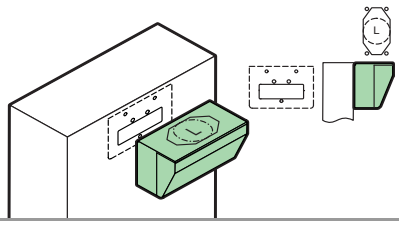
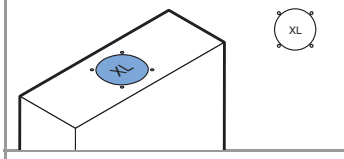
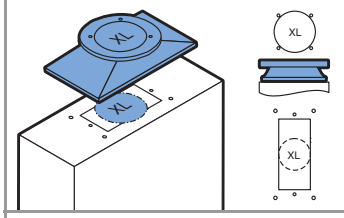
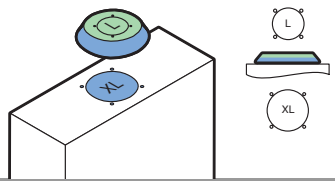
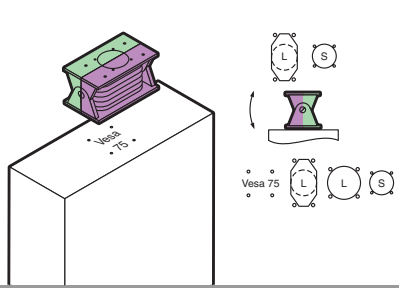
CP-S steel
For small and lightweight enclosures.

CP-S stainless steel
For use where there are special requirements in terms of corrosion and hygiene.

CP-L
The system for average command panel weights, stylish lines, and outstanding solution diversity.

CP-XL
The system for extreme loads. Also with open cable duct for super-easy cable entry.

	Enclosure	Continued with support arm system
CP-S steel		**CP-S steel: 1.1** see page 191 **CP-L: 1.6** see page 200
CP-S stainless steel		**CP-S stainless steel: 1.1** see page 277 – 280
CP-L Ø 130 mm		**CP-L: 1.1** see page 200
		**CP-L: 1.2** see page 200
		**CP-XL: 1.3 1.4** see page 218
		

	Enclosure	Continued with support arm system
CP-L ▭ 120 x 65 mm		**CP-L: 1.4** see page 200
		**CP-S steel: 1.2** see page 191
		
		
CP-XL		**CP-XL: 1.1** see page 218
		**CP-XL: 1.2** see page 218
		**CP-L: 1.3 1.4** see page 200
VESA 75		**CP-S: 1.3** see page 192 **CP-L Ø 130 mm: 1.6** see page 200 **CP-L ▭ 120 x 65 mm: 1.6** see page 200

Fast selection

Make a simple sketch showing the basic form of the support arm.
Next, select the corresponding support arm components.
Start with **1** system start by selecting the appopriate enclosure situation.

Continue with CP-S according to the item numbers.

System changes are indicated by the colour.
Green = CP-L

System continuation/system end:
all directions

vertical

horizontal

angled

tiltable or

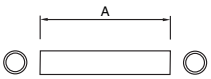
rotatable components

From position **3** enclosure attachments, a support section is required between each component (minimum length approx. 100 mm, for wall/floor mounting approx. 160 mm).

T Support sections

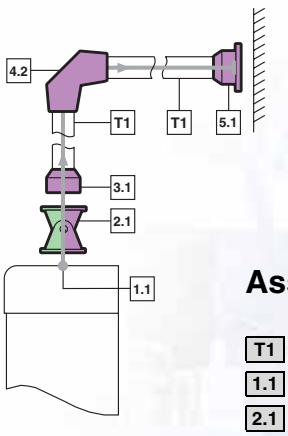
T1 Support section CP-S

$A_{min.}$ = 100 mm
$A_{max.}$ = 2000 mm



A mm	RAL 9006 **Model No. CP**
500	6501.010
1000	6501.030
To specifications	6501.340[1)]

see page 193.
[1)] Delivery times available on request.



Assembly example:

- T1 Support section CP-S
- 1.1 Mounting cutout CP-S
- 2.1 Tilting enclosure attachment, top mounting
- 3.1 Enclosure attachment CP-S
- 4.2 Angle piece 90° CP-S
- 5.1 Wall/base mounting CP-S

Note:
After any given support section, the 90° angle adaptor CP-L to CP-S may be used as a transition to the CP-L system.
Load diagram,
see page 188.

Support arm system CP-S steel

Fast selection

1 System start

Enclosure with mounting cutout

1.1 Mounting cutout CP-S

see page 190

▶ 2.1 3.1 3.2 3.4

1.2 Mounting cutout CP-L, ▭ 120 x 65 mm

see page 190

▶ 2.1 3.3

1.3 Mounting cutout VESA 75

see page 190

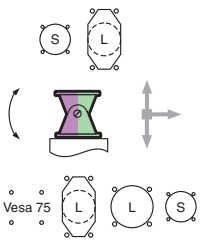
▶ 2.1

2 Tilting adaptor

2.1 Enclosure attachment, tilting, top mounting[1)]

IW 6902.670 (RAL 7024)

see page 193



▶ 3.1 3.2 3.4
▶ CP-L 2.4 see p. 201

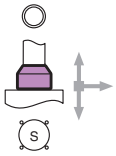
[1)] May also be used rotated through 180°, e.g. from CP-L ▭ 120 x 65 mm or CP-S to CP-L Ø 130 mm.

3 Enclosure attachments

3.1 Attachment CP-S

CP 6501.070 (RAL 7024)

see page 194

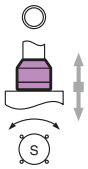


▶ 4.1 4.2 5.1 5.2 5.3

3.2 Housing coupling, round CP-S

CP 6501.050 (RAL 7024)

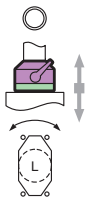
see page 195



3.3 Housing coupling, for support arm connection CP-L ▭ 120 x 65 mm

CP 6501.130 (RAL 7024)

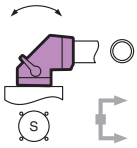
see page 195



3.4 Angle coupling 90° CP-S

CP 6501.120 (RAL 7024)

see page 196



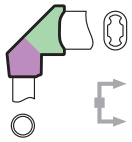
▶ 5.1 5.2 5.3

4 Angle components

4.1 Angle adaptor 90° CP-L to CP-S

CP 6501.090 (RAL 7024)

see page 214

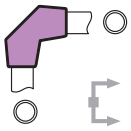


▶ CP-L cf. p. 200

4.2 Angle piece 90° CP-S

CP 6501.140 (RAL 7024)

see page 197



▶ 5.1 5.2 5.3

5 System end

5.1 Wall/base mounting CP-S

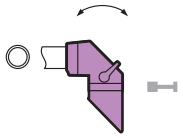
CP 6501.110 (RAL 7024)

see page 198

5.2 Wall mounted hinge CP-S

CP 6501.150 (RAL 7024)

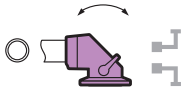
see page 199



5.3 Top mounted joint CP-S

CP 6501.160 (RAL 7024)

see page 198



Support section CP-S

Attachment to the connecting components with 2 clamping screws.

Size:
External diameter: 48.3 mm
Wall thickness: 4.0 mm

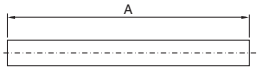
Material:
Steel conduit, powder-coated

Colour:
RAL 9006

Note:
Bent support sections available on request.

A mm	Weight kg	Model No. CP
500	2.1	**6501.010**
1000	4.2	**6501.030**
To specifications A =	4.2 kg/m	**6501.340**[1)]

[1)] Delivery times available on request.



$A_{min.}$ = 100 mm
$A_{max.}$ = 2000 mm

Enclosure attachment, tilting, top mounting

For mounting on:
- IW worktop, prepared for enclosure attachment CP-L, Ø 130 mm, see page 249
- Surfaces
- Enclosure attachment/coupling CP-L ▭ 120 x 65 mm, see page 210/212
- Attachment/housing coupling CP-S (may also be used as tilting adaptor +100°/–60° for CP-S), see page 194/195.

To fit enclosures up to 20 kg with support arm connection:
- CP-S
- CP-L ▭ 120 x 65 mm
- CP-L Ø 130 mm
- VESA Standard 75

With cable tube for protected cable entry.

Tilt angle:
+100°/–60°, adjustable in 7.2° increments via clamping lever and may be limited to +100°/–15° using the stop screw supplied loose.

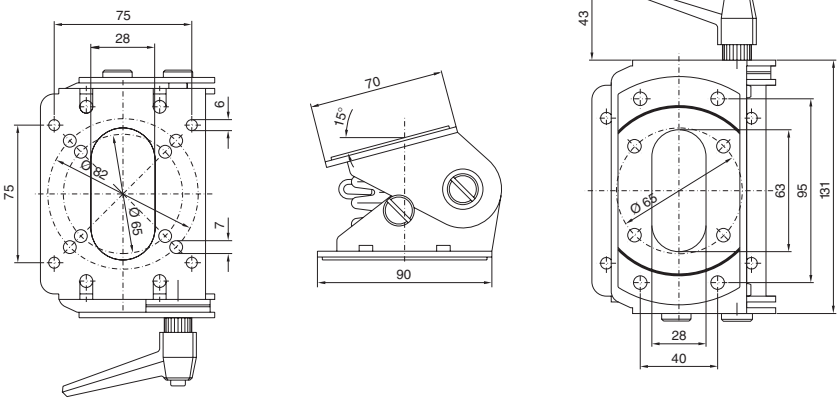
Colour RAL	Weight kg	Model No. IW
7024	0.8	**6902.670**

Material:
Sheet steel, spray-finished

Supply includes:
Assembly parts and plastic concertina section.

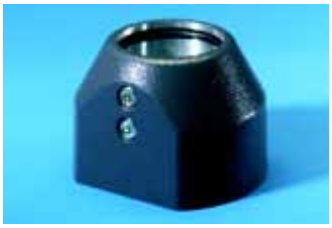
Accessories:

IW worktops prepared for enclosure attachment, see page 249.



Support arm system CP-S

Steel



CP-S attachment

For rigid attachment of the
- enclosure to the support section,
- support arm to flat surfaces, rear[1].

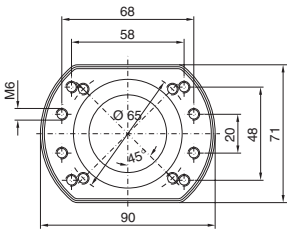
With two drilling patterns for
a) Rittal Command Panel
b) Complete Control Panel.

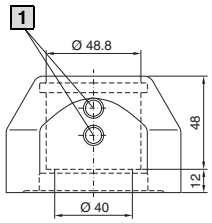
Material:
Die-cast zinc

Supply includes:
Seal and 2 clamping screws for support section CP-S.

Colour RAL	Weight kg	Model No. CP
7024	1.0	**6501.070**

[1] Maximum load 400 N.

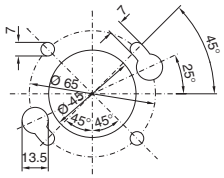




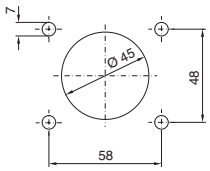
1 Clamping screw

Mounting cutouts

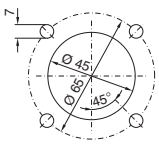
a)



b)



Like cutout a), but without lock holes



Enclosure coupling CP-S

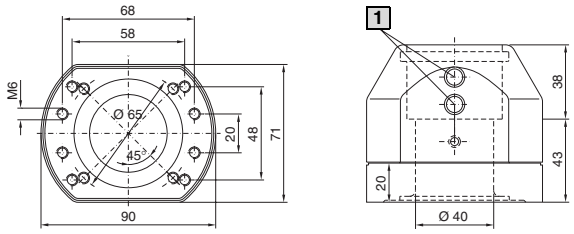
for support arm connection CP-S, round
For swivel mounting of the enclosure on the vertical section of the support arm system.
With two drilling patterns for
a) Rittal Command Panel
b) Complete Control Panel.

Rotation range:
Approx. 305°, lockable via clamping lever.
By inserting additional pins 4 x 16 mm to ISO 8752 the rotation range may be limited to ± 7°, 44°, 104°, 142°.

Colour RAL	Weight kg	Model No. CP
7024	1.1	**6501.050**

Material:
Die-cast zinc

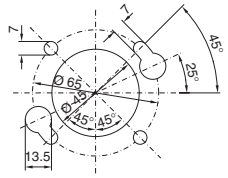
Supply includes:
Seal, 2 clamping screws for support section CP-S and clamping lever.



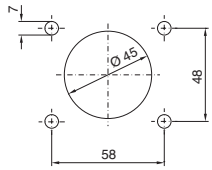
1 Clamping screw

Mounting cutouts

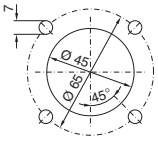
a)

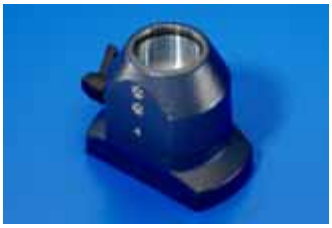


b)



Like cutout a), but without lock holes





Enclosure coupling CP-S

for support arm connection CP-L,
▭ 120 x 65 mm
For swivel mounting of the enclosure on the vertical section of the support arm system.

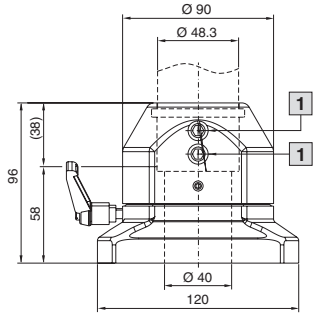
For mounting on:
- Optipanel to fit TFT monitors CP 6380.010 – .040 (see page 178)
- Optipanel W x H x D = 19″ x 7 U x 100 mm CP 6380.000 (see page 178)
- Optipanel installation depth 50 mm, with rear support arm connection.

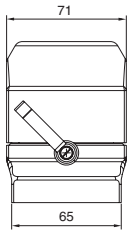
Rotation range:
Approx. 305°, lockable via clamping lever.
By inserting additional pins 4 x 16 mm to ISO 8752 the rotation range may be limited to ± 7°, 44°, 104°, 142°.

Colour RAL	Weight kg	Model No. CP
7024	1.5	**6501.130**

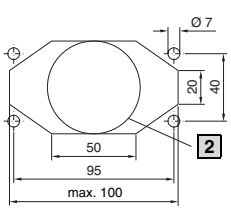
Material:
Die-cast zinc

Supply includes:
Seals, 2 locking screws.





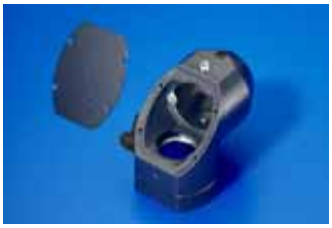
Mounting cutout, enclosure



1 Locking screw

2 alternative max. Ø 55 mm

Steel



Angle coupling 90° CP-S

For swivel fastening of the enclosure to the horizontal support arm system.

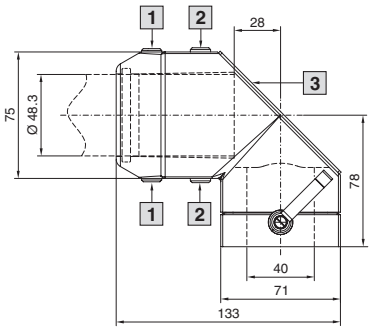
- Enclosure top-mounted or suspended
- Adjustment facility for the support arm system (see page 189)
- Removable panel for problem-free cable entry

Rotation range:
Approx. 305°, lockable via clamping lever.
By inserting additional pins 4 x 16 mm to ISO 8752 the rotation range may be limited to ± 7°, 44°, 104°, 142°.

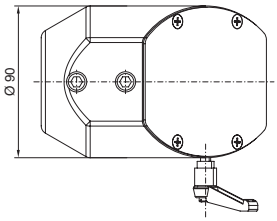
Colour RAL	Weight kg	Model No. CP
7024	1.6	**6501.120**

Material:
Cast aluminium/die-cast zinc

Supply includes:
Seals, 2 locking screws and 2 adjusting screws.

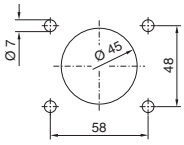


1 Locking screw
2 Adjusting screw
3 Removable plate

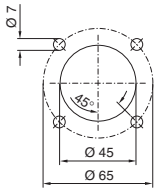


Possible mounting cutouts of enclosures

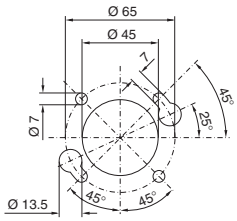
a)



b)



c)



Version c) for quick/one-man assembly

Angle adaptor 90° CP-L to CP-S

see page 214.

Angle piece 90° CP-S

For connecting horizontal and vertical support arm components.

- Adjustment facility for the support arm system (see page 189)
- Removable panel for problem-free cable entry

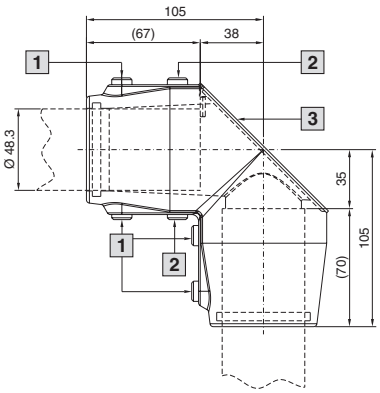
Material:
Cast aluminium

Supply includes:
Seals, 4 locking screws and 2 adjusting screws.

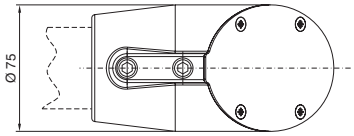
Colour RAL	Weight kg	Model No. CP
7024	1.1	**6501.140**

Accessories:

Mounting component for signal pillars (SZ 2375.030), see page 1045.



1 Locking screw
2 Adjusting screw
3 Removable plate



Mounting component CP-S

for signal pillars
For mounting a signal pillar with connection component for tube mounting on the angle piece 90° CP-S, see page 1045.

Support arm system CP-S

Steel

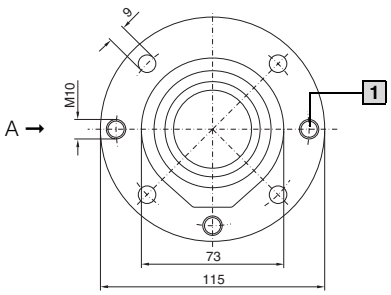
Wall/base mounting CP-S

For rigid attachment of the support section to surfaces. With flange for front mounting.

Material:
Cast aluminium

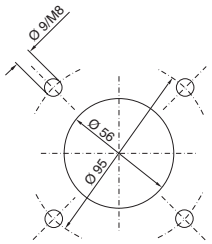
Supply includes:
Seal, 2 clamping screws for support section CP-S and 3 pre-fitted adjusting screws.

Colour RAL	Weight kg	Model No. CP
7024	0.7	**6501.110**

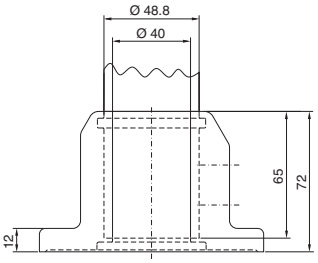


1 Adjusting screw

Mounting cutout



View A



Top mounted joint CP-S

For swivel mounting of the support arm system to horizontal surfaces.

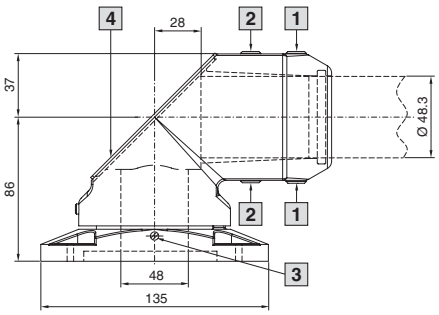
- Enclosure top-mounted or suspended
- Adjustment facility for the support arm system (see page 189)
- Removable panel for problem-free cable entry

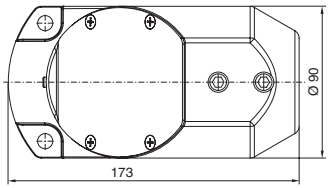
Rotation range:
Approx. 300°. By inserting additional pins 6 x 20 mm to ISO 8752 the rotation range may be limited to ± 6°, 51°, 96°. To lock the joint, the screw may be exchanged for standard clamping lever M6 x 25 mm.

Colour RAL	Weight kg	Model No. CP
7024	1.8	**6501.160**

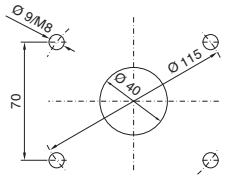
Material:
Cast aluminium

Supply includes:
Seals, 2 locking screws and 2 adjusting screws.





Mounting cutout



1 Locking screw
2 Adjusting screw
3 Screw for adjusting rotatability
4 Removable plate

Wall mounted hinge CP-S

For vertically hinged mounting of the support arm on vertical surfaces.

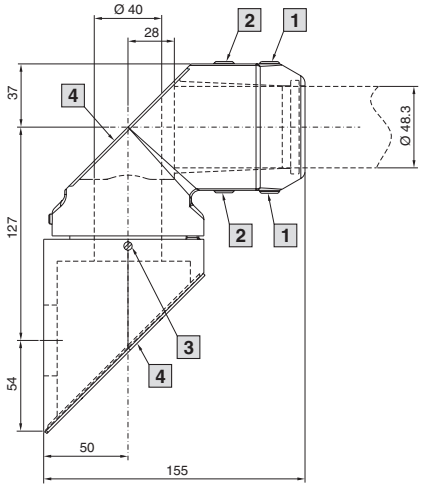
- Machined keyhole as mirror image for support arm outlet at the top or bottom for easy one-man assembly.
  – Pre-mount the screws on a vertical surface
  – Locate the wall-mounted hinge (support arm system pre-mounted)
  – Tighten the screws
- Adjustment facility for the support arm system (see page 189)
- Removable panel for problem-free cable entry

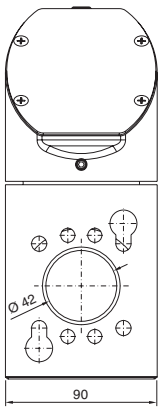
Rotation range:
Approx. 300°. By inserting additional pins 6 x 20 mm to ISO 8752 the rotation range may be limited to ± 6°, 51°, 96°. To lock the joint, the screw may be exchanged for standard clamping lever M6 x 25 mm.

Colour RAL	Weight kg	Model No. CP
7024	2.2	**6501.150**

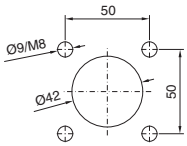
Material:
Cast aluminium

Supply includes:
Seals, 2 locking screws and 2 adjusting screws.





Mounting cutout 90°



1 Locking screw
2 Adjusting screw
3 Screw for adjusting rotatability
4 Removable plate

Support arm system CP-L

Fast selection

Make a simple sketch showing the basic form of the support arm.
Next, select the corresponding support arm components.
Start with **1** system start by selecting the appopriate enclosure situation.

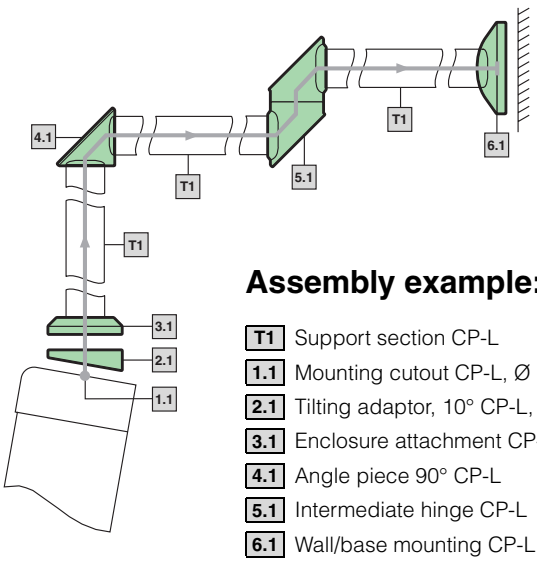
Continue with CP-L according to the item numbers.

System changes are indicated by the colour.
Violet = CP-S
Blue = CP-XL

System continuation/system end:
all directions
vertical
horizontal
angled
tiltable or
rotatable components

From position **3** enclosure attachments, a support section is required between each component (minimum length approx. 100 mm, for wall/floor mounting approx. 160 mm).
The cross-sections indicate the installation position(s).

X = 0 (RAL 7030)
X = 1 (RAL 7024)

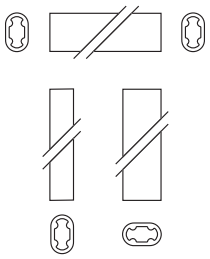


Assembly example:

- **T1** Support section CP-L
- **1.1** Mounting cutout CP-L, Ø 130 mm
- **2.1** Tilting adaptor, 10° CP-L, Ø 130 mm
- **3.1** Enclosure attachment CP-L, Ø 130 mm
- **4.1** Angle piece 90° CP-L
- **5.1** Intermediate hinge CP-L
- **6.1** Wall/base mounting CP-L

T Support sections

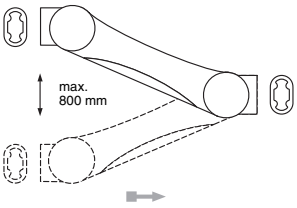
T1 Support section CP-L



Length mm	Colour RAL	**Model No. CP**
250	7035	6509.000
500	7035	6511.000
1000	7035	6513.000
2000	7035	6515.000
250	9006	6509.010
500	9006	6511.010
1000	9006	6513.010
2000	9006	6515.010

See page 204

T2 Support arm CP-L, height-adjustable

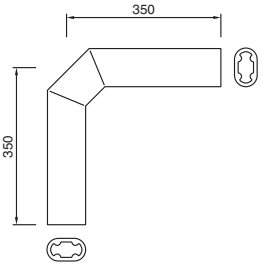


Colour: RAL 7024/9006

Weight range kg	Length mm	**Model No. CP**
10 – 20	962	6510.210
19 – 30	958	6510.310

See page 202

T3 Support arm bracket 90°, CP-L



Colour RAL	**Model No. CP**
7035	6519.000
9006	6519.010

See page 204

1 System start

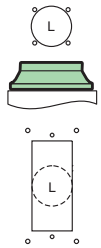
Enclosure with mounting cutout

1.1 Mounting cutout CP-L, Ø 130 mm

→ **2.1 2.2 2.4 3.1 3.2 3.3**

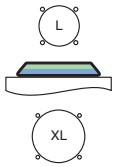
1.2 Connection plate for support arm CP-L

CP 6528.2X0, see page 209



1.3 Connection adaptor CP-L to CP-XL

CP 6528.000, see page 208



1.4 Mounting cutout CP-L, ▭ 120 x 65 mm

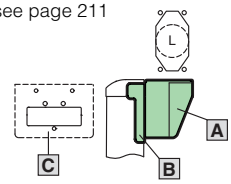
→ **2.3 2.4 3.4 3.5 3.6**
→ **CP-S 3.3** cf. p. 192

1.5 Connection console CP-L ▭ 120 x 65 mm A

CP 6508.0X0 on Optipanel support plate **B**
CP 6508.100

Other enclosures with mounting cutout **C** for connection console

see page 211



→ **2.3 2.4 3.4 3.5 3.6**
→ **CP-S 3.3** cf. p. 192

1.6 Mounting cutout VESA 75

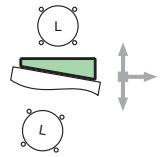
see page 190

→ **2.4**

2 Tilting adaptor

2.1 Tilting adaptor 10° CP-L, Ø 130 mm

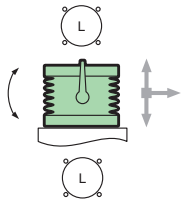
CP 6527.0X0, see page 205



3.1 3.2 3.3

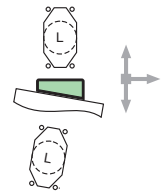
2.2 Tilting adaptor +/– 45° CP-L, Ø 130 mm

CP 6529.0X0, see page 205



2.3 Tilting adaptor 10° CP-L, ▭ 120 x 65 mm

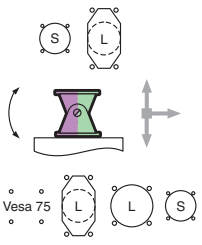
CP 6527.1X0, see page 206



3.4 3.5 3.6

2.4 Enclosure attachment tilting, top mounting[1)]

CP 6902.670 (RAL 7024), see page 193



3.4 3.5

▶ **CP-S** cf. p. 191/192

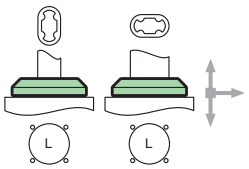
[1)] May also be used rotated through 180°, e.g. from CP-L ▭ 120 x 65 mm or CP-S to CP-L Ø 130 mm.

[2)] Via T3 support arm bracket 90° CP-L.

3 Enclosure attachments

3.1 Enclosure attachment CP-L, Ø 130 mm

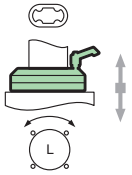
CP 6525.5X0, see page 206



4.1 4.2 4.3 6.1 6.2 6.3 6.4

3.2 Housing coupling CP-L, Ø 130 mm

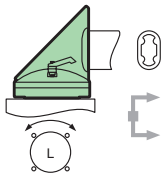
CP 6525.0X0, see page 212



4.1 4.3 6.1 6.2 6.3[2)] 6.4[2)]

3.3 Angle coupling 90° CP-L, Ø 130 mm

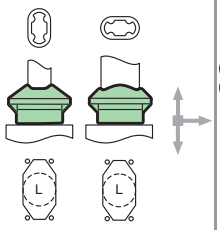
CP 6526.0X0, see page 213



4.1 5.1 6.1 6.2 6.3 6.4

3.4 Enclosure attachment CP-L, ▭ 120 x 65 mm

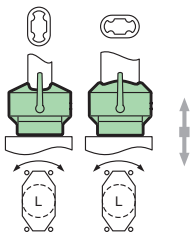
CP 6525.6X0, see page 207



4.1 4.2 4.3 6.1 6.2 6.3[2)] 6.4[2)]

3.5 Housing coupling CP-L, ▭ 120 x 65 mm

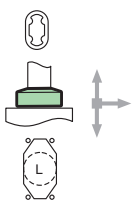
CP 6525.1X0, see page 212



4.1 4.3 6.1 6.2 6.3[2)] 6.4[2)]

3.6 Enclosure attachment CP-L, ▭ 120 x 65 mm, locatable

CP 6525.2X0, see page 210

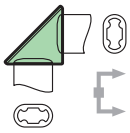


4.1 4.2 4.3 6.1 6.2

4 Angle components

4.1 Angle piece 90° CP-L

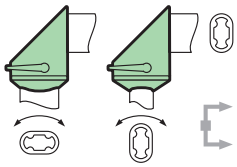
CP 6524.0X0, see page 213



5.1 6.1 6.2 6.3 6.4

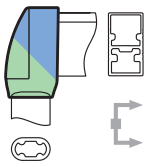
4.2 Angle joint 90° CP-L

CP 6524.2X0, see page 214



4.3 Angle adaptor 90° CP-L to CP-XL

CP 6528.100, see page 214



▶ **CP-XL** see p. 218

Notes:

Re T2
Support arm, height adjustable should always be inserted as the first horizontal component after the enclosure.

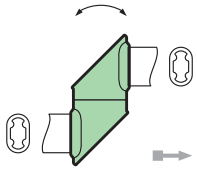
Re 5.1 / 6.3 / 6.4
It is always expedient to use only one intermediate hinge or one wall mounted hinge. Two joints will restrict load capacity and make positioning the command panel more difficult.
Load diagram,
see page 188.

Re 4.1
Two angle pieces may also be used one after the other.

5 Intermediate hinge

5.1 Intermediate hinge CP-L

CP 6523.0X0, see page 215



4.1 6.1 6.2

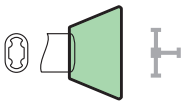
6 System end

6.1 Wall/base mounting, small, CP-L

CP 6520.5X0, see page 215

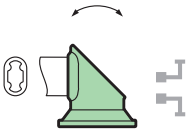
6.2 Wall/base mounting, large, CP-L

CP 6520.0X0, see page 216



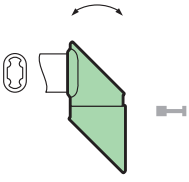
6.3 Top mounted joint CP-L

CP 6522.0X0, see page 216



6.4 Wall mounted hinge CP-L

CP 6521.0X0, see page 217



Support arm, height adjustable

Support arm, height adjustable CP-L

Offers enhanced ergonomics thanks to:

- Adjustment range
  – for tall and short operators
  – for seated and standing work
  adjustable to up to 800 mm as required via an adjusting screw at the front of the support arm.
- Precise coordination of the compression spring to the enclosure weight via an adjusting screw at the rear of the support arm.
- Complete functional reliabilty – if the compression spring breaks, the arm will remain in position.
- Plastic casing clips off for access to the integral U-section cable tray.
- Tilting angle of the mounted enclosure is identical in every height position.

Material:
Steel

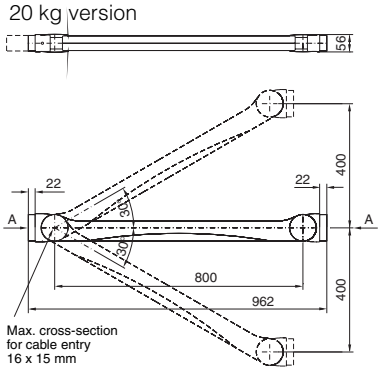
Supply includes:
Round tube with compression spring relief and U-section cable tray, 2 threaded connectors, plastic casing, including assembly parts.

Note:
Connection pieces for other support arms available on request.

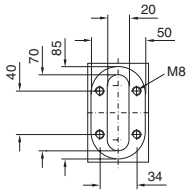
Overall length mm	Colour RAL	Weight range kg[1)]	**Model No. CP**
962	9006	10 – 20	**6510.210**
958	9006	19 – 30	**6510.310**

[1)] For configured enclosure and vertical support section

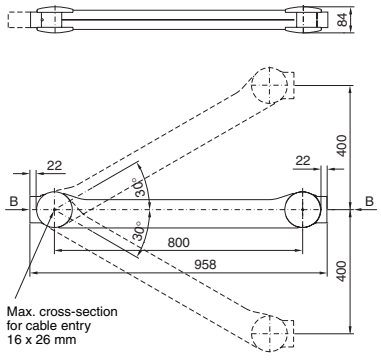
20 kg version



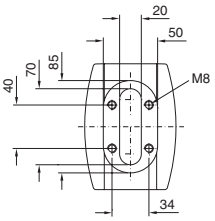
View A



30 kg version

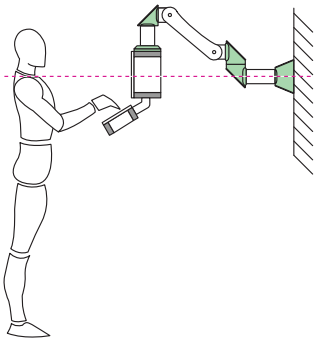


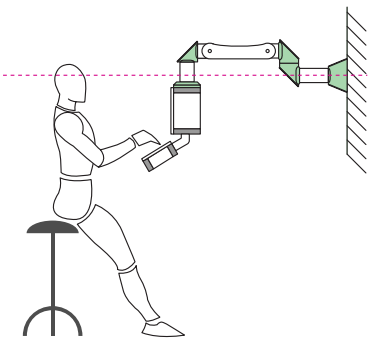
View B

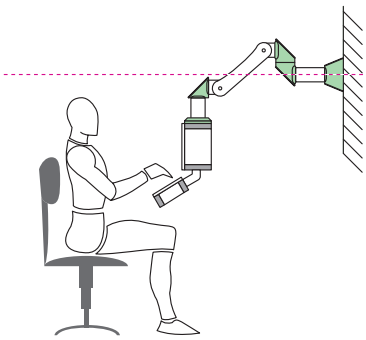


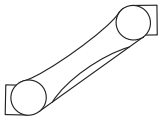
Support arm, height adjustable

The versatile combination options with horizontal mounting are illustrated in this diagram.

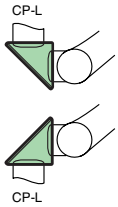




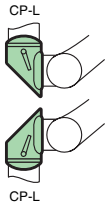




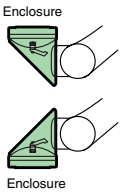
Enclosure side



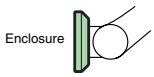
Angle piece 90° CP-L
Model No. 6524.0X0[1)],
see page 213.



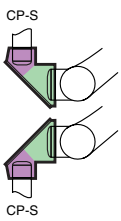
Articulated joint 90° CP-L
Model No. 6524.2X0[1)],
see page 214.



Angle coupling 90° CP-L
for support arm connection
Ø 130 mm
Model No. 6526.0X0[1)],
see page 213.

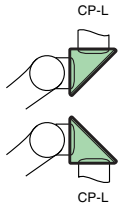


Enclosure attachment CP-L for support arm connection Ø 130 mm
Model No. 6525.5X0[1)],
enclosure attachment CP-L
for support arm connection
▭ 120 x 65 mm
Model No. 6525.6X0,
see page 206/207.
Enclosure with rear support arm cutout/reinforcement available on request.

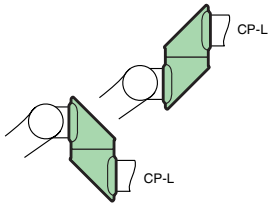


Angle adaptor 90°
CP-L to CP-S
Model No. 6501.090 (RAL 7024),
see page 214.

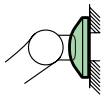
Attachment side



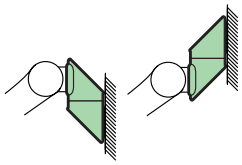
Angle piece 90° CP-L
Model No. 6524.0X0[1)],
see page 213.



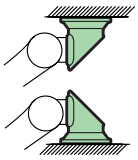
Intermediate hinge CP-L
Model No. 6523.0X0[1)],
see page 215.



Wall/base mounting, small, CP-L
Model No. 6520.5X0[1)],
see page 215.



Wall mounted hinge CP-L
Model No. 6521.0X0[1)],
see page 217.



Top mounted joint CP-L
Model No. 6522.0X0[1)],
see page 216.

[1)] Key:
X = 0 RAL 7030
X = 1 RAL 7024

Support arm system CP-L

Aluminium

Support section CP-L

Attachment to the connection components with 4 self-tapping screws in a screw channel, may be cut to any required length.

Size:
50 x 85 mm

Wall thickness:
8 mm

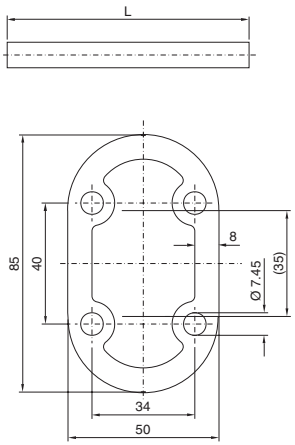
Material:
Extruded aluminium section

Note:
Load information,
see page 188.

German patent no. 43 31 124
French patent no. 94 10 806
Ital. patent no. 01275022
Jap. patent no. 2730621
US patent no. 5,460,894

Length (L)[1] mm	Weight kg	RAL 7035 Model No. CP	RAL 9006 Model No. CP
250	1.3	**6509.000**	**6509.010**
500	2.6	**6511.000**	**6511.010**
1000	5.1	**6513.000**	**6513.010**
2000	10.2	**6515.000**	**6515.010**

[1] L min = 135 mm

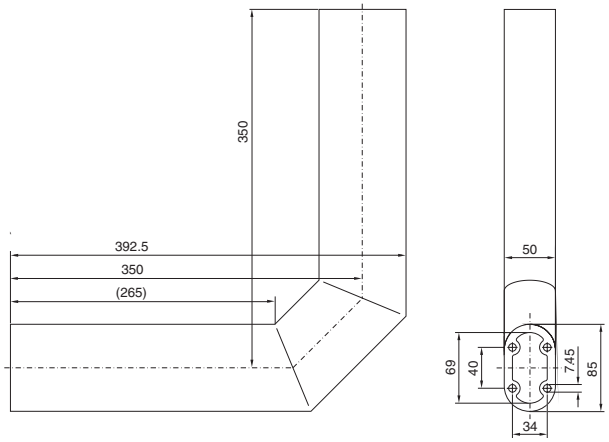


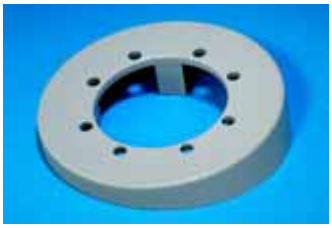
Support arm bracket 90° CP-L

The compact, firmly linked alternative.

Material:
Extruded aluminium section

Colour RAL	Weight kg	Model No. CP
7035	3.4	**6519.000**
9006	3.4	**6519.010**





Tilting adaptor, 10° CP-L

for support arm connection Ø 130 mm
For mounting between:
- Housing coupling CP-L (CP 6525.0X0)

or
- Enclosure attachment CP-L (CP 6525.0X0)

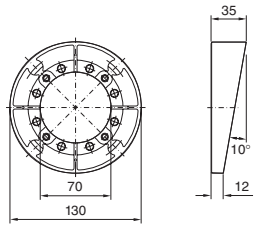
or
- Angle coupling 90° CP-L (CP 6526.0X0)

and the command panel.

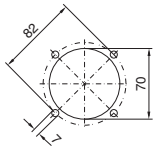
Material:
Die-cast zinc

Supply includes:
Seal and assembly parts.

Colour RAL	Weight kg	**Model No. CP**
7030	0.6	**6527.000**
7024	0.6	**6527.010**



Mounting cutout
Enclosure CP-L, Ø 130 mm



Tilting adaptor, ± 45° CP-L

for support arm connection Ø 130 mm
For mounting between:
- Housing coupling CP-L (CP 6525.0X0)

or
- Enclosure attachment CP-L (CP 6525.0X0)

or
- Angle coupling 90° CP-L (CP 6526.0X0)

and the command panel.

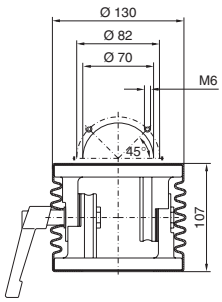
Tilting angle:
Adjustable in 7.5° increments

Material:
Cast aluminium

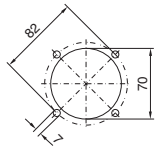
Supply includes:
Seal, plastic concertina section and assembly parts.

German patent no. 195 40 298
US patent no. 5,911,393

Colour RAL	Weight kg	**Model No. CP**
7030	1.3	**6529.000**
7024	1.3	**6529.010**



Mounting cutout
Enclosure CP-L, Ø 130 mm



Support arm system CP-L

Aluminium

Tilting adaptor, 10° CP-L

for support arm connection ▭ 120 x 65 mm
For mounting between:
- Housing coupling CP-L (CP 6525.1X0)

or
- Enclosure attachment CP-L (CP 6525.6X0)

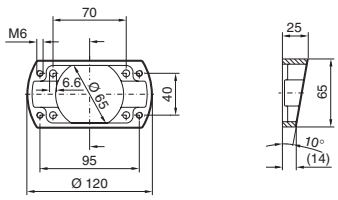
or
- Housing coupling CP-S (CP 6501.130)

and the command panel.

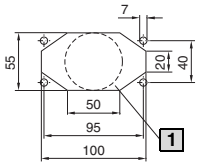
Material:
Die-cast zinc

Supply includes:
Seal and assembly parts.

Colour RAL	Weight kg	**Model No. CP**
7030	0.4	**6527.100**
7024	0.4	**6527.110**



Mounting cutout
Enclosure CP-L ▭ 120 x 65 mm



1 Alternative max. Ø 55 mm

Enclosure attachment, tilting

see page 193.

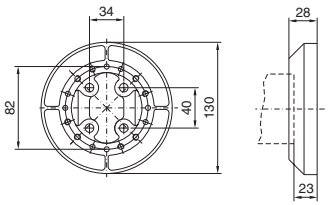
Enclosure attachment CP-L

for support arm connection Ø 130 mm
For rigid fastening of the enclosure to the support arm system.

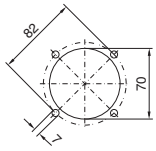
Material:
Die-cast zinc

Supply includes:
Seals and self-tapping screws for CP-L support section attachment.

Colour RAL	Weight kg	**Model No. CP**
7030	1.0	**6525.500**
7024	1.0	**6525.510**



Mounting cutout
Enclosure CP-L, Ø 130 mm



Enclosure attachment CP-L

for support arm connection ▭ 120 x 65 mm
For rigid fastening of the enclosure to the support arm system.

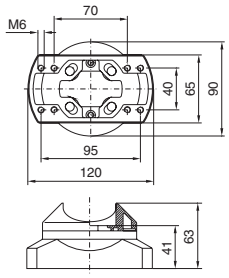
Material:
Die-cast zinc

Supply includes:
Seals and self-tapping screws for CP-L support section attachment.

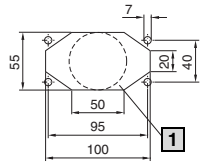
Colour RAL	Weight kg	Model No. CP
7030	1.0	**6525.600**
7024	1.0	**6525.610**

Accessories:

Connection console CP-L,
see page 211.



Mounting cutout
Enclosure CP-L, ▭ 120 x 65 mm



1 Alternative max. Ø 55 mm

Enclosure attachment, tilting, base mounting

CP-L ▭ 120 x 65 mm
For mounting beneath:
- IW worktop with pedestal
- Sufficiently large surfaces

Fits enclosures with mounting cutout:
- CP-L ▭ 120 x 65 mm (e.g. Optipanel), see page 175.

With mounting cutout for connector grommet for sealed cable entry.

Tilt angle:
+40°/–40°, lockable via clamping lever

Material:
Sheet steel, spray-finished

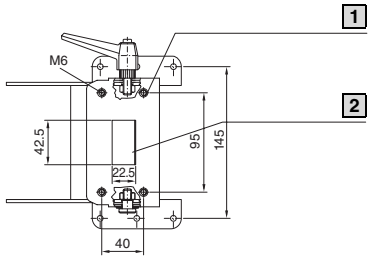
Supply includes:
Assembly parts

Colour RAL	Weight kg	Model No. IW
7024	1.6	**6902.640**

Note:
The enclosure attachment can be mounted either on the support arm connection of the Optipanel enclosure or on the underside or rear of any enclosure.

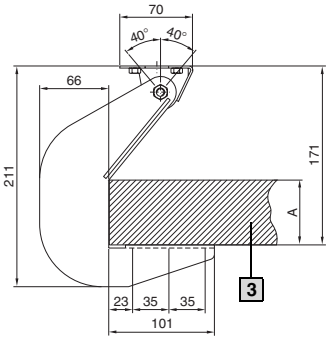
Accessories:

Connector grommet,
see page 975.
IW worktop,
see page 249.
Pedestal,
see page 232.



1 Prepared for enclosure with connection CP-L/CP-S, ▭ 120 x 65 mm or connection console CP-L CP 6508.0X0

2 Prepared for connector gland SZ 2400.300/SZ 2400.500



A = max. 62 mm

3 Worktop, e.g. IW 6902.310/ IW 6902.320

Support arm system CP-L

Aluminium

Connection adaptor CP-L to CP-XL

For mounting between:
- Enclosure with support arm connection CP-L and
- Support arm system CP-XL.

May also be used for the attachment of command panels with cutout for CP-L directly to machines and systems without a support arm.
Assembly sequence:
- Mount the connection adaptor on the supporting structure
- Mount the enclosure and tighten the screws

The seal to the supporting structure is available on request, if required.

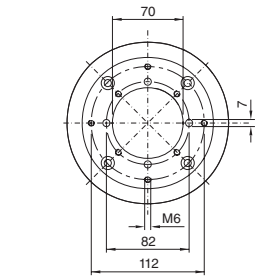
Material:
Cast aluminium

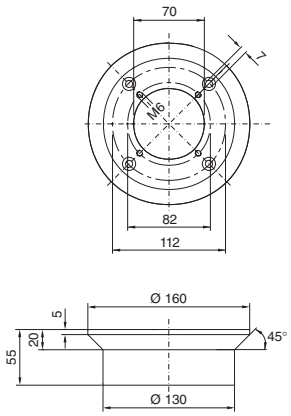
Supply includes:
Seal and assembly parts.

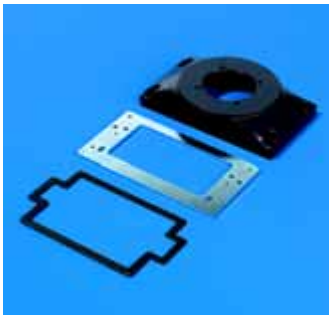
Height mm	Colour RAL	Weight kg	**Model No. CP**
20[1)]	7030	0.6	**6528.000**
55[2)]	7030	0.7	**6528.500**

[1)] Provided the load permits, may also be mounted between enclosure with support arm connection CP-XL and support arm system CP-L Ø 130 mm.

[2)] For command panel VIP 6000, see page 161, 3.1. Operating housing, design code number 1 to 5.







Connection plate

with reinforcement plate

- For easy location of the command panel onto the support arm or pedestal.
- After drilling 4 holes Ø 7 mm, simply screw-fasten from the outside.
- More space for cable entry plus clamping bracket.

For assembling:

- VIP 6000[1)]
- Optipanel[2)]
- Sheet steel command panel[3)]

to:

Support arm system components	CP-L	CP-XL
Enclosure attachment	CP 6525.5X0	CP 6130.600
Housing coupling	CP 6525.0X0	CP 6130.000
Angle coupling	CP 6526.0X0	CP 6040.000
Tilting adaptor 10°	CP 6527.0X0	–
Tilting adaptor +/– 45°	CP 6529.0X0	–

1 Pre-install screws, locate the enclosure, tighten the screws, and voila!

With support arm connection	Colour RAL	Weight kg	Model No. CP
CP-XL	7030	0.8	**6528.300**
CP-L	7030	0.7	**6528.200**
CP-L	7024	0.7	**6528.210**

Note:
The square support arm cutout can be prepared on request.

Material:
Connection plate: Cast aluminium
Reinforcement plate: Sheet steel 6 mm

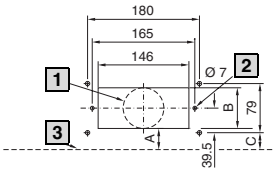
Supply includes:
Seals and assembly parts.

[1)] From a front panel width of 265 mm.
The CP-XL version cannot be used in conjunction with installation depth 155 mm and 295 mm.

[2)] From a front panel width of 220 mm and installation depth of 150 mm.

[3)] Mounting surface area, minimum W x D = 300 mm x 135 mm (e.g. command panel housing with door).

Mounting cutout CP-L/CP-XL



1 Alternative Ø B

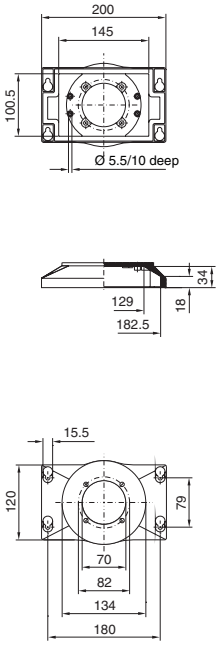
2 Ø 6 mm only with metal enclosures for securing the reinforcement plate

3 Enclosure outer edge rear

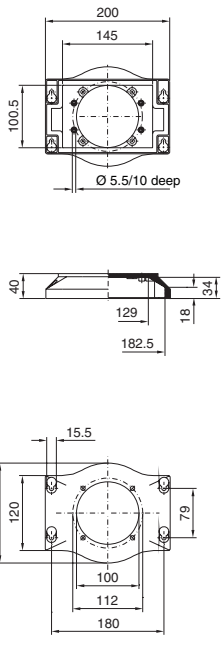
	Installation depth mm	A	B	C
VIP 6000	155 – 185	32	81	30.5
	295 – 438	174.5	81	173
Opti-panel	150	34	65.5	28
Metal enclo-sure	–	1)	86	1)

[1)] Drill the holes/cutout in the centre of the reinforcement plate of the enclosure.

CP-L

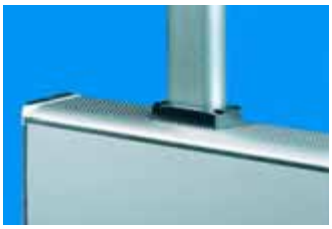


CP-XL



Support arm system CP-L

Aluminium



Enclosure attachment, locatable CP-L

for support arm connection ▭ 120 x 65 mm
For rigid fastening of the enclosure to the support section.
With “machined keyholes” for easy, secure mounting by just one person:

- Screw the enclosure attachment to the support arm.
- Secure the supporting plate to the inside of the enclosure and pre-fit two screws from the outside.
- Locate the enclosure and tighten the screws.

For enclosures from a depth of 70 mm. More space for entry of cables with connectors.

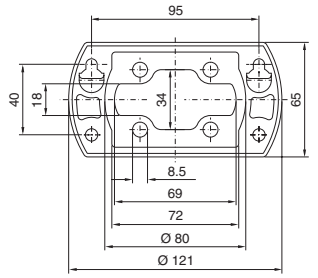
Material:
Enclosure attachment: Die-cast zinc
Support plate: Sheet steel

Supply includes:
Seal, support plate and assembly parts.

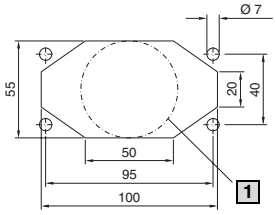
Colour RAL	Weight kg	**Model No. CP**
7030	0.4	**6525.200**
7024	0.4	**6525.210**

Also required:

90° articulated joint CP-L,
see page 214.



Mounting cutout
Enclosure ▭ 120 x 65 mm



1 Alternative max. Ø 55 mm

1. Optipanel

2. General

Connection console CP-L

For rear connection of slimline operating housings. Removable lid for simple cable entry.

Material:
Cast aluminium

Supply includes:
Seals and assembly parts for mounting on the enclosure and 2 cable ties.

Mounting options:

1. Optipanel
Retro-fitting:
- Cutout in rear panel/door
- With support plate CP 6508.100 (see page 212) directly screw-fastened to extrusion (see Fig. A)

Selection via design code number
(see page 175, item 2.3, selection 7 or 8):
Connection console and support plate are fitted.

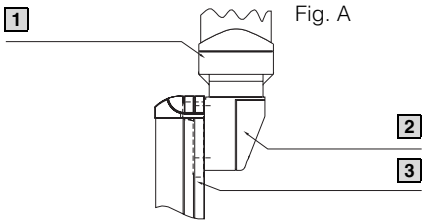


Fig. A

2. General
e.g.
- Terminal boxes (see page 107),
- Cast aluminium enclosures (see page 104)

the connection console may be mounted
a) directly, flush with enclosure edge (see Fig. B top),
b) in the centre with spacer plate CP 6508.200 (on request) (see Fig. B below),
on the rear wall of the enclosure. Additional reinforcement of the rear panel should be checked in individual cases.

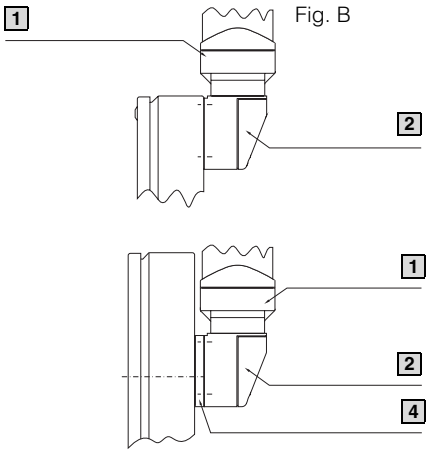


Fig. B

Colour RAL	Weight kg	**Model No. CP**
7030	0.7	**6508.000**
7024	0.7	**6508.010**

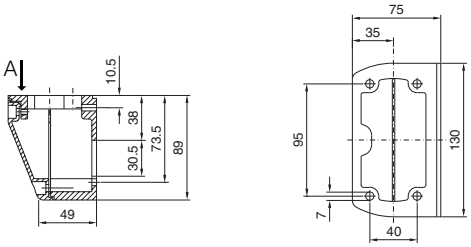
Also required:

Enclosure attachment CP 6525.6X0),
see page 207.
Housing coupling (CP 6525.1X0),
see page 212.
Tilting adaptor 10° (CP 6527.1X0),
see page 206.
Housing coupling CP-S (CP 6501.130),
see page 195.

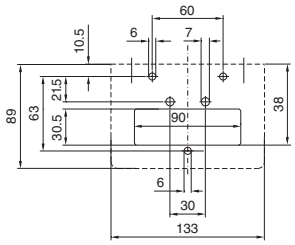
Accessories:

Spacer plate (CP 6508.200), available on request.
Support plate Optipanel CP 6508.100,
see page 212.

View A



Mounting cutout



1 Support arm component CP-L
□ 120 x 65 mm
2 Connection console CP-L
3 Support plate (inside)
4 Spacer plate

Support arm system CP-L

Aluminium

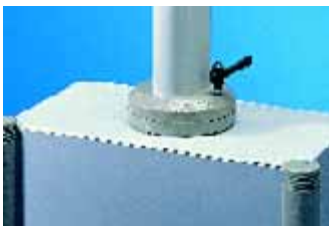
Optipanel support plate

For mounting on the enclosure section.
The rear panel or door are recessed in this area, thereby ensuring easy access in case of servicing.

Material:
Cast aluminium

Supply includes:
Seals and assembly parts.

Weight kg	Model No. CP
0.2	**6508.100**



Housing coupling CP-L

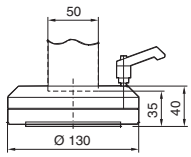
for support arm connection Ø 130 mm
For swivel mounting of the enclosure on the vertical section of the support arm system.

Rotation range:
Approx. 310°, lockable via clamping lever.
By inserting additional pins 5 x 18 mm to ISO 8752, the rotation range may be limited to ±5°, 65°, 95° and 155°.

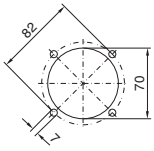
Material:
Die-cast zinc

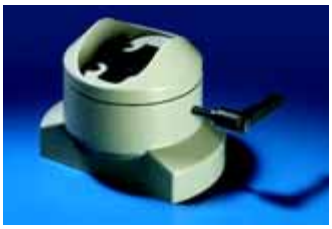
Supply includes:
Seals and self-tapping screws for CP-L support section attachment.

Colour RAL	Weight kg	Model No. CP
7030	1.7	**6525.000**
7024	1.7	**6525.010**



Mounting cutout
Enclosure CP-L, Ø 130 mm





Housing coupling CP-L

for support arm connection ▭ 120 x 65 mm
For swivel mounting of the enclosure on the vertical section of the support arm system.

Rotation range:
Approx. 350°, lockable via clamping lever.
By inserting additional pins 6 x 20 mm to ISO 8752, the rotation range may be limited to ±5° and ±100°.

Material:
Die-cast zinc

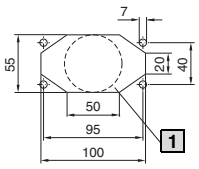
Supply includes:
Seals and self-tapping screws for CP-L support section attachment.

Colour RAL	Weight kg	Model No. CP
7030	1.4	**6525.100**
7024	1.4	**6525.110**

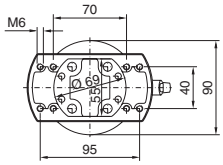
Accessories:

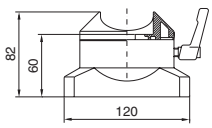
Connection console CP-L (CP 6508.0X0), see page 211.

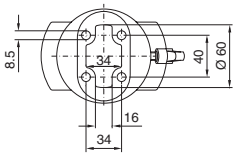
Mounting cutout
Enclosure CP-L, ▭ 120 x 65 mm

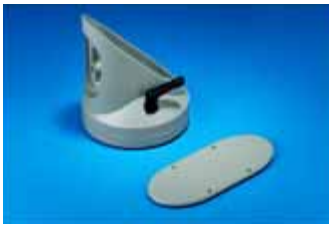


1 Alternative max. Ø 55 mm









Angle coupling 90° CP-L

for support arm connection Ø 130 mm
For swivel mounting of the enclosure on the horizontal part of the support arm system. Enclosure may be suspended or top-mounted.
The removable plate enables problem-free cable entry.

Rotation range:
Approx. 310°.
By inserting additional pins 5 x 18 mm to ISO 8752, the rotation range may be limited to ±5°, 65°, 95° and 155°.

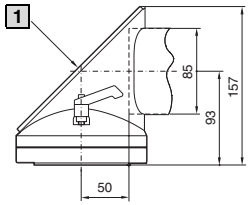
Material:
Cast aluminium/die-cast zinc

Supply includes:
Seals, adjustment set and self-tapping screws for CP-L support section attachment.

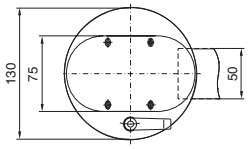
Colour RAL	Weight kg	**Model No. CP**
7030	1.9	**6526.000**
7024	1.9	**6526.010**

Accessories:

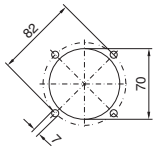
Mounting component for signal pillars (SZ 2375.000), see page 1045.



1 Removable plate



Mounting cutout
Enclosure CP-L Ø 130 mm



Angle piece 90° CP-L

For connecting horizontal and vertical support arm components. The removable plate ensures easier cable entry.

Material:
Die-cast zinc

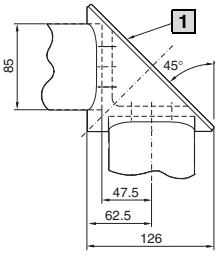
Supply includes:
Seals, adjustment set and self-tapping screws for CP-L support section attachment.

German patent no. 43 31 125
French patent no. 94 10901
Italian patent no. 012 74 738
Japanese patent no. 2 809 993
US patent no. 5,533,763

Colour RAL	Weight kg	**Model No. CP**
7030	1.4	**6524.000**
7024	1.4	**6524.010**

Accessories:

Mounting component for signal pillars (SZ 2375.000), see page 1045.



1 Removable plate
75 x 174 mm

Support arm system CP-L

Aluminium

Articulated joint 90° CP-L

The swivel connection between horizontal and vertical support sections.
With very slimline enclosures, there is no need for the deep housing coupling. With the shallow enclosure attachment (CP 6525.2X0), the support section may also be attached with its wide side.

Rotation range:
Approx. 325°.
Option of limiting the rotation range via the use of additional pins 5 x 18 mm to ISO 8752 to ±54° and ±98°.

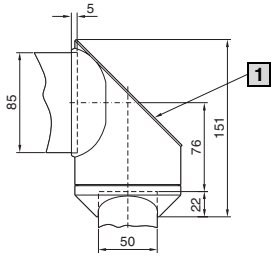
Material:
Cast aluminium/die-cast zinc

Supply includes:
Seals, self-tapping screws for support section attachment and adjustment set.

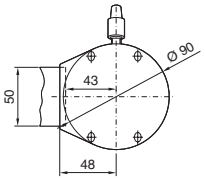
Colour RAL	Weight kg	**Model No. CP**
7030	1.2	**6524.200**
7024	1.2	**6524.210**

Also required:

Enclosure attachment, locatable CP-L for support arm connection ▭ 120 x 65 mm (CP 6525.2X0), see page 210,
or enclosure attachment CP-L for support arm connection ▭ 120 x 65 mm (CP 6525.6X0), see page 207.



1 Removable plate



Angle adaptor 90°

Connection component between:
- small and larger support arm systems.

Outlet optionally at the top or bottom if this configuration is chosen for static or visual reasons.
The removable cover ensures easier cable entry.

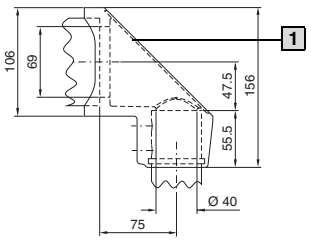
Material:
Cast aluminium

Supply includes:
Seal for support section attachment.

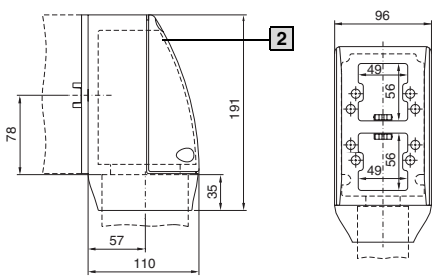
Note:
Mounting component for signal pillar available on request.

	Colour RAL	Weight kg	**Model No. CP**
CP-L to CP-S	7024	1.0	**6501.090**
CP-XL to CP-L	7030	1.7	**6528.100**

CP 6501.090

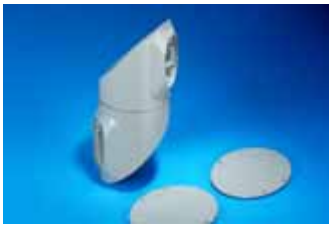


CP 6528.100



1 Removable plate 71 x 149 mm

2 Removable cover



Intermediate hinge CP-L

For vertically hinged connection of horizontal support sections within the support arm system. The removable plates allow simple cable entry.

Rotation range:
Approx. 315°.
With the option of restricting the rotation range in 60° increments using the screws supplied.

Material:
Cast aluminium

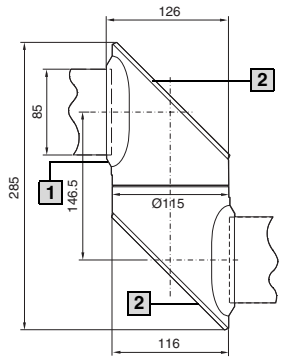
Supply includes:
Seals, adjustment set and self-tapping screws for CP-L support section attachment.

German patent no. 44 03 593
French patent no. 94 10902
Ital. patent no. 01274751
Japanese patent no. 2 675 264
US patent no. 5,522,118

Colour RAL	Weight kg	**Model No. CP**
7030	3.2	**6523.000**
7024	3.2	**6523.010**

Accessories:

Mounting component for signal pillars (SZ 2375.020),
see page 1045.



1 Screw for adjusting rotatability
2 Removable plate

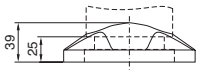
Wall/base mounting, small CP-L

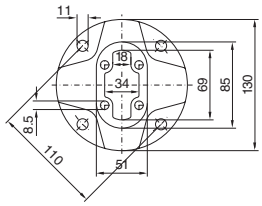
For rigid attachment of the support arm system to vertical or horizontal surfaces.
Particularly suitable for the configuration of compact support arm systems with cable infeed from the inside.

Material:
Cast aluminium

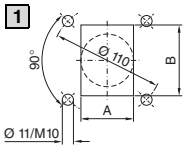
Supply includes:
Seals, adjustment set for support section and self-tapping screws for CP-L support section attachment.

Colour RAL	Weight kg	**Model No. CP**
7030	0.6	**6520.500**
7024	0.6	**6520.510**





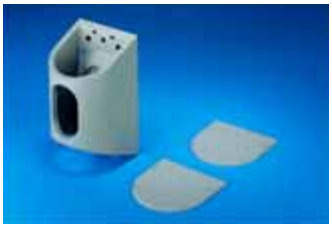
Mounting cutout



1 Alternative Ø 52
A = max. 52
B = max. 70

Support arm system CP-L

Aluminium



Wall/base mounting, large CP-L

For rigid attachment of the support arm system to vertical or horizontal surfaces with cable infeed from the inside.

Material:
Cast aluminium

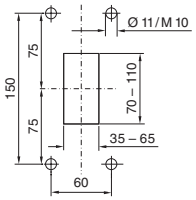
Supply includes:
Seals, opportunity for adjustment with grub screws and self-tapping screws supplied loose for CP-L support section attachment.

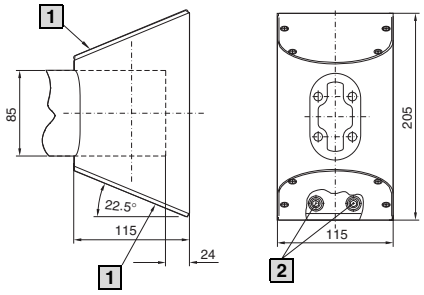
Colour RAL	Weight kg	Model No. CP
7030	1.9	**6520.000**
7024	1.9	**6520.010**

Accessories:

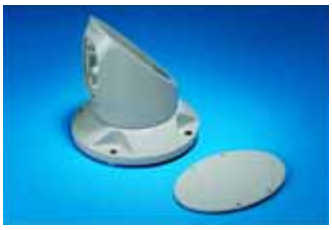
Pillar,
see page 236.

Mounting cutout





1 Removable plate
2 Adjusting screws



Top mounted joint CP-L

For swivel mounting of the support arm system on horizontal surfaces – also suitable for suspending from the ceiling. The removable plate allows easier cable entry.

Rotation range:
Approx. 315°.
Option of restricting the rotation range in 60° increments and adjusting the mobility of the joint with the screws supplied loose. To lock the joint, the screw may be exchanged for a standard commercially available clamping lever M8 x 16.

Material:
Cast aluminium

Supply includes:
Seals, adjustment set and self-tapping screws for CP-L support section attachment.

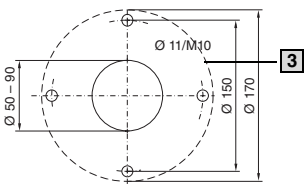
Note:
Not suitable for the suspension of enclosures.

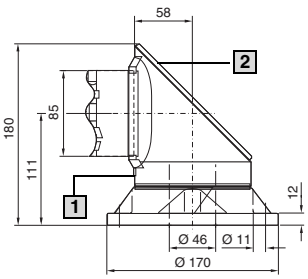
Colour RAL	Weight kg	Model No. CP
7030	3.0	**6522.000**
7024	3.0	**6522.010**

Accessories:

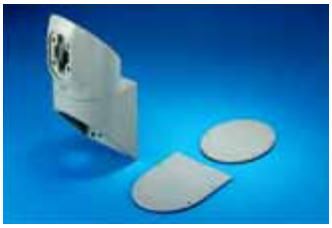
Pillar,
see page 236.
Mounting component for signal pillars (SZ 2375.020),
see page 1045.

Mounting cutout





1 Screw for adjusting rotatability
2 Removable plate
3 Mounting surface



Wall mounted hinge CP-L

For vertically hinged mounting of the support arm on vertical surfaces. The removable plates facilitate problem-free cable routing and cable entry.

Rotation range:
Approx. 315°.
Option of restricting the rotation range in 60° increments and adjusting the mobility of the joint with the screws supplied loose. To lock the joint, the screw may be exchanged for a standard commercially available clamping lever M8 x 16 to adjust rotatability.

Material:
Cast aluminium

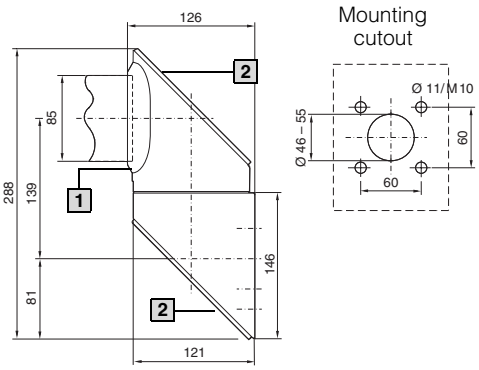
Supply includes:
Seals, adjustment via grub screws and self-tapping screws for CP-L support section attachment.

German patent no. 44 03 593
French patent no. 94 10902
Ital. patent no. 01274751
Japanese patent no. 2 675 264
US patent no. 5,522,118

Colour RAL	Weight kg	**Model No. CP**
7030	3.2	**6521.000**
7024	3.2	**6521.010**

Accessories:

Pillar, see page 236.
Mounting component for signal pillars (SZ 2375.020), see page 1045.



1 Screw for adjusting rotatability
2 Removable plate

Mounting component CP-L

for signal pillars
For mounting a signal pillar with connection component for conduit mounting on support arm system CP-L, see page 1045.

Support arm system CP-XL

Fast selection

Make a simple sketch showing the basic form of the support arm. Next, select the corresponding support arm components. Start with **1** system start by selecting the appopriate enclosure situation.

Continue with CP-XL according to the item numbers.

System continuation/system end:

all directions

vertical

horizontal

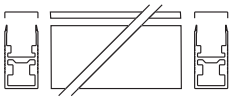
angled

rotatable components

From position **3** enclosure attachments, a support section is required between each component (minimum length approx. 100 mm, for wall/floor mounting approx. 160 mm).
The cross-sections indicate the installation position(s).

T Support sections

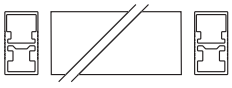
T1 Support section CP-XL, open



Length mm	Colour RAL	**Model No. CP**
500	7035	6050.000
1000	7035	6100.000
2000	7035	6200.000

See page 220

T2 Support arm CP-XL, solid



Length mm	Colour RAL	**Model No. CP**
500	7035	6050.500
1000	7035	6100.500
2000	7035	6200.500

See page 220

1 System start

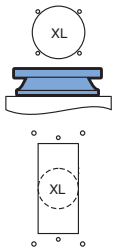
Enclosure with mounting cutout

1.1 Mounting cutout CP-XL

1.2 Connection plate CP-XL

CP 6528.300 (RAL 7030)

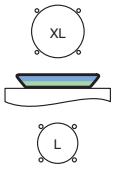
see page 209



1.3 Connection adaptor CP-L to CP-XL

CP 6528.000 (RAL 7030)

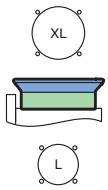
see page 208



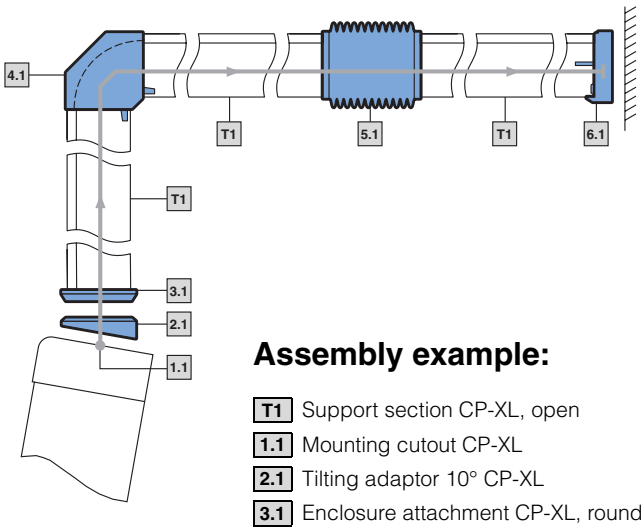
1.4 Connection adaptor CP-L to CP-XL
for VIP 6000 enclosure in installation depths 155, 185 and 295 mm

CP 6528.500 (RAL 7030)

see page 208



2.1
2.2
3.1
3.2
3.3
3.4



Assembly example:

- T1 Support section CP-XL, open
- 1.1 Mounting cutout CP-XL
- 2.1 Tilting adaptor 10° CP-XL
- 3.1 Enclosure attachment CP-XL, round
- 4.1 Angle piece 90° CP-XL, outlet at bottom
- 5.1 Intermediate hinge CP-XL
- 6.1 Wall/base mounting CP-XL

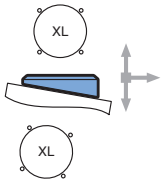
Note:

- Only insert one intermediate hinge
- Two angle pieces may also be used one after the other
- With angle pieces, take care to ensure correct positioning of the support section cable duct
- **Load diagram,** see page 188.

Fast selection

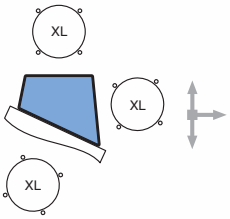
2 Tilting adaptor

2.1 Tilting adaptor 10° CP-XL
CP 6023.000 (RAL 7030)
see page 221



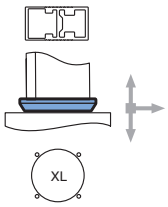
→ 3.1 3.3 3.4

2.2 Tilting adaptor 25°/60° CP-XL
CP 6150.000 (RAL 7030)
see page 222



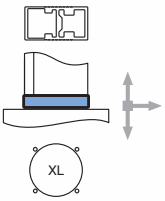
3 Enclosure attachments

3.1 Enclosure attachment CP-XL, round
CP 6130.600 (RAL 7030)
see page 222

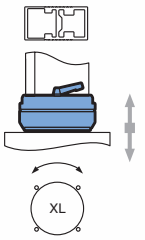


→ 4.1 4.2 5.1 6.1 6.2 6.3

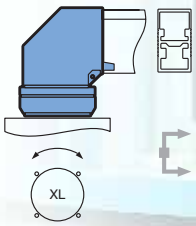
3.2 Enclosure attachment CP-XL, rectangular
CP 6130.500 (RAL 7030)
see page 223



3.3 Housing coupling CP-XL
CP 6130.000 (RAL 7030)
see page 223

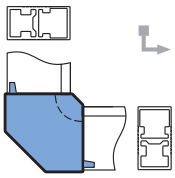


3.4 Angle coupling 90° CP-XL
CP 6040.000 (RAL 7030)
see page 224



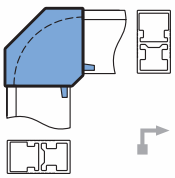
4 Angle components

4.1 Angle piece 90° CP-XL, outlet at bottom
CP 6140.000 (RAL 7030)
see page 225



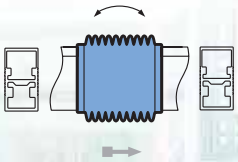
→ 5.1 6.1 6.2 6.3

4.2 Angle piece 90° CP-XL, outlet at top
CP 6180.000 (RAL 7030)
see page 225



5 Intermediate hinge

5.1 Intermediate hinge CP-XL
CP 6120.000 (RAL 7030)
see page 225

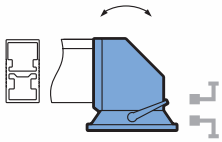


→ 4.1 4.2 6.2 6.3

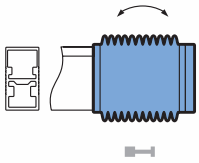
6 System end

6.1 Wall/base mounting CP-XL
CP 6160.000 (RAL 7030)
see page 227

6.2 Top mounted joint CP-XL
CP 6170.000 (RAL 7030)
see page 227

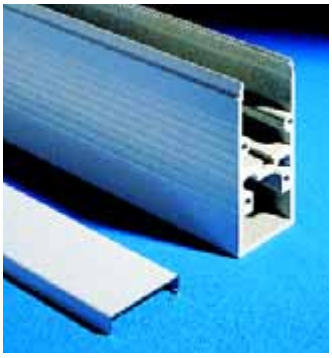


6.3 Wall mounted hinge CP-XL
CP 6110.000 (RAL 7030)
see page 226



Support arm system CP-XL

Aluminium



Support section CP-XL, open

Attachment to the connecting components with 4 self-tapping screws in the screw channel, may be cut to any required length.
With open cable duct, for easy servicing access and for pre-assembled cables with connectors; easily locked via clip-in lid.

Size:
80 x 155 mm

Material:
Extruded aluminium section

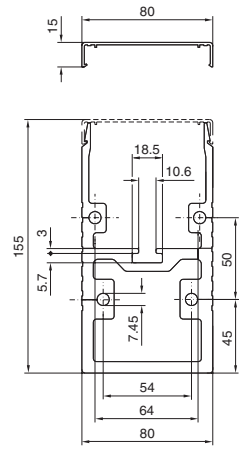
Supply includes:
Clip-in lid

Length mm	Colour RAL	Weight kg	Model No. CP
500	7035	4.9	**6050.000**
1000	7035	9.8	**6100.000**
2000	7035	19.6	**6200.000**

Note:
Load information, see page 188.

Accessories:

Adjustment set for support section, see page 221.



Support section CP-XL, solid

The alternative solution for higher loads and torsion compared with the CP-L support section, open.

Size:
80 x 155 mm

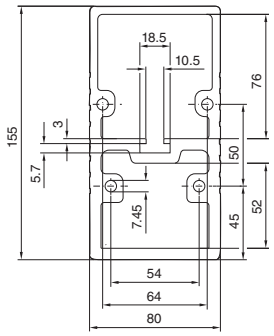
Material:
Extruded aluminium section

Length mm	Colour RAL	Weight kg	Model No. CP
500	7035	5.5	**6050.500**
1000	7035	11.0	**6100.500**
2000	7035	22.0	**6200.500**

Note:
Load information, see page 188.

Accessories:

Adjustment set for support section, see page 221.

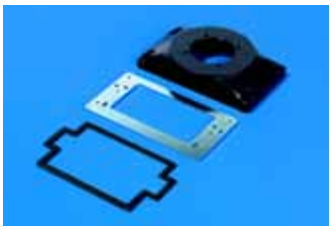


Adjustment set for support section CP-XL

The adjustment set permits retrospective alignment of the CP support section.

Material:
Sheet steel 1.0 mm, zinc-plated, passivated.

Packs of	Model No. CP
10	**6205.000**

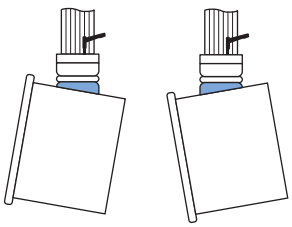


Connection plate

with reinforcement plate
see page 209.

Connection adaptor CP-L to CP-XL

see page 208.



Tilting adaptor 10° CP-XL

For mounting between:
- Housing coupling (CP 6130.000)

or
- Enclosure attachment (CP 6130.600)

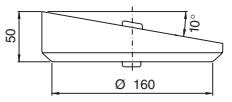
or
- Angle coupling (CP 6040.000)

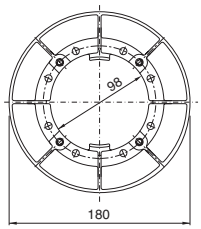
and the command panel.

Material:
Die-cast zinc

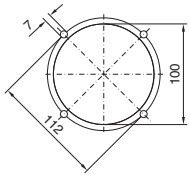
Supply includes:
Seals and assembly parts.

Colour RAL	Weight kg	Model No. CP
7030	1.4	**6023.000**





Mounting cutout
Enclosure CP-XL



Support arm system CP-XL

Aluminium

Tilting adaptor 25°/60° CP-XL

For mounting between:
- Housing coupling (CP 6130.000)

or
- Enclosure attachment (CP 6130.600)

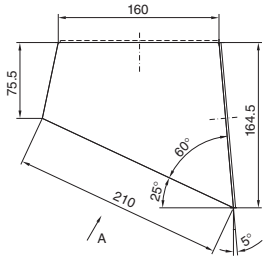
or
- Angle coupling (CP 6040.000)

and the command panel.

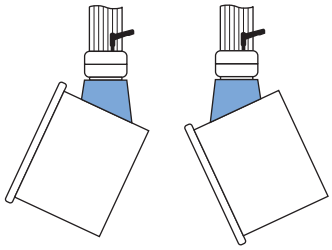
Material:
Cast aluminium

Supply includes:
Seals, plastic cover and assembly parts.

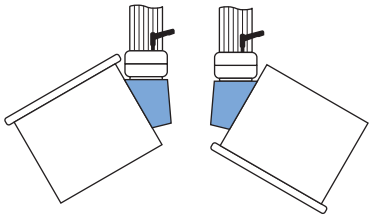
Colour RAL	Weight kg	**Model No. CP**
7030	1.7	**6150.000**

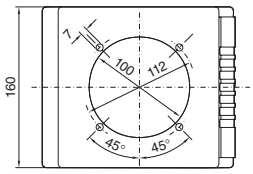


Tilt 25°

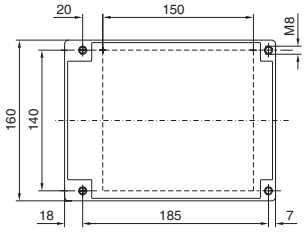


Tilt 60°





View A



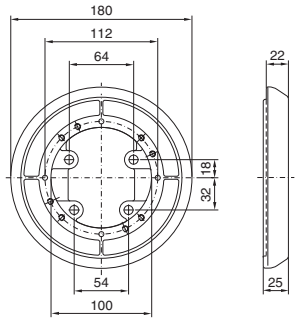
Enclosure attachment CP-XL, round

For rigid external mounting of enclosures to:
- Support section
- Tilting adaptor 10° (CP 6023.000)
- Tilting adaptor 25°/60° (CP 6150.000)

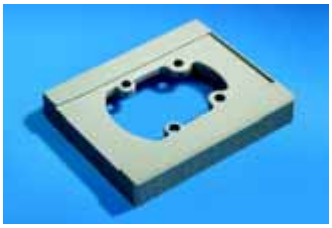
Material:
Die-cast zinc

Supply includes:
Seals and self-tapping screws for CP-XL support section attachment.

Colour RAL	Weight kg	**Model No. CP**
7030	1.6	**6130.600**



Aluminium



Enclosure attachment CP-XL, rectangular

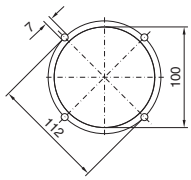
For rigid external mounting on the enclosure.

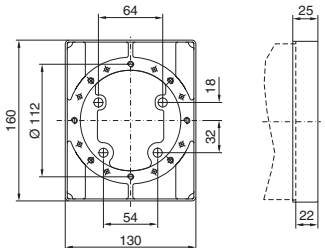
Material:
Die-cast zinc

Supply includes:
Seal and self-tapping screws for CP-XL support section attachment.

Colour RAL	Weight kg	Model No. CP
7030	1.2	**6130.500**

Mounting cutout enclosure CP-XL





Housing coupling CP-XL

For swivel mounting of the enclosure on the vertical section of the support arm system.

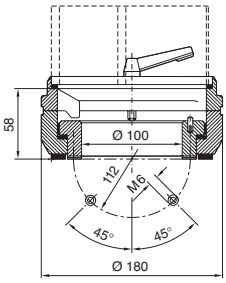
Rotation range:
Approx. 350°

Material:
Die-cast zinc

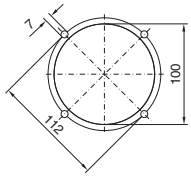
Supply includes:
Seals and self-tapping screws for CP-XL support section attachment.

Note:
By inserting pins 5 x 12 to DIN EN ISO 8741, the rotation range may be limited in 90° increments.

Colour RAL	Weight kg	Model No. CP
7030	6.8	**6130.000**

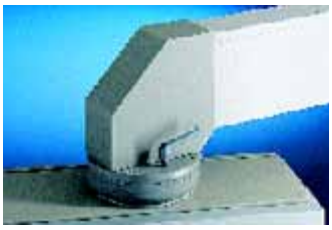


Mounting cutout
Enclosure CP-XL



Support arm system CP-XL

Aluminium



Angle coupling 90° CP-XL

For swivel mounting of the enclosure on the horizontal part of the support arm system. Enclosure may be suspended or top-mounted.

Rotation range:
Approx. 350°

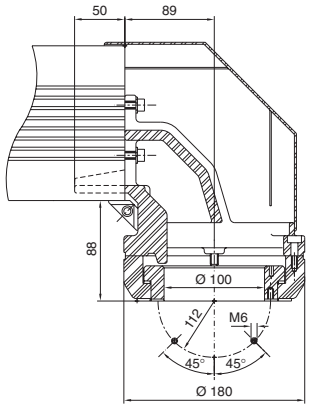
Material:
Spheroidal-graphite cast iron and die-cast zinc

Supply includes:
Seals, plastic casing and self-tapping screws for CP-XL support section attachment.

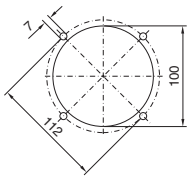
Note:
By inserting pins 5 x 12 to DIN EN ISO 8741, the rotation range may be limited in 90° increments.

German patent no. 4033747
Italian patent no. 1252120

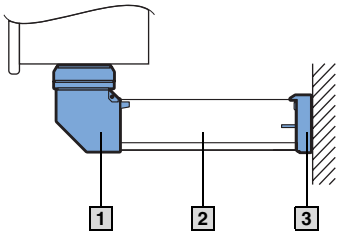
Colour RAL	Weight kg	Model No. CP
7030	6.2	**6040.000**



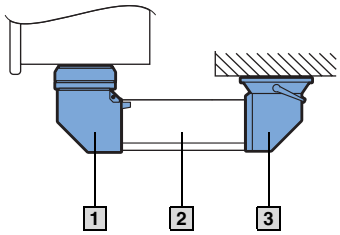
Mounting cutout
Enclosure CP-XL



Top-mounting is only possible as shown in the diagrams below (without intermediate hinge).



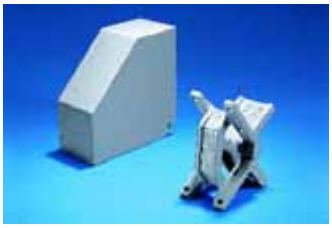
1 Angle coupling (CP 6040.000)
2 Support section CP-XL 6050.500
3 Wall/base mounting bracket 6160.000

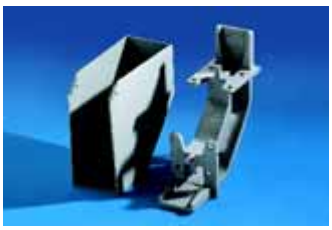


1 Angle coupling (CP 6040.000)
2 Support section CP-XL 6050.500
3 Top mounted joint 6170.000

Angle adaptor 90° CP-XL to CP-L

see page 214.





Angle piece 90° CP-XL

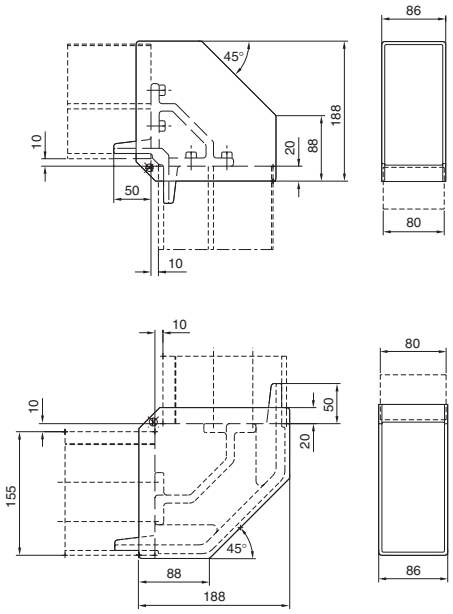
For connecting horizontal and vertical support arm components.

Material:
Spheroidal-graphite cast iron

Supply includes:
Seals, plastic casing and self-tapping screws for CP-XL support section attachment.

German patent no. 58901106
European patent no. 0330027
with validity for IT

Outlet	Colour RAL	Weight kg	Model No. CP
Bottom	7030	2.4	**6140.000**
Top	7030	3.6	**6180.000**



Intermediate hinge CP-XL

For vertically hinged connection of horizontal support sections within the support arm system.

Rotation range:
Approx. 180°

Material:
Spheroidal-graphite cast iron

Supply includes:
Self-tapping screws for CP-XL support section attachment and divided concertina section with zip for uninhibited access to the cable duct.

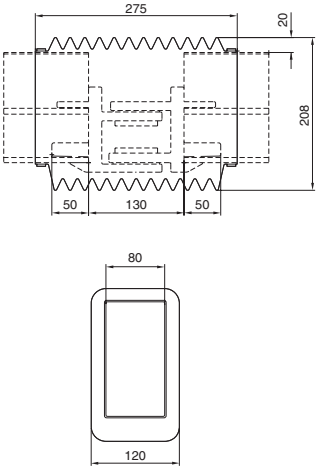
Note:
Rotation range may be reduced with rotation range restrictor.

German patent no. 3805424
European patent no. 0330029
with validity for IT

Colour RAL	Weight kg	Model No. CP
7030	6.5	**6120.000**

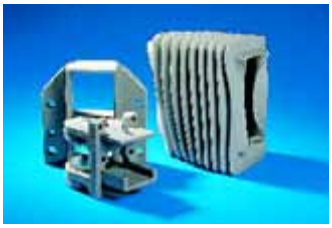
Accessories:

Rotation range restrictor CP-XL,
see page 226.



Support arm system CP-XL

Aluminium



Wall mounted hinge CP-XL

For vertically hinged mounting of the support arm on vertical surfaces.

Rotation range:
Approx. 180°

Material:
Spheroidal-graphite cast iron

Supply includes:
Seals, concertina section and assembly parts.

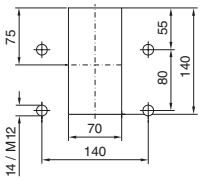
Note:
Rotation range may be reduced with rotation range restrictor CP-XL.

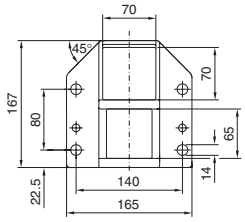
Colour RAL	Weight kg	Model No. CP
7030	8.5	**6110.000**

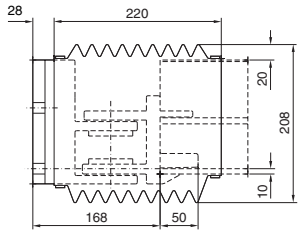
Accessories:

Pillar, see page 236.
Rotation range restrictor CP-XL, see page 226.

Mounting cutout







Rotation range restrictor CP-XL

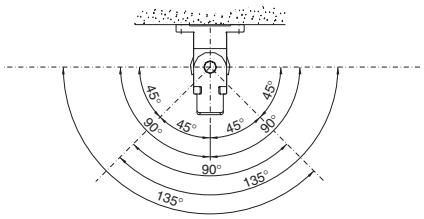
Suitable for:
- Wall-mounted hinge (CP 6110.000)
- Intermediate hinge (CP 6120.000).

Material:
Steel, zinc-plated, passivated

Supply includes:
2 steel disks, slotted, including 3 cheese-head screws for assembly.

Packs of	Weight kg	Model No. CP
1 set	0.6	**6110.100**

Adjustable swivel area:



Top mounted joint CP-XL

For swivel mounting of the support arm system on horizontal surfaces – also suitable for suspending from the ceiling.

Rotation range:
Approx. 350°, lockable.

Material:
Steel and cast parts

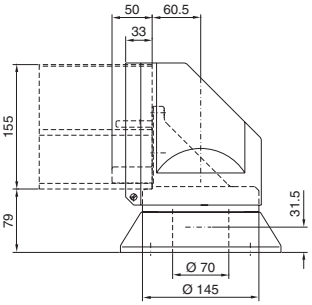
Supply includes:
Seals and plastic casing, self-tapping screws for CP-XL support section attachment.

Note:
Safety end stop as anti-twist protection.

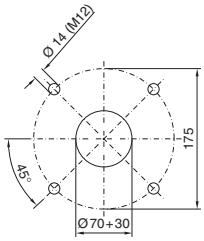
Colour RAL	Weight kg	Model No. CP
7030	11.9	**6170.000**

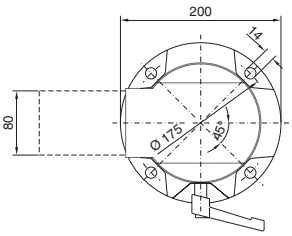
Accessories:

Pillar, see page 236.



Mounting cutout





Wall/base mounting CP-XL

For rigid attachment of the support arm system to vertical or horizontal surfaces.

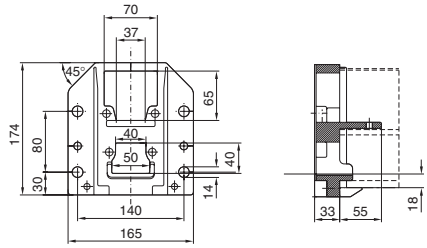
Material:
Spheroidal-graphite cast iron

Supply includes:
Seals and self-tapping screws for CP-XL support section attachment.

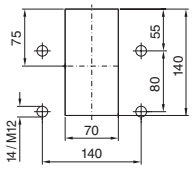
Colour RAL	Weight kg	Model No. CP
7030	4.1	**6160.000**

Accessories:

Pillar, see page 236.



Mounting cutout



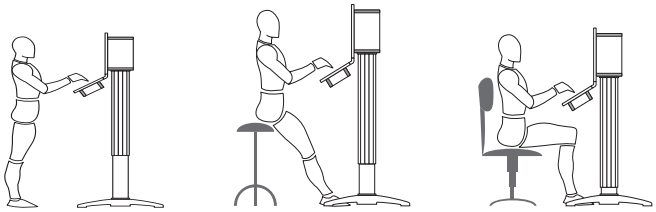
Stand systems

Features

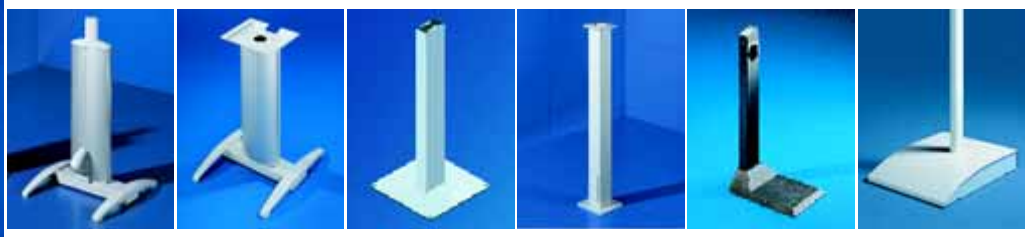
Bringing movement to Rittal stand systems, to meet all your ergonomic and technical requirements.

For every enclosure type, height variability, mobile use, and accommodation of cables.

Our extensive solution diversity meets every conceivable requirement.



Powerful pillars with numerous options – fixed …



Pedestal for Command Panel
with support section CP-L

Pedestal for IW worktops

Pillar, small
For compact assemblies

Pillar, large
The robust base point for heavy assemblies.

Pedestal for operating housing
Suitable for side mounting of operating housings.

Pedestal base plate, large

… and with variable height

Lifting pillar, electric
Height adjustment (from 670 to 1140 mm), spindle drive secured against unintentional dropping.

Support section, height-adjustable
Adjustment range from 732 to 1122 mm. Inner section for external mounting of operating housings.

Pedestal, modular, small
for the configuration of compact operating stations. Height of support section may be shortened by sawing to the required length.

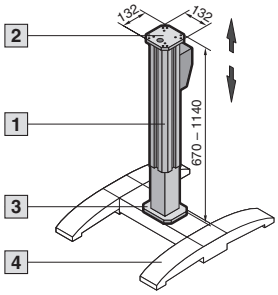
Pedestals in every variant – fixed or mobile

Pedestal base plate, large
Fitted with: Cutout for concealed mounting of cable conduit adaptors and PG segments.

Cross member with cast feet
Steel cross member with mounting holes for lifting pillar.

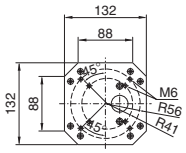
Pedestal, mobile
for changing locations.

Pedestal, height-adjustable

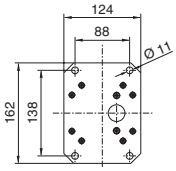


May be compiled from the following modules:	Model No. CP	Page
1 Lifting pillar, electric	**6142.000**	see below
Control unit for: – Manual operation – External mounting on surfaces/enclosures	**6142.010** **6142.020**	
4 Cross member with cast feet	**6142.100**	233

Mounting surface Head plate



Mounting surface Base plate



1 Lifting pillar, electric

Height adjustment 470 mm (from 670 to 1140 mm), spindle drive locked against unintentional dropping.
With electronic overload cutout to protect the drive.
Adjusting unit made from extruded aluminium section with groove on all sides for individual mounting using accessory attachment CP 6142.030.

2 Head plate

- For direct mounting of worktop attachment IW, enclosures with support arm connection
  – CP-L, Ø 130 mm
  – CP-XL
- For swivel mounting of enclosures, including those with keyboard support via wall/base mounting bracket, small CP-L CP 6520.510, in conjunction with support arm system CP-L, see page 200.

3 Base plate

For external mounting on the cross member or a sub-structure provided by the customer.

Weight kg	Packs of	Model No. CP
13.8	1	**6142.000**

Technical specifications:
Permissible load: max. 80 kg
Duty cycle: max. 6 min/h w. continuous operation
Ambient temperature: +5°C to +40°C
Mains connection: 230 V/50 Hz
Transformer: 24 V DC

Protection category:
IP 65 to EN 60 529
(for electrical components).

Supply includes:
Adjusting drive with transformer, head and base plate.

Also required:

Control unit, see page 229.

Accessories:

Cross member with cast feet CP 6142.100, see page 233.
Worktop attachment 6902.780, see page 1040.
Wall/base mounting bracket, small, CP-L, CP 6520.5X0, see page 215.

Control unit

for height adjustment of the lifting pillar. Design ready for connection with spiral cable and connector.

For manual operation:
With hooks for location e.g. on the enclosure handle set.

For external mounting:
With mounting brackets for screw fastening.

Version	Protection category	Model No. CP
Manual operation	IP 65	**6142.010**
Mounting on surfaces/enclosures	IP 30	**6142.020**

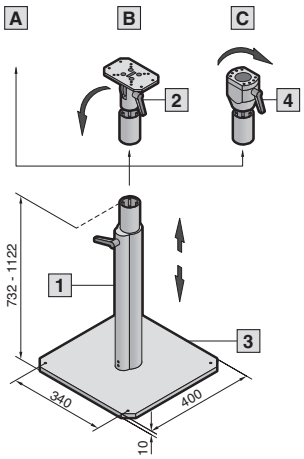
Accessory attachment

for lifting pillar
Simply slide into the groove of the lifting pillar and secure at any chosen height using the existing screws.
With M10 thread for mounting tools or your own components, such as utility trays.

Packs of	Model No. CP
1 set	**6142.030**

VIP 6000 Page 154 **Optipanel** Page 170 **Compact Panel** Page 183 **Support arm system CP-L** Page 200

Pedestal, modular, CP-S



For small panels and keyboard housings up to 20 kg

May be compiled from the following modules:	Model No. CP	Page
1 Support section, height-adjustable	**6146.200**	230
2 Tilt adjustment	**6146.300**	231
3 Pedestal base plate	**6146.100**	231
4 CP-S attachment	**6501.070**	194
or enclosure coupling CP-S	**6501.050**	195

External mounting of operating housings or other devices:

A Direct screw-fastening

B With tilt adjuster 2

C With attachment 6501.070 or housing coupling 6501.050 CP-S, see page 194/195.

Support arm section

height-adjustable

Adjustment range from 732 to 1122 mm.
Inner section for external mounting of operating housings.
External section with:

- Clamping screws at the rear for external mounting on pedestal base plate CP 6146.100
- Clamping lever for height fixing
- Surface for external cable routing.

Material:
Extruded aluminium section, natural anodised

Supply includes:
Inner and outer section including locking lever and assembly parts for external mounting on the base plate and enclosure.

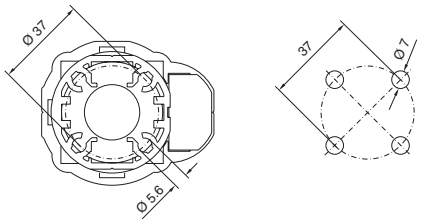
Weight kg	Packs of	Model No. CP
3.0	1	**6146.200**

Accessories:

Tilt adjustment CP 6146.300, see page 231.
Pedestal base plate CP 6146.100, see page 231.
Attachment CP-S CP 6501.070, see page 194.
Housing coupling CP-S CP 6501.050, see page 195.

Rittal service:

Other heights available on request.



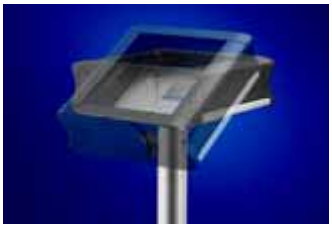
Gas pressurised spring

- For relief with height adjustment
- Optional installation
- Internal mounting
- Load capacity 15 kg
- Length 490/885 mm

Supply includes:
Assembly parts for installing in the support section, height-adjustable.

Packs of	Model No. CP
1	**6146.400**

Optipanel Page 170 **Compact Panel** Page 183



Tilt adjustment

For direct top-mounting on enclosures with mounting cutout:
- CP-S
- CP-L, ▭ 120 x 65 mm
- CP-L, Ø 130 mm

Cannot be combined with enclosure attachment or coupling.

Adjustment range:
± 30°

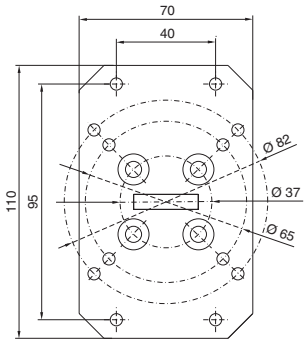
Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Locking lever and assembly parts for height-adjustable mounting on the support section.

Packs of	Model No. CP
1	**6146.300**

Rittal service:

As tilt adjustment for support arm system CP-S on request.



Pedestal base plate

With large surface for stability and welded tube connectors (Ø 48.3 mm) to accommodate the external profile of the support section, height-adjustable.

Material:
Sheet steel, powder-coated

Colour RAL	Packs of	Model No. CP
7024	1	**6146.100**

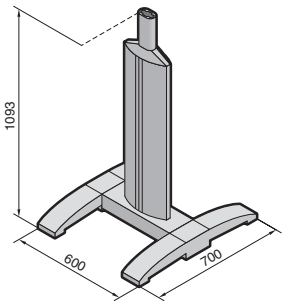
Accessories:

Twin castors CP 6148.000,
see page 848.
Base mount (from the outside using screws up to M10).

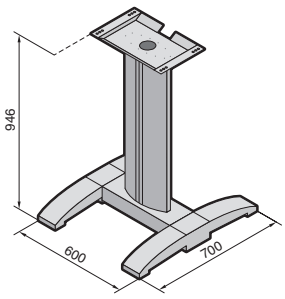
Optipanel Page 170 **Compact Panel** Page 183

Stand systems

Pedestals



1 + 2



3

Detailed drawing,
see page 1107.

1

2

3

Pedestal

One oval panel is permanently screw-fastened, whilst the other can be opened by "spreading" with a screwdriver for easy laying of cables.
In order to ensure opening of the front panels, we recommend that the adjustable frame connector or hinged frame connector be used with the Command Panel and VIP 6000 with keyboard housing (see page 907).

Material:
Feet: Cast aluminium
Cross member, vertical support tubes: Steel
Panels: Aluminium section

Supply includes:
for Command Panel:
2 cast aluminium feet,
1 cross member made of steel,
2 steel support tubes welded to cross member,
2 oval panels made from aluminium section,
1 top cover made from cast aluminium with support section CP-L,
partially pre-assembled.

for IW worktops:
2 cast aluminium feet,
1 cross member made of steel,
2 steel support tubes welded to cross member,
2 oval panels made from aluminium section,
1 worktop attachment of sheet steel.

	for Command Panel		for IW worktops	
Version	1 with drilled hole for cable entry in cross member	2 with cable conduit adaptor and drilled hole for cable entry in cross member	3 with drilled hole for cable entry in cross member	Page
W x H x D mm[1)]	600 x 1093 x 700	600 x 1093 x 700	600 x 946 x 700	
Model No.	**6141.000**	**6141.100**	**6141.200**	
Weight kg	34.9	35.1	33.7	
Colour RAL	7035/ natural anodised	7035/ natural anodised	7035/ natural anodised	
Accessories				
Twin castors	6148.000, 4611.000, 4634.500	6148.000, 4611.000, 4634.500	6148.000, 4611.000, 4634.500	848
Levelling feet	4612.000	4612.000	4612.000	848
Base mount	6147.000	6147.000	6147.000	233
Foot rest	6145.100	6145.100	6145.100	233
Trim panel	6144.100	6144.100	6144.100	233
Enclosure attachment CP-L, Ø 130 mm	6525.500	6525.500	–	206
Enclosure attachment CP-L, ▭ 120 x 65 mm	6525.600	6525.600	–	207
Housing coupling CP-L, Ø 130 mm	6525.000	6525.000	–	212
Housing coupling CP-L, ▭ 120 x 65 mm	6525.100	6525.100	–	212
Enclosure attachment CP-L, ▭ 120 x 65 mm, locatable	6525.2X0	6525.2X0	–	210
Enclosure attachment, tilting	–	–	6902.640	207
Worktop without handle (W x H x D 950 x 38 x 600 mm)	–	–	6902.310	249
Worktop with handle (W x H x D 950 x 38 x 658 mm)	–	–	6902.320	249

[1)] Other widths and heights and support tubes available on request.

VIP 6000 Page 154 **Optipanel** Page 170 **IW worktops** Page 247

Cross member

with cast feet
Steel cross member with mounting holes for lifting pillar or other individual assemblies, including 2 cast aluminium feet.

Colour RAL	Weight kg	Model No. CP
7035	5.8	**6142.100**

Accessories:

Foot rest CP 6145.100,
Trim panel CP 6144.100,
Base mount CP 6147.000,
see page 233.
Twin castors,
see page 848.

Detailed drawing,
see page 1108.

Base mount

Brackets for screw-fastening from below to the cast feet with posidrive raised countersunk screws M12.
Optionally with projection at the front, interior or sides, with Ø 11 mm hole for screw-fastening to the base.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Posidrive raised countersunk screws M12

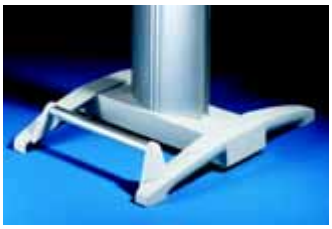
Packs of	Model No. CP
4	**6147.000**

Trim panel

Material:
Cast aluminium

Supply includes:
Assembly parts for screw-fastening between the cast feet at the front or rear.

Colour RAL	Model No. CP
7035 textured	**6144.100**



Foot rest

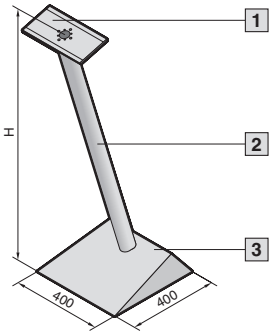
Material:
Connector pieces: Cast aluminium
Round tube section: Aluminium

Supply includes:
Assembly parts.

Colour RAL	Weight kg	Model No. CP
7035 textured/natural anodised	0.6	**6145.100**

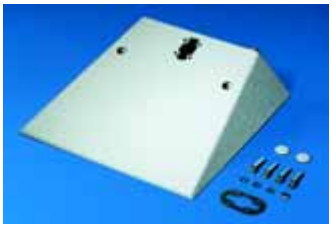
VIP 6000 Page 154 **Optipanel** Page 170 **IW worktops** Page 247

Pedestals



Pedestal
modular, CP-L

May be compiled from the following modules:	Model No. CP	Page
1 Enclosure reinforcement	**6143.210**	237
2 Support section, straight (may be shortened to required length by sawing)		
500 mm	**6511.000**	204
1000 mm (H + 65 mm)	**6513.000**	204
2000 mm	**6515.000**	204
3 Pedestal base plate, small	**6143.200**	234



Pedestal base plate
small

- With one hole at the rear for commercially available cable conduit gland M20.
- With two holes at the top (including sealing bung) for floor attachment.
- Prepared on the inside for a cable clamp for strain relief.

Material:
Sheet steel, 2.5 mm

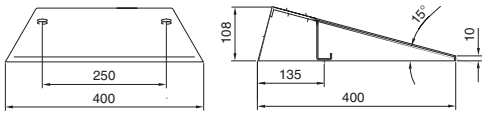
Supply includes:
Assembly parts.

Note:
Commercially available screws up to M8 may be used for floor attachment.

Weight kg	Colour RAL	Model No. CP
6.3	7035	**6143.200**

Accessories:

Cable clamp DK 7077.000 or DK 7078.000, see page 981.



Pedestal base plate
large

- Cutout for concealed mounting of cable conduit adaptor M50
- Cutout for PG segments (EL 2235.010 to EL 2235.080) or cable conduit adaptor up to Ø 70 mm
- Integral cable clamping bracket.

Material:
Sheet steel, powder-coated

Supply includes:
Integral reinforcement and mounting cutout for support section CP-L or CP-XL, including assembly parts for mounting the support section.

For support arm section	Colour RAL	Weight kg	Model No. CP
CP-L	7035	12.4	**6137.535**
CP-XL	7035	13.1	**6137.035**

Also required:

Support section
CP-L, see page 204,
CP-XL, see page 220.

Accessories:

CP enclosure or worktops according to choice.
Twin castors,
see page 848.
Levelling feet,
see page 848.
Wall mounting bracket KL 1580.000 or KL 1590.000 for base attachment,
see page 905.

Detailed drawing,
see page 1108.

Command panel housing with door Page 184 **Operating housing** Page 185 **Terminal boxes KL** Page 107

Pedestal

mobile

Consisting of:
2 sheet steel axles, each with
2 die-cast zinc roller bearings with plastic coating,
4 twin castors, 2 x with, 2 x without locks,
1 cross-brace, screw fastened, of sheet steel with integral cable clamping bracket,
1 support section of aluminium (for CP 6136.000 with clip-in lid).

Material:
Powder-coated in RAL 7035,
Roller bearings RAL 7030,
Partially pre-assembled.

Pedestal, mobile with support section	Model No. CP
CP-L (see page 204)	**6136.500**
CP-XL (see page 220)	**6136.000**

Accessories:

Enclosure attachment for	Model No. CP	Page
6136.500 CP-L	6525.5X0 6525.6X0	206/207
6136.000 CP-XL	6130.600 6130.500	222/223

Detailed drawing,
see page 1107.

Pedestal

for operating housing

For side mounting.

Consisting of:
- Pedestal plate, on castors
- Support section
- End cap with recessed handle.

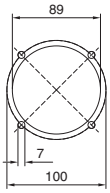
Supply includes:
Assembly parts.

Size:
W x H x D:
360 x 500 x 995 mm

Note:
Up to a maximum enclosure width of 380 mm.

Colour RAL	Weight kg	Model No. CP
9011	23.6	**6135.000**

Mounting cutout



Pillar

small

For heavy assemblies, connection plates at the top for support arm components CP-XL.
- With cutout for 24-pole connectors for cable entry at the bottom rear
- Height: 1,150 mm.

Material:
Steel

Design:
Base plate cross-section 500 x 500 mm,
12 mm thick, with 4 mounting holes.
Pedestal tube cross-section 160 x 80 mm,
wall thickness 3.2 mm) welded to base plate.

Colour RAL	Model No. CP
7035	**6214.500**

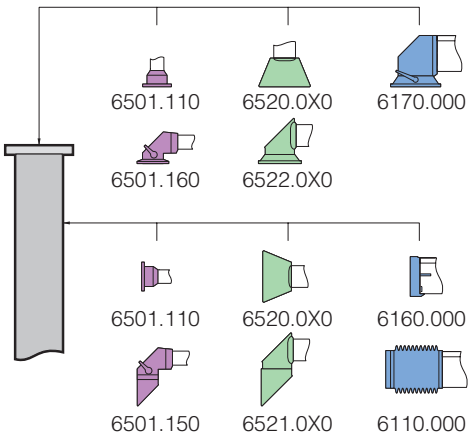
Accessories:

Enclosure coupling CP-XL,
see page 223.
Enclosure attachment CP-XL,
see page 222.

Detailed drawing,
see page 1107.

Command panel housing with door Page 184 **Operating housing** Page 185 **VIP 6000** Page 154 **Optipanel** Page 170

Pillars



Detailed drawing,
see page 1108.

Pillar

The stable base point for the support arm system. The attachment of additional enclosures, e.g. for security systems, is also possible.
There is a choice of 2 cross-sections:
- 140 x 140 mm
- 200 x 200 mm

Design:
Base plate 15 mm thick, with four mounting holes, cutout in the base plate according to the cross-section for cable entry from below. Pedestal tube (wall thickness 5 mm) welded to the base plate, with connection facilities for support arm systems as per the selection table.

Delivery time:
Extended delivery times

Material:
Steel, spray-finished

Colour:
RAL 7035

Supply includes:
Assembly parts for support arm system according to selection.

Note:
Customer-specific designs, such as:
- Other RAL colours
- Drilling patterns
- Heights
- Consoles for additional enclosures

available on request.

Accessories:

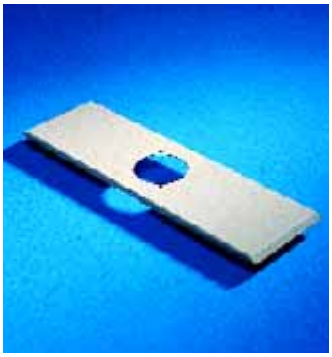
Support arm system
CP-S, see page 191,
CP-L, see page 200,
CP-XL, see page 218,
Metal gland plates,
see page 969.

Supply includes					**Model No. CP**				Page
Cross-section 140 x 140 mm, height 2000 mm					**6214.**	**X**	**X**	**0**	
Cross-section 200 x 200 mm, height 2000 mm					**6220.**	**X**	**X**	**0**	
Cutout for cable entry									
Without cutout in pillar						**0**			
Cutout on the front						**1**			
Cutout at rear						**2**			
Cutout on the left						**3**			
Cutout on the right						**4**			
Support arm connection									
	For								
	Wall/base mounting		Wall mounted hinge	Top mounted joint					
	Front	Top	Front	Top					
without							**0**		–
CP-S	6501.110						**6**		198
CP-S		6501.110					**7**		198
CP-S			6501.150				**8**		199
CP-S				6501.160			**9**		198
CP-L	6520.0X0						**2**		216
CP-L			6521.0X0				**3**		217
CP-L				6522.0X0			**4**		216
CP-XL	6160.000		6110.000				**1**		227/226
CP-XL				6170.000			**5**		227

Support arm system CP-S Page 191 **Support arm system CP-L** Page 200 **Support arm system CP-XL** Page 218

CP 6143.310

CP 6143.210



CP 6503.000

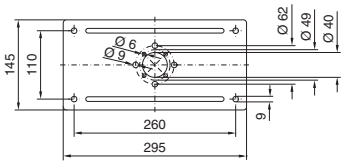
Enclosure reinforcement

For external or internal reinforcement of enclosures of a corresponding size.
Smaller enclosures may also be mounted directly without enclosure reinforcement.

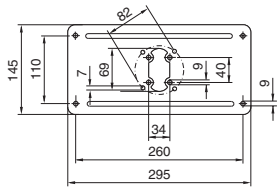
Supply includes:
Assembly parts for the enclosure and support section plus 2 seals.

For enclosure	Support arm connection	Material	Weight kg	**Model No. CP**
B1 ≥ 300 mm, T1 ≥ 150 mm	CP-S	Stainless steel 1.4301	0.9	**6143.310**
B1 ≥ 300 mm, T1 ≥ 150 mm	CP-L	Sheet steel	0.9	**6143.210**
CP 6662.000 or AE (B1 = 600 mm, T1 ≥ 210 mm)	CP-XL	Sheet steel	2.2	**6503.000**

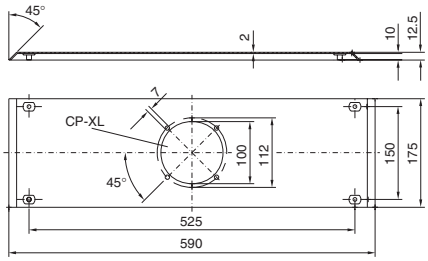
CP 6143.310



CP 6143.210



CP 6503.000



Support arm system CP-S Page 191 **Support arm system CP-L** Page 200 **Support arm system CP-XL** Page 218

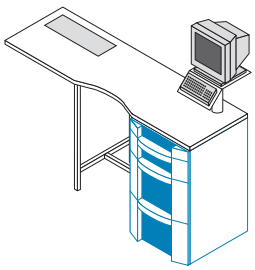
Industrial workstations

Features

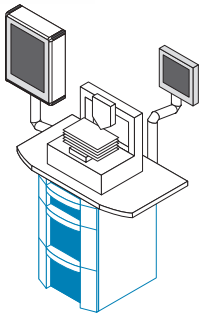
For Rittal, industrial workstations means the ability to create professional workstations for virtually any application from a comprehensive modular system.

In conjunction with operating housings, support arm systems, PC enclosures and the diverse range of system accessories, there are virtually no limits to your creativity.

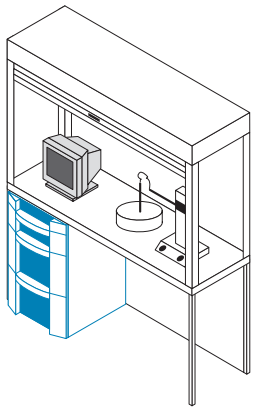
Here are few examples:



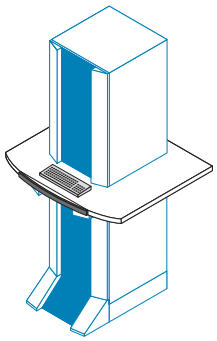
Workbench/assembly bench
consisting of:
- IW enclosure
- IW pedestal
- Individual worktop



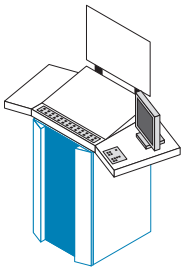
Laboratory equipment and **small machinery** consisting of:
- IW enclosure
- Worktop
- Support arm system
- Operating housings



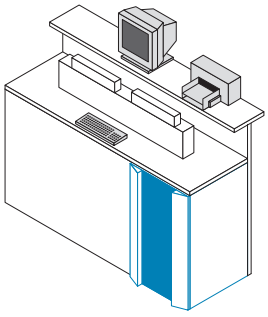
Protective cabinets:
with lockable roller blind on request.



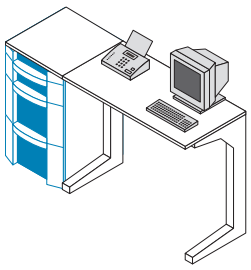
Measurement/control systems:
"More space" with the enclosure on top of the worktop.



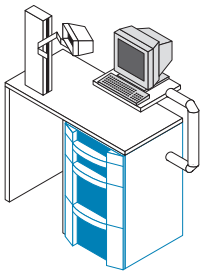
Control desks e.g. for printing presses consisting of:
- IW enclosure
- Individual worktop and assemblies



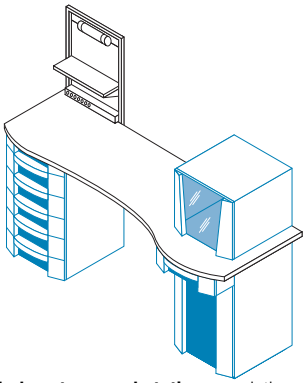
Workbench consisting of:
- IW enclosure for tools etc.
- Individual worktop with shelf for monitor, printer etc.



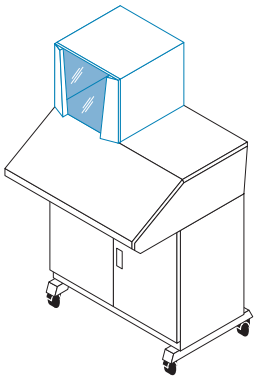
Calibration/measuring station
consisting of:
- IW enclosure
- IW pedestal
- Worktop



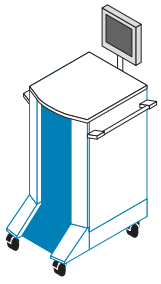
Programming station:
Ergonomically adaptable via the support arm system.



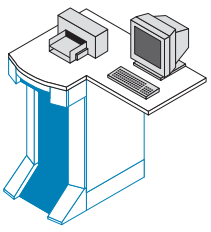
Laboratory workstation consisting of:
- IW enclosures
- Worktop
- Monitor housing
- Shelf system
- Socket strip, light



Process visualisation:
e.g. on production line via swivel-mounted IW monitor housing on AP console system.



Mobile workstation/workshop trolley consisting of:
- Base/plinth with castors
- IW enclosure
- Worktop
- Handle system
- Operating housing



Scanner/PC station consisting of:
- IW enclosure
- Individual worktop

Features

IW Quality Point

The integration of a TFT monitor creates space on the work surface.

The rotatable printer shelf and the paper tray are a perfect duo for the secure accommodation of printers in an industrial environment.

Optimum glare-free illumination of the workplace with the integral workstation light.

IW enclosure

In two standard heights, optionally with designer door or glazed door. Offers plenty of storage space.

With drawer front for an orderly filing system.
A pull-out lock which prevents the simultaneous opening of several drawers is integrated to increase operational safety.

If no enclosure is needed to accommodate documents or equipment, the IW pedestal may be used instead. By combining with a worktop, a large work surface is created.

IW monitor housing

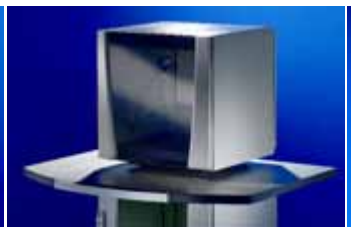
In two sizes for monitors up to 17″ and 21″ screen diagonal respectively. In conjunction with a turntable, the monitor can be viewed from all angles.

TFT monitors are increasingly being used in industrial environments. Thanks to the large number of standardised system components, TFTs may be easily integrated into the workstation.

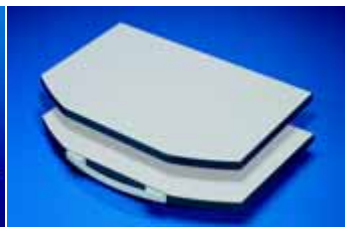
Mounting of a TFT monitor without reducing the work space. With the aid of the enclosure attachment, the angle of the display is ideally adapted to suit the user.

IW worktops

14 different worktops in 7 different sizes accommodate virtually all requirements.



Monitor housings may be mounted either rigidly or swivel-mounted on worktops prepared for a turntable.



Worktops with or without a handle – both variants are available off the shelf.

Fast selection

Choose the appropriate IW components according to your requirements.

► Continue with system assembly using the item numbers shown beneath the arrow.

⊢ System assembly can be completed here.

1 Pre-configured complete solutions

1.1 Quality Point L
Width 1000 mm
Height 2000 mm
IW 6920.100
Quality Point XL
Width 2000 mm
Height 2000 mm
IW 6920.200
see page 243
► **11.1**

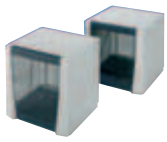
1.2 Enclosure with worktop
Height 1000 mm
IW 6901.100[1)]
see page 246
► **11.1 11.2 11.6**
⊢

1.3 Enclosure with roof
Height 1000 mm
IW 6901.200[1)]
see page 246

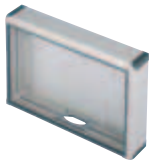
[1)] The assembled versions IW 6901.100 (with worktop) and IW 6901.200 (with roof) are also available with other worktops on request.

2 Monitor housing and add-ons

2.1 Monitor housing 17″
IW 6902.510
Monitor housing 21″
IW 6902.500
see page 250
► **3.1 3.2**



2.2 Optipanel
For TFT monitors or other display and input units
see page 172
For 15″ TFT
CP 6380.010
For 17″ TFT
CP 6380.030
see page 178
TFT monitor 15″
SM 6450.010
TFT monitor 17″
SM 6450.020
see page 1046
► **3.4 3.5 3.6**



2.3 Quality Point attachment L
Width 1000 mm
Height 960 mm
IW 6920.110
Quality Point attachment XL
Width 2000 mm
Height 960 mm
IW 6920.210
see page 250
► **4.3 4.4 5 6 4.5 4.6**

Assembly example:

- 2.2 Optipanel
- 3.4 Support arm system CP-L
- 6.1 Worktop, prepared for enclosure attachment
- 9.1 Enclosure with drawer section
- 11.1 Base/plinth, stationary
- 11.6 Twin castors

3 Mounting components

f. monitor a. operating housings

3.1 Feet for monitor housing

IW 6902.610

see page 251

3.2 Spacer plate for monitor housing

IW 6902.630

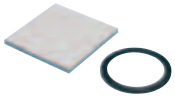
rotatable in conjunction with:

Turntable

for spacer and support plate

IW 6902.620

see page 252/253



3.3 Support plate for individual equipment

IW 6902.650

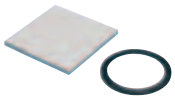
rotatable in conjunction with:

Turntable

for spacer and support plate

IW 6902.620

see page 252/253



3.4 Support arm system CP-L

for rotatable, swivel and height-adjustable positioning of the Optipanel command panel

see page 200

3.5 Enclosure attachment tilting, top mounting[1)]

IW 6902.670

see page 193

3.6 Enclosure attachment tilting, bottom mounting

IW 6902.640

see page 207

[1)] May also be used rotated through 180°.

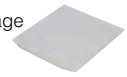
4 Worktops

Solid

4.1 Cover solid
Width 600 mm
Depth 640 mm

IW 6902.400

see page 247

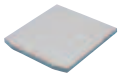


8.1 8.2 8.3 8.4 9.3

4.2 Without handle
Width 610 mm
Depth 645 mm

IW 6902.300

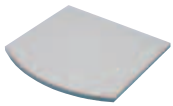
see page 248



4.3 Without handle
Width 1000 mm
Depth 895 mm

IW 6902.100

see page 248

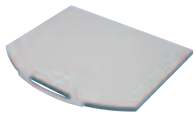


8.1 8.2 8.3 8.4 9 10.1

4.4 With handle
Width 1200 mm
Depth 950 mm

IW 6902.000

see page 248

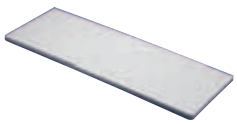


8.1 8.2 8.3 8.4 9.3 10.1

4.5 Without handle
Width 2000 mm
Depth 685 mm

IW 6902.200

see page 248



8.1 8.2 8.3 8.4 10.1

4.6 Without handle
Width 2000 mm
Depth 685/900 mm

IW 6902.210

Width 2000 mm
Depth 900/685 mm

IW 6902.220

see page 248

8.1 8.2 8.3 8.4 9 10.1

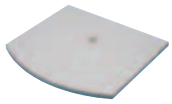
5 Worktops

for turntable
see 3.2/3.3

5.1 Without handle
Width 1000 mm
Depth 895 mm

IW 6902.110

see page 248

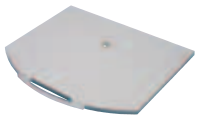


8.1 8.2 8.3 8.4 9 10.1

5.2 With handle
Width 1200 mm
Depth 950 mm

IW 6902.010

see page 248



8.1 8.2 8.3 8.4 9.3 10.1

6 Worktops

prepared for enclosure attachment CP-L, Ø 130 mm
see 3.4/3.5

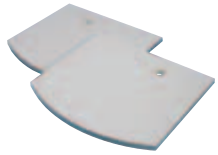
6.1 Without handle, prepared on l/h side
Width 1000 mm
Depth 895 mm

IW 6902.120[1)]

Without handle, prepared on r/h side
Width 1000 mm
Depth 895 mm

IW 6902.130[1)]

see page 249



8.1 8.2 8.3 8.4 9 10.1

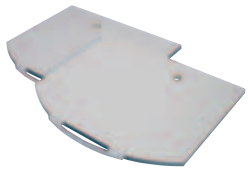
6.2 With handle, prepared on l/h side
Width 1200 mm
Depth 950 mm

IW 6902.020[1)]

With handle, prepared on r/h side
Width 1200 mm
Depth 950 mm

IW 6902.030[1)]

see page 249



8.1 8.2 8.3 8.4 9.3 10.1

[1)] Hole may be used in conjunction with the adaptor plate for connector entry IW 6902.660 (see page 975) for cable entry.

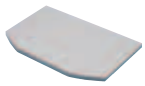
7 Worktops

for pedestal/enclosure
for tower PC
See 3.6

7.1 Without handle
Width 950 mm
Depth 600 mm

IW 6902.310

see page 249

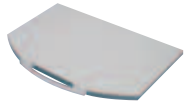


8.5 10.2

7.2 With handle
Width 950 mm
Depth 658 mm

IW 6902.320

see page 249



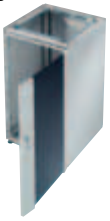
Industrial workstations

Fast selection

8 Enclosure
with doors

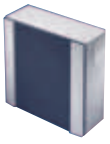
8.1 Designer door, rear panel screw-fastened from the inside
Height 900 mm
IW 6900.000
see page 245

11.1 11.2 11.6

8.2 Designer door, rear panel screw-fastened from the outside
Height 1000 mm
IW 6901.000
see page 245


8.3 Designer door, rear door
Height 900 mm
IW 6900.100
see page 245

8.4 Glazed door, rear door
Height 900 mm
IW 6900.200
see page 245

8.5 Enclosure for tower PC
Width 760 mm
Height 760 mm
IW 6900.300
see page 244

10.3

9 Enclosure
with drawers

9.1 Drawer section, designer door, rear door
Height 900 mm
IW 6900.400
see page 246

11.1 11.2 11.6

9.2 Drawer section for keyboard and mouse, designer door, rear door
Height 900 mm
IW 6900.410
see page 246

9.3 Drawer front, rear panel, screw fastened from the inside
Height 900 mm
IW 6900.600
see page 246

Note:
Component shelf, see page 942,
Drawer tray, see page 942.

10 Pedestals

10.1 Worktop base
Height 702 mm
IW 6900.500
Height 902 mm
IW 6900.510
Prepared for attachment of the:
Cable duct
IW 6903.700
see page 251

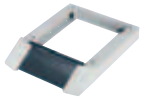
11.6

10.2 Pedestal
IW 6141.200
see page 232

10.3 Cast feet for tower PC
IW 6902.920
see page 845

11.6

11 Base/plinth components

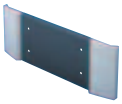
11.1 Base/plinth, stationary
PC 8800.920
see page 840

11.4

11.2 Base/plinth components, front and rear for TS, sealed
Height 100 mm
TS 8601.600 (RAL 7022)
Height 200 mm
TS 8602.600 (RAL 7022)
see page 835

11.3 11.4 11.6 11.5

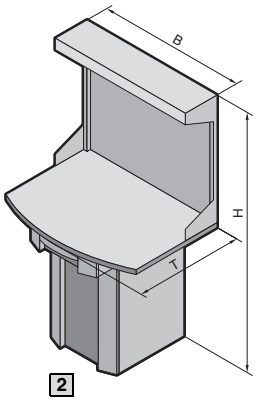
11.3 Base/plinth trim panels, side, for TS
Height 100 mm
TS 8601.060 (RAL 7022)
Height 200 mm
TS 8602.060 (RAL 7022)
see page 835

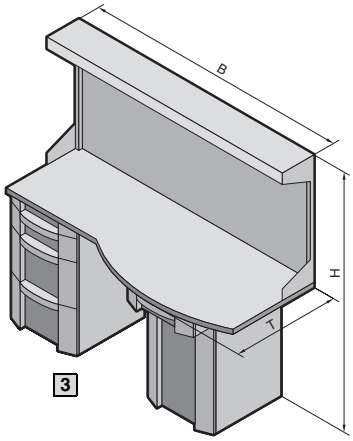
11.4 Base/plinth trim panels, with brush strip
Height 100 mm
TS 8601.610 (RAL 7022)
see page 839

11.5 Base/plinth trim panel PC
Height 200 mm
PC 8360.920
see page 839


11.6 Twin castors
PC 4634.500
see page 848

Quality Point L and XL





The complete system for use as a testing station in industrial environments (e.g. directly at the machine) where testing needs to be carried out and data processed electronically. An individual PC system is integrated to perfection.

Benefits:
- Plenty of space to accommodate test equipment
- Easy integration of PCs, monitors, printers etc.
- Integral lighting
- Theft protection

Colour:
RAL 7015/7035/9006

Supply includes Quality Point L:
Enclosure with keyboard drawer section IW 6900.410, see page 246, worktop W/H/D: 1000 x 38 x 895 mm, Quality Point attachment with side system punchings on a 25 mm pitch pattern for the attachment of system accessories (e.g. punched sections), workstation light IW, 2 x 36 W, 230 V, 50 Hz.

Supply includes Quality Point XL:
Enclosure with drawer front (left), IW 6900.600, see page 246, enclosure with keyboard drawer section (right) IW 6900.410, see page 246, worktop W/H/D: 2000 x 38 x 895 mm, Quality Point attachment with side system punchings on a 25 mm pitch pattern for the attachment of system accessories (e.g. punched sections), workstation light IW (quantity: 2), 2 x 36 W, 230 V, 50 Hz.

1 Assembly example
2 Quality Point L
3 Quality Point XL

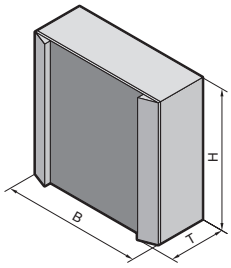
Material:
Enclosure, see page 246, Quality Point attachment, see page 250, Worktop, see page 248.

Detailed drawing,
see page 1110.

	Quality Point L	Quality Point XL	Page
Width (B) in mm	1000	2000	
Height (H) in mm	2000	2000	
Depth (T) in mm	895	895	
Model No. IW	**6920.100**	**6920.200**	
Weight (kg)	139	276	
Accessories			
Vertical section	–	6903.010	253
Bracket, locatable for shelves	6902.690	6902.690	951
Paper tray	6903.000	6903.000	1058
Cable duct	–	6903.700	251
Mounting plate	8614.675	8614.675	913
Component shelf, fixed installation	8800.900	8800.900	942
Component shelf, pull-out	6902.960	6902.960	942
Drawer tray	6902.700	6902.700	942
Lock systems			
Standard double-bit lock insert may be exchanged for lock inserts, lock cylinder inserts type B or comfort handle, see from page 881, With the designer door at the front, only in conjunction with handle adaptor PC 8611.300, see page 869.			

Accessories Page 832 **Optipanel** Page 170 **TFT monitor** Page 1046

Enclosure for tower PC



Compact enclosure, ready to connect. Standard commercially available tower PCs, up to W/H/D: 250 x 530 x 600 mm (max. 20 kg) may be attached securely to the base screw fastened to the door using the retaining strap supplied loose. The rear interfaces of the PC are readily accessible with the door open. Because the socket strip and fan-and-filter unit are already pre-installed, the enclosure is ready for immediate use.

Roof prepared for mounting
- of worktop IW 6902.310/IW 6902.320
- beneath surfaces

Base prepared for mounting
- of cast feet IW 6902.920
- on surfaces

Material:
Enclosure:
Sheet steel, powder-coated in textured RAL 7035
Door:
Sheet steel, spray-finished in RAL 7015 with fitted design strips of aluminium in RAL 7035.

Protection category:
IP 54 to EN 60 529 (in conjunction with connector gland SZ 2400.300/.500 supplied loose)

Supply includes:
Enclosure of all-round solid construction,
door hinged on r/h side, with base screw-fastened to the inside of the tubular door frame to accommodate a tower PC, lock with fitted cam lock at the side.

Rear panel with two cutouts for use of the connector gland SZ 2400.300 and .500 supplied loose,
connector for power supply,
retaining strap for securing the tower PC to the base,
side panel, left, with fitted outlet filter SK 3322.200,

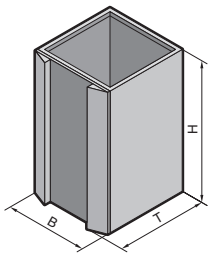
Side panel, right, fitted with:
- Fan-and-filter unit SK 3322.107, technical description see page 636, with door operated switch PS 4315.500
- Supply socket for 230 V power supply
- Socket strip with 3 sockets and overvoltage protection.

1 Assembly example

	Enclosure for tower PC	Page
Width (B) in mm	760	
Height (H) in mm	760	
Depth (T) in mm	300	
Model No. IW	**6900.300**	
Weight (kg)	55	
Accessories		
Cast feet	6902.920	845
Twin castors	4634.500	848
Worktop without handle	6902.310	249
Worktop with handle	6902.320	249
Enclosure attachment, tilting, base mounting	6902.640	207
Optipanel for TFT monitor 17″	6380.030	178
TFT monitor 17″ with safety glass screen	6450.020	1046
Desktop keyboard IP 65	6446.000	1047
IP 67 mouse	6445.000	1054
Mousepad IP 67 – PS/2 interface	6444.500	1054
Lock systems		
Standard double-bit lock insert may be exchanged for 27 mm lock inserts, type A, Lock cylinder, plastic handles and T handles, type B, see page 886 – 889.		

Accessories Page 832 **Optipanel** Page 170 **TFT monitor** Page 1046

Enclosure with doors



Material:
Enclosure, designer door, rear panel,
Rear door: Sheet steel, RAL 7035
Glazed door: Plastic to UL 94-V0, RAL 7035, safety glass 4.0 mm

Note:
- Other enclosure depths or heights variable on a 25 mm pitch pattern,
- All IW components as well as system accessories available fully assembled ex works

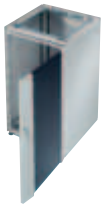
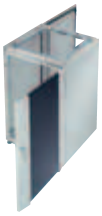
are available upon request.

1 Assembly example

For detailed supply scope,
see page 1109.

Detailed drawing,
see page 1110.

Property rights:
German patent
No. 100 13 034
German registered design
No. 400 02 953
US patent no. 6,538,876
US design patent no. D 487,730
UK reg. design no. 2 094 499
Japan. Reg. Design
no. 113 95 92
IR Reg. Design no. DM/053 554
with validity for FR, IT

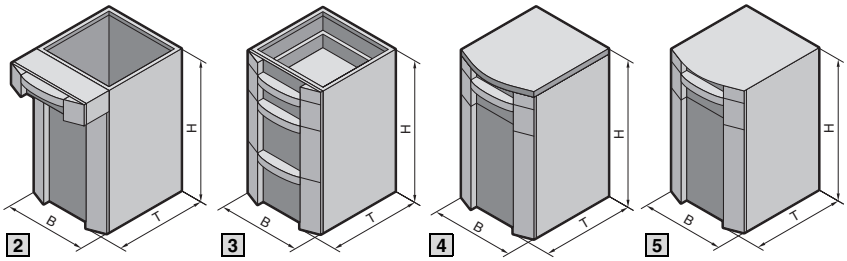
					
Version	Designer door, rear panel screw-fastened from the inside	Designer door, rear panel screw-fastened from the outside	Designer door, rear door	Glazed door, rear door	Page
Width (B) in mm	600	600	600	600	
Height (H) in mm	900	1000	900	900	
Depth (T) in mm	600	600	600	600	
Model No. IW	**6900.000**	**6901.000**	**6900.100**	**6900.200**	
Weight (kg)	54.9	59.8	59.9	60.6	
Accessories					
Base/plinth, stationary	8800.920	8800.920	8800.920	8800.920	840
Cross member, adjustable	8601.680	8601.680	8601.680	8601.680	845
Twin castors	4634.500	4634.500	4634.500	4634.500	848
Mounting plate for enclosure width 600 mm	8614.675	8614.675	8614.675	8614.675	913
Component shelf, fixed installation	8800.900	8800.900	8800.900	8800.900	942
Component shelf, pull-out	6902.960	6902.960	6902.960	6902.960	942
Drawer tray	6902.700	6902.700	6902.700	6902.700	942
Drawer extension lock	6902.730	6902.740	6902.730	6902.730	952
Mobile workstation	4641.000	4641.000	4641.000	4641.000	1057
Adaptor section 482.6 mm (19″)	8613.070	8613.070	8613.070	8613.070	1003
Lock systems					

Standard double-bit lock insert may be exchanged for lock inserts, lock cylinder inserts type B, or comfort handle,
see from page 881, with the designer door and glazed door only in conjunction with handle adaptor PC 8611.300, see page 869.

Accessories Page 832 **Optipanel** Page 170 **TFT monitor** Page 1046

Industrial workstations

Enclosure with drawers, worktop or roof



Material:
Enclosure, roof, drawer tray, designer door and rear door:
Sheet steel, RAL 7035
Worktop:
Chipboard, plastic-laminated on both sides, similar to RAL 7035, with tough plastic edging, similar to RAL 7015
Drawer trim panel:
Plastic, RAL 7035/7015/9006.

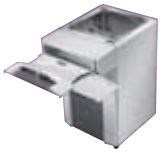
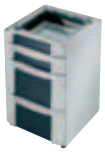
Note:
- Other enclosure depths or heights, variable on a 25 mm pitch pattern,
- All IW components as well as system accessories available fully assembled ex works,
- Other drawer combinations,
- The fitted versions IW 6901.100 (with worktop) and IW 6901.200 (with roof) also available with other worktops, see page 248,

are available upon request.

1 Assembly example

For detailed supply scope, see page 1109.

Detailed drawing, see page 1110.

	2	 2	 3	4	5	
Version	Drawer section for documents, designer door, rear door	Drawer section for keyboard and mouse, designer door, rear door	Drawer front, rear panel	Enclosure with worktop	Enclosure with roof	Page
Width (B) in mm	600	600	600	600	600	
Height (H) in mm	900	900	900	1000	1000	
Depth (T) in mm	600 (890)	600 (890)	600	645	645	
Model No. IW	**6900.400**	**6900.410**	**6900.600**	**6901.100**	**6901.200**	
Weight (kg)	73	73	78	91	86	
Accessories						
Base/plinth, stationary	8800.920	8800.920	8800.920	8800.920	8800.920	840
Cross member, adjustable	8601.680	8601.680	8601.680	–	–	845
Twin castors	4634.500	4634.500	4634.500	4634.500	4634.500	848
Paper tray	6903.000	6903.000	–	6903.000	6903.000	1058
Cable gland	6902.770	6902.770	–	6902.770	6902.770	976
Mounting plate	8614.675	8614.675	–	8614.675	8614.675	913
Component shelf, fixed installation	8800.900	8800.900	–	8800.900	8800.900	942
Component shelf, pull-out	6902.960	6902.960	–	6902.960	6902.960	942
Drawer tray	6902.700	6902.700	–	6902.700	6902.700	942
Drawer extension lock	6902.730	6902.730	■[1)]	–	–	952
Mobile workstation	4641.000	4641.000	–	–	–	1057
Adaptor section 482.6 mm (19″)	8613.070	8613.070	–	–	–	1003
Lock systems						
Standard double-bit lock insert may be exchanged for lock inserts, type B cylinder inserts, or comfort handle, see from page 881, with the designer door only in conjunction with handle adaptor PC 8611.300, see page 869.						

[1)] Included with the supply.

Accessories Page 832 **Optipanel** Page 170 **TFT monitor** Page 1046

Roof, worktops

Note:
- Keyboard and front panels for keys integrated into the worktop,
- Worktops in modified sizes,
- All IW components as well as system accessories available fully assembled ex works,

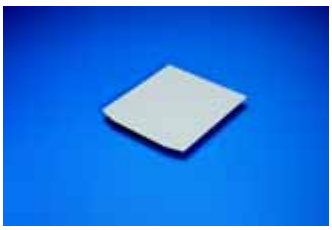
are available upon request.

Detailed drawing,
see page 1111.

Combination options for enclosures/worktops

Width in mm		600	600	600	600	600	600	600
Height in mm		900	900	900	900	900	900	1000
Depth in mm		600	600	600	600 (890)	600 (890)	600	600
Enclosure Model No. IW		6900.000	6900.100	6900.200	6900.400	6900.410	6900.600	6901.000
Worktop	Page							
6902.000	248	■	■	■	–	–	■	■
6902.010	248	■	■	■	–	–	■	■
6902.020 6902.030	249	■	■	■	–	–	■	■
6902.100	248	■	■	■	–	–	■	■
6902.110	248	■	■	■	■	■	■	■
6902.120 6902.130	249	■	■	■	■	■	■	■
6902.200	248	■	■	■	–	–	■	■
6902.210	248	■	■	■	■	■	■	■
6902.220	248	■	■	■	■	■	■	■
6902.300	248	■	■	■	–	–	■	■
Roof								
6902.400	247	■	■	■	–	–	■	■

To order worktops in the ESD version, please add the extension .XX8 to the Model No. Delivery times available on request.



Cover

Folded all-round, with brackets for screw-fastening to the enclosure from the inside.

Material:
1.5 mm sheet steel

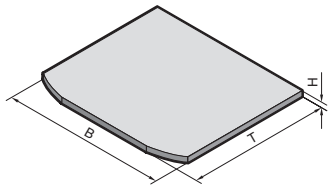
Surface finish:
Spray-finished in textured RAL 7035

Width (B) in mm	600
Height (H) in mm	13
Depth (T) in mm	640
Weight (kg)	7.4
Model No. IW	**6902.400**

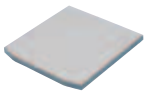
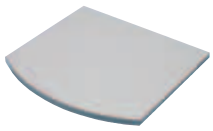
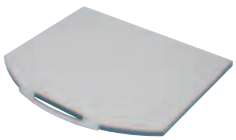
Accessories Page 832 **Optipanel** Page 170 **TFT monitor** Page 1046

Worktops

Material and surface finish:
Chipboard, plastic-laminated on both sides, similar to RAL 7035, with tough plastic edging, similar to RAL 7015
Handle made from aluminium, powder-coated in RAL 9006.



Solid

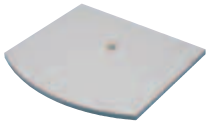
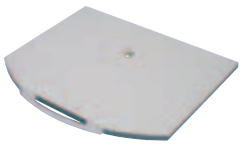




Version	Without handle for enclosure	Without handle for enclosure/worktop base	With handle for enclosure
Width (B) in mm	610	1000	1200
Height (H) in mm	38	38	38
Depth (T) in mm	645	895	950
Model No. IW	**6902.300**	**6902.100**	**6902.000**
Weight (kg)	11.6	24	34

Solid

Version	Without handle for enclosure/worktop base	Without handle for enclosure/worktop base	Without handle for enclosure/worktop base
Width (B) in mm	2000	2000	2000
Height (H) in mm	38	38	38
Depth (T) in mm	685	685/900	900/685
Model No. IW	**6902.200**	**6902.210**	**6902.220**
Weight (kg)	37	45	45

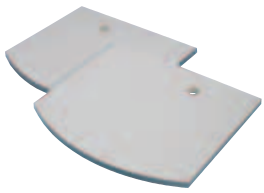
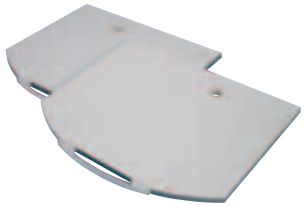
Prepared for turntable

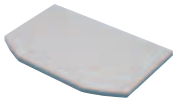
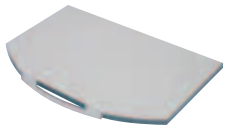
Version	Without handle	With handle	Page
Width (B) in mm	1000	1200	
Height (H) in mm	38	38	
Depth (T) in mm	895	950	
Model No. IW	**6902.110**	**6902.010**	
Weight (kg)	23	33	
Accessories			
Turntable	6902.620	6902.620	253
Spacer plate for monitor housing	6902.630	6902.630	252
Support plate for screen	6902.650	6902.650	252

Accessories Page 832 **Optipanel** Page 170 **TFT monitor** Page 1046

Roof, worktops

Prepared for enclosure attachment CP-L, Ø 130 mm[1]				
Version	Without handle prepared on l/h side	Without handle, prepared on r/h side	With handle prepared on l/h side	With handle prepared on r/h side
Width (B) in mm	1000	1000	1200	1200
Height (H) in mm	38	38	38	38
Depth (T) in mm	895	895	950	950
Model No. IW	**6902.120**	**6902.130**	**6902.020**	**6902.030**
Weight (kg)	23	23	33	33

[1] Hole may be used in conjunction with the adaptor plate for connector grommet IW 6902.660 (see page 975) for cable entry.

Prepared for mounting on **– Pedestal IW** **– Enclosure for tower PC** **– Worktop attachment**		
Version	Without handle for pedestsal	With handle for pedestsal
Width (B) in mm	950	950
Height (H) in mm	38	38
Depth (T) in mm	600	658
Model No. IW	**6902.310**	**6902.320**
Weight (kg)	16	18

Cable glands.
Model No. see page 976.

For tiltable attachment of operating housings.
Model No. see page 207.

Accessories Page 832 **Optipanel** Page 170 **TFT monitor** Page 1046

Attachments and monitor housings

Quality Point attachment

Existing IW solutions may be upgraded to a complete testing station. Side punched profile on a 25 mm pitch pattern for the attachment of system accessories (e.g. TS punched section with mounting flange 17 x 73 mm for inner mounting level, see page 921). Projection with integral glare shield prepared for mounting of workstation light 6903.080 (1 x for IW 6920.110/ 2 x for IW 6920.210).

Material:
Sheet steel, spray-finished

Colour:
RAL 7035

Supply includes:
Assembly parts for mounting on worktops (see page 248).

Note:
The Quality Point attachment may be mounted directly on the wall if necessary.
Shelf to finish off at the bottom available on request.

	Quality Point attachment L	Quality Point attachment XL	Page
Width (B) in mm	1000	2000	
Height (H) in mm	960	960	
Model No. IW	**6920.110**	**6920.210**	
Accessories			
Workstation light	6903.080	6903.080	255
Vertical section	–	6903.010	253
Display board with wall bracket	6013.100	6013.100	1030
Utility shelf 220 mm wide	6514.110	6514.110	1039
Utility shelf 450 mm wide	6514.100	6514.100	1039
Mounting plates, locatable	8612.400	8612.400	929
Hexagon socket screws BZ 5.5 x 13 mm	2486.500	2486.500	937
Bracket, locatable, for shelves	6902.690	6902.690	951

Monitor housing

For protected accomodation of monitors up to 17″ or 21″ screen diagonal.

Material:
Enclosure, rear door and component shelf: 1.5 mm sheet steel
Designer door: Vertical plastic decorative trim panels to UL 94-V0
Glass pane: Safety glass 4.0 mm

Surface finish:
Enclosure and rear door: Textured RAL 7035.
Designer door: Decorative trim panels RAL 7035, screen printed mask on pane RAL 7015
Component shelf: RAL 7015

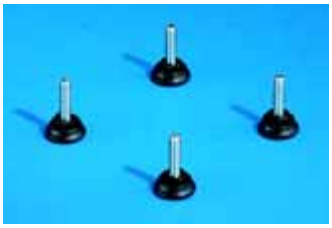
Supply includes:
Front designer door with internal lock, unlatched behind the rear door via a lever with Bowden cable.
Rear door with standard double-bit lock insert, may be exchanged for 27 mm lock inserts, type A or lock cylinder inserts, type B, see page 888/889, and Ergoform S lock system, see page 885.
Enclosure with cutout and reinforcement at the bottom for mounting
– on worktops, prepared for turntable, see page 248,
– on spacer plate for monitor housing, see page 252.
Base prepared for the mounting of feet for desktop use IW 6902.610.
Fitted component shelf, slotted, height-adjustable on a 25 mm pitch pattern, prepared for mounting fan extension kit DK 7980.000, see page 649, and a socket strip, 482.6 mm (19″) long, see page 746.

	Monitor housing for screen 17″	Monitor housing for screen 21″
Width (B) in mm	600	600
Height (H) in mm	600	600
Depth (T) in mm	500	600
Model No. IW	**6902.510**	**6902.500**
Weight (kg)	38.5	42.5

Accessories:

Feet for desktop use, see page 251.
Spacer plate for monitor housing, see page 252.
Turntable for spacer plate, see page 253.

Detailed drawing,
see page 1110.



Feet

for monitor housing
Thread length 29 mm.

Max. static load per foot:
300 kg

Thread	Packs of	Model No. IW
M8	4	**6902.610**

Worktop base

For mounting instead of an IW enclosure when using a wide worktop. Prepared for attachment of cable duct IW 6903.700.

Material:
Steel, spray-finished

Colour:
RAL 7035

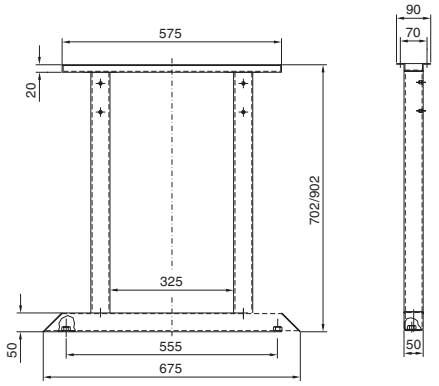
Supply includes:
Levelling feet and screws for the attachment of a worktop.

Note:
For reasons of stability, the worktop base should always be fitted in conjunction with cable duct IW 6903.700 or other suitable cross-braces.

Height mm	Packs of	Model No. IW
702	1	**6900.500**
902	1	**6900.510**

Accessories:

Cable duct,
see page 251.
Worktops,
see page 248.



Cable duct

With punchings for the attachment of cable ties and prepared for the installation of a socket strip. Extension to any length may be achieved by baying several cable ducts together.

Installation:
- Beneath worktops IW
- Beneath surfaces
- Between IW enclosures
- Between IW worktop bases

Material:
Sheet steel, spray-finished

Colour:
Textured RAL 7035

Length mm	Packs of	Model No. IW
760	1	**6903.700**

Accessories:

Cable tie for quick assembly SZ 2597.000,
see page 982.
Socket strip,
see page 746.

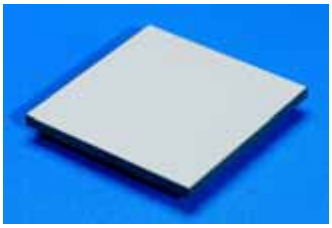
Adaptor plate

for connector entry,
see page 975.

Accessories

Cable gland

for IW worktops,
see page 976.



Support plate

for screen
Rotatable in conjunction with turntable IW 6902.620.

Material:
Chipboard, plastic laminated on both sides, similar to RAL 7035, with tough plastic edging, similar to RAL 7015.

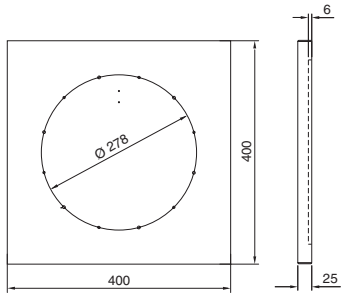
Note:
- Other sizes
- With drilled holes

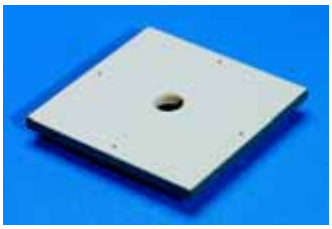
available upon request.

Width mm	Depth mm	Height mm	Model No. IW
400	400	25	**6902.650**

Accessories:

Turntable,
see page 253.





Spacer plate

for monitor housing
Creates distance from the worktop to prevent damage to the mouse and keyboard.

Material:
Chipboard, plastic laminated on both sides, similar to RAL 7035, with tough plastic edging, similar to RAL 7015.

Note:
If a wider gap is required, 2 spacer plates may also be screw-fastened on top of one another.

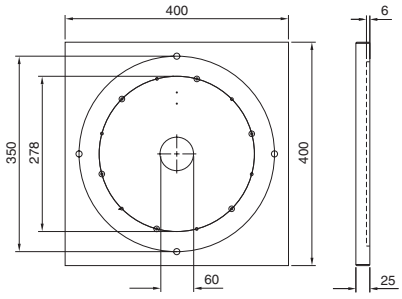
- Other sizes
- Other drilled holes

available upon request.

Width mm	Depth mm	Height mm	Model No. IW
400	400	25	**6902.630**

Accessories:

Turntable,
see page 253.



Turntable

for spacer plate IW 6902.630 and support plate IW 6902.650.
Diameter: 328 mm
Height: 14 mm
Load capacity: 300 kg, vertical

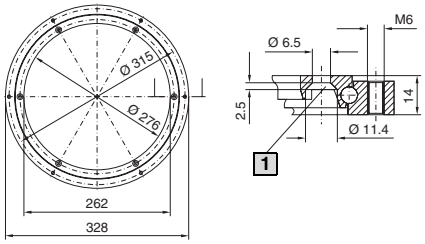
Rotation range:
350°, may be limited to 90°, 180° and 270° by 3 end stops.

Material:
Cast aluminium, powder-coated

Colour:
Black

Supply includes:
Assembly parts for screw-fastening on both sides.

Packs of	Model No. IW
1	6902.620



1 For csk screw M6

Optipanel

A stylish enclosure of extruded aluminium section. In installation depths 50, 100 and 150 mm the width and height are sized to the panel supplied by the customer.

For TFT monitors 15″ and 17″ with safety glass or touch screen, see page 1046, standard sizes are available off the shelf.

Full details of the Optipanel from page 170.

Support arm system CP-L

Using support section CP-L, operating housings may be positioned in a rotatable and swivelling configuration depending on the respective ergonomic conditions, see from page 200.

Compact Panel

For slimlline and compact panels, or as a visually appealing switch housing.
Thanks to the tiltable enclosure attachment IW 6902.670, see page 193, may also be fitted via support arm system CP-L on worktops prepared for enclosure attachment CP-L, Ø 130 mm, see page 206.

Full details of the Compact Panel from page 183.

Vertical section

For subdividing the vertical surface of the Quality Point XL. By locating e.g. TS punched sections with mounting flanges (17 x 73 mm) into the TS punched profile, the simple mounting of system accessories (e.g. utility shelves CP) is supported.
Length: 950 mm

Material:
Sheet steel, 1.5 mm

Colour:
RAL 7035

Supply includes:
Assembly parts.

Packs of	Model No. IW
1	6903.010

Accessories:

TS punched section with mounting flange, 17 x 73 mm, see page 921,
Utility shelves CP, see page 1039.
Snap-on nuts, see page 931.

Accessories

Worktop mat

To protect against damage, and as an anti-slip mat.

Material:
Rubber

Colour:
Black

To fit IW	Width mm	Depth mm	Packs of	Model No. IW
6902.300 6902.400	600	640	1	**6903.100**
6902.310 6902.320	950	600	1	**6903.110**
6902.100	1000	895	1	**6903.120**
6902.000	1200	950	1	**6903.130**
6902.200	2000	845	1	**6903.140**
6902.210	2000	685/900	1	**6903.150**
6902.220	2000	900/685	1	**6903.160**

Drawer

for documents

Under-mounting

For mounting beneath
- Worktop
- Sufficiently large surfaces

For test equipment, pens, production documents etc. Lockable, lock cylinder insert, lock no. 3524 E.

Material:
Drawer housing: Sheet steel
Front: Plastic to UL 94-V0

Colour:
RAL 7035,
front surface RAL 7015,
handle strip RAL 9006.

Protection category:
IP 55 to EN 60 529/10.91
Complies with NEMA 12.

Packs of	Model No. IW
1	**6902.900**

Delivery times available on request.

Accessories:

Cross members for drawer tray,
see page 943.

Drawer

for keyboard and mouse

Bottom-mounting

For mounting beneath
- Worktop
- Sufficiently large surfaces

With mouspad support, pulls out on the left or right, and hinged cable support for secure, pinch-free cable routing.
Sealed cable entry for 3 cables (up to Ø 6 mm).

Material:
Drawer housing: Sheet steel
Front: Plastic to UL 94-V0

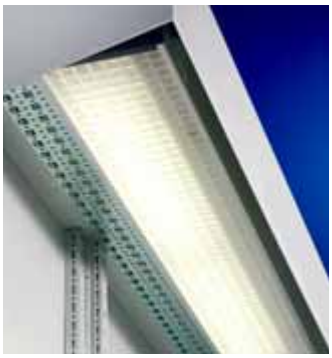
Colour:
RAL 7035,
front surface RAL 7015,
handle strip RAL 9006.

Protection category:
IP 55 to EN 60 529/10.91
Complies with NEMA 12.

Packs of	Model No. IW
1	**6902.910**

Accessories:

Mouse, mousepad IP 67,
see page 1054.



Workstation light

for IW

For mounting on the IW Quality Point attachment. The workstation light ensures optimum, glare-free illumination of the workstation.

Technical specifications:

2 compact fluorescent lamps (36 W, 230 V, 50 Hz) TC-L 36, cap 2 GL. With switch, sockets and connectors for power infeed and through-wiring.

Supply includes:

Assembly parts

Width mm	Height mm	Depth mm	**Model No. IW**
900	135	60	**6903.080**

Also required:

Connection accessories
see page 956.

PC enclosure systems

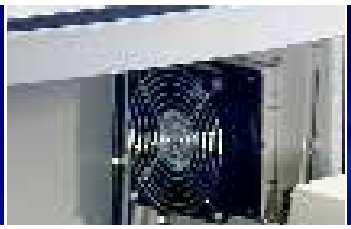
Features

Housing all your computer equipment, from the monitor, computer system, printer and keyboard to the mouse, becomes child's play with Rittal's PC enclosure systems.

The result is perfect protection from humidity and dirt, temperature fluctuations and unauthorised access. What is more, when it comes to ergonomics, design and accessory diversity, these systems will exceed your expectations.

IW enclosure for tower PC

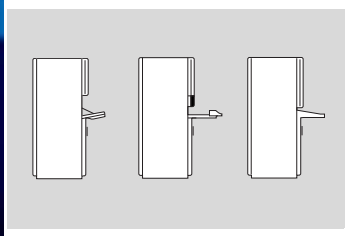
Enclosure ready for connection to accommodate a standard tower PC in the door.



The fan-and-filter unit integrated as standard ensures optimum climate control at protection category IP 54.

The cast feet with twin castors ensure optimum stability and mobility.

PC enclosure systems based on TS 8, bayable



Operated via:
- Folding keyboard
- Keyboard drawer
- Desk section

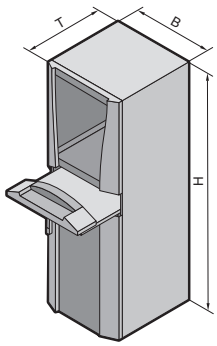
Monitored with:
- Mounting compartment, large, or
- Glazed door, large, or
- Combination of small glazed door and small mounting compartment

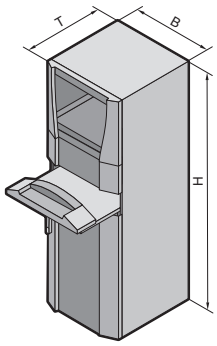
PC enclosure systems based on ES

Operated via:
- Folding keyboard
- Keyboard drawer
- Desk section

Monitored with:
- Mounting compartment, large, or
- Glazed door, large, or
- Combination of small glazed door and small mounting compartment

Based on TS 8, with keyboard drawer





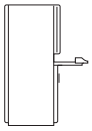
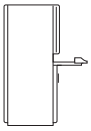
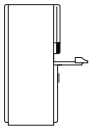
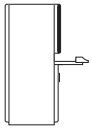
Material:
see page 1112.

Protection category:
IP 55 to EN 60 529,
complies with NEMA 12.

Supply includes,
see page 1112.

Detailed drawing,
see page 1112.

Approvals,
see page 34.

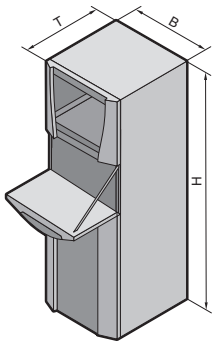
Version		Packs of	 with keyboard drawer, glazed door, top	 with keyboard drawer, glazed door, top	 with keyboard drawer, glazed door, top mounting compartment, small	 with keyboard drawer, mounting compartment, large	Page
Width (B) in mm			600	600	600	600	
Height (H) in mm			1600	1600	1600	1600	
Depth (T) in mm			636	836	636	636	
Model No. PC		1	**8366.000**	**8368.000**	**8366.300**	**8366.400**	
Maximum keyboard dimensions in mm	Width		480	480	480	480	
	Height		70	70	70	70	
	Depth		260	260	260	260	
Weight (kg)			118	133	118	117	
Accessories							
Base/plinth, stationary		1	8800.920	8800.920	8800.920	8800.920	840
Base/plinth components front and rear	Height 100 mm	1	8601.600	8601.600	8601.600	8601.600	835
	Height 200 mm	1	8602.600	8602.600	8602.600	8602.600	835
Base/plinth trim, front	Height 200 mm	1	8360.920	8360.920	8360.920	8360.920	839
Base/plinth trim, side	Height 100 mm	1	8601.060	8601.060	8601.060	8601.060	835
	Height 200 mm	1	8602.060	8602.060	8602.060	8602.060	835
Cross member, adjustable	Height 70 mm	2	8601.680	8601.680	8601.680	8601.680	845
Partial mounting plate	Height 775 mm	1	8614.675	8614.675	8614.675	8614.675	913
Lock systems							
Standard lock insert, may be exchanged for rear door: TS lock inserts, see page 881, comfort handle, see page 881. Designer door, front: TS lock inserts, see page 881, comfort handle, see page 881 (via handle adaptor PC 8611.300, see page 869). Keyboard drawer/fold-out tray: Lock inserts, 27 mm, version A, see page 888.							

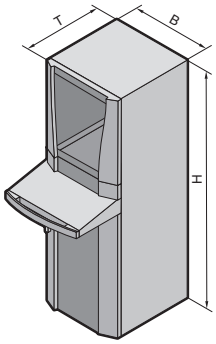
Handle set.
Model No. see page 1030.

Accessories Page 832 **Component shelves** Page 939 **Monitors, keyboards** Page 1046 **Climate control** Page 578

PC enclosure systems

Based on TS 8, with folding keyboard or desk section





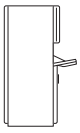
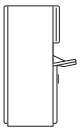
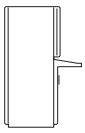
Material:
see page 1113.

Protection category:
IP 55 to EN 60 529,
complies with NEMA 12.

Supply includes,
see page 1113.

Detailed drawing,
see page 1113.

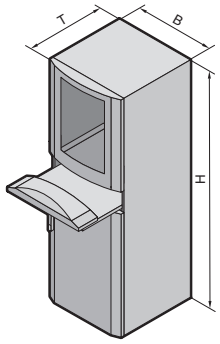
Approvals,
see page 34.

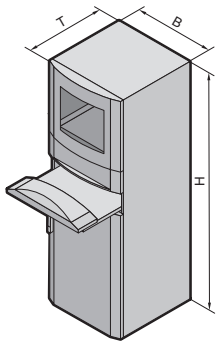
									
Version			Packs of	with fold-out keyboard tray, glazed door, top		with fold-out keyboard tray, glazed door, top		with desk section, glazed door, top	Page
Width (B) in mm				600		600		600	
Height (H) in mm				1600		1600		1600	
Depth (T) in mm				636		836		636	
Model No. PC			1	**8366.100**		**8368.100**		**8366.200**	
Maximum keyboard dimensions in mm		Width		475		475		540	
		Height		60	50	60	50	40	
		Depth		200	250	200	250	175	
Weight (kg)				118		124		108	
Accessories									
Base/plinth, stationary			1	8800.920		8800.920		8800.920	840
Base/plinth components front and rear	Height 100 mm		1	8601.600		8601.600		8601.600	835
	Height 200 mm		1	8602.600		8602.600		8602.600	835
Base/plinth trim, front	Height 200 mm		1	8360.920		8360.920		8360.920	839
Base/plinth trim, side	Height 100 mm		1	8601.060		8601.060		8601.060	835
	Height 200 mm		1	8602.060		8602.060		8602.060	835
Cross member, adjustable	Height 70 mm		2	8601.680		8601.680		8601.680	845
Partial mounting plate	Height 775 mm		1	8614.675		8614.675		8614.675	913
Lock systems									
Standard lock insert, may be exchanged for rear door: TS lock inserts, see page 881, comfort handle, see page 881. Designer door, front: TS lock inserts, see page 881, comfort handle, see page 881 (via handle adaptor PC 8611.300, see page 869). Keyboard drawer/fold-out tray: Lock inserts, 27 mm, version A, see page 888.									

Base/plinth trim PC
200 mm high.
Model No. see page 839.

Accessories Page 832 **Component shelves** Page 939 **Monitors, keyboards** Page 1046 **Climate control** Page 578

Based on TS 8, with keyboard drawer





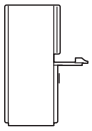
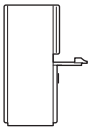
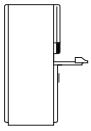
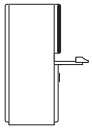
Material:
see page 1114.

Protection category:
IP 55 to EN 60 529,
complies with NEMA 12.

Supply includes,
see page 1114.

Detailed drawing,
see page 1114.

Approvals,
see page 34.

Version			Packs of	 with keyboard drawer, glazed door, top	 with keyboard drawer, glazed door, top	 with keyboard drawer, glazed door, top mounting compartment, small	 with keyboard drawer, mounting compartment, large	Page
Width (B) in mm				600	600	600	600	
Height (H) in mm				1600	1600	1600	1600	
Depth (T) in mm				650	850	650	650	
Model No. PC			1	**4603.703**	**4609.703**	**4603.913**	**4603.603**	
Maximum keyboard dimensions in mm		Width		480	480	480	480	
		Height		55[1]/40[2]	55[1]/40[2]	55[1]/40[2]	55[1]/40[2]	
		Depth		250	250	250	250	
Weight (kg)				106	121	107	106	
Accessories								
Base/plinth, complete		Height 100 mm	1	2813.200	2846.200	2813.200	2813.200	843
		Height 200 mm	1	2814.200	2847.200	2814.200	2814.200	843
Cross member, adjustable			2	8601.680	8601.680	8601.680	8601.680	845
Twin castors			1	4634.500	4634.500	4634.500	4634.500	848
Mousepad, passive			1	4614.000	4614.000	4614.000	4614.000	1055
Lock systems								
Standard lock insert, may be exchanged for rear door/designer door, front: Lock inserts, 27 mm, version A, see page 888. Ergoform-S lock system, see page 885. Keyboard drawer/fold-out tray: Lock inserts, 27 mm, version A, see page 888.								

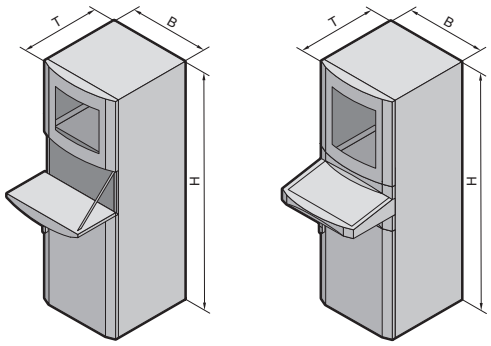
[1] Without mousepad
[2] With mousepad

Cross member, adjustable.
Model No. see page 845.

Accessories Page 832 **Component shelves** Page 939 **Monitors, keyboards** Page 1046 **Climate control** Page 578

PC enclosure systems

Based on ES with fold-out keyboard tray or desk section



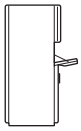
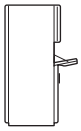
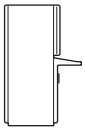
Material:
see page 1115.

Protection category:
IP 55 to EN 60 529,
complies with NEMA 12.

Supply includes,
see page 1115.

Detailed drawing,
see page 1115.

Approvals,
see page 34.

Version		Packs of	 with fold-out keyboard tray, glazed door, top	 with fold-out keyboard tray, glazed door, top	 with desk section, glazed door, top	Page
Width (B) in mm			600	600	600	
Height (H) in mm			1600	1600	1600	
Depth (T) in mm			650	850	650	
Model No. PC		1	**4603.920**	**4609.920**	**4603.704**	
Maximum keyboard dimensions in mm	Width		480	480	462	
	Height		69[1]/62[2]	69[1]/62[2]	40	
	Depth		230	230	208	
Weight (kg)			101	114	102	
Accessories						
Base/plinth, complete	Height 100 mm	1	2813.200	2846.200	2813.200	843
	Height 200 mm	1	2814.200	2847.200	2814.200	843
Cross member, adjustable		2	8601.680	8601.680	8601.680	845
Twin castors		1	4634.500	4634.500	4634.500	848
Mousepad, passive		1	4613.000	4613.000	–	1055
Lock systems						

Standard lock insert, may be exchanged for rear door/designer door, front: Lock inserts, 27 mm, version A, see page 888.
Ergoform-S lock system, see page 885.
Keyboard drawer/fold-out tray: Lock inserts, 27 mm, version A, see page 888.

[1] Without mousepad
[2] With mousepad

Mobile workstation.
Model No. see page 1057.

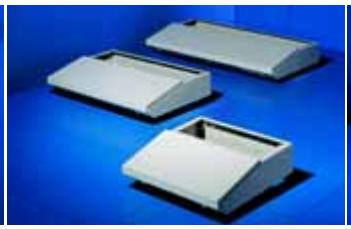
Accessories Page 832 **Component shelves** Page 939 **Monitors, keyboards** Page 1046 **Climate control** Page 578

Features

Function and variability are key features of all Rittal console systems. Perfect designs offer added benefits in terms of assembly, security and operation.

The performance capability of a machine or plant is decided at the console and operating unit. Only optimum packaging of today's sensitive controls combined with optimum ergonomic conditions for operating staff can create the pre-requisites for cost-effective plant operation.

Console systems AP



Consoles
with mounting plate, in two heights and three depths for virtually any installation situation.

Desk units
in two depths with perforated strips in the base and cover for easy installation.

Pedestals
with mounting plate, in two depths, also suitable for use as consoles.

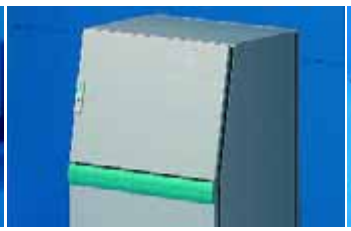
One-piece consoles AP

Cover
including perforated strips for cable routing. Safety lid stay may be unlatched with two-handed operation.

Door hinge
may be swapped from right to left by simply unscrewing the hinges.

Variable installation depth in the cover area
and cable entry from the rear via a mounting plate, height-adjustable by 2 x 40 mm.

Universal consoles AP



Optionally with short or tall door.
Short door offers free field for mounting desk section or keyboard drawer.

High stability and protection category
thanks to a body which is manufactured more or less from a single piece.

Universal interior installation
with partial mounting plates, component shelves, punched sections and rails.

Combination options for the modules

Easy selection of your required combination
The elements of the AP console system in depths 400 mm (blue) and 500 mm (green) may be combined in numerous user-specific variants, as shown in the diagram.
The table opposite allows you to find the order number for your selection immediately.

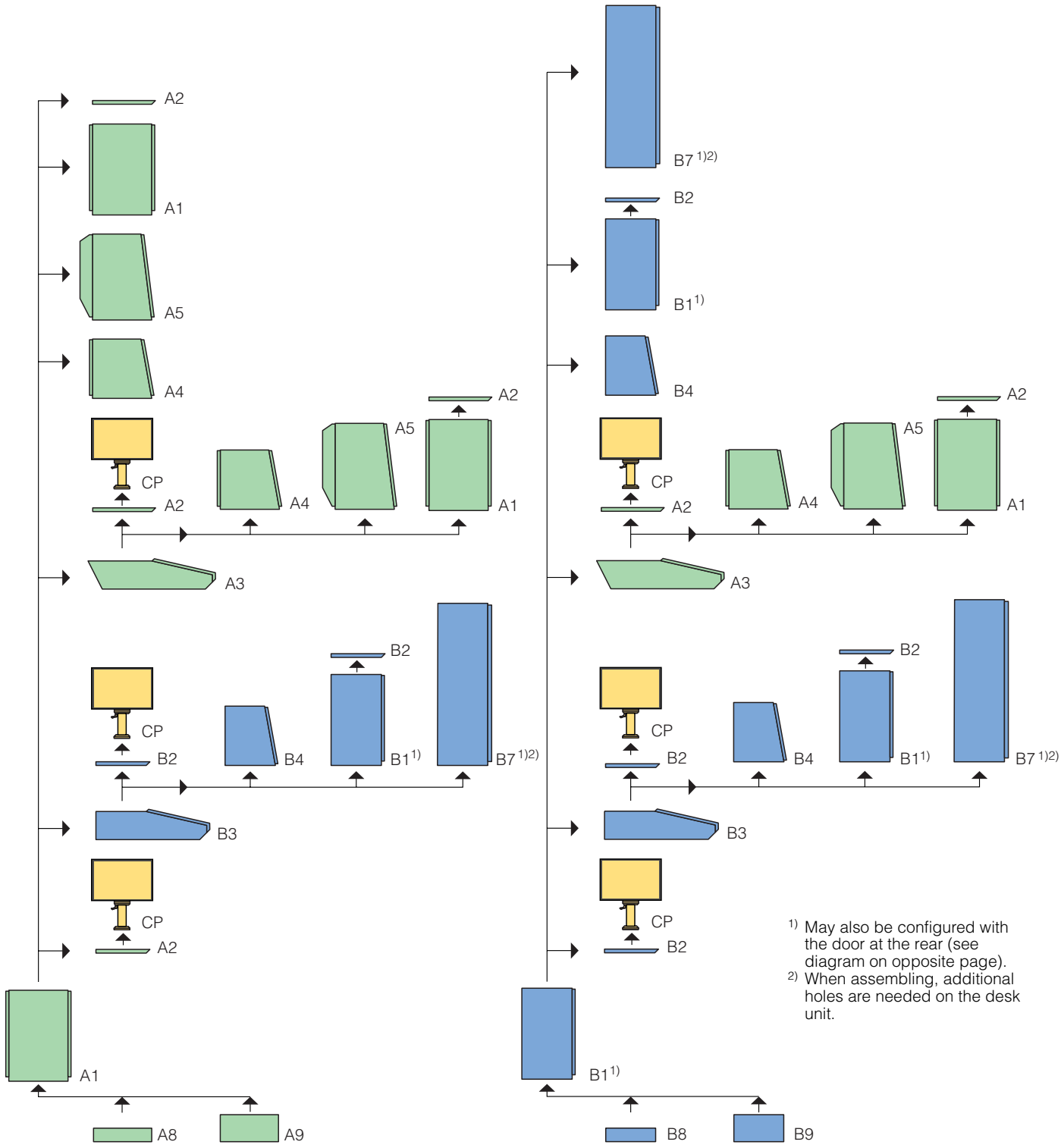
Modern, slimline HMI (human/machine interfaces) or displays may also be used.

Integrated into the stylish, tailor-made command panel systems VIP 6000, Optipanel and Compact Panel (yellow), this produces a wide range of modern extension options for the classic AP console systems.

- VIP 6000, see page 154.
- Optipanel, see page 170.
- Compact Panel, see page 183.
- Support arm systems, see page 188.

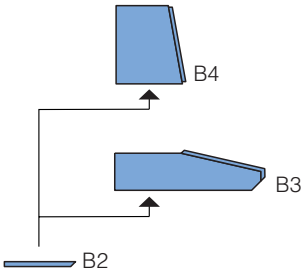
Trim plate (A2/B2) with reinforcement and cutout for support arm systems available on request.

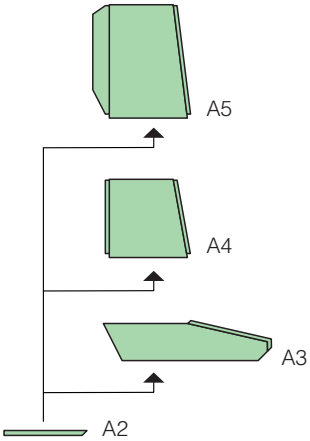
Please specify the dimensions for positioning on the end plate and the Model No. of the enclosure attachment.

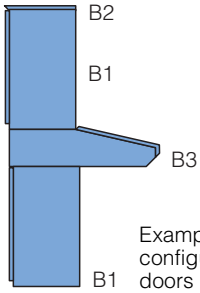


1) May also be configured with the door at the rear (see diagram on opposite page).
2) When assembling, additional holes are needed on the desk unit.

Combination options for the modules







Example of configuration with doors at rear

Further information,
see page 264 – 265.

Technical details,
see page 1116 – 1117.

Approvals,
see page 35.

D = 500 mm				Height mm	D = 400 mm			
Width	800	1200	1600		Width	800	1200	1600
	Model No.	**Model No.**	**Model No.**			**Model No.**	**Model No.**	**Model No.**
AK enclosure								
				1200	B7	**1648.500**	**1652.500**	
Console								
A5	**2647.500**	**2648.500**	**2649.500**	630 with deep rear door				
Console								
A4	**2614.500**	**2644.500**	**2654.500**	430	B4	**2612.500**	**2642.500**	**2652.500**
Desk unit								
A3	**2613.500**	**2643.500**	**2653.500**	200	B3	**2611.500**	**2641.500**	**2651.500**
Trim panel								
A2	**2616.500**	**2646.500**	**2656.500**	28	B2	**2615.500**	**2645.500**	**2655.500**
Pedestal								
A1	**2610.500**	**2640.500**	**2650.500**	670	B1	**2600.500**	**2620.500**	**2630.500**
Base/plinth								
A9	**2842.200**	**2852.200**	**2864.200**	200	B9	**2902.200**	**2922.000**	**2962.200**
A8	**2841.200**	**2851.200**	**2863.200**	100	B8	**2901.200**	**2921.200**	**2961.200**

Modules

Consoles

Material:
Sheet steel
Enclosure: 1.5 mm
Door: 2.0 mm
Mounting plate: 3.0 mm

Surface finish:
Dipcoat-primed,
powder-coated on the outside
Mounting plate: Zinc-plated

Colour:
Textured RAL 7035

Supply includes:
Enclosure, open at the bottom, door(s) hinged at the bottom with retaining cords at the front, for depth 500 mm with door(s) at the rear,
mounting plate for depth 500 mm, adjustable on a 25 mm pitch pattern.

Detailed drawing,
see page 1117.

Width in mm	Packs of	800	1200	1600	800	1200	1600	800	1200	1600
Height in mm		430						630		
Depth in mm		400			500			500 (with deep rear door)		
Model No. AP	1	**2612.500**	**2642.500**	**2652.500**	**2614.500**	**2644.500**	**2654.500**	**2647.500**	**2648.500**	**2649.500**
Number of lids		1	1	1	2	2	2	2	2	2
Weight (kg)		22.5	40.0	52.5	30.6	48.0	62.4	47.8	64.4	86.8
Lock systems										
Standard double-bit lock insert may be exchanged for 47 mm lock inserts, type D, see page 888.										

To order consoles in textured RAL 7032 please add extension .600 to the Model No., and for primed consoles use extension .800.
Delivery times available on request.

Desk units

Material:
Sheet steel
Enclosure: 1.5 mm
Console lid: 2.0 mm

Surface finish:
Dipcoat-primed,
powder-coated on the outside

Colour:
Textured RAL 7035

Supply includes:
Enclosure, open at the top and bottom, console lid with cam and support stand.

Detailed drawing,
see page 1117.

Width in mm	Packs of	800	1200	1600	800	1200	1600	Page
Height in mm		200						
Depth in mm		850 (for depth 400)			950 (for depth 500)			
Model No. AP	1	**2611.500**	**2641.500**	**2651.500**	**2613.500**	**2643.500**	**2653.500**	
Weight (kg)		25.5	35.5	44.0	30.6	42.6	52.8	
Accessories								
Aluminium strips	3	2678.000	2682.000	–	2678.000	2682.000	–	1040
Lock systems								
Standard double-bit lock insert may be exchanged for 47 mm lock inserts, type D, see page 888.								

To order desk units in textured RAL 7032 please add extension .200 to the Model No., and for primed desk units use extension .300.
Delivery times available on request.

Accessories Page 832 **Monitors, keyboards** Page 1046 **Climate control** Page 578

Pedestals

Material:
Sheet steel
Enclosures and gland plates: 1.5 mm
Door: 2.0 mm
Mounting plate: 3.0 mm

Surface finish:
Dipcoat-primed, powder-coated on the outside
Gland plates and mounting plate: Zinc-plated.

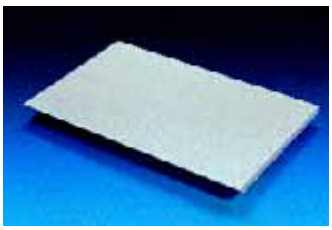
Colour:
Textured RAL 7035

Supply includes:
Enclosure, open at the top, door or double door with locking rod (with depth 400 mm at the front, with depth 500 mm at the front and rear),
two-part gland plates,
mounting plate, with depth 500 mm: infinitely adjustable.

Detailed drawing,
see page 1116.

Width in mm		Packs of	800	1200	1600	800	1200	1600	Page
Height in mm			670						
Depth in mm			400			500			
Model No. AP		1	**2600.500**	**2620.500**	**2630.500**	**2610.500**	**2640.500**	**2650.500**	
Door(s)			1	2	2	1/1	2/2	2/2	
Weight (kg)			43.5	62.3	80.0	52.2	75.0	96.0	
Accessories									
Base/plinth	Height 100 mm	1	2901.200	2921.200	2961.200	2841.200	2851.200	2863.200	843
	Height 200 mm	1	2902.200	2922.200	2962.200	2842.200	2852.200	2864.200	843
Cross member, adjustable		2	2697.450						845
Swing frame 11 U		1	2027.200	2027.200[1)]		2027.200	2027.200[1)]		1002
Lock systems									
Standard double-bit lock insert may be exchanged for 27 mm lock inserts, type A, see page 888 and Ergoform-S lock system, see page 885.									

[1)] Two swing frames may be installed
To order pedestals in textured RAL 7032 please add extension .600 to the Model No., and for primed pedestals use extension .800.
Delivery times available on request.

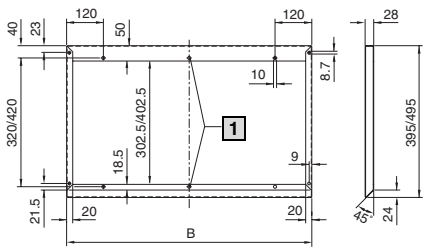


Trim panel

To finish off pedestals, desk units or consoles.

Material:
Sheet steel, spray-finished, 1.5 mm

Colour:
Textured RAL 7035



1 Not applicable to console width 800 mm

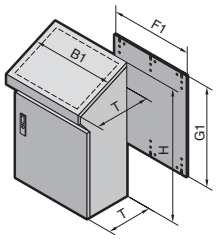
To fit		Model No. AP
Width mm	Depth mm	
800	400	**2615.500**
1200		**2645.500**
1600		**2655.500**
800	500	**2616.500**
1200		**2646.500**
1600		**2656.500**

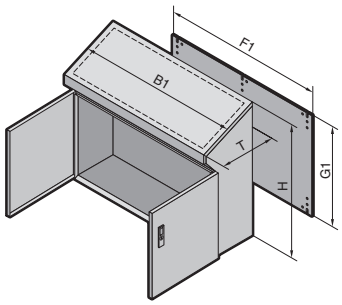
To order trim panels in textured RAL 7032 please add extension .200 to the Model No., and for primed versions use extension .300.
Delivery times available on request.

Accessories Page 832 **Monitors, keyboards** Page 1046 **Climate control** Page 578

One-piece consoles AP

Sheet steel





Material:
Sheet steel
Enclosure: 1.5 mm
Door and console lid: 2.0 mm
Mounting plate: 3.0 mm

Surface finish:
Enclosure, door and console lid: Dipcoat-primed, powder-coated on the outside
Mounting plate and gland plates: Zinc-plated

Colour:
Textured RAL 7035

Protection category:
IP 55 to EN 60 529/10.91, complies with NEMA 12.

Supply includes:
Enclosure, closed back and sides,
door or double door at front,
console lid with lid stay,
two-piece gland plate,
mounting plate.

Detailed drawing,
see page 1118.

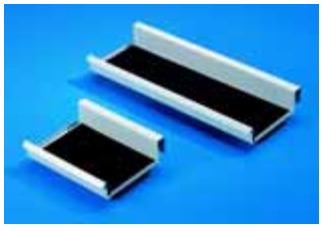
Approvals,
see page 36.

Width (B1) in mm		Packs of	600	800	1000	1200	Page
Height (H) in mm			960	960	960	960	
Depth (T) in mm			400/480	400/480	400/480	400/480	
Mounting plate width (F1) in mm			530	730	930	1130	
Mounting plate height (G1) in mm			780	780	780	780	
Model No. AP		1	**2666.500**	**2668.500**	**2670.500**	**2672.500**	
Door(s)			1	1	2	2	
Weight (kg)			52.0	65.2	79.5	90.3	
Accessories							
Base/plinth	Height 100 mm	1	2911.200	2901.200	2891.200	2921.200	843
	Height 200 mm	1	2912.200	2902.200	2892.200	2922.200	843
Cross member, adjustable		2	2697.450	2697.450	2697.450	2697.450	845
Aluminium strips		3	2676.000	2678.000	2682.000[1)]	2682.000	1040
Swing frame		1	–	2027.200	2027.200	2027.200	1002
Lock systems							
Console lid: Standard double-bit lock insert may be exchanged for 47 mm lock inserts, type D, see page 888. Door: Standard double-bit lock insert may be exchanged for 27 mm lock inserts, type A, see page 888, and Ergoform-S lock system, see page 885.							

[1)] To be shortened by 200 mm.

To order consoles in textured RAL 7032 please add extension .600 to the Model No., and for primed versions use extension .800.
Delivery times available on request.

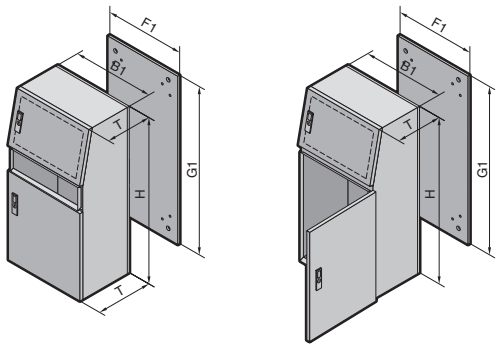
Cross member, adjustable
Model No. see page 845.



Utility shelf, screw-fastened
for measuring instruments, mouse or scanner.
Model No. see page 1039.

Accessories Page 832 **Monitors, keyboards** Page 1046 **Climate control** Page 578

Sheet steel



Material:
Sheet steel
Enclosure, gland plates: 1.5 mm
doors: 2.0 mm
Mounting plate: 3.0 mm
Design strips (AP 2695.500):
Aluminium section

Surface finish:
Enclosure:
Dipcoat-primed, powder-coated on the outside
Mounting plate and gland plates: Zinc-plated

Colour:
Enclosure: textured RAL 7035.
Design strips (AP 2695.500):
RAL 5018

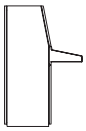
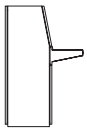
Protection category:
IP 55 to EN 60 529/10.91, complies with NEMA 12.
With a short door at the bottom (AP 2694.500), in order to preserve the protection category, a drawer or desk section (see page 1052/1039) should be fitted.

Supply includes:
Enclosure with doors,
mounting plate,
gland plates,
design strips (AP 2695.500).

Note:
Top door with studs left and right for installing vertical perforated mounting strips SZ 2310.038 and horizontal support strips SZ 2325.000 to be mounted on top (see page 896/895).
AP universal consoles are equivalent to free-standing enclosure ES 5000 in terms of interior installation – in other words, the accessory components will fit.

Detailed drawing,
see page 1118.

Approvals,
see page 36.

							
		Packs of	with short front door			with tall front door	Page
Width (B1) in mm			600			600	
Height (H) in mm			1300			1300	
Depth (T) in mm			500/417.5			500/417.5	
Mounting plate width (F1) in mm			499			499	
Mounting plate height (G1) in mm			1196			1196	
Model No. AP		1	**2694.500**			**2695.500**	
Weight (kg)			77.0			80.0	
Also required							
Desk section			2696.500	2696.500	–	–	1039
Drawer for keyboard			–	–	4757.500[1)]	–	1052
Accessories							
Base/plinth	Height 100 mm	1	2807.200			2807.200	843
	Height 200 mm	1	2808.200			2808.200	843
Cross member, adjustable		2	2697.450			2697.450	845
Cable clamp rail		1	4191.000			4191.000	979
Lock systems							
Standard double-bit lock insert may be exchanged for 27 mm lock inserts, type A, see page 888 and Ergoform-S lock system, see page 885.							

[1)] Only suitable for installation without a mounting plate.
To order in textured RAL 7032, please add extension .600 to the Model No. Delivery times available on request.

Accessories Page 832 **Monitors, keyboards** Page 1046 **Climate control** Page 578

Stainless steel

Features

Be it automation, communications or power supply technology, Rittal offers the correct enclosures and cabinets to suit virtually all requirement profiles in modern industrial technology. Of course, these are also available in stainless steel for extremely high standards of hygiene and corrosion protection. Cleverly thought-out system platforms in conjunction with an extensive selection of system accessories provide the basis for the outstanding solution diversity of the Rittal stainless steel range. Why not arrange a consultation? We will tailor a solution to suit your specific requirements.

Resistant to high-pressure cleaning, suitable for use in clean rooms

The compact enclosures **Premium Line KL** and the command panels **Premium Panel** offer a high level of EMC shielding and are resistant to high-pressure cleaning and suitable for use in clean rooms.

Resistant to high-pressure cleaning
The new gap-free sealing concept facilitates the high protection category of IP 69K.

Suitable for clean room use
For the highest standards in the food and hygiene sector (certified by the Fraunhofer-Institut IPA).

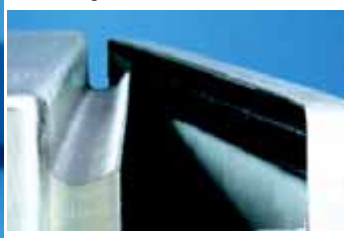
Compact enclosures

Terminal boxes with screw-fastened lid and profile strips with mounting holes on both sides for the installation of cross rails or mounting plate.

Bus enclosure with 180° hinges and built-in support rail.

Premium Line KL
Resistant to high-pressure cleaning, IP 69K and high level of EMC shielding thanks to the sealing system and metallic contact between the enclosure and rear panel.

Compact enclosures



Enclosure protection channel prevents the ingress of dirt and water when the door is opened.

To dismantle the door, the **hinge pin** is simply pulled out of the compact enclosures AE.

Rain canopies for AE offer additional protection.

Features

Command panel

Premium Panel
First-class in terms of sealing, protection, hygiene and design, with or without keyboard housing.

Operating housings
Front panel may optionally be used either for the installation of operating and display components, or as a rear panel.

Command panel housing with door
with handle strips and rear panel with welded studs for the attachment of a mounting plate or support rails.

Consoles

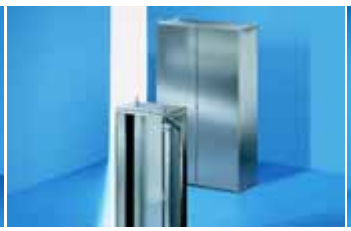
The lid stay of the one-piece consoles is locked against unintentional closure.

Maximum space for cable entry with divided gland plates.

The mounting plate is height-adjustable by 2 x 40 mm, e.g. with deep installed equipment in the lid or cable entry from the rear.

Enclosure systems

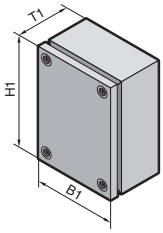
PC enclosure systems with keyboard drawer or with desk section.



Free-standing enclosures ES 5000 with profiled enclosure formed from a single piece (roof + side panel).

Baying systems TS 8 – infinite options for interior installation.

Terminal boxes KL



Material:
Stainless steel 1.4301
Enclosure: 1.25 mm
Cover: 1.25 mm

Surface finish:
Case and cover:
Brushed, grain 180

Protection category:
IP 66 to EN 60 529/10.91, complies with NEMA 4x.

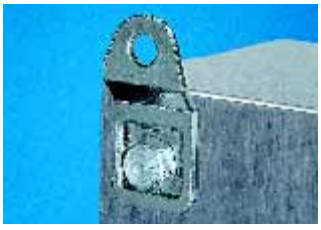
Supply includes:
Enclosure, cover with all-round foamed-in PU seal and cover screws, including plastic bushes.

Approvals,
see page 23.

Detailed drawing,
see page 1119.

Width (B1) in mm	Packs of	150	300	200	300	400	300	Page
Height (H1) in mm		150	150	200	200	200	300	
Depth (T1) in mm		80	80	80	80	120	120	
Model No. KL	1	**1521.010**	**1522.010**	**1523.010**	**1524.010**	**1525.010**	**1526.010**	
Weight (kg)		1.3	1.8	1.8	2.4	3.6	3.9	
Cover screws		4	4	4	4	4	4	
Accessories								
Mounting plate	1	1560.700	1561.700	1562.700	1563.700	1564.700	1567.700	909
Wall mounting bracket	4	1594.000	1594.000	1594.000	1594.000	1594.000	1594.000	905
Wall angle	1	2583.000	2583.000	2583.000	2583.000	2583.000	2583.000	906
Pole clamp	1	2584.000	2584.000	2584.000	2584.000	2584.000	2584.000	906
Support rails TS 35/7.5	10	2314.000	2316.000	2315.000	2316.000	2317.000	2316.000	927

To order terminal boxes in 1.4404 (AISI 316L), please add extension .510 the the Model No. Delivery times available on request.

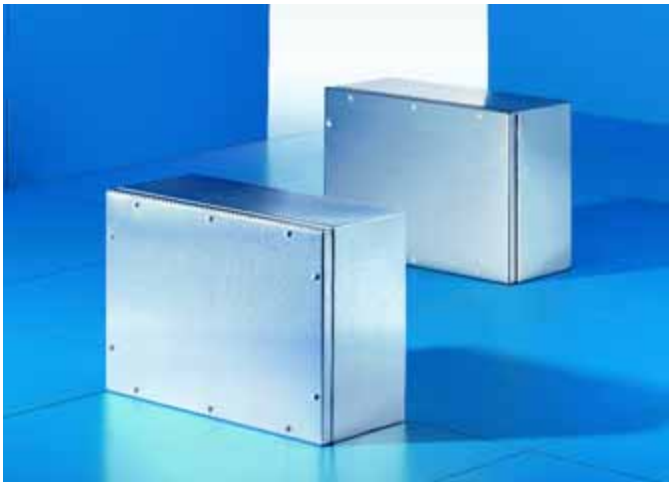


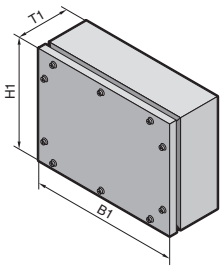
Wall mounting bracket
for secure attachment to the wall.
Model No. see page 905.

Housing coupling
for attaching the 120 mm deep KL to the support arm system.
Model No. see page 278.

Accessories Page 832 **Terminal boxes KL sheet steel** Page 107 **Terminal boxes KL Ex-proof** Page 287

Premium Line KL, protection category IP 69K





A new design, a new concept for the seal and lock

- **Resistant to high-pressure cleaning** (protection category IP 69K). The seal lies between two surfaces and is ideally compressed by the screw fastening (see detailed drawing, page 1119).
- **Suitable for clean room use.** Optional screw fastening to comply with high standards in the food and hygiene sectors: 1 external with hex screws, 2 internal with plastic stoppers.
- **Optimum EMC conditions.** The labyrinthine seal achieves a particularly high level of RF shielding of the enclosure.
- **Accessibility.** Internal rear panel bracket. This solution is clearly superior to external hinges from a hygiene point of view.
- Wall mounting can be implemented directly from the rear using M8 pull-in nuts, or from the front using wall mounting brackets.

Material:
Stainless steel 1.4301, 1.5 mm

Surface finish:
Brushed, grain 240

Protection category:
IP 69K to DIN 40 050-9/5.93

Rittal service:

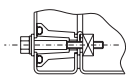
Other sizes and other enclosures with this sealing concept are available on request. Cutouts and drilled holes to your specifications.

Detailed drawing,
see page 1119.

Width (B1) in mm	Packs of	150	150	300	400	Page
Height (H1) in mm		150	150	200	300	
Depth (T1) in mm		80	120	120	120	
Model No. KL	1	**1024.010**	**1024.020**	**1024.030**	**1024.040**	
Number of lid screws		4	4	6	10	
Accessories						
Mounting plate	1	1024.910	1024.910	1024.920	1024.930	909
Wall mounting bracket	4	1594.000	1594.000	1594.000	1594.000	905
Wall angle	1	2583.000	2583.000	2583.000	2583.000	906
Rear panel bracket	2	6682.000	6682.000	6682.000	6682.000	893
Mounting brackets	1 set	1024.810	1024.810	1024.820	1024.830	909
Support rail TS 35/7.5	10	2314.000	2314.000	2316.000	2317.000	927

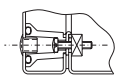
To order Premium Line KL in 1.4404 (AISI 316L), please add extension .5X0 to the Model No. Delivery times available on request.

1



Depending on customer requirements, screw head on the outside . . .

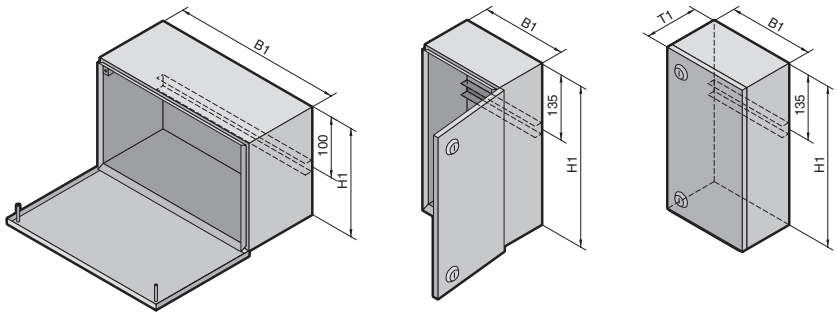
2



. . . or plastic stoppers on the outside with concealed screws (included in the supply).

Accessories Page 832

Bus enclosure BG



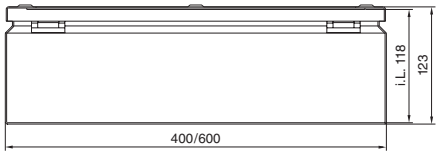
Material:
Stainless steel 1.4301
Enclosure: 1.25 mm
Cover: 1.25 mm
Hinges: Die-cast zinc

Surface finish:
Case and cover:
Brushed, grain 180
Hinges: Plated

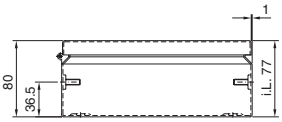
Protection category:
IP 66 to EN 60 529/10.91, complies with NEMA 4x.

Supply includes:
Enclosure with 1 support rail TS 35/7.5
Cover with foamed-in seal
180° hinges
with quick-release fasteners.

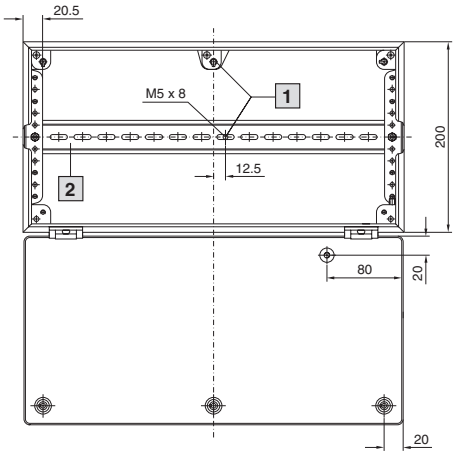
BG 1558.010, BG 1559.010

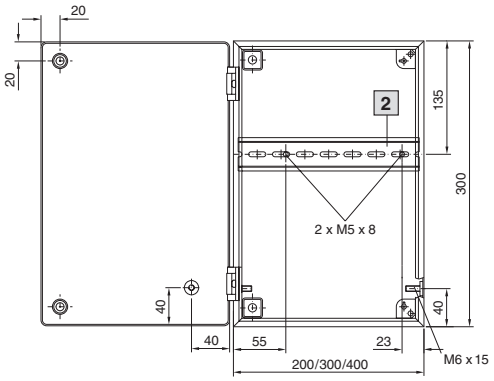


BG 1583.010, BG 1584.010, BG 1585.010



i.L. = Clearance width





1 Only for BG 1559.010
2 Support rail TS 35/7.5

Width (B1) in mm	Packs of	200	300	400	400	600	Page
Height (H1) in mm		300	300	300	200	200	
Depth (T1) in mm		80	80	80	123	123	
Model No. BG	1	**1583.010**[1)]	**1584.010**[1)]	**1585.010**[1)]	**1558.010**[2)]	**1559.010**[2)]	
Weight (kg)		2.8	3.7	4.5	4.5	6.0	
Accessories							
Wall mounting bracket	4	1594.000	1594.000	1594.000	1594.000	1594.000	905
Pole clamp	1	2584.000	2584.000	2584.000	2584.000	2584.000	906
Condensate discharge	6	2459.000	2459.000	2459.000	2459.000	2459.000	852

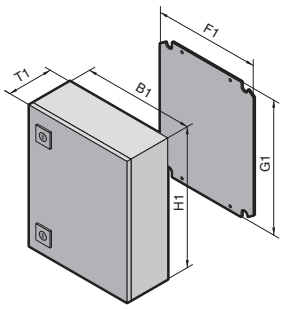
To order bus enclosures in 1.4404 (AISI 316L), please add extension .500 the the Model No. Delivery times available on request.
[1)] Support rail attached to studs
[2)] Support rail adjustable on profile strip

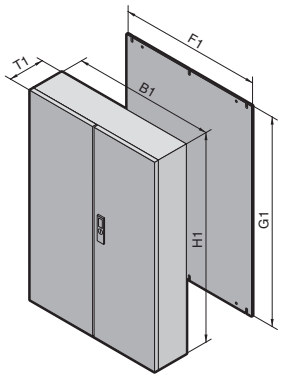
Wall mounting bracket
For secure attachment of enclosures.
Model No. see page 905.

EMC cable glands
with contact spring for optimum all-round contact.
Model No. see page 958.

Accessories Page 832 **Bus enclosures, sheet steel** Page 111

Compact enclosures AE





Material:
Stainless steel 1.4301
Enclosure and door:
Stainless steel
Mounting plate: Sheet steel
Cam lock: Die-cast zinc, nickel-plated

Surface finish:
Enclosure and door:
Brushed, grain 180
Mounting plate: Zinc-plated

Protection category:
IP 66 to EN 60 529/10.91 for AE 1002.600 – AE 1017.600, complies with NEMA 4x.
IP 55 to EN 60 529/10.91 for AE 1018.600/AE 1019.600, complies with NEMA 12.

Supply includes:
Enclosure, door(s) with foamed-in PU seal, mounting plate.

Approvals,
see page 26.

Detailed drawing,
see page 1120.

Width (B1) in mm	Packs of	200	380	300	380	500	500	380	Page
Height (H1) in mm		300	300	380	380	500	500	600	
Depth (T1) in mm		155	155	210	210	210	300	210	
Mounting plate width (F1) in mm		–	334	334	334	449	449	334	
Mounting plate height (G1) in mm		–	275	275	355	470	470	570	
Model No. AE	1	**1002.600**	**1004.600**	**1005.600**	**1006.600**	**1007.600**	**1013.600**	**1008.600**	
Door(s)		1	1	1	1	1	1	1	
Weight (kg)		4.5	8.8	8.7	12.0	18.4	18.9	17.0	
Accessories									
Rain canopy	1	2470.000	2471.000	2361.000	2472.000	2362.000	–	2472.000	899
Wall mounting bracket	4	2433.000	2433.000	2433.000	2433.000	2433.000	2433.000	2433.000	905
Wall angle	1	2583.000	2583.000	2583.000	2583.000	2583.000	2583.000	2583.000	906
Pole clamp	1	2584.000	2584.000	2584.000	2584.000	2584.000	2584.000	2584.000	906
Cam lock made from 1.4301	1	2304.000	2304.000	2304.000	2304.000	2304.000	2304.000	2304.000	887

Width (B1) in mm	Packs of	600	600	600	760	800	800	1000	1000	Page
Height (H1) in mm		380	600	760	760	1000	1200	1000	1200	
Depth (T1) in mm		210	210	210	300	300	300	300	300	
Mounting plate width (F1) in mm		549	549	549	704	739	–	939	–	
Mounting plate height (G1) in mm		355	570	730	730	955	–	955	–	
Model No. AE	1	**1009.600**	**1010.600**	**1012.600**	**1014.600**	**1016.600**	**1017.600**	**1018.600**	**1019.600**	
Door(s)		1	1	1	1	1	1	2	2	
Weight (kg)		17.0	25.0	31.7	42.5	52.9	70.0	71.0	85.0	
Accessories										
Rain canopy	1	2473.000	2473.000	2473.000	2474.000	2475.000	2475.000	2363.000	2363.000	899
Wall mounting bracket	4	2433.000	2433.000	2433.000	2433.000	2433.000	2433.000	2433.000	2433.000	905
Wall angle	1	2583.000	2583.000	2583.000	2583.000	2583.000	2583.000	2583.000	2583.000	906
Pole clamp	1	2584.000	2584.000	2584.000	–	–	–	–	–	906
Cam lock made from 1.4301	1	2304.000	2304.000	2304.000	2304.000	2304.000	–	–	–	887

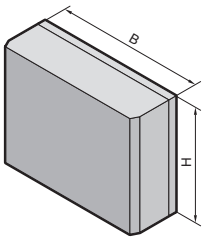
Lock systems

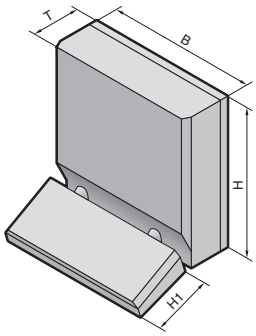
Standard double-bit lock insert may be exchanged in enclosures with cam (except AE 1018.600/AE 1019.600) for lock inserts 41 mm, lock cylinder insert, plastic handles, T-handles, type C, see page 886 – 889.
With AE 1018.600, may only be exchanged for 41 mm lock inserts, see page 888.
For enclosures with locking rod, may be exchanged for 27 mm lock inserts, type A, see page 888 and Ergoform-S lock system, see page 885.

To order compact enclosures in 1.4404 (AISI 316L), please add extension .500 to the Model No. Delivery times available on request.

Accessories Page 832 **Compact enclosures AE sheet steel** Page 118 **Compact enclosures AE, IP 69K** Page 121

Premium Panel, protection category IP 69K





A new design, a new concept for the seal and lock

- **Resistant to high-pressure cleaning** (protection category IP 69K). The seal lies between two surfaces and is ideally compressed by the screw fastening (see detailed drawing).
- **Suitable for clean room use.** Screw fastening to meet high standards in the food and hygiene sectors. With plastic stoppers on the inside or hex screws on the outside.
- **Optimum EMC conditions.** The labyrinthine seal achieves a particularly high level of RF shielding of the enclosure.
- **Accessibility.** Internal rear panel bracket. This solution is clearly superior to external hinges from a hygiene point of view.
- **Handling.** Two duct connectors between the enclosures.

Material:
Stainless steel 1.4301

Surface finish:
Brushed, grain 240

Protection category:
IP 69K to DIN 40 050-9/5.93

Property rights:
German patent
No. 102 16 430

Detailed drawing,
see page 1121.

		Packs of	Premium Panel					
			With keyboard housing				Without keyboard housing	
Model No. CP		1	**6680.000**	**6680.010**	**6680.100**	**6680.110**	**6681.000**	**6681.100**
Width (B) in mm			530	530	530	530	530	530
Height in mm	Operating housing (H)		460	460	460	460	360	360
	Keyboard housing (H1)		200	200	200	200	–	–
Depth in mm	Operating housing (T)		120	120	220	220	120	220
For installation panel W x H	Operating housing		482.6 mm (19″) x 354.8 mm (8 U)				482.6 mm (19″) x 310 mm (7 U)	
	Keyboard housing		482.6 mm (19″) x 177 mm (4 U)				–	–
Installation depth mm	Operating housing		115	115	215	215	115	215
	Keyboard housing		front 58 rear 63	front 58 rear 63	front 58 rear 63	front 58 rear 63	–	–
Support arm connection			top	bottom	top	bottom	top, bottom by rotating the enclosure	
Accessories								
Rear panel bracket		2	6682.000	6682.000	6682.000	6682.000	6682.000	6682.000

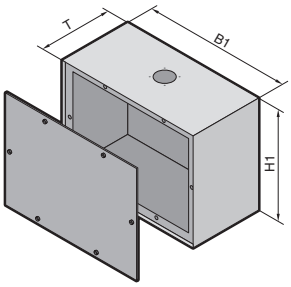
To order the Premium Panel in stainless steel 1.4404 (AISI 316L), use Model No. CP XX5X.XXX. Delivery times available on request.

The **rear panel bracket** holds the rear panel in an open position.
Model No. see page 893.

Premium Panel
with 17″ TFT.
Model No. see page 1046.

Accessories Page 832 **Premium Panel with 17″ TFT** Page 1046 **Support arm system CP-S stainless steel** Page 277

Command panel



Two configuration options:
- Front panel screw-fastened at the front, recessed front panel installation for a high level of mechanical protection for the top-mounted equipment.
- Front panel as rear panel, additional handle strips from plastic approved for use with foodstuffs similar to RAL 5002 (ultramarine blue) available on request.

Material:
Stainless steel 1.4301
Enclosure: 1.25 mm
Front panel: 2.0 mm

Surface finish:
Brushed, grain 240

Protection category:
IP 65 to EN 60 529/10.91

Supply includes:
Enclosure with cutout and reinforcement for support arm system (see page 277), front panel or rear panel with seal and assembly parts.

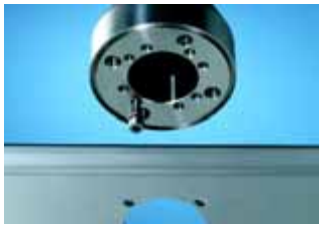
Approvals,
see page 38.

Detailed drawing,
see page 1122.

Width (B1) in mm	Packs of	320	400	Page
Height (H1) in mm		240	320	
Depth (T) in mm		160	160	
Model No. CP	1	**6670.000**	**6672.000**	
Weight (kg)		5	8	
Accessories				
Mounting plate	1	1563.700	1567.700	909
Mounting plate	4	4532.000	4532.000	929
Mounting brackets	4	4597.000	4597.000	930
Support rail TS 35/7.5 SZ	10	2316.000	2316.000	927

To order the operating housing in stainless steel 1.4404 (AISI 316L), please add extension .500 to the Model No. Delivery times available on request.

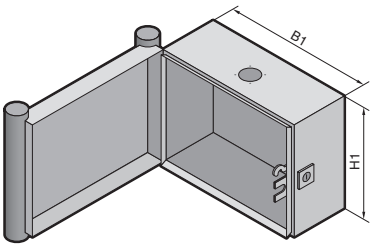
Handle strips
made from plastic approved for use with food, RAL 5002, on request.

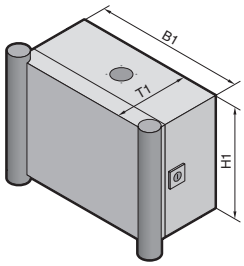


Enclosure attachment CP-S, stainless steel
with prefitted screw for location. Model No. see page 278.

Accessories Page 832 **Support arm system CP-S stainless steel** Page 277

Command panel housing with door





Material:
Enclosure and door:
Stainless steel 1.4301
Handle strips: Plastic approved for use with foodstuffs, similar to RAL 5002 (ultramarine blue).

Surface finish:
Brushed, grain 240

Protection category:
IP 66 to EN 60 529/10.91

Supply includes:
Enclosure of all-round solid construction, with cutout and reinforcement for support arm system,
fastener with guide plate.
Door with sealing frame and side handle strips.
The support arm connection and door hinge may be swapped over by rotating the enclosure.

Rittal service:
Separate keyboard housing, other sizes,
modified support arm cutout or door hinge,
holes and cutouts for switches and operator panels
available on request.

Approvals,
see page 32.

Detailed drawing,
see page 1122.

Width (B1) in mm	Packs of	300	400	400	600	Page
Height (H1) in mm		300	300	400	400	
Depth (T1) in mm		150	150	150	150	
Model No. CP	1	**6535.010**	**6536.010**	**6538.010**	**6539.010**	
Weight (kg)		6.3	7.5	8.8	12.1	
Accessories						
Matching mounting plate from AE		1033.500	1030.500	1380.500	1039.500	118
ID no.		271926	274131	271548	271351	
Support rails[1] SZ **Model No. SZ**	10	2316.000	2317.000	2317.000	2319.000	927
Lock systems						
Standard double-bit lock insert may be exchanged for 41 mm lock inserts, plastic handle and T handle, type C, see page 886 – 888.						

To order the command panel housing with door in stainless steel 1.4404 (AISI 316L), please add extension .510 to the Model No.
Delivery times available on request.
[1] Only with vertical attachment of punched rail 23 x 23 mm, see page 925.

Semi-cylinder lock
for retro-fitting to all stainless steel enclosures with cam lock.
Model No. see page 889.

Accessories Page 832 **Support arm system CP-S stainless steel** Page 277

Support arm system CP-S, stainless steel

In conjunction with stainless steel command panels, terminal boxes 120 mm deep and compact enclosures AE from stainless steel, this support arm system is particularly well-suited for meeting high standards of corrosion protection and hygiene.
The tilting adaptor and enclosure coupling may optionally be mounted on the top or bottom of the enclosure. **They are not suitable for use as the base point of a system.** For this purpose, we recommend wall/base mountings, or with larger heights and widths, an additional pillar made of steel tubing or stainless steel (available on request).

Material:
Stainless steel 1.4305

Protection category:
IP 69K to DIN 40 050-9/5.93
(resistant to high-pressure cleaning)

Load information:
see page 188.

Support section CP-S, stainless steel

Attachment to the connecting components with 2 clamping screws.

Dimensions:
External diameter: 48.3 mm
Wall thickness: 3.6 mm

Material:
Stainless steel 1.4301

Surface finish:
Brushed, grain 240

Other sizes possible on request according to specifications.

Order example:
U-shaped = CP 6660.200
Dimension A = 300 mm
Dimension B = 800 mm
Dimension C = 240 mm

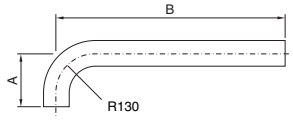
The minimum dimensions must be adhered to, because of the bending radius and insertion depth of the enclosure attachment, housing coupling and wall/base mountings.

Straight
$A_{min.}$ = 100 mm,
A_{max} = 2000 mm

A mm	Weight kg	Model No. CP
500	2.0	**6660.050**
1000	3.9	**6660.010**
2000	7.8	**6660.020**
To specifications A =	3.9 kg/m	**6660.000**[1)]

[1)] Extended delivery times.

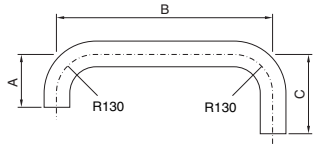
L-shaped
$A_{min.}$ = $B_{min.}$ = 240 mm,
$B_{max.}$ = 1500 mm



A mm	B mm	Weight kg	Model No. CP
240	500	2.6	**6660.110**
500	1000	5.5	**6660.120**
To specifications A =	To specifications B =	3.9 kg/m	**6660.100**[1)]

[1)] Extended delivery times.

U-shaped
$A_{min.}$ = $C_{min.}$ = 240 mm,
$B_{min.}$ = 410 mm,
$B_{max.}$=1500 mm



A mm	B mm	C mm	Weight kg	Model No. CP
240	800	800	6.6	**6660.210**
240	500	500	4.3	**6660.220**
To specifications A =	To specifications B =	To specifications C =	3.9 kg/m	**6660.200**[1)]

[1)] Extended delivery times.

Support arm system CP-S

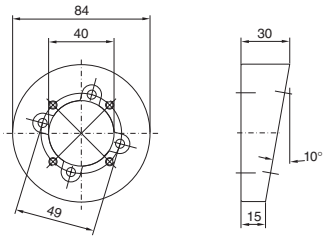
Tilting adaptor, 10° CP-S stainless steel

For mounting between the command panel and
- Enclosure attachment CP 6664.500
  or
- Housing coupling CP 6664.000

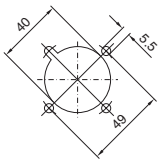
Material:
Stainless steel 1.4305

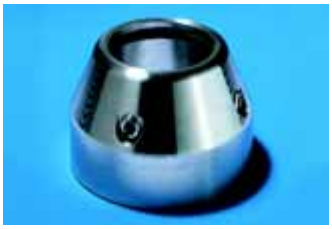
Weight kg	Model No. CP
0.7	**6664.100**

Supply includes:
Seal and assembly parts.



Mounting cutout
Enclosure





Enclosure attachment CP-S stainless steel

For rigid fastening of the enclosure to the support section.

Material:
Stainless steel 1.4305

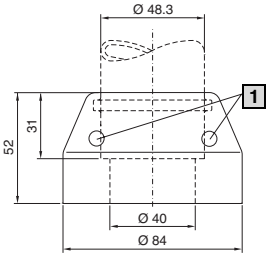
Supply includes:
Seals and 2 clamping screws for support section CP-S, stainless steel.

Note:
For assembly of a pedestal, modular, see page 281, 2 pieces are required.

Weight kg	Model No. CP
1.3	**6664.500**

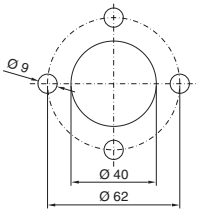
Accessories:

Enclosure reinforcement, see page 281.

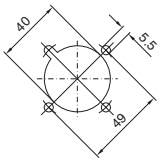


1 Clamping screw

Mounting cutout
for pedestal, bottom



Mounting cutout
enclosure



Housing coupling CP-S stainless steel

For mounting on the vertical part of the support arm system.

Rotation range:
Approx. 350°, lockable via knurled screw.

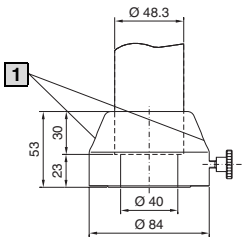
Material:
Stainless steel 1.4305

Supply includes:
Seals and 2 clamping screws for support section CP-S, stainless steel.

Weight kg	Model No. CP
1.1	**6664.000**

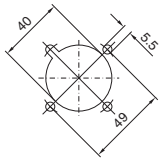
Accessories:

Enclosure reinforcement, see page 281.



1 Clamping screw

Mounting cutout
enclosure



Wall/base mounting, rigid, CP-S stainless steel

For attaching the support arm system to vertical or horizontal surfaces.

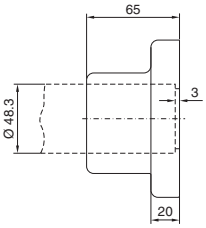
Material:
Stainless steel 1.4305

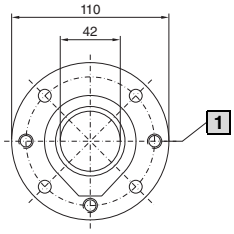
Supply includes:
Seals, 3 adjusting screws to compensate for any irregularities, and 2 clamping screws for support section CP-S, stainless steel.

Weight kg	Model No. CP
1.7	**6663.000**

Accessories:

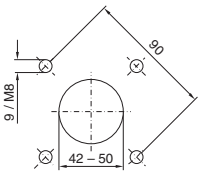
Wall consoles,
see page 280.





1 Adjusting screw

Mounting cutout



1

1

2

2

Swivel base mount, CP-S stainless steel

For external mounting on
- Horizontal surfaces (suspended or top-mounted)
- Wall console (CP 6663.500 only)

Rotation range:
Approx. 350°, lockable via knurled screw.

Material:
Stainless steel 1.4305

Supply includes:
Seals and 2 clamping screws for support section CP-S, stainless steel.

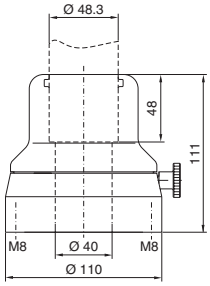
Note:
Rotation range may be limited in 60° increments using a limit plate, supplied loose.

Attachment	Weight kg	Model No. CP
1 rear, M8 thread	3.9	**6663.500**
2 front, hole Ø 9 mm	4.5	**6663.400**

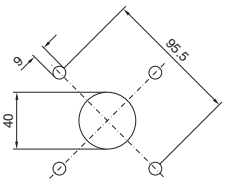
Accessories:

Wall consoles for base attachment CP 6663.500,
see page 280.

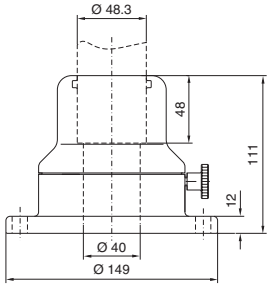
1 Rear attachment CP 6663.500



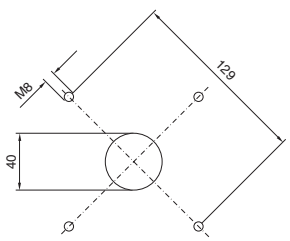
Mounting cutout



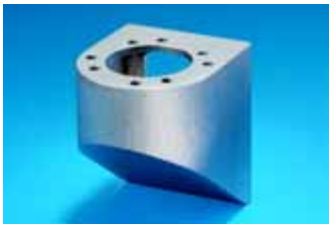
2 Front attachment CP 6663.400



Mounting cutout

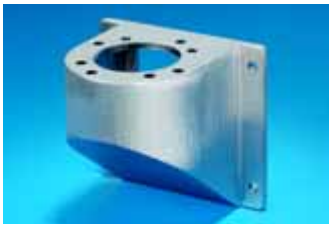


Support arm system CP-S



1

1



2

2

Wall console CP-S stainless steel

With holes for mounting

- Base mount, swivel, CP-S (CP 6663.500), with 4 screws
- Wall/base mount, rigid, CP-S (CP 6663.000), with 4 screws and nuts

Material:
Stainless steel 1.4301

Surface finish:
Brushed, grain 240

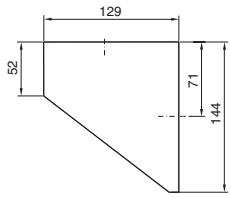
Supply includes:
Seals and assembly parts.

1 Rear attachment, M8 thread

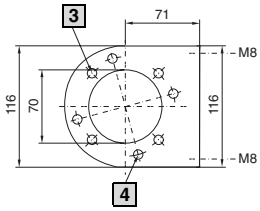
2 Front, hole Ø 9 mm

Attachment	Weight kg	Model No. CP
rear, M8 thread	1.5	**6665.000**
front, hole Ø 9 mm	1.8	**6665.500**

Rear fastening



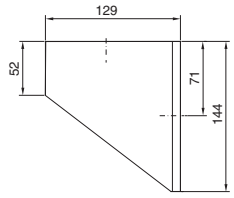
Mounting cutout



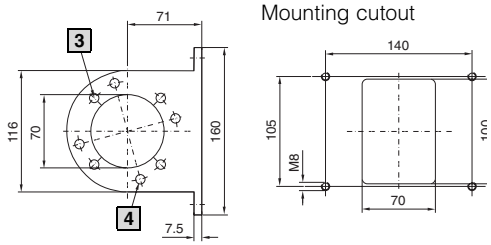
3 Hole for PG 6663.000

4 Hole for PG 6663.500

Front fastening

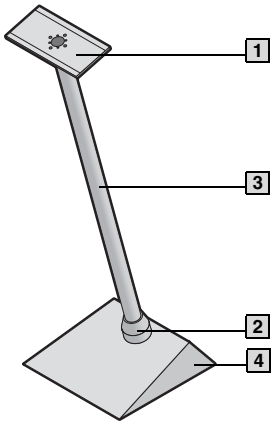


Mounting cutout



3 Hole for PG 6663.000

4 Hole for PG 6663.500

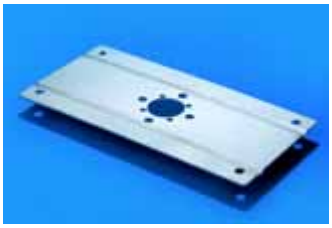


Pedestal, modular, CP-S stainless steel

For the configuration of compact operating stations.

May be compiled from the following modules:	Model No. CP	Page
1 Enclosure reinforcement	**6143.310**	281
2 2 enclosure attachments top/bottom	**6664.500**	278
3 Support section, straight (may be shortened to required length by sawing)		
500 mm	**6660.050**	277
1000 mm	**6660.010**	277
2000 mm	**6660.020**	277
4 Pedestal base plate, small	**6143.300**	281

Detailed drawing,
see page 1123.



Enclosure reinforcement CP-S stainless steel

For external or internal reinforcement of stainless steel enclosures of a corresponding size. Smaller enclosures may also be mounted directly without a flange.

For use with
- Enclosure attachment CP 6664.500
- Housing coupling CP 6664.000

Material:
Stainless steel 1.4301

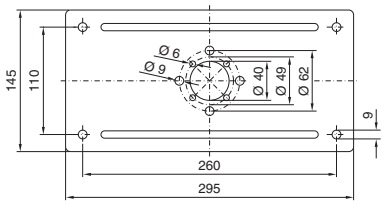
Surface finish:
Brushed

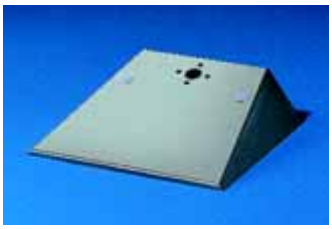
Supply includes:
Assembly parts for the enclosure and support section plus 2 seals.

Packs of	Model No. CP
1	**6143.310**

Accessories:

Enclosure attachment CP 6664.500,
see page 278.
Housing coupling CP 6664.000,
see page 278.





Pedestal base plate, small

With reinforcement bracket for assembling a support section via an enclosure attachment.

- With one hole at the rear for commercially available cable conduit gland M20.
- With two holes at the top (including sealing bung) for lower base attachment cross member.
- Prepared on the inside for a cable clamp DK 7077.000 or DK 7078.000 for strain relief.

Material:
Stainless steel 1.4301

Surface finish:
Brushed

Packs of	Model No. CP
1	**6143.300**

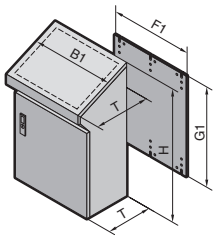
Supply includes:
Assembly parts for enclosure attachment plus seal.

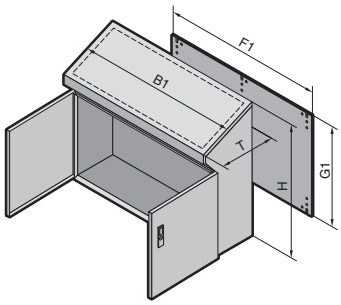
Note:
Commercially available screws up to M8 may be used for floor attachment.

Accessories:

Cable clamp DK 7077.000 or DK 7078.000,
see page 981.

One-piece consoles AP





Material:
Stainless steel 1.4301
Enclosure: 1.5 mm
Door or double door and console lid: 2.0 mm
Mounting plate:
3.0 mm sheet steel

Surface finish:
Enclosure, door and console lid:
Brushed, grain 120
Mounting plate: Zinc-plated

Protection category:
IP 55 to EN 60 529/10.91, complies with NEMA 12.

Supply includes:
Enclosure, solid rear and sides, door or double door at front, with locking rod,
console lid with lid stay and stainless steel cam latched in the enclosure,
two-piece gland plate,
mounting plate, zinc-plated, passivated.

Approvals,
see page 36.

Detailed drawing,
see page 1118.

Width (B1) in mm		Packs of	600	800	1000	1200	Page
Height (H) in mm			960	960	960	960	
Depth (T) in mm			400/480	400/480	400/480	400/480	
Mounting plate width (F1) in mm			530	730	930	1130	
Mounting plate height (G1) in mm			780	780	780	780	
Model No. AP		1	**2683.600**	**2684.600**	**2685.600**	**2686.600**	
Door(s)			1	1	2	2	
Weight (kg)			52.0	65.2	79.5	90.3	
Accessories							
Base/plinth	Height 100 mm	1	2865.000	2869.000	2867.000	2870.000	844
	Height 200 mm	1	2875.000	2878.000	2885.000	2886.000	844
Lock systems							
Standard double-bit lock insert of the locking rod may be exchanged for 27 mm lock inserts, type A, see page 888 and Ergoform-S lock system, see page 885.							

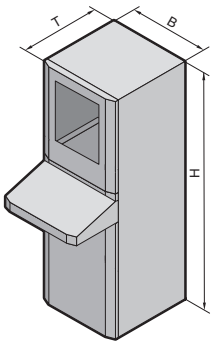
To order one-piece consoles in stainless steel 1.4404 (AISI 316L), please add extension .500 to the Model No. Delivery times available on request.

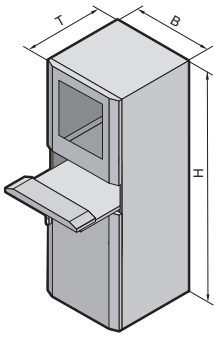
Wall console, stainless steel
mounted on the rear panel for an additional operating housing.
Model No. see page 280.

Cable gland, brass.
Model No. see page 972.

Accessories Page 832 **Monitors, keyboards** Page 1046 **Climate control** Page 578

PC enclosure systems





PC 4650.000
with keyboard drawer
- Lock insert, lock no. 3524 E
- Swing-down front for handrest
- Mousepad support (also suitable for IP 67 mouse), may optionally be used on the left or right
- Hinged cable support

PC 4650.704
with desk section
- Cover plate top and bottom
- Designer strip made from plastic approved for use with foodstuffs

Material:
Stainless steel 1.4301
Enclosure:
10-fold profiled, 1.8 mm
Rear door: 2.0 mm
Gland plates: 1.5 mm
Monitor field with single-panel safety glass for screen diagonal 482.6 mm (19″).

Surface finish:
Brushed, grain 240

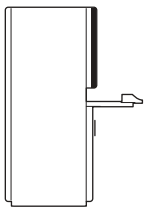
Protection category:
IP 55 to EN 60 529, complies with NEMA 12.

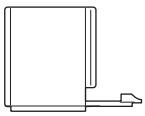
Supply includes:
see page 1123.

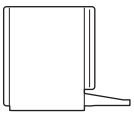
Available on request:
- PC enclosure system with mounting compartment, large and drawer
- PC enclosure system with drawer
- PC enclosure system with desk section

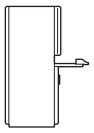
Approvals,
see page 34.

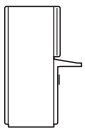
Detailed drawing,
see page 1123.











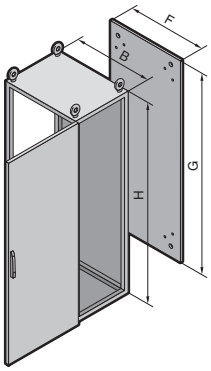
Version		Packs of	1 With keyboard drawer	2 With desk section	Page
Width (B) in mm			600	600	
Height (H) in mm			1600	1600	
Depth (T) in mm			620	620	
Model No. PC		1	**4650.000**	**4650.704**	
Weight (kg)			115	123	
Accessories					
Base/plinth	Height 100 mm	1	2855.000	2855.000	844
	Height 200 mm	1	2877.000	2877.000	844
Levelling feet, 100 mm high		1 set	2859.000	2859.000	848
Base/plinth trim, modular		4	2913.000	2913.000	841
Adaptor sections 482.6 mm (19″)		4	4632.000	4632.000	1003
Adaptor pieces 482.6 mm (19″)		8	4547.000	4547.000	1004
Lock systems					

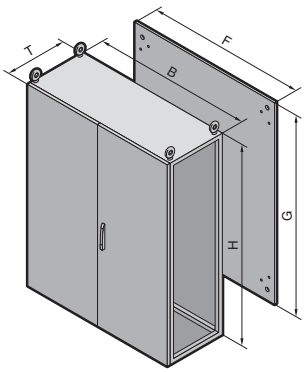
Standard double-bit lock insert may be exchanged for 27 mm lock inserts, type A, see page 888, or lock cylinder inserts, type B, see page 889.
Lower and rear door prepared for installation of the Ergoform-S lock system, see page 885.

To order enclosures in stainless steel 1.4404 (AISI 316L), please add extension .50X the the Model No. Delivery times available on request.

Accessories Page 832 **PC enclosure systems, sheet steel** Page 256 **Stainless steel keyboard 482.6 mm (19″)/4 U** Page 1047

Baying systems TS 8





Material:
Stainless steel 1.4301:
Enclosure frame, roof, rear panel and gland plates: 1.5 mm
Door(s): 2.0 mm
Mounting plate:
Sheet steel, 3.0 mm

Surface finish:
Enclosure frame and gland plates: Bare
Door, roof and rear panel: Brushed on the outside, grain size 240
Mounting plate: Zinc-plated

Protection category:
IP 55 to EN 60 529/10.91, complies with NEMA 12.

Supply includes:
Enclosure frame with door(s), mounting plate, gland plates, rear panel and roof, 2 support strips fitted in the enclosure depth (only with depth 600 mm).

Note:
Due to the hardness of the material, we recommend using metal hexagon socket screw SZ 2486.300, see page 937, for the interior installation.

Approvals,
see page 29.

Detailed drawing,
see page 1091.

Rittal service:

TS stainless steel (1.4301) available in protection category NEMA 4x on request – please add extension .640 to the Model No.

Width (B) in mm		Packs of	800	1200	600	800	1200	600	800	1200	Page
Height (H) in mm			1800	1800	1800	1800	1800	2000	2000	2000	
Depth (T) in mm			400	400	500	500	500	600	600	600	
Mounting plate width (F) in mm			699	1099	499	699	1099	499	699	1099	
Mounting plate height (G) in mm			1696	1696	1696	1696	1696	1896	1896	1896	
Model No. TS		1	**8454.600**	**8456.600**	**8457.600**	**8455.600**	**8453.600**	**8452.600**	**8450.600**	**8451.600**	
Door(s)			1	2	1	1	2	1	1	2	
Weight (kg)			112.9	170.4	92.5	116.3	174.9	104.4	129.7	194.7	
Walls											
Side panels		2	8700.840	8700.840	8700.850	8700.850	8700.850	8700.060	8700.060	8700.060	853
Divider panel		1	8609.840	8609.840	8609.850	8609.850	8609.850	8609.060	8609.060	8609.060	857
Divider panel for module plates		1	–	–	8609.100	8609.100	8609.100	8609.130	8609.130	8609.130	858
Base/plinth											
Components front and rear	Height 100 mm	1 set	8701.800	8701.200	8701.600	8701.800	8701.200	8701.600	8701.800	8701.200	841
	Height 200 mm	1 set	8702.800	8702.200	8702.600	8702.800	8702.200	8702.600	8702.800	8702.200	841
Trim panels (sides)	Height 100 mm	1 set	8701.040	8701.040	8701.050	8701.050	8701.050	8701.060	8701.060	8701.060	841
	Height 200 mm	1 set	8702.040	8702.040	8702.050	8702.050	8702.050	8702.060	8702.060	8702.060	841
Base/plinth trim, modular		4	2907.000	2907.000	2908.000	2908.000	2908.000	2913.000	2913.000	2913.000	841
Accessories											
Cable clamp rails		2	4192.000	4196.000	4191.000	4192.000	4196.000	4191.000	4192.000	4196.000	979
Cable entry plates		2	8700.800	8700.120[1)]	8700.600	8700.800	8700.120[1)]	8700.600	8700.800	8700.120[1)]	964
Wiring plan pocket, sheet steel		1	4118.000	4116.000	4116.000	4118.000	4116.000	4116.000	4118.000	4116.000	898
Lock systems											
Standard double-bit lock insert may be exchanged for other inserts and comfort handle, see page 881/888.											

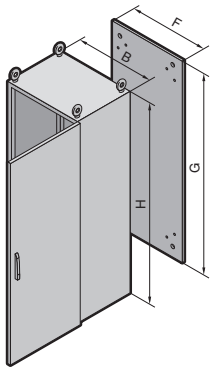
To order enclosures in stainless steel 1.4404 (AISI 316L), please add extension .500 to the Model No. Delivery times available on request.
[1)] Packs of 4

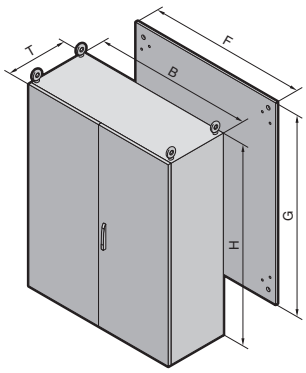
Snap-on nut
for screw-fastening to the vertical section with a thread.
Model No. see page 931.

Cable trunking, vertical,
sized to the section and horizontally on the mounting plate.
Model No. see page 977.

Accessories Page 832 **Baying systems TS 8, sheet steel** Page 138 **Baying systems TS 8 EMC-shielded** Page 291

Free-standing enclosures ES 5000





Material:
Stainless steel 1.4301
Enclosure: 1.8 mm
Door(s): 2.0 mm
Rear panel: 1.5 mm
Mounting plate:
3.0 mm sheet steel

Surface finish:
Enclosure, rear panel and doors:
Brushed, grain 240
Mounting plate: Zinc-plated

Protection category:
IP 56 to EN 60 529/10.91 (single-door ES),
IP 55 to EN 60 529/10.91 (double-door ES),
complies with NEMA 12.

Supply includes:
Enclosure, solid top and sides, removable rear panel,
r/h door hinge,
may be swapped to opposite side, except ES 5455.600;
130° hinges,
mounting plate,
three-piece gland plates.

Note:
Due to the hardness of the material, we recommend using metal hexagon socket screw SZ 2486.300 for the interior installation, see page 937.

Approvals,
see page 28.

Detailed drawing,
see page 1089.

Width (B) in mm		Packs of	600	600	800	800	1000	1200	Page
Height (H) in mm			1600	1800	1800	2000	1800	2000	
Depth (T) in mm			400	500	500	600	400	500	
Mounting plate width (F) in mm			499	499	699	699	899	1099	
Mounting plate height (G) in mm			1496	1696	1696	1896	1696	1896	
Model No. ES		1	**5450.600**	**5451.600**	**5452.600**	**5453.600**	**5454.600**	**5455.600**	
Door(s)			1	1	1	1	1	2	
Eyebolts			2	2	2	2	4	4	
Weight (kg)			92.5	169.6	131.8	154.0	146.9	205.4	
Accessories									
Base/plinth	Height 100 mm	1	2865.000	2868.000	2866.000	2856.000	2867.000	2860.000	844
	Height 200 mm	1	2875.000	2876.000	2879.000	2880.000	2885.000	2887.000	844
Base/plinth trim, modular		4	2907.000	2908.000	2908.000	2913.000	2907.000	2908.000	841
System support rails		2	4361.000	4361.000	4362.000	4362.000	4347.000	4363.000	926
Cable clamp rails		2	4191.000	4191.000	4192.000	4192.000	4336.000	4196.000	979
Mounting bars		20	4596.000	4596.000	4598.000	4598.000	4599.000	4596.000	895
Utility lectern		1	4638.600	4638.600	4638.800	4638.800	–	4638.600	896
Wiring plan pockets		1	4116.000	4116.000	4118.000	4118.000	4124.000	4116.000	898
Lock systems									
Standard double-bit lock insert may be exchanged for 27 mm lock inserts, type A, see page 888, and Ergoform-S lock system, see page 885.									

To order enclosures in stainless steel 1.4404 (AISI 316L), please add extension .500 to the Model No. Delivery times available on request.

Cable gland, brass,
nickel-plated in IP 68 (5 bar, 30 min),
Model No. see page 972.

Signal pillar LED compact,
Model No. see page 1041.

Accessories Page 832 **ES 5000 sheet steel** Page 136 **ES 5000 EMC-shielded** Page 291

Ex enclosures

Features

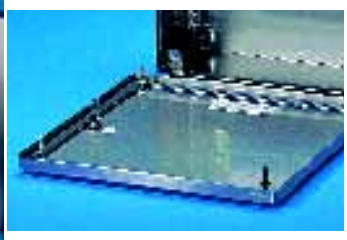
Under ATEX, the requirements placed on Ex enclosures for use in explosion hazard atmospheres are high. For this reason, Rittal refuses to compromise in this area. Enclosure concepts proven a million times over are tailored to the specific Ex requirements. The results is a series of empty enclosures providing ideal conditions for applications in the chemicals and petrochemicals industries, in the offshore sector and in the foods industry.

Baying systems TS 8 prepared for Ex pressurisation,

see page 152.

Rittal Ex enclosures — Individual Ex equipment — Signing-off by a test institute

Ex enclosures, stainless steel



Based on KL
with screw-fastened cover and profile strips with mounting holes on both sides of the enclosure for the attachment of support rails or mounting plate.

Based on AE
with hinged door, cam lock and mounting plate made from sheet steel, zinc-plated.

Blind threaded bushes M8 in the rear panel for wall mounting and side panel for **external connection of a PE conductor.**

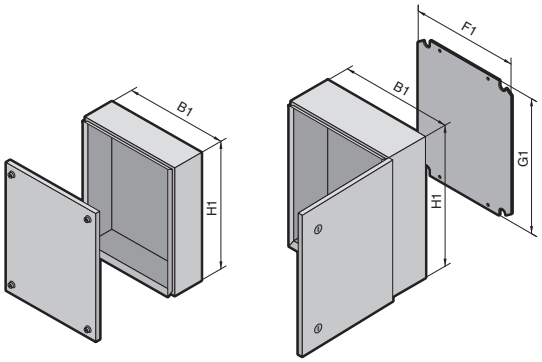
Ex enclosures, plastic

Double seal on top and/or bottom edges of the door thanks to additional, integral rain protection strip.

Attachment from the outside with **wall mounting bracket** 9266.000 into the threaded inserts M8 x 15.

Moulded **bosses** in the door for the attachment of cable routing.

Stainless steel



With screw-fastened lid

Material:
Stainless steel 1.4301

Surface finish:
Brushed, grain 240

Protection category:
IP 66 to EN 60 529/10.91

Supply includes:
Enclosure, lid with all-round foamed-in PU seal.

Certificates:
PTB 03 ATEX 1013U

With hinged door

Material:
Stainless steel 1.4301
Mounting plate: Sheet steel

Surface finish:
Brushed, grain 240
Mounting plate: Zinc-plated

Protection category:
IP 66 to EN 60 529/10.91

Supply includes:
Enclosure, door with all-round foamed-in PU seal, mounting plate.

Certificates:
PTB 02 ATEX 1082U

Approvals,
see page 38.

Detailed drawing,
see page 1119 – 1120.

With screw-fastened lid

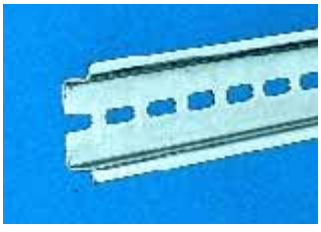
Width (B1) in mm	Packs of	150	200	300	300	300	400	Page
Height (H1) in mm		150	200	150	200	300	200	
Depth in mm		80	80	80	80	120	120	
Model No. KEL	1	**9301.000**	**9303.000**	**9302.000**	**9304.000**	**9306.000**	**9305.000**	
Weight (kg)		1.3	1.8	1.8	2.4	3.9	3.6	
Accessories								
Mounting plates		1560.700	1562.700	1561.700	1563.700	1567.700	1564.700	909

To order Ex enclosures in stainless steel 1.4404 (AISI 316L), please add extension .500 to the Model No. Delivery times available on request.

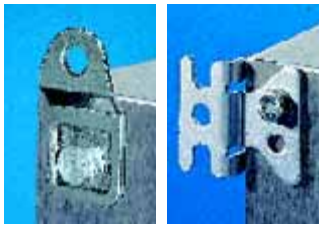
With hinged door

Width (B1) in mm	Packs of	200	300	380	380	380	600	600	760	800
Height (H1) in mm		300	380	300	380	600	600	760	760	1000
Depth in mm		155	210	155	210	210	210	210	300	300
Mounting plate width (F1) in mm		162	334	334	334	334	549	549	704	739
Mounting plate height (G1) in mm		275	275	275	355	570	570	730	730	955
Model No. KEL	1	**9401.600**	**9409.600**	**9402.600**	**9403.600**	**9404.600**	**9405.600**	**9406.600**	**9407.600**	**9408.600**
Number of fasteners		1	1	1	1	2	2	2	2	2
Weight (kg)		3.8	7.7	7.4	9.7	13.3	15.6	22.3	30.5	36.3

To order Ex enclosures in stainless steel 1.4404 (AISI 316L), please add extension .500 to the Model No. Delivery times available on request.



Support rails
in matching sizes,
Model No. see page 927.

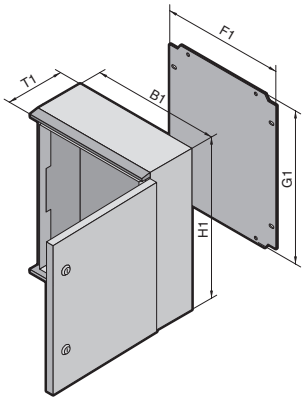


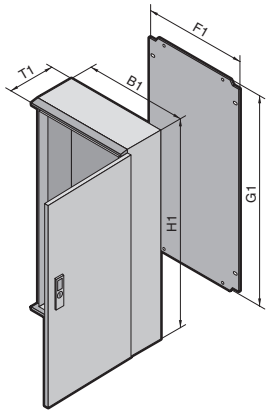
Wall mounting bracket,
Model No. see page 905.

Accessories Page 832 **Cable entry** Page 964

Ex enclosures

Plastic





Material:
Enclosure: Fibreglass-reinforced unsaturated polyester.
Surface resistance: < 10^9 Ω
Mounting plate:
Sheet steel, zinc-plated, passivated

Colour:
RAL 9011

Protection category:
IP 66 to EN 60 529/10.91
KEL 9209.600:
IP 56 to EN 60 529/10.91

Supply includes:
Enclosure, door with all-round foamed-in PU seal, mounting plate.

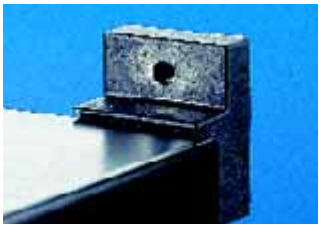
Certificates:
PTB 03 ATEX 1011U

Approvals,
see page 38.

Detailed drawing,
see page 1087 – 1088.

Width (B1) in mm	Packs of	200	250	300	400	400	500	600	600	800
Height (H1) in mm		300	350	400	400	600	500	600	800	1000
Depth (T1) in mm		150	150	200	200	200	300	200	300	300
Mounting plate width (F1) in mm		145	195	245	345	345	417	545	517	717
Mounting plate height (G1) in mm		250	300	350	350	550	450	550	750	950
Model No. KEL	1	**9201.600**	**9202.600**	**9203.600**	**9204.600**	**9205.600**	**9207.600**	**9206.600**	**9208.600**	**9209.600**
Number of cams		1	1	2	2	2	2	2	[1]	[1]
Weight (kg)		3.7	4.6	6.0	6.5	11.5	12.9	15.9	24.3	39.0

[1] 3-point lock system.

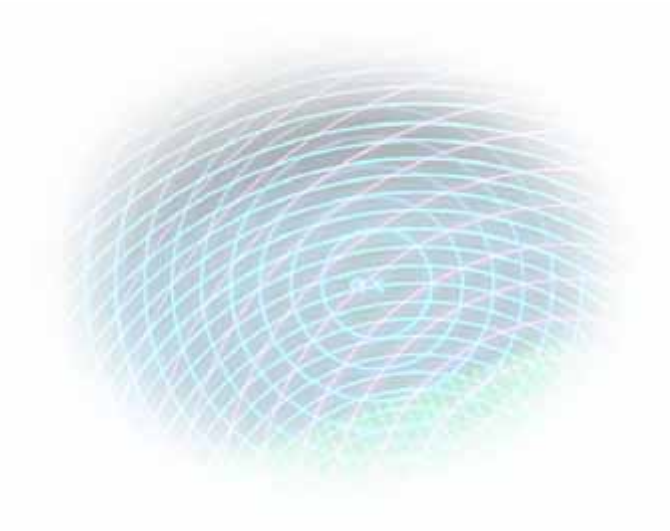


Wall mounting bracket,
Model No. see page 905.

Baying system TS 8,
prepared for EX pressurisation,
Model No. see page 152.

Accessories Page 832 **Cable entry** Page 964

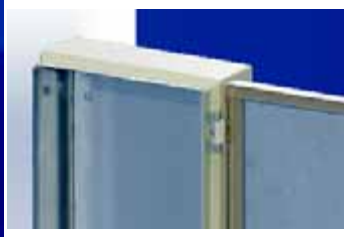
Features



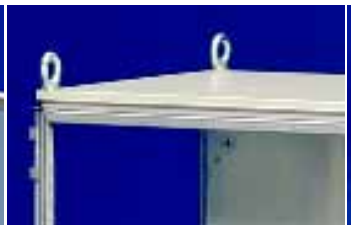
Forward-thinking EMC planning is crucial for the permanent functioning of sensitive electronics.

Electromagnetic compatibility is required of your product. For this reason, our EMC specialists will support you with expert assistance and advice. We can help you to effectively prevent both the inlet and outlet of interference fields into and from enclosures.

EMC enclosures and cases



EMC enclosures: Gland plates are deliberately omitted in order to achieve a high shielding effect.

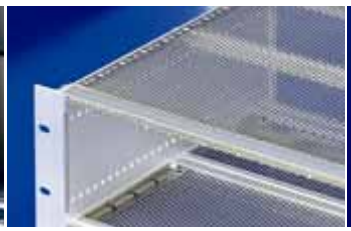


EMC baying system: Frame made from sheet steel with an aluminium zinc surface finish. EMC/IP combination seals ensure slot-free all-round contact.

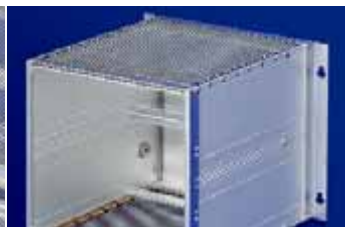
EMC free-standing enclosures: Solid top and sides. EMC/IP seals are attached to the door, rear panel and gland plate.

EMC subracks and systems

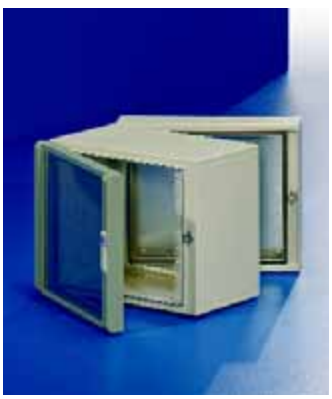
Ripac rack-mounted systems for CPCI and VMEbus, complete with power supply, backplane, climate control, EMC and ESD protection.



Ripac Vario EMC: Vibration and shock-tested subracks equipped for EMC-compatible installation.



Ripac Compact and Ripac Vario Mobil: The EMC specialists for mounting on top-hat rails, mounting plates, or for use in rail vehicles.



EMC electronic enlcosures

Electronic Kombi systems EL: Front door with EMC safety glass, hinged centre part, solid wall unit.

Low-resistance connection between the glazed door and conductive sealing edge ensures a high shielding effect.

Instrument case Vario-Case iS: The plastic base and cover tray are aluminium-coated.

The Rittal EMC concept

Rittal offers excellent pre-requisites for EMC enclosure configurations in the form of its standard sheet steel enclosures, EMC-shielded enclosures, and a practical range of EMC accessories.
Even the standard enclosures offer a good shielding effect against electrical fields which is sufficient for many applications.

Be it closely intermeshed potential equalisation in a standard enclosure to prevent line-bound interference, or extra shielding to protect against high-frequency electromagnetic fields – everything is possible, to suit the individual application.
The large enclosures in the TS 8 series offer "good" shielding, even in the standard version.

For Rittal EMC enclosures with a high level of shielding, excellent attenuation levels and attractive value-for-money products are achieved on the basis of zinc-plated metal surfaces in conjunction with low-resistance EMC shields.
According to EMC legislation, CE labelling is only compulsory for (active) equipment and systems.
Empty enclosures are not subject to the EMC Directive because these are passive components which cannot be furnished with a declaration of conformity with regard to EMC standards.

EMC terminal boxes KL

Material/surface finish:
Sheet steel with aluminium zinc coating, powder-coated on the outside in RAL 7035, interior surfaces conductive.

Protection category:
IP 55 to EN 60 529/10.91.
The EMC version ("high RF attenuation") has been certified by the VDE.

Supply includes:
Enclosure, cover with special seal and cover screws.

Width mm	Height mm	Depth mm	Model No. KL
300	300	120	**1507.750**

Other sizes available on request.

Approvals,
see page 39.

EMC diagram,
see page 293.

EMC E-Box EB

Material/surface finish:
Sheet steel with aluminium zinc coating, powder-coated on the outside in RAL 7035, interior surfaces conductive.

Protection category:
IP 55 to EN 60 529/10.91.
The EMC version ("high RF attenuation") has been certified by the VDE.

Supply includes:
Enclosure with mounting plate, door with special seal including 180° hinge and cam lock with double-bit insert.

Note:
All sizes available on request.

EMC diagram,
see page 293.

EMC compact enclosures AE

Material/surface finish:
Sheet steel with aluminium zinc coating, powder-coated on the outside in RAL 7035, interior surfaces conductive.

Protection category:
IP 55 to EN 60 529/10.91.
The EMC version ("high RF attenuation") has been certified by the VDE.

Supply includes:
Enclosure with mounting plate, door with special seal (130° hinge) including cam lock with double-bit insert.

Width mm	Height mm	Depth mm	Model No. AE
380	380	210	**1380.750**
600	380	210	**1039.750**
600	600	210	**1060.750**
800	1000	300	**1180.750**

Other sizes available on request.

Approvals,
see page 39.

EMC diagram,
see page 293.

EMC baying systems TS 8

Material:
Sheet steel with aluminium zinc coating
Door: 2.0 mm
Rear panel: 1.5 mm
Mounting plate: 3.0 mm

Surface finish:
Framework, door, rear panel and roof plate of sheet steel with an aluminium zinc coating, spray-finished on the outside in RAL 7035 and unpainted on the inside.

Protection category:
IP 55 to EN 60 529/10.91.
The EMC version ("high RF attenuation") has been certified by the VDE.

Supply includes:
Enclosure frame with door,
rear panel and roof plate removable,
r/h door hinge, may be swapped to opposite side,
4 eyebolts, fitted,
mounting plate,
three-piece gland plates.

Note:
All sizes and side panels available on request.

Property rights:
European patent no. 0 857 406
with validity for
CH, ES, FR, GB, IT, NL, SE
US patent no. 6,384,323
Japanese patent no. P 3 193 059

Also required:
EMC baying seal TS 8800.690,
see page 959, with bayed enclosure suites.

Approvals,
see page 293.

EMC diagram,
see page 293.

EMC free-standing enclosure ES 5000

Material:
Sheet steel with aluminium zinc coating
Enclosure body: 10-fold profiled
Door: 2.0 mm
Rear panel: 1.5 mm
Mounting plate: 3.0 mm

Surface finish:
Enclosure body, door and rear panel of sheet steel with aluminium zinc coating,
painted in RAL 7035 on the outside and unpainted on the inside.

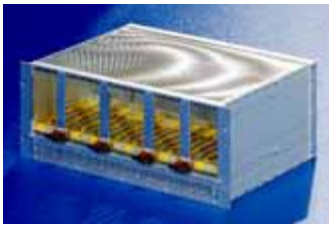
Protection category:
IP 55 to EN 60 529/10.91.
The EMC version ("high RF attenuation") has been certified by the VDE.

Supply includes:
Enclosure, solid top and sides, removable rear panel,
r/h door hinge, may be swapped to opposite side,
2 eyebolts, not fitted,
mounting plate,
three-piece gland plates.

Note:
All sizes available on request.

Approvals,
see page 293.

EMC diagram,
see page 293.



EMC subracks Ripac Vario

The Ripac Vario EMC subrack system was developed with consideration for EMC aspects. The subracks are equipped with a conductive surface finish and may be supplemented with additional EMC components such as springs and extrusions. This allows individual EMC requirements to be met, depending on the specific application in question.

Technical specifications:
Overall depth:
245, 285, 305, 345, 405, 465, 525, 585 mm
Installation width: 84 HP
Height: 3 U, 4 U, 6 U, 7 U, 9 U

Testing:
Vibration and shock-tested to:
IEC 600-68-2-6 test Fc
IEC 600-68-2-27 test Ea

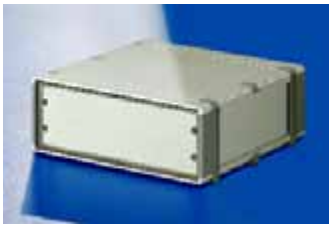
Standards:
Ripac Vario subracks are based on the system dimensions to IEC 60 297-3/-5.

Material:
Side panels: 2.5 mm aluminium
Gland plates and horizontal rails:
Extruded aluminium section
Cover plates: Aluminium

Surface finish:
Clear-chromated

Note:
For further information,
see page 491.

EMC diagram,
see page 293.



EMC instrument case Vario-Case iS

Instrument case for slide-in equipment, 482.6 mm (19″) and modular assemblies.
Width: 534 mm

Material:
Side panels:
Extruded aluminium section, chromated on the inside, painted on the outside
Cover trays:
Plastic to UL 94-V0 (self-extinguishing), with a conductive coating on the inside
Rear panel: 2 mm aluminium, clear-chromated
Front panel: 2 mm aluminium, clear-chromated

Surface finish:
Clear-chromated/spray-finished, RAL 7030/7035

Supply includes:
2 plastic cover trays,
8 enclosure feet (12 with 400 mm depth),
2 side panels,
1 rear panel,
1 front panel,
4 mounting flanges, 482.6 mm (19″),
4 tapped strips,
4 untapped strips,
assembly parts.

HP	U	Height mm	Depth mm	Model No. VC
84	4	208.10	300	**3743.700**
84	7	341.40	400	**3774.700**
84	3	163.65	300	**3733.700**
84	3	163.65	400	**3734.700**
84	6	297.00	400	**3764.700**
84	6	297.00	500	**3765.700**
84	9	430.50	500	**3795.700**

Delivery times available on request.

EMC diagram,
see page 293.

EMC electronic Kombi system EL, 3-part

Material:
Wall unit and centre part:
1.5 mm sheet steel, yellow-passivated on the inside
Mounting plate:
2.75 mm sheet steel
Front door:
Extruded aluminium section, die-cast aluminium corner connectors, 4 mm safety glass, with EMC mesh.

Surface finish:
Textured stove enamel,
enclosure RAL 7035,
interior surfaces zinc-plated and passivated,
door frame RAL 7033.

Protection category:
IP 55 to EN 60 529/10.91

Supply includes:
1 wall unit, solid,
2 gland plates, solid,
1 centre part, vertically hinged,
2 mounting angles, 482.6 mm (19″), fitted,
1 mounting plate, zinc-plated,
1 front door with EMC safety glass.

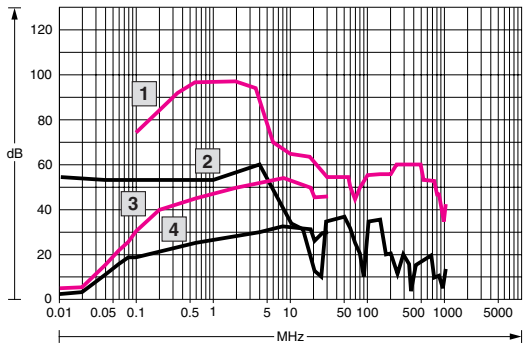
U	Width mm	Height mm	Depth mm	Model No. EL
3	600	212	415	**2243.705**
6	600	345	415	**2246.705**
9	600	478	415	**2249.705**
6	600	345	515	**2256.705**
9	600	478	515	**2259.705**
15	600	746	515	**2265.705**
21	600	1012	515	**2271.705**

Delivery times available on request.

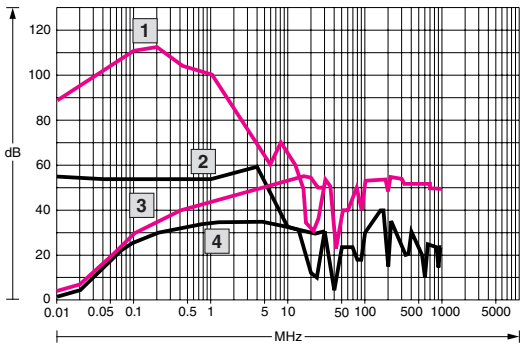
Approvals,
see page 293.

EMC diagram,
see page 293.

EMC terminal boxes KL Page 290



EMC free-standing enclosure ES 5000 Page 291



MHz = Frequency
dB = RF attenuation

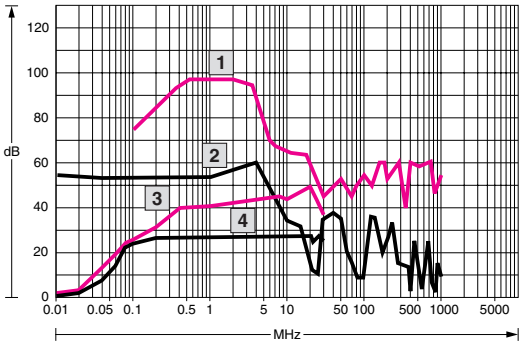
1 E field = Electrical field [V/m] EMC enclosures

2 E field standard enclosures

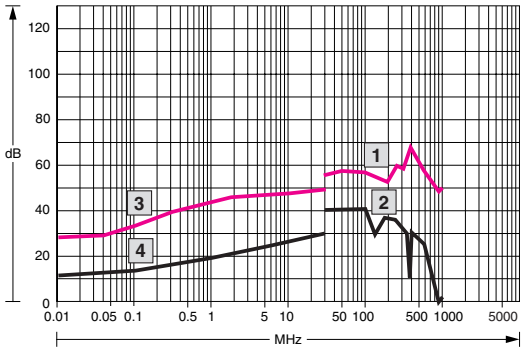
3 H field = Magnetic field [A/m] EMC enclosures

4 H field standard enclosures

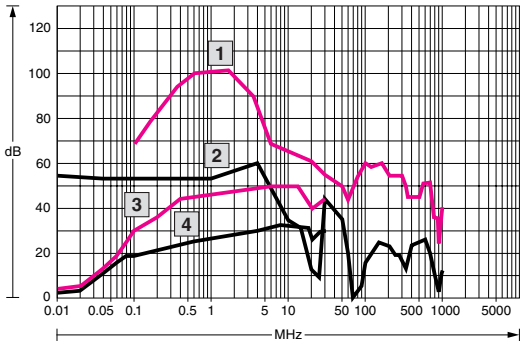
EMC E box EB Page 290



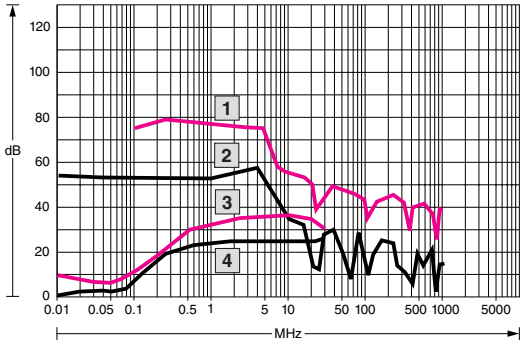
EMC subrack Ripac Vario Page 291



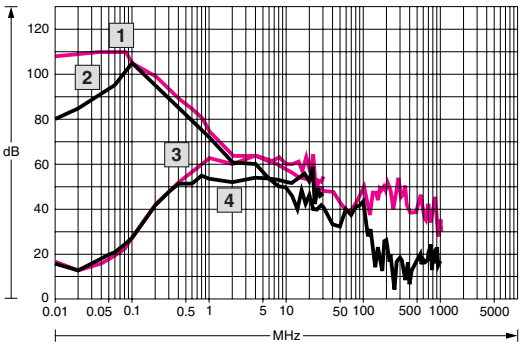
EMC compact enclosures AE Page 290



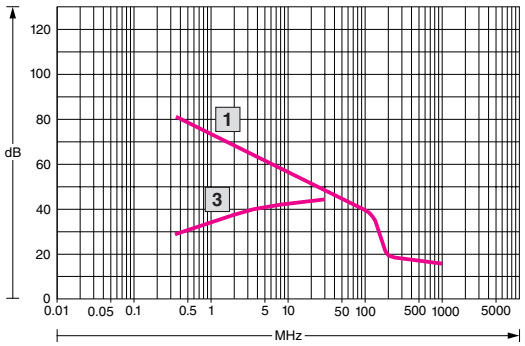
EMC electronic Kombi system EL, 3-part Page 292



EMC baying systems TS 8 Page 291



EMC instrument case Vario-Case iS Page 292



Approvals:

EMC terminal boxes KL
- UL
- CSA
- TÜV
- Norske Veritas
- Lloyds Register of Shipping
- VDE

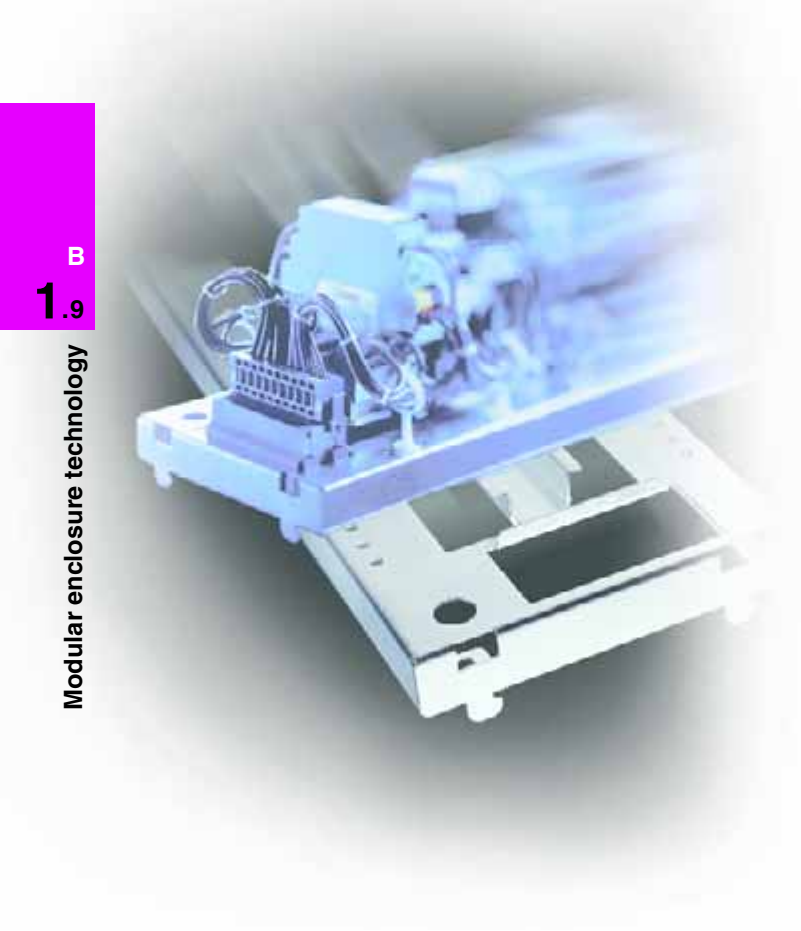
EMC baying systems TS 8
- UL – Underwriters Laboratories Inc. For USA and Canada

EMC free-standing enclosure ES 5000
- UL
- CSA

EMC electronic Kombi system EL, 3-part
- TÜV
- Norske Veritas
- Russian Maritime Register of Shipping
- Lloyds Register of Shipping
- VDE
- UL – Underwriters Laboratories Inc. For USA and Canada

Modular enclosure technology

Features



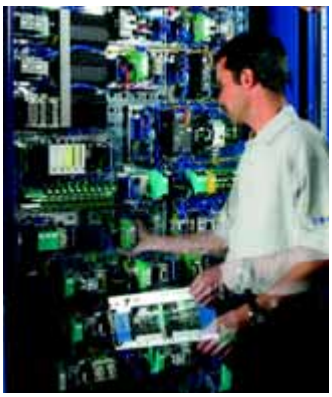
Trumpf, Phönix, Siemens and Rittal are collaborating on a new concept for mechanical and plant engineering.

Rittal supplies cases and enclosures with mounting plates that are specially perforated for module technology.

This helps to significantly reduce design, assembly and throughput times. The full range of modules is available from our partners. In addition, function modules for power supply and for the monitoring of climate control units are currently under development.

More rational, simpler and more secure is the outcome of this new, multi-functional modular system.

Please contact us for further information.

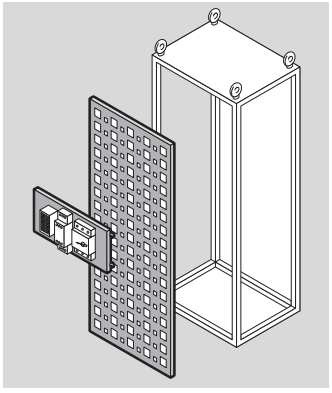


Modules

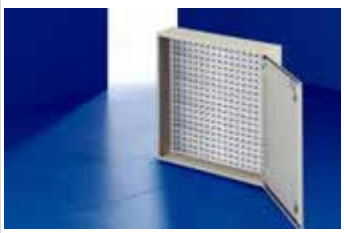
Function module, machine-neutral, standardised unit, pre-assembled on a module plate. In case of malfunctions, quickly replaced by the user.

A standardised mechnical interface is provided by the module plate. It is simply located into the modular pitch pattern of holes of the mounting plate.

Standardised electrical interfaces are pre-configured, multi-pole bus cables. No need for time-consuming point-to-point wiring and cable ducts.



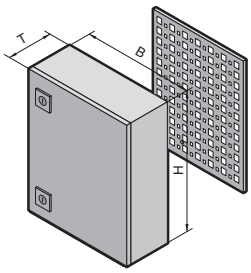
Enclosures and cases

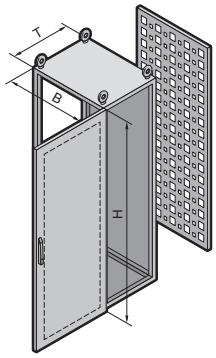


Compact enclosures AE
Mounting plate with modular pitch pattern of holes.
Design, see page 295.

Baying systems TS 8
Mounting plate with modular pitch pattern of holes.
Design, see page 295.

Compact enclosures AE, baying systems TS 8





Material:
Sheet steel

Surface finish, protection category, supply scope and technical details for

Compact enclosures AE,
see from page 118.

Baying systems TS 8,
see from page 138.

Compact enclosures AE

Width (B) in mm	Packs of	380	380	380	400	500	500	500	600	600
Height (H) in mm		380	600	600	500	500	500	700	380	380
Depth (T) in mm		210	210	350	210	210	300	250	210	350
Model No. AE	1	**1380.100**	**1038.100**	**1338.100**	**1045.100**	**1050.100**	**1350.100**	**1057.100**	**1039.100**	**1339.100**

Width (B) in mm	Packs of	600	600	600	600	600	600	600	760	760
Height (H) in mm		600	600	760	760	800	1000	1200	760	760
Depth (T) in mm		210	350	210	350	250	250	300	210	300
Model No. AE	1	**1060.100**	**1360.100**	**1076.100**	**1376.100**	**1058.100**	**1090.100**	**1260.100**	**1077.100**	**1073.100**

Width (B) in mm	Packs of	800	800	1000	1000	1000	1000	1000		
Height (H) in mm		1000	1200	760	760	1000	1200	1400		
Depth (T) in mm		300	300	210	300	300	300	300		
Model No. AE	1	**1180.100**	**1280.100**	**1100.100**[1)]	**1130.100**[1)]	**1110.100**[1)]	**1213.100**[1)]	**1114.100**[1)]		

[1)] Two-door

Baying systems TS 8

Width (B) in mm	Packs of	600	800	1200	600	800	1200	600	800	1000
Height (H) in mm		1400	1400	1400	1600	1600	1600	1800	1800	1800
Depth (T) in mm		500	500	500	500	500	500	400	400	400
Door(s)		1	1	2	1	1	2	1	1	1
Model No. TS	1	**8645.100**	**8845.100**	**8245.100**	**8665.100**	**8865.100**	**8265.100**	**8684.100**	**8884.100**	**8084.100**

Width (B) in mm	Packs of	1000	1200	600	800	800	1200	600	800	800
Height (H) in mm		1800	1800	1800	1800	1800	1800	1800	1800	1800
Depth (T) in mm		400	400	500	500	500	500	600	600	600
Door(s)		2	2	1	2	1	2	1	1	2
Model No.	1	**8080.100**	**8284.100**	**8685.100**	**8880.100**	**8885.100**	**8285.100**	**8686.100**	**8886.100**	**8881.100**

Width (B) in mm	Packs of	1200	600	800	1200	600	800	1000	1200	600
Height (H) in mm		1800	2000	2000	2000	2000	2000	2000	2000	2000
Depth (T) in mm		600	400	400	400	500	500	500	500	600
Door(s)		2	1	1	2	1	1	2	2	1
Model No. TS	1	**8286.100**	**8604.100**	**8804.100**	**8204.100**	**8605.100**	**8805.100**	**8005.100**	**8205.100**	**8606.100**

Width (B) in mm	Packs of	800	1000	1200	600	800	1200	600	800	1200
Height (H) in mm		2000	2000	2000	2000	2000	2000	2200	2200	2200
Depth (T) in mm		600	600	600	800	800	800	600	600	600
Door(s)		1	2	2	1	1	2	1	1	2
Model No. TS	1	**8806.100**	**8006.100**	**8206.100**	**8608.100**	**8808.100**	**8208.100**	**8626.100**	**8826.100**	**8226.100**

Accessories Page 832 **AE stainless steel** Page 273 **AE EMC-shielded** Page 290 **AE Ex-proof** Page 287
TS 8 stainless steel Page 284 **TS 8 EMC-shielded** Page 291 **TS 8 climate controlled enclosure** Page 582 **TS 8 climate control doors** Page 584

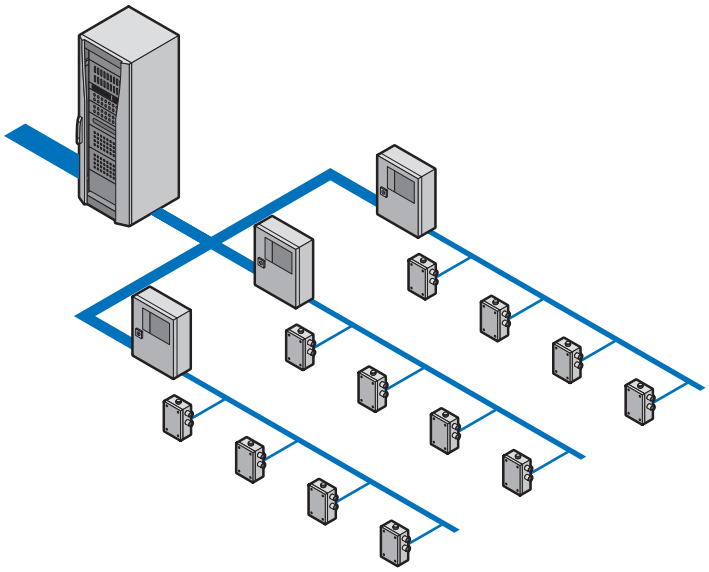
Ethernet infrastructure for production buildings

Building cabling to standard EN 50 173, based on the office sector model, is moving into the production halls. This standardisation of the Ethernet infrastructure simplifies plant modifications, integrates terminal workstations and employee information systems via a plug-in connection, connects machinery and plant to a central monitoring system, and much more besides . . . The successful concept: **Improved efficiency and superior reliability** through information exchange, process coordination and safety monitoring.

Fascinating future!

Ethernet goes factory! Cabling of industrial buildings to standard EN 50 173 (ISO/IEC 11801).

Ethernet infrastructure for production buildings



A concept with innovative enclosures and a comprehensive range of system accessories for outstanding implementation of industrial networks.

For the main distributor: Our extensive rack expertise from the office sector comes into play here.

For sub-distribution: Modified enclosures from the AE and KL series with a protection category tailored to industrial use, equipped with or without patch panel, cable routing supports and cable entry.

Terminal connection boxes: Made from die-cast aluminium in protection category IP 67.

When it comes to future-oriented solutions for modern low-voltage power distribution, you are most definitely on the right track with **Rittal busbar systems.**

Take this example showing the cross-section of a power circuit-breaker panel with main busbar system, cable connection system and connection kits. Achieved with Rittal Maxi-PLS, the modular system for optimum fast assembly.

Power distribution

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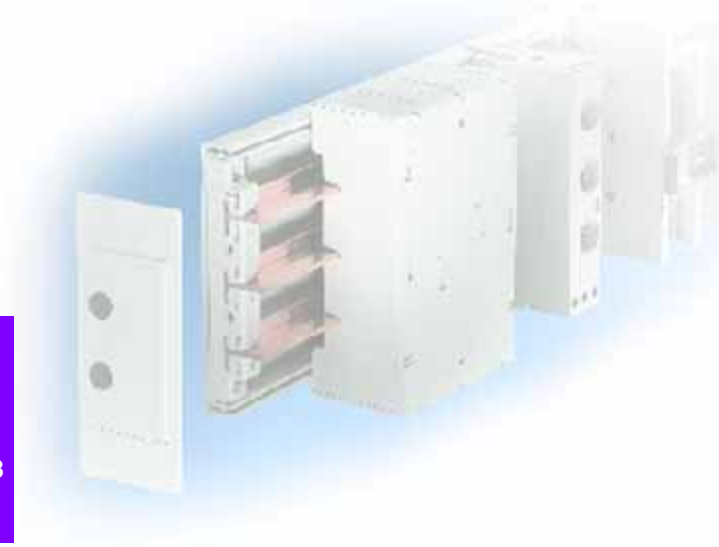
Busbar systems up to 250 A (40 mm)

Overview of Rittal Mini-PLS



The Rittal Mini-PLS busbar system with 40 mm bar centre distance is sure to impress, with its unique use of space and fast assembly.

- High static and thermal load capacity thanks to the T-support form of the special rail
- The components are simply plugged in from the front
- Busbar support suitable for top mounting
- Contact hazard protection thanks to all-round accommodation (end cover, base tray and cover section)

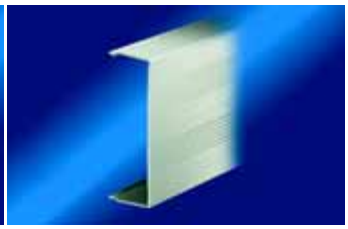
Compact

- The special busbars are simply pushed into the one-piece support and locked into position.
- Unrestricted top mounting of the busbar supports and busbar connector sets with top-mounting components.
- Precise-fit installation, because the build height (160 mm) matches the installation space requirement exactly.
- Simple component assembly via plug and lock action from the front.

System components

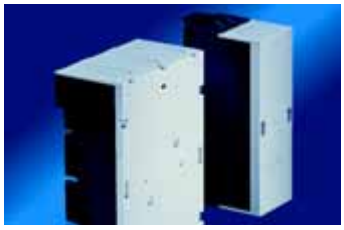
Mini-PLS end cover
Mini-PLS base tray section

Mini-PLS busbar supports up to 250 A, 3-pole
Mini-PLS special busbars E-Cu 250 A, 120 mm²
Mini-PLS busbar connectors up to 250 A



Mini-PLS cover sections

Assembly components



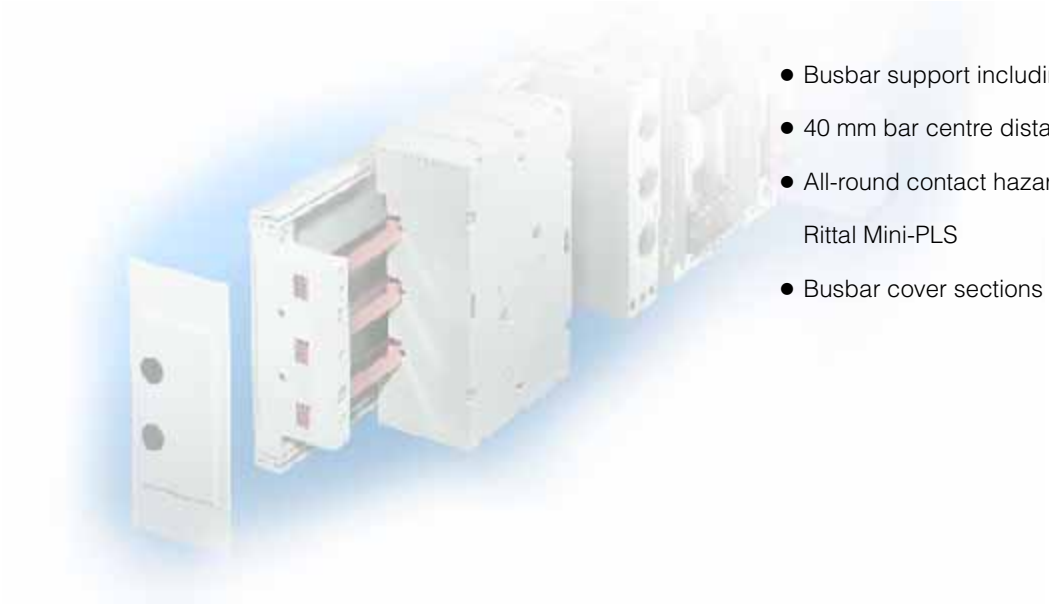
Mini-PLS busbar connection adaptor up to 63 A and up to 250 A

Mini-PLS bus-mounting fuse base D 02-E 18

Mini-PLS component adaptor 12/25/40/100 A
Mini-PLS quick-fit component adaptor 25 A (32 A)

NH on-load isolators, size 000

Overview

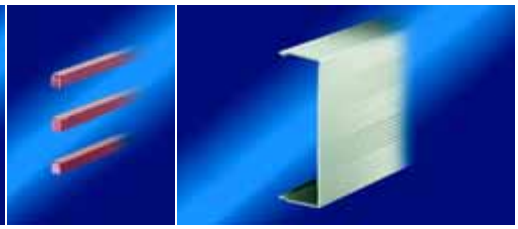


- Busbar support including inserts for flat copper rails
- 40 mm bar centre distance
- All-round contact hazard protection identical to the Rittal Mini-PLS
- Busbar cover sections may be used as an alternative.

System components

End cover
Base tray sections

Busbar support
up to 360 A, 3-pole
Busbars of E-Cu



Busbar cover sections

Cost-effective

- The inserts pre-integrated into the busbar support facilitate the bar accommodation of 12 x 5, 12 x 10 and 15 x 5 mm. Without these inserts, the maximum bar cross-section of 15 x 10 mm is used.
- Simple component assembly via insertion and/or snap-mounting.
- End cover, base tray section and cover section are identical to the Mini-PLS contact hazard protection.

Assembly components

Cover sections

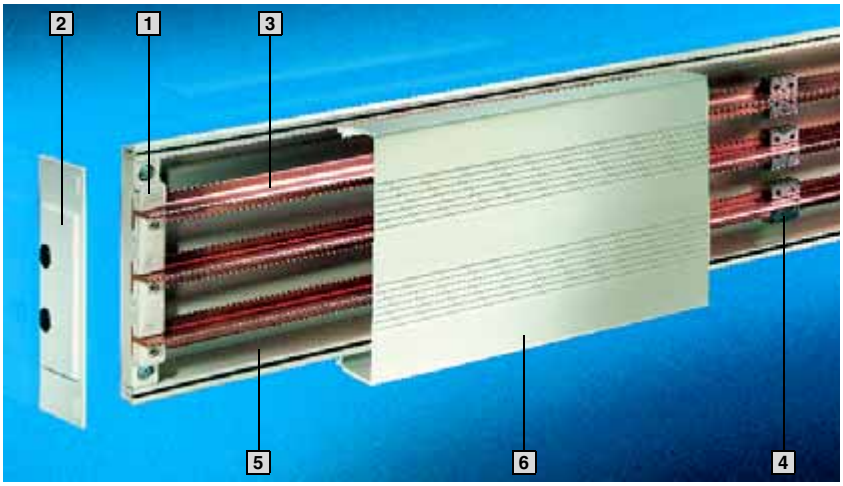
Connection adaptor
up to 360 A

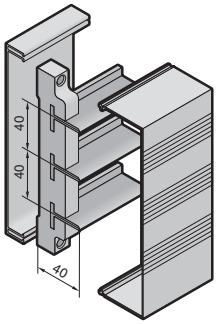
Bus-mounting fuse base
D 02-E-18

Multi-functional component adaptor 12/25/40 A
Component adaptor 100 A

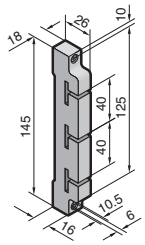
NH on-load isolators,
size 000

Rittal Mini-PLS





Planning software Rittal SV Plan/ Power Plan,
see page 1061.



1 Mini-PLS busbar support

Material:
Polyamide (PA 6.6), 30 % fibreglass-reinforced.
Continuous operating temperature: max. 140°C.
Fire protection corresponding to UL 94-V0.

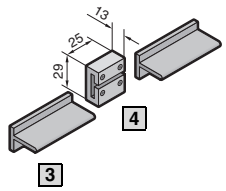
Short-circuit protection diagram,
see page 1124.

Rated current up to	250 A
Rated operating voltage up to	690 V~, 50/60 Hz to VDE 0660
Number of poles	3-pole
Bar centre distance	40 mm
Packs of	4
Model No. SV	**9600.000**

2 Mini-PLS end cover

For side contact hazard protection of the Mini-PLS assembly. For simple clip-on mounting on SV 9600.000.

Packs of	Model No. SV
2	**9610.000**



3 Mini-PLS special busbars

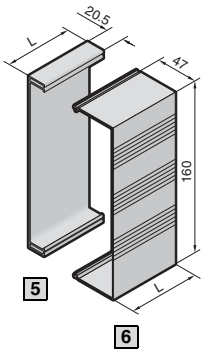
E-Cu 250 A, 120 mm²
3 mm bar thickness.

Length mm	Packs of	Model No. SV
500	3	**9601.000**
700	3	**9602.000**
1100	3	**9603.000**
1500	3	**9624.000**

4 Mini-PLS busbar connectors

up to 250 A
For connecting Mini-PLS special busbars; no drilling required.
Maximum tightening torque 2 Nm.

Packs of	Model No. SV
3	**9611.000**



5 Mini-PLS base tray sections

For rear contact hazard protection of the Mini-PLS assembly.

Length (L) mm	Packs of	Model No. SV
250	1	**9604.000**
500	1	**9605.000**
700	1	**9606.000**
1100	1	**9607.000**

6 Mini-PLS cover sections

May be cut to length individually; for clip-on mounting onto the Mini-PLS base tray section.

Length (L) mm	Packs of	Model No. SV
250	1	**9608.000**
500	1	**9609.000**

Material
Base tray and cover sections:
Thermally modified hard PVC.
Continuous operating temperature: max. 100°C.
Fire protection corresponding to UL 94-V0.

System overview Page 300 **Busbar connection adaptor** Page 303 **Component adaptor** Page 304 **Bus-mounting fuse base** Page 307
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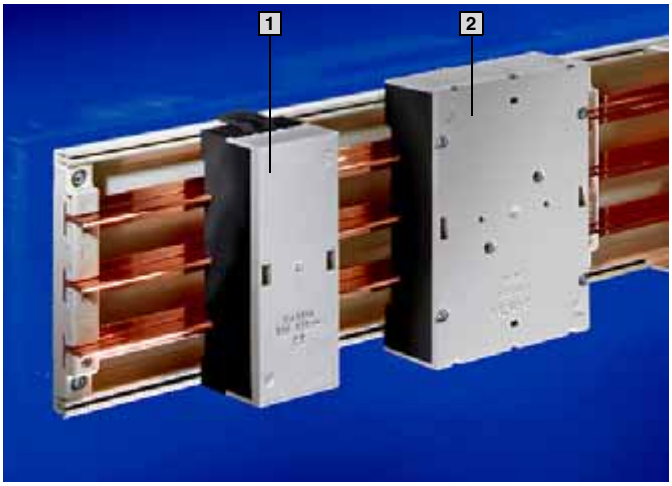
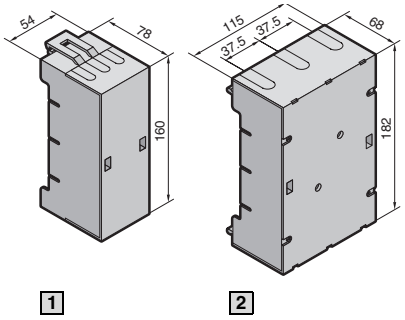
Mini-PLS busbar connection adaptor





Material:
Polyamide (PA 6.6),
30% fibreglass-reinforced.
Continuous operating temperature: max. 140°C.
Fire protection corresponding to UL 94-V0.

Supply includes:
Cover.

Version	1	2	Page
Rated current up to	63 A	250 A	
Rated operating voltage	690 V~	690 V~	
Connection	top/bottom	top/bottom	
Connection of round conductors[1)]	1.5 – 35 mm²	10 – 120 mm²	
Clamping area for laminated copper bars	10 x 8 mm	17 x 15 mm	
Tightening torque ● Terminal screw	2 – 3 Nm	4 – 6 Nm	
Packs of	1	1	
Model No. SV	**9613.000**	**9612.000**	
Accessories			
Laminated copper bars	■	■	361

[1)] Wire end ferrules should be used with fine wire conductors.

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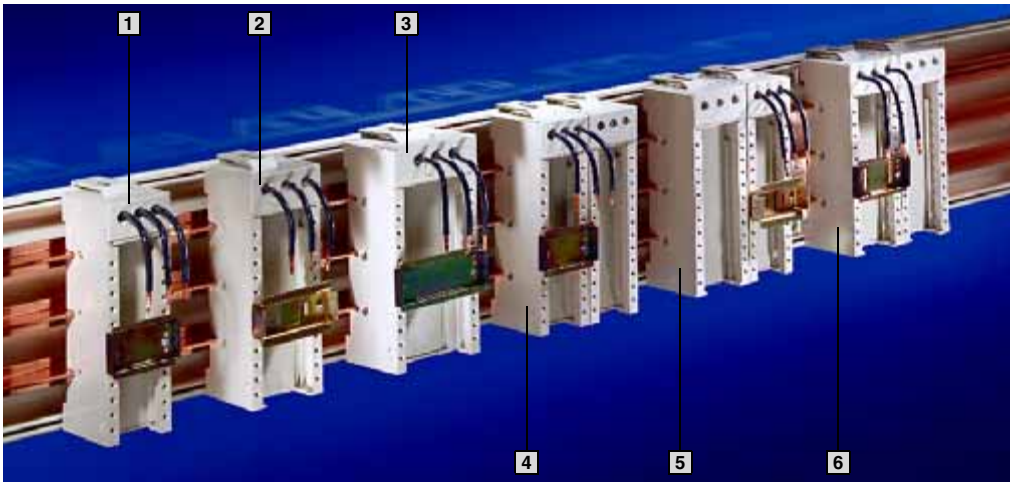
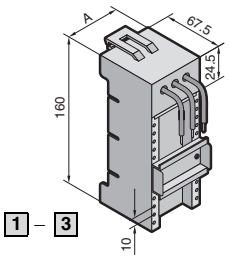
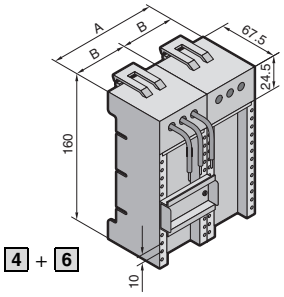
Busbar systems up to 250 A (40 mm)

Mini-PLS component adaptors 12 A/25 A

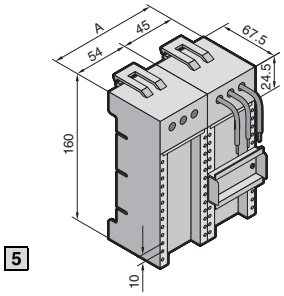




1 – 3



4 + 6



5

Material:
Polyamide (PA 6.6),
30 % fibreglass-reinforced.
Continuous operating temperature: max. 140°C.
Fire protection corresponding to UL 94-V0.

Note:
The current carrying capacity of the supply cables fitted as standard can be found on page 1128.

Version		1			2		3		4	5	6	Page
Construction width	A	45 mm			54 mm		72 mm		90 mm	99 mm	108 mm	
	B	–			–		–		45 mm	–	54 mm	
Rated current up to		12 A	25 A	25 A	25 A	25 A	25 A	25 A	25 A	25 A	25 A	
Rated operating voltage		690 V~	690 V~	690 V~	690 V~	690 V~	690 V~	690 V~	690 V~	690 V~	690 V~	
Cable outlet		top	top	top	top	top	top	top	top	top	top	
Connection cables[1)]		AWG 14	AWG 12	AWG 12	AWG 12	AWG 12	AWG 12	AWG 12	AWG 12	AWG 12	AWG 12	
Support rails	Quantity	1	1	1	1	1	1	1	1	1	1	
	Height	7.5 mm	7.5 mm	15 mm	7.5 mm	15 mm	7.5 mm	15 mm	7.5 mm	15 mm	7.5 mm	
Packs of		1	1	1	1	1	1	1	1	1	1	
Model No. SV		**9614.110**	**9614.100**	**9615.100**	**9614.000**	**9615.000**	**9625.000**	**9626.000**	**9629.010**	**9629.020**	**9629.030**	
For power circuit-breakers/starter combinations Make												
ABB		–	■	■	■	■	–	–	–	–	–	1128
AEG		–	■	■	■	■	–	–	–	–	–	
Allen Bradley		–	■	■	–	–	–	–	■	–	–	
Moeller Electric		–	■	■	–	■	■	■	■	–	■	
Siemens		■	■	■	–	■	–	–	■	■	–	
Telemecanique		–	■	■	–	–	–	■	■	–	■	
Universal application		■	■	■	■	■	■	■	■	■	■	
Accessories	Packs of											
Insert strip	2	9623.000	9623.000	9623.000	9623.000	9623.000	9623.000	9623.000	9623.000	9623.000	9623.000	362
Support rails, width 45 mm, height 7.5 mm	10	9320.150	9320.150	9320.150	–	–	–	–	9320.150	9320.150	–	362
Support rails, width 54 mm, height 7.5 mm	10	–	–	–	3548.000	3548.000	–	–	–	3548.000	3548.000	362
Support rails, width 72 mm, height 7.5 mm	10	–	–	–	–	–	3549.000	3549.000	–	–	–	362
Plug-in connector	1	9623.100	9623.100	9623.100	9623.100	9623.100	–	–	9623.100	9623.100	9623.100	362

[1)] AWG = American Wire Gauges
AWG 14 = 2.08 mm² ≙ 2.5 mm²
AWG 12 = 3.31 mm² ≙ 4 mm²

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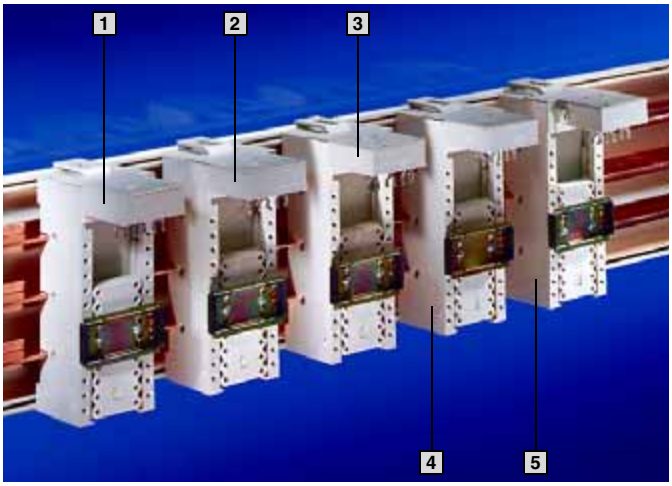
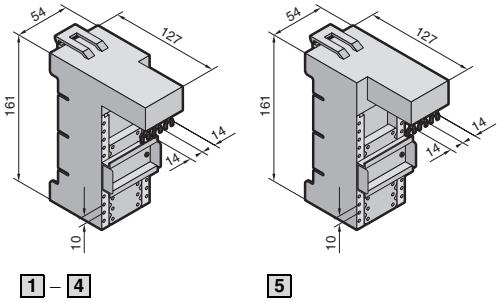
NH on-load isolator Page 307 **Accessories** Page 360

Mini-PLS quick-fit component adaptors 25 A (32 A)





Rapid DIN rail adjustment for component connection.

Material:
Polyamide (PA 6.6),
30 % fibreglass-reinforced.
Continuous operating temperature: max. 140°C.
Fire protection corresponding to UL 94-V0.

Version		1	2	3	4	5	Page
Construction width		54 mm	54 mm	54 mm	54 mm	54 mm	
Rated current up to		25 A at 35°C ambient temperature 32 A at 25°C ambient temperature					
Rated operating voltage		690 V~	690 V~	690 V~	690 V~	690 V~	
Support rails	Quantity	1	1	1	1	1	
	Height	7.5 mm	7.5 mm	7.5 mm	7.5 mm	7.5 mm	
Packs of		1	1	1	1	1	
Model No. SV		**9618.000**	**9619.000**	**9620.000**	**9621.000**	**9622.000**	
For power circuit-breakers/starter combinations Make							
ABB		–	–	–	–	■	1128
AEG		■	–	–	–	–	
Allen Bradley		–	–	■	–	–	
General Electric		■	–	–	–	–	
Moeller Electric		–	■	■	–	–	
Siemens		–	–	–	–	■	
Schiele		■	–	–	–	–	
Telemecanique		–	–	–	■	■	
Universal application		■	■	■	■	■	
Accessories	Packs of						
Insert strip	2	9623.000	9623.000	9623.000	9623.000	9623.000	362

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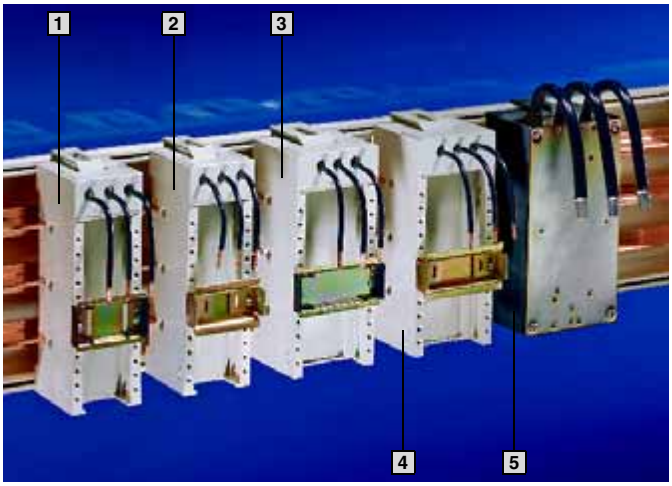
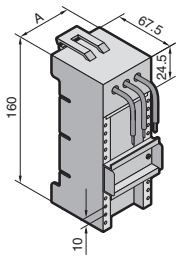
Busbar systems up to 250 A (40 mm)

Mini-PLS component adaptors 40 A/100 A





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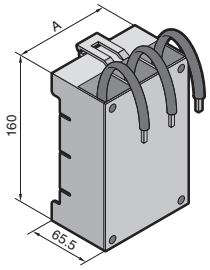

5

Material:
Polyamide (PA 6.6),
30 % fibreglass-reinforced.
Continuous operating temperature: max. 140°C.
Fire protection corresponding to UL 94-V0.

Note:
The current carrying capacity of the supply cables fitted as standard can be found on page 1128.

Version		1	2	3	4	5	Page
Construction width (A)		54 mm	54 mm	72 mm	72 mm	90 mm	
Rated current up to		40 A	40 A	40 A	40 A	100 A	
Rated operating voltage		690 V~	690 V~	690 V~	690 V~	690 V~	
Cable outlet		top	top	top	top	top	
Connection cables[1)]		AWG 10	AWG 10	AWG 10	AWG 10	35 mm²	
Support rails	Quantity	1	1	1	1	–	
	Height	7.5 mm	15 mm	7.5 mm	15 mm	–	
Packs of		1	1	1	1	1	
Model No. SV		**9616.000**	**9617.000**	**9627.000**	**9628.000**	**9629.000**	
For power circuit-breakers/starter combinations Make							
ABB		–	■	–	–	■	1129
AEG		–	–	–	–	■	
Allen Bradley		■	■	–	–	■	
Merlin Gerin		–	–	–	–	■	
Moeller Electric		–	■	■	■	■	
Siemens		–	■	–	–	■	
Telemecanique		–	–	–	■	■	
Universal application		■	■	■	■	■	
Accessories	Packs of						
Insert strip	2	9623.000	9623.000	9623.000	9623.000	–	362
Support rails width 54 mm, height 7.5 mm	10	3548.000	3548.000	–	–	–	362
Support rails width 72 mm, height 7.5 mm	10	–	–	3549.000	3549.000	–	362
Support rails width 72 mm, height 15 mm	5	–	–	–	–	9320.120	362
Plug-in connector	1	9623.100	9623.100	–	–	–	362

[1)] AWG = American Wire Gauges
AWG 10 = 5.26 mm² ≙ 6 mm²

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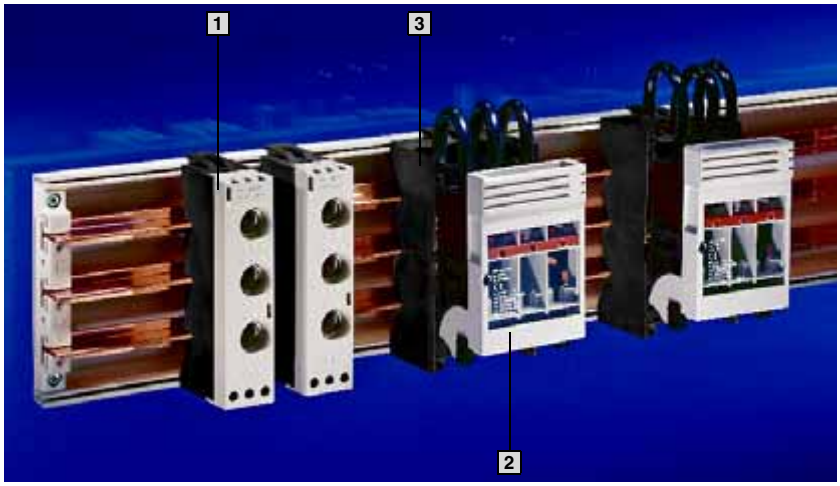
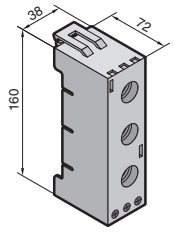
NH on-load isolator Page 307 **Accessories** Page 360

Mini-PLS bus-mounting fuse base/NH on-load isolator





1 Mini-PLS bus-mounting fuse base D 02-E 18

Material:
Polyamide (PA 6.6), 30 % fibreglass-reinforced.
Continuous operating temperature: max. 140°C.
Fire protection corresponding to UL 94-V0.

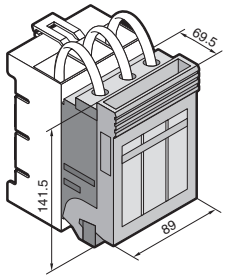
Supply includes:
Cover.

Rated current	63 A
Rated operating voltage	400 V~
Connection of round conductors[1)]	1.5 – 16 mm²
Tightening torque ● Terminal	2.5 Nm
Packs of	1
Model No. SV	**9630.000**

[1)] When using fine wire conductors, wire end ferrules should be used.

Accessories:

Identification labels SV 9320.080,
see page 363.



2 NH on-load isolators size 000

Material:
Isolator lid, contact hazard protection,
isolator chassis:
Fibreglass-reinforced polyamide
Contact tracks:
Silver-plated hard copper

Technical information,
see page 1132.

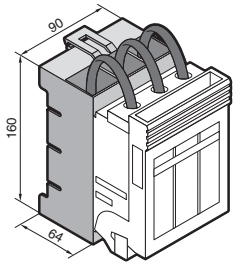
Size	000
Rated current	100 A
Rated operating voltage	690 V~
Cable outlet	top/bottom
Type of connection	Terminal up to 50 mm²
Tightening torque	3 Nm
Packs of	1
Model No. SV	**3431.000**

Also required:

Mini-PLS busbar adaptor,
see page 307.

Accessories:

Micro-switch SV 3071.000,
see page 363.



3 Mini-PLS busbar adaptor

For mounting SV 3431.000 on Rittal Mini-PLS.

Material:
Polyamide (PA 6.6), 30 % fibreglass-reinforced.
Continuous operating temperature: max. 140°C.
Fire protection corresponding to UL 94-V0.

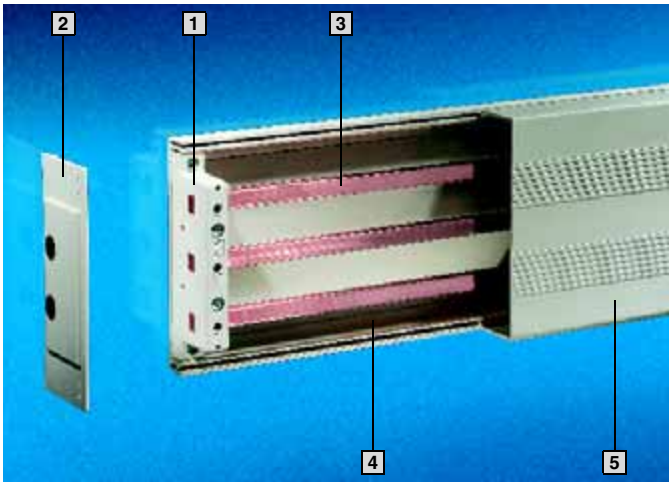
Supply includes:
35 mm² connection cables fitted as standard.

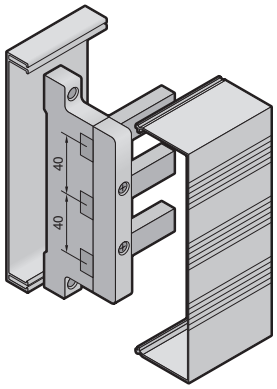
Packs of	Model No. SV
1	**9629.100**

System overview Page 300 **Busbar system** Page 302 **Busbar connection adaptor** Page 303 **Component adaptor** Page 304 **Accessories** Page 360

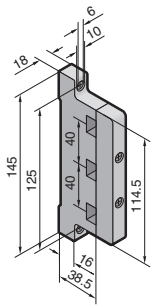
Busbar systems up to 360 A (40 mm)

System components





Planning software
Rittal SV Plan/
Power Plan,
see page 1061.



1 Busbar support

Material:
Fibreglass-reinforced, thermoplastic polyester (PBT). Continuous operating temperature: max. 140°C.
Fire protection corresponding to UL 94-V0.

Supply includes:
Inserts for adaptation of bar sizes 12 x 5 – 15 x 5 mm.

Short-circuit protection diagram,
see page 1124.

Technical information
for the calculation of rated currents,
see page 1137.

Rated current up to	360 A
Rated operating voltage up to	690 V~, 50/60 Hz to VDE 0660
Number of poles	3-pole
Bar centre distance	40 mm
Bar accommodation	12 x 5 – 15 x 10 mm
Tightening torque ● Assembly screw ● Cover attachment	 3 – 5 Nm 1 – 3 Nm
Packs of	4
Model No. SV	**9350.000**

2 End cover

For side contact hazard protection of the busbar assembly.
Suitable for connection to SV 9350.000.

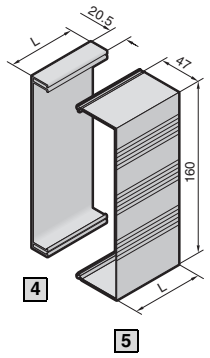
Packs of	Model No. SV
2	**9610.000**

3 Busbars

made from E-Cu
To DIN EN 13 601.
Length: 2400 mm/bar.

Dimensions mm	Packs of	Model No. SV
12 x 5	6	**3580.000**
12 x 10	6	**3580.100**
15 x 5	6	**3581.000**
15 x 10	6	**3581.100**

System overview Page 301 **Busbar connection adaptor** Page 310 **Bus-mounting fuse base** Page 311 **NH fused isolator** Page 311
Component adaptor Page 312 **Accessories** Page 360



4 Base tray sections

For rear contact hazard protection of the busbar assembly.

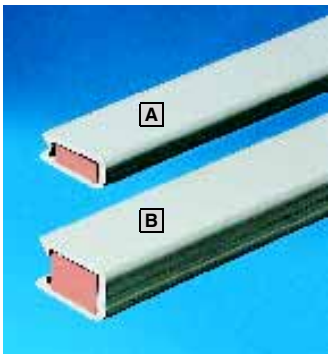
Length (L) mm	Packs of	Model No. SV
250	1	**9604.000**
500	1	**9605.000**
700	1	**9606.000**
1100	1	**9607.000**

5 Cover sections

May be cut to length as required; for clip-on mounting to the base tray section.

Length (L) mm	Packs of	Model No. SV
250	1	**9608.000**
500	1	**9609.000**

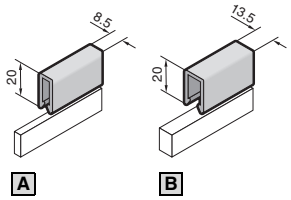
Material
Base tray and cover sections:
Thermally modified hard PVC.
Continuous operating temperature: max. 100°C.
Fire protection corresponding to UL 94-V0.



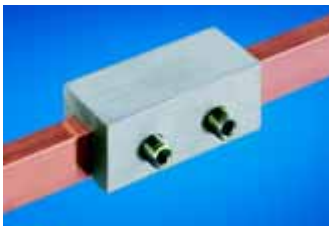
Busbar Cover sections

Contact hazard protection via covering of the busbars. May be cut to required length.
Length: 1000 mm/section.

Material:
Thermally modified hard PVC.
Continuous operating temperature: max. 100°C.
Fire protection corresponding to UL 94-V0.



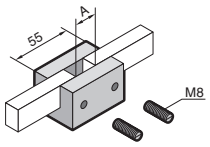
For busbars mm	Packs of	Model No. SV
A 12/15 x 5	4	**9350.010**
B 12/15 x 10	4	**9350.060**



Busbar connectors

For connecting SV busbars from 12 x 5 to 15 x 10 mm; no drilling required.
Tightening torque: 10 Nm.

Material:
Brass.
Nickel-plated surface finish.



A = max. 10 mm

Packs of	Model No. SV
3	**9350.070**

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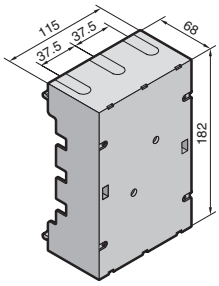
Component adaptor Page 312 **Accessories** Page 360

Busbar connection adaptor



Material:
Polyamide (PA 6.6),
30 % fibreglass-reinforced.
Continuous operating temperature: max. 140°C.
Fire protection corresponding to UL 94-V0.

Supply includes:
Cover.

Note:
Conductor connection clamps for the connection of round conductors 1 – 16 mm², see page 324.

Rated current up to	360 A		Page
Rated operating voltage	690 V~		
Connection	top/bottom		
Connection of round conductors[1)]	10 – 120 mm² (max. 250 A)		
Clamping area for laminated copper bars	17 x 15 mm (max. 360 A)		
Tightening torque ● Terminal screw	4 – 6 Nm		
For busbars	12 x 5/10 mm	15 x 5/10 mm	
Packs of	1	1	
Model No. SV	**9350.020**	**9350.030**	
Accessories			
Laminated copper bars	■	■	361

[1)] Wire end ferrules should be used with fine wire conductors.

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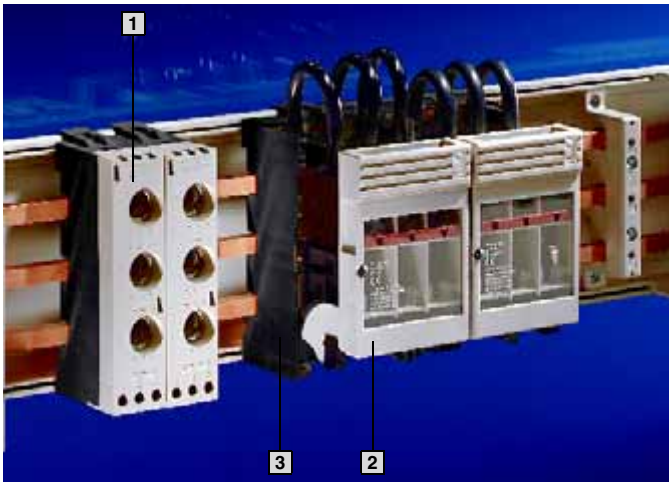
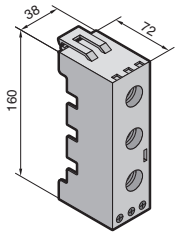
Component adaptor Page 312 **Accessories** Page 360

Bus-mounting fuse base/NH on-load isolator





1 Bus-mounting fuse base D 02-E 18

Material:
Polyamide (PA 6.6), 30 % fibreglass-reinforced.
Continuous operating temperature: max. 140°C.
Fire protection corresponding to UL 94-V0.

Supply includes:
Cover.

Accessories:

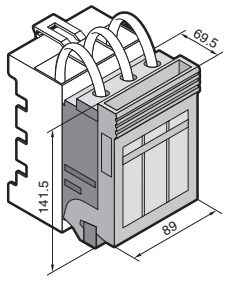
Identification labels SV 9320.080,
see page 363.

Rated current	63 A
Rated operating voltage	400 V~
Connection of round conductors[1)]	1.5 – 16 mm²
Tightening torque ● Terminal	2.5 Nm
Packs of	1
For busbars 12 x 5/10 mm **Model No. SV**	**9350.050**
For busbars 15 x 5/10 mm **Model No. SV**	**9350.500**

[1)] When using fine wire conductors, wire end ferrules should be used.

Also required:

Base tray section,
see page 309.



2 NH on-load isolators size 000

Material:
Isolator lid, contact hazard protection,
isolator chassis:
Fibreglass-reinforced polyamide
Contact tracks:
Silver-plated hard copper

Technical information,
see page 1132.

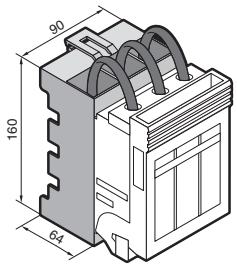
Accessories:

Micro-switch SV 3071.000,
see page 363.

Size	000
Rated current	100 A
Rated operating voltage	690 V~
Cable outlet	top/bottom
Type of connection	Terminal up to 50 mm²
Tightening torque	3 Nm
Packs of	1
Model No. SV	**3431.000**

Also required:

Busbar adaptor,
see page 311.



3 Busbar adaptor

For mounting SV 3431.000 on 40 mm busbar systems.

Material:
Polyamide (PA 6.6), 30 % fibreglass-reinforced.
Continuous operating temperature: max. 140°C.
Fire protection corresponding to UL 94-V0.

Supply includes:
35 mm² connection cables fitted as standard.

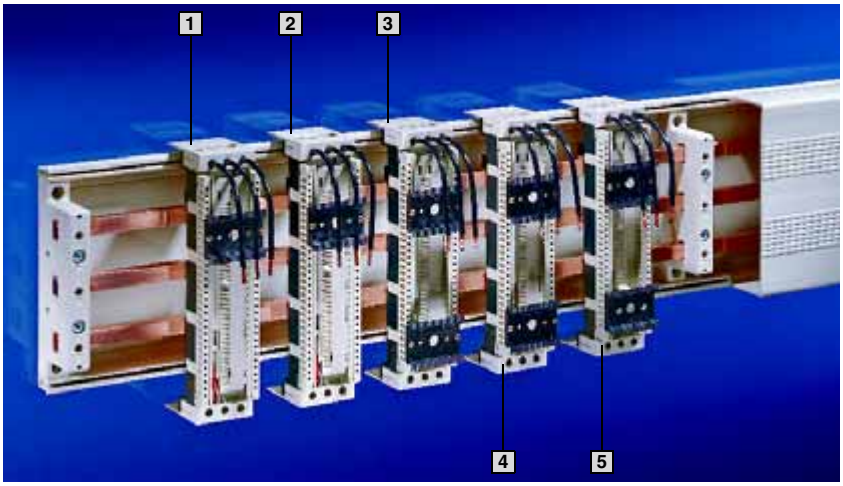
For busbars mm	Packs of	Model No. SV
12 x 5/10	1	**9350.400**
15 x 5/10	1	**9350.410**

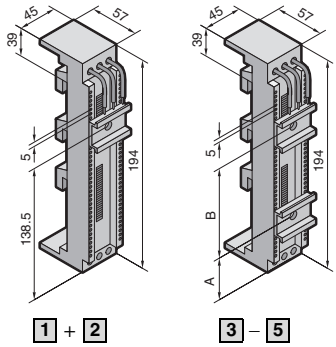
Also required:

Base tray section,
see page 309.

System overview Page 301 **Busbar system** Page 308 **Busbar connection adaptor** Page 310 **Component adaptor** Page 312 **Accessories** Page 360

Multi-functional component adaptor 25 A/40 A





Material:
Polyamide (PA 6.6),
30 % fibreglass-reinforced.
Continuous operating temperature: max. 140°C.
Fire protection corresponding to UL 94-V0.

Note:
The current carrying capacity of the supply cables fitted as standard can be found on page 1128.

For snap-on mounting		1	2	3	4	5	Page
Construction width		45 mm	45 mm	45 mm	45 mm	45 mm	
Rated current up to		12 A	25 A	25 A	25 A	25 A	
Rated operating voltage		690 V~	690 V~	690 V~	690 V~	690 V~	
Cable outlet		top	top	top	top	top	
Connection cables[1)]		AWG 14	AWG 12	AWG 12	AWG 12	AWG 12	
Support rails	Quantity	1	1	2	2	2 (1 variable)	
	Height	10 mm	10 mm	10 mm	10 mm	10 mm	
	A	–	–	38.5 mm	28 mm	variable	
	B	–	–	100 mm	125 mm	variable	
Packs of		1	1	1	1	1	
For 5 mm bar thickness **Model No. SV**		**9350.080**	**9350.100**	**9350.120**	**9350.260**	**9350.140**	
For 10 mm bar thickness **Model No. SV**		**9350.090**	**9350.110**	**9350.130**	**9350.270**	**9350.150**	
For power circuit-breakers/starter combinations Make							
AEG		–	■	–	–	–	1129
Allen Bradley		–	■	–	■	–	
Moeller Electric		–	■	–	–	–	
Siemens		■	■	–	–	–	
Telemecanique		–	■	–	■	–	
Universal application		■	■	■	■	■	
Accessories	Packs of						
Support rails width 45 mm, height 10 mm	5	9320.090	9320.090	9320.090	9320.090	9320.090	362
Plug-in connector	1	9320.110	9320.110	9320.110	9320.110	9320.110	362
Mounting clip	5	9320.140	9320.140	9320.140	9320.140	9320.140	363

[1)] AWG = American Wire Gauges
AWG 14 = 2.08 mm² ≙ 2.5 mm²
AWG 12 = 3.31 mm² ≙ 4 mm²

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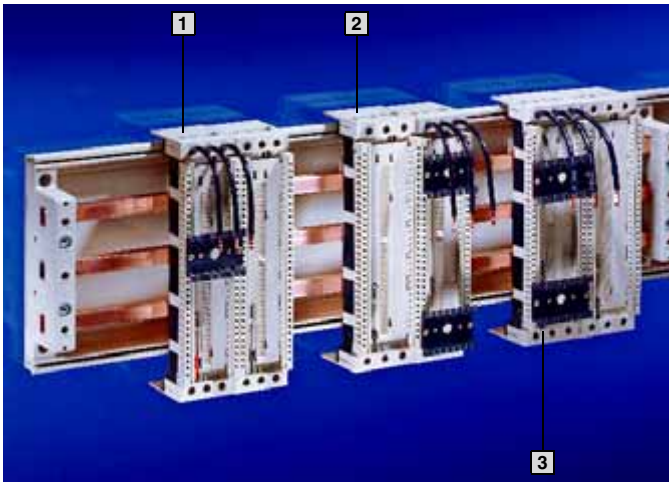
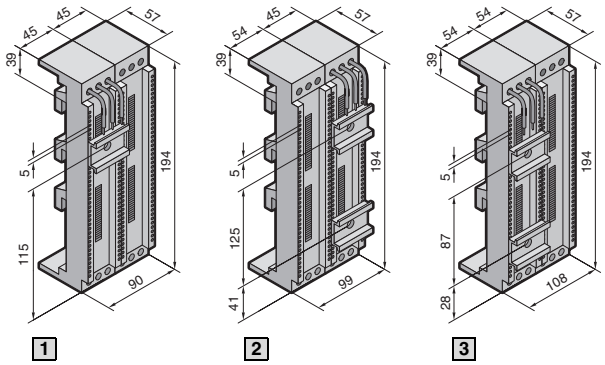
NH on-load isolator Page 311 **Accessories** Page 360

Multi-functional component adaptor 25 A





Material:
Polyamide (PA 6.6),
30 % fibreglass-reinforced.
Continuous operating temperature: max. 140°C.
Fire protection corresponding to UL 94-V0.

Note:
The current carrying capacity of the supply cables fitted as standard can be found on page 1128.

For snap-on mounting		1	2	3	Page
Construction width		90 mm	99 mm	108 mm	
Rated current up to		25 A	25 A	25 A	
Rated operating voltage		690 V~	690 V~	690 V~	
Cable outlet		top	top	top	
Connection cables[1)]		AWG 12	AWG 12	AWG 12	
Support rails	Quantity	1	2	2	
	Height	10 mm	10 mm	10 mm	
Packs of		1	1	1	
For 5 mm bar thickness **Model No. SV**		**9350.280**	**9350.300**	**9350.320**	
For 10 mm bar thickness **Model No. SV**		**9350.290**	**9350.310**	**9350.330**	
For power circuit-breakers/starter combinations Make					
Allen Bradley		■	–	–	1129
Moeller Electric		■	–	■	
Siemens		■	■	–	
Telemecanique		■	–	■	
Universal application		■	■	■	
Accessories	Packs of				
Support rails width 45 mm, height 10 mm	5	9320.090	9320.090	–	362
Support rails width 54 mm, height 10 mm	5	–	9320.100	9320.100	362
Mounting clip	5	9320.140	9320.140	–	363

[1)] AWG = American Wire Gauges
AWG 12 = 3.31 mm² ≙ 4 mm²

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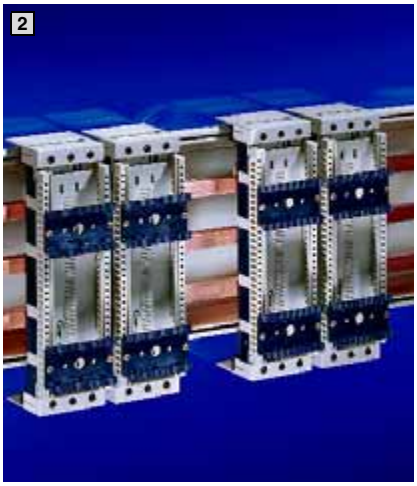
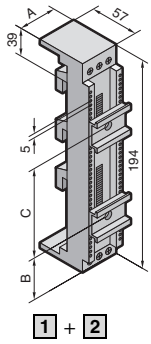
NH on-load isolator Page 311 **Accessories** Page 360

Busbar systems up to 360 A (40 mm)

Multi-functional component adaptor 25 A/40 A





Material:
Polyamide (PA 6.6),
30 % fibreglass-reinforced.
Continuous operating
temperature: max. 140°C.
Fire protection corresponding to
UL 94-V0.

For snap-on mounting		1		2		Page
Construction width (A)		45 mm		54 mm		
Rated current up to		25 A	25 A	40 A	40 A	
Rated operating voltage		690 V~	690 V~	690 V~	690 V~	
Cable outlet		top	top/bottom	top	top/bottom	
Connection of round conductors up to		16 mm²	16 mm²	16 mm²	16 mm²	
Support rails	Quantity	2 (1 variable)	2	2	2	
	Height	10 mm	10 mm	10 mm	10 mm	
	B	variable	38.5 mm	38.5 mm	38.5 mm	
	C	variable	100 mm	100 mm	100 mm	
Packs of		1	1	1	1	
For 5 mm bar thickness **Model No. SV**		**9350.160**	**9350.180**	**9350.220**	**9350.240**	
For 10 mm bar thickness **Model No. SV**		**9350.170**	**9350.190**	**9350.230**	**9350.250**	
Accessories	Packs of					
Support rails width 45 mm, height 10 mm	5	9320.090	9320.090	–	–	362
Support rails width 54 mm, height 10 mm	5	–	–	9320.100	9320.100	362
Plug-in connector	1	9320.110	–	–	–	362
Mounting clip	5	9320.140	9320.140	–	–	363

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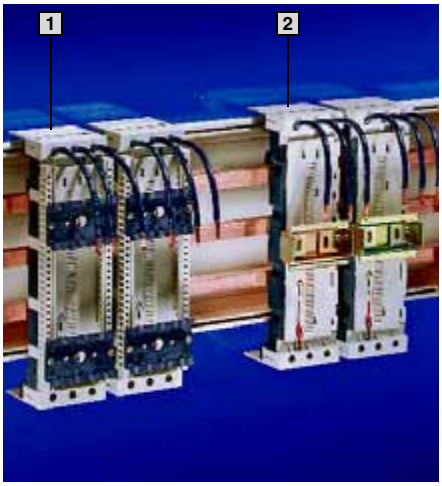
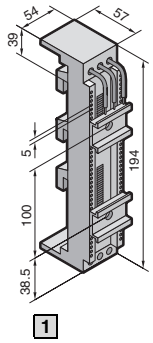
NH on-load isolator Page 311 **Accessories** Page 360

Multi-functional component adaptor 40 A/component adaptor 100 A





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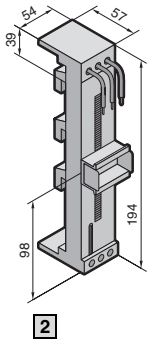

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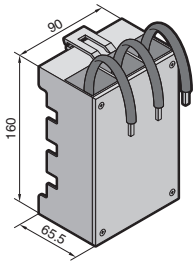

3

Material:
Polyamide (PA 6.6),
30 % fibreglass-reinforced.
Continuous operating temperature: max. 140°C.
Fire protection corresponding to UL 94-V0.

Note:
The current carrying capacity of the supply cables fitted as standard can be found on page 1128.

For snap-on mounting		1	2	3	3	Page
Construction width		54 mm	54 mm	90 mm	90 mm	
Rated current up to		40 A	40 A	100 A	100 A	
Rated operating voltage		690 V~	690 V~	690 V~	690 V~	
Cable outlet		top	top	top	top	
Connection cables		AWG 10[1)]	AWG 10[1)]	35 mm²	35 mm²	
Support rails	Quantity	2	1	–	–	
	Height	10 mm	15 mm	–	–	
For bar width		12/15 mm	12/15 mm	12 mm	15 mm	
Packs of		1	1	1	1	
For 5 mm bar thickness **Model No. SV**		**9350.200**	**9350.340**	**9350.420**	**9350.430**	
For 10 mm bar thickness **Model No. SV**		**9350.210**	**9350.350**			
For power circuit-breakers/starter combinations Make						
ABB		■	■	■	■	1130
AEG		■	–	■	■	
Allen Bradley		■	–	■	■	
Moeller Electric		–	■	■	■	
Siemens		–	■	■	■	
Merlin Gerin		–	–	■	■	
Telemecanique		–	–	■	■	
Universal application		■	■	■	■	
Also required						
Base tray section		–	–	■	■	309
Accessories	Packs of					
Support rails width 72 mm, height 15 mm	5	–	–	9320.120	9320.120	362

[1)] AWG = American Wire Gauges
AWG 10 = 5.26 mm² ≙ 6 mm²

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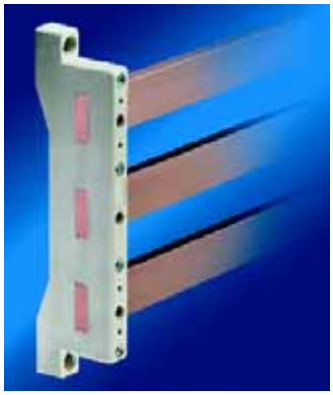
NH on-load isolator Page 311 **Accessories** Page 360

Busbar systems up to 800 A (60 mm)

Overview

- Busbar supports 1-pole, 2-pole, 3-pole, 4-pole and 5-pole (combination of 2-pole and 3-pole)
- 60 mm bar centre distance
- By using inserts, the maximum bar accommodation is reduced from 30 x 10 mm to 12 x 5 mm



System components

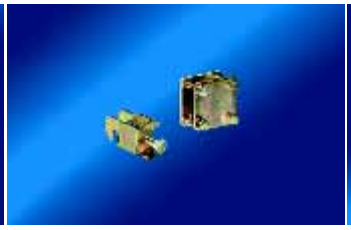
Busbar support, 1-pole
Busbar support, 2-pole
Busbar support, 3-pole
End cover
Support cover

Busbar support, 4-pole
End cover
Busbar support, 5-pole

Inserts
Busbar cover sections
System covers

Assembly components

Busbar connection adaptor
63 A to 1600 A



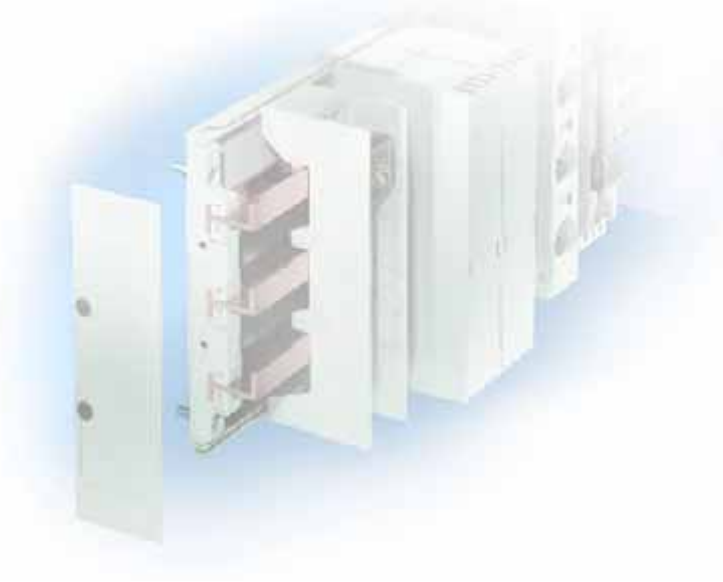
Conductor connection clamps
Plate clamp

Bus-mounting fuse bases

Multi-functional component
adaptor 12/25/40 A
Component adaptor
50/63/100/160/250 A
Component support

NH on-load isolators,
size 000
NH bus-mounting on-load
isolators, sizes 00, 1, 2 and 3

NH fused isolators,
size 00



Overview of Rittal PLS

The outstanding features of Rittal PLS include its consistent space utilisation, impressive safety back-up and contact hazard protection.

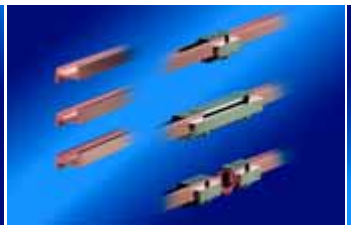
- Busbar support suitable for top mounting
- High static and thermal load capacity, thanks to the special styling of the profile
- Optimum heat dissipation, thanks to the large surface area of the special copper bars
- Contact hazard protection thanks to all-round encapsulation (end cover, base tray and cover section)

Performance in a confined space
Rittal PLS has two positive spatial advantages over flat copper bars:

- 60 mm bar centre distance with a load of up to 1600 A.
- The special busbars are simply pushed into the one-piece supports and locked into position.
- Unrestricted top-mounting of the PLS busbar support with power distribution components. In other words, free positioning of the support means easier planning, greater stability where required, and more effective space utilisation.

Rittal PLS up to 800 A

PLS end cover
PLS busbar supports up to 800 A, 3-pole
PLS base tray sections

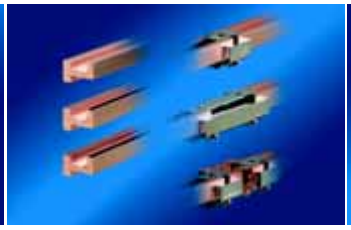


PLS special busbars E-Cu 800 A, 300 mm^2
PLS busbar connectors
PLS expansion connectors

PLS cover sections

Rittal PLS up to 1600 A

PLS end cover
PLS busbar supports up to 1600 A, 3-pole
PLS base tray sections

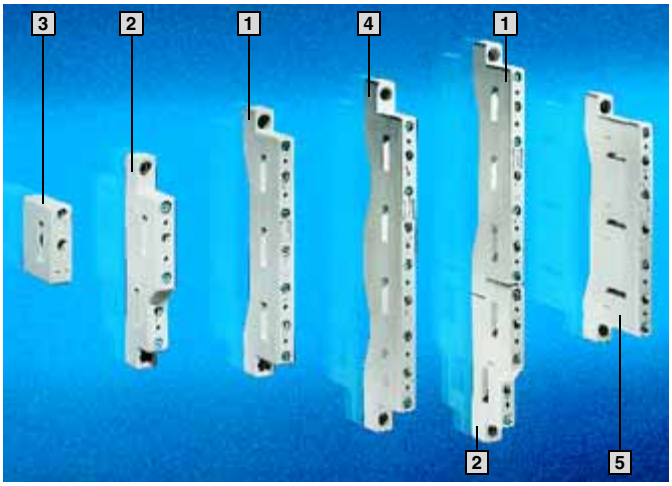


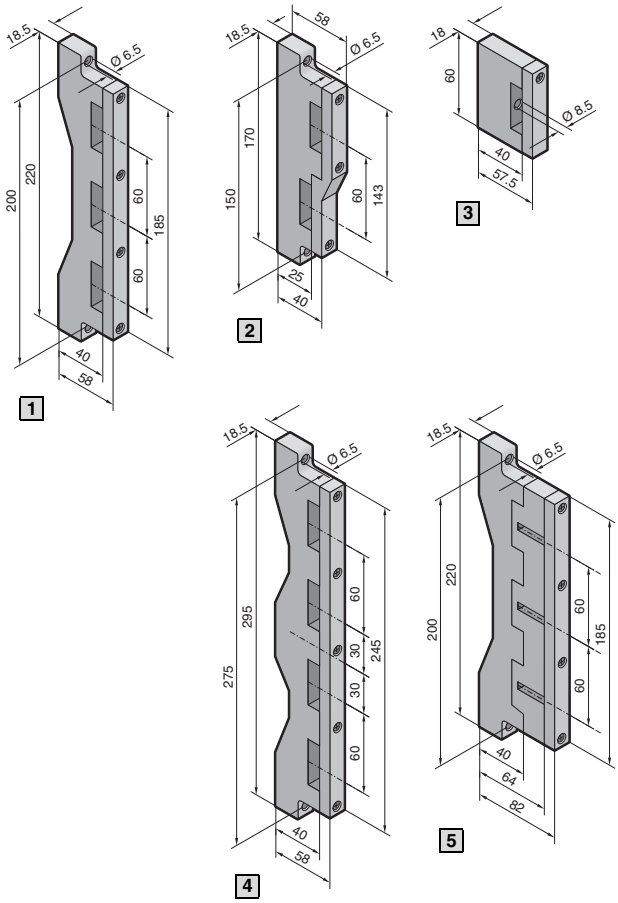
PLS busbars E-Cu 1600 A, 900 mm^2
PLS busbar connectors
PLS expansion connectors

PLS cover sections

The top-mounting components used in the Rittal PLS are identical to the top-mounting components for the 60 mm flat copper busbar system.

Busbar support





Material:
Fibreglass-reinforced, thermoplastic polyester (PBT).
Continuous operating temperature: max. 140°C.
Fire protection corresponding to UL 94-V0.

Short-circuit protection diagrams,
see page 1124 and 1125.

Technical information
for the calculation of rated currents,
see page 1137.

Planning software Rittal SV Plan/ Power Plan,
see page 1061.

Version		1	2	3	4	5	Page
Rated current up to		800 A	800 A	800 A	800 A	450 A	
Rated operating voltage up to		1000 V~, 50/60 Hz to VDE 0660					
Number of poles		3-pole	2-pole	1-pole	4-pole	3-pole	
Bar centre distance		60 mm	60 mm	–	60 mm	60 mm	
Max. bar accommodation without inserts		30 x 10 mm	30 x 10 mm	30 x 10 mm	30 x 10 mm	30 x 5 mm	
Tightening torque ● Assembly screw ● Cover attachment		3 – 5 Nm 1 – 3 Nm	3 – 5 Nm 1 – 3 Nm	5 – 8 Nm 1 – 3 Nm	3 – 5 Nm 1 – 3 Nm	3 – 5 Nm 1 – 3 Nm	
Packs of		4	4	4	3	4	
Model No. SV		**3000.000**	**3050.000**[1)]	**3078.000**[2)]	**3064.000**	**3066.000**	
Also required							
Inserts for busbars smaller than 30 x 10 mm		■	■	■	■	–	319
Accessories	Packs of						
End covers	10	3080.000	–	–	3084.000	–	319
Support cover	4	3089.000	–	–	–	–	319

[1)] N/PE support
[2)] PEN/N/PE support

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Component support Page 333 **Bus-mounting fuse bases** Page 334 **NH fused isolators** Page 336 **NH bus-mounting on-load isolators** Page 338
Accessories Page 360

Inserts

for busbar supports SV 3000.000, SV 3050.000, SV 3064.000, SV 3078.000

For busbars mm	Rated current	Packs of	Model No. SV
30 x 5	447 A	12	**3001.000**
25 x 5	384 A	12	**3002.000**
20 x 10	497 A	24	**3003.000**
20 x 5	319 A	12	**3004.000**
16 x 8	397 A	12	**3005.000**
16 x 3/4/5	198/225/280 A	12	**3006.000**
15 x 3/4/5	187/210/260 A	12	**3007.000**
12 x 10	340 A	24	**3008.000**
12 x 5	210 A	12	**3009.000**

For busbars mm (inches)	Rated current	Packs of	Model No. SV
9.53 x 25.40 ($^3/_8$ x 1″)	599 A	24	**3012.000**
6.35 x 25.40 ($^1/_4$ x 1″)	449 A	12	**3013.000**
4.76 x 25.40 ($^3/_{16}$ x 1″)	349 A	12	**3014.000**
3.18 x 25.40 ($^1/_8$ x 1″)	299 A	12	**3015.000**
9.53 x 19.05 ($^3/_8$ x $^3/_4$″)	449 A	24	**3016.000**
6.35 x 12.70 ($^1/_4$ x $^1/_2$″)	249 A	12	**3017.000**

End covers

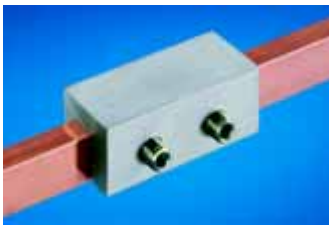
For side contact hazard protection on the busbar support. Simple clip-on mounting.

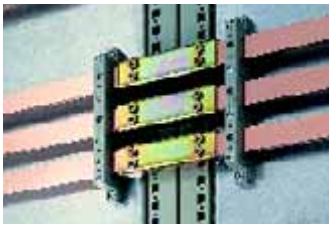
For busbar supports	Packs of	Model No. SV
SV 3000.000	10	**3080.000**
SV 3064.000	10	**3084.000**

Support cover

The support cover ensures side contact hazard protection from the assembled bus-mounting fuse bases. The build height is the same as the bus-mounting fuse bases, with contact hazard protection cover plate.

For busbar supports	Packs of	Model No. SV
SV 3000.000	4	**3089.000**





Busbars

made from E-Cu
To DIN EN 13 601.
Length: 2400 mm/bar.

Dimensions mm	Packs of	Model No. SV
30 x 10	6	**3586.000**
30 x 5	6	**3584.000**
25 x 5	6	**3583.000**
20 x 10	6	**3585.000**
20 x 5	6	**3582.000**
15 x 5	6	**3581.000**
12 x 10	6	**3580.100**
12 x 5	6	**3580.000**

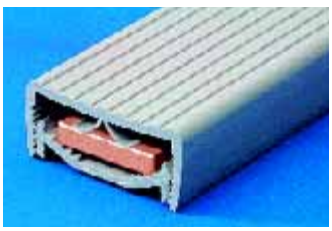
Busbar connectors

For connecting busbars, no drilling required.

For busbars mm	Application		Packs of	Model No. SV
	Single connection	Baying clamp[1]		
12 x 5 – 15 x 10	■	–	3	**9350.070**
20 x 5 – 30 x 10	■	–	3	**9320.020**
	–	■	3	**9320.030**

[1] From enclosure to enclosure

Note:
For technical data and material specifications, see page 360.

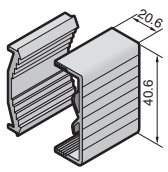


Busbar cover sections

Contact hazard protection via full encapsulation of the busbars. May be cut to required length.

Material:
Thermally modified hard PVC.
Continuous operating temperature: max. 100°C.
Fire protection corresponding to UL 94-V0.

For busbars mm	Packs of	Model No. SV
12 x 5 – 30 x 10	10 à 1 m	**3092.000**



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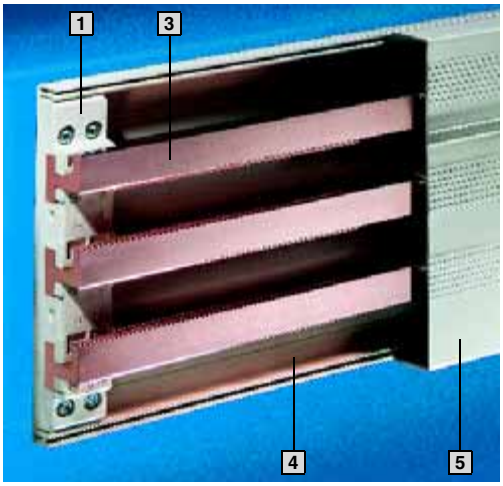
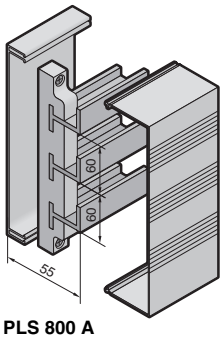
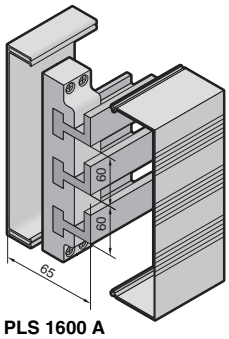
Component support Page 333 **Bus-mounting fuse bases** Page 334 **NH fused isolators** Page 336 **NH bus-mounting on-load isolators** Page 338
Accessories Page 360

Rittal PLS



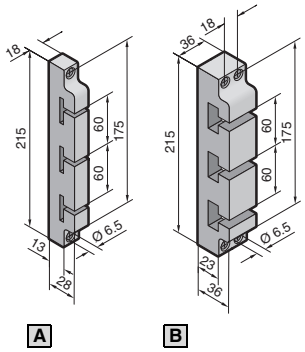


PLS 800 A



PLS 1600 A

Planing software Rittal SV Plan/ Power Plan,
see page 1061.



1 PLS busbar supports

Material:
Fibreglass-reinforced, thermoplastic polyester (PBT).
Continuous operating temperature: max. 140°C.
Fire protection corresponding to UL 94-V0.

Short-circuit protection diagrams,
see page 1125.

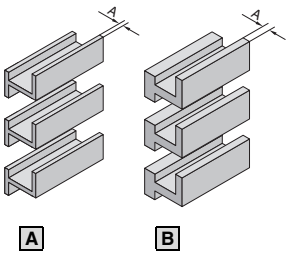
Technical information
for the calculation of rated currents,
see page 1137.

Rated current up to	A 800 A	B 1600 A
Rated operating voltage up to	1000 V~, 50/60 Hz to VDE 0660	
Number of poles	3-pole	
Bar centre distance	60 mm	
Packs of	4	4
Model No. SV	**3500.000**	**3510.000**

2 PLS end cover

For contact hazard protection of the PLS assembly on the sides. Simple clip-on mounting on the PLS busbar support.

For PLS busbar support	Packs of	Model No. SV
SV 3500.000	2	**3501.000**
SV 3510.000	2	**3511.000**



3 PLS special busbars

made from E-Cu

Rated current up to			A 800 A	B 1600 A
Cross-section mm²			300	900
Bar thickness (A) mm			5	10
Length mm	For enclosure width mm	Packs of	Model No. SV	
2400	variable	1	**3509.000**	**3516.000**
495	600[1)]	3	**3524.000**	**3527.000**
695	800[1)]	3	**3525.000**	**3528.000**
1095	1200[1)]	3	**3526.000**	**3529.000**

[1)] For Rittal TS 8/ES enclosure systems

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Component support Page 333 **Bus-mounting fuse bases** Page 334 **NH fused isolators** Page 336 **NH bus-mounting on-load isolators** Page 338
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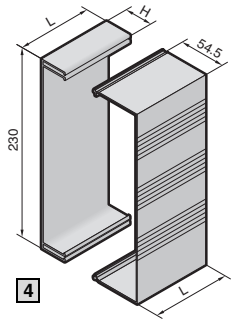


4

5

4 PLS base tray sections

For rear contact hazard protection of the PLS assembly.

Length (L) mm	Packs of	Model No. SV for PLS assembly	
		800 A	1600 A
500	2	**3502.000**	**3512.000**
700	1	**3503.000**	**3513.000**
1100	1	**3518.000**	**3519.000**
Height (H) mm		13.5	24.5

5 PLS cover sections

May be cut to length as required; for clip-on mounting to the PLS base tray section.

Length (L) mm	Packs of	Model No. SV for PLS assembly	
		800 A	1600 A
250	2	**3506.000**	
500	2	**3507.000**	
700	1	**3508.000**	

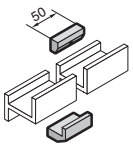
Material
Base tray and cover sections:
Thermally modified hard PVC.
Continuous operating temperature: max. 100°C.
Fire protection corresponding to UL 94-V0.

A

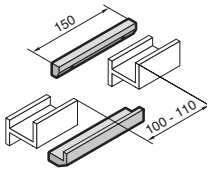
B

PLS busbar connectors

For connecting the PLS special busbars; no drilling required.



A



B

For	Packs of	Model No. SV for PLS assembly	
		800 A	1600 A
A Single connection	3	**3504.000**	**3514.000**
B Baying clamp[1)]	3	**3505.000**	**3515.000**
Tightening torque		10 – 15 Nm	15 – 20 Nm

[1)] From enclosure to enclosure (TS 8)

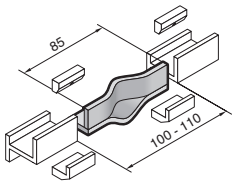
A

B

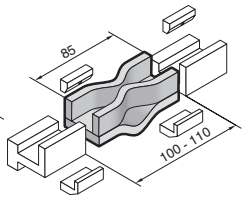
PLS expansion connectors

For thermal and mechanical compensation during connection of PLS special busbars from enclosure to enclosure (TS 8).

Material:
E-Cu



A



B

Packs of	Model No. SV for PLS assembly	
	A 800 A	B 1600 A
3	**9320.060**	**9320.070**
Also required		
PLS Busbar connectors[1)]	3504.000	3514.000

[1)] For mounting one expansion connector, two busbar connectors are required.

Note:
For a temperature increase of 30 K, the busbars are extended in length by around 0.5 mm/m. Consequently, the use of an expansion connector is recommended for busbar systems with lengths in excess of 3 m.

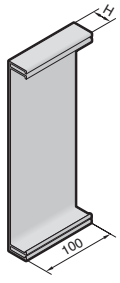
PLS base tray section infill

For rear contact hazard protection when connecting the PLS special busbars from enclosure to enclosure (TS 8).

Material:
Thermally modified hard PVC.
Continuous operating temperature: max. 100°C.
Fire protection corresponding to UL 94-V0.

Supply includes:
Assembly parts.

Packs of	Model No. SV for PLS assembly	
	800 A	1600 A
1	**3523.000**	**3533.000**
Height (H) mm	13.5	24.5



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Component support Page 333 **Bus-mounting fuse bases** Page 334 **NH fused isolators** Page 336 **NH bus-mounting on-load isolators** Page 338
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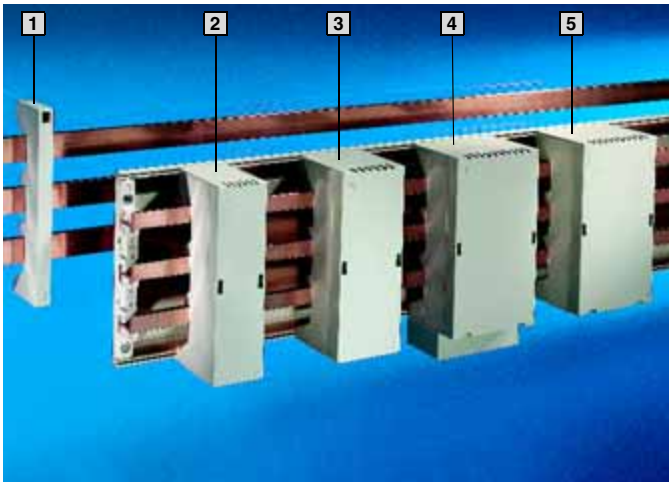
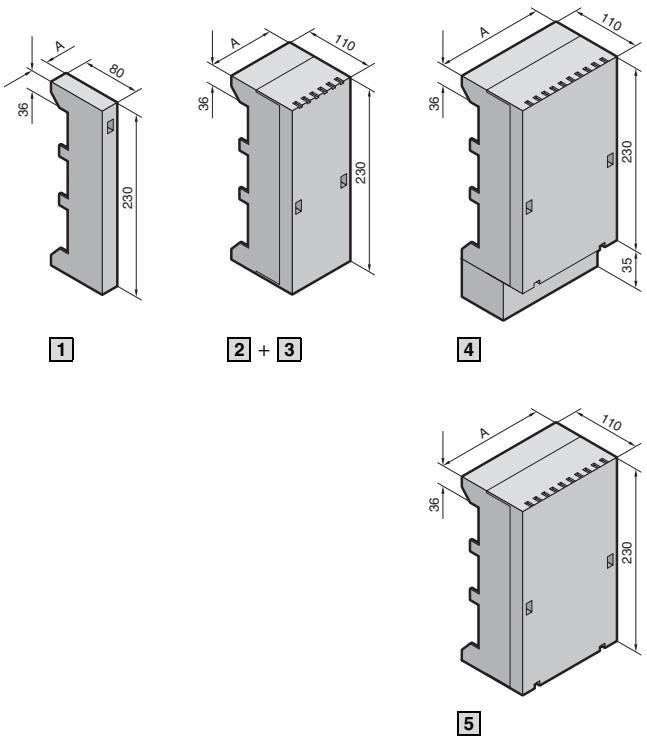
Busbar connection adaptor





Material:
Fibreglass-reinforced, thermoplastic polyester (PBT).
Continuous operating temperature: max. 140°C.
Fire protection corresponding to UL 94-V0.

Supply includes:
Cover.

Version	1	2	3	4	5	Page
Width (A)	17.5 mm	61 mm	85 mm	125 mm	125 mm	
Rated current up to	63 A	125 A	250 A	400 A	800 A	
Rated operating voltage	690 V~	690 V~	690 V~	690 V~	690 V~	
Connection	bottom	bottom	bottom	bottom	bottom	
Connection of round conductors up to	10 mm²/ 2 x 6 mm²	35 mm²	70 mm²	150 mm² 1)	185 mm² 2)	
Clamping area for laminated copper bars	–	11 x 14 mm	16 x 15 mm	–	30 x 25 mm	
Tightening torque ● Assembly screw ● Terminal screw	 2 Nm 2 Nm	 5 Nm 6 Nm	 6 Nm 10 Nm	 6 Nm 15 Nm	 6 Nm 12 Nm	
Packs of	1	1	1	1	1	
For 5 – 10 mm bar thickness **Model No. SV**	**3443.000**	**3444.000**	**3442.000**	**3440.000**	**3441.000**	
Accessories						
Laminated copper bars	–	■	■	–	■	361

1) With ring terminal M10
2) With neatly crimped wire end ferrule

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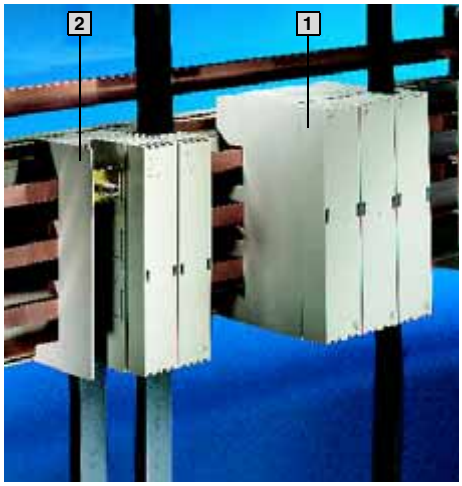
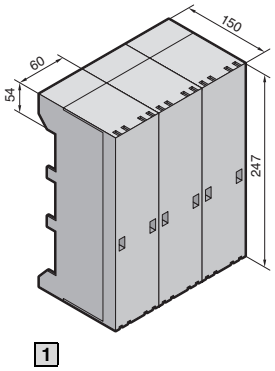
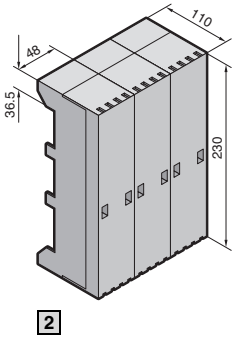
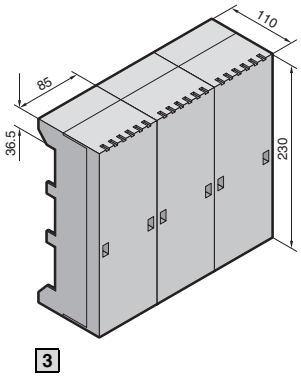
Busbar connection adaptor









Material:
Fibreglass-reinforced, thermoplastic polyester (PBT).
Continuous operating temperature: max. 140°C.
Fire protection corresponding to UL 94-V0.

Supply includes:
Cover.

Version	1	2	3	Page
Rated current up to	600 A	800 A	1600 A	
Rated operating voltage	690 V~	690 V~	690 V~	
Connection	top/bottom		top/bottom	
Connection of round conductors	35 – 240 mm² [1]	–	–	
Clamping area for laminated copper bars ● For 5 mm bar thickness ● For 10 mm bar thickness	 24 x 21 mm 24 x 21 mm	 34 x 21 mm 34 x 16 mm	 – 65 x 21 mm	
Tightening torque ● Assembly screw ● Terminal screw	 15 – 20 Nm 15 Nm	 – 10 – 12 Nm	 – 15 – 20 Nm	
Packs of	1 set (of 3)	1 set (of 3)	1 set (of 3)	
For 5 – 10 mm bar thickness **Model No. SV**	**3439.010**	**3439.000**	**–**	
For 10 mm bar thickness **Model No. SV**	**–**	**–**	**3517.000** [2]	
Accessories				
Laminated copper bars	■	■	■	361

[1] Connection of round conductors up to 300 mm² with ring terminal available on request.
[2] Only suitable for Rittal PLS 1600 A system.

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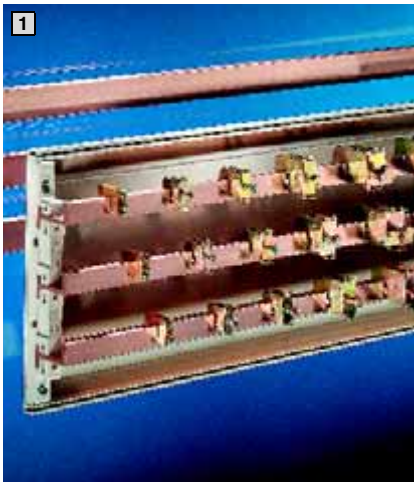
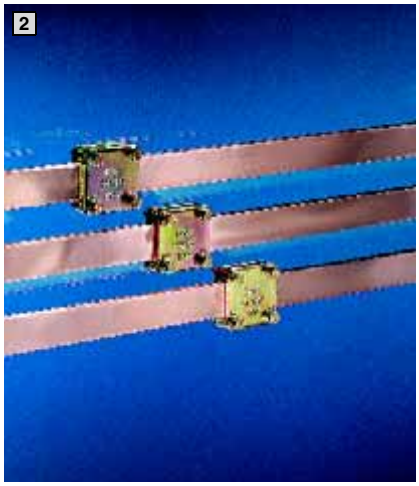
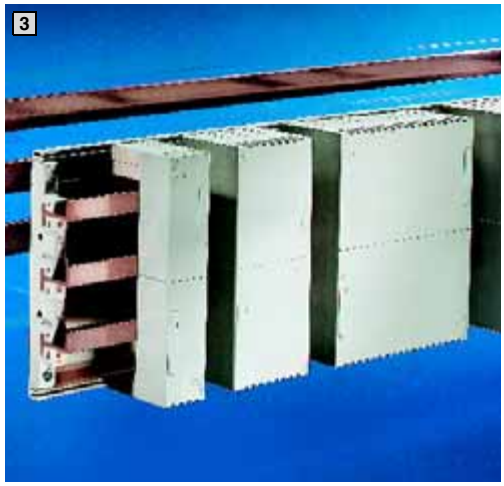
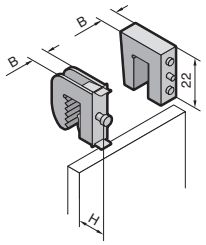
Connection clamps/system covers









1 Conductor connection clamps

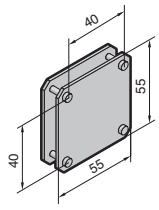
For bar thickness mm	Connection of round conductors[1] mm²	Clamping area for laminated copper bars mm	Tightening torque Nm	Width (B) mm	Height (H) mm min.	Height (H) mm max.	Packs of	Model No. SV
3 – 5	1 – 4	–	2	8.0	–	–	15	**3550.000**
5	1 – 4	–	2	11.0	17	23	15	**3450.500**
5	2.5 – 16	8 x 8	3	14.0	22	29	15	**3451.500**
5	16 – 50	10.5 x 11	6 – 8	18.5	26	39	15	**3452.500**
5	35 – 70	16.5 x 15	10 – 12	24.5	39	57	15	**3453.500**
5	70 – 185	22.5 x 20	12 – 15	30.5	44	66	15	**3454.500**
6 – 10	1 – 4	–	2	8.0	–	–	15	**3555.000**
10	1 – 4	–	2	11.0	17	23	15	**3455.500**
10	2.5 – 16	8 x 8	3	14.0	22	29	15	**3456.500**
10	16 – 50	10.5 x 11	6 – 8	18.5	26	39	15	**3457.500**
10	35 – 70	16.5 x 15	10 – 12	24.5	39	57	15	**3458.500**
10	70 – 185	22.5 x 20	12 – 15	30.5	44	66	15	**3459.500**

[1] Wire end ferrules should be used with fine wire conductors.

Material:
Sheet steel, zinc-plated, passivated
(SV 3450.500 – SV 3459.500),
brass
(SV 3550.000/SV 3555.000).

Accessories:

Laminated copper bars,
see page 361.



2 Plate clamp

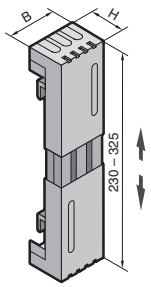
For busbars 12 x 5 – 30 x 10 mm.
Clamping area for laminated copper bars:
34 x 10 mm.
Tightening torque: 6 – 8 Nm.

Material:
Sheet steel, zinc-plated, passivated.

Packs of	Model No. SV
3	**3554.000**

Accessories:

Laminated copper bars,
see page 361.



3 System covers

For conductor connection clamps and plate clamps.

Material:
ABS.
Continuous operating temperature: max. 80°C.
Fire protection corresponding to UL 94-V0.

Width (B) mm	Height (H) mm	Packs of	Model No. SV
50	80	4	**3086.000**
100	80	4	**3087.000**
100	110	4	**3090.000**
200	80	4	**3088.000**
200	110	4	**3091.000**

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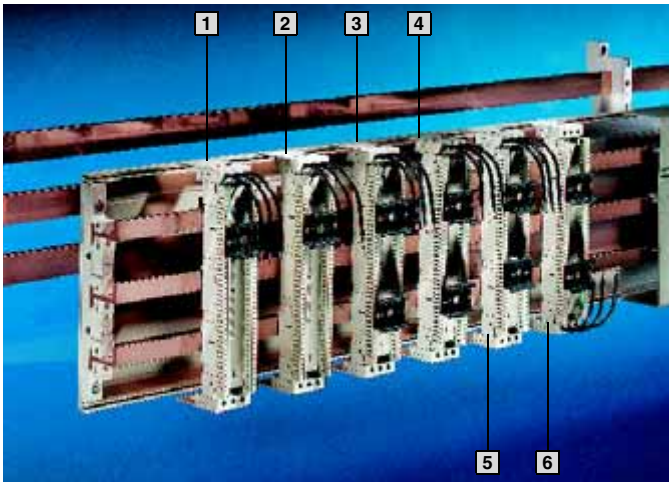
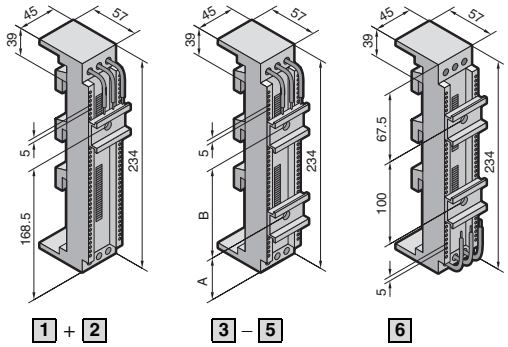
Multi-functional component adaptor 25 A/40 A





Material:
Polyamide (PA 6.6),
30 % fibreglass-reinforced.
Continuous operating temperature: max. 140°C.
Fire protection corresponding to UL 94-V0.

Note:
The current carrying capacity of the supply cables fitted as standard can be found on page 1128.

For snap-on mounting		1	2	3	4	5	6	Page
Construction width		45 mm	45 mm	45 mm	45 mm	45 mm	45 mm	
Rated current up to		12 A	25 A	25 A	25 A	25 A	25 A	
Rated operating voltage		690 V~	690 V~	690 V~	690 V~	690 V~	690 V~	
Cable outlet		top	top	top	top	top	bottom	
Connection cables[1)]		AWG 14	AWG 12	AWG 12	AWG 12	AWG 12	AWG 12	
Support rails	Quantity	1	1	2	2	2 (1 variable)	2	
	Height	10 mm	10 mm	10 mm	10 mm	10 mm	10 mm	
	A	–	–	68.5 mm	55 mm	variable	–	
	B	–	–	100 mm	125 mm	variable	–	
Packs of		1	1	1	1	1	1	
For 5 mm bar thickness **Model No. SV**		**9320.160**	**9320.180**	**9320.200**	**9320.440**	**9320.220**	**9320.240**	
For 10 mm bar thickness **Model No. SV**		**9320.170**	**9320.190**	**9320.210**	**9320.450**	**9320.230**	**9320.250**	
For power circuit-breakers/starter combinations Make								
AEG		–	■	–	–	–	–	1130
ABB		–	■	–	–	–	–	
Allen Bradley		–	■	–	■	–	–	
Moeller Electric		–	■	–	–	–	–	
Siemens		■	■	–	–	–	–	
Telemecanique		–	■	–	■	–	–	
Universal application		■	■	■	■	■	■	
Accessories	Packs of							
Support rails width 45 mm, height 10 mm	5	9320.090	9320.090	9320.090	9320.090	9320.090	9320.090	362
Plug-in connector	1	9320.110	9320.110	9320.110	9320.110	9320.110	–	362
Mounting clip	5	9320.140	9320.140	9320.140	9320.140	9320.140	9320.140	363

[1)] AWG = American Wire Gauges
AWG 14 = 2.08 mm² ≙ 2.5 mm²
AWG 12 = 3.31 mm² ≙ 4 mm²

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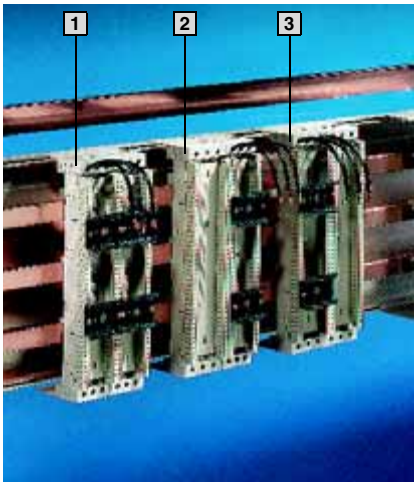
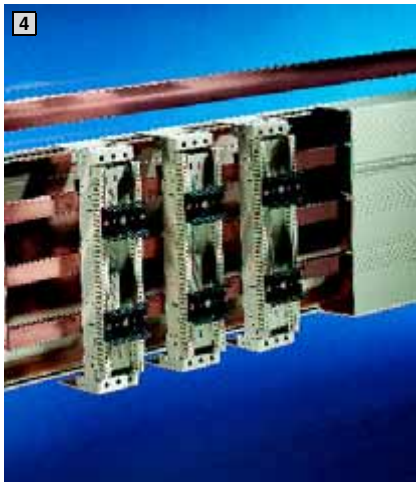
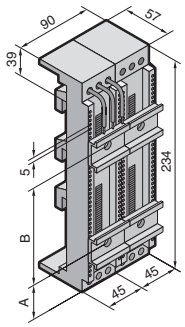
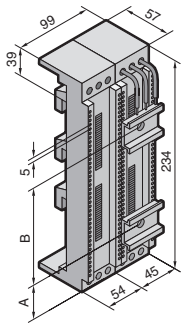
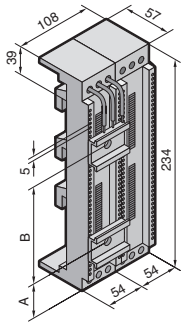
Multi-functional component adaptor 25 A

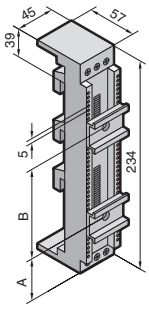












Material:
Polyamide (PA 6.6),
30 % fibreglass-reinforced.
Continuous operating temperature: max. 140°C.
Fire protection corresponding to UL 94-V0.

Note:
The current carrying capacity of the supply cables fitted as standard can be found on page 1128.

For snap-on mounting		1	2	3	4	4	Page
Construction width		90 mm	99 mm	108 mm	45 mm	45 mm	
Rated current up to		25 A	25 A	25 A	25 A	25 A	
Rated operating voltage		690 V~	690 V~	690 V~	690 V~	690 V~	
Cable outlet		top	top	top	top	top/bottom	
Connection cables[1)]		AWG 12	AWG 12	AWG 12	–	–	
Connection of round conductors up to		–	–	–	16 mm²	16 mm²	
Support rails	Quantity	2	2	2	2 (1 variable)	2	
	Height	10 mm	10 mm	10 mm	10 mm	10 mm	
	A	68.5 mm	43 mm	43 mm	variable	68.5 mm	
	B	100 mm	125 mm	90 mm	variable	100 mm	
Packs of		1	1	1	1	1	
For 5 mm bar thickness **Model No. SV**		**9320.380**	**9320.400**	**9320.420**	**9320.260**	**9320.280**	
For 10 mm bar thickness **Model No. SV**		**9320.390**	**9320.410**	**9320.430**	**9320.270**	**9320.290**	
For power circuit-breakers/starter combinations Make							
Allen Bradley		■	–	–	–	–	1130
Moeller Electric		■	–	■	–	–	
Siemens		■	■	–	–	–	
Telemecanique		■	–	■	–	–	
Universal application		■	■	■	■	■	
Accessories	Packs of						
Support rails width 45 mm, height 10 mm	5	9320.090	9320.090	–	9320.090	9320.090	362
Support rails width 54 mm, height 10 mm	5	–	9320.100	9320.100	–	–	362
Plug-in connector	1	–	–	–	9320.110	–	362
Mounting clip	5	9320.140	9320.140	–	9320.140	9320.140	363

[1)] AWG = American Wire Gauges
AWG 12 = 3.31 mm² ≙ 4 mm²

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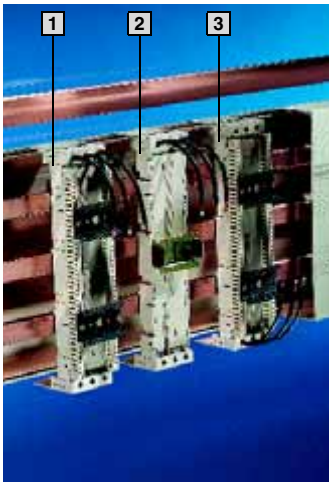
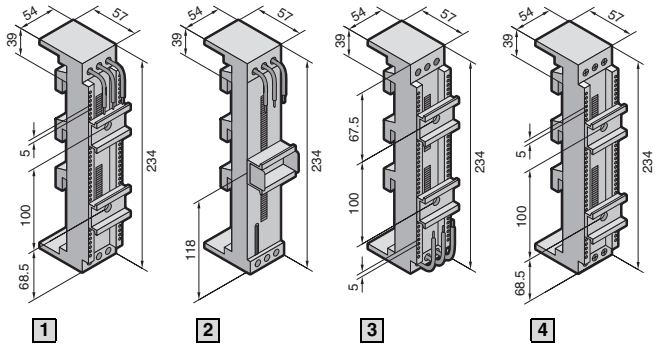
Multi-functional component adaptor 40 A





Material:
Polyamide (PA 6.6),
30 % fibreglass-reinforced.
Continuous operating temperature: max. 140°C.
Fire protection corresponding to UL 94-V0.

Note:
The current carrying capacity of the supply cables fitted as standard can be found on page 1128.

For snap-on mounting		1	2	3	4	4	Page
Construction width		54 mm	54 mm	54 mm	54 mm	54 mm	
Rated current up to		40 A	40 A	40 A	40 A	40 A	
Rated operating voltage		690 V~	690 V~	690 V~	690 V~	690 V~	
Cable outlet		top	top	bottom	top	top/bottom	
Connection cables[1)]		AWG 10	AWG 10	AWG 10	–	–	
Connection of round conductors up to		–	–	–	16 mm²	16 mm²	
Support rails	Quantity	2	1	2	2	2	
	Height	10 mm	15 mm	10 mm	10 mm	10 mm	
Packs of		1	1	1	1	1	
For 5 mm bar thickness **Model No. SV**		**9320.300**	**9320.460**	**9320.320**	**9320.340**	**9320.360**	
For 10 mm bar thickness **Model No. SV**		**9320.310**	**9320.470**	**9320.330**	**9320.350**	**9320.370**	
For power circuit-breakers/starter combinations Make							
ABB		■	■	–	–	–	1131
AEG		■	–	–	–	–	
Allen Bradley		■	–	–	–	–	
Moeller Electric		–	■	–	–	–	
Siemens		–	■	–	–	–	
Universal application		■	■	■	■	■	
Accessories	Packs of						
Support rails width 54 mm, height 10 mm	5	9320.100	–	9320.100	9320.100	9320.100	362

[1)] AWG = American Wire Gauges
AWG 10 = 5.26 mm² ≙ 6 mm²

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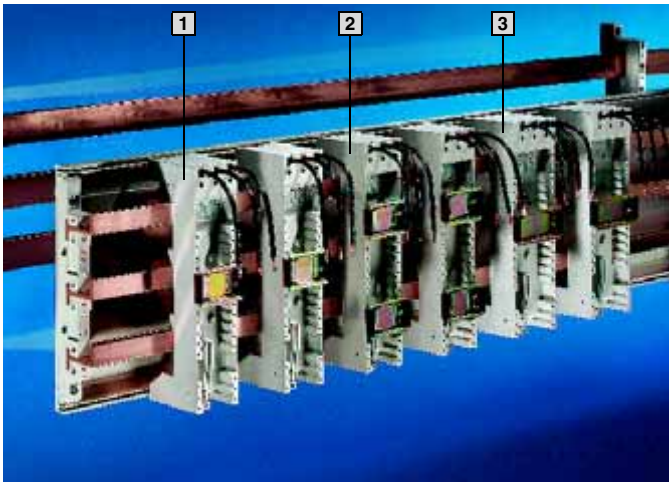
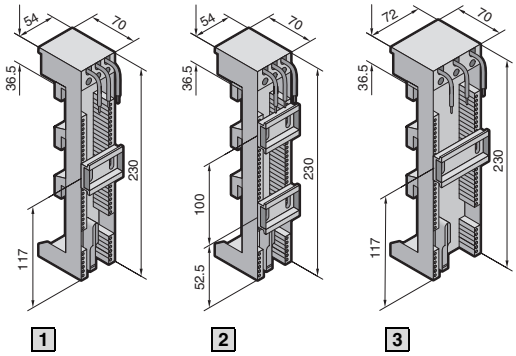
Component adaptor 50 A





Material:
Fibreglass-reinforced, thermoplastic polyester (PBT).
Continuous operating temperature: max. 140°C.
Fire protection corresponding to UL 94-V0.

Note:
The current carrying capacity of the supply cables fitted as standard can be found on page 1128.

For snap-on mounting, with additional terminals up to 10 mm²		1	2	3	Page
Construction width		54 mm	54 mm	72 mm	
Rated current up to		50 A	50 A	50 A	
Rated operating voltage		690 V~	690 V~	690 V~	
Cable outlet		top	top	top	
Connection cables[1)]		AWG 10 (32 A)	AWG 10 (32 A)	AWG 10 (32 A)	
Support rails	Quantity	1	2	1	
	Height	7.5 mm	7.5 mm	7.5 mm	
Packs of		1	1	1	
For 5 mm bar thickness **Model No. SV**		**3540.000**	**3040.000**	**3544.000**	
For 10 mm bar thickness **Model No. SV**		**3541.000**	**3041.000**	**3545.000**	
For power circuit-breakers/starter combinations Make					
ABB		■	–	–	1131
AEG		■	–	–	
Allen Bradley		■	–	–	
Moeller Electric		–	–	■	
Siemens		–	■	–	
Universal application		■	■	■	
Accessories	Packs of				
Insert strip	1	3538.000	3538.000	3538.000	362
Support rails width 54 mm, height 7.5 mm	10	3548.000	3548.000	–	362
Support rails width 72 mm, height 7.5 mm	10	–	–	3549.000	362
Cover strips, width 54 mm	20	3536.000	3536.000	–	363
Cover strips, width 72 mm	20	–	–	3537.000	363

[1)] AWG = American Wire Gauges
AWG 10 = 5.26 mm² ≙ 6 mm²

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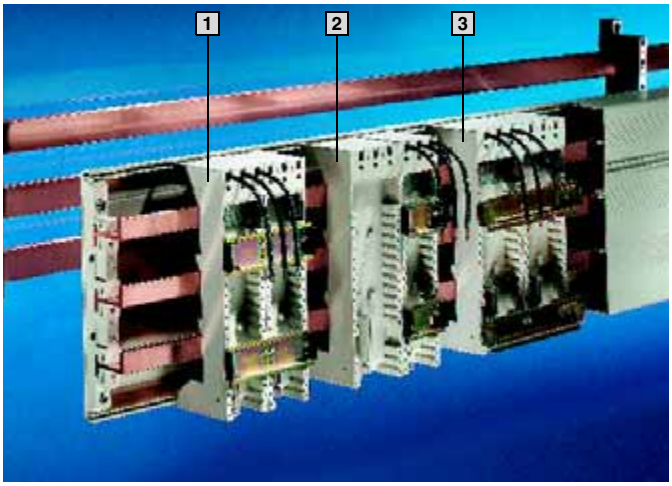
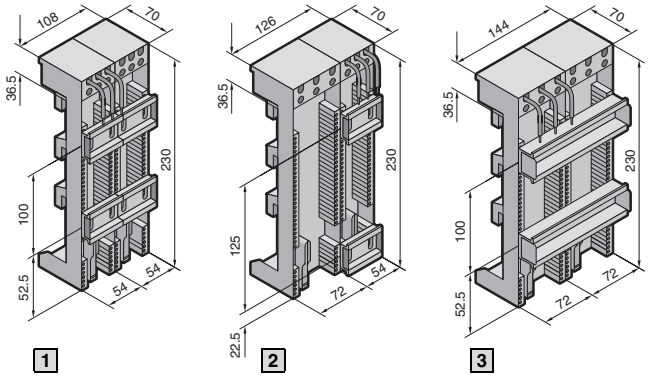
Component adaptor 50 A





Material:
Fibreglass-reinforced, thermoplastic polyester (PBT).
Continuous operating temperature: max. 140°C.
Fire protection corresponding to UL 94-V0.

Note:
The current carrying capacity of the supply cables fitted as standard can be found on page 1128.

For snap-on mounting, with additional terminals up to 10 mm²		1	2	3	Page
Construction width		108 mm	126 mm	144 mm	
Rated current up to		50 A	50 A	50 A	
Rated operating voltage		690 V~	690 V~	690 V~	
Cable outlet		top	top	top	
Connection cables[1)]		AWG 10 (32 A)	AWG 10 (32 A)	AWG 10 (32 A)	
Support rails	Quantity	2	2	2	
	Height	7.5 mm	7.5 mm	15 mm	
Packs of		1	1	1	
For 5 mm bar thickness **Model No. SV**		**3042.000**	**3069.000**	**3044.000**	
For 10 mm bar thickness **Model No. SV**		**3043.000**	**3070.000**	**3045.000**	
For power circuit-breakers/starter combinations Make					
Moeller Electric		■	–	–	1131
Siemens		–	■	–	
Telemecanique		■	–	–	
Universal application		■	■	■	
Accessories	Packs of				
Insert strip	1	3538.000	3538.000	3538.000	362
Support rails width 54 mm, height 7.5 mm	10	3548.000	3548.000	–	362
Support rails width 72 mm, height 7.5 mm	10	–	3549.000	3549.000	362
Cover strips, width 54 mm	20	3536.000	3536.000	–	363
Cover strips, width 72 mm	20	–	3537.000	3537.000	363

[1)] AWG = American Wire Gauges
AWG 10 = 5.26 mm² ≙ 6 mm²

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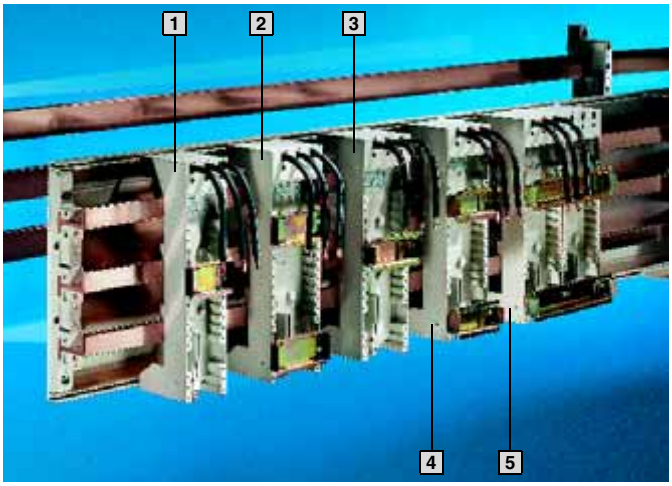
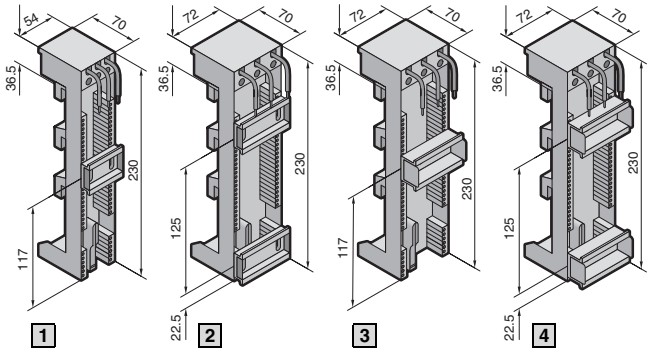
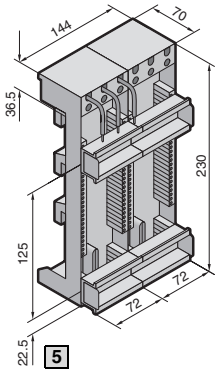
Component adaptor 63 A







Material:
Fibreglass-reinforced, thermoplastic polyester (PBT).
Continuous operating temperature: max. 140°C.
Fire protection corresponding to UL 94-V0.

Note:
The current carrying capacity of the supply cables fitted as standard can be found on page 1128.

For snap-on mounting, with additional terminals up to 10 mm²		1	2	3	4	5	Page
Construction width		54 mm	72 mm	72 mm	72 mm	144 mm	
Rated current up to		63 A	63 A	63 A	63 A	63 A	
Rated operating voltage		690 V~	690 V~	690 V~	690 V~	690 V~	
Cable outlet		top	top	top	top	top	
Connection cables[1)]		AWG 8	AWG 8	AWG 8	AWG 8	AWG 8	
Support rails	Quantity	1	2	1	2	2	
	Height	7.5 mm	7.5 mm	15 mm	15 mm	15 mm	
Packs of		1	1	1	1	1	
For 5 mm bar thickness **Model No. SV**		**3036.000**	**3038.000**	**3067.000**	**3046.000**	**3048.000**	
For 10 mm bar thickness **Model No. SV**		**3037.000**	**3039.000**	**3068.000**	**3047.000**	**3049.000**	
For power circuit-breakers/starter combinations Make							
ABB		■	–	■	–	–	1131
Moeller Electric		■	–	–	■	■	
Siemens		■	–	■	–	–	
Telemecanique		–	–	■	–	–	
Universal application		■	■	■	■	■	
Accessories	Packs of						
Insert strip	1	3538.000	3538.000	3538.000	3538.000	3538.000	362
Support rails width 54 mm, height 7.5 mm	10	3548.000	–	–	–	–	362
Support rails width 72 mm, height 7.5 mm	10	–	3549.000	3549.000	3549.000	3549.000	362
Cover strips, width 54 mm	20	3536.000	–	–	–	–	363
Cover strips, width 72 mm	20	–	3537.000	3537.000	3537.000	3537.000	363

[1)] AWG = American Wire Gauges
AWG 8 = 8.37 mm² ≙ 10 mm²

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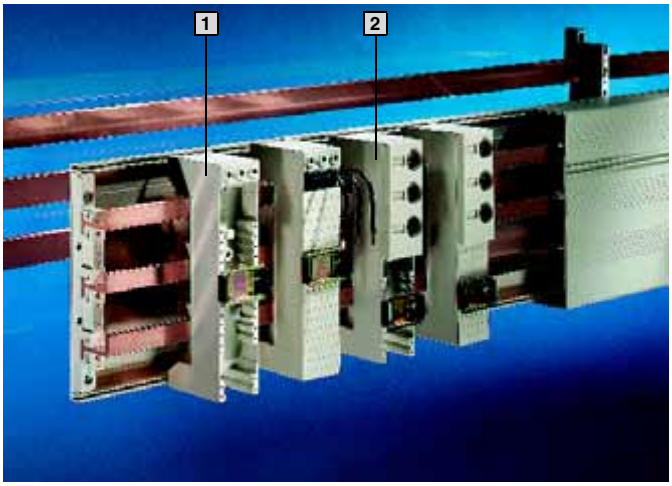
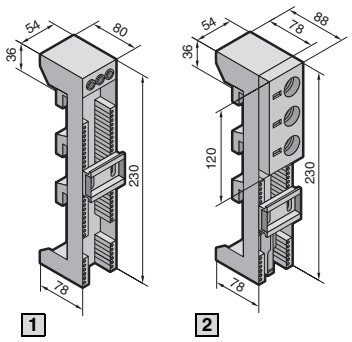
Component adaptor 63 A





Material:
Fibreglass-reinforced, thermoplastic polyester (PBT).
Continuous operating temperature: max. 140°C.
Fire protection corresponding to UL 94-V0.

Scope of supply SV 3445.000:
Including connection cables supplied loose (AWG 10 = 5.26 mm² ≙ 6 mm²) and cover strips.

Scope of supply SV 3446.000:
Including cover strips.

Note:
Current carrying capacity of connection cables, see page 1128.

For clamping screw attachment		1	2	Page
Construction width		54 mm	54 mm	
With pre-fuse unit		–	D 02-E 18	
Rated current up to		63 A	63 A	
Rated operating voltage		690 V~	400 V~	
Cable outlet		top	top	
Connection of round conductors		1.5 – 10 mm²	1.5 – 16 mm²	
Support rails	Quantity	1	1	
	Height	7.5 mm	7.5 mm	
Tightening torque ● Assembly screw ● Terminal screw		 2 Nm 2 Nm	 2 Nm 2 Nm	
Packs of		1	1	
For 5 – 10 mm bar thickness **Model No. SV**		**3445.000**	**3446.000**	
For power circuit-breakers/starter combinations **Make**				
ABB		■	■	1131
AEG		■	■	
Allen Bradley		■	■	
Moeller Electric		■	–	
Siemens		■	–	
Universal application		■	■	
Accessories	Packs of			
Insert strip	1	3448.000[1)]	3448.000[1)]	362
Support rails width 54 mm, height 7.5 mm	10	3447.000	3447.000	362
Support rails width 70 mm, height 7.5 mm	10	3496.000[2)]	3496.000[2)]	362

[1)] Including extended support rail and cover strips.
[2)] For component adaptor with adaptor extension piece SV 3448.000.

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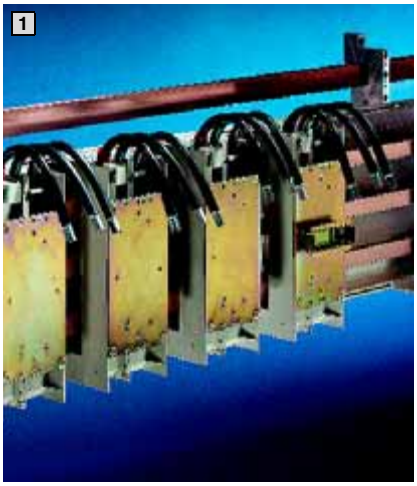
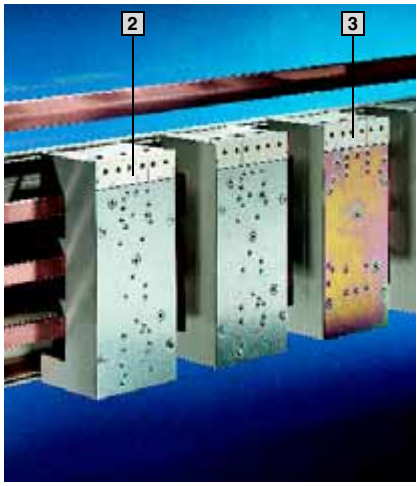
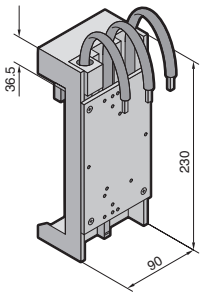
Component adaptor 100 A/160 A







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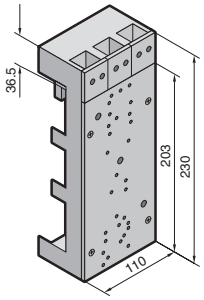

2 + 3

Material:
Fibreglass-reinforced, thermoplastic polyester (PBT).
Continuous operating temperature: max. 140°C.
Fire protection corresponding to UL 94-V0.

Note:
The current carrying capacity of the supply cables fitted as standard can be found on page 1128.

Component adaptor 100 A for snap-on mounting		**Component adaptor 160 A for clamping screw attachment**		Page
Version	1	2	3	
Construction width	90 mm	110 mm	110 mm	
Rated current up to	100 A	160 A	160 A	
Rated operating voltage	690 V~	690 V~	690 V~	
Connection cables	35 mm²	–	–	
Connection of round conductors up to	–	6 – 70 mm²	6 – 70 mm²	
Clamping area for laminated copper bars	–	13 x 10 mm	13 x 10 mm	
Tightening torque ● Assembly screw ● Terminal screw	 – –	 6 Nm 3 Nm	 6 Nm 3 Nm	
Packs of	1	1	1	
For 5 mm bar thickness **Model No. SV**	**9320.000**	**3438.000**	**3539.000**	
For 10 mm bar thickness **Model No. SV**	**9320.010**			
For power circuit-breakers Make				
ABB	LNA 32/63/100[1], Tmax (T1, T2)	S1/2/3, LNA 32/63/100	Tmax (T1, T2, T3)	
AEG	Mbs100[2]	MC 128/167/168	–	
Allen Bradley	140-CMN-...[2]	–	–	
Delta	–	Sizes E and F	–	
Merlin Gerin	Compact NS 80	Compact NS 80/100/160	Compact NS 80/100/160	
Moeller Electric	NZM 1, NZM 7	NZM 2	NZM 1/6/7	
Siemens	S3 (3RV104...)[2]	–	3VE4/5, 3VF3, 3VN4/5, 3VT4/5, 3VP5, Sentron VL 160 X (3VL1...)	
Telemecanique	GV3-M...[2], GK3-EF..[2]	–	–	
Vynckier	–	JF1/2, JS1/2/3, XF1/2, XH3, XS1/2/3	–	
Accessories	Packs of			
Laminated copper bars	–	■	■	361
Support rails width 72 mm, height 15 mm	5	9320.120	–	–	362

[1] Mounting of power circuit-breakers for fixed installation is only possible with ABB mounting bracket (Model No. UXAB 169264 R005).
[2] Mounting only possible with support rail.

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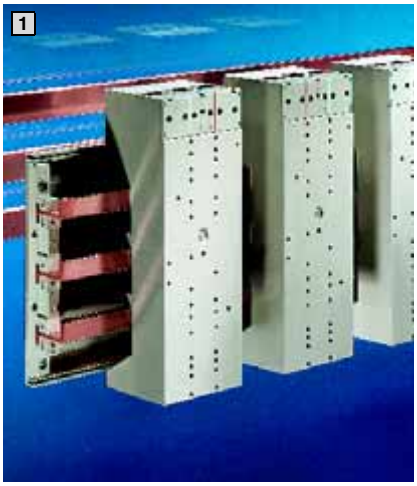
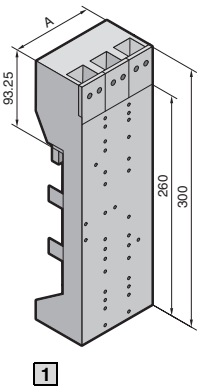
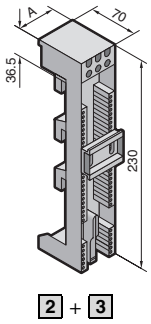
Component adaptor 250 A/component support







Material:
Fibreglass-reinforced, thermoplastic polyester (PBT).
Continuous operating temperature max. 140°C.
Fire protection corresponding to UL 94-V0.

Component adaptor 250 A for clamping screw attachment					**Component support (without contact system) for snap-on mounting**		Page
Version			1	1	2	3	
Construction width (A)			110 mm	110 mm	54 mm	72 mm	
Rated current up to			250 A	250 A	–	–	
Rated operating voltage			690 V~	690 V~	–	–	
Connection of round conductors up to			50 – 120 mm²	50 – 120 mm²	–	–	
Clamping area for laminated copper bars			16 x 12 mm	16 x 12 mm	–		
Tightening torque ● Assembly screw ● Terminal screw			4 – 6 Nm 8 – 10 Nm	4 – 6 Nm 8 – 10 Nm	– –	– –	
Support rails		Quantity	–	–	1	1	
		Height	–	–	7.5 mm	7.5 mm	
Packs of			1	1	1	1	
For 5 mm bar thickness **Model No. SV**			**3437.000**	**3437.010**	**3542.000**	**3546.000**	
For 10 mm bar thickness **Model No. SV**					**3543.000**	**3547.000**	
For power circuit-breakers							
Make	**Type**						
ABB	S3, S4		■	–	–	–	
AEG	MC 168/257/258		■	–	–	–	
Delta	Size J		■	–	–	–	
Merlin Gerin	Compact NS 250		■	–	–	–	
Moeller Electric	NZM 6/7		■	–	–	–	
	NZM 2		–	■	–	–	
Siemens	3VF3/4		■	–	–	–	
Sprecher & Schuh	KTA 3-250S		■	–	–	–	
Also required		Packs of					
Mounting kit for power circuit breaker	Moeller, Siemens (3VF3)	1 set	**3018.000**	–	–	–	
	AEG, Delta, Sprecher & Schuh	1 set	**3019.000**	–	–	–	
	ABB, Merlin Gerin, Siemens (3VF4)	1 set	**3063.000**	–	–	–	
Accessories							
Insert strip		1	–	–	3538.000	3538.000	362
Support rails, width 54 mm, height 7.5 mm		10	–	–	3548.000	–	362
Support rails, width 72 mm, height 7.5 mm		10	–	–	–	3549.000	362
Cover strips, width 54 mm		20	–	–	3536.000	–	363
Cover strips, width 72 mm		20	–	–	–	3537.000	363
Laminated copper bars			■	■	–	–	361

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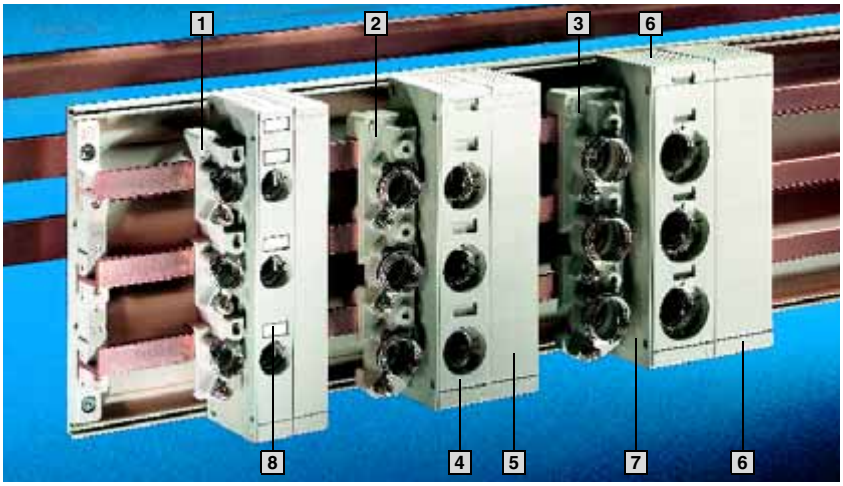
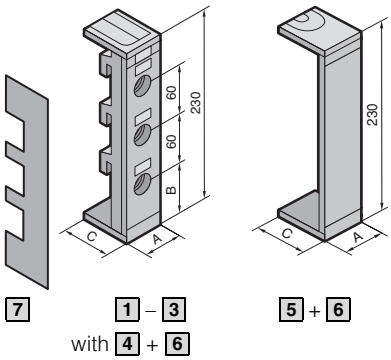
Bus-mounting fuse bases





7 | 1 – 3 with 4 + 6 | 5 + 6

Material:
Bus-mounting fuse base:
Fibreglass-reinforced, thermoplastic polyester (PBT).
Continuous operating temperature max. 140°C.
Fire protection corresponding to UL 94-V0.

Contact hazard protection cover:
Talcum-reinforced polypropylene.
Continuous operating temperature max. 100°C.
Fire protection corresponding to UL 94-V0.

For clamping screw attachment		1	2	3
Type		D 02-E 18 (adaptor sleeve)	D II-E 27 (adaptor screw)	D III-E 33 (adaptor screw)
Width (A)		27 mm	42 mm	57 mm
Rated current		63 A	25 A	63 A
Rated operating voltage		400 V~	500 V~	690 V~
Terminal for round conductors[1)]		1.5 – 16 mm²	1.5 – 16 mm²	1.5 – 16 mm²
Tightening torque ● Assembly screw ● Terminal screw		 2 Nm 2.5 Nm	 2 Nm 2.5 Nm	 2 Nm 2.5 Nm
Packs of		10	10	10
For 5 – 10 mm bar thickness **Model No. SV**		**3418.000**	**3427.000**	**3433.000**
Accessories	Packs of			
4 **Contact hazard protection cover** **Model No. SV**	10	**3419.000**	**3428.000**	**3434.000**
5 **Extension cover** **Model No. SV**	10	**3421.000**	**3430.000**	**3436.000**
6 **End caps** **Model No. SV**	10	**3420.000**	**3429.000**	**3435.000**
7 **Side cover** **Model No. SV**	10	**3093.000**	**3093.000**	**3093.000**
8 **Identification labels** **Model No. SV**	100	**9320.080**	**9320.080**	**9320.080**
Width (A) mm		27	42	57
Spacing (B) mm		57	40	40
Depth (C) mm		67	71.5	71.5

[1)] Wire end ferrules should be used with fine wire conductors.

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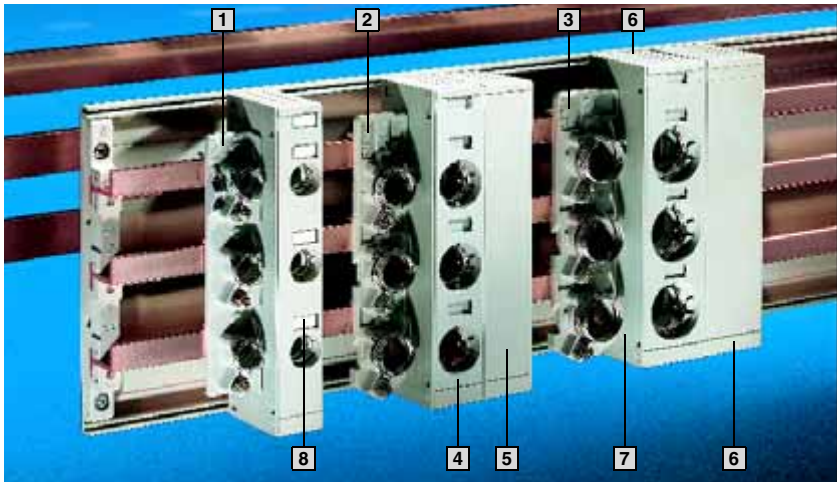
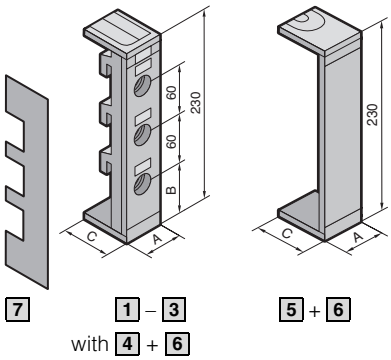
Bus-mounting fuse bases





7 1 – 3 with 4 + 6 5 + 6

Material:
Bus-mounting fuse base:
Fibreglass-reinforced, thermoplastic polyester (PBT).
Continuous operating temperature max. 140°C.
Fire protection corresponding to UL 94-V0.

Contact hazard protection cover:
Talcum-reinforced polypropylene.
Continuous operating temperature max. 100°C.
Fire protection corresponding to UL 94-V0.

For snap-on mounting		1	2	3
Type		D 02-E 18 (adaptor sleeve)	D II-E 27 (gauge ring)	D III-E 33 (gauge ring)
Width (A)		36 mm	42 mm	57 mm
Rated current		63 A	25 A	63 A
Rated operating voltage		400 V~	500 V~	690 V~
Terminal for round conductors[1)]		1.5 – 16 mm²	1.5 – 16 mm²	1.5 – 16 mm²
Tightening torque ● Terminal screw		2.5 Nm	2.5 Nm	2.5 Nm
Packs of		10	10	10
For 5 mm bar thickness **Model No. SV**		**3422.000**	**3520.000**	**3530.000**
For 10 mm bar thickness **Model No. SV**		**3423.000**	**3521.000**	**3531.000**
Accessories	Packs of			
4 **Contact hazard protection cover** **Model No. SV**	10	**3424.000**	**3522.000**	**3532.000**
5 **Extension cover** **Model No. SV**	10	**–**	**3430.000**	**3436.000**
6 **End caps** **Model No. SV**	10	**3425.000**	**3429.000**	**3435.000**
7 **Side cover** **Model No. SV**	10	**3093.000**	**3093.000**	**3093.000**
8 **Identification labels** **Model No. SV**	100	**9320.080**	**9320.080**	**9320.080**
Width (A) mm		36	42	57
Spacing (B) mm		57	40	40
Depth (C) mm		67	71.5	71.5

[1)] Wire end ferrules should be used with fine wire conductors.

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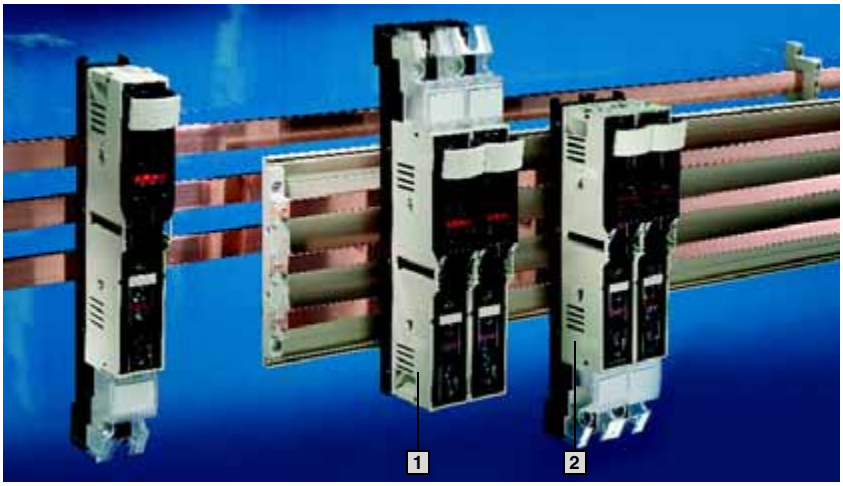
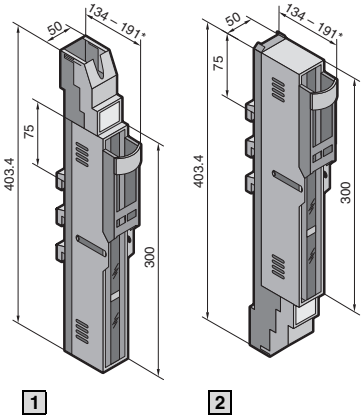
Accessories Page 360

NH fused isolators, size 00





* Off-load position

Material:
Cover:
Fibreglass-reinforced polyamide
Strip chassis:
Duroplastic polyester
Contact tracks:
Silver-plated hard copper

Note:
When using gR fuse inserts (VDE 0636/23) in NH equipment, please observe the information on page 1134.

Technical information,
see page 1134.

Version		1	2	Page
Size		00	00	
Rated current		160 A	160 A	
Rated operating voltage		690 V~	690 V~	
Cable outlet		Top	Bottom	
Type of connection		Screw M8	Screw M8	
Tightening torque ● Assembly screw ● Terminal screw		 6 Nm 14 Nm	 6 Nm 14 Nm	
For bar thickness		5 – 10 mm	5 – 10 mm	
Packs of		1	1	
Model No. SV		**3591.020**	**3591.030**	
Accessories	Packs of			
Identification label support	6	3595.010	3595.010	363
Micro-switch	5	3071.000	3071.000	363
PLS cover	2	3499.070	3499.070	364
Lug terminal connection parts	1 set	3592.020	3592.020	365
Clamp-type terminal connection	1 set	3592.010	3592.010	365

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Component adaptor Page 325 **Component support** Page 333 **Bus-mounting fuse bases** Page 334 **NH bus-mounting on-load isolators** Page 338
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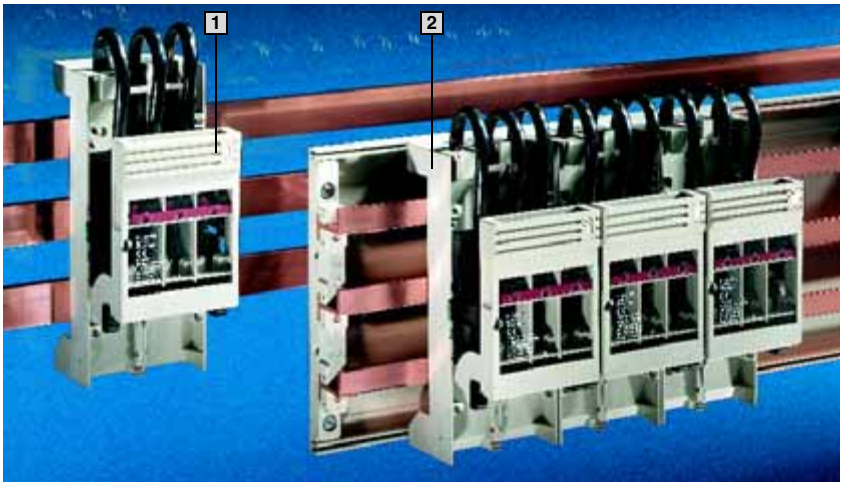
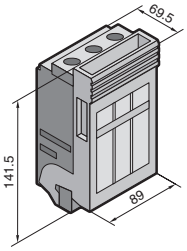
NH on-load isolators, size 000



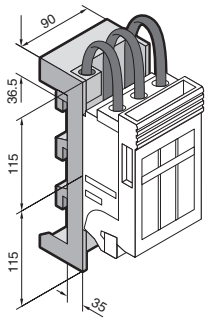


Material:
Isolator lid, contact hazard protection, isolator chassis:
Fibreglass-reinforced polyamide
Contact tracks:
Silver-plated hard copper

Technical information,
see page 1132.

Size		000	Page
Rated current		100 A (160 A)[1]	
Rated operating voltage		690 V~	
Cable outlet		top/bottom	
Type of connection		Terminal up to 50 mm²	
Tightening torque ● Terminal screw		3 Nm	
Packs of		1	
1 Model No. SV		**3431.000**	
Also required			
Busbar adaptor		see below	
Accessories	Packs of		
Micro-switch	5	3071.000	363

[1] 160 A at 95 mm² connection cross-section (95 mm² connector pieces available on request).



2 Busbar adaptor

For mounting SV 3431.000 on 60 mm busbar systems.

Material:
Fibreglass-reinforced, thermoplastic polyester (PBT).
Continuous operating temperature: max. 140°C.
Fire protection corresponding to UL 94-V0.

Supply includes:
35 mm² connection cables fitted as standard.

For bar thickness mm	Packs of	Model No. SV
5	1	**9320.040**
10	1	**9320.050**

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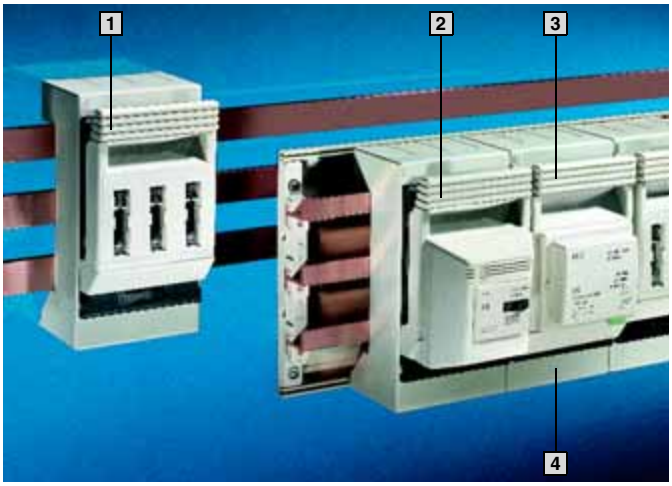
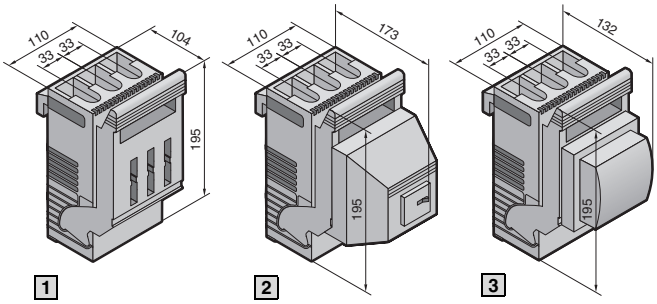
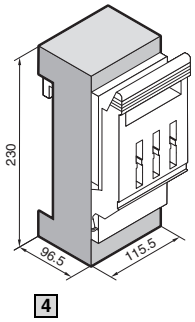
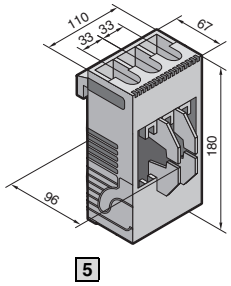
NH bus-mounting on-load isolator, size 00/NH bus-mounting fuse bases, size 00









Material:
Isolator lid, contact hazard protection, isolator chassis: Fibreglass-reinforced polyamide
Contact tracks:
Silver-plated hard copper

Note:
When using gR fuse inserts (VDE 0636/23) in NH equipment, please observe the information on page 1134.

The NH bus-mounting fuse base is not suitable for fitting with an isolator lid.

Technical information,
see page 1132.

NH bus-mounting on-load isolators						Page
Size		00		00		
Rated current		160 A		160 A		
Rated operating voltage		690 V~		690 V~		
Cable outlet		Top	Bottom	Top	Bottom	
Type of connection		Screw terminal M8 up to 95 mm²		Clamp-type terminal connection up to 70 mm²		
Tightening torque ● Assembly screw ● Terminal screw		5 – 6 Nm 10 – 15 Nm	5 – 6 Nm 10 – 15 Nm	5 – 6 Nm 2 – 3 Nm	5 – 6 Nm 2 – 3 Nm	
For bar thickness		5 – 10 mm	5 – 10 mm	5 – 10 mm	5 – 10 mm	
Packs of		1	1	1	1	
1 **Model No. SV**		**3400.000**	**3401.000**	**3402.000**	**3403.000**	
2 **with electromechanical fuse monitoring Model No. SV**		**3490.000**	**3491.000**	**3492.000**	**3493.000**	
3 **with electronic fuse monitoring and LED display Model No. SV**		**3490.210**	**3491.210**	**3492.210**	**3493.210**	
Accessories	Packs of					
Micro-switch	5	3071.000	3071.000	3071.000	3071.000	363
4 Contact hazard protection frame	1	3408.000	3408.000	3408.000	3408.000	364

NH bus-mounting fuse bases[1]				
Size	00		00	
Rated current	160 A		160 A	
Rated operating voltage	690 V~		690 V~	
Cable outlet	Top	Bottom	Top	Bottom
Type of connection	Screw terminal M8 up to 95 mm²		Clamp-type terminal connection up to 70 mm²	
Tightening torque ● Assembly screw ● Terminal screw	5 – 6 Nm 10 – 15 Nm	5 – 6 Nm 10 – 15 Nm	5 – 6 Nm 10 – 15 Nm	5 – 6 Nm 10 – 15 Nm
For bar thickness	5 – 10 mm	5 – 10 mm	5 – 10 mm	5 – 10 mm
Packs of	1	1	1	1
5 **Model No. SV**	**3406.000**	**3407.000**	**3404.000**	**3405.000**

[1] Component mounting with an isolator lid is not possible.

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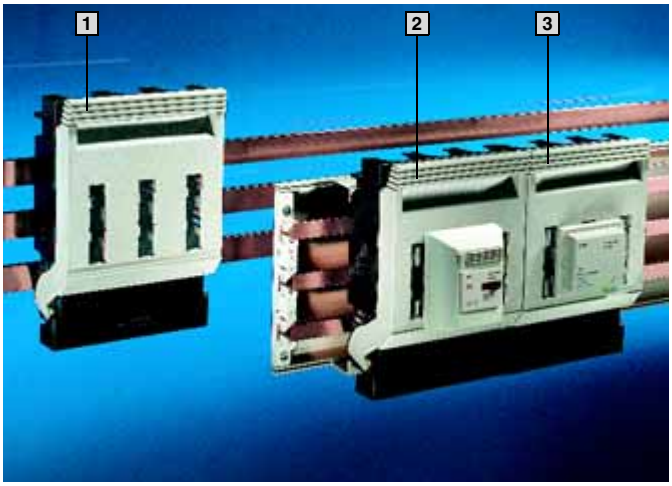
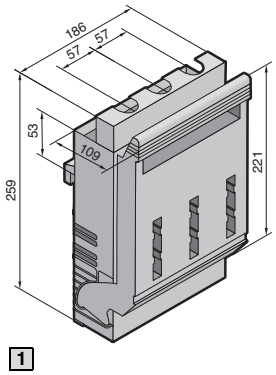
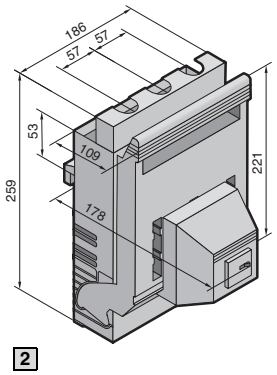
NH bus-mounting on-load isolators, size 1

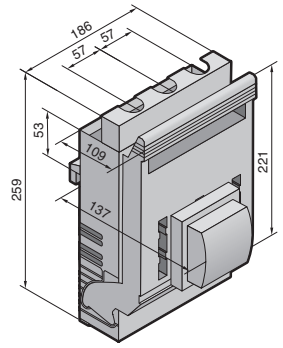




1



2



3

Material:
Isolator lid, contact hazard protection, isolator chassis: Fibreglass-reinforced polyamide
Contact tracks:
Silver-plated hard copper

Note:
When using gR fuse inserts (VDE 0636/23) in NH equipment, please observe the information on page 1134.

Technical information,
see page 1132.

Size		1		Page
Rated current		250 A		
Rated operating voltage		690 V~		
Cable outlet		Top	Bottom	
Type of connection		Screw terminal M10 up to 150 mm²	Screw terminal M10 up to 150 mm²	
Tightening torque ● Assembly screw ● Terminal screw		 8 – 10 Nm 15 – 20 Nm	 8 – 10 Nm 15 – 20 Nm	
For bar thickness		5 – 10 mm	5 – 10 mm	
Packs of		1	1	
1 **Model No. SV**		**3411.000**	**3410.000**	
2 **with electromechanical fuse monitoring Model No. SV**		**3495.000**	**3494.000**	
3 **with electronic fuse monitoring and LED display Model No. SV**		**3495.210**	**3494.210**	
Accessories	Packs of			
Micro-switch	5	3071.000	3071.000	363
PLS cover	2	3099.000	3099.000	364
Lug terminal connection parts	1 set	3414.000	3414.000	365

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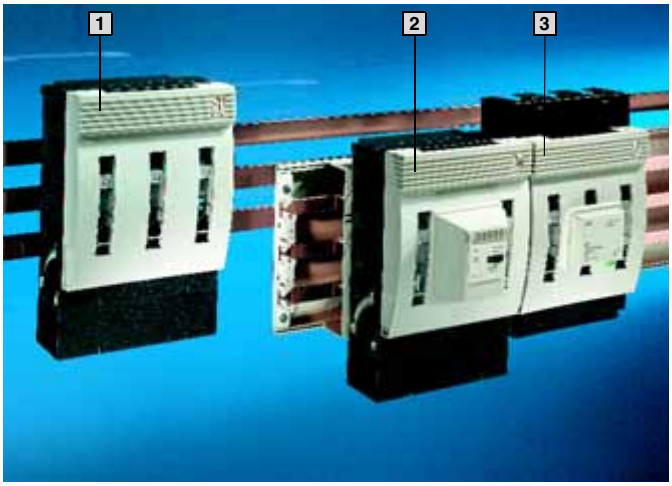
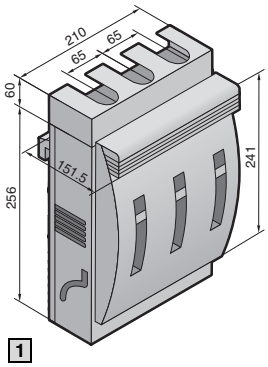
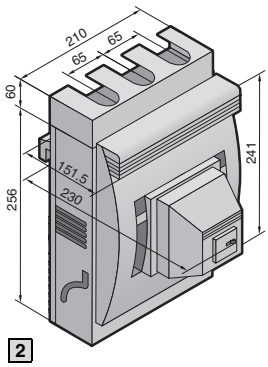
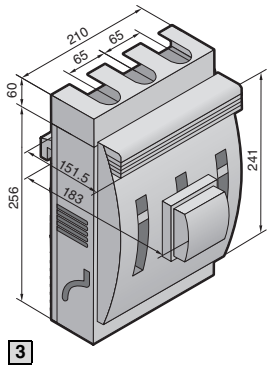
NH bus-mounting on-load isolators, size 2









Material:
Isolator lid, contact hazard protection, isolator chassis: Fibreglass-reinforced polyamide
Contact tracks:
Silver-plated hard copper

Note:
When using gR fuse inserts (VDE 0636/23) in NH equipment, please observe the information on page 1134.

Technical information,
see page 1132.

Detailed drawing,
see page 1135.

Size		2		Page
Rated current		400 A		
Rated operating voltage		690 V~		
Cable outlet		Top	Bottom	
Type of connection		Screw terminal M10 up to 240 mm²	Screw terminal M10 up to 240 mm²	
Tightening torque ● Assembly screw ● Terminal screw		 14 Nm 32 Nm	 14 Nm 32 Nm	
For bar thickness		5 – 10 mm	5 – 10 mm	
Packs of		1	1	
1 **Model No. SV**		**3415.020**	**3415.030**	
2 **with electromechanical fuse monitoring Model No. SV**		**3415.120**	**3415.130**	
3 **with electronic fuse monitoring and LED display Model No. SV**		**3415.210**	**3415.230**	
Accessories	Packs of			
Micro-switch	5	3071.000	3071.000	363
PLS cover	1	3499.040	3499.040	364
Lug terminal connection parts	1 set	3499.000	3499.000	365
Clamp-type terminal connection	1 set	3499.010	3499.010	365

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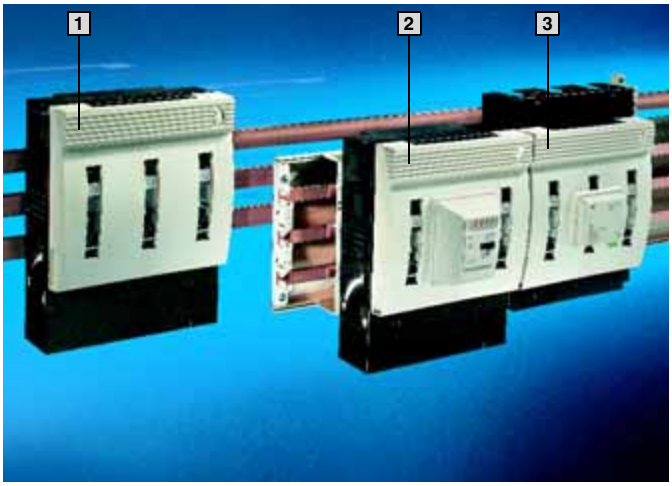
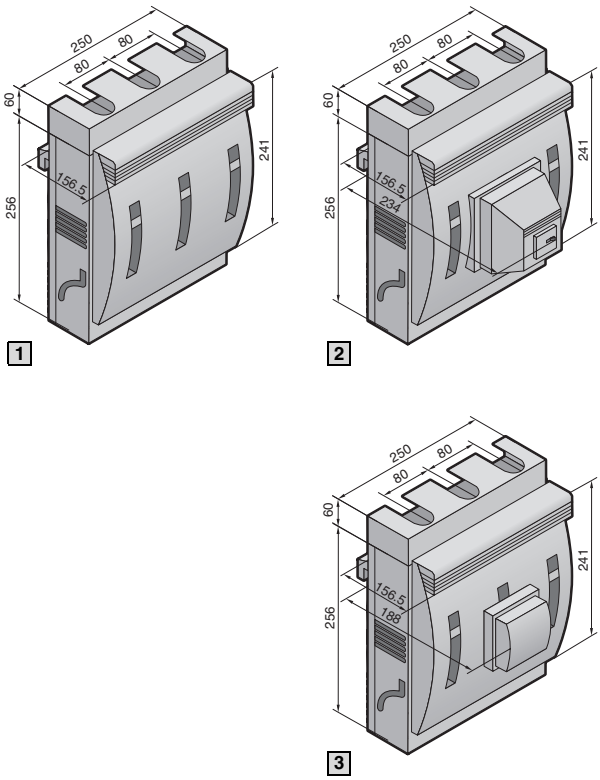
NH bus-mounting on-load isolators, size 3





Material:
Isolator lid, contact hazard protection, isolator chassis:
Fibreglass-reinforced polyamide
Contact tracks:
Silver-plated hard copper

Note:
When using gR fuse inserts (VDE 0636/23) in NH equipment, please observe the information on page 1134.

Technical information,
see page 1132.

Detailed drawing,
see page 1135.

Size		3		Page
Rated current		630 A		
Rated operating voltage		690 V~		
Cable outlet		Top	Bottom	
Type of connection		Screw terminal M10 up to 240 mm²	Screw terminal M10 up to 240 mm²	
Tightening torque ● Assembly screw ● Terminal screw		 14 Nm 32 Nm	 14 Nm 32 Nm	
For bar thickness		5 – 10 mm	5 – 10 mm	
Packs of		1	1	
1 **Model No. SV**		**3095.020**	**3095.030**	
2 **with electromechanical fuse monitoring Model No. SV**		**3095.120**	**3095.130**	
3 **with electronic fuse monitoring and LED display Model No. SV**		**3095.210**	**3095.230**	
Accessories	Packs of			
Micro-switch	5	3071.000	3071.000	363
PLS cover	1	3499.050	3499.050	364
Lug terminal connection parts	1 set	3499.000	3499.000	365
Clamp-type terminal connection	1 set	3499.010	3499.010	365

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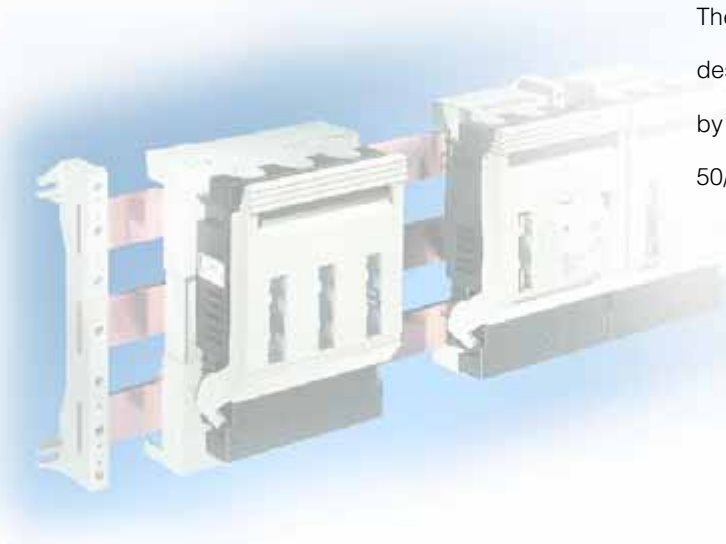
Busbar systems up to 1250 A (100 mm)

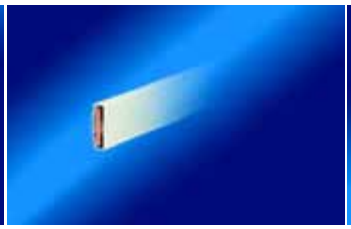
Overview



The busbar support with 100 mm bar centre distance is designed for the accommodation of bars 60 x 10 mm; by using inserts the cross-section may be reduced to 50/40/30 x 10 mm.

System components

End cover
Busbar support up to 1250 A, 3-pole
Inserts for busbar supports
Busbars E-Cu



Busbar cover sections

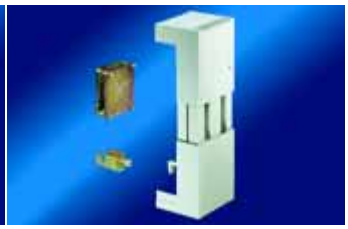
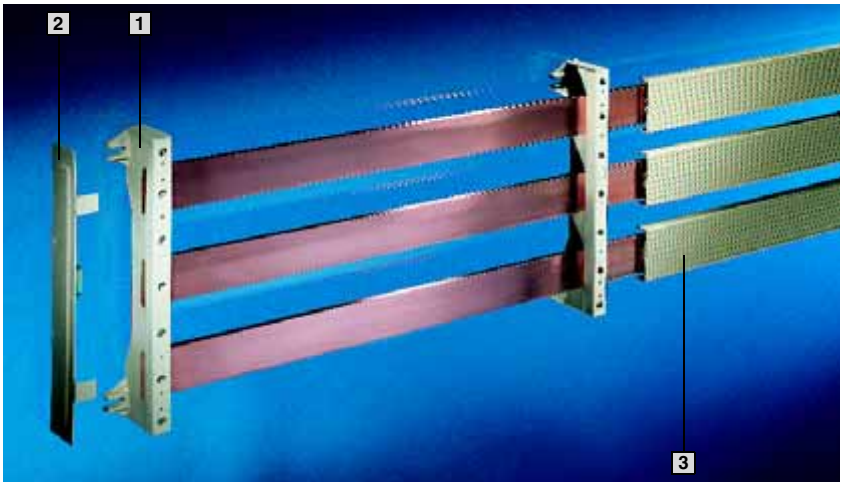


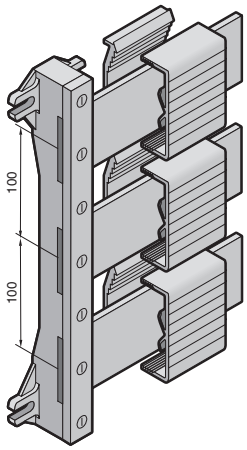
Plate clamps
Conductor connection clamps
System covers

NH-bus-mounting on-load isolator size 00, size 1, size 2 and size 3

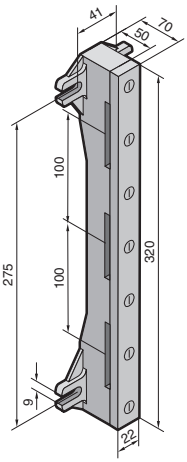
NH fused isolator, size 00

System components





Planning software Rittal SV Plan/ Power Plan,
see page 1061.



1 Busbar support

Material:
Fibreglass-reinforced, thermoplastic polyester (PBT).
Continuous operating temperature: max. 140°C.
Fire protection corresponding to UL 94-V0.

Short-circuit protection diagram,
see page 1126.

Technical information
for the calculation of rated currents,
see page 1137.

Rated current up to	1250 A
Rated operating voltage up to	1000 V~, 50/60 Hz to VDE 0660
Number of poles	3-pole
Bar centre distance	100 mm
Max. bar accommodation without inserts	60 x 10 mm
Tightening torque ● Assembly screw ● Cover attachment	 8 – 10 Nm 1 – 3 Nm
Packs of	4
Model No. SV	**3073.000**

Inserts

for SV 3073.000
To adapt bar dimensions
30 x 10 – 50 x 10 mm.

Busbars

made from E-Cu
To DIN EN 13 601.
Length: 2400 mm/bar.

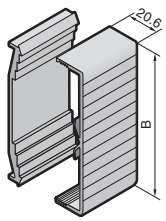
Rated current	Busbar dimensions mm	Inserts[1]	Busbars[2]
		Model No. SV	**Model No. SV**
800 A	30 x 10	**3074.000**	**3586.000[3]**
850 A	40 x 10	**3075.000**	**3587.000**
1000 A	50 x 10	**3076.000**	**3588.000**
1250 A	60 x 10	**–**	**3589.000**

Supply includes:
[1] Packs of 24
[2] Packs of 3
[3] Packs of 6

2 End cover

For side contact hazard protection of the busbar assembly. Simple clip-on mounting to SV 3073.000.

Packs of	**Model No. SV**
10	**3083.000**



3 Busbar covers

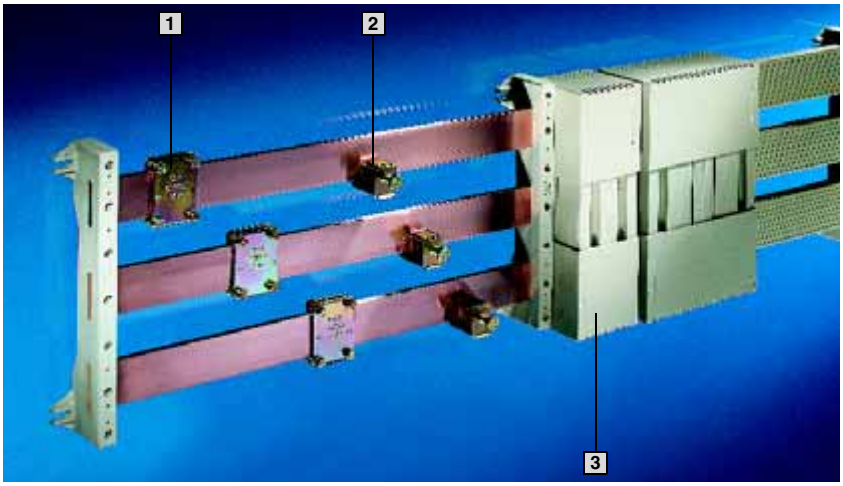
Contact hazard protection via full encapsulation of the busbars. May be cut to required length.

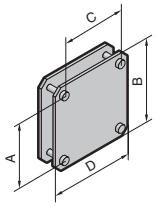
Material:
Thermally modified hard PVC.
Continuous operating temperature: max. 100°C.
Fire protection corresponding to UL 94-V0.

For busbars mm	Width (B) mm	Packs of	**Model No. SV**
12 x 5 – 30 x 10	40,6	10 à 1 m	**3092.000**
40 x 10 – 60 x 10	70,6	10 à 1 m	**3085.000**

System overview Page 342 **Connection clamps** Page 344 **NH bus-mounting on-load isolators** Page 345 **NH fused isolator** Page 349 **Accessories** Page 360

Connection clamps/system covers





1 Plate clamps

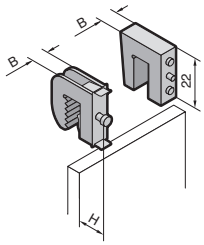
For connecting laminated copper bars; no drilling required.

Material:
Sheet steel, zinc-plated, passivated.

Accessories:

Laminated copper bars,
see page 361.

For busbars mm	Clamping area for laminated copper bars mm	Tightening torque Nm	A mm	B mm	C mm	D mm	Packs of	Model No. SV
30 x 10	34 x 10	6 – 8	40	55	40	55	3	**3554.000**
40 x 10	34 x 10	6 – 8	50	65	40	55	3	**3559.000**
50 x 10	34 x 10	6 – 8	60	75	40	55	3	**3560.000**
50 x 10	54 x 10	6 – 8	60	75	60	75	3	**3562.000**
60 x 10	34 x 10	6 – 8	70	85	40	55	3	**3561.000**
60 x 10	54 x 10	6 – 8	70	85	60	75	3	**3563.000**



2 Conductor connection clamps

For 10 mm bar thickness.

Material:
Sheet steel, zinc-plated, passivated (SV 3455.500 – SV 3459.500), brass (SV 3555.000).

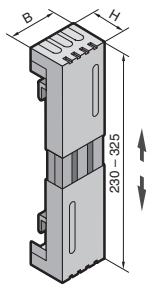
Note:
Conductor connection clamps for 5 mm bar thickness, see page 324.

Accessories:

Laminated copper bars,
see page 361.

Connection of round conductors[1] mm²	Clamping area for laminated copper bars mm	Tightening torque Nm	Width (B) mm	Height (H) mm min.	Height (H) mm max.	Packs of	Model No. SV
1 – 4	–	2	8	–	–	15	**3555.000**
1 – 4	–	2	11	17	23	15	**3455.500**
2.5 – 16	8 x 8	3	14	22	29	15	**3456.500**
16 – 50	10.5 x 11	6 – 8	18.5	26	39	15	**3457.500**
35 – 70	16.5 x 15	10 – 12	24.5	39	57	15	**3458.500**
70 – 185	22.5 x 20	12 – 15	30.5	44	66	15	**3459.500**

[1] Wire end ferrules should be used with fine wire conductors.



3 System covers

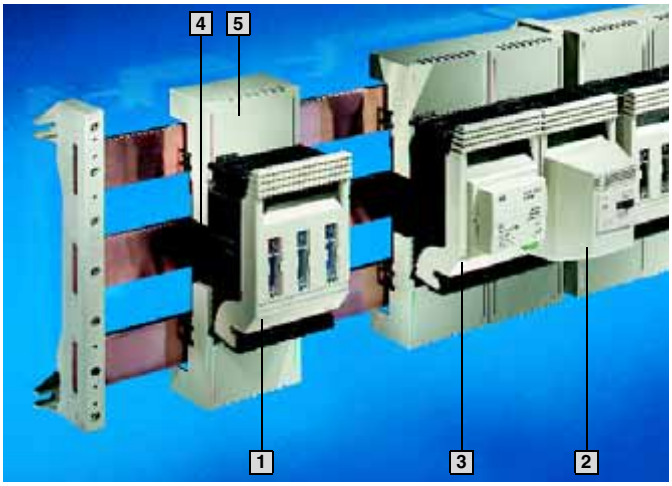
For conductor connection clamps and plate clamps.

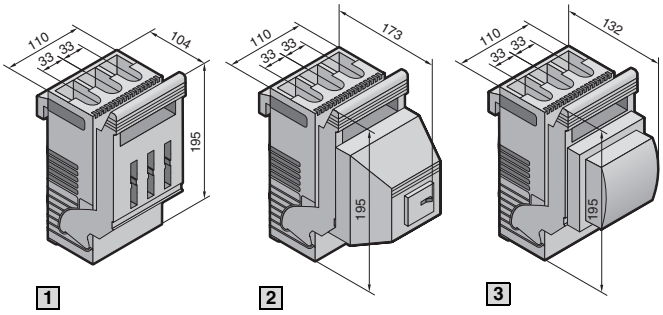
Material:
ABS.
Continuous operating temperature: max. 80°C.
Fire protection corresponding to UL 94-V0.

Width (B) mm	Height (H) mm	Packs of	Model No. SV
50	80	4	**3086.000**
100	80	4	**3087.000**
100	110	4	**3090.000**
200	80	4	**3088.000**
200	110	4	**3091.000**

System overview Page 342 **Busbar system** Page 343 **NH bus-mounting on-load isolator** Page 345 **NH fused isolator** Page 349
Accessories Page 360

NH bus-mounting on-load isolator, size 00



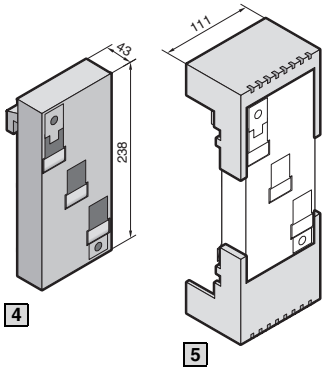


Material:
Isolator lid, contact hazard protection, isolator chassis: Fibreglass-reinforced polyamide
Contact tracks:
Silver-plated hard copper

Note:
When using gR fuse inserts (VDE 0636/23) in NH equipment, please observe the information on page 1134.

Technical information,
see page 1132.

Size		00		00		Page
Rated current		160 A		160 A		
Rated operating voltage		690 V~		690 V~		
Cable outlet		Top	Bottom	Top	Bottom	
Type of connection		Screw terminal M8 up to 95 mm²		Clamp-type terminal connection up to 70 mm²		
Tightening torque ● Assembly screw ● Terminal screw		5 – 6 Nm 10 – 15 Nm	5 – 6 Nm 10 – 15 Nm	5 – 6 Nm 2 – 3 Nm	5 – 6 Nm 2 – 3 Nm	
Packs of		1	1	1	1	
1 **Model No. SV**		**3400.000**	**3401.000**	**3402.000**	**3403.000**	
2 **with electromechanical fuse monitoring Model No. SV**		**3490.000**	**3491.000**	**3492.000**	**3493.000**	
3 **with electronic fuse monitoring and LED display Model No. SV**		**3490.210**	**3491.210**	**3492.210**	**3493.210**	
Also required						
4 Busbar adaptor		see below				
5 Cover		see below				
Accessories	Packs of					
Micro-switch	5	3071.000	3071.000	3071.000	3071.000	363



4 Busbar adaptor

For mounting SV 3400.000 – SV 3493.210 on 100 mm busbar systems.

Packs of	Model No. SV
1	**3412.000**

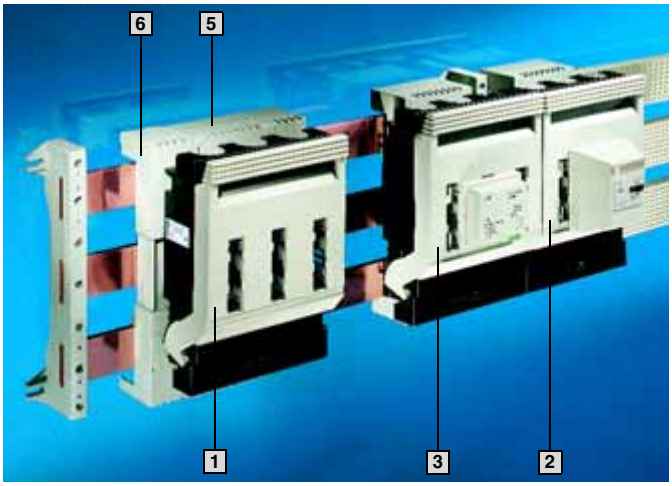
5 Cover

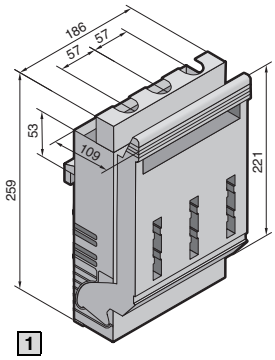
for SV 3412.000
To comply with contact hazard protection, plug-type.

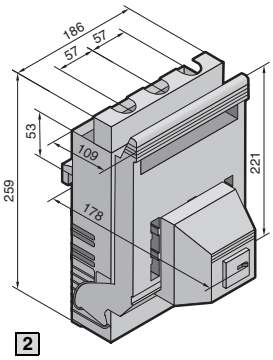
Packs of	Model No. SV
1 set	**3413.000**

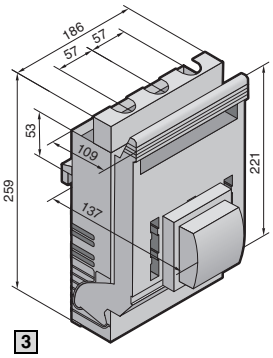
System overview Page 342 **Busbar system** Page 343 **Connection clamps** Page 344 **NH fused isolator** Page 349 **Accessories** Page 360

NH bus-mounting on-load isolators, size 1







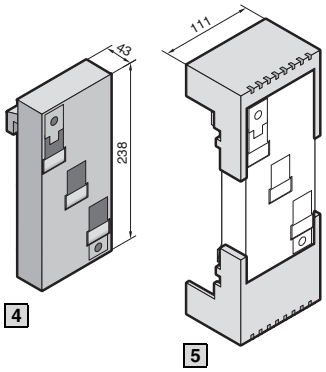


Material:
Isolator lid, contact hazard protection, isolator chassis: Fibreglass-reinforced polyamide
Contact tracks:
Silver-plated hard copper

Note:
When using gR fuse inserts (VDE 0636/23) in NH equipment, please observe the information on page 1134.

Technical information,
see page 1132.

Size		1		Page
Rated current		250 A		
Rated operating voltage		690 V~		
Cable outlet		Top	Bottom	
Type of connection		Screw terminal M10 up to 150 mm²		
Tightening torque ● Assembly screw ● Terminal screw		8 – 10 Nm 15 – 20 Nm	8 – 10 Nm 15 – 20 Nm	
Packs of		1	1	
1 **Model No. SV**		**3411.000**	**3410.000**	
2 **with electromechanical fuse monitoring Model No. SV**		**3495.000**	**3494.000**	
3 **with electronic fuse monitoring and LED display Model No. SV**		**3495.210**	**3494.210**	
Also required				
4 Busbar adaptor		see below		
5 Cover		see below		
6 System cover		see below		
Accessories	Packs of			
Micro-switch	5	3071.000	3071.000	363
Lug terminal connection parts	1 set	3414.000	3414.000	365



4 Busbar adaptor

For mounting SV 3410.000 – 3495.210 on 100 mm busbar systems.

Packs of	**Model No. SV**
1	**3412.000**

5 Cover

for SV 3412.000
To comply with contact hazard protection, plug-type.

Packs of	**Model No. SV**
1 set	**3413.000**

6 System cover

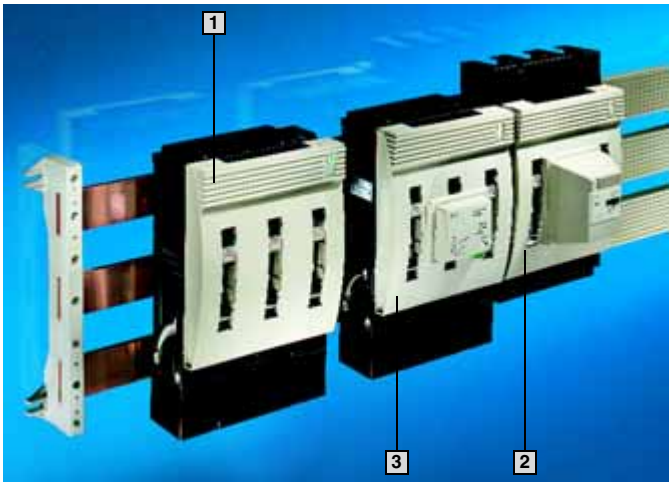
Width 50 mm, height 80 mm.

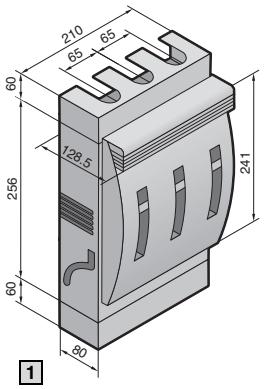
Further information,
see page 344.

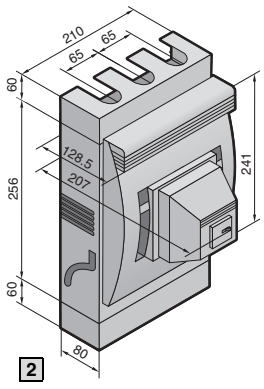
Packs of	**Model No. SV**
4	**3086.000**

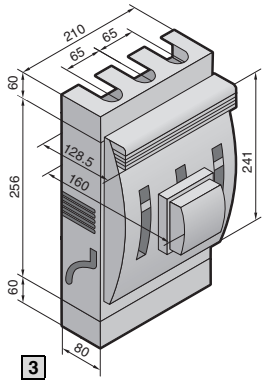
System overview Page 342 **Busbar system** Page 343 **Connection clamps** Page 344 **NH fused isolator** Page 349 **Accessories** Page 360

NH bus-mounting on-load isolators, size 2









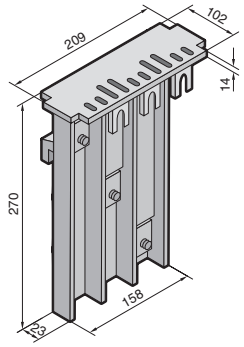
Material:
Isolator lid, contact hazard protection, isolator chassis: Fibreglass-reinforced polyamide
Contact tracks:
Silver-plated hard copper

Note:
When using gR fuse inserts (VDE 0636/23) in NH equipment, please observe the information on page 1134.

Technical information,
see page 1132.

Detailed drawing,
see page 1136.

Size		2	Page
Rated current		400 A	
Rated operating voltage		690 V~	
Cable outlet		top/bottom	
Type of connection		Screw terminal M10 up to 240 mm²	
Tightening torque ● Assembly screw ● Terminal screw		14 Nm 32 Nm	
Packs of		1	
1 **Model No. SV**		**3415.010**	
2 **with electromechanical fuse monitoring Model No. SV**		**3415.110**	
3 **with electronic fuse monitoring and LED display Model No. SV**		**3415.310**	
Also required			
Busbar adaptor		see below	
Accessories	Packs of		
Micro-switch	5	3071.000	363
Lug terminal connection parts	1 set	3499.000	365
Clamp-type terminal connection	1 set	3499.010	365



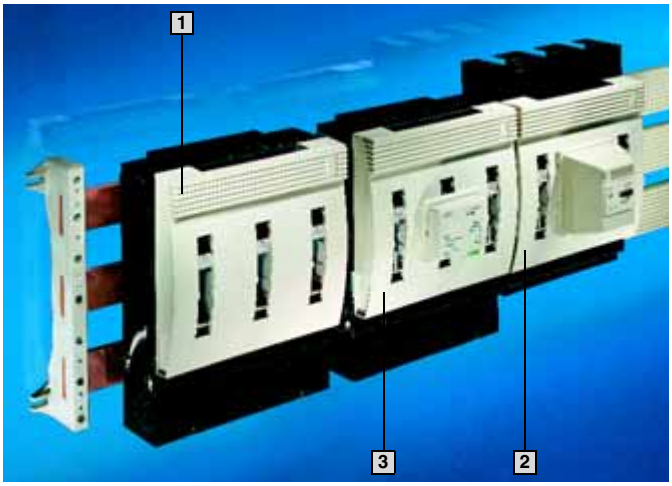
Busbar adaptor

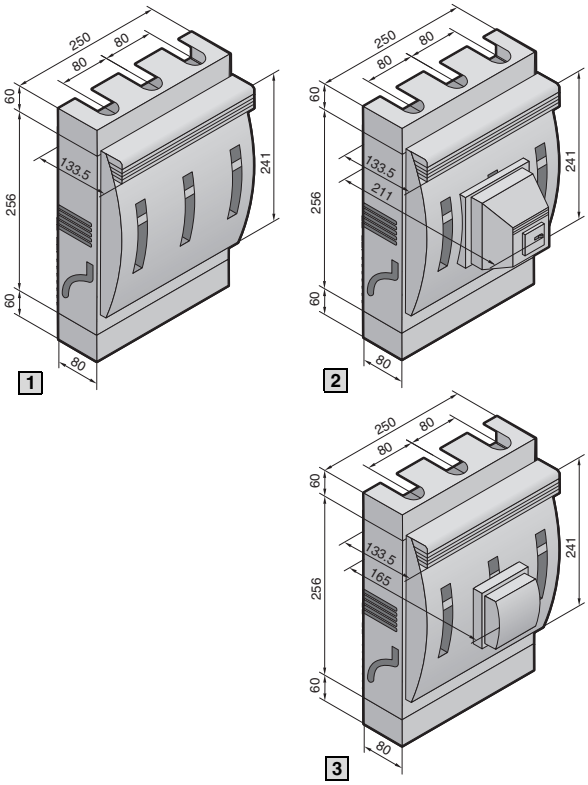
For mounting SV 3415.010 – SV 3415.310 on 100 mm busbar systems.
Outlet top/bottom.

Packs of	Model No. SV
1	**3499.020**

System overview Page 342 **Busbar system** Page 343 **Connection clamps** Page 344 **NH fused isolator** Page 349 **Accessories** Page 360

NH bus-mounting on-load isolators, size 3





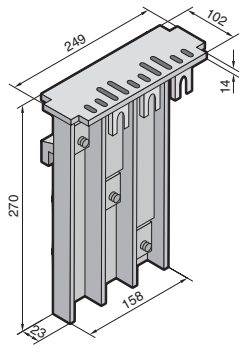
Material:
Isolator lid, contact hazard protection, isolator chassis: Fibreglass-reinforced polyamide
Contact tracks:
Silver-plated hard copper

Note:
When using gR fuse inserts (VDE 0636/23) in NH equipment, please observe the information on page 1134.

Technical information,
see page 1132.

Detailed drawing,
see page 1136.

Size		3	Page
Rated current		630 A	
Rated operating voltage		690 V~	
Cable outlet		top/bottom	
Type of connection		Screw terminal M10 up to 240 mm²	
Tightening torque ● Assembly screw ● Terminal screw		14 Nm 32 Nm	
Packs of		1	
1 **Model No. SV**		**3095.010**	
2 **with electromechanical fuse monitoring Model No. SV**		**3095.110**	
3 **with electronic fuse monitoring and LED display Model No. SV**		**3095.310**	
Also required			
Busbar adaptor		see below	
Accessories	Packs of		
Micro-switch	5	3071.000	363
Lug terminal connection parts	1 set	3499.000	365
Clamp-type terminal connection	1 set	3499.010	365



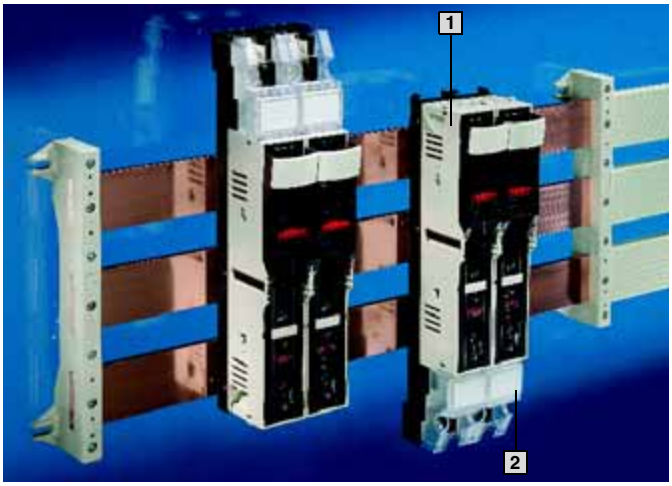
Busbar adaptor

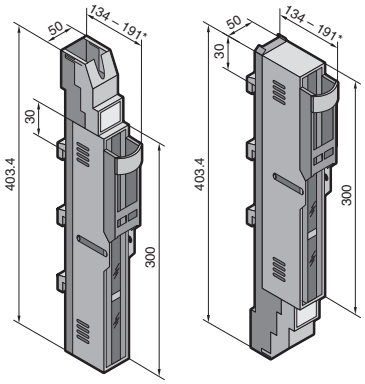
For mounting SV 3095.010 – SV 3095.310 on 100 mm busbar systems.
Outlet top/bottom.

Packs of	**Model No. SV**
1	**3499.030**

System overview Page 342 **Busbar system** Page 343 **Connection clamps** Page 344 **NH fused isolator** Page 349 **Accessories** Page 360

NH fused isolator, size 00





* Off-load position

Material:
Cover:
Fibreglass-reinforced polyamide
Strip chassis:
Duroplastic polyester
Contact tracks:
Silver-plated hard copper

Note:
When using gR fuse inserts (VDE 0636/23) in NH equipment, please observe the information on page 1134.

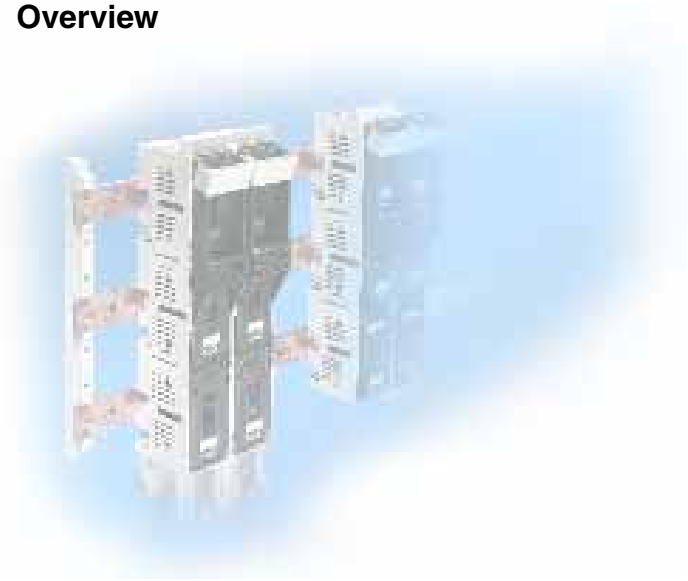
Technical information,
see page 1134.

Size		00	Page
Rated current		160 A	
Rated operating voltage		690 V~	
Cable outlet		top/bottom	
Type of connection		Screw M8	
Tightening torque ● Assembly screw ● Terminal screw		6 Nm 14 Nm	
Packs of		1	
1 Model No. SV		**3591.010**	
Accessories	Packs of		
2 Identification label support	6	3595.010	363
Micro-switch	5	3071.000	363
Lug terminal connection parts	1 set	3592.020	365
Clamp-type terminal connection	1 set	3592.010	365

System overview Page 342 **Busbar system** Page 343 **Connection clamps** Page 344 **NH bus-mounting on-load isolator** Page 345
Accessories Page 360

Busbar systems up to 1600 A (185 mm)

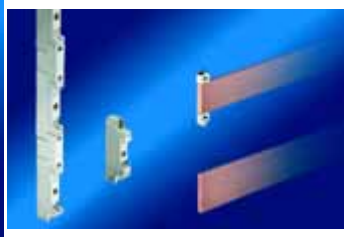
Overview



The busbar support with 185 mm bar centre distance is designed for the accommodation of bars 80 x 10 mm; by using inserts the cross-section may be reduced to 60/50 x 10 mm.

The special design of the busbar support facilitates seamless top mounting in the vicinity of the support. For this purpose, the isolator, bar and support are screwed together with a single screw.
In addition, the individual modules of the busbar support can also be used as single-pole supports.

System components



Busbar support
up to 1600 A, 3-pole

Inserts
for busbar supports

Busbars E-Cu

Busbar cover sections

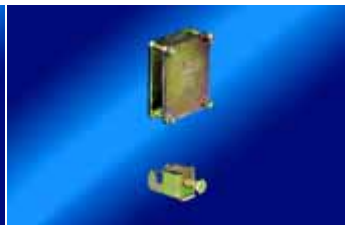


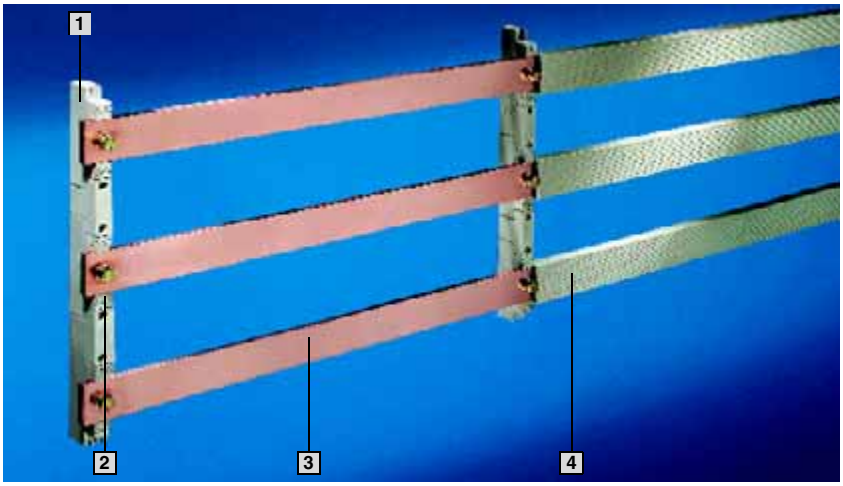
Plate clamps

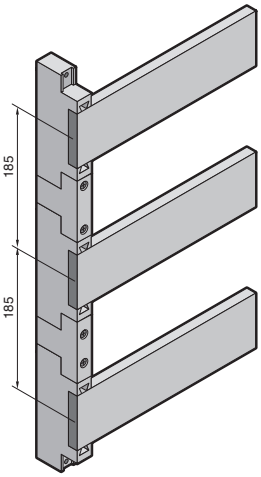
Conductor connection clamps

NH fused isolator, size 00
Included with the supply:
Single or double adaptor for mounting the NH strip on 185 mm bar systems

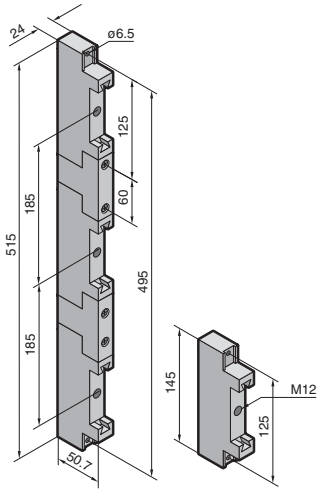
NH fused isolators, sizes 1 – 3
for direct mounting on 185 mm bar systems.

System components





Planning software Rittal SV Plan/ Power Plan,
see page 1061.



1 Busbar support

Material:
Fibreglass-reinforced, thermoplastic polyester (PBT).
Continuous operating temperature: max. 140°C.
Fire protection corresponding to UL 94-V0.

Note:
The base component of the busbar support may also be used as a single-pole support.

Short-circuit protection diagram,
see page 1126.

Technical information
for the calculation of rated currents,
see page 1137.

Rated current up to	1600 A
Rated operating voltage up to	1000 V~, 50/60 Hz to VDE 0660
Number of poles	3-pole
Bar centre distance	185 mm
Max. bar accommodation without inserts	80 x 10 mm
Tightening torque ● Assembly screw ● Bar attachment screw	 3 – 5 Nm 40 Nm
Packs of	2
Model No. SV	**3052.000**

2 Inserts

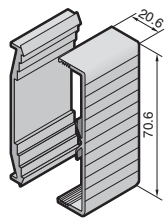
for SV 3052.000
To adapt bar dimensions 50 – 60 x 10 mm.

3 Busbars

made from E-Cu
To DIN EN 13 601.
Length: 2400 mm/bar.

Rated current	Busbar dimensions mm	Inserts[1]	Busbars[2]
		Model No. SV	**Model No. SV**
1000 A	50 x 10	**3074.000**	**3588.000**
1250 A	60 x 10	**3075.000**	**3589.000**
1600 A	80 x 10	**–**	**3590.000**

Supply includes:
[1] Packs of 24
[2] Packs of 3



4 Busbar covers

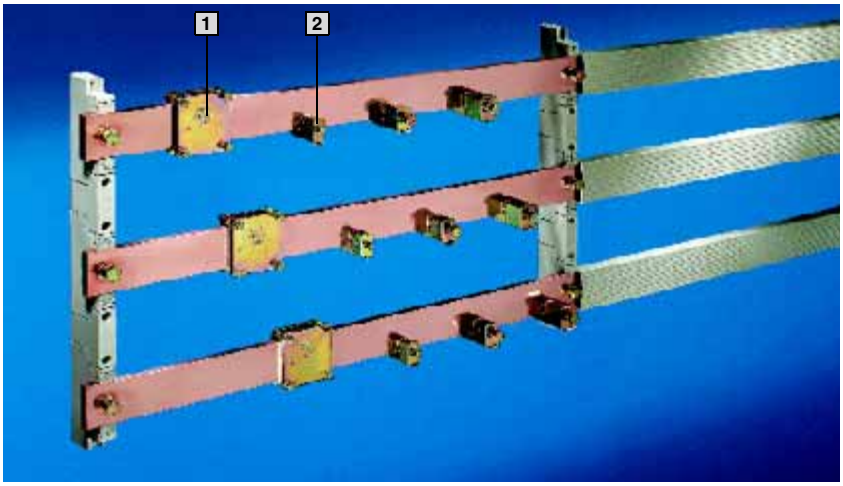
Contact hazard protection via full encapsulation of the busbars. May be cut to required length.

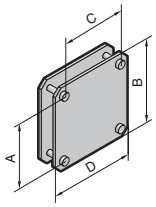
Material:
Thermally modified hard PVC.
Continuous operating temperature: max. 100°C.
Fire protection corresponding to UL 94-V0.

For busbars mm	Packs of	**Model No. SV**
40 – 60 x 10	10 à 1 m	**3085.000**

System overview Page 350 **Connection clamps** Page 352 **NH fused isolators** Page 353 **Accessories** Page 360

Connection clamps





1 Plate clamps

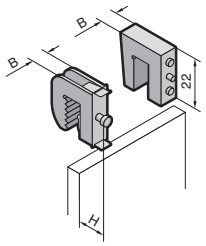
For connecting laminated copper bars; no drilling required.

Material:
Sheet steel, zinc-plated, passivated.

Accessories:

Laminated copper bars, see page 361.

For busbars mm	Clamping area for laminated copper bars mm	Tightening torque Nm	A mm	B mm	C mm	D mm	Packs of	Model No. SV
50 x 10	34 x 10	6 – 8	60	75	40	55	3	**3560.000**
50 x 10	54 x 10	6 – 8	60	75	60	75	3	**3562.000**
60 x 10	34 x 10	6 – 8	70	85	40	55	3	**3561.000**
60 x 10	54 x 10	6 – 8	70	85	60	75	3	**3563.000**
80 x 10	65 x 10	6 – 8	90	105	71	86	3	**3460.500**



2 Conductor connection clamps

For 10 mm bar thickness.

Material:
Sheet steel, zinc-plated, passivated (SV 3455.500 – SV 3459.500), brass (SV 3555.000).

Note:
Conductor connection clamps for 5 mm bar thickness, see page 324.

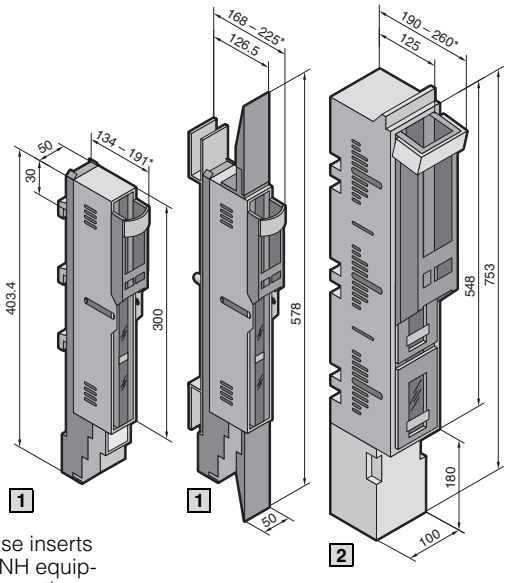
Accessories:

Laminated copper bars, see page 361.

Connection of round conductors[1] mm²	Clamping area for laminated copper bars mm	Tightening torque Nm	Width (B) mm	Height (H) mm min.	Height (H) mm max.	Packs of	Model No. SV
1 – 4	–	2	8	–	–	15	**3555.000**
1 – 4	–	2	11	17	23	15	**3455.500**
2.5 – 16	8 x 8	3	14	22	29	15	**3456.500**
16 – 50	10.5 x 11	6 – 8	18.5	26	39	15	**3457.500**
35 – 70	16.5 x 15	10 – 12	24.5	39	57	15	**3458.500**
70 – 185	22.5 x 20	12 – 15	30.5	44	66	15	**3459.500**

[1] Wire end ferrules should be used with fine wire conductors.

NH fused isolators, size 00 – 3



* Off-load position

Material:
Cover:
Fibreglass-reinforced polyamide
Strip chassis:
Duroplastic polyester
Contact tracks:
Silver-plated hard copper

Scope of supply SV 3591.040:
Including
1 busbar adaptor[1)],
2 compensating panels

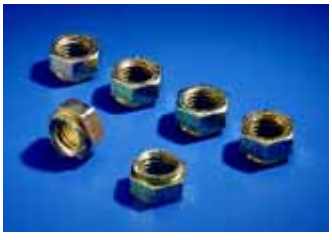
Scope of supply SV 3591.050:
Including
1 busbar adaptor[1)]
(two-way adaptor),
4 compensating panels

[1)] Tightening torque 25 Nm (bar attachment)

Note:
When using gR fuse inserts (VDE 0636/23) in NH equipment, please observe the information on page 1134.

Technical information,
see page 1134.

Version		1		2			Page
Size		00		1	2	3	
Rated current		160 A		250 A	400 A	630 A	
Rated operating voltage		690 V~		690 V~	690 V~	690 V~	
Cable outlet		top/bottom		top/bottom	top/bottom	top/bottom	
Type of connection		Screw M8		Screw M12	Screw M12	Screw M12	
Tightening torque ● Assembly screw ● Terminal screw		14 Nm 14 Nm		40 Nm 40 Nm	40 Nm 40 Nm	40 Nm 40 Nm	
Packs of		1	2	1	1	1	
Model No. SV		**3591.040**	**3591.050**	**3485.000**	**3486.000**	**3487.000**	
Accessories	Packs of						
3 Identification label support	6	3595.010	3595.010	–	–	–	363
Micro-switch	5	3071.000	3071.000	3071.000	3071.000	3071.000	363
Lug terminal connection parts	1 set	3592.020	3592.020	–	–	–	365
Clamp-type terminal connection	1 set	3592.010	3592.010	–	–	–	365



Inserted screw nuts M12

Self-holding nuts with knurled ring.
For drilled holes in busbars Ø 14.5 mm.

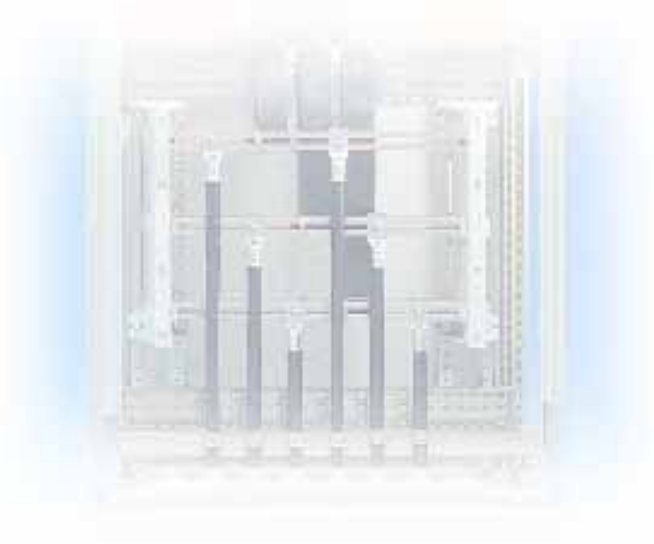
Note:
Inserted screw nuts M12 are already included in the supply of SV 3591.040/.050 and SV 3485.000 – SV 3487.000.

Packs of	Model No. SV
30	**3591.060**

System overview Page 350 **Busbar system** Page 351 **Connection clamps** Page 352 **Accessories** Page 360

Busbar systems up to 2500 A/3000 A (150 mm)

Overview

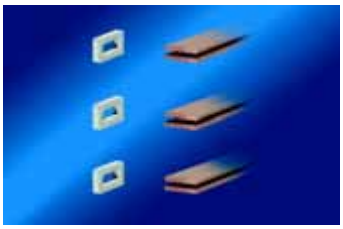


These bar systems with 150 mm bar centre distance are suitable for power transmission and distribution.

The maximum bar accommodation of the busbar supports is 80 x 10 mm or 100 x 10 mm.

System components

Busbar support
up to 2500 A, 2 x 3-pole



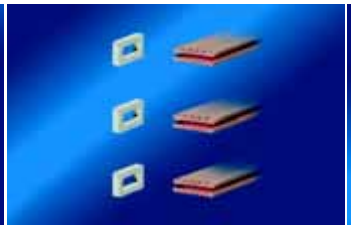
Spacing pieces
to reduce the bar cross-section in 10 mm increments

Busbars E-Cu

Connection plates

Bar insulation

Busbar support
up to 3000 A, 2 x 3-pole



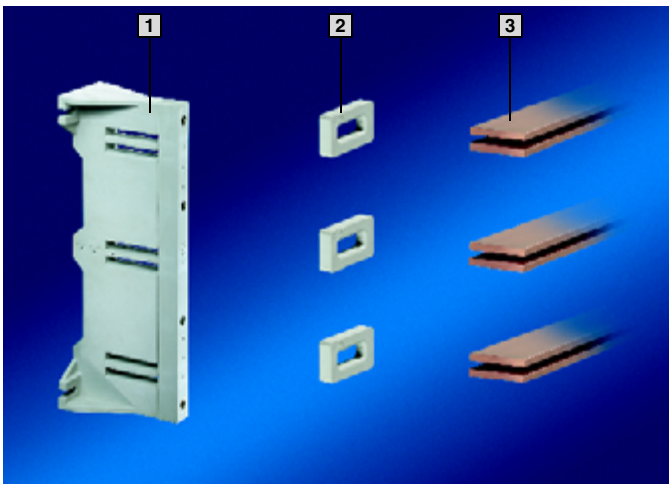
Spacing pieces
to reduce the bar cross-section in 10 mm increments

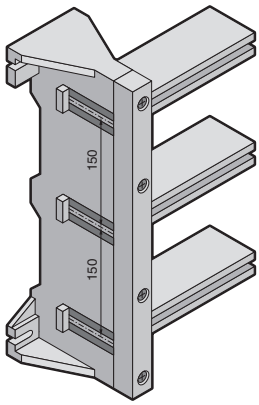
Commercially available
busbars E-Cu
Cross-sections: 100 x 10 mm

Connection plates

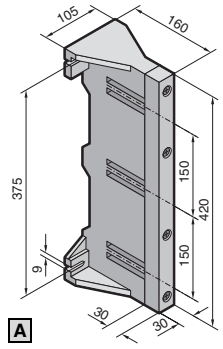
Bar insulation

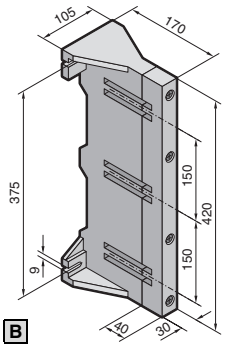
System components





Planning software Rittal SV Plan/ Power Plan,
see page 1061.





1 Busbar support

Material:
Fibreglass-reinforced, thermoplastic polyester (PBT).
Continuous operating temperature: max. 140°C.
Fire protection corresponding to UL 94-V0.

Short-circuit protection diagram,
see page 1126.

Technical information
for the calculation of rated currents,
see page 1137.

	A 2500 A	B 3000 A
Rated current up to		
Rated operating voltage up to	1000 V~, 50/60 Hz to VDE 0660	
Number of poles	3-pole	
Bar centre distance	150 mm	
Max. bar accommodation without spacing pieces	2 x 80 x 10 mm	2 x 100 x 10 mm
Tightening torque ● Assembly screw ● Cover attachment	 8 – 10 Nm 5 – 10 Nm	 8 – 10 Nm 5 – 10 Nm
Packs of	2	2
Model No. SV	**3055.000**	**3057.000**

2 Spacing pieces

for SV 3055.000/SV 3057.000
To reduce the bar dimensions in 10 mm increments. Also suitable for stepped busbar assemblies.

Packs of	Model No. SV
12	**3056.000**

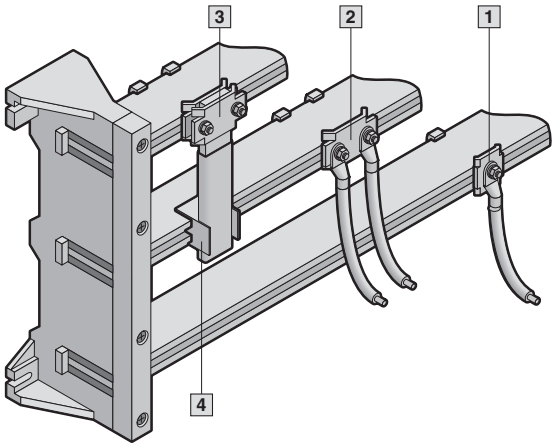
3 Busbars

made from E-Cu
To DIN EN 13 601.
Length: 2400 mm/bar.

Dimensions	Packs of	Model No. SV
60 x 10 mm	3	**3589.000**
80 x 10 mm	3	**3590.000**

System overview Page 354 **Connection plates** Page 356 **Bar insulation** Page 356

System components



Connection plates

for SV 3055.000
Tightening torque: 10 – 15 Nm.

Connection	Packs of	Model No. SV
1 Ring terminal M10 up to 240 mm²	3 sets	**3058.000[1)]**
2 2 x ring terminals M10 up to 240 mm²	3 sets	**3059.000[1)]**
3 Laminated flat copper up to 40 x 10 mm	3 sets	**3061.000[2)]**

T-head screws:
[1)] M10 x 100 mm
[2)] M10 x 120 mm

Accessories:

Laminated copper bars,
see page 361.

Connection plates

for SV 3057.000
Tightening torque: 10 – 15 Nm.

Note:
One connection plate per terminal connection is omitted.

Connection	Packs of	Model No. SV
3 2 x ring terminals M10 up to 240 mm²	3 sets	**3061.000[1)]**

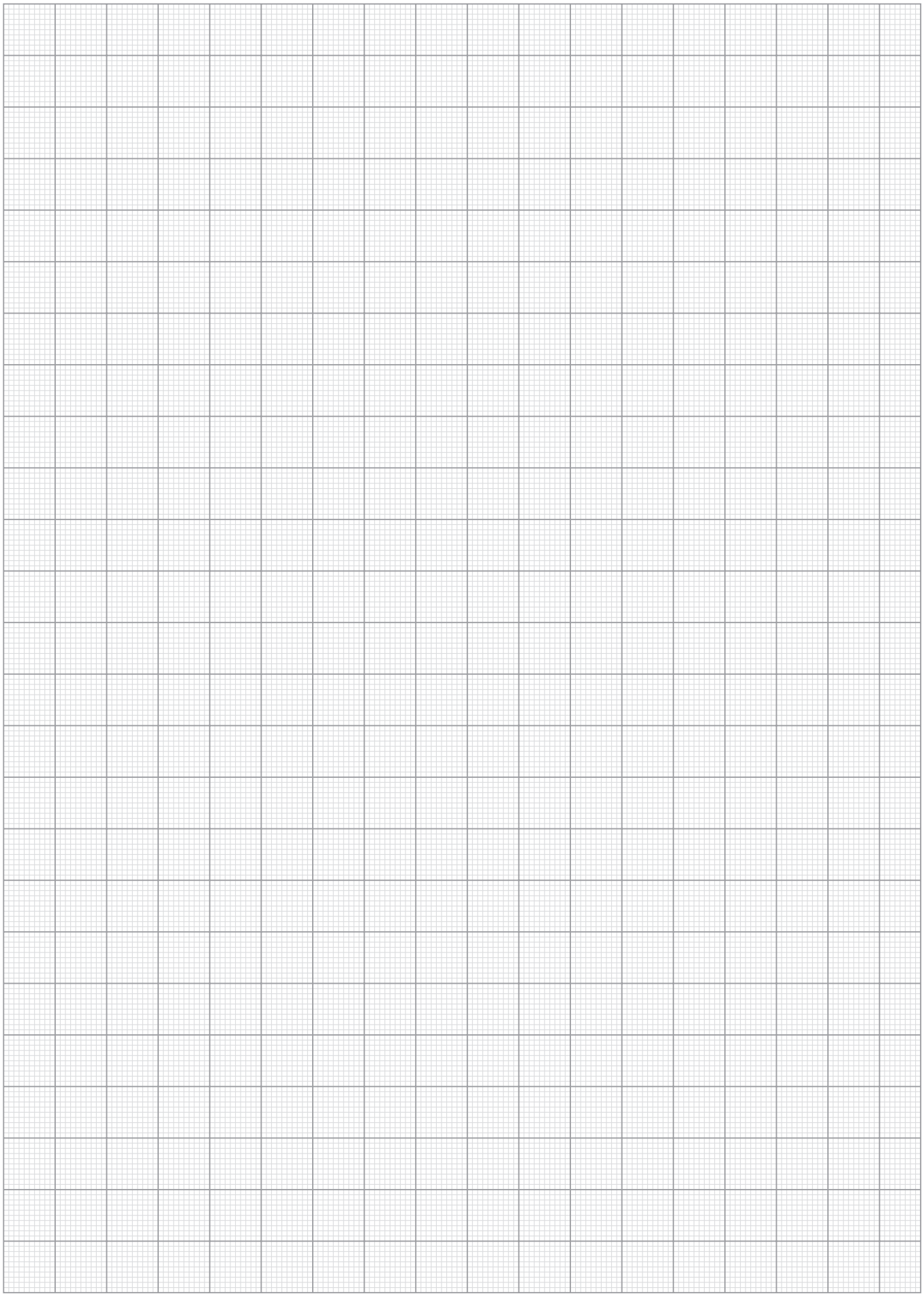
T-head screws:
[1)] M10 x 120 mm

4 Bar insulation

for SV 3055.000 and SV 3057.000
For supply lead routing, plug-type.

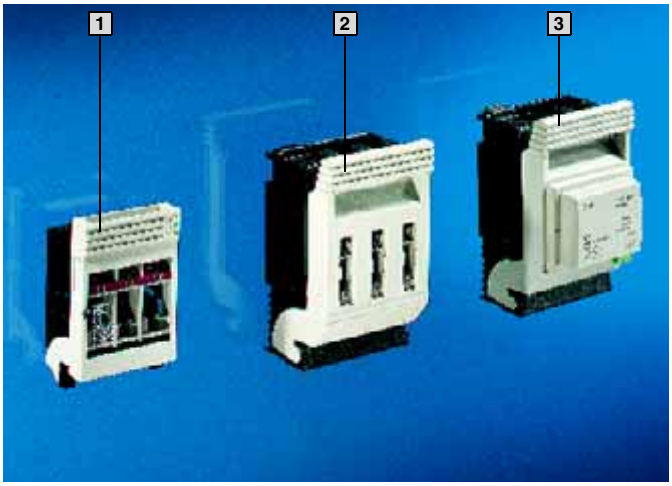
Packs of	Model No. SV
9	**3060.000**

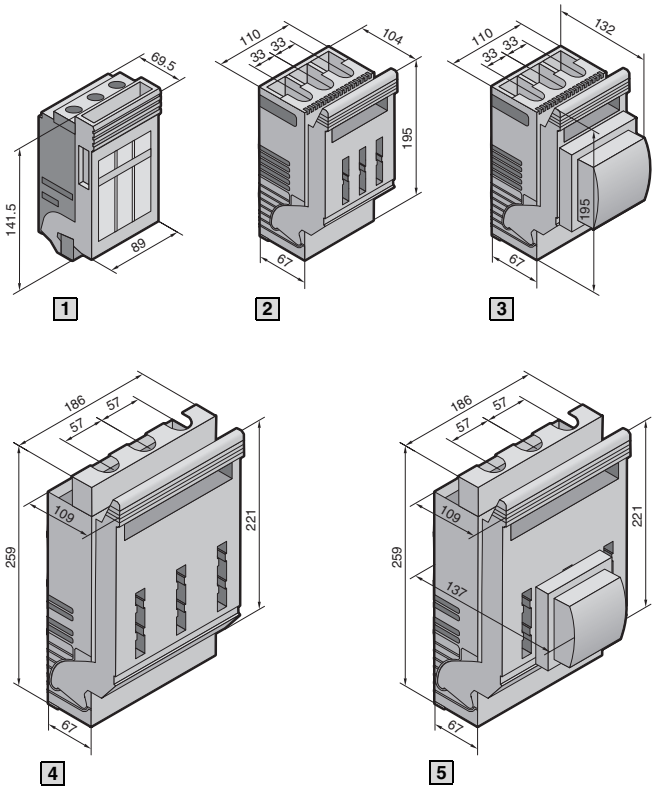
System overview Page 354 **Busbar system** Page 355



Mounting plate assembly

NH on-load isolator, size 000/00/1





Material:
Isolator lid, contact hazard protection, isolator chassis: Fibreglass-reinforced polyamide
Contact tracks:
Silver-plated hard copper

Note:
When using gR fuse inserts (VDE 0636/23) in NH equipment, please observe the information on page 1134.

Drilling dimensions,
see page 1136.

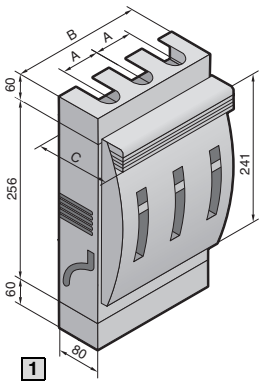
Technical information,
see page 1132.

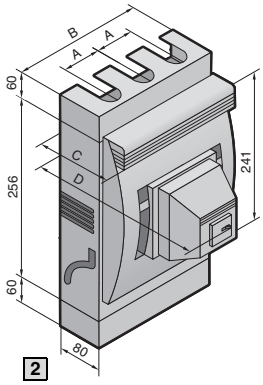
Version		1	2	3	2	3	4	5	Page
Size		000	00		00		1		
Rated current		100 A (160 A)[1]	160 A		160 A		250 A		
Rated operating voltage		690 V~	690 V~		690 V~		690 V~		
Cable outlet		top/ bottom	top/ bottom	bottom	top/ bottom	bottom	top/ bottom	bottom	
Type of connection	Terminal up to	50 mm²	–	–	–	–	–	–	
	Screw terminal	–	M8 up to 95 mm²		–	–	M10 up to 150 mm²		
	Clamp-type terminal connection up to	–	–	–	70 mm²	70 mm²	–	–	
Tightening torque ● Assembly screw ● Terminal screw		– 3 Nm	3 – 5 Nm 10 – 15 Nm	3 – 5 Nm 10 – 15 Nm	3 – 5 Nm 2 – 3 Nm	3 – 5 Nm 2 – 3 Nm	3 – 5 Nm 15 – 20 Nm	3 – 5 Nm 15 – 20 Nm	
Packs of		1	1	1	1	1	1	1	
Model No. SV		**3431.000**	**3488.000**	**–**	**3489.000**	**–**	**3409.000**	**–**	
with electronic fuse monitoring and LED display Model No. SV		**–**	**–**	**3488.310**	**–**	**3489.310**	**–**	**3409.310**	
Accessories	Packs of								
Micro-switch	5	3071.000	3071.000	3071.000	3071.000	3071.000	3071.000	3071.000	363
Mounting set	1	3432.000	–	–	–	–	–	–	364
Lug terminal connection parts	1 set	–	–	–	–	–	3414.000	3414.000	365

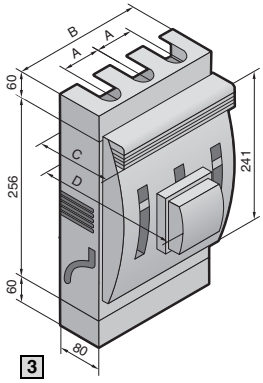
[1] 160 A with 95 mm² connection cross-section (95 mm² connector pieces available on request).

Accessories Page 360

NH on-load isolator, size 2/3







Material:
Isolator lid, contact hazard protection, isolator chassis: Fibreglass-reinforced polyamide
Contact tracks:
Silver-plated hard copper

Note:
When using gR fuse inserts (VDE 0636/23) in NH equipment, please observe the information on page 1134.

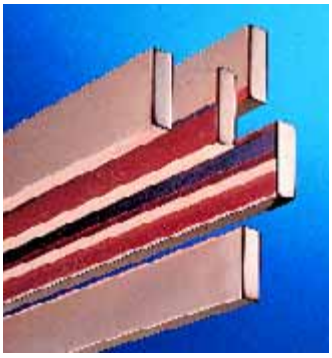
Drilling dimensions,
see page 1136.

Detailed drawing,
see page 1136.

Technical information,
see page 1132.

Size		2		3		Page
Rated current		400 A		630 A		
Rated operating voltage		690 V~		690 V~		
Cable outlet		top/bottom	bottom	top/bottom	bottom	
Type of connection		Screw terminal M10 up to 240 mm²		Screw terminal M10 up to 240 mm²		
Tightening torque ● Assembly screw ● Terminal screw		14 Nm 32 Nm		14 Nm 32 Nm		
A mm		65	65	80	80	
B mm		210	210	250	250	
C mm		128.5	128.5	133.5	133.5	
D mm		207	160	211	165	
Packs of		1		1		
1 **Model No. SV**		**3415.010**	**–**	**3095.010**	**–**	
2 **with electromechanical fuse monitoring Model No. SV**		**3415.110**	**–**	**3095.110**	**–**	
3 **with electronic fuse monitoring and LED display Model No. SV**		**–**	**3415.310**	**–**	**3095.310**	
Accessories	Packs of					
Micro-switch	5	3071.000	3071.000	3071.000	3071.000	363
Lug terminal connection parts	1 set	3499.000	3499.000	3499.000	3499.000	365
Clamp-type terminal connection	1 set	3499.010	3499.010	3499.010	3499.010	365

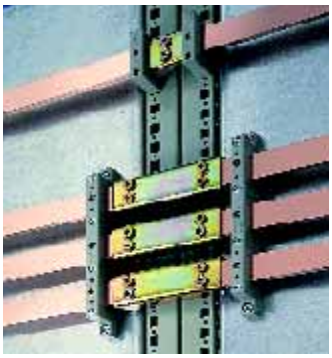
Accessories Page 360



Busbars

made from E-Cu
To DIN EN 13 601.
Length: 2400 mm/bar.

Dimensions mm	Weight per bar kg	Packs of	Model No. SV
12 x 5	1.28	6	**3580.000**
15 x 5	1.60	6	**3581.000**
20 x 5	2.14	6	**3582.000**
25 x 5	2.67	6	**3583.000**
30 x 5	3.20	6	**3584.000**
12 x 10	2.56	6	**3580.100**
15 x 10	3.20	6	**3581.100**
20 x 10	4.27	6	**3585.000**
30 x 10	6.41	6	**3586.000**
40 x 10	8.55	3	**3587.000**
50 x 10	10.68	3	**3588.000**
60 x 10	12.82	3	**3589.000**
80 x 10	17.09	3	**3590.000**



Busbar connectors

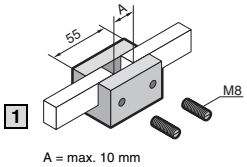
For connecting busbars, no drilling required.

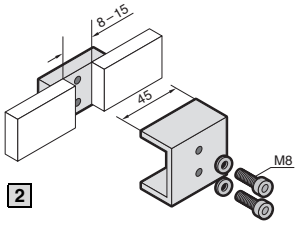
Material:
SV 9350.070
Brass, nickel-plated surface finish

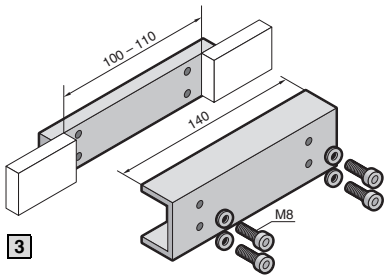
SV 9320.020/SV 9320.030
Top piece: Sheet steel, yellow passivated
Contact plate: E-Cu, silver-plated

For busbars mm	Application		Tightening torque	Packs of	Model No. SV
	Single connection	Baying connection[1)]			
12 x 5 – 15 x 10	1	–	10 Nm	3	**9350.070**
20 x 5 – 30 x 10	2	–	20 Nm	3	**9320.020**
	–	3	20 Nm	3	**9320.030**

[1)] From enclosure to enclosure



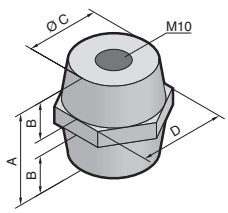




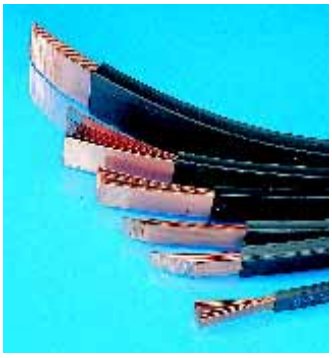
Base isolators

For configuring busbar systems with any given bar centre distances and for assembling PE or PEN bars.

Material:
Duroplastic polyester (UP resin).
Continuous operating temperature: max. 135°C.



Rated operating voltage	1 kV	1 kV
Tensile strength	12 kN	13 kN
Torsional strength	75 Nm	90 Nm
Bending strength	6 kN	6 kN
Tightening torque	40 Nm	40 Nm
A mm	40	50
B mm	15	19
Ø C mm	32	42
D mm	SW 36	SW 50
Packs of	6	6
Model No. SV	**3031.000**	**3032.000**



Laminated copper bars Rittal Flexibar “S”

Length: 2000 mm/bar.

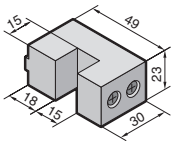
Material:
Cu lamina
- High-purity electrolyte copper F20

Insulation
- High-strength vinyl compound
- Expansion 370 %
- Temperature range: –30°C to +105°C
- Flame retardant version to UL 94-V0
- Dielectric strength: 20 kV/mm

Short-circuit protection diagram,
see page 1127.

Construction[1] mm	I_n at 50 K[2]	I_n at 30 K[2]	I_n at 10 K[2]	Packs of	Model No. SV
6 x 9.0 x 0.8	250 A	220 A	120 A	1	**3565.000**
6 x 13.0 x 0.5	200 A	150 A	110 A	1	**3566.000**
4 x 15.5 x 0.8	300 A	210 A	140 A	1	**3567.000**
6 x 15.5 x 0.8	350 A	290 A	170 A	1	**3568.000**
10 x 15.5 x 0.8	450 A	350 A	190 A	1	**3569.000**
5 x 20.0 x 1.0	400 A	300 A	180 A	1	**3570.000**
5 x 24.0 x 1.0	450 A	370 A	230 A	1	**3571.000**
10 x 24.0 x 1.0	800 A	600 A	340 A	1	**3572.000**
5 x 32.0 x 1.0	550 A	470 A	280 A	1	**3573.000**
10 x 32.0 x 1.0	1000 A	800 A	460 A	1	**3574.000**
5 x 40.0 x 1.0	800 A	600 A	340 A	1	**3575.000**
10 x 40.0 x 1.0	1200 A	950 A	500 A	1	**3576.000**
5 x 50.0 x 1.0	900 A	700 A	400 A	1	**3577.000**
10 x 50.0 x 1.0	1400 A	1000 A	600 A	1	**3578.000**
10 x 63.0 x 1.0	1600 A	1240 A	715 A	1	**3579.000**

[1] Number of lamina x lamina width x lamina thickness
[2] The sum total of the ambient temperature and the temperature increase produces the resultant conductor temperature of the laminated flat copper bar.
Example:
SV 3565.000 loaded with 220 A, i.e. the temperature increases by 30 K. At an ambient temperature of 35°C, this produces a resultant conductor temperature of 35°C + 30 K = 65°C.



Universal support

For the attachment of laminated copper bars from 20 x 5 to 63 x 10 mm.

Material:
Fibreglass-reinforced, thermoplastic polyester (PBT).
Fire protection corresponding to UL 94-V0.

Supply includes:
Screws and “U” nuts for mounting on PS/TS mounting rails.

Packs of	Model No. SV
3	**3079.000**

Short-circuit protection diagram,
see page 1127.

Universal support

For the attachment of laminated copper bars from 40 x 5 to 100 x 10 mm.

Material:
Fibreglass-reinforced, thermoplastic polyester (PBT).
Fire protection corresponding to UL 94-V0.

Supply includes:
Screws and sliding nuts for attachment on C rails.

Packs of	Model No. SV
3 sets	**3079.010**

Accessories:

C rails 30/15,
see page 928.

Accessories

1

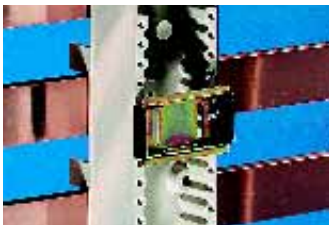
2

Insert strip

To extend the build width of the component adaptors and component supports.

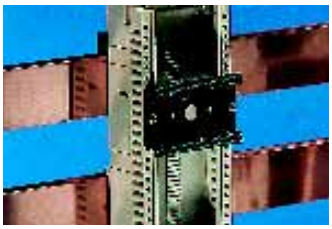
For	see page	Width mm	Packs of	Model No. SV
1 Mini-PLS component adaptors and quick-fit component adaptors	304 – 306	9	2	**9623.000**
2 Component adaptors and component supports	328 – 330 + 333	9	1	**3538.000**
2 Component adaptor (SV 3445.000/SV 3446.000)	331	17.5	1	**3448.000**[1)]

[1)] Including extended support rail and cover strips.



1

2



3

Support rails

Supply includes:
Assembly parts.

For	see page	Support rails				
		Fig.	Width mm	Height mm	Packs of	Model No. SV
Mini-PLS component adaptor	304	1	45	7.5	10	**9320.150**
	304 + 306		54	7.5	10	**3548.000**
			72	7.5	10	**3549.000**
	306	2	72	15	5	**9320.120**
Multi-functional component adaptor	312 – 314 325 + 326	3	45	10	5	**9320.090**
	313 + 314 326 + 327		54	10	5	**9320.100**
Component adaptor	304 + 306	1	54	7.5	10	**3548.000**
	328 – 330		72	7.5	10	**3549.000**
Component adaptor (SV 3445.000/SV 3446.000)	331	1	54	7.5	10	**3447.000**
Component adaptor (SV 3445.000/SV 3446.000 with SV 3448.000)	331	1	70	7.5	10	**3496.000**
Component adaptor (SV 9320.000/SV 9320.010)	332	2	72	15	5	**9320.120**
Component support	333	1	54	7.5	10	**3548.000**
			72	7.5	10	**3549.000**

Plug-in connector

For mounting the AS-interface load feeder module with matching support type 3RK1 901-3CA00, Siemens brand, on the Mini-PLS component adaptor and multi-functional component adaptor.

For	see page	Packs of	Model No. SV
Mini-PLS component adaptor (width 45/54 mm)	304 + 306	1	**9623.100**
Multi-functional component adaptor (width 45 mm)	312 + 314 325 + 326	1	**9320.110**

Mounting clip

for multi-functional component adaptor (width 45 mm)
For additional locking of motor starter combinations.

Supply includes:
Support rails, 45 mm wide.

Packs of	Model No. SV
5	**9320.140**

Cover strips

for component adaptors and component supports

For width mm	Packs of	Model No. SV
54	20	**3536.000**
72	20	**3537.000**

Identification labels

for bus-mounting fuse bases

Packs of	Model No. SV
100	**9320.080**

Identification label support

for NH fused isolators, size 00
For clip-on mounting on the isolator housing.

Packs of	Model No. SV
6	**3595.010**

Micro-switches

for NH isolators/NH fused isolators
To indicate the switching position of the NH device (lid unit).

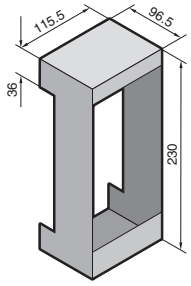
Packs of	Model No. SV
5	**3071.000**

Accessories

Contact hazard protection frame

Material:
ABS,
fire protection corresponding to UL 94-V0.

For	see page	Packs of	Model No. SV
NH bus-mounting on-load isolators, size 00	338	1	**3408.000**



PLS cover

The PLS cover guarantees additional contact hazard protection for special busbars when using NH equipment on Rittal PLS 800 A/1600 A. Attached by simply clipping onto the PLS base tray section.

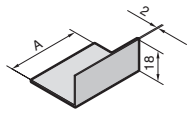
Material:
SV 3099.000/SV 3499.070
ABS.

SV 3499.040/SV 3499.050
Thermally modified hard PVC.

Fire protection corresponding to UL 94-V0.

For		see page	A mm	Packs of	Model No. SV
1 NH fused isolator	Size 00	336	50	2	**3499.070**
2 NH bus-mounting on-load isolators	Size 1	339	186	2	**3099.000**
3 NH bus-mounting on-load isolators	Size 2	340	210	1	**3499.040**
	Size 3	341	250	1	**3499.050**

1



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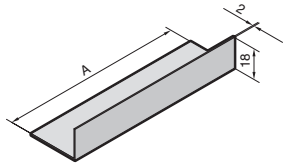

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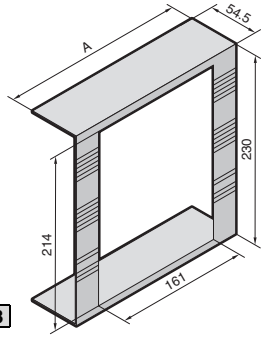
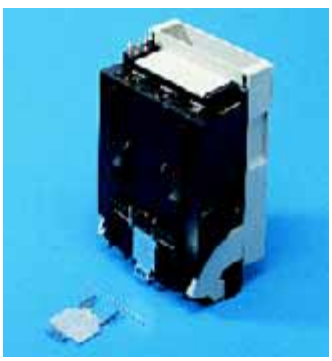




Mounting set

For mounting the NH on-load isolator on 35 mm support rails to DIN EN 715 (7.5 mm/15 mm high).

For	see page	Packs of	Model No. SV
NH on-load isolators, size 000	358	1	**3432.000**

Lug terminal connection parts

for NH isolators, sizes 1 to 3

For connecting laminated copper bars and round conductors up to 70 mm².
Tightening torque:
Terminal screw
[1] 8 Nm
[2] 15 Nm

For NH isolators	Clamping area	Packs of	Model No. SV
Size 1	16 x 12 mm	1 set	**3414.000[1]**
Size 2, 3	21 x 11 mm	1 set	**3499.000[2]**

Clamp-type terminal connection

for NH isolators, sizes 2 and 3

For the connection of round conductors up to 240 mm².
Tightening torque:
Terminal screw 15 Nm.

Packs of	Model No. SV
1 set	**3499.010**

Lug terminal connection parts

for NH fused isolators size 00

For connecting laminated copper bars and round conductors 1.5 to 25 mm².
Clamping area: 16 x 10 mm.
Tightening torque:
Terminal screw 4 Nm.

Packs of	Model No. SV
1 set	**3592.020**

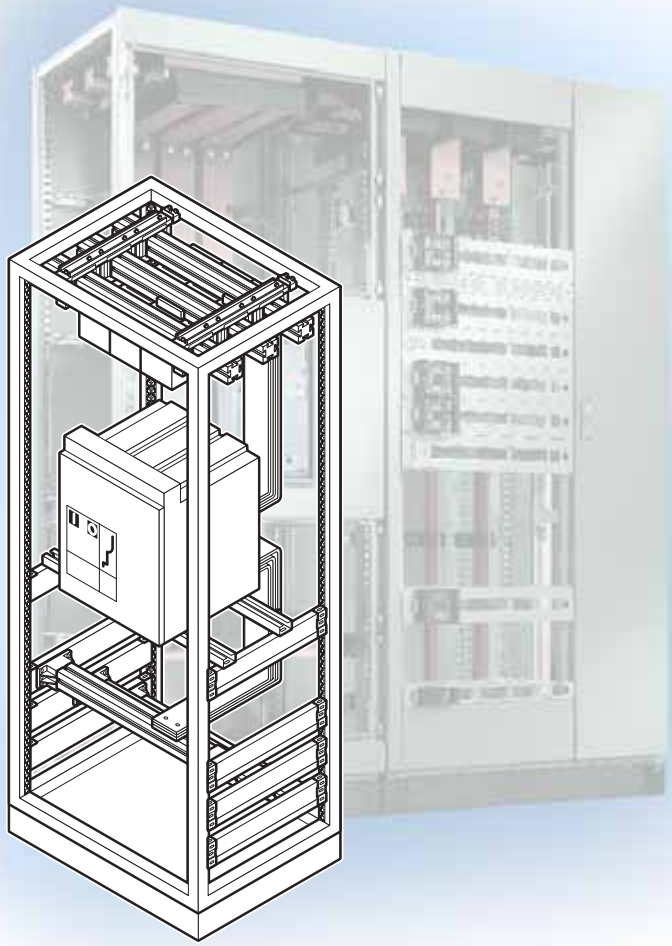
Clamp-type terminal connection

for NH fused isolators size 00

For the connection of round conductors 1.5 to 95 mm².
Tightening torque:
Terminal screw 4 Nm.

Packs of	Model No. SV
1 set	**3592.010**

Overview, Rittal SV-TS 8 and Maxi-PLS



SV-TS 8 and Maxi-PLS – the ideal combination for low-voltage distributors and switchgear in the heavy current range. The system is assembled without any form of machining (such as sawing, drilling, bending etc.). As a result, this future-oriented, fully modular system offers new dimensions in fast assembly and safety.

The futuristic modular system

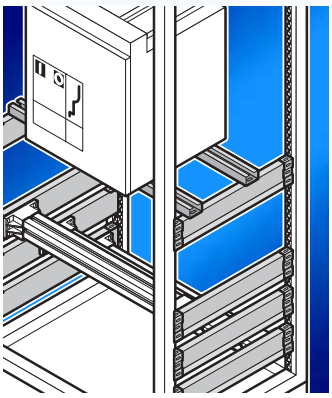
SV-TS 8 enclosures are fully prepared.
The enclosure frame is fully fitted with a three-piece gland plate, rear panel, roof and door or partial doors.
Punched sections without mounting flanges to accommodate the end supports and system support rails for the power circuit-breakers are fitted ready to install.

Standardised Maxi-PLS busbars with ingenious fastening technology
Thanks to the perfect system technology and customised pitch pattern, installation of Maxi-PLS supports and bars is precise-fit, simple and fast.
With the aid of sliding blocks or studs, the four attachment levels of the Maxi-PLS busbars permit infinitely variable attachment and contacting of round conductors, laminated flat copper and Maxi-PLS connection brackets and connection kits.

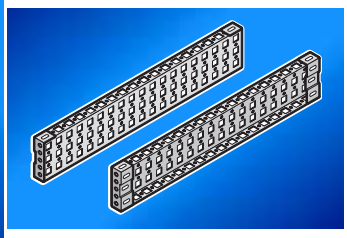
System packages for all commercially available power circuit-breakers.
Maxi-PLS busbars, in conjunction with the isolator chassis, U contact maker and connection brackets, form the heart of the modular system for connecting air circuit-breakers up to 3200 A with standard components.

The connection kits are precisely tailored to the respective power circuit-breakers.

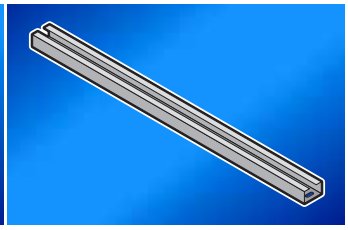
Type testing to
EN 60 439-1/IEC 60 439-1
Special testing under accidental arcing conditions to EN 60 439-1, supplement 2/IEC 1641



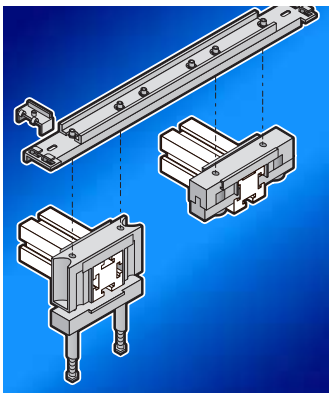
SV-TS 8 system components



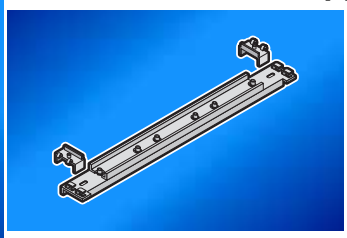
TS punched section with mounting flange, 23 x 73 mm



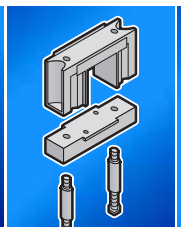
System support rails



Maxi-PLS busbar support

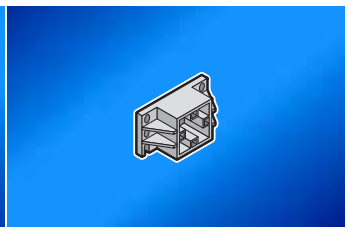


System attachment



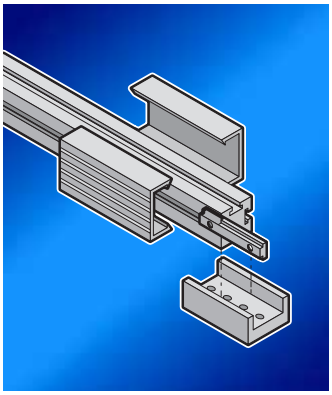
Busbar support

Busbar support, suitable for top mounting

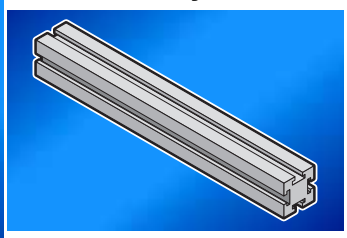


End supports

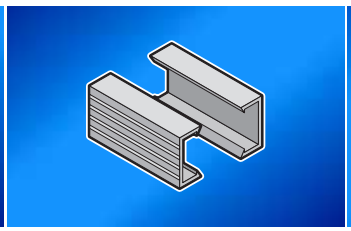
Overview, Rittal SV-TS 8 and Maxi-PLS



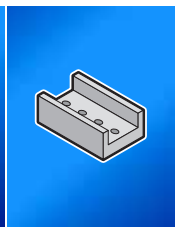
Maxi-PLS system components



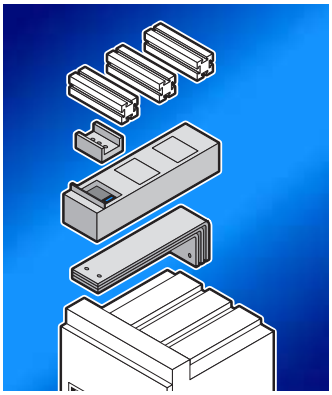
Busbars E-Cu



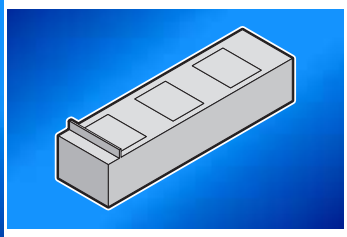
Cover section



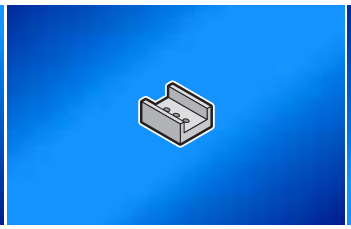
Longitudinal connector E-Cu
Sliding blocks



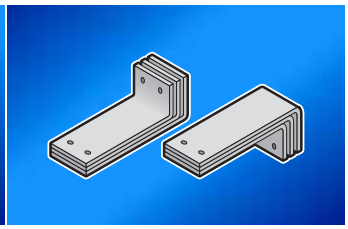
Maxi-PLS connection components



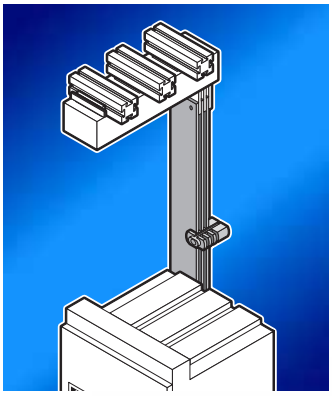
Isolator chassis



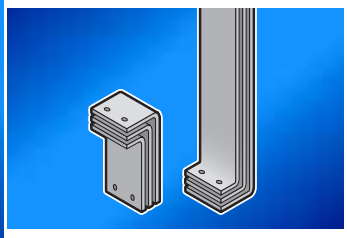
U contact makers E-Cu



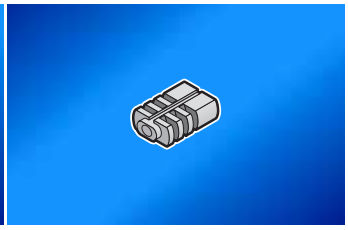
Connection bracket E-Cu



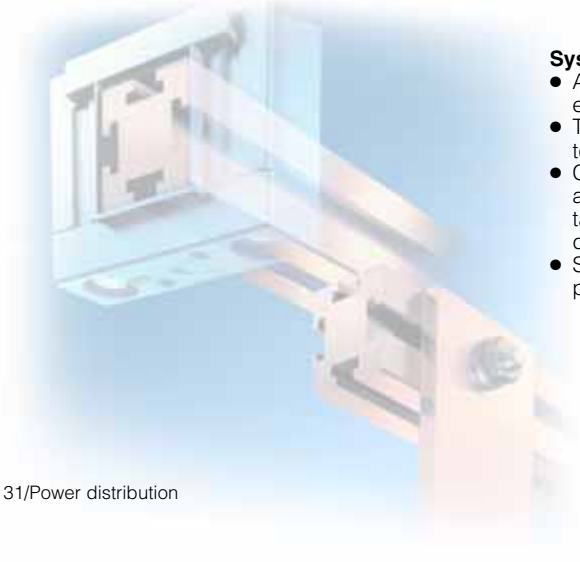
Maxi-PLS connector kits



Connector kits top/bottom



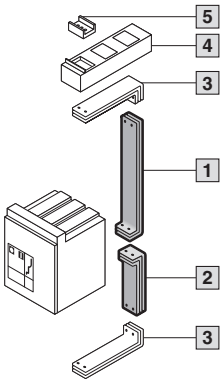
Stacking insulator

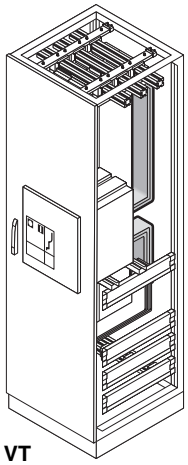


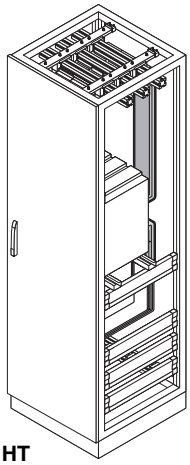
System concept
- All manual machining is eliminated
- Type testing of the system technology
- Compact busbar with four attachment levels; bar length tailored to the enclosure dimensions
- Standardised contact hazard protection

System benefits
- Increased productivity (easier project planning, no manual production of busbar connections and connection points, faster assembly)
- Compact configuration, easy access to all connection points

Connection kits (3-pole)







For installation in 600 mm deep and 2000 mm high enclosures. Recommended enclosure width 600 mm.

Correct selection should be made according to the following criteria:

- Make, size
- Rated current I_e
- Switch version either “static installation” or “rack-mounted”
- Position of the power circuit-breaker:
  VT = in door cutout
  HT = behind the door

1 Connection kit, top
2 Connection kit, bottom
3 Connection bracket
4 Isolator chassis
5 U contact maker

Note:
Technical modifications reserved.
Connection kits for other enclosure sizes or 4-pole systems available on request.

Extended
Extended delivery times.

Siemens 3WN6			**Model No. SV**						Page
Rated operating current I_e			630 A	800 A	1000 A	1250 A	1600 A	2000 A	
Size (BG)			I	I	I	I	I	–	
Static	VT	1 top	**9641.030**	**9641.070**	**9641.110**	**9641.150**	**9641.190**	**–**	
		2 bottom	**9641.040**	**9641.080**	**9641.120**	**9641.160**	**9641.200**	**–**	
	HT	1 top	**9641.010**	**9641.050**	**9641.090**	**9641.130**	**9641.170**	**–**	
		2 bottom	**9641.020**	**9641.060**	**9641.100**	**9641.140**	**9641.180**	**–**	
Rack-mounted	VT	1 top	**9641.350**	**9641.390**	**9641.430**	**9641.470**	**9641.510**	**–**	
		2 bottom	**9641.360**	**9641.400**	**9641.440**	**9641.480**	**9641.520**	**–**	
	HT	1 top	**9641.330**	**9641.370**	**9641.410**	**9641.450**	**9641.490**	**–**	
		2 bottom	**9641.340**	**9641.380**	**9641.420**	**9641.460**	**9641.500**	**–**	
Approximate weight (kg) top/bottom			16/10	16/10	31/19.5	31/19.5	31/19.5	–	
Accessories	Packs of								
3 Connection bracket	1 set		9640.430	9640.430	9640.440	9640.440	9640.440	–	377
4 Isolator chassis	1 set		9640.020	9640.020	9640.020	9640.020	9640.020	–	377
5 U contact maker	3		9640.170	9640.170	9640.170	9640.170	9640.170	–	377
Stacking insulator	6		9660.200	9660.200	9660.200	9660.200	9660.200	–	405

Siemens 3WL, Moeller IZM			**Model No. SV**						Page
Rated operating current I_e			630 A	800 A	1000 A	1250 A	1600 A	2000 A	
Size (BG)			I	I	I	I	I	II	
Static	VT	1 top	**9644.030**	**9644.070**	**9644.110**	**9644.150**	**9644.190**	**9644.510**	
		2 bottom	**9644.040**	**9644.080**	**9644.120**	**9644.160**	**9644.200**	**9644.520**	
	HT	1 top	**9644.010**	**9644.050**	**9644.090**	**9644.130**	**9644.170**	**9644.490**	
		2 bottom	**9644.020**	**9644.060**	**9644.100**	**9644.140**	**9644.180**	**9644.500**	
Rack-mounted	VT	1 top	**9644.310**	**9644.350**	**9644.390**	**9644.430**	**9644.470**	**9644.530**	
		2 bottom	**9644.320**	**9644.360**	**9644.400**	**9644.440**	**9644.480**	**9644.540**	
	HT	1 top	**9644.290**	**9644.330**	**9644.370**	**9644.410**	**9644.450**	**9644.550**[1)]	
		2 bottom	**9644.300**	**9644.340**	**9644.380**	**9644.420**	**9644.460**	**9644.560**[1)]	
Approximate weight (kg) top/bottom			16/10	16/10	16/10	31/19.5	31/19.5	41/29	
Accessories	Packs of								
3 Connection bracket	1 set		9640.430	9640.430	9640.430	9640.440	9640.440	9640.450	377
4 Isolator chassis	1 set		9640.020	9640.020	9640.020	9640.020	9640.020	9640.020	377
5 U contact maker	3		9640.170	9640.170	9640.170	9640.170	9640.170	9640.170	377
Stacking insulator	6		9660.200	9660.200	9660.200	9660.200	9660.200	9660.200	405

[1)] For installation in 800 mm deep enclosures.

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Connection kits (3-pole)

Mitsubishi AE-SS			Model No. SV					Page
Rated operating current I_e			800 A	1000 A	1250 A	1600 A	2000 A	
Static	VT	1 top	–	**9645.030**	**9645.070**	**9645.110**	**9645.150**	
		2 bottom	–	**9645.040**	**9645.080**	**9645.120**	**9645.160**	
	HT	1 top	–	**9645.010**	**9645.050**	**9645.090**	**9645.130**	
		2 bottom	–	**9645.020**	**9645.060**	**9645.100**	**9645.140**	
Rack-mounted	VT	1 top	–	**9645.350**	**9645.390**	**9645.430**	**9645.470**	
		2 bottom	–	**9645.360**	**9645.400**	**9645.440**	**9645.480**	
	HT	1 top	–	**9645.330**	**9645.370**	**9645.410**	**9645.450**	
		2 bottom	–	**9645.340**	**9645.380**	**9645.420**	**9645.460**	
Approximate weight (kg) top/bottom			–	16/10	31/19.5	31/19.5	47/29	
Accessories	Packs of							
3 Connection bracket	1 set		–	9640.430	9640.440	9640.440	9640.450	377
4 Isolator chassis	1 set		–	9640.020	9640.020	9640.020	9640.020	377
5 U contact maker	3		–	9640.170	9640.170	9640.170	9640.170	377
Stacking insulator	6		–	9660.200	9660.200	9660.200	9660.200	405

Merlin Gerin Masterpact NW			Model No. SV					Page
Rated operating current I_e			800 A	1000 A	1250 A	1600 A	2000 A	
Static	VT	1 top	**9642.030**	**9642.070**	**9642.110**	**9642.150**	**9642.190**	
		2 bottom	**9642.040**	**9642.080**	**9642.120**	**9642.160**	**9642.200**	
	HT	1 top	**9642.010**	**9642.050**	**9642.090**	**9642.130**	**9642.170**	
		2 bottom	**9642.020**	**9642.060**	**9642.100**	**9642.140**	**9642.180**	
Rack-mounted	VT	1 top	**9642.310**	**9642.350**	**9642.390**	**9642.430**	**9642.470**	
		2 bottom	**9642.320**	**9642.360**	**9642.400**	**9642.440**	**9642.480**	
	HT	1 top	**9642.290**	**9642.330**	**9642.370**	**9642.410**	**9642.450**	
		2 bottom	**9642.300**	**9642.340**	**9642.380**	**9642.420**	**9642.460**	
Approximate weight (kg) top/bottom			16/10	31/19.5	31/19.5	31/19.5	41/29	
Accessories	Packs of							
3 Connection bracket	1 set		9640.430	9640.440	9640.440	9640.440	9640.450	377
4 Isolator chassis	1 set		9640.020	9640.020	9640.020	9640.020	9640.020	377
5 U contact maker	3		9640.170	9640.170	9640.170	9640.170	9640.170	377
Stacking insulator	6		9660.200	9660.200	9660.200	9660.200	9660.200	405

ABB Sace Emax			Model No. SV					Page
Rated operating current I_e			800 A	1000 A	1250 A	1600 A	2000 A	
Size (BG)			E1	–	E1	E2	E2	
Static	VT	1 top	**9643.030**	**–**	**9643.070**	**9643.110**	**9643.150**	
		2 bottom	**9643.040**	**–**	**9643.080**	**9643.120**	**9643.160**	
	HT	1 top	**9643.010**	**–**	**9643.050**	**9643.090**	**9643.130**	
		2 bottom	**9643.020**	**–**	**9643.060**	**9643.100**	**9643.140**	
Rack-mounted	VT	1 top	**9643.310**	**–**	**9643.350**	**9643.390**	**9643.430**	
		2 bottom	**9643.320**	**–**	**9643.360**	**9643.400**	**9643.440**	
	HT	1 top	**9643.290**	**–**	**9643.330**	**9643.370**	**9643.410**	
		2 bottom	**9643.300**	**–**	**9643.340**	**9643.380**	**9643.420**	
Approximate weight (kg) top/bottom			16/10	–	31/19.5	31/19.5	47/29	
Accessories	Packs of							
3 Connection bracket	1 set		9640.430	–	9640.440	9640.440	9640.450	377
4 Isolator chassis	1 set		9640.020	–	9640.020	9640.020	9640.020	377
5 U contact maker	3		9640.170	–	9640.170	9640.170	9640.170	377
Stacking insulator	6		9660.200	–	9660.200	9660.200	9660.200	405

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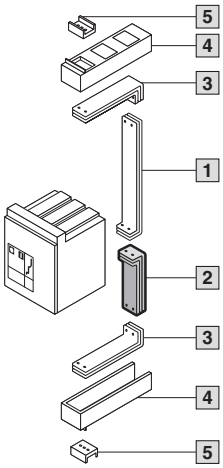
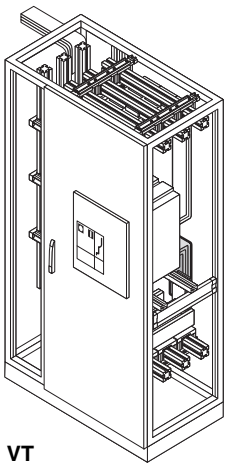
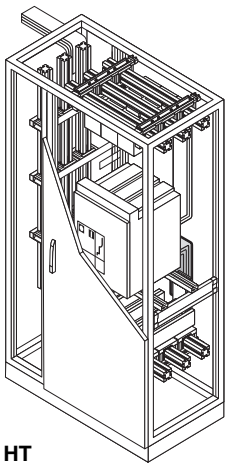
Connection kits for coupling sets (3-pole)







For installation in 600 mm deep and 2000 mm high enclosures. Recommended enclosure width 800 mm.

Correct selection should be made according to the following criteria:

- Make, size
- Rated current I_e
- Switch version either “static installation” or “rack-mounted”
- Position of the power circuit-breaker:
  VT = in door cutout
  HT = behind the door

1 Connection kit, top see page 368 and 369.

2 Connection kit, bottom for coupling set

3 Connection bracket

4 Isolator chassis

5 U contact maker

Note:
Technical modifications reserved.
Connection kits for other enclosure sizes or 4-pole systems available on request.

Delivery time:
Extended delivery times.

Siemens 3WN6		**Model No. SV**		Page
Rated operating current I_e		1600 A	2000 A	
Size (BG)		I	–	
Static	VT 2 bottom	**9641.205**	**–**	
	HT 2 bottom	**9641.185**	**–**	
Rack-mounted	VT 2 bottom	**9641.525**	**–**	
	HT 2 bottom	**9641.505**	**–**	
Approximate weight (kg)		19.5	–	
Accessories	Packs of			
3 Connection bracket	1 set	9640.440	–	377
4 Isolator chassis	1 set	9640.020	–	377
5 U contact maker	3	9640.170	–	377
Stacking insulator	6	9660.200	–	405

Siemens 3WL, Moeller IZM		**Model No. SV**		Page
Rated operating current I_e		1600 A	2000 A	
Size (BG)		I	II	
Static	VT 2 bottom	**9644.205**	**9644.525**	
	HT 2 bottom	**9644.185**	**9644.505**	
Rack-mounted	VT 2 bottom	**9644.485**	**9644.545**	
	HT 2 bottom	**9644.465**	**9644.565**[1)]	
Approximate weight (kg)		19.5	29	
Accessories	Packs of			
3 Connection bracket	1 set	9640.440	9640.450	377
4 Isolator chassis	1 set	9640.020	9640.020	377
5 U contact maker	3	9640.170	9640.170	377
Stacking insulator	6	9660.200	9660.200	405

[1)] For installation in 800 mm deep enclosures.

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Connection kits for coupling sets (3-pole)

Mitsubishi AE-SS		**Model No. SV**		Page
Rated operating current I_e		1600 A	2000 A	
Static	VT 2 bottom	**9645.125**	**9645.165**	
	HT 2 bottom	**9645.105**	**9645.145**	
Rack-mounted	VT 2 bottom	**9645.445**	**9645.485**	
	HT 2 bottom	**9645.425**	**9645.465**	
Approximate weight (kg)		19.5	29	
Accessories	Packs of			
3 Connection bracket	1 set	9640.440	9640.450	377
4 Isolator chassis	1 set	9640.020	9640.020	377
5 U contact maker	3	9640.170	9640.170	377
Stacking insulator	6	9660.200	9660.200	405

Merlin Gerin Masterpact NW		**Model No. SV**		Page
Rated operating current I_e		1600 A	2000 A	
Static	VT 2 bottom	**9642.165**	**9642.205**	
	HT 2 bottom	**9642.145**	**9642.185**	
Rack-mounted	VT 2 bottom	**9642.445**	**9642.485**	
	HT 2 bottom	**9642.425**	**9642.465**	
Approximate weight (kg)		19.5	29	
Accessories	Packs of			
3 Connection bracket	1 set	9640.440	9640.450	377
4 Isolator chassis	1 set	9640.020	9640.020	377
5 U contact maker	3	9640.170	9640.170	377
Stacking insulator	6	9660.200	9660.200	405

ABB Sace Emax		**Model No. SV**		Page
Rated operating current I_e		1600 A	2000 A	
Size (BG)		E2	E2	
Static	VT 2 bottom	**9643.125**	**9643.165**	
	HT 2 bottom	**9643.105**	**9643.145**	
Rack-mounted	VT 2 bottom	**9643.405**	**9643.445**	
	HT 2 bottom	**9643.385**	**9643.425**	
Approximate weight (kg)		19.5	29	
Accessories	Packs of			
3 Connection bracket	1 set	9640.440	9640.450	377
4 Isolator chassis	1 set	9640.020	9640.020	377
5 U contact maker	3	9640.170	9640.170	377
Stacking insulator	6	9660.200	9660.200	405

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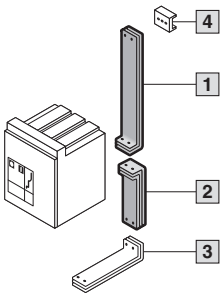
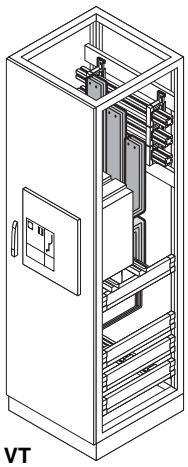
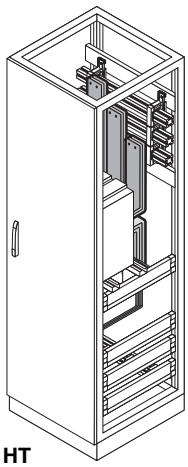
Connection kits for rear section (3-pole)







For installation in 600 mm deep and 2000 mm high enclosures. Recommended enclosure width 600 mm.

Correct selection should be made according to the following criteria:

- Make, size
- Rated current I_e
- Switch version either “static installation” or “rack-mounted”
- Position of the power circuit-breaker:
  VT = in door cutout
  HT = behind the door

1 Connection kit, top
2 Connection kit, bottom
3 Connection bracket
4 U contact maker

Note:
Technical modifications reserved.
Connection kits for other enclosure sizes or 4-pole systems available on request.

Delivery time:
Extended delivery times.

Siemens 3WN6			**Model No. SV**						Page
Rated operating current I_e			630 A	800 A	1000 A	1250 A	1600 A	2000 A	
Size (BG)			I	I	I	I	I	–	
Static	VT	1 top	**9641.033**	**9641.073**	**9641.113**	**9641.153**	**9641.193**	**–**	
		2 bottom	**9641.043**	**9641.083**	**9641.123**	**9641.163**	**9641.203**	**–**	
	HT	1 top	**9641.013**	**9641.053**	**9641.093**	**9641.133**	**9641.173**	**–**	
		2 bottom	**9641.023**	**9641.063**	**9641.103**	**9641.143**	**9641.183**	**–**	
Rack-mounted	VT	1 top	**9641.353**	**9641.393**	**9641.433**	**9641.473**	**9641.513**	**–**	
		2 bottom	**9641.363**	**9641.403**	**9641.443**	**9641.483**	**9641.523**	**–**	
	HT	1 top	**9641.333**[1)]	**9641.373**[1)]	**9641.413**[1)]	**9641.453**[1)]	**9641.493**[1)]	**–**	
		2 bottom	**9641.343**[1)]	**9641.383**[1)]	**9641.423**[1)]	**9641.463**[1)]	**9641.503**[1)]	**–**	
Approximate weight (kg) top/bottom			16/10	16/10	31/19.5	31/19.5	31/19.5	–	
Accessories	Packs of								
3 Connection bracket	1 set		9640.430	9640.430	9640.440	9640.440	9640.440	–	377
4 U contact maker	3		9640.170	9640.170	9640.170	9640.170	9640.170	–	377

Siemens 3WL, Moeller IZM			**Model No. SV**						Page
Rated operating current I_e			630 A	800 A	1000 A	1250 A	1600 A	2000 A	
Size (BG)			I	I	I	I	I	II	
Static	VT	1 top	**9644.033**	**9644.073**	**9644.113**	**9644.153**	**9644.193**	**9644.513**	
		2 bottom	**9644.043**	**9644.083**	**9644.123**	**9644.163**	**9644.203**	**9644.523**	
	HT	1 top	**9644.013**	**9644.053**	**9644.093**	**9644.133**	**9644.173**	**9644.493**	
		2 bottom	**9644.023**	**9644.063**	**9644.103**	**9644.143**	**9644.183**	**9644.503**	
Rack-mounted	VT	1 top	**9644.313**	**9644.353**	**9644.393**	**9644.433**	**9644.473**	**9644.533**[1)]	
		2 bottom	**9644.323**	**9644.363**	**9644.403**	**9644.443**	**9644.483**	**9644.543**[1)]	
	HT	1 top	**9644.293**[1)]	**9644.333**[1)]	**9644.373**[1)]	**9644.413**[1)]	**9644.453**[1)]	**9644.553**[1)]	
		2 bottom	**9644.303**[1)]	**9644.343**[1)]	**9644.383**[1)]	**9644.423**[1)]	**9644.463**[1)]	**9644.563**[1)]	
Approximate weight (kg) top/bottom			16/10	16/10	16/10	31/19.5	31/19.5	41/29	
Accessories	Packs of								
3 Connection bracket	1 set		9640.430	9640.430	9640.430	9640.440	9640.440	9640.450	377
4 U contact maker	3		9640.170	9640.170	9640.170	9640.170	9640.170	9640.170	377

[1)] For installation in 800 mm deep enclosures.

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Connection kits for rear section (3-pole)

Mitsubishi AE-SS			**Model No. SV**					Page
Rated operating current I_e			800 A	1000 A	1250 A	1600 A	2000 A	
Static	VT	1 top	–	**9645.033**	**9645.073**	**9645.113**	**9645.153**	
		2 bottom	–	**9645.043**	**9645.083**	**9645.123**	**9645.163**	
	HT	1 top	–	**9645.013**	**9645.053**	**9645.093**	**9645.133**	
		2 bottom	–	**9645.023**	**9645.063**	**9645.103**	**9645.143**	
Rack-mounted	VT	1 top	–	**9645.353**	**9645.393**	**9645.433**	**9645.473**	
		2 bottom	–	**9645.363**	**9645.403**	**9645.443**	**9645.483**	
	HT	1 top	–	**9645.333**	**9645.373**	**9645.413**	**9645.453**[1)]	
		2 bottom	–	**9645.343**	**9645.383**	**9645.423**	**9645.463**[1)]	
Approximate weight (kg) top/bottom			–	16/10	31/19.5	31/19.5	47/29	
Accessories	Packs of							
3 Connection bracket	1 set		–	9640.430	9640.440	9640.440	9640.450	377
4 U contact maker	3		–	9640.170	9640.170	9640.170	9640.170	377

Merlin Gerin Masterpact NW			**Model No. SV**					Page
Rated operating current I_e			800 A	1000 A	1250 A	1600 A	2000 A	
Static	VT	1 top	**9642.033**	**9642.073**	**9642.113**	**9642.153**	**9642.193**	
		2 bottom	**9642.043**	**9642.083**	**9642.123**	**9642.163**	**9642.203**	
	HT	1 top	**9642.013**	**9642.053**	**9642.093**	**9642.133**	**9642.173**	
		2 bottom	**9642.023**	**9642.063**	**9642.103**	**9642.143**	**9642.183**	
Rack-mounted	VT	1 top	**9642.313**	**9642.353**	**9642.393**	**9642.433**	**9642.473**	
		2 bottom	**9642.323**	**9642.363**	**9642.403**	**9642.443**	**9642.483**	
	HT	1 top	**9642.293**	**9642.333**	**9642.373**	**9642.413**	**9642.453**	
		2 bottom	**9642.303**	**9642.343**	**9642.383**	**9642.423**	**9642.463**	
Approximate weight (kg) top/bottom			16/10	31/19.5	31/19.5	31/19.5	41/29	
Accessories	Packs of							
3 Connection bracket	1 set		9640.430	9640.440	9640.440	9640.440	9640.450	377
4 U contact maker	3		9640.170	9640.170	9640.170	9640.170	9640.170	377

ABB Sace Emax			**Model No. SV**					Page
Rated operating current I_e			800 A	1000 A	1250 A	1600 A	2000 A	
Size (BG)			E1	–	E1	E2	E2	
Static	VT	1 top	**9643.033**	**–**	**9643.073**	**9643.113**	**9643.153**	
		2 bottom	**9643.043**	**–**	**9643.083**	**9643.123**	**9643.163**	
	HT	1 top	**9643.013**	**–**	**9643.053**	**9643.093**	**9643.133**	
		2 bottom	**9643.023**	**–**	**9643.063**	**9643.103**	**9643.143**	
Rack-mounted	VT	1 top	**9643.313**	**–**	**9643.353**	**9643.393**	**9643.433**	
		2 bottom	**9643.323**	**–**	**9643.363**	**9643.403**	**9643.443**	
	HT	1 top	**9643.293**	**–**	**9643.333**	**9643.373**	**9643.413**[1)]	
		2 bottom	**9643.303**	**–**	**9643.343**	**9643.383**	**9643.423**[1)]	
Approximate weight (kg) top/bottom			16/10	–	31/19.5	31/19.5	47/29	
Accessories	Packs of							
3 Connection bracket	1 set		9640.430	–	9640.440	9640.440	9640.450	377
4 U contact maker	3		9640.170	–	9640.170	9640.170	9640.170	377

[1)] For installation in 800 mm deep enclosures.

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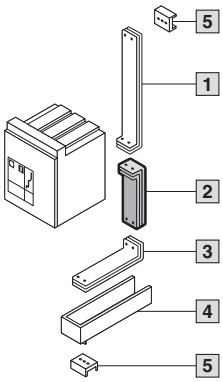
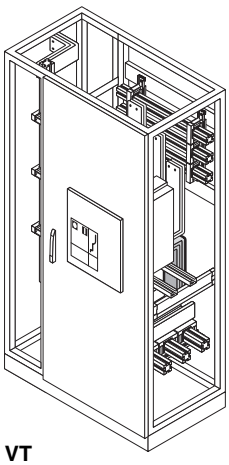
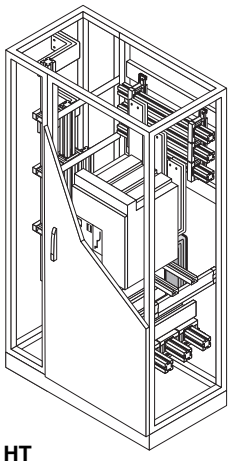
Connection kits for coupling sets – rear section (3-pole)





VT



HT

For installation in 600 mm deep and 2000 mm high enclosures. Recommended enclosure width 800 mm.

Correct selection should be made according to the following criteria:

- Make, size
- Rated current I_e
- Switch version either “static installation” or “rack-mounted”
- Position of the power circuit-breaker:
  VT = in door cutout
  HT = behind the door

1 Connection kit, top see page 368 and 369.

2 Connection kit, bottom for coupling set

3 Connection bracket

4 Isolator chassis

5 U contact maker

Note:
Technical modifications reserved.
Connection kits for other enclosure sizes or 4-pole systems available on request.

Delivery time:
Extended delivery times.

Siemens 3WN6		**Model No. SV**		Page
Rated operating current I_e		1600 A	2000 A	
Size (BG)		I	–	
Static	VT 2 bottom	**9641.204**	**–**	
	HT 2 bottom	**9641.184**	**–**	
Rack-mounted	VT 2 bottom	**9641.524**	**–**	
	HT 2 bottom	**9641.504**[1)]	**–**	
Approximate weight (kg)		19.5	–	
Accessories	Packs of			
3 Connection bracket	1 set	9640.440	–	377
4 Isolator chassis	1 set	9640.020	–	377
5 U contact maker	3	9640.170	–	377

Siemens 3WL, Moeller IZM		**Model No. SV**		Page
Rated operating current I_e		1600 A	2000 A	
Size (BG)		I	II	
Static	VT 2 bottom	**9644.204**	**9644.524**	
	HT 2 bottom	**9644.184**	**9644.504**	
Rack-mounted	VT 2 bottom	**9644.484**	**9644.544**[1)]	
	HT 2 bottom	**9644.464**[1)]	**9644.564**[1)]	
Approximate weight (kg)		19.5	29	
Accessories	Packs of			
3 Connection bracket	1 set	9640.440	9640.450	377
4 Isolator chassis	1 set	9640.020	9640.020	377
5 U contact maker	3	9640.170	9640.170	377

[1)] For installation in 800 mm deep enclosures.

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Connection kits for coupling sets – rear section (3-pole)

Mitsubishi AE-SS		**Model No. SV**		Page
Rated operating current I_e		1600 A	2000 A	
Static	VT 2 bottom	**9645.124**	**9645.164**	
	HT 2 bottom	**9645.104**	**9645.144**	
Rack-mounted	VT 2 bottom	**9645.444**	**9645.484**	
	HT 2 bottom	**9645.424**	**9645.464**[1)]	
Approximate weight (kg)		19.5	29	
Accessories	Packs of			
3 Connection bracket	1 set	9640.440	9640.450	377
4 Isolator chassis	1 set	9640.020	9640.020	377
5 U contact maker	3	9640.170	9640.170	377

Merlin Gerin Masterpact NW		**Model No. SV**		Page
Rated operating current I_e		1600 A	2000 A	
Static	VT 2 bottom	**9642.164**	**9642.204**	
	HT 2 bottom	**9642.144**	**9642.184**	
Rack-mounted	VT 2 bottom	**9642.444**	**9642.484**	
	HT 2 bottom	**9642.424**	**9642.464**	
Approximate weight (kg)		19.5	29	
Accessories	Packs of			
3 Connection bracket	1 set	9640.440	9640.450	377
4 Isolator chassis	1 set	9640.020	9640.020	377
5 U contact maker	3	9640.170	9640.170	377

ABB Sace Emax		**Model No. SV**		Page
Rated operating current I_e		1600 A	2000 A	
Size		E2	E2	
Static	VT 2 bottom	**9643.124**	**9643.164**	
	HT 2 bottom	**9643.104**	**9643.144**	
Rack-mounted	VT 2 bottom	**9643.404**	**9643.444**	
	HT 2 bottom	**9643.384**	**9643.424**[1)]	
Approximate weight (kg)		19.5	29	
Accessories	Packs of			
3 Connection bracket	1 set	9640.440	9640.450	377
4 Isolator chassis	1 set	9640.020	9640.020	377
5 U contact maker	3	9640.170	9640.170	377

[1)] For installation in 800 mm deep enclosures.

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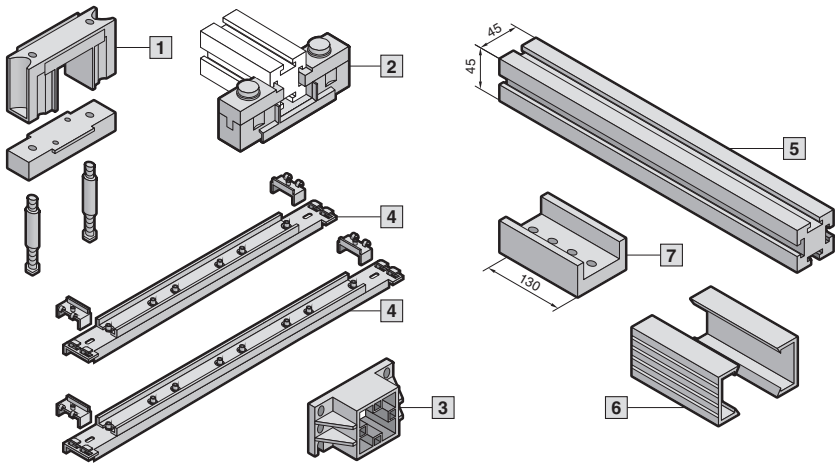
System components



Material:
Busbar support, end support, end cover: PA 6.6
System attachment: Stainless steel
Cover section: Hard PVC

Detailed drawing,
see page 1138.

Maxi-PLS system components			3-pole			4-pole		
			approx. weight (kg/pack)	Packs of	Model No. SV	approx. weight (kg/pack)	Packs of	Model No. SV
1 **Busbar support**			–	3	**9640.000**	–	3 + 1	**9640.000 9649.000**
2 **Busbar support, suitable for top mounting**			–	3	**9640.160**	–	3	**9640.160**
3 **End supports**			–	6	**9640.010**	–	6 + 2	**9640.010 9649.010**
4 **System attachment** for installing the busbar supports.								
For enclosures	Enclosure depth mm	Bar centre distance mm						
TS (roof section)	500	100	–	2	9640.100	–	–	–
	600	100	–	2	**9640.120**	–	2	**9640.080**
	600	150	–	2	9640.140	–	–	–
PS (roof section)	500	100	–	2	9640.110	–	–	–
	600	100	–	2	9640.130	–	–	–
TS/PS (rear section)	–	185	–	2	**9640.150**	–	–	–
	–	100	–	–	–	–	2	**9640.090**
5 **Maxi-PLS busbars E-Cu** (special lengths available on request).								
Length mm	For enclosure width mm	For application[1)]						
491	600	A	19.2	3	**9640.200**	25.6	4	**9649.200**
525	600	B	20.4	3	**9640.210**	27.2	4	**9649.210**
599	600	C	24.0	3	**9640.220**	32.0	4	**9649.220**
691	800	A	27.0	3	**9640.230**	36.0	4	**9649.230**
725	800	B	28.5	3	**9640.240**	38.0	4	**9649.240**
799	800	C	31.5	3	**9640.250**	42.0	4	**9649.250**
891	1000	A	36.0	3	**9640.260**	48.0	4	**9649.260**
925	1000	B	37.0	3	**9640.270**	49.4	4	**9649.270**
999	1000	C	40.0	3	**9640.280**	53.4	4	**9649.280**
1091	1200	A	43.0	3	**9640.290**	57.4	4	**9649.290**
1125	1200	B	45.0	3	**9640.300**	60.0	4	**9649.300**
1199	1200	C	48.0	3	**9640.310**	64.0	4	**9649.310**
2400	–	–	96.0	3	**9640.360**	128.0	4	**9649.360**
6 **Cover section** for clip-on mounting on the Maxi-PLS busbars, length 1000 mm.			–	5	**9640.050**	–	5	**9640.050**
7 **Longitudinal connector E-Cu** for simple baying connection of the Maxi-PLS busbars. Including sliding blocks, bolts, washers and nuts.			5.2	3	**9640.190**	5.2 1.7	3 + 1	**9640.190 9649.190**
End cover for clip-on mounting on the end surface of Maxi-PLS busbars.			–	6	**9640.060**	–	6 + 2	**9640.060 9649.060**

[1)] A = Cable connection system with end support
B = Left-hand or right-hand end enclosure in a switchgear installation
C = Bayed enclosure with panels bayed on the left and right

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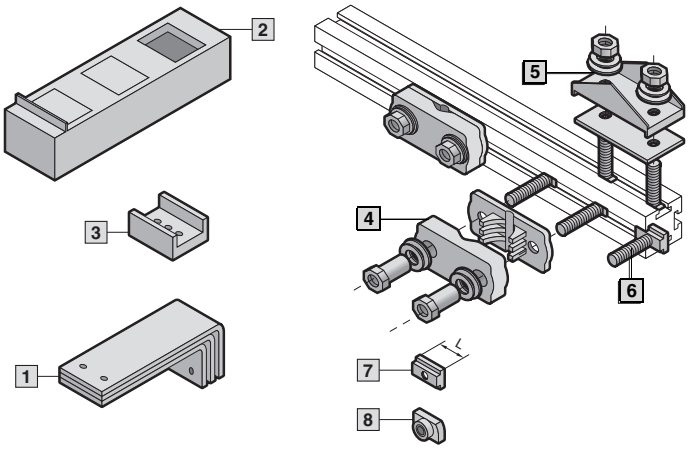
Connection components



Detailed drawing,
see page 1139.

Maxi-PLS connection components			3-pole approx. weight (kg/pack)	3-pole Packs of	3-pole Model No. SV	4-pole approx. weight (kg/pack)	4-pole Packs of	4-pole Model No. SV
1 **Connection bracket E-Cu** Transition from the main busbar system to the connection kits.								
For enclosure depth mm	Width mm	Number of brackets per phase						
500	60	1	5	1 set	9640.400	–	–	–
500	60	2	10	1 set	9640.410	–	–	–
500	60	3	14	1 set	9640.420	–	–	–
600	60	1	6	1 set	**9640.430**	9	1 sets	**9649.430**
600	60	2	11	1 set	**9640.440**	15	1 sets	**9649.440**
600	60	3	16	1 set	**9640.450**	22	1 sets	**9649.450**
2 **Isolator chassis** for isolated routing of the connection brackets. Material: PA 6.6, black, including assembly parts.								
Bar centre distance mm		For connection bracket width mm						
100		60	–	1 set	**9640.020**	–	1 set	**9649.020**
150		60	–	1 set	9650.020	–	–	–
150		100	–	1 set	9650.030	–	–	–
3 **U contact maker E-Cu** for contacting the connection brackets to the Maxi-PLS busbars. Including sliding blocks.								
Width 60 mm			2.4	3	**9640.170**	2.4 0.8	3 + 1	**9640.170** **9649.170**
Width 100 mm			4.0	3	9640.180	–	–	–
4 **Connection clamp** for the connection of round conductors 95 to 300 mm² (multi-wire and sector). Suitable for retro-fitting on Maxi-PLS busbars. Including assembly parts.								
			–	3	**9640.320**	–	3	**9640.320**
5 **Connection plates** for the connection of laminated flat copper bars. Including assembly parts.								
Maximum clamping area	2 x 10 x 32 x 1 mm		–	3	**9640.330**	–	3	**9640.330**
	2 x 10 x 63 x 1 mm		–	3	**9640.340**	–	3	**9640.340**
	2 x 10 x 100 x 1 mm		–	3	**9640.350**	–	3	**9640.350**
6 **Terminal stud** for connecting cables with ring terminals. Including sliding blocks.								
Thread	M12	Length 30 mm	–	3	**9640.370**	–	3	**9640.370**
	M16	Length 30 mm	–	3	**9640.380**	–	3	**9640.380**
7 **Sliding blocks** for sliding into the Maxi-PLS busbar section at the sides.								
Thread	M8	Length (L) 20 mm	–	15	**9640.970**	–	15	**9640.970**
	M10	Length (L) 25 mm	–	15	**9640.980**	–	15	**9640.980**
8 **Sliding nuts** for retrospective insertion into the Maxi-PLS busbar section.								
Thread	M6		–	15	**9640.900**	–	15	**9640.900**
	M8		–	15	**9640.910**	–	15	**9640.910**
	M10		–	15	**9640.920**	–	15	**9640.920**
Threaded bolts for individual connection options[1]. Including plain washers, spring lock washers and nuts.								
Thread	M6	Length 35 mm	–	6	**9640.930**	–	6	**9640.930**
	M8	Length 35 mm	–	6	**9640.940**	–	6	**9640.940**
	M10	Length 80 mm	–	6	**9640.960**	–	6	**9640.960**

[1] Sliding blocks or sliding nuts are additionally required for attachment.

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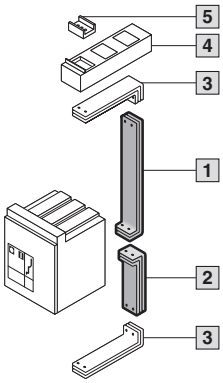
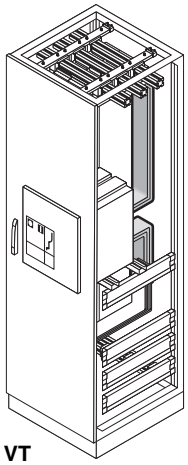
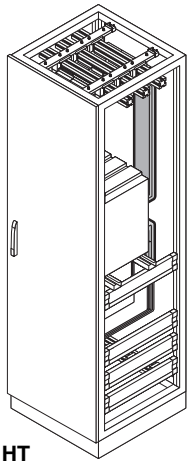
Connection kits (3-pole)







For installation in 600 mm deep and 2000 mm high enclosures. Recommended enclosure width 600 mm.

Correct selection should be made according to the following criteria:

- Make, size
- Rated current I_e
- Switch version either "static installation" or "rack-mounted"
- Position of the power circuit-breaker:
  VT = in door cutout
  HT = behind the door

1 Connection kit, top
2 Connection kit, bottom
3 Connection bracket
4 Isolator chassis
5 U contact maker

Note:
Technical modifications reserved.
Connection kits for other enclosure sizes or 4-pole systems available on request.

Delivery time:
Extended delivery times.

Siemens 3WN6			**Model No. SV**						Page
Rated operating current I_e			630 A	800 A	1000 A	1250 A	1600 A	2000 A	
Size (BG)			I	I	I	I	I	–	
Static	VT	1 top	**9651.030**	**9651.070**	**9651.110**	**9651.150**	**9651.190**	**–**	
		2 bottom	**9651.040**	**9651.080**	**9651.120**	**9651.160**	**9651.200**	**–**	
	HT	1 top	**9651.010**	**9651.050**	**9651.090**	**9651.130**	**9651.170**	**–**	
		2 bottom	**9651.020**	**9651.060**	**9651.100**	**9651.140**	**9651.180**	**–**	
Rack-mounted	VT	1 top	**9651.350**	**9651.390**	**9651.430**	**9651.470**	**9651.510**	**–**	
		2 bottom	**9651.360**	**9651.400**	**9651.440**	**9651.480**	**9651.520**	**–**	
	HT	1 top	**9651.330**	**9651.370**	**9651.410**	**9651.450**	**9651.490**	**–**	
		2 bottom	**9651.340**	**9651.380**	**9651.420**	**9651.460**	**9651.500**	**–**	
Approximate weight (kg) top/bottom			16/10	16/10	31/19.5	31/19.5	31/19.5	–	
Accessories	Packs of								
3 Connection bracket	1 set		9650.400	9650.400	9650.410	9650.410	9650.410	–	391
4 Isolator chassis	1 set		9650.020	9650.020	9650.020	9650.020	9650.020	–	391
5 U contact maker	3		9650.170	9650.170	9650.170	9650.170	9650.170	–	391
Stacking insulator	6		9660.200	9660.200	9660.200	9660.200	9660.200	–	405

Siemens 3WL, Moeller IZM			**Model No. SV**						Page
Rated operating current I_e			630 A	800 A	1000 A	1250 A	1600 A	2000 A	
Size (BG)			I	I	I	I	I	II	
Static	VT	1 top	**9654.030**	**9654.070**	**9654.110**	**9654.150**	**9654.190**	**9654.690**	
		2 bottom	**9654.040**	**9654.080**	**9654.120**	**9654.160**	**9654.200**	**9654.700**	
	HT	1 top	**9654.010**	**9654.050**	**9654.090**	**9654.130**	**9654.170**	**9654.710**	
		2 bottom	**9654.020**	**9654.060**	**9654.100**	**9654.140**	**9654.180**	**9654.720**	
Rack-mounted	VT	1 top	**9654.350**	**9654.390**	**9654.430**	**9654.470**	**9654.510**	**9654.650**	
		2 bottom	**9654.360**	**9654.400**	**9654.440**	**9654.480**	**9654.520**	**9654.660**	
	HT	1 top	**9654.330**	**9654.370**	**9654.410**	**9654.450**	**9654.490**	**9654.670**[1)]	
		2 bottom	**9654.340**	**9654.380**	**9654.420**	**9654.460**	**9654.500**	**9654.680**[1)]	
Approximate weight (kg) top/bottom			16/10	16/10	16/10	31/19.5	31/19.5	41/29	
Accessories	Packs of								
3 Connection bracket	1 set		9650.400	9650.400	9650.400	9650.410	9650.410	9650.420	391
4 Isolator chassis	1 set		9650.020	9650.020	9650.020	9650.020	9650.020	9650.020	391
5 U contact maker	3		9650.170	9650.170	9650.170	9650.170	9650.170	9650.170	391
Stacking insulator	6		9660.200	9660.200	9660.200	9660.200	9660.200	9660.200	405

[1)] For installation in 800 mm deep enclosures.

System overview Page 366 **System components** Page 390 **Connection components** Page 391 **SV-TS 8 enclosures** Page 392 **Accessories** Page 401

Connection kits (3-pole)

Mitsubishi AE-SS			Model No. SV					Page
Rated operating current I_e			800 A	1000 A	1250 A	1600 A	2000 A	
Static	VT	1 top	–	**9655.030**	**9655.070**	**9655.110**	**9655.150**	
		2 bottom	–	**9655.040**	**9655.080**	**9655.120**	**9655.160**	
	HT	1 top	–	**9655.010**	**9655.050**	**9655.090**	**9655.130**	
		2 bottom	–	**9655.020**	**9655.060**	**9655.100**	**9655.140**	
Rack-mounted	VT	1 top	–	**9655.310**	**9655.350**	**9655.390**	**9655.430**	
		2 bottom	–	**9655.320**	**9655.360**	**9655.400**	**9655.440**	
	HT	1 top	–	**9655.290**	**9655.330**	**9655.370**	**9655.410**	
		2 bottom	–	**9655.300**	**9655.340**	**9655.380**	**9655.420**	
Approximate weight (kg) top/bottom			–	16/10	31/19.5	31/19.5	47/29	
Accessories	Packs of							
3 Connection bracket	1 set		–	9650.400	9650.410	9650.410	9650.420	391
4 Isolator chassis	1 set		–	9650.020	9650.020	9650.020	9650.020	391
5 U contact maker	3		–	9650.170	9650.170	9650.170	9650.170	391
Stacking insulator	6		–	9660.200	9660.200	9660.200	9660.200	405

Merlin Gerin Masterpact NW			Model No. SV					Page
Rated operating current I_e			800 A	1000 A	1250 A	1600 A	2000 A	
Static	VT	1 top	**9652.030**	**9652.070**	**9652.110**	**9652.150**	–	
		2 bottom	**9652.040**	**9652.080**	**9652.120**	**9652.160**	–	
	HT	1 top	**9652.010**	**9652.050**	**9652.090**	**9652.130**	–	
		2 bottom	**9652.020**	**9652.060**	**9652.100**	**9652.140**	–	
Rack-mounted	VT	1 top	**9652.310**	**9652.350**	**9652.390**	**9652.430**	–	
		2 bottom	**9652.320**	**9652.360**	**9652.400**	**9652.440**	–	
	HT	1 top	**9652.290**	**9652.330**	**9652.370**	**9652.410**	–	
		2 bottom	**9652.300**	**9652.340**	**9652.380**	**9652.420**	–	
Approximate weight (kg) top/bottom			16/10	31/19.5	31/19.5	31/19.5	–	
Accessories	Packs of							
3 Connection bracket	1 set		9650.400	9650.410	9650.410	9650.410	–	391
4 Isolator chassis	1 set		9650.020	9650.020	9650.020	9650.020	–	391
5 U contact maker	3		9650.170	9650.170	9650.170	9650.170	–	391
Stacking insulator	6		9660.200	9660.200	9660.200	9660.200	–	405

ABB Sace Emax			Model No. SV					Page
Rated operating current I_e			800 A	1000 A	1250 A	1600 A	2000 A	
Size (BG)			E1	–	E1	E2	E2	
Static	VT	1 top	**9653.030**	**–**	**9653.070**	**9653.110**	**9653.150**	
		2 bottom	**9653.040**	**–**	**9653.080**	**9653.120**	**9653.160**	
	HT	1 top	**9653.010**	**–**	**9653.050**	**9653.090**	**9653.130**	
		2 bottom	**9653.020**	**–**	**9653.060**	**9653.100**	**9653.140**	
Rack-mounted	VT	1 top	**9653.310**	**–**	**9653.350**	**9653.390**	**9653.430**	
		2 bottom	**9653.320**	**–**	**9653.360**	**9653.400**	**9653.440**	
	HT	1 top	**9653.290**	**–**	**9653.330**	**9653.370**	**9653.410**	
		2 bottom	**9653.300**	**–**	**9653.340**	**9653.380**	**9653.420**	
Approximate weight (kg) top/bottom			16/10	–	31/19.5	31/19.5	47/29	
Accessories	Packs of							
3 Connection bracket	1 set		9650.400	–	9650.410	9650.410	9650.420	391
4 Isolator chassis	1 set		9650.020	–	9650.020	9650.020	9650.020	391
5 U contact maker	3		9650.170	–	9650.170	9650.170	9650.170	391
Stacking insulator	6		9660.200	–	9660.200	9660.200	9660.200	405

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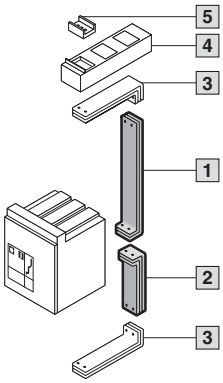
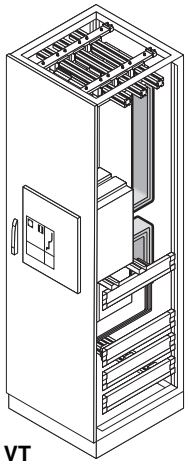
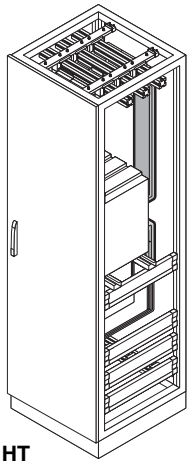
Connection kits (3-pole)







For installation in 600 mm deep and 2000 mm high enclosures. Recommended enclosure width 800 mm.

Correct selection should be made according to the following criteria:

- Make, size
- Rated current I_e
- Switch version either "static installation" or "rack-mounted"
- Position of the power circuit-breaker:
  VT = in door cutout
  HT = behind the door

1 Connection kit, top
2 Connection kit, bottom
3 Connection bracket
4 Isolator chassis
5 U contact maker

Note:
Technical modifications reserved.
Connection kits for other enclosure sizes or 4-pole systems available on request.

Delivery time:
Extended delivery times.

Siemens 3WN6		**Model No. SV**			Page
Rated operating current I_e		2000 A	2500 A	3200 A	
Size (BG)		II	II	II	
Static	VT 1 top	**9651.230**	**9651.270**	**9651.310**	
	VT 2 bottom	**9651.240**	**9651.280**	**9651.320**	
	HT 1 top	**9651.210**	**9651.250**	**9651.290**	
	HT 2 bottom	**9651.220**	**9651.260**	**9651.300**	
Rack-mounted	VT 1 top	**9651.550**	**9651.590**	**9651.630**	
	VT 2 bottom	**9651.560**	**9651.600**	**9651.640**	
	HT 1 top	**9651.530**	**9651.570**	**9651.610**	
	HT 2 bottom	**9651.540**	**9651.580**	**9651.620**	
Approximate weight (kg) top/bottom		48/32	67/50	67/50	
Accessories	Packs of				
3 Connection bracket	1 set	9650.470	9650.480	9650.480	391
4 Isolator chassis	1 set	9650.030	9650.030	9650.030	391
5 U contact maker	3	9650.180	9650.180	9650.180	391
Stacking insulator	6	9660.200	9660.200	9660.200	405

Siemens 3WL, Moeller IZM		**Model No. SV**			Page
Rated operating current I_e		2000 A	2500 A	3200 A	
Size (BG)		II	II	II	
Static	VT 1 top	**9654.690**	**9654.270**	**9654.310**	
	VT 2 bottom	**9654.700**	**9654.280**	**9654.320**	
	HT 1 top	**9654.710**	**9654.250**	**9654.290**	
	HT 2 bottom	**9654.720**	**9654.260**	**9654.300**	
Rack-mounted	VT 1 top	**9654.650**	**9654.590**	**9654.630**	
	VT 2 bottom	**9654.660**	**9654.600**	**9654.640**	
	HT 1 top	**9654.670**[1)]	**9654.570**[1)]	**9654.610**[1)]	
	HT 2 bottom	**9654.680**[1)]	**9654.580**[1)]	**9654.620**[1)]	
Approximate weight (kg) top/bottom		41/29	67/50	67/50	
Accessories	Packs of				
3 Connection bracket	1 set	9650.420	9650.480	9650.480	391
4 Isolator chassis	1 set	9650.020	9650.030	9650.030	391
5 U contact maker	3	9650.170	9650.180	9650.180	391
Stacking insulator	6	9660.200	9660.200	9660.200	405

[1)] For installation in 800 mm deep enclosures.

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Connection kits (3-pole)

Mitsubishi AE-SS			Model No. SV			Page
Rated operating current I_e			2000 A	2500 A	3200 A	
Static	VT	1 top	**9655.190**	**9655.230**	**9655.270**	
		2 bottom	**9655.200**	**9655.240**	**9655.280**	
	HT	1 top	**9655.170**	**9655.210**	**9655.250**	
		2 bottom	**9655.180**	**9655.220**	**9655.260**	
Rack-mounted	VT	1 top	**9655.470**	**9655.510**	**9655.550**	
		2 bottom	**9655.480**	**9655.520**	**9655.560**	
	HT	1 top	**9655.450**	**9655.490**	**9655.530**	
		2 bottom	**9655.460**	**9655.500**	**9655.540**	
Approximate weight (kg) top/bottom			48/32	67/50	67/50	
Accessories	Packs of					
3 Connection bracket	1 set		9650.470	9650.480	9650.480	391
4 Isolator chassis	1 set		9650.030	9650.030	9650.030	391
5 U contact maker	3		9650.180	9650.180	9650.180	391
Stacking insulator	6		9660.200	9660.200	9660.200	405

Merlin Gerin Masterpact NW			Model No. SV			Page
Rated operating current I_e			2000 A	2500 A	3200 A	
Static	VT	1 top	**9652.190**	**9652.230**	**9652.270**	
		2 bottom	**9652.200**	**9652.240**	**9652.280**	
	HT	1 top	**9652.170**	**9652.210**	**9652.250**	
		2 bottom	**9652.180**	**9652.220**	**9652.260**	
Rack-mounted	VT	1 top	**9652.470**	**9652.510**	**9652.550**	
		2 bottom	**9652.480**	**9652.520**	**9652.560**	
	HT	1 top	**9652.450**	**9652.490**	**9652.530**	
		2 bottom	**9652.460**	**9652.500**	**9652.540**	
Approximate weight (kg) top/bottom			41/29	48/32	67/50	
Accessories	Packs of					
3 Connection bracket	1 set		9650.420	9650.470	9650.480	391
4 Isolator chassis	1 set		9650.020	9650.030	9650.030	391
5 U contact maker	3		9650.170	9650.180	9650.180	391
Stacking insulator	6		9660.200	9660.200	9660.200	405

ABB Sace Emax			Model No. SV			Page
Rated operating current I_e			2000 A	2500 A	3200 A	
Size (BG)			E3	E3	E3	
Static	VT	1 top	**9653.190**	**9653.230**	**9653.270**	
		2 bottom	**9653.200**	**9653.240**	**9653.280**	
	HT	1 top	**9653.170**	**9653.210**	**9653.250**	
		2 bottom	**9653.180**	**9653.220**	**9653.260**	
Rack-mounted	VT	1 top	**9653.470**	**9653.510**	**9653.550**	
		2 bottom	**9653.480**	**9653.520**	**9653.560**	
	HT	1 top	**9653.450**	**9653.490**	**9653.530**	
		2 bottom	**9653.460**	**9653.500**	**9653.540**	
Approximate weight (kg) top/bottom			48/32	48/32	67/50	
Accessories	Packs of					
3 Connection bracket	1 set		9650.470	9650.470	9650.480	391
4 Isolator chassis	1 set		9650.030	9650.030	9650.030	391
5 U contact maker	3		9650.180	9650.180	9650.180	391
Stacking insulator	6		9660.200	9660.200	9660.200	405

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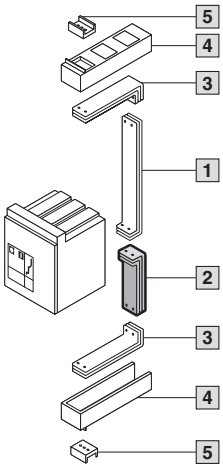
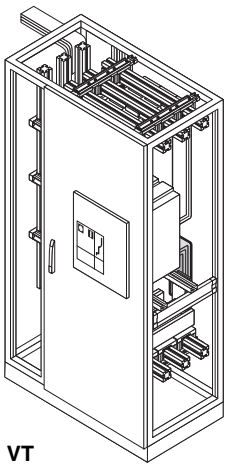
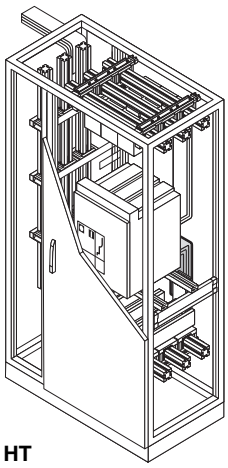
Connection kits for coupling sets (3-pole)







For installation in 600 mm deep and 2000 mm high enclosures. Recommended enclosure width 1000 mm.

Correct selection should be made according to the following criteria:

- Make, size
- Rated current I_e
- Switch version either “static installation” or “rack-mounted”
- Position of the power circuit-breaker:
  VT = in door cutout
  HT = behind the door

1 Connection kit, top see page 378 – 381.

2 Connection kit, bottom for coupling set

3 Connection bracket

4 Isolator chassis

5 U contact maker

Note:
Technical modifications reserved.
Connection kits for other enclosure sizes or 4-pole systems available on request.

Delivery time:
Extended delivery times.

Siemens 3WN6		**Model No. SV**				Page
Rated operating current I_e		1600 A[1)]	2000 A	2500 A	3200 A	
Size (BG)		I	II	II	II	
Static	VT 2 bottom	**9651.205**	**9651.245**	**9651.285**	**9651.325**	
	HT 2 bottom	**9651.185**	**9651.225**	**9651.265**	**9651.305**	
Rack-mounted	VT 2 bottom	**9651.525**	**9651.565**	**9651.605**	**9651.645**	
	HT 2 bottom	**9651.505**	**9651.545**	**9651.585**	**9651.625**	
Approximate weight (kg)		19.5	32	50	50	
Accessories	Packs of					
3 Connection bracket	1 set	9650.410	9650.470	9650.480	9650.480	391
4 Isolator chassis	1 set	9650.020	9650.030	9650.030	9650.030	391
5 U contact maker	3	9650.170	9650.180	9650.180	9650.180	391
Stacking insulator	6	9660.200	9660.200	9660.200	9660.200	405

Siemens 3WL, Moeller IZM		**Model No. SV**				Page
Rated operating current I_e		1600 A[1)]	2000 A[1)]	2500 A	3200 A	
Size (BG)		I	II	II	II	
Static	VT 2 bottom	**9654.205**	**9654.705**	**9654.285**	**9654.325**	
	HT 2 bottom	**9654.185**	**9654.725**	**9654.265**	**9654.305**	
Rack-mounted	VT 2 bottom	**9654.525**	**9654.665**	**9654.605**	**9654.645**	
	HT 2 bottom	**9654.505**	**9654.685[2)]**	**9654.585[2)]**	**9654.625[2)]**	
Approximate weight (kg)		19.5	29	50	50	
Accessories	Packs of					
3 Connection bracket	1 set	9650.410	9650.420	9650.480	9650.480	391
4 Isolator chassis	1 set	9650.020	9650.020	9650.030	9650.030	391
5 U contact maker	3	9650.170	9650.170	9650.180	9650.180	391
Stacking insulator	6	9660.200	9660.200	9660.200	9660.200	405

[1)] Installation of the power circuit-breaker is also possible in 800 mm wide enclosures.
[2)] For installation in 800 mm deep enclosures.

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Connection kits for coupling sets (3-pole)

Mitsubishi AE-SS		Model No. SV				Page
Rated operating current I_e		1600 A[1)]	2000 A	2500 A	3200 A	
Static	VT 2 bottom	**9655.125**	**9655.205**	**9655.245**	**9655.285**	
	HT 2 bottom	**9655.105**	**9655.185**	**9655.225**	**9655.265**	
Rack-mounted	VT 2 bottom	**9655.405**	**9655.485**	**9655.525**	**9655.565**	
	HT 2 bottom	**9655.385**	**9655.465**	**9655.505**	**9655.545**	
Approximate weight (kg)		19.5	32	50	50	
Accessories	Packs of					
3 Connection bracket	1 set	9650.410	9650.470	9650.480	9650.480	391
4 Isolator chassis	1 set	9650.020	9650.030	9650.030	9650.030	391
5 U contact maker	3	9650.170	9650.180	9650.180	9650.180	391
Stacking insulator	6	9660.200	9660.200	9660.200	9660.200	405

Merlin Gerin Masterpact NW		Model No. SV				Page
Rated operating current I_e		1600 A[1)]	2000 A[1)]	2500 A	3200 A	
Static	VT 2 bottom	**9652.165**	**9652.205**	**9652.245**	**9652.285**	
	HT 2 bottom	**9652.145**	**9652.185**	**9652.225**	**9652.265**	
Rack-mounted	VT 2 bottom	**9652.445**	**9652.485**	**9652.525**	**9652.565**	
	HT 2 bottom	**9652.425**	**9652.465**	**9652.505**	**9652.545**	
Approximate weight (kg)		19.5	29	32	50	
Accessories	Packs of					
3 Connection bracket	1 set	9650.410	9650.420	9650.470	9650.480	391
4 Isolator chassis	1 set	9650.020	9650.020	9650.030	9650.030	391
5 U contact maker	3	9650.170	9650.170	9650.180	9650.180	391
Stacking insulator	6	9660.200	9660.200	9660.200	9660.200	405

ABB Sace Emax		Model No. SV					Page
Rated operating current I_e		1600 A	2000 A		2500 A	3200 A	
Size (BG)		E2[1)]	E2[1)]	E3	E3	E3	
Static	VT 2 bottom	**9653.125**	**9653.165**	**9653.205**	**9653.245**	**9653.285**	
	HT 2 bottom	**9653.105**	**9653.145**	**9653.185**	**9653.225**	**9653.265**	
Rack-mounted	VT 2 bottom	**9653.405**	**9653.445**	**9653.485**	**9653.525**	**9653.565**	
	HT 2 bottom	**9653.385**	**9653.425**	**9653.465**	**9653.505**	**9653.545**	
Approximate weight (kg)		19.5	29	32	32	50	
Accessories	Packs of						
3 Connection bracket	1 set	9650.410	9650.420	9650.470	9650.470	9650.480	391
4 Isolator chassis	1 set	9650.020	9650.020	9650.030	9650.030	9650.030	391
5 U contact maker	3	9650.170	9650.170	9650.180	9650.180	9650.180	391
Stacking insulator	6	9660.200	9660.200	9660.200	9660.200	9660.200	405

[1)] Installation of the power circuit-breaker is also possible in 800 mm wide enclosures.

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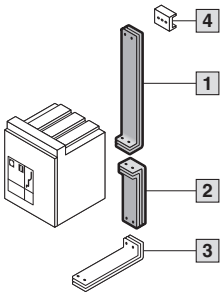
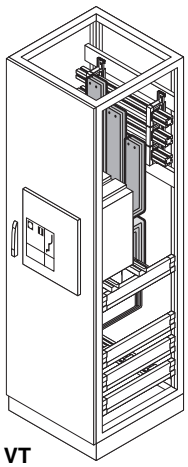
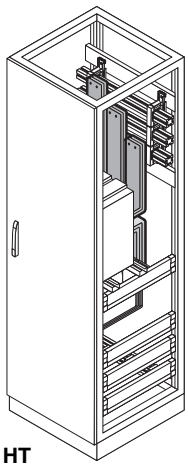
Connection kits for rear section (3-pole)







For installation in 600 mm deep and 2000 mm high enclosures. Recommended enclosure width 600 mm.

Correct selection should be made according to the following criteria:

- Make, size
- Rated current I_e
- Switch version either “static installation” or “rack-mounted”
- Position of the power circuit-breaker:
  VT = in door cutout
  HT = behind the door

1 Connection kit, top
2 Connection kit, bottom
3 Connection bracket
4 U contact maker

Note:
Technical modifications reserved.
Connection kits for other enclosure sizes or 4-pole systems available on request.

Delivery time:
Extended delivery times.

Siemens 3WN6			**Model No. SV**						Page
Rated operating current I_e			630 A	800 A	1000 A	1250 A	1600 A	2000 A	
Size (BG)			I	I	I	I	I	–	
Static	VT	1 top	**9651.033**	**9651.073**	**9651.113**	**9651.153**	**9651.193**	**–**	
		2 bottom	**9651.043**	**9651.083**	**9651.123**	**9651.163**	**9651.203**	**–**	
	HT	1 top	**9651.013**	**9651.053**	**9651.093**	**9651.133**	**9651.173**	**–**	
		2 bottom	**9651.023**	**9651.063**	**9651.103**	**9651.143**	**9651.183**	**–**	
Rack-mounted	VT	1 top	**9651.353**[1)]	**9651.393**[1)]	**9651.433**[1)]	**9651.473**[1)]	**9651.513**[1)]	**–**	
		2 bottom	**9651.363**[1)]	**9651.403**[1)]	**9651.443**[1)]	**9651.483**[1)]	**9651.523**[1)]	**–**	
	HT	1 top	**9651.333**[1)]	**9651.373**[1)]	**9651.413**[1)]	**9651.453**[1)]	**9651.493**[1)]	**–**	
		2 bottom	**9651.343**[1)]	**9651.383**[1)]	**9651.423**[1)]	**9651.463**[1)]	**9651.503**[1)]	**–**	
Approximate weight (kg) top/bottom			16/10	16/10	31/19.5	31/19.5	31/19.5	–	
Accessories	Packs of								
3 Connection bracket	1 set		9650.400	9650.400	9650.410	9650.410	9650.410	–	391
4 U contact maker	3		9650.170	9650.170	9650.170	9650.170	9650.170	–	391

Siemens 3WL, Moeller IZM			**Model No. SV**						Page
Rated operating current I_e			630 A	800 A	1000 A	1250 A	1600 A	2000 A	
Size (BG)			I	I	I	I	I	II	
Static	VT	1 top	**9654.033**	**9654.073**	**9654.113**	**9654.153**	**9654.193**	**9654.693**	
		2 bottom	**9654.043**	**9654.083**	**9654.123**	**9654.163**	**9654.203**	**9654.703**	
	HT	1 top	**9654.013**	**9654.053**	**9654.093**	**9654.133**	**9654.173**	**9654.713**	
		2 bottom	**9654.023**	**9654.063**	**9654.103**	**9654.143**	**9654.183**	**9654.723**	
Rack-mounted	VT	1 top	**9654.353**	**9654.393**	**9654.433**	**9654.473**[1)]	**9654.513**[1)]	**9654.653**[1)]	
		2 bottom	**9654.363**	**9654.403**	**9654.443**	**9654.483**[1)]	**9654.523**[1)]	**9654.663**[1)]	
	HT	1 top	**9654.333**[1)]	**9654.373**[1)]	**9654.413**[1)]	**9654.453**[1)]	**9654.493**[1)]	**9654.673**[1)]	
		2 bottom	**9654.343**[1)]	**9654.383**[1)]	**9654.423**[1)]	**9654.463**[1)]	**9654.503**[1)]	**9654.683**[1)]	
Approximate weight (kg) top/bottom			16/10	16/10	16/10	31/19.5	31/19.5	41/29	
Accessories	Packs of								
3 Connection bracket	1 set		9650.400	9650.400	9650.400	9650.410	9650.410	9650.420	391
4 U contact maker	3		9650.170	9650.170	9650.170	9650.170	9650.170	9650.170	391

[1)] For installation in 800 mm deep enclosures.

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Connection kits for rear section (3-pole)

Mitsubishi AE-SS			Model No. SV					Page
Rated operating current I_e			800 A	1000 A	1250 A	1600 A	2000 A	
Static	VT	1 top	–	**9655.033**	**9655.073**	**9655.113**	**9655.153**	
		2 bottom	–	**9655.043**	**9655.083**	**9655.123**	**9655.163**	
	HT	1 top	–	**9655.013**	**9655.053**	**9655.093**	**9655.133**	
		2 bottom	–	**9655.023**	**9655.063**	**9655.103**	**9655.143**	
Rack-mounted	VT	1 top	–	**9655.313**	**9655.353**	**9655.393**	**9655.433**[1)]	
		2 bottom	–	**9655.323**	**9655.363**	**9655.403**	**9655.443**[1)]	
	HT	1 top	–	**9655.293**	**9655.333**[1)]	**9655.373**[1)]	**9655.413**[1)]	
		2 bottom	–	**9655.303**	**9655.343**[1)]	**9655.383**[1)]	**9655.423**[1)]	
Approximate weight (kg) top/bottom			–	16/10	31/19.5	31/19.5	47/29	
Accessories	Packs of							
3 Connection bracket	1 set		–	9650.400	9650.410	9650.410	9650.420	391
4 U contact maker	3		–	9650.170	9650.170	9650.170	9650.170	391

Merlin Gerin Masterpact NW			Model No. SV					Page
Rated operating current I_e			800 A	1000 A	1250 A	1600 A	2000 A	
Static	VT	1 top	**9652.033**	**9652.073**	**9652.113**	**9652.153**	–	
		2 bottom	**9652.043**	**9652.083**	**9652.123**	**9652.163**	–	
	HT	1 top	**9652.013**	**9652.053**	**9652.093**	**9652.133**	–	
		2 bottom	**9652.023**	**9652.063**	**9652.103**	**9652.143**	–	
Rack-mounted	VT	1 top	**9652.313**	**9652.353**	**9652.393**	**9652.433**	–	
		2 bottom	**9652.323**	**9652.363**	**9652.403**	**9652.443**	–	
	HT	1 top	**9652.293**[1)]	**9652.333**[1)]	**9652.373**[1)]	**9652.413**[1)]	–	
		2 bottom	**9652.303**[1)]	**9652.343**[1)]	**9652.383**[1)]	**9652.423**[1)]	–	
Approximate weight (kg) top/bottom			16/10	31/19.5	31/19.5	31/19.5	–	
Accessories	Packs of							
3 Connection bracket	1 set		9650.400	9650.410	9650.410	9650.410	–	391
4 U contact maker	3		9650.170	9650.170	9650.170	9650.170	–	391

ABB Sace Emax			Model No. SV					Page
Rated operating current I_e			800 A	1000 A	1250 A	1600 A	2000 A	
Size			E1	–	E1	E2	E2	
Static	VT	1 top	**9653.033**	**–**	**9653.073**	**9653.113**	**9653.153**	
		2 bottom	**9653.043**	**–**	**9653.083**	**9653.123**	**9653.163**	
	HT	1 top	**9653.013**	**–**	**9653.053**	**9653.093**	**9653.133**	
		2 bottom	**9653.023**	**–**	**9653.063**	**9653.103**	**9653.143**	
Rack-mounted	VT	1 top	**9653.313**	**–**	**9653.353**	**9653.393**	**9653.433**[1)]	
		2 bottom	**9653.323**	**–**	**9653.363**	**9653.403**	**9653.443**[1)]	
	HT	1 top	**9653.293**[1)]	**–**	**9653.333**[1)]	**9653.373**[1)]	**9653.413**[1)]	
		2 bottom	**9653.303**[1)]	**–**	**9653.343**[1)]	**9653.383**[1)]	**9653.423**[1)]	
Approximate weight (kg) top/bottom			16/10	–	31/19.5	31/19.5	47/29	
Accessories	Packs of							
3 Connection bracket	1 set		9650.400	–	9650.410	9650.410	9650.420	391
4 U contact maker	3		9650.170	–	9650.170	9650.170	9650.170	391

[1)] For installation in 800 mm deep enclosures.

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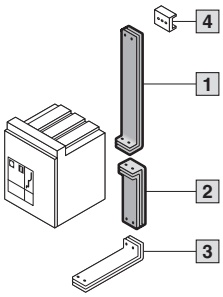
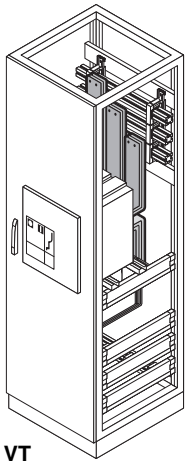
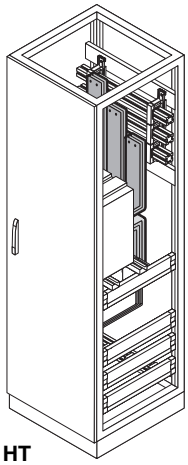
Connection kits for rear section (3-pole)







For installation in 600 mm deep and 2000 mm high enclosures. Recommended enclosure width 800 mm.

Correct selection should be made according to the following criteria:

- Make, size
- Rated current I_e
- Switch version either “static installation” or “rack-mounted”
- Position of the power circuit-breaker:
  VT = in door cutout
  HT = behind the door

1 Connection kit, top
2 Connection kit, bottom
3 Connection bracket
4 U contact maker

Note:
Technical modifications reserved.
Connection kits for other enclosure sizes or 4-pole systems available on request.

Delivery time:
Extended delivery times.

Siemens 3WN6			**Model No. SV**			Page
Rated operating current I_e			2000 A	2500 A	3200 A	
Size (BG)			II	II	II	
Static	VT	1 top	**9651.233**	**9651.273**	**9651.313**	
		2 bottom	**9651.243**	**9651.283**	**9651.323**	
	HT	1 top	**9651.213**	**9651.253**	**9651.293**	
		2 bottom	**9651.223**	**9651.263**	**9651.303**	
Rack-mounted	VT	1 top	**9651.553**[1)]	**9651.593**[1)]	**9651.633**[1)]	
		2 bottom	**9651.563**[1)]	**9651.603**[1)]	**9651.643**[1)]	
	HT	1 top	**9651.533**[1)]	**9651.573**[1)]	**9651.613**[1)]	
		2 bottom	**9651.543**[1)]	**9651.583**[1)]	**9651.623**[1)]	
Approximate weight (kg) top/bottom			48/32	67/50	67/50	
Accessories	Packs of					
3 Connection bracket	1 set		9650.470	9650.480	9650.480	391
4 U contact maker	3		9650.180	9650.180	9650.180	391

Siemens 3WL, Moeller IZM			**Model No. SV**			Page
Rated operating current I_e			2000 A	2500 A	3200 A	
Size (BG)			II	II	II	
Static	VT	1 top	**9654.693**	**9654.273**	**9654.313**	
		2 bottom	**9654.703**	**9654.283**	**9654.323**	
	HT	1 top	**9654.713**	**9654.253**	**9654.293**	
		2 bottom	**9654.723**	**9654.263**	**9654.303**	
Rack-mounted	VT	1 top	**9654.653**[1)]	**9654.593**[1)]	**9654.633**[1)]	
		2 bottom	**9654.663**[1)]	**9654.603**[1)]	**9654.643**[1)]	
	HT	1 top	**9654.673**[1)]	**9654.573**[1)]	**9654.613**[1)]	
		2 bottom	**9654.683**[1)]	**9654.583**[1)]	**9654.623**[1)]	
Approximate weight (kg) top/bottom			41/29	67/50	67/50	
Accessories	Packs of					
3 Connection bracket	1 set		9650.420	9650.480	9650.480	391
4 U contact maker	3		9650.170	9650.180	9650.180	391

[1)] For installation in 800 mm deep enclosures.

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Connection kits for rear section (3-pole)

Mitsubishi AE-SS			**Model No. SV**			Page
Rated operating current I_e			2000 A	2500 A	3200 A	
Static	VT	1 top	**9655.193**	**9655.233**	**9655.273**	
		2 bottom	**9655.203**	**9655.243**	**9655.283**	
	HT	1 top	**9655.173**	**9655.213**	**9655.253**	
		2 bottom	**9655.183**	**9655.223**	**9655.263**	
Rack-mounted	VT	1 top	**9655.473**	**9655.513**[1)]	**9655.553**[1)]	
		2 bottom	**9655.483**	**9655.523**[1)]	**9655.563**[1)]	
	HT	1 top	**9655.453**[1)]	**9655.493**[1)]	**9655.533**[1)]	
		2 bottom	**9655.463**[1)]	**9655.503**[1)]	**9655.543**[1)]	
Approximate weight (kg) top/bottom			48/32	67/50	67/50	
Accessories	Packs of					
3 Connection bracket	1 set		9650.470	9650.480	9650.480	391
4 U contact maker	3		9650.180	9650.180	9650.180	391

Merlin Gerin Masterpact NW			**Model No. SV**			Page
Rated operating current I_e			2000 A	2500 A	3200 A	
Static	VT	1 top	**9652.193**	**9652.233**	**9652.273**	
		2 bottom	**9652.203**	**9652.243**	**9652.283**	
	HT	1 top	**9652.173**	**9652.213**	**9652.253**	
		2 bottom	**9652.183**	**9652.223**	**9652.263**	
Rack-mounted	VT	1 top	**9652.473**	**9652.513**	**9652.553**[1)]	
		2 bottom	**9652.483**	**9652.523**	**9652.563**[1)]	
	HT	1 top	**9652.453**[1)]	**9652.493**[1)]	**9652.533**[1)]	
		2 bottom	**9652.463**[1)]	**9652.503**[1)]	**9652.543**[1)]	
Approximate weight (kg) top/bottom			41/29	48/32	67/50	
Accessories	Packs of					
3 Connection bracket	1 set		9650.420	9650.470	9650.480	391
4 U contact maker	3		9650.170	9650.180	9650.180	391

ABB Sace Emax			**Model No. SV**			Page
Rated operating current I_e			2000 A	2500 A	3200 A	
Size (BG)			E3	E3	E3	
Static	VT	1 top	**9653.193**	**9653.233**	**9653.273**	
		2 bottom	**9653.203**	**9653.243**	**9653.283**	
	HT	1 top	**9653.173**	**9653.213**	**9653.253**	
		2 bottom	**9653.183**	**9653.223**	**9653.263**	
Rack-mounted	VT	1 top	**9653.473**	**9653.513**	**9653.553**[1)]	
		2 bottom	**9653.483**	**9653.523**	**9653.563**[1)]	
	HT	1 top	**9653.453**[1)]	**9653.493**[1)]	**9653.533**[1)]	
		2 bottom	**9653.463**[1)]	**9653.503**[1)]	**9653.543**[1)]	
Approximate weight (kg) top/bottom			48/32	48/32	67/50	
Accessories	Packs of					
3 Connection bracket	1 set		9650.470	9650.470	9650.480	391
4 U contact maker	3		9650.180	9650.180	9650.180	391

[1)] For installation in 800 mm deep enclosures.

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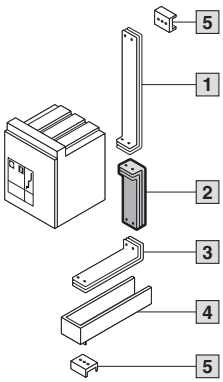
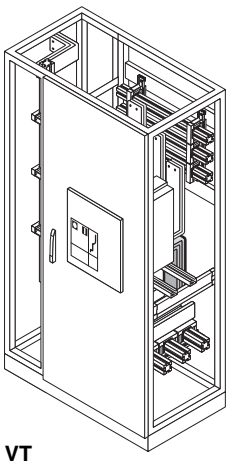
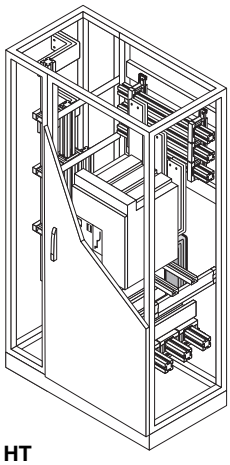
Connection kits for coupling sets – rear section (3-pole)




VT


HT

For installation in 600 mm deep and 2000 mm high enclosures. Recommended enclosure width 1000 mm.

Correct selection should be made according to the following criteria:

- Make, size
- Rated current I_e
- Switch version either “static installation” or “rack-mounted”
- Position of the power circuit-breaker:
  VT = in door cutout
  HT = behind the door

1 Connection kit, top, see page 378 – 381.

2 Connection kit, bottom for coupling set

3 Connection bracket

4 Isolator chassis

5 U contact maker

Note:
Technical modifications reserved.
Connection kits for other enclosure sizes or 4-pole systems available on request.

Delivery time:
Extended delivery times.

Siemens 3WN6		**Model No. SV**				Page
Rated operating current I_e		1600 A[1]	2000 A	2500 A	3200 A	
Size (BG)		I	II	II	II	
Static	VT 2 bottom	**9651.204**	**9651.244**	**9651.284**	**9651.324**	
	HT 2 bottom	**9651.184**	**9651.224**	**9651.264**	**9651.304**	
Rack-mounted	VT 2 bottom	**9651.524[2]**	**9651.564[2]**	**9651.604[2]**	**9651.644[2]**	
	HT 2 bottom	**9651.504[2]**	**9651.544[2]**	**9651.584[2]**	**9651.624[2]**	
Approximate weight (kg)		19.5	32	50	50	
Accessories	Packs of					
3 Connection bracket	1 set	9650.410	9650.470	9650.480	9650.480	391
4 Isolator chassis	1 set	9650.020	9650.030	9650.030	9650.030	391
5 U contact maker	3	9650.170	9650.180	9650.180	9650.180	391

Siemens 3WL, Moeller IZM		**Model No. SV**				Page
Rated operating current I_e		1600 A[1]	2000 A[1]	2500 A	3200 A	
Size (BG)		I	II	II	II	
Static	VT 2 bottom	**9654.204**	**9654.704**	**9654.284**	**9654.324**	
	HT 2 bottom	**9654.184**	**9654.724**	**9654.264**	**9654.304**	
Rack-mounted	VT 2 bottom	**9654.524[2]**	**9654.664[2]**	**9654.604[2]**	**9654.644[2]**	
	HT 2 bottom	**9654.504[2]**	**9654.684[2]**	**9654.584[2]**	**9654.624[2]**	
Approximate weight (kg)		19.5	29	50	50	
Accessories	Packs of					
3 Connection bracket	1 set	9650.410	9650.420	9650.480	9650.480	391
4 Isolator chassis	1 set	9650.020	9650.020	9650.030	9650.030	391
5 U contact maker	3	9650.170	9650.170	9650.180	9650.180	391

[1] Installation of the power circuit-breaker is also possible in 800 mm wide enclosures.
[2] For installation in 800 mm deep enclosures.

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Connection kits for coupling sets – rear section (3-pole)

Mitsubishi AE-SS		Model No. SV				Page
Rated operating current I_e		1600 A[1]	2000 A	2500 A	3200 A	
Static	VT 2 bottom	**9655.124**	**9655.204**	**9655.244**	**9655.284**	
	HT 2 bottom	**9655.104**	**9655.184**	**9655.224**	**9655.264**	
Rack-mounted	VT 2 bottom	**9655.404**	**9655.484**	**9655.524[2]**	**9655.564[2]**	
	HT 2 bottom	**9655.384[2]**	**9655.464[2]**	**9655.504[2]**	**9655.544[2]**	
Approximate weight (kg)		19.5	32	50	50	
Accessories	Packs of					
3 Connection bracket	1 set	9650.410	9650.470	9650.480	9650.480	391
4 Isolator chassis	1 set	9650.020	9650.030	9650.030	9650.030	391
5 U contact maker	3	9650.170	9650.180	9650.180	9650.180	391

Merlin Gerin Masterpact NW		Model No. SV				Page
Rated operating current I_e		1600 A[1]	2000 A[1]	2500 A	3200 A	
Static	VT 2 bottom	**9652.164**	**9652.204**	**9652.244**	**9652.284**	
	HT 2 bottom	**9652.144**	**9652.184**	**9652.224**	**9652.264**	
Rack-mounted	VT 2 bottom	**9652.444**	**9652.484**	**9652.524**	**9652.564[2]**	
	HT 2 bottom	**9652.424[2]**	**9652.464[2]**	**9652.504[2]**	**9652.544[2]**	
Approximate weight (kg)		19.5	29	32	50	
Accessories	Packs of					
3 Connection bracket	1 set	9650.410	9650.420	9650.470	9650.480	391
4 Isolator chassis	1 set	9650.020	9650.020	9650.030	9650.030	391
5 U contact maker	3	9650.170	9650.170	9650.180	9650.180	391

ABB Sace Emax		Model No. SV					Page
Rated operating current I_e		1600 A	2000 A		2500 A	3200 A	
Size (BG)		E2[1]	E2[1]	E3	E3	E3	
Static	VT 2 bottom	**9653.124**	**9653.164**	**9653.204**	**9653.244**	**9653.284**	
	HT 2 bottom	**9653.104**	**9653.144**	**9653.184**	**9653.224**	**9653.264**	
Rack-mounted	VT 2 bottom	**9653.404**	**9653.444[2]**	**9653.484**	**9653.524**	**9653.564[2]**	
	HT 2 bottom	**9653.384[2]**	**9653.424[2]**	**9653.464[2]**	**9653.504[2]**	**9653.544[2]**	
Approximate weight (kg)		19.5	29	32	32	50	
Accessories	Packs of						
3 Connection bracket	1 set	9650.410	9650.420	9650.470	9650.470	9650.480	391
4 Isolator chassis	1 set	9650.020	9650.020	9650.030	9650.030	9650.030	391
5 U contact maker	3	9650.170	9650.170	9650.180	9650.180	9650.180	391

[1] Installation of the power circuit-breaker is also possible in 800 mm wide enclosures.
[2] For installation in 800 mm deep enclosures.

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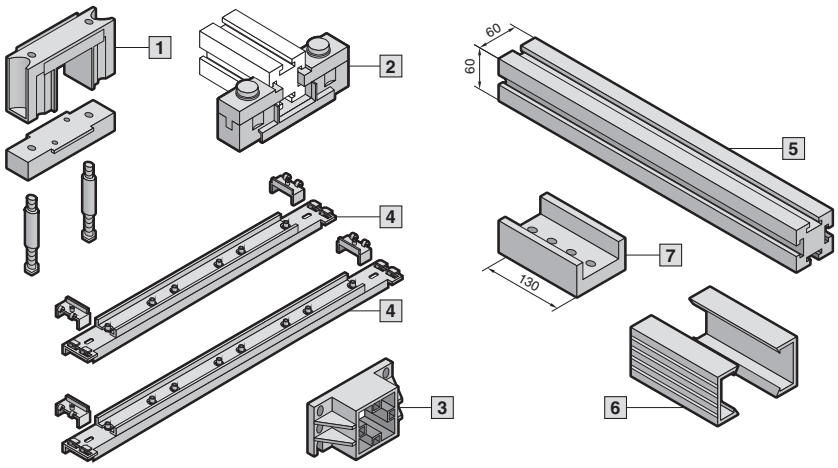
Rittal Maxi-PLS up to 3200 A

System components



Material:
Busbar support, end support, end cover: PA 6.6
System attachment: Stainless steel
Cover section: Hard PVC

Detailed drawing,
see page 1138.

Maxi-PLS system components			3-pole			4-pole		
			approx. weight (kg/pack)	Packs of	Model No. SV	approx. weight (kg/pack)	Packs of	Model No. SV
1	**Busbar support**		–	3	**9650.000**	–	3 + 1	**9650.000** **9659.000**
2	**Busbar support, suitable for top mounting**		–	3	**9650.160**	–	3	**9650.160**
3	**End supports**		–	6	**9650.010**	–	6 + 2	**9650.010** **9659.010**
4	**System attachment** for installing the busbar supports.							
	For enclosures	Enclosure depth mm / Bar centre distance mm						
	TS (roof section)	600 / 150	–	2	**9650.100**	–	–	**–**
		800 / 150	–	2	9650.120	–	2	**9650.080**
	PS (roof section)	600 / 150	–	2	9650.110	–	–	**–**
		800 / 150	–	2	9650.130	–	–	**–**
	TS/PS (rear section)	– / 185	–	2	**9650.150**	–	–	**–**
		– / 150	–	–	–	–	2	**9650.090**
5	**Maxi-PLS busbars E-Cu** (special lengths available on request).							
	Length mm	For enclosure width mm / For application[1)]						
	491	600 / A	35.0	3	**9650.200**	46.7	4	**9659.200**
	525	600 / B	37.0	3	**9650.210**	49.4	4	**9659.210**
	599	600 / C	43.0	3	**9650.220**	57.4	4	**9659.220**
	691	800 / A	49.0	3	**9650.230**	65.4	4	**9659.230**
	725	800 / B	51.0	3	**9650.240**	68.0	4	**9659.240**
	799	800 / C	56.0	3	**9650.250**	74.7	4	**9659.250**
	891	1000 / A	63.0	3	**9650.260**	84.0	4	**9659.260**
	925	1000 / B	65.0	3	**9650.270**	86.7	4	**9659.270**
	999	1000 / C	71.0	3	**9650.280**	94.7	4	**9659.280**
	1091	1200 / A	77.0	3	**9650.290**	102.7	4	**9659.290**
	1125	1200 / B	80.0	3	**9650.300**	106.7	4	**9659.300**
	1199	1200 / C	85.0	3	**9650.310**	113.4	4	**9659.310**
	2400	– / –	171.0	3	**9650.360**	228.0	4	**9659.360**
6	**Cover section** for clip-on mounting on the Maxi-PLS busbars, length 1000 mm.		–	5	**9650.050**	–	5	**9650.050**
7	**Longitudinal connector E-Cu** for simple baying connection of the Maxi-PLS busbars. Including sliding blocks, bolts, washers and nuts.		7.0	3	**9650.190**	7.0 2.4	3 + 1	**9650.190** **9659.190**
	End cover for clip-on mounting on the end surface of Maxi-PLS busbars.		–	6	**9650.060**	–	6 + 2	**9650.060** **9659.060**
	Stabiliser to increase short-circuit resistance (I_{cw} up to 120 kA).		–	4[2)]	**9650.140**	–	–	**–**

[1)] A = Cable connection system with end support
B = Left-hand or right-hand end enclosure in a switchgear installation
C = Bayed enclosure with panels bayed on the left and right
[2)] Modules for two complete stabilisers

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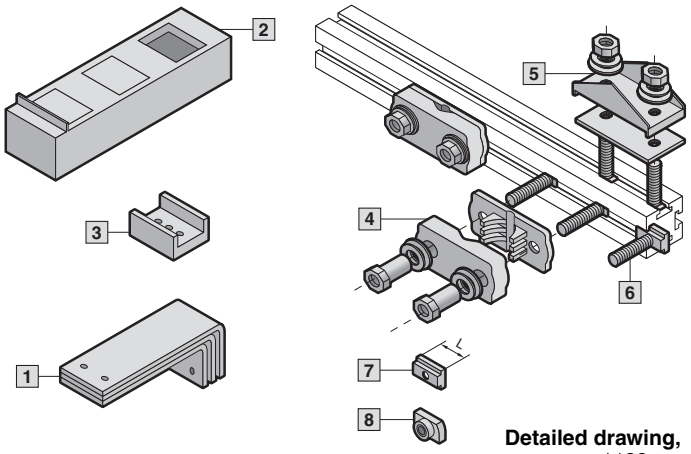
Connection components



Detailed drawing,
see page 1139.

Maxi-PLS connection components			3-pole			4-pole		
			approx. weight (kg/pack)	Packs of	Model No. SV	approx. weight (kg/pack)	Packs of	Model No. SV
1	**Connection bracket E-Cu** Transition from the main busbar system to the connection kits.							
For enclosure depth mm	Width mm	Number of brackets per phase						
600	60	1	6	1 set	**9650.400**	–	–	**–**
600	60	2	11	1 set	**9650.410**	–	–	**–**
600	60	3	17	1 set	**9650.420**	–	–	**–**
800	60	1	8	1 set	9650.430	11	1 set	**9659.400**
800	60	2	15	1 set	9650.440	20	1 set	**9659.410**
800	60	3	22	1 set	9650.450	30	1 set	**9659.420**
600	100	1	9	1 set	**9650.460**	–	–	**–**
600	100	2	18	1 set	**9650.470**	–	–	**–**
600	100	3	26	1 set	**9650.480**	–	–	**–**
800	100	1	13	1 set	9650.490	18	1 set	**9659.460**
800	100	2	24	1 set	9650.500	32	1 set	**9659.470**
800	100	3	36	1 set	9650.510	48	1 set	**9659.480**
2	**Isolator chassis** for isolated routing of the connection brackets. Material: PA 6.6, black, including assembly parts.							
Bar centre distance mm		For connection bracket width mm						
150		60	–	1 set	9650.020	–	1 set	**9659.020**
150		100	–	1 set	**9650.030**	–	1 set	**9659.030**
3	**U contact maker E-Cu** for contacting the connection brackets to the Maxi-PLS busbars. Including sliding blocks.							
Width 60 mm			3.4	3	9650.170	3.4 1.2	3 + 1	**9650.170** **9659.170**
Width 100 mm			5.7	3	**9650.180**	5.7 1.9	3 + 1	**9650.180** **9659.180**
4	**Connection clamp** for the connection of round conductors 95 to 300 mm² (multi-wire and sector). Suitable for retro-fitting on Maxi-PLS busbars. Including assembly parts.							
			–	3	**9650.320**	–	3	**9650.320**
5	**Connection plates** for the connection of laminated flat copper bars. Including assembly parts.							
Maximum clamping area	2 x 10 x 32 x 1 mm		–	3	**9650.330**	–	3	**9650.330**
	2 x 10 x 63 x 1 mm		–	3	**9650.340**	–	3	**9650.340**
	2 x 10 x 100 x 1 mm		–	3	**9650.350**	–	3	**9650.350**
6	**Terminal stud** for connecting cables with ring terminals. Including sliding blocks.							
Thread	M12	Length 32 mm	–	3	**9650.370**	–	3	**9650.370**
	M16	Length 32 mm	–	3	**9650.380**	–	3	**9650.380**
7	**Sliding blocks** for sliding into the Maxi-PLS busbar section at the sides.							
Thread	M10	Length (L) 25 mm	–	15	**9650.980**	–	15	**9650.980**
	M12	Length (L) 35 mm	–	15	**9650.990**	–	15	**9650.990**
8	**Sliding nuts** for retrospective insertion into the Maxi-PLS busbar section.							
Thread	M6		–	15	**9650.900**	–	15	**9650.900**
	M10		–	15	**9650.910**	–	15	**9650.910**
	M12		–	15	**9650.920**	–	15	**9650.920**
	Threaded bolts for individual connection options[1]. Including plain washers, spring lock washers and nuts.							
Thread	M6	Length 35 mm	–	6	**9650.930**	–	6	**9650.930**
	M10	Length 35 mm	–	6	**9650.940**	–	6	**9650.940**
	M12	Length 80 mm	–	6	**9650.960**	–	6	**9650.960**

[1] Sliding blocks or sliding nuts are additionally required for attachment.

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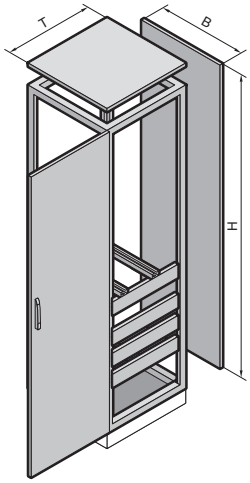
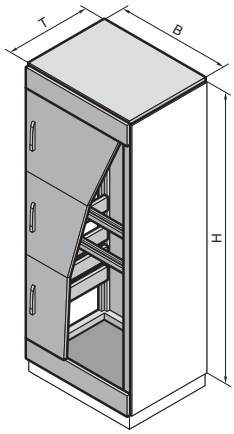
Rittal Maxi-PLS SV-TS 8 enclosures

for incoming/outgoing circuit





Pre-assembled for direct installation of power circuit-breakers

Material:
Sheet steel
Enclosure frame, roof, rear panel and gland plates: 1.5 mm
Door: 2.0 mm

Surface finish:
Enclosure frame:
Dipcoat-primed
Door, roof and rear panel:
Dipcoat-primed,
powder-coated on the outside in textured RAL 7035
Gland plates: Zinc-plated

Supply includes:
Enclosure frame
with fitted punched section without mounting flange for Maxi-PLS end support attachment and fitted system support rails for power circuit-breaker attachment;
door(s), roof, rear panel,
gland plates (three-piece).

Detailed drawing,
see page 1140.

Technical information,
see page 1142.

For Maxi-PLS		Packs of	**3-pole**				Page
			2000 A		3200 A		
Width (B) in mm			600		800		
Height (H) in mm			2000		2000		
Depth (T) in mm			600		600		
Model No. SV		1	**9660.665**	**9660.675**	**9660.865**	**9660.875**	
Door(s)			1	3	1	3	
Approximate weight (kg)			78	78	88	88	
Base/plinth							
Components front and rear	Height 100 mm	1 set	8601.600	8601.600	8601.800	8601.800	835
	Height 200 mm	1 set	8602.600	8602.600	8602.800	8602.800	835
Trim panels (sides)	Height 100 mm	1 set	8601.060	8601.060	8601.060	8601.060	835
	Height 200 mm	1 set	8602.060	8602.060	8602.060	8602.060	835
Accessories							
Cable clamp rails		2	4191.000	4191.000	4192.000	4192.000	979
Cable entry plates[1)]		2	8800.060	8800.060	8800.080	8800.080	964
Side panels		2	8106.235	8106.512	8106.235	8106.512	853
Roof plates, vented[2)]		1	9660.235	9660.235	9660.245	9660.245	406
Roof plates with pressure relief function[2)]		1	9660.935	9660.935	9660.945	9660.945	406
Cover attachment		8	–	9660.680	–	9660.680	404
Device module			■	■	■	■	401
Contact hazard protection cover			■	■	■	■	402
Mounting bracket		24	9660.090	9660.090	9660.090	9660.090	404
Lock systems							
Standard double-bit lock insert may be exchanged for comfort handle, see page 881 and other inserts, see page 888.							

[1)] Cable entry grommets, see page 965.
[2)] In exchange for the standard TS roof.
To order enclosures in textured RAL 7032, please add extension .XX0 to the Model No. Delivery times available on request.

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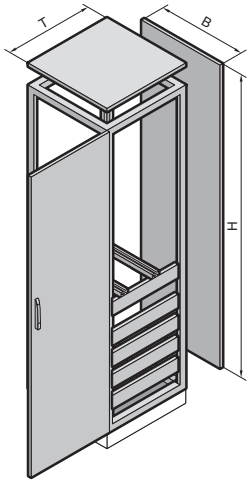
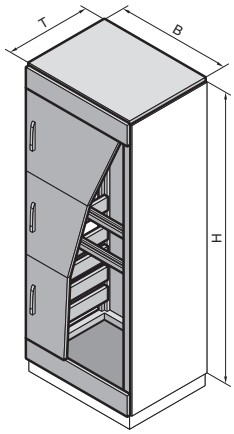
Accessories Page 401

for incoming/outgoing circuit





Pre-assembled for direct installation of power circuit-breakers

Material:
Sheet steel
Enclosure frame, roof, rear panel and gland plates: 1.5 mm
Door: 2.0 mm

Surface finish:
Enclosure frame:
Dipcoat-primed
Door, roof and rear panel:
Dipcoat-primed,
powder-coated on the outside in textured RAL 7035
Gland plates: Zinc-plated

Supply includes:
Enclosure frame
with fitted punched section without mounting flange for Maxi-PLS end support attachment and fitted system support rails for power circuit-breaker attachment;
door(s), roof, rear panel,
gland plates (three-piece).

Detailed drawing,
see page 1140.

Technical information,
see page 1142.

For Maxi-PLS		Packs of	4-pole				Page
			2000 A		3200 A		
Width (B) in mm			800		800		
Height (H) in mm			2000		2000		
Depth (T) in mm			600		800		
Model No. SV		1	**9649.625**	**9649.635**	**9659.625**	**9659.635**	
Door(s)			1	3	1	3	
Approximate weight (kg)			90	90	100	100	
Base/plinth							
Components front and rear	Height 100 mm	1 set	8601.800	8601.800	8601.800	8601.800	835
	Height 200 mm	1 set	8602.800	8602.800	8602.800	8602.800	835
Trim panels (sides)	Height 100 mm	1 set	8601.060	8601.060	8601.080	8601.080	835
	Height 200 mm	1 set	8602.060	8602.060	8602.080	8602.080	835
Accessories							
Cable clamp rails		2	4192.000	4192.000	4192.000	4192.000	979
Cable entry plates[1)]		2	8800.080	8800.080	8800.080	8800.080	964
Side panels		2	8106.235	8106.512	8108.235	8108.512	853
Roof plates, vented[2)]		1	9660.245	9660.245	9659.535	9659.535	406
Roof plates with pressure relief function[2)]		1	9660.945	9660.945	–	–	406
Cover attachment		8	–	9660.680	–	9660.680	404
Device module			■	■	■	■	401
Contact hazard protection cover			■	■	■	■	402
Mounting bracket		24	9660.090	9660.090	9660.090	9660.090	404
Lock systems							
Standard double-bit lock insert may be exchanged for comfort handle, see page 881 and other inserts, see page 888.							

[1)] Cable entry grommets, see page 965.
[2)] In exchange for the standard TS roof.
To order enclosures in textured RAL 7032, please add extension .XX0 to the Model No. Delivery times available on request.

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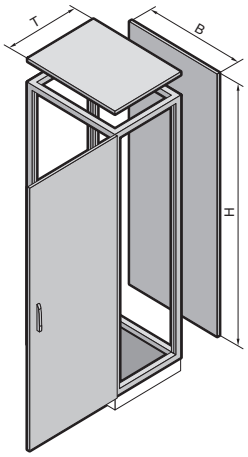
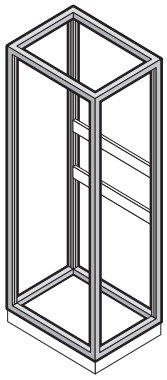
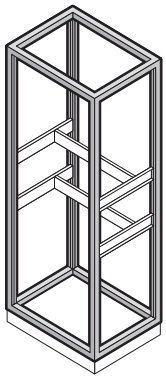
Rittal Maxi-PLS SV-TS 8 enclosures

for Rittal NH fused isolators





1 Mounting in rear section



2 Mounting in centre section

Material:
Sheet steel
Enclosure frame, roof, rear panel and gland plates: 1.5 mm
Door: 2.0 mm

Surface finish:
Enclosure frame:
Dipcoat-primed
Door, roof and rear panel:
Dipcoat-primed,
powder-coated on the outside in textured RAL 7035
Gland plates: Zinc-plated

Supply includes:
Enclosure frame, door, roof, rear panel, gland plates (three-piece), TS punched sections with mounting flanges

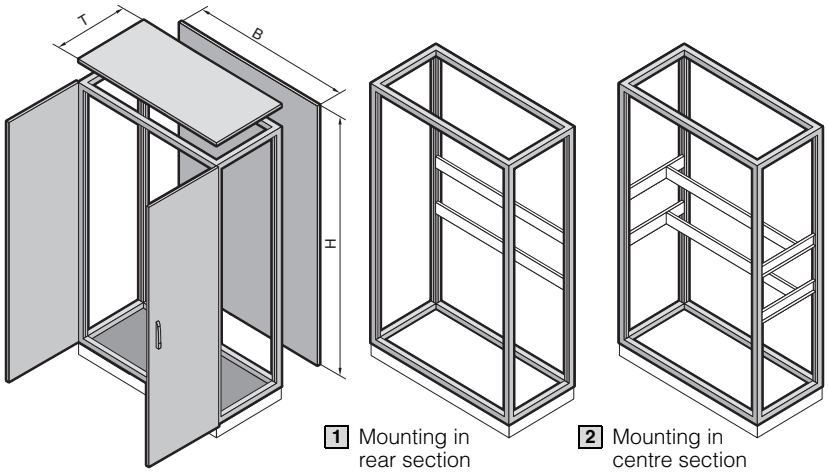
Technical information,
see page 1143.

Maxi-PLS **1 For mounting in the rear section**		Packs of	**3-pole/4-pole** 2000 A/3200 A						Page
Width (B) in mm			600	600	600	800	800	800	
Height (H) in mm			2000	2000	2000	2000	2000	2000	
Depth (T) in mm			500	600	800	500	600	800	
Model No. SV		1	**9660.505**[1)]	**9660.605**[1)]	**9660.805**[1)]	**9660.535**[1)]	**9660.635**[1)]	**9660.835**[1)]	
Technical specifications correspond to Model No. TS			8605.500	8606.500	8608.500	8805.500	8806.500	8808.500	144 – 146
Door			1	1	1	1	1	1	
Approximate weight (kg)			74.0	76.0	83.0	88.4	92.6	99.1	
Base/plinth									
Components front and rear	Height 100 mm	1 set	8601.600	8601.600	8601.600	8601.800	8601.800	8601.800	835
	Height 200 mm	1 set	8602.600	8602.600	8602.600	8602.800	8602.800	8602.800	835
Trim panels (sides)	Height 100 mm	1 set	8601.050	8601.060	8601.080	8601.050	8601.060	8601.080	835
	Height 200 mm	1 set	8602.050	8602.060	8602.080	8602.050	8602.060	8602.080	835
Also required									
2 For mounting in the centre section									
TS punched section with mounting flange (4 per enclosure)		4	8612.550	8612.560	8612.580	8612.550	8612.560	8612.580	922
PS punched section without mounting flange (2 per enclosure)		4	4376.000	4376.000	4376.000	4377.000	4377.000	4377.000	925
Support bracket (4 per enclosure)		24 sets	4183.000	4183.000	4183.000	4183.000	4183.000	4183.000	933
Threaded blocks M6 (8 per enclosure)		50	4162.000	4162.000	4162.000	4162.000	4162.000	4162.000	936
Accessories									
Cable clamp rails		2	4191.000	4191.000	4191.000	4192.000	4192.000	4192.000	979
Cable entry plates[2)]		2	8800.060	8800.060	8800.060	8800.080	8800.080	8800.080	964
Side panels		2	8105.235	8106.235	8108.235	8105.235	8106.235	8108.235	853
Roof plates, vented[3)]		1	–	9660.235	9659.525	–	9660.245	9659.535	406
Roof plates with pressure relief function[3)]		1	–	9660.935	–	–	9660.945	–	406
Cover plate, contact hazard protection[4)]		1 set	–	9660.460	–	–	9660.470	–	403
Mounting bracket		24	–	9660.090	–	–	9660.090	–	404
Blanking cover			■	■	■	■	■	■	404
Terminal studs			■	■	■	■	■	■	405
Lock systems									
Standard double-bit lock insert may be exchanged for comfort handle, see page 881 and other inserts, see page 888.									

[1)] Without mounting plate.
[2)] Cable entry grommets, see page 965.
[3)] In exchange for the standard TS roof.
[4)] Only used when mounting the Maxi-PLS system in the rear section.
To order enclosures in textured RAL 7032, please add extension .XX0 to the Model No. Delivery times available on request.

System overview Page 366 **NH fused isolators size 00 – 3** Page 353 **System components** Page 376/390 **Connection components** Page 377/391 **Accessories** Page 401

for Rittal NH fused isolators



1 Mounting in rear section

2 Mounting in centre section

Material:
Sheet steel
Enclosure frame, roof, rear panel and gland plates: 1.5 mm
Door: 2.0 mm

Surface finish:
Enclosure frame:
Dipcoat-primed
Door, roof and rear panel:
Dipcoat-primed,
powder-coated on the outside in textured RAL 7035
Gland plates: Zinc-plated

Supply includes:
Enclosure frame, door(s), roof, rear panel, gland plates (three-piece), TS punched sections with mounting flanges.

Technical information,
see page 1143.

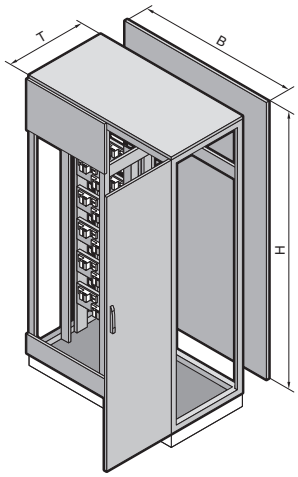
Maxi-PLS **1 For mounting in the rear section**		Packs of	3-pole/4-pole 2000 A/3200 A					Page
Width (B) in mm			1000	1000	1200	1200	1200	
Height (H) in mm			2000	2000	2000	2000	2000	
Depth (T) in mm			500	600	500	600	800	
Model No. SV		1	**9660.595**[1]	**9660.695**[1]	**9660.555**[1]	**9660.655**[1]	**9660.855**[1]	
Technical specifications correspond to Model No. TS			8005.500	8006.500	8205.500	8206.500	8208.500	144 – 146
Doors			2	2	2	2	2	
Approximate weight (kg)			109.6	113.7	133.6	137.6	146.0	
Base/plinth								
Components front and rear	Height 100 mm	1 set	8601.000	8601.000	8601.200	8601.200	8601.200	835
	Height 200 mm	1 set	8602.000	8602.000	8602.200	8602.200	8602.200	835
Trim panels (sides)	Height 100 mm	1 set	8601.050	8601.060	8601.050	8601.060	8601.080	835
	Height 200 mm	1 set	8602.050	8602.060	8602.050	8602.060	8602.080	835
Also required								
2 For mounting in the centre section								
TS punched section with mounting flange (4 per enclosure)		4	8612.550	8612.560	8612.550	8612.560	8612.580	922
PS punched section without mounting flange (2 per enclosure)		4	4382.000	4382.000	4378.000	4378.000	4378.000	925
Support bracket (4 per enclosure)		24 sets	4183.000	4183.000	4183.000	4183.000	4183.000	933
Threaded blocks M6 (8 per enclosure)		50	4162.000	4162.000	4162.000	4162.000	4162.000	936
Accessories								
Cable clamp rails		2	4336.000	4336.000	4196.000	4196.000	4196.000	979
Cable entry plates[2]		4	8800.100	8800.100	8800.120	8800.120	8800.120	964
Side panels		2	8105.235	8106.235	8105.235	8106.235	8108.235	853
Roof plates, vented[3]		1	–	9660.255	–	9660.265	9659.555	406
Roof plates with pressure relief function[3]		1	–	9660.955	–	9660.965	–	406
Cover plate, contact hazard protection[4]		1 set	–	9660.480	–	9660.490	–	403
Mounting bracket		24	–	9660.090	–	9660.090	–	404
Blanking cover			■	■	■	■	■	404
Terminal studs			■	■	■	■	■	405
Lock systems								
Standard double-bit lock insert may be exchanged for comfort handle, see page 881 and other inserts, see page 888.								

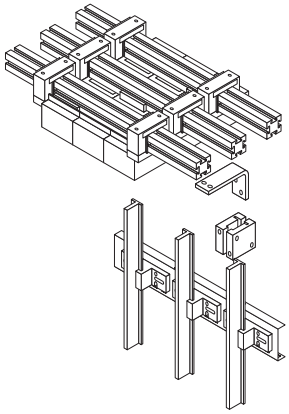
[1] Without mounting plate.
[2] Cable entry grommets, see page 965.
[3] In exchange for the standard TS roof.
[4] Only used when mounting the Maxi-PLS system in the rear section.
To order enclosures in textured RAL 7032, please add extension .XX0 to the Model No. Delivery times available on request.

System overview Page 366 **NH fused isolators size 00 – 3** Page 353 **System components** Page 376/390 **Connection components** Page 377/391 **Accessories** Page 401

Rittal Maxi-PLS SV-TS 8 enclosures

for NH fused isolators





Material:
Sheet steel
Enclosure frame, roof, rear panel and gland plates: 1.5 mm
Door: 2.0 mm

Surface finish:
Enclosure frame:
Dipcoat-primed
Door, roof and rear panel:
Dipcoat-primed,
powder-coated on the outside in textured RAL 7035
Gland plates: Zinc-plated

Supply includes:
Enclosure frame
with fitted support rails to accommodate the T-bar support;
Door, roof, rear panel, gland plates (three-piece).

Detailed drawing,
see page 1140.

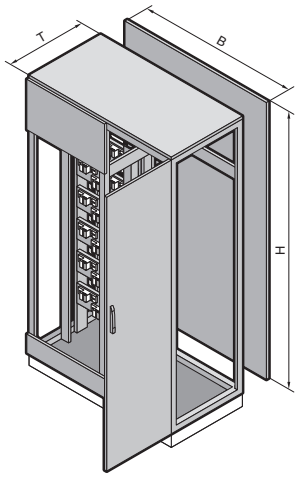
Technical information,
see page 1144.

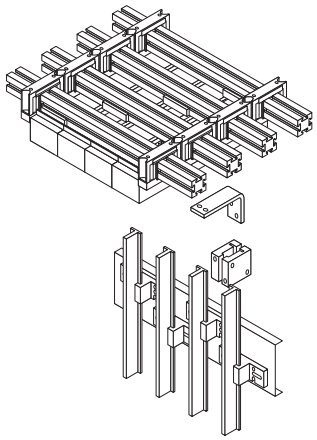
For Maxi-PLS		Packs of	**3-pole** 2000 A/3200 A				Page
For NH fused isolators brand			ABB SlimLine		Jean Müller SASIL		
Width (B) in mm			1000	1200	1000	1200	
Height (H) in mm			2000	2000	2000	2000	
Depth (T) in mm			600	600	600	600	
Model No. SV		1	**9660.515**	**9660.545**	**9660.415**	**9660.445**	
Door			1	1	1	1	
Approximate weight (kg)			110	135	110	135	
Base/plinth							
Components front and rear	Height 100 mm	1 set	8601.000	8601.200	8601.000	8601.200	835
	Height 200 mm	1 set	8602.000	8602.200	8602.000	8602.200	835
Trim panels (sides)	Height 100 mm	1 set	8601.060	8601.060	8601.060	8601.060	835
	Height 200 mm	1 set	8602.060	8602.060	8602.060	8602.060	835
Maxi-PLS system components							
T-bar supports up to 800 A	T-support	3	9660.000	9660.000	9660.000	9660.000	398
	T-end support	3	9660.010	9660.010	9660.010	9660.010	398
T-bar supports up to 1600 A	T-support	3	9660.100	9660.100	9660.100	9660.100	398
	T-end support	3	9660.110	9660.110	9660.110	9660.110	398
T-busbars E-Cu up to 800 A	Length 1000 mm	3	9660.020	9660.020	9660.020	9660.020	398
	Length 1600 mm	3	9660.030	9660.030	9660.030	9660.030	398
T-busbars E-Cu up to 1600 A	Length 1000 mm	3	9660.120	9660.120	9660.120	9660.120	398
	Length 1600 mm	3	9660.130	9660.130	9660.130	9660.130	398
T-connection kits up to 800 A, for Maxi-PLS	2000 A	1 set	9660.050	9660.050	9660.050	9660.050	398
	3200 A	1 set	9660.070	9660.070	9660.070	9660.070	398
T-connection kits up to 1600 A, for Maxi-PLS	2000 A	1 set	9660.140	9660.140	9660.140	9660.140	398
	3200 A	1 set	9660.160	9660.160	9660.160	9660.160	398
U contact maker			■	■	■	■	377/391
Isolator chassis			■	■	■	■	377/391
Accessories							
Side panels		2	8106.512	8106.512	8106.512	8106.512	853
Cover for distribution busbar (from the isolator manufacturer's range)			ABB Model No. NHP 407062 R..		Jean Müller Model No. A 8900 101		
Roof plates, vented[1)]		1	9660.255	9660.265	9660.255	9660.265	406
Roof plates with pressure relief function[1)]		1	9660.955	9660.965	9660.955	9660.965	406
Lock systems							
Standard double-bit lock insert may be exchanged for comfort handle, see page 881 and other inserts, see page 888.							

[1)] In exchange for the standard TS roof.
To order enclosures in textured RAL 7032, please add extension .XX0 to the Model No. Delivery times available on request.

System overview Pag 366 **System components** Page 376/390 **Connection components** Page 377/391 **Accessories** Page 401 **C rails** Page 928

for NH fused isolators





Material:
Sheet steel
Enclosure frame, roof, rear panel and gland plates: 1.5 mm
Door: 2.0 mm

Surface finish:
Enclosure frame:
Dipcoat-primed
Door, roof and rear panel:
Dipcoat-primed,
powder-coated on the outside in textured RAL 7035
Gland plates: Zinc-plated

Supply includes:
Enclosure frame
with fitted support rails to accommodate the T-bar support;
Door, roof, rear panel, gland plates (three-piece).

Detailed drawing,
see page 1141.

Technical information,
see page 1144.

For Maxi-PLS		Packs of	**4-pole**								Page
			2000 A				3200 A				
For NH fused isolators brand			ABB SlimLine		Jean Müller SASIL		ABB SlimLine		Jean Müller SASIL		
Width (B) in mm			1000	1200	1000	1200	1000	1200	1000	1200	
Height (H) in mm			2000	2000	2000	2000	2000	2000	2000	2000	
Depth (T) in mm			600	600	600	600	800	800	800	800	
Model No. SV		1	**9649.665**	**9649.675**	**9649.645**	**9649.655**	**9659.665**	**9659.675**	**9659.645**	**9659.655**	
Door			1	1	1	1	1	1	1	1	
Approximate weight (kg)			120	145	120	145	145	160	145	160	
Base/plinth											
Components front and rear	Height 100 mm	1 set	8601.000	8601.200	8601.000	8601.200	8601.000	8601.200	8601.000	8601.200	835
	Height 200 mm	1 set	8602.000	8602.200	8602.000	8602.200	8602.000	8602.200	8602.000	8602.200	835
Trim panels (sides)	Height 100 mm	1 set	8601.060	8601.060	8601.060	8601.060	8601.080	8601.080	8601.080	8601.080	835
	Height 200 mm	1 set	8602.060	8602.060	8602.060	8602.060	8602.080	8602.080	8602.080	8602.080	835
Maxi-PLS system components											
T-bar supports up to 800 A	T-support	3 + 1	9660.000 + 9649.100								398
	T-end support	3 + 1	9660.010 + 9649.110								398
T-bar supports up to 1600 A	T-support	3 + 1	9660.100 + 9659.100								398
	T-end support	3 + 1	9660.110 + 9659.110								398
T busbars E-Cu up to 800 A	Length 1000 mm	3 + 1	9660.020 + 9649.120								398
	Length 1600 mm	3 + 1	9660.030 + 9649.130								398
T busbars E-Cu up to 1600 A	Length 1000 mm	3 + 1	9660.120 + 9659.120								398
	Length 1600 mm	3 + 1	9660.130 + 9659.130								398
T-connection kits up to 800 A		1 set	9649.080	9649.080	9649.140	9649.140	9659.080	9659.080	9659.140	9659.140	398
T-connection kits up to 1600 A		1 set	9649.090	9649.090	9649.150	9649.150	9659.090	9659.090	9659.150	9659.150	398
U contact maker		3 + 1	9640.170 + 9649.170				9650.170 + 9659.170				377/391
Isolator chassis		1 set	9649.020	9649.020	9649.020	9649.020	9659.020	9659.020	9659.020	9659.020	377/391
Accessories											
Side panels		2	8106.512	8106.512	8106.512	8106.512	8108.512	8108.512	8108.512	8108.512	853
Cover for distribution busbar (from the isolator manufacturer's range)			ABB Model No. NHP 407062 R..		Jean Müller Model No. A 8900 101		ABB Model No. NHP 407062 R..		Jean Müller Model No. A 8900 101		
Roof plates, vented[1)]		1	9660.255	9660.265	9660.255	9660.265	9659.545	9659.555	9659.545	9659.555	406
Roof plates with pressure relief function[1)]		1	9660.955	9660.965	9660.955	9660.965	–	–	–	–	406
Lock systems											
Standard double-bit lock insert may be exchanged for comfort handle, see page 881 and other inserts, see page 888.											

[1)] In exchange for the standard TS roof.
To order enclosures in textured RAL 7032, please add extension .XX0 to the Model No. Delivery times available on request.

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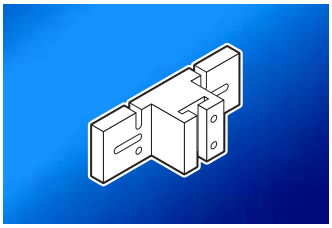
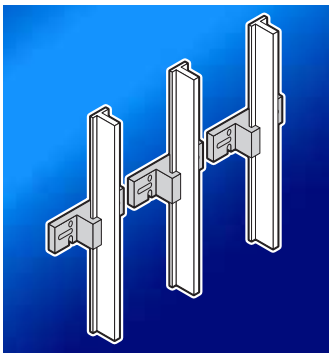
System components for NH fused isolator panels



T-bar supports

Rated current up to	Version	3-pole		4-pole				
		Packs of	Model No. SV	Packs of	Model No. SV		Packs of	Model No. SV
800 A	T-support	3	**9660.000**	3	**9660.000**	+	1	**9649.100**
	T-end support	3	**9660.010**	3	**9660.010**	+	1	**9649.110**
1600 A	T-support	3	**9660.100**	3	**9660.100**	+	1	**9659.100**
	T-end support	3	**9660.110**	3	**9660.110**	+	1	**9659.110**

Detailed drawing,
see page 1141.



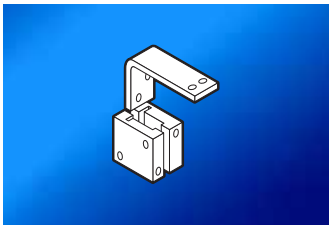
T-busbars E-Cu

10 mm knife edge

Rated current up to	Length mm	approx. weight (kg/busbar)	3-pole		4-pole				
			Packs of	Model No. SV	Packs of	Model No. SV		Packs of	Model No. SV
800 A	1000	4.3	3	**9660.020**	3	**9660.020**	+	1	**9649.120**
	1600	6.7	3	**9660.030**	3	**9660.030**	+	1	**9649.130**
1600 A	1000	8.3	3	**9660.120**	3	**9660.120**	+	1	**9659.120**
	1600	13.3	3	**9660.130**	3	**9660.130**	+	1	**9659.130**

Detailed drawing,
see page 1141.

Technical information,
see page 1144.



T-connection kits

800 A/1600 A
For NH fused isolator brands ABB and Jean Müller

For Maxi-PLS	Packs of	3-pole					4-pole		Page
		2000 A			3200 A		2000 A	3200 A	
For enclosure depth mm		500	600	600	600	800	600	800	
Bar centre distance mm		100	100	150	150	150	100	150	
For T-busbar up to 800 A									
Approximate weight (kg/set)		8	9	9	9	10	12	14	
For ABB SlimLine **Model No. SV**	1 set	9660.040	**9660.050**	9660.060	**9660.070**	9660.080	**9649.080**	**9659.080**	
For Jean Müller SASIL **Model No. SV**	1 set	9660.040	**9660.050**	9660.060	**9660.070**	9660.080	**9649.140**	**9659.140**	
For T-busbar up to 1600 A									
Approximate weight (kg/set)		–	13	13	13	15	18	20	
For ABB SlimLine **Model No. SV**	1 set	–	**9660.140**	9660.150	**9660.160**	9660.170	**9649.090**	**9659.090**	
For Jean Müller SASIL **Model No. SV**	1 set	–	**9660.140**	9660.150	**9660.160**	9660.170	**9649.150**	**9659.150**	
Accessories									
U contact maker	3 + 1	9640.170 –	9640.170 –	9640.170 –	9650.170 –	9650.170 –	9640.170 9649.170	9650.170 9659.170	377/ 391
Isolator chassis	1 set	9640.020	9640.020	9650.020	9650.020	9650.020	9649.020	9659.020	377/ 391

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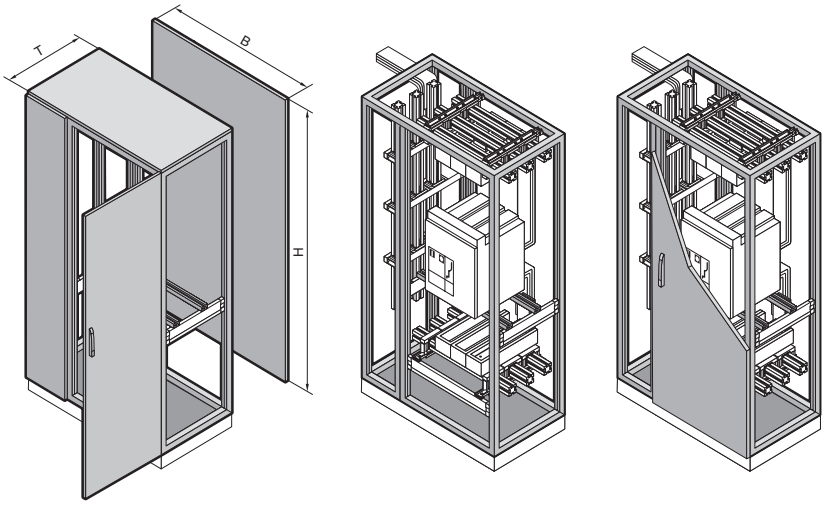
Accessories Page 401

for coupling sets



Material:
Sheet steel
Enclosure frame, roof, rear panel and gland plates: 1.5 mm
Door: 2.0 mm

Surface finish:
Enclosure frame:
Dipcoat-primed
Door, roof and rear panel:
Dipcoat-primed,
powder-coated on the outside in textured RAL 7035
Gland plates: Zinc-plated

Supply includes:
Enclosure frame
with fitted system support rails for power circuit-breaker attachment;
door, roof, rear panel,
gland plates (three-piece).

Detailed drawing,
see page 1141.

Technical information,
see page 1145.

For Maxi-PLS		Packs of	3-pole		4-pole		Page
			2000 A	3200 A	2000 A	3200 A	
Width (B) in mm			800	1000	1000	1000	
Height (H) in mm			2000	2000	2000	2000	
Depth (T) in mm			600	600	600	800	
Model No. SV		1	**9660.305**	**9660.355**	**9649.685**	**9659.695**	
Door			1	1	1	1	
Approximate weight (kg)			145	175	165	195	
Base/plinth							
Components front and rear	Height 100 mm	1 set	8601.800	8601.000	8601.000	8601.000	835
	Height 200 mm	1 set	8602.800	8602.000	8602.000	8602.000	835
Trim panels (sides)	Height 100 mm	1 set	8601.060	8601.060	8601.060	8601.080	835
	Height 200 mm	1 set	8602.060	8602.060	8602.060	8602.080	835
Maxi-PLS system components							
Coupling sets, vertical (Maxi-PLS in the roof section)		1 set	9660.320	9660.370	9649.700	9659.700	400
Coupling sets, vertical (Maxi-PLS in the rear section)		1 set	9660.310	9660.360	–	–	400
Maxi-PLS busbars, E-Cu 57		3	9640.210	9650.240	–	–	376/390
		4	–	–	9649.240	9659.240	376/390
System attachment (Maxi-PLS in the roof section)	for coupling set[1]	2	9640.070	9650.070	9649.070	9659.070	400
	for busbars[1]	2	9640.120	9650.100	9640.080	9650.080	376/390
System attachment (Maxi-PLS in the rear section)	for coupling set[1]	2	9640.070	9650.070	9649.070	9659.070	400
	for system rear[2]	2	9640.150	9650.150	9640.090	9650.090	376/390
	for system bottom[2]	2	9640.120	9650.100	9640.080	9650.080	376/390
Accessories							
Side panels		2	8106.512	8106.512	8106.512	8108.512	853
Roof plates, vented[3]		1	9660.245	9660.255	9660.255	9659.545	406
Roof plates with pressure relief function[3]		1	9660.945	9660.955	9660.955	–	406
Device module			■	■	■	■	401
Mounting bracket		24	9660.090	9660.090	9660.090	9660.090	404
Lock systems							
Standard double-bit lock insert may be exchanged for comfort handle, see page 881 and other inserts, see page 888.							

[1] 2 packs required per system configuration.
[2] 1 pack required per system configuration.
[3] In exchange for the standard TS roof.
To order enclosures in textured RAL 7032, please add extension .XX0 to the Model No. Delivery times available on request.

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System components for coupling sets

Coupling sets

vertical
For installation in 600/800 mm deep SV-TS 8 enclosures for coupling sets.

Coupling sets are selected according to the rated current I_e of the primary busbars to be coupled:
- Coupling set 2000 A:
  $I_e \leq 2000$ A
- Coupling set 3200 A:
  I_e 2000 A ≤ 3200 A

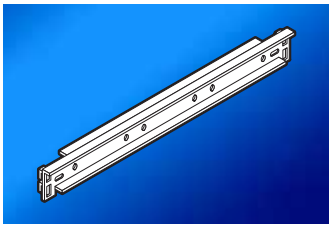
Supply includes:
3-pole
3 Maxi-PLS busbars E-Cu,
1 set of connection brackets E-Cu, top (L1 – L3),
1 set of connection brackets E-Cu, bottom (L1 – L3),
assembly parts.

4-pole
4 Maxi-PLS busbars E-Cu,
1 set of connection brackets E-Cu, top (L1 – L3, N),
1 set of connection brackets E-Cu, bottom (L1 – L3, N),
assembly parts.

For Maxi-PLS in the roof section	3-pole		4-pole		Page
	2000 A	3200 A	2000 A	3200 A	
Approximate weight (kg)	98	152	130	202	
Packs of	1 set	1 set	1 set	1 set	
Model No. SV	**9660.320**	**9660.370**	**9649.700**	**9659.700**	
Also required					
Sliding blocks (Packs of 15)	9640.980[1)]	9650.990[1)]	9640.980[2)]	9650.990[2)]	377/391

For Maxi-PLS in the rear section	3-pole			Page
	2000 A	3200 A		
Weight (kg)	82	140		
Packs of	1 set	1 set		
Model No. SV	**9660.310**	**9660.360**		
Also required				
Sliding blocks (Packs of 15)	9640.980[1)]	9650.990[1)]		377/391

[1)] Quantity required per system configuration: 24
[2)] Quantity required per system configuration: 32



System attachment

for vertical coupling set
For attaching the busbar supports – see page 376/390 – and coupling sets to the side TS frame section.

Material:
Stainless steel

For Maxi-PLS coupling section	3-pole		4-pole	
	2000 A	3200 A	2000 A	3200 A
Bar centre distance mm	100	150	100	150
Packs of	2	2	2	2
Model No. SV	**9640.070**	**9650.070**	**9649.070**	**9659.070**

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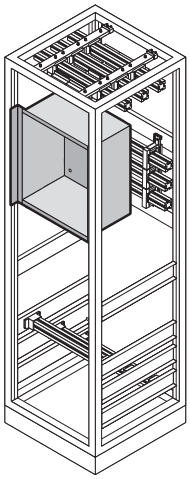
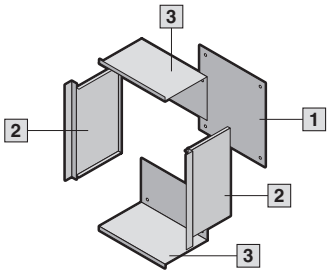
Device module





For use in power circuit breaker incoming/outgoing feeder panels with a minimum depth of 600 mm.
The removable mounting plate may be used for the configuration e.g. of fuses, power circuit-breakers and switchgear.

Material:
Side parts, centre parts:
Sheet steel, spray-finished in RAL 7035
Mounting plate:
Sheet steel, zinc-plated, passivated
Front panel:
Aluminium, anodised

Supply includes:
2 side parts,
2 centre parts,
connector parts,
mounting plate,
optional front panel.

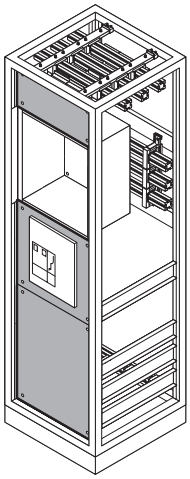
1 Mounting plate
2 Side parts
3 Centre parts

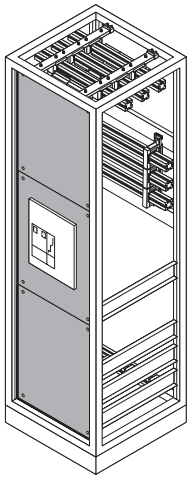
Note:
Please observe the manufacturer-specific data regarding the arcing space of power circuit-breakers.

Version		Packs of	For enclosure width 600 mm	For enclosure width 800 mm	Page
Interior dimensions, clearance width	Width in mm		432	632	
	Height in mm		263	263	
	Depth in mm		245.5	245.5	
Mounting plate	Width in mm		420	620	
	Height in mm		250	250	
without front panel **Model No. SV**		1	**9660.700**	**9660.710**	
with front panel **Model No. SV**		1	**9660.720**	**9660.730**	
with front panel, horizontally hinged **Model No. SV**		1	**9660.740**	**9660.750**	
with front panel, vertically hinged **Model No. SV**		1	**9660.760**	**9660.770**	
Also required					
Mounting bracket		24	9660.090[1)]	9660.090[1)]	404

[1)] 4 mounting brackets are required to attach a device module.

Contact hazard protection cover





For SV-TS 8 enclosures with power circuit-breaker
For covering incoming or outgoing feeder panels so that they are safe from finger-contact (IP 2X).

Material:
Sheet steel, spray-finished.

Colour:
RAL 7035

Supply includes:
3 front covers.

Note:
Cutouts for power circuit-breakers must be provided by the customer.
SV-TS 8 enclosures,
see page 392/393.

Device modules,
see page 401.

Variant A:
Incoming/outgoing panel with device module

Variant B:
Incoming/outgoing panel without device module

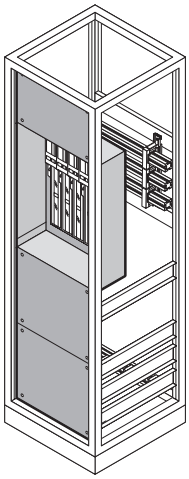
		Packs of	Variant A (for enclosures with device module)		Variant B (for enclosures without device module)		Page
For enclosure	Width in mm		600	800	600	800	
	Height in mm		2000	2000	2000	2000	
For design	1-door **Model No. SV**	1 set	**9660.280**	**9660.380**	**9660.780**	**9660.880**	
	3-door **Model No. SV**	1 set	**9660.290**[1)]	**9660.390**[1)]	**9660.790**	**9660.890**	
Also required							
Mounting bracket		24	9660.090[2)]	9660.090[2)]	9660.090[2)]	9660.090[2)]	404

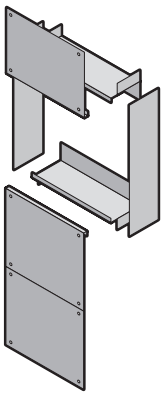
[1)] Including trim panel
[2)] 12 mounting brackets are required to attach the contact hazard protection cover plates.

Dimensions of the contact hazard protection cover plates

Model No. SV	Width mm	Height mm			
		Top	Middle	Bottom	Trim panel
9660.280	506	204	656	721	–
9660.290	506	246.5	567	567	20
9660.380	706	204	656	721	–
9660.390	706	246.5	567	567	20
9660.780	506	526	656	721	–
9660.790	506	567	567	567	–
9660.880	706	526	656	721	–
9660.890	706	567	567	567	–

Contact hazard protection cover





For SV-TS 8 enclosures with Rittal NH fused isolators
To cover NH fused isolators in the rear enclosure area so that they are safe from finger-contact (IP 2X).

Material:
Sheet steel, spray-finished.

Colour:
RAL 7035

Supply includes:
3 front covers,
2 depth covers,
2 side covers,
connector parts.

Note:
SV-TS 8 enclosures,
see page 394/395.
NH fused isolators,
see page 353.

For enclosure	Width in mm	Packs of	600	800	1000	1200	Page
	Height in mm		2000	2000	2000	2000	
	Depth in mm		600	600	600	600	
Free installation width for Rittal NH fused isolators[1] mm	**without** use of longitudinal connectors		500	700	900	1100	
	with use of longitudinal connectors		400	600	800	1000	
Model No. SV		1 set	**9660.460**	**9660.470**	**9660.480**	**9660.490**	
Also required							
Mounting bracket		24	9660.090[2]	9660.090[2]	9660.090[2]	9660.090[2]	404
Accessories							
Cover panel for NH isolators	Size 00	4	9660.180	9660.180	9660.180	9660.180	404
	Size 1 – 3	4	9660.190	9660.190	9660.190	9660.190	404

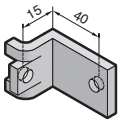
[1] When using the top-mounted busbars SV 9640.160/SV 9650.160, see page 376/390.
Longitudinal connectors SV 9640.190/SV 9650.190 for Maxi-PLS busbars, see page 376/390.
[2] 12 mounting brackets are required to attach the contact hazard protection cover plates.

Mounting bracket

For attaching the device modules and contact hazard protection covers.
Tapped hole M6.

Material:
Sheet steel, zinc-plated, passivated.

Supply includes:
Assembly screws.



Packs of	Model No. SV
24	**9660.090**

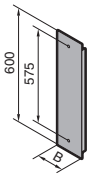
Blanking cover

To cover free NH fused isolator slots.

Material:
Sheet steel, spray-finished.

Colour:
RAL 7035

Supply includes:
Assembly screws.



For NH size	Width (B) mm	Packs of	Model No. SV
00	49.5	4	**9660.180**
1 to 3	99.5	4	**9660.190**

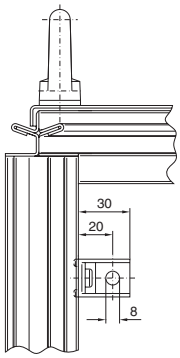
Note:
NH fused isolators,
see page 353.

Cover attachment

For simple mounting of covers.

Note:
Only suitable for use in conjunction with three-door enclosures.

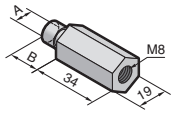
Packs of	Model No. SV
8	**9660.680**



Terminal studs

For the attachment of NH fused isolators, size 00 (Model No. SV 3591.040)
– see page 353 – on Maxi-PLS busbars.

For Maxi-PLS	2000 A	3200 A	Page
A	M10	M12	
B	9	12	
Packs of	3	3	
Model No. SV	**9640.390**	**9650.390**	
Also required			
Sliding blocks	9640.980	9650.990	377/391

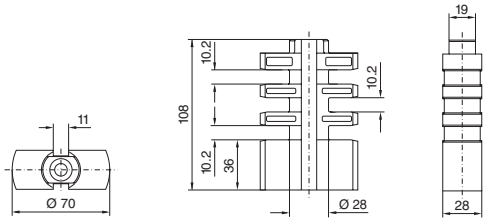


Stacking insulator

To support the connection kits top/bottom.
Easily retro-fitted.

Supply includes:
Assembly parts.

Packs of	**Model No. SV**
6	**9660.200**



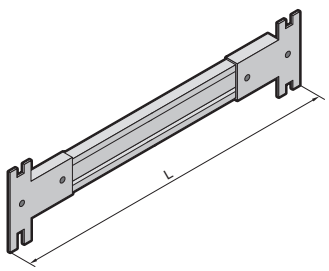
C rails

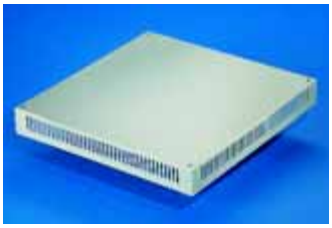
For attaching the stacking insulator to the TS frame section.

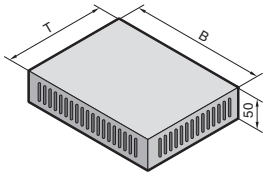
Material:
Sheet steel, zinc-plated, passivated.

Supply includes:
4 C rails,
8 brackets,
assembly parts.

For TS enclosures		Length (L) mm	Packs of	**Model No. SV**
Width mm	Depth mm			
600	600	600	4	**9660.210**
800	800	800	4	**9660.220**







Roof plates, vented

In exchange for the standard SV-TS roof.
All-round vent slots

Material:
Sheet steel, spray-finished.

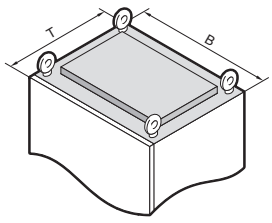
Colour:
RAL 7035

Protection category:
IP 2X

Supply includes:
Assembly parts.

For TS enclosures		Packs of	Model No. SV
Width (B) mm	Depth (T) mm		
600	600	1	**9660.235**
	800	1	**9659.525**
800	600	1	**9660.245**
	800	1	**9659.535**
1000	600	1	**9660.255**
	800	1	**9659.545**
1200	600	1	**9660.265**
	800	1	**9659.555**

To order roof plates in textured RAL 7032, please add extension .XX0 to the Model No.
Delivery times available on request.



Roof plates

with pressure relief function

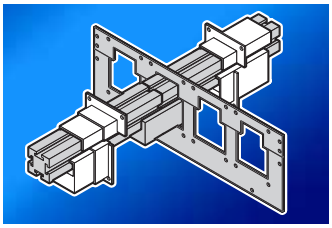
In exchange for the standard SV-TS roof.
Roof plates with pressure relief function to IEC 60 439-1, supplement 2 (special test): “Procedure for testing under accidental arc conditions”.

Material:
Sheet steel, spray-finished.

Colour:
RAL 7035

For TS enclosures		Packs of	Model No. SV
Width (B) mm	Depth (T) mm		
600	600	1	**9660.935**
800	600	1	**9660.945**
1000	600	1	**9660.955**
1200	600	1	**9660.965**

To order roof plates in textured RAL 7032, please add extension .XX0 to the Model No.
Delivery times available on request.



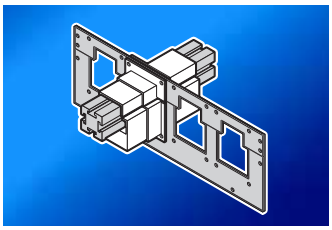
Busbar gland

Exceeds the requirements of BGV A2 in conjunction with the divider panel and the divider panel modules.

Material:
PA 6.6

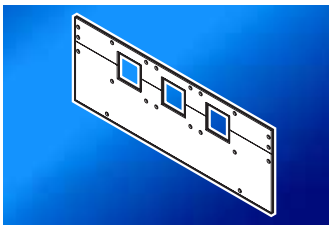
Supply includes:
Assembly parts.

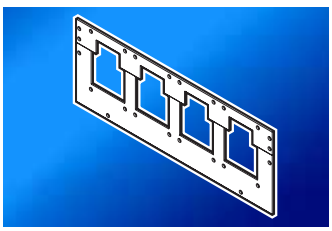
Note:
The busbar gland may also be used as a cover for the longitudinal connectors.



For Maxi-PLS	Packs of	For use **without** longitudinal connectors **Model No. SV**	For use **with** longitudinal connectors **Model No. SV**	
2000 A	1 set	**9640.600**[1)]	**9640.610**[2)]	–
3200 A	1 set	**9650.600**[1)]	–	**9650.610**[2)]
Also required				
Busbar gland	1 set	–	**9640.600**[2)]	**9650.600**[2)]

Required number of packs for system configuration
[1)] 3-pole = 6 packs
4-pole = 8 packs
[2)] 3-pole = 3 packs
4-pole = 4 packs



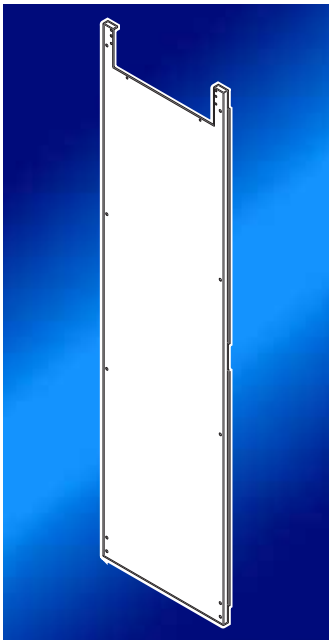


Divider panel modules

For Maxi-PLS		For enclosure depth mm	Bar centre distance mm	Packs of	For use **without** longitudinal connectors **Model No. SV**	For use **with** longitudinal connectors **Model No. SV**
2000 A	3-pole	600	100	1 set	**9640.620**	**9640.630**
	3-pole	–	185	1 set	**9640.640**	**9640.650**
	4-pole	600	100	1 set	**9649.600**	**9649.610**
3200 A	3-pole	600	150	1 set	**9650.620**	**9650.630**
	3-pole	–	185	1 set	**9650.640**	**9650.650**
	4-pole	800	150	1 set	**9659.600**	**9659.610**

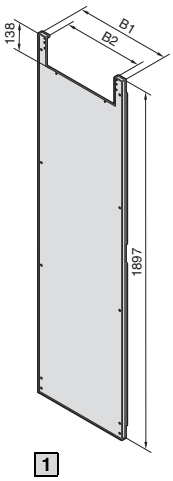
Material:
PA 6.6

Supply includes:
Assembly parts.

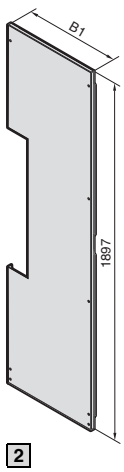


Divider panel

For side shielding from neighbouring panels. In conjunction with the busbar gland and the divider panel modules, as a preventive measure to prevent arcing.



1



2

B = Width

1 For TS enclosurs with Maxi-PLS busbars in the roof section

For TS enclosures		B1 mm	B2 mm	Packs of	Model No. SV
Depth mm	Height mm				
600	2000	502	418	1	**9660.620**
800	2000	702	618	1	**9659.590**

2 For TS enclosurs with Maxi-PLS busbars in the rear section

For TS enclosures		B1 mm	Packs of	Model No. SV
Depth mm	Height mm			
600	2000	502	1	**9660.610**
800	2000	702	1	**9659.580**

Material:
Sheet steel, 1.5 mm, zinc-plated, passivated.

Supply includes:
Assembly parts.

ISV distribution enclosure

up to 630 A/up to 1600 A

The “one-stop supplier” concept has distinct advantages. Easier planning and procurement with one partner, faster installation thanks to coordinated systems, and hence reduced labour and investment costs.

ISV-TS 8 enclosure system
- Bayable with all TS 8 enclosures of the same height and depth
- Pre-configured
- Flexible interior installation with the TS 8 enclosure accessories range, such as doors, lock systems, partial mounting plates, climate control components
- Optional door hinging on l/h or r/h side
- Suitable for component mounting as an incoming or outgoing feeder panel, depending on requirements
- Cable entry freely selectable depending on the enclosure configuration

ISV modules
- Pitch pattern 150 x 250 mm (H x W)
- Refined quick-fit assembly system facilitates precise positioning of the modules in the ISV-TS 8 enclosure
- Cover is prepared for a lead seal

ISV components
Fully configurable with Rittal components, such as
- NH fused isolators
- NH on-load isolators
- Bus-mounting fuse bases
- Connection components
- Optional busbar installation with SV busbar systems up to 1600 A (185 mm bar centre distance) or Rittal Maxi-PLS up to 2000 A

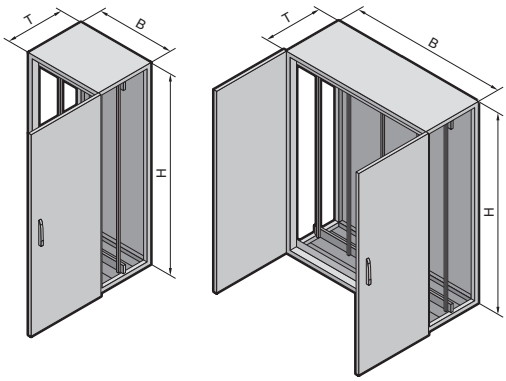
Systematic fast assembly

The ISV enclosure system, with its pre-configured mounting level, is perfectly prepared for mounting the installation modules.

The required modules may be screw-fastened directly to the mounting levels without any further accessories.

The matching contact hazard protection cover plates inside the enclosure guard against accidental contact with live parts.

ISV-TS 8 enclosures for distribution enclosures up to 630 A



Material:
Sheet steel
Enclosure frame, roof, rear panel and gland plates: 1.5 mm
Door: 2.0 mm
Contact hazard protection frame: Hard PVC, RAL 9002

Surface finish:
Enclosure frame:
Dipcoat-primed
Roof, rear panel, door(s):
Dipcoat-primed,
powder-coated on the outside in textured RAL 7035
Gland plates: Zinc-plated

Supply includes:
Enclosure frame with mounting level,
door(s), roof, rear panel, gland plates (three-piece), contact hazard protection frame.

Detailed drawing,
see page 1148.

Technical specifications,
see page 1148.

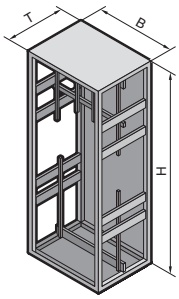
Width (B) in mm		Packs of	600		850		1100		Page
Height (H) in mm			2000		2000		2000		
Depth (T) in mm			400	600	400	600	400	600	
Model No. SV		1	**9665.945**	**9665.905**	**9665.955**	**9665.915**	**9665.965**	**9665.925**	
Door(s)			1	1	1	1	2	2	
Approximate weight (kg)			89.5	94.5	113.5	120	157	167	
Base/plinth									
Components front and rear	Height 100 mm	1 set	8601.600	8601.600	8601.850	8601.850	8601.300	8601.300	835
	Height 200 mm	1 set	8602.600	8602.600	8602.850	8602.850	8602.100	8602.100	835
Trim panels (sides)	Height 100 mm	1 set	8601.040	8601.060	8601.040	8601.060	8601.040	8601.060	835
	Height 200 mm	1 set	8602.040	8602.060	8602.040	8602.060	8602.040	8602.060	835
Accessories									
Cable clamp rails		2	4191.000	4191.000	4195.000	4195.000	–	–	979
Cable entry plates[1)]		2	8800.060	8800.060	8800.085	8800.085	–	–	964
Side panels		2	8104.235	8106.235	8104.235	8106.235	8104.235	8106.235	853
Cable entry gland			■	■	■	■	■	■	420
Lock systems									
Standard double-bit lock insert may be exchanged for comfort handle, see page 881 and other inserts, see page 888.									

[1)] Cable entry grommets, see page 965.
To order enclosures in textured RAL 7032, please add extension .XX0 to the Model No. Delivery times available on request.
To order side panels in textured RAL 7032, please add extension .200 to the Model No. Delivery times available on request.

System overview Page 408 **ISV installation modules** Page 411 **ISV accessories** Page 419 **Enclosure accessories** Page 832

ISV distribution enclosure

ISV-TS 8 enclosures for distribution enclosures up to 1600 A



Material:
Sheet steel
Enclosure frame, roof, rear panel and gland plates: 1.5 mm
Door: 2.0 mm
Contact hazard protection frame: Hard PVC, RAL 9002

Surface finish:
Enclosure frame:
Dipcoat primed
Roof, rear panel, door:
Dipcoat primed,
powder-coated on the outside in textured RAL 7035
Gland plates: Zinc-plated

Supply includes:
Enclosure frame with mounting level,
door, roof, rear panel,
gland plates (three-piece),
contact hazard protection frame.

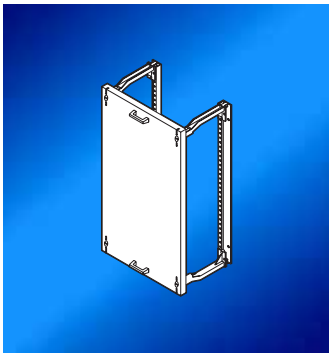
Note:
- For assembly and space reasons, a contact hazard protection module with 4 height units (600 mm) and 2 or 3 width units (500 or 750 mm), depending on the enclosure selection, is always required on the inlet or outlet side.
- When using Rittal NH fused isolators size 00 – 3, see page 353, care should be taken to ensure that for thermal reasons, a contact protection hazard module with at least 1 height unit (150 mm) is always fitted above the NH isolators.
- The contact hazard protection modules to cover the NH strips all round will need to be machined by the customer.

Detailed drawing,
see page 1148.

Width (B) in mm		Packs of	600	850	Page
Height (H) in mm			2000	2000	
Depth (T) in mm			600	600	
Model No. SV		1	**9665.975**	**9665.985**	
Door			1	1	
Approximate weight (kg)			94.5	120	
Base/plinth					
Components front and rear	Height 100 mm	1 set	8601.600	8601.850	835
	Height 200 mm	1 set	8602.600	8602.850	835
Trim panels (sides)	Height 100 mm	1 set	8601.060	8601.060	835
	Height 200 mm	1 set	8602.060	8602.060	835
Also required					
Support bracket		24 sets	4183.000	4183.000	933
Punched sections without mounting flanges		4	4376.000	4382.000	925
Maxi-PLS system attachment for mounting the busbar supports SV 3052.000, see page 351 or SV 9640.160, see page 376		2	9640.150	9640.150	376
Accessories					
Cable clamp rails		2	4191.000	4195.000	979
Cable entry plates[1)]		2	8800.060	8800.085	964
Side panels		2	8106.235	8106.235	853
Cable entry gland			■	■	420
Lock systems					
Standard double-bit lock insert may be exchanged for comfort handle, see page 881 and other inserts, see page 888.					

[1)] Cable entry grommets, see page 965.
To order enclosures in textured RAL 7032, please add extension .XX0 to the Model No. Delivery times available on request.
To order side panels in textured RAL 7032, please add extension .200 to the Model No. Delivery times available on request.

System overview Page 408 **ISV installation modules** Page 411 **ISV accessories** Page 419 **Enclosure accessories** Page 832



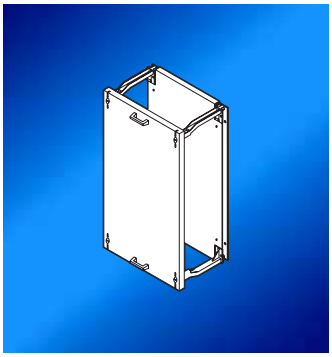
Contact hazard protection modules

- For covering free installation areas
- Cover is prepared for a lead seal
- Insulating material RAL 9002

Mechanical interior installation	Size				Packs of	Model No. SV
	Width unit (WU)[1]		Height unit (U)[2]			
Empty module	1	250 mm	1	150 mm	1	**9665.000**
	1	250 mm	2	300 mm	1	**9665.010**
	1	250 mm	3	450 mm	1	**9665.020**
	1	250 mm	4	600 mm	1	**9665.030**
	2	500 mm	1	150 mm	1	**9665.040**
	2	500 mm	2	300 mm	1	**9665.050**
	2	500 mm	3	450 mm	1	**9665.060**
	2	500 mm	4	600 mm	1	**9665.070**
	3	750 mm	4	600 mm	1	**9665.510**

Accessories	Page
Terminal block	420
Cable clamp rails	420

[1] 1 WU ≙ 250 mm
[2] 1 U ≙ 150 mm

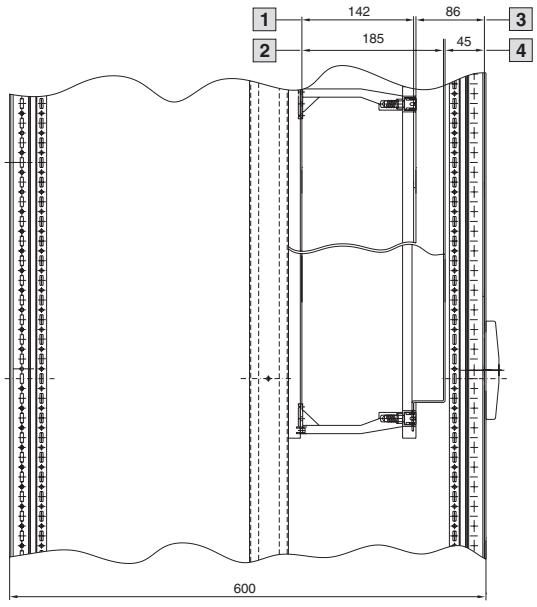


Mounting plate modules

- With mounting plate made from 2 mm zinc-plated sheet steel
- Cover is prepared for a lead seal
- Maximum usable depth 142 mm
- Insulating material RAL 9002

Mechanical interior installation: Mounting plate (W x H)	Size				Packs of	Model No. SV
	Width unit (WU)[1]		Height unit (U)[2]			
200 x 150 mm	1	250 mm	1	150 mm	1	**9665.080**
200 x 300 mm	1	250 mm	2	300 mm	1	**9665.090**
200 x 450 mm	1	250 mm	3	450 mm	1	**9665.100**
200 x 600 mm	1	250 mm	4	600 mm	1	**9665.110**
450 x 150 mm	2	500 mm	1	150 mm	1	**9665.120**
450 x 300 mm	2	500 mm	2	300 mm	1	**9665.130**
450 x 450 mm	2	500 mm	3	450 mm	1	**9665.140**
450 x 600 mm	2	500 mm	4	600 mm	1	**9665.150**

[1] 1 WU ≙ 250 mm
[2] 1 U ≙ 150 mm

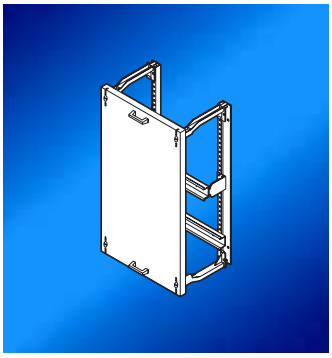


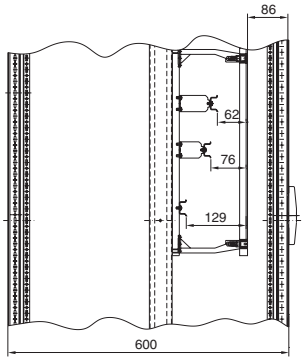
Clearance frame

1 Mounting plate module
2 Mounting plate module with deep cover
3 Contact hazard protection
4 Contact hazard protection with deep cover

System overview Page 408 **ISV-TS 8 enclosures** Page 409 **ISV accessories** Page 419

Installation modules





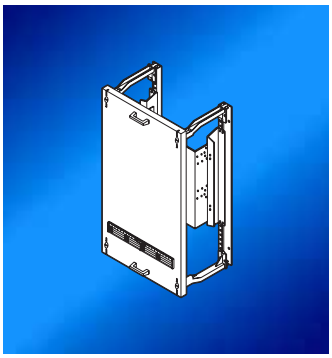
Support rail modules

- For the installation of terminal blocks, contactors etc.
- Support rails 35/15 mm
- Adjustable on a 25 mm pitch pattern
- Cover is prepared for a lead seal
- Insulating material RAL 9002

Mechanical interior installation: Number of support rails	Size				Packs of	Model No. SV
	Width unit (WU)[1]		Height unit (U)[2]			
1	1	250 mm	1	150 mm	1	**9665.160**
	1	250 mm	2	300 mm	1	**9665.170**
2	1	250 mm	3	450 mm	1	**9665.180**
3	1	250 mm	4	600 mm	1	**9665.190**
1	2	500 mm	1	150 mm	1	**9665.200**
	2	500 mm	2	300 mm	1	**9665.210**
2	2	500 mm	3	450 mm	1	**9665.220**
3	2	500 mm	4	600 mm	1	**9665.230**

Accessories	Page
Spacers	419
Terminal block	420
Cable clamp rails	420
Support rails	420

[1] 1 WU ≙ 250 mm
[2] 1 U ≙ 150 mm



Support modules

- Variably usable with switchgear
- Solid mounting plate
- Cover is prepared for a lead seal
- Insulating material RAL 9002

Mechanical interior installation: Mounting surface	Size				Packs of	Model No. SV
	Width unit (WU)[1]		Height unit (U)[2]			
W x H 190 x 210 mm, installation depth variable from 86 – 161 mm	1	250 mm	3	450 mm	1	**9665.360**
W x H 190 x 210 mm, installation depth variable from 86 – 153 mm	2	500 mm	3	450 mm	1	**9665.370**

[1] 1 WU ≙ 250 mm
[2] 1 U ≙ 150 mm

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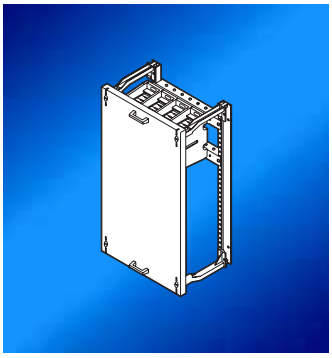


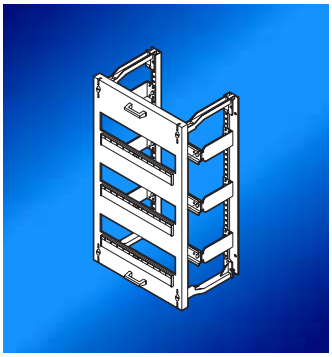
Connection modules

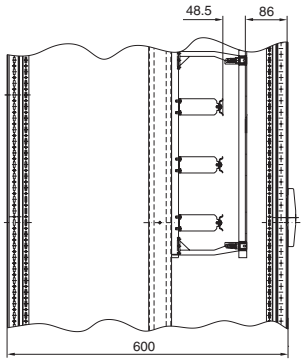
- For connecting copper and aluminium conductors
- Single-wire or multi-wire conductors with crimped wire end ferrule or laminated copper bar
- Cover is prepared for a lead seal
- Insulating material RAL 9002

Mechanical interior installation: Terminal connection top and bottom		Size				Packs of	Model No. SV
		Width unit (WU)[1]		Height unit (U)[2]			
250 A, 4-pole	Round conductor: 1 x 16 – 150 mm² or 2 x 16 – 70 mm² Laminated flat copper: Clamping area W x H 17 x 21 mm	1	250 mm	3	450 mm	1	**9665.300**
250 A, 5-pole		1	250 mm	3	450 mm	1	**9665.310**
400 A, 4-pole	Round conductor: 1 x 50 – 240 mm² or 2 x 25 – 120 mm² Laminated flat copper: Clamping area W x H 25 x 21 mm	1	250 mm	3	450 mm	1	**9665.320**
400 A, 5-pole		1	250 mm	3	450 mm	1	**9665.330**
630 A, 4-pole	Round conductor: 1 x 120 – 300 mm² or 2 x 120 – 185 mm² Laminated flat copper: Clamping area W x H 41 x 21 mm	2	500 mm	3	450 mm	1	**9665.340**
630 A, 5-pole		2	500 mm	3	450 mm	1	**9665.350**

Accessories	Page
Laminated copper bars	361
Cable clamp rails	420

[1] 1 WU ≙ 250 mm
[2] 1 U ≙ 150 mm





DIN rail mounted device modules

- To accommodate DIN rail mounted devices
- Support rails 35/7.5 mm
- Cover is prepared for a lead seal
- Insulating material RAL 9002

Mechanical interior installation	Size				Packs of	Model No. SV
	Width unit (WU)[1]		Height unit (U)[2]			
Horizontal pitch of 12 (1 x 12 x 18 mm)	1	250 mm	1	150 mm	1	**9665.240**
Horizontal pitch of 24 (2 x 12 x 18 mm)	1	250 mm	2	300 mm	1	**9665.250**
Horizontal pitch of 36 (3 x 12 x 18 mm)	1	250 mm	3	450 mm	1	**9665.260**
Horizontal pitch of 48 (4 x 12 x 18 mm)	1	250 mm	4	600 mm	1	**9665.270**
Horizontal pitch of 24 (2 x 12 x 18 mm)	2	500 mm	1	150 mm	1	**9665.280**
Horizontal pitch of 48 (4 x 12 x 18 mm)	2	500 mm	2	300 mm	1	**9665.290**
Horizontal pitch of 72 (6 x 12 x 18 mm)	2	500 mm	3	450 mm	1	**9665.500**

Accessories	Page
Cover strips	419
Terminal block	420

[1] 1 WU ≙ 250 mm
[2] 1 U ≙ 150 mm

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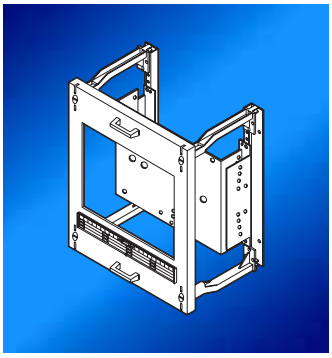
Installation modules



NH on-load isolator modules

- Suitable to accommodate Rittal on-load isolators for mounting plate assembly
- Cover is prepared for a lead seal
- Insulating material RAL 9002

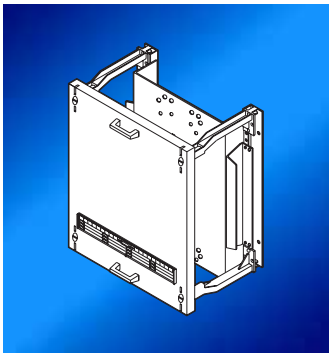
Mechanical interior installation			Size				Packs of	Model No. SV
			Width unit (WU)[1]		Height unit (U)[2]			
Mounting plate slotted and positioned plus cutout in the cover to fit NH on-load isolators	1 x size 00 160 A	1	1	250 mm	2	300 mm	1	**9665.380**
	2 x size 00 160 A	1	1	250 mm	2	300 mm	1	**9665.390**
	1 x size 1 250 A	2	1	250 mm	3	450 mm	1	**9665.400**
	1 x size 2 400 A	3	1	250 mm	3	450 mm	1	**9665.410**
	1 x size 3 630 A	4	2	500 mm	3	450 mm	1	**9665.420**

[1] 1 WU ≙ 250 mm
[2] 1 U ≙ 150 mm

NH on-load isolator for mounting plate assembly

	Size	Model No. SV	Model No. SV[1]	Page
1	Size 00	3488.000 3489.000	3488.310 3489.310	358
2	Size 1	3409.000	3409.310	358
3	Size 2	3415.010	3415.310	359
4	Size 3	3095.010	3095.310	359

[1] with electronic fuse monitoring and LED display



Power circuit-breaker modules

- Suitable for accommodating commercially available power circuit-breakers of brands ABB, Merlin Gerin, Moeller and Siemens in 3-pole versions, up to 630 A
- Cover is prepared for a lead seal
- Insulating material RAL 9002

Note:
The pitch patterns of holes for attachment of the power circuit-breakers and the corresponding cut-out dimensions for the covers are shown in the ISV assembly instructions.

Power circuit-breakers are not included with the supply.

Mechanical interior installation		Size				Packs of	Model No. SV
		Width unit (WU)[1]		Height unit (U)[2]			
Mounting plate slotted and positioned for power circuit-breakers	1	1	250 mm	2	300 mm	1	**9665.430**
	2	1	250 mm	3	450 mm	1	**9665.440**
	3	1	250 mm	2	300 mm	1	**9665.450**
	4	1	250 mm	3	450 mm	1	**9665.460**
	5	1	250 mm	3	450 mm	1	**9665.470**
	6	1	250 mm	3	450 mm	1	**9665.480**

[1] 1 WU ≙ 250 mm
[2] 1 U ≙ 150 mm

Power circuit-breakers

I_N	Brand							
	ABB		Merlin Gerin		Moeller Electric		Siemens	
160 A	1	Tmax T1 Tmax T2	3	Compact NS 100 Compact NS 160	1	NZM 1	3	Sentron VL160 Sentron VL160X
					3	NZM 7		
250 A	2	Tmax T3	4	Compact NS 250	1	NZM 2	4	Sentron VL250
					5	NZM 7		
400 A	5	SACE Isomax S5	6	Compact NS 400	5	NZM 10	5	Sentron VL400
630 A	5	SACE Isomax S5 SACE Isomax S6	6	Compact NS 630	5	NZM 10	5	Sentron VL630

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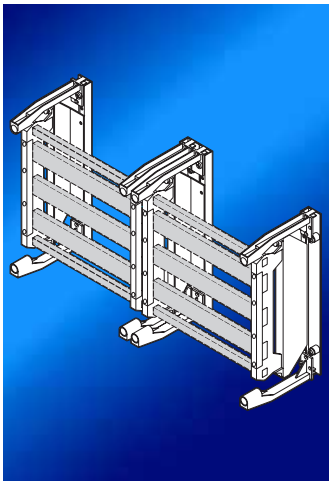
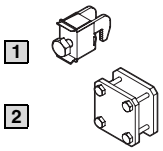


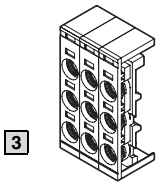
Busbar support

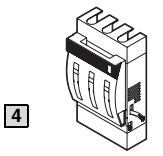
- 5-pole, 60 mm bar centre distance

Note:

- Depending on the configuration and connection variant, the busbars must be cut to length prior to installation, in accordance with the ISV assembly instructions.
- 5-pole busbar variant only suitable for the configuration of busbar connections and NH bus-mounting on-load isolators, size 00.
- With bus-mounting fuse bases, only 3-pole configuration (L1/L2/L3) is supported. In such cases, N and PE must be configured via busbar support SV 3050.000 (see page 318) or busbar module (Model No. SV 9665.590 or SV 9665.600, see page 418).







Mechanical interior installation	Usable busbar dimensions E-Cu	Packs of	Model No. SV
Busbar support for 2 height units[1] and max. 2 width units[2]	Busbars L1/L2/L3 30 x 5 mm (400 A) 30 x 10 mm (630 A)	4	**9665.490**
	Busbar N 25 x 10 mm		
	Busbar PE 12 x 10 mm		

Assembly components		Model No. SV	Page
1 Conductor connection clamps for bar thickness	5 mm	3450.500 – 3453.500/3550.000	324
	10 mm	3455.500 – 3458.500/3555.000	324
2 Plate clamp		3554.000	324
3 Bus-mounting fuse bases			see below
4 NH bus-mounting on-load isolators, size 00			see below
Also required			
Contact hazard protection cover plate for			
1 Conductor connection clamps			416
2 Plate clamp			416
3 Bus-mounting fuse bases			416
4 NH bus-mounting on-load isolators, size 00			416
Accessories			
Busbars E-Cu			360
Busbar connectors for E-Cu[3]	30 x 5/10 mm (L1/L2/L3)	9320.020	360
	25 x 10 mm (N)	9320.020	360
	12 x 10 mm (PE)	9350.070	360
Laminated copper bars			361

[1] 1 U ≙ 150 mm
[2] 1 WU ≙ 250 mm
[3] for busbar connections from enclosure to enclosure

3 Bus-mounting fuse bases and accessories

Type	Bus-mounting fuse base	Contact hazard protection cover	End caps	Page
	Model No. SV	Model No. SV	Model No. SV	
D 02-E 18	3418.000	3419.000	3420.000	334
D II-E 27	3427.000	3428.000	3429.000	334
D III-E 33	3433.000	3434.000	3435.000	334

4 NH bus-mounting on-load isolator

Size	Model No. SV	Model No. SV[1]	Page
Size 00	3400.000 3401.000 3402.000 3403.000	3490.210 3491.210 3492.210 3493.210	338

[1] with electronic fuse monitoring and LED display

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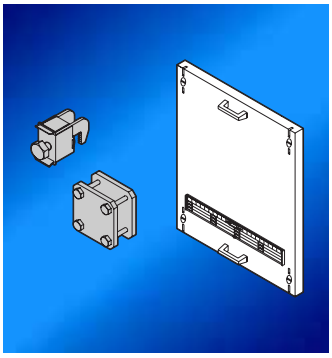
Installation modules



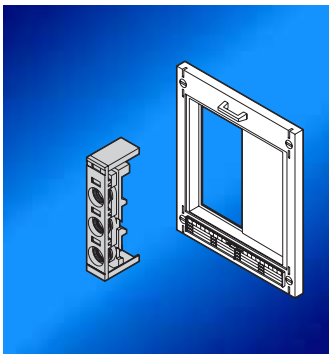
Contact hazard protection cover

for conductor connection clamps and plate clamp

- Cover is prepared for a lead seal
- Insulating material RAL 9002

Version	Size				Packs of	Model No. SV
	Width unit (WU)[1]		Height unit (U)[2]			
Solid	1	250 mm	2	300 mm	1	**9665.530**

[1] 1 WU ≙ 250 mm
[2] 1 U ≙ 150 mm



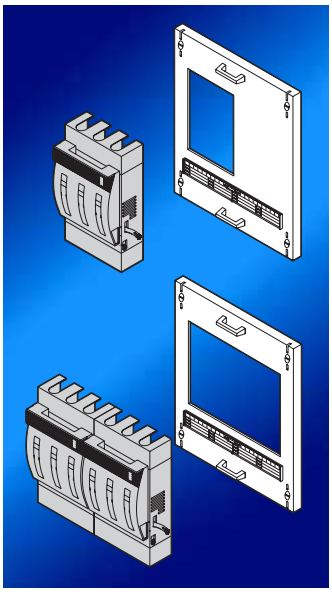
Contact hazard protection covers

for bus-mounting fuse bases

- Cover is prepared for a lead seal
- Insulating material RAL 9002

For	Size				Packs of	Model No. SV
	Width unit (WU)[1]		Height unit (U)[2]			
6 x D 02-E 18	1	250 mm	2	300 mm	1	**9665.520**
4 x D II-E 27, 3 x D III-E 33	1	250 mm	2	300 mm	1	**9665.540**

[1] 1 WU ≙ 250 mm
[2] 1 U ≙ 150 mm



Contact hazard protection covers

for NH bus-mounting on-load isolators, size 00

- Cover is prepared for a lead seal
- Insulating material RAL 9002

For	Size				Packs of	Model No. SV
	Width unit (WU)[1]		Height unit (U)[2]			
1 x size 00	1	250 mm	2	300 mm	1	**9665.550**
2 x size 00	1	250 mm	2	300 mm	1	**9665.560**

[1] 1 WU ≙ 250 mm
[2] 1 U ≙ 150 mm

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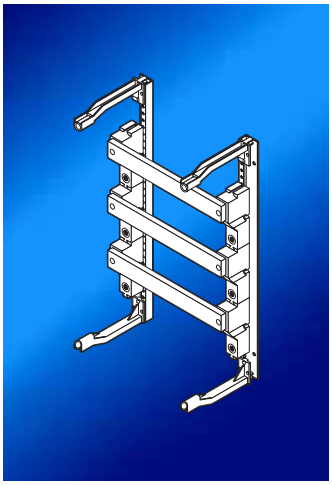


NH fused isolators modules

- With busbars E-Cu (100 mm bar centre distance)
- For NH fused isolator, size 00 or busbar connections

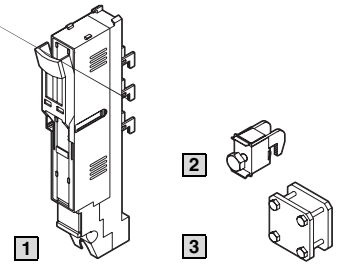
Note:

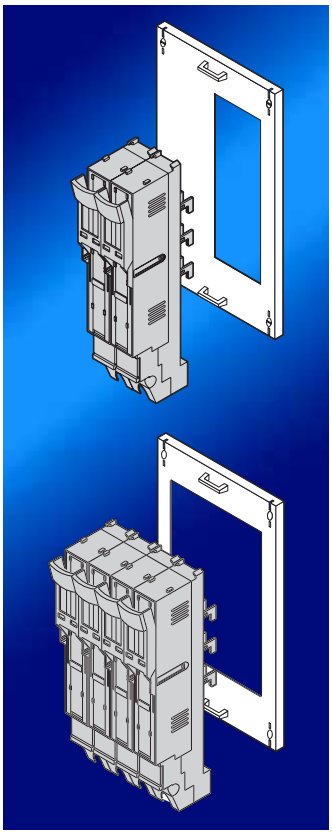
- In order to be able to guarantee problem-free cable connection, a contact hazard protection module (Model No. SV 9665.000, see page 411) must be installed beneath the NH fused isolator modules.
- Busbar connection in accordance with “ISV” assembly instructions.

Mechanical interior installation: Busbar system	Size				Packs of	Model No. SV
	Width unit (WU)[1]		Height unit (U)[2]			
630 A, 3-pole with busbars E-Cu 30 x 10 mm	1	250 mm	3	450 mm	1	**9665.570**
	2	500 mm	3	450 mm	1	**9665.580**

Assembly components	Model No. SV	Page
1 NH fused isolator, size 00	3591.010	349
2 Conductor connection clamps	3455.500 – 3459.500/3555.000	344
3 Plate clamp	3554.000	344
Also required		
Contact hazard protection cover plate for		
1 NH fused isolator, size 00		see below
2 Conductor connection clamps		418
3 Plate clamp		418
Accessories		
Laminated copper bars		361

[1] 1 WU ≙ 250 mm
[2] 1 U ≙ 150 mm





Contact hazard protection covers

For NH fused isolator, size 00

- Cover is prepared for a lead seal
- Insulating material RAL 9002

For	Size				Packs of	Model No. SV
	Width unit (WU)[1]		Height unit (U)[2]			
2 x size 00	1	250 mm	3	450 mm	1	**9665.620**
4 x size 00	1	250 mm	3	450 mm	1	**9665.630**

[1] 1 WU ≙ 250 mm
[2] 1 U ≙ 150 mm

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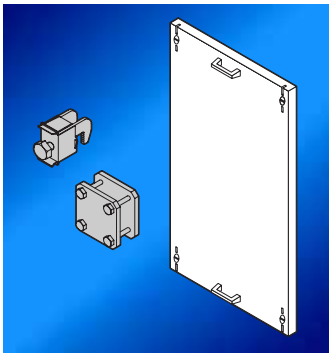
Installation modules



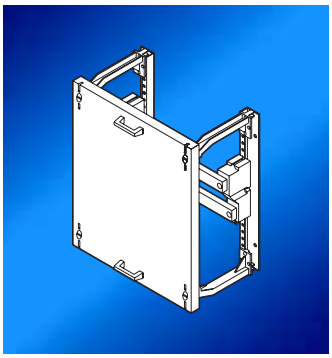
Contact hazard protection cover

for conductor connection clamps and plate clamp

- Cover is prepared for a lead seal
- Insulating material RAL 9002

Version	Size				Packs of	Model No. SV
	Width unit (WU)[1]		Height unit (U)[2]			
Solid	1	250 mm	3	450 mm	1	**9665.610**

[1] 1 WU ≙ 250 mm
[2] 1 U ≙ 150 mm



Busbar modules

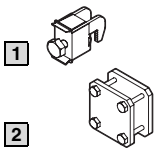
2-pole

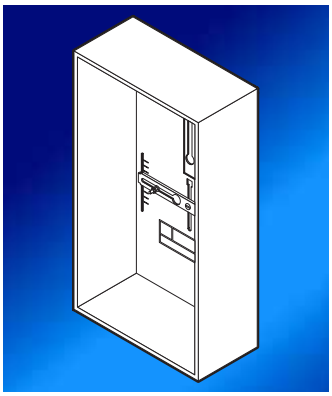
- For connecting N and PE
- Contact hazard protection cover included
- Cover is prepared for a lead seal
- Insulating material RAL 9002

Mechanical interior installation: Busbar system	Size				Packs of	Model No. SV
	Width unit (WU)[1]		Height unit (U)[2]			
2-pole for N and PE with busbars E-Cu 30 x 10 mm	1	250 mm	2	300 mm	1	**9665.590**
	2	500 mm	2	300 mm	1	**9665.600**

Assembly components	Model No. SV	Page
1 Conductor connection clamps	3455.500 – 3459.500/3555.000	324
2 Plate clamp	3554.000	324
Accessories		
Laminated copper bars		361

[1] 1 WU ≙ 250 mm
[2] 1 U ≙ 150 mm





Meter mounting board module

- Open module for internal measurements
- Clearance depth available for meter installation 170 mm
- Insulating material RAL 9002

Note:
The meter mounting board module does not comply with meter mounting board standard DIN 43 870/VDE 0603 and does not meet the conditions for total insulation.
Use in unmetered areas only by arrangement with the local electricity supply company.

Mechanical interior installation	Size				Packs of	Model No. SV
	Width unit (WU)[1]		Height unit (U)[2]			
Attachment rails to accommodate a meter	1	250 mm	3	450 mm	1	**9665.790**

[1] 1 WU ≙ 250 mm
[2] 1 U ≙ 150 mm

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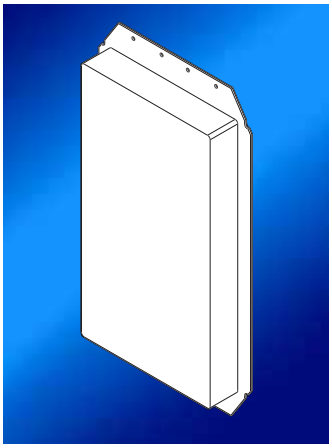
Accessories

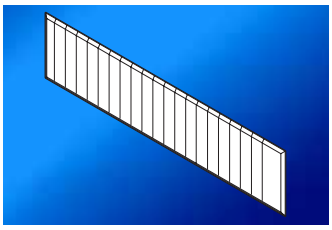


Deep cover

For increasing the usable depth.

- For installation on one-piece contact hazard protection covers
- W x H x D 450 x 250 x 43 mm
- Insulating material RAL 7035

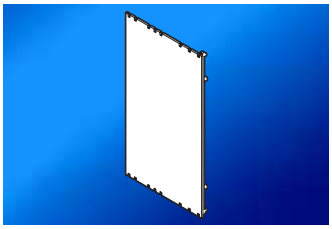
Packs of	Model No. SV
1	**9665.640**



Cover strips

For blanking spare component cutouts in DIN rail mounted device modules, max. 12 divider units (12 x 18 mm), divisible every 9 mm.

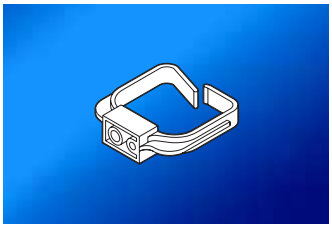
Packs of	Model No. SV
1	**9665.650**



Blanking cover

For blanking spare cutouts for bus-mounting fuse bases, 108 mm wide.

Packs of	Model No. SV
1	**9665.660**

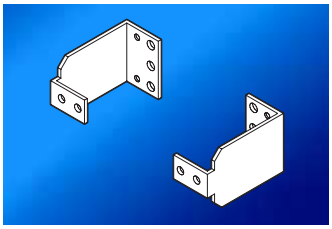


Wiring brackets

for installing

- C rails 30/15 mm
- TS punched sections with mounting flanges
- TS frame section

Packs of	Model No. SV
10	**9665.670**

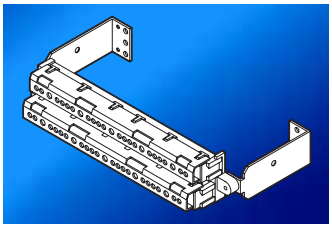


Spacers

For configuring support rails with attachment screws, 53 mm high.

Packs of	Model No. SV
2	**9665.680**

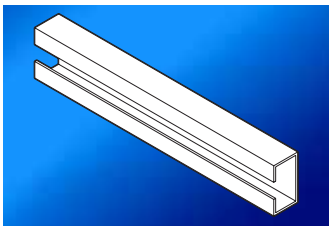
Accessories



Terminal block

For installation into 250 mm wide contact hazard protection and support rail modules 2-pole for N and PE, each with 20 x 4 mm², 5 x 25 mm².

Packs of	Model No. SV
1	**9665.690**

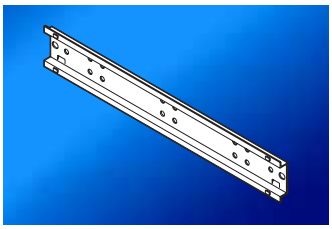


Cable clamp rails

For attaching cable clamps,
see page 981, in

- Connection modules
- Contact hazard protection modules
- Support rail modules

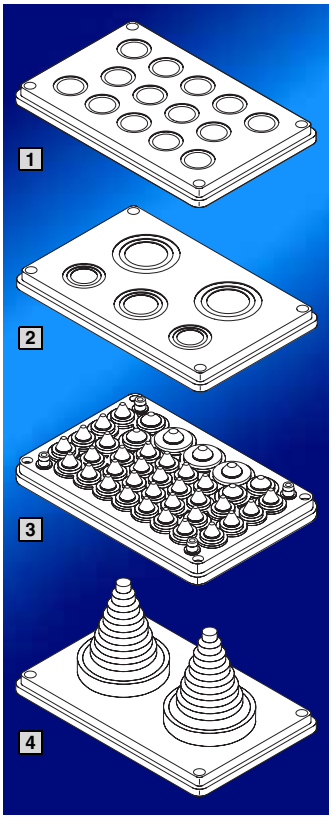
Width units required for the modules	Packs of	Model No. SV
1 WU (250 mm)	1	**9665.700**
2 WU (500 mm)	1	**9665.710**



Support rails

For snap fastening components or terminals, 15 mm high.

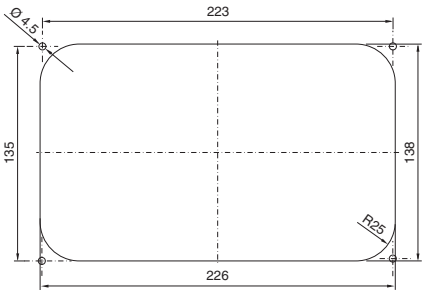
Width units required for the modules	Packs of	Model No. SV
1 WU (250 mm)	1	**9665.720**
2 WU (500 mm)	1	**9665.730**



Cable entry gland

- Including seal
- External dimensions 250 x 160 mm
- Protection category IP 55
- Insulating material RAL 7032

Version	Packs of	Model No. SV
1 14 x M25/32	1	**9665.750**
2 2 x M25/32/40, 1 x M32/40/50, 2 x M40/50/63	1	**9665.760**
3 With sealing membranes 32 x dia. 7 – 16 mm, 4 x dia. 10 – 20 mm, 3 x dia. 14 – 26 mm	1	**9665.770**
4 With entry glands up to 66 mm diameter	1	**9665.780**



Cutout dimensions for
SV 9665.750 to SV 9665.780

Rittal Electronic Systems offer “complete know-how” in the field of electronic packaging at a high level – up to Level 4 integration.

For CPCI, VME and AdvancedTCA applications.

This means “plug & play” systems for **extremely high data throughput levels –** in telecommunications, in the network and server segment, in automation, in traffic guidance systems and in medical technology.

System solutions in a modern design, with **super-fast backplanes,** with **integral power modules** and with **effective climate control concepts.**

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Features

ATCA – Advanced Telecom Computing Architecture –

The first cross-industry standard developed by the PICMG (PCI Industrial Computers Manufacturer Group) for telecommunications applications that were previously developed on a proprietary basis. ATCA – The solution for high demands in terms of system availability and performance, in both telecommunications and industrial automation, transport technology and medical technology. Rittal's product spectrum includes a range of complete systems in various designs with the corresponding accessories.

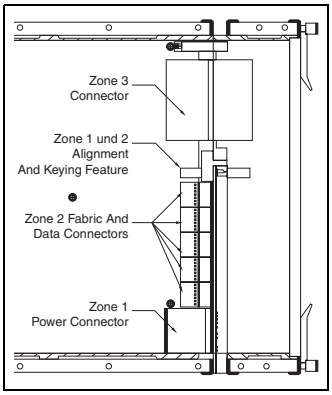
System benefits

AdvancedTCA™

- System availability of at least 99.999 %.
- Fail-safe maximised, thanks to redundancy
- Hot-swap capability ensures uninterrupted operation.
- Transfer rates of up to 2.5 Terabit/s.
- Large board formats: 8 U x 280 mm.
- Switched Fabric architecture.
- By reducing proprietary platforms, the high cost of development and training is eliminated.
- Available off the shelf.
- Specified heat losses up to 200 W per board.
- Support of different protocols (Ethernet, Infiniband, Rapid I/O, PCI-Express).
- Defined performance of up to 3.125 Gbit/sec.

The mechanical components ATCA Shelf (PICMG 3.0)

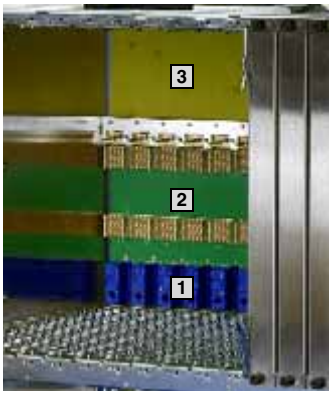
- 1 x system rack (mechanical)
- 1 x backplane (Switched Fabric)
- 1 x backplane (electrical distribution)
- 4 x fans
- 2 x or 4 x 48 V power entry modules (PEM)
- Installation space for 2 x Shelf Management Controllers
- Installation space for 2 x PC controllers
- A shelf has either 14 or 16 slots.
- A shelf with 14 slots is based on 482.6 mm (19″).
- A shelf with 16 slots is based on 23″ or ETSI.
- The height of a shelf is N x U (19″/23″) or N x 25 mm (ETSI).
- The depth of a shelf is 385 mm and is suitable for installation in 600 mm deep enclosures.



Boards

- Dimensions according to IEC 60297-3 and specifications to PICMG 3.0.
- The front boards (8 U x 6 HP and 280 mm depth) contain the electronic functions and the connectors. They are offset from the pitch line by 6.61 mm and are 1.6 to 2.4 mm thick, have an ESD clip on the component side 1, and attachment holes for the cover of component side 2. Essentially, a board type plug-in unit consists of a front panel with centering pin, EMC seal, ESD clip, injector/extractor handles with optional microswitch operation for hot swap, and optional M3-knurled screws.

  A cover is obligatory for component side 2 (rear) to reinforce the PCB and/or for EMC protection.
- Rear I/O boards (RTM): 8 U x 6 HP x 70 mm



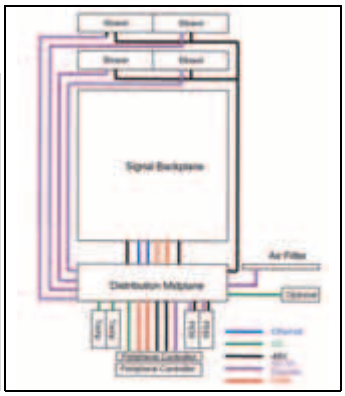
Connector zones

Zone 1:
Power supply and system management

Zone 2:
Data communication

Zone 3:
RTM (rear I/O)

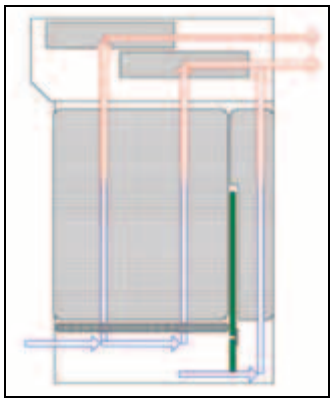
Zone 1 and Zone 2 are equipped with a special centering/keying device.



Shelf management

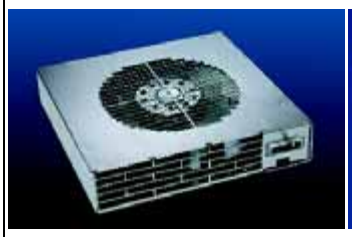
Interfaces for the monitoring and control of:

- Boards
- PEMs (power entry modules)
- Fan
- Air inlet temperature
- Remote alarm signals
- Air filter available/ not available

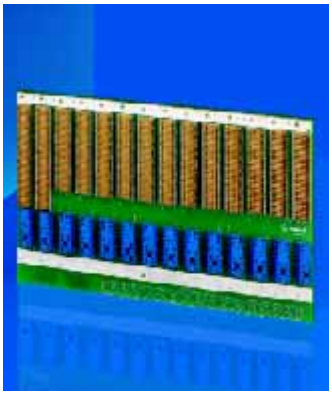


Side view, right

Shelf cooling



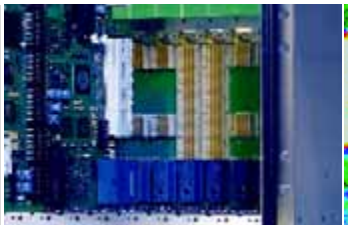
- ATCA specifies heat losses of up to 200 W per front board and 30 W per rear board, which translates into approximately 3 kW for a fully configured shelf with 14 boards.
- The four high-capacity RiCool fans from Rittal with 300 m^3/h ensure optimum climatic conditions.
- Redundancy and hot-swap ensure reliability, even in the event of a fan failure.
- Replaceable dust filter in the air inlet zone.

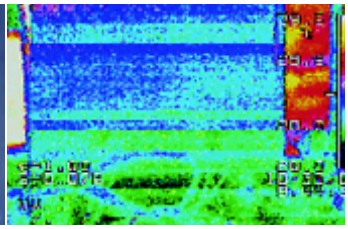


Backplanes

3 times higher performance!

- Full Mesh backplane from Rittal with 10 Gbit/sec. (acc. to PICMG 3.x, 3.125 Gbit/sec. is required).





- Dual Intelligent Platform Management Interface (IPMI), bussed or radial.
- Product range: Full Mesh, Dual Star, Dual Dual Star also optionally available with additional Mesh performance.

- Thermal image of a Rittal backplane under full load. The red zone at the top is attributable to resistive loads.

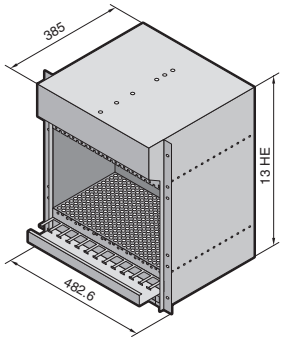
AdvancedTCA solutions from Rittal

As a competent supplier of Electronic Packaging Solutions, Rittal and its subsidiary Kaparel have been actively involved in development of the AdvancedTCA standard.

This knowledge and experience is incorporated into product development. Rittal offers complete solutions for ATCA applications. Upon request, these may also be tailored to specific requirements. There is a particular emphasis on the area of heat management.

Complex solutions, from direct cooling of the board via the shelf through to the enclosure, provide reliability, even with extreme requirements.

AdvancedTCA Shelf Version VA-1 (Rittal ShMC)



HE = U

Technical specifications:
- 482.6 mm (19″) x 13 U x 385 mm deep
- 14 x 6 HP slots for front boards and RTM
- 14 slot backplanes with bussed IPMI
- 2 or 4 x PEM connected at the rear
- Prepared for 2 x rear connected Rittal ShMC
- Rear connected PC (2 x)
- Space for rear telecom service connection
- RiCool fan connected at the front (4 fans each with 180 cfm/300 m³/h, dual IPMI, dual 48 V)
- Filter frame connected at the front (with air baffle plate and filter mat)
- Zone 3 air seal (14 x 6 HP – slot-based)
- Optional cable ducts for front and rear

ShMC:
The choice of backplane depends on the Shelf Management Controller (ShMC) used. The function of the chosen ShMC determines the function of the peripheral controller (PC).

PEM:
Depending on the application, different types of Power Entry Modules (PEMs) are available. At least two (@ 90 A) are required, and up to a maximum of four (@ 50 A) may be used

Detailed drawing,
see page 1149/1150.

AdvancedTCA Shelf VA-1 (ShMC connectable from rear)

Shelf	U	Slots	Backplane	IPMI	Rittal ShMC[1)]	SwitchSlots	PC	PEM	PEM-Amp	RiCool-2	Model No. RP
VA-1	13	14	Dual Star	bussed	2 x kernels	centre	2 x	2 x	90 A each	4 x 48 V-IPMI	**3688.306**
VA-1	13	14	Dual Star	bussed	2 x kernels	centre	2 x	4 x	50 A each	4 x 48 V-IPMI	**On request**
VA-1	13	14	Full Mesh	bussed	2 x kernels	1 + 2	2 x	2 x	90 A each	4 x 48 V-IPMI	**3688.305**
VA-1	13	14	Full Mesh	bussed	2 x kernels	1 + 2	2 x	4 x	50 A each	4 x 48 V-IPMI	**3688.463**

Accessories	Packs of		Page
Filler panel at front with airflow management	1	3688.267	429
Filler panel at rear with airflow management	1	3688.268	429
Filler panel front/rear without airflow management	1	3688.266	429
Cable duct, front	1	On request[2)]	
Cable duct, rear	1	On request[2)]	
Spare parts			
PC (Peripheral Controller)	1	**3688.323**	
PEM-IPMI 90 A (Power Entry Module)	1	**3688.464**	
PEM-IPMI 50 A	1	**3688.465**	
ShMC (Shelf Management Controller)	1	**3688.326**	
Filter (frame, air baffle plate, mat)	1	**3688.385**	
RiCool-2 fan	1	**3688.297**	
Zone 3 air seal 6 HP	1	**3688.290**	
Assembly parts for Zone 3 air seal	100	**3688.387**	

[1)] ShMC not included with the supply.
[2)] Standard attachment for application-specific solutions.

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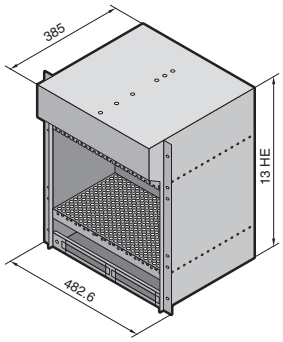
AdvancedTCA Shelf Version VB-1/VB-2



HE = U

Technical specifications:
Version VB-1 (Intel/ShMC)
- 482.6 mm (19″) x 13 U x 385 mm deep
- 14 x 6 HP slots for front boards and RTM
- 14 slot backplanes with radial IPMI
- 2 or 4 x PEM connected at the rear
- Prepared for 2 x front connectable Intel ShMC
- Rear connected PC (2 x)
- Space for rear telecom service connection
- RiCool fan connected at the front (4 fans each with 180 cfm/300 m³/h, dual IPMI, dual 48 V)
- Filter frame connected at the front (with air baffle plate and filter mat)
- Zone 3 air seal (14 x 6 HP – slot-based)
- Optional cable ducts for front and rear

Technical specifications:
Version VB-2 (PigeonPoint ShMC)
- 482.6 mm (19″) x 13 U x 385 mm deep
- 14 x 6 HP slots for front boards and RTM
- 14 slot backplanes with bussed IPMI
- 2 or 4 x PEM connected at the rear
- Prepared for 2 x rear connectable PigeonPoint ShMC
- Rear connected PC (2 x)
- Space for rear telecom service connection
- RiCool fan connected at the front (4 fans each with 180 cfm/300 m³/h, dual IPMI, dual 48 V)
- Filter frame connected at the front (with air baffle plate and filter mat)
- Zone 3 air seal (14 x 6 HP – slot-based)
- Optional cable ducts for front and rear

ShMC:
The choice of backplane depends on the Shelf Management Controller (ShMC) used. The function of the chosen ShMC determines the function of the peripheral controller (PC).

PEM:
Depending on the application, different types of Power Entry Modules (PEMs) are available. At least two (@ 90 A) are required, and up to a maximum of four may be used (@ 50 A).

Detailed drawing,
see page 1149/1150.

AdvancedTCA Shelf VB-1 (ShMC connectable from front)

Shelf	U	Slots	Backplane	IPMI	Intel ShMC[1)]	SwitchSlots	PC	PEM[2)]	PEM-Amp	RiCool-2	Model No. RP
VB-1	13	14	Dual Star	radial	2 x CMM	centre	2 x	2 x	90 A each	4 x 48 V-IPMI	**3688.303**
VB-1	13	14	Dual Star	radial	2 x CMM	centre	2 x	4 x	50 A each	4 x 48 V-IPMI	**On request**
VB-1	13	14	Full Mesh	radial	2 x CMM	1 + 2	2 x	2 x	90 A each	4 x 48 V-IPMI	**3688.301**
VB-1	13	14	Full Mesh	radial	2 x CMM	1 + 2	2 x	4 x	50 A each	4 x 48 V-IPMI	**3688.466**

AdvancedTCA Shelf VB-2 (ShMC connectable from front)

Shelf	U	Slots	Backplane	IPMI	PigeonPoint ShMC[1)]	SwitchSlots	PC	PEM[2)]	PEM-Amp	RiCool-2	Model No. RP
VB-2	13	14	Dual Star	bussed	2 x CMM	centre	2 x	2 x	90 A each	4 x 48 V-IPMI	**3688.304**
VB-2	13	14	Dual Star	bussed	2 x CMM	centre	2 x	4 x	50 A each	4 x 48 V-IPMI	**3688.469**
VB-2	13	14	Full Mesh	bussed	2 x CMM	1 + 2	2 x	2 x	90 A each	4 x 48 V-IPMI	**3688.302**
VB-2	13	14	Full Mesh	bussed	2 x CMM	1 + 2	2 x	4 x	50 A each	4 x 48 V-IPMI	**3688.470**

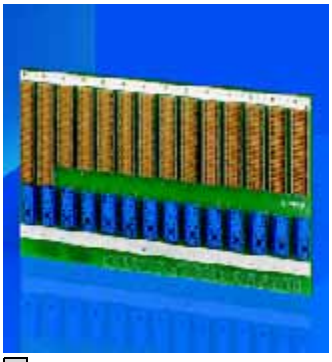
Accessories	Packs of		Page
Filler panel at front with airflow management	1	3688.267	429
Filler panel at rear with airflow management	1	3688.268	429
Filler panel front/rear without airflow management	1	3688.266	429
Cable duct, front	1	On request[3)]	
Cable duct, rear	1	On request[3)]	

Spare parts		for VB-1	for VB-2
PC (Peripheral Controller)	1	**3688.322**	**3688.324**
PEM-IPMI 90 A (Power Entry Module)	1	**3688.388**	
PEM-IPMI 50 A	1	**3688.467**	**3688.471**
PEM-Basic 90 A (Power Entry Module)	1	**3688.378**	
PEM-Basic 50 A	1	**3688.468**	**3688.472**
ShMC (Shelf Management Controller)	1	**3688.338**	**3688.320**
Filter (frame, air baffle plate, mat)	1	**3688.385**	
RiCool-2 fan	1	**3688.297**	
Zone 3 air seal 6 HP	1	**3688.290**	
Assembly parts for Zone 3 air seal	100	**3688.387**	

[1)] ShMC not included with the supply. [2)] PEM-IPMI included with the supply. [3)] Standard attachment for application-specific solutions.

Accessories for ATCA Page 428

Accessories



1

AdvancedTCA backplanes

- 4, 14, 16 slot version
- Dual Star, Full Mesh
- Meets AdvancedTCA specification Version 1.0
- Other versions available on request

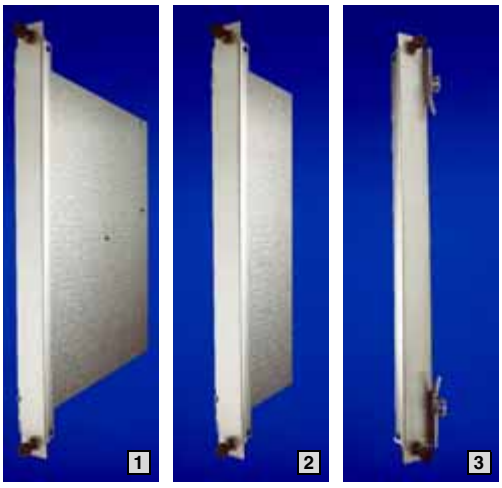
Description	Number of slots	Model No. RP
Triple Full Mesh with bussed IPMI	4	**3688.760**
1 Full Mesh with bussed IPMI	14	**3688.763**
Dual Star with bussed IPMI	14	**3688.307**
Full Mesh with bussed IPMI	16	**3688.317**
Dual Star with bussed IPMI	16	**3688.429**

Face plates, filler panels, handles

A complete customer-specific range of face plates and filler panels is available and offers individual cutouts, screen printing or coating on request, together with a range of handle types, including lock and microswitch actuation. The face plates and filler panels are optionally available with stick-on or snap-on EMC seals. The lock device of the handle also serves as earthing and guarantees a secure hold, even in earthquake zone 4 (NEBS level 3).

The AdvancedTCA face plates and filler panels may be used both for the front boards and for the RTMs (Rear Translation Modules). For the front board, the obligatory cover of component side 2 is integrated into the front panel design. An air management version for front slots or RTM is available for Zone 3.

- Every face plate has two locks.
- Injector/extractor handles, assembly parts and EMC seals must be ordered separately.
- The face plates are deigned for the I/O interface.
- The filler panels are used on unused or reserved slots and offer EMC protection and airflow management.
- The AdvancedTCA face plate with 6 HP is defined in PICMG 3.0.
- I/O units requiring a connection to the chassis ground should be connected via the front panel alignment/ground pin.



Face plate

1 Front, with cover for component side 2

2 Rear, with cover for component side 2

3 Front/rear, without cover for component side 2

Material:
Stainless steel

Face plate front with compulsory cover for component side

HP	Packs of	Model No. RP
6	1	**9805.174**
12	1	**On request**

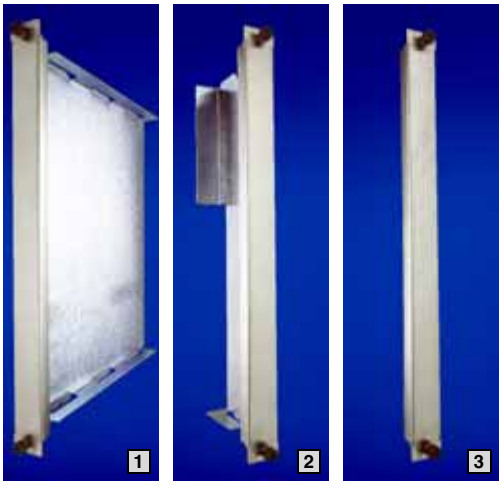
Face plate front with compulsory cover for component side

HP	Packs of	Model No. RP
6	1	**9808.764**
12	1	**On request**

Face plate front/rear (optional) without cover for component side 2

HP	Packs of	Model No. RP
6	1	**9805.172**
12	1	**On request**

Detailed drawing,
see page 1150.



Filler panel

1 Front with airflow management
2 Rear with airflow management
3 Front/rear without airflow management

Material:
Stainless steel

Filler panel, front with compulsory airflow regulation – 8 U, 6 HP, 280 mm

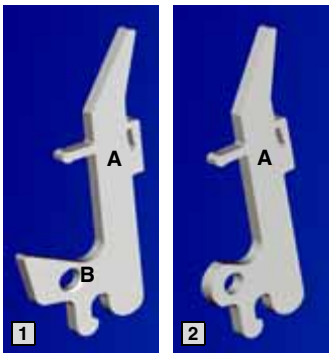
Type	HP	Packs of	Model No. RP
Front	6	1	**3688.267**

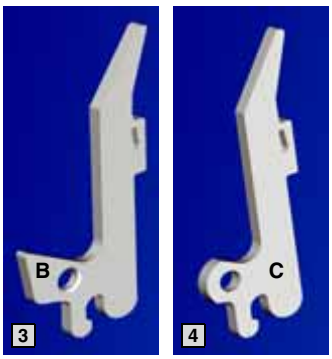
Filler panel, rear with compulsory airflow regulation – 8 U, 6 HP, 70 mm

Type	HP	Packs of	Model No. RP
Rear	6	1	**3688.268**

Filler panel front/rear (optional) without airflow regulation

Type	HP	Packs of	Model No. RP
Front/rear	6	1	**3688.266**





Handles

1 Handles, type 1 –
Handle with microswitch,
control component A + B

2 Handles, type 2 –
Handle with microswitch, control component A

3 Handles, type 1 –
Handle with microswitch, control component B

4 Handles, type 2 –
Handle without microswitch,
control component C

Type 1 handle
Microswitch A + B (B position for max. I/O)

Control component	Packs of	Material	Model No. RP
A + B	1	Stainless steel	**9805.161**
B	1	Stainless steel	**9808.691**

Type 2 handle
Microswitch A (position for 4 x PMC, if PMC is installed on the outermost position of the host)

Control component	Packs of	Material	Model No. RP
A	1	Stainless steel	**9808.692**
C	1		**9808.693**

Detailed drawing,
see page 1150.

EMC seals

for face plates and filler panels

Attachment	U	Packs of	Material	Model No. RP
Bonded	8	1	Foam	**9805.160**
Bonded	8	1	Stainless steel	**3688.342**
Snap-on	8	1	Stainless steel	**3688.397**

Screws

Type	Used for	Packs of	Head	Model No. RP
M2.5 x 6	PCB attachment	100	Phillips	**3654.340**
M3 x 10	Backplane	100		**3688.386**

Rack-mount systems for CPCI and VMEbus

Features

Rittal supplies complete plug-and-play solutions for VME and CompactPCI applications at a high level – up to Level 4 integration. The systems are supplied complete with power supply, backplane, measures for EMC and ESD protection, as well as climate control. Fully assembled, pre-wired and tested.

Individually customised to your requirements.

Systems for CompactPCI

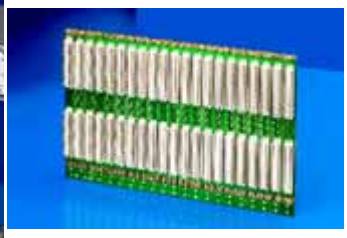
- Systems for the configuration of industrial computers to CompactPCI specifications
- Complies with IEC 60 297-3 and IEEE 1101.1/10/11 as well as CompactPCI Spec. Rev. 1.0 (PICMG)

Backplanes
High-speed CompactPCI backplanes. Optionally with H.110 bus and bridges for extension.

Power supplies in various output categories, plug-in or open frame.

PICMG EUROPE

Systems for VMEbus



- Systems for the configuration of industrial computers to VME specifications
- Complies with IEC 60 297-3 as well as IEEE 1101.1/ 1101.10 and 1101.11

Backplanes
High-speed backplanes to VME/ VME64x specifications.

Power supplies in various output categories, plug-in or open frame.

Design features

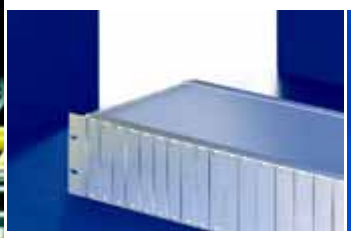
Side panels and flanges
of aluminium, clear-chromated.

10 mm pitch pattern of holes
in the side panels allows individual system configuration.

Horizontal rails with 10 mm extension for injector/extractor handles.

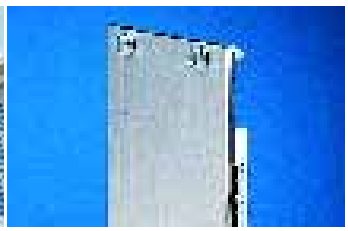
Features

EMC measures



Conductive surface finish of all system components.

EMC gaskets of stainless steel make contact with the individual components.



U-shaped EMC front panels with EMC gaskets ensure reliable contact.

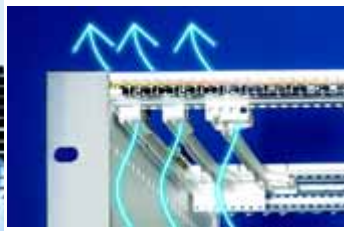
Safety and ESD protection

Keyable guide rails for the installation of keys.

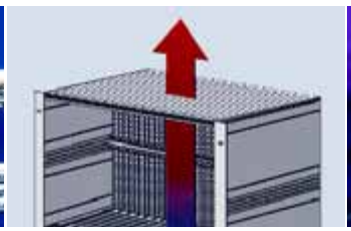
Potential equalisation
ESD pin and ESD clip in the guide rail to discharge static charges before making contact with the board type plug-in unit.

ESD clip in the guide rail ensures permanent direct discharge from the PCB.

Climate control



Maximum air flow, thanks to the narrow design of the guide rails and horizontal rails.

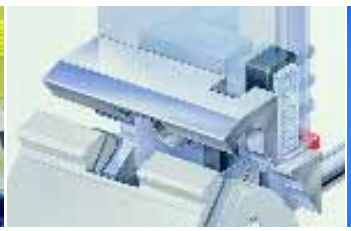


Individual air flow management ensures targeted air routing and optimum heat dissipation. Optionally from bottom to top or from front to rear.

High-performance RiCool fan ensures optimum ventilation. 1 U, hot swap-compatible 204 m^3/h, including speed control and fault alarm signal.

System configuration

Injector/extractor handles to reliably overcome high insertion/extraction forces.

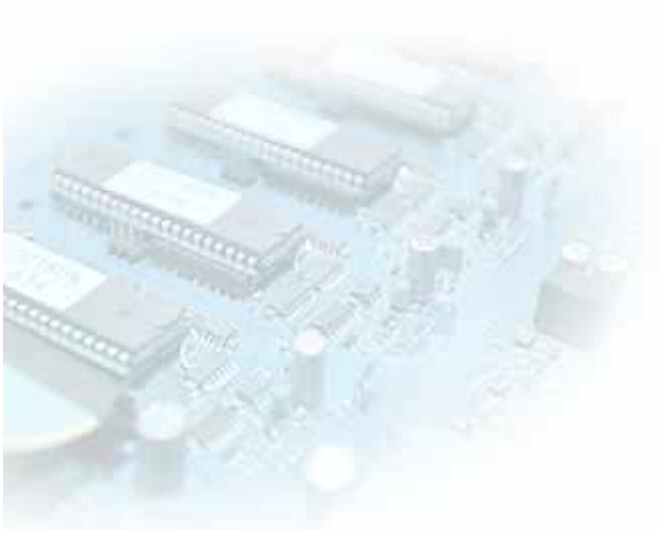


Live insertion
Microswitches in the injector/extractor handles inactivate the hot-swap circuitry.

Keyable, red guide rails for defined positioning of the CPU.

Rack-mount systems for CPCI and VMEbus

Features

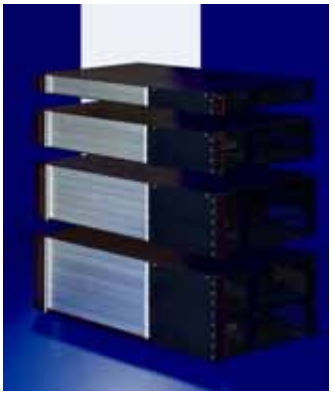


The 300 mm deep Slim-Box enclosures are designed for the horizontal installation of CPCI/VME boards.

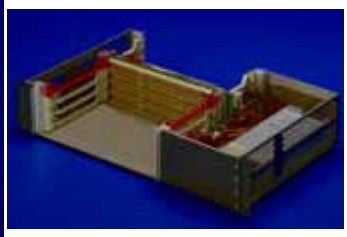
The technical features offered by the enclosures are truly impressive: 2 slots per U front and rear, excellent heat dissipation from left to right thanks to fans in the side panel, and a Monolithic backplane.

Depending on the design, including one ATX power supply or prepared for installation of a plug-in power supply.

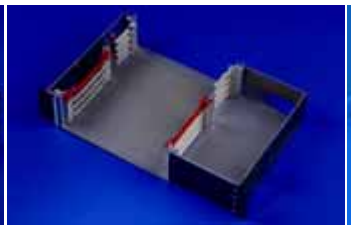
Slim-Box with VME backplane, see page 447.



Slim-Box rack-mount systems 1, 2, 3, 4 U



Version 1:
with backplane and ATX power supply or . . .

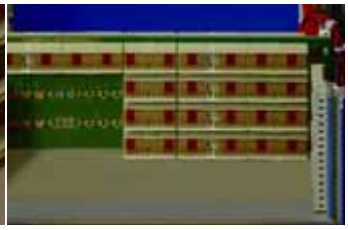


Version 2:
without backplane with ATX power supply for individual configuration or . . .

Version 3:
with backplane (from 2 U with H. 110) and prepared for installation of a plug-in power supply (accessory).

2 slots per U for CPCI/ VME boards at the front and rear.

Keyable plastic guide rail.



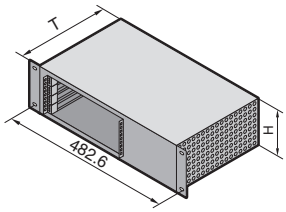
VME or CPCI backplane,
some with H. 110 (Version 3).

Integral ATX power supply
(Version 1, 2).

Optional plug-in power supply
hot swap-compatible
(Version 3).

DC fan in the side panel for optimum horizontal ventilation.

Rack-mount system, Slim-Box 1 U, 2 U, 3 U, 4 U



Technical specifications:
- Rack-mount housing 482.6 mm (19″) for the horizontal installation of boards
- Front and rear 2 slots per U for CPCI boards
- Enclosure cooling from left to right
- EMC and ESD-compatible design
- Including fan:
  for 1 U: 12 V DC, 21 m^3/h
  for 2 U: 12 V DC, 74 m^3/h
  for 3 U: 12 V DC, 195 m^3/h or 74 m^3/h,
  for 4 U: 12 V DC, 74 m^3/h
- Conforms to IEEE 1101.1/10/11, CompactPCI Spec. 2.0

Material:
Sheet steel, spray-finished

Slim-Box Version 1	**U** (H)	**1**	**1**	**2**	**2**	**3**	**3**	**4**	**4**
	Depth (T) in mm	300	300	300	300	300	300	300	300
Model No. RP with CPCI backplane and power supply		**9907.475**	**9907.471**	**9907.476**	**9907.472**	**9907.477**	**9907.473**	**9907.478**	**9907.474**
Installation space for boards, mm		160	160	160	160	160	160	160	160
Installation space for rear I/O boards, mm		80	–	80	–	80	–	80	–
Number of front/rear slots		2/2	2	4/4	4	6/6	6	8/8	8
Keyable guide rails		8	4	16	8	24	12	32	16
Power supply unit (ATX)		200 W	200 W	200 W	200 W	300 W	300 W	300 W	300 W
Monolithic CPCI backplane 64 Bit/33 MHz, 6.5 U		1	1	1	1	1	1	1	1
DC fan in the left-hand side panel		3	3	2	2	1	1	4	4

Slim-Box Version 2	**U** (H)	**1**	**2**	**3**	**4**
	Depth (T) in mm	300	300	300	300
Model No. RP without backplane, with power supply		**9907.479**	**9907.480**	**9907.481**	**9907.482**
Installation space for boards, mm		160	160	160	160
Installation space for rear I/O boards, mm		80	80	80	80
Number of front/rear slots		2	4	6	8
Keyable guide rails		8	16	24	32
Power supply unit (ATX)		200 W	200 W	300 W	300 W
DC fan in the left-hand side panel		3	2	1	4

Slim-Box Version 3	**U** (H)	**1**	**2**	**3**	**4**
	Depth (T) in mm	300	300	300	300
Model No. RP with CPCI backplane, without power supply		**3689.177**	**3689.178**	**3689.179**	**3689.180**
Installation space for boards, mm		160	160	160	160
Installation space for rear I/O boards, mm		80	80	80	80
Number of front/rear slots		2/1	4/2	6/3	8/4
Keyable guide rails		10	20	30	40
Monolithic CPCI backplane 6.5 U 64 Bit/33 MHz, H.110 (from 2 U)		1	1	1	1
DC fan in the left-hand/right-hand side panel		3/4	2/3	1/1 + 1	4/6
Plug-in power supply unit, order separately		see page 481			

Accessories		**EMC**	Page	**Non-EMC**	Page
Front panels	3 U, 4 HP	3685.178	538	3684.891	537
	3 U, 8 HP	3685.182	538	3684.895	537
	6 U, 4 HP	3685.186	538	3684.913	537
	6 U, 8 HP	3685.190	538	3684.917	537
H.110, 48 V connection cable		**3688.697**			

Accessories CPCI/VME Page 457 **Backplanes CPCI** Page 438 **Slide-in systems VME** Page 447 **Backplanes VME** Page 452 **Power supplies** Page 478

Rack-mount system, Ripac 3 U, 5 slots/4 U, 7 slots horizontal

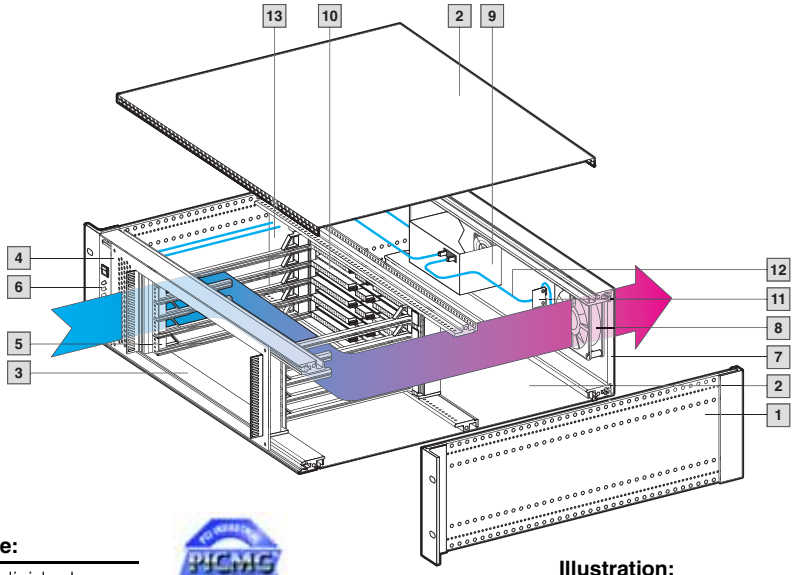


Illustration:
MPS system 3 U for CPCI

Technical specifications:
Subrack, 405 mm deep,
for installation in 482.6 mm (19″) enclosures or cases.
Prepared to accommodate CPCI boards and drives.
Complies with IEC 60 297-3/-5 and IEEE 1101.1/1101.10.
Fully assembled, pre-wired and tested.

Rittal service:
Modifications or individual system solutions can be provided at short notice. Rittal's system specialists will be happy to assist you with planning and configuration.

PICMG EUROPE

U			3	4	Page
Side panel depth mm			405	405	
Wiring space (depth in mm)			210	210	
For PCB			6 U x 160 mm	6 U x 160 mm	
MPS system Model No. RP for CPCI			**3687.717**	**3687.718**	
Mechanical supply includes					
Description		Material	Quantity		
1	Ripac basic subrack system (side panels, horizontal rails, flanges, EMC gaskets)	Aluminium, clear-chromated/ stainless steel	1	1	–
2	Top and bottom/covers, solid	Aluminium, unplated	2	2	515
13	Air block panel	Aluminium	1	1	521
	EMC shielding plate for fan	Aluminium, clear-chromated	1	1	524
3	Horizontal mounting kit	Aluminium, clear-chromated	1	1	508
4	Trim frame for horizontal mounting kit	2.5 mm aluminium, clear-chromated	1	1	509
5	Plastic guide rails, keyable	Polycarbonate UL 94-V0	8	12	510
	Plastic guide rails, keyable, red	Polycarbonate	2	2	510
6	EMC front panel 3 U/5 HP for switches/LED	2.5 mm aluminium, clear-chromated	1	–	457
	EMC front panel 4 U/5 HP for switches/LED	2.5 mm aluminium, clear-chromated	–	1	457
7	EMC rear panel 3 U/84 HP with fan and connector cutout	2.5 mm aluminium, clear-chromated	1	–	–
	EMC rear panel 4 U/84 HP with fan and connector cutout	2.5 mm aluminium, clear-chromated	–	1	–
Electrical/electronic supply includes					
Description		Technical specifications			
8	DC fan	12 V DC, 48 m³/h, per fan (UL, CSA, VDE) optionally speed-controlled	1	1	523
9	Power supply unit ATX, PS/2 (RP 3687.793)	300 W	1	1	483
10	CPCI backplane	6.5 U, 5 slots	1	–	440
	CPCI backplane	6.5 U, 7 slots	–	1	440
	LED display module with mains switch	for 3.3 V, +5 V, ±12 V, fan failure	1	1	–
11	Filter module for DC fan	Interference voltage filter	1	1	457
12	DC cable harness	–	■	■	–

Accessories CPCI/VME Page 457 **Backplanes CPCI** Page 438 **Rack-mount systems VME** Page 448 **Backplanes VME** Page 452
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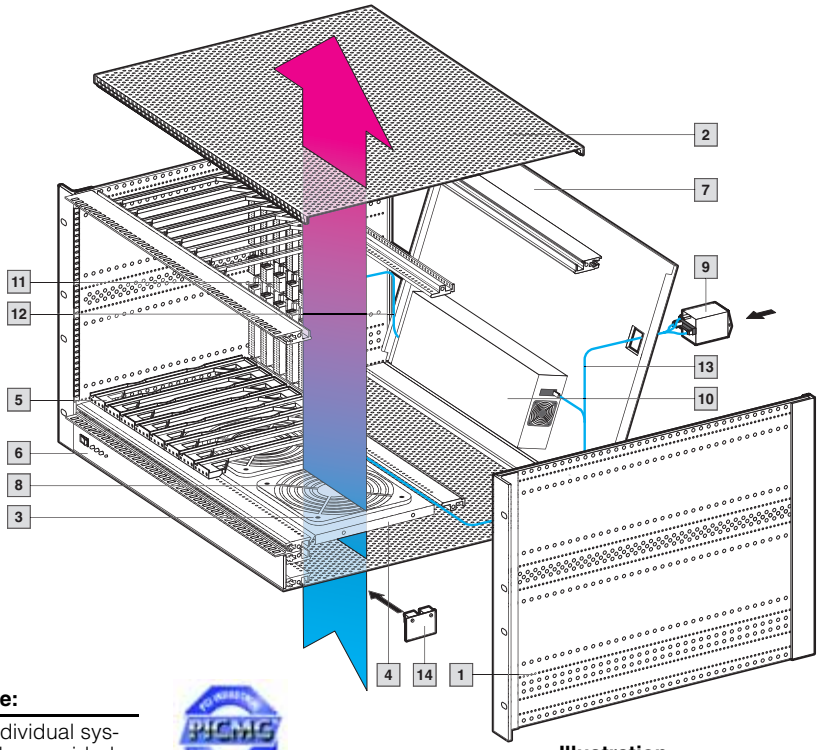
Rack-mount systems, Ripac 4 U/7 U, 8 slots



Technical specifications:
Subrack, 405 mm deep,
for installation in 482.6 mm (19″) enclosures or cases.
Prepared to accommodate CPCI boards and drives.
Complies with IEC 60 297-3/-5 and IEEE 1101.1/1101.10.
Fully assembled, pre-wired and tested.

Rittal service:
Modifications or individual system solutions can be provided at short notice. Rittal's system specialists will be happy to assist you with planning and configuration.

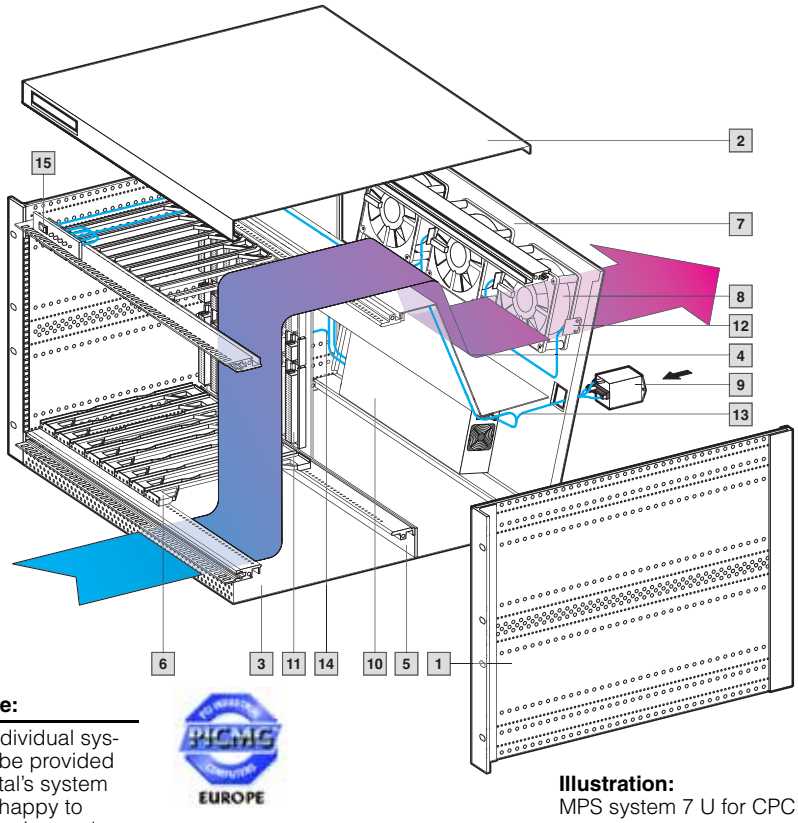
PICMG EUROPE

Illustration:
MPS system 7 U for CPCI

U			4 (3 + 1)	7 (6 + 1)	Page
Side panel depth mm			405	405	
Wiring space (depth in mm)			210	210	
For PCB			3 U/ 6 U x 160 mm	3 U/ 6 U x 160 mm	
MPS system Model No. RP for CPCI			**3687.719**	**3687.720**	
Mechanical supply includes					
Description		Material	Quantity		
1	Ripac basic subrack system (side panels, horizontal rails, flanges, EMC gaskets)	Aluminium, clear-chromated/ stainless steel	1	1	–
2	Top and bottom covers, vented	Aluminium, unplated	2	2	515
3	Finger guard	Polyamide	3	3	524
4	Fan mounting plate	1 mm aluminium, anodised	1	1	520
5	Plastic guide rails, keyable	Polycarbonate UL 94-V0	14	14	510
	Plastic guide rails, keyable, red	Polycarbonate	2	2	510
6	EMC front panel 1 U/84 HP for switches and LED	2.5 mm aluminium, clear-chromated	1	1	–
	EMC rear panel 4 U/84 HP, horizontally hinged with connector cutout	2.5 mm aluminium, clear-chromated	1	–	–
7	EMC rear panel 7 U/84 HP, horizontally hinged with connector cutout	2.5 mm aluminium, clear-chromated	–	1	–
Electrical/electronic supply includes					
Description		Technical specifications			
8	DC fan	24 V DC, 140 m^3/h, per fan (VDE, UL, CSA) optionally speed-controlled	3	3	523
9	IEC filtered mains inlet	6 A (VDE, UL, CSA)	1	1	458
10	Open frame power supply (RP 3687.695)	400 W, 3.3 V/25 A, 5 V/25 A, 12 V/8 A, –12 V/7 A (VDE, UL, CSA)	–	1	482
	Power supply unit ATX PS/2 (RP 3687.793)	300 W with switch connection cable	1	–	483
	CPCI backplane	3.5 U, 8 slots	1	–	440
11	CPCI backplane	6.5 U, 8 slots	–	1	440
	LED display module with mains switch	for 3.3 V, +5 V, ±12 V, fan failure	1	–	–
12	DC cable harness	–	■	■	–
13	AC cable harness	–	–	■	–
14	Filter module for DC fan	Interference voltage filter	3	3	457

Accessories CPCI/VME Page 457 **Backplanes CPCI** Page 438 **Rack-mount systems VME** Page 449 **Backplanes VME** Page 452
Power supplies Page 478

Rack-mount systems, Ripac 7 U, 8 slots



Technical specifications:
Subrack, 405 mm deep,
for installation in 482.6 mm (19″) enclosures or cases.
Prepared to accommodate CPCI boards and drives.
Complies with IEC 60 297-3/-5 and IEEE 1101.1/1101.10.
Fully assembled, pre-wired and tested.

Rittal service:
Modifications or individual system solutions can be provided at short notice. Rittal's system specialists will be happy to assist you with planning and configuration.

Illustration:
MPS system 7 U for CPCI

U			7 (6 + 2 x 1/2)	Page
Side panel depth mm			405	
Wiring space (depth in mm)			210	
For PCB			6 U x 160 mm	
MPS system Model No. RP for CPCI			**3687.721**	
Mechanical supply includes				
Description		Material	Quantity	
1	Ripac basic subrack system (side panels, horizontal rails, flanges, EMC gaskets)	Aluminium, clear-chromated/stainless steel	1	–
2	Cover with 1/2 U edge fold and cutouts for LED/switches	Aluminium, unplated	1	517
3	Bottom cover with 1/2 U edge fold, ventilated at the front	Aluminium, unplated	1	517
	EMC shielding plate for fan	Aluminium, clear-chromated	3	524
4	Air baffle plate	Aluminium	1	521
5	Air block panel 1/2 U	Epoxy	1	521
6	Plastic guide rails, keyable	Polycarbonate UL 94-V0	14	510
	Plastic guide rails, keyable, red	Polycarbonate	2	510
7	EMC rear panel, horizontally hinged, 7 U, with fan and connector cutout	2.5 mm aluminium, clear-chromated	1	
Electrical/electronic supply includes				
Description		Technical specifications		
8	DC fan	12 V DC, 140 m³/h, per fan (UL, CSA, VDE) optional speed control	3	523
9	IEC filtered mains inlet	6 A (VDE, UL, CSA)	1	458
10	Open frame power supply (RP 3687.695)	400 W, 3.3 V/25 A, 5 V/25 A, 12 V/8 A, –12 V/7 A (VDE, UL, CSA)	1	482
11	CPCI backplane	6.5 U, 8 slots	1	440
12	Filter module for DC fan	Interference voltage filter	3	457
13	AC cable harness	–	■	–
14	DC cable harness	–	■	–
15	LED display module with mains switch	for 3.3 V, +5 V, ±12 V, fan failure	1	–

Accessories CPCI/VME Page 457 **Backplanes CPCI** Page 438 **Rack-mount systems VME** Page 450 **Backplanes VME** Page 452
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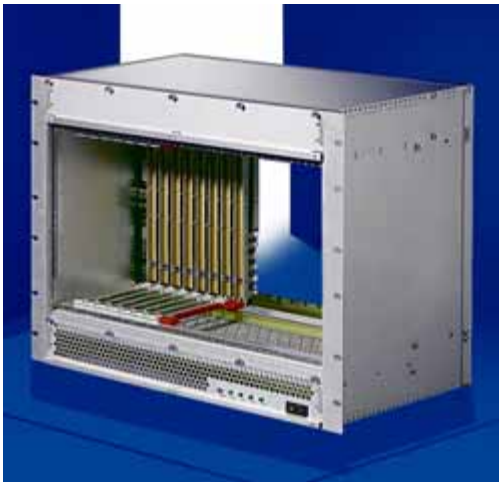
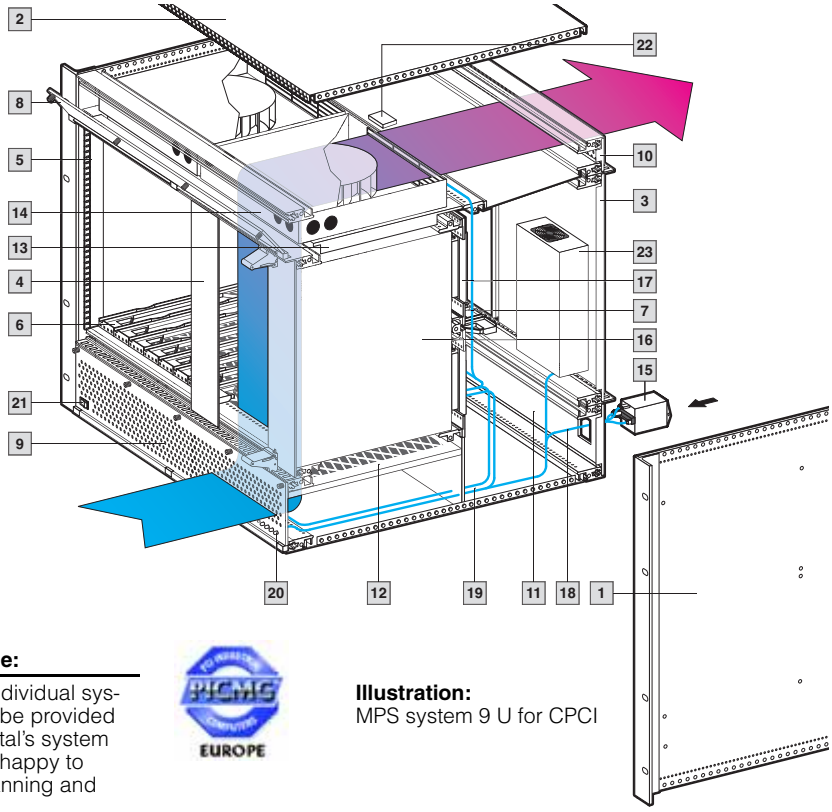
Rack-mount systems, Ripac 9 U, 8 slots, with RiCool radial fan





Technical specifications:
Subrack, 290.5 mm deep, for installation in 482.6 mm (19″) enclosures or cases.
Prepared to accommodate CPCI boards and drives.
Complies with IEC 60 297-3/-5 and IEEE 1101.1/10/11.
Fully assembled, pre-wired and tested.

Rittal service:
Modifications or individual system solutions can be provided at short notice. Rittal's system specialists will be happy to assist you with planning and configuration.

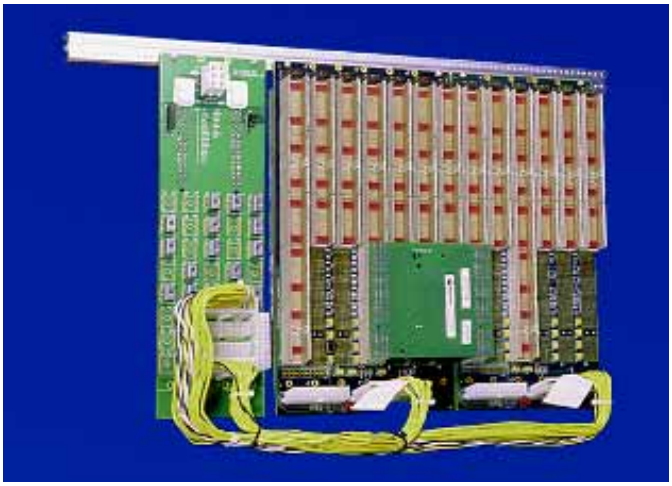
PICMG EUROPE

Illustration:
MPS system 9 U for CPCI

U			9 (6 + 2 x 1½)	Page
Side panel depth mm			290.5	
Wiring space (depth in mm)			85.5	
For PCB			6 U x 160 mm	
MPS system Model No. RP for CPCI			**3687.723**	
Mechanical supply includes				
Description		Material	Quantity	
1	Ripac basic subrack system (side panels, horizontal rails, flanges, EMC gaskets)	Aluminium, clear-chromated/stainless steel	1	–
2	Top and bottom covers	Aluminium, unplated	2	515
3	EMC rear panel 6 U/28 HP + 8 HP	2.5 mm aluminium, clear-chromated	1	–
4	EMC front panel	2.5 mm aluminium, clear-chromated	1	539
5	EMC contact strip	Aluminium, clear-chromated	1	507
6	Plastic guide rails, keyable	Polycarbonate UL 94-V0	14	510
	Plastic guide rails, keyable, red	Polycarbonate	2	510
7	Guide rails for I/O transition modules	Polycarbonate UL 94-V0	16	511
	Guide rails, keyable, green, for power supply	Polycarbonate	2	510
8	Front panel 1½ U/84 HP, horizontally hinged	2.5 mm aluminium, electrically conductive	1	–
9	Front panel 1½ U/84 HP, vented, horizontally hinged, for switch/LED	2.5 mm aluminium, electrically conductive	1	–
10	EMC rear panel 1½ U/84 HP, vented	2.5 mm aluminium, electrically conductive	1	–
11	EMC rear panel 1½ U/84 HP with connector cutout	2.5 mm aluminium, electrically conductive	–	–
12	Filter mat 84 HP, 160 mm, for slide-in attachment	–	1	–
13	Mounting plate for RiCool	1 mm sheet steel, zinc-plated, passivated	1	–
Electrical/electronic supply includes				
Description		Technical specifications		
14	RiCool DC fan, individually removable including fault alarm signal, speed control	24 V DC, 204 m³/h, 48 W	2	–
15	IEC filtered mains inlet	6 A (VDE, UL, CSA)	1	458
16	Power supply, plug-in, 6 U/8 HP	350 W	1	481
	CPCI backplane	6.5 U, 8 slots	1	440
17	CPCI backplane for power supply	–	1	–
18	AC cable harness	–	■	–
19	DC cable harness	–	■	–
20	LED display module	for 3.3 V, +5 V, ±12 V, fan failure	1	–
21	Mains switch	–	1	–
22	Monitoring module for RiCool	–	1	–
23	Power supply for RiCool	–	1	–

Accessories CPCI/VME Page 457 **Backplanes CPCI** Page 438 **Rack-mount systems VME** Page 451 **Backplanes VME** Page 452
Power supplies Page 478

Backplanes, technical specifications



Rittal offers an extensive range of powerful backplanes for CompactPCI.

- Modular assembly facilitates expansion up to a maximum of 21 slots
- Connection between the individual segments via CPCI or H.110 bridge modules
- Voltage supply via ATX-compatible connector
- Additional 2 x 3 Mate-N-Lock connector for 48 V with H.110 backplane
- Optional development of customer-specific Monolithic backplanes
- 8 layer multi-layer
- System slot on right (left upon request)

Modular assembly

The Ripac backplanes in 32 or 64-bit versions allow the configuration of CPCI systems from 2 to 21 slots. This is possible thanks to the modular design of the backplanes and connection of the individual segments via CPCI or H.110 bridge modules. Each backplane segment contains between 2 and 8 slots and operates in stand-alone mode in conjunction with a CPU board and a power supply unit.

For assembling larger systems, several segments may be joined together via PCI bridge modules fitted at the rear. In such cases, only one of the segments will run in the system slot with a CPU board. The remaining segments will have a subordinate status without CPU boards. However, the first slot on the right of the backplane is available for a standard 32 or 64 bit CompactPCI host CPU.

Technical specifications

CPU slot
A single 3 U or 6 U CPU board with 32 or 64 bits is required for each system. The system slot on the right-hand side ensures that 2-slot or wider system boards do not conceal other slots, thus rendering them unusable.

Available slots
Each backplane contains two to eight 3 U or 6 U slots (32 or 64 bit).

Data transfer rate
132/264 Mbytes for 32/64-bit version
+5 V, 33 MHz PCI bus interface
264/512 Mbytes for 32/64-bit version
+3.3 V, 66 MHz (max. 5 slots) PCI bus interface

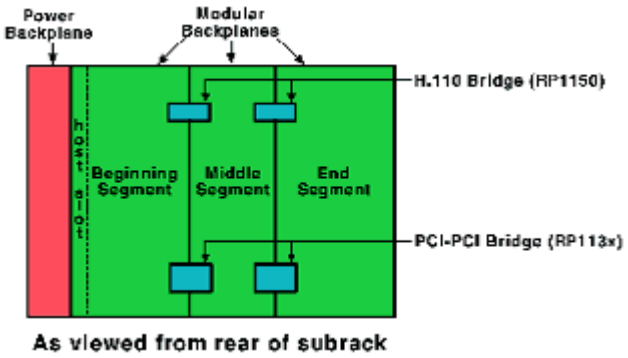
PCI bridges
Single backplanes do not require bridges. For each additional backplane, however, a bridge fitted at the rear is required.

Power supply
Voltage supply via one or more ATX connectors.

Control connector
Each backplane has a control connector at which +3.3, +5, ±12 V voltages can be picked off, e.g. for the connection of power LEDs.

I/O modules for J3 – J5
I/O modules can be connected at the rear of each slot.

Standards
- PCI 2.1 (PCI specification)
- PICMG 2.0 (CompactPCI spec.)
- PICMG 2.1 (hot swap spec.)
- IEEE 1101.1, mechanical system
- IEEE 1101.10, mechanical system
- IEEE 1101.11, mechanical system



32-bit pin assignment

P2 connector[9)]

PIN	Z[6)]	A	B	C	D	E	F
22	GND	GA4[5)]	GA3[5)]	GA2[5)]	GA1[5)]	GAO[5)]	GND
21	GND	**BP(I/O)**	**BP(I/O)**	BP(I/O)	BP(I/O)	BP(I/O)	GND
20	GND	**BP(I/O)**	**BP(I/O)**	BP(I/O)	**BP(I/O)**	BP(I/O)	GND
19	GND	**BP(I/O)**	**BP(I/O)**	BP(I/O)	BP(I/O)	BP(I/O)	GND
18	GND	**BP(I/O)**	**BP(I/O)**	**BP(I/O)**	**BP(I/O)**	**BP(I/O)**	GND
17	GND	**BP(I/O)**	**BP(I/O)**	**BP(I/O)**	**BP(I/O)**	**BP(I/O)**	GND
16	GND	**BP(I/O)**	**BP(I/O)**	**BP(I/O)**	**BP(I/O)**	**BP(I/O)**	GND
15	GND	**BP(I/O)**	**BP(I/O)**	**BP(I/O)**	**BP(I/O)**	**BP(I/O)**	GND
14	GND	BP(I/O)	BP(I/O)	BP(I/O)	**BP(I/O)**	BP(I/O)	GND
13	GND	**BP(I/O)**	**BP(I/O)**	**BP(I/O)**	BP(I/O)	BP(I/O)	GND
12	GND	BP(I/O)	BP(I/O)	BP(I/O)	**BP(I/O)**	BP(I/O)	GND
11	GND	BP(I/O)	**BP(I/O)**	**BP(I/O)**	BP(I/O)	BP(I/O)	GND
10	GND	BP(I/O)	BP(I/O)	BP(I/O)	**BP(I/O)**	BP(I/O)	GND
9	GND	BP(I/O)	**BP(I/O)**	**BP(I/O)**	BP(I/O)	BP(I/O)	GND
8	GND	BP(I/O)	BP(I/O)	BP(I/O)	**BP(I/O)**	BP(I/O)	GND
7	GND	BP(I/O)	**BP(I/O)**	**BP(I/O)**	BP(I/O)	BP(I/O)	GND
6	GND	BP(I/O)	BP(I/O)	BP(I/O)	**BP(I/O)**	BP(I/O)	GND
5	GND	BP(I/O)	**BP(I/O)**	**BP(I/O)**	BP(I/O)	BP(I/O)	GND
4	GND	**BP(I/O)**	**BP(I/O)**	BP(I/O)	**BP(I/O)**	BP(I/O)	GND
3	GND	**BP(I/O)**	**BP(I/O)**	**BP(I/O)**	**BP(I/O)**	**BP(I/O)**	GND
2	GND	**BP(I/O)**	**BP(I/O)**	**BP(I/O)**	**BP(I/O)**	**BP(I/O)**	GND
1	GND	**BP(I/O)**	**BP(I/O)**	**BP(I/O)**	**BP(I/O)**	**BP(I/O)**	GND

P1 connector[9)]

PIN	Z[6)]	A	B	C	D	E	F
25	GND	5 V	REQ64#	ENUM#	3.3 V	5 V	GND
24	GND	AD(1)	5 V	V(I/O)[3)]	AD(O)	ACK64#	GND
23	GND	3.3 V	AD(4)	AD(3)	5 V	AD(2)	GND
22	GND	AD(7)	GND	3.3 V	AD(6)	AD(5)	GND
21	GND	3.3 V	AD(9)	AD(8)	M66EN[3)]	C/BE(0)#	GND
20	GND	AD(12)	GND	V(I/O)[3)]	AD(11)	AD(10)	GND
19	GND	3.3 V	AD(15)	AD(14)	GND	AD(13)	GND
18	GND	SERR#	GND	3.3 V	PAR	C/BE(1)#	GND
17	GND	3.3 V	SDONE	SBQ#	GND	PERR#	GND
16	GND	DEVSEL	GND	V(I/O)[1)3)]	STOP#	LOCK#	GND
15	GND	3.3 V	FRAME#	IRDY	GND[2)]	TRDY#	GND
12 – 14			KEY AREA				GND
11	GND	AD(18)	AD(17)	AD(16)	GND	C/BE(2)#	GND
10	GND	AD(21)	GND	3.3 V	AD(20)	AD(19)	GND
9	GND	C/BE(3)#	IDSEL	AD(23)	GND	AD(22)	GND
8	GND	AD(26)	GND	V(I/O)[3)]	AD(25)	AD(24)	GND
7	GND	AD(30)	AD(29)	AD(28)	GND	AD(27)	GND
6	GND	REQ#	GND	3.3 V	CLK	AD(31)	GND
5	GND	BRSVP1A5	BRSVP1B5	RST#	GND	GNT#	GND
4	GND	BRSVP1A4	GND	V(I/O)[3)]	INTP	INTS	GND
3	GND	INTA#	INTB#	INTC#	5 V	INTD#	GND
2	GND	TCK	5 V	TMS	TDO	TDI	GND
1	GND	5 V	–12 V	TRST#	+12 V	5 V	GND

32-bit and 64-bit backplane – Technical specifications:
The CPCI specifications define both 32-bit and 64-bit versions. Both versions may be implemented on a 3 U daughterboard. However, the 32-bit version allows the complete P2/J2 connector to be used for user-defined I/O signals (slots 2 – 8). Slot 1 (system slot) uses separate P2/J2 pins for functions such as clock, arbitration, (grant/requests) and other system functions. These pins are printed in bold in the table. In 32-bit systems the P2/J2 connection may optionally be populated at the rear with 16 mm long pins and a transfer frame. Signals can be picked off or I/O boards connected at the rear.

64-bit CompactPCI pin assignments – Technical specifications:
With the 64-bit CompactPCI, both P1 and P2 connectors are fully assigned with signals. User-defined I/O signal pins are not available. I/O signals are only available with 6 U boards on connectors P3, P4 and P5.

64-bit pin assignment

P2 connector[9)]

PIN	Z[7)]	A	B	C	D	E	F
22	GND	GA4[6)]	GA3[6)]	GA2[6)]	GA1[6)]	GAO[6)]	GND
21	GND	**CLK6**	GND	RSV	RSV	RSV	GND
20	GND	**CLK5**	**GND**	RSV	GND[8)]	RSV	GND
19	GND	**GND**	GND[8)]	RSV	RSV	RSV	GND
18	GND	BRSVP2A18	BRSVP2B18	BRSVP2C18	GND[8)]	BRSVP2E18	GND
17	GND	BRSVP2A17	GND[8)]	PRST#	**REQ6#**	**GNT6#**	GND
16	GND	BRSVP2A16	BRSVP2B16	DEG#	GND[8)]	BRSVP2E16	GND
15	GND	BRSVP2A15	GND	FAL#	**REQ5#**	**GNT5#**	GND
14	GND	AD(35)	AD(34)	AD(33)	GND	AD(32)	GND
13	GND	AD(38)	GND	V(I/O)[3)]	AD(37)	AD(36)	GND
12	GND	AD(42)	AD(41)	AD(40)	GND	AD(39)	GND
11	GND	AD(45)	GND	V(I/O)[3)]	AD(44)	AD(43)	GND
10	GND	AD(49)	AD(48)	AD(47)	GND	AD(46)	GND
9	GND	AD(52)	GND	V(I/O)[3)]	AD(51)	AD(50)	GND
8	GND	AD(56)	AD(55)	AD(54)	GND	AD(53)	GND
7	GND	AD(59)	GND	V(I/O)[3)]	AD(58)	AD(57)	GND
6	GND	AD(63)	AD(62)	AD(61)	GND	AD(60)	GND
5	GND	C/BE(5)#	GND	V(I/O)[3)]	C/BE(4)#	PAR64	GND
4	GND	V(I/O)[3)]	BRSVP2B4	C/BE(7)#	–	C/BE(6)#	GND
3[3)]	GND	**CLK4**	GND	**GNT3#**	–	**GNT4#**	GND
2[3)]	GND	**CLK2**	**CLK3**	**SYSEN#[4)]**	–	**REQ3#**	GND
1[3)]	GND	**CLK1**	GND	**REQ1#**	–	**REQ2#**	GND

P1 connector[9)]

PIN	Z[7)]	A	B	C	D	E	F
25	GND	5 V	REQ64#	ENUM#	3.3 V	5 V	GND
24	GND	AD(1)	5 V	V(I/O)[3)]	AD(0)	ACK64#	GND
23	GND	3.3 V	AD(4)	AD(3)	5 V	AD(2)	GND
22	GND	AD(7)	GND	3.3 V	AD(6)	AD(5)	GND
21	GND	3.3 V	AD(9)	AD(8)	M66EN[4)5)]	C/BE(0)	GND
20	GND	AD(12)	GND	V(I/O)[3)]	AD(11)	AD(10)	GND
19	GND	3.3 V	AD(15)	AD(14)	GND	AD(13)	GND
18	GND	SERR#	GND	3.3 V	PAR	C/BE(1)#	GND
17	GND	3.3 V	SDONE	SBO#	GND	PERR#	GND
16	GND	DEVSEL#	GND	V(I/O)[1)3)]	STOP#	LOCK#	GND
15	GND	3.3 V	FRAME#	IRDY#	GND[2)3)]	TRDY#	GND
12 – 14			KEY AREA				
11	–	AD(18)	AD(17)	AD(16)	GND	C/BE(2)#	GND
10	GND	AD(21)	GND	3.3 V	AD(20)	AD(19)	GND
9	GND	C/BE(3)#	IDSEL	AD(23)	GND	AD(22)	GND
8	GND	AD(26)	GND	V(I/O)	AD(25)	AD(24)	GND
7	GND	AD(30)	AD(29)	AD(28)	GND	AD(27)	GND
6	GND	REQ#	GND	3.3 V	CLK	AD(31)	GND
5	GND	BRSVA5	BRSVB 5	RST#	GND	GNT#	GND
4	GND	BRSVA4	GND	V(I/O)	INTP	INTS	GND
3	GND	INTA#	INTB#	INTC	5 V	INTD#	GND
2	GND	TCK	5 V	TMS	TDO	TDI	GND
1	GND	5 V	–12 V	TRST#	+12 V	5 V	GND

The signals printed in bold are only assigned in the system slot
[1)] "Early mate" pin [2)] "Late mate" pin [3)] +3.3 V or 5 V [4)] Earthed with system slot [5)] GND with 33 MHz backplane, bussed in 66 MHz systems
[6)] Each slot may have its own address code (see CPCI specification) [7)] Not for daughterboards [8)] Not for CPCI boards after Version 1.0
[9)] All Rittal standard CPCI backplanes are designed for 64-bit applications on the layout side. With 32-bit versions, the P2/J2 connector is populated on request.

Backplanes

1

2

Backplanes, 3.5 U

Number of layers	8
Layer structure	2 GND layers
PCB thickness	3.2 mm
Data transfer rate	132/264 Mbytes/32, 64-bit version
Power inlets	2 – 4 slots: 1 x ATX connector 5 – 7 slots: 2 x ATX connector 8 slots: 3 x ATX connector
Control connector	+3.3 V, +5 V, +12 V, –12 V
CPU slot	on right (left upon request)
Standards	PCI 2.1 (PCI specification) PICMG 2.0 (CompactPCI) PICMG 2.1 (hot swap) IEEE 1101.1/10/11
Installation height	3.5 U (150.9 mm)
Distance between slots	4 HP
Connectors	J1, J2 32 or 64 bit, no rear I/O
Operating temperature range	0° – 70°C
Relative humidity	90 %, non-condensing
Geographic addressing	64-bit versions

Material:
Fibreglass epoxy to IEC 60 249 (type FR4)

Supply includes:
Backplane, fully populated.

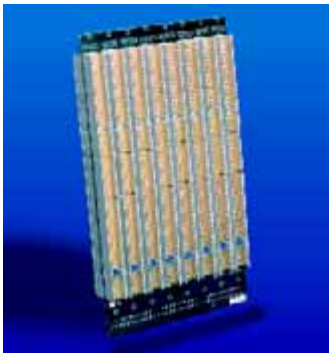
1 Front view
2 Rear view

Slots	Version	Model No. RP	
		32-bit	64-bit
2	SE	–	**3687.864**
3	SBE	**3687.865**	**3686.578**
4	SBE	**3687.863**	**3686.576**
5	SBE	**3687.862**	**3686.575**
6	SBME	**3687.861**	**3686.548**
7	SBE	**3687.860**	**3686.547**
8	S.	**3687.859**	**3686.546**

S = Stand alone
B = Beginning segment
M = Middle segment
E = Ending segment

Accessories:

CPCI/CPCI bridge, RP 3686.571,
see page 443.
Accessories for backplane mounting:
Conductive strips, see page 505.
Insulating strips, see page 505.



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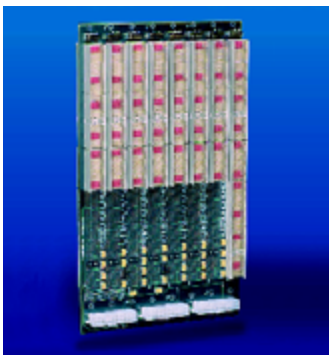


2

Backplanes, 6.5 U

Number of layers	8
Layer structure	2 GND layers
PCB thickness	3.2 mm
Data transfer rate	132/264 Mbytes/32, 64-bit version
Power inlets	2 – 4 slots: 1 x ATX connector 5 – 7 slots: 2 x ATX connector 8 slots: 3 x ATX connector
Control connector	+3.3 V, +5 V, +12 V, –12 V
CPU slot	on right (left upon request)
Standards	PCI 2.1 (PCI spec) PICMG 2.0 (CompactPCI) PICMG 2.1 (hot swap) IEEE 1101.1/10/11
Installation height	6.5 U (284.3 mm)
Distance between slots	4 HP
Connectors	J1, J2 32 or 64-bit J3, J4, J5 for rear I/O (64-bit only)
Operating temperature range	0° – 70°C
Relative humidity	90 %, non-condensing
Geographic addressing	64-bit versions

Material:
Fibreglass epoxy to IEC 60 249 (type FR4)

Supply includes:
Backplane, fully populated.

1 Front view
2 Rear view

Backplanes

Slots	Version	Model No. RP	
		32-bit	64-bit
2	SBE	–	**3686.581**
3	SBE	**3687.871**	**3686.580**
4	SBE	**3687.870**	**3686.579**
5	SBE	**3687.869**	**3686.552**
6	SBME	**3687.868**	**3686.551**
7	SBE	**3687.867**	**3686.550**
8	S	**3687.866**	**3686.549**

Note:
Cannot be used when rear connection of 80 mm is required.

Backplanes for low profile bridge

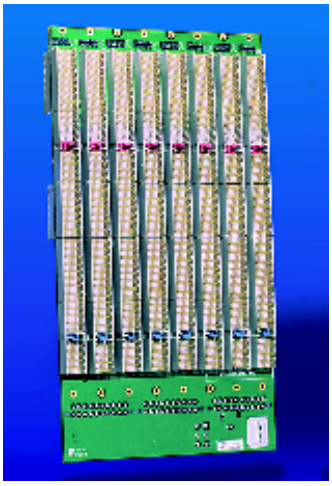
Slots	Version	Model No. RP
		64-bit
3	SBE	**3689.209**
4	SBE	**3689.208**
5	SBE	**3689.207**
6	SBME	**3689.206**
7	SBE	**3689.205**

Note:
May be used when rear connection of 80 mm is required.

S = Stand alone
B = Beginning segment
M = Middle segment
E = Ending segment

Accessories:

CPCI/CPCI bridge, RP 3686.571, see page 443.
CPCI/CPCI low profile bridge, see page 443.
Accessories for backplane mounting:
Conductive strips, see page 505.
Insulating strips, see page 505.



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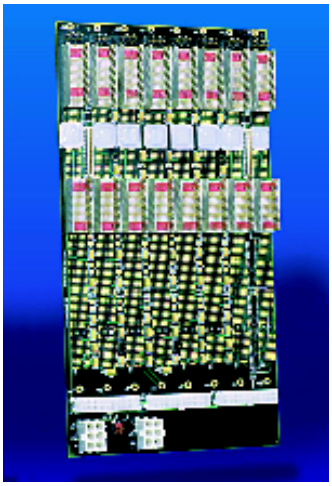


2

1 Front view
2 Rear view

Backplanes 7 U with H.110

Number of layers	8
Layer structure	2 GND layers
PCB thickness	3.2 mm
Data transfer rate	132/264 MBytes/32, 64-bit (for CPCI)
Power inlets	up to 4 slots 1 x ATX connector 5 – 7 slots: 2 x ATX connector 8 slots: 3 x ATX connector
CPU slot	right
Standards	PCI 2.1 (PCI specification) PICMG 2.0 (CompactPCI) PICMG 2.1 (hot swap) PICMG 2.5 (CPCI Computer Telephony) IEEE 1101.1/10/11
Installation height	7 U
Distance between slots	4 HP
Connectors	J1, J2 64 bit J3 rear I/O J4 H.110
Operating temperature range	0° – 70°C
Relative humidity	90 %, non-condensing
Geographic addressing	Yes

Material:
Fibreglass epoxy to IEC 60 249 (type FR4)

Supply includes:
Backplane, fully populated.

Slots	Version	Model No. RP	
		H.110 connected to system slot	H.110 not connected to system slot
3	S	**3688.508**[1)]	–
4	SE	**3688.507**[2)]	–
5	SB	**3687.875**[2)]	**3688.506**[2)]
6	SBME	**3687.874**[2)]	**3688.505**[2)]
7	SBE	**3687.873**[2)]	**3688.504**[2)]
8	S	**3687.877**	**9805.494**

[1)] Extendible with low profile bridges
[2)] Extendible with bridges RP 3686.571

S = Stand alone
M = Middle segment
B = Beginning segment
E = Ending segment

Accessories:

CPCI/CPCI bridge, RP 3686.571,
see page 443.
CPCI/CPCI low profile bridge,
see page 443.

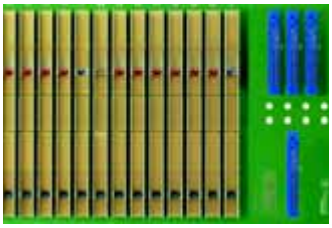
J4 pin assignment

No.	Row Z	Row A	Row B	Row C	Row D	Row E	Row F
25	NP	SGA4	SGA3	SGA2	SGA1	SGA0	FG
24	NP	GA4	GA3	GA2	GA1	GA0	FG
23	NP	+12 V	/CT reset	/CT EN	–12 V	CT_MC	FG
22	NP	PFSO#	RSVD	RSVD	RSDV	RSDV	FG
21	NP	-SEL Vbat	PFS1#	RSDV	RSDV	SEL VbatRtn	FG
20	NP	NP	NP	NP	NP	NP	NP
19	NP	NP	NP	NP	NP	NP	NP
18	NP	VRG	IN/C	IN/C	IN/C	VRGRtn	NP
17	NP	NP	NP	NP	NP	NP	NP
16	NP	NP	NP	NP	NP	NP	NP
15	NP	-Vbat	IN/C	IN/C	IN/C	Vbat Rtn	NP
14	KEY AREA						
13							
12							
11	NP	CT_D29	CT_D30	CT_D31	V(I/O)	/CT_FRAME	GND
10	NP	CT_D27	+3.3 V	CT_D28	+5 V	/C_FRAME B	GND
9	NP	CT_D24	CT_D25	CT_D26	GND	/FR_COMP	GND
8	NP	CT_D21	CT_D22	CT_D23	+5 V	CT_C8 A	GND
7	NP	CT_D19	+5 V	CT_D20	GND	CT_C8 B	GND
6	NP	CT_D16	CT_D17	CT_D18	GND	CT_NETREF	GND
5	NP	CT_D13	CT_D14	CT_D15	+3.3 V	CT_NETREF	GND
4	NP	CT_D11	+5 V	CT_D12	+3.3 V	SCLK	GND
3	NP	CT_D8	CT_D9	CT_D10	GND	SCLK-D	GND
2	NP	CT_D4	CT_D5	CT_D6	CT_D7	GND	GND
1	NP	CT_D0	+3.3 V	CT_D1	CT_D2	CT_D3	GND

Key to J4 pin assignment

CT_name	=	H.110 TDM bus signals
+5 V	=	+5 V power
+3.3 V	=	+3.3 V power
GND	=	Logic ground
V(I/O)	=	I/O cell power
FG	=	Frame ground
RSVD	=	reserved for future use
NP	=	a pin and pad REQUIRED to be not populated to meet safety regulations
IN/C	=	No connect required for safety agency insulation requirements

-SELVbat	= short loop battery
SELVbatRtn	= short loop battery return
-Vbat	= telecom power distribution bus
VbatRtn	= return bus pin for -Vbat
SGA0-SGA4	= shelf enumeration bus signals
GA0-GA4	= slot ID signals: not bussed
VRG	= bus for ringing voltage
VRGRtn	= bus for ringing voltage
PFSO#-PFS1#	= busses for power fail sense
KEY AREA	= area utilized for key



Backplanes 7 U, Switch Fabric to PICMG 2.16

The “Switch Fabric” backplanes comply with PICMG specification 2.16. They support telephony applications and systems with a high level of availability in which CompactPCI is combined with Ethernet for high-speed applications.

Power inlets	Positronic 47-pole, or ATX
CPU slot	right
Standards	PCI 2.1 (PCI specification) PICMG 2.0 (CompactPCI) PICMG 2.1 (hot swap) PICMG 2.5 (CPCI Computer Telephony) IEEE 1101.1/10/11 PICMG 2.16
Installation height	7 U (6 U for RP 3686.396 and RP 3689.186)
Distance between slots	4 HP
Operating temperature range	0° – 70°C
Relative humidity	90 %, non-condensing
Geographic addressing	Yes

Material:
Fibreglass epoxy to IEC 60 249 (type FR4)

Supply includes:
Backplane, fully populated.

Technical specifications:
- 7 U, 84 HP/32 HP
- Complies with PICMG 2.1, fully hot swap-compatible
- Selectable voltage V (I/O) (3.3 V or 5 V) where configured for 33 MHz CompactPCI
- Integral Schottky diode bus terminator
- Prepared for up to four backplane reinforcements to avoid bending during card insertion
- H.110 CT bus complies with specification PICMG 2.5 at all node slots.
- Supports 8 HP CPU boards when one node slot is relinquished
- Twin redundant support for Switch Fabric (2 fabric and 12 basic nodes), as specified in PICMG 2.16
- Supports rear transition modules with all board slots
- Configurable for power supply with either two 6 U x 8 HP, three 6 U x 4 HP, three 3 U x 4 HP, three 3 U x 8 HP or four 3 U x 4 HP
- All power supply slots conform to PICMG 2.11
- Power supply connectors for H.110-Vbat, -SELVbat and VRG power signals
- ATX power connector for auxiliary power inlet/outlet
- Two fan power connectors for 12 V and system management support
- System control bus (SMBus) conforms to PICMG 2.9 and supports all boards, power supplies, power entry modules, fans and alarm cards
- Support of I^2C bridge function on the alarm card for >19 SMBus nodes

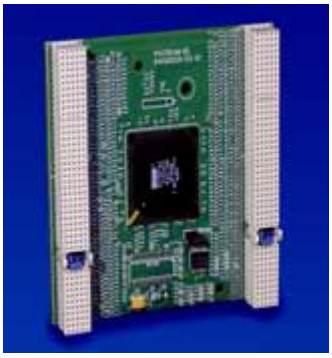
Width	Number of slots	Description of slots	Model No. RP
32 HP	8	1 fabric slot 6 node slots with CPCI and H.110 1 host slot	**3689.188**
		see RP 3689.188, but without H.110	**3686.414**
84 HP	16	1 fabric slot 6 node slots with CPCI and H.110 1 host slot 1 fabric slot 6 node slots with CPCI and H.110 1 host slot 3 slots for power supplies	**3686.396**
		see RP 3686.396, but without H.110	**3689.186**
84 HP	21	7 node slots with CPCI and H.110 1 host slot 1 node slot with H.110, without CPCI 1 fabric slot 7 node slots with CPCI and H.110 1 host slot 1 node slot with H.110, without CPCI 1 fabric slot 1 alarm slot	**3686.397**
		see RP 3686.397, but without H.110	**3689.190**
		see RP 3686.397, but without CPCI	**3689.191**

Front

1	System (CPU) card	12	Node card
2	Node card	13	Node card
3	Node card	14	Node card
4	Node card	15	Node card
5	Node card	16	Fabric card B
6	Node card	17	Blank
7	Node card	18	Power supply 1
8	Fabric card A	19	Power supply 2
9	System (CPU) card	20	Power supply 3
10	Node card	21	Blank
11	Node card		

Rear

1	System RTC	12	Node RTC
2	Node RTC	13	Node RTC
3	Node RTC	14	Node RTC
4	Node RTC	15	Node RTC
5	Node RTC	16	Fabric B RTC
6	Node RTC	17	Alarm card
7	Node RTC	18	PEM 1
8	Fabric A RTC	19	
9	System RTC	20	PEM 2
10	Node RTC	21	
11	Node RTC		



1

2

Modular CPCI bridge

CPCI bridge may be connected to the rear to extend the bus by a maximum of 7 additional slots. The CPCI bridge handles all communications between the individual bus segments. The front slots are freely available for CPCI boards. It supports the 64-bit PCI bus and may be used in conjunction with CPCI backplanes 3.5 U and 6.5 U.

Technical specifications:

- May be connected at the rear on CPCI backplanes
- PCI bridge
- 64 bit “high performance” Intel 21 154
- For use with all Rittal CPCI backplanes (not with low profile backplanes)
- Corresponding to PCI specifications 2.1
- Conforms to CPCI
- CPCI bridge connects CPCI backplanes from right to left (as viewed from the front) – i.e. the “left-hand” connector accommodates the host board

Material:
Fibreglass epoxy to IEC 60 249 (FR4)

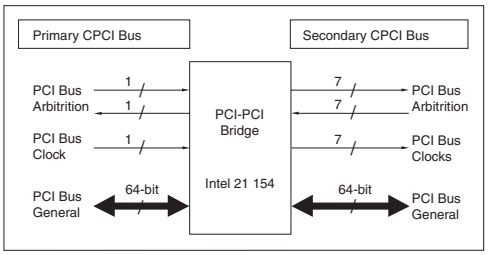
Supply includes:
Bridge, fully populated.

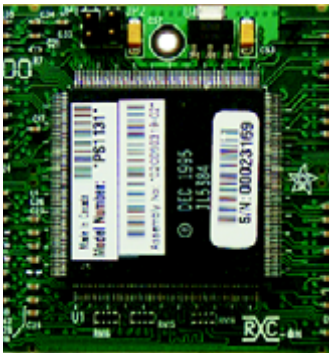
1 Front view

2 Rear view

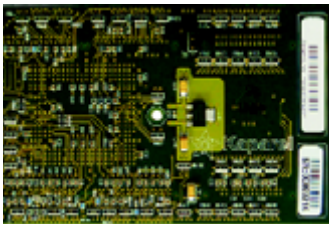
Description	Model No. RP
64-bit CPCI bridge	**3686.571**

Extended delivery times





1



2

Modular low profile bridge

CPCI bridge may be connected to the rear to extend the bus by a maximum of 7 additional slots, **without any loss of slots:** Optionally available as a 32-bit or 64-bit version. Only suitable for use in conjunction with low profile backplanes.

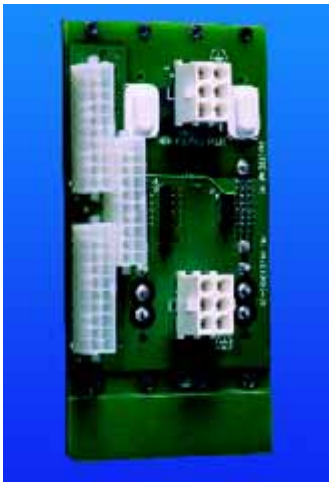
Material:
Fibreglass epoxy to IEC 60 249 (FR4)

Supply includes:
Bridge, fully populated.

1 32-bit version

2 64-bit version

Version	Bits	Model No. RP
left-right	32	**3689.210**
right-left	32	**3689.211**
left-right	64	**9810.637**
right-left	64	**9812.625**



Power supply backplane 3.5 U

- Board 3.5 U, 16 HP
- For use in conjunction with Rittal CPCI backplanes
- Accommodation of up to two power supplies with up to 250 W
- AC/DC connection is via two 2 x 3-pole connectors
- Output voltages to supply one or more CPCI backplanes are available at 3 ATX-compatible connectors
- Complies with PICMG 2.0, PICMG 2.11

Technical specifications:
Accommodation of 2 x 3 U, 8 HP CPCI power supplies with up to 250 W.

The second power supply unit may be used for redundancy (with power distribution) or, via parallel connection, to increase the current.

Input voltages:
- AC input via 2 x 3-pole AMP Mate-N-Lock (AMP # 350732-1), connector J12
- Connected via pin 45, 46, 47, type Positronic
- Maximum current load per pin is 25 A, matching counter-connector for cable harness AMP # 350715
- DC input via 2 x 3-pole AMP Mate-N-Lock (AMP # 350732-1), connector J5 connected through pin 46, 47, type Positronic
- Maximum current load per pin is 25 A, matching counter-connector for cable harness AMP # 350715

Output voltage:
- Three 20-pole ATX-compatible connectors for ATX cable harness (connection of power supply board to CPCI backplane)

Description	Model No. RP
Board for plug-in power supply with Positronic connector, 47-pin	**3688.603**
ATX (12″) cable harness	**9810.337**
ATX (16″) cable harness	**3686.570**
ATX (20″) cable harness	**9810.338**

Material:
Fibreglass epoxy to IEC 60 249 (FR4)

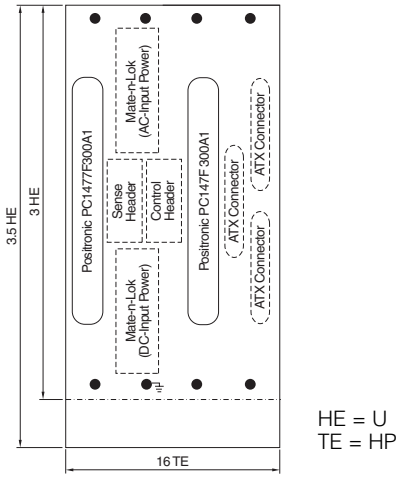
Supply includes:
Board, fully populated.

Note:
Plug-in power supplies for CPCI available on request,
see page 481.

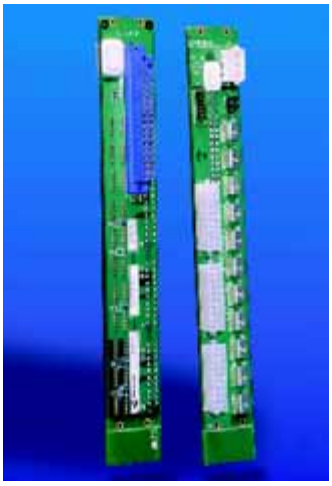
Connector assignment

Pin		Pin		Pin		Pin	
1	+5 V	13	+3.3 V	25	Not used	37	Not used
2	+5 V	14	+3.3 V	26	Not used	38	DEG#
3	+5 V	15	+3.3 V	27	R/EN	39	INH#
4	+5 V	16	+3.3 V	28	Not used	40	Not used
5	0 V (shared)	17	+3.3 V	29	Not used	41	Not used
6	0 V (shared)	18	+3.3 V	30	+5 V Sense	42	FAL#
7	0 V (shared)	19	0 V (shared)	31	Not used	43	Not used
8	0 V (shared)	20	+12 V	32	Not used	44	Not used
9	0 V (shared)	21	0 V	33	+3.3 V Sense	45	Chassis GND
10	0 V (shared)	22	0 V (shared)	34	0 V Sense	46	AC neutral
11	0 V (shared)	23	Not used	35	Not used	47	AC line
12	0 V (shared)	24	0 V (shared)	36	Not used		

RP 3688.603



HE = U
TE = HP



Power supply backplane 6.5 U, 8 HP

- Board 6.5 U, 8 HP
- For use in conjunction with Rittal CPCI backplanes 3.5 U, 6.5 U, H.110
- Accommodation of a power supply with up to 500 W
- AC/DC connection is made via 3-pole connectors
- Output voltages to supply one or more CPCI backplanes are available at 3 ATX-compatible connectors or at special power terminals

Technical specifications:
Accommodation of a 6 U CPCI power supply with up to 500 W.

Input voltages:
- AC input via 3-pole AMP Mate-N-Lock connector
  Max. current load per pin 25 A
- DC input via 3-pole AMP Mate-N-Lock connector
  Max. current load per pin 25 A

Output voltage:
- Three 20-pole ATX-compatible connectors for ATX cable harness (connection of power supply board to CPCI backplane) and/or special power terminals

Description	Model No. RP
Board for plug-in power supply with Positronic connector, 47-pin	**3688.607**
ATX (12″) cable harness	**9810.337**
ATX (16″) cable harness	**3686.570**
ATX (20″) cable harness	**9810.338**

Extended delivery times

Material:
Fibreglass epoxy to IEC 60 249 (FR4)

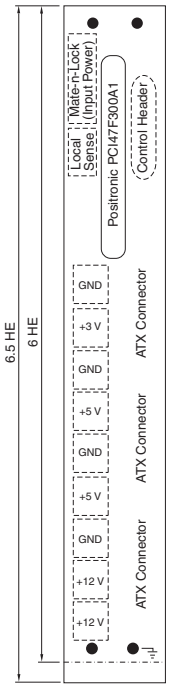
Supply includes:
Board, fully populated.

Note:
Plug-in power supplies for CPCI available on request,
see page 481.

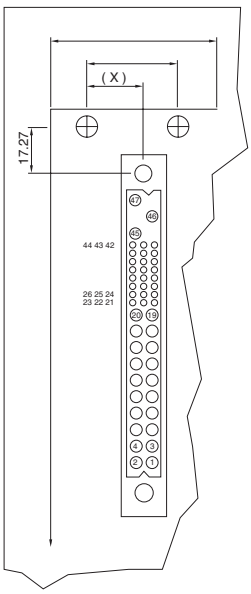
Connector assignment

Pin		Pin		Pin		Pin	
1	+5 V	13	+3.3 V	25	Not used	37	Not used
2	+5 V	14	+3.3 V	26	Not used	38	DEG#
3	+5 V	15	+3.3 V	27	R/EN	39	INH#
4	+5 V	16	+3.3 V	28	Not used	40	Not used
5	0 V (shared)	17	+3.3 V	29	Not used	41	Not used
6	0 V (shared)	18	+3.3 V	30	+5 V Sense	42	FAL#
7	0 V (shared)	19	0 V (shared)	31	Not used	43	Not used
8	0 V (shared)	20	+12 V	32	Not used	44	Not used
9	0 V (shared)	21	0 V	33	+3.3 V Sense	45	Chassis GND
10	0 V (shared)	22	0 V (shared)	34	0 V Sense	46	AC neutral
11	0 V (shared)	23	Not used	35	Not used	47	AC line
12	0 V (shared)	24	0 V (shared)	36	Not used		

RP 3688.607

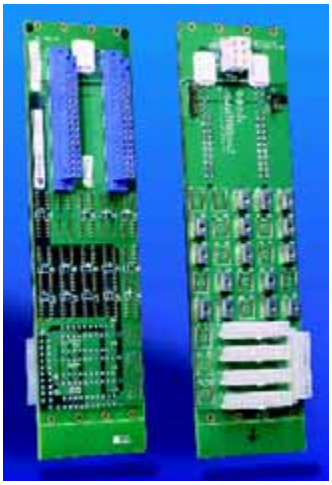


HE = U



X = 5.18 mm

Backplanes



Power supply backplane 6.5 U, 16 HP

- Board 6.5 U, 16 HP
- For use in conjunction with Rittal CPCI backplanes 3.5 and 6.5 U
- Accommodation of two power supplies with up to 500 W
- AC/DC connection is via two 2 x 3-pole connectors
- Output voltages to supply one or more CPCI backplanes are available at 5 ATX-compatible connectors or special power terminals

Technical specifications:
Accommodation of 2 x 6 U CPCI power supplies with up to 500 W

Input voltages:
- AC input via 2 x 3-pole AMP Mate-N-Lock connector
  Max. current load per pin 25 A
- DC input via 2 x 3-pole AMP Mate-N-Lock connector
  Max. current load per pin 25 A

Output voltage:
- Five 20-pole ATX-compatible connectors for ATX cable harness (connection of power supply board to CPCI backplane) and/or special power terminals

Description	Model No. RP
Board for 2 x plug-in power supplies with Positronic connector, 47-pin	**3688.608**
ATX (12″) cable harness	**9810.337**
ATX (16″) cable harness	**3686.570**
ATX (20″) cable harness	**9810.338**

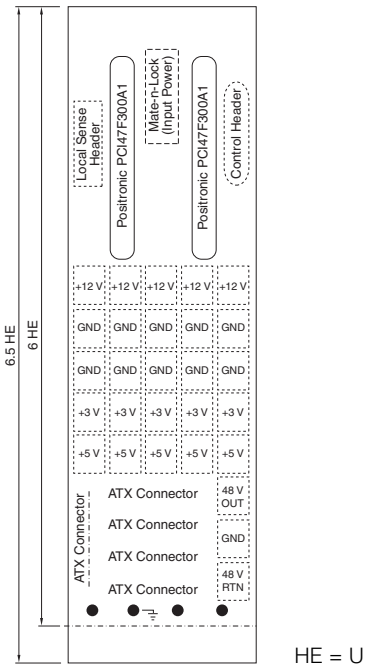
Extended delivery times

Material:
Fibreglass epoxy to IEC 60 249 (FR4)

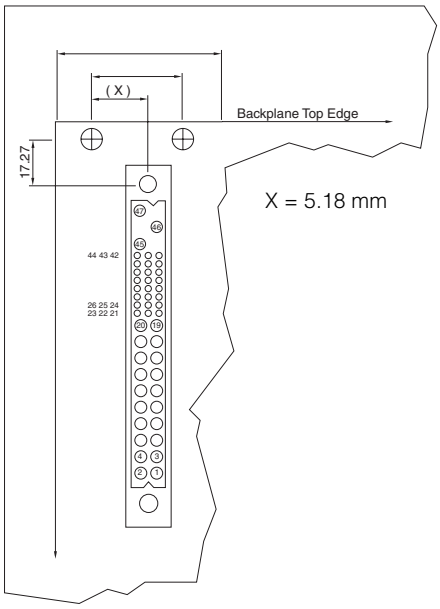
Supply includes:
Board, fully populated.

Note:
Pluggable power supplies,
see page 481.

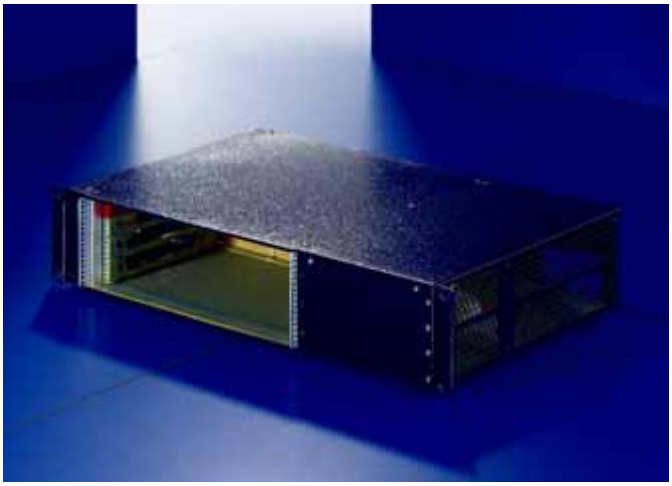
RP 3688.608

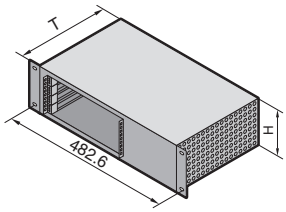


HE = U



Rack-mount systems, Slim-Box 1 U, 2 U, 3 U, 4 U





Technical specifications:
- Rack-mount housing 482.6 mm (19″) for the horizontal installation of boards
- Front and rear 2 slots per U for VME boards
- Enclosure cooling from left to right
- EMC and ESD-compatible design
- Including fan:
  for 1 U: 12 V DC, 21 m^3/h
  for 2 U: 12 V DC, 74 m^3/h
  for 3 U: 12 V DC, 195 m^3/h or 74 m^3/h,
  for 4 U: 12 V DC, 74 m^3/h
- Conforms to IEEE 1101.1/10/11, ANSI/VITA 1014, IEC 821

Material:
Sheet steel, spray-finished

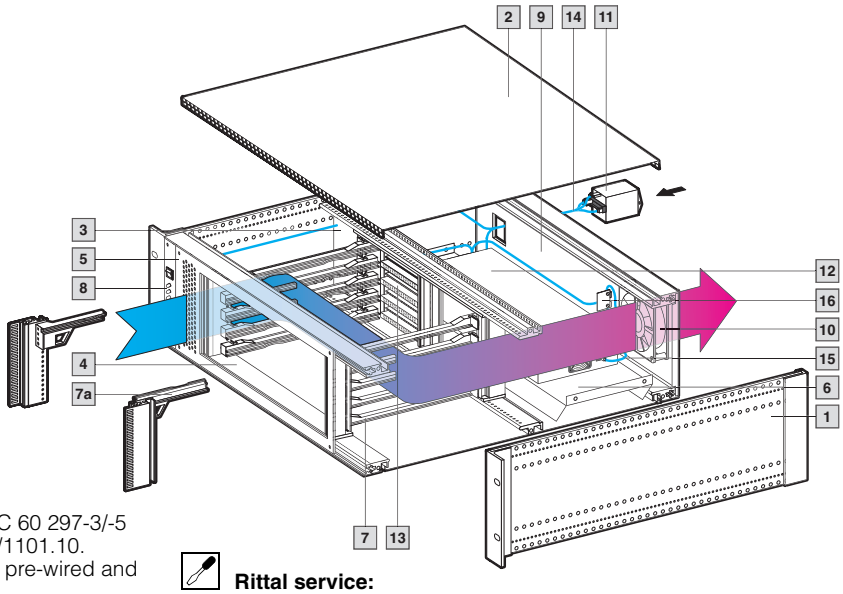
Slim-Box Version 1	**U** (H)	**1**	**1**	**2**	**2**	**3**	**3**	**4**	**4**
	Depth (T) in mm	360	300	360	300	360	300	360	300
Model No. RP with VME backplane and power supply		**9907.467**	**9907.463**	**9907.468**	**9907.464**	**9907.469**	**9907.465**	**9907.470**	**9907.466**
Installation space for boards, mm		160	160	160	160	160	160	160	160
Installation space for rear I/O boards, mm		160	–	160	–	160	–	160	–
Number of front/rear slots		2/2	2	4/4	4	6/6	6	8/8	8
Keyable guide rails		8	4	16	8	24	12	32	16
Power supply unit (ATX)		200 W	200 W	200 W	200 W	300 W	300 W	300 W	300 W
Monolithic VME backplane, passive		1	1	1	1	1	1	1	1
DC fan in the left-hand side panel		3	3	2	2	1	1	4	4

Slim-Box Version 2	**U** (H)	**1**	**2**	**3**	**4**
	Depth (T) in mm	300	300	300	300
Model No. RP without backplane, with power supply		**9907.479**	**9907.480**	**9907.481**	**9907.482**
Installation space for boards, mm		160	160	160	160
Installation space for rear I/O boards, mm		80	80	80	80
Number of front/rear slots		2	4	6	8
Keyable guide rails		8	16	24	32
Power supply unit (ATX)		200 W	200 W	300 W	300 W
DC fan in the left-hand side panel		3	2	1	4

Accessories		**EMC**	Page	**Non-EMC**	Page
Front panels	3 U, 4 HP	3685.178	538	3684.891	537
	3 U, 8 HP	3685.182	538	3684.895	537
	6 U, 4 HP	3685.186	538	3684.913	537
	6 U, 8 HP	3685.190	538	3684.917	537

Accessories CPCI/VME Page 457 **Backplanes VME** Page 452 **Rack-mount systems CPCI** Page 433 **Backplanes CPCI** Page 438
Power supplies Page 478

Rack-mount systems, Ripac 3 U, 5 slots/4 U, 7 slots horizontal



Technical specifications:
Subrack, 405 mm deep, for installation in 482.6 mm (19″) enclosures or cases. Prepared to accommodate VMEbus boards and drives.

Complies with IEC 60 297-3/-5 and IEEE 1101.1/1101.10. Fully assembled, pre-wired and tested.

Rittal service:

Modifications or individual system solutions can be provided at short notice.

Rittal's system specialists will assist you with planning and configuration.

U			3	3	4	4	Page
Side panel depth mm			405	405	405	405	
Wiring space (depth in mm)			210	210	210	210	
For PCB			6 U x 160 mm	6 U x 160 mm	6 U x 160 mm	6 U x 160 mm	
MPS system Model No. RP for VME			**3687.698**	**–**	**3687.700**	**–**	
MPS system Model No. RP for VME64x			**–**	**3687.699**	**–**	**3687.696**	
Mechanical supply includes							
Description		Material	Quantity				
1	Ripac basic subrack system (side panels, horizontal rails, flanges, EMC gaskets)	Aluminium, clear-chromated/ stainless steel	1	1	1	1	–
2	Top and bottom covers, solid	Aluminium, unplated	2	2	2	2	515
3	Air block panel	Aluminium	1	1	1	1	521
4	Horizontal mounting kit	Aluminium, clear-chromated	1	1	1	1	508
5	Trim frame for horizontal mounting kit	2.5 mm aluminium, clear-chromated	1	1	1	1	509
6	Mounting base for power supply unit	2 mm aluminium, anodised	1	1	1	1	485
	EMC shielding plate for fan	Aluminium, clear-chromated	1	1	1	1	524
7	Guide rails	Polycarbonate UL 94-V0	10	–	14	–	509
7a	Plastic guide rails, keyable	Polycarbonate UL 94-V0	–	10	–	14	510
8	EMC front panel 3 U or 4 U/5 HP, for switch LED	2.5 mm aluminium, clear-chromated	1	1	1	1	–
9	EMC rear panel 3 U/84 HP, with fan and connector cutout	2.5 mm aluminium, clear-chromated	1	1	–	–	–
	EMC rear panel 4 U/84 HP, with fan and connector cutout	2.5 mm aluminium, clear-chromated	–	–	1	1	–
Electrical/electronic supply includes							
Description		Technical specifications					
10	DC fan	12 V DC, 48 m³/h per fan (UL, CSA, VDE) optional speed control	1	1	1	1	523
11	IEC filtered mains inlet	6 A (VDE, UL, CSA)	1	1	1	1	458
12	Switch mode power supply unit	250 W, 5 V/35 A, +12 V/8 A, –12 V/8 A (VDE, UL, CSA)	1	1	1	1	479
13	VME backplane	J1, 5 slots, IN-board, passive, ADC	1	–	–	–	456
	VME64x backplane	J1/J2, 5 slots (without P0)	–	1	–	–	454
	VME backplane	J1, 7 slots, IN-board, passive, ADC	–	–	1	–	456
	VME64x backplane	J1/J2, 7 slots	–	–	–	1	454
	LED display module with mains switch	for +5 V, ±12 V, fan failure	1	1	1	1	–
14	AC cable harness	–	■	■	■	■	–
15	DC cable harness	–	■	■	■	■	–
16	Filter module for DC fan	Interference voltage filter	1	1	1	1	457

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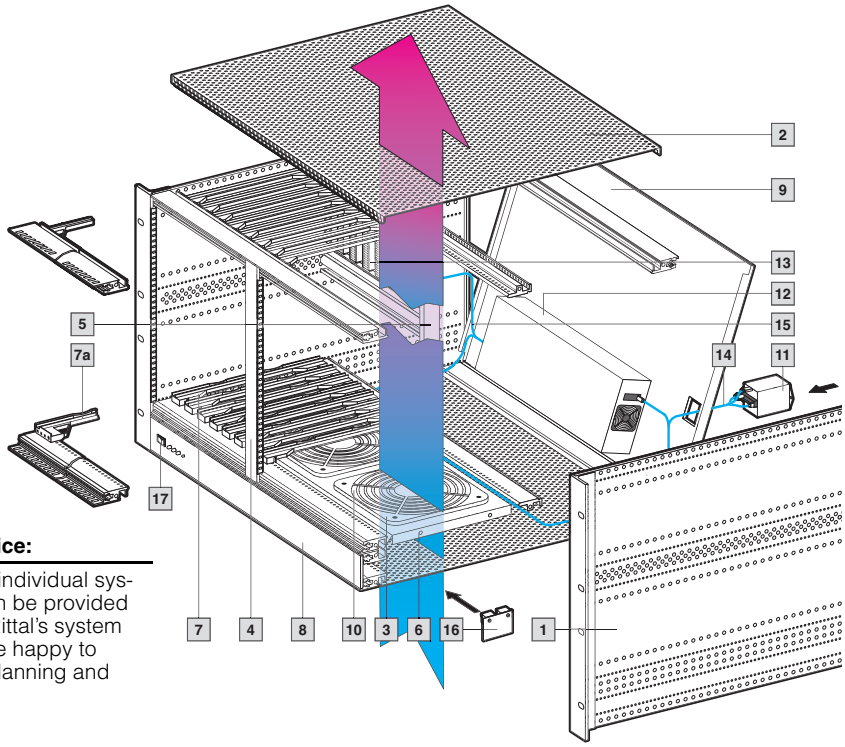
Rack-mount systems, Ripac 4 U/7 U, 12 slots



Technical specifications:
Subrack, 405 mm deep, for installation in 482.6 mm (19″) enclosures or cases. Prepared to accommodate VMEbus boards and drives. Complies with IEC 60 297-3/-5 and IEEE 1101.1/1101.10. Fully assembled, pre-wired and tested.

Rittal service:
Modifications or individual system solutions can be provided at short notice. Rittal's system specialists will be happy to assist you with planning and configuration.

U			4 (3 + 1)	7 (6 + 1)	7 (6 + 1)	Page
Side panel depth mm			405	405	405	
Wiring space (depth in mm)			210	210	210	
For PCB			3 U x 160 mm	3 U/6 U x 160 mm		
MPS system Model No. RP for VME			**3687.702**	**3687.703**	**–**	
MPS system Model No. RP for VME64x			**–**	**–**	**3687.704**	
Mechanical supply includes						
Description		Material	Quantity			
1	Ripac basic subrack system (side panels, horizontal rails, flanges, EMC gaskets)	Aluminium, clear-chromated/ stainless steel	1	1	1	–
2	Top and bottom covers, vented	Aluminium, unplated	2	2	2	515
3	Finger guard	polyamide	3	3	3	524
4	EMC front panel, 6 U/4 HP (with 7 U)	Aluminium, clear-chromated	–	1	–	
5	Support, vertical (with 7 U)	Aluminium, clear-chromated	–	1	–	508
6	Fan mounting plate	1 mm aluminium, anodised	1	1	1	520
7	Plastic guide rails	Polycarbonate UL 94-V0	24	24	–	509
7a	Plastic guide rails, keyable	Polycarbonate UL 94-V0	–	–	24	510
8	EMC front panel 1 U/84 HP for switches/LED	2.5 mm aluminium, clear-chromated	1	1	1	–
	Rear panel 4 U/84 HP, horizontally hinged with connector cutout	2.5 mm aluminium, clear-chromated	1	–	–	–
9	EMC rear panel 7 U/84 HP, horizontally hinged with connector cutout	2.5 mm aluminium, clear-chromated	–	1	1	–
Electrical/electronic supply includes						
Description		Technical specifications				
10	DC fan	12 V DC, 140 m^3/h per fan (VDE, UL, CSA) optionally speed-controlled	3	3	3	523
11	IEC filtered mains inlet	6 A (VDE, UL, CSA)	1	1	1	458
12	Switch mode power supply unit	400 W, 5 V/80 A, +12 V/8 A, –12 V/8 A (VDE, UL, CSA)	1	1	–	479
	Switch mode power supply unit (RP 3687.695)	400 W, 3.3 V/25 A, +5 V/25 A, +12 V/8 A, –12 V/7 A (VDE, UL, CSA)	–	–	1	482
13	VME backplane	J1, 12 slots, IN-board, passive, ADC	1	1	–	456
	VME64x backplane	J1/J2, 12 slots	–	–	1	454
17	LED display module with mains switch	for (3.3 V), +5 V, ±12 V, fan failure	1	1	1	–
14	AC cable harness	–	■	■	■	–
15	DC cable harness	–	■	■	■	–
16	Filter module for DC fan	Interference voltage filter	3	3	3	457

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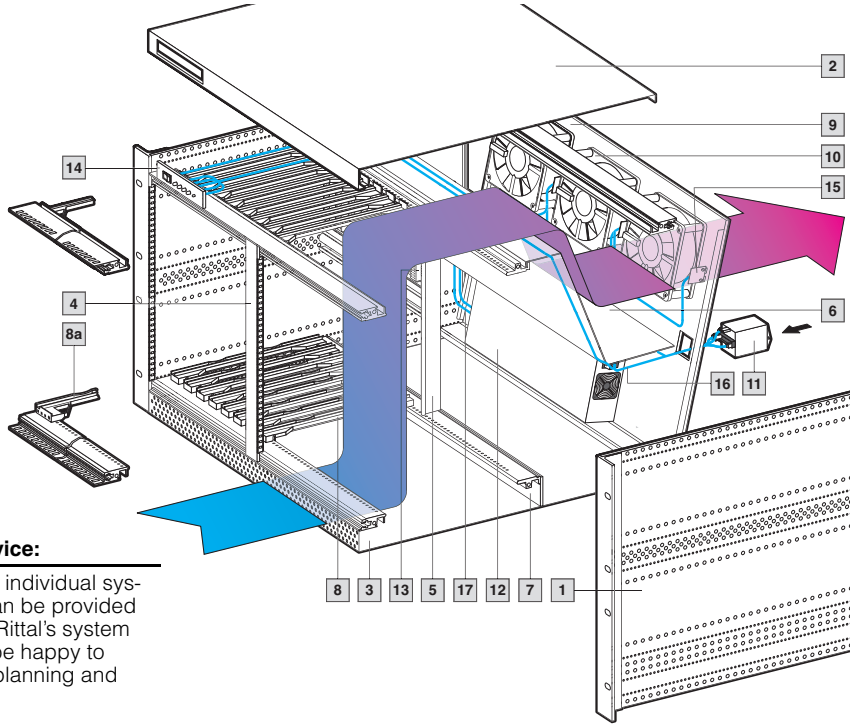
Rack-mount systems, Ripac 7 U, 12 slots



Technical specifications:
Subrack, 405 mm deep, for installation in 482.6 mm (19″) enclosures or cases. Prepared to accommodate VMEbus boards and drives. Complies with IEC 60 297-3/-5 and IEEE 1101.1/1101.10. Fully assembled, pre-wired and tested.

Rittal service:
Modifications or individual system solutions can be provided at short notice. Rittal's system specialists will be happy to assist you with planning and configuration.

U	7 (6 + 2 x 1/2)	7 (6 + 2 x 1/2)	Page
Side panel depth mm	405	405	
Wiring space (depth in mm)	210	210	
For PCB	6 U x 160 mm	6 U x 160 mm	
MPS system Model No. RP for VME	**3687.705**	**–**	
MPS system Model No. RP for VME64x	**–**	**3687.706**	

Mechanical supply includes

	Description	Material	Quantity		
1	Ripac basic subrack system (side panels, horizontal rails, flanges, EMC gaskets)	Aluminium, clear-chromated/stainless steel	1	1	–
2	Cover with 1/2 U edge fold and cutouts for switches/LEDs	Aluminium, unplated	1	1	517
3	Bottom cover with 1/2 U edge fold, ventilated at the front	Aluminium, unplated	1	1	517
4	EMC front panel, 6 U/4 HP	2.5 mm aluminium, clear-chromated	1	–	
	EMC shielding plate for fan	Aluminium, clear-chromated	3	3	524
5	Vertical support	Aluminium, clear-chromated	1	–	508
6	Air baffle plate	1 mm aluminium, anodised	1	1	521
7	Air block panel, 1/2 U	Epoxide	1	1	521
8	Plastic guide rails	Polycarbonate UL 94-V0	24	–	509
8a	Plastic guide rails, keyable	Polycarbonate UL 94-V0	–	24	510
9	EMC rear panel, horizontally hinged, 7 U, with fan and connector cutout	2.5 mm aluminium, clear-chromated	1	1	–

Electrical/electronic supply includes

	Description	Technical specifications			
10	DC fan	12 V DC, 140 m³/h per fan, (UL, CSA, VDE) optional speed control	3	3	523
11	IEC filtered mains inlet	6 A (VDE, UL, CSA)	1	1	458
12	Switch mode power supply unit	400 W, 5 V/80 A, +12 V/8 A, –12 V/8 A (VDE, UL,CSA)	1	–	479
	Switch mode power supply unit (RP 3687.695)	400 W, 3.3 V/25 A, 5 V/25 A, 12 V/8 A, –12 V/7 A (VDE, UL, CSA)	–	1	482
13	VME backplane	J1, 12 slots, IN-board passive, ADC	1	–	456
	VME64x backplane	J1/J2, 12 slots (without P0)	–	1	454
14	LED display module with mains switch	for (3.3 V), +5 V, ±12 V, fan failure	1	1	–
15	Filter module for DC fan	Interference voltage filter	3	3	457
16	AC cable harness	–	■	■	–
17	DC cable harness	–	■	■	–

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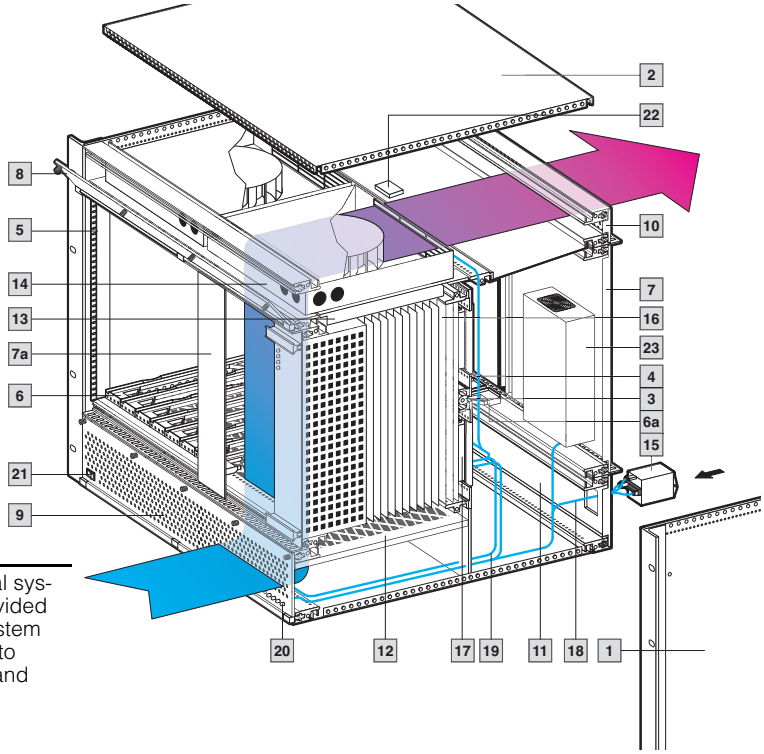
Rack-mount systems, Ripac 9 U, 12 slots, with RiCool radial fan



Technical specifications:
Subrack, 290.5 mm deep, for installation in 482.6 mm (19″) enclosures or cases. Prepared to accommodate VMEbus boards and drives. Complies with IEC 60 297-3/-5 and IEEE 1101.1/10/11. Fully assembled, pre-wired and tested.

Rittal service:
Modifications or individual system solutions can be provided at short notice. Rittal's system specialists will be happy to assist you with planning and configuration.

U		**9 (6 + 2 x 1 1/2)**	Page
Side panel depth mm		290.5	
Wiring space (depth in mm)		85.5	
For PCB		6 U x 160 mm	
MPS system Model No. RP for VME64x		**3687.708**	
Mechanical supply includes			
Description	Material	Quantity	
1 Ripac basic subrack system (side panels, horizontal rails, flanges, EMC gaskets)	Aluminium, clear-chromated/stainless steel	1	–
2 Top and bottom	1 mm aluminium, unplated	2	515
3 Centre horizontal rail 12 HP	1 mm aluminium, clear-chromated	1	–
4 Z rail 12 HP	Aluminium, clear-chromated	4	–
5 EMC contact strip	Aluminium, clear-chromated	2	507
6 Plastic guide rails, keyable	Polycarbonate UL 94-V0	24	510
Guide rails, keyable, green, for power supply	Polycarbonate UL 94-V0	2	510
6a Guide rails for I/O transition modules	Polycarbonate UL 94-V0	24	511
7 EMC rear panel 6 U/36 HP	2.5 mm aluminium, clear-chromated	1	–
7a EMC front panel	2.5 mm aluminium, clear-chromated	1	–
8 Front panel 1 1/2 U/84 HP, horizontally hinged	2.5 mm aluminium, clear-chromated	1	–
9 Front panel 1 1/2 U/84 HP, vented, horizontally hinged for switch/LED	2.5 mm aluminium, clear-chromated	1	–
10 EMC rear panel 1 1/2 U/84 HP, vented	2.5 mm aluminium, clear-chromated	1	–
11 EMC rear panel, 1 1/2 U/84 HP, with connector cutout	2.5 mm aluminium, clear-chromated	1	–
12 Filter mat 160 mm, 84 HP, for slide-in attachment	–	1	–
13 Mounting plate for RiCool	1 mm sheet steel, zinc-plated, passivated	1	–
Electrical/electronic supply includes			
Description	Technical specifications		
14 RiCool DC fan, individually removable. Including fault alarm signal, speed control	24 V DC, 204 m³/h, 48 W	2	–
15 IEC filtered mains inlet	6 A (VDE, UL, CSA)	1	458
16 Power supply, plug-in, 6 U/12 HP	270 W, 5 V/35 A, +12 V/6 A, –12 V/2 A (VDE, IEC)	1	480
Backplane VME64x, without P0	J1/J2, 12 slots	1	454
17 Female connector for power supply unit	H15	2	–
18 AC cable harness	–	■	–
19 DC cable harness	–	■	–
20 LED display module	for +5 V, ±12 V, fan failure	1	–
21 Mains switch	–	1	–
22 Monitoring module for RiCool and backplane	–	2	–
23 Power supply for RiCool	–	1	–

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General technical specifications – VMEbus

The VMEbus, based on standard IEEE 1014 and IEC 821, has become established worldwide as an industry standard.
The VME64 represents an extension of the VME family to ANSI/VITA 1-1994 and supports 64-bit data traffic. The VME64x extends the VME family to ANSI/VITA 1.1-1997 and is available with the optional 133-pole 2 mm connector J0. 160-pole connectors are used with VME64x. This system remains backward compatible, so that assemblies with 96-pole connectors to IEC 60 603-2 may still be used. All Rittal VMEbus boards are of a **HIGHSPEED-DESIGN.** Minimal reflections are achieved, due to even surge impedance of the signal track. Consistent shielding of every signal trace guarantees minimal feedback, and therefore ensures uninterrupted operation even in 64 bit mode with the **2e protocol** (160 Mbyte/s).

Daisy-chain circuit

With the daisy-chain circuit, a distinction is made between manual daisy-chaining and automatic daisy-chaining. Automatic daisy-chaining renders the connection of jumpers superfluous, and users are saved the time-consuming task of insertion and extraction. What is more, possible misconnections are avoided. Automatic daisy-chaining can be achieved in two ways. Rittal VMEbuses are generally supplied with automatic daisy-chaining.

Termination

In order to avoid malfunctions on signal tracks that may arise as a result of reflections on the exposed track end, these must be terminated with the VMEbus. Termination may be either ON-/IN-board (on the backplane) or OFF-board (external). With regard to the type of termination, a distinction is made between passive and active termination. The benefit of active termination lies in the lower closed-circuit current consumption. Passive termination is distinguished by superior frequency response and a broader temperature range.

Pin assignment J1 and J2

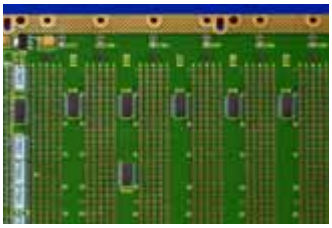
Pin assignment J1

Pin assignment for J1 connector VME64x					
		Pin assignment for J1 connector VME			
Pin no.	Row z	Row a	Row b	Row c	Row d
1	MPR	D00	BBSY	D08	VPC
2	GND	D01	BCLR	D09	GND
3	MCLK	D02	ACFAIL	D10	+ V1
4	GND	D03	BG0IN	D11	+ V2
5	MSD	D04	BG0OUT	D12	RsvU
6	GND	D05	BG1IN	D13	– V1
7	MMD	D06	BG1OUT	D14	– V2
8	GND	D07	BG2IN	D15	RsvU
9	MCTL	GND	BG2OUT	GND	GAP
10	GND	SYSCLK	BG3IN	SYSFAIL	GAO
11	RTRY1	GND	BG3OUT	BERR	GA1
12	GND	DS1	BR0	SYSRESET	+3.3 V
13	RsvBus	DS0	BR1	LWORD	GA2
14	GND	WRITE	BR2	AM5	+3.3 V
15	RsvBus	GND	BR3	A23	GA3
16	GND	DTACK	AM0	A22	+3.3 V
17	RsvBus	GND	AM1	A21	GA4
18	GND	AS	AM2	A20	+3.3 V
19	RsvBus	GND	AM3	A19	RsvBus
20	GND	IACK	GND	A18	+3.3 V
21	RsvBus	IACKIN	SERCLK (1)	A17	RsvBus
22	GND	IACKOUT	SERDAT (1)	A16	+3.3 V
23	RsvBus	AM4	GND	A15	RsvBus
24	GND	A07	IRQ7	A14	+3.3 V
25	RsvBus	A06	IRQ6	A13	RsvBus
26	GND	A05	IRQ5	A12	+3.3 V
27	RsvBus	A04	IRQ4	A11	LI/I
28	GND	A03	IRQ3	A10	+3.3 V
29	SBB	A02	IRQ2	A09	LI/O
30	GND	A01	IRQ1	A08	+3.3 V
31	SBA	–12 V	+5 V STDBT	+12 V	GND
32	GND	+5 V	+5 V	+5 V	VPC

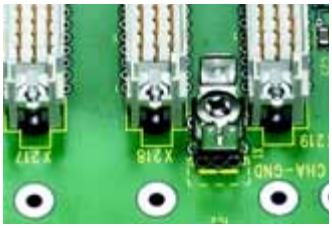
Pin assignment J2

Pin assignment for J2 connector VME64x					
		Pin assignment for J2 connector VME			
Pin no.	Row z	Row a	Row b	Row c	Row d
1	UD	User def.	+5 V	User def.	UD
2	GND	User def.	GND	User def.	UD
3	UD	User def.	Retry	User def.	UD
4	GND	User def.	A24	User def.	UD
5	UD	User def.	A25	User def.	UD
6	GND	User def.	A26	User def.	UD
7	UD	User def.	A27	User def.	UD
8	GND	User def.	A28	User def.	UD
9	UD	User def.	A29	User def.	UD
10	GND	User def.	A30	User def.	UD
11	UD	User def.	A31	User def.	UD
12	GND	User def.	GND	User def.	UD
13	UD	User def.	+5 V	User def.	UD
14	GND	User def.	D16	User def.	UD
15	UD	User def.	D17	User def.	UD
16	GND	User def.	D18	User def.	UD
17	UD	User def.	D19	User def.	UD
18	GND	User def.	D20	User def.	UD
19	UD	User def.	D21	User def.	UD
20	GND	User def.	D22	User def.	UD
21	UD	User def.	D23	User def.	UD
22	GND	User def.	GND	User def.	UD
23	UD	User def.	D24	User def.	UD
24	GND	User def.	D25	User def.	UD
25	UD	User def.	D26	User def.	UD
26	GND	User def.	D27	User def.	UD
27	UD	User def.	D28	User def.	UD
28	GND	User def.	D29	User def.	UD
29	UD	User def.	D30	User def.	UD
30	GND	User def.	D31	User def.	UD
31	UD	User def.	GND	User def.	UD
32	GND	User def.	+5 V	User def.	UD

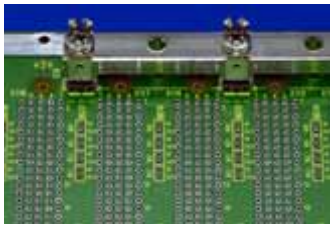
Automatic daisy chaining J1 and J1/J2
Via the use of connectors with integral mechanical switches, the contact is automatically opened when the daughter-board is inserted, and closed again when it is extracted.



Automatic daisy chaining VME64x
The second option for automatic daisy chaining is achieved here by an “or” logic integrated onto the backplane. If the daughter-board is extracted, the logic closes the daisy chain.



Chassis GND connection
An electrically conductive chassis GND surface is attached to the subracks in the mounting section of the backplane. This facilitates EMC-sealed mounting of the backplane in the subracks. With VME64x, subracks and system earth are linked in RF terms by capacitors (10nF, 200 V on each slot). Static charges are discharged via a resistor (≥ 1 MΩ). A combined connection component (screw M4 and Faston 2.8 or 6.3 x 0.8 mm) is provided for connection of the enclosure earth.



Power connections
Infeed of the main operating voltage +5 V/+3.3 V and GND is provided via busbars with M6 screw terminal. The auxiliary operating voltages are supplied via double Fastons with additional M4 screw thread. Optimum supply of the daughter-boards and hence problem-free operation is ensured, thanks to the arrangement of the infeed modules on the backplane.

Utility connector
The special signals to the power pack and to external LEDs are routed on a separate connector on the backplanes.

Depending on the backplane type, a 7-pole, a 10-pole or a 14-pole connector with 2.54 mm spacing is provided.

Pin assignment, 7 pins

1	GND sense
2	+5 V Sense
3	GND
4	+5 V
5	ACFAIL-
6	SYSFAIL-
7	SYSRESET-

Pin assignment, 10/14 pins

GND	1	2	GND sense (5 V)
+5 V	3	4	+5 V Sense
ACFAIL-	5	6	ACFAIL-
SYSFAIL-	7	8	SYSFAIL-
SYSRESET-	9	10	SYSRESET-
+3.3 V	11	12	+3.3 V Sense
GND	13	14	GND sense (3.3 V)

Geographic address pin assignments (VME64x)

Slot no.	GAP Pin J1-D9	GA4 Pin J1-D17	GA3 Pin J1-D15	GA2 Pin J1-D13	GA1 Pin J1-D11	GA0 Pin J1-D10
1	Open	Open	Open	Open	Open	GND
2	Open	Open	Open	Open	GND	Open
3	GND	Open	Open	Open	GND	GND
4	Open	Open	Open	GND	Open	Open
5	GND	Open	Open	GND	Open	GND
6	GND	Open	Open	GND	GND	Open
7	Open	Open	Open	GND	GND	GND
8	Open	Open	GND	Open	Open	Open
9	GND	Open	GND	Open	Open	GND
10	GND	Open	GND	Open	GND	Open
11	Open	Open	GND	Open	GND	GND
12	GND	Open	GND	GND	Open	Open
13	Open	Open	GND	GND	Open	GND
14	Open	Open	GND	GND	GND	Open
15	GND	Open	GND	GND	GND	GND
16	Open	GND	Open	Open	Open	Open
17	GND	GND	Open	Open	Open	GND
18	GND	GND	Open	Open	GND	Open
19	Open	GND	Open	Open	GND	GND
20	GND	GND	Open	GND	Open	Open
21	Open	GND	Open	GND	Open	GND

Pin assignments J0

Pin no.	ROW Z	ROW A	ROW B	ROW C	ROW D	ROW E	ROW F
1 – 19	GND	User Defined	User Defined	User Defined	User Defined	User Defined	GND

Backplanes VME64x

Technical specifications:

Number of layers	10
Layer structure	Optimised for optimum RF performance. Outer layers designed as shielding surface.
PCB thickness	4.3 mm
Ohmic resistance of the signal tracks	< 1.5 Ohm
Surge impedance Z of the signal tracks	50 Ohm
Basic power consumption, terminated at both ends	Active: < 0.1 A
Power supply: – Busbar with M6 screw terminal – M4 screw terminal and FASTON 6.3 x 0.8 mm – < 5 slots	 x x FASTON 6.3 x 0.8 mm
Current carrying capacity of busbar	200 A
Current carrying capacity of a combined Double flat-pin connector/screw terminal	25 A
Current carrying capacity of a FASTON flat connector	10 A
Current carrying capacity of the assembly, per slot	+3.3 V 12.5 A +12 V 9.0 A –12 V 1.5 A +5 VSTDBY 1.5 A +48 V (38 – 75 V) 3.0 A
Termination ON-/IN-board	active
Installation height	6 U/6.5 U
Distance between slots	4 HP
Connectors	Press-fit technique quality class 2, 400 connection cycles 160 pins compatible with C96 Optional J0, style 2 mm, 95/133 pins
Operating temperature range	Active termination 0°... +70°C
Relative humidity	90 %, non-condensing

VME64x 6 U

Slots	Dimensions		Model No. RP	
	Height mm	Width mm	without P0 connector	with P0 connector
5	261.6	100	**3687.608**	**3687.609**
7	261.6	141	**3687.610**	**3687.611**
9	261.6	181.5	**9904.930**	**9904.932**
10	261.6	202	**9904.931**	**9904.933**
12	261.6	242.5	**3686.634**	**3686.473**
21	261.6	425.5	**3686.635**	**3686.474**

VME64x 6.5 U

Slots	Dimensions		Model No. RP	
	Height mm	Width mm	without P0 connector	with P0 connector
5	283.7	100	**9910.012**	**9910.007**
7	283.7	141	**9910.013**	**9910.008**
9	283.7	181.5	**9910.014**	**9910.009**
10	283.7	202	**9904.928**	**9904.929**
12	283.7	242.5	**9910.015**	**9910.010**
21	283.7	425.5	**9910.016**	**9910.011**

Material:
Fibreglass epoxy to IEC 60 249 (type FR4)

Supply includes:
Backplane, fully populated.

Accessories:

for backplane mounting:
Conductive strips, see page 505.
Insulating strips, see page 505.

Backplanes VME J1/J2 Monolithic

Technical specifications:

Number of layers	6
Layer structure	Optimised for optimum RF performance. Outer layers designed as shielding surface.
PCB thickness	3.2 – 4.0 mm
Ohmic resistance of the signal tracks	< 1.5 Ohm
Surge impedance Z of the signal tracks	60 Ohm
Basic power consumption, terminated at both ends	Active: < 0.1 A Passive: < 1.4 A
Power supply: – Busbar with M6 screw terminal – M4 screw terminal and FASTON 6.3 x 0.8 mm – < 5 slots	 x x FASTON 6.3 x 0.8 mm
Current carrying capacity of busbar	200 A
Current carrying capacity of a combined double flat-pin connector/screw terminal	25 A
Current carrying capacity of a FASTON flat connector	10 A
Current carrying capacity of the assembly, per slot	+5 V 9.0 A +12 V 1.5 A –12 V 1.5 A +5 VSTDBY 1.5 A
Termination ON-/IN-board	Passive or active
Installation height	6 U
Distance between slots	4 HP
Connectors	Press-fit technique quality class 2, 400 connection cycles C96
Operating temperature range	Active termination 0°... +70°C Passive termination –40°...+85°C
Relative humidity	90 %, non-condensing

Slots	Dimensions		Model No. RP	
	Height mm	Width mm	passive	active
2	261.7	39.5	**3686.475**	**3686.495**
3	261.7	59.5	**3686.476**	**3686.496**
4	261.7	80	**3686.477**	**3686.497**
5	261.7	100	**3686.478**	**3686.498**
6	261.7	120.5	**3686.479**	**3686.499**
7	261.7	141	**3686.480**	**3686.500**
8	261.7	161.5	**3686.481**	**3686.501**
9	261.7	181.5	**3686.482**	**3686.502**
10	261.7	202	**3686.483**	**3686.503**
11	261.7	222.5	**3686.484**	**3686.504**
12	261.7	242.5	**3686.485**	**3686.505**
13	261.7	263	**3686.486**	**3686.506**
14	261.7	283	**3686.487**	**3686.507**
15	261.7	303.5	**3686.488**	**3686.508**
16	261.7	324	**3686.489**	**3686.509**
17	261.7	344	**3686.490**	**3686.510**
18	261.7	364.5	**3686.491**	**3686.511**
19	261.7	385	**3686.492**	**3686.512**
20	261.7	405	**3686.493**	**3686.513**
21	261.7	425.5	**3686.494**	**3686.514**

Material:
Fibreglass epoxy to IEC 60 249 (type FR4)

Supply includes:
Backplane, fully populated.

Accessories:

for backplane mounting:
Conductive strips, see page 505.
Insulating strips, see page 505.

Backplanes

VME J1 system bus

Technical specifications:

	VME J1	VME J2
Number of layers	6	2
Layer structure	Optimised for optimum RF performance. Outer layers designed as shielding surface.	
PCB thickness	3.2 mm	3.2 mm
Ohmic resistance of the signal tracks	< 1.5 Ohm	< 1.5 Ohm
Surge impedance Z of the signal tracks	60 Ohm	60 Ohm
Basic power consumption, terminated at both ends	Passive: < 1.0 A	< 0.6 A
Power supply: – M4 screw terminal and FASTON 6.3 x 0.8 mm – < 5 slots	x FASTON 6.3 x 0.8 mm	x FASTON 6.3 x 0.8 mm
Current carrying capacity of a combined double flat-pin connector/screw terminal	25 A	25 A
Current carrying capacity of a FASTON flat connector	10 A	10 A
Current carrying capacity of the assembly per slot	+5 V 4.5 A +12 V 1.5 A –12 V 1.5 A +5 VSTDBY 1.5 A	+5 V 4.5 A
Termination ON-/IN-board	Passive	Passive
Installation height	3 U	3 U
Distance between slots	4 HP	4 HP
Connectors	Press-fit technique, quality class 2, 400 connection cycles C96	Press-fit technique, quality class 2, 400 connection cycles C96
Operating temperature range	Passive termination –40°...+85°C	Passive termination –40°...+85°C
Relative humidity	90 %, non-condensing	90 %, non-condensing

Slots	Dimensions		Model No. RP
	Height mm	Width mm	
3	128.4	59.5	**3686.555**
4	128.4	80	**3686.556**
5	128.4	100	**3686.557**
6	128.4	120.5	**3686.558**
7	128.4	141	**3686.559**
8	128.4	161.5	**3686.560**
9	128.4	181.5	**3686.561**
10	128.4	202	**3686.562**

Slots	Dimensions		Model No. RP
	Height mm	Width mm	
12	128.4	242.5	**3686.563**
13	128.4	263	**3686.564**
14	128.4	283	**3686.565**
15	128.4	303.5	**3686.566**
18	128.4	364.5	**3686.567**
20	128.4	405	**3686.568**
21	128.4	425.5	**3686.569**

Material:
Fibreglass epoxy to IEC 60 249 (type FR4)

Supply includes:
Backplane, fully populated.

Accessories:

for backplane mounting:
Conductive strips, see page 505.
Insulating strips, see page 505.

VME J2 expansion bus

Material:
Fibreglass epoxy to IEC 60 249 (type FR4)

Supply includes:
Backplane, fully populated.

Accessories:

for backplane mounting:
Conductive strips, see page 505.
Insulating strips, see page 505.

Slots	Dimensions		Model No. RP
	Height mm	Width mm	
3	128.4	59.5	**3686.585**
4	128.4	80	**3686.586**
5	128.4	100	**3686.587**
6	128.4	120.5	**3686.588**
7	128.4	141	**3686.589**
8	128.4	161.5	**3686.590**
9	128.4	181.5	**3686.591**
10	128.4	202	**3686.592**

Slots	Dimensions		Model No. RP
	Height mm	Width mm	
12	128.4	242.5	**3686.593**
13	128.4	263	**3686.594**
14	128.4	283	**3686.595**
15	128.4	303.5	**3686.596**
18	128.4	364.5	**3686.597**
20	128.4	405	**3686.598**
21	128.4	425.5	**3686.599**

Mains switch

- Rocker switch 6 A/250 V, 2-pole, FASTON connections (4.7 x 0.8 mm)
- VDE, UL, CSA, TÜV, SEMKO, DEMCO, SEV, NEMKO, SETI, BEAB approvals
- Isolation resistance: > 10 MΩ
- Test voltage: 1 kV
- Frame: 21 x 15 mm
- Cutout: 19.2 x 12.9 mm
- Installation depth: 17 mm

Max. current	Packs of	Model No. RP
6 A	1	**3687.711**

Connection cable

for power supply,
see page 771.

EMC front panel

with LED and mains switch
Front panel with switch module and display board with LEDs.

Supply includes:
EMC front panel 5 HP,
Rocker switch,
Display board with LEDs:
+3.3 V/+5 V/+12 V/–12 V/fan failure,
assembly parts.

For	LED version	Model No. RP	
		3 U	4 U
CPCI/ VME 64x	+3.3 V +5 V ±12 V Alarm	**3687.712**	**3687.714**
VME	+5 V ±12 V Alarm	**3687.713**	**3687.715**

Filter module

for DC fan with fault monitoring
The filter module serves to suppress interference on the +12 V power supply. In addition, a signal is generated in the event of a fan failure or significant drop below the nominal speed (displayed via the LED display board).

- Max. current of fan: 700 mA at an operating voltage of 12 V DC.

Supply includes:
Board with 2 screw terminals.

Packs of	Model No. RP
1	**3687.716**

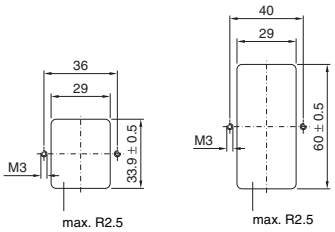
Accessories

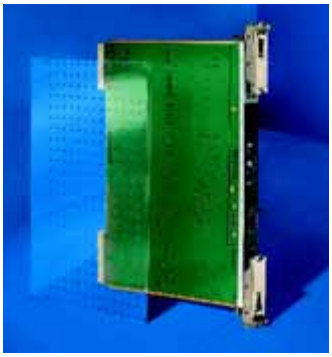
Filtered IEC mains inlet

Combination module consisting of IEC 320 socket, line filter and 5 x 20 mm fuse holder to IEC 320 and IEC 950.

Technical specifications:
Metal enclosure for screw mounting
Mains input: via IEC 320 socket
Mains output: via 3 FASTON contacts (L, N, PE, 6.3 x 0.8)
Versions with or without switches
Temperature range: – 25°C to +85°C

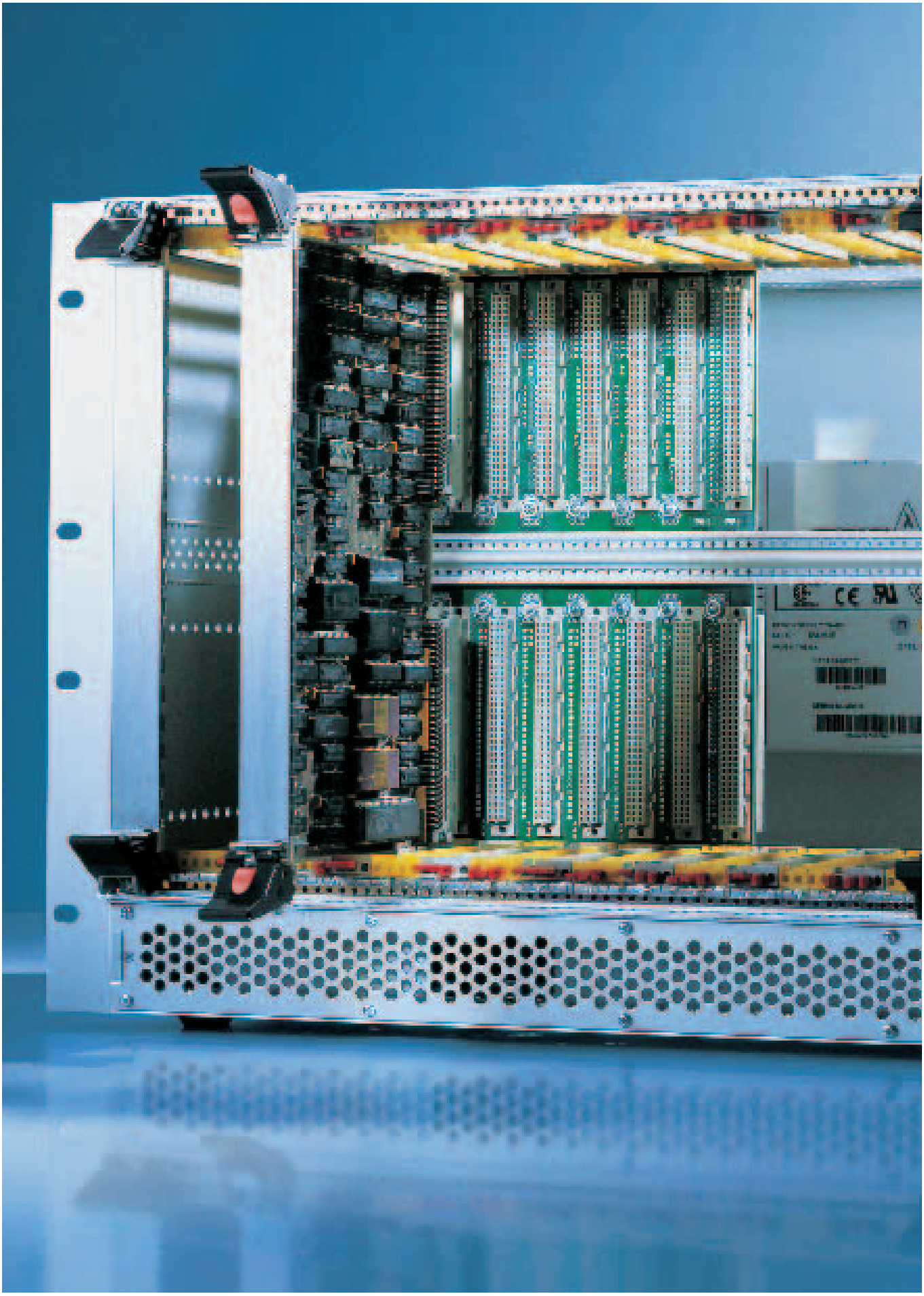
	Model No. RP	
	with switch	without switch
	3687.709	**3687.710**
Mains voltage max.	250 V AC	250 V AC
Leakage current	2 x 0.32 mA	≤ 500 µA
Max. current	6 A	6 A
Mounting holes	40 mm	36 mm
Installation depth	90 mm	56 mm
Cutout	60 x 29 mm	33.9 x 29 mm
Approvals	VDE, SEMKO, SEV, UL, CSA	VDE





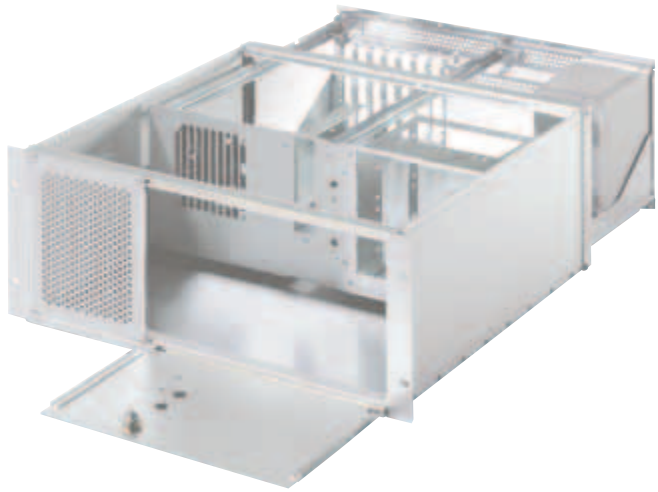
Plastic covers

for PCBs,
see page 531.



Rack-mount systems for industrial PCs and storage devices

Features



We offer an extensive range of products for industrial PCs to the ATX standard, from 482.6 mm (19″) rack-mount versions in 1, 2 and 4 U, through to solutions for direct mounting on mounting plates.

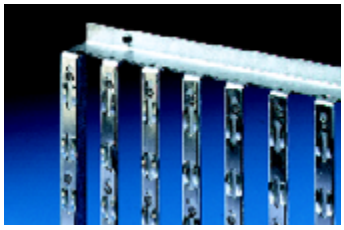
Shown opposite is a version with pull-out inner housing and electronics for automatic restart following a mains failure.

ATX Ripac, aluminium

The top-of-the-range model with outstanding maintenance-friendliness: The inner housing can be pulled out like a drawer.

Enclosure body of clear chromated aluminium, conductive.

Horizontally hinged, lockable front panel offers rapid access to drives and control components, as well as protecting against unauthorised access.



EMC gaskets – for unused slot covers – and conductive attachment of the motherboard.

Option of externally mounting 3 x 5¼″ and 1 x 3½″ drives for internal installation. Drive covers (accessory) for unused positions.

Integral electronics for automatic restart following a mains failure.

ATX 1, 2 U, sheet steel

The space-saving solution, e.g. in the server segment. The neutral design blends in well with other components.

Includes riser card for 1 slot or 2 slots.

Drive installation (1 and 2 U): Installation of 1 x 5¼″ and 1 x 3½″ drives.

Features

ATX 4 U, sheet steel

Lockable front panel protects against unauthorised access.

Slide rail mounting with no loss of height, due to reduced side panel height.

Unpainted contact points ensure reliable contact.

AT/ATX (Vario) Economy with front door

ATX Economy: Fully assembled and prewired.
AT/ATX Vario Economy: the basic case for individual installation and self-assembly.

Enclosure made from sheet steel zinc-plated/spray-finished, for demanding requirements in terms of stability and safety.

Easy removal of the drive module for external population.

ATX with front connections

As a 482.6 mm (19″) version for mounting in the enclosure, or for mounting directly onto the **mounting plate**.

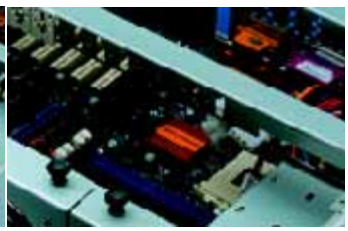
I/O connections at the front guarantee access from the front and flexibility, e.g. with minimal space available for connections to other systems.

Rear panel with cutout for PS/2 power pack.

Systems for storage devices

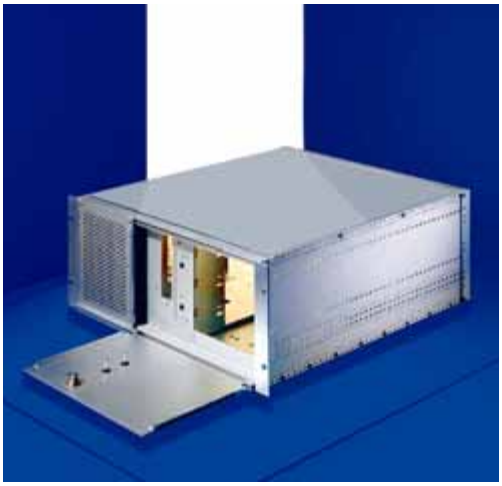
Protection under tough conditions is afforded by Rittal RAID systems, available in three variants. An optional ATX board may be installed.

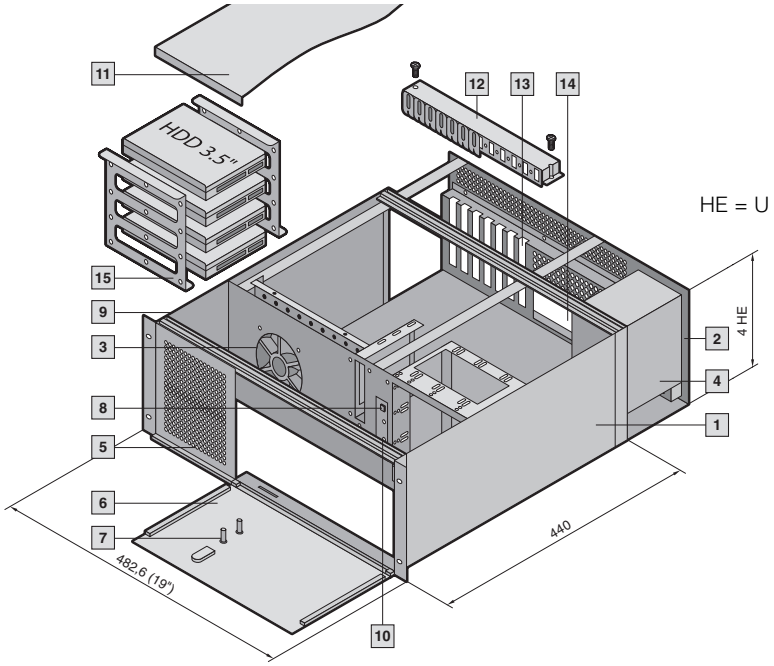
Fan inside (ATX 9-drive)



Optional **installation** of an ATX board with 6-drive and 9-drive version.

ATX Ripac 4 U, aluminium





Technical specifications:
482.6 mm (19″) rack-mount system for the installation of ATX/ Mini-ATX or Micro-ATX boards and 3 x 5¼″ and 1 x 3½″ drives.
Width: 482.6 mm (19″)
Height: 4 U (177.0 mm)
Overall depth: 440 mm.
EMC prepared.

Material/surface finish:
Side panels, front panels: Aluminium, clear-chromated
Cover:
1.0 mm aluminium, clear-chromated
Rack-mounted PC frame: Sheet steel, zinc-plated, passivated

Standards:
Complies with IEC 60 297-3 and ATX specification 2.01

Special designs available on request.

Supply includes:

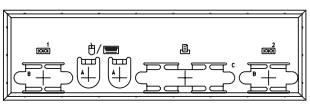
1 Rack-mount system 4 U, including drive module
2 Rack-mounted PC frame
3 1 fan 120 mm with filter
4 ATX power pack 300 W (Technical specifications, see RP 3688.129, page 483)
5 Front door, horizontally hinged
6 Front door, horizontally hinged, lockable
7 LED displays
8 Reset button
9 EMC gaskets, all round
10 ON/OFF switch with electronics for automatic restart following a mains failure (activation/deactivation of the electronics via jumper)
11 Covers

	Packs of		Page
U		**4**	
Width in mm		482.6 (19″)	
Height in mm		177.0	
Depth in mm		440.0	
Model No. RP basic system fully assembled	1	**3659.000**	
Accessories			
12 Card retainer	7	3659.010	476
Mounting bar for card retainer	1	3659.090	476
13 Unused slot cover	5	3659.030	475
Cover for 5¼″ drive space	1	3659.050	475
15 Drive support	1 set	3659.060	475
Spare filter mat	1	**3659.070**	–
Uninterruptible power supply Output: 300 VA/180 W	1	3659.080	482
14 **ATX I/O covers, sheet steel**[1)]			
Type “Aurora Marl”	1	**3659.040**	–
Type “Tucson”/“Venus”	1	**3659.130**	–
Type “Providence”	1	**3659.140**	–

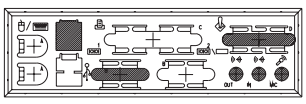
[1)] Other versions available on request; please specify the type of mainboard.

ATX I/O covers:

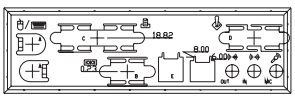
Type “Aurora Marl”



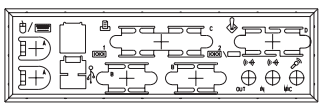
Type “Venus”



Type “Providence”

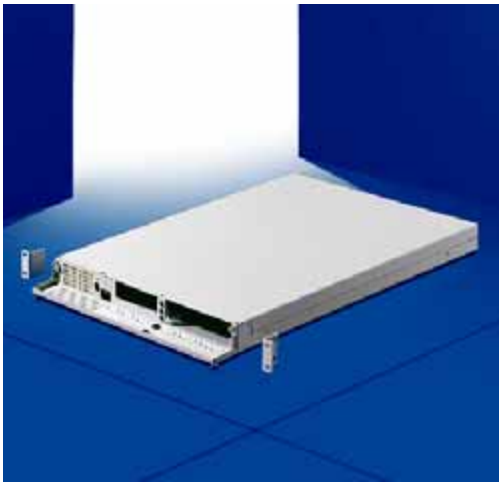


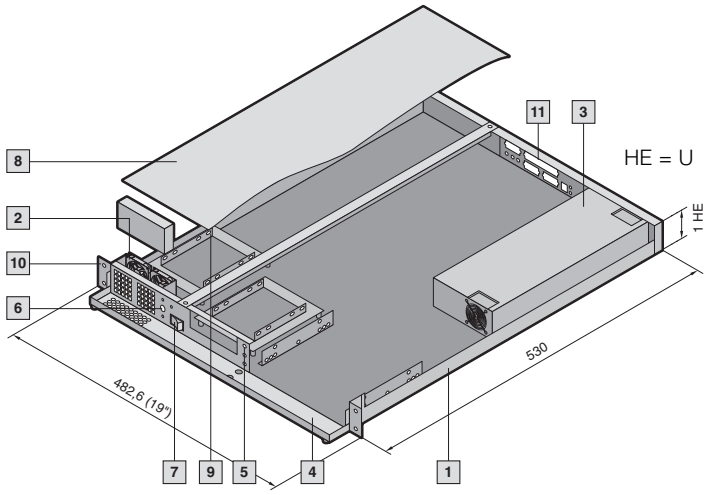
Type "Tucson"



Accessories Page 475 **Keyboard rack 482.6 mm (19″)** Page 1050 **TFT display 15″** Page 1050

ATX 1 U, sheet steel





Technical specifications:
482.6 mm (19″) rack-mount system for the installation of ATX/ Mini-ATX or Micro-ATX boards and 1 x 5¼″ and 1 x 3½″ drives.
Width: 482.6 mm (19″)
Height: 1 U (44.0 mm)
Overall depth: 532.5 mm.
EMC prepared.

Material/surface finish:
Case, cover:
1.2 mm sheet steel, zinc-plated and spray-finished in RAL 7035
Front door: 1.2 mm sheet steel, spray-finished in RAL 7035, unpainted contact points

Standards:
Complies with IEC 60 297-3 and ATX specification 2.01

Special designs available on request.

Supply includes:

1 Rack-mounted system 1 U, including drive module
2 2 x 40 mm fans and filter mat
3 ATX power pack 200 W (Technical specifications, see RP 3688.130, page 484)
4 Front door, horizontal hinge
5 LED displays, speakers
6 Reset button
7 On/off switch
8 Covers
9 Drive support for 1 x 3½″ hard drives
10 19″ flanges
11 Rear panel with integral I/O shield, type Venus

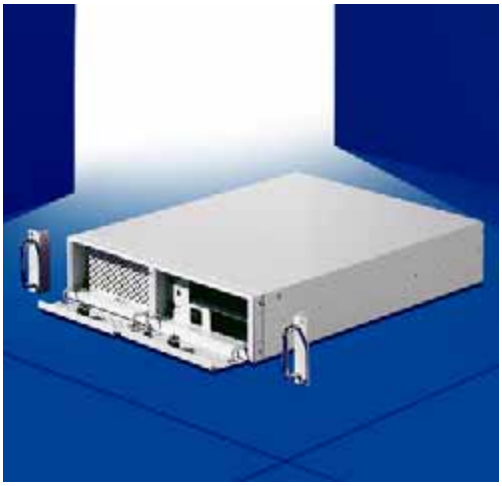
Riser card, 1 x PCI slot, 32 bit

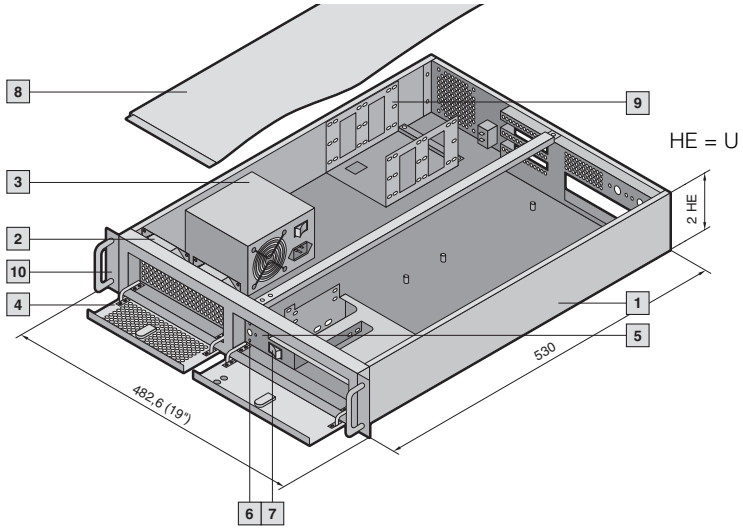
	Packs of		Page
U		**1**	
Width in mm		482.6 (19″)	
Height in mm		44.0 (1 U)	
Depth in mm		532.5/530.0	
Model No. RP basic system fully assembled	1	**3659.500**	
Accessories			
Unused slot cover	5	3659.030	475
Cover for 5¼″ drive space	1	3659.110	475
Cover for 3½″ drive space	1	3659.410	475
Uninterruptible power supply	1	3659.080	482
Front handles for ATX 1 U	2	3659.540	475

[1] Other versions available on request; please specify the type of mainboard.

Accessories Page 475 **Keyboard rack 482.6 mm (19″)** Page 1050 **TFT display 15″** Page 1050

ATX 2 U, sheet steel





Technical specifications:
482.6 mm (19″) rack-mount system for the installation of ATX/ Mini-ATX or Micro-ATX boards and 1 x 5¼″ and 1 x 3½″ drives.
Width: 482.6 mm (19″)
Height: 2 U (88.0 mm)
Overall depth: 532.5 mm.
EMC prepared.

Material/surface finish:
Case, cover:
1.2 mm sheet steel, zinc-plated and spray-finished in RAL 7035
Front door: 1.2 mm sheet steel, spray-finished in RAL 7035, unpainted contact points

Standards:
Complies with IEC 60 297-3 and ATX specification 2.01

Special designs available on request.

Supply includes:

1. Rack-mount system 2 U, including drive module
2. 2 x 80 mm fans and filter mat
3. ATX power pack 300 W with mains cable, PFC active (Technical specifications, see RP 3688.129, page 483)
4. Front door, horizontally hinged, lockable
5. LED displays, speakers
6. Reset button
7. On/off switch
8. Covers
9. Drive support for 3 x 3½″ hard drives
10. 19″ flanges

Bus and data connection cable

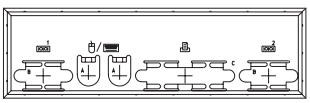
Riser card, 2 x PCI slot, 32 bit

	Packs of		Page
U		**2**	
Width in mm		482.6 (19″)	
Height of flanges/side panels in mm		88.0 (2 U)	
Depth in mm		532.5/530.0	
Model No. RP basic system fully assembled	1	**3659.600**	
Accessories			
Unused slot cover	5	3659.030	475
Cover for 5¼″ drive space	1	3659.110	475
Cover for 3½″ drive space	1	3659.410	475
Uninterruptible power supply	1	3659.080	482
Telescopic slides for 600 mm enclosure depth	1 set	3659.180	475
Telescopic slides for 800 mm enclosure depth	1 set	3659.190	475
Front handles for ATX 2 U	2	3659.020	475
Fan 12 V DC, 60 mm, for the rear panel	2	3659.250	476
ATX I/O covers, sheet steel[1)]			
Type “Aurora Marl”	1	**3659.040**	–
Type “Tucson”/“Venus"	1	**3659.130**	–
Type “Providence”	1	**3659.140**	–

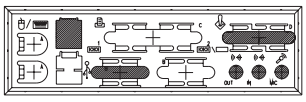
[1)] Other versions available on request; please specify the type of mainboard.

ATX I/O covers:

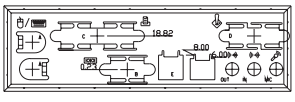
Type “Aurora Marl”



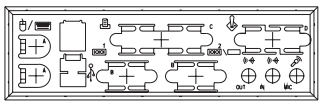
Type “Venus”



Type “Providence”

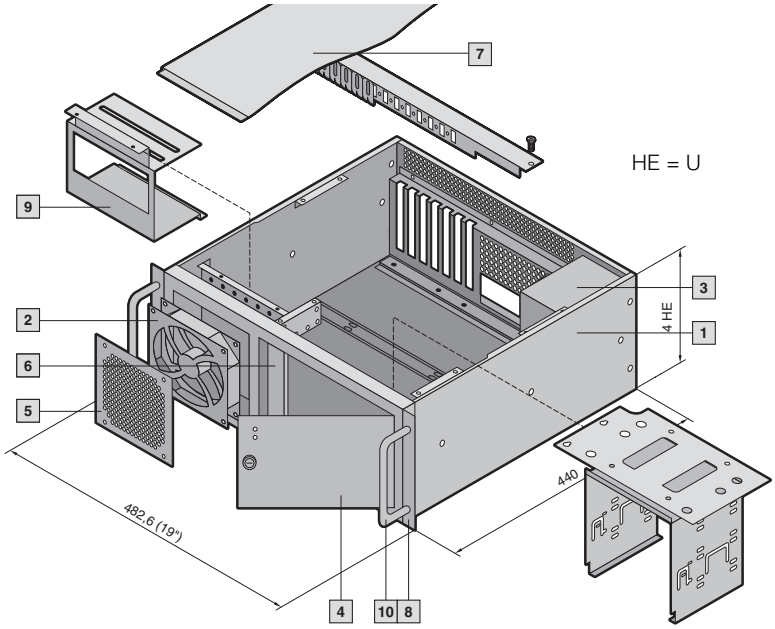


Type "Tucson"



Accessories Page 475 **Keyboard rack 482.6 mm (19″)** Page 1050 **TFT display 15″** Page 1050

ATX 4 U, sheet steel



Technical specifications:
482.6 mm (19″) rack-mount system for the installation of ATX/ Mini-ATX or Micro-ATX boards and 3 x 5¼″ and 1 x 3½″ drives.
Width: 482.6 mm (19″)
Height: 4 U (177.0 mm)
Side panels: 174.0 mm
Overall depth: 442.5 mm
Suitable for mounting on slide rails.

Material/surface finish:
Case, covers, front panels:
1.2 mm sheet steel, spray-finished in RAL 7035, unpainted contact points

Standards:
Complies with IEC 60 297-3 and ATX specification 2.01

Special designs available on request.

Supply includes:

1 Rack-mount system 4 U, including drive module

2 1 x 120 mm fan and filter mat, exchangeable from the front

3 ATX power pack 300 W (Technical specifications, see RP 3688.129, page 483)

4 Front door, vertically hinged, lockable

5 Front panel with ventilation holes and filter mat

6 LED displays, speakers Reset switch, on/off switch

7 Cover

8 Two 482.6 mm (19″) flanges

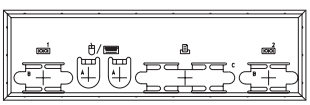
9 Drive support for 4 x 3½″ hard drives

	Packs of		Page
U		**4**	
Width in mm		482.6 (19″)	
Height of flanges/side panels in mm		177.0/174.0	
Depth in mm		442.5/440.0	
Model No. RP basic system fully assembled	1	**3659.900**	
Accessories			
Card retainer	7	3659.010	476
Mounting bar for card retainer	1	3659.090	476
Unused slot cover	5	3659.030	475
Cover for 5¼″ drive space	1	3659.110	475
Cover for 3½″ drive space	1	3659.410	475
Uninterruptible power supply	1	3659.080	482
Telescopic slides for 600 mm enclosure depth	1 set	3659.180	475
Telescopic slides for 800 mm enclosure depth	1 set	3659.190	475
10 Front handles for ATX 4 U	2	3659.240	475
ATX I/O covers, sheet steel[1]			
Type “Aurora Marl”	1	**3659.040**	–
Type “Tucson”/“Venus”	1	**3659.130**	–
Type “Providence”	1	**3659.140**	–

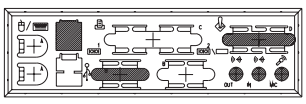
[1] Other versions available on request; please specify the type of mainboard.

ATX I/O covers:

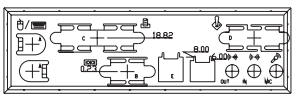
Type “Aurora Marl”



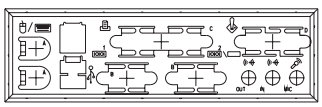
Type “Venus”



Type “Providence”

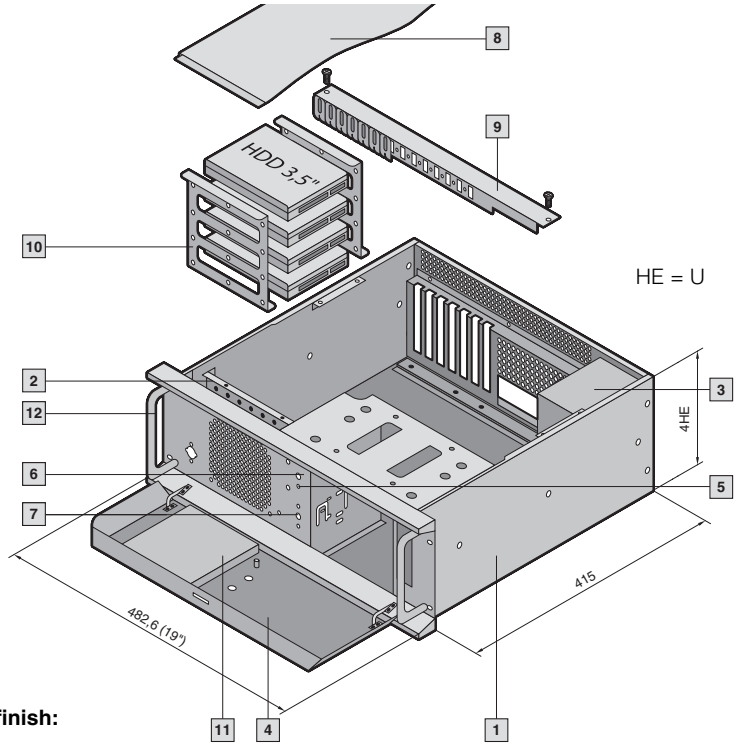


Type “Tucson”



Accessories Page 475 **Keyboard rack 482.6 mm (19″)** Page 1050 **TFT display 15″** Page 1050

ATX Economy with front door, 4 U, sheet steel



Technical specifications:
482.6 mm (19″) rack-mount system for the installation of ATX/ Mini-ATX or Micro-ATX boards and 3 x 5¼″ and 1 x 3½″ drives.
Width: 482.6 mm (19″)
Height: 4 U (177.0 mm)
Overall depth: 430 mm.
EMC prepared.

Material/surface finish:
Case, cover:
1.2 mm sheet steel, zinc-plated, passivated
Front door: 1.2 mm sheet steel, spray-finished in RAL 7035, unpainted contact points

Standards:
Complies with IEC 60 297-3 and ATX specification 2.01

Special designs available on request.

Supply includes:

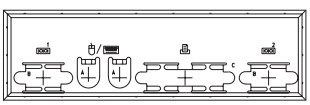
1 Rack-mount system 4 U, including drive module
2 1 x 120 mm fan and filter mat
3 ATX power pack 300 W (Technical specifications, see RP 3688.121, page 483)
4 Front door, horizontally hinged, lockable
5 LED displays, speakers
6 Reset button
7 On/off switch
8 Cover

	Packs of		Page
U		**4**	
Width in mm		482.6 (19″)	
Height of flanges/side panels in mm		177.0/174.0	
Depth in mm		430.0/415.0	
Model No. RP basic system fully assembled	1	**3659.100**	
Accessories			
9 Card retainer	7	3659.010	476
Mounting bar for card retainer	1	3659.090	476
Unused slot cover	5	3659.030	475
Cover for 5¼″ drive space	1	3659.110	475
Cover for 3½″ drive space	1	3659.410	475
10 Drive support for hard disks	1 set	3659.230	475
11 Spare filter mat	1	**3659.120**	–
Uninterruptible power supply	1	3659.080	482
Telescopic slides for 600 mm enclosure depth	1 set	3659.180	475
Telescopic slides for 800 mm enclosure depth	1 set	3659.190	475
12 Front handles for ATX 4 U	2	3659.240	475
ATX I/O covers, sheet steel[1]			
Type “Aurora Marl”	1	**3659.040**	–
Type “Tucson”/“Venus"	1	**3659.130**	–
Type “Providence”	1	**3659.140**	–

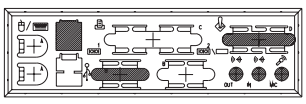
[1] Other versions available on request; please specify the type of mainboard.

ATX I/O covers:

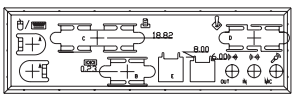
Type “Aurora Marl”



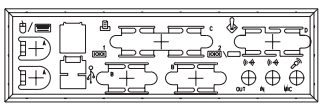
Type “Venus”



Type “Providence”

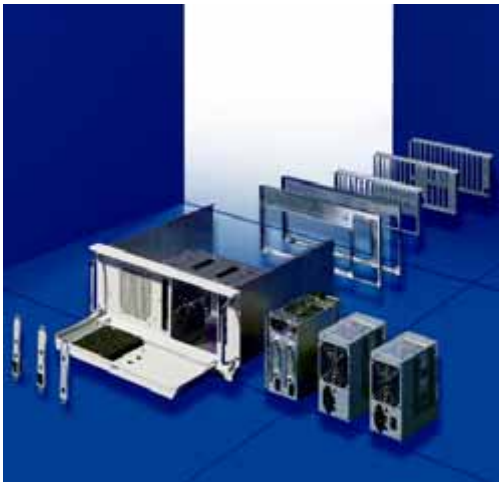


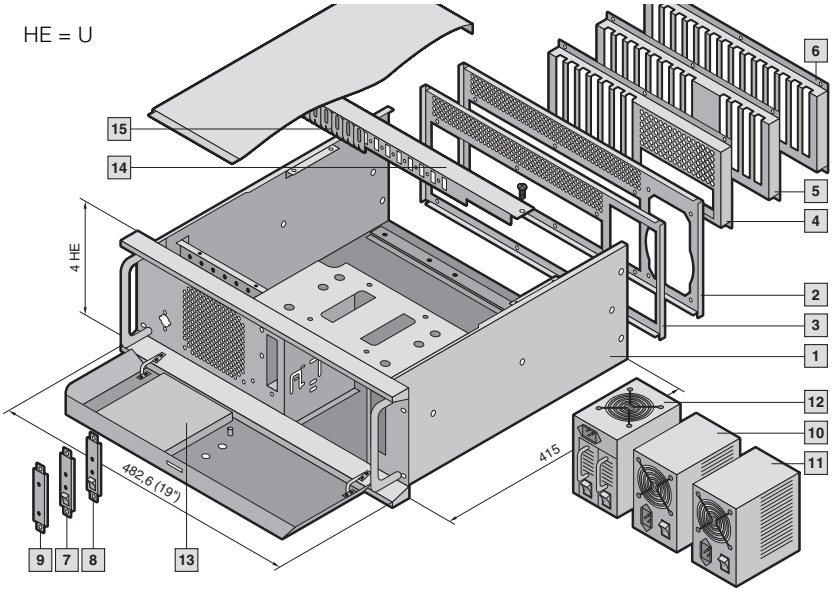
Type "Tucson"



Accessories Page 475 **Keyboard rack 482.6 mm (19″)** Page 1050 **TFT display 15″** Page 1050

Modular system AT/ATX Vario Economy with front door, 4 U, sheet steel





The modular principle of AT/ATX Vario Economy allows installation to accommodate individual requirements. The basic case may be fitted for both AT and ATX applications with the appropriate selection of rear panels, power packs and front trim panels. For self-assembly, or on request fully assembled and wired.

Technical specifications:
19″ rack-mount system for the installation of ATX/Mini-ATX, Micro-ATX boards or AT/Baby-AT boards as well as 3 x 5¼″ and 1 x 3½″ drives.
Width: 482.6 mm (19″)
Height: 4 U (177.0/174.0 mm)
Overall depth: 430 mm.

Material/surface finish:
Case, cover:
1.2 mm sheet steel, zinc-plated, passivated
Front door: 1.2 mm sheet steel, spray-finished in RAL 7035, unpainted contact points

Standards:
Complies with IEC 60 297-3 and ATX specification 2.01

Special designs available on request.

Basic enclosure supply includes:

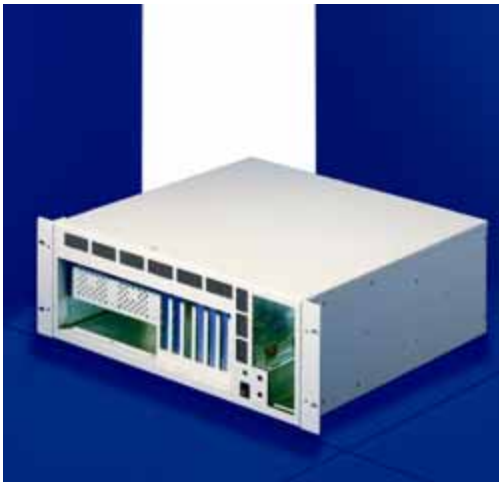
1 Case 4 U, 430 mm deep including assembly parts, covers, drive holder, fan, horizontally hinged front door, and air filter.

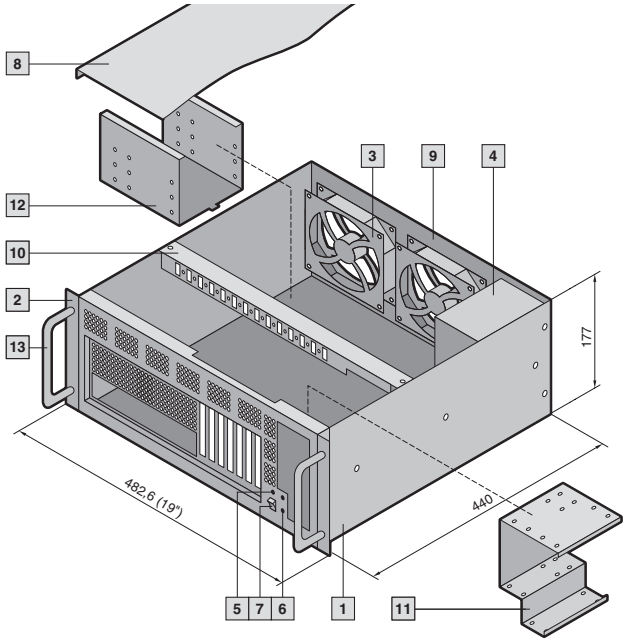
Note:
Rear panel, front trim panel and power pack should be ordered separately (for self-assembly).

	Packs of							Page
U		4						
		Installation for AT/ATX power pack (PS/2)			Installation for redundant power pack (PS/2)			
		ATX	AT 8 + 4 slots	AT 14 slots	ATX	AT 8 + 4 slots	AT 14 slots	
Model No. RP basic enclosure fitted	1	**3659.400**						
Installation, rear								
2 Rear panel for AT/ATX power pack	1	3659.290	3659.290	3659.290	–	–	–	476
3 Rear panel for redundant power pack	1	–	–	–	3659.310	3659.310	3659.310	476
4 Slotted rear panel for ATX 7 slot	1	3659.320	–	–	3659.320	–	–	476
5 Slotted rear panel 8 + 4 slots for AT	1	–	3659.330	–	–	3659.330	–	476
6 Slotted rear panel 14 slots for AT	1	–	–	3659.340	–	–	3659.340	476
Installation, front								
7 Front trim panel ATX with 2 x LED, reset switch	1	3659.350	–	–	3659.350	–	–	476
8 Front trim panel AT with 2 x LED, reset switch	1	–	3659.360	3659.360	–	3659.360	3659.360	476
9 Front trim panel ATX with automatic restart, 2 x LED, reset, Power On switch	1	3659.370	–	–	3659.370	–	–	476
Power packs								
10 ATX power pack 300 W, PFC passive	1	3688.121	–	–	–	–	–	483
ATX power pack 300 W, PFC active	1	3688.129	–	–	–	–	–	483
ATX power pack 400 W, PFC active	1	3688.128	–	–	–	–	–	483
11 AT power pack 300 W, PFC passive	1	–	3688.118	3688.118	–	–	–	483
12 Redundant power pack (PS/2), 2 x 300 W	1	–	–	–	3688.123	–	–	484
Fan 12 V DC, 60 mm, for the rear panel	2	3659.250	3659.250	3659.250	3659.250	3659.250	3659.250	476
13 Spare filter mat	1	**3659.120**	**3659.120**	**3659.120**	**3659.120**	**3659.120**	**3659.120**	–
Accessories								
14 Mounting bar for card retainer	1	3659.090	3659.090	3659.090	3659.090	3659.090	3659.090	476
15 Card retainer	7	3659.010	3659.010	3659.010	3659.010	3659.010	3659.010	476

Accessories Page 475 **Keyboard rack 482.6 mm (19″)** Page 1050 **TFT display 15″** Page 1050

ATX with front connections for 482.6 mm (19″) installation, 4 U





Technical specifications:
482.6 mm (19″) rack-mount system for the installation of ATX/ Mini-ATX or Micro-ATX boards and 1 x 5¼″ and 1 x 3½″ drives, vertical.
Width: 482.6 mm (19″)
Height: 4 U
Flanges: 177.0 mm
Side panels: 174.0 mm
Overall depth: 442.5 mm
Connections for I/Os, front
EMC prepared.
Suitable for mounting on slide rails.

Material/surface finish:
Case, covers:
1.2 mm sheet steel, spray-finished in RAL 7035, unpainted contact points

Standards:
Complies with IEC 60 297-3 and ATX specification 2.01

Special designs available on request.

Supply includes:

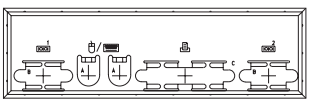
1 Rack-mount system 4 U, including drive holder
2 19″ flanges
3 2 x 120 mm fans
4 ATX power pack 300 W (Technical specifications, see RP 3688.129, page 483)
5 LED displays
6 Reset button
7 On/off switch
8 Cover
9 Rear panel with cutout and connection for power pack
10 Mounting bar for card retainer
11 Drive support for 1 x 5¼″ and 1 x 3½″
12 Drive support for 3 x hard drive 3½″

	Packs of		Page
U		**4**	
Width in mm		482.6 mm (19″)	
Height of flanges/side panels in mm		177.0/174.0	
Depth in mm		442.5/440.0	
Model No. RP basic system fully assembled	1	**3659.700**	
Accessories			
Card retainer	7	3659.010	476
Unused slot cover	5	3659.030	475
Cover for 5¼″ drive space	1	3659.110	475
Cover for 3½″ drive space	1	3659.410	475
Telescopic slides for 600 mm enclosure depth	1 set	3659.180	475
Telescopic slides for 800 mm enclosure depth	1 set	3659.190	475
13 Front handles for ATX 4 U	2	3659.240	475
ATX I/O covers, sheet steel[1]			
Type “Aurora Marl”	1	**3659.040**	–
Type “Tucson”/“Venus”	1	**3659.130**	–
Type “Providence”	1	**3659.140**	–

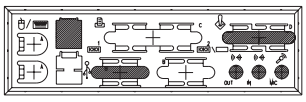
[1] Other versions available on request; please specify the type of mainboard.

ATX I/O covers:

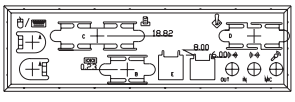
Type “Aurora Marl”



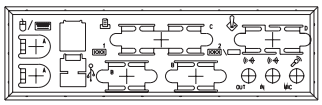
Type “Venus”



Type “Providence”

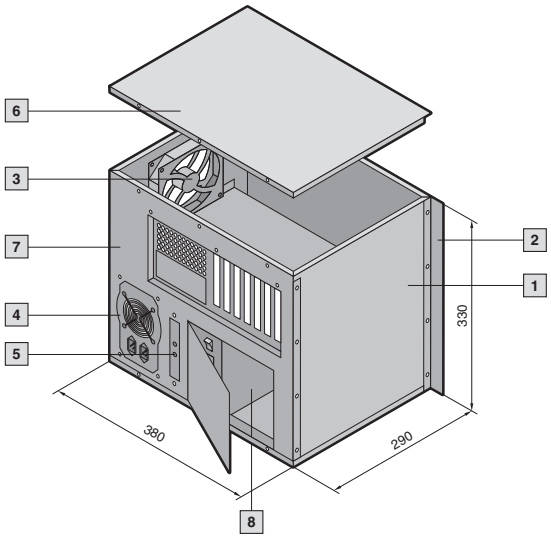


Type “Tucson”



Accessories Page 475 **Keyboard rack 482.6 mm (19″)** Page 1050 **TFT display 15″** Page 1050

ATX with front connections for wall mounting



Technical specifications:
System for the installation of ATX/Mini-ATX or Micro-ATX boards as well as 3 x 5¼″ and 1 x 3½″ drives, vertical.
Width: 380 mm
Height: 330 mm
Overall depth: 292.5 mm
Connections for I/Os, front
EMC prepared.
Suitable for mounting on mounting plates.

Material/surface finish:
Case, covers:
1.2 mm sheet steel, zinc-plated, passivated, unpainted, unpainted contact points

Standards:
Complies with IEC 60 297-3 and ATX specification 2.01

Special designs available on request.

Supply includes:

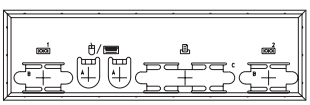
1 Rack-mounted system, including drive holder
2 Flanges for wall mounting
3 1 fans 120 mm
4 ATX power pack 300 W (Technical specifications, see RP 3688.129, page 483)
5 LED displays
6 Cover
7 Front panel
8 Drive support for 3 x 5¼″ and 1 x 3½″ drives

	Packs of		Page
Width in mm		380.0	
Height in mm		330.0	
Depth in mm		292.5/290.0	
Model No. RP basic system fully assembled	1	**3659.710**	
Accessories			
Unused slot cover	5	3659.030	475
Cover for 5¼″ drive space	1	3659.110	475
Cover for 3½″ drive space	1	3659.410	475
Uninterruptible power supply	1	3659.080	482
ATX I/O covers, sheet steel[1]			
Type “Aurora Marl”	1	**3659.040**	–
Type “Tucson”/“Venus”	1	**3659.130**	–
Type “Providence”	1	**3659.140**	–

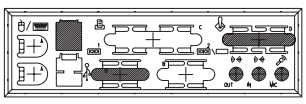
[1] Other versions available on request; please specify the type of mainboard.

ATX I/O covers:

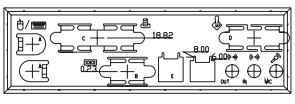
Type “Aurora Marl”



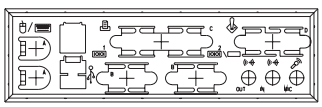
Type “Venus”



Type “Providence”



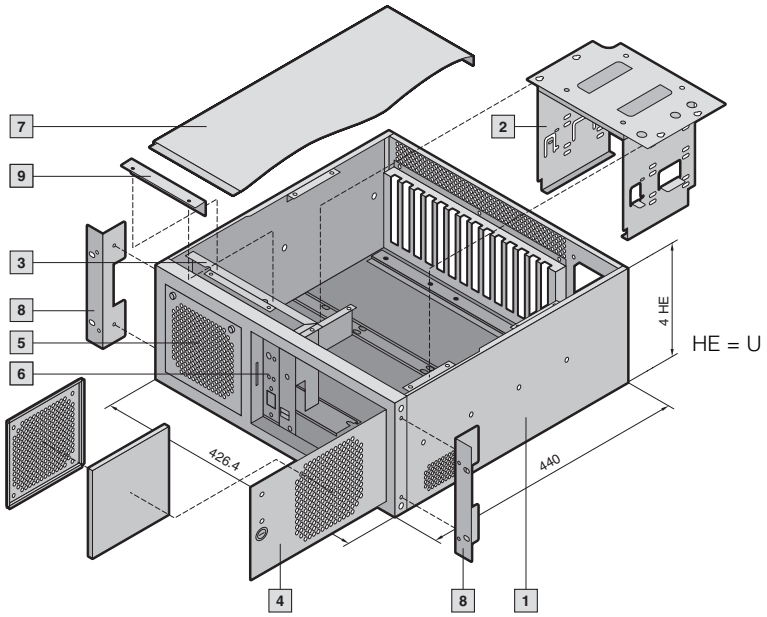
Type “Tucson”



Accessories Page 475 **Keyboard rack 482.6 mm (19″)** Page 1050 **TFT display 15″** Page 1050

Rack-mount systems for industrial PCs

for PICMG backplane, 4 U, sheet steel



Technical specifications:
19″ rack-mount system for the installation of a PICMG backplane, max. 14 slots as well as 3 x 5¼″ hard disks, and 1 x 3½″ hard disks, internal.
Width: 482.6 mm (19″)
Height: 4 U (177.0 mm)
Overall depth: 442.5 mm
EMC prepared.

Material/surface finish:
Case, cover:
1.2 mm sheet steel, spray-finished in RAL 7035, unpainted contact points

Standards:
Complies with IEC 60 297-3

Supply includes:

1 Rack-mount system 4 U, 440 mm deep 482.6 mm (19″) wide, for max 14 slot PICMG backplane (10 full size boards)

2 Drive holder for the installation of 3 x 5¼″ drives, externally and 1 x 3½″ drives, internally

3 1 fans 120 mm

4 Front door vented, including filter mat, vertically hinged, lockable.

5 Front panel with ventilation holes and filter mat

6 LED displays, speaker, reset button, 2 x USB 2.0, on/off button

7 Cover

8 19″ flanges

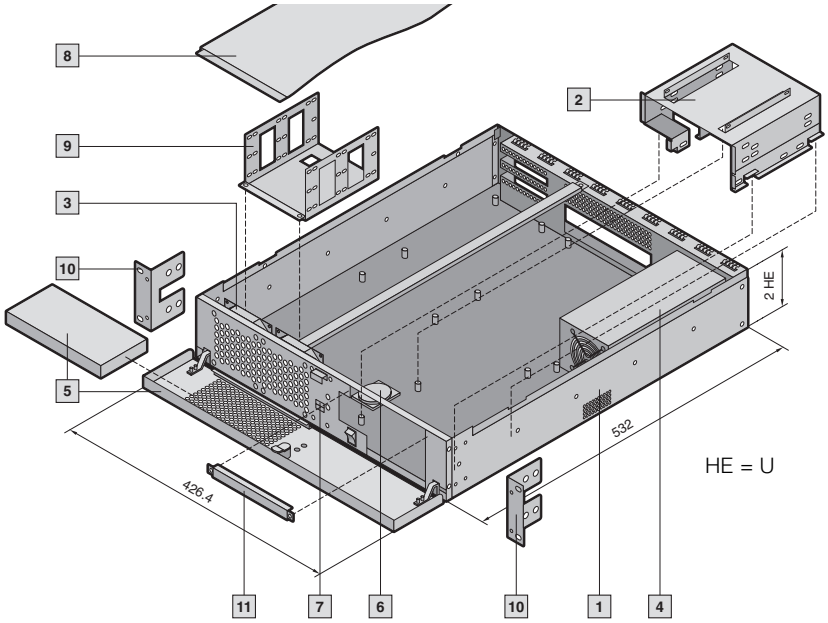
9 Support for full-size boards

Note:
Order power pack separately, see page 482 – 485.

	Packs of		Page
U		**4**	
Width in mm		482.6 (19″)	
Height of flanges/side panels in mm		177.0/174.0	
Depth in mm		442.5/440.0	
Model No. RP basic system fully assembled	1	**3659.650**	
Accessories			
Card retainer	7	3659.010	476
Mounting bar for card retainer	1	3659.090	476
Unused slot cover	5	3659.030	475
Cover for 5¼″ drive space	1	3659.110	475
Adaptor for installation of 3½″ floppy in 5¼″ space	1	3659.280	476
Adaptor for installation of 3½″ hard disk in 5¼″ space	1	3659.270	476
Uninterruptible power supply	1	3659.080	482
Telescopic slides for 600 mm enclosure depth	1 set	3659.180	475
Telescopic slides for 800 mm enclosure depth	1 set	3659.190	475
Front handles for ATX 4 U	2	3659.240	475

Accessories Page 475 **Keyboard rack 482.6 mm (19″)** Page 1050 **TFT display 15″** Page 1050

ATX with horizontally hinged front door, 2 U, sheet steel



Technical specifications:
19″ rack-mount system for the installation of ATX/Mini-ATX or Micro-ATX boards and 1 x 5¼″, 1 x 3½″ drives.
and 1 x Slim-CD-ROM.
Width: 482.6 mm (19″)
Height: 2 U (88.0 mm)
Overall depth: 532 mm
EMC prepared.

Material/surface finish:
Case, cover:
1.2 mm sheet steel, spray-finished in RAL 7035, unpainted contact points

Standards:
Complies with IEC 60 297-3 and ATX specification 2.01

Special designs available on request.

Supply includes:

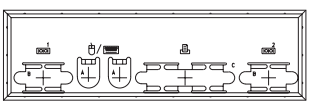
1 Rack-mount system
2 Disk drive holder for installation of 1 x 5¼″ and 1 x 3½″ drives and 1 x Slim-CD-ROM
3 2 x 80 mm fans
4 ATX power pack 300 W, PFC active
5 Front door, horizontally hinged, lockable, with filter mat
6 Speakers
7 Reset button, LED displays, On/off button, 2 x USB 2.0
8 Covers
9 Drive support for 3 x 3½″ hard disk
10 19″ flanges
11 Cover for Slim-CD-ROM
Bus and data connection cable
Riser card, 2 x PCI slot, 32 bit

	Packs of		Page
U		**2**	
Width in mm		482.6 (19″)	
Height in mm		88.0	
Depth in mm		532.0/530.0	
Model No. RP basic system fully assembled	1	**3659.640**	
Accessories			
Unused slot cover	5	3659.030	475
Cover for 5¼″ drive space	1	3659.110	475
Cover for 3½″ drive space	1	3659.410	475
Uninterruptible power supply	1	3659.080	482
Telescopic slides for 600 mm enclosure depth	1 set	3659.180	475
Telescopic slides for 800 mm enclosure depth	1 set	3659.190	475
Front handles for ATX 2 U	2	3659.020	475
ATX I/O covers, sheet steel[1)]			
Type “Aurora Marl”	1	**3659.040**	–
Type “Tucson”/“Venus”	1	**3659.130**	–
Type “Providence”	1	**3659.140**	–

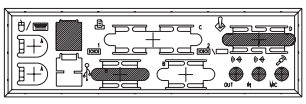
[1)] Other versions available on request; please specify the type of mainboard.

ATX I/O covers:

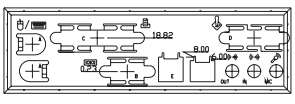
Type “Aurora Marl”



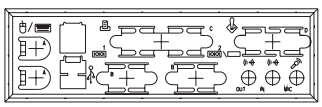
Type “Venus”



Type “Providence”



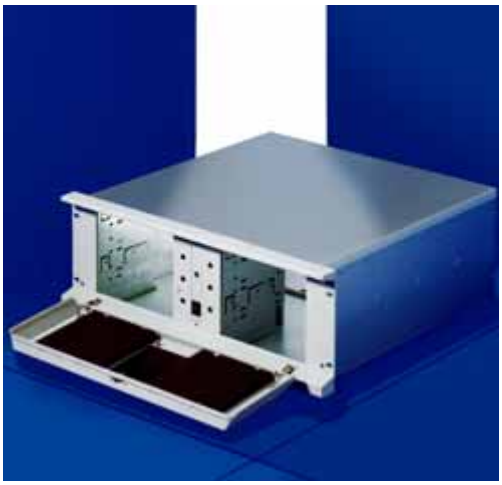
Type “Tucson”

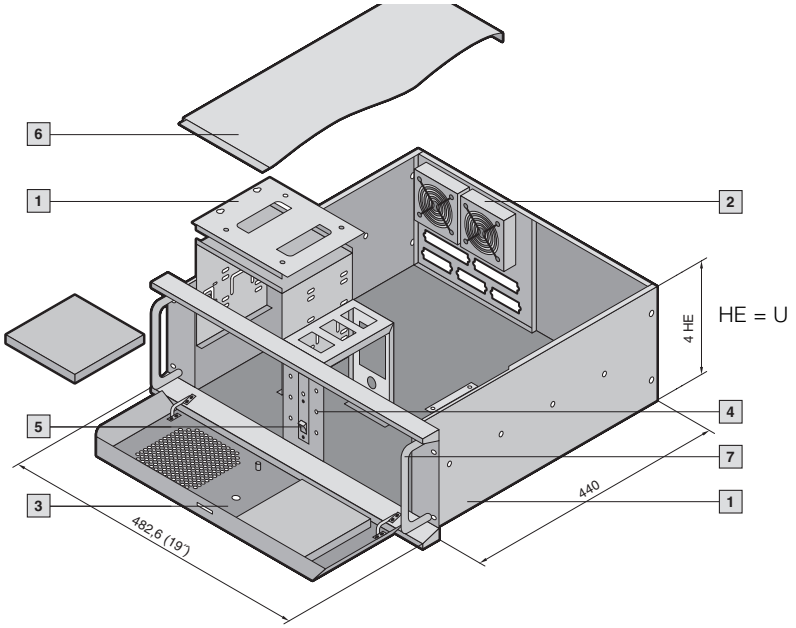


Accessories Page 475 **Keyboard rack 482.6 mm (19″)** Page 1050 **TFT display 15″** Page 1050

Rack-mount systems for storage devices

19″ RAID subrack





Technical specifications:
19″ rack-mount system for horizontal installation of storage devices $5^1/_4$″ or $3^1/_2$″.
Width: 482.6 mm (19″)
Height: 4 U
Overall depth: 455 mm
EMC prepared.

Material/surface finish:
Case, covers:
1.2 mm sheet steel, zinc-plated passivated and spray-finished in RAL 7035
Front door: Spray-finished in RAL 7035,
unpainted contact points

Standards:
Complies with IEC 60 297-3.

Special designs available on request.

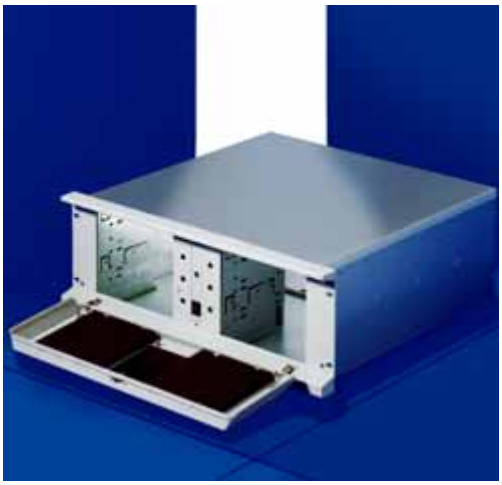
Supply includes:
1 Rack-mount system 4 U, including drive holders
2 2 x 120 mm fans
3 Front door, horizontally hinged, lockable
4 LED displays
5 On/off switch
6 Cover

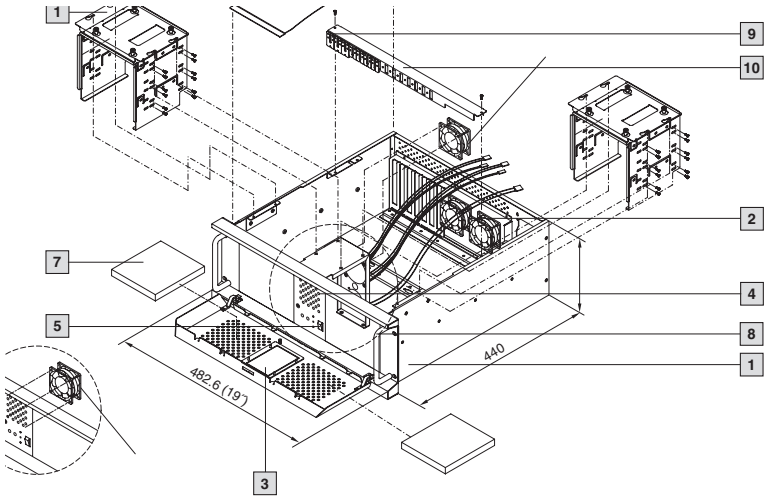
Note:
Order power pack separately, see page 483.

	Packs of		Page
U		**4**	
Width in mm		482.6 (19″)	
Height in mm		177.0 (4 U)	
Depth in mm		455.0/440.0	
Model No. RP basic system fully assembled	1	**3659.300**	
Accessories			
7 Front handles	2	3659.240	475
Redundant power pack for RAID (2 x 300 W) PFC active	1	3688.125	484
AT power pack for RAID (300 W) PFC passive	1	3688.119	483
Telescopic slides for 600 mm enclosure depth	1 set	3659.180	475
Telescopic slides for 800 mm enclosure depth	1 set	3659.190	475
Adaptor for installation of $3^1/_2$″ hard disks in $5^1/_4$″ space	1	3659.270	476
Adaptor for installation of $3^1/_2$″ floppy in $5^1/_4$″ space	1	3659.280	476
Cover for $5^1/_4$″ drive space	1	3659.110	475

Accessories Page 475 **Keyboard rack 482.6 mm (19″)** Page 1050 **TFT display 15″** Page 1050

19″ ATX RAID subrack, 6-drive





HE = U

Technical specifications:
19″ rack-mount system for the horizontal installation of 6 storage devices $5^1/_4$″ or $3^1/_2$″ horizontally and one ATX board.
Width: 482.6 mm (19″)
Height: 4 U
Overall depth: 455 mm
EMC prepared.

Material/surface finish:
Case, cover:
1.2 mm sheet steel, zinc-plated, passivated, unpainted
Front door: Spray-finished in RAL 7035, unpainted contact points

Standards:
Complies with IEC 60 297-3 and ATX specification 2.01.

Special designs available on request.

Supply includes:
- 1 Rack-mount system 4 U, including drive holders
- 2 2 fans 60 mm
- 3 Front door, horizontally hinged, lockable
- 4 LED displays
- 5 On/off switch
- 6 Cover
- 7 Filter mats
- 11 Option

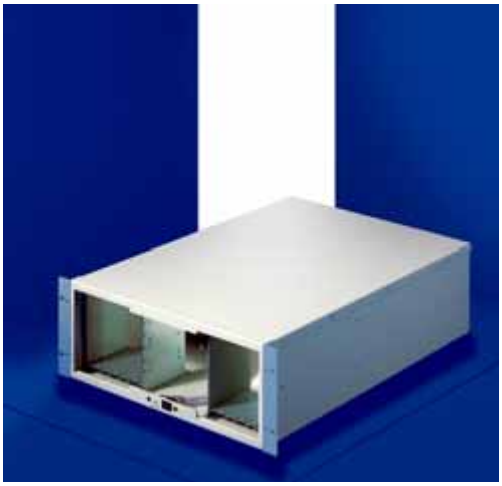
Note:
Order power pack separately, see page 483/485.

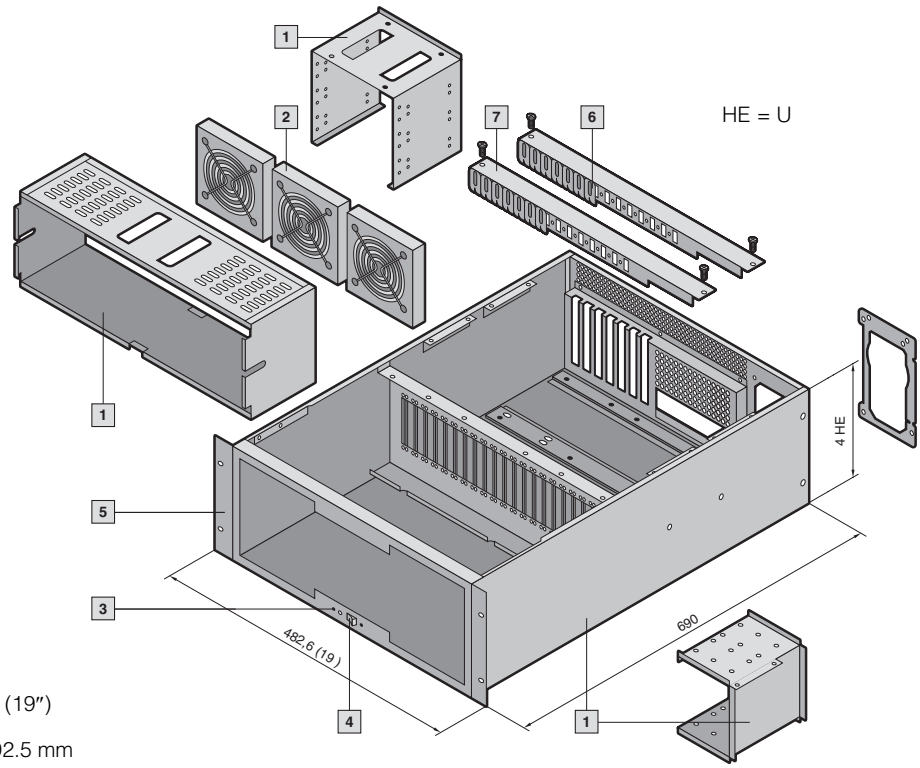
	Packs of		Page
U		**4**	
Width in mm		482.6 (19″)	
Height of flanges/side panels in mm		177.0/174.0	
Depth in mm		455.0/440.0	
Model No. RP basic system fully assembled	1	**3659.420**	
Accessories			
8 Front handles 4 U	2	3659.240	475
9 Card retainer	7	3659.010	476
10 Mounting bar for card retainer	1	3659.090	476
AT power pack 300 W, PFC passive	1	3688.118	483
ATX power pack 300 W, PFC passive	1	3688.121	483
ATX power pack 300 W, PFC active	1	3688.129	483
ATX power pack 250 W, PFC active	1	3688.127	483
Redundant power pack (PS/2)	1	3688.120	485
Fan 12 V DC, 60 mm, with 2 connectors	2	3659.250	476
Telescopic slides for 600 mm enclosure depth	1 set	3659.180	475
Telescopic slides for 800 mm enclosure depth	1 set	3659.190	475
Adaptor for installation of $3^1/_2$″ hard disks in $5^1/_4$″ spaces	1	3659.270	476
Adaptor for installation of $3^1/_2$″ floppy in $5^1/_4$″ spaces	1	3659.280	476
Cover for $5^1/_4$″ drive space	1	3659.110	475
Unused slot cover	5	3659.030	475
Front trim panel ATX with automatic restart, 2 x LED, reset, Power On switch	1	3659.370	476
ATX I/O covers, sheet steel[1)]			
Type “Aurora Marl”	1	3659.040	471
Type “Tucson”/“Venus”	1	3659.130	471
Type “Providence”	1	3659.140	471

[1)] Other versions available on request; please specify the type of mainboard.

Accessories Page 475 **Keyboard rack 482.6 mm (19″)** Page 1050 **TFT display 15″** Page 1050

19″ ATX RAID subrack, 9-drive





The 9-drive ATX RAID subrack is suitable for the horizontal and vertical installation of 9 storage devices and an ATX board. The rear panel is prepared for the installation of PS/2 or redundant power packs.

Technical specifications:
19″ rack-mount system for the installation of 6 x $5^1/_4$″ storage devices vertically and 3 x $5^1/_4$″ horizontally, plus 3 x $3^1/_2$″ storage devices internally and an ATX board.

Width: 482.6 mm (19″)
Height: 4 U
Overall depth: 692.5 mm
EMC prepared.

Material/surface finish:
Case, cover: 1.2 mm sheet steel, spray-finished RAL 7035
Front trim panel:
Spray-finished in RAL 7035

Standards:
Complies with IEC 60 297-3 and ATX specification 2.01.

Special designs available on request.

Supply includes:
1 Rack-mount system 4 U, including drive modules
2 3 x 120 mm fans
3 LED displays
4 On/off switch
5 Two 482.6 mm (19″) flanges
Cover

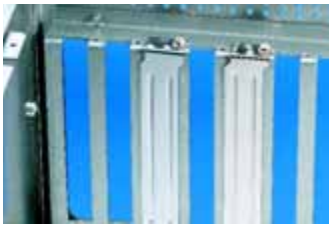
Note:
Order power pack separately, see page 483/485.

	Packs of		Page
U		**4**	
Width in mm		482.6 (19″)	
Height in mm		177.0 (4 U)	
Depth in mm		692.5/690.0	
Model No. RP basic system fully assembled	1	**3659.430**	
Accessories			
Front handles 4 U	2	3659.240	475
6 Card retainer	7	3659.010	476
7 Mounting bar for card retainer	1	3659.090	476
AT power pack 300 W, PFC passive	1	3688.118	483
ATX power pack 300 W, PFC passive	1	3688.121	483
ATX power pack 300 W, PFC active	1	3688.129	483
ATX power pack 250 W, PFC active	1	3688.127	483
Redundant power pack PS/2	1	3688.120	485
Telescopic slides for 800 mm enclosure depth	1 set	3659.190	475
Adaptor for installation of $3^1/_2$″ hard disks in $5^1/_4$″	1	3659.270	476
Adaptor for installation of $3^1/_2$″ floppy in $5^1/_4$″	1	3659.280	476
Cover for $5^1/_4$″ drive space	1	3659.110	475
Unused slot cover	5	3659.030	475
ATX I/O covers, sheet steel[1]			
Type “Aurora Marl”	1	3659.040	471
Type “Tucson”/“Venus”	1	3659.130	471
Type “Providence”	1	3659.140	471

[1] Other versions available on request; please specify the type of mainboard.

Accessories Page 475 **Keyboard rack 482.6 mm (19″)** Page 1050 **TFT display 15″** Page 1050

Accessories



Unused slot cover

Screw-on cover to conceal slot cutouts which are not required.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Packs of	Model No. RP
5	**3659.030**

Cover for drives

To conceal the $3^1/_2$″ or $5^1/_4$″ drive slots.

Material:
Sheet steel, zinc-plated/spray-finished in RAL 7035

Supply includes:
Assembly parts.

Version	Packs of	Model No. RP
$3^1/_2$″	1	**3659.410**
$5^1/_4$″	1	**3659.110**

For ATX Ripac

Version	Packs of	Model No. RP
$5^1/_4$″	1	**3659.050**

Telescopic slides

Facilitate optimum accessibility to the units, even when built-in.
For up to a maximum enclosure width of 426 mm.

Load capacity:
30 kg

Material:
Sheet steel

Supply includes:
1 set = 2 telescopic slides, installation kit, assembly parts.

For enclosure depth mm	Maximum extension mm	Model No. RP
600	511.2	**3659.180**
800	596.4	**3659.190**

Note:
May only be fitted in conjunction with L-shaped 482.6 mm (19″) sections!

Front handles

The handles are fitted onto the 482.6 mm (19″) flange. They allow easy withdrawal of the cases from the enclosure.

Material:
Sheet steel, plated

Supply includes:
Assembly parts.

For enclosure height (U)	Packs of	Model No. RP
1	2	**3659.540**
2	2	**3659.020**
4	2	**3659.240**

Drive support

The drive supports will additionally accommodate a maximum of 4 additional $3^1/_2$″ hard disks. They are mounted inside the enclosure behind the fan.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

For system	Packs of	Model No. RP
ATX Economy	1 set	**3659.230**
ATX Ripac	1 set	**3659.060**

Accessories

Card retainer

For secure attachment and stabilisation of slot cards up to 327 mm depth. The card retainers are height-adjustable so that even cards of different heights may be securely attached.
A mounting bar is needed to fit the card retainer (already included with ATX Ripac).

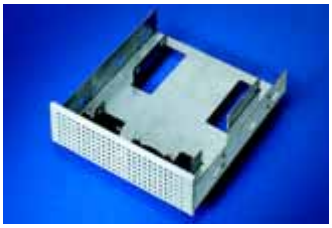
Material:
Card retainer: Plastic
Mounting bar: Sheet steel, zinc-plated, passivated

Card retainer

Packs of	Model No. RP
7	**3659.010**

Mounting bar

Packs of	Model No. RP
1	**3659.090**



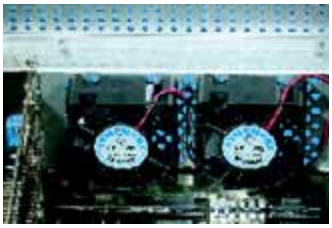
Adaptor

For the installation of $3^1/_2$″ hard disks or floppies in $5^1/_4$″ installation slots.

Material:
Sheet steel, zinc-plated,
Front panel spray-finished in RAL 7035.

Supply includes:
Assembly parts.

Version	Packs of	Model No. RP
for $3^1/_2$″ hard disk	1	**3659.270**
for $3^1/_2$″ floppy	1	**3659.280**

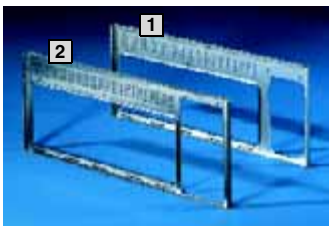


DC fan for rear panel

Fan 12 V DC, 60 mm, for mounting on the rear panel. Including two 4-pole connectors with terminal.

Supply includes:
2 fans with connection cable, including assembly parts.

Packs of	Model No. RP
2	**3659.250**



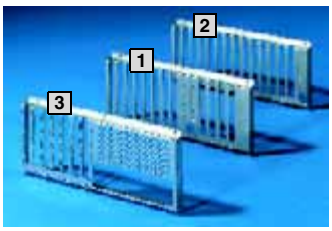
Rear panels

For the installation of AT/ATX Economy. Optionally with cutout for AT/ATX power pack or redundant power pack.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Version	Packs of	Model No. RP
1 for AT/ATX power pack PS/2	1	**3659.290**
2 for redundant power pack PS/2	1	**3659.310**



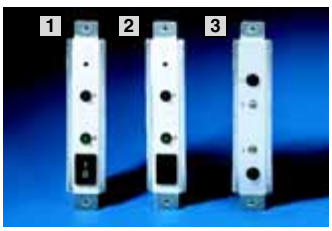
Slotted rear panels

For the installation of AT/ATX Economy. Mounted on the rear panels. Optionally for AT (8 + 4 or 14 slots) or ATX (7 slots).

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Version	Packs of	Model No. RP
1 AT 4 + 8 slots	1	**3659.330**
2 AT 14 slots	1	**3659.340**
3 ATX 7 slots	1	**3659.320**



Front trim panels

For the installation of AT/ATX Economy. Mounted in the front of the enclosure.

Optionally for:
- AT (2 x LED, reset button)
- ATX (2 x LED, reset button)
- ATX (2 x LED, reset button), electronics for automatic restart following mains failure

Version	Packs of	Model No. RP
1 AT	1	**3659.360**
2 ATX	1	**3659.350**
3 ATX (with electronics)	1	**3659.370**

Rack-mount systems for industrial PCs and storage devices

Power supply units

Features

Rittal offers an extensive range of power supply units in various designs.

The range includes 482.6 mm (19″) compatible, as well as Open Frame version or PS/2 variants as well as power supplies to supply DC voltage to controllers, systems and plant in many different areas.

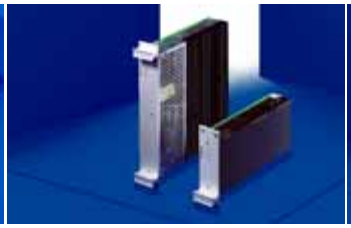
Open Frame (VME)

250/600/400/1000 W

Design features
- Open frame design
- Mounting on mounting base or enclosure rear panel
- Fan cooled
- Wide-range input
- Aluminium enclosure
- 3 outputs

User benefits
- Minimal space requirements with a high power output
- Universal applications
- Approvals: EN 60 950, UL 1950, IEC 950 and CSA 22.2 No. 234

3 U, 6 U (VME)



130/160/270 W, plug-in, integral VMEbus signalling

Design features
- 482.6 mm (19″) module to IEC 60 297-3
- Mounting in the subrack with the aid of plastic guide rails
- Connection via connectors H15, IEC 60 603-2 (DIN 41 612)
- 3 outputs

User benefits
- 482.6 mm (19″) compatible
- Hot swappable
- Approvals: EN 60 950, VDE 0805 and IEC 950

3 U, 6 U (CPCI)

175/200/250/350 W, plug-in

Design features
- 482.6 mm (19″) module to IEC 60 297-3
- Mounting in the subrack with the aid of plastic guide rails
- Positronic connector 47-pole PICMG 2.9
- 4 outputs

User benefits
- 482.6 (19″) compatible
- Hot swappable
- Approvals: EN 60 950 A1 – A4, CSA 22.2, UL 1950, C
- PICMG specification

PS/2 (AT/ATX)

250/300/400 W
Power supply units for ATX and CPCI systems

Design features
- Open frame design
- Mounting on a mounting plate or subrack rear panel
- Integral fan
- Sheet steel enclosure
- PFC active or passive
- Optional redundant versions

User benefits
- Universal applications
- Approvals: CSA

UPS

Uninterruptible power supply for installation in a 5¼″ drive bays. Guarantees power supply in the event of a mains failure (6 minutes).

Design features
- Installation in 1 or 2 standard 5¼″ drive holders
- Integral batteries

User benefits
- Minimal space requirements
- Approvals: CE, EN 60 950

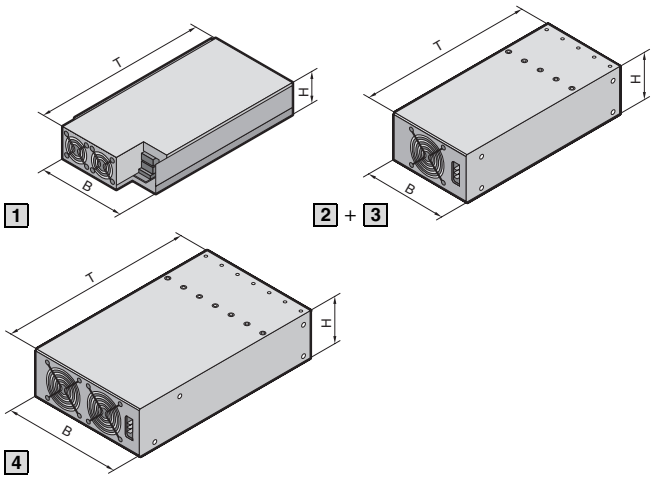
Redundant

2 x 300 W power supplies for RAID or ATX.

Design features
- Hot-swap version
- PFC active

User benefits
- Universal applications
- Hot swap-compatible

Ripac power supplies – Open Frame



Note:
Power supply 1000 W:
48 V DC input on request.

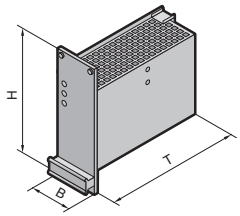
Detailed drawing,
see page 1151 – 1152.

	1 250 W			2 400 W			3 600 W			4 1000 W		
Height (H) in mm	49.5			63.0			63.0			63.0		
Width (B) in mm	126.5			126.5			126.5			175.5		
Depth (T) in mm	259.5			279.0			323.0			283.5		
Model No. RP 35 A	**3686.622**			**–**			**–**			**–**		
Model No. RP 60 A	**–**			**3686.623**			**–**			**–**		
Model No. RP 85 A	**–**			**3686.629**			**3686.624**			**–**		
Model No. RP 110 A	**–**			**–**			**–**			**3686.625**		
Output sizes												
Output	1	2	3	1	2	3	1	2	3	1	2	3
Output voltage	5 V	+12 V	–12 V	5 V	+12 V	–12 V	5 V	+12 V	–12 V	5 V	+12 V	–12 V
Output current	35 A	8 A		60 A 85 A	8 A		85 A	8 A		110 A	16 A	8 A
Maximum power output	250 watts			400 watts			600 watts			1000 watts		
Setting range of output voltage	5 – 5.5 V	9 – 15 V		2.5 – 5.7 V	5 – 16 V		± 10 %			4.5 – 5.5 V	9 – 15 V	5 – 15 V
Load compensation (load variation 0 – 100 %)	50 mV	± 3 %		< 0.5 %			< 0.5 %			< 0.5 %		
Line regulation ($U_{e\,min} – U_{e\,max}$)	± 50 mV or ± 3 %			< 25 mV	< 60 mV		< 25 mV	< 60 mV		< 0.5 %		
Base load	10 %	–		–			–			–		
Infeed compensation (Sense)	0.5 V	0.5 V	–	0.5 V	–		0.5 V	–		max. 0.5 V	1 V	
Residual ripple (max.)	1 %			1 %	2 %		1 %	2 %		1 %	2 %	
Temperature coefficient	0.02 %/°C			0.03 %/°C			0.03 %/°C			0.03 %/°C		
Overvoltage protection	Yes											
Overload protection[1)]	Yes			Thermal current limiting			Yes					
Overload protection, thermal	–						In case of fan failure or overtemperature					
Overload protection, electronic	–						at 132 % U_{rated} or short-circuit			Yes, each module separately		
Input variables												
Mains voltage U_e	85 – 264 V AC; 120 – 340 V DC			90 – 264 V AC						150 – 264 V AC		
Mains frequency	45 – 65 Hz			47 – 63 Hz						–		
Power factor	EN 61 000-3-2			> 0.95						–		
Start-up current limitation	< 40 A (cold start)			<50 A						–		
Efficiency (typ.)	70 %			75 %						72 %		
General specifications, see page 1151 – 1152												
Accessories: Mounting base for power supply, see page 485												

[1)] All outputs short circuit-resistant up to a maximum of 30 sec.

Power supply units

Ripac power supplies for VME, plug-in



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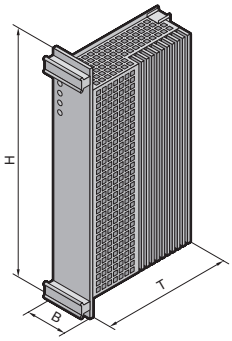


2

Connector assignment,
see page 1153.

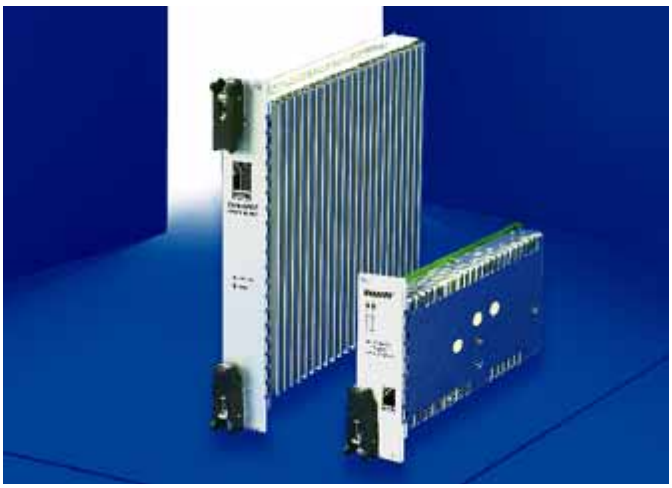
Characteristic curve diagram,
see page 1153.

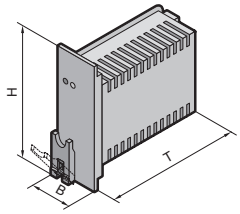
Detailed drawing,
see page 1153.

	1			2		
Height (H)	3 U			6 U		
Width (B)	10 HP		12 HP	8 HP		12 HP
Depth (T) in mm	170.0		170.0	170.0		170.0
Model No. RP power supply	**3686.469**		**3686.470**	**3686.471**		**3685.306**
Model No. RP front panel	**3685.304**		**3685.305**	**3686.472**		**3685.307**
Output sizes						
Output	1	2	3	1	2	3
Output voltage	5 V	+12 V	–12 V	5 V	+12 V	–12 V
Output current 3 U, 10 HP/6 U, 8 HP	14 A	5 A	2 A	20 A	5 A	2 A
Output current 3 U, 12 HP/6 U, 12 HP	20 A	5 A	2 A	35 A	6 A	2 A
Maximum power output	130 W (10 HP), 160 W (12 HP)			160 W (8 HP), 270 W (12 HP)		
Setting range of output voltage	± 5 %	–		± 5 %	–	
Load compensation (load variation 0 – 100 %)	< 0.1 %	< 1 %		< 0.1 %	< 1 %	
Line regulation ($U_{e\,min}$ – $U_{e\,max}$)	< 0.2 % at 99 – 138/187 – 264 V AC			< 0.2 % at 230 V AC + 15 % – 19 %		
Base load	–					
Compensation time	< 1 ms at I_a 20 – 80 %					
Infeed compensation (Sense)	± 0.25 V	–		± 0.25 V	–	
Residual ripple (max.)	< 35 mV		< 20 mV	< 45 mVss	< 30 mVss	< 15 mVss
Interference voltage	50 mV typ. (bandwidth 20 MHz)			< 80 mV typ. (bandwidth 20 MHz)		
Temperature coefficient	0.025 %/K					
Overvoltage protection (automatically recovery)	125 % + 5 %	125 % + 10 %		125 % ± 5%	120 % ± 10 %	
Overload protection	typ. 110 % $I_{a\,rated}$, U/I characteristic curve acting on all outputs, outputs short circuit-resistant					
Overtemperature protection	Cuts out if the internal temperature is too high, cuts in again with hysteresis					
AC-FAIL, SYSRESET	TTL signals with 48 mA drive current, active low					
ON delay	< 0.5 s			–		
Ramp-up time	< 30 ms			50 ms		
Input variables						
Mains voltage U_e	AC 187 – 264 V, 50/60 Hz with automatic changeover to AC 90 – 138 V (in the range 90 – 94 V AC only 85 % rated load) or 264 – 347 V DC			AC 187 – 264 V, 50/60 Hz with automatic changeover to AC 99 – 138 V		
Mains frequency	47 – 63 Hz					
Efficiency (typ.)	80 %					
Startup current limitation	< 10 A typ. – in cold state < 15 A typ. – in warm state			< 25 A typ. – in cold state < 35 A typ. – in warm state		
Fuse	4 AT			8 AT		

General specifications, see page 1153

Ripac power supplies for CPCI, plug-in





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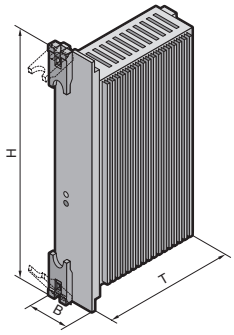


2

Connector assignment,
see page 1154.

Detailed drawing,
see page 1154.

	1								2							
Height (H)	3 U								6 U							
Width (B)	8 HP								8 HP							
Depth (T) in mm	170.0								170.0							
Model No. RP AC power supply	**3688.534**				**3688.694**				**3688.695**				**3688.528**			
Model No. RP DC power supply	**3688.537**				**3688.655**				**3688.696**				**3688.530**			
Output sizes																
Output	U_1	U_2	U_3	U_4	U_1	U_2	U_3	U_4	U_1	U_2	U_3	U_4	U_1	U_2	U_3	U_4
Output voltage	5 V	3.3 V	12 V	–12 V	5 V	3.3 V	12 V	–12 V	5 V	3.3 V	12 V	–12 V	5 V	3.3 V	12 V	–12 V
Output current	25 A	20 A	5 A	0.5 A	30 A	25 A	5 A	0.5 A	33 A	33 A	6 A	1.5 A	40 A	40 A	9 A	1 A
Outpu current U_1 and U_2	30 A max.				38 A max.								80 A max.			
Maximum power output	175 W				200 W				250 W				350 W			
Base load (only U_1)	5 %	–			5 %	–			5 %	–			10 %			
Load compensation (dyn.)	< 3 % at 25 % load variation (1A/µs) 1 % after 300 µs															
Line regulation	< ± 1 % (90 – 264 V AC)												< ± 1 % (90 – 264 V AC) U_1, U_2, U_3			
Infeed compensation (Sense)	0.25 V	0.25 V	0.25 V	–	0.25 V	0.25 V	0.25 V	–	–	–	–	–	0.25 V	0.25 V	0.25 V	–
Residual ripple (PARD)	50 mV or 1 % (bandwidth 20 MHz)															
Temperature coefficient	< ± 0.02 %/K (0° – 50°C) after 20 min. start-up time															
Overvoltage protection	125 % ± 10 %, reset by switching on again															
Overload protection	Current limiting of all outputs, automatic return at normal load															
Overtemperature protection	At overtemperature switches off all outputs, automatic return at normal temperature															
Input variables																
Mains voltage or DC input	90 – 264 V AC, 47 – 63 Hz, 3.2 A max. 36 – 72 V DC, 7.9 A												90 – 264 V AC, 47 – 63 Hz, 7 A 40 – 72 V DC, 14 A			
Power Factor	0.99 at V AC 115 V, full load															
Starting current	15 A (115 V AC) cold start, 30 A (230 V AC) cold start															
Fuse	3.15 A, 250 V AC or 10 A, DC												10 A, 250 V AC or 20 A, DC			
Signals and control cables																
Power Fail (Pin 42)	In the event of a mains failure > 4 ms before output voltages from control range and in the event of failure or undervoltage of any output voltage															
DEG (pin 38)	In case of overtemperature												–			
Remote enable	Use logic “0” (TTL level)															
Remote inhibit	Use logic “1” (TTL level)															
LED displays, two-colour	Green: “Power ON” and output voltages present Red: Error															
General specifications, see page 1154																

CPCI power supplies, uninterruptible power supply

CPCI power supply

Open Frame 400 watts

- Wide-range input (90 – 253 V AC)
- Power factor to EN 61 000-3-2
- Radio interference suppression to EN 55 022, curve B
- Immunity to interference to EN 61 000-4-2/4/5 Level 3 (formerly IEC 801-2/4/5)
- Quick installation due to “Fast On” connectors (approx. 30 sec.)
- Tested to EN 60 950, UL 1950 and CSA 22.2 No. 234

Technical specifications:
400 W max.
3.3 V/25 A
5.0 V/25 A
12.0 V/8 A
–12.0 V/7 A

Height mm	Width mm	Depth mm	Model No. RP
126	63	279	**3687.695**

CPCI power supply

Plug-type, 180 watts

- Module, 3 U, 12 HP, plug-in
- Connector M24/8/DIN 41612
- Automatic changeover 120/230 V AC
- All outputs permanently short-circuit resistant
- SELV outputs to EN 60 950
- Overvoltage protection on the primary and secondary circuits
- Overtemperature protection
- Control inputs: ENABLE, INHIBIT
- Signal output: DERATE
- EMC standards EN 50 081-1 and EN 50 082-2
- EN 60 950/VDE 0805-SELV, protection category I, VDE 0100

Technical specifications:
180 W max.
5.1 V/20 A
3.3 V/14 A
12.0 V/2 A
–12.0 V/1 A

Detailed data specification sheet available on request.

Height U	Width HP	Model No. RP	
		Power supply	Front panel for power supply
3	12	**3686.682**	**3685.330**

Accessories:

Female connector type M24/8,
see page 485.
Female connector type H15,
see page 550.
Guide rails,
see page 509 onwards.

Uninterruptible power supply

- Ensures power continuity in the event of a mains failure
- Suitable for installation in a 5¼″ drive holder
- Floating contacts (DB-9) for UPS communication: Indicates the operating states: mains ok/ mains failure/end of battery capacity/input for UPS deactivation signal
- Integral maintenance-free batteries
- CE certified, EN 60 950 tested (LVD/EMC)

Note:
The UPS does not have an RS-232 interface. Upon request you can obtain an adaptor cable including CD-ROM with shutdown drivers for automatic termination of program routines and shutdown of the system for Windows, Netware and Linux.
Additional battery (5¼″) to extend to 500 VA available on request.

Packs of	Model No. RP
1	**3659.080**

Technical specifications:
Output 300 VA/180 W
Input/output voltage: 220, 230, 240 V AC ± 15 %
Input frequency: 50 Hz ± 5 %
Output frequency: 50 Hz ± 1 %
Switch-over time: < 4 ms
Charging time: 6 – 8 hours
(to 90 % capacity)
Operating environment:
Temperature 0°C – 40°C,
Humidity 0 – 90 %
Status displays:
LED for mains operation, back-up, low battery, over-temperature
Acoustic alarms:
Mains interruption (sounds every 5 sec.),
Low battery (sounds every sec.)
Test function:
Test switch on the front panel to check the UPS function
Approvals:
CE, EN 60 950 tested (LVD/EMC)
Hold-up time: 6 min.

AT/ATX power supplies, redundant power supplies

ATX power supply unit

for external switches

- PS/2 model
- Built-in fan
- Short circuit-protected
- CSA-approved
- Connection cable for $5^1/_4$″ and $3^1/_2$″ disk drives, hard drive and motherboard
- PFC passive

Technical specifications:
300 W/230 V AC
+3.3 V, 0.2 A/16.0 A
+5.0 V, 30.0 A/19.5 A
+12.0 V, 11.0 A
–12.0 V, 0.8 A
–5.0 V, 0.3 A
+5.0 VSB, 2.0 A
+3.3 V and +5 V, total max. 150 W
if 3.3 V/0.2 A, target +5 V/30 A
if 3.3 V/16 A, target +5 V/19.5 A

Packs of	Model No. RP
1	**3687.793**

Supply includes:
Connection cable.

Accessories:
Front panel for ATX power supply, see page 483.

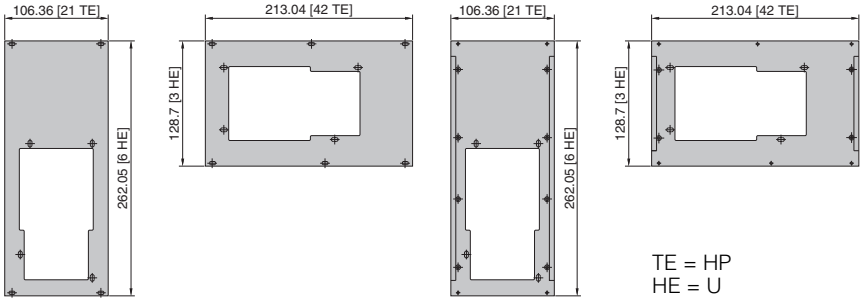
Front panel

for ATX power supply
Front panel with cutouts for mounting the ATX power supply units in the subrack.

Material:
Aluminium, clear-chromated

Supply includes:
1 front panel, assembly parts,
EMC gaskets (with EMC version).

U	HP	Model No. RP	
		EMC	Non-EMC
3	42	**3685.331**	**3685.328**
6	21	**3685.332**	**3685.329**



AT/ATX power supply

- PS/2 model
- Built-in fan
- Short circuit-protected
- CSA-approved
- On/off switch
- PFC active/passive
- W x H x D = 86 x 150 x 140 mm
- 47 – 63 Hz

Supply includes:
Connection cable.

Version	Power	Packs of	Model No. RP
AT	300 W	1	**3688.118**
AT for RAID	300 W	1	**3688.119**
ATX	300 W	1	**3688.121**
ATX	250 W	1	**3688.127**
ATX	300 W	1	**3688.129**
ATX	400 W	1	**3688.128**

Technical specifications:

3688.118	3688.119	3688.121	3688.127	3688.129	3688.128
300 W max./ 230 V AC 5.0 V/30.0 A –5.0 V/0.5 A 12.0 V/12.0 A –12.0 V/0.5 A PFC passive	300 W/ 230 V AC 5.0 V/16.0 A –5.0 V/1.0 A 12.0 V/18.0 A –12.0 V/1.0 A PFC passive	300 W max./ 115/230 V AC 3.3 V/15.0 A 5.0 V/30.0 A –5.0 V/0.3 A 12.0 V/15.0 A –12.0 V/0.8 A +5 VSB/2.0 A 3.3 V plus 5 V max. = 200 W 3.3 V, 5 V plus 12 V max. = 280 W PFC passive	250 W max./ 100 – 240 V AC 3.3 V/20.0 A 5.0 V/25.0 A –5.0 V/0.3 A 12.0 V/13.0 A –12.0 V/0.8 A +5 VSB/2.0 A 3.3 V plus 5 V max. = 150 W 3.3 V, 5 V plus 12 V max. = 230 W PFC active	300 W max./ 110 – 240 V AC 3.3 V/28.0 A 5.0 V/30.0 A –5.0 V/0.3 A +5 VSB/2 A 12.0 V/13.0 A –12.0 V/0.8 A 3.3 V plus 5 V max. = 180 W 3.3 V, 5 V plus 12 V max. = 280 W PFC active	400 W max./ 110 – 240 V AC 3.3 V/28.0 A 5.0 V/40.0 A –5.0 V/0.3 A 12.0 V/15.0 A –12.0 V/0.8 A +5 VSB/2.0 A 3.3 V plus 5 V max. = 235 W 3.3 V, 5 V plus 12 V max. = 380 W PFC active

AT/ATX power supplies, redundant power supplies

ATX power supply unit 1 U

- 2 built-in fans
- Short circuit-protected
- On/off switch
- PFC active
- W x H x D = 85 x 40 x 230 mm

Technical specifications:
200 W max./
100 – 240 V AC
47 – 63 Hz
3.3 V/14.0 A
5.0 V/20.0 A
–5.0 V/0.3 A
12.0 V/6.0 A
–12.0 V/0.8 A
+5 VSB/2 A
+3.3 V plus 5 V max. = 120 W
+3.3, 5 V plus 12 V max. = 180 W

Version	Packs of	Model No. RP
ATX	1	**3688.130**

Supply includes:
DC connection cable.

Redundant power supply

for RAID

- Built-in fan
- Hot-swap version
- PFC active
- Individual power pack available (separately)
- W x H x D = 190 x 170 x 183 mm

Technical specifications:
2 x 300 W
90 – 264 V AC
47 – 63 Hz
5.0 V/25.0 A
12.0 V/14.0 A
–5.0 V/0.5 A
–12.0 V/0.5 A

Version	Packs of	Model No. RP
RAID version	1	**3688.125**
Individual power pack (spare)	1	**3688.126**

Supply includes:
DC connection cable.

Redundant power supply

for ATX

- PS/2 model, 2 switches, 1 connector
- Built-in fan
- Hot-swap version
- PFC active
- Individual power pack available (separately)
- W x H x D = 86 x 150 x 185 mm

Technical specifications:
2 x 300 W
90 – 264 V AC
47 – 63 Hz
3.3 V/20.0 A
5.0 V/25.0 A
5 VSB/1.5 V
12.0 V/16.0 A max. 20 A
–12.0 V/0.5 A
5 V, 3.3 V and 12 V plus max. 285 W

Version	Packs of	Model No. RP
ATX version	1	**3688.123**
Individual power pack (spare)	1	**3688.124**

Supply includes:
DC connection cable.

AT/ATX power supplies, redundant power supplies

Redundant power supply

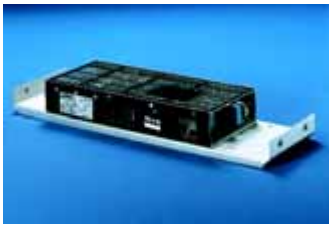
for ATX

- PS/2 model, 2 switches, 2 connector
- Built-in fan
- Hot-swap version
- PFC active
- Individual power pack available (separately)
- W x H x D = 86 x 160 x 220 mm

Technical specifications:
2 x 300 W
90 – 264 V AC
47 – 63 Hz
3.3 V/18.0 A
5.0 V/26.0 A
5.0 VSB/1.2 A
12.0 V/16.0 A max. 20 A
–12.0 V/1.0 A
+5 V, 3.3 V plus 12.0 V max. = 285 W

Version	Packs of	Model No. RP
ATX version	1	**3688.120**
Individual power pack (spare)	1	**3688.122**

Supply includes:
DC connection cable.



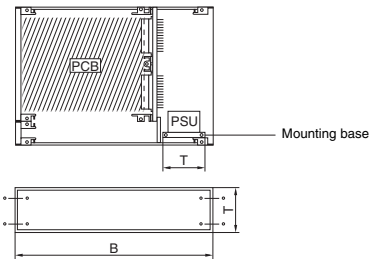
Mounting base for power supplies

- Attaches to the subrack side panel

Material:
2 mm aluminium, clear-chromated

Supply includes:
Assembly parts.

Width (B) mm	Depth (T) mm	Model No. RP
431.8	100	**3684.323**
431.8	130	**3684.324**



Female connector type M24/8

IEC 60 603-2 (DIN 41 612)

- Female connector for plug-in CPCI power supplies
- Quality level 2 to IEC 60 603-2 (DIN 41 612)
- Optional 20 A high current contacts for straight conductor connection either crimp or solder
- Volume resistance max. 1.5 mΩ
- Max. rated current: 40 A

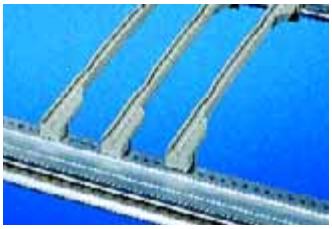
Supply includes:
5 connection sockets
(crimping or soldering method).

Type of connection	Packs of	Model No. RP
Soldering	1	**3687.665**
Crimping	1	**3687.666**

Also required:

For mounting in the subrack, a Z rail is required, see page 504.

Female connector type H15 IEC 60 603-2 (DIN 41 612)
for plug-in power supplies, see page 550.

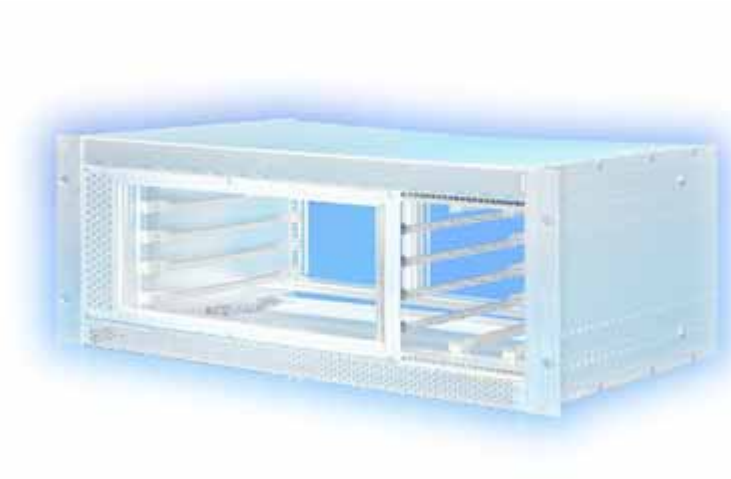


Plastic guide rails
for routing the plug-in power supply, see page 509.

Keyable guide rails, plastic, see page 510/511.

Note:
The CompactPCI specification prescribes green guide rails with $^1/_2$ HP offset for power supply installation (PICMG 2.11).

Features

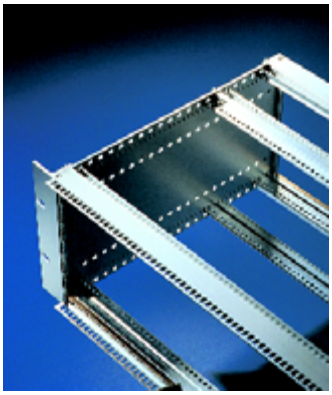


The modular concept of Ripac subracks facilitates a wide range of potential applications with a minimum of components.

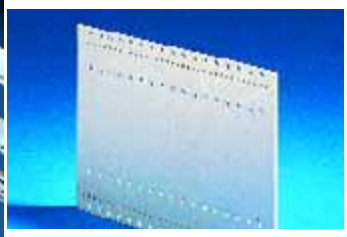
All Ripac subracks are based on to common horizontal rails and system components.

The difference lies in the design of the side panels and/or installation variants.

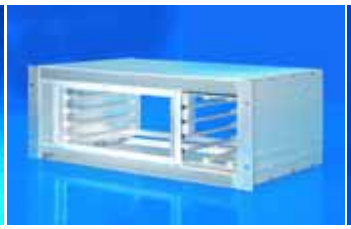
The subracks are shock- and vibration-tested and comply with IEC 60 297-3 as well as IEEE 1101.1/1101.10.



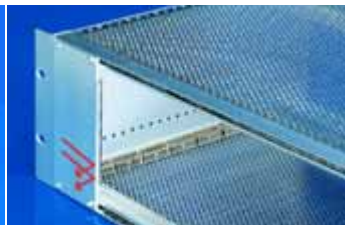
Design features, Ripac Vario and Vario EMC



Depth-variable system installation is supported by the 10 mm pitch pattern of holes in the side panels.



Complex applications thanks to numerous size variants and system accessories.

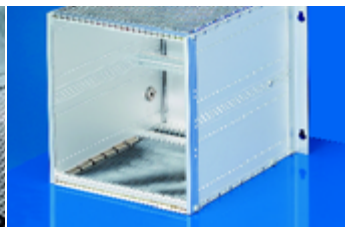


EMC shielding via horizontal and vertical EMC gaskets. May also be retrofitted.

Design features, Ripac Compact

Top-hat rail mounting
Rear adaptors allow simple snap-mounting directly onto the top-hat rail.

Mounting on mounting plates
Machined keyholes for direct mounting on mounting plates.

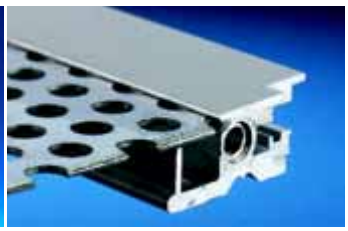


EMC version optional.

Design features, Ripac Vario Mobil

- The subracks have been tested for use in the German national railway. Testing was conducted in accordance with standard EN 50 155 (electronic equipment in rail vehicles). The construction of the subracks tested conforms to IEC 60 297.
- Vibration and shock-tested to: IEC 600-68-2-6, test Fc IEC 600-68-2-27, test Ea
- Supply includes: Subrack, fully assembled.

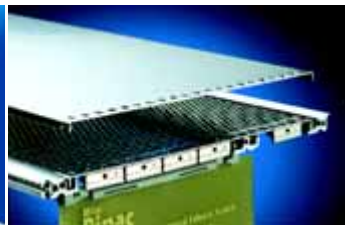
Design features, Ripac ECO



Side panels of sheet steel, zinc-plated. Flanges of aluminium, clear-chromated. Prescribed mounting positions for 160 and 220 mm board formats.

Simple cover mounting: Easily slid into the horizontal rails.

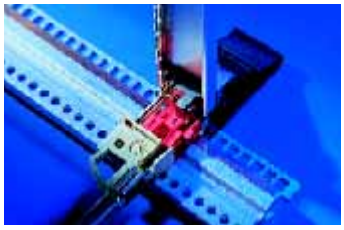
System installation, accessories

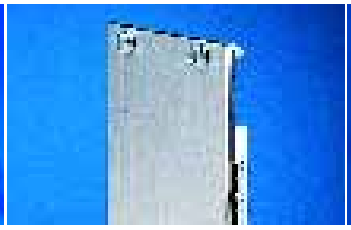


Guide rails of plastic or aluminium, also keyable.

Covers vented or solid, snap-fastening or screw-fastening.

ESD contacts for guide rails, to remove electrostatic charges.





Keys for keying the board-type plug-in units.

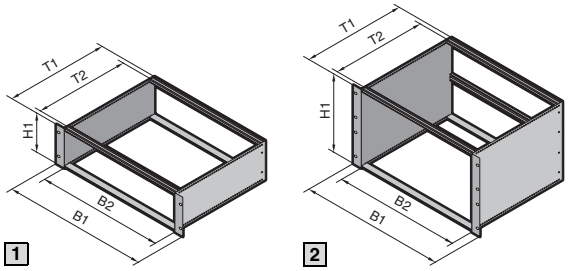
Front panels in various versions, e.g. with handles, vented or for EMC applications.

Injector/extractor handles self-latching, of plastic or aluminium.

Connectors IEC 60 603-2 (DIN 41 612) in various designs.

Mounting kits for combined installation of single and double Euroboards, horizontal or vertical.

Ripac ECO 3 U, 6 U, sheet steel



Material/surface finish:
Side panels:
1.5 mm sheet steel, zinc-plated, passivated
Flanges/horizontal rails:
Extruded aluminium section, clear-chromated

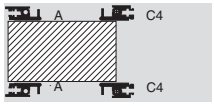
Supply includes:
Side panels, flanges, horizontal rails, threaded inserts

Detailed parts lists,
see page 1155.

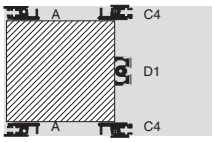
Tests:
Vibration and shock-tested to:
IEC 600-68-2-6 test Fc
IEC 600-68-2-27 test Ea

Standards:
Ripac subracks are based on the system dimensions of IEC 60 297-3/-5.

Detailed drawing,
see page 1155.



1 for backplane

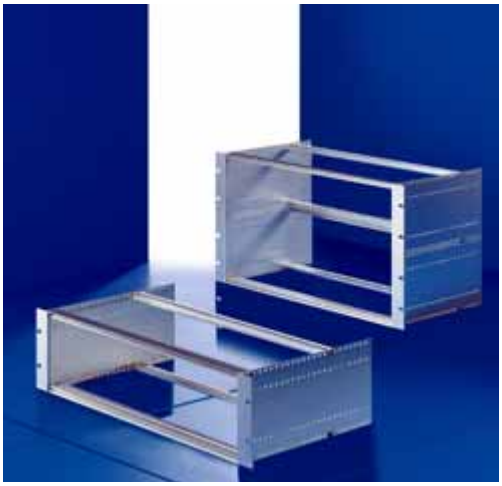


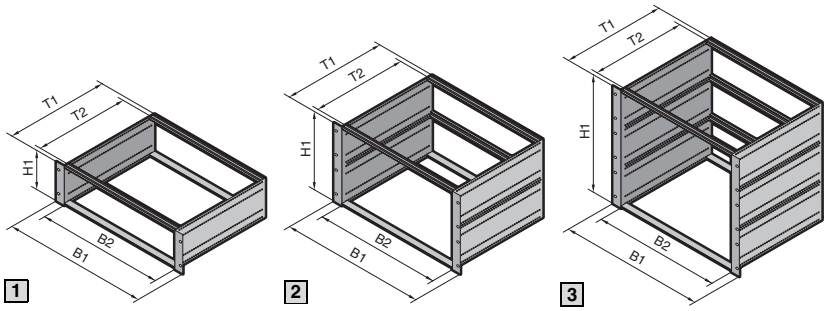
2 for backplane

					Model No. RP		Page
					1	2	
U (H1)					**3**	**6**	
B1 mm	B2 HP	Side panel (T1) mm	T2 mm	Max. PCB depth mm	For backplane	For backplane	
482.6 (19″)	84	175	150	160	**3688.114**	**3688.116**	
		235	210	220	**3688.115**	**3688.117**	
Accessories							
Trim section rear, 3 U					3688.112		497
Trim section rear, 6 U					3688.113		497
Z (connector) rail					3684.602		504
Insulating strips					3684.611		505
Cover, perforated, for 175 mm depth					3688.105		518
Cover, perforated, for 210 mm depth					3688.106		518
Cover, solid, for 175 mm depth					3688.107		518
Cover, solid, for 210 mm depth					3688.108		518
Mounting clips for covers					3688.109		518
Assembly screw for mounting clips					9902.188		518
Guide rails							509
Horizontal rails							498

Subrack components Page 495 **Accessories** Page 506 **Assembly parts** Page 576 **Ripac Vario** Page 489 **Ripac Compact** Page 493
Ripac Vario Mobil Page 494

Ripac Vario 3 U, 6 U, 9 U





B = Width
T = Depth

Material/surface finish:
Side panels:
2.5 mm aluminium,
clear-chromated
482.6 mm (19″) flanges and
horizontal rails:
Extruded aluminium section,
clear-chromated

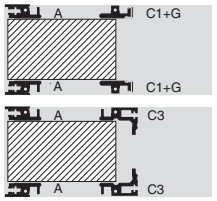
Supply includes:
Flanges, side panels,
horizontal rails,
threaded inserts, insulating
strips, fastenings.

Detailed parts lists,
see page 1156.

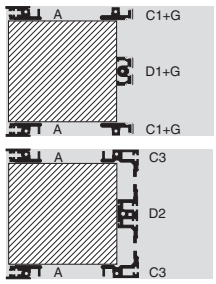
Tests:
Vibration and shock-tested to:
IEC 600-68-2-6 test Fc
IEC 600-68-2-27 test Ea

Standards:
Ripac subracks are based
on the system dimensions on
IEC 60 297-3/-5.

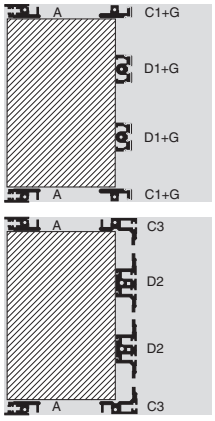
Detailed drawing,
see page 1155.



1 Top: For backplane
Bottom: For connector



2 Top: For backplane
Bottom: For connector

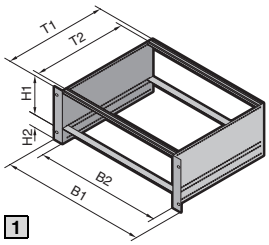


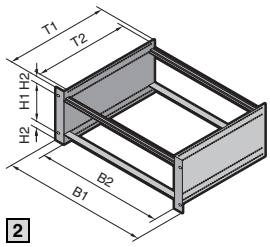
3 Top: For backplane
Bottom: For connector

					Model No. RP					
					1		2		3	
U					**3**	**3**	**6**	**6**	**9**	**9**
Height (H1) in mm					132		265.35		398.70	
B1 mm	B2 HP	Side panel (T1) mm	T2 mm	Max. PCB depth mm	For backplane	For connectors IEC 60 603-2 (DIN 41 612)	For backplane	For connectors IEC 60 603-2 (DIN 41 612)	For backplane	For connectors IEC 60 603-2 (DIN 41 612)
482.6 (19″)	84	185	160	160	**3684.020**	**3684.034**	**3684.043**	**3684.056**	–	–
		225	200	160	**3684.021**	**3684.035**	**3684.044**	**3684.057**	–	–
		245	220	220	**3684.022**	**3684.036**	**3684.045**	**3684.058**	–	–
		285	260	220	**3684.023**	**3685.281**	**3684.046**	–	–	–
		305	280	280	**3685.231**	**3685.233**	**3685.238**	**3685.240**	–	–
		345	320	280	**3684.024**	–	**3684.047**	–	**3684.051**	**3684.059**
		365	340	340	**3685.232**	**3685.234**	**3685.239**	–	–	–
		405	380	340	**3684.025**	–	**3684.048**	–	**3684.052**	**3684.060**
		465	440	400	**3684.026**	–	**3684.049**	–	**3684.053**	**3684.061**
		525	500	400	**3684.027**	–	**3684.050**	–	**3684.054**	–
		585	560	400	–	–	–	–	**3684.055**	–

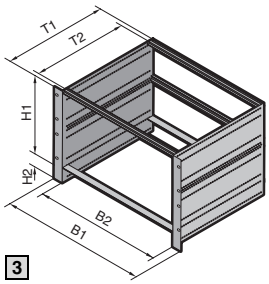
Covers Page 515 **Guide rails** Page 509 **Assembly kits** Page 508 **Horizontal rails** Page 498 **EMC accessories** Page 506 **Front panels** Page 525

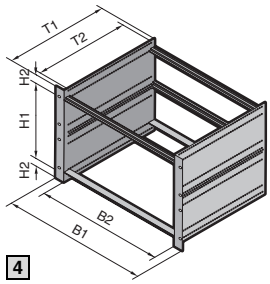
Ripac Vario 4 U, 7 U





B = Width
T = Depth





Material/surface finish:
Side panels:
2.5 mm aluminium,
clear-chromated
482.6 mm (19″) flanges and
horizontal rails:
Extruded aluminium section,
clear-chromated

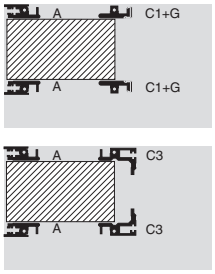
Supply includes:
Flanges, side panels,
horizontal rails,
threaded inserts, insulating
strips, fastenings.

Detailed parts lists,
see page 1156.

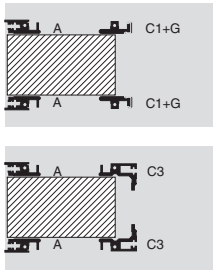
Tests:
Vibration and shock-tested to:
IEC 600-68-2-6 test Fc
IEC 600-68-2-27 test Ea

Standards:
Ripac subracks are based
on the system dimensions of
IEC 60 297-3/-5.

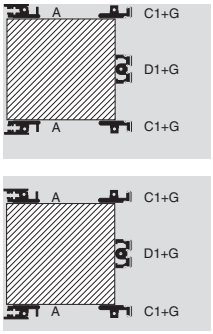
Detailed drawing,
see page 1155.



1 Top: For backplane
Bottom: For connector



2 Top: For backplane
Bottom: For connector



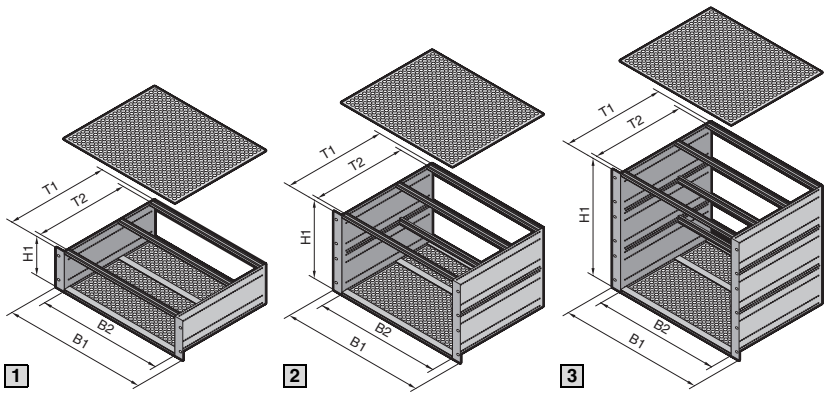
3 Top: For backplane
(6 U + 1 U)

4 Bottom: For backplane
(6 U + 2 x 1/2 U)

					Model No. RP					
					1		2		3	4
U (H1 + H2)					4 (3 + 1)	4 (3 + 1)	4 (3 + 2 x 1/2)	4 (3 + 2 x 1/2)	7 (6 + 1)	7 (6 + 2 x 1/2)
B1 mm	B2 HP	Side panel (T1) mm	T2 mm	Max. PCB depth mm	For backplane	For connectors IEC 60 603-2 (DIN 41 612)	For backplane	For connectors IEC 60 603-2 (DIN 41 612)	For backplane	For backplane
482.6 (19″)	84	245	220	220	**3685.235**	–	–	–	–	–
		285	260	220	**3684.028**	**3684.037**	**3684.031**	**3684.040**	–	–
		305	280	280	**3685.236**	–	–	–	–	–
		345	320	280	**3684.029**	**3684.038**	**3684.032**	**3684.041**	–	–
		365	340	340	**3685.237**	–	–	–	–	–
		405	380	340	**3684.030**	**3684.039**	**3684.033**	**3684.042**	**3684.064**	**3684.062**
		465	440	400	–	–	–	–	**3684.065**	**3684.063**

Covers Page 515 **Guide rails** Page 509 **Assembly kits** Page 508 **Horizontal rails** Page 498 **EMC accessories** Page 506 **Front panels** Page 525

Ripac Vario EMC 3 U, 6 U, 9 U



B = Width
T = Depth

Material/surface finish:
Side panels:
2.5 mm aluminium,
clear-chromated
Flanges and horizontal rails:
Extruded aluminium section,
clear-chromated
Covers: Aluminium, unplated

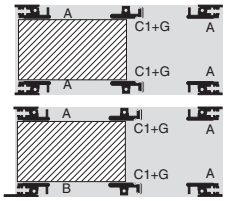
Supply includes:
Flanges, rear trim, side panels, EMC gaskets, covers, mounting blocks, horizontal rails, insulating strips.

Detailed parts lists,
see page 1156.

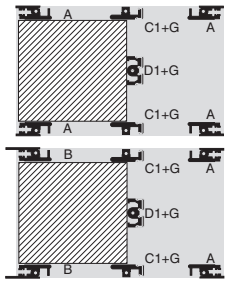
Tests:
Vibration and shock-tested to:
IEC 600-68-2-6 test Fc
IEC 600-68-2-27 test Ea

Standards:
Ripac subracks are based on the system dimensions of IEC 60 297-3/-5.

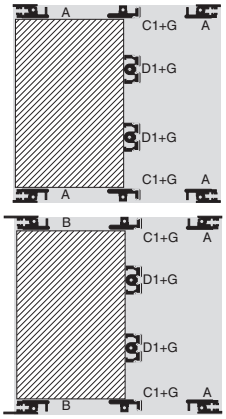
Detailed drawing,
see page 1155.



1
Top: For backplane
Bottom: For backplane/ front horizontal rail with 10 mm extension



2
Top: For backplane
Bottom: For backplane/ front horizontal rail with 10 mm extension



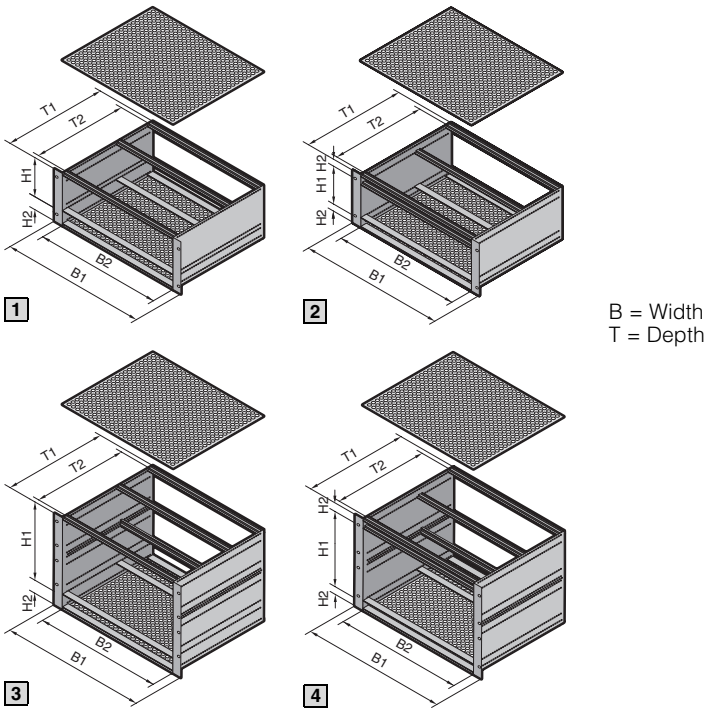
3
Top: For backplane
Bottom: For backplane/ front horizontal rail with 10 mm extension

					Model No. RP					
					1		2		3	
U					**3**		**6**		**9**	
Height (H1) in mm					132		265,35		398,70	
B1 mm	B2 HP	Side panel (T1) mm	T2 mm	Max. PCB depth mm	For backplane	For backplane[1)]	For backplane	For backplane[1)]	For backplane	For backplane[1)]
482.6 (19″)	84	245	220	160	**3684.128**	**3684.142**	**3684.156**	**3684.169**	–	–
		285	260	220	**3684.129**	**3684.143**	**3684.157**	**3684.170**	–	–
		305	280	220	**3685.241**	**3685.243**	**3685.242**	**3685.244**	–	–
		345	320	280	**3684.130**	**3684.144**	**3684.158**	**3684.171**	**3684.162**	**3684.175**
		405	380	340	**3684.131**	**3684.145**	**3684.159**	**3684.172**	**3684.163**	**3684.176**
		465	440	400	**3684.132**	**3684.146**	**3684.160**	**3684.173**	**3684.164**	**3684.177**
		525	500	400	**3684.133**	**3684.147**	**3684.161**	**3684.174**	**3684.165**	**3684.178**
		585	560	400	–	–	–	–	**3684.166**	**3684.179**

[1)] Front horizontal rails with 10 mm extension for injector/extractor handles (B)

Guide rails Page 509 **Assembly kits** Page 508 **Horizontal rails** Page 498 **EMC accessories** Page 506 **Front panels** Page 525

Ripac Vario EMC 4 U, 7 U



B = Width
T = Depth

Material/surface finish:
Side panels:
2.5 mm aluminium,
clear-chromated
Flanges and horizontal rails:
Extruded aluminium section,
clear-chromated
Covers: Aluminium, unplated

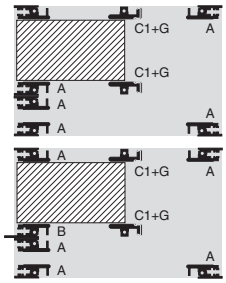
Supply includes:
Flanges, rear trims, side panels, EMC gaskets, covers, mounting blocks, horizontal rails, threaded inserts, insulating strips.

Detailed parts lists,
see page 1156.

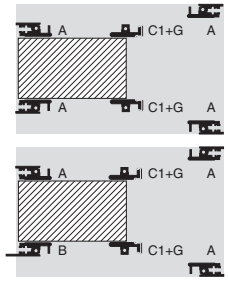
Tests:
Vibration and shock-tested to:
IEC 600-68-2-6 test Fc
IEC 600-68-2-27 test Ea

Standards:
Ripac subracks are based on the system dimensions of IEC 60 297-3/-5.

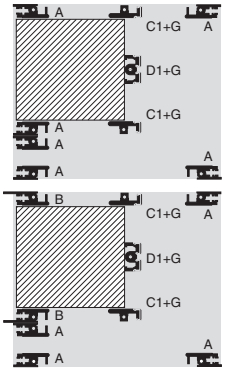
Detailed drawing,
see page 1155.



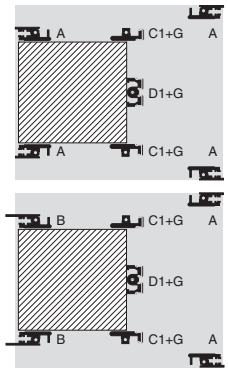
1
Top: For backplane
Bottom: For back-plane/front horizontal rail with 10 mm extension



2
Top: For backplane
Bottom: For back-plane/front hoprizontal rail with 10 mm extension



3
Top: For backplane
Bottom: For back-plane/front horizontal rail with 10 mm extension



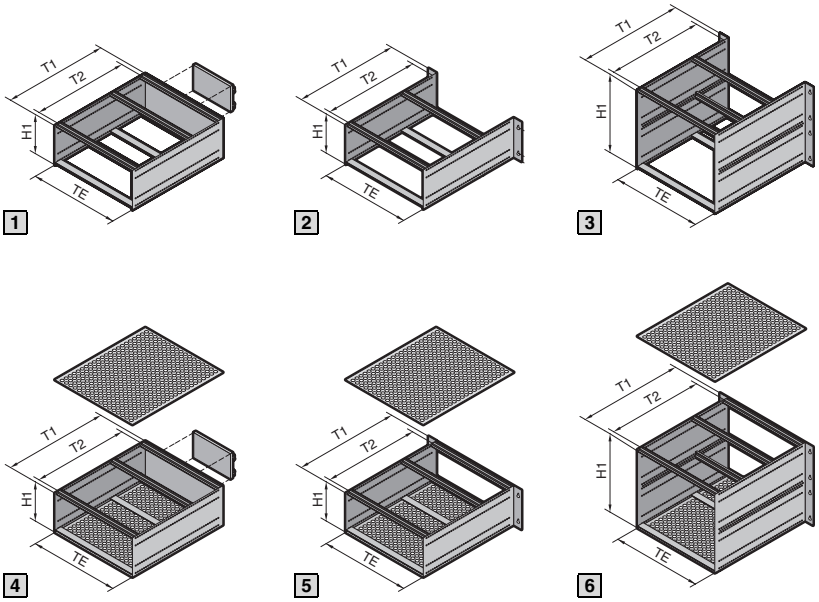
4
Top: For backplane
Bottom: For back-plane/horizontal rails, front, with 10 mm extension

					Model No. RP							
					1		2		3		4	
U (H1 + H2)					4 (3 + 1)	4 (3 + 1)	4 (3 + 2 x 1/2)	4 (3 + 2 x 1/2)	7 (6 + 1)	7 (6 + 1)	7 (6 + 2 x 1/2)	7 (6 + 2 x 1/2)
B1 mm	B2 HP	Side panel (T1) mm	T2 mm	Max. PCB depth mm	For backplane	For backplane[1]	For backplane	For backplane[1]	For backplane	For backplane[1]	For backplane	For backplane[1]
482.6 (19″)	84	285	260	220	**3684.134**	**3684.148**	**3684.137**	**3684.151**	**3684.187**	**3684.192**	–	–
		345	320	280	**3684.135**	**3684.149**	**3684.138**	**3684.152**	**3684.188**	**3684.193**	**3684.189**	**3684.196**
		405	380	340	**3684.136**	**3684.150**	**3684.139**	**3684.153**	**3684.180**	**3684.194**	**3684.190**	**3684.197**
		465	440	400	–	–	–	–	**3684.181**	**3684.195**	**3684.191**	**3684.198**

[1] Front cross rails with 10 mm extension for injector/extractor handles (B)

Guide rails Page 509 **Assembly kits** Page 508 **Horizontal rails** Page 498 **EMC accessories** Page 506 **Front panels** Page 525

Ripac Compact 3 U, 6 U



T = Depth
TE = HP

1 4
Ripac Compact 3 U
for top-hat rail

2 3 5 6
Ripac Compact 3 U
for mounting plate

Material/surface finish:
Side panels:
2.5 mm aluminium,
clear-chromated
Flanges and horizontal rails:
Extruded aluminium section,
clear-chromated

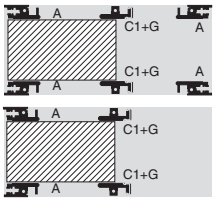
Supply includes:
Side panels, front trims, flanges for mounting plates or top-hat rail adaptors, EMC-front/rear panels, EMC gaskets, covers, horizontal rails, threaded inserts, insulating strips.

Detailed parts lists,
see page 1157.

Tests:
Vibration and shock-tested to:
IEC 600-68-2-6 test Fc
IEC 600-68-2-27 test Ea

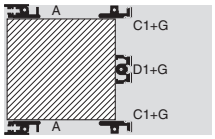
Standards:
Ripac subracks are based on the system dimensions of IEC 60 297-3/-5.

Detailed drawing,
see page 1155/1157.

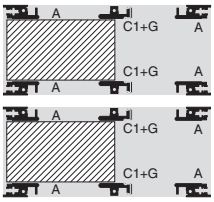


1 Top:
For top-hat rail

2 Bottom:
For mounting plate

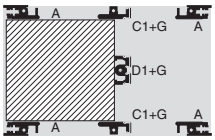


3 For mounting plate



4 Top: EMC for top-hat rail

5 Bottom: EMC for mounting plate

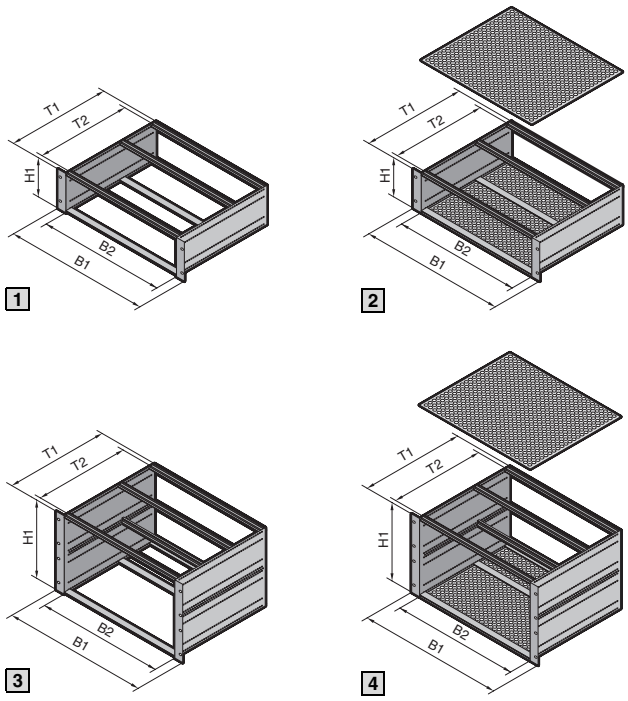


6 EMC for mounting plate

			Model No. RP					Model No. RP EMC				
			1	2	1	2	3	4	5	4	5	6
U			**3**	**3**	**3**	**3**	**6**	**3**	**3**	**3**	**3**	**6**
Height (H1) in mm			132				265.35	132				265.35
HP			21	21	42	42	42	21	21	42	42	42
Mounting			Top hat rail	Mounting plate	Top hat rail	Mounting plate	Mounting plate	Top hat rail	Mounting plate	Top hat rail	Mounting plate	Mounting plate
Side panel (T1) mm	T2 mm	Max. board depth mm	For backplane									
225	200	160	**3687.667**	**3687.669**	**3687.671**	**3687.673**	**3687.680**	**3687.682**	**3687.684**	**3687.686**	**3687.688**	**3687.690**
285	260	220	**3687.668**	**3687.670**	**3687.672**	**3687.674**	**3687.681**	**3687.683**	**3687.685**	**3687.687**	**3687.689**	**3687.691**

Covers Page 515 **Guide rails** Page 509 **Assembly kits** Page 508 **Horizontal rails** Page 498 **EMC accessories** Page 506 **Front panels** Page 525

Ripac Vario Mobil 3 U, 6 U, for mobile use



B = Width
T = Depth

Material/surface finish:
Side panels:
2.5 mm aluminium, clear-chromated
482.6 mm (19″) flanges and horizontal rails:
Extruded aluminium section, clear-chromated
Covers: Aluminium, unplated

Supply includes:
Flanges, rear trims, side panels, EMC gaskets, covers, mounting blocks, horizontal rails, threaded inserts, insulating strips, fully assembled.

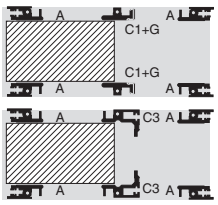
Detailed parts lists,
see page 1158.

Tests:
Vibration and shock-tested to:
IEC 600-68-2-6 test Fc
IEC 600-68-2-27 test Ea
The subracks have been tested for use in the German national railway. The test was conducted in accordance with standard EN 50 155, 1996 (electrical equipment for rail vehicles).
The configuration of the tested subracks conforms to IEC 48D.

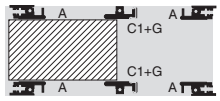
Standards:
Ripac subracks are based on the system dimensions of IEC 60 297-3/-5.

Note:
The subracks are supplied fully assembled.

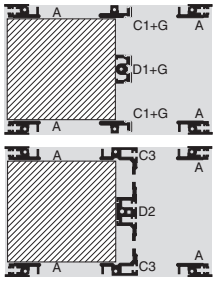
Detailed drawing,
see page 1155/1158.



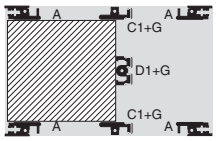
1 Top:
For backplane
Bottom:
For connector



2 EMC for backplane



3 Top:
For backplane
Bottom:
For connector

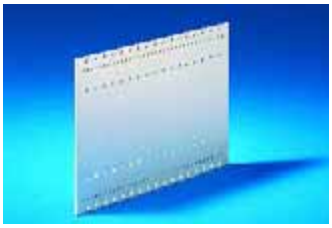


4 EMC for backplane

					Model No. RP 1		Model No. RP EMC 2	Model No. RP 3		Model No. RP EMC 4
U					**3**	**3**	**3**	**6**	**6**	**6**
Height (H1) in mm					132			265.35		
B1 mm	B2 HP	Side panel (T1) mm	T2 mm	Max. PCB depth mm	For backplane	For connectors IEC 60 603-2 (DIN 41 612)	For backplane	For backplane	For connectors IEC 60 603-2 (DIN 41 612)	For backplane
482.6 (19″)	84	245	220	220	**3687.782**	**3687.780**	**3687.784**	**3687.783**	**3687.781**	**3687.785**

Covers Page 515 **Guide rails** Page 509 **Assembly kits** Page 508 **EMC accessories** Page 506

Side panels and flanges



Side panels

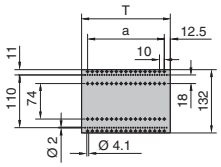
for Ripac Vario, Ripac Vario EMC, Ripac Compact and Ripac Vario Mobil
Mounting holes and anti-twist half-shears on a 10 mm pitch pattern.

Material:
2.5 mm aluminium, clear-chromated

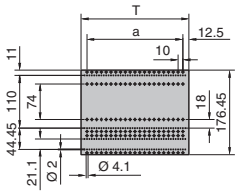
U			Model No. RP								
			3	4 (3 + 1)	4 (3 + 2 x 1/2)	6	7 (6 + 1)	7 (6 + 2 x 1/2)	9	10	11
D (T) mm	a[1] mm	Packs of									
185	160	1	**3684.511**	–	–	**3684.529**	–	–	–	–	–
225	200	1	**3684.512**	**3685.793**	**3685.890**	**3684.530**	**3685.896**	**3685.893**	**3685.797**	–	–
245	220	1	**3684.513**	**3685.850**	**3685.891**	**3684.531**	**3685.897**	**3685.894**	–	–	–
285	260	1	**3684.514**	**3684.523**	**3684.526**	**3684.532**	**3685.743**	**3685.895**	–	–	–
305	280	1	**3684.515**	**3685.794**	–	**3684.533**	–	–	**3685.798**	–	–
345	320	1	**3684.516**	**3684.524**	**3684.527**	**3684.534**	**3685.744**	**3685.745**	**3684.547**	–	–
365	340	1	**3684.517**	**3685.795**	–	**3684.535**	–	–	**3685.799**	–	–
405	380	1	**3684.518**	**3684.525**	**3684.528**	**3684.536**	**3684.541**	**3684.543**	**3684.548**	**3684.545**	–
425	400	1	**3684.519**	–	–	**3684.537**	–	–	–	–	–
465	440	1	**3684.520**	**3685.796**	**3685.892**	**3684.538**	**3684.542**	**3684.544**	**3684.549**	**3684.546**	**3684.552**
525	500	1	**3684.521**	–	–	**3684.539**	**3685.898**	**3685.959**	**3684.550**	**3685.899**	**3684.553**
585	560	1	**3684.522**	–	–	**3684.540**	–	–	**3684.551**	–	**3684.554**

[1] a = Distance between the first and last mounting hole

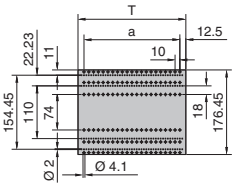
3 U



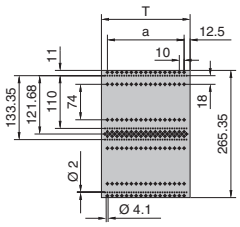
4 U (3 U + 1 U)



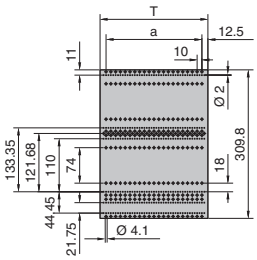
4 U (3 U + 2 x 1/2 U)



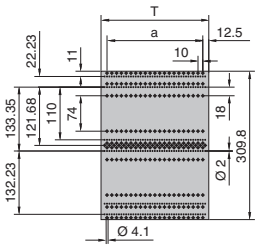
6 U



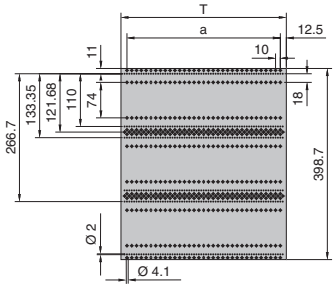
7 U (6 U + 1 U)



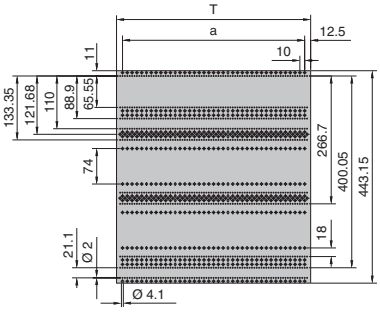
7 U (6 U + 2 x 1/2 U)



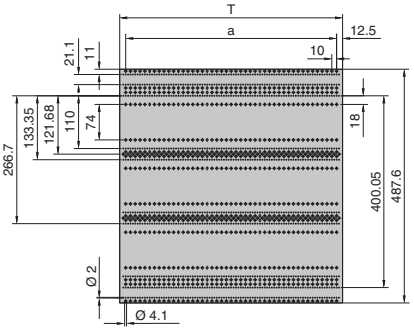
9 U



10 U



11 U



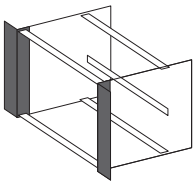
Side panels and flanges

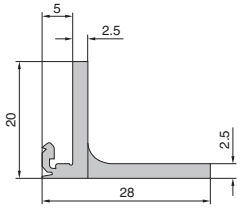
Flange 482.6 mm (19 ″)

To fit all Ripac Vario, Ripac Vario EMC, Ripac Compact and Ripac Vario Mobil subracks. With integral channel to accommodate EMC gaskets.

Material:
Extruded aluminium section

Surface finish:
Clear-chromated





U	Packs of	Model No. RP	
		with handle holes	without handle holes
2	1	–	**3684.614**
3	1	**3684.622**	**3684.615**
4	1	**3684.623**	**3684.616**
6	1	**3684.624**	**3684.617**
7	1	**3684.625**	**3684.618**
9	1	–	**3684.619**
10	1	–	**3684.620**
11	1	–	**3684.621**

Accessories:

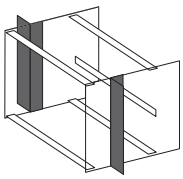
EMC gaskets, vertical,
see page 506.

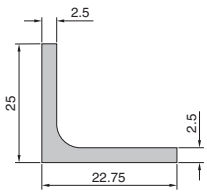
Flange 482.6 mm (19 ″)

set-back
To fit all Ripac Vario, Ripac Vario EMC and Ripac Vario Mobil subracks.

Material:
Extruded aluminium section

Surface finish:
Clear-chromated





U	Packs of	Model No. RP
3	1	**3684.626**
4	1	**3684.627**
6	1	**3684.628**
7	1	**3684.629**
9	1	**3684.630**
10	1	**3684.631**
11	1	**3684.632**

Also required:

Assembly screws, nuts and washers.
Packs of 4 sets, Model No. RP 3687.015,
see page 577.

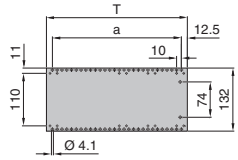
Side panels

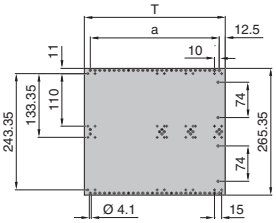
for Ripac ECO
Mounting holes for 160/220 mm PCB installation. Consistent pitch pattern of holes top and bottom for cover attachment.

Material:
1.5 mm sheet steel, zinc-plated, passivated

D (T) mm	a[1] mm	Packs of	Maximum board depth mm	Model No. RP	
				3 U	6 U
175	150	1	160	**3688.100**	**3688.102**
235	210	1	220	**3688.101**	**3688.103**

[1] a = Distance between the first and last mounting hole

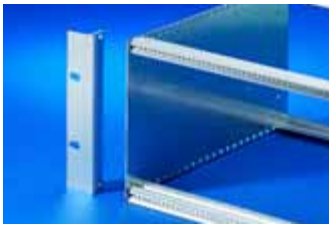




Accessories:

Flange for Ripac ECO,
see page 497.

Side panels and flanges

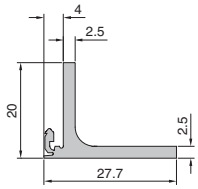


Flange 482.6 mm (19 ″)

for Ripac ECO
With integral channel to accommodate EMC gaskets.

Material:
Extruded aluminium section

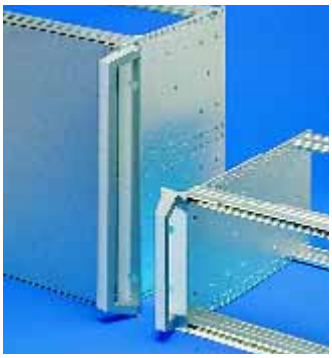
Surface finish:
Clear-chromated



U	Packs of	Model No. RP
3	1	**3688.110**
6	1	**3688.111**

Accessories:

EMC gaskets, vertical,
see page 506.



Handles

for subracks and component shelves
For fitting on the subrack flange with handle holes and on all component shelves

Material:
Die-cast zinc

Surface finish:
Spray-finished, silver-grey

Supply includes:
Assembly parts.

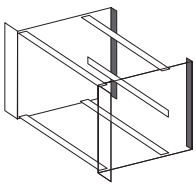
For	Packs of	Model No. RP
Subrack 3 U and 4 U	2	**3636.010**
Component shelves		
Subrack 6 U and 7 U	2	**3666.010**

Trim section, rear

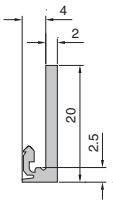
To fit all subrack versions. Ensures 84 HP fit at the rear of the subrack. With integral channel to accommodate EMC gaskets.

Material:
Extruded aluminium section

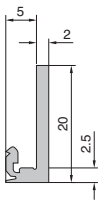
Surface finish:
Clear-chromated



Ripac ECO



Ripac Vario



For all Ripac Vario, Ripac Vario EMC, Ripac Compact and Ripac Vario Mobil

U	Model No. RP	
	Packs of 1	Packs of 2
2	**3684.633**	–
3	**3684.634**	**3685.276**
4	**3684.635**	–
6	**3684.636**	**3685.277**
7	**3684.637**	–
9	**3684.638**	–
10	**3684.639**	–
11	**3684.640**	–

For Ripac ECO subracks only

U	Packs of	Model No. RP
3	1	**3688.112**
6	1	**3688.113**

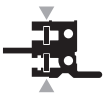
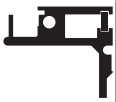
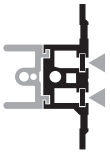
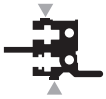
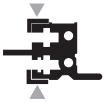
Accessories:

EMC gaskets, vertical,
see page 506.

Table of horizontal rails

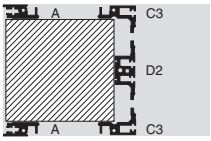
Ripac section system: Complete, simple and easy to manage

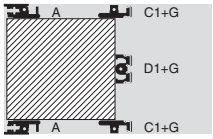
To fit all subrack systems as well as the Ripac Vario-Module instrument case/system enclosure range

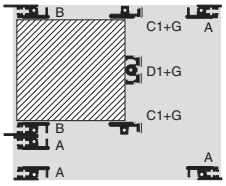
Main sections / Additional extrusions	**A** Front horizontal rail	**B** Front horizontal rail, with 10 mm extension, for extractor handle type IV or VII	**B1** Double front horizontal rail, with 10 mm extension	**C1** Rear horizontal rail	**C2** Rear horizontal rail, reinforced version	**C3** Rear horizontal rail, with integral Z rail	**C4** Rear horizontal rail, with channel, for Ripac ECO	**C5** Rear horizontal rail, with integral Z rail, for Ripac ECO	**D1** Rear horizontal rail, centre	**D2** Rear horizontal rail, centre with integral Z rail
	Page 499	Page 499	Page 500	Page 500	Page 500	Page 501	Page 501	Page 502	Page 502	Page 503
E Rear adaptor rail, centre, to acommodate guide rails Page 503	–	–	–	–	–	–	–	–		
F Z rail for connector Page 504	–	–	–			–		–		–
G Insulating strips[1] Page 505	–	–	–			–		–		–
H Conductive strips[1] Page 505	–	–	–			–		–		–
I Threaded insert Page 504				–					–	
J Identification strips Page 504								–	–	–
K EMC gaskets, horizontal Page 507				–	–	–		–	–	–

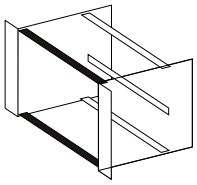
[1] For conductive or insulated attachment of backplanes

All system requirements may be covered with just a few basic types of horizontal rail. A cost-effective, easy-to-manage range.









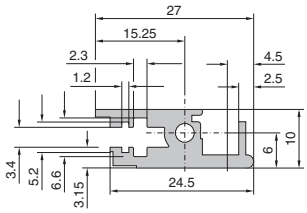
Front horizontal rail (A)

To accommodate guide rails and for the attachment of front panels.

- Front projection 2.5 mm in accordance with IEC 60 297-3.
- HP pitch patterns of holes for the precise installation of guide rails
- M4 thread on end face
- Straight-through core hole
- Horizontal rail 192 HP without machining on the end faces. Suitable for cutting to length

Material:
Extruded aluminium section

Surface finish:
Clear-chromated or anodised



Usable width (HP)	Packs of	Model No. RP
4 (left)	1	**3684.592**
4 (right)	1	**3684.955**
8 (left)	1	**3684.593**
8 (right)	1	**3684.956**
12	1	**3684.594**
16	1	**3684.595**
20	1	**3684.596**
21	1	**3685.985**
40	1	**3684.960**
42	1	**3684.560**
63	1	**3684.561**
84	1	**3684.562**
84	2	**3685.267**[1)]
192	1	**3688.000**[2)]

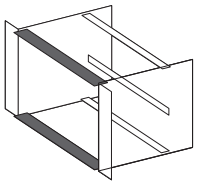
[1)] Including 4 assembly screws
[2)] Anodised

Also required:

Assembly screws M4 x 12,
packs of 100, Model No. RP 3654.300,
see page 576.

Accessories:

Threaded inserts,
see page 504.



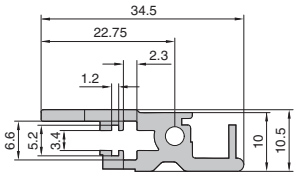
Front horizontal rail, with 10 mm extension (B)

for type IV, IVs and VII injector/extractor handle
To accommodate guide rails and for the attachment of front panels.

- Front projection and pitch pattern of holes based on IEEE 1101.10 and IEC 60 297-5-101, for use of type IV and VII injector/extractor handles
- HP pitch patterns of holes for the precise installation of guide rails
- M4 thread on end face
- Straight-through core hole
- Horizontal rail 192 HP without machining on the end faces. Suitable for cutting to length

Material:
Extruded aluminium section

Surface finish:
Clear-chromated or anodised



Usable width (HP)	Packs of	Model No. RP
40	1	**3684.961**
42	1	**3684.565**
63	1	**3684.566**
84	1	**3684.567**
84	2	**3685.269**[1)]
192	1	**3688.001**[2)]

[1)] Including 4 assembly screws
[2)] Anodised

Also required:

Assembly screws M4 x 12,
packs of 100, Model No. RP 3654.300,
see page 576.

Accessories:

Threaded inserts,
see page 504.

Horizontal rails

Double front horizontal rail, with 10 mm extension (B1)

To accommodate guide rails and for the attachment of front panels.

- Front projection and pitch pattern of holes based on IEEE 1101.10 and IEC 60 297-5-101, for use of type IV and VII injector/extractor handles
- HP pitch patterns of holes for the precise installation of guide rails
- M4 thread on end face
- Straight-through core hole

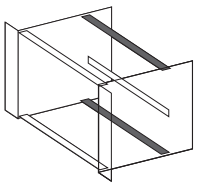
Material:
Extruded aluminium section

Surface finish:
Clear-chromated

Usable width (HP)	Packs of	Model No. RP
84	1	**3687.724**

Also required:

Assembly screws M4 x 12,
packs of 100, Model No. RP 3654.300,
see page 576.



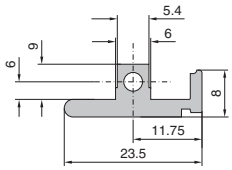
Rear horizontal rail (C1)

To accommodate guide rails and for the attachment of Z rails, insulating strips or conductive strips and backplanes.

- Tapped holes M2.5 on a 1 HP pitch pattern
- HP pitch patterns of holes for the precise installation of guide rails in the HP pitch pattern
- M2.5 thread for the installation of Z-rails, or backplanes.
- M4 thread on end face
- Straight-through core hole
- Horizontal rail 192 HP without machining on the end faces. Suitable for cutting to length

Material:
Extruded aluminium section

Surface finish:
Clear-chromated or anodised

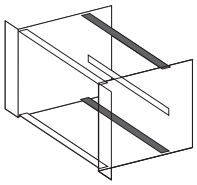


Usable width (HP)	Packs of	Model No. RP
21	1	**3685.991**
40	1	**3684.962**
42	1	**3684.570**
63	1	**3684.571**
84	1	**3684.572**
84	2	**3685.268**[1)]
192	1	**3688.002**[2)]

[1)] Including 4 assembly screws
[2)] Anodised

Also required:

Assembly screws M4 x 12,
packs of 100, Model No. RP 3654.300,
see page 576.

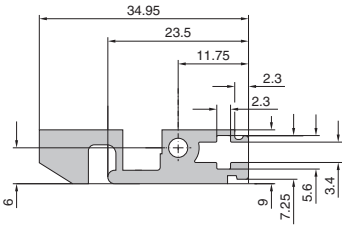


Rear horizontal rail, reinforced version (C2)

For use with high loads.

Material:
Extruded aluminium section

Surface finish:
Clear-chromated



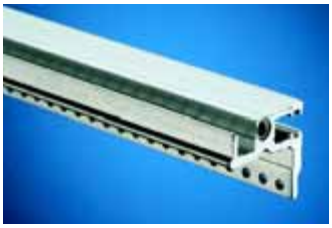
Usable width (HP)	Packs of	Model No. RP
42	1	**3687.604**
63	1	**3687.605**
84	1	**3687.606**

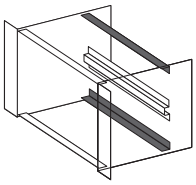
Also required:

Assembly screws M4 x 12,
packs of 100, Model No. RP 3654.300,
see page 576.

Accessories:

Threaded inserts,
see page 504.





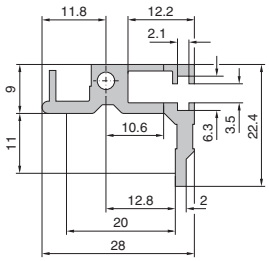
Rear horizontal rail, with integral Z rail (C3)

To accommodate guide rails. Integral Z rail for mounting connectors to IEC 60 603-2.

- HP pitch patterns of holes for the precise installation of guide rails
- 84 tapped holes M2.5 for the mounting of connectors
- M4 thread on end face
- Straight-through core hole

Material:
Extruded aluminium section

Surface finish:
Clear-chromated



Usable width (HP)	Packs of	Model No. RP
42	1	**3686.191**
63	1	**3686.919**
84	1	**3686.159**

Also required:

Assembly screws M4 x 12,
packs of 100, Model No. RP 3654.300,
see page 576.

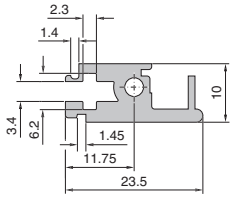
Rear horizontal rail, with channel, for Ripac ECO (C4)

For the accommodation of guide rails and for the attachment of Z rails, insulating strips or conductive strips and backplanes.

- HP pitch patterns of holes for the precise installation of guide rails
- Channel for sliding in covers
- For mounting backplanes/Z rails, threaded inserts (RP 3684.610) are additionally required
- M4 thread on end face
- Straight-through core hole
- Not suitable for mounting under covers

Material:
Extruded aluminium section

Surface finish:
Clear-chromated



Usable width (HP)	Packs of	Model No. RP
84	1	**3688.104**

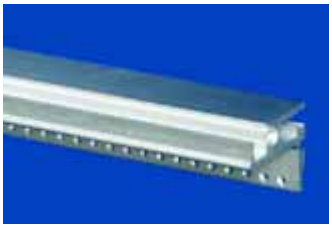
Also required:

Assembly screws M4 x 12,
packs of 100, Model No. RP 3654.300,
see page 576.

Accessories:

Threaded inserts,
see page 504.

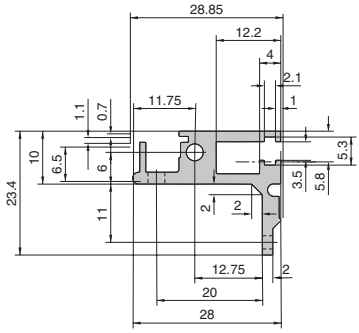
Horizontal rails



Rear horizontal rail, with integral Z rail, for Ripac ECO (C5)

To accommodate guide rails. Integral Z rail for mounting connectors to IEC 60 603-2.

- HP pitch patterns of holes for the precise installation of guide rails
- 84 tapped holes M2.5 for connector mounting
- M4 thread on end face
- Straight-through core hole



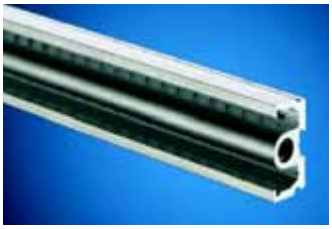
Usable width (HP)	Packs of	Model No. RP
84	1	**9901.991**

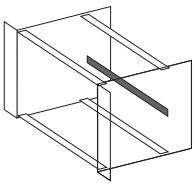
Material:
Extruded aluminium section

Surface finish:
Clear-chromated

Also required:

Assembly screws M4 x 12,
packs of 100, Model No. RP 3654.300,
see page 576.





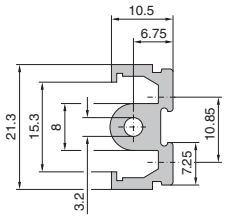
Rear horizontal rail, centre (D1)

When using 6 U PCBs or box-type plug-in units. Option of attaching Z rails, insulating strips or conductive strips.

- 2 x 84 tapped holes M2.5
- M4 thread on end face
- Straight-through core hole
- Horizontal rail 192 HP for cutting to length

Material:
Extruded aluminium section

Surface finish:
Clear-chromated or anodised

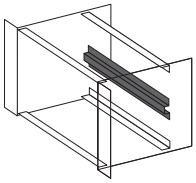


Usable width (HP)	Packs of	Model No. RP
40	1	**3684.963**
42	1	**3684.580**
63	1	**3684.581**
84	1	**3684.582**
84	1	**3685.270**[1)]
192	1	**3688.003**[2)]

[1)] Including 2 assembly screws
[2)] Anodised

Also required:

Assembly screws M4 x 12,
packs of 100, Model No. RP 3654.300,
see page 576.



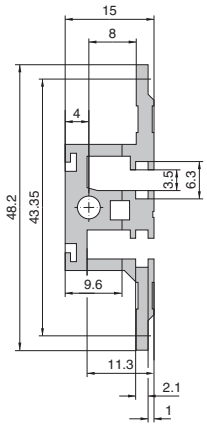
Rear horizontal rail, centre, with integral Z rail (D2)

When using 6 U PCBs or box type plug-in units. Integral Z rail for mounting connectors to IEC 60 603-2.

- 2 x 84 tapped holes M2.5
- M4 thread on end face
- Straight-through core hole

Material:
Extruded aluminium section

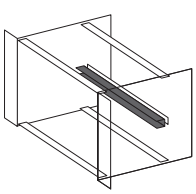
Surface finish:
Clear-chromated



Usable width (HP)	Packs of	Model No. RP
42	1	**3687.600**
63	1	**3687.601**
84	1	**3687.602**

Also required:

Assembly screws M4 x 12,
packs of 100, Model No. RP 3654.300,
see page 576.



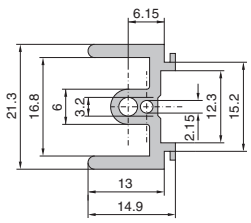
Rear adaptor rail, centre (E)

When subdividing 6 U into 2 x 3 U, the adaptor rail when fastened to the centre horizontal rail accommodates the guide rails.

- HP pitch patterns of holes for the precise installation of guide rails
- M4 and M2.5 thread on the end face
- Straight-through core hole
- Horizontal rail 192 HP without machining on the end faces. Suitable for cutting to length.

Material:
Extruded aluminium section

Surface finish:
Clear-chromated or anodised



Usable width (HP)	Packs of	Model No. RP
12	1	**3684.587**
16	1	**3684.588**
20	1	**3684.589**
40	1	**3684.964**
42	1	**3684.590**
63	1	**3686.005**
84	1	**3684.591**
84	1	**3685.272**[1)]
192	1	**3688.004**[2)]

[1)] Including 2 assembly screws
[2)] Anodised

Also required:

Assembly screws M4 x 12,
packs of 100, Model No. RP 3654.300,
see page 576.

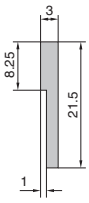
Horizontal rails

Z rail for connector IEC 60 603-2 (F)

With 84 x M2.5 thread.

Material:
Extruded aluminium section

Surface finish:
Clear-chromated



Usable width (HP)	Packs of	Model No. RP
4	1	**3684.597**
8	1	**3684.598**
20	1	**3684.599**
40	1	**3684.965**
42	1	**3684.600**
63	1	**3684.601**
84	1	**3684.602**
84	2	**3685.271**

Also required:

Assembly screws M2.5 x 6,
packs of 100, Model No. RP 3654.340,
see page 576.

Threaded insert (I)

With M2.5 threaded holes on an HP pitch pattern. To slide into the horizontal rail, type A, B, B1, C3, C5, D2 and for the rear horizontal rail, reinforced version, type C2.

Material:
Sheet steel, zinc-plated

Usable Width (HP)	Packs of	Model No. RP for horizontal rails	
		Front Type A, B, B1, C3, C4, C5, D2	Rear Type C2 Reinforced version
4	1	**3684.603**	**–**
8	1	**3684.604**	**–**
12	1	**3684.605**	**–**
16	1	**3684.606**	**–**
20	1	**3684.607**	**–**
21	1	**3686.149**	**–**
40	1	**3684.966**	**–**
42	1	**3684.608**	**3687.616**
63	1	**3684.609**	**3687.617**
84	1	**3684.610**	**–**
84	2	**–**	**3604.830**

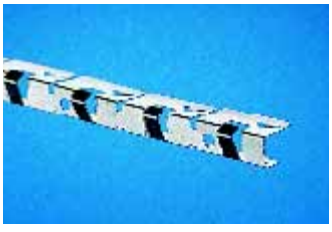
Identification strip (J)

To identify the slots on the subrack, self-adhesive. The following versions are available.

4 mm wide:
- for horizontal rails
- for rear horizontal rails

2 mm wide:
- for front horizontal rails (channel on front face)

for horizontal rail	Width mm	Label	Packs of	Model No. RP
Front	4	1 ... 84	1	**3687.575**
Front	4	1 ... 168	1	**3687.577**
rear	4	84 ... 1	1	**3687.574**
Front	2	1 ... 84	1	**3687.576**



EMC gaskets, horizontal (K)

see page 507.

Horizontal rails

Conductive strip (H)

For conductive mounting of backplanes.

- 84 HP
- Slides onto the rear horizontal rail

Material:
Aluminium, clear-chromated

Usable width (HP)	Packs of	Model No. RP
84	1	**3684.612**
84	2	**3685.273**

Insulating strip (G)

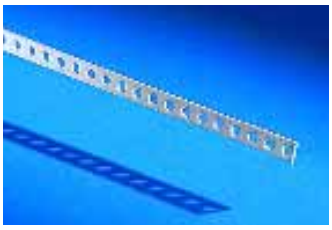
For insulated mounting of backplanes.

- 21 HP
- Slides onto the rear horizontal rail

Material:
Plastic, self-extinguishing to UL 94-V0

Usable width (HP)	Packs of	Model No. RP
21	1	**3684.611**
21	8	**3685.274**

Rear horizontal rail, centre, fitted with insulating strips (top) and conductive strips (bottom).

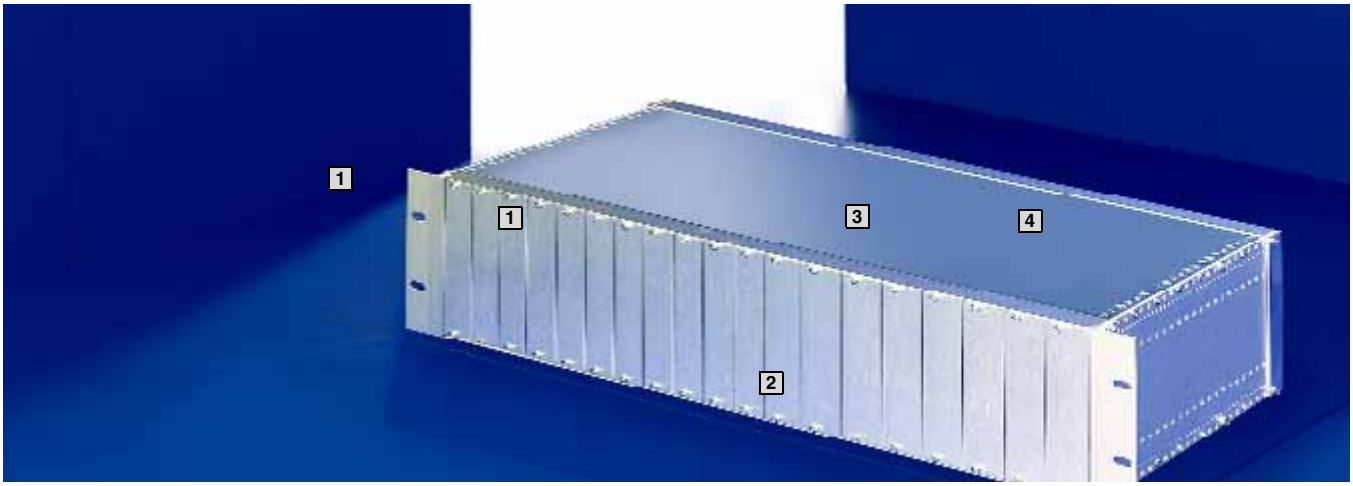


Punched strip

Material:
Aluminium, clear-chromated

Usable width (HP)	Packs of	Model No. RP
84	2	**3685.275**

Components for EMC installation

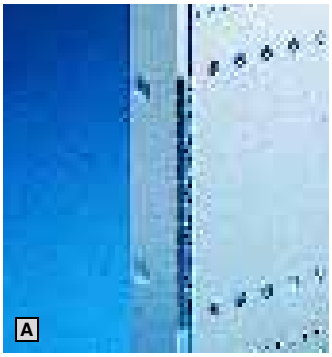


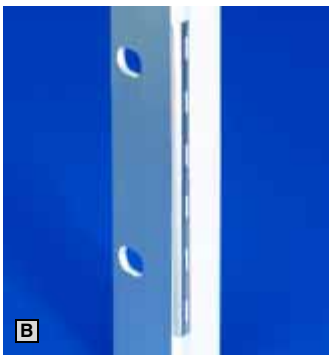
EMC (electromagnetic compatibility), refers to the ability of an electrical device to function satisfactorily in its electromagnetic environment without influencing or being influenced by this environment more than is admissible.

These requirements were taken into account when developing the Rittal subracks. They are made entirely from metal and coated with a conductive surface finish.

Stainless steel EMC gaskets ensure conductive connection of the seperate parts.

1 EMC gaskets, vertical
2 EMC gaskets, horizontal
3 EMC gaskets for covers
4 Mounting blocks





EMC gaskets, vertical

To ensure EMC protection between the subrack side panel and the front/rear panels. There are two versions available.

Suitable for mounting on:
- 482.6 mm (19″) flanges for subracks
- Corner trims, rear
- EMC contact strip
- U-shaped front panels
- Trim panels for Ripac Vario-Module
- Flanges for Ripac Vario-Module

Material:
Stainless steel

German patent
No. 101 15 252 and
No. 198 46 627
US patent no. 6,500,012

EMC

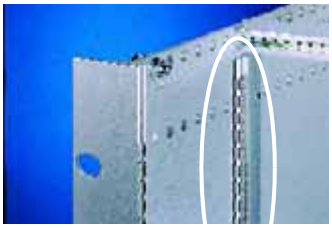
A Version 1: Segmented

U	Model No. RP Packs of 1	Model No. RP Packs of 10
1	**3686.973**	**3684.236**
2	**3686.974**	**3684.237**
3	**3686.975**	**3684.238**
4	**3686.976**	**3684.239**
6	**3686.977**	**3684.240**
7	**3686.978**	**3684.241**
9	**3686.979**	**3684.242**
10	**3686.980**	**3684.243**
11	**3686.981**	**3684.244**

B Version 2: One-piece

U	Model No. RP Packs of 1
2	**3688.610**
3	**3688.611**
4	**3688.612**
5	**3688.613**
6	**3688.614**
7	**3688.615**
8	**3688.634**
9	**3688.616**
10	**3688.609**
11	**3688.633**
12	**3688.606**

Components for EMC installation

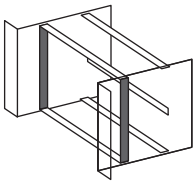


EMC contact strip

To ensure EMC protection horizontal rails are set-back.
Integral channel to accommodate EMC gaskets.

Material:
Extruded aluminium section, clear-chromated

Note:
2 sections are required for each subrack.



EMC

U	Packs of	Model No. RP
3	1	**3684.643**
6	1	**3684.644**
9	1	**3684.645**

Also required:

EMC gaskets, vertical, see page 506.
Assembly screws M3 x 6, packs of 100, Model No. RP 3684.233, see page 576.

EMC gaskets, horizontal (K)

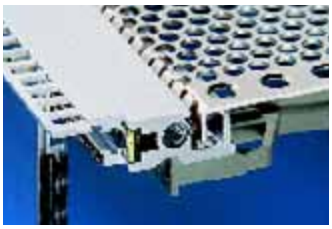
For horizontal EMC protection. For snap-fastening onto the front horizontal rails.

Material:
Stainless steel

European patent no. 0 937 375 with validity for DE
US patent no. 6,137,052
Chinese Patent No. ZL 97 1 98582.0

EMC

Usable width (HP)	Packs of	Model No. RP
For top/bottom horizontal rail		
40	1	**3684.974**
84	1	**3684.808**
84	10	**3684.246**
For subdivision of 6 U into 2 x 3 U, between 2 horizontal rails		
84	1	**3685.789**
84	10	**3685.229**



EMC gaskets

for covers
For EMC shielding between the horizontal rails and covers.

Material:
Stainless steel

EMC

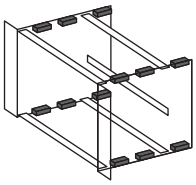
HP	Packs of	Model No. RP
84	10	**3684.245**

Mounting blocks

For mounting covers, versions 1 – 4, on the subrack side panel.

Material:
Die-cast zinc, nickel-plated

Note:
For EMC applications, mounting blocks must be fitted across the entire subrack depth. The table here shows the number of mounting blocks required to install 1 cover with EMC shielding.



EMC

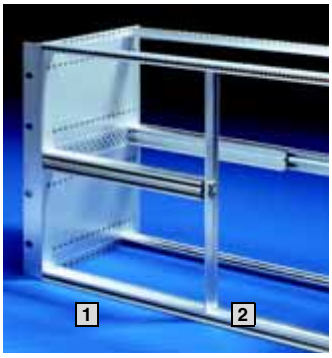
	Packs of	Model No. RP
Mounting blocks 28.5 mm long	10	**3684.234**

Also required:

Assembly screws M3 x 6, packs of 100, Model No. RP 3684.233, see page 576.

Number of mounting blocks for max. EMC protection	Cover plate depth mm
4	142
8	192
10	212
12	252
14	272
16	312
18	332
20	372
24	432
28	492
32	552

Mounting kits



Vertical divider kit

For the combined installation of single and double Euroboards in 6 U and 9 U subracks.

Material:
Aluminium, clear-chromated

Supply includes:
2 horizontal rails, front,
1 adaptor rail,
2 threaded inserts,
1 vertical support (from 12 HP),
assembly parts.

Accessories:

Front panel, see page 508.
EMC gaskets, horizontal, see page 507.

6 U (2 x 3 U)

HP 2 (6 U)	HP 1 (2 x 3 U)	Model No. RP
68	14	**3684.220**
61	21	**3684.221**
54	28	**3684.222**
42	40	**3684.223**
40	42	**3684.224**

9 U (1 x 6 U + 1 x 3 U)

HP (9 U)	HP (1 x 6 + 1 x 3 U)	Model No. RP
80	4	**3684.225**
76	8	**3684.226**
70	12	**3684.227**
66	16	**3684.228**
62	20	**3684.229**

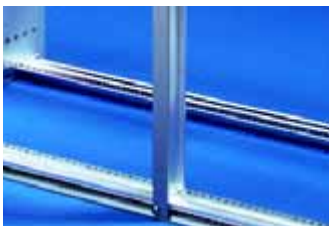
Vertical support

Required for the combined installation of single, double and triple Euroboards in one subrack.

Material:
Aluminium, extruded

Surface finish:
Clear-chromated

U	Packs of	Model No. RP
6	1	**3684.678**
9	1	**3684.679**



Front panel

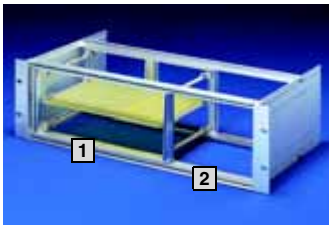
To conceal the vertical support of the vertical divider kit.

Material:
Aluminium, anodised

Supply includes:
Mounting parts.

U	HP	Packs of	Model No. RP
6	2	1	**3685.176**
9	2	1	**3685.286**

EMC version,
see page 538.



Horizontal divider kit

For the horizontal installation of 6 U/9 U PCBs in 3 U/4 U subracks.

1 Horizontal installation space:
3 U subrack: 20 HP (5 slots)
4 U subrack: 28 HP (7 slots)

2 Vertical installation space:
(with installation of double Euroboards)
31 HP (without trim frame)
28 HP (with trim frame)

Material:
Aluminium, clear-chromated

Supply includes:
2 horizontal rails, front,
2 horizontal rails, rear,
1 or 2 rear horizontal rails, centre
2 threaded inserts,
4 or 6 insulating strips,
4 connection parts,
assembly parts.

For backplane mounting
with standard horizontal rail, front

U horizontal	Model No. RP	
	for 3 U subrack	for 4 U subrack
6	**3684.206**	**3684.208**
9	**3684.207**	**3684.209**

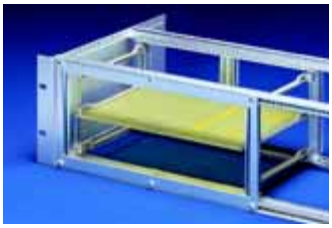
For backplane mounting,
front horizontal rail with 10 mm extension

U horizontal	Model No. RP	
	for 3 U subrack	for 4 U subrack
6	**3684.210**	**3684.212**
9	**3684.211**	**3684.213**

Accessories:

Trim frame,
see page 509.

Mounting kits/guide rails



Trim frame

for horizontal mounting kit
To conceal the front sections of the horizontal mounting kit.

Material:
Aluminium, anodised

U horizontal	HP	Model No. RP	
		for 3 U subrack	for 4 U subrack
6	56	**3685.783**	**3685.785**
9	84	**3685.784**	**3685.786**

Also required:
Collar screws and plastic collars,
packs of 100 sets, Model No. RP 3658.160,
see page 576.

Trim frame, vented

for horizontal mounting kit
To conceal the front sections of the horizontal mounting kit.

Material:
Aluminium

Surface finish:
Anodised,
clear-chromated (EMC version)

Supply includes:
EMC accessories
(for EMC version).

EMC

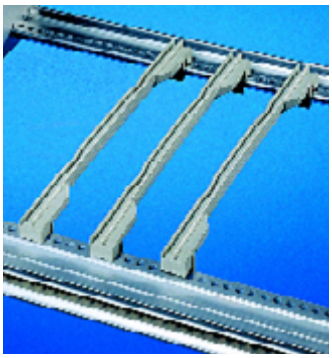
U horizontal	HP	Model No. RP	
		for 3 U subrack	for 4 U subrack
6	63	**3685.787**	**3685.788**

Also required:
Collar screws and plastic collars,
packs of 100 sets, Model No. RP 3658.160,
see page 576.

EMC version

U horizontal	HP	Model No. RP	
		for 3 U subrack	for 4 U subrack
6	63	**3685.291**	**3685.292**

Also required:
Centering screws,
packs of 100, Model No. RP 3687.050,
see page 577.



Plastic guide rails

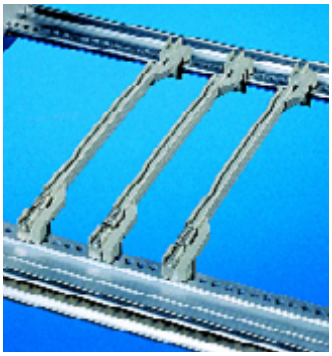
For 160, 220 and 280 mm PCBs up to 2 mm nominal thickness.

2 versions are available:
- Snap-in fastening and screw-fastening
- Snap-in fastening

Material:
Polycarbonate, base material to UL 94-V0

PCB depth mm	Packs of	Model No. RP	
		Snap-in fastening/ screw-fastening[1)]	Snap-in fastening
160	1	**3684.657**	**3684.654**
220	1	**3684.658**	**3684.655**
280	1	**3684.659**	**3684.656**

Also required:
[1)] Assembly screws,
packs of 100, Model No. RP 3654.360,
see page 576.



Plastic guide rails

for contact spring fitting
For 160, 220 and 280 mm PCBs up to 2 mm nominal thickness. By installing contact springs, an electrical connection can be made between the PCB and the assembly.

Material:
Polycarbonate, base material to UL 94-V0

PCB depth mm	Packs of	Model No. RP
160	1	**3684.660**
220	1	**3684.661**
280	1	**3684.662**

Accessories:
Contact springs,
see page 510.

Guide rails

Contact springs

For electrical connection between the PCB and the subrack, or to discharge static charges from the PCB.
Suitable for installation in “guide rails for contact spring fitting” and “end pieces for guide rails”.

Packs of	Model No. RP
10	**3687.726**

1

2

Guide rails, aluminium

For high loads. Suitable for nominal PCB thicknesses from 1.6 mm. A distinction is made between guide rails for and without end pieces. The guide rails without end pieces are screw-fastened directly into the horizontal rail.

Material:
Aluminium

PCB depth mm	Packs of	Model No. RP	
		1 Without end piece[1)]	2 For end pieces
160	1	**3687.526**	**3684.663**
220	1	**3687.527**	**3684.664**
280	1	**3687.528**	**3684.665**
1000	1	**3684.666**	–

Also required:

[1)] Screw M2.5 x 6, packs of 100,
Model No. RP 3654.340, see page 576.
[1)] Nut M2.5, packs of 100,
Model No. RP 3654.370, see page 576.
[1)] Retaining cage M2.5, packs of 100,
Model No. RP 9901.417, see page 576.

End pieces

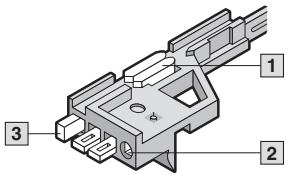
for guide rails, aluminium
To discharge static charges, contact springs RP 3687.726 may be used.

Material:
Polycarbonate, base material UL 94-V1

	Packs of	Model No. RP
End piece, front	1	**3684.668**
End piece, rear	1	**3685.759**

Accessories:

Contact springs,
see page 510.



Keyable guide rails, plastic

Guide rails 4 HP, keyable, to IEEE 1101.10.
- For 1.6 – 2.0 mm nominal thickness
- Chambers for the installation of keys
- Option of installing ESD contact to discharge static charges
- Narrow design for maximum air flow
- Various colour variants to identify the slots:
  – Red for system slot
  – Green for power supply
  – Yellow and grey for board-type plug-in units

1 ESD contact for PCB
2 ESD contact for front panel
3 Keys

Material:
Polycarbonate, base material to UL 94-V0

Note:
For coding use in conjunction with injector/extractor handles type IV, IVs, VII.

Accessories:

Keys, see page 514.
ESD contact, see page 513.
Extractor handles type IV, IVs, VII,
see page 528 – 530.

For PCB depth mm	Packs of	Model No. RP			
		Grey	Red	Green	Yellow
160	10	**3685.257**	–	–	–
220	10	**3685.258**	–	–	–
280	10	**3685.259**	–	–	–
160	1	**3684.669**	**3686.063**	**3688.055**	**3689.089**
220	1	**3684.953**	–	–	**3689.091**
280	1	**3684.954**	–	–	**3689.093**

Keyable guide rails

with $^1/_2$ HP offset

Guide rails with $^1/_2$ HP offset for use, in telecom applications. This allows PCBs to be populated on both sides. Green guide rails with offset are prescribed in the CompactPCI specification (PICMG 2.11) for the installation of power supply units.

- For 1.6 – 2.0 mm PCB thickness
- 4 HP x 160/220 mm
- Narrow design for maximum air flow
- Chambers for the installation of keys
- Option of installing ESD contact to discharge static charges

Material:
Polycarbonate, base material to UL 94-V0

Note:
For coding for use in conjunction with extractor handles type IV, IVs, VII with $^1/_2$ HP offset.

For PCB depth mm	Packs of	Colour	Model No. RP
160	1	Grey	**3686.137**
		Yellow	**3689.090**
		Green	**3687.832**
220	1	Grey	**3686.136**
		Yellow	**3689.092**
280	1	Grey	**3686.000**

Accessories:

Keys, see page 514.
ESD contact, see page 513.
Extractor handles type IVs, type VII, with $^1/_2$ HP offset, see page 529 – 530.

Keyable guide rails

for rear I/O assemblies

Guide rails 4 HP, keyable, to IEEE 1101.10. Prepared to accommodate a ground contact for assembly of a plug-type connection.

- For 1.6 – 2.0 mm nominal thickness
- For 80 mm deep PCBs
- Chambers for the installation of keys
- Option of installing ESD contact to discharge static charges
- Narrow design for maximum air flow
- For CPCI or VME applications

Material:
Polycarbonate, base material to UL 94-V0

Note:
For coding use in conjunction with type IV, IVs, VII injector/extractor handles.

Colour	For PCB depth mm	Packs of	Model No. RP	
			Guide rails	
			Top	Bottom
Grey	80	1	**3687.936**	**3687.937**
Yellow	80	1	**3689.097**	**3689.098**

Accessories:

Keys, see page 514.
ESD contact, see page 513.
Ground contact, see page 511.
Extractor handles type IV, IVs, VII, see page 528 – 530.

Ground contact

Ensures a plug-in ground connection. UL-approved.

Material:
Die-cast zinc

Supply includes:
Grounding bush, contact spring.

Note:
Only suitable for use in conjunction with keyable guide rails for rear I/O assemblies.

	Model No. RP	
	1 set	50 sets
Location bush and contact spring	**3689.036**	**3687.951**

Also required:

Assembly screws 3.5 x 12 mm, packs of 50, Model No. RP 3684.109, see page 576.

Guide rails

Keyable guide rails, aluminium, three-piece

Keyable guide rails with aluminium centre part, for high mechanical loads.
Suitable for 1.6 – 2.0 mm PCB thickness.

Guide rails comprise of the following individual components:

1 2 end pieces,
2 1 aluminium centre part,
3 Insulating centre part(s)

1 End pieces

for three-piece guide rails
For 1.6 – 2.0 mm PCB thickness.

Material:
Polycarbonate, base material to UL 94-V0

	Packs of	Model No. RP
	10 pairs	**3685.265**
Front end piece	1	**3685.790**
Rear end piece	1	**3684.670**

Note:
A front and a rear end piece is required for each guide rail.

2 Aluminium centre piece

for three-piece guide rails
For 1.6 – 2.0 mm PCB thickness.

Material:
Aluminium, unplated

For PCB depth mm	Model No. RP	
	Packs of 1	Packs of 10
220	**3684.673**	**3685.260**
280	**3684.674**	**3685.261**
340	**3684.675**	**3685.262**
400	**3684.676**	**3685.263**
1000	**3684.672**	–

3 Insulated centre part

for three-piece guide rails
The insulating centre part is pushed onto the aluminium centre piece.
Length: 60 mm.

Material:
Plastic, self-extinguishing to UL 94-V0

Packs of	Model No. RP
1	**3684.677**
10	**3685.264**

For PCB depth mm	Number of insulating strips required
160	1
220	2
280	3
340	4
400	5

Plastic guide rails

for box type plug-in units
For PCB depth 1.6 mm.
For insertion into covers with vent slots, see page 545.

Material:
Noryl

For PCB depth mm	Packs of	Model No. RP
160	10	**3606.140**
220	10	**3606.200**

Air block panel

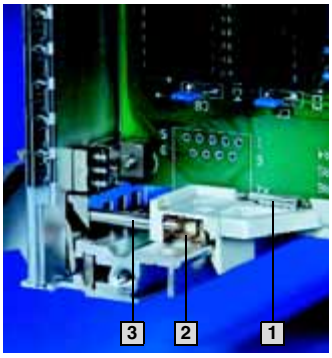
for unused slots
To conceal unused slots and prevent unwanted airflow. The air block panel simply snaps into position on the guide rails.

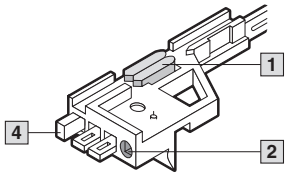
Material:
Polycarbonate, self-extinguishing UL 94-V0

Colour:
Blue

Note:
Not suitable for use in conjunction with guide rails with $^1/_2$ HP offset.

for guide rail	Packs of	Model No. RP
160 mm	1	**3687.924**





ESD contacts

for installation in keyable guide rails.
To discharge static charges.

1 **ESD contact for plug-in board**
For permanent, direct discharge from the PCB.

2 **ESD clip for front panel**
To discharge static charges in conjunction with the ESD pin. For insertion into the end piece of the guide rail.

3 **ESD pin**

4 **Keys**

Material:

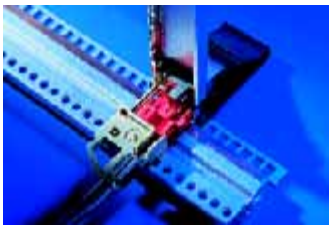
1 Stainless steel

2 Tin bronze

ESD contact for	Packs of	Model No. RP
PCB	50	**3684.204**
Font panel	50	**3684.205**

Note:
Only for use in conjunction with extractor handle with ESD pin (type IV, IVs, VII),
see page 528 – 530.

Keying/card ejectors



Keys

Keys are used for coding of board-type plug-in units and prevent their use of assemblies in incorrect slots. The keys are inserted into the chambers of the keyable guide rails and of injector/extractor handles, types IV, IVs and VII (4 positions are possible). This produces 64 keying combinations per guide rail. When keying the top and bottom guide rail, 4096 potential combinations are possible.

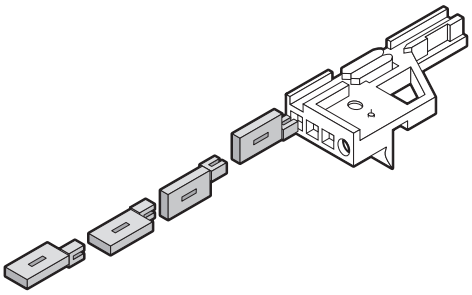
Standards:
IEEE 1101.10, IEC 602 97-5-104

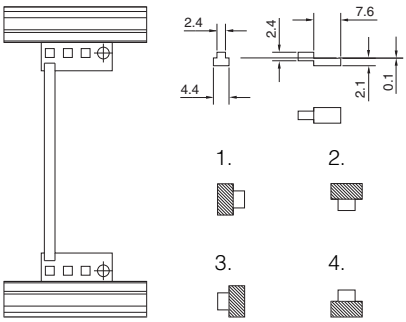
Material:
Plastic, PBTP, basic material to UL 94-V0

Colour	Packs of	Model No. RP
Grey	100	**3684.325**
Red	100	**3684.326**

Accessories:

Keying tool,
see page 514.



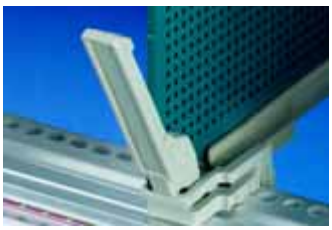


Coding tool

For simple assembly of coding keys. Up to 3 keys may be fitted at the same time. An integral alignment pin makes positioning easier.

Material:
Polycarbonate, base material to UL 94-V0

Packs of	Model No. RP
1	**3687.956**



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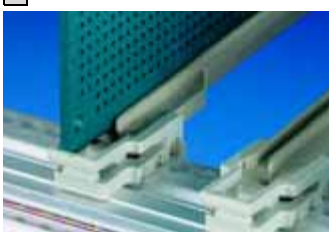


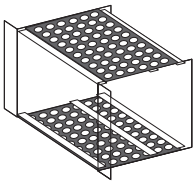
2

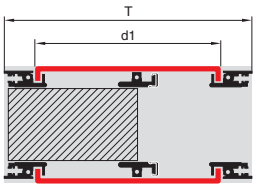
PCB ejector/retainer

The two-piece board ejector is used for securing and extracting PCBs without front panels. The base section may also be used separately for board retention only.

Material:
Polycarbonate, base material to UL 94-V0

	Packs of	Model No. RP
1 PCB ejector/retainer	10	**3687.014**
2 PCB retainer	10	**3687.052**





Covers version 1

For all Ripac Vario, Ripac Vario EMC, Ripac Compact and Ripac Vario Mobil subracks.
To cover the overall subrack depth.
(EMC application) or for connector protection.

- Flat design for top and bottom
- Optionally solid or perforated
- For mounting on the subrack side panel with the aid of mounting blocks.

Material:
1.0 mm aluminium, untreated, hole diameter 4 mm in vented version.

Set includes:
2 covers,
8 mounting blocks 28.5 mm long,
24 assembly screws

Single piece supply includes:
1 cover

Note:
For EMC applications, additional mounting blocks must be fitted across the entire subrack depth.

HP	For side panel depth D (T) mm	Cover depth d1 mm	Model No. RP			
			Single piece[1)]		Set	
			Perforated	Solid	Perforated	Solid
21	225	192	**3687.618**	**3687.620**	–	–
21	285	252	**3687.619**	**3687.621**	–	–
42	175	142	**3684.957**	**3687.626**	–	–
42	225	192	**3687.623**	**3687.627**	–	–
42	245	212	**3684.958**	**3687.628**	–	–
42	285	252	**3685.642**	**3687.629**	–	–
84	175	142	**3684.681**	**3684.680**	**3685.245**	**3685.250**
84	225	192	**3684.694**	**3684.683**	–	–
84	235	202	**3685.851**	**3685.813**	–	–
84	245	212	**3684.695**	**3684.684**	**3685.246**	**3685.251**
84	285	252	**3684.696**	**3684.685**	–	–
84	295	262	**3685.855**	**3685.814**	–	–
84	305	272	**3685.852**	**3684.686**	**3685.247**	**3685.252**
84	345	312	**3684.698**	**3684.687**	–	–
84	365	332	**3685.853**	**3684.688**	**3685.248**	**3685.253**
84	405	372	**3684.700**	**3684.689**	**3685.249**	**3685.254**
84	465	432	**3684.701**	**3684.691**	–	–
84	525	492	**3684.702**	**3684.692**	–	–
84	585	552	**3684.703**	**3684.693**	–	–

Also required:

[1)] Mounting blocks,
see page 507.
[1)] EMC gaskets for covers,
see page 507.
[1)] Assembly screws,
packs of 100, Model No. RP 3684.233,
see page 576.

Covers

Covers version 2

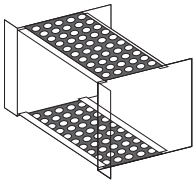
For all Ripac Vario, Ripac Vario EMC, Ripac Compact and Ripac Vario Mobil subracks.
To cover the PCB depth.

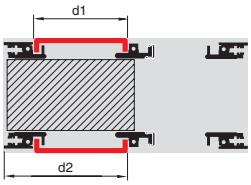
- Flat design for top and bottom
- Optionally solid or perforated
- For mounting on the subrack side panel with the aid of mounting blocks.

Material:
1.0 mm aluminium, untreated, hole diameter 4 mm with vented version.

Set includes:
2 covers,
8 mounting blocks à 28.5 mm,
24 assembly screws

Single piece supply includes:
1 cover

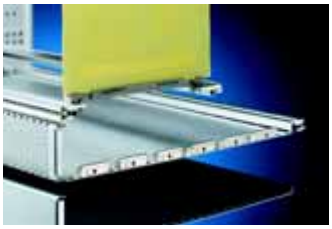




HP	For PCB depth d2 mm	Cover depth d1 mm	Model No. RP			
			Single piece[1]		Set	
			Perforated	Solid	Perforated	Solid
21	160	142	**3687.630**	**3687.634**	–	–
21	220	202	**3687.631**	**3687.635**	–	–
42	160	142	**3684.957**	**3687.626**	–	–
42	220	202	**3687.633**	**3687.637**	–	–
42	280	262	**3687.638**	**3687.639**	–	–
84	160	142	**3684.681**	**3684.680**	**3685.245**	**3685.250**
84	220	202	**3685.851**	**3685.813**	–	–
84	280	262	**3685.855**	**3685.814**	–	–
84	340	322	**3685.856**	–	–	–
84	400	382	**3685.857**	–	–	–

Also required:

[1] Mounting blocks,
see page 507.
[1] Assembly screws,
packs of 100, Model No. RP 3684.233,
see page 576.



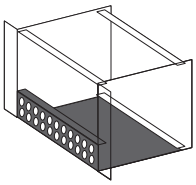
Covers version 3

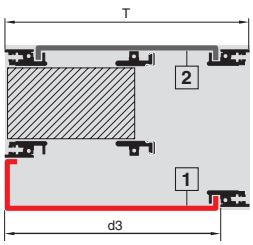
For all Ripac Vario, Ripac Vario EMC and Ripac Vario Mobil subracks.
To cover the overall subrack depth.
(EMC application).

- Cover with 1 U edge fold (item 1), to conceal the 1 U area in the subrack
- In addition, a flat cover version 1 (item 2) is required.
- Optionally perforated or solid on the front
- Suitable for subracks 4 U (3 + 1), 7 U (6 + 1)
- For mounting on the subrack side panel with the aid of mounting blocks.

Material:
1.0 mm aluminium, untreated, hole diameter 4 mm in vented version.

Note:
For EMC applications, mounting blocks must be fitted across the entire subrack depth.

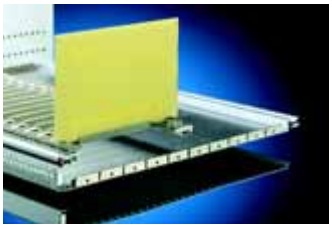


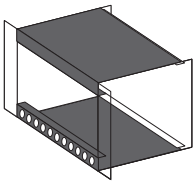


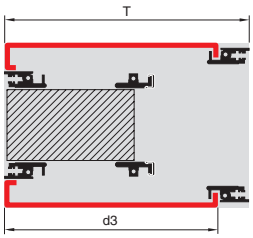
HP	For side panel depth D (T) mm	Cover depth d3 mm	Model No. RP	
			Perforated	Solid
84	285	270	**3684.720**	**3684.714**
84	345	330	**3684.721**	**3684.715**
84	405	390	**3684.722**	**3684.716**
84	465	450	**3684.723**	**3684.717**
84	525	510	**3684.724**	**3684.718**
84	585	570	**3684.725**	**3684.719**

Also required:

Mounting blocks, see page 507.
EMC gaskets for covers, see page 507.
Assembly screws,
packs of 100, Model No. RP 3684.233,
see page 576.
Cover, version 1, see page 515.







Covers version 4

For all Ripac Vario, Ripac Vario EMC and Ripac Vario Mobil subracks.
To cover the overall subrack depth.
(EMC application).

- Cover top/bottom with $^1/_2$ U edge fold to cover the $^1/_2$ U section in the subrack.
- Optionally perforated or solid on the front.
- Suitable for subracks 4 U (3 + 2 x $^1/_2$), 7 U (6 + 2 x $^1/_2$).
- For mounting on the subrack side panel with the aid of mounting blocks.

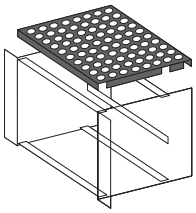
Material:
1.0 mm aluminium, untreated, hole diameter 4 mm in vented version.

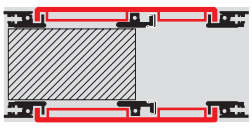
Note:
For EMC applications, mounting blocks must be fitted across the entire subrack depth.

HP	For side panel depth D (T) mm	Cover depth d3 mm	Model No. RP	
			Perforated	Solid
84	285	270	**3684.732**	**3684.726**
84	345	330	**3684.733**	**3684.727**
84	405	390	**3684.734**	**3684.728**
84	465	450	**3684.735**	**3684.729**
84	525	510	**3684.736**	**3684.730**
84	585	570	**3684.737**	**3684.731**

Also required:

Mounting blocks,
see page 507.
EMC gaskets for coves,
see page 507.
Assembly screws,
packs of 100, Model No. RP 3684.233,
see page 576.





Covers version 5

(snap fastening)
For all Ripac Vario, Ripac Vario EMC and Ripac Vario Mobil subracks.
To cover the overall subrack depth or PCB depth.

Simple assembly:
- Side edge fold with half shears facilitates fast assembly (without mounting blocks) by simply snap-fastening.
- Side notches for fitting horizontal rails in 160, 220 or 280 mm depth.
- Optionally solid or perforated.

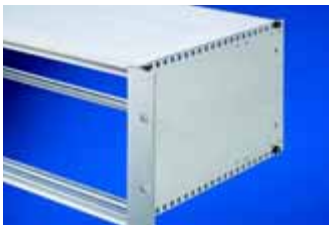
Material:
1.0 mm aluminium, untreated, hole diameter 4 mm in vented version.

Supply includes:
2 gaskets

EMC

HP	Position Side notches for horizontal rails mm	For side panel depth mm	Model No. RP	
			Perforated	Solid
21	160	175/185	**3687.624**	–
21	160/220	235	**3687.692**	–
42	160	175/185	**3687.625**	–
42	160/220	235	**3687.677**	–
42	160	245	**3687.640**	–
84	160	175/185	**3687.641**	**3687.647**
84	160	245	**3687.642**	**3687.648**
84	160/220	235	**3687.643**	**3687.649**
84	160/220	285	**3687.644**	**3687.650**
84	160/220	305	**3687.645**	**3687.651**
84	160/220/280	345	**3687.646**	**3687.652**

Covers



Covers

For Ripac Eco subracks
To cover the overall subrack depth.

- Optionally perforated or solid.
- The plates slide into the horizontal rails.
- Mounting clips may optionally be used for additional support.

Material:
Sheet steel, zinc-plated, passivated

HP	For side panel depth mm	Model No. RP	
		Perforated	Solid
84	175	**3688.105**	**3688.107**
84	235	**3688.106**	**3688.108**

Accessories:

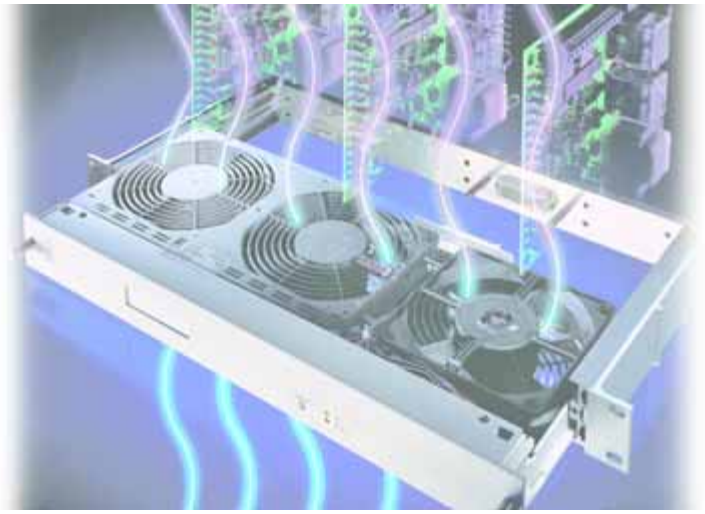
Mounting clips

Packs of	Model No. RP
1	**3688.109**

Assembly screws for mounting clips

Packs of	Model No. RP
1	**9902.188**

Features

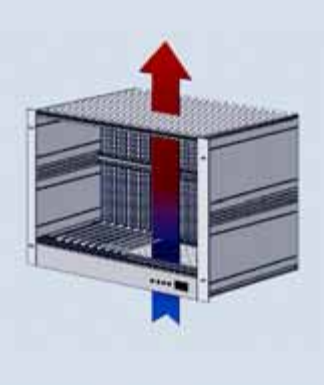


Heat shortens the service life of equipment leading to failure, and also diminishes the electronic high performance.

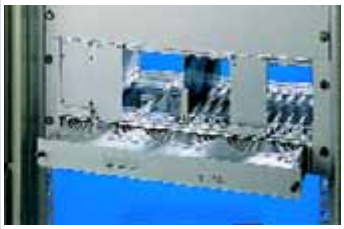
The problem lies in high heat losses and compact installation spaces. For this reason, effective heat dissipation is vital to ensure long service life and operational reliability.

As well as the components shown below, Rittal system climate control also offers a range of other 482.6 mm (19″) cooling systems and rack-mounted fans.

System climate control, see from page 578.



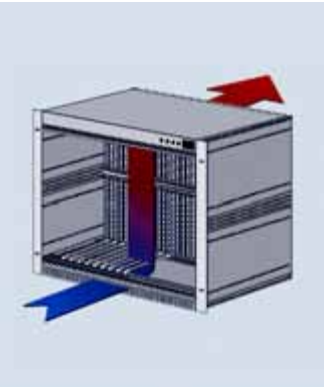
Vertical cooling



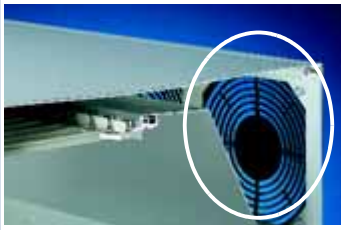
Rack-mounted fans are installed below the subrack in the enclosure. This ensures permanent air circulation to prevent the formation of hot spots.

Fans are installed directly in the subrack, below or above the PCBs, with the aid of fan mounting plates, thereby preventing heat accumulation.

AC and DC fans in various output categories, can be retrofitted.

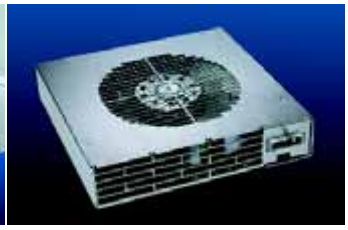


Diagonal cooling

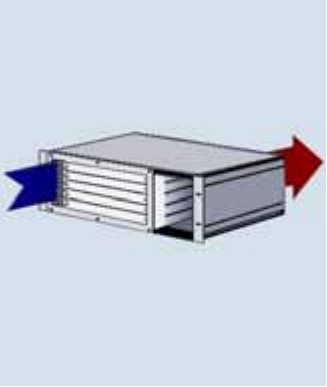


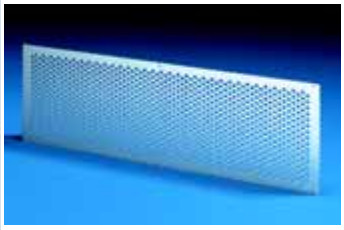
The air baffle plate in combination with . . .

. . . the air block panel ensures targeted air routing inside the subrack.



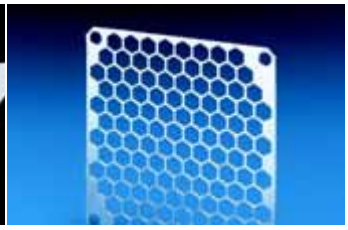
RiCool high-capacity fan for heat losses of 700 W or more.



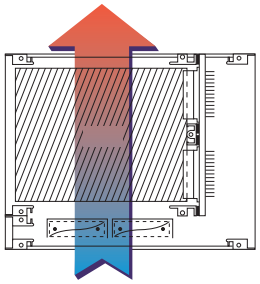


Front and rear panels for ventilation – also available in an EMC version.

Rear panels with cutouts for the installation of 80 or 120 mm fans.

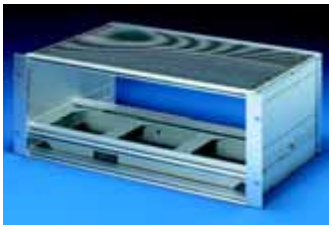


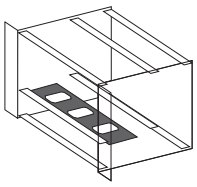
A finger guard or EMC shielding plate may be used to cover the fan cutouts.



Vertical cooling from bottom to top

- Air flow via normal convection or forced cooling devices in the enclosure or housing outside of the subrack.
- Vertical forced air flow, supported by fans installed at the bottom of the subrack (1 U). For the cooling of enclosures and housings, rack-mounted fans, see page 645 and rack-mounted cooling units, see page 644, are available.





Fan mounting plate

For installing 120 mm fans in 4 U and 7 U subracks.
For mounting on the subrack side panels.

Material:
1.5 mm Aluminium, anodised

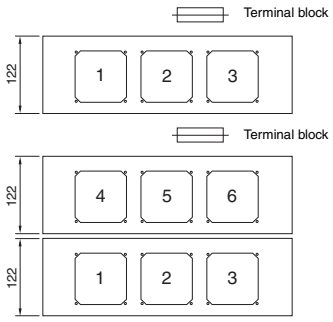
Supply includes:
1 fan mounting plate

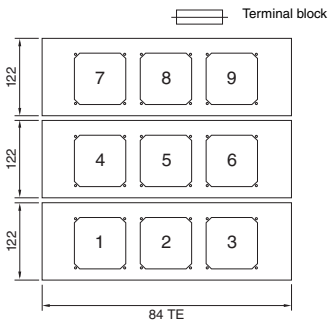
U	For PCB depth	No. of fan mounting plates required	HP	Model No. RP
1	160 mm	1	84	**3684.317**
	220 mm	1		
	280 mm	2		
	340 mm	2		
	400 mm	3		

Also required:

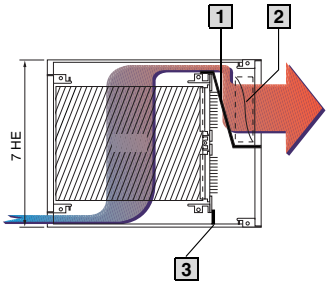
1 terminal block is required for each subrack.

Packs of	Model No. RP
1	**3686.805**





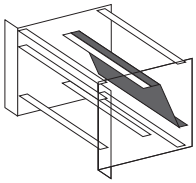
TE = HP



Diagonal cooling from front to back

Diagonal air flow from front to back allows individual cooling of PCBs in vertical installation position. An air baffle and air partition ensure controlled air flow.

1 Air baffle, see page 521.
2 Fan (mounted on the rear panel), see page 523.
3 Air partition, see page 521.



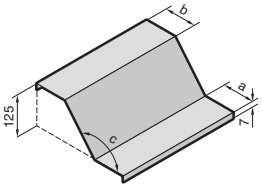
Air baffle

For controlled air flow in 7 U subracks. For mounting on subrack side panels with the aid of mounting blocks.

Material:
1 mm aluminium

Surface finish:
Anodised

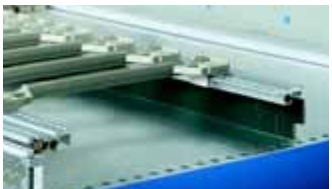
Supply includes:
Assembly parts.

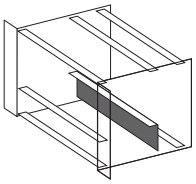


Subrack depth mm	a mm	b mm	c degrees	Model No. RP
285	71	56	90	**3685.302**
345	48	67	120	**3685.303**
405	108	67	120	**3684.320**
465	168	67	120	**3684.321**
525	228	67	120	**3684.322**

Also required:

Mounting blocks,
see page 507.

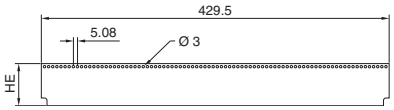




Air partition

For controlled air flow in the subrack. The partitions are mounted on the horizontal rails together with the backplanes.

Material:
Epoxy

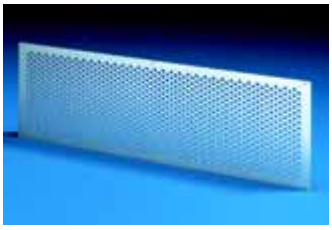


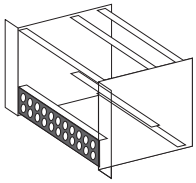
HE = U

U	Model No. RP
1/2	**3684.870**
1	**3684.871**
3	**3684.872**

Also required:

Fastening screws and washers,
packs of 100 sets, Model No. RP 3684.019,
see page 576.

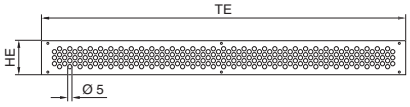




Front/rear panels for ventilation

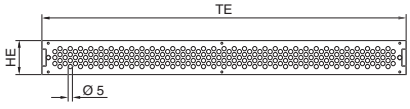
Material:
2.5 mm aluminium

Surface finish:
Anodised,
passivated (EMC version)



Scope of supply of the EMC version:
1 front panel
1 contact strip
1 gasket strip
1 vertical EMC gasket
assembly parts.

EMC



HE = U
TE = HP

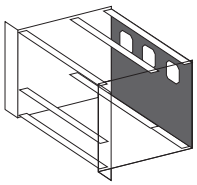
U	HP	Packs of	Model No. RP
1	84	1	**3684.812**
2	84	1	**3684.813**
3	84	1	**3684.814**

Also required:

Captive screw,
packs of 100 sets, Model No. RP 3685.097,
see page 577.

EMC version:

U	HP	Packs of	Model No. RP
1	84	1	**3684.281**
2	84	1	**3684.282**
3	84	1	**3684.283**



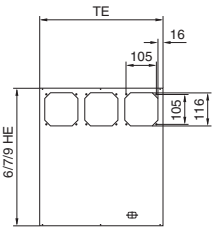
Rear panels for fan installation

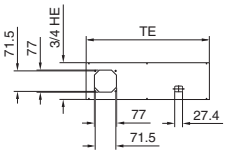
Material:
2.5 mm aluminium

Surface finish:
Anodised,
clear-chromated (EMC version)

Scope of supply of the EMC version:
1 rear panel
1 contact strip
1 gasket strip
1 vertical EMC gasket
assembly parts.

EMC





HE = U
TE = HP

U	HP	for fans	Packs of	Model No. RP
3	85	80 mm	1	**3684.839**
4	85	80 mm	1	**3684.840**
6	85	120 mm	1	**3684.841**
7	85	120 mm	1	**3684.842**
9	85	120 mm	1	**3684.843**

Also required:

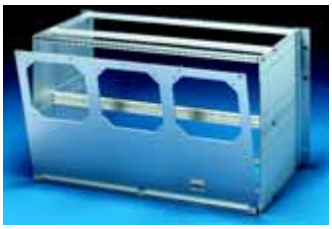
Captive screw,
packs of 100 sets, Model No. RP 3685.097,
see page 577.

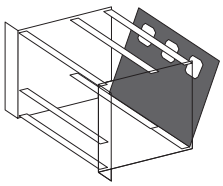
EMC version:

U	HP	for fans	Packs of	Model No. RP
3	84	80 mm	1	**3684.284**
4	84	80 mm	1	**3684.285**
6	84	120 mm	1	**3684.286**
7	84	120 mm	1	**3684.287**
9	84	120 mm	1	**3684.288**

Accessories:

Fan, see page 523.





Rear plates, horizontally hinged for fan installation

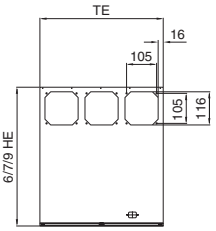
Material:
2.5 mm aluminium

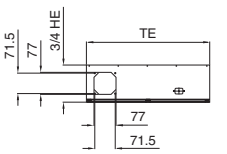
Surface finish:
Anodised,
clear-chromated (EMC version)

Supply includes:
1 rear panel
1 set of hinges,
incl. assembly parts.

EMC version supply includes:
1 rear panel
1 contact strip
1 gasket strip
1 vertical EMC gasket
1 set of hinges,
incl. assembly parts.

EMC





HE = U
TE = HP

U	HP	for fans	Packs of	Model No. RP
3	85	80 mm	1	**3684.304**
4	85	80 mm	1	**3684.305**
6	85	120 mm	1	**3684.306**
7	85	120 mm	1	**3684.307**
9	85	120 mm	1	**3684.308**

Also required:

Captive screw,
packs of 100 sets, Model No. RP 3685.097,
see page 577.

EMC version:

U	HP	for fans	Packs of	Model No. RP
3	84	80 mm	1	**3684.311**
4	84	80 mm	1	**3684.312**
6	84	120 mm	1	**3684.313**
7	84	120 mm	1	**3684.314**
9	84	120 mm	1	**3684.315**

Accessories:

Fan, see page 523.

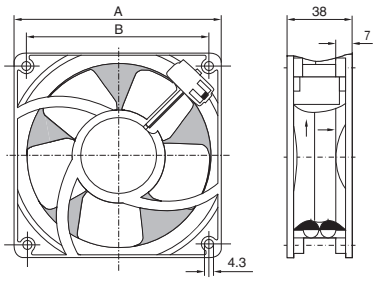
AC fans

For subracks and microcomputer systems.

Supply includes:
1 fan without connection cable.

Also required:

Assembly screws,
packs of 1 set, Model No. RP 3685.197,
see page 577.



AC fans

Dimensions			Bearing	Rated voltage V/Hz	Power watts	Noise level dB (A)	Temperature range °C	Volume flow m^3/h	**Model No. RP**
Fan mm	A mm	B mm							
80	79.5	71.5	Ball bearing	115/60	11.0	42	–40 to +95	57	**3686.645**
80	79.5	71.5	Ball bearing	230/50	12.0	37	–40 to +90	48	**3686.646**
120	119.0	105.0	Ball bearing	115/60	18.0	51	–40 to +90	180	**3686.643**
120	119.0	105.0	Ball bearing	230/50	19.0	47	–40 to +85	160	**3686.644**

Connection cable

Cable length mm	Packs of	**Model No. RP**
610	1	**3686.658**
1000	1	**3686.659**

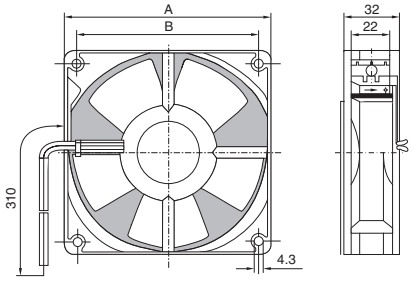
DC fans

Optionally available with temperature-dependent speed control via additional temperature sensor.

Supply includes:
1 fan with connection cable (310 mm).

Also required:

Assembly screws,
packs of 1 set, Model No. RP 3685.197,
see page 577.
Temperature sensor for DC fans with speed control, see page 524.



DC fan with speed control and alarm signal

Dimensions			Bearing	Rated voltage V (DC)	Voltage range Volt	Power watts	Noise level dB (A)	Temperature range °C	Temperature max. °C	Volume flow m^3/h	**Model No. RP**
Fan mm	A mm	B mm									
80	79.5	71.5	Ball bearing	12	8.0 – 14.0	2.2	34	–20 to +65	65	48	**3686.649**
80	79.5	71.5	Ball bearing	24	21.6 – 26.4	2.4	36	–20 to +65	65	54	**3686.650**
120	119.0	104.8	Ball bearing	12	8.0 – 12.6	5.4	45	–20 to +65	65	170	**3686.647**
120	119.0	104.8	Ball bearing	24	21.0 – 27.0	5.4	45	–20 to +65	65	170	**3686.648**

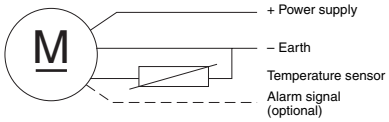
DC fan without speed control and, without alarm signal

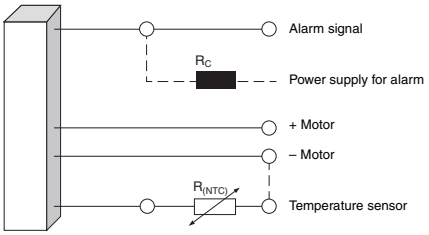
Dimensions			Bearing	Rated voltage V (DC)	Voltage range Volt	Power watts	Noise level dB (A)	Temperature range °C	Temperature max. °C	Volume flow m^3/h	**Model No. RP**
Fan mm	A mm	B mm									
80	79.5	71.5	Ball bearing	12	6.0 – 15.0	1.8	34	–20 to +75	75	48	**3687.612**
80	79.5	71.5	Ball bearing	24	12.0 – 28.0	2.1	34	–20 to +75	75	48	**3687.613**
120	119.0	104.8	Ball bearing	12	6.0 – 15.0	2.6	39	–20 to +75	75	140	**3687.614**
120	119.0	104.8	Ball bearing	24	12.0 – 28.0	2.6	39	–20 to +75	75	140	**3687.615**

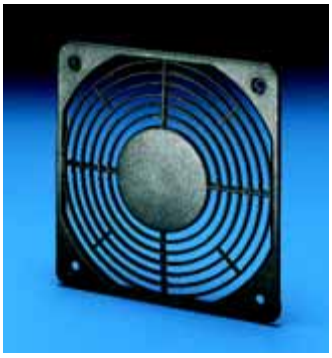
Temperature sensor

For DC fans 12/24 V with speed control.

Voltage	Packs of	Model No. RP
12 V/24 V (DC)	1	**3686.657**







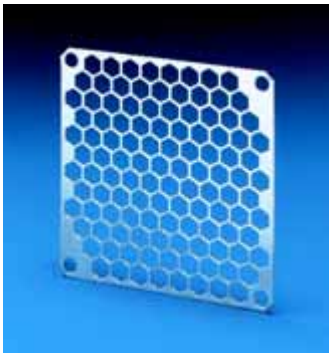
Finger guard

For AC fans and DC fans

Material:
Polyamide, self-extinguishing to UL 94-V0

Colour:
Black

For fans	Packs of	Model No. RP
80 mm	1	**3686.656**
120 mm	1	**3686.655**

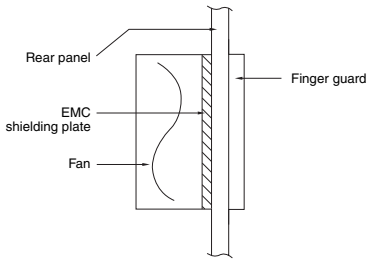


EMC shielding plate

For AC fans and DC fans

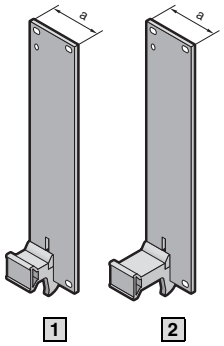
Material:
1 mm aluminium, clear-chromated

For fans	Packs of	Model No. RP
80 mm	1	**3686.359**
120 mm	1	**3686.329**



Air block panel

for unused slots
see page 513.



Flat front panels

with type I or II extractor handle
Complete modular systems

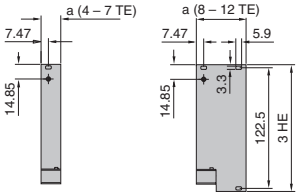
Material:
Front panel: 2.5 mm aluminium, anodised
Handle: Plastic, black

Supply includes:
1 front panel,
2 handles (1 for 3 U),
1 set of assembly parts,
1 PCB holder (for 3 U).

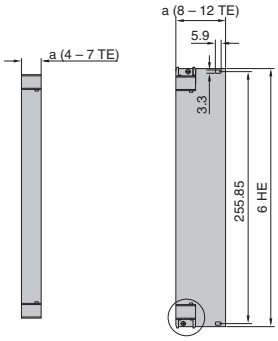
U	HP	a mm	Model No. RP 1 Type I	Model No. RP 2 Type II
3	4	20.0	**3684.330**	**3684.358**
3	5	25.1	**3684.331**	**3684.359**
3	6	30.2	**3684.332**	**3684.360**
3	7	35.3	**3684.333**	**3684.361**
3	8	40.3	**3684.334**	**3684.362**
3	10	50.5	**3684.335**	**3684.363**
3	12	60.7	**3684.336**	**3684.364**
6	4	20.0	**3684.337**	**3684.365**
6	5	25.1	**3684.338**	**3684.366**
6	6	30.2	**3684.339**	**3684.367**
6	7	35.3	**3684.340**	**3684.368**
6	8	40.3	**3684.341**	**3684.369**
6	10	50.5	**3684.342**	**3684.370**
6	12	60.7	**3684.343**	**3684.371**
9	4	20.0	–	**3684.372**
9	8	40.3	–	**3684.373**

Front panels with type I, II or IV, IVs extractor handles

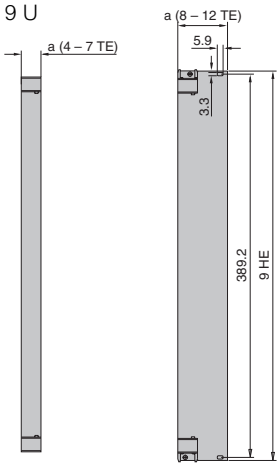
3 U



6 U



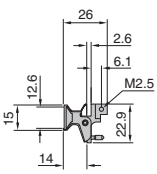
9 U



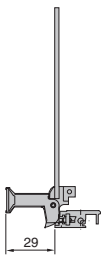
HE = U
TE = HP

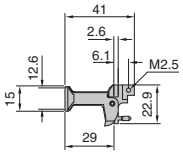
Extractor handles

Type I

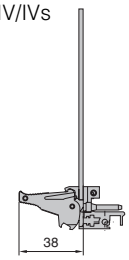


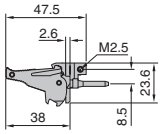
Type II



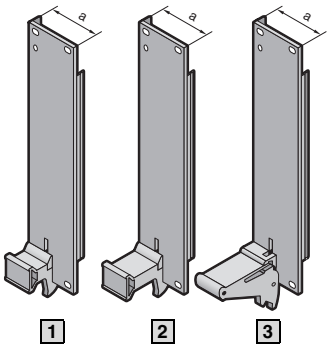


Type IV/IVs





Front panels, handles



U-channel front panels

with type I, II extractor handle or type IV injector/extractor handle
Complete modular systems

Material:
Front panel: Extruded aluminium section, clear chromated
Handle: Plastic, black

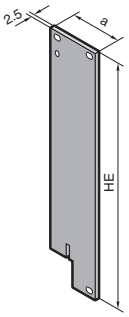
Supply includes:
1 front panel,
2 handles (1 for 3 U),
1 EMC gasket, vertical, version 1,
1 set of assembly parts,
1 PCB holder (for 3 U).

EMC

U	HP	a mm	Model No. RP 1 Type I	2 Type II	3 Type IV[1)]
3	4	20.0	**3684.344**	**3684.374**	**3684.413**
3	5	25.1	**3684.345**	**3684.375**	**3684.414**
3	6	30.2	**3684.346**	**3684.376**	**3684.415**
3	7	35.3	**3684.347**	**3684.377**	**3684.416**
3	8	40.3	**3684.348**	**3684.378**	**3684.417**
3	10	50.5	**3684.349**	**3684.379**	**3684.418**
3	12	60.7	**3684.350**	**3684.380**	**3684.419**
6	4	20.0	**3684.351**	**3684.381**	**3684.420**
6	5	25.1	**3684.352**	**3684.382**	**3684.421**
6	6	30.2	**3684.353**	**3684.383**	**3684.422**
6	7	35.3	**3684.354**	**3684.384**	**3684.423**
6	8	40.3	**3684.355**	**3684.385**	**3684.424**
6	10	50.5	**3684.356**	**3684.386**	**3684.425**
6	12	60.7	**3684.357**	**3684.387**	**3684.426**
9	4	20.0	–	**3684.388**	**3684.427**
9	5	25.1	–	–	**3684.428**
9	6	30.2	–	–	**3684.429**
9	7	35.3	–	–	**3684.430**
9	8	40.3	–	**3684.389**	**3684.431**
9	10	50.5	–	–	**3684.432**
9	12	60.7	–	–	**3684.433**

[1)] Insertion only in conjunction with front horizontal rails, with 10 mm extension (B), see page 499.

Detailed drawing,
see page 525.



HE = U

Flat front panels

for type I, II, IV, IVs or VII handles

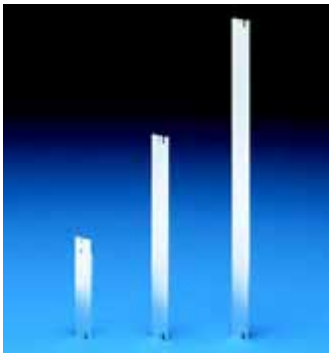
Material:
2.5 mm aluminium, anodised

HP	a mm	Model No. RP 3 U	6 U	9 U
4	20.0	**3685.500**	**3685.508**	**3685.516**
5	25.1	**3685.501**	**3685.509**	**3685.517**
6	30.2	**3685.502**	**3685.510**	**3685.518**
7	35.3	**3685.503**	**3685.511**	**3685.519**
8	40.3	**3685.504**	**3685.512**	**3685.520**
10	50.5	**3685.505**	**3685.513**	**3685.521**
12	60.7	**3685.506**	**3685.514**	**3685.522**

Detailed drawing,
see page 527.

Also required:

From front panel widths of 4 HP (at 3 U) and 7 HP (at 6 U):
Captive screws and plastic collars,
packs of 100 set, Model No. RP 3658.160,
see page 576.
For 3 U front panels:
PCB holder set, see page 536.



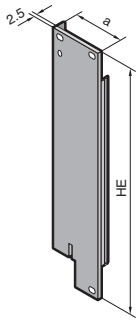
U-channel front panels

for type I, II, IV, IVs or VII handles

Material:
2.5 mm aluminium, clear chromated

EMC

HP	a mm	Model No. RP		
		3 U	6 U	9 U
4	20.0	**3685.524**	**3685.532**	**3685.540**
5	25.1	**3685.525**	**3685.533**	**3685.541**
6	30.2	**3685.526**	**3685.534**	**3685.542**
7	35.3	**3685.527**	**3685.535**	**3685.543**
8	40.3	**3685.528**	**3685.536**	**3685.544**
10	50.5	**3685.529**	**3685.537**	**3685.545**
12	60.7	**3685.530**	**3685.538**	**3685.546**

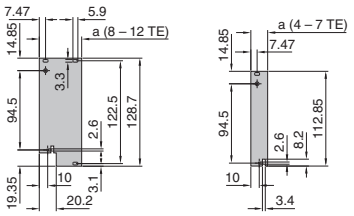


Also required:

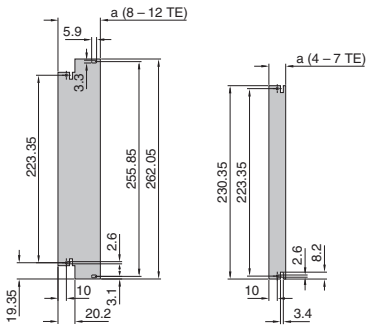
EMC gasket, see page 506.
From front panel widths of 4 HP (at 3 U) and 7 HP (at 6 U):
Centering screw with slot,
packs of 100 sets, Model No. RP 3687.050,
see page 577.
Posidrive centering screw,
packs of 100 sets, Model No. RP 3687.051,
see page 577.
For 3 U front panels:
PCB holder set, see page 536.

Front panels for type I, II, IV, IVs or VII handles

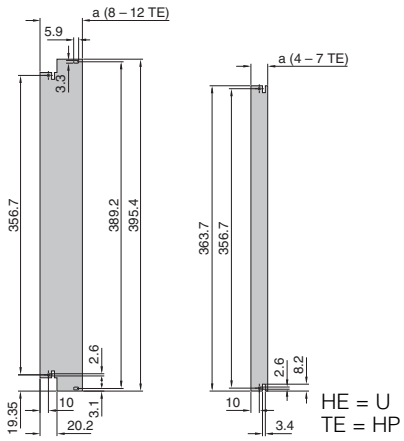
3 U



6 U



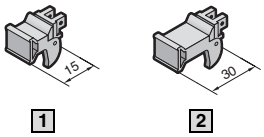
9 U



Flat front panel

U-channel front panel

Front panels, handles



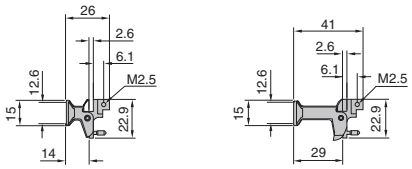
1 2

Extractor handle type I and type II

- Suitable for flat front panels/U-channel front panels
- For PCB removal
- May be used in combination with horizontal rails with 10 mm extension

Supply includes:
Assembly parts.

Note:
With 3 U, only one extractor handle is required.



1 2

1 Type I extractor handle, 15 mm

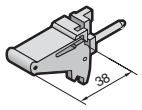
Colour	Packs of	Model No. RP
Grey	1	**3685.587**
Black	1	**3685.589**

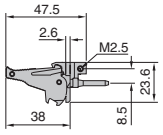
2 Type II extractor handle, 30 mm

Colour	Packs of	Model No. RP
Grey	1	**3685.588**
Black	1	**3685.590**

Accessories:

Identification strips for extractor handles, see page 529.





Injector/extractor handle type IV

Handles with micro-switch
For inserting and removing PCB's with a high connector pin-count.

- Insertion/removal function
- Integral microswitch for "live insertion" applications
- Sellf-activation of the micro-switch during insertion/removal
- ESD pin to dissipate static charges prior to making contact with the connectors and for precise positioning of the board type plug-in units
- Codeable
- Integral PCB attachment
- Self-locking
- Bayable

Handle without micro-switch
Description see above. Micro-switch may be retro-fitted.

Supply includes:
1 handle without or with micro-switch, assembly parts.

Note:

- Can only be inserted in conjunction with front horizontal rails, with 10 mm extension (B), see page 499.
- With 3 U, only one extractor handle is required.

Handles with micro-switch

Colour	Installation	Packs of	Model No. RP
Grey	Top	1	**3686.905**
Grey	Bottom	1	**3686.904**
Black	Top	1	**3686.907**
Black	Bottom	1	**3686.906**

Handle without micro-switch

Colour	Installation	Packs of	Model No. RP
Grey	Top	1	**3686.901**
Grey	Bottom	1	**3686.900**
Black	Top	1	**3686.903**
Black	Bottom	1	**3686.902**

Accessories:

Keying pins, see page 514.
Keyable guide rails, see page 510.
Micro-switch, see page 530.
Connector pin for baying, see page 529.

Injector/extractor handle type IV

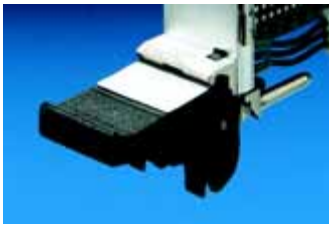
8 HP, bayed
Suitable for 4 HP front panels that must be connected to each other mechanically.

Supply includes:
2 bayed handles, fully assembled.

Colour	Installation	Packs of	Model No. RP
Black	Bottom	1	**3686.908**
Black	Top	1	**3686.909**

Accessories:

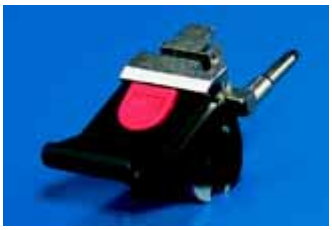
Connector pin for baying, see page 529.



Identification strips

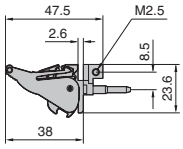
for type I, II extractor handle and type IV injector/extractor handle
Width 4 HP

Packs of	Model No. RP
100	**3684.328**



Injector/extractor handle type IVs

with push-button
For inserting and removing PCB's with a high pin-count. A metal insert ensures reliable functioning, even at forces of up to 815 N.



- Insertion/removal function
- Push-button for locking and unlocking the board type plug-in unit (cannot be extracted in the locked position)
- Optionally with 1/2 HP offset PCB attachment, e.g. for component mounting on both sides
- Optional micro-switch for "live insertion" applications
- ESD pin to dissipate static charges prior to making contact with the connectors and for precise positioning of the board type plug-in unit
- Codeable
- Integral PCB attachment
- Bayable

Material:
Plastic/metal

Supply includes:
Assembly parts.

Note:
- Insertion only in conjunction with front horizontal rails, with 10 mm extension (B), see page 499.
- With 3 U, only one extractor handle is required.

Handles without offset

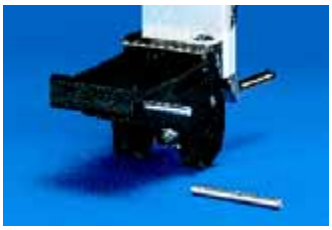
Installation	Packs of	Model No. RP
Top	1	**3688.770**
Bottom	1	**3688.771**

Handles with 1/2 HP offset

Installation	Packs of	Model No. RP
Top	1	**3688.772**
Bottom	1	**3688.773**

Accessories:

Keys, see page 514.
Keyable guide rails, see page 510.
Keyable guide rails with 1/2 HP offset, see page 511.
Micro-switch, see page 530.
Connector pin for baying, see page 529.



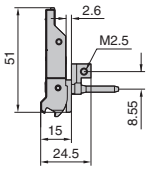
Connection pin

for injector/extractor handles, types IV, IVs and VII
The connection pin can be used to connect injector/extractor handles, types IV, IVs and VII.

Material:
Steel

Packs of	Model No. RP
20	**3685.319**

Front panels, handles



Injector/extractor handle type VII

Plastic (telecom)
For inserting and removing PCB's with a high connector pin-count. This handle was specifically designed for use in telecom applications.

- Insertion/removal function
- Optionally with 1/2 HP offset PCB attachment, e.g. for component mounting on both sides
- Minimum space requirements, due to fold-up handle
- Codeable
- Optional integral micro-switch for "live insertion" applications
- ESD pin to dissipate static charges prior to making contact with the connectors and for precise positioning of the board type plug-in unit
- Large labelling area on the front

Material:
Plastic

Supply includes:
Assembly parts.

Note:
Insertion only in conjunction with front horizontal rails, with 10 mm extension (B),
see page 499.

Handles without offset

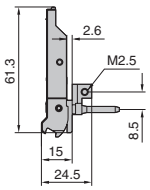
Installation	Packs of	Model No. RP
Top	1	**3688.784**
Bottom	1	**3688.785**

Handles with 1/2 HP offset

Installation	Packs of	Model No. RP
Top	1	**3688.780**
Bottom	1	**3688.781**

Accessories:

Keys, see page 514.
Keyable guide rails, see page 510.
Keyable guide rails with 1/2 HP offset, see page 511.
Micro-switch, see page 530.
Connector pin for baying, see page 529.



Injector/extractor handle type VII

Metal (telecom)
For inserting and removing PCB's with a high connector pin-count (up to 815 N). This handle was specifically designed for use in telecom applications.

- Insertion/removal function
- Optionally with 1/2 HP offset PCB attachment, e.g. for component mounting on both sides
- Minimum space requirements, due to fold-up handle
- Codeable
- Optional integral micro-switch for "live insertion" applications
- ESD pin to dissipate static charges prior to making contact with the connectors and for precise positioning of the board type plug-in unit
- Metal design for use in aggressive atmospheres

Material:
Die-cast zinc

Supply includes:
Assembly parts.

Note:
Insertion only in conjunction with front horizontal rails, with 10 mm extension (B),
see page 499.

Handles without offset

Installation	Packs of	Model No. RP
Top	1	**3688.790**
Bottom	1	**3688.791**

Handles with 1/2 HP offset

Installation	Packs of	Model No. RP
Top	1	**3688.786**
Bottom	1	**3688.787**

Accessories:

Keys, see page 514.
Keyable guide rails, see page 510.
Keyable guide rails with 1/2 HP offset, see page 511.
Micro-switch, see page 530.
Connector pin for baying, see page 529.

Micro-switch

For "live insertion" applications.
For mounting in type IV, IVs and VII injector/extractor handles.
May also be retro-fitted.

Technical specifications:
Switching load: 50 mA 30 V DC
Service life:
at nominal load: 30,000
mechanical: 50,000

Packs of	Model No. RP
10	**3684.410**

Also required:

Micro-switch mounting clip, see page 531.

Micro-switch

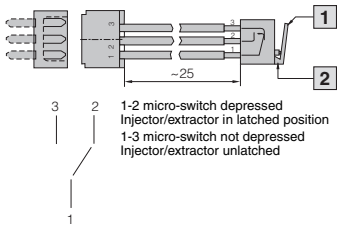
with cable and connector
For “live insertion” applications.
For mounting in type IV, IVs and VII injector/extractor handles.

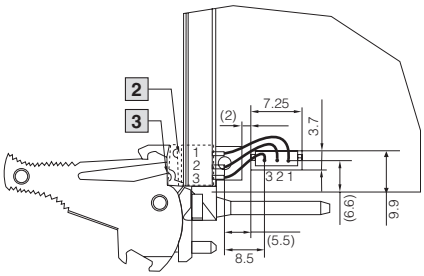
Supply includes:
Micro-switch, connector Type Molex 51021-0200, Mounting clips, 3 cables, 25 mm x #32 AWG, fully assembled.

Packs of	Model No. RP
1 set	**3686.536**

Also required:
Micro-switch mounting clip, see page 531.

1 Lever not depressed
2 Lever hinge
3 Lever contact point

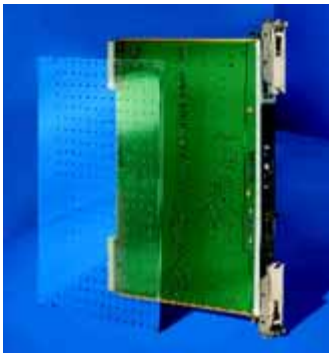




Micro-switch mounting clip

For mounting micro-switches in handles.

Packs of	Model No. RP
10	**3684.411**



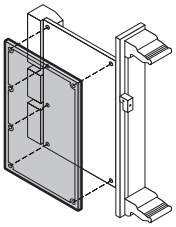
Plastic covers

for PCBs
For mechanical protection of the solder side and of the EMC gaskets.
Attachment holes as per CPCI or VME-specifications. Optionally available as perforated or solid version.

Material:
0.3 mm plastic, antistatic

0.5 mm plastic, antistatic[1)], UL 94-V0

for PCBs	Packs of	Model No. RP			
		for CPCI			for VME
		perforated[1)]	solid[1)]	solid	solid
3 U x 160 mm	1	**3687.932**	**3686.572**	**3685.966**	**3685.626**
	5	–	–	–	**3685.279**
3 U x 220 mm	1	–	–	–	**3685.805**
	5	–	–	–	**3685.266**
6 U x 80 mm	1	**3687.933**	**3686.573**	**3686.037**	**3685.146**
6 U x 160 mm	1	**3687.934**	**3686.574**	**3685.967**	**3685.627**
	5	–	–	–	**3685.280**
6 U x 220 mm	1	–	–	–	**3685.824**
	5	–	–	–	**3685.000**

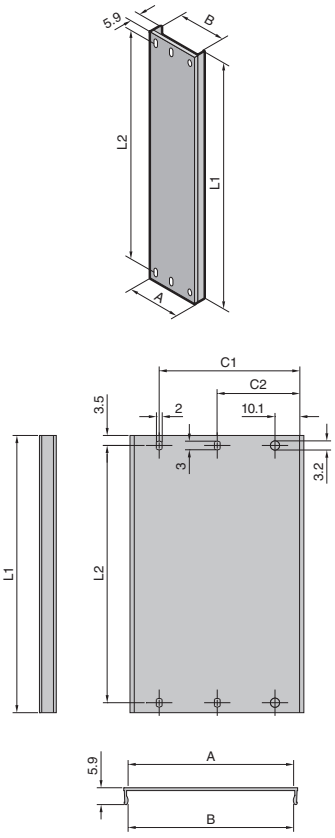


Also required:
Required for mounting the perforated CPCI covers:

Mounting clips

Packs of	Model No. RP
100	**3687.955**

Front panels, handles



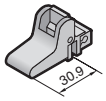
Front panels

for type III extractor handle

Material:
1.0 mm extruded aluminium section

Surface finish:
Untreated

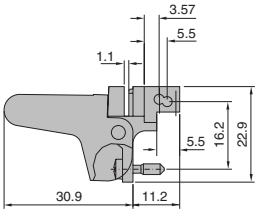
HP	A mm	B mm	C1 mm	C2 mm	Model No. RP		
					3 U	6 U	9 U
3	15.20	12.20	–	–	**3685.548**	**3685.555**	**–**
4	20.22	17.20	–	–	**3685.549**	**3685.556**	**3685.562**
5	25.28	22.28	–	22.68	**3685.550**	**3685.557**	**3685.563**
6	30.36	27.36	–	25.22	**3685.551**	**3685.558**	**3685.564**
8	40.52	37.52	–	30.30	**3685.552**	**3685.559**	**3685.566**
10	50.68	47.68	40.46	25.22	**3685.553**	**3685.560**	**3685.567**
12	60.84	57.84	50.62	30.30	**3685.554**	**3685.561**	**3685.568**
L1 mm					97.00	230.35	363.70
L2 mm					90.00	223.35	356.70



Type III handle, extractor

Material:
Fibreglass-reinforced polycarbonate
Base: nickle-plated ABS

Colour:
Grey



HP	Packs of	Model No. RP
3	1	**3685.591**
4	1	**3685.592**

Covers

for the end spaces

Material:
Fibreglass-reinforced polycarbonate

HP	Width mm	Packs of	Model No. RP
1	5	1	**3687.529**
2	10.08	1	**3687.530**
4	20.24	1	**3687.531**

Universal bracket

for front panel support

Material:
Nickel-plated plastic

HP	Packs of	Model No. RP
4	1	**3687.545**

Flat front panels

with type V handle and PCB holder
Complete modular systems

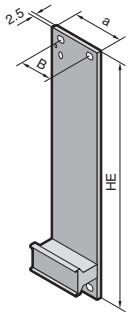
Material:
Front panel: 2.5 mm aluminium, natural anodised.
Handle: Aluminium, natural anodised.
PCB holder: Polycarbonate

Supply includes:
1 front panel,
1 handle (2 for 6 U),
1 PCB holder (2 for 6 U),
assembly parts.

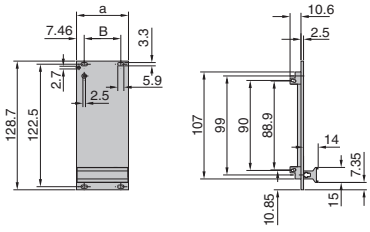
HP	a mm	B mm	Model No. RP	
			3 U H = 128.7	6 U H = 262.05
3	14.9	–	**3652.000**	**3652.200**
4	20.0	–	**3652.010**	**3652.210**
5	25.1	–	**3652.020**	**3652.220**
6	30.1	–	**3652.030**	**3652.230**
7	35.2	–	**3652.040**	**3652.240**
8	40.3	–	**3652.050**	**3652.250**
10	50.5	35.6	**3652.060**	**3652.260**
12	60.6	45.7	**3652.070**	**3652.270**
14	70.8	55.9	**3652.080**	**–**

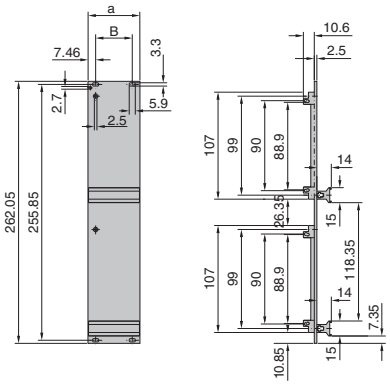
Accessories:

Identification strips for handles,
see page 535.

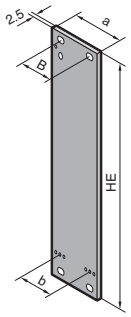


HE = U





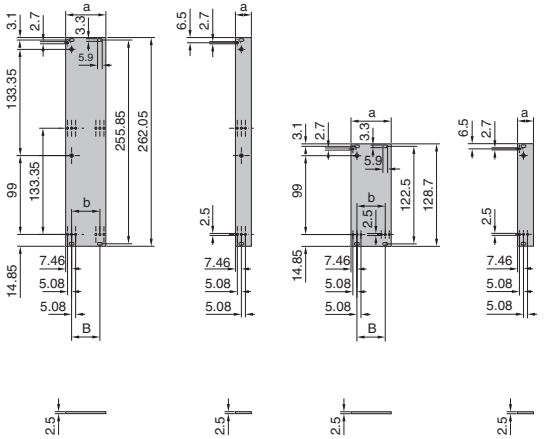
Front panels, handles



Flat front panels

for type V and VI handle

Material:
2.5 mm aluminium, anodised



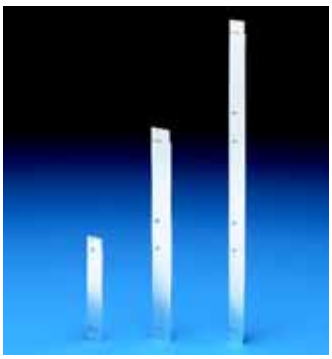
HP	a mm	B mm	b mm	Packs of	Model No. RP 3 U	Model No. RP 6 U
3	14.9	–	–	1	**3685.569**	**3685.578**
4	20.0	–	–	1	**3685.570**	**3685.579**
5	25.1	–	–	1	**3685.571**	**3685.580**
6	30.2	–	15.2	1	**3685.572**	**3685.581**
7	35.2	–	20.3	1	**3685.573**	**3685.582**
8	40.3	–	25.4	1	**3685.574**	**3685.583**
10	50.5	35.6	35.6	1	**3685.575**	**3685.584**
12	60.6	45.7	45.7	1	**3685.576**	**3685.585**
14	70.8	55.9	55.9	1	**3685.577**	**3685.586**

Also required:

Captive screws and plastic collars,
packs of 100 set, Model No. RP 3658.160,
see page 576.

Accessories:

Handles type V, see page 535.
Handles type VI, see page 536.



U-channel front panels

for type V and VI handle

Material:
2.5 mm aluminium, clear-chromated

Supply includes:
1 vertical EMC gasket, version 1.

EMC

HP	a mm	B mm	Packs of	Model No. RP 3 U	Model No. RP 6 U
4	20.0	–	1	**3687.655**	**3687.660**
6	30.2	–	1	**3687.656**	**3687.661**
8	40.3	–	1	**3687.657**	**3687.662**
10	50.5	35.6	1	**3687.658**	**3687.663**
12	60.6	45.7	1	**3687.659**	**3687.664**

Also required:

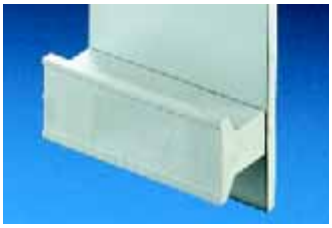
Centering screw with slot,
packs of 100 sets, Model No. RP 3687.050,
see page 577.

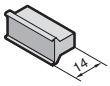
Accessories:

Handles type V, see page 535.
Handles type VI, see page 536.

Detailed drawing,
see page 534.

Front panels, handles





Type V handle

Plastic

Material:
Plastic

HP	Colour	Packs of	Model No. RP
3	Grey	1	**3685.490**
4	Grey	1	**3685.491**
8	Grey	1	**3685.492**
12	Grey	1	**3685.493**
20	Grey	1	**3685.494**
3	Black	1	**3685.495**
4	Black	1	**3685.496**
8	Black	1	**3685.497**
12	Black	1	**3685.498**
20	Black	1	**3685.499**

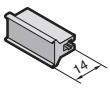
Also required:

Assembly kit,
packs of 1 set, Model No. RP 3687.519,
see page 576.

Identification strips

for type V handle, plastic
self-adhesive

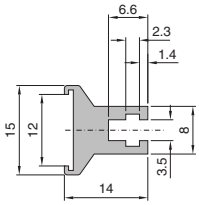
HP	Packs of	Model No. RP
24	1	**3687.693**



Type V handle

Aluminium

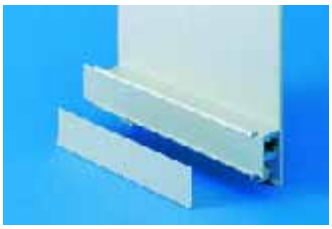
Material:
Aluminium, anodised.



HP	Model No. RP	HP	Model No. RP
3	**3685.595**	12	**3685.602**
4	**3685.596**	14	**3685.603**
5	**3685.597**	21	**3685.761**
6	**3685.598**	28	**3685.762**
7	**3685.599**	42	**3685.763**
8	**3685.600**	1 m	**3685.604**
10	**3685.601**		

Also required:

Assembly kit,
packs of 1 set, Model No. RP 3687.146,
(for 6 HP and above, 2 packs are required),
see page 577.



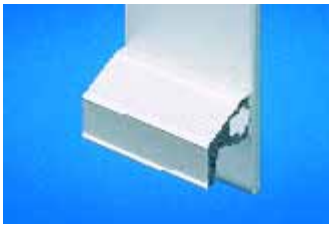
Identification strips

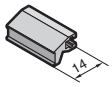
for type V handle, aluminium
For individual labelling of the handles.

Material:
0.5 mm aluminium, anodised

HP	Packs of	Model No. RP
3	1	**3685.746**
4	1	**3685.747**
5	1	**3685.748**
6	1	**3685.749**
7	1	**3685.750**
8	1	**3685.751**
10	1	**3685.752**
12	1	**3685.753**
14	1	**3685.754**
21	1	**3685.755**
28	1	**3685.756**
42	1	**3685.757**
1 m	1	**3685.758**
0.5 m	5	**3606.300**

Front panels, handles

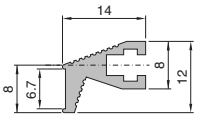




Type VI handle

Aluminium

Material:
Aluminium, anodised.



HP	Model No. RP	HP	Model No. RP
3	**3685.605**	12	**3685.612**
4	**3685.606**	14	**3685.613**
5	**3685.607**	21	**3685.614**
6	**3685.608**	28	**3685.615**
7	**3685.609**	42	**3685.616**
8	**3685.610**	84	**3685.617**
10	**3685.611**	1 m	**3685.618**

Also required:

Assembly kit,
packs of 1 set, Model No. RP 3687.146,
(for 6 HP and above, 2 packs are required),
see page 577.

PCB holder kit

For securing PCBs to front panels.

Material:
Die-cast

Note:
Only required at the top with 3 U front panels with lever handles.

Packs of	Model No. RP
10	**3685.198**

Also required:

For securing PCBs to PCB holders:
Pan-head screws,
packs of 100 sets, Model No. RP 3654.320,
see page 576.
For securing PCB holders to front panels:
Oval head screws,
packs of 100 sets, Model No. RP 3685.282,
see page 577.

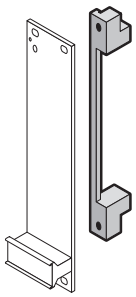
PCB holder

For front panels
For securing PCBs to front panels with type V and VI handles.

Material:
Noryl

Supply includes:
Assembly parts.

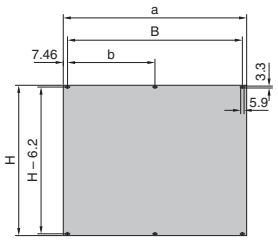
Packs of	Model No. RP
10	**3606.330**

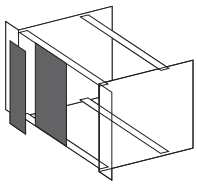


Front panels

as filler panel, flat

Material:
2.5 mm aluminium, natural anodised.





Also required:

Captive screws and plastic collars,
packs of 100 set, Model No. RP 3658.160,
see page 576.

HP	a mm	B mm	b mm	Model No. RP						
				1 U H = 39.8	2 U H = 84.25	3 U H = 128.7	4 U H = 173.15	6 U H = 262.05	7 U H = 306.5	9 U H = 395.4
2	9.8	–	–	–	–	**3684.889**	–	**3684.911**	–	**3684.738**
3	14.9	–	–	–	–	**3684.890**	–	**3684.912**	–	–
4	20.0	–	–	–	–	**3684.891**	–	**3684.913**	–	**3684.739**
5	25.1	–	–	–	–	**3684.892**	–	**3684.914**	–	–
6	30.1	–	–	–	–	**3684.893**	–	**3684.915**	–	–
7	35.2	–	–	–	–	**3684.894**	–	**3684.916**	–	–
8	40.3	–	–	–	–	**3684.895**	–	**3684.917**	–	**3684.740**
10	50.5	35.6	–	–	–	**3684.896**	–	**3684.918**	–	–
12	60.6	45.7	–	–	–	**3684.897**	–	**3684.919**	–	**3684.741**
14	70.8	55.9	–	–	–	**3684.898**	–	**3684.920**	–	–
20	101.3	86.4	–	–	–	**3684.899**	–	**3684.921**	–	–
21	106.4	91.4	–	–	**3685.350**	**3684.900**	–	**3684.922**	–	–
24	121.7	106.7	–	–	**3685.429**	–	–	–	–	–
27	136.8	121.9	–	–	–	**3684.901**	–	**3684.923**	–	–
28	141.9	127.0	–	–	–	**3684.902**	–	**3684.924**	–	–
40	202.9	188.0	–	–	–	**3684.903**	–	**3684.976**	–	**3684.977**
42	213.0	198.1	–	**3684.885**	**3684.887**	**3684.904**	**3684.908**	**3684.925**	**3684.928**	**3684.742**
60	304.5	289.6	–	–	–	**3684.905**	–	–	–	–
63	319.7	304.8	152.4	–	–	**3684.906**	**3684.909**	**3684.926**	**3684.929**	–
84	426.4	411.5	203.2	**3684.886**	**3684.888**	**3684.907**	**3684.910**	**3684.927**	**3684.930**	**3684.743**
85	413.5	411.5	203.2	–	–	**3684.744**	**3684.745**	**3684.746**	**3684.747**	**3684.748**

Front panels, handles

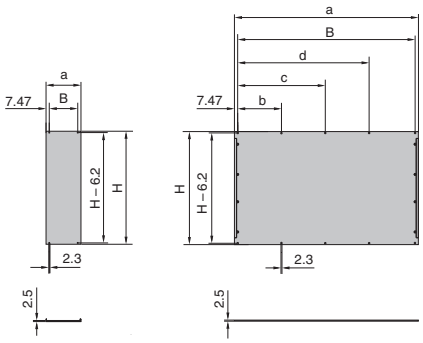
Front panels

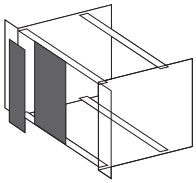
as filler panels, U-shaped

Material:
2.5 mm aluminium, clear-chromated

Supply includes:
1 one-part front panel (for 2 – 14 HP version)
or three-part (for > 14 HP version),
1 vertical EMC gasket, version 1,
1 contact strip (three-part only),
1 gasket strip (three-part only).

EMC

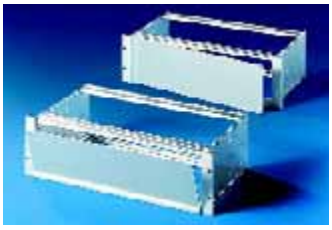




Also required:

Centering screw with slot,
packs of 100 sets, Model No. RP 3687.050,
see page 577.

HP	a mm	B mm	b mm	c mm	d mm	Model No. RP 1 U H = 39.8	2 U H = 84.25	3 U H = 128.7	4 U H = 173.15	6 U H = 262.05	7 U H = 306.5	9 U H = 395.4
2	9.8	–	–	–	–	–	–	**3685.177**	–	**3685.185**	–	**3685.193**
3	14.9	–	–	–	–	–	–	**3686.138**	–	**3686.139**	–	**3686.140**
4	20.0	–	–	–	–	–	–	**3685.178**	–	**3685.186**	–	**3685.194**
5	25.1	–	–	–	–	–	–	**3685.179**	–	**3685.187**	–	–
6	30.1	–	–	–	–	–	–	**3685.180**	–	**3685.188**	–	–
7	35.2	–	–	–	–	–	–	**3685.181**	–	**3685.189**	–	–
8	40.3	25.4	–	–	–	–	–	**3685.182**	–	**3685.190**	–	**3685.195**
10	50.5	35.6	–	–	–	–	–	**3685.183**	–	**3685.191**	–	–
12	60.6	45.7	–	–	–	–	–	**3685.184**	–	**3685.192**	–	**3685.196**
14	70.8	55.9	–	–	–	–	–	**3684.249**	–	**3684.258**	–	**3684.278**
16	80.9	66.0	–	–	–	–	–	**3685.348**	–	**3685.349**	–	–
20	101.3	86.4	–	–	–	–	–	**3684.250**	–	**3684.259**	–	**3684.279**
21	106.4	91.4	–	–	–	–	–	**3684.272**	–	**3684.275**	–	–
28	141.9	127.0	61.0	–	–	–	–	**3684.251**	–	**3684.260**	–	–
40	202.9	188.0	91.5	–	–	–	–	**3684.273**	–	**3684.276**	–	**3684.280**
42	213.0	198.1	96.5	–	–	–	–	**3684.252**	**3684.255**	**3684.261**	**3684.264**	**3684.267**
60	304.5	289.6	96.5	193.0	–	–	–	**3684.274**	–	**3684.277**	–	–
63	319.7	304.8	101.6	203.2	–	–	–	**3684.253**	**3684.256**	**3684.262**	**3684.265**	**3684.268**
84	426.4	411.5	101.6	203.2	304.8	**3684.247**	**3684.248**	**3684.254**	**3684.257**	**3684.263**	**3684.266**	**3684.269**

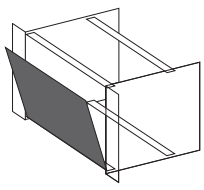


Front panels

Hinged

Material:
2.5 mm aluminium, anodised

Supply includes:
1 front panel,
1 set of hinges,
assembly parts.

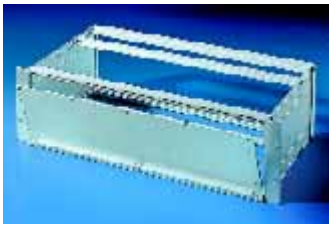


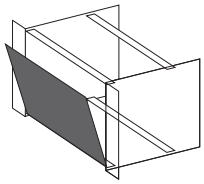
U	HP	Model No. RP vertically hinged	horizontally hinged
3	42[1)]	**3652.600**	**3652.500**
3	84[1)]	**3652.610**	**3652.510**
3	85	–	**3684.291**
4	85	–	**3684.292**
6	42[1)]	**3652.620**	**3652.520**
6	84[1)]	**3652.630**	**3652.530**
6	85	–	**3684.293**
7	85	–	**3684.294**
9	85	–	**3684.295**

Also required:

[1)] With rear mounting of 42 HP and 84 HP front panels, additonal trim sections must be attached at the rear of the subrack.
Trim sections, see page 497.

Front panels, handles





EMC front panels

Hinged

Material:
2.5 mm aluminium, clear-chromated

EMC

Supply includes:
1 front panel,
1 set of hinges,
1 contact strip,
1 gasket strip,
1 vertical EMC gasket, version 1,
assembly parts.

U	HP	**Model No. RP** horizontally hinged
3	84	**3684.298**
4	84	**3684.299**
6	84	**3684.300**
7	84	**3684.301**
9	84	**3684.302**

Mezzanine front panels

Die-cast zinc
For PCI mezzanine cards (PMC).

Conforms to IEEE 1386

Material:
Die-cast zinc

Packs of	**Model No. RP**
1	**3688.659**

Accessories:

EMC seals,
see page 540.
Assembly screws M2.5 x 6,
packs of 100 sets, Model No. RP 3654.340,
see page 576.

Mezzanine front panels

Extruded aluminium section
For PCI mezzanine cards (PMC).

Conforms to IEEE 1386

Material/surface finish:
Extruded aluminium section, clear-chromated

Packs of	**Model No. RP**
1	**3688.658**

Accessories:

EMC seals,
see page 540.
Assembly screws M2.5 x 6,
packs of 100 sets, Model No. RP 3654.340,
see page 576.

Support spacers

for mezzanine cards
10 mm, for mounting mezzanine cards.

Packs of	**Model No. RP**
1	**3688.663**

Front panels, handles

Covers

for mezzanine cutouts
To conceal unused mezzanine cutouts. The covers are simply clipped into the cutouts.

Material:
Stainless steel

Packs of	Model No. RP
1	**3688.660**

EMC seals

for mezzanine front panels
For inserting into the all-round channel of the mezzanine front panels.

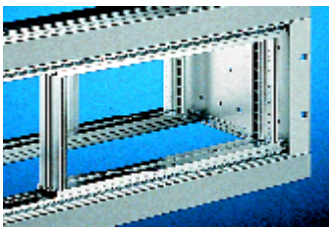
Material/surface finish:
Sealing ring made of conductive carbon filled silicon, sealing gasket made from stainless steel.

Option	Packs of	Model No. RP
Sealing ring	1	**3688.661**
Sealing gasket	1	**3688.662**

Keying pin

for mezzanine cards
To ensure the the correnct installation of mezzanine parent cards. The keying pins are bolted onto the parent boards.

Packs of	Model No. RP
1	**3688.664**

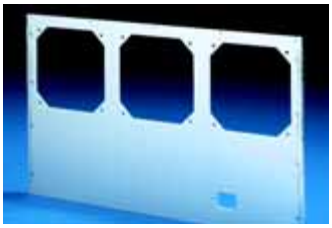


Door cutout trim

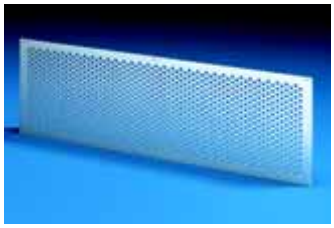
To conceal the cut-out edges when subracks are installed in the door.

Material:
Aluminium

Width	Packs of	Model No. UN
269.2 mm ($^1/_2$ 19″)	2	**3634.060**
482.6 mm (19″)	2	**3634.070**



Rear panels,
for fan installation,
see page 522.



Front/rear panels,
for ventilation,
see page 521.

Ripac box type plug-in units, type I

Technical specifications:
Installation depth: 160 and 220 mm
Height: 3 U and 6 U
to IEC 60 297-3,
to accommodate:
individual connectors

Material:
Front panel: 2.5 mm aluminium,
natural anodised
Rear panel: 2 mm aluminium, natural anodised
Side panel sections: Extruded aluminium section,
natural anodised
Handle: Aluminium, natural anodised.
PCB holder: Plastic

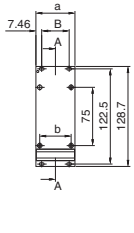
Available upon request:
- Box type plug-in units in special sizes or with printing
- EMC box type plug-in units with EMC front panels

Accessories:

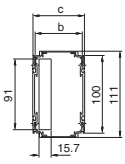
Covers,
see page 545.
Guide rails,
see page 512.
Individual components,
see page 542.

HP	a mm	B mm	b mm	c mm	C mm	d mm	e mm	f mm	Model No. RP 3 U	3 U	6 U
Board depth 160 mm											
6	32.2	–	20.3	27.5	–	171.5	122	167	**3653.000**	**–**	**–**
8	40.3	–	30.5	36.0	–	171.5	122	167	**–**	**3653.010**	**–**
10	50.5	35.6	40.6	46.2	–	171.5	122	167	**–**	**3653.020**	**3653.100**
12	60.6	45.7	50.8	56.4	–	171.5	122	167	**–**	**3653.030**	**3653.110**
14	70.8	55.9	60.9	66.5	–	171.5	122	167	**–**	**3653.040**	**3653.120**
21	106.3	91.4	96.4	102.0	86.3	171.5	122	167	**–**	**3653.050**	**3653.130**
28	141.9	127.0	132.0	137.6	121.8	171.5	122	167	**–**	**3653.060**	**3653.140**
42	213.1	198.1	203.2	208.8	193.0	171.5	122	167	**–**	**3653.070**	**3653.150**
Board depth 220 mm											
10	50.5	35.6	40.6	46.2	–	231.5	182	227	**–**	**3653.200**	**3653.300**
12	60.6	45.7	50.8	56.4	–	231.5	182	227	**–**	**3653.210**	**3653.310**
14	70.8	55.9	60.9	66.5	–	231.5	182	227	**–**	**3653.220**	**3653.320**
21	106.3	91.4	96.4	102.0	86.3	231.5	182	227	**–**	**3653.230**	**3653.330**
28	141.9	127.0	132.0	137.6	121.8	231.5	182	227	**–**	**3653.240**	**3653.340**
42	213.1	198.1	203.2	208.8	193.0	231.5	182	227	**–**	**3653.250**	**3653.350**
Supply includes											
Font panel									1	1	1
Handle									1	1	2
Side panels									1	2	2
Cover including rear panel									1	–	–
Rear panel									–	1	2
PCB holder									2	2	2
Assembly parts (set)									1	1	1

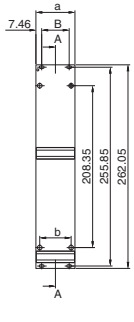
Section A – A
Board depth 160 mm



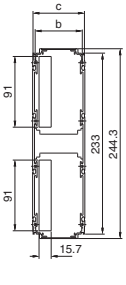
Section B – B
Type I, 3 U



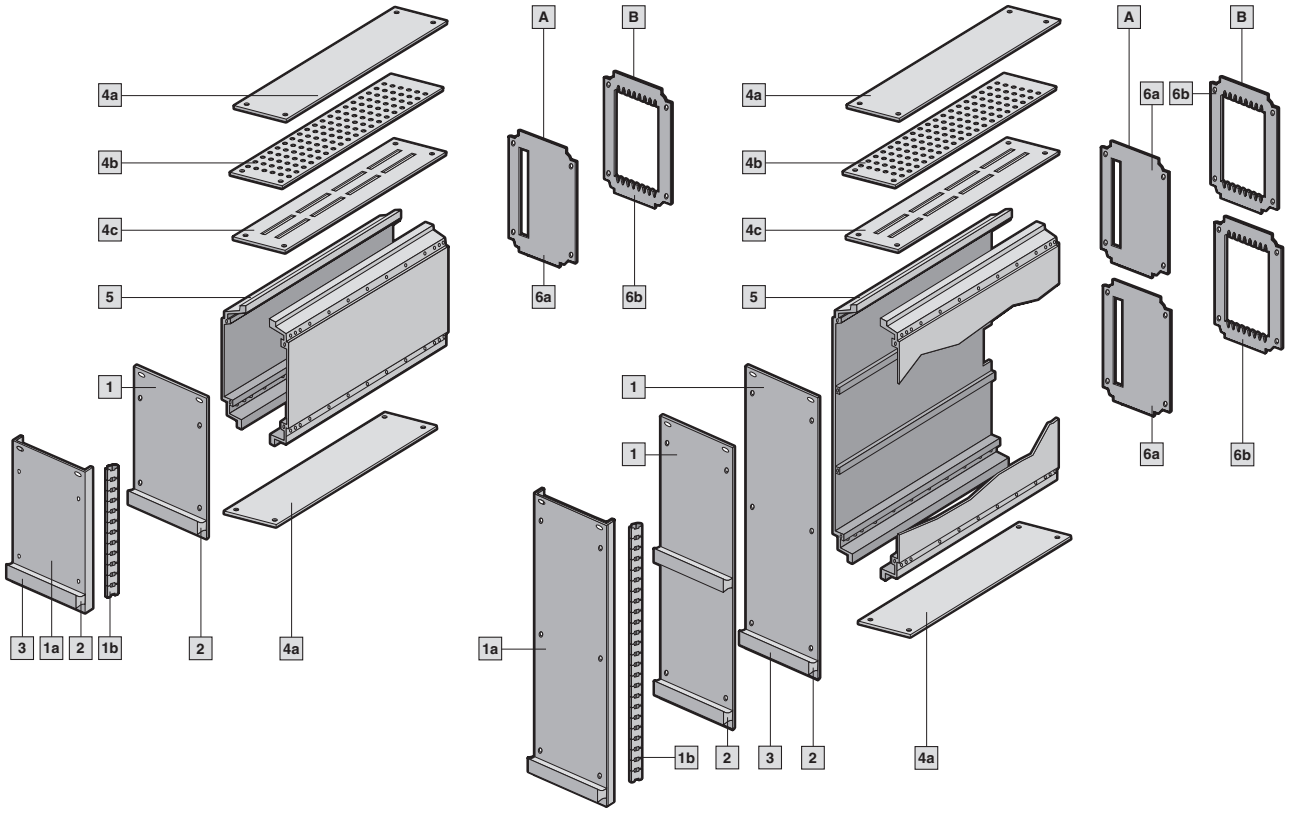
Section A – A
Board depth 160 mm



Section B – B
Type I, 6 U



Ripac box type plug-in units individual components

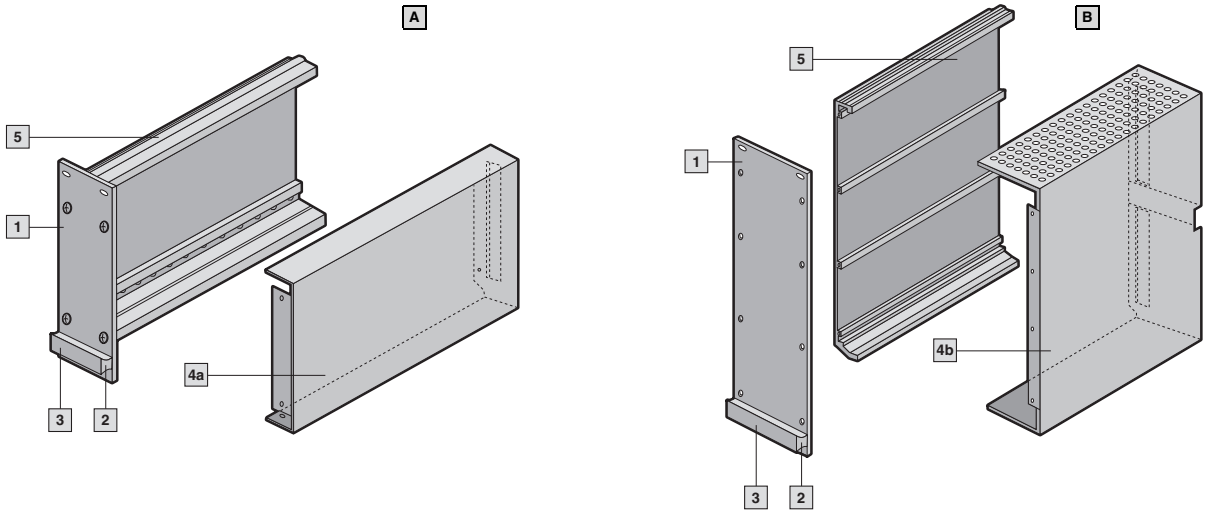


Ripac box type plug-in units, types I and II in 3 U and 6 U, individual components

Box type plug-in units, individual components		A Type I	B Type II	Packs of	8 HP	10 HP	12 HP	14 HP	21 HP	28 HP	42 HP	Page
Type I for one connector/type II for several connectors												
Front panels of 2.5 mm aluminium, anodised surface finish												
1	for 3 U	■	■	1	**3685.769**	**3685.629**	**3685.630**	**3685.631**	**3685.636**	**3685.637**	**3685.638**	–
	for 6 U (for 1 handle)	■	■	1	**3685.767**	**3685.633**	**3685.634**	**3685.635**	**3685.639**	**3685.640**	**3685.641**	–
	for 6 U (for 2 handles)	■	■	1	**–**	**3687.520**	**3687.521**	**3687.522**	**3687.523**	**3687.524**	**3687.525**	–
EMC front panels of 2.5 mm aluminium, surface finish clear-chromated (only for use in conjunction with 10 HP box type plug-in unit)												
1a	for 3 U/10 HP box type plug-in units	■	■	1	–	–	**3687.587**	–	–	–	–	–
	for 6 U/10 HP box type plug-in units	■	■	1	–	–	**3687.588**	–	–	–	–	–
EMC gaskets, vertical, for front panels												
1b	for 3 U	■	■	1	–	–	3686.975	–	–	–	–	506
	for 6 U	■	■	1	–	–	3686.977	–	–	–	–	506
Handle type V												
2	of aluminium, anodised surface finish	■	■	1	3685.600	3685.601	3685.602	3685.603	3685.761	3685.762	3685.763	535
	of plastic	■	■	1	3685.492	–	3685.493	–	3685.494	–	–	535
Identification strips												
3	of 0.5 mm aluminium, anodised surface finish	■	■	1	3685.751	3685.752	3685.753	3685.754	3685.755	3685.756	3685.757	535
Covers 4a 4b of 1 mm aluminium, untreated 4c of 1.2 mm sheet steel, painted, RAL 9006 (with vent slots)												
4a	unvented, for board depth 160 mm	■	■	1	3687.555	3685.689	3685.690	3685.691	3685.692	3685.693	3685.694	545
	unvented, for board depth 220 mm	■	■	1	3687.562	3685.701	3685.702	3685.703	3685.704	3685.705	3685.706	545
4b	vented, for board depth 160 mm	■	■	1	3687.585	3685.683	3685.684	3685.685	3685.686	3685.687	3685.688	545
	vented, for board depth 220 mm	■	■	1	–	3685.695	3685.696	3685.697	3685.698	3685.699	3685.700	545
4c	vent slots for guide rails, for board depth 160 mm	■	■	1	–	3687.556	3687.557	3687.558	3687.559	3687.560	3687.561	545
	vent slots for guide rails, for board depth 220 mm	■	■	1	–	3687.563	3687.564	3687.565	3687.566	3687.567	3687.568	545
Side panel of extruded aluminium section, anodised surface finish												
5	3 U, for board depth 160 mm	■	■	1				**3685.645**				–
	6 U, for board depth 160 mm	■	■	1				**3685.648**				–
	3 U, for board depth 220 mm	■	■	1				**3685.646**				–
	6 U, for board depth 220 mm	■	■	1				**3685.649**				–
Rear panel 6a of 2.0 mm aluminium, untreated 6b of 1.2 mm sheet steel, spray-finished												
6a	for 1 connector	■	–	1	**3687.536**	**3685.707**	**3685.708**	**3685.709**	**3685.710**	**3685.711**	**3685.712**	–
6b	for several connectors	–	■	1	**–**	**–**	**–**	**–**	**3687.537**	**3687.538**	**3687.539**	–

Assembly parts for box type plug-in units, see page 543

Ripac box type plug-in units individual components



Ripac box type plug-in units, types V and VI in 3 U and 6 U, individual components

Box type plug-in units, individual components		A Type V	B Type VI	Packs of	6 HP	7 HP	8 HP	10 HP	12 HP	14 HP	Page
Type V with cover (unvented)/type VI with cover (vented)											
Front panels of 2.5 mm aluminium, anodised surface finish											
1	for 3 U	■	■	1	**3685.768**	**3685.628**	**3685.769**	**3685.629**	**3685.630**	**3685.631**	–
	for 6 U	■	■	1	**3685.766**	**3685.632**	**3685.767**	**3685.633**	**3685.634**	**3685.635**	–
Handle type V											
2	of aluminium, anodised surface finish	■	■	1	3685.598	3685.599	3685.600	3685.601	3685.602	3685.603	535
	of plastic	■	■	1	–	–	3685.492	–	3685.493	–	535
Identification strips for 3 U											
3	of 0.5 mm aluminium, anodised surface finish	■	■	1	3685.749	3685.750	3685.751	3685.752	3685.753	3685.754	535
Cover of 1 mm aluminium, clear chromated surface finish											
4a	unvented, 3 U, for board depth 160 mm	■	–	1	**3685.774**	**3685.658**	**3685.776**	**3685.659**	**3685.660**	**3685.661**	–
	unvented, 3 U, for board depth 220 mm	■	–	1	**3685.775**	**3685.674**	**3685.777**	**3685.675**	**3685.676**	**3685.677**	–
	unvented, 6 U, for board depth 160 mm	■	–	1	**3685.717**	**3685.662**	**3685.764**	**3685.663**	**3685.664**	**3685.665**	–
	unvented, 6 U, for board depth 220 mm	■	–	1	**3685.718**	**3685.678**	**3685.765**	**3685.679**	**3685.680**	**3685.681**	–
4b	vented, 3 U, for board depth 160 mm	–	■	1	**3685.770**	**3685.650**	**3685.772**	**3685.651**	**3685.652**	**3685.653**	–
	vented, 3 U, for board depth 220 mm	–	■	1	**3685.771**	**3685.666**	**3685.773**	**3685.667**	**3685.668**	**3685.669**	–
	vented, 6 U, for board depth 160 mm	–	■	1	**3685.713**	**3685.654**	**3685.715**	**3685.655**	**3685.656**	**3685.657**	–
	vented, 6 U, for board depth 220 mm	–	■	1	**3685.714**	**3685.670**	**3685.716**	**3685.671**	**3685.672**	**3685.673**	–
Side panel of extruded aluminium section, anodised surface finish											
5	3 U, for board depth 160 mm	■	■	1	**3685.645**						–
	6 U, for board depth 160 mm	■	■	1	**3685.648**						–
	3 U, for board depth 220 mm	■	■	1	**3685.646**						–
	6 U, for board depth 220 mm	■	■	1	**3685.649**						–

Assembly parts for box type plug-in unit types I, II, V, VI				
Description	for installation of:	Packs of	**Model No. RP**	
Assembly kit for box type plug-in unit I/II, 3 U	Box type plug-in units, type I/II, 3 U	1 set	**3687.589**	–
Assembly kit for box type plug-in unit I/II, 6 U	Box type plug-in units, type I/II, 6 U	1 set	**3687.590**	–
Assembly kit for box type plug-in units type V/VI	Box type plug-in units, type V/VI	1 set	**3685.294**	–
Assembly kit for box type plug-in unit with EMC-front panel	Box type plug-in unit with EMC front panel	1 set	**3687.591**	–
Assembly kit for plastic handles	Plastic handles on box type plug-in units	1 set	3687.519	576

For more screws, see page 576

Ripac box type plug-in units for drives

Vertical drive chassis

For the installation of drives or CD-ROMs.
May be installed in all Ripac subracks.

- Optionally prepared for EMC or non-EMC
- Accomodation for $3^1/_2$″ or $5^1/_4$″ drives or CD-ROM, vertical
- Front panel and support plate integrated

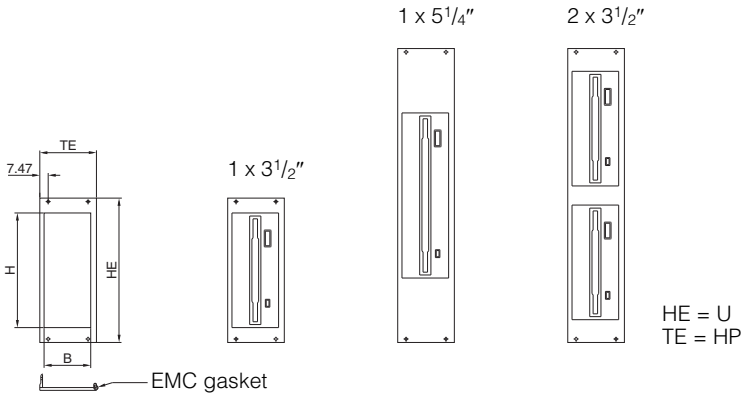
Material:
Front panel: 2.5 mm aluminium
Support plate: Aluminium

Surface finish:
Clear-chromated

EMC

Supply includes:
1 front panel with support plate,
1 EMC gasket (with EMC modules),
assembly parts.

Installation drives	Font panel		Depth drive approx. mm	Font panel cutout		Model No. RP	
	U	HP		Height (H) mm	Width (B) mm	EMC	Non-EMC
1 x $3^1/_2$″	3	8	160	102	26	**3684.469**	**3685.078**
2 x $3^1/_2$″	6	8	160	102	2 x 26	**3684.478**	**3685.087**
1 x $5^1/_4$″	6	10	220	147	41.5	**3684.481**	**3685.090**
1 x $3^1/_2$″	3	8	160	–	–	**–**	**3685.091**
	3	10	160	–	–	**–**	**3685.092**
2 x $3^1/_2$″	6	8	160	–	–	**–**	**3685.095**
	6	10	160	–	–	**–**	**3685.096**



Guide rails

for drive chassis
For routing drive chassis in the subrack.

Material:
Aluminium

Supply includes:
Press-fit pin.

For installation depth mm	Packs of	Model No. RP
160	1	**3686.989**

Note:
Two guide rails are required for each drive chassis.

Also required:

Assembly screws,
packs of = 100, Model No. RP 3654.340,
see page 576.

PCB holder

for box type plug-in units
For fastening PCBs in box type plug-in units.

Material:
PBTP, basic material to UL-94-V0

Supply includes:
Assembly parts.

Packs of	Model No. RP
2	**3606.321**

Ripac box type plug-in units/installation

Covers

for type I and II box type plug-in units

Without vent slots
For slide-in fastening.

Material:
1.0 mm aluminium, untreated

With vent slots
For screw fastening.
Suitable for the installation of guide rails.

Material:
1.2 mm sheet steel, spray-finished

Colour:
RAL 9006

Unit width	Packs of	Model No. RP	
		with vent slots[1)]	without vent slots
Board depth 160 mm			
8 HP	1	–	**3687.555**
10 HP	1	**3687.556**	**3685.689**
12 HP	1	**3687.557**	**3685.690**
14 HP	1	**3687.558**	**3685.691**
21 HP	1	**3687.559**	**3685.692**
28 HP	1	**3687.560**	**3685.693**
42 HP	1	**3687.561**	**3685.694**
Board depth 220 mm			
8 HP	1	–	**3687.562**
10 HP	1	**3687.563**	**3685.701**
12 HP	1	**3687.564**	**3685.702**
14 HP	1	**3687.565**	**3685.703**
21 HP	1	**3687.566**	**3685.704**
28 HP	1	**3687.567**	**3685.705**
42 HP	1	**3687.568**	**3685.706**

Also required:

[1)] Assembly screws,
packs of 100 sets, Model No. RP 3685.289,
see page 577.

Covers

for type I und II box type plug-in units
Slide-in, with vent holes (EMC).

Material:
1.0 mm aluminium, untreated

Unit width	Packs of	Model No. RP	
		Board depth	
		160 mm	220 mm
8 HP	1	**3687.585**	–
10 HP	1	**3685.683**	**3685.695**
12 HP	1	**3685.684**	**3685.696**
14 HP	1	**3685.685**	**3685.697**
21 HP	1	**3685.686**	**3685.698**
28 HP	1	**3685.687**	**3685.699**
42 HP	1	**3685.688**	**3685.700**

Guide rails

for box type plug-in units,
see page 512.

Connectors

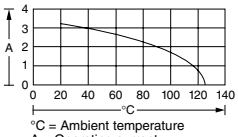
Specifications of male and female connectors to IEC 60 603-2 (DIN 41 612)

	Version B	Version C
Moulded body	Fibreglass-reinforced polyester, grey, self-exting. (UL 94-V0)	Fibreglass-reinforced polyester, grey, self-exting. (UL 94-V0)
Contacts	Male connector CuZn, female connector $CuSn_6$ or $CuSn_8$ optionally plated 2 µm Ni	Male connector CuZn, female connector $CuSn_6$ or $CuSn_8$ optionally plated 2 µm Ni
Connections	$CuNi_9Sn_2$, nickle-plated, optionally tin-plated, Connection zones optionally plated Au/Ni	$CuNi_9Sn_2$, nickle-plated, optionally tin-plated, Connection zones optionally plated Au/Ni
Test class	55/125/56 (to DIN 40 045)	55/125/56 (to DIN 40 045)
Temperature range	–55°C to +125°C	– 55°C to +125°C
Total insertion force	32 pin ≤ 30 N, 64 pin ≤ 60 N	32 pin ≤ 30 N, 48 pin ≤ 45 N, 64 pin ≤ 60 N, 96 pin ≤ 90 N
Retention force	≥ 0.15 N with 0.56 mm test blade	≥ 0.15 N with 0.56 mm test blade
Mechanical service life (connection cycles/quality level)	400 ≙ quality level II	400 ≙ quality level II
Assembling force	80 N (max. 150 N)	80 N (max. 150 N)
Pin retention force	min. 30 N	min. 30 N
Operating current according to derating curve	32 pin: 20°C: 3.2 A/70°C: 1.5 A/100°C: 1.0 A 64 pin: 20°C: 2.0 A/70°C: 1.0 A/100°C: 0.5 A	32/48 pin: 20°C: 3.2 A/70°C: 1.5 A/100°C: 1.0 A 64/96 pin: 20°C: 2.0 A/70°C: 1.0 A/100°C: 0.5 A
Dielectric strength	1.0 kV, 50 Hz (with 2.54 mm)	1.0 kV, 50 Hz (with 2.54 mm)
Operating voltage	250 V~ (with 2.54 mm) VDE 0110, insulation category A	250 V~ (with 2.54 mm) VDE 0110, insulation category A
Min. clearance and creapage distances	1.2 mm (row population) 1.3 mm (contact → contact)	2.5 mm (population rows a + c) 1.2 mm (row population) 3.0 mm (population rows a + c) 1.3 mm (contact → contact)
Volume resistance	≤ 20 mΩ (max. 2 mΩ deviation from standard)	≤ 20 mΩ (max. 2 mΩ deviation from standard)
Insulation resistance	≥ 10^{12}Ω (min. 10^9 Ω after climatic stress)	≥ 10^{12}Ω (min. 10^9 Ω after climatic stress)
Capacitance	approx. 0.5 – 1 pF (contact → contact)	approx. 0.5 – 1 pF (contact → contact)

	Version F	Version H	Version R
Moulded body	Fibreglass-reinforced polyester/ polycarbonate, grey, self-exting (UL 94-V0)	Fibreglass-reinforced polyester/ polycarbonate, grey, self-exting (UL 94-V0)	Fibreglass-reinforced polyester, grey, self-extinguishing (UL 94-V0)
Contacts	Male connector CuZn, female connector $CuSn_6$ or $CuSn_8$ optionally plated Au/2µ Nl	Male and femal connector copper alloy, hard silver-plated	Male connector CuZn, female connector $CuSn_6$ or $CuSn_8$ optionally plated Au/2µ Nl
Connections	$CuNi_9Sn_2$, nickle-plated, optionally tin-plated, connection zones optionally Au/Ni	Tin-plated	$CuNi_9Sn_2$, nickle-plated, optionally tin-plated, connection zones optionally Au/Ni
Test class	55/125/56 (to DIN 40 045)		55/125/56 (to DIN 40 045)
Temperature range	–55°C to +125°C	–65°C to +125°C	–55°C to +125°C
Total insertion force	32 pin ≤ 50 N, 48 pin ≤ 75 N	max. 90 N	32 pin ≤ 30 N, 48 pin ≤ 45 N; 64 pin ≤ 60 N, 96 pin ≤ 90 N
Retention force	≥ 0.15 N with 0.56 mm test blade		≥ 0.15 N with 0.56 mm test blade
Mechanical service life (connection cycles/quality level)	400 ≙ quality level II		400 ≙ quality level II
Assembling force			80 N (max.150 N)
Pin retention force			min. 30 N
Operating current according to derating curve	32/48 pin: 20°C: 6.0 A/70°C: 4.0 A/100°C: 2.5 A	20°C: 15 A/70°C: 12 A/100°C: 8 A	32/48 pin: 20°C: 3.2 A/70°C: 1.5 A/100°C: 1.0 A 64/96 pin: 20°C: 2.0 A/70°C: 1.0 A/100°C: 0.5 A
Dielectric strength	1.55 kV (with b, z), 3 kV (with d, z)	3.0 kV, 50 Hz	1.0 kV, 50 Hz (with 2.54 mm)
Operating voltage	125 V~ (b, z), 250 V~ (d, z)	500 V, VDE 0110 size C	250 V~ (with 2.54 mm) VDE 0110, insulation category A
Min. clearance and creapage distances	≥ 1.6 mm (≥ 3 mm for population rows d + z); ≥ 3.0 mm (≥ 5 mm for population rows d + z);	≥ 4.5 mm ≥ 8.0 mm	2.5 mm (population rows a + c) 1.2 mm (row population) 3.0 mm (population rows a + c) 1.3 mm (contact → contact)
Volume resistance	≤ 15 mΩ (max. 2 mΩ deviat. from stand.)	≤ 15 mΩ	≤ 20 mΩ (max. 2 mΩ deviat. from stand.)
Insulation resistance	≥ 10^{12}Ω	≥ 10^{12}Ω	≥ 10^{12}Ω (min. 10^9 Ω after climatic stress)
Capacitance	approx. 2.5 pF (1.5 pF for popul. d, z)		approx. 0.5 – 1 pF (contact → contact)

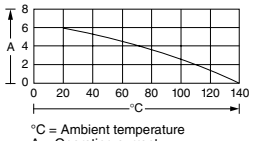
Derating curves

B, C, R



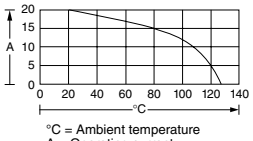
Version B, C, R
20°C – 3.20 A
70°C – 2.45 A
100°C – 1.65 A

F



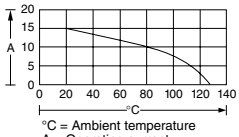
Version F
20°C – 6.0 A
70°C – 4.0 A
100°C – 2.5 A

H11



Version H11
20°C – 20.0 A
70°C – 16.0 A
100°C – 12.2 A

H15



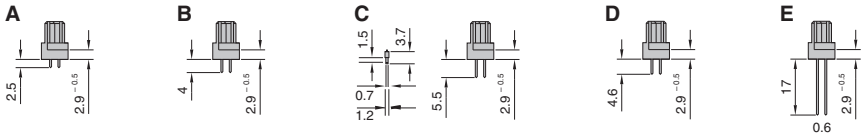
Version H15 R
20°C – 15.0 A
70°C – 11.0 A
100°C – 8.0 A

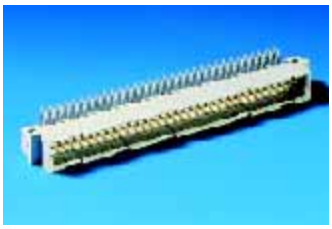
Female connector version B

IEC 60 603-2 (DIN 41 612)

- 3.2 A/pin (at 20°C ambient temperature)
- Solder or press-fit technology

Type of connection		Model No. RP Solder pin (A)	Solder pin (B)	Solder pin (C)	Press-fit pin (D)	Press-fit pin (E)	No. of contacts
Population	Row a 1, 2, 3 ...	**3686.700**	**3686.703**	**3686.706**	**3686.709**	**3686.712**	32
Population	Row a + b Pin 2, 4, 6 ...32	**3686.701**	**3686.704**	**3686.707**	**3686.710**	**3686.713**	32
Population	Row a + b 1, 2, 3 ...	**3686.702**	**3686.705**	**3686.708**	**3686.711**	**3686.714**	64
Hole diameter for printed circuit boards		$1^{\pm 0.1}$	$1^{\pm 0.1}$	$1^{\pm 0.1}$	$1^{+0.009}_{-0.006}$	$1^{+0.009}_{-0.006}$	



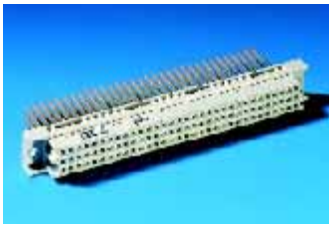


Male connector version B

IEC 60 603-2 (DIN 41 612)

- 3.2 A/pin (at 20°C ambient temperature)
- Solder or press-fit technology

Type of connection		Model No. RP Solder pin (A)	Press-fit pin (B)	No. of contacts
Population	Row a 1, 2, 3 ...	**3686.715**	**3686.718**	32
Population	Row a + b Pin 2, 4, 6 ...32	**3686.716**	**3686.719**	32
Population	Row a + b 1, 2, 3 ...	**3686.717**	**3686.720**	64
Hole diameter for printed circuit boards		$1^{\pm 0.1}$	$1^{+0.009}_{-0.006}$	

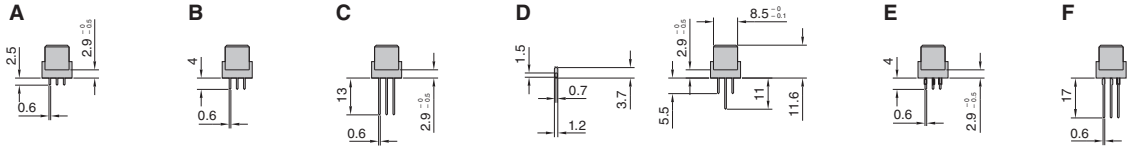


Female connector version C

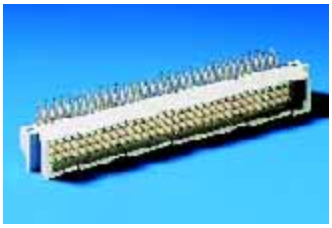
IEC 60 603-2 (DIN 41 612)

- 3.2 A/pin (at 20°C ambient temperature)
- Solder or press-fit technology

Type of connection		Model No. RP Solder pin (A)	Solder pin (B)	Wrap post (C)	Solder pin (D)	Press-fit pin (E)	Press-fit pin (F)	No. of contacts
Population	Row a + b Pin 2, 4, 6 ...32	**3686.721**	**3686.725**	**3686.729**	**3686.733**	**3686.737**	**3686.741**	32
Population	Row a + b + c Pin 2, 4, 6 ...32	**3686.722**	**3686.726**	**3686.730**	**3686.734**	**3686.738**	**3686.742**	48
Population	Row a + c	**3686.723**	**3686.727**	**3686.731**	**3686.735**	**3686.739**	**3686.743**	64
Population	Row a + b + c	**3686.724**	**3686.728**	**3686.732**	**3686.736**	**3686.740**	**3686.744**	96
Hole diameter for printed circuit boards		$1^{\pm 0.1}$	$1^{\pm 0.1}$	$1^{\pm 0.1}$	$1^{\pm 0.1}$	$1^{+0.009}_{-0.006}$	$1^{+0.009}_{-0.006}$	



Connectors



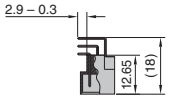
Female connector version C

IEC 60 603-2 (DIN 41 612)

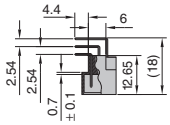
- 3.2 A/pin (at 20°C ambient temperature)
- Solder or press-fit technology

Type of connection		Model No. RP: Solder pin (A)	Solder pin (B)	Press-fit pin (C)	No. of contacts
Population	Row a + c Pin 2, 4, 6 ...32	**3686.745**	**3686.749**	**3686.753**	32
Population	Row a + b + c Pin 2, 4, 6 ...32	**3686.746**	**3686.750**	**3686.754**	48
Population	Row a + b	**3686.747**	**3686.751**	**3686.755**	64
Population	Row a + b + c	**3686.748**	**3686.752**	**3686.756**	96
Hole diameter for printed circuit boards		$1^{\pm 0.1}$	$1^{\pm 0.1}$	$1^{+0.009}_{-0.006}$	

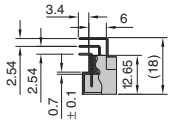
A



B



C



Female connector version F

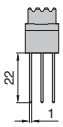
IEC 60 603-2 (DIN 41 612)

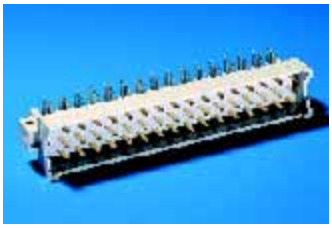
- 5.6 A/pin (at 20°C ambient temperature)
- Solder or wire-wrap technology

Type of connection		Model No. RP: Solder pin (A)	Wrap post (B)	No. of contacts
Population	Rows b, z Pin 2, 4, 6 ...32	**3686.814**	**3686.820**	32
Population	Rows d, z Pin 2, 4, 6 ...32	**3686.815**	**3686.821**	32
Population	Rows d, b, z Pin 2, 4, 6 ...32	**3686.816**	**3686.822**	48
Hole diameter for printed circuit boards		$1.6^{\pm 0.1}$	$1^{+0.009}_{-0.006}$	

A

B





Male connector version F

IEC 60 603-2 (DIN 41 612)

- 5.6 A/pin (at 20°C ambient temperature)
- Solder or pins

Type of connection		Model No. RP: Solder pin	No. of contacts
Population	Rows b, z Pin 2, 4, 6 ...32	**3686.817**	32
Population	Rows d, z Pin 2, 4, 6 ...32	**3686.818**	32
Population	Rows d, b, z Pin 2, 4, 6 ...32	**3686.819**	48
Hole diameter for printed circuit boards		$1^{\pm 0.1}$	

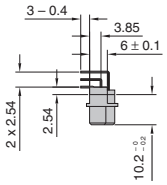
Female connector version R

IEC 60 603-2 (DIN 41 612)

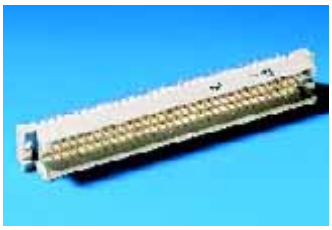
- 3.2 A/pin (at 20°C ambient temperature)
- Solder or press-fit technology

Type of connection		Model No. RP: Solder pin (A)	Press-fit (B)	No. of contacts
Population	Row a + c Pin 2, 4, 6 ...32	**3686.757**	–	32
Population	Row a + b + c Pin 2, 4, 6 ...32	**3686.758**	–	48
Population	Row a + c	**3686.759**	**3686.761**	65
Population	Row a + b + c	**3686.760**	**3686.762**	96
Hole diameter for printed circuit boards		$1^{\pm 0.1}$	$1^{+0.009}_{-0.006}$	

A



B



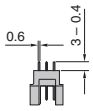
Male connector version R

IEC 60 603-2 (DIN 41 612)

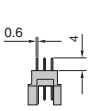
- 3.2 A/pin (at 20°C ambient temperature)
- Solder or press-fit technology

Type of connection		Model No. RP: Solder pin (A)	Solder pin (B)	Wrap post (C)	Press-fit pin (D)	Press-fit pin (E)	No. of contacts
Population	Row a + c Pin 2, 4, 6 ...32	**3686.763**	**3686.767**	**3686.771**	**3686.775**	**3686.779**	32
Population	Row a + b + c Pin 2, 4, 6 ...32	**3686.764**	**3686.768**	**3686.772**	**3686.776**	**3686.780**	48
Population	Row a + c	**3686.765**	**3686.769**	**3686.773**	**3686.777**	**3686.781**	64
Population	Row a + b + c	**3686.766**	**3686.770**	**3686.774**	**3686.778**	**3686.782**	96
Hole diameter for printed circuit boards		$1^{\pm 0.1}$	$1^{\pm 0.1}$	$1^{\pm 0.1}$	$1^{+0.009}_{-0.006}$	$1^{+0.009}_{-0.006}$	

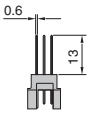
A



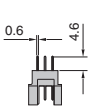
B



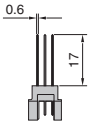
C



D



E



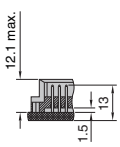
Male connector shroud type R

IEC 60 603-2 (DIN 41 612)

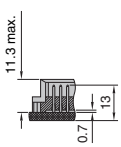
- For adaptor connectors

Type of connection	Model No. RP: A	B	C	D
Population 96 pins	**3686.783**	**3686.784**	**3686.807**	**3686.808**

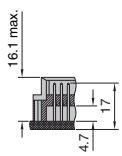
A



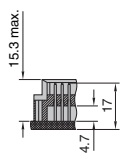
B



C



D



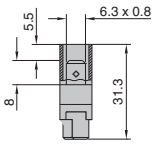
Connectors

Female connector version H11

IEC 60 603-2 (DIN 41 612)

- 15 A/pin (at 20°C ambient temperature)
- Flat-pin connector terminal

	Model No. RP
Type of connection	Faston
Population 11 pins	**3686.788**

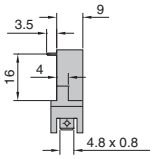


Male connector version H11

IEC 60 603-2 (DIN 41 612)

- 15 A/pin (at 20°C ambient temperature)
- Solder technique
- Optional leading earth (2)

	Model No. RP
Type of connection	Solder pin
Population 11 pins	**3686.785**
Population 10 + 1 pin	**3686.786**
Population 9 + 2 pin	**3686.787**

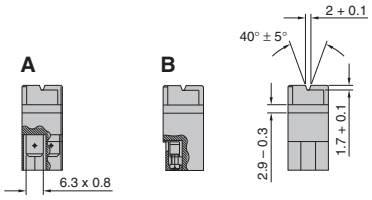


Female connector version H15

IEC 60 603-2 (DIN 41 612)

- 15 A/pin (at 20°C ambient temperature)
- Blade terminals or screw termination

	Model No. RP	
Type of connection	Faston (A)	Screw termination (B)
Population 15 pins	**3686.789**	**3686.790**

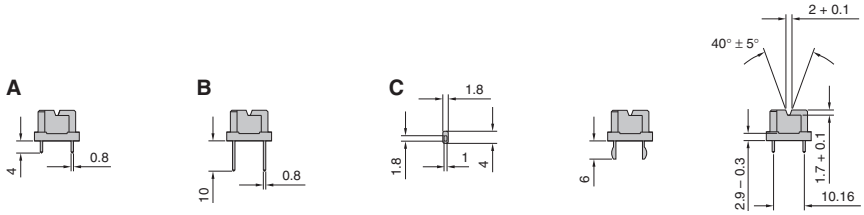


Female connector version H15

IEC 60 603-2 (DIN 41 612)

- 15 A/pin (at 20°C ambient temperature)
- Solder technique

	Model No. RP		
Type of connection	Solder pin (A)	Solder pin (B)	Solder lug (C)
Population 15 pins	**3686.791**	**3686.792**	**3686.793**



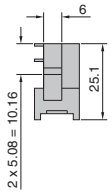
Connectors

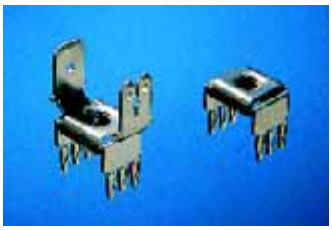
Female connector version H15

IEC 60 603-2 (DIN 41 612)

- 15 A/pin (at 20°C ambient temperature)
- Solder technique

	Model No. RP
Type of connection	Solder pin
Population 15 pins	**3686.794**



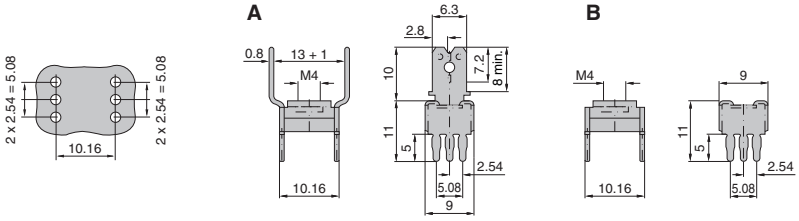


Screw/plug-in connections

Press-fit technique.

- With 6 pins
- 30 A rated current maximum

Type	Pins	Model No. RP
A	6	**3686.801**
B	6	**3686.802**



Faston

Press-fit or solder.

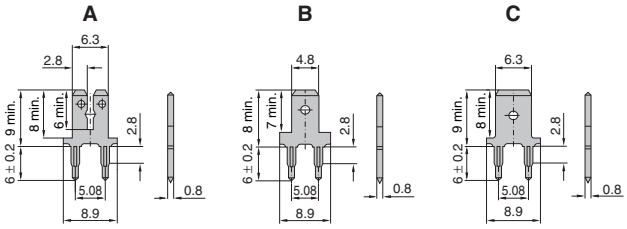
Material:
$CuSn_6$

Surface finish:
min. 2 µm SnPb

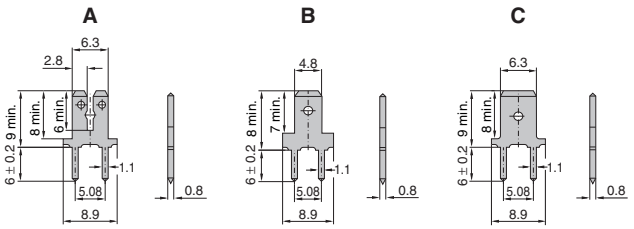
Technical specifications:
Assembling force: max. 60 kg
Pin retention force: at least 12 kg
Drill bit: 1.75 mm
Hole: 1.6 ± 0.9 mm after plating

Type	Model No. RP	
	Press-fit pin	Solder pin
A	**3686.795**	**3686.798**
B	**3686.796**	**3686.799**
C	**3686.797**	**3686.800**

Press-fit technique



Solder technique



Assembly parts

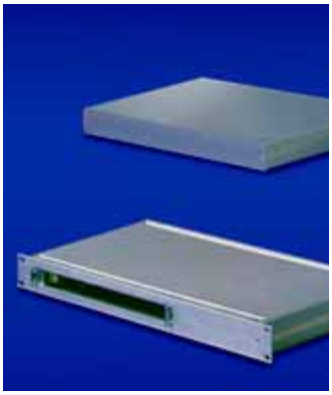
For fastening	Dimensions	Description	Packs of	Model No. RP	Page
Connectors to Z rails	M2.5 x 6	Posidrive screw	100	3654.340	576
Connectors to PCBs	M2.5 x 12	Posidrive screw	100	3654.350	576

Instrument cases/system enclosures

Features

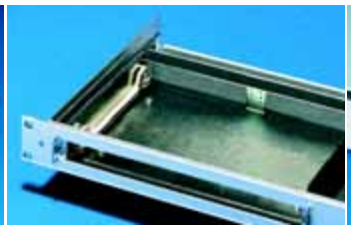
Alongside the Rittal Vario-Case iS, the classic instrument case with its wide range of application-related benefits, the RiCase instrument case stands out with its modern design. Particular features include the numerous colour variants and the all-metal enclosure construction.

The system enclosure (instrument case or rack-mounted enclosure) Ripac Vario-Module is fully compatible with the latest Ripac subrack range, making it ideal for individual configuration and assembly as a microcomputer system.



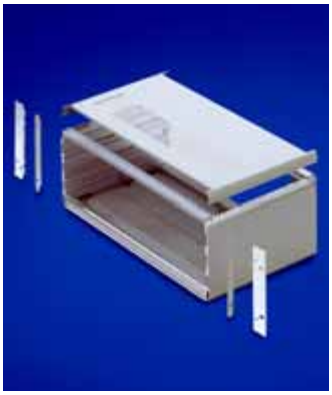
RiBox

System enclosure for horizontal installation of individual boards, hubs, routers and modems.



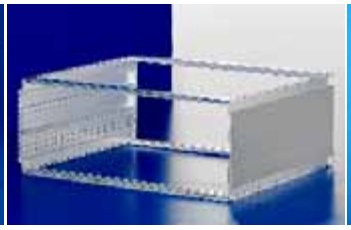
Mounting plate of sheet steel for individual population.

Installation kit for horizontal installation of boards.



Ripac Vario-Module

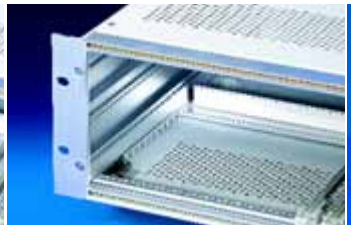
System enclosure
for direct installation of PCBs or board-type plug-in units.



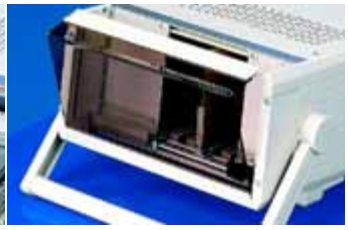
Basic enclosure
optionally for EMC or non-EMC applications and . . .

. . . individually configurable with cover plates.

Optionally with **corner trim** for configuration as an instrument case or . . .



. . . with **482.6 mm (19″) flanges** for configuration as a rack-mounted enclosure.

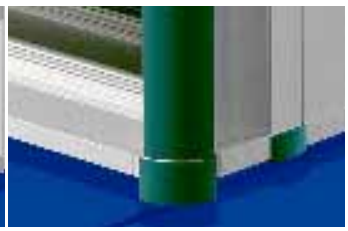


Acrylic glazed front doors, horizontally hinged, to protect built-in control components.

Features

Rittal RiCase

All-metal instrument case for 482.6 mm (19″) slide-in equipment
The perfect “safe” for valuable electronics. Extruded aluminium sections and die-cast elements form an extremely robust yet lightweight enclosure.



Stability and non-slip properties are guaranteed by 10 mm high corner caps. The distance from the desktop or from the lower enclosure offers excellent ventilation conditions.

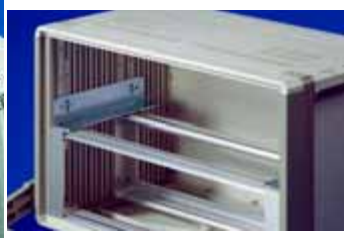
The styling and colours add **innovative design accents.** This emphasises the high value of the electronic fittings within.

Slide-in strips are simply pushed into a suitable profile channel, and any required attachment is supported.

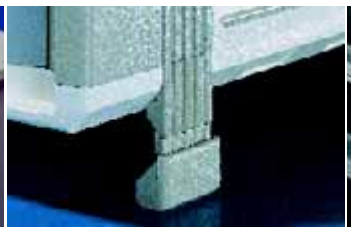
Natural convection from bottom to top, via optional perforations in the base and cover trays.

Rack-mounted fans provide forced ventilation.

Rittal Vario-Case iS



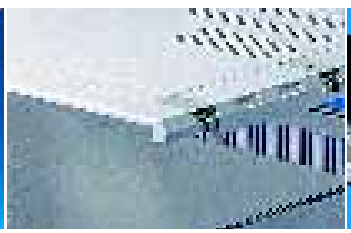
Instrument cases for the installation of slide-in equipment as well as modular assemblies and PCBs. The pitch pattern of channels in the side panels provides variable support attachments.



Twin **fold-out enclosure feet** in the base trays enable two different angles of inclination.

Stackability thanks to integral enclosure feet and recesses, even with different depths.

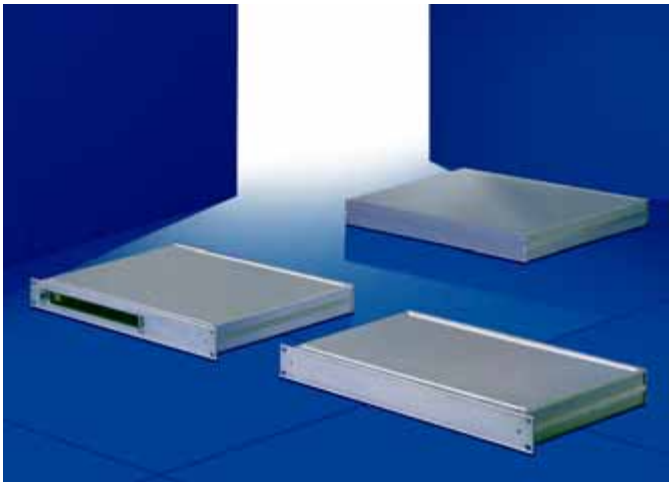
Versatile **handling options** with support stands, carrying handles and recessed handles.

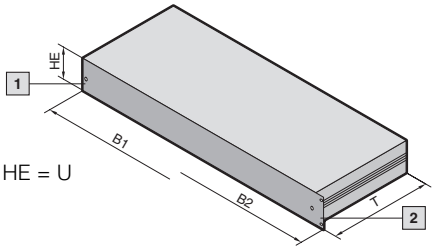


Concealed screw fastenings for an excellent design.

Individual climate control: Front panels with vent slots, vented base/cover trays, rack-mounted fans.

RiBox system enclosures 1 U





Technical specifications:
System enclosures 1 U, 150, 200, 250, 300, 350 mm deep
Easy to assembly with just 4 screws.
Optionally for use as an instrument case or 19″ rack-mounted enclosure,
Front panel to hold a an overlay to conceal the screws.
Maximum possible useful interior space.
Optional EMC upgrades with additional EMC gaskets.
Option of installing 1 VME or CPCI board horizontally.

Design:
System enclosure 1 U, to IEC 60 297-1.
Optionally available for 19″ rack-mounting in the enclosure or as an instrument case version.

1 Designed as desktop unit

2 Designed as rack

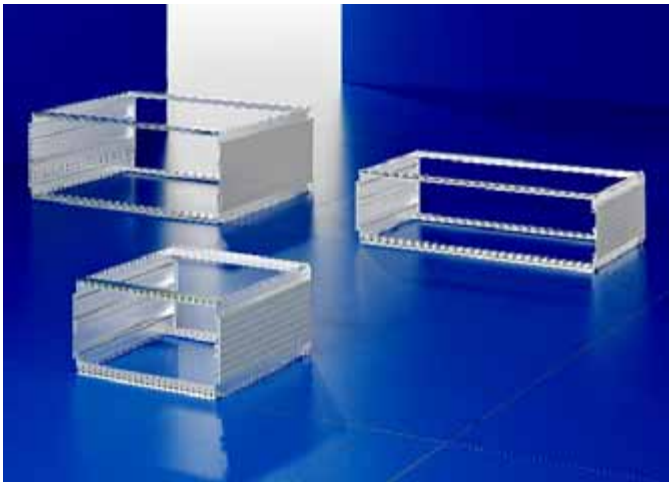
Material/surface finish:
Side panels:
Extruded aluminium section, untreated
Base/cover trays:
Aluminium, clear-chromated
Front/rear panel:
Extruded aluminium section, clear-chromated
Mounting plate:
Sheet steel

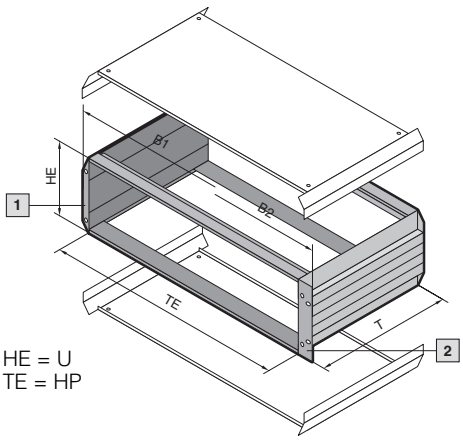
Detailed drawing,
see page 1159.

U	1	1	1	1	1	–	–
Width (B1) in mm	447	447	447	447	447	–	–
Width (B2) in mm	19″ (482.6)	19″ (482.6)	19″ (482.6)	19″ (482.6)	19″ (482.6)	19″ (482.6)	19″ (482.6)
Depth (T) in mm	150	200	250	300	350	250	350
Model No. RP instrument case	**3687.819**	**3687.820**	**3687.821**	**3687.822**	**3687.823**	**–**	**–**
Model No. RP rack	**3687.814**	**3687.815**	**3687.816**	**3687.817**	**3687.818**	**–**	**–**
Model No. RP rack-mount including mounting kit for double Euroboards	**–**	**–**	**–**	**–**	**–**	**3684.072**	**3684.073**
Supply includes							
Side panel	2	2	2	2	2	2	2
Font panel	1	1	1	1	1	1	1
Rear panel	1	1	1	1	1	1	1
Base/cover tray	2	2	2	2	2	2	2
Mounting kit	–	–	–	–	–	1	1
Accessories							
EMC set	**3684.080**	**3684.080**	**3684.080**	**3684.080**	**3684.080**	**3684.080**	**3684.080**
Mounting plate	**3684.074**	**3684.075**	**3684.076**	**3684.077**	**3684.078**	**–**	**–**

Ripac Vario-Module Page 555 **RiCase** Page 562 **Vario-Case** Page 569

Ripac Vario-Module 3 U, 4 U





Technical specifications:
May be used as a rack-mounted enclosure or instrument case. External dimensions to IEC 60 297-1 for installation in enclosures, 482.6 mm (19″). Installation dimensions for board type plug-in assemblies to IEC 60 297-3 and IEEE 1101.1/1101.10.

Material/Surface finish:
Side panels:
Extruded aluminium section, spray-finished in RAL 7035
Horizontal rails: Extruded aluminium section, clear-chromated
Corner trims: Die-cast zinc, spray-finished in RAL 7035
Side trims: Extruded aluminium section, spray-finished in RAL 7035

Protection category:
IP 40 for non-vented version.

Supply includes:
2 side panels,
4 horizontal rails,
4 threaded inserts,
2 rear corner trim pieces,
assembly parts.

1 Equipped as an instrument case

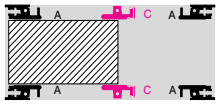
2 Equipped as a rack-mounted unit

Note:
Corner trim pieces, mounting flanges or top and bottom covers must be ordered separately.

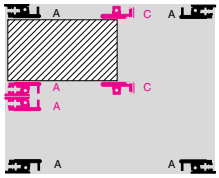
Horizontal rails for further configuration must be ordered separately,
see page 498.

Detailed drawing,
see page 1160.

Horizontal rail configuration



3 U



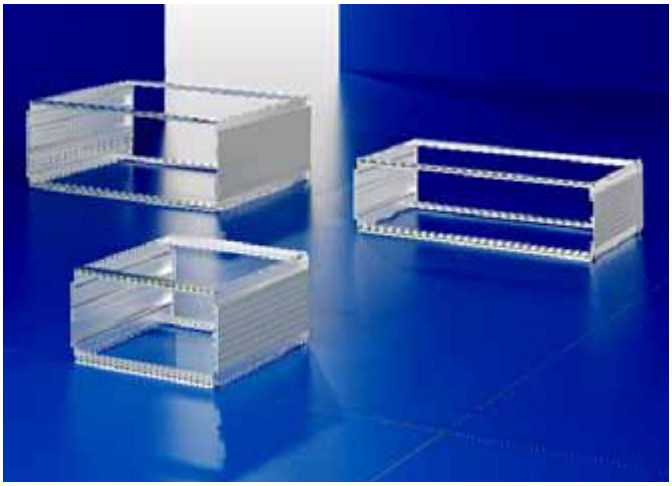
4 U (3 + 1)

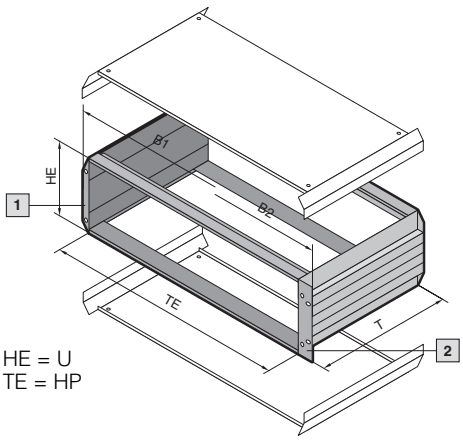
Ripac Vario-Module	Packs of	3 U							4 U (3 + 1)			Page
Installation width (HP)		42	42	63	63	84	84	84	84	84	84	
Width (B1) in mm		235,6	235,6	342,3	342,3	449,0	449,0	449,0	449,0	449,0	449,0	
Width (B2) in mm		251.6	251.6	358.3	358.3	465.1	465.1	465.1	465.1	465.1	465.1	
Depth (T) in mm		250.4	310.4	250.4	310.4	250.4	310.4	370.4	250.4	310.4	370.4	
Model No. VM Basic enclosure	1	**3982.040**	**3982.070**	**3982.050**	**3982.080**	**3982.060**	**3982.090**	**3982.100**	**3982.110**	**3982.120**	**3982.130**	
Also required												
Top covers												
– with vent holes	1	3982.941	3982.951	3982.942	3982.952	3982.940	3982.950	3982.960	3982.940	3982.950	3982.960	559
– without vent holes	1	3982.901	3982.911	3982.902	3982.912	3982.900	3982.910	3982.920	3982.900	3982.910	3982.920	559
Bottom covers												
– with vent holes	1	3982.741	3982.751	3982.742	3982.752	3982.740	3982.750	3982.760	3982.740	3982.750	3982.760	559
– without vent holes	1	3982.701	3982.711	3982.702	3982.712	3982.700	3982.710	3982.720	3982.700	3982.710	3982.720	559
Front corner trim pieces for assembly as instrument case	2	3981.310	3981.310	3981.310	3981.310	3981.310	3981.310	3981.310	3981.320	3981.320	3981.320	560
Flange for configuration as rack mount												
– without handle holes	2	3981.210	3981.210	3981.210	3981.210	3981.210	3981.210	3981.210	3981.220	3981.220	3981.220	560
– with handle holes	2	3981.260	3981.260	3981.260	3981.260	3981.260	3981.260	3981.260	3981.270	3981.270	3981.270	560
Accessories												
Front/rear panels		see page 525 – 540										
Carrying handles	2	3981.350	3981.360	3981.350	3981.360	3981.350	3981.360	3981.370	3981.350	3981.360	3981.370	560
Front handles[1)]	2	3636.010	3636.010	3636.010	3636.010	3636.010	3636.010	3636.010	3636.010	3636.010	3636.010	497
Acrylic front door	1	3981.420	3981.420	3981.430	3981.430	3981.440	3981.440	3981.440	3981.450	3981.450	3981.450	561
Rear adjustable feet	4	3901.000	3901.000	3901.000	3901.000	3901.000	3901.000	3901.000	3901.000	3901.000	3901.000	561

[1)] only for use in conjunction with mounting flanges with handle holes.

Accessories Ripac Vario-Module Page 559 **RiBox** Page 554 **RiCase** Page 562 **Vario-Case** Page 569

Ripac Vario-Module 3 U, 4 U EMC





Technical specifications:
May be used as a rack-mounted enclosure or instrument case.
External dimensions to IEC 60 297-1, for installation in enclosures, 482.6 mm (19″).
Installation dimensions for board type plug-in assemblies to IEC 60 297-3 and IEEE 1101.1/1101.10.

Material/Surface finish:
Side panels:
Extruded aluminium section, spray-finished in RAL 7035
Horizontal rails: Extruded aluminium section, clear-chromated
Corner trims: Die-cast zinc, Spray-finished in RAL 7035
Side trims: Extruded aluminium section, spray-finished in RAL 7035
Contact points: Conductive

Protection category:
IP 40 for non-vented version.

Supply includes:
2 side panels,
4 horizontal rails,
4 threaded inserts,
2 rear corner trim pieces,
assembly parts.

1 Equipped as an instrument case

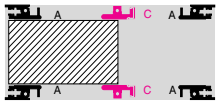
2 Equipped as a rack-mounted unit

Note:
Corner trim pieces, mounting flanges or top and bottom covers must be ordered separately.

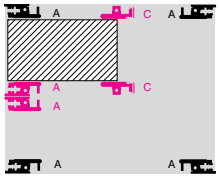
Horizontal rails for further configuration must be ordered separately,
see page 498.

Detailed drawing,
see page 1160.

Horizontal rail configuration



3 U



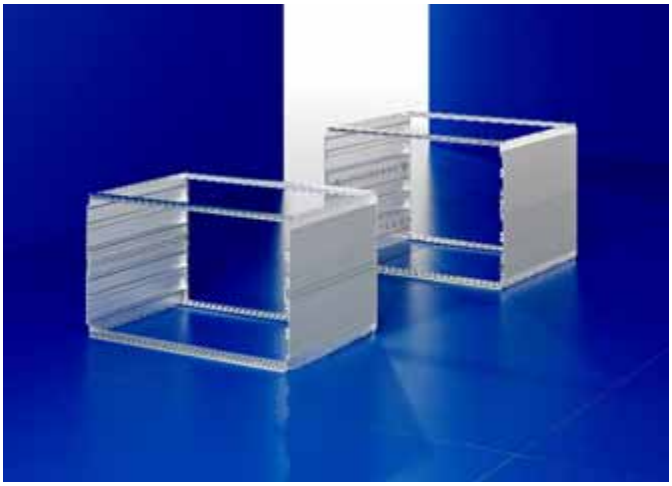
4 U (3 + 1)

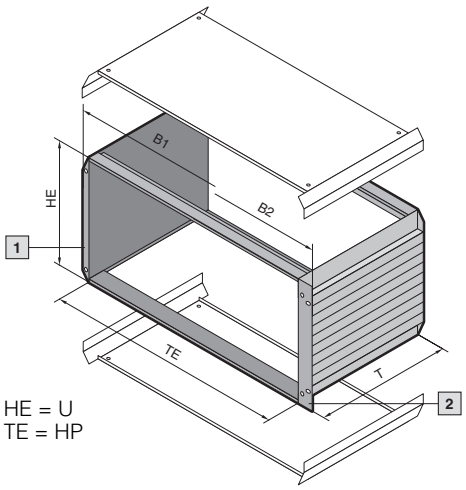
Ripac Vario-Module	Packs of	3 U							4 U (3 + 1)			Page
Installation width (HP)		42	42	63	63	84	84	84	84	84	84	
Width (B1) in mm		235.6	235.6	342.3	342.3	449.0	449.0	449.0	449.0	449.0	449.0	
Width (B2) in mm		251.6	251.6	358.3	358.3	465.1	465.1	465.1	465.1	465.1	465.1	
Depth (T) in mm		250.4	310.4	250.4	310.4	250.4	310.4	370.4	250.4	310.4	370.4	
Model No. VM Basic enclosure EMC	1	**3983.040**	**3983.070**	**3983.050**	**3983.080**	**3983.060**	**3983.090**	**3983.100**	**3983.110**	**3983.120**	**3983.130**	
Also required												
EMC top covers												
– with vent holes	1	3981.941	3981.951	3981.942	3981.952	3981.940	3981.950	3981.960	3981.940	3981.950	3981.960	559
– without vent holes	1	3981.901	3981.911	3981.902	3981.912	3981.900	3981.910	3981.920	3981.900	3981.910	3981.920	559
EMC bottom covers												
– with vent holes	1	3981.741	3981.751	3981.742	3981.752	3981.740	3981.750	3981.760	3981.740	3981.750	3981.760	559
– without vent holes	1	3981.701	3981.711	3981.702	3981.712	3981.700	3981.710	3981.720	3981.700	3981.710	3981.720	559
Front corner trim pieces for assembly as instrument case	2	3981.310	3981.310	3981.310	3981.310	3981.310	3981.310	3981.310	3981.320	3981.320	3981.320	560
Flange for assembly as rack-mounted unit												
– without handle holes	2	3981.210	3981.210	3981.210	3981.210	3981.210	3981.210	3981.210	3981.220	3981.220	3981.220	560
– with handle holes	2	3981.260	3981.260	3981.260	3981.260	3981.260	3981.260	3981.260	3981.270	3981.270	3981.270	560
EMC installation												
EMC gaskets, horizontal												
– for upper/lower horizontal rail	1	3684.808	3684.808	3684.808	3684.808	3684.808	3684.808	3684.808	3684.808	3684.808	3684.808	507
– between covers and horizontal rails	10	3684.245	3684.245	3684.245	3684.245	3684.245	3684.245	3684.245	3684.245	3684.245	3684.245	507
EMC gaskets, vertical	1	3686.975	3686.975	3686.975	3686.975	3686.975	3686.975	3686.975	3686.976	3686.976	3686.976	506
Front/rear panels EMC	see page 525 – 540											
Accessories												
Front/rear panels	see page 525 – 540											
Carrying handles	2	3981.350	3981.360	3981.350	3981.360	3981.350	3981.360	3981.370	3981.350	3981.360	3981.370	560
Front handles[1)]	2	3636.010	3636.010	3636.010	3636.010	3636.010	3636.010	3636.010	3636.010	3636.010	3636.010	497
Acrylic front door	1	3981.420	3981.420	3981.430	3981.430	3981.440	3981.440	3981.440	3981.450	3981.450	3981.450	561
Rear adjustable feet	4	3901.000	3901.000	3901.000	3901.000	3901.000	3901.000	3901.000	3901.000	3901.000	3901.000	561

[1)] only in conjunction with mounting flanges with handle holes.

Accessories Ripac Vario-Module Page 559 **RiBox** Page 554 **RiCase** Page 562 **Vario-Case** Page 569

Ripac Vario-Module 6 U, 7 U





Technical specifications:
May be used as a rack-mounted enclosure or instrument case.
External dimensions to IEC 60 297-1 for installation in enclosures, 482.6 mm (19″).
Installation dimensions for board type plug-in assemblies to IEC 60 297-3 and IEEE 1101.1/1101.10.

Material/surface finish:
Side panels:
Extruded aluminium section, spray-finished in RAL 7035
Horizontal rails:
Extruded aluminium section, clear-chromated
Corner trims: Die-cast zinc, Spray-finished in RAL 7035

Protection category:
IP 40 for non-vented version.

Supply includes:
2 side panels,
4 horizontal rails,
4 threaded inserts,
2 rear corner trim pieces,
2 side trims centre,
assembly parts.

1 Equipped as an instrument case

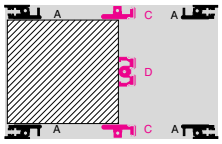
2 Equipped as a rack-mounted unit

Note:
Corner trim pieces, mounting flanges or top and bottom covers must be ordered separately.

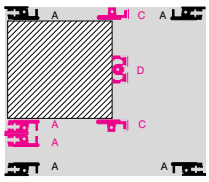
Horizontal rails for further configuration must be ordered separately,
see page 498.

Detailed drawing,
see page 1160.

Horizontal rail configuration



6 U



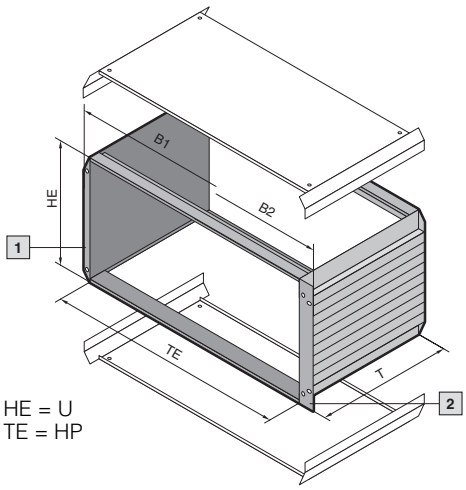
7 U (6 + 1)

Ripac Vario-Module	Packs of	6 U			7 U (6 + 1)		Page
Installation width (HP)		84	84	84	84	84	
Width (B1) in mm		449.0	449.0	449.0	449.0	449.0	
Width (B2) in mm		465.1	465.1	465.1	465.1	465.1	
Depth (T) in mm		310.4	370.4	430.4	310.4	430.4	
Model No. VM Basic enclosure	1	**3982.140**	**3982.150**	**3982.160**	**3982.170**	**3982.190**	
Also required							
Top covers – with vent holes – without vent holes	 1 1	 3982.950 3982.910	 3982.960 3982.920	 3982.970 3982.930	 3982.950 3982.910	 3982.970 3982.930	 559 559
Bottom covers – with vent holes – without vent holes	 1 1	 3982.750 3982.710	 3982.760 3982.720	 3982.770 3982.730	 3982.750 3982.710	 3982.790 3982.730	 559 559
Corner trim pieces for assembly as instrument case	2	3981.330	3981.330	3981.330	3981.340	3981.340	560
Mounting flanges for assembly as rack-mounted unit – without handle holes – with handle holes	 2 2	 3981.230 3981.280	 3981.230 3981.280	 3981.230 3981.280	 3981.240 3981.290	 3981.240 3981.290	 560 560
Accessories							
Front/rear panel	see page 525 – 540						
Carrying handles	2	3981.360	3981.370	3981.380	3981.360	3981.370	560
Front handles[1)]	2	3666.010	3666.010	3666.010	3666.010	3666.010	497
Acrylic front door	1	3981.460	3981.460	3981.460	3981.470	3981.470	561
Rear adjustable feet	4	3901.000	3901.000	3901.000	3901.000	3901.000	561

[1)] only in conjunction with mounting flanges with handle holes.

Accessories Ripac Vario-Module Page 559 **RiBox** Page 554 **RiCase** Page 562 **Vario-Case** Page 569

Ripac Vario-Module 6 U, 7 U EMC



Technical specifications:
May be used as a rack-mounted enclosure or instrument case.
External dimensions to IEC 60 297-1 for installation in enclosures, 482.6 mm (19″).
Installation dimensions for board type plug-in assemblies to IEC 60 297-3 and IEEE 1101.1/1101.10.

Material/surface finish:
Side panels:
Extruded aluminium section, spray-finished in RAL 7035
Horizontal rails:
Extruded aluminium section, chromated
Corner trims: Die-cast zinc, Spray-finished in RAL 7035
Contact points: Conductive

Protection category:
IP 40 for non-vented version.

Supply includes:
2 side panels,
4 horizontal rails,
4 threaded inserts,
2 rear corner trim pieces,
2 side trims centre,
assembly parts.

1 Equipped as an instrument case

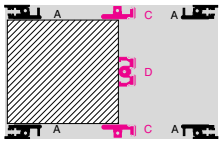
2 Equipped as a rack-mounted unit

Note:
Corner trim pieces, mounting flanges or top and bottom covers must be ordered separately.

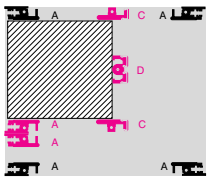
Horizontal rails for further configuration must be ordered separately,
see page 498.

Detailed drawing,
see page 1160.

Horizontal rail configuration



6 U



7 U (6 + 1)

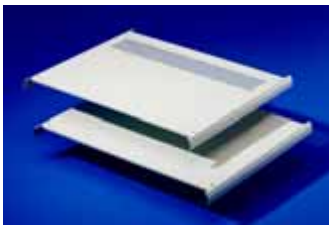
Ripac Vario-Module	Packs of	6 U			7 U (6 + 1)		Page
Installation width (HP)		84	84	84	84	84	
Width (B1) in mm		449.0	449.0	449.0	449.0	449.0	
Width (B2) in mm		465.1	465.1	465.1	465.1	465.1	
Depth (T) in mm		310.4	370.4	430.4	310.4	430.4	
Model No. VM Basic enclosure EMC	1	**3983.140**	**3983.150**	**3983.160**	**3983.170**	**3983.190**	
Also required							
EMC top covers – with vent holes – without vent holes	 1 1	 3981.950 3981.910	 3981.960 3981.920	 3981.970 3981.930	 3981.950 3981.910	 3981.970 3981.930	 559 559
EMC bottom covers – with vent holes – without vent holes	 1 1	 3981.750 3981.710	 3981.760 3981.720	 3981.770 3981.730	 3981.750 3981.710	 3981.770 3981.730	 559 559
Front corner trim pieces for assembly as instrument case	2	3981.330	3981.330	3981.330	3981.340	3981.340	560
Mounting flanges for assembly as rack-mounted unit – without handle holes – with handle holes	 2 2	 3981.230 3981.280	 3981.230 3981.280	 3981.230 3981.280	 3981.240 3981.290	 3981.240 3981.290	 560 560
EMC installation							
EMC gaskets, horizontal – for upper/lower horizontal rail – between covers and horizontal rails	 1 10	 3684.808 3684.245	 3684.808 3684.245	 3684.808 3684.245	 3684.808 3684.245	 3684.808 3684.245	507
EMC gaskets, vertical	1	3686.977	3686.977	3686.977	3686.978	3686.978	506
Front/rear panels EMC	see page 525 – 540						
Accessories							
Front/rear panel	see page 525 – 540						
Carrying handles	2	3981.360	3981.370	3981.380	3981.360	3981.370	560
Front handles[1)]	2	3666.010	3666.010	3666.010	3666.010	3666.010	497
Acrylic front door	1	3981.460	3981.460	3981.460	3981.470	3981.470	561
Rear adjustable feet	4	3901.000	3901.000	3901.000	3901.000	3901.000	561

[1)] only in conjunction with mounting flanges with handle holes.

Accessories Ripac Vario-Module Page 559 **RiBox** Page 554 **RiCase** Page 562 **Vario-Case** Page 569

Enclosure population

For individual interior installation of the enclosures, system components from the Ripac range may be used (see from page 498).



Top covers

For Ripac Vario-Module

Standard version
Material:
Sheet steel, spray-finished

Colour:
RAL 7035

EMC version
Material:
Sheet steel, spray-finished
Contact points: Conductive

Width HP	Depth mm	Model No. VM standard		Model No. VM EMC	
		with vent holes	without vent holes	with vent holes	without vent holes
42	250.4	**3982.941**	**3982.901**	**3981.941**	**3981.901**
	310.4	**3982.951**	**3982.911**	**3981.951**	**3981.911**
63	250.4	**3982.942**	**3982.902**	**3981.942**	**3981.902**
	310.4	**3982.952**	**3982.912**	**3981.952**	**3981.912**
84	250.4	**3982.940**	**3982.900**	**3981.940**	**3981.900**
	310.4	**3982.950**	**3982.910**	**3981.950**	**3981.910**
	370.4	**3982.960**	**3982.920**	**3981.960**	**3981.920**
	430.4	**3982.970**	**3982.930**	**3981.970**	**3981.930**

Bottom covers

For Ripac Vario-Module

Standard version
Material:
Sheet steel, spray-finished

Colour:
RAL 7035

EMC version
Material:
Sheet steel, spray-finished
Contact points: Conductive

Width HP	Depth mm	Model No. VM standard		Model No. VM EMC	
		with vent holes	without vent holes	with vent holes	without vent holes
42	250.4	**3982.741**	**3982.701**	**3981.741**	**3981.701**
	310.4	**3982.751**	**3982.711**	**3981.751**	**3981.711**
63	250.4	**3982.742**	**3982.702**	**3981.742**	**3981.702**
	310.4	**3982.752**	**3982.712**	**3981.752**	**3981.712**
84	250.4	**3982.740**	**3982.700**	**3981.740**	**3981.700**
	310.4	**3982.750**	**3982.710**	**3981.750**	**3981.710**
	370.4	**3982.760**	**3982.720**	**3981.760**	**3981.720**
	430.4	**3982.770**	**3982.730**	**3981.770**	**3981.730**

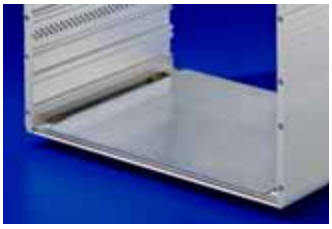
Feet

with fold-out support stand.
Load capacity up to 20 kg.

Material:
Plastic

Colour:
RAL 7035

Packs of	Model No. VM
2	**3919.000**



Mounting plate

For mounting heavy components.

Material:
Aluminium

Supply includes:
Assembly parts.

Width HP	Depth mm	Packs of	Model No. VM
42	220	1	**3982.370**
63	250	1	**3982.380**
84	250	1	**3982.390**

Ripac Vario-Module accessories

Front flanges

Required when the Ripac Vario-Module is to be used as a rack-mounted enclosure.
The flanges have a channel to accommodate vertical EMC gaskets.

Material:
Aluminium, clear-chromated

U	Packs of	Model No. VM	
		without handle hole	with handle hole
3	2	**3981.210**	**3981.260**
4	2	**3981.220**	**3981.270**
6	2	**3981.230**	**3981.280**
7	2	**3981.240**	**3981.290**

Accessories:

EMC gaskets, vertical,
see page 506.
Front handles for mounting on front flanges,
see page 497.

Front corner trims

Required when the Ripac Vario-Module is to be used as a desk-top case.
The corner trims have a channel to accommodate vertical EMC gaskets.

Material:
Die-cast zinc

Colour:
RAL 7035

U	Packs of	Model No. VM
1	2	**3981.570**
2	2	**3981.300**
3	2	**3981.310**
4	2	**3981.320**
6	2	**3981.330**
7	2	**3981.340**
8	2	**3981.590**

Accessories:

Vertical EMC gaskets,
see page 506.
Front handles for mounting on front corner trim pieces, see page 560.

Front handles

For mounting on front corner trims

Maximum load capacity: 500 N

Material:
Cover: ABS
Handle part: Aluminium, clear-anodised.

Supply includes:
2 handle parts, 4 covers, assembly parts.

U	Packs of	Model No. VM
3	2	**3982.350**
4	2	**3982.360**
6	2	**3982.400**
7	2	**3982.410**

Carrying handles

For ergonomic transportation, even with stacked enclosures.
May also be used as a support stand.

Max. load capacity: 350 N.

Material:
Die-cast zinc and extruded aluminium section

Colour:
RAL 7035

Note:
Only for use with front and rear trims.

For enclosure depth	Packs of	Model No. VM
250.4 mm	2	**3981.350**
310.4 mm	2	**3981.360**
370.4 mm	2	**3981.370**
430.4 mm	2	**3981.380**

Ripac Vario-Module accessories

Rear feet

For mounting on the rear of the enclosure.
Dual function:
- Mechanical protection of the connection components.
- Also acts as a cable tidy during transportation.

Material:
PA, self-extinguishing to UL 94-V0

Colour:
RAL 7035

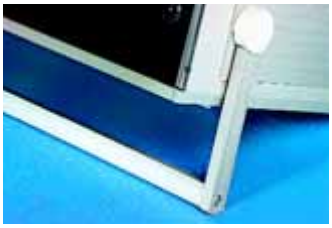
Packs of	Model No. VM
4	**3901.000**

Earthing set

For connecting the cover plates/gland plates to the side panels with PE conductors.

Supply includes:
Conductor cable green/yellow, 1.5 mm^2, with washer, flat-pin connector and assembly parts.

Packs of	Model No. RP
4	**3900.000**



Support stand/carrying handle

To fit Ripac Vario Module 3 U, 4 U and 6 U, adjustable on a 30° pitch pattern.

Material:
Extruded aluminium section/die-cast

Colour:
RAL 7035

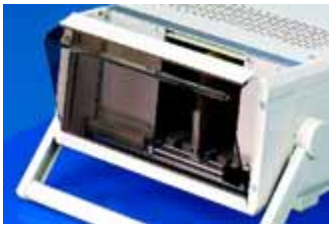
Supply includes:
Assembly parts.

Note:
Corner trim for support stands/carrying handles should be ordered separately.

For Ripac Vario-Module	Packs of	Model No. VM
42 HP	1	**3981.390**
63 HP	1	**3981.400**
84 HP	1	**3981.410**

German patent no. 41 10 873

Corner trim for support stand	Packs of	Model No. VM
3 U	2	**3981.310**
4 U	2	**3981.500**
6 U	2	**3981.510**



Acrylic front doors

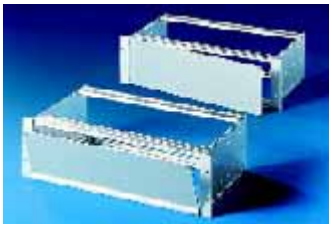
horizontally hinged
For protection of built-in control components.

Material:
Side parts:
Aluminium, spray-finished in RAL 7035.
Window: Smoked acrylic

Supply includes:
Assembly parts.

U	For Ripac Vario-Module	Packs of	Model No. VM
3	42 HP	1	**3981.420**
3	63 HP	1	**3981.430**
3	84 HP	1	**3981.440**
4	84 HP	1	**3981.450**
6	84 HP	1	**3981.460**
7	84 HP	1	**3981.470**

German patent no. 41 10 872

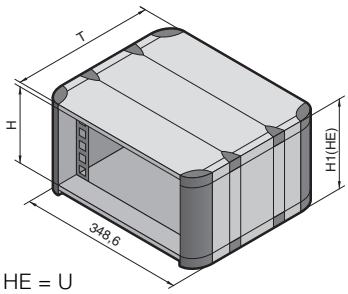


Front panels/rear panels

To cover the enclosures front and rear.
Also available as a hinged or EMC version.
Model No. see page 538/539.

Instrument cases/system enclosures

Rittal RiCase 269.2 mm ($^1/_2$ 19″)



HE = U

Technical specifications:
Depth:
300 mm, 420 mm, 540 mm
Installation width:
269.2 mm ($^1/_2$ 19″)
Installation options:
269.2 mm ($^1/_2$ 19″) slide-in equipment and modular assemblies to IEC 60 297-3

Material/surface finish:
Covers: Extruded aluinium section/die-cast, spray-finished
Side panels: Extruded aluinium section, spray-finished
Corner caps: Plastic
482.6 mm (19″) mounting bracket: Extruded aluminium section, clear-chromated

Colour:
RAL 7035 (pale grey)

Decorative colours and corner caps:
RAL 5018 (turquoise)
RAL 5012 (pale blue)
RAL 7030 (stone grey)

Protection category:
IP 42 for unvented version.

Supply includes:
2 side panels,
2 covers,
8 corner caps,
8/12/16 cover caps (300/420/540 mm depth),
4 482.6 mm (19″) mounting brackets,
4 tapped strips,
2 untapped strips,
1 rear wall
Enclosures are supplied partially assembled.

Special sizes and colours available on request.

Property rights:
German registered design no. 96 09 457
IR Reg. Design no. DM/039 974 with validity for FR, IT
UK reg. design no. 2064682
US Design Patents Des. 402,640 and Des. 423,464
Japan. Reg. Designs No. 1045507 and 1045508

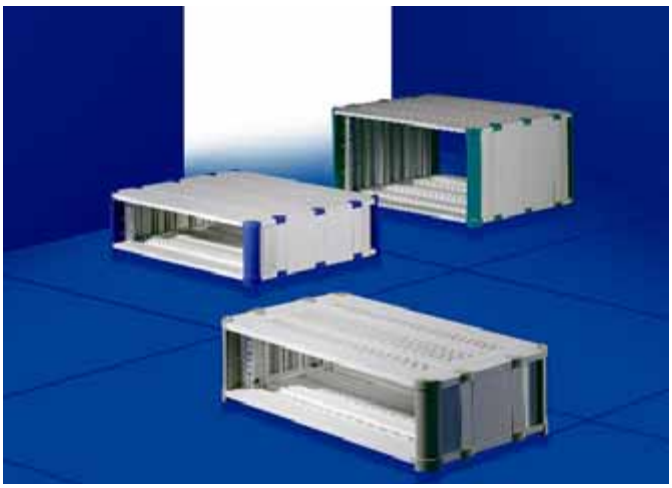
Detailed drawing,
see page 1161.

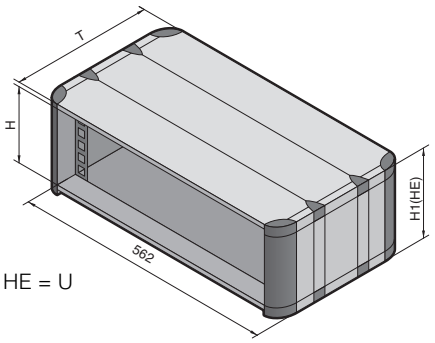
Enclosures for subrack width 269.2 mm ($^1/_2$ 19″)		Packs of	1 U		2 U		3 U			4 U		Page
Height (H) in mm			77.5	77.5	121.9	121.9	166.4	166.4	166.4	210.8	210.8	
H1 (U) in mm			45.0	45.0	89.4	89.4	133.8	133.8	133.8	178.3	178.3	
Depth (T) in mm			300.0	420.0	300.0	540.0	300.0	420.0	540.0	420.0	540.0	
Unvented												
Model No. RC, RAL 5018[1)]		1	**3750.100**	**–**	**3750.200**	**–**	**3750.210**	**3750.300**	**–**	**3750.400**	**–**	
Model No. RC, RAL 5012[1)]		1	**3750.102**	**–**	**3750.202**	**–**	**3750.212**	**3750.302**	**–**	**3750.402**	**–**	
Model No. RC, RAL 7030		1	**3750.104**	**–**	**3750.204**	**–**	**3750.214**	**3750.304**	**–**	**3750.404**	**–**	
Vented												
Model No. RC, RAL 5018[1)]		1	**–**	**3750.110**	**–**	**3750.220**	**–**	**3750.350**	**3750.360**	**–**	**3750.450**	
Model No. RC, RAL 5012[1)]		1	**–**	**3750.112**	**–**	**3750.222**	**–**	**3750.352**	**3750.362**	**–**	**3750.452**	
Model No. RC, RAL 7030		1	**–**	**3750.114**	**–**	**3750.224**	**–**	**3750.354**	**3750.364**	**–**	**3750.454**	
Weight (kg)	Vented/ unvented		3.3 3.4	4.2 4.4	3.7 3.8	5.4 6.1	4.1 4.2	5.2 5.4	6.1 6.8	5.8 6.0	6.8 7.5	
Accessories												
Carrying handles, horizontal		2	3751.250	3751.260	3751.250	3751.270	3751.250	3751.260	3751.270	3751.260	3751.270	565
Support stand/ carrying handle	RAL 5018[1)]	1	3751.200	3751.200	3751.200	3751.200	3751.200	3751.200	3751.200	3751.200	3751.200	566
	RAL 5012[1)]	1	3751.202	3751.202	3751.202	3751.202	3751.202	3751.202	3751.202	3751.202	3751.202	566
	RAL 7030	1	3751.204	3751.204	3751.204	3751.204	3751.204	3751.204	3751.204	3751.204	3751.204	566
Blanking plates (rear panel)		3	3746.000	3746.000	3747.000	3747.000	3748.000	3748.000	3748.000	3749.000	3749.000	1013
Front door, vertically hinged		1	–	–	–	–	3751.300	3751.300	3751.300	3751.300	3751.300	566
Slide rails		2	3751.500	3751.510	3751.500	3751.520	3751.500	3751.510	3751.520	3751.510	3751.520	565
Mounting bracket 482.6 mm (19″)		2	3751.650	3751.650	3751.660	3751.660	3751.670	3751.670	3751.670	3751.680	3751.680	564
Tapped strips with M4 thread		8	3751.700	3751.700	3751.710	3751.710	3751.720	3751.720	3751.720	3751.730	3751.730	564
End section		2	–	–	–	–	3751.900	3751.900	3751.900	3751.910	3751.910	565

[1)] Extended delivery times.

RiCase accessories Page 564 **Subracks** Page 486 **RiBox** Page 554 **Ripac Vario-Module** Page 555 **Vario-Case** Page 569

Rittal RiCase 482.6 mm (19″)





Technical specifications:
Depth:
300 mm, 420 mm, 540 mm
Installation width:
482.6 mm (19″)
Installation options:
482.6 mm (19″) slide-in equipment and modular assemblies to IEC 60 297-3

Material/surface finish:
Covers: Extruded aluinium section/die-cast, spray-finished
Side panels: Extruded aluinium section, spray-finished
Corner caps: Plastic
482.6 mm (19″) mounting bracket: Extruded aluminium section, clear-chromated

Colour:
RAL 7035 (pale grey)

Decorative colours and corner caps:
RAL 5018 (turquoise)
RAL 5012 (pale blue)
RAL 7030 (stone grey)

Protection category:
IP 42 for unvented version.

Supply includes:
2 side panels,
2 covers,
8 corner caps,
8/12/16 cover caps (300/420/540 mm depth),
2 482.6 mm (19″) mounting brackets,
2 tapped strips,
2 untapped strips,
enclosures are supplied partially assembled.

Note:
For rear installation, order back panel/door separately.

Special sizes and colours available on request.

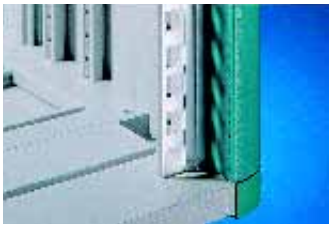
Detailed drawing,
see page 1161.

Enclosures for subrack width 482.6 mm (19″)		P. of	3 U		4 U		6 U			7 U		9 U		12 U	Page
Height (H) in mm			166.4	166.4	210.8	210.8	299.7	299.7	299.7	344.2	344.2	433.1	433.1	566.5	
H1 (U) in mm			133.8	133.8	178.3	178.3	267.2	267.2	267.2	311.7	311.7	400.6	400.6	534.0	
Depth (T) in mm			300.0	420.0	300.	420.	300.0	420.0	540.0	420.0	540.0	420.0	540.0	540.0	
Unvented															
Model No. RC, RAL 5018[1)]		1	**3750.310**	**3750.320**	**3750.410**	**3750.420**	**3750.600**	**3750.610**	**3750.620**	**3750.700**	**3750.710**	**3750.900**	**3750.910**	**3750.000**	
Model No. RC, RAL 5012[1)]		1	**3750.312**	**3750.322**	**3750.412**	**3750.422**	**3750.602**	**3750.612**	**3750.622**	**3750.702**	**3750.712**	**3750.902**	**3750.912**	**3750.002**	
Model No. RC, RAL 7030		1	**3750.314**	**3750.324**	**3750.414**	**3750.424**	**3750.604**	**3750.614**	**3750.624**	**3750.704**	**3750.714**	**3750.904**	**3750.914**	**3750.004**	
Vented															
Model No. RC, RAL 5018[1)]		1	**3750.330**	**3750.340**	**3750.430**	**3750.440**	**3750.630**	**3750.640**	**3750.650**	**3750.720**	**3750.730**	**3750.920**	**3750.930**	**3750.030**	
Model No. RC, RAL 5012[1)]		1	**3750.332**	**3750.342**	**3750.432**	**3750.442**	**3750.632**	**3750.642**	**3750.652**	**3750.722**	**3750.732**	**3750.922**	**3750.932**	**3750.032**	
Model No. RC, RAL 7030		1	**3750.334**	**3750.344**	**3750.434**	**3750.444**	**3750.634**	**3750.644**	**3750.654**	**3750.724**	**3750.734**	**3750.924**	**3750.934**	**3750.034**	
Weight (kg)	Vented/ unvented		5.3 5.4	6.9 7.1	5.7 7.2	7.5 7.7	6.5 6.6	8.5 8.7	10.8 12.2	9.1 9.3	11.5 12.9	10.1 10.3	12.9 14.3	15.0 16.4	
Accessories															
Carrying handles, horizontal		2	3751.250	3751.260	3751.250	3751.260	3751.250	3751.260	3751.270	3751.260	3751.270	3751.260	3751.270	3751.270	565
Support stand/carrying handle	RAL 5018[1)]	1	3751.210	3751.210	3751.210	3751.210	3751.210	3751.210	3751.210	3751.210	3751.210	3751.210	3751.210	3751.210	566
	RAL 5012[1)]	1	3751.212	3751.212	3751.212	3751.212	3751.212	3751.212	3751.212	3751.212	3751.212	3751.212	3751.212	3751.212	566
	RAL 7030	1	3751.214	3751.214	3751.214	3751.214	3751.214	3751.214	3751.214	3751.214	3751.214	3751.214	3751.214	3751.214	566
Back panel, screw-fastened		1	3751.600	3751.600	3751.610	3751.610	3751.620	3751.620	3751.620	3751.630	3751.630	3751.530	3751.530	3751.540	568
Rear door, vertically hinged		1	3751.100	3751.100	3751.110	3751.110	3751.120	3751.120	3751.120	3751.130	3751.130	–	–	–	568
Rear door for fan installation		1	3751.150	3751.150	3751.160	3751.160	3751.170	3751.170	3751.170	3751.180	3751.180	–	–	–	568
Front door, vertically hinged		1	3751.320	3751.320	3751.330	3751.330	3751.340	3751.340	3751.340	3751.350	3751.350	–	–	–	566
Slide rails		2	3751.500	3751.510	3751.500	3751.510	3751.500	3751.510	3751.520	3751.510	3751.520	3751.510	3751.510	3751.520	565
Mounting angles 482.6 mm (19″)		2	3751.670	3751.670	3751.680	3751.680	3751.690	3751.690	3751.690	3751.640	3751.640	3751.780	3751.780	3751.790	564
Slide-in strips with M4 thread		8	3751.720	3751.720	3751.730	3751.730	3751.740	3751.740	3751.740	3751.750	3751.750	3751.760	3751.760	3751.770	564
End section		2	3751.900	3751.900	3751.910	3751.910	3751.920	3751.920	3751.920	3751.930	3751.930	3751.820	3751.820	3751.830	565

[1)] Extended delivery times.

RiCase accessories Page 564 **Subracks** Page 486 **RiBox** Page 554 **Ripac Vario-Module** Page 555 **Vario-Case** Page 569

Rittal RiCase accessories



Mounting angles 482.6 mm (19 ″)

For front/rear installation of subracks and blanking plates.

Material:
Extruded aluminium section, clear-chromated

Supply includes:
Assembly parts.

Note:
1 pack of tapped strips and 2 packs of mounting rails and spacers are required for depth-adjustable installation.

For enclosure height	Packs of	Model No. RC
1 U	2	**3751.650**
2 U	2	**3751.660**
3 U	2	**3751.670**
4 U	2	**3751.680**
6 U	2	**3751.690**
7 U	2	**3751.640**
9 U	2	**3751.780**
12 U	2	**3751.790**

Also required:

Slide-in strips, see page 564.
Mounting rails, see page 564.
Spacers, see page 564.

Threaded inserts

with M4 thread
for RiCase, Vario-Case iS
For the installation of mounting brackets, slide rails, mounting kits, cable ducts etc. Simply slide into the channels in the side panels.

Material:
Extruded aluminium section, clear-chromated

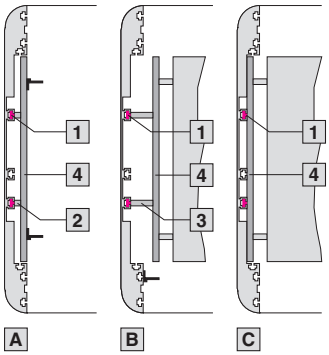
For enclosure height	Packs of	Model No. RC
1 U	8	**3751.700**
2 U	8	**3751.710**
3 U	8	**3751.720**
4 U	8	**3751.730**
6 U	8	**3751.740**
7 U	8	**3751.750**
9 U	8	**3751.760**
12 U	8	**3751.770**

Mounting rails

- For depth-variable installation of mounting angles
- For the installation of component shelves, static or pull-out

Material:
Aluminium, clear-chromated

Supply includes:
Assembly parts.



A Version for depth-variable mounting angles
B Component shelf installation for 482.6 mm/19″ (width 409 mm, also with telescopic slides)
C Direct component shelf installation (width 471 mm)

1 Slide-in strips
2 Short spacers
3 Long spacers
4 Mounting rails

For enclosure depth mm	Packs of	Model No. RC
420	2	**3751.410**
540	2	**3751.420**

Also required:

Threaded inserts, see page 564.
Spacers, see page 564.

Accessories:

Component shelf, see page 944.
Component shelf, 482.6 mm (19″), see page 939.

Spacers

For the attachment of mounting rails.

Version	Packs of	Model No. RC
Short for depth-variable mounting bracket	4	**3751.450**
Long for component shelf installation (width 409 mm)	4	**3751.460**

Rittal RiCase accessories

Slide rails

To support heavy installed equipment.

Material:
1.5 mm sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

For enclosure depth mm	Packs of	Model No. RC
300	2	**3751.500**
420	2	**3751.510**
540	2	**3751.520**

Also required:

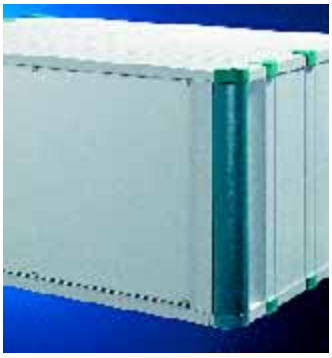
Threaded inserts,
see page 564.

Earthing set

for RiCase, Vario-Case iS
To meet electrical protective measures; fits all RiCase and Vario-Case iS enclosures.

Supply includes:
Threaded insert, screw, green/yellow connection cable, serrated washer, nut.

Packs of	Model No. VC
4	**3798.000**



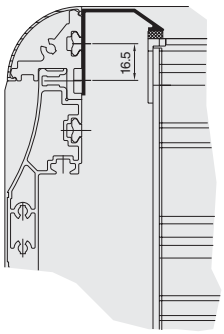
Rear trim

To cover the sides to the left and right of the sub-rack when no rear door or rear panel is used.

Material:
Extruded aluminium section, spray-finished

Colour:
RAL 7035

Supply includes:
Assembly parts.



For enclosure height	Packs of	Model No. RC
3 U	2	**3751.900**
4 U	2	**3751.910**
6 U	2	**3751.920**
7 U	2	**3751.930**
9 U	2	**3751.820**
12 U	2	**3751.830**

Carrying handles

horizontal
For easy, secure transportation.
- May be retrofitted
- Load capacity 30 kg/pair

Material:
Side parts: Die-cast, spray-finished
Centre part: Extruded aluminium section, spray-finished

Colour:
RAL 7035

Supply includes:
Assembly parts.

For enclosure depth mm	Packs of	Model No. RC
300	2	**3751.250**
420	2	**3751.260**
540	2	**3751.270**

Rittal RiCase accessories

1

2

3

Support stand/carrying handle

- Support stand/carrying handle adjustable on a 30° pitch pattern.
- Suitable for retrofitting with 2 – 7 U.
- For 269.2 mm ($^1/_2$ 19″) and 482.6 mm (19″) wide enclosures
- Load capacity 30 kg

Material:
Hinged part: Die-cast, spray-finished
Centre part: Extruded aluminium section, spray-finished with plastic cover

Colour:
RAL 7035

Decorative colours:

1 RAL 7030 (stone grey)

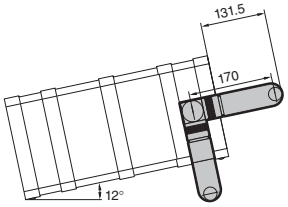
2 RAL 5018 (turquoise)

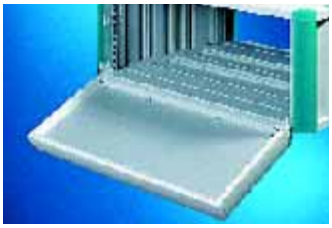
3 RAL 5012 (pale blue)

Supply includes:
Assembly parts.

For enclosure width mm	Decorative colour RAL	B mm	Model No. RC
269.2 ($^1/_2$ 19″)	5018[1)]	392	**3751.200**
269.2 ($^1/_2$ 19″)	5012[1)]	392	**3751.202**
269.2 ($^1/_2$ 19″)	7030	392	**3751.204**
482.6 (19″)	5018[1)]	605	**3751.210**
482.6 (19″)	5012[1)]	605	**3751.212**
482.6 (19″)	7030	605	**3751.214**

B = Overall width of handle
[1)] Extended delivery times.





Keyboard lid

Suitable for the installation of 482.6 mm (19″) keyboards.
- Horizontally hinged with security lock
- Removable cover plate

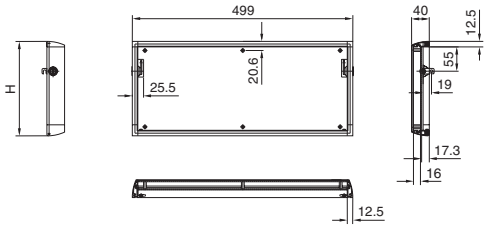
Material:
Frame section: Extruded aluminium section/die-cast, spray-finished
Base and cover plate: Aluminium, spray-finished.

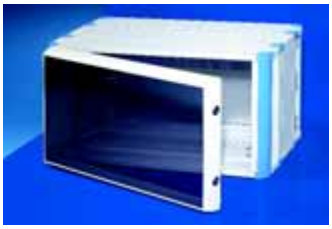
Colour:
RAL 7035

Supply includes:
Assembly parts.

For enclosure width mm	H (U)	Packs of	Model No. RC
482.6 (19″)	4	1	**3751.800**
482.6 (19″)	6	1	**3751.810**

Note:
Use only in conjunction with support stand/carrying handle.





Glazed front door

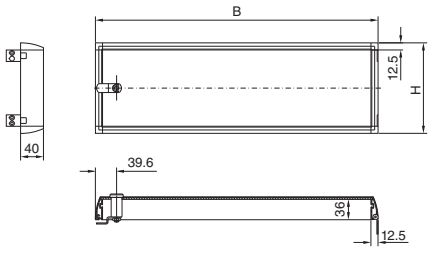
vertically hinged
For mechanical protection of built-in control components.
- Optionally hinged on the right or left
- With security lock

Material:
Frame section: Extruded aluminium section, spray-finished
Corner pieces: Die-cast aluminium, spray-finished
Glass pane: Smoked acrylic

Colour:
RAL 7035

Supply includes:
Assembly parts.

For enclosure width mm	B mm	H (U)	Model No. RC
269.2 ($^1/_2$ 19″)	289	3	**3751.300**
269.2 ($^1/_2$ 19″)	289	4	**3751.310**
482.6 (19″)	503	3	**3751.320**
482.6 (19″)	503	4	**3751.330**
482.6 (19″)	503	6	**3751.340**
482.6 (19″)	503	7	**3751.350**



Aluminium front door

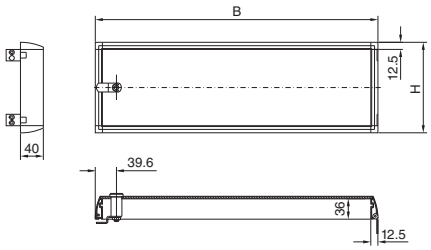
vertically hinged
For mechanical protection of built-in control components.
- Optionally hinged on the right or left
- With security lock

Material:
Frame section: Extruded aluminium section, spray-finished
Corner pieces: Die-cast aluminium, spray-finished
Aluminium plate

Colour:
RAL 7035

Supply includes:
Assembly parts.

For enclosure width mm	B mm	H (U)	Model No. RC
482.6 (19″)	503	3	**3751.360**
482.6 (19″)	503	4	**3751.370**
482.6 (19″)	503	6	**3751.380**



Front door

For tower enclosure
For mechanical protection of built-in control components.
- Optionally hinged on the right or left
- With security lock

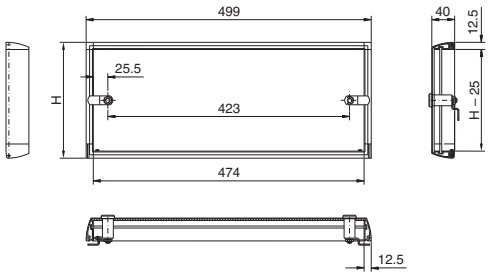
Material:
Frame section: Extruded aluminium section, spray-finished
Corner pieces: Die-cast aluminium, spray-finished
Glazed pane: Smoked acrylic

Colour:
RAL 7035

Supply includes:
Assembly parts.

For enclosure width mm	B mm	H (U)	Model No. RC
482.6 (19″)	503	3	**3751.390**
482.6 (19″)	503	4	**3751.430**

B = Overall width of front door



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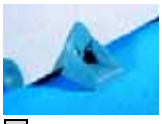


3

Tower feet

For vertical siting of enclosures.
May be retrofitted.

Material:
Plastic to UL 94-V0, self-extinguishing

Decorative colours:

1 RAL 7030 (stone grey)

2 RAL 5018 (turquoise)

3 RAL 5012 (pale blue)

Supply includes:
4 tower feet,
assembly parts.

Decorative colour RAL	Packs of	Model No. RC
5018	1 set	**3751.850**
5012	1 set	**3751.852**
7030	1 set	**3751.854**

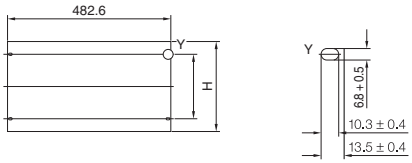
Rittal RiCase accessories

Back panel

Screw-fastened
To close off the rear.

Material:
2/3 mm aluminium, natural anodised

Supply includes:
482.6 mm (19″) mounting bracket, assembly parts.



For enclosure width mm	H (U)	Packs of	Model No. RC
482.6 (19″)	3	1	**3751.600**
482.6 (19″)	4	1	**3751.610**
482.6 (19″)	6	1	**3751.620**
482.6 (19″)	7	1	**3751.630**
482.6 (19″)	9	1	**3751.530**
482.6 (19″)	12	1	**3751.540**

Rear door

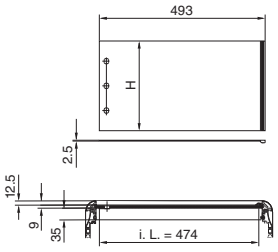
vertically hinged
To close off the rear.
- Hinged, with security lock
- Optionally hinged on the left or right

Material:
Aluminium, spray-finished

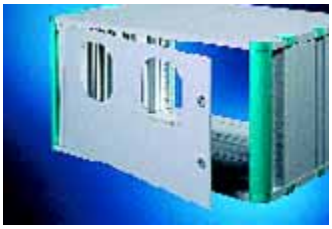
Colour:
RAL 7035

Supply includes:
Assembly parts.

For Enclosure width mm	H (U)	Packs of	Model No. RC
482.6 (19″)	3	1	**3751.100**
482.6 (19″)	4	1	**3751.110**
482.6 (19″)	6	1	**3751.120**
482.6 (19″)	7	1	**3751.130**



i.L. = Clearance width



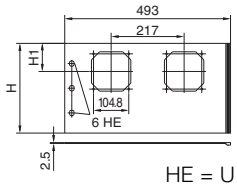
Rear door

for fan installation
To close off the rear.
- With security lock
- Optionally hinged on the left or right
- For the installation of 120 mm fans

Material:
Aluminium, spray-finished

Colour:
RAL 7035

Supply includes:
Assembly parts.



HE = U

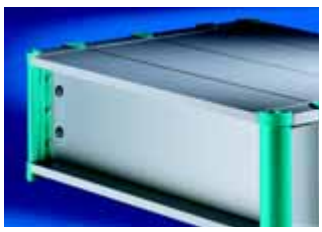
For Enclosure width mm	H (U)	H1 mm	Model No. RC
482.6 (19″)	3	66.65	**3751.150**
482.6 (19″)	4	88.90	**3751.160**
482.6 (19″)	6	83.50	**3751.170**
482.6 (19″)	7	83.50	**3751.180**

Accessories:

Fan expansion kit,
see page 649.

Assembly screws M6,
see page 1019.
Captive nuts M6,
see page 1020.

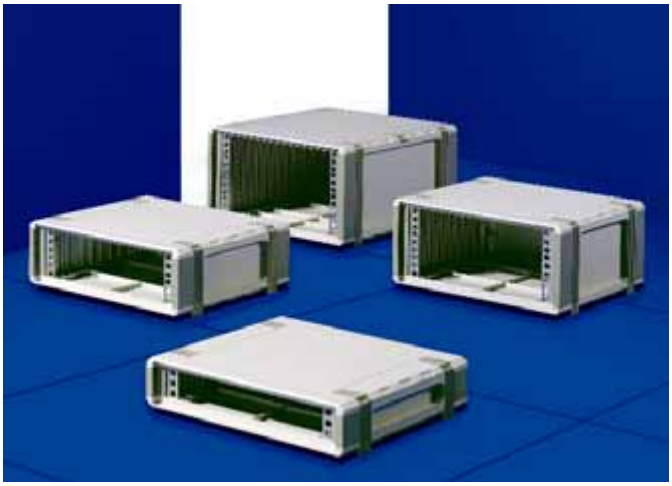
Fan expansion kit,
see page 649.

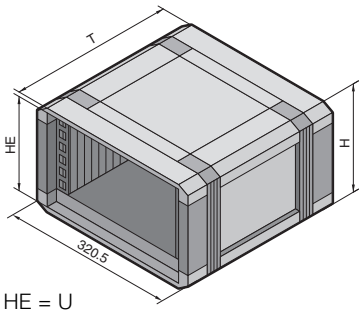


Blanking plates,
see page 1013.
Hinged blanking plates,
see page 1013.

Ventilation front panels,
see page 1013.

Rittal Vario-Case iS, 269.2 mm (1/2 19″) 1 U, 2 U, 3 U, 4 U





HE = U

Technical specifications:
Total depth: 300 mm, 400 mm
Installation width:
269.2 mm (1/2 19″)
Installation option:
269.2 mm (1/2 19″) racks and modular assemblies to IEC 60 297-3

Material/surface finish:
Side panels: Extruded aluminium section, spray-finished similar to RAL 7030/7035
Cover trays: Plastic UL 94-V0 (self-extinguishing), colour similar to RAL 7035
Rear panel: 2 mm aluminium, natural anodised.

Supply includes:
2 plastic covers,
4 (6) enclosure feet and
4 (6) screw covers,
2 side panels,
1 rear panel,
without vent slots,
4 mounting angles,
4 threaded inserts,
4 untapped strips,
assembly parts.
Enclosures are supplied partially assembled.

EMC version,
see page 292.

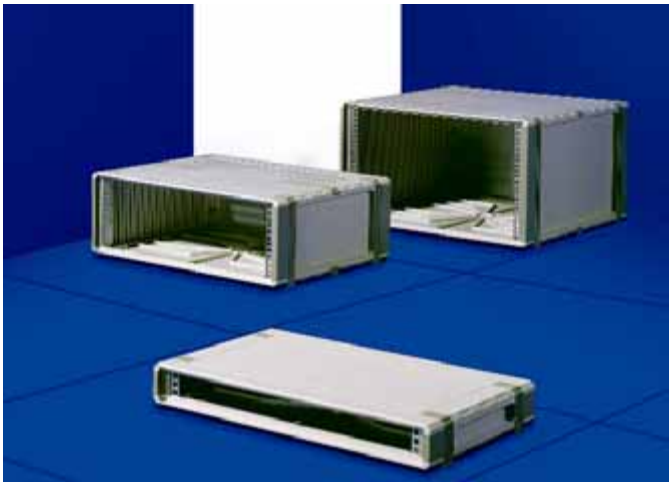
Special sizes and colours available on request.

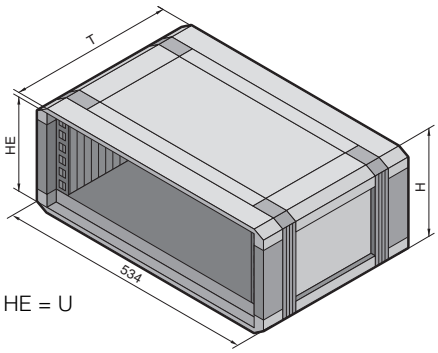
Detailed drawing,
see page 1162.

Enclosure for subrack width 269.2 mm (1/2 19″)	Packs of	1 U	2 U	3 U		4 U		Page
Depth (T) in mm		300	300	300	400	300	400	
Height (H) in mm		74.75	119.20	163.65	163.65	208.10	208.10	
Model No. VC without vent slots	1	**3710.000**	**3720.000**	**3730.000**	**3731.000**	**3740.000**	**3741.000**	
Accessories								
Mounting kit	1	–	–	3780.000	3780.000	–	–	572
Carrying handle, vertical	2	–	–	3785.000	3785.000	–	–	575
Carrying handles, horizontal	2	3787.000	3787.000	3787.000	3788.000	3787.000	3788.000	575
Blanking plate (rear panel)	3	3746.000	3747.000	3748.000	3748.000	3749.000	3749.000	1013
Slide rails	4	3782.000	3782.000	3782.000	3783.000	3782.000	3783.000	573
Front door, vertically hinged (acrylic door)	1	–	–	3700.000	3700.000	3701.000	3701.000	574

Accessories Vario-Case Page 572 **Subracks** Page 486 **RiBox** Page 554 **Ripac Vario-Module** Page 555 **RiCase** Page 562

Rittal Vario-Case iS, 482.6 mm (19″)/1 U, 4 U, 7 U





Technical specifications:
Total depth: 300 mm, 400 mm, 500 mm
Installation width:
482.6 mm (19″)
Installation option:
482.6 mm (19″) slide-in equipment and modular assemblies to IEC 60 297-3

Material/surface finish:
Side panels: Extruded aluminium section spray-finished similar to RAL 7030/7035
Cover trays: Plastic
UL 94-V0 (self-extinguishing), colour similar to RAL 7035
Rear panel: 2 mm aluminium, natural anodised.

Supply includes:
2 plastic covers,
4 (6) enclosure feet and
4 (6) screw covers,
2 side panels,
1 rear panel,
without/with vent slots,
4 mounting angles,
4 threaded inserts,
4 untapped strips,
assembly parts.
Enclosures are supplied partially assembled.

EMC version,
see page 292.

Special sizes and colours available on request.

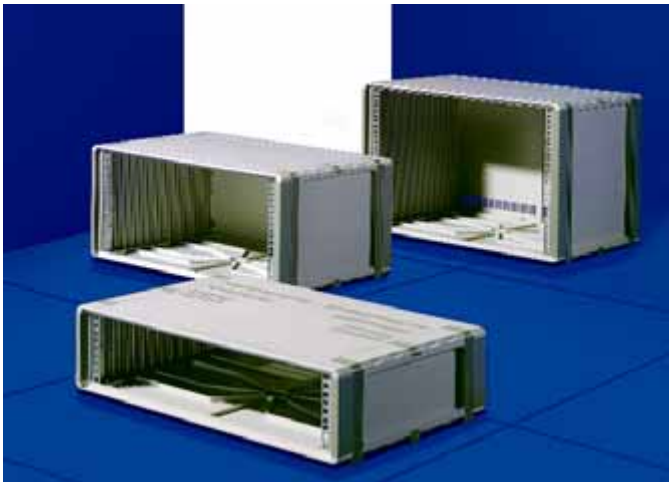
Detailed drawing,
see page 1163.

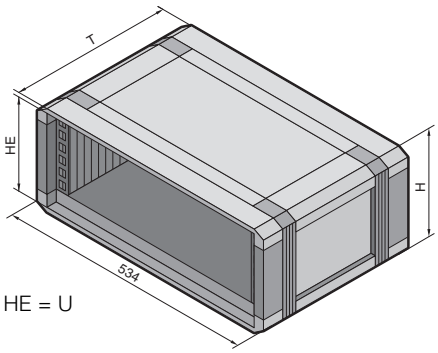
Enclosure for subrack width 482.6 mm (19″)	Packs of	1 U		4 U			7 U		Page
Depth (T) in mm		300	400	300	400	500	400	500	
Height (H) in mm		74.75	74.75	208.10	208.10	208.10	341.40	341.40	
Model No. VC without vent slots	1	**3713.000**[1)]	**3714.000**	**3743.000**	**3744.000**	**3745.000**[1)]	**3774.000**	**3775.000**	
Model No. VC with vent slots	1	**3713.200**[1)]	**3714.200**	**3743.200**	**3744.200**	**3745.200**[1)]	**3774.200**	**3775.200**	
Accessories									
Carrying handles, horizontal	2	3787.000	3788.000	3787.000	3788.000	3789.000	3788.000	3789.000	575
Support stand/carrying handle	1	3797.000	3797.000	3797.000	3797.000	3797.000	3797.000	3797.000	573
Blanking plate (rear panel)	3	1931.200	1931.200	1934.200	1934.200	1934.200	1935.200	1935.200	1013
Slide rails	4	3782.000	3783.000	3782.000	3783.000	3784.000	3783.000	3784.000	573
Front door, vertically hinged (acrylic door)	1	–	–	3703.000	3703.000	3703.000	3705.000	3705.000	574
Front door, horizontally hinged (acrylic door)	1	–	–	3727.000	3727.000	3727.000	3729.000	3729.000	574
482.6 mm (19″) 1 U drawer	1	–	–	–	–	4541.000	–	4541.000	1015
482.6 mm (19″) 3 U drawer	1	–	–	–	–	4542.000	–	4542.000	1015

[1)] Delivery times approx. 4 weeks.

Accessories Vario-Case Page 572 **Subracks** Page 486 **RiBox** Page 554 **Ripac Vario-Module** Page 555 **RiCase** Page 562

Rittal Vario-Case iS, 482.6 mm (19″)/3 U, 6 U, 9 U





Technical specifications:
Total depth: 300 mm, 400 mm, 500 mm
Installation width:
482.6 mm (19″)
Installation option:
482.6 mm (19″) slide-in equipment and modular assemblies to IEC 60 297-3

Material/surface finish:
Side panels: Extruded aluminium section, spray-finished similar to RAL 7030/7035
Cover trays: Plastic
UL 94-V0 (self-extinguishing), colour similar to RAL 7035
Rear panel: Plastic
UL 94-V0 (self-extinguishing), Colour similar to RAL 7035

Supply includes:
2 plastic covers,
4 (6) enclosure feet and
4 (6) screw covers,
2 side panels,
1 rear panel,
without/with vent slots,
2 mounting angles,
2 threaded inserts,
2 untapped strips,
assembly parts.
Enclosures are supplied partially assembled.

EMC version,
see page 292.

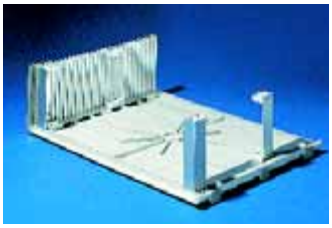
Special sizes and colours available on request.

Detailed drawing,
see page 1163.

Enclosure for subrack width 482.6 mm (19″)	Packs of	3 U			6 U			9 U		Page
Depth (T) in mm		300	400	500	300	400	500	400	500	
Height (H) in mm		163.65	163.65	163.65	297.00	297.00	297.00	430.50	430.50	
Model No. VC without vent slots	1	**3733.000**	**3734.000**	**3735.000**	**3763.000**	**3764.000**	**3765.000**	**3794.000**	**3795.000**	
Model No. VC with vent slots	1	**3733.200**	**3734.200**	**3735.200**	**3763.200**	**3764.200**	**3765.200**	**3794.200**	**3795.200**	
Accessories										
Mounting kit	1	3780.000	3780.000	3780.000	3781.000	3781.000	3781.000	–	–	572
Carrying handles, horizontal	2	3787.000	3788.000	3789.000	3787.000	3788.000	3789.000	3788.000	3789.000	575
Carrying handle, vertical	2	3785.000	3785.000	3785.000	3786.000	3786.000	3786.000	–	–	575
Support stand/carrying handle	1	3797.000	3797.000	3797.000	3797.000	3797.000	3797.000	3797.000	3797.000	573
Blanking plate (rear panel)	3	1933.200	1933.200	1933.200	1936.200	1936.200	1936.200	1939.200	1939.200	1013
Slide rails	4	3782.000	3783.000	3784.000	3782.000	3783.000	3784.000	3783.000	3784.000	573
Front door, vertically hinged (acrylic door)	1	3702.000	3702.000	3702.000	3704.000	3704.000	3704.000	–	–	574
Front door, horizontally hinged (acrylic door)	1	3726.000	3726.000	3726.000	3728.000	3728.000	3728.000	–	–	574
482.6 mm (19″) 1 U drawer	1	–	–	4541.000	–	–	4541.000	–	4541.000	1015
482.6 mm (19″) 3 U drawer	1	–	–	4542.000	–	–	4542.000	–	4542.000	1015

Accessories Vario-Case Page 572 **Subracks** Page 486 **RiBox** Page 554 **Ripac Vario-Module** Page 555 **RiCase** Page 562

Rittal Vario-Case iS accessories



Mounting kit

For direct installation of board type plug-in units without using a subrack.
The vertical rails/adaptors of the mounting kit are used to fasten horizontal rails/horizontal rail sets in Vario-Case iS enclosures.

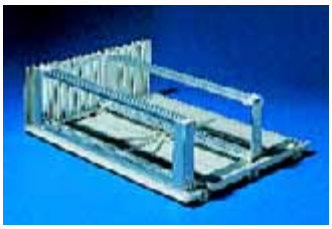
Material:
Vertical rails: Aluminium, natural anodised.
Adaptor: Plastic

Supply includes:
2 vertical rails, front,
2 vertical rails, rear,
4 threaded inserts,
8 adaptors (12 for 6 U),
assembly parts.

For VC	Model No. VC
3 U	**3780.000**
6 U	**3781.000**

Also required:

Horizontal rail sets,
see page 572.



Horizontal rail sets

To equip Rittal Vario-Case iS enclosures.
For direct installation of board type plug-in units without using a subrack.

	Fitting 3 U, 84 HP		Fitting 6 U, 84 HP	
	Without integrated Z rails for backplanes or female connectors to IEC 60 603-2 (DIN 41 612)	**With integrated Z rails** for female connectors to IEC 60 603-2 (DIN 41 612)	**Without integrated Z rails** for backplanes or female connectors to IEC 60 603-2 (DIN 41 612)	**With integrated Z rails** for female connectors to IEC 60 603-2 (DIN 41 612)
Model No. UV	**3663.301**	**3663.311**	**3663.601**	**3663.611**
Packs of	1 set	1 set	1 set	1 set
Horizontal rails, front	2	2	2	2
Horizontal rails, rear	2	–	2	–
Horizontal rails, rear, with integrated Z rails	–	2	–	2
Centre horizontal rail	–	–	1	–
Centre horizontal rail, with integrated Z rails	–	–	–	1
Threaded inserts	4	2	6	2
HP strips	4	4	4	4
Assembly screws	8	8	12	12

Also required:

For horizontal rail sets without integral Z rails:
Z rails, see page 504.

Accessories:

		Packs of	Model No. UV
Guide rails	160 mm	10	**3606.700**
	220 mm	10	**3606.720**
Insulating strips		2	**3604.850**

Mounting angle for 482.6 mm (19″)

Depth-adjustable on a 12.5 mm pitch pattern, for fastening slide-in equipment or front plates in Vario-Case iS enclosures.
For depth-variable installation of subracks/slide-in equipment via threaded inserts.

Material:
Aluminium, natural anodised.

Supply includes:
Assembly screws.

U	Packs of	Model No. VC
1	4	**3717.000**
2	4	**3716.000**
3	4	**3790.000**
4	4	**3718.000**
6	4	**3791.000**
7	4	**3719.000**
9	4	**3792.000**

Also required:

Threaded inserts M4,
see page 564.

Rittal Vario-Case iS accessories

Slide rails

To support heavy subracks/slide-in equipment.

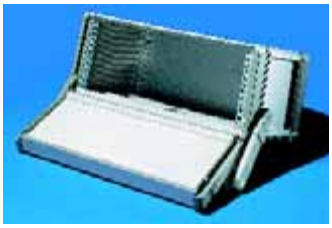
Material:
1.5 mm sheet steel, passivated

Supply includes:
Assembly screws.

For enclosures mm	Packs of	Model No. VC
300	4	**3782.000**
400	4	**3783.000**
500	4	**3784.000**

Also required:

To secure the slide rails in the enclosure:
Threaded inserts M4, see page 564.



Keyboard lid

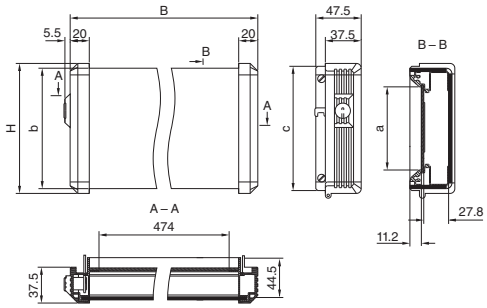
Suitable for the installation of 482.6 mm (19″) keyboards. Hinged, with security lock.

Material:
Centre/side parts: Aluminium,
spray-finished similar to RAL 7030/7035
Corner pieces:
Die-cast zinc, spray-finished similar to RAL 7030
Insertion plate:
Aluminium, spray-finished
similar to RAL 7035

Supply includes:
Fitted keyboard lid,
with solid aluminium plate on the inside,assembly parts.

	Model No. VC	
	4 U	6 U
	3722.000	**3723.000**
W (B) mm	534	534
H mm	203	292
a mm	155	244
b mm	193	282
c mm	197	286

3 U on request.



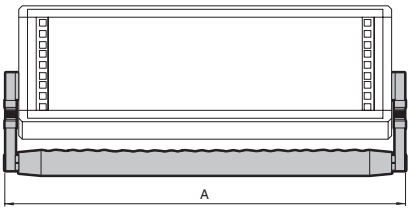
Support stand/carrying handle

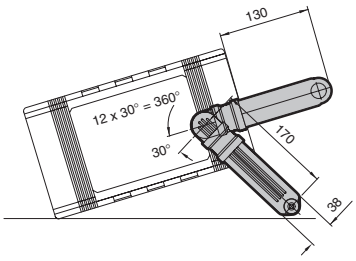
- Suitable for retrofitting to 2 U – 6 U enclosures
- Support stand/carrying handle adjustable in 30° increments
- Load capacity up to 30 kg

Material:
End pieces:
Die-cast zinc, spray-finished in RAL 7030
Centre part: Extruded aluminium section with plastic cover, spray-finished in RAL 7030

Supply includes:
Assembly parts.

For VC mm	A mm	Packs of	Model No. VC
269.2 ($^1/_2$19″)	364.5	1	**3796.000**
482.6 (19″)	578.0	1	**3797.000**





Rittal Vario-Case iS accessories

Front doors, vertically hinged

Aluminium or acrylic

- For the protection of the installed control components
- Optional right-hand or left-hand hinge
- Fitted with security lock
- May be used as a front or rear door

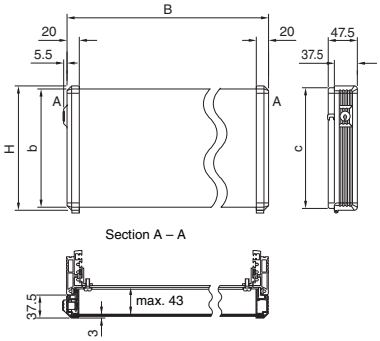
Material of the aluminium door:
Side panels: Extruded aluminium section/die-cast, spray-finished in RAL7030
Centre part: Aluminium, spray-finished, similar to RAL 7035

Material of the acrylic door:
Side panels: Extruded aluminium section/die-cast, spray-finished in RAL7030
Window: Smoked acrylic

Supply includes:
1 door, assembly parts.

Aluminium door	U	W (B) mm	H mm	b mm	c mm	Model No. VC
482.6 mm (19″)	3	534	159	149	153	**3707.000**
482.6 mm (19″)	4	534	203	193	197	**3708.000**
482.6 mm (19″)	6	534	292	282	286	**3709.000**

Acrylic door	U	W (B) mm	H mm	b mm	c mm	Model No. VC
269.2 mm (1/2 19″)	3	320.5	157.5	147.0	151.5	**3700.000**
269.2 mm (1/2 19″)	4	320.5	202.0	192.0	196.0	**3701.000**
482.6 mm (19″)	3	534.0	157.5	147.0	151.5	**3702.000**
482.6 mm (19″)	4	534.0	202.0	192.0	196.0	**3703.000**
482.6 mm (19″)	6	534.0	291.0	281.0	285.0	**3704.000**
482.6 mm (19″)	7	534.0	335.3	325.5	329.4	**3705.000**



Front doors, horizontally hinged

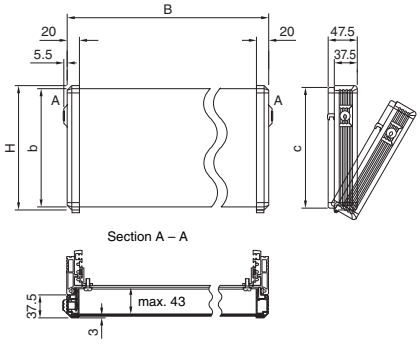
Acrylic

- For the protection of the installed control components
- Optional bottom or top hinges
- Fitted with security lock

Material:
Side panels: Extruded aluminium section/die-cast, spray-finished in RAL7030
Window: Smoked acrylic

Supply includes:
1 door, assembly parts.

Acrylic door	U	W (B) mm	H mm	b mm	c mm	Model No. VC
269.2 mm (1/2 19″)	3	320.5	157.5	147.0	151.5	**3724.000**
269.2 mm (1/2 19″)	4	320.5	202.0	192.0	196.0	**3725.000**
482.6 mm (19″)	3	534.0	157.5	147.0	151.5	**3726.000**
482.6 mm (19″)	4	534.0	202.0	192.0	196.0	**3727.000**
482.6 mm (19″)	6	534.0	291.0	281.0	285.0	**3728.000**
482.6 mm (19″)	7	534.0	335.3	325.5	329.4	**3729.000**



Rittal Vario-Case iS accessories

Carrying handles, vertical

For easy, convenient transportation.

Material:
End pieces: Die-cast zinc,
spray-finished similar to RAL 7035
Centre part: Extruded aluminium section,
spray-finished in RAL 7035

Supply includes:
Assembly parts.

For VC	Packs of	Model No. VC
3 U	2	**3785.000**
6 U	2	**3786.000**

Carrying handles, horizontal

For easy, convenient transportation.

Material:
Side panels: Die-cast zinc,
spray-finished similar to RAL 7035
Centre part: Extruded aluminium section,
spray-finished in RAL 7035

Supply includes:
Assembly parts.

For VC	Packs of	Model No. VC
300 mm deep	2	**3787.000**
400 mm deep	2	**3788.000**
500 mm deep	2	**3789.000**

Plastic caps

for VC feet
Designed for retrofitting to the feet of Vario-Case iS enclosures, these soft plastic caps prevent slipping on smooth surfaces.

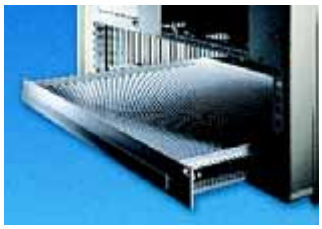
Material:
Soft PVC, Shore hardness 60°

Colour:
RAL 7030

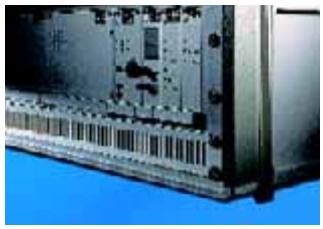
Packs of	Model No. VC
12	**3736.000**

Threaded insert M4,
see page 564.

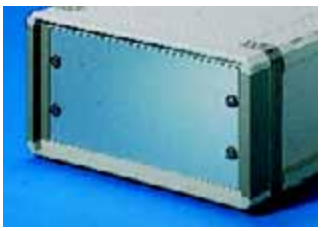
Earthing set,
see page 565.



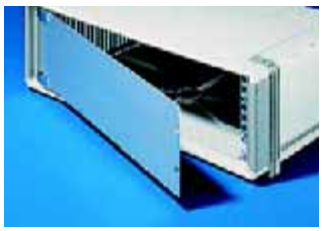
Drawer/utility table
pull-out drawer with base,
see page 1015,
drawer with frame open bottom,
see page 1015.



Ventilation front panels,
see page 1013.



Blanking plates,
see page 1013.



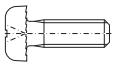
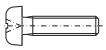
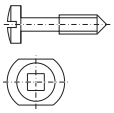
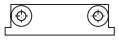
Blanking plate, vertically hinged,
see page 1013.
Horizontally hinged,
see page 1013.

Hinge,
see page 1013.

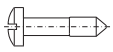
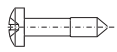
M6 assembly screws,
see page 1019.

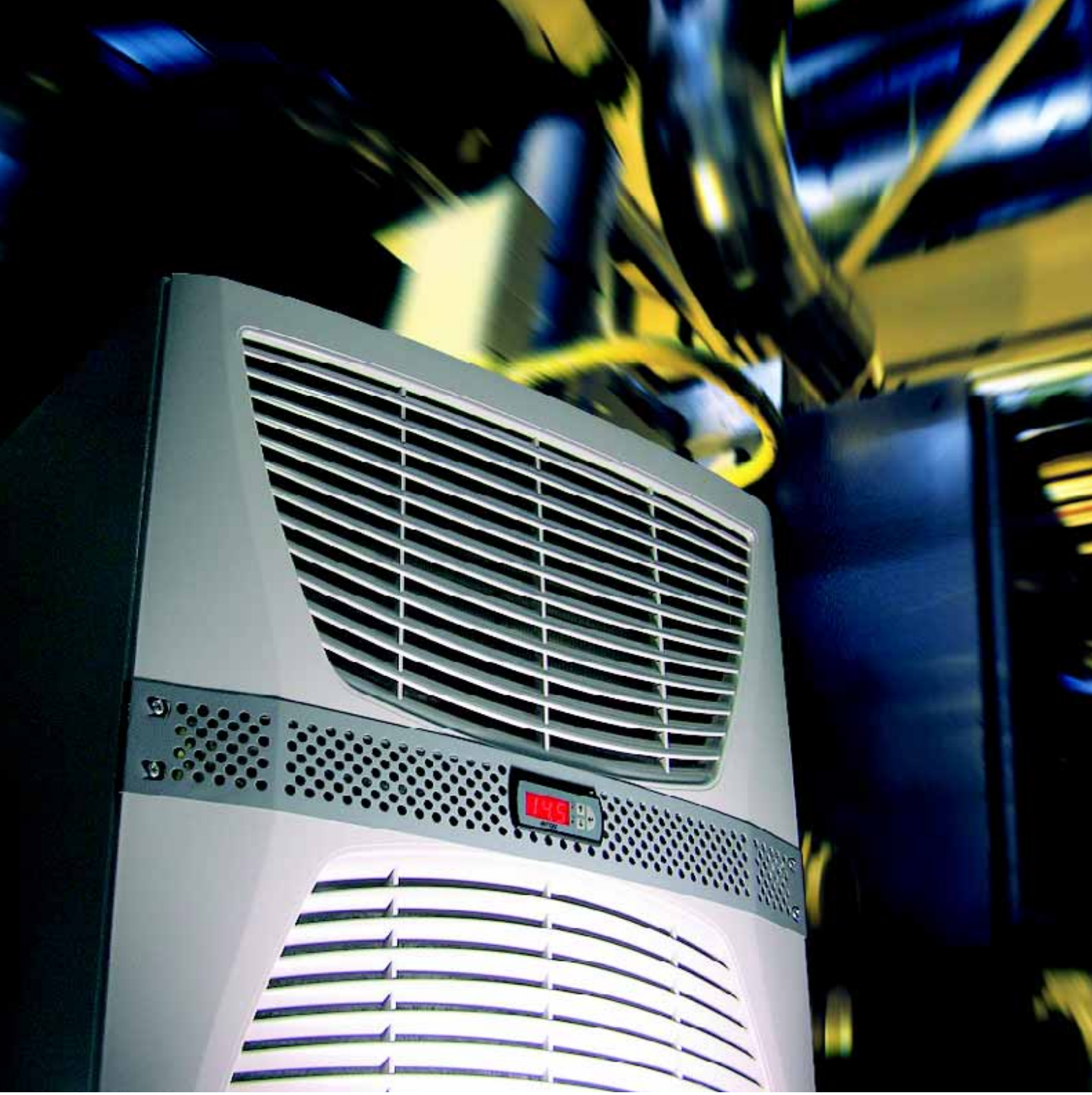
Captive nut M6,
see page 1020.

Assembly parts

For the attachment of	Description	Dimensions	Model No.	Packs of
Front panels to unit side panels	Oval csk-screw ISO 7047-4.8-Z-A2F	M3 x 8	**3606.550**	100
Rear panels to box-type plug-in units	Panhead posidrive screw ISO 7045-4.8-Z-A2F	M3 x 8	**3606.560**	100
PCB holders (plastic) to front panels, top	Oval csk-screw ISO 7047-4.8-Z-A2F	M2.5 x 10	**3606.610**	100
– Horizontal rails to side panels – Divider panels to horizontal rails – Horizontal rails to vertical supports	Panhead self-locking screw similar to DIN ISO 7045-8.8-Z-A2F	M4 x 12 	**3654.300**	100
– PCBs to PCB holders (die-cast for 3 U, 6 U), top – PCBs to extractor handles with 6 U	Panhead screw ISO 7045-4.8-Z-A2F	M2.5 x 8	**3654.320**	100
– PCB holder (plastic) to type V/VI handles, bottom – PCBs to PCB holders (plastic) – Backplanes to tapped strips	Panhead screw ISO 7045-4.8-Z-A2F	M2.5 x 10 	**3654.330**	100
– Connectors to Z rails – Z rails to horizontal rails – Type V/VI handles to partial front panels, bottom right for ≥ 5 HP – Aluminium guide rails to horizontal rails – Mezzanine front panels	Panhead screw ISO 7045-4.8-Z-A2F	M2.5 x 6	**3654.340**	100
Aluminium guide rails to horizontal rails (fastening of sqare nuts)	Retaining cage	M2.5	**9901.417**	100
Handle type V (plastic) to front panels and box type plug-in units	Mounting kit for type V handle (plastic): Cover black Cover grey Hex nut Screw Screw Square nut DIN 502-11H-A2F	 M2.5 M2.5 x 16 M2.5 x 12 M2.5	**3687.519**	1 set
Connectors to PCBs	Panhead screw ISO 7045-4.8-Z-A2F	M2.5 x 12	**3654.350**	100
Guide rails (plastic) to horizontal rails	Screw for plastic WN 1413	M2.2 x 6	**3654.360**	100
– Flat front panels to handles type V, VI – Aluminium guide rails to horizontal rails	Square nut DIN 562-A2F	M2.5	**3654.370**	100
– Flat front panels to horizontal rails – Trim frame to conceal the front sections of the horizontal mounting kit	Captive screws (cheese-head) and plastic collars	M2.5 x 11 	**3658.160**	100 set
Flat front panels	Plastic collars		**3687.021**	100
PCB to type III handle	Screw for plastic WN 1412	M3.0 x 8	**3658.190**	100
– PCBs to PCB holders (plastic) – PCB holders to front panels, top	Hex nut ISO 4032-8	M2.5	**3658.210**	100
– Backplanes to threaded inserts – Air partitions to horizontal rails	Mounting kit for backplanes: Panhead screw ISO 7045-4.8-Z-A2F Washer PE, natural DIN 125	 M2.5 x 6 2.7	**3684.019**	100
– Covers to mounting blocks – EMC contact profiles	Flat csk-screw ISO 7046-1-4.8-Z-A2F	M3 x 6	**3684.233**	100
Covers to side panels	Mounting block		**3684.234**	10
Type V/VI handle to front panels	Bracket		**3684.435**	100
Female connector to PCB attachment	Pop rivet DIN 7340-B-CuZn	2.5 x 0.3 x 10	**3684.482**	100
Ground contact to keyable guide rails	Fastening screw for ground contact	M3.5 x 12	**3684.109**	50

Assembly parts

For the attachment of	Description	Dimensions	Model No.	Packs of
Fans to fan mounting plate	Mounting kit for fans:		**3685.197**	1 set
	Flat csk-screw ISO 7046-1-4.8-Z-A2F	M4 x 12		
	Hex nut ISO 4032-8	M4		
	Serrated washer DIN 6797-A-Fst	4.3		
Covers to side panels	Mounting kit for covers:		**3685.256**	24 sets
	Mounting block			
	Flat csk-screw ISO 7046-1-4.8-Z-A2F	M3 x 6		
PCB holders (die-cast) to front panels, top	Oval csk-screw ISO 7047-4.8-Z-A2F	M2.5 x 8	**3685.282**	100
– Covers/box type plug-in units type I/II – Contact/spring sections for 3-part front panels	Flat csk-screw ISO 7046-1-4.8-Z-A2F	M2.5 x 5	**3685.289**	100
– Handles on front panels for box type plug-in units – Front panels to hinge strip	Flat csk-screw ISO 7046-1-4.8-Z-A2F	M2.5 x 6	**3685.290**	100
Holder (horizontal assembly kit) to horizontal rail	Flat csk-screw similar to ISO 7046-1-4.8-Z-A2F	M2.5 x 5	**3686.916**	100
Holder (horizontal assembly kit) to horizontal rail	Flat csk-screw similar to ISO 7046-1-4.8-Z-A2F	M2.5 x 8	**3686.917**	100
Contact and spring sections on 3-part front panels without countersink	Panhead csk-screw ISO 7046-4.8-Z-A2F	M2.5 x 5	**3686.924**	100
Recessed flanges to side panels	Mounting kit for recessed flanges:		**3687.015**	4 sets
	Panhead self-locking screw similar to DIN ISO 7045-8.8-Z-A2F	M4 x 8		
	Hex nut ISO 4032-8	M4		
	Washer	4.3		
Fastening the threaded inserts in horizontal rails	Grub screw ISO 7434-14H	M2.5 x 8	**3687.020**	100
– EMC front panels to horizontal rails – EMC trim frame to conceal the front sections of the horizontal mounting kit	Centering screw with slotted head	M2.5 x 11 	**3687.050**	100
EMC front panels to horizontal rails	Centering screw posidrive	M2.5 x 11 	**3687.051**	100
Front panels and rear panels to horizontal rails	Collar screw, cheese-hed slotted	M2.5 x 11	**3685.097**	100
Type V/VI handles (aluminium) to front panels	Mounting kit for type V/VI handles:		**3687.146**	1 set
	Panhead screw ISO 7045-1-4.8-Z-A2F	M2.5 x 6		
	Bracket			
	Square nut DIN 562-11H-A2F	M2.5		



Everyone talks about the future, but Rittal helps shape it – and that includes the field of climate control.

Development work focuses on the holistic **protection of process control with the minimum possible energy consumption.**

Modern cooling units with excellent efficiency and perfect interface technology, together with **liquid cooling concepts,** offer fresh new perspectives for the correct cooling of electronic components. This is crucial to the availability and reliability of machinery and IT technology.

For this reason, Rittal collaborates closely with you to develop customised climate control concepts.

System climate control

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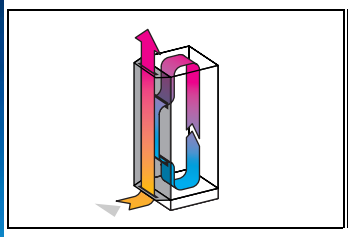
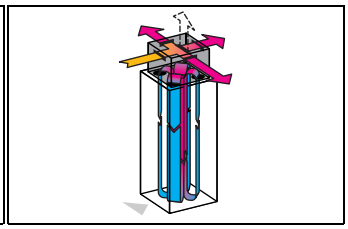
Features

Rittal system climate control offers holistic process protection. This includes the cooling of sensitive electronics in enclosures and cases for industrial process control, as well as server and network technology, regardless of the ambient conditions. But these are not isolated solutions – with Rittal, everything is interconnected. Perfectly linked and controlled cooling technology with eco-friendly, energy-efficient equipment.

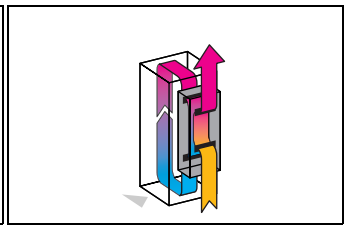
Selection criteria



Integral cooling technology
The unity of enclosure and cooling components achieves particularly effective cooling. Assembly time is eliminated. The investment costs for the complete unit offer exceptionally good value for money.



Roof-mounted cooling units
Requirement-oriented routing of cooling air in the internal circuit is possible, with up to four cold air outlet openings and the optional use of ducts. In the external circuit, the heated air is expelled to the rear, left and right, and optionally upwards. This means that there are no obstacles to bayed use and siting close to the wall.



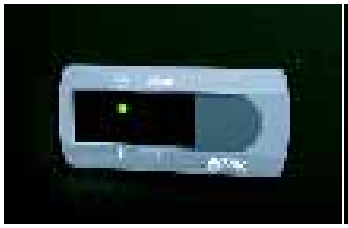
Wall-mounted cooling units
Depending on the space and design requirements, internal mounting, partial internal mounting and external mounting are all possible. Thanks to large distances between the air intake and outlet openings, effective cold air throughput of the enclosure is achieved.

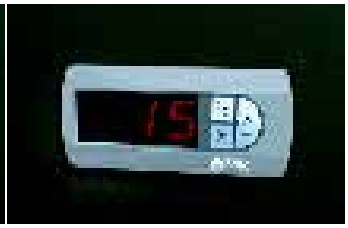
Intelligent control

The two controller variants for operational reliability offer a comprehensive range of functions. Essential control electronics are well protected and cooled in the inner circuit.

Both variants have the following properties:

- Three voltage options: 115 V, 230 V, 400/460 V 3~
- Integral start-up delay and door limit switch function
- Icing protection function
- Monitoring of all motors
- Phase monitoring for three-phase units





Basic controller:

- Visualisation of the operating status via LED display
- Switching hysteresis: 5 K
- Floating fault signal contact in case of overtemperature
- Setpoint adjustable from outside via potentiometer (setting range 20° – 55°C)

Comfort controller

- Switching hysteresis: 2 – 10 K preset to 5 K
- System alarm, individually configurable for 2 floating fault signal contacts
- Visualisation of the current enclosure internal temperature and all system messages on the display
- Storage of all system states in the log file
- Optional extension card for integration into superordinate remote monitoring systems e.g. with CMC

Features

Integral cooling technology

Infinite possibilities
The TS 8 Top enclosure system platform offers full compatibility in terms of baying techniques, lock systems and interior installation.

Fast exchange of the door and side panel
The symmetrical design means that the door hinge can be swapped very quickly to the opposite side, even with the designer climate control door.

Exchangeable in a flash
With all integrated cooling technology models, the cooling module can be very rapidly exchanged in just a few actions for servicing purposes.

Roof-mounted cooling units

Flexible performance
Only 3 mounting cutouts for 6 different output categories in 28 design variants.

Targeted air routing in the enclosure
The internal air circulation is targeted and effective: The heated air is extracted centrally. Air exhaust occurs in the four corners, depending on requirements.

Flexible condensate management
All roof-mounted cooling units with Comfort controller are equipped with condensate warning feature. A condensate pump and condensate evaporation may be integrated.

Wall-mounted cooling units

Wall-mounted cooling units – Practical and stylish
The mounting cutout is selected depending on the mounting variant: external, internal or partial internal mounting. This makes optimum use of the space available.

Effective air routing inside the enclosure
The large distance between the air inlet and outlet in the internal circuit makes wall-mounted cooling units particularly effective. This ensures optimum air throughput inside the enclosure, and air short-circuits are avoided.

Developed for easy servicing, inside and out
The assemblies, their arrangement and the divided internal case construction make all types of maintenance and servicing work much easier.

Benefits:

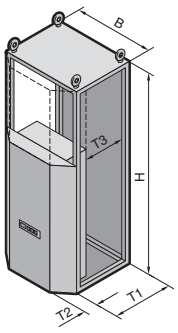
- Useful cooling output from 225 W to 4000 W
- Extensive control and monitoring features, even with the basic version
- Three-phase cooling units support multiple voltages as standard
- Uniform, output-related, cross-system mounting cutouts, to match TopTherm air/air heat exchangers
- Targeted, individual air routing
- No assembly work and low investment costs, thanks to the complete solution consisting of an enclosure and integral cooling unit[1)]
- May be integrated directly into TS 8 bayed enclosure suites[1)]

Important:

- Use a base/plinth of at least 100 mm height to ensure uninhibited air entry[1)]
- Avoid overloading the roof plate by using stays (see TS 8 system accessories)
- Air inlet and outlet openings in the internal and external circuit must not be obstructed.

[1)] Only for integral cooling technology.

Enclosures, single-door, useful cooling output 1100/1500 W



B = Width
T = Depth

Property rights:
German patent no. 196 09 794
European patent no. 0 886 994
with validity for ES, FR, GB, IT, NL, SE
Taiwanese patent no. N 11 05 287
US patent no. 6,134,109
South Korean patent
no. 3 295 093

Supply includes:
Enclosure frame with rear panel, roof and climate control door, including TS 8 hinges, door opening angle approx. 110°, spray-finished, including pre-assembled cooling module, r/h door hinge, may be swapped to opposite side, 4 eyebolts, pre-fitted, mounting plate, three-part gland plates, depth stay as shipping brace.

Also required:
For correct functioning of the external circuit:
Base/plinth, 100 or 200 mm high,
see page 835.

Optionally available:
Microcontroller control with
- digital temperature indicator,
- floating contact for collective fault signal,
- connection for door operated switch for start-up delay.

Automatic condensate evaporation.

Approvals,
see page 66.

Detailed drawing,
see page 1164.

Performance diagrams,
available on the Internet.

Model No. SK[1]		**8687.100**	**8607.100**	**8687.840**	**8607.840**	**8887.150**	**8807.100**	**8887.140**	**8807.140**
Rated operating voltage V, Hz		230, 50/60		400, 2~, 50/60		230, 50/60		400, 2~, 50/60	
Dimensions in mm	B	600	600	600	600	800	800	800	800
	H	1800	2000	1800	2000	1800	2000	1800	2000
	T1	600	600	600	600	600	600	600	600
	T2	100	100	100	100	100	100	100	100
Maximum installation depth up to mounting plate	T3	478							
Suitable for baying with TS 8 enclosures mm	T	600							
Useful cooling output $\dot{Q}_K$ to DIN 3168	**L 35 L 35**	**1100 W/1250 W**				**1500 W/1510 W**			
	L 35 L 50	**820 W/1000 W**				**1065 W/1240 W**			

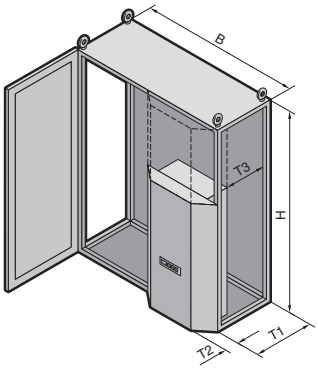
Rated current max.		3.2 A/3.8 A		1.9 A/2.2 A		4.0 A/4.5 A		2.3 A/2.6 A	
Start-up current		11.0 A/12.0 A		6.3 A/6.9 A		9.0 A/10.0 A		5.2 A/5.7 A	
Pre-fuse T		10.0 A/10.0 A		6.0 A/6.0 A		10.0 A/10.0 A		6.0 A/6.0 A	
Power consumption P_{el} to DIN 3168	L 35 L 35	525 W/630 W		540 W/650 W		650 W/750 W		670 W/780 W	
	L 35 L 50	605 W/725 W		625 W/750 W		750 W/850 W		780 W/880 W	
Refrigeration factor $\varepsilon = \dot{Q}_K/P_{el}$	L 35 L 35	2.1				2.3			
Refrigerant		R134a, 675 g				R134a, 700 g			
Permissible operating pressure p. max.		23 bar							
Temperature and setting range		+20°C to +55°C							
Protection category to EN 60 529/10.91	External circuit	IP 24							
	Internal circuit	IP 54							
Duty cycle		100 %							
Type of connection		Terminal strip							
Weight		155 kg	163 kg	158 kg	166 kg	182 kg	192 kg	185 kg	195 kg
Colour		RAL 7035[2]							
Air throughput of fans	External circuit	580 m³/h				600 m³/h			
	Internal circuit	420 m³/h				480 m³/h			
Temperature control		Internal thermostat (factory setting +35°C)							

Also required	Packs of									Page
Base/plinth components front/rear, 100 mm	1 set	8601.600				8601.800				835
Base/plinth trim, side, 100 mm	1 set	8601.060								835
Side panels	2	8186.200	8106.200	8186.200	8106.200	8186.200	8106.200	8186.200	8106.200	853

[1] Delivery times available on request.
[2] RAL 7032 on request.
Special voltages available on request. We reserve the right to make technical modifications.

Accessories Page 657 **TS 8 enclosures** From page 142 **Configuration software** Page 1063

Enclosures, two-door, useful cooling output 2000/2500 W



B = Width
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German patent no. 196 09 794
European patent no. 0 886 994
with validity for ES, FR, GB, IT, NL, SE
Taiwanese patent no. N 11 05 287
US patent no. 6,134,109
South Korean patent
no. 3 295 093

Supply includes:
Enclosure frame with rear panel, roof and climate control door, including TS 8 hinges, door opening angle approx. 110°, lockable door with standard hinges, spray-finished, including pre-assembled cooling module, 4 eyebolts, pre-fitted,
mounting plate, three-part gland plates, depth stays as shipping braces.

Also required:
For correct functioning of the external circuit:
Base/plinth, 100 or 200 mm high,
see page 835.

Optionally available:
Microcontroller control with
- digital temperature indicator,
- floating contact for collective fault signal,
- connection for door operated switch for start-up delay.

Automatic condensate evaporation.

Approvals,
see page 66.

Detailed drawing,
see page 1164.

Performance diagrams,
available on the Internet.

Model No. SK[1]		**8287.170**	**8807.180**	**8207.170**	**8207.180**	**8807.260**	**8807.250**
Device position		right	left	right	left	left	
Rated operating voltage V, Hz		230, 50/60				400, 3~, 50/60	
Dimensions in mm	B H T1 T2	1200 1800 600 100	1200 1800 600 100	1200 2000 600 100		1200 1800 600 100	1200 2000 600 100
Maximum installation depth up to mounting plate	T3	445	445	445		415	415
Suitable for baying with TS 8 enclosures mm	T	600					
Useful cooling output $\dot{Q}_K$ to DIN 3168	**L 35 L 35** **L 35 L 50**	**2000 W/2010 W** **1420 W/1650 W**				**2500 W/2550 W** **1650 W/1750 W**	

Rated current max.		5.8 A/6.3 A			3.0 A/3.2 A	
Start-up current		26.0 A/29.0 A			14.0 A/16.0 A	
Pre-fuse T		16.0 A/16.0 A			6.0 A/6.0 A	
Power consumption P_{el} to DIN 3168	L 35 L 35 L 35 L 50	960 W/1070 W 1030 W/1180 W			1330 W/1640 W 1580 W/2000 W	
Refrigeration factor $\varepsilon = \dot{Q}_K/P_{el}$	L 35 L 35	2.1			1.9	
Refrigerant		R134a, 925 g			R134a, 975 g	
Permissible operating pressure p. max.		28 bar				
Temperature and setting range		+20°C to +55°C				
Protection category to EN 60 529/10.91	External circuit	IP 24				
	Internal circuit	IP 54				
Duty cycle		100 %				
Type of connection		Terminal strip				
Weight		231 kg	246 kg		231 kg	245 kg
Colour		RAL 7035[2]				
Air throughput of fans	External circuit	630 m^3/h			700 m^3/h	
	Internal circuit	520 m^3/h			620 m^3/h	
Temperature control		Internal thermostat (factory setting +35°C)				

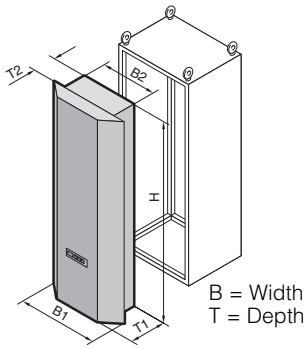
Also required	Packs of					Page
Base/plinth components front/rear, 100 mm	1 set	8601.200				835
Base/plinth trim, side, 100 mm	1 set	8601.060				835
Side panels	1 set	8186.200	8106.200	8186.200	8106.200	853

[1] Delivery times available on request.
[2] RAL 7032 on request.
Special voltages available on request. We reserve the right to make technical modifications.

Accessories Page 657 **TS 8 enclosures** From page 142 **Configuration software** Page 1063

Climate control doors

Doors, for installing on 600 mm wide TS 8 enclosures, useful cooling output 1100/1500



B = Width
T = Depth

Property rights:
German patent no. 196 09 794
European patent no. 0 886 994
with validity for ES, FR, GB, IT, NL, SE
Taiwanese patent
no. N 11 05 287
US patent no. 6,134,109
South Korean patent
no. 0 299 406
Japanese patent no. 3 295 093

Supply includes:
Climate control door unit with pre-fitted cooling module, including TS 8 hinges, door opening angle approx. 110°.

Note:
Climate control doors for two-door TS 8 enclosures
see page 587/588.

Also required:
Base/plinth, 100 or 200 mm high,
see page 835.

Optionally available:
Automatic condensate evaporation.

Approvals,
see page 66/67.

Detailed drawing,
see page 1165.

Performance diagrams,
available on the Internet.

Model No. SK with thermostat		**3306.880[1)]**	**3306.800[1)]**	**3306.884[1)]**	**3306.840[1)]**	**3307.880[1)]**	**3307.800[1)]**	**3307.890[1)]**	**3307.840**
Model No. SK with microcontroller		**3306.580[1)]**	**3306.500[1)]**	**3306.590[1)]**	**3306.540[1)]**	**3307.580[1)]**	**3307.500[1)]**	**3307.590[1)]**	**3307.540[1)]**
Rated operating voltage V, Hz		230, 50/60		400, 2~, 50/60		230, 50/60		400, 2~, 50/60	
Dimensions in mm	B1	592	592	592	592	592	592	592	592
	B2	461	461	461	461	461	461	461	461
	H	1777.5	1977.5	1777.5	1977.5	1777.5	1977.5	1777.5	1977.5
	T1	157	157	157	157	190	190	190	190
	T2	57	57	57	57	90	90	90	90
Dimensions to fit TS enclosures mm	B	600	600	600	600	600	600	600	600
	H	1800	2000	1800	2000	1800	2000	1800	2000
Useful cooling output $\dot{Q}_K$ to DIN 3168	**L 35 L 35**	**1100 W/1250 W**				**1500 W/1680 W**			
	L 35 L 50	**820 W/1000 W**				**1110 W/1120 W**			

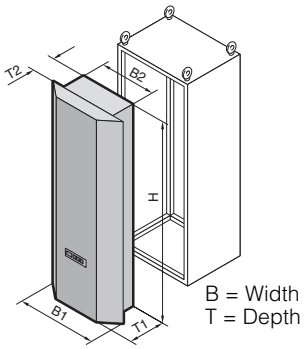
Rated current max.		3.2 A/3.8 A		1.9 A/2.2 A		4.2 A/4.8 A	2.4 A/2.8 A
Start-up current		11.0 A/12.0 A		6.3 A/6.9 A		22.0 A/24.0 A	12.7 A/13.8 A
Pre-fuse T		10.0 A/10.0 A		6.0 A/6.0 A		16.0 A/16.0 A	10.0 A/10.0 A
Power consumption P_{el} to DIN 3168	L 35 L 35	525 W/630 W		540 W/650 W		560 W/710 W	570 W/725 W
	L 35 L 50	605 W/725 W		625 W/750 W		670 W/840 W	680 W/860 W
Refrigeration factor $\varepsilon = \dot{Q}_K/P_{el}$	L 35 L 35	2.1					
Refrigerant		R134a, 675 g				R134a, 800 g	
Permissible operating pressure p. max.		23 bar				26 bar	
Temperature and setting range		+20°C to +55°C					
Protection category to EN 60 529/10.91	External circuit	IP 24					
	Internal circuit	IP 54					
Duty cycle		100 %					
Type of connection		Terminal strip					
Weight		58 kg	60 kg	61 kg	63 kg	72 kg	75 kg
Colour		RAL 7035[2)]					
Air throughput of fans	External circuit	580 m^3/h				600 m^3/h	
	Internal circuit	420 m^3/h				480 m^3/h	
Temperature control		Internal thermostat or microcontroller control (factory setting +35°C)					

Accessories	Packs of			Page
Metal filters	1	3284.200		669
Door-operated switch	1	4127.000		956
Temperature indicator	1	3114.100		660
Air diverter	1	3213.300	–	659

[1)] Delivery times available on request.
[2)] RAL 7032 on request.
Special voltages available on request. We reserve the right to make technical modifications.

Accessories Page 657 **TS 8 enclosures** From page 142 **Configuration software** Page 1063

Doors, for installing on 800 mm wide TS 8 enclosures, useful cooling output 1500 W



Property rights:
German patent no. 196 09 794
European patent no. 0 886 994
with validity for ES, FR, GB, IT, NL, SE
Taiwanese patent no. N 11 05 287
US patent no. 6,134,109
South Korean patent
no. 0 299 406
Japanese patent no. 3 295 093

Supply includes:
Climate control door unit with pre-fitted cooling module, including TS 8 hinges, door opening angle approx. 110°.

Also required:
Base/plinth, 100 or 200 mm high,
see page 835.

Optionally available:
Automatic condensate evaporation.

Approvals,
see page 66/67.

Detailed drawing,
see page 1165.

Performance diagrams,
available on the Internet.

Model No. SK with thermostat		**3308.880**[1]	**3308.800**[1]	**3308.884**[1]	**3308.840**[1]
Model No. SK with microcontroller		**3308.580**[1]	**3308.500**	**3308.590**[1]	**3308.540**
Rated operating voltage V, Hz		230, 50/60		400, 2~, 50/60	
Dimensions in mm	B1 B2 H T1 T2	792 661 1777.5 157 57	792 661 1977.5 157 57	792 661 1777.5 157 57	792 661 1977.5 157 57
Dimensions to fit TS enclosures mm	B H	800 1800	800 2000	800 1800	800 2000
Useful cooling output $\dot{Q}_K$ to DIN 3168	**L 35 L 35 L 35 L 50**	**1500 W/1510 W 1065 W/1240 W**			

Rated current max.		4.0 A/4.5 A		2.3 A/2.6 A	
Start-up current		9.0 A/10.0 A		5.2 A/5.7 A	
Pre-fuse T		10.0 A/10.0 A		6.0 A/6.0 A	
Power consumption P_{el} to DIN 3168	L 35 L 35 L 35 L 50	650 W/750 W 750 W/850 W		670 W/780 W 780 W/880 W	
Refrigeration factor $\varepsilon = \dot{Q}_K/P_{el}$	L 35 L 35	2.3			
Refrigerant		R134a, 700 g			
Permissible operating pressure p. max.		23 bar			
Temperature and setting range		+20°C to +55°C			
Protection category to EN 60 529/10.91	External circuit	IP 24			
	Internal circuit	IP 54			
Duty cycle		100 %			
Type of connection		Terminal strip			
Weight		65 kg	67 kg	68 kg	70 kg
Colour		RAL 7035[2]			
Air throughput of fans	External circuit	600 m^3/h			
	Internal circuit	480 m^3/h			
Temperature control		Internal thermostat or microcontroller control (factory setting +35°C)			

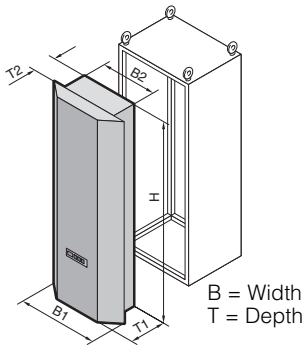
Accessories	Packs of		Page
Metal filters	1	3288.200	669
Door-operated switch	1	4127.000	956
Temperature indicator	1	3114.100	660
Air diverter	1	Available on request.	–

[1] Delivery times available on request.
[2] RAL 7032 on request.
Special voltages available on request. We reserve the right to make technical modifications.

Accessories Page 657 **TS 8 enclosures** From page 142 **Configuration software** Page 1063

Climate control doors

Doors, for installing on 600 mm wide TS 8 enclosures, useful cooling output 2000/2500



Property rights:
German patent no. 196 09 794
European patent no. 0 886 994
with validity for ES, FR, GB, IT, NL, SE
Taiwanese patent no. N 11 05 287
US patent no. 6,134,109
South Korean patent
no. 0 299 406
Japanese patent no. 3 295 093

Supply includes:
Climate control door unit with pre-fitted cooling module, including TS 8 hinges, door opening angle approx. 110°.

Note:
Climate control doors for two-door TS 8 enclosures,
see page 587/588.

Also required:
Base/plinth, 100 or 200 mm high,
see page 835.

Optionally available:
Automatic condensate evaporation.

Approvals,
see page 66/67.

Detailed drawing,
see page 1165.

Performance diagrams,
available on the Internet.

Model No. SK with thermostat		**3309.880[1)]**	**3309.800**	**3309.884[1)]**	**3309.840[1)]**	**3310.880[1)]**	**3310.800**
Model No. SK with microcontroller		**3309.580[1)]**	**3309.500**	**3309.590[1)]**	**3309.540**	**3310.580[1)]**	**3310.500[1)]**
Rated operating voltage V, Hz		230, 50/60		400, 2~, 50/60		400, 3~, 50/60	
Dimensions in mm	B1	592	592	592	592	592	592
	B2	461	461	461	461	461	461
	H	1777.5	1977.5	1777.5	1977.5	1777.5	1977.5
	T1	190	190	190	190	220	220
	T2	90	90	90	90	120	120
Dimensions to fit TS enclosures mm	B	600	600	600	600	600	600
	H	1800	2000	1800	2000	1800	2000
Useful cooling output $\dot{Q}_K$ to DIN 3168	**L 35 L 35**	**2000 W/2010 W**				**2500 W/2550 W**	
	L 35 L 50	**1420 W/1650 W**				**1650 W/1750 W**	

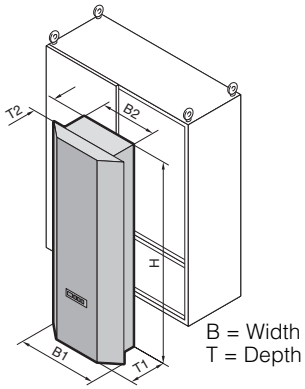
Rated current max.		5.8 A/6.3 A		3.4 A/3.6 A		3.0 A/3.2 A	
Start-up current		26.0 A/29.0 A		15.0 A/16.5 A		14.0 A/16.0 A	
Pre-fuse T		16.0 A/16.0 A		10.0 A/10.0 A		6.0 A/6.0 A	
Power consumption P_{el} to DIN 3168	L 35 L 35	960 W/1070 W		985 W/1100 W		1330 W/1640 W	
	L 35 L 50	1030 W/1180 W		1055 W/1210 W		1580 W/2000 W	
Refrigeration factor $\varepsilon = \dot{Q}_K/P_{el}$	L 35 L 35	2.1				1.9	
Refrigerant		R134a, 925 g				R134a, 975 g	
Permissible operating pressure p. max.		28 bar					
Temperature and setting range		+20°C to +55°C					
Protection category to EN 60 529/10.91	External circuit	IP 24					
	Internal circuit	IP 54					
Duty cycle		100 %					
Type of connection		Terminal strip					
Weight		72 kg	74 kg	75 kg	77 kg	74 kg	76 kg
Colour		RAL 7035[2)]					
Air throughput of fans	External circuit	630 m^3/h				700 m^3/h	
	Internal circuit	520 m^3/h				620 m^3/h	
Temperature control		Internal thermostat or microcontroller control (factory setting +35°C)					

Accessories	Packs of		Page
Metal filters	1	3284.200	669
Door-operated switch	1	4127.000	956
Temperature indicator	1	3114.100	660

[1)] Delivery times available on request.
[2)] RAL 7032 on request.
Special voltages available on request. We reserve the right to make technical modifications.

Accessories Page 657 **TS 8 enclosures** From page 142 **Configuration software** Page 1063

Doors, for installing on 1200 mm wide TS 8 enclosures, useful cooling output 1100/1500



Property rights:
German patent no. 196 09 794
European patent no. 0 886 994
with validity for ES, FR, GB, IT, NL, SE
Taiwanese patent no. N 11 05 287
US patent no. 6,134,109
South Korean patent
no. 0 299 406
Japanese patent no. 3 295 093

Supply includes:
Climate control door unit with pre-fitted cooling module, including TS 8 hinges, door opening angle approx. 110°.

Note:
With the device positioned on the right, one pack consists of a climate control door for installing in the right-hand half of the enclosure, plus a special lockable door for the left-hand half.

With the device positioned on the left, one pack consists of a climate control door for installing on the left-hand half of the enclosure. The existing lockable door on the right may be used.

Climate control doors for single-door TS 8 enclosures,
see page 584 – 588.

Also required:
Base/plinth, 100 or 200 mm high,
see page 835.

Optionally available:
Automatic condensate evaporation.

Approvals,
see page 67.

Detailed drawing,
see page 1165.

Performance diagrams,
available on the Internet.

Model No. SK with thermostat[1)]	left	**3306.270**	**3306.230**	**3306.470**	**3306.430**	**3307.270**	**3307.230**	**3307.470**	**3307.430**
	right	**3306.250**	**3306.210**	**3306.450**	**3306.410**	**3307.250**	**3307.210**	**3307.450**	**3307.410**
Model No. SK with microcontroller[1)]	left	**3306.570**	**3306.530**	**3306.670**	**3306.630**	**3307.570**	**3307.530**	**3307.670**	**3307.630**
	right	**3306.550**	**3306.510**	**3306.650**	**3306.610**	**3307.550**	**3307.510**	**3307.650**	**3307.610**
Rated operating voltage V, Hz		230, 50/60		400, 2~, 50/60		230, 50/60		400, 2~, 50/60	
Dimensions in mm	B1 B2 H T1 T2	592 461 1777.5 157 57	592 461 1977.5 157 57	592 461 1777.5 157 57	592 461 1977.5 157 57	592 461 1777.5 190 90	592 461 1977.5 190 90	592 461 1777.5 190 90	592 461 1977.5 190 90
Dimensions to fit TS enclosures mm	B H	1200 1800	1200 2000	1200 1800	1200 2000	1200 1800	1200 2000	1200 1800	1200 2000
Useful cooling output $\dot{Q}_K$ to DIN 3168	**L 35 L 35 L 35 L 50**	**1100 W/1250 W 820 W/1000 W**				**1500 W/1680 W 1110 W/1120 W**			

Rated current max.		3.2 A/3.8 A		1.9 A/2.2 A		4.2 A/4.8 A	2.4 A/2.8 A
Start-up current		11.0 A/12.0 A		6.3 A/6.9 A		22.0 A/24.0 A	12.7 A/13.8 A
Pre-fuse T		10.0 A/10.0 A		6.0 A/6.0 A		16.0 A/16.0 A	10.0 A/10.0 A
Power consumption P_{el} to DIN 3168	L 35 L 35 L 35 L 50	525 W/630 W 605 W/725 W		540 W/650 W 625 W/750 W		560 W/710 W 670 W/840 W	570 W/725 W 680 W/860 W
Refrigeration factor $\varepsilon = \dot{Q}_K/P_{el}$	L 35 L 35	2.1					
Refrigerant		R134a, 675 g				R134a, 800 g	
Permissible operating pressure p. max.		23 bar				26 bar	
Temperature and setting range		+20°C to +55°C					
Protection category to EN 60 529/10.91	External circuit	IP 24					
	Internal circuit	IP 54					
Duty cycle		100 %					
Type of connection		Terminal strip					
Weight		58 kg	60 kg	61 kg	63 kg	72 kg	75 kg
Colour		RAL 7035[2)]					
Air throughput of fans	External circuit	580 m^3/h				600 m^3/h	
	Internal circuit	420 m^3/h				480 m^3/h	
Temperature control		Internal thermostat or microcontroller control (factory setting +35°C)					

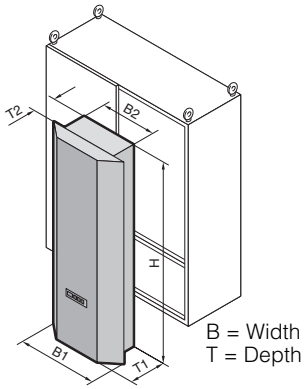
Accessories	Packs of			Page
Metal filters	1	3284.200		669
Door-operated switch	1	4127.000		956
Temperature indicator	1	3114.100		660
Air diverter	1	3213.300	–	659

[1)] Delivery times on request. [2)] RAL 7032 on request. Special voltages available on request. Technical modifications reserved.

Accessories Page 657 **TS 8 enclosures** From page 142 **Configuration software** Page 1063

Climate control doors

Doors, for installing on 1200 mm wide TS 8 enclosures, useful cooling output 2000/2500



Property rights:
German patent no. 196 09 794
European patent no. 0 886 994
with validity for ES, FR, GB, IT, NL, SE
Taiwanese patent no. N 11 05 287
US patent no. 6,134,109
South Korean patent
no. 0 299 406
Japanese patent no. 3 295 093

Supply includes:
Climate control door unit with pre-fitted cooling module, including TS 8 hinges, door opening angle approx. 110°.

Note:
With the device positioned on the right, one pack consists of a climate control door for installing in the right-hand half of the enclosure, plus a special lockable door for the left-hand half.

With the device positioned on the left, one pack consists of a climate control door for installing on the left-hand half of the enclosure. The existing lockable door on the right may be used.

Climate control doors for single-door TS 8 enclosures,
see page 584 – 588.

Also required:
Base/plinth, 100 or 200 mm high,
see page 835.

Optionally available:
Automatic condensate evaporation.

Approvals,
see page 67.

Detailed drawing,
see page 1165.

Performance diagrams,
available on the Internet.

Model No. SK with thermostat[1)]	left	**3309.210**	**3309.140**	**3309.410**	**3309.440**	**3310.150**	**3310.130**
	right	**3309.170**	**3309.120**	**3309.470**	**3309.420**	**3310.250**	**3310.230**
Model No. SK with microcontroller[1)]	left	**3309.510**	**3309.530**	**3309.610**	**3309.640**	**3310.550**	**3310.530**
	right	**3309.570**	**3309.520**	**3309.670**	**3309.620**	**3310.650**	**3310.630**
Rated operating voltage V, Hz		230, 50/60		400, 2~, 50/60		400, 3~, 50/60	
Dimensions in mm	B1 B2 H T1 T2	592 461 1777.5 190 90	592 461 1977.5 190 90	592 461 1777.5 190 90	592 461 1977.5 190 90	592 461 1777.5 220 120	592 461 1977.5 220 120
Dimensions to fit TS enclosures mm	B H	1200 1800	1200 2000	1200 1800	1200 2000	1200 1800	1200 2000
Useful cooling output $\dot{Q}_K$ to DIN 3168	**L 35 L 35** **L 35 L 50**	**2000 W/2010 W** **1420 W/1650 W**				**2500 W/2550 W** **1650 W/1750 W**	

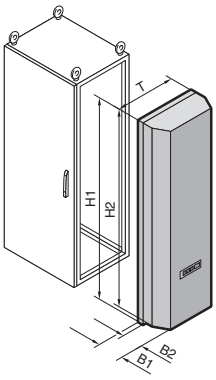
Rated current max.		5.8 A/6.3 A		3.4 A/3.6 A		3.0 A/3.2 A	
Start-up current		26.0 A/29.0 A		15.0 A/16.5 A		14.0 A/16.0 A	
Pre-fuse T		16.0 A/16.0 A		10.0 A/10.0 A		6.0 A/6.0 A	
Power consumption P_{el} to DIN 3168	L 35 L 35 L 35 L 50	960 W/1070 W 1030 W/1180 W		985 W/1100 W 1055 W/1210 W		1330 W/1640 W 1580 W/2000 W	
Refrigeration factor $\varepsilon = \dot{Q}_K/P_{el}$	L 35 L 35	2.1				1.9	
Refrigerant		R134a, 925 g				R134a, 975 g	
Permissible operating pressure p. max.		28 bar					
Temperature and setting range		+20°C to +55°C					
Protection category to EN 60 529/10.91	External circuit	IP 24					
	Internal circuit	IP 54					
Duty cycle		100 %					
Type of connection		Terminal strip					
Weight		72 kg	74 kg	75 kg	77 kg	74 kg	76 kg
Colour		RAL 7035[2)]					
Air throughput of fans	External circuit	630 m³/h				700 m³/h	
	Internal circuit	520 m³/h				620 m³/h	
Temperature control		Internal thermostat or microcontroller control (factory setting +35°C)					

Accessories	Packs of		Page
Metal filters	1	3284.200	669
Door-operated switch	1	4127.000	956
Temperature indicator	1	3114.100	660

[1)] Delivery times on request. [2)] RAL 7032 on request.
Special voltages available on request. We reserve the right to make technical modifications.

Accessories Page 657 **TS 8 enclosures** From page 142 **Configuration software** Page 1063

Panels, for installing on 600 mm deep TS 8 enclosures, useful cooling output 1100/1400



B = Width
T = Depth

Supply includes:
Climate control side panel with pre-fitted cooling module.

Also required:
Base/plinth, 100 or 200 mm high,
see page 835.

Optionally available:
Microcontroller control with
- digital temperature indicator,
- floating contact for collective fault signal,
- connection for door operated switch for start-up delay.

Automatic condensate evaporation.

Approvals,
see page 68.

Performance diagrams,
can be found on the Internet.

Model No. SK		**3331.116**	**3331.316**	**3331.140**[1]	**3331.340**[1]	**3331.216**[1]	**3331.416**	**3331.240**[1]	**3331.440**[1]
Rated operating voltage V, Hz		230, 50/60		400, 2~, 50/60		230, 50/60		400, 2~, 50/60	
Dimensions in mm	B1	171	171	171	171	171	171	171	171
	B2	157	157	157	157	157	157	157	157
	H1	1797	1997	1797	1997	1797	1997	1797	1997
	H2	1782.5	1982.5	1782.5	1982.5	1782.5	1982.5	1782.5	1982.5
	T	562	562	562	562	562	562	562	562
Dimensions to fit TS enclosures mm	H	1800	2000	1800	2000	1800	2000	1800	2000
	T	600	600	600	600	600	600	600	600
Useful cooling output $\dot{Q}_K$ to DIN 3168	**L 35 L 35**	**1100 W/1200 W**				**1400 W/1450 W**			
	L 35 L 50	**730 W/830 W**				**1010 W/1060 W**			

Rated current max.		4.0 A/4.6 A	2.3 A/2.7 A	4.0 A/4.6 A	2.3 A/2.7 A
Start-up current		11.0 A/12.0 A	6.4 A/6.9 A	11.0 A/12.0 A	6.4 A/6.9 A
Pre-fuse T		6.0 A/6.0 A		6.0 A/6.0 A	
Power consumption P_{el} to DIN 3168	L 35 L 35	670 W/850 W	690 W/870 W	710 W/910 W	725 W/930 W
	L 35 L 50	800 W/1000 W	820 W/1020 W	810 W/1030 W	830 W/1050 W
Refrigeration factor $\varepsilon = \dot{Q}_K/P_{el}$	L 35 L 35	1.6		2.0	1.9
Refrigerant		R134a, 825 g		R134a, 875 g	
Permissible operating pressure p. max.		25 bar		24 bar	
Temperature and setting range		+20°C to +50°C			
Protection category to EN 60 529/10.91	External circuit	IP 34			
	Internal circuit	IP 54			
Duty cycle		100 %			
Type of connection		Terminal strip			
Weight		58 kg	62 kg	58 kg	62 kg
Colour		RAL 7035[2]			
Air throughput of fans	External circuit	550 m^3/h			
	Internal circuit	275 m^3/h			
Temperature control		Internal thermostat (factory setting +35°C)			

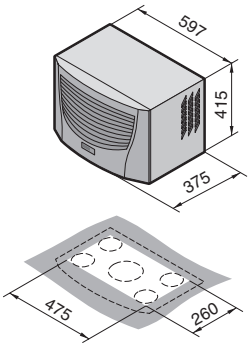
Accessories	Packs of		Page
Metal filters	1	3289.200	669
Door-operated switch	1	4127.000	956
Temperature indicator	1	3114.100	660
Air diverter	1	3213.300	659

[1] Delivery times available on request.
[2] RAL 7032 on request.
Special voltages available on request. We reserve the right to make technical modifications.

Accessories Page 657 **TS 8 enclosures** From page 142 **Configuration software** Page 1063

Roof-mounted cooling units

Useful cooling output 500/750 W



Property rights:
German registered design no. 402 02 324
German registered design no. 402 02 325

Supply includes:
Fully wired ready for connection, including drilling template and assembly parts.

Note:
Cooling units with Comfort controller may be integrated e.g. into superordinate remote monitoring systems by way of an optional interface board **SK 3124.200** (RS 232, RS 485, RS 422 and PLC interface).

Accessories:
Roof plate for TS 8 with mounting cutout, see page 664.

Optionally available:
With automatic condensate evaporation.

Approvals,
see page 68/69.

Detailed drawing,
see page 1166.

Performance diagrams,
available on the Internet.

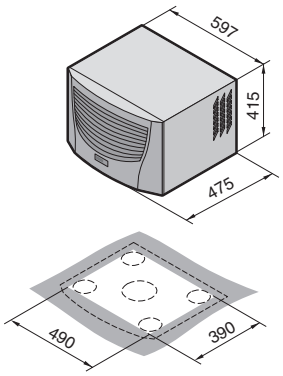
Model No. SK with Basic controller, RAL 7035		**3382.100**	**3382.110**	**3359.100**	**3359.110**	**3359.140**
Model No. SK with Comfort controller, RAL 7035		**3382.500**	**3382.510**	**3359.500**	**3359.510**	**3359.540**
Model No. SK with Basic controller, stainless steel[1)]		**3382.200**	**3382.210**	**3359.200**	**3359.210**	**3359.240**
Model No. SK with Comfort controller, stainless steel[1)]		**3382.600**	**3382.610**	**3359.600**	**3359.610**	**3359.640**
Rated operating voltage V, Hz		230, 50/60	115, 50/60	230, 50/60	115, 50/60	400, 2~, 50/60
Dimensions in mm	WHD	597 x 415 x 375				
Useful cooling output $\dot{Q}_K$ to DIN 3168	**L 35 L 35**	**500 W/510 W**		**750 W/810 W**		
	L 35 L 50	**270 W/370 W**		**545 W/590 W**		
Rated current max.		2.7 A/2.9 A	5.5 A/6.0 A	3.0 A/3.9 A	6.0 A/7.8 A	1.7 A/2.2 A
Start-up current		9.2 A/10.2 A	18.4 A/18.4 A	10.0 A/10.7 A	20.0 A/21.4 A	5.8 A/6.2 A
Pre-fuse T		10.0 A/10.0 A	10.0 A/10.0 A	10.0 A/10.0 A	16.0 A/16.0 A	10.0 A/10.0 A
Power consumption P_{el} to DIN 3168	L 35 L 35	360 W/410 W	370 W/420 W	410 W/520 W	420 W/535 W	
	L 35 L 50	410 W/450 W	420 W/470 W	490 W/600 W	500 W/615 W	
Refrigeration factor $\varepsilon = \dot{Q}_K/P_{el}$	L 35 L 35	1.4		1.8		
Refrigerant		R134a, 250 g		R134a, 300 g		
Permissible operating pressure p. max.		25 bar				
Temperature and setting range		+20°C to +55°C				
Protection category to EN 60 529/10.91	External circuit	IP 34				
	Internal circuit	IP 54				
Duty cycle		100 %				
Type of connection		Plug-in terminal strip				
Weight		30 kg	35 kg	32 kg	37 kg	
Air throughput of fans (unimpeded air flow)	External circuit	910 m^3/h				
	Internal circuit	440 m^3/h				
Temperature control		Basic or Comfort controller (factory setting +35°C)				

Accessories	Packs of		Page
Filter mats	3	3286.500	668
Metal filters	1	3286.510	669
Quick-change frame	1	3286.700	665
Door-operated switch	1	4127.000	956
SK bus system for Comfort controller	1	3124.100	663
RiDiag II including cables for Comfort controller	1	3159.100	1063
Interface card for Comfort controller	1	3124.200	662
Air ducting system	1	3286.870	658
Cover stoppers for interior air outlet	2	3286.780	658
Condensate hose	1	3301.612	665

[1)] Delivery times on request. Special voltages available on request. Technical modifications reserved.

Accessories Page 657 **Configuration software** Page 1063

Useful cooling output 1000 W



Property rights:
German registered design no. 402 02 324
German registered design no. 402 02 325

Supply includes:
Fully wired ready for connection, including drilling template and assembly parts.

Note:
Integration of the cooling units with Comfort controller, e.g. into superordinate remote monitoring systems, can be achieved by means of an optional interface board **SK 3124.200** (RS 232, RS 485, RS 422 and PLC interface).

Accessories:
Roof plate for TS 8 with mounting cutout, see page 664.

Optionally available:
With automatic condensate evaporation.

Approvals,
see page 68/69.

Detailed drawing,
see page 1166.

Performance diagrams,
available on the Internet.

Model No. SK with Basic controller, RAL 7035		**3383.100**	**3383.110**	**3383.140**
Model No. SK with Comfort controller, RAL 7035		**3383.500**	**3383.510**	**3383.540**
Model No. SK with Basic controller, stainless steel[1)]		**3383.200**	**3383.210**	**3383.240**
Model No. SK with Comfort controller, stainless steel[1)]		**3383.600**	**3383.610**	**3383.640**
Rated operating voltage V, Hz		230, 50/60	115, 50/60	400, 2~, 50/60
Dimensions in mm	WHD	597 x 415 x 475		
Useful cooling output $\dot{Q}_K$ to DIN 3168	**L 35 L 35** **L 35 L 50**	**1000 W/1080 W** **760 W/820 W**		
Rated current max.		4.3 A/4.5 A	8.3 A/8.7 A	2.4 A/2.4 A
Start-up current		15.5 A/15.5 A	25.3 A/24.3 A	8.0 A/8.8 A
Pre-fuse T		10.0 A/10.0 A	16.0 A/16.0 A	10.0 A/10.0 A
Power consumption P_{el} to DIN 3168	L 35 L 35 L 35 L 50	550 W/650 W 660 W/750 W	580 W/660 W 670 W/755 W	
Refrigeration factor $\varepsilon = \dot{Q}_K/P_{el}$	L 35 L 35	1.8		
Refrigerant		R134a, 500 g		
Permissible operating pressure p. max.		25 bar		
Temperature and setting range		+20°C to +55°C		
Protection category to EN 60 529/10.91	External circuit	IP 34		
	Internal circuit	IP 54		
Duty cycle		100 %		
Type of connection		Plug-in terminal strip		
Weight		40 kg	46 kg	46 kg
Air throughput of fans	External circuit	1760 m^3/h		
	Internal circuit	440 m^3/h		
Temperature control		Basic or Comfort controller (factory setting +35°C)		

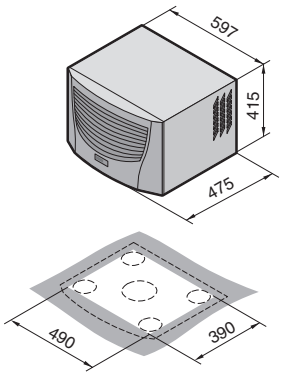
Accessories	Packs of		Page
Filter mats	3	3286.500	668
Metal filters	1	3286.510	669
Quick-change frame	1	3286.800	665
Door-operated switch	1	4127.000	956
SK bus system for Comfort controller	1	3124.100	663
RiDiag II including cables for Comfort controller	1	3159.100	1063
Interface card for Comfort controller	1	3124.200	662
Air ducting system	1	3286.870	658
Cover stoppers for interior air outlet	2	3286.880	658
Condensate hose	1	3301.612	665

[1)] Delivery times on request. Special voltages available on request. Technical modifications reserved.

Accessories Page 657 **Configuration software** Page 1063

Roof-mounted cooling units

Useful cooling output 1100 W



Property rights:
German registered design no. 402 02 324
German registered design no. 402 02 325

Especially for office applications. Low noise level (considerably quieter than cooling units for industrial applications).

Supply includes:
Fully wired ready for connection, including automatic condensate evaporation, drilling template and assembly parts.

Note:
Integration of the cooling units with Comfort controller, e.g. into superordinate remote monitoring systems, can be achieved by means of an optional interface board **SK 3124.200** (RS 232, RS 485, RS 422 and PLC interface).

Accessories:
Roof plate for TS 8 with mounting cutout, see page 664.

Approvals,
see page 68.

Detailed drawing,
see page 1166.

Performance diagrams,
available on the Internet.

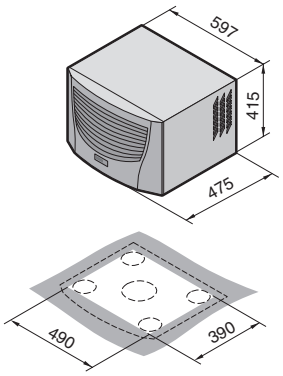
Model No. SK with Comfort controller		**3273.500**	**3273.515[1)]**
Rated operating voltage V, Hz		230, 50/60	115, 50/60
Dimensions in mm	WHD	597 x 415 x 475	
Useful cooling output $\dot{Q}_K$ to DIN 3168	**L 35 L 35** **L 35 L 50**	**1100 W/1200 W** **850 W/870 W**	
Rated current max.		5.2 A/5.4 A	11.0 A/11.5 A
Start-up current		15.5 A/16.5 A	32.0 A/35.0 A
Pre-fuse T		10.0 A/10.0 A	20.0 A/20.0 A
Power consumption P_{el} to DIN 3168	L 35 L 35 L 35 L 50	890 W/910 W 960 W/1100 W	920 W/940 W 990 W/1140 W
Refrigeration factor $\varepsilon = \dot{Q}_K/P_{el}$	L 35 L 35	1.2	
Refrigerant		R134a, 700 g	
Permissible operating pressure p. max.		25 bar	
Temperature and setting range		+20°C to +55°C	
Protection category to EN 60 529/10.91	External circuit	IP 34	
	Internal circuit	IP 54[2)]	
Duty cycle		100 %	
Type of connection		Plug-in terminal strip	
Weight		42 kg	47 kg
Colour		RAL 7035	
Air throughput of fans	External circuit	1760 m^3/h	
	Internal circuit	440 m^3/h	
Temperature control		Basic or Comfort controller (factory setting +35°C)	

Accessories	Packs of		Page
Filter mats	3	3286.100	668
Metal filters	1	3286.210	669
Door-operated switch	1	4127.000	956
SK bus system for Comfort controller	1	3124.100	663
RiDiag II including cables for Comfort controller	1	3159.100	1063
Interface card for Comfort controller	1	3124.200	662
Air ducting system	1	3286.870	658
Cover stoppers for interior air outlet	2	3286.980	658
Condensate hose	1	3301.612	665

[1)] Delivery times available on request.
[2)] In order to avoid increased condensation, we recommend enclosures with a protection category of at least IP 54.
Special voltages available on request. We reserve the right to make technical modifications.

Accessories Page 657 **Configuration software** Page 1063

Useful cooling output 1500/2000 W



Property rights:
German registered design no. 402 02 324
German registered design no. 402 02 325

Supply includes:
Fully wired ready for connection, including drilling template and assembly parts.

Note:
Integration of the cooling units with Comfort controller, e. g. into superordinate remote monitoring systems, can be achieved by means of an optional interface board **SK 3124.200** (RS 232, RS 485, RS 422 and PLC interface).

Accessories:
Roof plate for TS 8 with mounting cutout, see page 664.

Optionally available:
With automatic condensate evaporation.

Approvals,
see page 68/69.

Detailed drawing,
see page 1166.

Performance diagrams,
available on the Internet.

Model No. SK with Basic controller, RAL 7035		**3384.100**	**3384.110**	**3384.140**	**3385.100**	**3385.110**	**3385.140**
Model No. SK with Comfort controller, RAL 7035		**3384.500**	**3384.510**	**3384.540**	**3385.500**	**3385.510**	**3385.540**
Model No. SK with Basic controller, stainless steel[1)]		**3384.200**	**3384.210**	**3384.240**	**3385.200**	**3385.210**	**3385.240**
Model No. SK with Comfort controller, stainless steel[1)]		**3384.600**	**3384.610**	**3384.640**	**3385.600**	**3385.610**	**3385.640**
Rated operating voltage V, Hz		230, 50/60	115, 50/60	400, 2~, 50/60	230, 50/60	115, 50/60	400, 2~,50/60
Dimensions in mm	WHD	597 x 415 x 475			597 x 415 x 475		
Useful cooling output $\dot{Q}_K$ to DIN 3168	**L 35 L 35** **L 35 L 50**	**1500 W/1520 W** **1100 W/1210 W**			**2000 W/2130 W** **1570 W/1670 W**		
Rated current max.		5.7 A/6.8 A	12.5 A/14.1 A	3.4 A/4.0 A	5.7 A/6.6 A	13.0 A/14.2 A	3.3 A/3.8 A
Start-up current		16.6 A/17.1 A	30.7 A/29.1 A	9.8 A/9.6 A	16.8 A/18.4 A	36.0 A/32.0 A	10.0 A/12.0 A
Pre-fuse T		10.0 A/10.0 A	20.0 A/20.0 A	10.0 A/10.0 A	10.0 A/10.0 A	20.0 A/20.0 A	10.0 A/10.0 A
Power consumption P_{el} to DIN 3168	L 35 L 35 L 35 L 50	815 W/930 W 950 W/1090 W	850 W/950 W 1000 W/1150 W		1000 W/1175 W 1100 W/1310 W	1050 W/1250 W 1160 W/1380 W	
Refrigeration factor $\varepsilon = \dot{Q}_K/P_{el}$	L 35 L 35	1.8			2.0		
Refrigerant		R134a, 500 g			R134a, 950 g		
Permissible operating pressure p. max.		25 bar					
Temperature and setting range		+20°C to +55°C					
Protection category to EN 60 529/10.91	External circuit	IP 34					
	Internal circuit	IP 54					
Duty cycle		100 %					
Type of connection		Plug-in terminal strip					
Weight		41 kg	47 kg	47 kg	42 kg	48 kg	48 kg
Air throughput of fans	External circuit	1760 m^3/h			1820 m^3/h		
	Internal circuit	470 m^3/h					
Temperature control		Basic or Comfort controller (factory setting +35°C)					

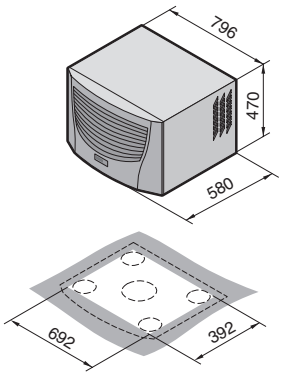
Accessories	Packs of		Page
Filter mats	3	3286.500	668
Metal filters	1	3286.510	669
Quick-change frame	1	3286.800	665
Door-operated switch	1	4127.000	956
SK bus system for Comfort controller	1	3124.100	663
RiDiag II including cables for Comfort controller	1	3159.100	1063
Interface card for Comfort controller	1	3124.200	662
Air ducting system	1	3286.870	658
Cover stoppers for interior air outlet	2	3286.880	658
Condensate hose	1	3301.612	665

[1)] Delivery times available on request.
Special voltages available on request. We reserve the right to make technical modifications.

Accessories Page 657 **Configuration software** Page 1063

Roof-mounted cooling units

Useful cooling output 3000/4000 W



Property rights:
German registered design no. 402 02 324
German registered design no. 402 02 325

Supply includes:
Fully wired ready for connection, including drilling template, eyebolt and assembly parts.

Note:
Integration of the cooling units with Comfort controller, e.g. into superordinate remote monitoring systems, can be achieved by means of an optional interface board **SK 3124.200** (RS 232, RS 485, RS 422 and PLC interface).

Accessories:
Roof plate for TS 8 with mounting cutout, see page 664.

Optionally available:
With automatic condensate evaporation.

Approvals,
see page 68/69.

Detailed drawing,
see page 1166.

Performance diagrams,
available on the Internet.

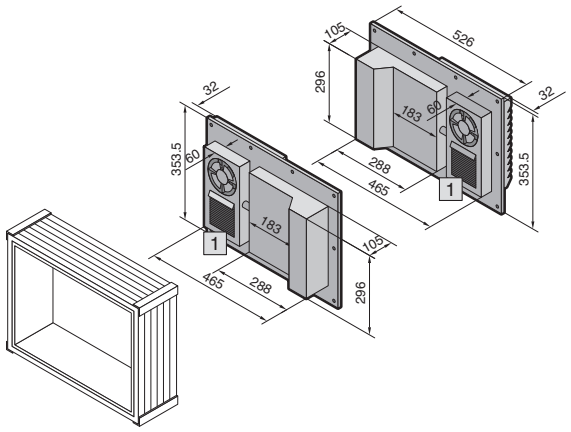
Model No. SK with Basic controller, RAL 7035		**3386.140**	**3387.140**
Model No. SK with Comfort controller, RAL 7035		**3386.540**	**3387.540**
Model No. SK with Basic controller, stainless steel[1)]		**3386.240**	**3387.240**
Model No. SK with Comfort controller, stainless steel[1)]		**3386.640**	**3387.640**
Rated operating voltage V, Hz		400, 50/460, 60, 3~	400, 50/460, 60, 3~
Dimensions in mm	WHD	796 x 470 x 580	796 x 470 x 580
Useful cooling output $\dot{Q}_K$ to DIN 3168	**L 35 L 35** **L 35 L 50**	**3000 W/3300 W** **2460 W/2750 W**	**4000 W/4200 W** **3250 W/3490 W**
Rated current max.		3.0 A/3.1 A	3.5 A/3.6 A
Start-up current		8.0 A/9.0 A	17.0 A/19.0 A
Pre-fuse T		Motor circuit breaker 10.0 A/10.0 A	
Power consumption P_{el} to DIN 3168	L 35 L 35 L 35 L 50	1180 W/1490 W 1430 W/1770 W	1620 W/2060 W 1870 W/2340 W
Refrigeration factor $\varepsilon = \dot{Q}_K/P_{el}$	L 35 L 35	2.5	
Refrigerant		R134a, 1600 g	R134a, 1800 g
Permissible operating pressure p. max.		25 bar	
Temperature and setting range		+20°C to +55°C	
Protection category to EN 60 529/10.91	External circuit	IP 34	
	Internal circuit	IP 54	
Duty cycle		100 %	
Type of connection		Plug-in terminal strip	
Weight		70 kg	77 kg
Air throughput of fans	External circuit	3450 m^3/h	3870 m^3/h
	Internal circuit	1280 m^3/h	1420 m^3/h
Temperature control		Basic or Comfort controller (factory setting +35°C)	

Accessories	Packs of		Page
Filter mats	3	3286.600	668
Metal filters	1	3286.610	669
Quick-change frame	1	3286.900	665
Door-operated switch	1	4127.000	956
SK bus system for Comfort controller	1	3124.100	663
RiDiag II including cables for Comfort controller	1	3159.100	1063
Interface card for Comfort controller	1	3124.200	662
Air ducting system	1	3286.970	658
Cover stoppers for interior air outlet	2	3286.980	658
Condensate hose	1	3301.612	665

[1)] Delivery times on request. Special voltages available on request. Technical modifications reserved.

Accessories Page 657 **Configuration software** Page 1063

VIP small cooling units, useful cooling output 225 W



The new VIP small cooling units were developed especially for cooling the VIP 6000 command panel. In addition, VIP small cooling units also offer a space-saving, economical solution for the climate control of small enclosures where small heat loads are generated by the system.

Supply includes:
Fully wired ready for connection and pre-mounted on an aluminium rear panel to fit VIP 6000 operating housing 7 U.

Property rights:
German patent
no. 198 17 917

[1] **Distance from installed equipment at least 60 mm**

Approvals,
see page 69.

Performance diagrams,
available on the Internet.

Model No. SK		**3201.100**	**3202.100**
Condenser version		left	right
Rated operating voltage V, Hz		230, 50/60	
Dimensions in mm	W H D	526 353.5 105	
Useful cooling output $\dot{Q}_K$ to DIN 3168	**L 35 L 35** **L 35 L 45**	**225 W/270 W** **160 W/200 W**	

Rated current max.		1.5 A/1.5 A
Start-up current		1.9 A/2.0 A
Pre-fuse T		4.0 A/4.0 A
Power consumption P_{el} to DIN 3168	L 35 L 35 L 35 L 45	285 W/300 W 315 W/325 W
Refrigeration factor $\varepsilon = \dot{Q}_K/P_{el}$	L 35 L 35	0.8/0.9
Refrigerant		R134a, 170 g
Permissible operating pressure p. max.		27 bar
Temperature and setting range		+20°C to +45°C
Protection category to EN 60 529/10.91	External circuit	IP 24
	Internal circuit	IP 54
Duty cycle		100 %
Type of connection		Terminal strip
Weight		10.5 kg
Colour		Rear panel aluminium, vent grille RAL 7035
Air throughput of fans	External circuit	235 m^3/h / 270 m^3/h
	Internal circuit	160 m^3/h / 180 m^3/h
Temperature control		Electronic control (factory setting +35°C)

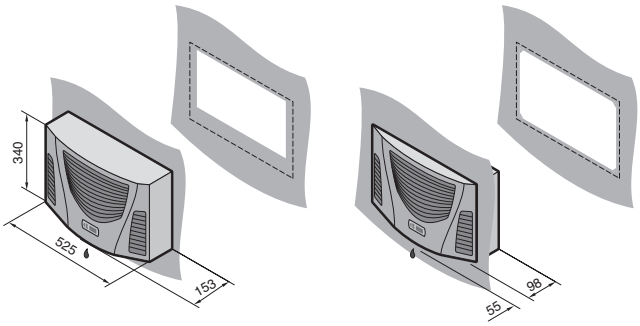
Accessories	Packs of		Page
Temperature indicator	1	3114.100	660
Condensate hose	1	3301.608	665

Special voltages available on request. We reserve the right to make technical modifications.

Accessories Page 657 **Configuration software** Page 1063

Wall-mounted cooling units

Mini cooling unit in horizontal format, useful cooling output 300 W



Mini cooling units in horizontal format, ideal for cooling small and operating housings with optimum space utilisation.

Supply includes:
Fully wired ready for connection, including drilling template and assembly parts.

Approvals,
see page 69.

Detailed drawing,
see page 1167.

Performance diagrams,
available on the Internet.

RITTAL TOP THERM

Model No. SK		**3302.300**	**3302.310**
Rated operating voltage V, Hz		230, 50/60	115, 60
Dimensions in mm	W H D	525 340 153	
Useful cooling output $\dot{Q}_K$ to DIN 3168	**L 35 L 35** **L 35 L 50**	**300 W/320 W** **150 W/160 W**	

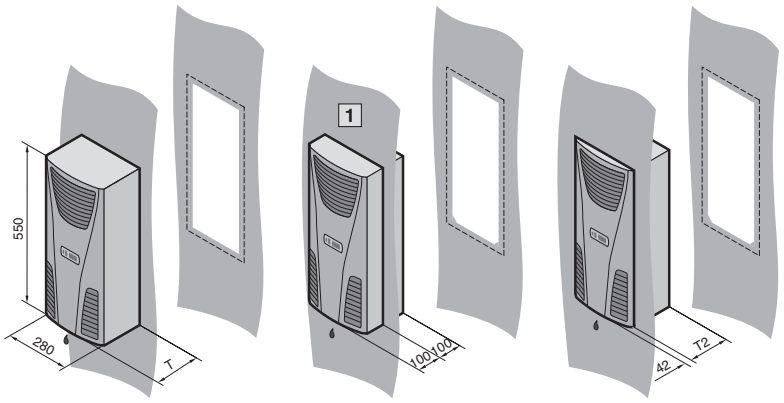
Rated current max.		1.6 A/1.7 A	3.3 A
Start-up current		4.3 A/5.3 A	8.0 A
Pre-fuse T		10 A/10 A	10 A
Power consumption P_{el} to DIN 3168	L 35 L 35 L 35 L 50	285 W/300 W 320 W/340 W	290 W 340 W
Refrigeration factor $\varepsilon = \dot{Q}_K/P_{el}$	L 35 L 35	1.1	
Refrigerant		R134a, 100 g	
Permissible operating pressure p. max.		25 bar	
Temperature and setting range		+20°C to +55°C	
Protection category to EN 60 529/10.91	External circuit	IP 34	
	Internal circuit	IP 54	
Duty cycle		100 %	
Type of connection		Plug-in terminal strip	
Weight		13 kg	
Colour		RAL 7035	
Air throughput of fans	External circuit	345 m^3/h	
	Internal circuit	310 m^3/h	
Temperature control		Basic controller	

Accessories	Packs of		Page
Temperature indicator	1	3114.100	660
Condensate hose	1	3301.608	665
Filter mats	3	3286.110	668
Metal filters	1	3286.120	669

Special voltages available on request. We reserve the right to make technical modifications.

Accessories Page 657 **Configuration software** Page 1063

Useful cooling output 300/500 W



B = Width
T = Depth

RITTAL TOP THERM

Supply includes:
Fully wired ready for connection, including drilling template and assembly parts.

Note:
Integration of the cooling units with Comfort controller, e. g. into superordinate remote monitoring systems, can be achieved by means of an optional interface board **SK 3124.200** (RS 232, RS 485, RS 422 and PLC interface).

1 Partial internal mounting possible with 3303.XXX only.

Approvals,
see page 69.

Detailed drawing,
see page 1167.

Performance diagrams,
available on the Internet.

Property rights:
German registered designs
no. 402 02 324 and
no. 402 02 325
Japanese registered design
no. 1 187 896
Indian registered design
no. 189 953
US design patent no. D 488,480
IR reg. design no. DM/061 967
with validity for FR, IT, ES

Model No. SK with Basic controller, RAL 7035		**3302.100**	**3302.110**	**3303.100**	**3303.110**
Model No. SK with Comfort controller, RAL 7035		**–**	**–**	**3303.500**	**3303.510**
Model No. SK with Basic controller, stainless steel[1)]		**3302.200**	**3302.210**	**3303.200**	**3303.210**
Model No. SK with Comfort controller, stainless steel[1)]		**–**	**–**	**3303.600**	**3303.610**
Rated operating voltage V, Hz		230, 50/60	115, 60	230, 50/60	115, 60
Dimensions in mm	B H T T2	280 550 140 98		280 550 200 158	
Useful cooling output $\dot{Q}_K$ to DIN 3168	**L 35 L 35** **L 35 L 50**	**300 W/320 W** **150 W/170 W**	**300 W** **150 W**	**500 W/610 W** **280 W/350 W**	**500 W** **280 W**
Rated current max.		1.6 A/1.7 A	3.3 A	2.6 A/2.6 A	5.7 A
Start-up current		3.0 A/3.4 A	8.0 A	5.1 A/6.4 A	11.5 A
Pre-fuse T		10.0 A/10.0 A	10.0 A	10.0 A/10.0 A	10.0 A
Power consumption P_{el} to DIN 3168	L 35 L 35 L 35 L 50	245 W/255 W 255 W/275 W	290 W 340 W	360 W/380 W 420 W/390 W	470 W 500 W
Refrigeration factor $\varepsilon = \dot{Q}_K/P_{el}$	L 35 L 35	1.2		1.4	
Refrigerant		R134a, 100 g		R134a, 170 g	
Permissible operating pressure p. max.		25 bar		28 bar	
Temperature and setting range		+20°C to +55°C			
Protection category to EN 60 529/10.91	External circuit	IP 34			
	Internal circuit	IP 54			
Duty cycle		100 %			
Type of connection		Plug-in terminal strip			
Weight		13 kg		17 kg	
Air throughput of fans	External circuit	310 m³/h		345 m³/h	
	Internal circuit	345 m³/h		310 m³/h	
Temperature control		Basic or Comfort controller (factory setting +35°C)			

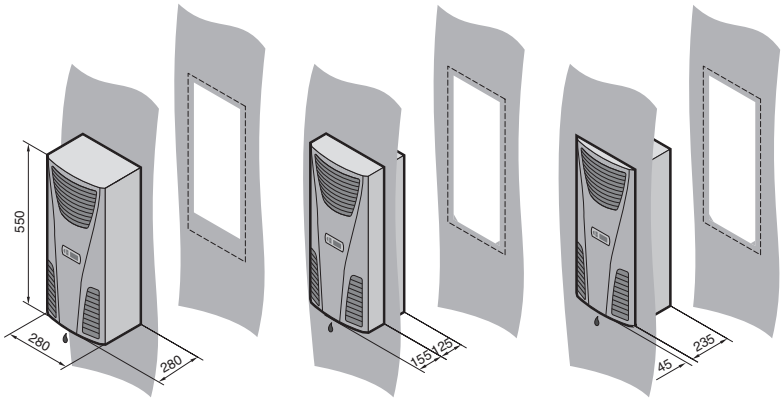
Accessories	Packs of			Page
Filter mats	3	3286.300		668
Metal filters	1	3286.310		669
Door-operated switch	1	4127.000		956
SK bus system for Comfort controller	1	–	3124.100	663
RiDiag II including cables for Comfort controller	1	–	3159.100	1063
Interface card for Comfort controller	1	–	3124.200	662
Condensate hose	1	3301.608	3301.610	665

[1)] Delivery times on request. Special voltages available on request. Technical modifications reserved.

Accessories Page 657 **Configuration software** Page 1063

Wall-mounted cooling units

Useful cooling output 750 W



Supply includes:
Fully wired ready for connection, including drilling template and assembly parts.

Note:
Cooling units with Comfort controller may be integrated e.g. into superordinate remote monitoring systems by way of an optional interface board **SK 3124.200** (RS 232, RS 485, RS 422 and PLC interface).

Approvals,
see page 70.

Detailed drawing,
see page 1167.

Performance diagrams,
available on the Internet.

Property rights:
German registered designs
no. 402 02 324 and
no. 402 02 325
Japanese registered design
no. 1 187 896
Indian registered design
no. 189 953
US design patent no. D 488,480
IR reg. design no. DM/061 967
with validity for FR, IT, ES

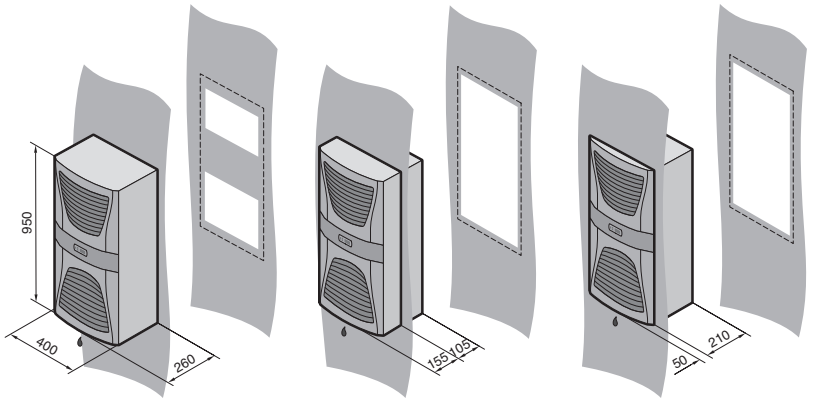
Model No. SK with Basic controller, RAL 7035		**3361.100**	**3361.110**	**3361.140**
Model No. SK with Comfort controller, RAL 7035		**3361.500**	**3361.510**	**3361.540**
Model No. SK with Basic controller, stainless steel[1)]		**3361.200**	**3361.210**	**3361.240**
Model No. SK with Comfort controller, stainless steel[1)]		**3361.600**	**3361.610**	**3361.640**
Rated operating voltage V, Hz		230, 50/60[3)]	115, 60[3)]	400[2)], 2~, 50/60[3)]
Dimensions in mm	W H D	280 550 280		
Useful cooling output $\dot{Q}_K$ to DIN 3168	**L 35 L 35** **L 35 L 50**	**750 W/780 W** **510 W/540 W**	**750 W** **500 W**	**750 W/780 W** **510 W/540 W**
Rated current max.		2.3 A/2.4 A	6.5 A	1.3 A/1.4 A
Start-up current		5.7 A/5.7 A	13.9 A	3.3 A/3.3 A
Pre-fuse T		10 A/10 A	10 A	10 A/10 A
Power consumption P_{el} to DIN 3168	L 35 L 35 L 35 L 50	480 W/555 W 545 W/610 W	560 W 650 W	490 W/570 W 560 W/630 W
Refrigeration factor $\varepsilon = \dot{Q}_K/P_{el}$	L 35 L 35	1.5		
Refrigerant		R134a, 280 g		
Permissible operating pressure p. max.		28 bar		
Temperature and setting range		+20°C to +55°C		
Protection category to EN 60 529/10.91	External circuit	IP 34		
	Internal circuit	IP 54		
Duty cycle		100 %		
Type of connection		Plug-in terminal strip		
Weight		22 kg		
Air throughput of fans (unimpeded air flow)	External circuit	480 m^3/h		
	Internal circuit	600 m^3/h		
Temperature control		Basic or Comfort controller (factory setting +35°C)		

Accessories	Packs of		Page
Filter mats	3	3286.300	668
Metal filters	1	3286.310	669
Door-operated switch	1	4127.000	956
SK bus system for Comfort controller	1	3124.100	663
RiDiag II including cables for Comfort controller	1	3159.100	1063
Interface card for Comfort controller	1	3124.200	662
Condensate hose	1	3301.608	665

[1)] Delivery times on request. [2)] external toroidal core transformer Ø 126 x 65 mm deep for mounting in the enclosure. [3)] T_u max. = 52°C/60 Hz.
Special voltages available on request. We reserve the right to make technical modifications.

Accessories Page 657 **Configuration software** Page 1063

Useful cooling output 500/1000 W



Supply includes:
Fully wired ready for connection, including drilling template and assembly parts.

Note:
Integration of the cooling units with Comfort controller, e.g. into superordinate remote monitoring systems, can be achieved by means of an optional interface board **SK 3124.200** (RS 232, RS 485, RS 422 and PLC interface).

Optionally available:
With automatic condensate evaporation.

Approvals,
see page 70.

Detailed drawing,
see page 1168.

Performance diagrams,
available on the Internet.

Property rights:
German registered design no. 402 02 325
IR reg. design no. DM/062 557 with validity for FR, IT, ES
Indian registered design no. 190 269
Japanese registered design no. 1 187 905

Model No. SK with Basic controller, RAL 7035		**3304.100**	**3304.110**	**3304.140**	**3305.100**	**3305.110**	**3305.140**
Model No. SK with Comfort controller, RAL 7035		**3304.500**	**3304.510**	**3304.540**	**3305.500**	**3305.510**	**3305.540**
Model No. SK with Basic controller, stainless steel		**3304.200**	**3304.210**	**3304.240**	**3305.200**	**3305.210**	**3305.240**
Model No. SK with Comfort controller, stainless steel		**3304.600**	**3304.610**	**3304.640**	**3305.600**	**3305.610**	**3305.640**
Rated operating voltage V, Hz		230, 50/60	115[1], 50/60	400, 50/ 460, 60, 3~	230, 50/60	115[1], 50/60	400, 50/ 460, 60, 3~
Dimensions in mm	W H D	400 950 260			400 950 260		
Useful cooling output $\dot{Q}_K$ to DIN 3168	**L 35 L 35** **L 35 L 50**	**1000 W/1060 W** **790 W/840 W**			**1500 W/1510 W** **1230 W/1250 W**		
Rated current max.		4.8 A/4.4 A	9.5 A/10.0 A	2.5 A/2.6 A	5.4 A/6.0 A	11.0 A/12.5 A	2.3 A/2.6 A
Start-up current		12.0 A/14.0 A	26.0 A/28.0 A	11.5 A/12.7 A	22.0 A/24.0 A	42.0 A/46.0 A	12.2 A/11.3 A
Pre-fuse T		10.0 A/10.0 A	16.0 A/16.0 A	10.0 A/10.0 A[2]	16.0 A/16.0 A	20.0 A/20.0 A	10.0 A/10.0 A[2]
Power consumption P_{el} to DIN 3168	L 35 L 35 L 35 L 50	700 W/650 W 750 W/710 W	725 W/680 W 780 W/750 W	580 W/550 W 660 W/680 W	850 W/1000 W 1000 W/1160 W	880 W/1050 W 1040 W/1200 W	800 W/980 W 960 W/1150 W
Refrigeration factor $\varepsilon = \dot{Q}_K/P_{el}$	L 35 L 35	1.4		1.7	1.8	1.7	1.9
Refrigerant		R134a, 500 g			R134a, 600 g		
Permissible operating pressure p. max.		25 bar					
Temperature and setting range		+20°C to +55°C					
Protection category to EN 60 529/10.91	External circuit	IP 34					
	Internal circuit	IP 54					
Duty cycle		100 %					
Type of connection		Plug-in terminal strip					
Weight		39 kg	44 kg	40 kg	41 kg	46 kg	42 kg
Air throughput of fans	External circuit	900 m³/h					
	Internal circuit	600 m³/h			800 m³/h		
Temperature control		Basic or Comfort controller (factory setting +35°C)					

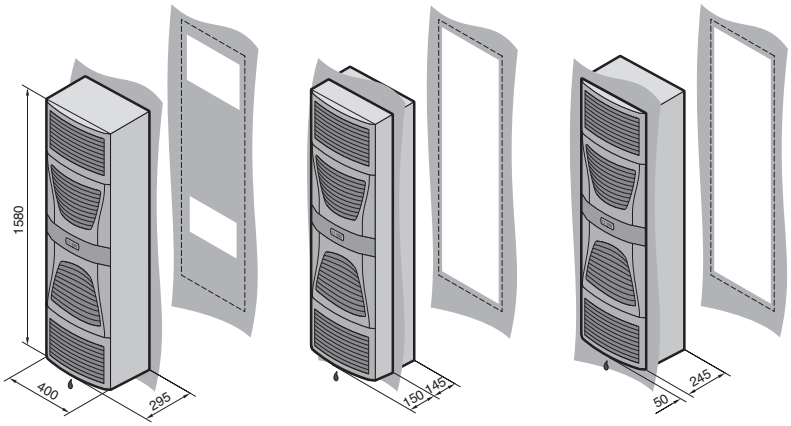
Accessories	P. of		Page
Filter mats	3	3286.400	668
Metal filters	1	3286.410	669
Door-operated switch	1	4127.000	956
SK bus system for Comfort controller	1	3124.100	663
RiDiag II including cables for Comfort controller	1	3159.100	1063
Interface card for Comfort controller	1	3124.200	662
Condensate hose	1	3301.612	665

[1] Delivery times available on request. [2] Motor circuit-breaker
Optionally available with automatic condesate evaporation. Special voltages available on request. We reserve the right to make technical modifications.

Accessories Page 657 **Configuration software** Page 1063

Wall-mounted cooling units

Useful cooling output 2000/2500 W



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Supply includes:
Fully wired ready for connection, including drilling template, eyebolt and assembly parts.

Note:
Integration of the cooling units with Comfort controller, e.g. into superordinate remote monitoring systems, can be achieved by means of an optional interface board **SK 3124.200** (RS 232, RS 485, RS 422 and PLC interface).

Optionally available:
With automatic condensate evaporation.

Also required:
For installation in the door, the use of a ride-up roller is recommended, see page 898.

Approvals,
see page 70.

Detailed drawing,
see page 1168.

Performance diagrams,
available on the Internet.

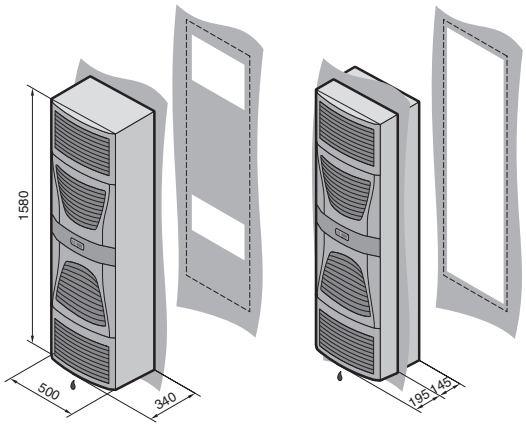
Model No. SK with Basic controller, RAL 7035		**3328.100**	**3328.110**	**3328.140**	**3329.100**	**3329.110**	**3329.140**
Model No. SK with Comfort controller, RAL 7035		**3328.500**	**3328.510**	**3328.540**	**3329.500**	**3329.510**	**3329.540**
Model No. SK with Basic contr., stainless steel[1)]		**3328.200**	**3328.210**	**3328.240**	**3329.200**	**3329.210**	**3329.240**
Model No. SK with Comfort contr., stainl. steel[1)]		**3328.600**	**3328.610**	**3328.640**	**3329.600**	**3329.610**	**3329.640**
Rated operating voltage V, Hz		230, 50/60	115, 50/60	400, 50/ 460, 60, 3~	230, 50/60	115, 50/60	400, 50/ 460, 60, 3~
Dimensions in mm	W	400			400		
	H	1580			1580		
	D	290			290		
Useful cooling output $\dot{Q}_K$ to DIN 3168	**L 35 L 35**	**2000 W/2350 W**			**2500 W/2750 W**		**2500 W/2700 W**
	L 35 L 50	**1450 W/1690 W**			**1600 W/1750 W**		**1900 W/1950 W**
Rated current max.		6.9 A/8.5 A	13.6 A/16.2 A	2.5 A/3.0 A	8.0 A/10.0 A	16.0 A/21.0 A	3.4 A/3.5 A
Start-up current		22.0 A/26.0 A	36.0 A/39.0 A	6.5 A/7.5 A	21.0 A/21.0 A	44.0 A/42.0 A	6.5 A/7.3 A
Pre-fuse T		16.0 A/16.0 A	25.0 A/25.0 A	10.0 A/10.0 A[2)]	16.0 A/16.0 A	25.0 A/25.0 A	10.0 A/10.0 A[2)]
Power consumption P_{el} to DIN 3168	L 35 L 35	900 W/1070 W	960 W/1130 W	930 W/1150 W	1320 W/1550 W	1380 W/1600 W	1300 W/1500 W
	L 35 L 50	1130 W/1220 W	1170 W/1290 W	1150 W/1400 W	1500 W/1880 W	1550 W/1940 W	1550 W/1850 W
Refrigeration factor $\varepsilon = \dot{Q}_K/P_{el}$	L 35 L 35	1.7		2.3	1.9		2.0
Refrigerant		R134a, 950 g					
Permissible operating pressure p. max.		28 bar					
Temperature and setting range		+20°C to +55°C					
Protection category to EN 60 529/10.91	External circuit	IP 34					
	Internal circuit	IP 54					
Duty cycle		100 %					
Type of connection		Plug-in terminal strip					
Weight		66 kg	73 kg	67 kg	69 kg	76 kg	70 kg
Air throughput of fans	External circuit	640 m³/h			710 m³/h		
	Internal circuit	550 m³/h			640 m³/h		
Temperature control		Basic or Comfort controller (factory setting +35°C)					

Accessories	Packs of		Page
Filter mats	3	3286.400	668
Metal filters	1	3286.410	669
Door-operated switch	1	4127.000	956
SK bus system for Comfort controller	1	3124.100	663
RiDiag II incl. cables for Comfort contr.	1	3159.100	1063
Interface card for Comfort controller	1	3124.200	662
Condensate hose	1	3301.612	665

[1)] Delivery times available on request. [2)] Motor circuit-breaker
Optionally available with automatic condesate evaporation. Special voltages available on request. We reserve the right to make technical modifications.

Accessories Page 657 **Configuration software** Page 1063

Useful cooling output 4000 W



Supply includes:
Fully wired ready for connection, including drilling template, eyebolt and assembly parts.

Note:
Integration of the cooling units with Comfort controller, e.g. into superordinate remote monitoring systems, can be achieved by means of an optional interface board **SK 3124.200** (RS 232, RS 485, RS 422 and PLC interface).

Optionally available:
With automatic condensate evaporation.

Also required:
For installation in the door, the use of a ride-up roller is recommended, see page 898.

Approvals,
see page 70.

Detailed drawing,
see page 1168.

Performance diagrams,
available on the Internet.

Model No. SK with Basic controller, RAL 7035		**3332.140**
Model No. SK with Comfort controller, RAL 7035		**3332.540**
Model No. SK with Basic controller, stainless steel[1)]		**3332.240**
Model No. SK with Comfort controller, stainless steel[1)]		**3332.640**
Rated operating voltage V, Hz		400, 50/460, 60, 3~
Dimensions in mm	W H D	500 1580 340
Useful cooling output $\dot{Q}_K$ to DIN 3168	**L 35 L 35** **L 35 L 50**	**4000 W/4400 W** **3070 W/3570 W**

Rated current max.		3.8 A/3.9 A
Start-up current		9.2 A/11.0 A
Pre-fuse T		Motor circuit breaker 10.0 A/10.0 A
Power consumption P_{el} to DIN 3168	L 35 L 35 L 35 L 50	1710 W/2110 W 1980 W/2450 W
Refrigeration factor $\varepsilon = \dot{Q}_K/P_{el}$	L 35 L 35	2.3
Refrigerant		R134a, 3000 g
Permissible operating pressure p. max.		28 bar
Temperature and setting range		+20°C to +55°C
Protection category to EN 60 529/10.91	External circuit	IP 34
	Internal circuit	IP 54
Duty cycle		100 %
Type of connection		Plug-in terminal strip
Weight		91 kg
Air throughput of fans	External circuit	2000 m^3/h
	Internal circuit	1500 m^3/h
Temperature control		Basic or Comfort controller (factory setting +35°C)

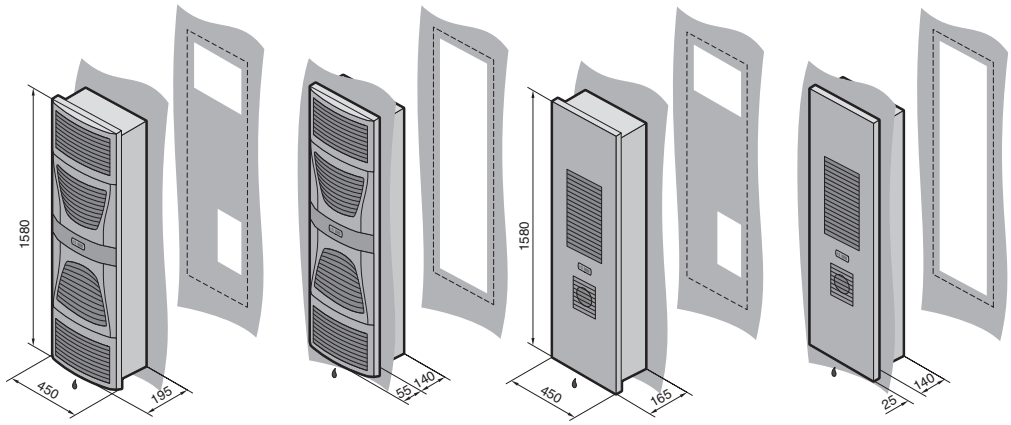
Accessories	Packs of		Page
Filter mats	3	3286.400	668
Metal filters	1	3286.410	669
Door-operated switch	1	4127.000	956
SK bus system for Comfort controller	1	3124.100	663
RiDiag II including cables for Comfort controller	1	3159.100	1063
Interface card for Comfort controller	1	3124.200	662
Condensate hose	1	3301.612	665

[1)] Delivery times available on request.
Optionally available with automatic condesate evaporation. Special voltages available on request. We reserve the right to make technical modifications.

Accessories Page 657 **Configuration software** Page 1063

Wall-mounted cooling units

Slimline, useful cooling output 1500 W



The super-slimline design permits system adaptation for applications where high heat loads are accommodated in a confined space.

Supply includes:
Fully wired ready for connection, including drilling template and assembly parts.

Note:
Cooling units with Comfort controller may be integrated e.g. into superordinate remote monitoring systems by way of an optional interface board **SK 3124.200** (RS 232, RS 485, RS 422 and PLC interface).

Optionally available:
With automatic condensate evaporation.

Approvals,
see page 71.

Detailed drawing,
see page 1169.

Performance diagrams,
available on the Internet.

Model No. SK with Basic controller, RAL 7035		**3366.100**	**3377.100[1)]**	**3366.110**	**3377.110[1)]**	**3366.140**	**3377.140[1)]**
Model No. SK with Comfort controller, RAL 7035		**3366.500**	**3377.500[1)]**	**3366.510**	**3377.510[1)]**	**3366.540**	**3377.540[1)]**
Model No. SK with Basic controller, stainless steel		**3366.200[1)]**	**3377.200[1)]**	**3366.210[1)]**	**3377.210[1)]**	**3366.240[1)]**	**3377.240[1)]**
Model No. SK with Comfort controller, stainless steel		**3366.600[1)]**	**3377.600[1)]**	**3366.610[1)]**	**3377.610[1)]**	**3366.640[1)]**	**3377.640[1)]**
Rated operating voltage V, Hz		230, 50/60		115, 50/60		400/460, 3~, 50/60	
Dimensions in mm	W H D	450 1580 195	450 1580 165	450 1580 195	450 1580 165	450 1580 195	450 1580 165
Useful cooling output $\dot{Q}_K$ to DIN 3168	**L 35 L 35** **L 35 L 50**	**1500 W/1500 W** **1050 W/1100 W**					

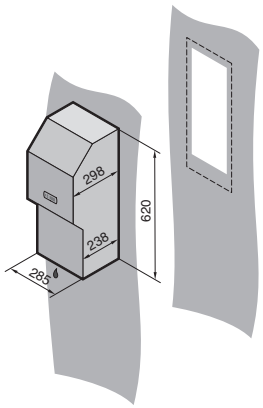
Rated current max.		6.5 A/6.7 A	13.2 A/13.6 A	2.6 A/2.8 A
Start-up current		22.0 A/24.0 A	43.0 A/47.0 A	8.0 A/8.8 A
Pre-fuse T		10.0 A/10.0 A	20.0 A/20.0 A	10.0 A/10.0 A[2)]
Power consumption P_{el} to DIN 3168	L 35 L 35 L 35 L 50	920 W/1050 W 1095 W/1210 W	950 W/1080 W 1140 W/1250 W	950 W/1100 W 1120 W/1290 W
Refrigeration factor $\varepsilon = \dot{Q}_K/P_{el}$	L 35 L 35	1.6		
Refrigerant		R134a, 700 g		
Permissible operating pressure p. max.		28 bar		
Temperature and setting range		+20°C to +55°C		
Protection category to EN 60 529/10.91	External circuit	IP 34		
	Internal circuit	IP 54		
Duty cycle		100 %		
Type of connection		Plug-in terminal strip		
Weight		45 kg	50 kg	46 kg
Air throughput of fans (unimpeded air flow)	External circuit	910 m^3/h		
	Internal circuit	860 m^3/h		
Temperature control		Basic or Comfort controller (factory setting +35°C)		

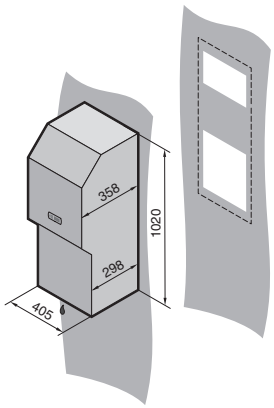
Accessories	Packs of							Page
Filter mats	3	3286.400	3253.010	3286.400	3253.010	3286.400	3253.010	668
Metal filters	1	3286.410	3253.220	3286.410	3253.220	3286.410	3253.220	669
Trim frame for external mounting	1	3377.000						664
Door-operated switch	1	4127.000						956
SK bus system for Comfort controller	1	3124.100						663
RiDiag II including cables for Comfort controller	1	3159.100						1063
Interface card for Comfort controller	1	3124.200						662
Condensate hose	1	3301.612						665

[1)] Delivery times available on request. [2)] Motor circuit-breaker
Special voltages available on request. We reserve the right to make technical modifications.

Accessories Page 657 **Configuration software** Page 1063

Design NEMA 4x, useful cooling output 500/1000/1500 W





Supply includes:
Fully wired ready for connection, including drilling template and assembly parts.

Note:
Cooling units with Comfort controller may be integrated e.g. into superordinate remote monitoring systems by way of an optional interface board SK 3124.200 (RS 232, RS 485, RS 422 and PLC interface).

Approvals,
see page 71.

Detailed drawing,
see page 1169.

Performance diagrams,
available on the Internet.

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Model No. SK with Basic controller[1)]		**3303.104**	**3303.114**	**3304.104**	**3304.114**	**3304.144**	**3305.104**	**3305.114**	**3305.144**
Model No. SK with Comfort controller[1)]		**3303.504**	**3303.514**	**3304.504**	**3304.514**	**3304.544**	**3305.504**	**3305.514**	**3305.544**
Rated operating voltage V, Hz		230, 50/60	115, 60	230, 50/60	115, 50/60	400, 50/ 460, 60, 3~	230, 50/60	115, 50/60	400, 50/ 460, 60, 3~
Dimensions in mm	W H D	285 620 298		405 1020 358			405 1020 358		
Useful cooling output $\dot{Q}_K$ to DIN 3168	**L 35 L 35** **L 35 L 50**	**500 W/610 W** **280 W/350 W**	**500 W** **280 W**	**1000 W/1060 W** **790 W/840 W**			**1500 W/1510 W** **1230 W/1250 W**		
Rated current max.		2.6/2.6 A	5.7 A	4.8/4.4 A	9.5/10.0 A	2.5/2.6 A	5.4/6.0 A	11.0/12.5 A	2.3/2.6 A
Start-up current		5.1/6.4 A	11.5 A	12.0/14.0 A	26.0/28.0 A	11.5/12.7 A	22.0/24.0 A	42.0/46.0 A	12.2/11.3 A
Pre-fuse T		10.0/10.0 A	10.0 A	10.0/10.0 A	16.0/16.0 A	10.0 A[2)]	16.0/16.0 A	20.0/20.0 A	10.0 A[2)]
Power consumption P_{el} to DIN 3168	L 35 L 35 L 35 L 50	360/380 W 420/390 W	470 W 500 W	700/650 W 750/710 W	725/680 W 780/750 W	580/550 W 660/680 W	850/1000 W 1000/1160 W	880/1050 W 1040/1200 W	800/980 W 960/1150 W
Refrigeration factor $\varepsilon = \dot{Q}_K/P_{el}$	L 35 L 35	1.4				1.7	1.8	1.7	1.9
Refrigerant		R134a, 170 g		R134a, 500 g			R134a, 600 g		
Permissible operating pressure p. max.		28 bar		25 bar			25 bar		
Temperature and setting range		+20°C to +55°C							
Protection category		NEMA 4x							
Duty cycle		100 %							
Type of connection		Plug-in terminal strip							
Weight		25 kg		49 kg	54 kg	50 kg	51 kg	56 kg	52 kg
Material		Stainless steel 1.4301 (V2A)							
Air throughput of fans	External circuit	345 m^3/h		900 m^3/h			900 m^3/h		
	Internal circuit	310 m^3/h		600 m^3/h			800 m^3/h		
Temperature control		Basic or Comfort controller (factory setting +35°C)							

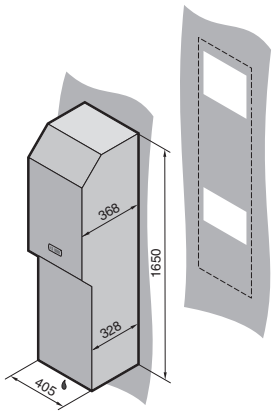
Accessories	P. of			Page
Door-operated switch	1	4127.000	4127.000	956
SK bus system for Comfort controller	1	3124.100	– / 3124.100	663
RiDiag II for Comfort controller, incl. cables	1	3159.100		1063
Interface card for Comfort controller	1	3124.200		662
Condensate hose	1	3301.610	3301.612	665

[1)] Delivery times available on request. [2)] Motor circuit-breaker
Special voltages and technical modifications available on request.

Accessories Page 657 **Configuration software** Page 1063

Wall-mounted cooling units

Design NEMA 4x, useful cooling output 2000/2500 W



Supply includes:
Fully wired ready for connection, including drilling template and assembly parts.

Note:
Integration of the cooling units with Comfort controller, e.g. into superordinate remote monitoring systems, can be achieved by means of an optional interface board **SK 3124.200** (RS 232, RS 485, RS 422 and PLC interface).

Approvals,
see page 71.

Detailed drawing,
see page 1170.

Performance diagrams,
available on the Internet.

RITTAL TOP THERM

Model No. SK with Basic controller[1)]		**3328.104**	**3328.114**	**3328.144**	**3329.104**	**3329.114**	**3329.144**
Model No. SK with Comfort controller[1)]		**3328.504**	**3328.514**	**3328.544**	**3329.504**	**3329.514**	**3329.544**
Rated operating voltage V, Hz		230, 50/60	115, 50/60	400, 50/ 460, 60, 3~	230, 50/60	115, 50/60	400, 50/ 460, 60, 3~
Dimensions in mm	W H D	405 1650 368					
Useful cooling output $\dot{Q}_K$ to DIN 3168	**L 35 L 35** **L 35 L 50**	**2000 W/2350 W** **1450 W/1690 W**			**2500 W/2850 W** **1600 W/1750 W**		
Rated current max.		6.9 A/5.0 A	13.6 A/16.2 A	2.5 A/3.0 A	8.0 A/10.0 A	16.0 A/21.0 A	3.4 A/3.5 A
Start-up current		22.0 A/26.0 A	36.0 A/39.0 A	6.5 A/7.5 A	21.0 A/21.0 A	44.0 A/42.0 A	6.5 A/7.3 A
Pre-fuse T		16.0 A/16.0 A	25.0 A/25.0 A	10.0 A/10.0 A[2)]	16.0 A/16.0 A	25.0 A/25.0 A	10.0 A/10.0 A[2)]
Power consumption P_{el} to DIN 3168	L 35 L 35 L 35 L 50	900/1070 W 1330/1220 W	960/1130 W 1170/1290 W	930/1150 W 1150/1400 W	1320/1550 W 1500/1880 W	1380/1600 W 1550/1980 W	1300/1500 W 1550/1850 W
Refrigeration factor $\varepsilon = \dot{Q}_K/P_{el}$	L 35 L 35	1.7		2.3	1.9		2.0
Refrigerant		R134a, 900 g					
Permissible operating pressure p. max.		28 bar					
Temperature and setting range		+20°C to +55°C					
Protection category		NEMA 4x					
Duty cycle		100 %					
Type of connection		Plug-in terminal strip					
Weight		80 kg	87 kg	80 kg	83 kg	90 kg	83 kg
Material		Stainless steel 1.4301 (V2A)					
Air throughput of fans	External circuit	640 m^3/h			710 m^3/h		
	Internal circuit	550 m^3/h			640 m^3/h		
Temperature control		Basic or Comfort controller (factory setting +35°C)					

Accessories	P. of		Page
Door-operated switch	1	4127.000	956
SK bus system for Comfort controller	1	3124.100	663
RiDiag II including cables for Comfort controller	1	3159.100	1063
Interface card for Comfort controller	1	3124.200	662
Condensate hose	1	3301.612	665

[1)] Delivery times available on request. [2)] Motor circuit-breaker
Special voltages and technical modifications available on request.

Accessories Page 657 **Configuration software** Page 1063

Design NEMA 4x, useful cooling output 2000/2500 W

Recooling systems

Features

Recooling systems ensure centralised, efficient cooling and provision of the cooling medium (generally water). For example, all cooling tasks on a system or machine can be solved via a single pipeline system. Spatial separation between cooling production and process cooling can be achieved with recooling systems.

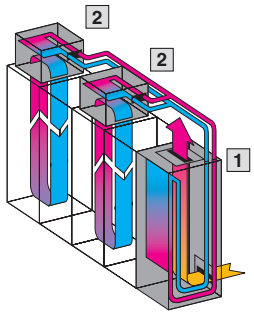
Application diversity of centralised cooling technology

Enclosure cooling
In conjunction with air/water heat exchangers, optimum dissipation of high heat loads is guaranteed, even under extreme environmental temperatures and air pollution.

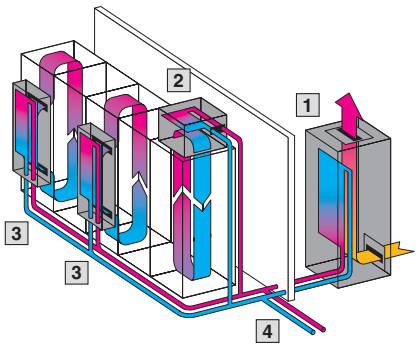
Cooling of liquid media
Direct and indirect cooling of liquids are the prerequisite for ensuring essential machine precision and speed.

Process cooling
High-quality material processing, such as laser cutting, necessitates high levels of temperature precision with simultaneous cooling of the peripheral technology.

Siting conditions



Unity with enclosures
For example, recooling systems may be attached directly to a bayed enclosure suite to provide effective, centralised cooling of all cases and enclosures on a machine or plant.



Spatially separated
High heat loads can even be dissipated in confined and awkward spaces, thanks to the spatial separation of the recooling system from the enclosures and machine. In all cases, as well as enclosure cooling, cooling water may also be produced for process and machine cooling or for cooling liquid media.

1 Recooling system
2 Air/water heat exchanger, roof-mounted
3 Air/water heat exchanger, wall-mounted
4 Further cooling options, e.g. machine cooling

Benefits:

- A single system for enclosure cooling, process and machine cooling, and the cooling of liquid media.
- Integration into bayed enclosure suites
- Individual project planning
- Commissioning and servicing

Important:

- Cooling output calculated at an ambient temperature of 32°C and an inlet temperature of 10°C and 18°C (water)/20°C (oil)

Project planning examples

Example 1

Production line

High-quality material processing requires a high degree of temperature precision with simultaneous cooling of the peripheral technology. This task – the cost-effective cooling of various equipment in the production line – is performed centrally by the recooling system in an industrial enclosure. It supplies the machine and process cooling with the required cooling water, as well as supplying the control enclosures via air/water heat exchangers.

Example 2

Test laboratory

Every single product is subjected to in-depth functional and quality testing at the in-house test laboratory. In order to ensure that the test process runs smoothly, the control enclosures are cooled via air/water heat exchangers, and the three test benches are supplied with the required cooling water in line with requirements. These diverse cooling tasks are performed by the recooling system integrated into the TS 8 Top enclosure system.
Visually, they form a single unit with the TS 8 control enclosures.

Example 3

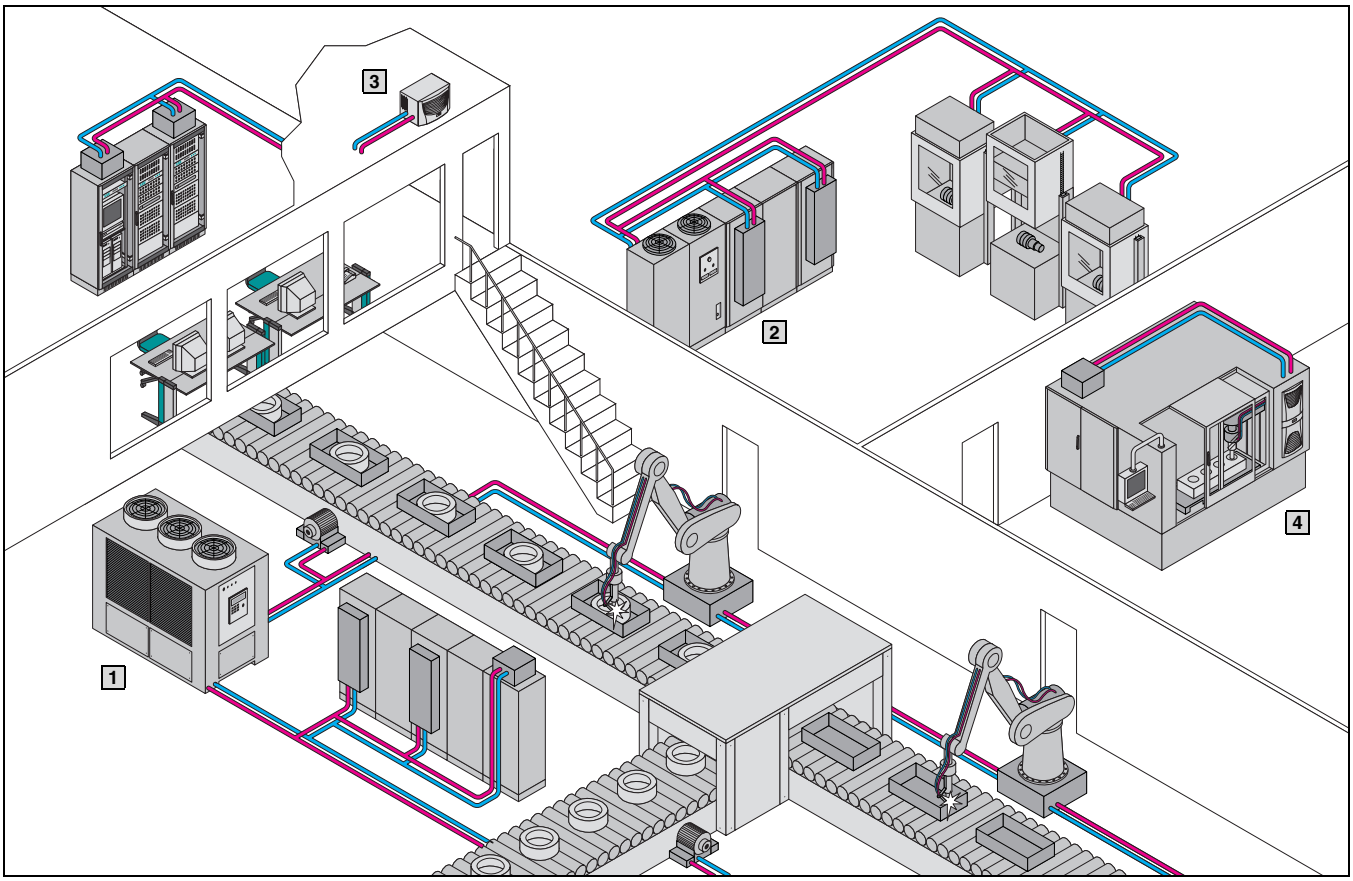
Control room

In conjunction with air/water heat exchangers, the server and network enclosures installed in the production control room are cooled by a Mini recooling system. To avoid contaminating the room air, and to facilitate optimum dissipation of the heat loss generated by the recooling systems, this is installed outside of the production control room.

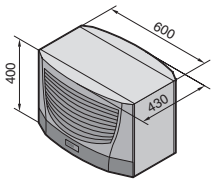
Example 4

Tool production

The heat loss generated during tool machining (e.g. by water-cooled motor spindles with high-frequency drives) must be dissipated efficiently. In such cases, this task is performed by a wall-mounted Mini recooling system which at the same time ensures cooling of the control unit, likewise integrated into the machine.



Mini, cooling output 960/1490 W



Technical design:
- Compact and modular layout of the cooling components on a base plate which functions as a collecting tray.
- Medium-conveying pumps.
- Precise temperature control, based on microprocessor technology.
- Collective fault signal with floating contact.
- Application-specific special equipment available on request.
- Pressure-sealed system (.600) or open system with tank (.610).

Supply includes:
Recooling system wired and plumbed ready for connection, with multilingual documentation including functional diagram and wiring plans.

Note:
The illustration shows units with customer-specific options.

Approvals,
available on the Internet.

Detailed drawing,
available on the Internet.

Layout diagram,
see page 1173.

Characteristic curves of pump,
see page 1173.

Options,
see page 1171.

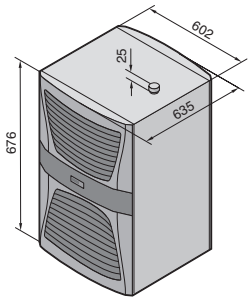
Model No. SK		**3318.600**	**3318.610**	**3319.600**	**3319.610**
Rated operating voltage V, Hz		230, 50/60			
Dimensions in mm	W H D	600 400 430			
Cooling output at **T_w = 10°C/T_u = 32°C** **T_w = 18°C/T_u = 32°C**		**780 W/870 W** **960 W/1070 W**		**1200 W/1330 W** **1490 W/1660 W**	
Power consumption		630 W/780 W		845 W/1050 W	
Rated current max.		4.2 A		5.4 A	
Refrigerant		R134a			
$P_{max.}$ cooling circuit		25 bar			
Temperature range	Environment	+5°C to +43°C			
	Liquid media	+10°C to +30°C			
Pump capacity		See characteristic curve			
Tank		Pressure-sealed	Made from PP plastic	Pressure-sealed	Made from PP plastic
Tank capacity		–	2.5 l	–	2.5 l
Water connections		2 x $^1/_2$″ IG			
Weight		48 kg		51 kg	
Colour		RAL 7035			
Protection category (electrics)		IP 44			
Air throughput of fans		900 m³/h			
Temperature control		Microcontroller control, setting range +10°C to +30°C (factory setting +18°C)			

Accessories	Packs of		Page
Metal filter mat	1	3286.510	669

Customised solutions and technical modifications available on request.

Air/water heat exchangers From page 626 **Configuration software** Page 1063 **By-pass safety valve** Page 667 **Additives** Page 668

Mini, cooling output 3000/4500 W



Technical design:
- Compact, modular configuration of the cooling components with integral water tank. Operator display may optionally be mounted on the front or rear.
- Integral tank level display.
- Medium-conveying pumps.
- Precise temperature control, based on microprocessor technology.
- Collective fault signal with floating contact.
- Application-specific special equipment available on request.

Supply includes:
Recooling system wired and plumbed ready for connection, with multilingual documentation including functional diagram and wiring plans.

Note:
The illustration shows units with customer-specific options.

Approvals,
available on the Internet.

Detailed drawing,
available on the Internet.

Layout diagram,
see page 1173.

Characteristic curves of pump,
see page 1173.

Options,
see page 1171.

Model No. SK		**3320.600**	**3334.600**
Rated operating voltage V, Hz		400, 3~, 50/60/460, 3~, 60[1)]	
Dimensions in mm	W H D	602 676 635	
Cooling output at **T_w = 10°C/T_u = 32°C** **T_w = 18°C/T_u = 32°C**		 **2650 W/3000 W** **3000 W/3400 W**	 **3900 W/4700 W** **4500 W/5400 W**

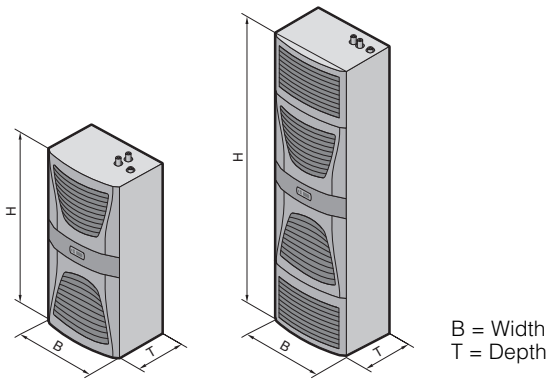
Power consumption		1716 W/1953 W	2001 W/2505 W
Rated current max.		3.8 A/3.9 A	4.9 A/5.0 A
Refrigerant		R134a	
$P_{max.}$ cooling circuit		25 bar	
Temperature range	Environment	+5°C to +43°C	
	Liquid media	+10°C to +30°C	
Pump capacity		See characteristic curve	
Tank		Made from stainless steel 1.4301	
Tank capacity		30 l	
Water connections		2 x 1/2″ IG	
Weight		88 kg	94 kg
Colour		RAL 7035	
Protection category (electrics)		IP 44	
Air throughput of fans		1785 m³/h	
Temperature control		Microcontroller control, setting range +10°C to +30°C (factory setting +18°C)	

Accessories	Packs of		Page
Metal filter mat	1	3286.520	669

[1)] Supports multiple voltages without rewiring.
Special voltages and technical modifications available on request.

Air/water heat exchangers From page 626 **Configuration software** Page 1063 **By-pass safety valve** Page 667 **Additives** Page 668

Mini, for wall mounting, cooling output 1000/2500/4000 W



B = Width
T = Depth

Technical design:
- Compact, modular configuration of the cooling components with integral water tank.
- Application-specific special equipment available on request.
- Open system with tank.

Supply includes:
Recooling system fully wired and plumbed ready for connection,
with multilingual documentation including functional diagram and wiring plans.

Note:
The illustration shows units with customer-specific options.

Approvals,
available on the Internet.

Detailed drawing,
available on the Internet.

Layout diagram,
see page 1174.

Characteristic curves of pump,
see page 1174.

Options,
see page 1171.

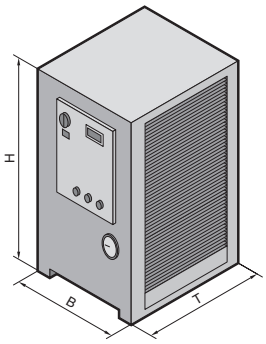
Model No. SK		**3360.100**	**3360.250**	**3360.400**
Rated operating voltage V, Hz		400, 3~, 50/60/460, 3~, 60[1]		
Dimensions in mm	W H D	400 950 310	400 1580 290	500 1580 340
Cooling output at **T_w = 10°C/T_u = 32°C** **T_w = 18°C/T_u = 32°C**		**830 W/930 W** **1000 W/1120 W**	**2100 W/2350 W** **2500 W/2800 W**	**3300 W/3700 W** **4000 W/4500 W**
Power consumption		700 W/760 W	1550 W/2000 W	1980 W/2450 W
Rated current max.		2.7 A/3.0 A	3.7 A/3.8 A	3.9 A/4.2 A
Refrigerant		R134a		
$P_{max.}$ cooling circuit		23 bar		
Temperature range	Environment	+5°C to +43°C		
	Liquid media	+10°C to +30°C		
Pump capacity		See characteristic curve		
Tank		Made from PP plastic		
Tank capacity		5 l	10 l	15 l
Water connections		Quick-release coupling (counterpart included in accessory bag)		
Weight		47 kg	78 kg	99 kg
Colour		RAL 7035		
Protection category (electrics)		IP 44		
Air throughput of fans		500 m³/h	710 m³/h	2000 m³/h
Temperature control		Microcontroller control, setting range +10°C to +30°C (factory setting +18°C)		

Accessories	Packs of		Page
Filter mat	1	3286.400	668
Metal filter mat	1	3286.410	669

[1] Supports multiple voltages without rewiring.
Special voltages and technical modifications available on request.

Air/water heat exchangers From page 626 **Configuration software** Page 1063 **By-pass safety valve** Page 667 **Additives** Page 668

In floor-standing enclosure, cooling output 2100 to 7700 W



B = Width
T = Depth

Technical design:
- Robust industrial standard in 3 enclosure sizes.
- Identical basic enclosure for oil and water recooling systems.
- Spare space for the integration of special equipment.
- Variable air routing is possible via the l/h or r/h side panel.
- Floating contact for collective fault signal.
- Level monitor.
- Multi-coil vaporiser in the tank.

Supply includes:
Recooling system wired and plumbed ready for connection, with multilingual documentation including functional diagram and wiring plans.

Note:
The illustration shows units with customer-specific options.

Accessories:

Metal filter mats, castors, eyebolts and safety modules available on request.

Approvals,
available on the Internet.

Detailed drawing,
available on the Internet.

Layout diagram,
see page 1174.

Characteristic curves of pump,
see page 1174.

Options,
see page 1171.

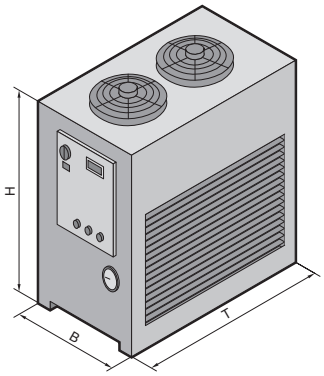
Model No. SK		**3336.100**	**3336.200**	**3336.300**	**3336.500**	**3336.600**	**3336.650**
Rated operating voltage V, Hz		400, 3~, 50					
Dimensions in mm	W H D	470 725 540	485 965 650		595 1180 800		
Cooling output at **T_w = 10°C/T_u = 32°C** **T_w = 18°C/T_u = 32°C**		**1700 W** **2100 W**	**2100 W** **2580 W**	**2300 W** **3360 W**	**3550 W** **5040 W**	**4800 W** **6160 W**	**5200 W** **7700 W**

Power consumption		1.5 kW		1.8 kW	2.3 kW	2.9 kW	3.6 kW
Rated current max.		2.8 A		3.5 A	4.2 A	4.9 A	5.7 A
Refrigerant		R134a					
$P_{max.}$ cooling circuit		24 bar					
Temperature range	Environment	+15°C to +45°C					
	Liquid media	+10°C to +25°C					
Pump capacity		See characteristic curve					
Tank		Made from stainless steel 1.4301					
Tank capacity		17 l	33 l		57 l		
Water connections		$^3/_4$″ IG			1″ IG		
Weight		75 kg	97 kg	99 kg	141 kg	143 kg	147 kg
Colour		RAL 7035					
Protection category (electrics)		IP 54					
Air throughput of fans		700 m³/h	1250 m³/h	1785 m³/h	3140 m³/h		
Temperature control		Electronic control with digital display, setting range +10°C to +25°C (factory setting +18°C)					

Delivery times available on request.
Special voltages, other frequencies, and technical modifications available on request.

Air/water heat exchangers From page 626 **Configuration software** Page 1063 **By-pass safety valve** Page 667 **Additives** Page 668

In floor-standing enclosure, cooling output 10000 to 25200 W



B = Width
T = Depth

Technical design:
- Robust industrial enclosures in 2 sizes.
- Identical basic enclosure for oil and water recooling systems.
- Integration of application-specific special equipment on request.
- Variable air routing is possible via the l/h or r/h side panel.
- Optimum accessibility for servicing purposes by removing the side panel.
- Floating contact for collective fault signal.
- Bi-frequency version (50/60 Hz).
- Flow monitor.

Supply includes:
Recooling system wired and plumbed ready for connection, with multilingual documentation including functional diagram and wiring plans.

Note:
The illustration shows units with customer-specific options.

Accessories:

Metal filter mats, castors, lifting eyes and safety modules available on request.

Approvals,
available on the Internet.

Detailed drawing,
available on the Internet.

Layout diagram,
see page 1175.

Characteristic curves of pump,
see page 1175.

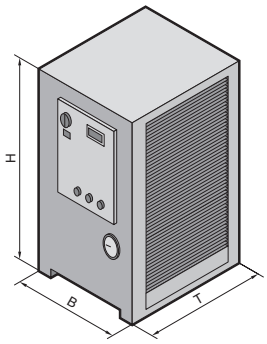
Options,
see page 1171.

Model No. SK		**3336.700**	**3336.710**	**3336.720**	**3336.730**	**3336.740**	**3336.750**
Rated operating voltage V, Hz		400, 3~, 50/460, 3~, 60					
Dimensions in mm	W	615			715		
	H	1178			1178		
	D	1160			1360		
Cooling output at							
T_w = 10°C/T_u = 32°C		**8250 W/10400 W**	**11900 W/15500 W**	**13450 W/16550 W**	**15000 W/18100 W**	**17000 W/20650 W**	**20600 W/26350 W**
T_w = 18°C/T_u = 32°C		**10000 W/12600 W**	**14350 W/18700 W**	**16300 W/20100 W**	**18500 W/22350 W**	**20900 W/25400 W**	**25200 W/32250 W**
Power consumption		3800 W/5300 W	4800 W/6500 W	5300 W/7100 W	6400 W/9000 W	7100 W/9900 W	8100 W/11500 W
Rated current max.		10.6 A/10.8 A	13.1 A/13.3 A	14.1 A/14.3 A	16.2 A/18.4 A	18.2 A/20.4 A	19.7 A/22.4 A
Refrigerant		R407C					
$P_{max.}$ cooling circuit		27 bar					
Temperature range	Environment	+15°C to +45°C[1)]					
	Liquid media	+10°C to +25°C					
Pump capacity		See characteristic curve					
Tank		Made from stainless steel 1.4301					
Tank capacity		60 l			100 l		
Water connections		1″ IG					
Weight		215 kg	225 kg	235 kg	240 kg	250 kg	260 kg
Colour		RAL 7035					
Protection category (electrics)		IP 54					
Air throughput of fans		6280 m³/h			10880 m³/h		
Temperature control		Electronic control with digital display, setting range +10°C to +25°C (factory setting +18°C)					

[1)] SK 3336.720 and SK 3336.750 +15°C to +40°C.
Delivery times available on request.
Special voltages and technical modifications available on request.

Air/water heat exchangers From page 626 **Configuration software** Page 1063 **By-pass safety valve** Page 667 **Additives** Page 668

In floor-standing enclosure for oil, cooling output 2550 to 7900 W



B = Width
T = Depth

Technical design:
- Robust industrial standard in 2 enclosure sizes.
- Identical basic enclosure for oil and water recooling systems.
- Variable air routing is possible via the l/h or r/h side panel.
- High-capacity gear pump.
- Floating contact for collective fault signal.
- Integration of application-specific special equipment on request.

Supply includes:
Recooling system wired and plumbed ready for connection, with multilingual documentation including functional diagram and wiring plans.

Note:
The illustration shows units with customer-specific options.

Accessories:

Metal filter mats, castors, lifting eyes available on request.

Approvals,
available on the Internet.

Detailed drawing,
available on the Internet.

Layout diagram,
see page 1175.

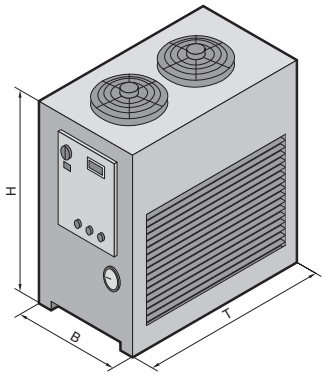
Options,
see page 1171.

Model No. SK		**3337.200**	**3337.300**	**3337.500**	**3337.600**	**3337.650**
Rated operating voltage V, Hz		400, 3~, 50				
Dimensions in mm	W H D	485 965 650		595 1180 800		
Cooling output with oil ISO VG 32 **T_{oil} = 20°C** **T_u = 32°C**		**2550 W**	**3400 W**	**5150 W**	**6700 W**	**7900 W**
Power consumption		1.2 kW	1.6 kW	2.3 kW	2.8 kW	3.6 kW
Rated current max.		3.1 A	3.7 A	4.9 A	5.4 A	5.7 A
Refrigerant		R134a				
$P_{max.}$ cooling circuit		24 bar				
Temperature range	Environment	+15°C to +45°C				
	Liquid media	+15°C to +35°C				
Pump capacity at 10 bar		10 l/min		24 l/min		
Optional tank		Made from stainless steel 1.4301				
Optional tank capacity		33 l		57 l		
Connections		$^3/_4$″ IG		1″ IG		
Weight		103 kg	105 kg	148 kg	150 kg	154 kg
Colour		RAL 7035				
Protection category (electrics)		IP 54				
Air throughput of fans		1250 m³/h	1785 m³/h	3140 m³/h		
Temperature control		Electronic control with digital display, setting range +15°C to +35°C (factory setting +20°C)				

Delivery times available on request.
Special voltages, other frequencies, and technical modifications available on request.

Configuration software Page 1063

In floor-standing enclosure for oil, cooling output 10600 to 26100 W



B = Width
T = Depth

Technical design:
- Robust industrial housing in 2 enclosure sizes.
- Identical basic enclosure for oil and water recooling systems.
- Variable air routing is possible via the l/h or r/h side panel.
- Optimum accessibility for servicing purposes by removing the side panel.
- High-capacity gear pump.
- Floating contact for collective fault signal.
- Integration of application-specific special equipment on request.

Supply includes:
Recooling system wired and plumbed ready for connection, with multilingual documentation including functional diagram and wiring plans.

Note:
The illustration shows units with customer-specific options.

Accessories:

Metal filter mats, castors, lifting eyes available on request.

Approvals,
available on the Internet.

Detailed drawing,
available on the Internet.

Layout diagram,
see page 1176.

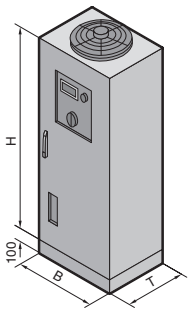
Options,
see page 1171.

Model No. SK		**3337.700**	**3337.710**	**3337.720**	**3337.730**	**3337.740**	**3337.750**
Rated operating voltage V, Hz		400, 3~, 50/460, 3~, 60					
Dimensions in mm	W H D	615 1178 1160			715 1178 1360		
Cooling output with oil ISO VG 32 **T_{oil} = 20°C** **T_u = 32°C**		**10600 W** **12000 W**	**15150 W** **17500 W**	**17200 W** **20000 W**	**19250 W** **22500 W**	**21600 W** **25000 W**	**26100 W** **30000 W**
Power consumption		5300 W/ 6300 W	6400 W/ 7700 W	7100 W/ 8200 W	8700 W/ 10300 W	9600 W/ 11300 W	10500 W/ 13300 W
Rated current max.		12 A/12 A	15 A/15 A	16 A/16 A	19 A/20 A	21 A/22 A	22 A/24 A
Refrigerant		R407C					
$P_{max.}$ cooling circuit		28 bar					
Temperature range	Environment	+15°C to +45°C[1)]					
	Liquid media	+15°C to +35°C					
Pump capacity at 10 bar		45 l/min			68 l/min		
Optional tank		Made from stainless steel 1.4301					
Optional tank capacity		60 l			100 l		
Connections		1″ IG					
Weight		222 kg	232 kg	242 kg	248 kg	258 kg	268 kg
Colour		RAL 7035					
Protection category (electrics)		IP 54					
Air throughput of fans		6280 m^3/h			10880 m^3/h		
Temperature control		Electronic control with digital display, setting range +15°C to +35°C (factory setting +20°C)					

[1)] SK 3337.720 and SK 3337.750 +15°C to +40°C.
Delivery times available on request.
Special voltages, other refrigerants, and technical modifications available on request.

Configuration software Page 1063

In TS 8 Top enclosure system, cooling output 6000/7500 W



B = Width
T = Depth

Technical design:
- Compact structure with control components in the front and air intake via the rear.
- Suitable for bayed siting.
- Special fittings and options available on request.
- Float-actuated switch as protection against running dry.
- Floating collective fault signal.
- Equipped with Grundfos pumps and Siemens components.
- Service accessibility from all sides.

Supply includes:
Recooling system wired and plumbed ready for connection, with multilingual documentation including functional diagram and wiring plans.

Note:
The illustration shows units with customer-specific options.

Accessories:
Metal filter mat and safety module available on request.

Approvals,
available on the Internet.

Detailed drawing,
available on the Internet.

Layout diagram,
see page 1176.

Characteristic curves of pump,
see page 1176.

Options,
see page 1171.

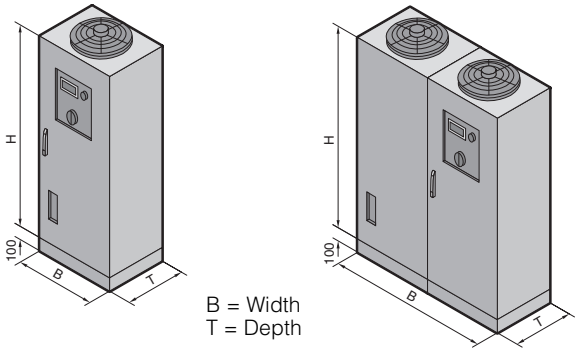
Model No. SK		**3335.060**	**3335.075**
Rated operating voltage V, Hz		400, 3~, 50	
Dimensions in mm	W H D	600 2000 600	
Base/plinth height mm		100	
Cooling output at **T_w = 10°C/T_u = 32°C** **T_w = 18°C/T_u = 32°C**		 **4800 W** **6000 W**	 **6000 W** **7500 W**
Power consumption		2.4 kW	3.0 kW
Rated current max.		7.6 A	8.1 A
Refrigerant		R407C	
$P_{max.}$ cooling circuit		24 bar	
Temperature range	Environment	+10°C to +43°C	
	Liquid media	+10°C to +30°C	
Pump capacity		See characteristic curve	
Tank		Made from PP plastic	
Tank capacity		80 l	
Water connections		3/4″ IG	
Weight		180 kg	190 kg
Colour		RAL 7035	
Protection category (electrics)		IP 54	
Air throughput of fans		4000 m³/h	
Temperature control		Electronic control with digital display, setting range +10°C to +30°C (factory setting +18°C)	

Delivery times available on request.
Special voltages, other frequencies and refrigerants, and technical modifications available on request.

Air/water heat exchanger From page 626 **TS 8 lock systems** From page 881 **TS 8 baying systems** From page 861 **Configuration software** Page 1063
By-pass safety valve Page 667 **Additives** Page 668

Recooling systems

In TS 8 Top enclosure system, cooling output 10000 to 25000 W



Technical design:
- Compact structure with control components in the front and air intake via the rear.
- Suitable for bayed siting.
- Special fittings and options available on request.
- Float-actuated switch as protection against running dry.
- Floating collective fault signal.
- Magnetic valve in the cooling circuit.
- Equipped with Grundfos pumps and Siemens components.
- Service accessibility from all sides.

Supply includes:
Recooling system wired and plumbed ready for connection, with multilingual documentation including functional diagram and wiring plans.

Note:
The illustration shows units with customer-specific options.

Accessories:

Metal filter mat and safety module available on request.

Approvals,
available on the Internet.

Detailed drawing,
available on the Internet.

Layout diagram,
see page 1176.

Characteristic curves of pump,
see page 1176.

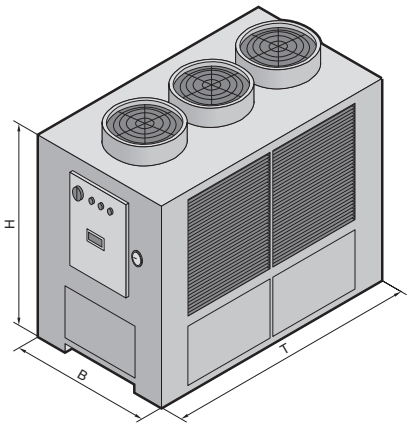
Options,
see page 1171.

SK		3335.100	3335.120	3335.150	3335.200	3335.250
Rated operating voltage V, Hz		400, 3~, 50				
Dimensions in mm	W H D	800 2000 600			1200 2000 600	
Base/plinth height mm		100				
Cooling output at **T_w = 10°C/T_u = 32°C** **T_w = 18°C/T_u = 32°C**		**8000 W** **10000 W**	**10000 W** **12000 W**	**11500 W** **15000 W**	**17000 W** **20000 W**	**22000 W** **25000 W**
Power consumption		4.0 kW	4.8 kW	6.0 kW	8.0 kW	10.0 kW
Rated current max.		12.5 A	17.3 A	18.5 A	23.5 A	27.5 A
Refrigerant		R407C				
$P_{max.}$ cooling circuit		24 bar				
Temperature range	Environment	+10°C to +43°C				
	Liquid media	+10°C to +30°C				
Pump capacity		See characteristic curve				
Tank		Made from PP plastic				
Tank capacity		120 l			240 l	
Water connections		3/4″ IG			1″ IG	
Weight		250 kg	270 kg	380 kg	530 kg	560 kg
Colour		RAL 7035				
Protection category (electrics)		IP 54				
Air throughput of fans		6000 m³/h			8000 m³/h	
Temperature control		Electronic control with digital display, setting range +10°C to +30°C (factory setting +18°C)				

Delivery times available on request.
Special voltages, other frequencies, and technical modifications available on request.

Air/water heat exchanger From page 626 **TS 8 lock systems** From page 881 **TS 8 baying systems** From page 861 **Configuration software** Page 1063
By-pass safety valve Page 667 **Additives** Page 668

In industrial enclosure, cooling output 32 kW to 172 kW



B = Width
T = Depth

Technical design:
- Robust industrial enclosure,
- Optimum service accessbility by removing the panels.
- Floating contact for collective fault signal.
- With shell-and-tube evaporator, without tank (SK 3339.300 – .500).
- Integration of application-specific special equipment on request.

Supply includes:
Recooling system wired and plumbed ready for connection, with multilingual documentation including functional diagram and wiring plans.

Note:
The illustration shows units with customer-specific options.

Accessories:

Metal filter mat available on request.

Approvals,
available on the Internet.

Detailed drawing,
available on the Internet.

Layout diagram,
see page 1177.

Characteristic curves of pump,
see page 1177.

Options,
see page 1171.

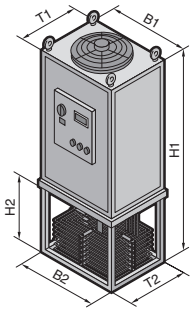
Model No. SK		**3339.100**	**3339.200**	**3339.300**	**3339.400**	**3339.500**
Rated operating voltage V, Hz		400, 3~, 50/460, 3~, 60		400, 3~, 50		
Dimensions in mm	W H D	815 1400 1560		1550 2000 2500		1630 2200 3400
Cooling output at **T_w = 10°C/T_u = 32°C** **T_w = 18°C/T_u = 32°C**		**26150 W/31350 W** **32025 W/38430 W**	**29550 W/35450 W** **36225 W/43480 W**	**54700 W** **66700 W**	**62200 W** **75900 W**	**141000 W** **172200 W**
Power consumption		15900 W	17600 W	27000 W	28300 W	61000 W
Rated current max.		24.4 A	26.9 A	67 A	74 A	108 A
Refrigerant		R407C				
$P_{max.}$ cooling circuit		28 bar				
Temperature range	Environment	+15°C to +45°C				
	Liquid media	+10°C to +25°C				
Pump capacity		See characteristic curve				
Tank		Made from stainless steel 1.4301				
Tank capacity		150 l		Pressure-sealed		
Water connections		1 1/4″ IG		2″ IG		3″ IG
Weight		280 kg	300 kg	800 kg	850 kg	2100 kg
Colour		RAL 7035				
Protection category (electrics)		IP 44				
Air throughput of fans		18000 m³/h		32000 m³/h		48000 m³/h
Temperature control		Electronic control with digital display, setting range +10°C to +25°C (factory setting +18°C)				

Delivery times available on request.
Special voltages, other frequencies and refrigerants, and technical modifications available on request.

Air/water heat exchangers From page 626 **Configuration software** Page 1063 **By-pass safety valve** Page 667 **Additives** Page 668

Immersible recooling systems

for oil, cooling output 2400 to 5600 W



B = Width
T = Depth

Technical design:
- For the cooling of oil
- Robust industrial standard in 3 enclosure sizes
- Flat evaporator coil insensitive to dirt
- Bi-frequency components (50/60 Hz)

Supply includes:
Immersible recooling system wired and plumbed ready for connection, **metal filter, eyebolts,** with multilingual documentation, including functional diagram and wiring plans.

Approvals,
available on the Internet.

Detailed drawing,
available on the Internet.

Layout diagram,
see page 1177.

Options,
see page 1171.

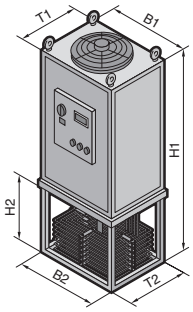
Model No. SK for oil		**3338.020**	**3338.040**	**3338.060**	**3338.080**
Rated operating voltage V, Hz		400, 3~, 50/460, 3~, 60			
Cooling output at T_{oil} = 20°C/T_u = 32°C		**2400 W/2700 W**	**3200 W/3600 W**	**4600 W/5200 W**	**5600 W/6300 W**
Dimensions in mm	B1 H1 T1	785 1650 785			
Dimensions of immersible part, mm	B2 T2	719 719			
Immersion depth mm	H2	550			
Minimum medium level with flat evaporator coil, mm		205		280	

Power consumption		2.2 kW/2.7 kW	2.5 kW/3.1 kW	3.5 kW/4.3 kW	3.9 kW/4.7 kW
Rated current max.		3.5 A/3.7 A	3.8 A/4.0 A	5.5 A/5.9 A	5.6 A/5.8 A
Refrigerant		R134a			
$P_{max.}$ cooling circuit		24 bar			
Temperature range	Environment	+15°C to +42°C			
	Liquid media	+10°C to +25°C			
Weight		133 kg	143 kg	158 kg	173 kg
Colour		RAL 7035			
Protection category (electrics)		IP 44			
Air throughput of fans		1500/1560 m^3/h		2200/2350 m^3/h	
Temperature control		Electronic control with digital display, setting range +10°C to +25°C (factory setting +20°C)			

Delivery times available on request.
Special voltages available on request. We reserve the right to make technical modifications.

Configuration software Page 1063

for oil, cooling output 8500 to 17300 W



B = Width
T = Depth

Technical design:
- For the cooling of oil
- Robust industrial standard in 3 enclosure sizes
- Flat evaporator coil insensitive to dirt
- Bi-frequency components (50/60 Hz)

Supply includes:
Immersible recooling system wired and plumbed ready for connection, **metal filter, eyebolts,** with multilingual documentation, including functional diagram and wiring plans.

Approvals,
available on the Internet.

Detailed drawing,
available on the Internet.

Layout diagram,
see page 1177.

Options,
see page 1171.

Model No. SK for oil		**3338.100**	**3338.120**	**3338.140**	**3338.160**	**3338.180**	**3338.200**
Rated operating voltage V, Hz		400, 3~, 50/460, 3~, 60					
Cooling output at T_{oil} = 20°C/T_u = 32°C		**8500 W/ 9500 W**	**10500 W/ 11800 W**	**12000 W/ 13400 W**	**13600 W/ 15200 W**	**15300 W/ 17100 W**	**17300 W/ 19400 W**
Dimensions in mm	B1 H1 T1	785 1650 785					
Dimensions of immersible part, mm	B2 T2	719 719					
Immersion depth mm	H2	550					
Minimum medium level with flat evaporator coil, mm		330	380		430		

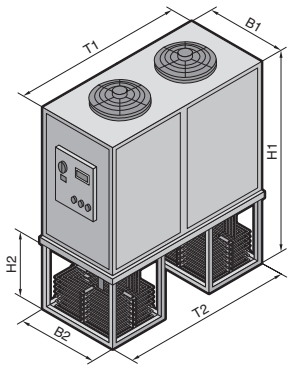
Power consumption		6.2 kW/7.4 kW	6.8 kW/8.1 kW	7.6 kW/9.0 kW	8.4 kW/10.0 kW	9.3 kW/11.0 kW	10.4 kW/12.3 kW
Rated current max.		8.4 A/8.6 A	9.2 A/9.3 A	10.1 A/10.5 A	11.1 A/11.5 A	12.1 A/12.4 A	13.3 A/13.7 A
Refrigerant		R407C					
$P_{max.}$ cooling circuit		27 bar					
Temperature range	Environment	+15°C to +42°C					
	Liquid media	+10°C to +25°C					
Weight		183 kg	203 kg	228 kg	248 kg	253 kg	263 kg
Colour		RAL 7035					
Protection category (electrics)		IP 54					
Air throughput of fans		7200/7480 m³/h			7900/8480 m³/h		
Temperature control		Electronic control with digital display, setting range +10°C to +25°C (factory setting +20°C)					

Delivery times available on request.
Special voltages available on request. We reserve the right to make technical modifications.

Configuration software Page 1063

Immersible recooling systems

for oil, cooling output 20700 to 77900 W



B = Width
T = Depth

Technical design:
- For the cooling of oil
- Robust industrial standard in 3 enclosure sizes
- Flat evaporator coil insensitive to dirt
- Bi-frequency components (50/60 Hz)

Supply includes:
Immersible recooling system wired and plumbed ready for connection, **metal filter, eyebolts,** with multilingual documentation, including functional diagram and wiring plans.

Approvals,
available on the Internet.

Detailed drawing,
available on the Internet.

Layout diagram,
see page 1177.

Options,
see page 1171.

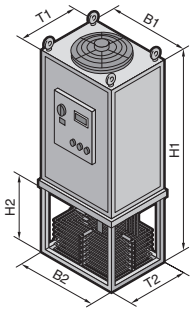
Model No. SK for oil		**3338.220**	**3338.240**	**3338.260**	**3338.280**	**3338.300**	**3338.320**	**3338.340**	**3338.360**
Rated operating voltage V, Hz		400, 3~, 50/460, 3~, 60							
Cooling output at T_{oil} = 20°C/T_u = 32°C		**20700 W/ 23200 W**	**30800 W/ 34500 W**	**34900 W/ 39100 W**	**44500 W/ 49800 W**	**48600 W/ 54400 W**	**60600 W/ 67900 W**	**72600 W/ 81300 W**	**77900 W/ 87200 W**
Dimensions in mm	B1 H1 T1	785 1650 1830			1830 1650 1830				
Dimensions of immersible part, mm	B2 T2	719 1764			1764 1764				
Immersion depth mm	H2	550							
Minimum medium level with flat evaporator coil, mm		380	430		380		430		

Power consumption		12.9 kW/ 16.1 kW	18.0 kW/ 22.0 kW	20.1 kW/ 24.8 kW	26.4 kW/ 31.4 kW	28.9 kW/ 34.4 kW	34.4 kW/ 41.1 kW	39.9 kW/ 47.8 kW	42.5 kW/ 50.9 kW
Rated current max.		17.3 A/ 17.8 A	21.6 A/ 23.0 A	24.3 A/ 25.5 A	35.5 A/ 35.2 A	35.4 A/ 35.8 A	42.7 A/ 42.9 A	50.0 A/ 50.0 A	53.0 A/ 53.0 A
Refrigerant		R407C							
$P_{max.}$ cooling circuit		27 bar							
Temperature range	Environment	+15°C to +45°C							
	Liquid media	+10°C to +25°C							
Weight		305 kg	380 kg		425 kg			435 kg	455 kg
Colour		RAL 7035							
Protection category (electrics)		IP 54							
Air throughput of fans		15000/15600 m³/h			30000/31200 m³/h				
Temperature control		Electronic control with digital display, setting range +10°C to +25°C (factory setting +20°C)							

Delivery times available on request.
Special voltages available on request. We reserve the right to make technical modifications.

Configuration software Page 1063

for emulsion, cooling output 2400 to 5600 W



B = Width
T = Depth

Technical design:
- For the cooling of emulsion
- Robust industrial standard in 3 enclosure sizes
- Flat evaporator coil insensitive to dirt
- Bi-frequency components (50/60 Hz)

Supply includes:
Immersible recooling system wired and plumbed ready for connection, **metal filter, eyebolts,** with multilingual documentation, including functional diagram and wiring plans.

Approvals,
available on the Internet.

Detailed drawing,
available on the Internet.

Layout diagram,
see page 1177.

Options,
see page 1171.

Model No. SK for emulsion		**3338.500**	**3338.520**	**3338.540**	**3338.560**
Rated operating voltage V, Hz		400, 3~, 50/460, 3~, 60			
Cooling output at T_{EM} = 20°C/T_u = 32°C		**2400 W/2700 W**	**3200 W/3600 W**	**4600 W/5200 W**	**5600 W/6300 W**
Dimensions in mm	B1 H1 T1	785 1650 785			
Dimensions of immersible part, mm	B2 T2	719 719			
Immersion depth mm	H2	550			
Minimum medium level with flat evaporator coil, mm		180		205	

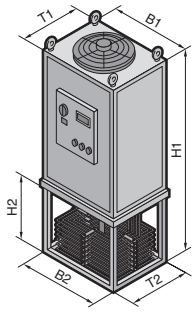
Power consumption		2.4 kW/3.0 kW	2.7 kW/3.4 kW	3.7 kW/4.6 kW	4.1 kW/5.0 kW
Rated current max.		3.8 A/4.0 A	4.1 A/4.3 A	5.9 A/6.3 A	6.0 A/6.3 A
Refrigerant		R134a			
$P_{max.}$ cooling circuit		24 bar			
Temperature range	Environment	+15°C to +42°C			
	Liquid media	+10°C to +25°C			
Weight		130 kg	140 kg	155 kg	170 kg
Colour		RAL 7035			
Protection category (electrics)		IP 44			
Air throughput of fans		1500/1560 m³/h		2200/2350 m³/h	
Temperature control		Electronic control with digital display, setting range +10°C to +25°C (factory setting +20°C)			

Delivery times available on request.
Special voltages available on request. We reserve the right to make technical modifications.

Configuration software Page 1063

Immersible recooling systems

for emulsion, cooling output 8500 to 17300 W



B = Width
T = Depth

Technical design:
- For the cooling of emulsion
- Robust industrial standard in 3 enclosure sizes
- Flat evaporator coil insensitive to dirt
- Bi-frequency components (50/60 Hz)

Supply includes:
Immersible recooling system wired and plumbed ready for connection, **metal filter, eyebolts,** with multilingual documentation, including functional diagram and wiring plans.

Approvals,
available on the Internet.

Detailed drawing,
available on the Internet.

Layout diagram,
see page 1177.

Options,
see page 1171.

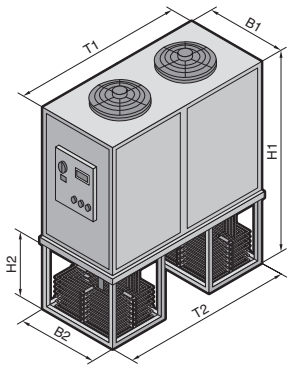
Model No. SK for emulsion		**3338.580**	**3338.600**	**3338.620**	**3338.640**	**3338.660**	**3338.680**
Rated operating voltage V, Hz		400, 3~, 50/460, 3~, 60					
Cooling output at T_{EM} = 20°C/T_u = 32°C		**8500 W/ 9500 W**	**10500 W/ 11800 W**	**12000 W/ 13400 W**	**13600 W/ 15200 W**	**15300 W/ 17100 W**	**17300 W/ 19400 W**
Dimensions in mm	B1 H1 T1	785 1650 785					
Dimensions of immersible part, mm	B2 T2	719 719					
Immersion depth mm	H2	550					
Minimum medium level with flat evaporator coil, mm		280			330		

Power consumption		6.4 kW/7.6 kW	7.0 kW/8.3 kW	7.8 kW/9.5 kW	8.6 kW/10.2 kW	9.5 kW/11.3 kW	10.6 kW/12.6 kW
Rated current max.		8.9 A/9.0 A	9.6 A/9.9 A	10.6 A/11.2 A	11.5 A/12.0 A	12.5 A/13.2 A	13.7 A/14.1 A
Refrigerant		R407C					
P_{max}. cooling circuit		27 bar					
Temperature range	Environment	+15°C to +42°C					
	Liquid media	+10°C to +25°C					
Weight		180 kg	200 kg	225 kg	245 kg	250 kg	260 kg
Colour		RAL 7035					
Protection category (electrics)		IP 54					
Air throughput of fans		7200/7480 m³/h			7900/8480 m³/h		
Temperature control		Electronic control with digital display, setting range +10°C to +25°C (factory setting +20°C)					

Delivery times available on request.
Special voltages available on request. We reserve the right to make technical modifications.

Configuration software Page 1063

for emulsion, cooling output 20700 to 77900 W



B = Width
T = Depth

Technical design:
- For the cooling of emulsion
- Robust industrial standard in 3 enclosure sizes
- Flat evaporator coil insensitive to dirt
- Bi-frequency components (50/60 Hz)

Supply includes:
Immersible recooling system wired and plumbed ready for connection, **metal filter, eyebolts,** with multilingual documentation, including functional diagram and wiring plans.

Approvals,
available on the Internet.

Detailed drawing,
available on the Internet.

Layout diagram,
see page 1177.

Options,
see page 1171.

Model No. SK for emulsion		**3338.700**	**3338.720**	**3338.740**	**3338.760**	**3338.780**	**3338.800**	**3338.820**	**3338.840**
Rated operating voltage V, Hz		400, 3~, 50/460, 3~, 60							
Cooling output at T_{EM} = 20°C/T_u = 32°C		**20700 W/ 23200 W**	**30800 W/ 34500 W**	**34900 W/ 39100 W**	**44500 W/ 49800 W**	**48600 W/ 54400 W**	**60600 W/ 67900 W**	**72600 W/ 81300 W**	**77900 W/ 87200 W**
Dimensions in mm	B1 H1 T1	785 1650 1830			1830 1650 1830				
Dimensions of immersible part, mm	B1 T2	719 1764			1764 1764				
Immersion depth mm	H2	550							
Minimum medium level with flat evaporator coil, mm		280	330		280			330	380

Power consumption		13.3 kW/ 16.6 kW	18.4 kW/ 22.5 kW	20.5 kW/ 25.3 kW	27.1 kW/ 27.8 kW	29.7 kW/ 35.4 kW	35.2 kW/ 42.1 kW	40.7 kW/ 48.8 kW	43.3 kW/ 51.9 kW
Rated current max.		17.9 A/ 18.4 A	22.2 A/ 23.6 A	24.9 A/ 26.1 A	36.7 A/ 36.5 A	36.6 A/ 37.0 A	43.9 A/ 44.1 A	51.2 A/ 51.1 A	54.2 A/ 54.2 A
Refrigerant		R407C							
$P_{max.}$ cooling circuit		27 bar							
Temperature range	Environment	+15°C to +45°C							
	Liquid media	+10°C to +25°C							
Weight		300 kg	375 kg		420 kg		420 kg	430 kg	450 kg
Colour		RAL 7035							
Protection category (electrics)		IP 54							
Air throughput of fans		15000/15600 m³/h			30000/31200 m³/h				
Temperature control		Electronic control with digital display, setting range +10°C to +25°C (factory setting +20°C)							

Delivery times available on request.
Special voltages available on request. We reserve the right to make technical modifications.

Configuration software Page 1063

Features of air/air heat exchangers

The requirement for use of **air/air heat exchangers** is that the ambient temperature must be below the enclosure internal temperature. Dust and any aggressive ambient air is unable to ingress the enclosure interior, thanks to the two separate air circuits.

The air of the enclosure interior may also be cooled to below the level of the external temperature by using **air/water heat exchangers** with a central recooling system. Dust is unable to penetrate the enclosure. The waste heat from the enclosure does not raise the temperature of the ambient air, provided the cold water supply system is spatially separated.

Platform strategy/installation

Identical installation cutouts
for various output categories.

Easily retro-fitted
Thanks to the low weight, simple assembly cutouts and problem-free attachment of the heat exchangers, a cabinet or enclosure is easily retro-fitted.

Servicing/security

Simple maintenance
The heat exchanger module is very easily removed, for effortless cleaning. The cleverly thought-out structure enables fast, economical maintenance.

Benefits:

- Specific thermal output from 17.5 W/K to 90 W/K
- External and internal circuit may be controlled separately
- Mounting cutouts and enclosure dimensions identical to TopTherm wall-mounted cooling units
- Suitable for external and internal mounting
- Top design identical to TopTherm wall-mounted cooling units

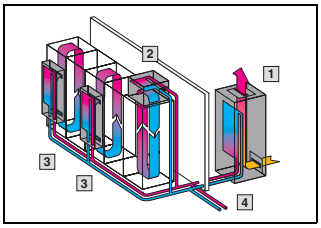
Important:

- The temperature difference between the room temperature and enclosure internal temperature will have a decisive effect on the heat loss that may be dissipated.

For calculation bases, refer to our website: www.rittal.com

Features of air/water heat exchangers

Even suitable for use in extreme conditions



Example: Parallel connection of air/water heat exchangers with cold water supply via a recooling system.

Overflow valves and bypass control should be integrated into the recooling system and the customer's own pipeline system respectively.

1 Recooling system

2 Air/water heat exchanger, roof-mounted

3 Air/water heat exchanger, wall-mounted

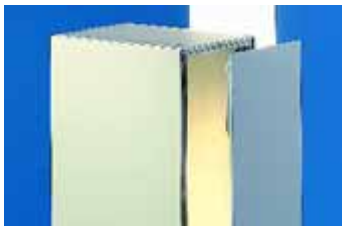
4 Additional cooling water circuit for machine cooling

Ideal for any location
If direct dissipation of heat loss to the ambient air is not desired or ineffective due to confined spaces, the air/water heat exchanger may provide the ideal solution. Particularly by spatially separating the exchanger from the recooling system, highly individual and effective solutions for cooling individual enclosures or bayed enclsosure suites can be achieved.

Variants

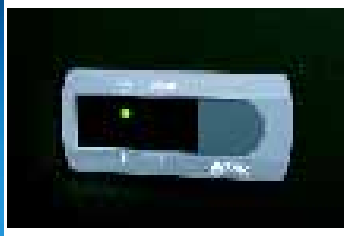
Roof mounting
Especially for bayed enclosures, where wall-mounted devices would obstruct the door.

Wall mounting
For mounting on the wall or any sufficiently large vertical surface.

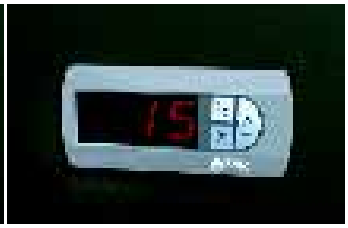


Side panel
Economical use: Air/water heat exchanger as a side panel in the TS 8 enclosure system.

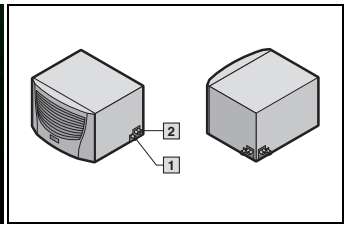
Controller



Basic controller:
- Visualisation of the operating status via LED display
- Switching hysteresis: 5 K
- Floating fault signal contact in case of overtemperature
- Setpoint adjustable from outside via potentiometer (setting range 20° – 55°C)



Comfort controller
- Switching hysteresis: 2 – 10 K preset to 5 K
- System alarm, individually configurable for 2 floating fault signal contacts
- Visualisation of the current enclosure internal temperature and all system messages on the display
- Storage of all system states in the log file
- Optional extension card for integration into superordinate remote monitoring systems e.g. with CMC



Flexible water logistics and condensate management
Any condensate arising is discharged via one of the two tube connectors ($^1/_2$″) and a discharge hose, which should be laid with a gradient ensuring that there are no kinks. In order to avoid increased condensation, the cooling water temperature should be adapted to match the required cooling output.

1 Condensate discharge (flexible)

2 Cooling water connection (flexible)

Benefits:

- Useful cooling output from 600 W to 5000 W
- Suitable for use even in extreme conditions and ambient temperatures up to +70°C
- Also available with all water-carrying parts made from V4A
- System for TS 8 integrated into the side panel

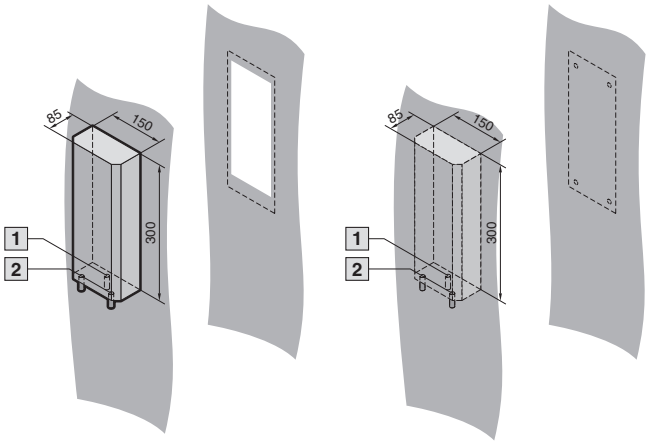
Important:

- Air/water heat exchangers should always be used in conjunction with recooling systems or a cooling water circuit

For calculation formulae and requirements regarding water quality, refer to our website: www.rittal.com

Air/water heat exchanger

Micro, wall-mounted, useful cooling output 300 W



Especially for selective cooling of hotspots in small enclosures.

Supply includes:
Fully wired ready for connection, including drilling template and assembly parts.

1 Condensate discharge
2 Cooling water connection (quick-release fastener)

Approvals,
see page 75.

Detailed drawing,
see page 1178.

Performance diagrams,
available on the Internet.

Model No. SK		**3212.230**	**3212.115[1)]**	**3212.024**
Rated operating voltage V, Hz		230, 50/60	115, 50/60	24 V (DC)
Dimensions in mm	W H D	150 300 85		
Useful cooling output	**L 35 W 10, 200 l/h**	**300 W**		

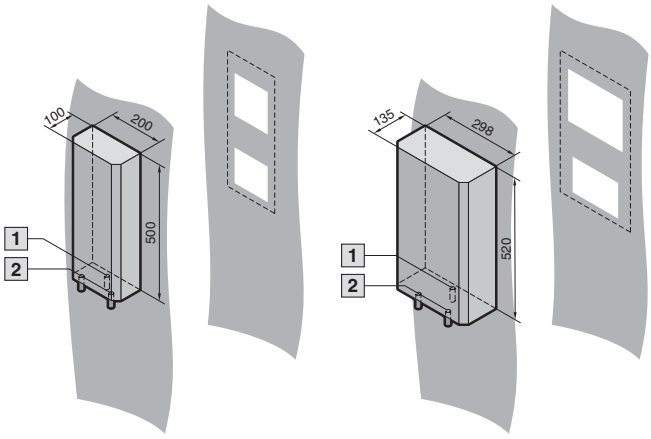
Rated current max.	0.11 A/0.13 A	0.23 A/0.24 A	1.20 A
Pre-fuse T	4.0 A		
Cooling medium	Water (refer to specifications on the Internet; assembly instructions chapter 12)		
Water inlet temperature	> +1°C to +30°C		
Permissible operating pressure p. max.	1 to 10 bar		
Temperature range	+1°C to +70°C		
Protection category to EN 60 529/10.91	IP 55[2)]		
Duty cycle	100 %		
Type of connection	Connection clamp		
Weight	3 kg		
Colour	RAL 7035		
Air throughput of fans (unimpeded air flow)	280 m^3/h		250 m^3/h

Accessories	Packs of		Page
Temperature indicator	1	3114.100	660
Door-operated switch	1	4127.000	956
Condensate hose	1	3301.612	665
Flow regulator valve	1	see accessories	667

[1)] Delivery times available on request.
[2)] IP 65 available on request.
Special voltages available on request. We reserve the right to make technical modifications.

Accessories Page 657 **Recooling systems** From page 606 **Configuration software** Page 1063

Wall mounting, useful cooling output 600/1000 W



Supply includes:
Fully wired ready for connection with terminal strip, including drilling template, sealing mat and assembly parts.

Also required:
Cooling water system such as Rittal recooling systems, see page 608 onwards.

1 Condensate discharge 1/2″
2 Cooling water connection 1/2″

Approvals, see page 76.

Detailed drawing, see page 1178.

Performance diagrams, available on the Internet.

Model No. SK		**3214.100**	**3217.100**
Rated operating voltage V, Hz		230, 50/60	
Dimensions in mm	W H D	200 500 100	298 520 135
Useful cooling output	**L 35 W 10, 200 l/h** **L 35 W 10, 400 l/h**	**600 W** **650 W**	**1000 W** **1100 W**

Rated current max.	0.17 A/0.18 A	0.6 A/0.55 A
Pre-fuse T	2.0 A	4.0 A
Cooling medium	Water (refer to specifications on the Internet; assembly instructions chapter 12)	
Water inlet temperature	> +1°C to +30°C	
Permissible operating pressure p. max.	1 to 10 bar	
Temperature range	+1°C to +70°C	
Protection category to EN 60 529/10.91	IP 55[1)]	
Duty cycle	100 %	
Type of connection	Terminal strip	
Weight	7 kg	9.5 kg
Colour	RAL 7032	
Air throughput of fans	120 m³/h	240 m³/h
Temperature control	Thermostat-controlled magnetic valve	
Temperature monitoring	Internal thermostat, with change-over contact, switching load 16 A, setting range +20°C to +60°C (factory setting +35°C)	

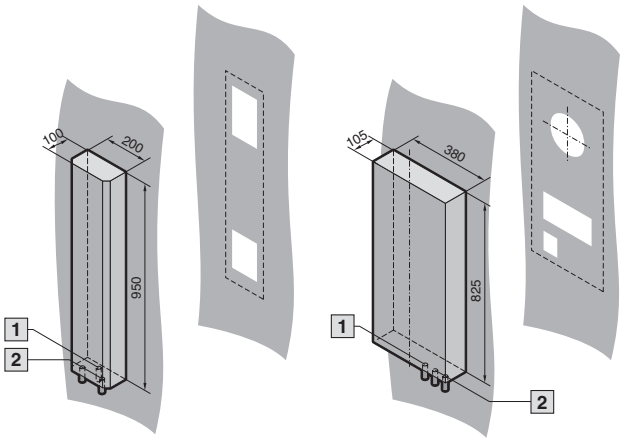
Accessories	Packs of		Page
Temperature indicator	1	3114.100	660
Door-operated switch	1	4127.000	956
Condensate hose	1	3301.612	665
Flow regulator valve	1	see accessories	667

[1)] IP 65 available on request.
Special voltages available on request. We reserve the right to make technical modifications.

Accessories Page 657 **Recooling systems** From page 606 **Configuration software** Page 1063

Air/water heat exchanger

Wall mounting, useful cooling output 1250/1540 W



Supply includes:
Fully wired ready for connection with terminal strip or connection cable (3 m), including drilling template, sealing mat and assembly parts.

Also required:
Cooling water system such as Rittal recooling systems, see page 608 onwards.

1 Condensate discharge 1/2″
2 Cooling water connection 1/2″

Approvals, see page 76.

Detailed drawing, see page 1179.

Performance diagrams, available on the Internet.

Model No. SK		**3215.100**	**3247.000**
Rated operating voltage V, Hz		230, 50/60	
Dimensions in mm	W H D	200 950 100	380 825 105
Useful cooling output	**L 35 W 10, 200 l/h** **L 35 W 10, 400 l/h**	**1250 W** **1300 W**	**1540 W** **1700 W**

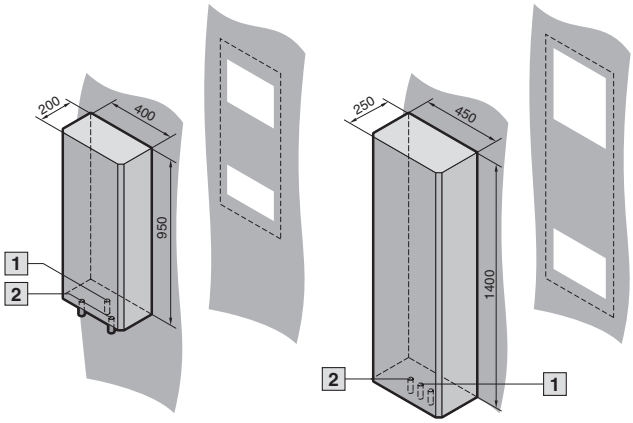
Rated current max.	0.38 A/0.4 A	0.43 A/0.5 A
Pre-fuse T	4.0 A	
Cooling medium	Water (refer to specifications on the Internet; assembly instructions chapter 12)	
Water inlet temperature	> +1°C to +30°C	
Permissible operating pressure p. max.	1 to 10 bar	
Temperature range	+1°C to +70°C	
Protection category to EN 60 529/10.91	IP 55[1)]	
Duty cycle	100 %	
Type of connection	Terminal strip	Connection cable 3 m
Weight	13 kg	17 kg
Colour	RAL 7032	
Air throughput of fans	200 m^3/h	240 m^3/h
Temperature control	Thermostat-controlled magnetic valve	
Temperature monitoring	Internal thermostat, with change-over contact, switching load 16 A, setting range +20°C to +60°C (factory setting +35°C)	

Accessories	Packs of		Page
Temperature indicator	1	3114.100	660
Door-operated switch	1	4127.000	956
Condensate hose	1	3301.612	665
Flow regulator valve	1	see accessories	667

[1)] IP 65 available on request.
Special voltages available on request. We reserve the right to make technical modifications.

Accessories Page 657 **Recooling systems** From page 606 **Configuration software** Page 1063

Wall mounted, useful cooling output 2250/3000/4500 W



Supply includes:
Fully wired ready for connection with terminal strip, including drilling template, sealing mat and assembly parts.

Also required:
Cooling water system such as Rittal recooling systems, see page 608 onwards.

1 Condensate discharge $^1/_2$″
2 Cooling water connection $^1/_2$″

Approvals, see page 76.

Detailed drawing, see page 1179.

Performance diagrams, available on the Internet.

Model No. SK		**3218.104**[1]	**3218.100**	**3216.100**
Rated operating voltage V, Hz		230, 50/60		
Dimensions in mm	W	400		450
	H	950		1400
	D	200		250
Useful cooling output	**L 35 W 10, 200 l/h**	**2250 W**	**3000 W**	**4500 W**
	L 35 W 10, 400 l/h	**2650 W**	**3500 W**	**5000 W**

Rated current max.	0.42 A/0.48 A		1.0 A/1.1 A
Pre-fuse T	4.0 A		
Cooling medium	Water (refer to specifications on the Internet; assembly instructions chapter 12)		
Water inlet temperature	> +1°C to +30°C		
Permissible operating pressure p. max.	1 to 10 bar		
Temperature range	+1°C to +70°C		
Protection category to EN 60 529/10.91	IP 55[2]		
Duty cycle	100 %		
Type of connection	Terminal strip		
Weight	19 kg	21 kg	56 kg
Colour	RAL 7032		
Air throughput of fans	240 m^3/h	450 m^3/h	1000 m^3/h
Temperature control	Thermostat-controlled magnetic valve		

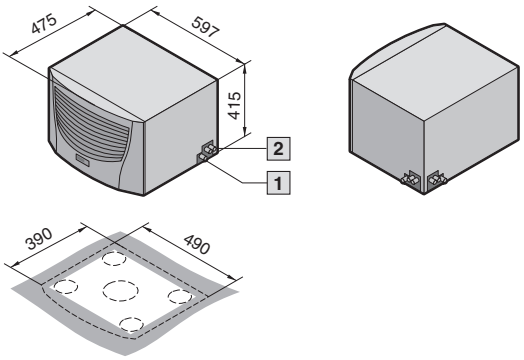
Accessories	Packs of		Page
Temperature indicator	1	3114.100	660
Door-operated switch	1	4127.000	956
Condensate hose	1	3301.612	665
Flow regulator valve	1	see accessories	667

[1] Delivery times available on request, all water-carrying parts V4A 1.4571.
[2] IP 65 available on request.
Special voltages available on request. We reserve the right to make technical modifications.

Accessories Page 657 **Recooling systems** From page 606 **Configuration software** Page 1063

Air/water heat exchanger

Roof-mounted, useful cooling output 2500 W



Supply includes:
Fully wired ready for connection with connector, including drilling template, sealing mat and assembly parts.

Also required:
Cooling water system such as Rittal recooling systems, from page 608.

1 Condensate discharge (flexible)

2 Cooling water connection (flexible)

Approvals,
see page 76.

Detailed drawing,
see page 1180.

Performance diagrams,
available on the Internet.

Property rights:
German registered designs
no. 402 02 324 and
no. 402 02 325
US design patent
no. US D 492,319S
Indian registered design
no. 189 956
Chinese registered design
no. ZL 0330 6415.6

	Water-carrying parts			
Model No. SK Basic controller	**CuAL**	**3209.100**	**3209.110**	**3209.140[1)]**
Model No. SK Comfort controller	**CuAL**	**3209.500**	**3209.510**	**3209.540[1)]**
Useful cooling output CuAL	**L 35 W 10, 400 l/h**	**2500 W**		
Model No. SK Basic controller	**V4A (stainless steel)**	**3209.104[1)]**	**3209.114[1)]**	**3209.144[1)]**
Model No. SK Comfort controller	**V4A (stainless steel)**	**3209.504[1)]**	**3209.514[1)]**	**3209.544[1)]**
Useful cooling output V4A	**L 35 W 10, 400 l/h**	**1875 W**		
Rated operating voltage V, Hz		230, 50/60	115, 50/60	400, 2~, 50/60
Dimensions in mm	W H D	597 415 475		

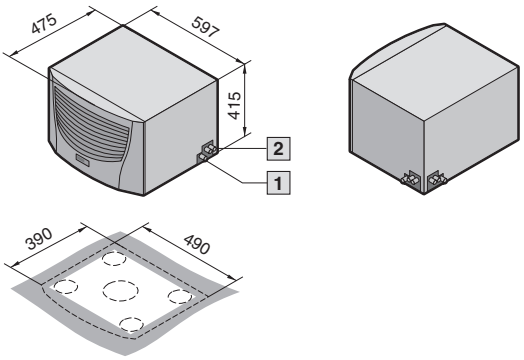
Rated current max.	0.40 A	0.85 A	0.25 A
Pre-fuse T	4.0 A		
Cooling medium	Water (refer to specifications on the Internet; assembly instructions chapter 13)		
Water inlet temperature	> +1°C to +30°C		
Permissible operating pressure p. max.	1 to 10 bar		
Temperature range	+1°C to +70°C		
Protection category to EN 60 529/10.91	IP 55[2)]		
Duty cycle	100 %		
Type of connection	Plug-in terminal strip		
Weight	23.5 kg	27.5 kg	27.5 kg
Colour	RAL 7035		
Air throughput of fans (unimpeded air flow)	1030 m^3/h		
Temperature control	Basic or Comfort controller (factory setting +35°C)		

Accessories	Packs of		Page
Door-operated switch	1	4127.000	956
SK bus system for Comfort controller	1	3124.100	663
Interface card for Comfort controller	1	3124.200	662
Air ducting system	1	3286.870	658
Cover stoppers for interior air outlet	1	3286.880	658
Condensate hose	1	3301.612	665
Flow regulator valve	1	see accessories	667

[1)] Delivery times available on request.
[2)] IP 65 available on request.
Special voltages available on request. We reserve the right to make technical modifications.

Accessories Page 657 **Recooling systems** From page 606 **Configuration software** Page 1063

Roof-mounted, useful cooling output 4000 W



Supply includes:
Fully wired ready for connection with connector, including drilling template, sealing mat and assembly parts.

Also required:
Cooling water system such as Rittal recooling systems, from page 608.

1 Condensate discharge (flexible)

2 Cooling water connection (flexible)

Approvals,
see page 76.

Detailed drawing,
see page 1180.

Performance diagrams,
available on the Internet.

Property rights:
German registered designs
no. 402 02 324 and
no. 402 02 325
US design patent
no. US D 492,319S
Indian registered design
no. 189 956
Chinese registered design
no. ZL 0330 6415.6

	Water-carrying parts			
Model No. SK Basic controller	**CuAL**	**3210.100**	**3210.110**	**3210.140[1)]**
Model No. SK Comfort controller	**CuAL**	**3210.500**	**3210.510**	**3210.540[1)]**
Useful cooling output CuAL	**L 35 W 10, 400 l/h**	**4000 W**		
Model No. SK Basic controller	**V4A (stainless steel)**	**3210.104[1)]**	**3210.114[1)]**	**3210.144[1)]**
Model No. SK Comfort controller	**V4A (stainless steel)**	**3210.504[1)]**	**3210.514[1)]**	**3210.544[1)]**
Useful cooling output V4A	**L 35 W 10, 400 l/h**	**3000 W**		
Rated operating voltage V, Hz		230, 50/60	115, 50/60	400, 2~, 50/60
Dimensions in mm	W H D	597 415 475		

Rated current max.	0.44 A	0.9 A	0.25 A
Pre-fuse T	4.0 A		
Cooling medium	Water (refer to specifications on the Internet; assembly instructions chapter 13)		
Water inlet temperature	> +1°C to +30°C		
Permissible operating pressure p. max.	1 to 10 bar		
Temperature range	+1°C to +70°C		
Protection category to EN 60 529/10.91	IP 55[2)]		
Duty cycle	100 %		
Type of connection	Plug-in terminal strip		
Weight	25.5 kg	29.5 kg	29.5 kg
Colour	RAL 7035		
Air throughput of fans (unimpeded air flow)	925 m^3/h		
Temperature control	Basic or Comfort controller (factory setting +35°C)		

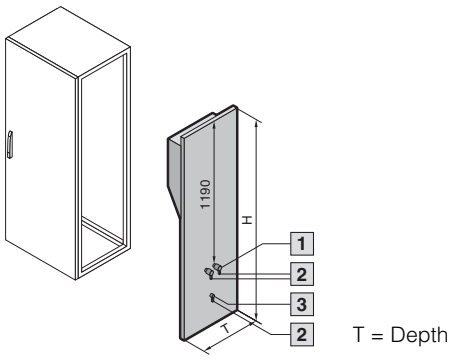
Accessories	Packs of		Page
Door-operated switch	1	4127.000	956
SK bus system for Comfort controller	1	3124.100	663
Interface card for Comfort controller	1	3124.200	662
Air ducting system	1	3286.870	658
Cover stoppers for interior air outlet	1	3286.880	658
Condensate hose	1	3301.612	665
Flow regulator valve	1	see accessories	667

[1)] Delivery times available on request.
[2)] IP 65 available on request.
Special voltages available on request. We reserve the right to make technical modifications.

Accessories Page 657 **Recooling systems** From page 606 **Configuration software** Page 1063

Air/water heat exchanger

As a side panel for 600 mm deep TS 8 enclosures, useful cooling output 700 W



T = Depth

Supply includes:
Wired ready for connection, with terminal strip, sealing material and assembly parts.

Also required:
Cooling water system such as Rittal recooling systems, see page 608 onwards.

1 Water connections
2 Hose 10 mm diameter
3 Condensate discharge

Approvals,
see page 76.

Detailed drawing,
see page 1180.

Performance diagrams,
available on the Internet.

Property rights:
German patent no. 198 04 901
European patent no. 1 053 582 with validity for ES, FR, GR, IT
Australian patent no. 740 300
US patent no. 6,488,214

Model No. SK		**3316.180**	**3316.200**
Rated operating voltage V, Hz		230, 50/60	
Dimensions to fit TS enclosures mm	D H	600 1800	600 2000
Useful cooling output	**L 35 W 10, 100 l/h**	**700 W**	

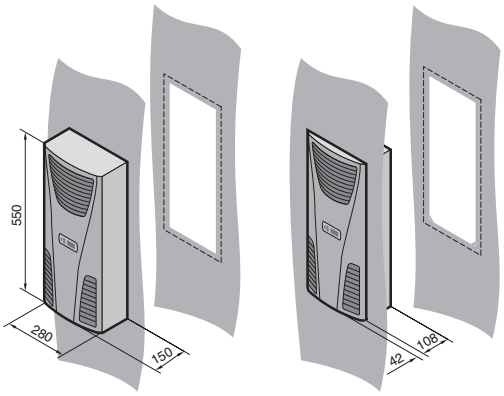
Rated current max.	0.45 A/0.51 A
Pre-fuse T	4.0 A
Cooling medium	Water (refer to specifications on the Internet; assembly instructions chapter 12)
Water inlet temperature	> +1°C to +35°C
Permissible operating pressure p. max.	1 to 10 bar
Temperature range	+1°C to +70°C
Protection category to EN 60 529/10.91	IP 54
Duty cycle	100 %
Type of connection	Terminal strip
Weight	26 kg
Colour	RAL 7035[1)]
Air throughput of fans	170 m³/h
Temperature control	Thermostat-controlled magnetic valve
Temperature monitoring	Internal thermostat, with change-over contact, switching load 16 A, setting range +20°C to +60°C (factory setting +35°C)

Accessories	Packs of		Page
Temperature indicator	1	3114.100	660
Door-operated switch	1	4127.000	956
Condensate hose	1	3301.610	665
Flow regulator valve	1	see accessories	667

[1)] RAL 7032 on request.
Special voltages available on request. We reserve the right to make technical modifications.

Accessories Page 657 **Recooling systems** From page 606 **Configuration software** Page 1063

Wall mounted, specific thermal output 17.5 – 60 W/K



RITTAL TOP THERM

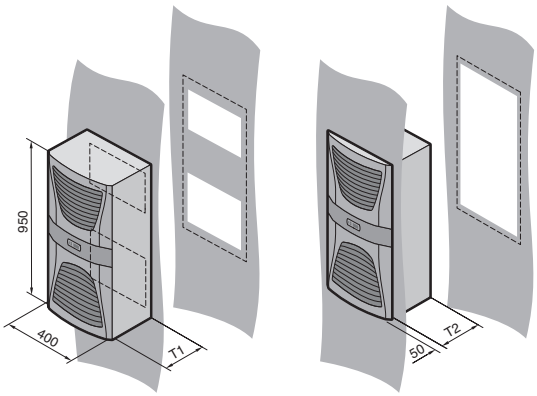
Supply includes:
Fully wired unit ready for connection.

Approvals,
see page 77.

Detailed drawing,
see page 1181.

Performance diagrams,
available on the Internet.

Property rights:
German registered designs
no. 402 02 324 and
no. 402 02 325
IR reg. design no. DM/061 967
and no. DM/062 557
Chinese registered design
no. ZL 0330 8461.1
Indian registered design
no. 190 269 and no. 189 953
Japanese registered design
no. 1 187 905 and
no. 1 187 896
US design patent
no. US D 488,480S



B = Width
T = Depth

Model No. SK		3126.100	3127.100	3128.100	3129.100
Rated operating voltage V, Hz		230, 50/60			
Dimensions in mm	B H T1 T2	280 550 150 –	400 950 205 155	400 950 225 175	
Specific thermal output		**17.5 W/K**	**30 W/K**	**45 W/K**	**60 W/K**

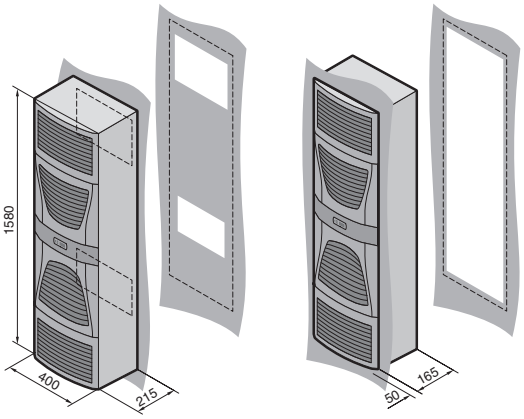
Fans		2 per heat exchanger			
Max. rated current per fan		0.11 A/0.13 A	0.28 A/0.34 A	0.3 A/0.4 A	0.38 A/0.4 A
Power per fan		23 W/27 W	60 W/75 W	70 W/90 W	85 W/90 W
Air throughput of fans	External circuit	265 m^3/h / 315 m^3/h	480 m^3/h / 525 m^3/h	600 m^3/h / 625 m^3/h	860 m^3/h / 900 m^3/h
	Internal circuit	265 m^3/h / 315 m^3/h	480 m^3/h / 525 m^3/h	600 m^3/h / 625 m^3/h	860 m^3/h / 900 m^3/h
Temperature range		–5°C to +55°C			
Type of connection		Plug-in terminal strip			
Weight		10 kg	18 kg	19 kg	21 kg
Colour		RAL 7035			
Protection category to EN 60 529/10.91	Internal circuit	IP 54			

Accessories	Packs of			Page
Filter mats	3	3286.300	3286.400	668
Metal filters	1	3286.310	3286.410	669
Thermostat	1	3110.000		661
Temperature indicator	1	3114.100		660
Speed control	1	3120.000		662

Special voltages available on request. We reserve the right to make technical modifications.

Accessories Page 657 **Configuration software** Page 1063

Wall mounted, specific thermal output 90 W/K



Supply includes:
Fully wired unit ready for connection.

Approvals,
see page 77.

Detailed drawing,
see page 1181.

Performance diagrams,
available on the Internet.

Property rights:
German registered designs
no. 402 02 324 and
no. 402 02 325
IR reg. design no. DM/061 967
and no. DM/062 557
Brazilian registered design
no. DI 6203240-2
Chinese registered design
no. ZL 0330 4386.8
Indian registered designs
nos. 190 270, 189 954, 189 955,
189 958
Japanese registered design
no. 1 187 906 and no. 1 187 897
US design patent
no. US D 492,319S and
US D 492,320S

RITTAL TOP THERM

Model No. SK		**3130.100**
Rated operating voltage V, Hz		230, 50/60
Dimensions in mm	W H D	400 1580 215
Specific thermal output		**90 W/K**

Fans		2 per heat exchanger
Max. rated current per fan		0.67 A/0.88 A
Power per fan		150 W/200 W
Air throughput of fans	External circuit	850 m^3/h / 945 m^3/h
	Internal circuit	850 m^3/h / 945 m^3/h
Temperature range		–5°C to +55°C
Type of connection		Plug-in terminal strip
Weight		34 kg
Colour		RAL 7035
Protection category to EN 60 529/10.91	Internal circuit	IP 54

Accessories	Packs of		Page
Filter mats	3	3286.400	668
Metal filters	1	3286.410	669
Thermostat	1	3110.000	661
Temperature indicator	1	3114.100	660
Speed control	1	3120.000	662

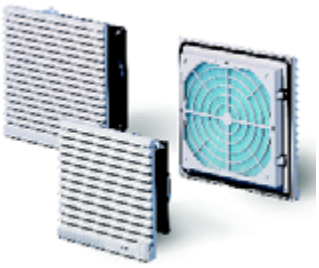
Special voltages available on request. We reserve the right to make technical modifications.

Accessories Page 657 **Configuration software** Page 1063

Features

Fan-and-filter units are ideal for dissipating high heat loads cost-effectively. The pre-requisite is that the ambient air must be relatively clean with a temperature below the desired enclosure internal temperature.

The entire range of fan-and-filter units is now also available with EMC shielding and all required rated voltages.



Fast assembly

Super-fast clip-on mounting
This guarantees fast, completely secure attachment of the fan-and-filter unit. The pre-requisites for protection category IP 54 are met as standard.

Screws are not required. Removal of the louvred grille, likewise without any screws, means that filter mat changes can be achieved in next to no time.

Blowing or extracting?
The air direction may be quickly reversed from blowing (standard setting) to extracting. Simply rotate the fan through 180°.

Application diversity and functions

Not always full power!
At lower ambient temperatures, the air throughput may be reduced. By adapting the fan-and-filter speed to match the temperature using a controller, noise generation is reduced.

Also available with EMC shielding
All fan-and-filter units and outlet filters are alternatively available with EMC shielding.
The required conductive connection is achieved via a metallic coating on the fan-and-filter unit housing and a special sealing frame.

Hosed water protection
Particularly for applications in the food industry, the hose-proof hood prevents the ingress of damp. The protection category of IP 56 is achieved in conjunction with filter mats.

Benefits:

- Air throughput of 20 m^3/h to 700 m^3/h
- Super-fast assembly
- IP 54 as standard
- Air flow direction may be reversed from extracting (standard setting) to blowing
- All fans also available with EMC shielding

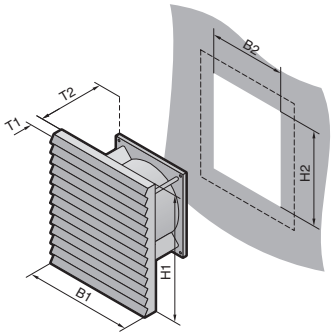
Important:

- The prescribed heat loss and the maximum anticipated ambient temperature define the required volumetric flow
- Always use the fan-and-filter units and outlet filters together

For calculation formulae refer to our website: www.rittal.com

Fan-and-filter units

Air throughput 20/55 m³/h



B = Width
T = Depth

Supply includes:
Fan-and-filter unit ready for installation, including filter mats.

German registered design no. M 93 04 846

Approvals,
see page 77.

Performance diagrams,
available on the Internet.

Model No. fan-and-filter unit SK		**3321.107**	**3321.117**	**3321.027**	**3321.047**[1]	**3322.107**	**3322.117**	**3322.027**	**3322.047**[1]
Rated operating voltage V, Hz		230, 50/60	115, 50/60	24 (DC)	48 (DC)	230, 50/60	115, 50/60	24 (DC)	48 (DC)
Dimensions in mm	B1/H1	116.5				148.5			
	B2/H2	92 + 0.8[2]				124[2]			
	T1	10				10.5			
Max. installation depth mm	T2	42				57			
Air throughput, unimpeded air flow		**20/25 m³/h**		**20 m³/h**		**55/66 m³/h**		**55 m³/h**	
Air throughput with outlet filter including standard filter mat		1 x SK 3321.207: **15/18 m³/h**				1 x SK 3322.207: **43/50 m³/h**			

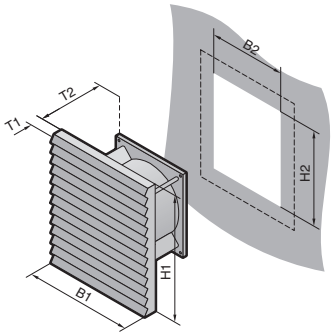
Axial fan		self-starting shaded pole motor		DC motor		self-starting shaded pole motor		DC motor	
Rated current max.		69 mA 58 mA	138 mA 115 mA	125 mA	90 mA	0.12 A 0.11 A	0.24 A 0.23 A	0.35 A	90 mA
Power		12.5 W/10.3 W		3.0 W	4.1 W	19.0 W/18.0 W		7.7 W	4.4 W
Noise level		41/46 dB (A)		41 dB (A)		46/49 dB (A)		46 dB (A)	
Temperature range		–10°C to +55°C							
Colour		RAL 7035[3]							
Protection category to EN 60 529/10.91		IP 54 standard IP 56 when using a hose-proof hood							
Model No. outlet filter SK		**3321.207**				**3322.207**			

Accessories	Packs of									Page
Spare filter mats	5	3321.700				3322.700				670
Thermostat	1	3110.000								661
Temperature indicator	1	3114.100	3114.115	3114.024	–	3114.100	3114.115	3114.024	–	660
Speed control	1	3120.000	3120.115	–	–	3120.000	3120.115	–	–	662
Hose-proof hood	1	3321.800				3322.800				666

[1] Delivery times available on request.
[2] For metal thickness > 2.5 mm, the cutout B2/H2 must be 1 mm larger.
[3] RAL 7032 on request.
Special voltages available on request. We reserve the right to make technical modifications.

Accessories Page 657 **EMC-protected design** Page 640 **Configuration software** Page 1063

Air throughput 105/180 m³/h



B = Width
T = Depth

Supply includes:
Fan-and-filter unit ready for installation, including filter mats.

German registered design no. M 93 04 846

Approvals,
see page 77.

Performance diagrams,
available on the Internet.

Model No. fan-and-filter unit SK		**3323.107**	**3323.117**	**3323.027**	**3323.047**[1]	**3324.107**	**3324.117**	**3324.027**	**3324.047**[1]
Rated operating voltage V, Hz		230, 50/60	115, 50/60	24 (DC)	48 (DC)	230, 50/60	115, 50/60	24 (DC)	48 (DC)
Dimensions in mm	B1/H1	204				255			
	B2/H2	177[2]				224[2]			
	T1	12.5				12.5			
Max. installation depth mm	T2	82.5				105			
Air throughput, unimpeded air flow		**105/120 m³/h**		**105 m³/h**		**180/160 m³/h**		**180 m³/h**	
Air throughput with outlet filter including standard filter mat		1 x SK 3323.207: **71/82 m³/h** 2 x SK 3323.207: **85/98 m³/h** 1 x SK 3325.207: **78/90 m³/h**				1 x SK 3325.207: **115/95 m³/h** 2 x SK 3325.207: **165/140 m³/h** 1 x SK 3326.207: **155/130 m³/h**			

Axial fan		self-starting shaded pole motor		DC motor		self-starting shaded pole motor		DC motor	
Rated current max.		0.12 A 0.11 A	0.24 A 0.23 A	0.35 A	90 mA	0.19 A 0.20 A	0.38 A 0.40 A	0.3 A	0.34 A
Power		19.0 W/18.0 W		8.0 W	4.3 W	30.0 W/35.0 W		7.2 W	14.0 W
Noise level		46/49 dB (A)		46 dB (A)		52/48 dB (A)		52 dB (A)	
Temperature range		–10°C to +55°C							
Colour		RAL 7035[3]							
Protection category to EN 60 529/10.91		IP 54 standard IP 55 when using an additional fine filter mat IP 56 when using an additional fine filter mat and hose-proof hood							
Model No. outlet filter SK		**3323.207**				**3325.207**			

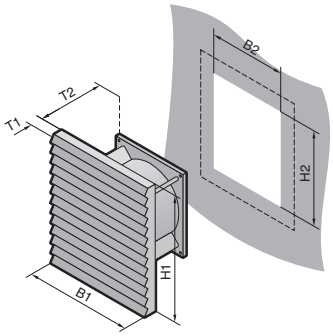
Accessories	Packs of									Page
Spare filter mats	5	3171.100				3172.100				670
Fine filter mats	5	3181.100				3182.100				670
Thermostat	1	3110.000								661
Temperature indicator	1	3114.100	3114.115	3114.024	–	3114.100	3114.115	3114.024	–	660
Speed control	1	3120.000	3120.115	–	–	3120.000	3120.115	–	–	662
Hose-proof hood	1	3323.800				3324.800				666

[1] Delivery times available on request.
[2] For metal thickness > 2.5 mm, the cutout B2/H2 must be 1 mm larger.
[3] RAL 7032 on request.
Special voltages available on request. We reserve the right to make technical modifications.

Accessories Page 657 **EMC-protected design** Page 640 **Configuration software** Page 1063

Fan-and-filter units

Air throughput 230 m³/h



B = Width
T = Depth

Supply includes:
Fan-and-filter unit ready for installation, including filter mats.

German registered design no. M 93 04 846

Approvals,
see page 77.

Performance diagrams,
available on the Internet.

Model No. fan-and-filter unit SK		**3325.107**	**3325.117**	**3325.027**	**3325.047**[1]
Rated operating voltage V, Hz		230, 50/60	115, 50/60	24 (DC)	48 (DC)
Dimensions in mm	B1/H1	255			
	B2/H2	224[2]			
	T1	12.5			
Max. installation depth mm	T2	105			
Air throughput, unimpeded air flow		**230/265 m³/h**		**230 m³/h**	
Air throughput with outlet filter including standard filter mat		1 x SK 3325.207: **170/205 m³/h** 2 x SK 3325.207: **200/230 m³/h** 1 x SK 3326.207: **190/215 m³/h**			

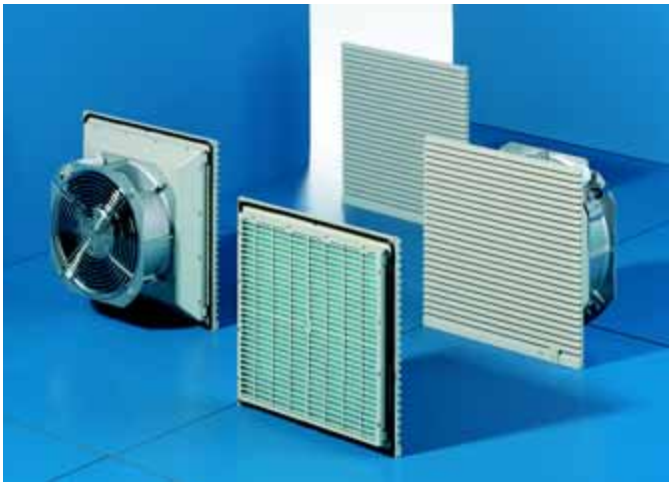
Axial fan	self-starting shaded pole motor		DC motor	
Rated current max.	0.28 A 0.24 A	0.53 A 0.49 A	0.59 A	0.31 A
Power	41.0 W/38.0 W		14.0 W	15.0 W
Noise level	54/56 dB (A)		54 dB (A)	
Temperature range	–10°C to +55°C			
Colour	RAL 7035[3]			
Protection category to EN 60 529/10.91	IP 54 standard IP 55 when using an additional fine filter mat IP 56 when using an additional fine filter mat and hose-proof hood			
Model No. outlet filter SK	**3325.207**			

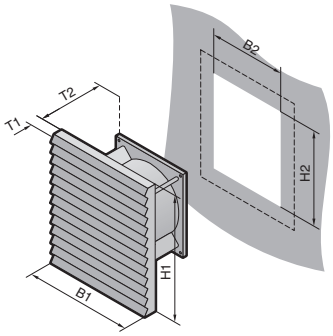
Accessories	Packs of					Page
Spare filter mats	5	3172.100				670
Fine filter mats	5	3182.100				670
Thermostat	1	3110.000				661
Temperature indicator	1	3114.100	3114.115	3114.024	–	660
Speed control	1	3120.000	3120.115	–	–	662
Hose-proof hood	1	3324.800				666

[1] Delivery times available on request.
[2] For metal thickness > 2.5 mm, the cutout B2/H2 must be 1 mm larger.
[3] RAL 7032 on request.
Special voltages available on request. We reserve the right to make technical modifications.

Accessories Page 657 **EMC-protected design** Page 640 **Configuration software** Page 1063

Air throughput 550/700 m³/h





B = Width
T = Depth

Supply includes:
Fan-and-filter unit ready for installation, including filter mats.

German registered design no. M 93 04 846

Approvals,
see page 77.

Performance diagrams,
available on the Internet.

Model No. fan-and-filter unit SK		**3326.107**	**3326.117**	**3327.107**	**3327.117**	**3327.147**
Rated operating voltage V, Hz		230, 50/60	115, 50/60	230, 50/60	115, 50/60	400/460, 3~, 50/60
Dimensions in mm	B1/H1	323				
	B2/H2	292[1]				
	T1	12.5				
Max. installation depth mm	T2	125		145		
Air throughput, unimpeded air flow		**550/600 m³/h**		**700/720 m³/h**		
Air throughput with outlet filter including standard filter mat		1 x SK 3326.207: **360/390 m³/h** 2 x SK 3326.207: **440/495 m³/h**		1 x SK 3326.207: **525/575 m³/h**		

Axial fan	Capacitor motor				Rotary current motor
Rated current max.	0.29 A 0.35 A	0.58 A 0.70 A	0.65 A 0.95 A	1.5 A 2.0 A	0.27 A 0.37 A
Power	64.0 W/80.0 W		115.0 W/212.0 W	167.0 W/230.0 W	146.0 W/220.0 W
Noise level	59/61 dB (A)		75/76 dB (A)		
Temperature range	–10°C to +55°C				
Colour	RAL 7035[2]				
Protection category to EN 60 529/10.91	IP 54 standard IP 55 when using an additional fine filter mat IP 56 when using an additional fine filter mat and hose-proof hood				
Model No. outlet filter SK	**3326.207**				

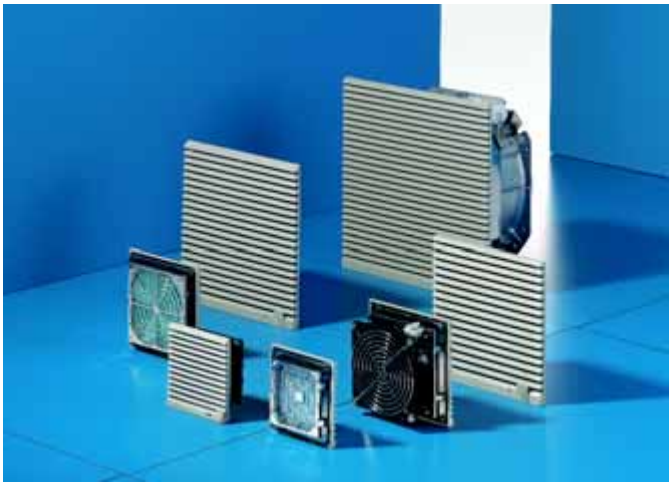
Accessories	Packs of						Page
Spare filter mats	5	3173.100		3327.700			670
Fine filter mats	5	3183.100					670
Thermostat	1	3110.000				–	661
Temperature indicator	1	3114.100	3114.115	3114.100	3114.115	–	660
Speed control	1	3120.000	3120.115	3120.000	–	–	662
Hose-proof hood	1	3326.800					666

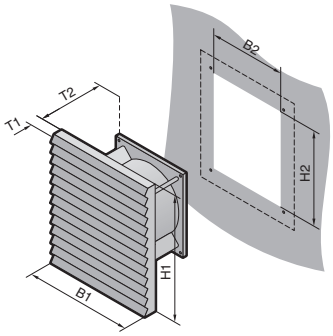
[1] For metal thickness > 2.5 mm, the cutout B2/H2 must be 1 mm larger.
[2] RAL 7032 on request.
Special voltages available on request. We reserve the right to make technical modifications.

Accessories Page 657 **EMC-protected design** Page 640 **Configuration software** Page 1063

Fan-and-filter unit – EMC

Air throughput 20 – 105 m³/h





B = Width
T = Depth

Supply includes:
Fan-and-filter unit ready for installation, including drilling template, filter mat and assembly parts.

Approvals,
see page 78.

Performance diagrams,
available on the Internet.

Model No. fan-and-filter unit SK		**3321.607**	**3321.617[1]**	**3322.607**	**3322.617[1]**	**3323.607**	**3323.617[1]**
Rated operating voltage V, Hz		230, 50/60	115, 50/60	230, 50/60	115, 50/60	230, 50/60	115, 50/60
Dimensions in mm	B1/H1	116.5		148.5		204	
	B2/H2	92 + 0.8[2]		124[2]		177[2]	
	T1	10		10.5		12.5	
Max. installation depth mm	T2	42		57		82,5	
Air throughput, unimpeded air flow		**20/25 m³/h**		**55/66 m³/h**		**105/120 m³/h**	
Air throughput with outlet filter including standard filter mat		1 x 3321.267: **15/18 m³/h**		1 x 3322.267: **43/50 m³/h** 2 x 3322.267: **48/55 m³/h** 1 x 3323.267: **48/55 m³/h**		1 x 3323.267: **71/82 m³/h** 2 x 3323.267: **85/98 m³/h** 1 x 3325.267: **78/90 m³/h**	

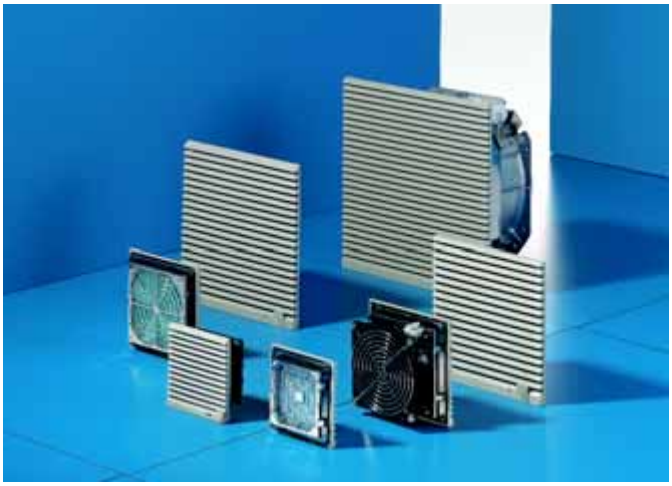
Axial fan		self-starting shaded pole motor					
Rated current max.		69 mA/ 58 mA	138 mA/ 115 mA	0.12 A/ 0.11 A	0.24 A/ 0.23 A	0.12 A/ 0.11 A	0.24 A/ 0.23 A
Power		12.5 W/10.3 W		19.0 W/18.0 W			
Noise level		41/46 dB (A)		46/49 dB (A)			
Temperature range		–10°C to +55°C					
Colour		RAL 7035[3]					
Protection category to EN 60 529/10.91		IP 54 standard					
Model No. outlet filter – EMC SK		**3321.267**		**3322.267**		**3323.267**	

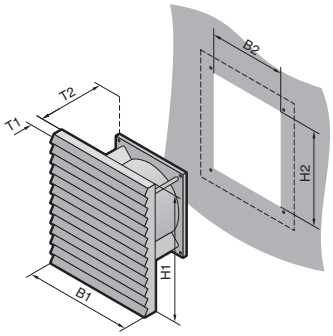
Accessories	Packs of							Page
Spare filter mats	5	3321.700		3322.700		3171.100		670
Fine filter mats	5	–				3181.100		670
Thermostat	1	3110.000						661
Temperature indicator	1	3114.100	3114.115	3114.100	3114.115	3114.100	3114.115	660
Speed control	1	3120.000	3120.115	3120.000	3120.115	3120.000	3120.115	662
Hose-proof hood	1	3321.800		3322.800		3323.800		666

[1] Delivery times available on request.
[2] For metal thickness > 2.5 mm, the cutout B2/H2 must be 1 mm larger.
[3] RAL 7032 on request.
Special voltages available on request. We reserve the right to make technical modifications.

Accessories Page 657 **Configuration software** Page 1063

Air throughput 180 – 700 m³/h





B = Width
T = Depth

Supply includes:
Fan-and-filter unit ready for installation, including drilling template, filter mat and assembly parts.

Approvals,
see page 78.

Performance diagrams,
available on the Internet.

Model No. fan-and-filter unit SK		**3324.607**	**3324.617**[1]	**3325.607**	**3325.617**	**3326.607**	**3326.617**[1]	**3327.607**	**3327.617**[1]
Rated operating voltage V, Hz		230, 50/60	115, 50/60	230, 50/60	115, 50/60	230, 50/60	115, 50/60	230, 50/60	115, 50/60
Dimensions in mm	B1/H1	255				323			
	B2/H2	224[2]				292[2]			
	T1	12.5				12.5			
Max. installation depth mm	T2	105				129		145	
Air throughput, unimpeded air flow		**180/160 m³/h**		**230/265 m³/h**		**550/600 m³/h**		**700/720 m³/h**	
Air throughput with outlet filter including standard filter mat		1 x 3325.267: **115/95 m³/h** 2 x 3325.267: **165/140 m³/h** 1 x 3326.267: **155/130 m³/h**		1 x 3325.267: **170/205 m³/h** 2 x 3325.267: **200/230 m³/h** 1 x 3326.267: **190/215 m³/h**		1 x 3325.267: **170/205 m³/h** 2 x 3325.267: **200/230 m³/h** 1 x 3326.267: **360/390 m³/h**		1 x 3326.267: **525/575 m³/h**	

Axial fan		self-starting shaded pole motor				Capacitor motor			
Rated current max.		0.19 A/ 0.20 A	0.38 A/ 0.40 A	0.28 A/ 0.24 A	0.53 A/ 0.49 A	0.29 A/ 0.35 A	0.58 A/ 0.70 A	0.65 A/ 0.95 A	1.50 A/ 2.00 A
Power		30.0 W/ 35.0 W		41.0 W/ 38.0 W		64.0 W/ 80.0 W		155.0 W/ 212.0 W	167.0 W/ 230.0 W
Noise level		52/48 dB (A)		54/56 dB (A)		59/61 dB (A)		75/76 dB (A)	
Temperature range		–10°C to +55°C							
Colour		RAL 7035[3]							
Protection category to EN 60 529/10.91		IP 54 standard							
Model No. outlet filter – EMC SK		**3325.267**				**3326.267**			

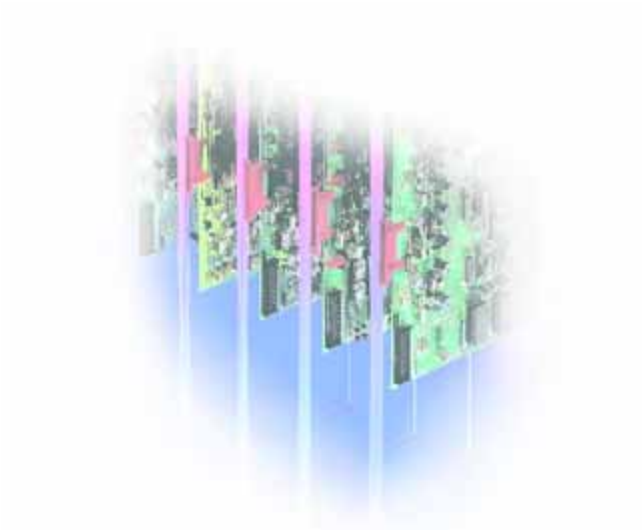
Accessories	Packs of									Page
Spare filter mats	5	3172.100				3173.100		3327.700		670
Fine filter mats	5	3182.100				3183.100				670
Thermostat	1	3110.000								661
Temperature indicator	1	3114.100	3114.115	3114.100	3114.115	3114.100	3114.115	3114.100	3114.115	660
Speed control	1	3120.000	3120.115	3120.000	3120.115	3120.000	3120.115	3120.000	3120.115	662
Hose-proof hood	1	3324.800				3326.800				666

[1] Delivery times available on request.
[2] For metal thickness > 2.5 mm, the cutout B2/H2 must be 1 mm larger.
[3] RAL 7032 on request.
Special voltages available on request. We reserve the right to make technical modifications.

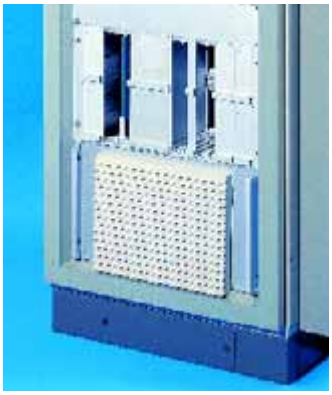
Accessories Page 657 **Configuration software** Page 1063

Climate control tailored to enclosures

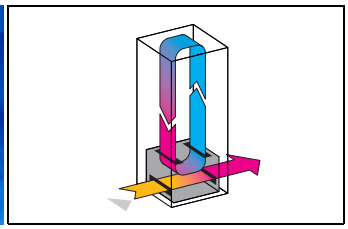
Features



All rack-mounted climate control components are mounted directly on the 482.6 mm (19″) mounting angles. Positioning directly beneath the electronic components ensures effective cooling, and prevents the formation of hot spots.



Rack-mounted cooling units



Useful cooling output 1000 W, 6 U
The heated air is drawn in, cooled, and blown out underneath the electronic equipment being cooled.

Simple attachment to the 482.6 mm (19″) mounting angles
Sealed enclosures require a door cutout for the external air circuit.

With open enclosures, a fully equipped front is essential. The setpoint of the temperature controller is set via a service flap.

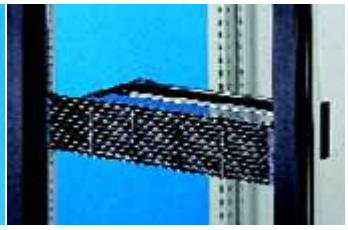
Rack-mounted fan

Vario rack-mounted fan
The rack-mounted fan slides into the guide frame like a drawer. Connectors on the rear ensure immediate contact.

Installation options for the guide frame: Directly in the subrack, via two mounting brackets on the 482.6 mm (19″) mounting angles.

Ideal for avoiding hot spots in fully populated enclosures.

Centrifugal fan



320 m³/h air throughput, 2 U
The high air throughput means that Rittal centrifugal fans are capable of dissipating large heat losses from the enclosure. The minimal noise generation of 52 dB creates a pleasant working environment.

Front outlet grille 2 U for hot air outlet to the outside in the upper section of the enclosure.

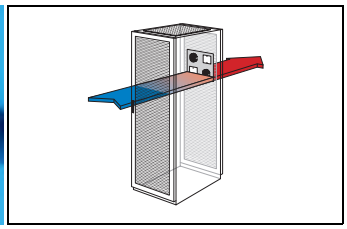
Features

Ready-to-use, wired modules equipped with fans for numerous Rittal enclosure system platforms offer effective air throughput and minimal assembly work. Fan roofs, fan cross members for server enclosures (door installation), internal fan mounting panels and enclosure internal fans are all available.

Fan for integration into the door

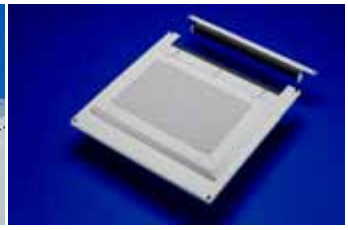
For TS 8: Door mounted fans for server enclosures
Specifically for installation in the tubular door frame of perforated doors.

Door mounted fans for TS 8 server enclosures
Specifically for installing in perforated doors. The growing packaging density in data communications and network enclosures means that active, direct ventilation of the enclosure has become indispensable. The door-mounted fans, attached to the rear or front door, support horizontal air routing of the servers.



Fans for integration into the roof

For all enclosures: Roof-mounted fans, passive or active
May be integrated into any enclosure roof area with suitable dimensions for the mounting cutout.



For TS 8: Fan roof, modular
In exchange for the existing roof plate. Fan and cable entry are pre-integrated.

For the office sector: Roof-mounted fan
Low noise generation and high performance for sensitive office areas. Unit consisting of TS roof plate and fan.

Air baffle systems

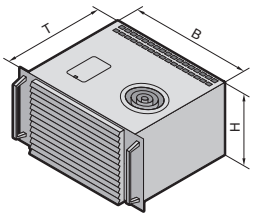
For TS 8: Internal fan mounting panel
Twin-walled side panel for targeted air routing.

Enclosure internal fan
Supports active climate control components and thereby selectively avoids hot spots.

For TS 8: Air baffle system
Cold air from the hollow base is routed to the twin-walled door and distributed in a targeted manner.

Rack-mounted cooling units

for 482.6 mm (19″), useful cooling output 1000 W



B = Width
T = Depth

Supply includes:
Wired ready for connection with connection cable (3 m), including drilling template.

Also required:
For installation in a closed enclosure:
Adaptor for front air supply and air duct for waste air, see Accessories.

Approvals,
see page 78.

Detailed drawing,
see page 1182.

Performance diagrams
can be found on the Internet.

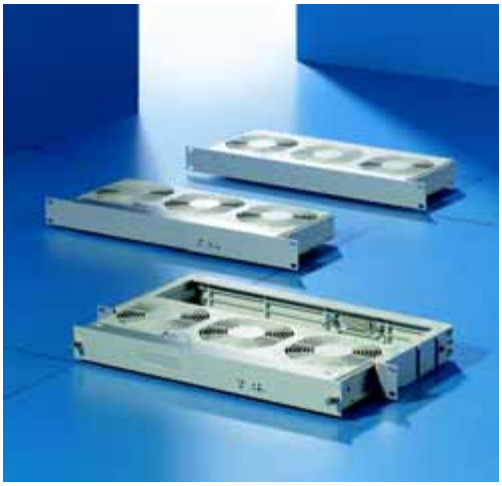
Model No. SK		**3278.134[1)]**	**3292.134**
Rated operating voltage V, Hz		115, 50/60	230, 50/60
Dimensions in mm	W H D	445 265.9 (6 U) 542	
Useful cooling output $\dot{Q}_K$ to DIN 3168	**L 35 L 35** **L 35 L 50**	**1000 W/1050 W** **660 W/770 W**	
Rated current max.		8.4 A/10.8 A	3.8 A/4.5 A
Start-up current		21.0 A/22.0 A	10.0 A/11.8 A
Pre-fuse T		10.0 A/16.0 A	6.0 A/6.0 A
Power consumption P_{el} to DIN 3168	L 35 L 35 L 35 L 50	615 W/710 W 680 W/800 W	585 W/650 W 650 W/720 W
Refrigeration factor $\varepsilon = \dot{Q}_K/P_{el}$	L 35 L 35	1.6	1.7
Refrigerant		R134a, 700 g	
Permissible operating pressure p. max.		25 bar	
Temperature and setting range		+20°C to +55°C	
Protection category to EN 60 529/10.91	External circuit	IP 34	
	Internal circuit	IP 54	
Duty cycle		100 %	
Type of connection		Connection cable 3 m	
Weight		38 kg	35 kg
Colour		RAL 7032	
Air throughput of fans	External circuit	620 m³/h	
	Internal circuit	460 m³/h	
Temperature control		Internal thermostat (factory setting +35°C)	

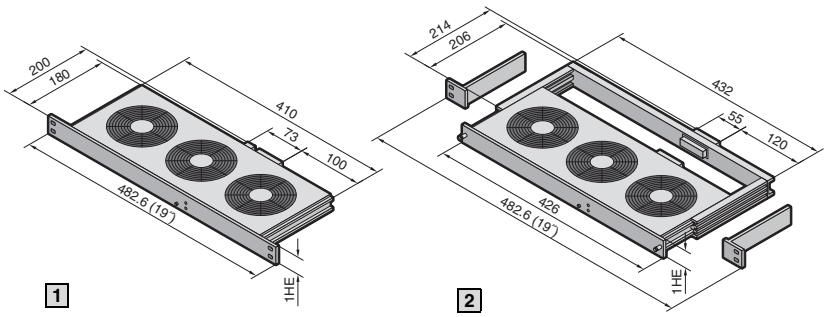
Accessories	Packs of			Page
Filter mats	3	3286.000		668
Adaptor for front air supply	1	3259.000		659
Air duct	10	3220.000		659
Temperature indicator	1	3114.115	3114.100	660
Door-operated switch	1	4127.000		956

[1)] Delivery times available on request.
Special voltages available on request. We reserve the right to make technical modifications.

Accessories Page 657 **Configuration software** Page 1063

for 482.6 mm (19″), air throughput 320/480 m³/h





1 2

HE = U

Rack-mounted fan/Vario rack-mounted fan supply includes:
Wired unit ready for connection, including terminal strip and assembly parts.

Guide frame supply includes:
Guide frame including connector and fitted connection cable (3 m), bracket for optional attachment to the 482.6 mm (19″) system, assembly parts.

Also required:
Remember to order the appropriate guide frame for your chosen application.

Approvals,
see page 78.

Detailed drawing,
see page 1182.

Performance diagrams
can be found on the Internet.

		1 Rack-mounted fans					2 Vario rack-mounted fans			
		Model No. SK					**Model No. SK**			
2 fans Distance between axes 85 mm		**3340.024**[1]	**3340.115**[1]	**3340.230**	**–**	**–**	**3350.024**[1]	**3350.115**[1]	**3350.230**	**–**
3 fans Distance between axes 85 mm		**3341.024**[1]	**3341.115**	**3341.230**	**–**	**9769.002**[1][2]	**3351.024**[1]	**3351.115**[1]	**3351.230**	**–**
3 fans Distance between axes 105 mm		**3342.024**	**3342.115**[1]	**3342.230**	**3342.500**[2]	**–**	**3352.024**[1]	**3352.115**[1]	**3352.230**	**3352.500**[1][3]
Rated operating voltage V		24 V (DC)	115 V (AC)	230 V (AC)	24 V (DC) 115 – 230 V (AC)	36 V (DC) up to 72 V (DC)	24 V (DC)	115 V (AC)	230 V (AC)	24 V (DC) 115 – 230 V (AC)
Model No. SK matching guide frame		**–**	**–**	**–**	**–**	**–**	**3356.100**[1]	**3355.100**	**3355.100**	**3357.100**[1]
Accessories	Page									
Temperature indicator 230 V (AC)	660	3114.100	3114.115	3114.100	3114.024	–	3114.100	3114.115	3114.100	3114.024
Thermostat	661	3110.000								
Speed control	662	3120.000	3120.115	3120.000	–	–	3120.000	3120.115	3120.000	–

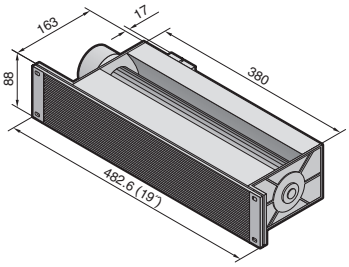
Technical specifications								
Model No. SK/CS	**3340.230** **3350.230**	**3340.115** **3350.115**	**3340.024** **3350.024**	**3341.230** **3351.230** **3342.230** **3352.230**	**3341.115** **3351.115** **3342.115** **3352.115**	**3341.024** **3351.024** **3342.024** **3352.024**	**3342.500**[2] **3352.500**[2]	**9769.002**
Rated operating voltage V, Hz	AC 230 V 50/60 Hz	AC 115 V 50/60 Hz	DC 24 V –	AC 230 V 50/60 Hz	AC 115 V 50/60 Hz	DC 24 V –	DC 24 V AC 115 – 230 V 50/60 Hz	36 V (DC) up to 72 V (DC)
Rated current max.	0.24 A/ 0.22 A	0.46 A/ 0.46 A	0.49 A	0.36 A/ 0.33 A	0.69 A/ 0.69 A	0.74 A	0.85 A	0.28 A
Pre-fuse T	6 A							6 A
Number of fans	2			3				3
Air throughput, unimpeded air flow	320 m³/h			480 m³/h				250 m³/h
Temperature range	–10°C to +55°C							–33°C to +55°C
Noise level	51 dB (A)	52 dB (A)	51 dB (A)	51 dB (A)	52 dB (A)	51 dB (A)		52 dB (A)

[1] Delivery times available on request.
[2] Rack-mounted fan for metric mounting angles available on request.
[3] Version with monitoring.

Accessories Page 657 **Configuration software** Page 1063

Centrifugal fan

Air throughput 320 m³/h



Supply includes:
Fully assembled and wired unit, ready for connection, including filter mat.

Approvals,
see page 79.

Detailed drawing,
see page 1182.

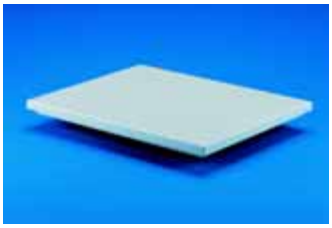
Performance diagrams
can be found on the Internet.

Model No. SK		**3145.000**	**3144.000**
Rated operating voltage V, Hz		115, 50/60	230, 50/60
Dimensions in mm	W H D	482.6 (19″) 88 (2 U) 158	
Air throughput, unimpeded air flow		**320 m³/h**	

Rated current max.		0.32 A	0.16 A	
Power		37 watts		
Noise level		52 dB (A)		
Speed		2245 rpm^{-1}		
Temperature range		–10°C to +55°C		
Maximum static pressure difference		65 – 70 Pa		
Accessories	Packs of			Page
Temperature indicator	1	3114.115	3114.100	660
Thermostat	1	3110.000		661
Filter mats	5	3177.000		668
Front outlet grille 2 U	1	3176.000		667
Roof vent	1	3148.007		647
Speed control	1	3120.115	3120.000	662

Special voltages available on request. We reserve the right to make technical modifications.

Accessories Page 657 **Configuration software** Page 1063

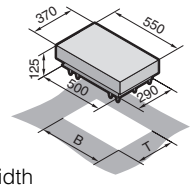


Roof-mounted fan and vent attachment

for TS

The active roof-mounted fan and the passive vent attachment (TS 8801.380) integrate perfectly into the system-wide mounting concept of Rittal system climate control. They fit precisely onto the cut-outs of the small and medium performance category of TopTherm roof-mounted cooling units.

Of course, they may also be mounted on any sufficiently large roof surface.



B = Width
T = Depth

TS roof plates with prepared mounting cutouts are additionally available.

Roof-mounted fan supply includes:
Unit ready to connect with built-in radial fan, sealing material and assembly parts.

Vent attachment:
see page 664.

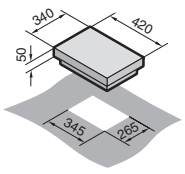
Protection category:
IP 43 to EN 60 529/10.91

Detailed drawing,
see page 1183.

Model No. SK		**3149.410**	**3149.420**	**3149.440**	**3149.810**	**3149.820**	**3149.840**	**8801.380**	Page
Rated operating voltage V, Hz		115, 50/60	230, 50/60	400, 3~, 50/60 460, 3~, 60	115, 50/60	230, 50/60	400, 3~, 50/60 460, 3~, 60	Roof vent	
Air throughput, unimpeded air flow		**400 m³/h**			**800 m³/h**			**Without motor**	
Required mounting cutout	W x D mm	475 x 260						490 x 390	
Power consumption of fan		120 W/170 W		95 W/140 W	170 W/225 W		180 W/310 W		
Rated current of fan		1.1/1.6 A	0.55/0.88 A	0.35/0.35 A	1.5/2.2 A	0.75/1.1 A	0.35/0.55 A		
Temperature range		–10°C to +55°C							
Noise level		68/69 dB (A)			69/70 dB (A)				
Weight		10 kg			11 kg				
Colour shade		RAL 7035							
Accessories									
Roof plate 600 x 600 mm for TS 8 with cutout		8801.300						8801.310	664
Roof plate 600 x 800 mm for TS 8 with cutout		8801.320						8801.330	664
Roof plate 1200 x 600 mm for TS 8 with cutout		–						8801.350	664
Temperature indicator		3114.115	3114.100	–	3114.115	3114.100	–	–	660
Speed control		3120.115	3120.100	–	3120.115	3120.100	–	–	662

Roof-mounted fan

- The roof-mounted fan is easily installed using 6 screws. The sealing tape supplied can be used to seal it against the enclosure.
- The assembly screws are invisible from the outside.
- The roof-mounted fan casing has a large air outlet surface and labyrinthine air ducting.



Protection category:
IP 43 to EN 60 529/10.91. By additionally installing the filter holder with filter mat SK 3175.000, with roof vent SK 3148.000 a protection category of IP 44 is achieved.

Supply includes:
Fully wired unit ready for connection with built-in radial fan, sealing material and assembly parts, connection cable (3 m), drilling template.

Accessories:

Filter holder,
see page 667.

Detailed drawing,
see page 1183.

Model No. SK	**3149.007**	**3169.007**	**3148.007**
Rated operating voltage V, Hz	230, 50/60	115, 50/60	Without fan motor
Air throughput	**360 m³/h**		
Rated current max.	0.2 A	0.55 A	
Power consumption	42 W	65 W	
Temperature range	–10°C to +60°C		
Noise level	53 dB (A)		
Weight	7.8 kg		
Colour[1)]	RAL 7035, textured enamel		

[1)] To order the version in RAL 7032, please add extension .000 to the Model No.
Special voltages available on request. Technical modifications reserved.

for TS/FR(i)

Roof-mounted fan

for TS/FR(i) for the office sector

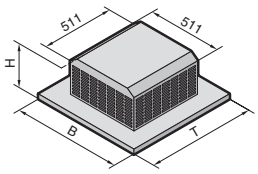
This new roof ventilation concept offers a wealth of performance, assembly and cost benefits associated with the use of integrated ventilation systems. This roof-mounted fan may be ordered with and without a roof plate. Another outstanding feature is the enormous volumetric flow in proportion to exceptionally low noise levels, making it ideal for use in sensitive office areas.

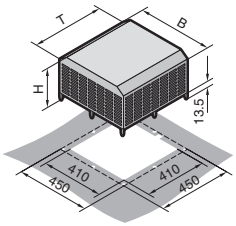
Technical specifications:
- Fitted onto a roof plate based on TS.
- Easy assembly; the work of creating mounting cutouts has been eliminated altogether.
- Radial fan.

Supply includes:
Fully wired ready for connection, including assembly parts.

Model No. SK	**3164.610**	**3164.620**	**3164.810**	**3164.820**	**3164.115**	**3164.230**	Page
Rated operating voltage V, Hz	115, 50/60	230, 50/60	115, 50/60	230, 50/60	115, 50/60	230, 50/60	
Air throughput (unimpeded air flow)	**1500 m³/h[1)]**						
Version	with roof plate				without roof plate		
Dimensions in mm W H D	800 240 800		800 240 900		511 227 511		
Power consumption	6.8 W/8.1 W						
Rated current	0.6 A/0.7 A	0.3 A/0.35 A	0.6 A/0.7 A	0.3 A/0.35 A	0.6 A/0.7 A	0.3 A/0.35 A	
Radial fan	–						
Noise level	40 dB (A)						
Temperature range	+20°C to +55°C						
Colour	RAL 7035						
Accessories							
Temperature indicator in 1 U patch panel	7109.035						660
Temperature indicator	3114.115	3114.100	3114.115	3114.100	3114.115	3114.100	660
Thermostat	3110.000						661

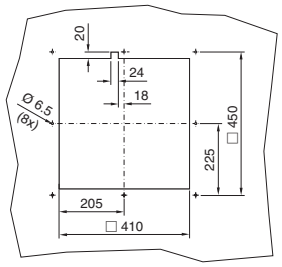
[1)] 800 m³/h at 40 Pa counterpressure using two integrated louvres, type DK 7580.500, in the enclosure base/plinth.
Special voltages available on request. Technical modifications reserved.





B = Width
T = Depth

Mounting cutout
only required for fans without roof plate

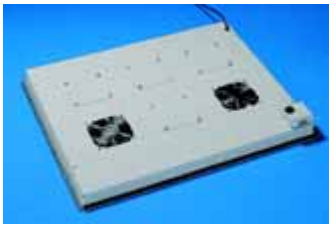


TS 8 air baffle system

The system has an air inlet nozzle in the base frame. In this way, cold air may be drawn in from below. The air is routed into the twin-walled door. The cold air can then be distributed inside the rack with special covers. 15 covers are supplied with every door.

Colour:
RAL 7035

	Packs of	**Model No. DK**
TS 8 sheet steel door, twin-walled W 600 x H 2000 mm	1	**7766.520**
TS 8 sheet steel door, twin-walled W 600 x H 2200 mm	1	**7766.522**
Air inlet nozzle W 600 mm	1	**7766.500**



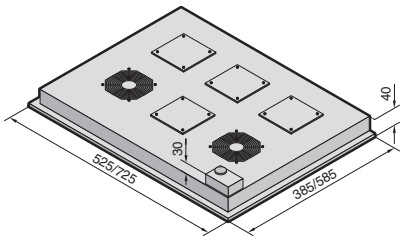
Fan mounting plate

for TS

The fan mounting plate may be retrospectively installed in all TS 8 network enclosures from above. The plate is mounted at the front of the enclosure, whilst the rear section is left free for cable entry. A rubber cable clamp strip is supplied loose for optimum sealing at the rear and sides, to ensure targeted air routing.
Not suitable for crane transportation!
Not suitable for combination with 482.6 mm (19″) mounting frame.

The following combinations are possible:
- Solid roof plate raised with 20 or 50 mm roof spacers.
- Roof plate for cable entry raised with 20 or 50 mm roof spacers.
- Vented roof plate for cable entry.

In conjunction with the large swing frame, usage is only possible from an enclosure depth of 800 mm, in conjunction with a roof plate for cable entry from 900 mm.



For enclosures		No. of fans	Max. no. of fans	Model No. DK
Width mm	Depth mm			
600	600	2	4	**7966.035**
600	800 900 1000	2	6	**7968.035**
800	600	2	6	**7986.035**
800	800 900 1000	2	6	**7988.035**

The air throughput can be increased with the fan expansion kit DK 7980.000.

Technical specifications for one fan:
Rated operating voltage: 230 V
Power consumption: 15/14 W at 50/60 Hz
Air throughput (unimpeded air flow):
160/180 m^3/h, 50/60 Hz
Temperature range: –10°C to +55°C

Technical specifications of thermostat:
Rated operating voltage: 250 V
Temperature range: +5°C to +55°C

Colour:
RAL 7035

Supply includes:
2 fans, 2/4 cutouts to extend to 4/6 fans, thermostat optionally for attachment to the fan mounting plate or to the 25 mm DIN pitch pattern of the enclosure,
Rubber cable clamp strip.
Thermostat and fan fully wired to connection cable (2.5 m).

Accessories:

Fan expansion kit, see below.

Fan expansion kit

For retro-fitting various fan units or to supplement the fan mounting plate and fan roof, modular.

Technical specifications DK 7980.000:
Rated operating voltage: 230 V~
Power consumption: 15/14 W at 50/60 Hz
Air throughput (unimpeded air flow):
160/180 m^3/h, 50/60 Hz
Noise level (unimpeded air flow): 37 dB (A)
Temperature range: –10°C to +55°C

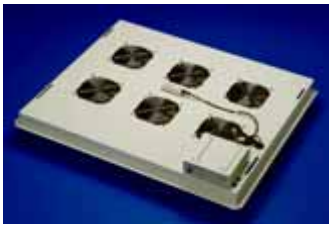
Technical specifications DK 7980.100:
Rated operating voltage: 230 V~
Power consumption: 14/12 W at 50/60 Hz
Air throughput (unimpeded air flow):
108/120 m^3/h, 50/60 Hz
Noise level (unimpeded air flow): 34 dB (A)
Temperature range: –20°C to +70°C

Technical specifications DK 7980.148:
Rated operating voltage: 48 V (DC)
Power consumption: 7.7 W
Air throughput (unimpeded air flow): 184 m^3/h
Noise level (unimpeded air flow): 42 dB (A)
Temperature range: –20°C to +70°C

Dimensions W x H x D mm	Packs of	Model No. DK
119 x 119 x 38	1 set	**7980.000**
119 x 119 x 25	1 set	**7980.100**
119 x 119 x 25	1 set	**7980.148**

Supply includes:
Fan, including assembly parts and connection cable (0.61 m).

DC fan mounting plate



DC fan mounting plate

for TS

Exceptionally low-noise thanks to FCS speed control, fully fitted
Suitable for TS 8 enclosures with a raised roof (> 20 mm) or TS 8 roof plate, vented. The fan mounting plate may be used as an alternative to fan mounting plate 7988.035. It is installed from above. A cable entry is prepared in the rear section of the plate.
Not suitable for combination with 482.6 mm (19″) mounting frame.

Advantages of the DC fan mounting plate with FCS technology:

- Exceptionally low-noise thanks to speed control.
- All fans are individually monitored for failure.
- High air throughput thanks to DC technology (unimpeded air flow 6 x 165 m^3/h = 990 m^3/h).
- EMC-compatible thanks to DC fan.
- Temperature monitoring and control.
- High level of safety thanks to low safety voltage with 24 V DC power pack.
- Visual and acoustic alarm messages, plus relay alarm output.
- Freely selectable installation location for the FCS control unit (included with the supply of the fan mounting plate, in 482.6 mm (19″) with 7320.440 or on the frame with 7320.450).
- Suitable for international use, thanks to wide-range power pack 100 – 240 V AC and socket to IEC 320.
- Fully pre-configured.
- Network-compatible via CMC-TC processing unit 7320.100 (all relevant data such as temperature etc. are displayed in the web browser, or alarms are sent in the form of an SNMP trap).

For enclosures width mm	For enclosures depth mm	Number of DC fans	**Model No. DK**
800	800 900 1000	6	**7858.488**

Technical specifications:
Power pack rated voltage:
100 – 240 V AC, 50/60 Hz
Power pack rated current: Max. 1.5 A
Power pack secondary range: 24 V DC, 3 A
Temperature range: +5°C to +40°C
Total air throughput (unimpeded air flow):
6 x 165 m^3/h = 990 m^3/h

Technical specifications for one fan:
Rated voltage: 24 V DC
Rated current: max. 0.28 A
Rated output: max. 6.72 W
Air throughput (unimpeded air flow): 165 m^3/h
Speed: 2650 rpm
Noise level: up to 41.0 dB (A)
at maximum speed activation

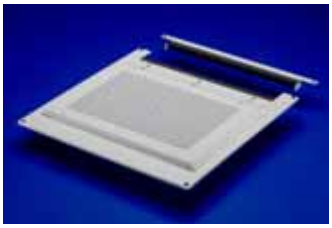
Also required:

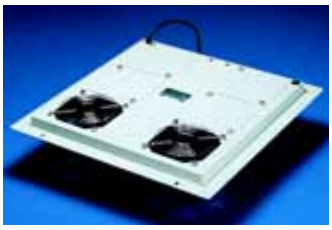
Connection cable 230/115 V.
Example D version, Model No. 7200.210,
see page 771.

Accessories:

1 U mounting unit, Model No. 7320.440,
see page 771.
Mounting module, Model No. 7320.450,
see page 772.

Note:
For more information on the FCS system,
see page 786.





Fan roof, modular, two-piece

for TS/FR(i)

The modular roof plate consists of individual components and can be configured for the ventilation of TS 8 enclosures in line with requirements.
The modules:

Roof plate, two-piece with cutout
For fan mounting and cable entry at the rear via a sliding angular bracket with rubber cable clamp strip. In exchange for the existing roof plate. The two-piece design allows convenient retrofitting of cables at any time.

Cover plate
To cover the cutout, optionally solid or vented. The top-mounted cover plate may be raised for extra air throughput using the supplied spacers.

Fan insert
For active ventilation:
A fully pre-wired fan tray including 2.5 m connection cable, with two fan motors and additional cutouts. The air throughput may be increased with a fan expansion kit.

Material:
Sheet steel, spray-finished

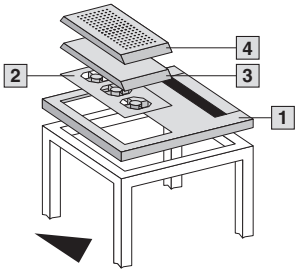
Colour:
RAL 7035

Technical specifications for one fan:
Rated operating voltage: 230 V
Power consumption: 15/14 W at 50/60 Hz
Air throughput (unimpeded air flow):
160/180 m^3/h at 50/60 Hz
Temperature range: –10°C to +55°C

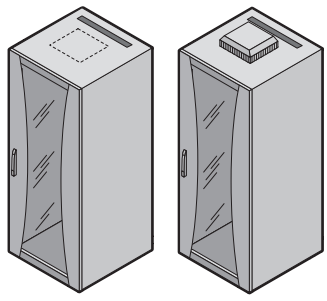
Detailed drawing,
see page 1183.

Accessories:

Fan expansion kit DK 7980.000,
see page 649.
Thermostat SK 3110.000,
see page 661.
Speed control SK 3120.000,
see page 662.



For enclosures		Model No. DK				Fan insert	
		Roof plate	Cover plate				
Width mm	Depth mm	1 With cutout	3 Solid	4 Vented	2 Fan insert	Fan pre-wired	Maximum no. of fans
600	600	**7826.366**	**2102.180**	**2102.400**	**2102.320**	2	2
600	800	**7826.368**	**2102.190**	**2102.410**	**2102.490**	2	6
600	900	**7826.369**	**2102.190**	**2102.410**	**2102.490**	2	6
600	1000	**7826.360**	**2102.190**	**2102.410**	**2102.490**	2	6
800	600	**7826.486**	**7885.100**	**7885.200**	**7885.000**	2	3
800	800	**7826.488**	**7886.100**	**7886.200**	**7886.000**	2	8
800	900	**7826.489**	**7886.100**	**7886.200**	**7886.000**	2	8
800	1000	**7826.480**	**7886.100**	**7886.200**	**7886.000**	2	8



Fan unit, active

for TE

For active ventilation of the TE 7000, a ventilation opening may be broken out of the front area in the standard roof plate and fitted with the fan module. The fan module is pre-wired ready for connection and has 2 fans, 1 thermostat and a connection cable including IEC 320 connector. An additional fan may optionally be integrated.

Supply includes:
Fan unit including assembly parts, 2 fans, thermostat and connection cable.

Technical specifications for one fan:
Fan extension kit, see page 649.

Technical specifications of thermostat:
Rated operating voltage: 250 V
Temperature range: +5°C to +55°C

For enclosures W x D mm	Number of pre-wired fans	Possible number of fans	Model No. TE
All dimensions	2	3	**7000.670**

Also required:

Connection cable,
see page 771.

Accessories:

Fan expansion kit,
see page 649.

Door mounted fan

for TS 8 server enclosures,
especially for installing in perforated doors.
The growing packaging density in data communications and network enclosures make active, direct ventilation of the enclosure indispensable. The door mounted fan, which is attached to the rear or front door, supports horizontal air routing for the servers and therefore facilitates faster heat dissipation from active components.

Technical specifications:
- Standard cross member with two fans.
- Air throughput, unimpeded air flow 600 m³/h.
- By adding two fan expansion kits, the air throughput may be increased to 1200 m³/h.
- The direction of air flow is easily reversed by rotating the fan.
- Several units may be positioned in a cascade arrangement.
- Simple mounting on the tubular door frame.

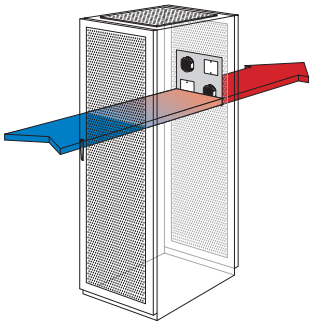
Supply includes:
Wired ready for connection with 2.5 m connection cable, including assembly parts.

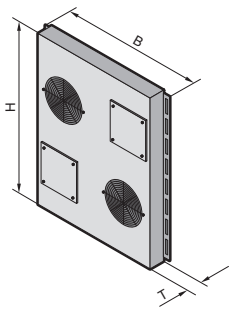
Accessories:

Fan expansion kit,
see below.

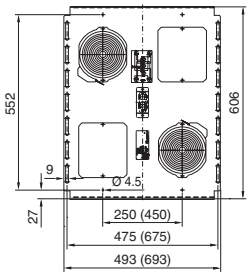
Note:
Only for mounting on the tubular door frame!

Door configuration for installation in 2 and 4-door ISP racks available on request.



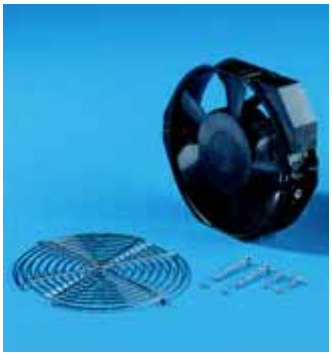


B = Width
T = Depth



Model No. SK	3165.624[1)]	3165.648[1)]	3165.615[1)]	3165.630[1)]	3165.824[1)]	3165.848[1)]	3165.815[1)]	3165.830[1)]	Page
Rated operating voltage V, Hz	24 (DC)	48 (DC)	115, 50/60	230, 50/60	24 (DC)	48 (DC)	115, 50/60	230, 50/60	
Air throughput (unimpeded air flow)	**600 m³/h**								
Power consumpion for two fans	40 W	48 W	70 W/64 W	70 W/70 W	40 W	48 W	70 W/64 W	70 W/70 W	
Rated current of fan	1.5 A	1.0 A	0.76 A/0.72 A	0.38 A/0.36 A	1.5 A	1.0 A	0.76 A/0.72 A	0.38 A/0.36 A	
Dimensions in mm W H D	493 606 64.5				693 606 64.5				
For doors with width (mm)	600				800				
Noise level	55 dB (A)								
Temperature range	+20°C to +55°C								
Colour	RAL 7035								
Accessories									
Temperature indicator	3114.024	–	3114.115	3114.100	3114.024	–	3114.115	3114.100	660
Thermostat	3110.000								661

[1)] Delivery times available on request.
Special voltages available on request. Technical modifications reserved.



Fan expansion kit

for door mounted fan
To increase the air throughput of the door mounted fan.

To fit door mounted fan	Model No. SK
3165.624, 3165.824	**3165.024**
3165.648, 3165.848	**3165.048**
3165.615, 3165.815	**3165.115**
3165.630, 3165.830	**3165.230**

Internal fan mounting panel

for TS 8

A fan unit integrated into the TS 8 twin wall for targeted air routing in the lower part of the enclosure. A second fan unit may optionally be mounted to reinforce air circulation. Optional air routing design may be achieved retrospectively by simply inserting or exchanging cover plates.

Technical specifications:

- Rated operating voltage: 230 V, 50/60 Hz
- Air throughput (3 fans): 200/230 m^3/h (unimpeded air flow)
- Power consumption (3 fans): 57/54 W
- Rated current (3 fans) 0.36/0.33 A

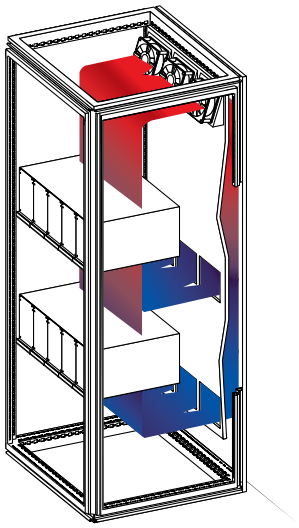
Supply includes:

1 pack =
1 internal fan mounting panel,
3 fan cross members,
3 cover plates.

Property rights:

German patent no. 198 04 219
European patent no. 1 053 581
with validity for ES, FR, GB, IT
Australian patent no. 737 950
US patent no. 6,494,779

For TS enclosure		Height of internal panel mm	Model No. SK
Width mm	Height mm		
600	1800	1548	**3347.180**
600	2000	1748	**3347.200**
800	1800	1548	**3348.180**
800	2000	1748	**3348.200**



Fan cross member

for internal fan mounting panel

May be additionally installed to increase the air circulation.

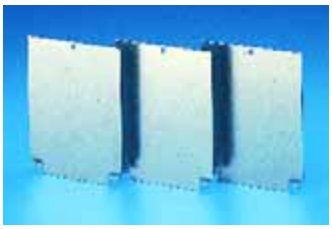
Technical specifications:

- Rated operating voltage: 230 V, 50/60 Hz
- Air throughput (3 fans): 200/230 m^3/h (unimpeded air flow)

Packs of	Model No. SK
3	**3349.100**

Property rights:

German patent no. 198 04 906
European patent no. 1 053 662
with validity for ES, FR, GB, IT
Australian patent no. 737 485
US patent no. 6,315,656
Chinese patent no. ZL 988 13378.4



Cover plates

for internal fan mounting panel

For optional design of the air routing.

Packs of	Model No. SK
3	**3349.300**

Enclosure internal fan

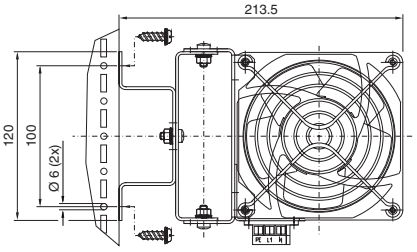
for TS

To prevent hot spots and support the air routing of active enclosure climate control components. Adjustable in two axes. Attached to the TS 8 frame section. Several fans may be cascaded using the quick-release clamping strip.

Supply includes:

Fully wired unit ready for connection with radial fan and lockable swivel device, as well as assembly parts.

Air throughput, unimpeded air flow	Power consumption W	Rated current A	Rated voltage V, Hz	Model No. SK
160 m^3/h	19.0/18.0	0.12/0.11	230, 50/60	**3108.100**
160 m^3/h	19.0/18.0	0.24/0.23	115, 50/60	**3108.115**
160 m^3/h	3.5	0.15	24 V (DC)	**3108.024**



Features

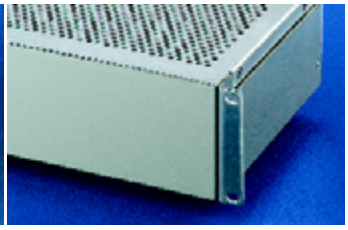
Condensation poses a particular risk for control electronics, especially with outdoor siting, but also indoors. Various different output categories ensure that the correct thermal output is always available. In this way, the total required thermal output can be distributed with complete accuracy within an enclosure.

Simple assembly and perfect control

Fast assembly
This is achieved with a screw or snap fastening on the mounting plate or 35 mm EN 50 022 support rails.

No condensation, and always the right temperature
The heater is controlled as required via a hygrostat or enclosure internal thermostat.

Maximum performance in the outdoor sector



Fully wired unit ready for connection
Compact power with 1000 W thermal output.

19″ rack mount
For seamless integration into the 482.6 mm (19″) structure, with 3 thermal components and 3 fan units. This creates circulation, so that condensation is reliably avoided.

Benefits:

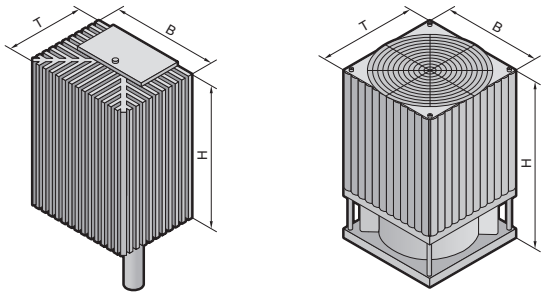
- Continuous thermal output of 10 W to 1000 W
- Self-regulating PTC technology
- Quick-assembly system

Important:

- For the correct temperature and to avoid compensation, use a thermostat or hygrostat, see page 661
- The thermal output is increased with fans
- Heaters should always be installed in an upright position. Leave a distance of 50 mm at the top and bottom to allow convection
- Heat is distributed evenly in large enclosures by using several low-output heaters

General remarks and calculation formulae can be found on our website: www.rittal.com

Continuous thermal output 10 – 300 W



B = Width
T = Depth

Supply includes:
Unit ready to install with permanently attached connection cable (0.3 m). SK 3102.000 with fitted fan including terminal strip.

Note:
- Thermostat SK 3110.000 (see accessories) is recommended for precise temperature control in the enclosure.
- In order to prevent condensation on assemblies, hygrostat SK 3118.000 (see accessories) is recommended to regulate heating.
- In larger enclosures, even heat distribution is best achieved by installing several low-output heaters.
- Installation in the enclosure is generally advisable, even when using heat exchangers and cooling units, in order to prevent condensation.

Approvals,
see page 80.

Detailed drawing,
see page 1183.

Performance diagrams
are available on the Internet.

Model No. SK		**3105.000**	**3106.000**	**3115.000**	**3116.000**	**3107.000**	**3107.000 + 3108.000**	**3102.000 (incl. fan)**
Dimensions in mm	W	45	45	64	64	80	80	120
	H	75	125	110	185	140	178	168
	D	35	35	45	45	118	118	120
Rated operating voltage V, Hz		110 – 240 V AC/DC					230 V, 50/60	
Continuous thermal output at T_u = 20°C		**10 W**	**20 W**	**30 W**	**50 W**	**130 W**	**200 W[1)]**	**300 W[1)]**
Pre-fuse T		2 A		4 A				

Accessories	Packs of		Page
Thermostat	1	3110.000	661
Hygrostat	1	3118.000	661
Temperature indicator	1	3114.000	660

[1)] Output with fan
Special voltages available on request. We reserve the right to make technical modifications.

Axial fan

for heater SK 3107.000
Ball bearing
Temperature range: –40°C/+85°C
Rated operating voltage:
230 V, 50/60 Hz
Power consumption: 18 watts
Noise level: 33 dB (A)
Speed: 2800/3300 rpm
Air throughput: 50 m^3/h

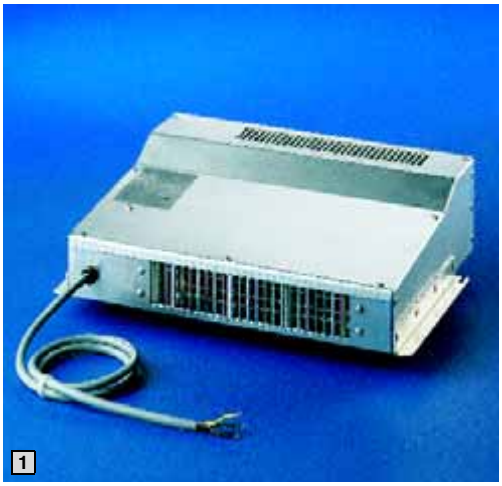
Packs of	**Model No. SK**
1	**3108.000**

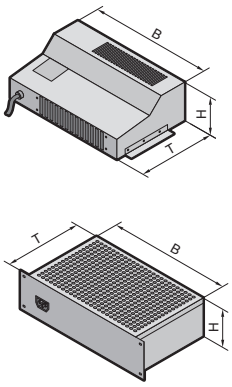
Detailed drawing,
see page 1184.

Accessories Page 657 **Configuration software** Page 1063

Enclosure heaters

for CS Outdoor enclosures, continuous thermal output 600/1000 W





B = Width
T = Depth

1 Enclosure heater
2 Heater module

Material:
Enclosure: Aluminium

Surface finish:
Natural, 9763.023 with spray-finished front panel

Supply includes:

1 Fully wired unit ready for connection with permanently attached connection cable.

2 Fully wired unit ready for connection, designed as a 482.6 mm (19″) rack mount with 3 thermal components and 3 fan units.

Approvals,
see page 80.

Detailed drawing,
are available on the Internet.

Performance diagrams
can be found on the Internet.

Model No. CS		**9769.015**	**9769.023**
Installation		in the enclosure	19″ mounting angles
Dimensions in mm	W H D	325 82 220	482.6 (19″) 87.2 (2 U) 236
Rated operating voltage V, Hz		230 V AC, 50/60	230 V AC, 50/60
Continuous thermal output		**1000 W**	**600 W**
Rated current max.		5.0 A	2.6 A
Temperature range		–33°C to +65°C	–33°C to +65°C
Air throughput, unimpeded air flow		120 m³/h	480 m³/h
Type of connection		Connection cable with wire end ferrules	Via front IEC connector (3-pole)
Weight		3.0 kg	3.1 kg
Accessories	Packs of		Page
Thermostat	1	3110.000	3110.000 661
Hygrostat	1	3118.000	3118.000 661

Accessories Page 657 **Configuration software** Page 1063 **Outdoor enclosures** Page 814

Features

Finding the perfect climate control solution is now even easier, with matching system accessories. Perfectly coordinated components adapt the climate control components superbly to your specific requirements. Be it targeted air routing or precise control of the equipment, Rittal has the perfect solution for everything.

Air routing

Air duct system for TopTherm roof-mounted cooling unit and air/water heat exchanger
With the air duct system, cold air may be routed directly to specific areas of the enclosure.

Air diverter
For targeted, downward cold air routing in climate controlled enclosures, climate control doors and TopTherm wall-mounted cooling units.

Adaptor
For unhindered front air infeed when using rack-mounted cooling units in enclosures with front doors.

Controller

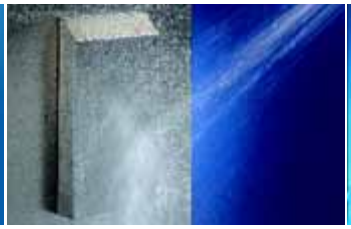
Enclosure internal thermostat and hygrostat
Constant temperature and humidity to protect sensitive electronics.

Speed control
Temperature-dependent speed control to minimise noise and save energy in part-load operation.

SK Bus system
SK bus system with master/slave function to enable several cooling units to communicate with one another.

Installation/maintenance

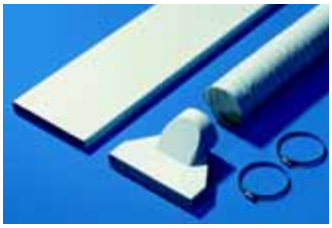
Fast assembly
Easy installation with prepared TS roof plates.



Hose-proof hoods
For protection category IP 55 to EN 60 529/10.91 with fan-and-filter units and outlet filters.

Filter mats
For use in cooling units under exterme conditions.

Air routing



Air duct system

for TopTherm roof-mounted cooling units

The air duct system for Rittal TopTherm roof-mounted cooling units makes it possible to route the cold air directly to specific areas of the enclosure. The risk of “short circuits” in the air circulation due to self-ventilated installed devices is therefore effectively eliminated.
The length of the shallow duct is 1500 mm, and it may be cut to the desired length.

Material:
Flame-resistant plastic to DIN 4102/B1.

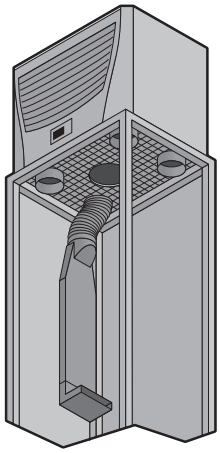
Supply includes:
Shallow duct, compensating hose

Accessories:

90° deflector,
see page 658.
Cover bungs,
see page 658.

For cooling unit	Packs of	Model No. Air duct system SK
SK 3382. . . ./SK 3383. . . ./SK 3384. . . ./SK 3385. . . .	1	**3286.870**
SK 3386. . . ./SK 3387. . . .	1	**3286.970**

Note:
Do not direct cold air straight at active components. When using the ducting system, the performance of the cooling unit may be reduced, depending on the application in question.



90° deflector

for air duct system

For targeted air deflection at the end of the shallow channel.

Material:
Flame-resistant plastic to DIN 4102/B1.

Packs of	Model No. SK
1	**3286.990**

Cover bungs

for TopTherm roof-mounted cooling units

To cover unneeded cold air outlets in TopTherm roof-mounted cooling units.

Material:
Polyurethane foam

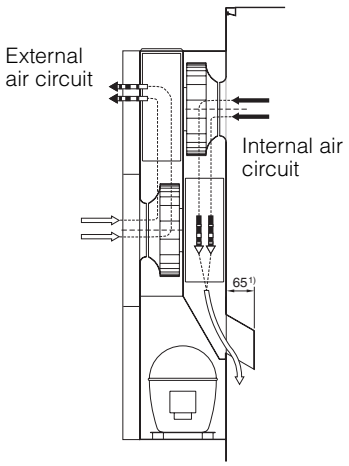
For cooling unit	Packs of	Model No. SK
SK 3382. . . .	2	**3286.780**
SK 3383. . . ./SK 3384. . . ./SK 3385. . . .	2	**3286.880**
SK 3386. . . ./SK 3387. . . .	2	**3286.980**

Air diverter

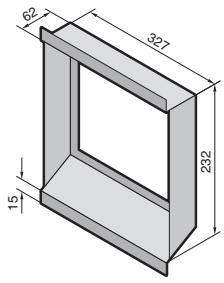
For use in climate controlled enclosures, climate control doors, climate control side panels and TopTherm wall-mounted cooling units.
For targeted air routing of the cold air in a downward direction.
Particularly well-suited for densely-packed electrical components in the lower section of the enclosure.

Material:
Sheet steel

For devices	Model No. SK
SK 8607. . . ./SK 8687. . . . SK 3306. . . ./SK 3331. . . .	**3213.300**
SK 3304. . . ./SK 3305. . . .	**3213.310**
SK 3328. . . ./SK 3329. . . .	**3213.320**
SK 3332. . . .	**3213.330**[1)]



[1)] 115 mm for SK 3213.330



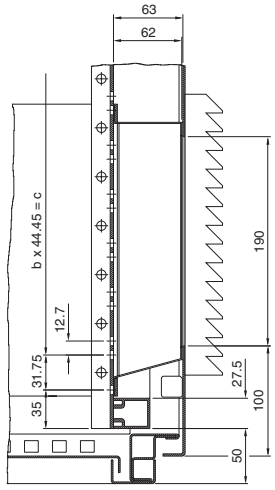
Adaptor

for front air infeed
When using rack-mounted cooling units SK 3278.134/SK 3292.134 in enclosures with front doors (sheet steel or acrylic), this adaptor must be used. It enables ambient air to be extracted unhindered from outside, which is essential for correct functioning of the cooling unit.

Material:
Sheet steel

Supply includes:
Adaptor, sealing gasket, foamed plastic gasket, assembly parts.

Packs of	Model No. SK
1	**3259.000**



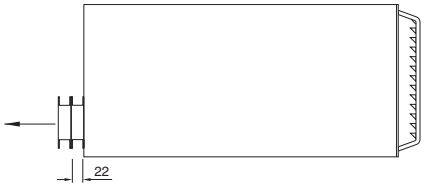
Air duct

for discharge of waste air
For use of rack-mounted cooling units SK 3292.134/SK 3278.134 in enclosures with a depth > 600 mm.
The heated ambient air is blown backwards out of the enclosure through the air duct. The air duct may be extended as required.

Material:
ABS plastic

Supply includes:
Air duct including attachment clamps.

Packs of	Model No. SK
10	**3220.000**



Air duct, may be extended to any length

Regulation/control

Digital enclosure internal temperature display and thermostat

For installing on the enclosure door or wall and in a cooling unit or heat exchanger.

Technical specifications:

- Small dimensions.
- Depth: 100 mm.
- The 3-digit 7-segment display is 13 mm high and clearly legible.
- Can be switched from °C/°F.
- The display can be used in a temperature range from +5°C to +70°C.
- With 1500 mm long NTC sensor.
- Two relay outputs as change-over contact and normally open contact (maximum contact load 230 V, 6 A).
- Freely selectable switching difference.
- The freely adjustable setpoint values can be adjusted via the membrane keyboard at the front.
  Setting range: +5°C to +55°C.
- Display and switching accuracy +/– 2 K.
- Mounting cutout 68 x 33 mm.
- Storage of the minimum and maximum recorded temperature until resetting is next carried out.

Rated operating voltage	Model No. SK
230 V (AC)	**3114.100**
115 V (AC)	**3114.115**[1)]
24 V (DC)	**3114.024**[1)]

[1)] Delivery times available on request.
Special requirements available on request.

Digital enclosure internal temperature display and thermostat

Integrated into a patch panel 1 U.
Including cable attachment for connection cable and label holder.

Rated operating voltage:
230 V (AC)
Special voltages available on request.

Technical specifications:

- Small dimensions.
- Depth: 100 mm.
- The 3-digit 7-segment display is 13 mm high and clearly legible.
- Can be switched from °C/°F.
- The display can be used in a temperature range from +5°C to +70°C.
- With 1500 mm long NTC sensor.
- Two relay outputs as change-over contact and normally open contact (maximum contact load 230 V, 6 A).
- Freely selectable switching difference.
- The freely adjustable setpoint values can be adjusted via the membrane keyboard at the front.
  Setting range: +5°C to +55°C.
- Display and switching accuracy +/– 2 K.
- Mounting cutout 68 x 33 mm.
- Storage of the minimum and maximum recorded temperature until resetting is next carried out.

Supply includes:
Panel, temperature indicator and thermostat, identification strip.

Colour	Model No. DK
RAL 7035	**7109.035**

Enclosure internal thermostat

Especially suitable for controlling fan-and-filter units, heaters and heat exchangers, this thermostat can also be used as a signal generator for monitoring the enclosure internal temperature.

Technical specifications:

- Bi-metal sensor as a temperature-sensitive element with thermal feedback.
- Contact population: Single-pole change-over contact as a quick-break contact.
- Permissible contact load:
  Category 5 – 3 (heating)
  AC 10 (4)[1)] A,
  DC = 30 W
  Category 5 – 4 (cooling)
  AC 5 (4)[1)] A,
  DC = 30 W
  ([1)]) = Inductive load at cos φ = 0.6
- Setting range +5°C to +60°C
- Weight approx. 105 grams
- Dimensions 71 x 71 x 33.5 mm
- Switching difference approx. 1 K ± 0.8 K.

Rated operating voltage	Model No. SK
230/115/60/48/24 V (AC)	3110.000
60/48/24 V (DC)	

- A broad voltage spectrum i.e. just one model covers 24 to 230 V.
- Time-saving connection technique using a terminal strip with a screw connection from the outside.
- Flexible mounting on a vertical or horizontal 35 mm support rail to EN 50 022, and snap fastening in the TS/ES enclosure section using the supplied adaptor.

Hygrostat

The hygrostat switches on the heater and/or fan when a preset relative humidity in the enclosure is exceeded.
In this way, the relative humidity is raised above the dew point, and condensation on assemblies or electronic components is avoided.

Technical specifications:

- Contact population: Single-pole change-over contact as a quick-break contact.
- Permissible contact load:
  AC ~ 5 (0.2)[1)] A
  DC = max. 20 W
  ([1)]) = Inductive load at cos φ = 0.6
- Setting range 50 – 100 % relative humidity
- Weight approx. 100 g
- Dimensions 71 x 71 x 33.5 mm
- Switching difference approx. 4 %

Rated operating voltage	Model No. SK
24 – 230 V (AC/DC)	3118.000

- A broad voltage spectrum i.e. just one model covers 24 to 230 V.
- Time-saving connection technique using a terminal strip with a screw connection from the outside.
- Flexible mounting on a vertical or horizontal 35 mm support rail to EN 50 022, and snap fastening in the TS/ES enclosure section using the supplied adaptor.

Bottom-mounted adaptor

for enclosure internal thermostat SK 3110.000 and hygrostat SK 3118.000

Bottom-mounted adaptor with mounting option for screwed cable glands, for targeted cable infeed from appropriate equipment such as SK fan-and-filter units and enclosure heaters. In conjunction with screwed cable glands, it is also suitable for use as strain relief.

Packs of	Model No. SK
1	3110.200

Regulation/control

Speed control

Temperature-dependent speed control for Rittal fan-and-filter units and air/air heat exchangers with a rated operating voltage of 230 V AC, for noise reduction and to save energy in part-load operation.

Technical specifications:

- For mounting on a 35 mm support rail DIN EN 50 022.
- Dimensions (W x H x D): 94 x 57 x 180 mm
- Rated operating voltage: 230 V (AC)/115 V (AC)
- Setting range: +20°C to +55°C
- Phase cross-over with microcontroller
- Maximum fan output 250 W or 1.2 A at 230 V (AC)
- Maximum fan output 100 W or 1.2 A at 115 V (AC)

Rated operating voltage	Model No. SK
230 V (AC)	**3120.000**
115 V (AC)	**3120.115**[1)]

[1)] Delivery times available on request.

Supply includes:
Speed control, built into a PK enclosure 9512.100, NTC sensor, length 1.80 m.

Mounting adaptor

for speed control

The mounting adaptor enables direct attachment of the speed control SK 3120.000/.115 to the vertical frame sections of network enclosures.

Material:
Sheet steel, zinc-plated, passivated.

Packs of	Model No. DK
1 set	**7526.964**

Supply includes:
Mounting adaptor including assembly parts.

Interface card

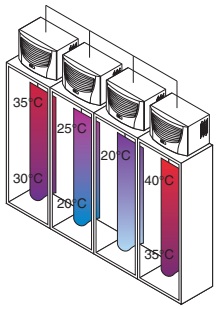
for TopTherm cooling units with Comfort controller

The interface card is an extension for TopTherm cooling units with Comfort controller. In this way it is possible, e.g. to monitor a master/slave combination of up to 10 cooling units. Control is achieved via standardised interfaces: RS232 (DB9) or RS 485, one PLC interface (DB9). RS 422 (RJ45 jack) is the connection to the Rittal CMC-TC. Remote monitoring via TCP-IP, graphical interfaces for operation, evaluation and control, documentation, connection to additional sensors for access control, monitoring is therefore possible. The extension card is built into a 1 U plastic housing. A voltage supply of 24 V DC is needed. This may be supplied from the CMC-TC via a wide-range power pack DK 7320.425 (100 to 240 V AC, 50/60 Hz) or externally via a Kycon connector.

Packs of	Model No. SK
1	**3124.200**

Supply includes:
Interface card integrated into a plastic box W x H x D (mm): 136 x 44 (1 U) x 129.

Serial SUB-D cable, 1.5 m.



SK bus system

The SK bus system facilitates communications between several enclosure cooling units, version Rittal TopTherm .500/.510/.540, production date 05/02 or later, via a master/slave construction such as that required e.g. in complex bayed enclosure systems for optimum operating results.

Technical specifications:
The master/slave construction facilitates common activation and deactivation via door limit switches, parallel activation and deactivation via a temperature setpoint, and common collective fault signals and temperature logging, thereby eliminating the need for intricate wiring.

For	Model No. SK
TopTherm	**3124.100**
Climate controlled enclosures	**3124.000**

Supply includes:
3 m shielded interface cable, including operating manual on programming the cooling units.

Note:
$n_B = n_K - 1$
n_B: Number of order units (SK bus system)
n_K: Number of cooling units to be linked

Property rights:
German patent no. 196 15 469

Cable connection kit

for CS Outdoor cooling units
For simple connection of CS cooling units. All cables preassembled with the corresponding connectors.
Length of cables approx. 2500 mm.

Supply includes:
1 set = 3 cables for AC,
door operated switch and
alarm connection.

Packs of	Model No. CS
1 set	**9765.105**

Cable connection kit

for CS Outdoor heat exchangers
For simple connection of CS heat exchangers. All cables preassembled with the corresponding connectors.
Length of cables approx. 2500 mm.

Option	Model No. CS
3 cables for AC/DC and alarm connection	**9765.110**
2 cables for DC and alarm connection	**9765.115**

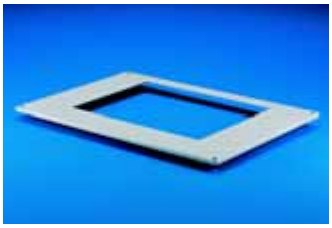
Test adaptor

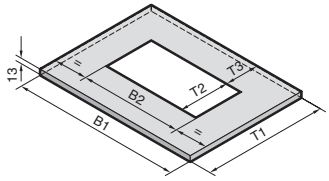
for CS Outdoor climate control equipment
The 9-pole sub-D interface allows testing of all CS climate control equipment. Alternatively supports automatic or manual test procedures.

Supply includes:
1 set = test adaptor
including 2 m connection cable.

Packs of	Model No. CS
1 set	**9765.050**

General





B = Width
T = Depth

Roof plates TS

For mounting on:
- TopTherm roof-mounted cooling units
- TopTherm roof-mounted fan
- Vent attachment TS

The cutouts in the roof plate are arranged in such a way that the TopTherm roof-mounted cooling units are positioned centrally on the enclosure.

Material:
Sheet steel

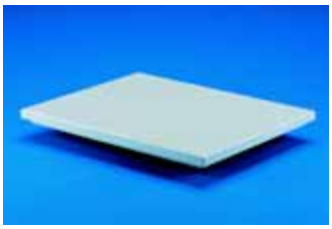
Supply includes:
Assembly parts.

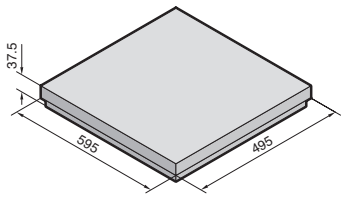
Colour:
RAL 7035

For enclosures W x D mm	To fit the mounting of TopTherm	Model No. TS
600 x 600	SK 3382. . . .	**8801.300**[1]
800 x 600		**8801.320**
600 x 600	SK 3273.5. . SK 3383. . . . SK 3384. . . . SK 3385. . . .	**8801.310**[1]
800 x 600		**8801.330**
1200 x 600		**8801.350**
800 x 600	SK 3386. . . . SK 3387. . . .	**8801.340**[2]
1200 x 600		**8801.360**

[1] When mounting the cooling units, there may be a collision with the eyebolts of the enclosure; for this reason roof fastening screws are supplied loose with the roof plates.
[2] Attachment is from the inside using metal brackets and retaining clamps.

For mounting TopTherm	B1	B2	T1	T2	T3	Model No. TS
SK 3382. . .	567.5	475	567.5	260	129.3	**8801.300**
SK 3382. . .	767.5	475	567.5	260	129.3	**8801.320**
SK 3383. . . /SK 3384. . . /SK 3385. . .	567.5	490	567.5	390	61.3	**8801.310**
SK 3383. . . /SK 3384. . . /SK 3385. . .	767.5	490	567.5	390	61.3	**8801.330**
SK 3383. . . /SK 3384. . . /SK 3385.XXX	1167.5	490	567.5	390	61.3	**8801.350**
SK 3386. . . /SK 3387. . .	767.5	692	567.5	392	57.8	**8801.340**
SK 3386. . . /SK 3387. . .	1167.5	692	567.5	392	57.8	**8801.360**





Vent attachment TS

For passive ventilation with labyrinthine air flow routing, to match the roofs for TopTherm roof-mounted cooling units.

Colour:
RAL 7035

Protection category:
IP 43

Supply includes:
Assembly parts.

For roof plates with cutout	Model No. TS
490 x 390 mm	**8801.380**

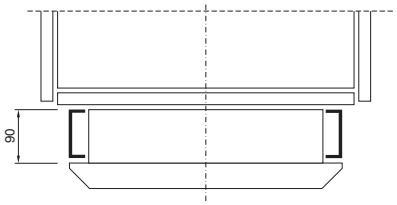
Trim frame

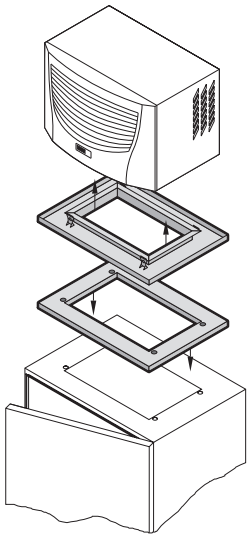
for slimline cooling units
Slimline cooling units can be internally or externally mounted on an enclosure door or wall. The trim frame presents a closed front for the cooling unit.

Material:
Sheet steel

Colour:
RAL 7035

For cooling unit	Model No. SK
SK 3366. . . . SK 3377. . . .	**3377.000**





Quick-change frame

for TopTherm roof-mounted cooling units

The quick-change frame is more than just an alternate frame. Together with the seal, the lower part of the frame is screw-fastened to the enclosure, making it possible to attach or remove the plug-in cooling unit to/from the top part of the quick-change frame previously mounted on the cooling unit using quick-release fasteners. In case of servicing, this means minimal assembly times and hence minimal downtime. What is more, the quick-change frame offers effective protection against the ingress of oil into the enclosure in oily atmospheres, thanks to its integral drainage trough.

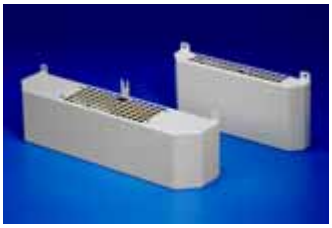
Material:
Sheet steel

Colour:
RAL 7035

Supply includes:
Quick-change frame, seal, quick-release fasteners.

For TopTherm cooling unit	Model No. SK
SK 3382. . . .	**3286.700**
SK 3383. . . . SK 3384. . . . SK 3385. . . .	**3286.800**
SK 3386. . . . SK 3387. . . .	**3286.900**

Property rights:
German patent no. 41 10 323
French Patent no. 2 675 317
GB patent no. 2 254 735



Electronic condensate evaporator

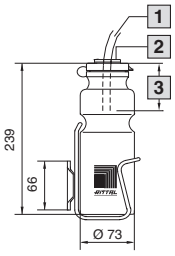
For external mounting on enclosures.
For use with all enclosure cooling units and air/water heat exchangers.
Evaporation performance:
[1] 2.4 l/d
[2] 4.2 l/d

Colour:
RAL 7035

Supply includes:
Electronic condensate evaporator, ready for connection.

Rated operating voltage	Model No. SK	
	For SK 3302/ SK 3303	For 400 mm wide cooling units
230 V, 50/60 Hz	**3301.560[1)]**	**3301.570[2)]**
115 V, 50/60 Hz	**3301.580[1)]**	**3301.590[2)]**

Detailed drawing,
see page 1184.



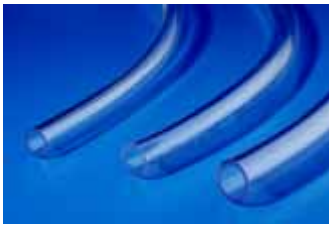
Condensate collecting bottle

For mounting on the enclosure.
For use with all enclosure cooling units and air/water heat exchangers.
Safety overflow at the side.
Capacity approximately 0.75 l.

1 Condensate discharge tube
2 Membrane grommet
3 max. 70 mm

Packs of	Model No. SK
1	**3301.600**

Supply includes:
Condensate collecting bottle, bottle holder including assembly parts.



Condensate hose

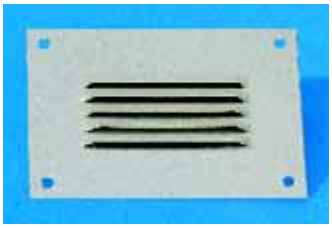
For removing and forwarding condensate. For connecting to enclosure cooling units.

Material:
PVC, transparent

Supply includes:
10 m hose

For devices	Material thickness Ø	Model No. SK
SK 3302. . . /SK 320.	8 x 1.5 mm	**3301.608**
SK 3303. . . /SK 3361. . . .	10 x 1.5 mm	**3301.610**
SK 3273. . . /SK 3304. . . / SK 3305. . . /SK 3328. . . / SK 3329. . . /SK 3332. . . / SK 3366. . . /SK 3359. . . / SK 3382. . . /SK 3383. . . / SK 3384. . . /SK 3385. . . / SK 3386. . . /SK 3387. . . / SK 3377. . . .	12 x 2 mm	**3301.612**

General



Integrated louvres

For ventilation by convection; easily retro-fitted using 4 screws.

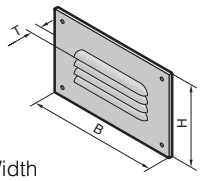
Material:
Sheet steel

Colour:
RAL 7035

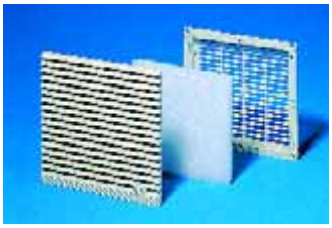
W mm	H mm	D mm	Packs of	Model No. SK
160	110	8	4	**2541.235**
210	100	8	4	**2542.235**
330	110	8	4	**2543.235**

For RAL 7032, use order extension .200; to order primed version, use extension .300. Delivery times available on request.

Detailed drawing,
see page 1184.



B = Width
T = Depth



Outlet filter

For ventilation by convection, an outlet filter can be installed in the upper and lower sections of the enclosure.

Material:
ABS,
material resistance to UL 94-V0.

Colour:
RAL 7035

Supply includes:
Outlet filter including filter mat.

Dimensions in mm	Model No. SK
116.5 x 22	**3321.207**
148.5 x 24.5	**3322.207**
204 x 30	**3323.207**
255 x 30	**3325.207**
323 x 30	**3326.207**

For RAL 7032, use order extension .200.

Note:
EMC version,
see page 640.

Accessories:

Spare filter mats,
see page 670.
Fine filter mats,
see page 670.

Hose-proof hoods

for fan-and-filter units/outlet filters
When the hose-proof hood is mounted above the fan-and-filter unit and outlet filter in conjunction with a fine filter mat, a protection category of IP 56 to EN 60 529/10.91 is achieved. Particularly suitable for use in the food industry.

Material:
Stainless steel

Protection category:
In conjunction with the fan-and-filter units/outlet filters, NEMA 3R + 12 is met.

For	Dimensions in mm	Model No. SK
SK 3321. . . .	150 x 260 x 40	**3321.800**[1)]
SK 3322. . . .	176 x 270 x 55	**3322.800**
SK 3323. . . .	233 x 410 x 55	**3323.800**
SK 3324. . . . SK 3325. . . .	282 x 500 x 85	**3324.800**
SK 3326. . . . SK 3327. . . .	350 x 560 x 110	**3326.800**

[1)] Delivery times available on request.

Front outlet grille 2 U

for centrifugal fans

This front outlet grille is required if a 482.6 mm (19″) cross-flow blower (SK 3144.000/SK 3145.000) is used in the lower section of the electronic enclosure and the hot air is to be expelled to the outside from the upper section of the enclosure. The design of the grille matches that of the intake grille in the cross-flow blower.
These grilles can also be used as simple inflow and outflow grilles with natural convection.

Packs of	Model No. SK
1	**3176.000**

Accessories:

Filter mat,
see page 668.

Filter holder

for roof ventilation

The use of a filter mat is required in order to increase the protection category of the roof vent (SK 3148.000).
Protection category IP 43 to EN 60 529/10.91 is achieved.

Material:
Sheet steel

Supply includes:
Filter holder including filter mat.

W x H x D mm	Model No. SK
340 x 244 x 15	**3175.000**

Accessories:

Spare filter mat,
see page 670.

Bypass safety valve

For use with recooling systems and air/water heat exchangers.

Material:
Brass

Option	Packs of	Model No. SK
1/2″_619_E bypass valve	1	**3301.900**
3/4″_619_E bypass valve	1	**3301.910**
1″_619_E bypass valve	1	**3301.920**

Flow regulator valve

For use with air/water heat exchangers. Especially if more than one heat exchanger (n > 1) is used in the water cooling circuit.

Material:
Brass

Option	Packs of	Model No. SK
3/4″ x 1/2″ flow regulator valve	1	**3301.930**
3/4″ x 3/4″ flow regulator valve	1	**3301.940**

Filter mats

Additives for recooling systems

Supply includes:
10 l canister

Rifrost	Antifrogen water mixture	Model No. SK
Outdoor	1 : 2	**3301.950**
Standard	1 : 4	**3301.960**

Filter mats

Rittal cooling units are low-maintenance and are supplied without filter mats. Filter mats may be used for extreme conditions.

Material:
Open-celled polyurethane foamed plastic with excellent physical and mechanical properties. Temperature-resistant from –40°C to +80°C. Thickness: 10 mm.

For TopTherm cooling units

For cooling unit	W x H x D mm	Packs of	Model No. SK
SK 3302.300/SK 3302.310	190 x 95 x 10	3	**3286.110**
SK 3302. . . /SK 3303. . . /SK 3361. . . .	265 x 200 x 10	3	**3286.300**
SK 3304. . . /SK 3305. . . /SK 3328. . . /SK 3329. . . / SK 3332. . . /SK 3366. . . .	344 x 268 x 10	3	**3286.400**
SK 3273. . . /SK 3382. . . /SK 3383. . . /SK 3384. . . / SK 3385. . . /SK 3359. . . .	530 x 255 x 10	3	**3286.500**
SK 3386. . . /SK 3387. . . .	720 x 300 x 10	3	**3286.600**
SK 3377. . . .	205 x 210 x 10	3	**3253.010**

For discontinued cooling units

For cooling unit	W x H x D mm	Packs of	Model No. SK
SK 3296. . . /SK 3272.100/SK 3290. . . /SK 3280.100/ SK 3299. . . /SK 3261. . . .	539 x 332 x 10	3	**3286.100**
SK 3265.100/SK 3266.100	270 x 332 x 10	3	**3267.100**
SK 3256. . . .	395 x 300 x 10	3	**3254.000**
SK 3293. . . /SK 3281.100/SK 3298. . . /SK 3279.100/ SK 3260. . . /SK 3269. . . /SK 3262.100/SK 3393. . . / SK 3381.100/SK 3391. . . .	334 x 313 x 10	3	**3294.100**
SK 3255. . . /SK 3395. . . .	350 x 245 x 10	3	**3253.000**
SK 3394. . . .	315 x 200 x 10	3	**3285.000**
SK 3292.134/SK 3278.134	325 x 250 x 10	3	**3286.000**

Filter mats

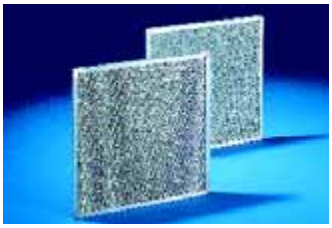
Made of chopped-fibre mat with a progressive structure. Temperature-resistant to 100°C, self-extinguishing category F1 to DIN 53 438.
Dust-laden air side: Open structure.
Clean air end: Closed structure.
Reliable filtering of virtually all types of dust from a particle size of 10 µm.

Material:
Chemical fibre

For centrifugal fans/front outlet grilles 2 U

For centrifugal fans/front outlet grilles 2 U	W x H x D mm	Packs of	Model No. SK
SK 3144.000/SK 3145.000/SK 3176.000	425 x 85 x 8	5	**3177.000**

Filter mats



Metal filter

Particularly when cooling units are used in dusty and damp environments, it is advisable to use washable metal filters.
If air or steam condenses on the metal surfaces, any particles that may be present will adhere to the metal and are easily washed out with water or grease-dissolving detergents.

Material:
Aluminium
Thickness: 10 mm

For TopTherm cooling units

For cooling unit	W x H x D mm	Packs of	Model No. SK
SK 3302.300/SK 3302.310	190 x 95 x 10	1	**3286.120**
SK 3302.100/SK 3302.110/SK 3303. . . ./SK 3361. . . .	265 x 200 x 10	1	**3286.310**
SK 3304. . . ./SK 3305. . . ./SK 3328. . . ./SK 3329. . . ./ SK 3332. . . ./SK 3366. . . .	344 x 288 x 10	1	**3286.410**
SK 3273. . . ./SK 3382. . . ./SK 3383. . . ./SK 3384. . . ./ SK 3385. . . ./SK 3359. . . .	530 x 255 x 10	1	**3286.510**
SK 3386. . . ./SK 3387. . . .	720 x 300 x 10	1	**3286.610**
SK 3377. . . .	205 x 210 x 10	1	**3253.220**

For discontinued cooling units

For cooling unit	W x H x D mm	Packs of	Model No. SK
SK 3296. . . ./SK 3272.100/SK 3290. . . ./SK 3280.100	520 x 290 x 10	1	**3286.210**
SK 3299. . . ./SK 3261. . . .	520 x 315 x 10	1	**3286.200**
SK 3265.100/SK 3266.100	265 x 320 x 10	1	**3267.200**
SK 3256. . . .	315 x 365 x 10	1	**3254.200**
SK 3293. . . ./SK 3281.100/SK 3298. . . ./SK 3279.100/ SK 3260. . . ./SK 3269. . . ./SK 3262.100/SK 3393. . . ./ SK 3381.100/SK 3391. . . .	300 x 328 x 10	1	**3294.200**
SK 3255. . . ./SK 3395. . . .	348 x 210 x 10	1	**3253.200**
SK 3394. . . .	375 x 415 x 10	1	**3285.200**

For climate control doors

For climate control door	W x H x D mm	Packs of	Model No. SK
SK 3306. . . ./SK 3307. . . ./SK 3309. . . ./SK 3310. . . .	424 x 100 x 10	1	**3284.200**
SK 3308. . . .	624 x 100 x 10	1	**3288.200**
SK 3331. . . .	380 x 150 x 10	1	**3289.200**

For Mini recooling systems

For recooling systems	W x H x D mm	Packs of	Model No. SK
SK 3318.600/SK 3318.610/SK 3319.600/SK 3319.610	530 x 255 x 10	1	**3286.510**
SK 3320.600/SK 3334.600	500 x 558 x 8	1	**3286.520**
SK 3360. . . .	344 x 268 x 10	1	**3286.410**

Filter mats

Spare filter mats

Made of chopped-fibre mat with a progressive structure.
Temperature-resistant to 100°C, self-extinguishing category F1 to DIN 53 438.
Dust-laden air side: Open structure.
Clean air end: Closed structure.
Reliable filtering of virtually all types of dust from a particle size of 10 µm.

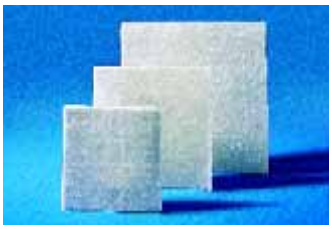
Material:
Chemical fibre

For fan-and-filter units

For fan-and-filter units	W x H x D mm	Packs of	Model No. SK
SK 3321. . . .	89 x 89 x 10	5	**3321.700**
SK 3322. . . .	120 x 120 x 12	5	**3322.700**
SK 3323. . . .	173 x 173 x 17	5	**3171.100**
SK 3324. . . /SK 3325. . . .	221 x 221 x 17	5	**3172.100**
SK 3326. . . .	289 x 289 x 17	5	**3173.100**
SK 3327. . . .	289 x 289 x 10	5	**3327.700**

For filter holders

For filter holders	W x H x D mm	Packs of	Model No. SK
SK 3175.000	338 x 242 x 20	3	**3174.000**



Fine filter mats

Made of chopped-fibre mat with a progressive structure.
Temperature-resistant to 100°C,
self-extinguishing category F1 to DIN 53 438.
Dust-laden air side: Open structure.
Clean air end: Closed structure.
Reliable filtering of virtually all types of dust from a particle size of 10 µm.

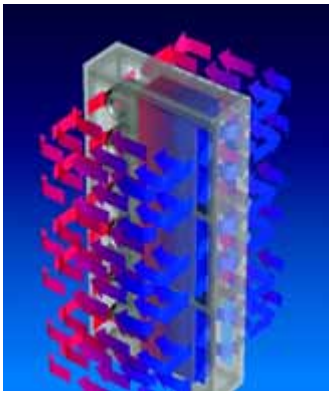
Material:
Chemical fibre

For fan-and-filter units/outlet filters

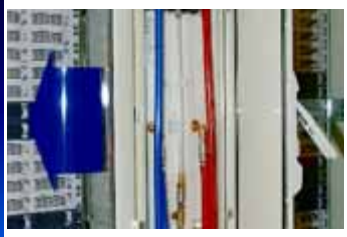
For fan-and-filter units/outlet filters	W x H x D mm	Packs of	Model No. SK
SK 3323. . . .	173 x 173 x 12	5	**3181.100**
SK 3324. . . /SK 3325. . . .	221 x 221 x 12	5	**3182.100**
SK 3326. . . /SK 3327. . . .	289 x 289 x 12	5	**3183.100**

Features

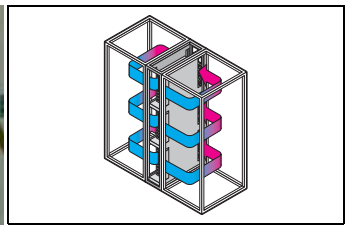
From passive air climate control to active liquid cooling of high-performance CPUs, Rittal provides all the required components and systems. They are designed precisely according to your requirements and application spectrum. Software-assisted planning and calculation of requirements, together with modular, rack-compatible technology, help to minimise investment costs, thereby offering a particularly future-safe solution with a high degree of flexibility.



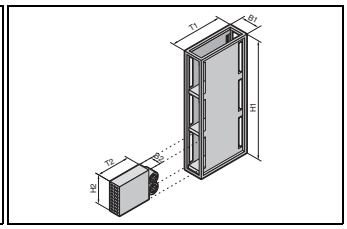
Liquid cooling package



Modular, upgradable and temperature-neutral cooling concept. 12 kW cooling output, with three cooling modules supported per cooling rack.



Optimised air routing
Cold air is blown in at the sides, so that the cold air is evenly distributed in front of the 482.6 mm (19″) level.



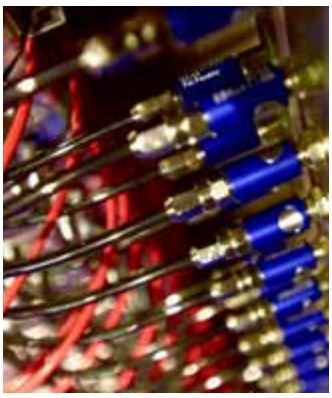
Optionally 1 or 2 server racks may be cooled – both standalone and bayed siting are possible. Bayable to TS and PS server racks, even retrospectively.

Rack-mounted recooling system

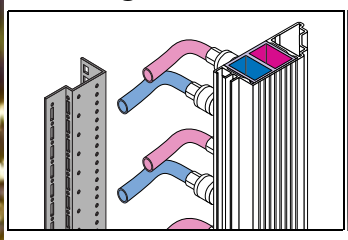
Microcontroller control

Liquid-cooled computers
in a 482.6 mm (19″) server rack are supplied via the shortest route via six cooling circuits, without the need for an additional rising main.

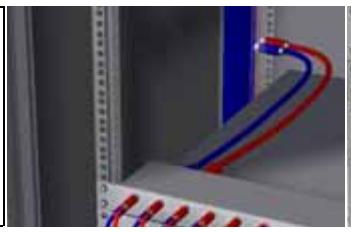
Vibration-free installation



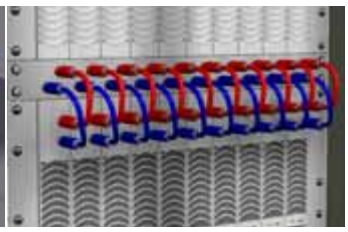
Cooling circuit distributor for processor climate control



The distributor pipes for inlet and return lines for targeted, reliable liquid cooling may be integrated into all standard rack systems.

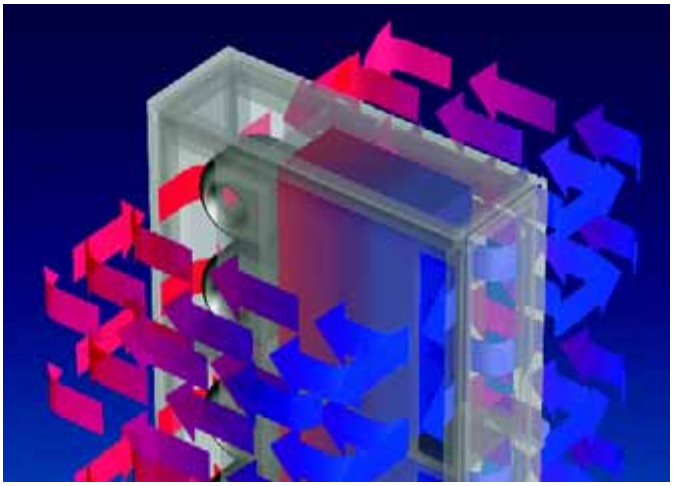


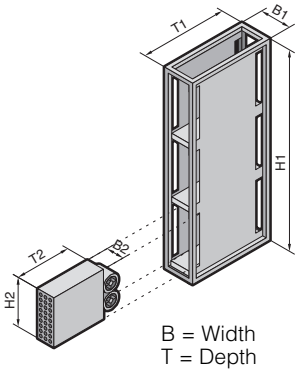
Cooling circuit distributor kit Blade server
The 482.6 mm (19″) distributors are connected to the rising main.



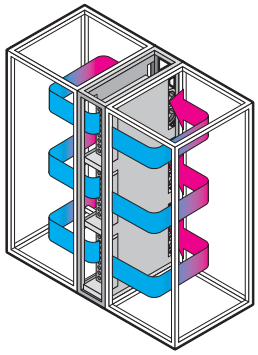
Cooling circuit distributor 482.6 mm (19″)
Connections for 10 servers and a main connection to the vertical rising main.

Rittal liquid cooling package





B = Width
T = Depth



Modular, upgradable and temperature-neutral cooling concept.

- Max. 12 kW cooling output, with three cooling modules possible per cooling rack.
- Approx. 4 kW cooling output per cooling module at 800 m³/h air throughput.
- Optimised air routing: Cold air is blown in at the sides, so that the cold air is evenly distributed in front of the 482.6 mm (19″) level.
- Optionally 1 or 2 server racks may be cooled – stand-alone and bayed siting possible.
- Bayable to TS and PS server racks, even retrospectively.
- Active condensate handling.
- Optional control and monitoring[1] of the cooling rack via Rittal CMC-TC.
- Two-piece modules; for easy installation in narrow passageways.

Technical specifications:

- Mounted as a cooling rack on a server rack based on TS 8, with H = 2000 mm, D = 1000 mm.
- Each cooling rack can accommodate a maximum of three air/water heat exchanger cooling modules.
- Standard supply: Cooling rack equipped with one cooling module.
- Individual modules upgradable to full installation via quick-release couplings.
- Control via a separate module which may be connected to the CMC-TC for incorporation into the network (monitoring).
- Condensation management: The pump in the condensate tray pumps any condensation into the return section of the cooling circuit.

		Enclosure + 3 modules		Individual module for 230 V/115 V
Model No. SK		**3301.230**	**3301.210**	**3301.250**
Rated operating voltage V, Hz		230, 50/60	115, 50/60	230, 50/60
Dimensions in mm	W H D	300 2000 1000		250 550 950
Useful cooling output at 15°C water inlet, 15 l/min, 20°C cold air		**4000 W/3500 W**	**4000 W/3500 W**	**4000 W/3500 W**

Rated current max.	1.8 A	
Pre-fuse T	5.0 A	
Cooling medium	Water (specifications may be found on the Internet)	
Water inlet temperature	+5°C to +30°C	
Permissible operating pressure p. max.	2 to 8 bar	
Temperature range	+5°C to +40°C	
Protection category to EN 60 529/10.91	IP 30	–
Duty cycle	100 %	
Type of connection	Current: Connection cable with earthing-pin plug: Water: ³/₄″ quick-release fastener	
Weight	max. 160 kg	approx. 25 kg
Colour	RAL 7035	
Air throughput of fans	max. 2400/2100 m³/h	800/700 m³/h
Temperature control	Electronically controlled magnetic valve and 4-way fan control	

[1] Flow, leakage, inlet/return, intake/exhaust temperature.
The general remarks on air/water heat exchangers (available on the Internet) apply.

For professional installation of the heat exchanger, where possible, the enclosures being cooled should be sealed against the ingress of ambient air:

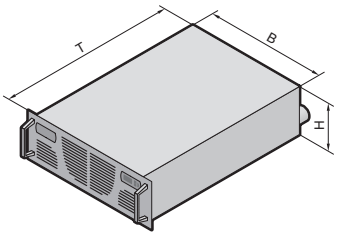
Description	Dimensions in mm		Packs of	Model No.
Side panel, screw-fastened	H x D	2000 x 1000	2	**8100.235**
Glazed door	W x H	600 x 2000	1	**8610.600**[2]
		800 x 2000	1	**8610.800**[2]
Sheet steel door, solid	W x H	600 x 2000	1	**7824.205**[2]
		800 x 2000	1	**7824.207**[2]
[2] Alternatively: Sealing kit for vented sheet steel doors, size	W x H	600 x 2000	1	**7824.185**
	W x H	800 x 2000	1	**7824.187**

Description	Dimensions in mm		Packs of	Model No.
Divided partitioning plate for retrospective sealing in the base area	W x D	600 x 1000	1	**7825.300**
		800 x 1000	1	**7825.302**
Divided roof plate for cable entry	W x D	600 x 1000	1	**7826.605**[3]
		800 x 1000	1	**7826.805**[3]
Sealing kit for two-sided cooling when bayed			1 set	**7825.305**

[3] Retrospective installation is not possible.

Accessories Page 657 **Recooling systems** From page 606 **Server enclosures** From page 734 **Configuration software** Page 1063

Rack-mounted recooling system



B = Width
T = Depth

Liquid-cooled computers in a 482.6 mm (19″) server rack are supplied via the shortest route via six cooling circuits, without an additional rising main.

- Partial liquid cooling in heterogeneous environments.
- Combination of air and liquid cooling possible.

Technical specifications:

- Installation in the 482.6 mm (19″) level of the enclosure.
- 6 cooling circuit connections for server/CPU cooling on the back of the chiller via drip-free quick-release coupling.
- Vibration-free installation.
- 2 freely programmable alarm outputs.
- Operating pressure display.
- Optional automatic bypass.

Also required:

- Quick-release couplings
- Heat sink, retaining clamps
- Hose,
  see page 675.

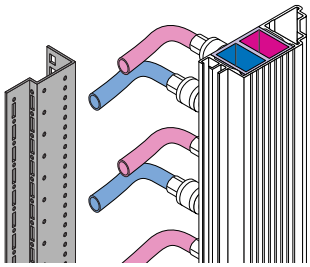
Model No. SK		**3301.260**
Rated operating voltage V, Hz		230, 50/60
Dimensions in mm	W H D	442 175 751 + 100 mm for water connections
Cooling output at T_w = 25°C T_u = 32°C, 2 l/h		**1000 W/1070 W**

Power consumption		640/790 W
Rated current max.		4.5 A
Refrigerant		R134a, 550 g
$P_{max.}$ cooling circuit		25 bar
Temperature range	Environment	+10°C to +40°C
	Liquid media	+10°C to +35°C
Pump capacity		4 l/min at 2 bar
Tank		Pressure-sealed
Tank capacity		–
Water connections		Quick-release coupling, drip-free
Weight		45 kg
Colour		Textured RAL 7035.
Protection category (electrics)		IP 20
Air throughput of fans		450 m³/h
Temperature control		Microcontroller, setting range +10°C to +30°C, factory setting +18°C

Delivery times available on request.

Accessories Page 657 **Recooling systems** From page 606 **Server enclosures** From page 734 **Configuration software** Page 1063

Power Cooling System PCS



Cooling circuit distributor for racks

Water cooling
High performance for CPUs, power packs and disk drives by cooling directly at the area where heat is generated. The distributor pipes for inlet and return lines for targeted, reliable liquid cooling may be integrated into all standard rack systems.
They are linked to an external, central recooling unit which also controls the inlet temperature. The drip-free quick-release coupling ensures an extremely high level of operational reliability. Monitoring of the system functions is performed by the tried-and-trusted Rittal CMC-TC module.
There are 2 complete basic packages available for retro-fitting for different enclosure heights.

Supply includes:

Package 1
Water infeed:
Connection system, non-return valve and 10 m hose, $^1/_2$″, fittings, filter, vent valve.

Water distribution:
Cooling circuit distributor for 20 CPU cooling circuits, vent valve, 40 bulkhead couplings, 50 m distributor hose, 6 mm.

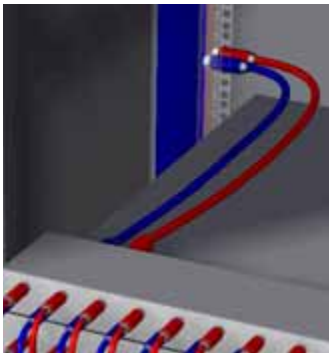
Package 2
Water infeed:
Connection system, non-return valve and 10 m hose, $^1/_2$″, fittings, filter, vent valve.

Water distribution:
Cooling circuit distributor for 40 CPU cooling circuits, vent valve, 80 bulkhead couplings, 100 m distributor hose, 6 mm.

For enclosure height		Model No. SK	
mm	U	Package 1	Package 2
1200	24	**3301.810**	–
2000	42	–	**3301.820**

Also required:
Recooling system,
see page 608 onwards.

Accessories:
Distributor accessories,
see page 675.



Cooling circuit distributor kit

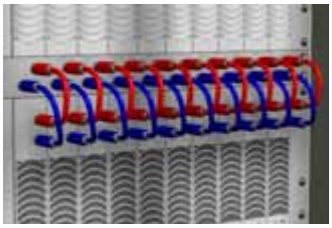
for Blade server
Our liquid cooling for server racks serves as a basis for this solution. The large number of drip-free taps to the individual computers is now replaced by the connection of horizontal liquid sub-distributors, where the drip-free connectors for connection of the Powerblade are found.
5 units are possible with 7 U per server and 1 per 482.6 mm (19″) distributor. The individual 482.6 mm (19″) distributors are connected to the rising main with drip-free connectors, so that the system is modular and scalable.

Supply includes:
1 vertical rising main with 5 taps,
1 482.6 mm (19″) cooling circuit distributor with 10 inlet and return connections,
1 connection hose (inlet and return) from the 482.6 mm (19″) cooling circuit distributor to the vertical rising main,
1 connection hose (inlet and return) from the vertical rising main to the recooler

Packs of	Model No. SK
1	**3301.280**

Also required:
Recooling system,
see page 608 onwards.

Accessories:
482.6 mm (19″) distributor,
distributor accessories,
see page 675.



Cooling circuit distributor 19″

For installation in the 482.6 mm (19″) level with drip-free connections for 10 servers and a main connection to the vertical rising main;
0.5 m hose in each case for the inlet and return.

Packs of	Model No. SK
1	**3301.270**

Accessories:

Distributor accessories,
see page 675.

Distributor accessories

Description		Packs of	Model No. SK
Heat sink		1	**3301.000**
Connector for heat sink	6 mm	2	**3301.010**
	4 mm	2	**3301.020**
Retaining clamps	Athlon	1	**3301.030**
	Opteron	1	**3301.040**
	Xeon	1	**3301.050**
	P 4	1	**3301.060**
Connection system for hose (sold by the metre)	4 mm	1	**3301.070**
	6 mm	1	**3301.080**
Screw-in coupling G 1/8″ with seal		10	**3301.090**
Screw-in connector G 1/8″ with seal		10	**3301.130**
Connector sleeve, 6 mm		10	**3301.160**
Connector grommet, 6 mm		10	**3301.170**
Straight screw-in connector G 1/8″, 6 mm		10	**3301.180**
Sealing bung, 6 mm		10	**3301.190**
Y-adaptor, 6 to 2 x 4 mm		10	**3301.700**
Water distribution: 2 x rising main 24 U for TS 8, vent valve, screw-in connector 1/2″, screw-in coupling 1/2″		1	**3301.710**
Water distribution: 2 x rising main 42 U for TS 8, vent valve, screw-in connector 1/2″, screw-in coupling 1/2″		1	**3301.720**
Water infeed: 2 x connector grommet 1/2″, 2 x connector sleeve 1/2″, hose 1/2″ (10 m), non-return valve 1/2″, dirt trap (with 2 x 1/2″ connector sleeve), screw-in connector 1/2″ (on the cooling unit), screw-in coupling 1/2″ (on the cooling unit), 6 x hose clamps 1/2″		1	**3301.730**
Monitoring at the connection to the CMC: Temperature sensor + clamping screw fastening		1	**3301.740**
Accessories/work materials	Hose cutter	1	**3301.750**
	Thermally conductive paste	1	**3301.760**
	Teflon sealing tape	1	**3301.770**
	Sealing bung 1/4″	1	**3301.780**

Permanent availability of your IT systems is undoubtedly crucial. This is your company's heartbeat. For this reason, it is important to ensure stable conditions for your complex server and software system architecture. With this in mind, Rittal combines the five key elementary infrastructure components to create an extremely variable, and above all secure system: **Rack, Power, Cooling, Security, Monitoring & Remote Management.** With Rittal, a high level of IT availability is guaranteed.

IT Solutions

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RimatriX5

The data centre of the future

New software, rising computer performance, high levels of availability –

these are the new challenges placed on the physical IT infrastructure.

Whether your company is small, medium-sized or large, the requirements on IT performance are growing. Highly complex applications, faster processors, and round-the-clock information and communication – all this demands a physical infrastructure which is more than intact. This leads to a number of elementary questions:

- Will the climate control of individual racks, entire server rooms and data centres withstand the rising heat generated?
- Is the energy supply and back-up designed for a high level of availability?
- How can the existing space be used to optimum effect, even with expansion?
- Are the applications and servers protected from physically-induced failures?
- Can all functions be efficiently managed via a perfect monitoring and remote system?
- Is uninterrupted expansion possible at any time?
- Are the costs under control?

The RimatriX5 concept solves all these tasks. The complete solution from Rittal, for the data centre of the future.

Rittal has the solution: RimatriX5 – the holistic, scalable,

efficient system solution for high levels of IT peformance,

with the added benefits and cost advantages of modularity.

RIMATRIX5
DRIVING IT-PERFORMANCE

With the perfectly coordinated components of rack, power, cooling, security and monitoring/remote management, you get an integral, holistic solution for the IT infrastructure. **Added value is provided by RimatriX5 with its globally available, local service:** Configuration and monitoring support via software, precise risk analysis, application-tailored installation and maintenance service and a rapid escalation service.

With RimatriX5, Rittal offers holistic solutions for a reliable, available and cost-saving IT infrastructure.

Be it server room or data centre, high or exceptional availability – the individual modules of RimatriX5 adapt at any time to suit the individual requirements. What's more, they grow along with requirements:

Monitoring & Remote Management

Thanks to simple operation and administration with the "Monitoring & Remote Management" module of RimatriX5, maintenance and operating costs may be permanently reduced in day-to-day operation, whilst overall availability is enhanced. For example, comprehensive monitoring, measurement and control tasks via the CMC module reduce the risk of failure and facilitate preventive intervention.

Security

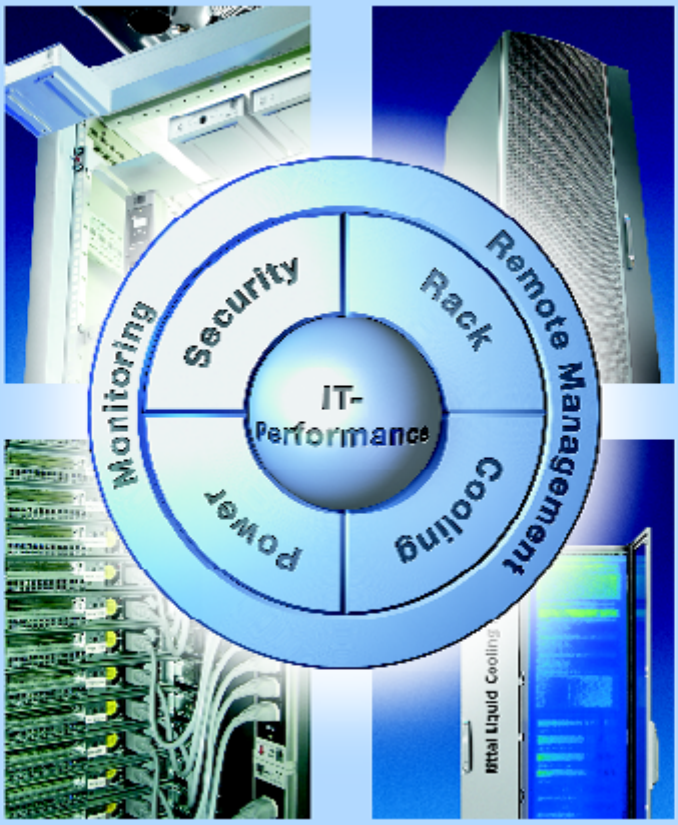
Due to modules for physical rack security and room protection within RimatriX5, a high level of protection of the IT infrastructure is guaranteed. For example, when it comes to physical rack security, temperature, smoke and vibration sensors coupled with modern access control solutions and tested enclosure extinguisher systems provide reliable protection against external influences.

See page 762.

Power

The Power module within the RimatriX5 concept ensures a constant and consistent energy supply.
From plug & play power distribution in the IT rack, to power distribution within the space, to power supply back-up with requirement-based UPS, the Power module of RimatriX5 offers optimum energy performance for a high level of availability.

See page 742.



Rack

As one of the world's leading manufacturers of server and network enclosures, Rittal offers an extensive selection with a unique range of accessories.
In this way, you can create the requirements for high-end individual expansion of your IT infrastructure with greater freedom, more flexibility, and enhanced security.

See page 680.

Cooling

With the climate control concepts of RimatriX5, investment costs are minimised, and investment security is maximised. From fans to active liquid cooling, the climate control solutions may be tailored to actual requirements. This helps to cut investment costs and offers adequate scope for future expansions.

See page 758.

The modular principle for the physical IT infrastructure means system solutions rather than piecework – scalable, flexible, and tailored to your application:

RimatriX5 – Driving IT performance

Features

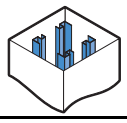
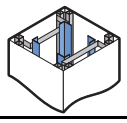
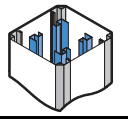
You define your requirements – Rittal has the solution!

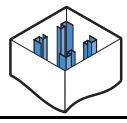
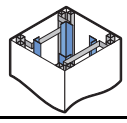
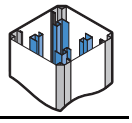
A variety of system platforms will accommodate your differentiated requirements in the networking sector.

You have the performance for new technologies today.

Consequently, your network grows effortlessly in line with new tasks.

The flexbility of its systems allows Rittal to offer this exceptional future-proofing.

Rittal system comparison	TE 7000	TS 8	FR(i)
One platform for all requirements in the IT market			
Load capacity			
up to 400 kg	■■■	■■■	■■■
up to 1000 kg		■■■	■■■
Baying			
side	■■■	■■■	■■■
in all levels		■■■	
Climate control			
Fan	■■■	■■■	■■■
Climate control device		■■■	■■
Air/water heat exchanger		■■■	
CPU liquid cooling		■■■	■■■
Cabling			
Cable space	■■■	■■	■■
Cable management	■■■	■■■	■■■

Rittal system comparison	TE 7000	TS 8	FR(i)
One platform for all requirements in the IT market			
Lock system			
2-point	■■■	■■■	■■■
4-point		■■■	
Security			
Access control	■■■	■■■	■■■
Climate control	■■■	■■■	■■■
Dismantling	■■■	■	■
Interior installation			
Depth-variable	■	■■■	■■
Partial installation		■■■	
2-level principle		■■■	■
Design	■■	■■	■■■
Standards IEC 60 297-1/2	■■■	■■■	■■■

Note: The more (symbol) the greater the compatibility.

TE 7000

Two 482.6 mm (19″) mounting levels in the multi-functional section create a solid framework. Load capacity 400 kg!

The benefits of this rack without an enclosure frame: Optimum accessibility, maximum use of the interior space, and superfast assembly.

482.6 mm (19″) distance between levels:
Tailored to Premium accessories in 50 mm increments, or fully depth-variable via the slot attachment.

TS 8

An ingenious symmetrical concept with baying on all sides. With two levels, the frame section affords infinite assembly diversity.

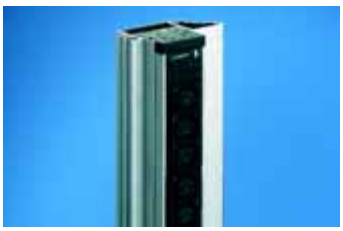
Fully depth-variable interior installation creates flexibility for various installed equipment. Fast assembly by simply locating and securing.

Climate control
For example, a fan unit integrated into the TS 8 twin wall for targeted air routing in the lower part of the enclosure.

Features

flexRack(i)

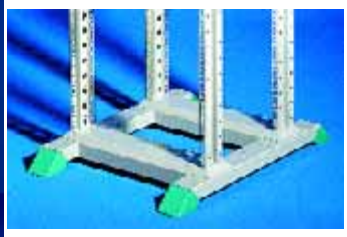
Cable management
Cables may be routed and system accessories integrated within the hollow chamber of the frame section.



Power management integrated directly into the frame section. Three-phase infeed using the plug & play system, with no loss of enclosure volume.

Liquid cooling
The profile of the flexRack(i) allows integration of the inlet and return lines for targeted, safe liquid cooling.

DataRack



A second mounting level for heavy equipment or double panel assembly. Compatible with Rittal system accessories.

RiLab

Supporting column with two vertical tapped strips for flexible mounting on a 32 mm height pitch pattern. The 6-way socket strip with switch may be integrated into the power column.

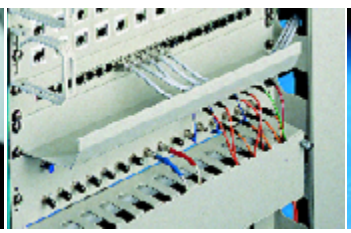
Cable management

Gland plate module with brush strip for cable entry in the base area.

Cable clamp rail, depth-variable
The cable clamp rails may be located directly between two mounting frames.

Cable management 482.6 mm (19″)

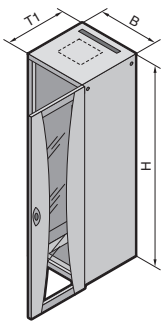
The surplus cable holder may be attached to all support strips or to punched sections and rails with a 25 mm pitch pattern.

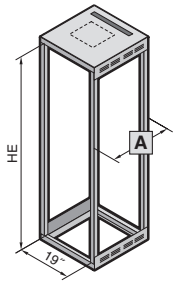


Grooved cable routing panel 482.6 mm (19″)
To hold the patching cables.

Fibre-optic shunting rings
Strain relief and bend radii are guaranteed by the specific design.

Network enclosures, based on Rittal TE 7000, width 600





B = Width
T = Depth
HE = U

A = Defined mounting distance for Premium accessories, see below.

Benefits:
- Coordinated accessories for fast installation in the delivered state
- No frame structure, optimum accessibility
- Load capacity up to 400 kg.

Material:
Sheet steel

Surface finish:
Mounting frame:
Electrophoretic dipcoat-primed
Enclosure panels:
Powder-coated,
RAL 7035/RAL 9005.

Supply includes:
Self-supporting 482.6 mm (19″) frame structure,
glazed door at the front,
two-point locking rod, recessed handle and security lock 3524 E,
sheet steel door at rear, two-point locking rod, recessed handle and security lock 3524 E,
pluggable side panels with security lock 3524 E,
base frame with maximum cutout (for optional population with module plates), roof plate for cable entry with covered cutout for fan, levelling feet, spacers for raising the cover plate.

Detailed drawing,
available on the Internet.

U	12	12	24	24	42	42	47	47
Width (B) in mm	600	600	600	600	600	600	600	600
Height (H) in mm	600	600	1200	1200	2000	2000	2200	2200
Depth (T1) in mm	600	800	600	800	600	800	600	800
482.6 mm (19″) distance between levels in its delivered state A	495	495	495	495	495	495	495	495
Model No. TE	**7000.390**	**7000.410**	**7000.430**	**7000.440**	**7000.500**	**7000.510**	**7000.560**	**7000.570**
Model No. TE as a bayed enclosure without side panels, incl. baying kit	–	–	–	–	**7000.502**	–	**7000.562**	–
Model No. TE incl. side panels, RAL 9005	–	–	–	–	**7000.505**	**7000.515**	–	–

A 495 mm – that is the distance between the two 482.6 mm (19″) levels in the delivered state for all enclosure formats. Corresponds to TS 8 nominal size, depth 400 mm, inner level.

B Pitch spacing 50 mm. The distance between the two 482.6 mm (19″) levels may be varied in 50 mm increments (445 to 695 mm).

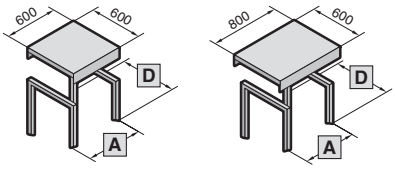
C Distance from door:
52.5 mm for depth 600
152.5 mm for depth 800

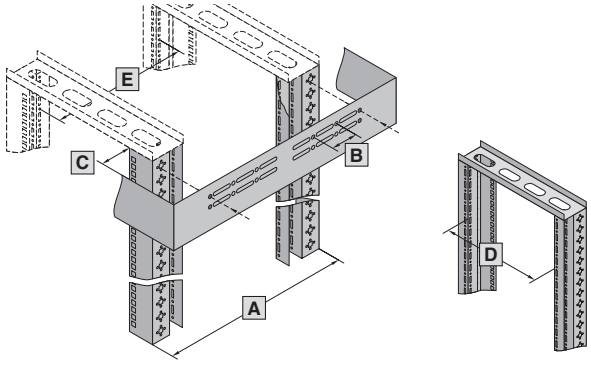
D The mounting distance in a rear mounting frame, horizontal, corresponds to the frame mounting dimensions of a 600 mm wide TS 8 (outer level, 525 mm).

E = A – 120 mm

The distance between levels is freely selectable via the slot fastening. All key mounting components – punched sections with mounting flanges, divider kits, slide rails, component shelves – are also available in depth-variable format.

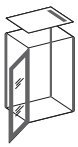
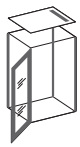
German registered design no. 403 07 489





Accessories Page 832 **Monitoring** Page 762 **Climate control** Page 578

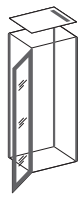
Network enclosures, based on Rittal TE 7000, width 600

					
U	12	12	24	24	Page
Width (B) in mm	600	600	600	600	
Height (H) in mm	600	600	1200	1200	
Depth (T1) in mm	600	800	600	800	
482.6 mm (19″) distance between levels in its delivered state A mm	495	495	495	495	
Model No. TE	**7000.390**	**7000.410**	**7000.430**	**7000.440**	
Model No. TE as a bayed enclosure without side panels, including baying kit	–	–	–	–	
Doors					
Glazed front door/sheet steel rear door	■	■	■	■	
Sheet steel front door/sheet steel rear door	On request	On request	On request	On request	
Ergoform-S handle for semi-cylinder, in exchange for the existing lock	2435.000	2435.000	2435.000	2435.000	885
Side panel					
Side panel, plug-type, including security lock 3524 E	■	■	■	■	856
Baying kit	7000.640	7000.640	7000.640	7000.640	867
Roof					
Roof plate with brush strip for cable entry, prepared to accommodate an active fan unit	■	■	■	■	
Fan unit, 2 fans (max. 3) including thermostat	7000.670	7000.670	7000.670	7000.670	651
Fan expansion kit	7980.000	7980.000	7980.000	7980.000	649
Spacers 20 mm to raise the cover plate above the fan cutout	■	■	■	■	
Base/plinth					
Roof frame with maximum cutout for individual population with module plates, levelling feet M10	■	■	■	■	
Module plate variants for individual population	from page 903	from page 903	from page 903	from page 903	
Base/plinth components solid, front and rear	8601.605	8601.605	8601.605	8601.605	835
Base/plinth components, vented, front and rear	7825.601	7825.601	7825.601	7825.601	835
Base/plinth trim, side	8601.065	8601.085	8601.065	8601.085	835
Base/plinth adaptor for levelling feet M12	8800.220	8800.220	8800.220	8800.220	849
Levelling feet M12	4612.000	4612.000	4612.000	4612.000	848
Base/plinth installation accessories	from page 834	from page 834	from page 834	from page 834	
Interior installation/Premium accessories					
482.6 mm (19″) mounting frames front and rear	■	■	■	■	
Punched section with mounting flange 17 x 73 mm, for mounting installation components, attached in the enclosure depth between the 482.6 mm (19″) mounting frames	8612.040	8612.040	8612.040	8612.040	921
Cable clamp rail, depth variable 425 – 725 mm, for cable attachment in the enclosure depth using cable ties	7858.160	7858.160	7858.160	7858.160	984
Cable clamp rail, for cable attachment in the enclosure width via cable ties, on the 482.6 mm (19″) mounting frame at the rear	7828.062	7828.062	7828.062	7828.062	983
C rail, for cable clamping in the enclosure depth via cable clamps	7828.040	7828.040	7828.040	7828.040	928
C rail, for cable clamping in the enclosure width via cable clamps, on the 482.6 mm (19″) mounting frame at the rear	7828.060	7828.060	7828.060	7828.060	928
Earthing kit for TE	7000.675	7000.675	7000.675	7000.675	961
TE socket strip, 8-way, with earthing-pin plug	7000.630	7000.630	7000.630	7000.630	748
Power management	from page 742	from page 742	from page 742	from page 742	
Slide rail for TE, for attachment between the 482.6 mm (19″) mounting frames, length 424 mm	7963.410	7963.410	7963.410	7963.410	1011
482.6 mm (19″) component shelf for fixed installation, for direct screw fastening without an installation kit, 412 mm deep, load capacity 30 kg, static	7000.620	7000.620	7000.620	7000.620	945
Cable management	from page 984	from page 984	from page 984	from page 984	
CMC-TC system monitoring	from page 762	from page 762	from page 762	from page 762	

■ included with the supply

Accessories Page 832 **Monitoring** Page 762 **Climate control** Page 578

Network enclosures, based on Rittal TE 7000, width 600

					
U	42	42	47	47	Page
Width (B) in mm	600	600	600	600	
Height (H) in mm	2000	2000	2200	2200	
Depth (T1) in mm	600	800	600	800	
482.6 mm (19″) distance between levels in its delivered state A mm	495	495	495	495	
Model No. TE	**7000.500**	**7000.510**	**7000.560**	**7000.570**	
Model No. TE as a bayed enclosure without side panels, including baying kit	**7000.502**	**–**	**7000.562**	**–**	
Doors					
Glazed front door/sheet steel rear door	■	■	■	■	
Sheet steel front door/sheet steel rear door	On request	On request	On request	On request	
Ergoform-S handle for semi-cylinder, in exchange for the existing lock	2435.000	2435.000	2435.000	2435.000	885
Side panel					
Side panel, plug-type, including security lock 3524 E	■ (7000.500 only)	■	■ (7000.560 only)	■	856
Baying kit	■ (7000.502 only)	7000.640	■ (7000.562 only)	7000.640	867
Roof					
Roof plate with brush strip for cable entry, prepared to accommodate an active fan unit	■	■	■	■	
Fan unit, 2 fans (max. 3) including thermostat	7000.670	7000.670	7000.670	7000.670	651
Fan expansion kit	7980.000	7980.000	7980.000	7980.000	649
Spacers 20 mm to raise the cover plate above the fan cutout	■	■	■	■	904
Base/plinth					
Roof frame with maximum cutout for individual population with module plates, levelling feet M10	■	■	■	■	
Module plate variants for individual population	from page 903	from page 903	from page 903	from page 903	
Base/plinth components solid, front and rear	8601.605	8601.605	8601.605	8601.605	835
Base/plinth components, vented, front and rear	7825.601	7825.601	7825.601	7825.601	835
Base/plinth trim, side	8601.065	8601.085	8601.065	8601.085	835
Base/plinth adaptor for levelling feet M12	8800.220	8800.220	8800.220	8800.220	849
Levelling feet M12	4612.000	4612.000	4612.000	4612.000	848
Base/plinth installation accessories	from page 834	from page 834	from page 834	from page 834	
Interior installation/Premium accessories					
482.6 mm (19″) mounting frames front and rear	■	■	■	■	
Punched section with mounting flange 17 x 73 mm, for mounting installation components, attached in the enclosure depth between the 482.6 mm (19″) mounting frames	8612.040	8612.040	8612.040	8612.040	921
Cable clamp rail, depth variable 425 – 725 mm, for cable attachment in the enclosure depth using cable ties	7858.160	7858.160	7858.160	7858.160	984
Cable clamp rail, for cable attachment in the enclosure width via cable ties, on the 482.6 mm (19″) mounting frame at the rear	7828.062	7828.062	7828.062	7828.062	983
C rail, for cable clamping in the enclosure depth via cable clamps	7828.040	7828.040	7828.040	7828.040	928
C rail, for cable clamping in the enclosure width via cable clamps, on the 482.6 mm (19″) mounting frame at the rear	7828.060	7828.060	7828.060	7828.060	928
Earthing kit for TE	7000.675	7000.675	7000.675	7000.675	961
TE socket strip, 8-way, with earthing-pin plug	7000.630	7000.630	7000.630	7000.630	748
Power management	from page 742	from page 742	from page 742	from page 742	
Slide rail for TE, for attachment between the 482.6 mm (19″) mounting frames, length 424 mm	7963.410	7963.410	7963.410	7963.410	1011
482.6 mm (19″) component shelf for fixed installation, for direct screw fastening without an installation kit, 412 mm deep, load capacity 30 kg, static	7000.620	7000.620	7000.620	7000.620	945
Cable management	from page 984	from page 984	from page 984	from page 984	
CMC-TC system monitoring	from page 762	from page 762	from page 762	from page 762	

■ included with the supply.

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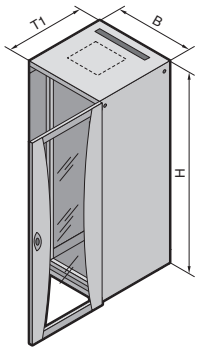
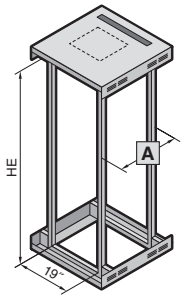
Network enclosures, based on Rittal TE 7000, width 800





B = Width
T = Depth
HE = U

A = Defined mounting distance for Premium accessories, see below.

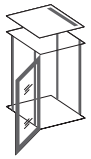
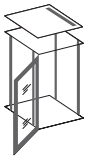
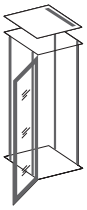
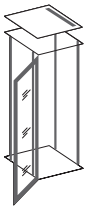
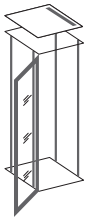
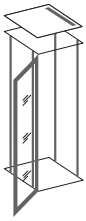
Benefits:
- Coordinated accessories for fast installation in the delivered state
- No frame structure, optimum accessibility
- Load capacity up to 400 kg.

Material:
Sheet steel

Surface finish:
Mounting frame:
Electrophoretic dipcoat-primed
Enclosure panels:
Powder coated,
RAL 7035/RAL 9005.

Supply includes:
Self-supporting 482.6 mm (19″) frame structure, glazed door at the front, two-point locking rod, recessed handle and security lock 3524 E, sheet steel door at rear, two-point locking rod, recessed handle and security lock 3524 E, pluggable side panels with security lock 3524 E, base frame with maximum cutout (for optional population with module plates), roof plate for cable entry with covered cutout for fan, levelling feet, spacers for raising the cover plate.

Detailed drawing,
available on the Internet.

						
U	24	24	42	42	47	47
Width (B) in mm	800	800	800	800	800	800
Height (H) in mm	1200	1200	2000	2000	2200	2200
Depth (T1) in mm	600	800	600	800	600	800
482.6 mm (19″) distance between levels in its delivered state A mm	495	495	495	495	495	495
Model No. TE	**7000.450**	**7000.460**[1)]	**7000.520**	**7000.530**[1)]	**7000.580**	**7000.590**
Model No. TE as bayed enclosure without side panels, including baying kit	–	–	–	**7000.532**[1)]	–	**7000.592**
Model No. TE incl. side panels, RAL 9005	–	–	**7000.525**	**7000.535**	–	–

[1)] **Model No. TE preconfigured with base/plinth, earthing and accessory kit:**
Height 1200 mm: 7000.840. Height 2000 mm: With side panel 7000.850, without side panel 7000.852.

A 495 mm – that is the distance between the two 482.6 mm (19″) level in the delivered state for all enclosure formats. Corresponds to TS 8 nominal size, depth 400 mm, inner level.

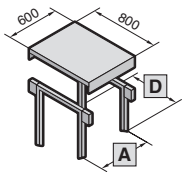
B Pitch spacing 50 mm. The distance between the two 482.6 mm (19″) levels may be varied in 50 mm increments (445 to 695 mm).

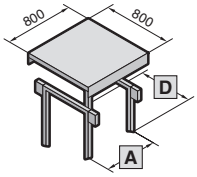
C Distance from door:
52.5 mm for depth 600
152.5 mm for depth 800

D The mounting distance in a rear mounting frame, horizontal, corresponds to the frame mounting dimensions of a 600 mm wide TS 8 (outer level, 525 mm).

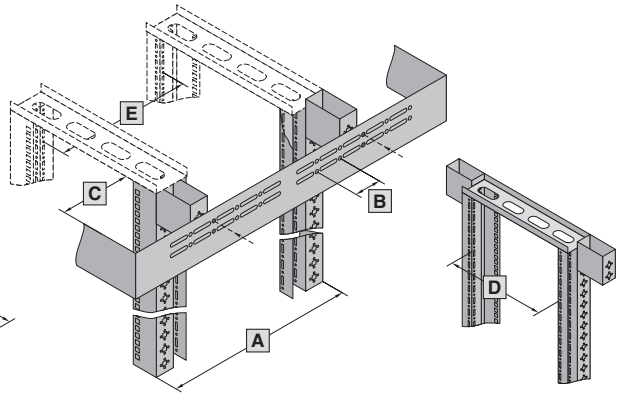
E = **A** – 120 mm

The distance between levels is freely selectable via the slot fastening. All key mounting components – punched sections with mounting flanges, divider kits, slide rails, component shelves – are also available in depth-variable format.





German registered design no.
M 403 07 489



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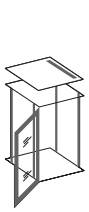
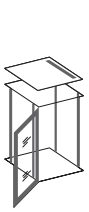
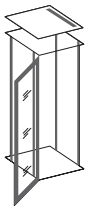
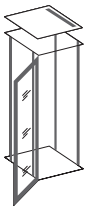
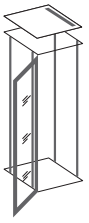
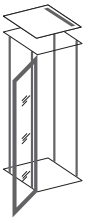
Network enclosures, based on Rittal TE 7000, width 800

U	24	24	42	42	47	47	Page
Width (B) in mm	800	800	800	800	800	800	
Height (H) in mm	1200	1200	2000	2000	2200	2200	
Depth (T1) in mm	600	800	600	800	600	800	
482.6 mm (19″) distance between levels in its delivered state A mm	495	495	495	495	495	495	
Model No. TE	**7000.450**	**7000.460**[1)]	**7000.520**	**7000.530**[1)]	**7000.580**	**7000.590**	
Model No. TE as a bayed enclosure without side panels, including baying kit	–	–	–	**7000.532**[1)]	–	**7000.592**	
Doors							
Glazed front door/sheet steel rear door	■	■	■	■	■	■	
Sheet steel front door/sheet steel rear door	On request	On request	On request	On request	On request	On request	
Ergoform-S handle for semi-cylinder, in exchange for the existing lock	2435.000	2435.000	2435.000	2435.000	2435.000	2435.000	885
Side panel							
Side panel, plug-type, including security lock 3524 E	■	■	■	■ (7000.530 only)	■	■ (7000.590 only)	856
Baying kit	7000.640	7000.640	7000.640	■ (7000.532 only)	7000.640	■ (7000.592 only)	867
Roof							
Roof plate with brush strip for cable entry, prepared to accommodate an active fan unit	■	■	■	■	■	■	
Fan unit, 2 fans (max. 3) including thermostat	7000.670	7000.670	7000.670	7000.670	7000.670	7000.670	651
Fan expansion kit	7980.000	7980.000	7980.000	7980.000	7980.000	7980.000	649
Spacers 20 mm to raise the cover plate above the fan cutout	■	■	■	■	■	■	904
Base/plinth							
Roof frame with maximum cutout for individual population with module plates, levelling feet M10	■	■	■	■	■	■	
Module plate variants for individual population	from p. 903	from p. 903	from p. 903	from p. 903	from p. 903	from p. 903	
Base/plinth components, solid, front and rear	8601.805	8601.805	8601.805	8601.805	8601.805	8601.805	835
Base/plinth components, vented, front and rear	7825.801	7825.801	7825.801	7825.801	7825.801	7825.801	835
Base/plinth trim, side	8601.065	8601.085	8601.065	8601.085	8601.065	8601.085	835
Base/plinth adaptor for levelling feet M12	8800.220	8800.220	8800.220	8800.220	8800.220	8800.220	849
Levelling feet M12	4612.000	4612.000	4612.000	4612.000	4612.000	4612.000	848
Interior installation/Premium accessories							
482.6 mm (19″) mounting frames front and rear	■	■	■	■	■	■	
Punched section with mounting flange 17 x 73 mm, for mounting installation components, attached in the enclosure depth between the 482.6 mm (19″) mounting frames	8612.040	8612.040	8612.040	8612.040	8612.040	8612.040	921
Cable clamp rail, depth variable 425 – 725 mm, for cable attachment in the enclosure depth using cable ties	7858.160	7858.160	7858.160	7858.160	7858.160	7858.160	984
Cable clamp rail, for cable attachment in the enclosure width via cable ties, on the 482.6 mm (19″) mounting frame at the rear	7828.062	7828.062	7828.062	7828.062	7828.062	7828.062	983
C rail, for cable clamping in the enclosure depth via cable clamps	4943.000	4943.000	4943.000	4943.000	4943.000	4943.000	928
C rail, for cable clamping in the enclosure width via cable clamps, on the 482.6 mm (19″) mounting frame at the rear	7828.060	7828.060	7828.060	7828.060	7828.060	7828.060	928
Earthing kit for TE	7000.675	7000.675	7000.675	7000.675	7000.675	7000.675	961
TE socket strip, 8-way, with earthing-pin plug	7000.630	7000.630	7000.630	7000.630	7000.630	7000.630	748
Power management	from p. 742	from p. 742	from p. 742	from p. 742	from p. 742	from p. 742	
Slide rail for TE, for attachment between the 482.6 mm (19″) mounting frames, length 424 mm	7963.410	7963.410	7963.410	7963.410	7963.410	7963.410	1011
482.6 mm (19″) component shelf for fixed installation, for direct screw fastening without an installation kit, 412 mm deep, load capacity 30 kg, static	7000.620	7000.620	7000.620	7000.620	7000.620	7000.620	945
Cable management	from p. 984	from p. 984	from p. 984	from p. 984	from p. 984	from p. 984	
CMC-TC system monitoring	from p. 762	from p. 762	from p. 762	from p. 762	from p. 762	from p. 762	

■ included with the supply.

[1)] **Model No. TE preconfigured with base/plinth, earthing and accessory kit:**
Height 1200 mm: 7000.840. Height 2000 mm: With side panel 7000.850, without side panel 7000.852.

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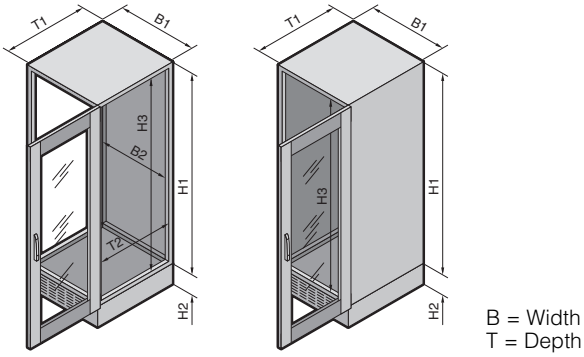
Network enclosures, based on Rittal TS 8, pre-configured



B = Width
T = Depth

Material:
Sheet steel

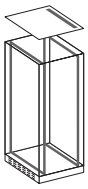
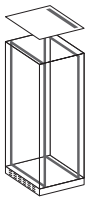
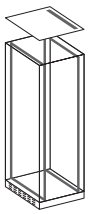
Surface finish:
Enclosure frame:
Dipcoat-primed
Doors, roof and base/plinth:
Dipcoat-primed,
powder-coated in RAL 7035
Gland plates, punched sections with mounting flanges and mounting angles:
Zinc-plated, passivated

Supply includes:
System frame with doors or rear panel, roof plate, vented base/plinth 100 mm,
earthing of all enclosure panels; supplied loose:
Levelling feet incl. base/plinth adaptor,
4 spacers, for raising the roof,
4 cable clamp rails for the inner frame level,
10 cable shunting rings (105 x 70 mm, plastic),
50 captive nuts, M6, conductive,
50 multi-tooth screws M6.

P 1
Glazed door at the front, 180°, sheet steel door at the rear, 130°. 482.6 mm (19″) mounting angles, front, fitted approx. 150 mm behind the frame front edge, screw-fastened to the TS punched sections with mounting flange as depth stays. Gland plate, one-piece, vented, with cable entry.

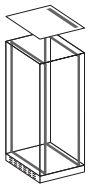
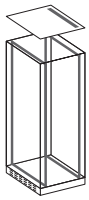
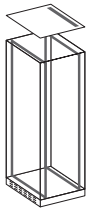
P 2
Glazed door at the front, 180°, sheet steel door at the rear, 130°. 482.6 mm (19″) mounting angles at the front and rear, distance between levels 498 mm. Cranked mounting angles screw-fastened to installation brackets approx. 150 mm behind the frame front edge. Gland plate at the front, fitted as an infill panel.

Detailed drawing,
available on the Internet.

	P 1	P 2	P 2	P 2
				
U	24	38	42	47
Width (B1) in mm	600	800	800	800
Height (H1 + H2) in mm	1200 + 100	1800 + 100	2000 + 100	2200 + 100
Depth (T1) in mm	600	800	800	800
Clearance width (B2) in mm	512	712	712	712
Clearance height (H3) in mm	1112	1712	1912	2112
Clearance depth (T2) in mm	512	712	712	712
Model No. DK including 2 plug-in side panels, with security lock 3524 E	**7830.100**	**7830.800**	**7830.200**	**7830.220**
Model No. DK as a bayed enclosure without side panels, incl. baying kit TS 8800.500	**–**	**7830.850**	**7830.250**	**7830.270**

Accessories Page 832 **Monitoring** Page 762 **Climate control** Page 578

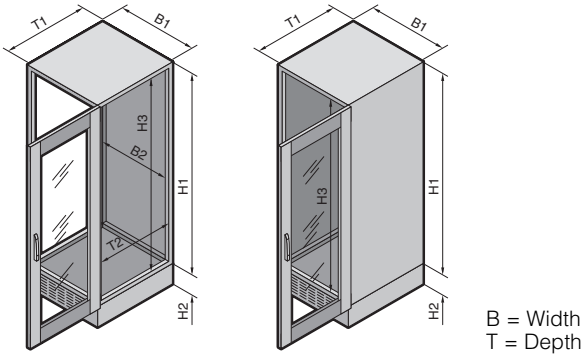
Network enclosures, based on Rittal TS 8, pre-configured

	P 1	P 2	P 2	P 2	Page
					
U	24	38	42	47	
Width (B1) in mm	600	800	800	800	
Height (H1 + H2) in mm	1200 + 100	1800 + 100	2000 + 100	2200 + 100	
Depth (T1) in mm	600	800	800	800	
Model No. DK incl. 2 plug-in side panels, with security lock 3524 E	**7830.100**	**7830.800**	**7830.200**	**7830.220**	
Model No. DK as bayed enclosure without side panels, incl. baying kit TS 8800.500	**–**	**7830.850**	**7830.250**	**7830.270**	
Doors					
Glazed front door/sheet steel rear door	■	■	■	■	
Various door options	from page 869	from page 869	from page 869	from page 869	
180° hinges for sheet steel rear door	8800.190	8800.190	8800.190	8800.190	893
Side panel					
Side panel, plug-in, IP 20	■	■ (7830.800 only)	■ (7830.200 only)	■/– (7830.220 only)	
Lock for side panel, plug-in, 3524 E	■	■	■	■	
Internal latch for side panel, plug-in	7824.510	7824.510	7824.510	7824.510	855
Side panel, screw-fastened, IP 55	8170.235	8188.235	8108.235	8128.235	853
Baying	from page 861	from page 861	from page 861	from page 861	
Roof					
Roof plate for cable entry	■	■	■	■	
Roof plate, vented	7826.766	7826.788	7826.788	7826.788	902
Roof plate, vented, for cable entry	7826.669	7826.889	7826.889	7826.889	902
Fan roof, modular	see page 651	see page 651	see page 651	see page 651	
Fan mounting plate, active, with controller	7966.035	7988.035	7988.035	7988.035	649
DC fan mounting plate with FCS speed control	–	7858.488	7858.488	7858.488	650
Spacers, 50 mm	7967.000	7967.000	7967.000	7967.000	904
Base/plinth					
Base/plinth components, solid, front and rear	8601.605	8601.805	8601.805	8601.805	835
Gland plate, multi-piece	–	7825.382	7825.382	7825.382	852
Gland plate variants	from page 851	from page 851	from page 851	from page 851	
Castors	see page 848	see page 848	see page 848	see page 848	
Interior installation					
482.6 mm (19″) mounting angles, cranked (for network technology)	■ (front)	■ (front and rear)	■ (front and rear)	■ (front and rear)	
Punched section with mounting flange, interior installation, rail systems	from page 917	from page 917	from page 917	from page 917	
Cable clamp rails, C rails	see page 980	see page 980	see page 980	see page 980	
Earthing/potential equalisation	■	■	■	■	
Socket strips, power management	from page 742	from page 742	from page 742	from page 742	
Component shelves	from page 939	from page 939	from page 939	from page 939	
482.6 mm (19″) installation system	from page 1010	from page 1010	from page 1010	from page 1010	
Cable management	from page 984	from page 984	from page 984	from page 984	
CMC-TC system monitoring	from page 762	from page 762	from page 762	from page 762	

■ included with the supply.

Accessories Page 832 **Monitoring** Page 762 **Climate control** Page 578

Network enclosures, based on Rittal TS 8, pre-configured



B = Width
T = Depth

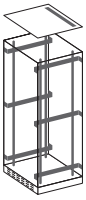
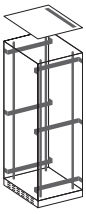
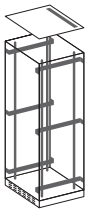
Material:
Sheet steel

Surface finish:
Enclosure frame:
Dipcoat-primed
Doors, roof and base/plinth:
Dipcoat-primed,
powder-coated in RAL 7035
Gland plates, punched sections with mounting flanges and mounting angles:
Zinc-plated, passivated

Supply includes:
System frame with doors or rear panel, roof plate,
vented base/plinth 100 mm,
earthing of all enclosure panels;
supplied loose:
Levelling feet incl. base/plinth adaptor,
4 spacers, for raising the roof,
4 cable clamp rails for the inner frame level,
10 cable shunting rings (105 x 70 mm, plastic),
50 captive nuts, M6, conductive,
50 multi-tooth screws M6.

P 3
Glazed door, vented, at the front, 180°,
sheet steel door, vented, at the rear, 180°.
482.6 mm (19″) mounting angles at the front and rear, distance between levels 740 mm.
L-shaped mounting angles screw-fastened to 2 or 3 depth stays respectively.
Gland plate, one-piece, vented, with cable entry.

Detailed drawing,
available on the Internet.

	P 3	P 3	P 3	P 3	P 3
					
U	24	42	42	47	47
Width (B1) in mm	800	800	800	800	800
Height (H1 + H2) in mm	1200 + 100	2000 + 100	2000 + 100	2200 + 100	2200 + 100
Depth (T1) in mm	900	900	1000	900	1000
Clearance width (B2) in mm	712	712	712	712	712
Clearance height (H3) in mm	1112	1912	1912	2112	2112
Clearance depth (T2) in mm	812	812	912	812	912
Model No. DK including 2 plug-in side panels, with security lock 3524 E	**7830.120**	**7830.300**	**7830.330**	**7830.320**	**7830.340**
Model No. DK as a bayed enclosure without side panels, incl. baying kit TS 8800.500	**–**	**7830.350**	**7830.335**	**7830.370**	**7830.380**

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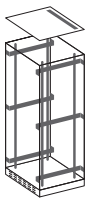
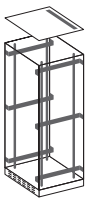
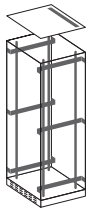
Network enclosures, based on Rittal TS 8, pre-configured

	P 3	P 3	P 3	P 3	P 3	Page
						
U	24	42	42	47	47	
Width (B1) in mm	800	800	800	800	800	
Height (H1 + H2) in mm	1200 + 100	2000 + 100	2000 + 100	2200 + 100	2200 + 100	
Depth (T1) in mm	900	900	1000	900	1000	
Model No. DK incl. 2 plug-in side panels, with security lock 3524 E	**7830.120**	**7830.300**	**7830.330**	**7830.320**	**7830.340**	
Model No. DK as bayed enclosure without side panels, incl. baying kit TS 8800.500	**–**	**7830.350**	**7830.335**	**7830.370**	**7830.380**	
Doors						
Glazed front door/sheet steel rear door, vented	■	■	■	■	■	
Various door options	from page 869	from page 869	from page 869	from page 869	from page 869	
Side panel						
Side panel, plug-in, IP 20	■	■ (7830.300 only)	■ (7830.330 only)	■/– (7830.320 only)	■/– (7830.340 only)	
Lock for side panel, plug-in, 3524 E	■	■	■	■	■	
Internal latch for side panel, plug-in	7824.510	7824.510	7824.510	7824.510	7824.510	855
Side panel, screw-fastened, IP 55	–	8109.235	8100.235	8129.235	–	853
Baying	from page 861	from page 861	from page 861	from page 861	from page 861	
Roof						
Roof plate for cable entry	■	■	■	■	■	
Roof plate, vented	7826.789	7826.789	7826.780	7826.789	7826.780	902
Roof plate, vented, for cable entry	7826.899	7826.899	7826.809	7826.899	7826.809	902
Fan roof, modular	see page 651	see page 651	see page 651	see page 651	see page 651	
Fan mounting plate, active, with controller	7988.035	7988.035	7988.035	7988.035	7988.035	649
DC fan mounting plate with FCS speed control	–			–	–	
Spacers, 50 mm	7967.000	7967.000	7967.000	7967.000	7967.000	904
Base/plinth						
Base/plinth components, solid, front and rear	8601.805	8601.805	8601.805	8601.805	8601.805	835
Gland plate variants	from page 851	from page 851	from page 851	from page 851	from page 851	
Castors	see page 848	see page 848	see page 848	see page 848	see page 848	
Interior installation						
482.6 mm (19″) mounting angles, L-shaped (for server technology)	■	■ (front and rear)	■ (front and rear)	■ (front and rear)	■ (front and rear)	
Punched section with mounting flange, interior installation, rail systems	from page 917	from page 917	from page 917	from page 917	from page 917	
Cable clamp rails, C rails	see page 980	see page 980	see page 980	see page 980	see page 980	
Earthing/potential equalisation	■	■	■	■	■	
Socket strips, power management	from page 742	from page 742	from page 742	from page 742	from page 742	
Component shelves	from page 939	from page 939	from page 939	from page 939	from page 939	
482.6 mm (19″) installation system	from page 1010	from page 1010	from page 1010	from page 1010	from page 1010	
Cable management	from page 984	from page 984	from page 984	from page 984	from page 984	
CMC-TC system monitoring	from page 762	from page 762	from page 762	from page 762	from page 762	

■ included with the supply.

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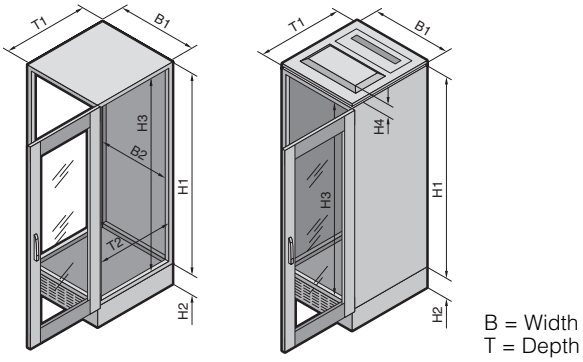
Network enclosures, based on Rittal TS 8, pre-configured



B = Width
T = Depth

Material:
Sheet steel

Surface finish:
Enclosure frame:
Dipcoat-primed
Doors, roof and base/plinth:
Dipcoat-primed,
powder-coated in RAL 7035
Gland plates, punched sections with mounting flanges and mounting angles:
Zinc-plated, passivated

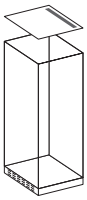
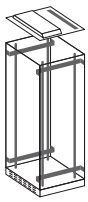
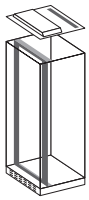
Supply includes:
System frame with doors or rear panel, roof plate,
vented base/plinth 100 mm,
earthing of all enclosure panels;
supplied loose:
Levelling feet incl. base/plinth adaptor,
4 spacers for raising the roof or vent panel,
4 cable clamp rails for the inner frame level,
10 cable shunting rings (105 x 70 mm, plastic),
50 captive nuts, M6, conductive,
50 multi-tooth screws M6.

P 4
Glazed door at the front, 180°, sheet steel door at the rear, 180°. Empty enclosure for individual configuration, 482.6 mm (19″)/ metric or combined partial installation of mounting angles/ enclosure frames is possible. Gland plate at the front, fitted as an infill panel.

P 5
Glazed door at the front, 180°, sheet steel door at the rear, 180°. 482.6 mm (19″) mounting angles at the front and rear, distance between levels 498 mm. L-shaped mounting angles screw-fastened to depth stays in the centre. Roof plate with cutout for fan insert with a vent panel on spacers. Gland plate at the front, fitted as an infill panel.

P 6
Glazed door at the front, 180°, sheet steel rear panel, 180°. Swing frame, large, with trim panel for the installation of 482.6 mm (19″) mounting components whilst utilising the full enclosure height. Full installation at the front, rear panel, including installation kit for swing frames SK 1995.825 up to a total static load capacity of 150 kg. Roof plate with cutout for fan insert with a vent panel on spacers. Gland plate, one-piece, vented, with cable entry.

Detailed drawing,
available on the Internet.

	P 4	P 5	P 6
			
U	42	42	40
Width (B1) in mm	800	800	800
Height (H1 + H2) in mm, (H1 + H2 + H4) in mm	2000 + 100	2000 + 100 + 25	2000 + 100 + 25
Depth (T1) in mm	800	800	800
Clearance width (B2) in mm	712	712	712
Clearance height (H3) in mm	1912	1912	1912
Clearance depth (T2) in mm	712	712	712
Model No. DK incl. 2 plug-in side panels, with security lock 3524 E	**7830.400**	**7830.500**	**7830.660**
Model No. DK as a bayed enclosure without side panels, incl. baying kit TS 8800.500	**–**	**7830.550**	**7830.670**

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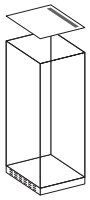
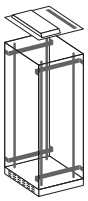
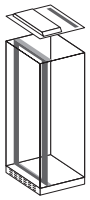
Network enclosures, based on Rittal TS 8, pre-configured

	P 4	P 5	P 6	Page
				
U	–	42	40	
Width (B1) in mm	800	800	800	
Height (H1 + H2) in mm, (H1 + H2 + H4) in mm	2000 + 100	2000 + 100 + 25	2000 + 100 + 25	
Depth (T1) in mm	800	800	800	
Model No. DK incl. 2 plug-in side panels, with security lock 3524 E	**7830.400**	**7830.500**	**7830.660**	
Model No. DK as a bayed enclosure without side panels, incl. baying kit TS 8800.500	**–**	**7830.550**	**7830.670**	
Doors				
Various door options	from page 869	from page 869	from page 869	
180° hinges for sheet steel rear door	8800.190	8800.190	–	
Side panel				
Side panel, plug-in, IP 20	■	■ (7830.500 only)	■ (7830.660 only)	
Lock for side panel, plug-in, 3524 E	■	■	■	
Internal latch for side panel, plug-in	7824.510	7824.510	7824.510	855
Side panel, screw-fastened, IP 55	8108.235	8108.235	8108.235	853
Baying	from page 861	from page 861	from page 861	
Roof				
Roof plate for cable entry	■	7826.885	7826.885	901
Roof plate, vented	7826.788	7826.788	7826.788	902
Roof plate, vented, for cable entry	7826.889	7826.889	7826.889	902
Fan roof, modular	see page 651	■ (without fan insert)	■ (without fan insert)	
Fan mounting plate, active, with controller	7988.035	–	–	649
DC fan mounting plate with FCS speed control	7858.488	7858.488	–	650
Spacers, 50 mm	7967.000	–	–	904
Base/plinth				
Base/plinth components, solid, front and rear	8601.805	8601.805	8601.805	835
Gland plate, multi-piece	7825.382	7825.382	–	852
Gland plate variants	from page 851	from page 851	from page 851	
Castors	see page 848	see page 848	see page 848	
Interior installation				
482.6 mm (19″) mounting angles, L-shaped (for server technology)	from page 1004	■ (front and rear)	482.6 mm (19″) large swing frame (40 U)	
Punched section with mounting flange, interior installation, rail systems	from page 917	from page 917	from page 917	
Cable clamp rails, C rails	see page 980	see page 980	see page 980	
Earthing/potential equalisation	■	■	■	
Socket strips, power management	from page 742	from page 742	from page 742	
Component shelves	from page 939	from page 939	from page 939	
482.6 mm (19″) installation system	from page 1010	from page 1010	from page 1010	
Cable management	from page 984	from page 984	from page 984	
CMC-TC system monitoring	from page 762	from page 762	from page 762	

■ included with the supply.

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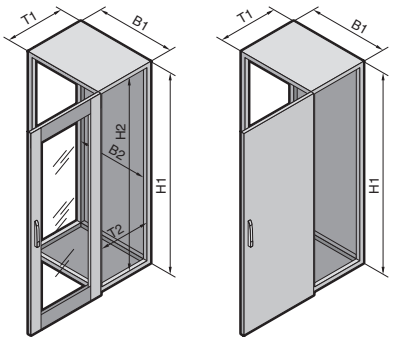
Network enclosures, based on Rittal TS 8, types 1 and 2



B = Width
T = Depth

Type 1
Glazed aluminium door at the front (180°),
with 3 mm single-pane safety glass, comfort handle for semi-cylinder and security lock 3524 E;
sheet steel door at the rear (130°) with handle and security lock 3524 E.

Type 2
Sheet steel door at the front (180°), with comfort handle for semi-cylinder and security lock 3524 E; sheet steel door at the rear (130°) with handle and security lock 3524 E.

Material:
Sheet steel

Surface finish:
Enclosure frame:
Dipcoat-primed
Doors and roof: Dipcoat-primed, powder-coated in RAL 7035
Base plates and punched sections with mounting flanges:
Zinc-plated, passivated

Supply includes:
Enclsoure frame with doors, roof plate, multi-piece gland plate, 2 punched sections with mounting flanges in the enclosure depth.

Approvals,
see page 82.

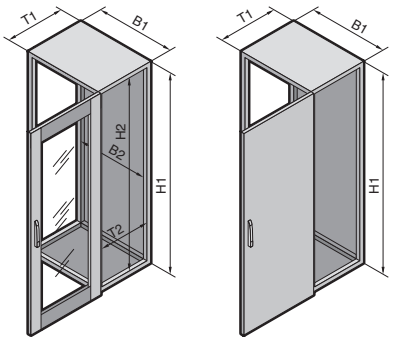
Detailed drawing,
available on the Internet.

U	15	20	20	24	24	24	24	24
Width (B1) in mm	600	600	800	600	800	800	800	800
Height (H1) in mm	800	1000	1000	1200	1200	1200	1200	1200
Depth (T1) in mm	600	600	600	600	600	800	900	1000
Clearance width (B2) in mm	512	512	712	512	712	712	712	712
Clearance height (H2) in mm	712	912	912	1112	1112	1112	1112	1112
Clearance depth (T2) in mm	512	512	512	512	512	712	812	912
Model No. DK, type 1 with glazed door at the front	**7820.100**	**7820.200**	**7820.240**	**7820.300**	**7820.340**	**7820.350**	**7820.355**	**7820.360**
Model No. DK, type 2 with sheet steel door at the front	**7821.100**	**7821.200**	**7821.240**	**7821.300**	**7821.340**	**–**	**7821.355**	**–**

U	29	29	29	33	33	33	38	38
Width (B1) in mm	600	600	800	600	600	800	600	600
Height (H1) in mm	1400	1400	1400	1600	1600	1600	1800	1800
Depth (T1) in mm	600	800	600	600	800	600	600	800
Clearance width (B2) in mm	512	512	712	712	512	712	712	512
Clearance height (H2) in mm	1312	1312	1312	1512	1512	1512	1512	1712
Clearance depth (T2) in mm	512	712	512	512	712	512	512	712
Model No. DK, type 1 with glazed door at the front	**7820.400**	**7820.410**	**7820.440**	**7820.500**	**7820.510**	**7820.540**	**7820.600**	**7820.610**
Model No. DK, type 2 with sheet steel door at the front	**7821.400**	**7821.410**	**7821.440**	**7821.500**	**7821.510**	**7821.540**	**7821.600**	**7821.610**

Accessories Page 832 **Monitoring** Page 762 **Climate control** Page 578

Network enclosures, based on Rittal TS 8, types 1 and 2



B = Width
T = Depth

Type 1
Glazed aluminium door at the front (180°),
with 3 mm single-pane safety glass, comfort handle for semi-cylinder and security lock 3524 E;
sheet steel door at the rear (130°) with handle and security lock 3524 E.

Type 2
Sheet steel door at the front (180°), with comfort handle for semi-cylinder and security lock 3524 E; sheet steel door at the rear (130°) with handle and security lock 3524 E.

Material:
Sheet steel

Surface finish:
Enclosure frame:
Dipcoat-primed
Doors and roof: Dipcoat-primed, powder-coated in RAL 7035
Base plates and punched sections with mounting flanges:
Zinc-plated, passivated

Supply includes:
Enclosure frame with doors, roof plate, multi-piece gland plate, 2 punched sections with mounting flanges in the enclosure depth.

Approvals,
see page 82.

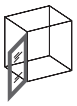
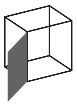
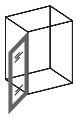
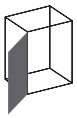
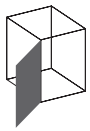
Detailed drawing,
available on the Internet.

U	38	38	38	38	42	42	42	42
Width (B1) in mm	600	800	800	800	600	600	800	800
Height (H1) in mm	1800	1800	1800	1800	2000	2000	2000	2000
Depth (T1) in mm	900	600	800	1000	600	800	600	800
Clearance width (B2) in mm	512	712	712	712	712	512	512	712
Clearance height (H2) in mm	1712	1712	1712	1712	1912	1912	1912	1912
Clearance depth (T2) in mm	812	512	712	912	512	712	512	712
Model No. DK, type 1 with glazed door at the front	**7820.620**	**7820.640**	**7820.650**	**7820.670**	**7820.700**	**7820.710**	**7820.740**	**7820.750**
Model No. DK, type 2 with sheet steel door at the front	**7821.620**	**7821.640**	**7821.650**	**7821.670**	**7821.700**	**7821.710**	**7821.740**	**7821.750**

U	42	42	47	47	47	47	47	47
Width (B1) in mm	800	800	600	600	800	800	800	800
Height (H1) in mm	2000	2000	2200	2200	2200	2200	2200	2200
Depth (T1) in mm	900	1000	600	800	600	800	900	1000
Clearance width (B2) in mm	712	712	712	512	512	712	712	712
Clearance height (H2) in mm	1912	1912	2112	2112	2112	2112	2112	2112
Clearance depth (T2) in mm	812	912	512	712	512	712	812	912
Model No. DK, type 1 with glazed door at the front	**7820.760**	**7820.770**	**7820.800**	**7820.810**	**7820.840**	**7820.850**	**7820.860**	**7820.870**
Model No. DK, type 2 with sheet steel door at the front	**7821.760**	**7821.770**	**7821.800**	**7821.810**	**7821.840**	**7821.850**	**7821.860**	**7821.870**

Accessories Page 832 **Monitoring** Page 762 **Climate control** Page 578

Network enclosures, based on Rittal TS 8, 15 – 20 U

	Type 1	Type 2	Type 1	Type 2	Type 1	Type 2	Page
							
U	15		20		20		
Width (B1) in mm	600		600		800		
Height (H1) in mm	800		1000		1000		
Depth (T1) in mm	600		600		600		
Model No. DK	**7820.100**	**7821.100**	**7820.200**	**7821.200**	**7820.240**	**7821.240**	
Doors							
Glazed front door/sheet steel rear door	■	–	■	–	■	–	
Sheet steel front door/sheet steel rear door	–	■	–	■	–	■	
Various door options	from page 869		from page 869		from page 869		
180° hinges for sheet steel rear door	8800.190		8800.190		8800.190		893
Side panel							
Side panel, plug-in,IP 20	7824.086		7824.106		7824.106		855
Lock for side panel, plug-in	7824.500		7824.500		7824.500		855
Internal latch for side panel, plug-in, 3524 E	7824.510		7824.510		7824.510		855
Side panel, screw-fastened, IP 55	8173.235		8174.235		8174.235		853
Baying	from page 861		from page 861		from page 861		
Roof							
Roof plate, solid	■		■		■		
Roof plate, vented	7826.766		7826.766		7826.786		902
Roof plate for cable entry	7826.665		7826.665		7826.865		901
Roof plate, vented, for cable entry	7826.669		7826.669		7826.869		902
Fan mounting plate, active, with controller	7966.035		7966.035		7986.035		649
Fan roof, modular	see page 651		see page 651		see page 651		
Spacers, 20 mm	2423.000		2423.000		2423.000		904
Spacers, 50 mm	7967.000		7967.000		7967.000		904
Climate control	see page 579		see page 579		see page 579		
Base/plinth							
Base/plinth components, vented, front and rear, H = 100 mm	7825.601		7825.601		7825.601		835
Base/plinth components, solid, front and rear, H = 100 mm	8601.605		8601.605		8601.805		835
Base/plinth trim panels, side, H = 100 mm	8601.065		8601.065		8601.065		835
Gland plate variants	from page 851		from page 851		from page 851		
Castors	see page 848		see page 848		see page 848		
Interior installation							
482.6 mm (19″) mounting angles, cranked (for network technology)	7827.080		7827.100		7827.100		1004
482.6 mm (19″) mounting angles, L-shaped (for server technology)	7827.081		7827.101		7827.101		1004
Depth stays for mounting angles	8612.060		8612.060		7827.600		1008
Installation brackets for mounting angles	–		–		7827.480		1009
Cable clamp rails	see page 980		see page 980		see page 980		
Earthing/potential equalisation	from page 960		from page 960		from page 960		
Socket strips/power management	from page 742		from page 742		from page 742		
Component shelves	from page 939		from page 939		from page 939		
482.6 mm (19″) installation system	from page 1010		from page 1010		from page 1010		
Cable management	from page 984		from page 984		from page 984		
CMC-TC system monitoring	from page 762		from page 762		from page 762		

■ included with the supply.

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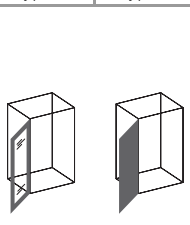
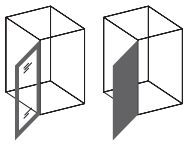
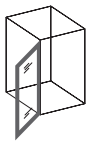
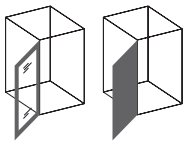
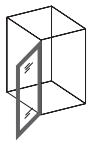
Network enclosures, based on Rittal TS 8, 24 U

	Type 1	Type 2	Type 1	Type 2	Type 1	Type 1	Type 2	Type 1	Page
									
U	24		24		24	24		24	
Width (B1) in mm	600		800		800	800		800	
Height (H1) in mm	1200		1200		1200	1200		1200	
Depth (T1) in mm	600		600		800	900		1000	
Model No. DK	**7820.300**	**7821.300**	**7820.340**	**7821.340**	**7820.350**	**7820.355**	**7821.355**	**7820.360**	
Doors									
Glazed front door/sheet steel rear door	■	–	■	–	■	■	–	■	
Sheet steel front door/ sheet steel rear door	–	■	–	■	–	–	■	–	
Various door options	from page 869		from page 869		from page 869	from page 869		from page 869	
180° hinges for sheet steel rear door	8800.190		8800.190		8800.190	8800.190		8800.190	893
Side panel									
Side panel, plug-in, IP 20	7824.126		7824.126		7824.128	7824.129		7824.120	855
Lock for side panel, plug-in	7824.500		7824.500		7824.500	7824.500		–	855
Internal latch for side panel, plug-in, 3524 E	7824.510		7824.510		7824.510	7824.510		–	855
Side panel, screw-fastened, IP 55	8170.235		8170.235		8175.235	–		8176.235	853
Baying	from page 861		from page 861		from page 861	from page 861		from page 861	
Roof									
Roof plate, solid	■		■		■	■		■	
Roof plate, vented	7826.766		7826.786		7826.788	7826.789		7826.780	902
Roof plate for cable entry	7826.665		7826.865		7826.885	7826.895		7826.805	901
Roof plate, vented, for cable entry	7826.669		7826.869		7826.889	7826.899		7826.809	902
Fan mounting plate, active, with controller	7966.035		7986.035		7988.035	7988.035		7988.035	649
Fan roof, modular	see page 651		see page 651		see page 651	see page 651		see page 651	
Spacers, 20 mm	2423.000		2423.000		2423.000	2423.000		2423.000	904
Spacers, 50 mm	7967.000		7967.000		7967.000	7967.000		7967.000	904
Climate control	see page 579		see page 579		see page 579	see page 579		see page 579	
Base/plinth									
Base/plinth components, vented, front and rear, H = 100 mm	7825.601		7825.801		7825.801	7825.801		7825.801	835
Base/plinth components, solid, front and rear, H = 100 mm	8601.605		8601.805		8601.805	8601.805		8601.805	835
Base/plinth trim panels, side, H = 100 mm	8601.065		8601.065		8601.085	8601.095		8601.015	835
Gland plate variants	from page 851		from page 851		from page 851	from page 851		from page 851	
Castors	see page 848		see page 848		see page 848	see page 848		see page 848	
Interior installation									
482.6 mm (19″) mounting angles, cranked (for network technology)	7827.120		7827.120		7827.120	7827.120		7827.120	1004
482.6 mm (19″) mounting angles, L-shaped (for server technology)	7827.121		7827.121		7827.121	7827.121		7827.121	1004
Depth stays for mounting angles	8612.060		7827.600		7827.800	7827.900		7827.000	1008
Installation brackets for mounting angles	–		7827.480		7827.480	7827.480		7827.480	1009
Cable clamp rails	see page 980		see page 980		see page 980	see page 980		see page 980	
Earthing/potential equalisation	from page 960		from page 960		from page 960	from page 960		from page 960	
Socket strips/power management	from page 742		from page 742		from page 742	from page 742		from page 742	
Component shelves	from page 939		from page 939		from page 939	from page 939		from page 939	
482.6 mm (19″) installation system	from page 1010		from page 1010		from page 1010	from page 1010		from page 1010	
Cable management	from page 984		from page 984		from page 984	from page 984		from page 984	
CMC-TC system monitoring	from page 762		from page 762		from page 762	from page 762		from page 762	

■ included with the supply.

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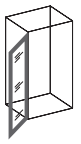
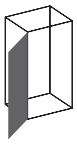
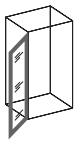
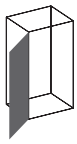
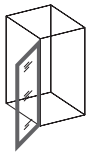
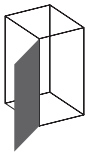
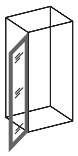
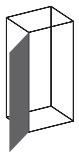
Network enclosures, based on Rittal TS 8, 29 – 33 U

	Type 1	Type 2	Type 1	Type 2	Type 1	Type 1	Type 2	Type 1	Page
									
U	29		29		29		33		
Width (B1) in mm	600		600		800		600		
Height (H1) in mm	1400		1400		1400		1600		
Depth (T1) in mm	600		800		600		600		
Model No. DK	**7820.400**	**7821.400**	**7820.410**	**7821.410**	**7820.440**	**7821.440**	**7820.500**	**7821.500**	
Doors									
Glazed front door/sheet steel rear door	■	–	■	–	■	–	■	–	
Sheet steel front door/sheet steel rear door	–	■	–	■	–	■	–	■	
Various door options	from page 869		from page 869		from page 869		from page 869		
180° hinges for sheet steel rear door	8800.190		8800.190		8800.190		8800.190		893
Side panel									
Side panel, plug-in, IP 20	7824.146		7824.148		7824.146		7824.166		855
Lock for side panel, plug-in	7824.500		7824.500		7824.500		7824.500		855
Internal latch for side panel, plug-in, 3524 E	7824.510		7824.510		7824.510		7824.510		855
Side panel, screw-fastened, IP 55	8146.235		8148.235		8146.235		8166.235		853
Baying	from page 861		from page 861		from page 861		from page 861		
Roof									
Roof plate, solid	■		■		■		■		
Roof plate, vented	7826.766		7826.768		7826.786		7826.766		902
Roof plate for cable entry	7826.665		7826.685		7826.865		7826.665		901
Roof plate, vented, for cable entry	7826.669		7826.689		7826.869		7826.669		902
Fan mounting plate, active, with controller	7966.035		7968.035		7986.035		7966.035		649
Fan roof, modular	see page 651		see page 651		see page 651		see page 651		
Spacers, 20 mm	2423.000		2423.000		2423.000		2423.000		904
Spacers, 50 mm	7967.000		7967.000		7967.000		7967.000		904
Climate control	see page 579		see page 579		see page 579		see page 579		
Base/plinth									
Base/plinth components, vented, front and rear, H = 100 mm	7825.601		7825.601		7825.801		7825.601		835
Base/plinth components, solid, front and rear, H = 100 mm	8601.605		8601.605		8601.805		8601.605		835
Base/plinth trim panels, side, H = 100 mm	8601.065		8601.085		8601.065		8601.065		835
Gland plate variants	from page 851		from page 851		from page 851		from page 851		
Castors	see page 848		see page 848		see page 848		see page 848		
Interior installation									
482.6 mm (19″) mounting angles, cranked (for network technology)	7827.140		7827.140		7827.140		7827.160		1004
482.6 mm (19″) mounting angles, L-shaped (for server technology)	7827.141		7827.141		7827.141		7827.161		1004
Depth stays for mounting angles	8612.060		8612.080		7827.600		8612.060		1008
Installation brackets for mounting angles	–		–		7827.480		–		1009
Cable clamp rails	see page 980		see page 980		see page 980		see page 980		
Earthing/potential equalisation	from page 960		from page 960		from page 960		from page 960		
Socket strips/power management	from page 742		from page 742		from page 742		from page 742		
Component shelves	from page 939		from page 939		from page 939		from page 939		
482.6 mm (19″) installation system	from page 1010		from page 1010		from page 1010		from page 1010		
Cable management	from page 984		from page 984		from page 984		from page 984		
CMC-TC system monitoring	from page 762		from page 762		from page 762		from page 762		

■ included with the supply.

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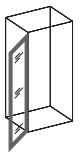
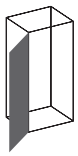
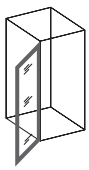
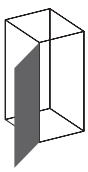
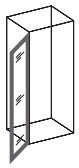
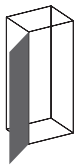
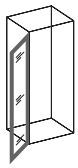
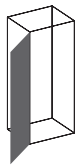
Network enclosures, based on Rittal TS 8, 33 – 38 U

	Type 1	Type 2	Type 1	Type 2	Type 1	Type 2	Type 1	Type 2	Page
									
U	33		33		38		38		
Width (B1) in mm	600		800		600		600		
Height (H1) in mm	1600		1600		1800		1800		
Depth (T1) in mm	800		600		600		800		
Model No. DK	**7820.510**	**7821.510**	**7820.540**	**7821.540**	**7820.600**	**7821.600**	**7820.610**	**7821.610**	
Doors									
Glazed front door/sheet steel rear door	■	–	■	–	■	–	■	–	
Sheet steel front door/sheet steel rear door	–	■	–	■	–	■	–	■	
Various door options	from page 869		from page 869		from page 869		from page 869		
180° hinges for sheet steel rear door	8800.190		8800.190		8800.190		8800.190		893
Side panel									
Side panel, plug-in, IP 20	7824.168		7824.166		7824.186		7824.188		855
Lock for side panel, plug-in	7824.500		7824.500		7824.500		7824.500		855
Internal latch for side panel, plug-in, 3524 E	7824.510		7824.510		7824.510		7824.510		855
Side panel, screw-fastened, IP 55	8168.235		8166.235		8186.235		8188.235		853
Baying	from page 861		from page 861		from page 861		from page 861		
Roof									
Roof plate, solid	■		■		■		■		
Roof plate, vented	7826.768		7826.786		7826.766		7826.768		902
Roof plate for cable entry	7826.685		7826.865		7826.665		7826.685		901
Roof plate, vented, for cable entry	7826.689		7826.869		7826.669		7826.689		902
Fan mounting plate, active, with controller	7968.035		7986.035		7966.035		7968.035		649
Fan roof, modular	see page 651		see page 651		see page 651		see page 651		
Spacers, 20 mm	2423.000		2423.000		2423.000		2423.000		904
Spacers, 50 mm	7967.000		7967.000		7967.000		7967.000		904
Climate control	see page 579		see page 579		see page 579		see page 579		
Base/plinth									
Base/plinth components, vented, front and rear, H = 100 mm	7825.601		7825.801		7825.601		7825.601		835
Base/plinth components, solid, front and rear, H = 100 mm	8601.605		8601.805		8601.605		8601.605		835
Base/plinth trim panels, side, H = 100 mm	8601.085		8601.065		8601.065		8601.085		835
Gland plate variants	from page 851		from page 851		from page 851		from page 851		
Castors	see page 848		see page 848		see page 848		see page 848		
Interior installation									
482.6 mm (19″) mounting angles, cranked (for network technology)	7827.160		7827.160		7827.180		7827.180		1004
482.6 mm (19″) mounting angles, L-shaped (for server technology)	7827.161		7827.161		7827.181		7827.181		1004
Depth stays for mounting angles	8612.080		7827.600		8612.060		8612.080		1008
Installation brackets for mounting angles	–		7827.480		–		–		1009
Cable clamp rails	see page 980		see page 980		see page 980		see page 980		
Earthing/potential equalisation	from page 960		from page 960		from page 960		from page 960		
Socket strips/power management	from page 742		from page 742		from page 742		from page 742		
Component shelves	from page 939		from page 939		from page 939		from page 939		
482.6 mm (19″) installation system	from page 1010		from page 1010		from page 1010		from page 1010		
Cable management	from page 984		from page 984		from page 984		from page 984		
CMC-TC system monitoring	from page 762		from page 762		from page 762		from page 762		

■ included with the supply.

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	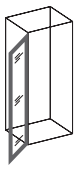	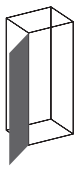	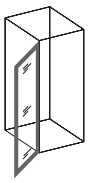	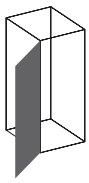	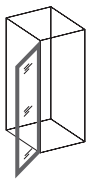	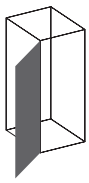	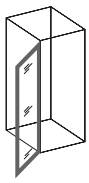	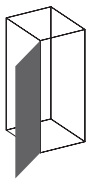	
U	38		38		38		38		
Width (B1) in mm	600		800		800		800		
Height (H1) in mm	1800		1800		1800		1800		
Depth (T1) in mm	900		600		800		1000		
Model No. DK	**7820.620**	**7821.620**	**7820.640**	**7821.640**	**7820.650**	**7821.650**	**7820.670**	**7821.670**	
Doors									
Glazed front door/sheet steel rear door	■	–	■	–	■	–	■	–	
Sheet steel front door/sheet steel rear door	–	■	–	■	–	■	–	■	
Various door options	from page 869		from page 869		from page 869		from page 869		
180° hinges for sheet steel rear door	8800.190		8800.190		8800.190		8800.190		893
Side panel									
Side panel, plug-in, IP 20	7824.189		7824.186		7824.188		7824.180		855
Lock for side panel, plug-in	7824.500		7824.500		7824.500		7824.500		855
Internal latch for side panel, plug-in, 3524 E	7824.510		7824.510		7824.510		7824.510		855
Side panel, screw-fastened, IP 55	8189.235		8186.235		8188.235		8180.235		853
Baying	from page 861		from page 861		from page 861		from page 861		
Roof									
Roof plate, solid	■		■		■		■		
Roof plate, vented	7826.769		7826.786		7826.788		7826.780		902
Roof plate for cable entry	7826.695		7826.865		7826.885		7826.805		901
Roof plate, vented, for cable entry	7826.699		7826.869		7826.869		7826.809		902
Fan mounting plate, active, with controller	7968.035		7986.035		7988.035		7988.035		649
Fan roof, modular	see page 651		see page 651		see page 651		see page 651		
Spacers, 20 mm	2423.000		2423.000		2423.000		2423.000		904
Spacers, 50 mm	7967.000		7967.000		7967.000		7967.000		904
Climate control	see page 579		see page 579		see page 579		see page 579		
Base/plinth									
Base/plinth components, vented, front and rear, H = 100 mm	7825.601		7825.801		7825.801		7825.801		835
Base/plinth components, solid, front and rear, H = 100 mm	8601.605		8601.805		8601.805		8601.805		835
Base/plinth trim panels, side, H = 100 mm	8601.095		8601.065		8601.085		8601.015		835
Gland plate variants	from page 851		from page 851		from page 851		from page 851		
Castors	see page 848		see page 848		see page 848		see page 848		
Interior installation									
482.6 mm (19″) mounting angles, cranked (for network technology)	7827.180		7827.180		7827.180		7827.180		1004
482.6 mm (19″) mounting angles, L-shaped (for server technology)	7827.181		7827.181		7827.181		7827.181		1004
Depth stays for mounting angles	8612.090		7827.600		7827.800		7827.000		1008
Installation brackets for mounting angles	–		7827.480		7827.480		7827.480		1009
Cable clamp rails	see page 980		see page 980		see page 980		see page 980		
Earthing/potential equalisation	from page 960		from page 960		from page 960		from page 960		
Socket strips/power management	from page 742		from page 742		from page 742		from page 742		
Component shelves	from page 939		from page 939		from page 939		from page 939		
482.6 mm (19″) installation system	from page 1010		from page 1010		from page 1010		from page 1010		
Cable management	from page 984		from page 984		from page 984		from page 984		
CMC-TC system monitoring	from page 762		from page 762		from page 762		from page 762		

■ included with the supply.

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Network enclosures, based on Rittal TS 8, 42 U

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	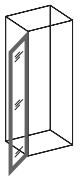	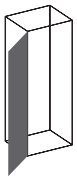	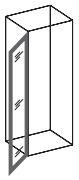	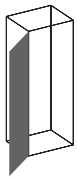	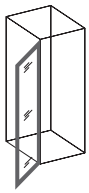	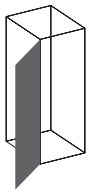	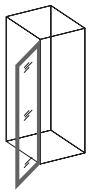	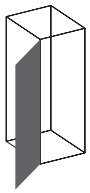	
U	42		42		42		42		
Width (B1) in mm	600		600		800		800		
Height (H1) in mm	2000		2000		2000		2000		
Depth (T1) in mm	600		800		600		800		
Model No. DK	**7820.700**	**7821.700**	**7820.710**	**7821.710**	**7820.740**	**7821.740**	**7820.750**	**7821.750**	
Doors									
Glazed front door/sheet steel rear door	■	–	■	–	■	–	■	–	
Sheet steel front door/sheet steel rear door	–	■	–	■	–	■	–	■	
Various door options	from page 869		from page 869		from page 869		from page 869		
180° hinges for sheet steel rear door	8800.190		8800.190		8800.190		8800.190		893
Side panel									
Side panel, plug-in, IP 20	7824.206		7824.208		7824.206		7824.208		855
Lock for side panel, plug-in	7824.500		7824.500		7824.500		7824.500		855
Internal latch for side panel, plug-in, 3524 E	7824.510		7824.510		7824.510		7824.510		855
Side panel, screw-fastened, IP 55	8106.235		8108.235		8106.235		8108.235		853
Baying	from page 861		from page 861		from page 861		from page 861		
Roof									
Roof plate, solid	■		■		■		■		
Roof plate, vented	7826.766		7826.768		7826.786		7826.788		902
Roof plate for cable entry	7826.665		7826.685		7826.865		7826.885		901
Roof plate, vented, for cable entry	7826.669		7826.689		7826.869		7826.889		902
Fan mounting plate, active, with controller	7966.035		7968.035		7986.035		7988.035		649
Fan roof, modular	see page 651		see page 651		see page 651		see page 651		
Spacers, 20 mm	2423.000		2423.000		2423.000		2423.000		904
Spacers, 50 mm	7967.000		7967.000		7967.000		7967.000		904
Climate control	see page 579		see page 579		see page 579		see page 579		
Base/plinth									
Base/plinth components, vented, front and rear, H = 100 mm	7825.601		7825.601		7825.801		7825.801		835
Base/plinth components, solid, front and rear, H = 100 mm	8601.605		8601.605		8601.805		8601.805		835
Base/plinth trim panels, side, H = 100 mm	8601.065		8601.085		8601.065		8601.085		835
Gland plate variants	from page 851		from page 851		from page 851		from page 851		
Castors	see page 848		see page 848		see page 848		see page 848		
Interior installation									
482.6 mm (19″) mounting angles, cranked (for network technology)	7827.200		7827.200		7827.200		7827.200		1004
482.6 mm (19″) mounting angles, L-shaped (for server technology)	7827.201		7827.201		7827.201		7827.201		1004
Depth stays for mounting angles	8612.060		8612.080		7827.600		7827.800		1008
Installation brackets for mounting angles	–		–		7827.480		7827.480		1009
Cable clamp rails	see page 980		see page 980		see page 980		see page 980		
Earthing/potential equalisation	from page 960		from page 960		from page 960		from page 960		
Socket strips/power management	from page 742		from page 742		from page 742		from page 742		
Component shelves	from page 939		from page 939		from page 939		from page 939		
482.6 mm (19″) installation system	from page 1010		from page 1010		from page 1010		from page 1010		
Cable management	from page 984		from page 984		from page 984		from page 984		
CMC-TC system monitoring	from page 762		from page 762		from page 762		from page 762		

■ included with the supply.

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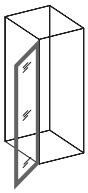
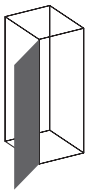
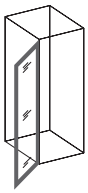
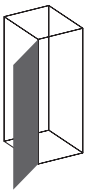
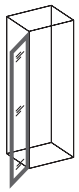
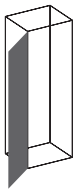
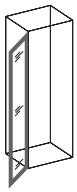
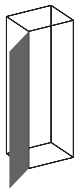
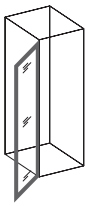
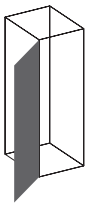
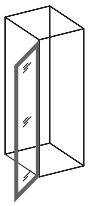
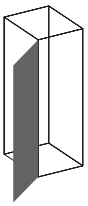
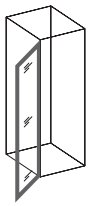
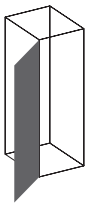
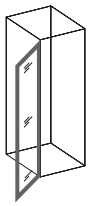
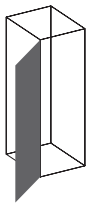
Network enclosures, based on Rittal TS 8, 42 – 47 U

	Type 1	Type 2	Type 1	Type 2	Type 1	Type 2	Type 1	Type 2	Page
									
U	42		42		47		47		
Width (B1) in mm	800		800		600		600		
Height (H1) in mm	2000		2000		2200		2200		
Depth (T1) in mm	900		1000		600		800		
Model No. DK	**7820.760**	**7821.760**	**7820.770**	**7821.770**	**7820.800**	**7821.800**	**7820.810**	**7821.810**	
Doors									
Glazed front door/sheet steel rear door	■	–	■	–	■	–	■	–	
Sheet steel front door/sheet steel rear door	–	■	–	■	–	■	–	■	
Various door options	from page 869		from page 869		from page 869		from page 869		
180° hinges for sheet steel rear door	8800.190		8800.190		8800.190		8800.190		893
Side panel									
Side panel, plug-in, IP 20	7824.209		7824.200		7824.226		7824.228		855
Lock for side panel, plug-in	7824.500		7824.500		7824.500		7824.500		855
Internal latch for side panel, plug-in, 3524 E	7824.510		7824.510		7824.510		7824.510		855
Side panel, screw-fastened, IP 55	8109.235		8100.235		8126.235		8128.235		853
Baying	from page 861		from page 861		from page 861		from page 861		
Roof									
Roof plate, solid	■		■		■		■		
Roof plate, vented	7826.789		7826.780		7826.766		7826.768		902
Roof plate for cable entry	7826.895		7826.805		7826.665		7826.685		901
Roof plate, vented, for cable entry	7826.899		7826.809		7826.669		7826.689		902
Fan mounting plate, active, with controller	7988.035		7988.035		7966.035		7968.035		649
Fan roof, modular	see page 651		see page 651		see page 651		see page 651		
Spacers, 20 mm	2423.000		2423.000		2423.000		2423.000		904
Spacers, 50 mm	7967.000		7967.000		7967.000		7967.000		904
Climate control	see page 579		see page 579		see page 579		see page 579		
Base/plinth									
Base/plinth components, vented, front and rear, H = 100 mm	7825.801		7825.801		7825.601		7825.601		835
Base/plinth components, solid, front and rear, H = 100 mm	8601.805		8601.805		8601.605		8601.605		835
Base/plinth trim panels, side, H = 100 mm	8601.095		8601.015		8601.065		8601.085		835
Gland plate variants	from page 851		from page 851		from page 851		from page 851		
Castors	see page 848		see page 848		see page 848		see page 848		
Interior installation									
482.6 mm (19″) mounting angles, cranked (for network technology)	7827.200		7827.200		7827.220		7827.220		1004
482.6 mm (19″) mounting angles, L-shaped (for server technology)	7827.201		7827.201		7827.221		7827.221		1004
Depth stays for mounting angles	7827.900		7827.000		8612.060		8612.080		1008
Installation brackets for mounting angles	7827.480		7827.480		–		–		1009
Cable clamp rails	see page 980		see page 980		see page 980		see page 980		
Earthing/potential equalisation	from page 960		from page 960		from page 960		from page 960		
Socket strips/power management	from page 742		from page 742		from page 742		from page 742		
Component shelves	from page 939		from page 939		from page 939		from page 939		
482.6 mm (19″) installation system	from page 1010		from page 1010		from page 1010		from page 1010		
Cable management	from page 984		from page 984		from page 984		from page 984		
CMC-TC system monitoring	from page 762		from page 762		from page 762		from page 762		

■ included with the supply.

Accessories Page 832

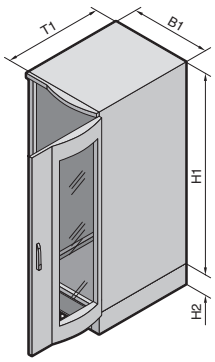
Network enclosures, based on Rittal TS 8, 47 U

	Type 1	Type 2	Type 1	Type 2	Type 1	Type 2	Type 1	Type 2	Page
									
U	47		47		47		47		
Width (B1) in mm	800		800		800		800		
Height (H1) in mm	2200		2200		2200		2200		
Depth (T1) in mm	600		800		900		1000		
Model No. DK	**7820.840**	**7821.840**	**7820.850**	**7821.850**	**7820.860**	**7821.860**	**7820.870**	**7821.870**	
Doors									
Glazed front door/sheet steel rear door	■	–	■	–	■	–	■	–	
Sheet steel front door/sheet steel rear door	–	■	–	■	–	■	–	■	
Various door options	from page 869		from page 869		from page 869		from page 869		
180° hinges for sheet steel rear door	8800.190		8800.190		8800.190		8800.190		893
Side panel									
Side panel, plug-in, IP 20	7824.226		7824.228		7824.229		7824.220		855
Lock for side panel, plug-in	7824.500		7824.500		7824.500		7824.500		855
Internal latch for side panel, plug-in, 3524 E	7824.510		7824.510		7824.510		7824.510		855
Side panel, screw-fastened, IP 55	8126.235		8128.235		8129.235		–		853
Baying	from page 861		from page 861		from page 861		from page 861		
Roof									
Roof plate, solid	■		■		■		■		
Roof plate, vented	7826.786		7826.788		7826.789		7826.780		902
Roof plate for cable entry	7826.865		7826.885		7826.895		7826.805		901
Roof plate, vented, for cable entry	7826.869		7826.889		7826.899		7826.809		902
Fan mounting plate, active, with controller	7986.035		7988.035		7988.035		7988.035		649
Fan roof, modular	see page 651		see page 651		see page 651		see page 651		
Spacers, 20 mm	2423.000		2423.000		2423.000		2423.000		904
Spacers, 50 mm	7967.000		7967.000		7967.000		7967.000		904
Climate control	see page 579		see page 579		see page 579		see page 579		
Base/plinth									
Base/plinth components, vented, front and rear, H = 100 mm	7825.801		7825.801		7825.801		7825.801		835
Base/plinth components, solid, front and rear, H = 100 mm	8601.805		8601.805		8601.805		8601.805		835
Base/plinth trim panels, side, H = 100 mm	8601.065		8601.085		8601.095		8601.015		835
Gland plate variants	from page 851		from page 851		from page 851		from page 851		
Castors	see page 848		see page 848		see page 848		see page 848		
Interior installation									
482.6 mm (19″) mounting angles, cranked (for network technology)	7827.220		7827.220		7827.220		7827.220		1004
482.6 mm (19″) mounting angles, L-shaped (for server technology)	7827.221		7827.221		7827.221		7827.221		1004
Depth stays for mounting angles	7827.600		7827.800		7827.900		7827.000		1008
Installation brackets for mounting angles	7827.480		7827.480		7827.480		7827.480		1009
Cable clamp rails	see page 980		see page 980		see page 980		see page 980		
Earthing/potential equalisation	from page 960		from page 960		from page 960		from page 960		
Socket strips/power management	from page 742		from page 742		from page 742		from page 742		
Component shelves	from page 939		from page 939		from page 939		from page 939		
482.6 mm (19″) installation system	from page 1010		from page 1010		from page 1010		from page 1010		
Cable management	from page 984		from page 984		from page 984		from page 984		
CMC-TC system monitoring	from page 762		from page 762		from page 762		from page 762		

■ included with the supply.

Accessories Page 832

Network enclosures, based on Rittal flexRack(i), pre-configured



B = Width
T = Depth

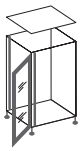
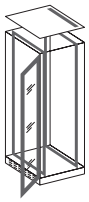
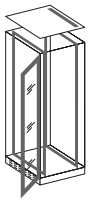
Material:
Vertical frame sections:
Extruded aluminium section
Base, roof frame, base/plinth, panels: Sheet steel.

Surface finish:
Enclosure panels:
Spray-finished in RAL 7035, frame sections and doors: RAL 9006,
Lock panels: RAL 7035,
Viewing window:
tinted, parsol grey,
Gland plates, 482.6 mm (19″) mounting angles:
Zinc-plated, passivated.

Supply includes:
Multi-platform frame FR(i) with designer glazed door at front (130°), sheet steel door at rear (130°).
Roof plate, side panels, vented base/plinth, gland plate, interior installation depending on design, see table on page 704.
Earthing of all enclosure panels, comfort handles for semi-cylinders with security lock 12321, front and rear.

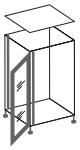
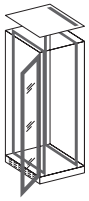
Property rights:
German patent no. 103 11 376
German Registered Design no. 403 04 312 and 401 03 180
British Registered Design no. 301 54 31 and 210 49 77
US Design Patent no. 479,241

Detailed drawing,
available on the Internet.

					
U	11	11	25	42	42
Width (B1) in mm	600	600	600	800	800
Height (H1 + H2) in mm	600	600	1200	2000 + 100	2000 + 100
Depth (T1) in mm	805	1005	1005	805	1005
Depth absolute, incl. handles and roof curvature (T1) in mm + 90 mm	895	1095	1095	895	1095
Model No. FR(i) as single enclosure incl. 2 side panels	**7855.480**	**7855.500**	**7855.510**	**7855.550**	**7855.570**
Model No. FR(i) as bayed enclosure without side panels, incl. baying kit	**–**	**–**	**–**	**7855.540**	**7855.560**

Accessories Page 832 **Monitoring** Page 762 **Climate control** Page 578

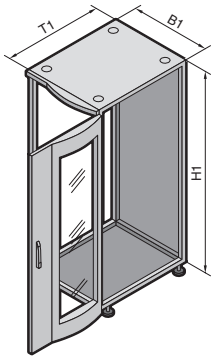
Network enclosures, based on Rittal flexRack(i), pre-configured

						
U	11	11	25	42	42	Page
Width (B1) in mm	600	600	600	800	800	
Height (H1 + H2) in mm	600	600	1200	2000 + 100	2000 + 100	
Depth (T1) in mm	805	1005	1005	805	1005	
Depth absolute, incl. handles and roof curvature (T1) in mm + 90 mm	895	1095	1095	895	1095	
Model No. FR(i) as single enclosure incl. 2 side panels	**7855.480**	**7855.500**	**7855.510**	**7855.550**	**7855.570**	
Model No. FR(i) as bayed enclosure without side panels, incl. baying kit	**–**	**–**	**–**	**7855.540**	**7855.560**	
Doors						
Designer glazed front door/sheet steel rear door	■	■	■	■	■	
Various door variants, based on TS 8, available on request	–	–	–	–	–	
Side panel						
Side panel, plug-type, incl. security lock 12321	■	■	■	■ (7855.550 only)	■ (7855.570 only)	856
Internal latch for side panel, plug-in	■	■	■	■	■	855
Baying	from page 861	from page 861	from page 861	from page 861	from page 861	
Roof						
Designer roof plate, solid	■	■	■	–	–	
Designer roof plate for cable entry, two-piece	–	–	–	■	■	901
Various roof plate variants, based on TS 8	from page 901	from page 901	from page 901	from page 901	from page 901	
Base/plinth						
Base/plinth components solid, front and rear	8601.605	8601.605	8601.605	8601.805	8601.805	835
Base/plinth components, vented, front and rear	7825.601	7825.601	7825.601	■	■	835
Base/plinth trim, side	8601.085	8601.015	8601.015	■	■	835
Base/gland plate, mounted at front as infill panel, rear part open	–	–	–	■	■	
Gland plate, one-piece, vented	■	■	■	–	–	851
Gland plate variants, based on TS 8	from page 851	from page 851	from page 851	from page 851	from page 851	
Interior installation						
482.6 mm (19″) mounting angles, L-shaped at front	■	■	■	–	–	1005
Additional 482.6 mm (19″) mounting angles, L-shaped	7856.800	7856.800	7856.803	7856.809	7856.809	1005
482.6 mm (19″) mounting frames, front and rear	–	–	–	■	■	1007
Additional 482.6 mm (19″) mounting frame	7856.710	7856.710	7856.713	7856.719	7856.719	1007
System punched section, interior installation of rail systems	from page 917	from page 917	from page 917	from page 917	from page 917	
Cable clamp rails	from page 980	from page 980	from page 980	from page 980	from page 980	
Earthing/potential equalisation	from page 960	from page 960	from page 960	from page 960	from page 960	
Socket strips/power management	from page 742	from page 742	from page 742	from page 742	from page 742	
Component shelves	from page 939	from page 939	from page 939	from page 939	from page 939	
482.6 mm (19″) installation system	from page 1010	from page 1010	from page 1010	from page 1010	from page 1010	
4 hammerhead rails incl. system adaptor, supplied loose, for cable clamping in the enclosure depth	–	–	–	■	■	983
10 cable shunting rings 105 x 70 mm, supplied loose	–	–	–	■	■	984
50 cage nuts and hexagon socket screws, supplied loose	–	–	–	■	■	936
Cable management	from page 984	from page 984	from page 984	from page 984	from page 984	
CMC-TC system monitoring	from page 762	from page 762	from page 762	from page 762	from page 762	

■ included with the supply.

Accessories Page 832 **Monitoring** Page 762 **Climate control** Page 578

Network enclosures, based on Rittal flexRack(i)



Material:
Vertical frame sections:
Extruded aluminium section
Base, roof frame, panels:
Sheet steel

Surface finish:
Enclosure panels:
Spray-finished in RAL 7035,
Frame sections and doors:
RAL 9006,
Lock panels: RAL 7035,
Viewing window:
Tinted, parsol grey,
Gland plates:
Zinc-plated, passivated

Supply includes:
Multi-platform frame FR(i) with designer glazed door front (130°), sheet steel rear door (130°), solid roof plate, multi-piece gland plate, levelling feet, comfort handles for semi-cylinder with security lock 12321, front and rear.

Property rights:
German patent no. 103 11 376
German Registered Design no. 403 04 312 and 401 03 180
British Registered Design no. 301 54 31 and 210 49 77
US Design Patent no. 479,241

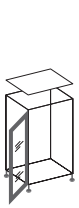
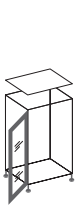
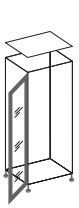
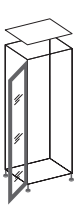
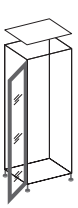
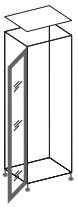
Detailed drawing,
available on the Internet.

U	11	11	24	24	38	42	42	47
Width (B1) in mm	600	600	600	600	600	600	600	600
Height (H1) in mm	600	600	1200	1200	1800	2000	2000	2200
Depth (T1) in mm	605	1005	605	1005	605	605	1005	1005
Depth absolute, incl. handles and roof curvature (T1) in mm + 90 mm	695	1095	695	1095	695	695	1095	1095
Model No. FR(i)	**7855.610**	**7855.620**	**7855.630**	**7855.640**	**7855.650**	**7855.660**	**7855.670**	**7855.680**

U	24	38	42	42	47	47
Width (B1) in mm	800	800	800	800	800	800
Height (H1) in mm	1200	1800	2000	2000	2200	2200
Depth (T1) in mm	805	805	805	1005	805	1005
Depth absolute, incl. handles and roof curvature (T1) in mm + 90 mm	895	895	895	1095	895	1095
Model No. FR(i)	**7855.690**	**7855.700**	**7855.710**	**7855.720**	**7855.730**	**7855.740**

Accessories Page 832 **Monitoring** Page 762 **Climate control** Page 578

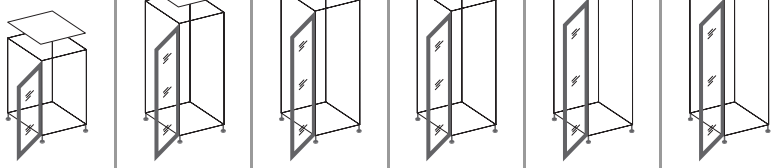
Network enclosures, based on Rittal flexRack(i)

									
U	11	11	24	24	38	42	42	47	Page
Width (B1) in mm	600	600	600	600	600	600	600	600	
Height (H1) in mm	600	600	1200	1200	1800	2000	2000	2200	
Depth (T1) in mm	605	1005	605	1005	605	605	1005	1005	
Depth absolute, incl. handles and roof curvature (T1) in mm + 90 mm	695	1095	695	1095	695	695	1095	1095	
Model No. FR(i)	**7855.610**	**7855.620**	**7855.630**	**7855.640**	**7855.650**	**7855.660**	**7855.670**	**7855.680**	
Doors									
Designer glazed front door/ sheet steel rear door	■	■	■	■	■	■	■	■	
Various door variants, based on TS 8, available on request	–	–	–	–	–	–	–	–	
Side panel									
Side panel, plug-type incl. security lock 12321	7856.660	7856.663	7856.666	7856.672	7856.675	7856.681	7856.687	7856.696	856
Internal latch for side panel, plug-in	7856.700	7856.700	7856.700	7856.700	7856.700	7856.700	7856.700	7856.700	855
Baying	from page 861	from page 861	from page 861	from page 861	from page 861	from page 861	from page 861	from page 861	
Roof									
Designer roof plate, solid	■	■	■	■	■	■	■	■	
Various roof plate options, based on TS 8	from page 901	from page 901	from page 901	from page 901	from page 901	from page 901	from page 901	from page 901	
Base/plinth									
Base/plinth components, solid, front and rear	8601.605	8601.605	8601.605	8601.605	8601.605	8601.605	8601.605	8601.605	835
Base/plinth components, vented, front and rear	7825.601	7825.601	7825.601	7825.601	7825.601	7825.601	7825.601	7825.601	835
Base/plinth trim, side	8601.065	8601.015	8601.065	8601.015	8601.065	8601.065	8601.015	8601.015	835
Multi-piece gland plate	■	■	■	■	■	■	■	■	
Gland plate variants, based on TS 8	from page 851	from page 851	from page 851	from page 851	from page 851	from page 851	from page 851	from page 851	
Interior installation									
482.6 mm (19″) mounting angles, L-shaped	7856.800	7856.800	7856.803	7856.803	7856.806	7856.809	7856.809	7856.812	1005
482.6 mm (19″) mounting frame	7856.710	7856.710	7856.713	7856.713	7856.716	7856.719	7856.719	7856.722	1007
Punched sections with mounting flanges, interior installation, rail systems	from page 917	from page 917	from page 917	from page 917	from page 917	from page 917	from page 917	from page 917	
Cable clamp rails	from page 980	from page 980	from page 980	from page 980	from page 980	from page 980	from page 980	from page 980	
Earthing/potential equalisation	from page 960	from page 960	from page 960	from page 960	from page 960	from page 960	from page 960	from page 960	
Socket strips/ power management	from page 742	from page 742	from page 742	from page 742	from page 742	from page 742	from page 742	from page 742	
Component shelves	from page 939	from page 939	from page 939	from page 939	from page 939	from page 939	from page 939	from page 939	
482.6 mm (19″) installation system	from page 1010	from page 1010	from page 1010	from page 1010	from page 1010	from page 1010	from page 1010	from page 1010	
Cable management	from page 984	from page 984	from page 984	from page 984	from page 984	from page 984	from page 984	from page 984	
CMC-TC system monitoring	from page 762	from page 762	from page 762	from page 762	from page 762	from page 762	from page 762	from page 762	

■ included with the supply.

Accessories Page 832 **Monitoring** Page 762 **Climate control** Page 578

Network enclosures, based on Rittal flexRack(i)

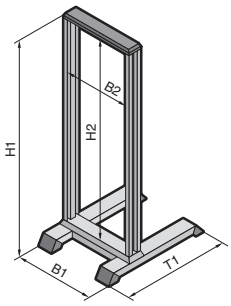


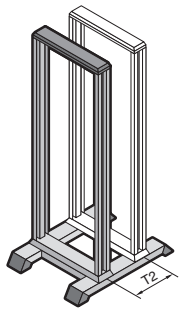
U	24	38	42	42	47	47	Page
Width (B1) in mm	800	800	800	800	800	800	
Height (H1) in mm	1200	1800	2000	2000	2200	2200	
Depth (T1) in mm	805	805	805	1005	805	1005	
Depth absolute, incl. handles and roof curvature (T1) in mm + 90 mm	895	895	895	1095	895	1095	
Model No. FR(i)	**7855.690**	**7855.700**	**7855.710**	**7855.720**	**7855.730**	**7855.740**	
Doors							
Designer glazed front door/sheet steel rear door	■	■	■	■	■	■	
Various door variants, based on TS 8, available on request	–	–	–	–	–	–	
Side panel							
Side panel, plug-in incl. security lock 12321	7856.669	7856.678	7856.684	7856.687	7856.693	7856.696	856
Internal latch for side panel, plug-in	7856.700	7856.700	7856.700	7856.700	7856.700	7856.700	855
Baying	from page 861	from page 861	from page 861	from page 861	from page 861	from page 861	
Roof							
Designer roof plate, solid	■	■	■	■	■	■	
Various roof plate options, based on TS 8	from page 901	from page 901	from page 901	from page 901	from page 901	from page 901	
Base/plinth							
Base/plinth components solid, front and rear	8601.805	8601.805	8601.805	8601.805	8601.805	8601.805	835
Base/plinth components, vented, front and rear	7825.801	7825.801	7825.801	7825.801	7825.801	7825.801	835
Base/plinth trim, side	8601.085	8601.085	8601.085	8601.015	8601.085	8601.015	835
Multi-piece gland plate	■	■	■	■	■	■	
Gland plate variants, based on TS 8	from page 851	from page 851	from page 851	from page 851	from page 851	from page 851	
Interior installation							
482.6 mm (19″) mounting frame	7856.725	7856.728	7856.731	7856.731	7856.734	7856.734	1007
System punched section, interior installation of rail systems	from page 917	from page 917	from page 917	from page 917	from page 917	from page 917	
Cable clamp rails	from page 980	from page 980	from page 980	from page 980	from page 980	from page 980	
Earthing/potential equalisation	from page 960	from page 960	from page 960	from page 960	from page 960	from page 960	
Socket strips/power management	from page 742	from page 742	from page 742	from page 742	from page 742	from page 742	
Component shelves	from page 939	from page 939	from page 939	from page 939	from page 939	from page 939	
482.6 mm (19″) installation system	from page 1010	from page 1010	from page 1010	from page 1010	from page 1010	from page 1010	
Cable management	from page 984	from page 984	from page 984	from page 984	from page 984	from page 984	
CMC-TC system monitoring	from page 762	from page 762	from page 762	from page 762	from page 762	from page 762	

■ included with the supply.

Accessories Page 832 **Monitoring** Page 762 **Climate control** Page 578

Distributor racks, based on Rittal Data Rack





Supply includes:
1 torsionally stiff section frame welded from 2 mm sheet steel with 482.6 mm(19″) punchings, spray finished in RAL 7035, trim in RAL 5018,
1 stable base/plinth of folded sheet steel and integral die-cast zinc feet (RAL 5018) with the option of floor anchoring, including mounting accessories. Alternatively, levelling feet (DK 7493.000) or castors (DK 7495.000) may be fitted.

Available on request:
- Metric (535 mm) version
- Side rails
- Special versions and special sizes

Load capacity:
max. 150 kg/level

Property rights:
German registered design M 9201859
German patent no. 4207282

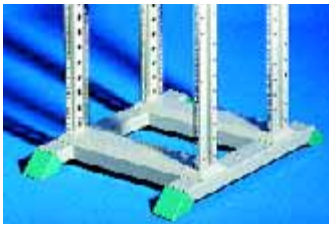
Detailed drawing,
available on the Internet.

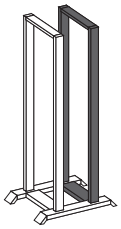
U	Packs of	31	36	40	45	Page
Width (B1) in mm		550	550	550	550	
Height (H1) in mm		1499.5	1721.8	1899.5	2121.8	
Depth (T1) in mm		750	750	750	750	
Clearance width (B2) mm		450	450	450	450	
Clearance height (H2) mm		1381.5	1603.8	1781.5	2003.8	
Distance from the second mounting level (T2) mm[1]		min. 150 – max. 350	min. 150 – max. 350	min. 150 – max. 350	min. 150 – max. 350	
U x 44.45 mm =		1377.95	1600.2	1778	2000.25	
Model No. DK		**7391.000**	**7396.000**	**7400.000**	**7445.000**	
Accessories						
Second mounting level[1]	1	7296.000	7297.000	7298.000	7299.000	709
Baying clamp	3	7494.000	7494.000	7494.000	7494.000	709
Levelling feet	4	7493.000	7493.000	7493.000	7493.000	710
Cable duct	1	7827.333	7827.338	7827.342	7827.347	987
C rails, 482.6 mm (19″)	6	7016.100	7016.100	7016.100	7016.100	992
Cable clamp rail, 482.6 mm (19″)	6	7016.110	7016.110	7016.110	7016.110	992
Cable clamp strap D = 250 mm	6	7016.120	7016.120	7016.120	7016.120	992
Twin castors	4	7495.000	7495.000	7495.000	7495.000	848
Depth stays	2	7401.000	7401.000	7401.000	7401.000	710
Component shelf 2 U for one pair of mounting angles D = 250 mm	1	7119.250	7119.250	7119.250	7119.250	948
Component shelf 2 U for one pair of mounting angles D = 400 mm	1	7119.400	7119.400	7119.400	7119.400	948
Component shelf 2 U for one level D = 300 mm[3]	1	7148.035	7148.035	7148.035	7148.035	946
Drawer 2 U	1	7281.035	7281.035	7281.035	7281.035	1051
Component shelf D = 300 mm[2) 3)]	1	7143.035	7143.035	7143.035	7143.035	944
Component shelf D = 400 mm[2) 3)]	1	7144.035	7144.035	7144.035	7144.035	944
Component shelf D = 500 mm[2) 3)]	1	7145.035	7145.035	7145.035	7145.035	944
Slide rails D max. < 190 mm	10	1962.200	1962.200	1962.200	1962.200	999
Slide rails D max. > 190 mm	10	1963.200	1963.200	1963.200	1963.200	999
Slide rails for pairs of mounting angles[1]	2	7402.000	7402.000	7402.000	7402.000	710

[1] Second mounting level may be positioned on a 50 mm pitch pattern.
[2] A second pair of mounting angles is required for assembly.
[3] Stationary installation or full withdrawal, telescopic slides see page 951.

Accesories Page 832 **Monitoring** Page 762 **19″ installation system** Page 1010 **Patch panels** Page 1021

Acessories for Rittal Data Rack





Second mounting level

In order to accommodate 482.6 mm (19″) network components or for the attachment of component shelves, slide rails and telescopic rails.
The mounting level may be positioned on a 50 mm pitch pattern.
Minimum distance between levels 150 mm, Maximum distance between levels 350 mm.

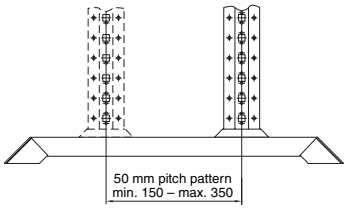
Material:
Sheet steel, 2 mm

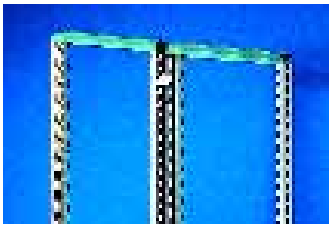
Colour:
RAL 7035

Supply includes:
1 torsionally stiff section frame including assembly parts. 482.6 mm (19″) punched profile at the front, hole centre distance 465 (470 mm at the rear), tailored to the attachment of patch panels and cable routing rails.

U	Model No. DK
31	**7296.000**
36	**7297.000**
40	**7298.000**
45	**7299.000**

Detailed drawing,
can be found on the Internet.





Baying connector

For assembling rows of distributor frames, or for cable routing between data racks.

Technical specifications:
Length: 53 mm

Colour:
RAL 7035

Packs of	Model No. DK
3	**7494.000**

Roof plate for cable routing

For optimised use of the Data Rack as a corridor distributor or cable management rack. By moving the guide plates, the individual cableways can be separately sized, thus enabling structured cable routing in data highways, even in the roof area.
On all Data Racks, the roof plate can be attached with two mounting levels and a distance between the levels of 350 mm.

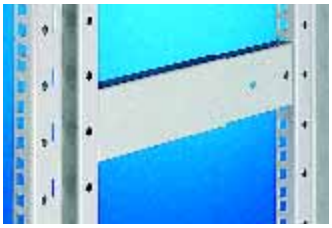
Packs of	Model No. DK
1	**7411.000**

Material:
Sheet steel, spray-finished

Colour:
RAL 7035

Supply includes:
Roof plate including assembly parts.

Acessories for Rittal Data Rack



Depth stays

For securing and stabilising two pairs of 482.6 mm (19″) mounting angles in the data rack. The length of the depth stay is adjustable, and can accommodate all spacings of mounting angles.

Colour:
RAL 7035

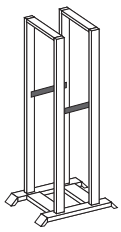
Depth stays	Packs of	Model No. DK
	2	**7401.000**

Continuous slide rail

for two pairs of mounting angles, 482.6 mm (19″)
The continuous slide rail is used to support heavy installed equipment in the Data Rack.
The mounting dimensions of the slide rails were selected to enable them to be combined with 500 mm deep, 482.6 mm (19″) component shelves. The mounting distance of the 482.6 mm (19″) mounting angles is 350 mm.

Requirements:
Second pair of mounting angles

Material:
Sheet steel, zinc-plated, passivated



Packs of	Model No. DK
2	**7402.000**

Accessories:

Component shelf, 500 mm deep, DK 7145.035, see page 944 .

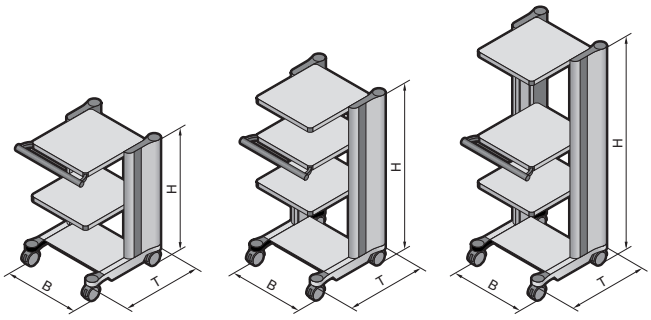
Levelling feet

To compensate for height differences with floor irregularities.
The levelling feet are attached to the die-cast zinc feet of the base/plinth.

Supply includes:
4 levelling feet M12,
levelling range 40 mm.

Packs of	Model No. DK
4	**7493.000**

Mobile workstation, Rittal RiLab



Type 1 Type 2 Type 3

The workstation is ideal for positioning sensitive equipment securely whilst remaining flexible in terms of location. Useful accessories turn the RiLab into a "master of disguise" for the most diverse applications in the networking environment. It can be used as a mobile laboratory or test stand, a flexible measurement station or assembly workstation.

The versatile opportunities are almost unlimited. Particularly designed for the 482.6 mm (19″) systems, the mobile workstation can also be combined with Rittal RiCase enclosures.

Load capacity:
Base frame 225 kg in total, shelves max. 50 kg per shelf.

Material:
Sheet steel, 1.5 mm, spray-finished in RAL 7035, support column of extruded aluminium section, corner pieces and trim panels in ABS, RAL 5018. Special colours available on request.

Supply includes:
Base frame with two integral power columns,
shelf with handle rod,
additional shelf, twin castors,
fully assembled.

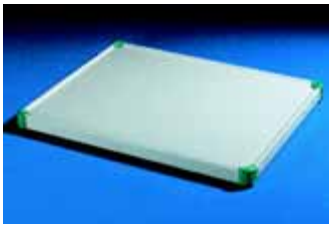
Approvals,
see page 83.

Detailed drawing,
available on the Internet.

		Type 1	Type 2	Type 3	Page
Width (B) in mm		714	714	714	
Height (H) in mm		820	1108	1428	
Depth (T) in mm		625	625	625	
Model No. DK		**7600.100**	**7600.200**	**7600.300**	
Accessories					
1 additional shelf, W x D 600 mm x 490 mm	Static surface load 50 kg	7600.500	7600.500	7600.500	712
1 monitor shelf, rotating, tilting, W x D 410 mm x 491 mm	Static surface load 35 kg	7600.530	7600.530	7600.530	712
1 pull-out shelf, with integral mouse pad, W x D 542 mm x 490 mm	Static surface load 20 kg	7600.520	7600.520	7600.520	712
1 pull-out shelf, W x D 542 mm x 490 mm	Static surface load 20 kg	7600.510	7600.510	7600.510	712
1 drawer with integral identification strip, W x H x D 600 mm x 96 mm x 490 mm	Static surface load 20 kg	7600.540	7600.540	7600.540	713
1 adaptor set for installing Rittal RiCase enclosures, tiltable		7600.590	7600.590	7600.590	713
1 6-way socket with switch, 16 A, 250 V, for installation in the power column		7600.600	7600.600	7600.600	713

Accessories Page 832 **RiCase enclosures** Page 563

Accessories for Rittal RiLab



RiLab shelf

With all-round raised safety edge. Reduces the risk of assemblies slipping off.

Technical specifications:
Load capacity 50 kg surface load, static

Material:
Sheet steel, 1.5 mm, RAL 7035,
Decorative trims of ABS, RAL 5018.

W x H x D mm	Packs of	Model No. DK
600 x 32 x 490	1	**7600.500**

Supply includes:
1 shelf,
including assembly parts.

Pull-out RiLab shelf

The pull-out shelf is fastened to the supporting pillars via telescopic slides. It guarantees and extension of up to 300 mm. The shelf can be locked in an inserted and extended position via two locating points.

Technical specifications:
Load capacity 20 kg surface load, static

Material:
Sheet steel, 1.5 mm, RAL 7035,
Decorative trims of ABS, RAL 5018.

W x H x D mm	Packs of	Model No. DK
542 x 48 x 490	1	**7600.510**

Supply includes:
1 shelf with telescopic slides,
including assembly parts.

Pull-out RiLab shelf with mouse pad

The pull-out shelf with integral mouse pad offers ideal accommodation for the mouse and key-board. The maximum extension is 295 mm.

Technical specifications:
Load capacity 20 kg surface load, static

Material:
Sheet steel, 1.5 mm, RAL 7035,
Decorative trims of ABS, RAL 5018.

W x H x D mm	Packs of	Model No. DK
542 x 64 x 490	1	**7600.520**

Supply includes:
1 shelf with telescopic slides and integral mouse pad,
including assembly parts.

Rotating, tilting monitor shelf

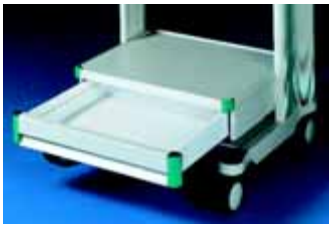
The monitor shelf has got an all-round safety edge. It can be tilted with infinite variation through ±15°. Horizontally, the shelf can be rotated through 70° with infinite variation, and locked.

Technical specifications:
Load capacity 35 kg surface load, static

Material:
Sheet steel, 1.5 mm, RAL 7035,
Decorative trims of ABS, RAL 5018.

W x H x D mm	Packs of	Model No. DK
410 x 32 x 491	1	**7600.530**

Supply includes:
1 monitor shelf with hinge and cable retainer,
including assembly parts.



Drawer

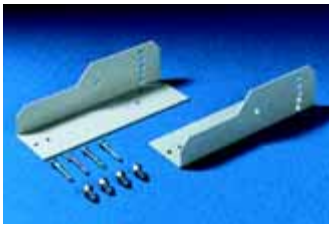
The drawer, which is open at the top, offers a practical solution for storing documents and equipment, and also features a front identification strip. The drawer can be closed at the top via a shelf fitted above it.

Technical specifications:
Load capacity 20 kg static surface load

Material:
1.0 mm sheet steel on the outside, polystyrene on the inside, RAL 7035, trim and corner pieces of ABS, RAL 5018.
Telescopic ball bearings slide.

W x H x D mm	Packs of	Model No. DK
600 x 96 x 490	1	**7600.540**

Supply includes:
1 drawer, including assembly parts.



Adaptor set

for Rittal RiCase enclosures, 600 mm wide
The adaptor set allows RiCase enclosures with a width of 600 mm to be integrated into the base frame. This achieves optimum synergy between the flexibility of the mobile workstation, and the mounting opportunities of the RiCase enclosure. The adaptor set is designed in such a way that the enclosure can be locked in five stages within a tilting range of ±15°.

Technical specifications:
Load capacity max. enclosure weigth 50 kg.

Material:
Sheet steel, 2.0 mm, RAL 7035

Packs of	Model No. DK
1 set	**7600.590**

Supply includes:
1 adaptor set, consisting of two mounting brackets, including mounting accessories.

6-way socket strip with switch

The socket strip has a 3 m long connection cable, and is conveniently housed in the power column of the mobile workstation. This permits direct on-site power supply over short distances without taking up any additional space.

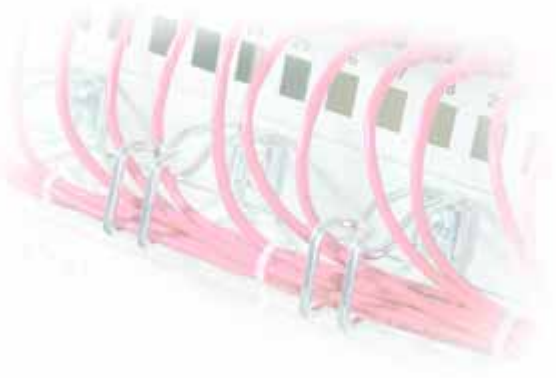
Technical specifications:
Socket strip with switch, 16 A, 250 V,
3 m connection cable, manufactured to
CEI 884-1, tested to VDE.

Material:
Aluminium section with polycarbonate cover, self-extinguishing to UL 94-V0.

Packs of	Model No. DK
1	**7600.600**

Supply includes:
1 socket strip, including assembly parts.

Features



The configuration of decentralised network units is extremely important for small and medium-sized companies.

Rittal creates new solutions to accommodate the growing demands.

RNC enclosure

Prepared for the installation of $^1/_2$ 19″ components. 10″ components may also be installed by using an adaptor. 482.6 mm (19″) variant for vertical population.

Plug & play side panels with integral vent slots.

Wall-mounting with frame.

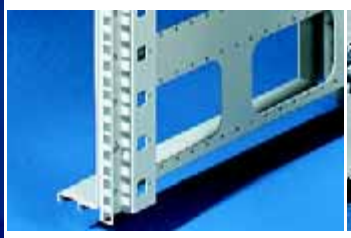
RNC universal enclosure

The universal enclosure, vertical for 482.6 mm (19″) configuration, horizontal for $^1/_2$ 19″ or 10″ configuration.

Bayed for 482.6 mm (19″) configuration, vertical and horizontal.

Passive ventilation
To accommodate a prepared fan, cable entry with brush strip.

Wall-mounted enclosure, based on Rittal QuickBox



Cutouts in the mounting bracket for access to the rear of the patch panels or active components.

Optimum cable clamping on the vertical or horizontal rail using cable ties.

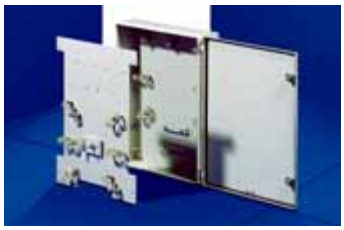
Vent slots for passive ventilation.

Wall-mounted and distribution enclosures

Wall-mounted enclosure based on AE with pull-out frame or depth-adjustable 482.6 mm (19″) level.

Office distributor
Comprehensive cabling for one storey can be achieved with the Office distributor.
The vertical arrangement of the 482.6 mm (19″) level guarantees a very slimline construction.

Small fibre-optic distributors
As a corridor and intermediate distributor of fibre-optic cables.



Small fibre-optic distributor, based on AE
The ideal enclosure for break-out applications.

Fibre-optic marshalling enclosure
Two access areas: Separate doors and security locks:
1. For splicing cassette mounting
2. For the patching chamber.

Small fibre-optic distributors, polycarbonate for extreme conditions: The small plastic enclosure with a high protection category of IP 66 to EN 60 529/ 10.91.

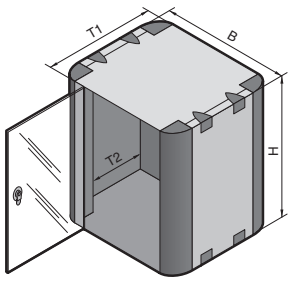
Wall-mounted enclosure, based on Rittal EL, 3-part/2-part

Optimum accessibility, thanks to 3-part or 2-part vertically hinged construction.

Equipped with **Mini comfort handle** (3 – 15 U), **comfort handle** (18 and 21 U) and replaceable **cable gland plates.**

2-part enclosure with swing frame. Facility for installing sub-racks and electronic components.

RNC enclosure



Rittal-Net.com is the passive platform for the fast, future-proof assembly of communications networks in the small office sector.
Three designer enclosures, for population with connection cables, patch cables and distributor panels, are tailored to the specific criteria of the SOHO market. Work groups may be set up quickly and easily.

Material:
1.5 mm sheet steel
Smoked grey acrylic glazing
Corner sections of aluminium
Corner feet made from thermoplastic foam

Colour:
Enclosure panels: RAL 7035
Corner sections: RAL 7030

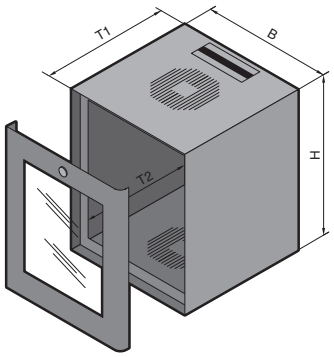
Further information on the RNC distribution channel may be found at **www.rittal-net.com** (pages in German only)

Detailed drawing,
available on the Internet.

U		Packs of	4	8	6
Width (B) in mm			342	342	342
Height (H) in mm			215	390	490
Depth (T1) in mm			280	280	400
Max. installation depth (T2) mm			250	250	335
Model No. DK empty enclosure, individual		1	**7870.100**	**7870.200**	**7870.300**
Model No. DK, bulk pack		24	**7870.500**	**–**	**–**
		18	**–**	**7870.510**	**–**
		12	**–**	**–**	**7870.520**
Version			42 HP ($^1/_2$ 19″)	42 HP ($^1/_2$ 19″)	84 HP (19″)
Installation position			horizontal	horizontal	vertical
Accessory kits					
Telephone distributor, including patch cable					
Telephone VF Cat. 3, 10 ports, UTP, LSA, modular, including 8 patch cables with RJ 45 connector, on both sides, extruded insulation, cable design in blue, cable length 0.25 m	Single	1	7870.802	7870.802	–
	Bulk pack	6	7870.582	7870.582	–
Telephone VF Cat. 3, 8 ports, UTP, modular, including 8 patch cables with RJ 45 connector, on both sides, extruded insulation, cable design in blue, cable length 0.25 m	Single	1	7870.800	7870.800	–
	Bulk pack	6	7870.580	7870.580	–
Telephone VF Cat. 3, 25 ports, UTP, LSA, including 12 patch cables with RJ 45 connector, on both sides, extruded insulation, MegaLine 526 SC flex 4P, cable design in blue, cable length 0.6 m	Single	1	–	–	7870.810
	Bulk pack	6	–	–	7870.590
Data distributor, including patch cable					
VF Cat. 5, 8 ports, STP, LSA, including 8 patch cables with RJ 45 connector, on both sides, extruded insulation, cable design in yellow, cable length 0.25 m	Single	1	7870.882	7870.882	–
	Bulk pack	6	7870.597	7870.597	–
VF Cat. 5, 8 ports, UTP, modular, including 8 patch cables with RJ 45 connector, on both sides, extruded insulation, cable design in yellow, cable length 0.25 m	Single	1	7870.820	7870.820	–
	Bulk pack	6	7870.595	7870.595	–
VF Cat. 6, 24 ports, STP, LSA, including 12 patch cables with RJ 45 connector, on both sides, extruded insulation, cable design in yellow, cable length 0.6 m	Single	1	–	–	7870.830
	Bulk pack	6	–	–	7870.600

Accessories Page 832

RNC universal enclosure



A contemporary design in black, with compact dimensions and a glazed door with tinted safety glass. Central locking with just one lock, the side panels cannot be removed whilst the front door is latched.

Suitable for use both as a stand-alone model and for wall mounting. The plug-in side panels ensure rapid access and plenty of scope when mounting.
Optional 1/2 19″, 10″ or 19″ components may be installed.

Simple baying is supported, both horizontally and vertically, using the connector kit supplied loose.

Passive ventilation via openings in the rear frame and via perforations in the roof and gland plate, prepared to accommodate a fan expansion kit DK 7980.100.
Cable entry optionally via the rear panel, roof or base.
All frame parts and panels are prepared for earthing.

Material:
Sheet steel, ESG

Colour:
Black, similar to RAL 9011

Supply includes:
Enclosure with glazed door,
Baying kit,
Brush strips for cable entry,
482.6 mm (19″) mounting level at front.

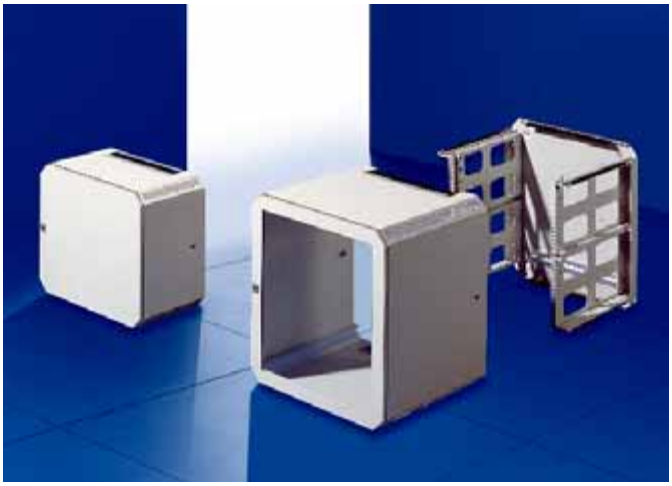
Property rights:
German patents
No. 10 210 481
No. 10 210 482

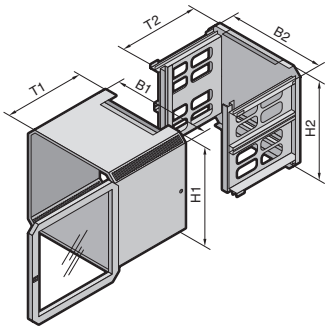
Detailed drawing,
available on the Internet.

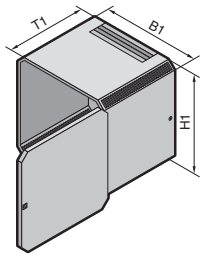
269.2 mm	Packs of	10	Page
U 482.6 mm (19 ″)		5	
Width (B) in mm		350	
Height (H) in mm		500	
Depth (T1) in mm		350	
Max. installation depth (T2) mm		270	
Model No. DK	1	**7870.350**	
Model No. DK	12	**7870.530**	
Accessories			
Socket strip 3-way, without switch	1	7240.110	746
Socket strip 7-way, without switch, for 482.6 mm (19″) level	1	7240.210	746
Socket strip 7-way, with switch, for 482.6 mm (19″) level	1	7240.220	746
1/2 19″ component shelf	1	7502.600	948
Cable management panel	1	7502.610	989
1/2 19″ blanking panel	2	7870.720	1025
1/2 19″ cable entry panel	2	7870.730	989
Blanking panel 1 U	2	7151.035	1025
Blanking panel 2 U	2	7152.035	1025
Blanking panel 3 U	2	7153.035	1025
Combination rail, length 200 mm	6	7502.302	980
Adaptor for 10″ system, 1 U	1	7870.760	1019
Adaptor for 10″ system, 4 U	1	7870.765	1019
Phillips-head screw M5, with plastic washer	100	2099.500	1019
Phillips-head screw M6, with plastic washer	100	2089.000	1019
Captive nuts M5, with contact	50	2094.500	1020
Captive nuts M6, with contact	50	2094.200	1020

Data and telephone distributor Page 807

Wall-mounted enclosure, based on Rittal QuickBox, 6 – 12 U







Perfect handling during installation and servicing, thanks to a removable cover.

Material:
Wall mounting plate with mounting brackets:
2.0 mm sheet steel
Enclosure cover:
1.0 mm sheet steel
Door: Sheet steel door or glazed door with sheet steel frame and safety glass ESG 3 mm

Surface finish:
Powder-coated
Enclosure: RAL 7035

Supply includes:
Wall section:
Pre-configured mounting bracket,
brush strip for cable entry at the bottom/top,
cable clamp rail

Enclosure cover:
consisting of base and cover tray with vent slots, brush strip for cable entry at the top/bottom, 2 side security locks, sheet steel door/glazed door with security lock, 482.6 mm (19″) mounting angles, infinitely depth-variable.

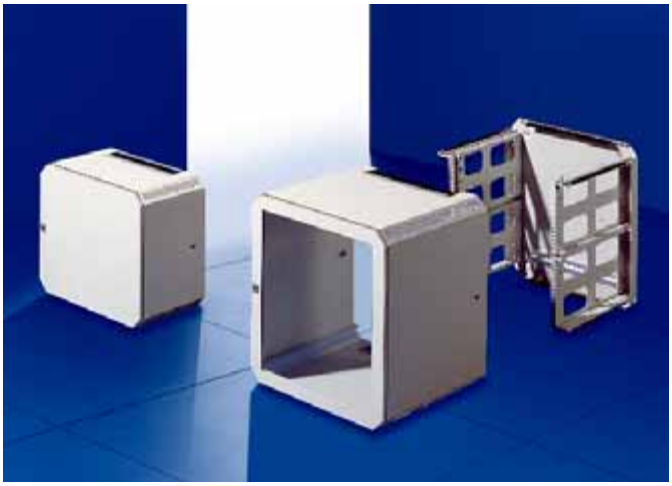
Property rights:
German patent
No. 198 11 711
German utility model
No. 298 23 843
European Patent No. 1 064 709
with validity for BE, ES, FR, GB, IT, NL, SE
Taiwanese Patent
No. NI 123 288
Russian Patent No. 2190912
Australian Patent
No. 733078
South Korean patent
No. 10-0375062
US patent no. 6,435,364

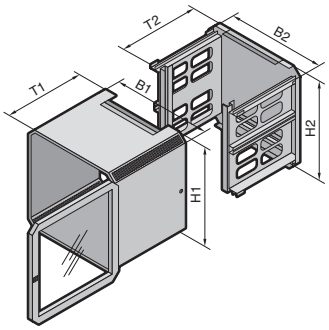
Detailed drawing,
available on the Internet.

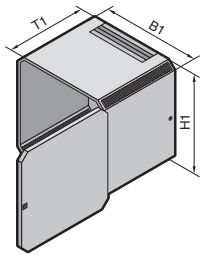
U/SU		P. of	6/10	6/10	6/10	9/15	9/15	9/15	12/20	12/20	12/20	Page
Enclosure cover	**Width** (B1) in mm		600	600	600	600	600	600	600	600	600	
	Height (H1) in mm		362	362	362	495	495	495	628	628	628	
	Depth (T1) in mm		300	400	600	300	400	600	400	500	600	
Wall section	**Width** (B2) in mm		595	595	595	595	595	595	595	595	595	
	Height (H2) in mm		355	355	355	488	488	488	621	621	621	
	Depth (T2) in mm		230	330	530	230	330	530	330	430	530	
Model No. with glazed door		1	**7502.013**	**7502.014**	**7502.016**	**7502.023**	**7502.024**	**7502.026**	**7502.034**	**7502.035**	**7502.036**	
Model No. with sheet steel door		1	**–**	**7502.114**	**–**	**7502.123**	**7502.124**	**7502.126**	**7502.134**	**–**	**7502.136**	
Accessories												
Mounting angles, 482.6 mm (19")		2	7502.201	7502.201	7502.201	7502.202	7502.202	7502.202	7502.203	7502.203	7502.203	1005
Mounting angles, metric		2	7502.211	7502.211	7502.211	7502.212	7502.212	7502.212	7502.213	7502.213	7502.213	1005
Solid gland plate		2	7502.310	7502.310	7502.310	7502.310	7502.310	7502.310	7502.310	7502.310	7502.310	970
Wall mounting bracket, 10 mm		1	2508.000	2508.000	2508.000	2508.000	2508.000	2508.000	2508.000	2508.000	2508.000	905
Wall mounting bracket, 40 mm		1	2503.000	2503.000	2503.000	2503.000	2503.000	2503.000	2503.000	2503.000	2503.000	905
Combination rails for enclosure width		6	7502.304	7502.304	7502.304	7502.304	7502.304	7502.304	7502.304	7502.304	7502.304	980
Combination rails for enclosure depth	300/400 mm	6	7502.302	7502.302	7502.302	7502.302	7502.302	7502.302	7502.302	7502.302	7502.302	980
	500/600 mm		7502.304	7502.304	7502.304	7502.304	7502.304	7502.304	7502.304	7502.304	7502.304	980
Slide rails for enclosure depth	300 mm	2	7063.000	7063.000	7063.000	7063.000	7063.000	7063.000	7063.000	7063.000	7063.000	1011
	400 mm		7063.300	7063.300	7063.300	7063.300	7063.300	7063.300	7063.300	7063.300	7063.300	1011
	500/600 mm		7063.400	7063.400	7063.400	7063.400	7063.400	7063.400	7063.400	7063.400	7063.400	1011
Earthing kit		1	7502.240	7502.240	7502.260	7502.240	7502.240	7502.260	7502.240	7502.260	7502.260	962
Quick-release fastener		2	7502.220	7502.220	7502.220	7502.220	7502.220	7502.220	7502.220	7502.220	7502.220	891

Accessories Page 832

Wall-mounted enclosure, based on Rittal QuickBox, 15 – 21 U







Perfect handling during installation and servicing, thanks to a removable cover.

Material:
Wall mounting plate with mounting brackets:
2.0 mm sheet steel
Enclosure cover:
1.0 mm sheet steel
Door: Sheet steel door or glazed door with sheet steel frame and single-pane safety glass, 3 mm

Surface finish:
Powder-coated
Enclosure: RAL 7035

Supply includes:
Wall section:
Pre-configured mounting bracket,
brush strip for cable entry at the bottom/top,
cable clamp rail

Enclosure cover:
consisting of base and cover tray with vent slots, brush strip for cable entry at the top/bottom, 2 side security locks, sheet steel door/glazed door with security lock, 482.6 mm (19″) mounting angles, infinitely depth-variable.

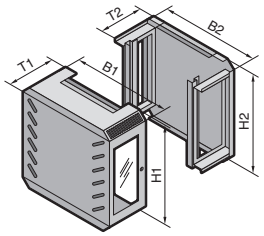
Property rights:
German patent
No. 198 11 711
German utility model
No. 298 23 843
European Patent No. 1 064 709
with validity for BE, ES, FR, GB, IT, NL, SE
Taiwanese Patent
No. NI 123 288
Russian Patent No. 2190912
Australian Patent
No. 733078
South Korean patent
No. 10-0375062
US patent no. 6,435,364

Detailed drawing,
available on the Internet.

U/SU		P. of	15/26	15/26	15/26	18/31	18/31	18/31	21/36	21/36	Page
Enclosure cover	**Width** (B1) in mm		600	600	600	600	600	600	600	600	
	Height (H1) in mm		762	762	762	895	895	895	1028	1028	
	Depth (T1) in mm		400	500	600	400	500	600	400	600	
Wall section	**Width** (B2) in mm		595	595	595	595	595	595	595	595	
	Height (H2) in mm		755	755	755	888	888	888	1021	1021	
	Depth (T2) in mm		330	430	530	330	430	530	330	530	
Model No. with glazed door		1	**7502.044**	**7502.045**	**7502.046**	**7502.054**	**7502.055**	**7502.056**	**7502.064**	**7502.066**	
Model No. with sheet steel door		1	**7502.144**	**–**	**7502.146**	**–**	**–**	**–**	**–**	**7502.166**	
Accessories											
Mounting angles, 482.6 mm (19″)		2	7502.204	7502.204	7502.204	7502.205	7502.205	7502.205	7502.206	7502.206	1005
Mounting angles, metric		2	7502.214	7502.214	7502.214	7502.215	7502.215	7502.215	7502.216	7502.216	1005
Solid gland plate		2	7502.310	7502.310	7502.310	7502.310	7502.310	7502.310	7502.310	7502.310	970
Wall mounting bracket, 10 mm		1	2508.000	2508.000	2508.000	2508.000	2508.000	2508.000	2508.000	2508.000	905
Wall mounting bracket, 40 mm		1	2503.000	2503.000	2503.000	2503.000	2503.000	2503.000	2503.000	2503.000	905
Combination rails for enclosure width		6	7502.304	7502.304	7502.304	7502.304	7502.304	7502.304	7502.304	7502.304	980
Combination rails for enclosure depth	300/400 mm	6	7502.302	7502.302	7502.302	7502.302	7502.302	7502.302	7502.302	7502.302	980
	500/600 mm		7502.304	7502.304	7502.304	7502.304	7502.304	7502.304	7502.304	7502.304	980
Slide rails for enclosure depth	300 mm	2	7063.000	7063.000	7063.000	7063.000	7063.000	7063.000	7063.000	7063.000	1011
	400 mm		7063.300	7063.300	7063.300	7063.300	7063.300	7063.300	7063.300	7063.300	1011
	500/600 mm		7063.400	7063.400	7063.400	7063.400	7063.400	7063.400	7063.400	7063.400	1011
Earthing kit		1	7502.240	7502.260	7502.260	7502.240	7502.260	7502.260	7502.240	7502.260	962
Quick-release fastener		2	7502.220	7502.220	7502.220	7502.220	7502.220	7502.220	7502.220	7502.220	891

Accessories Page 832

Wall-mounted enclosure, based on Rittal QuickBox with vertical 482.6 mm (19″) level



Optimum use of the interior space via side installation of the 482.6 mm (19″) components. Status monitoring via side viewing window.

Material:
Wall mounting plate with mounting brackets:
2.0 mm sheet steel
Enclosure cover:
1.0 mm sheet steel with side single-pane safety glass, 3 mm

Surface finish:
Spray-finished in RAL 7035

Supply includes:
Wall section:
with pre-configured 482.6 mm (19″) mounting brackets for side accommodation of mounting components and brush strip for cable entry from the bottom and top.

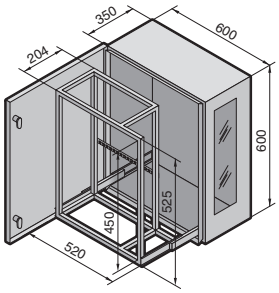
Enclosure cover:
with side vent slots to support passive climate control. The enclosure is secured via two security locks positioned at the sides.

Detailed drawing,
available on the Internet.

U vertical		Packs of	3	6	Page
Enclosure cover	**Width** (B1) in mm		600	600	
	Height (H1) in mm		631	631	
	Depth (T1) in mm		210	360	
Wall section	**Width** (B2) in mm		595	595	
	Height (H2) in mm		630.3	630.3	
	Depth (T2) in mm		198	348	
Model No. DK		1	**7502.630**	**7502.660**	
Accessories					
Gland plates, solid		2	7502.310	7502.310	970
Wall mounting bracket, 10 mm		1	2508.000	2508.000	905
Wall mounting bracket, 40 mm		1	2503.000	2503.000	905
Combination rails for vertical mounting on the wall section QB		6	7502.302	7502.302	980
Combination rails for horizontal mounting		6	7502.304	7502.304	980
Mounting and cable management panel for cable routing and the attachment of small equipment		1	7502.270	7502.270	988
Mounting angles, 482.6 mm (19″) for front mounting, 12 U		2	7502.203	7502.203	1005

Accessories Page 832

Wall mounted enclosure, based on Rittal AE, with pull-out frame



Wall mounted distributor with 482.6 mm (19″) pull-out frame. Side and front installation with 482.6 mm (19″) components in a vertical mounting position. Horizontal installation also optionally supported at the front. Status monitoring via side viewing window. Pull-out frame may be removed for population via snap fastenings. Passive cooling via pre-configured outlet filter, may be upgraded to active. Optional accommodation facilities for earth rail DK 7113.000 in a vertical position on the pull-out frame.

Material:
Sheet steel

Surface finish:
Enclosure spray-finished, RAL 7035
Pull-out frame zinc-plated, passivated.

Supply includes:
1 wall-mounted distributor enclosure with sheet steel door, cam lock and double-bit insert. Pull-out frame attached to telescopic slides. Outlet filter in enclosure base and on left-hand side. Viewing window on right-hand side. Combination rail for cable clamping behind the cable entry. Additional cable clamp rail for mounting on the pull-out frame.

Protection category:
IP 43 to EN 60 529/10.91

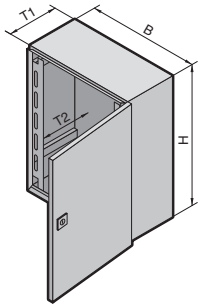
Available on request:
- Fully modified wall-mounted distributors.
- Special designs

Detailed drawing,
available on the Internet.

Width in mm	Packs of	600	Page
Height in mm		600	
Depth in mm		350	
Model No. DK	1	**7644.000**	
Side 482.6 mm (19″) level, vertical		4 U	
Front 482.6 mm (19″) level, vertical and horizontal		10 U	
Accessories			
Plastic cable gland plates with prepunched PG holes	5	2563.000	966
Wall mounting bracket, 10 mm	1	2508.000	905
Wall mounting bracket, 40 mm	1	2503.000	905
Shelf	1	7644.400	949
Component shelf, 1 U	1	7119.140	947
Earth rail, horizontal	1	7113.000	962
Fan expension kit 220 V (may only be used at the bottom)	1 set	7980.100	649
Lock systems			
Plastic handle, version B, see page 886.			
Standard double-bit lock insert may be exchanged for 27 mm lock inserts, type A, see page 888.			

Accessories Page 832

Wall-mounted enclosure, based on Rittal AE



Wall-mounted distributor with infinitely depth-variable 482.6 mm (19″) mounting level at the front. The ideal solution for small networks or corridor distributors.
Max. attainable protection category up to IP 55 (to EN 60 529/10.91) when using the prepunched plastic cable gland plates 2563.000 (optional).

Material:
Sheet steel

Surface finish:
Spray-finished in RAL 7035

Supply includes:
1 wall-mounted distributor enclosure with sheet steel door, cam lock and double-bit insert.
Gland plate with brush strip for cable entry at the bottom,
2 mounting angles, 482.6 mm (19″), depth-adjustable
1 C-rail for cable routing,
1 metal bracket for optional accommodation of an earth rail or 482.6 mm (19″) socket strip.

Available on request:
- Fully modified wall-mounted distributors.
- Special designs

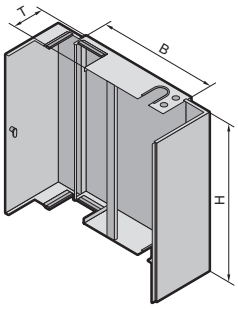
Approvals,
see page 85.

Detailed drawing,
available on the Internet.

U	Packs of	8	13	16	Page
Width (B) in mm		600	600	600	
Height (H) in mm		380	600	760	
Depth (T1) in mm		350	350	350	
Max. installation depth (T2) mm		310	310	310	
Model No. DK	1	**7641.000**	**7643.000**	**7645.000**	
Accessories					
Plastic cable gland plates with prepunched PG holes	5	2563.000	2563.000	2563.000	966
Wall mounting bracket, 10 mm	1	2508.000	2508.000	2508.000	905
Wall mounting bracket, 40 mm	1	2503.000	2503.000	2503.000	905
Glazed door, 34 mm profile depth	1	2730.000	2731.000	2732.000	878
Glazed door, 60 mm profile depth	1	2760.000	2761.000	2762.000	878
Rain canopy of sheet steel, RAL 7035	1	2511.500	2511.500	2511.500	899
Component shelf 2 U, fixed installation, 250 mm	1	7119.250	7119.250	7119.250	948
Swing frame, RAL 7035	1	2026.200	2027.200	2034.200	1002
Earth rail	1	7113.000	7113.000	7113.000	962
Lock systems					
Plastic handle, version B, see page 886.					
Standard double-bit lock insert may be exchanged for 27 mm lock inserts, type A, see page 888.					

Accessories Page 832

Office distributor, 2 and 4 U, for fibre-optic and copper cables



The super-slimline design of this corridor distributor is achieved thanks to the vertical arrangement of the patch level.
The 2 or 4 U mounting level may be populated with patch panels and/or active components.
Cable entry is in the left-hand enclosure via brush strips. The right-hand part offers a large opening for cable sections and the option of attaching cable glands.

Material:
Sheet steel, 1.5 mm

Colour:
RAL 7035

Supply includes:
Office distributor, fully assembled, with security lock.

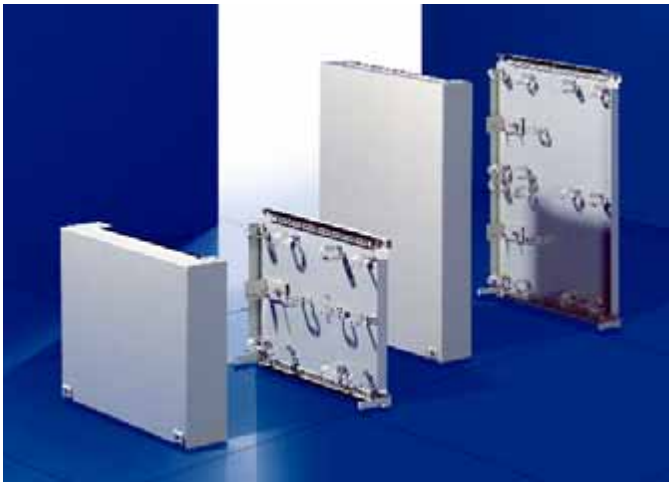
Available on request:
- Other variants
- Separate access authorisation available on request.

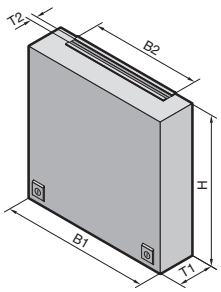
Detailed drawing,
available on the Internet.

U	Packs of	2	4
Width (B) in mm		400	400
Height (H) in mm		504	504
Depth (T) in mm		106	195
Model No. DK	1	**7245.000**	**7245.400**

Patch panels for fibre-optic and copper technology see page 1021 to 1025

Small fibre-optic distributor





Material:
Sheet steel, 1.5 mm

Surface finish:
Powder-coated in RAL 7035

Supply includes:
1 enclosure, two-part, in two designs to accommodate a maximum of 48 or 96 optical fibres respectively,
1 wall section:
with mounting holes for wall mounting,
11/16 shunting rings:
for patching cables/fibre stock,
1/2 splicing cassette holders:
To accommodate a maximum of 8 splicing cassettes,
2 comb strips:
for cable clamping, and brush inserts to provide protection against dust,
1 cover:
with suspension device and two cam locks.

Note:
When the small fibre-optic distributor is used without a patch panel, 1/2 splicing cassette holders may be retrofitted (maximum splicing cassette accommodation 16/32).

Available on request:
- Special designs

Property rights:
German patent no. 44 10 795

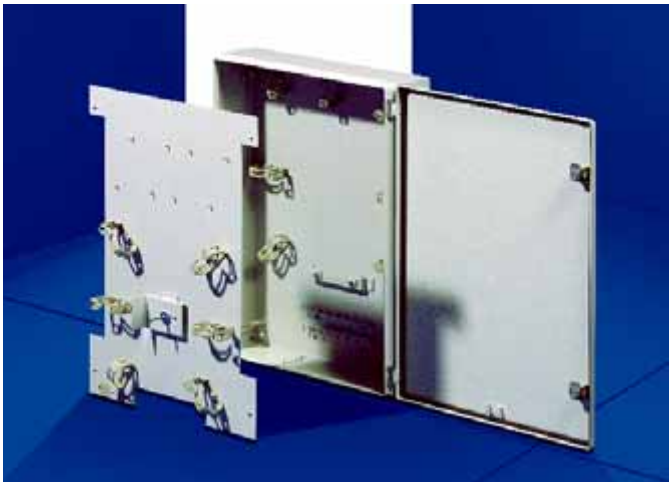
Detailed drawing,
available on the Internet.

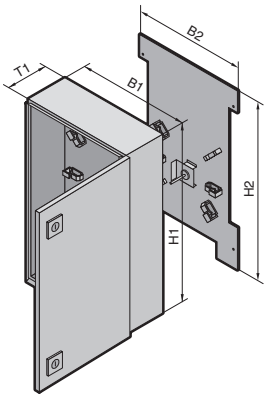
Width (B1) in mm	Packs of	500	500	Page
Height (H) in mm		500	900	
Depth (T1) in mm		120	120	
Width of cable entry (B2) in mm		395	395	
Depth of cable entry (T2) in mm		29	29	
Model No. DK	1	**7452.035**	**7453.035**	
Number of fibres (when using patch panels)		1 – 48	1 – 96	
Accessories				
Patch panels with 12/24 locations for fibre-optic couplings		Maximum population 2 patch panels	Maximum population 4 patch panels	
F-SMA 6.5 mm, 24 locations	2	**7456.035**[1)]	**7456.035**[1)]	–
F-SMA 7.5 mm, 24 locations	2	**7457.035**[1)]	**7457.035**[1)]	–
ST, 24 locations	2	**7458.035**	**7458.035**	–
DIN 47 256, 24 locations	2	**7459.035**[1)]	**7459.035**[1)]	–
SC-, E-2000-, E-2000-Duplex, 24/12 locations	2	**7460.035**[1)]	**7460.035**[1)]	–
SC duplex, 12 locations	2	**7460.135**[1)]	**7460.135**[1)]	–
Splicing cassette holder for retrofitting	1	**7450.035**	**7450.035**	1026
Lock systems				
T handle without lock insert	1	2572.000	2572.000	887
T handle with lock insert no. 3524 E	1	2575.000	2575.000	887
Lock “15” (Zeiß-Ikon)	2	7059.035[1)]	7059.035[1)]	891
Key “15” (Zeiß-Ikon)	1	7059.100[1)]	7059.100[1)]	891
Plastic handle with lock no. 3524 E	1	2576.000	2576.000	886
Plastic handle	1	2533.000	2533.000	886
Standard double-bit lock insert may be exchanged for 27 mm lock inserts, type A, see page 888.				

[1)] Extended delivery times.

Accessories Page 832

Small fibre-optic distributors, based on Rittal AE





Layout of the small fibre-optic distributor:

Basic enclosure:
With cable shunting rings to accommodate the fibre stock and a strain relief system for incoming and outgoing cables.

Mounting plate:
With accommodation for 4 splicing cassettes and 4 patch panels.

Patch panels:
There are 4 patch panels available with varying cutouts.
Other special variants available on request.

Material:
Sheet steel

Surface finish:
Spray-finished in RAL 7035

Colour:
RAL 7035

Protection category:
IP 55 (to EN 60 529/10.91) when using suitable cable gland plates.

Supply includes:
1 enclosure of sheet steel with
2 gland plates of sheet steel, sides,
1 gland plate, bottom
7 cable shunting rings 70 x 44 mm,
2 strain relief clips,
1 cable clamp rail, double,
1 door of sheet steel, with double-bit locks, with 2 hinges on the right,
1 mounting plate of sheet steel with 6 cable shunting rings 70 x 44 mm,
4 recesses for patch panels,
1 splicing cassette holder.

Detailed drawing,
available on the Internet.

Width (B1) in mm		Packs of	400	Page
Height (H1) in mm			500	
Depth (T1) in mm			155	
Mounting plate width (B2) mm			355	
Mounting plate height (H2) mm			455	
Model No. DK		1	**7454.000**	
Number of fibres (when using patch panels)			1 – 48	
Accessories				
Patch panel, maximum population with 4 patch panels	Locations			
Patch panel for 7.5 mm F-SMA couplings	12	2	7461.000	
Patch panel for ST couplings	12	2	7462.000	
Patch panel for SC, E-2000, E-2000 duplex couplings	12/6	2	7463.100	
Patch panel for SC duplex couplings	6	2	7463.200	
Cable gland with 2 half-shells, cable diameter from 8 – 36 mm, for mounting at the bottom, reduced protection category		1	2400.000	974
Plastic cable gland plates, PG size 13.5, for side mounting		5	1581.000	967
Plastic cable gland plates, PG size 13.5/16/21, for side mounting		5	1582.000	967
Wall mounting bracket, 40 mm		1	2503.000	905
Wall mounting bracket, 10 mm		1	2508.000	905
Lock systems				
Plastic handle		1	2533.000	886
Plastic handle with security cylinder insert		1	2576.000	886
Security cylinder insert no. 3524 E		1	2571.000	889
Standard double-bit lock insert may be exchanged for 27 mm lock inserts, type A, see page 888.				

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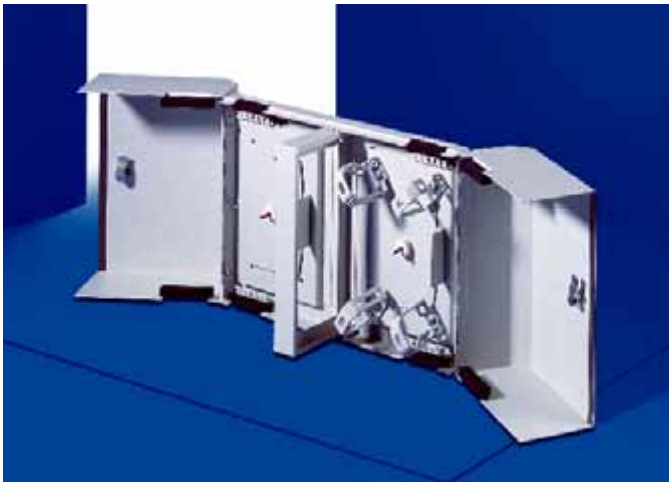
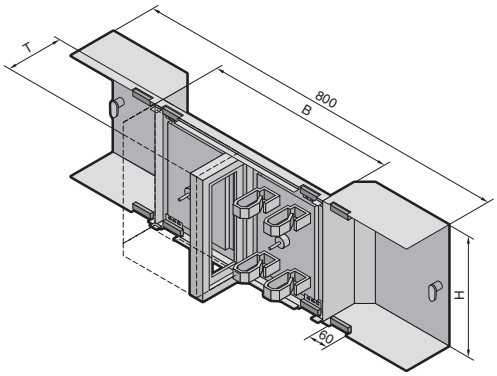
Fibre-optic marshalling enclosure





Patch panels are easily fastened to the gap. A door to cover and lock the splicing cassette accommodation, with separate lock. A second door to cover and lock the chamber/ splicing cassette accommodation, with separate lock.

Material:
Sheet steel, 1.0 mm

Colour:
RAL 7035

Supply includes:
1 enclosure to accommodate a maximum of 24 optical fibres, wall section with mounting holes for wall mounting,
2 doors with different locks, for separate access,
4 shunting rings, 70 x 44 mm,
2 splicing cassette holders each for 2 splicing cassettes,
4 rubber seals for cable entry,
4 comb strips for cable clamping.

Note:
If the marshalling enclosure is used without patch panels, 4 splicing cassettes, 2 per side, may be integrated.

Property rights:
German patent
No. 195 47 135
European patent no. 0 867 058 with validity for NL
European patent no. 0 867 059 with validity for DE, FR, GB, IT

Available on request:
- Other variants

Detailed drawing,
available on the Internet.

Width (B) in mm	Packs of	400	Page
Height (H) in mm		250	
Depth (T) in mm		120	
Model No. DK	1	**7247.000**	
Number of fibres (when using patch panels)		1 – 24	
Accessories			
Patch panel for 24 ST couplings	1	7247.010	
Patch panel for 24 SC, E -2000 couplings[1)]	1	7247.020	
Patch panel for 12 SC duplex couplings	1	7247.030	

[1)] 12 E-2000 duplex couplings may be accommodated.

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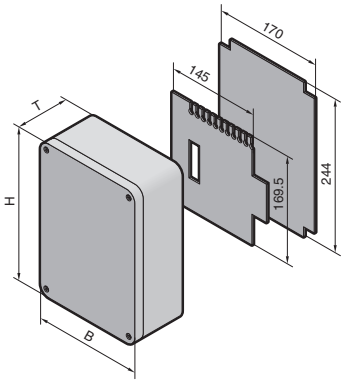
Small fibre-optic distributor, polycarbonate



Configuration
Small fibre-optic distributor:

Mounting plate:
With accommodation for one or two splicing cassettes, whereby the width of the cassettes may vary from 92 to 120 mm.

Dividing plate:
Serves to cover the splicing cassettes and separates them from the patch cables. Accommodation for patch panels and a cable clamp are also integrated.

Patch panels:
Patch panels for
F-SMA, E-2000-ST couplings,
E-2000 duplex and
SC and SC-duplex couplings
are available.
Other special variants available on request.

Cable entry:
For cable entry, there are prepunchings for PG cable glands integrated into the small fibre-optic distributor.
The cable glands (12 x PG 7 and 1 x PG 16) are included with the supply. Pre-assembled connectors will also fit through the knockout apertures (for diameters, see below). The cable may be held in the prepunched knockouts by a 2-piece cable entry or by cable entry grommets, depending on the diameter. The two-part cable entry and the grommets are not included with the supply, due to the different cable diameters.
Diameter of the prepunched knockouts:
12 x 12.5 mm
2 x 22.5 mm

Colour:
RAL 7035

Protection category:
IP 66 to EN 60 529/10.91.

Supply includes:
1 enclosure and lid of fibreglass-reinforced polycarbonate to accommodate splicing cassettes and patch panels,
1 enclosure lid with 2 hinges,
knockouts for PG glands are integrated into the enclosure,
12 x cable glands PG 7,
1 x cable gland PG 16,
1 mounting plate with variable accommodation of 2 splicing cassettes and integral anti-twist guard,
1 dividing plate to cover the splicing cassette, accommodation for 2 patch panels and comb strip for cable clamping,
2 lid screws of polyamide with option of preparing for a lead seal, polyamide insulating bungs for wall mounting screws.
All-round foamed-in PU seal.

Detailed drawing,
available on the Internet.

Width (B) in mm			Packs of	180	Page
Height (H) in mm				254	
Depth (T) in mm				90	
Model No. DK			1	**7451.000**	
Number of fibres (when using patch panels)				1 – 24	
Accessories					
	Locations per patch panel	Locations per enclosure			
Patch panel for 7.5 mm F-SMA couplings	12	24	2	7461.000	
Patch panel for ST couplings	12	24	2	7462.000	
Patch panel for SC, E-2000, E-2000 duplex couplings	12/6	24/12	2	7463.100	
Patch panel for SC duplex couplings	6	12	2	7463.200	
Wall mounting brackets			40	9583.000	103

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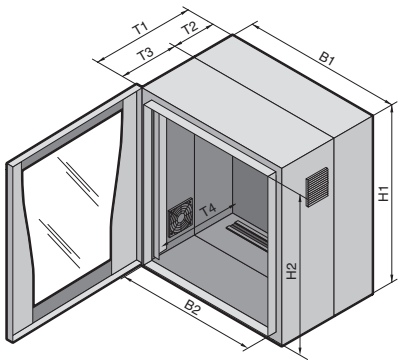
Wall-mounted enclosure, based on Rittal EL, 3-part, pre-configured, depth 573



Material:
Wall and hinged part:
Sheet steel, 1.5 mm
Viewing window:
3 mm safety glass.

Colour:
Wall and hinged part spray-finished in RAL 7035,
Glazed door RAL 7035/7015 (slate grey).

Protection category:
IP 43 to EN 60 529/10.91 for 77XX.735

Supply includes:
Wall section:
with vertical punched rails and C rail mounted horizontally for cable clamping, top cable gland plate solid, bottom cable gland plate with brush strips, earthing rail with star earthing, wall mounting bracket 10 mm.

Hinged part:
with 25 mm pitch pattern of holes in the front and rear frame, Two 482.6 mm (19″) mounting angles mounted on C rails, infinitely depth-variable, one outlet filter each on the left and right side.

Designer glazed door:
With 3 mm safety glass or slotted plate, 9 + 15 U with mini comfort handle for lock inserts, 21 U with comfort handle and 2-point locking, including lock 3524 E.

On request, fitted ex works:
- Fully modified wall-mounted distributors.
- Glazed door with aluminium frame[1)]
- Sheet steel door, solid[1)]

Approvals,
see page 86.

Detailed drawing,
available on the Internet.

U	Packs of	9	15	21	Page
Width (B1) in mm		600	600	600	
Height (H1) in mm		478	746	1012	
Depth (T1) in mm		572.5	572.5	572.5	
Clearance width (B2) mm		451	451	451	
Clearance height (H2) mm		432	699	965	
Depth of wall section (T2) mm		135	135	135	
Depth of hinged part (T3) mm		416	416	416	
Maximum installation depth (T4) mm		520	520	520	
Model No. DK glazed door	1	**7709.735**	**7715.735**	**7721.735**	
Model No. DK slotted metal door[1)]	1	**7709.835**	**7715.835**	**7721.835**	
Load capacity, hinged part (kg)		45	75	75	
Accessories					
Solid gland plate	1	2235.135	2235.135	2235.135	970
Gland plate with brush insert	1	7705.035	7705.035	7705.035	970
Gland plate for metric cable glands	1	7705.235	7705.235	7705.235	970
Fan expansion kit, 230 V	1	7980.100	7980.100	7980.100	649
Spare filter mats	5	3322.700	3322.700	3322.700	670
Wall mounting bracket, 40 mm	1	2503.000	2503.000	2503.000	905
Lock inserts		see page 888			
Component shelf 2 U, fixed installation or fully extendible, 300 mm deep	1	7148.035	7148.035	7148.035	946
Component shelf 2 U, static installation, 250 mm	1	7119.250	7119.250	7119.250	948

[1)] Extended delivery times.

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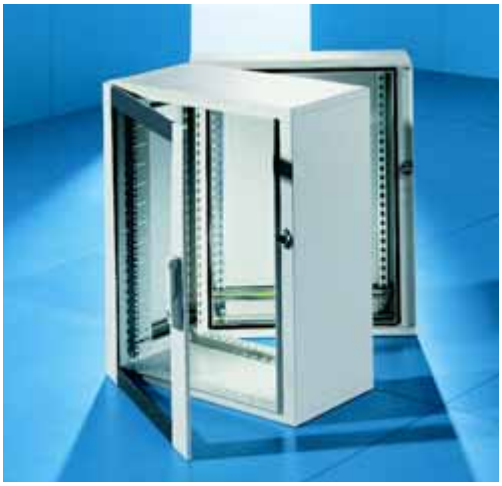
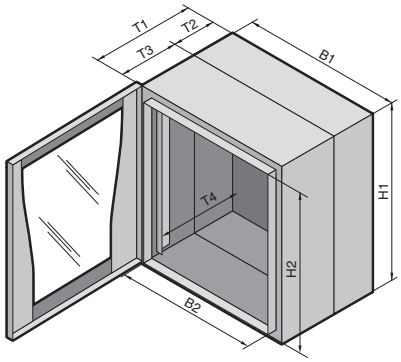
Wall-mounted enclosure, based on Rittal EL, 3-part, with punched rails, depth 473





Material:
Wall and hinged part:
Sheet steel, 1.5 mm
Viewing window:
3 mm safety glass.

Colour:
Wall and hinged part spray-finished in RAL 7035,
Glazed door RAL 7035/7015 (slate grey).

Protection category:
IP 55 to EN 60 529/10.91

Supply includes:
Wall section:
With vertical punched rails and C rail mounted horizontally for cable clamping, solid cable gland plate top and bottom, wall mounting bracket 10 mm.

Hinged part:
with 25 mm pitch pattern of holes in the front and rear frame, Two 482.6 mm (19″) mounting angles mounted on C rails, infinitely depth-variable.

Designer glazed door:
6 – 15 U with mini comfort handle for lock inserts,
18 – 21 U with comfort handle and 2-point locking, including lock 3524 E.

On request, fitted ex works:
- Fully modified wall-mounted distributors.
- Special sizes[1)] (T = 373 mm, 573 mm)
- Glazed door with aluminium frame[1)]
- Sheet steel door, solid[1)]

Approvals,
see page 86.

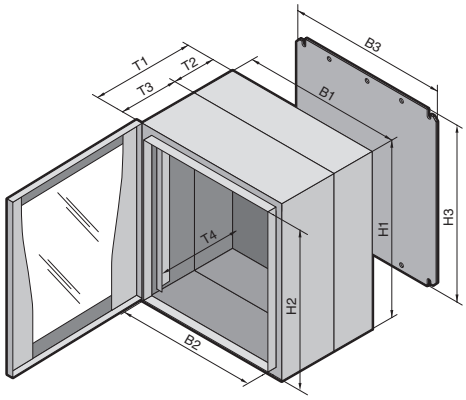
Detailed drawing,
available on the Internet.

U	Packs of	6	9	12	15	18	21	Page
Width (B1) in mm		600	600	600	600	600	600	
Height (H1) in mm		345	478	612	746	878	1012	
Depth (T1) in mm		472.5	472.5	472.5	472.5	472.5	472.5	
Clearance width (B2) mm		451	451	451	451	451	451	
Clearance height (H2) mm		299	432	565	699	832	965	
Depth of wall section (T2) mm		135	135	135	135	135	135	
Depth of hinged part (T3) mm		316	316	316	316	316	316	
Maximum installation depth (T4) mm		420	420	420	420	420	420	
Model No. DK	1	**7706.135**	**7709.135**	**7712.135**	**7715.135**	**7718.135**	**7721.135**	
Load capacity, hinged part (kg)		30	45	60	75	75	75	
Accessories								
Gland plate with brush insert	1	7705.035	7705.035	7705.035	7705.035	7705.035	7705.035	970
Gland plate for metric cable glands	1	7705.235	7705.235	7705.235	7705.235	7705.235	7705.235	970
Wall mounting bracket, 40 mm	1	2503.000	2503.000	2503.000	2503.000	2503.000	2503.000	905
Lock inserts		see page 888						
Earth rail, horizontal	1	7113.000	7113.000	7113.000	7113.000	7113.000	7113.000	962
Component shelf 2 U, static installation and fully extendible	1	7148.035	7148.035	7148.035	7148.035	7148.035	7148.035	946
Component shelf 2 U, static installation	1	7119.250	7119.250	7119.250	7119.250	7119.250	7119.250	948
Component shelf 1 U, static installation, 140 mm	1	7119.140	7119.140	7119.140	7119.140	7119.140	7119.140	947

[1)] Extended delivery times.

Accessories Page 832

Wall-mounted enclosure, based on Rittal EL, 3-part, with mounting plate, depth 373



Material:
Wall and hinged part:
1.5 mm sheet steel
Mounting plate:
2.5 mm sheet steel, zinc-plated, passivated
Viewing window:
3 mm safety glass

Colour:
Wall and hinged part spray-finished in RAL 7035,
Glazed door RAL 7035/7015 (slate grey).

Protection category:
IP 55 to EN 60 529/10.91

Supply includes:
Wall section:
with 2 cable gland plates,
1 mounting plate supplied loose, assembly parts.

Hinged part:
with 2 mounting angles,
482.6 mm (19″), fitted at the front, assembly parts.

Designer glazed door:
3 – 15 U with mini comfort handle for lock inserts,
18 – 21 U with comfort handle and 2-point locking,
including lock 3524 E.

On request, fitted ex works:
- Special sizes and colours[1)]
- Glazed door with aluminium frame[1)]
- Sheet steel door, solid[1)]

Approvals,
see page 87.

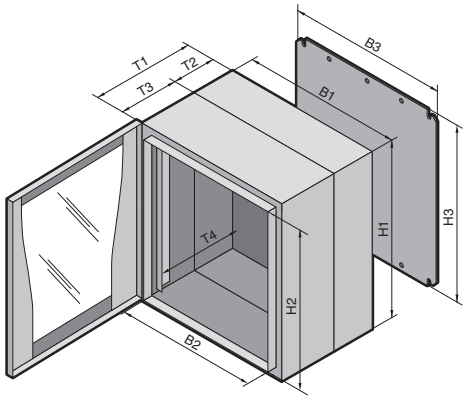
Detailed drawing,
available on the Internet.

U	Packs of	3	6	9	12	15	18	21	Page
Width (B1) in mm		600	600	600	600	600	600	600	
Height (H1) in mm		212	345	478	612	746	878	1012	
Depth (T1) in mm		373	373	373	373	373	373	373	
Clearance width (B2) mm		490	490	490	490	490	490	490	
Clearance height (H2) mm		166	299	432	565	699	832	965	
Depth of wall section (T2) mm		135	135	135	135	135	135	135	
Depth of hinged part (T3) mm		216	216	216	216	216	216	216	
Maximum installation depth (T4) mm		342	342	342	342	342	342	342	
Width of mounting plate (B3) mm		485	485	485	485	485	485	485	
Height of mounting plate (H3) mm		165	299	432	565	699	832	965	
Model No. EL	1	**2243.605**	**2246.605**	**2249.605**	**2252.605**	**2255.605**	**2258.605**	**2261.605**	
Load capacity, hinged part (kg)		15	30	45	60	75	75	75	
Accessories									
Wall mounting bracket – 10 mm – 40 mm	1	2508.000 2503.000	2508.000 2503.000	2508.000 2503.000	2508.000 2503.000	2508.000 2503.000	2508.000 2503.000	2508.000 2503.000	905
Gland plate – with brush strip – for metric cable glands	1	7705.035 7705.235	7705.035 7705.235	7705.035 7705.235	7705.035 7705.235	7705.035 7705.235	7705.035 7705.235	7705.035 7705.235	970 970
Screwed cable glands		see page 972							
Lock inserts		see page 888							
Slide rails	10	2240.000	2240.000	2240.000	2240.000	2240.000	2240.000	2240.000	1011
C rails	4	2238.000	2238.000	2238.000	2238.000	2238.000	2238.000	2238.000	929
Blanking plates	3	see page 1013							

[1)] Extended delivery times.

Accessories Page 832

Wall-mounted enclosure, based on Rittal EL, 3-part, with mounting plate, depth 473



Material:
Wall and hinged part:
1.5 mm sheet steel
Mounting plate:
2.5 mm sheet steel, zinc-plated, passivated
Viewing window:
3 mm safety glass

Colour:
Wall and hinged part spray-finished in RAL 7035,
Glazed door RAL 7035/7015 (slate grey).

Protection category:
IP 55 to EN 60 529/10.91

Supply includes:
Wall section:
with 2 cable gland plates,
1 mounting plate supplied loose,
assembly parts.

Hinged part:
with 2 mounting angles,
482.6 mm (19″), fitted,
assembly parts.

Designer glazed door:
3 – 15 U with mini comfort handle for lock inserts,
18 – 21 U with comfort handle and 2-point locking,
including lock 3524 E.

On request, fitted ex works:
- Special sizes and colours[1)]
- Glazed door with aluminium frame[1)]
- Sheet steel door, solid[1)]

Approvals,
see page 87.

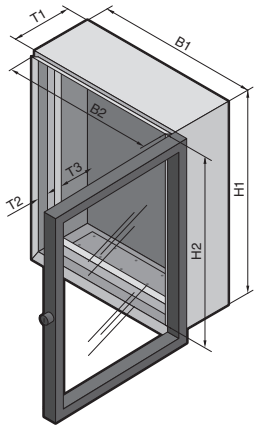
Detailed drawing,
available on the Internet.

U	Packs of	3	6	9	12	15	18	21	Page
Width (B1) in mm		600	600	600	600	600	600	600	
Height (H1) in mm		212	345	478	612	746	878	1012	
Depth (T1) in mm		473	473	473	473	473	473	473	
Clearance width (B2) mm		490	490	490	490	490	490	490	
Clearance height (H2) mm		166	299	432	565	699	832	965	
Depth of wall section (T2) mm		135	135	135	135	135	135	135	
Depth of hinged part (T3) mm		316	316	316	316	316	316	316	
Maximum installation depth (T4) mm		442	442	442	442	442	442	442	
Width of mounting plate (B3) mm		485	485	485	485	485	485	485	
Height of mounting plate (H3) mm		165	299	432	565	699	832	965	
Model No. EL	1	**2253.605**	**2256.605**	**2259.605**	**2262.605**	**2265.605**	**2268.605**	**2271.605**	
Load capacity, hinged part (kg)		15	30	45	60	75	75	75	
Accessories									
Wall mounting bracket – 10 mm – 40 mm	1	2508.000 2503.000	2508.000 2503.000	2508.000 2503.000	2508.000 2503.000	2508.000 2503.000	2508.000 2503.000	2508.000 2503.000	905
Lock inserts		see page 888							
Gland plate – with brush strip – for metric cable glands	1	7705.035 2235.000	7705.035 2235.000	7705.035 2235.000	7705.035 2235.000	7705.035 2235.000	7705.035 2235.000	7705.035 2235.000	970 970
Screwed cable glands		see page 972							
Slide rails	10	2250.000	2250.000	2250.000	2250.000	2250.000	2250.000	2250.000	1011
C rails	4	2239.000	2239.000	2239.000	2239.000	2239.000	2239.000	2239.000	929
Blanking plates	3	see page 1013							

[1)] Extended delivery times.

Accessories Page 832

Wall-mounted enclosure, based on Rittal EL, 2-part, with swing frame, depth 369



Material:
Enclosure: 1.5 mm sheet steel
Swing frame: Sheet steel
Front door: Extruded aluminium section, 3 mm glazed acrylic

Surface finish:
Enclosure and swing frame: Electrophoretic dipcoat-primed and powder-coated RAL 7035
Front door: Dark brown anodised

Protection category:
IP 55 to EN 60 529/10.91

Supply includes:
Enclosure, front door, fitted swing frame, including assembly parts.

Available on request:
- Special sizes and colours

Approvals,
see page 87.

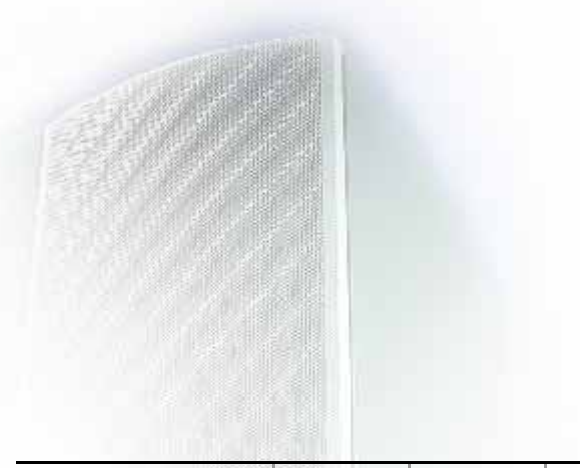
Detailed drawing,
available on the Internet.

U	Packs of	6	11	14	Page
Width (B1) in mm		600	600	600	
Height (H1) in mm		380	600	760	
Depth (T1) in mm		369	369	369	
Clearance width (B2) mm		537	537	537	
Clearance height (H2) mm		317	537	697	
Distance from glazed door to swing frame (T2) mm		67 – 97	67 – 97	67 – 97	
Maximum installation depth (T3) mm		270	270	270	
Model No. EL	1	**1919.500**	**1920.500**	**1926.500**	
Weight (kg)		20.8	26.7	31.2	
Accessories					
Wall mounting bracket, 10 mm	1	2508.000	2508.000	2508.000	905
Wall mounting bracket, 40 mm	1	2503.000	2503.000	2503.000	905
Gland plates with hole	5	2563.000	2563.000	2563.000	966
Blanking plates	3	see page 1013			
Standard swing frame with double-bit lock insert may be exchanged for 27 mm lock inserts, type A, see page 888.					

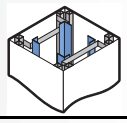
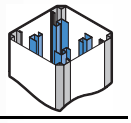
Accessories Page 832

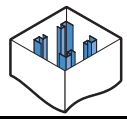
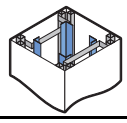
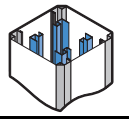
Server racks

Features



Each individual rack makes an important contribution to the physical security of your IT infrastructure. Our comprehensive range of benefits is based on more than 40 years of rack expertise, far-ranging experience in energy management, and the development of pioneering climate concepts. For this reason, Rittal server racks offer the ideal conditions to fuse all the relevant technologies into complete IT infrastructure solutions.

Rittal system comparison	TE 7000	TS 8	FR(i)
One platform for all requirements in the IT market			
Load capacity			
up to 400 kg	■■■	■■■	■■■
up to 1000 kg		■■■	■■■
Baying			
side	■■■	■■■	■■■
in all levels		■■■	
Climate control			
Fan	■■■	■■■	■■■
Climate control device		■■■	■■
Air/water heat exchanger		■■■	
CPU liquid cooling		■■■	■■■
Cabling			
Cable space	■■■	■■	■■
Cable management	■■■	■■■	■■■

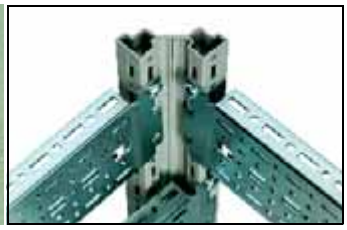
Rittal system comparison	TE 7000	TS 8	FR(i)
One platform for all requirements in the IT market			
Lock-system			
2-point	■■■	■■■	■■■
4-point		■■■	
Security			
Access control	■■■	■■■	■■■
Climate control	■■■	■■■	■■■
Dismantling	■■■	■	■
Interior installation			
Depth-variable	■	■■■	■■
Partial installation		■■■	
2-level principle		■■■	■
Design	■■	■■	■■■
Standards IEC 60 297-1/2	■■■	■■■	■■■

Note: The more ■ the greater the compatibility.

TS 8

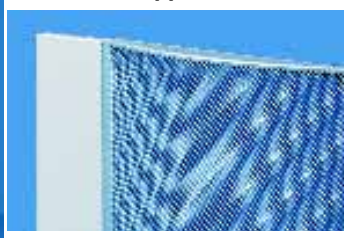
Ventilation
Via perforated front and rear door with free surface area of 78 % in the perforated plate part.

Lock system
with comfort handle and 4-point locking.



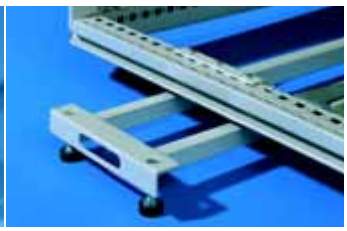
The ingenious symmetrical concept
of the frame offers baying on all sides. With two levels, the frame section affords infinite assembly diversity.

flexRack(i)



The new designer door
unites functionality with aesthetics.

Robust 482.6 mm (19″) mounting frame. Load capacity 1000 kg.



Optimised stability
for optimum operational reliability.

Features

TE 7000

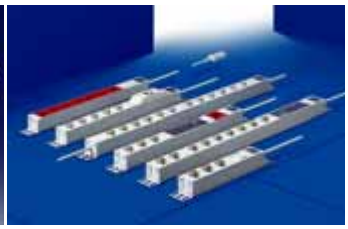
Fully vented front and rear door.

Two-point locking rod, optionally with Ergoform-S handle system.

Power

Power Distribution Module PDR/PDM
Power sub-distribution in 482.6 mm (19″) format. May be retrofitted whilst the system is operational.

Power System Module PSM
Power management up to 96 A or 48 A with redundant circuit. Shock-hazard protected.



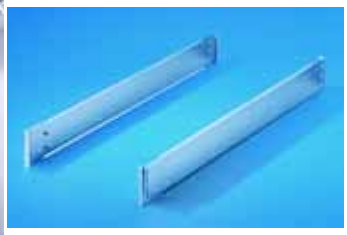
Socket strips
available in various length variants with various functional elements.

Cooling

Processor climate control
Enclosure climate control for heat loss of 13 kW – 22 kW

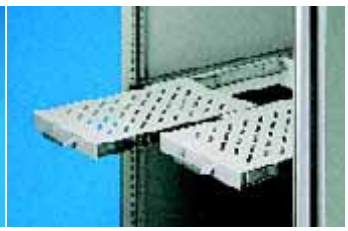
Rack-mounted recooling system
Liquid-cooled computers are supplied via the shortest route via six cooling circuits.

Server integration



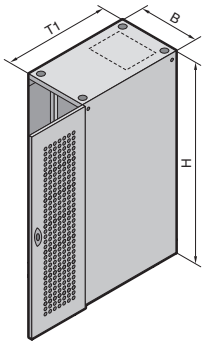
Unversal server installation kit
For integration of the most common server types, using the original installation accessories.

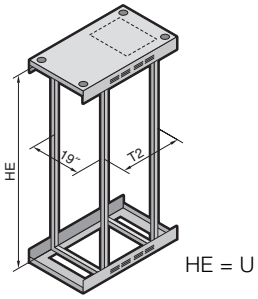
Depth-variable slide rail for flexible adaptation to the existing distance between levels.



Component shelves, two-part
Two tower format servers may be moved independently of one another.

Based on Rittal TE 7000, 1000 mm deep





HE = U

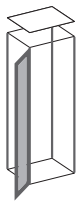
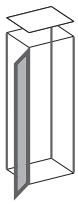
Benefits:
- No frame structure, optimum accessibility

Material:
Sheet steel

Surface finish:
Mounting frame:
Dipcoat-primed
Enclosure panels:
Powder-coated, RAL 7035/9005.

Supply includes:
Self-supporting 482.6 mm (19″) frame structure,
vented sheet steel door front and rear, two-point locking rod, recessed handle (front) and security lock 3524 E, roof plate for cable entry in corners with concealed cut-out for integrating fans, with levelling feet.

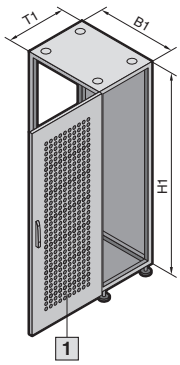
Detailed drawing,
available on the Internet.

					
U		42	42	42	42
Width (B) in mm		600	600	800	800
Height (H) in mm		2000	2000	2000	2000
Depth (T1) in mm		1000	1000	1000	1000
482.6 mm (19″) distance between levels in its delivered state (T2) mm		740	740	740	740
Model No. TE as bayed enclosure without side panels, including baying kit	RAL 7035	**7000.882**	**–**	**7000.892**	**–**
	RAL 9005	**–**	**7000.885**	**–**	**7000.895**
Doors					
Sheet steel doors, fully vented, front and rear		■	■	■	■
Roof					
Roof plate including including concealed cut-outs for cable entry in corners and for optimum population with active fan units		■	■	■	■
Base					
Base frame with maximum cut-outs for cable entry in corners for optional population with solid modular plates, passively vented, or for cable entry		■	■	■	■
Interior installation					
482.6 mm (19″) mounting frames front and rear		■	■	■	■
Accessories					
Side panels, pluggable, including security lock 3524 E		**7000.653**	**7000.663**	**7000.653**	**7000.663**
Ergoform-S handle for semi-cylinder, in exchange for the existing lock		2435.000	2435.000	2435.000	2435.000
Fan unit, with 2 fans and thermostat, prewired ready for connection		7000.670	7000.670	7000.670	7000.670
Stabiliser		On request.	On request.	On request.	On request.
Transport kit, 4 castors including assembly parts		7000.672	7000.672	7000.672	7000.672
C-rail, for cable clamping in the enclosure width via cable clamps, on the 482.6 mm (19″) mounting frame at the rear		7828.060	7828.060	7828.060	7828.060
Cable clamp rail, depth variable 425 – 725 mm, for cable attachment in the enclosure depth using cable ties		7858.160	7858.160	7858.160	7858.160
Cable clamp rail for cable attachment in the enclosure width via cable ties, on the 482.6 mm (19″) mounting frame at the rear		7828.062	7828.062	7828.062	7828.062
Earthing kit for TE		7000.675	7000.675	7000.675	7000.675
Socket strip, 8-way, earthing-pin plug		7000.630	7000.630	7000.630	7000.630

■ Included with the supply.

Cable routing Page 964 **Power management** Page 742 **CMC-TC system monitoring** Page 762

Based on Rittal TS 8, pre-configured



Design features
- Firmly linked frame structure
- Front and rear door fully vented; free vented surface area 78 % in the perforated plate part
- 4-point locking, 2-point locking with multiple door versions
- Door hinge may be swapped to opposite side without any machining
- Cable entry via the roof and base/plinth
- Bayable at all levels
- Load capacity up to 1000 kg

Material:
Sheet steel

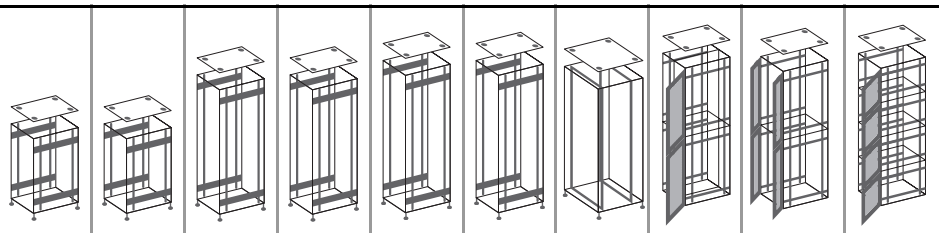
Surface finish:
Enclosure frame:
Dipcoat-primed
Enclosure panels:
Dipcoat-primed, powder-coated in RAL 7035 or RAL 9005

Mounting angles and punched sections with mounting flanges:
Zinc-plated, passivated

Supply includes:
Enclosure frame TS 8 with sheet steel doors front and rear, vented, with 130° hinges, L-shaped, depth-variable fitted mounting angles and/or 482.6 mm (19″) mounting frame, levelling feet, comfort handle with security lock and 4-point lock.

Detailed drawing,
available on the Internet.

1 Optimised air flow



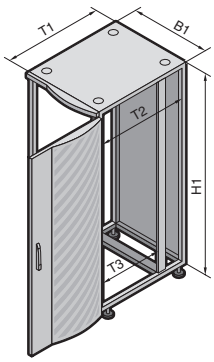
Number of front and rear doors		1	1	1	1	1	1	1	2	2 (vertically divided)	4
U		24	24	42	42	47	47	42	2 x 21	2 x 21	4 x 10
Width (B1) in mm		600	600	600	600	600	600	800	600	600	600
Height (H1) in mm		1200	1200	2000	2000	2200	2200	2000	2200	2200	2200
Depth (T1) in mm		900	1000	900	1000	900	1000	1000	900	900	900
Model No. DK as bayed enclosure without side panels	RAL 7035	**7831.431**	**7831.433**	**7831.436**	**7831.438**	**7831.440**	**7831.442**	**7831.446**	**7831.450**	**7831.457**	**7831.460**
	RAL 9005	**7831.432**	**7831.434**	**7831.437**	**7831.439**	**7831.441**	**7831.443**	**–**	**7831.451**	**7831.458**	**7831.461**
Doors											
Sheet steel doors, vented, front and rear[1)]		■	■	■	■	■	■	■	■	■	■
Roof											
with openings for cable entry		■	■	■	■	■	■	■	■	■	■
Base/plinth											
Levelling feet		■	■	■	■	■	■	■	–	–	–
Interior installation											
482.6 mm (19″) levels, front and rear		■	■	■	■	■	■	■	–	–	–
L-shaped mounting angles		■	■	■	■	■	■	–	–	–	–
Mounting angles attached to depth stays		■	■	■	■	■	■	–	■	■	■
482.6 mm (19″) mounting frames front and rear		–	–	–	–	–	–	■	–	–	–
Panel earthing, fitted		■	■	■	■	■	■	■	–	–	–
Individual compartments, partitioned		–	–	–	–	–	–	–	■	■	■
Protected, separate cable routing per compartment		–	–	–	–	–	–	–	■	■	■
Accessories											
Side panels, plug-type, with T lock	RAL 7035	7824.129	7824.120	7824.209	7824.200	7824.229	7824.220	7824.200	7824.229	7824.229	7824.229
	RAL 9005	7816.129	7816.120	7816.209	7816.200	7816.229	7816.220	–	7816.229	7816.229	7816.229
Security lock for side panels		7824.500	7824.500	7824.500	7824.500	7824.500	7824.500	7824.500	7824.500	7824.500	7824.500
Base attachment bracket		8800.210	8800.210	8800.210	8800.210	8800.210	8800.210	8800.210	8800.210	8800.210	8800.210
Depth-variable slide rail, 1 U		7063.880	7063.880	7063.880	7063.880	7063.880	7063.880	7063.880	7063.878	7063.878	7063.878
Stabiliser, pull-out		7825.200	7825.250	7825.200	7825.250	7825.200	7825.250	7825.250	7825.200	7825.200	7825.200

■ Included with the supply [1)] Free space in perforated plate part 78 %

Accessories Page 832 **Liquid Cooling** Page 672

Server racks

Based on Rittal flexRack(i), 1000 and 1200 mm deep, pre-configured



Design features
- Enclosure system may be dismantled because the vertical sections are screw-fastened to the roof and base frame.
- Aluminium vertical section with multi-functional system channel
- Vented front and rear door with free surface area of 64 % in the perforated plate part
- 2-point locking
- Cable entry via the roof and base
- Pull-out stabiliser
- Suitable for baying
- Load capacity up to 1000 kg

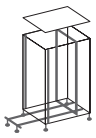
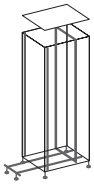
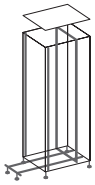
Material:
Vertical frame sections:
Extruded aluminium section.
Roof frame, panels: Sheet steel

Surface finish:
Enclosure panels/door trim panel:
Spray-finished in RAL 7035,
Frame sections, perforated plate of door: RAL 9006
482.6 mm (19″) mounting angles: Zinc-plated, passivated

Supply includes:
System frame section FR(i)[1] with designer door, vented, sheet steel door at rear, vented, levelling feet, stabiliser, earthing of all enclosure panels,
comfort handles for semi-cylinders with security lock 12321.

Property rights:
German patent
no. 103 11 376
German registered design
no. 403 04 312 and 401 03 180
British Registered Design
no. 301 54 31 and 210 49 77
US Design Patent no. 479,241

Detailed drawing,
available on the Internet.

				
U	24	42	24	42
Width (B1) in mm	600	600	600	600
Height (H1) in mm	1200	2000	1200	2000
Depth (T1) in mm	1005	1005	1205	1205
Depth absolute, including handles and roof curvature (T1) mm + 90 mm	1095	1095	1295	1295
Maximum distance between levels (T2) mm	829	829	1029	1029
Distance between the 482.6 mm (19″) levels (T3) mm	750	750	850	850
Model No. FR(i) as bayed enclosure without side panels	**7855.310**	**7855.330**	**7855.312**	**7855.332**
Doors				
Designer door, front, vented[2]	■	■	■	■
Sheet steel door, rear, vented[2]	■	■	■	■
Roof				
Solid roof plate	■	–	■	–
Roof plate with cable entry openings	–	■	–	■
Base frame				
Levelling feet	■	■	■	■
Stabiliser	■	■	■	■
Interior installation				
482.6 mm (19″) mounting angles, front	■	■	■	■
482.6 mm (19″) mounting frame, rear	■	■	■	■
Earthing				
Earthing of all enclosure panels on the enclosure frame	■	■	■	■
1 central earthing point fitted at the rear of the base frame	■	■	■	■
Accessories				
2 designer side panels with beading, including security lock 12321	7856.672	7856.687	7856.673	7856.688
Transport kit, 4 castors including assembly parts	7825.900	7825.900	7825.900	7825.900

[1] The system frame FR(i) is generally suitable for the installation of TS 8 accessories. [2] Free space in the perforated plate part 64 %.
■ Included with the supply.

Accessories Page 832 **Liquid Cooling** Page 672

Monitor/keyboard unit, 1 U

with 15″ and 17″ TFT display

This compact 1 U console in a new 2-colour design was developed for secure, space-saving server administration. In order to access other servers, this monitor/keyboard unit is easily combined with the Rittal KVM-Switch SSC view 8 (see page 740). This makes it possible to connect up to 8 servers to one unit in 1 U. The peculiarity of this compact solution is that a 482.6 mm (19″) keyboard including number pad and keypad may be integrated, in spite of its small size. The minimal depth of the unit, at just 490 mm (610 mm with 17″ TFT display, each without SSC extension), makes it suitable for installation in enclosures of depth 700 – 1000 mm. The installation kits supplied allow it to be adapted to an existing difference between levels of 680 – 850 mm for the 482.6 mm (19″) levels.
When closed, the drawer can be locked for protection against unauthorised operation.
In order to prevent heat accummulation when folded, the backlight is deactivated automatically. The illuminated master switch is easily accessbile on the front.

Upon request, it is also possible to integrate a trackball instead of the touchpad and the number pad (international versions). The display may be activated in both analog and digital form via the new standard Digital Visual Interface (DVI), which makes this monitor unit particularly future-proof for forthcoming server generations. The integral active mini-speakers ensure audio feedback in case of error messages or system sounds. The unit has a German keyboard layout. Versions in English and French, as well as country- and customer-specific versions, including USB keyboard connection, available on request.

Supply includes:
Complete monitor/keyboard unit in colour version RAL 7035 (light grey) or RAL 9005 (black) with design components and handle in RAL 9006 (silver) including assembly parts and all the required connection cables (approx. 1.6 m) for:

- Power supply
- VGA (15-pole D-Sub)
- DVI-D
- Audio (2 x jack plugs 3.5 mm, stereo)
- Keyboard connection (PS/2)
- Mouse connection (touchpad or trackball, PS/2).

		15″		17″	
		RAL 7035/ RAL 9006	RAL 9005/ RAL 9006	RAL 7035/ RAL 9006	RAL 9005/ RAL 9006
Touchpad	German	**9050.100**	**9050.200**	**9050.300**	**9050.400**[1]
	English	**9050.102**	**9050.202**	**9050.302**[1]	**9050.402**[1]
	French	**9050.103**[1]	**9050.203**[1]	**9050.303**[1]	**9050.403**[1]
Trackball	German	**9050.150**	**9050.250**	**9050.350**	**9050.450**
	International	**9050.151**[2]	**9050.251**[2]	**9050.351**[2]	**9050.451**[2]
Technical design					
TFT screen with anti-reflection coated security glass		15″ (381 mm)		17″ (432 mm)	
Maximum resolution		1024 x 768		1280 x 1024	
Colours		16.7 million			
Brightness		250 cd/m²			
Contrast ratio		approx. 400 : 1			
Sound		2 active mini-speakers			
Mains voltage		100 – 240 V AC, 50 – 60 Hz			
Dimensions (W x H x D)		448 mm x 1 U x 490 mm		448 mm x 1 U x 610 mm	
Connections at rear					
Mains voltage		IEC 320 connection			
Video input		Analog (D-SUB 15-pole, jack)			
		Digital (DVI-D, jack)			
Audio		3.5 mm, stereo			
Keyboard		PS/2, jack			
Mouse		PS/2, jack			
Power out		(12 V DC) for SSC view 8/view 32 Cat			

[1] Delivery time approx. 2 weeks. [2] International version only available with trackball and without numeric keypad. Please state the required language on the order.
Versions: French/Spanish/Portuguese/Italian/Danish/Norwegian/Finnish/Swedish/Belgian/ UK English/US English with EURO/Swiss/German. Other country-specific versions available on request.

1

2

SSC view 8/SSC view 32 Cat

8 or 32-port KVM switch
for monitor/keyboard unit 9050.XXX

These compact SSC views optionally extend the Rittal monitor/keyboard unit to include the function of an 8- or 32-port KVM switch, without requiring an additional U in the server rack for mounting. The switch may be mounted behind the existing monitor unit, and voltage is supplied via the power pack integrated into the drawer. The SSC has a password-protected OSD menu, but server selection may also be made via hotkeys.

The SSC view 8 may be cascaded with KVM switches from the SSCmulti series if more than the 8 servers are to be administered. In this way, the Rittal SSC switching system is able to grow flexibly in line with requirements. With the SSC view 32 Cat, the computers are connected via CAT cables and SSC converters (PS/2 or USB). In this way, the signals for video, keyboard and mouse are transmitted via a shared cable, considerably reducing the cabling work involved, particularly in fully configured racks. One SSC converter is required for each computer. Processor-controlled keyboard and mouse emulation for each channel ensures fault-free booting and reliable switching between the connected computers.

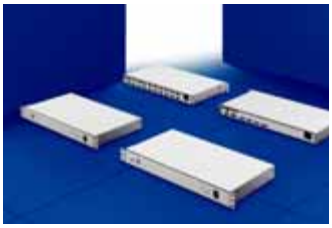
Rittal SSC	1 SSC view 8	2 SSC view 32 Cat
Model No. DK	**7552.000**	**7552.100**
Equipment		
Number of computers in stand-alone mode	8	32
Number of users	1	1
Number of users that may be administered (with allocation of rights)	2	10
Cascading as slave to SSCmulti series	■	–
Integral user/computer administration	■	■
OSD menu with mouse operation (English)	■	■
OSD superimposed on computer screen (may be deactivated)	■	■
OSD display of channels used	■	■
Hotkeys for computer selection	■	■
Autoscan	■	■
Autoskip (skip over unused channels)	■	■
Cable type to computer (view 8) or to SSC converter (view 32)	VGA/HD15, PS/2	Cat 5, 6, 7
Maximum cable length, SSC to computer (depending on cable quality)	4 m	15 m (30 m)
Port and system support	PS/2[1)]	PS/2, USB, SUN-USB
Automatic cable alignment (manually readjustable)	–	■[3)]
LED displays (rear)	None	Power
Maximum video resolution (depending on cable length)	1280 x 1024@85 Hz	1920 x 1440@75 Hz
Bandwidth	200 MHz	250 MHz
Connections		
Computer	SUB-HD15/PS/2	RJ45
Console	SUB-HD15/PS/2	SUB-HD15/PS/2
Service (for firmware update)	–	Jack 2.5 mm
Power supply 12 V from MTE[3)]	Hollow connector	Hollow connector
External power supply	12 V/approx. 0.8 A	12 V/approx. 1.0 A
Power consumption (approx.)	9 W	12 W
Operating temperature	+5 to +45°C	+5 to +45°C
Protection category	IP 40	IP 40
Enclosure	Sheet steel, powder-coated	Sheet steel, powder-coated
Colour	RAL 9006	RAL 9006
Dimensions (excluding projecting parts) approx. W x H x D mm	325 x 44 x 85	325 x 44 x 85
Dimensions (with rack installation) approx. W x H x D	19″ x 1 U x 140 mm	19″ x 1 U x 140 mm
Certifications	CE	CE
Accessories		
3 SSC converter PS/2	–	7552.201
4 SSC converter USB	–	7552.202
SSC converter SUN-USB	–	7552.203
5 CPU cable 2 m (with interlocking PS/2 connectors)	7552.120	–
CPU cable 4 m (with interlocking PS/2 connectors)	7552.140	–
Cat 5 cable 0.5 m	–	7320.470
Cat 5 cable 2 m	–	7320.472
Cat 5 cable 5 m	–	7320.475
Cat 5 cable 10 m	–	7320.481
Cat 5 cable 15 m	–	7320.485

[1)] Adaptor for SUN/MAC server available on request.
[2)] External long-range power input available on request.
[3)] With a cable length of max. 15 m, there is no need for any manual readjustments.
Above and beyond this, the maximum permissible cable length is approximately 30 m (depending on the cable quality).
Here, manual readjustment is needed.

3

4

5



Rittal SSCmini/SSCmulti

By using the Rittal SSC, the number of keyboards, monitors and mice required is reduced to just one. Computer access becomes easier, more effective and more cost-efficient. As the number of computers increases, the SSC easily grows with it by cascading. The basic variant, the SSCmini, offers 4 channels and an integral hotkey function. The SSCmulti, the multi-talented all-rounder, additionally has 4/8/16 channels, an OSD menu, auto scan, auto skip and multi-platform capabilities. The multi-console feature supports a second Cat 5 console on the SSCmulti. As a hardware changeover switch, the Rittal SSC utilises the keyboard, monitor and mouse interfaces of the computer, irrespective of the software and operating system.

The SSCmulti is ideal for use in a heterogeneous server environment with different platforms such as PS/2 and IBM-compatible, HP 9000, sgi, SUN, RS 6000 and laptops.

Dimensions:
(W x H x D) 482.6 x 44 x 245 mm

Material:
Enclosure: Sheet steel

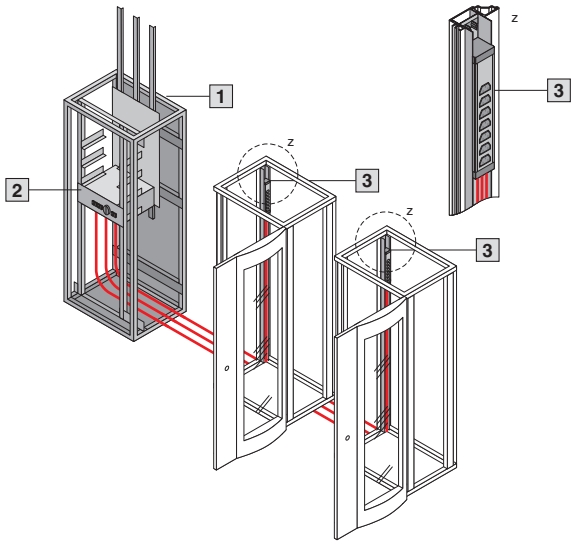
Surface finish:
Spray finished in RAL 7035

Available on request:
- Converter for Apple Mac and USB interface.
- Distance bridging via fibre-optics.
- Global access for remote server maintenance.

Rittal Server Switch Control SSC	SSCmini 4	SSCmulti 4	SSCmulti 8	SSCmulti 16
Model No. DK	**7551.000**	**7551.010**	**7551.020**	**7551.030**
Number of computers in stand-alone mode	4	4	8	16
Number of computers in cascade configuration (identical types/maximum)	–/64	16/64	64/128	256/256
Number of local operating consoles	1	1	1	1
Additional remote consoles (concurrent)	1	1	1	1
Integral remote control booster, Cat 5 port	–	■	■	■
Status displays	LEDs	OSD menu	OSD menu	OSD menu
On-screeen display (OSD)	(■)	■	■	■
Keyboard hotkey operation	■	■	■	■
Auto scan/auto skip	(■)	■	■	■
Free server name allocation	(■)	■	■	■
Password protection	(■)	■	■	■
Allocation of user rights	(■)	■	■	■
Keyboard and mouse emulation by 1 processor in each case	■	■	■	■
Combined operation of various different server platforms is supported	■	■	■	■
Direct connection of Sun servers (MiniDIN 8/SUN-VGA) – no adaptor required	–	■	■	■
Independent from the software and operating system	■	■	■	■
Stay live function in case of power loss	■	■	■	■
Power supply via	Keyboard output	Mains cable	Mains cable	Mains cable
Maximum video resolution (depending on distance) at 85 Hz	1600 x 1200	1600 x 1200	1600 x 1200	1600 x 1200
Bandwidth	250 MHz	250 MHz	250 MHz	250 MHz
Accessories				
CPU cable for video (HD15), PS/2 keyboard and PS/2 mouse,[2] 1 m	7551.110	7551.110	7551.110	7551.110
CPU cable for video (HD15), PS/2 keyboard and PS/2 mouse,[2] 2 m	7551.120	7551.120	7551.120	7551.120
CPU cable for video (HD15), PS/2 keyboard and PS/2 mouse,[2] 4 m	7551.140	7551.140	7551.140	7551.140
CPU cable for video (HD15), PS/2 keyboard and PS/2 mouse,[2] 6 m	7551.160	7551.160	7551.160	7551.160
CPU cable for video (HD15), PS/2 keyboard and PS/2 mouse,[2] 9 m	7551.190	7551.190	7551.190	7551.190
CPU cable for SUN video (HD15), miniDIN 8 keyboard/mouse, 1 m	–	7551.111	7551.111	7551.111
CPU cable for SUN video (HD15), miniDIN 8 keyboard/mouse, 2 m	–	7551.121	7551.121	7551.121
CPU cable for SUN video (HD15), miniDIN 8 keyboard/mouse, 4 m	–	7551.141	7551.141	7551.141
CPU cable for SUN video (HD15), miniDIN 8 keyboard/mouse, 6 m	–	7551.161	7551.161	7551.161
CPU cable for SUN video (HD15), miniDIN 8 keyboard/mouse, 9 m	–	7551.191	7551.191	7551.191
230 V connection cable with earthing-pin plug and IEC 320 connector, version D	–	7200.210	7200.210	7200.210
Remote console receiver module, desktop, transmission via 1 x Cat 5, up to 200 m	–	7551.900	7551.900	7551.900
Transmission kit (sender and receiver) up to 200 m (Cat 5)/up to 300 m (coax)	on request	on request	on request	on request
Console cable kit (HD15, 2 x RS/2) for passive extension, 2, 5, 7, 10 m	on request	on request	on request	on request

[2] Adaptor for serial mouse and DIN 5 keyboard enclosed (■) in conjunction with a SSCmulti.

Features



The permanent availability of IT is undoubtedly a crucial consideration for you. For this reason, you need to ensure high availability, stable electric power supply to your complex server and software system architecture. Create the framework conditions to ensure that all business processes operate on schedule with exceptionally high-level security parameters for the physical IT infrastructure.

1 Power Distribution Rack, PDR
2 Power Distribution Module, PDM
3 Power System Module, PSM

Power Distribution PDR/PDM

Power Distribution Rack
to accommodate a maximum of 8 PDMs. A maximum of 32 server racks may be connected.

Power Distribution Module PDM 482.6 mm (19″) subrack for power distribution of 40 kW in server and network enclosures.

Power System Module PSM

Busbar
Fully wired, shock-hazard protected, load capacity up to 96 A or 48 A, with redundant circuit.

Plug-in modules
for busbars, various country versions. May be retrofitted whilst the system is operational.

Active Power System Module PSM
Remote administration of the power supply, editing and monitoring of remote limits, SNMP trap message in case of alarm.

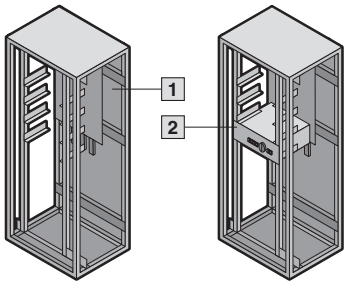
Power Modular Concept PMC – UPS systems

Modularity
High level of flexibility through modular expansion, depending on the UPS capacity requirements.

Redundancy
Multi-server configurations are protected by the redundant Rittal UPS concept.

Scalability
In large output categories, output and autonomy times may be scaled.

Power Distribution Rack PDR



- Power Distribution Rack to accommodate a maximum of 8 PDMs
- Height 1.20 m for 4 PDMs and 2 m height for 8 PDMs
- PDM may be retrofitted whilst operational
- A maximum of 32 racks may be fitted to the sub-distributor
- Fully shock-hazard protected
- Main switch in various options[1]:
  - Isolator switch
  - On-load isolator
  - Power circuit-breakers
  - RC circuit-breaker
- Low-voltage distribution up to 250 A

[1] Depending on the standards of the local power supply company

Note:
Observe the standards of the local power supply companies.

Material:
Sheet steel

Surface finish:
Enclosure frame:
Dipcoat-primed

Doors, roof and base/plinth:
Dipcoat-primed, powder-coated in RAL 7035
Gland plates, punched sections with mounting flanges and mounting angles:
Zinc-plated, passivated

Supply includes:
Enclosure frame with door (without tubular door frame), rear panel, side panels and roof plate, levelling feet including base/plinth adaptor, earthing of all enclosure panels, busbars shock-hazard protected, main switch integrated.

Extended delivery times.

Also required:
Power Distribution Module PDM, see page 743.

Detailed drawing,
available on the Internet.

Power Distribution Rack PDR		Packs of	1	1
Possible number of PDM modules			4	8
Dimensions in mm	W H D		800 1200 500	800 2000 500
Model No. DK		1	**7857.310**	**7857.300**
Accessories				
Base/plinth components front and rear	Height 100 mm	1 set	8601.800	8601.800
	Height 200 mm	1 set	8602.800	8602.800
Base/plinth trim side	Height 100 mm	1 set	8601.050	8601.050
	Height 200 mm	1 set	8602.050	8602.050

2 Power Distribution Module PDM

- 482.6 mm (19″) Power Distribution Module mechanically locked in the rack
- Scalable
- Including master switch, optional RC circuit-breaker
- 4 fused 3-phase outlets to the rack
- 3 x 230 V/16 A per outlet
- Connected load 400 V/3 AC, max. 63 A

Supply includes:
482.6 mm (19″) module, 3 U

Version	Model No. DK
PDM 482.6 mm (19″), 4 outlets per 10 kW	**7857.320**
PDM 19″, 4 outlets, project-specific	**7857.350**
Connection cable with 32 A CEEkon connector	**7857.321**

Plug & play connection cable

to the server enclosures

Length	Packs of	Model No. DK
3 m	1	**7857.130**
5 m	1	**7857.150**
8 m	1	**7857.180**
9 m	1	**7857.190**

assembly

Power System Module PSM

The ever-expanding power requirements of modern IT infrastructures demand refined solutions for power distribution inside the racks. This leads to an associated requirement for additional sockets. The new “intelligent power distribution system” from Rittal significantly reduces cabling and assembly work.

The modular system facilitates basic configuration of the racks, thanks to a vertical support rail with 3-phase infeed. The various insert modules to supply the active components may be snap-fitted into the support rail. This can even be done whilst the system is operational, because the support section is shock-hazard-protected.

The various modules, earthing pins, IEC320 etc. may be inserted into the support rail in any combination. This is easily achieved, even by non-electricians, thanks to the shock-hazard protected plug & play system.

Technical specifications/benefits:

- 3-phase construction with a maximum current of 3 x 16 A
- A redundant three-phase infeed with 3 x 16 A may also be added.
- The redundant circuit is completely separate from the 3 phases of the support rail.
- Each plug-in module picks off a phase on the support rail, either from infeed A or from the redundant infeed B, depending on the direction of connection.
- Modules may be retrofitted whilst the system is operational.
- All plug-in modules are equipped with integral overcurrent protection, so that only the affected module is deactivated in the event of an excessively high current. The other modules remain operational.
- Overvoltage protection may be integrated into the supply line.
- Support rail may be integrated into the vertical frame section of the flexRack(i) without additional equipment.

The vertical support rail allows the slots to be used flexibly across the entire enclosure height, and configured in a redundant manner via separate power infeed to the individual modules.

Supply includes:
Busbar with connection socket and operating instructions. Without cable.

Also required:

Connection cables, assembly kit and plug-in modules,
see page 744, 745.

Possible alternative:

Active Power System Module,
see page 775.

VDE **Reg. no. A592**

Busbar

Direct integration into the flexRack(i)
The busbar is supplied fully wired, without fuse, in two variants (infeed):

- EU: 5-pole with neutral conductor, 3 x 16 A
- US: 4-pole without neutral conductor

Busbar	For enclosure height mm	No. of modules	Model No. DK
EU type	1200	4	**7856.010**
EU type	2000	7	**7856.020**
US type	1200	4	**7856.050**[1)]
US type	2000	7	**7856.060**[1)]

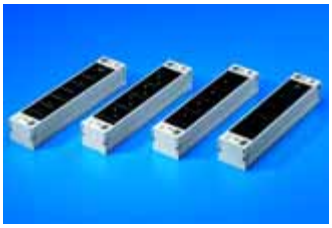
[1)] Delivery times available on request.

Property rights:
German patent no. 101 60 418

Mounting kit, fixed installation

for retrofitting in 600/700/800 mm wide TS 8 enclosure systems

For enclosure height 1200/2000 mm	Model No. DK
For static installation	**7856.011**
Hinged	**7856.012**



Plug-in modules

for busbar version EU and US. Length 250 mm.

Plug-in module	IEC320	IEC320	D/NL/A	F/B	USA	UK	CH
Number of sockets	6	4	4	4	4	3	4
Without overcurrent protection	**7856.080**	–	**7856.100**	**7856.120**[1)]	**7856.140**[1)]	**7856.160**[1)]	**7856.190**[1)]
With overcurrent protection	**7856.070**	**7856.220**[2)]	**7856.090**	**7856.110**[1)]	**7856.130**	**7856.150**[1)]	**7856.180**[1)]

[1)] Extended delivery times. Other modules available on request. [2)] With individual overcurrent fuse, see page 775.

Overvoltage protection

is connected upstream of the busbar.

Overvoltage protection	Model No. DK
With adaptor connector	**7856.170**

Active Power System Module PSM

Detailled information may be found under “Monitoring”, on page 775.

Connection cable, three-phase

3 m, fully wired ready for connection with adaptor and mains connector in two variants:

- EU: IEC309 connector
- US: L15-30P Nema connector

Connection cable	Model No. DK
EU type	**7856.025**
US type	**7856.055**[1)]

[1)] Delivery times available on request.

Connection cable, single-phase

The PSM system is easily operated as a single-phase system as well:

- CEE connector 230 V, 2P+E 16 A
- Cable length 3 m

Supply includes:
PVC cable, 3-pole
Connection cable, length 3 m
Contact protection CEE22

Packs of	Model No. DK
1	**7856.026**

Connection cable, UPS, single-phase

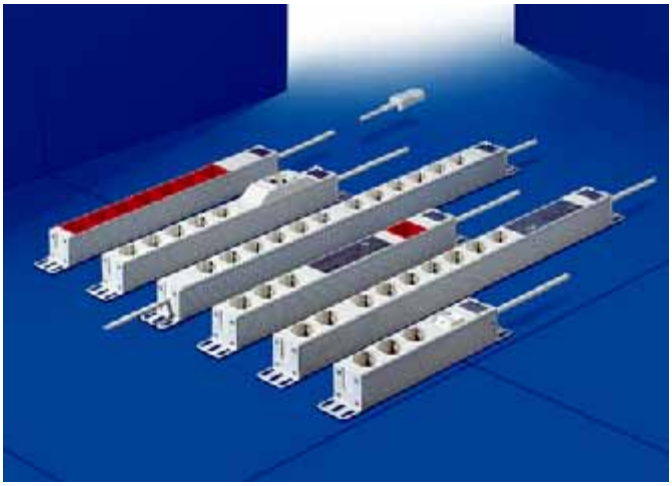
For connecting to an existing UPS:

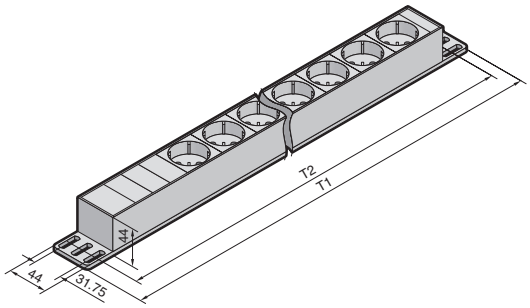
- IEC320 C14 connector (non-heating appliances)
- Cable length 3 m

Supply includes:
PVC cable, 3-pole
Connection cable, length 3 m
IEC cable coupler

Packs of	Model No. DK
1	**7856.027**

Voltage supply





Socket strips

The socket strips in the aluminium channel are available in various lengths with different functional elements. Special attention has been devoted to practical, universal fastening: With a bracket which may be used in four positions, there is a range of attachment options. Hence, for example, the 482 mm long socket strip may optionally be mounted on 482.6 mm (19″) mounting angles, on the enclosure frame, or in the rear section of the wall-mounted distributor. Without additional mounting accessories. The socket strip may be inserted into all sections with a 25 mm pitch pattern. This makes selection much easier, as well as providing additional flexibility and saving on warehousing.
Provision has also been made for the cable routing of the infeed, and when mounting in the 482.6 mm (19″) section there is adequate space to route the infeed between the socket strip and the mounting angle without kinks.
The arrangement of the sockets at a 45° angle allows unrestricted use of angular connectors.

Technical specifications:
Rated voltage: 250 V
Rated current: 10/16 A
Connection cable: 2 m long
H05VV-F3G1.5

Material:
Aluminium section natural anodised,
socket inserts polycarbonate.

Supply includes:
Socket strip,
two mounting brackets,
including assembly parts.

Standards:
Sockets:
E DIN VDE 0620-1/A1
(VDE 0620 part 1/A1): 2003-
E DIN VDE 0620-1/A2
(VDE 0620 part 1/A2): 2004-
Sockets B/F:
UTE NFC 61-303, CEE 7/NV
Overvoltage protection for low voltage:
DIN EN 61 643-11
(VDE 0675 part 6-11): 2002: 12
EMC interference suppression filter: EN 1332000: 1994

Detailed drawing,
available on the Internet.

Version	No. of sockets	Attachment			Length (T1) mm	Mounting dimension (T2) mm[1]	Model No. DK
		Frame	Wall-mounted distributor, horizontal	482.6 mm (19″) level			
Without switch	3	■			262.6	232.5	**7240.110**
	7	■	■	■	482.6	452.5	**7240.210**
	12	■			658.6	628.5	**7240.310**
With switch	3	■	■		306.6	276.5	**7240.120**
	7	■	■	■	482.6	452.5	**7240.220**
Overvoltage protection and interference suppression filter	5	■	■	■	482.6	452.5	**7240.230**
	9	■			658.6	628.5	**7240.330**
Overvoltage protection and interference suppression filter, with RJ 11 connector for CMC connection	9	■			812.6	782.5	**7200.630**
Miniature circuit-breaker	5	■	■	■	482.6	452.5	**7240.240**
Master/slave	1 + 3	■	■	■	482.6	452.5	**7240.250**
UPS strip	7	■	■	■	482.6	452.5	**7240.260**
RCCB	5	■	■	■	482.6	452.5	**7240.280**
RCCB and line protection	5	■	■	■	482.6	452.5	**7240.290**
For IEC 320 connector 10 A	12	■	■	■	482.6	452.5	**7240.200**
For IEC 320 connectors with IEC 320 input, 10 A	9	■	■	■	482.6	452.5	**7240.201**
For IEC 320 connectors with overvoltage protection and interference suppressor filter, 10 A	6	■	■	■	482.6	452.5	**7240.205**
With 2 circuits	6 + 6	■			720.6	690.5	**7240.370**
B/F sockets (Belgium, France)	7	■	■	■	482.6	452.5	**7240.510**
B/F sockets (Belgium, France)	12	■			658.6	628.5	**7240.512**

[1] Variable attachment distance within a range of 5 mm, the distance given is hole centre – hole centre of mounting bracket.

Variants:

Rocker switch
Illuminated, 2-pole switch. The safety bars prevent accidental contact.

Master/slave
2-pole electronic automatic switching unit. The operating point may be set from 9 W to 35 W. Equipment which switches to energy-saving or stand-by mode when switched on cannot be used as the master device. In the ON state, the master device must draw 9 W, and must not draw more than 35 W in the OFF state.

Overvoltage protection and interference suppression filter
The connected equipment is protected from voltage peaks in the mains and switching operations by the power suppliers. The EMC interference suppression filter provides protection from high-frequency interference voltage from both directions – the mains and the connected equipment.
The green ready light is extinguished in the event of disconnection or malfunctions. Connected equipment remains disconnected.

Overvoltage protection device (SPD), type 3
Maximum continuous voltage Uc: 280 V AC
Rated load current IL: 16 A
Maximum overvoltage protection at the mains end:
LS:B16A or 16AgL/gG
Protection level Up: 1.5 kV
Combined surge Uco (L-N): 5 kV
Combined surge Uco (L/N-PE): 6 kV
Rated discharge current In (L-N): 3.0 kA
Rated discharge current In (L/N-PE): 6.5 kA
Arrester disconnector: Permanently disconnects SPD and equipment from the mains
Status display: Green ready light is extinguished upon disconnection.

Overvoltage protection and interference suppression filter, with RJ 11 connector for connection to the CMC.
With the relay message contact, undervoltage and any failures caused by overvoltage can be reported via the CMC in the network using an SNMP trap.
Relay alarm output: RJ 11 jack
Load capacity of relay: 50 V DC, 100 mA

Miniature circuit-breaker
Protects cables from short-circuit and overload. 2-pole switching (thermal/magnetic). Tripping characteristic B.

UPS strip
With red socket inserts. These indicate the items of equipment protected by a UPS.
Connection cable with IEC 320 connector.
Cable: H05VV-F3G1.0/rated current: 10 A

2 circuits
Two circuits with two separate connection cables, 2.5 m.

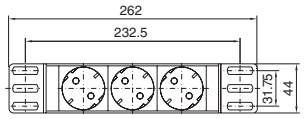
RCCB
For personal protection. With residual-current circuit-breaker IΔn 30 mA to DIN VDE 0664 part 1/85.

RCCB and line protection
A combination of personal, overload and short-circuit protection. With residual-current circuit-breaker IΔn 30 mA to DIN VDE 0664 part 1/85 and residual-current circuit-breaker to DIN VDE 0641/A 4/11.88 16 A/250 V~.

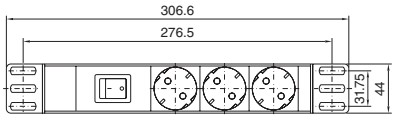
Version B/F (Belgium/France)
With 7 or 12 sockets to CEE 7-V UTE, with child-proof system.

IEC connector
With connection sockets to IEC 320, connection cable, 2 metres or IEC 320 input in the connector panel.
Cable: H05VV-F3G1.0/rated current: 10 A

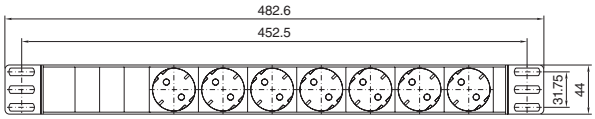
DK 7240.110



DK 7240.120



DK 7240.200 – DK 7240.290/DK 7240.510



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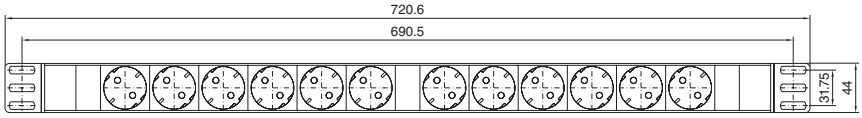
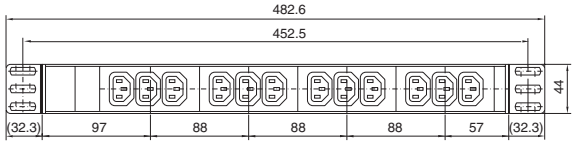
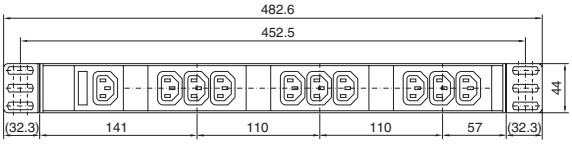


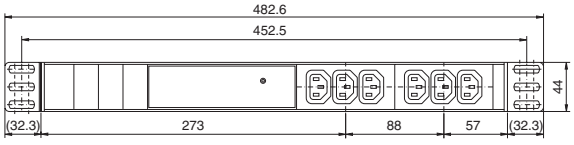
DK 7240.200



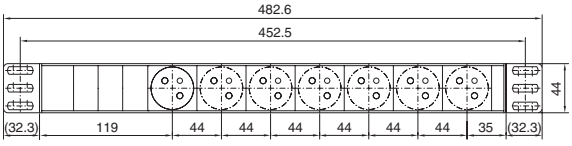
DK 7240.201



DK 7240.205



DK 7240.510



Voltage supply

Socket strips 230 V

Technical specifications:
Rated voltage 250 V AC,
maximum load
CH 10 A,
GB 13 A.

Material:
Plastic, halogen-free
Connection cable, 2 m long, without connector
H05VV-F3G1 (CH)
H05VV-F3G1.5 (GB)
Unrestricted use, including
angular connectors, thanks to the long row arrangement of plug-type contacts.

UK, CH version			Model No. DK UK version	Model No. DK CH version
No. of sockets	Length mm	With rocker switch		
6	470[1]		**7404.000**	**7604.000[2]**
8	553		**7406.510**	**7606.510[2]**
12	793		**7408.510**	**7608.510[2]**
16	1033		**7409.510[2]**	**7609.510[2]**
18	1153		**7412.510[2]**	**7612.510[2]**
5	470[1]	■	**7405.000**	**7605.000[2]**

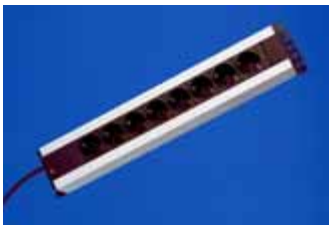
[1] The socket strips can be mounted horizontally at the rear of the DK wall-mounted distributor based on EL/AE.
[2] Extended delivery times.

Socket strips

- Loading up to 16 A/max. 250 V AC.
- Plastic, self-extinguishing to UL 94-V0.
- Connection cable without connector, 2 m long.
- Various national versions available.

Versions for	No. of sockets	Model No. VR
D 16 A/250 V	4	**3850.500**
GB 13 A/250 V	4	**3851.500**
F/B 16 A/250 V	4	**3852.500**
CH 10 A/250 V	4	**3853.500**
USA/CDN 15 A/125 V	6	**3854.500**

Socket strips for IEC 320 connectors
see page 746.



TE socket strip

8-way socket strip for earthing-pin plug/version D. The strip is made of plastic and may be mounted vertically on the TE frame or in the rear 482.6 mm (19″) section. In the 482.6 mm (19″) section, more than 2 U of space is required. The sockets are arranged at an angle of 45° so that angular connectors are also easily used. The socket strip is supplied with a 2 m connection cable. The connection cable is contacted in a terminal slot in the strip. The terminal slot is equipped with a separate cover, so that this connection point can always be quickly and easily accessed. Replacement of the connection cable is likewise simple. Furthermore, the socket strip has external terminals for separate earthing.

Technical specifications:
Rated voltage: 230 Volt AC
Rated current: max. 16 A
Connection cable: Length 2 m, H05VV-F3G 1.5 mm^2, without connectors with wire end ferrules

TE socket strip	Model No. DK
8-way, earthing-pin	**7000.630**

Junction box with multi-functional bracket

The angle bracket can be installed in all network enclosures in a system-compatible design. The junction box serves as a transfer point for the power supply to all equipment (fans, lamps and socket strips). As well as being used as a junction box or interchange point, the bracket may also accommodate the thermostat (SK 3110.000) or the hygrostat (SK 3118.000) thanks to its integral holes.

Packs of	Model No. DK
1 set	**7280.035**

Material of bracket:
Sheet steel

Colour of bracket:
RAL 7035

Supply includes:
1 bracket, 1 junction box,
6 m connection cable 3 x 1.5 mm^2 (flexible).

Energy-Box, 482.6 mm (19″)

Technical specifications:
A depth-variable top hat rail for installed equipment to DIN 43 880, sizes 1 – 3 (e.g. to accommodate built-in sockets, miniature circuit-breakers etc.). Cable clamping at the rear, one N and one PE rail on an insulated plinth. Plastic cover including extension cover (UL 94-V0), maximum accommodation of 22 installed devices (width 18 mm). Maximum accommodation capacity = 22 HP (22 x 18 mm = 396 mm).

Packs of	U	Model No. DK
1	3	**7480.035[1)]**

[1)] To order versions in RAL 7032, please add extension .000 to the Model No.

Colour:
RAL 7035/RAL 7032[1)]

Supply includes:
Energy-Box with blanking covers

Note:
Individual population with circuit-breakers at the factory available on request.

German patent no. 42 00 836

Energy-Box, 482.6 mm (19″), pull-out

This Energy-Box is designed to accommodate both DC and AC components. The pull-out component front affords optimum accesss to the wiring space from above and below.

Connection clamps
for DC current:
2 clamps 35 mm^2,
9 clamps 16 mm^2 (per rail)

for AC current:
1 clamp 16 mm^2 (PE or N),
20 clamps 4 mm^2 (per rail)

Technical specifications:
Depth-adjustable top hat rail for snap-in attachment of installed equipment to DIN 43 880 in sizes 1 – 3 (e.g. to accommodate built-in sockets, miniature circuit-breakers etc. or entire installation assemblies such as the ABB “smissline” system). Cable clamping at the rear, two power distribution rails with connection clamps on isolated base/plinth. Plastic cover including extension cover, maximum accommodation of 22 installed devices (width 18 mm).
Maximum accommodation capacity = 22 HP (22 x 18 mm = 396 mm).
Depth: 220 mm.

U	Model No. DK
3	**7480.300**

Extended delivery times.

Colour:
RAL 7035

Supply includes:
Energy-Box with plastic blanking covers.

Available on request:
Distribution box for DC distribution in the outdoor enclosure.

Features

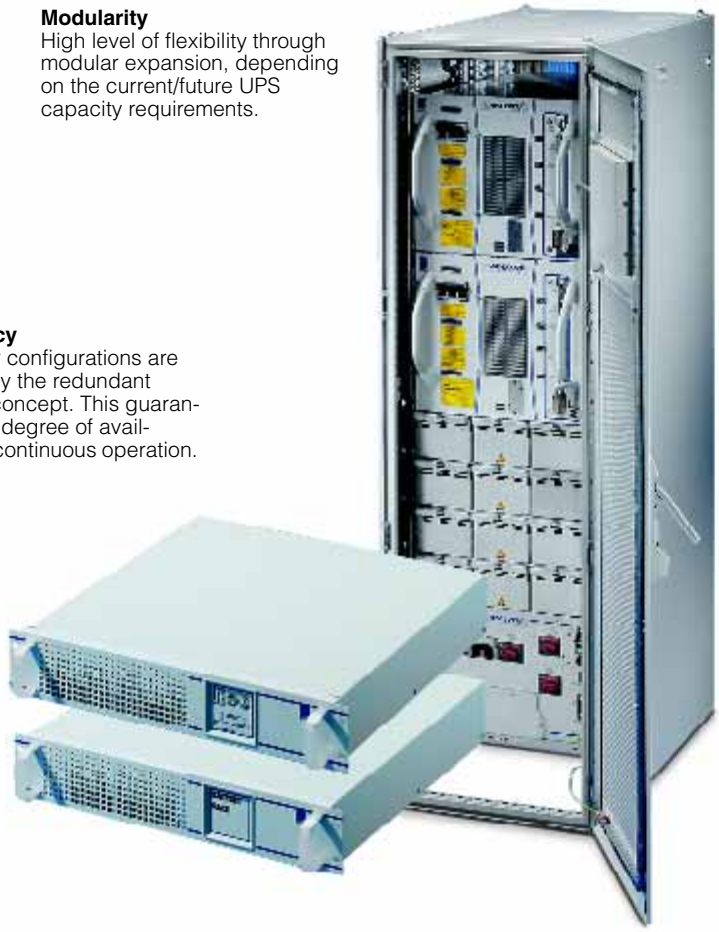
Rittal Modular Power Concept PMC – Applications

The modular Rittal UPS concept meets the versatile data center requirements and is easily expanded with additional UPS modules. High initial investments for the first-time installation are avoided thanks to the modular design concept, since UPS capacities may be upgraded at any time as and when required. The modular concept allows customers to invest as their business expands, and avoids unnecessary electrical installation.

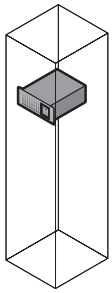
Modularity
High level of flexibility through modular expansion, depending on the current/future UPS capacity requirements.

Scalability
In large output categories, output and autonomy times may be scaled, while in small output categories autonomy times may be scaled.

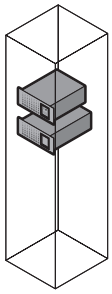
Redundancy
Multi-server configurations are protected by the redundant Rittal UPS concept. This guarantees a high degree of availability and continuous operation.



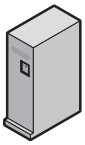
Output range 1 – 6 kVA



2 U UPS with integral battery pack (1/1.5 kVA).

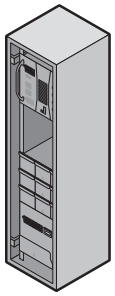


2 U UPS with 2 U battery pack (2/3 kVA).

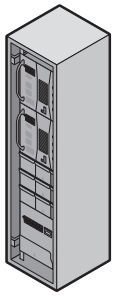


UPS floor standing enclosure with integral battery pack (6/1.5 kVA).

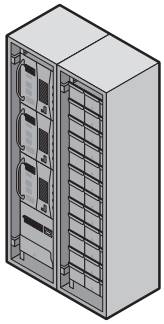
Output range 10 – 120 kVA



One PMC module 10 – 40 kVA with batteries in a TS 8 enclosure.



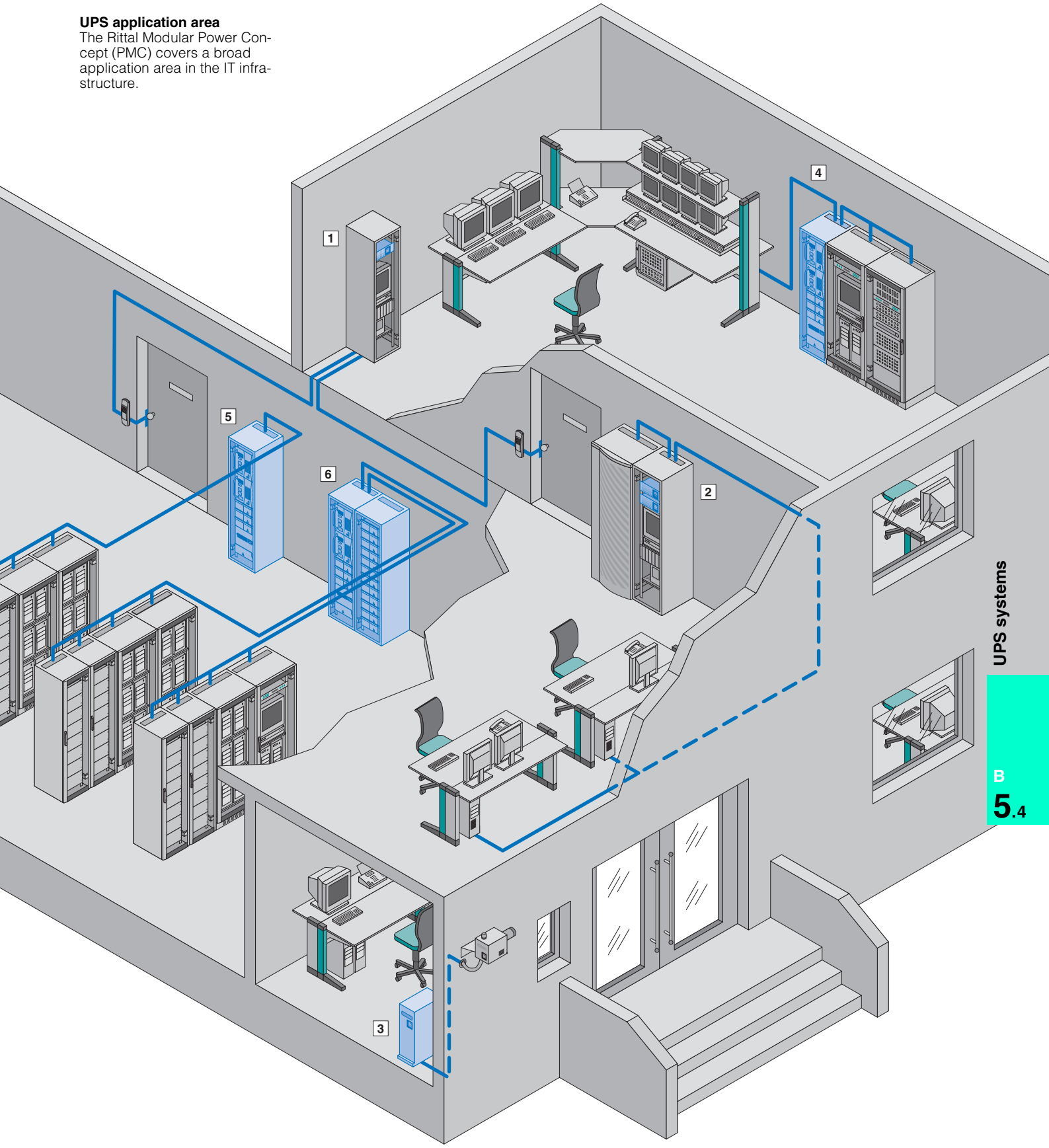
Two PMC modules 10 – 40 kVA each with batteries in a TS 8 enclosure.



Three PMC modules 10 – 40 kVA each with separate battery enclosure.

Features

UPS application area
The Rittal Modular Power Concept (PMC) covers a broad application area in the IT infrastructure.



1 UPS safeguards the access system to the building.

2 UPS safeguards the company's CAD system.

3 UPS for stand-alone applications.

4 Automatic system shutdown with administration option.

5 Central back-up of computer centres with redundant UPS functions.

6 Scalable UPS system for output and autonomy times.

UPS, single-phase, output range 1 – 6 kVA

The Rittal UPS with double conversion technology protects the IT infrastructure from hardware damage, data loss and operational standstill, triggered by power failures, voltage peaks or similar disruptions. Thanks to the active-power factor generated by the batteries/transformers, terminals are supplied with a constant energy quality. The system conforms to the UPS classification based on operating response in accordance with standard IEC 62 040-3 and VDE 0558 part 530. The Rittal UPS carries the classification code VFI-SS-111. The UPS software included as standard with the supply also facilitates the fully automated shutdown of systems and servers, as well as visualisation of the operating status.

Benefits of the Rittal Modular Power Concept (PMC)

- High-quality double transformer technology with perfect sinusoidal output voltage
- Electronic bypass
- Autonomy time may be extended with battery expansion
- Integral battery management, self-test and fast-charge system
- Sealed, maintenance-free lead gel battery, 5 year service life under Eurobat
- Clear LED display
- Alarm function
- Serial interface (RS-232)
- Optional relay, SNMP or AS 400 slide-in board
- Compatible with the Rittal CMC-TC monitoring system

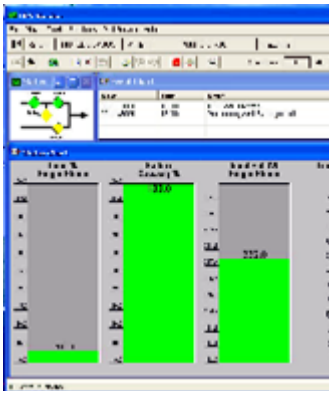
Technical features

Double-conversion technology
This technology is also known as online technology. The electrics with isolating transformer supplies connected equipment with a perfect sinusoidal output voltage.

Bypass function
The Rittal UPS system is equipped with an internal electronic bypass. This protects the UPS system from damage resulting from overload.

Intelligent battery management
The integral charging control checks the readiness of the battery units and ensures constant system availability. The battery remains protected from overcharging or exhaustive discharge.

Battery pack
All Rittal UPS systems may be equipped with additional battery packs. The battery packs serve to extend the autonomy time.
For UPS output categories 2 kVA and 3 kVA at least one battery pack is needed, since the control unit and battery are divided into separate enclosures here.

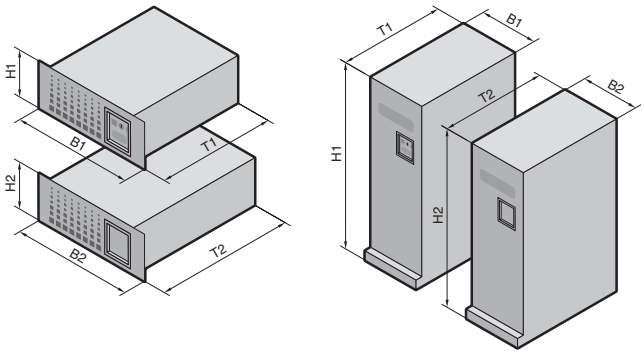


Software

The Rittal UPS software is included with the supply of UPS systems. It operates in the background and communicates with the Rittal UPS in an event-oriented manner via a serial interface. As soon as a malfunction is identified, a freely configurable shutdown routine may be used to shut down the systems automatically. All current operating systems are supported. Several network servers may be controlled simultaneously via the software. For each additional server, only an RCCMD (remote control command) licence is needed. The software also contains professional UPS management with the option of sending individual messages via e-mail, fax or mobile phone. A diverse spectrum of information is documented in the event memory.

Software benefits:
- Software compatible with all standard operating systems, included with the supply.
- HPOpenView plug-in for Windows included in the software package.
- If several servers are shut down via RCCMD, permanent polling of the servers is not necessary, which considerably reduces the system load. Each additional server requires an RCCMD licence.

UPS, single-phase, output range 1 – 6 kVA



Rittal Modular Power Concept (PMC)

Supply includes:
1-phase UPS systems based on the double-conversion technology with/without battery pack.

Available on request:
Replacement batteries,
AS 400 interface adaptor.

Also required:

Country-specific connection cables are required to operate the UPS systems.
Model No. see page 771.

Stored energy times (in minutes) in the event of a power failure at 100 %/ 50 % load:

UPS type 230 V	Supplied state Standard version	Additional battery packs				
		1	2	3	4	5
1 kVA	7/16	35/76	53/122	–	–	–
1.5 kVA	5/14	26/67	46/125	–	–	–
2 kVA	0/0	10/22	24/55	45/102	58/141	80/178
3 kVA	0/0	6/15	13/34	25/63	36/86	50/124
6 kVA	8/23	38/88	60/141	–	–	–

		UPS for 482.6 mm (19″) racks				UPS floor-standing enclosure with integral battery
		UPS with integral battery		UPS control unit		
Model No. DK		**7857.401**	**7857.402**	**7857.403**[1]	**7857.404**[1]	**7857.405**
Battery packs required, 2 U		–	–	7857.408	7857.408	–
Max. number of additional battery packs		2	2	5	5	2
Power	VA	1000	1500	2000	3000	6000
	Watts	700	1050	1400	2100	4200
Input	Rated voltage	230 V (160 – 276 V) AC ±3 %				
	Frequency	50/60 Hz ±5 %, automatic selection				
Output	Voltage	220/230/240 ±3 %				
	Frequency, synchronised	50/60 Hz ±0.5 % (sine)				
	Frequency, asynchronous	50/60 Hz ±5 % (sine)				

Rated current (max.)		4 A	5.7 A	7.7 A	12 A	29.6 A
Power factor to IEC 555-2		> 0.95				
Crest factor		3 : 1				
Overload response		110 % – 130 % for 10 sec., > 130 % ±10 % for 1.5 sec.				
Dimensions and weights						
Width (B1) in mm		482.6 (19″)				260
Height (H1) in mm		2 U				710
Depth (T1) in mm		410	493	410	460	555
Weight (kg)		17	20	8	11	91
Input socket-contacts		1 x IEC 320 C 13			1 x IEC 320 C 19	Clamps
Output socket-contacts		4 x IEC 320 C 13			1 x IEC 320 C 19	Clamps
Battery packs						
Model No. DK extension kit for UPS		**7857.406**	**7857.407**	**7857.408**	**7857.408**	**7857.409**
Width (B2) in mm		482.6 (19″)				260
Height (H2) in mm		2 U				705
Depth (T2) in mm		460				555
Weight (kg)		23	29	29	29	125
Accessories	Packs of					
Alarm relay slide-in card	1	**7857.400**				
RCCMD licence (Remote Control Command)	1	**7857.421**[2]				
SNMP slide-in card Ethernet, FTP, Telnet …	1	**7857.420**[2]				

[1] At least one battery pack 2/3 kVA 7857.408 must be ordered at the same time, because the UPS control units do not contain any batteries.
[2] Extended delivery times

Battery:
Maintenance-free lead battery, service life approx. 5 years according to EUROBAT.
Operating environments:
Temperature: 10°C – 40°C to 1500 m NN
Relative humidity: 20 – 90 %, non-condensing

USV application examples Page 750 **UPS, 3-phase** Page 754

UPS, three-phase, output range 10 – 120 kVA per rack

A modular, 3-phase technology which meets the growing requirements of the business-critical infrastructure. These days, no company can afford to have its business processes interrupted as a result of hardware errors, production failures or a breakdown in communications.

The Rittal UPS concept is more than just an uninterruptible power supply, it is a new concept in voltage protection, offering decisive advantages compared with traditional double-conversion 3-phase UPSs.

Benefits of the Rittal Modular Power Concept (PMC)

Performance/modularity/ redundancy
PMC is a new, 3-phase, modular N+1 redundant UPS technology.
PMC enables simple output expansion to cope with rising output demands.
PMC is more than just a UPS – it is a new concept in power supply (Modular Power Concept – PMC) offering key advantages compared with conventional double-conversion 3-phase UPS technology.
PMC is a flexible protection system consisting of 3-phase UPS modules in the output categories 10, 20, 30 and 40 kVA.
The modules may be extended without restriction in order to increase the overall output or achieve redundancy.

Scalability
Retrofitting of individual modules while the **system is operational** (hot swap) as required. This UPS offers an infrastructure with a permanently high level of availability.

High availability
Each UPS module operates **independently with its own intelligence.**

Monitoring
Simple and proven with **optional SNMP adaptor.**

Service-friendly
Individual modules may be exchanged, leading to **fast response times** in case of a malfunction plus enhanced availability.

Other features

Rittal offers a diverse range of pre-configured variation options for the UPS, embeded in a tried-and-trusted TS 8 enclosure.

Tailored to the requirements of a modern infrastructure in terms of space, performance and availability.

Rittal Modular Power Concept (PMC)

PMC is an innovative power protection system which ensures a high level of availability for critical applications by combining modularity (flexible, unlimited scalability and redundancy) with decentralised parallel architecture or DPA (redundant protection without “single point of failure”). Modularity supports easy upgrading of the capacity or battery time of the UPS system. The PMC UPS not only protects the critical load, but also the environment. Thanks to the high operating ratios (low power loss), low input distortion factor (low emission of harmonics from the mains end) and low noise generation, the PMC UPS has proven itself to be an environmentally compatible product.

Key properties of the PMC at a glance:
Modularity, redundancy, scalability, eco-friendliness, serviceability.

Modular Power Concept

The Rittal Modular Power Concept (PMC) allows easy adaptation to customer-specific reuqirements, thanks to its modular character, combined with investment security and a high level of availability.

The modules are integrated into prepared Rittal TS 8 UPS enclosures, where they may be extended whilst the system is operational.

PMC module

- Every individual UPS module contains a rectifier/booster, inverter, a static bypass and a separate CPU which monitors and controls all parts and coordinates parallel communication with the other modules.
- The modules are available in the output sizes 10, 20, 30 and 40 kVA and are prepared for easy 482.6 mm (19″) integration into the Rittal TS 8 UPS enclosure.
- The weight of the modules ranges from 40 kg (10/20 kVA) to 59 kg (40 kVA).
- In conjunction with the batteries, a diverse range of combinations may be quickly and easily compiled.
- Parallel connection occurs within the enclosure, thus facilitating a space-saving configuration of the UPS system.

UPS classification

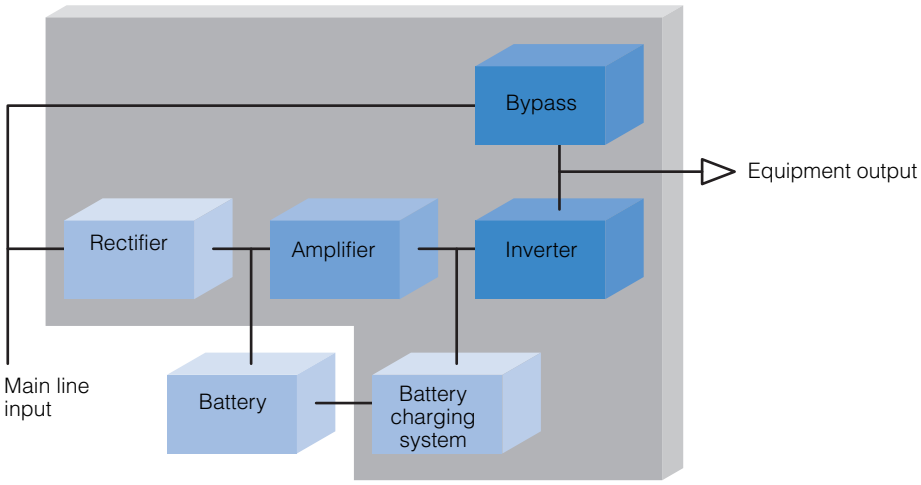
In order to facilitate comparability of UPS appliances from different manufacturers, a classification has been developed on the basis of operating response.

Modules bearing the code VFI-SS-111[1)] under the new IEC 62 040-3 classification are truly outstanding.

These UPS modules are transformerless, genuine online, double-conversion UPSs with static bypass.

[1)] New standard of high availability to protect the server environment.

UPS modules



UPS application examples Page 750 **UPS, 1-phase** Page 752

Redundant UPS concept

New standard of high availability to protect the server environment

Parallel connection of UPS systems:

- Increase capacity to enable the system to supply a greater load than a single installation.
- Redundancy, to increase UPS availability.

The fault-tolerant DPA (Distributed Parallel Architecture) design protects against “single point of failure”, and, therefore, ensures permanent availability.

Rittal PMC (2 modules and battery)

This enclosure has been developed for 2 modules with n+1 redundancy with a battery with a short autonomy time, in order to achieve the smallest possible basic surface area.

Modules are available in 10, 20, 30 and 40 kVA.

What is Distributed Parallel Architecture (DPA)?

The decentralised parallel architecture (DPA) of the modules includes integrated control electronics (CPU) for a rectifier, booster, inverter and static bypass. The CPU of each UPS module also has its own parallel intelligence. The commonalities of a complete UPS system with several modules are confined to control of the parallel bus connection.

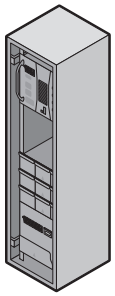
DPA guarantees supply of UPS power as long as the UPS power is higher than or equal to the critical load. This occurs without the UPS switching to bypass.

Switching to bypass only occurs if there is an overload or a short-circuit on the load side.

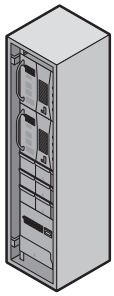
To consistently increase the availability, DPA is an extension of the bypass, so as to protect or ensure the supply of the critical load in the event of a short-circuit or overload.

High availability

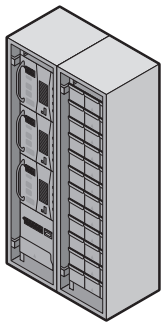
Redundancy means that at least two or more modules always share the critical load equally. In the event of failure of a UPS module, the other will assume the entire connected load without interruption.



One PMC module 10 – 40 kVA with batteries in a TS 8 enclosure.



Two PMC modules 10 – 40 kVA each with batteries in a TS 8 enclosure.



Three PMC modules 10 – 40 kVA each with separate battery enclosure.

UPS application examples Page 750 **UPS, 1-phase** Page 752

Scalable UPS concept

Extend your system at the same speed as your business.

The challenges faced by your infrastructure not only include the current circumstances, but also in particular the requirements of the future. Thanks to the scalable concept, your installation is easily extended.

Integration of up to three modules in one enclosure

This achieves maximum flexibility.

Your output may be easily extended by adding a further UPS module.

This can occur as a “hot swap” with the system operational, without needing to switch the system to bypass.

For this configuration, an additional battery enclosure is always required. The autonomy times may be flexibly adapted to your requirements.

Environmentally compatible UPS concept

High level of efficiency

- Thanks to the transformerless technology and the ESIS (Energy Saving Inverter Switching) technology, a 5 % higher efficiency is achieved, on average, than with conventional UPS systems. With efficiencies of up to 96 % operating costs are reduced, as is heat dissipation into the environment.

Low noise levels

- The noise level is dependent on the load; at <70 % of the nominal load the level is significantly reduced. This leads to a pleasant, user-friendly noise level in the environment.

Battery protection and battery management

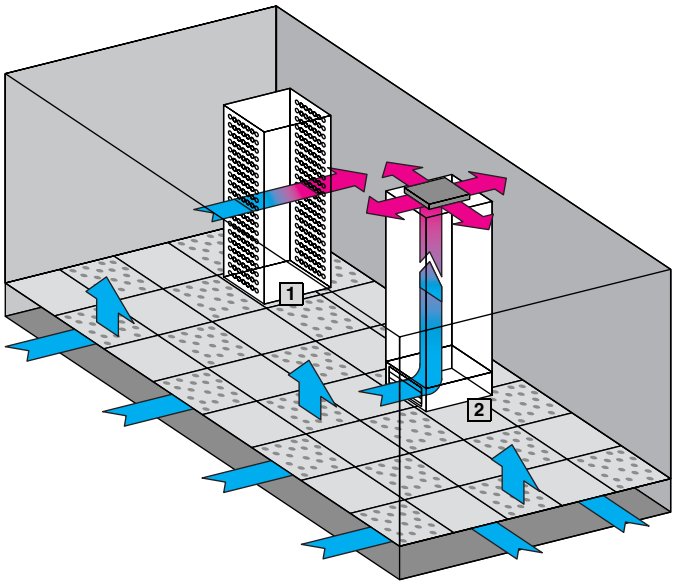
The batteries are protected from overcharging by ripple-free charging electronics. The electronics regulate the charge current depending on the ambient temperatures. The built-in flexible battery management (FBM) periodically checks the “fitness” of the batteries and automatically generates alarms in case of irregularities.

UPS application examples Page 750 **UPS, 1-phase** Page 752

Perfect solutions for every application

From passive air climate control to active liquid cooling of high-performance CPUs, Rittal offers the full range of components and systems. They are designed precisely according to your requirements and application spectrum. Allowance is made, not only for the conditions inside the rack, but also for the ambient conditions.

Software-assisted planning helps to minimise investment costs and also offers peace of mind.



Passive cooling (use of the ambient air)

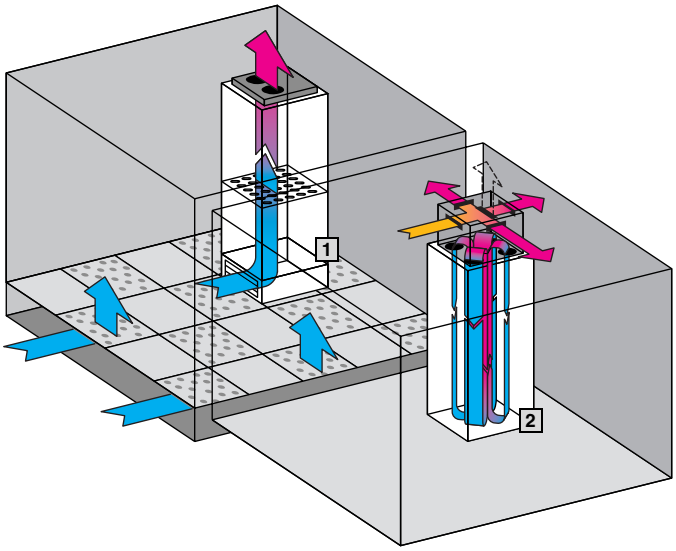
The air cooled via the regular ambient air or via the building's air-conditioning system is routed into the raised floor for rack cooling.

Doors with 78 % open surface area (diagram 1) or openings in the base/plinth and roof (diagram 2) ensure maximum air throughput via convection in conjunction with the fans.

Diagram 1 Horizontal cooling: 2 doors with high air throughput (78 % free space per door)

Diagram 2 Vertical cooling: via vented base/plinth and roof ventilation

See page 759.



Active cooling (use of the ambient air)

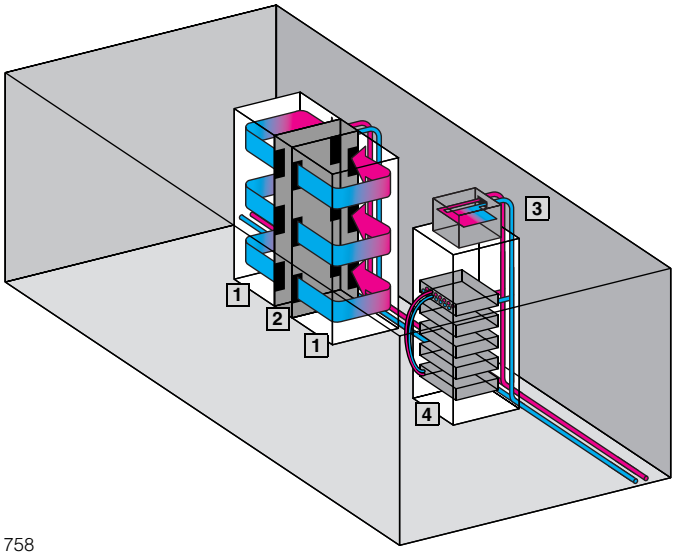
Fan systems for active cooling (diagram 1) amplify the air exchange inside the rack and use ambient air for cooling.

Active, rack-related cooling

By contrast, rack-related, active cooling (diagram 2) is capable of reducing the interior temperature of the rack to below the ambient temperature. This cooling technique is very effective with an appropriate room volume and in industrial environments.

Diagram 1 Fan systems, see page 759.

Diagram 2 Cooling units and rack-mounted recooling system 19″, see page 760.



High-performance cooling (liquid cooling, independent of the ambient air)

With liquid, under the same volumetric flow, approximately one thousand times as much heat loss may be dissipated as with air. This opens up a brand new dimension in cooling.

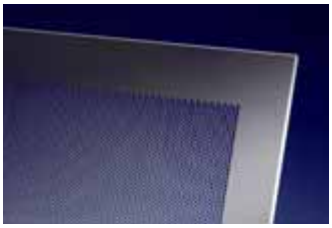
Liquid cooling systems for rack cooling
Extremely high heat loads are dissipated via air/water heat exchanger systems (diagram 2) from the racks (diagram 1).

Liquid cooling systems (4) for component cooling
CPUs, as well as power packs, hard disk drives and other electronic components are cooled directly – effectively and quietly.

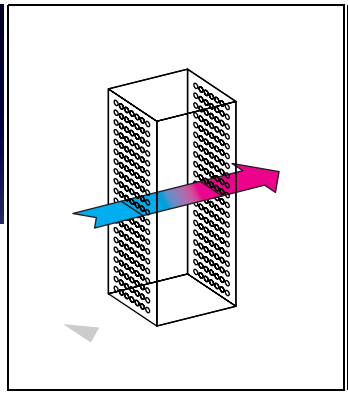
Diagram 1 Server racks
Diagram 2 LCP (Liquid Cooling Package)
Diagram 3 Air/water heat exchanger
Diagram 4 CPU cooling

See page 760.

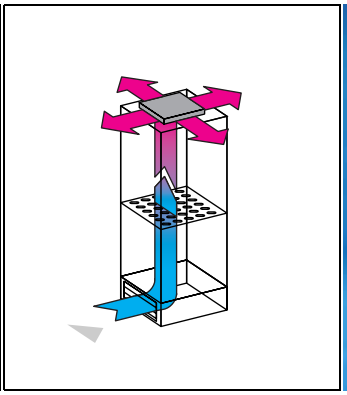
Passive cooling (use of the ambient air)



The perforations in the doors or openings in the base/plinth and roof ensure maximum air throughput via convection in conjunction with the equipment fans.



Horizontal ventilation
A high air throughput, stylish design and outstanding security are provided by the doors (with 78 % free surface area per door) of the server racks.



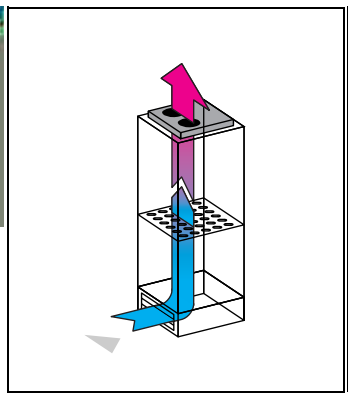
Vertical ventilation
Ventilation base/plinth, roof vent and slotted component shelves ensure heat dissipation.

Air baffle system
Cool air from the hollow base is routed over the base/plinth and distributed via the door in a targeted manner.

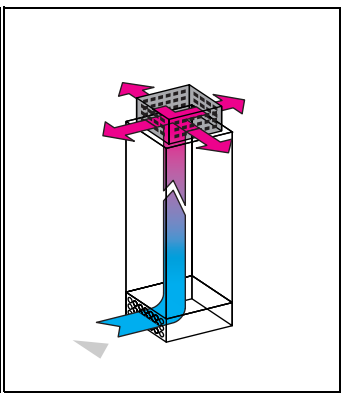
Active cooling (use of the ambient air)

Fan systems to reinforce air exchange

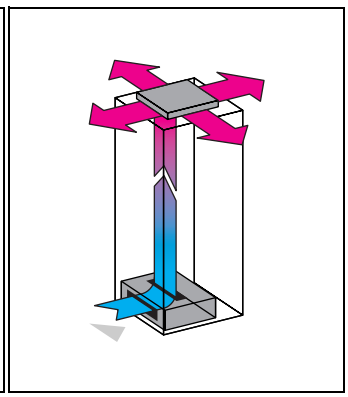
Rittal fan and filter units, see page 636.



Fan roofs
Various designs and outputs, extendible with fan kits. Fast assembly tailored to racks,
see page 647.

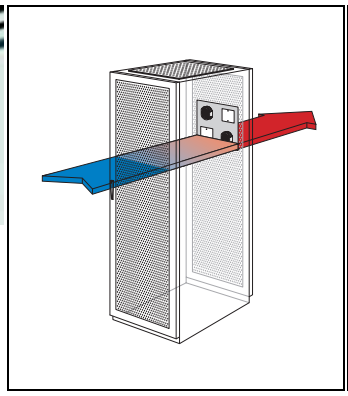


Roof-mounted fans
Quiet performance (1500 m^3/h) for office applications, wired ready for connection, easy assembly,
see page 647.

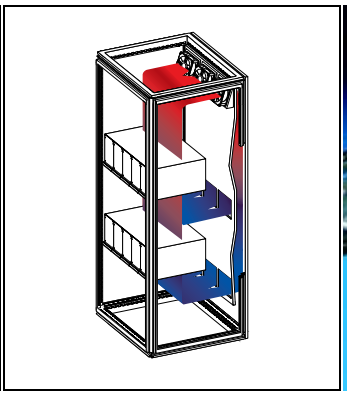


Centrifugal fan/rack-mounted fan
Centrifugal fan,
Rack-mounted fan,
Vario rack-mounted fan,
see page 645.

Fan systems to reinforce air exchange and circulation inside the rack



Fan cross member
For the perforated door of TS 8 server racks.
Air throughput up to 1200 m^3/h,
see page 652.



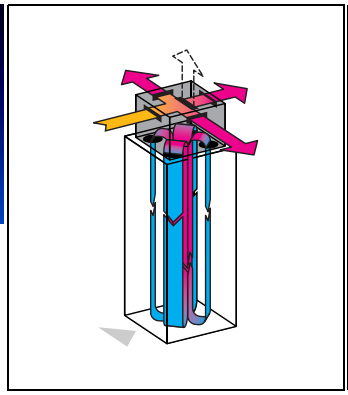
Internal fan mounting panel
for TS 8 enclosures. For improved air blending and heat dissipation,
see page 653.

Internal fan
To avoid hot spots and support climate control components,
see page 653.

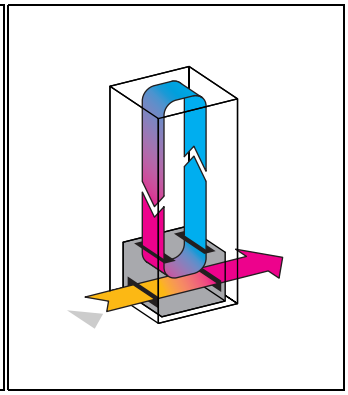
Active, rack-related cooling

Cooling of the rack interior to below the ambient temperature!
The three systems shown opposite are specifically designed for the cooling of servers, IT and electronic components.

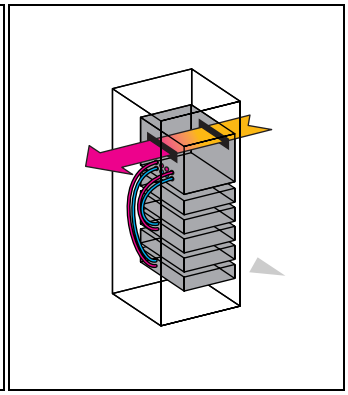
Rittal roof-mounted and wall-mounted cooling units,
see page 590.



Roof-mounted cooling unit (office application)
Useful cooling output 1100 W at an extremely low noise level,
see page 590.



Rack-mounted cooling units 482.6 mm (19″)
Useful cooling output 1000 W, simple installation in the 482.6 mm (19″) level,
see page 644.

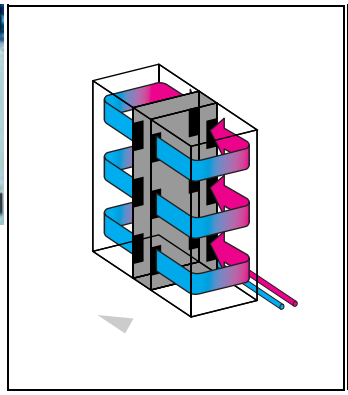


Rack-mounted recooling system 482.6 mm (19″)
Liquid-cooled computers are supplied directly via 6 cooling circuits.
Cooling output 1000 W,
see page 673.

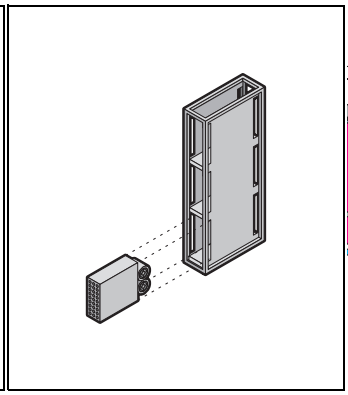
High-performance cooling (independent from the ambient air)

Liquid cooling systems to dissipate high heat loads
Also suitable for use in confined rooms without air-conditioning by using external recooling systems.

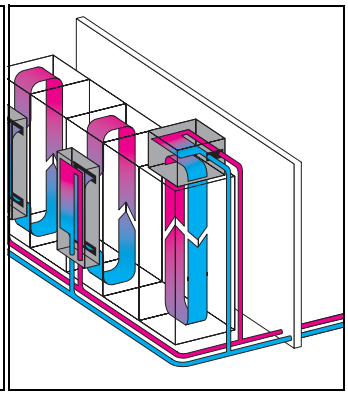
Recooling systems for liquid cooling,
see page 608.



Liquid cooling package
This cooling rack is fitted with up to 3 cooling modules (air/water heat exchangers),
see page 672.

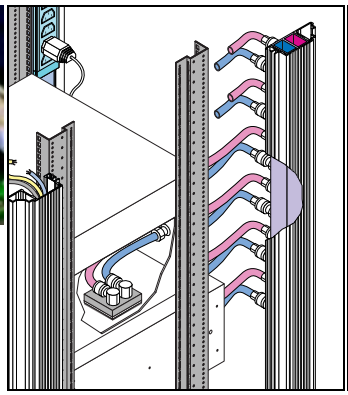


It is bayed with one or two TS 8 server racks (H 2000 x D 1000 mm).
Useful cooling output per module 4000 W (max. 12000 W),
see page 672.

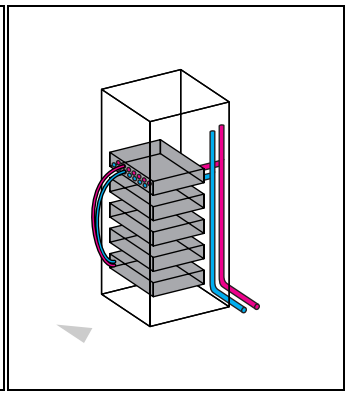


Air/water heat exchanger
Installation: Roof-mounting, wall-mounting and as TS 8 side panel (H 1800 x D 600 mm).
Useful cooling output from 600 to 4000 W,
see page 626.

Liquid cooling systems for component cooling
CPUs, as well as power packs, hard disk drives and other electronic components are cooled directly – effectively and quietly.

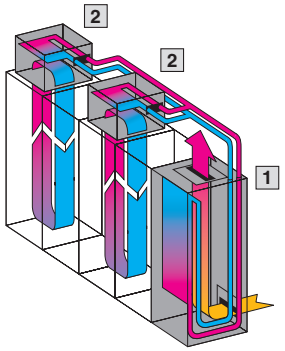


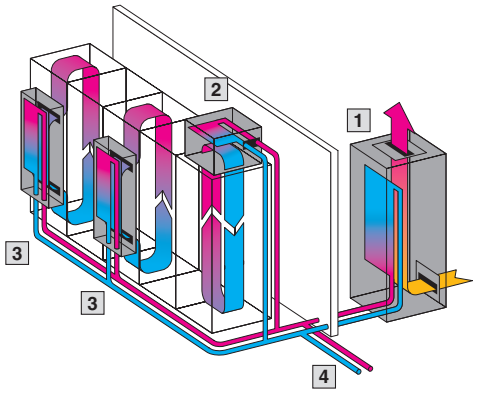
Cooling circuit distributor for racks
Pack 1 for 20, pack 2 for 40 CPU cooling circuits. Enclosure heights 1200 and 2000 mm,
see page 674.



Cooling circuit distributor 482.6 mm (19″)
Complete kit or individual distributors with drip-free connection of up to 10 servers,
see page 675.

Background technology: Recooling systems





Recooling systems ensure central cooling and supply of the cooling medium for liquid cooling systems. This makes it possible to achieve spatial separation between the generation of cold air and cooling itself, for the temperature-neutral expansion of data centres.

1 Recooling system
2 Air/water heat exchanger, roof-mounted
3 Air/water heat exchanger, wall-mounted
4 Further cooling options

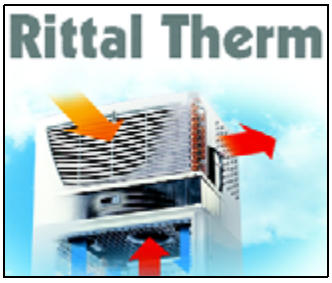
Recooling systems solve all cooling tasks via a system of piping.
As well as IT and electronic components, production processes, machines and systems are also cooled.
A range of products from 960 W to 172 kW meets all required cooling services.

Recooling systems Mini
Smart design,
simple assembly,
cooling output from 960 to 4500 W,
see page 608 – 609.

Recooling systems in the TS 8 Top enclosure system
Compact design,
bayable with TS 8 racks,
cooling output from 6000 to 25000 W,
see page 615 – 616.

Recooling systems in floor-standing and industrial enclosures
Cooling media water or oil,
cooling output from 2100 to 172000 W,
see page 617.

Advice, calculation, planning



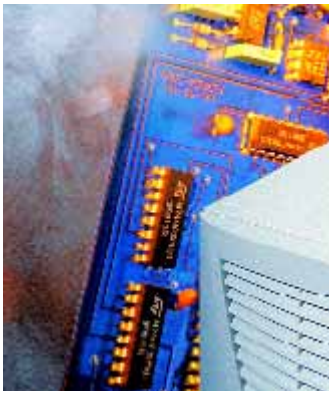
- **Software Rittal Therm**
  Simple calculation of heat loss, calculation of dissipation via the surface, device selection.
- **CFD** (Computer Fluid Dynamics) offers system reliability, because the temperature, pressure and flow speed at every point of the calculated space are simulated at the planning phase.
- **Eliminate risks through thermography.** Even with the prototype of your plant or machine, the Rittal thermography service offers precise imaging of the real temperature conditions on site.
- **Support**
  Project planning,
  tests and measurements in the Rittal climate laboratory,
  commissioning,
  maintenance

Rittal CMC-TC – Security management concept

Effective prevention, comprehensive security and central organisation of rack security. The new, modular CMC-TC facilitates the implementation of highly individual security solutions, thanks to its modular plug & play system and, therefore, affords a high level of protection for your investments.

More detailed information can be found at:

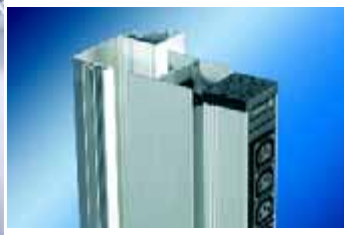
www.cmc-tc.com



Climate Control

Consistent low temperatures for electronics are a key safety factor in the network and in the production process. Monitoring of the internal rack temperature and the control of climate technology to reliably dissipate heat loss is provided by the Rittal CMC-TC security system to minimise operating costs.

Power Management



Power requirements are on the increase, and there is a growing need for maximum availability of modern IT infrastructures. Rittal addresses the associated additional requirement for redundant power supply with a new, intelligent power distribution system which may be integrated with no loss of enclosure internal rack volume.

Access Control

Access authorisation is one of the most important security factors in any company. With the CMC-TC, this is registered for the entire network. In case of an unauthorised access attempt, the system raises the alarm. For example, doors may be opened by authorised individuals via a numerical code, magnetic card, smartcard, or the latest transponder technology.

Rittal CMC-TC – Security management concept

	Sensor unit	I/O unit	Climate unit			Access unit
	Sensors/actuators:				**Lock/reader:**	
7320.500	Temperature sensor	■	■	7320.700	Elec.-magn. Ergoform-S FR/PS/TC/TE	■
7320.510	Humidity sensor	■		7320.710	Elec.-magn. Ergoform-S QR	■
7320.520	Analog sensor input module “4 – 20 mA”	■		7320.721	Electro-magnetic TS 8 handle with master key function	■
7320.530	Access sensor[1)]	■	■	7320.730	Universal lock	■
7320.540	Vandalism sensor	■		7320.740	Relay output module for room door	■
7320.550	Airflow monitor	■	■	7320.750	Smart card reader	■
7320.560	Smoke alarm	■	■	7320.760	Magnetic card reader	■
7320.570	Motion sensor	■	■	7320.770	Coded lock	■
7320.580	Digital input module	■	■	7320.530	Access sensor[1)]	■
7320.590	Digital relay output module	■		7320.580	Digital input module for door release	■
7320.600	Voltage monitor	■	■	7320.900 7320.910 7320.920 7320.930	Lock FR(i)	■
7320.610	Voltage monitor with switch output	■				
7320.620	48 V voltage monitor	■	■			
7320.630	Leakage sensor	■		7320.950	Universal handle	■
7320.811	Fan Alarm System FAS	■				

[1)] Up to a maximum of 5 sensors may be connected in series.

The sensor units (SU)

Universal I/O unit

- The I/O unit is the measurement and alarm module.
- Alarm sensors may be connected (e.g. motion detector).
- Analog measurements can be transmitted and monitored (temperature, humidity, 4 – 20 mA).
- The system is capable of switching relay output modules.
- The unit has 4 universal ports for 4 sensors/actuators.
- The I/O unit must be connected to the PU. Data exchange and energy supply to the electronics are provided in this way.

Climate unit

- The climate unit serves to control the fans and hence regulate the temperature.
- The physical airflow of the fan is monitored with due regard for the controller.
- If no temperature sensor or airflow sensor is used, the two universal ports can also be fitted with other sensors (see table).
- Simple fan connection via IEC socket.
- The unit is designed for one fan system.
- The climate unit must be connected to the PU.

Access unit

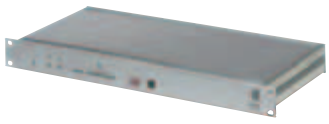
- The access unit serves to control door systems.
- The doors can be opened remotely via the network.
- The doors can also be opened by selected individuals via a coded lock, magnetic card or smartcard.
- The doors of enclosures or rooms can be monitored and activated.
- The unit is designed for two separate door systems.
- The access unit must be connected to the PU. Data exchange and power supply to the electronics are provided in this way.

Processing unit (PU)

- The processing unit (PU) forms the basis of the monitoring system.
- The system can be incorporated directly into the user network via the network interface 10BaseT, TCP/IP, SNMP.
- The system has an integral web server, through which the system can be configured.
- The system can optionally be linked to the CMC-TC master via the network interface.

- The monitoring functions are determined by the sensor units or sensors/actuators linked to the PU, and can therefore be flexibly selected.
- Up to 4 sensor units may be connected in any given combination (I/O, access, climate, FCS).

Master unit



- The CMC-TC master is required in all situations where it is necessary to monitor large numbers of security-relevant factors or where high demands are placed on the system.
- The CMC-TC master offers high performance and conserves IP resources.
- The PU with the sensor units is always required for monitoring.

- Up to 10 processing units (PUs) may be connected to a sub-network as slaves.
- The master offers a 10/100BaseT interface to the user network and comprises all monitoring variables on HTTPS and SNMP.
- The system can be connected and operated directly via the Rittal SSC.

Sensor units

1

2

3

There is a choice of 4 sensor units:

I/O unit:
The alarm and measurement module

Access unit:
For controlling door systems

Climate unit:
For fan control and monitoring

FAN Control System FCS for DC fans

Benefits:

- Choice of functions thanks to 4 sensor units (active PSM, RTT I/O unit, RLCP on request)
- Open to customer-specific sensors/actuators
- Automatic sensor detection
- Simple installation based on the plug & play system
- No additional power pack required
- Choice of mounting on the enclosure frame or 482.6 mm (19″) mounting angles
- I/O unit: Freely selectable sensors/actuators
- Access unit: Personalised access detection
- Climate unit: Fan control with airflow monitoring

1 Interface for the sensor unit and processing unit connection. Used for data communication and power supply.
Cable 7320.470/.472/.481.

2 Just one press of the button, and the system automatically reconfigures itself.

3 Up to 3 systems may be integrated into the 1 U mounting unit: Model No. 7320.440.

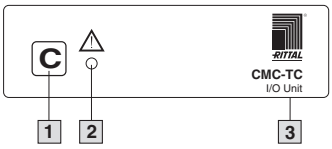
Technical specifications:
The sensors/actuators are set up via an automatic electronic ID system. Because it is installed using a flexible plug & play system, there is no need for time-consuming programming and wiring. Power is supplied centrally via the connection cable to the PU.

Technical specifications:
W x H x D: 136 mm x 44 mm (1 U) x 129 mm
Temperature application range: +5°C to +45°C
Humidity application range:
5 % to 95 % relative humidity,
non-condensing

Protection category:
IP 40 to EN 60 529

CMC-TC sensor unit I/O unit

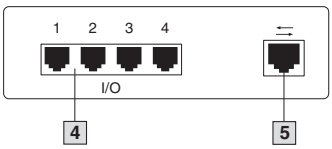
This sensor unit allows alarm messages, status messages and measurements to be forwarded or remote actions to be executed via relay output modules.
The I/O unit has 4 universal inputs/outputs. The sensors/actuators listed below can be operated here.
The interface to the user network is via the PU (processing unit), which is always required to operate the system.



1 **Control key** for detection/set-up of the sensors/actuators

2 **Alarm LED** signals alarms or configuration changes

3 **Mounting fixture** for 7320.440 or 7320.450



4 **RJ 12, 4 inputs for sensors/actuators** (see table)

5 **RJ 45, connection** to PU 7320.100 via connection cable 7320.470/.472/.481
(The unit is also supplied with power via this connection.)

Sensor unit I/O unit	**Model No. DK**
4 universal inputs or outputs	**7320.210**

Also required:

Sensors/actuators	max.	**Model No. DK**	Page
Temperature sensor	4	7320.500	773
Humidity sensor	4	7320.510	773
Analog sensor input module “4 – 20 mA”	4	7320.520	779
Access sensor[1)]	4 x 5	7320.530	777
Vandalism sensor	4	7320.540	777
Airflow monitor	4	7320.550	774
Smoke alarm	4	7320.560	773
Motion sensor	4	7320.570	778
Digital input module	4	7320.580	779
Digital relay output module	4	7320.590	779
Voltage monitor	4	7320.600	774
Voltage monitor with switch output	2 – 4	7320.610	774
48 V voltage monitor	4	7320.620	775
Leakage sensor	4	7320.630	778
Fan Alarm System FAS	4	7320.811	787

[1)] Up to a maximum of 5 sensors may be connected in series.

For selection aid, see page 770.

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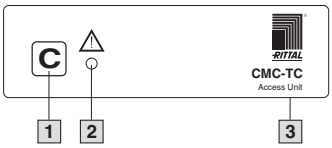
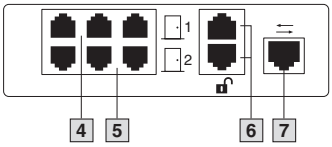
CMC-TC sensor unit Access unit

With this sensor unit, one or two doors may be released for access via the network, or personalised opening via a read system (e.g. smartcard reader) may be initiated. The system also monitors the status of the door, handle or latch. Authorised access codes can be set up via HTTP. The sensors/actuators/readers listed below can be operated here.
In order to operate the unit, at least one access sensor and at least one latch (e.g. handle) per door system must always be used.





1 **Control key** for detection/set-up of the sensors/actuators

2 **Alarm LED** signals alarms or configuration changes

3 **Mounting fixture** for 7320.440 or 7320.450

4 **Inputs for access sensor, handles** Latch system 1 (see table)

5 **Inputs for access sensor, handles** Latch system 2 (see table)

6 **I²C bus for reader units** Door system 1 and 2 (see table)

7 **RJ 45 connection** to PU 7320.100 via connection cable 7320.470/.472/.481 (The unit is also supplied with power via this connection.)

Sensor unit access unit	Model No. DK
Control of 2 door systems	**7320.220**

Also required:

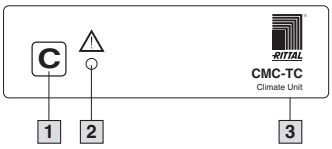
Sensors/actuators	max.	Model No. DK	Page
Access sensor[1)]	2 x 5	7320.530	777
Digital input module for door release	2	7320.580	779
Latch/reader			
Electromagnetic Ergoform-S FR/PS/TC/TE	2	7320.700	781
Electromagnetic Ergoform-S QR	2	7320.710	781
Electromagnetic TS 8 handle Master key	2	7320.721	781
Universal lock	2	7320.730	783
Digital relay output module for room door	2	7320.740	780
Lock FR(i)	2	7320.900 / .910 / .920 / .930	783
Universal handle	2	7320.950	784
Smartcard reader for door release	2	7320.750	782
Magnetic card reader for door release	2	7320.760	782
Coded lock for door release	2	7320.770	782

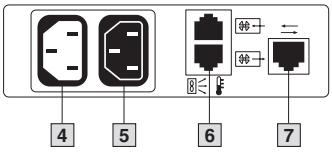
[1)] Up to a maximum of 5 sensors may be connected in series.

For selection aid, see page 770.

CMC-TC sensor unit Climate unit

A temperature control circuit is installed with this sensor unit. Temperature setpoints are set via the PU, and these are compared with the actual temperature. Depending on the evaluation, the fan system is activated. The function of the fans can also be monitored with an airflow sensor. Monitoring is only active whilst the fan is operational. Other sensors may optionally be connected to the unit.
In order to operate the unit as a temperature fan control circuit, at least one temperature sensor must always be used.





1 **Control key** for detection/set-up of the sensors/actuators

2 **Alarm LED** signals alarms or configuration changes

3 **Mounting fixture** for 7320.440 or 7320.450

4 **Input for fan supply** 115/230 V AC, cable 7200.210 – .215

5 **Output to fan** with cable 7200.215

6 **RJ 12, 2 inputs for sensors/actuators** (see table)

7 **RJ 45 connection** to PU 7320.100 via connection cable 7320.470/.472/.481 (The unit is also supplied with power via this connection.)

Sensor unit climate unit	Model No. DK
Control of a fan system	**7320.230**

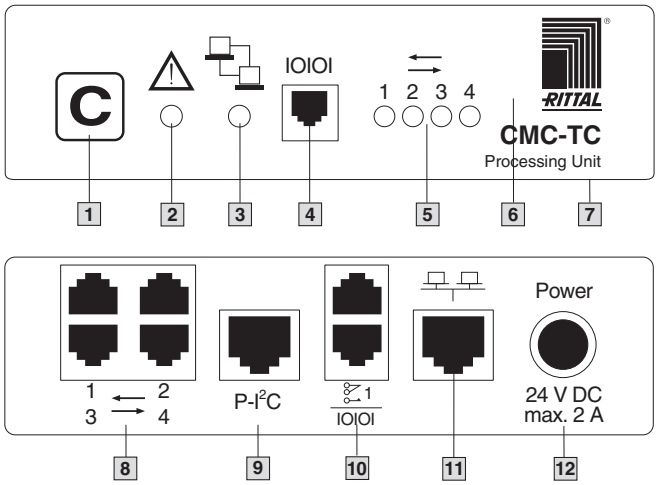
Also required:

Sensors	max.	Model No. DK	Page
Temperature sensor	2	7320.500	773
Access sensor[1)]	2 x 5	7320.530	777
Airflow monitor	2	7320.550	774
Smoke alarm	2	7320.560	773
Motion sensor	2	7320.570	778
Digital input module	2	7320.580	779
Voltage monitor	2	7320.600	774
48 V voltage monitor	2	7320.620	775

[1)] Up to a maximum of 5 sensors may be connected in series.

For selection aid, see page 770.

Monitoring system processing unit



Benefits:
- Freely selectable monitoring functions
- Sensor/actuator ports extendible
- Network connection TCP/IP SNMP
- Integral web server for configuration
- Automatic menu generation
- Simple installation based on the plug & play system
- Alarm continues to record even in the event of a network failure
- Built-in real-time clock
- May be used via power supply unit for 115/230V AC or 48 V DC may be used
- Choice of mounting on the enclosure frame or 482.6 mm (19″) mounting angles
- The protocol for the master/slave system is TCP/IP SNMP
- May be used for large data centres or small individual applications

The processing unit forms the basis of the CMC-TC system. This unit is required for every monitoring application.

Interface to the customer:
The PU can be incorporated directly into the user network via 10BaseT. The PU can also be linked to the master 7320.000 via this interface (TCP/IP, SNMP).

Interface to the sensors/actuators:
The PU provides 4 open ports for sensor units. The sensor units determine the function of the PU. There is a choice of 4 different sensor units (I/O, access, climate, FCS) with varying functions. In this way, the monitoring functions may be freely combined.

Fast, easy programming and installation:
The sensors/actuators are set up via an automatic electronic ID system. Installation is via a flexible plug & play system.
This eliminates the need for time-consuming programming and wiring.

Power supply:
Power is supplied centrally via a power pack in the PU. The connected sensor units and all connected sensors are supplied with power in this way. There is a choice of two input voltages (AC power pack 7320.425 and DC power pack 7320.435).

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Model No. DK	7320.100
W x H x D in mm	136 x 44 (1 U) x 129
Network interface	Ethernet to IEEE 802.3 via 10BaseT half-duplex 10 Mbit/s
Protocols	TCP/IP, SNMP V1.0, TELNET, FTP, HTTP

Rated voltage	24 V DC
Serial interfaces	RS 232
Ports for sensor units	4 jacks RJ 45, shielded
Bus system	Power I²C for extension unit voltage AC 7200.520
Alarm relay output	Change-over contact max. 24 V DC 1 A
Audio display	Piezo signal generator
Time function	Real-time clock
Temperature application range	+5°C to +45°C
Humidity application range	5 % to 95 % relative humidity, non-condensing
IP protection category	IP 40 to EN 60 529

1 Control key
The control key is used for sensor/actuator detection, set-up of the system and acknowledgement.

2 Alarm LED
The LED signals alarms or configuration changes.

3 Link/Traffic LED
The LED indicates the status of the 10BaseT network interface.

4 RS 232 interface RJ 10
For programming via a serial PC interface.

5 LEDs channels of the sensor units
The LEDs indicate the status of the attached sensor units.

6 Audio alarm
There is an audio alarm signalling device integrated into the PU.

7 Mounting attachment
For attachment with individual bracket 7320.450 or 1 U mounting units 7320.440.

8 Inputs for the RJ 45 sensor units
Up to 4 sensor units may be connected to the PU via the 4 inputs. The sensor units determine the function of the PU.
There is a choice of 4 sensor units:
– I/O unit 7320.210
– Access unit 7320.220
– Climate unit 7320.230
– FCS 7320.810
Connection cable 7320.470/.472/.481.
Other connections available on request:
RTT I/O unit see page 764
active PSM see page 775
RLCP see page 672.

9 Power I²C bus RJ 45
Up to 2 voltage extension units 7200.520 may be connected via the power I²C Bus.
Up to three AC voltages may be monitored with every extension unit.
Connection cable 7320.470/.472/.481.

10 Alarm relay RJ 12/ RS 232 RJ 12
The upper RJ 12 jack provides a change-over contact for the PU alarm relay.
Connection cable 7200.430.
The lower RJ 12 jack provides a serial interface (display unit/GSM module/ISDN unit).

11 Ethernet 10BaseT RJ 45
Integral Ethernet interface to IEEE 802.3 via 10BaseT half-duplex 10 MBit/s.

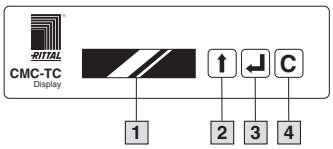
12 Voltage supply
The rated voltage for the PU is 24 V DC. There is a choice of power packs with varying primary voltages.
AC power pack 7320.425.

Also required:

For selection aid, see page 770.

CMC-TC display unit

For the local representation of CMC alarm and status messages on the rack.
The CMC-TC display unit is designed for connection to processing unit 7320.100. It comprises 2 lines each with 20 characters. The character height is 3 mm. The display is illuminated in order to ensure legibility even in poor light conditions. It is mounted in the 1 U component support 7320.440 or with the individual mounting unit 7320.450.
Power supply is via the processing unit.
The display is also ideal for use as a service tool for commissioning.

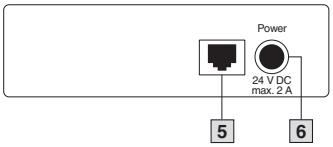


1 **LCD display** illuminates 2 x 20 characters

2 **“Change”** for selection

3 **“Enter”** to confirm

4 **“Clear”** to delete/acknowledge



5 **RJ 12 jack for connecting** to the serial interface of the PU

6 The GSM unit may optionally be supplied with **24 V DC,** 150 mA via this input. For applications with the PU, this is not necessary.

CMC-TC display unit	**Model No. DK**
Alarm text display	**7320.490**

Technical specifications:
- Plug & play installation via RJ 12 connector
- 2 x 20 characters
- Character height 3 mm
- Illuminated

Supply includes:
CMC-TC display module, connection cable for connection to the processing unit, operating instructions, assembly parts.

Note:
Only one tool, either “Display”, “ISDN Unit” or “GSM Unit”, may be connected to one PU.

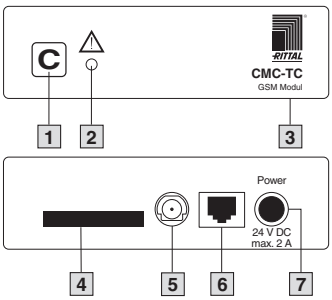
Also required:

Components	**Model No. DK**
Processing unit	7320.100

CMC-TC GSM unit

In order to configure a redundant transmission channel or if there is no LAN infrastructure available, the unit may be used for alarm forwarding. The alarm signal is designed in SMS format. The GSM unit is linked to the processing unit 7320.100 via a serial interface. The power supply is likewise achieved via the connection cable. The only other thing needed to operate the module is a SIM card. This may either be a “data only” card or a conventional SIM card.
The GSM unit operates in the 900/1800 MHz frequency range – in other words, either D or E network cards may be used. Up to four target call numbers may be set and allocated to the various events.
To activate CMC-TC switch outputs, an SMS message may be sent to the modem via any commercially available mobile phone, and actions executed via this route. The aerial included with the supply has a connection cable of 2.8 m. Voltage supply is achieved via the processing unit.

Other functions, where offered by the provider:
- Voice mail



1 **Alarm LED**

2 **GSM LED**

3 **Mounting fixture** for 7320.440 or 7320.450

4 **SIM card rack mount**

5 **Aerial system**

6 **RJ 12 jack for connecting** to the serial interface of the PU

7 The GSM unit may optionally be supplied with **24 V DC, 500 mA** via this input. For applications with the PU, this is not necessary.

GSM unit	**Model No. DK**
SMS function	**7320.820**

A commercially available SIM card for D or E networks must be provided by the customer.

Note:
Only one tool, either “GSM Unit”, “ISDN Unit” or “Display”, may be connected to one PU.

Also required:

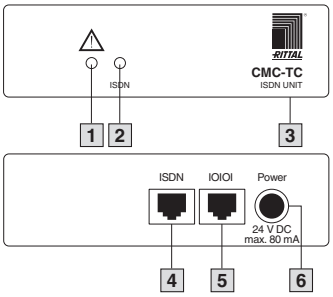
Components	**Model No. DK**
Processing unit	7320.100

Additional units

CMC-TC ISDN unit

In order to configure a redundant transmission channel or if there is no LAN infrastructure available, the unit may be used for alarm forwarding. The alarm signal is designed in SMS format. The ISDN unit is linked to the processing unit 7320.100 via a serial interface. The power supply is likewise achieved via the connection cable. An ISDN connection is required in order to operate the module (the requirements for an ISDN connection). Up to four target call numbers may be set and allocated to the various events.
This variant of alarm reporting may also be used in countries with “SMS in the fixed network”. Furthermore, with “SMS in the fixed network”, it is also possible to control switch outputs via an SMS.
Power supply is via the processing unit.

Other functions, where offered by the provider:
- Voice mail



1 **Alarm LED**

2 **Status ISDN-LED**

3 **Mounting fixture** for 7320.440 or 7320.450

4 **RJ 45 ISDN jack**

5 **RJ 12 jack for connecting** to the serial interface of the PU

6 The ISDN unit may optionally be supplied with **24 V DC, 80 mA** via this input. For applications with the PU, this is not necessary.

Components	Model No. DK
ISDN unit	**7320.830**

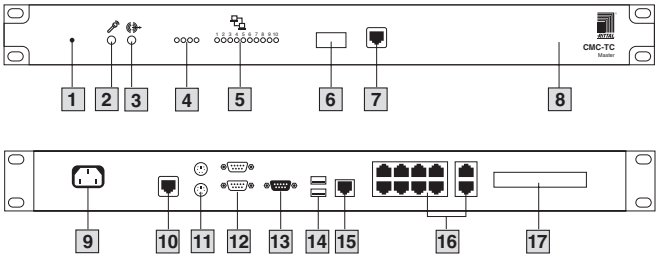
Requirements for the ISDN connection:
- DSS1 (Euro-ISDN) must also be provided when connecting to the ISDN system.
- Point-to-multi-point configuration.

Note:
Only one tool, either “ISDN Unit”, “GSM Unit” or “Display”, may be connected to one PU.

Also required:

Components	Model No. DK
Processing unit	7320.100

Master monitoring system



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no. 402 02 444

Benefits:
- Centralised administration
- Network connection 10/100BaseT
- Central web server for configuration
- Local administration via PS2/ VGA console
- Logging function for alarm messages
- Link for USB camera
- Free function selection for monitoring
- Ideal for large data centres
- **Web access via SSL 3.0 128-bit encryption**
- **Remote administration via SSH.**

The master system may be connected between the processing unit and the user network. There are ten 10BaseT network inputs available for the processing units (PU). The PUs transmit all monitoring-related data and messages to the master system via TCP/IP, SNMP. The master has a 10BaseT/100BaseT network interface for the user network.

All monitoring data is provided in a separate MIB via TCP/IP, SNMP. The system may optionally be configured remotely, via the integral web server, or directly, via a local console. Basic settings can also be implemented serially via RS 232 or Telnet. A Telnet routing function to the individual processing units is also pre-installed. This provides the user with a clear central monitoring facility.
For example, up to 160 temperature sensors may be accessed or up to 80 enclosure doors may be monitored and activated via one IP address.
Combined applications are also possible, and may be compiled individually from processing units and sensor units. Further functional scope for the CMC-TC master is available on request in the form of a software update. Images may be archived on the hard drive via an optional web camera. USB web camera available on request.

1 Key
Offset system reset key with contact hazard protection.

2 Input for microphone[1)]
3.5 mm jack socket.

3 Output for speaker[1)]
3.5 mm jack socket.

4 Status LEDs
LED 1 Alarm – Alarm system message.
LED 2 changeover 10/100 Mbit/s, network interface user network.
LED 3 Link/Activity, network interface user network.

5 LEDs
for the 10 network inputs of the processing units 7320.100.

6 IrDA[1)]
Infrared interface.

7 RJ 10
RS 232 interface for CMC-TC menu program.

8 Audio alarm
There is an audio alarm signalling device integrated into the master.

9 Voltage supply
The IEC jack supplies the system with power, connection cables 7200.210 to .215.

10 Alarm relays
RJ 12 socket with changeover contact.

11 Keyboard/mouse
PS2 jacks for keyboard and mouse.

12 RS 232
Two serial D-SUB 9 interfaces.

13 VGA interface HD15
Connection for monitor or Rittal SSC.

14 USB interfaces
Standard 1.1, for applications with Rittal camera.

15 Ethernet 10/100BaseT
RJ 45 jack network interface, user network Ethernet 10BaseT/100BaseT, IEEE 802.3 (10/100 Mbit/s), TCP/IP.

16 Ethernet 10BaseT (internal)
Ten RJ 45 jacks, network inputs for the processing units 7320.100
Ethernet 10BaseT, IEEE 802.3 (10/100 Mbit/s), TCP/IP.

17 PCMCIA[1)]
Two PCMCIA ports for applications with the Rittal modem.

[1)] These functions are prepared for specific customer application, on request.

Model No. DK	7320.000
W x D in mm	1 U x 200
Network interface	Ethernet to IEEE 802.3 via 10BaseT/100BaseT, 10/100 Mbit/s
Protocols	TCP/IP, SNMP V1.0, TELNET, SSH, TFTP, HTTPS

Rated voltage	100 – 240 Volt AC, 50/60 Hz
Ports for processing unit	10 jacks RJ 45, shielded, 10BaseT, TCP/IP, SNMP
Serial interfaces	RJ 10 jack RS 232 menu program, 2 D-SUB 9 jacks RS 232
USB	Standard 1.1 for Rittal web cameras
Infrared interface[1)]	IrDA 1.0 (SIR) on the front
PCMCIA[1)]	2 x type I/II or 1x type III for applications with Rittal modem
Relay output module	Change-over contact, max. load capacity 24 V DC, 1 A
Time function	Real-time clock
Temperature application range	+5°C to +40°C
Humidity application range	5 % to 95 % relative humidity, non-condensing
IP protection category	IP 40 to EN 60 529

! Also required:

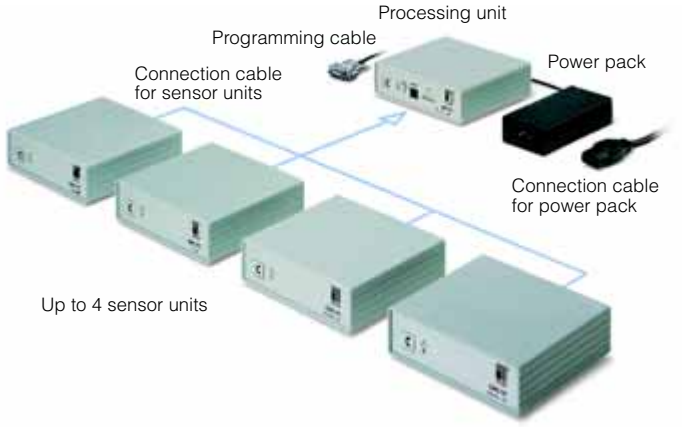
For selection aid, see page 770.

Camera available on request.

Connection tables

The basic system
The processing unit (PU) is the basis of any CMC-TC application. Connectivity is offered by the network interface (10BaseT, TCP/IP, SNMP) which connects directly into the user network or to the CMC-TC master. The following products are required for each CMC-TC application:

- Processing unit (7320.100)
- Power pack 100 – 240 V 50 – 60 Hz (7320.425) or power pack 48 V DC (7320.435)
- Connection cable for power pack, country-specific (7200.210 – .215)
- Connection cable, sensor unit (7320.470/.472/.481)
- At least one sensor unit (7320.210/.220/.230)
- Programming cable (7200.221)



Required accessories		Power pack 24 V DC	IEC connection cable	Programming cable	Connection cable Sensor unit	Mounting unit	Interference suppression capacitor
Model No. DK		**7320.425 7320.435**	**7200.210 7200.211 7200.213 7200.214 7200.215**	**7200.221**	**7320.470 7320.472 7320.481**	**7320.440 7320.450**	**7200.490**
Item selection		Page 771	Page 771	Page 771	Page 772	Page 771	Page 780
7320.000	Master		■	■			
7320.100	Processing unit	■	■ AC	■		□	
7320.210	I/O unit				■	□	
7320.220	Access unit				■	□	
7320.230	Climate unit		■		■	□	□
7320.600/.610	Voltage monitor with IEC jack		■				
7320.700	Electromagnetic Ergoform-S handle for FR, PS, TC and TE						
7320.730	Universal latch						
7320.750	Smart card reader						
7320.760	Magnetic card reader						
7320.770	Coded lock						
7200.630	CMC-TC socket strip						
7200.520	Voltage expansion unit		■ max. 3 x		■ max. 1 x		
2372.000	CMC-TC alarm signal lamp						

Required accessories		Adaptor for reader units	Connection cable RJ 10/12	Extension cable RJ 10/12	Locking bar PS/FR	Attachment for universal latch	Digital sensor input module
Model No. DK		**7200.344 7200.345 7200.346 7200.347**	**7200.420 7200.430**	**7200.440 7200.450 7320.814**	**7200.371 7200.372**	**7200.61X**	**7320.580**
Item selection		Page 782	Page 772	Page 772	Page 781	Page 783	Page 779
7320.000	Master						
7320.100	Processing unit						
7320.210	I/O unit			RJ 12 □[1)]			
7320.220	Access unit			RJ 12 □[1)]			
7320.230	Climate unit			RJ 12 □[1)]			
7320.600/.610	Voltage monitor with IEC jack						
7320.700	Electromagnetic Ergoform-S handle for FR, PS, TC and TE				■		
7320.730	Universal latch					□	
7320.750	Smart card reader	□					
7320.760	Magnetic card reader	□					
7320.770	Coded lock	□					
7200.630	CMC-TC socket strip		RJ 10 ■	RJ 10 □			■
7200.520	Voltage expansion unit						
2372.000	CMC-TC alarm signal lamp		RJ 12 ■	RJ 12 □			

□ = Optional accessories
■ = Required accessories
[1)] = In conjunction with CMC-TC accessories (sensors/actuators/handles/readers) type RJ 12

Connection cable/extension

The cable is used to connect to:
- CMC-TC master
- 24 V power pack for PU
- Active fan unit for TE
- Climate unit (connected fan)
- Voltage monitor
- Voltage expansion unit

Technical specifications:
PVC cable, 3-pole, with IEC connector (non-heating appliances) with contact protection CEE22.

Supply includes:
1 connection cable, length 2.5 m.

Country version	Voltage	Model No. DK
D/F/B	230	**7200.210**
GB	230	**7200.211**
CH	230	**7200.213**
USA/CDN	230/115	**7200.214**
IEC 320 extension	230/115	**7200.215**

Power pack for PU, FCS, FAS

A 24 V DC power pack is required to supply the processing unit with power. There are two variants available:
- The 100 – 240 V AC power pack requires an IEC connection cable to supply the voltage.
- An alternative power pack is designed for the telecommunications sector (48 V battery voltages) and is connected at the input end via a terminal block.

Both power packs include an output cable, 1.65 m long.

Technical specifications 7320.425:
Rated voltage: 100 – 240 V AC, 50/60 Hz
Rated current: max. 1.5 A
Secondary range: 24 V DC, 3 A

Technical specifications 7320.435:
Rated voltage: 20 – 72 V DC
Rated current: max. 2.5 A
Secondary range: 24 V DC, 1.3 A

Primary input voltage	Output voltage	Model No. DK
100 – 240 V AC/ 50/60 Hz	24 V DC	**7320.425**
48 V DC	24 V DC	**7320.435**

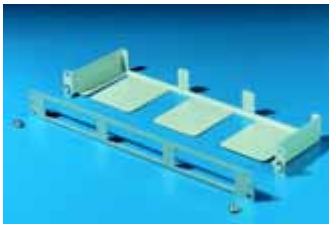
Also required:

Connection cable for DK 7320.425 power pack, see page 771.

Programming cable

The interface cable is used to configure the network parameters in the processing unit and the master unit.
The RJ 10 connector is connected to the front jack of the PU/master, whilst the 9-pole SUB-D connector is connected to a serial PC interface.

Packs of	Model No. DK
1	**7200.221**



Mounting unit 1 U

The mounting unit can accommodate up to 3 sensor units or processing units in the 482.6 mm (19″) attachment level. Cable clamp straps 7610.000 or 7611.000 can be used for cable clamping.

Material:
Sheet steel, spray-finished

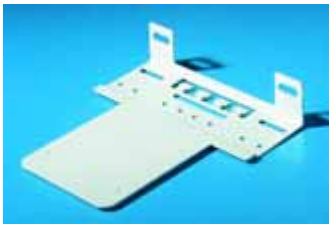
Colour:
RAL 7035

Packs of	Model No. DK
1	**7320.440**

Accessories:

Cable clamp strap, see page 985.

Cables/mounting accessories



Mounting module

The mounting module accommodates individual sensor units or processing units, for mounting on the frame section.

Material:
Sheet steel, spray-finished

Colour:
RAL 7035

Packs of	Model No. DK
1	**7320.450**

Connection cable RJ 45

This cable is for data exchange and power supply to a sensor unit via the processing unit. There is an RJ 45 connector at each end of the shielded cable.

Length m	Packs of	Model No. DK
0.5	4	**7320.470**
2.0	4	**7320.472**
10.0	1	**7320.481**

Connection cable RJ 10, RJ 12

With the RJ 12 connection cable, the alarm relay output of the processing unit may be used for individual alarm lights/indicators. The RJ 10 connection cable facilitates connection to the CMC socket strip in conjunction with the digital input module. The cable is equipped with an RJ 10/12 connector at one end. The other end is open.

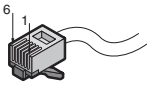
Connector	Length m	Packs of	Model No. DK
RJ 10	5	4	**7200.420**
RJ 12	5	4	**7200.430**

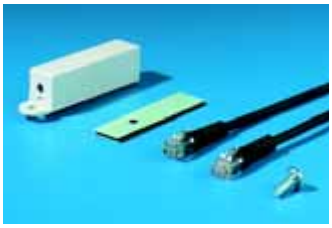
Extension cable RJ 10, RJ 12

The cable is used to extend the sensor supply cables (RJ 12) and individual actuator cables. The cable is equipped with an RJ 10/12 connector at one end. There is an RJ 10/12 jack at the other end.

Connector/jack	Length m	Packs of	Model No. DK
RJ 10	5	4	**7200.440**
RJ 12	5	4	**7200.450**
RJ 12	1	2	**7320.814**

Example: RJ 12





Temperature sensor

The sensor assumes the function of a temperature monitor and contains an ID so that it is automatically detected and set up by the CMC-TC system. It is connected to a sensor unit via the connection cable supplied loose. If required, extension cable RJ 12 may be used. The sensor can also control a fan on the climate unit or fan control system (FCS).

Packs of	Model No. DK
1	**7320.500**

To fit sensor unit:

I/O unit	Access unit	Climate unit	FCS
■		■	■

Technical specifications:
Type: NTC
Resistance: 10 kOhm at 25°C
Tolerance: ±2°C
Connection: RJ 12 jack, 6-pole
Connection cable: Length 2 m,
RJ 12 connector 6/6 on both sides
Temperature application range:
+5°C to +45°C

Smoke alarm

The smoke alarm is based on an opto-electronic smoke particle evaluation within a measurement chamber. The alarm contains an ID so that it is automatically detected and set up by the CMC-TC system. The power supply and alarm relay to the sensor unit occurs via the supplied connection cable. If required, extension cable RJ 12 may be used.

Packs of	Model No. DK
1	**7320.560**

To fit sensor unit:

I/O unit	Access unit	Climate unit
■		■

Technical specifications:
Alarm type: Combustion product alarm (smoke)
Sensor/transmitter: Silicon PIN photodiode/
GaAs infr. LED
Measurement frequency: Once every ten seconds
Power consumption: max. 61 mA
Connection: RJ 12 jack, 6-pole
Connection cable: Length 2 m,
RJ 12 connector 6/6 on both sides
Dimensions (alarm with base/plinth):
D = 100 mm, H = 50 mm
Temperature application range: +5°C to +45°C

Humidity sensor

The sensor measures relative air humidity and converts it into a frequency signal. It contains an ID so that it is automatically detected and set up by the CMC-TC system. Power supply and data evaluation is performed by the I/O sensor unit via the connection cable supplied loose. If required, extension cable RJ 12 may be used.

Packs of	Model No. DK
1	**7320.510**

To fit sensor unit:

I/O unit	Access unit	Climate unit
■		

Technical specifications:
Sensor: With humidity/frequency converter
(50 kHz at 76 % rel. humidity)
Sensor measurement range:
Relative humidity 10...90 % rel. humidity ± 3 %
(at 20°C)
Connection: RJ 12 jack, 6-pole
Connection cable: Length 2 m,
RJ 12 connector 6/6 on both sides
Temperature application range:
+5°C to +45°C

Internal security

Airflow monitor

The airflow monitor determines whether the fan is achieving its full operating capacity.
Storage damage, dirty filter mats or jammed fan blades are promptly detected and reported by the sensor. The sensor contains an ID so that it is automatically detected and set up by the CMC-TC system. Its switch point is adjustable. The power supply and data exchange to the sensor unit occurs via the attached connection cable. If required, extension cable RJ 12 may be used.

Technical specifications:
Connection: RJ 12 jack, 6-pole on the cable
Connection cable: Length 2 m
Temperature application range: +5°C to +45°C

Packs of	Model No. DK
1	7320.550

To fit sensor unit:

I/O unit	Access unit	Climate unit
■		■

Note:
The sensor can be operated with temperature-controlled fan via the climate unit sensor unit.

Accessories:

Connection cable RJ 12, see page 772.

Voltage monitor

The voltage monitor picks up a mains voltage to be monitored via the mains cable, and reports its status to a sensor unit:
Voltage ON or voltage OFF. The monitor contains an ID so that it is automatically detected and set up by the CMC-TC system. The connection cable, supplied loose, should be used for connection to the sensor unit. If required, extension cable RJ 12 may be used.

Packs of	Model No. DK
1	7320.600

To fit sensor unit:

I/O unit	Access unit	Climate unit
■		■

Technical specifications:
Monitored rated voltage:
230 V AC 50/60 Hz
Connections:
IEC connector, RJ 12 jack, 6-pole
Connection cable: Length 2 m,
RJ 12 connector 6/6 on both sides
Temperature application range:
+5°C to +45°C

Protection category:
IP 40

Also required:

For selection aid, see page 770.

Voltage monitor with IEC switch output

This sensor is used in conjunction with the CMC-TC to monitor voltage limits. The limits may be set via the WEB interface or SNMP. As an additional option, this voltage may also be switched on and off via the module, in order to reboot connected equipment via Ethernet.
It is connected via standard, commercially available IEC320 connectors as the input signal, and an IEC320 socket to connect the equipment.

Technical specifications:
- Plug & play installation via IEC320 connector
- The switching operation may be initiated in a time or event-based manner or via SNMP or WEB
- The maximum and minimum limits of voltage measurement are freely selectable
- Measurement range 100 – 250 V AC, 50/60 Hz
- Max. switching load 250 V AC and 8 A at cosphi = 1
- Tolerance: ±5 % at 20 – 30°C

Note:
The system has two functions. Each function occupies one input of the I/O unit.
1st function: Voltage measurement
2nd function: Relay switching

Packs of	Model No. DK
1	7320.610

To fit sensor unit:

I/O unit	Access unit	Climate unit
■		

Also required:

For selection aid, see page 770.

Optionally available:

IEC connection cable 7200.210,
German version,
IEC extension cable 7200.215
for connecting the equipment.

Voltage monitor 48 V DC

The voltage monitor picks off a mains voltage to be monitored via the 3-pole jack, and reports its status to a sensor unit: Voltage ON or voltage OFF. The monitor contains an ID so that it is automatically detected and set up by the CMC-TC system. The connection cable, supplied loose, should be used for connection to the sensor unit. If required, extension cable RJ 12 may be used.

Technical specifications:
Monitored rated voltage:
48 V DC (12 – 60 Volt DC/12 – 25 Volt AC 50/60 Hz)
Connections:
3-pole connector, RJ 12 jack, 6-pole
Connection cable: Length 2 m,
RJ 12 connector 6/6 on both sides
Temperature application range:
+5°C to +45°C

Protection category:
IP 40

Packs of	Model No. DK
1	**7320.620**

To fit sensor unit:

I/O unit	Access unit	Climate unit
■		■

Active Power System Module PSM

New active plug-in module for the busbar system PSM. The module has 4 x IEC320 C13 sockets and an integral overload tripping device.

The following active functions are additionally achieved:

- 2-digit local LED 7-segment current display on the module. Legibility is independent from the installation position.
- Measuring and monitoring of the current per module. Min./max. limits may be set. Measurement range 0 – 16 A.
- Alarm indication via a flashing 7-segment display.
- Monitoring of the overload fuse.
- Modules may be combined via the bus system, thereby enabling sequential activation.
- In conjunction with the CMC-TC, the modules may be activated and deactivated via HTTP and SNMP. The 4 jacks are always activated and deactivated together. A special software is required for operating processing unit 7320.100 together with the active PSM (see www.cmc-tc.com). The 4 free channels of PU can be switched with up to 4 active PSM systems in each case. The active PSM does not require any separate powerpack in conjunction with PU.
- Remote administration of the power supply, editing and monitoring of remote limits, SNMP trap message in case of alarm.
- 4 IEC320 C13 sockets per module.

Version	Packs of	Model No. DK
Entire active module with quadruple fuse to IEC320	1	**7856.200**

Material:
Aluminium chassis with plastic cover

Supply includes:
1 module (max. 10 A per module),
10 A integral overload tripping device,
1 bus cable,
1 infeed cable 24 V DC,
1 adaptor for powerpack 24 V DC.

Also required:

A separate powerpack (100 – 240 V AC/24 V DC) is required for stand-alone operation without CMC-TC (7201.210) and the relevant connection cables, see page 745.

Note:
For more information on the power rail system, see page 744.

Internal security

CMC-TC socket strip

With integral
- Interference suppressor filter
- Overvoltage protection
- Alarm contact

In the event of interference caused by overvoltage, the connected active network components are protected. With the relay message contact, undervoltage and any malfunctions caused by overvoltage can be reported via the CMC-TC in the network (SNMP trap). A green lamp on the strip indicates that the device is operational. The second protective device is the interference suppressor filter which protects valuable equipment as a passive component.

Packs of	Model No. DK
1	**7200.630**

To fit sensor unit:

I/O unit	Access unit	Climate unit
■		■

Technical specifications:
Number of sockets: 9
Length of strip: 650 mm
Rated voltage:
230 V AC, 50/60 Hz
Rated current: 16 A
Relay alarm output: RJ 10 jack
Relay load capacity: 50 Volt DC 100 mA

Technical specifications, overvoltage protection:
Arrester application category: D
Surge current resistance per conductor: 2.5 kA
Maximum surge strength: 8 kA

Also required:

A digital input module and an RJ10 connection cable is needed to link the CMC socket strip to the CMC-TC system.
For selection aid, see page 770.

CMC-TC extension unit

The CMC-TC extension unit picks off three independently monitored mains voltages via network cables and forwards the measurements to the processing unit. It is linked to the PU via the RJ 45 connection cable on the P-I²C port (sep. accessory). Up to two extension units may be connected serially to one PU. A separate power pack is not required. Alarm limits may be preset for all voltages.

Max. number per PU	Packs of	Model No. DK
2	1	**7200.520**

To fit processing unit, see page 766.

Technical specifications:
Voltage inputs:
3 x 100 – 230 V AC, IEC connector
Interface: I²C, P-I²C,
max. cable length 2 m
Temperature application range:
+5°C to +45°C
Tolerance: ± 5 % at 20 – 30°C

Protection category:
IP 40

Also required:

For selection aid, see page 770.

Accessories:

RJ 45 connection cable, see page 772.

Vandalism sensor

The sensor contains a position-insensitive alarm contact and an ID so that it is automatically detected and set up by the CMC-TC system.
It is connected to the I/O sensor unit via the connection cable supplied loose. If required, extension cable RJ 12 may be used.
The sensitivity of the sensor may be set using the PU software.

Packs of	Model No. DK
1	**7320.540**

To fit sensor unit:

I/O unit	Access unit	Climate unit
■		

Technical specifications:
Mercury-free contact, position-insensitive
Connection: RJ 12 jack, 6-pole
Connection cable: Length 2 m,
RJ 12 connector 6/6 on both sides

Access sensor

The access sensors monitor doors, side panels or windows in the enclosure. The magnet is secured to the moving part (e.g. side panel), whilst the reed contact is fastened to the immobile part (enclosure frame).
The permanent magnet holds the reed contact in a closed position. When the door is opened or the side panel removed, the reed contact drops off and opens the circuit. This triggers an alarm in the CMC-TC.
The sensor contains an ID so that it is automatically detected and set up by the CMC-TC system. It is connected to a sensor unit via the connection cable supplied loose. Up to five access sensors may be connected in series to one monitoring line, if necessary in conjunction with extension cable RJ 12. The jumper plug forms the end.

Packs of	Model No. DK
2	**7320.530**

To fit sensor unit:

I/O unit	Access unit	Climate unit
■	■	■

Technical specifications:
2 magnets
(mounted on the moving part, directly adjacent)
2 sensors with reed contact
(mounting on the enclosure frame)
Connection 1: RJ 12 jack, 6-pole
(connection to the sensor unit)
Connection 2: RJ 12 socket, 6-pole (series connection with other access sensors, or finished with the jumper plug)
2 jumper plugs RJ 12 at the end
2 connection cables: Length 2 m,
RJ 12 connector 6/6 on both sides

External security

CMC-TC motion detector

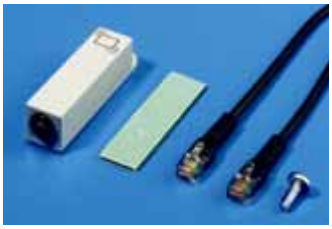
The motion detector may be used in enclosures or in rooms. Any modifications to the enclosure, such as opening a door or side panel, are indicated. The motion detector can also detect persons in the room or in front of the data cabinet.
The alarm contains an ID so that it is automatically detected and set up by the CMC-TC system. The power supply and data exchange to the sensor unit occurs via the connection cable, supplied loose. If required, extension cable RJ 12 may be used.

Packs of	Model No. DK
1	**7320.570**

To fit sensor unit:

I/O unit	Access unit	Climate unit
■		■

Technical specifications:
Alarm type: Infrared (IR) detector
Range: max. 7 m
Power consumption: max. 30 mA/24 V DC
Connection: RJ 12 jack, 6-pole
Connection cable: Length 2 m,
RJ 12 connector 6/6 on both sides
Dimensions:
W x H x D: 59 x 102 x 32 mm



Leakage sensor

The leakage sensor is equipped with an optical sensor head. If this sensor head becomes wet with moisture, it reports a leakage alarm. The sensor head may be mounted facing the floor. If water collects there and comes into contact with the sensor head, the alarm is triggered. The sensor contains an ID so that it is automatically detected and set up by the CMC-TC system. The connection cable, supplied loose, should be used for connection to the sensor unit. If required, extension cable RJ 12 may be used.

Packs of	Model No. DK
1	**7320.630**

To fit sensor unit:

I/O unit	Access unit	Climate unit
■		

Technical specifications:
Monitoring: Visual
Connection: RJ 12 jack, 6-pole
Connection cable: Length 2 m,
RJ 12 connector 6/6 on both sides
Temperature application range: +5°C to +45°C

Protection category:
IP 40

Analog sensor input module

The input module facilitates the connection of individual external analog sensors (4 – 20 mA) to the I/O sensor unit. As an adaptor, it performs the function of identification, so that an external sensor is automatically identified and set up by the CMC-TC system.
Sensors with 4 – 20 mA signal output and 24 V DC operating voltage (max. 50 mA) may be connected. The CMC-TC makes its internal power source available.
It is connected to a sensor unit via the connection cable supplied loose. If required, extension cable RJ 12 may be used.

Packs of	Model No. DK
1	**7320.520**

To fit sensor unit:

I/O unit	Access unit	Climate unit
■		

Technical specifications:
Analog input: 4 – 20 mA at 24 V DC
Maximum current output of the module: 50 mA
Sensors without GND may also be used.
Connection: RJ 12 jack, 6-pole
Connection cable: Length 2 m,
RJ 12 connector 6/6 on both sides
Sensor connection:
Pull-off clamping strip, 3-pole

Digital sensor input module

The input module facilitates the connection of individual external digital sensors to a sensor unit. As an adaptor, it performs the function of identification, so that an external sensor is automatically identified and set up by the CMC-TC system.
External sensors or detectors must have a floating contact (normally-closed or normally-open), because the module makes its internal voltage source available.
It is connected to a sensor unit via the connection cable supplied loose. If required, extension cable RJ 12 may be used.
In conjunction with the access unit, any given door release system (e.g. transponder) with a floating relay contact may be connected via the input module.

Packs of	Model No. DK
1	**7320.580**

To fit sensor unit:

I/O unit	Access unit	Climate unit
■	■	■

Technical specifications:
Floating external sensor contact:
Voltage min. 24 V DC load capacity
Current: min. 10 mA load capacity
Connection: RJ 12 jack, 6-pole
Connection cable: Length 2 m,
RJ 12 connector 6/6 on both sides
Sensor connection:
Pull-off clamping strip, 3-pole

Relay output module

The output module allows individual, external extra-low voltage actuators to be switched via a change-over contact. As an intermediate relay, it performs the function of identification and isolation, so that an actuator is automatically identified and set up by the CMC-TC system.
It is connected to the I/O sensor unit via the connection cable supplied loose. If required, extension cable RJ 12 may be used. At the output end, the module contains a pull-off terminal strip for assignment with actuator cables. Power supply to the actuator must be provided externally.
The output relay may be switched remotely via SNMP or HTTP. Alternatively, alarm links can also be created with alarm inputs.

Packs of	Model No. DK
1	**7320.590**

To fit sensor unit:

I/O unit	Access unit	Climate unit
■		

Technical specifications:
Condition of the actuator: cosPhi = 1
Max. load of the switch contact:
1 A, 30 V DC and 0.5 A, 48 V AC
Max. switching voltage: 48 V AC; 48 V DC
Max. switched current: 1 A
Max. switching load: 30 W, 62.5 VA
Min. switched current: 1 mA at 5 V DC
Connection: RJ 12 jack, 6-pole
Connection cable: Length 2 m,
RJ 12 connector 6/6 on both sides
Sensor connection:
Pull-off clamping strip, 3-pole

Individual security

Room door output module

The room door output module allows external door opener systems to be switched via a change-over contact. As an intermediate relay, it performs the function of identification and isolation, so that a door opener is automatically identified and set up by the CMC-TC system.
It is connected to the access unit via the connection cable supplied loose. If required, extension cable RJ 12 may be used. At the output end, the module contains a pull-off terminal strip for assignment with actuator cables. Power supply to the door opener must be provided externally.

Packs of	Model No. DK
1	**7320.740**

To fit sensor unit:

I/O unit	Access unit	Climate unit
	■	

Technical specifications:
Condition of the actuator: cosPhi = 1
Max. load of the switch contact:
1 A, 30 V DC and 0.5 A, 48 V AC
Max. switching voltage: 48 V AC; 48 V DC
Max. switched current: 1 A
Max. switching load: 30 W; 62.5 VA
Min. switched current: 1 mA at 5 V DC
Connection: RJ 12 jack, 6-pole
Connection cable: Length 2 m,
RJ 12 connector 6/6 on both sides
Sensor connection:
Pull-off clamping strip, 3-pole

Note:
One access sensor 7320.530 is always needed for each output module.

CMC-TC alarm signal lamp

The alarm signal lamp serves as a collective fault signal for all alarms in the CMC-TC.
Example: Temperature exceeded, fan defect, smoke alarm etc. The CMC-TC provides a user-friendly menu allowing the operator to select which message will affect the CMC-TC alarm relay.
The alarm signal lamp is activated via the alarm relay.
The lamp may be attached to the network enclosure or any other desired position, e.g. in the corridor.
The RJ 12 connection cable is required for connection to the PU.

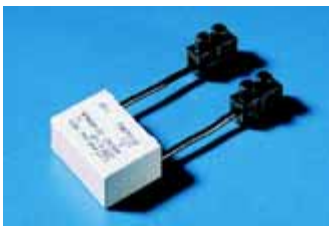
Item	Model No. SZ
LED steady light component 24 V DC, red	**2372.000**
Connection component	**2368.010**

To fit processing unit, see page 766.

Technical specifications:
Rated operating voltage: 24 V DC
Rated current: 60 mA

Also required:

For selection aid, see page 770.



Interference suppression capacitors

for fans

The capacitors are used for the interference suppression of fans with self-starting shaded pole motors. One capacitor should be connected directly parallel to the mains voltage for each fan unit. The capacitors are equipped with a terminal, which means that they are easily fitted to the fan cable.

Version	Packs of	Model No. DK
100 nF	20	**7200.490**

Technical specifications:
Dielectric strength: 275 V AC
Capacity: 100 nF
Type: X2

Comfort handle for TS 8 unit with master key function

The handle assumes the function of a door lock and lever handle monitoring.
The TS 8 handle 7320.721 includes the master key function. This means that the handle can always be opened with the master key, independently of the control system. A semi-cylinder is supplied loose, but a semi-cylinder 40 or 45 mm overall length to DIN 18 254 may also be used.
An access sensor (DK 7320.530) must be connected to the corresponding door for each handle.
If the lever handle is closed, the locking mechanism integrated into the handle latches automatically. The handle may be released via the CMC-TC system in the network or via optional add-on systems, such as smartcard readers etc. The handle is locked in a de-energised manner (without electrical connection). The push-button may be depressed following electrical release and then opens the lever automatically. The opening process must be completed within 15 seconds. Opening via the key is always superordinate, i.e. the enclosure may always be opened with the key in the case of electrical locking and in the event of a power failure (emergency opening).

Handle system	**Model No. DK**
TS 8 comfort handle master key	**7320.721**

To fit sensor unit:

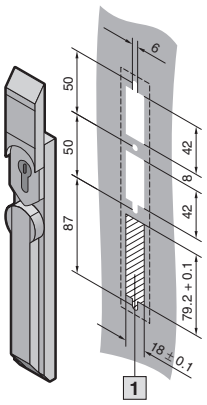
I/O unit	Access unit	Climate unit
	■	

Technical specifications:
Rated voltage: 24 V DC
Rated current: max. 100 mA
Connection cable: Length 3 m, RJ 12 connector
Connection cable:
Length 2 m, RJ 12/RJ 12 connector
Coupling for extension:
RJ 12/RJ 12 jack
Temperature application range:
+5°C to +40°C

Protection category:
IP 40

Also required:

For selection aid, see page 770.



Handle systems with electromagnetic lock

The lock unit consists of a Rittal handle system whose handle is electromagnetically locked. It contains an identifier so that it is automatically detected and set up by the CMC-TC system. The power supply and data exchange to the access unit occurs via the attached connection cable. An access sensor (DK 7320.530) is always required for door monitoring. With the door closed and the clip-down handle locked home, latching is activated by switching on the lock magnet. The CMC-TC enables the handle to be pulled out by deactivating the lock magnet, thereby allowing the door to be opened. This deactivation can be initiated via an access unit such as a smartcard reader, magnetic card reader, coded lock and/or network management systems. The handle system likewise contains handle monitoring. The CMC-TC reports an alarm if the handle is not swung in and locked home after closing the door.
The push-button insert supplied can also be exchanged for **lock inserts.**

Note:
When using the Ergoform-S handle, an additional hole is required.

1 Additional hole for electronic lock (PS/FR/QR/VR/TC/TE)

Handle system	**Model No. DK**
Ergoform-S handle for FR, PS, TC, VR, TE	**7320.700**
Ergoform-S handle for QR	**7320.710**

To fit sensor unit:

I/O unit	Access unit	Climate unit
	■	

Note:
For PS and FR glazed doors, the locking bars listed below are required:

Locking bars

Version	**Model No. DK**
Lower door locking bar for 2000 mm high PS enclosures	**7200.371**
Lower door locking bar for 2000 mm high FR enclosures	**7200.372**
Lower door locking bar for TE enclosures	**on request**

Other sizes available on request.

Technical specifications:
Rated voltage: 24 V DC
Rated current: max. 100 mA
Connection cable: Length 3 m, RJ 12 connector
Connection cable:
Length 2 m, RJ 12/RJ 12 connector
Coupling for extension:
RJ 12/RJ 12 jack
Temperature application range:
+5°C to +40°C

Protection category:
IP 40

Also required:

For selection aid, see page 770.

Smartcard reader/ magnetic card reader/ coded lock

The door handle is released to authorised persons who have identified themselves with a smartcard/magnetic card/combination code. Smartcard readers/magnetic readers/coded locks are installed above the enclosure handle and can also function as a central unit for releasing several doors.
The entire access procedure can also be registered with the CMC-TC where there is network connection.

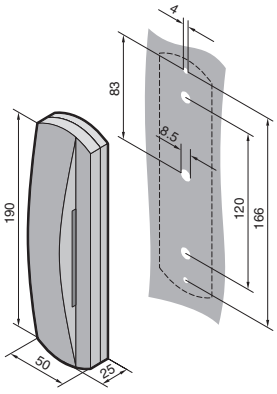
Technical specifications:
Rated voltage: 24 V DC
Rated current: max. 20 mA
Interface: I^2C bus
Smartcard type: I^2C chip
Magnetic card type:
Magnetic strip card with data on track 2.
The read system is designed for cards with both a high and a low level of magnetism.

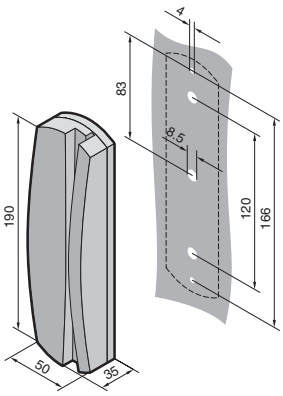
Read system	Model No. DK
Smart card reader	**7320.750**
Magnetic card reader	**7320.760**
Coded lock	**7320.770**

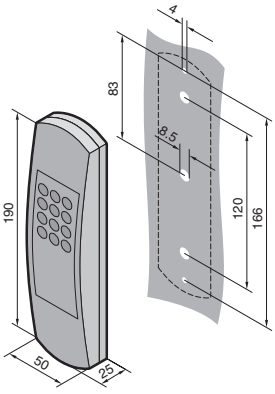
To fit sensor unit:

I/O unit	Access unit	Climate unit
	■	

Note:
Smartcard readers/magnetic card readers/coded locks may only be used in conjunction with the CMC-TC and an electric lock. 3 cards are supplied with the smartcard reader/magnetic card reader. Each card contains a four-digit code, which is different on all three cards. All cards are access-authorised. The code may be input directly on the coded lock.
Authorised codes may be set in the CMC-TC via WEB. The input code is transmitted to the CMC-TC and, where applicable, to the network management system, via the I^2C bus. A mounting adaptor for a TS aluminium glazed door is supplied loose with every reader.







More lock systems

can be found under system accessories from page 881 on.

Adaptor for reader units

The adaptors are used to install the reader units. They are screw-fastened between the design section of the door frame and the reader unit. No adaptor is required for shallow mounting levels. For TS aluminium glazed doors, an adaptor is supplied loose with every reader unit. One adaptor is required for each reader unit.

Glazed door enclosure type	Packs of	Model No. DK
VR	10	**7200.344**
PC	10	**7200.345**
PS	10	**7200.346**
TS design	10	**7200.347**

Type PC: For PC glazed doors
Type VR: For VR glazed doors and VR sheet steel doors
Type PS: For PS aluminium glazed door

Access door panels

for FR(i)

The access door panels contain an electromagnetic lock with a security lock. They may be exchanged for the existing trim panel of the FR(i) door. The door panel is easily linked to the CMC-TC monitoring system, allowing the FR(i) door to be remotely opened and monitored via the network. If a door trim panel variant with read system is selected, door release may also be implemented via the CMC-TC using the respective medium (smartcard, magnetic card or numerical code pad).
The standard door panels of FR(i) doors are easily exchanged for access door panels.

Jacks are provided for connection to the CMC-TC. This ensures plug & play exchange. The system may be connected to access unit 7320.220.
To operate the system, an access sensor (DK 7320.530) is additionally required. For the door panels with card reader systems, 3 cards are included with the supply.

Technical specifications:
Rated voltage: 24 V DC
Interface: I^2C
Smartcard type: I^2C chip
Magnetic card type:
Magnetic strip card with data on track 2.
The read system is designed for cards with both a high and a low level of magnetism.

Access door panels to exchange for standard trim panels in FR(i) doors

Access door panels	Enclosure height mm	Electromagnetic lock system	Read system	**Model No. DK**
FR(i)	2000	■	–	**7320.900**
FR(i)	2000	■	Smart card reader	**7320.910**
FR(i)	2000	■	Magnetic card reader	**7320.920**
FR(i)	2000	■	Coded lock	**7320.930**

■ Comfort handle TS 8 with master key function 7320.721 (see page 781) for the CMC-TC monitoring system is installed. All other height variants (FR(i) enclosure height 600, 1200, 1800 and 2200 mm) are available on request.

To fit sensor unit:

I/O unit	Access unit	Climate unit
	■	

Universal lock unit

The security lock consists of a base unit and a lock counterpart. The base unit is attached to the enclosure frame. The lock counterpart is attached to the door.
A mechanical setting allows you to choose between two states: at zero current when open, or at zero current when closed.
In order to identify the operating mode used, one of the two identifier modules (supplied loose) should be used, so that it is automatically identified and set up by the CMC-TC system. Power supply and data exchange is via the access unit, using the identifier modules and connection cables supplied loose. If required, extension cable RJ 12 may be used.
An access sensor (DK 7320.530) is always required for door monitoring.

Technical specifications:
Rated voltage: 24 V DC
Rated current: 140 mA
Temperature application range:
+10°C to +40°C

Supply includes:
1 base unit with connection cable 0.1 m, RJ 12 connector
1 lock counterpart
2 identifier modules with RJ 12 jack, 6-pole (connection to access unit),
RJ 12 jack, 6-pole (connection to universal lock),
1 connection cable for identifier modules,
2 m, RJ 12/RJ 12 connector without mounting kit.

Packs of	**Model No. DK**
1 set	**7320.730**

To fit sensor unit:

I/O unit	Access unit	Climate unit
	■	

Installation kit	**Model No. DK**
PS steel door	**7200.611**
PS aluminium glazed door	**7200.612**
FR sheet steel door[1)]	**7200.613**
FR glazed door[1)]	**7200.614**
TS steel door	**7200.615**
TS glazed door	**7200.616**
VR enclosure	**7200.617**

[1)] Attachment in 600 mm wide FR enclosures is only possible with recessed mounting of the 482.6 mm (19″) or metric attachment levels.

Note:
Attachment kits for the various different enclosure types and enclosure doors can be taken from the table.

Also required:

For selection aid, see page 770.

Note!
The handle only fits into the cut-out shown in the drawing. For other hole patterns, additional adaptors are needed, and/or machining of the door. Solutions provided on request.

Handle system for universal installation

with electromagnetic lock for the CMC-TC monitoring system

The universal handle is equipped with a pitch pattern of mounting holes which will fit many existing door systems. This handle is ideal for retrofitting to projects with varying enclosure types and variants.
The new handle may be connected to the CMC-TC system via plug & play.
Additionally, an access sensor (DK 7320.530) must always be used to enable polling of the door status. The handle is equipped with a connection cable and an RJ 12 connector, which may be plugged into the access unit 7320.220 of the CMC-TC system. The handle is equipped with a push-button insert which may be depressed when the electromagnetic lock is released.

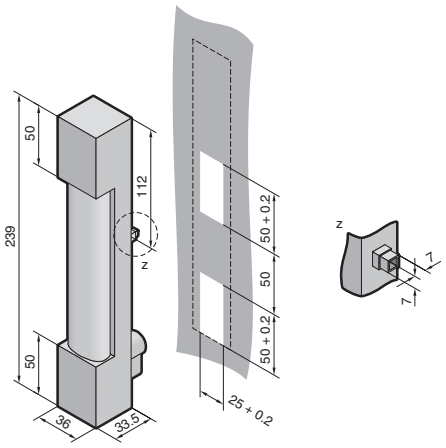
Technical specifications:
Rated voltage: 24 V DC
Rated current: max. 100 mA
Connection cable: Length 5 m, RJ 12 connector

	Type	Model No. DK
electro-magnetic handle	CMC-TC	**7320.950**

Extended delivery times.

To fit sensor unit:

I/O unit	Access unit	Climate unit
	■	



TS 8 transponder handle

with integral transponder release system from Simons & Voss

The electromagnetic TS 8 transponder handle may be retrofitted in the doors of TS 8 enclosures. The handle is equipped with an integral radio transponder. The transponder receiver with battery is integrated into the handle housing. Apart from the transponder transmitter, no additional accessories, such as additional electronics, cables, power pack etc., are required. The handle is easily exchanged without the need for wiring.
If battery servicing is required, this is indicated acoustically.
The handle is supplied in the zero state, so that it may be opened with any transponder transmitter.

Use with hand-held transmitter:
The transponder transmitter is actuated from the handle, as a result of which the latter is unlatched for a specified time window and may be opened by pressing the push-button.

Use with the CMC-TC transmitter:
The transponder transmitter is linked to the CMC-TC system via the room door output 7320.740 and the access unit. The transmitter is placed in the enclosure frame, near the handle. In this way, the door may be released via the CMC-TC system. Additionally, an access sensor (DK 7320.530) should always be used to enable polling of the door status.

Use of the programmable transponder:
The programmable transponder allows the individual transponder transmitters to be allocated to individual handles. Matrix programming is supported.

	Type	Model No. DK
Electromagnetic handle	Transponder, stand-alone application	**7320.960**
Transponder transmitter	Hand-held transmitter	**7320.961**
Transponder transmitter	CMC-TC transmitter	**7320.962**
Programmable transponder	programming	**7320.963**

Extended delivery times.

Benefits:
- No cables on the handle, because the electronics and battery are integrated into the handle.
- Several users may be set for one handle.
- Plug & play installation both mechanical and electrical.
- Individual control of the transponders and the set-up of each transponder is possible for up to 3 locking systems.
- With additional overlay to automatically block the old transponder in the event of reprogramming.
- Counterfeit-proof data communication is achieved via radio using crypto-codes.
- The “challenge response procedure” ensures protection against surveillance.
- The standard interface means that connections to other access and monitoring systems are not a problem.

The lock and organisation sytem is graded in the highest category with respect to unlocking protection to BSI 7500.

Systems with extra electronics and access control from Simons & Voss available on request.

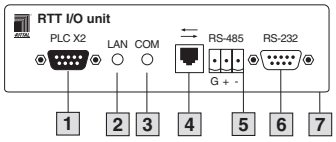
Monitoring of climate control units

Benefits:

- All data for the climate control units via the WEB browser.
- Setpoints may be set via WEB, SNMP, Telnet, RS232.
- Automatic alarm messages in the network via SNMP.
- SMS text messages via GSM (optional).

The “Monitoring of climate control units” set provides all the modules required for monitoring Rittal TopTherm cooling units with comfort control. Temperatures, messages, alarms etc. may be displayed directly on the Web interface in the intranet or Internet. Trap alarms are sent automatically to incorporate SNMP network management systems. SMS text messages are optionally possible via the Rittal GSM module.

Extensions/configuration:
The processing unit PU has 4 channels for 4 interface cards climate control unit RTT I/O unit. An RTT-I/O unit is supplied with the set. Three RTT-I/O may optionally be added. Each RTT-I/O unit is capable of monitoring one master TopTherm cooling unit, each with 9 slave climate control units. The set allows you to monitor up to 10 cooling units, and with extensions up to a maximum of 40 cooling units.
The I/O unit and climate unit may also be connected instead of the interface card. This facilitates additional monitoring of smoke, humidity, air flow etc.



1 **PLC X2** Optocoupler alarm Outputs for SPS

2 **LAN LED** Internal communication

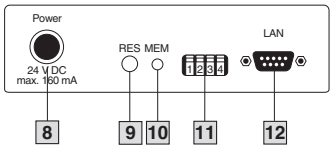
3 **COM LED** Status of serial interfaces

4 **RJ 45** for connecting to processing unit 7320.100

5 **RS-485** Interface

6 **RS-232** For set-up with a serial PC interface (e.g. Hyperterm)

7 **Mounting fixture** for 7320.440 or 7320.450



8 The ISDN unit may optionally be supplied with 24 V DC, 160 mA via this input. For applications with the PU, this is not necessary.

9 **RES** Reset key

10 **MEM** Eeprom fault

11 **Changeover switch** Serial interface

12 **LAN** Connection to the master cooling unit with comfort control

Monitoring of climate control unit	**Model No. DK**
Set	**7320.120**

Accessories:

Description	**Model No. DK**	Page
Programming cable Programming cable for setting up the PU	7200.221	771
CMC-TC 1 U mounting unit	7320.440	771
Interface card RTT-I/O unit (maximum of 3 additioanl cards)	3124.200	662
Connection cable GB 230 V AC	7200.211	771
Connection cable CH 230 V AC	7200.213	771
Connection cable USA/CDN 230/115 V AC	7200.214	771
IEC 320 extension 230 115 V AC	7200.215	771
GSM unit for SMS alarm message for TopTherm cooling units with comfort control	7320.820	767

Functions/settings:

- Setpoint temperature for enclosure
- Alarm temperature value for enclosure
- Warning temperature value for enclosure
- Filter mat monitoring

Warnings/alarms:

- Internal temperature too high
- Icing
- High-pressure sensor
- Leakage
- Condenser/fan defect
- Evaporator coil/fan defect
- Compressor defect
- Sensor failure, internal temperature
- Sensor failure, internal temperature
- Sensor failure, icing sensor
- Sensor failure, condensate level
- Sensor failure, internal temperature
- Phase missing or incorrect
- EEPROM defect

Supply includes:
Processing unit PU with firmware/software for applications with climate control units,
interface card, climate control unit RTT-I/O unit (SK 3124.200)
power pack 24 V DC, input 100 – 240 V AC (DK 7320.425),
connection cable D with IEC320 connector (DK 7200.210),
Cat5 connection cable, 2 m,
for connecting the RTT-I/O unit to the processing unit PU,
data cable RS232, 2 m, for connecting the RTT-I/O unit to the RTT climate control unit with comfort control.

Speed monitored/controlled fan system

Benefits:
- Excellent air throughput at a high operating ratio.
- Monitoring of fan speed.
- Plug and play compatibility system.
- Easily installed in Rittal fan roofs.
- Long service life.
- Noise minimisation/speed control.
- Alarm message via the CMC-TC in the network optionally possible.
- Open supply system 24/48 V DC/100 – 230 V AC.
- EMC compatibility via DC fan systems.

Equipment

Properties	Model No. FCS DK 7320.810	Model No. FAS DK 7320.811
Fan speed monitoring	■	■
Pre-selectable speed	■	
Non-temperature dependent speed	■	
Speed increase in the event of a fan failure	■	
Collective fault signal	■	■
Floating change-over contact	■	■
LAN connection via PU	■	
LAN via I/O unit + PU		■
Configurable via LAN	■	
Alarm output	Beeper, LED, relay, RJ 45 output for PU	Beeper, LED, relay, RJ 12 output for I/O unit

FCS example:
Control system with fan regulation and monitoring

Description	Required packs of	Model No. DK
Fan Control System FCS	1	7320.810
CMC-TC power pack 24 V, input 100 – 230 V AC	1	7320.425
CMC-TC temperature sensor	1	7320.500
Fan 24 V DC (packs of 2) with speed monitoring	3	7320.812
RJ 12 extension for DC fans, 1 m (packs of 2)	3	7320.814
CMC connection cable D 230 V AC	1	7200.210

FAS example:
Control system with fan monitoring

Description	Required packs of	Model No. DK
Fan Alarm System FAS	1	7320.811
CMC-TC power pack 24 V, input 100 – 230 V AC	1	7320.425
Fan 24 V DC (packs of 2) with speed monitoring	3	7320.812
RJ 12 extension for DC fans, 1 m (packs of 2)	3	7320.814
CMC connection cable D 230 V AC	1	7200.210

Fan Control System FCS

Speed-monitored fan system

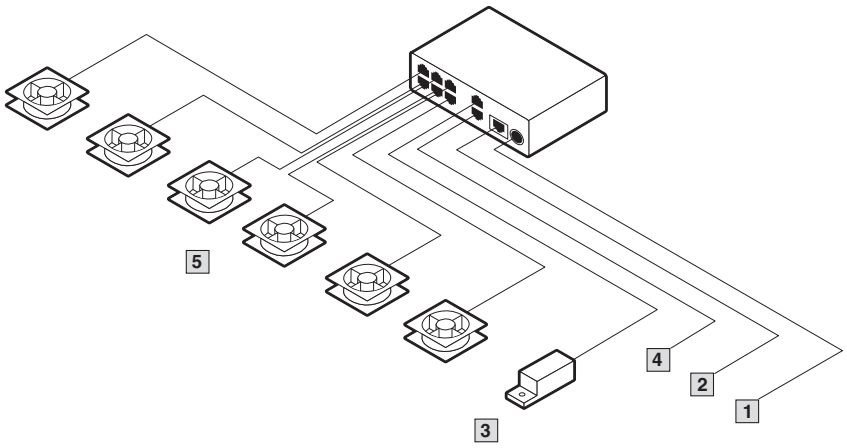
The Fan Control System regulates and controls the speed of up to 6 fans 7320.812, 24 V DC. This helps to save energy and reduce the noise level of the fans, as well as extending the service life of the fans. The failure of one or more fans is detected and notified in the form of a collective fault signal via LED display, beeper and integral alarm relay (floating change-over contact). Control is temperature-based using an external temperature sensor 7320.500. The temperature setpoint is set via a switch on the front. The system may also optionally be set and monitored via the network (Web/SNMP). It is connected directly to the CMC-TC (processing unit) 7320.100.

FCS	To fit processing unit	Model No. DK
Without fan	■	**7320.810**

Functions:
- Speed-regulated speed control.
- Fan speed monitoring.
- Optional connection via Web/SNMP.
- Redundant fan control; the air throughput of all fans is automatically increased in the event of a system failure.
- Plug & play installation via RJ 12 connector system.
- 482.6 mm (19″) mounting is possible via 7320.440.

Note:
Supplied pre-configured on request:
The FCS system may be fitted in all Rittal fan roofs.

FCS fitted in fan roof,
see page 650.



1 **Supply with 24 V/48 V DC** via
- Supply connection cable direct 7320.813
- CMC 24 V power pack 100 – 230 V AC (input) 7320.425
- CMC 24 V power pack 48 V DC (input) 7320.435
  For operation with 48 V DC, fans with 48 V DC must be used.

2 **RJ 45 jack** for connecting to the processing unit 7320.100 (optional) (Cat5 cable)

3 **CMC-TC temperature sensor** 7320.500

4 **Alarm relay output**
24/48 V DC, 1 A (floating change-over contact)

5 **Fan with speed monitoring**
7320.812 (24V DC). 48 V DC fans may optionally be used.

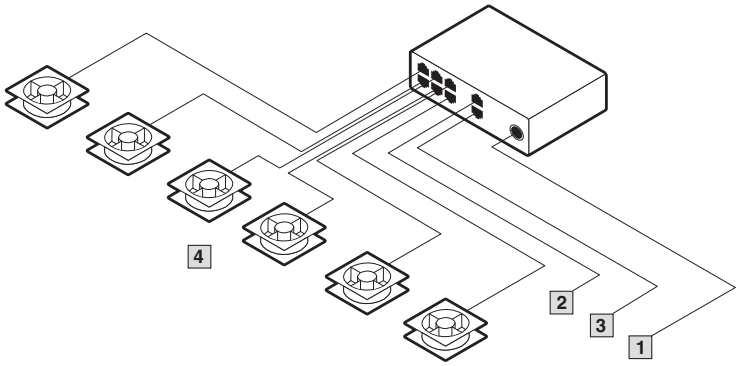
Fan Alarm System FAS

Speed-controlled fan system

The Fan Alarm System monitors the speed of up to 6 fans 7320.812, 24 V DC. The failure of one or more fans is detected and notified in the form of a collective fault signal via LED display, beeper and integral alarm relay (floating change-over contact). The system is designed as a plug & play system. The system may also be optionally monitored via the network (Web/SNMP). It is connected directly to the CMC-TC (the I/O unit) 7320.210.

Functions:

- Fan speed monitoring.
- Optional connection via Web/SNMP.
- Plug & play installation via RJ 12 connector system.
- 482.6 mm (19″) mounting is possible via 7320.440.



FAS	Model No. DK
Without fan	7320.811

To fit sensor unit:

I/O unit	Access unit	Climate unit
■		

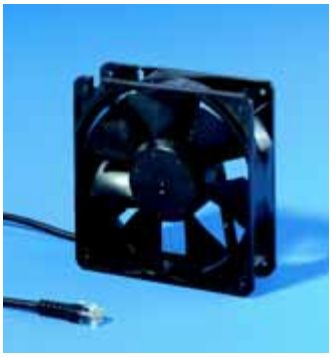
Note:
Supplied pre-configured on request:
The FAS system may be supplied fitted in all Rittal fan roofs.

1 **Supply with 24 V/48 V DC** via
- Supply connection cable direct 7320.813
- CMC 24 V power pack 100 – 230 V AC (input) 7320.425
- CMC 24 V power pack 48 V DC (input) 7320.435
  For operation with 48 V DC, fans with 48 V DC must be used.

2 **RJ 12 jack** for connecting to the I/O unit 7320.210 (optional)

3 **Alarm relay output** 48 V DC, 1 A (floating change-over contact)

4 **Fan with speed monitoring** 7320.812 (24 V DC). 48 V DC fans may optionally be used.



Fan 24 V DC

with speed monitoring

Fan with integral speed monitoring with RJ 12 connector/connection cable 0.6 m for connecting to FCS 7320.810 and FAS 7320.811.

Technical specifications:
Rated voltage: 24 V DC
Rated current: 0.28 A (max.)
Rated output: 6.72 W (max.)
Air throughput (unimpeded air flow): 165 m^3/h
Speed: 2650 rpm
Noise level: 41 dB (A)

Packs of	Model No. DK
2	7320.812

Note:
Fan variant with 48 V DC available on request.

RJ 12 extension

for 24 V DC fan, 1 m

The DC fans DK 7320.812 are equipped with a 0.6 m connection cable. If this length is not sufficient to connect to the FCS or FAS, the cable may be extended by 1 m using the RJ 12 coupling included in the set.

Technical specifications:
Coupling: RJ 12 jacks 6/6 at both ends
Connection cable: Length 1 m,
RJ 12 connector 6/6 on both sides
Temperature application range: +5°C to +45°C

Fan extension	Packs of	Model No. DK
1 m	2	7320.814

Supply connection cable

for FCS/FAS

If the customer has access to 24 V or 48 V DC, the FCS/FAS systems may be supplied with power (max. 48 V DC) via the supply connection cable. No power packs are then required for the application.
Length: 2 m

Packs of	Model No. DK
1	7320.813

Software

Network management systems

By using SNMP network management systems (NMS) such as HP Open View or Novell Manage Wise, it is possible to incorporate and address the CMC-TC system via SNMP. The required MIB is included with the supply.
The MIB is easily incorporated by simply copying. Standard MIB-II (RFC 1213) is also supported. It is included with the supply of the NMS. The private MIB contains all the required system variables, and is easily linked to the functions of the software HP Open View, Novell Manage Wise etc.

Note:
The MIB is also available from the Internet at
www.rittal.com, www.cmc-tc.com
as a download, and is included with the supply of every CMC-TC system.

Management system Aprisma Spectrum Enterprise Manager

The graphical user interface for the Spectrum Enterprise Manager covers every conceivable requirement. The MIB variables are arranged on the interface in a user-friendly configuration. This professional software package combines the highlights of the CMC-TC monitoring system with the Aprisma product.
The management module for Rittal CMC-TC, developed by DICOS, facilitates the integration of all information sent out by the CMC-TC agent into the Spectrum management platform. It also supports configuration of the threshold values being monitored. The SpectroServer receives all the information from the CMC-TC and provides users with an opportunity to visualise, control and configure Rittal racks direclty via the central Spectrum console. Integration into the enterprise management system supports central processing of alarms, so that these may be forwarded, e.g. via a voice mail system, or used as the basis for the automatic generation of a trouble ticket.

Note:
Further information can be found on the Internet at:
www.dicos.de
or by sending an order by e-mail to
sales@dicos.de

CMC-TC configurator

The CMC-TC configurator automatically compiles all the modules and accessories required for a CMC project. The user simply enters the monitoring requirements and the ambient conditions. The result is a list containing all the item numbers required for the project. In this way a project can be compiled quickly and effectively. This software requires MS Excel, Version 97 or above.

Note:
The CMC-TC configurator is available on the Internet at
www.rittal.com, www.cmc-tc.com
and may be downloaded free of charge.

CMC-TC Manager

The new CMC-TC Manager allows all Rittal SNMP agents to be managed in a single software package.

- CMC II (7200.100)
- PCU Web sockets (7200.000)
- CMC-TC processing unit (7320.100)

The graphical interface reproduces information from the system and offers the opportunity of configuring systems via SNMP.
Only the Java Runtime Environment JRE 1.3 (or higher version) must be installed on the relevant PC system. Java may be downloaded from the Internet at **www.sun.com**.
The various products (PCU, CMC II, CMC-TC) may be sorted on the basis of type or location. All important alarm messages enter the built-in trap receiver, and can be recorded with the logging function. The alarm messages can be forwarded directly using the e-mail function. The search function is used to distinguish and automatically list the SNMP agents.

Benefits:

- Open to operating systems via Java (Windows/ Linux).
- Graphical information and operator interface for:
  – CMC II
  – Web socket strip PCU
  – CMC-TC/processing unit
- Full integration of the management information base (MIB) of Rittal systems.
- Trap receiver with logging function.
- E-mails sent in the event of trap alarm messages.
- User-oriented system listing according to locations.

Note:
The software is available free of charge from the Internet.
www.rittal.com, www.cmc-tc.com

Plug-in for HP Open View

Thanks to its integration into HP Open View NNM, StableNet™ CMC-TC is centrally and permanently available. The management functions of HP Open View have been extended to optimum effect: NNM monitors the traps occurring in CMC-TCs and forwards them to StableNet™ CMC-TC. The MIB of processing unit 7320.100 of the CMC-TC system has been incorporated.

Functions:

- Integral trap manager
- Various alarm functions, e.g. e-mail, SMS etc.
- Integral MIB browser (cf. illustration)
- Graphical display of the monitored values with diagrams and tables
- Individual representation and organisation of the monitoring tools
- Pre-configured graphical interface for the CMC-TC
- Microsoft® Outlook® “look and feel”
- Non-platform-dependent (JAVA).

Other products from the StableNet™ suite with the option of integrating the StableNet™ CMC-TC manager:

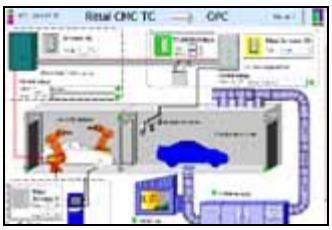
StableNet™ ARC
Advanced Router Configuration

- Management of all network components and CMC-TCs from within HP Open View NNM
- Efficient management of routers and switches

StableNet™ PME
Performance Management Engine

- Evaluation of the data obtained with StableNet™ CMC-TCs by means of comprehensive reporting functions
- Diverse opportunities for measuring network performance

Note:
Further information can be found on the Internet at:
www.infosim.net
or by sending an e-mail enquiry to
info@infosim.net



SNMP-OPC Server

The OPC Server allows all variables in the CMC-TC (MIB) to be integrated into control desk interfaces. Be it industrial automation technology or building automation, with OEL Process Control (OPC) “OEL: Object linking and Embedding” you get the ideal interface between your control desk software and the CMC-TC system.
Software available on request.
www.cmc-tc.com

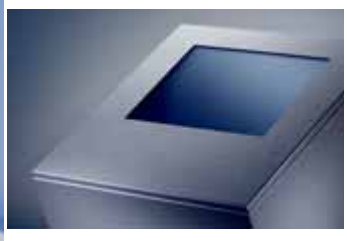
Note:
Further information can be found on the Internet at:
www.obermeier-software.de
or by sending an e-mail enquiry to
info@obermeier-software

Kiosks

Information and service anytime, anywhere

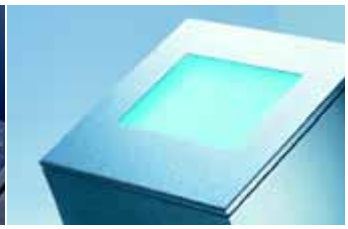
New markets, new application areas, new opportunities! Kiosks are on hand 24 – 7 to provide up-to-the-minute information, attract interest, and receive requests, messages, reservations and orders. Sports, arts, entertainment, administration, transport, industry, trade and hotels – suitable applications are everywhere! Located directly at the point where they are needed, offering a high standard of quality and elegant design, kiosks represent valuable “partners” for information and business.

Arc-Line II



User-friendly TFT touchscreen display or . . .

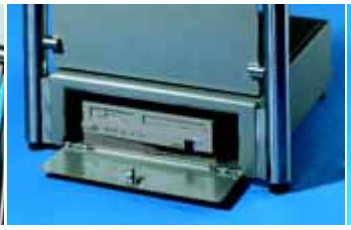
. . . perfectly integrated into a keyboard recess.



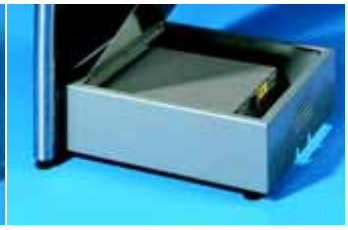
Which design do you prefer? Spray-finished sheet steel or stainless steel?

Opti-Line II

Keyboard: A new design in a smart aluminium cover.



Small door, optimise operation of the built-in PC-technology.



Large lid, easy to service and readily customised.

Opti-Desk

Various keyboard variants may be integrated, e.g. in stainless steel.

Design line A:
The worktop and base plate are harmoniously curved inwards.

Design line B:
The worktop and base plate are curved outwards, adding a dynamic touch.

Information and service anytime, anywhere

Opti-Wall

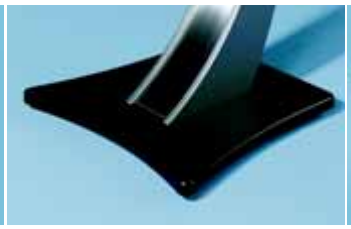
The optional electronic height adjustment also makes it easy for children and wheelchair users to access the multimedia world.

The speakers are protected by integration into the kiosk.

Compact, low-noise PC technology: The connections are easily accessible.

Alpha-Line

Powerful: The kiosk PC-systems Silent and Pro.
The door makes servicing work easy.



For stability coupled with striking elegance.

Simplicity to inspire you: Alpha-Line keyboard.

Out-Line Wall

The transparent trim panel and rain canopy ensure optimum operation.

Optionally integrated speakers are situated on the lower side, without affecting the protection category.

High-quality materials such as aluminium and stainless steel facilitate semi-outdoor use.

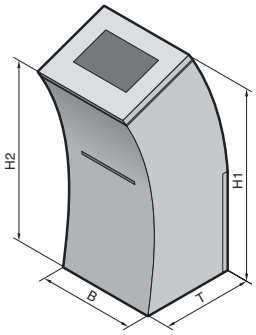
Out-Line Pro

The base/plinth is attached to the ground for stability.

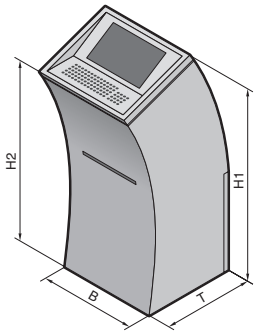
Protection against vandalism also extends to the robust stainless steel keyboard with trackball.

A high protection category of IP 55 is achieved, thanks to a sealing frame and lock system.

Arc-Line II



Touch



Keyboard

B = Width
T = Depth

Modern communications and technology with a new look. The Arc-Line now with TFT technology and with significantly more space for the installation of additional hardware. Thanks to the modified dimensions, the familiar kiosk standard keyboards may be installed in the lid.

Components with 482.6 m (19″) mounting dimensions may be integrated in the interior. All Arc-Line Classic models now have a protection category of IP 55. Additional installation of a sound system is possible, subject to compliance with the protection category.

Material:
Basic:
Sheet steel, spray-finished
Classic:
Stainless steel, brushed

Colour:
Basic:
RAL 9007

Protection category:
Classic:
IP 55

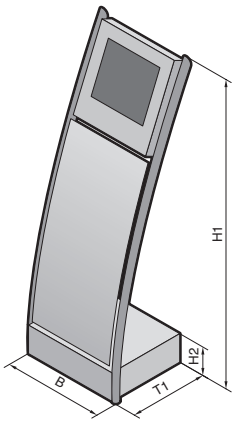
Specifications and the online configurator
can be found on the Internet at
www.terminals-by-rittal.de
or
www.kiosks-uk.com

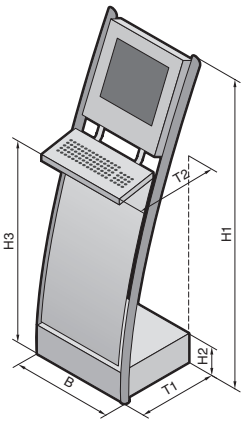
Arc-Line II		Basic				Classic				Page
		Rear door		Front Door		Rear door		Front Door		
TFT display		17″	17″	17″	17″	17″	17″	17″	17″	
Contact sensor (touchscreen) including controller		■	–	■	–	■	–	■	–	
Keyboard recess for the insertion of ITS keyboards		–	■	–	■	–	■	–	■	
Basic electrical equipment with cabling and power pack for display and sound system (100 – 260 V, 50/60 Hz)		■	■	■	■	■	■	■	■	
Concealed paper slot		■	■	■	■	–	–	–	–	
Door		Hinged, rear		Hinged, front		Hinged, rear		Hinged, front		
Material		Sheet steel		Sheet steel		Stainless steel		Stainless steel		
Surface finish		Spray-finished in RAL 9007 (finely-textured)		Spray-finished in RAL 9007 (finely-textured)		Brushed		Brushed		
Dimen. of terminal enclosure approximately (B x H1 x T mm)		550 x 1180 x 700		550 x 1180 x 700		550 x 1180 x 700		550 x 1180 x 700		
H2 approx. mm		940		940		940		940		
Model No. ITS		**9012.100**	**9012.110**	**9012.200**	**9012.210**	**9012.300**	**9012.310**	**9012.400**	**9012.410**	
Accessories										
Active sound system including 2 speakers, fitted		9010.540	9010.540	9010.540	9010.540	9010.540	9010.540	9010.540	9010.540	–
Long-stroke keyboard with trackball, RAL 9005	German[1]	–	9004.300	–	9004.300	–	–	–	–	800
	US English[1]	–	9004.310	–	9004.310	–	–	–	–	800
Adaptor plate for internal mounting of the long-stroke keyboard, stainless steel		–	9003.160	–	9003.160	–	–	–	–	800
Service keyboard with trackball for touch systems	German	9004.500	–	9004.500	–	9004.500	–	9004.500	–	801
	US English	9004.502	–	9004.502	–	9004.502	–	9004.502	–	801
Membrane keyboard with mouse pad, IP 65	German[1]	–	9010.910	–	9010.910	–	9010.910	–	9010.910	801
	US English[1]	–	9010.912	–	9010.912	–	9010.912	–	9010.912	801
Stainless steel keyboard with trackball, IP 65	German[1]	–	9004.220	–	9004.220	–	9004.220	–	9004.220	800
	US English[1]	–	9004.222	–	9004.222	–	9004.222	–	9004.222	800
Component shelf for mounting on the 482.6 mm (19″) level		7144.035	7144.035	7144.035	7144.035	7144.035	7144.035	7144.035	7144.035	944
Mounting kit for component shelves		7063.858	7063.858	7063.858	7063.858	7063.858	7063.858	7063.858	7063.858	949
Telescopic slide		7061.000	7061.000	7061.000	7061.000	7061.000	7061.000	7061.000	7061.000	951
Slide rail		7963.410	7963.410	7963.410	7963.410	7963.410	7963.410	7963.410	7963.410	1011
Castors for Arc-Line II		7495.000	7495.000	7495.000	7495.000	7495.000	7495.000	7495.000	7495.000	848
ITS PC system “Silent”		9010.110	9010.110	9010.110	9010.110	9010.110	9010.110	9010.110	9010.110	799
ITS PC system “Pro II”		9010.125	9010.125	9010.125	9010.125	9010.125	9010.125	9010.125	9010.125	799
ITS PC system “Basic”		9003.070	9003.070	9003.070	9003.070	9003.070	9003.070	9003.070	9003.070	799
PC operating operating system[2] MS Windows XP Home	German[1]	9030.100	9030.100	9030.100	9030.100	9030.100	9030.100	9030.100	9030.100	–
	English[1]	9030.102	9030.102	9030.102	9030.102	9030.102	9030.102	9030.102	9030.102	–

[1] Other language variants available on request.
[2] Operating system OEM version may only be ordered in conjunction with a PC system; other operating systems available on request.
Other accessories: Thermo-printers, DSL/ISDN modems and card readers, coin checkers etc. available on request.

Accessories Page 832 **Keyboards** Page 800

Opti-Line II





B = Width
T = Depth

The Opti-Line II creates fresh visions with a tactile appeal. Stainless steel and aluminium, simplicity and elegance, function and aesthetics – these are all timeless attributes for successful communication. This is stylish packaging at its most attractive. A keyboard support with new lines, more modularity and a consistent design. A successful innovation from the legendary Opti-Line generation.

This is a modular system that meets all requirements, combining a flexible range of choices for keyboard variants and PC systems, depending on the intended application.

Material:
Display enclosure:
Sheet steel/plastic, grey aluminium (RAL 9007), spray-finished, smooth
Pedestal tubes:
Stainless steel V2A, brushed
PC case:
Sheet steel, grey aluminium (RAL 9007), spray-finished
Keyboard support:
Aluminium.

Property rights:
US design patent no. 478,582
German registered design no. 400 02 325

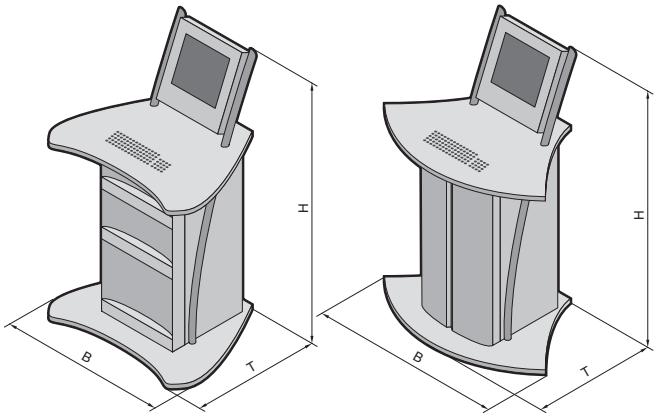
Specifications and the online configurator
can be found on the Internet at
www.terminals-by-rittal.de
or
www.kiosks-uk.com

Opti-Line II		Touchscreen		Prepared for keyboard		Page
TFT display		15″	17″	15″	17″	
Basic electrical equipment with cabling and power pack for display and sound system (100 – 260 V, 50/60 Hz)		■	■	■	■	
Dimensions of terminal enclosure approximately (B x H1 x T1 mm)		560 x 1500 x 510	560 x 1500 x 510	560 x 1500 x 580	560 x 1500 x 580	
H2 approx. mm		140	140	140	140	
H3 approx. mm		965	965	965	965	
T2 approx. mm		580	580	580	580	
Model No. ITS		**9006.505**	**9006.705**	**9006.605**	**9006.805**	
Accessories						
Active sound system including 2 speakers, fitted		9010.510	9010.510	9010.510	9010.510	–
Long-stroke keyboard with trackball, RAL 9005	German[1]	–	–	9004.300	9004.300	800
	US English[1]	–	–	9004.310	9004.310	800
Adaptor plate for internal mounting of the long-stroke keyboard, stainless steel		–	–	9003.160	9003.160	800
Service keyboard with trackball for touch systems	German	9004.500	9004.500	–	–	801
	US English	9004.502	9004.502	–	–	801
Stainless steel keyboard with trackball, IP 65	German[1]	–	–	9004.220	9004.220	800
	US English[1]	–	–	9004.222	9004.222	800
Membrane keyboard with mouse pad, IP 65	German[1]	–	–	9010.910	9010.910	801
	US English[1]	–	–	9010.912	9010.912	801
ITS PC system “Silent”		9010.110	9010.110	9010.110	9010.110	799
ITS PC system “Pro II”		9010.125	9010.125	9010.125	9010.125	799
ITS PC system “Basic”		9003.070	9003.070	9003.070	9003.070	799
PC operating system[2] MS Windows XP Home	German[1]	9030.100	9030.100	9030.100	9030.100	–
	English[1]	9030.102	9030.102	9030.102	9030.102	–
WLAN upgrade kit IEEE 802.11 type 1 (USB)		9011.100	9011.100	9011.100	9011.100	–
Base plate for Opti-Line II		9006.150	9006.150	9006.150	9006.150	–

[1] Other language variants available on request.
[2] Operating system OEM version may only be ordered in conjunction with a PC system; other operating systems available on request.
Other accessories: ISDN/DSL modems and card readers, coin checkers, webcams etc. available on request.

Accessories Page 832 **Keyboards** Page 800

Opti-Desk



B = Width
T = Depth

The Opti-Desk is designed as a stylish free-standing PC workstation for the office environment and for use in the administrative sector.
The generous worktop offers plenty of work space, and its successful design blends harmoniously into any environment where effective advice, information and presentations are needed.

The PC hardware is housed in the lockable lower cupboard, where other equipment such as printers, scanners etc. may also be integrated on additional built-in component shelves. Several workstations may be bayed or sited in groups via optional worktops.

Material:
Display enclosure:
Sheet steel, spray-finished
Stainless steel
Worktop: MDF

Colour:
Body: RAL 9006
Display enclosure: RAL 9007
Worktop/base plate: RAL 9007
Design elements: RAL 9007

Property rights:
German registered design no. 403 02 344

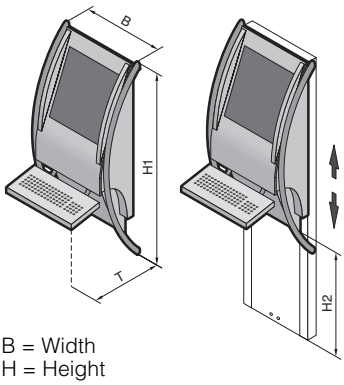
Specifications and the online configurator
can be found on the Internet at **www.terminals-by-rittal.de** or **www.kiosks-uk.com**

Opti-Desk		Worktop curved inwards		Worktop curved outwards		Page
TFT display		15″	17″	15″	17″	
Basic electrical equipment with cabling and power pack for display (100 – 260 V, 50/60 Hz)		■	■	■	■	
Component shelf mounted in the bottom cupboard		■	■	■	■	
Base plate with slides		■	■	■	■	
Dimensions approximately (W x H x D mm)		1000 x 1500 x 800	1000 x 1500 x 800	1000 x 1500 x 800	1000 x 1500 x 800	
Dimensions of bottom cupboard with front door only approximately (W x H x D mm)		435 x 1000 x 530	435 x 1000 x 530	435 x 1000 x 530	435 x 1000 x 530	
Model No. ITS		**9021.250**	**9021.270**	**9021.255**	**9021.275**	
Accessories						
Active sound system including 2 speakers, fitted		9010.510	9010.510	9010.510	9010.510	–
Long-stroke keyboard with trackball, RAL 9005	German[1]	9004.300	9004.300	9004.300	9004.300	800
	US English[1]	9004.310	9004.310	9004.310	9004.310	800
Adaptor plate for long-stroke keyboard with trackball, stainless steel		9003.160	9003.160	9003.160	9003.160	800
Stainless steel keyboard with trackball, IP 65/IP 54	German[1]	9004.220	9004.220	9004.220	9004.220	800
	US English[1]	9004.222	9004.222	9004.222	9004.222	800
Membrane keyboard with mouse pad, IP 65	German[1]	9010.910	9010.910	9010.910	9010.910	801
	US English[1]	9010.912	9010.912	9010.912	9010.912	801
Component shelf for lower cupboard		9021.600	9021.600	9021.600	9021.600	–
Set of castors (2 with locks) to exchange for levelling feet		9021.650	9021.650	9021.650	9021.650	–
ITS PC system “Silent”		9010.110	9010.110	9010.110	9010.110	799
ITS PC system “Pro II”		9010.125	9010.125	9010.125	9010.125	799
ITS PC system “Basic”		9003.070	9003.070	9003.070	9003.070	799
PC operating system[2] MS Windows XP Home	German[1]	9030.100	9030.100	9030.100	9030.100	–
	English[1]	9030.102	9030.102	9030.102	9030.102	–
WLAN upgrade kit IEEE 802.11 type 1 (USB)		9011.100	9011.100	9011.100	9011.100	–

[1] Other language variants available on request.
[2] Operating system OEM version may only be ordered in conjunction with a PC system; other operating systems available on request.
Further accessories such as DSL/ISDN modem, card reader and coin checker, webcam etc. available on request.

Accessories Page 832 **Keyboards** Page 800

Opti-Wall



B = Width
H = Height

This new compact kiosk for wall mounting was developed on the basis of the successful Opti-Line design. This wall-mounted kiosk system, designed for representative indoor applications, is sure to impress, not only with its refined design, but with the benefits of internal space utilisation. Despite the minimal dimensions of this kiosk, there are a range of different configuration variants available. You decide which TFT, PC or keyboard you require for your specific application.
There is a choice of two PC systems, specifically tailored to the intended application in terminal systems. In order to make it easier for children and wheelchair users to use a multimedia kiosk, the accessories for the Opti-Wall include an electric height adjuster which may be adjusted to the user's requirements via controls.

Material:
Sheet steel, spray-finished
Stainless steel

Colour:
RAL 9007 (display enclosure)
RAL 9006 (basic enclosure)

Property rights:
German registered design no. 403 02 344

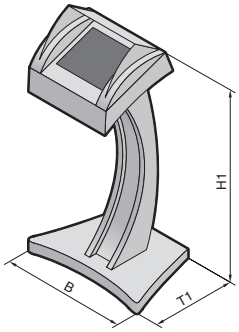
Specifications and the online configurator
can be found on the Internet at **www.terminals-by-rittal.de** or **www.kiosks-uk.com**

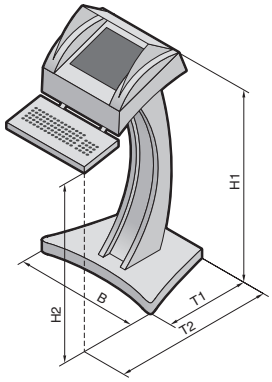
Opti-Wall		Touchscreen		Prepared for keyboard		Page
TFT display		15″	17″	15″	17″	
Basic electrical equipment with cabling and power pack for display (100 – 260 V, 50/60 Hz)		■	■	■	■	
Dimensions of terminal enclosure approximately (B x H1 x T mm)		560 x 1000 x 200	560 x 1000 x 200	560 x 1000 x 400	560 x 1000 x 400	
Model No. ITS		**9020.150**	**9020.170**	**9020.250**	**9020.270**	
Accessories						
Active sound system including 2 speakers, fitted		9010.510	9010.510	9010.510	9010.510	–
Long-stroke keyboard with trackball, RAL 9005	German[1)]	–	–	9004.300	9004.300	800
	US English[1)]	–	–	9004.310	9004.310	800
Adaptor plate for long-stroke keyboard, stainless steel (required for the installation of 9004.300/.310)		–	–	9003.160	9003.160	800
Service keyboard with trackball for touch systems	German	9004.500	9004.500	–	–	801
	US English	9004.502	9004.502	–	–	801
Stainless steel keyboard with trackball, IP 65/IP 54	German[1)]	–	–	9004.220	9004.220	800
	US English[1)]	–	–	9004.222	9004.222	800
Membrane keyboard with mouse pad, IP 65	German[1)]	–	–	9010.910	9010.910	801
	US English[1)]	–	–	9010.912	9010.912	801
Electric height adjuster for Opti-Wall kiosk, H2 400 mm		9020.500	9020.500	9020.500	9020.500	–
ITS PC system "Silent"		9010.110	9010.110	9010.110	9010.110	799
ITS PC system "Pro II"		9010.125	9010.125	9010.125	9010.125	799
PC operating system[2)] MS Windows XP Home	German[1)]	9030.100	9030.100	9030.100	9030.100	–
	English[1)]	9030.102	9030.102	9030.102	9030.102	–
WLAN upgrade kit IEEE 802.11 type 1 (USB)		9011.100	9011.100	9011.100	9011.100	–

[1)] Other language variants available on request.
[2)] Operating system OEM version may only be ordered in conjunction with a PC system; other operating systems available on request.
Further accessories such as DSL/ISDN modem, webcam etc. available on request.

Accessories Page 832 **Keyboards** Page 800

Alpha-Line





B = Width
T = Depth

The kiosk for tomorrow's world. Here, communication becomes an experience. Two ambitious objectives are united in a single kiosk: The traditional and the mundane have given way to lightness and design. Rounded shapes add rhythm and style, ensuring a powerful impact from any perspective. Eye-catching and out-of-the-ordinary. Simply unusual.

Suitable for the installation of compact and powerful PC systems (Silent and Pro) as well as your choice of keyboard. Navigate your way into the future with a touchscreen or keyboard.

Material:
Monitor housing:
Sheet steel, grey aluminium (RAL 9007), spray-finished
Pedestal:
MDF, grey aluminium (RAL 9007), spray-finished, with stainless steel trim
Base plate:
MDF, spray-finished black (RAL 9005)

Keyboard support:
Aluminium
Design-elements:
Spray-finished black (RAL 9005)

Property rights:
German registered design no. 402 06 035
Japanese registered design no. 1181196
Brazilian registered design no. DI6202609
Chinese registered design no. ZL 02338459
GB registered design no. 3006546
IR registered design no. DM/062 638
US design patent no. US D480,731

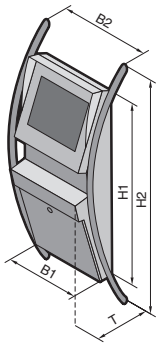
Specifications and the online configurator
can be found on the Internet at
www.terminals-by-rittal.de
or
www. kiosks-uk.com

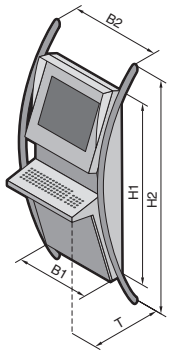
Alpha-Line		Touchscreen	Prepared for keyboard	Page
TFT display		15″	15″	
Basic electrical equipment with cabling and power pack for display and sound system (100 – 260 V, 50/60 Hz)		■	■	
Dimensions including base plate and viewing guard approximately (B x H1 x T1 mm)		580 x 1300 x 540	580 x 1300 x 640	
H2 approx. mm		1010	1010	
T2 approx. mm		620	620	
Model No. ITS		**9007.105**	**9007.205**	
Accessories				
Active sound system including 2 speakers, fitted		9010.510	9010.510	–
Long-stroke keyboard with trackball, RAL 9005	German[1]	–	9004.300	800
	US English[1]	–	9004.310	800
Adaptor plate for long-stroke keyboard with trackball, stainless steel		–	9003.160	800
Service keyboard with trackball for touch systems	German	9004.500	–	801
	US English	9004.502	–	801
Stainless steel keyboard with trackball, IP 65/IP 54	German[1]	–	9004.220	800
	US English[1]	–	9004.222	800
Membrane keyboard with mouse pad, IP 65	German[1]	–	9010.910	801
	US English[1]	–	9010.912	801
ITS PC system "Silent"		9010.110	9010.110	799
ITS PC system "Pro II"		9010.125	9010.125	799
PC operating system[2] MS Windows XP Home	German[1]	9030.100	9030.100	–
	English[1]	9030.102	9030.102	–

[1] Other language variants available on request.
[2] Operating system OEM version may only be ordered in conjunction with a PC system; other operating systems available on request.

Accessories Page 832 **Keyboards** Page 800

Out-Line Wall





B = Width
T = Depth

The new Out-Line Wall is a further development of the Opti-Wall kiosk for the semi-outdoor sector (+5 to +40°C). Despite the minimal dimensions of this kiosk, there are a range of different configuration variants available.

Options include, an outdoor-compatible sound system with protection category IP 55. Climate control kits, consisting of a heater and fan-and-filter units, are also available. In addition to the accessories listed here, other variants are also possible, together with various colour variants as customer-specific complete systems.

Colour:
RAL 9007

Various spray-finishes, including anti-grafitti spray finish, available on request.

Protection category:
IP 55

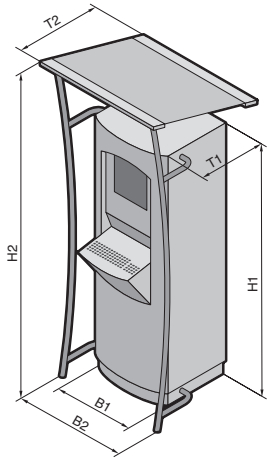
Specifications and the online configurator
can be found on the Internet at
www.terminals-by-rittal.de
or
www.kiosks-uk.com

Out-Line Wall with protection category IP 55		Touchscreen		Prepared for keyboard		Page
TFT display (high brightness for outdoor applications)		15″	17″	15″	17″	
Basic electrical equipment with cabling and power pack for display and sound system (100 – 260 V, 50/60 Hz)		■	■	■	■	
Wall bracket		■	■	■	■	
Dimensions of enclosure body approximately (B1 x H1 x T mm)		480 x 1100 x 305	480 x 1100 x 305	480 x 1100 x 365	480 x 1100 x 365	
Enclosure dimensions including all projecting parts approximately (B2 x H2 x T mm)		600 x 1360 x 305	600 x 1360 x 305	600 x 1360 x 365	600 x 1360 x 365	
Model No. ITS		**9023.150**	**9023.170**	**9023.250**	**9023.270**	
Accessories						
Active sound system including 2 speakers, fitted		9010.540	9010.540	9010.540	9010.540	–
Service keyboard with trackball for touch systems	German	9004.500	9004.500	–	–	801
	US English	9004.502	9004.502	–	–	801
Stainless steel keyboard with trackball, IP 65/IP 54	German[1]	–	–	9004.220	9004.220	800
	US English[1]	–	–	9004.222	9004.222	800
Membrane keyboard with mouse pad, IP 65	German[1]	–	–	9010.910	9010.910	801
	US English[1]	–	–	9010.912	9010.912	801
ITS PC system “Pro II”		9010.125	9010.125	9010.125	9010.125	799
ITS PC system “Silent”		9010.110	9010.110	9010.110	9010.110	799
PC operating system[2] MS Windows XP Home	German[1]	9030.100	9030.100	9030.100	9030.100	–
	English[1]	9030.102	9030.102	9030.102	9030.102	–
Climate control kit for Out-Line Wall[3]	Type 1 (mains voltage: 115 V, 50/60 Hz)	9010.331	9010.331	9010.331	9010.331	–
	Type 2 (mains voltage: 230 V, 50/60 Hz)	9010.332	9010.332	9010.332	9010.332	–

[1] Other language variants available on request.
[2] Operating system OEM version may only be ordered in conjunction with a PC system; other operating systems available on request.
[3] Detailed knowledge of the conditions on-site exactly is required to dimension the climate control kit accurately.

Accessories Page 832 **Keyboards** Page 800

Out-Line Pro



B = Width
T = Depth

This outdoor kiosk is designed for multimedia in an outdoor setting.
Based on Rittal's expertise in the outdoor sector, this twin-walled aluminium kiosk offers a high level of security in terms of protection from a wide variety of climatic and physical conditions, including protection against vandalism.

Internally, the enclosure may be configured with other components from the Rittal range of accessories, such as component shelves etc. Special displays suitable for outdoor use with high levels of light intensity are used in complete systems.

Material:
Aluminium, spray-finished
Tubes: Stainless steel

Colour:
RAL 9007

Various spray-finishes, including anti-grafitti spray-finish, available on request.

Protection category:
IP 55

Property rights:
German registered design no. 403 02 344

Specifications and the online configurator
can be found on the Internet at **www.terminals-by-rittal.de**
or
www.kiosks-uk.com

Out-Line Pro		Touchscreen		Prepared for keyboard		Page
TFT display (suitable for outdoor use with an increased light intensity)		15″	17″	15″	17″	
Basic electrical equipment with cabling and power pack for display and sound system (100 – 260 V, 50/60 Hz)		■	■	■	■	
Base/plinth with stabilisers, may be screw-fastened to the ground.		■	■	■	■	
Dimensions of terminal enclosure approximately (B1 x H1 x T1 mm)		650 x 2000 x 400	650 x 2000 x 400	650 x 2000 x 400	650 x 2000 x 400	
Dimensions of terminal including roof approximately (B2 x H2 x T2 mm)		1000 x 2400 x 1000	1000 x 2400 x 1000	1000 x 2400 x 1000	1000 x 2400 x 1000	
Model No. ITS		**9022.150**	**9022.170**	**9022.250**	**9022.270**	
Accessories						
Active sound system including 2 speakers, fitted		9010.540	9010.540	9010.540	9010.540	–
Service keyboard with trackball for touch systems	German	9004.500	9004.500	–	–	801
	US English	9004.502	9004.502	–	–	801
Stainless steel keyboard with trackball, IP 65	German[1)]	–	–	9004.220	9004.220	800
	US English[1)]	–	–	9004.222	9004.222	800
Membrane keyboard with mouse pad, IP 65	German[1)]	–	–	9010.910	9010.910	801
	US English[1)]	–	–	9010.912	9010.912	801
ITS PC system "Silent"		9010.110	9010.110	9010.110	9010.110	799
ITS PC system "Pro II"		9010.125	9010.125	9010.125	9010.125	799
PC operating system[2)] MS Windows XP Home	German[1)]	9030.100	9030.100	9030.100	9030.100	–
	English[1)]	9030.102	9030.102	9030.102	9030.102	–
WLAN upgrade kit IEEE 802.11, type 2 (PCI card with external outdoor aerial for the PC system "Pro" and "Basic")		9011.110	9011.110	9011.110	9011.110	–
Climate control kit for outdoor terminals[3)]	Type 1 (mains voltage: 115 V)	9010.311	9010.311	9010.311	9010.311	–
	Type 2 (mains voltage: 230 V)	9010.312	9010.312	9010.312	9010.312	–

[1)] Other language variants available on request.
[2)] Operating system OEM version may only be ordered in conjunction with a PC system; other operating systems available on request.
[3)] Detailed knowledge of the conditions on-site is required to dimension the climate control kit accurately.
Operation at –20 to +40°C in Central Europe is possible under the conditions defined in IEC 68.
Further accessories such as card reader, coin checker as well as climate control units available on request.

Accessories Page 832 **Keyboards** Page 800

PC systems

Kiosks Mini-PC system
Rittal now offers innovative PC technology to match the kiosk systems which is specifically tailored to the requirements of the kiosk sector. There is a choice of three PC systems which are ideally suited for use in all terminal systems in terms of noise emission, system performance and compact design.

With the PC system “Silent”, the designers focussed their attention on a noise- and heat loss-reducing design. In this way, we have managed to dispense with the use of active fans for the power pack and for cooling the PCU.

Mini-PC configuration[1]		Silent	Pro II	Basic[4]
Fanless PC (Mini-ITX, VIA Eden CPU), 633 MHz		■	–	–
Intel Pentium M CPU min. 1.6 GHz with active fan		–	■	–
Intel Celeron CPU min. 2.0 GHz with active fan		–	–	■
Main memory		256 MB	256 MB	256 MB
Hard disk (minimum capacity, approx.)		40 GB	40 GB	40 GB
CD-ROM		■	–	■
DVD-ROM		–	■	–
Model No. ITS		**9010.110**	**9010.125**	**9003.070**
Interfaces				
PS/2 (keyboard and mouse)		■	■	■
VGA (onboard)		■	■	■
Sound (onboard, 6-way surround sound 5.1, AC97 codec) connections in/out		2/1	1/1	–
Sound (onboard AC97 codec) connections in/out		–	–	2/1
Ethernet 10 and 100 Mbit/s (RJ 45)		■	■	■
Serial (RS232, D-Sub 9 pin)		1 x	1 x	1 x
Parallel (ECP/EPP, D-Sub 25 pin)		1 x	–	1 x
USB		2 x	2 x	4 x rear/2 x front
Firewire (IEEE 1394)		2 x	–	–
SP-DIF out (RCA, if TV-out is not used)		■	–	–
TV-out (PAL & NTSC) (RCA, if SP-DIF is not used)		■	–	–
Extension slot PCI		–	–	2 x/1 x AGP Low Profile
External power pack (prim.: 100 – 240 V, 50/60 Hz/sec. 12 V, 60 – 80 W)		■	■	–
Internal power pack (100 – 240 V, 50/60 Hz)		–	–	■
Dimensions approximately (W x H x D mm)		300 x 55 x 300	300 x 55 x 300	350 x 95 x 385
Accessories[1]				
PC operating operating system[2] MS Windows XP Home	German[3]	9030.100	9030.100	9030.100
	English[3]	9030.102	9030.102	9030.102
	French[3]	9030.103	9030.103	9030.103
	Spanish[3]	9030.104	9030.104	9030.104

[1] We reserve the right to make configuration changes in line with technical progress.
[2] Operating system OEM version may only be ordered in conjunction with a PC system.
[3] Other language variants available on request.
[4] **PC system Basic not for use in: ITS Alpha-Line, ITS Opti-Wall, ITS Out-Line Wall and ITS Out-Line Pro.**
Other PC configurations available on request.

Accessories Page 832 **Keyboards** Page 800

Keyboards

Long-stroke keyboard

with trackball
Super-slimline, compact long-stroke keyboard (83/84 keys) with top-quality 16 mm trackball. Available in two different colours and several country layouts.

For independent installation into the keyboard supports or keyboard recesses, an adaptor plate is additionally required.

Mechanical specifications:
Key buttons in an 18 mm pitch pattern
Trackball Ø 16 mm
Weight: 720 g
Storage temperature: –20°C to +60°C
Operating temperature: 0°C to +50°C
Dimensions W x H x D:
370 x 138.5 x 20 mm.

Electrical specifications:
Connections: PS/2 for keyboard and trackball
Operating voltage: 5 V DC type 18 mA

USB version available on request.

Material:
Plastic

Language[1]	Model No. ITS	
	RAL 9005 (black)	RAL 7032 (beige)
German	**9004.300**	**9004.320**
US English	**9004.310**	**9004.330**
French	**9004.303**	**9004.323**
Spanish	**9004.304**	**9004.324**

[1] Other language variants available on request.

	Model No. ITS
Adaptor plate in brushed stainless steel	**9003.160**
Adaptor plate, sheet steel, RAL 9005 (black)	**9003.170**

Stainless steel keyboard

with trackball
The stainless-steel full-stroke keys (86 keys) with a stroke of 3.5 mm are laser-engraved and protected against being twisted out or snapped off. The keyboard conforms to CE requirements.

Mechanical specifications:
Actuator travel: 3.5 mm
Actuator force: 0.56 N, tactile
Service life: > 10 million actuations
Storage temperature: –40°C to +70°C
Operating temperature: –20°C to +60°C
Dimensions W x H x D:
432 x 155 x 34 mm (R = 10 mm).

Electrical specifications:
Connections: PS/2 for keyboard and trackball
Operating voltage: 5 V DC, max. 50 mA

USB version available on request.

Protection category:
Keyboard and trackball
IP 65 (idle)
IP 54 (in motion)

Language[1]	Model No. ITS
German	**9004.220**
US English	**9004.222**
French	**9004.223**
Spanish	**9004.224**
Finnish	**9004.226**
Swedish	**9004.227**

[1] Other language variants available on request.

Service keyboard

with trackball

Compact keyboard with intgral trackball for mobile on-site service use with kiosk systems. This keyboard makes maintenance work and software installation easier for kiosk systems with a touchscreen which do not have their own keyboard. This keyboard is not essential for operation of the terminals, but in many terminals it may remain inside the enclosure, thanks to the minimal dimensions. This keyboard additionally has 18 multimedia keys.

Mechanical specifications:
Actuator travel: 2.2 mm
Trackball: Ø 19 mm
Service life: 1 million actuations
Operating temperature: 0°C to +50°C
Dimensions W x H x D:
316 x 152 x 21 mm.

Electrical specifications:
Connections: PS/2 for keyboard and trackball

USB version available on request.

Language	Model No. ITS
German	**9004.500**
US English	**9004.502**

Material:
Plastic

Protection category:
IP 20

Membrane keyboard

with mouse pad

Membrane keyboard with 86 keys and integrated mouse pad in MF-II/WIN-compatible layout for integration into the keyboard support of all kiosk systems.

Mechanical specifications:
Actuator travel: 0.5 mm
Actuator force: 2.55 N ± 0.65 N
Service life: >1 million actuations
Touchpad: Active area 62 x 47 mm
Dimensions W x H x D:
432 x 155 x 18 mm
Front film: Resistant polyester
Keys: With key edge embossing
Carrier plate: Metal.

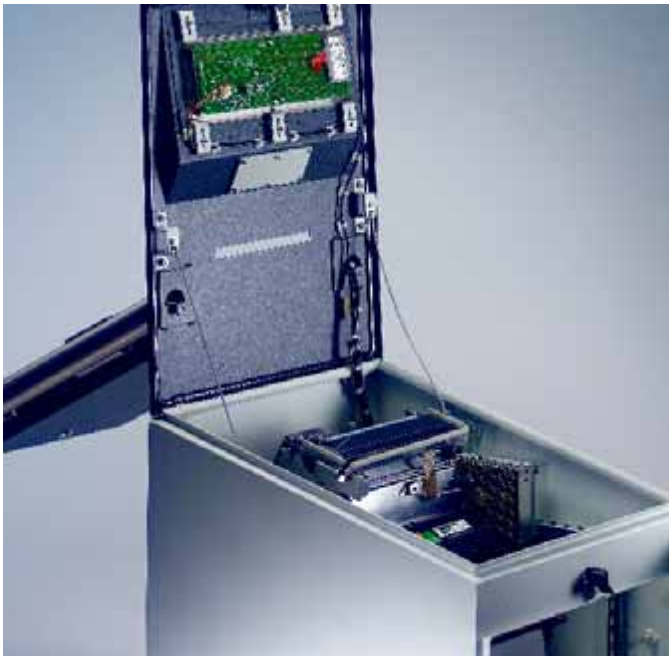
Electrical specifications:
Connections: PS/2 for keyboard and trackball

USB version available on request.

Language[1)]	Model No. ITS
German	**9010.910**
US English	**9010.912**
French	**9010.913**
Spanish	**9010.914**
Finnish	**9010.916**
Swedish	**9010.917**

[1)] Other language variants available on request.

Protection category:
IP 65

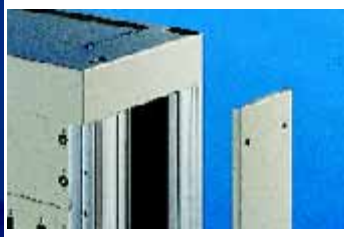


Example of a customer-specific terminal solution with 4000-page thermo-printer.

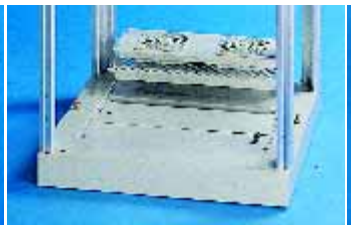
Features

Modern telecommunications continuously place new demands on racks and enclosures. Above all, maximum flexibility is crucial to conform with the various standards. Combined with creative scope, you get cost-effective solutions for your individual requirements.

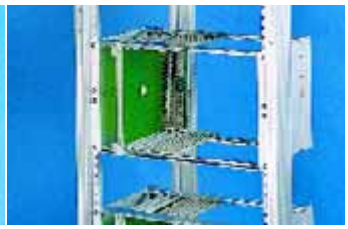
TC rack



Rear/side panel
to finish off a complete enclosure unit.



Roof and base/plinth insert
The inserts may be fitted as required in the roof or base/plinth.

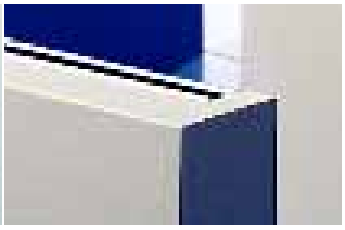


Option of installing all standard **482.6 mm (19″) or metric (535 mm) components.**

Small FM distributors

FM universal mounting brackets for LSA-Plus, VS-Standard and other common connection systems.

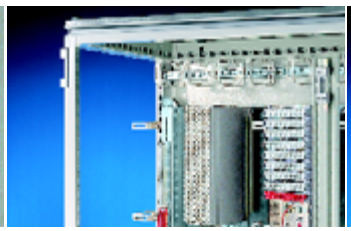
Prepared for mounting **LSA cable retainers** or routing troughs.



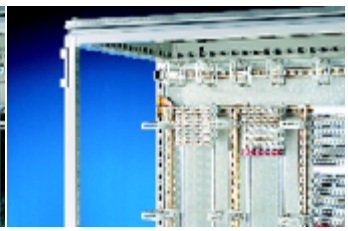
Cable entry
top and bottom. With 2 comb strips for cable clamping.

Modular FM distribution enclosures

Wall-mounted and bayed enclosures
Rittal diversity, from small distributors, to FM wall-mounted distributors, to two-door bayed enclosures.

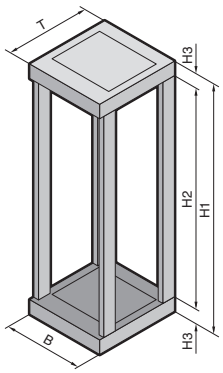


FM system strips
for DIN strips, dividing strips 71 and FM universal mounting brackets.



FM system rods
for LSA-Plus-Profil modules 2/10.

Rack system, based on Rittal TC rack



Material:
Roof/base frame:
Sheet steel, 2 mm
Frame:
Aluminium

Surface finish:
Roof/base frame:
Powder-coated in RAL 7035
Frame:
Natural, zinc-plated, passivated

Supply includes:
Frame:
4 supporting aluminium uprights,
the two front uprights are prepared to accommodate doors whilst the two rear uprights are prepared to accommodate a rear panel and a ceiling fastening.

Roof/base frame:
To accommodate roof/base cover modules.
Fitted as standard with cover plate (D = 300 mm) or sliding cover (D = 600 mm),
4 levelling feet.

Property rights:
German patent no. 43 33 027
European patent no. 645 957
with validity for FR, GB, IT, NL
US patent no. 5,513,759
Jap. patent no. 233373/94

Note:
Used in conjunction with metric (535 mm) mounting angles, the Telecommunication Rack meets the requirements of ETS standard 300119-3.

Available on request:
- TC rack fully fitted with all mounting parts
- Divided front doors
- Special sizes

Detailed drawing,
available on the Internet.

Width (B) in mm	Packs of	600	600	Page
Height (H1) in mm		2200	2200	
Depth (T) in mm		300	600	
Height or mounting dimension (H2) in mm		2050 (46 U/82 SU)	2050 (46 U/82 SU)	
Height roof/base frame (H3) in mm		75	75	
Model No. DK	1	**7723.035**	**7726.035**	
Door				
Sheet steel door, front, solid	1	7720.035[2)]	7720.035[2)]	804
Sheet steel door, front, with vent slots	1	7722.035[2)]	7722.035[2)]	804
Sheet steel door, front, with safety glass insert	1	7725.035[2)]	7725.035[2)]	804
Rear/side panel				
Rear panel	1	7729.235[2)]	7729.235[2)]	804
Side panels	2	7713.235	7716.235	804
Roof				
Ceiling fastening	1 set	7719.000	7719.000	804
Roof insert for cable entry	1	–[1)]	7701.035	804
Roof insert with vent slots	1	7702.035	7702.035	804
Active fan insert	1	7703.035	7703.035	804
Base/plinth				
Base insert for cable entry	1	–[1)]	7701.035	804
Base insert with vent slots	1	7702.035	7702.035	804
Active fan insert	1	7703.035	7703.035	804
Interior installation				
Component shelves for 482.6 mm (19″) mounting angles	1	7119.250	7119.400	948
Component shelves for metric mounting angles (530 mm)	1	7119.255[2)]	7119.455[2)]	948
Mounting angles, 482.6 mm (19″), 46 U	2	7758.000	7758.000	805
Metric mounting angles (535 mm), 82 SU	2	7760.000	7760.000	805
Depth stays	6	7128.000	7129.000	805
Cable clamp rails for installation in the enclosure width	4	7101.000	7101.000	805
Cable clamp rails for installation in the enclosure depth	4	7090.000	7107.000	805
Cable clamp straps for 482.6 mm (19″)	6	7875.400	7875.400	805

[1)] Special designs available on request. [2)] Extended delivery times.

Acessories for Rittal TC Rack

Door

For front mounting, with 180° hinges, locking rod, double-bit lock insert (may be exchanged for Ergoform-S lock system).

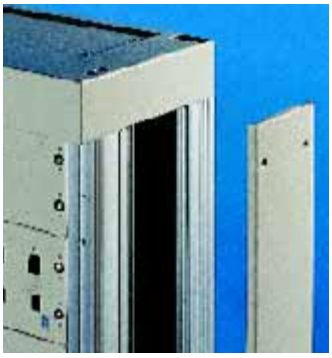
Material:
Sheet steel

Colour:
RAL 7035

Sheet steel door at front	Model No. DK
Solid	**7720.035**[1)]
With vent slots	**7722.035**[1)]
With safety glass insert	**7725.035**[1)]

Lock system	Model No. SZ
Ergoform-S handle RAL 7035	2435.000
Lock no. 3524 E	2467.000

[1)] Extended delivery times.
Available on request.



Rear/side panel

To finish off a complete enclosure unit, including assembly material.

Material:
Sheet steel

Colour:
RAL 7035

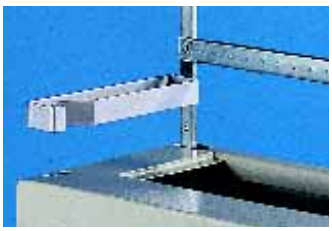
For side panels DK 7713.235 and DK 7716.235:

German patent no. 43 33 025
US patent no. 5,584,406

	For enclosure depth mm	Packs of	Model No. DK
Side panel	300	2	**7713.235**
Side panel	600	2	**7716.235**

	For enclosure width mm	Model No. DK
Rear panel	600	**7729.235**[1)]

[1)] Extended delivery times.



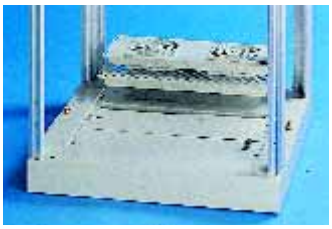
Ceiling fastening

Infinitely height-adjustable for ceiling fastening of free-standing Rittal TC Racks and for cable routing.
Max. mounting height of vertical stays: 550 mm

Material:
Sheet steel, zinc-plated, passivated

Model No. DK	7719.000

Supply includes:
2 vertical stays,
1 horizontal rail,
2 cable shunting rings,
including assembly parts.



Roof and base/plinth insert

The inserts may be fitted in the roof or base/plinth as required.

Material:
Sheet steel

Colour:
RAL 7035

Roof and base/plinth insert	Model No. DK
For cable entry[1)]	**7701.035**
With vent slots	**7702.035**
With active fan insert	**7703.035**

[1)] For Rittal TC Rack DK 7726.035.
Special design for DK 7723.035 available on request.

Mounting angles on a U/SU pitch pattern and T channel mounting angles,

482.6 mm (19″)/metric (535 mm)

The mounting angles are simply screwed to the rack upright; a combination of 482.6 mm (19″) and metric (535 mm) mounting angles is also possible. Also available in a T channel version. The mounting angles are depth-adjustable including mounting material.

	Packs of	Model No. DK		
		U pitch pattern mounting angles	SU pitch pattern mounting angles	T channel mounting angles
46 U	2	**7758.000**	–	**7758.100**
82 SU	2	–	**7760.000**	**7760.100**

Material:
Aluminium, clear-chromated

Accessories:

Captive nuts M5 /M6, spring nuts, screws M5 /M6,
see page 1019.

Depth stays

For infinitely variable adjustment of metric (535 mm) or 482.6 mm (19″) mounting angles across the entire enclosure depth, or for attachment of a second pair of 482.6 mm (19″) mounting angles at the rear.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Depth stays, including assembly parts.

Enclosure depth mm	Packs of	Model No. DK
300	6	**7128.000**
600	6	**7129.000**

Cable clamp rails

For installation in the enclosure width and depth. Fully height-adjustable for cable clamping with rear or side cable routing.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Cable clamp rails,
including assembly parts.

Enclosure width mm	Packs of	Model No. DK
600	4	**7101.000**

Enclosure depth mm	Packs of	Model No. DK
300	4	**7090.000**
600	4	**7107.000**

Clip-on nuts

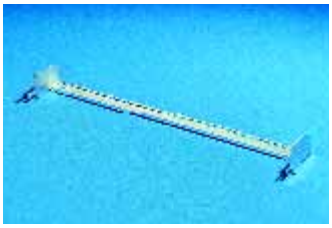
For variable interior installation of TC racks. Simply clip onto one of the two channels, for infinitely variable component mounting.

German patent no. 195 24 648
European patent no. 0 836 679
Japanese patent no. 28 91 779
US patent no. 5,897,276

Packs of	Model No. FR
50	**2102.500**

Accessories:

M6 assembly screws,
see page 1019.



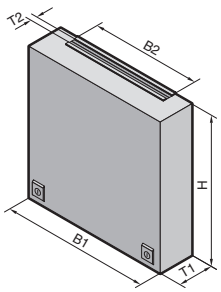
Cable clamp strap

For system-compatible cable routing in the TC Rack, behind a pair of 482.6 mm (19″) mounting angles.

Material:
Sheet steel, zinc-plated, passivated

Depth mm	Packs of	Model No. DK
100	6	**7875.400**

Small FM distributors



Material:
Sheet steel, 1.5 mm

Surface finish:
Powder-coated in RAL 7035

Supply includes:
Two-part enclosure

Wall section:
With mounting holes for wall mounting, 2 comb strips for cable clamping and brush insert for cable entry, shunting ring for system-compatible routing of telecommunications cables.

Cover:
Retaining device and two cam locks with double-bit lock insert.

Property rights:
German patent
no. 44 10 795

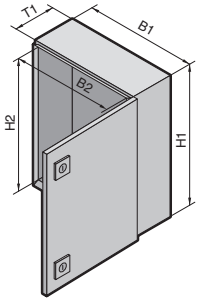
Detailed drawing,
available on the Internet.

Width (B1) in mm	Packs of	300	500	500	900	Page
Height (H) in mm		500	500	700	700	
Depth (T1) in mm		120	120	120	120	
Width of cable entry (B2) in mm		195	395	395	795	
Depth of cable entry (T2) in mm		29	29	29	29	
Model No. DK	1	**7052.035**	**7053.035**	**7054.035**	**7055.035**	
Max. number of adjacent cable retainers or mounting troughs (LSA)		1	2	2	4	
Max. accommodation when using cable retainers or mounting troughs (LSA)		100 DA	200 DA	400 DA	800 DA	
Shunting ring, plastic, 70 x 44 mm		2	3	3	5	
Accessories						
FM universal mouting brackets type A, L = 275 mm, LSA-Plus	1 set	7031.100	7031.100	7031.100	7031.100	811
FM universal mouting brackets type B, L = 275 mm, VS-Standard	1 set	7031.101	7031.101	7031.101	7031.101	811
Lock systems						
“15” locks (Zeiss-Ikon)	2	7059.035[1)]	7059.035[1)]	7059.035[1)]	7059.035[1)]	891
“15” key (Zeiss-Ikon)	1	7059.100[1)]	7059.100[1)]	7059.100[1)]	7059.100[1)]	891
T handle without lock insert	1	2572.000	2572.000	2572.000	2572.000	887
T handle with lock insert no. 3524 E	1	2575.000	2575.000	2575.000	2575.000	887
Plastic handle with lock no. Nr. 3524 E	1	2576.000	2576.000	2576.000	2576.000	886
Plastic handle	1	2533.000	2533.000	2533.000	2533.000	886

Standard double-bit lock insert may be exchanged for 27 mm lock inserts, version A, see page 888.

[1)] Extended delivery times.

Modular FM wall-mounted distributor



Material:
Sheet steel, 1.5 mm
Door: 2.0 mm

Colour:
RAL 7035

Protection category:
IP 55 to EN 60 529/10.91

Supply includes:
Enclosure: Based on Rittal AE with gland plate at bottom, swappable door hinge (height 1200 mm with 3-point locking rod and double-bit lock), earth rail, cable clamp rail,
2 punched rails to accommodate FM system strips,
FM system rods and
FM cable shunting strips.
Top horizontal punched rail to accommodate cable shunting rings, double-bit lock inserts.

Available on request:
- FM wall-mounted distributor configured with Rittal standard accessories (FM system strips, FM system rods, FM cable shunting strips etc.) to order.
- Cable routing with brush strips top/bottom.

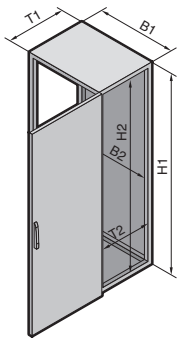
Approvals,
see page 92.

Detailed drawing,
available on the Internet.

Width (B1) in mm	Packs of	600	760	800	800	Page
Height (H1) in mm		600	760	1000	1200	
Depth (T1) in mm		350	300	300	300	
Clearance width (B2) in mm		560	720	760	760	
Clearance height (H2) in mm		560	720	960	1160	
Model No. DK	1	**7011.535**	**7012.535**	**7013.535**	**7014.535**	
Maximum accommodation when using FM system strips with trays or FM rods		340 paired wires	500 paired wires	990 paired wires	1170 paired wires	
Installation of FM system strips FM system towers FM system rods		2 set	2 set	3 set	3 set	
Accessories						
Plastic handles with lock cylinder insert	1	2439.000	2439.000	2439.000	2439.000	886
Ergoform-S handle	1	–	–	–	2435.000	885
FM system strips[1)]	1 set	7032.500	7033.500	7034.500	7035.500	809
FM system rods	1 set	7533.000	7534.000	7535.000	7536.000	810
FM cable shunting strips	1 set	7233.000	7234.000	7235.000	7236.000	810
Plastic cable gland plates	5	2563.000	2563.000	2563.000	2563.000	966
Wall mounting bracket, 10 mm	1	2508.000	2508.000	2508.000	2508.000	905
Wall mounting bracket, 40 mm	1	2503.000	2503.000	2503.000	2503.000	905

[1)] FM universal mounting bracket, VS standard, DIN strips, 71 dividing strip and distributor system series 5000 may be fitted.

Modular FM distributor racks



Material:
Sheet steel,
Enclosure frame, roof, rear panel and gland plates:
1.5 mm
Door: 2 mm

Colour:
RAL 7035

Protection category:
IP 55 to EN 60 529/10.91

Supply includes:
Enclosure frame with door or 2 doors, without side panels, comfort handle with security lock, three-piece gland plate, rear panel and roof plate, 3 punched rails to accommodate FM system strips, FM system rods, FM cable shunting strips, 1 top horizontal punched rail to accommodate cable shunting rings, cable clamp rail, earth rail.

Available on request:
- FM distributor racks configured with Rittal standard accessories (FM system strips, FM system rods, FM cable shunting strips etc.) to order.
- FM distributor racks in special sizes.

Approvals,
see page 92.

Detailed drawing,
available on the Internet.

Width (B) in mm		Packs of	600	800	1200	Page
Height (H) in mm			2000	2000	2000	
Depth (T) in mm			400	400	400	
Clearance width (B2) in mm			512	712	1112	
Clearance height (H2) in mm			1912	1912	1912	
Clearance depth (T2) in mm			312	312	312	
Model No. DK		1	**7834.060**	**7834.080**	**7834.120**	
Maximum accommodation when using FM system strips with trays or FM rods			1300 paired wires	1950 paired wires	3250 paired wires	
Installation of FM system strips FM system towers FM system rods			2	3	5	
Accessories						
FM system strips[1]		1 set	7038.500	7038.500	7038.500	809
FM system rods		1 set	7538.000	7538.000	7538.000	810
FM cable shunting strips		1	7238.000	7238.000	7238.000	810
Cable shunting ring	120 x 90 mm	10	7111.900	7111.900	7111.900	810
	120 x 60 mm	10	7111.000	7111.000	7111.000	810
	80 x 40 mm	10	7112.000	7112.000	7112.000	810
Side panels		2	8104.235	8104.235	8104.235	853
Quick-fit baying clamps		6	8800.500	8800.500	8800.500	863
Roof plate for cable entry		1	7826.645[2]	7826.845[2]	7826.245[2]	901
Height 100 mm, base/plinth components front/rear		1 set	8601.600	8601.800	8601.200	835
Height 100 mm, base/plinth components sides 400 mm		1 set	8601.040	8601.040	8601.040	835
Height 200 mm, base/plinth components front/rear		1 set	8602.600	8602.800	8602.200	835
Height 200 mm, base/plinth components sides 400 mm		1 set	8602.040	8602.040	8602.040	835

[1] FM universal mounting bracket, VS standard, DIN strips, 71 dividing strip and distributor system series 5000 may be fitted.
[2] Extended delivery times.

Accessories Page 832

FM system strips

For user-specific solutions or modular FM enclosure assembly. The following connection systems may be mounted on the FM system strips:

- DIN connector strips to DIN 47 614, type B; soldering lugs to DIN 41 499, LSA-Plus connector strips 1/20 to DIN 47 608 with 170 mm mounting dimension, vertical (with 2 FM system strips, horizontal mounting is possible).
- Cable retainers or routing troughs for LSA connection technology.
- Dividing strip 71.
- Corning series 5000 distribution system for professional assembly of modern distributors with plug-type Faston technology.

The FM system strip features a 25 mm DIN pitch pattern (DIN 43 660). Shunting rings of plastic or metal may be fitted here for cable routing. As an alternative to this, however, FM cable shunting strips may also be used.

Design:
Installation height: 120 mm
Installation width: 75 mm

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
1 FM system strip,
2 shunting rings (105 x 70 mm),
including assembly parts.

Accessories:

FM universal mounting bracket,
see page 811.
Shunting ring (plastic) DK 7218.035,
DK 7219.035,
see page 984.
Shunting ring (metal) DK 7111.000, DK 7111.900,
DK 7112.000,
see page 810.
FM cable shunting strips,
see page 810.

Population opportunities for DIN, LSA and dividing strips

	Model No. DK					
FM system strips	**7032.500[1)]**	**7033.500[1)]**	**7034.500[1)]**	**7035.500[1)]**	**7038.500**	**7039.500**
Length mm	425	625	825	975	1625	1825
Connection system	Maximum population[1)] paired wires					
DIN connector strip	20	60	80	100	160	180
LSA connector strip	170	250	330	390	650	730
Dividing strip 71	100	200	200	300	500	600

[1)] Based on the following mounting dimensions:
– DIN connector strip 170 mm
– LSA connector strip 25 mm
– Dividing strip 71: 290 mm

Population opportunities for Corning distributor system series 5000

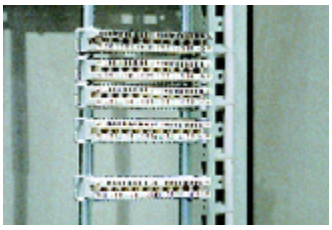
	Model No. DK					
FM system strips	**7032.500[1)]**	**7033.500[1)]**	**7034.500[1)]**	**7035.500[1)]**	**7038.500**	**7039.500**
Length mm	425	625	825	975	1625	1825
	No. of blocks per FM system strip					
Block 128 p. wires, L = 218 mm Block 100 p. wires, L = 152 mm	1 1	1 2	1 3	2 2	3 5	3 6
Block 384 p. wires, L = 640 mm Block 600 p. wires, L = 925 mm	– –	– –	– –	– –	1 1	1 1
Block 104 p. wires, L = 180 mm	2	3	4	5	8	9
Block 128 p. wires, L = 218 mm	1	2	3	4	7	8
Block 200 p. wires, L = 333 mm	1	1	2	2	4	5
Block 1000 p. wires, L = 1,690 mm	–	–	–	–	–	1

Population opportunities for FM universal mounting bracket

		Model No. DK					
FM system strips		**7032.500[1)]**	**7033.500[1)]**	**7034.500[1)]**	**7035.500[1)]**	**7038.500**	**7039.500**
Length mm		425	625	825	975	1625	1825
Max. packs of mounting brackets		1	2	2	3	5	6
Vertical bracket distance in mm		–	50	50	50	50	35
Connection system	Pitch pattern distance mm	No. of strips per system strip					
LSA-Plus	22,5	12	24	24	36	60	72
VS-Standard	25	11	22	22	33	55	66
Other connection systems	22.5	12	24	24	36	60	72
	17.5	15	30	30	45	75	90
	16	17	34	34	51	85	102

[1)] Extended delivery times.

Accessories for FM distribution racks



FM system rods

For user-specific solutions or modular FM enclosure assembly. LSA-Plus profile modules 2/10 may be mounted on the FM system rods. The rod diameter is 12 mm and the rod spacing 95 mm. The FM system rods may be supplemented with FM cable shunting strips, to permit the accommodation of patching cables.

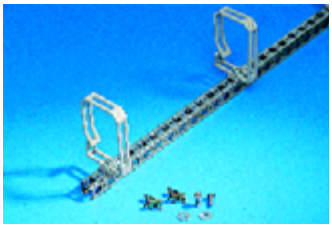
Design:
Installation height: 120 mm
Installation width: 110 mm

Material:
Round steel, clear-chromated

Supply includes:
2 rods,
2 rod holders, plus (with 650 paired wires and more) an additional rod spacer,
2 shunting rings (105 x 70 mm),
including assembly parts.

LSA-Plus[1] profile module 2/10	Length mm	Packs of	Model No. DK
170 DA	425	1 set	**7533.000**
250 DA	625	1 set	**7534.000**
330 DA	825	1 set	**7535.000**
390 DA	975	1 set	**7536.000**
650 DA	1625	1 set	**7538.000**
730 DA	1825	1 set	**7539.000**

[1] Refers to LSA strip pitch pattern of 25 mm.



FM cable shunting strips

For user-specific solutions or modular FM enclosure assembly.
FM cable shunting strips allow shunting between the connection systems.
The FM cable shunting strips are supplementary to FM system strips and FM system rods, and are designed for routing patch cables. They are mounted on the sides, next to the FM system strips or FM system rods.

Design:
Installation height: 132 mm
Installation width: 70 mm
Shunting ring: 105 x 70 mm

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
1 punched rail,
shunting rings,
including mounting accessories.

Shunting ring	Length mm	Packs of	Model No. DK
2	425	1 set	**7233.000[1]**
3	625	1 set	**7234.000[1]**
4	825	1 set	**7235.000[1]**
5	975	1 set	**7236.000[1]**
7	1625	1 set	**7238.000**
8	1825	1 set	**7239.000**

[1] Extended delivery times.

Cable shunting ring

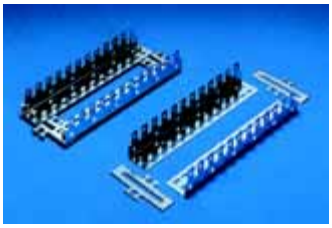
For flexible and system-compatible cable routing on FM system strips, FM distribution enclosures or at the sides on 482.6 mm (19″) mounting angles.

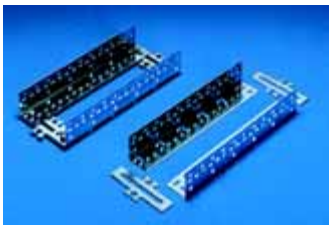
Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Locating plate and assembly parts.

Dimensions mm	Packs of	Model No. DK
120 x 90	10	**7111.900**
120 x 60	10	**7111.000**
80 x 40	10	**7112.000**

German patent no. 38 13 002





FM universal mounting bracket

The universal mounting brackets consist of 2 brackets that can be combined with the connection systems of other manufacturers, depending on how they are positioned next to each other. The brackets may be slid flexibly against each other so that strips with different lengths can be used. The mounting brackets can be mounted in FM distribution enclosures or on FM system strips.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
2 mounting brackets, support strips, assembly parts.
Mounting bracket, type A for LSA-Plus strips (8 or 10 p. wires) and other commercially available connection systems.
Mounting bracket, type B for VS-Standard and other commercially available connection systems.

Mounting bracket	Length mm	Connection system	LSA-Plus	VS standard	Other connection systems			Packs of	**Model No. DK**
		Pitch pattern in mm	22.5	25	22.5	17.5	16		
Type A	275	No. of strips	12	–	–	15	–	1 set	**7031.100**
Type B	275	No. of strips	–	11	12	–	17	1 set	**7031.101**[1)]

[1)] Extended delivery times.

Rittal **outdoor enclosures, outdoor climate control components and remote monitoring systems** will withstand even the toughest conditions.

In this respect, we are uncompromising.

From basic requirements such as humidity, temperature fluctuations and sunlight, to **extreme conditions** such as seawater resistance or earthquake resistance, through to protection against vandalism, Rittal has the answer.

In this way, we ensure that there are no limits to our customers' targets.

Communication Systems

CS Outdoor enclosures from page 814

Features ... 814

CS Toptec page 817

CS wall-mounted enclosures page 818

CS compact enclosures page 819

Compact enclosures, Outdoor page 820

CS Basic enclosures from page 821

CS Basic enclosures, single-door ... 821
CS Basic enclosures, two-door ... 822

CS modular enclosures from page 823

CS modular enclosures, installation variants ... 824

CS Indoor Rack page 825

CS Outdoor climate control page 826

Features ... 826

Heat exchangers from page 827

Heat exchanger for CS modular enclosures ... 827
Heat exchanger for CS modular enclosures/ compact enclosures ... 828

Cooling units page 829

Cooling units for CS modular enclosures ... 829

Climate control units for CS Toptec page 830

Geothermal heat exchanger page 831

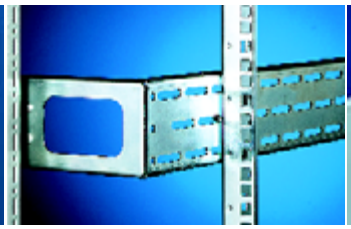
CS outdoor enclosures

Features

For all requirements in the outdoor sector, Rittal has the ideal enclosure solution, thanks to its platform strategy.
With single-walled or twin-walled enclosures of aluminium or coated sheet steel, as well as an extensive range of accessories. With constant interior temperatures and perfect climate, thanks to in-house development and production of cooling units, heat exchangers and heaters.

CS Toptec

The CS Toptec is based on the **TS 8 frame of stainless steel** 1.4301. Fully symmetrical,



more options for universal interior installation thanks to two all-round mounting levels on

a 25 mm pitch pattern, and **compatibility with system accessories TS 8.**

In the twin-walled enclosure all panels and doors are built up externally. This chimney effect reduces the influence of sunlight on the enclosure.

You are able to utilise the entire interior for your installation.

Bayed enclosure suites and enclosures with doors all round can be achieved thanks to the **combination of assembly components.**

CS wall-mounted enclosures

The **enclosure-within-an-enclosure concept** with the curved designer cover is a characteristic feature.

Security lock on the designer cover and door of the interior enclosure.

Air louvres at the sides and in the rear panel.

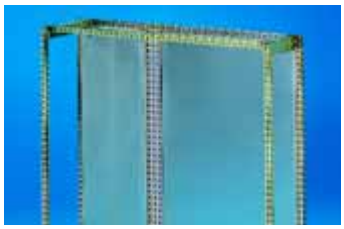
Features

CS compact enclosures

Application diversity: The basic dimensions of the compact enclosures correspond to Deutsche Telekom's base/plinth dimensions KVz 83 and 84.

The **rain canopy for optimum weather protection** and to accommodate an air/air heat exchanger.

Ergoform padlock handle system.
Security with semi-cylinder.



Assembly-friendly: Remove the enclosure cover, interior installation is soon complete on the open mounting frame, slip the cover back over, screw-fasten into position, and voila!

The gland plates ensure a **high degree of flexibility with cable entry.**

With the **roof-mounted heat exchanger** for 1100 mm wide enclosures, the protection category of IP 55 is retained.

CS basic enclosures

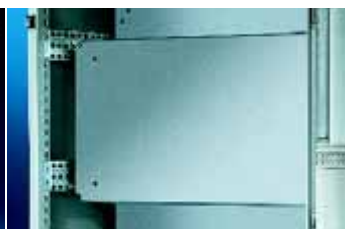
Eyebolts, concealed by the rain canopy, for crane transportation of the fully fitted unit.

Ventilation louvres all-round in the hinged rain canopy – with an all-round roof projection of 25 mm.

Width 1200 mm: **With removable centre bar** and two lockable doors with or without centre bar, with overlapping doors.

The open base frame may be covered with **gland plates.**

Individual installation with an **extensive choice of system accessories.**



25 mm system punchings for mounting 482.6 mm (19″) mounting angles, mounting plates or partial mounting plates.

CS outdoor enclosures

Features

CS modular enclosures

Protection against vandalism – These features will protect your equipment against unauthorised access:

No point of entry for leverage-type tools, because the double side panel seamlessly conceals the door hinges. The hinged

roof is screw-fastened to the enclosure frame, the base/plinth trim secured with security screws.

Batteries for emergency power back-up are securely housed in the **pull-out drawer** of the battery base/plinth.

High level of stability thanks to **ten-fold profiling** of the enclosure body.

The Rittal system punchings facilitate **highly flexible interior installation** at various levels.

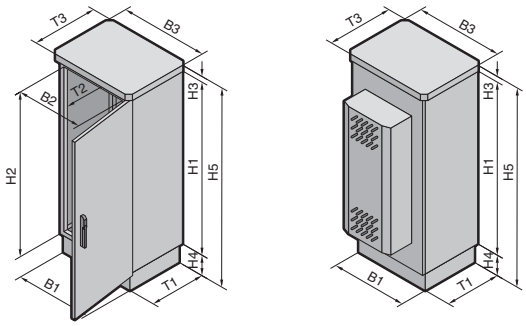
Project business

Particularly in project business, compliance with standards is of vital importance. We meet many of the required standards directly with standard enclosures or with slight modifications.
With Rittal, you get everything from a single source: From the enclosure, to climate control technology, to cable assembly. Within the framework of system integration, the entire AC/DC power supply and customer's system technology are installed.

Examples of some of the tests passed are listed below:

- Toptec without climate control module:
  Protection category testing IP 55 and NEMA 4x, transport tests to IEC 60 271-3-4 class 4M5, temperature cycling and humidity to Bellcore 487-R3-204,
- CS Toptec with climate control module:
  Salt spray fog testing (2 x 7 days) to Bellcore 487-R3-203,
- CS modular enclosures:
  Storage, transportation and operation to IEC 721-2-3.

CS Toptec



B = Width
T = Depth

Material:
Enclosure frame:
1.5 mm stainless steel 1.4301
Doors, side panels, roof:
2.0 mm aluminium, AlMg3
Base/plinth:
2.0 – 4.0 mm aluminium, AlMg3

Colour:
RAL 7035

Protection category:
IP 55 to EN 60 529/10.91, complies with NEMA 3R.

Supply includes:
Twin-walled outdoor enclosure fully preconfigured.
Door front and rear, side panels left and right.
Walls and doors doubled on the outside by 25 mm,
doors hinged on r/h side,
with handle and security lock to DIN 18 254.
Roof projecting on all sides screw-fastened with security screws,
may be exchanged for eyebolts.
Roof additionally protected from dismantling by the door edge fold.
Side panels vented, inner side panel screw-fastened to the enclosure frame from the outside,
base/plinth including two screw-fastened gland plates for cable entry, screw-fastened base/plinth trim panels at the front and rear.

Version with heat exchanger/cooling unit:
Door with integral climate control unit.
Climate control unit attached to the mounting frame in the door.
Supplied state: as a built-in unit inside the enclosure, minimum exterior projection.

Note:
The enclosure dimensions correspond to IEC EN 61 969.

Property rights:
German patent
no. 101 13 893
UK Patent no. 2 375 472

Also required:

For versions with climate control units, cable connection kit, see page 663.

Optionally available:

Size variants, baying variants, complete system integration up to Level 4.

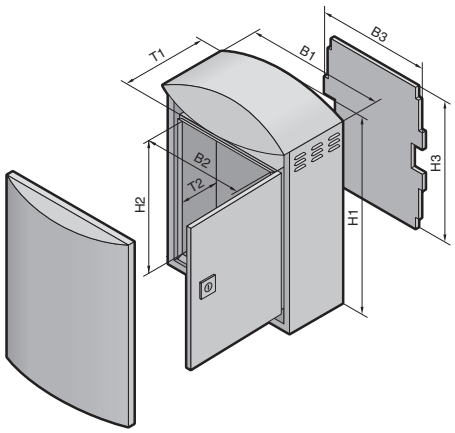
Detailed drawing,
available on the Internet.

Width (B1) in mm	Packs of	650	800	650	800	Page
Height (H1) in mm		1200	1200	1600	1600	
Depth (T1) in mm		650	650	650	650	
Clearance width (B2) in mm		562	712	562	712	
Clearance height (H2) in mm		1112	1112	1512	1512	
Clearance depth (T2) in mm		562	562	562	562	
Rain canopy width (B3) in mm		744	894	744	894	
Rain canopy height (H3) in mm		45	45	45	45	
Rain canopy depth (T3) in mm		744	744	744	744	
Base/plinth height (H4) in mm		100	100	100	100	
Overall height (H5) in mm		1345	1345	1745	1745	
Model No. CS without climate control module	1	**9774.100**	**9774.200**	**9774.300**	**9774.400**	
Model No. CS with heat exchanger 9776.100[1)]	1	**–**	**9774.210**	**–**	**9774.410**	
Model No. CS with heat exchanger 9776.150[1)]	1	**–**	**9774.230[2)]**	**–**	**9774.430[2)]**	
Model No. CS with cooling unit 9776.500[1)]	1	**–**	**9774.250**	**–**	**9774.450**	
Model No. CS with cooling unit 9776.550[1)]	1	**–**	**9774.270[2)]**	**–**	**9774.470[2)]**	
Accessories						
Concrete base/plinth	1	9765.184	9765.185	9765.184	9765.185	842
Mounting angles 482.6 mm (19″), full installation	2	7827.120	7827.120	7827.160	7827.160	1004
Divider kit for mounting angles 482.6 mm (19″)	4	7794.165	7794.280	7794.165	7794.280	1008
Mounting plate, full installation	1	9765.193	9765.193	9765.194	9765.194	916
Metal gland plate, prepunched	1	2562.100	2562.100	2562.100	2562.100	968
Enclosure light 48 V DC	1	9765.100	9765.100	9765.100	9765.100	955
Heater, 1000 W	1	9769.015	9769.015	9769.015	9769.015	656

[1)] For technical specifications of climate control unit, refer to page 830.
[2)] Delivery times available on request.

Accessories Page 832 **Mounting plates** Page 916 **Rail systems** Page 917 **482.6 mm (19″) installation** Page 993 **Monitoring** Page 762

CS wall-mounted enclosures



Material:
Aluminium AlMg3
Enclosure:
Exterior: 2.0 mm
Interior: 1.5 mm/2.0 mm
Doors: 2.0 mm
Mounting plate/rotating frame:
2.0 mm clear-chromated

Colour:
RAL 7035

Protection category:
IP 55 to EN 60 529/10.91

Supply includes:
Inner enclosure with door,
aluminium mounting plate
or rotating frame,
security lock
(CS 9791.045 and CS 9791.145
with 2 security locks),
foamed-in door seals,
gland plate at bottom,
mounting bracket for thermostat,
outer enclosure with integral
vent louvres,
designer cover with security
lock, C rails on the rear panel.

Protection rights for wall-mounted enclosure with mounting plate:
German utility model
no. 297 16 467
German registered design
no. 97 08 625
UK Registered Design
no. 2 072 965
IR reg. design no. DM/044 110
with validity for ES, FR, IT,
Indonesia
US patent no. 6,024,236
European patent no. 0 902 514
with validity for FI, GB, SE
Japan. patent no. 3 189 210

1 Wall-mounted enclosure with mounting plate

2 482.6 mm (19″) rotating frame

Rittal service:

Complete customised interior installation
of the wall-mounted enclosure up to integration level 4 to the customer's specifications is available.

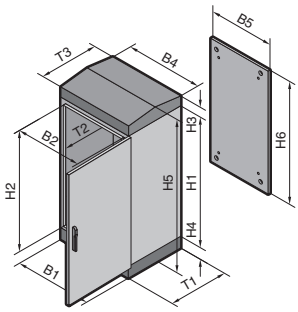
Detailed drawing,
available on the Internet.

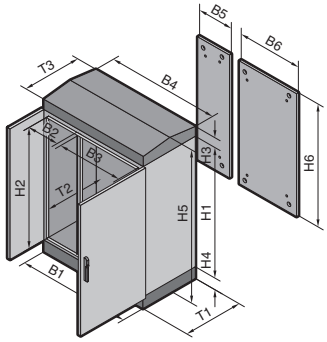
Width (B1) in mm	Packs of	370/300	420/350	530/460	630/580	630/580	Page
Height (H1) in mm		522.5/400	560.5/440	700/565	780/580	780/580	
Depth (T1) in mm		210/170	210/170	265/220	380/333	380/333	
Clearance width (B2) in mm		280	330	440	560	560	
Clearance height (H2) in mm		380	420	545	560	560	
Clearance depth (T2) in mm		145	145	195	308	240[2)]	
Mounting plate width (B3) in mm		270	320	430	550	–	
Mounting plate height (H3) in mm		380	410	535	550	–	
Model No. CS	1	**9791.015**	**9791.025**	**9791.035**	**9791.045**	**9791.145[1)]**	
Accessories							
Wall mounting	4	9765.120	9765.120	9765.120	9765.120	9765.120	906
Pole clamp	1 set	9765.125	9765.125	9765.125	9765.125	9765.125	906
Heater, 30 W	1	3115.000	3115.000	3115.000	3115.000	3115.000	655
Thermostat	1	3110.000	3110.000	3110.000	3110.000	3110.000	661

[1)] With 5 U rotating frame instead of mounting plate.
[2)] Max. installation depth in the 482.6 mm (19″) level.

Accessories Page 832 **Climate control** Page 826

CS compact enclosures





Version
Aluminium AlMg3

Material:
Enclosure, doors and rain canopy:
2.0 mm aluminium AlMg3
Mounting plate:
3.0 mm aluminium AlMg3
Base/plinth:
2.0 mm stainless steel 1.4301

Version
Sheet steel, zinc-plated, passivated

Material:
Enclosure and doors:
2.0 mm sheet steel, zinc-plated, passivated
Mounting plate:
3.0 mm sheet steel, zinc-plated, passivated
Base/plinth:
2.0 mm stainless steel 1.4301
Rain canopy:
2.0 mm aluminium AlMg3

Colour:
RAL 7035

Protection category:
IP 55 to EN 60 529/10.91

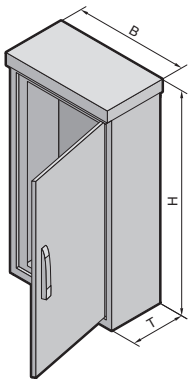
Supply includes:
Single-walled enclosure, one or two doors, door(s) with a 130° hinge with door stay 110°, Ergoform padlock with security lock, 3-point lock, foamed-in door seal, mounting plate(s), mounting frame with 25 mm DIN rows of holes, enclosure basic support, base/plinth, rain canopy.

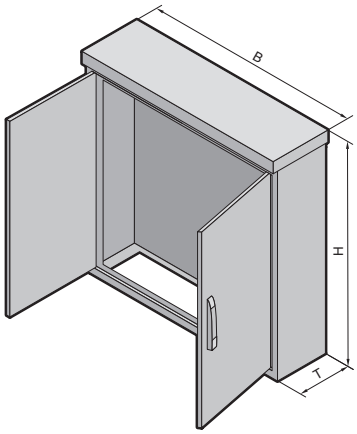
Detailed drawing,
available on the Internet.

	Packs of	Aluminium AlMg3		Sheet steel, zinc-plated, passivated		Page
Width (B1) in mm		800	1100	800	1100	
Height (H1) in mm		1100	1100	1100	1100	
Depth (T1) in mm		320	320	320	320	
Clearance width (B2/B3) in mm		760/ –	360/660	760/ –	360/660	
Clearance height (H2) in mm		1060	1060	1060	1060	
Clearance depth (T2) in mm		296	296	296	296	
Rain canopy width (B4) in mm		814	1114	814	1114	
Rain canopy height (H3) in mm		60	60	60	60	
Rain canopy depth (T3) in mm		334	334	334	334	
Base/plinth height (H4) in mm		100	100	100	100	
Overall height (H5) in mm		1260	1260	1260	1260	
Mounting plate width (B5/B6) in mm		720/ –	321.5/621.5	720/ –	321.5/621.5	
Mounting plate height (H6) in mm		1020	1020	1020	1020	
Model No. CS	1	**9771.115**	**9772.115**	**9771.111**	**9772.111**	
Door(s)		1	2	1	2	
Accessories						
Roof-mounted heat exchanger, 15 W/K	1	–	9767.012	–	9767.012	828
Rain canopy for roof-mounted heat exchanger	1	–	**9779.053**	–	**9779.004**	–
Plastic gland plate	1	2562.500	2563.500	2562.500	2563.500	967
Metal gland plate	1	2562.100	2563.100	2562.100	2563.100	968

Accessories Page 832 **Cable entry** Page 964

Compact enclosures, Outdoor





Material:
Optionally
Sheet steel, zinc-plated,
or
Stainless steel 1.4301

Colour:
RAL 7035

Supply includes:
Enclosure, closed back and sides,
interior door(s):
Swing handle prepared for semi-cylinder 40 or 45 mm, overall length to DIN 18 254.

Roof plate:
With bonded insulating plate to prevent the formation of drips, screw-fastened at a distance to prevent condensation.

Protection category:
IP 44 to 60 529/10.91

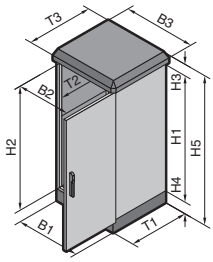
Detailed drawing,
see page 1185.

Width (B) in mm	Packs of	800	1200	1200	Page
Height (H) in mm		1200	800	1200	
Depth (T) in mm		350	350	350	
Model No. Sheet steel	1	**1620.000**	**1621.000**	**1622.000**	
Model No. Stainless steel	1	**1620.100**	**1621.100**	**1622.100**	
Doors		1	2	2	
Accessories					
Mounting plate sheet steel, 3 mm, zinc-plated, passivated	1	1616.200	1616.210	1616.220	916
Mounting plate MDF, 15 mm	1	1616.230	1616.230	1616.240	916
Concrete base/plinth	1	1616.300[1)]	1616.310[1)]	1616.310[1)]	842
Wiring plan pocket	1	4116.000	4115.000	4115.000	898
Door stay	1	1616.110	1616.110	1616.110	898

[1)] Delivery times available on request.

Accessories Page 832

CS Basic enclosures, single-door



Material:
Enclosure, roof and doors:
2.0 mm aluminium AlMg3
Base/plinth:
3.0 mm aluminium AlMg3

Colour:
RAL 7035

Protection category:
IP 55 to EN 60 529/10.91
in conjunction with the gland plates available as accessories.

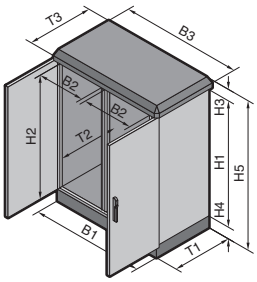
Supply includes:
Single-walled enclosure of all-round solid construction, with open base,
3-point locking via Ergoform padlock and lock cylinder, base/plinth, rain canopy.

Detailed drawing,
available on the Internet.

Width (B1) in mm	Packs of	600	600	600	600	800	800	800	800	Page
Height (H1) in mm		800	1200	1400	1200	800	1200	1400	1200	
Depth (T1) in mm		400	400	400	500	400	400	400	500	
Clearance width (B2) in mm		511.4	511.4	511.4	511.4	711.4	711.4	711.4	711.4	
Clearance height (H2) in mm		711.4	1111.4	1311.4	1111.4	711.4	1111.4	1311.4	1111.4	
Clearance depth (T2) in mm		349	349	349	449	349	349	349	449	
Rain canopy width (B3) in mm		650	650	650	650	850	850	850	850	
Rain canopy height (H3) in mm		75	75	75	75	75	75	75	75	
Rain canopy depth (T3) in mm		450	450	450	550	450	450	450	550	
Base/plinth height (H4) in mm		100	100	100	100	100	100	100	100	
Overall height (H5) in mm		975	1375	1575	1375	975	1375	1575	1375	
Model No. CS	1	**9783.040**	**9783.050**	**9783.060**	**9783.030**	**9783.010**	**9783.020**	**9783.120**	**9783.110**	
Accessories										
Concrete base/plinth	1 set	9765.182	9765.182	9765.182	9765.082	9765.088	9765.088	9765.088	9765.084	842
One-piece gland plate	1 set	9785.017	9785.017	9785.017	9785.020	9785.018	9785.018	9785.018	9785.019	852
Gland plate, divided	1 set	9785.011	9785.011	9785.011	9785.014	9785.012	9785.012	9785.012	9785.013	852
Cable entry plate	1 set	4320.700	4320.700	4320.700	4320.700	4321.700	4321.700	4321.700	4321.700	852
Mounting plate	1	9765.090	9765.092	9765.098	9765.092	9765.097	9765.095	9765.099	9765.095	916
Mounting angles 482.6 mm (19″), full installation	2	7685.000	7688.000	7689.000	7688.000	7685.000	7688.000	7689.000	7688.000	1006
Installation kit for mounting angles	2	7696.000	7696.000	7696.000	7696.000	7698.000	7698.000	7698.000	7698.000	1006
Heater 1000 W	1	9769.015	9769.015	9769.015	9769.015	9769.015	9769.015	9769.015	9769.015	656
Thermostat	1	3110.000	3110.000	3110.000	3110.000	3110.000	3110.000	3110.000	3110.000	661

Accessories Page 832 **Rail systems** Page 917 **Cable entry** Page 964 **482.6 mm (19″) installation** Page 993 **Monitoring** Page 762

CS Basic enclosures, two-door



Material:
Enclosure, roof and doors:
2.0 mm aluminium AlMg3
Base/plinth:
3.0 mm aluminium AlMg3

Colour:
RAL 7035

Protection category:
IP 55 to EN 60 529/10.91
in conjunction with the gland plates available as accessories.

Supply includes:
Single-walled enclosure of all-round solid construction, with open base,
3-point locking via Ergoform padlock and lock cylinder.
Version without centre bar: overlapping doors, lockable door with r/h hinge.
Version with with centre bar: 2 lockable doors, base/plinth, rain canopy.

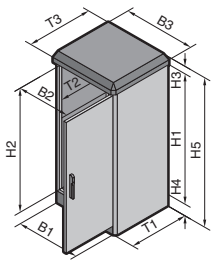
Detailed drawing,
available on the Internet.

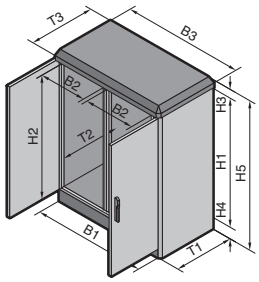
Width (B1) in mm	Packs of	1200	1200	1200	1200	Page
Height (H1) in mm		800	1200	1200	1400	
Depth (T1) in mm		400	400	500	400	
Clearance width (B2) in mm		511.4	511.4	511.4	511.4	
Clearance height (H2) in mm		711.4	1111.4	1111.4	1311.4	
Clearance depth (T2) in mm		349	349	449	349	
Rain canopy width (B3) in mm		1250	1250	1250	1250	
Rain canopy height (H3) in mm		75	75	75	75	
Rain canopy depth (T3) in mm		450	450	550	450	
Base/plinth height (H4) in mm		100	100	100	100	
Overall height (H5) in mm		975	1375	1375	1575	
Model No. CS without centre bar	1	**9784.110**[1)]	**9784.120**	**9784.140**	**9784.130**	
Model No. CS with centre bar	1	**9784.010**[1)]	**9784.020**	**9784.040**	**9784.030**	
Accessories						
Concrete base/plinth	1	9765.089	9765.089	9765.086	9765.089	842
One-piece gland plate	1 set	2 x 9785.017	2 x 9785.017	2 x 9785.020	2 x 9785.017	852
Gland plate, divided	1 set	2 x 9785.011	2 x 9785.011	2 x 9785.014	2 x 9785.011	852
Cable entry plates	1 set	4320.700	4320.700	4320.700	4320.700	852
Mounting plate for one half of the enclosure	1	9765.090	9765.092	9765.092	9765.098	916
Mounting plate	1	9765.190	9765.191	9765.191	9765.192	916
Mounting angles 482.6 mm (19″) for one half of the enclosure	2	7685.000	7688.000	7688.000	7689.000	1006
Divider kit for mounting angles 482.6 mm (19″)	2	7696.000	7696.000	7696.000	7696.000	1006
Heater 1000 W	1	9769.015	9769.015	9769.015	9769.015	656
Thermostat	1	3110.000	3110.000	3110.000	3110.000	661

[1)] Extended delivery times.

Accessories Page 832 **Rail systems** Page 917 **Cable entry** Page 964 **482.6 mm (19″) installation** Page 993 **Monitoring** Page 762

CS modular enclosures





Technical specifications:
Basic module:
Solid top and sides, solid base with 4 gland plates (width 600 mm with 2 gland plates).
Double-walled rear panel screw-fastened from the inside.
Double-walled door with Ergoform padlock handle with 3-point locking, foamed-in PU seal. Gas pressurised spring as door stay.
Double side panel across the enclosure and base/plinth, screw-fastened from the inside, screws not visible from the outside.
Rain canopy, 75 mm high, hinged, 25 mm projection on all sides.
Base/plinth, 100 mm high.

Material:
Enclosure, roof and side panel:
2.0 mm aluminium AlMg3
Base/plinth:
3.0 mm aluminium AlMg3

Colour:
RAL 7035

Protection category:
IP 55 to EN 60 529/10.91, complies with NEMA 3R.

Supply includes:
Twin-walled, fully assembled enclosure, consisting of basic module, roof, side panels and base/plinth.

Note:
Modular enclosure sheet steel, zinc-plated, on request.

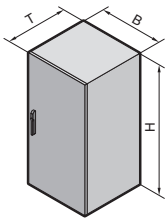
Property rights:
German patents
no. 196 09 699 and 196 09 704
German utility model
no. 296 23 678
European patents
no. 0 886 899 and 0 886 900
with validity for FR, IT, GB, SE
US patents no. 6,109,053 and 5,971,511
South Korean patents
no. 0 334 548 and 0 325 930
Japan. patent no. 3 401 015

Detailed drawing,
available on the Internet.

Width (B1) in mm	Packs of	600	800	800	1200	Page
Height (H1) in mm		1200	1200	1600	1200	
Depth (T1) in mm		600	500	600	600	
Clearance width (B2) in mm		511.4	711.4	711.4	511.4	
Clearance height (H2) in mm		1111.4	1111.4	1511.4	1111.4	
Clearance depth (T2) in mm		554	454	554	554	
Rain canopy width (B3) in mm		700	900	900	1300	
Rain canopy height (H3) in mm		75	75	75	75	
Rain canopy depth (T3) in mm		650	550	650	650	
Base/plinth height (H4) in mm		100	100	100	100	
Overall height (H5) in mm		1375	1375	1775	1375	
Model No. CS	1	**9751.125**	**9751.145**	**9751.165**	**9752.125**	
Accessories						
Concrete base/plinth	1	9765.083	9765.084	9765.085	9765.087	842
Mounting plate	1	9765.092	9765.095	9765.096	9765.191	916
Mounting angles, 482.6 mm (19″)	2	7688.000	7688.000	7690.000	7688.000	1006
Divider kit, 482.6 mm (19″)	2	7696.000	7698.000	7698.000	7696.000 + 4371.000	1006
Mounting angles, metric (T-slot)	2	–	7000.240	7000.330	7000.240	1006
Divider kit, metric	1	–	7000.100	7000.100	7000.100 + 4371.000	1006
Plastic gland plates	1	2562.500	2562.500	2562.500	2562.500	967
Metal gland plate, pre-punched	1	2562.100	2562.100	2562.100	2562.100	968
Support rails	4	4396.000	4395.000	4396.000	4396.000	927
Heater 1000 W	1	9769.015	9769.015	9769.015	9769.015	656
Thermostat	1	3110.000	3110.000	3110.000	3110.000	661
Enclosure light 48 V DC	1	9765.100	9765.100	9765.100	9765.100	955

Accessories Page 832 **Rail systems** Page 917 **Cable entry** Page 964 **482.6 mm (19″) installation** Page 993 **Monitoring** Page 762

CS modular enclosures, installation variants



Material:
2.0 mm aluminium AlMg3
Base/plinth, battery plinth:
3.0 mm aluminium AlMg3

Colour:
RAL 7035

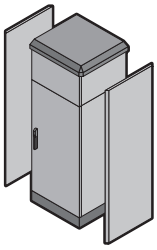
Protection category:
IP 55 to EN 60 529/10.91, complies with NEMA 3R.

Note:
Modular enclosures sheet steel, zinc-pl., available on request.

Other climate control devices, from page 826.
Please note the minimum enclosure dimensions when making your selection.

The enclosures are manufactured to order from individual modules.
Delivery times available on request.

Width (B) in mm	600	600	600	600	800	800	800	800	1200	1200	Page
Height (H) in mm	800	1000	1200	1600	1000	1200	1200	1600	1200	1200	
Depth (T) in mm	600	500	600	600	500	500	600	600	500	600	
Model No. CS	**9751.015**	**9751.075**	**9751.025**	**9751.035**	**9751.085**	**9751.045**	**9751.055**	**9751.065**	**9752.015**	**9752.025**	
Base/plinth											
Battery plinth 350 mm	**9754.025**	**9754.015**	**9754.025**	**9754.025**	**9754.035**	**9754.035**	**9754.045**	**9754.045**	2 x **9754.015**	2 x **9754.025**	
Standard base/plinth 100 mm	**9755.015**	**9755.065**	**9755.015**	**9755.015**	**9755.025**	**9755.025**	**9755.035**	**9755.035**	**9755.045**	**9755.055**	
Roof-mounted climate control											
Cooling unit	9762.012	9762.012	9762.012	9762.012	9762.012	9762.012	9762.012	9762.012	9762.012	9762.012	829
Heat exchangers	9764.012	9764.012	9764.012	9764.012	9764.012	9764.012	9764.012	9764.012	9764.012	9764.012	827
Climate hood	**9756.015**	**9756.065**	**9756.015**	**9756.015**	**9756.025**	**9756.025**	**9756.035**	**9756.035**	**9756.045**	**9756.055**	
Wall-mounted climate control											
Cooling unit	–	–	9761.012	9761.012	–	9761.032	9761.032	9761.032	9761.012	9761.012	829
Heat exchangers	–	–	9763.012	9763.012	–	9763.012	9763.012	9763.012	9763.012	9763.012	827
Roof											
Standard roof	**9757.015**	**9757.065**	**9757.015**	**9757.015**	**9757.025**	**9757.025**	**9757.035**	**9757.035**	**9757.045**	**9757.055**	
Roof for wall-mounted climate control	**–**	**–**	**9758.015**	**9758.015**	**–**	**9758.025**	**9758.035**	**9758.035**	**9758.045**	**9758.055**	
Side panel											
Side panel for 100 mm base/plinth	**9753.015**	**9753.175**	**9753.035**	**9753.045**	**9753.175**	**9753.025**	**9753.035**	**9753.045**	**9753.025**	**9753.035**	
Side panel for 350 mm base/plinth	**9753.055**	**9753.195**	**9753.075**	**9753.085**	**9753.195**	**9753.065**	**9753.075**	**9753.085**	**9753.065**	**9753.075**	
Side panel for 100 mm base/plinth and roof-mounted climate control	**9753.095**	**9753.185**	**9753.115**	**9753.125**	**9753.185**	**9753.105**	**9753.115**	**9753.125**	**9753.105**	**9753.115**	
Side panel for 350 mm base/plinth and roof-mounted climate control	**9753.135**	**9753.205**	**9753.155**	**9753.165**	**9753.205**	**9753.145**	**9753.155**	**9753.165**	**9753.145**	**9753.155**	

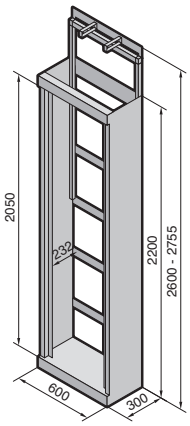


Order example:
Enclosure 600 x 800 x 600 mm of aluminium AlMg3 with standard base/plinth and roof-mounted cooling unit.

You will need:

Enclosure:	Basic enclosure 600 x 800 x 600 mm	**CS 9751.015**
Base/plinth:	Standard base/plinth 100 mm	**CS 9755.015**
Roof-mounted climate control:	Roof-mounted cooling unit	**CS 9762.012**
	Climate hood	**CS 9756.015**
Roof:	Standard roof	**CS 9757.015**
Side panel:	Side panel for 100 mm base/plinth and roof-mounted climate control	**CS 9753.095**

CS Indoor Rack



Material:
Side panels, roof and base frame:
Sheet steel, 2.0 mm
Mounting angles:
Extruded aluminium section

Surface finish:
Powder coated in textured RAL 7035
Mounting angles:
Natural aluminium, clear-chromated

Supply includes:
Screw-fastened frame, consisting of
2 side panels,
roof and base frame,
front plinth trim.
2 mounting angles,
ceiling attachment,
4 levelling feet,
4 rear panel struts,
enclosure panels, earthed.

Note:
The screw-fastened rack will accommodate metric or 482.6 mm (19″) installed equipment (to IEC 907 or IEC 297 and DIN 41 494). In addition to the basic rack, which satisfies the requirements of ETSI standard 300119-3, customised solutions can be designed in next to no time and implemented cost-effectively.

The following variants of the Indoor rack are available, amongst others:
- Solid front door
- Vented front door
- Horizontally divided doors
- Folding doors
- Overlapping doors
- Roof modules
- Cutouts in the enclosure panels
- Interior installation with system accessories

Detailed drawing,
available on the Internet.

Width in mm	Packs of	600
Height in mm		2200
Depth in mm		300
Clearance width in mm		500
Clearance height in mm		2050
Clearance depth in mm		232
Model No. CS with mounting angles 482.6 mm (19″)	1	**9790.042**
Model No. CS with mounting angles, metric	1	**9790.043**
Accessories		
Rear panel for screw fastening, sheet steel 2.0 mm	1	**9790.003**

Extended delivery times.

Accessories Page 832 **Component shelves** Page 939 **482.6 mm (19″) installation** Page 993

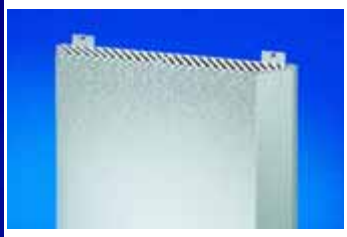
CS Outdoor climate control

Features

Rittal Communication Systems offer everything you need to protect your electronic equipment, from weather-tested enclosure solutions, to a variety of climate control components, through to complete security management systems. Cooling units, heat exchangers, fans and heaters especially designed for outdoor use ensure constant interior temperatures.

The protection category of IP 55 for the system as a whole is retained when using Outdoor heat exchangers and cooling units.

Flexible climate control



Climate control modules in various different output levels may be variably positioned on the door, rear panel, side panel or roof of the modular enclosure. For use in a temperature range from –33°C to +55°C (with cooling unit) or +65°C (with heat exchanger).

Cooling of the sensitive electronics in an outdoor enclosure requires **intelligent climate management.**

Rittal climate control modules keep the interior temperature at a consistently low level.

CS Toptec climate control

The **full 25 mm double wall** ensures heat exchange and minimises the influence of sunlight. The **concept for active climate control** with fixed cut-out dimensions and a depth-variable mounting frame leaves freedom of choice between a heat exchanger and a cooling unit, depending on the parameters at the installation site.

Heat exchanger for CS modular enclosures

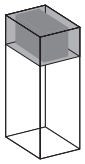
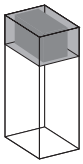
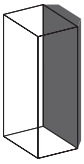
Type 1 for roof mounting
Without microcontroller, without heater.

Type 2 for roof mounting
With microcontroller and heater as standard.

Mounting frame:
required for CS 9765.051.

Type 3 for wall mounting
With microcontroller and heater as standard. For external mounting on side panels and rear panels.
The picture shows the heat exchanger with designer cover (not included in the supply).

Property rights for type 1:
German patent no. 196 09 794
US patent no. 6,092,384
European patent no. 0 913 015 with validity for FR, GB, IT, SE
Japan. patent no. 23 279 576
South Korean patent no. 0 337 973

					
Model No. CS		**9764.040**	**9764.012**	**9763.012**	Page
Installation		Type 1 Roof-mounted	Type 2 Roof-mounted	Type 3 wall-mounted	
Rated operating voltage	DC (fan/ microcontroller)	48 V			
	AC (heater)	–	230 V, 50/60 Hz		
Enclosure dimensions (mm)	W H D	470 158 380	535 390 400	515 1170 151.5	
Minimum enclosure dimensions (mm)	W x H/D x H	–	–	600 x 1200	
	W x D	600 x 500	600 x 500	–	
Specific thermal output		**30 W/K**	**60 W/K**	**60 W/K**	
Heater		–	400 W	400 W	
Rated current max.	DC (fan/ microcontroller)	1.3 A	3.1 A	3.2 A	
	AC (heater)	–	1.9 A	1.9 A	
Temperature range		–33°C to +65°C			
Air throughput of fans – unimpeded air flow	internal/external circuit fan	345 m^3/h	830 m^3/h	830 m^3/h	
Temperature control		without[1]	Microcontroller[2]		
Type of connection		Plug panel			
Weight		7 kg	17 kg	31 kg	
Protection category to EN 60 529/10.91		IP 55 (internal circuit to external circuit)			
Material (enclosure)		Aluminium		Sheet steel	
Surface finish		spray-finished in RAL 7035			
CE Declaration of Conformity		■	■	■	
UL/CUL		–	■	■	
Accessories					
Cable connection kit		9765.110	9765.110	9765.110	663
Thermostat		3110.000	–	–	661
Mounting frame		–	**9765.051**	–	–

[1] Customers may fit their own temperature control (SK 3110.000).
[2] With temperature-controlled activation of the components (internal/external circuit, heater). Setpoints are preset. Modifications can only be made by arrangement.

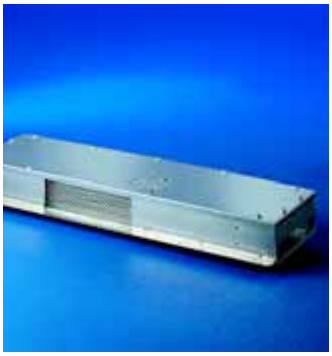
CS modular enclosures Page 823

CS Outdoor climate control

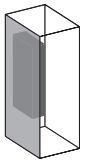
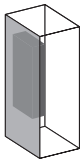
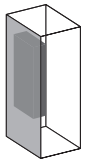
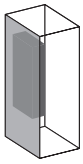
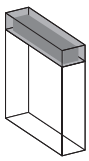
Heat exchanger for CS modular/compact enclosures

Type 4 for door mounting
With microcontroller and heater as standard.

Type 5 for door mounting
With microcontroller and heater as standard.



Type 6 for roof mounting
For installation in the rain canopy of the 1100 mm wide CS compact enclosure.

							
Model No. CS		**9768.032**	**9768.012**	**9768.042**	**9768.062**	**9767.012**	Page
Installation		Type 4 Door-mounted		Type 5 Door-mounted		Type 6 Roof-mounted[1]	
Rated operating voltage	DC (fan/ microcontroller)	48 V					
	AC (heater)	230 V, 50/60 Hz		–			
Enclosure dimensions (mm)	W H D	480 1005 110	510 1005 150	445 1050 150	575 1050 195	855 95 240	
Minimum enclosure dimensions (mm)	W H	600 1200	650 1200	650 1300	800 1300	1100 –	
Specific thermal output		**40 W/K**	**60 W/K**	**85 W/K**	**120 W/K**	**15 W/K**	
Heater		400 W		–			
Rated current max.	DC (fan/ microcontroller)	2.0 A	3.2 A	6.4 A	7.9 A	1.0 A	
	AC (heater)	1.9 A		–			
Temperature range		–33°C to +65°C					
Air throughput of fans – unimpeded air flow	Internal/external circuit fan	515 m^3/h	530 m^3/h	1020 m^3/h		100 m^3/h	
Temperature control		Microcontroller[2]				without[3]	
Type of connection		Plug panel			Sub-D connector 13W3[4]	Sub-D connector 3W3[4]	
Weight		13 kg	15 kg		32 kg	6 kg	
Protection category to EN 60 529/10.91		IP 55 (internal circuit to external circuit)					
Material (enclosure)		Aluminium					
Surface finish		spray finished in RAL 7035					
CE Declaration of Conformity		■	■	■	■	■	
UL/CUL		■	■	■	■	–	
Accessories							
Cable connection kit		9765.110	9765.110	9765.115	–	–	663
Thermostat		–	–	–	–	3110.000	661

[1] For compact enclosures.
[2] With temperature-controlled activation of the components (internal/external circuit, heater). Setpoints are preset. Modifications can only be made by arrangement.
[3] Customers may fit their own temperature control (SK 3110.000).
[4] Special connection cable included in the supply.

CS modular enclosures Page 823 **CS compact enclosures** Page 819

Cooling units for CS modular enclosures

Type 1 for roof mounting
With microcontroller and 400 watt heater as standard.

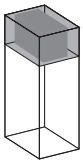
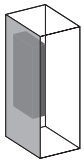
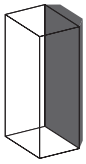
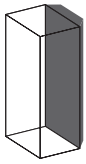
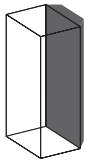
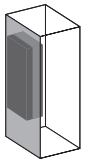
Mounting frame:
required for CS 9765.051.

Type 2 for door mounting
With microcontroller and 400 watt heater as standard.

Type 3 for wall mounting
With microcontroller and 400 watt heater as standard. Alternative mounting on the rear panel or side panels is also possible.
The picture shows the cooling unit with designer cover (not included in the supply).

Type 4 for universal installation
With microcontroller and 800 watt heater as standard.

Installation options:
- in the door or rear panel
- in the side panel

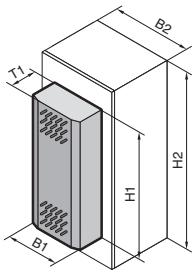
								
Model No. CS		**9762.012**	**9768.100**	**9761.012**	**9761.032**	**9761.042**	**9768.150**	Page
Installation		Type 1 Roof-mounted	Type 2 Door-mounted	Type 3 Wall-mounted			Type 4 Universal	
Rated operating voltage	AC	230 V, 50/60 Hz						
Enclosure dimensions (mm)	W H D	535 390 400	430 1070 210	515 1170 151,5	695 1132 151,5	776 1100 250	400 1050 310	
Minimum enclosure dimensions (mm)	W x H/D x H	–	600 x 1200	600 x 1200	800 x 1200	800 x 1200	600 x 1200	
	W x D	600 x 500	–	–	–	–	–	
Useful cooling output EN 814	**L35 L35** **L35 L50**	**900 W** **750 W**	**900 W** **650 W**	**900 W** **750 W**	**1400 W** **1050 W**	**2500 W** **2000 W**	**1500 W** **1250 W**	
Heater		400 W	400 W	400 W	400 W	400 W	800 W	
Rated current max.		4.0 A	4.0 A	3.5 A	5.5 A	10.0 A	5.8 A	
Start-up current max.		10.7 A	11.6 A	10.8 A	15.5 A	32.0 A	19.0 A	
Power consumption	L35 L35 L35 L50	460 W 520 W	470 W 530 W	450 W 520 W	900 W 1000 W	1450 W 1650 W	940 W 1045 W	
Coolant		R134a						
p. max.		26 bar	28 bar	24 bar	24 bar	28 bar	28 bar	
Temperature range		–33°C to +55°C						
Air throughput of fans – unimpeded air flow	Internal circuit fan External circuit fan	570 m^3/h 570 m^3/h	580 m^3/h 430 m^3/h	880 m^3/h 880 m^3/h	850 m^3/h 880 m^3/h	1450 m^3/h 1450 m^3/h	850 m^3/h 680 m^3/h	
Temperature control		Microcontroller[1)]						
Type of connection		Plug panel						
Weight		29 kg	31 kg	45 kg	48 kg	52 kg	40 kg	
Protection category to EN 60 529/10.91		IP 55 (internal circuit to external circuit)						
Material (enclosure)		Aluminium		Sheet steel		Aluminium		
Surface finish		spray-finished in RAL 7035						
CE Declaration of Conformity		■	■	■	■	■	■	
UL/CUL		–	–	■	■	–	–	
Accessories								
Cable connection kit		9765.105	9765.105	9765.105	9765.105	9765.105	9765.105	663
Mounting frame		**9765.051**	–	–	–	–	–	–

[1)] With temperature-controlled activation of the components (internal/external circuit, heater). Setpoints are preset. Modifications can only be made by arrangement.

CS modular enclosures Page 823

CS Outdoor climate control

Climate control units for CS Toptec



B = Width
T = Depth

1 Heat exchanger/cooling unit
With three mounting positions for internal mounting, partial internal mounting or external mounting plus a choice between cooling via front or rear door.

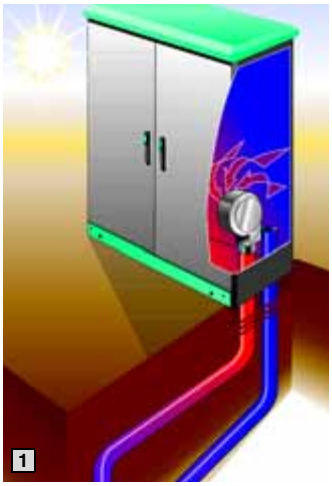
2 Heat exchanger/cooling unit
built into the CS Toptec

			Heat exchanger		Cooling units		Page
Model No. CS			**9776.100**	**9776.150**	**9776.500**	**9776.550**	
Installation			Universal		Universal		
Rated operating voltage	DC (fan/ microcontroller)		48 V		–		
	AC (heater)		–		230 V, 50/60 Hz		
Enclosure dimensions (mm)		B1 H1 T1	500 1000 150	500 1000 260	500 1000 150	500 1000 260	
Minimum enclosure dimensions mm			800 x 1200		800 x 1200		
Specific thermal output			**85 W/K**	**135 W/K**	**–**	**–**	
Useful cooling output EN 814		**L35 L35 L35 L50**	**–**	**–**	**1000 W/1020 W 680 W/555 W**	**1500 W/1425 W 1150 W/1060 W**	
Heater			–	–	400 W		
Rated current max.	DC (fan/ microcontroller)		4.5 A	8.0 A	–	–	
	AC (heater)		–		2.8 A/3.3 A	22.0 A/20.0 A	
Start-up current max.			–		7.5 A/8.3 A	8.0 A/9.6 A	
Power consumption		L35 L35 L35 L50	–		540 W/670 W 630 W/750 W	900 W 1000 W	
Coolant			–		R134a		
p. max.			–		28 bar	28 bar	
Temperature range			–		–33°C to +55°C		
Air throughput of fans – unimpeded air flow	Internal/ external circuit fan		530 m^3/h	–	580 m^3/h 630 m^3/h	880 m^3/h 950 m^3/h	
Temperature control			Microcontroller[1)]				
Type of connection			Plug panel		Female multi-point connector 9-pole		
Weight			25 kg	32 kg	31 kg	45 kg	
Protection category to EN 60 529/10.91			IP 55 (internal circuit to external circuit)				
Material (enclosure)			Aluminium				
Surface finish			spray-finished in RAL 7035				
CE Declaration of Conformity			■	■	■	■	
UL/CUL			–	–	–	–	
Accessories							
Cable connection kit			9765.115	9765.115	–	–	663

[1)] With temperature-controlled activation of the components (internal/external circuit, heater). Setpoints are preset. Modifications can only be made by arrangement.

CS Toptec Page 817

Geothermal heat exchangers, Terravent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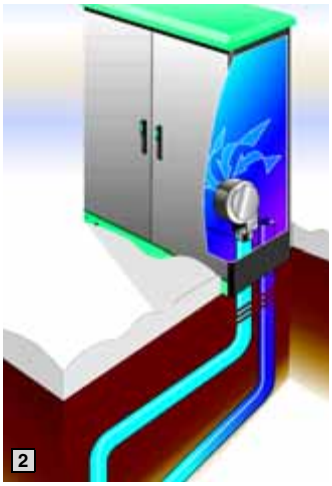
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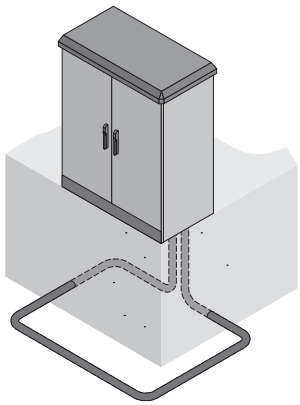
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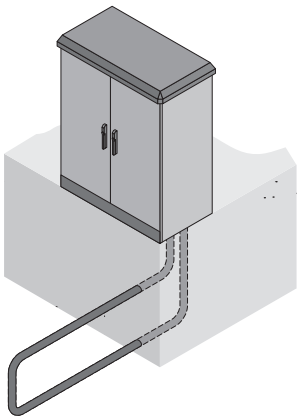
4

Rittal Terravent
This ingeniously simple and effective climate control principle, which uses geothermal effects to cool and heat, underscores Rittal's expertise in all aspects of enclosure systems for outdoor siting. The geothermal heat transmitter is suitable for use whenever earthworks are required to install an outdoor enclosure.
Throughout the world, at a certain depth beneath the earth's crust, the temperature is always roughly the same, whatever the season; and this fact is used to cool and heat outdoor enclosures. The hot air from the enclosure is forced into a pipe with a radial or axial fan.

A pipeline system laid in the earth cools the air, which in turn is used to cool the enclosure. In cool external temperatures, the temperature of the air inside the pipeline system rises, and this achieves a heating effect.
The inlet and outlet points of the pipes can be freely positioned to effectively avoid hot spots. Depending on the application, the air discharge and air inlet can be positioned in the base/plinth, in the roof, or at freely selectable positions inside the enclosure.

Benefits of the geothermal heat exchanger
- With the sealed ventilation system, ambient air is unable to penetrate the enclosure, which in turn prevents the ingress of humidity and aggressive pollutants from the air.
- Minimal energy requirements, since only a radial or axial fan is required to generate the air flow. The fan motors are available in various operating voltages.
- Reduction of noise emissions, since there are no active climate control components mounted on the outside of the enclosure.
- Minimal maintenance required for the fan system.
- Control, monitoring and alarm relays can be achieved via the CMC.

US patent no. 6,523,602

1 With a radial or axial fan, the hot air from the enclosure is forced into a pipe. A pipeline system laid in the earth cools the air, which in turn is used to cool the enclosure.

2 In cool external temperatures, the temperature of the air inside the pipeline system rises, and this achieves a heating effect.

3 **With the pipeline system laid horizontally**
Excellent heat dissipation is effected, because the pipeline system is laid horizontally on one level. Major excavation work is, however, required.

4 **With the pipeline system laid vertically**
The pipeline system to and from the outdoor enclosure is laid in a pit. The effects of heat dissipation are somewhat less pronounced, but the pipes are simply laid in a pit where the supply lines to the enclosure can also be laid.

Terravent supply includes
- Calculation of the maximum required and maximum possible thermal output.
- Calculation and dimensioning of the fan, the pipe diameter, the pipe length, and the best way of laying the pipe.
- Determination of the optimum positioning of the air inlet and air outlet on the enclosure.
- Supply of all components, pre-assembly of the fan pipe fixtures in the outdoor enclosure, installation of the fan, insulation of the enclosure (where necessary).

Packs of	Model No. CS
1 set	9767.500

Examples of temperature variation,
see page 1185.

System accessories

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Base/plinth TS 834
Base/plinth 843
Base 848

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Divider panels 857
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Module plates 859

Baying system from page 861

For TS 8 861
Baying at the installation site 862
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Doors/locks from page 869

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Viewing panels/operating panels 877
Lock systems 881
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Roof/wall mounting from page 899

Roof 899
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Assembly components ... 931
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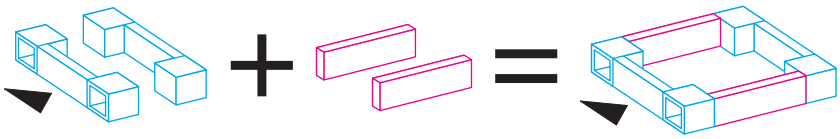
Base/plinth TS



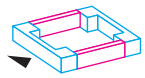
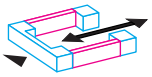
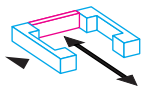
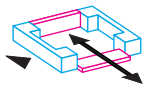
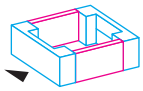
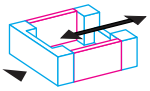
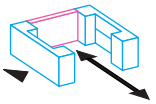
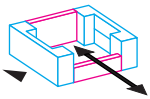
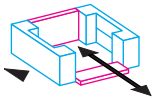
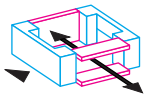
One Model No.
for the
base/plinth components
front and rear.

One Model No.
for the
base/plinth trims
at the sides.

A complete
base/plinth.

Modular base/plinth diversity

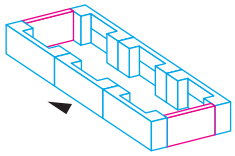
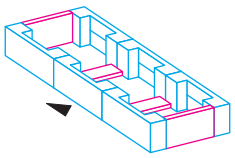
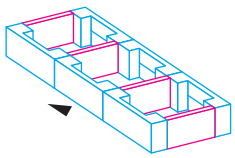
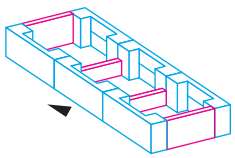
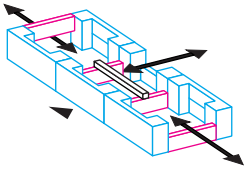
Regardless of the enclosure depth:
The base/plinth components at the front and rear, pre-configured with corner pieces, are always the same for the chosen width.
Only the side trim panels are selected according to the enclosure depth and the required base/plinth configuration. The modular concept produces exceptional advantages in terms of cost and function.
Assembly to the enclosure is conveniently carried out from the outside. The base/plinth interior offers diverse opportunities for mounting levels for cable management.

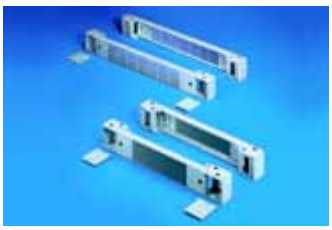
Base/plinth height	Basic form	Cable gland options			Stabilisation of bayed base/plinth	
100 mm						
200 mm						

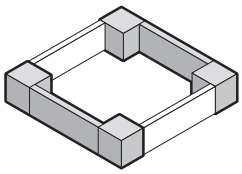
Function and cost benefits

Fewer parts, more opportunities, lower purchasing, storage and assembly costs – the formula for the new modular base/plinth system.

The following table shows three bayed base/plinths in 200 mm height illustrating a wide range of possible solutions and the potential savings with trim panels compared with the previous 200 mm base/plinth system each with two trim panels of 100 mm height at the sides.

Sample solutions	New supply includes	Functional benefits	Savings potential compared with twelve 100 mm trim panels
	3 packs of base/plinth components 1 pack of base plinth trim panels 200 mm high	Continuous cable chamber	2 trim panels 200 mm
	3 packs of base/plinth components 1 pack of base plinth trim panels 200 mm high 1 pack of base plinth trim panels 100 mm high 1 pack of base/plinth baying bracket TS 8601.100 (packs of 20) 4 units are required for this solution	Additional stabilisation for transportation purposes with base/plinth trim rotated through 90°	2 trim panels 200 mm 2 trim panels 100 mm
	3 packs of base/plinth components 2 packs of base plinth trim panels 200 mm high	Shielding of the base/plinths from one another	4 trim panels 200 mm
	3 packs of base/plinth components 1 pack of base plinth trim panels 200 mm high 1 pack of base plinth trim panels 100 mm high	Additional connection of the base/plinth	2 trim panels 200 mm 2 trim panels 100 mm
	Other options: • Cable entry at the side by mounting a 100 mm base/plinth trim panel (top or bottom). • Cable entry from the rear by dismantling one or more trim panels of the base/plinth components. • Cable clamp rail fitted on the 100 mm high trim panel.		





Base/plinth components front and rear

Sheet steel
for TS, CM, CL, PC-TS, IW, FR(i), TE
Base/plinth component consisting of one trim panel and two pre-configured corner pieces.
In 200 mm high base/plinth components, one trim panel is divided into two for cable entry.

Material:
Sheet steel, spray-finished
Cover caps plastic RAL 9005/7035

Supply includes:
1 set =
2 base/plinth components, 4 cover caps,
4 screws and captive nuts M12
for mounting on the enclosure.

Accessories:

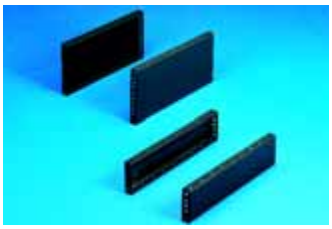
Base assembly plate SO 2817.000,
see page 838.
Filter mat for trim panel, vented,
see page 840.

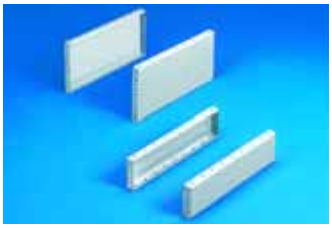
Detailed drawing,
see page 836.

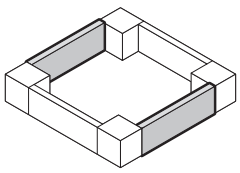
German patent no. 198 60 408

For enclosure width mm	Version	Colour		Model No. TS	
		RAL 7022	RAL 7035	100 mm high	200 mm high
400	Solid	■	–	**8601.400**	**8602.400**
500	Solid	■	–	**8601.500**	**8602.500**
600	Solid	■	–	**8601.600**	**8602.600**
	Solid	–	■	**8601.605**[1]	**8602.605**
	Vented	–	■	**7825.601**[2]	**–**
	Vented with designer cover	–	■	**7825.603**	**–**
800	Solid	■	–	**8601.800**	**8602.800**
	Solid	–	■	**8601.805**	**8602.805**
	Vented	–	■	**7825.801**	**–**
	Vented with designer cover	–	■	**7825.803**	**–**
850	Solid	■	–	**8601.850**	**8602.850**
1000	Solid	■	–	**8601.000**	**8602.000**
1100	Solid	■	–	**8601.300**	**8602.100**
1200	Solid	■	–	**8601.200**	**8602.200**

[1] **Version in RAL 9005: TS 8601.602**
[2] **Version in RAL 9005: TS 7825.605**







Base/plinth trim, side

Sheet steel
for TS, CM, CL, PC-TS, IW, FR(i), TE
For mounting between the base/plinth components. At 200 mm height, two 100 mm base/plinth trims may be used. Base/plinth trim panels (100 mm high) may be installed rotated through 90° in order to stabilise bayed base/plinth components.

Material:
Sheet steel, spray-finished

Supply includes:
1 set =
2 base/plinth trim panels, including parts for attaching to the base/plinth components.

Also required:

Base/plinth baying bracket TS 8601.100,
see page 838,
when base/plinth components are fitted by rotating through 90°.

Accessories:

Assembly bolts for base/plinth,
see page 838.

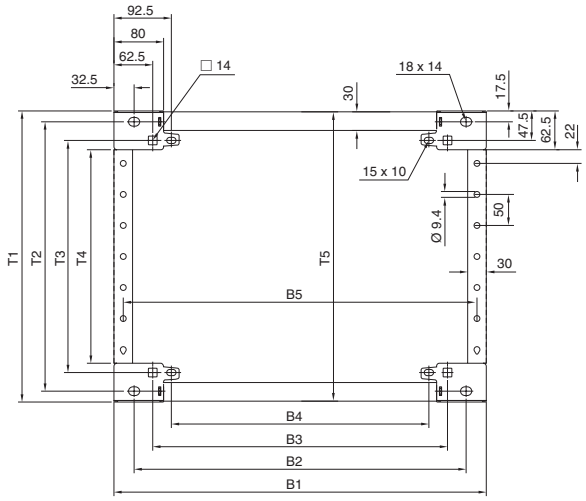
Detailed drawing,
see page 836.

For enclosure depth mm	Colour		Model No. TS	
	RAL 7022	RAL 7035	100 mm high	200 mm high
300	■	–	**8601.030**	**8602.030**
400	■	–	**8601.040**	**8602.040**
500	■	–	**8601.050**	**8602.050**
600	■	–	**8601.060**	**8602.060**
	–	■	**8601.065**	**8602.065**
800	■	–	**8601.080**	**8602.080**
	–	■	**8601.085**	**8602.085**
900	–	■	**8601.095**[1]	**8602.095**
1000	–	■	**8601.015**[2]	**8602.015**

[1] **Version in RAL 9005: TS 8601.090**
[2] **Version in RAL 9005: TS 8601.010**

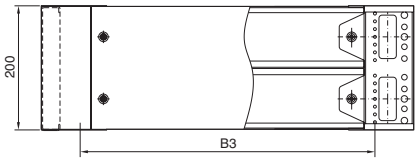
Base/plinth TS

Base/plinth TS
Sheet steel



Plinth, 100 mm high

Plinth, 200 mm high



Description of the hole patterns

B1/T1 = External dimensions

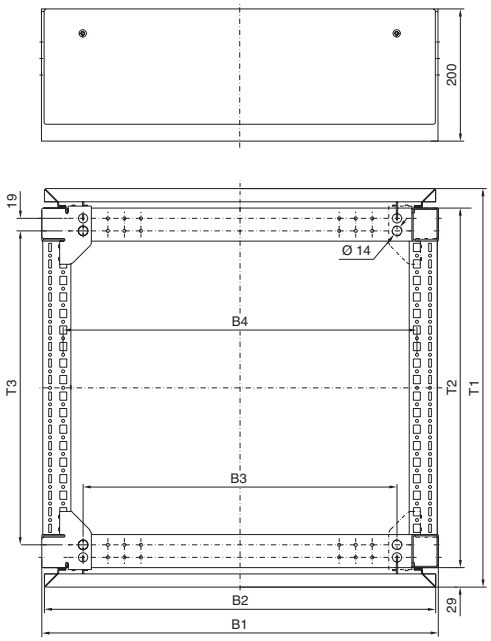
B2/T2 = For screw-fastening in the thread of the enclosure corner piece from below

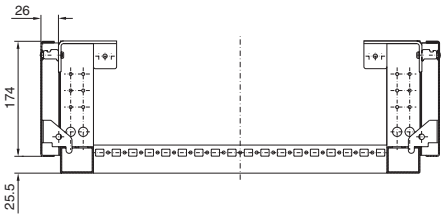
B3/T3 = for screw-fastening with captive nuts to the enclosure base from below or above

All holes (B2 – B4/T2 – T4) may be used for screw-fastening to the base.

Base/plinth components front/rear						Base/plinth trim, side						Page
Width mm	B1	B2	B3	B4	B5	Depth mm	T1	T2	T3	T4	T5	
–	–	–	–	–	–	300	269	235	175	144	268	835
400	400	335	275	215	370	400	369	335	275	244	368	835
500	500	435	375	315	470	500	469	435	375	344	468	835
600	600	535	475	415	570	600	569	535	475	444	568	835
800	800	735	675	615	770	800	769	735	675	644	768	835
850	850	785	725	665	820	–	–	–	–	–	–	835
1000	1000	935	875	815	970	900	869	835	775	744	868	835
1100	1100	1035	975	915	1070	–	–	–	–	–	–	835
1200	1200	1135	1075	1015	1170	1000	969	935	875	844	968	835

Cable chamber
for TS





Enclosure width mm	400	600	800	1200
B1	400	600	800	1200
B2	392	592	792	1192
B3	275	475	675	1075
B4	335	535	735	1135

Enclosure depth mm	500	600
T1	502	602
T2	444	544
T3	375	475

Cable chamber

for TS
The front and rear sheet steel trim panels are simply plugged in at the bottom by means of a guide, and are screw-fastened to the frame. Cable chambers can be bayed at the sides if required; they are bayed in the same way as base frames.

Material:
Sheet steel

Colour:
RAL 7035

Supply includes:
Assembly parts for mounting on the enclosure.

For enclosures		Model No. TS
Width mm	Depth mm	
400	500	**8600.455**
400	600	**8600.465**
600	500	**8600.655**
600	600	**8600.665**
800	500	**8600.855**
800	600	**8600.865**
1200	500	**8600.255**
1200	600	**8600.265**

To order versions in RAL 7032, please use order number extension .XX0.
For primed version, please add extension .XX1 to the Model No.
Delivery times on request.

Accessories:

Side panels for cable chamber,
see page 837.

Detailed drawing,
see page 836.

Side panels

for cable chamber
Attachment is achieved by simply plugging in, flipping up and screw-fastening.

Material:
Sheet steel

Colour:
RAL 7035

Supply includes:
Assembly parts.

For enclosure depth mm	Packs of	Model No. TS
500	2	**8600.510**
600	2	**8600.520**

To order versions in RAL 7032, please use order number extension .0X0.
For primed version, please add extension .XX1 to the Model No.
Delivery times on request.

Transport castors

for base/plinth TS
For locating onto the base/plinth corner piece 100 or 200 mm high by raising or tilting.

Load capacity:
Maximum permissible load per twin castor:
static: 100 kg

Supply includes:
1 set =
4 twin castors,
2 with, 2 without brakes.

Colour:
RAL 7022

Note:
Base/plinth trims, side, must be fitted in a free-standing position.

Ground clearance mm	Model No. TS
100	**8800.390**

Also required:

Base/plinth trim, side,
see page 835.

Base/plinth TS

Base assembly plate

for base/plinth TS and base/plinth, complete
For fastening the plinth to the floor without moving the enclosure or the bayed enclosure suite. For assembly screws up to 12 mm Ø.

Material:
Sheet steel, zinc-plated, passivated

Packs of	Model No. SO
10	**2817.000**

Fastening bolts

For
- **Base/plinth TS**
- **Base/plinth, complete**
- **Base/plinth, stationary**

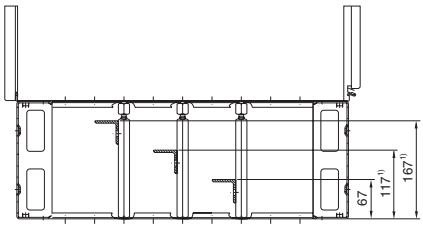
For mounting on base/plinth trim panels, side. The lockable assembly bolt allows the installation of cable clamp rails and standard C rails.

Material:
Hexagon steel, zinc-plated, passivated,
19 mm across flats

Base/plinth trim panel mm high	Packs of	Model No. SZ
100	10	**2819.000**
200	10	**2819.200**

Accessories:

Cable clamp rail,
see page 979.



1) only for height 200 mm

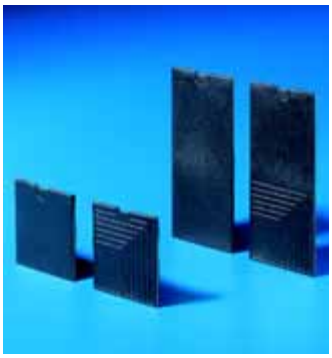
Base/plinth baying brackets

for base/plinth TS
Essential if the trim panels are mounted rotated through 90° for additional stabilisation during the transportation of bayed enclosures.
Additionally required for each trim panel: 2 units.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Screws M8 x 16 mm.

Packs of	Model No. TS
20	**8601.100**



Cover cap

for base/plinth components TS
As a replacement.

Material:
Plastic ABS

Colour:
RAL 9005

For base/plinth height mm	Packs of	Model No. TS
100	4	**8601.130**
200	4	**8601.140**

Base/plinth trim

with brush strip
for TS base/plinth

The supplement to the modular base/plinth concept (see page 834).
May also be exchanged retrospectively for the front or rear trim panel of the base/plinth components 100 or 200 mm high. By rotating the trim panel, the hammer-head strip for cable attachment may optionally be positioned at the top or bottom.

Material:
Sheet steel, spray-finished

Width mm	Height mm	Model No. TS	
		RAL 7022	RAL 7035
600	100	**8601.610**	**8601.615**

Accessories:

Cable tie SZ 2597.000,
see page 982.

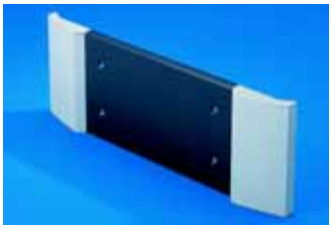
Connecting plinth trim

for base/plinth TS

For covering gaps in the case of back to back or corner enclosure suites. Simply push in between the trim panel and the corner piece before tightening the screws.

Material:
Sheet steel

For base/plinth height mm	Colour RAL	Packs of	Model No. TS
100	7022	2	**8601.110**
200	7022	2	**8601.120**
100	7035	2	**8601.115**
200	7035	2	**8601.125**



Base/plinth trim

for base/plinth TS

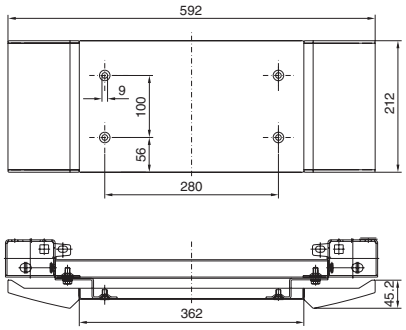
To continue the design of the
- bottom front door of PC enclosures based on TS,
- door of the IW enclosure.

The base/plinth trim is screw-fastened to the corner pieces of the TS base/plinth components from the outside.

Material:
Sheet steel, spray-finished
Designer covers: Extruded aluminium section

Colour:
RAL 7015
Designer covers: RAL 7035

Width mm	Height mm	Model No. PC
600	200	**8360.920**



Base/plinth TS

Base/plinth, stationary

for PC-TS, IW
Adapted to the design of the enclosure,
Height 100 mm, front projection.

Material:
Sheet steel, 2.0 mm

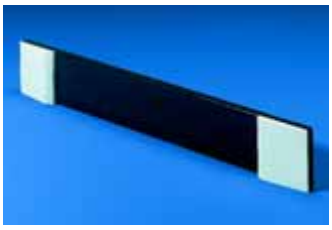
Colour:
RAL 7035
design component, front: RAL 7015

Supply includes:
1 design component, front
1 base/plinth component, rear
2 base/plinth trims, side

For depth mm	Model No. PC
600	**8800.920**
800	**8800.930**

Accessories:

Attachment opportunities for:
- Twin castors PC 4634.500, see page 848,
- Levelling feet PS 4612.000, see page 848,
- Fastening bolts for cable clamp rails SO 2819.000, see page 838,
- Support bracket PS 4183.000, see page 933.



Designer cover

for base/plinth TS
to continue the design of the
- Designer glazed door TS
- Designer sheet steel door TS

The trim panel is simply exchanged for the existing front trim panel of the base/plinth.

Material:
Sheet steel, spray-finished
design elements: Aluminium, spray-finished

Colour:
RAL 7024,
Design elements: RAL 7035

Supply includes:
Assembly parts.

Enclosure width mm	Version	Model No. DK
800	Solid	**7825.804**
800	Vented	**7825.806**

Filter mat

For
- **Base/plinth component, vented**
- **Base/plinth component, vented with designer trim**

To cover the trim panel in the base/plinth component.
The mounting frame simply clips into the base/plinth trim panel from behind.
Filter class G3 to DIN EN 779.

Supply includes:
Assembly frame.

For enclosure width mm	Packs of	Model No. DK
600	1	**7561.500**
800	1	**7581.500**

Spare filter mat

Supply includes:
Filter mat without mounting frames for base/plinth trim panels up to 800 mm wide.

	Packs of	Model No. DK
Spare filter mats	5	**7582.500**

Base/plinth components front and rear

Stainless steel for TS, CM, CL

Material:
Stainless steel 1.4301

Surface finish:
Brushed

Supply includes:
Assembly parts including 4 screws and captive nuts M12 for mounting on the enclosure.

100 mm high:
2 trim panels front/rear

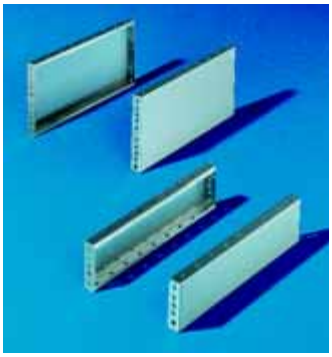
200 mm high:
2 corner pieces with removable trim panel, 1 trim panel front/rear.

For enclosure width mm	Model No. TS	
	100 mm high	200 mm high
600	**8701.600**	**8702.600**
800	**8701.800**	**8702.800**
1200	**8701.200**	**8702.200**

To order enclosures in stainless steel 1.4404 (AISI 316L) please add the extension .X05 to the Model No.
Delivery times on request.

Accessories:

Base/plinth trim, modular (perforated plate), see page 841.



Base/plinth trim, side

Stainless steel for TS, CM, CL

For mounting between the base/plinth components. At 200 mm height, two 100 mm base/plinth trims may be used.
Base/plinth trim (100 mm high) may be installed rotated through 90° in order to stabilise bayed base/plinth components.

Material:
Stainless steel 1.4301

Surface finish:
Brushed

Supply includes:
2 base/plinth trim panels, including parts for attaching to the base/plinth components.

For enclosure depth mm	Model No. TS	
	100 mm high	200 mm high
400	**8701.040**	**8702.040**
500	**8701.050**	**8702.050**
600	**8701.060**	**8702.060**

To order enclosures in stainless steel 1.4404 (AISI 316L) please add the extension .0X5 to the Model No.
Delivery times on request.

Also required:

Base/plinth baying bracket TS 8601.100, see page 838, when base/plinth components are fitted by rotating through 90°.

Accessories:

Assembly bolts for base/plinth, see page 838.
Levelling feet PS 4612.000, see page 848.

1 Base/plinth comp., front/rear
2 Base/plinth trim panels, side
3 Base/plinth corner piece
4 Trim panel, removable

Description of the hole patterns

B/T =
enclosure dimensions

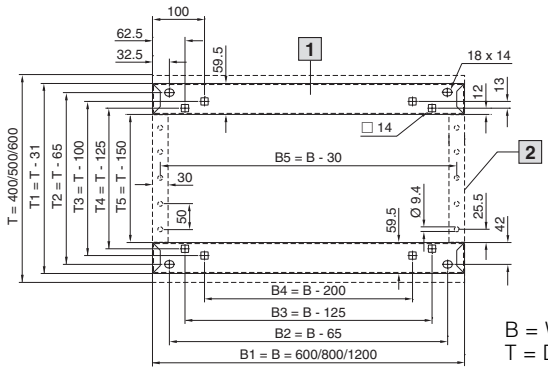
B1/T1 =
external dimensions

B2/T2 =
for screw-fastening in the thread of the enclosure corner piece from below

B3/T3 =
for screw-fastening with captive nuts to the enclosure base from below or above

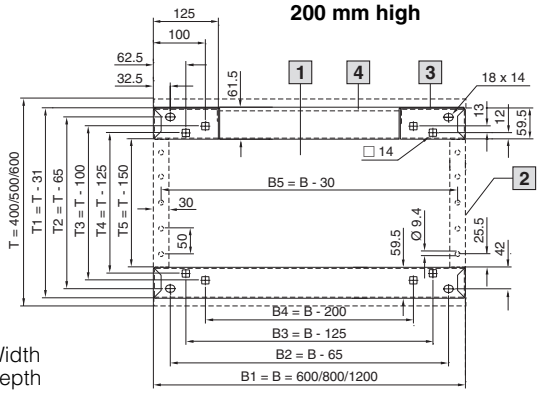
All holes (B2 – B4/T2 – T4) may be used for screw-fastening to the base.

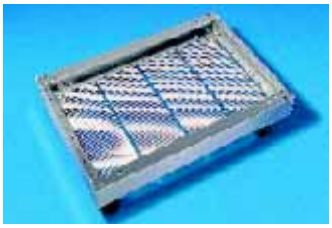
100 mm high



B = Width
T = Depth

200 mm high





Base/plinth trim, modular

for base/plinth TS and base/plinth, complete stainless steel

For cable routing in the stainless steel base/plinth, i.e. if levelling feet SO 2889.000 or SO 2890.000, see page 845, are used.
Width: 175 mm.

Material:
Stainless steel 1.4301

Supply includes:
4 base/plinth trim panels.

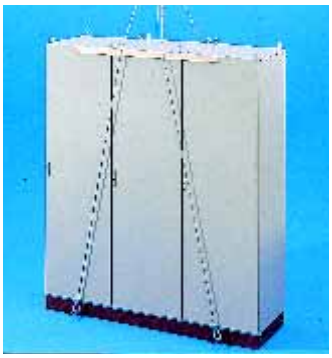
For enclosure depth mm	No. of base/plinth trims required for base/plinth width[1]				Model No. SO
	600 mm	800 mm	1000 mm	1200 mm	
400	3	4	5	6	**2907.000**
500	3	4	5	6	**2908.000**
600	3	4	5	6	**2913.000**

[1] If the surface is to be completely sealed.

Accessories:

Cable tie SZ 2597.000, see page 982.

Base/plinth TS



Transport plinth

for TS

For the transportation of heavy, bayed enclosure suites. Available in 200 mm increments from 2 to 5 m.
Transport plinths can have 2 tubes welded to receive cross-bars for transportation.
Variable punchings to suit all enclosure widths of 600 mm and above.

Surface finish:
Primed in reddish-brown rust-inhibiting paint, optionally spray-finished.

Note:
Please state the required width and depth of the enclosure suite when ordering.

Version with transport tubes

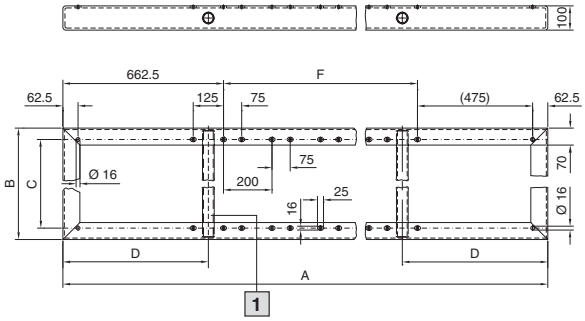
Colour	Packs of	Model No. SO
Primed, reddish-brown rust-inhibiting paint	1	**1228.010**
Similar to RAL 7022	1	**1228.110**
Similar to RAL 7032	1	**1228.210**
Similar to RAL 7035	1	**1228.310**

Delivery times on request.

Version without transport tubes

Colour	Packs of	Model No. SO
Primed, reddish-brown rust-inhibiting paint	1	**1228.000**
Similar to RAL 7022	1	**1228.100**
Similar to RAL 7032	1	**1228.200**
Similar to RAL 7035	1	**1228.300**

Delivery times on request.

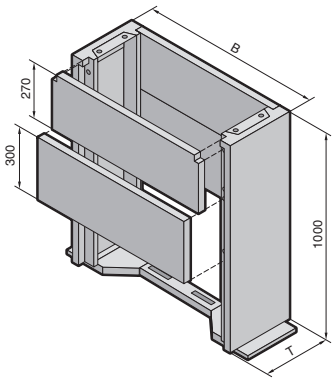


1 Optionally transport tube, internal diameter 40 mm and wall thickness of 3.25 mm

A	2000	2200	2400	2600	2800	3000	3200	3400
D	300	300	300	300	300	600	600	600
F	800	1000	1200	1400	1600	1800	2000	2200

A	3600	3800	4000	4200	4400	4600	4800	5000
D	600	600	600	1000	1000	1000	1000	1000
F	2400	2600	2800	3000	3200	3400	3600	3800

Enclosure depth mm	B	C
400	369	275
500	469	375
600	569	475
800	769	675



Concrete base/plinth

for Outdoor enclosures

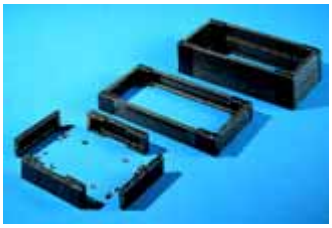
The base/plinth is made from pre-cast concrete sections which are easily fitted in situ. Front/rear base/plinth plates may be withdrawn for servicing works.
Total height approx. 1000 mm,
excavation depth approx. 700 mm.

Material/Surface finish:
Light concrete, untreated

Supply includes:
1 base plate,
2 side parts,
two-piece rear and front panel,
assembly parts
and fastening screws for mounting the enclosure.

For enclosures/housings		Model No. CS
Width (B) mm	Depth (T) mm	
Outdoor compact enclosures		
800	350	**1616.300**
1200	350	**1616.310**
CS compact enclosures		
800	320	**9765.080**
1100	320	**9765.081**
CS modular and basic enclosures		
600	400	**9765.182**
600	500	**9765.082**
600	600	**9765.083**
800	400	**9765.088**
800	500	**9765.084**
800	600	**9765.085**
1200	400	**9765.089**
1200	500	**9765.086**
1200	600	**9765.087**
CS Toptec		
650	650	**9765.184**
800	650	**9765.185**

Extended delivery times.
Other modules available on request.



Base/plinth, complete

Sheet steel for
AE, AK, AP, AP universal console, ES, PC-ES
Consisting of:
Trim panels at the front and rear with fitted corner pieces and side trim panels.

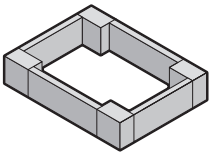
Material:
Sheet steel, spray-finished

Colour:
RAL 7022

Supply includes:
Assembly parts including 4 screws and captive nuts M12 for mounting on the enclosure.

100 mm high:
4 corner pieces, 2 trim panels front/rear,
2 trim panels, side

200 mm high:
4 corner pieces, 1 trim panel front/rear x 200 mm,
2 trim panels front/rear x 100 mm,
4 trim panels, side



Base/plinth for ES, PC-ES, AP universal console

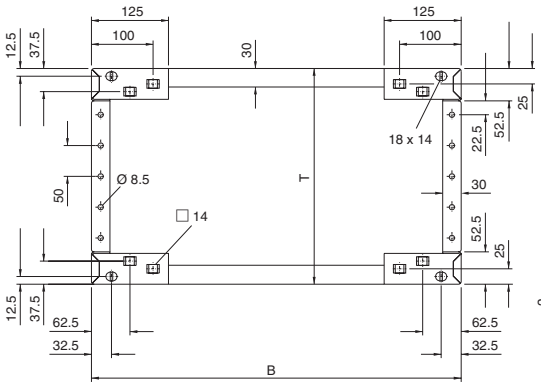
For enclosures/consoles			Model No. SO	
Width mm	Depth mm	Base/plinth depth (T) mm	100 mm high	200 mm high
600	400	350	**2804.200**	**2805.200**
600	500	450	**2807.200**	**2808.200**
600	600	550	**2813.200**	**2814.200**
600	800	750	**2846.200**	**2847.200**
800	400	350	**2823.200**	**2824.200**
800	500	450	**2829.200**	**2830.200**
1000	400	350	**2909.200**	**2910.200**
1200	400	350	**2836.200**	**2837.200**
1200	500	450	**2839.200**	**2840.200**
1600	400	350	**2905.200**	**2906.200**
1800	500	450	**2903.200**	**2904.200**

Base/plinth for AE, AK, AP

For enclosures/consoles			Model No. SO	
Width mm	Depth mm	Base/plinth depth (T) mm	100 mm high	200 mm high
600	300	279	**2816.200**	**2826.200**
600	400	370	**2911.200**	**2912.200**
800	300	279	**2818.200**	**2828.200**
800	400	370	**2901.200**	**2902.200**
800	500	440	**2841.200**	**2842.200**
1000	300	279	**2801.200**	**2802.200**
1000	400	370	**2891.200**	**2892.200**
1200	400	370	**2921.200**	**2922.200**
1200	500	440	**2851.200**	**2852.200**
1600	400	370	**2961.200**	**2962.200**
1600	500	440	**2863.200**	**2864.200**

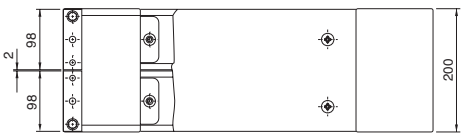
Accessories:

Assembly bolts for base/plinth,
see page 838.
Base assembly plate,
see page 838.

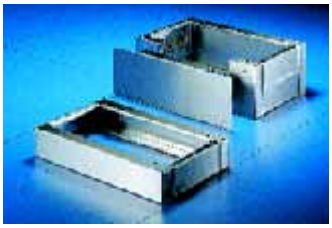


Plinth, 100 mm high

Plinth, 200 mm high



Base/plinth



Base/plinth, complete

Stainless steel
for ES, PC-ES, AP

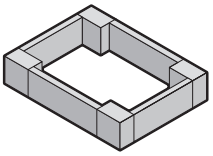
Material:
Stainless steel 1.4301

Surface finish:
Brushed

Supply includes:
Assembly parts including 4 screws and captive nuts M12 for mounting on the enclosure.

100 mm high:
2 trim panels front/rear,
2 trim panels, side

200 mm high:
2 corner pieces with removable trim panel,
1 trim panel front/rear, 4 trim panels, side.



Accessories:

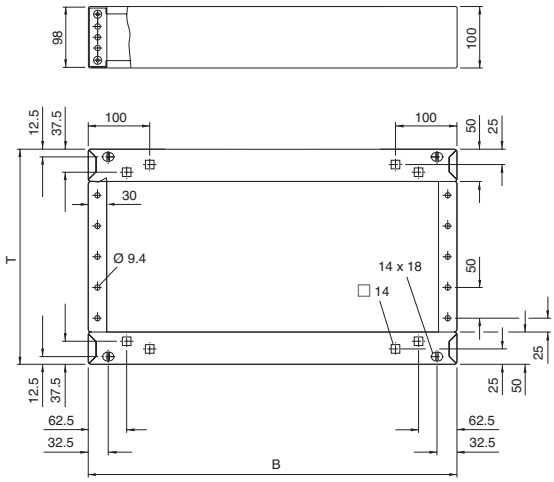
Levelling feet,
see page 845.
Base/plinth trim, modular (perforated plate),
see page 841.

Base/plinth for ES, PC, AP

For enclosures/consoles		Model No. SO	
Width mm	Depth mm	100 mm high	200 mm high
600	400	**2865.000**	**2875.000**
600	500	**2868.000**	**2876.000**
600	600	**2855.000**	**2877.000**
800	400	**2869.000**	**2878.000**
800	500	**2866.000**	**2879.000**
800	600	**2856.000**	**2880.000**
1000	400	**2867.000**	**2885.000**
1200	400	**2870.000**	**2886.000**
1200	500	**2860.000**	**2887.000**

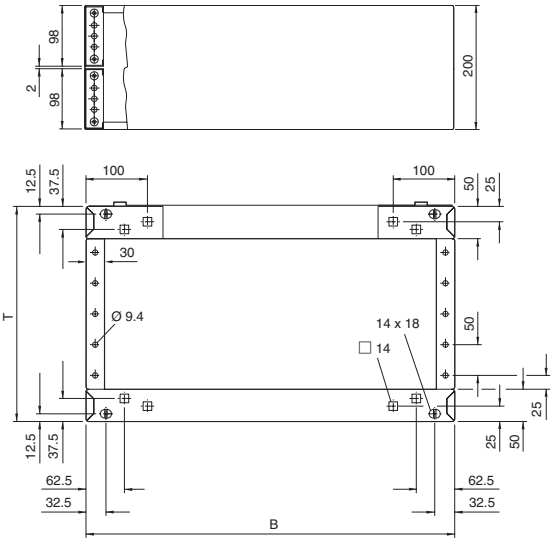
To order enclosures in 1.4404 (AISI 316L) please add the extension .500 to the Model No.
Delivery times available on request.

Plinth, 100 mm high



T = Enclosure depth – 50 mm
B = Enclosure width

Plinth, 200 mm high



T = Enclosure depth – 50 mm
B = Enclosure width

Transport castors

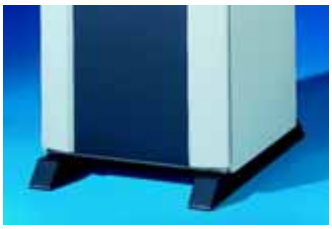
for base/plinth, complete
For locating onto the base/plinth corner piece 100 or 200 mm high by raising or tilting.

Load capacity:
Maximum permissible static load:
100 kg per twin castor

Supply includes:
1 set =
4 twin castors,
2 with, 2 without brakes.

Colour:
RAL 7022

Ground clearance mm	Model No. PS
60	**4570.000**



Cross-member

for TS, PC, IW, ES, AP
adjustable

To increase stability, the cross-member is positioned 138 mm above the base frame of the enclosure at the front and rear. For deeper enclosures, the rear part may be extended and screw-fastened again. For screw-fastening to the floor and enclosure with mounting hole at the sides front and rear. The castors and levelling feet may be secured to the welded nuts M12.

Material:
Sheet steel, spray-finished

Colour:
RAL 7015

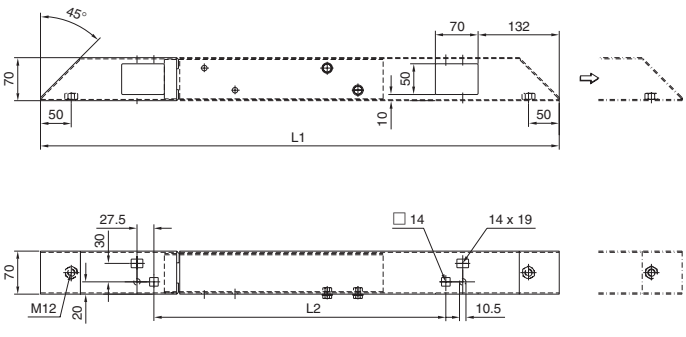
Note:
For mobile use, the cross-member must be screw-fastened twice in the corners of the enclosure.

For	Enclosure depth mm	L1	L2	Packs of	Model No. TS/AP
TS, PC, IW, ES	400	644	275	2	**8601.450**
	500	744	375		
	600	844	475	2	**8601.680**
	800	1044	675		
AP	400	634	320	2	**2697.450**
	500	734	390		

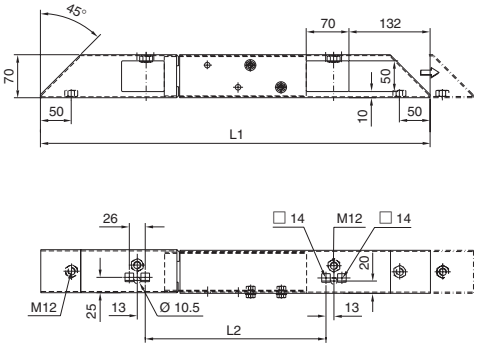
Accessories:

Attachment opportunities for
- Twin castors PC 4634.500, see page 848.
- Levelling feet PS 4612.000, see page 848.

TS 8601.450, TS 8601.680



AP 2697.450



Cast feet

For IW

For secure siting of
- enclosure for tower PC

or
- other own assemblies

Depth 700 mm

Material:
Cast aluminium

Colour:
RAL 7035

Supply includes:
Assembly parts.

Packs of	Model No. IW
2	**6902.920**

Accessories:

Base mount CP 6147.000, see page 233.
Twin castors, see page 848.

Levelling feet

For direct mounting underneath the base/plinth TS and the base/plinth, complete.
For unhindered access e.g. when cleaning the floor, and to compensate for floor irregularities.

Load capacity:
Maximum permissible static load:
400 kg per levelling foot

Adjustment range:
M12: 55 mm – 125 mm
M16: 45 mm – 120 mm

Material:
Stainless steel 1.4301

Thread	Packs of	Model No. SO
M12	4	**2889.000**
M16	4	**2890.000**

German utility model no. G 9406 468

Base/plinth

Base/plinth, mobile

For PC enclosure based on ES
Not assembled

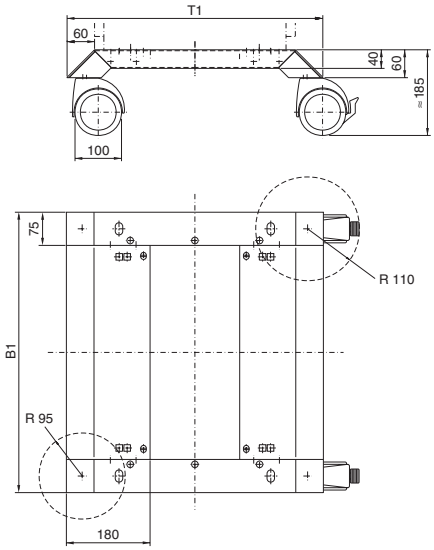
Load capacity per castor:
120 kg static load

Total load:
360 kg static load

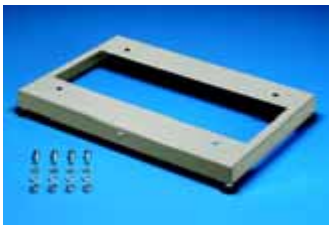
Colour:
RAL 7035/RAL 5018

German registered design
No. M 92 01 858
German patent no. 42 00 315
IR design no. DM/023580
with validity for DE, FR, IT

For enclosures		Model No. SO
Width mm	Depth mm	
600	600	**2981.235**
600	800	**2982.235**



B1 = Enclosure width
T1 = Enclosure depth + 150 mm



Base/plinth

for EL
The base/plinth can be fitted onto all EL enclosures with a centre part depth of 316 or 416 mm. Holes must be made for attaching to the centre part. A drilling template is supplied. These may additionally be fitted with castors for use as a mobile base/plinth.

Material:
Sheet steel

Colour:
RAL 7044

Supply includes:
4 levelling feet and assembly parts.

For centre part depth mm	Packs of	Height mm	Model No. DK/VR
316	1	50	**7505.300**
416	1	50	**7505.400**
Additional castors for base/plinth	4	50	**3805.500**

Under-floor frame

for DK-TS, FR(i)
For siting the enclosure on a false floor when heavy equipment is installed.

Material:
Sheet steel

Colour:
RAL 7044

Supply includes:
Baying connector and base attachment plate.

Width mm	Height mm	Depth mm	Model No. DK
600	400	1000	**7855.340**

Base/plinth

for RNC
To accommodate a maximum of two 3-way socket strips DK 7240.110 and also as storage space for cables.
Height: 60 mm.

Material:
Sheet steel

Colour:
RAL 7035

Supply includes:
4 levelling feet and 2/4 cable shunting rings.

For RNC enclosures 42 HP (1/2 19″)		Model No. DK
Width mm	Depth mm	
342	280	**7870.710**

For RNC tower enclosures 84 HP (19″) vertical		Model No. DK
Width mm	Depth mm	
342	400	**7870.715**

Accessories:

Socket strip,
see page 746.

Stabiliser bracket

for base/plinth TS
The stabiliser bracket may be retrospectively screw-fastened to the outside of the base/plinth corner pieces.

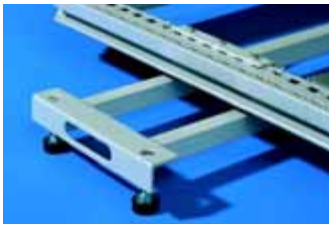
Load capacity:
Up to a maximum of 80 kg static load.

Material:
Sheet steel, spray-finished

Colour:
RAL 7035, warning markings RAL 2002

Supply includes:
Assembly parts.

Packs of	Model No. DK
2	**7825.150**



Stabiliser

for server racks DK-TS, FR(i)
The pull-out stabiliser is quickly and easily retro-fitted to the base frame of an FR(i) or TS 8 server rack and only extended when necessary. It may be used in combination with levelling feet and/or castors.

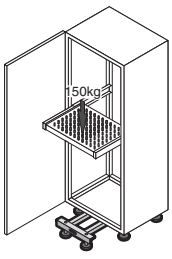
Load capacity:
Up to a maximum of 150 kg static load.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Enclosure depth mm	Model No. DK
900	**7825.200**
1000	**7825.250**

Note:
The stabiliser cannot be used with gland plates or base/plinths.



Base

Levelling feet

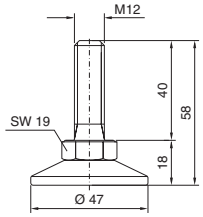
18 – 43 mm high
To compensate for height differences with floor irregularities. Thread length 40 mm.
Assembly thread M12.

Maximum permissible static load:
approx. 300 kg per levelling foot.

For:
- Baying system TS 8
- PC enclosure system
- Pedestal base plate CP 6137.035 – CP 6137.535
- Pedestal CP 6141.XXX
- Industrial workstations
- flexRack(i)

Packs of	Model No. PS
4	**4612.000**

Also required:
For mounting on the TS base/plinth:
Base/plinth adaptor TS 8800.220,
see page 849.



Levelling feet

85 – 115 mm high
For mounting on TS, ES and PC enclosures, for easier floor cleaning and to compensate for floor irregularities.
Height 100 mm.

Maximum permissible static load:
350 kg per levelling foot.

Packs of	Model No. SO
4	**2859.000**

Material:
Feet: Brass, nickel-plated
Threaded bolts and mounting plates:
Stainless steel 1.4301

Supply includes:
Assembly parts to the enclosure.

1

2

3

4

Twin castors

Mounting thread M12 x 20.

Maximum permissible static load (per castor) kg	Ground clearance mm	Lock	Packs of		Colour	Model No.
40	50	4 without	1 set	1	Black	**4611.000**
75	85	2 with, 2 without	1 set	2	Black with grey running surface	**6148.000**
120	125	2 with, 2 without	1 set	3	Black	**4634.500**
				4		**7495.000**

For:
- Baying system TS 8
- PC enclosure system
- Pedestal base plate CP 6137.035 – CP 6137.535
- Pedestal CP 6141.XXX
- Industrial workstations
- flexRack(i)
- Data Rack

Also required:
For mounting on the TS base/plinth:
Base/plinth adaptor for twin castors TS 8800.290,
see page 849.

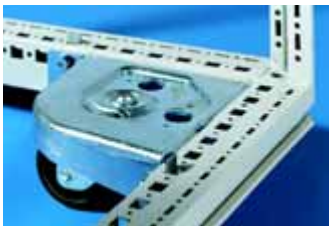
Transport castors

for TE
For easy transportation between sites.
The castors may additionally be screw-fastened to the levelling feet in the corner areas within the base frame.
Ground clearance: 58 mm

Permissible static load:
300 kg per enclosure

Supply includes:
1 set = 4 castors
including assembly parts.

Packs of	Model No. TE
1 set	7000.672



Transport kit

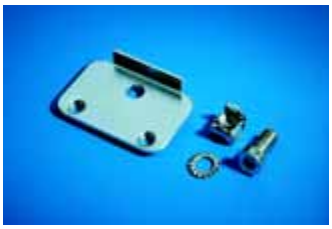
for DK-TS
For convenient movement of the network enclosures or as a mobile rack. Ground clearance approx. 40 mm.

Permissible static load:
750 kg per enclosure

Supply includes:
1 set = 4 castors (2 steerable ones)
including assembly parts.

Packs of	Model No. DK
1 set	7825.900

Note:
Only for enclosures without gland plates or gland plate frames.



Base/plinth adaptor

for levelling feet
Connection component for fastening M12 levelling feet PS 4612.000 to the TS base/plinth.

Material:
Sheet steel, zinc-plated, passivated

Packs of	Model No. TS
4	8800.220

Also required:
Levelling feet, PS 4612.000,
see page 848.

Base/plinth adaptor

for twin castors
Connection component for mounting twin castors to the TS base/plinth.

Material:
Sheet steel, zinc-plated, passivated

Packs of	Model No. TS
4	8800.290

Also required:
Base/plinth trim, side,
see page 835,
in all situations where a twin castor is mounted.

Base

Width divider

Divides 1200 mm wide TS enclosure into two halves.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
1 set =
1 bracket each for right/left,
2 compensation plates for the top,
assembly parts.

Packs of	Model No. TS
1 set	**8800.200**

Also required:

Depending on the installation situation:
TS punched rail 18 x 38 mm,
see page 923.
PS punched section without mounting flange,
see page 925.

1st mounting situation:
Two mounting plates side by side.
Two mounting plates (from 600 mm wide enclosures) in a 1200 mm wide enclosure permit independent positioning and easy handling.

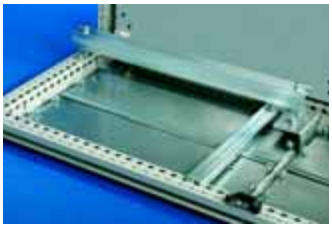
Also required:

In accordance with the enclosure depth:
4 TS punched rails 18 x 38 mm at the bottom,
see page 923,
1 PS punched section without mounting flange 23 x 73 mm at the top,
see page 925.

2nd mounting situation:
System support rails, fitted on the left.
Whilst heavy installed equipment rests on the system support rails, the remaining floor space is left free, e.g. for unhindered cable entry.

Also required:

2 system support rails PS 4361.000,
see page 926.
1 TS punched rail 18 x 38 mm
in accordance with the enclosure depth
(included with the supply of the standard enclosure).



3rd mounting situation:
Cable clamp rail, installed on the left.
With 1200 mm wide enclosures, the width divider allows cable entry and cable clamping to be arranged differently on the left and right of the enclosure.

Also required:

1 cable clamp rail PS 4191.000,
see page 979.
1 TS punched rail 18 x 38 mm
in accordance with the enclosure depth
(included with the supply of the standard enclosure).

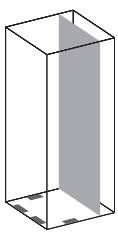
Base assembly bracket

for TS, ES, AP universal console
For anchoring the enclosure at any position of the base frame, particularly in cases where the existing holes in the frame or base tray cannot be used due to the installed equipment or because the substructure prevents them from being used.

Material:
Sheet steel, zinc-plated, passivated

Packs of	Model No. TS
4	**8800.210**

Note:
Additional holes in the base are required for mounting.



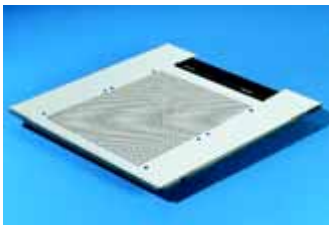
Reinforcement bracket

for TS, ES, AP universal console
For use as an additional stabiliser to the clamping straps when populated enclosures are screw-fastened via the base tray to the base/ plinth or pallet for transportation purposes.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts

Packs of	Model No. TS
4	**8800.830**



One-piece gland plate

vented, for DK-TS, FR(i)
The slotted gland plate has a cutout in the rear for cable entry, which is concealed with brush strips. The gland plate can be mounted or removed even when installation is already completed.

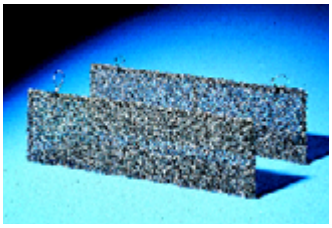
Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts

For enclosures		Model No. DK
Width mm	Depth mm	
600	600	**7825.660**
600	800	**7825.680**
600	900	**7825.690**
600	1000	**7825.610**
800	600	**7825.860**
800	800	**7825.880**
800	900	**7825.890**
800	1000	**7825.810**

Accessories:

Filter mat for gland plate,
see page 851.



Filter mat

for one-piece gland plate
To conceal the slots in the gland plate. Depending on the enclosure depth, several filter mats may be required for complete concealment.

Enclosure depth mm	Filter mats required for complete concealment	Packs of	Model No. VR
600	1	1	**3804.000**
800	2		
900	2		
1000	3		

Gland plate modules

for DK-TS
For use in the base frame of the network enclosure. Used in exchange for an existing gland plate of the same depth or in conjunction with a multi-piece gland plate for pre-configuered TS 8 enclosures, see page 852.

Gland plate depth:
237.5 mm

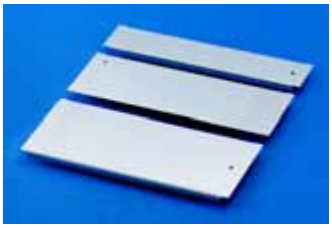
Design for cable entry:
With brush strip

Vented design:
With filter mat for concealing the holes and nylon tape for securing from the inside or outside.

For enclosure width mm	Model No. DK	
	Design	
	for cable entry	Vented
600	**7825.361**	**7825.360**
800	**7825.381**	**7825.380**

Material:
Sheet steel, zinc-plated, passivated.

Base



Gland plate, multi-piece

for DK-TS, pre-configured
Gland plates including sliding panel with foam rubber cable clamp strip for cable entry.

Material:
Sheet steel, zinc-plated, passivated.

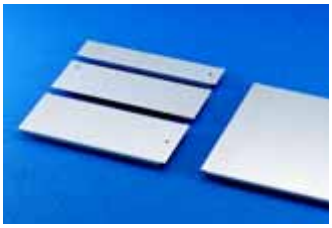
Supply includes:
Assembly parts.

Note:
For the size variant 800 x 800 mm, the gland plate included with the supply for pre-configured network enclosures should be additionally used. Also suitable for combined use with vented gland plate modules and those for cable entry.

For enclosures		Packs of	Model No. DK
Width mm	Depth mm		
800	800	1 set	**7825.382**
800	900	1 set	**7825.383**
800	1000	1 set	**7825.384**

Accessories:

Gland plate modules,
see page 851.



Gland plates

for CS basic enclosures
For sealing the base opening and for cable entry.

Material:
Aluminium, 2 mm.

Supply includes:
Assembly parts.

For enclosure dimensions		Packs of	Model No. CS	
Width mm	Depth mm		One-piece	Divided
600	400	1 set	**9785.017**	**9785.011**
600	500	1 set	**9785.020**	**9785.014**
800	400	1 set	**9785.018**	**9785.012**
800	500	1 set	**9785.019**	**9785.013**
1200	400	1 set	**2 x 9785.017**	**2 x 9785.011**
1200	500	1 set	**2 x 9785.020**	**2 x 9785.014**

Cable entry plates

for CS basic enclosures
For simple, fast cable entry and sealing in conjunction with cable entry grommets.
To replace individual modules in the divided gland plates.

German patent no. 42 07 281
European patent no. 0 560 119
with validity for FR, GB, IT, NL
Japan. Patent no. 2 533 052
US patent no. 5,422,436

Enclosure width mm	Cutouts per plate	Packs of	Model No. PS
600	5	2	**4320.700**
800	8	2	**4321.700**
1200	5	2	**2 x 4320.700**

Material:
Sheet steel, zinc-plated, passivated.

Supply includes:
Assembly parts.

Accessories:

Cable entry grommets,
see page 965.

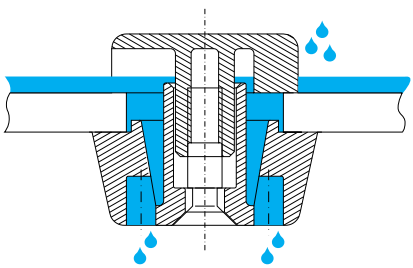
Condensate discharge

For reliable discharge from the inside and protection against splashes from the outside (labyrinth effect).
A hole diameter of 16 mm is required.
(With AE sheet steel, the holes are already provided in the base.)

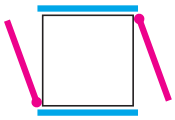
Material:
Polyamide

Colour:
Similar to RAL 7035

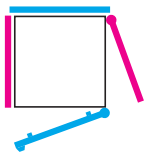
Packs of	Model No. SZ
6	**2459.000**



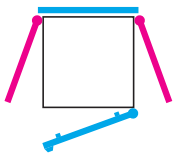
Side panels

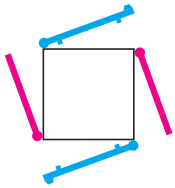


The TS side panel provides new dimensions in convenient access to the TS interior, thanks to the option of hinging.



Important:
Red areas (side panels), hinged and unhinged, must always be opposite one another. Blue areas (doors/rear panels) must always be opposite one another.





Only one surface on each vertical enclosure section may be hinged.

Note:
Climate control side panels with integral cooling module may be retrofitted instead of an enclosure side panel, see page 589.

Automatic potential equalisation

Side panels, screw-fastened, sheet steel

for TS
Easy positioning on the frame with the location aid. Six or eight enclosure panel holders with earthing insert ensure automatic potential equalisation and higher EMC protection. Earthing bolts with contact surface are pre-integrated.

Material:
1.5 mm sheet steel

Surface finish:
Dipcoat-primed,
powder-coated in textured RAL 7035 on the outside.

Protection category:
IP 55 to EN 60 529/10.91

Supply includes:
Assembly parts.

Note:
Enclosure panel holders may optionally be fitted from the inside or outside of the enclosure.
Area available for population:
External dimension – 100 mm.

Accessories:

Earth straps,
see page 960.

German patent no. 198 01 720

For enclosures		Packs of	Model No. TS
Height mm	Depth mm		
800	600	2	**8173.235**
1000	600	2	**8174.235**
1200	600	2	**8170.235**
1200	800	2	**8175.235**
1200	1000	2	**8176.235**
1400	500	2	**8145.235**
1400	600	2	**8146.235**
1400	800	2	**8148.235**
1600	500	2	**8165.235**
1600	600	2	**8166.235**
1600	800	2	**8168.235**
1800	400	2	**8184.235**
1800	500	2	**8185.235**
1800	600	2	**8186.235**
1800	800	2	**8188.235**
1800	900	2	**8189.235**
1800	1000	2	**8180.235**
2000	400	2	**8104.235**
2000	500	2	**8105.235**
2000	600	2	**8106.235**
2000	800	2	**8108.235**
2000	900	2	**8109.235**
2000	1000	2	**8100.235**
2200	600	2	**8126.235**
2200	800	2	**8128.235**
2200	900	2	**8129.235**

For RAL 7032 version, use order extension .200; to order primed version, use extension .300.
Delivery times on request.

Side panels, screw-fastened, sheet steel

for TS
To finish a complete enclosure. Easy attachment on the inside vertical enclosure frame member. Earthing inserts ensure automatic potential equalisation and a higher degree of EMC protection. Earth studs with contact surfaces are already included.

Material:
Stainless steel 1.4301, 1.5 mm

Surface finish:
Brushed, grain 240

Protection category:
IP 55 to EN 60 529/10.91

Supply includes:
Assembly parts.

For enclosures		Packs of	Model No. TS
Height mm	Depth mm		
1800	400	2	**8700.840**
1800	500	2	**8700.850**
2000	600	2	**8700.060**

To order enclosures in stainless steel 1.4404 (AISI 316L), use Model No. 8705.XXX.
Delivery times on request.

Detailed drawing,
see side panels for modular front design, page 876.

Side panels

Side panels, asymmetrical

for TS

The alternative to the standard side panel for improved visual appearance in the event of back to back, back to side or corner baying. The gap (A) which occurs with standard side panels is reduced to a standard dimension (B), see technical drawing.
In the case of the TS 8 corner enclosure, an asymmetrical side panel is included in the supply. The number of additionally required asymmetrical side panels depends on the baying variant which is selected.

Material:
Sheet steel, 1.5 mm

Colour:
RAL 7035

Protection category:
IP 55 to EN 60 529/10.91

Supply includes:
Assembly parts.

For enclosures		Packs of	Model No. TS
Height mm	Depth mm		
1800	400	2	**8184.500**
1800	500	2	**8185.500**
1800	600	2	**8186.500**
2000	400	2	**8104.500**
2000	500	2	**8105.500**
2000	600	2	**8106.500**
2000	800	2	**8108.500**
2200	600	2	**8126.500**

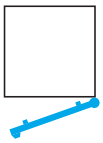
For RAL 7032 version, use order extension .400; to order primed version, use extension .450. Delivery times on request.

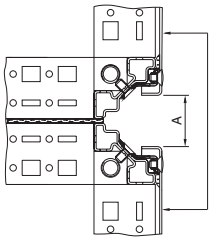
Asymmetrical side panel

Side panel

Rear panel

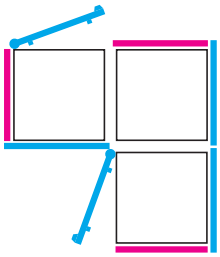
Door

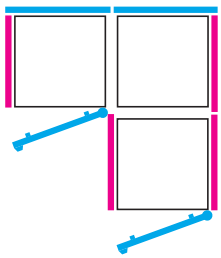


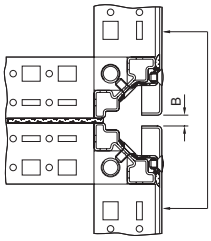


Side panel Standard

Corner baying

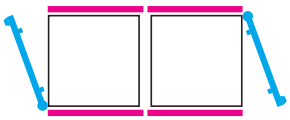




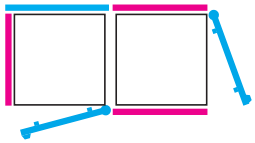


Side panel asymmetrical

Back-to-back baying



Side-to-back baying



Hinges

for
TS side panels, screw-fastened, sheet steel
TS side panels, asymmetrical

The 180° opening angle allows unhindered access. May be installed optionally from the inside or outside of the enclosure: Simply replace 3 enclosure panel holders with hinges. Despite the hinge, the protection category of the enclosure is retained.

Material:
Die-cast zinc

Supply includes:
Assembly screws.

Version	Packs of	Model No. TS
RAL 7035	6	**8800.110**
RAL 7032	6	**8800.010**

German utility model no. 298 20 604
US patent no. 6,238,027

Note:
Side panel and door hinges may only be installed on the same enclosure section when using a 180° door hinge (see page 893).

Side panel, plug-type

for TS
Side panel, lockable with 3 options:
- With lock
- Internal latch

Plug-and-play compatibility system: insert side panel into the base, press upwards into the recessed handle, and rotate the two toggle locks – there is no faster way of finishing off an entire enclosure suite at the side.
In addition, the Rittal cable routing components may be attached to the integral top hat rail.

Material:
Sheet steel, spray-finished

Colour:
RAL 7035/RAL 9005

Protection category:
IP 20/NEMA 1

Supply includes:
2 side panels with toggle locks.

Note:
The punched section (with mounting flanges) must be notched for use on the outer level.

For enclosures		Model No. DK	
Height mm	Depth mm	RAL 7035	RAL 9005
800	600	**7824.086**	–
1000	600	**7824.106**	–
1200	600	**7824.126**	–
1200	800	**7824.128**	–
1200	900	**7824.129**	**7816.129**
1200	1000	**7824.120**	**7816.120**
1400	600	**7824.146**	–
1400	800	**7824.148**	–
1600	600	**7824.166**	–
1600	800	**7824.168**	–
1800	600	**7824.186**	–
1800	800	**7824.188**	–
1800	900	**7824.189**	**7816.189**
1800	1000	**7824.180**	–
2000	600	**7824.206**	–
2000	800	**7824.208**	–
2000	900	**7824.209**	**7816.209**
2000	1000	**7824.200**	**7816.200**
2200	600	**7824.226**	–
2200	800	**7824.228**	–
2200	900	**7824.229**	**7816.229**
2200	1000	**7824.220**	**7816.220**

Accessories:

TS punched section with mounting flange, 17 x 73 mm, notched,
see page 921.
Internal latch DK 7824.510,
see page 855.

Lock

for side panel, plug-type
With security lock insert no. 3524 E, in exchange for the existing toggle locks.

Supply includes:
4 locks, 2 keys.

Packs of	Model No. DK
4	**7824.500**

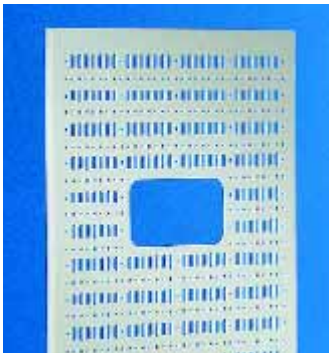
Internal latch

for side panel, plug-type
Additional security is achieved via the option of latching the side panel from the inside.
The side panels on the frame section are screw-fastened from the inside with latching brackets.

Supply includes:
Assembly parts.

For enclosure system	Packs of	Model No. DK	Model No. FR
TS	4	**7824.510**	–
FR(i)	4	–	**7856.700**

Side panels



Cable management panel

for DK-TS

The ideal, universal routing aid for network enclosures where large quantities of cables and lines are managed. Cutouts for for the attachment of cable shunting rings and nylon loop fasteners. Cable ties are available from the accessories range. With bayed enclosures, the panel may also be used as a partition with cable management facilities.
By attaching to the inner level, cables may be secured inside and out, and may also be used when a single panel is fitted.
The panel is secured to the inner mounting level of TS 8 enclosures using the assembly parts supplied. The cable management panel may be screwed to the outer mounting level on punched sections with mounting flanges.

Material:
Sheet steel, spray-finished

Colour:
RAL 7035

Supply includes:
Assembly parts.

For enclosures		Model No. DK
Width/depth mm	Height mm	
600	2000	**7824.560**
800	2000	**7824.580**
900	2000	**7824.590**

Further dimensions available on request.

German patent no. 100 07 470

Accessories:

Nylon loops,
see page 982.

Side panel, plug-type

for FR(i)

The lockable side panel is simply plugged in and secured via two security locks. The integral beading gives the side panels a special touch. Additional security is achieved via the option of latching the side panel from the inside. The side panels may be screw-fastened to the frame section from the inside using locking brackets FR 7856.700.

Material:
Sheet steel, spray-finished

Colour:
RAL 7035

Protection category:
IP 20

Supply includes:
Safety lock 12321.

For enclosures		Packs of	Model No. FR
Height mm	Depth mm		
600	600	2	**7856.660**
600	1000	2	**7856.663**
1200	600	2	**7856.666**
1200	800	2	**7856.669**
1200	1000	2	**7856.672**
1800	600	2	**7856.675**
1800	800	2	**7856.678**
2000	600	2	**7856.681**
2000	800	2	**7856.684**
2000	1000	2	**7856.687**
2200	800	2	**7856.693**
2200	1000	2	**7856.696**

Accessories:

Internal latch FR 7856.700,
see page 855.

Side panels

for TE

To finish of individual racks or entire bayed suites of racks at the sides.
The side panels are simply located and secured with the integral padlock.
The super-lightweight design means that it is easily handled by one person.

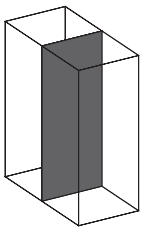
Material:
Sheet steel, powder-coated

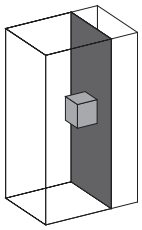
Colour:
RAL 7035

Protection category:
IP 20

Supply includes:
Security lock 3524 E.

For enclosures		Packs of	Model No. TE
Height mm	Depth mm		
1200	600	2	**7000.642**
1200	800	2	**7000.644**
2000	600	2	**7000.650**
2000	800	2	**7000.652**
2200	600	2	**7000.654**
2200	800	2	**7000.656**





Divider panel

for TS

For shielding individual enclosure cells. Thanks to the symmetry of the frame system, the divider panel can also be used at the rear. All-round, double fold for stability and to hold the seal. Notches in the corners and half-way up the sides permit the use of angular baying brackets and baying brackets, even with a divider panel fitted. For mounting on the outer mounting level. This leaves the inner level free for further population.

Material:
Sheet steel, 1.5 mm, zinc-plated, passivated

Protection category:
IP 54 to EN 60 529/10.91

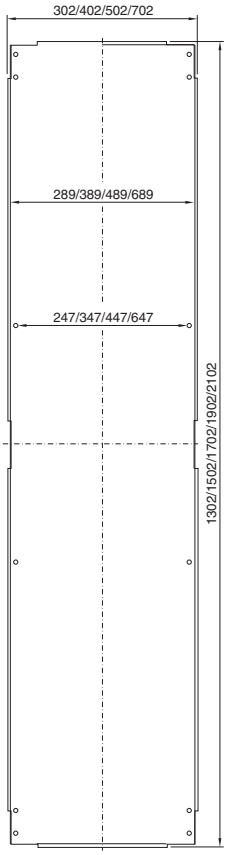
Supply includes:
Assembly parts.

Accessories:

Cover with door,
see page 860.
Baying bracket TS 8800.470 for enclosures with fitted divider panel.
see page 866.

Note:
The divider panel may also be fitted to the rear. This allows, e.g. frequency converters for heat dissipation to be installed in a divider panel with the cooling units facing outwards and protected/ finished off with a cover (see page 860).

For enclosures		Model No. TS
Height mm	Depth mm	
1400	500	**8609.450**
1600	500	**8609.650**
1800	400	**8609.840**
1800	500	**8609.850**
1800	600	**8609.860**
2000	400	**8609.040**
2000	500	**8609.050**
2000	600	**8609.060**
2000	800	**8609.080**
2200	600	**8609.260**



Divider panel

for TS

Solid partition for rack mounting, suspended between two TS 8 enclosures.

Material:
Sheet steel, zinc-plated, passivated

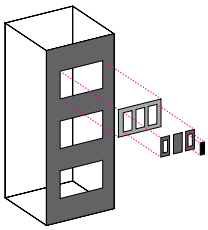
Note:
Baying connector TS 8800.490, for external use. Not suitable for use in conjunction with a baying seal. A seal that may be present must be removed prior to installation.

For enclosures		Model No. DK
Height mm	Depth mm	
2000	900	**7831.720**
2000	1000	**7831.722**

Accessories:

Baying connector TS 8800.490,
see page 864.

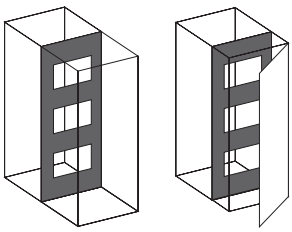
Divider panels for module plates



The divider panel and module plate system

More options:
The cutouts of a divider panel are individually equipped with module plates for 16-pole or 24-pole connectors, with module plates for cable entry and with solid module plates.

Faster assembly:
Usually only part of the total number of connector cutouts are used. Thanks to the new divider panel technique the cutouts do not need to be covered individually. The solid module plate is used instead.
The benefits: Less plates, less screws, less assembly work.



Divider panel

for module plates TS
With cutouts for the installation of module plates for connectors or for cable entry, and also for the entry of busbar systems and other installed equipment. All-round, double fold for stability and to hold the seal. Thanks to the symmetry of the enclosure frame, divider panels may also be fitted at the rear, dimenions permitting.
For mounting on the outer mounting level. This leaves the inner level free for further population.

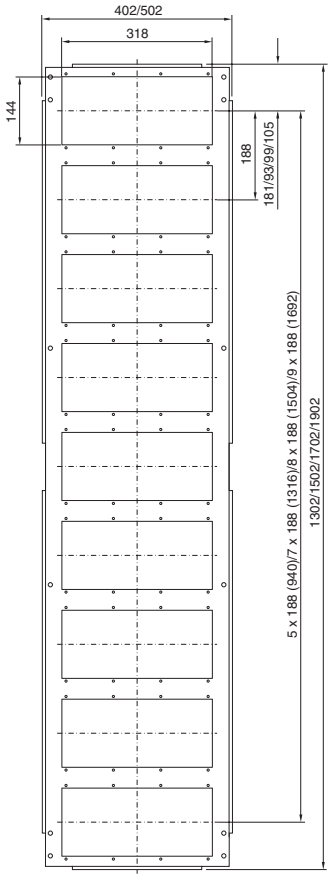
Material:
Sheet steel, 2 mm, zinc-plated, passivated

Supply includes:
Assembly parts and multi-tooth screws M5 x 12 mm for mounting the module plates.

Note:
Notches in the corners and half-way up the sides permit the use of angular baying brackets and baying brackets, even with a divider panel fitted.

Accessories:

Module plates,
see page 859.
Cover with door,
see page 860.
Baying bracket TS 8800.470 for enclosures with fitted divider panel,
see page 866.



For enclosures		Number of cutouts	Model No. TS
Height mm	Depth mm		
1400	500	6	**8609.180**
1600	500	8	**8609.165**
1800	500	9	**8609.100**
1800	600	9	**8609.110**
2000	500	10	**8609.120**
2000	600	10	**8609.130**

Primer/paint

For touching up and repairing powder-coated and wet-painted surfaces, air-drying.

Colour RAL	Model No. SZ		
	Touch-up pen 12 ml	Spray can 150 ml	Spray can 1000 ml
7022	–	**2581.000**	–
7032	**2436.732**	**2437.000**	**2438.000**
7035	**2436.735**	**2440.735**	**2438.735**

Module plates

Material:
Sheet steel, 2 mm, zinc-plated, passivated

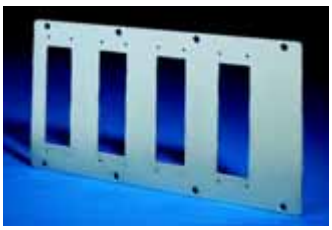
Supply includes:
Seal

Version	Cutouts	Packs of	Model No. TS
Solid	–	1	**8609.160**
For 16-pole connectors	4	1	**8609.150**
For 24-pole connectors	4	1	**8609.140**
For cable entry	1	1	**8609.170**
For cable entry grommets	4	1	**8609.190**

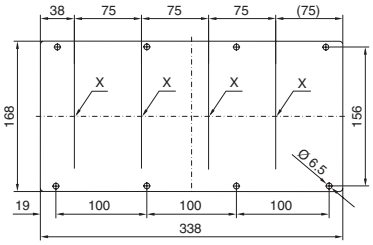
Solid
For sealing unused cutouts. Easily machined for individual cutouts.

Accessories:

Adaptor, cover,
see page 860.
Cable gland for connector cutouts,
see page 860.

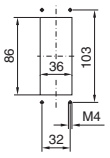


For 16/24-pole connectors
With cutouts to accommodate connectors. In addition to mounting on divider panels, module plates may also be attached to the 25 mm pitch pattern of the enclosure and to the rails of the TS/PS system.

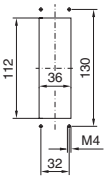


Accessories:

Adaptor, cover,
see page 860.
Cable gland for connector cutouts,
see page 860.

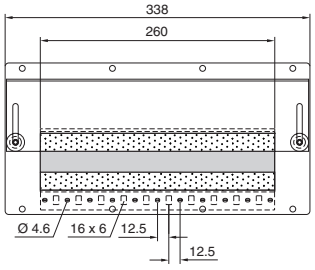


X 16-pole



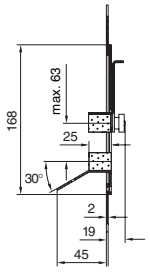
X 24-pole

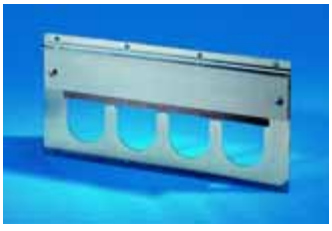
For cable entry
For the entry of pre-assemble cables. Sealed, routing is achieved via adjustable angle brackets with inserted foam cable clamp strip. Attachment bracket, punched, for cable clamping.



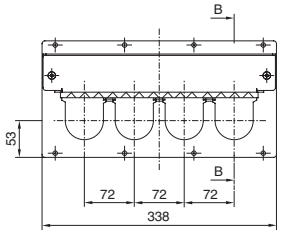
Accessories:

Cable tie for quick assembly SZ 2597.000,
see page 982.



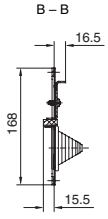


For cable entry grommets
For mounting on the divider panel for module plates TS. Slide the grommets into the cutouts, slide the clamp plate with seal down over them, and screw-fasten.

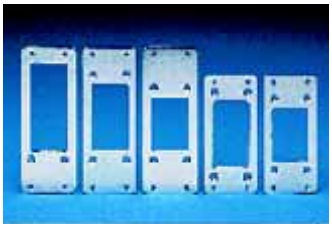


Also required:

Cable entry grommets,
see page 965
or connector grommets,
see page 965.



Module plates



Adaptor

for connector cutouts
For using connectors with varying numbers of poles.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Seal for adaptor and assembly parts.

For reduction	Packs of	Model No. SZ
From 24 to 16 poles	5	**2479.000**
From 24 to 10 poles	5	**2480.000**
From 24 to 6 poles	5	**2481.000**
From 16 to 10 poles	5	**2401.000**
From 16 to 6 poles	5	**2402.000**

Cover plate

for connector cutouts
For unused cutouts.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Seal and assembly parts.

For	Packs of	Model No. SZ
24-pole cutouts	20	**2477.000**
16-pole cutouts	20	**2478.000**

Note:
Connector grommet,
see page 974.

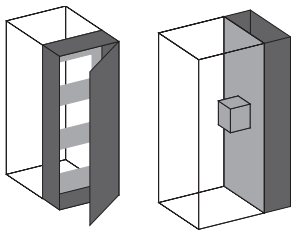
Partition

for DK-TS
For side partitioning of bayed TS server enclosures.
Up to 8 cable glands to the adjacent rack are possible, covered with blanking plates.

Material:
Sheet steel, zinc-plated, passivated

For enclosures		Packs of	Model No. DK
Height mm	Depth mm		
2200	900	1	**7831.715**

Note:
Only available on request for direct mounting on the enclosure.



Cover with door

for TS
To protect and finish off connectors or other installed equipment. 200 mm wide cover, with opening at the top or bottom for cable entry including a cover plate for unused opening.

Material:
Sheet steel
Cover: 1.5 mm
Door: 2.0 mm

Colour:
In textured RAL 7032

Supply includes:
Cover, door with locking rod and double-bit lock insert, 1 cover plate for the top or bottom.

Note:
May also be fitted at the rear to extend the enclosure depth. To cover the resultant gap, we recommend asymmetrical side panels (see page 854). In this way, for example, frequency converters to dissipate heat can be installed in a divider panel (see page 857) with the heat sinks facing outwards and protected/concealed with a cover.

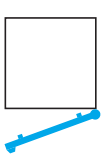
For enclosures		Model No. TS	
Height mm	Depth mm	RAL 7032	RAL 7035
2000	500	**8609.000**[1)]	**8609.020**
2000	600	**8609.010**[1)]	**8609.030**

[1)] Delivery times available on request.
For primed version, please add extension .XX1 to the Model No.
Delivery times on request.

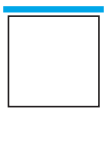
Accessories:

Lock inserts,
see page 881.
Comfort handle,
see page 881.
180° hinge,
see page 893.

Versatile door and side panel concept

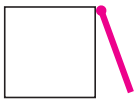


Door with lock



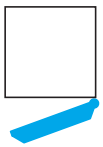
Rear panel

Side panel



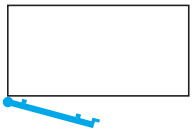
Hinged side panel

Side panel, asymmetrical



Climate control door

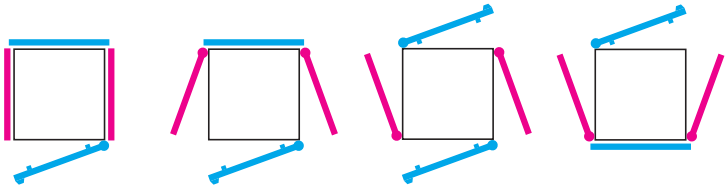
Climate control side panel



Adjacent door

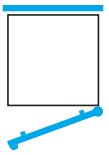
Important:

- Red areas (side panels, hinged and unhinged) must always be opposite one another.
- Blue areas (doors/rear panels) must always be opposite one another.

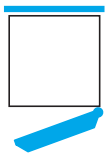


The versatile door and side panel concept also applies to the following baying variants:

. . . infinite possibilities

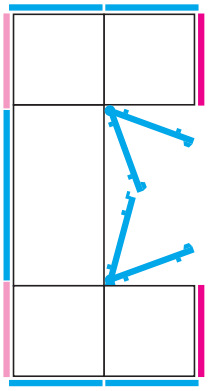


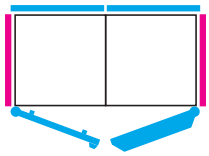
TS 8 standard enclosure

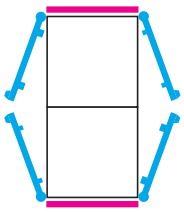


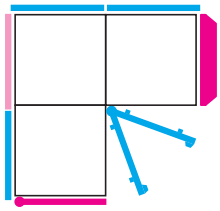
TS climate control enclosure

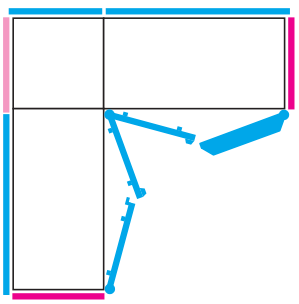
TS 8 corner enclosure

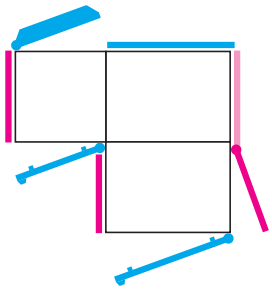


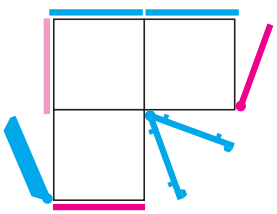




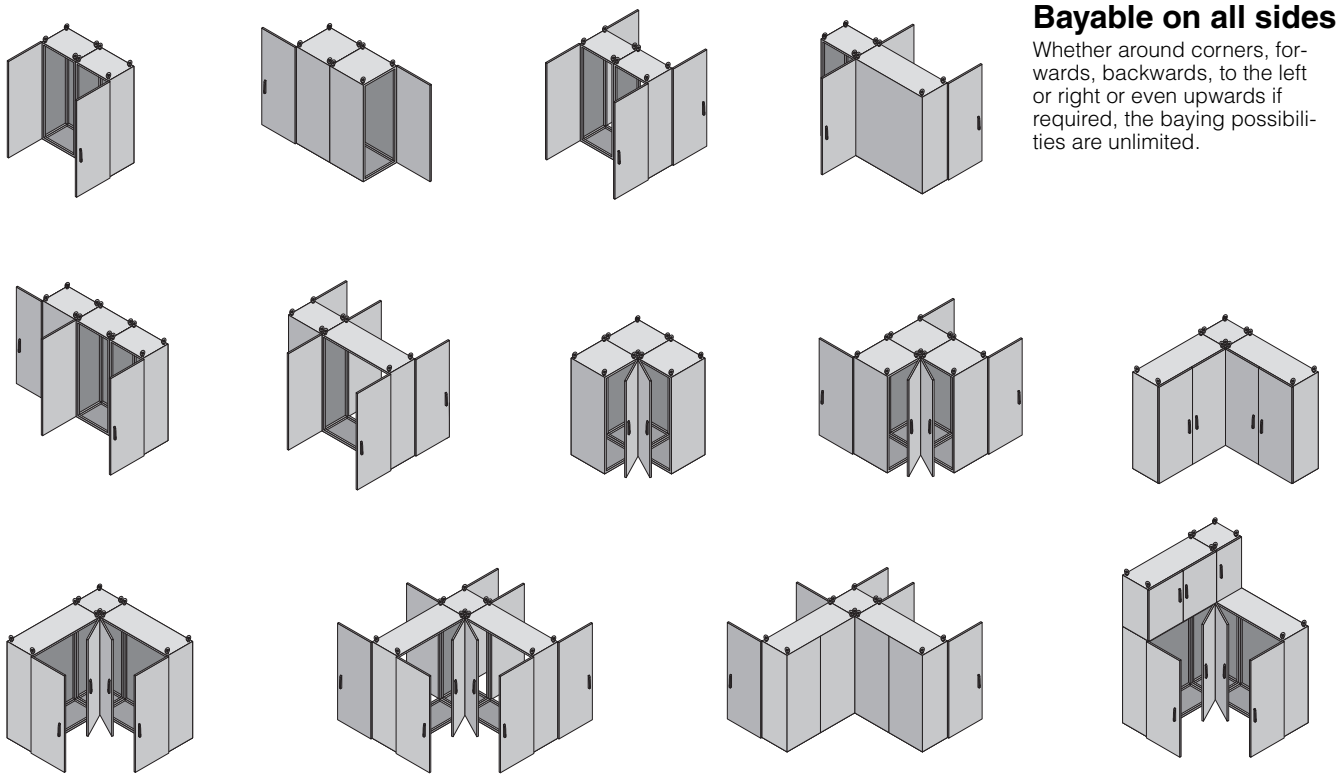






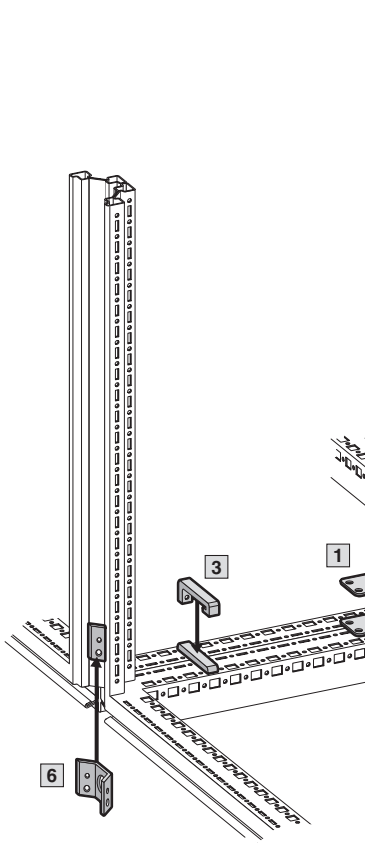


Baying at the installation site



Bayable on all sides

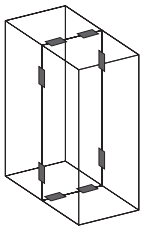
Whether around corners, forwards, backwards, to the left or right or even upwards if required, the baying possibilities are unlimited.



For baying at the installation site or for provisional siting in the workshop

1 Quick-fit baying clamps, one-piece
2 Quick-fit baying clamps, three-piece
3 Baying clamp, horizontal
4 Baying clamp, vertical for TS/TS
5 Baying clamp, vertical for TS/PS
6 Baying connector, external

Notes on the transport of bayed enclosures,
see page 864.



1 Quick-fit baying clamps, one-piece

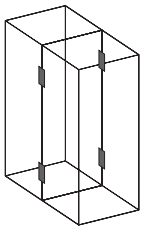
for TS/TS and FR(i)/FR(i)
Simply attach the screws, insert the quick-fit baying clamp, tap in with a hammer and lock.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Packs of	Model No. TS
6	8800.500

Note:
Only for monting on vertical enclosure sections of FR(i).



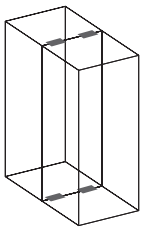
2 Quick-fit baying clamps, three-piece

for TS/TS
Simply locate, connect with the lock plate, and secure.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Packs of	Model No. TS
6	8800.590



3 Baying clamp, horizontal

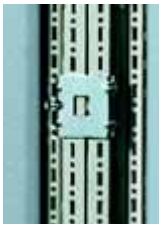
for TS/TS, TS/PS and FR(i)/FR(i)
For mounting on the horizontal enclosure sections.

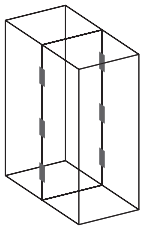
Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Packs of	Model No. TS
4	8800.400

German patent no. 197 35 251
French patent no. 98 104 58
Jap. patent no. 2 965 975





4 Baying clamp, vertical

for TS/TS
For mounting on the vertical enclosure sections.

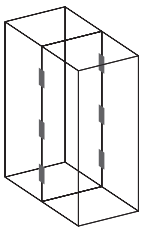
Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Packs of	Model No. TS
6	8800.410

German patent no. 197 35 251
French patent no. 98 104 58
Jap. patent no. 2 965 975

Baying at the installation site



5 Baying clamp, vertical

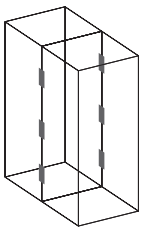
for TS/PS
For mounting on the vertical enclosure sections.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Packs of	Model No. TS
6	**8800.420**

German patent no. 198 01 185
US patent no. 6,435,759
European patent no. 104 8098
with validity for FR, GB, IT



6 Baying connector, external

for TS/TS
For mounting on the vertical enclosure sections.

Simply position on the outside and screw-fasten either from the inside or outside.

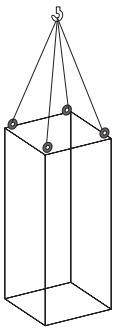
Material:
Sheet steel, zinc-plated, passivated
or stainless steel 1.4301

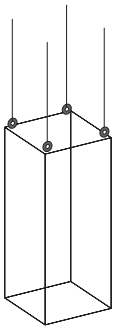
Supply includes:
Assembly parts.

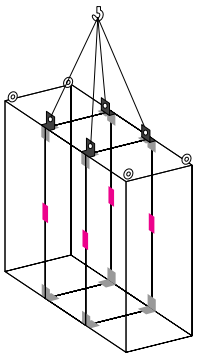
Version	Packs of	Model No. TS
Sheet steel	6	**8800.490**
Stainless steel	6	**8700.000**

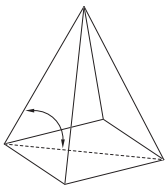
German patent no. 197 37 668

Note on the transport of bayed enclosures









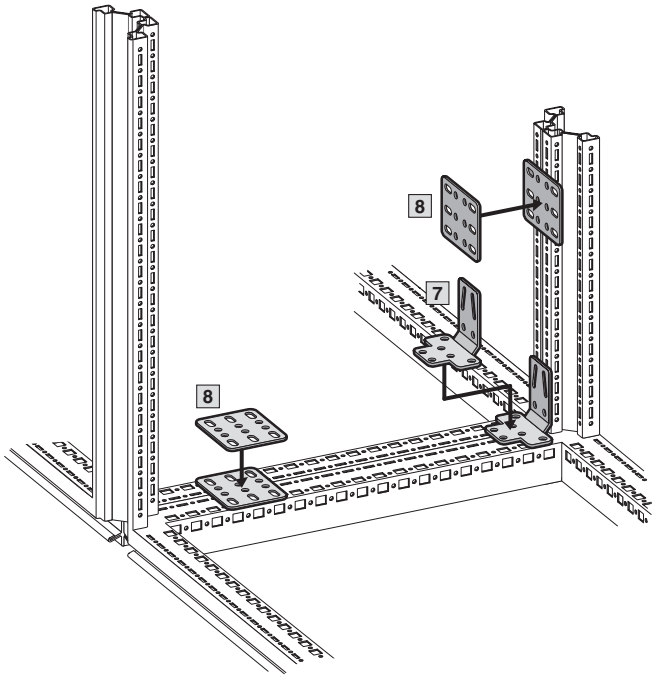
Individual enclosures are reliably transported using the eyebolts included with the supply.
For symmetrical loads, the following maximum permissible loads apply:
at 45° sling angle 4,800 N,
at 60° sling angle 6,400 N,
at 90° sling angle 13,600 N.

For the enclosure combination with angular baying brackets, quick-fit baying clamps and combination angles shown here, the load capacity with a sling angle of 60° is as follows:
for the left enclosure: 7,000 N,
for the middle enclosure: 14,000 N,
for the right enclosure: 7,000 N.

The sling angle between the roof plate and the sling has a significant influence on the total permissible load.
The sling angle must not be less than 45°, and where possible, should be less than 60°.

Note:
For larger baying combinations, we recommend the use of a transport base/plinth, see page 842.

Baying for transport



When transporting bayed enclosures

7 Baying bracket for TS/TS

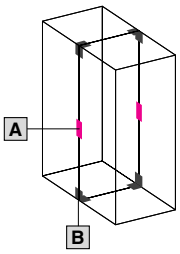
8 Baying bracket for TS/TS and for TS/PS

Note:
- In addition, the outer baying connector (see page 864), can be used.
- When transporting large, heavy enclosure combinations by crane, we additionally recommend the use of combination angles TS 4540.000, see page 866.

Also required:

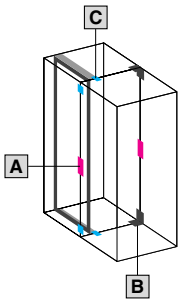
For protection category IP 55: One connector/clamp is required half-way up the enclosure height, see page 863.
Baying clamp, see page 863 – 864.

Notes on the transport of bayed enclosures, see page 864.



A 2 quick-fit baying clamps **TS 8800.500** (see page 863).

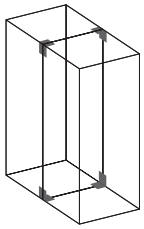
B 4 baying brackets **TS 8800.430** (see page 865).



A 2 quick-fit baying clamps **TS 8800.500** (see page 863).

B 2 baying brackets **TS 8800.430** (see page 865).

C 4 baying brackets **TS 4582.500** (see page 865) if the angular baying brackets cannot be fitted in the foremost installation position due to installed equipment such as large swing frames.



7 Angular baying brackets

for TS/TS

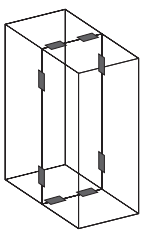
The robust connection when transporting bayed enclosure suites.

Screw-fastening may be optionally
- Horizontally and vertically with 8 screws
- Horizontally with 2 screws and M8 threaded blocks, vertically with 4 screws.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Packs of	Model No. TS
4	8800.430



8 Baying brackets

for TS/TS and TS/PS

For additional stabilisation, or in cases where:
- Mounting plate brackets
- Swing frames
- Busbar supports

prevent the installation of angular baying brackets.

Material:
Sheet steel, zinc-plated, passivated

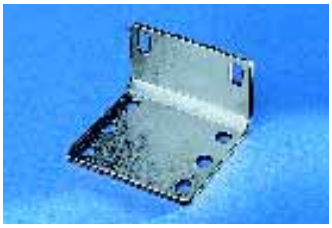
Supply includes:
Assembly parts.

Packs of	Model No. TS
4	4582.500

Accessories:

For mounting on the vertical TS enclosure section: Snap-on nut M8, TS 8800.808, see page 931.

Baying



Angular baying brackets

The alternative to baying bracket TS 4582.500 and for individual interior installations.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Screws M8 x 16 mm.

Packs of	Model No. PS
4	**4582.000**

Also required:

For mounting on:
horizontal TS enclosure section
Captive nut/threaded block M8, see page 936,
vertical TS enclosure section
Snap-on nut M8, TS 8800.808, see page 931.

Combination angle

For optimum distribution of tensile forces during transportation of bayed enclosures by crane.

Material:
Sheet steel, zinc-plated, passivated

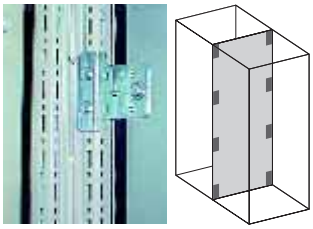
Supply includes:
Assembly parts.

Packs of	Model No. TS
4	**4540.000**

Accessories:

Baying cover,
see page 867.

Notes on the transport of bayed enclosures,
see page 864.



Baying attachment, vertical

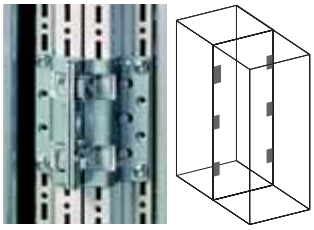
for TS/TS with divider panel
Only suitable for mounting in conjunction with the angle brackets of the divider panel (included with the supply).

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Packs of	Model No. TS
8	**8800.470**

Note:
May also be used for side or wall attachment/ fastening of enclosures. In such cases, additional holes must be drilled in the side or rear panel.



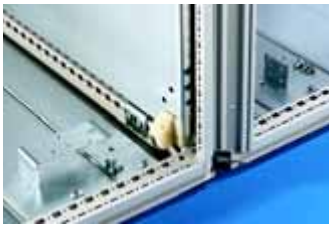
Baying attachment, vertical

for TS/TS
For baying two populated enclosures on the vertical enclosure section.
Simply locate into the vertical TS punchings, secure and connect both brackets by using the hex screws (supplied loose).
Using the fastening bolts, the enclosure is pulled into a defined end position, with a height or side offset of up to ±2 mm.

Packs of	Model No. TS
6	**8800.670**

Material:
Sheet steel 3 mm, zinc-plated, passivated.

Supply includes:
Assembly parts.



Baying clamp, horizontal

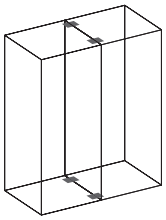
for back-to-back mounting
Two-piece, for in situ assembly of enclosures with mounting plate in the rearmost installation position.

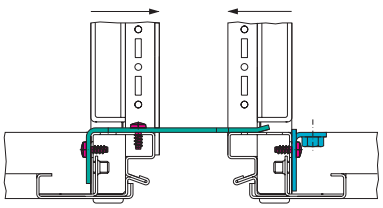
Material:
Sheet steel, zinc-plated, passivated

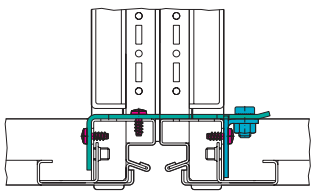
Supply includes:
Assembly parts.

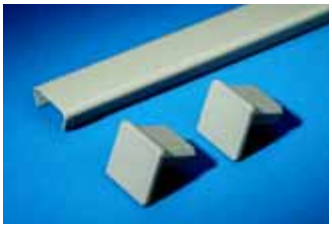
Packs of	Model No. TS
4	**8800.170**

German patent no. 10 157 979









Baying cover, top

A cover with two end caps may additionally be clipped over the seal between the two enclosures. This prevents dirt and liquid from collecting on the baying seal.

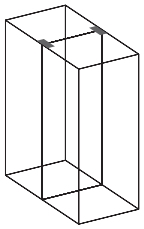
Material:
Cover section: Sheet steel, spray-finished or stainless steel 1.4301
End caps: Plastic

For enclosure depth mm	Packs of	Model No. TS		
		RAL 7032	RAL 7035	Stainless steel
400	1	**8800.440**	**8800.840**	**8700.140**
500	1	**8800.450**	**8800.850**	**8700.150**
600	1	**8800.460**	**8800.860**	**8700.160**
800	1	**8800.480**	**8800.880**	**–**

German patent no. 197 37 667
US patent no. 6,312,068
European patent no. 10 12,935
with validity for FR, IT

Note:
May also be fitted in the width with enclosure suites bayed back-to-back.

May also be used in conjunction with dust guard trim, see page 900.



Baying connector, external

for DK-TS/DK-TS with side panels
For retrospective baying of enclosures with side panels.

Material:
Sheet steel

Colour:
RAL 7035

Supply includes:
Assembly parts.

Packs of	Model No. DK
4	**7824.540**

Compensating panel

for TS
The panel is screw-fastened to the outside of the enclosure frame and serves as an infill panel when baying 2000 mm high enclosures of varying depths.
No seal between the enclosures.

Material:
Sheet steel

Colour:
RAL 7035

Supply includes:
Assembly parts.

Depth difference mm	Model No. DK
100	**7067.100**
200	**7067.200**

Baying kit

for FR(i)/FR(i) and FR(i)/FR
For mounting on the vertical enclosure sections.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Baying of/to	Packs of	Model No. FR(i)
FR(i)/FR(i)	1	**7856.752**
FR(i)/FR	1	**7856.750**

Baying kit

for TE
For connecting individual enclosures into bayed suites at the sides. The enclosures are connected between the base and roof frame.

Material:
Sheet steel, zinc-plated, passivated

Packs of	Model No. TE
1 set	**7000.640**

TS 8 corner enclosures

TS 8 corner enclosures

The corner enclosure and the supplied components will accommodate the various baying options of the TS 8 frame on all outer surfaces. Fitted with a rear panel and an asymmetrical side panel (see page 854, mounted on the l/h (left hand) side), the corner enclosure also permits the option of baying in both the width and depth. The gland plates are aligned parallel to the rear panel. In TS 8 enclosures with a footprint outline, the gland plates may also be rotated through 90°. The baying system is identical to all other TS 8 enclosures.

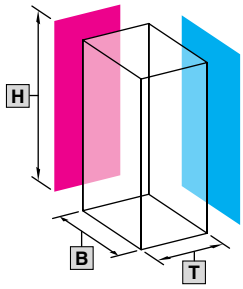
Material:
Sheet steel, 1.5 mm

Surface finish:
Dip-coat primed, powder-coated on the outside in textured RAL 7035
Gland plates: Zinc-plated

Supply includes:
Enclosure frame with roof, rear panel (on the longest side), asymmetrical side panel, gland plates (divided lengthwise).

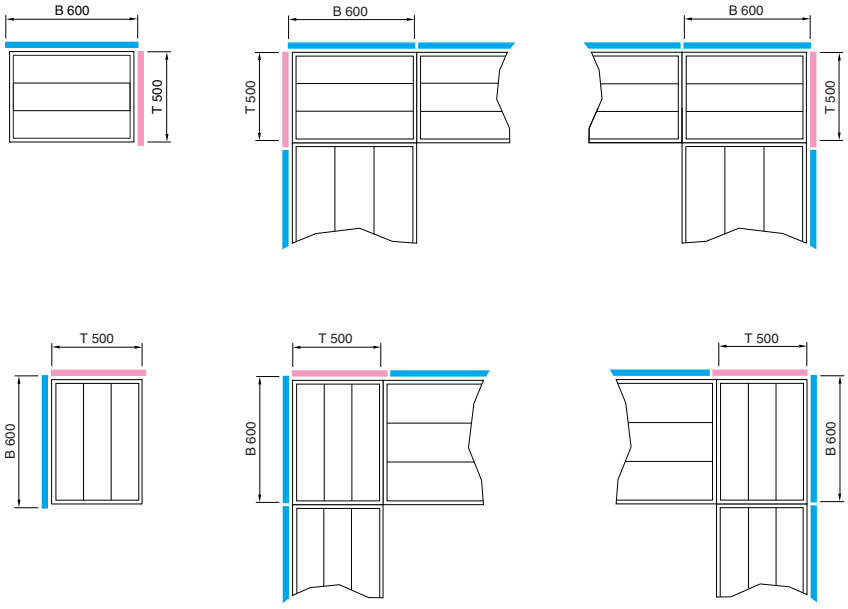
Width mm	Height mm	Depth mm	Model No. TS
400	1800	400	**8484.300**
500	1800	400	**8584.300**
600	1800	400	**8684.300**
500	1800	500	**8585.300**
600	1800	500	**8685.300**
600	1800	600	**8686.300**
400	2000	400	**8404.300**
500	2000	400	**8504.300**
600	2000	400	**8604.300**
800	2000	400	**8804.300**
500	2000	500	**8505.300**
600	2000	500	**8605.300**
800	2000	500	**8805.300**
600	2000	600	**8606.300**
800	2000	600	**8806.300**
600	2200	600	**8626.300**

Extended delivery times.
To order versions in RAL 7032, please use order number extension .400.
Delivery times on request.



Baying examples

TS 8 corner enclosures



B = Width
T = Depth

Glazed door

for TS, CL
Instead of a sheet steel door or rear panel.

Design:
Frame:
Extruded aluminium section,
die-cast zinc corner pieces,
powder-coated in RAL 7035
Single-pane safety glass,
3 mm thick,
printed mask on the inside
RAL 7015
Locking rod with double-bit insert
180° hinges (4)
Visible area:
W – 140 mm,
H – 160 mm.

Protection category:
IP 55 to EN 60 529/10.91

German registered design
No. M 98 03 844
IR reg. design no. DM/045 440
with validity for BE, FR, NL, HU, LU
UK reg. design no. 2 076 673
South Korean reg. design no. 0 240 621
Russian reg. design no. 46 300
Japanese reg. design no. 1 056 165
US design patent no. 418 608

For enclosures		Model No. TS
Width mm	Height mm	
600	1800	**8610.680**
800	1800	**8610.880**
600	2000	**8610.600**
800	2000	**8610.800**
600	2200	**8610.620**
800	2200	**8610.820**

Also required:

When mounting instead of the rear panel:
Lock components for frame TS 8800.040,
see page 869.

Accessories:

Lock inserts,
see page 881.
Comfort handle,
see page 881.

Handle adaptor

The handle adaptor compensates for the design chamfer in the door profile to enable installation of the comfort handle.

Material:
Plastic

Supply includes:
1 adaptor plate,
1 extension for drive,
2 assembly screws.

for glazed door TS, CL

Colour	Model No. TS
RAL 7035	**8611.080**
RAL 8019	**8611.090**

for designer door IW and PC-TS, bottom door

Colour	Model No. PC
RAL 7035	**8611.300**

for glazed door IW

Colour	Model No. IW
RAL 7035	**6903.170**

Lock components

for frame TS
For retrofitting a glazed door or sheet steel door in place of a rear panel.

Material:
Die-cast zinc

Supply includes:
Assembly screws.

Packs of	Model No. TS
4	**8800.040**

Door variants

Sheet steel door

for DK-TS
To replace existing doors. With 180° hinges and swivel handle with security lock no. 3524 E, in exchange for comfort handle.

Material:
Sheet steel

Colour:
RAL 7035

Protection category:
IP 55 to EN 60 529/10.91

Supply includes:
Assembly parts.

For enclosures		Model No. DK
Width mm	Height mm	
600	2000	**7824.205**
800	2000	**7824.207**
600	2200	**7824.225**
800	2200	**7824.227**

Accessories:

Comfort handle,
see page 881.
180° hinge for bayed TS enclosure suites with comfort handle, see page 893.

Sheet steel door, vented

for DK-TS
With 180° hinges and swivel handle with security lock no. 3524 E, in exchange for comfort handle. For optimum air throughput in network enclosures with a high proportion of active equipment. Slotted surface (SWG-6.7 hexagon) with air inlet opening >78 %.

Material:
Sheet steel

Colour:
RAL 7035

Supply includes:
Assembly parts.

For enclosures		Model No. DK
Width mm	Height mm	
600	1200	**7824.123**
600	1800	**7824.183**
800	1800	**7824.184**
600	2000	**7824.203**
800	2000	**7824.204**
600	2200	**7824.223**
800	2200	**7824.224**

Accessories:

Comfort handle,
see page 881.
180° hinge for bayed TS enclosure suites with comfort handle, see page 893.

Glazed door, vented

for DK-TS
With 180° hinges and comfort handle with security lock no. 3524 E. For optimum air throughput in network enclosures with a low proportion of active equipment.

Material:
Sheet steel, spray-finished
Viewing window of 3 mm single-pane safety glass, side slotted surfaces (SWG-6.7 hexagon) for air inlet.

Colour:
RAL 7035

Supply includes:
Assembly parts.

For enclosures		Model No. DK
Width mm	Height mm	
600	1200	**7824.121**
600	1800	**7824.181**
800	1800	**7824.182**
600	2000	**7824.201**
800	2000	**7824.202**
600	2200	**7824.221**
800	2200	**7824.222**

Accessories:

180° hinge for bayed TS enclosure suites with comfort handle, see page 893.

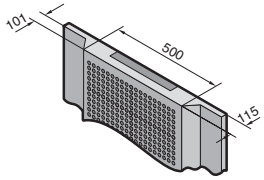
Adaptor door

for DK-TS
With 180° hinges and comfort handle with security lock no. 3524 E. To extend the enclosure depth by 100 mm. This creates the necessary free space at the rear for retro-fitting deep-build active components or space for system-compatible cabling at the front. Retro-fitting with deeper components is therefore easily achieved whilst in operation. The adaptor door is vented across the surface. Slotted surface (Ø 3 mm), air inlet opening > 60 %.
Simple cable routing via brush strips top and bottom.

Material:
Sheet steel

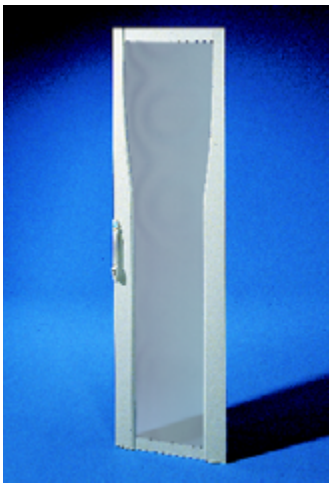
Colour:
RAL 7035

Supply includes:
Assembly parts.



For enclosures		Model No. DK
Width mm	Height mm	
600	2000	**7824.760**
600	2200	**7824.762**
800	2000	**7824.780**

Note:
Other sizes and side adaptor available on request.



Designer sheet steel door, vented

for TS
With 130° hinges and comfort handle with security lock no. 3524 E. For increased air throughput when installing active components. Slotted surface with air inlet opening > 78 %.

Material:
Sheet steel,
Design components of plastic

Colour:
RAL 7035

Supply includes:
Assembly parts.

For enclosures		Model No. DK
Width mm	Height mm	
600	1200	**7816.612**
600	2000	**7816.620**
600	2200	**7816.622**
800	2000	**7816.820**
800	2200	**7816.822**

Note:
Non-interchangeable door hinge.
180° hinges not supported.

Designer glazed door

for TS
With 130° hinges and comfort handle with security lock no. 3524 E. For visual monitoring of the installed equipment.

Material:
Frame: Sheet steel, spray-finished
Design components of plastic
Window of 4 mm single-pane safety glass

Colour:
Frame elements, RAL 7035
Viewing window tinted, parsol grey

Protection category:
IP 55 to EN 60 529/10.91

Supply includes:
Assembly parts.

For enclosures		Model No. DK
Width mm	Height mm	
600	1200	**7824.612**
600	1800	**7824.618**
600	2000	**7824.620**
600	2200	**7824.622**
800	1800	**7824.818**
800	2000	**7824.820**
800	2200	**7824.822**

German registered design no. 401 03 180
UK reg. design no. 2104977
US design patent no. 479 241

Note:
Non-interchangeable door hinge.
180° hinges not supported.

Door variants

Sheet steel door, vertically divided

for TS
With 130° hinges and locking rod including comfort handle for semi-cylinder with security lock no. 3524 E. Thanks to the minimal rotation radius of the individual doors, the distance between individual bayed enclosure suites may be reduced. The extensive door perforations additionally support climate control of the installed equipment. Slotted surface with air inlet opening > 78 %.

Material:
Sheet steel

Protection category:
IP 55 to EN 60 529/10.91 (unvented)
IP 20 to EN 60 529/10.91 (vented)

Colour:
RAL 7035

Supply includes:
Assembly parts.

For enclosures		Model No. DK	
Width mm	Height mm	Vented	Unvented
600	2000	**7824.360**	**7816.360**
600	2200	**7824.362**	**7816.362**
800	2000	**7824.380**	**7816.380**
800	2200	**7824.382**	**7816.382**

Accessories:

180° hinge TS 8800.190,
see page 893.

All-glass door, vertically divided

for TS
With 130°/180° hinges and locking rod including comfort handle for semi-cylinder with security lock no. 3524 E. Thanks to the minimal rotation radius of the individual doors, the distance between individual bayed enclosure suites may be reduced. When baying, an external 180° hinge is required.

Material:
5 mm single-pane safety glass, frame of aluminium frame elements.

Colour:
Frame elements, RAL 7035
Viewing windows tinted, parsol grey.

Supply includes:
Assembly parts.

For enclosures		Rotation range[1)]	Model No. DK
Width mm	Height mm		
800	2000	130°	**7824.480**
800	2000	180°	**7824.490**

[1)] Stand-alone siting

Note:
Not to be used in conjunction with a swing frame.

Lockable and adjacent door

for TS, CL
For example, if two 400 mm doors instead of one 800 mm wide door are used to comply with escape routes.

Material:
Sheet steel

Surface finish:
Dipcoat-primed,
powder-coated on the outside.

Supply includes:
2 doors
including hinges and lock parts.

For enclosures		Colour RAL	Model No. TS
Width mm	Height mm		
800	2000	7035	**8801.450**
800	2000	7032[1)]	**8801.400**

[1)] Delivery times available on request.

Note:
Enclosure without door (TS 8806.512),
see page 149.

Accessories:

Lock system,
see page 881.

Variable door concept

Instead of an enclosure door in a 600 mm/ 800 mm wide and 1800 mm/2000 mm high TS enclosure, climate control doors with integral cooling module may be retrofitted without major assembly work.

Possible alternative:

Climate control doors,
see page 584.

Trim frame

for TS

To conceal the TS 8 front frame in enclosures without a door.

Possible application areas include, for example:
- Studio technology
- Electronic configuration

Material:
Sheet steel

Colour:
RAL 7035

Supply includes:
Assembly parts.

For enclosures		Model No. DK
Width mm	Height mm	
600	2000	**7824.130**
800	2000	**7824.132**

Note:
The trim frame conceals the system punchings in the inner mounting level. The TS punched sections with mounting flange 23 x 73 mm (see page 922) may be used for installation.

Profile blanking frame

for TS

On request, all enclosures in the TS 8 series (see page 138) may be manufactured with a fitted profile blanking frame (design to match the TS glazed door) instead of door(s). For optimum access to installed equipment, trim frame hinged on the right, held by a mechanical snap fastener on the left.

Material:
Extruded aluminium section, die-cast zinc corner pieces, powder-coated

Colour:
RAL 7035

Packs of	Model No. TS
1	**xxxx.590**

Delivery times available on request.

Order example:
Baying system TS 8,
W x H x D: 800 x 2000 x 600 mm
- Standard TS 8806.500
- with profile blanking frame TS 8806.590

Interior door

with mounting frame
for compact enclosure AE IP 69K

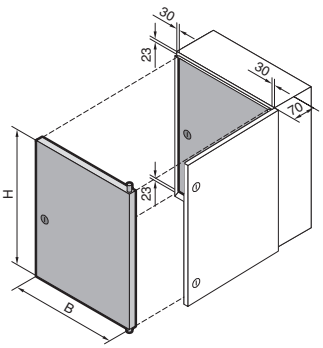
For the installation of control and display components. Mounting frame, depth-adjustable for a distance between the outer surface and the inside of the outer door of 35 to 85 mm (80 mm with AE 1101.010).

Material:
Sheet steel, 1.5 mm

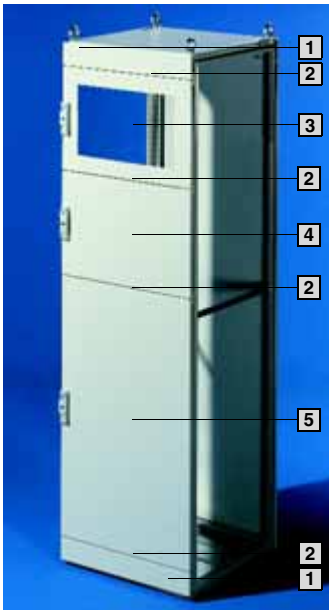
Colour:
RAL 7035

Supply includes:
Mounting frame, door with cam lock and screwdriver insert,
including assembly parts.

For AE enclosure	W (B) mm	H mm	Model No. AE
1101.010	160	260	**1101.910**
1101.020	330	330	**1101.920**
1101.030	330	580	**1101.930**
1101.040	580	580	**1101.940**



Modular front design for TS 8



Modular front design

for TS 8606.512
WHD 600 x 2000 x 600 mm,
for TS 8806.512
WHD 800 x 2000 x 600 mm
(see page 149)
and all other 600 and 800 mm wide TS 8 enclosures instead of a door or rear panel, insofar as the modular front is positioned in a suite between two enclosures with normal doors. If positioned as a free-standing enclosure or at the end of an enclosure suite, special side panels such as TS 8106.512 (see page 876) are required.
The partial doors with and without viewing panels can be arbitrarily combined with cross members. A trim panel and a cross member are each required a the top and bottom.
The requirements for you individual front design and the considerations which must be taken into account are illustrated on the sample configuration opposite.

Protection category:
With a completed enclosure
IP 55 to EN 60 529/10.91, NEMA 12 is met.

Also required:

1	Trim panels, height 100 mm or trim panel, hinged at the top, height 300 mm
2	Cross member

Accessories:

3	Partial door with viewing window, height 400 mm
4	Partial door without viewing window, height 400 mm
5	Partial door without viewing window, height 1000 mm

1 Trim piece, hinged at the top

for TS
For the installation of control and display components.

Material:
Sheet steel, 2 mm

Supply includes:
Hinges, cam locks with double-bit insert and assembly parts.

Note:
Not in combination with top-mounted module for TS (see page 900).

Width mm	Height mm	Colour RAL	Model No. TS
600	300	7035	**8801.230**
800			**8801.240**
1200			**8801.250**
600		7032	**8801.200**[1)]
800			**8801.210**[1)]
1200			**8801.220**[1)]

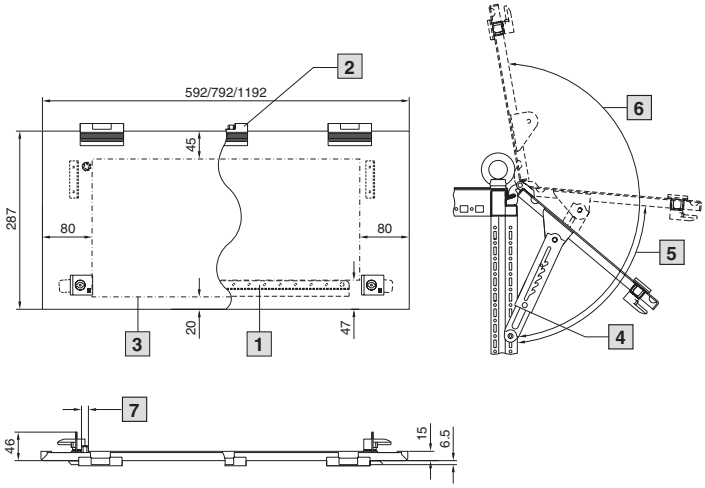
[1)] Delivery times available on request.

Accessories:

Support stay for trim piece, hinged at the top see page 876.
Lock inserts, version A, see page 888.

Rittal service:

Combination with shortened door, enclosure with already mounted trim instead of door, cutouts for operator and display components on request.



1	Only for width 800 mm and 1200 mm
2	Only for width 1200 mm
3	Usable interior area
4	Optional: Stay TS 8801.260
5	Maximum opening with support stay approx. 85°
6	Maximum opening without stay approx. 190°
7	Earthing bolt M8

Modular front design for TS 8

1 Trim panels

for TS
Required as upper and lower height trim.

Material:
Sheet steel, 2 mm, textured

Supply includes:
2 trim panels, assembly parts.

Height mm	Colour RAL	Model No. TS	
		Width 600 mm	Width 800 mm
100	7035	**8801.510**	**8801.110**
100	7032	**8801.610**[1)]	**8801.810**[1)]

[1)] Delivery times available on request.

Also required:

Cross member,
see page 875.

2 Cross member

for TS
As sealing member between:
- Trim panels
- Partial doors
- Trim piece, hinged at the top

Material:
Sheet steel

Colour:
RAL 7035

Supply includes:
Assembly parts.

Packs of	Model No. TS	
	Width 600 mm	Width 800 mm
5	**8801.630**	**8801.830**

3 4 5 Partial doors

for TS
Door can be optionally hinged on the right or left side.
In the case of doors without viewing panel (height 600 – 1000 mm) the installation of monitor frame SZ 2305.000 is possible.
Standard double-bit lock insert may be exchanged for TS lock inserts, and from 600 mm height, for comfort handle.

Material:
Sheet steel, 2 mm

Supply includes:
Hinges and lock.

Also required:

Cross member,
see page 875.

Accessories:

Monitor frame SZ 2305.000,
see page 879.
TS lock inserts,
see page 881.
Comfort handle,
see page 881.

Solid

Height mm	Model No. TS			
	Width 600 mm		Width 800 mm	
	RAL 7035	RAL 7032[1)]	RAL 7035	RAL 7032[1)]
200	**8801.520**	**8801.620**	**8801.120**	**8801.820**
400	**8801.540**	**8801.640**	**8801.140**	**8801.840**
600	**8801.560**	**8801.660**	**8801.160**	**8801.860**
800	**8801.580**	**8801.680**	**8801.180**	**8801.880**
1000	**8801.500**	**8801.600**	**8801.100**	**8801.800**

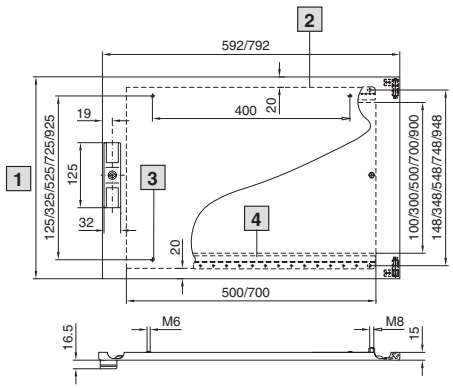
[1)] Delivery times available on request.

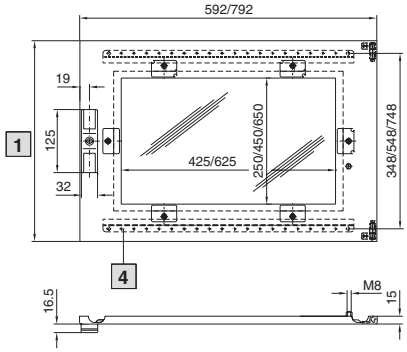
With 3 mm single-pane safety glass

Height mm	Model No. TS			
	Width 600 mm		Width 800 mm	
	RAL 7035	RAL 7032[1)]	RAL 7035	RAL 7032[1)]
400	**8801.550**	**8801.650**	**8801.150**	**8801.850**
600	**8801.570**	**8801.670**	**8801.170**	**8801.870**
800	**8801.590**	**8801.690**	**8801.190**	**8801.890**

[1)] Delivery times available on request.

1 Height – 2 mm
2 Usable interior area
3 M6 bolt only for width 600 mm
4 Perforated strip only for width 800 mm





Modular front design for TS 8

Drawer

for TS
Height 200 mm.
For mouse and keyboard with a maximum width of 500/700 mm.
A high level of protection is retained, even with the flap open.
Standard double-bit lock insert may be exchanged for 27 mm lock inserts, version A, plastic handles, type B and T handles, type B.

Material:
Sheet steel

Supply includes:
Flap and assembly parts.

Colour	Model No. TS	
	Width 600 mm	Width 800 mm
RAL 7035	**8801.715**	**8801.915**
RAL 7032	**8801.710**[1)]	**8801.910**[1)]

[1)] Delivery times available on request.

Also required:

Cross member,
see page 875.

Accessories:

27 mm lock inserts, type A,
see page 888.
Plastic handles, type B,
see page 886.
T handles, type B,
see page 887.

Desk section

for TS
Height 200 mm.
For installing
- Keyboard, IP 67 mouse and mousepad
- Display and control elements

with screw-fastened cover plates top and bottom.

Material:
Sheet steel

Supply includes:
Assembly parts.

Colour	Model No. TS	
	Width 600 mm	Width 800 mm
RAL 7035	**8801.705**	**8801.905**
RAL 7032	**8801.700**[1)]	**8801.900**[1)]

[1)] Delivery times available on request.

Also required:

Cross member,
see page 875.

Side panels for Modular front design

for TS
Attachment on the inside vertical enclosure frame member.
The TS 8106.235 side panel retainers (page 853) could conflict with the partial door fasteners.

Material:
1.5 mm sheet steel

Surface finish:
Dip-coat primed, powder-coated on the outside
Textured RAL 7035.

Protection category:
IP 55 to EN 60 529/10.91

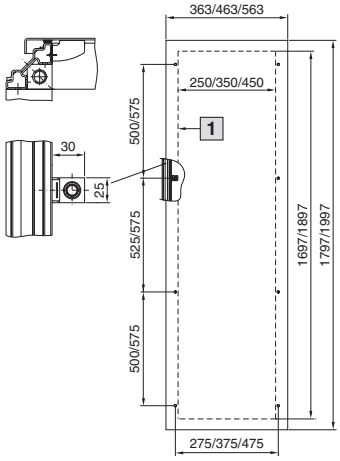
Supply includes:
2 side panels,
16 retainers with automatic potential equalisation.

Note:
Can also be used in enclosures without modular front design!

1 Usable interior area

For enclosure		Model No. TS
Height mm	Depth mm	
2000	600	**8106.512**
2000	800	**8108.512**

For RAL 7032 design, use order extension .212.
Delivery times on request.



Support stay

for trim panel, hinged at the top
5 pitch pattern positions up to a maximum opening of approx. 85°.

Material:
Sheet steel, zinc-plated, passivated.

Packs of	Model No. TS
2	**8801.260**

System windows

To conceal display and operating instruments or cutouts, and to protect against dirt and liquids as well as unauthorised access.

Consisting of the following components:

1. Base frame:
- Easily screw-fastened to the door thanks to modified dimensions (tubular door frame may be used as a drilling template).
- Readily height-adjustable.
- Stabilises the door cutout.
- Conceals the cut edge.
- The rain canopy
  – prevents dirt from landing on the seal,
  – protects the glass from being lifted out,
  – prevents the ingress of dirt and moisture when opening the window.

2. Viewing window:
- Made from single-pane safety glass:
  – high level of resistance to solvents and scratches,
  – anti-static,
  – reduced risk of injury if broken.
- Integral cam lock with double-bit insert, easily exchanged for all standard lock inserts and semi-cylinders in the Ergoform-S lock system (not with FT 2735.500 and .560).
- Hinge with 180° opening angle, easily inserted.

Material:
System windows:
Extruded aluminium sections with die-cast zinc corner pieces and single-pane safety glass.

Surface finish:
Base frame:
powder-coated in RAL 7035.
Hinge and lock section:
natural anodised.

Protection category:
IP 54 to EN 60 529/10.91.

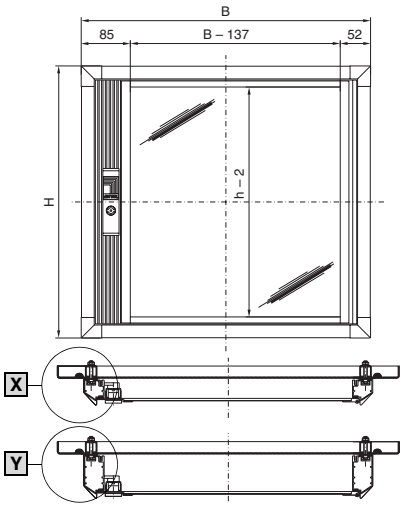
To fit TS, ES, IW with width mm	Window size (mm) exterior B	exterior H	internal b	internal h	Model No. FT 30 section	Model No. FT 60 section
600	500	270	430	200	**2735.500**	–
		370		300	**2735.510**	**2736.510**
		470		400	**2735.520**	**2736.520**
		570		500	**2735.530**	**2736.530**
		670		600	**2735.540**	**2736.540**
800	700	270	630	200	**2735.560**	–
		370		300	**2735.570**	–
		470		400	**2735.580**	**2736.580**
		570		500	**2735.590**	**2736.590**
		670		600	**2735.250**	**2736.500**
Other sizes[1)]					**2735.509**	**2736.509**

Lock systems

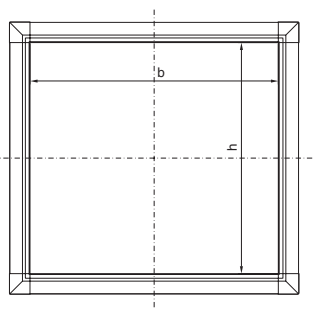
Standard double-bit lock insert may be exchanged for 27 mm lock inserts, version A, see page 888 and Ergoform-S lock system (except H = 270 mm), see page 885.

[1)] Please also specify the external dimensions of the viewing window. Delivery times available on request.

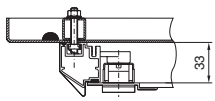
Example:
System window (30 profile) to fit door width 500 mm
with width B = 400 mm x height H = 480 mm (b x h = 330 mm x 410 mm)
Model No. FT 2735.509/W x H = 400 x 480 mm.



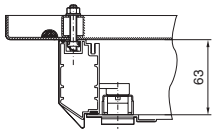
Viewing area (W – 137) offset by 16.5 mm towards the hinge side.



View X
for profile height 30



View Y
for profile height 60



Viewing panels/operating panels

Viewing window

For mounting on
- AE instead of door
- Surfaces

Material:
Frame: Aluminium, natural anodised.
Glass panel: Acrylic

Protection category:
IP 54 to EN 60 529/10.91

Supply includes:
Plastic handle with lock insert no. 3524 E.

For use as door variant with AE	Width mm	Height mm	Model No. FT	
			Depth = 34 mm	Depth = 60 mm
1039.500 1339.500 1009.500	599	377	**2730.000**	**2760.000**
1050.500 1350.500 1007.500	499	497	**2733.000**	**2763.000**
1010.500 1060.500 1360.500	599	597	**2731.000**	**2761.000**
1012.500 1076.500 1376.500	599	757	**2732.000**	**2762.000**
for 3 U subrack	599	197	**2734.000**	–

Max. installation depth: (depth – 4 mm)
Visible area:
(width – 60 mm) x (height – 60 mm)

Note:
Other sizes available on request.

Horizontally hinged FT stay

A gas pressurised spring holds the viewing window securely open (top or side).
When the viewing window is closed, the gas pressurised spring disappears into the frame section.

Packs of	Model No. FT
2	**2772.000**

Acrylic glazed cover

With security lock, lock no. 3524 E

Material:
Frame:
Extruded aluminium sections with die-cast corner pieces
Glass panel: Smoked acrylic

Protection category:
IP 54 to EN 60 529/10.91

Acrylic glazed covers, 482.6 mm (19″)

U	Width mm	Height mm	Depth mm	Model No. FT
3	320	158	47.5	**2780.000**
3	534	158	47.5	**2781.000**
6	534	291.5	47.5	**2782.000**
9	534	425	47.5	**2796.000**

Max. installation depth: 43 mm
Visible area:
(width – 40 mm) x (height – 20.5 mm)

Metric acrylic glazed covers

Width mm	Height mm	Depth mm	Model No. FT
400	200	47.5	**2784.000**
400	400	47.5	**2785.000**
500	200	47.5	**2786.000**
500	400	47.5	**2787.000**
600	200	47.5	**2788.000**
600	400	47.5	**2789.000**

Max. installation depth: 43 mm
Visible area:
(width – 40 mm) x (height – 20.5 mm)

Viewing panel

Stainless steel
Fitted as standard with internal 130° hinges and all-round seal.
Standard double-bit lock insert may be exchanged for 27 mm lock inserts, type A and Ergoform-S handle SZ 2452.000.

Material:
Stainless steel 1.4301
Single-pane safety glass

Protection category:
IP 54 to EN 60 529/10.91

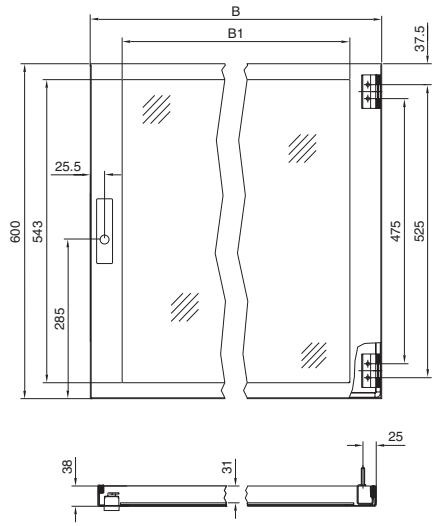
Supply includes:
Assembly parts.

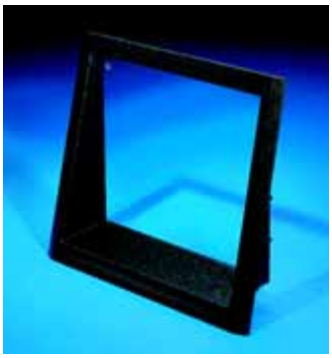
Width (B) mm	Height mm	Depth mm	B1 mm	Model No. FT
522	600	38	408	**2793.560**
722	600	38	608	**2793.760**

Note:
Other sizes available on request.

Accessories:

Lock inserts 27 mm, version A,
see page 888.
Ergoform-S handle SZ 2452.000,
see page 885.





Monitor frame

For door width 600 and 800 mm
For covering a door cutout, for all standard monitors up to 482.6 mm (19″).

Protection category:
IP 54 to EN 60 529/10.91

Supply includes:
Security glass pane.

Monitor frame	Model No. SZ	
	2305.000	
Dimensions	Width mm	Height mm
External dimensions	470	430
Viewing area	375	325
Cutout required	415	375

German registered design
No. M 93 03 143

Identification strips

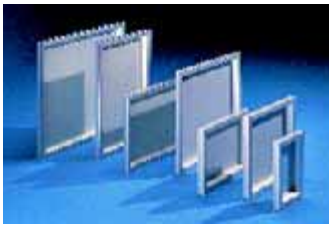
For individual field identifiers on the door, including transparent cover and assembly parts.
For labels:
Width: Enclosure width minus 150 mm
Height: 29 mm
Thickness: 0.75 mm.

Colour:
RAL 7033

For enclosure width mm	Model No. SZ
600	**2403.000**
800	**2404.000**

German registered design
No. M 92 02 456
IR reg. design no. DM/023 581
with validity for DE, FR, IT

Viewing panels/operating panels



Operating panel

For mounting on:
- AE instead of door
- Surfaces

Frame construction with corner connectors on the inside, 3 mm aluminium plate secured from the inside and sealed against the frame

Material:
Aluminium, natural anodised.

Protection category:
IP 54 to EN 60 529/10.91

Supply includes:
Aluminium frame, display panel, hinges, brackets.

German patent no. 28 47 994
European patent no. 0 010 763
with validity for AT, BE, CH, FR, GB, NL, SE

For use as door variant for AE	Width mm	Height mm	Depth mm	Model No. FT
1002.500 1032.500 1035.500	199	297	34	**2740.000**[1]
1004.500 1030.500 1031.500	379	297	34	**2741.000**
1006.500 1380.500	379	377	34	**2742.000**
1008.500 1038.500 1338.500	379	597	34	**2743.000**
1007.500 1013.500 1050.500 1350.500	499	497	34	**2745.000**
1009.500 1039.500 1339.500	599	377	34	**2744.000**
1010.500 1060.500 1360.500	599	597	34	**2746.000**

[1] With AE, only for use on the rear panel

Area available for population:
(width – 70 mm) x (height – 70 mm)

Dimensions of aluminium plate:
(width – 54 mm) x (height – 54 mm)

Note:
Other sizes available on request.

Accessories:

Cam lock FT 2749.000,
see page 880.

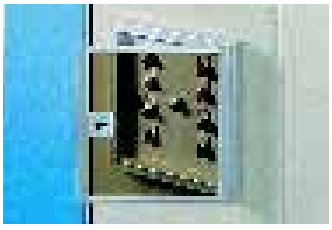
Cam lock

May be retrofitted to the operating area or enclosure panel of operating panels.
Standard double-bit lock insert may be exchanged for type C lock inserts and type C plastic handle.

Packs of	Model No. FT
1	**2749.000**

Accessories:

Lock inserts, type C,
see page 888.
and plastic handle, type C,
see page 886.



Viewing window

for operating panel
For the protection of display and control components. With a build height of max. 35 mm.

Material:
Frame: Aluminium, natural anodised.
Glass panel: Smoked acrylic.

Supply includes:
Lock insert no. 3524 E.

For operating panel	Model No. FT
FT 2741.000	**2791.000**
FT 2742.000	**2792.000**

Note:
Other sizes available on request.

The Rittal comfort handle

The door area can be used to optimum effect for installed equipment, because the handle does not take up any of the swivel area, thanks to its folding action.

Material:
Die-cast zinc

Surface finish:
Powder-coated

German patent no. 198 01 720
German registered design no. M98 00 539
IR reg. design no. DM/045 065 with validity for BE, CH, ES, FR, IT, NL, HU, LU
Austrian design no. 32290
Czech design no. 28278
UK reg. design no. 2 075 910
Swedish design no. 64 750
South Korean design no. 241,505
Israel. design no. 30 123
Slovenian design no. 98 500 73
Russian design no. 46307
South African design no. 98/0865
Finnish design no. 20461
Chinese design no. 983 03439
Australian design no. 13887
US design patent no. 428,322
Brazilian design no. DI 5801235-4
Jap. design no. 1 081 561
Taiwanese design no. 68683
European patent no. 1 049 842 with validity for FR, GB, IT
Jap. patent no. 3 485 892
US patent no. 6,418,762

Comfort handle

for lock inserts
Prepared for the installation of lock inserts, safety and push-button inserts, see page 881.
Length: 295 mm.

Design	Model No. TS
RAL 7032	**8611.010**
RAL 7035	**8611.020**
RAL 8019	**8611.250**
RAL 9005	**8611.350**
Matt nickel-plated	**8611.330**

Also required:

Handle adaptor for mounting on a TS glazed door, PC-TS bottom door, IW designer door see page 869.

Comfort handle

for padlock and lock inserts
Prepared for the installation of lock inserts, safety and push-button inserts, and with additional shackle (hole diameter 8 mm) for a padlock.
Length: 295 mm.

Design	Model No. TS
RAL 7032	**8611.030**
RAL 7035	**8611.290**
RAL 8019	**8611.260**

Also required:

Handle adaptor for mounting on a TS glazed door, PC-TS bottom door, IW designer door, see page 869.

Lock inserts

For comfort handles and standard TS lock (in exchange for the standard double-bit lock insert).

Design	Model No. TS
7 mm square	**8611.100**
8 mm square	**8611.110**
6.5 mm triangular	**8611.220**
7 mm triangular	**8611.120**
8 mm triangular	**8611.130**
Screwdriver	**8611.140**
Daimler	**8611.150**
3 mm double-bit	**8611.160**
Fiat	**8611.170**

Lock and push-button inserts

For installation in the comfort handles for lock inserts.

Design	Model No. TS
Security lock insert no. 3524 E	**8611.180**[1)]
Push-button insert	**8611.190**
Push-button and lock inserts Lock no. 12321; No other lock is possible	**8611.200**[1)]

[1)] with 2 keys

Lock systems

Comfort handle

With security lock insert E1
Only for use with **VW, Audi, SEAT, SkodaAuto.**
Supplied without key.
Length: 295 mm.
Other VW locks available on request.

Design	Model No. TS
RAL 7032	**8611.040**
RAL 7035	**8611.045**

Also required:

Handle adaptor for mounting on a TS glazed door, PC-TS bottom door, IW designer door, see page 869.

Comfort handle

for semi-cylinder
Prepared for the installation of commercially available semi-cylinders, 40 or 45 mm total length, to DIN 18 254, and lock and push-button inserts, see page 882.
Length: 302 mm.

Design	Model No. TS
RAL 7032	**8611.060**
RAL 7035	**8611.070**
RAL 8019	**8611.270**
RAL 9005	**8611.360**
Matt nickel-plated	**8611.340**

Also required:

Handle adaptor for mounting on a TS glazed door, PC-TS bottom door, IW designer door, see page 869.

Lock and push-button inserts

For installation in
- comfort handle for semi-cylinder, see above,
- Ergoform-S standard see page 885,
- CM hinged handle

Design	Model No. SZ
Security lock insert no. 3524 E	**2467.000**[1)]
Push-button insert	**2468.000**
Lock and puch-button inserts, Lock no. 2123 E; No other lock is possible	**2469.000**[1)]

[1)] with 2 keys

Comfort handle

Prepared for ASSA lock system.
Length: 302 mm.

Design	Model No. TS
RAL 7032	**8611.050**
RAL 7035	**8611.280**

Also required:

Handle adaptor for mounting on a TS glazed door, PC-TS bottom door, IW designer door, see page 869.

Security handle

with code

Flexible access opportunities with

- individual 3-digit code without key
  or
- with the master key function via an additional semi-cylinder of 40 or 45 mm to DIN 18 254, irrespective of the code.

Design with	Model No. DK
Comfort handle TS, FR(i)	**7200.800**
Ergoform-S handle	**7200.810**

Accessories:

Lock and push-button inserts,
see page 882.

Adjacent door locking

for TS, CL

For optimum operation of the adjacent door from the outside if the handle on the inside is difficult to access due to swing frames or 482.6 mm (19″) installed equipment. Retrospective conversion of the adjacent door is easily achieved using the supplied drilling template.
The handle on the inside is no longer required.

Supply includes:
Assembly parts.

Packs of	Model No. TS
1	**8611.370**

Accessories:

Standard double-bit lock insert may be exchanged for 27 mm lock inserts, version A,
see page 888.

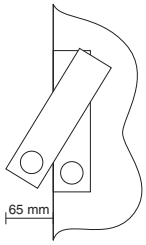
Swivel handle

for sheet steel door TS, CL

With lock insert, lock no. 3524 E.
The use of semi-cylinders is not possible.
Length: 150 mm.

Note:
When used in a bayed enclosure suite, the hinges must be on the same side.

Design	Model No. DK
RAL 7035	**7829.300**



Lock systems

Locking bar latch to CNOMO[1)]

To fit all locking bars in TS doors and glazed doors with standard lock or comfort handle.
The latch prevents the locking bars from moving when the door is open.
For mounting on the bolt of the bar guide.

[1)] CNOMO is a specification by the French automobile industry. For safety reasons, it must not be possible to lock the handle whilst the door is open.

Packs of	Model No. TS
10	**8611.210**

Also required:

For CNOMO[1)]
6.5 mm triangular insert TS 8611.220,
see page 881.

Spring washer

When dismantling the TS or CL locking rods the spring washers cannot be used again.

Material:
Spring steel, zinc-plated, passivated

Packs of	Model No. TS
100	**8800.070**

Assembly tool

for spring washers
For simple pressing-on of the spring washers via inlet ring magnets.

Packs of	Model No. TS
1	**8800.270**

Mini-comfort handle

for use in all 3-part EL enclosures
Prepared for the installation of lock inserts and for the installation of commercially available 40 or 45 mm semi-cylinders, and of lock and push-button inserts.

Material:
Die-cast zinc

Colour:
RAL 7035

Design	Model No. DK
For lock inserts[1)]	**7705.110**
For semi-cylinder[2)]	**7705.120**

Accessories:

[1)] Lock inserts,
see page 881.
[2)] Lock and push-button inserts,
see page 882.

The Ergoform S lock system

The unlocked handle folds down forwards and is swivelled to open the lock.

Material:
Die-cast zinc

Surface finish:
Powder-coated

Ergoform standard

Prepared for the installation of semi-cylinders with a total length of 40 or 45 mm (to DIN 18 254) and all 27 mm lock inserts, version A, see page 888.

Design	Model No. SZ
RAL 7032 With brown handle	**2450.000**
Brown	**2451.000**
Matt nickel-plated	**2452.000**
RAL 7032	**2454.000**
RAL 7035	**2435.000**
RAL 7032[1)] With brown handle and bracket	**2455.000**

[1)] Hole diameter = 7 mm for padlock

To fit **KS plastic enclosures.** Prepared for the installation of semi-cylinders with a total length of 40 mm (to DIN 18 254), all 27 mm lock inserts, version A, and lock and push-button inserts, see page 882.

Design	Model No. KS
RAL 7032 With brown handle	**1490.000**

1

2

3

Ergoform special

1 **With lock insert, lock E1.**
Only for use with **VW, Audi, SEAT, SkodaAuto.**
Supplied without key.
Other lock systems available on request.

E1	Model No. SZ
RAL 7035 With brown handle	**2456.500**

2 **Prepared for ASSA lock system.**

ASSA	Model No. SZ
Completely brown	**2453.000[1)]**

[1)] to fit plastic enclosures KS on request.

3 **To fit all ES enclosures with CNOMO lock, 6.5 mm.**
Triangular lock insert. The handle can only be locked if the door is completely closed **(French motor car industry).** Not suitable for glazed doors.

CNOMO	Model No. SZ
RAL 7035 With brown handle	**2421.500**

Ergoform padlock handle system

for CS Outdoor
With an additional shackle for a padlock.
Hole diameter of shackle: 9 mm.
Prepared for the installation of 40 mm semi-cylinders (length: 10/30 mm).

Packs of	Model No. CS
1	**9785.030**

Lock systems

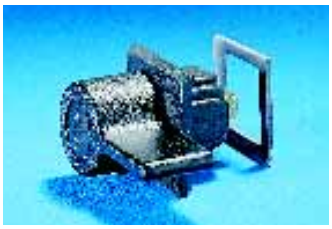
Plastic handles

with cylinder insert.
Lock no. 3524 E including assembly parts, seal and 2 keys.

Note:
The universal lock systems allows the installation of a suitable handle to suit almost any application or customer specification. The relevant product ordering page shows which handles can be fitted into each particular assembly.

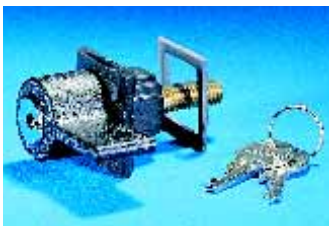
Version B

Colour	Model No. SZ
RAL 9011	**2576.000**
RAL 7030	**2439.000**



Version B,
but without cylinder insert.

Colour	Model No. SZ
RAL 9011	**2533.000**



Version G

Colour	Model No. SZ
RAL 9011	**2599.000**

Version C

Colour	Model No. SZ
RAL 9011	**2485.000**

Version C,
but without cylinder insert.

Colour	Model No. SZ
RAL 9011	**2485.100**

Version E

Colour	Model No. KS
RAL 9011	**1484.000**

T handles

Material:
Die-cast zinc, chrome-plated

Supply includes:
Seal and 2 keys.

Version B

Design	Model No. SZ
With lock insert, lock no. 3524 E	**2575.000**
Without lock insert	**2572.000**

Version C

Design	Model No. SZ
With lock insert, lock no. 3524 E	**2535.000**
Without lock insert	**2536.000**

Cam locks

Housing made of die-cast zinc, nickel-plated

	Model No. SZ
With double-bit insert[1)]	**2520.000**
With lock insert, lock no. 3524 E	**2530.000**

[1)] exchangeable for lock inserts, Version C, see page 888.

Housing of fibre-glass reinforced polyamide, also as a replacement for compact enclosures AE.

	Model No. SZ
With double-bit insert[1)]	**2420.000**
With lock insert, lock no. 3524 E	**2430.000**

[1)] exchangeable for cylinder inserts, Version B, see page 889 and 27 mm lock inserts, version A, see page 888.

Housing of fibre-glass reinforced polyamide, also as a replacement for compact enclosures AE.

With lock no. E1.
Only for use with **VW, SEAT, Audi, Skoda Auto.**
Supplied without key.
Other lock systems available on request.

Colour	Model No. SZ
RAL 7032	**2540.000**
RAL 7035	**2540.500**

Entirely of stainless steel 1.4301.
For AE compact enclosures, stainless steel (with cam lock).

	Model No. SZ
With double-bit insert	**2304.000**

Stainless steel design 1.4404 (AISI 316L) available on request.

Lock inserts

Note:
The universal lock systems allows the installation of a suitable handle to suit almost any application or customer specification. The relevant product ordering page shows which handles can be fitted into each particular assembly.

Version A

Material:
Die-cast zinc

Length 27 mm	Model No. SZ
7 mm square	**2460.000**
8 mm square	**2461.000**
7 mm triangular	**2462.000**
8 mm triangular	**2463.000**
Screwdriver	**2464.000**
Daimler insert	**2465.000**
3 mm double-bit	**2466.000**
Fiat	**2307.000**
6.5 mm triangular (CNOMO)	**2460.650**

Version C

Material:
Die-cast zinc

Length 41 mm	Model No. SZ
7 mm triangular	**2527.000**
8 mm triangular	**2528.000**
7 mm square	**2523.000**
8 mm square	**2526.000**
Daimler insert	**2522.000**
3 mm double-bit	**2483.000**

Version D

Material:
Die-cast zinc

Length 47 mm	Model No. SZ
7 mm triangular	**2555.000**
8 mm triangular	**2556.000**
7 mm square	**2557.000**
8 mm square	**2558.000**
Daimler insert	**2554.000**
3 mm double-bit	**2484.000**

Version E

Material:
Plastic

	Model No. KS
7 mm triangular	**1485.000**
8 mm triangular	**1486.000**
7 mm square	**1487.000**
8 mm square	**1488.000**
Screwdriver	**1489.000**
Double-bit	**1492.000**

Cylinder inserts

Material:
Die-cast zinc

Version B

Lock no. 3524 E with 2 keys.

Packs of	Model No. SZ
1	**2571.000**

Version C

Lock no. 3524 E with 2 keys.

Packs of	Model No. SZ
1	**2525.000**

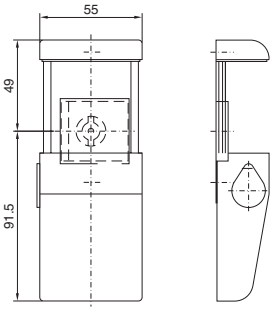
Semi-cylinder lock

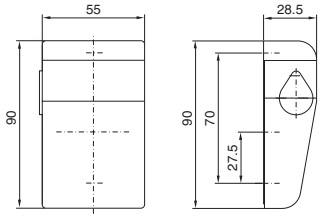
for compact enclosures AE
For retro-fitting to single-door enclosures with cam lock.
The cover plate is locked by semi-cylinders 40/45 mm total length (to DIN 18 254). An additional cover protects the cylinder against dirt.
The protection category of the enclosure is not impaired.
Supplied without semi-cylinder.

Material:
Die-cast zinc

Design	Model No. SZ
RAL 7035	**2534.100**
RAL 7032	**2534.000**
Nickel-plated (matt)	**2534.500**

German patent no. 195 12 280
European patent no. 0778 913
with validity for GB, FR, IT
US patent no. 5,916,282
Jap. patent no. 3.088.465





Lock systems

Lock cover

for padlocks or multiple locks
For retrospective mounting on all compact enclosures AE, of sheet steel and with cam lock.

Material:
Die-cast zinc, nickel-plated, passivated

Packs of	Model No. SZ
1	**2493.000**

Multiple lock

for 6 cam locks
The the ideal solution in cases where individual access for several persons is required for maintenance and repair purposes.

Material:
Sheet steel, zinc-plated, passivated

Packs of	Model No. SZ
2	**2493.500**

Lock cover

prepared for lead seal
For all enclosure types with Rittal-specific locks, such as AE, EB and AP.

Material:
Polyamide

Colour	Packs of	Model No. SZ
RAL 7035	2	**2476.000**

German registered design no. M 92 07 062

Security lock

Fitted to doors, to protect against contact with live electrical equipment whilst the main switch is ON.

Function:
- Locks the door when the main switch is ON.
- Mains power (voltage) is only enabled whilst the door is closed.
- Monitoring of the lock magnet via an additional closing contact.

Supply includes:
Lock, actuator, angle bracket, assembly parts.

Connection voltage for lock magnet	Model No. SZ
230 V AC 11 VA	**2416.000**
24 V DC 8 W	**2418.000**
120 V AC 8 VA	**2419.000**

Also required:

For twin-door enclosures (for the overlapping door, for the message “enclosure door closed”), Rittal door-operated switch PS 4127.000, see page 956.

Enclosure key

For lock inserts (one double-bit key is supplied with every enclosure).

Design	Model No. SZ
Double-bit key no. 5	**2531.000**
Security key no. 3524 E	**2532.000**
7 mm triangular	**2545.000**
8 mm triangular	**2546.000**
7 mm square	**2547.000**
8 mm square	**2548.000**
Daimler key	**2521.000**
Fiat key	**2308.000**

Universal enclosure key

Double-bit, 8 mm square, 8 mm triangular (also for 7 mm inserts), with integral screwdriver.

Packs of	Model No. SZ
1	**2549.000**

Spare key

for QuickBox/FR(i)

Spare key for standard lock no. 12321.

Packs of	Model No. QB
2	**7526.050**

Quick-release fastener

for QuickBox

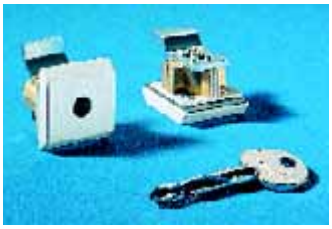
The quick-release fastener provides optimum access, even when used in problem areas. To facilitate locking, the quick-release fastener is screw-fastened to the mounting bracket at the front. This enables the QuickBox to be locked even when the fasteners of the sides are opened, allowing the enclosure cover to be attached and removed easily.

Packs of	Model No. QB
2	**7502.220**

Material:
Sheet steel, spray-finished

Colour:
RAL 7035

Supply includes:
2 mounting brackets, mounting material and quick-release fasteners



Lock “15”

For retro-fitting in all FM/fibre-optic small distributors (Zeiss-Ikon “15”).
For cross-bit keys.

Colour:
RAL 7035

Lock	Packs of	Model No. DK
“15”	2	**7059.035**

Extended delivery times.

Key “15”

Cross-bit key for security lock (Zeiss Ikon “15”).
Two keys are required for a small distributor.

Key	Packs of	Model No. DK
“15”	1	**7059.100**

Extended delivery times.

Lock systems

1

Door locking for bayed suites

For extending the door locking of **commercially available main switches** to bayed suites TS. Adjacent door cannot be opened until the main door has been opened.

The main switch can be positioned anywhere in the suite; its function is independent from the door hinge position.
Subsequent locking of the adjacent doors in the suite is possible: they are thus automatically included in locking operation.

2

1 Operating mechanism
(Fitted in the enclosure with main switch and additionally in every fourth adjacent enclosure)

	Model No. TS
Operating mechanism	**4912.000**

2 Adjacent door locking
(Installation in adjacent enclosure)

	Model No. TS
Adjacent door locking	**4911.000**

3

3 Interconnecting rods
To extend locking from the main enclosure to the adjacent enclosures of a bayed suite. An interconnecting rod corresponding to the width of the enclosure is required for each adjacent enclosure.

For enclosure width mm	Packs of	Model No. TS
600	10	**4916.000**
800	10	**4918.000**
1200	10	**4920.000**

Isolator door locking (USA version)

For safety locking of enclosures and bayed suites according to USA specifications, only in conjunction with **the following types of main switches:**

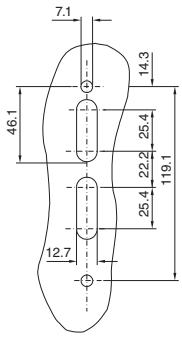
- Allen Bradley 1494 V-H1 (actuating lever)
- Square D 9422 A1
- ITE Siemens Max-Flex series/FHOH (only available in the USA)
- General Electric TDA Typ 1 and 2.

For assembly, a main door lock plus adjacent cubicle latch mechanisms are required, together with interconnecting rods to match the bayed enclosures.

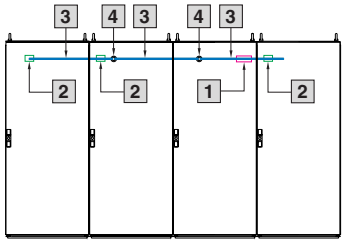
Note!
On configuration of bayed suites, it must be noted that the isolator main enclosures can only be attached to the right side (USA version).

Main door locking	Model No. TS
for TS	**8611.310**

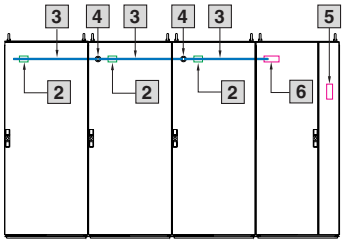
Cutout for main switch



Door locking for TS bayed suites (commercially available main switches)



Isolator door locking (USA version)



1 Operating mechanism, installation in enclosure with main switch

2 Adjacent door locking, installation in adjacent enclosure

3 Interconnecting rod

4 Connection component (included in the supply of interconnecting rod)

5 Main door lock (for isolator door locking, USA version)

6 Operating mechanism, installation in the main enclosure (included in the supply of the main door lock pos. 5)

Hinges 130°

for ES
For retrofitting a sheet steel door instead of the rear panel.

Material:
Die-cast zinc

Supply includes:
Assembly screws.

Packs of	Model No. PS
6	**4190.000**

Note:
Lock components for frame should be ordered separately:

Packs of	Model No. ES
8 sets	**4167.000**

Hinges 130°

for TS
For retrofitting a sheet steel door instead of the rear panel.

Material:
Die-cast zinc

Supply includes:
Assembly screws.

Packs of	Model No. TS
4	**8800.020**

Also required:
Lock components for frame TS 8800.040,
see page 869.

Hinges 180°

for TS, CL
For retrospective conversion of sheet steel doors with 130° hinges.

One-man assembly:
- Exchange the hinge parts on the frame side for 180° hinges (4 screws).
- Drill the door at the pre-marked points.
- Screw-fasten the hinge parts onto the door.
- Locate the door.
- Press in the captive hinge pins.

Material:
Die-cast zinc

Supply includes:
Assembly screws.

Version	Packs of	Model No. TS
RAL 7035	4	**8800.190**
RAL 7032	4	**8800.030**
RAL 8019	4	**8800.230**
Matt nickel-plated	4	**8701.180**

Note:
Door assemblies such as the comfort handle may restrict the door opening angle.

The hinge pins may only be actuated and the door removed with the door open.
The hinge cannot be dismantled from the outside with the door closed (access protection).

Hinges 180°

for TS bayed enclosure suites with comfort handle
In TS bayed enclosure suites with comfort handle for semi-cylinder, the following door opening angles may be achieved:
Sheet steel door: max. 180°
Glazed door: max. 140°

Material:
Die-cast zinc

Colour:
RAL 7035/RAL 9005

Supply includes:
Assembly screws.

Version for	Packs of	Model No. TS	
		RAL 7035	RAL 9005
Sheet steel door	4	**7824.520**	**7824.522**
Glazed door	4	**7824.525**	–

Note:
- The protection category of the enclosure may be reduced.
- Not for divided doors.
- Door hinge remains the same within a bayed enclosure suite.
- Not suitable for use with TS designer glazed doors.

Rear panel bracket

For:
- Premium Panel
- Premium Line KL, from height 200 mm

For fitting on the inside, so that there are no exterior surfaces where substances could accumulate and pose a potential threat to hygiene. Holds the rear panel against the enclosure when it is flipped down; easily removed if required.

Packs of	Model No. CP
1 set	**6682.000**

Material:
Stainless steel 1.4301

Supply includes:
Assembly parts.

Hinges

Hinges 180°

For retrospective conversion of standard doors with 130° hinges.
Including assembly parts.

For ES, TE

Material:
Aluminium

Surface finish:
Powder-coated in RAL 8019

Packs of	Model No. PS
6	4189.000

For ES

Material:
Stainless steel 1.4301

Packs of	Model No. PS
6	4156.000

For AK, AP

Material:
Sheet steel

Packs of	Model No. SZ
6	2579.000

For AE

Material:
Die-cast zinc

Packs of	Model No. SZ
2	2449.000

For CM

Packs of	Model No. CM
2	5001.000

Cover hinge

for KL cover
The cover hinge is simply screwed to the box protection channel and to the edge fold.

Packs of	Model No. KL
6	1592.000

Hinge pin remover

For safe and easy removal of hinge pins.

For enclosure	Model No. SM
AP/AK	2431.000
AE/FM	2432.000

Support strips

For attachment of
- Cable ducts
- Cable conduit holders
- Contact hazard protection covers
- Equipment installed on the door
- Cable clamping and attachment

4.5 mm diameter hole on a 25 mm DIN pitch pattern.

Material:
Sheet steel, zinc-plated, passivated

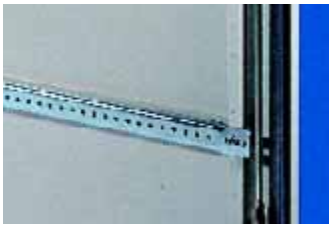
Supply includes:
Packs of 20,
including screws

Accessories:

Screws and self-tapping screws M5,
see page 937.

For TS, CM, CL, ES

For door width mm	Model No. SZ
400	**4594.000**
500	**4309.000**
600	**4596.000**
800	**4598.000**
900	**4579.000**
1000	**4599.000**



For AE

For enclosures AE	Model No. SZ
1007.500[2], 1013.500[2] 1018.500[2], 1019.500[2] 1050.500[1], 1057.500 1100.500, 1110.500 1114.500[1], 1130.500 1213.500[1], 1350.500[1]	**2325.000**
1009.500[2], 1010.500[2] 1012.500[2], 1039.500 1058.500, 1060.500 1076.500, 1090.500 1260.500[1], 1339.500 1360.500, 1376.500	**2326.000**
1014.500[2], 1073.500 1077.500,	**2327.000**
1016.500[2], 1017.500[2] 1180.500, 1280.500[1]	**2328.000**

[1] For these AE models, the door rails should be cut to length.
[2] Only in conjunction with perforated mounting strips. (see page 896).

Cross brace

for TS, CM, CL, ES doors
To stabilise heavy equipment installed on and in the door.
With slots for enclosure duct connector,
see page 1035.
Frame connector, adjustable,
see page 907 and
enclosure surface connector,
see page 1034.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts for screw-fastening to the tubular door frame.

For door width mm	Model No. TS
600	**8800.960**
800	**8800.980**

Door, internal

Perforated mounting strip

For AE stainless steel, AP universal console[1)]
For vertical mounting on the threaded bolts of the door, for attaching
- Door rails AE
- Door stays SZ 2519.000, see page 898.

3.7 mm diameter hole on a 25 mm DIN pitch pattern.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Packs of 20,
including nuts and serrated washers.

To match AE	Length mm	Model No. SZ
1005.500, 1006.500 1009.500	318	**2310.038[1)]**
1012.500, 1014.500	698	**2310.076**
1016.500, 1018.500	938	**2310.100**
1017.500, 1019.500	1138	**2310.120**

[1)] for door at top

Accessories:
Screws,
see page 937.

Utility lectern

For programming units etc. Prepared for mounting on the tubular door frame of TS, CM, CL, ES, PC or on any sufficiently large surface.
When required for servicing, it folds down quickly with a maximum support area, and after use is stowed between the tubular door frames in a space-saving design.
Load capacity: max. 30 kg.

Material:
Sheet steel

Colour:
RAL 7035

Support area mm		For door width mm	Model No. TS
Width	Depth		
413	400	600	**4638.600**
613	400	800	**4638.800**

Wiring plan lectern

Holds wiring plans during fault finding and maintenance work.
The wiring plan lecterns can be bayed according to the door width.
For mounting on the tubular door frame.

Material:
Utility lectern: Polypropylene
Mounting bracket: Die-cast zinc

Colour:
Similar to RAL 7035

Supply includes:
Wiring plan lectern (width 210 mm).
Assembly parts.

For enclosures	Packs of	Model No. TS
For TS, CM, CL, ES, PC	1	**4120.000**

For door width mm	Required/possible number of wiring plan lecterns	
	min.	max.
400	1	1
500	1	1
600	2	2
800	2	3
1000	3	3

CD/disk box

For fixing to all flat, clean surfaces with double-sided adhesive tape.

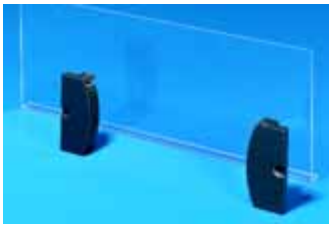
Capacity:
max. 10 CDs/DVDs,
or 18 (3 1/2″) disks.

Material:
Polyamide

Colour:
RAL 7033

Packs of	Model No. SZ
1	**2446.000**

German registered design
No. M 92 07 061
U.K. reg. des. no. 2 029 365
IR reg. design no. DM/025 474
with validity for FR, IT



Wiring plan pocket made of plastic

for AE

For installation options, refer to table

- B = Screw-fastened to the perforated door strip on both sides
- E = Screw-fastened on one side, other side stuck with adhesive

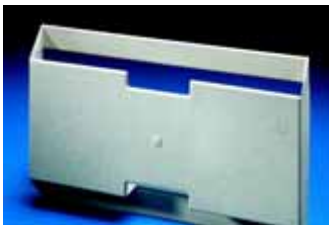
or stuck entirely with adhesive

Supply includes:
2 holders with double-sided adhesive tape,
plexiglass pane,
assembly parts.

Note:
The plexiglass pane may be shortened to any required size for shorter doors.

Model No. SZ		2514.500	2514.600	2514.800
Usable width mm		340	415	615
Usable depth mm		18	18	18
Height of plexiglass panel mm		167	167	167
Installation options				
For Model No. AE	Width mm			
1050.500	500	B	–	–
1057.500	500	B	–	–
1058.500	600	E	E	–
1060.500	600	E	E	–
1073.500	760	E	E	–
1076.500	600	E	E	–
1077.500	760	E	E	–
1090.500	600	E	E	–
1100.500	1000	B	–	–
1110.500	1000	B	–	–
1114.500	1000	B[1)]	–	–
1130.500	1000	B	–	–
1180.500	800	E	E	E
1213.500	1000	B[1)]	–	–
1260.500	600	E	B	–
1280.500	800	E	E	B
1350.500	500	B	–	–
1360.500	600	E	E	–
1376.500	600	E	E	–

[1)] Prepared for the installation in the l/h side door; for installation in the r/h side door, the acrylic glazed pane can be shortened.



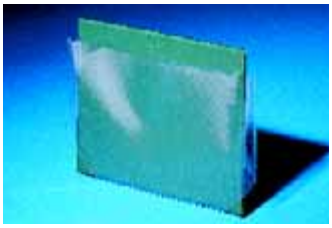
Wiring plan pockets made of plastic

For affixing to the inside surfaces of doors.

Material:
Polystyrene with self-adhesive fastening strips.

Colour:
Similar to RAL 7035

For Format	Clearance openings mm			Model No. SZ
	W (B)	H	D	
A3 landscape	438	287	45	**2513.000**
A4 portrait	228	256	17	**2514.000**
A5 landscape	228	176	17	**2515.000**

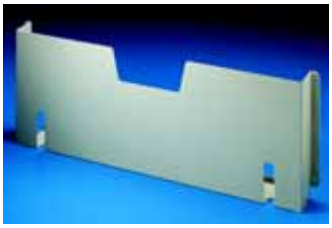


Wiring plan pockets with transparent pouch

With welded-on transparent pouch and self-adhesive backing.

For format	Model No. SZ
DIN A4	**2510.000**
DIN A3	**2512.000**

Door, internal



Wiring plan pockets of sheet steel

for TS, CM, CL, ES, PC
For fastening to tubular door frames at any height.

Colour:
RAL 7035

Supply includes:
Assembly screws

To fit door width mm	Clearance openings mm			Model No. TS
	W (B)	H	D	
400	255	260	90	**4114.000**
500	355	260	90	**4115.000**
600	455	260	90	**4116.000**
800	655	260	90	**4118.000**
900	755	260	90	**4123.000**
1000	855	260	90	**4124.000**

Wiring plan pockets of sheet steel

for AK
For screw-fastening on the left or right of the perforated door strip in any height.
The opposite side is fastened with adhesive tape.

Colour:
RAL 7035

For format	Clearance openings mm			Model No. SZ
	W (B)	H	D	
DIN A4	298	260	58	**2516.000**
A3 landscape	434	260	58	**2517.000**[1)]

[1)] Not for AK 1647.XXX, AK 1650.XXX

Door stay

To secure the door in the open position.

For	Packs of	Model No.
TS, CL, ES, PC	5	**4583.000**
AK, AP pedestals (not illustrated)	5	**2518.000**
AE (except AE 1032.500 and AE 1035.500) and all AE stainless steel enclosures[1)] can only be mounted at the top (not illustrated)	5	**2519.000**
AE IP 69K	1	**1101.800**
Outdoor compact enclosures	1	**1616.110**

[1)] With AE stainless steel, only in conjunction with perforated mounting strip, see page 896.

Ride-up roller

for TS, ES, PC
Lifts the door with heavy installed equipment (e.g. cooling unit) as a closing aid. For attaching to the tubular door frame.

Packs of	Model No. TS
10	**4538.000**

Transport and mounting handle

for TS, CL, ES doors
For secure attachment and dismantling of the door and for movement into the workshop. The matching hinge pin removal tool for 130° hinges is pre-integrated, and supplied loose for 180° hinges.

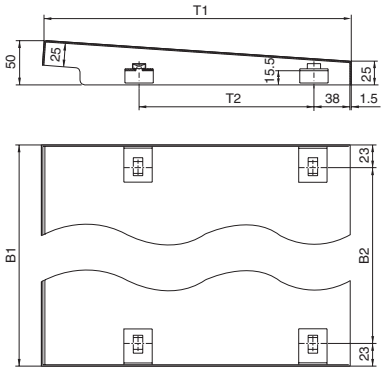
Packs of	Model No. SM
1	**2415.100**

Rain canopies

for AE
Reliable protection for outside siting – with water run-off to the rear. Easily retro-fitted.

Supply includes:
Assembly parts.

Note:
For outdoor siting, we generally recommend a rain canopy above the enclosure or the gap between the door or screw-fastened rear panel and the enclosure, in order to protect against water and UV radiation.
The tests of IP protection categories for water protection (2nd code number to EN 60 529) cannot be compared with an enclosure sited outdoors or under similar conditions.
Upon request, rain canopies of sheet steel, stainless steel or aluminium can also be produced for other enclosures.



B = Width
T = Depth

Sheet steel version

For AE enclosures	B1	B2	T1	T2	Model No. SZ
1031.500 1038.500 1380.500	391	340	235	120	**2501.500**
1039.500 1060.500 1076.500	611	560	235	95	**2502.500**
1339.500 1360.500 1376.500	611	560	375	235	**2511.500**

Stainless steel version

For AE enclosures	B1	B2	T1	T2	Model No. SZ
1002.600 1035.500	211	160	180	65	**2470.000**
1005.600 1033.500 1034.500	311	260	235	120	**2361.000**
1004.600 1030.500	391	340	180	65	**2471.000**
1006.600 1008.600 1031.500 1038.500 1380.500	391	340	235	120	**2472.000**
1007.600 1050.500	511	460	235	120	**2362.000**
1009.600 1010.600 1012.600 1039.500 1060.500 1076.500	611	560	235	95	**2473.000**
1014.600 1073.500	771	720	325	185	**2474.000**
1016.600 1017.600 1180.500 1280.500	811	760	325	185	**2475.000**
1018.600 1019.600 1110.500 1114.500 1130.500 1213.500	1011	960	325	185	**2363.000**

Accessories:

Condensate discharge,
see page 852.

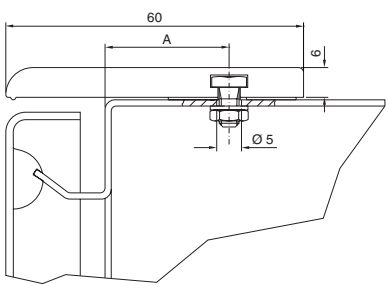
Dust guard trim

for AE, AK, EB, KL and BG
To protect against deposits on the upper edge of the door and between the enclosure and the door/lid. Cut the door protection strip to length according to the enclosure width. Drill the enclosure and mount the strip using the adhesive strips and screws.

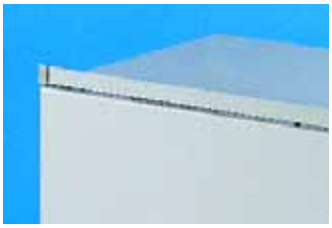
Material:
Plastic, UV-resistant

Colour:
Similar to RAL 7024

For enclosure	Length mm	A mm	Model No. SZ
AE	1200	25	**2426.500**
AK		15	
KL, EB, BG		20.5	



Roof



Dust guard trim

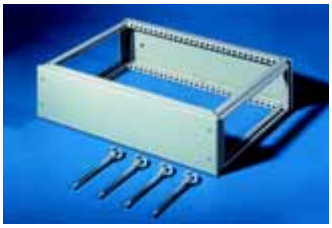
for TS, ES, FR(i)
To protect against dust deposits on the upper edge of the door and between the door and upper horizontal enclosure section. The dust guard trim provides space to accommodate texts or company logos.

Colour:
RAL 7035

Supply includes:
Clear plastic strip for text labels (Height 29.5 mm).

Length mm	Model No. SZ
600	**2424.100**
800	**2425.100**
1000	**2427.100**
1200	**2426.100**

Note:
Also suitable for use in conjunction with baying cover top,
see page 867.



Top mounting module

for TS, FR(i)
As a cable chamber for cable infeed from above or for power distribution with busbar systems across bayed enclosures. The TS cover plate is used as standard to finish off at the top. The enclosure height is increased by 200 mm with the top mounting module fitted.
The top baying cover cannot be fitted. Installation accessories for top and bottom, see diagram and explanations below.

Material:
Sheet steel, 1.5 mm

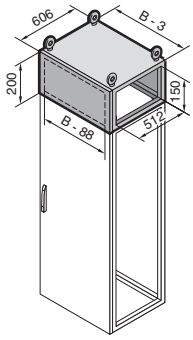
Surface finish:
Spray-finished in textured RAL 7035/RAL 7032

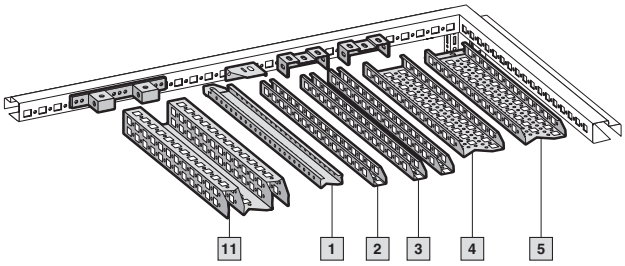
Protection category:
IP 55 to EN 60 529/10.91
Complies with NEMA 12
(in conjunction with side panel for top mounting module, see page 901).

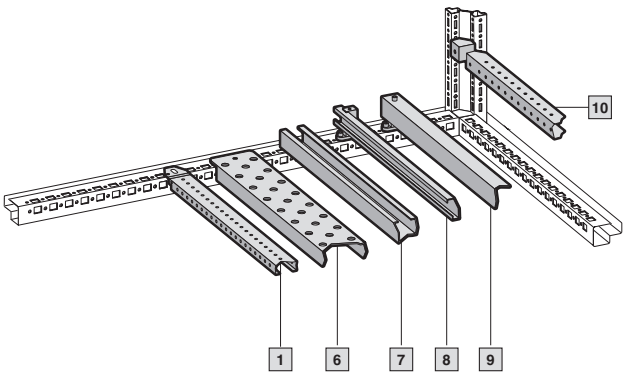
For enclosures		Model No. TS	
Width (B) mm	Depth mm	RAL 7032	RAL 7035
400	600	**8801.720**[1)]	**8801.725**
600	600	**8801.730**[1)]	**8801.735**
800	600	**8801.740**[1)]	**8801.745**
1000	600	**8801.750**[1)]	**8801.755**
1200	600	**8801.760**[1)]	**8801.765**

[1)] Delivery times available on request.

Supply includes:
1 frame module,
2 trim panels (front and rear),
8 holders
with automatic potential equalisation,
4 tapped rods with eyebolts.







Accessories:

Description	Page
1 TS punched rail 18 x 38 mm	923
2 PS punched rail 23 x 23 mm with angle bracket	925
3 PS punched rail 23 x 23 mm with support bracket PS	925
4 PS punched section without mounting flange, 23 x 73 mm with support bracket PS	925
5 PS punched section with mounting flange 23 x 73 mm	926
6 Support rail	927
7 System support rails	926
8 C rail 30/15 with support bracket or spacer	928
9 Cable clamp rail	979
10 TS punched rail 25 x 38 mm	923
11 TS punched section without mounting flanges, 45 x 88 mm	922

Side panel

for top mounting module
To finish off the side of a top mounting module or bayed suite.

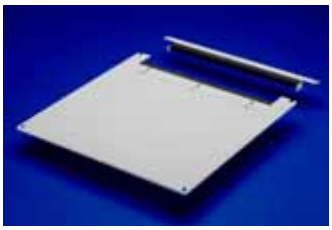
Material:
Sheet steel, 1.5 mm

Surface finish:
Spray-finished in textured RAL 7035/RAL 7032

Supply includes:
2 side panels,
8 holders
with automatic potential equalisation.

Version	Packs of	Model No. TS
RAL 7035	2	**8801.775**
RAL 7032	2	**8801.770**[1)]

[1)] Delivery times available on request.



Roof plate

for cable entry, two-piece
for TS, FR(i)
In exchange for the standard roof. Equipped with a sliding angular bracket in the rear section. Rubber cable clamp strip on both sides for attaching cable bundles and bunched cables.
Thanks to the symmetrical design of the TS 8 frame, side cable entry can also be achieved by rotating the roof plate.
The two-piece design additionally allows easy retro-fitting, by simply removing the front part of the plate for retrospective cable entry.
For active ventilation, a fan mounting plate may be fitted in the front section of the enclosure (only for TS, not in conjunction with the 482.6 mm (19″) mounting frame). To this end, the roof plate must be raised by at least 20 mm with spacers.

Material:
Sheet steel

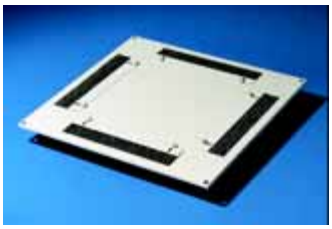
Colour:
RAL 7035

For enclosures		Model No. DK
Width mm	Depth mm	
600	400	**7826.645**
600	600	**7826.665**
600	800	**7826.685**
600	900	**7826.695**
600	1000	**7826.605**
800	400	**7826.845**
800	600	**7826.865**
800	800	**7826.885**
800	900	**7826.895**
800	1000	**7826.805**
1200	400	**7826.245**

Accessories:

Fan mounting plate,
see page 649.
Spacers,
see page 904.

Detailed drawing,
available on the Internet.



Roof plate

for cable entry on all sides
for TS, FR(i)
The roof plate has sliding plates for cable entry on all four sides, and therefore allows individual selection of cable routing tailored to the specific requirements. After cable entry, the sliding plate is closed again as far as possible, and the rubber cable clamp strips supplied loose then seal the cable entry area.

Material:
Sheet steel

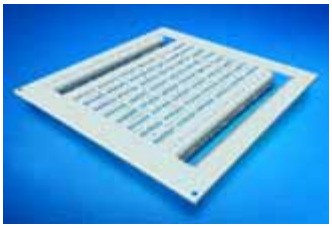
Colour:
RAL 7035

Supply includes:
Assembly parts.

For enclosures		Model No. DK
Width mm	Depth mm	
800	800	**7826.588**
800	900	**7826.589**

Detailed drawing,
available on the Internet.

Roof



Cable management roof plate

for TS, FR(i)
In exchange for the standard roof plate. Thanks to the rounded side cutouts, large quantities of cables may be routed into the rack whilst preserving the bend radii. The roof has system punchings for the attachment of cables with nylon tape or cable ties.

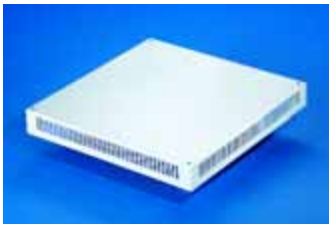
Material:
Sheet steel

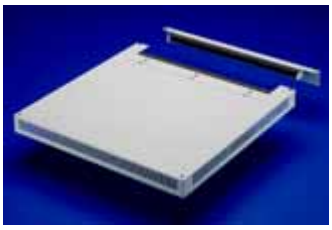
Colour:
RAL 7035

For enclosures		Model No. DK
Width mm	Depth mm	
800	600	**7826.864**
800	800	**7826.884**
800	900	**7826.894**

Other sizes available on request.

Detailed drawing,
available on the Internet.





Roof plate, vented

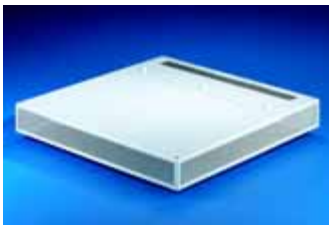
for TS, FR(i)
In exchange for the standard roof.

Variant 1:
72 mm high roof plate, all-round vent slots, optionally with clamp strip for cable entry. The two-piece design with cable entry allows easy retro-fitting, by simply removing the front part of the plate. The cables are held in position via a guide at the side.

Material:
Sheet steel

Colour:
RAL 7035

For enclosures		Model No. DK	
Width mm	Depth mm	One-piece without cable entry	Two-piece with cable entry
600	600	**7826.766**	**7826.669**
600	800	**7826.768**	**7826.689**
600	900	**7826.769**	**7826.699**
600	1000	**7826.760**	**7826.609**
800	600	**7826.786**	**7826.869**
800	800	**7826.788**	**7826.889**
800	900	**7826.789**	**7826.899**
800	1000	**7826.780**	**7826.809**



Variant 2:
Ventilation holes (Ø 3 mm) are incorporated all-round into the 97 mm high roof plate. In conjunction with the vented glazed and sheet steel door, the roof plate matches the door design to perfection.

Material:
Sheet steel

Colour:
RAL 7035

For enclosures		Model No. DK
Width mm	Depth mm	
800	600	**7826.866**
800	800	**7826.886**
800	900	**7826.896**
800	1000	**7826.806**

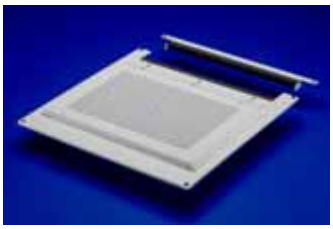
Accessories:

Fan mounting plate for active ventilation.
see page 649.

Detailed drawing,
available on the Internet.

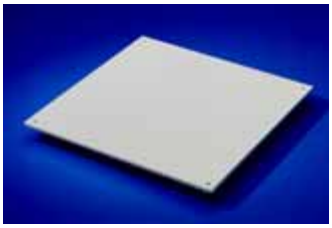
Roof-mounted fans

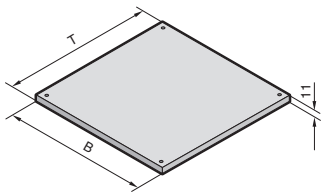
for TS, FR(i)
For the office sector,
see page 648.



Fan roof, modular, two-piece

for TS, FR(i)
see page 651.





Roof/gland plate, solid

for TE
To conceal the entire roof or base area.
The roof/gland plate may be raised with spacers to support passive climate control.

Material:
Sheet steel

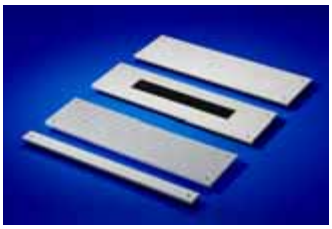
Colour:
RAL 7035, on request in RAL 9005

Supply includes:
Assembly parts.

Width (B) mm	Depth (T) mm	Model No. TE
450	450	**7526.770**
450	650	**7526.780**
650	450	
650	650	**7526.820**

Accessories:

Spacers,
see page 904.



Module plates

for TE
The module plates allow the roof or base area of the TE 7000, in exchange for the existing roof plate, to be varied as required.
The module plates may be raised with spacers to support passive climate control.

Material:
Sheet steel

Colour:
RAL 7035, on request in RAL 9005.

Supply includes:
Assembly parts.

Note:
Configuration details,
see below.

Version	Width mm	Depth mm	Model No. TE
Solid	450	200	**7526.760**
	650	200	**7526.800**
With brush strip	450	200	**7526.850**
	650	200	**7526.860**
Vented	450	200	**7526.829**
	650	200	**7526.834**
Compensating plate	450	50	**7526.750**
	650	50	**7526.790**

Also required:

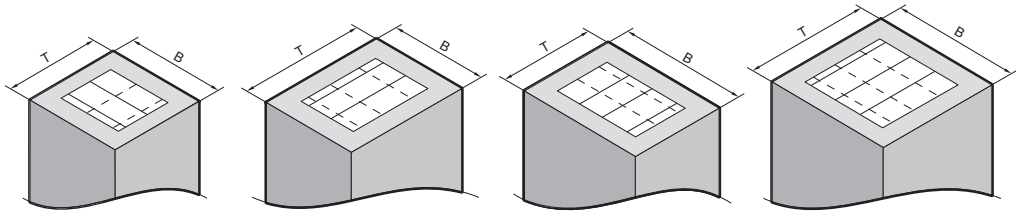
For a completely sealed roof/base assembly, a compensating plate is required.

Accessories:

Spacers,
see page 904.

Configuration: Roof frame, base frame, TE 7000 network enclosures

Enclosure dimensions mm					
	W (B)	600	600	800	800
	D (T)	600	800	600	800
Installation position/ enclosure		2 x module plates in the width or depth plus 1 x compensating plate each	3 x module plates in the width or 2 x module plates in the depth plus 1 x compensating plate each	2 x module plates in the width or 3 x module plates in the depth plus 1 x compensating plate each	3 x module plates in the width or depth plus 1 x compensating plate each



Roof

Roof mounting screw

For screw-fastening the roof plate instead of eye-bolts. With the TS 8, the contact washers for potential equalisation may be taken from the eye-bolts included with the supply of the enclosures.

Material:
Sheet steel, zinc plated, passivated

Packs of	Model No. PS
20	**4198.000**

Spacers

for roof plate
To raise the TS 8 roof for ventilation purposes, in three different heights.
Not suitable for crane transportation!

Height mm	Packs of	Model No. SZ/DK
10	4	**2422.000**
20	4	**2423.000**
50	4	**7967.000**

Spacers

for module plates TE
To assist passive ventilation, spacers may be used to raise the module plates.

Material:
Hexagonal sectional steel, zinc plated, passivated.

Supply includes:
Assembly parts.

Height mm	Packs of	Model No. TE
20	4	**7526.963**

Eyebolts

for TS, ES
For crane transportation of enclosures, may already be included in the supply.
Thread: M12

Packs of	Model No. PS
4	**4568.000**

Eyebolts

for AE, AK
For crane transportation of enclosures, with reinforcement plate to be inserted underneath.
Thread: M12

Supply includes:
Eyebolts, reinforcement plates.

Packs of	Model No. SZ
4	**2509.000**

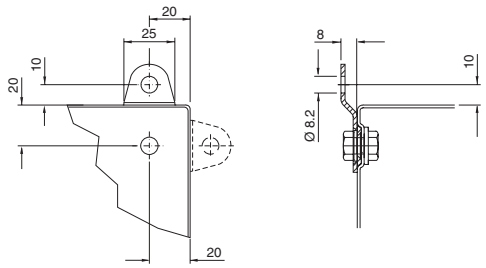
Wall mounting bracket

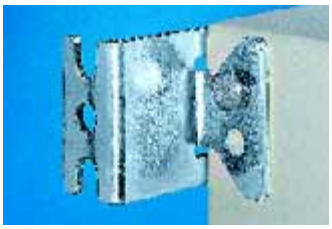
For the attachment of KL, EB, BG and EL enclosures as well as DK and FM wall-mounted distributors.

Supply includes:
Assembly parts for mounting on the enclosure.

Note:
For hygiene reasons, and in view of the protection category, the stainless steel enclosures do not have any drilled holes for the wall mounting brackets.

Material	Wall distance mm	Packs of	Model No. KL
Brass nickel-plated	8	4	**1580.000**
Sheet steel zinc-plated, passivated	8	4	**1590.000**
Stainless steel 1.4301	8	4	**1594.000**





Wall mounting bracket

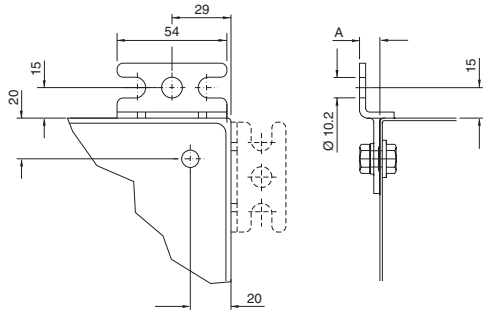
For the attachment of KL, EB, BG, AE, CM and EL enclosures as well as DK and FM wall-mounted distributors.

Supply includes:
Assembly parts for mounting on the enclosure.

Note:
For hygiene reasons, and in view of the protection category, the stainless steel enclosures do not have any drilled holes for the wall mounting brackets.

Material	Wall distance (A) mm	Packs of	Model No. SZ
Sheet steel zinc-plated, passivated	40	1	**2503.000**[1]
		4	**2503.010**
	10	1	**2508.000**[1]
		4	**2508.010**
Stainless steel 1.4301	10	4	**2433.000**

[1] Without assembly parts.



Wall mounting bracket

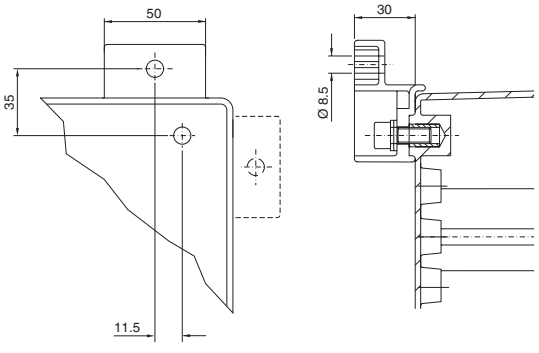
for KS
For attachment to the wall, only possible from the outside of the enclosure.

Material:
Fibreglass-reinforced polyamide[1]

Supply includes:
Assembly parts for mounting on the enclosure.

Colour	Packs of	Model No. KS/KE
Sim. to RAL 7032	4	**1483.000**
Sim. to RAL 9011	4	**9266.000**[1]

[1] With graphite additive for Ex applications.

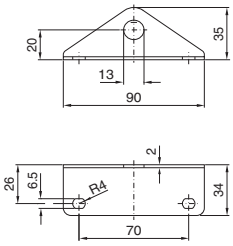


Wall mounting

Wall angle

For compact enclosures (additional holes required in the enclosure).

Material	Colour	Packs of	Model No. SZ
Sheet steel	RAL 7035	1	**2505.500**
	RAL 7032	1	**2505.200**
Stainless steel 1.4301	–	1	**2583.000**



Wall bracket

For wall attachment of TS and ES enclosures at the roof, e.g. with heavy components on the door.

Material:
Sheet steel, zinc-plated, passivated

Packs of	Model No. PS
4	**4595.000**

Possible alternative:

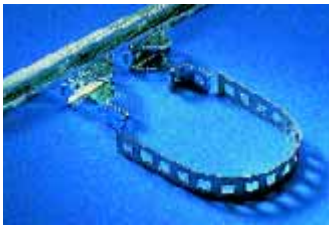
With TS 8 inside the enclosure (without mounting plate), baying bracket TS 8800.470, see page 866.

Wall mounting bracket

for CS wall-mounted enclosures
For mounting on a wall or panel.

Material:
Stainless steel 1.4301

Packs of	Model No. CS
4	**9765.120**



Pole clamp

For reliable, convenient fastening to round or square poles.

For pole diameter/size:
Ø from 40 to 190 mm
□ from 50 to 150 mm

Material:
Mounting angles, clamping section:
Sheet steel, zinc-plated, passivated
Clamping strap: Stainless steel 1.4301

For KL, EB, BG, AE, KS

Supply includes:
2 mounting angles, 600 mm long,
4 clamping sections,
2 clamping straps,
4 clamping brackets,
4 screws and nuts M8
for attachment to the enclosure.

Packs of	Model No. SZ
1 set	**2584.000**

For CS wall-mounted enclosures

Supply includes:
4 clamping sections,
2 clamping straps,
4 clamping brackets.

Packs of	Model No. CS
1 set	**9765.125**

Enclosure connectors

adjustable
Between Command Panels, terminal boxes, compact enclosures
and
horizontal or vertical surfaces.
Pre-mount the connector halves on both sides, screw together and secure with a locking screw, and/or adjust the angle of rotation.

Rotation range:
±105° with 7.5° stepped increments.

Material:
Die-cast zinc, powder-coated

Colour:
RAL 7035

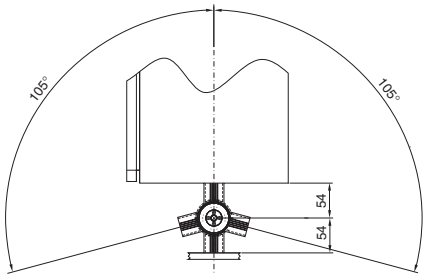
Supply includes:
Assembly parts for both sides.

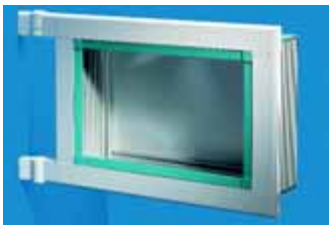
Packs of	Model No. CP
1 set	**6016.200**

Note:
The locking screws may be exchanged for standard, commercially available clamping levers (M10 x 50 mm).

Also required:

Cross-brace for door,
see page 895.





Frame connector

adjustable
Between the Command Panel VIP 6000 with wide front frame
and
horizontal or vertical surfaces.
Pre-mount the connector halves on both sides, screw together and secure with a locking screw, and/or adjust the angle of rotation.

Rotation range:
±105° with 7.5° stepped increments.

Material:
Die-cast zinc, powder-coated

Colour:
RAL 7035

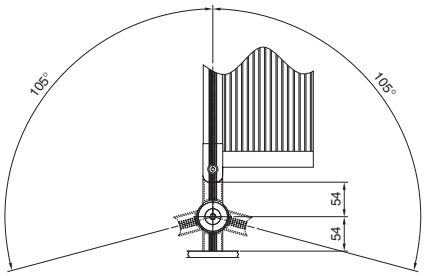
Supply includes:
Assembly parts for both sides.

Packs of	Model No. CP
1 set	**6016.100**

Note:
The locking screws may be exchanged for standard, commercially available clamping levers (M10 x 50 mm).

Also required:

Cross-brace for door,
see page 895.



Wall mounting

Wall mounting bracket

vertically hinged
Between the Compact Panel
and
horizontal or vertical surfaces.

Rotation range:
180° adjustable on a 7.2° pitch pattern.

Material:
Wall mounting bracket: Sheet steel
Locking screw: Steel with plastic knurled handle

Supply includes:
Locking screw and assembly parts for mounting on the Compact Panel.

Packs of	Model No. CP
1 set	**6341.000**

Console

for wall mounting, for RNC
With space for optimum cable routing in the wall area.

Material:
Sheet steel

Colour:
RAL 7035

Supply includes:
Assembly parts

For RNC enclosures 42 HP (1/2 19″)		Model No. DK
Width mm	Depth mm	
342	280	**7870.700**

For RNC tower enclosures 84 HP (19″) vertical		Model No. DK
Width mm	Depth mm	
342	400	**7870.705**

Angle bracket

for RNC
With space for optimum cable routing in the wall area.

Material:
Sheet steel

Colour:
RAL 7035

Supply includes:
Assembly parts

For RNC enclosures 42 HP (1/2 19″)		Packs of	Model No. DK
Width mm	Depth mm		
342	280	2	**7870.701**

For RNC tower enclosures 84 HP (19″) vertical		Packs of	Model No. DK
Width mm	Depth mm		
342	400	2	**7870.706**

Mounting plates

for KL
For component installation outside of the enclosure. Assembly screws included as accessories with the enclosure.

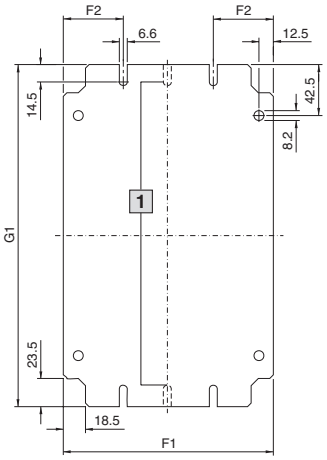
Material:
Sheet steel, 2 mm, zinc-plated, passivated

Accessories:

Self-tapping screws SZ 2487.000,
see page 937.

Possible alternative:

Support rails,
see page 927.



1 Attachment in the centre only for 125 mm wide plates

For size mm	For Model No. KL	Dimensions in mm			Model No. KL
		G1	F1	F2	
150 x 150	1500.510, 1514.510, 1521.010	135	125	–	**1560.700**
200 x 150	1528.510, 1529.510	185	125	–	**1575.700**
300 x 150	1501.510, 1515.510, 1522.010, 1530.510	285	125	–	**1561.700**
400 x 150	1589.510	385	125	–	**1576.700**
200 x 200	1502.510, 1516.510, 1523.010	185	175	50	**1562.700**
300 x 200	1503.510, 1517.510, 1524.010, 1531.510	285	175	50	**1563.700**
400 x 200	1504.510, 1518.510, 1525.010, 1532.510	385	175	50	**1564.700**
500 x 200	1505.510, 1533.510	485	175	50	**1565.700**
600 x 200	1506.510, 1519.510, 1534.510	585	175	50	**1566.700**
800 x 200	1527.510, 1542.510	785	175	50	**1574.700**
300 x 300	1507.510, 1526.010, 1535.510	285	275	50	**1567.700**
400 x 300	1508.510, 1536.510	385	275	50	**1568.700**
500 x 300	1509.510, 1537.510	485	275	50	**1569.700**
600 x 300	1510.510, 1538.510	585	275	50	**1570.700**
400 x 400	1511.510, 1539.510	385	375	62.5	**1571.700**
600 x 400	1512.510, 1540.510	585	375	62.5	**1572.700**
800 x 400	1513.510, 1541.510	785	375	62.5	**1573.700**

Mounting plate

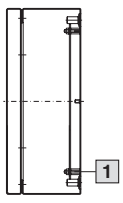
for Premium KL
For installing at a distance from the rear panel.

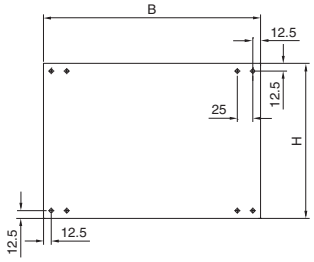
Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Spacer bolts
and assembly parts.

For KL enclosures	W (B) mm	H mm	Packs of	Model No. KL
1024.010 1024.020	100	100	1	**1024.910**
1024.030	250	150	1	**1024.920**
1024.040	350	250	1	**1024.930**

Mounting plate attachment





1 Spacer bolts M5 x 15

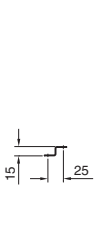
Mounting bracket

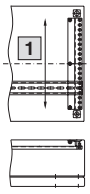
for Premium KL
For variable attachment of support rails on a 12.5 mm pitch pattern.

Material:
Stainless steel 1.4301

Supply includes:
Assembly parts.

For KL enclosures	L	N	Packs of	Model No. KL
1024.010 1024.020	85	6	2	**1024.810**
1024.030	135	10	2	**1024.820**
1024.040	235	18	2	**1024.830**





1 Variable to mounting bracket

Mounting plates

Mounting plate attachment

For additional clamping and to reduce potential vibration of the mounting plate. Select according to mounting position, installation type and enclosure.

Material:
Sheet steel, zinc plated, passivated

Supply includes:
Assembly parts.

For TS
Installation options:
- Side, at half height in conjunction with mounting plate infill
- In the penultimate position
- Set forward (supplied state)

Advantage:
No impairment to the mounting surface, but mounting is only possible from the enclosure rear.

Packs of	Model No. TS
10	8800.630

Accessories:

Mounting plate infill,
see page 912.

For TS
Installation options:
- Side
- Rear, flush with enclosure frame

Advantage:
No impairment to the mounting surface, but mounting is only possible from the enclosure rear.

Packs of	Model No. TS
10	8800.610

For TS
Installation options:
- Side
- Rear, flush with enclosure frame
- Set forward on a 25 mm pitch pattern

Advantage:
No impairment to the mounting surface.
May optionally used for attachment or screw fastening.

Packs of	Model No. TS
10	8800.090

Also required:

Punched section with mounting flange 17 x 73 mm for the inner mounting level,
see page 921 (with Fig. 3).

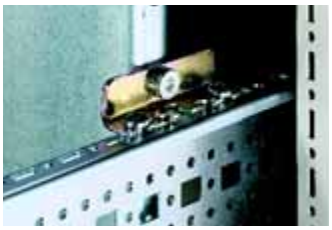
1

2

1 Mounting plate screw-fastened in the rearmost installation position.

2 Mounting plate screw-fastened from the rear in the rearmost installation position.

3 Mounting plate in a set forward position, either attached or screw-fastened (not shown).



3

For TS
Installation options:
- Side
- Rear, flush with enclosure frame

Slide over the plate at the side and secure with screws. Additionally, the mounting plate may be drilled and screw-fastened at the rear C-edge.

Packs of	Model No. TS
10	8800.050

Mounting plate attachment

For additional clamping and to reduce potential vibration of the mounting plate. Select according to mounting position, installation type and enclosure.

Material:
Sheet steel, zinc plated, passivated

Supply includes:
Assembly parts.

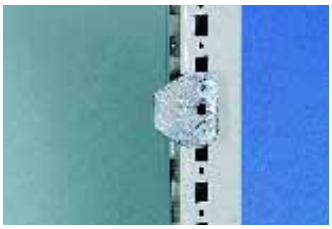
For TS, ES
Installation options:
- All-round
- Set forward on a 25 mm pitch pattern

Slide in between the bar and plate from below or above or from the side, and secure with screws.

Packs of	Model No. TS
10	4593.000

Also required:

Support strip (with TS for inner level), see page 924 or
punched section with mounting flange (with TS for inner level), illustration see page 921 or
punched rails and punched sections, see page 925.



For TS, ES
Installation options:
- On the top and bottom of the mounting plate (with ES all-round)
- Rear, flush with enclosure frame

Screw in the clip behind the plate and secure with screws.

Packs of	Model No. TS
10	4576.000

Installation kit

For mounting plates TS, back-to-back
Thanks to a minimum distance between the two mounting plates, a maximum installation depth is achieved for installed equipment on both sides.

Material:
Sheet steel, zinc-plated, passivated

Note:
Build height front and rear
with central installation =
(enclosure depth minus 48 mm) : 2
Example:
TS 8806.521 = Depth 600 mm
Build depth = 2 x 276 mm

Packs of	Model No. TS
1 set	8800.280

Rittal service:

Enclosures with 2 mounting plates (mounted in the centre unless otherwise specified) and door(s) on both sides may be ordered as complete units.
Model No.: TS 8xxx.521

Hinge attachment

for mounting plate TS, ES

In enclosures with width 600 and 800 mm.
Hinge pin with adjusting screws
– May be unlatched by hand for installation/ removal
– Secured via a screw

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Packs of	Model No. TS
1 set	8800.810

Also required:

Two PS support rails according to the enclosure width, see page 927.

Mounting plates

Mounting plate infill

for TS
For a continuous mounting surface in bayed suites where the mounting plate is set forward.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

For enclosure height mm	Model No. TS
1800	**4590.700**
2000	**4591.700**
2200	**4592.700**

Mounting plate adjustment bracket

for KS
Infinitely adjustable.
Other equipment can also be installed in this way, instead of the mounting plate.

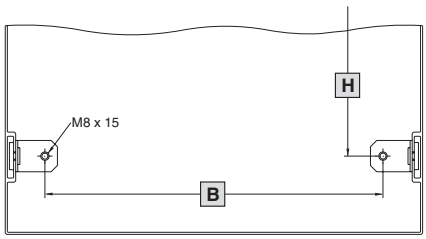
Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

For enclosures KS	Packs of	Model No. KS
1423.600, 1432.600 1434.600, 1444.600 1446.600, 1448.600 1449.600, 1466.600 1467.600	4	**1481.000**
1453.600, 1454.600 1468.600, 1469.600 1479.600, 1480.600 1400.600	4	**1491.000**

B Enclosure width:
– 76 mm (KS 1481.000)
– 104 mm (KS 1491.000)

H Enclosure height:
– 150 mm



B = Width

Cross-brace for mounting plates

for TS, CL, ES
Additional horizontal rigidity for vibration resistance and/or stabilisation of wide mounting plates. This brace may also be used as an attachment aid for heavy components.

Material:
Sheet steel, zinc plated, passivated

Supply includes:
2 sections,
4 clamps,
4 grub screws M10 x 16 mm.

For enclosure width mm	Model No. TS
1200	**4333.120**
1600	**4333.160**
1800	**4333.180**

Other widths available on request.

Transport handles for mounting plates

for TS, CL, ES
Suitable for use in any position of the side C-fold.
Benefits include:
- Can be used by people of different heights
- Optimised force transmission
- Easy handling

Packs of	Model No. SZ
2	**2415.500**

Partial mounting plates

for TS, CL, CS Toptec

For

- Universal interior installation, also in conjunction with punched sections with mounting flanges and support strips. Defective assemblies are quickly and easily replaced
- Additional mounting levels

Partial mounting plates are fastened directly onto the vertical enclosure sections with the inner mounting level using the assembly parts supplied loose. In this mounting position (in both the width and the depth) they form one level with TS punched sections with mounting flanges 17 x 73 mm and TS support strips for the inner mounting level.

Material:
Sheet steel, 2.5 mm, zinc-plated, passivated

Supply includes:
Assembly parts.

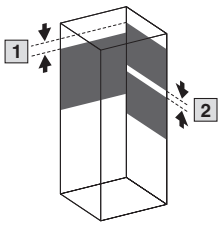
Accessories:

TS punched section with mounting flange 17 x 73 mm for the outer mounting level, see page 921.
TS support strip, see page 924.
Hinge attachment, see page 914.
Self-tapping screws, SZ 2487.000, see page 937.
Adaptor for CS Toptec, width 650 mm, see page 916.

For installation in									Size mm	Packs of	Model No. TS
Enclosure width mm					Enclosure depth (side) mm						
400	600	800	1000	1200	400	500	600	800			
■	■				■		■		500 x 300	1	**8614.640**[2]
	■					■	■		500 x 400	1	**8614.650**[2]
	■						■		500 x 500	1	**8614.660**[2]
	■	■					■	■	500 x 700	1	**8614.680**[2]
	■						■		500 x 775	1	**8614.675**[1][2]
■		■			■			■	700 x 300	1	**8614.840**
		■				■		■	700 x 400	1	**8614.850**
		■						■	700 x 700	1	**8614.880**
■			■		■				900 x 300	1	**8614.040**
			■			■			900 x 400	1	**8614.050**
	■		■				■		900 x 500	1	**8614.060**[2]
■				■	■				1100 x 300	1	**8614.240**
				■		■			1100 x 400	1	**8614.250**
	■			■			■		1100 x 500	1	**8614.260**[2]

[1] Also suitable for installing in
- PC enclosures based on TS behind the lower front door
- IW enclosures, height 900 and 1000 mm

[2] In conjunction with adaptor CS 9765.195 may also be installed in 650 mm wide/deep CS Toptec, see page 916.

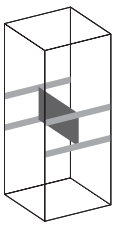


When **installing around corners** due to collision between the assembly components

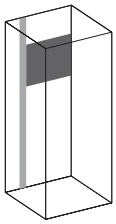
1 At least 75 mm (adjustable on a 25 mm pitch pattern).

Maximum space utilisation

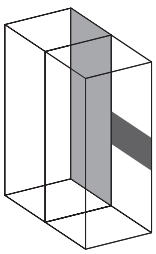
2 1 mm (adjustable on a 25 mm pitch pattern).



Set forward installation position
Quickly and easily achieved wtih four TS punched sections with mounting flanges 17 x 73 mm for the outer mounting level, see page 921.



Partial installation
Partial utilisation of the enclosure depth or width is also possible. In this example, using a PS punched section without mounting flange 23 x 73 mm, see page 925.



Continuously flush
In bayed enclosures, the partial mounting plate is in the rearmost position flush with the standard mounting plate. This facilitates continuous component mounting.

Mounting plates

Hinge attachment

for partial mounting plate TS

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Packs of	Model No. TS
1 set	**8614.100**

Also required:

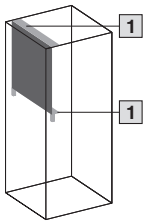
Depending on the installation position
1 Divider kit for swing frame, small,
for enclosure width
600 mm, Model No. SR 2377.860,
800 mm, Model No. SR 2377.880,
see page 994.
2 PS punched section without mounting flange
23 x 73 mm according to the enclosure depth,
see page 925.
Support brackets TS 8800.330,
see page 933.

Side installation:
In conjunction with hinge, for side panel,
see page 854, for an enclosure depth of
600 or 800 mm, side installation is identical to
installation parallel to the front.

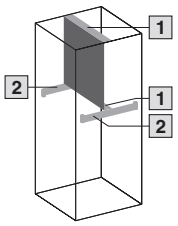
Examples

In the highest or lowest position

Front

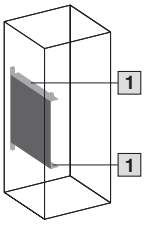


Set back

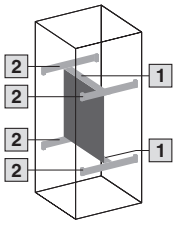


In a central position

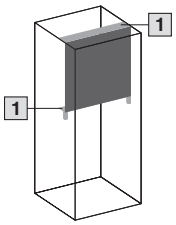
Front

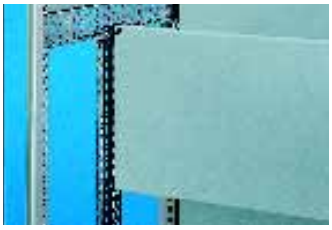


Set back



Side installation





Partial mounting plates

for ES, CS Basic and modular enclosures
For additional mounting levels.

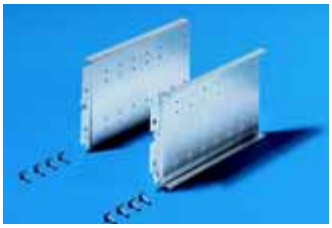
Material:
Sheet steel 2.5 mm, zinc-plated

Supply includes:
Assembly parts.

For enclosure width mm	Width x height mm	Packs of	Model No. PS
600	492 x 173	2	**4130.700**
600	492 x 373	2	**4131.700**
600	492 x 573	2	**4132.700**
800	692 x 173	2	**4135.700**
800	692 x 373	2	**4136.700**
800	692 x 573	2	**4137.700**
1200	1092 x 373	2	**4141.700**
1200	1092 x 573	2	**4142.700**

Accessories:

Self-tapping screws, SZ 2487.000,
see page 937.



Support rail, locatable

for TS, CM, CL, PC-TS

To fit:
- Internal mounting behind the mounting compartment, small, of the PC enclosure,
- Mounting on the vertical TS enclosure section,
- Mounting in CM, CL on a rail for internal installation.

Integral 25 mm pitch pattern of holes
To accommodate:
– Mounting plate, small
– PS punched section without mounting flange via support brackets PS
as a second mounting level if due to an installed:
– Mounting plate infill
– Cable duct, vertical
no punched sections or other assemblies can be mounted in the depth.

Static load: max. 15 kg

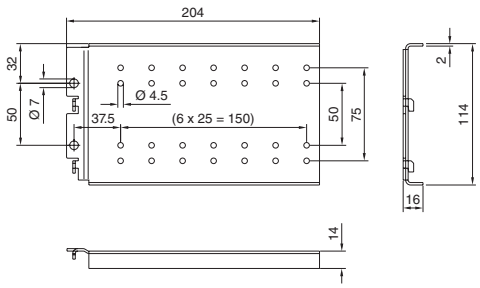
Material:
Sheet steel, 2.0 mm,
Zinc-plated, passivated

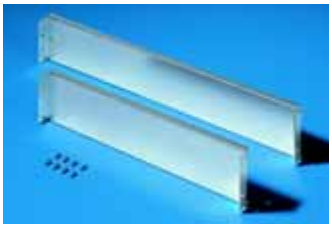
Supply includes:
Assembly parts.

Packs of	Model No. TS
1 set	**8612.200**

Accessories:

PS punched section without mounting flange, see page 925.





Mounting plate, small

For external mounting on:
- Support rail TS, locatable, depth-adjustable on a 25 mm pitch pattern,
- Punched sections with mounting flanges, attached to the outer mounting level.

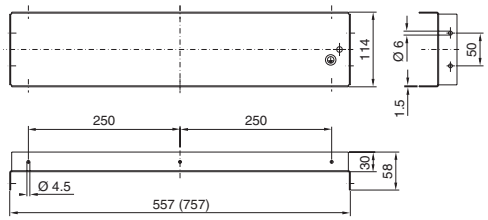
Material:
Sheet steel, 1.5 mm,
Zinc-plated, passivated

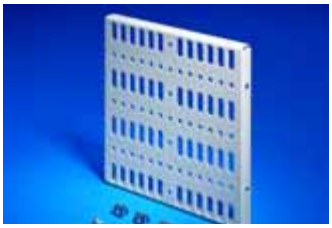
Supply includes:
Assembly parts.

Enclosure width mm	Packs of	Model No. TS
600	1	**8612.600**
800	1	**8612.800**

Accessories:

TS punched section with mounting flange, see page 921.
Self-tapping screws, SZ 2487.000, see page 937.





Mounting plate

for RNC, RiCase

Slotted, for the attachment of cables or small equipment.

Material:
Sheet steel

Colour:
RAL 7035

Supply includes:
Assembly parts.

W x H mm	Model No. DK
178 x 178	**7870.740**

Mounting plates

Mounting plate

for compact enclosures, Outdoor
In two versions:
- Sheet steel, 3 mm, zinc-plated
  – for contacted (EMC) assemblies
  – including assembly screws
- MDF, 15 mm
  – for insulated assembly
  – including 2 mounting brackets and assembly screws

For compact enclosures, Outdoor	Model No.	
	Sheet steel	MDF
1620.000, 1620.100	**1616.200**	**1616.230**
1621.000, 1621.100	**1616.210**	
1622.000, 1622.100	**1616.220**	**1616.240**

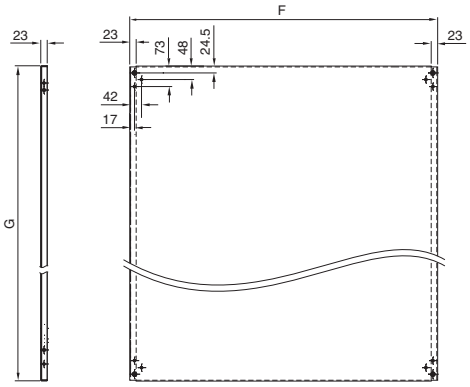
Mounting plates

for CS Toptec, Basic and modular enclosures
For the configuration of mounting levels.
The mounting plates are depth-adjustable on a 25 mm pitch pattern.

Material:
Aluminium, 3 mm

Supply includes:
Assembly parts.

Note:
For an enclosure depth of 1200 mm partial installation with one or two 600 mm wide mounting plates is possible.



For enclosure		F	G	Model No. CS
Width mm	Height mm			
600	800	499	696	**9765.090**
600	1000	499	896	**9765.091**[1)]
600	1200	499	1096	**9765.092**
600	1400	499	1296	**9765.098**
600	1600	499	1496	**9765.093**
650	1200	549	1096	**9765.193**
650	1600	549	1496	**9765.194**
800	800	699	696	**9765.097**
800	1000	699	896	**9765.094**[1)]
800	1200	699	1096	**9765.095**
800	1400	699	1296	**9765.099**
800	1600	699	1496	**9765.096**
1200	800	1099	696	**9765.190**[1)]
1200	1200	1099	1096	**9765.191**
1200	1400	1099	1296	**9765.192**

[1)] Delivery times available on request.

Adaptor

for the attachment of partial mounting plates
In CS Toptec, width or depth 650 mm.

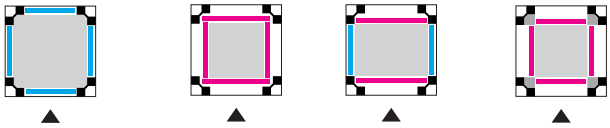
Packs of	Model No. CS
4	**9765.195**

Self-tapping screws

Order information may be found on page 937.

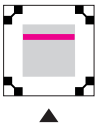
Overview of TS installation systems

Clearance width
Depending on attachment, the following values apply to the clearance between the mounting levels:
- Outer mounting level = Enclosure width and depth minus 42 mm
- Inner mounting level = Enclosure width and depth minus 88 mm

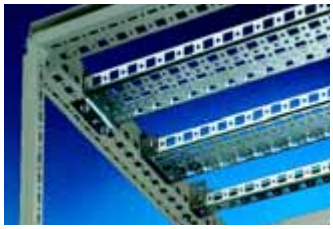


External level | Internal level | External and internal level | PS-compatible installation

Cover installation



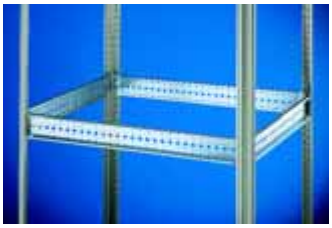
Installation with:
- PS punched section with mounting flange
- PS punched section without mounting flange
- PS punched rail in three mounting variants
- TS punched rails
- TS punched sections without mounting flanges
- TS punched sections with mounting flanges



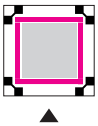
TS 8 rails for the outer level

- TS punched sections with mounting flanges
- TS mounting bar
- TS punched rail

Benefits:
- Largest clearance width
- May be installed directly, on one level all round



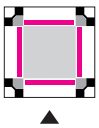
TS 8 rails, PS rail for the inner level



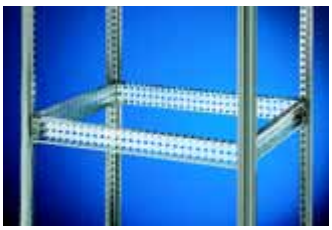
- TS punched sections with mounting flanges
- TS mounting bar
- PS punched section without mounting flange, with support bracket TS

Benefits:
- Use of a second level
- Height-offset mounting all-round

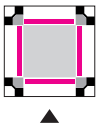
With adaptor rail for PS compatibility



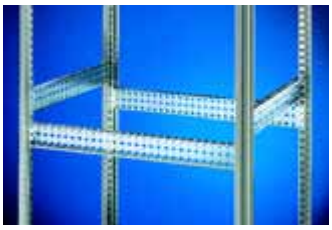
On one level all round with:
- PS punched section without mounting flange, with support bracket PS
- PS punched rail with angle bracket, mounting bracket or support bracket PS



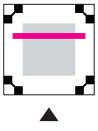
With adaptor rail for PS compatibility



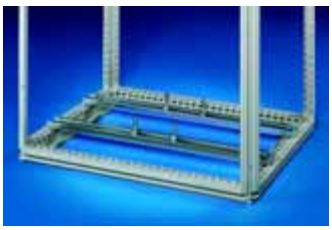
Height-offset in the width and depth with:
- PS punched section with mounting flange
- PS punched rail with mounting bracket
- TS punched rail

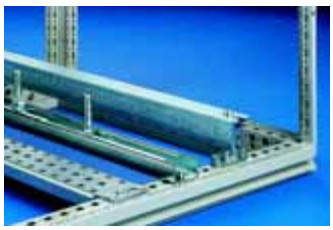


Base installation

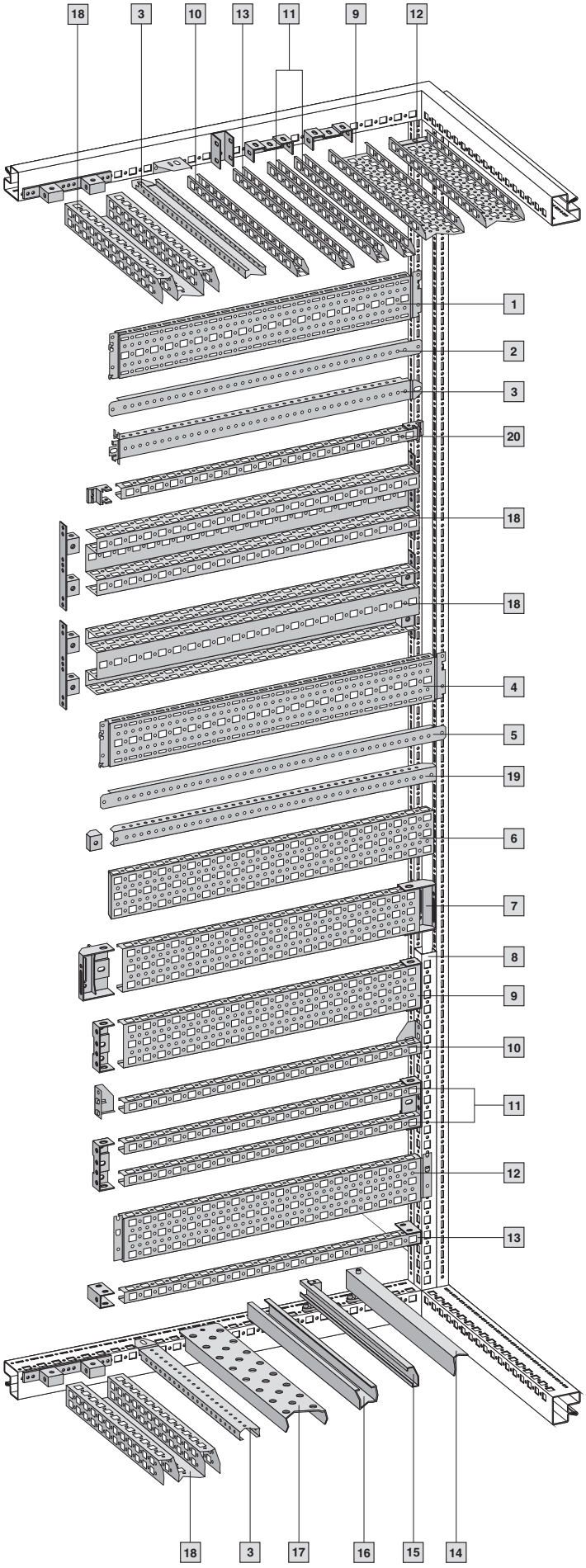


Installation with:
- Cable clamp rails
- C rails 30/15 with bracket/spacer
- System support rails
- Support rail
- TS punched rails





Rail systems



Cover installation

Punched sections and rails may be mounted on the horizontal enclosure sections in both the width and depth.

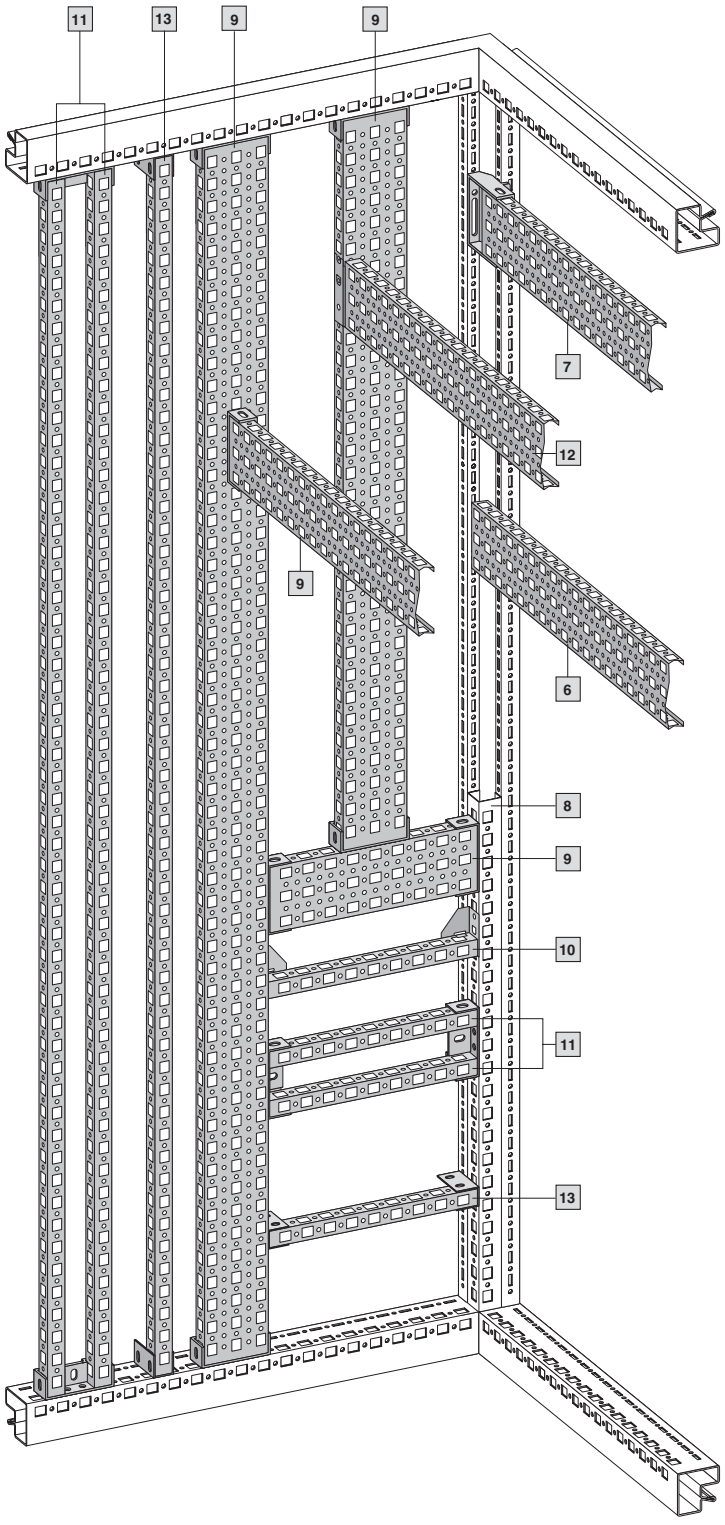
Installation accessories	Page
1 TS punched section with mounting flange, 17 x 73 mm for the outer level	921
2 TS support strip for the outer level	924
3 TS punched rail 18 x 38 mm[1] for the ● outer level ● horizontal enclosure sections ● adaptor rail for PS compatibility	923
4 TS punched section with mounting flange, 17 x 73 mm for the inner level	921
5 TS support strip for the inner level	924
6 TS punched section with mounting flange, 23 x 73 mm for the inner level	922
7 PS punched section without mounting flange 23 x 73 mm with support bracket TS (alternatively with one or two punched rails 23 x 23 mm)	925
8 Adaptor rail for PS compatibility	924
9 PS punched section without mounting flange, 23 x 73 mm with support bracket PS	925
10 PS punched rail 23 x 23 mm with angle bracket	925
11 PS punched rails 23 x 23 mm with support bracket PS (alternatively with one or two punched rails 23 x 23 mm)	925
12 PS punched section with mounting flange 23 x 73 mm	926
13 PS punched rail 23 x 23 mm with mounting bracket PS	925
14 Cable clamp rail	979
15 C rails 30/15 with support bracket or spacer	928
16 System support rails	926
17 Support rail	927
18 TS punched sections without mounting flanges, 45 x 88 mm	922
19 TS punched rail 25 x 38 mm with snap-on nut	923
20 PS punched rail 23 x 23 mm with mounting bracket TS	925

[1] Two TS punched rails 18 x 38 mm are included in the supply of enclosures with a mounting plate. After installing the mounting plate, the TS punched rail may be inserted, as shown here.

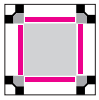
Base installation

Punched sections and rails may be mounted on the horizontal enclosure sections in both the width and depth.

Attachment may be made at any point in the TS 8 enclosure space. Not only with horizontal rail installations directly between the TS sections, but by combining vertical and horizontal rails, any given mounting level in the width, height and depth may be achieved.

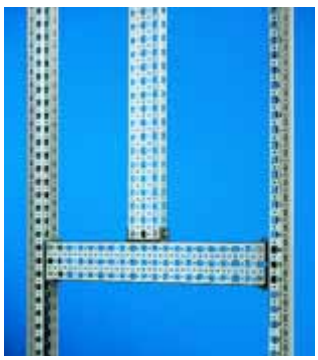


Vertical mounting levels – PS-compatible



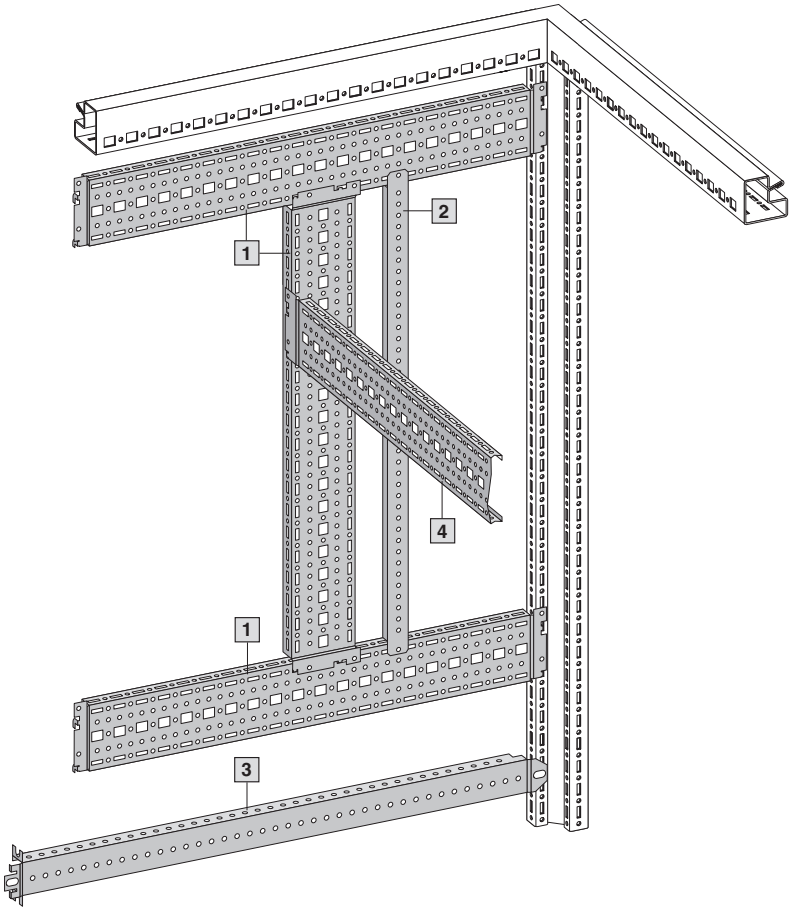
The basis for a second mounting level across the entire enclosure height is quickly achieved, e.g. with two PS punched sections without mounting flanges 23 x 73 mm **9.** Between these two sections, configuration may be achieved with PS punched rails **10, 11** and **13,** with PS punched sections without mounting flanges **9** and PS punched sections with mounting flanges **12.** When using the adaptor rail for PS compatibility **8,** installation is easily achieved across a suitable sub-height, or with suitable enclosure dimensions, across a sub-width or sub-depth.

Installation accessories (Consecutive numbering in accordance with diagram on page 918)	**Page**
6 TS punched section with mounting flange, 23 x 73 mm for the inner level	921
7 PS punched section without mounting flange, 23 x 73 mm with support bracket TS (alternatively with one or two punched rails 23 x 23 mm)	925
8 Adaptor rail for PS compatibility	924
9 PS punched section without mounting flange, 23 x 73 mm with support bracket PS	925
10 PS punched rail 23 x 23 mm with angle bracket	925
11 PS punched rails 23 x 23 mm with support bracket PS (alternatively with one or two punched rails 23 x 23 mm)	925
12 PS punched section with mounting flange 23 x 73 mm	926
13 PS punched rail 23 x 23 mm with mounting bracket PS	925



If PS punched rails or PS punched sections without mounting flanges are installed vertically on roof or base frames, a PS rail is also required for horizontal sub-division.

Rail systems

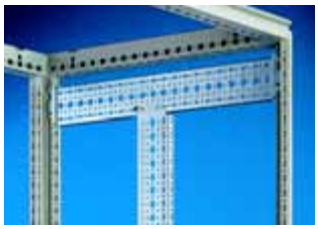


Vertical outer mounting level

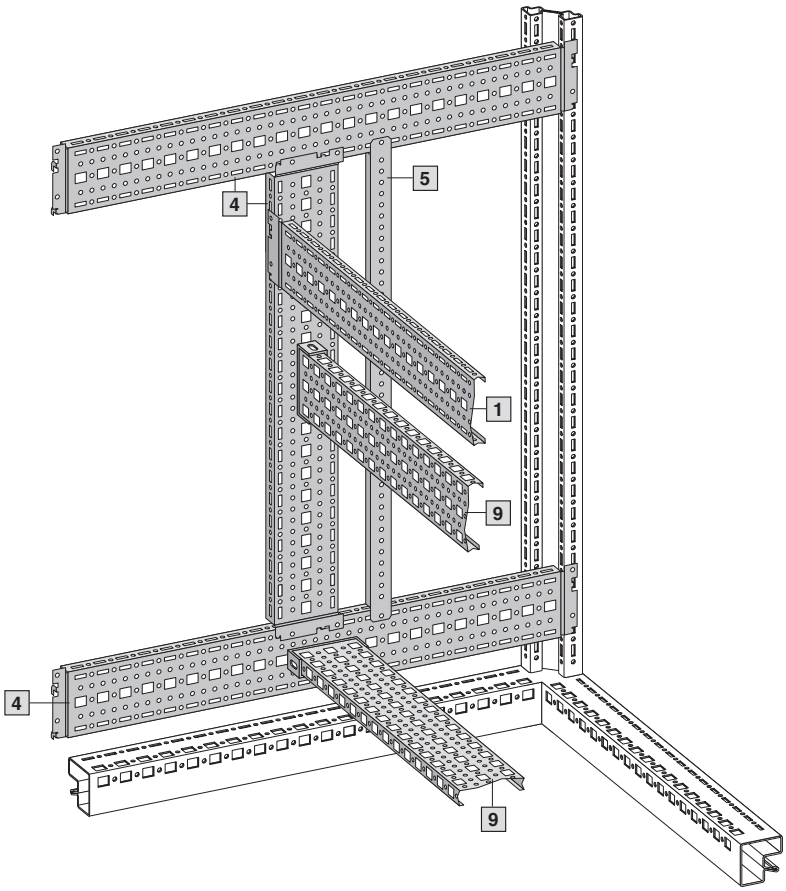
Optimum space utilisation and super-fast assembly by mounting the TS punched section with mounting flange directly onto the outer level of the TS 8 vertical section. Simply snap into position and secure!

Installation accessories (Consecutive numbering in accordance with diagram on page 918)	**Page**
1 TS punched section with mounting flange, 17 x 73 mm for the outer level	921
2 TS support strip for the outer level	924
3 TS punched rail 18 x 38 mm[1] for the ● outer level ● horizontal enclosure sections ● adaptor rail for PS compatibility	923
4 TS punched section with mounting flange, 17 x 73 mm for the inner level	921

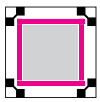
[1] Two TS punched rails 18 x 38 mm are included in the supply of enclosures with a mounting plate. After installing the mounting plate, the TS punched rail may be inserted, as shown here.



German patent no. 196 47 802

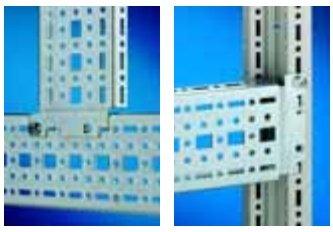


Vertical inner mounting level

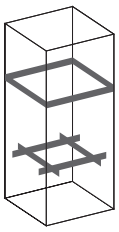


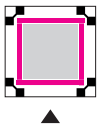
Separate utilisation of the inner level of the TS 8 vertical section, irrespective of the outer level, creates additional opportunities. Even in one enclosure, all installation systems may complement one another perfectly for brand new, customer-specific solutions. Endless possibilities! Simply snap into position, secure, and voila! Super-fast assembly by mounting the TS punched section with mounting flange directly onto the inner level of the TS 8 vertical section.

Installation accessories (Consecutive numbering in accordance with diagram on page 918)	**Page**
1 TS punched section with mounting flange, 17 x 73 mm for the outer level	921
4 TS punched section with mounting flange, 17 x 23 mm for the inner level	921
5 TS support strip for the inner level	924
9 Punched section without mounting flange, 23 x 73 mm with support bracket PS	925



German patent no. 196 47 802





TS punched section with mounting flange, 17 x 73 mm

Variable, with 5 rows of holes for universal skeleton structures or partial assembly. Simply locate into the TS punchings and secure.

Installation options:
- On the vertical TS enclosure section
  - On the outer mounting level, all-round, at the same height
  - On the inner mounting level, all-round, height-offset
- In CM, CL via rail for interior installation
  - In the depth, for outer mounting level
  - In the width, for innner mounting level

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly screws.

German patent no. 196 47 802

Also required:

For installation in CM, CL:
Rail for interior installation,
see page 133.

Accessories:

Screws,
see page 937.
Cable tie for quick assembly SZ 2597.000,
see page 982.

For the outer mounting level[1)]

For enclosure width/depth mm	Packs of	Model No. TS
300	4	**8612.130**
400	4	**8612.140**
500	4	**8612.150**
600	4	**8612.160**
650	4	**8612.165**
800	4	**8612.180**
1000	4	**8612.100**
1200	4	**8612.120**

1) Note:
In conjunction with plug-in side panels, notched punched sections are required.

For the inner mounting level

For enclosure width/depth mm	Packs of	Model No. TS
400	4	**8612.040**
500	4	**8612.050**
600	4	**8612.060**
650	4	**8612.065**
800	4	**8612.080**
900	4	**8612.090**
1000	4	**8612.000**
1200	4	**8612.020**

TS punched section with mounting flange, 17 x 73 mm

Notched version
For enclosures with plug-in side panels.
Variable, with 5 rows of holes for universal skeleton structures or partial assembly. Simply locate into the TS punchings and secure.

Installation options:
- On the vertical TS enclosure section
  - On the outer mounting level, all-round, at the same height

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly screws.

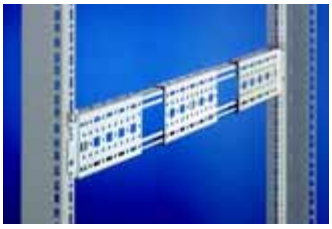
For the outer mounting level; Notched version

For enclosure width/depth mm	Packs of	Model No. TS
600	4	**7828.064**
800	4	**7828.084**
900	4	**7828.094**
1000	4	**7828.104**

Accessories:

Screws, see page 937.
Cable tie for quick assembly SZ 2597.000,
see page 982.

German patent no. 196 47 802



TS punched section with mounting flange, 17 x 73 mm

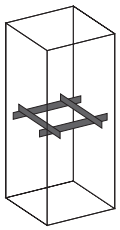
depth-variable for mounting frames for DK-TS, FR(i), TE
For designing flexible interior installation, and/or to accommodate additional built-in components.
The punched sections with mounting flanges may be located in the enclosure depth between two mounting frames. An additional screw fastening secures the unit.
The depth variability of the rails facilitates flexible adaptation of their length to the existing attachment distance between the two 482.6 mm (19″) mounting frames. An additional punched section centre piece may be slid flexibly along the rail in the depth and secured to slots. This facilitates flexible attachment at any point between the mounting frames in the enclosure depth.

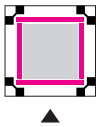
19″ distance between levels mm	Packs of	Model No. TE
420 – 590	2	**7000.676**
650 – 820	2	**7000.678**

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
2 variable punched sections with mounting flanges,
including one sliding centre part each,
including assembly parts.

Rail systems





TS punched section with mounting flange, 23 x 73 mm

The alternative to the TS punched section with mounting flange 17 x 73 mm, see page 921, with punchings for captive nuts/threaded blocks instead of the slotted holes top and bottom. Simply locate and secure.

Installation options:
- On the vertical TS enclosure section

Material:
Sheet steel, zinc-plated, passivated

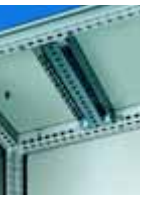
Supply includes:
Assembly screws.

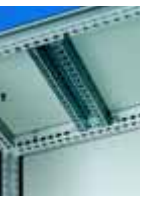
For the inner mounting level

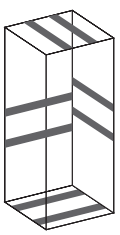
For enclosure width/depth mm	Packs of	Model No. TS
500	4	**8612.550**
600	4	**8612.560**
800	4	**8612.580**
900	4	**8612.590**
1000	4	**8612.500**
1200	4	**8612.520**

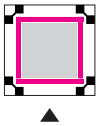
Accessories:

Screws,
see page 937.
Threaded blocks, captive nuts,
see page 936.









TS punched section without mounting flange, 45 x 88 mm

Heavy top-mounted equipment mounted directly on the internal surfaces (e.g. roof) is supported. Mounted on the side or rear, the enclosure can then be screw-fastened securely to the machine. The twin profile with 11 rows of holes offers numerous additional opportunities for interior installation.

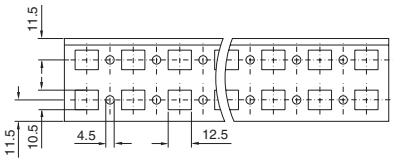
Installation options:
- On the vertical and horizontal TS enclosure section

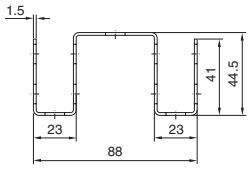
Material:
Sheet steel, zinc-plated, passivated.

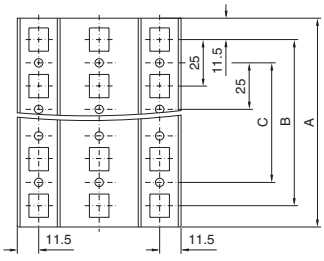
Supply includes:
Assembly parts.

For enclosure width/depth mm	Packs of	Model No. TS
500	2	**8612.650**
600	2	**8612.660**
800	2	**8612.680**

Side punchings







For enclosure width/depth mm	A	B	C
500	398	375	350
600	498	475	450
800	698	675	650

TS punched rail 25 x 38 mm

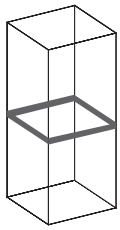
For heavy installations, with attachment holes.

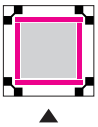
Installation options:
- On the vertical TS enclosure section

With 9 mm round holes all round on a 25 mm pitch pattern, for the configuration of:
- Support rails, see page 927
- System support rails, see page 926
- C rails 30/15, see page 928
- Cable clamp rails (right angle section), see page 979
- Own assemblies

Material:
Sheet steel 3.0 mm, zinc-plated, passivated

Supply includes:
Assembly screws.





For enclosure width/depth mm	Packs of	Model No. TS
400	2	**8612.740**
500	2	**8612.750**
600	2	**8612.760**
800	2	**8612.780**

Also required:

Snap-on nut M8, TS 8800.808,
see page 931.

Note:
In conjunction with the snap-on nut, particularly well-suited for dynamic connections.

TS punched rail 18 x 38 mm

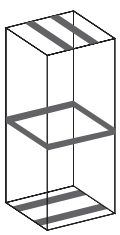
Simply locate and secure with a screw. The location system makes assembly and dismantling easier. It only needs to be secured on one side, but may be secured on both sides if required.

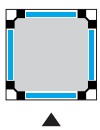
Installation options:
- On the vertical TS enclosure section
  – On the outer mounting level
- On the horizontal TS enclosure section

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly screws.

Note:
In enclosures with a mounting plate, 2 punched rails are already included with the supply.





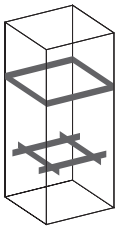
For enclosure width/depth mm	Packs of	Model No. TS
400	4	**8612.240**
500	4	**8612.250**
600	4	**8612.260**
800	4	**8612.280**

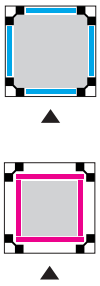
German patent no. 197 37 673
European patent no. 0 940 067
with validity for FR, GB, IT, SE
US patent no. 6,145,943
Chinese patent no. ZL 971 995 32.X
Australian patent no. 725 979

Accessories:

Screws,
see page 937.
Cable tie for quick assembly SZ 2597.000,
see page 982.
Cable clamps,
see page 981.

Rail systems





TS support strips

Installation options:
- On the vertical and horizontal TS enclosure section
  - On the outer mounting level, all-round, at the same height
  - On the inner mounting level, all-round, height-offset
- On the tubular door frame TS, CL, ES
- On the perforated door strip CM
- On the ES system punchings, in the enclosure depth

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly screws.

For the outer mounting level

For enclosure width/depth mm	Length mm	Packs of	Model No. TS
400	340	20	**4694.000**
500	440	20	**4695.000**
600	540	20	**4696.000**
800	740	20	**4697.000**

Accessories:

Screws,
see page 937.
Cable tie for quick assembly SZ 2597.000,
see page 982.

For the inner mounting level and for mounting on doors

For enclosure width/depth mm	For door width mm	Length mm	Packs of	Model No. TS
–	400	290	20	**4594.000**
400	500	390	20	**4309.000**
500	600	490	20	**4596.000**
600	–	590	20	**8800.130**
–	800	690	20	**4598.000**
800	900	790	20	**4579.000**
–	1000	890	20	**4599.000**

Adaptor rail

for PS compatibility
Installation in the vertical TS enclosure sections (across the entire enclosure height or in sub-sections) to create compatibility with:
- PS punched rail 23 x 23 mm
- Punched section without mounting flange, 23 x 73 mm
- PS punched section with mounting flange, 23 x 73 mm

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly screws.

German patent no. 19 647 781
European patent no. 0 939 990
with validity for FR, GB, IT, SE
US patent no. 6,206,494
Australian patent no. 727 880
Chinese patent no. ZL 971 997 31.4

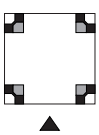
For enclosure height mm	Packs of	Model No. TS
1800	4	**8800.380**
2000	4	**8800.300**
2200	4	**8800.320**

Accessories:

Screws,
see page 937.

Possible alternative:

Snap-on nut,
see page 931.



TS assembly block

Installation in the vertical TS enclosure sections for mounting PS-compatible individual components.

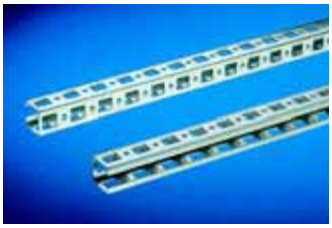
Material:
Die-cast zinc

Supply includes:
Assembly screws.

Packs of	Model No. TS
4	**8800.310**

Possible alternative:

Snap-on nut,
see page 931.



TS punched rails 23 x 23 mm

Installation options:

- On the vertical enclosure section
  - Directly via support brackets TS
  - Via adaptor rail for PS compatibility in conjunction with angle brackets, mounting brackets or support brackets PS
- On the horizontal enclosure section
  - Directly via angle brackets, mounting brackets or support brackets PS

Material:
Sheet steel, zinc-plated, passivated

Length mm	For WHD mm	Packs of	Model No. PS
295	400	12	**4169.000**
395	500	12	**4170.000**
495	600	12	**4171.000**
695	800	12	**4172.000**
895	1000	12	**4173.000**
1095	1200	6	**4174.000**
1295	1400	6	**4393.000**
1495	1600	6	**4175.000**
1695	1800	6	**4176.000**
1895	2000	6	**4177.000**
2095	2200	6	**4178.000**

Also required:

U nuts,
see page 936.
Mounting brackets TS/PS,
see page 932
or
Angle brackets, support brackets TS/PS,
see page 933.

Accessories:

Cable attachment,
see page 982.
Screws,
see page 937.
Cable tie for quick assembly SZ 2597.000,
see page 982.

PS punched section without mounting flange, 23 x 73 mm

Installation options:

- On the vertical enclosure section
  - Directly via support brackets TS
  - Via adaptor rail for PS compatibility in conjunction with support brackets PS
- On the horizontal enclosure section
  - Directly via support brackets PS

Material:
Sheet steel, zinc-plated, passivated

Length mm	For WHD mm	Packs of	Model No. PS
295	400	4	**4374.000**
395	500	4	**4375.000**
495	600	4	**4376.000**
695	800	4	**4377.000**
895	1000	4	**4382.000**
1095	1200	4	**4378.000**
1695	1800	4	**4379.000**
1895	2000	4	**4380.000**
2095	2200	4	**4381.000**

Also required:

Support brackets PS/TS,
see page 933.

Accessories:

Screws,
see page 937.
Cable tie for quick assembly SZ 2597.000,
see page 982.
U nuts,
see page 936.

Rail systems

PS punched section with mounting flange, 23 x 73 mm

Variable, with 5 rows of holes for universal skeleton structures or partial assembly. Simply locate into the system punchings and secure.

Installation options:
- On the vertical TS enclosure section
  – Via adaptor rail for PS compatibility
- On the horizontal TS enclosure section
- On the ES system punchings, in the enclosure depth

Material:
Sheet steel, zinc-plated, passivated

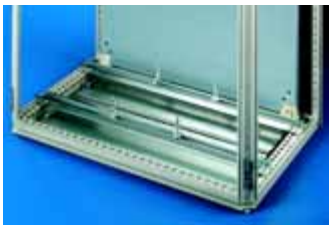
Supply includes:
Assembly screws.

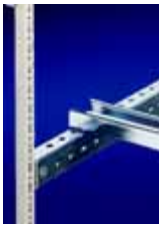
Installation in enclosure width/depth TS mm	Packs of	Model No. PS
400	4	**8800.640**
500	4	**8800.650**
600	4	**4364.000**
800	4	**4365.000**
1000	4	**4373.000**
1200	4	**4367.000**

Installation in enclosure depth ES, AP universal console, CS modular enclosures mm	Packs of	Model No. PS
400	4	**4369.000**
500	4	**4370.000**
600	4	**4371.000**
800	4	**4372.000**

Also required:

Adaptor rail for PS compatibility
(when mounting on the vertical TS enclosure section), see page 924.





System support rails

For heavy installed equipment such as transformers. T-head screw and slot in the support rail for any mounting position.

Installation options:
- On the vertical TS enclosure section
  – Via snap-on nut TS 8800.808 (Fig. left)
  – Via adaptor rail for PS compatibility
  – Offset in the height, via TS punched rail 25 x 38 mm (Fig. right)
- On the horizontal TS enclosure section
  – In the width
  – In the depth (without mounting plate)
- On the ES system punchings, in the enclosure depth

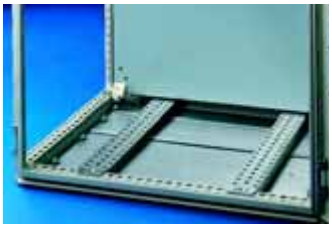
Material:
Sheet steel, zinc-plated, passivated

Supply includes:
2 system support rails (45 x 25 mm),
4 T-head screws M12 x 60 mm,
and assembly parts.

For enclosure width mm	Packs of	Model No. PS
600	2	**4361.000**
800	2	**4362.000**
1000	2	**4347.000**
1200	2	**4363.000**

Accessories:

Width divider e.g. for the installation of 2 system support rails (for 600 mm width) in 1200 mm wide enclosures,
see page 850.
Snap-on nut M8, TS 8800.808,
see page 931.
Adaptor rail,
see page 924.
TS punched rail 25 x 38 mm
see page 923.



Support rails

For heavy installations, with attachment holes. Particularly suitable for the installation of base isolators.

Installation options:

- On the vertical TS enclosure section
  - Via snap-on nut TS 8800.808 (Fig. left)
  - Via adaptor rail for PS compatibility
  - Offset in the height, via TS punched rail 25 x 38 mm (Fig. right)
- On the horizontal TS enclosure section
  - In the width
  - In the depth
- On the ES system punchings, in the enclosure depth

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

For enclosure width/depth mm	Packs of	Model No. PS
400	4	**4394.000**
500	4	**4395.000**
600	4	**4396.000**
800	4	**4398.000**

Accessories:

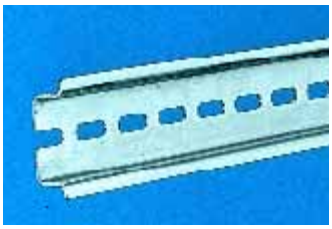
Snap-on nut M8, TS 8800.808,
see page 931.
Adaptor rail,
see page 924.
TS punched rail 25 x 38 mm
see page 923.

Support rails TS 35/15

to EN 50 022
for TS, ES

Mounting on the TS vertical section via snap-on nut M8, TS 8800.808, see page 931, assembly block see page 924 or adaptor rail, see page 924.

For enclosure width/ depth mm	Support rails length mm	Packs of	Model No. PS
500	455	6	**4933.000**
600	555	6	**4934.000**
800	755	6	**4935.000**
1200	1155	6	**4937.000**



Support rails TS 35/7.5 and TS 35/15

to EN 50 022
for KL, AE

Length sized to the enclosure width

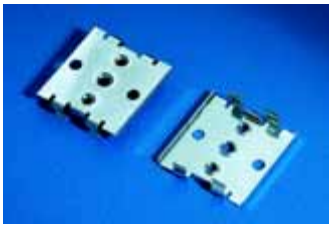
For enclosure width mm	Support rails length mm	Version	Packs of	Model No. SZ
150	137	TS 35/7.5	10	**2314.000**
200	187		10	**2315.000**
300	287		10	**2316.000**
400	387		10	**2317.000**
500	487	TS 35/15	10	**2318.000**
600	587		10	**2319.000**

Support rails

to EN 50 022
for AE

Fixed length 2 m

Version	Length	Packs of	Model No. SZ
TS 35/15	2 m	6	**2313.150**
TS 35/7.5	2 m	6	**2313.750**



Mounting clip

for support rails
For fast, secure attachment of:

- Cable trunking
- Mounting plates
- Mounting angles

on support rail TS 35/7.5 and TS 35/15 to EN 50 022.
Simply pre-assemble the mounting clip on the part to be installed, then snap into position on the support rail.

Packs of	Model No. SZ
30	**2309.000**

German patent no. 195 44 083
European patent no. 0 776 077
with validity for ES, FR, IT, SE

Rail systems

C rails 30/15

to EN 60 715
for TS, ES

Installation options:
- On the vertical TS enclosure section
  – Via snap-on nut TS 8800.808 (Fig. left)
  – Via adaptor rail for PS compatibility
- On the horizontal TS enclosure section (Fig. right)
- On the ES system punchings

Material:
Sheet steel, zinc-plated, passivated

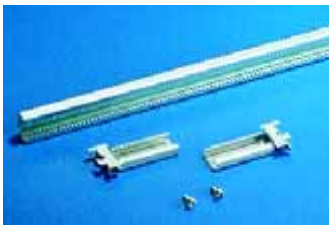
For enclosure width/ depth mm	Length mm	Packs of	Model No. PS
500	455	6	**4943.000**
600	555	6	**4944.000**
800	755	6	**4945.000**
1000	955	6	**4946.000**
1200	1155	6	**4947.000**

Accessories:

Cable clamps, see page 981.
Support bracket or spacer, see page 934.
Quick-assembly block, see page 934.
Snap-on nut M8, TS 8800.808, see page 931.
Adaptor rail, see page 924.

Possible alternative:

Rail for EMC shielding bracket and strain relief, see page 957.



C rails

for DK-TS, CS Toptec

For direct mounting on the vertical enclosure section.
Thanks to the universally designed attachment piece, the C rails may optionally be attached to the inner or outer level of the TS 8 frame.

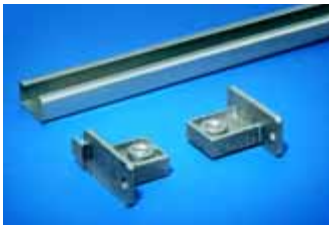
Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

For enclosure width/depth mm	Length mm	Packs of	Model No. DK
400	298	4	**7828.040**
500	398	4	**7828.050**
600	498	4	**7828.060**
650	548	4	**7794.120**
800	698	4	**7828.080**
900	798	4	**7828.090**
1000	898	4	**7828.100**

Accessories:

Cable clamps,
see page 981.



C rails

for TS, ES

Installation options:
- On the horizontal enclosure sections
- On the vertical TS enclosure section via adaptor rail for PS compatibility

Material:
Sheet steel, zinc-plated, passivated
Bracket: Die-cast zinc

Supply includes:
Assembly parts.

For enclosure width/depth mm	Length mm	Packs of	Model No. DK
400	290	6	**7091.000**
500	390	6	**7092.000**
600	490	6	**7095.000**
800	690	6	**7096.000**
1000	900	6	**7100.000**
1200	1100	6	**7102.000**

German patent no. 39 30 161
US patent no. 5,052,565
GB patent no. 2 236 374
French patent no. 2 651 954
Italian patent no. 0 124 3002

Also required:

Adaptor rail for PS compatibility
(when mounting on the vertical TS enclosure section), see page 924.

Accessories:

Cable clamps,
see page 981.

C rails

for EL
For infinite adjustment of the mounting angles in the depth.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

For centre part depth mm	Packs of	Model No. EL
216	4	**2238.000**
316	4	**2239.000**
416	4	**2237.000**

German patent no. 39 30 161

Accessories:

Cable clamps,
see page 981.

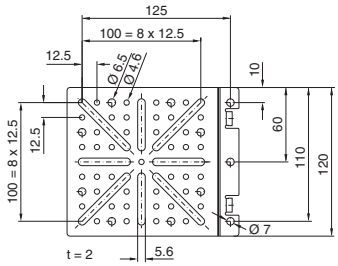
Mounting plates

Locatable
On the vertical TS enclosure section or
TS punched section with mounting flange
17 x 73 mm on the inner and outer mounting level.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly screws.

Packs of	Model No. TS
4	**8612.400**



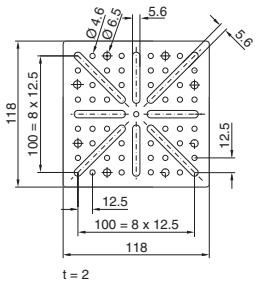
Mounting plates

Screw-fastened, large
On all enclosures and mounting parts with system punchings on a 25mm pitch pattern.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly screws.

Packs of	Model No. TS
4	**8612.410**



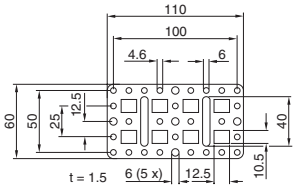
Mounting plates

Screw-fastened, small

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly screws.

Packs of	Model No. PS
4	**4532.000**



Rail systems

Mounting bracket

Screw-fastened on all enclosures and mounting parts with system punchings on a 25 mm pitch pattern.

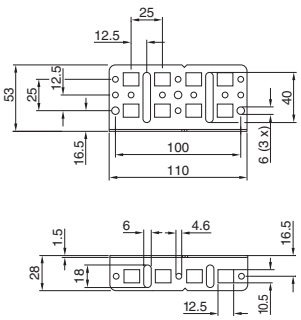
Material:
Sheet steel, zinc-plated, passivated

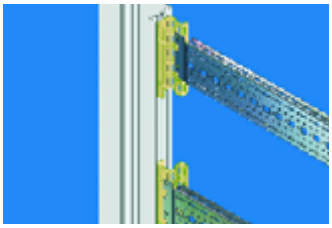
Supply includes:
Assembly screws.

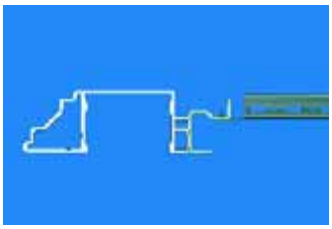
Packs of	Model No. PS
4	**4597.000**

Accessories:

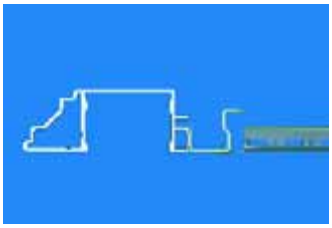
Screws,
see page 937.
Cable tie for quick assembly SZ 2597.000,
see page 982.







1



2

System adaptor

for FR(i)

By using the system adaptor, the principle of two TS 8 attachment levels within this enclosure system is easily achieved. This supports the integration of all rail systems which are attached to the outer enclosure level, and therefore offers a diverse choice of installation options. The inner attachment level may be emulated by simply rotating the system adaptor, and therefore creates the requirements for perfect cable management and completely flexible interior installation. Rail systems attached between the front and rear frame section must be 200 mm shorter than the external enclosure dimensions.

1 Installation position, outer level

2 Installation position, inner level

Packs of	Model No. FR(i)
8	**7856.760**

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Snap-on nut TS

Metric thread for vertical TS enclosure section. To install, insert into slot and clip into position. The snap-on nut is then secure. By tightening the screw, it is securely tightened against the section, and potential equalisation is automatically created.

Installation options:

- On the vertical TS enclosure section
  - with metric thread M6 or M8
  - the alternative to metal screws
  - particularly well-suited for dynamically loaded connections.

Material:
Precision-cast stainless steel

Thread	Packs of	Model No. TS
M6	20	**8800.806**
M8	20	**8800.808**

German patent no. 101 49 599

Accessories:

Allen screw M6 x 12 or M8 x 12,
see page 937.

1

2

3

4

5

Accessories for interior installation

1 Support rails,
see page 927

2 Cable clamp rails,
see page 979

3 C rails 30/15,
see page 928

4 System support rails,
see page 926

5 TS punched rail 25 x 38 mm,
see page 923

Adaptor bracket TS

For external mounting of

- System lights
- Cable duct

on the vertical TS enclosure section.

Material:
Sheet steel, zinc plated, passivated

Supply includes:
Assembly screws.

Packs of	Model No. TS
6	**8800.360**

Assembly components

Mounting bracket TS

Offers variable mounting opportunities for the mounting angle 23 x 23 mm.
E.g. for supporting external surfaces or creating an additional internal level.

Material:
Die-cast zinc

Supply includes:
24 metal screws BZ 5.5 x 13 mm.

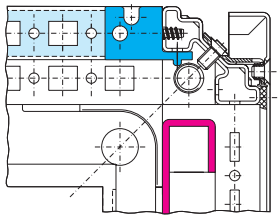
Packs of	Model No. TS
24	**8800.370**

Accessories:

U nuts for punched rails (recommended: M6), see page 936.

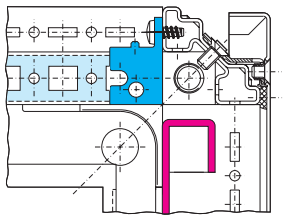
Installation options:
- On the vertical TS enclosure section
  – flush with the outer edge of the enclosure or
  – flush with the enclosure clearance width.

1



1 Support of the external surfaces with two mounting options:
- Without mounting plate (photo)
- With mounting plate (drawing)

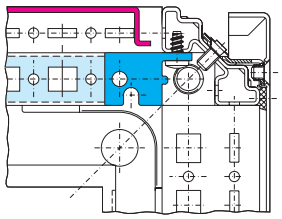
2



Two installation options for the inner mounting level:

2 If there is no divider panel fitted.

3



3 With a divider panel fitted, with or without mounting plate in a set forward position.

Mounting bracket PS

For variable attachment of punched rails 23 x 23 mm.

Installation options:
- Optionally flush with:
  – Outer enclosure edge or
  – Enclosure clearance width
- On the vertical TS enclosure section via
  – Adaptor rail for PS compatibility
  see page 924
- On the horizontal TS enclosure section
- On enclosures and rails with square system punchings 12.5 x 10.5 mm.

Material:
Die-cast zinc

Supply includes:
1 set =
1 mounting bracket,
1 screw M6 x 12 mm,
1 cage nut M6.

Packs of	Model No. PS
24 sets	**4182.000**

Also required:

U nuts for punched rails (recommended): M6, see page 936.
Multi-tooth screws M6 x 12 mm, see page 937.

Angle bracket PS

For quick attachment of punched rails 23 x 23 mm.

Installation options:
- On the vertical TS enclosure section via
  – Adaptor rail for PS compatibility
  see page 924
- On the horizontal TS enclosure section
- On enclosures and rails with square system punchings 12.5 x 10.5 mm.

Material:
Sheet steel, zinc plated, passivated

Supply includes:
1 set =
1 angle bracket, left,
1 angle bracket, right,
2 screws BZ 5.5 x 13 mm.

Packs of	Model No. PS
12 sets	**4181.000**

Also required:

U nuts for punched rails (recommended): M6, see page 936.
Multi-tooth screws M6 x 12 mm, see page 937.

Support bracket TS

For fastening
punched sections without mounting flanges 23 x 73 mm or
punched rails 23 x 23 mm.

Installation options:
- On the vertical and horizontal TS enclosure section
  – on a 25 mm pitch pattern
  – in 2 mm increments

Material:
Die-cast zinc

Supply includes:
1 set =
1 support bracket,
1 stay,
3 screws BZ 5.5 x 13 mm.

Packs of	Model No. TS
6 sets	**8800.330**

German patent no. 199 37 892

Also required:

U nuts for punched rails (recommended): M6, see page 936.
Multi-tooth screws M6 x 12 mm, see page 937.

Support bracket PS

For fastening
punched sections without mounting flanges 23 x 73 mm or punched rails 23 x 23 mm.

Installation options:
- On the vertical TS enclosure section via
  – Snap-on nut TS 8800.806, see page 931, or
  – Adaptor rail for PS compatibility
  see page 924
- On the horizontal TS enclosure section
- On enclosures and rails with square system punchings 12.5 x 10.5 mm.

Material:
Die-cast zinc

Supply includes:
1 set =
1 support bracket,
2 countersunk screws,
2 serrated lock washers.

Packs of	Model No. PS
24 sets	**4183.000**

Also required:

U nuts for punched rails (recommended): M6, see page 936.
Multi-tooth screws M6 x 12 mm, see page 937.
Adaptor rail for PS compatibility (when mounting on the vertical enclosure section), see page 924.

Assembly components

Support bracket or spacer

For fastening C rails, punched rails or cable clamp rails (angle section). On the sides, to accommodate square sections or tubes (Ø 20 mm).
Attachment points with M8 thread.

Installation options:
- On the vertical TS enclosure section via
  – Snap-on nut TS 8800.808, see page 931, or
  – Adaptor rail for PS compatibility see page 924
- On the horizontal TS enclosure section
- On enclosures and rails with square system punchings 12.5 x 10.5 mm.

Material:
Die-cast zinc

Supply includes:
1 set =
1 bracket or spacer,
2 screws M8 x 16 mm,
2 spring lock washers,
2 captive nuts M8,
2 serrated lock washers,
2 screws.

Packs of	Model No. TS
6 sets	4199.000

Accessories:

Angle piece TS 4134.000, see page 934.

Quick-assembly block

For a variety of installation options.

Installation options:
- On the vertical TS enclosure section via
  – Snap-on nut TS 8800.808, see page 931, or
  – Adaptor rail for PS compatibility see page 924
- On the horizontal TS enclosure section
- On enclosures and rails with square system punchings 12.5 x 10.5 mm.

Material:
Die-cast zinc

Supply includes:
12 quick-assembly blocks,
12 threaded blocks M8,
24 screws M8 x 12 mm,
24 square nuts M8.

Packs of	Model No. TS
12	4133.000

German patent no. 42 33 205

Angle piece

For assembling punched rails and mounting surfaces with a 45° incline.

Installation options:
- On the vertical TS enclosure section via
  – Snap-on nut TS 8800.806, see page 931, or
  – Adaptor rail for PS compatibility see page 924
- On the horizontal TS enclosure section
- On enclosures and rails with square system punchings 12.5 x 10.5 mm.

Material:
Angle pieces: Die-cast zinc
Insulating pieces: Plastic

Supply includes:
1 set =
1 angle piece,
1 insulating piece,
1 insulating screw and
2 assembly screws,
1 threaded block M6.

Packs of	Model No. TS
12 sets	4134.000

Universal bracket

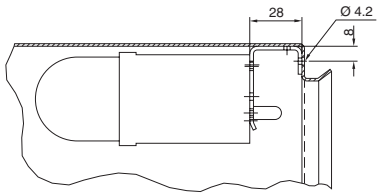
For installing
- Enclosure lights in
  – Compact enclosures AE and AK
  – Console systems AP
- Door-operated switches in
  – Compact enclosures AE
  – Console systems AP
- Cable conduit holder SZ 2593.000 and SZ 2591.000 in
  – Compact enclosures AE
  – Console systems AP
- Support rails for terminals in
  – Operating housings and command panel housings with door.

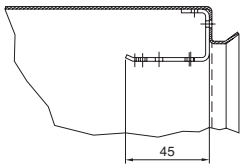
Mounting screws are concealed when the door is closed. Existing holes for mounting blocks or hinges may be used with AE.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Packs of	Model No. SZ
6	**2373.000**



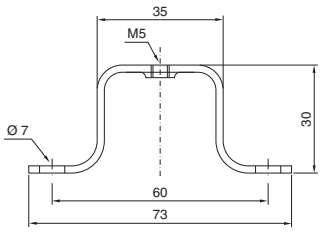


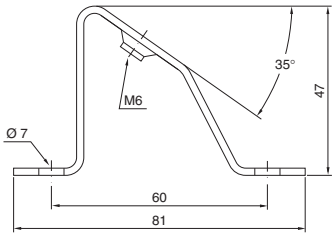
Rail mounting bracket

for individual rail mounting.

Material:
Sheet steel, zinc-plated, passivated

Mounting bracket	Packs of	Model No. SZ
Flat	20	**2365.000**
Inclined	20	**2366.000**





Mounting block

for AE

As an accessory for additional interior installation, e.g. mounting of cable ties, PS punched rails, top hat rails and C rails (e.g. for a second pair of mounting angles).

Supply includes:
Assembly parts.

Packs of	Model No. SZ
20	**2574.000**

Assembly components

U nuts

For
- Punched rail 23 x 23 mm
- Punched section without mounting flange, 23 x 73 mm
- Punched section without mounting flange, 45 x 88 mm
- Punched section with mounting flange, 23 x 73 mm

For mounting punched rails and punched sections without mounting flanges on angle brackets, mounting brackets and support brackets, we recommend U nuts with M6 thread (PS 4179.000).

Thread	Packs of	Model No. PS
M4	20	**4119.000**
M5	20	**4157.000**
M6	20	**4179.000**
M8	20	**4180.000**

Accessories:

Multi-tooth screws M6 x 12 mm, (for PS 4179.000), see page 937.

Cage nuts/threaded blocks

Installation options:
On enclosures and rails with square system punchings 12.5 x 10.5 mm, for example on:
- TS enclosure section
  – vertical, via adaptor rail for PS compatibility
  – horizontal, direct
- ES enclosure body, all-round
- Punched rails 23 x 23 mm
- Punched sections without mounting flanges, 23 x 73 mm
- Punched sections without mounting flanges, 45 x 88 mm
- Punched sections with mounting flanges, 23 x 73 mm

Possible alternative:

On the vertical TS enclosure section TS snap-on nut, see page 931.

Cage nuts
The compression spring designed as an insertion aid ensures reliable, mechanical and electrical connection in the system punchings.

Thread	Packs of	Model No. TS
M6	50	**4164.000**
M8	50	**4165.000**

Threaded blocks
With snap-off insertion aid, die-cast zinc.

Thread	Packs of	Model No. TS
M6	50	**4162.000**
M8	50	**4163.000**

Cage nuts
The nuts are inserted from the same side as screw-fastening takes place. Consequently, attachment points in the same height or width may also be used around corners.
The spring cage also ensures electrical connection in the system punchings.

Thread	Packs of	Model No. TS
M6	50	**8800.340**
M8	50	**8800.350**

German patent no. 198 60 434

Spring nut M5

For
- Optipanel from an installation depth of 100 mm
- VIP 6000 from an installation depth of 185 mm

The spring ensures reliable protection against unintentional displacement.
Other interior installation, e.g. with mounting bracket PS 4597.000 (see page 930).

Material:
Sheet steel, zinc-plated, passivated

Packs of	Model No. CP
50	**6108.000**

Threaded inserts M6

for KS
For securing installed equipment to the moulded bosses in the door and in the enclosure rear panel.
Screw length available for insertion: 8 mm.

Packs of	Model No. KS
20	**1482.000**

Multi-tooth screws

M6 x 12 to fit:
- Snap-on nut (TS 8800.806)
- U nuts for punched rails (PS 4179.000)
- Cage nuts (PS 4164.000)
- Threaded blocks (TS 4162.000)

M6 x 12 to fit:
- Snap-on nut (TS 8800.808)

Multi-tooth screws

For the round holes 4.5 mm diameter in the enclosure section, punched rails and punched sections without mounting flanges.

Self-tapping screws

For the round holes 4.5 mm diameter in the enclosure section, punched rails and punched sections without mounting flanges.

Self-tapping screws

Mark, drill and tighten in a single operation using electric or pneumatic tools.

For metal thickness: 0.8 – 3 mm
Length: 16 mm
Usable length: 9.5 mm
Width across flats: 8 mm

Multi-tooth drive for optimum transmission of torques, an extended tool life and increased safety and reliability when tightening and loosening screw connections.

Type of screw	Dimensions mm	Packs of	Model No. SZ
Multi-tooth screws	M6 x 12 M8 x 12	300 300	**2504.500** **2504.800**
Multi-tooth screws	BZ 5.5 x 13	300	**2486.500**
Multi-tooth screws for stainless steel	BZ 5.5 x 13	300	**2486.300**
Self-tapping screws:			
• Hex screws	M5 x 10	500	**2504.000**
• Posidrive raised countersunk screws	M5 x 12	500	**2488.000**
• Pan head screws, posidrive	M5 x 12	500	**2489.000**
• Pan-head screws, multi-tooth	M5 x 12	500	**2489.500**
Self-tapping screws	ST 4.8 x 16	300	**2487.000**

Assembly components

TS adaptor for wiring systems

Adaptior rail
for the Lütze LSC wiring system.

Supply includes:
1 set =
6 adaptor rails,
24 spring lock washers,
24 screws BZ 5.5 x 13 mm.

Note:
Mounting parts for the LCS wiring system not included with the supply.

For enclosure depth mm	Packs of	Model No. TS
400	1 sets	**8800.140**
500		**8800.150**
600		**8800.160**
800		**8800.180**

Installation kit
for the Moeller MR 25 wiring system.

Supply includes:
1 set =
2 mounting brackets,
4 mounting rails,
including assembly parts.

For enclosure depth mm	Packs of	Model No. TS
400	1 sets	**8800.240**
500		**8800.250**
600		**8800.260**

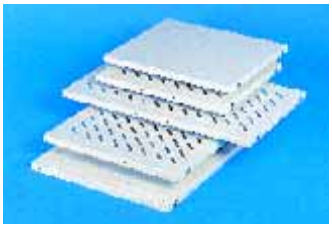
Kit

for separate frame TS
Every TS 8 frame is easily converted to a rack suitable for dismantling. To this end, the frame sections in the roof and base frame are separated, optionally in the width or depth. The four connection components are inserted into the frame section and screw-fastened. The external dimensions of the frame remain unchanged.

Supply includes:
Assembly parts.

Note:
The IP water protection of the enclosure system is lost once the frame is separated.

Packs of	Model No. DK
4	**7829.400**



Component shelf for frame attachment

Enclosure width 600 mm or between two 482.6 mm (19″) mounting frames

Maximum depth of component shelves with enclosure frame attachment = Enclosure depth minus 100 mm.

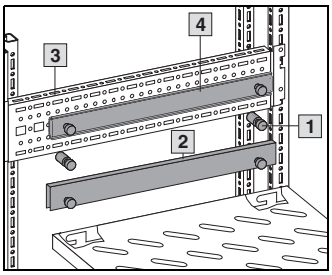
Technical specifications:
Mounting bolts or mounting rails may be installed on a 25 mm pitch pattern in the enclosure depth. Mounting hole for handles provided.

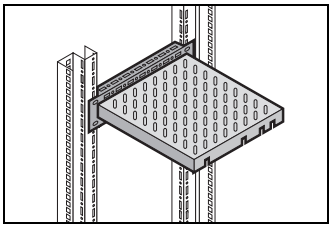
Load capacity:
50 kg/100 kg surface load, static

Material:
Sheet steel

Colour:
RAL 7035

Supply includes:
Assembly parts.





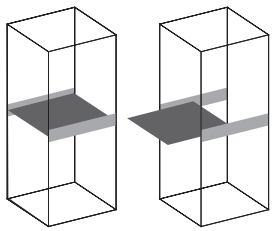
1 Fastening bolts
2 Mounting rails
3 Divider kit
4 Telescopic slides

Also required:

TS punched section with mounting flange, 17 x 73 mm, as divider kit for component shelves, see page 949.
For FR(i) plus system adaptor, see page 930.

Load capacity kg	50				100			
Component shelf depth mm	400	500	600	700	400	500	600	700
Component shelf height mm	29				45			
Model No. DK, slotted	**7164.035**	**7165.035**	**7166.035**	**7166.735**	**7464.035**	**7465.035**	**7466.035**	**7466.735**
Model No. DK, unslotted	**7264.035**	**7265.035**	**7266.035**	–	–	–	–	–

Mounting on a 600 mm wide enclosure frame



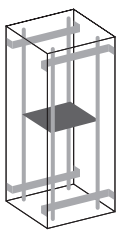
Additionally required:

For TS TS punched sections with mounting flanges 17 x 73 mm as divider kit for enclosure depth mm	600	8612.060
	800	8612.080
	900	8612.090
	1000	8612.000
For FR(i) TS punched sections with mounting flanges 17 x 73 mm as divider kit for enclosure depth mm	600	8612.140
	800	8612.160
	1000	8612.180
	1200	8612.100
	System adaptor	7856.760

Accessories:

Telescopic slides see page 951	7061.000	7081.000	7161.000	7161.700	7064.000	7065.000	7066.000	7066.700
Handles for component shelves see page 953	3636.010							

Mounting on the 482.6 mm (19″) mounting frame[1)]



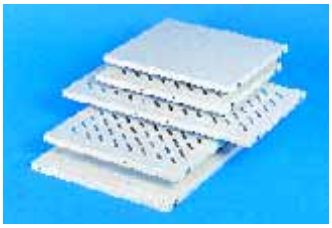
482.6 mm (19″) distance between levels, minimal	495	595	695	895	495	595	695	895

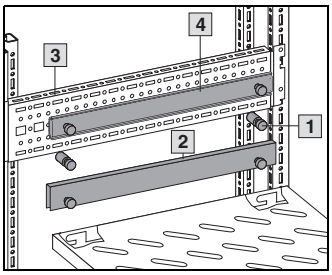
Additionally required:

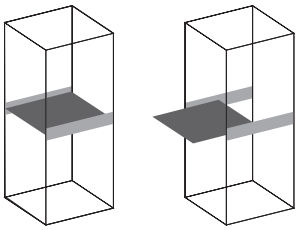
TS punched sections with mounting flanges 17 x 73 mm as divider kit in the enclosure depth between the 482.6 mm (19″) mounting frames	8612.040	8612.050	8612.060	8612.080	8612.040	8612.050	8612.060	8612.080

[1)] **Note:**
Combination with telescopic slides is not possible.

Component shelves for frame attachment







Component shelf for frame attachment

Enclosure width 800 mm

For installation in enclosures **without** 482.6 mm (19″) accommodation.

Maximum depth of component shelves with enclosure frame attachment = Enclosure depth minus 100 mm.

Technical specifications:
Mounting bolts or mounting rails may be installed on a 25 mm pitch pattern in the enclosure depth. Mounting hole for handles provided.

Load capacity:
50 kg/100 kg surface load, static

Material:
Sheet steel

Colour:
RAL 7035

Supply includes:
Assembly parts.

1 Fastening bolts
2 Mounting rails
3 Divider kit
4 Telescopic slides

Also required:

TS punched section with mounting flange, 17 x 73 mm, as divider kit for component shelves, see page 949.
For FR(i) plus system adaptor, see page 930.

Load capacity kg	50				100			
Component shelf depth mm	400	500	600	700	400	500	600	700
Component shelf height mm	29				45			
Model No. DK, slotted	**7184.035**	**7185.035**	**7186.035**	**7186.735**	**7484.035**	**7485.035**	**7486.035**	**7486.735**

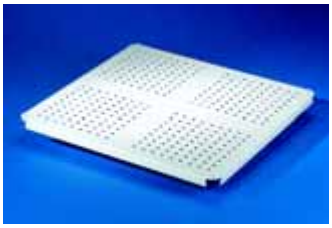
Additionally required:

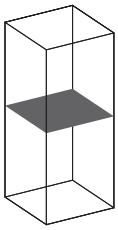
For TS TS punched section with mounting flange, 17 x 73 mm as divider kit for enclosure depth mm	600	8612.060
	800	8612.080
	900	8612.090
	1000	8612.000
For FR(i) TS punched section with mounting flange, 17 x 73 mm as divider kit for enclosure depth mm	600	8612.140
	800	8612.160
	1000	8612.180
	1200	8612.100
	System adaptor	7856.760

Accessories:

Telescopic slides see page 951	7061.000	7081.000	7161.000	7161.700	7064.000	7065.000	7066.000	7066.700
Handles for component shelves see page 953	3636.010							

Component shelves for frame attachment





Component shelf, static installation

for TS, CS Toptec

Locate the mounting pieces in the frame and attach the component shelf. Attachment in the TS enclosure section offers the greatest possible support surface.

Dimensions:
Height: 25 mm
Width: Enclosure width – 44 mm
Depth: Enclosure depth – 44 mm

Load capacity:
75 kg surface load, static

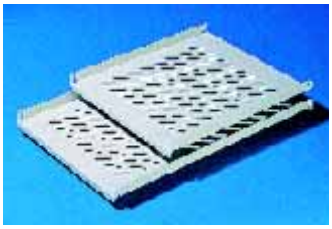
Material:
Sheet steel

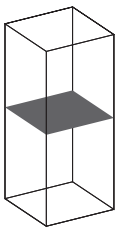
Colour:
RAL 7035

Supply includes:
Assembly parts.

For enclosures		Model No. DK
Width mm	Depth mm	
600	600	**7828.660**
600	800	**7828.680**
600	900	**7828.690**
600	1000	**7828.600**
650	650	**7794.210**
800	600	**7828.680**
800	650	**7794.220**
800	800	**7828.880**
800	900	**7828.890**
800	1000	**7828.800**

Note:
Combined use with vertically divided doors is not possible.
Not suitable for combination with telescopic slides.





Component shelf, static installation

for PC-ES

For direct mounting on the enclosure frame. Simply locate into the 4 screws, tighten, and voilà!

Load capacity:
40 kg surface load, static

Material:
Sheet steel

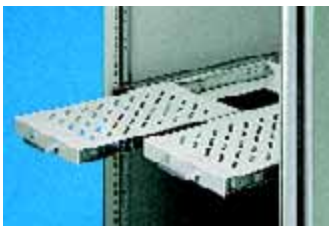
Colour:
RAL 7035

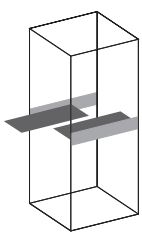
Supply includes:
Assembly parts.

For enclosures		Support area		Model No. PC
Width mm	Depth mm	Width mm	Depth mm	
600	650	510	555	**4619.660**
600	850	510	755	**4619.680**

Accessories:

Mounting bolts for slotted component shelves DK 7115.000,
see page 953.





Component shelf, two-piece

with telescopic extension and handles for TS, FR(i)

For attaching to the enclosure frame. The component shelves can be pulled out independently of one another on telescopic slides.

Load capacity:
25 kg surface load per shelf, static

Material:
Sheet steel

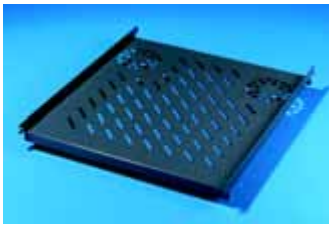
Colour:
RAL 7035

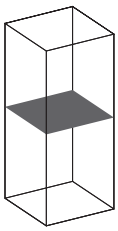
For enclosure width mm	Dimensions of component shelf			Packs of	Model No. DK
	Width mm	Depth mm	Height mm		
600	220	500	35	2	**7183.205**
800	320	500	35	2	**7183.215**

Also required:

TS punched section with mounting flange 17 x 73 mm for the inner mounting level,
see page 949.
For FR(i): TS punched section with mounting flange for the outer mounting level plus system adaptor FR(i),
see page 930, as divider kit for component shelves.

Component shelves for frame attachment





Component shelf, static installation

for TS, PC-TS, IW
prepared for fan expansion kit
For direct mounting on the vertical TS enclosure section. Simply located into 4 pre-fitted screws and secure.

Load capacity:
40 kg surface load, static

Material:
Sheet steel

Colour:
RAL 7015

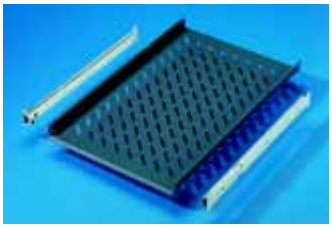
Supply includes:
Assembly parts.

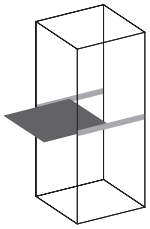
For enclosures		Support area		Model No. PC
Width mm	Depth mm	Width mm	Depth mm	
600	600	507	550	**8800.900**
600	800	507	750	**8800.910**

[1] For enclosures without a mounting plate.

Accessories:

Fan expansion kit DK 7980.000,
see page 652.





Component shelf, pull-out

for TS, PC-TS, IW
For direct mounting on the vertical TS enclosure section.

Load capacity:
40 kg surface load, static

Material:
Sheet steel

Colour:
RAL 7015

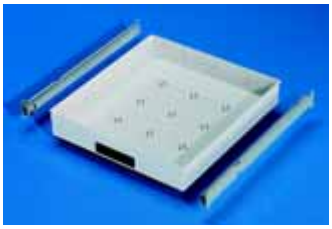
Supply includes:
2 telescopic slides.

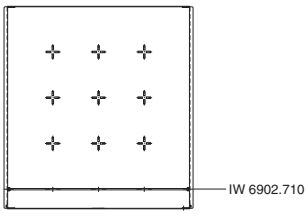
For enclosures[1]		Support area		Model No. IW
Width mm	Depth mm	Width mm	Depth mm	
600	600	465	545	**6902.960[2]**
600	800	465	745	**6902.980**

[1] For enclosures without a mounting plate.
[2] May also be installed in 800 mm deep enclosures based on TS (pull-out rear attachment).

Also required:

When installing more than one pull-out component shelf/drawer tray, we recommend that for reasons of work safety to DIN EN 349, a drawer extension lock should be used, see page 952.





Drawer tray

pull-out
For enclosures with TS frame construction in series IW, PC-TS, DK.
Width 600 mm and depth 600 – 800 mm.
Individual sub-division is possible via the use of cross members.
Tray height: 83 mm

Load capacity:
40 kg surface load, static

Material:
Sheet steel

Colour:
RAL 7035

Supply includes:
2 telescopic slides.

Note:
Suitable for installation in all enclosures, without mounting plate, with W x D 600 x 600/800 mm based on TS (rear attachment of telescopic slides extendible).

When sub-dividing the drawer tray, one cross member is always needed for the entire width (IW 6902.710).

Packs of	Model No. IW
1	**6902.700**

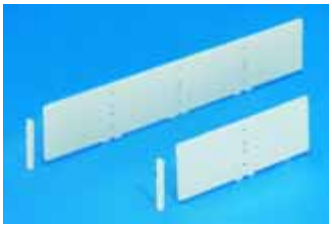
Also required:

When installing more than one pull-out component shelf/drawer tray, we recommend that for reasons of work safety to DIN EN 349 a drawer extension lock should be used, see page 952.

Accessories:

Cross members,
see page 943.

Component shelves for frame attachment



Cross members

for drawer tray
For individual sub-division.

Material:
Aluminium, 3 mm

Colour:
RAL 7035

Supply includes:
Plastic holder.

For subdivision in	Packs of	Model No. IW
the full width	4	**6902.710**
half the width	6	**6902.720**

Note:
When sub-dividing the drawer tray, one cross member is always needed for the entire width (IW 6902.710).

Telescopic slides

For location into the vertical TS frame section. Additional punched sections are not required. Fully extendible.

Load capacity:
40 kg per pair

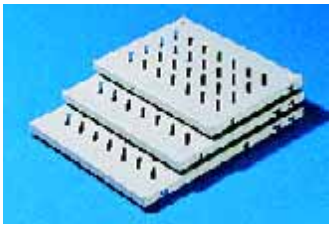
Material:
Sheet steel, zinc-plated, passivated

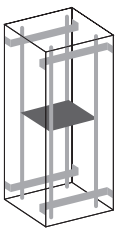
Supply includes:
Assembly parts.

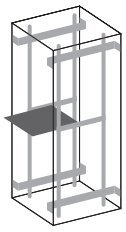
Packs of	Model No. IW
2	**6902.800**

Note:
Suitable for installation in all enclosures, without mounting plate, with W x D 600 x 600/800 mm based on TS (rear attachment of telescopic slides extendible).

Component shelves for attachment to the 482.6 mm (19″) frame







Component shelf, 482.6 mm (19″) installation

For enclosures with two 482.6 mm (19″) mounting levels.

Depending on their depth, the component shelves have several attachment points, so the distance between the 482.6 mm (19″) mounting angles is variable within certain limits. Each component shelf secured in this way can be retrospectively upgraded to full withdrawal using telescopic slides. For this purpose, the telescopic slides are screw-fastened in place of the spacers.

Load capacity:
50 kg surface load, static

Material:
Sheet steel

Colour:
RAL 7035

Supply includes:
Assembly parts.

Note:
For installation in one 482.6 mm (19″) level:
In conjunction with 3 U side parts, mounting on only one 482.6 mm (19″) level is possible.
30 kg surface load, static.

Also required:

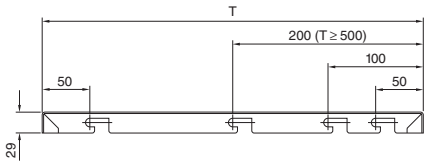
Adaptor for L-shaped mounting angles TS, see page 950.
Divider kit, depth-variable, for installation on mounting frames and L-shaped mouning angles, see page 949.

Accessories:

Telescopic slides, see page 951.
Cable support, hinged, see page 951.
Side parts 3 U, see page 950.

Possible alternative:

Component shelf, heavy duty, for 482.6 mm (19″) population, see page 945 – 946.



T = Depth

Component shelf width mm	409					Page
Component shelf depth mm	300	400	500	600	700	
Distance between levels (X)	298	348/398	348/448/498	448/548/598	548/648/698	
Model No. DK	**7143.035**	**7144.035**	**7145.035**	**7145.635**	**7145.735**	

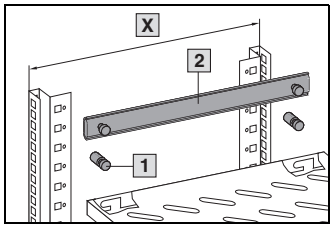
Accessories:

Telescopic slides for 50 kg	7051.000	7061.000	7081.000	7161.000	7161.700	951
Handles for component shelf	3636.010	3636.010	3636.010	3636.010	3636.010	953

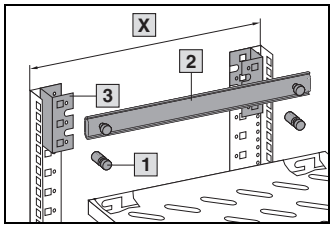
Component shelf version in RAL 7032 available on request.

1 Spacers
2 Telescopic slides
3 Adaptor
4 Divider kit, depth-variable
X Distance between levels

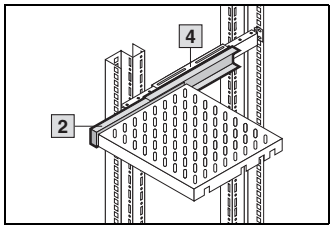
Note for installation in network enclosures based on TS, cranked mounting angle:
The component shelves are mounted on the sides of the 482.6 mm (19″) cranked mounting angle with spacers on a U pitch pattern.



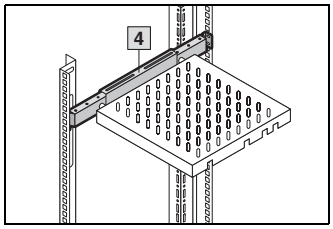
Note for installation in network enclosures based on TS, L-shaped mounting angle:
If L-shaped mounting angles are used, adaptor DK 7827.300 is required.



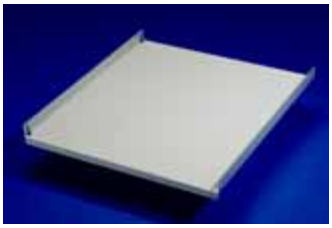
Note for installation between two mounting frames or L-shaped mounting angles:
May be mounted directly on the 482.6 mm (19″) system punchings using the depth-variable divider kit.

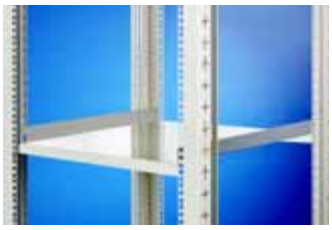


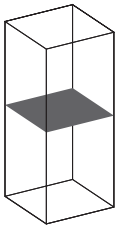
Note for installation between mounting angles and mounting frames:
May be mounted directly on the 482.6 mm (19″) system punchings using the depth-variable divider kit.



Component shelves for attachment to the 482.6 mm (19″) frame







Component shelf, static installation

on the 482.6 mm (19″) mounting frame
The component shelf is attached directly to the front and rear 482.6 mm (19″) mounting frame.

Load capacity:
30 kg surface load, static

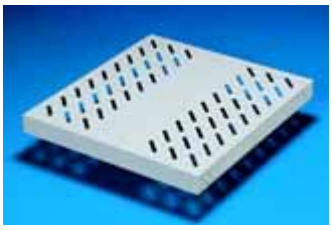
Material:
Sheet steel

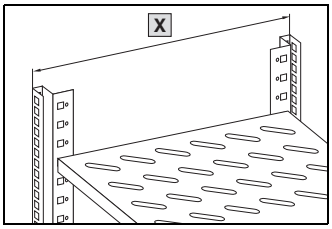
Colour:
RAL 7035

Supply includes:
Assembly parts.

Width mm	Height mm	Depth mm	19″ distance between levels mm	Model No. DK
512	22	412	495	**7000.620**

Note:
Combination with telescopic slides is not possible.





Component shelf, heavy duty

for network enclosures TS with cranked mounting angles
For static installation between two 482.6 mm (19″) mounting levels.
The component shelf is located directly onto the **cranked** mounting angles.

Zinc-plated version:
Load capacity:
75 kg surface load, static

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Spray-finished version:
Load capacity:
100 kg surface load, static

Material:
Sheet steel

Colour:
RAL 7035

Supply includes:
Assembly parts.

Zinc-plated version:

Dimensions			Distance between levels (X) mm	Model No. DK
Width mm	Height mm	Depth mm		
452.5	20	478	498	**7828.950**
452.5	20	578	598	**7828.960**
452.5	20	678	698	**7828.970**

Spray-finished version:

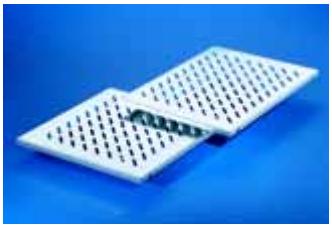
Dimensions			Distance between levels (X) mm	Model No. DK
Width mm	Height mm	Depth mm		
453	44	470	498	**7145.535**

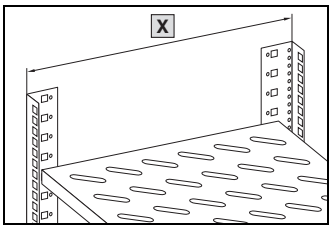
Note:
Not suitable for combination with telescopic slides.

Possible alternative:

Component shelf, heavy duty, for 482.6 mm (19″) population, may be combined with telescopic slides, see page 946.

Component shelves for attachment to the 482.6 mm (19″) frame/system punchings





Component shelf, heavy duty

for network enclosures TS with L-shaped mounting angles
For static installation between two 482.6 mm (19″) mounting levels.
The component shelf is located directly onto the **L-shaped** mountin angles (not with TS server enclosures DK 7831.xxx).

Load capacity:
75 kg surface load, static

Material:
Sheet steel, zinc-plated, passivated

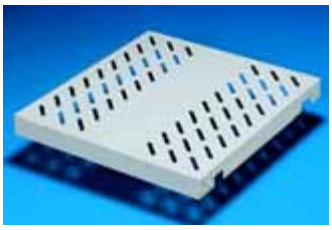
Supply includes:
Assembly parts.

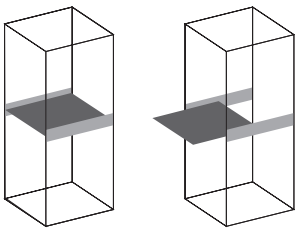
Note:
Not suitable for combination with telescopic slides.

Dimensions			Distance between levels (X) mm	Model No. DK
Width mm	Height mm	Depth mm		
507.5	20	478	498	**7828.951**
507.5	20	578	598	**7828.961**
507.5	20	678	698	**7828.971**

Possible alternative:

Component shelf, heavy duty, for 482.6 mm (19″) population, may be combined with telescopic slides, see page 946.





Component shelf, heavy duty

482.6 mm (19″)
For
- L-shaped mounting angles
- Mounting frame 482.6 mm (19″)

Load capacity:
100 kg surface load, static

Material:
Sheet steel

Colour:
RAL 7035/RAL 9005

Supply includes:
Assembly parts.

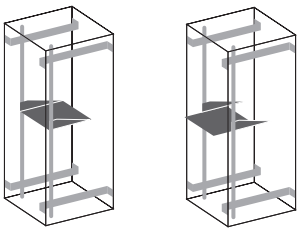
Component shelf depth mm	Model No. DK	
	RAL 7035	RAL 9005
500	**7063.895**	**7063.835**
700	**7063.897**	**7063.837**

Also required:

Divider kit, depth-variable DK 7063.890, see page 949.

Accessories:

Telescopic slides (100 kg) for 482.6 mm (19″) component shelf, see page 951.



Component shelf 2 U

482.6 mm (19″)
Suitable for installation in all enclosures with only one 482.6 mm (19″) mounting level and all swing frames with flange mounting, 482.6 mm (19″).

Load capacity:
25 kg surface load, static

Material:
Sheet steel

Colour:
RAL 7035

Supply includes:
Assembly parts.

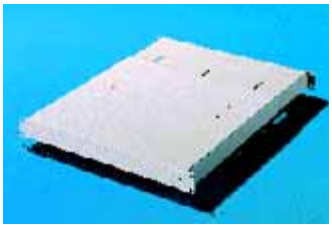
Width mm	Depth mm	Model No. DK
390	300	**7148.035**

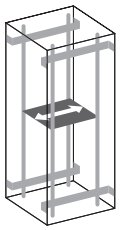
To order the version in RAL 7032, please add extension .000 to the Model No.
Delivery times available on request.

Accessories:

Telescopic slides for component shelves, see page 951.
Handles, see page 953.

Component shelves for attachment to the 482.6 mm (19″) system punchings





Component shelf, 1 U, depth-variable

482.6 mm (19″)
For mounting between the front and rear 482.6 mm (19″) levels. The component shelf is infinitely depth-adjustable from 488 mm to 750 mm.

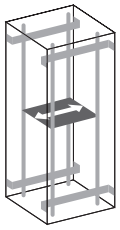
Load capacity:
50 kg surface load, static

Material:
Sheet steel

Colour:
RAL 7035

Distance between levels mm	Model No. VR
488 – 750	**3861.580**

Note:
Not suitable for combination with telescopic slides.



Component shelf, 1/2 U, depth-variable

482.6 mm (19″)
This space-saving component shelf is screw-fastened to the front and rear 482.6 mm (19″) mounting angles. It is infinitely depth-adjustable and may be fitted independently from the enclosure.

Load capacity:
50 kg surface load, static

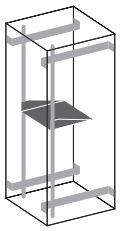
Material:
Sheet steel

Colour:
RAL 7035

Supply includes:
Assembly parts.

Distance between levels mm	Model No. DK
400 – 600	**7063.710**
600 – 900	**7063.720**

Note:
Not suitable for combination with telescopic slides.



Component shelf 1 U, static installation

482.6 mm (19″)/535 mm (metric)
The ideal support surface for small active components such as modems or mini-hubs in 482.6 mm (19″) or metric levels.

Load capacity:
10 kg surface load, static

Material:
Sheet steel

Colour:
RAL 7035

Component shelf depth mm	Model No. DK	
	482.6 mm (19″)	Metric
140	**7119.140**	**7119.155**

Also required:

Cage nuts,
see page 1020.
Screws,
see page 1019.

Component shelves for attachment to the 482.6 mm (19″) system punchings

Component shelf 1 U, static installation

42 HP (1/2 19″)
The ideal support surface for small active components such as modems or mini-hubs.

Material:
Sheet steel

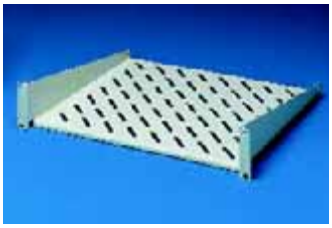
Colour:
RAL 7035

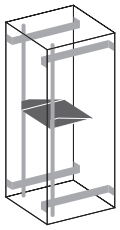
Note:
Combination with telescopic slides is not possible.

Component shelf depth mm	Model No. DK
140	**7502.600**

Also required:

Cage nuts,
see page 1020.
Screws,
see page 1019.





Component shelf 2 U, static installation

482.6 mm (19″)/535 mm (metric)
If only one 482.6 mm (19″) or metric mounting level is available for mounting a component shelf, this variant offers a particularly cost-effective solution.

Load capacity:
25 kg surface load, static

Material:
Sheet steel

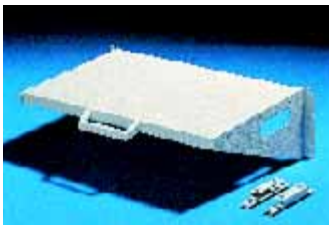
Colour:
RAL 7035

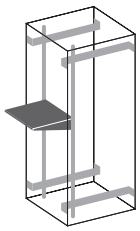
Note:
Combination with telescopic slides is not possible.

Component shelf depth mm	Model No. DK	
	482.6 mm (19″)	Metric
250	**7119.250**	**7119.255**
400	**7119.400**	**7119.455**

Also required:

Cage nuts,
see page 1020.
Screws,
see page 1019.





Utility table

for location in the 482.6 mm (19″) level
The utility table may be attached directly between the 482.6 mm (19″) mounting angles without any additional assembly work. The utility table has a height of 3 U and a support area of 450 x 295 mm; it can be used as a support for measuring devices or splicing equipment during maintenance and wiring work.

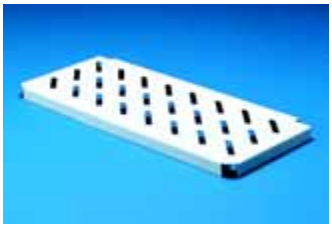
Material:
Sheet steel

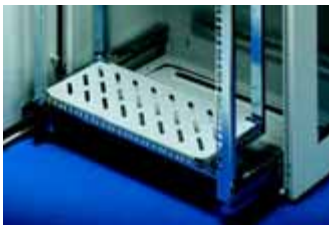
Colour:
RAL 7035

Supply includes:
Assembly parts.

Support surface mm	Model No. DK
450 x 295	**7183.100**

Component shelves for attachment to the 482.6 mm (19″) system punchings/divider kits





Shelf

for AE with pull-out frame
The vented shelf is inserted into the pull-out frame of wall-mounted distributor DK 7644.000 and may additionally be screw-fastened. In this way, an additional support surface can be created with very little effort. Cage nuts may be clipped into the punchings of the frame, even after the shelf has been inserted.

Material:
Sheet steel

Colour:
RAL 7035

Supply includes:
Assembly parts.

Width mm	Depth mm	Model No. DK
430	195	**7644.400**

TS punched section with mounting flange, 17 x 73 mm

as divider kit for component shelves
Simply locate and secure. One pack is sufficient for 2 component shelves.

Load capacity:
100 kg surface load, static

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Installation in enclosure depth mm	Packs of	Model No. TS	
		for TS	for FR(i)
500	4	**8612.050**	**–**
600	4	**8612.060**	**8612.140**
800	4	**8612.080**	**8612.160**
900	4	**8612.090**	**–**
1000	4	**8612.000**	**8612.180**
1200	4	**–**	**8612.100**

Installation kit, depth-variable

for 482.6 mm (19″) component shelf
In conjunction with
- L-shaped mounting angles or
- Mounting frame 482.6 mm (19″)

Infinitely adjustable to the spacing between the two 482.6 mm (19″) levels.
Suitable for all 482.6 mm (19″) component shelves in 409 mm width.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
1 set =
2 mounting rails including assembly parts.

Length mm	Load capacity	Model No. DK
400 – 600	50 kg	**7063.858**
600 – 850	50 kg	**7063.860**
610 – 900	100 kg	**7063.891**[1)]
710 – 1000	100 kg	**7063.890**

[1)] Only in conjunction with 500 mm deep component shelves

Accessories:

Telescopic slides,
see page 951.

Divider kits for component shelves

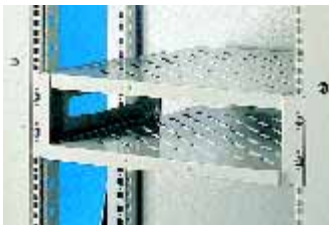
Adaptor for L-shaped mounting angles

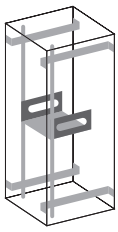
for TS network enclosures
For mounting component shelves and slide rails on L-shaped mounting angles.

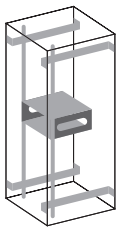
Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Packs of	Model No. DK
4	**7827.300**







Side parts 3 U

for static installation of component shelves, 482.6 mm (19″)
For the attachment of component shelves to a single pair of 482.6 mm (19″) mounting angles. The component shelves are screw-fastened to the 3 U side part.
Either one or two component shelves may be secured.

Load capacity:
30 kg surface load, static

Material:
Sheet steel

Colour:
RAL 7035

Supply includes:
2 side parts.

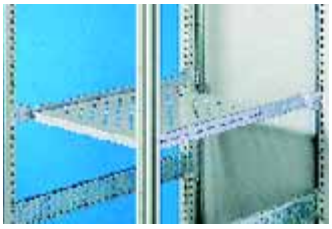
Note:
Combination with telescopic slides is not possible.

Depth of side parts mm	For component shelves DK	Component shelf depth mm	Model No. DK
300	7143.035	300	**7146.035**
400	7143.035	300	**7147.035**
400	7144.035	400	
400	7145.035	500	

To order the version in RAL 7032, please add extension .000 to the Model No.
Delivery times available on request.

Accessories:

Component shelves, 482.6 mm (19″),
see page 944.



Divider kit

for component shelves and drawers, 482.6 mm (19″) installation in TS
For installation between the front and rear adaptor sections or adaptor pieces, 482.6 mm (19″) in 600 mm wide enclosures.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

For enclosure depth mm	Packs of	Model No. TS
500	1 set	**8800.550**
600	1 set	**8800.560**
800	1 set	**8800.580**

Max. depth of component shelves = Enclosure depth – 100 mm

Also required:

Mounting angles, 482.6 mm (19″),
see page 1003.
Adaptor pieces 482.6 mm (19″),
see page 1004.

Accessories for component shelves

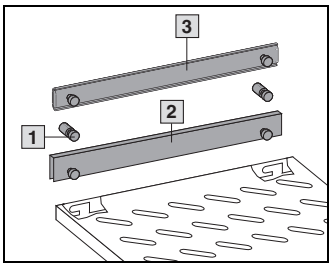
Telescopic slides

for component shelves
Fixed component shelves are easily retro-converted to full withdrawal. For this purpose, the existing fastening bolts or mounting rails (heavy-duty version) are exchanged for the telescopic slides.

Technical specifications:
For installation and locking on a 25 mm pitch pattern in the enclosure depth.

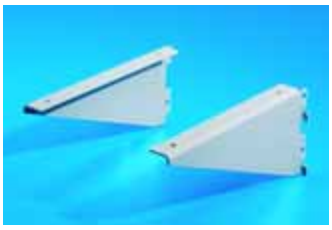
Load capacity:
50 kg/100 kg per set

Material:
Sheet steel, zinc-plated, passivated



For component shelf depth mm	Packs of	Model No. DK	
		50 kg	100 kg
300	2	**7051.000**	**–**
400	2	**7061.000**	**7064.000**
500	2	**7081.000**	**7065.000**
600	2	**7161.000**	**7066.000**
700	2	**7161.700**	**7066.700**

1 Fastening bolts
2 Mounting rails
3 Telescopic slides

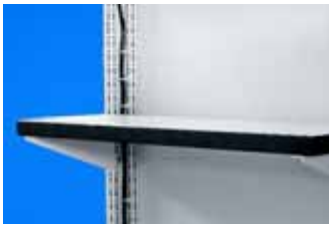


Bracket, locatable

for shelves
Simply locate into the vertical TS section. May be additionally secured with screws.
Support surface for shelves: 200 mm.

Material:
Sheet steel

Colour:
RAL 7035



Packs of	Model No. IW
3 pairs	**6902.690**

Cable support

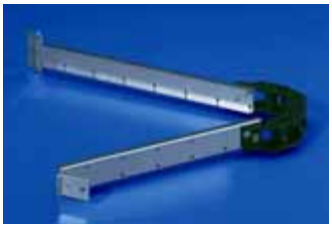
hinged, with clamp
For secure routing of connection cables from the component shelf to the clamping point.
The attachment may be released on both sides thanks to clamps.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

For enclosure depth mm	Model No. DK
< 600	**7163.500**
> 600	**7163.550**

Accessories for component shelves



Cable support

hinged, with anti-kink device and clamp
For secure routing of connection cables from the component shelf to the clamping point. Kink-free cable routing in the central part via mobile chain links. The attachment may be released on both sides, thanks to clamps.

Material:
Sheet steel, zinc-plated, passivated; plastic.

Supply includes:
Assembly parts.

For enclosure depth mm	Model No. DK
< 600	**7163.560**
> 600	**7163.565**

Drawer extension lock

for 600 mm wide enclosures based on TS 8
To increase work safety.
In conjunction with the stay, prevents simultaneous extension of up to 5 drawer trays or pull-out component shelves and thereby ensures stability.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
PS punched section with mounting flange 23 x 73 mm (to match the enclosure height) and assembly parts.

For enclosure height mm	Packs of	Model No. IW
900	1 set	**6902.730**
1000	1 set	**6902.740**

Note:
When installing more than one extendible component shelf/drawer tray, we recommend using the drawer extension lock for work safety reasons.
For installation in taller enclosures, one PS punched section with mounting flange 23 x 73 mm (to match the enclosure height) is required.

Accessories:

Stay for drawer extension lock.

Stay

for drawer extension lock

For	Packs of	Model No. IW
Drawers	5	**6902.750**
Component shelves	5	**6902.760**

Accessories for component shelves

Monitor shelf mounting kit

for ES
For inclined installation of a component shelf in the enclosure when used as a monitor shelf.

Supply includes:
2 holders for inclined installation,
2 wire clamps for monitor base,
2 fastening bolts for positioning the monitor base.

	Model No. SZ
Monitor shelf mounting kit	**2306.000**

Handles

for component shelves
All component shelves are prepared for the attachment of handles.

Material:
Die-cast zinc

Surface finish:
Spray-finished, silver-grey

Supply includes:
Assembly parts.

Packs of	Model No. RP
2	**3636.010**

Fastening bolts

for slotted component shelves
For non-slip attachment of your components. The bolts are screwed into the slots of the component shelf support surface. Consequently, they are infinitely adjustable and can be adapted to suit any appliance.

Packs of	Model No. DK
4	**7115.000**

System lights

System lights

With assembly parts for mounting:
- On the enclosure profile:
  For TS, horizontally (directly), or vertically in conjunction with an adaptor angle
- directly onto rail systems with 25 mm system punchings
- in AE, AK and AP using universal bracket SZ 2373.000.

Light:
Universal white

Protection category:
IP 20 to EN 60 529/10.91

Also required:

Connection accessories,
see page 956.

Accessories:

Adaptor bracket,
see page 931.
Universal bracket,
see page 935.

Components	Standard light	Courtesy light	Universal light	System light
Sockets and connectors for:				
– Power supply	■	■	■	■
– Through-wiring	■	■	■	■
– Facility for connecting a door-operated switch	■	■		■
Jack for normally open contact			■	■
Motion sensor			■	
Interference suppression via:				
– Radio interference suppression capacitor	■			
– Full-electronic ballast		■	■	
Additional manual switching with rocker or slide switch	■	■	■	■
Light cover		■	■	
Light cone adjustment			■	
Individual voltage supply 110 – 240 V		■	■	

Standard light

Technical specifications	Socket	Width mm	Height mm	Depth mm	**Model No. SZ**	Approvals
14 W, 230 V, 50 Hz	Yes	452	117	50	**4138.140**	ENEC
					4138.150[1)]	
18 W, 230 V, 50 Hz	Yes	682	117	50	**4138.180**	ENEC
					4138.190[1)]	
30 W, 230 V, 50 Hz	Yes	987	117	50	**4138.300**	ENEC
					4138.350[1)]	

With fluorescent lamp, socket G 13, length 375/604/908 mm
[1)] with door operated switch

Courtex light

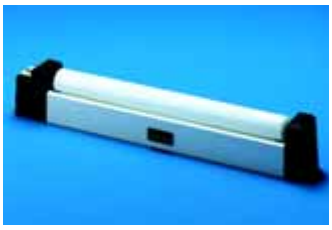
Technical specifications	Socket	Width mm	Height mm	Depth mm	**Model No. SZ**	Approvals
14 W, 100 – 240 V, 50/60 Hz	Yes	452	117	50	**4139.140**	ENEC
					4139.150[1)]	
18 W, 100 – 240 V, 50/60 Hz	Yes	682	117	50	**4139.180**	ENEC
					4139.190[1)]	
30 W, 230 V, 50 Hz[2)]	Yes	987	117	50	**4139.300**	ENEC
					4139.350[1)]	

With fluorescent lamp, socket G 13, length 375/604/908 mm
[1)] with door operated switch
[2)] from April 2005 on: 100 – 240 V, 50/60 Hz

Universal light

Technical specifications	Socket	W mm	H mm	D mm	**Model No. SZ**	Approvals
26 W, 110 – 240 V, 50/-60 Hz	Yes	345	95	55	**4155.100**	VDE
	No	345	95	55	**4155.000**	VDE
	No	345	95	55	**4155.500**	UL

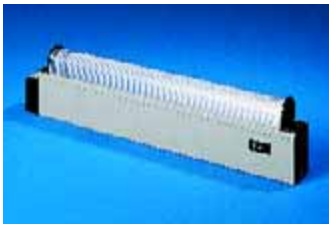
with compact fluorescent lamp, base G24q-3, length 174 mm



System light with filament tube (Linestra)

Technical specifications	Socket	W mm	H mm	D mm	**Model No. SZ**
35 W, 230 V AC/DC	No	380	59	41	**4103.350**[1)]
60 W, 230 V AC/DC	No	580	59	41	**4103.600**[2)]

with filament tube.
[1)] base 35 S14s, length 300 mm
[2)] base 60 S14s, length 500 mm

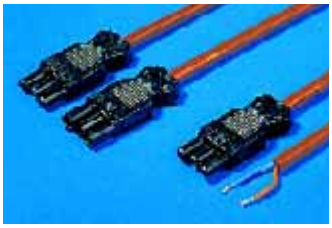


Enclosure light 48 V DC

Specifically designed for use in telecommunication when built-in equipment may require a battery back-up. For mounting on the 25 mm system punchings.

Technical specifications:
14 W, 48 V DC, rated current: 0.38 A

Width mm	Height mm	Depth mm	**Model No. CS**
452	117	50	**9765.100**



Connection cables

for enclosure light 48 V DC

For	Cable length m	Packs of	**Model No. CS**
Power supply	3	1	**9765.137**
Through-wiring	1	1	**9765.138**

Light 1 U

Complete ready-to-connect light for installation in the 482.6 mm (19″) mounting angles. The slot attachment additionally allows it to be fastened to the 25 mm system punchings.

Technical specifications:
8 W, 230 V, 50 Hz.
With mains switch and 2.5 m connection cable with fitted earthing-pin plug.

Material:
Aluminium, anodised,
plastic

Packs of	**Model No. DK**
1	**7109.200**

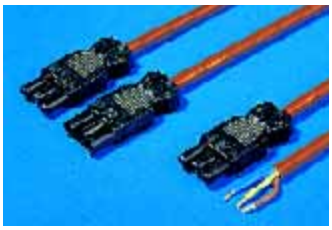
System lights

Connection accessories

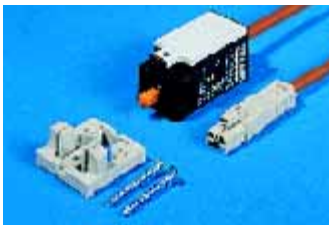
The following components can be used for time-saving and simple installation of the lights:

Accessories:

Cable ties for quick assembly,
see page 982.



Connection cable for	UL	Length mm	Packs of	Model No. SZ		
				orange	yellow	grey
Power supply (with socket, without connector)		3000	5	**4315.100**	**4315.110**	–
Power supply (with socket and strain relief, without connector)	■	3000	1	–	–	**4315.150**
Through-wiring (with socket and connector)	■	600	1	–	–	**4315.450**
Power supply via connection component/ through-wiring (with socket and connector)		600	5	**4315.400**	**4315.410**	–
		1000		**4315.200**	**4315.210**	–
		4000	1	**4315.600**	**4315.610**	–

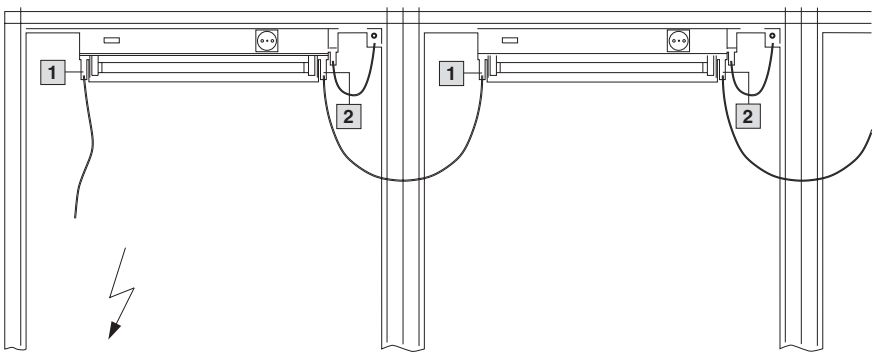


Door-operated switch With mounting accessories	UL	Length mm	Packs of	Model No. SZ	
				orange	yellow
With connection cable		600	1	**4315.500**	**4315.510**
		1000		**4315.300**	**4315.310**
Without connection cable	■	–		**4127.000**	

Door-operated switch With toggle	Technical specifications	Packs of	Model No. SZ
Without connection cable, for TS enclosures with installed large swing frame. The toggle is actuated via the tubular door frame of the sheet steel door, or in the case of glazed doors, via an adaptor included with the supply.	230 V AC, 6 A 24 V DC, 10 A	1	**4127.200**

Connection component with circuit-breaker 10 A	Packs of	Model No. SZ
Reduce assembly costs: Power is supplied rapidly and reliably to system lights and workstation via connection cables. For independently configured cables, connector SZ 2507.200 must be used. Connection component to be snapped onto the top hat rail.	1	**2507.500**

For self-assembly	Packs of	Model No. SZ
Sockets for power supply Through-wiring	5	**2507.100**
Connectors for connection component Through-wiring		**2507.200**
T distributor with 2 sockets, 1 connector		**2507.300**
Connector for door operated switch cable		**2507.400**



1 Connector
2 Socket

Rail

for EMC shielding bracket and strain relief
Combined rail for strain relief and EMC contacting of inserted cables.

Mounting options:
- On the horizontal/vertical TS, PC, ES enclosure section
- On a mounting plate

May also be fitted without a retaining bracket.
Additional contacting on the left or right of the rail via existing holes (9 mm diameter).

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Width mm	Packs of	Model No. SZ
600	1	**2388.600**
800	1	**2388.800**

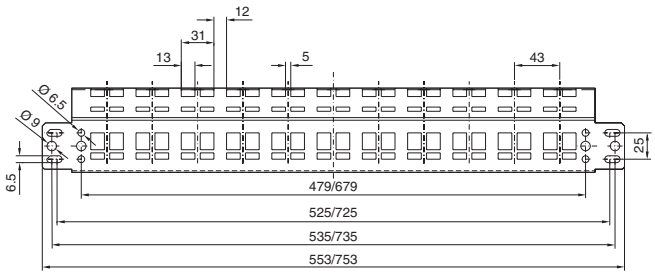
Also required:

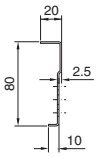
EMC shielding bracket,
see page 957.
Cable clamps for strain relief,
see page 957.

Accessories:

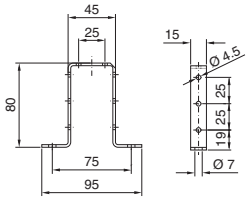
Earth straps,
see page 960.
Earthing strap,
see page 960.

Rail

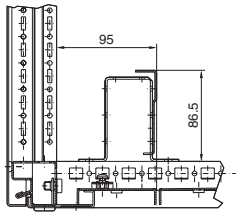




Retaining bracket



Mounting position



EMC shielding bracket

Diameter changes are compensated in full by the spring of the EMC shielding bracket.
Attachment without the use of tools:
Press the EMC shielding bracket against the cable shield and clip into the rail.

Material:
Sheet steel, zinc-plated, passivated

For shield diameter mm	Packs of	Model No. SZ
3 – 10	10	**2388.100**
4 – 15	10	**2388.150**
10 – 20	10	**2388.200**
15 – 28	10	**2388.280**

Cable clamps

Simply locate into the bottom of the rail and tighten the pressure plate for strain relief.

Material:
Sheet steel, zinc-plated, passivated

For cable diameter mm	Packs of	Model No. SZ
6 – 14	10	**2388.140**
12 – 18	10	**2388.180**
18 – 22	10	**2388.220**
22 – 26	10	**2388.260**
26 – 30	10	**2388.300**
30 – 34	10	**2388.340**

EMC

EMC gland plates

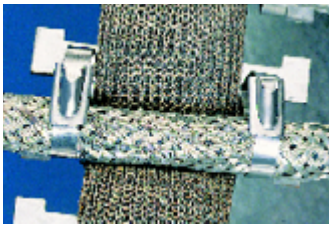
For shielded cables with a maximum diameter of 20 mm.
Combined EMC/IP seal provides low-resistance contact between cable shield and gland plate.
For all 400, 500, 600 and 800 mm deep enclosure in conjunction with standard gland plates.

Supply includes:
1 gland plate with twin hammer-head punching,
1 sliding gland plate,
2 IP/EMC gaskets.

Width mm	Packs of	Model No. TS
600	1 set	**8800.660**
800	1 set	**8800.680**
1000	1 set	**8800.600**[1)]
1200	1 set	**8800.620**[1)]

[1)] For one enclosure half only

German patent no. 196 04 219



Metal cable ties

For 360° contact of shielded cables on the EMC gland plate. The cable ties are not toothed, thereby eliminating the risk of damage to insulation and braided screens.

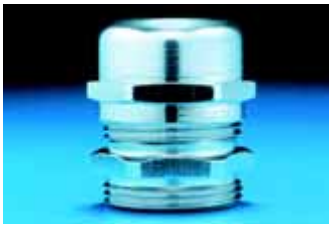
Material:
Stainless steel, anti-magnetic and rust-proof

Length mm	Width mm	Packs of	Model No. SZ
125	4.6	50	**2598.125**
200	4.6	50	**2598.200**

Tightening tool

For simple tightening of the metal cable ties.

Packs of	Model No. SM
1	**2585.000**



EMC cable glands

The cable sheathing may optionally be interrupted at the contact point or removed completely inside the enclosure.
The cable shield in the enclosure is retained.
The supplied lock nut cuts automatically into the paint when screwed down, thus creating a conductive connection.

Protection category:
IP 68 to EN 60 529/10.91

Cable glands, metric

Size	Cable diameter mm	Minimum [1)] shield diameter mm	Packs of	Model No. SZ
M16	4.5 – 10	3	5	**2843.160**
M20	6 – 12	5	5	**2843.200**
M25	11 – 17	8	5	**2843.250**
M32	15 – 21	10	1	**2843.320**
M40	19 – 28	15	1	**2843.400**
M50	27 – 38	19	1	**2843.500**
M63	34 – 44	30	1	**2843.630**

Cable glands, PG

PG size	Cable diameter mm	Minimum[1)] shield diameter mm	Packs of	Model No. SZ
9	4 – 8	3	5	**2411.090**
11	5 – 10	4	5	**2411.110**
13.5	6 – 12	5	5	**2411.140**
16	10 – 14	8	5	**2411.160**
21	13 – 18	10	1	**2411.210**
29	18 – 25	15	1	**2411.290**

[1)] Minimum shield diameter =
Cable diameter minus cable sheathing.

EMC shield bus

Made of yellow passivated steel strip, 75 mm² cross section, for cable shield contact.

Supply includes:
Assembly parts.

Rail length mm	Connections	Packs of	Model No. SZ
375	10	1	**2413.375**
550	16	1	**2413.550**

EMC earth clamps

The clamps may be used directly on the consumer or operating equipment on the mounting plate for cable shield contact.

Material:
Sheet steel, zinc-plated, passivated

Size mm	Packs of	Model No. SZ
4	50	**2367.040**
6	50	**2367.060**
8	50	**2367.080**
12	50	**2367.120**
16	50	**2367.160**
20	25	**2367.200**[1)]
25	25	**2367.250**[1)]

[1)] 2 assembly brackets

EMC baying seal

for TS
For baying enclosure systems.
Seal with all-round, electrically conductive sheathing.

Cross-section mm	Model No. TS
6.3 x 6.3	**8800.690**

Packs of 1 set consisting of 3 units, Length 2 m each

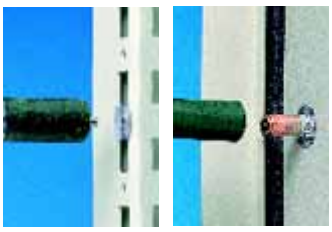
EMC divider panel seal

This seal ensures optimum contact in bayed EMC enclosure systems and when using a zinc-plated divider panel.

Material:
PU foam with electrically conductive sheathing.

Supply includes:
1 roll (12.7 x 12.7 x 5300 mm)

Packs of	Model No. SZ
1	**4348.000**



Contact cutter

The contact cutter enables EMC-compatible preparation of the contact point e.g. for earthing straps.
Plastic-bound abrasive with guide pin for round system punchings.
With location point for drill, grinder etc.

	Model No. SM
For frame section	**2414.000**
For earthing bolts[1)]	**2414.500**

[1)] not necessary with TS 8

Contact paint

Contact paint prevents the corrosion of conductive, unprotected contact points.

Contents:
12 ml

Packs of	Model No. SZ
1	**2415.000**

Earthing

Earth straps

For configuring a reliable earthing connection with perfect contact.

- With ring terminals in M6 and M8 to match the earthing screw
- Length-optimised and ready to install

For	Door/lid	Enclosures
KL, EB, AE 1032.XXX, AE 1035.XXX	M6	M6
AE, AP	M6	M8
TS, ES, PC, AP universal console, KE	M8	M8

Connection	Cross-section mm^2	Length mm	Packs of	Model No. SZ
M8 – M8	4	170	5	**2564.000**
M8 – M8	16	170	5	**2565.000**
M8 – M8	25	170	5	**2566.000**
M6 – M6	10	200	5	**2565.100**
M8 – M8	4	300	5	**2567.000**
M6 – M8	10	300	5	**2565.110**
M8 – M8	10	300	5	**2565.120**
M8 – M8	16	300	5	**2568.000**
M8 – M8	25	300	5	**2569.000**

Earthing strap

Tin-plated copper, in various lengths and cross-sections with press-fitted contact rings. Earthing straps counteract the current displacement effect at high frequencies, whilst at the same time offering highly flexible connection opportunities.

For	Cross-section mm^2	Length mm	Packs of	Model No. SZ
M6	10	200	10	**2412.210**
M8	16	200	10	**2412.216**
M8	25	200	10	**2412.225**
M6	10	300	10	**2412.310**
M8	16	300	10	**2412.316**
M8	25	300	10	**2412.325**

Assembly parts

For fastening the earth straps and earthing braids to:

- Horizontal TS enclosure sections
- RS rail system
- ES system punchings

Size	Packs of	Model No. SZ
M6	10 set	**2570.000**
M8	10 set	**2559.000**

Also required:

For mounting on the horizontal TS enclosure section:
Captive nut,
see page 936.

Contact washers

Toothed contact washers facilitate secure PE conductor connection. As a result, there is no need to manually strip paint in the connection area.

Size	Packs of	Model No. SZ
M5	100	**2343.000**
M6	100	**2334.000**
M8	100	**2335.000**

Central earthing point

For connecting
- Earth straps
- Earthing braids

to the vertical and horizontal enclosure profile.
The connection bracket is connected to the enclosure frame with 2 screws and is securely contacted.
Earth connection is carried out via the threaded bolt M8 x 20 mm.

Material:
Sheet steel, zinc-plated, passivated.

Supply includes:
1 connection bracket,
2 screws BZ 5.5 x 13 mm,
2 serrated washers,
1 nut M8,
1 contact washer M8,
1 washer.

Packs of	Model No. DK
1	**7829.200**

Earthing plate

For installation in:
- Command Panel
- VIP 6000
- Optipanel
- TS
- ES

One earthing cable can be screw-fastened to the threaded bolt and can be distributed to up to 8 components via 6.3 mm flat-pin connectors.

Supply includes:
Assembly parts.

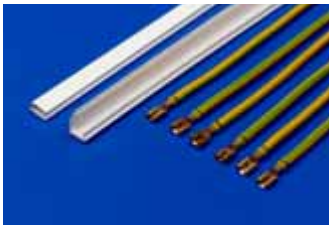
Packs of	Model No. SZ
1	**2570.500**

Complete earthing kit

for DK-TS
To DIN EN 60 950/VDE 0805, Ø 4 mm^2,
$I_{max.}$ 40 A.
For system-compatible earthing of all enclosure parts on the enclosure frame according to VDE.
The earth conductors are pre-assembled ready for connection with connectors and cut to the right length.

Supply includes:
Assembly parts.

Packs of	Model No. DK
1 set	**7829.150**



Complete earthing kit

for TE
To DIN EN 60 950/VDE 0805, Ø 4 mm^2,
$I_{max.}$ 40 A.
For system-compatible earthing of all enclosure parts on the enclosure frame according to VDE.
The earth conductors are pre-assembled ready for connection with connectors and cut to the right length.

Supply includes:
Assembly parts.

Packs of	Model No. TE
1 set	**7000.675**

Earthing

Earthing kit

for TC Rack

For star earthing. With the pre-assembled earth conductors, star potential equalisation is easily integrated.

Supply includes:
Earthing cables 4 mm², to DIN EN 60 950/ VDE 0805, $I_{max.}$ 40 A.
Assembly parts for earthing leads, earth rail.

Packs of	Model No. DK
1 set	**7277.000**

Earthing kit

for QuickBox

Earth straps in the appropriate lengths to match the enclosure depth are included in the earthin set, for earthing all enclosuore panels on the wall mounting part. The earth strap is a fast-end connector which is quickly disconnected and conveniently accessible when the door is open.
In this way, the enclosure cover can be removed completely.

Supply includes:
Assembly parts.

For enclosure depth mm	Packs of	Model No. QB
300/400	5	**7502.240**
500/600	5	**7502.260**

PE busbar

695 mm long PE busbar with pre-fitted screws, including terminal clamps up to 6 mm² (fine wire conductors), 10 mm² (single wire or multi-wire conductors) and main terminal clamp up to 35 mm².

Packs of	Model No. SZ
1	**2364.000**

Accessories:

Rail mounting bracket,
see page 935.

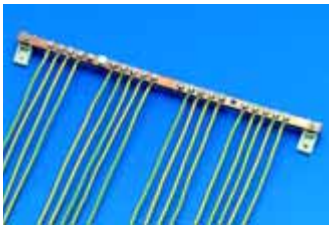
Earth rail, horizontal

Potential equalisation rail

Current carrying capacity approx. 200 A.

Supply includes:
Earth rail made from E-Cu 57 to DIN 1759, DIN 40 500, 15 x 5 mm,
20 connection points with M5 screws,
2 earth connections 25 mm²,
2 isolators, including assembly parts.

Length mm	Packs of	Model No. DK
450	1	**7113.000**



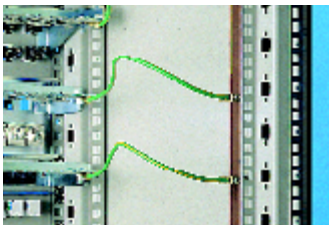
Earthing set, pre-assembled

for DK-TS

For star earthing. With the pre-assembled earth conductors on a potential equalisation rail, star potential equalisation is easily integrated into network enclosures.

Supply includes:
Earthing leads 6 mm²,
2 isolators, including assembly parts.

For TS enclosures up to W x H x D mm	Packs of	Model No. DK
800 x 2000 x 800	1 set	**7829.100**
800 x 2200 x 1000	1 set	**7829.110**



Earth rail, vertical

Potential equalisation rails
for network enclosures. Easily fitted to the 25 mm DIN pitch pattern of distributors or to the 482.6 mm (19″) mounting angles. The supplied earth conductors facilitate star earthing of the cable clamp straps in the patch panels.
The earth terminals are fully adjustable.
Current carrying capacity of rail approx. 200 A.

Supply includes:
Earth rail made from E-Cu 57 to DIN 1759, DIN 40 500, 15 x 5 mm, 16 conductor connection clamps 2.5 – 16 mm^2, 15 earthing leads 6 mm^2, L = 500 mm, including assembly parts.

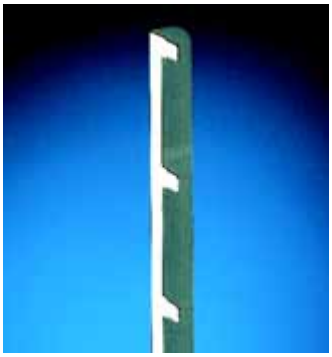
For enclosure height mm	Length mm	Packs of	Model No. DK
800	600	1 set	**7541.000**
1000	800	1 set	**7542.000**
1200	1000	1 set	**7543.000**
1400	1200	1 set	**7544.000**
1600	1400	1 set	**7545.000**
1800	1600	1 set	**7546.000**
2000	1800	1 set	**7547.000**
2200	2000	1 set	**7548.000**

Expansion kit

for earth rail, vertical
For system-compatible expansion of the star earthing on the vertical potential equalisation rail.

Supply includes:
Earthing leads 6 mm^2, pre-configured, with ring terminals and wire end ferrules. L = 500 mm, with earth terminals 2.5 – 16 mm^2, including assembly parts.

Packs of	Model No. DK
10	**7549.000**



Vertical potential equalisation rail

with 6.3 mm flat-pin connector
Rail for mounting parallel to the mounting angle. With a short cable connection, any 482.6 mm (19″) device (e.g. patch panel) may be held at the same potential by connecting the flat-pin connector.

Material:
Sheet steel, zinc-plated, passivated.

Supply includes:
Potential equalisation rail, pre-assembled connection cable 350 mm, connection cable with 6.3 mm flat-pin connector and lugs with 6 mm drilled hole, including assembly parts.

For enclosure height mm	Packs of	Model No. DK
1800	1 set	**7548.200**

ESD connection point

During maintenance or conversion work on the enclosure, dangerously high potential differences can occur. To protect sensitive electronic components, this standardised connection point (push-button) provides potential equalisation. The connection point is directly conductively connected to the enclosure frame via two screws.

Material:
Sheet steel

Supply includes:
Assembly parts.

Packs of	Model No. DK
1	**7752.950**

Cable entry

Cable entry plates

for
- Cable entry grommets
- Connector grommets

instead of segments of the standard divided gland plates.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Suitable for installation in TS, CM, CL and PC enclosures based on TS

Enclosure width mm	Cutouts per plate	Packs of	Model No. TS
600	5	2	**8800.060**
800	8	2	**8800.080**
850	9	2	**8800.085**
1000	4	4	**8800.100**
1200	6	4	**8800.120**

Suitable for installation in ES, PC enclosures based on ES and in AP universal console, CS basic enclosure

Enclosure width mm	Cutouts per plate	Packs of[1)]	Model No. TS
600	5	2	**4320.700**
800	8	2	**4321.700**
1000	10	2	**4323.700**
1200[2)]	6	4	**4325.700**

[1)] incl. compensating plate
[2)] for CS basic enclosures, two TS 4320.700 are required.

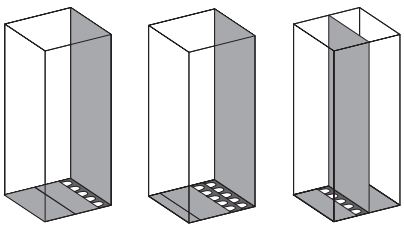
for TS stainless steel

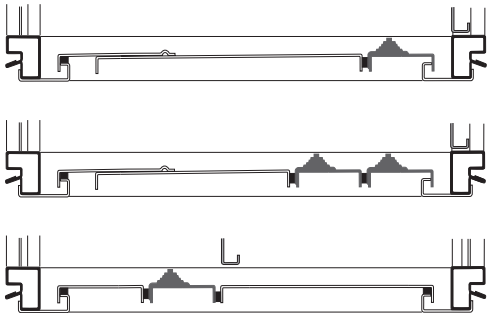
Material:
Stainless steel 1.4301

For installation in TS, stainless steel

Enclosure width mm	Cutouts per plate	Packs of	Model No. TS
600	5	2	**8700.600**
800	8	2	**8700.800**
1200	6	4	**8700.120**

Three examples from a wide range of possibilities
The diagrams show three TS examples for the positioning of cable entry plates instead of segments of the three-piece gland plates supplied as standard. This facilitates positioning to fit the mounting plate.
Thanks to the enclosure symmetry, where dimensions permit, cable entry plates may also be inserted in the enclosure depth, right and left, analogous to the gland plates.





Cable entry grommets

In conjunction with the cable entry plate, simple and fast sealing of cables inserted in the base area of enclosures.

Material:
Body: Polypropylene
Cover: Thermoplastic elastomer

Protection category:
IP 55 subject to correct mounting.

Cables per grommet	max. Ø mm	Packs of	Model No. PS
8	13	25	**4316.000**
3	21	25	**4317.000**
1	47	25	**4318.000**

German patent no. 42 07 281
European patent no. 0560119
with validity for FR, GB, IT, NL
Japanese paten no. 2533052
US patent no. 5,422,436

Connector grommets

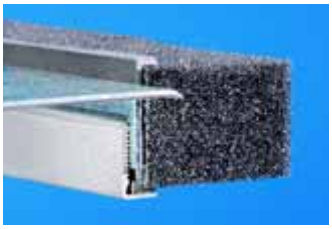
Suitable for cable diameters from 8 to 36 mm.

Material:
Outer cover: Polypropylene covered with thermo-plastic elastomer
Seal: Cellular rubber

Protection category:
IP 55 subject to correct mounting.

Packs of	Model No. PS
10	**4311.000**

German patent no. 44 05 328
Italian patent no. 0 127 3503
French patent no. 2 716 583



Section for cable entry

for TS, CM, CL

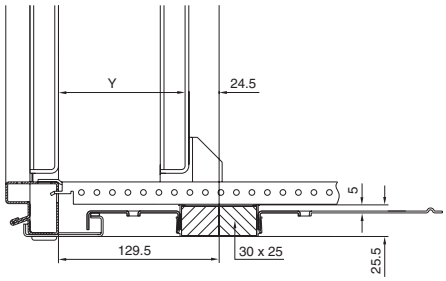
For mounting on top of the gland plates already in the enclosure. The better alternative to the foam rubber cable clamp strip, thanks to:

- Easier mounting
- Full-surface support
- High level of sealing of cables inserted into the enclosure.

Material:
Extruded aluminium section,
seal PU foam,
cross-section: 30 x 25 mm

Protection category:
IP 55 subject to correct mounting.

For Enclosure width mm	Packs of	Model No. TS
600	2	**8802.060**
800	2	**8802.080**
1000	4	**8802.100**
1200	4	**8802.120**



Y = Mounting plate depth-adjustable
on a 25 mm pitch pattern (final pitch 30 mm).

Foam rubber cable clamp strip

For sealing the cable entry between the gland plates. Particularly suitable for identical cable cross-sections.

Material:
Seal PU foam,
cross-section: 30 x 30 mm

Protection category:
IP 55 subject to correct mounting.

Packs of	Model No. SZ
3 m	**2573.000**

Gland plates

EMC gland plates

see page 958.

Plastic cable gland plates

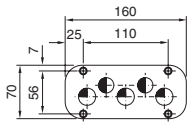
With prepunched PG holes for cable glands.
Used for sealing standard gland plates.
Temperature range:
suitable for use from –40°C to +70°C.

Material:
SZ 2560.000, SZ 2561.000 = PS
SZ 2562.000 = ABS
SZ 2563.000 = Polyamide, glass bead reinforced

Colour:
RAL 7035

Size	For	Packs of	Model No. SZ
1	AE 1032.500, AE 1035.500	10	**2560.000**
3	AE 1030.500, AE 1031.500, AE 1380.500, AE 1038.500	10	**2561.000**
4	AE 1110.500, AE 1114.500, AE 1338.500, AE 1100.500, AE 1045.500, AE 1057.500, AE 1050.500, AE 1130.500, AE 1213.500, AE 1350.500, CS 9771.111, CS 9771.115, CS 9751.145, CS 9751.165, CS 9774.200, CS 9774.210, CS 9774.250, CS 9774.400, CS 9774.410, CS 9774.450,	5	**2562.000**
5	AE 1039.500, AE 1339.500, AE 1060.500, AE 1076.500, AE 1077.500, AE 1180.500, AE 1058.500, AE 1090.500, AE 1360.500, AE 1376.500, AE 1073.500, AE 1260.500, AE 1280.500, AE 1919.200, EL 1920.200, EL 1926.200, DK 7011.535, DK 7012.535, DK 7013.535, DK 7014.535, DK 7644.000, DK 7641.000, DK 7643.000, DK 7645.000, CS 9772.111, CS 9772.115,	5	**2563.000**

Size 1



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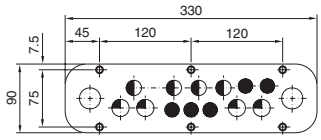

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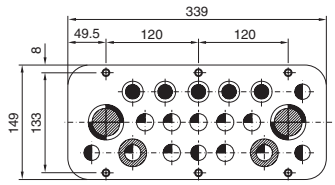

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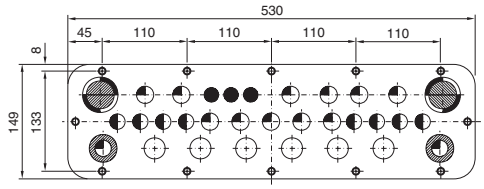
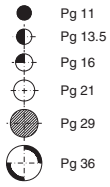
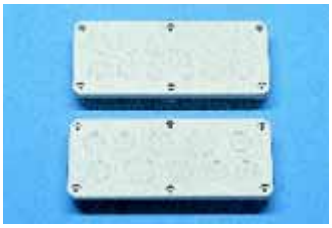






Plastic gland plates

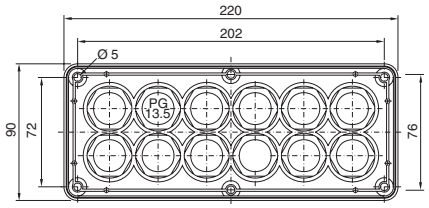
for KL and small fibre-optic distributors based on AE.
With prepunched PG holes for cable glands.
Used for sealing standard gland plates.
Temperature range:
suitable for use from –40°C to +70°C.

Material:
ABS

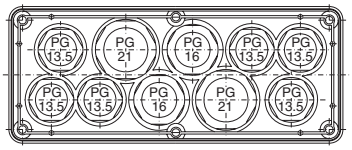
Colour:
RAL 7035

Size	PG	Number of	Packs of	Model No. KL
2	13.5	12	5	**1581.000**
	13.5 16 21	6 2 2	5	**1582.000**

KL 1581.000



KL 1582.000



Plastic gland plates

with membranes
for AE, EL, DK, CS
Simply pierce the plastic with a sharp object, and pull through the cable.

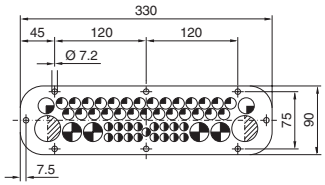
Material:
Plastic to UL 94-V2

Colour:
Similar to RAL 7035

Protection category:
IP 65 with careful cable entry.

Size	For	Packs of	Model No. SZ
3	AE 1030.500, AE 1031.500, AE 1038.500, AE 1380.500	1	**2561.500**
4	AE 1045.500, AE 1050.500, AE 1057.500, AE 1100.500, AE 1110.500, AE 1114.500, AE 1130.500, AE 1213.500, AE 1338.500, AE 1350.500, CS 9771.111, CS 9771.115, CS 9751.145, CS 9751.165, CS 9774.200, CS 9774.210, CS 9774.250, CS 9774.400, CS 9774.410, CS 9774.450,	1	**2562.500**
5	AE 1039.500, AE 1058.500, AE 1060.500, AE 1073.500, AE 1076.500, AE 1077.500, AE 1090.500, AE 1180.500, AE 1260.500, AE 1280.500, AE 1339.500, AE 1360.500, AE 1376.500, EL 1919.200, EL 1920.200, EL 1926.200, DK 7011.535, DK 7012.535, DK 7013.535, DK 7014.535, DK 7641.000, DK 7643.000, DK 7644.000, DK 7645.000, CS 9772.111, CS 9772.115	1	**2563.500**

Size 3



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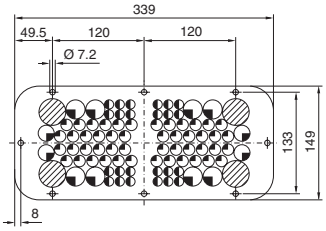

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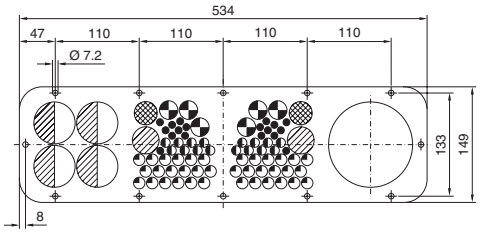


	Diameter mm	Number of cable entries for **Model No. SZ**		
		2561.500	**2562.500**	**2563.500**
●	5 – 9	–	–	18
◑	6 – 11	17	–	–
◐	7 – 12	–	24	16
◔	10 – 15	27	48	36
◒	15 – 21	2	4	–
◕	15 – 24	–	–	6
◒	15 – 25	–	8	–
◕	16 – 25	4	–	–
◑	19 – 34	2	–	–
▩	23 – 30	–	–	2
▨	26 – 35	–	4	2
◧	26 – 54	–	–	4
○	50 – 110	–	–	1

Gland plates

Metal gland plates

pre-punched
for AE, EL, DK, CS
Simply knock out the holes for the cable glands using a screwdriver.

Material:
Sheet steel

Colour:
RAL 7035

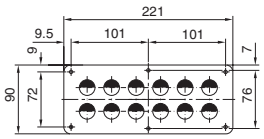
Protection category:
IP 66 when mounting in the usual position, bottom.

Size	For	Packs of	Model No. SZ
2	KL 1530.510, KL 1531.510, KL 1532.510, KL 1533.510, KL 1534.510, KL 1535.510, KL 1536.510, KL 1537.510, KL 1538.510, KL 1539.510, KL 1540.510, KL 1541.510, KL 1542.510	1	**1581.100**
3	AE 1030.500, AE 1031.500, AE 1038.500, AE 1380.500	1	**2561.100**
4	AE 1045.500, AE 1050.500, AE 1057.500, AE 1100.500, AE 1110.500, AE 1114.500, AE 1130.500, AE 1213.500, AE 1338.500, AE 1350.500, CS 9771.111, CS 9771.115, CS 9751.145, CS 9751.165, CS 9774.200, CS 9774.210, CS 9774.250, CS 9774.400, CS 9774.410, CS 9774.450	1 St.	**2562.100**
5	AE 1039.500, AE 1058.500, AE 1060.500, AE 1073.500, AE 1076.500, AE 1077.500, AE 1090.500, AE 1180.500, AE 1260.500, AE 1280.500, AE 1339.500, AE 1360.500, AE 1376.500, EL 1919.200, EL 1920.200, EL 1926.200, DK 7011.535, DK 7012.535, DK 7013.535, DK 7014.535, DK 7641.000, DK 7643.000, DK 7644.000, DK 7645.000, CS 9772.111, CS 9772.115	1	**2563.100**

Accessories:

Cable glands made from polyamide or brass, see page 972.

Size 2



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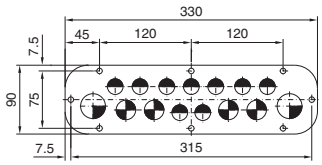

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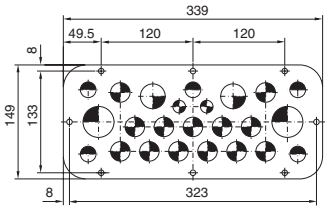

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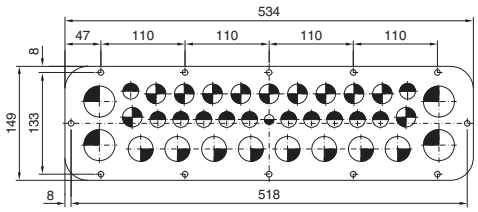
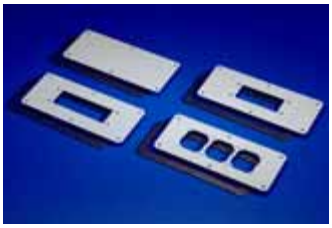


	Diameter	Number of cable entries for **Model No. SZ**			
		1581.100	**2561.100**	**2562.100**	**2563.100**
	M12	–	–	–	1
	M16	–	–	2	–
	M20	12	9	5	12
	M25	–	4	13	11
	M32	–	2	2	8
	M40	–	–	2	4



Metal gland plates

for
- KL terminal boxes, see page 109,
- CP pillar, see page 236,
- IW enclosures, see page 240 – 255.

Material:
Sheet steel, spray-finished

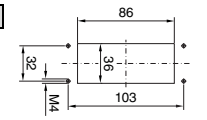
Colour:
RAL 7035

Cutout	Packs of	Model No. KL
Without	6	**1158.500**
1 x connector, 16-pole	6	**1158.560**
1 x connector, 24-pole	6	**1158.540**
3 x module plates	6	**1158.530**

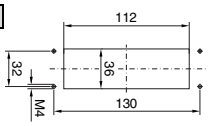
Accessories:

Module plates for individual cable entry, see page 969.

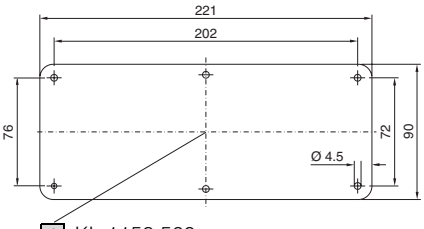
1 16-pole



2 24-pole

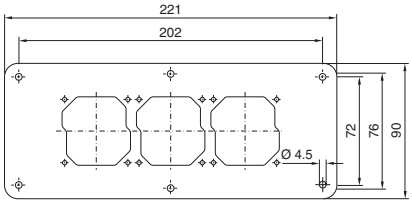


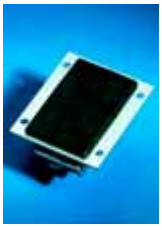
KL 1158.500



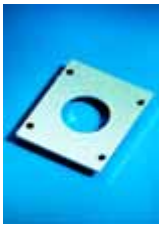
1 KL 1158.560
2 KL 1158.540

KL 1158.530

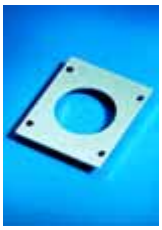




1



2



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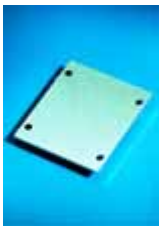


4

5

6

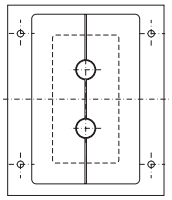
Module plates

for individual cable entry

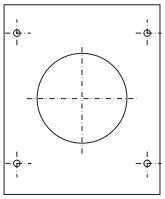
Fig.	Design		Material	Packs of	Model No. BG
1	With connector grommet for 2 cables with connectors up to d = 8.5 mm		Module plate: Sheet steel, zinc-plated, passivated Connector gland: (For details, see SZ 2400.300, page 975)	1	**1158.900**
2	Perforated for metric Cable gland	M25	Sheet steel, zinc-plated, passivated	10	**1158.910**
3		M32			**1158.920**
4	Solid				**1158.930**
5	For direct, IP-protected insertion of sensor/actuator cables	2 + 2[1)]	Plastic module plate with strain relief and flexible sealing membrane, including stoppers for any unused openings	1	**1158.940**
6		8[2)]			**1158.950**

To fit Ø
[1)] 2 cables from 6.8 to 8.8 mm and 2 cables from 7.8 to 10.7 mm
[2)] 8 cables from 3.8 to 6.3 mm

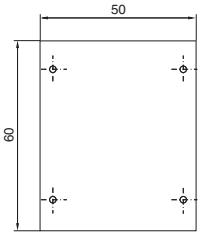
BG 1158.900



BG 1158.910 /.920



BG 1158.930



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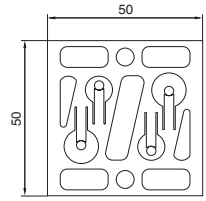
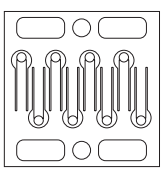


BG 1158.950



Gland plates

Gland plate

solid, for QuickBox
To conceal the cable entry openings. In exchange for the brush strip at the top and bottom that is used as standard.

Material:
Sheet steel

Colour:
RAL 7035

Supply includes:
Assembly parts.

Packs of	Model No. QB
2	7502.310

Gland plate

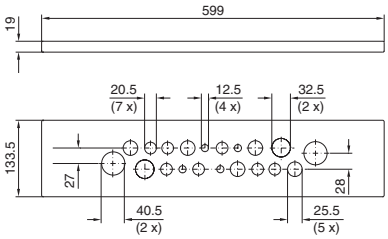
for metric cable glands, for EL
Multi-folded and welded gland plate with foamed-in seal and pre-punched, knock-out holes for metric cable glands M12, M20, M25, M32, M40.

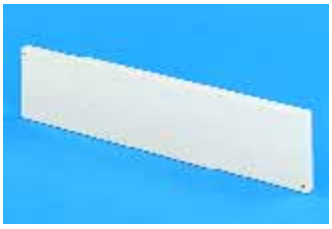
Material:
1.5 mm sheet steel

Colour:
RAL 7035

Protection category:
IP 55 to EN 60 529/10.91

Packs of	Model No. DK
1	7705.235





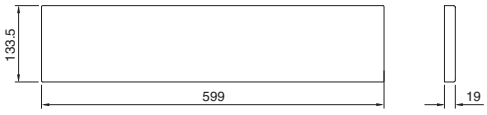
Gland plate

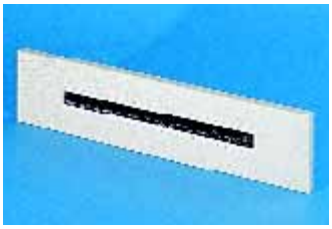
solid, for EL
Multi-fold and welded gland plate for the basic box, with foamed-in seal.

Material:
1.5 mm sheet steel

Colour:
RAL 7035

Packs of	Model No. EL
1	2235.135





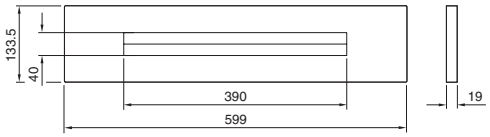
Gland plate

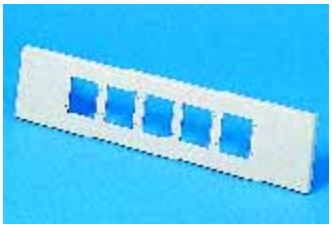
with brush insert, for EL
Multi-folded and welded gland plate with foamed-in seal and plastic brush inserts for simple cable entry.

Material:
1.5 mm sheet steel

Colour:
RAL 7035

Packs of	Model No. DK
1	7705.035





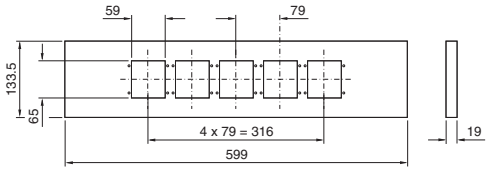
Gland plate

for PG segments, for EL
Multi-fold and welded gland plate with foamed-in seal and cut-outs for PG segments.

Material:
1.5 mm sheet steel

Colour:
RAL 7035

Packs of	Model No. EL
1	**2235.005**



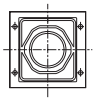
PG segments

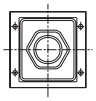
for EL
Plastic segments with pre-punched, knock-out holes for cable glands.
Suitable for retrospective screw-fastening to gland plate EL 2235.005.

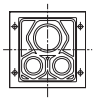
Material:
ABS, self-extinguishing to UL 94-V0

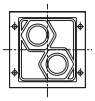
Colour:
RAL 7035

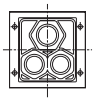
PG sizes	Packs of	Model No. EL
29	5	**2235.015**
21	5	**2235.025**
21/11	5	**2235.035**
16	5	**2235.045**
16/13.5	5	**2235.055**
13.5	5	**2235.065**
11	5	**2235.075**
neutral	5	**2235.085**

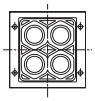
EL 2235.015 

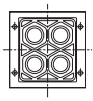
EL 2235.025 

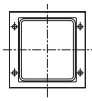
EL 2235.035 

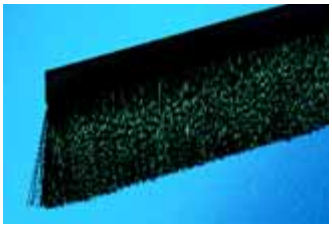
EL 2235.045 

EL 2235.055 

EL 2235.065 

EL 2235.075 

EL 2235.085 



Brush strip

For individual instalation of enclosure panels, gland plates and panels. Cut-outs for cable routing at any given positions in the side panel, rear panel, doors, roof and gland plate may be finished off attractively by simply attaching the brush strip.

Packs of	Model No. DK
2 m	**7072.200**

Technical specifications:
Bristle length: 30 mm
Plastic sheathing: 18 mm
Snap-on surface: 10 mm
Maximum cut-out height: 38 mm

Edge protector

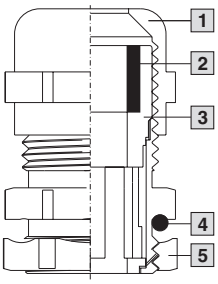
For covering sharp edges of cut-outs. Provides protection from injuries and prevents damage to inserted cables. The edge protector is suitable for material thicknesses of approx. 1.0 – 2.0 mm, and may be cut to length individually.

Material:
Plastic PVC

Colour:
Black

Packs of	Model No. DK
10 m	**7072.100**

Cable gland



Cable gland, brass

Benefits:

- Because the gland and lock nut are sold together in a single pack, this saves additional ordering work and storage locations.
- Clamping membranes for even tightening and strain relief which protects the cables.
- Insulation thanks to plastic insert.
- Optimum seal on the connection thread, thanks to O-ring.
- The lock nut cuts automatically into the spray-finish, thereby creating a conductive connection.

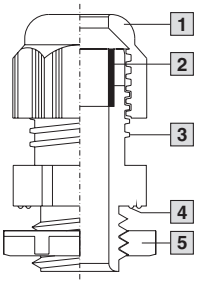
1 Top-hat nut
2 Neoprene seal
3 Plastic insert
4 O-ring
5 Lock nut

Size	Cable diameter mm	Packs of	Model No. SZ
M12 x 1.5	3 – 6.5	15	**2411.800**
M16 x 1.5	4.5 – 10	15	**2411.810**
M20 x 1.5	6 – 12	10	**2411.820**
M25 x 1.5	11 – 17	10	**2411.830**
M32 x 1.5	15 – 21	5	**2411.840**
M40 x 1.5	19 – 28	4	**2411.850**
M50 x 1.5	27 – 38	2	**2411.860**
M63 x 1.5	34 – 44	1	**2411.870**

Material:
Nickel-plated brass, neoprene seal

Protection category:
IP 68 (5 bar, 30 min.) to EN 60 529/10.91

Approval:
VDE tested to EN 50 262



Cable gland, polyamide

Benefits:

- Because the gland and lock nut are sold together in a single pack, this saves additional ordering work and storage locations.
- Clamping membranes for even tightening and strain relief which protects the cables.
- Spray-moulded sealing lip ensures an optimum seal against the enclosure.
- Trapezoid thread for secure screw-fastening of the top-hat nut.

1 Top-hat nut
2 Neoprene seal
3 Trapezoid thread
4 Sealing lip
5 Lock nut

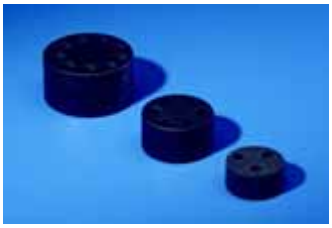
Size	Cable diameter mm	Packs of	Model No. SZ
M12 x 1.5	3 – 6.5	50	**2411.600**
M16 x 1.5	4.5 – 10	50	**2411.610**
M20 x 1.5	6 – 12	50	**2411.620**
M25 x 1.5	11 – 17	25	**2411.630**
M32 x 1.5	15 – 21	15	**2411.640**
M40 x 1.5	19 – 28	5	**2411.650**
M50 x 1.5	27 – 38	5	**2411.660**
M63 x 1.5	34 – 44	3	**2411.670**

Material:
Polyamide 6, neoprene seal

Colour:
RAL 7035

Protection category:
IP 68 (5 bar, 30 min.) to EN 60 529/10.91

Approval:
VDE tested to EN 50 262



Multi-seal inserts

For the secure entry of several individual cables into a single cable gland.

Material:
Neoprene

Size	Cable diameter mm	Number of cables	Packs of	Model No. SZ
M20	3	4	25	**2411.500**
	4	3	25	**2411.501**
	5	3	25	**2411.502**
	6	2	25	**2411.503**
M25	3	7	25	**2411.504**
	4	6	25	**2411.505**
	5	4	25	**2411.506**
	6	3	25	**2411.507**
M32	3	9	25	**2411.508**
	4	9	25	**2411.509**
	5	6	25	**2411.510**
	6	6	25	**2411.511**

Stoppers

For the reliable sealing of unused cable entries. Simply insert into the multi-seal inserts instead of a cable, and clamp via the cable gland.
Length 14 mm.

Material:
Polyamide 6

Diameter mm	Packs of	Model No. SZ
3	25	**2411.520**
4	25	**2411.521**
5	25	**2411.522**
6	25	**2411.523**

Double-membrane gland

for wall thicknesses from 1.5 to 4.5 mm
A high protection category can be achieved with cable entry, thanks to the double seal.

Material:
Plastic to UL 94-HB

Protection category:
IP 66 with careful cable entry.

For hole	Sealing range mm	Packs of	Model No. SZ
M16	5 – 9	50	**2898.160**
M20	7 – 12	50	**2898.200**
M25	9 – 16	50	**2898.250**
M32	14 – 21	25	**2898.320**

Stepped collar

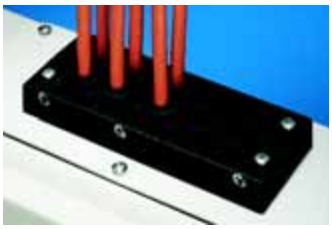
for wall thicknesses from 1.5 to 4.5 mm
For cable entry, simply cut off at the required level to match the cable diameter.

Material:
Plastic to UL 94-HB

Protection category:
IP 54 with careful cable entry.

For hole	Sealing range mm	Packs of	Model No. SZ
M20	5 – 16	100	**2899.200**
M25	5 – 21	50	**2899.250**
M32	13 – 26.5	25	**2899.320**
M40	13 – 34	20	**2899.400**

Cable gland



Connector gland

modular
For pre-assembled cables with connectors.
For mounting on 24-pole or 16-pole connector cutouts in:
- Module plates for TS divider panel
- Metal gland plates

Material:
Plastic to UL 94-V0

Protection category:
IP 54, provided the correct connector grommet is selected.

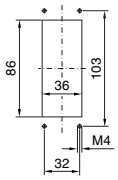
Supply includes:
Assembly parts.

Note:
Temperature range: –40°C to +120°C

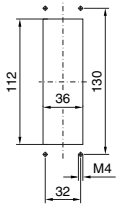
For Cutouts	For number of connector grommets	Model No. SZ
24-pole	10	**2400.700**
16-pole	8	**2400.710**

Accessories:

Module plates for TS divider panel,
see page 859.
Metal gland plates,
see page 969.



16-pole



24-pole

Connector grommets

To seal cables in conjunction with the connector gland and option of strain relief via cable ties.

Material:
Thermoplastic rubber

Protection category:
IP 54, provided the correct connector grommet is selected.

For cable diameter	Packs of	Model No. SZ
5 – 6 mm	10	**2400.720**
6 – 7 mm	10	**2400.730**
7 – 8 mm	10	**2400.740**
8 – 9 mm	10	**2400.750**
9 – 10 mm	10	**2400.760**
10 – 11 mm	10	**2400.770**
11 – 12 mm	10	**2400.780**
12 – 13 mm	10	**2400.790**
Solid	10	**2400.800**

Connector gland

for connector cutouts (24-pole)
For the entry of 2 pre-assembled cables in the connector cutout, without dismantling the connector.
For cable diameter from 8 – 36 mm.

Material:
Plastic
Clamp terminals: Sheet steel, zinc-plated, passivated

Supply includes:
1 set =
2 half-shells, including seals,
with fastening clamp.

Packs of	Model No. SZ
1 set	**2400.000**

Connector gland

For pre-assembled cables with connectors.
- For material thickness of up to 4 mm.
- Strain relief of the pre-assembled cables can be achieved with cable ties.

Material:
Plastic

Colour:
RAL 9005

Protection category:
IP 65 subject to correct mounting.

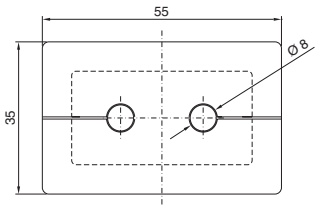
Supply includes:
Assembly parts.

To fit	Packs of	Model No. SZ
2 cables up to Ø 8 mm	1	**2400.300**
3 cables up to Ø 6 mm	5	**2400.500**

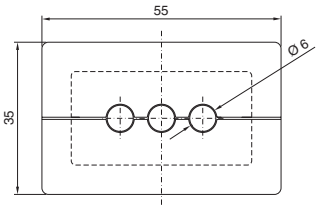
German patent no. 199 08 657

Rittal service:

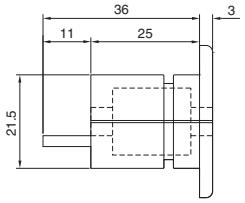
The cutouts may be made by our service centres.

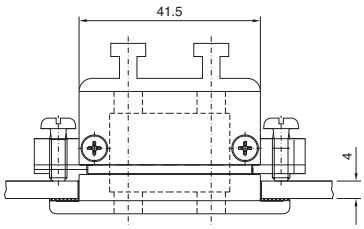


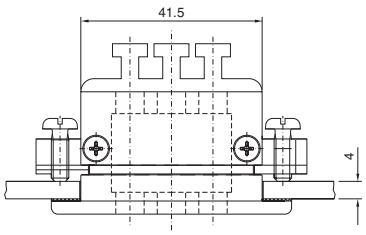
SZ 2400.300



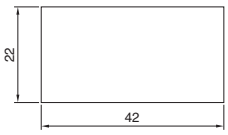
SZ 2400.500







Mounting cutout



Adaptor plate

for connector entry

To fit
- IW worktop, prepared for turntable or enclosure attachment
- Operating housing with mounting cutout CPL, round
- Surfaces.

With 4 studs M6 x 45 mm.

Material:
Sheet steel, zinc-plated, passivated.

Supply includes:
Seal and assembly parts.

Packs of	Model No. IW
1	**6902.660**

Also required:

Connector gland
SZ 2400.300 or SZ 2400.500,
see page 975.

Cable gland

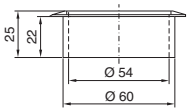
Cable gland

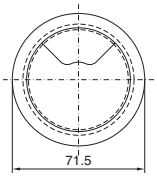
for IW worktops
To fit drilled holes 60 mm. For the entry of cables with pre-assembled connectors, the rotating flap and cover are easily removed.

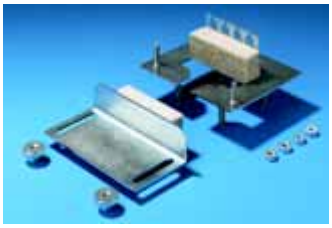
Material:
Plastic

Colour:
RAL 7035

Packs of	Model No. IW
1	6902.770







Cable gland module

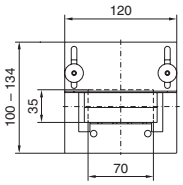
CP-L, Ø 130 mm
Use with the support arm cutout CP-L, round, only with enclosures mounted on the wall, for sealed cable entry. May also be mounted retrospectively with the cables already inserted.
Fitted with T-heads for cable clamping. Particularly well-suited to cables with identical cross-sections.

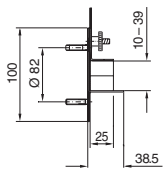
Material:
Sheet steel, zinc-plated, passivated.

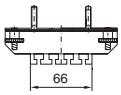
Supply includes:
Assembly parts.

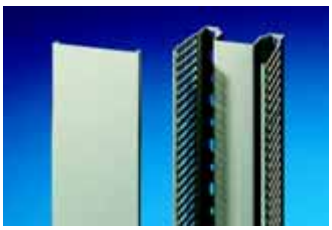
Packs of	Model No. CP
1 unit	6052.500

Note:
Mounting cutout CP-L, Ø 130 mm,
see page 190.









Cable duct

for vertical TS profile

For direct mounting on the vertical enclosure section.

Width 50 mm,
for assembly on a vertical enclosure section in the area of the side panel.

Width 100 mm,
for assembly on two bayed enclosure profiles in the baying area. Baying brackets and baying clamps which have already been fitted can be covered over with the cable duct.

The nominal break points of the members are also oriented towards combination with the cable ducts for mounting plates; in addition a further nominal break at the level of the mounting plate enables direct insertion into the cable duct.

The cable duct fastening points are co-ordinated with the TS system hole pattern; elaborate drilling, as in the case of DIN ducts, is dispensed with.

Width mm	Height mm	Packs of	Model No. TS
50	1600	8 sets	**8800.570**
50	1800	8 sets	**8800.520**
100	1600	4 sets	**8800.540**
100	1800	4 sets	**8800.510**

Technical specifications:
Depth: 80 mm
Length:
- 1,600 mm (for enclosure height 1,800 mm)
- 1,800 mm (for enclosure height 2,000 mm)

can be shortened for other enclosure sizes.
Member width: 5.5 mm
Slot width: 4.5 mm

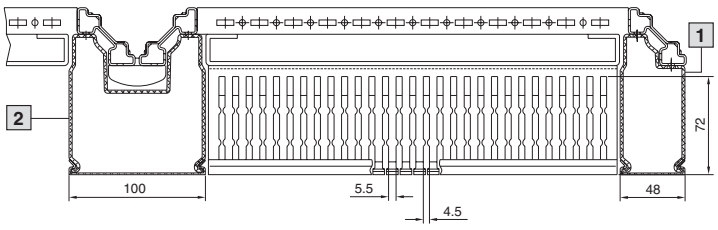
Material:
Hard PVC, hardly inflammable, self-extinguishing, temperature-resistant to +60°C.

Colour:
Similar to RAL 7030

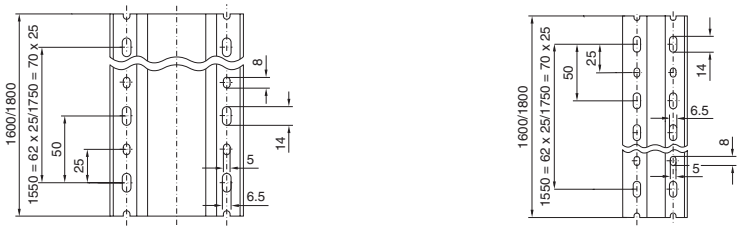
Supply includes:
1 set =
1 cable duct with cover.

Accessories:

Plastic rivet for attachment,
see page 978.

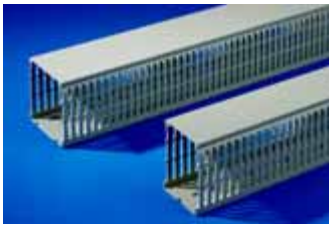


1 TS 8800.570/TS 8800.520
2 TS 8800.540/TS 8800.510



Length (L) mm	1600	1800
Width mm	**Model No. TS**	
48	**8800.570**	**8800.520**
100	**8800.540**	**8800.510**

Cable management



Cable duct

for mounting plate

- To fit the cable ducts for vertical TS profiles. If the TS mounting plate is installed in the rearmost position, the horizontally mounted cable ducts are flush with the vertical ones.
- For external mounting on surfaces

Technical specifications:
Depth 80 mm
Length:
- Sized to the width of the TS, CL and ES mounting plates
- 2,000 mm

Bar width: 5.5 mm
Slot width: 4.5 mm

Material:
Hard PVC, hardly inflammable, self-extinguishing, temperature-resistant to +60°C

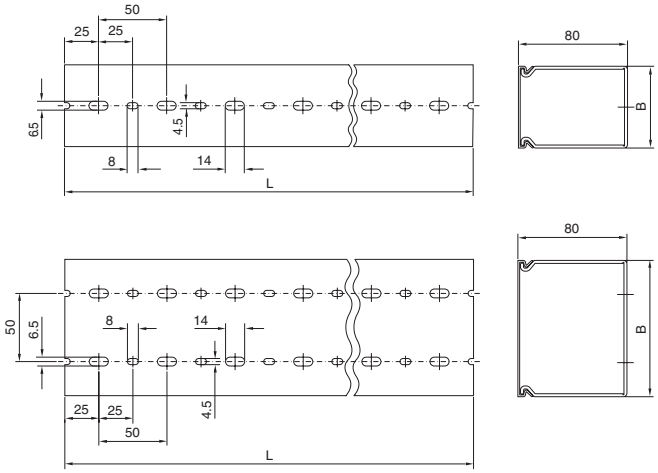
Colour:
Similar to RAL 7030

Supply includes:
1 set =
1 cable duct with cover.

Accessories:

Plastic rivet for attachment,
see page 978.

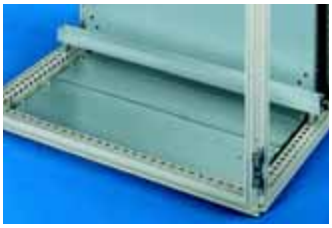
For enclosure width mm		600	800	1000	1200	Length 2,000 mm
Length (L) mm		499	699	899	1099	
Width mm	Packs of	Model No. TS				
30	24 sets	**8800.730**	**8800.735**	**8800.740**	**8800.745**	**8800.750**
40	20 sets	**8800.731**	**8800.736**	**8800.741**	**8800.746**	**8800.751**
60	18 sets	**8800.732**	**8800.737**	**8800.742**	**8800.747**	**8800.752**
80	12 sets	**8800.733**	**8800.738**	**8800.743**	**8800.748**	**8800.753**
100	12 sets	**8800.734**	**8800.739**	**8800.744**	**8800.749**	**8800.754**



Plastic rivet

Easily mounted with a standard commercially available blind rivet tool.
For fastening the cable ducts in the
- TS system hole pattern
- Drilled hole Ø 4.5 mm

Packs of	Model No. TS
100	**8800.530**



Cable clamp rails

Right angle section
For strain relief with cable entry. Depth-variable mounting on a 25 mm pitch pattern on the horizontal enclosure section or in side base/plinth trim panels with assembly bolts.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

For TS, ES, PC, AP universal console, base/plinths

Enclosure width mm	Length mm	Packs of	Model No. PS
400	385	2	**4193.000**
600	585	2	**4191.000**
800	785	2	**4192.000**
850	835	2	**4195.000**
1000	985	2	**4336.000**
1200	1185	2	**4196.000**
1600	1585	2	**4338.000**
1800	1785	2	**4339.000**

(may also be used for AP, AK and AE base/plinths)

Accessories:

Fastening bolts for baying base/plinth trim,
see page 838.
Cable clamp,
see page 979.

Cable clamps,

for cable clamp rails
For fastening the cables to the cable clamp rails.

Material:
Sheet steel, zinc-plated, passivated

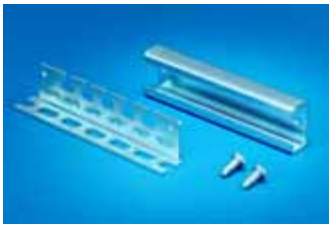
Supply includes:
Plastic insert.

For Cable diameter mm	Packs of	Model No. SZ
6 – 12	25	**2350.000**
12 – 16	25	**2351.000**
14 – 18	25	**2352.000**
18 – 22	25	**2353.000**
22 – 26	25	**2354.000**
26 – 30	25	**2355.000**
30 – 34	25	**2356.000**
34 – 38	25	**2357.000**
38 – 42	25	**2358.000**
42 – 46	25	**2359.000**
46 – 50	25	**2360.000**

Possible alternative:

Rail for EMC shielding bracket and strain relief,
see page 957.

Cable management



Cable clamping bracket

For installing in the operating housing with mounting cutout CP-L and CP-XL.
Cable clamping optionally via:

- Cable clamps
  or
- Cable tie SZ 2597.000
- Commercially available cable ties.

Bracket height = 25 mm with fitted C rail 40 mm.

Material:
Sheet steel, zinc-plated, passivated.

Supply includes:
C rail
and screws.

Packs of	Model No. CP
1 set	**6052.000**

Accessories:

Cable clamps,
see page 981.
Cable ties,
see page 982.

C rails

may be found under rail systems
from page 928.

Cable clamp rails

see page 983.

Combination rails

For cable clamping and routing.
Cables and leads can be fastened to the hammer heads top and bottom with cable ties. In addition, the C section of the combination rail will accommodate cable clamps with inserts.

Material:
Aluminium

Supply includes:
Assembly parts.

For Enclosure depth mm	Length mm	Packs of	Model No. QB
300/400	200	6	**7502.302**
500/600	400	6	**7502.304**

For Enclosure width mm	Length mm	Packs of	Model No. QB
600	400	6	**7502.304**

Accessories:

Cable ties,
see page 982.
Cable clamps,
see page 981.

Cascade cable routing

for frame attachent
for DK-TS, FR(i)
Professional cable routing system for cascading of cables in several levels of the enclosure depth. The cables are attached to the C rail by means of clamps. Suitable for installation on the inner enclosure level.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
6 mounting brackets and 3 C rails, including assembly parts.

For Enclosure width mm	Packs of	Model No. DK
600	3	**7831.570**
800	3	**7831.571**

Accessories:

TS punched section with mounting flange for the inner or outer attachment level,
see page 921.
PS punched section without mounting flange for vertical mounting in the enclosure frame,
see page 925.
Cable clamps,
see page 981.

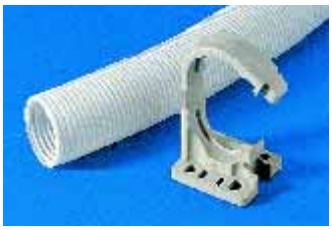
Cable clamps

for C rails
For attaching the cables to the C rails.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Plastic insert.

For Cable diameter mm	Packs of	Model No. DK
6 – 14	25	**7077.000**
12 – 18	25	**7078.000**
18 – 22	25	**7097.000**
22 – 26	25	**7097.220**
26 – 30	25	**7097.260**
30 – 34	25	**7097.300**
34 – 38	25	**7097.340**
38 – 42	25	**7098.000**
42 – 56	25	**7098.100**
56 – 64	25	**7099.000**



Cable conduit and cable conduit holder

For secure cable routing e.g. from the enclosure or mounting plate to the door. Option of attaching the cable conduit holder tailored to system punchings TS and to 482.6 mm (19″) pitch pattern with no drilling required.
Attachment facility for standard commercially available cable ties is provided on the cable conduit holder, so that cables may be attached upon entry to/exit from the cable conduit.

Material:
Cable conduit: Polythene
Cable conduit holder: Polyamide

Cable conduit holder:
German patent no. 37 60 110
European patent no. 0 257 367
with validity for DE, ES, FR, GB, IT
US patent no. 4,779,828

Cable conduit

Internal Ø mm	Packs of	Model No. SZ
16	25 m	**2595.000**
29	25 m	**2589.000**
36	25 m	**2596.000**
48	25 m	**2590.000**

Cable conduit holder

For cable conduit Ø mm	Packs of	Model No. SZ
16	20	**2593.000**[1)]
29	20	**2591.000**[1)]
36	20	**2594.000**
48	20	**2592.000**

[1)] Installation in compact enclosures AE with universal bracket SZ 2373.000,
see page 935.

Cable management

Cable fastening

For professional, secure fastening of cables and conduits.

For fastening:
- Slide into the mounting rail 23 x 23 mm
- screw-fasten onto the round punchings of the enclosures, as well as all punched rails and punched sections.

As the fastening attachments are bayable, several fastening attachments, even those of different sizes, can be assembled using just 2 screws.

Material:
Polyamide

For Cable diameter from – to mm	Packs of	Model No. PS
6 – 9	50	**4319.090**
9 – 12	50	**4319.120**
12 – 16	50	**4319.160**
16 – 20	50	**4319.200**

Also required:

Posidrive raised countersunk screw M5 x 12 mm, SZ 2488.000, for screw-fastening to the round system punchings,
see page 937.

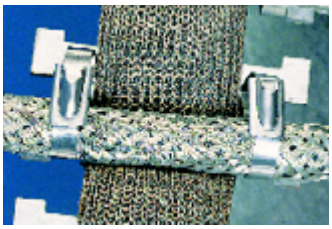
Accessories:

Punched rail 23 x 23 mm,
see page 925.

Cable ties

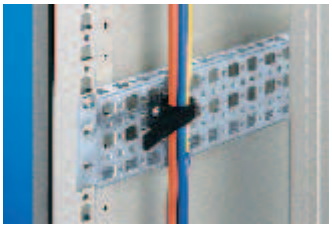
The super-fast solution for fastening cables to the enclosure profile or mounting system parts. Simply clip into the round system punchings.

Length mm	Packs of	Model No. SZ
150	100	**2597.000**



Metal cable ties

see page 958.



Nylon loop

With the nylon loop, secured cables are easily released, allowing individual cables to be added or removed. Ideal for sensitive data cables (fibre-optic/Cu), as it avoids indentations on the cable sheathing.
In addition, the nylon loop may be screw-fastened to the round system punchings.

Colour:
Black

Width mm	Length mm	Max. cable diameter mm	Packs of	Model No. DK
16	130	30	10	**7072.220**
16	200	50	10	**7072.230**
16	300	90	10	**7072.240**

Also required:

Screw SZ 2486.500 for screw-fastening to the round system punchings,
see page 937.

Cable tie fastener

for round system punchings and VIP 6000

For all commercially available cable ties up to a tie width of 4.8 mm.

Simply insert into the round system punchings or into the screw channel, and secure by hammering down the split rivet.

Material:
Polyamide 6.6

Packs of	Model No. CP
100	**6059.000**

Cable tie fastener

for Optipanel

For secure cable routing of all standard commercially available cable ties up to a tie width of 4.0 mm.

Secured in the T channel by rotating through 45°.

Material:
Polyamide 6.6

Packs of	Model No. CP
100	**6059.500**

Cable clamp rails

for TS and 482.6 mm (19″) mounting frames
The cables may be attached to the cable clamp rails with cable ties or nylon tapes. The cable clamp rails are simply located onto the frame section and may be additionally secured with a screw.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Accessories:

Cable ties, see page 982.
Nylon loop, see page 982.

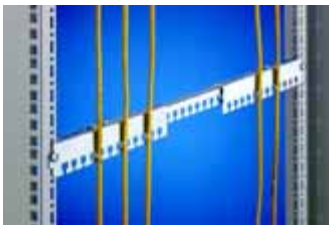
For the inner mounting level

For enclosures		Packs of	Model No. DK
Width mm	Depth mm		
600	600	4	**7828.061**
800	800	4	**7828.081**
900	900	4	**7828.091**
1000	1000	4	**7828.101**

For the outer mounting level

For enclosures		Packs of	Model No. DK
Width mm	Depth mm		
600	600	4	**7828.062**
800	800	4	**7828.082**
900	900	4	**7828.092**
1000	1000	4	**7828.102**

Cable management



Cable clamp rails, depth-variable

for TS and 482.6 mm (19″) mounting frames
For strain relief of the routed cables. The cables may be attached to the cable clamp rails with cable ties or nylon tapes.
The cable clamp rails may be located directly on a 482.6 mm (19″) mounting frame horizontally at the rear or in the enclosure depth between two mounting frames. An additional screw-fastening secures the unit.
The depth variability of the rails facilitates flexible adaptation of their length to the existing attachment distance between the two 482.6 mm (19″) mounting frames.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

19″ distance between levels mm	Packs of	Model No. DK
445 – 695	4	**7858.160**
620 – 1015	4	**7858.162**

Accessories:

Cable ties,
see page 982.
Nylon loop,
see page 982.

Shunting ring, plastic

For flexible cable routing, in two materials and three size variants.
Option of mounting to the 482.6 mm (19″) enclosure and swing frame profile of the data distributor, to the system strips of FM distribution enclosures, to all patch panels, to the Rittal Data Rack and all components on a 25 mm DIN pitch pattern.

Polyamide version:
Infinitely variable mounting thanks to a longitudinal slot. The shunting ring DK 7218.035 may also be used on 1 U patch panels.

Colour:
RAL 7035

Material	Dimensions mm	Packs of	Model No. DK
Polyamide	70 x 44	10	**7218.035[1)]**
Polyamide	105 x 70	10	**7219.035[1)]**
Polycarbonate	95 x 50	10	**7228.035**

[1)] German patent no. 44 13 124

Polycarbonate version:
Variable mounting. With 45° attachment the cable shunting ring may be attached to a 1 U panel.

Colour:
RAL 7035

Possible alternative:

Cable management panel, 482.6 mm (19″), 1 U,
see page 989.

Cable shunting ring

For flexible, system-compatible cable routing at the side of the 482.6 mm (19″) mounting frame.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Dimensions mm	Packs of	Model No. DK
120 x 80	10	**7111.900**
120 x 60	10	**7111.000**
80 x 37	10	**7112.000**

German patent no. 38 13 002

Cable management

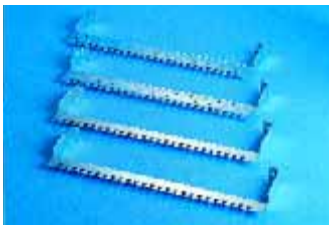
Shunting ring

To accommodate large quantities of cables. Shunting ring for side attachment to 482.6 mm (19″) sections and 482.6 mm (19″) mounting frames in 800 mm wide network enclosures. The ring is attached asymmetrically, with $^{1}/_{3}$ in front and $^{2}/_{3}$ behind the 482.6 mm (19″) front mounting angle. In this way, even large quantities of cables can be effectively managed.

Material:
Round steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Dimensions mm	Packs of	Model No. DK
300 x 90	4	**7220.600**



Cable clamp straps

for patch panels
To provide strain relief of incoming or outgoing data cables. Optionally available with spring brackets for accommodating and contacting the cable screen. Connection to the patch panel is by means of bolts on the panel itself.

Material:
Sheet steel 2 mm, zinc-plated, passivated

Supply includes:
Assembly parts.

Design	Model No. DK
Without cable screen contact	**7610.000**
With spring clips for contacting the cable screen	**7611.000**

Rail spacing brackets

for patch panels
For fastening punched rails PS 4170.000 with 2 U nuts PS 4179.000, as cable clamps or cable routing directly behind the panel.

Material:
Sheet steel, zinc-plated, passivated

Packs of	Model No. DK
12	**7110.000**

Extended delivery times.

Accessories:

Mounting rails,
see page 925.
Sliding nut M6,
see page 936.

Cable management

Fibre-optic shunting rings

The inner body is grooved, and fibre-optic shunting or jumper cables can be inserted into these. A rubber ring holds different fibre-optic cables with diameters of up to 4.5 mm. Strain relief and bending radius are ensured. Length: 120 mm.

Material:
Plastic

Colour:
Outside: RAL 7035
Inner body: Black

Supply includes:
2 shunting rings,
2 rubber rings,
baying kit,
including mounting accessories.

Assembly:
The supplied mouting brackts are suitable for universal use; the fibre-optic cables can be routed to the patch panel in all directions in various mounting positions:

1

2

3

4

1 At the side, directly on the patch panel

2 In front of the patch panel

3 At the side next to the patch panel

4 Behind the patch panel

Packs of	Model No. DK
2	**7116.500**

German patent no. 196 48 489
German patent no. 196 48 490

Possible alternative:

Fibre-optic cable management panel 482.6 mm (19″) 1 U,
see page 992.

Cable route

For cable routing between two 482.6 mm (19″) mounting angles in bayed enclosure suites (enclosure width 800 mm, mounting angles fitted centrally). Suitable for L-shaped and cranked mounting angles.

Material:
Sheet steel

Colour:
RAL 7035

Supply includes:
Assembly parts.

Packs of	Model No. DK
1	**7827.050**

Surplus cable holder

For fastening at the rear area of the enclosure, or at the side of network enclosures. The surplus cable holder can be attached to all depth stays or to punched sections and rails with a 25 mm pitch pattern – mounting dimension 150 mm. Units may also be fastened to each other.

Material:
Sheet steel

Colour:
RAL 7035

W x H x D mm	Model No. DK
280 x 151 x 75	**7220.500**

Cable management

Cable management duct

for TS

For side cable routing. The cable management duct is attached to 482.6 mm (19″) mounting angles at the sides of the 800 mm wide TS network enclosure. For this purpose, the mounting angles must be mounted on installation brackets. Thanks to the removable front trim panel equipped with quick-release fasteners, cables can also be retrospectively removed or added.

Dimensions:
W x D: 95 x 94 mm

Material:
Sheet steel, spray-finished

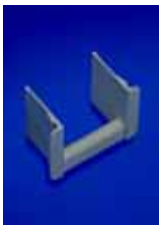
Colour:
RAL 7035

Supply includes:
Assembly parts.

U	For enclosure height mm	Model No. DK
31	1600	**7827.333**
36	1800	**7827.338**
40	2000	**7827.342**
45	2200	**7827.347**

Also required:

Installation brackets TS for mounting angles, see page 1009.



Cable routing components

for FR(i)

For snap-fastening into the vertical frame channel.

Type 1:
With horizontal bar for attaching the cables in the frame channel.

Type 2:
Additionally with semi-circular bead for kink-free cable entry and exit.

Type	Packs of	Model No. DK
1	10	**7218.100**
2	10	**7218.105**

Material:
Polycarbonate

Colour:
RAL 7035

Expansion kit

horizontal cable management
for FR(i)

Allows the enclosure frame to be extended in the depth by approximately 100 mm. The space thereby acquired may be used for horizontal cable management between bayed enclosures.

Expansion kit

Packs of	Model No. FR
1 set	**7856.740**

Note:
Combination of the extension kit with divided doors is not possible.

Material:
Sheet steel, spray-finished

Colour:
RAL 7035

Supply includes:
1 set =
8 spacer supports, including assembly parts.

Trim panels

Enclosure height mm	Packs of	Model No. FR
2000	2	**7856.743**
2200	2	**7856.746**

Note:
Upon request, trim panels may be inserted on the outer sides of the bayed enclosure suites to protect the enclosures against unauthorised access.

Cable management

Mounting/cable management panel

for QB 3 U, 6 U with vertical 482.6 mm (19″) level

For structured cable routing or for mounting small components or distributors (such as hubs, switches etc.). The cable management panel is easily fitted in the front of the rear panel from the front.

Material:
Sheet steel

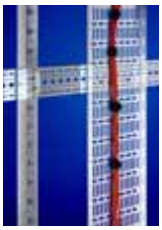
Colour:
RAL 7035

Supply includes:
Assembly parts.

Packs of	Model No. QB
1	**7502.270**

Accessories:

Nylon loop, see page 982.
Cable ties, see page 982.



Cable route

Universal cable tray. Ideal for network enclosures with large quantities of cable.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Width mm	Length mm	Packs of	Model No. DK
150	1700	1	**7858.150**
200	1700	1	**7858.152**
300	1700	1	**7858.154**

Accessories:

Nylon loop, see page 982.
Cable ties, see page 982.

Cable glands

for fibre-optic technology

The standard sizes PG 7 and PG 13.5 have a slotted inner seal. This allows super-easy cable entry. Ideal for routing break-out cables, as this eliminates unnecessary bending of the fibre-optic cables.

Material:
Cable gland: Brass, nickle-plated
Inner seal: Soft PVC insert

Fibre-optic cable glands	Packs of	Model No. DK
PG 7	12	**7455.010**
PG 13.5	12	**7455.030**

Cable management panel 1 U

42 HP (1/2 19″)
for RNC, RiCase
For horizontal cable routing.

Material:
Sheet steel

Colour:
RAL 7035

Supply includes:
Tray and 5 shunting rings.

U	Model No. DK
1	**7502.610**

Entry panel 1 U

42 HP (1/2 19″)
for RNC, RiCase
For system-compatible entry of patch cables which complies with the minimum bending radii. Cutout approximately 227 x 30 mm.

Material:
Sheet steel

Colour:
RAL 7035

Packs of	Model No. DK
2	**7870.730**

Cable management panel, 482.6 mm (19″), 1 U

482.6 mm (19″)
For horizontal management of the patching cables with 5 cable shunting rings, supplied loose.

Material:
Panel: Sheet steel
Ring: Polyamide

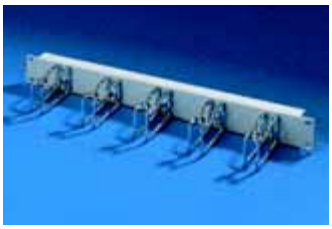
Colour:
RAL 7035

U	Ring size mm	Model No. DK
1	70 x 44	**7159.035**

Material:
Panel: Sheet steel
Ring: Polycarbonate

Colour:
RAL 7035

U	Ring size mm	Model No. DK
1	95 x 50	**7255.035**



Material:
Panel: Sheet steel
Ring: Sheet steel, zinc-plated, passivated

Colour:
RAL 7035

U	Ring size mm	Model No. DK
1	100 x 37	**7257.035**
2	120 x 80	**7257.100**

Cable routing 482.6 mm (19″)

Cable management panel, 2 U

482.6 mm (19″)
The cable routing chamber has cutouts from above, into which the patch cables can be inserted. The cable management panel is equipped with a flap and quick-release fasteners at the front, for optimum access to the cables. From the rear, the cables can be inserted via a cutout with brush strips. With accommodation facility for cable clamp straps DK 7610.000 or DK 7611.000.

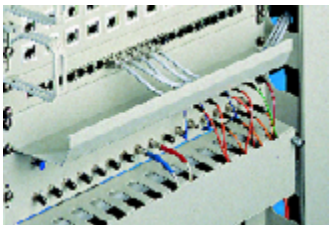
Material:
Sheet steel

Colour:
RAL 7035

U	Depth mm	Model No. DK
2	85	**7158.035**

Accessories:

Cable clamp straps,
see page 985.



Cable routing channel

482.6 mm (19″)
To hold the patching cables.

Material:
Sheet steel

Colour:
RAL 7035

U	Depth mm	Model No. DK
1	85	**7149.135**
3	100	**7149.035**

Other versions available on request.

Cable management panel, 2 U

To accommodated fibre-optic and copper cables. Fibres from the patch panels are placed into the tray via openings and may be distributed at the sides. Rounded openings protect the cable sheathing.

Material:
Sheet steel

Colour:
RAL 7035

U	Model No. DK
2	**7269.135**

Cable management duct, horizontal

482.6 mm (19″)

The duct facilitates concealed, simple cable routing of large quantities of cables to equipment within the 482.6 mm (19″) attachment level. Large cutouts ensure convenient, kink-free cable routing to the cables top and bottom.
For simple handling, the entire front panel may be removed via quick-release fasteners. After attaching the cables, these are held in position via nylon ties, whilst the duct may be resealed.

Material:
Sheet steel

Colour:
RAL 7035

Supply includes:
5 nylon loops.

U	Model No. DK
2	**7158.100**
3	**7158.150**

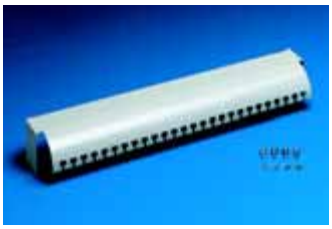
Cable tray, 2 U

For side routing and distribution of fibre-optic and copper cables. In this way, cables inserted into the roof area may be routed at the side of the mounting angles in the upper section of the rack. Depth 85 mm.

Material:
Sheet steel

Colour:
RAL 7035

U	Model No. DK
2	**7269.235**



Copper and fibre-optic cable management panel

The panel is attached between the cranked 482.6 mm (19″) mounting angles. The fibres are routed via the panel; minimum bend radii are maintained.
The hammer heads provide strain relief for individual cables.

Material:
Sheet steel

Colour:
RAL 7035

Supply includes:
Assembly parts.

U	Model No. DK
2	**7269.335**

Other versions available on request.

Fibre-optic cable management panel, 2 U

482.6 mm (19″)

This panel supports routing of the fibre-optics whilst observing the minimum bend radii within horizontal and vertical cable management.

Material:
Sheet steel

Colour:
RAL 7035

U	Model No. DK
2	**7116.560**

Cable routing 482.6 mm (19″)

Fibre-optic cable management panel, 1 U

482.6 mm (19″)
The four fibre-optic cable shunting rings integrated into the front permit optimum management of up to 48 fibres.

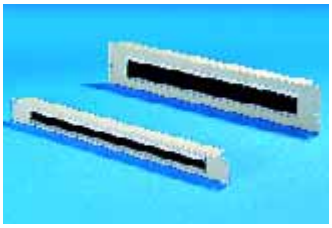
Material:
Panel: Sheet steel
Ring: Plastic

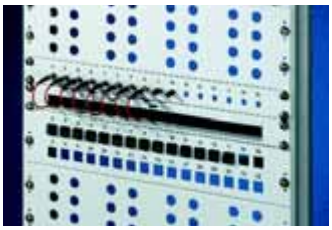
Colour:
Panel: RAL 7035
Cable shunting rings on the outside: RAL 7035
Black interior

U	Model No. DK
1	**7256.035**

Possible alternative:

Fibre-optic support guide DK 7116.500,
see page 986.





Cable entry panel

482.6 mm (19″)
Cutout 390 x 40 mm (2 U) or 390 x 20 mm (1 U) with brush insert. With accommodation facility for cable clamp straps DK 7610.000 or DK 7611.000.

Material:
Sheet steel

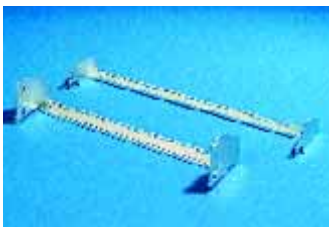
Colour:
RAL 7035

U	Model No. DK
1	**7140.535**
2	**7150.535**

Other versions available on request.

Accessories:

Cable clamp straps,
see page 985.



Cable routing across the 482.6 mm (19″) mounting level

There is a choice of five different cable clamping systems for system-compatible cable routing in 482.6 mm (19″) systems with one or two pairs of mounting angles:

C rail
for fastening across all 482.6 mm (19″) mounting angles.

Cable clamp rails
for fastening across all 482.6 mm (19″) mounting angles, for cable ties.

Cable clamp straps for large swing frames, and Data Rack,
the cable clamp straps are mounted on the frame at the rear, whilst the cables are clamped 250 mm behind the 482.6 mm (19″) mounting angles.

Cable clamp straps for DK-TS mounting angles,
with side lugs suspending from the cranked 482.6 mm (19″) mounting angles. Cable clamping is via cable ties.

Cable clamp strap for Rittal TC Rack,
for fastening across all 482.6 mm (19″) mounting angles, for cable ties.

Material:
Sheet steel, zinc-plated, passivated

C rail	Depth in mm	Model No. DK
482.6 mm (19″) mounting angles	–	**7016.100**

Cable clamp rail	Depth in mm	Model No. DK
482.6 mm (19″) mounting angles	–	**7016.110**

Cable clamp strap for	Depth in mm	Model No. DK/FR
Data Rack, and large swing frame	250	**7016.120**
DK-TS mounting angles	100	**7016.130**
TC rack mounting angles	100	**7875.400**[1)]

Packs of 6
[1)] Extended delivery times.

Also required:

With L-shaped TS mounting angles,
adaptor DK 7827.300 is additionally required,
see page 950.

Swing frame, small

for 600 mm and 800 mm wide TS enclosures
For mounting 482.6 mm (19″) equipment.
The front mounting situation, at the top or bottom of the enclosure frame, is achieved with the divider kit. The installation accessories required for other installation variants are described separately (see page 994).
With 800 mm wide enclosures, central or side-offset installation is possible.

Technical specifications:
Torsionally stiff frame, welded from rectangular tube and triple folded support section.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Cam with double-bit lock insert and parts for attaching to the divider kit.

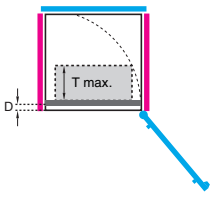
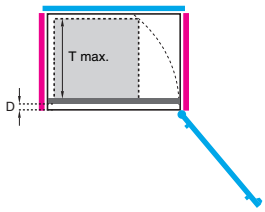
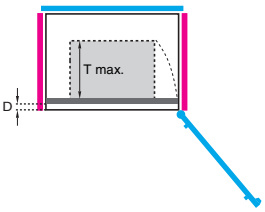
Also required:

Divider kit for swing frame, small,
see page 994.

Accessories:

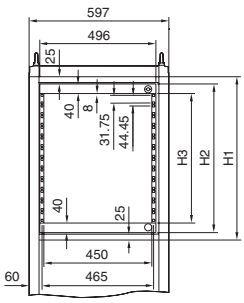
PS punched section without mounting flange
see page 925.
Support bracket TS,
see page 933.
Lock inserts, type D,
see page 888.
Plastic handle, type C,
see page 886.

Height units	3 U	6 U	9 U	12 U	15 U	18 U
Model No. SR	**2377.030**	**2377.060**	**2377.090**	**2377.120**	**2377.150**	**2377.180**
H1 mm	275	408	541	675	808	941
H2 mm	217	350	483	617	750	883
H3 mm	137	270	403	537	670	803

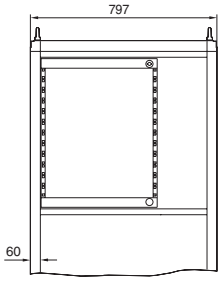
Installation depth T max. = mm with dimension D[1] of at least 45 mm			
Enclosure width mm	600	800	800
			
Installation	central	side	central
Enclosure depth mm 400 500 ≥ = 600	T max. 185 185 185	T max. 310 410 500	T max. 310 370 370

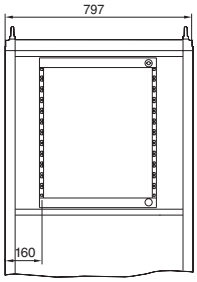
[1] D = Distance from the inner edge of the door to the front edge of the swing frame may be installed deeper on a 25 mm pitch pattern.

For 600 mm wide enclosures



For 800 mm wide enclosures optionally side or central

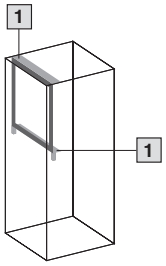




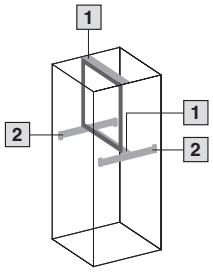
Swing frame

5 examples for TS

Partial installation in 600 and 800 mm wide enclosures,
in the foremost or rearmost position.

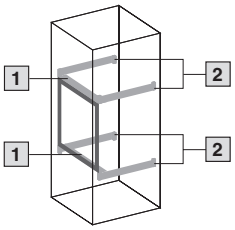


Front

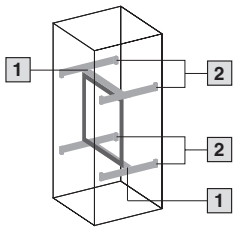


Set back

Partial installation, centre
in 600 and 800 mm wide enclosures.



Front



Set back

Also required:

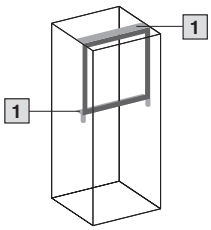
Depending on the installation position:

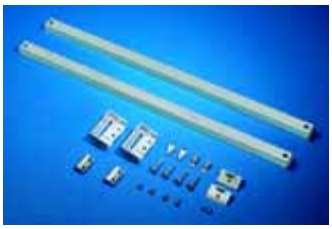
1 Divider kit for swing frame, small.

2 PS punched section without mounting flange 23 x 73 mm according to the enclosure depth in conjunction with 4 support brackets TS 8800.330 (2 included with the supply of the divider kit).

Note:
Height compensation between the 25 mm pitch pattern of holes in the enclosure and the height units of the swing frame is achieved by the support brackets TS (two are included with the supply of the divider kit).

Side installation
With an enclosure depth of 600 or 800 mm, side installation of a small swing frame is identical to installation parallel to the front.
For access to the swing frame we recommend the hinges for the TS side panel,
see page 854.





Divider kit

for swing frame, small, or hinge attachment for partial mounting plate in TS 8.

Material:
Cross member: Sheet steel, passivated
Support bracket TS: Die-cast zinc

Supply includes:
2 cross members,
including assembly parts.

Enclosure width mm	Model No. SR
600	**2377.860**
800	**2377.880**

Accessories:

Depending on the installation position
(see above):
Support brackets TS 8800.330,
see page 933,
and PS punched sections without mounting flanges to match the enclosure depth,
see page 925.

Divider kit

for swing frame, small in ES, AP universal console

Enclosure width mm	Packs of	Model No. SR
600	1 sets	**2377.460**

Accessories:

Depending on the installation position:
Support brackets PS 4183.000,
see page 933,
and PS punched sections without mounting flanges to match the enclosure depth,
see page 925.

Swing frame, large

without trim panel
for TS, ES, AK, AP universal console
For mounting 482.6 mm (19″) equipment.
The installation accessories required for other installation variants are described separately (see page 996).

Technical specifications:
Torsionally stiff frame, welded from rectangular tube and triple folded support section.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
2 cams with double-bit lock insert and parts for attaching to the divider kit.

Note:
If the enclosure height is not fully utilised by the swing frame, additional mounting accessories – see page 996 – will be required.

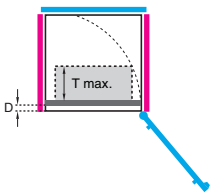
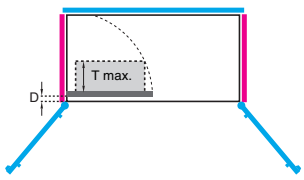
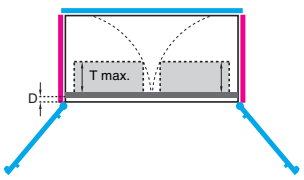
Also required:

Divider kit for swing frame, large,
see page 996.

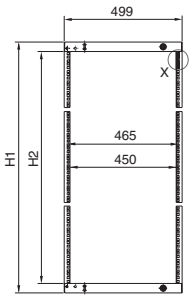
Accessories:

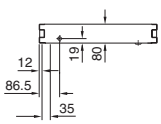
Depending on the installation position:
TS punched section with mounting flange, 23 x 73 mm,
see page 922.
TS punched rail 18 x 38 mm,
see page 923.
Punched sections with mounting flanges,
see page 926.
Width divider,
see page 850.
Lock inserts, type D,
see page 888.

Height units	22 U	31 U	36 U	40 U	45 U
Model No. SR	**2322.700**	**2331.700**	**2336.700**	**2340.700**	**2345.700**
for enclosure height mm (or higher)	1200	1600	1800	2000	2200
H1 mm	1061.5	1461.5	1684.5	1861.5	2084.0
H2 mm	981.5	1381.5	1604.0	1781.5	2004.0

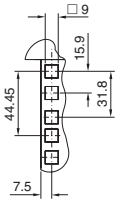
Installation depth T max. = mm with dimension D[1] of at least 49 mm			
Enclosure width mm	600	1200	1200
			
Installation	central	left or right	left and right
Enclosure depth mm	T max.	T max.	T max.
400	185	295	295
500	185	395	365
600	185	495	365
800	185	695	365

[1] D = Distance from the inner edge of the door to the front edge of the swing frame may be installed deeper on a 25 mm pitch pattern.





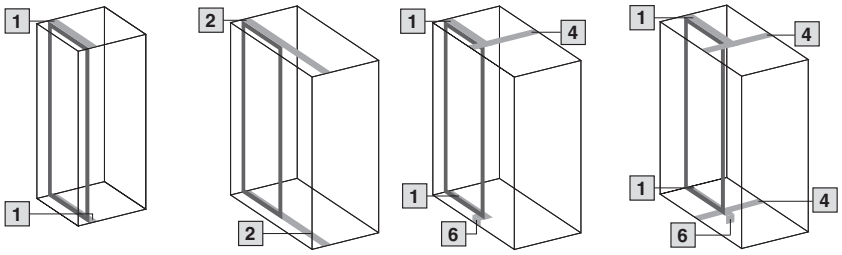
Cutout “X”



Swing frame

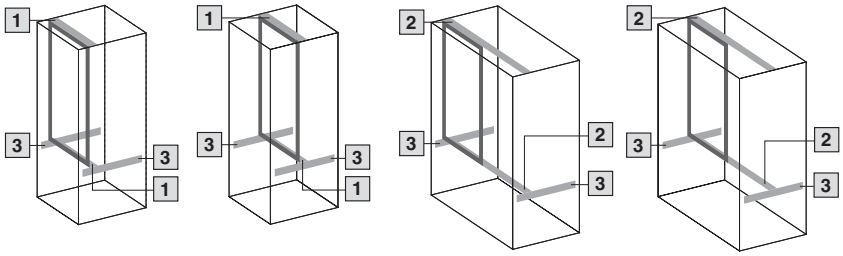
13 examples for TS

Full installation



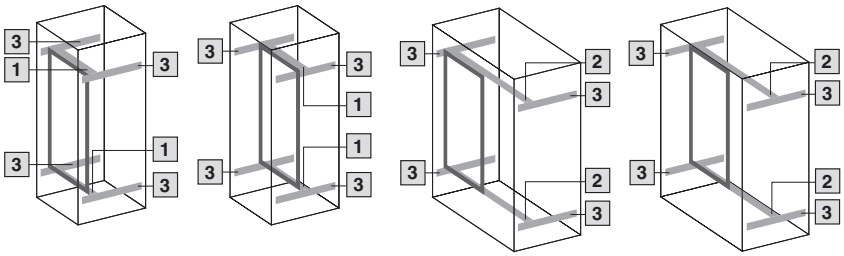
600 mm front | 1200 mm front | 1200 mm front with width divider | 1200 mm set back with width divider

Partial installation, top



600 mm front | 600 mm set back | 1200 mm front | 1200 mm set back

Partial installation, centre



600 mm front | 600 mm set back | 1200 mm front | 1200 mm set back

Also required:

Depending on the installation position:

1 Installation kit for 600 mm wide enclosures

2 Installation kit for 1200 mm wide enclosures

3 TS punched section with mounting flange 23 x 73 mm for the inner mounting level in the respective enclosure depth, for installation in ES = PS punched sections with mounting flanges

4 PS punched section without mounting flange in the respective enclosure depth in conjunction with support bracket PS

5 TS punched rail 18 x 38 mm in the corresponding enclosure depth[1)]

6 Width divider (left-hand or right-hand angle)[1)]

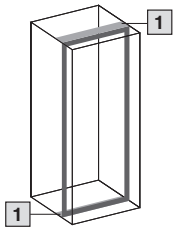
[1)] Not possible with ES, AK.

Notes:

- Height compensation between the 25 mm pitch pattern of holes in the enclosure and the height units of the swing frame is achieved by the upper divider kit.
- Partial installation at the bottom matches partial installation at the top.
- Only full installation at the front possible with AK.

Side installation

With an enclosure depth of 600 mm, side installation of a large swing frame is identical to installation parallel to the front.
For access to the swing frame we recommend the hinges for the TS side panel,
see page 854.



German patent
No. 38 13 004
Swedish patent
No. 505 069
Dutch patent
No. 193 708
(Patents do not apply to SR 1985.235/SR 1986.235)

Divider kits

for swing frame, large

With for 800 mm wide enclosures, the swing frame may also be installed in the centre or offset to the side.

Material:
Sheet steel

Colour:
RAL 7035

Supply includes:
Parts for attaching to the enclosure.

Accessories:

Swing frame stay,
see page 999.

Divider kits for swing frame, large without trim panel

For enclosure width mm	For enclosures			With 130° hinge			With 180° hinge		
				Mounting plate slide rail[1)]			Mounting plate slide rail[1)]		
				without < 800 N	with < 1500 N	without < 1500 N	without < 800 N	with < 1200 N	without < 1200 N
	TS	ES, AP Universal console	AK	**Model No. SR**	**Model No. SR**	**Model No. SR**	**Model No. SR**	**Model No. SR**	**Model No. SR**
600	■			**1994.835**	**1994.835**	**1994.635**	–	–	–
		■		**1994.835**	**1994.835**	–	–	–	–
			■	**1985.235**	–	–	–	–	–
800	■			**1995.235**	**1995.235**	**1995.835**	**1997.235**	**1997.235**	**1997.835**
		■		**1995.235**	**1995.235**	–	**1997.235**	**1997.235**	–
			■	**1986.235**	–	–	–	–	–
1200	■			–	–	**1996.535**	–	–	–
		■		**1996.835**	**1996.835**	–	–	–	–

[1)] For: TS screw-fastened, removable/ES welded/AK not possible.

Swing frame, large

with trim panel
for TS, ES, AK

For mounting 482.6 mm (19″) equipment.
The installation accessories required for other installation variants are described separately (see page 994).

Technical specifications:
Torsionally stiff frame, welded from rectangular tube and six-folded support section. The side trim panels are screw-fastened to the frame. The right-hand trim panel has a handle strip at the side and is equipped with a locking rod system.

Material:
Sheet steel

Surface finish:
Frame, zinc-plated, passivated
Trim panels spray-finished

Colour:
RAL 7035

Supply includes:
Locking rod system with double-bit lock insert and parts for attaching to the divider kit.

Note:
If the enclosure height is not fully utilised by the swing frame, additional mounting accessories – see page 998 – will be required.
For two-door enclosures with height 1800 and 2200 mm the next-smallest swing frame must be installed, due to collision with the lock.

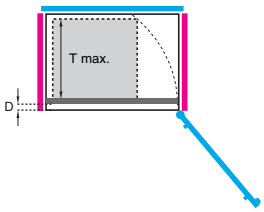
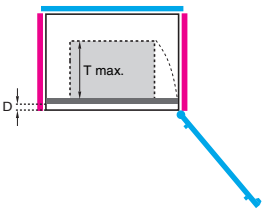
Also required:

Divider kit for swing frame, large,
see page 998.

Accessories:

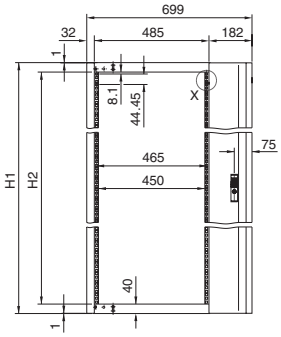
TS punched section with mounting flange, 23 x 73 mm,
see page 922.
Punched sections with mounting flanges,
see page 926.
Lock inserts, version A,
see page 888.
Ergoform S lock system,
see page 885.

Height units	22 U		31 U		36 U		40 U		45 U	
Trim panel	side	central	side	central	side	central	side	central	side	central
Model No. SR RAL 7035	**2323.235**	**2324.235**	**2332.235**	**2333.235**	**2337.235**	**2338.235**	**2341.235**	**2342.235**	**2346.235**	**2347.235**
for enclosure height mm (or higher)	1200		1600		1800		2000		2200	
H1 mm	1061.5		1461.5		1684.5		1861.5		2084.0	
H2 mm	981.5		1381.5		1604.0		1781.5		2004.0	

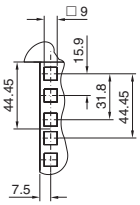
Installation depth T max. = mm with dimension D[1] of at least 49 mm with 130° hinge, 95 mm with 180° hinge			
Enclosure width mm	800		
			
Installation	side		central
Hinge	130°	180°	180°
Enclosure depth mm	T max.	T max.	T max.
400	295	252	252
500	395	352	345
600	470	428	345
800	470	428	345

[1] D = Distance from the inner edge of the door to the front edge of the swing frame may be installed deeper on a 25 mm pitch pattern.

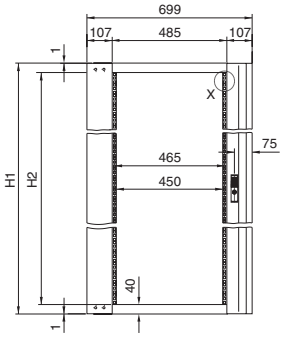
Installation components side



Cutout "X"



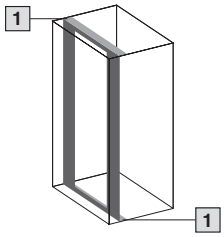
Installation components centre



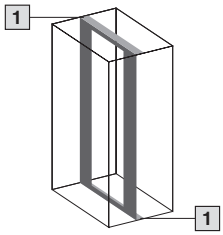
Swing frame

7 examples for TS

Full installation

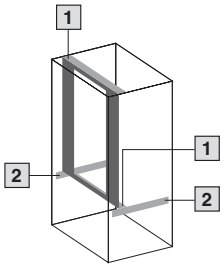


800 mm
front

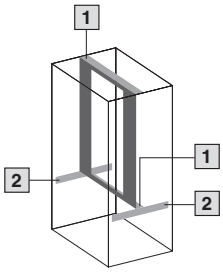


800 mm
set back

Partial installation, top

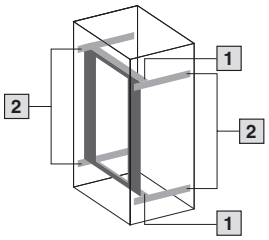


800 mm
front

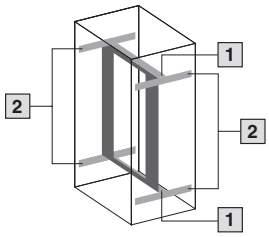


800 mm
set back

Partial installation, centre



800 mm
front



800 mm
set back

Also required:

Depending on the installation position:

1 Divider kit for 800 mm wide enclosures

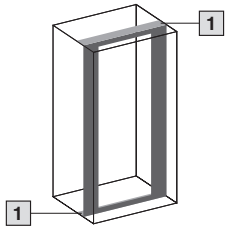
2 TS punched section with mounting flange 23 x 73 mm for the inner mounting level corresponding to the enclosure depth, for installation in ES = PS punched sections with mounting flanges

Notes:

- Height compensation between the 25 mm pitch pattern of holes in the enclosure and the height units of the swing frame is achieved by the upper divider kit.
- Partial installation at the bottom matches partial installation at the top.
- Only full installation at the front is possible with AK.

Side installation

With an enclosure depth of 800 mm, side installation of a large swing frame is identical to installation parallel to the front.
For access to the swing frame we recommend the hinges for the TS side panel,
see page 854.



German patent no. 38 13 004
Swedish patent no. 505 069
Dutch patent no. 193 708
(Patents do not apply to
SR 1986.235/SR 19878.235)

Divider kits

for swing frame, large

Material:
Sheet steel

Colour:
RAL 7035

Supply includes:
Parts for attaching to the enclosure.

Accessories:

Swing frame stay,
see page 999.

Divider kits for swing frame, large with trim panel

For enclosure width mm	For enclosures			With 130° hinge			With 180° hinge		
				Mounting plate slide rail[1]			Mounting plate slide rail[1]		
				without < 800 N	with < 1500 N	without < 1500 N	without < 800 N	with < 1200 N	without < 1200 N
	TS	ES, AP Universal console	AK	**Model No. SR**	**Model No. SR**	**Model No. SR**	**Model No. SR**	**Model No. SR**	**Model No. SR**
800	■			**1995.235**	**1995.235**	**1995.835**	**1997.235**	**1997.235**	**1997.835**
		■		**1995.235**	**1995.235**	–	**1997.235**	**1997.235**	–
			■	**1986.235**	–	–	**1986.235 + 1978.200**	–	–

[1] For: TS screw-fastened, removable/ES welded/AK not possible.

Swing frame, 482.6 mm (19″)

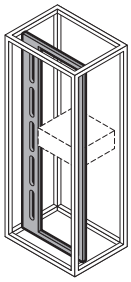
Heavy-duty version
for 800 mm wide enclosures, based on TS 8
The swing frame facilitates the accommodation of a wide range of 482.6 mm (19″) components up to a weight load of 350 kg. By swinging it out, access may be gained to the rear of the equipment and its cabling at any time.
At the side, the swing frame has a trim panel with integral handle strip and two-point locking bar. A semi-cylinder lock can be achieved by using the Ergoform-S handle system.
Several openings in the trim panel permit convenient cable routing from the rear of the swing frame in the front section. The openings may also be optionally top-mounted with standard commercially available plastic cable ducts.
An additional vertical row of holes integrated into the trim panel facilitates vertical and horizontal cable routing via cable shunting rings.
Installation is only possible in the form of full enclosure installation. The installation position may be varied in the enclosure depth.

U	For enclosure height mm	Model No. DK
40	2000	**7858.100**

Load capacity:
350 kg

Material:
Swing frame: Sheet steel, zinc-plated, passivated
Trim panel and divider kit: Sheet steel, spray-finished, RAL 7035

Supply includes:
Locking rod with double-bit lock insert, heavy-duty divider kit and assembly parts.



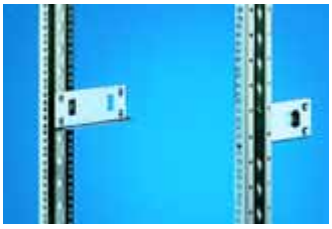
Swing frame stay

Holds the swing frame in the open position.

For mounting on:
Swing frame, large
- SR 1979.200, at the top of the enclosure
- SR 1980.200, at the bottom of the enclosure (with safety catch at 160°)

For mounting on:
Swing frame, small
- SR 1979.200, may be mounted at the top or bottom of the divider kit.

	Packs of	Model No. SR
With 130° hinge	5	**1979.200**
With 180° hinge	1	**1980.200**



Slide rails

To support heavy slide-in electronic equipment, 482.6 mm (19″) in the swing frame.

Material:
Sheet steel, zinc-plated, passivated

For equipment with a max. installation depth	Packs of	Model No. SR
T max. < 190 mm	10	**1962.200**
T max. > 190 mm	10	**1963.200**

Swing frame

Pull-out frame, 482.6 mm (19″)

For the installation of a pull-out 482.6 mm (19″) front. For 600 and 800 mm wide TS enclosures, from a depth of 800 mm.

Overall depth: 525 mm
Extension piece: 500 mm
Distance: 300 mm

Load capacity: 50 kg

Colour:
RAL 7035

Supply includes:
Telescopic slides and assembly parts.

German patent no. 39 07 471

For U	Height mm	Model No. DK
12	637	**7124.035**
18	903	**7125.035**
21	1037	**7126.035**

Also required:

Divider kit according to the enclosure width.
As divider kit for enclosure width 600 mm:
TS punched section with mounting flange, 17 x 73 mm,
see page 1000.
As divider kit for enclosure width 800 mm:
Depth stays,
see page 1000.

TS punched section with mounting flange as divider kit

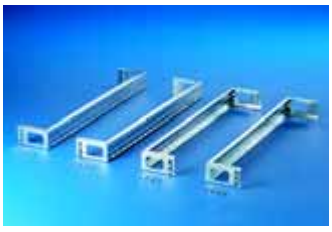
for pull-out frame

Installation in enclosure width 600 mm.
The divider kit comprises 4 TS punched sections with mounting flanges 17 x 73 mm.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

For enclosures		Packs of	Model No. TS
Width mm	Depth mm		
600	800	4	**8612.080**
600	900	4	**8612.090**
600	1000	4	**8612.000**



Depth stays as divider kit

for pull-out frame

Installation in enclosure width 800 mm.
The divider kit consists of 4 depth stays.

Material:
Sheet steel, zinc-plated, passivated

For enclosures		Packs of	Model No. TS
Width mm	Depth mm		
800	800	4	**7827.800**
800	900	4	**7827.900**
800	1000	4	**7827.000**

Vario swing frames

for ES, width 800 mm
For the installation of 482.6 mm (19″) equipment.

Technical specifications:
Torsionally stiff frame, welded from rectangular tube and triple-folded support section. Firmly linked extension panels on the left and right.

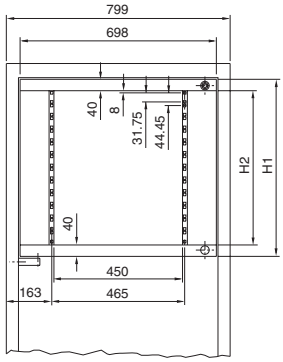
Material:
Sheet steel

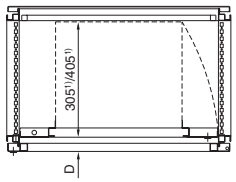
Colour:
RAL 7035

Supply includes:
Double-bit lock insert and assembly parts.

Accessories:

Lock insert 47 mm, type D,
see page 888.





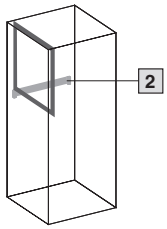
¹) at D 41.5 mm

For 800 mm wide enclosures

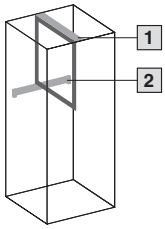
Height units		6 U	9 U	12 U	15 U	18 U
Model No. SR		**2004.235**	**2007.235**	**2008.235**	**2010.235**	**2011.235**
H1 mm		350	483	616,5	750	883
H2 mm		270	403	536,5	670	803
Max. installation depth for enclosure depth	400 mm	305 mm				
	500 mm	405 mm				
Dimension D mm		41.5 – 59.5 – 77.5 – 116.5 – 134.5 – 141.5 – 159.5				

Installation examples

Mounting accessories according to the installation position (swing frame in topmost position)



Front



Set back

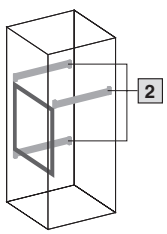
Also required:

Depending on the installation position:

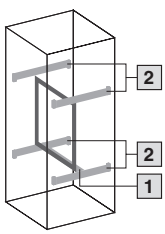
1 PS punched section with mounting flange for enclosure width 800 mm,
see page 926.

2 PS punched section with mounting flange to match the enclosure depth,
see page 926.

Mounting accessories according to the installation position (swing frame offset downwards)



Front



Set back

Compact swing frame

for AE, AP
For the installation of electronic equipment, 482.6 mm (19″) across the entire height.

Technical specifications:
Torsionally stiff frame, welded from rectangular tube and triple-folded support section.

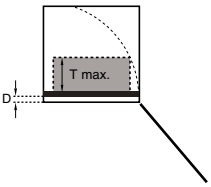
Material:
Sheet steel

Colour:
RAL 7035

Supply includes:
Double-bit lock insert and assembly parts.

Accessories:

41 mm lock insert, type C,
see page 888.



For AE

For compact enclosure AE			Height units	6 U	11 U	14 U
Enclosure		Max. installation depth (T max.) mm	**Model No. SR**	**2026.200**	**2027.200**	**2034.200**
Width mm	Depth mm		For enclosure height mm	380	600	760
			H1 (mm)	320	542	676
			H2 (mm)	270	492	626
600	210	145	Spray-finished	1039.500	1060.500	1076.500
			Stainless steel	1009.500	1010.500	1012.500
600	350	265	Spray-finished	1339.500	1360.500	1376.500
760	210	145	Spray-finished	–	–	1077.500
760	300	235	Spray-finished	–	–	1073.500
			Stainless steel	–	–	1014.500

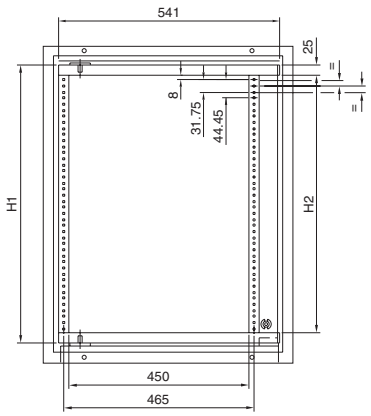
For AP

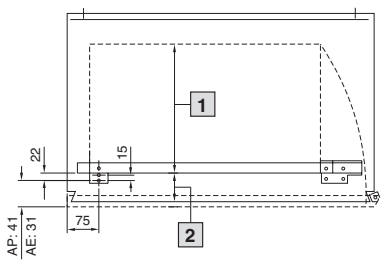
Height units	11 U
Model No. SR	**2027.200**
H1 mm	542
H2 mm	492

For pedestals AP	Max. installation depth (T max.) mm
2600.500 2610.500 2620.500 2640.500 2630.500 2650.500	315 (at D min. 38 mm)

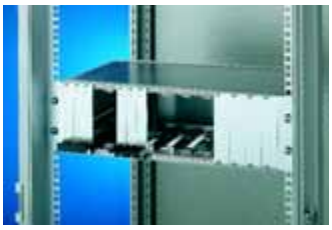
For one-piece consoles AP	Max. installation depth (T max.) mm
2668.500	315
2672.500	315
2684.500	295[1)]
2686.500	295[1)]

[1)] When fitting 2 swing frames





1 T = max. installation depth (see table)
2 D min. = 38 (53, 68, 83)



Mounting angles, 482.6 mm (19″)

For the installation of subracks and other equipment.
Mounting angles are easily shortened for partial assemblies.

Surface finish:
Conductive, corrosion-protected coating.

Supply includes:
Assembly parts.

Note:
Assembly example,
see page 1003.

Accessories:

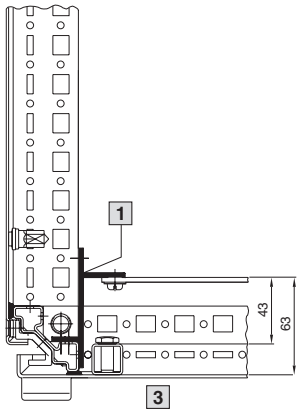
Infill panels,
see page 1014.
Captive nuts,
see page 1020.
Assembly screws,
see page 1019.
Slide rails with one-sided mounting,
see page 1010,
Slide rails with two-sided mounting,
see page 1010.

For enclosure height mm	Packs of	For enclosure system TS[1]		For enclosure system ES			
		U	Aluminium Extruded section	U	Aluminium Extruded section	Sheet steel, spray-finished RAL 7035	Sheet steel, zinc-plated, passivated
			Model No. TS		**Model No. PS**		
1600	4	33	**8613.060**	33	**4389.000**	–	–
1800	4	38	**8613.080**	37	–	–	–
2000	4	42	**8613.000**	42	**4391.000**	**4358.200**	–
2200	4	47	**8613.020**	46	–	–	**4358.700**
For PC enclosure[2]	4	17	**8613.070**	17	**4632.000**	–	–

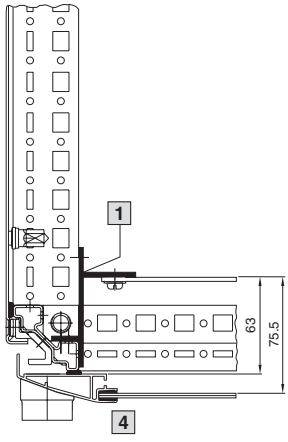
[1] For the rear of electronic enclosures, see page 1004.
[2] behind bottom door.

Assembly examples of TS:

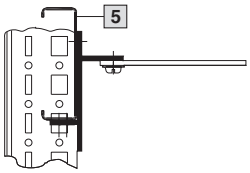
Drawing 1



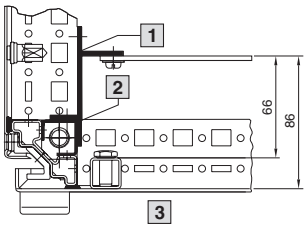
Drawing 2



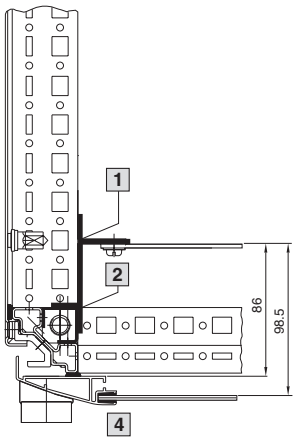
Drawing 3



Drawing 4



Drawing 5



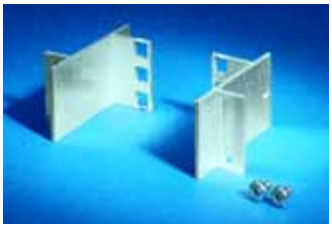
Drawing 1 and 2:
Mounting angle or adaptor piece fitted in the foremost installation position, directly on the vertical section.
When installing slide rails with two-sided mounting (see page 1010), the same mounting angles or adaptor pieces must also be mounted on the vertical section at the rear.

Drawing 3:
Mounting on two vertically installed PS punched sections permits fully flexible use of the enclosure depths,

Drawing 4 and 5:
Greater distance from the door is achieved by mounting on adaptor rails for PS compatibility.
In this position, the slide rails can be fitted with one-sided mounting.

1 Mounting angles/piece
2 Adaptor rail
3 TS sheet steel door
4 TS glazed door
5 Punched section without mounting flange

Mounting angles



Adaptor pieces, 482.6 mm (19″)

The “1 U” sub-section of mounting angles.
For the installation of individual subracks and other equipment.

Supply includes:
Assembly parts.

For	U	Packs of	Model No. TS	Model No. PS
TS	1	4	**8613.010**	**–**
ES	1	8	**–**	**4547.000**

Note:
Assembly example,
see page 1003.

Accessories:

Captive nuts,
see page 1020.
Assembly screws,
see page 1019.
Slide rails with one-sided mounting,
see page 1010.

Mounting angles, 482.6 mm (19″)

for rear installation in TS electronic enclosures
For installing subracks at the front and back, and for attaching the slide rails TS 8613.150, TS 8613.160 and TS 8613.180 (see page 1010).
Assembly is carried out on the inner mounting level.
The outer mounting level can, e.g. still be used for cable routing on depth-mounted TS punched sections with mounting flange.

Material:
Extruded aluminium section

Surface finish:
Conductive, corrosion-protected coating.

Supply includes:
Assembly parts.

For enclosure height mm	U	Packs of	Model No. TS
1600	33	2	**8613.360**
2000	42	2	**8613.300**

Note:
Design similar to mounting angles, 482.6 mm (19″) (see page 1003), but asymmetrical height, suitable for TS electronic enclosure.

Possible alternative:

Adaptor pieces, 482.6 mm (19″),
see above.

Mounting angles, 482.6 mm (19″)

for TS, CS Toptec

In two versions:

Cranked
The integral U markings in the front facilitate systematic assembly within the 482.6 mm (19″) attachment level.

L-shaped
The L-shaped mounting angles accommodate the installation kits of server systems. The integral U markings in the front facilitate systematic assembly within the 482.6 mm (19″) attachment level.

Technical specifications:
2 mm sheet steel, with integral 482.6 mm (19″) punchings and side round and square holes. Zinc-plated, passivated for conductive connection of the 482.6 mm (19″) installed equipment.

Supply includes:
Assembly parts.

Explanation of the fastening measurements for interior installations, see page 1020.

Full installation Rack height mm	U	Packs of	Model No. DK	
			Cranked	**L-shaped**
600	11	2	**–**	**7827.061**
800	15	2	**7827.080**	**7827.081**
1000	20	2	**7827.100**	**7827.101**
1200	24	2	**7827.120**	**7827.121**
1400	29	2	**7827.140**	**7827.141**
1600	33	2	**7827.160**	**7827.161**
1800	38	2	**7827.180**	**7827.181**
2000	42	2	**7827.200**	**7827.201**
2200	47	2	**7827.220**	**7827.221**

Note:
The mounting angles can also be used to accommodate 21″, 23″ and 24″ attachment dimensions.

Also required:

Punched sections without mounting flanges or depth stays for TS as installation kit for mounting angles,
see page 1008 – 1009.
For L-shaped mounting angle variant:
for mounting slide rails or component shelves:
adaptor DK 7827.300,
see page 950.

Mounting angles, 482.6 mm (19″)

for TS server enclosures
For front and rear mounting of 482.6 mm (19″) components.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Explanation of the fastening measurements for interior installations, see page 1020.

U	Packs of	Model No. DK
10	2	**7831.630**[1)]
21	2	**7831.635**[1)]
42	2	**7831.642**
47	2	**7831.647**

[1)] Delivery times available on request.

Mounting angles, 482.6 mm (19″)

for FR(i), width 600 mm
For the installation of 482.6 mm (19″) components in the foremost mounting position.
The mounting angle may be rotated through 180°, so as to create additional free space for cable routing in the front section. Side openings allow the hollow section of the enclosure frame to continue being used for cable routing.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Explanation of the fastening measurements for interior installations, see page 1020.

Enclosure height mm	Usable U with full installation	Packs of	Model No. FR(i)
600	11	2	**7856.800**
1200	24	2	**7856.803**
1800	38	2	**7856.806**
2000	42	2	**7856.809**
2200	47	2	**7856.812**

Mounting angles

for QuickBox
For installing 482.6 mm (19″)/metric 485 mm or 535 mm equipment.

Material:
Sheet steel

Colour:
RAL 7035

Supply includes:
Assembly parts.

Explanation of the fastening measurements for interior installations, see page 1020.

For Enclosure		Packs of	Model No. QB	
U	SU	2	482.6 mm (19″)	Metric
6	10	2	**7502.201**	**7502.211**
9	15	2	**7502.202**	**7502.212**
12	20	2	**7502.203**	**7502.213**
15	26	2	**7502.204**	**7502.214**
18	31	2	**7502.205**	**7502.215**
21	36	2	**7502.206**	**7502.216**

Mounting angle kit

for DK-EL
This mounting angle kit allows you to integrate a second 482.6 mm (19″) level into EL enclosures.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Explanation of the fastening measurements for interior installations, see page 1020.

U	Packs of	Model No. DK
6	2	**7705.706**
9	2	**7705.709**
12	2	**7705.712**
15	2	**7705.715**
18	2	**7705.718**
21	2	**7705.721**

Mounting angles

T-slot mounting angles, 482.6 mm (19″)/metric

for TS, FR(i)
With integral T-slot for U nuts. Holes on a U pitch pattern are integrated into the rear section of the T-slot. Round and square holes on a 25 mm DIN 43 660 pitch pattern of holes are provided for side attachment. The mounting angle may optionally be integrated using PS metric or 482.6 mm (19″) installation brackets. The surface finish is chromated for conductive connection to the metric/482.6 mm (19″) mounting components.

Material:
Extruded aluminium section, chromated

Supply includes:
Assembly parts.

Explanation of the fastening measurements for interior installations, see page 1020.

Full installation Rack height mm	U	SU	Packs of	Model No. DK
800	15	26	2	**7000.150**
1000	20	35	2	**7000.200**
1200	24	42	2	**7000.240**
1400	29	51	2	**7000.290**
1600	33	58	2	**7000.330**
1800	38	67	2	**7000.380**
2000	42	74	2	**7000.420**
2200	47	83	2	**7000.470**

Note:
In 600 mm wide enclosures, mounting angles may be alternatively depth-mounted on TS punched sections with mounting flanges.

Also required:

Punched secion with mounting flange as installation kit for mounting angles, see page 1008,
or
depth stay for PS, see page 1006.

Mounting angles, 482.6 mm (19″)

for CS modular and basic enclosures
For mounting 482.6 mm (19″) components in Outdoor enclosures. The mounting angles are depth-adjustable on a 25 mm pitch pattern. An installation bracket is required to attach the mounting angles.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Explanation of the fastening measurements for interior installations, see page 1020.

Enclosure height mm	U	Packs of	Model No. DK
800	15	2	**7685.000**
1200	24	2	**7688.000**
1400	29	2	**7689.000**
1600	33	2	**7690.000**

Also required:

Depth stay for PS, see page 1006.

Depth stay for PS

For
- T-slot mounting angles
- Mounting angles for CS modular and basic enclosures.

Material:
Sheet steel, zinc-plated, passivated

Enclosure width mm		600/1200[1]	800		
Standards		482.6 mm (19″)	482.6 mm (19″)/metric (465 mm)		metric (515 mm)
Installation position		central	central	side	central
Model No. DK	2	**7696.000**	**7698.000**	**7697.000**	**7000.100**

[1] 1200 mm wide CS modular and basic enclosures are divided in two fields of 600 mm.

Mounting angles, 482.6 mm (19″)

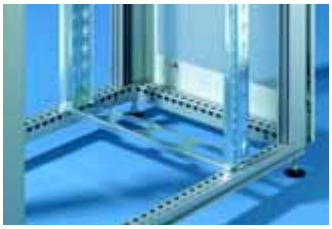
for CS modular and basic enclosures
For mounting 482.6 mm (19″) components. Mounting position on the front frame section, not depth adjustable. Easily retro-fitted.

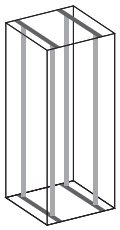
Material:
Sheet steel

Supply includes:
Assembly parts.

Explanation of the fastening measurements for interior installations, see page 1020.

For enclosure dimensions		U	Packs of	Model No. CS	
Width mm	Height mm			spray-finished in RAL 7035	zinc-plated, passivated
600	800	15	4	**9785.001**	**9785.002**
600	1200	24	4	**9785.003**	**9785.004**
600	1400	29	4	**9785.005**	**9785.006**





Mounting frame, 482.6 mm (19″)

for TS, FR(i)
The welded 482.6 mm (19″) mounting frame may be attached with complete depth variability and is used to structure the front and rear 482.6 mm (19″) level.
The mounting frame has the same system punchings as the TS 8 enclosure section at the sides and rear, and therefore supports the mounting of various TS 8 system accessories such as cable clamp rails, cable shunting rings etc.

Load capacity:
Up to 1,000 kg static load, with even load distribution on two 482.6 mm (19″) mounting frames, with full installation.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Note:
A combination of 482.6 mm (19″) mounting frame plus fan mounting plate is not possible. For active ventilation, we recommend use with modular fan roof.

Explanation of the fastening measurements in interior installations, see page 1020.

For enclosures		U	Model No. FR(i)
Width mm	Height mm		
600	600	11	**7856.710**
600	1200	24	**7856.713**
600	1800	38	**7856.716**
600	2000	42	**7856.719**
600	2200	47	**7856.722**
800	1200	24	**7856.725**
800	1800	38	**7856.728**
800	2000	42	**7856.731**
800	2200	47	**7856.734**

Accessories:

Captive nuts,
see page 1020.
Assembly screws,
see page 1019.
Cable clamp rails TS,
see page 983.
C rails,
see page 928.
Slide rails, depth-variable,
see page 1010.
Component shelves,
see page 939 and page 944.
Fan roof, modular,
see page 651.

Mounting angles, metric

for TS
The L-shaped mounting angles accommodate metric assemblies and components. Depending on the installation kit, mounting dimensions 465 mm and 515 mm can be configured.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Explanation of the fastening measurements for interior installations, see page 1020.

Full installation Rack height mm	SU	Packs of	Model No. DK
–	17	2	**7831.611**
1000	37	2	**7831.621**
1200	42	2	**7794.420**
1600	58	2	**7794.740**
2000	76	2	**7831.631**
2200	84	2	**7831.641**

Also required:

Punched sections with mounting flange or depth stays for TS as installation kit for mounting angles,
see page 1008 – 1009.

Mounting kits for mounting angles

Mounting angles centre fastening attachment

for 800 mm wide TS network enclosures

The centre fastening attachment counteracts bending of the mounting angles mounted on installation brackets in case of unevenly distributed loads. It is attached directly to 482.6 mm (19″) mounting angles and to the punched section with mounting flange fitted in the depth (inner mounting level).

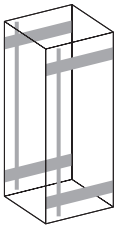
Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Packs of	Model No. DK
2	**7284.135**

Also required:

TS punched section with mounting flange, see page 921 – 922.



TS punched section with mounting flange as installation kit

for

- **Mounting angles, 482.6 mm (19″)**
- **Mounting angles, metric, Mounting dimension 465 mm**

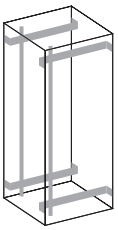
Installation in enclosure width 600 mm

The installation kit consists of 4 TS punched sections with mounting flange 17 x 73 to accommodate mounting angles. One pack is sufficient for installing one or two 482.6 mm (19″) attachment levels. For exceptionally heavy installed equipment, we recommend the installation of additional punched sections.

For enclosures		Packs of	Model No. TS
Width mm	Depth mm		
600	600	4	**8612.060**
600	800	4	**8612.080**
600	900	4	**8612.090**
600	1000	4	**8612.000**

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.



Depth stays as installation kit

for

- **Mounting angles, 482.6 mm (19″)**

Installation in enclosure width 650 mm
Installation in enclosure width 800 mm

One installation kit consists of 4 depths stays to accommodated mounting angles. One pack is sufficient for installing one or two 482.6 mm (19″) attachment levels. For exceptionally heavy installed equipment, we recommend the installation of an additional depth stay in the centre. The front cutout makes cable routing easier with full configuration (cutout only at a width of 800 mm).

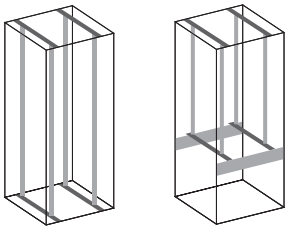
Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

For enclosures		Packs of	Model No. DK
Width mm	Depth mm		
650	650	4	**7794.165**
800	600	4	**7827.600**
800	650	4	**7794.280**
800	800	4	**7827.800**
800	900	4	**7827.900**
800	1000	4	**7827.000**

Possible alternative:

Installation brackets TS for mounting angles, see page 1009.



Depth stay for TS

for

- **Mounting angles, 482.6 mm (19″)**

Installation in enclosure width 800 mm

Installation brackets are screw-fastened to the enclosure frame in the enclosure width. The mounting angle is attached to the bracket at the top and bottom. The bracket ensures optimum clearance at the sides for cable routing. For partial enclosure configuration, the installation brackets may be attached to the TS punched sections with mounting flanges 17 x 73 mm on the outer attachment level of the enclosure frame. Fully depth-variable attachment is facilitated by the attachment slots. Either cranked or L-shaped mounting angles may be used.

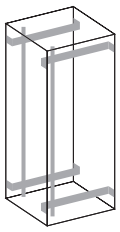
Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Packs of	Model No. DK
2	**7827.480**

Accessories:

For partial installation,
TS punched section with mounting flange,
17 x 73 mm,
see page 921 – 922.



Depth stays as installation kit

for

- **Mounting angles, metric, Mounting dimension 515 mm**
- **Mounting angles, 482.6 mm (19″), Mounting dimension 21″**

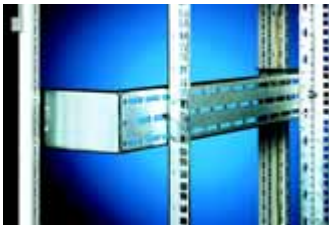
Installation in enclosure width 650 mm
Installation in enclosure width 800 mm

One installation kit consists of 4 depths stays to accommodated mounting angles. One pack is sufficient for installing one or two 482.6 mm (19″) attachment levels. For exceptionally heavy installed equipment, we recommend the installation of an additional depth stay at the centre. The front cutout makes cable routing easier with full configuration (cutout only at a width of 800 mm).

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

For enclosures		Packs of	Model No. DK
Width mm	Depth mm		
650	650	4	**7794.300**
800	650	4	**7794.320**
800	800	4	**7794.330**



Depth stays as installation kit

for

- **Mounting angles, 482.6 mm (19″), Mounting dimensions 23″ and 24″**

Installation in enclosure width 800 mm

When using depth stays in 800 mm wide enclosures, attachment spacings of 23″ and 24″ are achieved. Either cranked or L-shaped, 482.6 mm (19″) mounting angles may be used.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

For enclosures		Model No. DK	
Width mm	Depth mm	Design	
		23″	24″
800	800	**7827.823**	**7827.824**
800	900	**7827.923**	**7827.924**
800	1000	**7827.023**	**7827.024**

Slide rails

Slide rails

With one-sided mounting on the 482.6 mm (19″) mounting angles.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Length mm	Packs of	Model No. PS
185	10	**4530.000**
270	10	**4531.000**

Also required:

Mounting angles, 482.6 mm (19″),
see page 1003.

Slide rails

With two-sided mounting between the 482.6 mm (19″) front and rear mounting angles or 482.6 mm (19″) adaptor pieces.

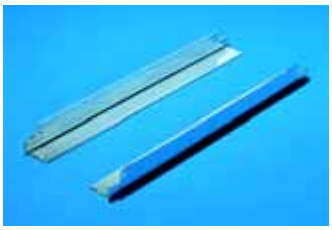
Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

For enclosure depth mm	Packs of	Model No. TS	Model No. PS
500	10	**8613.150**	–
600	10	**8613.160**	**4546.000**
800	10	**8613.180**	**4549.000**

Also required:

Mounting angles, 482.6 mm (19″),
see page 1003.
Adaptor pieces, 482.6 mm (19″),
see page 1004.



Slide rails, heavy-duty

for TS network enclosures
with two mounting levels
To support extremely heavy installed equipment. The slide rails are simply located into the cranked mounting angles and secured with screws. We recommend combined use with additional depth stays or, in case of 800 mm wide enclosures, the mounting angle centre attachment.

Load capacity:
80 kg, static load

Material:
Sheet steel, zinc-plated, passivated

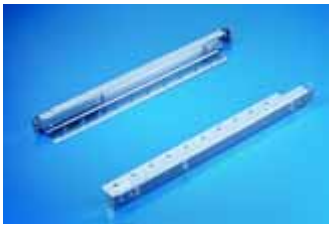
Supply includes:
Assembly parts.

Distance between 19″ levels mm	Contact surface		Packs of	Model No. DK
	Width mm	Depth mm		
298	40	261	2	**7492.300**
398	40	361	2	**7492.400**
498	40	461	2	**7492.500**

Note:
Not suitable for use in 482.6 mm (19″) mounting frames.

Also required:

For fastening to L-shaped TS mounting angles:
Adaptor DK 7827.300,
see page 950.



Depth-variable slide rails 1 U

for TS, FR(i), TE
with L-shaped mounting angles or 482.6 mm (19″) mounting frame
The slide rail facilitates integration of 482.6 mm (19″) components without loss of installation height.
Installation of the slide rail is independent from the chosen distance between levels, since the installation length may be flexibly adapted.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Length mm	Load capacity	Contact surface		Packs of	Model No. DK
		Width mm	Depth mm		
390 – 600	80 kg	50	330	2	**7063.878**
590 – 930	80 kg	50	525	2	**7063.880**
590 – 930	150 kg	50	525	2	**7063.884**

Slide rails, vented

for TS network enclosures with two 482.6 mm (19″) levels

To support heavy 482.6 mm (19″) network components. The slide rails are simply located into the cranked mounting angles and secured with screws. Thanks to the option of side ventilation, hot spots with active equipment are avoided with the side climate control concept.

Load capacity:
50 kg, static load

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Distance between 19″ levels mm	Contact surface		Packs of	Model No. DK
	Width mm	Depth mm		
–	50	152[1)]	2	**7063.000**
298	50	261	2	**7063.300**
398	50	361	2	**7063.400**
498	50	461	2	**7063.500**
598	50	561	2	**7063.600**
698	50	661	2	**7063.700**

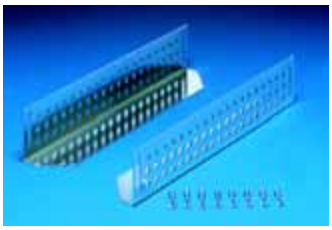
[1)] Only fasten to the front or rear mounting angles.

Also required:

For fastening to L-shaped TS mounting angles: Adaptor DK 7827.300,
see page 950.

Possible alternative:

If the depth of the 482.6 mm (19″) mounting levels is variable, we recommend the use of slide rail, depth-variable, see page 1010.



Slide rails

for FR(i), TE

For mounting between a front and a rear pair of mounting angles. The slide rails can be used to support heavy 482.6 mm (19″) components.

Load capacity:
80 kg, static load

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Distance between 19″ levels mm	Contact surface		Packs of	Model No. DK
	Width mm	Depth mm		
395	85	324	2	**7963.310**
495	85	424	2	**7963.410**
595	85	524	2	**7963.510**
695	85	624	2	**7963.610**

Possible alternative:

Slide rail, depth-variable,
see page 1010.

Slide rails

for EL

For the installation of heavy slide-in equipment.

Material:
Sheet steel, zinc-plated, passivated

For centre part depth mm	Packs of	Model No. EL
216	10	**2240.000**
316	10	**2250.000**
416	10	**2260.000**

Server integration

Universal server installation kit, 482.6 mm (19″)

for TS, FR(i)

The universal server installation kit is ideally suited for integrating most standard server types into Rittal enclosures with L-shaped mounting angles and a minimum enclosure depth of 900 mm. The installation kit is specially designed to ensure free access to the 482.6 mm (19″) level, for securing the individual servers in the retracted position using the screws (M5) provided.
Distance between angles: 750 mm

For	Packs of	Model No. DK
all common server types	1 kit	**7063.100**

Load capacity:
80 kg, static load

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Also required:

Mounting adaptor depending on the server type.
For FR(i) and enclosures with two 482.6 mm (19″) mounting frames:
Installation kit DK 7063.102,
see page 1012.

Mounting adaptor

The adaptors (additionally required) allow servers to be secured to the universal installation kit using the original installation kits supplied by the server manufacturers. The adaptor should be chosen according to the server type being installed. This specific mounting adaptor allows problem-free configuration of combined systems and facilitates flexible use of the individual enclosures in future.

For server types	Packs of	Model No. DK
With front 482.6 mm (19″) server attachment	1 set	**7063.110**
With side attachment (SUN)	1 set	**7063.120**
With side attachment (HP rack system/E)	1 set	**7063.130**

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
1 set of mounting adaptors, sufficient for integration of an individual server, including assembly parts.

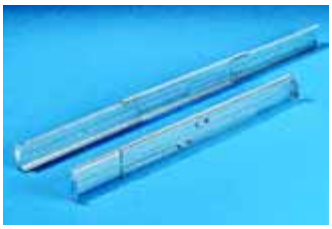
Installation kit

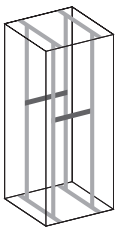
for FR(i) and 482.6 mm (19″) mounting frames

This installation kit makes it possible to mount the universal server installation kit DK 7063.100 both in FR(i) server racks and on two 482.6 mm (19″) mounting frames.

Material:
Sheet steel, zinc-plated, passivated

Packs of	Model No. DK
1 set	**7063.102**





Server rails, 482.6 mm (19″)

for TS network enclosures
with two 482.6 mm (19″) levels
Mounting is infinitely adjustable

Allows servers or active network components to slide into the enclosures, which can be screwed to the server rail via telescopic rails. The length of the server rails is fully adjustable between 550 to 850 mm.

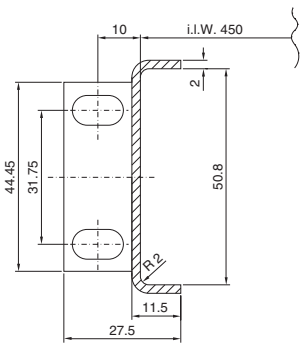
Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

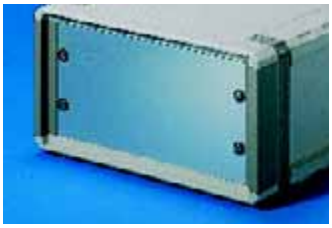
Note:
Alternatively, the server rail may also be used as a depth-variable installation kit for 409 mm wide, 482.6 mm (19″) component shelves on both L-shaped and cranked mounting angles.

Distance between 19″ levels mm	Packs of	Model No. DK
550 – 850	2	**7063.850**

German patent no. 197 10 023



482.6 mm (19″)/metric installation

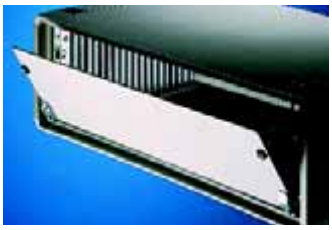


Blanking plate, 482.6 mm (19″)

For the installation in electronic enclosures or housings.

Material:
Aluminium, natural anodised.

U	Packs of	Model No. VC	
		269.2 mm (1/2 19″)	482.6 mm (19″)
1	3	**3746.000**	**1931.200**
2	3	**3747.000**	**1932.200**
3	3	**3748.000**	**1933.200**
4	3	**3749.000**	**1934.200**
6	3	–	**1936.200**
7	3	–	**1935.200**
9	3	–	**1939.200**
12	3	–	**1937.200**



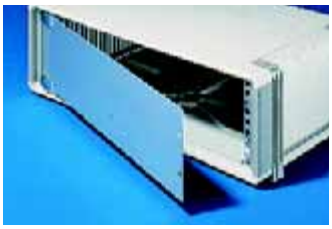
Horizontally hinged blanking plate

For the installation in electronic enclosures or housings.

Material:
3 mm aluminium, natural anodised.
Hinge: Die-cast zinc, zinc-plated

Supply includes:
Assembly parts.

Width	U	Packs of	Model No. EL
482.6 mm (19″)	3	2	**1944.000**
482.6 mm (19″)	6	2	**1945.000**



Vertically hinged blanking plate

For the installation in electronic enclosures or housings.

Material:
3 mm aluminium, natural anodised.
Hinge: Die-cast zinc, zinc-plated

Supply includes:
Assembly parts.

Width	U	Packs of	Model No. EL
482.6 mm (19″)	3	2	**1940.000**
482.6 mm (19″)	6	2	**1941.000**

Hinge

for blanking plates

Material:
Die-cast zinc, zinc-plated

Supply includes:
Assembly parts.

Packs of	Model No. EL
2	**1950.000**

German patent no. 40 04 264

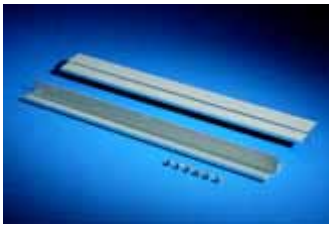
Ventilation front panels

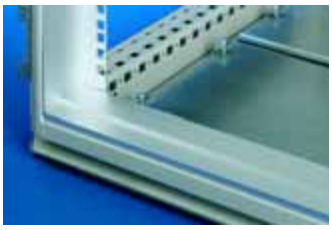
For venting enclosures and cases.

Material:
Aluminium, natural anodised.

Width	U	Packs of	Model No. EL
482.6 mm (19″)	1	3	**2231.000**
482.6 mm (19″)	2	3	**2232.000**
482.6 mm (19″)	3	3	**2233.000**

482.6 mm (19″)/metric installation





Infill panels, 482.6 mm (19″), horizontal

for TS electronic enclosure
To infill between installed 482.6 mm (19″) equipment positioned in the full enclosure height and the enclosure clearance height.

Material:
Extruded aluminium section

Surface finish:
Conductive, corrosion-protected coating

Supply includes:
Assembly parts.

For enclosure height mm	Packs of	Model No. TS
1600/2000	2	**8613.040**
1800/2200	2	**8613.030**

Aluminium cross rail

for TS electronic enclosure
for sub-division of the front.

Material:
Extruded aluminium section

Colour:
RAL 7035

Supply includes:
Assembly parts.

Height	Model No. TS
1 U	**8613.240**

Infill panel, hinged

for 800 mm wide TS network enclosures
To conceal the side cable chamber.
In order to off-set the infill panel in the enclosure depth, it may be alternatively fastened to the side of TS punched section with mounting flange.
Cable routing from the enclosure sides to the front is easily achieved.

Material:
Sheet steel

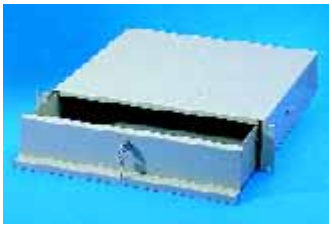
Colour:
RAL 7035

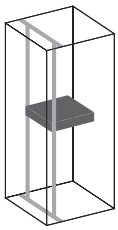
Supply includes:
Assembly parts.

For enclosure height mm	Packs of	Model No. DK
1800	2	**7827.518**
2000	2	**7827.520**
2200	2	**7827.522**

Accessories:

TS punched section with mounting flange,
see page 921 – 922.





Drawer, 2 U, 3 U

for a 482.6 mm (19″) attachment level
For front attachment to mounting angles, 482.6 mm (19″). With cover and telescopic slides to accommodate assignment lists, operating manuals and small parts. The small version of the 2 U variant is also suitable for mounting inside a swing frame.

Material:
Sheet steel

Colour:
RAL 7035

Supply includes:
Fully assembled, assembly parts.

Height	Clearance openings		Installed components mm	Model No. DK
	Width mm	Depth mm		
2 U	411	250	427	**7282.135**
2 U	411	419	427	**7282.035**
3 U	411	419	427	**7283.035**

Drawer for 482.6 mm (19″)

with shelf
For keyboards, operating manuals etc. The perforated plate in the base helps air to circulate in the enclosure. Load capacity 50 kg. The 1 U drawer can be istalled rotated through 180° , allowing it to be used as a utility table.

Material:
Drawer: Aluminium, anodised.
Telescopic slides:
Sheet steel, zinc-plated, passivated

Supply includes:
Telescopic slides.

U	Model No. PS
1	**4541.000**
3	**4542.000**

Also required:

Drawer assembly kit, corresponding to the chosen enclosure system,
see page 1016.

Drawer for 482.6 mm (19″)

Frame open at the bottom
For keyboards up to 440 mm width and maximum 350 mm depth.

Material:
Drawer: Aluminium
Telescopic slides:
Sheet steel, zinc-plated, passivated

Supply includes:
Telescopic slides.

U	Model No. PS
2	**4548.000**

Also required:

Drawer assembly kit, corresponding to the chosen enclosure system,
see page 1016.

482.6 mm (19″)/metric installation

Drawer assembly kit

for TS with mounting angles
For the installation between the front and rear 482.6 mm (19″) mounting angles or 482.6 mm (19″) adaptor pieces.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

For enclosure depth mm	Packs of	For enclosure system	
		TS	ES
		Model No. TS	**Model No. PS**
500	1	**8800.550**	**–**
600	1	**8800.560**	**4544.000**
800	1	**8800.580**	**–**

Also required:
Mounting angles, 482.6 mm (19″), or adaptor pieces, 482.6 mm (19″), see page 1004.

Drawer assembly kit

for TS with mounting angles
Depending on the distance between the two 482.6 mm (19″) mounting levels, the assembly kit is screw-fastened in the depth between the cranked mounting angles.

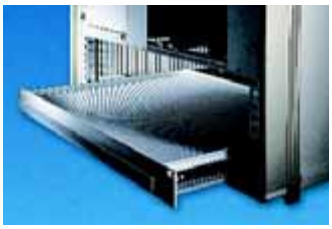
Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Length mm	Distance between angles mm	Packs of	Model No. DK
255	298	2	**7229.200**[1)]
355	398	2	**7229.300**[1)]
455	498	2	**7229.400**

[1)] Delivery time approx. 4 weeks.

Also required:
In conjunction with L-shaped TS mounting angles: Adaptor DK 7827.300, see page 950.



Drawer assembly kit

for Vario-Case iS
Minimum depth of Vario-Case iS enclosures: 500 mm

Packs of	Model No. VC
4	**3793.000**

Also required:
Threaded inserts, see page 564.

Adaptor, 3 U

Depth offset 100 mm
This adaptor is used to recess 482.6 mm (19″) mounting of equipment inside enclosures with 19″ installation in the foremost position, such as server or electronic enclosures. In this way, sufficient space can be gained in front of the mounting equipment to integrate patch panels or switches, whilst at the same time exploiting the maximum enclosure depth.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Packs of	Model No. DK
2	**7246.400**

482.6 mm (19″)/metric installation

Mounting kit, 2 U

For 482.6 mm (19″) equipment
Facilitates fast, simple integration of additional 2 U mounting space within an enclosure by attaching to the enclosure frame or to the existing mounting angles at the sides. The flexible slot fastening of the brackets means that the distance between the two installation brackets may be freely selected, so that other 482.6 mm (19″) attachment dimensions may be implemented. The second row of holes is used for the optional configuration of additional mounting surfaces.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Packs of	Model No. DK
2	**7246.420**

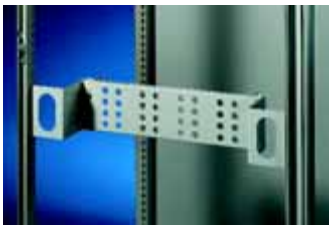
Adaptor, metric/482.6 mm (19″) 21″/19″

With this adaptor, 482.6 mm (19″) assemblies may be fastened to metric (535 mm) mounting angles, or combined systems may be configured.

Material:
Extruded aluminium section

Supply includes:
Assembly parts.

SU	U	Packs of	Model No. DK
2	1	2	**7246.010**
6	3	2	**7246.030**
11	6	2	**7246.060**



Adaptor kit 3 U/5 SU

for 800 mm wide TS enclosures
For fastening individual 482.6 mm (19″) or metric (535 mm) components, or as an additional mounting facility at the rear of the enclosure. The mounting level in the adaptor angle can be adjusted by 100 mm in the depth, leaving sufficient space for baying where patch panels or splicing boxes are used.

Material:
Sheet steel

Height	Mounting position	Model No. DK	
		Spray-finished RAL 7035	Zinc-plated, passivated
3 U	482.6 mm (19″), centre	**7246.100**	**7246.150**[1)]
3 U	482.6 mm (19″), side	**7246.200**[1)]	**7246.250**[1)]
5 SU	Metric, centre	**7246.300**[1)]	**7246.350**[1)]

[1)] Delivery time approx. 2 weeks.

Also required:

Adaptor rail,
see page 924 or
Assembly block,
see page 924.

482.6 mm (19″)/metric installation

Mounting frame 54 U

for TS, FR(i)

The mounting frame allows configuration of a side-offset 482.6 mm (19″) level with 42 U useful installation space plus the additional integration of a further 12 U for vertical installation. The additional side extension is divided into three installation levels arranged on top of one another, each with 4 U.
The mounting frame may be installed at either the front or rear.

Material:
Sheet steel

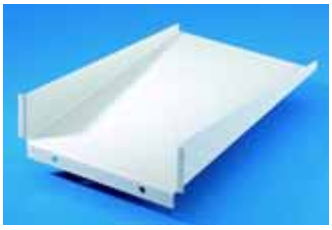
Colour:
RAL 7035

Supply includes:
12 U mounting trim at the side .

For enclosures		Additional vertical installation area	Model No. DK
Width mm	Height mm		
800	2000	12 U	**7827.554**

Also required:

2 mounting angles, 482.6 mm (19″),
see page 1004.



Component shelf

for mounting frame 54 U

For alternative attachment of small equipment, component shelves may optionally be attached within the individual 4 U wide mounting surfaces.

Load capacity:
10 kg

Material:
Sheet steel

Colour:
RAL 7035

Contact surface		Model No. DK
Width mm	Depth mm	
175	300	**7827.555**

Mounting aid

For simple handling when installing network components or subracks. May be fitted to any 482.6 mm (19″) level using quick-release screws. Mounting equipment can securely be inserted and screw-fastened to the 482.6 mm (19″) mounting angles.
Mounting aids can still be easily removed.
It is advisable to commence component mounting from the top.

Material:
Sheet steel, zinc-plated, passivated

Build height	Packs of	Model No. DK
1 U	2	**7094.900**

German patent no. 199 17 290

482.6 mm (19″)/metric installation

Adaptor

for RNC
For installing 10″ components in 296.2 mm (1/2 19″) enclosures.

Material:
Sheet steel

Colour:
RAL 7035

U	Model No. DK
1	**7870.760**
4	**7870.765**

Spring nuts with screws

M5 x 10 mm/M6 x 10 mm for T-slot mounting angle
The spring nuts ensure flexible, secure mounting of accessory components on the T-slot of the FR(i) frame and on the T-slot mounting angles.

Supply includes:
50 spring nuts,
50 spring nuts, 10 mm, self-locking.

Design	Packs of	Model No. DK
Phillips-head, M6	50	**7000.990**
Multi-tooth 25, M5	50	**7856.755**

Assembly screws

M5 x 16 mm/M6 x 16 mm
For electronic equipment, 482.6 mm (19″) installed components and blanking plates.

Supply includes:
Plastic washers.

Design	Packs of	Model No. EL
Phillips-head screw M5	100	**2099.500**
Cheese-head screw M6	100	**2093.200**
Phillips-head screw M6	100	**2089.000**

Multi-tooth screw

M5 x 16 mm/M6 x 16 mm
For optimum transmission of torques, an extended tool life and increased safety and reliability when tightening and loosening screw connections.

Supply includes:
Plastic washers.

	Bit size	Packs of	Model No. DK
M5	Multi-tooth 25	100	**7094.500**
M6	Multi-tooth 30	100	**7094.600**

482.6 mm (19″)/metric installation

Captive nuts M5/M6

For the attachment of rack-mounted electronic equipment, 482.6 mm (19″) installed equipment and blanking plates to mounting angles, 482.6 mm (19″).
For use with metal thickness from 0.8 – 2.0 mm. In areas of narrow tolerance, captive nuts for metal thicknesses of 1.2 – 1.5 mm should be used. Optionally with or without contact of the installed equipment to the 482.6 mm (19″) section/enclosure.

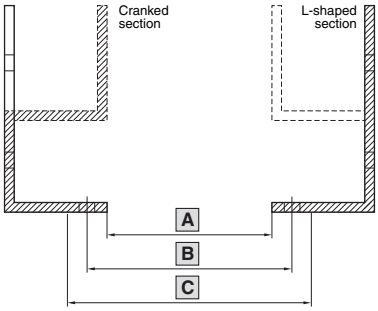
Captive nut M5

Design	For metal thicknesses mm	Packs of	Model No. EL
With contact	0.8 – 2.0	50	**2094.500**
Without contact	0.8 – 2.0	50	**2092.500**

Captive nut M6

Design	For metal thicknesses mm	Packs of	Model No. EL
With contact	0.8 – 2.0	50	**2094.200**
Without contact	0.8 – 2.0	50	**2092.200**
With contact	1.2 – 1.5	50	**2094.300**
Without contact	1.2 – 1.5	50	**2092.300**

Explanation of the fastening dimensions in interior installations



A = Clearance width
B = Mounting dimension
C = External dimension of the rack-mounted equipment or of the front panels

Installation width	A mm	B mm	C mm
19″	450	465	482.6
21″	500	515	533.4
23″	552	567	584.2
24″	577	592	609.6
10″/39 HP	221.4	236	254
1/2 19″/42 HP	236.6	251.2	269.2
9.5″	208.7	223.3	241.3
18 SU	450	465	485
20 SU	500	515	535

Telephone and data distributor

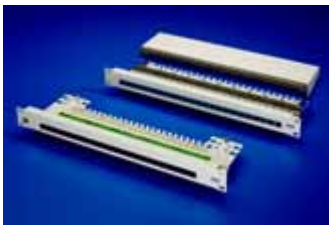
1 U (1/2 19″) 42 HP
Modular system
Mini patch panels, fitted with RJ 45 snap-in trhough-connectors (for top-hat rails to DIN 50 002) with earth connection.

Version	Cat.	Packs of	Model No. DK
8 ports, UTP, modular, 2 x RJ 45, including 8 patch cables 0.25 m, blue	3	1	**7870.800**
		6	**7870.580**
8 ports, UTP, modular, 2 x RJ 45, including 8 patch cables 0.25 m, yellow	5	1	**7870.820**
		6	**7870.595**

LSA-plus system
Telephone distributor:
10 x RJ 45 jacks, unshielded, without cover, suitable for 4-pole assignment, with strain relief and earth connection.

Data distributor:
8 x RJ 45 jacks, shielded, cover with quick-release fastener, suitable for 4-pole assignment, with strain relief and earth connection.

Version	Cat.	Packs of	Model No. DK
10 ports, UTP, RJ 45/LSA, including 8 patch cables 0.25 m, blue	3	1	**7870.802**
		6	**7870.582**
8 ports, UTP, RJ 45/LSA, including 8 patch cables 0.25 m, yellow	5	1	**7870.822**
		6	**7870.597**



Telephone and data distributor

1 U (19″) 84 HP
LSA-plus system
Telephone distributor:
25 x RJ 45 jacks, unshielded, without cover, suitable for 4-pole assignment, with strain relief and earth connection.

Version	Cat.	Packs of	Model No. DK
25 ports, UTP, RJ 45/LSA, including 12 patch cables 0.6 m, blue	3	1	**7870.810**
		6	**7870.590**

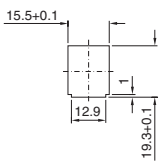
Data distributor:
24 x RJ 45 jacks, shielded, cover with quick-release fastener, with strain relief and earth connection.

Version	Cat.	Packs of	Model No. DK
24 ports, STP, RJ 45/LSA, including 12 patch cables 0.6 m, yellow	6	1	**7870.830**
		6	**7870.600**

Top-hat rail module

Top-hat rail module with mounting clip for top-hat rails to DIN 50 002, robust metal housing, with strain relief.
Cat. 6, 2 x RJ 45, System Corning Future Com S 250 (cables are attached without the use of tools).

Version	Cat.	Packs of	Model No. DK
2 x Corning Future Com S 250	6	3	**7870.614**



To accommodate 48 RJ 11 – 45 (modular jacks)

With accommodation facility for cable clamp straps DK 7610.000 or DK 7611.000.

Material:
Sheet steel

Colour:
RAL 7035

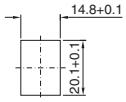
U	Number locations	Model No. DK
2	48	**7194.535**

Other versions available on request.

Accessories:

Cable clamp strap DK 7610.000 or DK 7611.000, see page 985.

Patch panels for copper technology



For shielded RJ 45 modular jacks

To accommodate screened RJ 45 jacks.
Cutouts and rear of patch panels electrically conductive to contact the fitted jacks with the patch panel and the zinc-plated, passivated 482.6 mm (19″) mounting angles.
With accommodation facility for cable clamp straps DK 7610.000 or DK 7611.000.

Material:
Sheet steel, zinc-plated, passivated

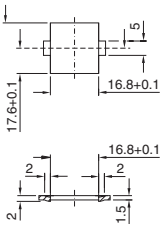
Colour:
Front: RAL 7035
Rear: zinc-plated, passivated.

U	Number locations	Model No. DK
1	16	**7394.035**
2	32	**7395.035**
3	48	**7300.435**[1)]

[1)] Extended delivery times.
Other designs available on request.

Accessories:

Cable clamp strap DK 7610.000 or DK 7611.000, see page 985.



For RJ 45 Brand AT&T/Lucent

To accommodate 16 or 32 RJ 45 built-in jacks and with accommodation facility for cable clamp straps DK 7610.000 or DK 7611.000.

Material:
Sheet steel

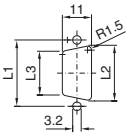
Colour:
RAL 7035

U	Number locations	Model No. DK
1	16	**7397.535**
2	32	**7398.535**[1)]

[1)] Extended delivery times.
Other designs available on request.

Accessories:

Cable clamp strap DK 7610.000 or DK 7611.000, see page 985.



For 24 V interfaces

For the installation of 16 sub-D (trapezoid) jacks and connectors.
With accommodation facility for cable clamp straps DK 7610.000 or DK 7611.000.

L1 mm	L2 mm	L3 mm	
25	21	16.5	9-pole
33.3	29.2	24.7	15-pole
47	43	38.5	25-pole

Material:
Sheet steel

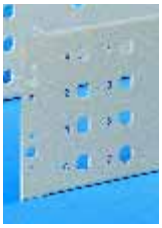
Colour:
RAL 7035

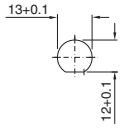
U	For no. of poles	No. of locations	Model No. DK
2	9	16	**7087.535**
2	15	16	**7086.535**
2	25	16	**7089.535**

Other versions available on request.

Accessories:

Cable clamp strap DK 7610.000 or DK 7611.000, see page 985.





To accommodate BNC jacks (version E)

With accommodation facility for cable clamp straps DK 7610.000 or DK 7611.000.

Material:
Sheet steel

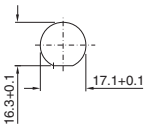
Colour:
RAL 7035

U	No. of locations	Model No. DK
3	32	**7069.535**

Other versions available on request.

Accessories:

Cable clamp strap DK 7610.000 or DK 7611.000, see page 985.



To accommodate BNC jacks (version F)

With accommodation for cable clamp straps DK 7610.000 or DK 7611.000.

Material:
Sheet steel

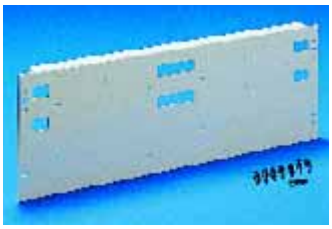
Colour:
RAL 7035

U	Number of locations	Model No. DK
3	32	**7071.535**[1)]

[1)] Extended delivery times.
Other designs available on request.

Accessories:

Cable clamp strap DK 7610.000 or DK 7611.000, see page 985.



To accommodate the AT & T Connector System 110

For the attachment of 2 wiring blocks each with 100 paired wires and accommodation facility for 2 cable holders (backboards). With rear accommodation facility for cable clamp straps DK 7610.000 or DK 7611.000.

Material:
Sheet steel

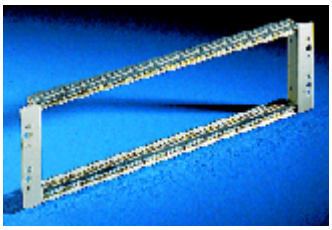
Colour:
RAL 7035

Supply includes:
12 quick-release fasteners for wiring blocks and cable holders.

U	Paired wires (DA)	Model No. DK
4	200	**7049.035**

Accessories:

Cable clamp strap DK 7610.000 or DK 7611.000, see page 985.



Module panel, 482.6 mm (19″) 3 U/84 HP

To accommodate various partial front plates and hence for individual assembly of a patch panel with any given combination of data connectors and couplings. The useful width is 84 HP.

Material:
Aluminium

Colour:
RAL 7035

Supply includes:
Two 482.6 mm (19″) flanges,
2 horizontal rails,
including 2 tapped strips.

Packs of	Model No. DK
1	**7330.035**

Also required:

Partial front plates, see page 1023.

Partial front plates

To accommodate various data connectors and couplings in the module panel DK 7330.035.

Material:
Sheet steel

Colour:
RAL 7035

For socket/ coupling	No. of locations	HP	Packs of	Model No. DK
ST	4	4	2	**7334.035**
SC, E-2000	6	6	2	**7336.105**[1)]
E-2000 duplex	3	6	2	
SC duplex	2	4	2	**7336.115**[1)]
BNC-E	4	6	2	**7339.035**
D-Sub 9-pole	3	4	2	**7342.035**
D-Sub 15-pole	2	4	2	**7343.035**
D-Sub 25-pole	1	4	2	**7344.035**
RJ 11 – 45	4	8	2	**7349.035**
Blanking plate	–	4	2	**7355.035**
Blanking plate	–	6	2	**7356.035**
Blanking plate	–	8	2	**7357.035**
Blanking plate	–	24	1	**7359.035**
Blanking plate	–	42	1	**7360.035**

Other versions available on request.
[1)] Extended delivery times

Note:
For drawings of the cutouts, see page 1021 – 1025.

Patch panels for fibre-optic technology

To accommodate F-SMA 6.5 mm fibre-optic couplings

With accommodation facility for cable clamp straps DK 7610.000 or DK 7611.000.

Material:
Sheet steel

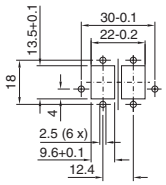
Colour:
RAL 7035

U	Number locations	Model No. DK
2	32	**7632.035**

Extended delivery times.
Other designs available on request.

Accessories:

Cable clamp strap DK 7610.000 or DK 7611.000, see page 985.



To accommodate E-2000, E-2000 duplex or SC fibre-optic couplings

For 1 U with accommodation facility for cable clamp straps DK 7610.000 or DK 7611.000.

Material:
Sheet steel

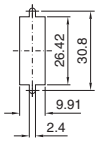
Colour:
RAL 7035

U	Number locations single/duplex	Model No. DK
1	16/8	**7433.035**
2	48/24	**7133.248**

Other versions available on request.

Accessories:

Cable clamp strap DK 7610.000 or DK 7611.000, see page 985.



To accommodate SC duplex fibre-optic couplings

With accommodation facility for cable clamp straps DK 7610.000 or DK 7611.000.

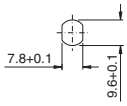
Material:
Sheet steel

Colour:
RAL 7035

U	Number locations	Model No. DK
1	12	**7154.035**
2	24	**7155.035**

Accessories:

Cable clamp strap DK 7610.000 or DK 7611.000, see page 985.



To accommodate ST fibre-optic couplings

With accommodation facility for cable clamp straps DK 7610.000 or DK 7611.000.

Material:
Sheet steel

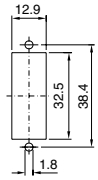
Colour:
RAL 7035

U	Number locations	Model No. DK
1	16	**7437.035**
2	24	**7137.535**
2	32	**7637.035**[1)]

[1)] Extended delivery times.
Other designs available on request.

Accessories:

Cable clamp strap DK 7610.000 or DK 7611.000, see page 985.



To accommodate ST duplex fibre-optic couplings

With accommodation facility for cable clamp straps DK 7610.000 or DK 7611.000.

Material:
Sheet steel

Colour:
RAL 7035

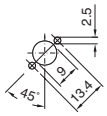
U	Number locations	Model No. DK
2	12	**7142.535**

Other versions available on request.

Accessories:

Cable clamp strap DK 7610.000 or DK 7611.000, see page 985.

Patch panels for fibre-optic technology



To accommodate FC-PC fibre-optic couplings

With accommodation facility for cable clamp straps DK 7610.000 or DK 7611.000.

Material:
Sheet steel

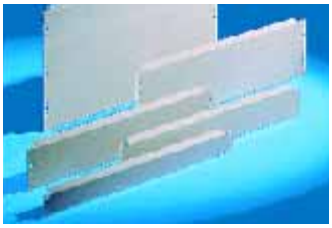
Colour:
RAL 7035

U	Number locations	Model No. DK
1	16	**7439.035**

Extended delivery times.
Other designs available on request.

Accessories:

Cable clamp strap DK 7610.000 or DK 7611.000, see page 985.



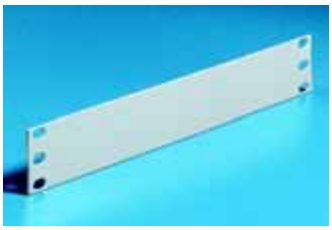
Blanking panel, 482.6 mm (19″)

As an extension cover or for population as required.

Material:
Sheet steel

Colour:
RAL 7035

U	Installation height mm	Packs of	Model No. DK
1	44	2	**7151.035**
1.5	66	2	**7157.035**
2	88	2	**7152.035**
3	132.5	2	**7153.035**
6	266	2	**7156.035**



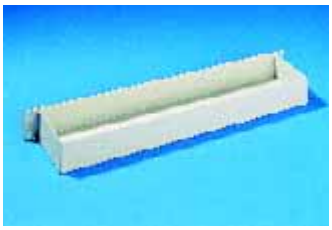
Blanking panel 1 U, 42 HP ($^1/_2$ 19″)

for RNC and RiCase
As an extension cover.

Material:
Sheet steel

Colour:
RAL 7035

Packs of	Model No. DK
2	**7870.720**



Panel 1 U, 482.6 mm (19″)

with solid tray
For the stroage of fibre-optic coupling covers or assembly parts.
Depth: 100 mm

Material:
Sheet steel

Colour:
RAL 7035

U	Model No. DK
1	**7300.335**

Identification strips

for patch panels
For individual labelling of different slots, self-adhesive.
Length: 210 mm, height: 10 mm.

Packs of	Model No. DK
32	**7167.000**

Splicing boxes

Splicing cassette holder

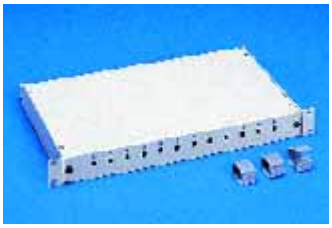
To accommodate differently sized splicing cassettes with variable cassette accommodation. Up to 8 splicing cassettes may be fitted in one holder. The splicing cassette holder can be flexibly secured to any mounting surface, and is particularly suitable for retro-fitting tor small fibre-optic distributors without patch panels.
One extra holder may be fitted in small fibre-optic distributor DK 7452.035
→ max.: 16 splicing cassettes.
Two extra holders may be fitted in small fibre-optic distributor DK 7453.035
→ max.: 32 splicing cassettes.

Height		Model No. DK
Overall height mm	Threaded bolts mm	
93	85	**7450.035**

Material:
Sheet steel

Colour:
RAL 7035

Supply includes:
Holder with threaded bolts,
variable angle bracket, cassette cover,
knurled nut and assembly parts.



Fibre-optic splicing box, depth-variable

The 482.6 mm (19″) splicing box is designed to accommodate splicing cassettes and can be installed in any network distributor with 482.6 mm (19″) accommodation and used as a fibre-optic termination or distributor. The variable cassette fixture permits twist-proof installation of all standard splicing cassettes. The rear section of the splicing box is completely open for cable entry; a rubber cable clamp strip provides protection against dust. The fibre-optic cables can be secured with cable ties or cable clamps.
The splicing box is infinitely depth-adjustable up to 100 mm within the 482.6 mm (19″) flanges. In addition, the splicing box may be fully withdrawn from the 482.6 mm (19″) flanges. Two strain relief clips and cable routing clips for the fibre stock provide a solution to suit any fibre-optic wiring system.

U	Maximum no. of splicing cassettes	Model No. DK
1	2	**7241.005**
2	4	**7242.005**

Other versions available on request.

German patent no. 196 08 385

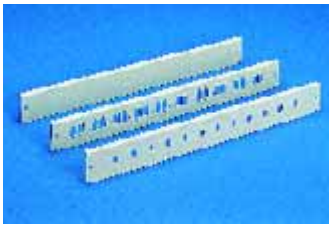
Installation depth:
302 mm

Material:
Sheet steel

Colour:
RAL 7035

Supply includes:
Splicing box, cable routing clips and cassette cover and assembly parts for patch panel.

Note:
Supplied without patch panel and splicing cassettes.



Patch panels

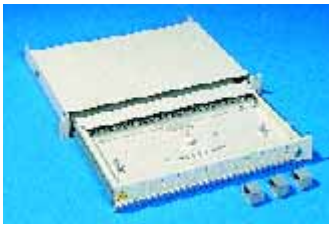
for fibre-optic splicing box, depth-variable
There is a choice of 9 panels with appropriate cutouts for the installation of various fibre-optic couplings, together with 2 blanking panels for individual population or as a cover.
The patch panels are fastened to the splicing box with quick-release fasteners.

Material:
Sheet steel

Colour:
RAL 7035

For coupling	No. of installation positions	Model No. DK 1 U	No. of installation positions	Model No. DK 2 U
ST	12	**7241.015**	24	**7242.015**
	16	**7241.065**		
E-2000, E-2000 Duplex[2] or SC	24	**7241.024**	48	**7242.024**
FDDI	6	**7241.035**	12	**7242.035[1]**
SC duplex	12	**7241.045**	24	**7242.045[1]**
Blanking panel	–	**7241.055[1]**	–	**7242.055[1]**

Other versions available on request.
[1] Delivery time approx. 2 weeks.
[2] For E-2000 Duplex only half of the locations are available.



Fibre-optic splicing box with telescopic pull-out

lockable

The 482.6 mm (19″) splicing box is designed to accommodate splicing cassettes and can be installed in any network distributor with 482.6 mm (19″) accommodation and used as a fibre-optic termination or distributor. The telescopic pull-out provides optimum access to the splicing cassettes and cable clamp. The variable cassette fixture permits twist-proof installation of all standard splicing cassettes. The security lock fitted at the front protects against unauthorised access. The rear section of the splicing box is completely open for cable entry; a rubber cable clamp strip provides protection against dust. The fibre-optic cables can be secured with cable ties or cable clamps; two strain relief clips and cable routing clips for the fibre stock provide a solution to suit any fibre-optic wiring system.

U	Maximum no. of Splicing cassettes	Model No. DK
1	2	**7170.535**
2	4	**7470.535**
3	6	**7570.535**[1)]

Other versions available on request.
[1)] **German patent no. 44 13 136**

Installation depth:
363 mm

Material:
Sheet steel

Colour:
RAL 7035

Supply includes:
Splicing box, cable routing clips, security lock and cassette cover,
incl. assembly parts for patch panel.

Note:
Supplied without patch panel and splicing cassettes.

Patch panels

for fibre-optic splicing box, lockable

There is a choice of 20 panels with appropriate cutouts for the installation of various fibre-optic couplings, together with 3 blanking panels for individual population or as a cover.

Material:
Sheet steel

Colour:
RAL 7035

For coupling	No. of installation positions	Model No. DK 1 U	No. of installation positions	Model No. DK 2 U	No. of installation positions	Model No. DK 3 U
F-SMA 6.5 mm	12	**7171.535**[1)]	24	**7471.535**[1)]	48	**7571.535**[1)]
DIN 47 256	12	**7173.535**	24	**7473.535**[1)]	48	**7573.535**[1)]
ST	12	**7174.535**	24	**7474.535**	48	**7574.535**
	16	**7174.135**				
FC-PC	12	**7175.535**[1)]	24	**7475.535**[1)]	48	**7575.535**[1)]
E-2000, E-2000 Duplex[2)] or SC	20	**7178.535**	24	**7478.535**	48	**7578.535**
			40	**7491.535**[1)]		
SC duplex	12	**7169.535**	24	**7469.535**	36	**7569.535**
Blanking panel	–	**7179.535**	–	**7479.535**[1)]	–	**7579.535**[1)]

Other versions available on request.
[1)] Delivery time approx. 2 weeks.
[2)] For E-2000 Duplex only half of the locations are available.

Cover panel

for fibre-optic cutouts

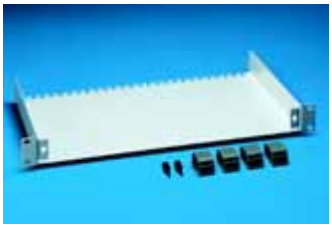
To cover unused cutouts in patch panels.

Material:
Nylon

Colour:
Black

	Packs of	Model No. DK
SC, E-2000	20	**7300.230**
E-2000 Duplex	20	
SC duplex	20	**7300.240**
ST	20	**7300.250**

Splicing boxes



Fibre-optic breakout box 1 U

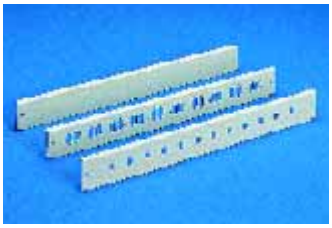
For splice-free cabling of fibre-optic breakout cables.
Cable bundles may be clamped on the hammer heads at the rear. 4 self-adhesive cable clips are are supplied loose for cable clamping and for storing excess lengths inside the box.

Material:
Sheet steel

Colour:
RAL 7035

Supply includes:
Breakout box,
cable routing clips,
assembly parts for patch panel.

Installation depth	Model No. DK
250 mm	**7241.500**



Patch panels

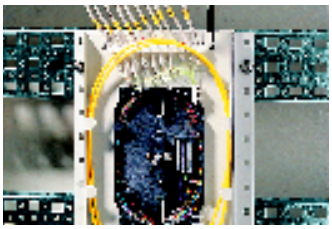
for fibre-optic breakout box 1 U
There is a choice of 5 panels for the breakout box with appropriate cutouts for the installation of various fibre-optic couplings, together with 1 blanking panel for individual population or as a cover.

Material:
Sheet steel

Colour:
RAL 7035

For Coupling	No. of installation positions	Model No. DK
ST	12	**7241.015**
ST	16	**7241.065**
E-2000, E-2000 Duplex[2] or SC	24	**7241.024**
FDDI	6	**7241.035**
SC duplex	12	**7241.045**
Blanking panel	–	**7241.055[1]**

Other versions available on request.
[1] Delivery time approx. 1 week.
[2] 10 installation positions are available for E-2000 Duplex.



Fibre-optic splicing distributor

Unlike the splicing box, the splicing distributor may optionally be installed inside or outside of network distribution enclosures.
The splicing distributor is designed to accommodate fibre-optic splicing cassettes. These are mounted individually between mounting trays which can be stacked on top of one another as required. Strain relief for the cables and individual fibres is provided by cable ties.
The basic unit can accommodated a total of 2 packs of 4 extension units DK 7381.035.

Dimensions:
W x H x D: 190 x 250 x 90 mm

Threaded bolts:
75 mm

	Model No. DK
Fibre-optic splicing distributor	**7380.035**

German patent no. 40 08 840

Material:
Sheet steel

Colour:
RAL 7035

Supply includes:
Base including one pair of mounting trays, lid and assembly parts.

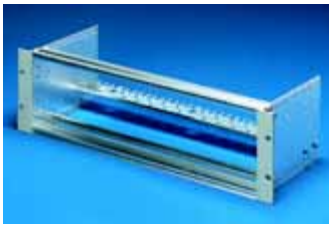
Fibre-optic splicing distributor extension unit

Additional pairs of mounting trays, each of which can accommodate one splicing cassette and the fibre stock, are used to extend the splicing distributor.

Material:
Sheet steel

Colour:
RAL 7035

Packs of	Model No. DK
2	**7381.035**



Fixture with rods, 3 U

for LSA strips
To accommodate
15 LSA profile dividing strips 2/10 on
2 rods, Ø 12 mm.
The fixture unit may be integrated in all 482.6 mm (19″) mounting levels. With cable clamp rail at the rear.

Dimensions:
W x H x D:
482.6 mm (19″) x 132.5 mm (3 U) x 175 mm

U	Model No. DK
3	**7050.200**

Material:
Side panels: Aluminium plates
482.6 mm (19″) side panels/cross rail:
Extruded aluminium section

Supply includes:
Fixture with rods as modular system.

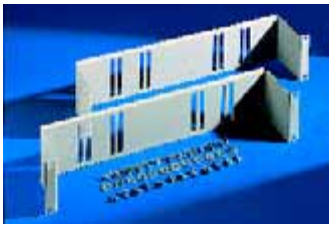
3 U support unit

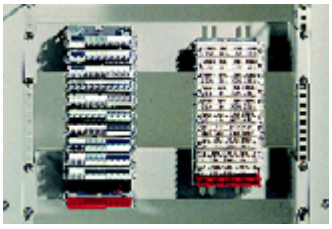
for LSA-Plus strips, max. 150 paired wires
To accommodate a maximum of 15 LSA-Plus strips (each with 10 paired wires). 3 x 5 LSA-Plus connection strips 2/10, series 2, may be installed horizontally. Strip length 124 mm, height pitch pattern 22.5 mm. The support unit may be integrated in all 482.6 mm (19″) mounting levels. The mounting level is recessed 100 mm behind the 482.6 mm (19″) flanges. Integral shunting rings enable tidy routing and distribution of the telecommunication cables.

U	Model No. DK
3	**7050.100**

Material:
Stainless steel

Supply includes:
Support unit, 8 shunting rings.





2 U accommodation system

for LSA installation kit
To accommodate LSA mounting troughs/cable retainers on the 482.6 mm (19″) mounting angle.

Dimensions:
Total depth: 98.5 mm
Height: 2 U

Material:
Sheet steel

Colour:
RAL 7035

U	Packs of	Model No. DK
2	2	**7050.035**

Accessories:

FM universal mounting bracket,
see page 811.

Handles, external mounting accessories

Clipboard

For securing operating instructions or plans (A4 size) at eye level.
Prepared for mounting on the right-hand side; mounting on the left is also possible by unscrewing and moving the clip part.
For mounting purposes, a straight tube length of ≥ 200 mm, 25 mm dia. is required.

Material:
Sheet steel, RAL 7035
Clip part: Aluminium, natural anodised.

Width mm	Height mm	Model No. CP
225	315	**6013.000**

Clipboard in conjunction with command panel VIP 6000:
European patent no. 0 839 093 with validity for DE, FR, GB, IT

Also required:

Handle set SZ 2389.000, see page 1030
or
Handle set VIP 6000, see page 1033
or
Handle set for Optipanel, see page 1031
or
U handle CP 6107.200, see page 1032.

Ring board

The alternative for attaching paper or plastic covers in A4 format, in either landscape or portrait format.
Board folded over on three sides and punched for mounting the assembly parts on the handle tube (length ≥ 200 mm, Ø 25 mm).

Material:
Sheet steel, RAL 7035
Ring strip, 16 mm: Sheet steel, plated

Width mm	Height mm	Model No. CP
225	315	**6013.500**

Also required:

Handle set SZ 2389.000, see page 1030
or
Handle set VIP 6000, see page 1033
or
Handle set for Optipanel, see page 1031
or
U handle CP 6107.200, see page 1032.

Display board with wall bracket

To accommodate test plans, documents etc. in A4 format.

Assembly:
- on surfaces,
- on a 25 mm pitch pattern of the TS frame or rail system,
- on the handle set.

Packs of	Model No. CP
1	**6013.100**

Supply includes:
10 display boards,
wall brackets and assembly parts.

Accessories:

Handle set SZ 2389.000, see page 1030
or
Handle set VIP 6000, see page 1033
or
Handle set for Optipanel, see page 1031
or
U handle CP 6107.200, see page 1032.

Handle set

For vertical and horizontal mounting on all surfaces.
Overall length: 420 mm.

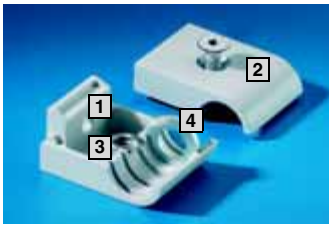
Material:
Handle tube: Aluminium, natural anodised.
Conduit holder: Die-cast zinc, RAL 7035

Supply includes:
1 set =
4 rail holders,
2 handle tubes.

Packs of	Model No. SZ
1 set	**2389.000**

Accessories:

Clipboard, ringboard, display board, see page 1030.



Rail holder

For mounting on surfaces, horizontal or vertical, also suitable for height-adjustable and/or swivel mounting of enclosures.
For 25 mm dia. sections made from
- Steel, seamless DIN 2448
- Aluminium to DIN 1795

as a handle or for limiting support surfaces.

Consisting of:

1 Assembly tray with one drilled hole and M8 screw and two pins as anti-twist guard.

2 Clamping tray with tolerance compensation and screw for tightening the rails.

3 Washer, small, prevents tensioning of the rails e.g. should it become necessary to remove the fitted ring board.

4 Washer, large, secures the uninhibited, rotating rail between the two trays to prevent it from falling out.

Material:
Die-cast zinc

Colour:
RAL 7035

Packs of	**Model No. SZ**
2	**2389.100**

Handle set

for Optipanel
For external mounting on corner pieces, also suitable for retro-fitting.

Material:
Handle tube: Aluminium, natural anodised.
Handle holder: Die-cast zinc, powder-coated in RAL 7035
Covers: Polyamide, RAL 7024

Note:
Shorter heights and widths can be achieved by cutting the handle tube to length.

For enclosures with 100 mm depth, cannot be mounted on the same side as the
- Support arm connection
- Interface flap
  (SZ 2482.200, see page 1059)

Accessories:

Clipboard, ringboard, display board
see page 1030.

For horizontal mounting

With front panel width	Packs of	**Model No. CP**
482.6 mm (19″)	1 set	**6385.010**
As specified	1 set	**6385.019**[2)]

Supply includes:
Handle tube, Ø 25 mm,
2 handle holders,
2 covers.

For vertical mounting

With front panel height	Packs of	**Model No. CP**
7 U	1 set	**6385.020**
7 U + 2 x 3.5 U[1)]	1 set	**6385.030**
As specified	1 set	**6385.029**[2)]

[1)] Divided by 2 cross members for Optipanel.

[2)] Please additionally state when ordering:
– Number/dimensions of front panels
– Number of cross members/sealing bars or
– Model Number of enclosure

Supply includes:
2 handle tubes, Ø 25 mm,
4 handle holders,
4 covers.

Handles, external mounting accessories

Handles

For horizontal or vertical attachment to the enclosure panel of:
- VIP 6000 with combined or narrow front frame,
- Optipanel,
- other enclosures or
- surfaces.

Mounting holes and surfaces without fins are required for assembly purposes. For VIP 6000 version with fins, corresponding milling work can be carried out. With the operating/keyboard housing, please specify “Prepared for handle set CP 6107.XXX”.

Material:
Handle holder: Die-cast zinc, RAL 7035
Cover bungs: Plastic, similar to RAL 7035
Handle tube: Aluminium, powder-coated similar to RAL 9006.

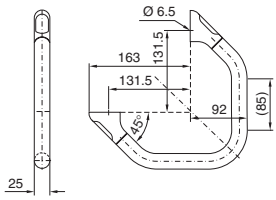
German patent no. 19 937 966
French patent no. 2 797 555
Italian patent no. 0 131 8210
US patent no. 6,507,978

Corner handle

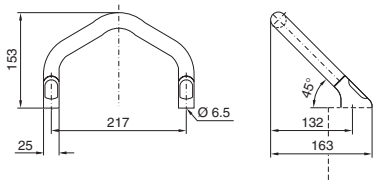
Supply includes:
4 handle holders,
2 handle tubes,
assembly parts.

Packs of	Model No. CP
1 set	**6107.000**

Mounting on enclosure corner



Mounting on straight surfaces
(90° rotation of handle holder)



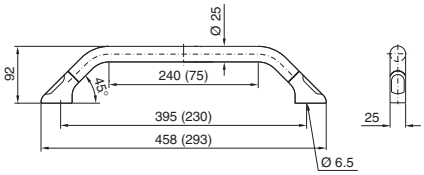
U handle

Supply includes:
2 handle holders,
1 handle tube,
assembly parts.

For front panel size	Packs of	Model No. CP
≥ 7 U	1 set	**6107.100**
482.6 mm (19″)	1 set	**6107.200**

Accessories:

For CP 6107.200:
Clipboard, ringboard, display board,
see page 1030.



Note:
Dimensions in brackets for CP 7 U.

Display board with wall bracket

see page 1030.

Handle set VIP

for VIP 6000 with wide frame

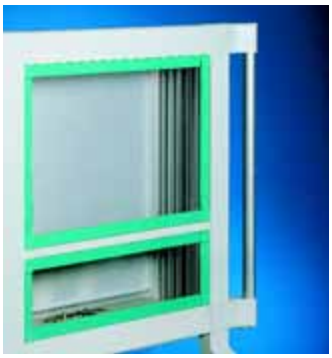
For mounting on the corner connectors of the enclosure frame.

Material:
Handle tube: Extruded aluminium section, natural anodised
Handle holder: Die-cast zinc, powder-coated in RAL 7035

Note:
Shorter heights and widths can be achieved by cutting the handle tube to length.

Accessories:

Clipboard, ringboard, display board,
see page 1030.



For horizontal mounting

With front panel width	Packs of	Model No. CP
482.6 mm (19″)	1 set	**6101.000**
As specified	1 set	**6101.009**[2)]

Supply includes:
2 handle holders,
1 handle tube,
2 screws.

For vertical mounting

With front panel height	Packs of	Model No. CP
7 U	1 set	**6102.000**
7 + 3.5 U[1)]	1 set	**6103.000**
As specified	1 set	**6102.009**[2)]

[1)] Divided by cross member for VIP 6000.

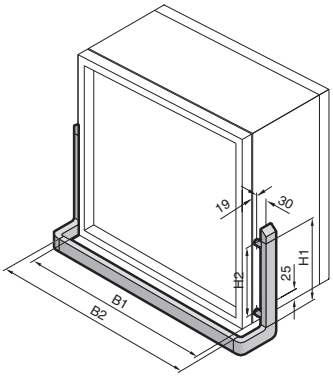
[2)] Please additionally state when ordering:
– Number/dimensions of front panels
– Number of cross members/sealing bars or
– Model Number of enclosure

Supply includes:
4 handle holders,
2 handle tubes,
4 screws.

Handle frame

for operating housing with display panel front

For operating housing with display panel front	CP 6442.500 CP 6462.500	CP 6552.500	CP 6662.500
Model No. CP	**6191.000**	**6192.000**	**6190.000**
Operating housing width (B1) mm	380	500	600
Width of the horizontal rectangular tube (B2 = B1 + 48) mm	428	548	648
Height of the vertical rectangular tube (H1) mm	345	465	299
Hole distance between the assembly holes (H2) mm	295	415	249



Colour:
RAL 8019

Supply includes:
Square aluminium tube,
plastic corner bracket,
end caps,
assembly parts.

Connection components

Connector

for compact enclosures
Between
- Compact enclosure AE from depth 210 mm (see page 118)
- Operating housings from depth 210 mm (see page 185)

and
- Terminal boxes from depth 80 mm (see page 108)
- E-Boxes EB from depth 80 mm (see page 110)

Material:
Sheet steel

Colour:
RAL 7024

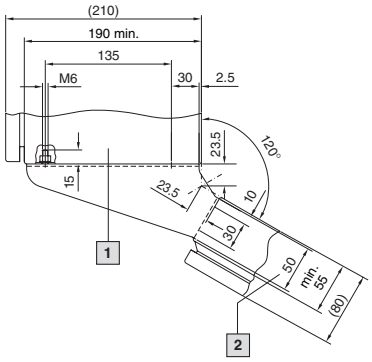
Supply includes:
Assembly parts.

Packs of	Model No. CP
1 set	6005.100

Note:
During retrofitting, appropriate mounting holes are required for assembly purposes.

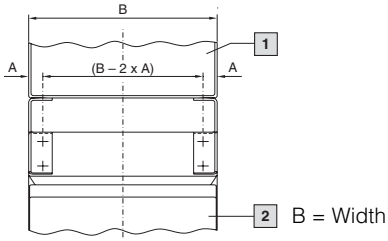
Rittal service:

Terminal box, E-Box and compact enclosure available on request with front panel and handle strips mounted on the rear panel.

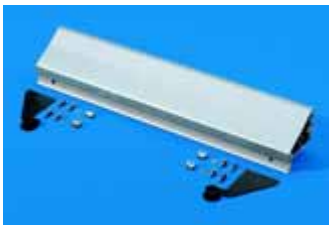


1 e.g. AE
2 e.g. KL/EB

Drilling pattern for attaching the connector to both enclosures



Handle strips	min. dimension A mm
Without	15
With	35



Enclosure surface connector

To accommodate:
- Support for keyboards (SM 2383.000)
- Optipanel keyboard housing for front panel width = 482.6 mm (19″) CP 6384.009. Please state front panel height and installation depth (50 or 100 mm) in addition to Model No.

Material:
Extruded aluminium section, natural anodised
Side cover, sheet steel RAL 7024.

Supply includes:
Assembly parts.

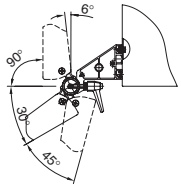
Packs of	Model No. SM
1 set	2383.010

Note:
Other widths available on request.

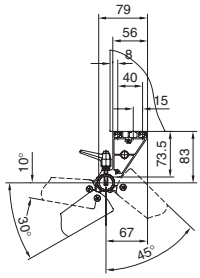
Also required:

Cross-brace for door,
see page 895.

Mounting on surfaces



Mounting underneath surfaces



Enclosure duct connector

for VIP 6000

To fit narrow and combined frames in conjunction with the keyboard housing 105 mm deep.

- The angle between the operating and keyboard housing is 120°.
- At the same time, the duct connector is used for cable routing from the operating housing to the keyboard housing.

Material:
Aluminium

Colour:
RAL 7035

Supply includes:
Assembly parts.

Weight kg	Packs of	Model No. CP
2.0	1 set	**6006.000**

Delivery times on request.

Note:
When retro-fitting, appropriate mounting holes and cutouts must be made in the operating and keyboard housings for assembly purposes.

Also required:

Cross-brace for door,
see page 895.

Cable tube, flexible

for VIP 6000

Suitable for cable routing from the operating housing to the keyboard housing.
Suitable for use with

- Frame connector, adjustable
- Hinged frame connector
- Frame connector, rigid
- Enclosure bar connector

May be mounted on the following keyboard housings:

- Keyboard housing: 105 mm
- Keyboard housing: 44 mm
- Keyboard housing: 27 mm
  with connection for flexible cable conduit (design 4.1, see page 166).

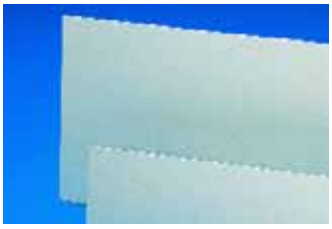
Corresponding cutouts are required for connecting the cable tube in the operating and keyboard housing.

A cable tube is included with the supply to selection 4.5, see page 169.

Colour:
RAL 7035

Supply includes:
Assembly parts.

for keyboard housings	Model No. CP
CP 6351.009 Designs **4.1, 2 and 4**	**6017.100**
Others	**6017.000**



Front panels

for VIP 6000 and Optipanel

Material:
3 mm aluminium, natural anodised

Note:
If more than one front panel is used a cross member is required,
see page 1037.

Width mm	Height mm	Model No. CP	
		with mounting holes	with threaded bolts M5
482.6 (19″)	155.0 (3.5 U)	**6027.000**	**6027.010**
482.6 (19″)	177.0 (4 U)	**6019.000**	–
482.6 (19″)	310.3 (7 U)	**6028.000**	**6028.010**
482.6 (19″)	493.8[1)]	**6029.000**	–

[1)] For VIP 6000, this corresponds to the height of two front panels (7 + 3.5 U) and of one cross member (285 mm).

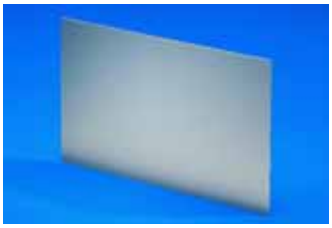
Also required:

Mounting kit CP 6053.000 or CP 6053.500,
see page 1037.

Rittal service:

Other sizes and versions with threaded bolts, cutouts and engravings available on request.

Front assembly

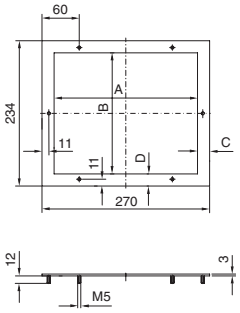


Front panels
for Optipanel CP 6380.100
With threaded bolts M5.

Dimensions:
270 x 234 mm

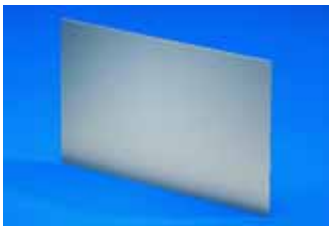
Material:
3 mm aluminium, natural anodised

Supply includes:
Mounting kit.



Mounting cutout	Packs of	Model No. CP
Without	1	**6027.500**
For Siemens Simatic OP 17	1	**6027.510**
For Siemens Simatic TP 170 A/B	1	**6027.520**
Acc. to specifications	1	**6027.509**

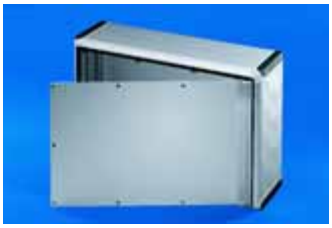
Model No. CP	A	B	C	D
6027.510	231.0	195.0	19.5	19.5
6027.520	197.5	141.5	36.25	46.25



Front panels
for Compact Panel

Material:
3 mm aluminium, natural anodised

Size W x H mm	To fit Compact Panel	Model No. CP
178 x 200	CP 6340.0X0	**6028.500**
178 x 350	CP 6340.1X0	**6028.510**
178 x 482.6	CP 6340.2X0	**6028.520**
252 x 200	CP 6340.3X0	**6028.530**
252 x 350	CP 6340.4X0	**6028.540**



Front panels, hinged
for VIP 6000 and Optipanel

Dimensions:
19″ x 7 U
(482.6 x 310.3 mm)

Opening angle:
Optipanel: 125°
VIP 6000: 95°

Material:
Front panel: 3 mm aluminium, natural anodised
Extruded aluminium section: Natural anodised

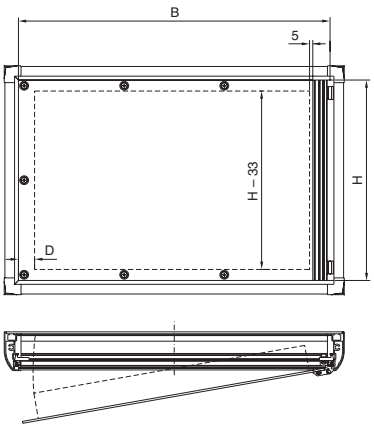
Supply includes:
Hinge section, hinge strip,
2 end trims and assembly parts.

Front panel for	Design	Model No. CP
Optipanel	Screw-fastened from the outside	**6027.100**
	Screw-fastened from the inside	**6027.110**
	With cam	**6027.120**
VIP 6000	Screw-fastened from the outside[1)]	**6027.200**
	Screw-fastened from the inside[1)]	**6027.210**
	With cam[1)]	**6027.220**

Delivery times on request.
For other sizes, please add the extension .XX9 to the Model No.
[1)] When ordering, please specify the colour of the required end trim (see page 163).

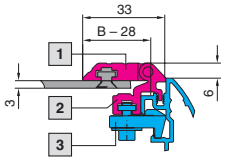
Required distance from edge “D” to avoid collisions

Installation depth	Dimension “D”
Optipanel 50 mm	25 mm
Optipanel 100 mm	34 mm
Optipanel 150 mm	48 mm
VIP 6000 44 mm	25 mm
VIP 6000 105 mm	36 mm
VIP 6000 155 mm	52 mm

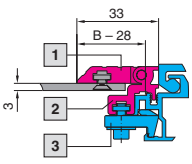


B = Width

Mounting position Optipanel



Mounting position VIP 6000



1 Hinge strip
2 Hinge section
3 Retaining claw

Mounting kit

for VIP 6000 and Optipanel
For installing
- Aluminium front plates
- Command panels
- Keyboards

For holes

For Front panels	Thread	Model No. CP
Others	M4	**6058.000**
Rittal and others	M5	**6053.000**

Supply includes:
Packs of
30 retaining claws, captive nuts, screws and sealing washers.

For bolts

Thread	Model No. CP
M4	**6058.500**
M5	**6053.500**

Supply includes:
Packs of
10 retaining claws and cap screws.

For screw clamp

For direct installation of	Model No. CP
Siemens Sinumerik OP010, OP010C, OP012, OP015, MCP, PP012, Querty 19″	**6053.210**
Siemens Simatic Panel PC 670: 12″-Touch, 15″-Touch, 10″ keys, 12″ keys, 15″ keys Panel PC 870: 12″-Touch, 15″-Touch, 10″ keys, 15″ keys	

The mounting set can only be installed vertically.
Mounting in VIP 6000 is only possible in conjunction with end trim.

Supply includes:
Packs of
4 pressure plates,
4 attachment strips.

Sealing bar

for VIP 6000 and Optipanel
For horizontal and/or vertical division of operating housings.
The “slot-free” division produces a height gain of 28 mm (VIP 6000) or 22 mm (Optipanel) respectively.

Material:
Aluminium section 8 x 20 mm

Supply includes:
Assembly parts.

Note:
Sealing bar may not be used in conjunction with spacer trim.

For front panel width mm	Model No. CP
482.6 (19″)	**6015.500**
As specified[1)]	**6015.509**

[1)] Please specify width of front panel.

Detailed drawing,
see page 1097.

Cross member

for VIP 6000 and Optipanel
For horizontal and/or vertical division of the command panel front.
With mounting channel on both sides to accommodate mounting kits.

Material:
Extruded aluminium section

Supply includes:
2 retainig claws,
2 screws with washers,
2 trim sections.

For front panel width mm	Model No. CP	
	for VIP 6000[2)]	for Optipanel
482.6 (19″)	**6015.000**	**6386.000**
As specified[1)]	**6015.009**	**6386.009**

[1)] Please specify width/height of front panel.
[2)] Trim type and trim colour, see page 163. Please state on the order.

Accessories:

Mounting kit,
see page 1037.

Detailed drawing,
for VIP 6000,
see page 1097.
For Optipanel,
see page 1101.

Front assembly

Spacer panel and built-in trim panel

for VIP 6000 and Optipanel

For additional space with cable entry and for installing

- Switches/indicator lamps
- Emergency-off switches/key switches
- CD-ROM/disk drives
- Interfaces

etc.

For mounting (horizontally or vertically) on the enclosure, snap into position and screw-fasten from behind.
Other spacer panels and built-in trim panels, front panels and operator panels may be installed without an additional cross member.

Material:
Extruded aluminium section, natural anodised

Supply includes:
Assembly parts and end trim (VIP 6000), spacer trim (Optipanel).

For VIP 6000

For front panel width mm	Model No. CP[2)]
482.6 (19″)	**6015.300**
As specified[1)]	**6015.309**

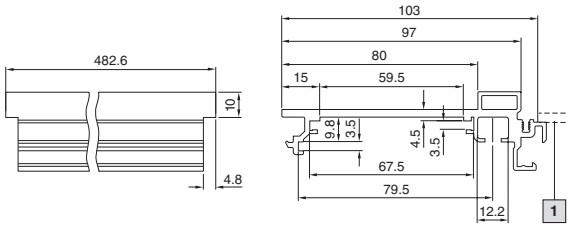
Height corresponding to a front panel height of 103 mm.
[1)] Please specify width of front panel.
[2)] Trim colour see page 163.
Please state on the order.

For Optipanel

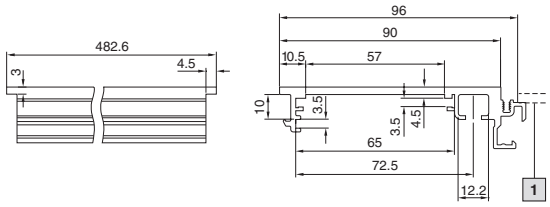
For front panel width mm	Model No. CP
482.6 (19″)	**6386.300**
As specified[1)]	**6386.309**

Height corresponding to a front panel height of 96 mm.
[1)] Please specify width of front panel.

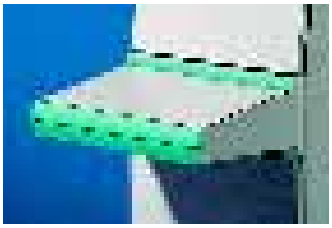
VIP 6000

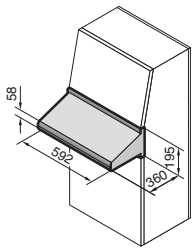


Optipanel



1 Another spacer panel and built-in trim panel, front plate or operator panel





Desk section

for AP universal console

Solid sides and front, removable plates for top and bottom. May optionally be attached with the inclined or straight edge on top, by rotating through 180°

Material:
Sheet steel

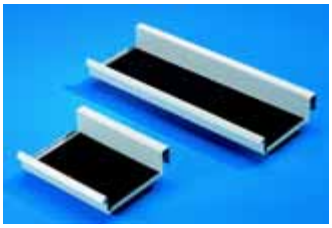
Colour:
RAL 7035,
design strip RAL 5018

Protection category:
IP 55 to EN 60 529/10.91,
Complies with NEMA 12.

Supply includes:
Assembly parts.

Packs of	Model No. AP
1	**2696.500**

To order versions in RAL 7032, please use order number extension .200.
Delivery times on request.



Utility shelf

screw-fastened

With support mat for:
Measuring tools, writing equipment, mouse, scanner, small parts etc.

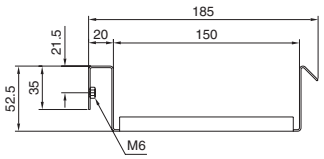
For mounting
- Underneath:
  – VIP 6000
  – Optipanel
  – Command panel housings with door
  – Operating housings
  – IW worktop
  For visual reasons, not drilled for assembly.
- On surfaces (doors, rear panels) via rear assembly holes
- To TS punched section with mounting flange 17 x 73 mm, locatable, without screw-fastening,
  – for servicing work on the enclosure.

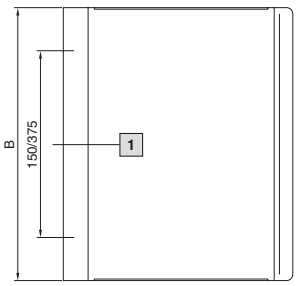
Material:
Sheet steel

Colour:
RAL 7035

Supply includes:
Assembly parts.

Width (B) mm	Model No. CP
220	**6514.110**
450	**6514.100**





1 Additional central thread only for CP 6514.100

General accessories

Cover plate

for support arm connection
For secure sealing of a support arm connection in the enclosure which is not required.

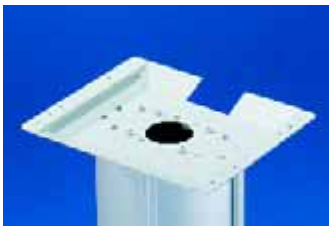
Material:
Sheet steel

Supply includes:
Seal and assembly parts.

Note:
If with
- VIP 6000
- Optipanel
- Compact panel

command panels there are already 2 support arm cutouts provided, a cover plate is included with the supply of the enclosure.

Support arm connection	Surface finish	**Model No. CP**
CP-S	Spray-finished 7024	**6505.200**
CP-L, Ø 130 mm	Zinc-plated, passivated	**6505.500**
CP-L, ▭ 120 x 65 mm	Zinc-plated, passivated	**6505.100**



Worktop attachment

for pedestal and support arm system
For mounting worktops on:
- Lifting pillar, electric
- Enclosure attachment CP-L, round
- Housing coupling CP-L, round
- Enclosure attachment CP-XL, round
- Housing coupling CP-XL

Material:
Sheet steel

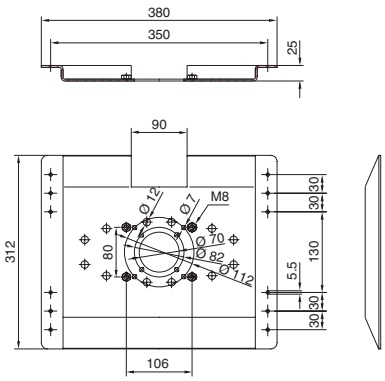
Colour:
RAL 7035

Supply includes:
Assembly parts.

Packs of	**Model No. IW**
1	**6902.780**

Accessories:

Accessories	Model No. CP	see page
Lifting pillar, electric	6142.000	229
Enclosure attachment, CP-L, Ø 130 mm	6525.5X0	206
Housing coupling, CP-L, Ø 130 mm	6525.0X0	212
Enclosure attachment, CP-XL, round	6130.600	222
Housing coupling, CP-XL	6130.000	223



Aluminium strip

for
- AP
- Surfaces

Prevents wiring plans etc. from slipping.

For console	Length mm	Packs of	**Model No. AP**
AP 2611.500 AP 2613.500 AP 2668.500	783	3	**2678.000**
AP 2641.500 AP 2643.500 AP 2672.500	1183	3	**2682.000**
AP 2666.500	583	3	**2676.000**

May be cut to length for other dimensions.

Signal pillar, LED compact

red, yellow, green

Benefits:
- Complete, ready-to-connect solution
- Minimal build height of just 177 mm
- Extremely long service life of the LEDs (at least 70,000 h) – therefore maintenance-free
- Minimal assembly work and warehousing costs

Technical specifications:
Operating voltage: 24 V AC/DC
Electrical connection: Screw terminals
Light: LED
Transmission angle: 3 x 120°
Operating temperature: –20 to +70°C
Flashing function: Controllable via SPC
Cable entry: Metric cable gland
M12 x 1.5 for cable diameter 3.0 – 6.5 mm

Packs of	Model No. SG
1	2372.100

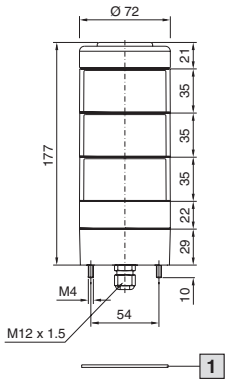
Protection category:
IP 65 to EN 60 529/10.91

Note:
- Design with acoustic component
- 1 to 4-stage version in various colour combinations
- Version with magnetic base

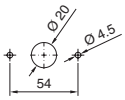
available upon request.

Also required:

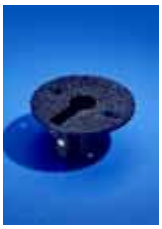
For wall/base mounting:
Bracket for wall mounting,
see page 1044.
For conduit mounting/support arm systems:
Busbar connection adaptor,
see page 1041.



Mounting cutout



1 Seal



Busbar connection adaptor

for signal pillar, LED compact
For conduit mounting and mounting on support arm systems.

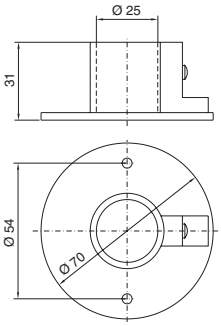
Material:
Plastic

Colour:
Black

Packs of	Model No. SG
1	2372.120

Accessories:

Mounting components for conduit mounting,
see page 1045.
Mounting components for support arm systems,
see page 1045.



Modular

Signal pillars, modular

Benefits:

- Simple assembly and contact via bayonet fastener.
- Configuration of up to five components with the same voltage.
- The incandescent lamps are replaced in seconds – no need for tools.
- Components are available in a range of colours and voltages.

For modular configuration from:

- Connection components
- Optical components
- Incandescent lamps/LED lamps
- Acoustic components
- Label panel

Connection component

for signal pillars, modular

Optionally for conduit or wall/base mounting. Screw terminals in the connection component. With cover for optical components. Contact hazard protection to VDE.

Material:
Enclosure of polyamide

Colour:
Black

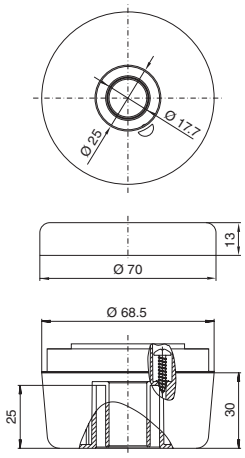
Protection category:
IP 54

Connection component	Model No. SG
For conduit mounting	**2368.000**
For wall/base mounting	**2368.010**

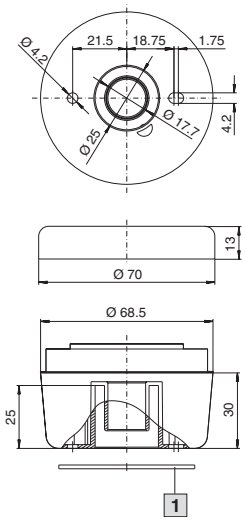
Accessories:

Mounting components for wall/base mounting, see page 1044.
Mounting components for conduit mounting, see page 1045.
Mounting components for support arm systems, see page 1045.

Connection component for conduit mounting
SG 2368.000



Connection component for wall/base mounting
SG 2368.010



1 Seal

1

2

3

4

Optical components

for signal pillars, modular
With 360° signal transmission thanks to optimised prism system.
Possible number of levels = 5 components, with the same voltage.
115 V components available on request.

Material:
Enclosure: polyamide
Cap: transparent polycarbonate

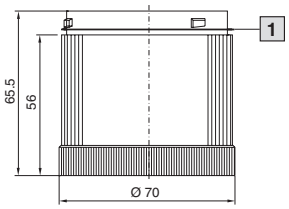
Protection category:
IP 54 if a cover or acoustic component is fitted at the top.

Also required:
Incandescent or LED lamps for steady and flashing light component,
see page 1043.

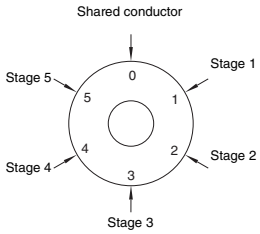
Optical components	Model No. SG				
Colour	Red	Green	Yellow	Clear	Blue
1 Steady light component[1)] 12 – 240 V AC/DC	**2369.000**	**2369.010**	**2369.020**	**2369.030**	**2369.040**
2 Flashing light component[1)] 24 V AC/DC, 125 mA/225 mA	**2370.000**	**2370.010**	**2370.020**	**2370.030**	**2370.040**
2 Flashing light component[1)] 230 V AC/DC, 15 mA	**2370.050**	**2370.060**	**2370.070**	**2370.080**	**2370.090**
3 Stroboscopic light component 24 V DC, 125 mA/225 mA	**2371.000**	**2371.010**	**2371.020**	**2371.030**	**2371.040**
3 Stroboscopic light component 230 V AC, 15 mA	**2371.050**	**2371.060**	**2371.070**	**2371.080**	**2371.090**
4 LED steady light component 24 V AC/DC, 60 mA	**2372.000**	**2372.010**	**2372.020**	**2372.030**	**2372.040**

[1)] Incandescent or LED lamps not included with the supply.

1 Preconfigured seal



Connection diagram



Incandescent lamps

for steady and flashing light components
With BA 15d base/plinth.
For new orders or replacements.

Incandescent lamp	Packs of	Model No. SG
24 V, 5 W	3	**2374.060**
230 V, 5 W	3	**2374.070**

LED lamp

for steady and flashing light components
The energy-saving alternative with a long service life.
The LEDs have a trasnmission angle of 2 x 180°.

LED lamp	Packs of	Model No. SG				
Colour		Red	Green	Yellow	Clear	Blue
24 V AC/DC	1	**2374.200**	**2374.210**	**2374.220**	**2374.230**	**2374.240**
		For steady and flashing light components from SG 2369.000 to SG 2370.040				
230 V AC	1	**2374.300**	**2374.310**	**2374.320**	**2374.330**	**2374.340**
		For steady light components SG 2369.000 to SG 2369.040				

Mounting components

Acoustic components

for signal pillars, modular
To indicate warnings or malfunctions. The sound pressure is 85 dB/100 dB. Mounting only on the upper end of the optical components or directly on the connection component.

Material:
Enclosure: polyamide

Colour:
Black

Acoustic components	Model No. SG	
	24 V AC/DC	230 V AC
85 dB[1] max. 25 mA	**2376.000**	**2376.020**
100 dB[2] max. 25 mA	**2376.010**	**2376.030**

[1] Continuous tone or pulsating
[2] Volume and 8 tones may be set

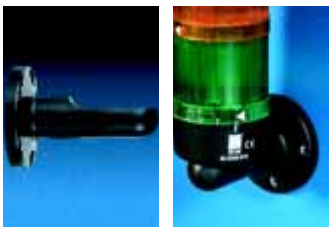
Label panel

for signal pillars, modular
For text additions for a maximum of 5 optical components, with break point for any fields that are not required (50 x 150 mm), including clamping section for base or tube with a diameter of 25 mm.

Material:
Acrylic, transparent

Label panel	Model No. SG
For 5 optical components	**2374.150**

1



2

3

Mounting components

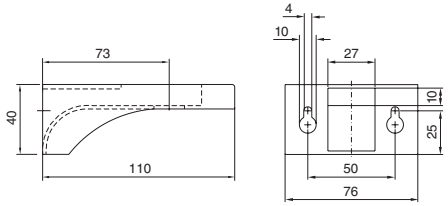
For wall/base mounting

Fig.	Mounting component	Colour	Suitable for signal pillar		Model No. SG
			LED compact	modular	
1	Bracket for wall mounting, including rubber gland for concealed cable routing	Black	■		**2372.110**
2	Bracket for connection component	Black		■[1]	**2374.040**
3	For side cable outlet	Black		■[1]	**2374.080**

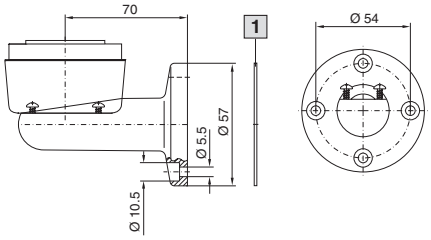
Also required:

[1] Connection component SG 2368.010, see page 1042.

Bracket for wall mounting

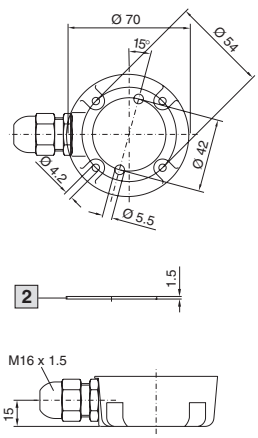


Bracket for connection component



1 Seal
2 Flat seal

For side cable outlet



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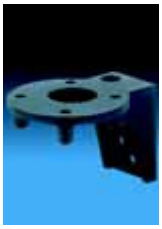
5

6



7

Mounting components

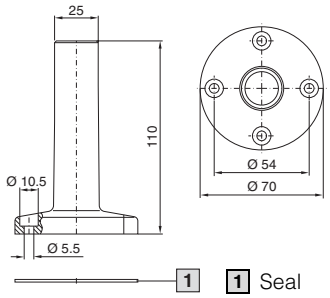
for conduit mounting

Fig.	Mounting component	Colour	Suitable for signal pillar		Model No. SG
			LED compact	modular	
4	Base with integral conduit, Ø 25 mm, 110 mm long	Black	■[1]	■[2]	**2374.000**
5	Individual base	Black	■	■	**2374.010**
6	Single conduit, 250 mm long	Aluminium	■[1]	■[2]	**2374.020**
	Single conduit, 400 mm long	Aluminium	■[1]	■[2]	**2374.030**
7	Angle bracket for conduit mounting	Black	■	■	**2374.050**

Also required:

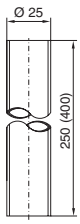
[1] Busbar connection adaptor SG 2372.120, see page 1041.
[2] Connection component SG 2368.000, see page 1042.

Base with integral conduit

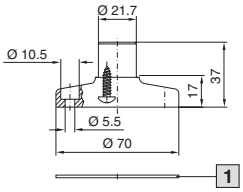


1 Seal

Single conduit

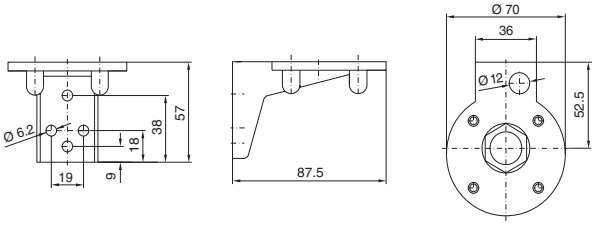


Individual base



1 Seal

Angle bracket for conduit mounting



8

9

10

Mounting components

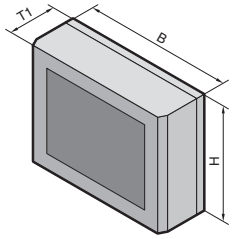
for support arm systems

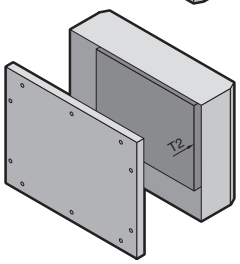
Fig.	Mounting component	Colour	Suitable for signal pillar		Model No. SG
			LED compact	modular	
8	for support arm system CP-L – Angle piece CP 6524.0X0 – Angle coupling CP 6526.0X0	RAL 9017 (traffic black)	■[1]	■[2]	**2375.000**
9	for support arm system CP-L – Intermediate hinge CP 6523.0X0 – Wall mounted hinge CP 6521.0X0 – Top mounted joint CP 6522.0X0	RAL 9017 (traffic black)	■[1]	■[2]	**2375.020**
10	for support arm system CP-S – Angle piece 90° CP 6501.140	RAL 7024 (graphite grey)	■[1]	■[2]	**2375.030**

Also required:

[1] Busbar connection adaptor SG 2372.120, see page 1041.
[2] Connection component SG 2368.000, see page 1042.

Monitors, keyboards





Premium TFT 17″, IP 69K

This high pressure cleaner-resistant complete solution is particularly well-suited for use in the food and hygiene sectors.

Technical specifications:
Resolution max.:
17″: 1280 x 1024 pixels,
VGA + SXGA non-interlaced
Colours: 16.7 million
Brightness: 250 cd/m²
Reading angle: 130° horizontal, 110° vertical
Contrast ratio: 300 : 1
MTBF backlight: 50,000 h
Voltage: 12 V DC
On Screen Display (OSD) at rear
VGA input: 15 pin D-Sub
Operating temperature: 0°C to +50°C

Material:
Stainless steel 1.4301

Surface finish:
Brushed, grain 240

Protection category:
IP 69K to DIN 40 050-9/5.93

Support arm connection	W (B) mm	H mm	D (T1) mm	D (T2) mm	Model No. SM
Bottom	530	360	120	70	**6450.100**
Top	530	360	120	70	**6450.110**

To order version in stainless steel 1.4404 (AISI 316L) please use Model No. SM 6450.5XX.
Delivery times on request.

Accessories:

Rear panel holder CP 6682.000,
see page 893.
Power pack SM 6450.050 and
connection cable SM 6450.060,
see page 1047,
if an operating voltage of 100 – 240 V AC is only available instead of 12 V DC.

TFT monitor

Installation variant for surfaces and command panels.
Particular benefits:
- High-quality industrial design
- Reduced installation work thanks to integral front frame
- No additional ventilation required
- Very small installation depth (73 mm).

Resistive touchscreen for operation with a pen, finger and glove.

Technical specifications:
Resolution max.:
15″: 1024 x 768 pixels, VGA + XGA non-interlaced
17″: 1280 x 1024 pixels, VGA + SXGA non-interlaced
Colours: 16.7 million
Brightness: 250 cd/m²
Reading angle: 130° horizontal, 110° vertical
Contrast ratio: 300 : 1
MTBF backlight: 50,000 h
Voltage: 12 V DC
On Screen Display (OSD) at rear
VGA input: 15 pin D-Sub
Operating temperature: 0°C to +50°C

Front frame:
Dimensions:
15″: W/H 430 x 343 mm
17″: W/H 482.6 x 354.8 mm
Aluminium, powder-coated in RAL 7035
Rear threaded bolts M5 (14 units)

Protection category:
IP 65 to EN 60 529/10.91, front

Supply includes:
Seal and hex nuts (for installation in surfaces) and VGA cables. Touchscreen with additional 5 V adaptor cable and driver CD-ROM.

	Model No. SM
Monitor 15″ [1]	**6450.010**
Monitor 17″ [1]	**6450.020**
Touchscreen 15″	**6450.030**
Touchscreen 17″	**6450.040**

[1] With anti-reflection coated safety glass screen

Also required:

Mounting kit CP 6053.500
(for installation in VIP 6000 and Optipanel),
see page 1037.
Power pack SM 6450.050 and
connection cable SM 6450.060,
see page 1047,
if an operating voltage of 100 – 240 V AC is only available instead of 12 V DC.

Rittal service:

Matching Optipanel operating hounsings,
see page 178.
Mounted in command panels,
see page 173.

Possible alternative:

Unit consisting of TFT monitor and Premium Panel, specificly designed for the food industry,
see page 1046.

Power pack

for TFT monitor and touchscreen

- With IEC 320 socket,
- With connection cable (1.5 m) and connector for connecting to the TFT monitor.

Dimension: 107 x 30 x 59 mm.

Technical specifications:
Input voltage: 100 – 240 V AC
Output voltage: 12 V DC

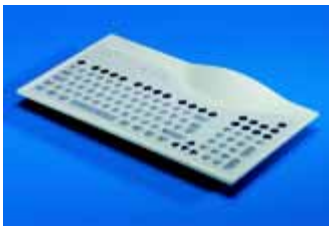
Packs of	Model No. SM
1	6450.050

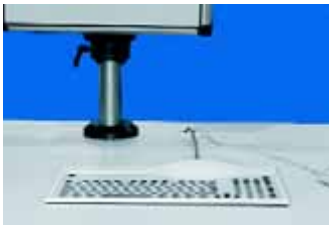
Material:
Enclosure: Plastic

Connection cable

for power pack
With IEC connector at one end,
length: 1.5 m.

Packs of	Model No. SM
1	6450.060





Desktop keyboard IP 65

Particularly well-suited to all areas with dusty or damp industrial atmospheres and places where hygiene is particularly crucial, such as in the food industry or medical technology.

- Sealed, wipeable surface finish.
- High level of mechanical and chemical resistance to DIN 42 115.
- Lenticular key caps and minimal typing force for optimum finger guidance and fast operation.

This makes it ideally suited for workstations where it is necessary to input large quantities of data.

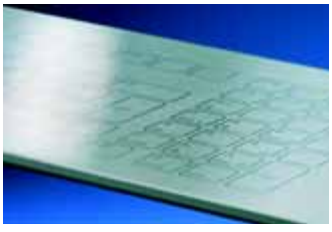
Supply includes:
Connection cable with PS/2 connector,
length 1.8 m.

	Model No. SM
Desktop keyboard	6446.000

Technical specifications:
Dimensions: 410 x 220 x 25 mm
105 keys
Actuation travel/force: 0.4 mm/2 N
Service life: ≥ 1 million switching cycles
Operating temperature: –20°C to +70°C
German layout

Rittal service:

Country-specific layout and USB connection available on request.



Stainless steel keyboard 19″/4 U

based on the piezo system.
With this innovative technology, merely tapping lightly with your finger is sufficent to initiate switching. There are no edges, cracks or hollows, as with conventional keyboards. This makes it particularly suitable for use in the food industry.

Technical specifications:
Dimensions of front panel:
482.6 x 177 x 3.7 mm
Installation depth 25 mm
105 keys
Actuation travel/force: 0 mm/0.7 N
Service life: ≥ 10 million switching cycles
Keypad: Abrasion-resistant electrolyte lettering
Operating temperature: –25°C to +75°C
PS/2 and USB connection
German layout

Material:
Stainless steel 1.4301

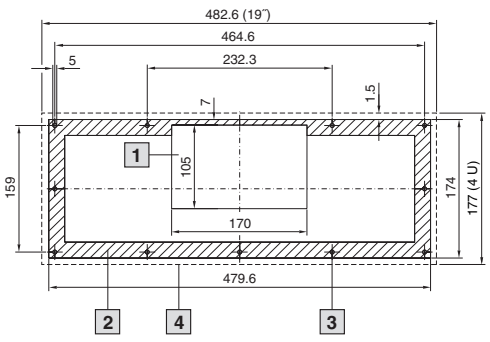
Protection category:
IP 69K to DIN 40 050/5.93

Supply includes:
1 connection cable, length 1.8 m,
with PS/2 connector and hex nuts.

	Model No. SM
Stainless steel keyboard	6446.010

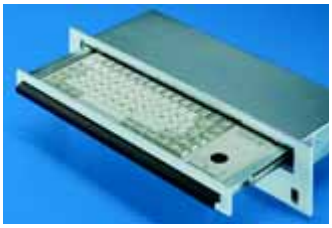
Rittal service:

Country-specific layout available on request.



1 Front panel cutout
2 Seal
3 Holes for fastening bolts
4 Contact surface

Monitors, keyboards



Keyboard, pull-out

with integral trackball
Super-slimline keyboard with cursor keys and trackball.

For installation in:
- Command panels VIP 6000 (see page 161) and Optipanel (see page 173) from installation depth 150 mm
- 482.6 mm (19″) systems
- Any sufficiently large surface (e.g. door, side panel)

Technical specifications:
- Keyboard:
  – 84 short-stroke keys, IBM-AT compatible (MF2), including cursor keys
  – With integral 16 mm trackball
  – German layout
  – Interface: 2 x 6-pole PS/2 DIN connector
  – Operating temperature: +5°C to +50°C
  – Storage temperature: –10°C to +60°C
  – Humidity: max. 95 % (no condensation)
- Front panel made from aluminium, with film similar to RAL 7035

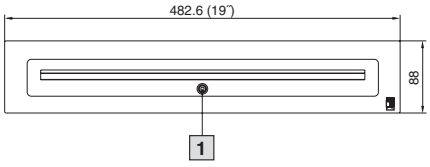
Protection category:
IP 65 (at the front, closed)
to EN 60 529/10.91

	Packs of	Model No. CP
Without lock	1	**6002.100**
With lock	1	**6002.110**

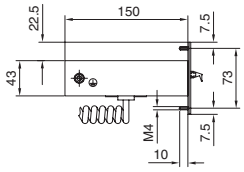
Note:
For sub-division of the operating front, a cross member is required for:
- VIP 6000 (see page 162, version 3.2). At the same time, the end trim (see page 163, version 3.4) must be selected.
- Optipanel (see page 174, version 2.2).

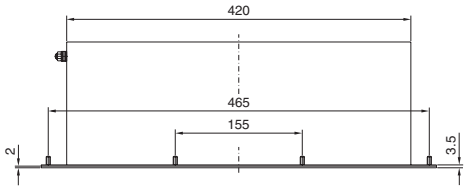
Accessories:

Standard double-bit lock insert may be exchanged for 27 mm lock inserts, version A, see page 888, and lock cylinders, version B, see page 889.

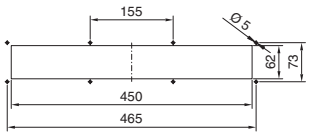


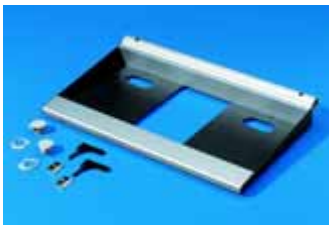
1 Optional lock (CP 6002.110)





Mounting cutout





Support

for keyboards
for max. 473 x 210 mm.
Prepared for
- Cable gland
- Support for mousepad, vertically hinged (SM 2383.020)

Material/surface finish:
Side parts: Sheet steel, RAL 7024
Front and rear:
Extruded aluminium section, natural anodised

Supply includes:
2 clamping screws, end stoppers, cover plate, cable entry grommet and nylon loop tape.

Rittal service:

Other widths available on request.
Fully mounted on the VIP 6000 (see page 160) or the Optipanel (see page 173) via the design code number.

Packs of	Model No. SM
1 set	**2383.000**

Also required:

For mounting on surfaces: enclosure surface connector, see page 1034.

Accessories:

Support for mousepad, vertically hinged, see page 1055.

Detailed drawing
for VIP 6000, see page 1100, for Optipanel, see page 1102.

Utility bars, vertically hinged

To support standard keyboards during programming and servicing work:
- min. width 300 mm
- max. depth 210 mm

For mounting beneath:
- VIP 6000 with narrow or combined frame
- Optipanel
- Command panel
- Command panel housing with door
- Adequately large surfaces (e.g. worktops IW)

to:
- Vertical services (doors/side panels)

After use, the utility bars fit securely and neatly under the mounting surface, thus giving the operator more space to move around.

Packs of	Model No. CP
1 set	**6514.200**

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Fold-out tray

for keyboard and mouse
For installation in
- 600 and 800 mm wide doors
- 482.6 mm (19″) swing frames and enclosures

Standard double-bit lock insert which may be exchanged for lock inserts 27 mm, version A, see page 888 and for lock cylinder SZ 2571.000, see page 889.

Material:
Cover: Sheet steel
Side parts: Cast aluminium
Tray: Extruded aluminium section

Surface finish:
Cover, side parts: RAL 7035
Tray: Natural anodised

Protection category:
IP 55 to EN 60 529/10.91

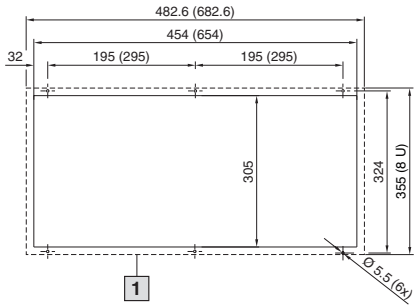
Accessories:

Mousepad support, pull-out, see page 1056.

Rittal service:

Other widths available on request.

Mounting cutout



1 Contact surface

For door width mm	External dimensions WHD mm	Installation depth mm	Max. keyboard size WHD mm	Model No. SZ
600	482.6 (19″) x 355 (8 U) x 126	93	405 x 50 x 250 405 x 50 x 195[1)]	**2379.600**
800	682.6 x 355 (8 U) x 126	93	605 x 50 x 250 605 x 50 x 195[1)] 475[1)] x 50 x 250	**2379.800**

[1)] Maximum keyboard size with holder for mouse.

Panel for monitors

for monitors with screen diagonals of up to 17″
For mounting between 482.6 mm (19″) mounting angles. Fitted with safety glass.

Material:
Sheet steel

Colour:
RAL 7035

U	Model No. DK
9	**7300.135**

Extended delivery times.

Monitors, keyboards

Keyboard rack, 482.6 mm (19″)

- 482.6 mm (19″) rack-mounted chassis 1 U, 430 mm deep
- Prepared for the installation of 482.6 mm (19″) keyboards with touchpad or trackball with the following dimensions:
  max. height: 39 mm,
  max. width: 417 mm,
  max. depth: 210 mm
- Solid, lockable front
- Telescopic slides with integral clamp
- Prepared for installation of a mousepad

Material:
Sheet steel

Packs of	Model No. RP
1	**3659.520**

Colour:
RAL 7035

Supply includes:
482.6 mm (19″) chassis **excluding keyboard,**
connection cable,
mounting bracket for 800 and 900 mm enclosure depth,
assembly parts.

Mousepad

for keyboard drawer

- For optional mounting on the left, right or front of the keyboard drawer (fold-away design)
- Maybe folded into the keyboard drawer after use
- Only suitable for use in conjunction with 482.6 mm (19″) keyboards with a total height of max. 39 mm (Model No. RP 3659.590)

Material:
Sheet steel

Packs of	Assembly	Model No. RP
1	right/left	**3659.620**
1	front	**3659.630**

Colour:
RAL 7035

Supply includes:
Assembly parts.

Keyboard, 482.6 mm (19″)

- Keyboard for installation in the 482.6 mm (19″) keyboard drawer in conjunction with the touch-pad mouse
- German keyboard layout
- 38.9 mm high keys facilitate installation in 1 U keyboard drawers
- PS/2 connector
- IP 20
- Touch-sensitive technology
- W x H x D = 405 x 38.9 x 180 mm
- 105 keys (including WIN 95 keys)
- Actuating force 0.6 N/4.0 mm
- Operating temperature: 0°C to 50°C

Packs of	Model No. RP
1	**3659.590**

Supply includes:
Connection cable.

TFT display, 15″

- 482.6 mm (19″) front panel 7 U, RAL 7035
- TFT LCD 15.1″
- Automatic brightness control depending on the ambient light
- Anti-reflection coated safety glass screen
- Brightness: 250 cd/m²
- On-screen display
- Colours: 16.7 million
- Power pack: Input voltage: 100 – 240 V AC, output: 12 V DC/3.75 A
- OSD membrane keyboard and infrared sensor
- VGA + SVGA, non-interlaced
- Maximum resolution 1024 x 768 pixels
- Contrast ratio: 300 : 1
- Viewing angle: 160° (H+V)
- Video input 15-pin D-SUB (analog RGB)
- RS 232 monitor interface

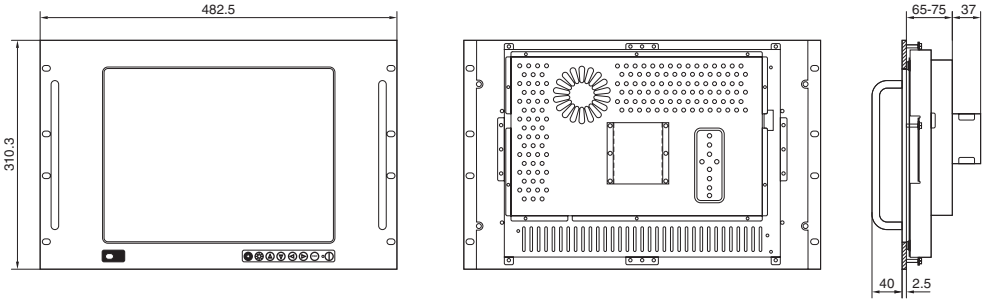
Packs of	Model No. RP
1	**3659.530**

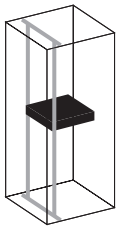
Material:
Front panel: Aluminium, powder-coated

Colour:
RAL 7035

Protection category:
Tested to EN 60 950 and
EMC directive 89/336/EEC.

Note:
Depth varies according to the display design (protective glass, touchscreen etc.).





Keyboard drawer 2 U

for one 482.6 mm (19″) attachment level
For keyboards up to 430 mm wide and 250 mm deep with the front panel folded over.

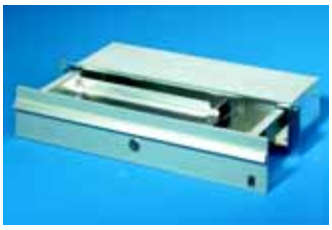
Material:
Sheet steel with aluminium front

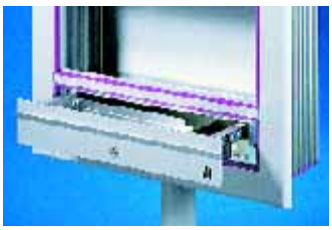
Colour:
RAL 7035

Supply includes:
Lockable drawer with handles,
folding front,
pull-out mousepad,
mouse support,
practical cable entry
and strain relief.

Height	Model No. DK
2 U	**7281.035**

To order in RAL 7032, please add the extension .000 to the Model No.
Delivery times available on request.
Installation depth: 390 mm.





Drawer 482.6 mm (19″)/2 U

for keyboard and mouse

For installation in:
- VIP 6000 command panel[1] (all installation depths **1** to **9**, see page 161).
- Optipanel Command Panel[1] (installation depth **3** = 150 mm, see page 173).
- Any sufficiently large surface. (e.g. door, side panel).
- 482.6 mm (19″) systems.

Suitable for
- Accommodation of keyboards up to a maximum of 390 x 32 x 139 mm.
- Support of standard commercially available mouse or trackball.

Design:
- Drawer:
  – with stay
- Font panel
  – with security lock (lock no. 12321)
  – with handle strip

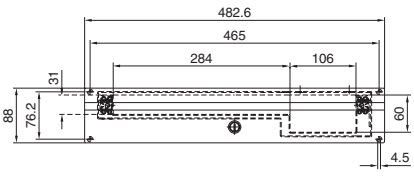
Width mm	Height	Depth mm	Model No. CP
482.6 (19″)	2 U	150	**6002.000**

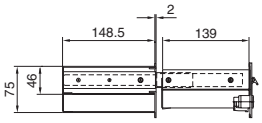
Material:
Drawer housing:
Sheet steel, zinc-plated, passivated
Drawer and front panel:
Aluminium, natural anodised.

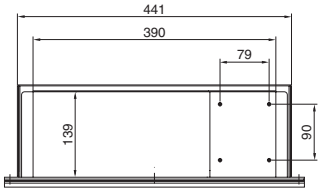
Supply includes:
Assembly parts for installation in
VIP 6000/Optipanel command panels.

Also required:

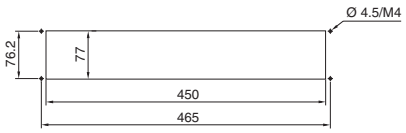
[1] For sub-division of the operating front:
- With VIP 6000, a cross member (recommended) or sealing bar is required (see page 162, version 3.2).
  At the same time, the end trim (see page 163, version 3.4) must be selected.
- With Optipanel, a cross member (see page 174, version 2.2) is required.



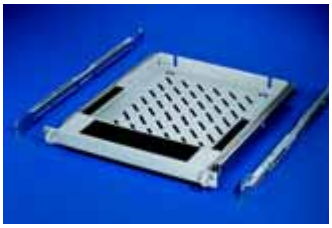




Mounting cutout
(for installation in surfaces)



Drawers for keyboards



Drawer 482.6 mm (19″)

for keyboard
For attaching to the 482.6 mm (19″) mounting angles front and rear. Suitable for standard keyboards larger than 482.6 mm (19″). Keyboard support with non-slip base, plus wrist support. Depth-variable installation from 610 – 950 mm. Clearance opening W x H x D:
408 x 40 x 550 mm.

Material:
Sheet steel

Colour:
RAL 7035

Supply includes:
Assembly parts, excluding keyboard..

Packs of	Model No. DK
1	**7063.888**

Keyboard drawer 1 U

for 482.6 mm (19″) attachment level
This space-saving keyboard drawer is screw-fastened to the front and rear 482.6 mm (19″) attachment level. The installation spacing is infinitely adjustable from 460 – 800 mm.
It is fully extendible, lockable, with strain relief and hinged cable support.
The drawer is suitable to accommodate 482.6 mm (19″) keyboards.

Interior dimensions:
W x H x D approx. 420 x 40 x 220 mm

Material:
Sheet steel

Colour:
RAL 7035

Supply includes:
Assembly parts, excluding keyboard.

Distance between levels mm	Model No. DK
460 – 800	**7281.200**

Accessories:

482.6 mm (19″) long-stroke keyboard with numeric keypad and touchpad, connection cable (approx. 1.15 m) and PS/2 connector, colour RAL 7035.

W x H x D mm	Keyboard layout	Model No. DK
415 x 37 x 193	German	**9004.400**
	US English	**9004.402**
	French	**9004.403**
	Spanish	**9004.404**
	Finnish	**9004.406**
	Swedish	**9004.407**

Drawer for keyboard

For a max. keyboard width of 500 mm.
Drawer with mousepad at the front.
A high level of protection is retained, even with the flap open.

Material:
Sheet steel

Colour:
RAL 7035

Protection category:
IP 55 to EN 60 529/10.91,
Complies with NEMA 12.

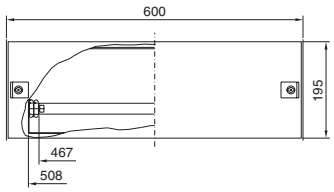
Supply includes:
Assembly parts.

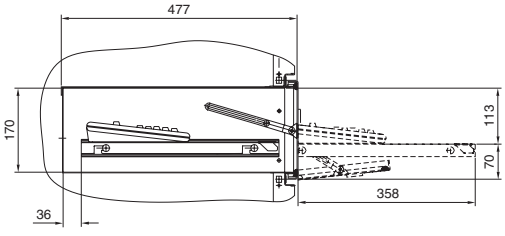
Note:
Only suitable for installation without mounting plate.

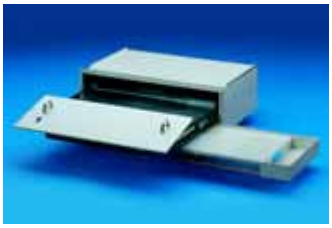
For universal console AP 2694.500	Model No. AP
	4757.500

Accessories:

Standard double-bit lock insert may be exchanged for 27 mm lock inserts, version A, see page 888.
Plastic handles, version B, see page 886.







Drawer for keyboard and mouse

with mousepad support

For installation in:
- VIP 6000 Command Panel[1)] (installation depth **4**, **6** or **8**, see page 161, 3.1)
- Any sufficiently large surface (e.g. door, side panel)

Suitable for accommodating
- Keyboards up to a maximum of 460 x 42 x 170 mm
- IP 67 mouse and mousepad
- Standard mouse and mousepad

Design:
- Drawer and enclosure
  – with side pull-out mousepad support and tray
- Font panel
  – with 3 mm double-bit lock insert
  – folds out as a wrist support

Width mm	Height	Depth mm	Model No. CP
482.6 (19″)	3.5 U	261	**6003.000**

Material:
Keyboard and drawer: Sheet steel
Front panel: Aluminium, natural anodised.

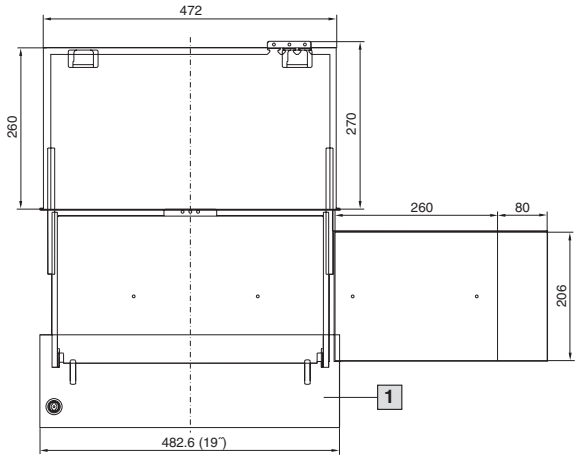
Supply includes:
Assembly parts for installation in VIP 6000 Command Panel.

Also required:

[1)] For sub-division of the operating front a cross member (see page 162, version 3.2) is required. At the same time, the end trim (see page 163, version 3.4) must be selected.

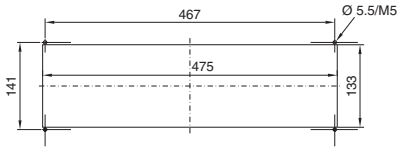
Accessories:

Mouse, mousepad IP 67, see page 1054.
Standard double-bit lock insert may be exchanged for 27 mm lock insert, version A, see page 888.



1 Front trim panel

Mounting cutout
for installation in surfaces



Drawer for keyboard and mouse

Bottom-mounting
Lockable with mousepad support, may be extended to the left and right, and hinged cable support for safe, pinch-free cable routing. Sealed cable entry for 3 cables (up to Ø 6 mm).

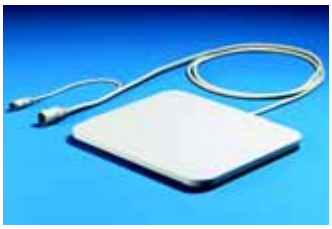
For mounting beneath
- Worktop
- Sufficiently large surfaces

Material:
Drawer housing:
Sheet steel, spray-finished in RAL 7035.
Drawer trim panel:
Plastic to UL 94-V0
in RAL 7035, 7015, 9006.

Protection category:
IP 55 to EN 60 529/10.91,
complies with NEMA 12.

Packs of	Model No. IW
1	**6902.910**

Mouse, mousepad



Mouse, mousepad IP 67

An ideal input device for all areas where heavy contamination is unavoidable, or where exceptional standards of hygiene are required, for example in the food industry or medical technology.
Because the mouse detects positions inductively, there is no need for a trackball, and the housing can be completely sealed with a protective film. This achieves a high protection category of IP 67. The mouse will only work in conjunction with the inductive mousepad IP 67.

Technical specifications:
PS/2 connection
Temperature range: 0°C to +55°C
Power consumption: < 20 mA
Cable lengths: 2000 mm

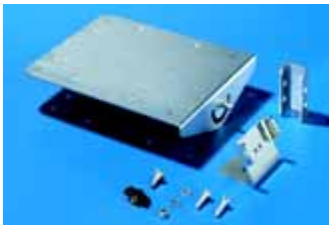
Material:
Mousepad: Plastic PBT
Mouse: Plastic ABS 9006.

Accessories:

Connector gland (SZ 2400.500),
see page 975.
Support for mousepad,
see page 1054.

	W x H x D mm	Colour RAL	Model No. SM
Inductive mousepad IP 67 PS/2 interface	250 x 205 x 15	similar to 7035	**6444.500[1)]**
Mouse IP 67 for mousepad SM 6444.500	–	similar to 7032	**6445.000**

[1)] German patent no. 198 51 619



Support for mousepad

for command panels and surfaces
To fit IP 67 mousepad SM 6444.500.
The angle of the mousepad support is individually adjustable.
Two holes are needed on the enclosure for attachment purposes.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Weight kg	Model No. SM
1.0	**2381.000**

Also required:

Vertical handle set for wide frame (for mounting on VIP 6000 with wide front frame),
see page 1033.

Accessories:

Holder for mouse,
see page 1055.
Mouse, mousepad IP 67,
see page 1054.

Holder for mouse

To match the mousepad support and for secure accommodation of a standard mouse or the IP 67 mouse SM 6445.000.

Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Weight kg	Model No. SM
0.3	**2382.000**

Also required:

Support for mousepad,
see page 1054.

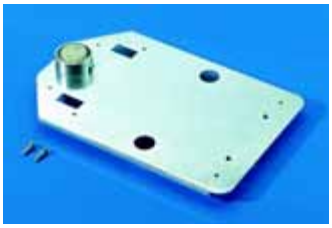
Mousepad, passive

For installing in PC enclosures based on ES.
Pulls out to the front or on the left or right.

For folding keyboard of PC enclosure/case	Model No. PC
4603.920 4617.920	**4613.000**

German patent no. 43 30 926

For drawer of PC enclosure/case	Model No. PC
4603.603 4603.913 4609.703 4617.703	**4614.000**



Support for mousepad, vertically hinged

For mounting on the left/right, beneath support for keyboards. Latches home automatically, both when retracted and extended.
With attachment holes for:
- Mousepad IP 67 (SM 6444.500)
- Mouse holder (SM 2382.000) to accommodate the IP 67 mouse.

With cutouts for cable routing and holes for attachment via cable ties, for fast assembly (SZ 2597.000).

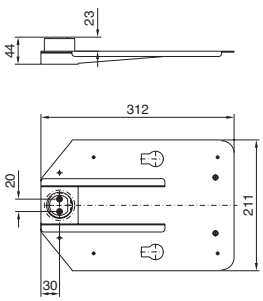
Material:
Sheet steel, zinc-plated, passivated

Supply includes:
Assembly parts.

Packs of	Model No. SM
1	**2383.020**

Accessories:

Mouse, mousepad IP 67,
see page 1054.
Holder for mouse,
see page 1055.
Cable ties,
see page 982.



Mobile workstation

Support for mousepad, pull-out

with mouse holder

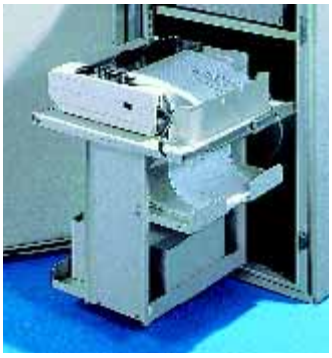
For screw-fastening into the fold-out tray SZ 2379.600/SZ 2379.800. To fit all standard mousepads up to 250 x 205 mm.

Note:
When installing the fold-out tray into the swing frame, the swing frame must be open in order to pull the mousepad out of the fold-out tray.

Packs of	Model No. SZ
1 set	**2379.900**

Accessories:

Mouse, mousepad IP 67,
see page 1054.



Printer rack

For installation in enclosures with
- 600 mm width
- 600 and 800 mm depth

Load capacity: 25 kg
Surface for printer (A4) 375 x 471 mm.

Material:
Sheet steel

Colour:
RAL 7035

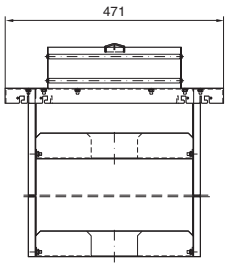
Supply includes:
Shelf for printer with telescopic slides,
paper tray and paper guide,
base for paper supply,
hinged cable support.

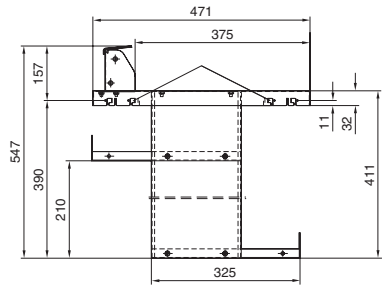
Packs of	Model No. PS
1	**4635.000**

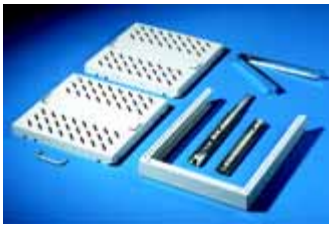
German patent no. 41 08 379
IR reg. design no. DM/016 439
with validity for BE, CH, DE, ES, FR, IT, LU, NL
French patent no. 2 660 534
GB patent no. 2 243 069

Also required:

For enclosure depth mm	For installation in TS, PC based on TS, 2 punched sections with mounting flanges, see page 921	ES, PC based on ES, 2 punched sections without mounting flanges, see page 925
600	TS 8612.060	PS 4376.000
800	TS 8612.080	PS 4377.000







Mobile workstation

for tower PCs, printers, UPS, servers etc.

Load capacity: 75 kg

Material:
Sheet steel

Colour:
RAL 7035

Supply includes:
1 mounting frame,
2 shelves, top/bottom,
1 set of telescopic slides,
1 handle,
1 cable support, hinged,
assembly parts.

Packs of	Model No. PC
1	**4641.000**

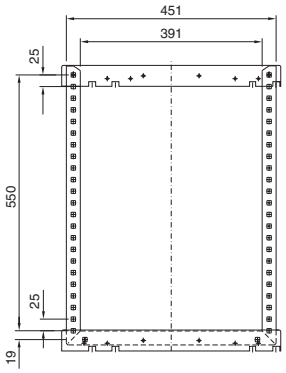
Also required:

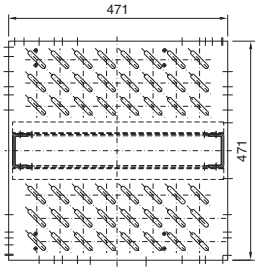
For enclosure depth mm	For installation in TS, PC based on TS, IW 2 punched sections with mounting flanges, see page 921	For installation in ES, PC based on ES 2 punched sections without mounting flanges[1], see page 925
600	TS 8612.060	PS 4376.000
800	TS 8612.080	PS 4377.000

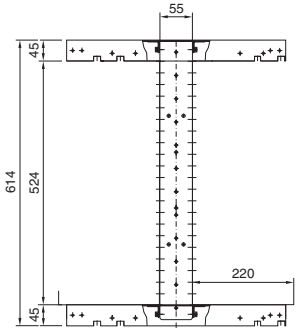
[1] plus:
4 support brackets, PS 4183.000, see page 933,
8 threaded blocks M6, PS 4162.000, see page 936,
8 screws M6, PS 2504.500, see page 937.

Accessories:

Fastening bolts DK 7115.000,
see page 953.
Shelf,
see page 1057.







Shelf

for mobile workstation
For additional equipment such as modems, power packs etc. or simply as a paper tray.
Installation heigth-adjustable on a 25 mm pitch pattern.

Material:
Sheet steel

Colour:
RAL 7035

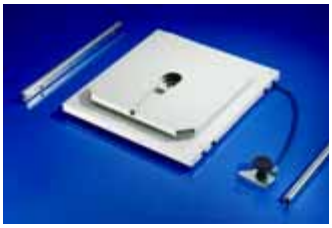
Supply includes:
Assembly parts.

Packs of	Model No. PC
1	**4642.000**

Accessories:

Fastening bolts DK 7115.000,
see page 953.

Printer accessories



Printer base, swivel

Operation of the printer for servicing purposes is possible, even in enclosures which are only accessible from the front.

Load capacity: 20 kg.
Surface for printer 340 x 360 mm.

Material:
Sheet steel

Colour:
RAL 7035

Supply includes:
Component shelf,
turntable with cable routing and stay,
telescopic slides.

To fit TS width x depth mm	Model No. IW
600 x 600	**6902.990**

Also required:

2 TS punched sections with mounting flages for enclosure depth of 600 mm,
see page 921.

Accessories:

Paper tray,
see page 1058.

Paper tray

for laser printers with rear output.
Printed pages are routed to the outside and collated. The door only needs to be opened for servicing purposes. This protects the printer against dust, humidity and theft. The paper tray may be mounted on surfaces with a width of 600 mm or more (e.g. door, side panel) and accommodates up to 20 pages of standard A4 paper.

Material:
Sheet steel

Colour:
RAL 7035

Supply includes:
Assembly parts.

Width x height x depth mm	Model No. IW
270 x 390 x 122	**6903.000**

Accessories:

Printer base, swivel,
see page 1058.

Rittal service:

Installation in doors and side panels on request.

Base

for tubular door frame
The space-saving alternative instead of component shelves to accommodate tower PCs (maximum 40 kg).
For screw-fastening to the tubular door frame of 600 mm wide enclosures based on TS.

Load capacity: 40 kg.

Material:
Sheet steel, spray-finished

Colour:
RAL 7015

Supply includes:
Retaining strap and assembly parts.

Width x height x depth mm	Model No. IW
495 x 159 x 230	**6902.950**

Also required:

Support strips for direct screw-fastening to the tubular door frame, see page 924.

Interface box

For secure accommodation for all common computer ports, 3½″ disk drives and sockets. The lockable metal cover provides a high mechanical load-bearing capacity, protects against unauthorised access and ensures an increased shielding effect for the installed equipment.

Modifications such as
- Other sizes
- Acrylic covers
- Cutouts for connectors etc.

are possible.

Material:
Frame:
Extruded aluminium section, powder-coated
Mounting tray:
Sheet steel, 1.5 mm, powder-coated
Flap:
Aluminium, 3.0 mm, natural anodised

Colour:
RAL 7035

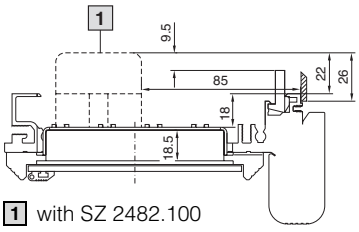
Supply includes:
Frame with hinged flap,
cam with security lock (No. 12321).
Mounting tray including seal and assembly parts.

Earthing-pin socket	Weight kg	Model No. SZ
Without	0.8	**2482.000**
With	0.8	**2482.100**

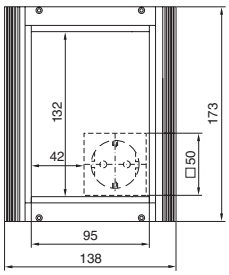
Rittal service:

Upon request, the interface box can be supplied with customer-specific cutouts, pre-installed in the operating housing. If required, please specify the desired treatment and installation position.

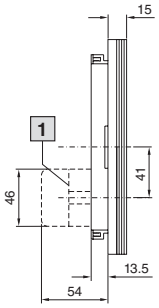
Mounting example in the VIP 6000:

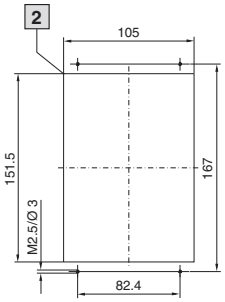


1 with SZ 2482.100
2 max. R3



Mounting cutout





Interface flap

The compact alternative to the interface box.
For secure accommodation of all standard sockets, computer ports, 3½″ or CD-ROM drives.
The cast aluminium flap ensures a high mechanical load-bearing capacity, and guards against unauthorised access.

For:
- Optipanel from D = 100 mm
- Any sufficiently large surface.

Standard double-bit insert may be exchanged for lock inserts, see page 881.

Material:
Flap: Cast aluminium, finely textured
Cover plate: Sheet steel 2 mm, zinc-plated, passivated

Colour:
RAL 7035

Protection category:
IP 65 to EN 60 529/10.91

Supply includes:
Seal and assembly parts.

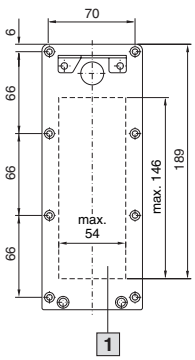
Packs of	Model No. SZ
1	**2482.200**

Note:
For side mounting in 100 mm deep Optipanels, a handle set (CP 6385.0XX, see page 1031), may be mounted, although not in the same place.

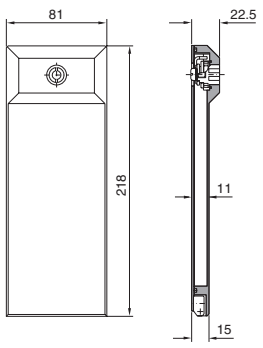
Rittal service:

Cutouts are possible in the cover plate and enclosure.
Available without cover plate on request.

View without flap



View with flap



1 Surface for interface cutouts

Planning/project management/selection

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- FAQs on our products

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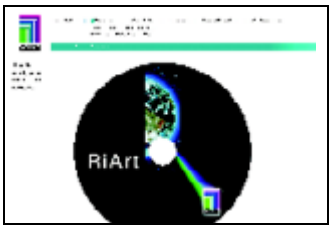
More detailed information can be found on the Internet.



RiArt

The electronic price list with product catalogue offers you:
- Data sheets in HTML, text and PDF format
- Excel price list
- DATANORM/ELDANORM component database
- Catalogues to eCl@ss/ETIM/BMEcat
- Shopping basket with Excel interface
- Component data for SV-Plan and EPLAN
- Contract tender texts
- DWG catalogue drawings
- Assembly instructions
- Quick climate calculation
- Software demo
- PDF pages from our latest brochures
- Accessory assignment

System requirements (minimum):
- Processor Pentium 233
- Internet Browser Version 4 or higher
- Adobe Acrobat Reader version 4 or above

Installation:
- Installation is not necessary. The program launches automatically when the CD is inserted.
- For a manual launch, click on the file microweb.exe.

Note:
Please order your free copy from **www.rittal.de**

German language only.

PlanIT 1.0

From Rittal's extensive range of products and solutions, we have compiled the information that is specifically relevant for the planning of IT enclosures, IT infrastructure and data centres.

The following applications are contained on this CD:
- Product overview
- Product search
- Documentation
- Enclosure monitoring software
- Drawings (VISIO)
- Brochures
- Contract tender texts (TXT, DOC, PDF, GAEB format)
- Contacts and contact deatils
- Lists of materials

In order to help you find your way around the CD, we have adapted the interface of the planning software to our website.

System requirements (minimum):
- Windows 98/NT/2000/XP
- Adobe Acrobat Reader version 4.x or above
- Visio

Note:
The software PlanIT 1.0 is sent free of charge on CD. Request from **info@rittal.de**

German language only.

Planning/project management/selection

Rittal SV-Plan

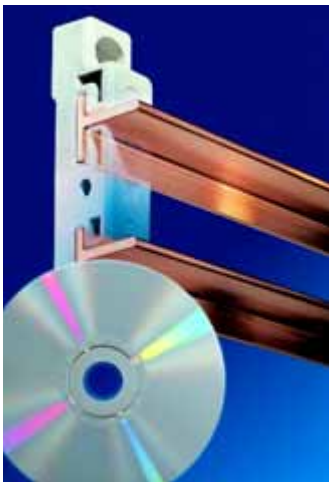
Rittal SV-Plan is an innovative tool for simple, time-saving project planning of Rittal SV busbar systems.
The network-compatible, multi-lingual software package includes the following functions:

- Planning certainty, thanks to logical allocation e.g. of standard commercially available power circuit-breakers to Rittal component adaptors.
- Detailed system and product information in the form of tender texts, product information, assembly instructions, CAD drawings etc.
- Integration of Rittal Power-Plan.
- Integration of a CAD interface based on Eplan View.
- Project documentation with calculations, parts lists and CAD system assembly drawing.
- Interfaces to all standard Windows applications such as Microsoft Word.
- Compatible with Eplan 5.

Supply includes	
CD-ROM	
Operating manual	
Language: German/English	
Model No. SV	**3020.100**

System requirements (minimum):

- Windows 95/98/NT/2000/XP
- RAM: 128 MB
- Hard disk capacity: at least 125 MB



Rittal Power-Plan

Rittal Power-Plan supports the calculation and documentation of busbar system assemblies with reference to the valid international test provisions. The network-compatible software provides a comprehensive database of power circuit-breakers.

The following calculations may be performed with Rittal Power-Plan:

- Testing the short-circuit resistance of the entire system assembly to IEC 60 865-1 or DIN VDE 0103.
- Testing the rated current load limit of the busbar system to DIN 43 671.
- Testing the heat loss of the entire system assembly, for D/NH fuse inserts to VDE 0636.
- Testing all data inputs for plausibility with corresponding, clear error messages.
- Calculations/documentation in accordance with IEC 60 439-1/EN 60 439 and DIN VDE 0660 part 500.

Supply includes	
CD-ROM	
Operating manual	
Language: German/English	
Model No. SV	**3020.000**

System requirements (minimum):

- Windows 95/98 or NT
- RAM: 8 MB
- Memory space required: 20 MB

ISV order software

for distribution enclosures

The ISV order software gives peace of mind when preparing a bill of materials, thanks to its logic. Specifically, this means that all the essential and optional accessory components are available to choose from a broad selection, and can be added to your shopping basket with a click of the mouse. Drawings support the user when selecting components.

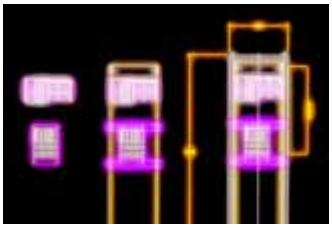
System requirements (minimum):

- Windows 98/ME/NT/2000/XP
- Pentium 90
- RAM: 16 MB
- Memory space required: 11 MB
- Resolution 800 x 600 pixels or higher
- Internet Explorer 4.0 or higher
- For the use of all functions, MS Excel and a CAD program with DXF import function are also required.

Language: German/English

Note:
Please download free of charge from
www.rittal.com/Service/Downloads/Software

Planning/project management/selection



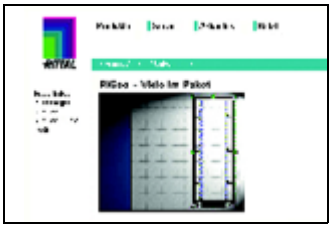
RiGeo

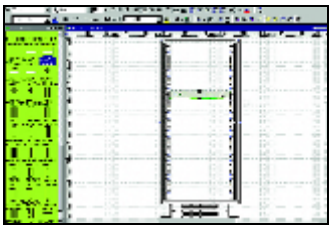
From the design into the CNC machine
With the RiGeo CD-ROM, Rittal offers an extensive library of geometry data for virtually all Rittal products in a variety of views and data formats. The files on the CD-ROM are divided into directories based on individual product groups to simplify the search process. It also supports a database search function.
Installation on the hard disk is not necessary, since the data may be read directly from the CD-ROM into your CAD system.

Features in brief:
- No unnecessary, memory-consuming storage on the hard disk.
- Simple positioning of accessory components.
- The correct format to suit every application.
- Representation to scale, suitable for CNC machining.

Supply includes	
CD-ROM	
Language: German/English/French/Dutch	
Model No. SZ	**2406.100**

System requirements (minimum):
- AutoCAD from Release 12 or LT for DOS or Windows or CAD with DXF interface





RiGeo + Visio package

The benefit to you:
The combination of the Visio program and the drawing library RiGeo offers perfect documentation of your projects in the shortest possible time.

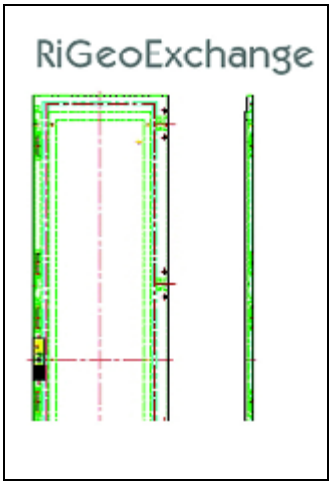
Features in brief:
- Carry out design and project planning work quickly and easily.
- No lengthy training needed.
- All Visio and DXF drawings are readily integrated.

Supply includes:
The package comprises:
- Several thousand DWG and DXF drawings of Rittal components.
- Visio drawings of TS network enclosures and accessories.
- The CAD drawing program “Visio 2000 Technical International Edition (English)”.

Drawing library and program for the preparation of precise technical drawings
With the drawing program “Visio 2000 Technical Edition”, technicians and engineers have at their disposal all the drawing tools needed to produce precise two-dimensional drawings and diagrams. Existing CAD drawings may be inserted into Visio 2000 Technical Edition drawings. You can cut and move the drawings, and show or mask out individual layers.

Supply includes	
CD-ROM	
Language: German/English	
Model No. SZ	**7700.200**

System requirements (minimum):
- Pentium 166 MHz, 64 MB RAM
- 125 MB free memory on the hard disk for Visio
- 400 MB free space for RiGeo



RiGeo Exchange

CAD components library for data exchange
The software offers significant benefits for all designers and technicians when preparing technical drawings of the Rittal enclosure and case systems AE, KL and TS.
- Rapid access to all essential drawings. RiGeo Exchange will immediately make the required detailed drawings available in the CAD file formats DWG and DXF for all standard CAD programs.
- Perfect generation of individual designs. Our customers receive all the necessary details to position cutouts and holes correctly on the electronic drawing board.
- Shorter delivery times. Depending on the type of modifications, drawing data may be forwarded directly into our machines for laser-cutting, nibbling and punching.

Note:
The software RiGeo Exchange is sent free of charge on CD.
Order your copy at **info@rittal.com**

RiDiag II

RiDiag II is a tool for diagnosing the operating behaviour of Comfort controller-regulated cooling units. By connecting a PC, it is possible to retrieve error messages, temperatures and capacity utilisation levels of the cooling units which are stored in the Comfort controller. The system includes integrated temperature measurement from four sensors in the cooling unit, and also features graphical representation of the temperature development over time.

Supply includes	
CD-ROM	
Connection cable	
Language: German/English/Italian	
Model No. SZ	**3159.100**

System requirements (minimum):
- Windows 95/98/2000/NT

CMC-TC Manager

For detailed information, see page 789.

Note:
The CMC-TC Manager may be downloaded free of charge from the Internet at **www.rittal.com, www.cmc-tc.com**.

CMC-TC Configurator

For detailed information, see page 788.

Note:
The CMC-TC Configurator may be downloaded free of charge from the Internet at **www.rittal.com, www.cmc-tc.com**.

Therm Software

Rittal Therm is a calculation program for climate control of enclosures.
All electrical and electronic components have a certain power loss which is dissipated to the environment in the form of heat. Because an increasing number of components are now being housed in ever smaller spaces, the heat produced can soon reach levels which are harmful to electronic components and may severely curtail their useful lives.
The Therm software package takes care of the complex calculation of climate control requirements. A user-friendly interface guides the operator to the most suitable, correctly dimensioned climate control component. All evaluations are closely based on the requirements of IEC/TR 60 890 AMD 1/02.95 and DIN3168 for enclosure cooling units.
Rittal Therm contains 15 languages.

Supply includes	
CD-ROM	
Model No. SK	**3121.000**

System requirements (minimum):
- Windows 95/98/ME/NT/2000/XP
- Adobe Acrobat Reader version 4.x or above

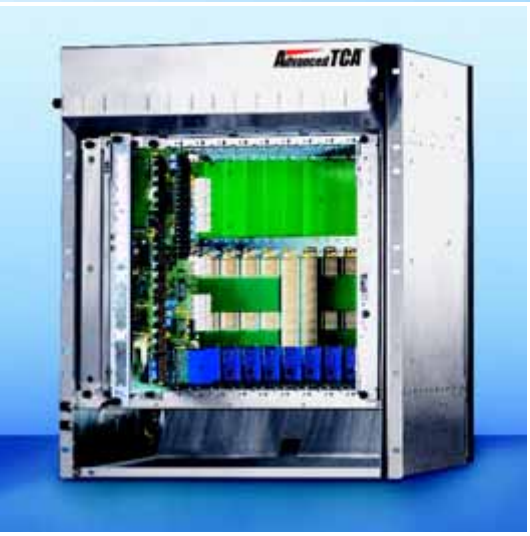
Note:
Your 30-day trial version may be downloaded free of charge from **www.rittal.com**

System integration

Rittal IT solutions – a broad spectrum of services for individual, complete packages.

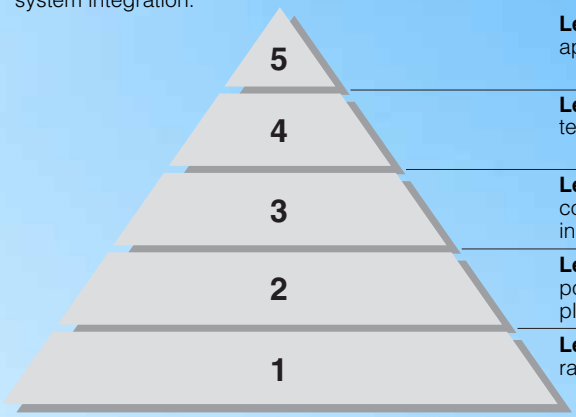
Thanks to **modular, mass-produced system components,** Rittal is able to achieve the optimum individual solution for every client, **quickly and cost-effectively.** Complete solutions, with no ifs or buts.

The extensive Rittal range, including climate control components, control and monitoring technology, system accessories and hardware components such as monitors and keyboards, is available for the configuration of individual solutions. **The benefits of system integration are as follows:** Only one project partner, significantly reduced planning and assembly work, and minimal logistics and procurement input. Rittal IT solutions – Simple and complete.



Rittal system integration up to Level 4

This is the cumulative result of extensive in-depth consultations and precision planning. For example, with climate control, power supply and security management through to Level 4 system integration.



Level 5: Level 4 with I/O and application software, tested

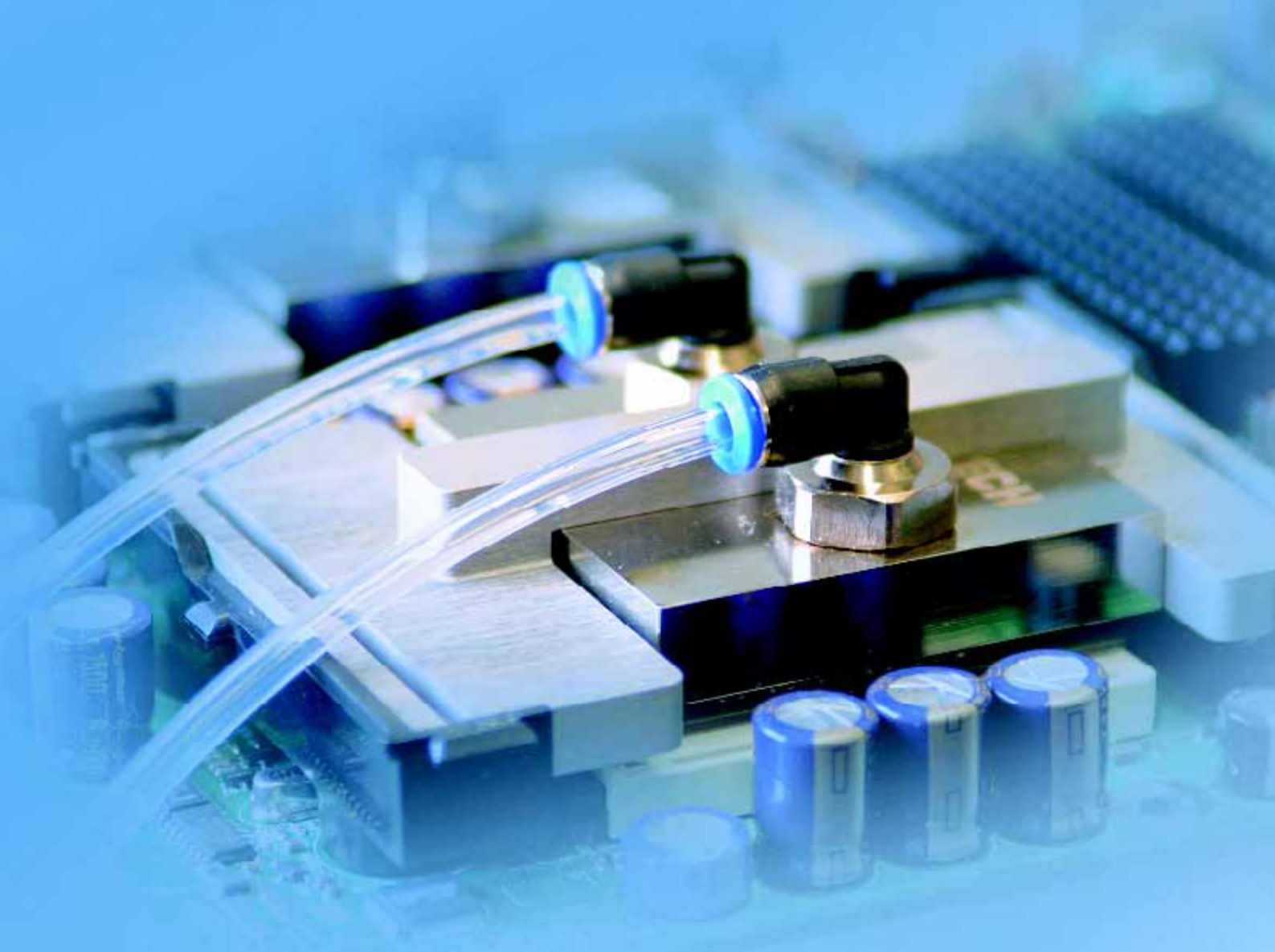
Level 4: Level 3 with integral boards, tested

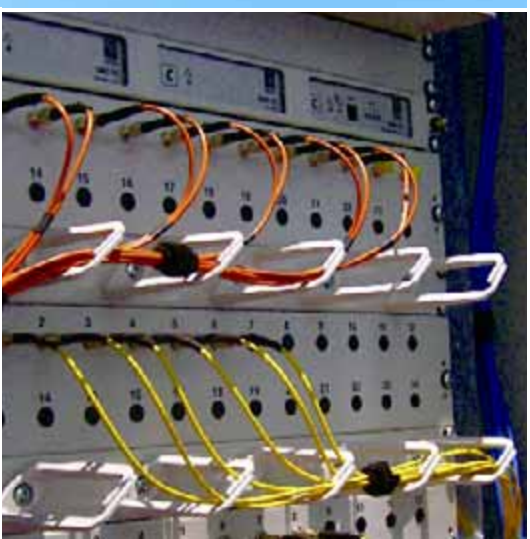
Level 3: Integration, wiring of various components (e.g. MPS systems including backplane, power pack)

Level 2: Pre-configuration, population (e.g. subracks, backplanes, front panels)

Level 1: Components (e.g. guide rails, connectors, etc.)

The complete Rittal IT solutions know-how for products and services is a coordinated, integrative system. It comprises advice, planning, prototype construction, individual production and assembly, as well as distribution tailored to customer requirements.





To suit your applications

Rittal views every customer requirement as a challenge. The **extensive product portfolio** with the matching system accessories and the **comprehensive range of services ensures that your requirements** are met.

2

3

4

Top quality ex-works

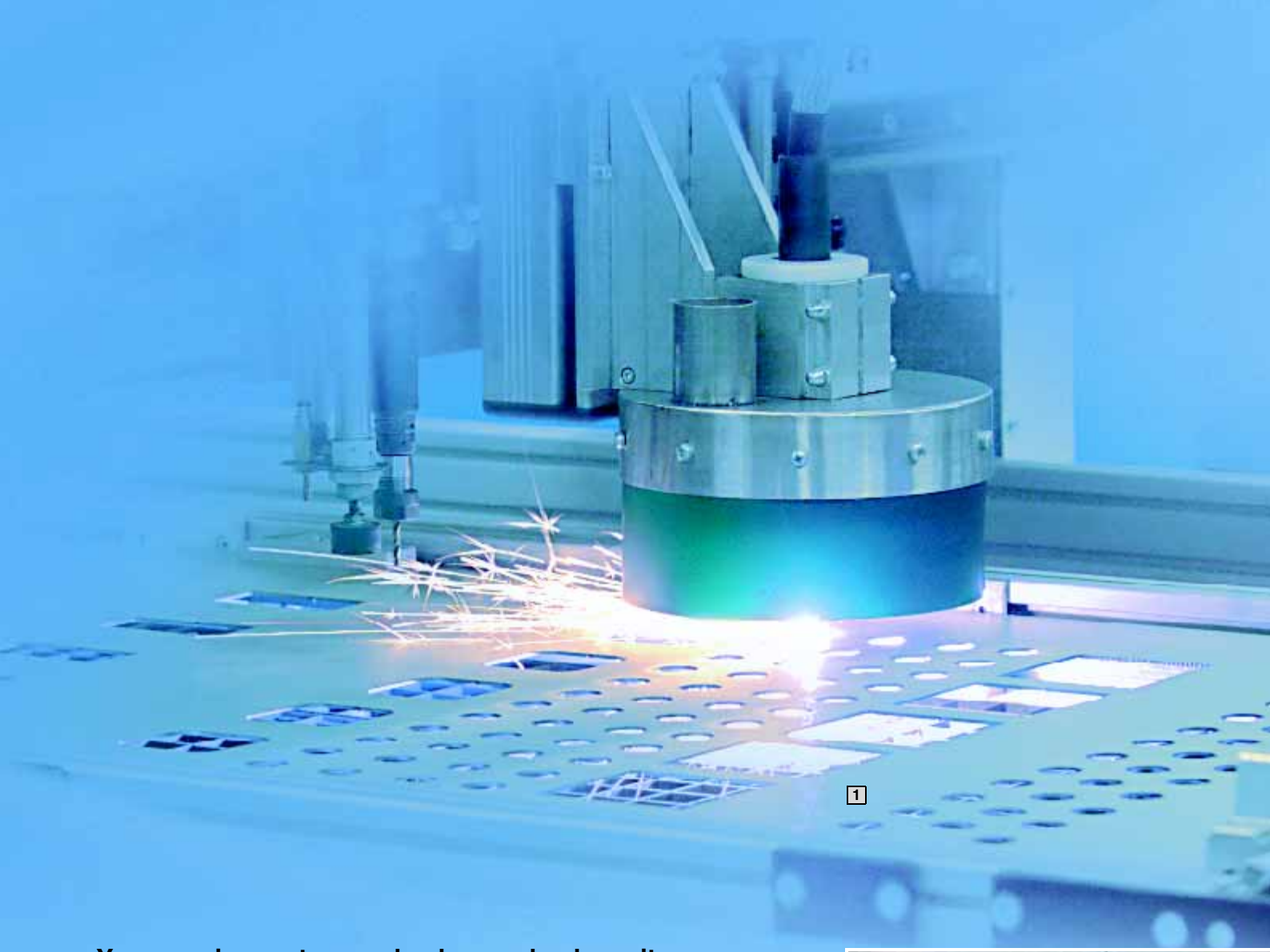
Rittal combines mass production with customisation in a variety of ways, to your benefit.

1 **Mass-produced individuality**
Cutouts and holes are made in the factory, prior to surface coating. The advantage: Unrestricted corrosion resistance.

2 Modified **dimensions**
With the Optipanel command panel, individual sizes come as standard.
Special sizes can also be produced for our other product series.

3 **Mounting of accessories**
The comprehensive range of Rittal system accessories and assembly ex-works offer cost advantages.

4 **Project-specific production**
...such as this rack for mobile railway technology.



Your requirements can also be resolved on site

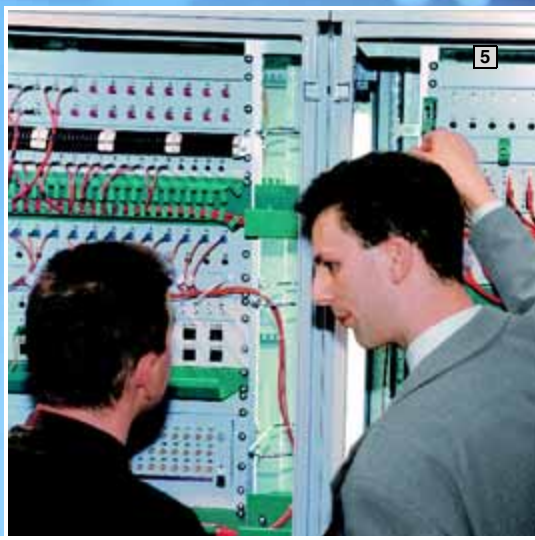
We put our good advice into practice. Impressive solutions, achieved with partners in your proximity. Availability and service combine to create convincing results. Fast and cost-effective.

5 Advice, exhibitions, training
Get your product information hands-on! Discover new routes to practical, inexpensive solutions.

6 Preparing cutouts
Cutouts and drilled holes for climate control components, switches, instruments and monitors. Take the easy option.

7 Plug and play with system accessories
Opt for the ready-made solution. Opt to install base/plinths, side panels, fan-and-filter units, lights, punched sections, earth rails, CMC monitoring systems and many other modules from our extensive range of accessories.

This service offers substantial time and money savings.



1 **Herborn** is the collation point for outstanding ideas from all the world's markets, as well as being our research and development site.
Compact enclosures are also produced in Herborn.

2 **Rittershausen –** Rittal's birthplace, and the production site for all large enclosure systems. New techniques have been developed here for manufacturing the "ri-volutionary" profile of the new Top enclosure system TS 8, the system platform for a broad, future-oriented application range.

3 The factory in **Burbach** concentrates on the production of large enclosures (free-standing enclosures and bayed systems) and accessory components.

Rittal in Germany

Rittal draws on the technological expertise of entire regions. At the heart of Rittal's success are innovations consistently tailored to market requirements, encompassing the product range, the production techniques and our services. Specialist expertise is concentrated at each of our sites, using state-of-the-art production techniques. Each day, we produced thousands of products whose quality and perfection are a constant source of delight to our customers worldwide.

4 Climate control is a decisive safety factor in modern factory automation. In order to meet these growing requirements, the Rittal climate control factory in **Rennerod** has been fitted according to the very latest criteria.

5 Rittal **Wissenbach** specialises in the production of stainless steel enclosures and cases. The requirement profiles are corrosion protection and hygiene – particularly for the chemicals and food production industries.

6 Rittal **Bad Köstritz** utilises its knowledge of steel processing for the versatile components of enclosure interior installation. Customer-specific solutions are also realised here.

7 The new Rittal logistics centre in **Haiger** boasts an ideal location, with excellent motorway and rail links. CS Outdoor enclosures, with an emphasis on mobile communications applications, are developed and produced here.

Rittal in Asia and Australia

China is a key market for Rittal. The domestic market is booming, the regional proximity to Japan also offers a host of benefits, and the presence of multinational companies is constantly growing. For this reason, we also manufacture in China according to popular international standards, in one of the most modern enclosure and case production plants in the world.

The Indian economy is likewise showing impressive growth rates. In order to ensure that products are available within the shortest possible time, we have been producing enclosures and climate control components to international standards in India since 1997, for distribution throughout Asia and Australia.

1

1 Since November 2000, Rittal **Shanghai, China** has supplied the Chinese market, which already has a successfully established distribution network. Apart from industrial enclosures and cases, the focus is also on products for the IT market.

2 At the Rittal production site in **Doddaballapur, India** standardised enclosures and cases are mass-produced for the large Asian market. Here too, Rittal offers its renowned international customer service, as well as local advice and expertise.

3 Since 1998, a Rittal subsidiary in **Japan** has been offering customised solution diversity. The modification centre with state-of-the-art machinery and a flexible assembly team achieves customised requirements with speed and perfection, as well as offering integration of system accessories. Four locations with more than 6000 m^2 of storage space ensure market proximity and availability.

4 At the modification centre in Rittal **Australia**, mechanical modifications are carried out, and special panels and spray finishes are produced. These services are a perfect representation of the Rittal concept, “individual solutions on the basis of standard modules”.

Rittal in Europe and the USA

Europe: In Plymouth, England, the main focus is on enclosure technologies for electronics. Effective cooling is the theme of our plant in Valeggio, Italy. There, recooling systems with cooling outputs of up to 172 kW leave the factory, either as standard products or manufactured to individual specifications. With its favourable location, the Ertop plant in France supplies high-tech application sectors with packaging products. Meanwhile, in the USA: State-of-the-art, sales-oriented production plants in Urbana and Springfield serve the markets on the American continent. Here, the emphasis is on speed and meeting customer-specific requirements.

1 Rittal products for modern electronic packaging leave the Rittal plant in **Plymouth,** England for distribution around the world.

2 System climate control is the theme of the Rittal plant in **Valeggio,** Italy.
In 2003 a brand new production line commenced operation, producing recooling systems, cooling units, heat exchangers and fan-and-filter units on an area of 9500 m^2. One particular strength is the production of customised recooling systems.

3 On a production and administration site of 8700 m^2, products for discerning applications are manufactured, as well as providing a comprehensive customer service. Integral 482.6 mm (19″) solutions and enclosures for the aviation and aerospace industries are just some of the specialities of the Rittal plant in **Ertop,** France.

4 The Rittal production and distribution centre at **Springfield,** USA serves the entire American market with modern, sales-oriented production and distribution control.

5 Rittal's largest distribution and production site outside of Europe is the plant in **Urbana,** USA. Here, predominantly large enclosures, PC enclosure systems and Top-Therm cooling units are produced on a site of around 20000 m^2. The affiliated logistics centre serves the entire US market.

5

4

To ensure a perfect solution, the final element needed is **technical background information.** Here, we supplement the order information with detailed drawings, load curves, parts lists and performance diagrams. Additional **information and download options** such as approvals, CAD drawings or assembly instructions are available from **www.rittal.com.**

The CD-ROM has the same content as the Catalogue – with added user-friendliness. Cross-references help you to arrive quickly at the desired solution.

What is more, whilst online, any Model Number will take you directly to further information in the Rittal database on the Internet.

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Surface protection

The triple treatment of outer surfaces – phosphating, electrophoretic dipcoat-priming and textured powder-coating – provides optimum corrosion protection for enclosures such as TS, AE, KL. In order to ensure optimum corrosion protection in all climatic zones, the materials aluminium or zinc-plated metal with subsequent zinc phosphating and powder-coating are used for outdoor enclosures.

The standard coating is resistant to:

- Mineral oils
- Lubricants
- Machining emulsions
- Solvent (briefly e.g. for cleaning)
- Weak acids and alkalines.

This has been tested and confirmed by various independent test institutes.

Quality is ensured by continuous process monitoring.

Priming or powder coating suitable for overpainting

After careful cleaning of the surface, the standard coating may be overpainted with:

- DD gloss paints
- Single and dual-component gloss paints
- Car repair paints
- Powder paints
- Water-based paints

If in doubt, perform a compatibility test. Always follow the paint manufacturer's instructions. When overpainting, take care not to exceed 180°C and a baking time of 15 minutes.

Special coatings

Tropical coating:
For high corrosion resistance in warm, damp climates, also suitable for outdoor and long-term use.

Chemical paint:
For the best possible resistance to organic and anorganic substances that can be achieved with paint.

Outdoor use of enclosures

In order to guarantee satisfactory long-term function of enclosures in outdoor use, the relevant environmental factors need to be taken into account.

These include:

- UV radiation, the corrosive action of air pollution, rain, icing, snow, wind or other factors in special climatic conditions.

Influence of weather conditions on the outer coating
It is necessary to ensure the UV and corrosion resistance of components exposed to the weather. A special 3-phase paint finish is suitable for outdoor siting in European climates. For outdoor siting of an enclosure, a rain canopy should be provided to protect the seal against permanent humidity and UV radiation.

Condensation inside the enclosure
Condensation needs to be prevented by means of appropriate measures, e.g. by venting or heating the enclosure.

Protection category
The enclosure is exposed to extreme weather conditions during outdoor use.
Long periods of rain, snow, ice, high winds and temperature fluctuations place particularly high demands on the enclosure sealing. Often, the protection category for outdoor weather exposure prescribed in DIN VDE 0100, part 737, point 5.2, IP X3 is insufficient to provide permanent protection of electrical installations.

Standard IEC 60 529 offers the option of labelling with the supplementary letter "W". Enclosures thus labelled are suitable for use in weather conditions agreed between the manufacturer and the user, and are equipped with additional protective features or techniques (e.g.: rain canopy, special spray finish, special colour shade).

The three-phase coating process for enclosures

Coating procedures	Technical properties	Technical specifications	
Degreasing, iron phosphating, rinsing	Used for passivation, as a temporary corrosion protection, and to improve paint adhesion.		
Anodic dipcoat priming	Even layer formation on all surfaces, edges and in cavities, which produces a high level of corrosion protection even at the assembly stage.	Coat thickness	approx. 20 µm
		Erichsen cupping DIN EN ISO 20 482	≥ 4 mm
		Buchholz hardness DIN EN ISO 2815	≥ 80
		Cross cutting DIN EN ISO 2409	Gt 0
	The primer is readily overpainted and free from heavy metals, chromate and silicone.		
Stove enamelling			
Textured powder coating	Powder coating is distinguished by a high level of mechanical resistance, excellent corrosion protection, good resistance to chemicals, temperature and weather, and its facility for decontamination.	Outer coating thickness	60 µm . . . 110 µm
		Erichsen cupping DIN EN ISO 20 482	≥ 4 mm
		Buchholz hardness DIN EN ISO 2815	≥ 80
		Cross cutting DIN EN ISO 2409	Gt 0
	The powder coating is readily overpainted and is free from heavy metals, chromate and silicone.		
Stove enamelling		Overall outer coating thickness	Ø 80 µm . . . 135 µm

Protection categories to IEC 60 529

The IP protection category is characterised by 2 numbers.

Example of protection category: e.g. IP 43:

Code letters	
IP	
First characteristic numeral	Second characteristic numeral
4	3

Degrees of protection for protection against contact and foreign bodies: First characteristic numeral			**Degrees of protection for protection against water: Second characteristic numeral**		
First characteristic numeral	Degree of protection		Second characteristic numeral	Degree of protection	
	Description	Definition		Description	Definition
1	Protected against solid foreign objects with a diameter of 50 mm and greater	The object probe, a sphere 50 mm in diameter, must not penetrate fully[1].	1	Protected against vertically falling water drops	Vertically falling drops shall have no harmful effects.
2	Protected against solid foreign objects with a diameter of 12.5 mm and greater	The object probe, a sphere 12.5 mm in diameter, must not penetrate fully[1]. The articulated test finger may penetrate up to its length of 80 mm, but adequate distance must be adhered to.	2	Protected against vertically falling water drops when the enclosure is tilted up to 15°	Vertically falling drops must not have any harmful effects when the enclosure is tilted up to 15° in both directions from the vertical.
3	Protected against solid foreign objects with a diameter of 2.5 mm and greater	The object probe, a sphere 2.5 mm in diameter, must not penetrate at all[1].	3	Protected against spraying water	Water sprayed at an angle of up to 60° on either side of the vertical must have no harmful effects.
4	Protected against solid foreign objects with a diameter of 1.0 mm and greater	The object probe, a sphere 1.0 mm in diameter, must not penetrate at all[1].	4	Protected against splashing water	Water splashed on the enclosure from every direction must not have any adverse effects.
5	Dust-protected	The ingress of dust is not fully prevented, but dust may not enter to such an extent as to impair satisfactory operation of the device or safety.	5	Protected against water jets	Water splashed on the enclosure from every direction must not have any adverse effects.
6	Dust-tight	No ingress of dust at a partial vacuum of 20 mbar inside the enclosure.	6	Protected against powerful water jets	Water splashed on the enclosure from every direction in a powerful jet must not have any adverse effects.
			7	Protected against the effects of temporary immersion in water	Water must not ingress to such an extent as to cause harmful effects when the enclosure is temporarily immersed in water under standardised pressure and time conditions.
			9K[2]	Water with high-pressure/steam-jet cleaning[2]	Water directed at the enclosure from every direction under greatly increased pressure must not have any adverse effects.

[1] The full diameter of the object probe must not pass through an opening of the enclosure.
[2] This test is not regulated by EN 60 529, but by DIN EN 40 050, part 9.
Extracts from BS EN 60 259: 1991 are reproduced with the permission of BSI. Complete editions of the standards can be obtained by post from BSI Customer Services, 889 Chiswick High Road, London W4 4AL

NEMA

The **N**ational **E**lectrical **M**anufacturers **A**ssociation (NEMA) is a standards organisation in Washington, USA, which publishes a number of technical standards but does not test or certify products itself.

The following NEMA classification outlines the protection of individuals from unintentional contact with equipment and the protection of an enclosure from external factors.

Further information on protection categories may be found on the Internet at: **www.rittal.com**

UL/NEMA Type	Intended use and description
1	Enclosures for use predominantly inside. Protection against the penetration of foreign bodies.
3	Enclosures for use predominantly inside. Protection against the penetration of solid bodies, protection against the ingress of rain and dust and damage caused by icing.
3R	Enclosures for use predominantly inside. Protection against the penetration of solid bodies, protection against the ingress of rain and dust and damage caused by icing.
3S	Enclosures for use predominantly inside. Protection against rain, snow and foreign bodies. External mechanisms remain usable despite being coated in ice.
4	Enclosures for indoor or outdoor use. Protection against rain, foreign bodies, splashed water and hosed water and against damage caused by icing on the exterior of the enclosure.
4x	Enclosures for indoor or outdoor use. Protection against rain, foreign bodies, splashed water and hosed water and against damage caused by icing on the exterior of the enclosure.
12, 12K	Enclosures for use predominantly inside. Protection against dust deposits, foreign bodies and non-corrosive dripping liquids.
13	Enclosures for use predominantly inside. Protection against dust deposits, sprayed water, oil, and non-corrosive coolants.

The UL classifications are not directly comparable with IP protection categories, since both the test conditions and the evaluation of the test results are different.

Approvals and permits

Product certifications and approvals are key requirements for the global acceptance of industrial products.

Rittal products meet the highest internationally recognised quality yardsticks. All components are subjected to the most stringent testing in accordance with international standards and regulations.

The consistently high product quality is ensured by a comprehensive quality management system. Regular production inspections by external test institutes also guarantee compliance with global standards.

A precise allocation of products to marks of conformity can be found on our product and service pages on the Internet. **www.rittal.com**

Enclosure designs guaranteeing hygiene and effective cleaning

Special applications require special solutions – in terms of materials, design and security.

This is all the more true for applications in the foods and hygiene sector and in sensitive fields such as medical technology and pharmaceuticals.

Consequently, Rittal has been looking intensively at the quality standards in these branches and has subjected its products to stringent testing.

The CE symbol

All Rittal products subject to an EU Directive which envisages labelling are labelled CE.

Up-to-date manufacturer declarations for the respective products are available on the Internet at: **www.rittal.com**

Note:
The CE symbol is not a quality symbol. Conformity is certified by the manufacturer on an independent basis. This distinguishes CE labelling from approvals, which are issued by independent bodies.

Earthing

The earthing must be designed by the manufacturer of switchgear in accordance with the relevant VDE provisions or local regulations.

The enclosure packs generally contain earthing materials (screws, nuts, washers). The assembly instructions contain recommendations on installing a protective earth.

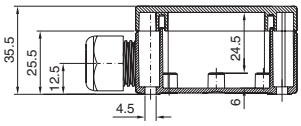
The pre-assembled earth straps available in various cross-sections and lengths, are intended to make assembly of a PE conductor easier.

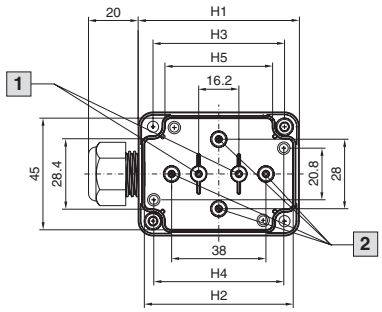
Further information can be found in our technical documentation “PE conductor connection, current carrying capacity”.

1.1 Polycarbonate enclosures PK

with cable gland Page 100

Model No. PK with cable gland	H1	H2	H3	H4	H5
9530.000	52	47	40	39.4	30.4
9531.000	65	60	53	52.4	43.4





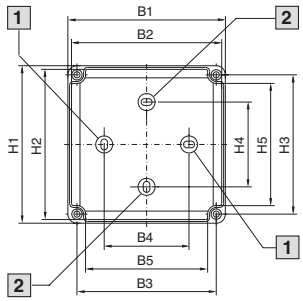
1 does not apply to PK 9531.000

2 does not apply to PK 9530.000

1.1 Polycarbonate enclosures PK

Page 100 – 101

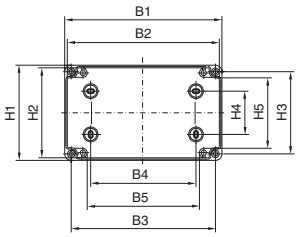
Version A



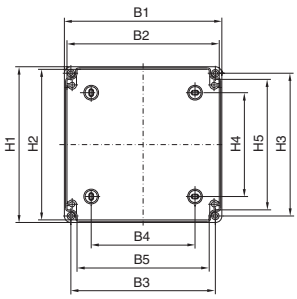
1 Does not apply to PK 9500.000, PK 9501.000

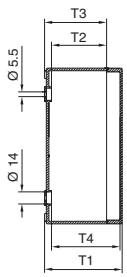
2 Does not apply to PK 9502.000, PK 9503.000

Version B



Version C





B1 = Enclosure width
B2 = Usable width
B3 = Centre/centre wall attachment outside the seal
B4 = Centre/centre wall attachment in the enclosure
B5 = Clearance width

H1 = Enclosure height
H2 = Usable height
H3 = Centre/centre wall attachment outside the seal
H4 = Centre/centre wall attachment in the enclosure
H5 = Clearance height

T1 = Overall depth
T2 = Usable enclosure depth
T3 = Enclosure depth
T4 = Clearance height available for installation

Model No. PK		Version	Width dimensions mm					Height dimensions mm					Depth dimensions mm			
Grey lids	Transparent lids		B1	B2	B3	B4	B5	H1	H2	H3	H4	H5	T1	T2	T3	T4
9500.000	–	A	65	59	50	–	36	65	59	50	25	36	57	33	41	45
9501.000	–	A	65	59	50	–	36	65	59	50	25	36	81	33	41	69
9502.000	–	A	94	88	79	50	64	65	59	50	–	36	57	33	41	45
9503.000	–	A	94	88	79	50	64	65	59	50	–	36	81	33	41	69
9504.000	**9504.100**	A	94	88	79	50	64	94	88	79	50	64	57	33	41	45
9505.000	–	A	94	88	79	50	64	94	88	79	50	64	81	33	41	69
9506.000	**9506.100**	A	110	104	95	65	80	110	104	95	65	80	66	42	50	53
9507.000	**9507.100**	A	110	104	95	65	80	110	104	95	65	80	90	42	50	77
9508.000	**9508.100**	A	130	124	115	90	101	94	88	79	50	64	57	33	41	45
9509.000	**9509.100**	A	130	124	115	90	101	94	88	79	50	64	81	33	41	69
9510.000	**9510.100**	A	130	124	115	70	101	130	124	115	70	101	75	51	59	63
9511.000	**9511.100**	A	130	124	115	70	101	130	124	115	70	101	99	51	59	87
9512.000	**9512.100**	A	180	174	165	120	150	94	88	79	50	64	57	33	41	45
9513.000	**9513.100**	A	180	174	165	120	150	94	88	79	50	64	81	33	41	69
9514.000	**9514.100**	B	180	173	165	120	128	110	103	95	50	80	90	63	71	75
9515.000	**9515.100**	B	180	173	165	120	128	110	103	95	50	80	111	63	71	97
9516.000[1)]	**9516.100**	B	180	173	165	120	128	110	103	95	50	80	165	63	71	150
9517.000	**9517.100**	C	182	175	167	120	152	180	173	165	120	128	90	63	71	75
9518.000	**9518.100**	C	182	175	167	120	152	180	173	165	120	128	111	63	71	97
9519.000[1)]	**9519.100**	C	182	175	167	120	152	180	173	165	120	128	165	63	71	150
9520.000	**9520.100**	C	254	247	239	190	224	180	173	165	120	128	90	63	71	75
9521.000	**9521.100**	C	254	247	239	190	224	180	173	165	120	128	111	63	71	97
9522.000[1)]	**9522.100**	C	254	247	239	190	224	180	173	165	120	128	165	63	71	150
9523.000	**9523.100**	B	360	355	346	240	309	254	248	239	190	224	111	63	71	97
9524.000[1)]	**9524.100**	B	360	355	346	240	309	254	248	239	190	224	165	63	71	150

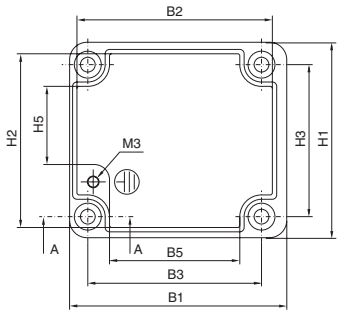
[1)] with slanted lid

Small enclosures

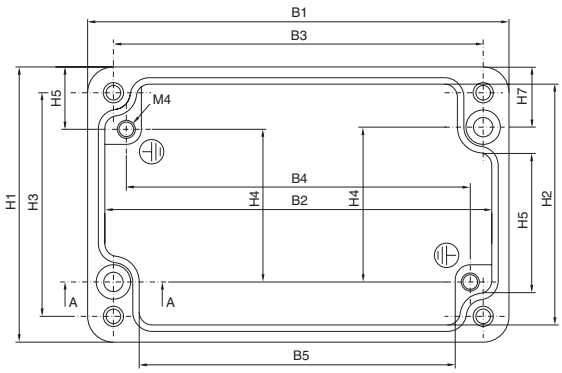
1.1 Cast aluminium enclosures GA

Page 104

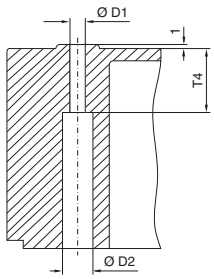
Version A



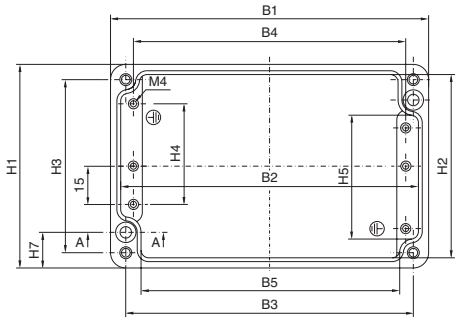
Version B



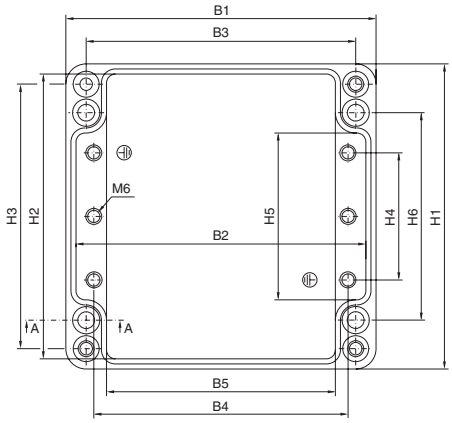
Section A – A

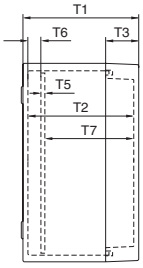


Version C



Version D





Note:
For installations manufactured by the customer, the width and height dimensions of the mounting plate (see page 105) must not be exceeded. For enclosures where no mounting plate is available, the following dimensions shall apply analogously:

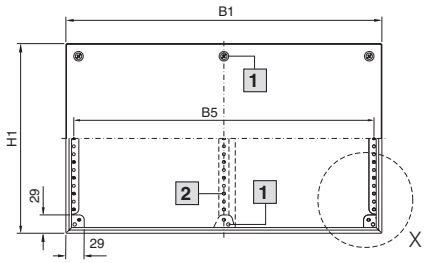
Model No. GA	Width (B) mm	Height mm
9100.210	43	38
9101.210	48	54
9102.210	88	54
9103.210	140	54
9104.210	64	69

Model No. GA	Version	Width dimensions mm					Height dimensions mm							Depth dimensions mm							Diameter mm	
		B1	B2	B3	B4	B5	H1	H2	H3	H4	H5	H6	H7	T1	T2	T3	T4	T5	T6	T7	D1	D2
9100.210	A	50	45	40	–	30	45	40	35	–	18	–	–	30	25	6	5.5	–	–	–	4.2	7.5
9101.210	B	58	50	46	40	34	64	56	52	35	32	–	14	36	29	10	9	–	–	–	4.5	8
9102.210	B	98	90	86	80	75	64	56	52	35	32	–	14	36	29	10	8	–	–	–	4.5	8
9103.210	B	150	142	138	132	126	64	56	52	35	32	–	14	36	29	10	9	–	–	–	4.5	8
9104.210	C	75	67	63	57	52	80	72	68	39	48	–	14	57	50	15	11.5	–	–	–	4.5	9
9105.210	C	125	117	113	106	99	80	72	68	39	48	–	14	57	50	15	10	1.5	7	41.5	4.5	8.5
9106.210	C	175	167	163	156	152	80	72	68	39	48	–	14	57	50	15	10.5	1.5	6	42.5	4.5	9
9107.210	C	250	242	238	231	226	80	72	68	39	48	–	14	57	50	15	10	1.5	6	42.5	4.5	8
9108.210	D	122	113	106	95	90	120	111	104	52	64	82	–	80	72	20	18	1.5	9	61.5	6.5	10.8
9110.210	D	220	211	204	195	183	120	111	104	50	64	82	–	90	82	30	15	1.5	9	69.5	6.8	11
9111.210	D	360	349	344	333	326	120	111	106	52	64	82	–	80	72	20	19	2	9	61	7	10.8
9112.210	D	160	151	140	130	120	160	151	140	76	90	110	–	90	82	20	20.5	2	9	71	6.2	12.5
9113.210	D	260	251	240	230	220	160	151	140	76	90	110	–	90	82	20	18	2	9	71	6.3	14
9114.210	D	360	351	340	330	316	160	151	140	74	84	110	–	90	82	20	19	2	9	71	7.1	14
9116.210	D	200	191	180	170	160	230	221	210	144	160	180	–	110	102	20	19	2	9	91	7.3	14
9117.210	D	280	271	260	250	240	230	221	210	144	160	180	–	110	102	20	24	2	9	91	6.2	14.2
9118.210	D	330	321	310	300	290	230	221	210	144	160	180	–	110	102	20	24.5	2	9	91	6.2	14.2
9119.210	D	330	321	310	300	290	230	221	210	144	160	180	–	180	172	20	14	2	10	160	7.5	12.5

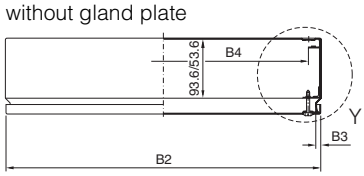
1.1 Terminal boxes KL

Spray-finished Page 107 – 109

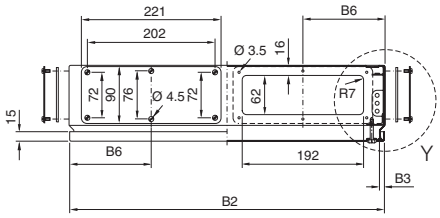
Stainless steel Page 270



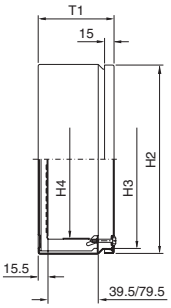
without gland plate



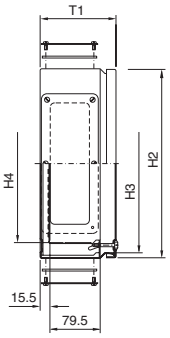
with gland plate



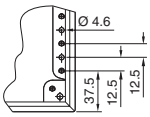
without gland plate



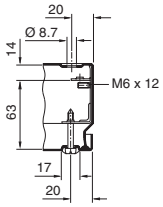
with gland plate



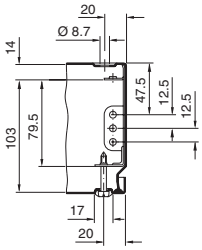
Detail X



Detail Y
T1 = 80



Detail Y
T1 = 120



B1 = Overall width
B2 = Cover width
B3 = Clearance width of enclosure
B4 = Clearance frame/width between profile strips
B5 = Distance between axes of the mounting holes in the profile strips
B6 = Distance from outer edge of enclosure to centre of gland plate

H1 = Overall height
H2 = Cover height
H3 = Clearance height of enclosure
H4 = Clearance frame/height between profile strips

T1 = Overall depth

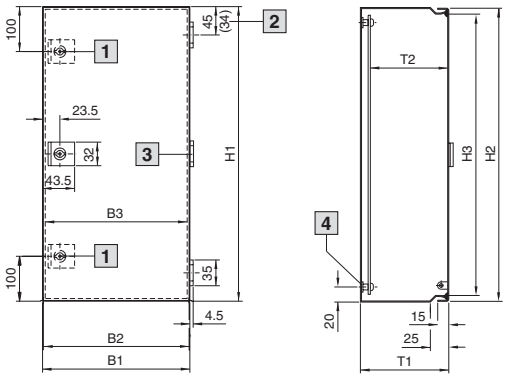
1 Only with B ≥ 600 mm
2 Only with B = 800 mm

Model No. KL			Width dimensions mm						Height dimensions mm				Depth dimensions mm
Without gland plate	With gland plate	Stainless steel without gland plate	B1	B2	B3	B4	B5	B6	H1	H2	H3	H4	T1
1514.510	**–**	**1521.010**	150	148	132	109	125	–	150	148	132	–	80
1528.510	**–**	**–**	200	198	182	159	175	–	150	148	132	–	80
1516.510	**–**	**1523.010**	200	198	182	159	175	–	200	198	182	–	80
1515.510	**–**	**1522.010**	300	298	282	259	275	–	150	148	132	–	80
1517.510	**–**	**1524.010**	300	298	282	259	275	–	200	198	182	–	80
1518.510	**–**	**–**	400	398	382	359	375	–	200	198	182	–	80
1519.510	**–**	**–**	600	598	582	559	575	–	200	198	182	–	80
1500.510	**–**	**–**	150	148	132	109	125	–	150	148	132	100	120
1529.510	**–**	**–**	200	198	182	159	175	–	150	148	132	100	120
1502.510	**–**	**–**	200	198	182	159	175	–	200	198	182	150	120
1501.510	**1530.510**	**–**	300	298	282	259	275	150	150	148	132	100	120
1503.510	**1531.510**	**–**	300	298	282	259	275	150	200	198	182	150	120
1507.510	**1535.510**	**1526.010**	300	298	282	259	275	150	300	298	282	250	120
1589.510	**–**	**–**	400	398	382	359	375	–	150	148	132	100	120
1504.510	**1532.510**	**1525.010**	400	398	382	359	375	200	200	198	182	150	120
1508.510	**1536.510**	**–**	400	398	382	359	375	200	300	298	282	250	120
1511.510	**1539.510**	**–**	400	398	382	359	375	200	400	398	382	350	120
1505.510	**1533.510**	**–**	500	498	482	459	475	130	200	198	182	150	120
1509.510	**1537.510**	**–**	500	498	482	459	475	130	300	298	282	250	120
1506.510	**1534.510**	**–**	600	598	582	559	575	150	200	198	182	150	120
1510.510	**1538.510**	**–**	600	598	582	559	575	150	300	298	282	250	120
1512.510	**1540.510**	**–**	600	598	582	559	575	150	400	398	382	350	120
1527.510	**1542.510**	**–**	800	798	782	759	775	150	200	198	182	150	120
1513.510	**1541.510**	**–**	800	798	782	759	775	150	400	398	382	350	120

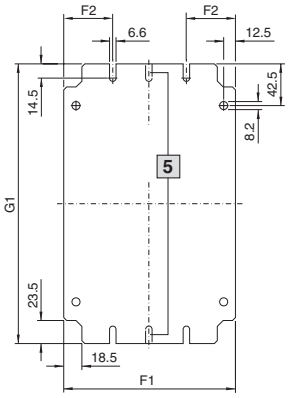
Small enclosures

1.1 E-Box EB

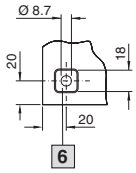
Page 110



Mounting plate



View A
for
wall mounting



1 For EB 1557.500/
EB 1578.500/EB 1579.500
two locks

2 For EB 1551.500 and
EB 1553.500

3 Only for EB 1579.500

4 View A

5 For 125 mm wide mounting
plates, attachment is in the
centre only

6 2 mm recessed

B1 = Overall width
B2 = Door width
B3 = Clearance width

H1 = Overall height
H2 = Door height
H3 = Clearance height

T1 = Overall depth
T2 = Clearance depth available
for installation

F1 = Mounting plate width
F2 = Outer edge to centre of
mounting holes

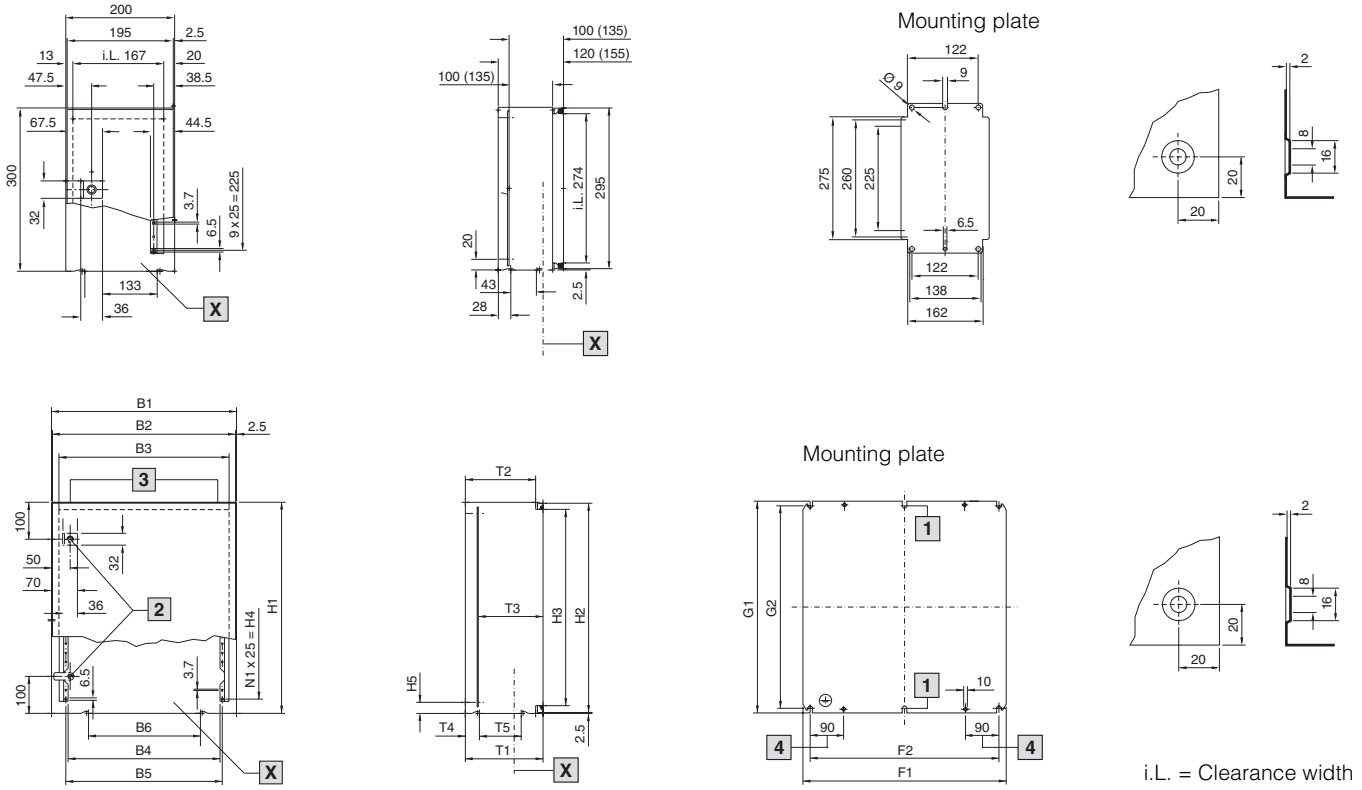
G1 = Mounting plate height

Model No. EB	Width dimensions mm			Height dimensions mm			Depth dimensions mm		Mounting plate dimensions mm		
	B1	B2	B3	H1	H2	H3	T1	T2	F1	F2	G1
1551.500	150	148	132	150	148	132	80	65	125	62.5	135
1545.500	150	148	132	300	298	282	80	65	125	62.5	285
1546.500	200	198	182	200	198	182	80	65	175	50	185
1552.500	200	198	182	300	298	282	80	65	175	50	285
1547.500	200	198	182	400	398	382	80	65	175	50	385
1553.500	150	148	132	150	148	132	120	105	125	62.5	135
1548.500	150	148	132	300	298	282	120	105	125	62.5	285
1549.500	200	198	182	200	198	182	120	105	175	50	185
1554.500	200	198	182	300	298	282	120	105	175	50	285
1550.500	200	198	182	400	398	382	120	105	175	50	385
1555.500	300	298	282	300	298	282	120	105	275	50	285
1556.500	300	298	282	400	398	382	120	105	275	50	385
1557.500	200	198	182	500	498	482	120	105	175	50	485
1577.500	300	298	282	400	398	382	155	140	275	50	385
1578.500	300	298	282	600	598	582	155	140	275	50	585
1579.500	300	298	282	800	798	782	155	140	275	50	785

1.2 Compact enclosures AE

Spray-finished Page 118 – 119

AE 1032.500 (AE 1035.500)



i.L. = Clearance width

X Door interior view

1 Only for AE 1180.500

2 From 500 mm high with 2 cam locks, less than 500 mm with 1 cam lock in the centre

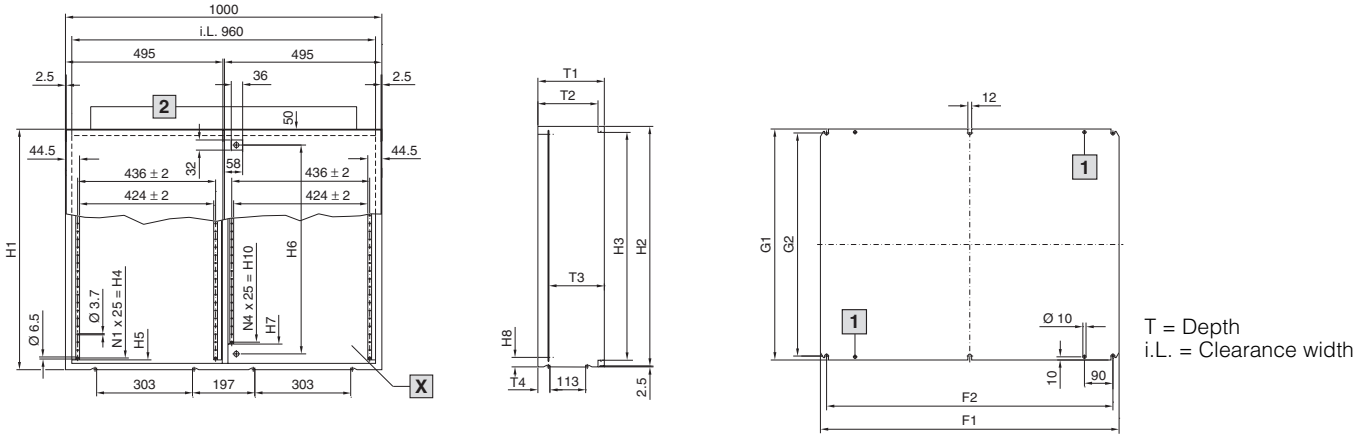
3 AE 1090.500 and AE 1180.500 with holes for eyebolts, see page 1084.

4 (50) for AE 1033.500 and AE 1034.500

Model No. AE	Width dimensions mm						Height dimensions mm						Depth dimensions mm					Mounting plates mm			
Spray-finished	B1	B2	B3	B4	B5	B6	H1	H2	H3	H4	H5	N1	T1	T2	T3	T4	T5	F1	F2	G1	G2
1033.500	300	295	260	211	223	233	300	295	260	225	27,5	9	210	190	168 – 184	33	45	254	215	275	250
1034.500	300	295	260	211	223	233	400	395	360	325	27,5	13	210	190	168 – 184	33	45	254	215	375	350
1030.500	380	375	340	291	303	303	300	295	260	225	27,5	9	155	132	113 – 129	33	63	334	295	275	250
1031.500	380	375	340	291	303	303	300	295	260	225	27,5	9	210	190	168 – 184	33	63	334	295	275	250
1380.500	380	375	340	291	303	303	380	375	340	275	27,5	11	210	190	168 – 184	33	63	334	295	355	330
1039.500	600	595	560	511	523	500	380	375	340	275	27,5	11	210	190	168 – 184	38	113	549	510	355	330
1339.500	600	595	560	511	523	500	380	375	340	275	27,5	11	350	330	308 – 324	38	113	549	510	355	330
1038.500	380	375	340	291	303	303	600	595	560	525	30	21	210	190	168 – 184	33	63	334	295	570	545
1338.500	380	375	340	291	303	303	600	595	560	525	30	21	350	330	308 – 324	84	113	334	295	570	545
1045.500	400	395	360	311	323	303	500	495	460	425	30	17	210	190	168 – 184	38	113	354	315	475	450
1050.500	500	495	460	411	423	303	500	495	460	425	30	17	210	190	168 – 184	38	113	449	410	470	445
1350.500	500	495	460	411	423	303	500	495	460	425	30	17	300	280	258 – 274	38	113	449	410	470	445
1057.500	500	495	460	411	423	303	700	695	660	625	30	25	250	230	208 – 224	38	113	449	410	670	645
1060.500	600	595	560	511	523	500	600	595	560	525	30	21	210	190	168 – 184	38	113	549	510	570	545
1360.500	600	595	560	511	523	500	600	595	560	525	30	21	350	330	308 – 324	38	113	549	510	570	545
1076.500	600	595	560	511	523	500	760	755	720	675	30	27	210	190	168 – 184	38	113	549	510	730	705
1376.500	600	595	560	511	523	500	760	755	720	675	30	27	350	330	308 – 324	38	113	549	510	730	705
1058.500	600	595	560	511	523	500	800	795	760	725	30	29	250	230	208 – 224	38	113	549	510	770	745
1090.500	600	595	560	511	523	500	1000	995	960	925	35	37	250	230	208 – 224	38	113	539	500	955	930
1077.500	760	755	720	671	683	500	760	755	720	675	30	27	210	190	168 – 184	38	113	704	665	730	705
1073.500	760	755	720	671	683	500	760	755	720	675	30	27	300	280	258 – 274	38	113	704	665	730	705
1180.500	800	795	760	711	723	500	1000	995	960	925	35	37	300	280	258 – 274	70	113	739	700	955	930

1.2 Compact enclosures AE

Spray-finished Page 120



T = Depth
i.L. = Clearance width

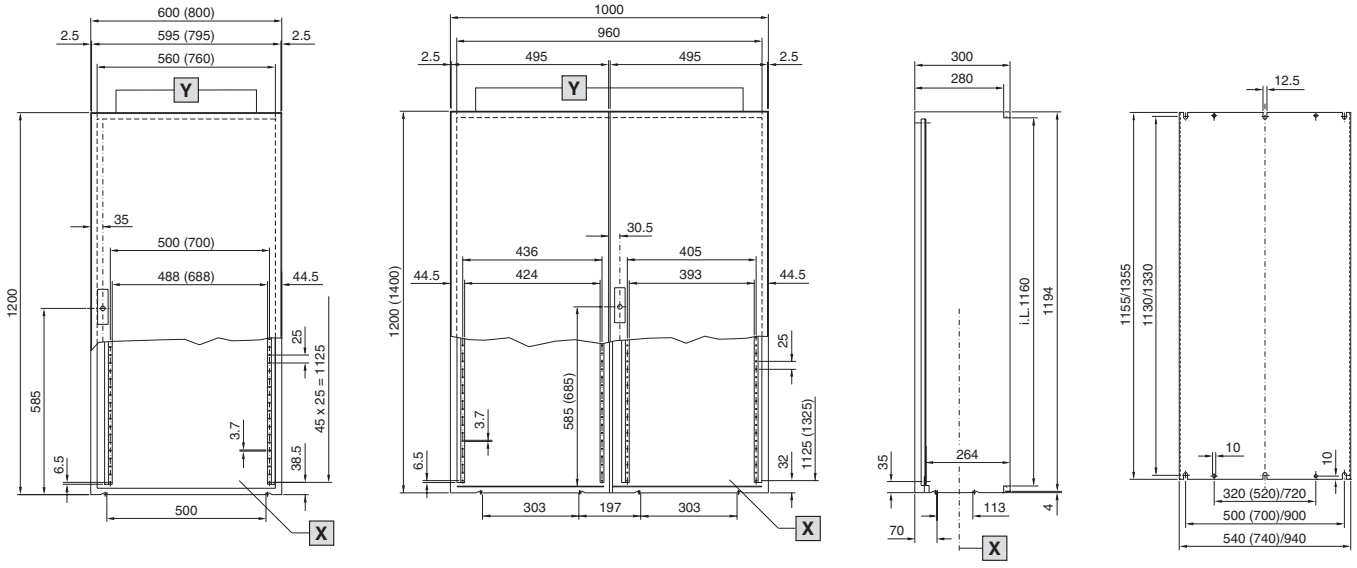
X Door interior view

1 Only for AE 1100.500

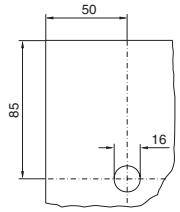
2 AE 1110.500 with holes for eyebolts, see page 1084.

Model No. AE Spray-finished	H1	H2	H3	H4	H5	H6	H7	H8	H10	N1	N4	T1	T2	T3	T4	F1	F2	G1	G2
1100.500	760	755	720	675	698	660	598	30	575	27	23	210	190	168 – 184	38	944	905	730	705
1130.500	760	755	720	675	698	660	598	30	575	27	23	300	280	258 – 274	70	944	905	730	705
1110.500	1000	995	960	925	938	900	838	35	825	37	33	300	280	258 – 274	70	939	900	955	930

Spray-finished Page 120



Detail Y



X Door interior view

Y Hole for eyebolts

Model No. AE Spray-finished	W	H	D	Door(s)
1260.500	600	1200	300	1
1280.500	800	1200	300	1
1213.500	1000	1200	300	2
1114.500	1000	1400	300	2

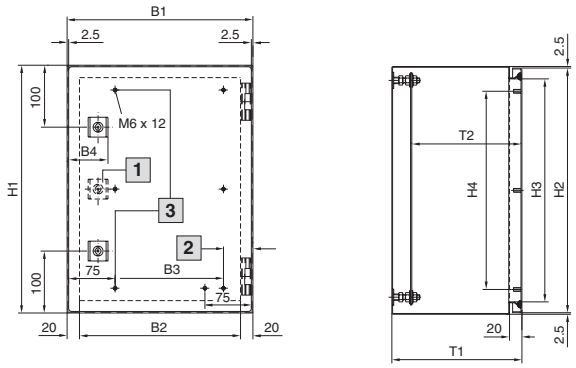
i.L. = Clearance width

1.2 Compact enclosures AE

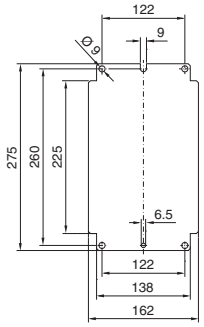
Width: 200 – 1000, height: 300 – 1200, stainless steel Page 273

Mounting plates

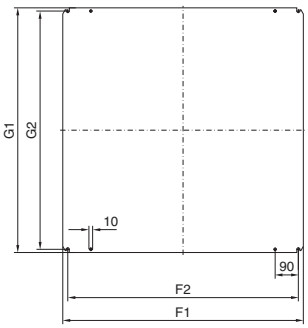
AE 1002.600, AE 1016.600



AE 1002.600



AE 1004.600 – AE 1016.600



Installation position of the mounting plate is rotated through 90° for AE 1005.600.

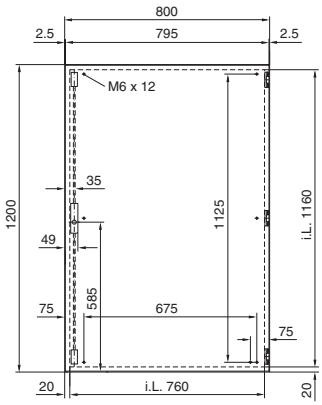
1 For AE 1002.600, AE 1004.600, AE 1005.600, AE 1006.600, AE 1009.600 only one cam lock in the centre and without bolts in the centre

2 50 for AE 1002.600

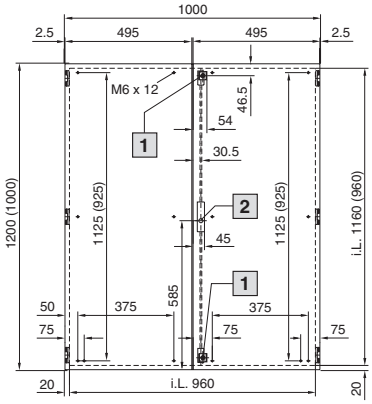
3 Does not apply to AE 1002.600

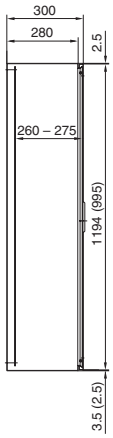
Mounting plates

AE 1017.600



AE 1018.600/AE 1019.600





1 Cam lock for AE 1018.600

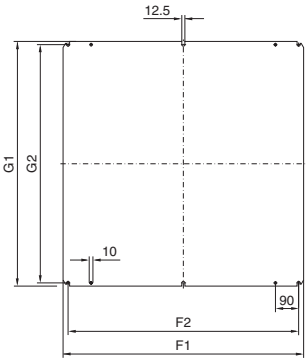
2 Locking rod for AE 1019.600

Dimensions in brackets for AE 1018.600.

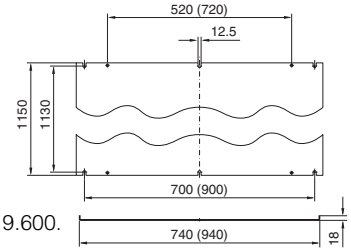
i.L. = Clearance width

Mounting plates

AE 1018.600



AE 1017/AE 1019.600

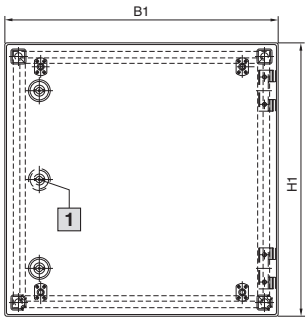


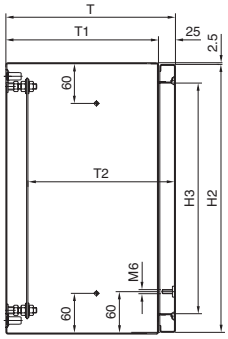
Dimensions in brackets for AE 1019.600.

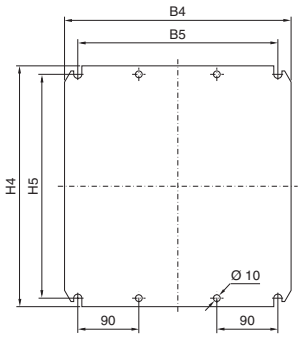
Model No. AE	Width dimensions mm				Height dimensions mm				Depth dimensions mm		Mounting plates mm				Material thickness mm		
Stainless steel	B1	B2	B3	B4	H1	H2	H3	H4	T1	T2	G1	G2	F1	F2	Enclosures	Door	Mounting plate
1002.600	200	167	–	56	300	295	274	225	155	135	–	–	–	–	1.25	1.5	2.0
1004.600	380	340	250	66	300	295	260	225	155	113 – 129	275	250	334	295	1.38	1.5	2.0
1005.600	300	260	175	66	380	375	340	275	210	168 – 184	275	250	334	295	1.38	1.5	2.0
1006.600	380	340	250	66	380	375	340	275	210	168 – 184	355	330	334	295	1.38	1.5	2.5
1007.600	500	460	375	66	500	495	460	425	210	168 – 184	470	445	449	410	1.38	1.5	2.5
1013.600	500	460	375	66	500	495	460	425	300	258 – 274	470	445	449	410	1.50	1.5	2.5
1008.600	380	340	250	66	600	595	560	525	210	168 – 184	570	545	334	295	1.38	1.5	2.5
1009.600	600	560	475	66	380	375	340	275	210	168 – 184	355	330	549	510	1.38	1.5	2.5
1010.600	600	560	475	66	600	595	560	525	210	168 – 184	570	545	549	510	1.38	2.0	2.5
1012.600	600	560	475	66	760	755	720	675	210	168 – 184	730	705	549	510	1.38	2.0	3.0
1014.600	760	720	625	66	760	755	720	675	300	258 – 274	730	705	704	665	1.50	2.0	3.0
1016.600	800	760	675	66	1000	955	960	925	300	258 – 274	955	930	739	700	1.50	2.0	3.0
1017.600	800	–	–	–	1200	–	–	–	300	–	–	–	–	–	1.50	2.0	3.0
1018.600	1000	–	–	–	1000	–	–	–	300	–	955	930	939	900	1.50	2.0	3.0
1019.600	1000	–	–	–	1200	–	–	–	300	–	–	–	–	–	1.50	2.0	3.0

1.2 Compact enclosures AE

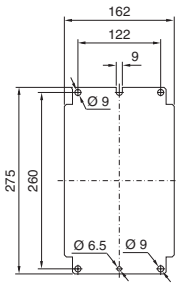
Protection category IP 69K Page 121



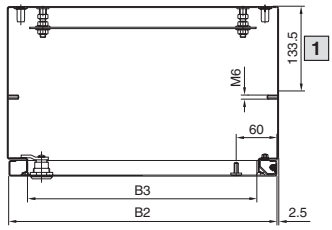




Mounting plate
AE 1101.010



1 With AE 1101.010 one cam lock



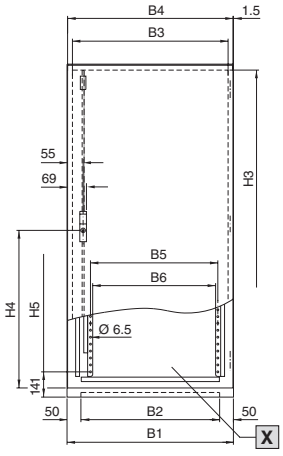
1 58.5 for AE 1101.010

Model No. AE	1101.010	1101.020	1101.030	1101.040
Width (B1) mm	230	400	400	650
Height (H1) mm	330	400	650	650
Depth (T) mm	155	250	250	250
Door width (B2) mm	225	395	395	645
Door height (H2) mm	325	395	645	645
Clearance width (B3) mm	170	340	340	590
Clearance height (H3) mm	270	340	590	590
Enclosure depth (T1) mm	130	225	225	225
Installation depth (T2) mm	135	208 – 224	208 – 224	208 – 224
Mounting plate width (B4) mm	–	334	334	549
Centre-to-centre spacing of the attachment holes (B5) mm	–	295	295	510
Mounting plate height (H4) in mm	–	355	570	570
Centre-to-centre spacing of the attachment holes (H5) mm	–	330	545	545
Mounting plate thickness mm	2	2	2.5	2.5

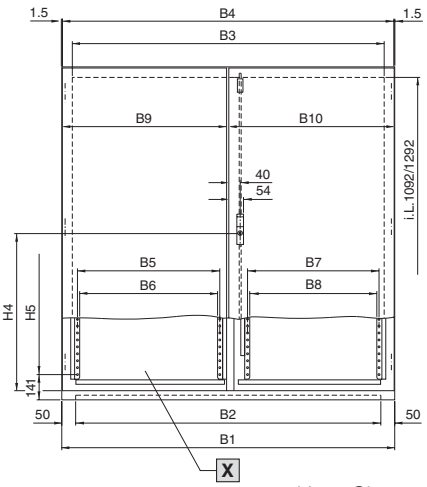
1.2 Compact enclosures AK

Page 122

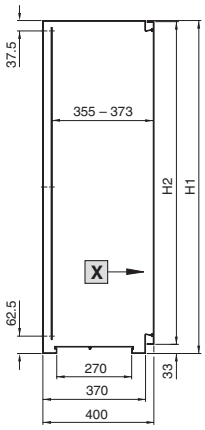
AK 1646.500
AK 1648.500



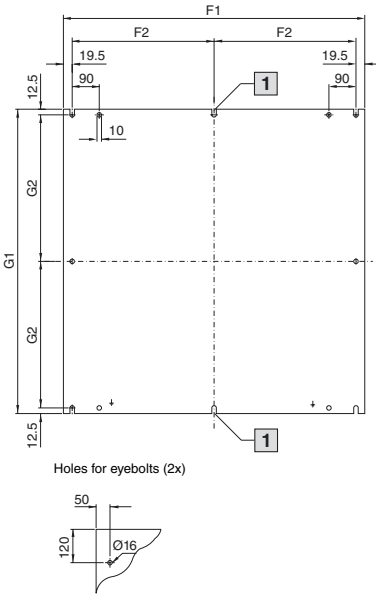
AK 1652.500
AK 1650.500



AK 1647.500



Mounting plate



X Door interior view

1 Only for 1647.500/1650.500/ 1652.500

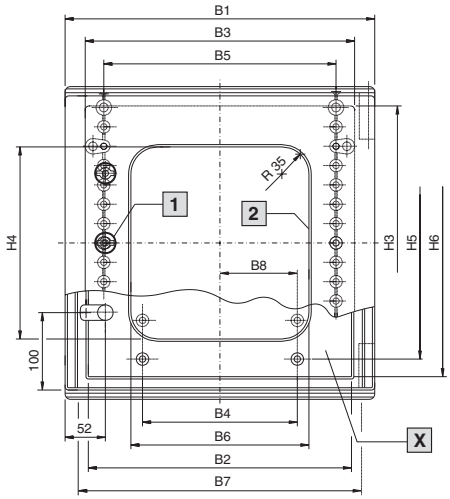
i.L. = Clearance width

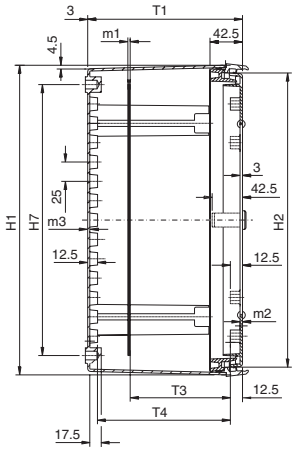
Model No. AK	Width dimensions mm										Height dimensions mm					Mounting plates mm			
	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	H1	H2	H3	H4	H5	F1	F2	G1	G2
1646.500	600	500	524	597	459	443	–	–	–	–	1200	1166	1092	568	38 x 25 = 950	514	–	1125	550
1648.500	800	700	724	797	659	643	–	–	–	–	1200	1166	1092	568	38 x 25 = 950	714	–	1125	550
1652.500	1200	1100	1124	1197	513	497	477	461	595	597	1200	1166	1092	568	38 x 25 = 950	1114	537.5	1125	550
1650.500	1000	900	924	997	413	397	377	361	495	497	1200	1166	1092	568	38 x 25 = 950	914	437.5	1125	550
1647.500	1000	900	924	997	413	397	377	361	495	497	1400	1366	1292	668	46 x 25 = 1150	914	437.5	1325	650

1.2 Plastic enclosures KS

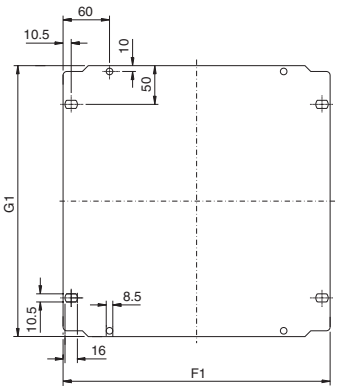
Page 123

KS 1423.600 and KS 1432.600 with only one cam lock in the centre





Mounting plate



B7 = Separation width for wall mounting hole

H7 = Separation height for wall mounting hole

1 Only for KS 1423.600 and KS 1432.600

2 Viewing window only with KS 1448.600, KS 1449.600, KS 1454.600, KS 1467.600

X Door interior view

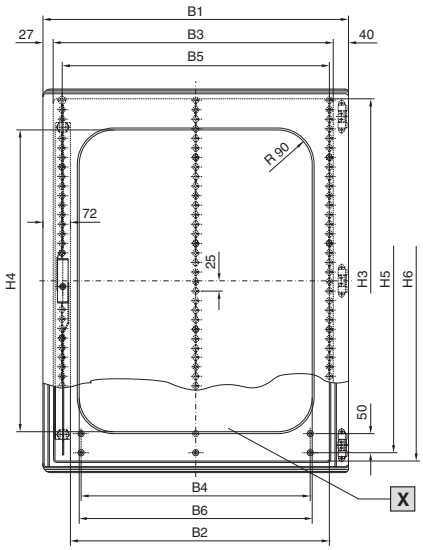
Model No. KS	Width dimensions mm								Height dimensions mm							Depth dimensions mm			Mounting plates mm				
	B1	B2	B3	B4	B5	B6[1)]	B7	B8	H1	H2	H3	H4[1)]	H5	H6	H7	T1	T3	T4	m1	m2	m3	F1	G1
1423.600	200	140	150	–	100	–	150	25	300	280	256	–	200	245	250	150	80 – 110/117	119	2.0	3.0	3.0	145	250
1432.600	250	190	200	75	150	–	200	50	350	330	306	–	250	295	300	150	80 – 110/117	119	2.0	3.0	3.0	195	300
1434.600	300	240	249	100	200	–	250	50	400	380	355	–	300	345	350	200	80 – 160/167	169	2.0	3.0	3.0	245	350
1444.600/ 1448.600	400	340	348	200	300	230	350	100	400	380	354	250	300	345	350	200	80 – 159/166	168.5	2.5	3.2	3.2	345	350
1446.600/ 1449.600	400	340	348	200	300	230	350	100	600	580	554	450	500	545	550	200	80 – 158/165	168	2.5	3.5	3.5	345	550
1466.600/ 1467.600	600	540	548	400	500	430	550	200	600	580	554	450	500	545	550	200	80 – 158/165	168	2.5	3.5	3.5	545	550
1453.600/ 1454.600	500	440	434	300	400	330	450	150	500	480	454	350	400	445	450	300	80 – 258/265	268	2.5	3.5	3.5	417	450

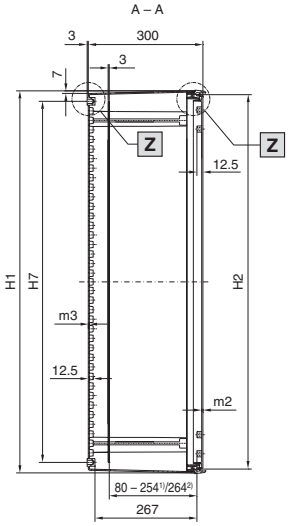
[1)] Only in enclosures with viewing window.

1.2 Plastic enclosures KS

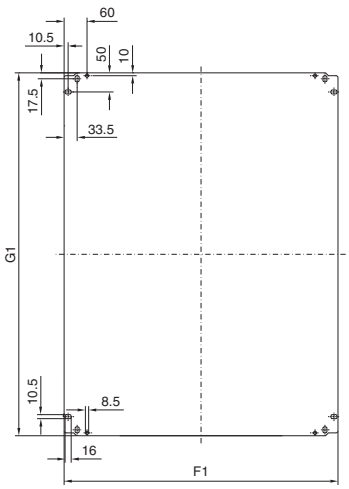
Page 124

KS 1469.600/KS 1479.600
KS 1468.600/KS 1480.600 without viewing window

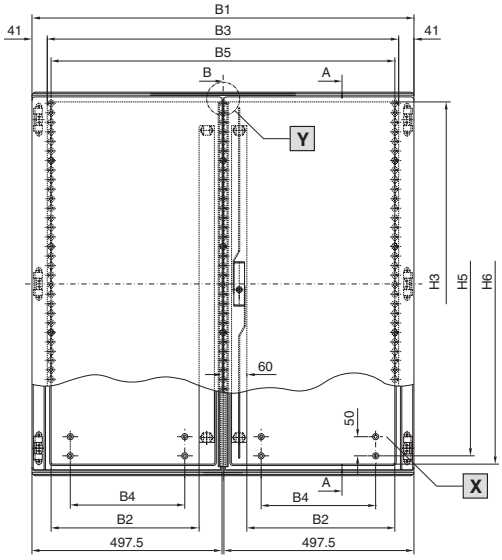




Mounting plate



KS 1400.600



1) Infinitely variable with mounting plate depth adjuster KS 1491.000

2) When mounting on studs directly on the threaded insert

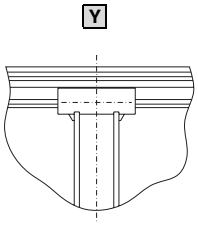
B7 = Separation width for wall mounting hole

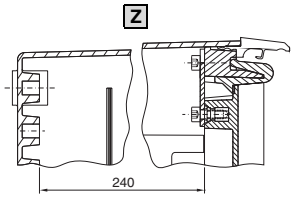
H7 = Separation height for wall mounting hole

X Door interior view

Y Screw-fastened centre bar for KS 1400.000

Z Distance from mounting insert to centre bar





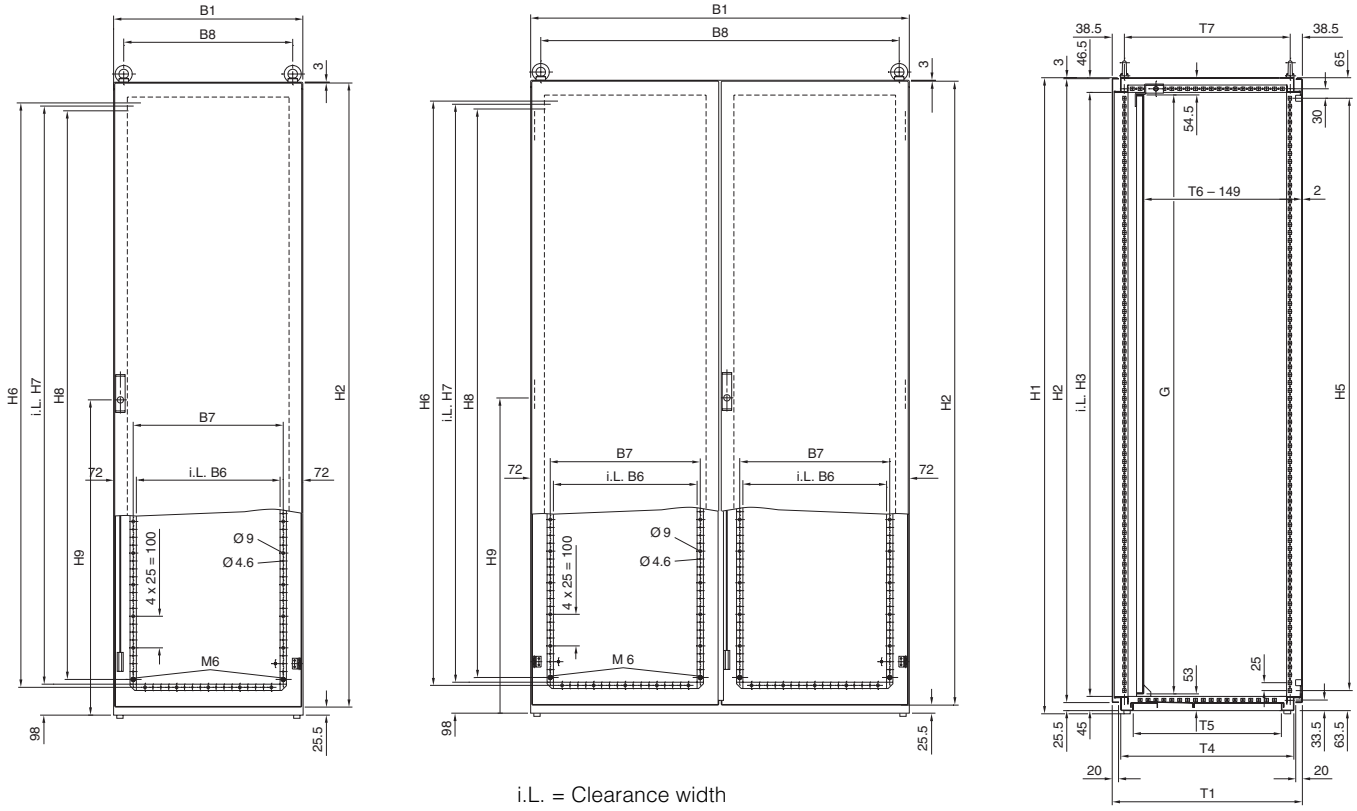
Model No. KS	Width dimensions mm							Height dimensions mm							Mounting plates mm			
	B1	B2	B3	B4	B5	B6[1]	B7	H1	H2	H3	H4[1]	H5	H6	H7	m2	m3	G1	F1
1468.600/1469.600	600	485	533	400	500	410	550	780	753	590	700	740	750	600	3.7	3.7	750	517
1479.600/1480.600	800	685	733	600	700	610	750	980	953	790	900	940	950	800	3.7	4.0	950	717
1400.600	1000	387	918	300	900	–	950	980	952	–	900	940	950	1000	3.5	4.0	950	917

[1] Only in enclosures with viewing window.

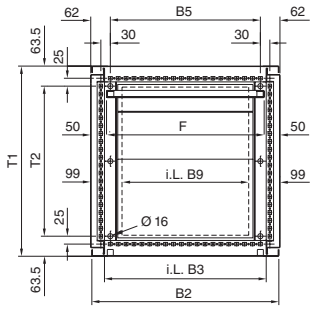
1.4 Free-standing enclosure ES 5000

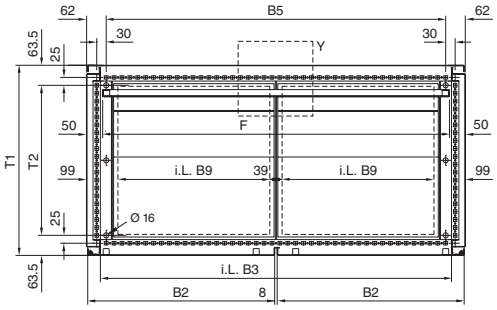
Spray-finished Page 136, 137

Stainless steel Page 285

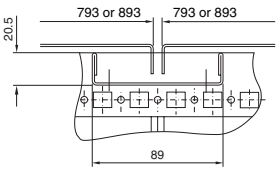


i.L. = Clearance width





Detail Y
(only with ES 5784.500
and ES 5905.500)



Double-door

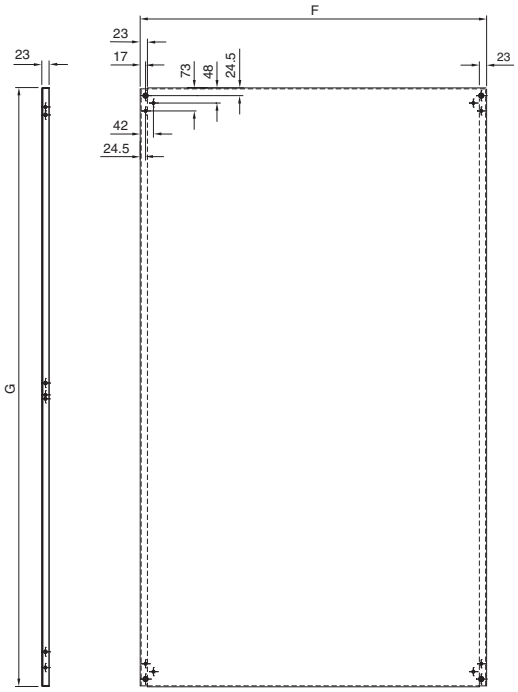
Model No. ES		Width dimensions mm								Height dimensions mm								Depth dimensions mm						Mounting plates mm	
Spray-finished	Stainless steel	B1	B2	B3	B5	B6	B7	B8	B9	H1	H2	H3	H5	H6	H7	H8	H9	T1	T2	T4	T5	T6	T7	F	G
5080.500	–	999	492	912	875	355	375	935	801	1810	1775	1712	1675	1650	1630	1600	898	402	275	349	269	349	325	899	1696
5265.500	–	1199	592	1112	1075	455	475	1135	481	1610	1575	1512	1475	1450	1430	1400	798	502	375	449	369	449	425	1099	1496
5284.500	–	1199	592	1112	1075	455	475	1135	481	1810	1775	1712	1675	1650	1630	1600	898	402	275	349	269	349	325	1099	1696
5205.500	**5455.600**	1199	592	1112	1075	455	475	1135	481	2010	1975	1912	1875	1850	1830	1800	998	502	375	449	369	449	425	1099	1896
5784.500	–	1599	792	1512	1475	655	675	1535	681	1810	1775	1712	1675	1650	1630	1600	898	402	275	349	269	349	325	1499	1696
5905.500	–	1799	892	1712	1675	755	775	1735	781	2010	1975	1912	1875	1850	1830	1800	998	502	375	449	369	449	425	1699	1896

1.4 Free-standing enclosure ES 5000

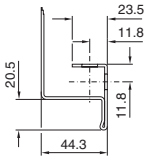
Spray-finished Page 136, 137

Stainless steel Page 285

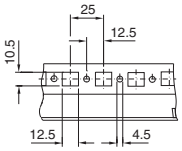
Mounting plate



Cross-section



Pitch pattern of holes



Enclosure

B1 = Overall width
B2 = Width of door
B3 = Clearance between enclosure frame sections
B5 = Section length of system punchings/hole distance of base and plinth attachment
B6 = Clearance between the tubular door frame sections
B7 = Distance between the rows of tubular door frame holes
B8 = Spacing between eyebolts
B9 = Clearance in base aperture

H1 = Overall height
H2 = Height of rear panel and door
H3 = Clearance between enclosure frame sections
H5 = Section length of system punchings
H6 = Distance between the rows of tubular door frame holes
H7 = Clearance between the tubular door frame sections
H8 = Spacing of tubular door frame fastening bolts
H9 = Distance from base to centre of lock

T1 = Overall depth
T2 = Section length of system punchings/hole distance of base and plinth attachment
T4 = Depth of base frame
T5 = Clearance in base aperture
T6 = Possible mounting depth (mounting plate assembly) up to 149 mm, depth-adjustable on a 25 mm pitch pattern
T7 = Centre-to-centre distance between eyebolts

Mounting plate

F = Overall width
G = Overall height

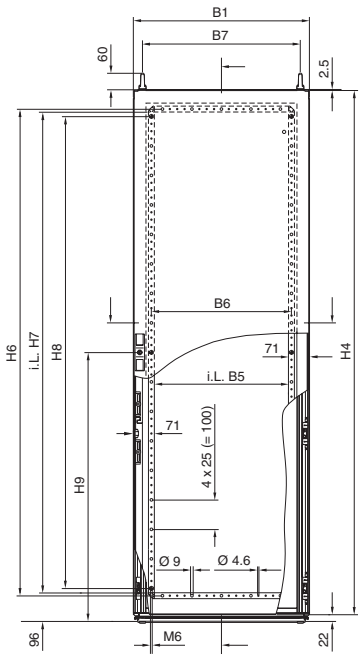
Single-door

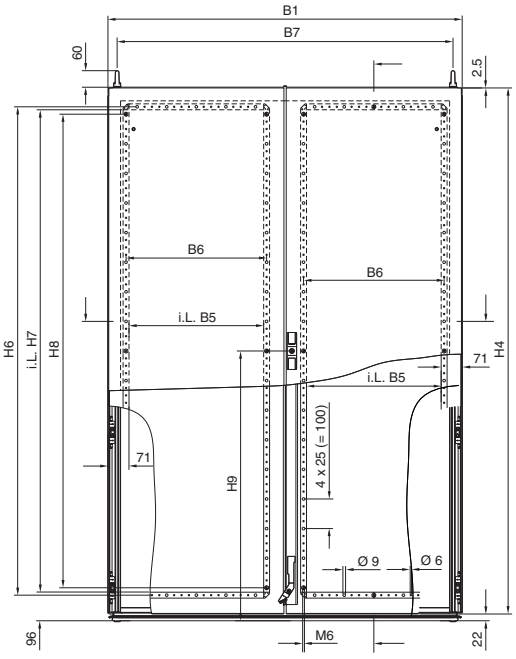
Model No. ES		Width dimensions mm								Height dimensions mm								Depth dimensions mm						Mounting plates mm	
Spray-finished	Stainless steel	B1	B2	B3	B5	B6	B7	B8	B9	H1	H2	H3	H5	H6	H7	H8	H9	T1	T2	T4	T5	T6	T7	F	G
–	**5450.600**	599	592	512	475	455	475	535	401	1610	1575	1512	1475	1450	1430	1400	798	402	275	349	269	349	325	499	1496
5665.500	–	599	592	512	475	455	475	535	401	1610	1575	1512	1475	1450	1430	1400	798	502	375	449	369	449	425	499	1496
5684.500	–	599	592	512	475	455	475	535	401	1810	1775	1712	1675	1650	1630	1600	898	402	275	349	269	349	325	499	1696
–	**5451.600**	599	592	512	475	455	475	535	401	1810	1775	1712	1675	1650	1630	1600	898	502	375	449	369	449	425	499	1696
5605.500	–	599	592	512	475	455	475	535	401	2010	1975	1912	1875	1850	1830	1800	998	502	375	449	369	449	425	499	1896
5865.500	–	799	792	712	675	655	675	735	601	1610	1575	1512	1475	1450	1430	1400	798	502	375	449	369	449	425	699	1496
5884.500	–	799	792	712	675	655	675	735	601	1810	1775	1712	1675	1650	1630	1600	898	402	275	349	269	349	325	699	1696
5805.500	–	799	792	712	675	655	675	735	601	2010	1975	1912	1875	1850	1830	1800	998	502	375	449	369	449	425	699	1896
5084.500	**5454.600**	999	992	912	875	855	875	935	801	1810	1775	1712	1675	1650	1630	1600	898	402	275	349	269	349	325	899	1696
–	**5452.600**	799	792	712	675	655	675	735	601	1810	1775	1712	1675	1650	1630	1600	898	502	375	449	369	449	425	699	1696
–	**5453.600**	799	792	712	675	655	675	735	601	2010	1975	1912	1875	1850	1830	1800	998	602	475	549	469	549	525	699	1896

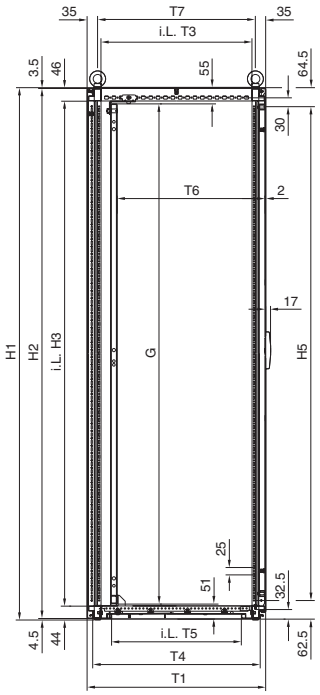
1.4 Baying system TS 8

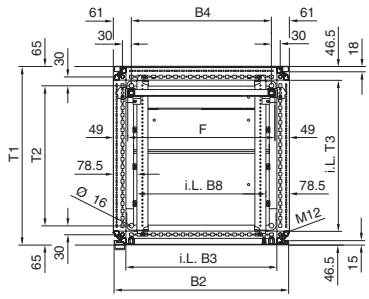
Spray-finished Page 138 – 147

Stainless steel Page 284

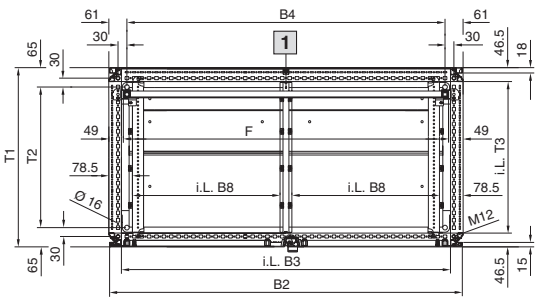








Base/plinth mounting: B4 x T2



Base/plinth mounting: B4 x T2

Note:
With fitted side panels, the overall width (B1) is increased by 9 mm. Between bayed enclosures, allow 3 mm for the seal.

1 Does not apply to TS 8880.500/TS 8881.500

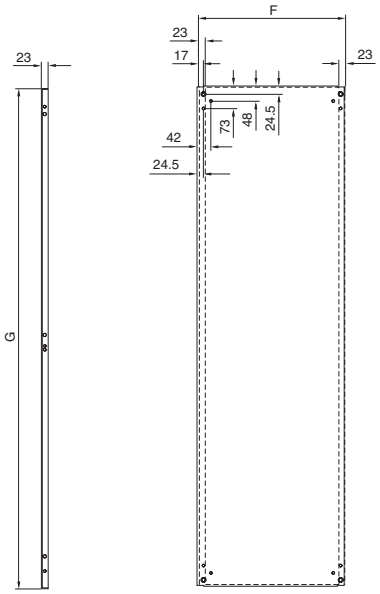
i.L. = Clearance width

Double-door

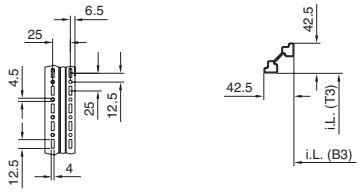
Model No. TS		Width dimensions mm								Height dimensions mm									Depth dimensions mm							Mounting plates mm	
Spray-finished	Stainless steel	B1	B2	B3	B4	B5	B6	B7	B8	H1	H2	H3	H4	H5	H6	H7	H8	H9	T1	T2	T3	T4	T5	T6	T7	F	G
8245.500	–	1197	1192	1112	1075	455	475	1135	500	1405	1397	1312	1377.5	1275	1250	1230	1200	711	505	375	412	468	340	130 – 455	435	1099	1296
8080.500	–	997	992	912	875	355	375	935	400	1805	1797	1712	1777.5	1675	1650	1630	1600	911	405	275	312	368	240	130 – 355	335	899	1696
8284.500	**8456.600**	1197	1192	1112	1075	455	475	1135	500	1805	1797	1712	1777.5	1675	1650	1630	1600	911	405	275	312	368	240	130 – 355	335	1099	1696
8880.500	–	797	792	712	675	255	275	735	640	1805	1797	1712	1777.5	1675	1650	1630	1600	911	505	375	412	468	340	130 – 455	435	699	1696
8285.500	**8453.600**	1197	1192	1112	1075	455	475	1135	500	1805	1797	1712	1777.5	1675	1650	1630	1600	911	505	375	412	468	340	130 – 455	435	1099	1696
8881.500	–	797	792	712	675	255	275	735	640	1805	1797	1712	1777.5	1675	1650	1630	1600	911	605	475	512	568	440	130 – 555	535	699	1696
8286.500	–	1197	1192	1112	1075	455	475	1135	500	1805	1797	1712	1777.5	1675	1650	1630	1600	911	605	475	512	568	440	130 – 555	535	1099	1696
8204.500	–	1197	1192	1112	1075	455	475	1135	500	2005	1997	1912	1977.5	1875	1850	1830	1800	1011	405	275	312	368	240	130 – 355	335	1099	1896
8005.500	–	997	992	912	875	355	375	935	400	2005	1997	1912	1977.5	1875	1850	1830	1800	1011	505	375	412	468	340	130 – 455	435	899	1896
8205.500	–	1197	1192	1112	1075	455	475	1135	500	2005	1997	1912	1977.5	1875	1850	1830	1800	1011	505	375	412	468	340	130 – 455	435	1099	1896
8006.500	–	997	992	912	875	355	375	935	400	2005	1997	1912	1977.5	1875	1850	1830	1800	1011	605	475	512	568	440	130 – 555	535	899	1896
8206.500	**8451.600**	1197	1192	1112	1075	455	475	1135	500	2005	1997	1912	1977.5	1875	1850	1830	1800	1011	605	475	512	568	440	130 – 555	535	1099	1896
8208.500	–	1197	1192	1112	1075	455	475	1135	500	2005	1997	1912	1977.5	1875	1850	1830	1800	1011	805	675	712	768	640	130 – 755	735	1099	1896
8226.500	–	1197	1192	1112	1075	455	475	1135	500	2205	2197	2112	2177.5	2075	2050	2030	2000	1111	605	475	512	568	440	130 – 555	535	1099	2096
8265.500	–	1197	1192	1112	1075	455	475	1135	500	1605	1597	1512	1577.5	1475	1450	1430	1400	–	505	375	412	468	340	130 – 455	435	1099	1496

Large enclosures

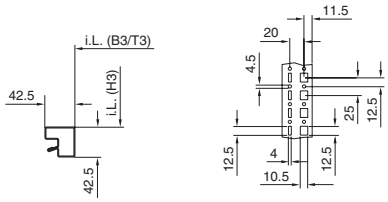
Mounting plate



Cross-sections
vertical



horizontal



i.L. = Clearance width

Enclosure

B1 = Overall width
B2 = Width of door
B3 = Clearance between enclosure frame sections
B4 = Section length of system punchings/hole distance of base and plinth attachment
B5 = Clearance between the tubular door frame sections
B6 = Distance between the rows of tubular door frame holes
B7 = Spacing between eyebolts
B8 = Clearance in base aperture

H1 = Overall height
H2 = Height of rear panel
H3 = Clearance between enclosure frame sections
H4 = Height of door
H5 = Section length of system punchings
H6 = Distance between the rows of tubular door frame holes
H7 = Clearance between the tubular door frame sections
H8 = Spacing of tubular door frame fastening bolts
H9 = Distance from base to centre of lock

T1 = Overall depth
T2 = Section length of system punchings/hole distance of base and plinth attachment
T3 = Clearance between enclosure frame sections
T4 = Depth of base frame
T5 = Clearance in base aperture
T6 = Possible mounting depth (mounting plate assembl), depth-adjustable on a 25 mm pitch pattern
T7 = Centre-to-centre distance between eyebolts

Mounting plate

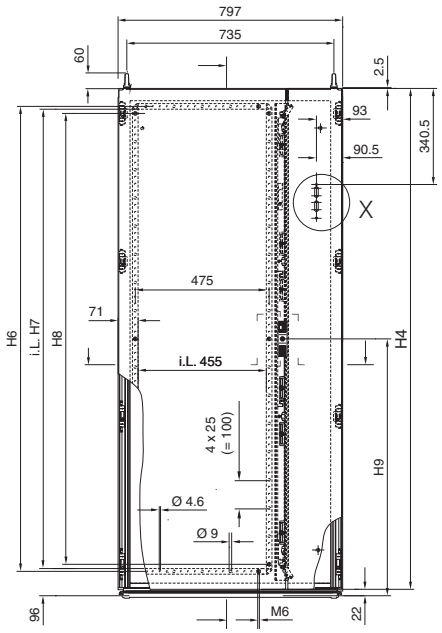
F = Overall width
G = Overall height

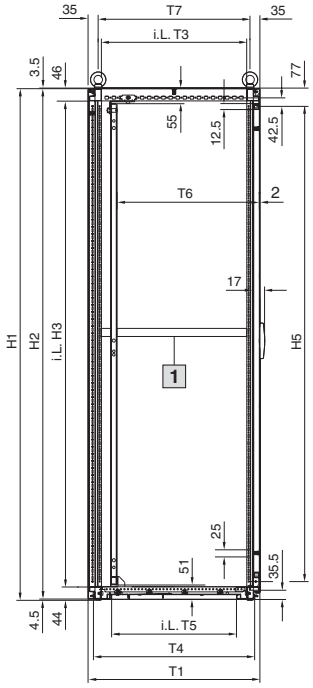
Single-door

Model No. TS		Width dimensions mm								Height dimensions mm									Depth dimensions mm							Mounting plates mm	
Spray-finished	Stainless steel	B1	B2	B3	B4	B5	B6	B7	B8	H1	H2	H3	H4	H5	H6	H7	H8	H9	T1	T2	T3	T4	T5	T6	T7	F	G
8645.500	–	597	592	512	475	455	475	535	440	1405	1397	1312	1377.5	1275	1250	1230	1200	711	505	375	412	468	340	130 – 455	435	499	1296
8845.500	–	797	792	712	675	655	675	735	640	1405	1397	1312	1377.5	1275	1250	1230	1200	711	505	375	412	468	340	130 – 455	435	499	1296
8684.500	–	597	592	512	475	455	475	535	440	1805	1797	1712	1777.5	1675	1650	1630	1600	911	405	275	312	368	240	130 – 355	335	499	1696
8884.500	**8454.600**	797	792	712	675	655	675	735	640	1805	1797	1712	1777.5	1675	1650	1630	1600	911	405	275	312	368	240	130 – 355	335	699	1696
8084.500	–	997	992	912	875	855	875	935	840	1805	1797	1712	1777.5	1675	1650	1630	1600	911	405	275	312	368	240	130 – 355	335	899	1696
8485.510	–	397	392	312	275	255	275	335	240	1805	1797	1712	1777.5	1675	1650	1630	1600	911	505	375	412	468	340	130 – 455	435	–	–
8685.500	**8457.600**	597	592	512	475	455	475	535	440	1805	1797	1712	1777.5	1675	1650	1630	1600	911	505	375	412	468	340	130 – 455	435	499	1696
8885.500	**8455.600**	797	792	712	675	655	675	735	640	1805	1797	1712	1777.5	1675	1650	1630	1600	911	505	375	412	468	340	130 – 455	435	699	1696
8486.510	–	397	392	312	275	255	275	335	240	1805	1797	1712	1777.5	1675	1650	1630	1600	911	605	475	512	568	440	130 – 555	535	–	–
8686.500	–	597	592	512	475	455	475	535	440	1805	1797	1712	1777.5	1675	1650	1630	1600	911	605	475	512	568	440	130 – 555	535	499	1696
8886.500	–	797	792	712	675	655	675	735	640	1805	1797	1712	1777.5	1675	1650	1630	1600	911	605	475	512	568	440	130 – 555	535	699	1696
8604.500	–	597	592	512	475	455	475	535	440	2005	1997	1912	1977.5	1875	1850	1830	1800	1011	405	275	312	368	240	130 – 355	335	499	1896
8804.500	–	797	792	712	675	655	675	735	640	2005	1997	1912	1977.5	1875	1850	1830	1800	1011	405	275	312	368	240	130 – 355	335	699	1896
8405.510	–	397	392	312	275	255	275	335	240	2005	1997	1912	1977.5	1875	1850	1830	1800	1011	505	375	412	468	340	130 – 455	435	–	–
8605.500	–	597	592	512	475	455	475	535	440	2005	1997	1912	1977.5	1875	1850	1830	1800	1011	505	375	412	468	340	130 – 455	435	499	1896
8805.500	–	797	792	712	675	655	675	735	640	2005	1997	1912	1977.5	1875	1850	1830	1800	1011	505	375	412	468	340	130 – 455	435	699	1896
8406.510	–	397	392	312	275	255	275	335	240	2005	1997	1912	1977.5	1875	1850	1830	1800	1011	605	475	512	568	440	130 – 555	535	–	–
8606.500	**8452.600**	597	592	512	475	455	475	535	440	2005	1997	1912	1977.5	1875	1850	1830	1800	1011	605	475	512	568	440	130 – 555	535	499	1896
8806.500	**8450.600**	797	792	712	675	655	675	735	640	2005	1997	1912	1977.5	1875	1850	1830	1800	1011	605	475	512	568	440	130 – 555	535	699	1896
8608.500	–	597	592	512	475	455	475	535	440	2005	1997	1912	1977.5	1875	1850	1830	1800	1011	805	675	712	768	640	130 – 755	735	499	1896
8808.500	–	797	792	712	675	655	675	735	640	2005	1997	1912	1977.5	1875	1850	1830	1800	1011	805	675	712	768	640	130 – 755	735	699	1896
8626.500	–	597	592	512	475	455	475	535	440	2205	2197	2112	2177.5	2075	2050	2030	2000	1111	605	475	512	568	440	130 – 555	535	499	2096
8826.500	–	797	792	712	675	655	675	735	640	2205	2197	2112	2177.5	2075	2050	2030	2000	1111	605	475	512	568	440	130 – 555	535	699	2096
8665.500	–	597	592	512	475	455	475	535	440	1605	1597	1512	1577.5	1475	1450	1430	1400	–	505	375	412	468	340	130 – 455	435	499	1496
8865.500	–	797	792	712	675	655	675	735	640	1605	1597	1512	1577.5	1475	1450	1430	1400	–	505	375	412	468	340	130 – 455	435	699	1696

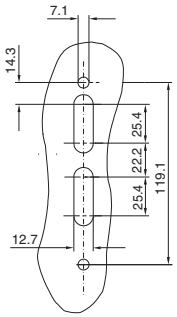
1.4 Baying system TS 8

For isolator door locking Page 150



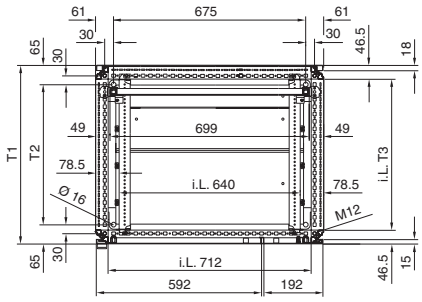


Detail X



1 Only for TS 8906.500

i.L. = Clearance width



Enclosure

H1 = Overall height
H2 = Height of rear panel
H3 = Clearance between enclosure frame sections
H4 = Height of door and trim panel
H5 = Section length of system punchings
H6 = Distance between the rows of tubular door frame holes
H7 = Clearance between the tubular door frame sections
H8 = Spacing of tubular door frame fastening bolts
H9 = Distance from base to centre of lock

T1 = Overall depth
T2 = Section length of system punchings/ hole distance of base and plinth attachment
T3 = Clearance between enclosure frame sections
T4 = Depth of base frame
T5 = Clearance in base aperture
T6 = Possible mounting depth (mounting plate assembly)
T7 = Centre-to-centre distance between eyebolts

Note:
The cutouts in the right trim piece are suitable for the following isolator actuators: Allen Bradley 1494 V-H11, Square D9422A1, ITE Siemens[1)] Max-Flex Serie/F HOH, General Electric TDA Type 1 and 2.

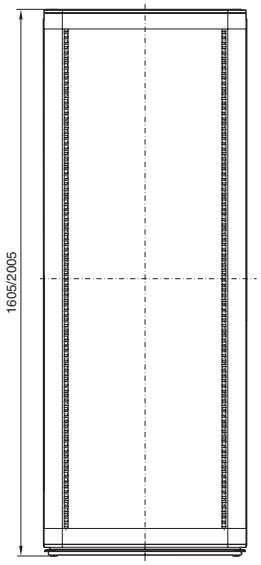
[1)] Available in USA only.

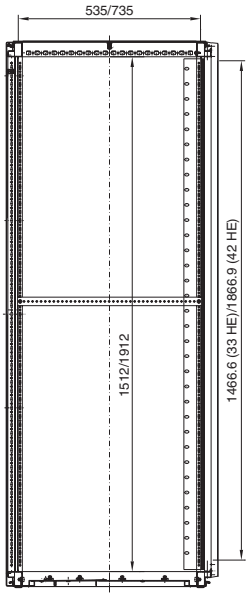
Model No. TS	Height dimensions mm									Depth dimensions mm						
	H1	H2	H3	H4	H5	H6	H7	H8	H9	T1	T2	T3	T4	T5	T6	T7
8984.500	1805	1797	1712	1778	1650	1650	1630	1600	911	405	275	312	368	240	130 – 355	335
8985.500	1805	1797	1712	1778	1650	1650	1630	1600	911	505	375	412	468	340	130 – 455	435
8905.500	2005	1997	1912	1978	1850	1850	1830	1800	1011	505	375	412	468	340	130 – 455	435
8906.500	2005	1997	1912	1978	1850	1850	1830	1800	1011	605	475	512	568	440	130 – 555	535

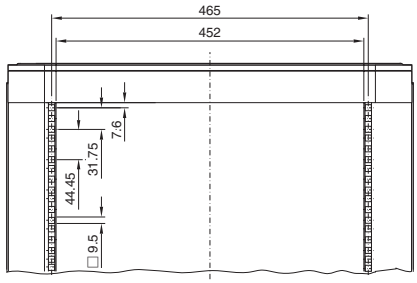
Large enclosures

1.4 Baying system TS 8

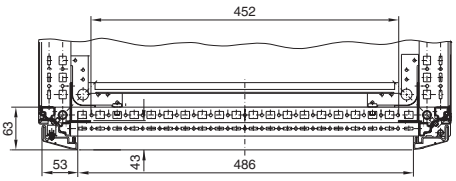
Electronic enclosures Page 148

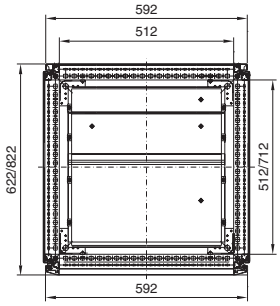






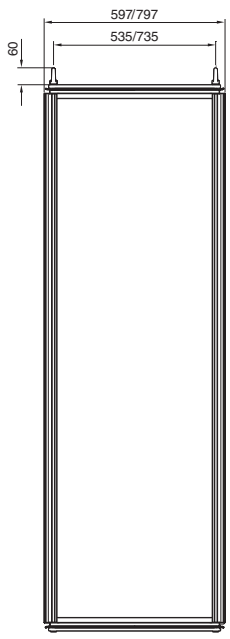
HE = U

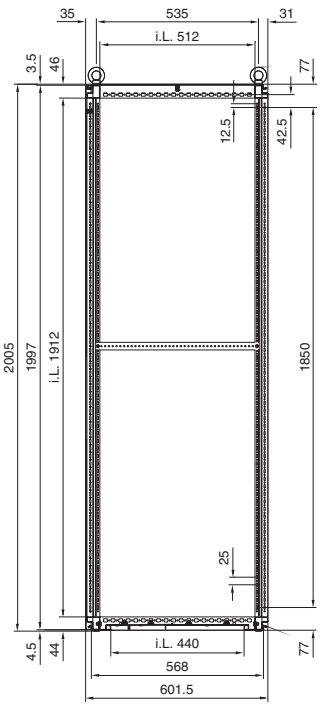


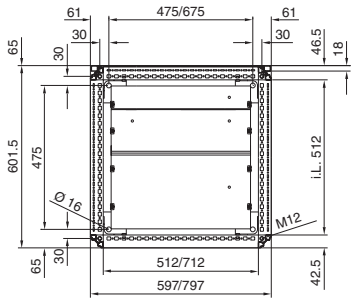


1.4 Baying system TS 8

For modular front design Page 149

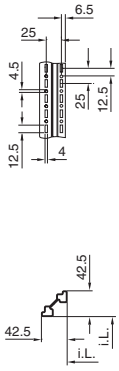




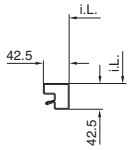


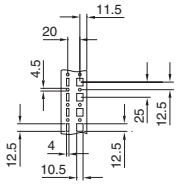
Cross-sections

vertical



horizontal



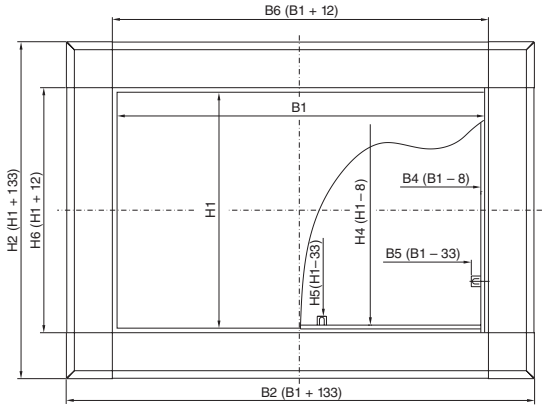


i.L. = Clearance width

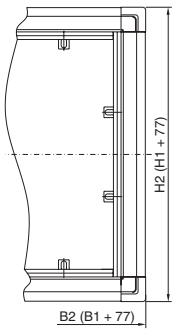
1.5 Rittal Command Panel VIP 6000

3.1 Installation depth Page 161

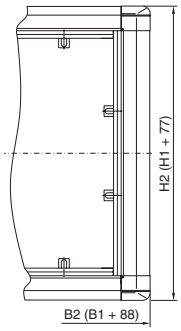
Front frame, wide



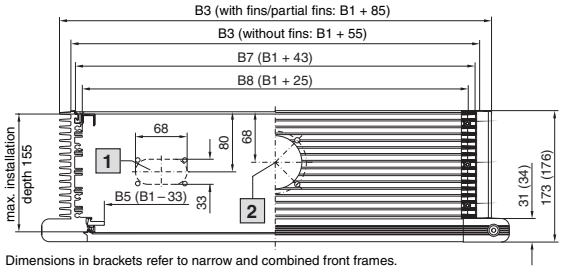
Narrow



Combined



1 155 mm



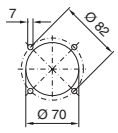
Dimensions in brackets refer to narrow and combined front frames.

1 Cross section of the cable duct

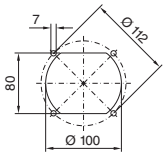
2 Support arm cutout for CP-L system, Ø 130 mm

Support arm connections

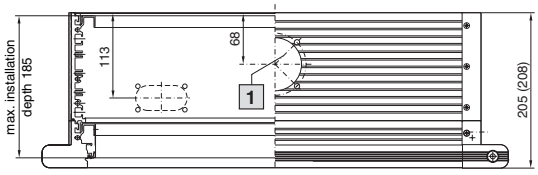
CP-L, Ø 130 mm



CP-XL



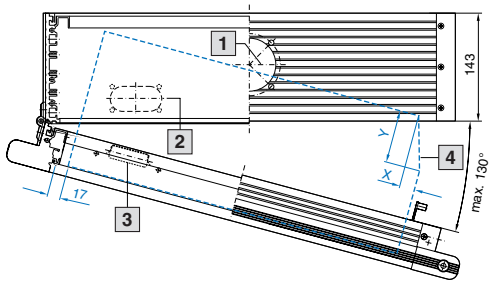
2 185 mm, screw-fastened



Dimensions in brackets refer to narrow and combined front frames.

1 Support arm connection for system Ø 130 mm

3 185 mm, hinged



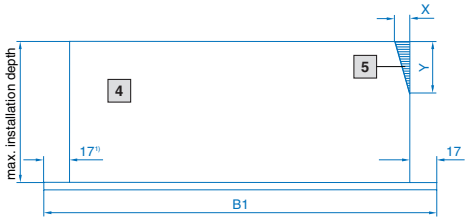
1 Support arm connection for CP-L system, Ø 130 mm

2 Only for CP 6392.109, CP 6392.209

3 Only for CP 6392.009

4 Max. installation space for hinged enclosures

5 Collision zone



1) see page 160.

Width dimensions:

B1 = Width of the front panel

B2 = Overall width

B3 = Enclosure width

B4 = Clearance width between enclosure sections

B5 = Clearance width between retaining claws of the mounting kit

B6 = Clearance width between the front frames

B7 = Width of the rear panel

B8 = Internal clearance of enclosure, width

Height dimensions:

H1 = Height of the front panel

H2 = Overall height

H3 = Enclosure height (with fins: H1 + 85, without fins: H1 + 55)

H4 = Clearance height between enclosure sections

H5 = Clearance height between retaining claws

H6 = Clearance height between front frames

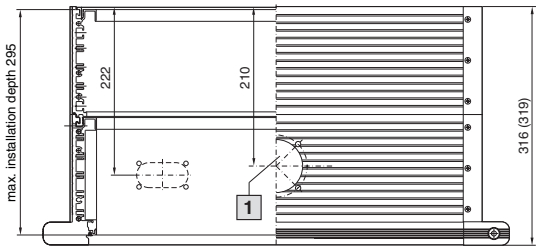
H7 = Height of the rear panel (H1 + 43)

H8 = Internal clearance of enclosure, height (H1 + 25)

1.5. Command Panel VIP 6000

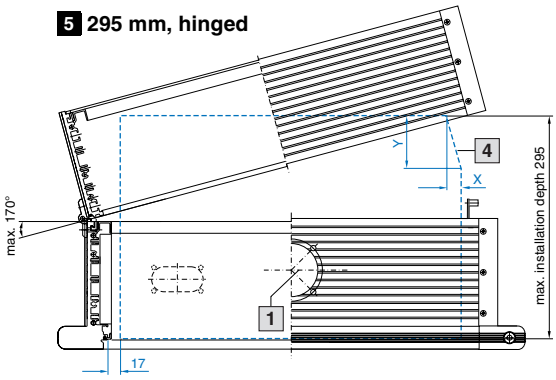
3.1 Installation depth Page 161

4 295 mm, screw-fastened

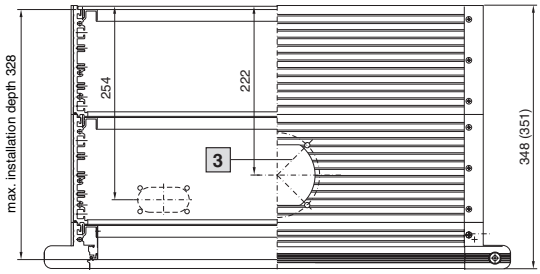


Dimensions in brackets refer to narrow and combined front frames.

5 295 mm, hinged

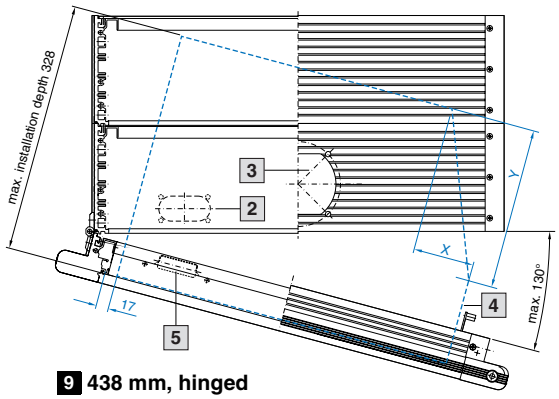


6 328 mm, screw-fastened

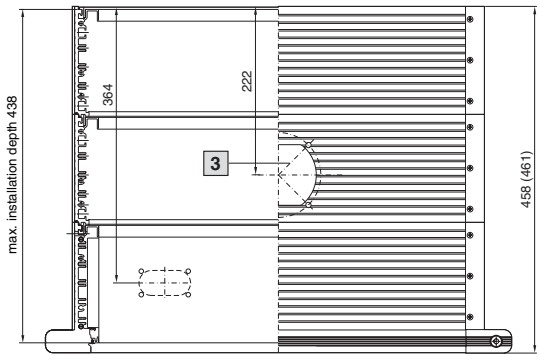


Dimensions in brackets refer to narrow and combined front frames.

7 328 mm, hinged

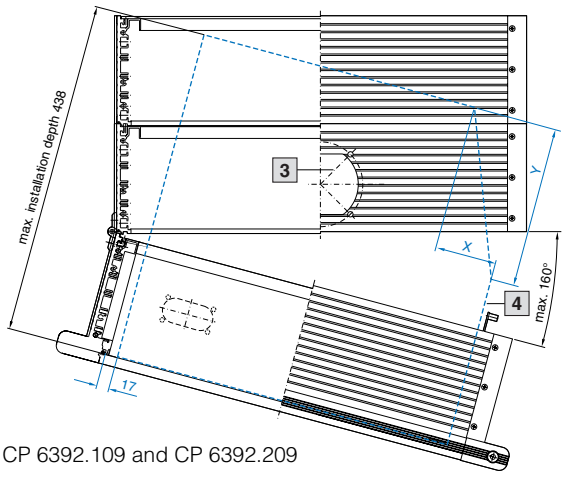


8 438 mm, screw-fastened



Dimensions in brackets refer to narrow and combined front frames.

9 438 mm, hinged



1 Support arm cutout for CP-L system, Ø 130 mm

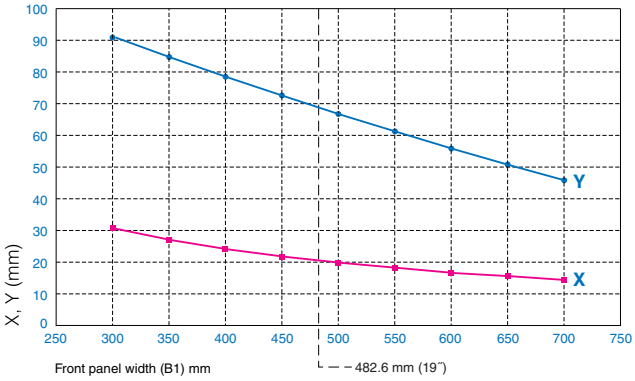
4 Max. installation space for hinged enclosures

3 Support arm connection for system CP-XL

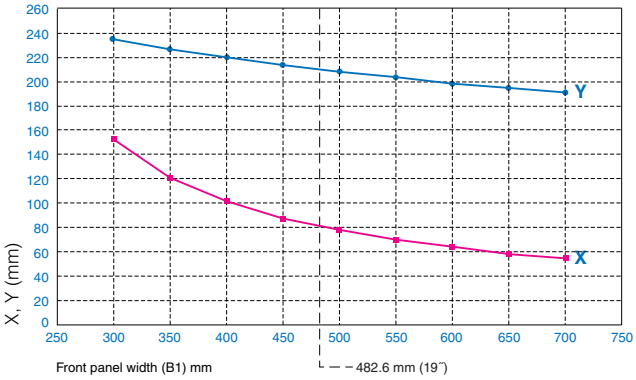
2 Only for CP 6392.109 and CP 6392.209

5 Only for CP 6392.009

Calculating the swivel mounting space (for installation depth 185 mm und 295 mm, hinged)



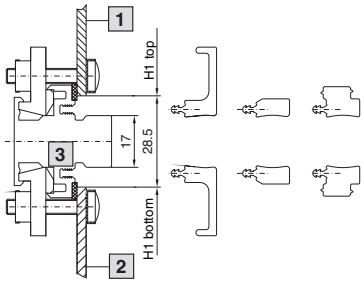
Calculating the swivel mounting space (for installation depth 328 mm und 438 mm, hinged)



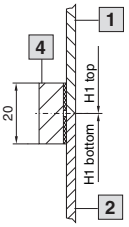
1.5 Rittal Command Panel VIP 6000

3.2 Front design Page 162

1 3 5 Cross member



2 4 5 Sealing bar



1 Front panel 1
2 Front panel 2
3 Cross member
4 Sealing bar

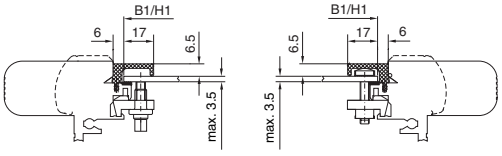
Minimum front panel width (B1)
Depending on the
- Installation depth of the operating housing
- Connection between the operating housing/keyboard housing
- Position of the support arm connection

Dimensions in mm		Installation depth of operating housing (see page 161)				
		155	185	295	328	438
Prepared for the external mounting of keyboard housing (see design code number 3.7, page 164)	Support arm/ wall-mounted and pedestal connection (see design code number 3.6, page 164)	1	2 Screw-fastened 3 Hinged	4 Screw-fastened 5 Hinged	6 Screw-fastened 7 Hinged	8 Screw-fastened 9 Hinged
		Minimum front panel width				
0 None	**0** to **3** top or bottom	169	265	169	265	265
1 Frame connector or **4** hinged frame connector	**1** top	169	265	169	265	
	2 and **3** bottom	339[1)]	445[1)]	339[1)]	445[1)]	
2 Enclosure duct connector	**1** top	189	265	189	265	
	2 and **3** bottom	339	445	339	445	
3 Enclosure bar connector	**1** top	169	265	169	265	
	2 and **3** bottom	397[1)]	445[1)]	397[1)]	445[1)]	

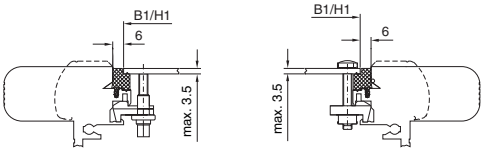
[1)] Smaller front panel widths for asymmetrical support arm connection available on request.

3.4 Trim types Page 163

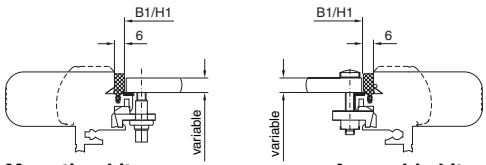
1 Cover trim
Front panel recessed, screws concealed



3 Spacer trim
Front panel flush



2 End trim
Front panel recessed



Mounting kit for threaded bolts:
M5: CP 6053.500
M4: CP 6058.500

Mounting kit for screw clamp:
CP 6053.210

Mounting kits,
see page 1037.

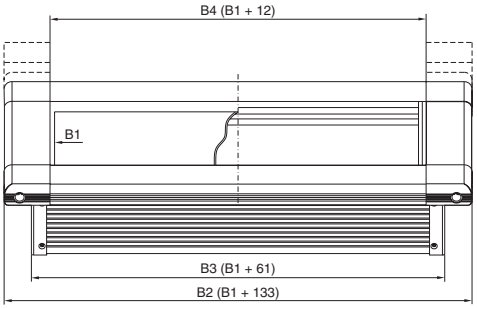
Assembly kit for holes:
M5: CP 6053.000
M4: CP 6058.000
M6: CP 6053.000/6058.000
+ EL 2092.200
+ screws M6 x 25

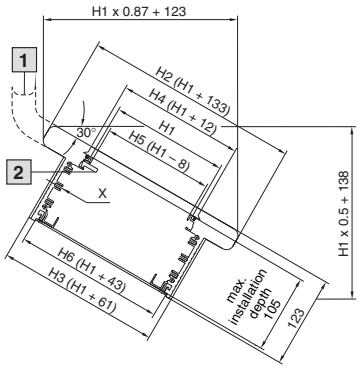
1.5 Rittal Command Panel VIP 6000

4.1 Keyboard housing Page 166

1 Installation depth 105 mm

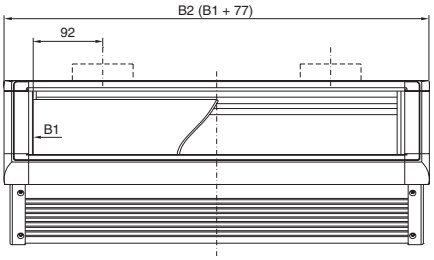
Front frames
Wide

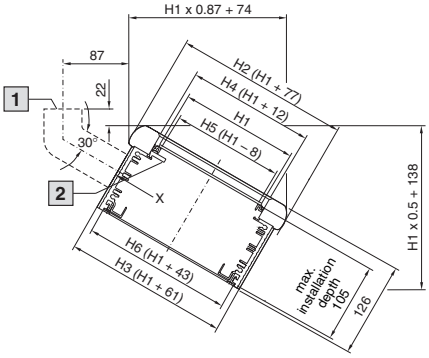




1 Frame connector, rigid/adjustable
2 CP 6058.XXX: M4
CP 6053.XXX: M5

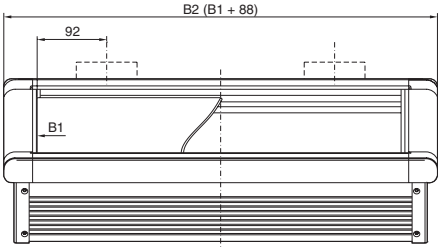
Narrow

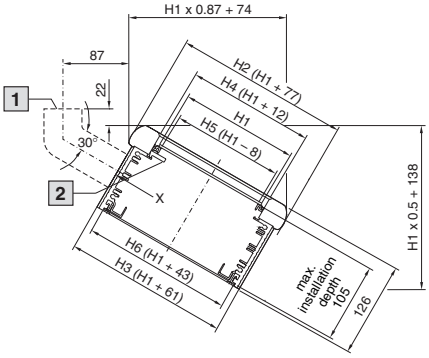




1 Enclosure duct connector
2 CP 6058.XXX: M4
CP 6053.XXX: M5

Combined





1 Enclosure duct connector
2 CP 6058.XXX: M4
CP 6053.XXX: M5

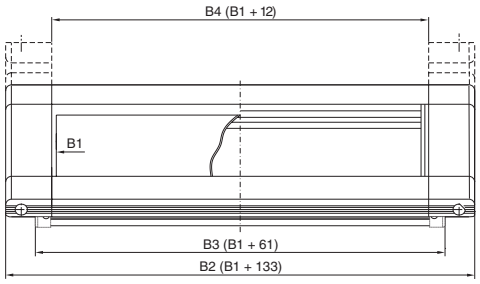
B = Width

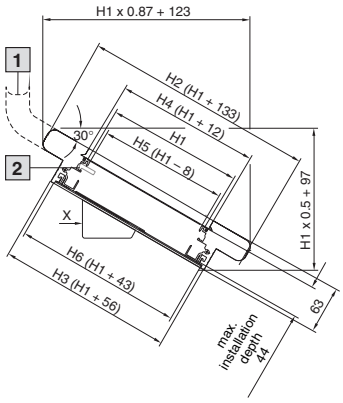
1.5 Command Panel VIP 6000

4.1 Keyboard housing Page 166

2 Installation depth 44 mm

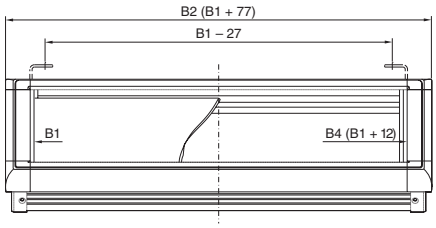
Front frames
Wide

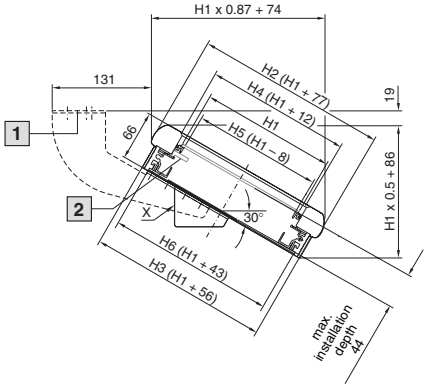




1 Frame connector, rigid/adjustable
2 CP 6058.XXX: M4
CP 6053.XXX: M5

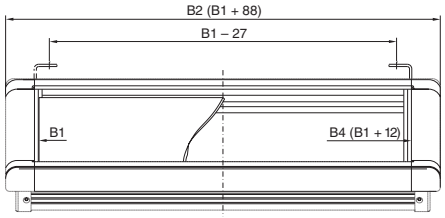
Narrow

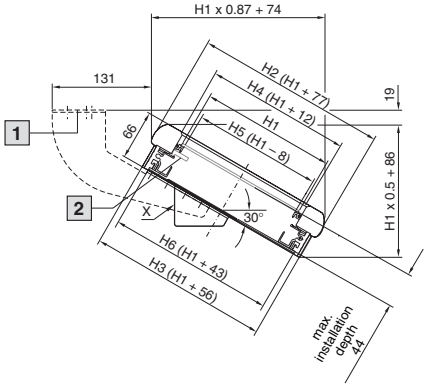




1 Enclosure bar connector
2 CP 6058.XXX: M4
CP 6053.XXX: M5

Combined





1 Enclosure bar connector
2 CP 6058.XXX: M4
CP 6053.XXX: M5

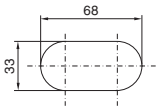
Width dimensions:

B1 = Width of the front panel
B2 = Overall width
B3 = Enclosure width
B4 = Clearance width between front frames
B6 = Width of the rear panel
B7 = Distance between rear panel holes, width

Height dimensions:

H1 = Height of the front panel
H2 = Overall height
H3 = Enclosure height
H4 = Clearance height between front frames
H5 = Clearance height between enclosure sections
H6 = Height of rear panel
H7 = Distance between rear panel holes, width

X = Cross-section of cable tube connection

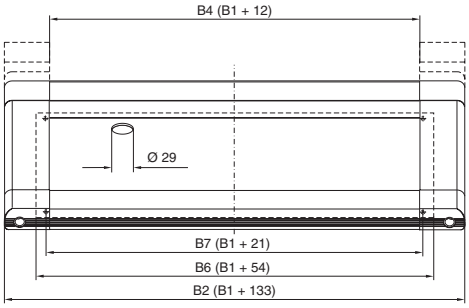


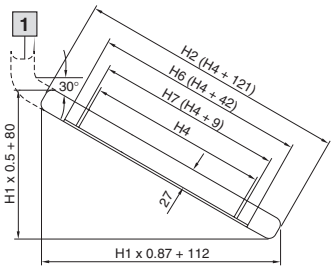
1.5. Command Panel VIP 6000

4.1 Keyboard housing Page 166

3 Depth 27 mm

**Front frame, wide,
with cable entry grommet**

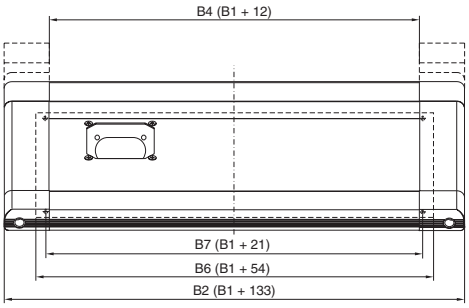


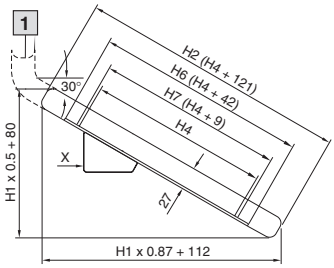


1 Frame connector, rigid/adjustable

4 Depth 27 mm

**Front frame, wide,
for cable tube, flexible**

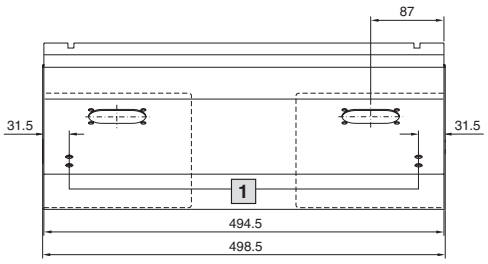




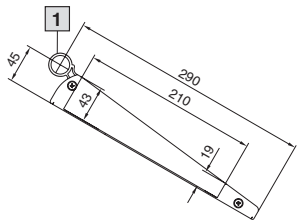
1 Frame connector, rigid/adjustable

5 Support for keyboards

**Narrow front frame and
combined with cable entry grommet**

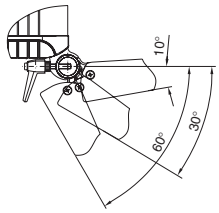


1 Prepared for the support for mousepad, vertically hinged SM 2383.020



1 Hinged frame connector

Rotation range



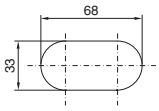
Width dimensions:

B1 = Width of the front panel
B2 = Overall width
B3 = Enclosure width
B4 = Clearance width between front frames
B6 = Width of the rear panel
B7 = Distance between rear panel holes, width

Height dimensions:

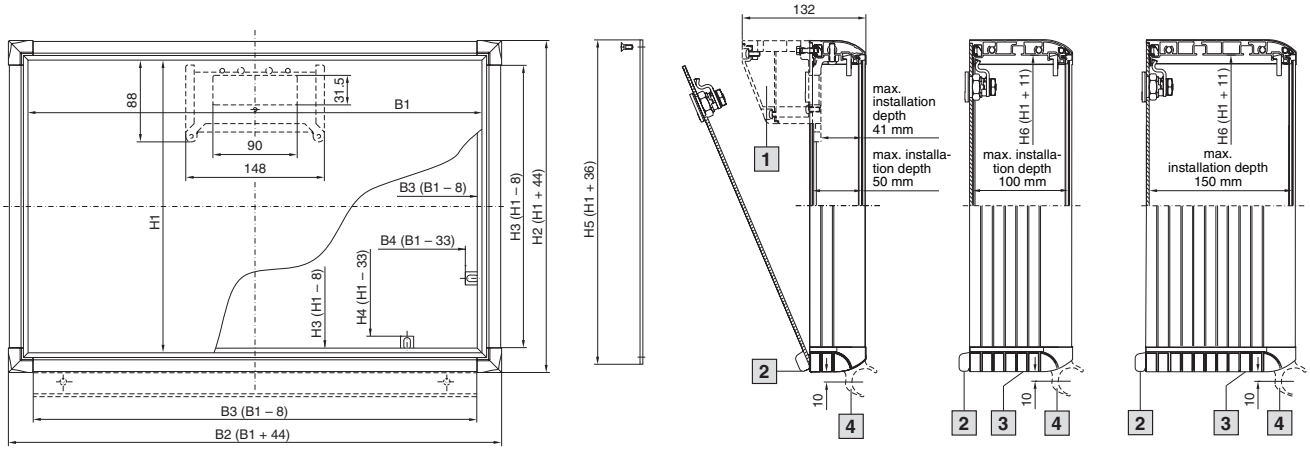
H1 = Height of the front panel
H2 = Overall height
H3 = Enclosure height
H4 = Clearance height between front frames
H5 = Clearance height between enclosure sections
H6 = Height of rear panel
H7 = Distance between rear panel holes, width

X = Cross-section of cable tube connection

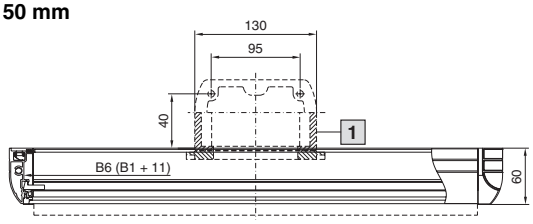


1.5 Optipanel

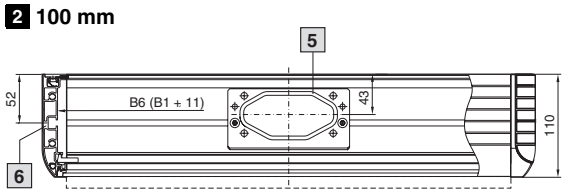
2.1 Installation depth Page 173



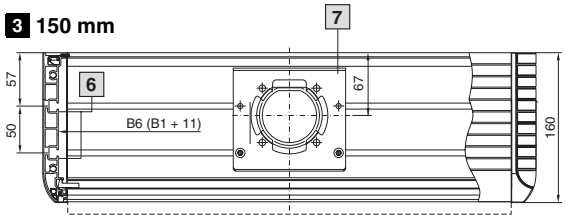
1 50 mm



2 100 mm



3 150 mm



1 When preparing for rear support arm connection CP-L, ▭ 120 x 65 mm
2 Hinge
3 Cable tube
4 When preparing for keyboard housings
5 Prepared for CP-L, ▭ 120 x 65 mm
6 Channels for inserting the spring nuts M5
7 Prepared for CP-L, Ø 130 mm

Width dimensions:

B1 = Width of the front panel
B2 = Overall width
B3 = Clearance width between enclosure sections
B4 = Clearance width between the retaining claws of the mounting kit
B5 = Width of rear panel (B1 + 36)
B6 = Clearance width for assembly

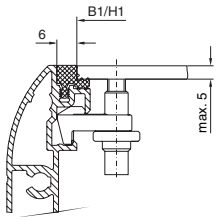
Height dimensions:

H1 = Height of the front panel
H2 = Overall height
H3 = Clearance height between enclosure sections
H4 = Clearance height between the retaining claws of the mounting kit
H5 = Height of rear panel
H6 = Clearance height for assembly

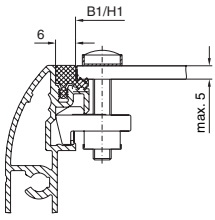
1.5 Optipanel

2.2 Front design Page 174

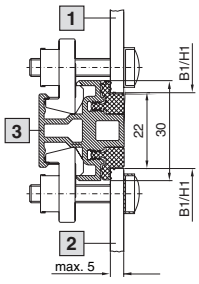
Front panel screw-fastened from the inside



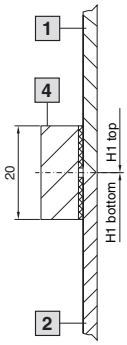
Front panel screw-fastened from the outside



Cross member



Sealing bar

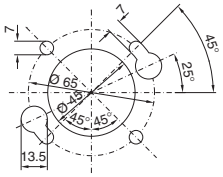


1 Front panel 1
2 Front panel 2
3 Cross member
4 Sealing bar

1.5 Command Panel VIP 6000/Optipanel

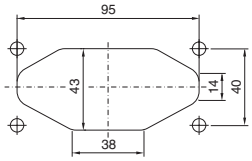
3.6/2.3 Support arm/wall and pedestal connection Page 164/175

CP-S
For installation depths 100/150 mm



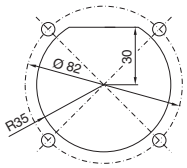
External mounting of support arm connections, see page 192.

CP-L, ▭ 120 x 65 mm
For installation depths 100/150 mm



External mounting of support arm connections, see page 200.

CP-L, Ø 130 mm
For installation depth 150 mm

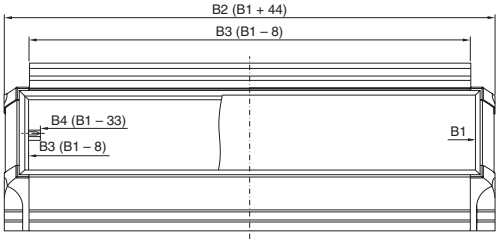


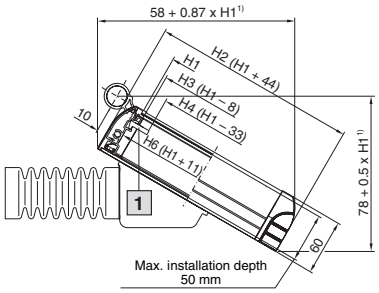
External mounting of support arm connections, see page 200.

1.5 Optipanel

2.5 Keyboard housing Page 177

1 Installation depth 50 mm

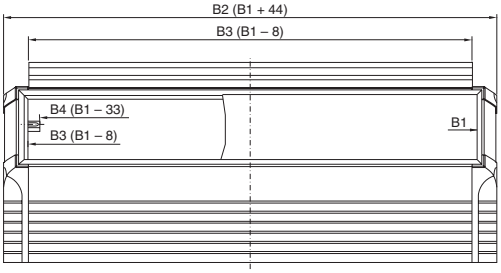


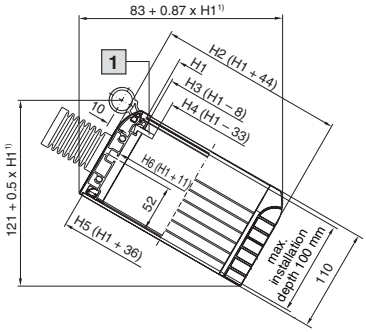


1 CP 6053.XXX: M5
CP 6058.XXX: M4

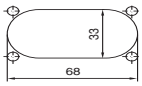
1) Applies to a tilting angle of 30° to the horizontal.

2 Installation depth 100 mm



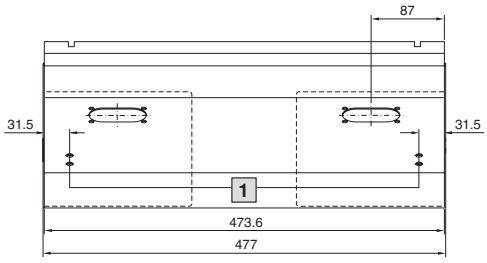


Cross-section
Cable duct connection

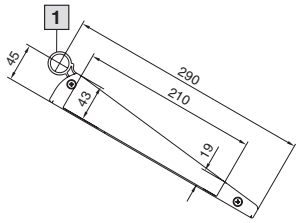


3 Support for keyboards

Narrow front frame and
combined with cable entry grommet

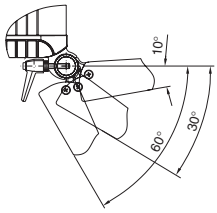


1 Prepared for the support for mousepad, vertically hinged SM 2383.020



1 Hinged frame connector

Rotation range



Width dimensions:

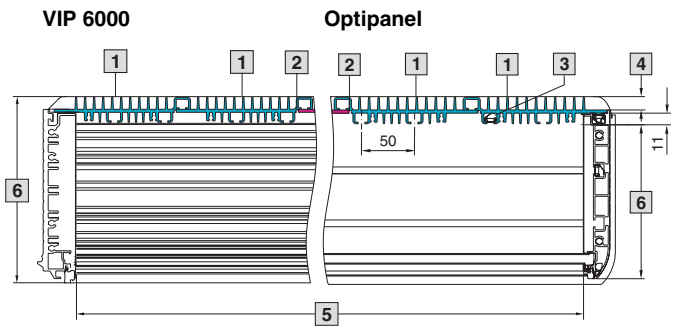
B1 = Width of the front panel
B2 = Overall width
B3 = Clearance width between enclosure sections
B4 = Clearance width between the retaining claws of the mounting kit
B5 = Width of rear panel (B1 + 36)
B6 = Clearance width for assembly

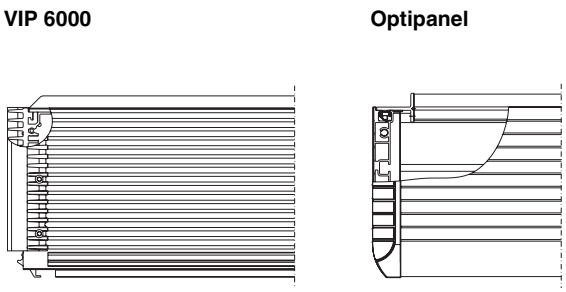
Height dimensions:

H1 = Height of the front panel
H2 = Overall height
H3 = Clearance height between enclosure sections
H4 = Clearance height between the retaining claws of the mounting kit
H5 = Height of rear panel
H6 = Clearance height for assembly

1.5 Command Panel VIP 6000/Optipanel

Rear cooling panel Page 165/176





1 Rear cooling panel section, unless otherwise specified the cooling fins are arranged vertically.

2 Width compensating panel, mounted in the centre with an even number of heat sinks, or on the right with an uneven number. By rotating the entire rear panel through 180°, this position may be modified individually.

3 Spring nut M5, CP 6108.000 for interior installation on screw channels.

4 The total depth of the enclosure is increased by 13 mm.

5 Front panel width for determining the cooling modules and compensating panel.

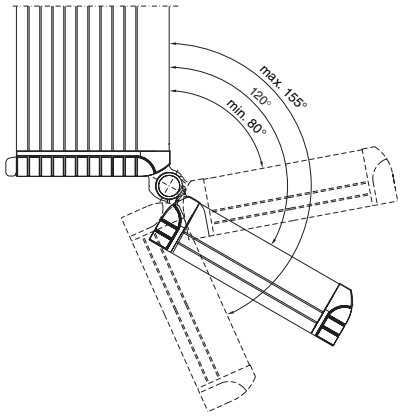
6 Installation depth is reduced by 11 mm.

Recommendation:
The minimum front panel width for the installation of at least 2 heat sink sections is 240 mm and should not be undercut, if possible.

1.5 Optipanel

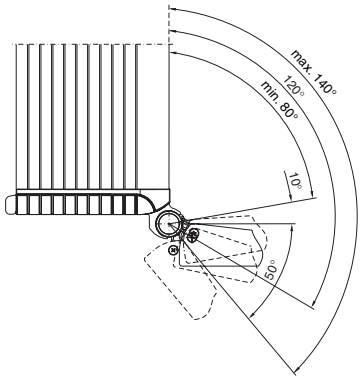
Keyboard housing connection Page 168

1 2 Hinged frame connector with Optipanel keyboard housing



Tilting angle infinitely ajustable from 80° to 155°.

3 Hinged frame connector with support for keyboards



Tilting angle infinitely ajustable from 80° to 140°.

Minimum front panel width (B1):
Depending on the
- Installation depth of the operating housing
- With or without keyboard housing
- Position of the support arm connection

		Installation depth of operating housing (see page 173)		
Keyboard housing (see page 177)	Position of the support arm connection (see page 175)	50 mm	100 mm	150 mm
		Minimum front panel width (mm)		
0 without	**0** to **8** top, bottom or rear	160 (265)	150	150
1 and **2** with	**1, 4, 7, 8** top or rear			
	2, 3, 5, 6 at bottom	378[1)]	339[1)]	339[1)]

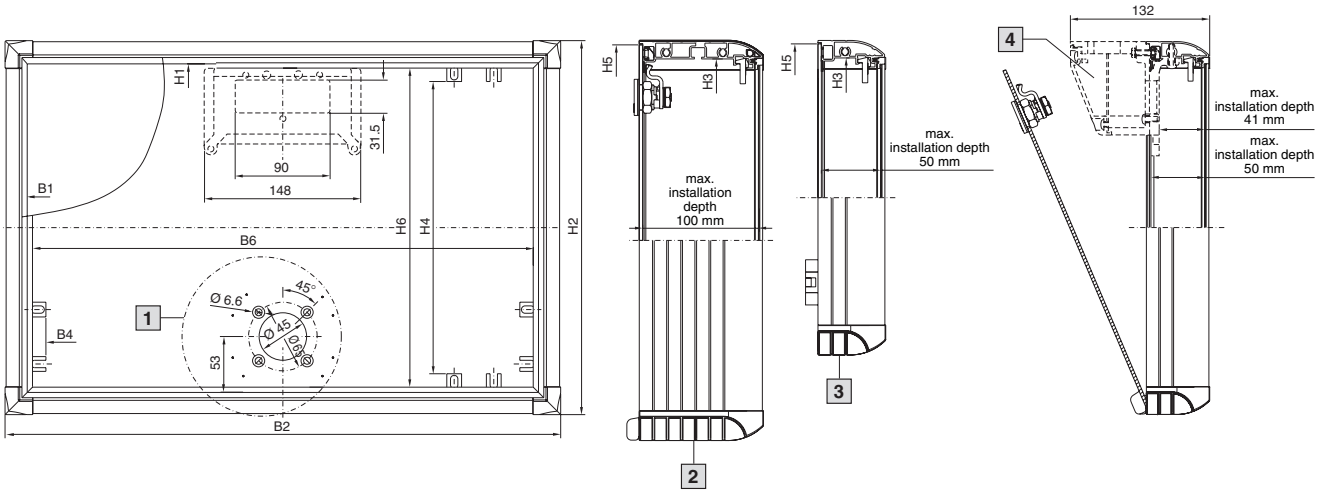
( ) Figures in brackets:
Only with the hinged rear panel combination (see page 176) version **2** and **4** with connection rear panel (see page 175) version **7** and **8.**

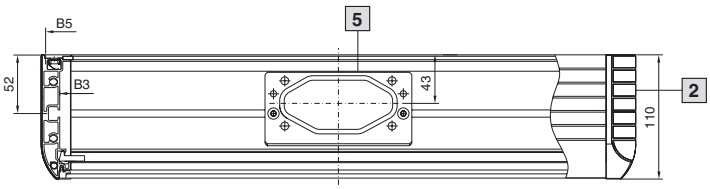
[1)] Smaller front panel widths for asymmetrical support arm connection available on request.

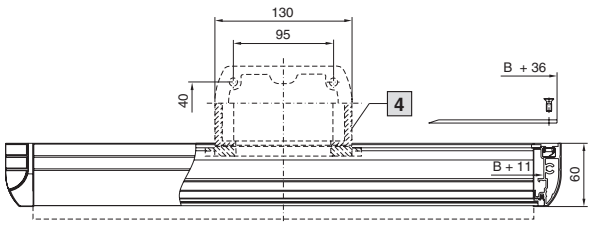
Operating housings

1.5 Optipanel

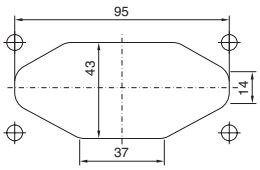
Standard sizes Page 178







Prepared for CP-L, ▭ 120 x 65 mm
for CP 6380.000

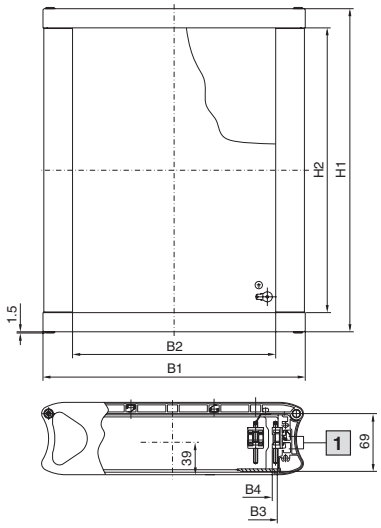


1 Only for CP 6380.100
2 CP 6380.000, CP 6380.020, CP 6380.040
3 CP 6380.100
4 When preparing for rear support arm connections CP 6380.010, CP 6380.030
5 Prepared for CP-L, ▭ 120 x 65 mm

Model No. CP	6380.100	6380.000	6380.010	6380.020	6380.030	6380.040
B1 = Width of front panel mm	270	482.6	430	430	482.6	482.6
H1 = Height of front panel mm	234	310.3	343	343	354.8	354.8
Max. installation depth mm	50	100	50	100	50	100
Overall depth mm	60	110	60	110	60	110
B2 = Overall width mm	314	527	475	475	527	527
B3 = Clearance width between enclosure sections mm	281	494	441	441	494	494
B4 = Clearance width between the retaining claws of the mounting kit mm	237	450	397	397	450	450
B5 = Width of rear panel mm	306	519	466	466	519	519
B6 = Clearance width for assembly mm	262	475	422	422	475	475
H2 = Overall height mm	278	354	387	387	399	399
H3 = Clearance height between enclosure sections mm	245	321	354	354	365	365
H4 = Clearance height between the retaining claws of the mounting kit mm	201	277	310	310	321	321
H5 = Height of rear panel mm	270	346	379	379	391	391
H6 = Clearance height for assembly mm	226	302	335	335	347	347

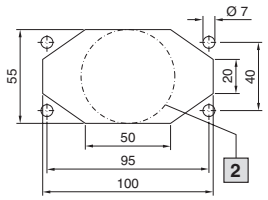
1.5 Compact Panel

Page 183

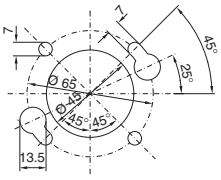


Mounting cutouts

CP-L, ▭ 120 x 65 mm



CP-S



1 Channels for M5 spring nuts

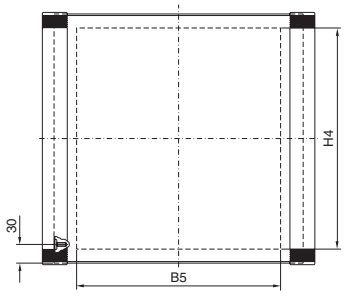
2 Alternative max. Ø 55

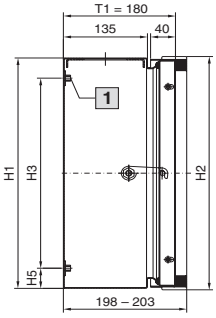
Model No. CP (with support arm connection CP-S)	**6340.000**	**6340.100**	**6340.200**	**6340.300**	**6340.400**
Model No. CP[1)] (with support arm connection CP-L, ▭ 120 x 65 mm)	**6340.010**	**6340.110**	**6340.210**	**6340.310**	**6340.410**
Model No. CP[1)] (without support arm connection)	**6340.020**	**6340.120**	**6340.220**	**6340.320**	**6340.420**
Width (B1) in mm	241	241	241	315	315
Height (H1) in mm	238	388	521	238	388
Depth (T1) in mm	87	87	87	87	87
B2 = Enclosure clearance width	170	170	170	244	244
B3 = Front panel width	178	178	178/4 U	252	252
B4 = Clearance width between screw clamps	164	164	164	238	238
H2 = Enclosure clearance height	192	342	475	192	342
H3 = Front panel height	200	350	482.6/19″	200	350
H4 = Clearance height between screw clamps	186	336	469	186	336

[1)] Delivery time approx. 2 weeks.

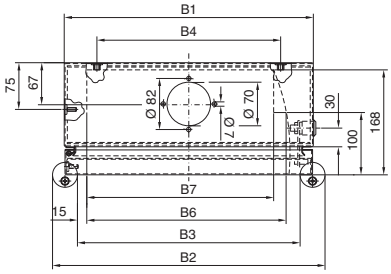
1.5 Command panel housing with door

based on AE Page 184





Top view

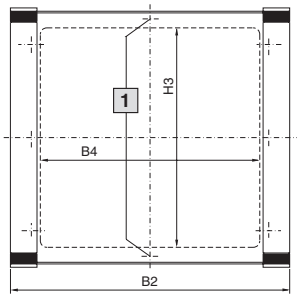


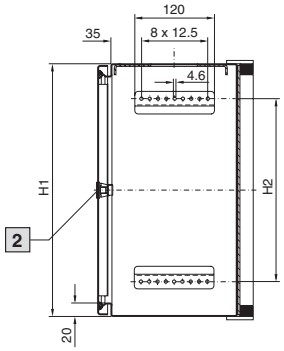
1 Welded nut M8 for the attachment of mounting plates or support rails

Model No. CP	1	**6534.000**	**6535.000**	**6537.000**	**6536.000**	**6538.000**	**6544.000**
Width (B1) in mm	Packs of	300	300	300	400	400	500
Height (H1) in mm		200	300	400	300	400	500
Depth (T1) in mm		180	180	180	180	180	180
B2 = Enclosure width with handle strips		338	338	338	438	438	538
B3 = Clearance opening, front		258	258	258	358	358	458
B4 = Spacing of mounting plate attachment		260	215	215	295	295	410
B5 = Max. front cutout, width		227	227	227	327	327	427
B6 = Hinged width for depth 100 mm		220	220	220	320	320	420
B7 = Hinged width for depth 168 mm		200	200	200	300	300	400
H2 = Enclosure height with handle strips		205	305	405	305	405	505
H3 = Spacing of mounting plate attachment		122	250	350	250	330	445
H4 = Max. front cutout, height		155	255	355	255	355	455
H5 = Distance from base – mounting plate attachment		39	25	25	25	35	27.5

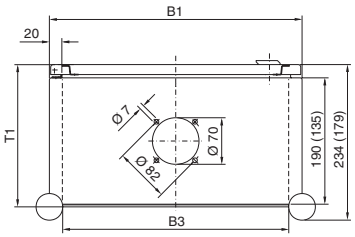
1.5 Operating housings

based on AE Page 185





Top view



1 Only for CP 6532.200 and CP 6533.200

2 For CP 6532.200 2 cams

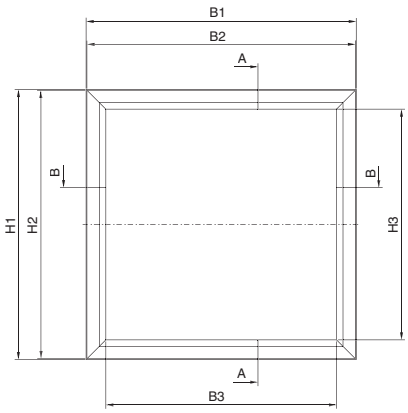
Note:
Dimensions in brackets for CP 6540.200.

Model No. CP	1	**6540.200**[1)]	**6531.200**	**6530.200**	**6532.200**	**6533.200**
Width (B1) in mm	Packs of	300	380	380	500	600
Height (H1) in mm		200	300	380	500	380
Depth (T1) in mm		155	210	210	210	210
B2 = Enclosure width with handle strips		340	420	420	540	640
B3 = Clearance opening, front		260	340	340	460	560
B4 = Cutout, in enclosure		250	330	330	450	550
H2 = Hole distance of side mounting angles		75	175	275	375	275
H3 = Cutout, in enclosure		150	250	330	450	330

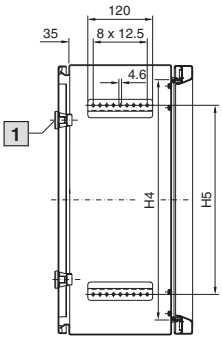
[1)] Support arm connection and door hinge at the bottom.

1.5 Operating housing

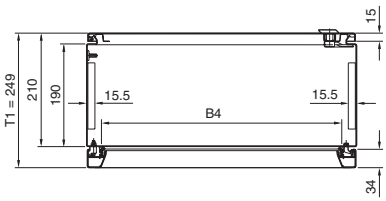
based on AE with display panel front Page 186



Section A – A



Section B - B



1 For CP 6442.500 only 1 cam in the centre.

Model No. CP	1	**6442.500**	**6462.500**	**6552.500**	**6662.500**
Width (B1) in mm	Packs of	380	380	500	600
Height (H1) in mm		380	600	500	600
Depth (T1) in mm		249	249	249	249
B2 = Width of display panel front		379	379	499	599
B3 = Clearance opening, front		309	309	429	529
B4 = Width of front panel		323	323	443	543
H2 = Height of display panel front		377	597	497	597
H3 = Clearance opening, front		307	527	427	527
H4 = Height of front panel		321	541	441	541
H5 = Hole distance of side mounting angles		250	450	350	450

1.5 Pedestal

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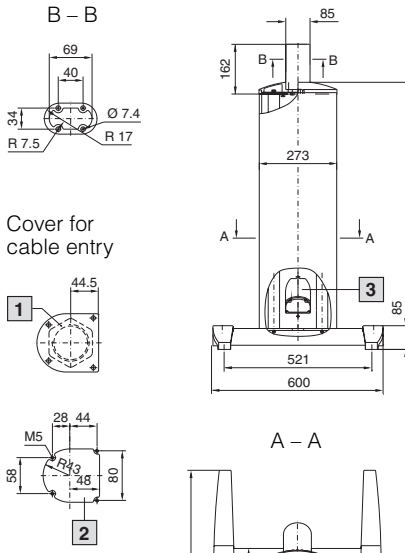
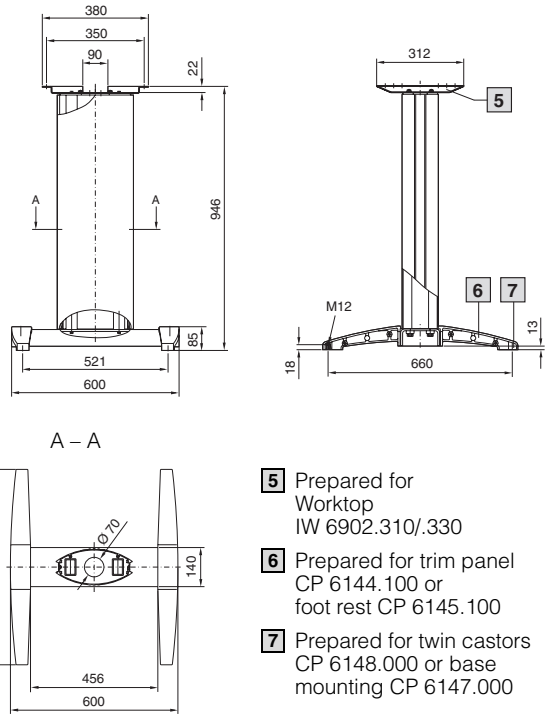
for Command Panel



for IW worktops



1 Max. PG 48/M50

2 Cross-section cable entry

3 Cutout only for CP 6141.100

4 Cable conduit adaptor only for CP 6141.100

5 Prepared for Worktop IW 6902.310/.330

6 Prepared for trim panel CP 6144.100 or foot rest CP 6145.100

7 Prepared for twin castors CP 6148.000 or base mounting CP 6147.000

1.5 Pedestal mobile

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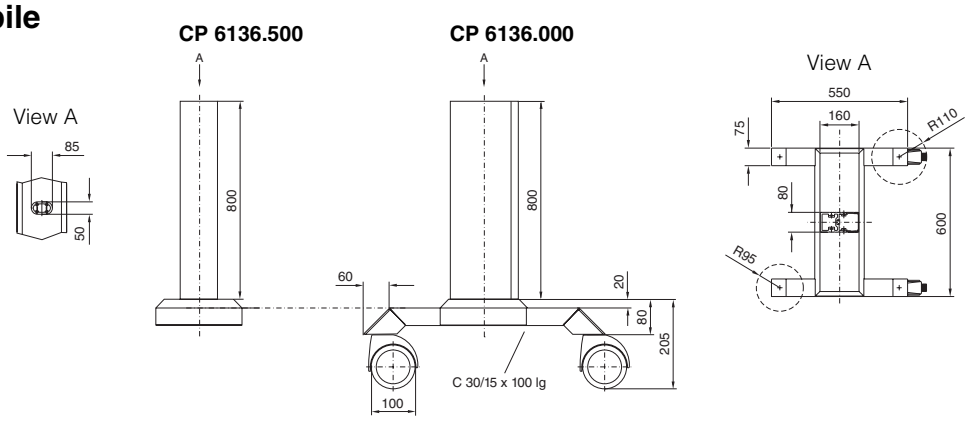

1.5 Pillar, small

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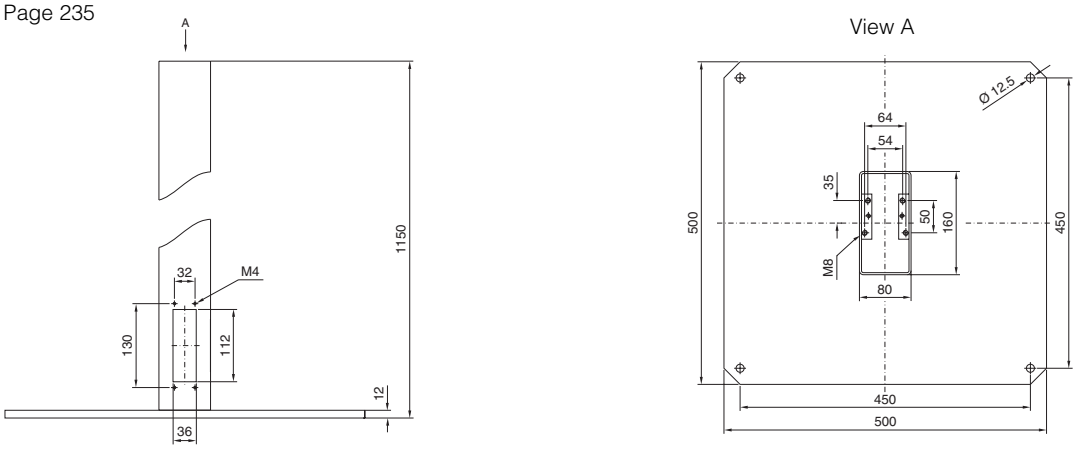

1.5 Cross member/base plate

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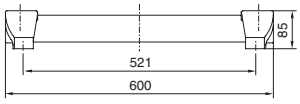
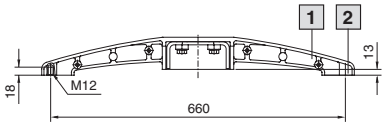
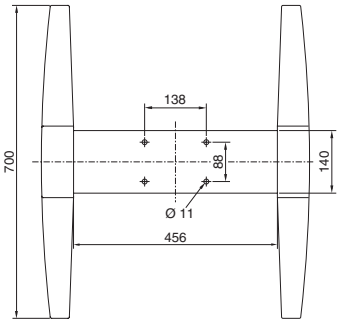
Cross member with cast feet





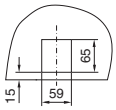
Pedestal base plate, large



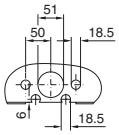
1 Prepared for trim panel CP 6144.100 or foot rest CP 6145.100

2 Prepared for twin castors CP 6148.000 or base mounting CP 6147.000

View A



View B

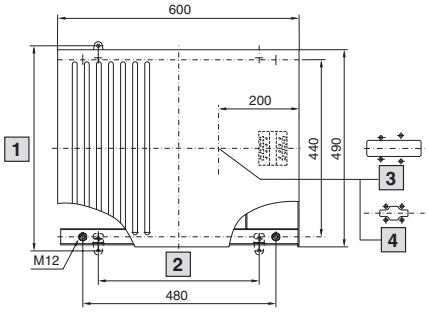


1 510 for floor anchoring with KL 1580.000, KL 1590.000

400 for floor anchoring with KL 1580.000, KL 1590.000

3 Cutout for CP 6137.035

4 Cutout for CP 6137.535



1.5 Pillar

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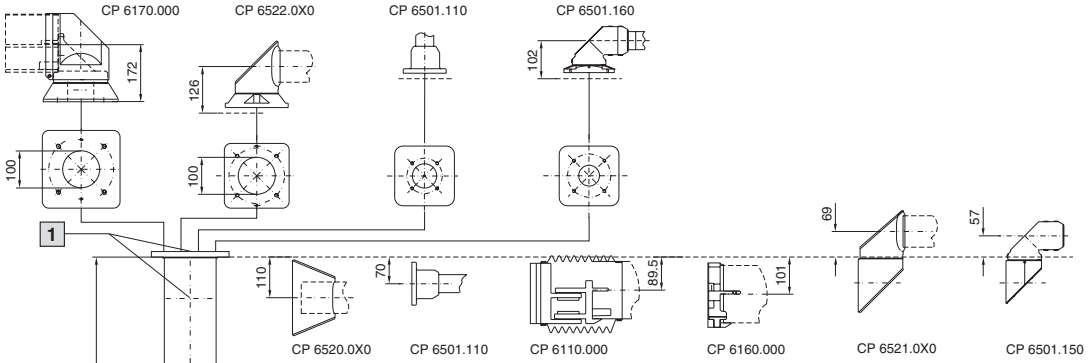
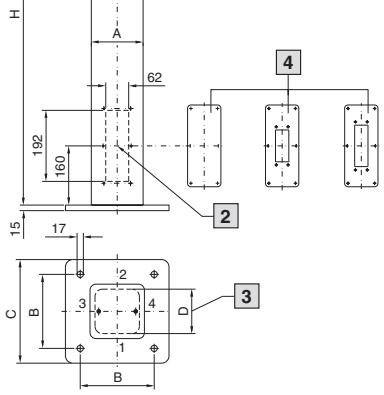
Model No. CP	A	B	C	D
6214.XX0	140	200	280	120
6220.XX0	200	300	400	180





1 Support arm connection according to the design code number

2 Cutout for cable entry according to the design code number

3 Cutout in base plate

4 Metal gland plate, see page 969.

1.5 Enclosures

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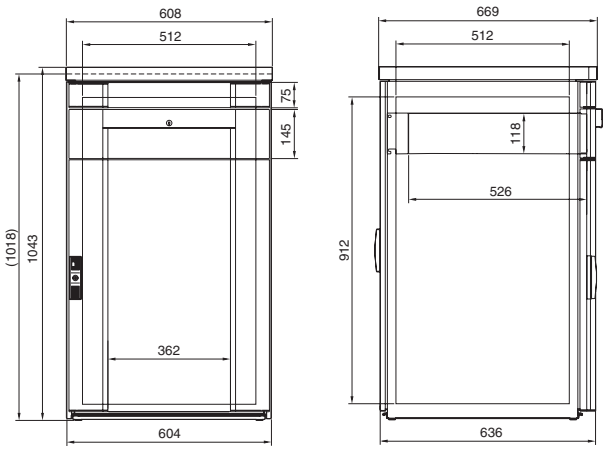
		Model No. IW	W/D mm 600/600	6900.000	6900.100	6900.200	6900.400	6900.410	6900.600	6901.000	6901.100	6901.200
			H mm	900	900	900	900	900	900	1000	1000	1000
Supply includes	**Version**	**Material**	**Colour RAL**									
Enclosures	Frame construction with side panels, screw-fastened from the inside	Sheet steel, 1.5 mm	7035 textured	■	■	■	■	■	■	■	■	■
	Base with gland plate for cable entry											
	Levelling feet to compensate for floor irregularities											
Trim panel, top	To finish off the enclosure at the top	Plastic to UL 94-V0	7035/ 7015						■		■	■
Keyboard drawer	Drawer housing	1.5 mm sheet steel	7035								■	■
	Extension piece with cable support, hinged, plus pull-out mouse-pad and keyboard cradle											
	Trim panel with recessed handle, folded as handrest, with lock no. 3524 E	Plastic to UL 94-V0	7035/ 7015/ 9006									
Drawer section	Drawer tray, fitted with drawer trim panel and telescopic slides	Sheet steel, 1.5 mm	7035				■					
	Extension piece with cable support, hinged, plus pull-out mouse-pad	Sheet steel, 1.5 mm	7035					■				
	Drawer trim panel with handle recess, with lock no. 3524 E	Plastic to UL 94-V0	7035/ 7015/ 9006				■	■				
Designer door	Vertical bars with locking rod and double-bit insert, hinged on right-hand side	Aluminium section	7035	■	■		■	■		■	■	■
	Door or installation plate, folded	Sheet steel, 1.5 mm	7015									
Glazed door	Vertical decorative trim panels	Plastic to UL 94-V0	7035									
	Pane with screen-printed mask	Safety glass 4.0 mm	7015			■						
Drawer front	Drawer tray, slotted all round for cross member retainers, 1x with low trim piece, 2x with high trim piece, each with handle recess, telescopic slides	Sheet steel, 1.5 mm	7035/ 7015/ 9006						■			
Worktop	Solid	Chipboard, plastic-laminated on both sides, with edge strip	similar to 7035 Edge strip: similar to 7015								■	
Roof	Edged, screw-fastened from the inside	Sheet steel, 1.5 mm	7035 textured									■
Rear panel	Screw-fastened from the inside	Sheet steel, 1.5 mm	7035 textured	■					■			
	Screw-fastened from the outside									■		
Rear door	With locking rod and double-bit, insert, r/h hinge	Sheet steel, 1.5 mm	7035 textured		■	■	■	■			■	■

1.5 Enclosures

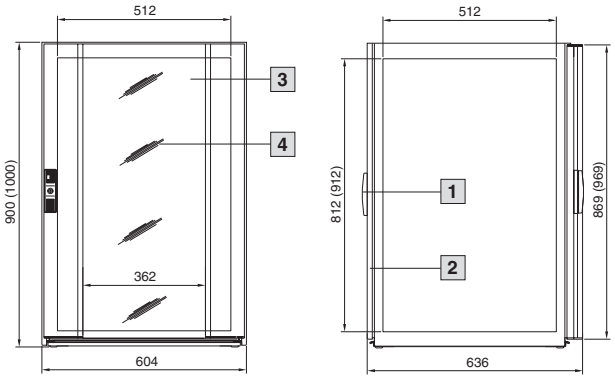
Page 245/246/250

Enclosure
IW 6901.100
IW 6901.200



Dimensions in brackets for IW 6901.200.

Enclosure
IW 6900.000
IW 6901.000
IW 6900.100
IW 6900.200



Dimensions in brackets for IW 6901.000.

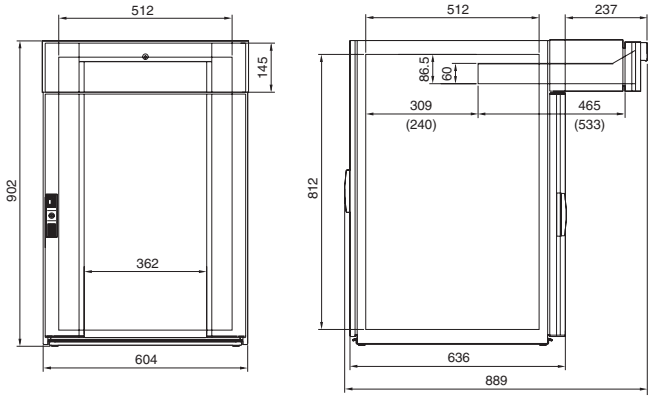
[1] Rear panel for IW 6900.100 and IW 6900.200

[2] Rear panel for IW 6900.000 and IW 6901.000

[3] Design door for IW 6900.000, IW 6901.000 and IW 6900.100

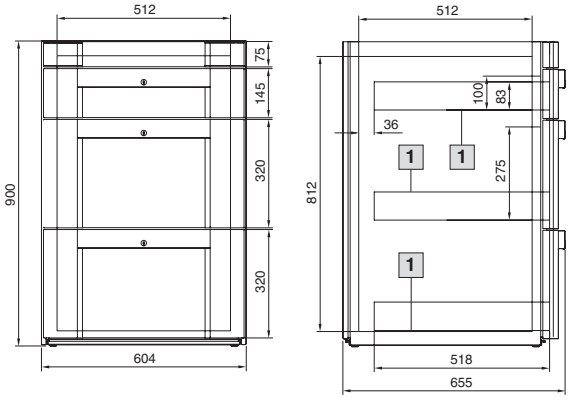
[4] Glazed door for IW 6900.200

Enclosure
IW 6900.400
IW 6900.410



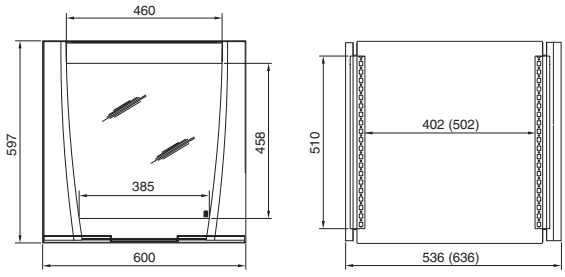
Dimensions in brackets for IW 6900.410.

Enclosure
IW 6900.600



[1] Shelves with punchings for cross members

Monitor housing
IW 6902.500
IW 6902.510

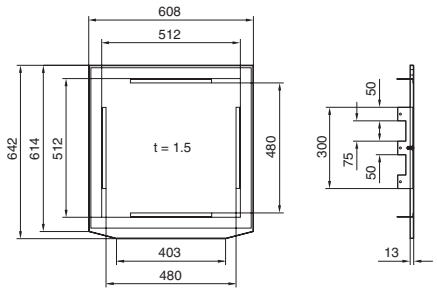


Dimensions in brackets only for IW 6902.XXX.

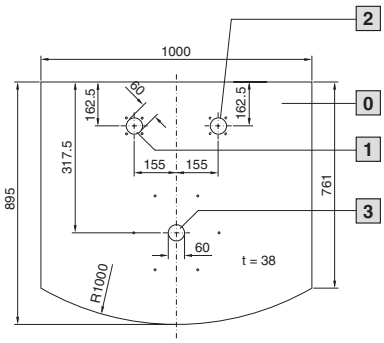
1.5 Worktops

Page 247 – 249

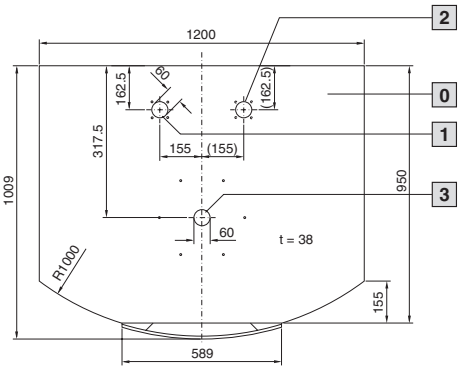
Roof
IW 6902.400



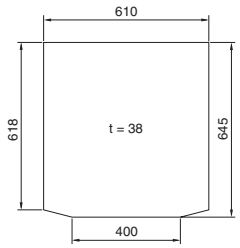
Worktop, without handle,
IW 6902.100
IW 6902.110
IW 6902.120
IW 6902.130



Worktop, with handle,
IW 6902.000
IW 6902.010
IW 6902.020
IW 6902.030



Worktop
IW 6902.300



0 Without mounting cutout for IW 6902.100

1 Mounting cutout, l/h (left hand) side, for enclosure attachment, only for CP 6902.120

2 Mounting cutout, r/h (right hand) side, for enclosure attachment, only for CP 6902.130

3 Mounting cutout prepared for turntable, only for CP 6902.110

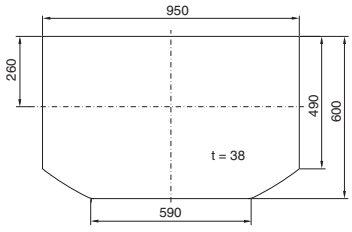
0 Without mounting cutout for IW 6902.000

1 Mounting cutout, l/h side, for enclosure attachment, only for CP 6902.020

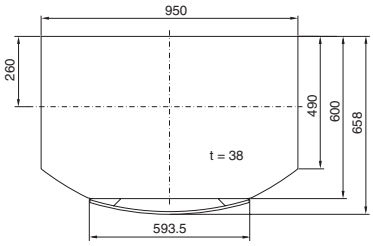
2 Mounting cutout, r/h side, for enclosure attachment, only for CP 6902.030

3 Mounting cutout prepared for turntable, only for CP 6902.010

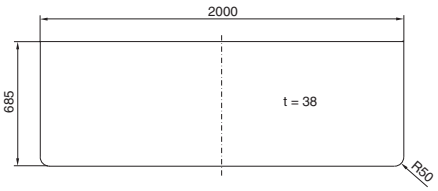
Worktop
IW 6902.310



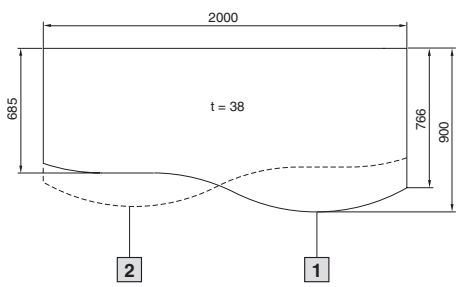
Worktop
IW 6902.320



Worktop
IW 6902.200



Worktop
IW 6902.210



1 IW 6902.210

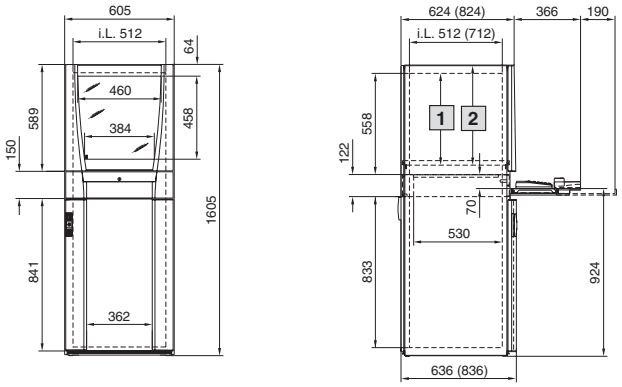
2 IW 6902.220 (arranged as mirror)

PC enclosure systems

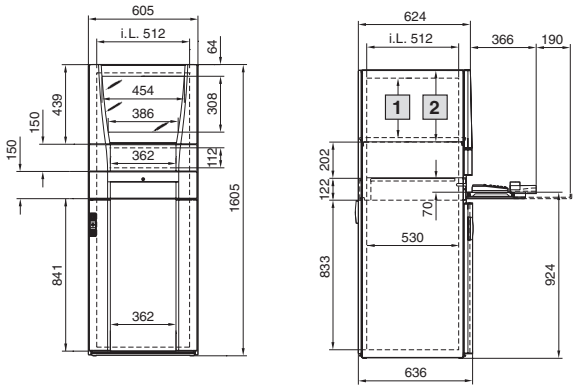
1.5 Based on TS 8

with keyboard drawer Page 257

With drawer
PC 8366.000, PC 8368.000



With mounting compartment, small and drawer
PC 8366.300



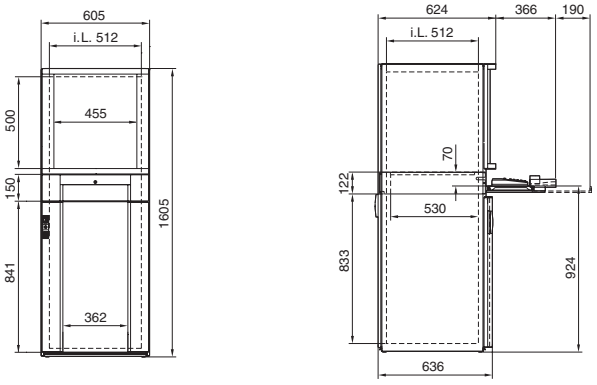
1 max. 505, adjustable on a 25 mm pitch pattern

2 max. 549, adjustable on a 25 mm pitch pattern

1 max. 355, adjustable on a 25 mm pitch pattern

2 max. 397, adjustable on a 25 mm pitch pattern

With mounting compartment, large and drawer
PC 8366.400



i.L. = Clearance width

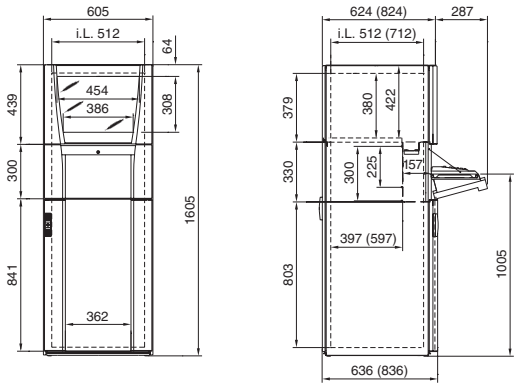
				Model No. PC		
			Depth 636 mm	**8366.000**	**8366.300**	**8366.400**
			Depth 836 mm	**8368.000**	–	–
Supply includes	**Design**	**Material**	**Colour RAL**			
Enclosure	Frame construction with side panels and roof secured from the inside	Sheet steel 1.5 mm	7035 textured	■	■	■
	Gland plates, three-part	Sheet steel 1.5 mm	Zinc-plated			
Rear door	With locking rod and double-bit insert, hinged on the right-hand side	Sheet steel 2.0 mm	7035 textured	■	■	■
Glazed door, top	With support frame latched from the inside[1], r/h hinge	Sheet steel 1.5 mm	7015	■	■	
	Vertical decorative trim panels	Plastic to UL 94-V0	7035			
	Pane with screen-printed mask	Safety glass 4.0 mm	7015			
Mounting compartment, large, top	Vertical bars, latched from the inside[1], r/h hinge	Aluminium section	7035			■
	Installation plate	Sheet steel 1.5 mm	7015			
	Trim strip top/bottom	Plastic to UL 94-V0	7035			
Component shelf for monitor	Slotted, permanently installed	Sheet steel 1.5 mm	7015	■	■	
Drawer for keyboard	Enclosure	Sheet steel 1.5 mm	7035	■	■	■
	Keyboard extension piece with cable support, hinged mousepad extension piece and keyboard cradle	Sheet steel 1.5 mm	7035			
	Trim panel with recessed handle, folded as handrest, with lock no. 3524 E	Plastic to UL 94-V0	7035/7015/9006			
Mounting compartment, small	R/h hinge, screw-fastened from the inside on left, folded installation plate	Sheet steel 1.5 mm	7015		■	
	Decorative side trim panels	Plastic to UL 94-V0	7035			
Bottom door	Vertical bars with locking rod and double-bit insert, hinged on right-hand side	Aluminium section	7035	■	■	■
	Door or installation plate folded	Sheet steel 1.5 mm	7015			

[1] With unlatching for glazed door, top.

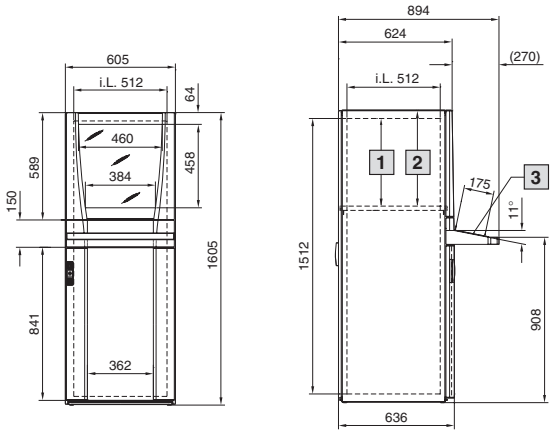
1.5 Based on TS 8

with folding keyboard or desk section Page 258

With fold-out tray
PC 8366.100, PC 8368.100



With desk section
PC 8366.200



1 max. 505, adjustable on a 25 mm pitch pattern
2 max. 549, adjustable on a 25 mm pitch pattern
3 max. installation area 540 x 175 mm

i.L. = Clearance width

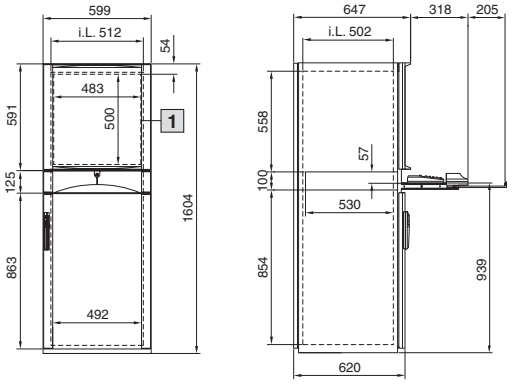
				Model No. PC	
			Depth 636 mm	**8366.100**	**8366.200**
			Depth 836 mm	**8368.100**	**–**
Supply includes	**Design**	**Material**	**Colour RAL**		
Enclosure	Frame construction with side panels and roof secured from the inside	Sheet steel 1.5 mm	7035 textured	■	■
	Gland plates, three-part	Sheet steel 1.5 mm	Zinc-plated		
Rear door	With locking rod and double-bit insert, r/h hinge	Sheet steel 2.0 mm	7035 textured	■	■
Glazed door, top	With support frame latched from the inside[1], r/h hinge	Sheet steel 1.5 mm	7015	■	■
	Vertical decorative trim panels	Plastic to UL 94-V0	7035		
	Pane with screen-printed mask	Safety glass 4.0 mm	7015		
Component shelf for monitor	Slotted, permanently installed	Sheet steel 1.5 mm	7015	■	■
Fold-out tray for keyboard	Enclosure with mouse holder and cutout in the rear panel, width 482.6 mm (19″) x height 4 U, for rear attachment	Sheet steel 1.5 mm	7035	■	
	Trim panel hinged at the bottom, with 2 retaining cords, with lock no. 3524 E	Plastic to UL 94-V0	7035/7015/9006		
	Keyboard support with mousepad extension piece and 2 nylon bands for keyboard	Sheet steel 1.5 mm	7035		
Desk section	Enclosure with removable cover top and bottom	Sheet steel 1.5 mm/2.0 mm	7035		■
	Trim strip, top and handle strip	Plastic to UL 94-V0	7035/7015/9006		
Bottom door	Vertical bars with locking rod and double-bit insert, r/h hinge	Aluminium section	7035	■	■
	Door or installation plate folded	Sheet steel 1.5 mm	7015		

[1] With unlatching for top glazed door.

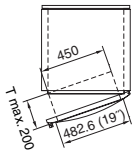
1.5 Based on ES

with keyboard drawer Page 259

With mounting compartment, large and drawer
PC 4603.603

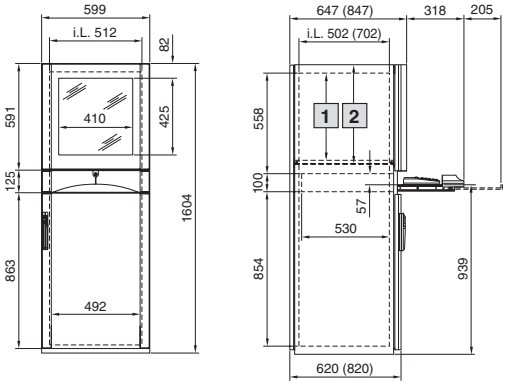


1 External surface available for population



i.L. = Clearance width

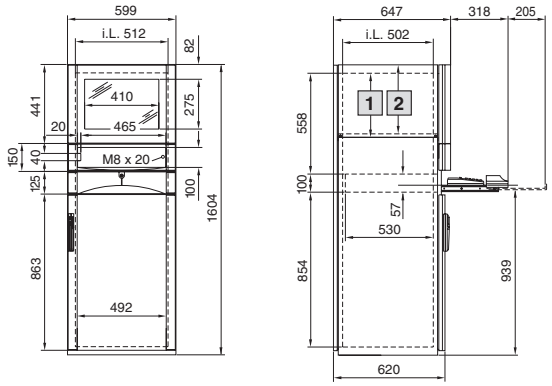
With drawer
PC 4603.703, PC 4609.703



1 max. 505, adjustable on a 25 mm pitch pattern

2 max. 547, adjustable on a 25 mm pitch pattern

With mounting compartment, small and drawer
PC 4603.913



1 max. 355, adjustable on a 25 mm pitch pattern

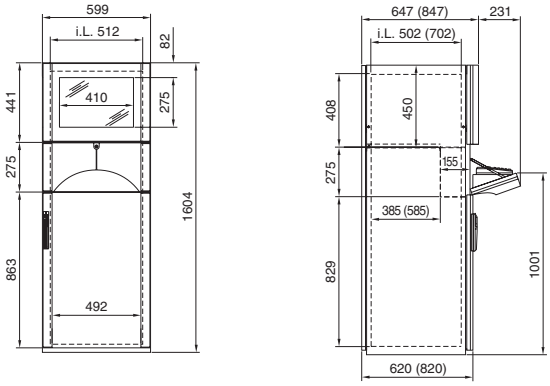
2 max. 397, adjustable on a 25 mm pitch pattern

Supply includes	Design	Material	Colour RAL	PC 4603.603	PC 4603.703 PC 4609.703	PC 4603.913
Enclosure	Solid, open at bottom	Sheet steel 1.5 mm	7035 textured	■	■	■
	Gland plates, three-part	Sheet steel 1.5 mm	Zinc-plated			
Rear door	With locking rod and double-bit insert, r/h hinge	Sheet steel 2.0 mm	7035 textured	■	■	■
Mounting compartment, large, top	Vertical bars, latched from the inside[1], hinged on right-hand side	Aluminium section	5018	■		
	Folded installation plate	Sheet steel 1.5 mm	7035			
	Trim strip top/bottom	Plastic to UL 94-V0	7035			
Glazed door top	Vertical bars, latched from the inside[2], r/h hinge	Aluminium section	5018		■	■
	Trim strip top/bottom	Plastic to UL 94-V0	7035			
	Pane with screen-printed mask	Safety glass 4.0 mm	7015			
Component shelf for monitor	Slotted, permanently installed	Sheet steel 1.5 mm	7035		■	■
Drawer for keyboard	Enclosure	Sheet steel 1.5 mm	7035	■	■	■
	Keyboard extension piece with 1 pair of telescopic slides	Sheet steel 1.5 mm	7035			
	Trim panel with recessed handle, folded as handrest, with lock no. 3524 E	Plastic to UL 94-V0	7035			
	Decorative side trim panels	Aluminium section	5018			
	2 spacers for slimline keyboards	Cellular rubber				
	[1] With unlatching for top glazed door					
Mounting compartment, small	R/h hinge, screw-fastened from the inside on left, folded installation plate	Sheet steel 1.5 mm	7035			■
	Trim strip at the bottom	Plastic to UL 94-V0	7035			
	Vertical bars	Aluminium section	5018			
Bottom door	Vertical bars with locking rod, Ergoform-S handle and double-bit insert, r/h hinge	Aluminium section	5018	■	■	■
	Door or installation plate folded	Sheet steel 1.5 mm	7035			
	[2] With unlatching for top glazed door with desk section					

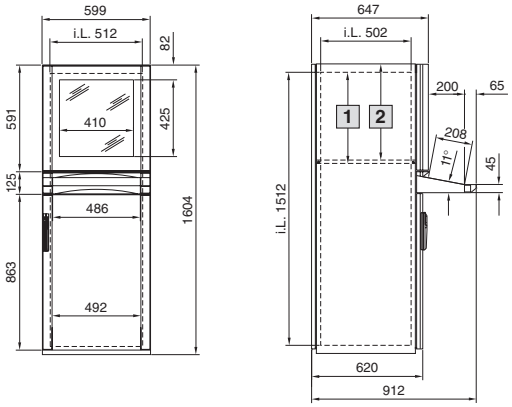
1.5 Based on ES

with folding keyboard or desk section Page 260

With fold-out tray
PC 4603.920, PC 4609.920



With desk section
PC 4603.704



i.L. = Clearance width

1 max. 505, adjustable on a 25 mm pitch pattern

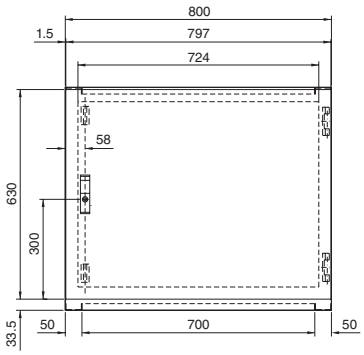
2 max. 547, adjustable on a 25 mm pitch pattern

Supply includes	Design	Material	Colour RAL	PC 4603.920 PC 4609.920	PC 4603.704
Enclosure	Solid, open at bottom	Sheet steel 1.5 mm	7035 textured	■	■
	Gland plates, three-part	Sheet steel 1.5 mm	Zinc-plated		
Rear door	With locking rod and double-bit insert, r/h hinge	Sheet steel 2.0 mm	7035 textured	■	■
Glazed door, top	Curved outwards, vertical bars, latched on the inside[1], r/h hinge	Aluminium section	5018	■	■
	Trim strip top/bottom	Plastic to UL 94-V0	7035		
	Pane with screen-printed mask	Safety glass 4.0 mm	7015		
Component shelf for monitor	Slotted, permanently installed	Sheet steel 1.5 mm	7035	■	■
Fold-out tray for keyboard	Enclosure with cutout in rear panel, width 19″ x height 4 U, with screw-fastened lid	Sheet steel 1.5 mm	7035	■	
	Trim panel hinged at the bottom with 2 retaining shears, with lock no. 3524 E	Plastic to UL 94-V0	7035		
	Decorative side trim panels	Aluminium section	5018		
	Keyboard support, with 2 nylon loops for keyboard	Sheet steel	7035		
	[1] With unlatching for top glazed door				
Desk section	Enclosure with removable lid top and bottom.	Sheet steel 1.5 mm/2.0 mm	7035		■
	Trim strip, top and handle	Plastic to UL 94-V0	7035		
	Decorative side trim panels	Aluminium section	5018		
Bottom door	Vertical bars with locking rod, Ergoform-S handle and double-bit insert, r/h hinge	Aluminium section	5018	■	■
	Door or installation plate folded	Sheet steel 1.5 mm	7035		
	[1] With unlatching for top glazed door with desk section				

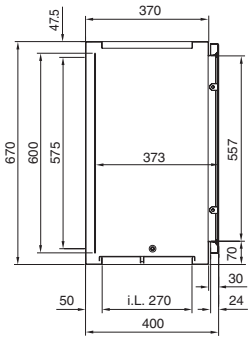
1.5 Pedestals

Page 265

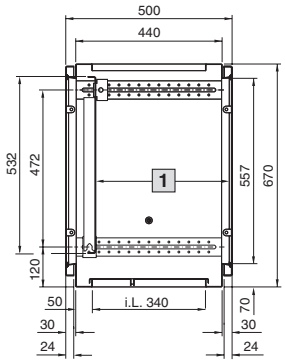
W x H 800 x 670 mm
AP 2600.500, AP 2610.500



D 400 mm
AP 2600.500, AP 2620.500, AP 2630.500



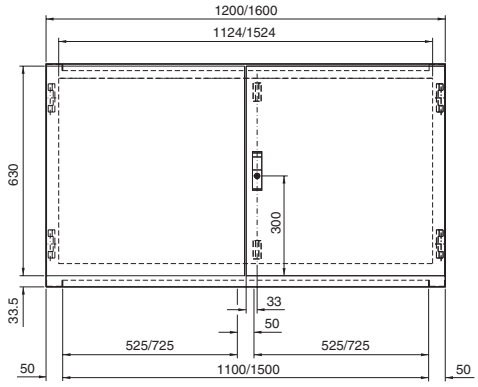
D 500 mm
AP 2610.500, AP 2640.500, AP 2650.500



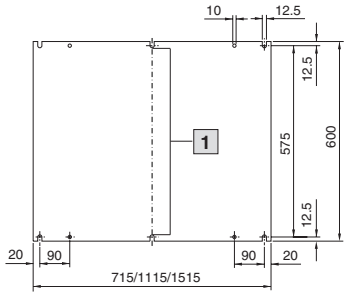
1 max. 407

i.L. = Clearance width

W x H 1200/1600 x 670 mm
AP 2620.500, AP 2630.500, AP 2640.500, AP 2650.500

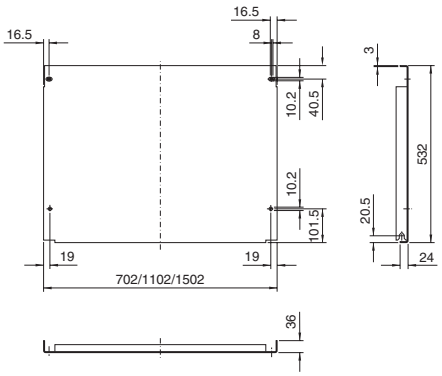


Mounting plate for D 400 mm

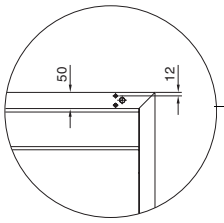


1 Does not apply to AP 2600.500

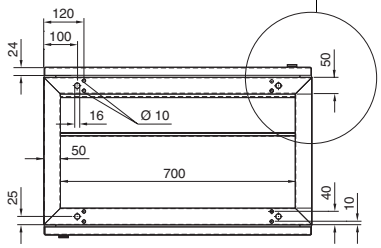
Mounting plate for D 500 mm



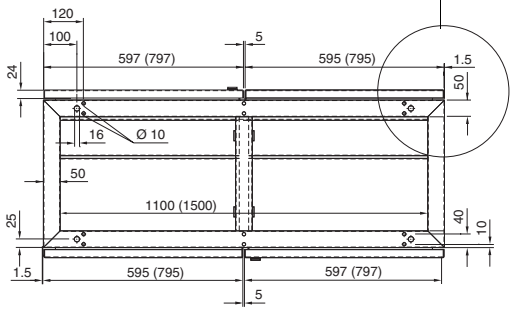
D 400 mm
without rear door AP 2600.500, AP 2620.500, AP 2630.500



D 500 mm
AP 2610.500



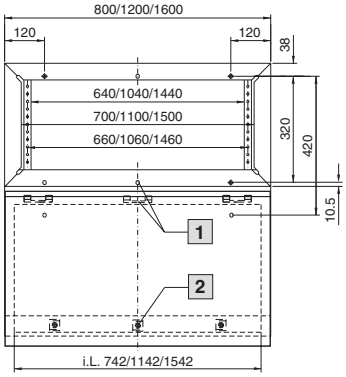
D 500 mm
AP 2640.500, AP 2650.500



1.5 Desk units

Page 264

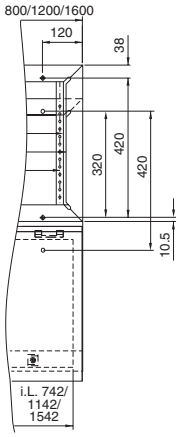
H x D 200 x 850 mm
AP 2611.500, AP 2641.500, AP 2651.500



1 Does not apply to AP 2611.500

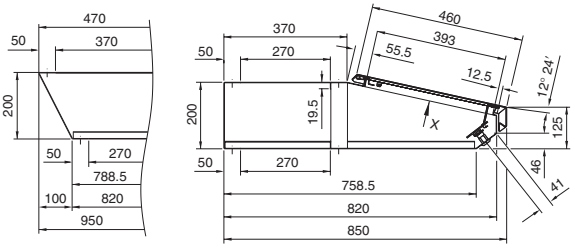
2 Does not apply to AP 2611.500, AP 2641.500

H x D 200 x 950 mm
AP 2613.500, AP 2643.500, AP 2653.500

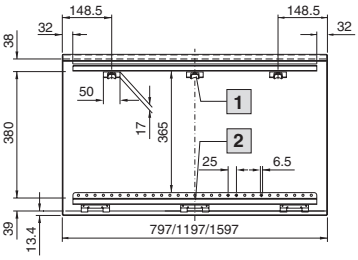


i.L. = Clearance width

Side view



View in X direction



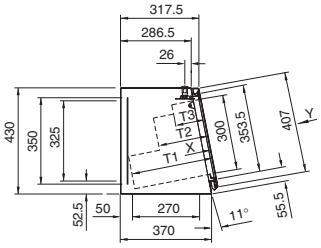
1 Does not apply to AP 2611.500, AP 2613.500, AP 2641.500, AP 2643.500

2 Does not apply to AP 2611.500, AP 2613.500

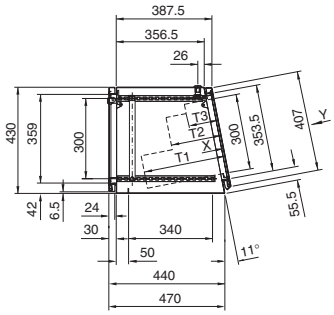
1.5 Consoles

Page 264

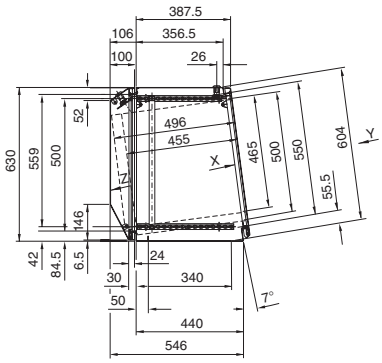
H x D 430 x 400 mm
AP 2612.500, AP 2642.500, AP 2652.500



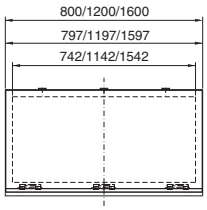
H x D 430 x 500 mm
AP 2614.500, AP 2644.500, AP 2654.500



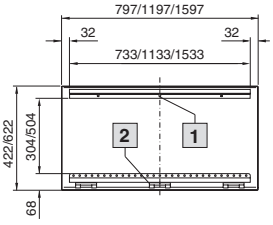
H x D 630 x 500 mm with deep rear door
AP 2647.500, AP 2648.500, AP 2649.500



View in Y direction



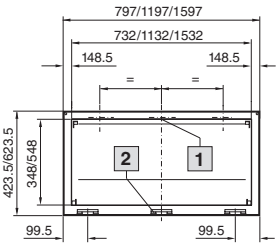
View in X direction



1 Only for AP 2649.500, AP 2652.500, AP 2654.500, AP 2664.500

2 Does not apply to AP 2612.500, AP 2614.500, AP 2647.500, AP 2662.500

View in Z direction

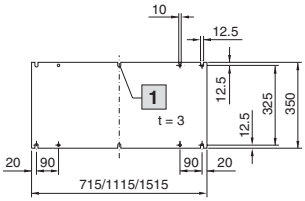


1 Only for AP 2649.500

2 Only for AP 2648.500/ AP 2649.500

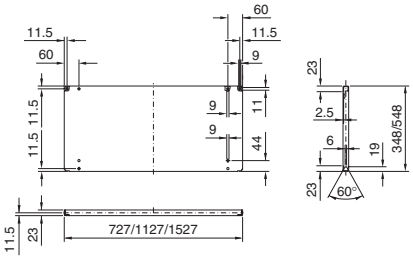
	Depth 400	Depth 500
T1 = vertically hinged 3 U	300	
T2 = vertically hinged 6 U	195	
T3 = vertically hinged, max.	110	
T1 = static, max.	300	400

Mounting plate for D 400 mm



1 Does not apply to AP 2612.500

Mounting plate for D 500 mm

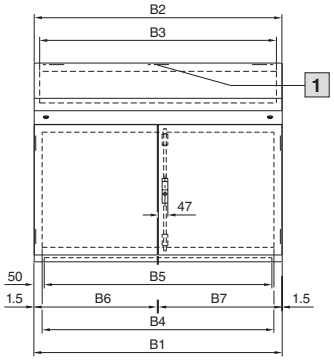


Consoles AP

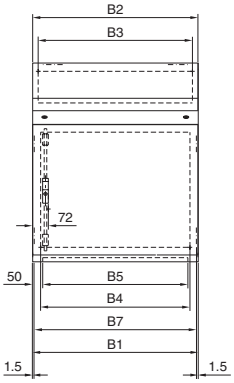
1.5 One-piece consoles AP

Sheet steel Page 266

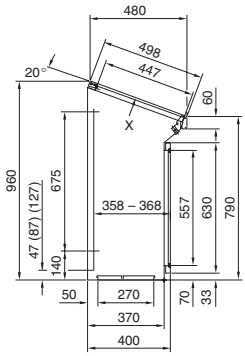
Stainless steel Page 282

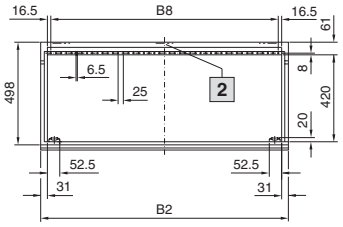


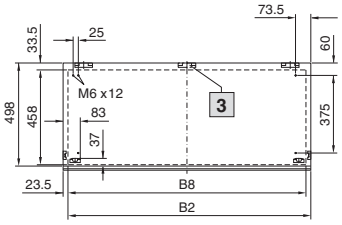
Sheet steel – view in X direction

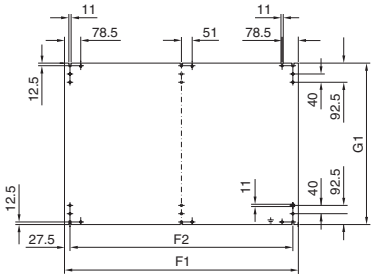


Stainless steel – view in X direction









1 Hinge does not apply to AP 2670.500, 2685.600

2 Hinge does not apply to AP 2666.500, 2668.500

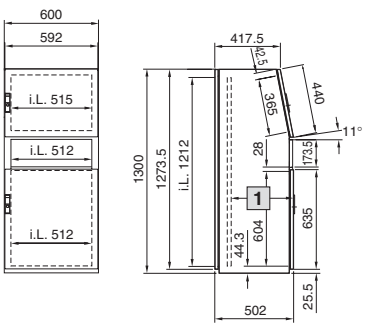
3 Hinge does not apply to AP 2683.600, 2684.600

Model No. AP, sheet steel	**2666.500**	**2668.500**	**2670.500**	**2672.500**
Model No. AP, stainless steel	**2683.600**	**2684.600**	**2685.600**	**2686.600**
Width (B1) in mm	600	800	1000	1200
Height in mm	960			
Depth in mm	400/480			
B2 = Width	597	797	997	1197
B3 = Clearance width	544	744	944	1144
B4 = Clearance width, front	524	724	924	1124
B5 = Clearance width, bottom	500	700	900	1100
B6 = Wide adjacent door	–	–	495	595
B7 = Wide lockable door	597	797	497	597
B8 = Punched length	500	700	900	1100
F1 = Mounting plate width	530	730	930	1130
F2 = Distance between mounting holes	475	675	875	1075
G1 = Mounting plate height	780	780	780	780

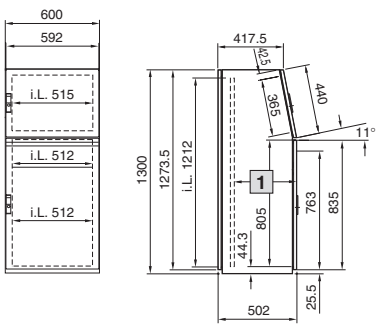
1.5 Universal consoles AP

Sheet steel Page 267

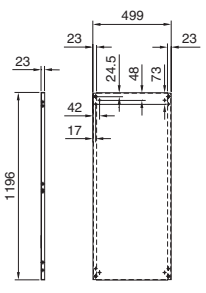
with short front door
AP 2694.500



with tall front door
AP 2695.500



Mounting plate



1 Adjustable from 200 to 400 mm on a 25 mm pitch pattern.

i.L. = Clearance width

1.6 Terminal boxes KL/Ex enclosures KEL with screw-fastened lid

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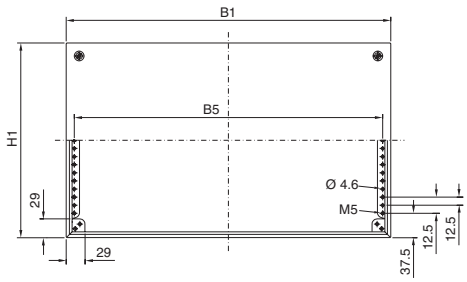
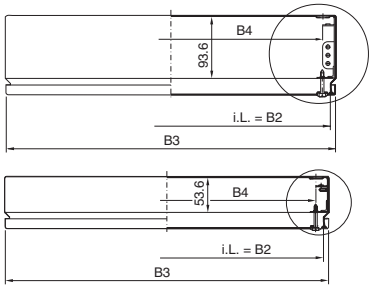
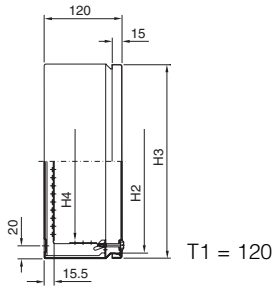
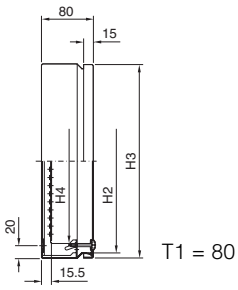
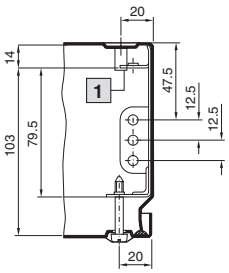




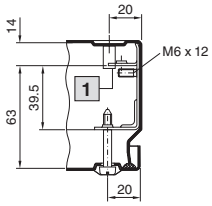




Detail X, T1 = 120



Detail Y, T1 = 80



i.L. = Clearance width

With internal thread M8 x 10

1 Only for KEL

Model No. KL	1521.010	1522.010	1523.010	1524.010	1525.010	1526.010
Model No. KEL	**9301.000**	**9302.000**	**9303.000**	**9304.000**	**9305.000**	**9306.000**
Width (B1) in mm	150	300	200	300	400	300
Height (H1) in mm	150	150	200	200	200	300
Depth (T1) in mm	80	80	80	80	120	120
B2 = Clearance opening width	132	282	182	282	382	282
B3 = Cover width	148	298	198	298	398	298
B4 = Clearance width between profile strips	109	259	159	259	359	259
B5 = Hole-centre distance of profile strips	125	275	175	275	375	275
H2 = Clearance opening height	132	132	182	182	182	282
H3 = Cover height	148	148	198	198	198	298
H4 = Clearance height between profile strips	100	100	150	150	150	250

1.6 Premium Line KL

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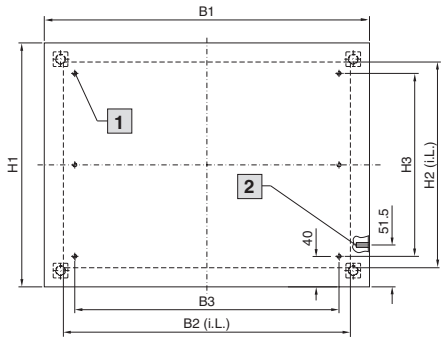

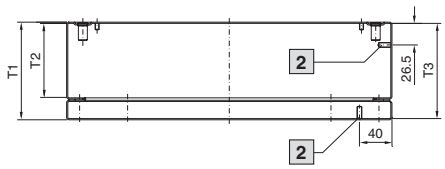

1 Welded stud M5 x 8 (6x)

2 Earthing bolts M6 x 15

i.L. = Clearance width

Model No. KL	1024.010	1024.020	1024.030	1024.040
B1 = Overall width in mm	150	150	300	400
H1 = Overall height in mm	150	150	200	300
T1 = Overall depth in mm	80	120	120	120
B2 = Clearance width of enclosure	103	103	253	353
B3 = Distance between axes of bolts	75	75	225	325
H2 = Clearance height of enclosure	103	103	153	253
H3 = Distance between axes of bolts	75	75	125	225
T2 = Clearance depth, enclosure only	51.5	91.5	91.5	91.5
T3 = Clearance depth	77	117	117	117
Possible mounting depth: T4 = Mounting plate configuration, see mounting plate	60	100	100	100
T5 = Support rail configuration, see mounting bracket	69.5/54.5	109.5/94.5	109.5/94.5	109.5/94.5

1.6 Compact AE/Ex enclosures KEL with hinged door

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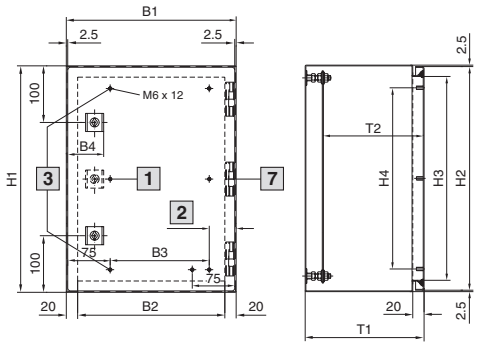
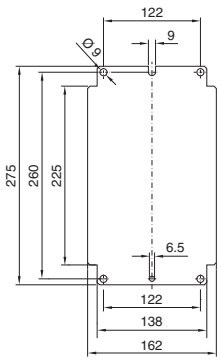
AE 1002.600 – AE 1016.600
KEL 9401.600 – KEL 9409.600

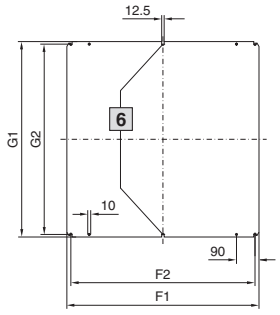


Mounting plates

AE 1002.600
KEL 9401.600

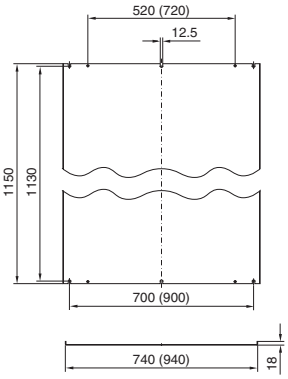


AE 1004.600 –
AE 1016.600, AE 1018.600
KEL 9402.600 –
KEL 9409.600



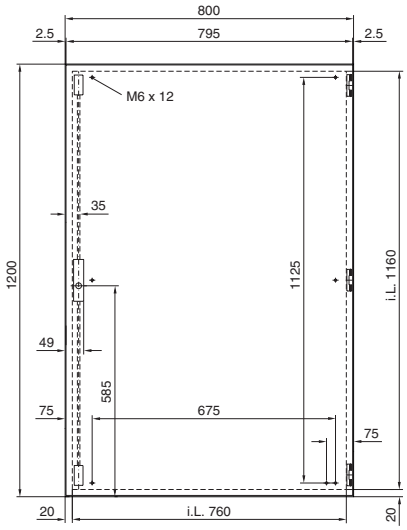
Installation position of the mounting plate is rotated through 90° for AE 1005.600, KEL 9409.600.

AE 1017.600,
AE 1019.600

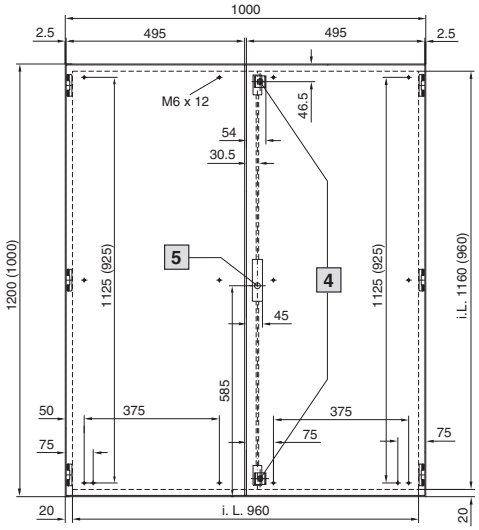


Dimensions in brackets for AE 1019.600.

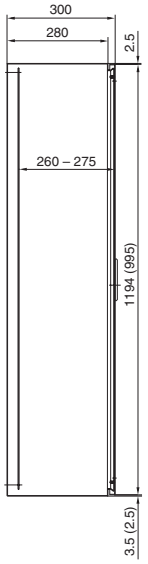
AE 1017.600

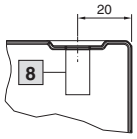


AE 1018.600, AE 1019.600



Dimensions in brackets for AE 1018.600.





With internal thread M8 x 20

8 Only for KEL

1 For H1 = 300/380 only one cam in the centre and without central bolt

2 50 for AE 1002.600

3 Does not apply to AE 1002.600

4 Cam lock for AE 1018.600

5 Locking rod for AE 1019.600

6 Only AE 1018.600

7 Only KEL 9408.600

i.L. = Clearance width

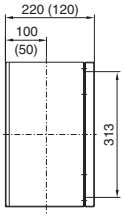
Compact AE stainless steel/Ex enclosures KEL with hinged door

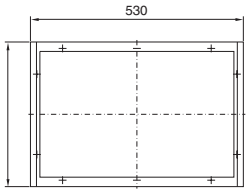
Model No.		Dimensions of enclosures										Dimensions of mounting plate				Material thicknesses in mm		
AE	KEL	B1	B2	B3	B4	H1	H2	H3	H4	T1	T2	G1	G2	F1	F2	Enclosure	Door	Mounting plate
1002.600	**9401.600**	200	167	–	56	300	295	274	225	155	135	–	–	–	–	1.25	1.5	2.0
1004.600	**9402.600**	380	340	250	66	300	295	260	225	155	113 – 129	275	250	334	295	1.38	1.5	2.0
1005.600	**9409.600**	300	260	175	66	380	375	340	275	210	168 – 184	275	250	334	295	1.38	1.5	2.0
1006.600	**9403.600**	380	340	250	66	380	375	340	275	210	168 – 184	355	330	334	295	1.38	1.5	2.5
1007.600	**–**	500	460	375	66	500	495	460	425	210	168 – 184	470	445	449	410	1.38	1.5	2.5
1013.600	**–**	500	460	375	66	500	495	460	425	300	258 – 274	470	445	449	410	1.50	1.5	2.5
1008.600	**9404.600**	380	340	250	66	600	595	560	525	210	168 – 184	570	545	334	295	1.38	1.5	2.5
1009.600	**–**	600	560	475	66	380	375	340	275	210	168 – 184	355	330	549	510	1.38	1.5	2.5
1010.600	**9405.600**	600	560	475	66	600	595	560	525	210	168 – 184	570	545	549	510	1.38	2.0	2.5
1012.600	**9406.600**	600	560	475	66	760	755	720	675	210	168 – 184	730	705	549	510	1.38	2.0	3.0
1014.600	**9407.600**	760	720	625	66	760	755	720	675	300	258 – 274	730	705	704	665	1.50	2.0	3.0
1016.600	**9408.600**	800	760	675	66	1000	955	960	925	300	258 – 274	955	930	739	700	1.50	2.0	3.0
1017.600	**–**	800	–	–	–	1200	–	–	–	300	–	–	–	–	–	1.50	2.0	3.0
1018.600	**–**	1000	–	–	–	1000	–	–	–	300	–	955	930	939	900	1.50	2.0	3.0
1019.600	**–**	1000	–	–	–	1200	–	–	–	300	–	–	–	–	–	1.50	2.0	3.0

1.6 Premium Panel

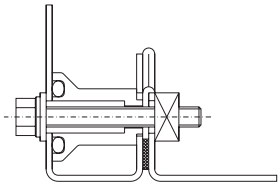
Protection category IP 69K Page 274

Operating housing

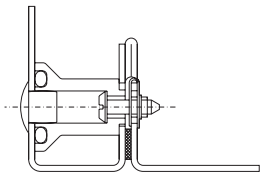




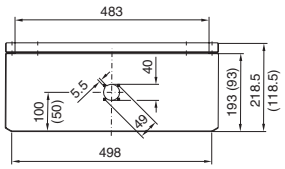
Hex screws, exposed



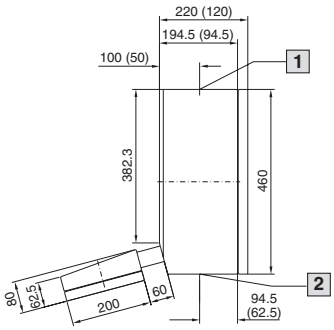
Internal screw with plastic stoppers

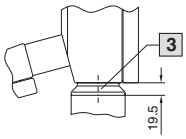


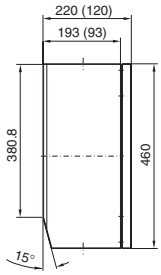
Support arm connection at the bottom, by rotating the enclosure. Dimensions in brackets for CP 6681.000.

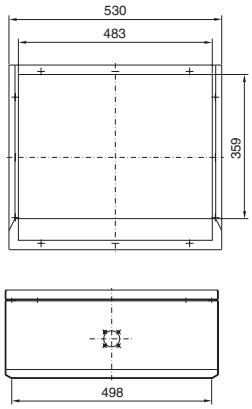


Operating and keyboard housing









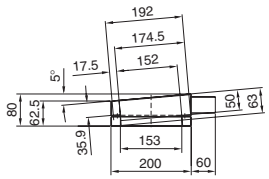
1 Support arm connection at the top only for CP 6680.000, CP 6680.100

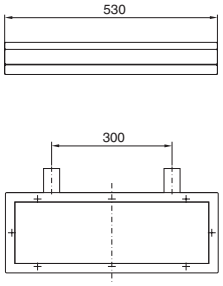
2 Support arm connection at the bottom only for CP 6680.010 (see **3**), CP 6680.110

Dimensions in brackets for CP 6680.010.

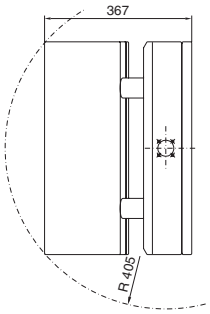
3 Connector pieces for CP 6680.010 included in the supply.

Keyboard housing

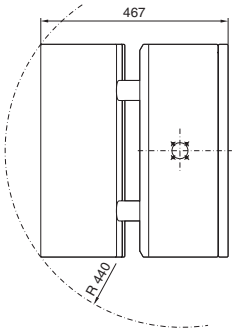




Top view
Depth 120 mm



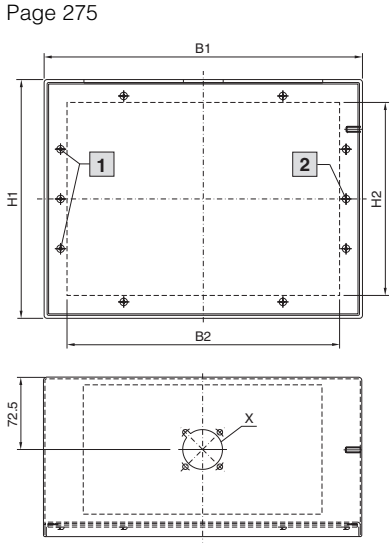
Top view
Depth 220 mm

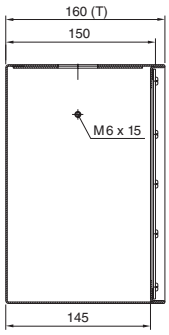


Stainless steel

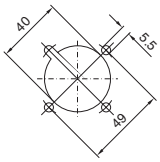
1.6 Command panel

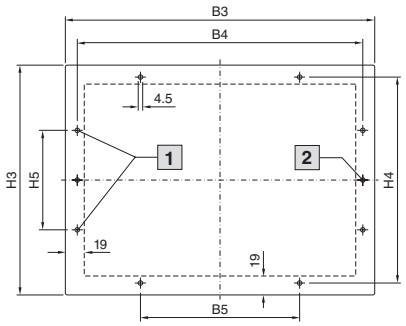
Page 275





X = Mounting cutout





1 Does not apply to CP 6670.000
2 Does not apply to CP 6672.000

Model No. CP	6670.000	6672.000
Width (B1) in mm	320	400
Height (H1) in mm	240	320
Depth (T) in mm	160	
B2 = Clearance in width	275	355
B3[1)] = Width of front panel	313	393
B4 = Hole spacing	288	368
B5 = Hole spacing	180	220
H2 = Clearance in height	195	275
H3[1)] = Height of front panel	233	313
H4 = Hole spacing	208	288
H5 = Hole spacing	–	180

[1)] Other sizes and machining of the front panel available on request.

1.6 Command panel housing with door

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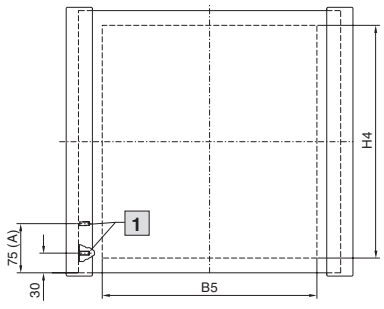
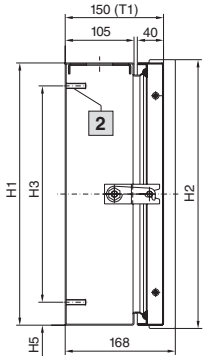
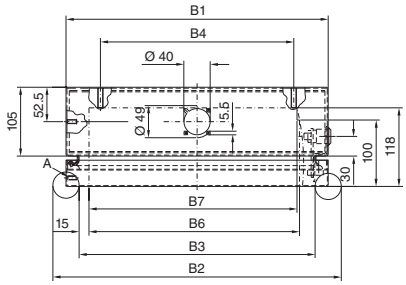




1 Welded studs M6 x 15
2 Welded studs M8 x 30



Model No. CP	6535.010	6536.010	6538.010	6539.010
Width (B1) in mm	300	400	400	600
Height (H1) in mm	300	300	400	400
Depth (T1) in mm	150	150	150	150
B2 = Enclosure width with handle strips	340	440	440	640
B3 = Clearance opening, front	260	360	360	560
B4 = Spacing of mounting plate attachment	215	295	295	510
B5 = Max. front cutout, width	225	325	325	525
B6 = Hinged width for depth 100 mm	220	320	320	520
B7 = Hinged width for depth 118 mm	212	317	317	519
H2 = Enclosure height with handle strips	310	310	410	410
H3 = Spacing of mounting plate attachment	250	250	330	330
H4 = Max. front cutout, height	255	255	355	355
H5 = Distance from base – mounting plate attachment	25	25	35	35

1.6 Modular pedestal CP-S

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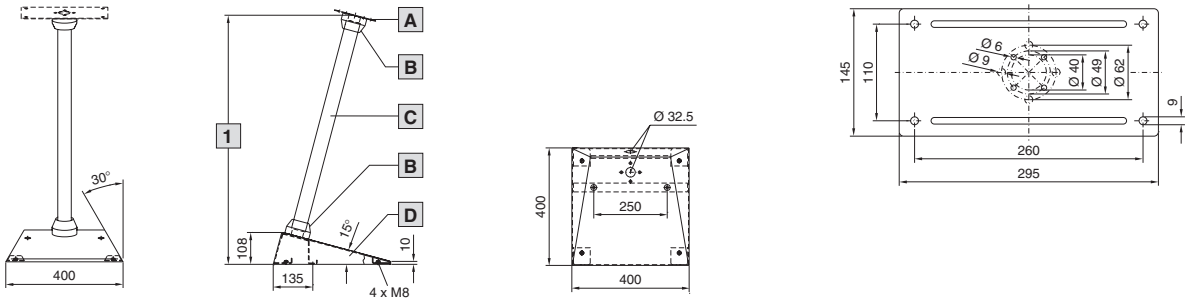

1 1104 mm for support section length 1000 mm

1.6 PC enclosure system

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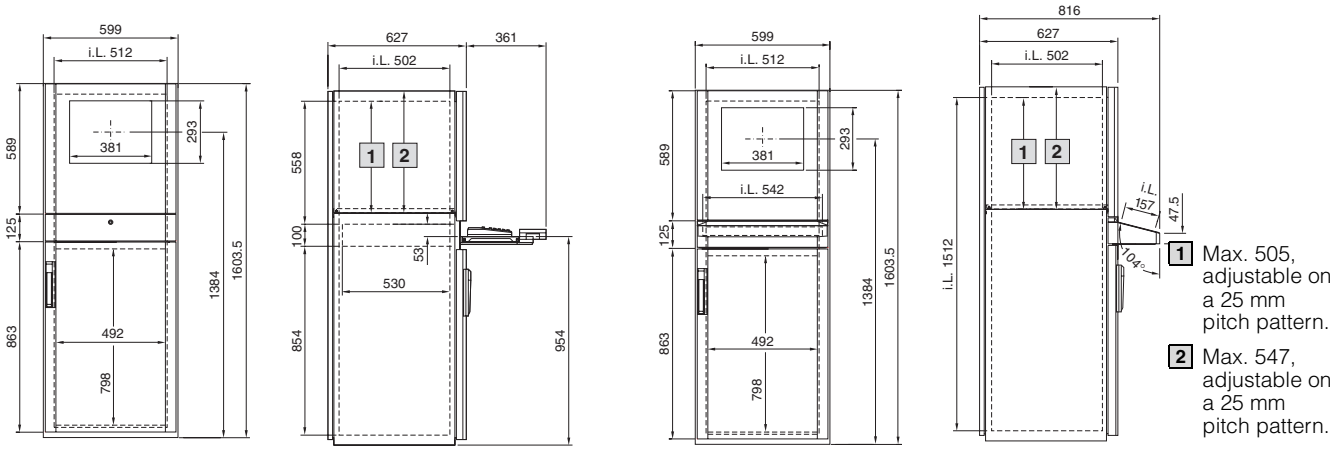
With keyboard drawer
PC 4650.000

With desk section
PC 4650.704



i.L. = Clearance width

				Model No. PC	
				4650.000[1]	4650.704[2]
			Width in mm	600	
			Height in mm	1600	
			Depth in mm	620	620/820
Supply includes	**Design**	**Material**	**Surface finish/Colour**		
Enclosure	Solid top and sides, open at the bottom	Stainless steel 1.4301, 1.8 mm	Brushed, grain size 240	■	■
	Gland plates, three-part	Stainless steel 1.4301, 1.5 mm			
Rear door	With locking rod and double-bit insert, hinged on the right-hand side	Stainless steel 1.4301, 2.0 mm	Brushed, grain size 240	■	■
Glazed door, top	Latched from the inside[3], r/h hinge	Stainless steel 1.4301, 1.5 mm	Brushed, grain size 240	■	■
	Viewing window	Safety glass 4.0 mm			
Component shelf	Slotted, permanently installed	Sheet steel ST 1203, 1.5 mm	RAL 7035	■	■
Drawer	Enclosure	Sheet steel ST 1203, 1.25 mm	RAL 7035	■	
	Keyboard extension piece with cable support, hinged, plus pull-out mousepad and keyboard cradle	Sheet steel ST 1203, 1.5 mm	RAL 7035		
	Trim panel, folded as handrest, with fastener, lock no. 3524 E	Stainless steel 1.4301, 1.25 mm	Brushed, grain size 240		
	[3] With unlatching for top glazed door			■	
Desk section	Enclosure with cover plate top and bottom	Stainless steel 1.4301, 1.5 mm	Brushed, grain size 240		■
	Design strip	Plastic approved for use with foodstuffs	RAL 5002		
Bottom door	With locking rod and double-bit insert, r/h hinge	Stainless steel 1.4301, 1.5 mm	Brushed, grain size 240	■	■
	[3] With unlatching for glazed door with desk section				■

[1] Enclosures in stainless steel 1.4404 (AISI 316L) please add the extension .500 to the Model No. Delivery times on request.
[2] Enclosures in stainless steel 1.4404 (AISI 316L) please add the extension .504 to the Model No. Delivery times available on request.

Short-circuit resistance diagrams

2.1 Mini-PLS busbar support

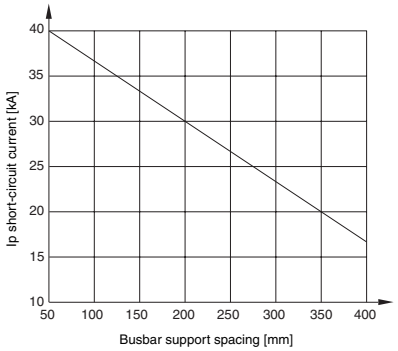
up to 250 A, 3-pole Page 302

Model No.: SV 9600.000

40 mm bar centre distance.
Rated current up to 250 A,
rated operating voltage up
to 690 V AC,
50/60 Hz to VDE 0660.

Basis of test:
VDE 0660, part 500/IEC 60 439.

Test implemented:
Dynamic short-circuit resistance
to IEC 60 439.



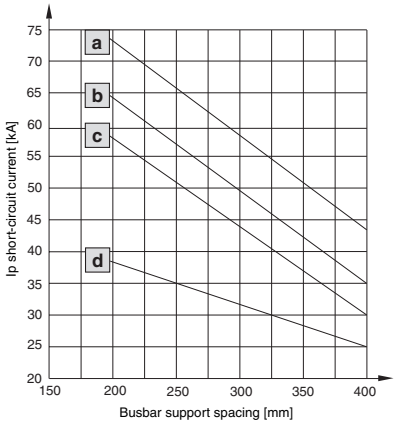
2.1 Busbar support

up to 360 A, 3-pole Page 308

Model No.: SV 9350.000

40 mm bar centre distance.
Rated current up to 360 A,
rated operating voltage up
to 690 V AC,
50/60 Hz to VDE 0660.

Calculation basis:
VDE 0103/IEC 60 865.



Busbar E-Cu (mm)	Rated curent up to (A)	Curve
12 x 5	210	d
12 x 10	340	b
15 x 5	260	c
15 x 10	360	a

2.2 Busbar supports

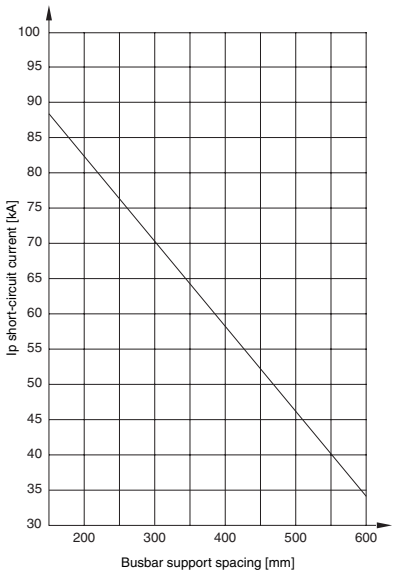
up to 450 A, 3-pole Page 318

Model No.: SV 3066.000

60 mm bar centre distance.
Rated current up to 450 A,
rated operating voltage up
to 1000 V AC,
50/60 Hz to VDE 0660.
Bar accommodation 30 x 5 mm.

Basis of test:
VDE 0660, part 500/IEC 60 439.

Test implemented:
Dynamic short-circuit resistance
to IEC 60 439.



2.2 Busbar supports

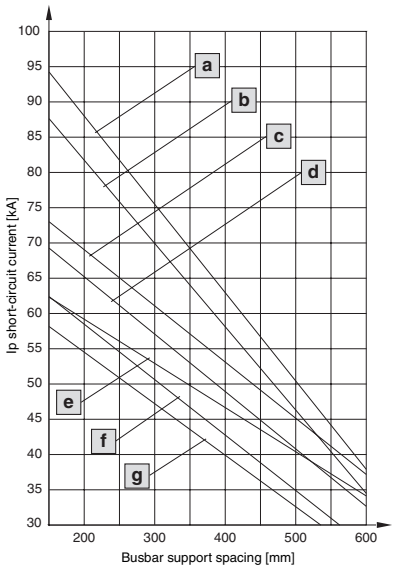
up to 800 A Page 318

Model No.: SV 3000.000 (3-pole), SV 3050.000 (2-pole), SV 3064.000 (4-pole)

60 mm bar centre distance.
Rated current up to 800 A,
rated operating voltage up
to 1000 V AC,
50/60 Hz to VDE 0660.

Basis of test:
VDE 0660, part 500/IEC 60 439.

Test implemented:
Dynamic short-circuit resistance
to IEC 60 439.



Busbar E-Cu (mm)	Rated curent up to (A)	Curve
12 x 5	210	g
12 x 10	340	f
15 x 3	187	f
15 x 4	210	f
15 x 5	260	f
16 x 3	198	f
16 x 4	225	f
16 x 5	280	f
16 x 8	397	e
20 x 5	319	e
20 x 10	497	c
25 x 5	384	d
30 x 5	447	b
30 x 10	800	a

Busbar E-Cu mm (inches)	Rated current up to (A)	Curve
9.53 x 25.40 ($^3/_8$ x 1″)	599	a
6.35 x 25.40 ($^1/_4$ x 1″)	449	d
4.76 x 25.40 ($^3/_{16}$ x 1″)	349	d
3.18 x 25.40 ($^1/_8$ x 1″)	299	d
9.53 x 19.05 ($^3/_8$ x $^3/_4$″)	449	a
6.35 x 12.70 ($^1/_4$ x $^1/_4$″)	249	f

2.2 PLS busbar supports

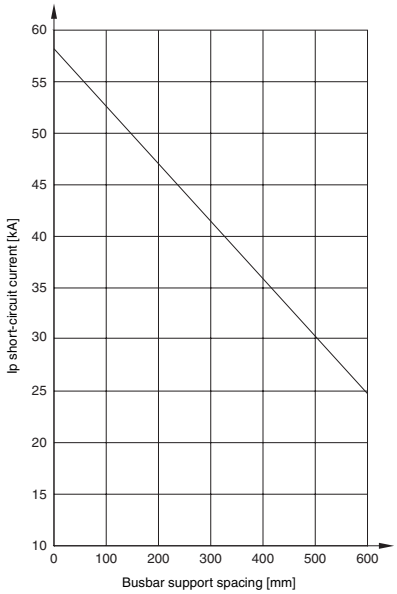
up to 800 A/1600 A, 3-pole Page 320

Model No.: SV 3500.000
Rated current up to 800 A

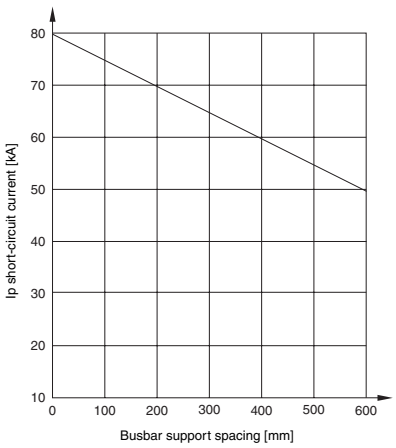
60 mm bar centre distance.
Rated operating voltage up
to 1000 V~,
50/60 Hz to VDE 0660.

Basis of test:
VDE 0660, part 500/IEC 60 439.

Test implemented:
Dynamic short-circuit resistance
to IEC 60 439.



Model No.: SV 3510.000
Rated current up to 1600 A



Short-circuit resistance diagrams

2.3 Busbar supports

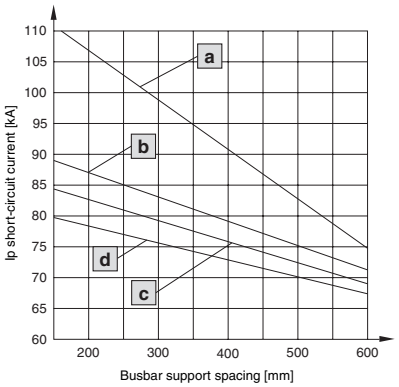
up to 1250 A, 3-pole Page 343

Model No.: SV 3073.000

100 mm bar centre distance.
Rated current up to 1250 A,
rated operating voltage up
to 1000 V AC,
50/60 Hz to VDE 0660.

Basis of test:
VDE 0660, part 500/IEC 60 439.

Test implemented:
Dynamic short-circuit resistance
to IEC 60 439.



Busbar E-Cu (mm)	Rated curent up to (A)	Curve
30 x 10	800	d
40 x 10	850	c
50 x 10	1000	b
60 x 10	1250	a

2.4 Busbar supports

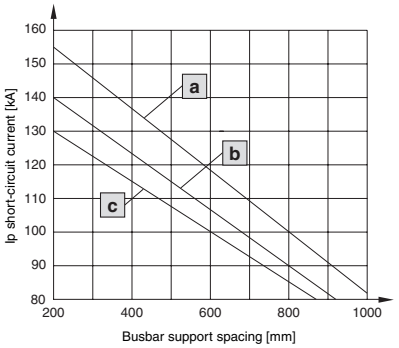
up to 1600 A, 3-pole Page 351

Model No.: SV 3052.000

185 mm bar centre distance.
Rated current up to 1600 A,
rated operating voltage up
to 1000 V AC,
50/60 Hz to VDE 0660.

Basis of test:
VDE 0660, part 500/IEC 60 439.

Test implemented:
Dynamic short-circuit resistance
to IEC 60 439.



Busbar E-Cu (mm)	Rated curent up to (A)	Curve
50 x 10	1000	c
60 x 10	1250	b
80 x 10	1600	a

2.5 Busbar supports

up to 2500 A/3000 A, 3-pole Page 355

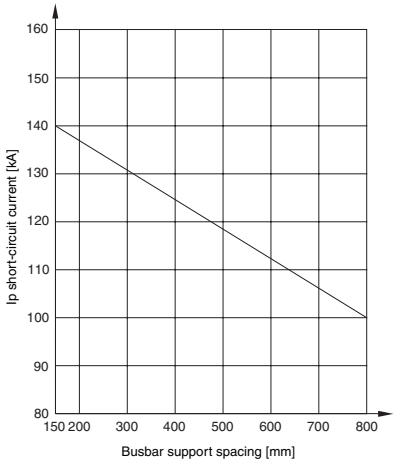
Model No.: SV 3055.000
Rated current up to 2500 A,
busbar accommodation
3 x 2 x 80 x 10 mm.

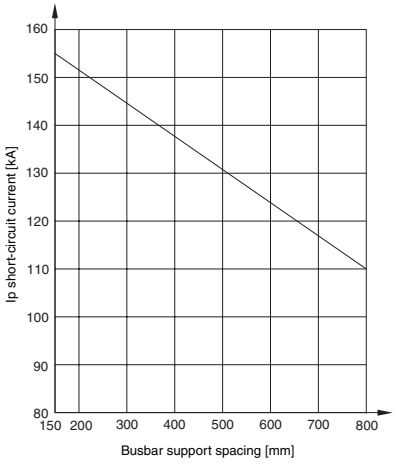
Model No.: SV 3057.000
Rated current up to 3000 A,
busbar accommodation
3 x 2 x 100 x 10 mm.

150 mm bar centre distance.
Rated operating voltage up
to 1000 V AC,
50/60 Hz to VDE 0660.

Basis of test:
VDE 0660, part 500/IEC 60 439.

Test implemented:
Dynamic short-circuit resistance
to IEC 60 439.





2.7 Laminated copper bars Rittal Flexibar “S”

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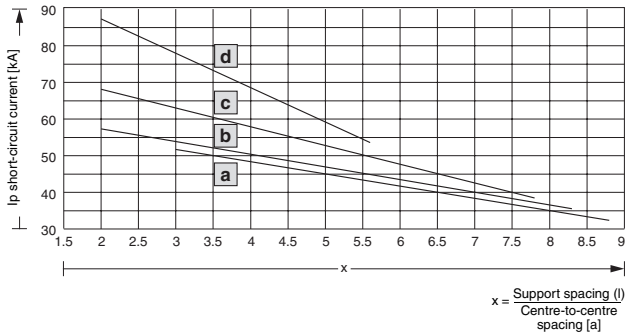
Configuration[1] mm	I_n for 50 K[2]	I_n for 30 K[2]	I_n for 10 K[2]	Curve (short-circuit resistance)	Installation type	**Model No. SV**
6 x 9.0 x 0.8	250 A	220 A	120 A	–	–	3565.000
6 x 13.0 x 0.5	200 A	150 A	110 A	–	–	3566.000
4 x 15.5 x 0.8	300 A	210 A	140 A	–	–	3567.000
6 x 15.5 x 0.8	350 A	290 A	170 A	a	1	3568.000
10 x 15.5 x 0.8	450 A	350 A	190 A	a	1	3569.000
5 x 20.0 x 1.0	400 A	300 A	180 A	a	1	3570.000
5 x 24.0 x 1.0	450 A	370 A	230 A	a	1	3571.000
10 x 24.0 x 1.0	800 A	600 A	340 A	b	1	3572.000
5 x 32.0 x 1.0	550 A	470 A	280 A	b	2/3	3573.000
10 x 32.0 x 1.0	1000 A	800 A	460 A	c	2/3	3574.000
5 x 40.0 x 1.0	800 A	600 A	340 A	b	2/3	3575.000
10 x 40.0 x 1.0	1200 A	950 A	500 A	c	2/3	3576.000
5 x 50.0 x 1.0	900 A	700 A	400 A	b	2/3	3577.000
10 x 50.0 x 1.0	1400 A	1000 A	600 A	c	2/3	3578.000
10 x 63.0 x 1.0	1600 A	1240 A	715 A	d	2/3	3579.000

[1] Number of lamina x lamina width x lamina thickness
[2] The conductor temperature of the laminated copper bar is derived from the sum total of the ambient temperature and the temperature increase.
Example:
SV 3565.000 loaded with 220 A, i.e. the temperature increases by 30 K. At an ambient temperature of 35°C, this produces a resultant conductor temperature of 35°C + 30 K = 65°C.

Short-circuit resistance diagrams

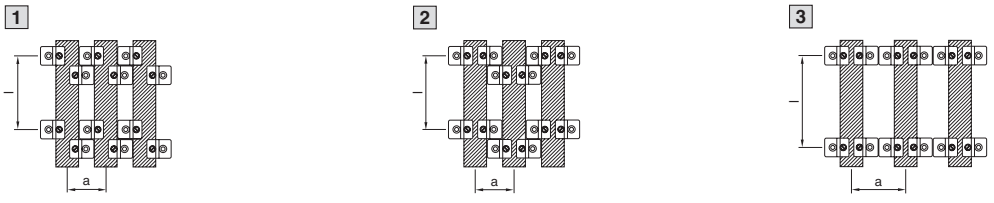
Basis of test:
VDE 0660, part 500/IEC 60 439-1.
Test implemented:
Dynamic short-circuit resistance to IEC 60 439-1.

The dimensions for the support spacing (l) and for the centre-to-centre spacing (a) must be within the specified min./max. limits. The quotients of l/a can be used to determine the permissible short-circuit current I_p by using curves a to d. The prescribed installation type must be taken into account.



Curve	Support spacing (l) mm		Centre-to-centre spacing (a) mm	
	min.	max.	min.	max.
a	150	300	34	60
b	150	350	42	85
c	200	400	51	85
d	200	450	81	100

Type of assembly with universal support SV 3079.000



Overview of power circuit-breakers/starter combinations

Current carrying capacity of connection cables

Page 304 and 306, 312 – 315, 325 – 332

Current carrying capacity of insulated PVC cables at an ambient temperature of +40°C, installation type E (DIN EN 60 204-1:1998-11)	
Nominal cross-section (mm^2)	Current capacity (A)
1.5	16
2.5	22
4	30
6	37
10	52
16	70
25	88
35	114

Conversion factors for the load capacity of cables (DIN EN 60 204-1:1998-11)	
Ambient temperature (°C)	Factor
30	1.15
35	1.08
40	1.00
45	0.91
50	0.82
55	0.71
60	0.58

2.1 Busbar systems up to 250 A (40 mm)

Mini-PLS component adaptors 12 A/25 A Page 304

Make/model	Model No. SV	
ABB		
MS25-TM-..	9614.000	9615.000
MS116-..	9614.100	9615.100
MS225-..	9614.000	9615.000
MS325-..	9614.000	9615.000
MS450-.. (max. 25 A)	9615.000	–
MS451-.. (max. 25 A)	9615.000	–
AEG		
Mbs25	9614.100	9615.100
Mbs28	9614.000	9615.000
Allen Bradley		
103-...R	9614.100	9615.100
107-...R	9629.010	–
140M-...-...	9614.100	9615.100
140-MN-...	9614.100	9615.100
190-M1-...	9615.100[1]	–
190-M2-...	9615.100[1]	–
Moeller Electric		
PKM0...	9614.100	9615.100
PKZM0-...	9614.100	9615.100
PKZM0-...T	9614.100	9615.100
PKZM0-../E-10-D	9614.100	9615.100
PKZM0-../0.-	9614.100	9615.100
PKZM0-../S00-11	9614.100	9615.100
PKZM0-../SE00-11	9614.100	9615.100
PKZ2/ZM-... (max. 25 A)	9625.000	9626.000
PKZ2/ZM-...-8 (max. 25 A)	9625.000	9626.000
PKZM0-.../E01-G-W	9629.010	–
PKZM0-.../.-..-W	9629.010	–
PKZM0-.../.-..WMF	9629.030	–
PKZM4-... (max. 25 A)	9615.000	–

Make/model	Model No. SV	
Siemens		
S0		
3RA11 20...2.-0...	9614.100[1]	–
3RA12 20-....-...	9629.020	–
3RV1. 21-...1.	9614.100	9615.100
3RW30 2.-1AB..	9614.100	9615.100
S00		
3RA11 10..0.1.-1...	9614.100[1]	–
3RA12 10-...-...	9629.010	–
3RV10 11-..A1.	9614.100	9615.100
3RW30 1.-1CB.4	9614.100	9615.100
S00 Cage Clamp		
RV10 11-..A20	9614.110	–
S2		
3RV1. 31-4..10 (max. 25 A)	9615.000	–
3RW30 3.-1AB.. (max. 25 A)	9615.000	–
Telemecanique		
GK3-EF.. (max. 25 A)	9626.000	–
GV2-....	9614.100	9615.100
GV2-M..K1..	9614.100	9615.100
GV2-M..K2..	9629.010	–
GV2-P..D2..	9629.030	–
GV2-P..D1..	9615.100[1]	–
GV3-M...	9626.000	–
LD1-L.030 (max. 25 A)	9615.100	–
LH4-N1....7	9614.100	9615.100
LH4-N2....7	9629.010	–

[1] Support rail must be offset

Mini-PLS quick-fit component adaptors 25 A (32 A) Page 305

Make/model	Model No. SV
ABB	
MS25-TM-..	9622.000
AEG	
Mbs25	9618.000
Allen Bradley	
140M-...-...	9620.000
General Electric	
SFKO1	9618.000
Moeller Electric	
PKM0...	9619.000
PKZM0-...	9619.000
PKZM0-...T	9619.000
PKZM0-../S00-11	9620.000
PKZM0-../SE00-11	9620.000

Make/model	Model No. SV
Schiele	
MSU-K	9618.000
Siemens	
S0	
3RA11 20...2.-0...	9622.000
3RV1. 21-...1.	9622.000
Telemecanique	
GV2-LE	9621.000
GV2-M	9621.000
GV2-P	9622.000

2.1 Busbar systems up to 250 A (40 mm)

Mini-PLS component adaptors 40 A/100 A Page 306

Make/model	Model No. SV		Accessories Model No. SV
ABB			
MS450-.. (max. 40 A)	9617.000	–	–
MS450-..	9629.000	–	9320.120
MS451-.. (max. 40 A)	9617.000	–	–
MS451-..	9629.000	–	9320.120
MS495-..	9629.000	–	9320.120
MS496-..	9629.000	–	9320.120
MS497-..	9629.000	–	9320.120
LNA 32	9629.000	–	–
LNA 63	9629.000	–	–
LNA 100	9629.000	–	–
Tmax			
T1	9629.000	–	–
T2	9629.000	–	–
AEG			
Mbs100	9629.000	–	9320.120
Allen Bradley			
140M-F8.-... (max. 40 A)	9616.000	9617.000	–
140-CMN-....	9629.000	–	9320.120
Merlin Gerin			
Compact NS 80H-MA	9629.000	–	–

Make/model	Model No. SV		Accessories Model No. SV
Moeller Electric			
NZM 1	9629.000	–	–
PKZ2/ZM-...	9627.000	9628.000	–
PKZ2/ZM-...-8	9627.000	9628.000	–
PKZ2/ZM-.../SE1A/11	9628.000	–	–
PKZ2/ZM-.../S	9628.000	–	–
PKZ2/SE1A/11	9628.000	–	–
PKZ2/S	9628.000	–	–
PKZM4-... (max. 40 A)	9617.000	–	–
PKZM4-...	9629.000	–	9320.120
Siemens			
S2			
3RV1. 31-4..10 (max. 40 A)	9617.000	–	–
3RV1. 31-4..10	9629.000	–	9320.120
3RW30 3.-1AB.. (max. 40 A)	9617.000	–	–
3RW30 3.-1AB..	9629.000	–	9320.120
S3			
3RV1. 4.-4..10	9629.000	–	9320.120
3RW30 4.-1AB..	9629.000	–	9320.120
Telemecanique			
GK3-EF.. (max. 40 A)	9628.000	–	–
GK3-EF..	9629.000	–	9320.120
GV3-M... (max. 40 A)	9628.000	–	–
GV3-M...	9629.000	–	9320.120

2.1 Busbar systems up to 360 A (40 mm)

Multi-functional component adaptor 12 A/25 A Page 312 and 313

Make/model	SV 3431.000 5 mm Model No. SV	SV 3431.000 10 mm Model No. SV	Accessories Model No. SV
ABB			
MS116-..	9350.100	9350.110	–
AEG			
Mbs25	9350.100	9350.110	–
Allen Bradley			
103-...R	9350.100	9350.110	–
107-...R	9350.280	9350.290	–
140M-...-...	9350.100	9350.110	–
140-MN-...	9350.100	9350.110	–
190-M1-...	9350.260	9350.270	–
190-M2-...	9350.260	9350.270	–
Moeller Electric			
PKM0...	9350.100	9350.110	–
PKZM0-...	9350.100	9350.110	–
PKZM0-...T	9350.100	9350.110	–
PKZM0-../0.-.	9350.100	9350.110	–
PKM0.../E01-G-W	9350.280	9350.290	–
PKZM0-../E-10-D	9350.100	9350.110	–
PKZM0-../S00-11	9350.100	9350.110	9320.140
PKZM0-../SE00-11	9350.100	9350.110	9320.140
PKZM0-.../.-..-W	9350.280	9350.290	–
PKZM0-.../.-..-WMF	9350.320[1]	9350.330[1]	–

Make/model	SV 3431.000 5 mm Model No. SV	SV 3431.000 10 mm Model No. SV	Accessories Model No. SV
Siemens			
S0			
3RA11 20-...2.-0...	9350.100	9350.110	9320.140
3RA12 20-....-...	9350.300	9350.310	–
3RV1. 21-...1.	9350.100	9350.110	–
3RW30 2.-1AB..	9350.100	9350.110	–
S00			
3RA11 10..0.1.-1...	9350.100	9350.110	9320.140
3RA12 10-....-...	9350.280[2]	9350.290[2]	9320.140
3RV10 11-..A1.	9350.100	9350.110	–
3RW30 1.-1CB.4	9350.100	9350.110	–
S00 Cage Clamp			
3RV10 11-..A20	9350.080	9350.090	–
Telemecanique			
GV2-....	9350.100	9350.110	–
GV2-M..K1..	9350.100	9350.110	–
GV2-M..K2..	9350.280	9350.290	–
GV2-P..D1..	9350.260	9350.270	–
GV2-P..D2..	9350.320[1]	9350.330[1]	–
LD1-L.030 (max. 25 A)	9350.100	9350.110	–
LH4-N1....7	9350.100	9350.110	–
LH4-N2....7	9350.280	9350.290	–

[1] Moeller: The bottom support rail is eliminated
Telemecanique: The upper support rail is offset at a distance of 125 mm from the lower support rail (support rail centre-to-centre spacing)
[2] Support rail must be offset

Overview of power circuit-breakers/starter combinations

2.1 Busbar systems up to 360 A (40 mm)

Multi-functional component adaptor 40 A Page 315

Component adaptor 100 A Page 315

Make/model	SV 3431.000	
	5 mm **Model No. SV**	10 mm **Model No. SV**
ABB		
DLA..-30	9350.200[1)]	9350.210[1)]
MS25-TM-..	9350.200[2)]	9350.210[2)]
MS225-..	9350.200[2)]	9350.210[2)]
MS325-..	9350.200[2)]	9350.210[2)]
MS450-.. (max. 40 A)	9350.340	9350.350
MS450-..	9350.420	9350.430
MS451-.. (max. 40 A)	9350.340	9350.350
MS451-..	9350.420	9350.430
MS495-..	9350.420	9350.430
MS496-..	9350.420	9350.430
MS497-..	9350.420	9350.430
LNA 32/63/100	9350.420	9350.430
AEG		
Mbs28	9350.200[2)]	9350.210[2)]
Mbs100	9350.420	9350.430
Allen Bradley		
140M-F8.-... (max. 40 A)	9350.200[2)]	9350.210[2)]
140-CMN-...	9350.420	9350.430
Merlin Gerin		
Compact NS 80H-MA	9350.420	9350.430

Make/model	SV 3431.000	
	5 mm **Model No. SV**	10 mm **Model No. SV**
Moeller Electric		
NZM 1	9350.420	9350.430
PKZM4-... (max. 40 A)	9350.340	9350.350
PKZM4-...	9350.420	9350.430
Siemens		
S2		
3RV1. 31-4..10 (max. 40 A)	9350.340	9350.350
3RV1. 31-4..10	9350.420	9350.430
3RW30 3.-1AB.. (max. 40 A)	9350.340	9350.350
3RW30 3.-1AB..	9350.420	9350.430
S3		
3RV1. 4.-4..10	9350.420	9350.430
3RW30 4.-1AB..	9350.420	9350.430
Telemecanique		
GK3-EF..	9350.420	9350.430
GV3-M...	9350.420	9350.430

[1)] The top support rail is eliminated
[2)] The bottom support rail is eliminated

2.2 Busbar systems up to 800 A/1600 A (60 mm)

Multi-functional component adaptor 12 A/25 A Page 325 and 326

Make/model	SV 3431.000		**Accessories**
	5 mm **Model No. SV**	10 mm **Model No. SV**	**Model No. SV**
ABB			
MS116-..	9320.180	9320.190	–
AEG			
Mbs25	9320.180	9320.190	–
Allen Bradley			
103-...R	9320.180	9320.190	–
107-...R	9320.380	9320.390	–
140M-...-...	9320.180	9320.190	–
140-MN-...	9320.180	9320.190	–
190-M1-...	9320.440	9320.450	–
190-M2-...	9320.440	9320.450	–
Moeller Electric			
PKM0...	9320.180	9320.190	–
PKZM0-...	9320.180	9320.190	–
PKZM0-...T	9320.180	9320.190	–
PKZM0-../0.-.	9320.180	9320.190	–
PKZM0.../E01-G-W	9320.380	9320.390	–
PKZM0-../E-10-D	9320.180	9320.190	–
PKZM0-../S00-11	9320.180	9320.190	9320.140
PKZM0-../SE00-11	9320.200	9320.210	–
PKZM0-.../.-..-W	9320.380	9320.390	–
PKZM0-.../.-..WMF	9320.420[1)]	9320.430[1)]	–

Make/model	SV 3431.000		**Accessories**
	5 mm **Model No. SV**	10 mm **Model No. SV**	**Model No. SV**
Siemens			
S0			
3RA11 20-...2.-0...	9320.180	9320.190	9320.140
3RA12 20-....-...	9320.400	9320.410	–
3RV1. 21-...1.	9320.180	9320.190	–
3RW30 2.-1AB..	9320.180	9320.190	–
S00			
3RA11 10..0.1.-1...	9320.180	9320.190	9320.140
3RA12 10-....-...	9320.380[1)]	9320.390[1)]	9320.140
3RV10 11-..A1.	9320.180	9320.190	–
3RW30 1.-1CB.4	9320.180	9320.190	–
S00 Cage Clamp			
3RV10 11-..A20	9320.160	9320.170	–
Telemecanique			
GV2-....	9320.180	9320.190	–
GV2-M..K1..	9320.180	9320.190	–
GV2-M..K2..	9320.380	9320.390	–
GV2-P..D1..	9320.440	9320.450	–
GV2-P..D2..	9320.420[2)]	9320.430[2)]	–
LD1-L.030 (max. 25 A)	9320.180	9320.190	–
LH4-N1....7	9320.180	9320.190	–
LH4-N2....7	9320.380	9320.390	–

[1)] The bottom support rail is eliminated
[2)] The upper support rail is offset at a distance of 125 mm from the lower support rail (support rail centre-to-centre spacing)

2.2 Busbar systems up to 800 A/1600 A (60 mm)

Multi-functional component adaptor 40 A Page 327

Make/model	SV 3431.000 5 mm **Model No. SV**	SV 3431.000 10 mm **Model No. SV**
ABB		
MS25-TM-..	9320.300[1)]	9320.310[1)]
MS225-..	9320.300[1)]	9320.310[1)]
MS325-..	9320.300[1)]	9320.310[1)]
MS450-.. (max. 40 A)	9320.460	9320.470
MS451-.. (max. 40 A)	9320.460	9320.470
DLA..-30	9320.300[2)]	9320.310[2)]
AEG		
Mbs28	9320.300[1)]	9320.310[1)]
Allen Bradley		
140M-F8.-... (max. 40 A)	9320.300[1)]	9320.310[1)]

Make/model	SV 3431.000 5 mm **Model No. SV**	SV 3431.000 10 mm **Model No. SV**
Moeller Electric		
PKZM4-... (max. 40 A)	9320.460	9320.470
Siemens		
S2		
3RV1. 31-4..10 (max. 40 A)	9320.460	9320.470
3RW30 3.-1AB.. (max. 40 A)	9320.460	9320.470

[1)] The bottom support rail is eliminated
[2)] The top support rail is eliminated

Component adaptor 50 A Page 328 and 329

Make/model	SV 3431.000 5 mm **Model No. SV**	SV 3431.000 10 mm **Model No. SV**
ABB		
MS25-TM-..	3540.000	3541.000
MS225-..	3540.000	3541.000
MS325-..	3540.000	3541.000
AEG		
Mbs28	3540.000	3541.000
Allen Bradley		
140M-F8.-...	3540.000	3541.000
Moeller Electric		
PKZ2/ZM-...	3544.000	3545.000
PKZ2/ZM-...-8	3544.000	3545.000
PKZM0-.../.-..WMF	3042.000[1)]	3043.000[1)]

Make/model	SV 3431.000 5 mm **Model No. SV**	SV 3431.000 10 mm **Model No. SV**
Siemens		
S2		
3RA11 30-..0.3.-0...	3040.000[2)]	3041.000[2)]
3RV10 31-....	3069.000	3070.000
Telemecanique		
GV2-P..D2..	3042.000[2)]	3043.000[2)]

[1)] The bottom support rail must be offset
[2)] One support rail must be offset

Component adaptor 63 A Page 330 and 331

Make/model	SV 3431.000 5 mm **Model No. SV**	SV 3431.000 10 mm **Model No. SV**
ABB		
MS25-TM-..	3445.000	3445.000
MS25-TM-..	3446.000	3446.000
MS225-..	3445.000	3445.000
MS225-..	3446.000	3446.000
MS325-..	3445.000	3445.000
MS325-..	3446.000	3446.000
MS450-..	3036.000	3037.000
MS450-..	3445.000	3445.000
MS451-..	3036.000	3037.000
MS451-..	3445.000	3445.000
MS495-.. (max. 63 A)	3067.000	3068.000
MS496-.. (max. 63 A)	3067.000	3068.000
MS497-.. (max. 63 A)	3067.000	3068.000
AEG		
Mbs28	3445.000	3445.000
Mbs28	3446.000	3446.000
Allen Bradley		
140M-F8.-...	3445.000	3445.000
140M-F8.-...	3446.000	3446.000

Make/model	SV 3431.000 5 mm **Model No. SV**	SV 3431.000 10 mm **Model No. SV**
Moeller Electric		
PKZ2/S	3046.000	3047.000
PKZ2/SE1A/11	3046.000	3047.000
PKZ2/ZM-.../S	3046.000	3047.000
PKZ2/ZM-.../SE1A/11	3046.000	3047.000
PKZM0-../0-SD	3048.000[1)]	3049.000[1)]
PKZM0../00(A)-SD	3048.000[1)]	3049.000[1)]
PKZM0-../E-10-SD	3048.000[1)]	3049.000[1)]
PKZM0-../E-10-G-SD	3048.000[1)]	3049.000[1)]
PKZM4-...	3036.000	3037.000
PKZM4-...	3445.000	3445.000
Siemens		
S2		
3RV1. 31-4..10	3036.000	3037.000
3RV1. 31-4..10	3445.000	3445.000
3RW30 3.-1AB..	3036.000	3037.000
3RW30 3.-1AB..	3445.000	3445.000
S3		
3RV1. 4-4..10 (max. 63 A)	3067.000	3068.000
3RW30 4.-1AB.. (max. 63 A)	3067.000	3068.000
Telemecanique		
GK3-EF.. (max. 63 A)	3067.000	3068.000
GV3-M... (max. 63 A)	3067.000	3068.000
LD1-L.030	3067.000	3068.000
LD4-L..30	3067.000	3068.000

[1)] One support rail is eliminated

NH isolators, size 000

Page 307, 311, 337, 358

- Thanks to a specially developed locking mechanism, the fuse inserts are easily and quickly installed.
- A special switching aid pre-stresses the lyre contact when the isolator lid is closed. This means that the fuse insert slides reliably into its final position without damaging the contact.
- Microswitches for monitoring the lid position are readily integrated on the right and left.
- The unit can be protected from unauthorised switching via the readily accessible sealing device on the front of the unit.
- The spaciously designed viewing window of the isolator lid allows easy monitoring of the fuse insert indicators.
- Test holes drilled in the viewing window allow direct measurement access to the contact parts of the fuse inserts.

NH isolator, sizes 00 to 3

Page 338 – 341, 345 – 348, 358 and 359

- Easy assembly with removable push-in isolator lid and top mounted contact hazard protection cover.
- Two-part contact hazard protection cover plate with service-friendly central unlocking facility allows connection in accordance with BGV-A2 (VBG 4), even whilst the supply end is live.
- Apart from its protective function, the design of the NH on-load isolator facilitates the activation and deactivation of electrical equipment and system components.
- The units may be actuated whilst live (see table below).
- Microswitches to indicate the switching position of the isolator lid are easily installed via snap-mounting on the left and right.
- The viewing window integrated into the lid unit has test holes which can be opened by sliding the viewing window, for direct measurement access to the contact parts of the fuse inserts (see photograph).

Technical specifications to VDE 0660, part 107/IEC 60 947-3						
Size (NH fuse inserts to DIN 43 620)		000	000/00	1	2	3
Rated operating current I_e Conventional thermal current I_{th}		100 A 160 A[1)]	160 A 160 A	250 A 250 A	400 A 400 A	630 A 630 A
Rated operating voltage U_e		AC 690 V	AC 690 V			
Rated insulation voltage U_i		690 V	800 V			
Rated surge voltage resistance U_{imp}		6 kV	8 kV			
Conditional rated short-circuit current when protected with fuses		80 kA	50 kA	50 kA	50 kA	50 kA
Rated breaking capacity to VDE 0660, part 107/IEC 60 947-3 (utilisation category)	400 V	AC-22B I_e = 100 A	AC-22B I_e = 160 A	AC-22B I_e = 250 A	AC-22B I_e = 400 A	AC-22B I_e = 630 A
	690 V	AC-21B I_e = 100 A	AC-22B I_e = 160 A	AC-21B I_e = 250 A	AC-21B I_e = 400 A	AC-21B I_e = 630 A
	440 V[2)]	DC-21B I_e = 100 A	DC-21B I_e = 160 A	DC-21B I_e = 250 A	DC-21B I_e = 400 A	DC-21B I_e = 630 A
Mechanical life (switching cycles)		2000	1600	1000	600	600
Permissible ambient temperature		–25°C to +55°C				
Fire protection corresponding to		UL 94-V0				
$P_{v\,max}$/fuse insert		7.5 W (9 W [1)])	12 W	23 W	34 W	48 W

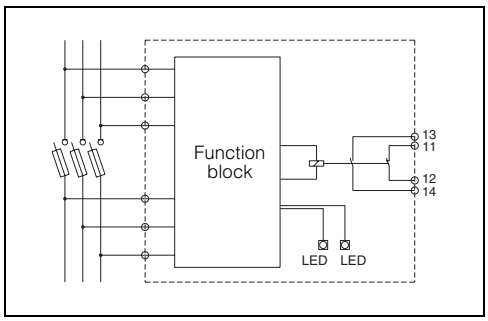
[1)] For 95 mm² connection cross-section (95 mm² connection pieces available on request)
[2)] With population of phases L_1 and L_3.

Electronic fuse monitoring

- No separate auxiliary voltage required.
- Automatic activation following fault rectification.
- Reliable functioning, thanks to surge-proof microelectronics.
- Readily accessible connector facilitates service-friendly connection of the signal tracks.
- Rapid response behaviour in the event of a fault.

Electronic fuse monitoring may be used in 50/60 Hz three-phase circuits ranging from 400 V AC to 690 V AC (max. +5 %). The auxiliary voltage required for operation is obtained from the mains voltage (supply end) via live puller lugs.

Consequently, this function is only available with the mains voltage connected and the isolator lid closed. If one or more of the NH fuse inserts is switched due to a malfunction, an error signal is generated. Evaluation is achieved by comparing the voltage on the puller lugs with the NH fuse inserts used (differential voltage ≥ 75 V). In the event of a fault, a corresponding signal message for further processing is provided via the separate relay contacts. Additionally, malfunctions are visually indicated by a red LED display, whilst a green LED indicates that the sytem is operational.

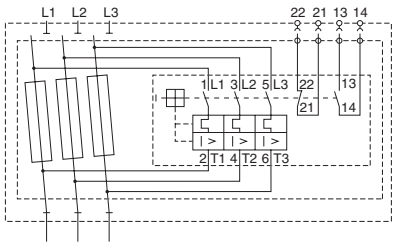


Electromechanical fuse monitoring

The connection clamps of the floating switch contacts which serve as indicators are arranged on the top of the isolator base. This arrangement guarantees extremely simple installation.

The isolator lids can be removed without disconnecting any pilot wires, in the same way as NH isolators without fuse monitoring. Unlike an electronic monitor, this system operates without auxiliary power, yet still performs the same functions.

Wiring diagram



Technical specifications	Electromechanical fuse monitoring	Electronic fuse monitoring
Rated operating voltage U_e	AC 24 V to AC 690 V (50/60 Hz) DC 24 V to DC 250 V	AC 400 V to AC 690 V (50/60 Hz)
Rated surge voltage resistance U_{imp}	6 kV	6 kV
Response time	< 2 s	< 0.5 s
Auxiliary contacts	1 normally closed contact, 1 normally open contact	1 normally closed contact, 1 normally open contact, bounce-free
Load capacity of auxiliary contacts	1.5 A	2 A
Permissible ambient temperature	–25°C to +55°C	–25°C to +55°C
Displays	“I” switch dial position (operational) “0” switch dial position (error message)	1 green LED (operational) 1 red LED (error message)
Connection of auxiliary contacts	Terminal up to 1.5 mm²	4-pole rack connector up to 1.5 mm²
NH fuse inserts	with contacted, live puller lugs	

Technical information

NH fused isolators, sizes 00 to 3

Page 336, 349, 353

- The cable outlet – top or bottom – is selected directly during assembly on the same device. The switch cover unit is simply rotated through 180° (sizes 1 to 3).
- Reliable isolated or off-load position of the switch cover unit, thanks to the integral multi-function key.
- Switch locking can be achieved via the installation of padlocks in the closed and isolated position.
- For inspection purposes, there are viewing windows with integral holes in the switch cover unit or sliding viewing windows.
- Simple external/internal mounting of microswitches to indicate the switch position of the NH unit (lid unit).

Technical specifications to VDE 0660, part 107/IEC 60 947-3					
Size (NH fuse inserts to DIN 43 620)		00	1	2	3
Rated operating current I_e Conventional thermal current I_{th}		160 A 160 A	250 A 250 A	400 A 400 A	630 A 630 A
Rated operating voltage U_e		AC 690 V			
Rated insulation voltage U_i		800 V			
Rated surge voltage resistance U_{imp}		8 kV			
Conditional rated short-circuit current when protected with fuses		50 kA	50 kA	50 kA	50 kA
Rated breaking capacity to VDE 0660, part 107/IEC 60 947-3 (utilisation category)	400 V	AC-22B I_e = 160 A	AC-22B I_e = 250 A	AC-22B I_e = 400 A	AC-22B I_e = 630 A
	690 V	AC-21B I_e = 160 A	AC-21B I_e = 250 A	AC-21B I_e = 400 A	AC-21B I_e = 630 A
Mechanical life (switching cycles)		1600	1000	1000	1000
Permissible ambient temperature		–25°C to +55°C			
Fire protection corresponding to		UL 94-V0			
$P_{v\ max.}$/fuse insert		12 W	23 W	34 W	48 W

Use of semi-conductor fuses in Rittal NH switchgear

The overload and short-circuit protection of semi-conductor components places very high demands on the fuse inserts, due to the time pattern for effective protection of the defective or damaged sub-circuit. Because semi-conductor components have a low thermal capacity, the integral disconnect value (I^2t-value) of the semi-conductor fuse inserts type aR, gR or gRL must match the integral limit value of the semi-conductor cell being protected. Consequently, the tripping characteristic of the fuse inserts must be very fast, and overvoltage during the disconnection process (switching or arc voltage) must be as minimal as possible. Compared with fuse inserts for cable and line protection and transformer protection, the particular features of semi-conductor fuse inserts produce a comparatively high heat loss. The high heat loss is dissipated to the environment in the form of thermal energy. Because NH switchgear only has a limited capacity to dissipate thermal energy to the environment, the maximum heat loss ($P_{v\ max.}$/fuse insert) is listed in the technical specifications of the NH switchgear. If the values exceed the heat loss specified by the manufacturer, the rated current should be reduced in accordance with the table opposite, or the minimum connection cross-section increased accordingly to encourage heat dissipation.

Semi-conductor fuses type aR/gR/gRL				Minimum cross-section (Cu) [mm²]	Reduction factor for rated current
Size	I_N [A]	Operating category	Heat loss [W]		
00	25	gR	6	4	1.00
00	35	gR	9	6	1.00
00	50	gR	12	10	0.87
00	63	gR	15	16	0.87
00	80	aR	19	25	0.85
00	100	aR	21	35	0.85
00	125	aR	26	50	0.80
00	160	aR	34	70	0.75
1	160	gR	24	70	1.00
1	200	gR	27	95	1.00
1	250	gR	30	120	1.00
2	250	aR	105	120	0.77
2	315	aR	120	185	0.75
2	450	aR	140	2 x (30 x 5)	0.75
3	150	gR	40	70	0.90
3	200	gR	55	95	0.90
3	250	gR	72	120	0.88
3	350	gR	95	240	0.81
3	500	gR	130	2 x 150	0.76

NH bus-mounting on-load isolator, size 2

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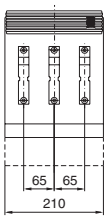
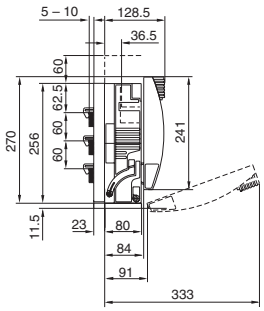
SV 3415.020





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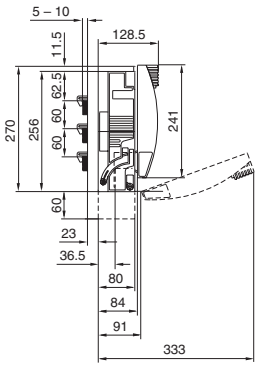

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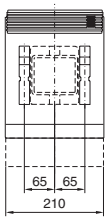

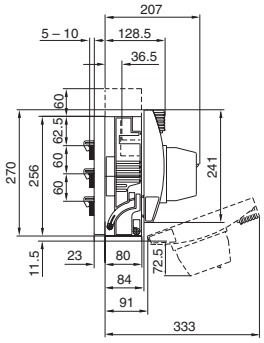

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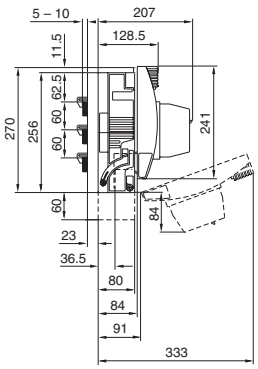

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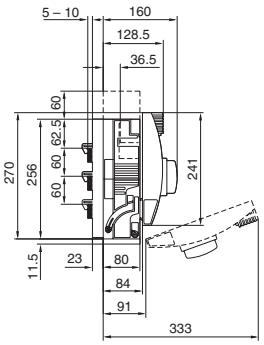

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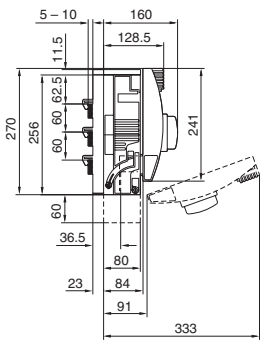

NH bus-mounting on-load isolator, size 3

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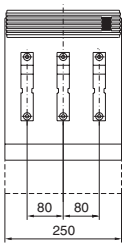
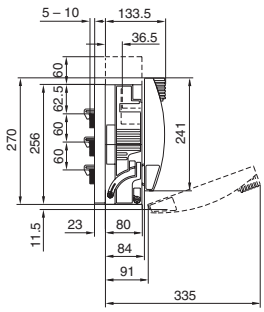
SV 3095.020





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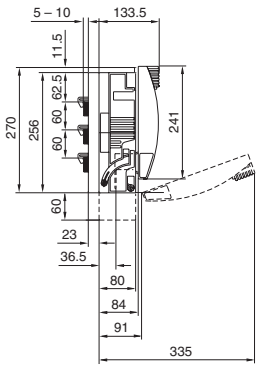

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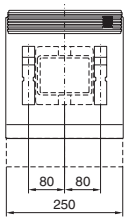

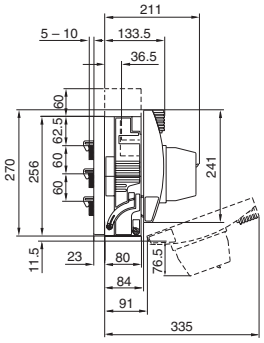

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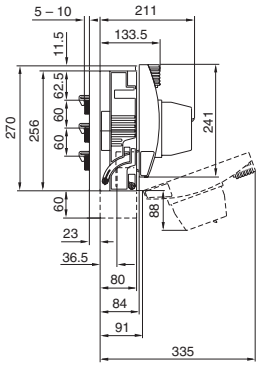

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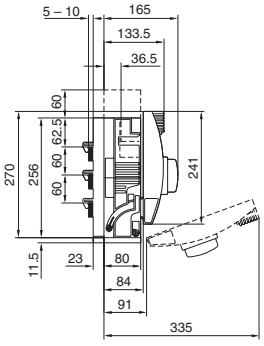

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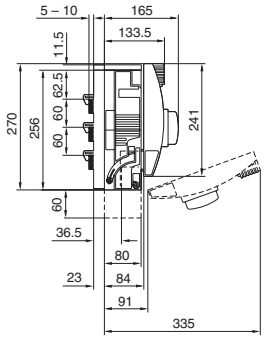

Technical information

NH on-load isolator, size 2

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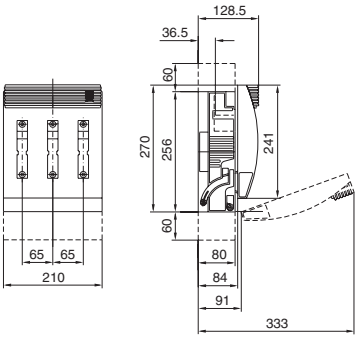
SV 3415.010



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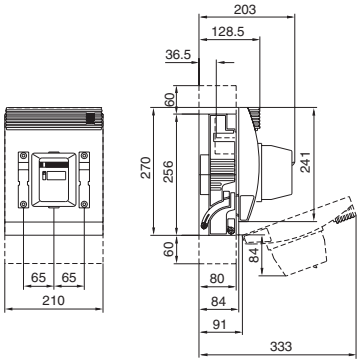

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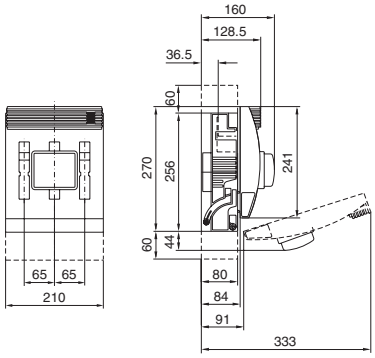

NH on-load isolator, size 3

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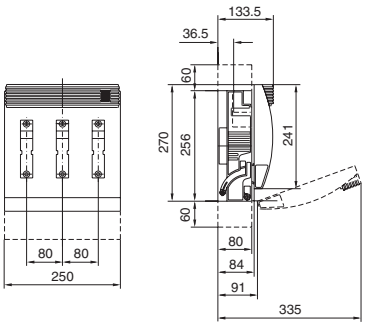
SV 3095.010



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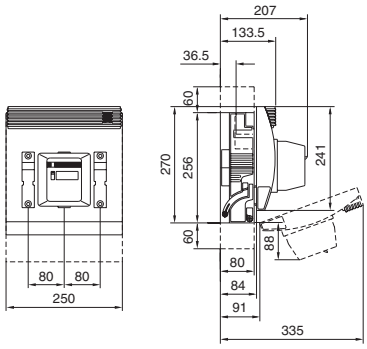

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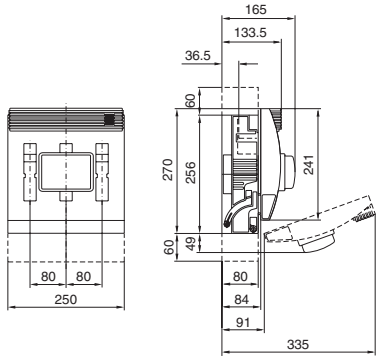
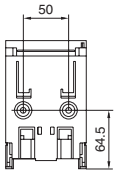


NH on-load isolator, size 000 to 3

Hole size Page 358 and 359

SV 3431.000



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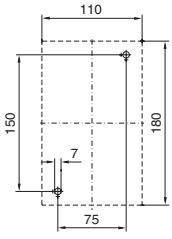
SV 3489.000, SV 3489.310



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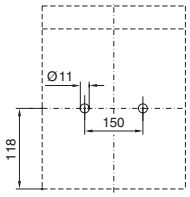

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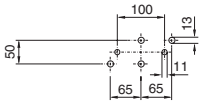

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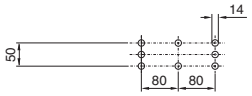


Rated currents of busbars E-Cu (DIN 43 671)

DIN 43 671 specifies the continuous currents of busbars at an ambient temperature of 35°C and an average busbar temperature of 65°C. The continuous currents specified in the following table may be adjusted to alternative operating temperatures using a correction factor (k_2).

For safe operation with thermal reserve, it is desirable to limit the busbar temperature to a maximum of 85°C. However, the decisive factor is the lowest permissible continuous temperature of the components which directly contact the busbar system (fuse bases, outgoing cables etc.). The ambient air temperature of the busbars or the busbar system should not be more than 40°C; an average of 35°C maximum is recommended.

For the continuous temperatures specified in the table, an emission level of 0.4 applies, equivalent to an oxidating copper bar. In modern busbar systems – built into enclosures with a protection category of IP 54 and above – a more favourable emission level can be assumed. The lower emission level facilitates an additional increase in continuous currents compared with the figures in DIN 43 671, irrespective of the specified air and busbar temperature. Experience has shown an increase in the continuous current of 6 – 10 % compared with the table figures for bare copper bars, and 60 % for surface-oxidised copper bars.

Example:
For a Cu bar 30 x 10 mm (E-Cu F30), DIN 43 671 specifies a continuous current of I_{N65} = 573 A.
The correction factor diagram for square cross-sections indicates a correction factor k_2 = 1.29 at an air temperature of 35°C and a busbar temperature of 85°C. Thanks to the favourable emission level, the continuous current is increased by a further 6 – 10 %. In this example, a mean value of 8 % is used. Compared with the table figure from DIN 43 671, the Rittal rated current specification for a Cu bar 30 x 10 mm is:

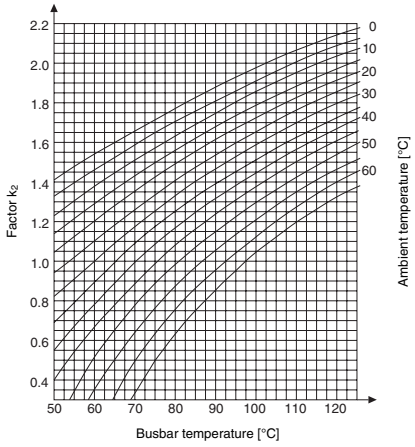
$$I_{N85} = I_{N65} \cdot k_2 + 8\ \%$$
$$= 573\ A \cdot 1.29 \cdot 1.08$$
$$I_{N85} = 800\ A$$

Continuous currents for busbars
Made from E-Cu with square cross-section in indoor locations at 35°C air temperature and 65°C bar temperature, vertical position or horizontal position of the bar width.

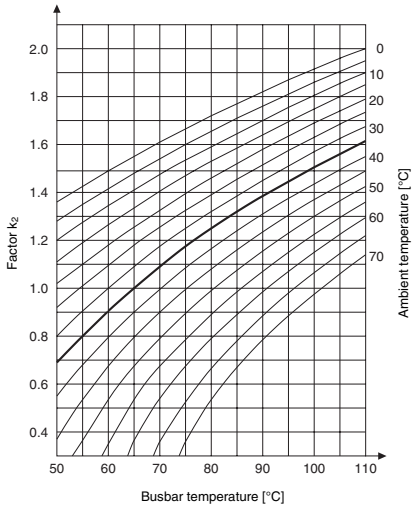
Width x Thickness mm	Cross-section mm²	Weight[1]	Material[2]	Continuous current in A			
				AC current up to 60 Hz		DC current + AC current 16 Hz	
				Bare bar	Coated bar	Bare bar	Coated bar
12 x 2	23.5	0.209		108	123	108	123
15 x 2	29.5	0.262		128	148	128	148
15 x 3	44.5	0.396		162	187	162	187
20 x 2	39.5	0.351		162	189	162	189
20 x 3	59.5	0.529		204	237	204	237
20 x 5	99.1	0.882		274	319	274	320
20 x 10	199.0	1.770		427	497	428	499
25 x 3	74.5	0.663		245	287	245	287
25 x 5	124.0	1.110		327	384	327	384
30 x 3	89.5	0.796		285	337	286	337
30 x 5	149.0	1.330	E-Cu F30	379	447	380	448
30 x 10	299.0	2.660		573	676	579	683
40 x 3	119.0	1.060		366	435	367	436
40 x 5	199.0	1.770		482	573	484	576
40 x 10	399.0	3.550		715	850	728	865
50 x 5	249.0	2.220		583	697	588	703
50 x 10	499.0	4.440		852	1020	875	1050
60 x 5	299.0	2.660		688	826	696	836
60 x 10	599.0	5.330		985	1180	1020	1230
80 x 5	399.0	3.550		885	1070	902	1090
80 x 10	799.0	7.110		1240	1500	1310	1590

[1] Calculated with a density of 8.9 kg/dm³
[2] Reference basis for the continuous current levels (figures taken from DIN 43 671)

Correction factor diagram to DIN 43 671



Correction factor diagram for PLS



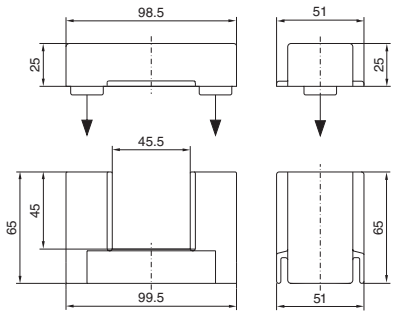
Rittal PLS current load
According to DIN 43 671, the correction factor k_2 (correction factor diagram) is used to correct the basic rated current with reference to the existing temperatures of the ambient air and the busbar.
In accordance with DIN 43 671, the load figures of the Rittal PLS special bars have been determined on the basis of measurement trials, as follows:

PLS special busbars	Basic rated current WS 50/60 Hz	
	for 35/75°C	for 35/65°C
E-Cu 800 A	800 A	684 A
E-Cu 1600 A	1600 A	1368 A

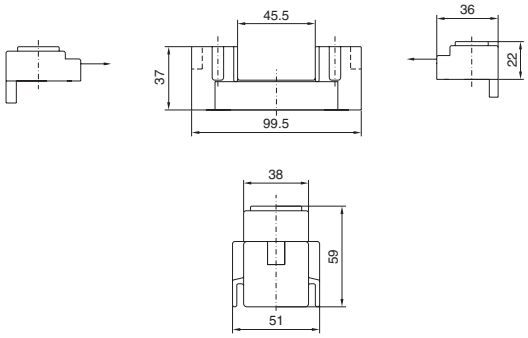
2.8 System components

Maxi-PLS 2000 A Page 376

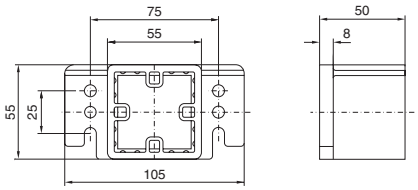
Busbar supports
Model No. SV 9640.000, SV 9649.000



Busbar support, suitable for top mounting
Model No. SV 9640.160



End supports
Model No. SV 9640.010, SV 9649.010



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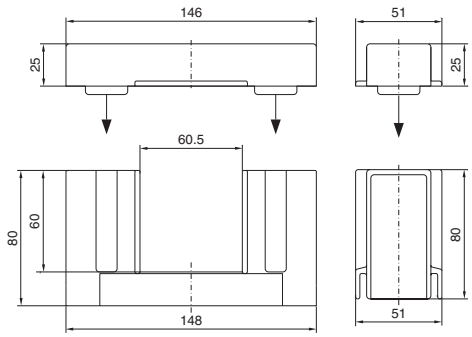
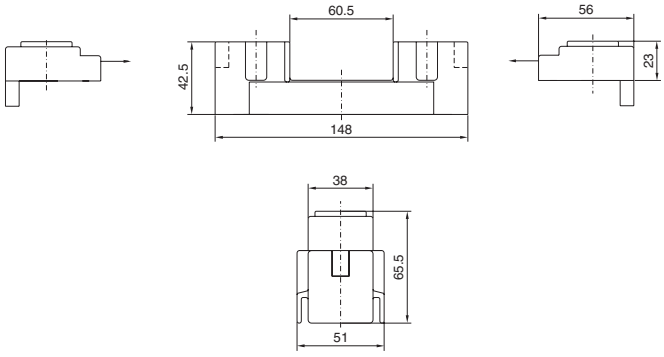
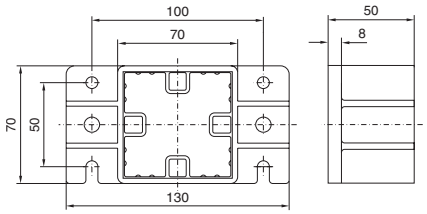
Busbar supports
Model No. SV 9650.000, SV 9659.000



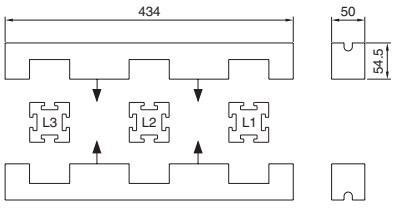
Busbar support, suitable for top mounting
Model No. SV 9650.160



End supports
Model No. SV 9650.010, SV 9659.010



Stabiliser
Model No. SV 9650.140



2.8 Connection components

Maxi-PLS 2000 A Page 377

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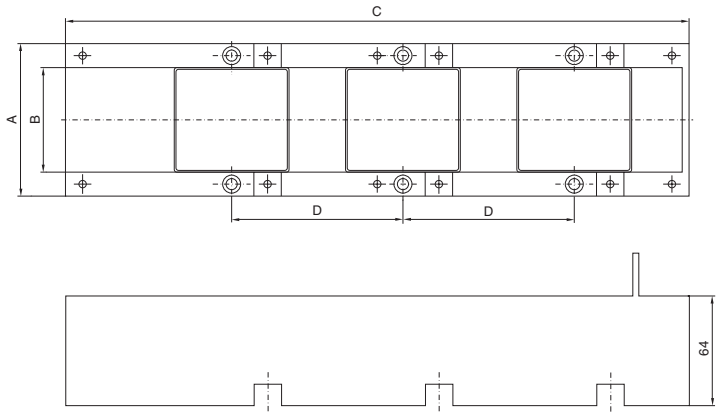
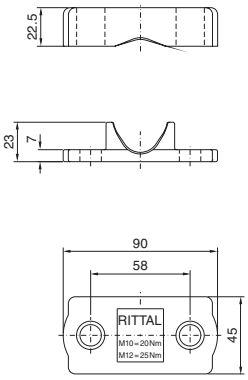
Isolator chassis

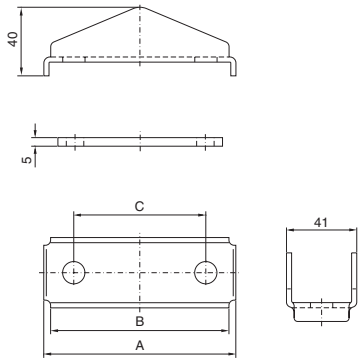


Model No. SV	A	B	C	D	E
9640.020	89	61	346	100	89
9650.020	89	61	479	150	94
9650.030	129	101	479	150	94

Connection clamp
Model No. SV 9640.320,
SV 9650.320

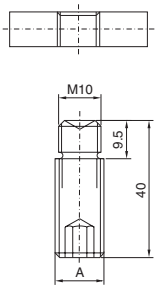


Connection plates



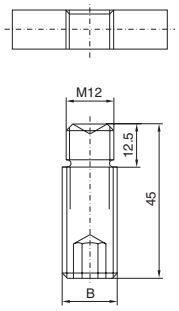
Model No. SV	Size	A	B	C	T-head screws	Tightening torque
9640.330	1	81	73	46	M10	20 Nm
9640.340	2	112	104	77	M10	25 Nm
9640.350	3	149	141	114	M10	30 Nm
9650.330	1	81	73	46	M12	25 Nm
9650.340	2	112	104	77	M12	30 Nm
9650.350	3	149	141	114	M12	35 Nm

Terminal studs
(2000 A)

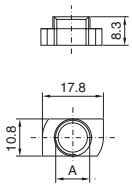


Model No. SV	A	B
9640.370	M12	–
9640.380	M16	–
9650.370	–	M12
9650.380	–	M16

Terminal studs
(3200 A)

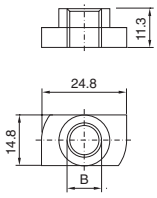


Sliding nuts
(2000 A)



Model No. SV	A	B
9640.900	M6	–
9640.910	M8	–
9640.920	M10	–
9650.900	–	M6
9650.910	–	M10
9650.920	–	M12

Sliding nuts
(3200 A)

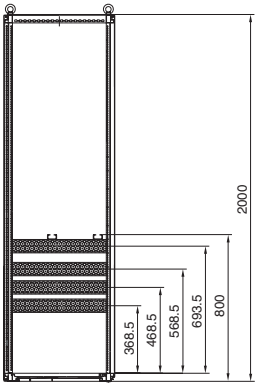


Rittal Maxi-PLS

2.8 SV-TS 8 enclosures

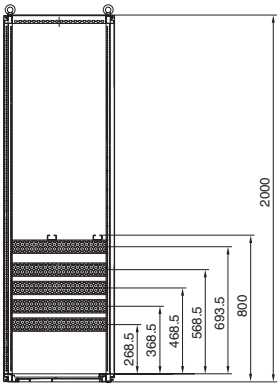
for incoming/outgoing circuit 3-pole, page 392, 4-pole, page 393

3-pole



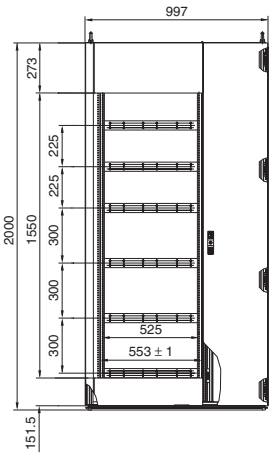
Model No. SV	Width mm	Depth mm	Door(s)
9660.665	600	600	1
9660.675	600	600	3
9660.865	800	600	1
9660.875	800	600	3

4-pole

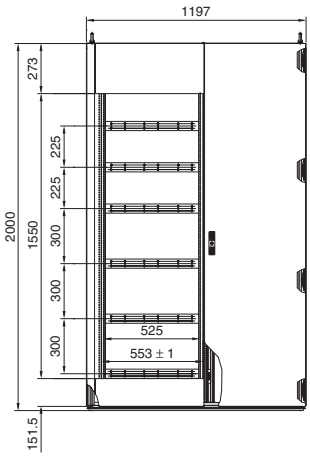


Model No. SV	Width mm	Depth mm	Door(s)
9649.625	800	600	1
9649.635	800	600	3
9659.625	800	800	1
9659.635	800	800	3

for NH fused isolators 3-pole, page 396



Model No. SV	Depth mm	For[1)]
9660.515	600	A
9660.415	600	B

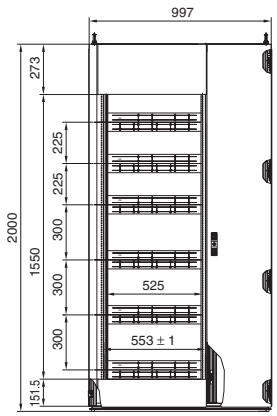


Model No. SV	Depth mm	For[1)]
9660.545	600	A
9660.445	600	B

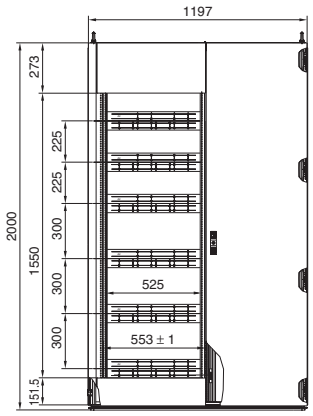
[1)] NH fused isolators brand
A = ABB SlimLine
B = Jean Müller SASIL

2.8 SV-TS 8 enclosures

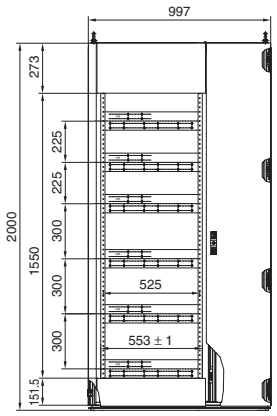
for NH fused isolators 4-pole, page 397



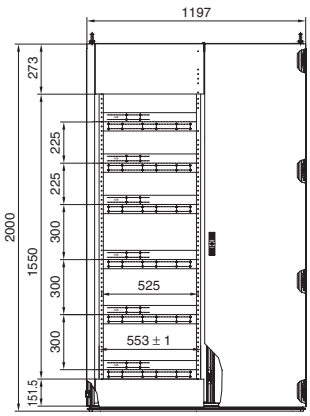
Model No. SV	Depth mm	For[1)]
9649.645	600	B
9659.645	800	B



Model No. SV	Depth mm	For[1)]
9649.655	600	B
9659.655	800	B



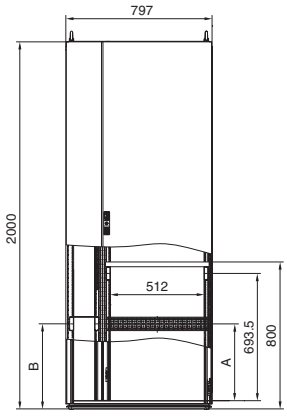
Model No. SV	Depth mm	For[1)]
9649.665	600	A
9659.665	800	A



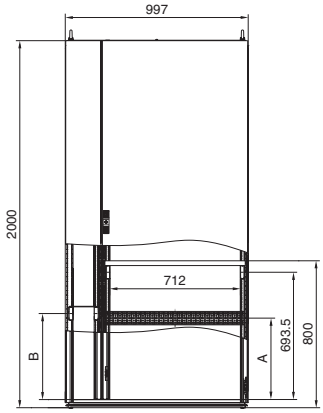
Model No. SV	Depth mm	For[1)]
9649.675	600	A
9659.675	800	A

[1)] NH-fused isolators brand A = ABB SlimLine, B = Jean Müller SASIL

for coupling sets Page 399



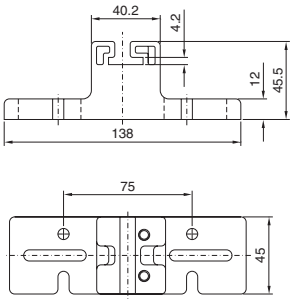
Model No. SV	Depth mm	A mm	B mm
9660.305	600	418.5	418.5



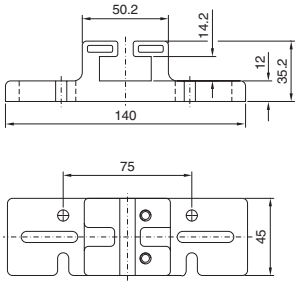
Model No. SV	Depth mm	A mm	B mm
9660.355	600	443.5	468.5
9649.685	600	418.5	418.5
9659.695	800	443.5	468.5

System components for NH fused isolators panels Page 398

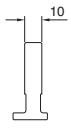
T-bar supports up to 800 A
Model No. SV 9660.000/.010,
SV 9649.100/.110



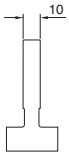
T-bar supports up to 1600 A
Model No. SV 9660.100/.110,
SV 9659.100/.110



T-busbars E-Cu up to 800 A
Model No. SV 9660.020/.030,
SV 9649.120/.130



T-busbars E-Cu
up to 1600 A
Model No. SV 9660.120/.130
SV 9659.120/.130



2.8 SV-TS 8 enclosures

for incoming/outgoing circuit Page 392

Maxi-PLS 2000 A (incoming panel)

Electrical characteristics	Rated voltage	Rated insulation voltage U_i	1000 V	EN 60 439-1
		Rated operating voltage U_e	690 V	
		Rated surge voltage resistence U_{imp}	8 kV	
		Overvoltage category	IV	
		Level of contamination	3	
		Rated frequency	50 Hz	
	Rated current (main busbar)	Rated operating current I_e	1700 A	For IP 54
			2000 A	For IP 2X[1]
		Rated surge current resistance I_{pk}	110 kA	
		Rated short-time current resistance I_{cw}	50 kA	
Mechanical characteristics	Dimensions	Enclosure width: 600 and 800 mm, enclosure height: 2000 mm², enclosure depth: 600 mm[2]		EN 50 298
		Pitch pattern	25 mm	
	Protection category		Max. IP 54	
	Design		1	EN 60 439-1
	Surface protection/ Material	Enclosure frame	Dipcoat-primed	
		Panels (roof plate, rear panel)	Dipcoat-primed, powder-coated in RAL 7035 on the outside	
		System attachment	Stainless steel	
		System rails and punched sections with mounting flanges	Sheet steel, zinc-plated, passivated	
	Busbar	Material	E-Cu, bare	
		External dimensions (cross-section)	45 x 45 mm (1380 mm²)	
Operating and ambient conditions	Ambient temperature	Short-term peak	+40°C	EN 60 439-1
		Maximum on a 24 h average	+35°C	
		Low	–5°C	
	Atmospheric conditions	Normal climatic stress		EN 60 439-1
		Relative humidity	50 % at 40°C	
			Operation up to 1000 m above sea level	

[1] Using outlet filter SK 3326.207 and roof plate SV 9660.235/.245
[2] Other sizes available on request.

Maxi-PLS 3200 A (incoming panel)

Electrical characteristics	Rated voltage	Rated insulation voltage U_i	1000 V	EN 60 439-1
		Rated operating voltage U_e	690 V	
		Rated surge voltage resistence U_{imp}	8 kV	
		Overvoltage category	IV	
		Level of contamination	3	
		Rated frequency	50 Hz	
	Rated current (main busbar)	Rated operating current I_e	2100 A	For IP 54
			2600 A	For IP 2X[1]
			3000 A	For IP 2X[2]
			3200 A	[3]
		Rated surge current resistance I_{pk}	165 kA (264 kA)[4]	
		Rated short-time current resistance I_{cw}	70 kA (124 kA)[4]	
Mechanical characteristics	Dimensions	Enclosure width: 600 and 800 mm, enclosure height: 2000 mm[5], enclosure depth: 600 mm[5]		EN 50 298
		Pitch pattern	25 mm	
	Protection category		Max. IP 54	
	Design		1	EN 60 439-1
	Surface protection/ Material	Enclosure frame	Dipcoat-primed	
		Panels (roof plate, rear panel)	Dipcoat-primed, powder-coated in RAL 7035 on the outside	
		System attachment	Stainless steel	
		System rails and punched sections with mounting flanges	Sheet steel, zinc-plated, passivated	
	Busbar	Material	E-Cu, bare	
		External dimensions (cross-section)	60 x 60 mm (2700 mm²)	
Operating and ambient conditions	Ambient temperature	Short-term peak	+40°C	EN 60 439-1
		Maximum on a 24 h average	+35°C	
		Low	–5°C	
	Atmospheric conditions	Normal climatic stress		EN 60 439-1
		Relative humidity	50 % at 40°C	
			Operation up to 1000 m above sea level	

[1] Using outlet filter SK 3326.207 and roof plate SV 9660.235/.245 [2] Using fan-and-filter unit SK 3327.107 (700 m³/h) and roof plate SV 9660.235/.245
[3] Busbars in open frame (free air convection) or special climate control measures to maintain the enclosure internal temperature
[4] Using stabiliser SV 9650.140 [5] Other sizes available on request

2.8 SV-TS 8 enclosures

for NH fused isolators Page 394

Maxi-PLS 2000 A (185 mm busbar system in the rear section of the enclosure)

Electrical characteristics	Rated voltage	Rated insulation voltage U_i	1000 V	EN 60 439-1
		Rated operating voltage U_e	690 V	
		Rated surge voltage resistence U_{imp}	8 kV	
		Overvoltage category	IV	
		Level of contamination	3	
		Rated frequency	50 Hz	
	Rated current (main busbar)	Rated operating current I_e	1700 A	For IP 54
			2000 A	For IP 2X[1]
		Rated surge current resistance I_{pk}	143 kA[2]	
		Rated short-time current resistance I_{cw}	65 kA[2]	
Mechanical characteristics	Dimensions	Enclosure width: 600, 800, 1000 and 1200 mm, enclosure height: 2000 mm[3], enclosure depth: 500, 600 und 800 mm		EN 50 298
		Pitch pattern	25 mm	
	Protection category		Max. IP 54	
	Design		1	EN 60 439-1
	Surface protection/ Material	Enclosure frame	Dipcoat-primed	
		Panels (roof plate, rear panel)	Dipcoat-primed, powder-coated in RAL 7035 on the outside	
		System attachment	Stainless steel	
		System rails and punched sections with mounting flanges	Sheet steel, zinc-plated, passivated	
	Busbar	Material	E-Cu, bare	
		External dimensions (cross-section)	45 x 45 mm (1380 mm²)	
Operating and ambient conditions	Ambient temperature	Short-term peak	+40°C	EN 60 439-1
		Maximum on a 24 h average	+35°C	
		Low	–5°C	
	Atmospheric conditions	Normal climatic stress		EN 60 439-1
		Relative humidity	50 % at 40°C	
			Operation up to 1000 m above sea level	

Maxi-PLS 3200 A (185 mm busbar system in the rear section of the enclosure)

Electrical characteristics	Rated voltage	Rated insulation voltage U_i	1000 V	EN 60 439-1
		Rated operating voltage U_e	690 V	
		Rated surge voltage resistence U_{imp}	8 kV	
		Overvoltage category	IV	
		Level of contamination	3	
		Rated frequency	50 Hz	
	Rated current (main busbar)	Rated operating current I_e	2100 A	For IP 54
			2600 A	For IP 2X[1]
			3000 A	For IP 2X[4]
			3200 A	[5]
		Rated surge current resistance I_{pk}	176 kA[6]	
		Rated short-time current resistance I_{cw}	80 kA[6]	
Mechanical characteristics	Dimensions	Enclosure width: 600, 800, 1000 and 1200 mm, enclosure height: 2000 mm[3], enclosure depth: 500, 600 und 800 mm		EN 50 298
		Pitch pattern	25 mm	
	Protection category		Max. IP 54	
	Design		1	EN 60 439-1
	Surface protection/ Material	Enclosure frame	Dipcoat-primed	
		Panels (roof plate, rear panel)	Dipcoat-primed, powder-coated in RAL 7035 on the outside	
		System attachment	Stainless steel	
		System rails and punched sections with mounting flanges	Sheet steel, zinc-plated, passivated	
	Busbar	Material	E-Cu, bare	
		External dimensions (cross-section)	60 x 60 mm (2,700 mm²)	
Operating and ambient conditions	Ambient temperature	Short-term peak	+40°C	EN 60 439-1
		Maximum on a 24 h average	+35°C	
		Low	–5°C	
	Atmospheric conditions	Normal climatic stress		EN 60 439-1
		Relative humidity	50 % at 40°C	
			Operation up to 1000 m above sea level	

[1] Using outlet filter SK 3326.207 and roof plate SV 9660.235/.245/.255/.265 [2] Using busbar support, suitable for top mounting SV 9640.160
[3] Enclosure height 1800 and 2200 mm available on request [4] Using fan-and-filter unit SK 3327.107 (700 m³/h) and roof plate SV 9660.235/.245/.255/.265
[5] Busbars in open frame (free air convection) or special climate control measures to maintain the enclosure internal temperature
[6] Using busbar support, suitable for top mounting SV 9650.160

Rittal Maxi-PLS – Technical information

2.8 SV-TS 8 enclosures

for NH fused isolators Page 396

T-bar system 800 A

Electrical characteristics	Rated voltage	Rated insulation voltage U_i	1000 V	EN 60 439-1
		Rated operating voltage U_e	690 V	
		Rated surge voltage resistence U_{imp}	8 kV	
		Overvoltage category	IV	
		Level of contamination	3	
		Rated frequency	50 Hz	
	Rated current (main busbar)	Rated operating current I_e	1000 A	For IP 3X
		Rated surge current resistance I_{pk}	110 kA	
		Rated short-time current resistance I_{cw}	50 kA	
Mechanical characteristics	Dimensions	Enclosure width: 1000 and 1200 mm, enclosure height: 2000 mm[1], enclosure depth: 600 mm[1]		EN 50 298
		Pitch pattern	25 mm	
	Protection category		IP 3X	
	Design		1	EN 60 439-1
	Surface protection/ Material	Enclosure frame	Dipcoat-primed	
		Panels (roof plate, rear panel)	Dipcoat-primed, powder-coated in RAL 7035 on the outside	
		System rails and punched sections with mounting flanges	Sheet steel, zinc-plated, passivated	
		System attachment	Stainless steel	
	Busbar	Material	E-Cu, bare	
		Width contact strip	10 mm	
		Cross-section	470 mm²	
Operating and ambient conditions	Ambient temperature	Short-term peak	+40°C	EN 60 439-1
		Maximum on a 24 h average	+35°C	
		Low	–5°C	
	Atmospheric conditions	Normal climatic stress		EN 60 439-1
		Relative humidity	50 % at 40°C	
			Operation up to 1000 m above sea level	

[1] Other sizes available on request

T-bar system 1600 A

Electrical characteristics	Rated voltage	Rated insulation voltage U_i	1000 V	EN 60 439-1
		Rated operating voltage U_e	690 V	
		Rated surge voltage resistence U_{imp}	8 kV	
		Overvoltage category	IV	
		Level of contamination	3	
		Rated frequency	50 Hz	
	Rated current (main busbar)	Rated operating current I_e	1600 A	For IP 3X
		Rated surge current resistance I_{pk}	110 kA	
		Rated short-time current resistance I_{cw}	50 kA	
Mechanical characteristics	Dimensions	Enclosure width: 1000 and 1200 mm, enclosure height: 2000 mm[1], enclosure depth: 600 mm[1]		EN 50 298
		Pitch pattern	25 mm	
	Protection category		IP 3X	
	Design		1	EN 60 439-1
	Surface protection/ Material	Enclosure frame	Dipcoat-primed	
		Panels (roof plate, rear panel)	Dipcoat-primed, powder-coated in RAL 7035 on the outside	
		System rails and punched sections with mounting flanges	Sheet steel, zinc-plated, passivated	
		System attachment	Stainless steel	
	Busbar	Material	E-Cu, bare	
		Width contact strip	10 mm	
		Cross-section	910 mm²	
Operating and ambient conditions	Ambient temperature	Short-term peak	+40°C	EN 60 439-1
		Maximum on a 24 h average	+35°C	
		Low	–5°C	
	Atmospheric conditions	Normal climatic stress		EN 60 439-1
		Relative humidity	50 % at 40°C	
			Operation up to 1000 m above sea level	

[1] Other sizes available on request

2.8 SV-TS 8 enclosures

for coupling sets Page 399

Maxi-PLS 2000 A (coupling section)

Electrical characteristics	Rated voltage	Rated insulation voltage U_i	1000 V	EN 60 439-1
		Rated operating voltage U_e	690 V	
		Rated surge voltage resistence U_{imp}	8 kV	
		Overvoltage category	IV	
		Level of contamination	3	
		Rated frequency	50 Hz	
	Rated current (main busbar)	Rated operating current I_e	1700 A	For IP 54
			2000 A	For IP 2X[1]
		Rated surge current resistance I_{pk}	110 kA	
		Rated short-time current resistance I_{cw}	50 kA	
Mechanical characteristics	Dimensions	Enclosure width: 800 mm[2], enclosure height: 2000 mm[2], enclosure depth: 600 mm[2]		EN 50 298
		Pitch pattern	25 mm	
	Protection category		Max. IP 54	
	Design		1	EN 60 439-1
	Surface protection/ Material	Enclosure frame	Dipcoat-primed	
		Panels (roof plate, rear panel)	Dipcoat-primed, powder-coated in RAL 7035 on the outside	
		System attachment	Stainless steel	
		System rails and punched sections with mounting flanges	Sheet steel, zinc-plated, passivated	
	Busbar	Material	E-Cu, bare	
		External dimensions (cross-section)	45 x 45 mm (1380 mm²)	
Operating and ambient conditions	Ambient temperature	Short-term peak	+40°C	EN 60 439-1
		Maximum on a 24 h average	+35°C	
		Low	–5°C	
	Atmospheric conditions	Normal climatic stress		EN 60 439-1
		Relative humidity	50 % at 40°C	
			Operation up to 1000 m above sea level	

[1] Using outlet filter SK 3326.207 and roof plate SV 9660.245
[2] Other sizes available on request

Maxi-PLS 3200 A (coupling section)

Electrical characteristics	Rated voltage	Rated insulation voltage U_i	1000 V	EN 60 439-1
		Rated operating voltage U_e	690 V	
		Rated surge voltage resistence U_{imp}	8 kV	
		Overvoltage category	IV	
		Level of contamination	3	
		Rated frequency	50 Hz	
	Rated current (main busbar)	Rated operating current I_e	2100 A	For IP 54
			2600 A	For IP 2X[1]
			3000 A	For IP 2X[2]
			3200 A	[3]
		Rated surge current resistance I_{pk}	110 kA	
		Rated short-time current resistance I_{cw}	50 kA	
Mechanical characteristics	Dimensions	Enclosure width: 1000 mm[4], enclosure height: 2000 mm[4], enclosure depth: 600 mm[4]		EN 50 298
		Pitch pattern	25 mm	
	Protection category		Max. IP 54	
	Design		1	EN 60 439-1
	Surface protection/ Material	Enclosure frame	Dipcoat-primed	
		Panels (roof plate, rear panel)	Dipcoat-primed, powder-coated in RAL 7035 on the outside	
		System attachment	Stainless steel	
		System rails and punched sections with mounting flanges	Sheet steel, zinc-plated, passivated	
	Busbar	Material	E-Cu, bare	
		External dimensions (cross-section)	60 x 60 mm (2700 mm²)	
Operating and ambient conditions	Ambient temperature	Short-term peak	+40°C	EN 60 439-1
		Maximum on a 24 h average	+35°C	
		Low	–5°C	
	Atmospheric conditions	Normal climatic stress		EN 60 439-1
		Relative humidity	50 % at 40°C	
			Operation up to 1000 m above sea level	

[1] Using outlet filter SK 3326.207 and roof plate SV 9660.255 [2] Using fan-and-filter unit SK 3327.107 (700 m³/h) and roof plate SV 9660.255
[3] Busbars in open frame (free air convection) or special climate control measures to maintain the enclosure internal temperature
[4] Other sizes available on request

Rittal Maxi-PLS – Technical information

Planning and project management in line with regulations

As a general principle, low-voltage switchgear and distributors should be planned to meet the operating conditions of their final installation site. To this end, the operator of the plant, in collaboration with the manufacturer, should stipulate the operating and ambient conditions. Moreover, as a general rule, the operator or planning office should also supply the manufacturer with full electrical specifications of both the mains supply end and the distributor outlet end. This makes it possible to plan and manufacture a cost-effective system with optimum adaptation to the technical requirements.

Important operating and ambient conditions

- Rated operating voltage U_e
- Mains frequency f_N
- Rated insulation voltage U_i
- Busbar rated current I_{sas}
- Rated current for the supply end I_{zu}
- Rated surge current resistance I_{pk}
- Rated short-time current resistance I_{cw}
- Ambient temperature condition ϑ
- Atmospheric climatic stress, specifying the relative humidity and temperature
- Protection category of the overall system IP . . .
- Specification to DIN EN 60 529
- Protection category

Important basic data for planning and project management

- Applicable regulations and standards, both regional and international
- Electricity supply company conditions
- Operator-specific regulations
- Mains-specific protective measures/mains type
- Rated voltage and frequency
- Rated current with due regard for the number of conductors (infeed and busbars)
- Rated insulation voltage
- Short-circuit current at the point of installation
- Location of incoming cables, from above or below
- Number of incoming cables and wires, specifying the type and cross-section
- Number of outlets, specifying the operating load and the envisaged outgoing cables with type and cross-section
- For the outlet side, specification of the simultaneity factor and rated load factor of the relevant equipment items

Rated load factor

The rated load factor of a switchgear enclosure or part thereof (e.g. a field) comprising several main circuits refers to the ratio between the largest sum total of all currents anticipated at any given time in the affected main circuits and the sum total of the rated currents of all main circuits of the switchgear enclosure or observed part thereof.

Number of main circuits	Load factor
2 and 3	0.9
4 and 5	0.8
6 and 7	0.7
10 or more	0.6

Rated currents and short-circuit currents of standard transformers

Rated voltage U_N = 400 V	400 V		
Short-circuit voltage U_k		4 %[1]	6 %[2]
Power consumption S_{NT} [kVA]	Rated current I_N [A]	Short-circuit current $I_{k''}$[3] [kA]	
50	72	1.89	1.20
100	144	3.61	2.41
160	230	5.77	3.85
200	288	7.22	4.81
250	360	9.02	6.01
315	455	11.36	7.58
400	589	14.43	9.62
500	722	18.04	12.03
630	910	22.73	15.15
800	1156	28.86	19.24
1000	1444	36.08	24.05
1250	1805	45.09	30.06
1600	2312	57.72	38.48
2000	2882	72.15	48,10

[1] U_k = 4 % standardised to DIN 42 503 for S_{NT} = 50 . . . 630 kVA
[2] U_k = 6 % standardised to DIN 42 511 for S_{NT} = 100 . . . 1600 kVA
[3] $I_{k''}$ = Initial symmetrical short-circuit current of transformer when connecting to a mains supply with unlimited short-circuit lead

Design differences between TTA and PTTA

The following regulation applies to the manufacture of low-voltage switchgear and distributors with Rittal SV technology:
DIN EN 60 439-1 (DIN VDE 0660 part 500)
Low-voltage switchgear enclosures – requirements for type-tested and partially type-tested enclosures.

This standard makes a distinction between
- type-tested switchgear enclosures (TTA) and
- partially type-tested switchgear enclosures (PTTA).

This refers to the following:
Type-tested switchgear enclosures (TTA)
are switchgear enclosures or parts thereof (e.g. functional units, assemblies) which match the switchgear enclosure type-tested under the standard, without any major deviations from the original type or system.

Partially type-tested switchgear enclosures (PTTA)
are switchgear enclosures which are manufactured individually or in small quantities for specific application conditions and which contain both type-tested and non-type-tested assemblies, provided the latter are derived from type-tested assemblies (e.g. by means of calculation) which have passed the appropriate tests.

There are no quality differences defined between the two design variants TTA and PTTA. In other words, they are deemed to be of equal value.
However, both design variants require different proof and tests.

The following proof and tests must be provided for system configurationin line with regulations and evidence of CE conformity:

TTA/PTTA to DIN EN 60 439-1
- Compliance with the limit overtemperature
- Dielectric strength
- Short-circuit resistance
- Effectiveness of the PE conductor
- Creepage distances and clearance
- Mechanical function
- IP protection categories
- Wiring, electrical function
- Insulation
- Protective measures

Amongst type-tested switchgear enclosures TTA, this evidence is provided by one-off type testing and unit testing following assembly.

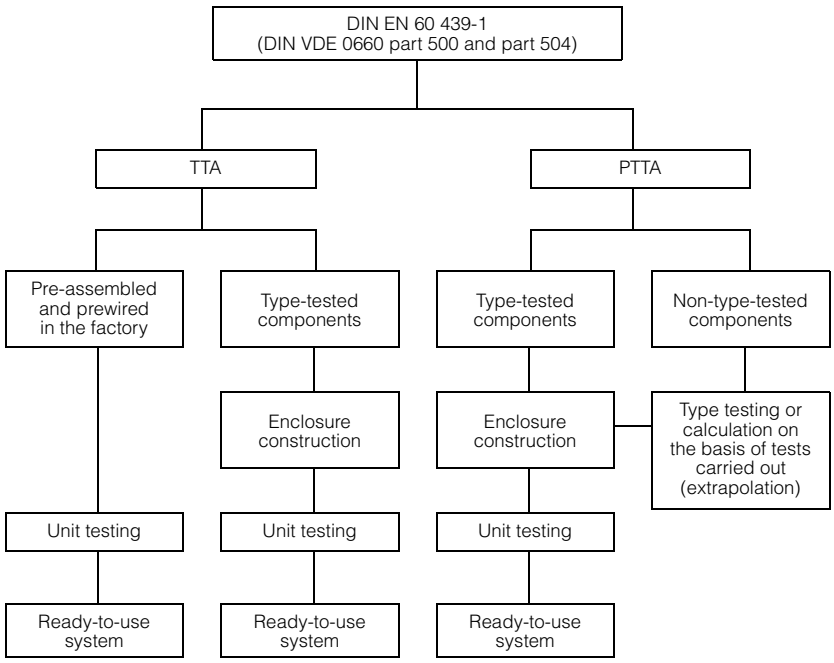
In the case of partially type-tested switchgear enclosures PTTA, complete evidence must be provided for each system installed, either by means of testing or by means of calculation based on the tests performed.

For details of the scope of testing for both design variants, please refer to table 7 in DIN EN 60 439-1 which contains references to the standard section number.

This standard specifies that random variation e.g. of switchgear and protective devices of different makes or models within a switchgear installation is no longer possible without evidence of testing or calculation. This evidence can only be supplied by the manufacturer/workshop.

Special consideration must be made for this fact, both when planning and when purchasing switchgear and distributors.

Difference between TTA and PTTA



Unit testing (final inspection of installations)

According to DIN VDE 0100 part 610 (original inspection), low-voltage installations, including switchgear and distributors, should be subjected to an original inspection prior to commissioning and handover to the customer.

On-site inspection of the customer's system is not necessary for switchgear and distributors, provided an inspection record from the manufacturer/workshop is available.

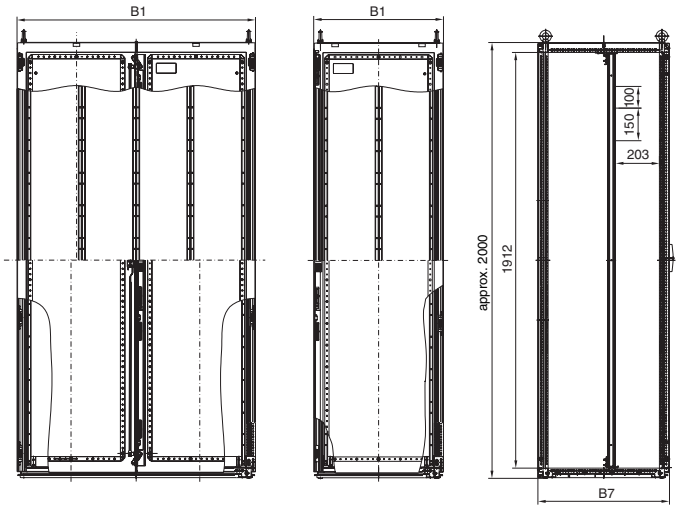
This cost-saving variant should be the norm in all cases where no retrospective modifications have been implemented on site.

ISV distribution enclosure

2.9 ISV-TS 8 enclosures

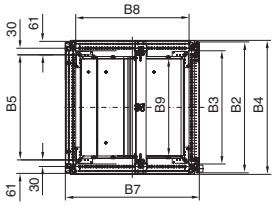
for ISV installation distribution enclosure up to 630 A Page 409

Technical specifications		
Rated current up to	400 A	630 A
Rated surge current resistance I_{pk} at a maximum busbar support centre distance of 300 mm	30 kA	45 kA
Rated insulation voltage U_i to VDE 0110	690 V AC	
cos phi	0.3	
Cross-section of phase conductor L1 – L3	30 x 5 mm	30 x 10 mm
Cross-section of neutral conductor N	25 x 10 mm	25 x 10 mm
Cross-section of PE conductor	12 x 10 mm	12 x 10 mm
Protective measures	Protection category 1 (with PE conductor)	
Overvoltage category	3	3
IP protection category	IP 20 without door, IP 55 with door	



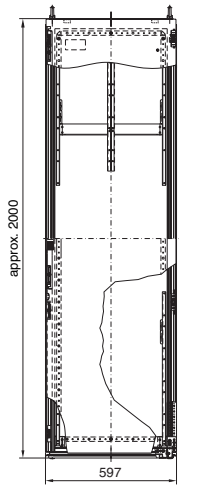
Width measurements									Model No. SV
B1	B2	B3	B4	B5	B6	B7	B8	B9	
597	592	512	606	475	455	605	512	440	**9665.905**
847	842	762	856	725	705	605	512	690	**9665.915**
1097	1092	1012	1106	975	955	605	512	940	**9665.925**
597	592	512	606	475	455	405	312	440	**9665.945**
847	842	762	856	725	705	405	312	690	**9665.955**
1097	1092	1012	1106	975	955	405	312	940	**9665.965**

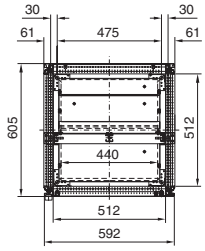
Top view with side panels shown (B4).



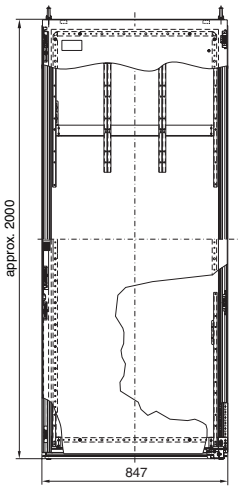
for ISV distribution enclosures up to 1600 A Page 410

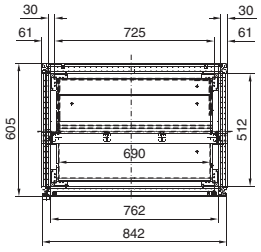
SV 9665.975

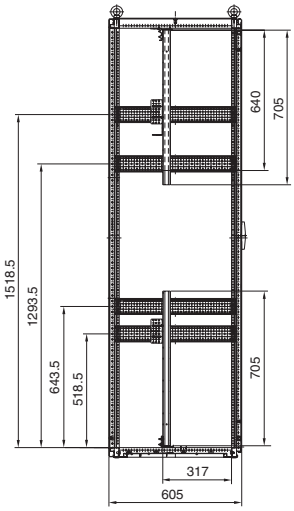




SV 9665.985



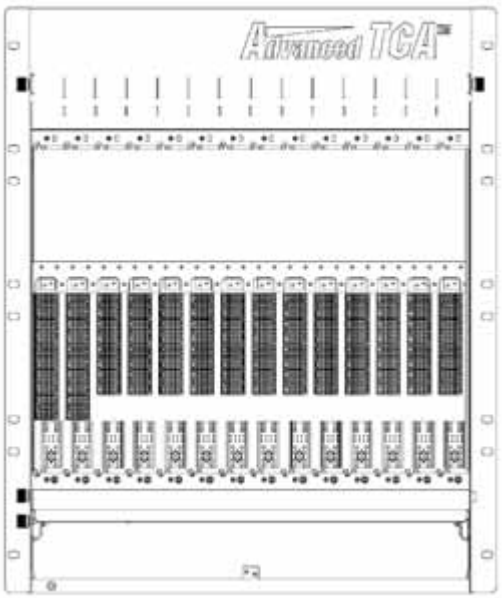




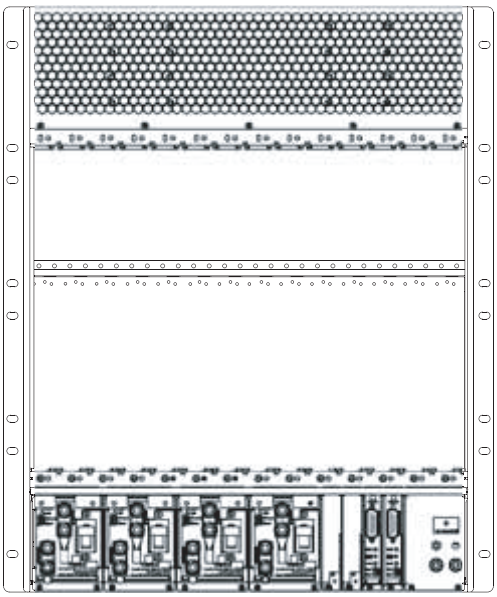
3.1 ATCA

AdvancedTCA Shelf Page 426/427

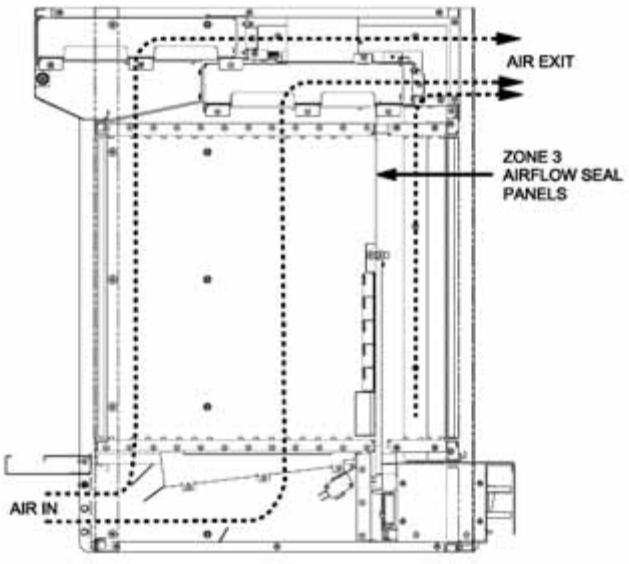
Front view, version VA



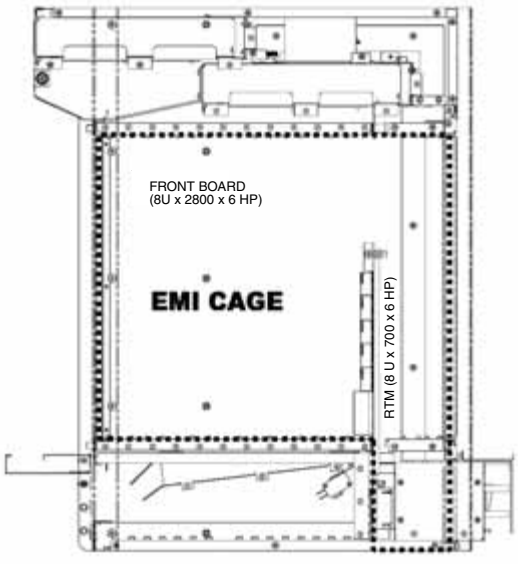
Rear view, version VA/VB



Air routing, version VA/VB



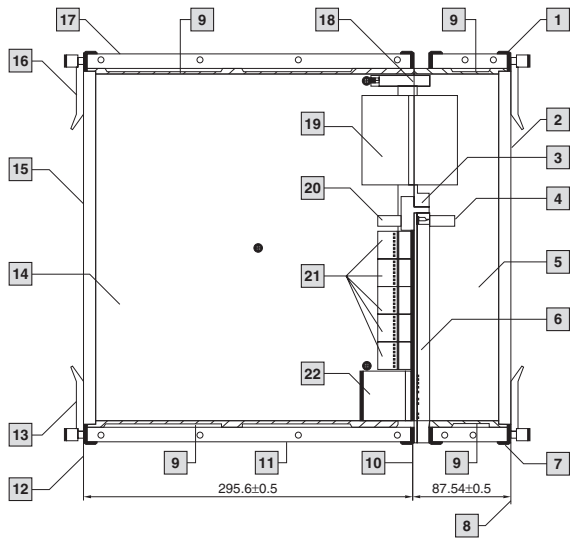
EMC provision, version VA/VB



3.1 ATCA

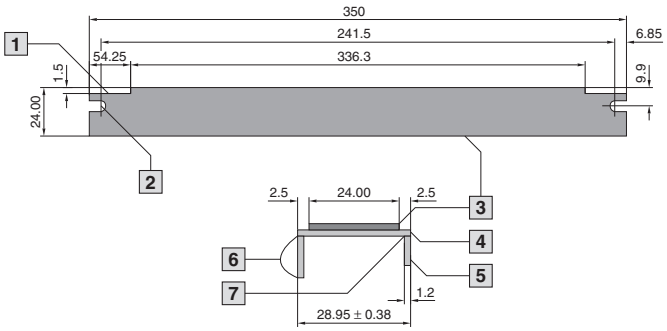
AdvancedTCA Shelf Page 426/427

Subrack side view



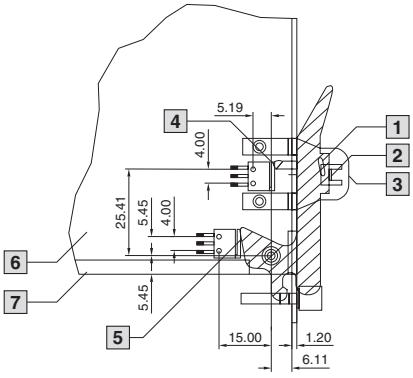
1 RTM upper support member
2 RTM panel
3 Backplane support bar
4 RTM alignment feature
5 RTM
6 Backplane
7 RTM lower support member
8 RTM attachment plane
9 Guide rail
10 Backplane datum
11 Front board lower support member
12 Front board attachment plane
13 Bottom handle
14 Front board
15 Front board face plate
16 Top handle
17 Front board upper support member
18 Zone 3 air flow seal
19 Zone 3 connector
20 Zone 1 and 2 alignment and keying feature
21 Zone 2 fabric and data connectors
22 Zone 1 power connector

Face plate Page 428



1 Handle clearance
2 7.00 dia 2 x screw positions
3 Overlay
4 External R 2.2
5 Contact face
6 EMI gasket
7 Internal R 1.0

Handle/microswitch Page 429



1 Stage 2 “RCSI”
2 Stage 1 “Locking”
3 Locking latch
4 Switch actuates between 1° – 2° handle rotation
5 Switch actuates between 3° – 4° handle rotation
6 Side 2 cover
7 PCB

3.4 Power supply units

Ripac power supply units – Open Frame 250 and 400 W Page 479

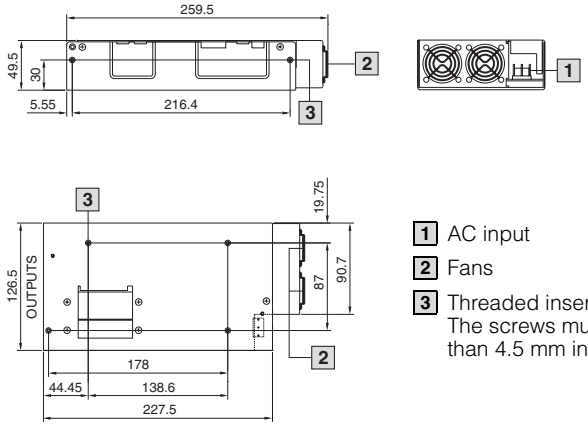
General specifications

	250 watts	400 watts
Model No. RP 35 A	**3686.622**	**–**
Model No. RP 60 A	**–**	**3686.623**
Model No. RP 85 A	**–**	**3686.629**
Operating temperature range	0°C to +70°C (derating from 50°C)	0°C to +70°C (derating from 50°C, 2.5 %/K)
Storage temperature	–40°C to +85°C	–40°C to +85°C
Mains buffering time (min. at 90 V AC)	16 ms minimum	15 ms minimum
Cooling	Fan-cooled	Fan-cooled
Isolation voltages	Input – output: 4350 V DC Input – enclosure: 2350 V DC Output – enclosure: 100 V DC	Input – output: 3000 V AC Input – enclosure: 1500 V AC Output – enclosure: 500 V DC
Radio interference suppression	EN 55 022 curve B	EN 55 022 curve B
Immunity to interference/emmission	EN 61 000-4-2 (level 4) EN 61 000-4-3 (level 3) EN 61 000-4-4 (level 4) EN 61 000-4-5 (level 3) EN 61 000-4-6 (level 3) EN 61 000-4-11 compliant	EN 61 000-4-2 (level 4) EN 61 000-4-3 (level 3) EN 61 000-4-4 (level 4) EN 61 000-4-5 (level 3) EN 61 000-4-6 (level 3) EN 61 000-4-11 compliant
Approvals	UL 1950, VDE 0805, EN 60 950, CSA 22.2, CE	EN 60 950, UL 1950, CSA 22.2 no. 234, CE

[1] All outputs short-circuit resistant to a maximum of 30 seconds.

Ripac power supply unit
Open Frame 250 W

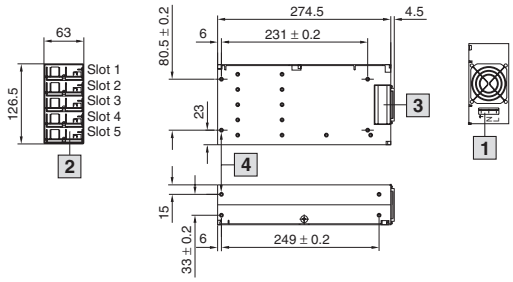
- On/off controller with three outputs
- Design: Solid
- 85 – 265 V AC/120 – 340 V DC
- Radio interference suppressed to EN 55 022 curve B, FCC curve B
- Approvals: EN 60 950, UL 1950, VDE 0805, CSA 22.2/CE



1 AC input
2 Fans
3 Threaded inserts M4 for fastening. The screws must not protrude more than 4.5 mm into the unit.

Ripac power supply unit
Open Frame 400 W

- Modular power supply unit
- 3 outputs
- Wide-range input (85 – 253 V AC)
- Power factor in accordance EN 61 000-3-2
- Radio interference suppressed to EN 55 022 curve B
- Immunity to interference in acccordance with EN 61 000-4-3, -5, -6 (level 3) EN 61 000-4-2, -4 (level 4) EN 61 000-4-11 compliant
- FASTON connectors mean faster installation in the terminal equipment
- Tested to EN 60 950, UL 1950 and CSA 22.2 no. 234



1 AC input
2 DC outputs
3 Fans
4 Threaded inserts M4 for fastening. The screws must not protrude more than 4.5 mm into the unit.

3.4 Power supplies

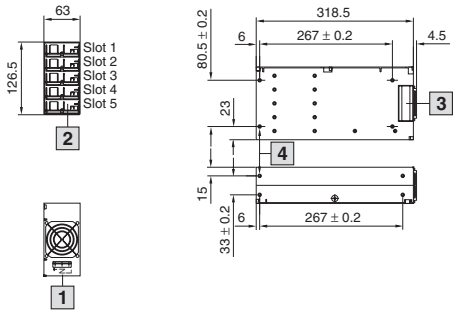
Ripac power supply units – Open Frame 600 and 1000 W Page 479

General specifications

	600 watts	1000 watts
Model No. RP 85 A	**3686.624**	**–**
Model No. RP 110 A	**–**	**3686.625**
Operating temperature range	0°C to +70°C (derating from 50°C, 2.5 %/K)	0°C to +70°C (derating from 50°C, 2.5 %/K)
Storage temperature	–40°C to +85°C	–40°C to +85°C
Mains buffering time (min. at 90 V AC)	15 ms minimum	13 ms minimum
Cooling	Fan-cooled	Fan-cooled
Isolation voltages	Input – output: 3000 V AC Input – enclosure: 1500 V AC Output – enclosure: 500 V DC	Input – output: 3000 V AC Input – enclosure: 1500 V AC Output – enclosure: 500 V DC
Radio interference suppression	EN 55 022 curve B	EN 55 022 curve A
Immunity to interference/emmission	EN 61 000-4-2 (level 4) EN 61 000-4-3 (level 3) EN 61 000-4-4 (level 4) EN 61 000-4-5 (level 3) EN 61 000-4-6 (level 3) EN 61 000-4-11 compliant	EN 61 000-4-2 (level 4) EN 61 000-4-3 (level 3) EN 61 000-4-4 (level 4) EN 61 000-4-5 (level 3) EN 61 000-4-6 (level 3) EN 61 000-4-11 compliant
Approvals	EN 60 950, UL 1950, CSA 22.2 no. 234, CE	EN 60 950, UL 1950, CSA 22.2 no. 234, CE

Ripac power supply unit Open Frame 600 W

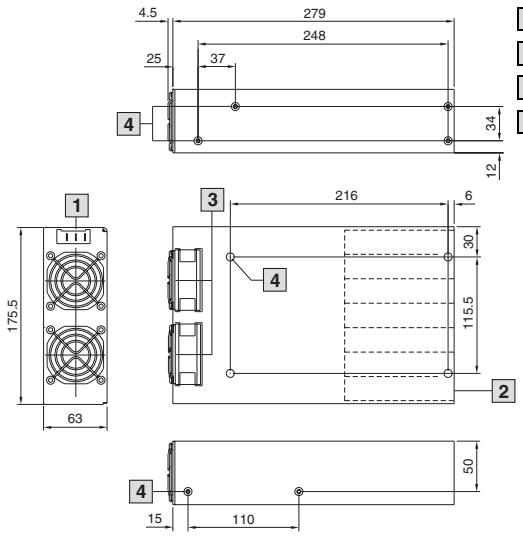
- Modul power supply unit
- 3 outputs
- Long-range input (85 – 253 V AC)
- Power factor in accordance EN 61 000-3-2
- Radio interference suppressed to EN 55 022 curve B
- Immunity to interference in acccordance with EN 61 000-4-2, -5, -6 (level 3) EN 61 000-4-2, -4 (level 4) EN 61 000-4-11 compliant
- FASTON connectors mean faster installation in the terminal equipment
- Tested to EN 60 950, UL 1950 and CSA 22.2 no. 234



1 AC input
2 DC outputs
3 Fans
4 Threaded inserts M4 for fastening. The screws must not protrude moe than 4.5 mm into the unit.

Ripac power supply unit Open Frame 1000 W

- Ultra-compact units with 3 outputs
- Suitable for universal applications, as the outputs can be set with in a broad range
- No base load required
- Peak current may be loaded for start-up operation of drives (up to 3 times the rated current for 10 seconds)
- Immunity to interference in acccordance with EN 61 000-4-2, -5, -6 (level 3) EN 61 000-4-2, -4 (level 4) EN 61 000-4-11 compliant
- Power factor correction to EN 61 000-3-2
- Long-range input: 85 – 265 V AC
- Radio interference suppressed to EN 55 022 curve A
- EN 60 950, EN 41 003, IEC 950, UL 1950, CSA 234 M 90, BS 6301
- SELV (all models < 48 V U_A)
- 48 V DC input for telecom applications available on request



1 AC input
2 DC outputs
3 Fans
4 Threaded inserts M4 for fastening. The screws must not protrude more than 4.5 mm into the unit.

3.4 Power supply units

Ripac power supply units for VME, plug-in Page 480

General specifications

Height	3 U		6 U	
Width (HP)	10	12	8	12
Model No. RP power supply	**3686.469**	**3686.470**	**3686.471**	**3685.306**
Model No. RP front panel	**3685.304**	**3685.305**	**3686.472**	**3685.307**
Operating temperature range	0°C to +70°C with free convection		0°C to +70°C with free convection	
Storage temperature	–20°C to +85°C		0°C to +85°C	
Output reduction	3 %/K from +50°C		3 %/K from +50°C	
Size/weight	10 HP: 0.7 kg, 12 HP: 0.8 kg		8 HP: 1.2 kg, 12 HP: 2 kg	
Mains buffering	> 20 ms at 100 % load		> 20 ms at 100 % load	
Radio interference suppression	EN 50 081-1, EN 55 011/EN 55 022 curve B Interfering radiation depending on installation		EN 50 081-1, EN 55 011/EN 55 022 curve B Interfering radiation depending on installation	
Immunity to interference/emmission	EN 50 082-2 EN 61 000-4-2 level 4 EN 61 000-4-3 EN 61 000-4-4 level 4 EN 61 000-4-5 level 4 EN 61 000-4-11 compliant		EN 50 082-2 EN 61 000-4-2 level 4 EN 61 000-4-3 EN 61 000-4-4 level 4 EN 61 000-4-5 level 4 EN 61 000-4-11 compliant	
Connection	Connector H15, IEC 60 603-2 keyable		2 connectors H15, IEC 60 603-2 keyable	
Approvals LGA design-tested	IEC 950/EN 60 950/VDE 0805 Protection category I/VDE 0100 EN 61 000-4-3 interference level 10 V/m EN 61 000-4-11		IEC 950/EN 60 950/VDE 0805 Protection category I/VDE 0100 EN 61 000-4-3 interference level 10 V/m EN 61 000-4-11	

- 482.6 mm (19″) module to IEC 60 297-3.
- Automatice changeover 115/230 V AC.
- All outputs are continuously short-circuit resistant.
- Overtemperature protection.
- AC-FAIL and SYSRESET signals.
- Integrated VME bus signals (AC-FAIL, SYSRESET).
- Design-tested: EN 60 950/VDE 0805 protection category I, VDE 0100.
- EMC standards EN 50 081-1 and 50 082-2.

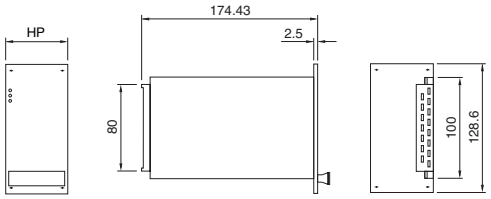
PE earthing contact:
Must be connected to the PE conductor of the mains supply network!
L1/N: Mains conductors
L: Load connection
F: Sensor connection (sense)
0 VL: Common ground for outputs 1 – 3.

With sensor lead operation (5 V only):
Max. voltage compensation per lead 0.25 V.
The sensor lead must be connected to the load.

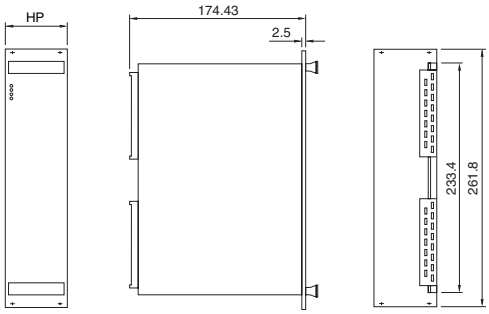
Without sensor lead operation:
For safe operation of the unit, +5 VL must be connected to +5 VF and 0 VL to 0 VF.

Caution:
Fire protection must be provided via the superordinate enclosure system!

3 U

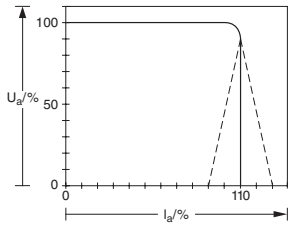


6 U

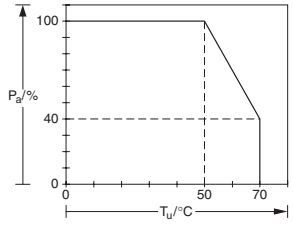


Connector assignment H15, IEC 60 603-2 (DIN 41 612)

	3 U	6 U	
Pin	Function	Function (P1)	Function (P2)
4	+5 VF	+5 VL	AC-FAIL
6	0 VF	+5 VL	SYSRESET
8	+5 VF	+5 VL	assigned internally
10	0 VF	+5 VL	assigned internally
12	+5 VF	+5 VF	assigned internally
14	0 VL	+5 VF	assigned internally
16	SYSRESET	–12 VL	assigned internally
18	0 VL	0 VL	mains-related
20	+12 VL	0 VL	mains-related
22	–12 VL	0 VL	mains-related
24	AC-FAIL	0 VL	mains-related
26	assigned internally (mains-related)	0 VL	mains-related
28	L1	+12 VL	L1
30	N	+12 VL	N
32	PE	0 VF	PE



Current limiting characteristic



Temperature-dependent power reduction

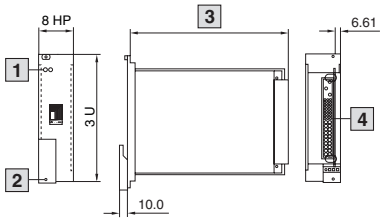
3.4 Power supply units

Ripac power supply units for CPCI, plug-in Page 481

General specifications

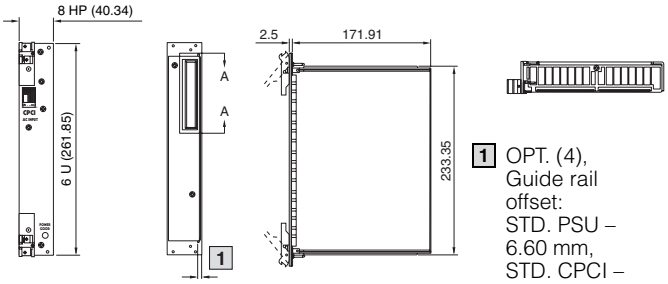
Height	3 U			6 U
Width (HP)	8 HP			8 HP
Model No. RP AC power supply	**3688.534**	**3688.694**	**3688.695**	**3688.528**
Model No. RP DC power supply	**3688.537**	**3688.655**	**3688.696**	**3688.530**
Current splitting/N+1 with parallel connection (redundancy)	U_1, U_2 and U_3, internal diodes, "hotswap"-compatible			
Operating temperature range	0° to 70°C (0° – 50°C full load) 50° to 70°C, linear derating			
Cooling	Min. 15 cfm for full load			Min. 90 cfm for full load
Storage temperature	–40°C to +85°C			
Rel. humidity	< 90 % non-condensed			
Weight	approx. 1 kg			approx. 2.4 kg
MTBF	150,000 h at an ambient temperature of 25°C			
Handle	Type VII, Model No. RP 3686.135			
Guide rail	2.54 mm offset, Model No. RP 3687.832			
EMC	FCC Level B, EN 55 022 Level B (conducted)			FCC Level A, EN 55 022 Level A
Connector	Positronic 47-pin, PICMG 2.11			
Approvals	EN 60 950 A1 – A4, CSA 22.2, UL 1950, CE			

3 U



1 LED display
2 Injector/extractor handle IEEE 1101.10-compatible
3 For 160 mm insertion depth
4 Power supply connector Positronic

6 U



1 OPT. (4), Guide rail offset: STD. PSU – 6.60 mm, STD. CPCI – 4.06 mm

Connector assignment 3 U

Pin#	SEQ[1)]	FUNCTION	
01 – 04	2	+5.0 V	V 1 Output
05 – 12	2	GND	V 1 + V 2 Return
13 – 18	2	+3.3 V	V 2 Output
19	2	GND	V 3 Return
20	2	+12.0 V	V 3 Output
21	2	–12.0 V	V 4 Output
22	2	RTN	Signal Return
23	2	N/C	No Connection (Reserved)
24	2	GND	V 4 Return
25, 26	2	N/C	No Connection (Reserved)
27	3	R/EN	Remote Enable, Close circuit to GND
28, 29	2	N/C	No Connection (Reserved)
30	2	+ S 1	+5.0 V (V 1) Remote Sense
31, 32	2	N/C	No Connection (Reserved)
33	2	+ S 2	+3.3 V (V 2) Remote Sense
34	2	S-RTN	Sense Return for V 1, V 2, V 3
35	3	N/C	No Connection (Reserved)
36	2	+ S 3	+12.0 V (V 3) Remote Sense
37	2	N/C	No Connection (Reserved)
38	2	DEG	Overtemperature
39	2	R/INH	Remote Inhibit, Close circuit to GND
40	2	N/C	No Connection (Reserved)
41	3	N/C	No Connection (Reserved)
42	2	PF	Power Fail Signal
43	2	N/C	No Connection (Reserved)
44	3	N/C	No Connection (Reserved)
45	1	PE	Protective Earth (chassis) Safety Ground
46	2	ACC	Neutral (N) AC Power Input[3)]
47	2	AC	Line (L) AC Power Input[3)]

[1)] Contact mating sequence
1 = First to make/Last to break
[3)] DC to DC version

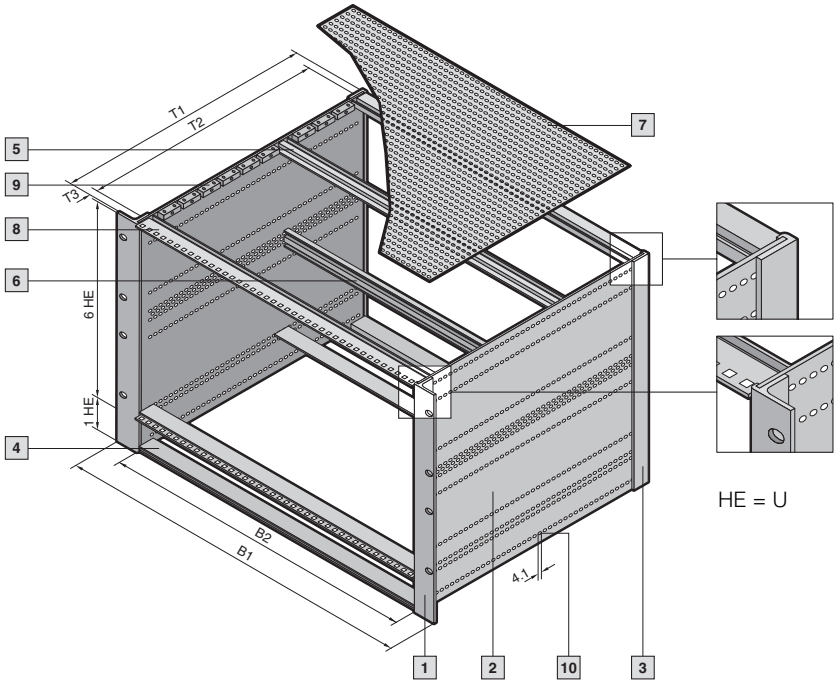
Connector assignment 6 U

Pin#	SEQ[1)]	FUNCTION	
01 – 04	2	+5.0 V	V 1 Output
05 – 12	2	GND	V 1 + V 2 Return
13 – 18	2	+3.3 V	V 2 Output
19	2	GND	V 3 Return
20	2	+12.0 V	V 3 Output
21	2	–12.0 V	V 4 Output
22	2	RTN	Signal Return
23	2	N/C	No Connection (Reserved)
24	2	GND	V 4 Return
25, 26	2	N/C	No Connection (Reserved)
27	3	R/EN	Remote Enable, Close circuit to GND
28	2	N/C	No Connection (Reserved)
29	2	V 1-ADJ	+5.0 V Remote Voltage Adjust
30	2	+ S 1	+5.0 V (V 1) Remote Sense
31	2	N/C	No Connection (Reserved)
32	2	V 2-ADJ	+3.3 V Remote Voltage Adjust
33	2	+ S 2	+3.3 V (V 2) Remote Sense
34	2	S-RTN	Sense Return for V 1, V 2, V 3
35	3	ISHR-1	+5.0 V (V 1) Current Share
36	2	+ S 3	+12.0 V (V 3) Remote Sense
37	2	N/C	No Connection (Reserved)
38	2	DEG	Overtemperature
39	2	R/INH	Remote Inhibit, Close circuit to GND
40	2	N/C	No Connection (Reserved)
41	3	ISHR-2	+3.3 V (V 2) Current Share
42	2	PF	Power Fail Signal
43	2	N/C	No Connection (Reserved)
44	3	ISHR-3	+12.0 V (V 3) Current Share
45	1	PE	Protective Earth (chassis) Safety Ground
46	2	ACC	Neutral AC Power Input[3)]
47	2	AC	Line AC Power Input[3)]

[3)] DC to DC version

3.5 Subracks

Key to all Ripac subrack drawings Page 488 – 494

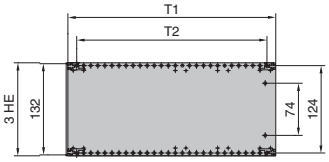


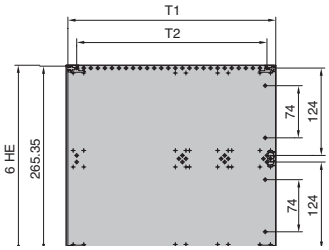
Ripac Vario EMC 7 U taken as an example

B1	482.6 mm (19″)
B2	HP horizontal pitch (with 19″: 84 HP)
T1	Side panel depth
T2	Mounting position depth
T3	12.5 mm (position of the front horizontal rail)
10	Attachment holes Ø 4.1 mm for screws M4 x 12

Ripac ECO 3 U, 6 U – supply includes Page 488

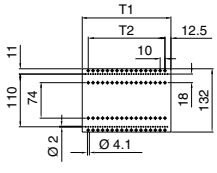
Height units U					3	6	Page
			D (T1) mm	D (T2) mm	Packs of			
2	Side panels		175	150	1	3688.100	3688.102	496
			235	210	1	3688.101	3688.103	
1		Flanges 3 U		3688.110	1	2	–	497
		Flanges 6 U		3688.111	1	–	2	
2		Side panels		see above	1	2	2	496
4	A	Horizontal rails, front		3684.562	1	2	2	499
	I	Threaded inserts		3684.610	1	4	4	504
5	C4	Horizontal rails, rear		3688.104	1	2	2	501
6	D1	Horizontal rails, rear, centre		3684.582	1	–	1	502
10		Assembly screws M4 x 12		3684.881	1	8	10	–



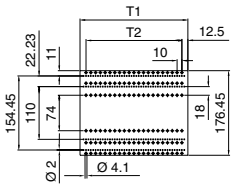


Ripac Vario, Ripac Vario EMC Page 489 – 492

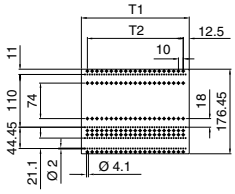
3 U



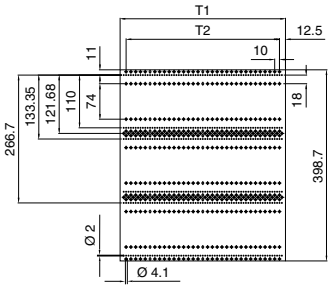
4 U (3 + 2 x 1/2)



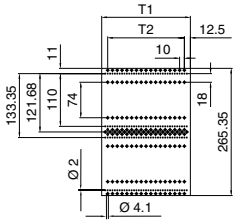
4 U (3 + 1)



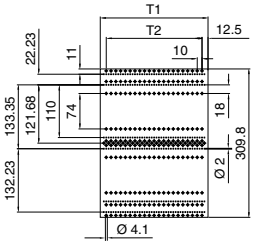
9 U



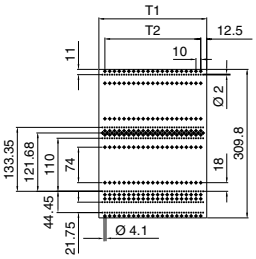
6 U



7 U (8 + 2 x 1/2)



7 U (6 + 1)



3.5 Subracks

Ripac Vario, Ripac Vario EMC 3 U, 4 U, 6 U, 7 U, 9 U – supply includes Page 489 – 492

Height units U		D (T1) mm	D (T2) mm	Packs of	3	6	9	4 (3 + 1)	4 (3 + 2 x 1/2)	7 (6 + 1)	7 (6 + 2 x 1/2)	Page
2	Side panels	185	160	1	3684.511	3684.529	–	–	–	–	–	495
		225	200	1	3684.512	3684.530	3685.797	3685.793	3685.890	3685.896	3685.893	
		245	220	1	3684.513	3684.531	–	3685.850	3685.891	3685.897	3685.894	
		285	260	1	3684.514	3684.532	–	3684.523	3684.526	3685.743	3685.895	
		305	280	1	3684.515	3684.533	3685.798	3685.794	–	–	–	
		345	320	1	3684.516	3684.534	3684.547	3684.524	3684.527	3685.744	3685.745	
		365	340	1	3684.517	3684.535	3685.799	3685.795	–	–	–	
		405	380	1	3684.518	3684.536	3684.548	3684.525	3684.528	3684.541	3684.543	
		425	400	1	3684.519	3684.537	–	–	–	–	–	
		465	440	1	3684.520	3684.538	3684.549	3685.796	3685.892	3684.542	3684.544	
		525	500	1	3684.521	3684.539	3684.550	–	–	3685.898	3685.959	
		585	560	1	3684.522	3684.540	3684.551	–	–	–	–	

Subrack Ripac Vario

	PT		Model No.	P. of	BP	C	BP	C	BP	C	BP	C	BP	C	BP	C	Page
1		Flanges	–	1	3684.615		3684.617		3684.619		3684.616				3684.618		496
					2	2	2	2	2	2	2	2	2	2	2	2	
2		Side panels	see above	1	2	2	2	2	2	2	2	2	2	2	2	2	495
4	A	Horizontal rails, front	3684.562	1	2	2	2	2	2	2	2	2	2	2	2	2	499
	I	Threaded inserts	3684.610	1	2	2	2	2	2	2	2	2	2	2	2	2	504
5	C1	Horizontal rails, rear	3684.572	1	2	–	2	–	2	–	2	–	2	–	2	2	500
6	D1	Horizontal rails, rear, centre	3684.582	1	–	–	1	–	2	–	–	–	–	–	1	1	502
	G	Insulating strips 21 HP	3684.611	1	8	–	16	–	24	–	8	–	8	–	16	16	505
	C3	Horizontal rails, rear, with Z rails	3686.159	1	–	2	–	2	–	2	–	2	–	2	–	–	501
	D2	Horizontal rails, rear, centre, with integral Z rails	3687.602	1	–	–	–	1	–	2	–	–	–	–	–	–	503
10		Assembly screws M4 x 12	3684.881	1	8	8	10	10	12	12	8	8	8	8	10	10	–

Subrack Ripac Vario EMC

	PT		Model No.	P.of	BP	BP[1)]	BP	BP[1)]	BP	BP[1)]	BP	BP[1)]	BP	BP[1)]	BP	BP[1)]	BP	BP[1)]	Page
1		Flanges	–	1	3684.615		3684.617		3684.619		3684.616				3684.618				496
					2	2	2	2	2	2	2	2	2	2	2	2	2	2	
3		Trim sections, rear	–	1	3684.634		3684.636		3684.638		3684.635				3684.637				497
					2	2	2	2	2	2	2	2	2	2	2	2	2	2	
2		Side panels	see above	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	495
		EMC gaskets, vertical	–	1	3686.975		3686.977		3686.979		3686.976				3686.978				506
					4	4	4	4	4	4	4	4	3	3	4	4	3	3	
7		Covers, vented	see below	1	2	2	2	2	2	2	2	2	–	–	2	2	–	–	515
		Covers, L-shaped, 1/2 U, top solid/bottom vented at front	see below	1	–	–	–	–	–	–	–	–	1/1	1/1	–	–	1/1	1/1	517
9		Mounting blocks	3684.234	10	Depending on depth														507
	K	EMC gaskets for covers	3684.245	10	4	4	4	4	4	4	4	4	2	2	4	4	2	2	507
4	A	Horizontal rails, front	3684.562	1	4	3	4	2	4	2	6	5	4	3	6	4	4	2	499
	I	Threaded inserts	3684.610	1	4	4	4	4	4	4	6	6	4	4	6	6	4	4	504
8	B	Front horizontal rails with 10 mm extension	3684.567	1	–	1	–	2	–	2	–	1	–	1	–	2	–	2	499
5	C1	Horizontal rails, rear	3684.572	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	500
6	D1	Horizontal rails, rear, centre	3684.582	1	–	–	1	1	2	2	–	–	–	–	1	1	1	1	502
	G	Insulating strips 21 HP	3684.611	1	8	8	16	16	24	24	8	8	8	8	16	16	16	16	505
10		Assembly screws M4 x 12	3684.881	1	12	12	14	14	16	16	16	16	12	12	18	18	14	14	–

Covers for Ripac Vario EMC

Height units U		D (T1) mm	Packs of	3	6	9	4 (3 + 1)	4 (3 + 2 x 1/2)	7 (6 + 1)	7 (6 + 2 x 1/2)	Page
7	Covers	245	1		3684.695		–	–	–	–	515 – 517
		285	1		3684.696		3684.696	3684.732/ 3684.726[2)]	3684.696	3684.732/ 3684.726[2)]	
		305	1		3685.852		–	–	–	–	
		345	1		3684.698		3684.698	3684.733/ 3684.727[2)]	3684.698	3684.733/ 3684.727[2)]	
		405	1		3684.700		3684.700	3684.734/ 3684.728[2)]	3684.700	3684.734/ 3684.728[2)]	
		465	1		3684.701		–	–	3684.701	3684.735/ 3684.729[2)]	
		525	1		3684.702		–	–	–	–	
		585	1		3684.703		–	–	–	–	

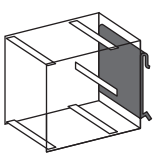
BP = for backplane C = for DIN connector PT = rail type
[1)] Front horizontal rails with 10 mm extension for injector/extractor handles (B) [2)] vented/not vented

3.5 Subracks

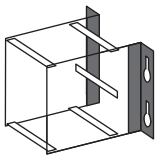
Ripac Compact, 3 U, 6 U – supply includes Page 493

											EMC version						Page
Height units U					**3**	**3**	**3**	**3**	**6**	**3**	**3**	**3**	**3**	**6**	
Horizontal pitch HP					**21**	**21**	**42**	**42**	**42**	**21**	**21**	**42**	**42**	**42**	
		D (T1) mm	D (T2) mm	Packs of	HS	MP	HS	MP	MP	HS	MP	HS	MP	MP	
2	Side panels	225	200	x	3684.512				3684.530	3684.512				3684.530	495
		285	260	x	3684.514				3684.532	3684.514				3684.532	
	PT	Attachment		Packs of	For backplane										
2		Side panels	see above	x	2	2	2	2	2	1	1	1	1	1	495
		Side panels for cable entry		x	–	–	–	–	–	1	1	1	1	1	–
		EMC PG cable gland		x	–	–	–	–	–	1	1	1	1	1	–
3		Trim sections, rear		x	4	2	4	2	2	4	2	4	2	2	497
1		Flanges with keyhole		x	–	2	–	2	2	–	2	–	2	2	–
		EMC front/rear panels		x	–	–	–	–	–	–	1	–	1	1	–
		EMC rear panel for rail adaptor		x	–	–	–	–	–	1	–	1	–	–	–
		Rear panel for rail adaptor		x	1	–	1	–	–	–	–	–	–	–	–
		Rail adaptor		x	1	–	1	–	–	1	–	1	–	–	–
		EMC gaskets, vertical		x	–	–	–	–	–	3	3	3	3	3	506
7		Covers, vented	see below	x	–	–	–	–	–	2	2	2	2	2	517
4	A	Horizontal rails, front		x	4	2	4	2	2	4	4	4	4	4	499
5	C1	Horizontal rails, rear		x	2	2	2	2	2	2	2	2	2	2	500
	I	Threaded inserts		x	4	2	4	2	2	4	4	4	4	4	504
	G	Insulating strips 21 HP		x	2	2	4	4	8	2	2	4	4	8	505
6	D1	Horizontal rails, rear, centre		x	–	–	–	–	1	–	–	–	–	1	502
Covers for Ripac Compact															
			LP mm	Packs of	**3**	**3**	**3**	**3**	**6**	**3**	**3**	**3**	**3**	**6**	Page
7		Covers, vented	160	1	3687.624		3687.625			3687.624[1)]		3687.625[1)]			517
		Covers, vented	220	1	3687.692		3687.677			3687.692[1)]		3687.677[1)]			517
	F	Z rails IEC 60 603-2 (DIN 41 612)		1	3684.599		3684.600			3684.599		3684.600			504

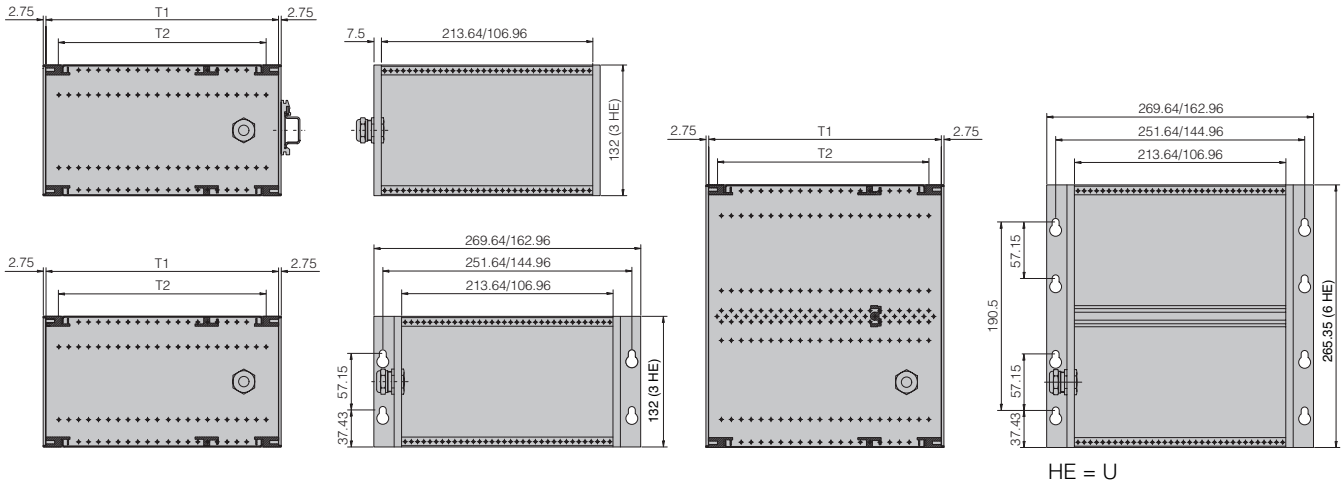
HS = top hat rail MP = mounting plate PT = rail type LP = PCB depth
[1)] Included with the supply



For top hat rail



For mounting plate



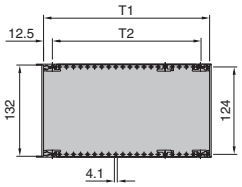
HE = U

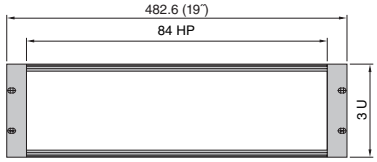
3.5 Subracks

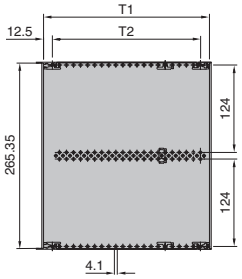
Ripac Vario Mobil 3 U, 6 U – supply includes Page 494

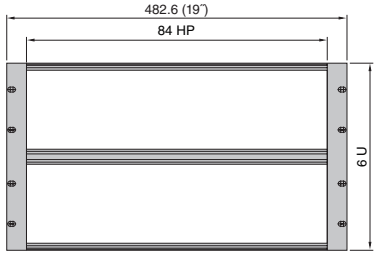
							EMC				EMC	Page
Height units U					**3**	**3**	**3**	**6**	**6**	**6**	
			D (T1) mm	D (T2) mm	Packs of	BP	C	BP	BP	C	BP	
2	Side panels		245	220	1		3684.513			3684.531		495
	PT			Model No.	Packs of							
1		Flanges		–	1		3684.615			3684.617		496
						2	2	2	2	2	2	
3		Trim sections, rear		–	1	–	–	2 3684.634	–	–	2 3684.636	497
2		Side panels		see above	1	2	2	2	2	2	2	495
		EMC gaskets, vertical		–	1	–	–	2 3686.975	–	–	2 3686.977	506
7		Covers, vented		3684.695	1	–	–	2	–	–	2	515
9		Mounting blocks		3684.234	10	–	–	20	–	–	20	507
	K	EMC gaskets for covers		3684.245	10	–	–	4	–	–	4	507
4	A	Horizontal rails, front		3684.562	1	4	4	4	4	4	4	499
	I	Threaded inserts		3684.610	1	4	4	4	4	4	4	504
5	C1	Horizontal rails, rear		3684.572	1	2	–	2	2	–	2	500
6	D1	Horizontal rails, rear, centre		3684.582	1	–	–		1	–	1	502
	G	Insulating strips 21 HP		3684.611	1	8	–	8	16	–	16	505
	C3	Horizontal rails, rear, with integral Z rails		3686.159	1	–	2	–	–	2	–	501
	D2	Horizontal rails, rear, centre, with integral Z rails		3687.602	1	–	–	–		1	–	503
		Assembly screws M4 x 12		3684.881	1	12	12	12	14	14	14	–
		Assembly screws M3 x 6		3684.883	1	–	–	60	–	–	60	–

BP = for backplane C = for DIN connector PT = rail type





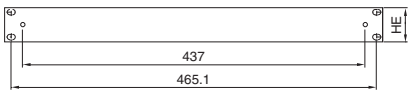


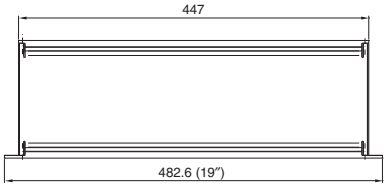


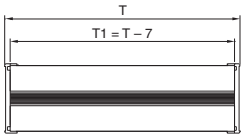
3.6 Instrument cases/system enclosures

RiBox system enclosures 1 U Page 554

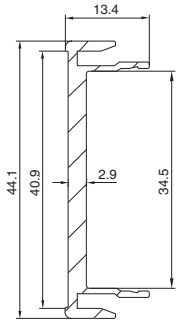
482.6 mm (19″) rack mount



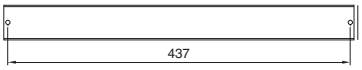


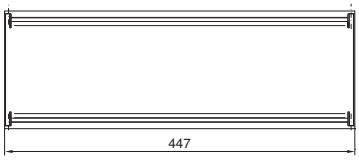


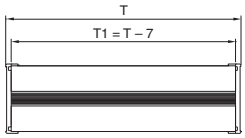
HE = U



Instrument cases







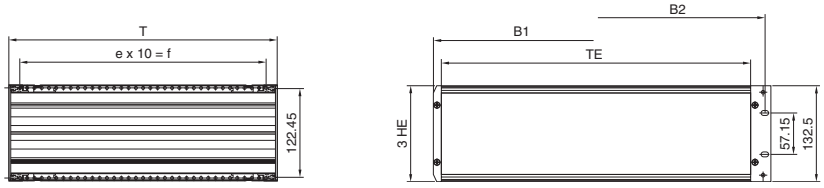
Model No. RP			D (T) mm
Instrument cases	19″ rack mount	19″ rack mount[1)]	
3687.819	**3687.814**	**–**	150
3687.820	**3687.815**	**–**	200
3687.821	**3687.816**	**3684.072**	250
3687.822	**3687.817**	**–**	300
3687.823	**3687.818**	**3684.073**	350

[1)] including assembly kit for double Euroboards

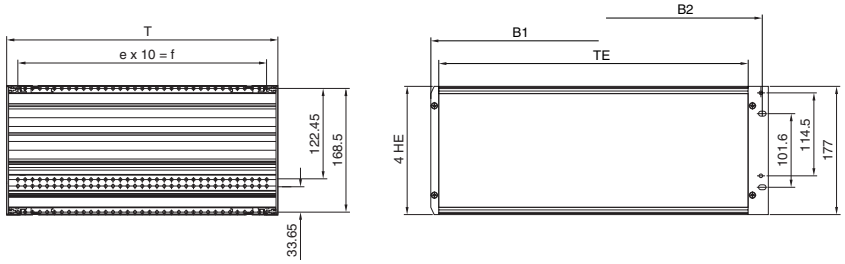
3.6 Instrument cases/system enclosures

Ripac Vario-Module Page 555 – 558

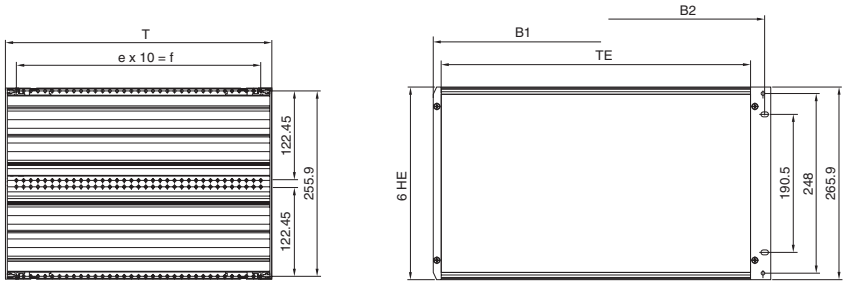
3 U



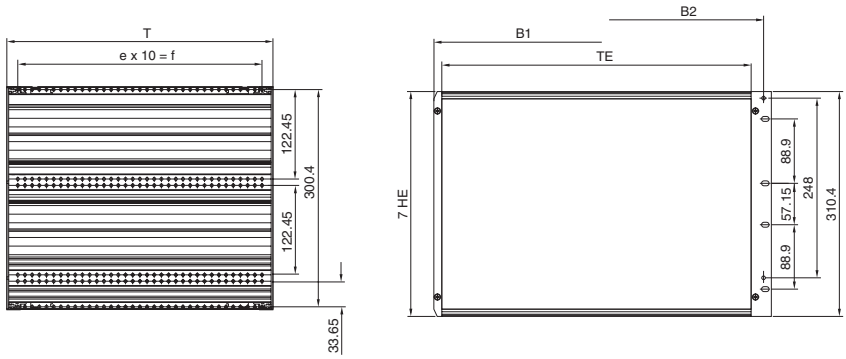
4 U



6 U



7 U



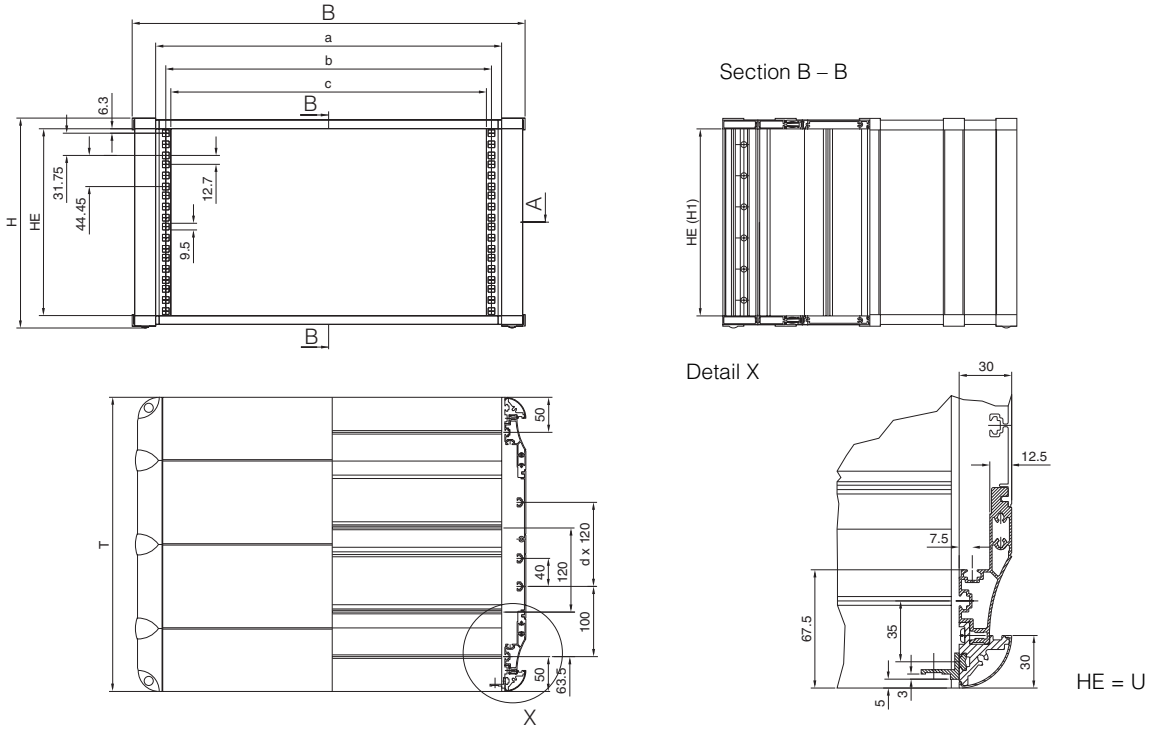
Model No. VM	U (HE)	HP (TE)	D (T) mm	e	W (B1) mm	W (B2) mm
3982.040	3	42	250.4	22	235.6	251.6
3982.070	3	42	310.4	28	235.6	251.6
3982.050	3	63	250.4	22	342.3	358.3
3982.080	3	63	310.4	28	342.3	358.3
3982.060	3	84	250.4	22	449.0	465.1
3982.090	3	84	310.4	28	449.0	465.1
3982.100	3	84	370.4	34	449.0	465.1
3982.110	4	84	250.4	22	449.0	465.1
3982.120	4	84	310.4	28	449.0	465.1
3982.130	4	84	370.4	34	449.0	465.1
3982.140	6	84	310.4	28	449.0	465.1
3982.150	6	84	370.4	34	449.0	465.1
3982.160	6	84	430.4	40	449.0	465.1
3982.170	7	84	310.4	28	449.0	465.1
3982.190	7	84	430.4	40	449.0	465.1

Model No. VM (EMC)	U (HE)	HP (TE)	D (T) mm	e	W (B1) mm	W (B2) mm
3983.040	3	42	250.4	22	235.6	251.6
3983.070	3	42	310.4	28	235.6	251.6
3983.050	3	63	250.4	22	342.3	358.3
3983.080	3	63	310.4	28	342.3	358.3
3983.060	3	84	250.4	22	449.0	465.1
3983.090	3	84	310.4	28	449.0	465.1
3983.100	3	84	370.4	34	449.0	465.1
3983.110	4	84	250.4	22	449.0	465.1
3983.120	4	84	310.4	28	449.0	465.1
3983.130	4	84	370.4	34	449.0	465.1
3983.140	6	84	310.4	28	449.0	465.1
3983.150	6	84	370.4	34	449.0	465.1
3983.160	6	84	430.4	40	449.0	465.1
3983.170	7	84	310.4	28	449.0	465.1
3983.190	7	84	430.4	40	449.0	465.1

3.6 Instrument cases/system enclosures

Rittal RiCase 269.2 mm (1/2 19″) Page 562

Rittal RiCase 482.6 mm (19″) Page 563



Rittal RiCase 269.2 mm (1/2 19″)

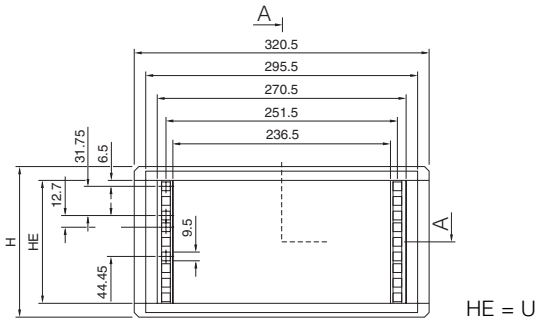
Not vented									
Model No. RC, RAL 5018	**3750.100**	**–**	**3750.200**	**–**	**3750.210**	**3750.300**	**–**	**3750.400**	**–**
Model No. RC, RAL 5012	**3750.102**	**–**	**3750.202**	**–**	**3750.212**	**3750.302**	**–**	**3750.402**	**–**
Model No. RC, RAL 7030	**3750.104**	**–**	**3750.204**	**–**	**3750.214**	**3750.304**	**–**	**3750.404**	**–**
Vented									
Model No. RC, RAL 5018	**–**	**3750.110**	**–**	**3750.220**	**–**	**3750.350**	**3750.360**	**–**	**3750.450**
Model No. RC, RAL 5012	**–**	**3750.112**	**–**	**3750.222**	**–**	**3750.352**	**3750.362**	**–**	**3750.452**
Model No. RC, RAL 7030	**–**	**3750.114**	**–**	**3750.224**	**–**	**3750.354**	**3750.364**	**–**	**3750.454**
U	1		2		3			4	
Width (B) mm	348.6	348.6	348.6	348.6	348.6	348.6	348.6	348.6	348.6
Height (H) mm	77.5	77.5	121.9	121.9	166.4	166.4	166.4	210.8	210.8
H1 (HE) mm	45.0	45.0	89.4	89.4	133.8	133.8	133.8	178.3	178.3
Depth (T) mm	300.0	420.0	300.0	540.0	300.0	420.0	540.0	420.0	540.0
a	280.6	280.6	280.6	280.6	280.6	280.6	280.6	280.6	280.6
b	251.6	251.6	251.6	251.6	251.6	251.6	251.6	251.6	251.6
c	237.2	237.2	237.2	237.2	237.2	237.2	237.2	237.2	237.2
d	–	1	–	2	–	1	2	1	2

Rittal RiCase 482.6 mm (19″)

Not vented												
Model No. RC, RAL 5018	**3750.310**	**3750.320**	**3750.410**	**3750.420**	**3750.600**	**3750.610**	**3750.620**	**3750.700**	**3750.710**	**3750.900**	**3750.910**	**3750.000**
Model No. RC, RAL 5012	**3750.312**	**3750.322**	**3750.412**	**3750.422**	**3750.602**	**3750.612**	**3750.622**	**3750.702**	**3750.712**	**3750.902**	**3750.912**	**3750.002**
Model No. RC, RAL 7030	**3750.314**	**3750.324**	**3750.414**	**3750.424**	**3750.604**	**3750.614**	**3750.624**	**3750.704**	**3750.714**	**3750.904**	**3750.914**	**3750.004**
Vented												
Model No. RC, RAL 5018	**3750.330**	**3750.340**	**3750.430**	**3750.440**	**3750.630**	**3750.640**	**3750.650**	**3750.720**	**3750.730**	**3750.920**	**3750.930**	**3750.030**
Model No. RC, RAL 5012	**3750.332**	**3750.342**	**3750.432**	**3750.442**	**3750.632**	**3750.642**	**3750.652**	**3750.722**	**3750.732**	**3750.922**	**3750.932**	**3750.032**
Model No. RC, RAL 7030	**3750.334**	**3750.344**	**3750.434**	**3750.444**	**3750.634**	**3750.644**	**3750.654**	**3750.724**	**3750.734**	**3750.924**	**3750.934**	**3750.034**
U	3		4		6			7		9		12
Width (B) mm	562.0	562.0	562.0	562.0	562.0	562.0	562.0	562.0	562.0	562.0	562.0	562.0
Height (H) mm	166.4	166.4	210.8	210.8	299.7	299.7	299.7	344.2	344.2	433.1	433.1	566.5
H1 (HE) mm	133.8	133.8	178.3	178.3	267.2	267.2	267.2	311.7	311.7	400.6	400.6	534.0
Depth (T) mm	300.0	420.0	300.0	420.0	300.0	420.0	540.0	420.0	540.0	420.0	540.0	540.0
a	494.0	494.0	494.0	494.0	494.0	494.0	494.0	494.0	494.0	494.0	494.0	494.0
b	465.0	465.0	465.0	465.0	465.0	465.0	465.0	465.0	465.0	465.0	465.0	465.0
c	450.6	450.6	450.6	450.6	450.6	450.6	450.6	450.6	450.6	450.6	450.6	450.6
d	–	1	–	1	–	1	2	1	2	1	2	2

3.6 Instrument cases/system enclosures

Rittal Vario-Case iS 269.2 mm (1/2 19″) Page 569



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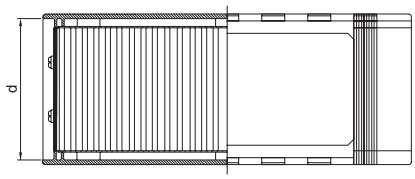

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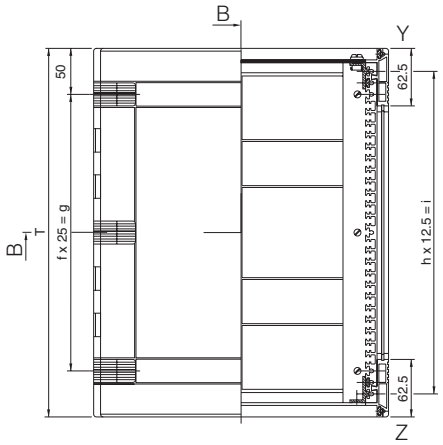
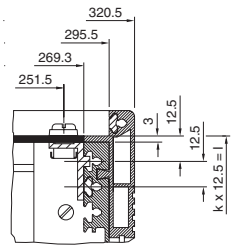
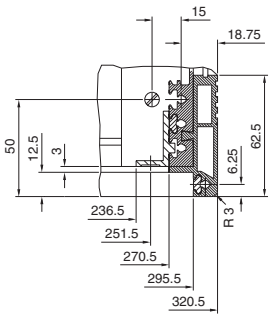


Detail Y



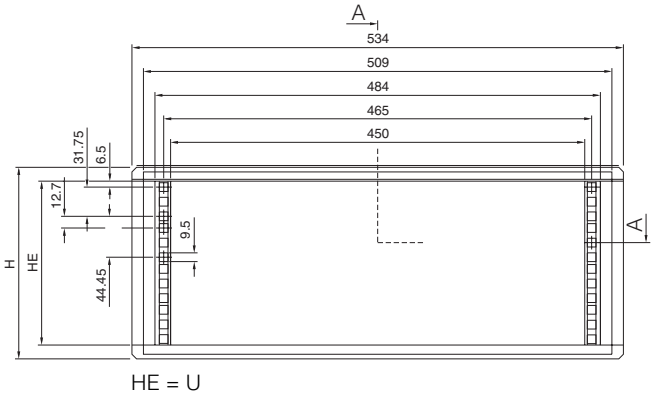
Detail Z



Model No. VC without vent slots	3710.000	3720.000	3730.000	3731.000	3740.000	3741.000
U	1	2	3		4	
Depth (T) mm	300	300	300	400	300	400
Height (H) mm	74.75	119.20	163.65	163.65	208.10	208.10
d	64.75	109.20	153.65	153.65	198.10	198.10
f	8	8	8	12	8	12
g	200	200	200	300	200	300
h	20	20	20	28	20	28
i	250	250	250	350	250	350
k	22	22	22	30	22	30
l	275	275	275	375	275	375

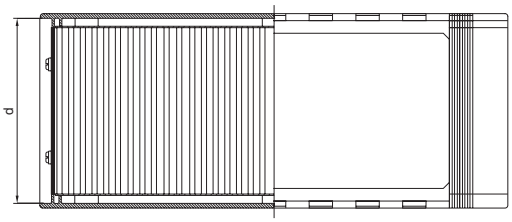
3.6 Instrument cases/system enclosures

Rittal Vario-Case iS 482.6 mm (19″) Page 570 – 571.

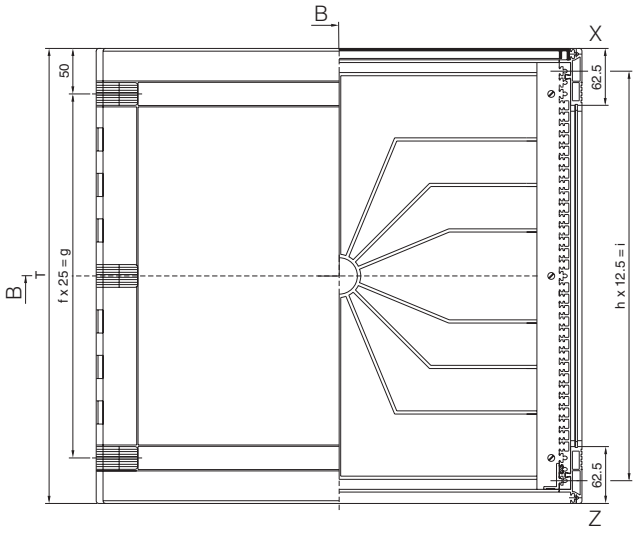


HE = U

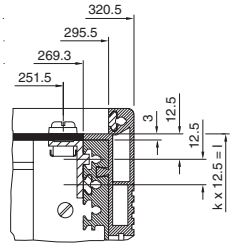
Section B – B



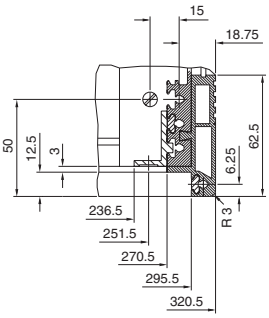
Section A – A



Detail Y



Detail Z



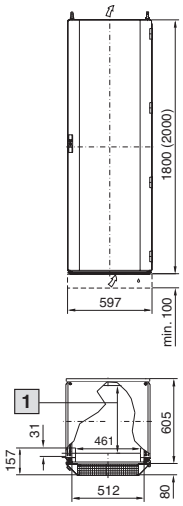
Model No. VC without vent slots	3713.000	3714.000	3743.000	3744.000	3745.000	3774.000	3775.000
Model No. VC with vent slots	**3713.200**	**3714.200**	**3743.200**	**3744.200**	**3745.200**	**3774.200**	**3775.200**
U	1		4			7	
Depth (T) mm	300	400	300	400	500	400	500
Height (H) mm	74.75	74.75	208.10	208.10	208.10	341.40	341.40
d	64.75	64.75	198.10	198.10	198.10	331.40	331.40
f	8	12	8	12	16	12	16
g	200	300	200	300	400	300	400
h	20	28	20	28	36	28	36
i	250	350	250	350	450	350	450
k	22	30	22	30	38	30	38
l	275	375	275	375	475	375	475

Model No. VC without vent slots	3733.000	3734.000	3735.000	3763.000	3764.000	3765.000	3794.000	3795.000
Model No. VC with vent slots	**3733.200**	**3734.200**	**3735.200**	**3763.200**	**3764.200**	**3765.200**	**3794.200**	**3795.200**
U	3			6			9	
Depth (T) mm	300	400	500	300	400	500	400	500
Height (H) mm	163.65	163.65	163.65	297.00	297.00	297.00	430.50	430.50
d	153.65	153.65	153.65	287.00	287.00	287.00	420.50	420.50
f	8	12	16	8	12	16	12	16
g	200	300	400	200	300	400	300	400
h	20	28	36	20	28	36	28	36
i	250	350	450	250	350	450	350	450
k	22	30	38	22	30	38	30	38
l	275	375	475	275	375	475	375	475

4.1 Climate controlled enclosures

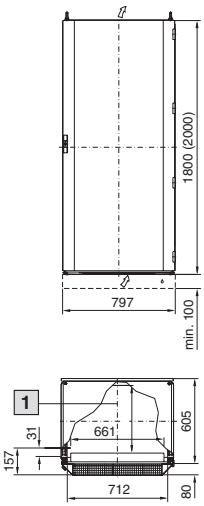
single-door, useful cooling output 1100/1500 W Page 582

1100 W



1 max. installation depth = 478

1500 W

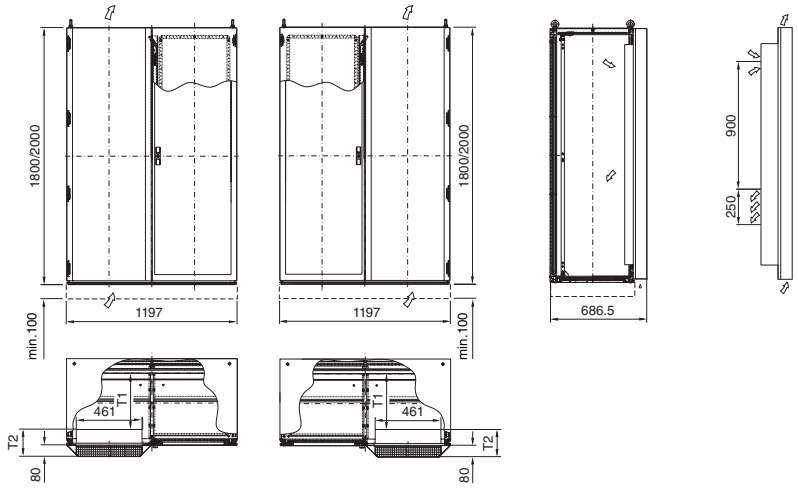


1 max. installation depth = 478

two-door, useful cooling output 2000/2500 W Page 583

Device position left

Device position right



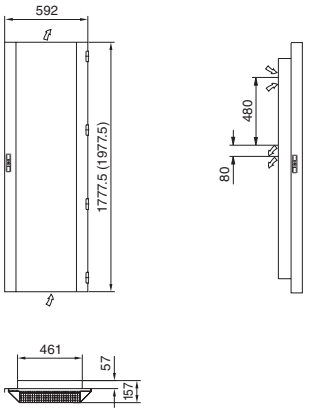
	2000 W	2500 W
D (T1) max.	445	415
D (T2)	190	220

4.1 Climate control doors

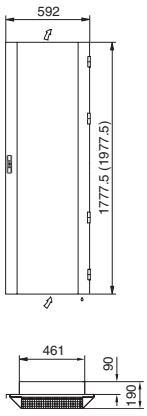
for installing in 600 mm wide TS 8 enclosures, useful cooling output 1100/1500 W Page 584

for installing in 600 mm wide TS 8 enclosures, useful cooling output 2000/2500 W Page 586

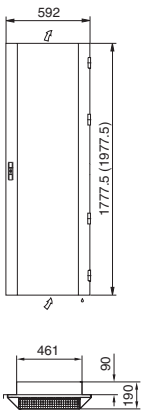
1100 W



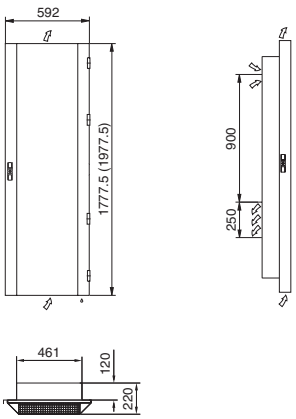
1500 W



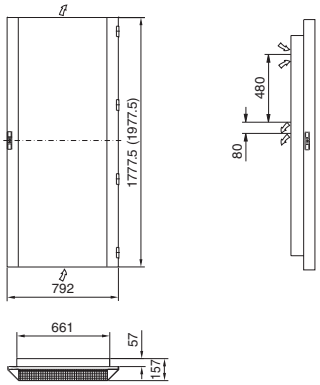
2000 W



2500 W



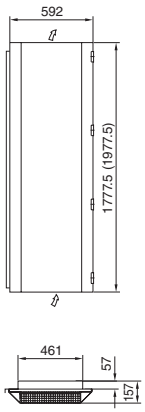
for installing in 800 mm wide TS 8 enclosures, useful cooling output 1500 W Page 585



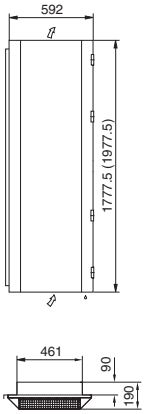
for installing in 1200 mm wide TS 8 enclosures, useful cooling output 1100/1500 W Page 587

for installing in 1200 mm wide TS 8 enclosures, useful cooling output 2000/2500 W Page 588

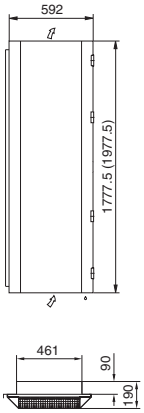
1100 W



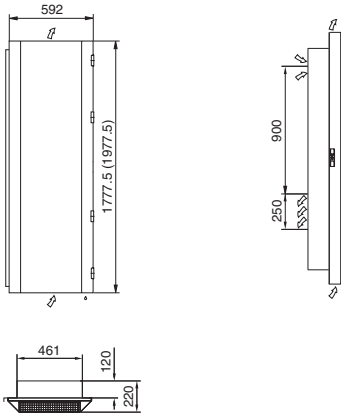
1500 W



2000 W



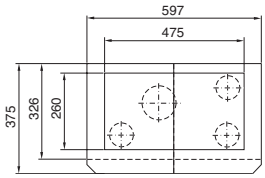
2500 W

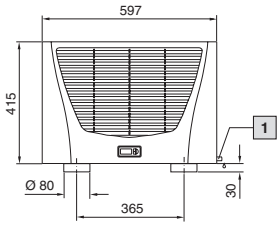


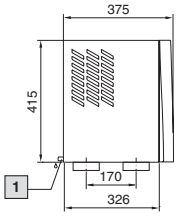
4.1 Roof-mounted cooling units

Useful cooling output 500/750 W Page 590

Mounting cutout







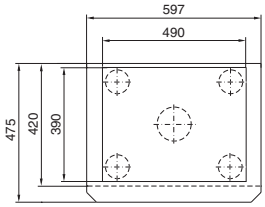
1 Condensate discharge 1/2″, flexible

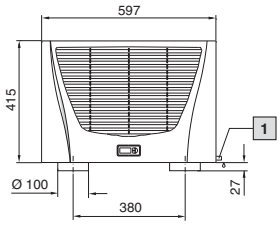
Useful cooling output 1000 W Page 591

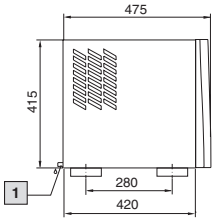
Useful cooling output 1100 W Page 592

Useful cooling output 1500/2000 W Page 593

Mounting cutout



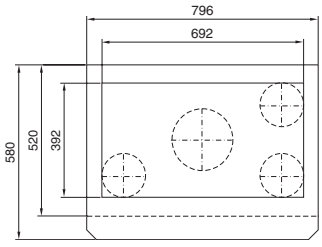


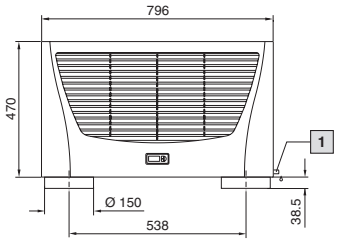


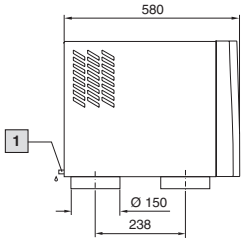
1 Condensate discharge 1/2″, flexible

Useful cooling output 3000/4000 W Page 594

Mounting cutout





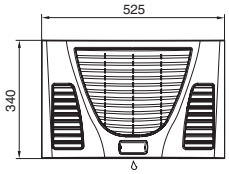


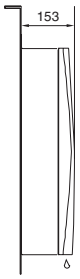
1 Condensate discharge 1/2″, flexible

4.1 Wall-mounted cooling units

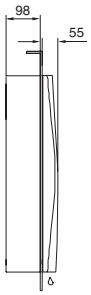
Mini in horizontal format, useful cooling output 300 W Page 596

External mounting

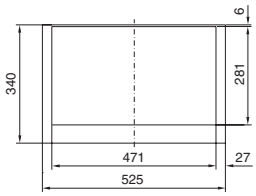




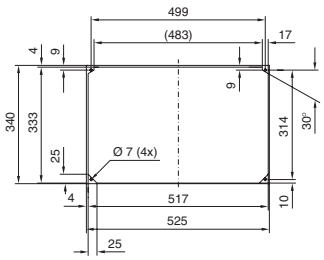
Internal mounting



Mounting cutout External mounting

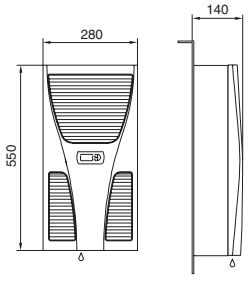


Mounting cutout Internal mounting

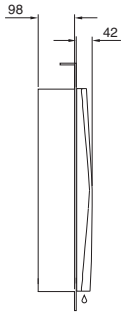


Useful cooling output 300 W Page 597

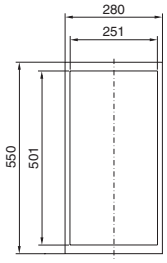
External mounting



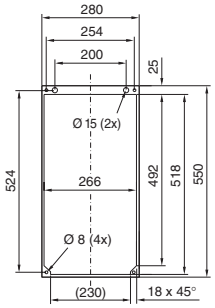
Internal mounting



Mounting cutout External mounting



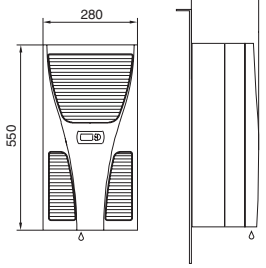
Mounting cutout Internal mounting

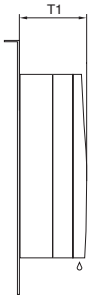


Useful cooling output 500 W Page 597

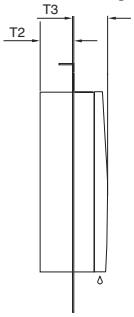
Useful cooling output 750 W Page 598

External mounting

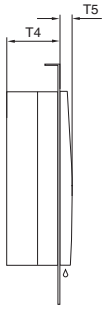




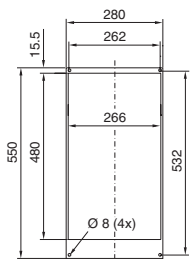
Partial internal mounting



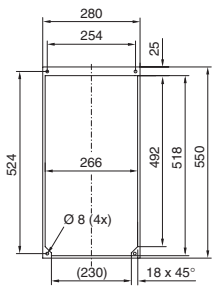
Internal mounting



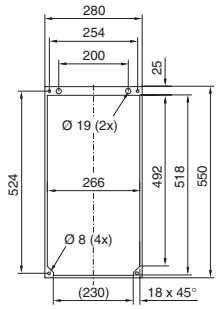
Mounting cutout External mounting



Mounting cutout Partial internal mounting



Mounting cutout Internal mounting



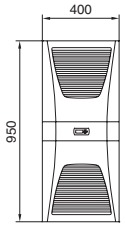
	D (T1)	D (T2)	D (T3)	D (T4)	D (T5)
500 W	200	100	100	158	42
750 W	280	125	155	235	45

Wall-mounted cooling units

4.1 Wall-mounted cooling units

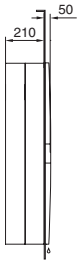
Useful cooling output 1500/2000 W Page 599

External mounting

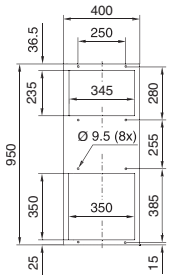


Partial internal mounting

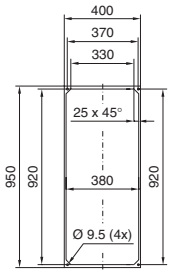
Internal mounting



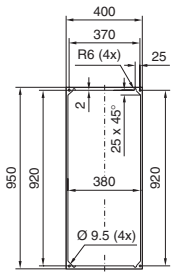
Mounting cutout External mounting



Mounting cutout Partial internal mounting

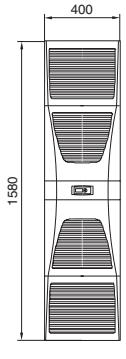


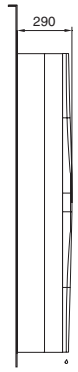
Mounting cutout Internal mounting



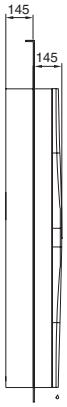
Useful cooling output 1500/2000 W Page 600

External mounting

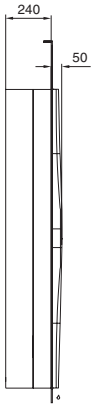




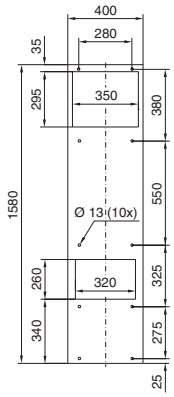
Partial internal mounting



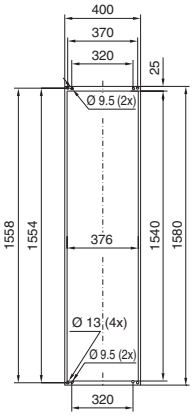
Internal mounting[1)]



Mounting cutout External mounting



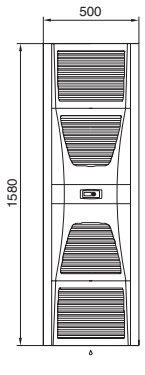
Mounting cutout Partial internal mounting, internal mounting

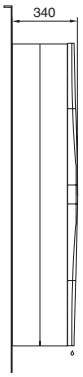


[1)] For installation in 600 mm wide doors, move the mounting cutout from the centre of the door to the hinged side by at least 10 mm.

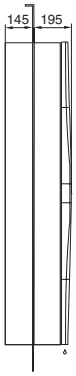
Useful cooling output 4000 W Page 601

External mounting

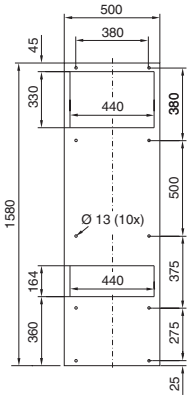




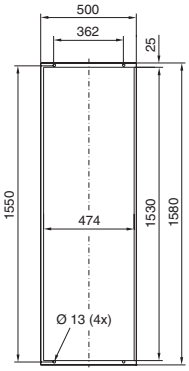
Partial internal mounting



Mounting cutout External mounting

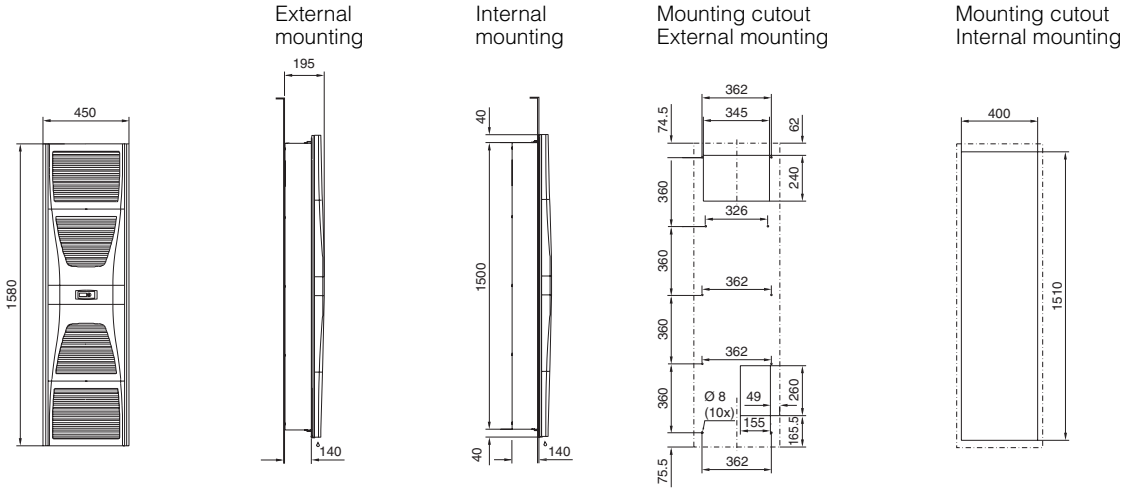


Mounting cutout Partial internal mounting

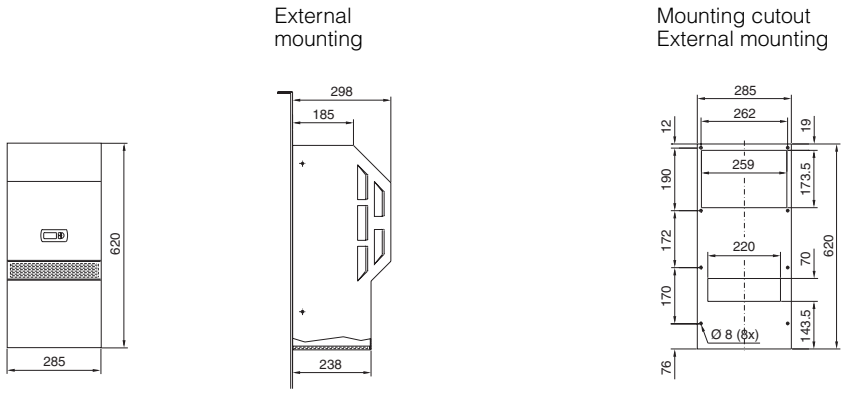


4.1 Wall-mounted cooling units

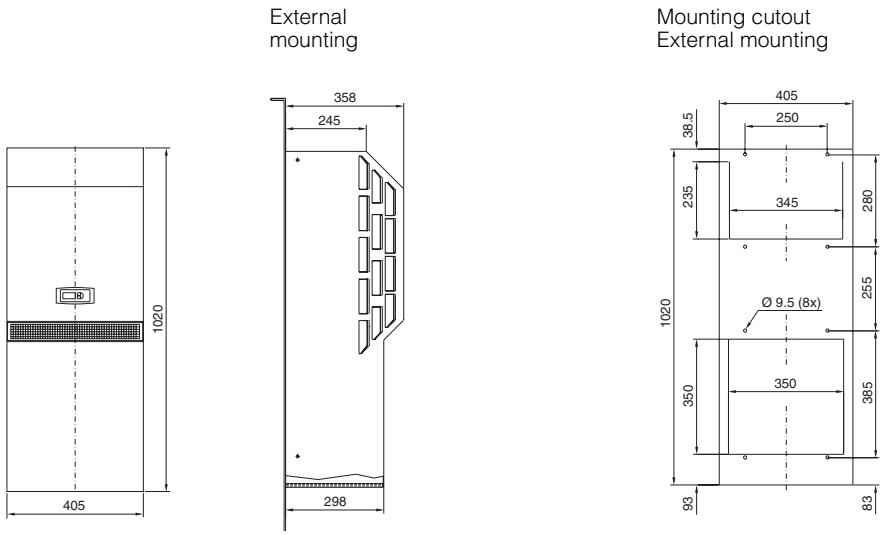
Useful cooling output 1500 W Page 602
(SK 3366.XXX and SK 3377.XXX)



Design NEMA 4x, useful cooling output 500 W Page 603



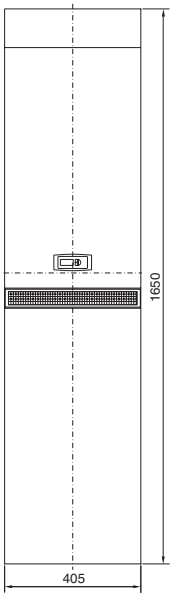
Design NEMA 4x, useful cooling output 1000/1500 W Page 603

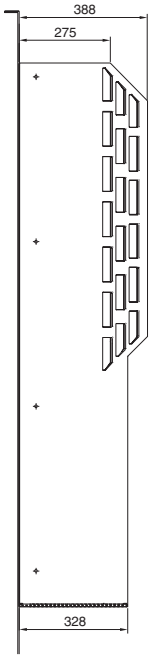


4.1 Wall-mounted cooling units

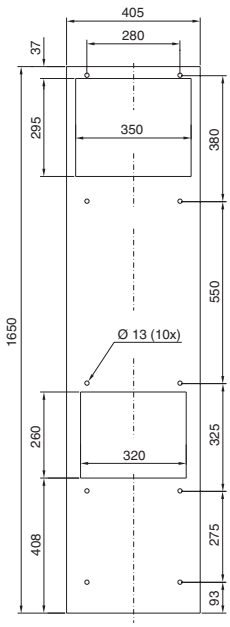
Design NEMA 4x, useful cooling output 2000/2500 W Page 604

External mounting





Mounting cutout
External mounting



4.2 Options for recooling systems

	Pressure-sealed system	Open system with tank	Designed as a once-through cooler without tank	Hot gas bypass control in the cooling circuit	More powerful pump(s)	Heater in the tank (1000 W)	Water level switch	Flow monitor	Water filter/oil filter	Water-cooled condenser	Upstream pipework, free from non-ferrous metals	Automatic tank filling	Fault signal with individual messages	Ambient temperature control	Automatic bypass	Manual bypass	Harting connector	Outdoor siting	Special spray finish	Special voltage	Metal filter mat	Castors	Refrigerant R134a	Double pump unit	Filter mat monitoring	Base tray	Tank (stainless steel 1.4301)	Additional medium connections
Recooling systems Mini and Mini for wall mounting																												
SK 3318.600	■	–	■	–	□	–	–	■	–	□	□	–	–	□	–	□	□	□	□	□	□	□	■	–	■	–	–	–
SK 3318.610	–	■	–	–	□	–	–	■	–	□	□	–	–	□	–	□	□	□	□	□	□	□	■	–	■	–	–	–
SK 3319.600	■	–	■	–	□	–	–	■	–	□	□	–	–	□	–	□	□	□	□	□	□	□	■	–	■	–	–	–
SK 3319.610	–	■	–	–	□	–	–	■	–	□	□	–	–	□	–	□	□	□	□	□	□	□	■	–	■	–	–	–
SK 3320.600	–	■	–	□	□	□	□	■	–	□	□	–	–	□	□	□	□	□	□	□	□	□	■	–	■	–	■	–
SK 3334.600	–	■	–	□	□	□	□	■	–	□	□	–	–	□	□	□	□	□	□	□	□	□	■	–	■	–	■	–
SK 3360.100	–	■	–	□	□	–	□	■	–	□	□	–	–	□	–	□	□	–	□	□	□	–	■	–	■	–	–	–
SK 3360.250	–	■	–	□	□	–	□	■	–	□	□	–	–	□	–	□	□	–	□	□	□	–	■	–	■	–	–	–
SK 3360.400	–	■	–	□	□	–	□	■	–	□	□	–	–	□	–	□	□	–	□	□	□	–	■	–	■	–	–	–
Recooling systems in floor-standing enclosure and industrial enclosure																												
SK 3336.100	–	■	□	□	□	□	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	■	–	–	–	■	□
SK 3336.200	–	■	□	□	□	□	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	■	–	–	–	■	□
SK 3336.300	–	■	□	□	□	□	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	■	–	–	–	■	□
SK 3336.500	–	■	□	□	□	□	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	■	–	–	–	■	□
SK 3336.600	–	■	□	□	□	□	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	■	–	–	–	■	□
SK 3336.650	–	■	□	□	□	□	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	■	–	–	–	■	□
SK 3336.700	–	■	□	□	□	□	□	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□	–	–	–	–	■	□
SK 3336.710	–	■	□	□	□	□	□	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□	–	–	–	–	■	□
SK 3336.720	–	■	□	□	□	□	□	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□	–	–	–	–	■	□
SK 3336.730	–	■	□	□	□	□	□	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□	–	–	–	–	■	□
SK 3336.740	–	■	□	□	□	□	□	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□	–	–	–	–	■	□
SK 3336.750	–	■	□	□	□	□	□	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□	–	–	–	–	■	□
SK 3339.100	–	■	□	□	□	□	□	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□	–	–	–	–	■	□
SK 3339.200	–	■	□	□	□	□	□	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□	–	–	–	–	■	□
SK 3339.300	■	–	■	□	□	□	□	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□	–	–	–	–	–	□
SK 3339.400	■	–	■	□	□	□	□	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□	–	–	–	–	–	□
SK 3339.500	■	–	■	□	□	□	□	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□	–	–	–	–	–	□
Recooling systems in a floor standing enclosure for oil																												
SK 3337.200	■	□	■	□	□	□	–	□	□	–	–	–	□	□	–	–	□	□	□	□	□	□	–	–	–	–	□	□
SK 3337.300	■	□	■	□	□	□	–	□	□	–	–	–	□	□	–	–	□	□	□	□	□	□	–	–	–	–	□	□
SK 3337.500	■	□	■	□	□	□	–	□	□	–	–	–	□	□	–	–	□	□	□	□	□	□	–	–	–	–	□	□
SK 3337.600	■	□	■	□	□	□	–	□	□	–	–	–	□	□	–	–	□	□	□	□	□	□	–	–	–	–	□	□
SK 3337.650	■	□	■	□	□	□	–	□	□	–	–	–	□	□	–	–	□	□	□	□	□	□	–	–	–	–	□	□
SK 3337.700	■	□	■	□	□	□	–	□	□	–	–	–	□	□	–	–	□	□	□	□	□	□	–	–	–	–	□	□
SK 3337.710	■	□	■	□	□	□	–	□	□	–	–	–	□	□	–	–	□	□	□	□	□	□	–	–	–	–	□	□
SK 3337.720	■	□	■	□	□	□	–	□	□	–	–	–	□	□	–	–	□	□	□	□	□	□	–	–	–	–	□	□
SK 3337.730	■	□	■	□	□	□	–	□	□	–	–	–	□	□	–	–	□	□	□	□	□	□	–	–	–	–	□	□
SK 3337.740	■	□	■	□	□	□	–	□	□	–	–	–	□	□	–	–	□	□	□	□	□	□	–	–	–	–	□	□
SK 3337.750	■	□	■	□	□	□	–	□	□	–	–	–	□	□	–	–	□	□	□	□	□	□	–	–	–	–	□	□
Recooling systems in the TS 8 Top enclosure system																												
SK 3335.060	–	■	–	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	–
SK 3335.075	–	■	–	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	–
SK 3335.100	–	■	–	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	–
SK 3335.120	–	■	–	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	–
SK 3335.150	–	■	–	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	–
SK 3335.200	–	■	–	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	–
SK 3335.250	–	■	–	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	–

■ Standard
□ Optional

Recooling systems

4.2 Options for recooling systems

	Water-cooled condenser	Radial fan	Hot gas bypass control in the cooling circuit	Harting connector	Special spray finish	Special voltage	Ambient temperature control	Control voltage 24 V DC	Liquid injection valve	Fault signal "Filter mat dirty"	Immersion depth 650 mm	Immersion depth 750 mm	Immersion depth 850 mm	Immersion depth 1000 mm
Immersible recooling systems														
SK 3338.020	□	□	□	□	□	□	□	■	□	□	□	□	□	□
SK 3338.040	□	□	□	□	□	□	□	■	□	□	□	□	□	□
SK 3338.060	□	□	□	□	□	□	□	■	□	□	□	□	□	□
SK 3338.080	□	□	□	□	□	□	□	■	□	□	□	□	□	□
SK 3338.100	□	□	□	□	□	□	□	□	□	□	□	□	□	□
SK 3338.120	□	□	□	□	□	□	□	□	□	□	□	□	□	□
SK 3338.140	□	□	□	□	□	□	□	□	□	□	□	□	□	□
SK 3338.160	□	□	□	□	□	□	□	□	□	□	□	□	□	□
SK 3338.180	□	□	□	□	□	□	□	□	□	□	□	□	□	□
SK 3338.200	□	□	□	□	□	□	□	□	□	□	□	□	□	□
SK 3338.220	□	□	□	□	□	□	□	□	□	□	□	□	□	□
SK 3338.220	□	□	□	□	□	□	□	□	□	□	□	□	□	□
SK 3338.240	□	□	□	□	□	□	□	□	□	□	□	□	□	□
SK 3338.260	□	□	□	□	□	□	□	□	□	□	□	□	□	□
SK 3338.280	□	□	□	□	□	□	□	□	□	□	□	□	□	□
SK 3338.300	□	□	□	□	□	□	□	□	□	□	□	□	□	□
SK 3338.320	□	□	□	□	□	□	□	□	□	□	□	□	□	□
SK 3338.340	□	□	□	□	□	□	□	□	□	□	□	□	□	□
SK 3338.360	□	□	□	□	□	□	□	□	□	□	□	□	□	□
SK 3338.500	□	□	□	□	□	□	□	■	□	□	□	□	□	□
SK 3338.520	□	□	□	□	□	□	□	■	□	□	□	□	□	□
SK 3338.540	□	□	□	□	□	□	□	■	□	□	□	□	□	□
SK 3338.560	□	□	□	□	□	□	□	■	□	□	□	□	□	□
SK 3338.580	□	□	□	□	□	□	□	□	□	□	□	□	□	□
SK 3338.600	□	□	□	□	□	□	□	□	□	□	□	□	□	□
SK 3338.620	□	□	□	□	□	□	□	□	□	□	□	□	□	□
SK 3338.640	□	□	□	□	□	□	□	□	□	□	□	□	□	□
SK 3338.660	□	□	□	□	□	□	□	□	□	□	□	□	□	□
SK 3338.680	□	□	□	□	□	□	□	□	□	□	□	□	□	□
SK 3338.700	□	□	□	□	□	□	□	□	□	□	□	□	□	□
SK 3338.720	□	□	□	□	□	□	□	□	□	□	□	□	□	□
SK 3338.740	□	□	□	□	□	□	□	□	□	□	□	□	□	□
SK 3338.760	□	□	□	□	□	□	□	□	□	□	□	□	□	□
SK 3338.780	□	□	□	□	□	□	□	□	□	□	□	□	□	□
SK 3338.800	□	□	□	□	□	□	□	□	□	□	□	□	□	□
SK 3338.800	□	□	□	□	□	□	□	□	□	□	□	□	□	□
SK 3338.820	□	□	□	□	□	□	□	□	□	□	□	□	□	□
SK 3338.840	□	□	□	□	□	□	□	□	□	□	□	□	□	□

■ Standard
□ Optional

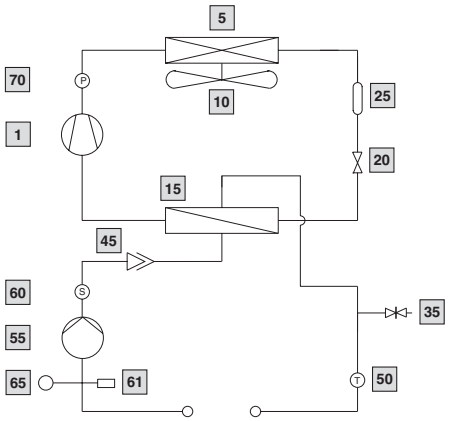
4.2 Recooling systems

Mini, cooling output 960/1490 W Page 608

Key to the adjacent drawing:

- 1 Compressor
- 5 Condenser
- 10 Condenser fan
- 15 Evaporator coil
- 20 Expansion valve
- 25 Filter dryer
- 35 Filling
- 45 Vent valve
- 50 Temperature sensor
- 55 Pump
- 60 Flow monitor
- 61 Overpressure valve
- 65 Pressure relief valve
- 70 High-pressure switch

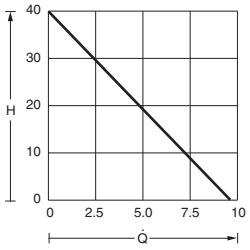
Layout diagram



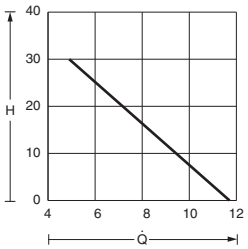
Note:
With a lockable external cooling cycle, a bypass (overpressure valve) should be provided in the external water pipes.

Characteristic curves of pump
Model No. SK
3318.600/3318.610/
3319.600/3319.610

50 Hz



60 Hz



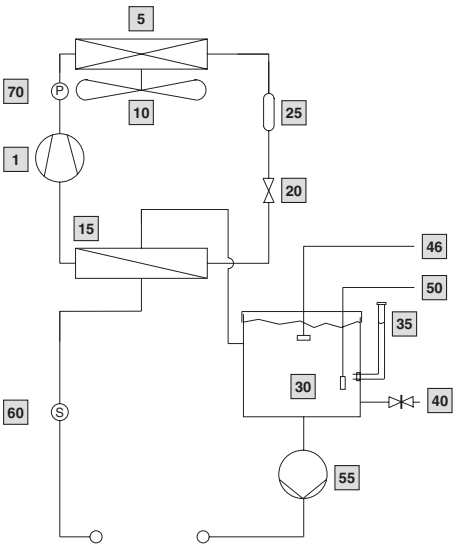
H = Delivery head H [m]
Q̇ = Delivery flow Q [l/min]

Mini, cooling output 3000/4500 W Page 609

Key to the adjacent drawing:

- 1 Compressor
- 5 Condenser
- 10 Condenser fan
- 15 Evaporator coil
- 20 Expansion valve
- 25 Filter dryer
- 30 Tank
- 35 Filling
- 40 Tank drain
- 46 Water level switch, optional
- 50 Temperature sensor
- 55 Pump
- 60 Flow monitor
- 70 High-pressure switch

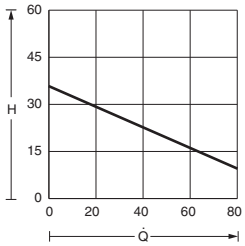
Layout diagram



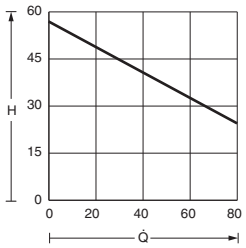
Note:
With a lockable external cooling cycle, a bypass (overpressure valve) should be provided in the external water pipes.

Characteristic curves of pump
Model No. SK
3320.600/3334.600

50 Hz



60 Hz



H = Delivery head H [m]
Q̇ = Delivery flow Q [l/min]

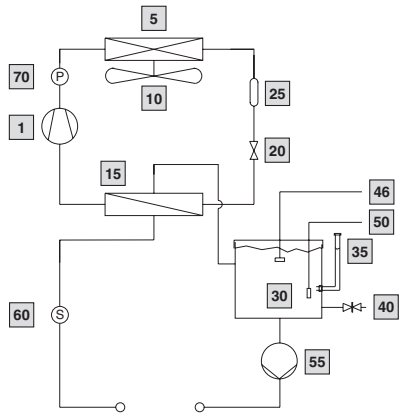
4.2 Recooling systems

Mini, for wall mounting, cooling output 1000/2500/4000 W Page 610

Key to the adjacent drawing:

- 1 Compressor
- 5 Condenser
- 10 Condenser fan
- 15 Evaporator coil
- 20 Expansion valve
- 25 Filter dryer
- 30 Tank
- 35 Filling
- 40 Tank drain
- 46 Water level switch, optional
- 50 Temperature sensor
- 55 Pump
- 60 Flow monitor
- 70 High-pressure switch

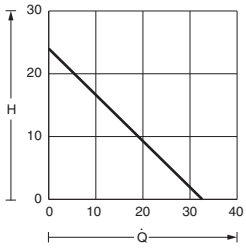
Layout diagram



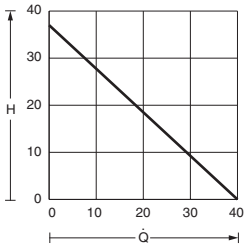
Note:
With a lockable external cooling cycle, a bypass (overpressure valve) should be provided in the external water pipes.

Characteristic curves of pump
Model No. SK 3360.100/3360.250/ 3360.400

50 Hz



60 Hz



H = Delivery head H [m]
Q̇ = Delivery flow Q [l/min]

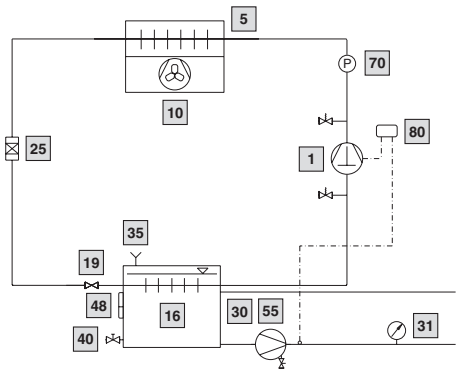
In floor-standing enclosure, cooling output 2100 to 7700 W Page 611

Key to the adjacent drawing:

- 1 Compressor
- 5 Condenser
- 10 Condenser fan
- 16 Multi-coil vaporiser
- 19 Capillary tube/expansion valve[1)]
- 25 Filter dryer
- 30 Tank
- 31 Manometer
- 35 Filling
- 40 Tank drain
- 48 Level indicator
- 55 Pump
- 70 High-pressure switch
- 80 Thermostat

[1)] from SK 3336.500

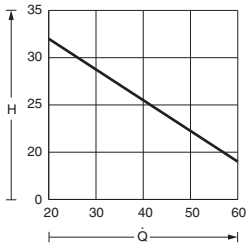
Layout diagram



Note:
With a lockable external cooling cycle, a bypass (overpressure valve) should be provided in the external water pipes.

Characteristic curves of pump
Model No. SK 3336.100/3336.200/3336.300/ 3336.500/3336.600/3336.650

50 Hz



H = Delivery head H [m]
Q̇ = Delivery flow Q [l/min]

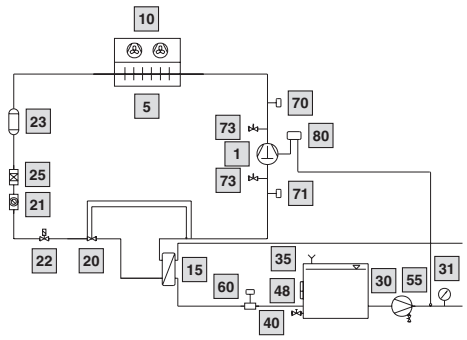
4.2 Recooling systems

In floor-standing enclosure, cooling output 10000 to 25200 W Page 612

Key to the adjacent drawing:

1 Compressor
5 Condenser
10 Condenser fan
15 Evaporator coil
20 Expansion valve
21 Inspection glass
22 Magnetic valve
23 Liquid collector
25 Filter dryer
30 Tank
31 Manometer
35 Filling
40 Tank drain
48 Level indicator
55 Pump
60 Flow monitor
70 High-pressure switch
71 Low-pressure switch
73 Shut-off valve
80 Thermostat

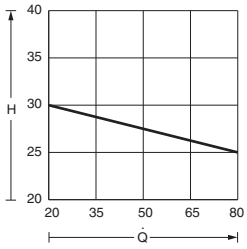
Layout diagram



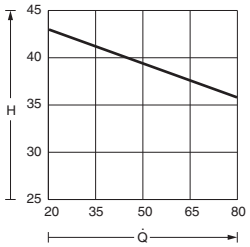
Note:
With a lockable external cooling cycle, a bypass (overpressure valve) should be provided in the external water pipes.

Characteristic curves of pump
Model No. SK
3336.700/3336.710/3336.720

50 Hz

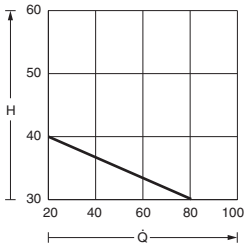


60 Hz

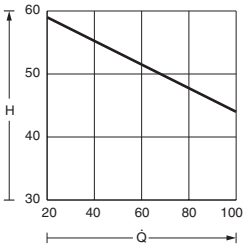


Model No. SK
3336.730/3336.740/3336.750

50 Hz



60 Hz



H = Delivery head H [m]
Q̇ = Delivery flow Q [l/min]

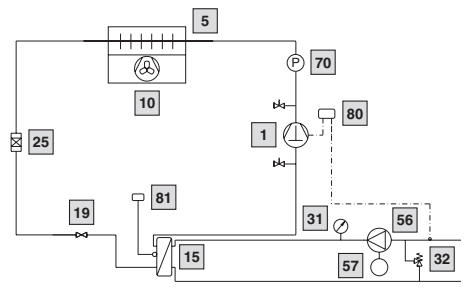
In floor-standing enclosure for oil, cooling output 2550 to 7900 W Page 613

Key to the adjacent drawing:

1 Compressor
5 Condenser
10 Condenser fan
15 Evaporator coil
19 Capillary tube/expansion valve[1)]
25 Filter dryer
31 Manometer
32 Automatic bypass valve
56 Oil pump
57 Motor for oil pump
70 High-pressure switch
80 Thermostat
81 Anti-frost thermostat

[1)] from SK 3337.500

Layout diagram



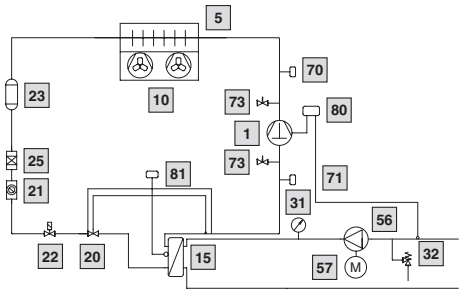
4.2 Recooling systems

In floor-standing enclosure for oil, cooling output 10600 to 26100 W Page 614

Key to the adjacent drawing:

- 1 Compressor
- 5 Condenser
- 10 Condenser fan
- 15 Evaporator coil
- 20 Expansion valve
- 21 Inspection glass
- 22 Magnetic valve
- 23 Liquid collector
- 25 Filter dryer
- 31 Manometer
- 32 Automatic bypass valve
- 56 Oil pump
- 57 Motor for oil pump
- 70 High-pressure switch
- 71 Low-pressure switch
- 73 Shut-off valve
- 80 Thermostat
- 81 Anti-frost thermostat

Layout diagram

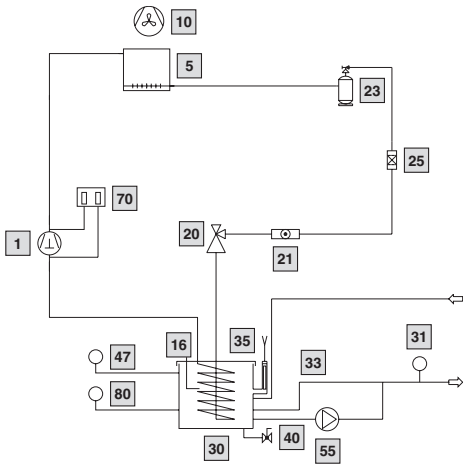


In TS 8 Top enclosure system, cooling output 6000/7500 W Page 615

Key to the adjacent drawing:

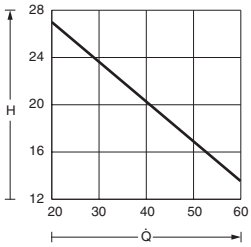
- 1 Compressor
- 5 Condenser
- 10 Condenser fan
- 16 Multi-coil vaporiser
- 20 Expansion valve
- 21 Inspection glass
- 23 Liquid collector
- 25 Filter dryer
- 30 Tank
- 31 Manometer
- 33 Fixed pump bypass
- 35 Filling
- 40 Tank drain
- 47 Level switch
- 55 Pump
- 70 High-pressure switch
- 80 Thermostat

Layout diagram



Characteristic curves of pump
Model No. SK 3335.060/3335.075

50 Hz



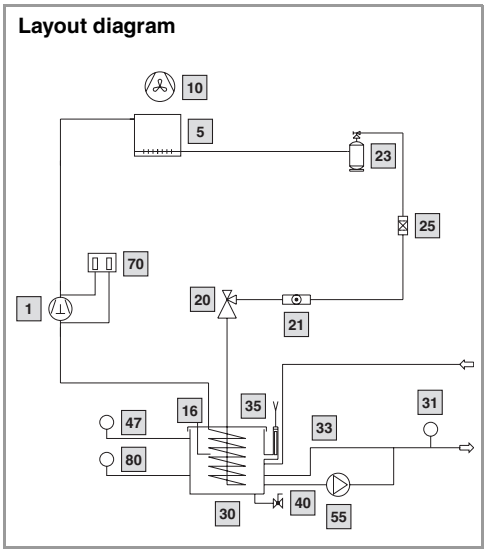
H = Delivery head H [m]
Q̇ = Delivery flow Q [l/min]

In TS 8 Top enclosure system, cooling output 10000 to 25000 W Page 616

Key to the adjacent drawing:

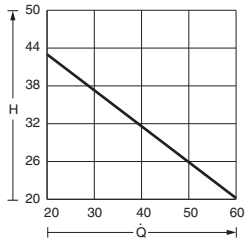
- 1 Compressor
- 5 Condenser
- 10 Condenser fan
- 16 Multi-coil vaporiser
- 20 Expansion valve
- 21 Inspection glass
- 23 Liquid collector
- 25 Filter dryer
- 30 Tank
- 31 Manometer
- 33 Fixed pump bypass
- 35 Filling
- 40 Tank drain
- 47 Level switch
- 55 Pump
- 70 High-pressure switch
- 80 Thermostat

Layout diagram

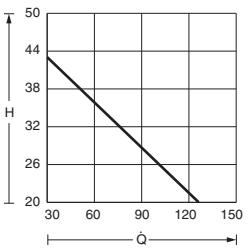


Characteristic curves of pump
Model No. SK

50 Hz 3335.100/3335.120/ 3335.150



50 Hz 3335.200/3335.250



H = Delivery head H [m]
Q̇ = Delivery flow Q [l/min]

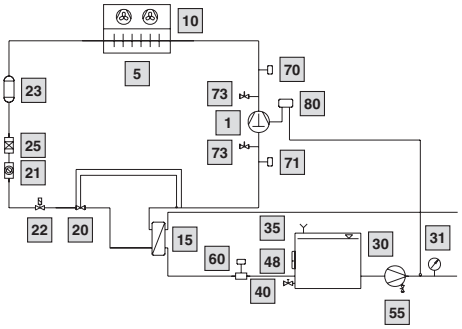
4.2 Recooling systems

In industrial enclosure, cooling output 32 kW to 172 kW Page 617

Key to the adjacent drawing:

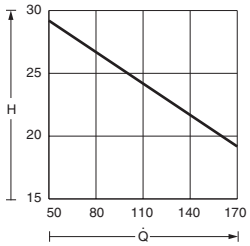
1 Compressor
5 Condenser
10 Condenser fan
15 Evaporator coil
20 Expansion valve
21 Inspection glass
22 Magnetic valve
23 Liquid collector
25 Filter dryer
30 Tank
31 Manometer
35 Filling
40 Tank drain
48 Level indicator
55 Pump
60 Flow monitor
70 High-pressure switch
71 Low-pressure switch
73 Shut-off valve
80 Thermostat

Layout diagram SK 3339.100/200[1)]

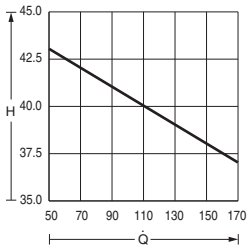


Characteristic curves of pump
Model No. SK

50 Hz 3339.100/3339.200

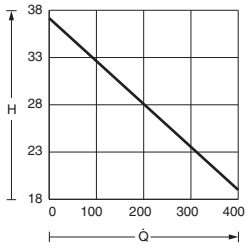


60 Hz 3339.100/3339.200

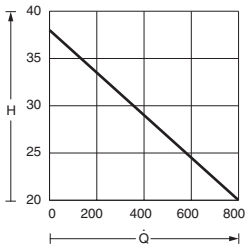


[1)] Layout diagram SK 3339.300 – .500 available on request.

50 Hz 3339.300/3339.400



50 Hz 3339.500



H = Delivery head H [m]
Q̇ = Delivery flow Q [l/min]

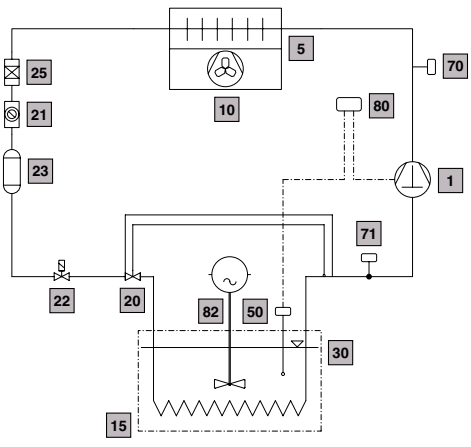
4.2 Immersible recooling systems

Useful cooling output 2400 to 77900 W Page 618 – 623

Key to the adjacent drawing:

1 Compressor
5 Condenser
10 Condenser fan
15 Evaporator coil
20 Expansion valve
21 Inspection glass
22 Magnetic valve
23 Liquid collector
25 Filter dryer
30 Tank, to be supplied by the customer
50 Temperature sensor
70 High-pressure switch
71 Low-pressure switch
80 Thermostat
82 Stirrer

Layout diagram



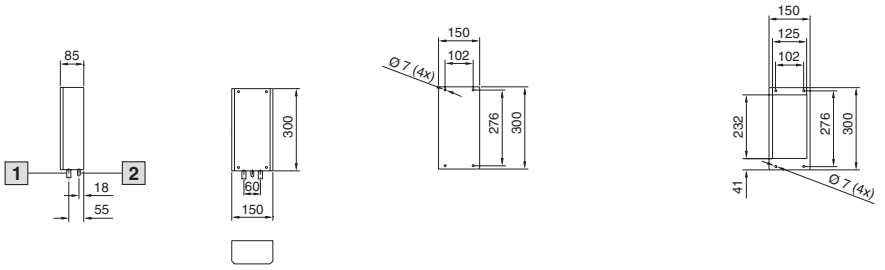
4.3 Air/water heat exchanger

Micro, wall-mounted, useful cooling output 300 W Page 626

Mounting holes for internal mounting

Mounting cutout for external mounting

1 Cooling water connection
2 Condensate discharge

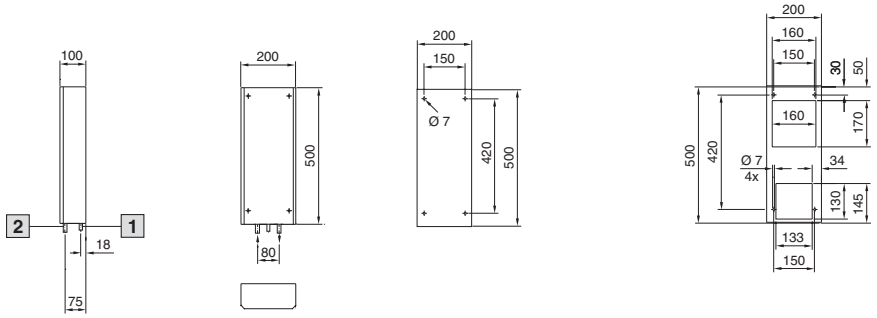


Wall mounting, useful cooling output 600 W Page 627

Mounting holes for internal mounting

Mounting cutout for external mounting

1 Condensate discharge 1/2″
2 Cooling water connection 1/2″

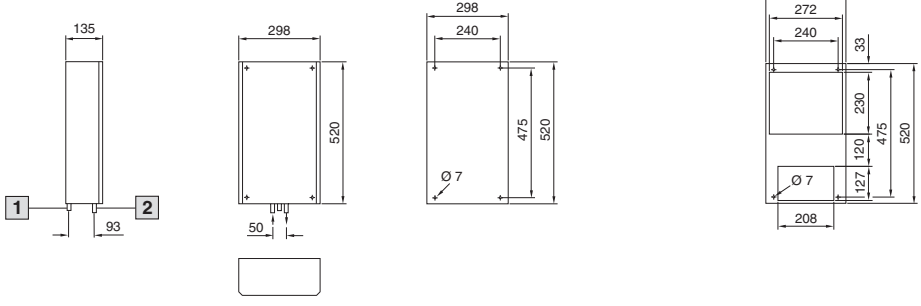


Wall mounting, useful cooling output 1000 W Page 627

Mounting holes for internal mounting

Mounting cutout for external mounting

1 Condensate discharge 1/2″
2 Cooling water connection 1/2″



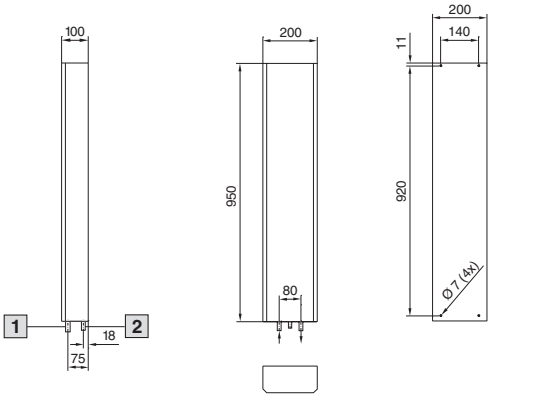
4.3 Air/water heat exchanger

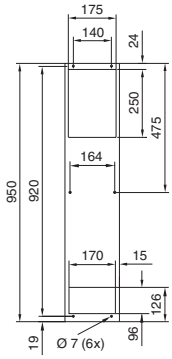
Wall mounting, useful cooling output 1250 W Page 628

Mounting holes
for internal mounting

Mounting cutout
for external mounting

1 Condensate discharge 1/2″
2 Cooling water connection 1/2″



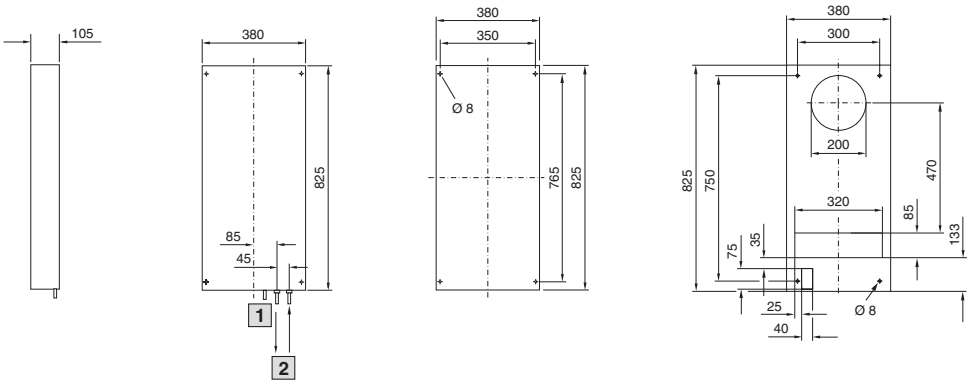


Wall mounting, useful cooling output 1540 W Page 628

Mounting holes
for internal mounting

Mounting cutout
for external mounting

1 Condensate discharge 1/2″
2 Cooling water connection 1/2″

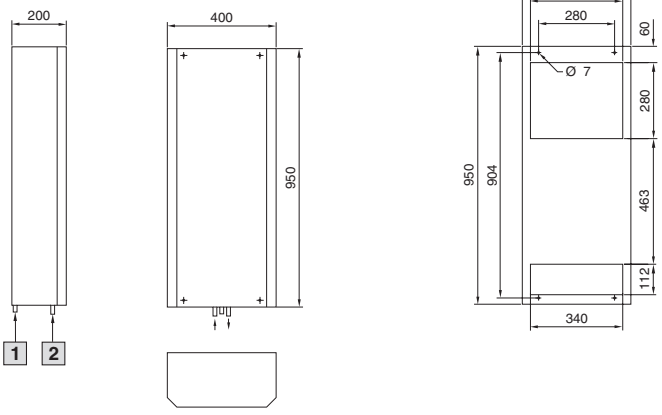


Wall mounting, useful cooling output 2250/3000 W Page 629

Mounting cutout
for external/internal mounting

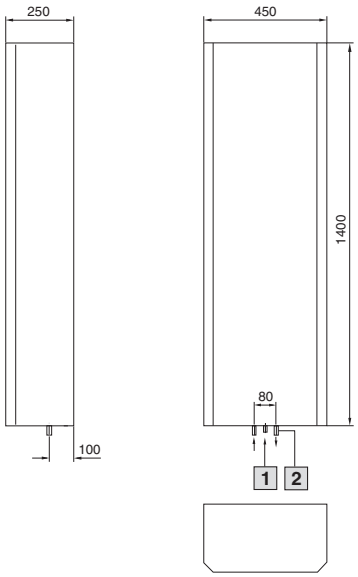
Only the 4 mounting holes, 7 mm diameter, are required for internal mounting.

1 Condensate discharge 1/2″
2 Cooling water connection 1/2″

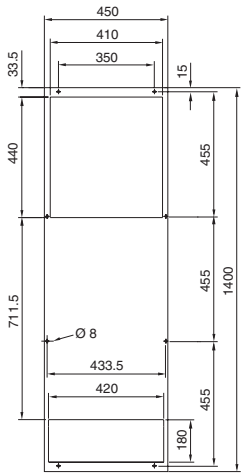


4.3 Air/water heat exchangers

Wall mounting, useful cooling output 4500 W Page 629

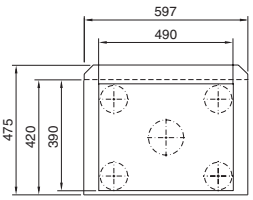


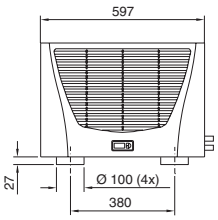
Mounting cutout
for external mounting

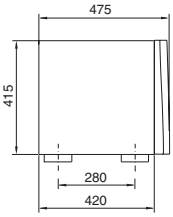


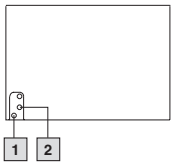
1 Condensate discharge 1/2″
2 Cooling water connection 1/2″

Roof-mounted, useful cooling output 2500 W Page 630
Roof-mounted, useful cooling output 4000 W Page 631





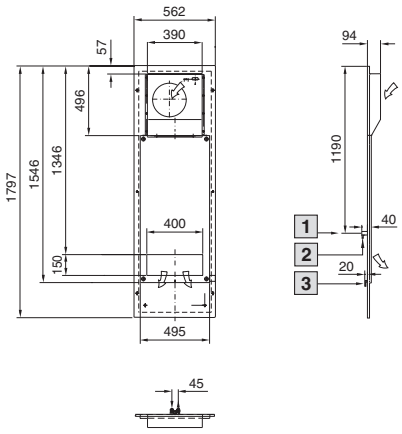




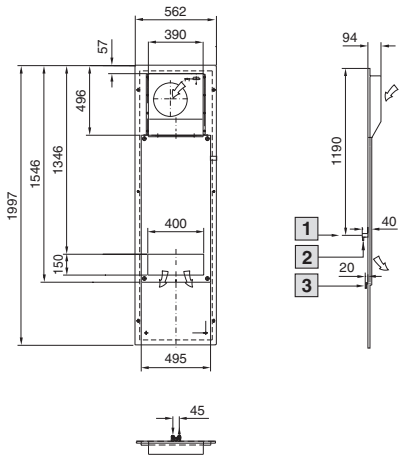
1 Condensate discharge 1/2″
2 Cooling water connection 1/2″

As a side panel for 600 mm deep TS 8 enclosures, useful cooling output 700 W Page 632

SK 3316.180



SK 3316.200

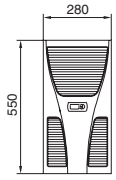


1 Water connections
2 Hose 10 mm diameter
3 Condensate discharge

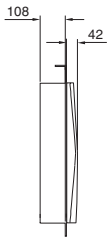
4.3 TopTherm air/air heat exchanger

Wall mounted, specific thermal output 17.5 W/K Page 633

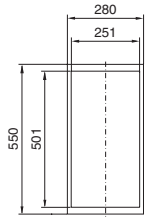
External mounting



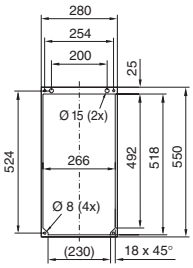
Internal mounting



Mounting cutout for external mounting

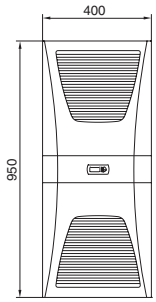


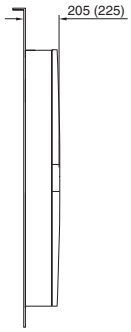
Mounting cutout for internal mounting



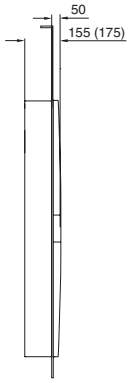
Wall mounting, specific thermal output 30 – 60 W/K Page 633

External mounting

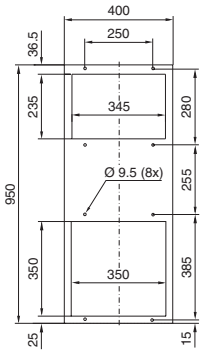




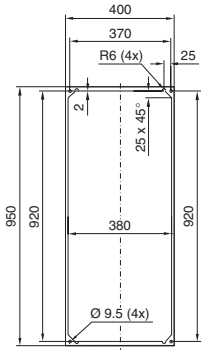
Internal mounting



Mounting cutout for external mounting



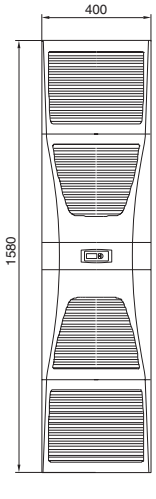
Mounting cutout for internal mounting



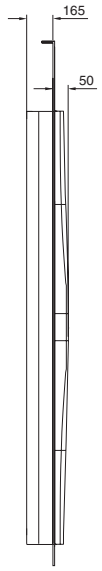
Dimensions in brackets for 45 W/K and 60 W/K

Wall mounted, specific thermal output 90 W/K Page 634

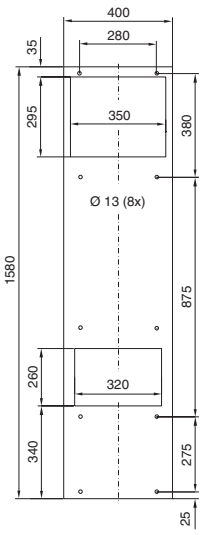
External mounting



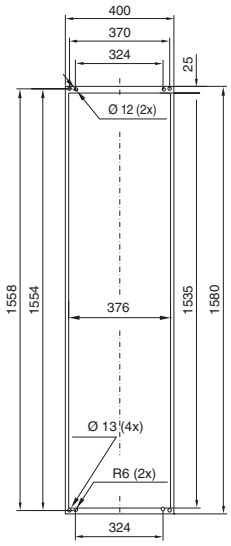
Internal mounting



Mounting cutout for external mounting



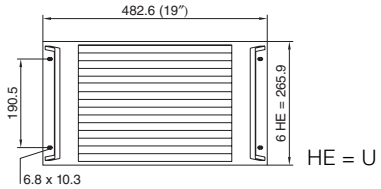
Mounting cutout for internal mounting



Rack-mounted climate control

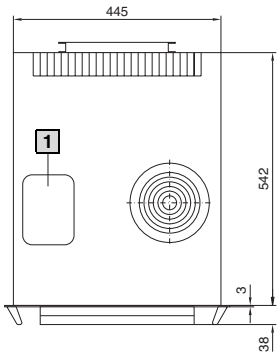
4.5 Rack-mounted cooling unit

for 482.6 mm (19″), useful cooling output 1000 W Page 644

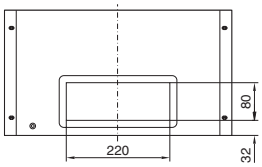


HE = U

Air duct, extendible to any length



View of the rear of the unit

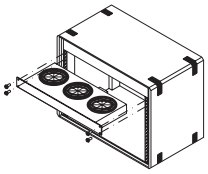


1 Service flap (thermostat)

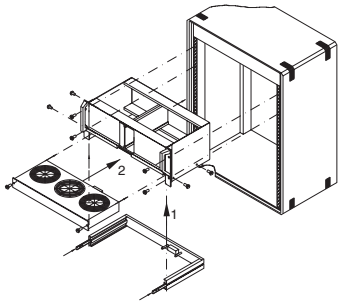
4.5 Rack-mounted fan

for 482.6 mm (19″), air throughput 320/480 m³/h Page 645

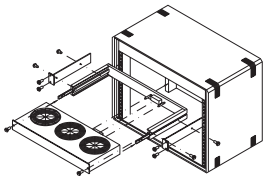
Rack-mounted fan mounted between a pair of 482.6 mm (19″) mounting angles



Vario rack-mounted fan mounted in subracks 84 HP

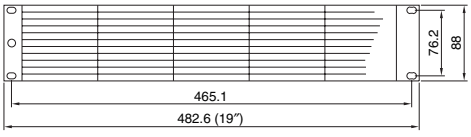


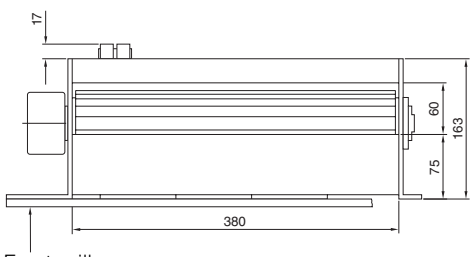
Vario rack-mounted fan mounted between a pair of 482.6 mm (19″) mounting angles



4.5 Centrifugal fan

Air throughput 320 m³/h Page 646



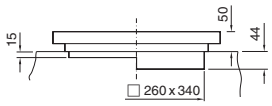


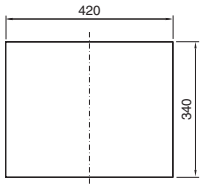
Front grille

4.5 Roof-mounted fan

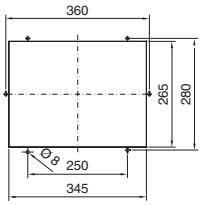
Air throughput 360 m³/h Page 647

Without fan With fan



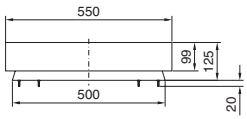


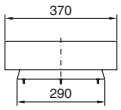
Mounting cutout



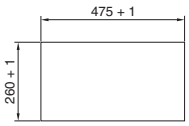
4.5 Roof-mounted fan and vent attachment

Air throughput (unimpeded air flow) 400/800 m³/h Page 647



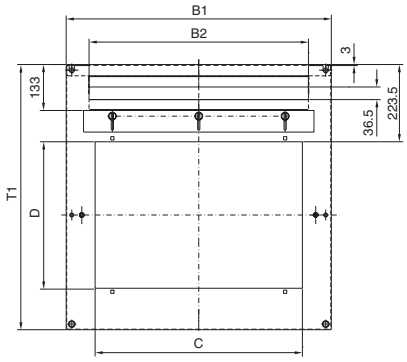


Mounting cutout



4.5 Fan roof, modular, two-piece for TS/FR(i)

Air throughput per fan (unimpeded air flow) 160/180 mm³/h at 50/60 Hz Page 651

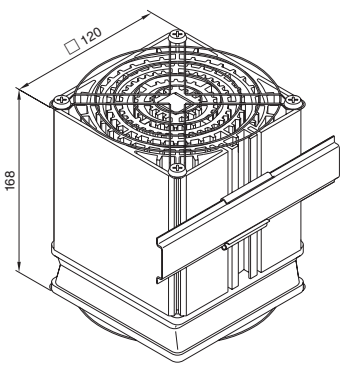


For enclosures		Cover plate		Roof dimensions			C	D	Model No. TS
W (B) mm	D (T) mm	Solid	Vented	W (B1) mm	W (B2) mm	D (T1) mm			
600	600	2102.180	2102.400	567.5	435	567.5	400	224	**7826.366**
600	800	2102.190	2102.410	567.5	435	767.5	400	424	**7826.368**
600	900	2102.190	2102.410	567.5	435	867.5	400	424	**7826.369**
600	1000	2102.190	2102.410	567.5	435	967.5	400	424	**7826.360**
800	600	7885.100	7885.200	767.5	635	567.5	600	224	**7826.486**
800	800	7886.100	7886.200	767.5	635	767.5	600	424	**7826.488**
800	900	7886.100	7886.200	767.5	635	867.5	600	424	**7826.489**
800	1000	7886.100	7886.200	767.5	635	967.5	600	424	**7826.480**

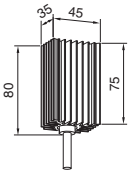
4.6 Enclosure heaters

Continuous thermal output 10 – 300 W Page 655

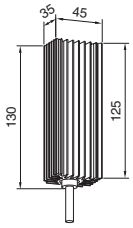
SK 3102.000
including fan



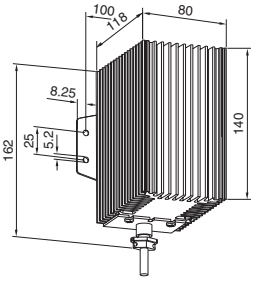
SK 3105.000



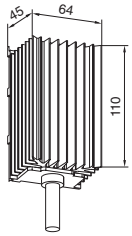
SK 3106.000



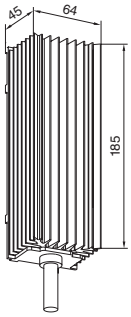
SK 3107.000



SK 3115.000



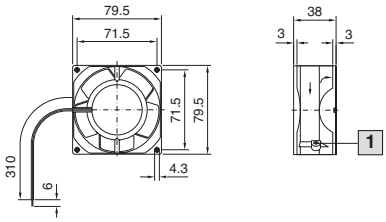
SK 3116.000



Accessories for system climate control

4.6 Axial fan

for heater SK 3107.000 Page 655

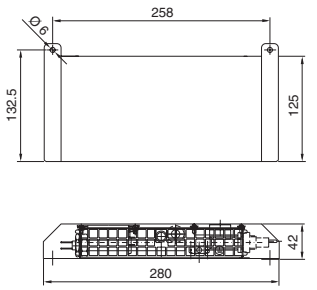


1 Earthing lug for M4 or 8 – 32 UNC

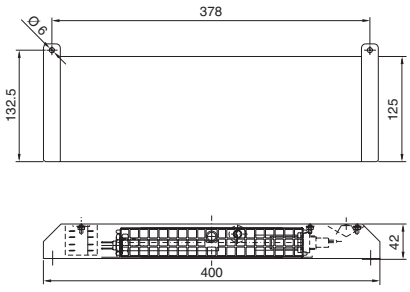
4.7 Electronic condensate evaporator

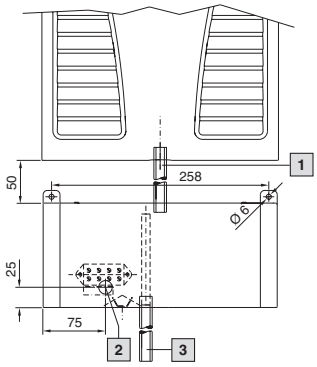
Page 665

SK 3301.560/.580



SK 3301.570/.590

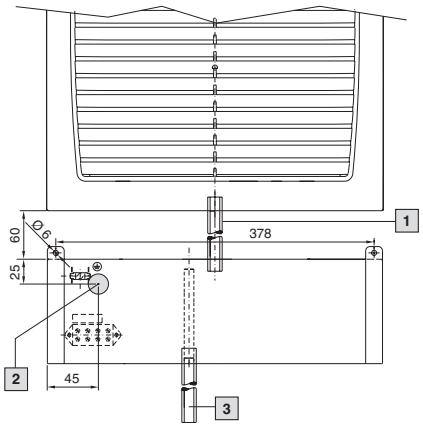




1 Condensate hose
SK 3301.608 for SK 3302.XXX
SK 3301.610 for SK 3303.XXX

2 Suggestion for position of cable entry

3 Hose
Length as required



1 Condensate hose SK 3301.612

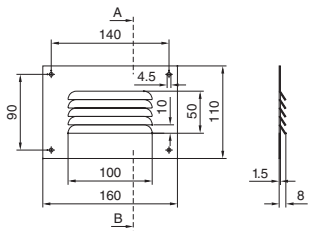
2 Suggestion for position of cable entry

3 Hose
Length as required

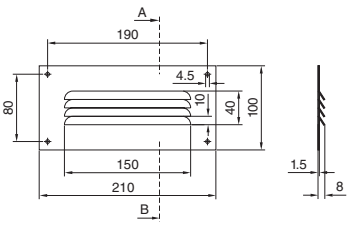
4.7 Integrated louvres

Page 666

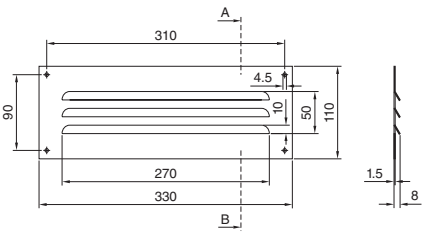
SK 2541.235



SK 2542.235



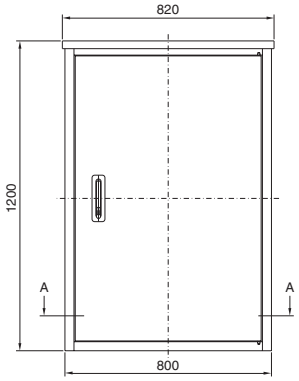
SK 2543.235



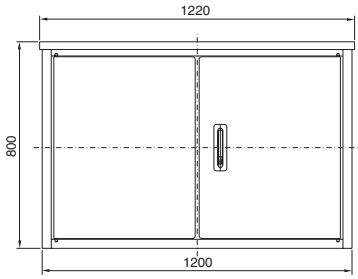
6.1 Compact enclosures, Outdoor

Page 820

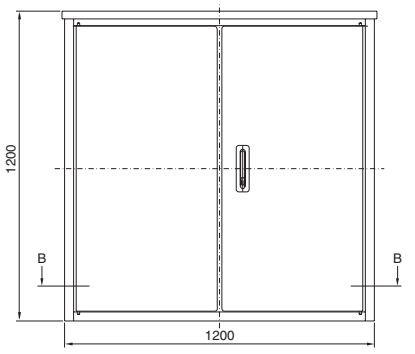
1620.000, 1620.100

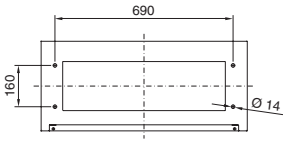


1621.000, 1621.100



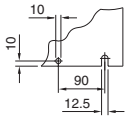
1622.000, 1622.100

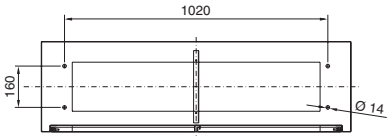




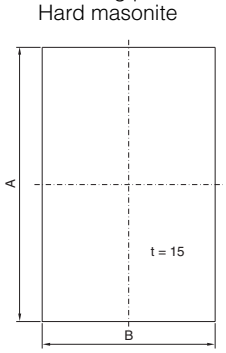
Mounting plate
Sheet steel

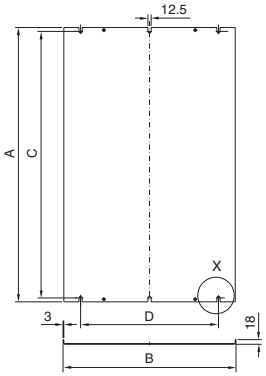
Detail X





Mounting plate
Hard masonite

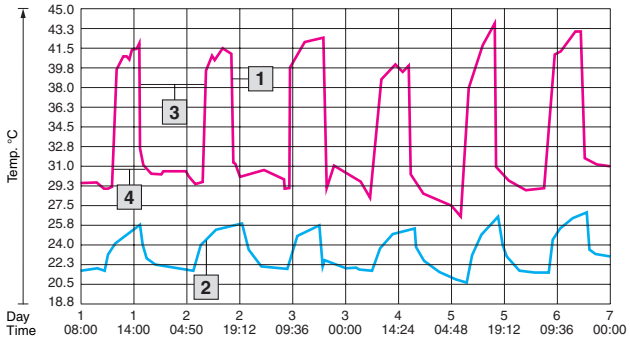




Model No.	A	B	C	D
1616.200	1133	670	1103	534
1616.210	733	1070	703	934
1616.220	1133	1070	1103	934
1616.230	1070 ±1	670 ±1	–	–
1616.240	1070 ±1	1070 ±1	–	–

6.2 Geothermal heat exchanger

Terravent Page 831



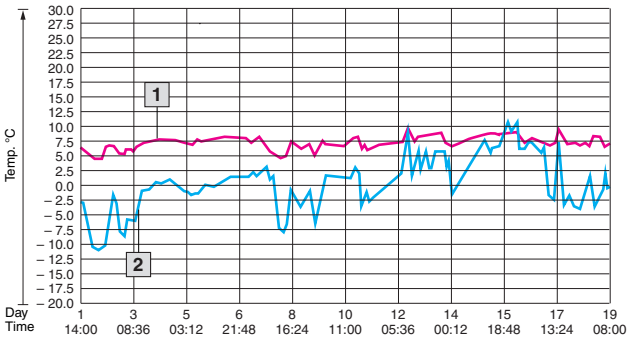
1 Internal temperature = Terravent inlet temperature

2 Terravent outlet temperature

3 Night-time operation

4 Day-time operation

Operating status – cooling:
1300 W heat loss from 8 am – 4 pm
800 W heat loss from 4 pm – 8 am
CS Outdoor modular enclosure, thermally insulated
Enclosure size: W x H x D = 800 x 1200 x 500 mm



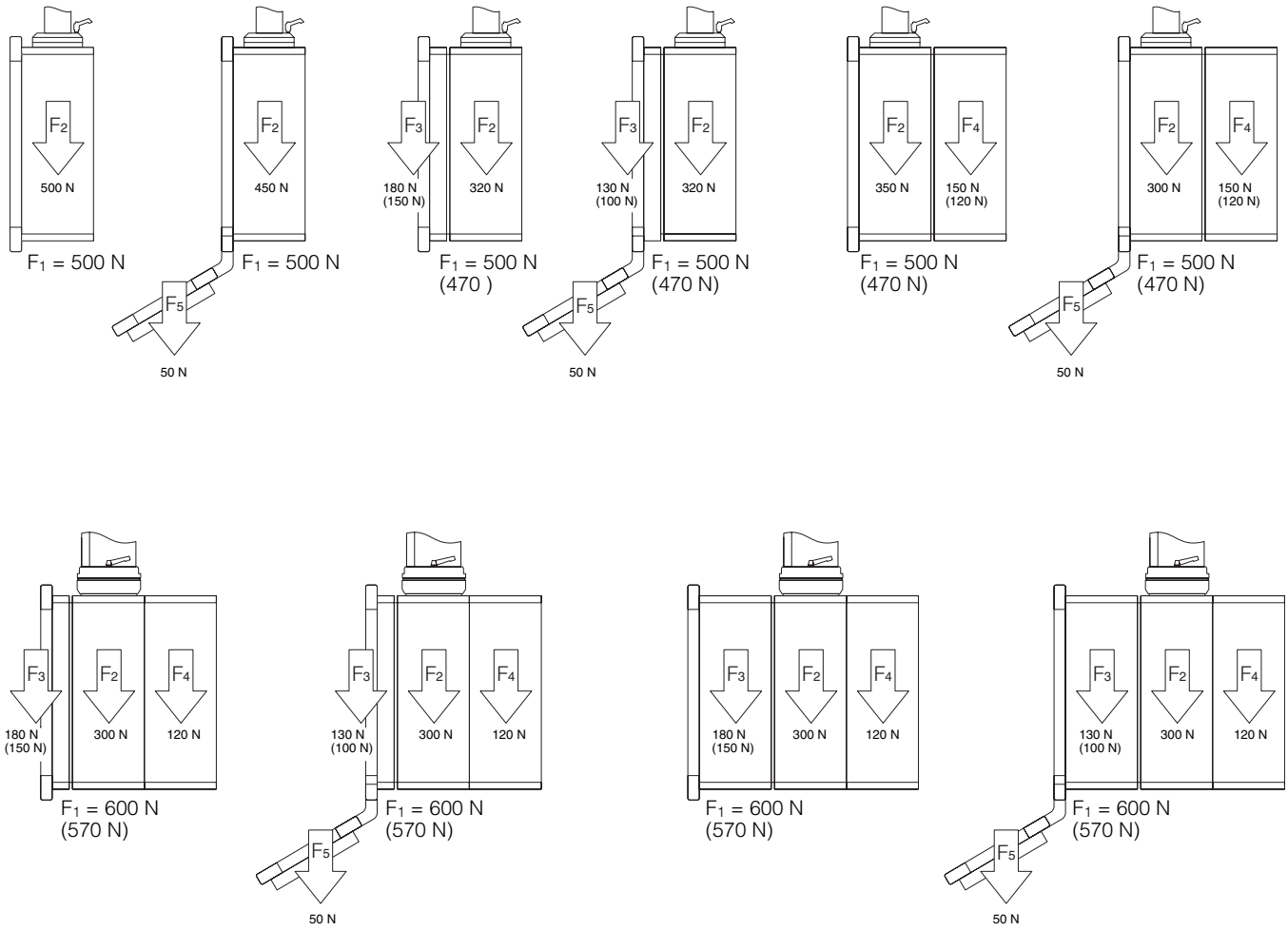
1 Internal temperature = Enclosure internal temperature

2 External temperature

Operating status – heating:
No heat loss installed in the enclosure
External temperature below –10°C
CS Outdoor modular enclosure, not thermally insulated
Enclosure size: W x H x D = 800 x 1200 x 500 mm

1.5 Command Panel VIP 6000

Load specifications for installed equipment Page 160



Permissible installed weight

F_1 = Total

F_2 = Enclosure part (with support arm connection)

F_3 = Front part

F_4 = Rear part

F_5 = Keyboard housing

Figures in brackets are for hinged version (see 3.1 installation depth, page 161).
Enclosures for larger weights available on request.

1002.600 to 2364.000

Model No.	Page
1000	
1002.600	273
1004.600	273
1005.600	273
1006.600	273
1007.600	273
1008.600	273
1009.600	273
1010.600	273
1012.600	273
1013.600	273
1014.600	273
1016.600	273
1017.600	273
1018.600	273
1019.600	273
1024.010	271
1024.020	271
1024.030	271
1024.040	271
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1024.820	909
1024.830	909
1024.910	909
1024.920	909
1024.930	909
1030.500	118
1031.500	118
1032.500	118
1033.500	118
1034.500	118
1035.500	118
1038.100	295
1038.500	119
1039.100	295
1039.500	118
1039.750	290
1045.100	295
1045.500	119
1050.100	295
1050.500	119
1050.900	114
1057.100	295
1057.500	119
1058.100	295
1058.500	119
1060.100	295
1060.500	119
1060.750	290
1073.100	295
1073.500	119
1076.100	295
1076.500	119
1077.100	295
1077.500	119
1090.100	295
1090.500	119
1100.100	295
1100.500	120
1101.010	121
1101.020	121
1101.030	121
1101.040	121
1101.800	898
1101.910	873
1101.920	873
1101.930	873
1101.940	873
1110.100	295
1110.500	120

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1114.100	295
1114.500	120
1130.100	295
1130.500	120
1158.500	969
1158.530	969
1158.540	969
1158.560	969
1158.900	969
1158.910	969
1158.920	969
1158.930	969
1158.940	969
1158.950	969
1180.100	295
1180.500	119
1180.750	290
1213.100	295
1213.500	120
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1228.100	842
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1280.100	295
1280.500	120
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1338.500	119
1339.100	295
1339.500	118
1350.100	295
1350.500	119
1360.100	295
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1376.100	295
1376.500	119
1380.100	295
1380.500	118
1380.750	290
1400.600	124
1423.600	123
1432.600	123
1434.600	123
1444.600	123
1446.600	123
1448.600	123
1449.600	123
1453.600	123
1454.600	123
1466.600	123
1467.600	123
1468.600	124
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1479.600	124
1480.600	124
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1484.000	886
1485.000	888
1486.000	888
1487.000	888
1488.000	888
1489.000	888
1490.000	885

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1491.000	912
1492.000	888
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1501.510	108
1502.510	108
1503.510	108
1504.510	108
1505.510	108
1506.510	108
1507.510	108
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1512.510	108
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1559.510	112
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1566.700	909
1567.700	909

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1573.700	909
1574.700	909
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1589.510	108
1590.000	905
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1592.000	894
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1605.510	112
1605.520	112
1606.510	112
1606.520	112
1609.510	114
1611.510	113
1616.110	898
1616.200	916
1616.210	916
1616.220	916
1616.230	916
1616.240	916
1616.300	842
1616.310	842
1620.000	125, 820
1620.100	125, 820
1621.000	125, 820
1621.100	125, 820
1622.000	125, 820
1622.100	125, 820
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1932.200	1013
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1936.200	1013
1937.200	1013
1939.200	1013

Model No.	Page
1940.000	1013
1941.000	1013
1944.000	1013
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1950.000	1013
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1963.200	999
1978.200	998
1979.200	999
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1985.235	996
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1994.635	996
1994.835	996
1995.235	996, 998
1995.835	996, 998
1996.535	996
1996.835	996
1997.235	996, 998
1997.835	996, 998
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2094.500	1020
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2102.320	651
2102.400	651
2102.410	651
2102.490	651
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2233.000	1013
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2235.085	971
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2238.000	929
2239.000	929
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2243.705	292
2246.605	730
2246.705	292
2249.605	730
2249.705	292
2250.000	1011
2252.605	730

Model No.	Page
2253.605	731
2255.605	730
2256.605	731
2256.705	292
2258.605	730
2259.605	731
2259.705	292
2260.000	1011
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2265.705	292
2268.605	731
2271.605	731
2271.705	292
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2306.000	953
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2309.000	927
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2310.076	896
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2313.750	927
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2323.235	997
2324.235	997
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RAL colours

	Colour RAL	Designation
	3001	signal red
	5002	ultramarine blue
	5005	signal blue
	5018	turquoise blue
	7015	slate grey
	7022	umbra grey
	7024	graphite grey
	7030	stone grey
	7032	pebble grey
	7033	cement grey
	7035	pale grey
	7044	silky grey
	8019	grey brown
	9005	jet black
	9006	white aluminium
	9011	graphite black
	9017	traffic black

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▶ *Distribution industrial fuselinks (type gG)*

Fuse size	F1(1)	F2(1)	A1(2)	A2(2)	A3(2)
Type	NS / NSD	ES / ESD	NIT / NITD	TIA / AAO	TIS / BAO

Rating (A)	Voltage (VAC)	References	Voltage (VAC)	References	Voltage (VAC)	References	Voltage (VAC)	References	Voltage (VAC)	References
2	550	6F10 **0002**	550	6F20 **0002**	660	6A10 **0002**	550	6A20 **0002**		
4	550	6F10 **0004**	550	6F20 **0004**	660	6A10 **0004**	550	6A20 **0004**		
6	550	6F10 **0006**	550	6F20 **0006**	660	6A10 **0006**	550	6A20 **0006**		
10	550	6F10 **0010**	550	6F20 **0010**	660	6A10 **0010**	550	6A20 **0010**		
16	550	6F10 **0016**	550	6F20 **0016**	660	6A10 **0016**	550	6A20 **0016**		
20	550	6F10 **0020**	550	6F20 **0020**	660	6A10 **0020**	550	6A20 **0020**		
25	550	6F10 **0025**	550	6F20 **0025**	660	6A10 **0025**	550	6A20 **0025**		
32	550	6F10 **0032**	550	6F20 **0032**	660	6A10 **0032**	550	6A20 **0032**		
40			550	6F20 **0040**					550	6A30 **0040**
50			550	6F20 **0050**					550	6A30 **0050**
63			550	6F20 **0063**					550	6A30 **0063**

Fuse size	A3(2)	A4(2)	A4(2)	B1(3)	B1(3)
Type	OS / OSD	TCP / CEO	TFP / DEO	TBC / AD	TBC / BD

Rating (A)	Voltage (VAC)	References	Voltage (VAC)	References	Voltage (VAC)	References	Voltage (VAC)	References	Voltage (VAC)	References
2							550	6B10 **0002**		
4							550	6B10 **0004**		
6							550	6B10 **0006**		
10							550	6B10 **0010**		
16							550	6B10 **0016**		
20							550	6B10 **0020**		
25							550	6B10 **0025**		
32			550	6A40 **0032**			550	6B10 **0032**		
40			550	6A40 **0040**					550	6B10 **0040**
50			550	6A40 **0050**					550	6B10 **0050**
63			550	6A40 **0063**					550	6B10 **0063**
80	550	6A30 **0080**	550	6A40 **0080**						
100	550	6A30 **0100**	550	6A40 **0100**						
125					415	6A40 **0125**				
160					415	6A40 **0160**				
200					415	6A40 **0200**				

(1) Offset blade type fuselinks
(2) Offset bolted tag type fuselinks
(3) Centre bolted tag type fuselinks.
Note: pack quantity 3 pieces for each product.

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Characteristics

▶ *Distribution industrial fuselinks (type gG)*

Fuse cut off current

Fuse size Type	F1 NS/NSD	F2 ES/ESD	A1 NIT/NITD	A2 TIA/AAO	A3 TIS/BAO	A3 OS/OSD	A4 TCP/CEO
Rating (A)	50/80 kA	50/80 kA	50/80 kA	50/80 kA	50/80 kA	50/80 kA	50/80 kA
2	0.5/0.6	0.5/0.6	0.5/0.6	0.5/0.6			
4	0.9/1.0	0.9/1.0	0.7/0.8	1.0/1.1			
6	1.4/1.6	1.4/1.6	1.0/1.1	1.5/1.8			
10	2.4/2.6	2.4/2.6	1.7/2.0	2.4/2.8			
16	2.5/2.9	2.5/2.9	2.5/3.0	2.6/3.0			
20	3.2/3.8	3.2/3.8	2.5/3.0	3.3/4.0			
25	3.5/4.0	3.5/4.0	3.5/4.0	3.8/4.1			
32	4.1/4.9	4.1/4.9	3.5/4.0	4.2/5.0			4.4/5.0
40		5.0/5.9			5.1/6.0		5.0/6.0
50		5.2/6.0			7.0/8.0		6.6/7.8
63		5.8/6.6			9.0/10.0		8.9/10.0
80						9.5/11.0	9.5/11.0
100						12.0/14.0	12.0/14.0

Fuse cut off current

Fuse size Type	A4 TFP/DEO	B1 TBC/AD	B1 TBC/BD	B1 TC/CD	B2 TF/DD	CI TKM/EFS	B3 TKF/ED
Rating (A)	50/80 kA	50/80 kA	50/80 kA	50/80 kA	50/80 kA	50/80 kA	50/80 kA
2		0.4/0.5					
4		1.0/1.1					
6		1.4/1.6					
10		1.8/2.0					
16		2.0/2.2					
20		2.6/3.0					
25		3.6/4.0					
32		4.4/5.0					
40			5.0/6.0				
50			6.6/7.8				
63			8.9/10.0				
80				9.5/11.0			
100				12.0/14.0			
125	12.0/14.0				12.0/14.0	12.0/14.0	
160	17.0/19.0				17.0/19.0	17.0/19.0	
200	19.0/24.0				19.0/24.0	19.0/24.0	
250						23.0/28.0	23.0/28.0
315						27.0/30.0	27.0/30.0

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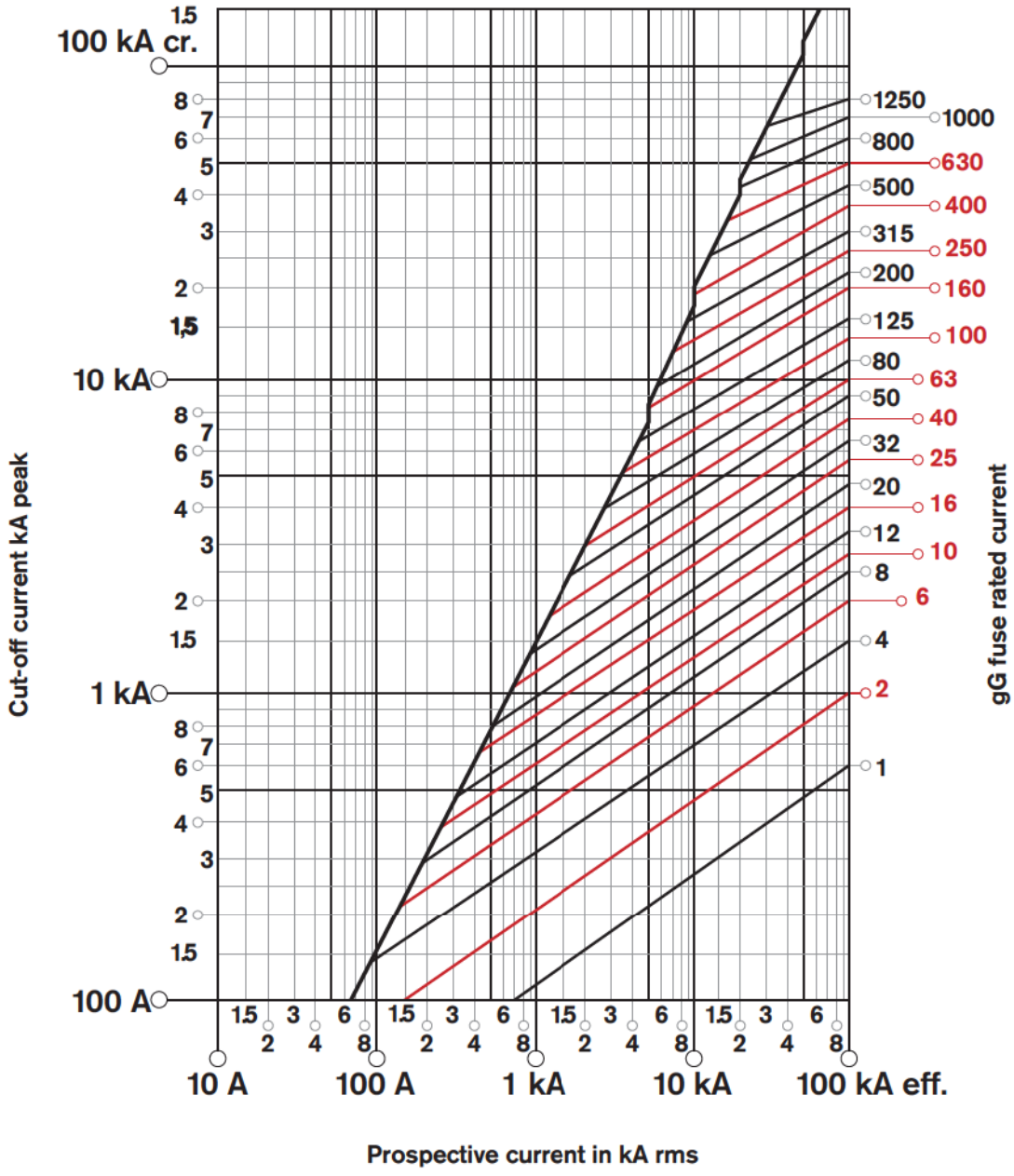
Curves characteristic of “gG” fuses

Cut-off current diagram



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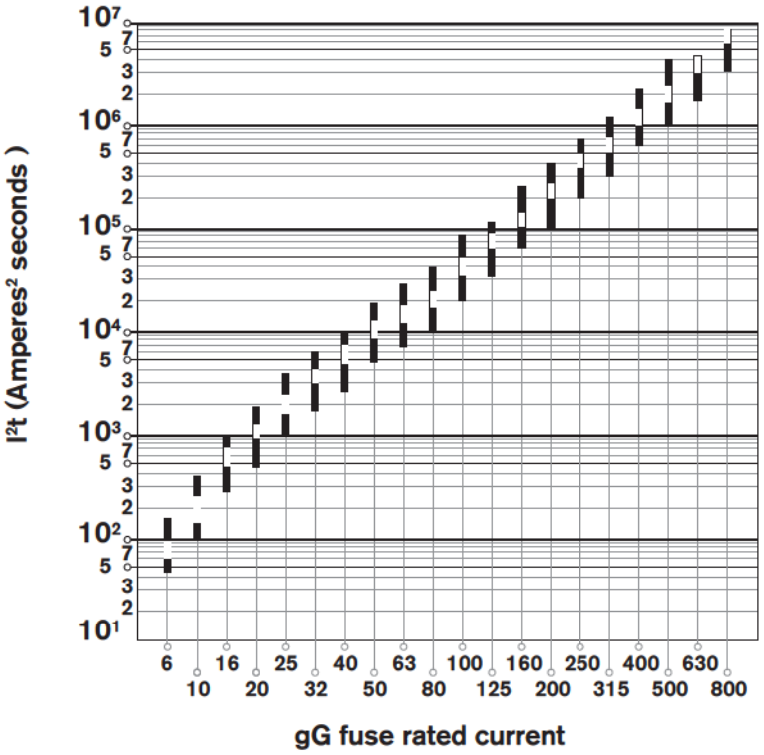
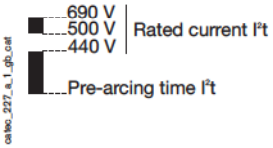
Fuses

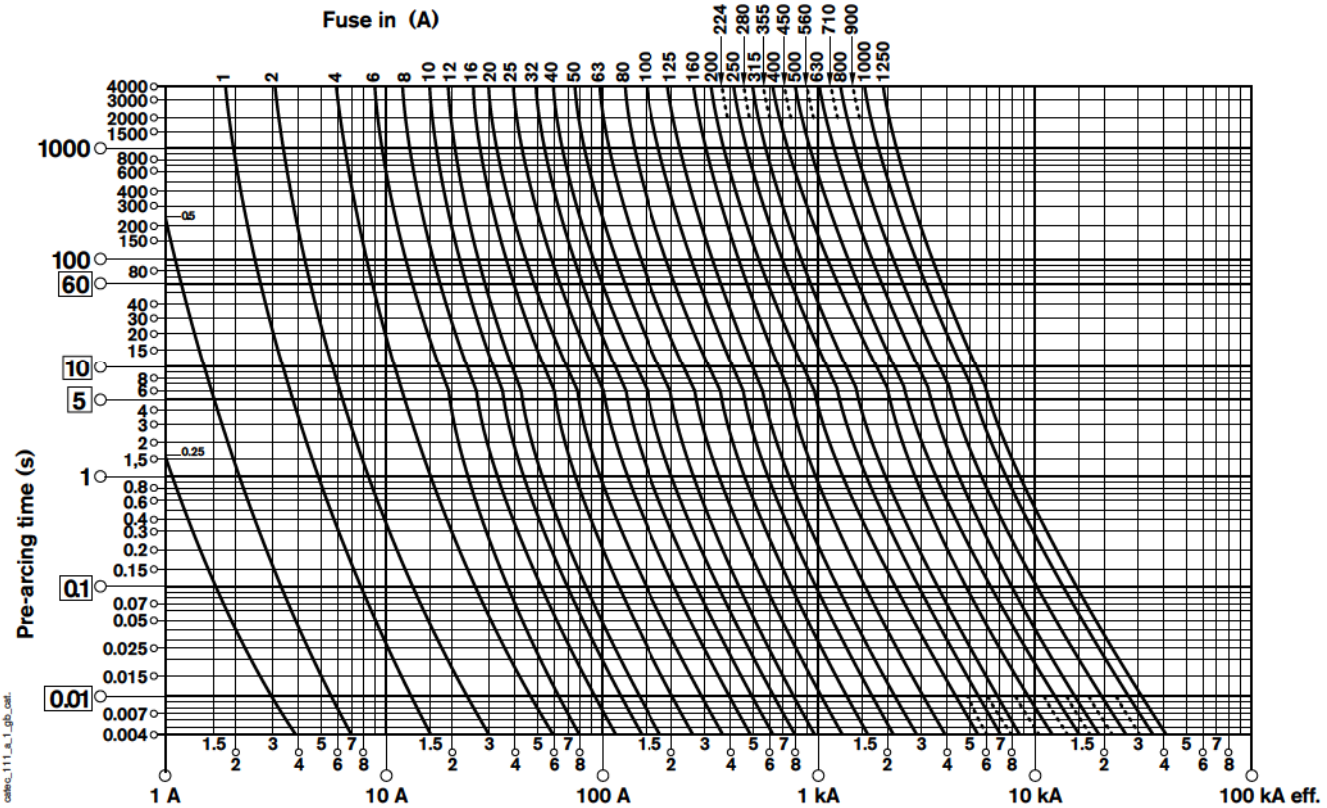
Curves characteristic of "gG" fuses (continued)

Diagram of thermal constraint limitation





Time/current operation characteristics (IEC or BS standard)



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Control and signalling units Ø 22

Harmony® XB4, metal

Harmony® XB5, plastic

Catalogue
june

06

a brand of Schneider Electric

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Flexibility

- Interchangeable modular functions, to better meet the requirements for extensions
- Software and accessories common to multiple product families

Ingenuity

- Auto-adapts to its environment, "plug & play"
- Application functions, control, communication and diagnostics embedded in the products
- User-friendly operation either directly on the product or remotely

Simplicity

- Cost effective “optimum” offers that make selection easy for most typical applications
- Products that are easy to understand for users, electricians and automation specialists
- User-friendly intuitive programming

Compactness

- High functionality in a minimum of space
- Freedom in implementation

Openness

- Compliance with field bus, connection, and software standards
- Enabling decentralised or remote surveillance via the web with Transparent Ready products

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Harmony® XB5, plastic

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Control and signalling units Ø 22

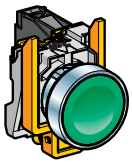
Harmony® XB4, metal

Pushbuttons, switches and pilot lights

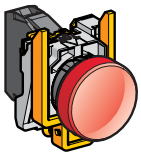
Description

The Ø 22 range of metal control and signalling units comprises:

Complete units with chromium plated metal bezel, XB4 B

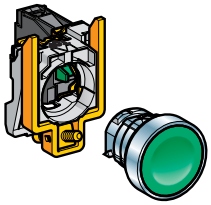


Pushbuttons and switches

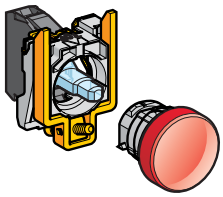


Pilot lights

Sub-assemblies with chromium plated or black metal bezel, ZB4 B

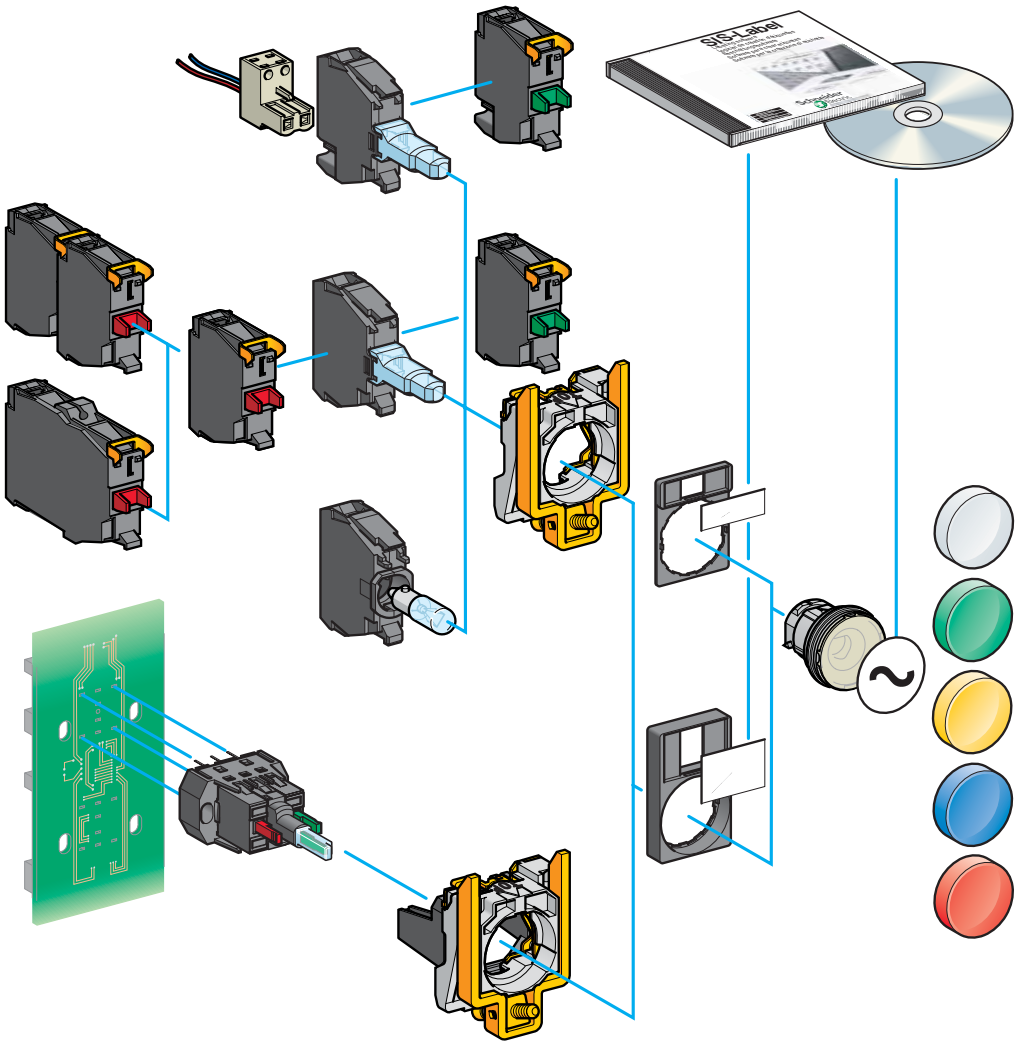


Pushbuttons and switches: body + head sub-assemblies



Pilot lights: body + head sub-assemblies

ZB component parts and accessories



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Control and signalling units Ø 22

Harmony® XB4, metal

Pushbuttons, switches and pilot lights

Schematic library

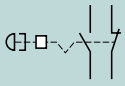
Contact functions (pushbuttons and Emergency stop pushbuttons)

Pushbutton
N/O contact

Pushbutton
N/C contact

Mushroom head spring return
N/O contact

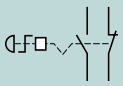
Emergency stop
mushroom head - Push-pull
N/C contact



Emergency stop trigger
action mushroom head -
Push-pull
N/O + N/C contacts

Emergency stop mushroom
head - Turn to release
N/C contact

Emergency stop mushroom
head - Turn to release,
with key
N/C contact



Emergency stop trigger
action mushroom head -
Turn to release
N/O + N/C contacts

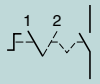
Emergency stop trigger
action mushroom head
Turn to release, with key
N/O + N/C contacts

Double-headed
pushbutton
N/O + N/C contacts

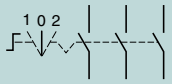
Early make contact block
N/O contact

Late break contact block
N/C contact

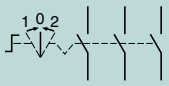
Contact functions (selector switches)



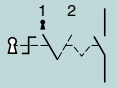
Selector switch
2-position stay put
N/O contact



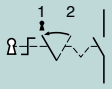
Selector switch
3-position stay put
N/O+N/O+N/O contacts



Selector switch
3-position
2 spring return to centre
N/O+N/O+N/O contacts



Selector switch
2-position stay put,
key withdrawal from LH
position - N/O contact

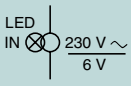


Selector switch
2-position spring return from right to left,
key withdrawal from LH position
N/O contact

Signalling functions

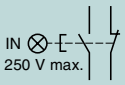
Pilot light with BA 9s
incandescent bulb

LED pilot light

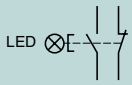


Pilot light with integral transformer
230 V primary, 6 V secondary
BA 9s bulb, incandescent or LED

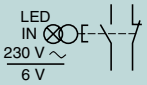
Combined functions, contact + signalling (pushbuttons and selector switches)



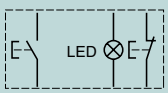
Illuminated pushbutton,
BA 9s incandescent bulb
N/O+N/C contacts



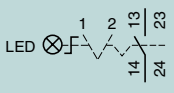
Illuminated pushbutton
LED - N/O+ N/C contacts



Illuminated pushbutton with integral transformer
230 V ~ 50/60 Hz primary, 6 V secondary
BA 9s bulb, incandescent or LED - N/O+ N/C contacts



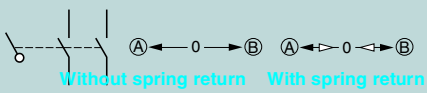
Double-headed pushbutton with LED pilot light



Illuminated selector switch with LED, 2-position stay put
N/O + N/C contacts

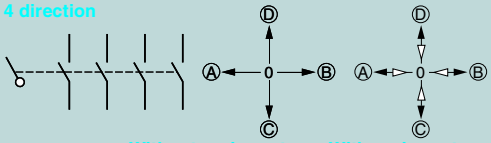
Joystick controller functions

2 direction



Without spring return With spring return

4 direction



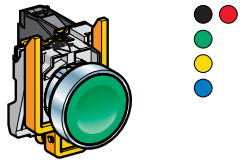
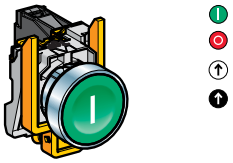
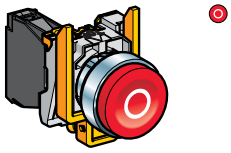
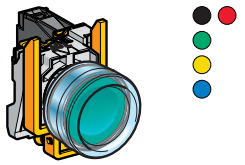
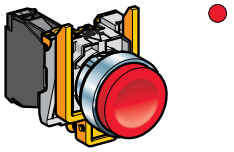
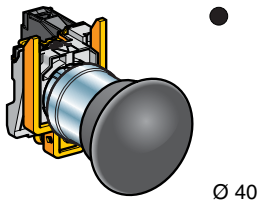
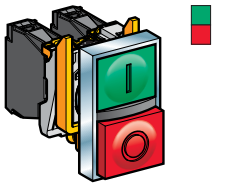
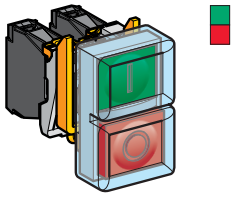
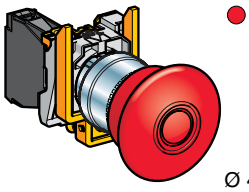
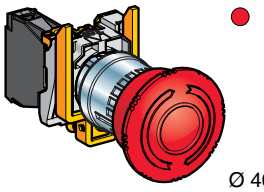
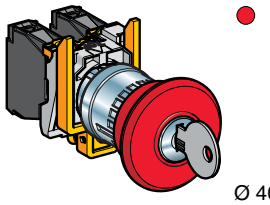
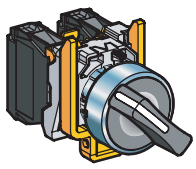
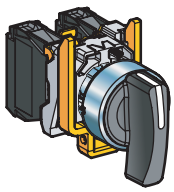
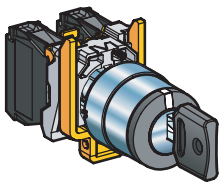
Without spring return With spring return

Characteristics : pages 10 to 13
References : pages 16 to 59
Dimensions : pages 62 to 73

Control and signalling units Ø 22

Harmony® XB4, metal

Pushbuttons, switches and pilot lights:
complete units, XB4 B

Complete units	Contact functions		
Pushbuttons, spring return, with chromium plated metal bezel			
	Flush push, unmarked XB4 BA●1/BA42 see page 16	Flush push, with marking XB4 BA3311 see page 18	Projecting push, with marking XB4 BL4322 see page 18
			 Ø 40
	Booted flush push XB4 BP●1/BP42 see page 17	Projecting push, unmarked XB4 BL42 see page 17	Mushroom head XB4 BC21 see page 24
Double-headed pushbuttons, spring return, with chromium plated metal bezel			
	Flush push + projecting push XB4 BL845 see page 23	Booted flush push + projecting push XB4 BL945 see page 23	
Emergency stop mushroom head pushbuttons, Ø 40, with chromium plated metal bezel ■ **trigger action and mechanical latching** **or** ■ **mechanical latching only**	 Ø 40	 Ø 40	 Ø 40
	Push-pull (EN 418/ISO 13850) XB4 BT845 see page 26	Turn to release (EN 418/ISO 13850) XB4 BS844● see page 26	Key release (EN 418/ISO 13850) XB4 BS9445 see page 26
	Push-pull XB4 BT42 see page 27	Turn to release XB4 BS542 see page 27	Key release XB4 BS142 see page 27
Selector switches and key switches, with chromium plated metal bezel			
	Standard handle, black XB4 BD●● see page 30	Long handle, black XB4 BJ●● see page 34	Key switch XB4 BG●● see page 35

Characteristics : pages 10 to 13
References : pages 16 to 37
Dimensions : pages 62 to 73

Control and signalling units Ø 22

Harmony® XB4, metal

Pushbuttons, switches and pilot lights: complete units, XB4 B

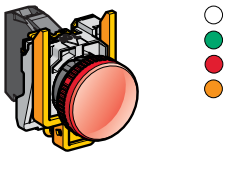
Complete units

Signalling functions

Pilot lights

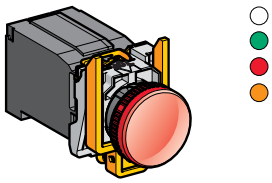
Integral LED

XB4 BVB●/BVG●/BVM●
see page 36



For bulb with BA 9s base fitting
Direct supply

XB4 BV6●
see page 37



Via integral transformer with secondary

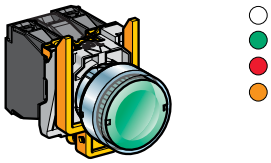
XB4 BV3●/BV4●
see page 37

Combined functions (contact + signalling)

Illuminated pushbuttons, spring return, flush push, chromium plated metal bezel

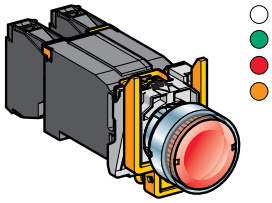
Integral LED

XB4 BW3●B5/BW3●G5/BW3●M5
see page 19



For bulb with BA 9s base fitting
Direct supply

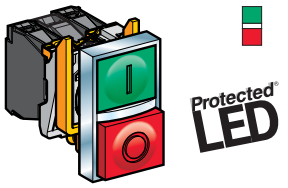
XB4 BW3●65
see page 21



Via integral transformer

XB4 BW3●35/BW3●45
see page 21

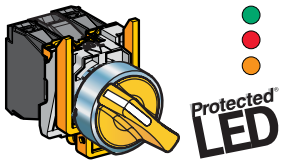
Illuminated double-headed pushbuttons, spring return, chromium plated metal bezel



Integral LED

XB4 BW84●5
see page 23

Illuminated selector switches with standard handle, chromium plated metal bezel



Integral LED

XB4 BK12●●5, XB4 BK13●●5
see page 32

Control and signalling units Ø 22

Harmony® XB4, metal

Pushbuttons, switches and pilot lights: sub-assemblies, ZB4 B

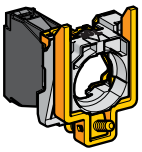
Non illuminated units for user assembly

Contact functions

Body sub-assemblies

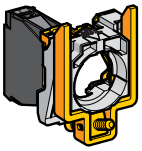
Head sub-assemblies, chromium plated or black metal bezel

For pushbuttons, spring return, unmarked



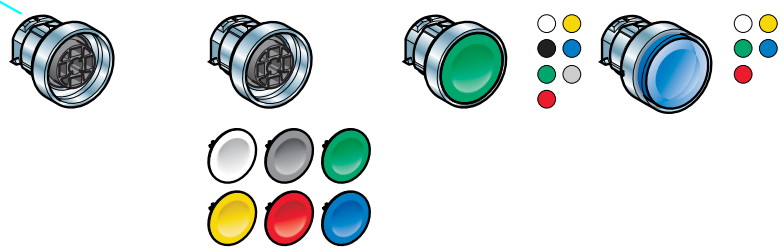
Screw clamp terminals

ZB4 BZ10●/BZ141
see page 40



Faston

ZB4 BZ10●3
see page 41



Flush push without cap

ZB4 BA0
see page 16

Flush push with set of 6 caps

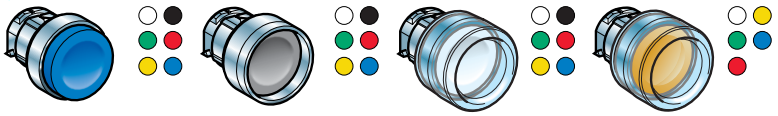
ZB4 BA9
see page 16

Flush push

ZB4 BA●
see page 16

Flush push for insertion of legend

ZB4 BA●8
see page 16



Projecting push

ZB4 BL●
see page 16

Recessed push

ZB4 BA●6
see page 16

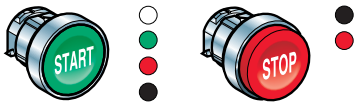
Booted flush/ projecting push

ZB4 BP●/ BP●S
see page 17

Booted flush push for insertion of legend

ZB4 BP●8
see page 17

For pushbuttons, spring return, with marking



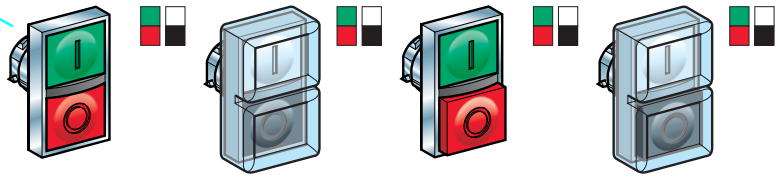
Flush push

ZB4 BA●3●/BA●4●
ZB4 BA334/335
see page 16

Projecting push

ZB4 BL●3●
see page 18

For double-headed pushbuttons, spring return



Flush pushes (IP 40/IP 66) Unmarked/with marking

ZB4 BA81●●
see page 22
ZB4 BA82●●
see page 23

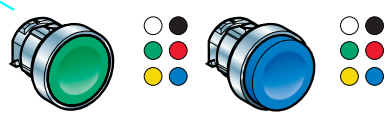
ZB4 BA91●●
see page 22
ZB4 BA92●●
see page 23

Flush push + projecting push (IP 40/IP 66) Unmarked/with marking

ZB4 BL83●●
see page 22
ZB4 BL84●●
see page 23

ZB4 BL93●●
see page 22
ZB4 BL94●●
see page 23

For "push-push to release" pushbuttons



Flush push

ZB4 BH0●
see page 28

Projecting push

ZB4 BH●
see page 28

Control and signalling units Ø 22

Harmony® XB4, metal

Pushbuttons, switches and pilot lights: sub-assemblies, ZB4 B

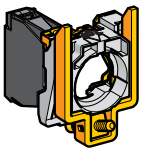
Non illuminated units for user assembly *(continued)*

Contact functions

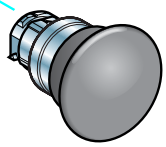
Body sub-assemblies

Head sub-assemblies, chromium plated or black metal bezel

For mushroom head pushbuttons

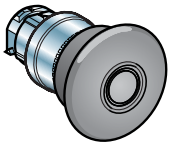


Screw clamp terminals
ZB4 BZ10●/BZ141
see page 40



Ø 30
Ø 40
Ø 60

Spring return
ZB4 BC●/BR●
see page 24

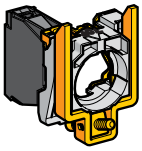


Ø 30
Ø 40
Ø 60

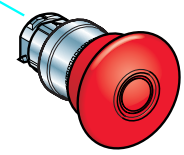
Latching
ZB4 B●2/BS●2/BS55
see page 25

For mushroom head Emergency Stop pushbuttons
- **trigger action and mechanical latching**

or
- **mechanical latching only**

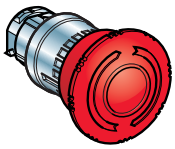


Faston
ZB4 BZ10●3
see page 41



Ø 30
Ø 40
Ø 60

Push-pull (EN 418/ISO 13850)
ZB4 BT84
see page 26

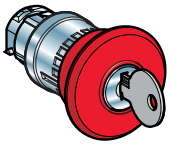


Ø 30
Ø 40
Ø 60

Turn to release (EN 418/ISO 13850)
ZB4 BS8●4
see page 26

Push-pull
ZB4 BT4/BX4
see page 27

Turn to release
ZB4 BS44/BS54/BS64
see page 27

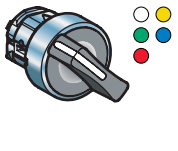


Ø 30
Ø 40
Ø 60

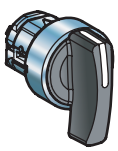
Key release (EN 418/ISO 13850)
ZB4 BS9●4
see page 26

Key release
ZB4 BS74/BS14/BS24
see page 27

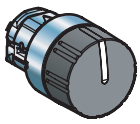
For selector switches and key switches



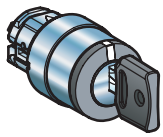
Standard black handle *(1)*
ZB4 BD●
see page 30



Long black handle *(1)*
ZB4 BJ●
see page 34

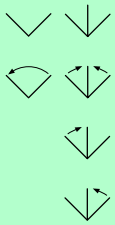


Knurled black knob *(1)*
ZB4 BD●9
see page 31

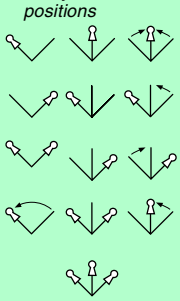


Key switch *(2)*
ZB4 BG●●/
BG●TEC10
see page 35

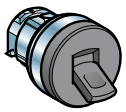
(1) Switch handle and knob positions



(2) Key switch positions
Key withdrawal positions

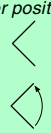


For toggle switches



2-position lever *(3)*
ZB4 BD●8, see page 31

(3) Lever positions



Control and signalling units Ø 22

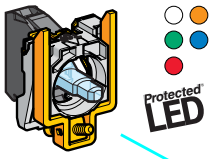
Harmony® XB4, metal

Pushbuttons, switches and pilot lights: sub-assemblies, ZB4 B

Pilot lights for user assembly

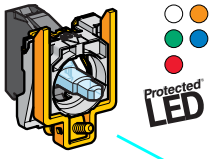
Signalling functions

Body sub-assemblies with integral LED



Connection: screw clamp terminals

ZB4 BVJ/BVB/BVG/BVM
see page 48

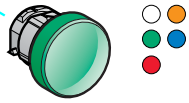


Connection: plug-in connector

ZB4 BVB●4/BVG●4/BVM●4

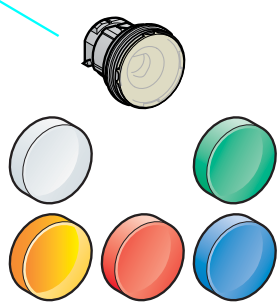
please consult your Regional Sales Office

Head sub-assemblies



With lens fitted

ZB4 BV0●3
see page 36



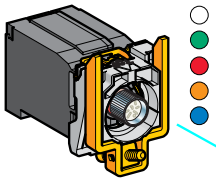
With 5 separate lenses, not fitted

ZB4 BV003
see page 36

Body sub-assemblies for BA 9s bulb

Direct supply
Connection: screw clamp terminals

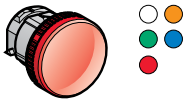
ZB4 BV6
see page 49



Via integral transformer
Connection: screw clamp terminals

ZB4 BV●D●
see page 49

Head sub-assemblies



With lens fitted

ZB4 BV0●, ZB4 BV0●S
see page 37

Control and signalling units Ø 22

Harmony® XB4, metal

Pushbuttons, switches and pilot lights: sub-assemblies, ZB4 B

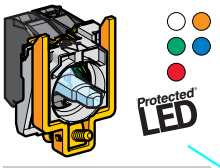
Illuminated pushbuttons for user assembly

Combined functions (contact + signalling)

For illuminated pushbuttons, spring return

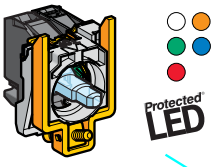
Body sub-assemblies with integral LED

Head sub-assemblies, chromium plated or black metal bezel



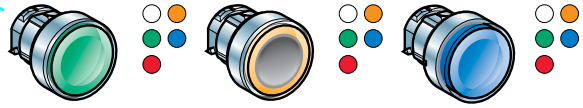
Screw clamp terminals

ZB4 BW0B/BW0G/ BW0M see pages 44 and 45



Plug-in connector

ZB4 BW0B●●4 please consult your Regional Sales Office



Flush push

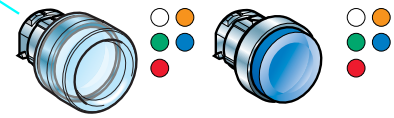
ZB4 BW3●3 see page 20

Flush push with illuminated ring

ZB4 BW9●3 see page 20

Flush push for insertion of legend

ZB4 BA●8 see page 20



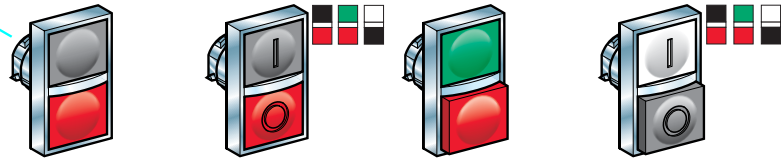
Booted flush push

ZB4 BW5●3 see page 20

Projecting push

ZB4 BW1●3, ZB4 BW1●3S see page 20

For double-headed pushbuttons, spring return, with pilot light



Flush push
Unmarked/with marking

ZB4 BW81●●●3 see page 22

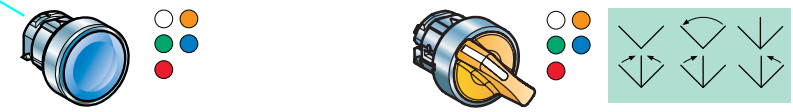
ZB4 BW82●●●3 see page 23

Flush push + projecting push
Unmarked/with marking

ZB4 BW83●●●3 see page 22

ZB4 BW84●●●3 see page 23

For illuminated "push-push to release" pushbuttons and illuminated selector switches with standard handle



Flush or projecting "push-push to release"

ZB4 BH0●3/BH●3 see page 29

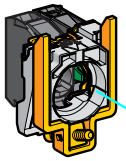
Selector switches with standard handle

ZB4 BK1●●3 see page 33

Body sub-assemblies for BA 9s bulb

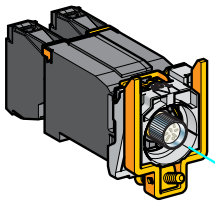
Head sub-assemblies, chromium plated or black metal bezel

For illuminated pushbuttons, spring return



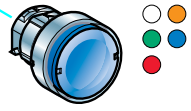
Direct supply
Screw clamp terminals

ZB4 BW06● see page 46



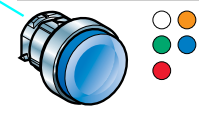
Via integral transformer
Screw clamp terminals

ZB4 BW0●D●5 see page 46



Flush push

ZB4 BW3●, ZB4 BW3●S see page 21



Projecting push

ZB4 BW1●, ZB4 BW1●S see page 21

Characteristics : pages 10 to 13

References : pages 16 to 49

Dimensions : pages 62 to 73

Control and signalling units Ø 22
Harmony® XB4, metal
Pushbuttons, switches and pilot lights

Environment

Protective treatment standard version			"TH"
Ambient air temperature around the device	Storage	**°C**	- 40…+ 70
	Operation	**°C**	- 25…+ 70: LED and neon bulb versions - 25…+ 55: incandescent bulb version
Electric shock protection	Conforming to IEC 60536		Class I
Degree of protection	Conforming to IEC 60529		IP 66 IP 69 K (Selector switch)
	Conforming to NEMA		NEMA type 4X and 13, unless otherwise stated
Resistance to high pressure washer		**Pa**	70 x 10^5 (70 bar); distance: 0.1 m Temperature: 55°C
Mechanical shock protection	Conforming to IEC 50102		Non illuminated heads: IK 03 Illuminated heads: IK 05 Selector switch heads: IK 06
Conforming to standards			IEC/EN 60947-1, IEC/EN 60947-5-1, IEC/EN 60947-5-4, IEC/EN 60947-5-5, EN 418/ISO 13850 (trigger action Emergency stops and mechanical latching pushbuttons, see page 26), JIS C 4520, UL 508, CSA C22-2 n° 14
Product certifications	UL Listed, CSA		Standard single contacts with screw clamp terminals: A600; Q600 Double contacts with screw clamp terminals: A600; Q600 Light blocks with screw clamp terminals Joystick controllers XD4 PA/ZD4 PA: A600; R300 Special contact blocks: □ ZBE 201: A300; Q300 □ ZBE 202: A600; Q600
	UL Recognized, CSA		Standard single contacts for plug-in connector: A300; R300 Standard contacts for printed circuit board: B300; R300
	BV, RINA, LROS, DNV, GL		Standard single contacts and double contacts with screw clamp terminals:
Terminal referencing	Conforming to EN 50005 and EN 50013		

Characteristics of contact or combined contact and signalling functions (see page 14)

Mechanical characteristics

Contact operation	N/C or N/O		Slow break
Positive operation	Conforming to IEC/EN 60947-5-1 appendix K		All functions incorporating a N/C contact have positive opening operation
Operating travel (to change the electrical state)	Pushbutton	**mm**	Changing N/C state: 1.5 Changing N/O state: 2.6 Total travel: 4.3
Operating force	Pushbutton	**N**	Changing N/C state: 3.5 Changing N/O state: 3.8
	Additional contact only (extra to change state)	**N**	Single N/C contact: 2 Single N/O contact: 2.3
		N	Double N/C contact: 3.4 Double N/O contact: 5 Double contact N/C + N/O: 4.6
	Emergency stop with N/C + N/O	**N**	Standard push-pull: 45 Trigger action push-pull: 50
		N	Standard turn to release and key release: 40 Standard turn to release and key release, trigger action: 44

General:
pages 2 to 9

References:
pages 16 to 59

Dimensions:
pages 62 to 73

Characteristics of contact or combined contact and signalling functions (continued) **(see page 14)**

Mechanical characteristics (continued)

Operating torque (to change the electrical state)	Selector switches		**N.m**	N/O contact: 0.14
	Additional contact only		**N.m**	N/O contact: 0.05
Mechanical durability (in millions of operating cycles)	Pushbutton	Spring return		5
		Double-headed		1
		Push-push to release		0.5
	Selector switch	Non illuminated		1
		Illuminated		0.5
	Toggle switch			0.5
	Emergency stop pushbutton			0.3 with 3 contacts
	Joystick controller			1
	Standard contact block only			5
	Low power switching contact block only (dust protected)			0.5
Vibration resistance	Conforming to IEC 60068-2-6			Frequency: 2 to 500 Hz: 5 gn
Electric shock resistance	Conforming to IEC 60068-2-27			All functions except mushroom head pushbuttons, spring return: □ half sine wave acceleration 11 ms: 50 gn □ half sine wave acceleration 18 ms: 30 gn
				Mushroom head pushbutton, spring return □ half sine wave acceleration 11 ms: 10 gn

Electrical characteristics

Cabling capacity	Conforming to EN60947-1	**mm²**	Screw clamp terminals Min: 1 x 0.22 without cable end Max: 2 x 1.5 with cable end Cross headed screw (Pozidriv or Philips type 1), slotted for flat 4 and 5.5 mm screwdriver Tightening torque: 0.8 N.m (max 1.2 N.m)
Contact material	Silver alloy (Ag / Ni)		Standard single and double blocks with screw clamp terminals Blocks for plug-in connector Standard blocks for printed circuit board connection
	Gold flashed (Ag / Ni / Au)		Low power switching contact blocks with screw clamp terminals Low power switching contact blocks for printed circuit board connection
Short-circuit protection	Conforming to IEC/EN 60947-5-1	**A**	Standard single and double blocks with screw clamp terminals: 10 (gG cartridge fuse conforming to IEC 60269-1) Blocks for plug-in connector: 4 (gG cartridge fuse conforming to IEC 60269-1) Standard blocks for printed circuit board connection: 4 (gG cartridge fuse conforming to IEC 60269-1)
Rated thermal current	Conforming to IEC/EN 60947-5-1	**A**	Standard single and double blocks with screw clamp terminals: 10 Blocks for plug-in connector: 10 Standard blocks for printed circuit board connection: 6
Rated insulation voltage	Conforming to EN60947-1	**V**	Standard single and double blocks with screw clamp terminals: Ui = 600, degree of pollution 3 Blocks for plug-in connector or Faston connectors: Ui = 250, degree of pollution 3 Standard blocks for printed circuit board connection: Ui = 250, degree of pollution 3
Rated impulse withstand voltage	Conforming to EN60947-1	**kV**	Standard single and double blocks with screw clamp terminals: Uimp = 6 Blocks for plug-in connector: Uimp = 4 Standard blocks for printed circuit board connection: Uimp = 4

Characteristics of contact or combined contact and signalling functions (continued) (see page 14)

Electrical characteristics (continued)

Rated operational characteristics Conforming to IEC/EN 60947-5-1	a.c. supply: utilisation category AC-15		Standard single and double blocks with screw clamp terminals: A600: Ue = 600 V and Ie = 1.2 A or Ue = 240 V and Ie = 3 A or Ue = 120 V and Ie = 6 A Blocks for plug-in connector: A300: Ue = 120 V and Ie = 6 A or Ue = 240 V and Ie = 3 A Standard blocks for printed circuit board connection: B300: Ue = 120 V and Ie = 3 A or Ue = 240 V and Ie = 1.5 A Special contact blocks: □ ZBE 201: A300: Ue = 240 V and Ie = 3 A or Ue = 120 V and Ie = 6 A (with insulation voltage Ui = 500 V) □ ZBE 202: A600: Ue = 600 V and Ie = 1.2 A or Ue = 240 V and Ie = 3 A or Ue = 120 V and Ie = 6 A
	d.c.supply: utilisation category DC-13		Standard single and double blocks with screw clamp terminals: Q600: Ue = 600 V and Ie = 0.1 A or Ue = 250 V and Ie = 0.27 A or Ue = 125 V and Ie = 0.55 A Joystick controllers XD4 PA/ZD4 PA: R300: Ue = 125 V and Ie = 0.22 A or Ue = 250 V and Ie = 0.1 A Blocks for plug-in connector: R300: Ue = 125 V and Ie = 0.22 A or Ue = 250 V and Ie = 0.1 A Standard blocks for printed circuit board connection: R300: Ue = 125 V and Ie = 0.22 A or Ue = 250 V and Ie = 0.1 A Special contact blocks: □ ZBE 201: Q300; Ue = 125 V and Ie = 0.55 A or Ue = 250 V and Ie = 0.27 A □ ZBE 202: Q600: Ue = 600 V and Ie = 0.1 A or Ue = 250 V and Ie = 0.27 A or Ue = 125 V and Ie = 0.55 A
Characteristics of special contact blocks for low power switching		**VA** **A** **V**	P max: 12 I max: 0.1 U max: 24
Electrical durability Conforming to IEC/EN 60947-5-1 appendix C Operating rate 3600 operating cycles/hour Load factor: 0.5	a.c. supply for 1 million operating cycles utilisation category AC-15		Standard single blocks with screw clamp terminals:
		V **A**	24 | 120 | 230 4 | 3 | 2
			Standard double blocks with screw clamp terminals and blocks for plug-in connector:
		V **A**	24 | 120 | 230 3 | 1.5 | 1
	d.c. supply for 1 million operating cycles utilisation category DC-13		Standard single blocks with screw clamp terminals:
		V **A**	24 | 110 0.5 | 0.2
			Standard double blocks with screw clamp terminals and blocks for plug-in connector:
		V **A**	24 | 110 0.4 | 0.15
Electrical reliability Failure rate Conforming to IEC/EN 60947-5-4	In clean environment		Standard blocks: - at 17 V and 5 mA. $\lambda < 10^{-8}$ - at 5 V and 1 mA. $\lambda < 10^{-6}$ Special blocks with gold flashed contacts, for low power switching: - at 5 V and 1 mA. $\lambda < 10^{-7}$
	In dusty environment		Special blocks with gold flashed contacts and dust protection for low power switching only: - at 5 V and 1 mA, $\lambda < 10^{-7}$

General: pages 2 to 9
References: pages 16 to 59
Dimensions: pages 62 to 73

Characteristics of illuminated units (pilot lights)

Mechanical characteristics

Vibration resistance	Conforming to IEC 60068-2-6		Frequency: 12 to 500 Hz: 5 gn
Electric shock resistance	Conforming to IEC 60068-2-27		Half sine wave acceleration 11 ms: 50 gn Half sine wave acceleration 18 ms: 30 gn

Electrical characteristics

Cabling capacity	Conforming to EN60947-1	**mm²**	Screw clamp terminals Min: 1 x 0.22 without cable end (1 x 0.34 for linking) Max: 2 x 1.5 with cable end
Rated insulation voltage	Conforming to EN60947-1	**V**	Direct supply pilot light blocks (BA 9s bulb): Ui = 250, degree of pollution 3 Pilot light blocks with integral LED: Ui = 250, degree of pollution 3 Pilot light blocks with transformer: Ui = 600, degree of pollution 3
Rated impulse withstand voltage	Conforming to EN60947-1	**kV**	Direct supply pilot light blocks (BA 9s bulb): Uimp = 4 Pilot light blocks with integral LED: Uimp = 4 Pilot light blocks with transformer: Uimp = 6

Specific characteristics of single light blocks with integral LED

Voltage limits	For rated voltage	**V**	12 V: 10 to 15 ⎓; 10.2 to 13.8 ∿ 24 V: 19.2 to 30 ⎓; 21.6 to 26.4 ∿ 24 to 120 V: 20 to 132 ≂ 48 to 120 V: 40 to 132 ∿ 240 V: 195 to 264 ∿
Current consumption	Applicable to all colours	**mA**	Blocks with ≂ 12 V supply: 18 Blocks with ≂ 24 V supply: 18 Blocks with ∿ 120 V supply: 14 Blocks with ∿ 240 V supply: 14
Service life	At rated voltage and at an ambient temperature of 25 °C	**H**	100 000
Surge withstand	Conforming to IEC 61000-4-5	**kV**	1
Resistance to fast transients	Conforming to IEC 61000-4-4	**kV**	2
Resistance to electromagnetic fields	Conforming to IEC 61000-4-3	**V/m**	10
Resistance to electrostatic discharges	Conforming to IEC 61000-4-2	**kV**	8: in free air, in insulating parts 6: on contact, on metal parts
Direct parallel connection across inductive load e.g.: contactor coil or solenoid	Maximum power of load	**VA**	For high power applications (≥ 30 VA), a **ZBZ V●** LED suppressor must be connected across the light block terminals (see page 47)
Electromagnetic emission	Conforming to IEC 55011		Class B

Specific characteristics

Body/fixing collar

Tightening torque of fixing screw		**N.m**	0.8 (max 1.2)

Hour counters and annunciators

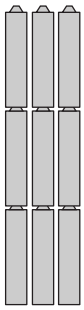
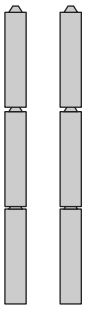
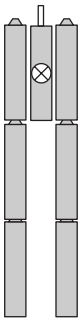
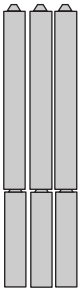
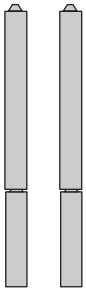
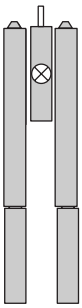
Voltage limits	Hour counter and annunciator		± 10% of the nominal voltage
Current consumption	Hour counter	**mA**	XB5 DSB: 7 to 15 XB5 DSG: 8 XB5 DSM: 8
	Annunciator	**mA**	5

Control and signalling units Ø 22

Harmony® XB4, metal

Contact mounting - Contact sequence

Maximum recommended configurations guaranteeing achievement of catalogue characteristics

Unit type (complete units XB4 B, heads ZB4 B)		Pushbuttons, spring return XB4 BA●, ZB4 BA●, XB4 BC●, ZB4 BC●, XB4 BL●, ZB4 BL●, XB4 BP●, ZB4 BP●, ZB4 BR●	Double-headed pushbuttons XB4 BL●45, ZB4 BL8●, ZB4 BA8●, ZB4 BA9●, ZB4 BL9●	Illuminated pushbuttons XB4 BW●, ZB4 BW● Illuminated double-headed pushbuttons XB4 BW84●, ZB4 BW8●●●●●3	
Solution using single contacts					
Solution using single and double contacts					
Maximum recommended configurations	Single contacts	9	6	6	
	Double contacts + single contacts	3 + 3	2 + 2	2 + 2	
	Light block	–	–	1	

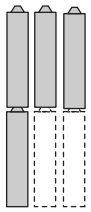
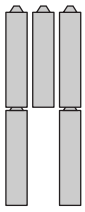
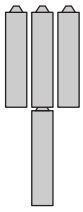
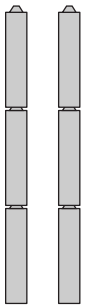
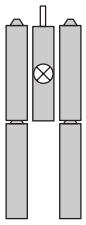
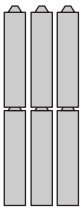
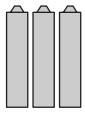
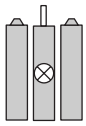
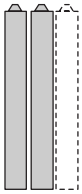
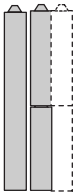
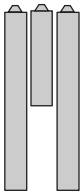
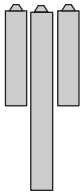
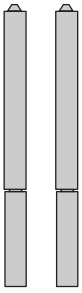
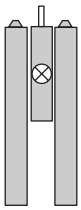
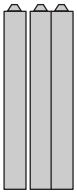
Single contact

Double contact

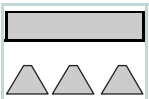
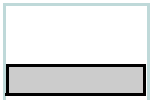
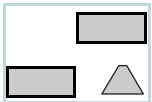
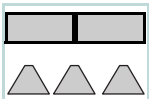
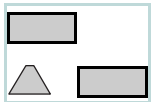
Light block

Possible location

General : pages 2 to 9 | Characteristics : pages 10 to 13 | References : pages 16 to 59 | Dimensions : pages 62 to 73

	Emergency Stop XB4BT●, ZB4BT●, XB4BS●, ZB4BS●		Selector switches ■ Standard handle XB4 BD●, ZB4 BD●, ■ Long handle XB4 BJ●, ZB4 BJ●, ■ Knurled knob ZB4 BD●9, ■ Key switch XB4 BG●, ZB4 BG●			Illuminated selector switches with standard handle XB4 BK●, ZB4 BK●	Toggle switches ZB4 BD●8	Pushbuttons, push-push ZB4 BH●	Illuminated pushbuttons push-push ZB4 BH●3
									
								–	–
	4	4	5	4	6	4	6	3	2
	2 + 0	1 + 2	2 + 1	1 + 2	2 + 2	2 + 0	3 + 0	–	–
	–	–	–	–	–	1	–	–	1

Sequence of contacts fitted to selector switch bodies

Unit type			Selector switches													
			2-position						3-position							
			315°			45°			315°			0°			45°	
Push	Position	Up															
		Down														
	Location		L	C	R	L	C	R	L	C	R	L	C	R	L	C	R
	State		0	0	0	1	1	1	1	1	0	0	0	0	0	1	1
Contacts	N/O		□	□	□	■	■	■	■	■	□	□	□	□	□	■	■
	N/C		■	■	■	□	□	□	□	□	■	■	■	■	■	□	□

L left, C centre, R right

□ open, ■ closed

Control and signalling units Ø 22

Harmony® XB4, metal

Spring return pushbuttons, unmarked

Assembly of other products using:
body/contact assemblies: see page 40
accessories: see pages 50 and 52

814084

XB4 BA31

814141

ZB4 BA0

814142

ZB4 BA4

814143

ZB4 BA38

103541

ZB4 BA34

814146

ZB4 BA36

Pushbuttons with flush push *(1)*

Screw clamp terminal connections

Shape of head	Type of push	Type of contact N/O	Type of contact N/C	Colour of push	Reference	Weight kg
Complete units						
	Flush	1	–	Black	**XB4 BA21** (ZB4 BZ101 + ZB4 BA2)	0.080
				Green	**XB4 BA31** (ZB4 BZ101 + ZB4 BA3)	0.080
				Yellow	**XB4 BA51** (ZB4 BZ101 + ZB4 BA5)	0.080
				Blue	**XB4 BA61** (ZB4 BZ101 + ZB4 BA6)	0.080
		–	1	Red	**XB4 BA42** (ZB4 BZ102 + ZB4 BA4)	0.080
Heads only						
	Without cap *(2)*			–	**ZB4 BA0**	0.028
	Flush, with set of 6 coloured caps			6 colours *(3)*	**ZB4 BA9**	0.038
	Flush			White	**ZB4 BA1**	0.029
				Black	**ZB4 BA2**	0.029
				Green	**ZB4 BA3**	0.029
				Red	**ZB4 BA4**	0.029
				Yellow	**ZB4 BA5**	0.029
				Blue	**ZB4 BA6**	0.029
				Grey	**ZB4 BA8**	0.029
	Flush with transparent cap for insertion of legend *(4)*			White	**ZB4 BA18**	0.028
				Green	**ZB4 BA38**	0.028
				Red	**ZB4 BA48**	0.028
				Yellow	**ZB4 BA58**	0.028
				Blue	**ZB4 BA68**	0.028
	Flush (high bezel)			White	**ZB4 BA14**	0.034
				Black	**ZB4 BA24**	0.034
				Green	**ZB4 BA34**	0.034
				Red	**ZB4 BA44**	0.034
				Yellow	**ZB4 BA54**	0.034
				Blue	**ZB4 BA64**	0.034

Pushbuttons with recessed push *(1)*

High guard

Shape of head	Type of push	Colour	Reference	Weight kg
Heads only				
	Recessed (high guard)	White	**ZB4 BA16**	0.034
		Black	**ZB4 BA26**	0.034
		Green	**ZB4 BA36**	0.034
		Red	**ZB4 BA46**	0.034
		Yellow	**ZB4 BA56**	0.034
		Blue	**ZB4 BA66**	0.034

Heads with black metal bezel

To order, add a figure **7** to the references listed above.
Example: **ZB4 BA0** becomes **ZB4 BA07**.

(1) Recommended maximum number of contacts constituting the body (fixing collar + contact) associated with the head, see page 14.
(2) Coloured cap to be ordered separately: see page 50.
(3) Head supplied with 6 different coloured caps (white, black, green, red, yellow, blue) not fitted.
(4) For legend ordering information, see page 52.

Control and signalling units Ø 22

Harmony® XB4, metal

Spring return pushbuttons, unmarked

Assembly of other products using:
body/contact assemblies: see page 40
accessories: see pages 50 and 52

814087

XB4 BL42

109495

ZB4 BL1

110009

XB4 BP21

814144

ZB4 BP18

814144

ZB4 BP18

103542

ZB4 BP2S

Pushbuttons with projecting push *(1)*

Screw clamp terminal connections

Shape of head	Type of push	Type of contact N/O	Type of contact N/C	Colour of push	Reference	Weight kg
Complete units						
	Projecting	–	1	Red	**XB4 BL42** (ZB4 BZ102 + ZB4 BL4)	0.081
Heads only						
	Projecting			White	**ZB4 BL1**	0.030
				Black	**ZB4 BL2**	0.030
				Green	**ZB4 BL3**	0.030
				Red	**ZB4 BL4**	0.030
				Yellow	**ZB4 BL5**	0.030
				Blue	**ZB4 BL6**	0.030

Pushbuttons with booted head *(1)*

Screw clamp terminal connections

Shape of head	Type of push	Type of contact N/O	Type of contact N/C	Colour of push	Reference	Weight kg
Complete units						
	Booted, clear silicone (colour of push unobscured)	1	–	Black	**XB4 BP21** (ZB4 BZ101 + ZB4 BP2)	0.082
				Green	**XB4 BP31** (ZB4 BZ101 + ZB4 BP3)	0.082
				Yellow	**XB4 BP51** (ZB4 BZ101 + ZB4 BP5)	0.082
				Blue	**XB4 BP61** (ZB4 BZ101 + ZB4 BP6)	0.082
		–	1	Red	**XB4 BP42** (ZB4 BZ102 + ZB4 BP4)	0.082
Heads only						
	Flush, booted (clear), for insertion of legend *(2)* (colour of push unobscured)			White	**ZB4 BP18**	0.034
				Green	**ZB4 BP38**	0.034
				Red	**ZB4 BP48**	0.034
				Yellow	**ZB4 BP58**	0.034
				Blue	**ZB4 BP68**	0.034
	Flush, booted (clear), integral boot (colour of push unobscured)			White	**ZB4 BP18**	0.026
				Green	**ZB4 BP383**	0.026
				Red	**ZB4 BP483**	0.026
				Yellow	**ZB4 BP583**	0.026
				Blue	**ZB4 BP683**	0.026
	Projecting, booted (clear silicone) (colour of push unobscured)			White	**ZB4 BP1**	0.031
				Black	**ZB4 BP2**	0.031
				Green	**ZB4 BP3**	0.031
				Red	**ZB4 BP4**	0.031
				Yellow	**ZB4 BP5**	0.031
				Blue	**ZB4 BP6**	0.031
	Projecting, booted (coloured silicone) can be replaced without dismantling the head, compatible with legend holder			White	**ZB4 BP1S**	0.034
				Black	**ZB4 BP2S**	0.034
				Green	**ZB4 BP3S**	0.034
				Red	**ZB4 BP4S**	0.034
				Yellow	**ZB4 BP5S**	0.034
				Blue	**ZB4 BP6S**	0.034

Heads with black metal bezel

To order, add a figure **7** to the references selected above.
Example: **ZB4 BP18** becomes **ZB4 BP187**.

(1) Recommended maximum number of contacts constituting the body (fixing collar + contact) associated with the head, see page 14.
(2) For legend ordering information, see page 52.

General : pages 2 to 9
Characteristics : pages 10 to 13
Dimensions : pages 62 to 73

Control and signalling units Ø 22

Harmony® XB4, metal

Spring return pushbuttons, with marking

Assembly of other products using:
body/contact assemblies: see page 40
accessories: see pages 50 and 52

814085

XB4 BA4322

814151

ZB4 BA331

814152

ZB4 BA334

814153

ZB4 BL432

Pushbuttons with flush or projecting push *(1)*

Screw clamp terminal connections

Shape of head	Type of push	Type of contact N/O	Type of contact N/C	Marking Text (colour)	Colour of push	Reference	Weight kg
Complete units							
	Flush	1	–	"I" (white)	Green	**XB4 BA3311** (ZB4 BZ101 + ZB4 BA331)	0.080
	Flush	–	1	"O" (white)	Red	**XB4 BA4322** (ZB4 BZ102 + ZB4 BA432)	0.080
	Projecting	–	1	"O" (white)	Red	**XB4 BL4322** ▲ (ZB4 BZ102 + ZB4 BL432)	0.080
	Flush *(2)*	1	–	↑ (black)	White	**XB4 BA3341** (ZB4 BZ101 + ZB4 BA334)	0.080
	Flush *(2)*	1	–	↑ (white)	Black	**XB4 BA3351** (ZB4 BZ101 + ZB4 BA335)	0.080
Heads only							
	Flush			"I" (white)	Green	**ZB4 BA331**	0.029
				"I" (black)	White	**ZB4 BA131**	0.029
				"II" (white)	Green	**ZB4 BA336**	0.029
				"II" (black)	White	**ZB4 BA136**	0.029
				"START" (white)	Green	**ZB4 BA333**	0.029
				"START" (black)	White	**ZB4 BA133**	0.029
				"ON" (white)	Green	**ZB4 BA341**	0.029
				"ON" (black)	White	**ZB4 BA141**	0.029
				"MARCHE" (white)	Green	**ZB4 BA342**	0.029
				"MARCHE" (black)	White	**ZB4 BA142**	0.029
				(white)	Black	**ZB4 BA245**	0.029
				(black)	White	**ZB4 BA145**	0.029
				"O" (white)	Red	**ZB4 BA432**	0.029
					Black	**ZB4 BA232**	0.029
				"ARRET" (white)	Red	**ZB4 BA433**	0.029
					Black	**ZB4 BA233**	0.029
				"STOP" (white)	Red	**ZB4 BA434**	0.029
					Black	**ZB4 BA234**	0.029
				"OFF" (white)	Red	**ZB4 BA435**	0.029
					Black	**ZB4 BA235**	0.029
				↑ (white) *(2)*	Black	**ZB4 BA335**	0.029
				↑ (black) *(2)*	White	**ZB4 BA334**	0.029
	Projecting			"O" (white)	Red	**ZB4 BL432**	0.030
					Black	**ZB4 BL232**	0.030
				"ARRET" (white)	Red	**ZB4 BL433**	0.030
					Black	**ZB4 BL233**	0.030
				"STOP" (white)	Red	**ZB4 BL434**	0.030
					Black	**ZB4 BL234**	0.030
				"OFF" (white)	Red	**ZB4 BL435**	0.030
					Black	**ZB4 BL235**	0.030

Heads with black metal bezel

To order, add a figure **7** to the references selected above.
Example: **ZB4 BA331** becomes **ZB4 BA3317**.

(1) Recommended maximum number of contacts constituting the body (fixing collar + contact) associated with the head, see page 14.
(2) Product supplied with cap not clipped-in, allowing orientation through 360° in 90° steps.

▲ Available:
3rd quarter 2006.

General : pages 2 to 9
Characteristics : pages 10 to 13
Dimensions : pages 62 to 73

Control and signalling units Ø 22

Harmony® XB4, metal

Illuminated pushbuttons, spring return, with integral LED

Assembly of other products using:
body/contact assemblies: see page 40
combined sub-assemblies: see page 44
accessories: see page 52

Illuminated pushbuttons with flush push *(1)*

Screw clamp terminal connections

Shape of head	Description	Type of contact N/O	Type of contact N/C	Supply voltage V	Colour of push	Reference	Weight kg
Complete units - With plain lens							
XB4 BW33B5	**Integral LED** Protected LED	1	1	≂ 24	White	**XB4 BW31B5** (ZB4 BW0B15 + ZB4 BW313)	0.097
					Green	**XB4 BW33B5** (ZB4 BW0B35 + ZB4 BW333)	0.097
					Red	**XB4 BW34B5** (ZB4 BW0B45 + ZB4 BW343)	0.097
					Orange	**XB4 BW35B5** (ZB4 BW0B55 + ZB4 BW353)	0.097
					Blue	**XB4 BW36B5** (ZB4 BW0B65 + ZB4 BW363)	0.097
XB4 BW34G5				~ 48...120	White	**XB4 BW31G5** (ZB4 BW0G15 + ZB4 BW313)	0.097
					Green	**XB4 BW33G5** (ZB4 BW0G35 + ZB4 BW333)	0.097
					Red	**XB4 BW34G5** (ZB4 BW0G45 + ZB4 BW343)	0.097
					Orange	**XB4 BW35G5** (ZB4 BW0G55 + ZB4 BW353)	0.097
					Blue	**XB4 BW36G5** (ZB4 BW0G65 + ZB4 BW363)	0.097
				~ 230…240	White	**XB4 BW31M5** (ZB4 BW0M15 + ZB4 BW313)	0.097
					Green	**XB4 BW33M5** (ZB4 BW0M35 + ZB4 BW333)	0.097
					Red	**XB4 BW34M5** (ZB4 BW0M45 + ZB4 BW343)	0.097
					Orange	**XB4 BW35M5** (ZB4 BW0M55 + ZB4 BW353)	0.097
					Blue	**XB4 BW36M5** (ZB4 BW0M65 + ZB4 BW363)	0.097

(1) Recommended maximum number of contacts constituting the body (fixing collar + contact) associated with the head, see page 14.

Control and signalling units Ø 22

Harmony® XB4, metal

Illuminated pushbuttons, spring return, with integral LED

Assembly of other products using:
combined sub-assemblies: see page 44
accessories: see page 52

ZB4 BW333

ZB4 BW563

ZB4 BW113

Illuminated pushbuttons with flush push *(1)*

Shape of head	Type of push	Colour	Reference	Weight kg
Heads only *(2)* **- With plain lens**				
	Flush	White	**ZB4 BW313**	0.026
		Green	**ZB4 BW333**	0.026
		Red	**ZB4 BW343**	0.026
		Orange	**ZB4 BW353**	0.026
		Blue	**ZB4 BW363**	0.026
	Flush with illuminated ring	White	**ZB4 BW913**	0.026
		Green	**ZB4 BW933**	0.026
		Red	**ZB4 BW943**	0.026
		Orange	**ZB4 BW953**	0.026
		Blue	**ZB4 BW963**	0.026
	Flush with clear boot	White	**ZB4 BW513**	0.031
		Green	**ZB4 BW533**	0.031
		Red	**ZB4 BW543**	0.031
		Orange	**ZB4 BW553**	0.031
		Blue	**ZB4 BW563**	0.031
	Flush for insertion of legend *(3)*	White	**ZB4 BA18**	0.028
		Green	**ZB4 BA38**	0.028
		Red	**ZB4 BA48**	0.028
		Orange	**ZB4 BA58**	0.028
		Blue	**ZB4 BA68**	0.028
Heads only *(2)* **- With grooved lens** *(4)*				
	Flush	White	**ZB4 BW313S**	0.026
		Green	**ZB4 BW333S**	0.026
		Red	**ZB4 BW343S**	0.026
		Orange	**ZB4 BW353S**	0.026
		Blue	**ZB4 BW363S**	0.026

Illuminated pushbuttons with projecting push *(1)*

Shape of head	Type of push	Colour	Reference	Weight kg
Heads only *(2)* **- With plain lens**				
	Projecting	White	**ZB4 BW113**	0.029
		Green	**ZB4 BW133**	0.029
		Red	**ZB4 BW143**	0.029
		Orange	**ZB4 BW153**	0.029
		Blue	**ZB4 BW163**	0.029
Heads only *(2)* **- With grooved lens** *(4)*				
	Projecting	White	**ZB4 BW113S**	0.026
		Green	**ZB4 BW133S**	0.026
		Red	**ZB4 BW143S**	0.026
		Orange	**ZB4 BW153S**	0.026
		Blue	**ZB4 BW163S**	0.026

Heads with black metal bezel

To order, add a figure **7** to the references selected above.
Example: **ZB4 BW313** becomes **ZB4 BW3137**.
Example 2: **ZB4 BW313S** becomes **ZB4 BW313S7**.

(1) Recommended maximum number of contacts constituting the body (fixing collar + contact) associated with the head, see page 14.
(2) Only for use with bodies comprising a light source with integral LED.
(3) For legend ordering information, see page 52.
(4) For use in bright ambient light conditions (outdoors in sunlight, for example).

Control and signalling units Ø 22

Harmony® XB4, metal

Illuminated pushbuttons, spring return, with BA 9s base fitting

Assembly of other products using:
combined sub-assemblies: see page 46
accessories: see page 52

XB4 BW3545

ZB4 BW33

ZB4 BW14

Illuminated pushbuttons with flush push *(1)*

Screw clamp terminal connections

Shape of head	Description	Type of contact N/O	Type of contact N/C	Supply voltage V	Colour of push	Reference	Weight kg
Complete units - With plain lens							
	Direct supply for bulb with BA 9s base fitting, 2.4 W max **(bulb not included)**	1	1	≤ 250	White	**XB4 BW3165** (ZB4 BW065 + ZB4 BW31)	0.097
					Green	**XB4 BW3365** (ZB4 BW065 + ZB4 BW33)	0.097
					Red	**XB4 BW3465** (ZB4 BW065 + ZB4 BW34)	0.097
					Orange	**XB4 BW3565** (ZB4 BW065 + ZB4 BW35)	0.097
	Via integral transformer 1.2 VA, 6 V secondary, incandescent bulb with BA 9s base fitting **(bulb included)**	1	1	∿110…120 50/60 Hz	White	**XB4 BW3135** (ZB4 BW035 + ZB4 BW31)	0.169
					Green	**XB4 BW3335** (ZB4 BW035 + ZB4 BW33)	0.169
					Red	**XB4 BW3435** (ZB4 BW035 + ZB4 BW34)	0.169
					Orange	**XB4 BW3535** (ZB4 BW035 + ZB4 BW35)	0.169
				∿ 230 50 Hz ∿220…240 60 Hz	White	**XB4 BW3145** (ZB4 BW045 + ZB4 BW31)	0.170
					Green	**XB4 BW3345** (ZB4 BW045 + ZB4 BW33)	0.170
					Red	**XB4 BW34M5** (ZB4 BW045 + ZB4 BW34)	0.170
					Orange	**XB4 BW3545** (ZB4 BW045 + ZB4 BW35)	0.170
Heads only *(2)* **- With plain lens**							
	Flush				White	**ZB4 BW31**	0.027
					Green	**ZB4 BW33**	0.027
					Red	**ZB4 BW34**	0.027
					Orange	**ZB4 BW35**	0.027
					Blue	**ZB4 BW36**	0.027
					Clear	**ZB4 BW37**	0.027
Heads only *(2)* **- With grooved lens** *(3)*							
	Flush				White	**ZB4 BW31S**	0.027
					Green	**ZB4 BW33S**	0.027
					Red	**ZB4 BW34S**	0.027
					Orange	**ZB4 BW35S**	0.027
					Blue	**ZB4 BW36S**	0.027
					Clear	**ZB4 BW37S**	0.027

Illuminated pushbuttons with projecting push *(1)*

Heads only *(2)* **- With plain lens**							
	Projecting				White	**ZB4 BW11**	0.028
					Green	**ZB4 BW13**	0.028
					Red	**ZB4 BW14**	0.028
					Orange	**ZB4 BW15**	0.028
					Blue	**ZB4 BW16**	0.028
					Clear	**ZB4 BW17**	0.028
Heads only *(2)* **- With grooved lens** *(3)*							
	Projecting				White	**ZB4 BW11S**	0.027
					Green	**ZB4 BW13S**	0.027
					Red	**ZB4 BW14S**	0.027
					Orange	**ZB4 BW15S**	0.027
					Blue	**ZB4 BW16S**	0.027
					Clear	**ZB4 BW17S**	0.027

Heads with black metal bezel

To order, add a figure **7** to the references selected above.
Example: **ZB4 BW31** becomes **ZB4 BW317**. Example 2: **ZB4 BW31S** becomes **ZB4 BW31S7**.

(1) Recommended maximum number of contacts constituting the body (fixing collar + contact) associated with the head, see page 14.
(2) Only for use with bodies comprising a light source with BA9s base fitting bulb (incandescent, neon or LED).
(3) For use in bright ambient light conditions (outdoors in sunlight, for example).

General : pages 2 to 9
Characteristics : pages 10 to 13
Dimensions : pages 62 to 73

Control and signalling units Ø 22

Harmony® XB4, metal

Double-headed pushbuttons, spring return, unmarked

Assembly of other products using:
combined sub-assemblies: see page 44
accessories: see pages 51 and 52

814160

ZB4 BA8134

814161

ZB4 BL8312

814162

ZB4 BL9312

Double-headed pushbuttons *(1)*

Shape of head	Description	Colour of pushes	Degree of protection	Reference	Weight kg
Heads only					
	2 flush pushes	Green Red	IP 40	**ZB4 BA8134**	0.047
			IP 66	**ZB4 BA9134**	0.052
		White Black	IP 40	**ZB4 BA8112**	0.047
			IP 66	**ZB4 BA9112**	0.052
	1 flush push **1 projecting push**	Green Red	IP 40	**ZB4 BL8334**	0.046
			IP 66	**ZB4 BL9334**	0.051
		White Black	IP 40	**ZB4 BL8312**	0.046
			IP 66	**ZB4 BL9312**	0.051

814246

ZB4 BW812743

Double-headed pushbuttons with pilot light (IP 40) *(1) (2)*

Shape of head	Description	Colour of pushes	Colour of pilot light	Reference	Weight kg
Heads only *(3)*					
 	1 flush push **1 central pilot light** **1 flush push**	Black Red	Clear *(4)*	**ZB4 BW812743**	0.047
		Green Red	Clear *(4)*	**ZB4 BW813743**	0.047
		White Black	Clear *(4)*	**ZB4 BW811723**	0.047
 	1 flush push **1 central pilot light** **1 projecting push**	Black Red	Clear *(4)*	**ZB4 BW832743**	0.046
		Green Red	Clear *(4)*	**ZB4 BW833743**	0.046
		White Black	Clear *(4)*	**ZB4 BW831723**	0.046

Heads with black metal bezel

To order, add a figure **7** to the references selected above.
Example: **ZB4 BA8134** becomes **ZB4 BA81347**.

(1) Recommended maximum number of contacts constituting the body (fixing collar + contact) associated with the head, see page 14.
*(2) For a head with IP 66 degree of protection or NEMA type 4X, fit a clear sealing boot **ZBW 008**, see page 51.*
(3) Only for use with bodies comprising a light source with integral LED.
(4) Colour of centrally positioned pilot light determined by the colour of the LED incorporated in the body sub-assembly.

General : pages 2 to 9
Characteristics : pages 10 to 13
Dimensions : pages 62 to 73

Control and signalling units Ø 22

Harmony® XB4, metal

Double-headed pushbuttons, spring return, with marking

Assembly of other products using:
combined sub-assemblies: see page 44
accessories: see pages 51 and 52

814089

XB4 BL845

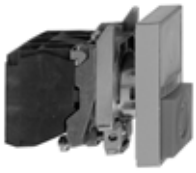
814164

ZB4 BL8434

814163

ZB4 BL8412

814130



XB4 BW84B5

814247

ZB4 BW823743

814248

ZB4 BW841723

Double-headed pushbuttons *(1)*

Screw clamp terminal connections

Shape of head	Description	Type of contact N/O	Type of contact N/C	Colour of pushes	Degree of protection	Reference	Weight kg
Complete units							
	1 flush green push (marked “I”) **1 projecting red push** (marked “O”)	1	1	Green Red	IP 40	**XB4 BL845** (ZB4 BZ105 + ZB4 BL8434)	0.106
					IP 66	**XB4 BL945** (ZB4 BZ105 + ZB4 BL9434)	0.111
Heads only							
	2 flush pushes (marked “I”) (marked “O”)			Green Red	IP 40	**ZB4 BA8234**	0.047
					IP 66	**ZB4 BA9234**	0.052
				White Black	IP 40	**ZB4 BA8212**	0.047
					IP 66	**ZB4 BA9212**	0.052
	1 flush push (marked “I”) **1 projecting push** (marked “O”)			Green Red	IP 40	**ZB4 BL8434**	0.046
					IP 66	**ZB4 BL9434**	0.051
				White Black	IP 40	**ZB4 BL8412**	0.046
					IP 66	**ZB4 BL9412**	0.051

Double-headed pushbuttons with integral LED (IP 40) *(1) (2)*

Screw clamp terminal connections

Shape of head	Description	Type of contact N/O	Type of contact N/C	Supply voltage V	Colour of pushes	Reference	Weight kg
Complete units							
Protected LED	**1 flush green push** (marked “I”) **1 yellow pilot light** **1 projecting red push** (marked “O”)	1	1	⎓ 24	Green Red	**XB4 BW84B5** (ZB4 BW0B55 + ZB4 BW843743)	0.116
				∿ 48...120	Green Red	**XB4 BW84G5** (ZB4 BW0G55 + ZB4 BW843743)	0.116
				∿ 230...240	Green Red	**XB4 BW84M5** (ZB4 BW0M55 + ZB4 BW843743)	0.116
Heads only *(3)*							
Protected LED	**1 flush push** (marked “I”) **1 clear central pilot light** *(4)* **1 flush push** (marked “O”)				Black Red	**ZB4 BW822743**	0.047
					Green Red	**ZB4 BW823743**	0.047
					White Black	**ZB4 BW821723**	0.047
Protected LED	**1 flush push** (marked “I”) **1 clear central pilot light** *(4)* **1 projecting push** (marked “O”)				Black Red	**ZB4 BW842743**	0.046
					Green Red	**ZB4 BW843743**	0.046
					White Black	**ZB4 BW841723**	0.046

Heads with black metal bezel

To order, add a figure **7** to the references selected above.
Example: **ZB4 BA8234** becomes **ZB4 BA82347.**

(1) Recommended maximum number of contacts constituting the body (fixing collar + contact) associated with the head, see page 14.
*(2) For IP 66 degree of protection or NEMA type 4, fit a clear sealing boot **ZBW 008**, see page 51.*
(3) Only for use with bodies comprising a light source with integral LED.
(4) Colour of centrally positioned pilot light determined by the colour of the LED incorporated in the body sub-assembly.

General : pages 2 to 9
Characteristics : pages 10 to 13
Dimensions : pages 62 to 73

Control and signalling units Ø 22

Harmony® XB4, metal

Mushroom head pushbuttons, spring return

Assembly of other products using:
body/contact assemblies: see page 40
accessories: see page 52

814088

XB4 BC21

814166

ZB4 BC24

814167

ZB4 BC2

814168

ZB4 BR2

103543

ZB4 BR216

ZB4 BW443

Mushroom head pushbuttons *(1) (2)*

Screw clamp terminal connections

Shape of head	Type of push	Type of contact N/O	Type of contact N/C	Push Ø (mm)	Colour	Reference	Weight kg
Complete units							
	Mushroom head	1	–	40	Black	**XB4 BC21** (ZB4 BZ101 + ZB4 BC2)	0.122
Heads only							
	Mushroom head			30	Black	**ZB4 BC24**	0.075
					Green	**ZB4 BC34**	0.075
					Red	**ZB4 BC44**	0.075
					Yellow	**ZB4 BC54**	0.075
					Blue	**ZB4 BC64**	0.075
				40	Black	**ZB4 BC2**	0.074
					Green	**ZB4 BC3**	0.074
					Red	**ZB4 BC4**	0.074
					Yellow	**ZB4 BC5**	0.074
					Blue	**ZB4 BC6**	0.074
				60	Black	**ZB4 BR2**	0.093
					Green	**ZB4 BR3**	0.093
					Red	**ZB4 BR4**	0.093
					Yellow	**ZB4 BR5**	0.093
					Blue	**ZB4 BR6**	0.093
				60 *(3)* Hemispherical	Black	**ZB4 BR216**	0.054
					Green	**ZB4 BR316**	0.054
					Red	**ZB4 BR416**	0.054
					Yellow	**ZB4 BR516**	0.054
					Blue	**ZB4 BR616**	0.054

Illuminated mushroom head pushbuttons *(1) (2)*

Integral LED

Shape of head	Type of push	Push Ø (mm)	Colour	Reference	Weight kg
Heads only *(4)*					
	Mushroom head	40	White	**ZB4 BW413**	0.051
			Green	**ZB4 BW433**	0.051
			Red	**ZB4 BW443**	0.051
			Orange	**ZB4 BW453**	0.051
			Blue	**ZB4 BW463**	0.051

Heads with black metal bezel

To order, add a figure **7** to the references selected above.
Example: **ZB4 BC24** becomes **ZB4 BC247**.

(1) These pushbuttons and heads cannot be used for an Emergency Stop function.
(2) Recommended maximum number of contacts constituting the body (fixing collar + contact) associated with the head, see page 14.
(3) Ergonomic product used in two-handed control applications. Recommended maximum number of contacts constituting the body (fixing collar + contact) associated with the head: 6.
(4) Only for use with bodies comprising a light block with integral LED.

General : pages 2 to 9
Characteristics : pages 10 to 13
Dimensions : pages 62 to 73

Control and signalling units Ø 22

Harmony® XB4, metal

Mushroom head pushbuttons, latching

Assembly of other products using:
body/contact assemblies: see page 40
accessories: see page 52

110130

ZB4 BT2

523765

ZB4 BS62

523766

ZB4 BS72

Mushroom head pushbuttons *(1) (2)*

Shape of head	Type of reset	Push Ø (mm)	Push Colour	Reference	Weight kg
Heads only					
	Push-pull	40	Black	**ZB4 BT2**	0.077
		60	Black	**ZB4 BX2**	0.095
	Turn to release	30	Black	**ZB4 BS42**	0.066
		40	Black	**ZB4 BS52**	0.070
		40	Yellow	**ZB4 BS55**	0.070
		60	Black	**ZB4 BS62**	0.090
	Key release (key n° 455) *(2 keys included with head) (3)* *(4)*	30	Black	**ZB4 BS72**	0.066
		40	Black	**ZB4 BS12**	0.070
		60	Black	**ZB4 BS22**	0.090

Heads with black metal bezel

To order, add a figure **7** to the references selected above.
Example: **ZB4 BT2** becomes **ZB4 BT27**.

(1) These pushbuttons and heads cannot be used for an Emergency Stop function.
(2) Recommended maximum number of contacts constituting the body (fixing collar + contact) associated with the head, see page 14.
(3) For specific keys with other numbers, please consult your Regional Sales Office.
(4) The symbol ⚷ indicates key withdrawal position(s).

Assembly of other products using:
body/contact assemblies: see page 40
accessories: see pages 57 and 58

Control and signalling units Ø 22

Harmony® XB4, metal
Emergency stop
Conforming to Machinery Directive 98/37/EC and standard EN 418/ISO 13850

Mushroom head Emergency stop trigger action and mechanical latching pushbuttons conform to standard EN 418/ISO 13850, to Machinery Directive 98/37/EC and to standard IEC/EN 60947-5-5. Please consult your Regional Sales Office for a full explanation of these standards and directives.

550275

XB4 BT845

550276

XB4 BS9445

550278

ZB4 BS834

Emergency stop trigger action and mechanical latching pushbuttons *(1)*

Screw clamp terminal connections

Shape of head	Type of reset	Type of contact N/O	Type of contact N/C	Push Ø (mm)	Push Colour	Reference	Weight kg
Complete units							
	Push-pull	1	1	40	Red	**XB4 BT845** (ZB4 BZ105 + ZB4 BT84)	0.136
	Turn to release	1	1	40	Red	**XB4 BS8445** (ZB4 BZ105 + ZB4 BS844)	0.130
		–	2	40	Red	**XB4 BS8444** (ZB4 BZ104 + ZB4 BS844)	0.130
		1	2	40	Red	**XB4 BS84441** (ZB4 BZ141 + ZB4 BS844)	0.140
	Key release (key n° 455) *(2)*	1	1	40	Red	**XB4 BS9445** (ZB4 BZ105 + ZB4 BS944)	0.170
Heads only							
Shape of head	**Type of reset**			**Ø mm**	**Colour**	**Reference**	**Weight kg**
	Push-pull			30	Red	**ZB4 BT844** ▲	0.078
				40	Red	**ZB4 BT84**	0.078
	Turn to release			30	Red	**ZB4 BS834**	0.068
				40	Red	**ZB4 BS844**	0.073
				60	Red	**ZB4 BS864**	0.093
	Key release (key n° 455) 2 keys included with head *(3)* *(2)*			30	Red	**ZB4 BS934**	0.094
				40	Red	**ZB4 BS944** *(4)*	0.098
				60	Red	**ZB4 BS964**	0.118

Heads with black metal bezel

To order, add a figure **7** to the references selected above.
Example: **ZB4 BT84** becomes **ZB4 BT847**.

(1) Recommended maximum number of contacts constituting the body (fixing collar + contact) associated with the head, see page 14.
(2) The symbol ⟟ indicates key withdrawal position(s).
(3) For specific keys with other numbers, please consult your Regional Sales Office.
(4) Other key numbers:
*- key n° 421E: add suffix **12** to the reference.*
*- key n° 458A: add suffix **10** to the reference.*
*- key n° 520E: add suffix **14** to the reference.*
*- key n° 3131A: add suffix **20** to the reference.*
*Example: To order a Ø 40 red mushroom head for a trigger action and mechanical latching Emergency Stop pushbutton, with release by key n° 421E, the reference becomes: **ZB4 BS94412**.*

▲ Available:
3rd quarter 2006.

General : pages 2 to 9
Characteristics : pages 10 to 13
Dimensions : pages 62 to 73

Control and signalling units Ø 22
Harmony® XB4, metal
Emergency stop

Assembly of other products using:
body/contact assemblies: see page 40
combined sub-assemblies: see page 44
accessories: see pages 57 and 58

Emergency stop mechanical latching pushbuttons conform to standard IEC/EN 60947-5-5. Please consult your Regional Sales Office for a full explanation of these standards and directives.

550277

XB4 BS542

550279

ZB4 BT4

550280

ZB4 BS64

550281

ZB4 BS74

Emergency stop mechanical latching pushbuttons *(1)*
Screw clamp terminal connections

Shape of head	Type of reset	Type of contact N/O	Type of contact N/C	Push Ø mm	Push Colour	Reference	Weight kg
Complete units							
	Push-pull	–	1	40	Red	**XB4 BT42** (ZB4 BZ102 + ZB4 BT4)	0.125
	Turn to release	–	1	40	Red	**XB4 BS542** (ZB4 BZ102 + ZB4 BS54)	0.118
	Key release (key n° 455) *(2)*	–	1	40	Red	**XB4 BS142** (ZB4 BZ102 + ZB4 BS14)	0.133
Heads only							
	Push-pull			30	Red	**ZB4 BT44** ▲	0.077
				40	Red	**ZB4 BT4**	0.077
				60	Red	**ZB4 BX4**	0.095
	Turn to release			30	Red	**ZB4 BS44**	0.066
				40	Red	**ZB4 BS54**	0.070
				60	Red	**ZB4 BS64**	0.090
	Key release (key n° 455) 2 keys included with head *(3)* *(2)*			30	Red	**ZB4 BS74**	0.066
				40	Red	**ZB4 BS14** *(4)*	0.070
				60	Red	**ZB4 BS24**	0.090

Illuminated Emergency stop, mechanical latching pushbuttons *(1)*
Screw clamp terminal connections

Shape of head	Type of reset	Push Ø mm	Push Colour	Reference	Weight kg
Heads only *(5)*					
Protected LED	**Push-pull**	40	Red	**ZB4 BW643**	0.051

Heads with black metal bezel

To order, add a figure **7** to the references selected above.
Example: **ZB4 BT4** becomes **ZB4 BT47**.

(1) Recommended maximum number of contacts constituting the body (fixing collar + contact) associated with the head, see page 14.
(2) The symbol ⚷ indicates key withdrawal position(s).
(3) For specific keys with other numbers, please consult your Regional Sales Office.
(4) Other key numbers:
*- key n° 421E: add suffix **12** to the reference.*
*- key n° 458A: add suffix **10** to the reference.*
*- key n° 520E: add suffix **14** to the reference.*
*- key n° 3131A: add suffix **20** to the reference.*
*Example: To order a Ø 40 red mushroom head for a trigger action and mechanical latching Emergency Stop pushbutton, with release by key n° 421E, the reference becomes: **ZB4 BS1412**.*
(5) Only for use with bodies comprising a light source with integral LED.

▲ Available:
3rd quarter 2006.

General : pages 2 to 9
Characteristics : pages 10 to 13
Dimensions : pages 62 to 73

Control and signalling units Ø 22
Harmony® XB4, metal
Pushbuttons, push-push

Assembly of other products using:
body/contact assemblies: see page 40
accessories: see page 52

814154

ZB4 BH02

Pushbuttons with flush push *(1)*

Shape of head	Type of push	Colour of push	Reference	Weight kg
Heads only				
	Flush	White	**ZB4 BH01**	0.029
		Black	**ZB4 BH02**	0.029
		Green	**ZB4 BH03**	0.029
		Red	**ZB4 BH04**	0.029
		Yellow	**ZB4 BH05**	0.029
		Blue	**ZB4 BH06**	0.029

523792

ZB4 BH6

Pushbuttons with projecting push *(1)*

Shape of head	Type of push	Colour of push	Reference	Weight kg
Heads only				
	Projecting	White	**ZB4 BH1**	0.029
		Black	**ZB4 BH2**	0.029
		Green	**ZB4 BH3**	0.029
		Red	**ZB4 BH4**	0.029
		Yellow	**ZB4 BH5**	0.029
		Blue	**ZB4 BH6**	0.029

Heads with black metal bezel

To order, add a figure **7** to the references selected above.
Example: **ZB4 BH01** becomes **ZB4 BH017**.

(1) Recommended maximum number of contacts constituting the body (fixing collar + contact) associated with the head, see page 14.

Control and signalling units Ø 22

Harmony® XB4, metal

Illuminated pushbuttons, push-push, with integral LED

Assembly of other products using:
combined sub-assemblies: see page 44
accessories: see page 52

ZB4 BH033

Illuminated pushbuttons with flush push *(1)*

Shape of head	Type of push	Colour of lens	Reference	Weight kg
Heads only *(2)*				
Protected LED	**Flush**	White	**ZB4 BH013**	0.026
		Green	**ZB4 BH033**	0.026
		Red	**ZB4 BH043**	0.026
		Orange	**ZB4 BH053**	0.026
		Blue	**ZB4 BH063**	0.026

ZB4 BH63

Illuminated pushbuttons with projecting push *(1)*

Shape of head	Type of push	Colour of lens	Reference	Weight kg
Heads only *(2)*				
Protected LED	**Projecting**	White	**ZB4 BH13**	0.026
		Green	**ZB4 BH33**	0.026
		Red	**ZB4 BH43**	0.026
		Orange	**ZB4 BH53**	0.026
		Blue	**ZB4 BH63**	0.026

Heads with black metal bezel

To order, add a figure **7** to the references selected above.
Example: **ZB4 BH013** becomes **ZB4 BH0137**.

(1) Recommended maximum number of contacts constituting the body (fixing collar + contact) associated with the head, see page 14.
(2) Only for use with bodies comprising a light source with integral LED.

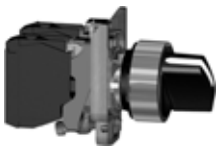
Control and signalling units Ø 22

Harmony® XB4, metal

Selector switches with standard handle

Assembly of other products using:
body/contact assemblies: see page 40
accessories: see page 52

106188



XB4 BD33

106195

ZB4 BD4

Selector switches with standard handle *(1)*

Screw clamp terminal connections

Shape of head	Type of operator	Type of contact N/O	Type of contact N/C	Positions Number	Positions Type	Reference	Weight kg
Complete units							
	Standard handle, black	1	–	2-position	Stay put	**XB4 BD21** (ZB4 BZ101 + ZB4 BD2)	0.095
		1	–		Spring return from right to left	**XB4 BD41** (ZB4 BZ101 + ZB4 BD4)	0.100
		1	1		Stay put	**XB4 BD25** (ZB4 BZ105 + ZB4 BD2)	0.095
		2	–	3-position	Stay put	**XB4 BD33** (ZB4 BZ103 + ZB4 BD3)	0.095
					Spring return to centre	**XB4 BD53** (ZB4 BZ103 + ZB4 BD5)	0.095
Heads only							
	Standard handle, black			2-position	Stay put	**ZB4 BD2**	0.040
					Spring return from right to left	**ZB4 BD4**	0.045
				3-position	Stay put	**ZB4 BD3**	0.040
					Spring return to centre	**ZB4 BD5**	0.040
					Spring return from left to centre	**ZB4 BD7**	0.040
					Spring return from right to centre	**ZB4 BD8**	0.040

Heads only with other coloured handles

Standard handle, white	add suffix **01** to the reference, example: **ZB4 BD201**
Standard handle, green	add suffix **03** to the reference, example: **ZB4 BD203**
Standard handle, red	add suffix **04** to the reference, example: **ZB4 BD204**
Standard handle, yellow	add suffix **05** to the reference, example: **ZB4 BD205**
Standard handle, blue	add suffix **06** to the reference, example: **ZB4 BD206**

Heads with black metal bezel

To order, add a figure **7** to the references selected above.
Example: **ZB4 BD2** becomes **ZB4 BD27**.

(1) Recommended maximum number of contacts and sequence of contacts constituting the body (fixing collar + contact) associated with the head, see page 14.

Control and signalling units Ø 22

Harmony® XB4, metal

Selector switches with knurled knob - Toggle switches

Assembly of other products using:
body/contact assemblies: see page 40
accessories: see page 52

106198

ZB4 BD29

Selector switches with knurled knob *(1)*

Shape of head	Type of operator	Positions		Reference	Weight kg
		Number	Type		
Heads only					
	Black knurled knob	2-position	Stay put	**ZB4 BD29**	0.043
			Spring return from right to left	**ZB4 BD49**	0.050
		3-position	Stay put	**ZB4 BD39**	0.040
			Spring return to centre	**ZB4 BD59**	0.040
			Spring return from left to centre	**ZB4 BD79**	0.040
			Spring return from right to centre	**ZB4 BD89**	0.040

814205

ZB4 BD28

Toggle switches *(1)*

Shape of head	Type of operator	Positions		Reference	Weight kg
		Number	Type		
Heads only					
	Black lever	2-position	Stay put	**ZB4 BD28**	0.026
			Spring return	**ZB4 BD48**	0.026

Heads with black metal bezel

To order, add a figure **7** to the references selected above.
Example: **ZB4 BD29** becomes **ZB4 BD297**.

(1) Recommended maximum number of contacts and sequence of contacts constituting the body (fixing collar + contact) associated with the head, see page 14.

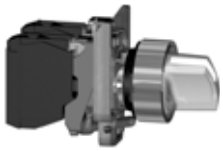
Control and signalling units Ø 22

Harmony® XB4, metal

Illuminated selector switches with standard handle, with integral LED

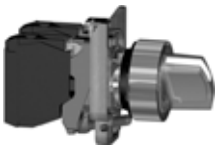
Assembly of other products using:
combined sub-assemblies: see page 44
accessories: see page 52

106192



XB4 BK123B5

106193



XB4 BK134B5

Illuminated selector switches with standard handle, with integral LED *(1)*

Screw clamp terminal connections

Shape of head	Type of operator	Type of contact N/O	Type of contact N/C	Positions Number Type	Supply voltage V	Colour of handle	Reference	Weight kg
Complete units								
	Standard handle	1	1	2-position Stay put	≂ 24	Green	**XB4 BK123B5** (ZB4 BW0B35 + ZB4 BK1233)	0.101
						Red	**XB4 BK124B5** (ZB4 BW0B45 + ZB4 BK1243)	0.101
						Orange	**XB4 BK125B5** (ZB4 BW0B55 + ZB4 BK1253)	0.101
					~ 48...120	Green	**XB4 BK123G5** (ZB4 BW0G35 + ZB4 BK1233)	0.101
						Red	**XB4 BK124G5** (ZB4 BW0G45 + ZB4 BK1243)	0.101
						Orange	**XB4 BK125G5** (ZB4 BW0G55 + ZB4 BK1253)	0.101
					~ 230...240	Green	**XB4 BK123M5** (ZB4 BW0M35 + ZB4 BK1233)	0.101
						Red	**XB4 BK124M5** (ZB4 BW0M45 + ZB4 BK1243)	0.101
						Orange	**XB4 BK125M5** (ZB4 BW0M55 + ZB4 BK1253)	0.101
		1	1	3-position Stay put	≂ 24	Green	**XB4 BK133B5** (ZB4 BW0B35 + ZB4 BK1333)	0.101
						Red	**XB4 BK134B5** (ZB4 BW0B45 + ZB4 BK1343)	0.101
						Orange	**XB4 BK135B5** (ZB4 BW0B55 + ZB4 BK1353)	0.101
					~ 48...120	Green	**XB4 BK133G5** (ZB4 BW0G35 + ZB4 BK1333)	0.101
						Red	**XB4 BK134G5** (ZB4 BW0G45 + ZB4 BK1343)	0.101
						Orange	**XB4 BK135G5** (ZB4 BW0G55 + ZB4 BK1353)	0.101
					~ 230...240	Green	**XB4 BK133M5** (ZB4 BW0M35 + ZB4 BK1333)	0.101
						Red	**XB4 BK134M5** (ZB4 BW0M45 + ZB4 BK1343)	0.101
						Orange	**XB4 BK135M5** (ZB4 BW0M55 + ZB4 BK1353)	0.101

(1) Recommended maximum number of contacts constituting the body (fixing collar + contact) associated with the head, see page 14.

Control and signalling units Ø 22

Harmony® XB4, metal

Illuminated selector switches with standard handle, with integral LED

Assembly of other products using:
combined sub-assemblies: see page 44
accessories: see page 52

Illuminated selector switches with standard handle, with integral LED (continued) *(1)*

Shape of head	Type of operator	Positions		Colour of handle	Reference	Weight kg
		Number	Type			
Heads only *(2)*						
	Standard handle	2-position	Stay put	White	**ZB4 BK1213**	0.036
				Green	**ZB4 BK1233**	0.036
				Red	**ZB4 BK1243**	0.036
				Orange	**ZB4 BK1253**	0.036
				Blue	**ZB4 BK1263**	0.036
			Spring return from right to left	White	**ZB4 BK1413**	0.037
				Green	**ZB4 BK1433**	0.037
				Red	**ZB4 BK1443**	0.037
				Orange	**ZB4 BK1453**	0.037
				Blue	**ZB4 BK1463**	0.037
		3-position	Stay put	White	**ZB4 BK1313**	0.036
				Green	**ZB4 BK1333**	0.036
				Red	**ZB4 BK1343**	0.036
				Orange	**ZB4 BK1353**	0.036
				Blue	**ZB4 BK1363**	0.036
			Spring return to centre	White	**ZB4 BK1513**	0.036
				Green	**ZB4 BK1533**	0.036
				Red	**ZB4 BK1543**	0.036
				Orange	**ZB4 BK1553**	0.036
				Blue	**ZB4 BK1563**	0.036
			Spring return from right to centre	White	**ZB4 BK1813**	0.036
				Green	**ZB4 BK1833**	0.036
				Red	**ZB4 BK1843**	0.036
				Orange	**ZB4 BK1853**	0.036
				Blue	**ZB4 BK1863**	0.036
			Spring return from left to centre	White	**ZB4 BK1713**	0.036
				Green	**ZB4 BK1733**	0.036
				Red	**ZB4 BK1743**	0.036
				Orange	**ZB4 BK1753**	0.036
				Blue	**ZB4 BK1763**	0.036

106200

ZB4 BK1343

Heads with black metal bezel

To order, add a figure **7** to the references selected above.
Example: **ZB4 BK1213** becomes **ZB4 BK12137**.

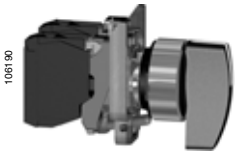
(1) Recommended maximum number of contacts constituting the body (fixing collar + contact) associated with the head, see page 14.
(2) Only for use with bodies comprising a light source with integral LED.

Control and signalling units Ø 22

Harmony® XB4, metal

Selector switches with long handle: normal and padlockable

Assembly of other products using:
body/contact assemblies: see page 40
accessories: see page 52


106190

ZB4 BJ21

106196

ZB4 BJ3

106197

ZB4 BJ291

Selector switches with long handle *(1)*

Screw clamp terminal connections

Shape of head	Type of operator	Type of contact N/O	Type of contact N/C	Positions Number	Positions Type	Reference	Weight kg
Complete units							
	Long handle, black	1	–	2-position	Stay put	**XB4 BJ21** (ZB4 BZ101 + ZB4 BJ2)	0.096
		2	–	3-position	Stay put	**XB4 BJ33 +** (ZB4 BZ103 + ZB4 BJ3)	0.096
					Spring return to centre	**XB4 BJ53** (ZB4 BZ103 + ZB4 BJ5)	0.096
Heads only							
	Long handle, black			2-position	Stay put	**ZB4 BJ2**	0.040
					Spring return from right to left	**ZB4 BJ4**	0.045
				3-position	Stay put	**ZB4 BJ3**	0.040
					Spring return to centre	**ZB4 BJ5**	0.040
					Spring return from left to centre	**ZB4 BJ7**	0.040
					Spring return from right to centre	**ZB4 BJ8**	0.040
	Long handle, padlockable *(2)*			2-position	Stay put	**ZB4 BJ291**	0.048
						ZB4 BJ292	0.048
						ZB4 BJ294	0.048
					Spring return from right to left	**ZB4 BJ491**	0.054
				3-position	Stay put	**ZB4 BJ391**	0.048
						ZB4 BJ392	0.048
						ZB4 BJ393	0.048
						ZB4 BJ394	0.048
						ZB4 BJ395	0.048
						ZB4 BJ396	0.048
						ZB4 BJ397	0.048
					Spring return to centre	**ZB4 BJ593**	0.048
					Spring return from right to centre	**ZB4 BJ891**	0.048
						ZB4 BJ893	0.048
						ZB4 BJ895	0.048
					Spring return from left to centre	**ZB4 BJ792**	0.048
						ZB4 BJ793	0.048
						ZB4 BJ796	0.048

Heads with black metal bezel

To order, add a figure **7** to the references selected above.
Example: **ZB4 BJ2** becomes **ZB4 BJ27**.

(1) Recommended maximum number of contacts and sequence of contacts constituting the body (fixing collar + contact) associated with the head, see page 14.
(2) The symbol ○ indicates the padlocking positions.

General : pages 2 to 9
Characteristics : pages 10 to 13
Dimensions : pages 62 to 73

Control and signalling units Ø 22

Harmony® XB4, metal

Key switches

Key n° 455, 421E, 458A, 520E, 3131A or TEC10

Assembly of other products using:
body/contact assemblies: see page 40
accessories: see page 52

106189

XB4 BG33

106199

ZB4 BG0

Key switches *(1) (2)*

Screw clamp terminal connections

Shape of head	Type of operator	Type of contact N/O	Type of contact N/C	Positions Number	Positions Type		Reference	Weight kg
Complete units								
	Key switch with key n° 455	1	–	2-position	Stay put		**XB4 BG21** (ZB4 BZ101 + ZB4 BG2)	0.153
							XB4 BG41 (ZB4 BZ101 + ZB4 BG4)	0.153
					Spring return to left		**XB4 BG61** (ZB4 BZ101 + ZB4 BG6)	0.153
		2	–	3-position	Stay put		**XB4 BG03** (ZB4 BZ103 + ZB4 BG0)	0.153
							XB4 BG33 (ZB4 BZ103 + ZB4 BG3)	0.153
Heads only								
	Key switch with key n° 455 *(3) (4)*			2-position	Stay put		**ZB4 BG2**	0.098
							ZB4 BG02	0.098
							ZB4 BG4	0.098
					Spring return from right to left		**ZB4 BG6**	0.098
				3-position	Stay put		**ZB4 BG0**	0.098
							ZB4 BG3	0.098
							ZB4 BG5	0.098
							ZB4 BG9	0.098
							ZB4 BG09	0.098
					Spring return from left to centre		**ZB4 BG1**	0.098
					Spring return to centre		**ZB4 BG7**	0.098
					Spring return from right to centre		**ZB4 BG8**	0.098
							ZB4 BG05	0.098
							ZB4 BG08	0.098
	Key switch with key TEC10			2-position	Stay put		**ZB4 BG2TEC10**	0.160
							ZB4 BG4TEC10	0.160
					Spring return from right to left		**ZB4 BG6TEC10**	0.170
				3-position	Stay put		**ZB4 BG0TEC10**	0.160
							ZB4 BG3TEC10	0.160
							ZB4 BG5TEC10	0.160
							ZB4 BG9TEC10	0.160
					Spring return to centre		**ZB4 BG7TEC10**	0.170
					Spring return from right to centre		**ZB4 BG05TEC10**	0.170

Heads with black metal bezel

To order, add a figure **7** to the references selected above. Example: **ZB4 BG2** becomes **ZB4 BG27**.

(1) Recommended maximum number of contacts and sequence of contacts constituting the body (fixing collar + contact) associated with the head, see page 14.

(2) The symbol ⚷ indicates key withdrawal position(s).

*(3) Other key numbers: Key n° 421E: add suffix **12** to the reference. Key n° 458A: add suffix **10** to the reference. Key n° 520E: add suffix **14** to the reference. Key n° 3131A: add suffix **20** to the reference. Example: For a switch head with key n° 421E, 2-position stay put, with key withdrawal from the left-hand position, the reference becomes **ZB4 BG212**.*

(4) For specific keys with other numbers, please consult your Regional Sales Office.

General : pages 2 to 9
Characteristics : pages 10 to 13
Dimensions : pages 62 to 73

Control and signalling units Ø 22
Harmony® XB4, metal
Pilot lights with integral LED

Assembly of other products using:
body/light assemblies: see page 48
accessories: see pages 50 and 52

XB4 BVB5

Pilot lights with integral LED
Screw clamp terminal connections

Shape of head	Supply voltage V	Colour	Reference	Weight kg
Complete units				
■ With plain lens				
Protected LED	≂ 24	White	**XB4 BVB1** (ZB4 BVB1 + ZB4 BV013)	0.080
		Green	**XB4 BVB3** (ZB4 BVB3 + ZB4 BV033)	0.080
		Red	**XB4 BVB4** (ZB4 BVB4 + ZB4 BV043)	0.080
		Orange	**XB4 BVB5** (ZB4 BVB5 + ZB4 BV053)	0.080
		Blue	**XB4 BVB6** (ZB4 BVB6 + ZB4 BV063)	0.080
	∿ 48...120	White	**XB4 BVG1** (ZB4 BVG1 + ZB4 BV013)	0.080
		Green	**XB4 BVG3** (ZB4 BVG3 + ZB4 BV033)	0.080
		Red	**XB4 BVG4** (ZB4 BVG4 + ZB4 BV043)	0.080
		Orange	**XB4 BVG5** (ZB4 BVG5 + ZB4 BV053)	0.080
		Blue	**XB4 BVG6** (ZB4 BVG6 + ZB4 BV063)	0.080
	∿ 230...240	White	**XB4 BVM1** (ZB4 BVM1 + ZB4 BV013)	0.080
		Green	**XB4 BVM3** (ZB4 BVM3 + ZB4 BV033)	0.080
		Red	**XB4 BVM4** (ZB4 BVM4 + ZB4 BV043)	0.080
		Orange	**XB4 BVM5** (ZB4 BVM5 + ZB4 BV053)	0.080
		Blue	**XB4 BVM6** (ZB4 BVM6 + ZB4 BV063)	0.080

ZB4 BV063

Heads only *(1)*

Shape of head	For use with body comprising light source type	Colour of lens	Reference	Weight kg
■ With plain lens				
	Integral LED only	White	**ZB4 BV013**	0.026
		Green	**ZB4 BV033**	0.026
		Red	**ZB4 BV043**	0.026
		Orange	**ZB4 BV053**	0.026
		Blue	**ZB4 BV063**	0.026
		5 colours *(2) (3)*	**ZB4 BV003**	0.026
■ With plain lens, for insertion of legend *(3)*				
	Integral LED only	White	**ZB4 BV013E**	0.026
		Green	**ZB4 BV033E**	0.026
		Red	**ZB4 BV043E**	0.026
		Orange	**ZB4 BV053E**	0.026
		Blue	**ZB4 BV063E**	0.026
■ With grooved lens *(4)*				
	Integral LED only	White	**ZB4 BV013S**	0.026
		Green	**ZB4 BV033S**	0.026
		Red	**ZB4 BV043S**	0.026
		Orange	**ZB4 BV053S**	0.026
		Blue	**ZB4 BV063S**	0.026

ZB4 BV043S

(1) Only for use with bodies comprising a light source with integral LED.
(2) Head supplied with 5 different coloured lenses (white, green, red, orange, blue) not fitted, for insertion of legend.
(3) For legend ordering information: see page 52.
(4) For use in bright ambient light conditions (outdoors in sunlight, for example).

Control and signalling units Ø 22

Harmony® XB4, metal

Pilot lights with BA 9s base fitting

Assembly of other products using:
body/light assemblies: see page 49
accessories: see pages 50 and 52

XB4 BV64

XB4 BV33

ZB4 BV04

ZB4 BV06S

Pilot lights with BA 9s base fitting, with plain lens

Screw clamp terminal connections

Shape of head	Supply voltage V	Colour	Reference	Weight kg
Complete units - With plain lens				
■ Direct supply, for BA 9s bulb, U ⩽ 250 V, 2.4 W max (bulb not included)				
	≤ 250	White	**XB4 BV61** (ZB4 BV6 + ZB4 BV01)	0.075
		Green	**XB4 BV63** (ZB4 BV6 + ZB4 BV03)	0.075
		Red	**XB4 BV64** (ZB4 BV6 + ZB4 BV04)	0.075
		Orange	**XB4 BV65** (ZB4 BV6 + ZB4 BV05)	0.075
■ Via integral transformer, 1.2 VA, 6 V secondary, with BA 9s incandescent bulb (included)				
	∿ 110...120 - 50/60 Hz	White	**XB4 BV31** (ZB4 BV3 + ZB4 BV01)	0.152
		Green	**XB4 BV33** (ZB4 BV3 + ZB4 BV03)	0.152
		Red	**XB4 BV34** (ZB4 BV3 + ZB4 BV04)	0.152
		Orange	**XB4 BV35** (ZB4 BV3 + ZB4 BV05)	0.152
	∿ 230 - 50 Hz ∿ 220...240 - 60 Hz	White	**XB4 BV41** (ZB4 BV4 + ZB4 BV01)	0.152
		Green	**XB4 BV43** (ZB4 BV4 + ZB4 BV03)	0.152
		Red	**XB4 BV44** (ZB4 BV4 + ZB4 BV04)	0.152
		Orange	**XB4 BV45** (ZB4 BV4 + ZB4 BV05)	0.152

Heads only *(1)*

Shape of head	For use with body comprising light source type	Colour of lens	Reference	Weight kg
■ With plain lens				
	With BA 9s base fitting (incandescent, neon or LED)	White	**ZB4 BV01**	0.027
		Green	**ZB4 BV03**	0.027
		Red	**ZB4 BV04**	0.027
		Orange	**ZB4 BV05**	0.027
		Blue	**ZB4 BV06**	0.027
		Clear	**ZB4 BV07**	0.027
■ With grooved lens *(2)*				
	With BA 9s base fitting (neon or LED only)	White	**ZB4 BV01S**	0.027
		Green	**ZB4 BV03S**	0.027
		Red	**ZB4 BV04S**	0.027
		Orange	**ZB4 BV05S**	0.027
		Blue	**ZB4 BV06S**	0.027
		Clear	**ZB4 BV07S**	0.027

(1) Only for use with bodies comprising a light source with BA 9s base fitting (incandescent, neon or LED).
(2) For use in bright ambient light conditions (outdoors in sunlight, for example).

Assembly of other products using:
body/contact assemblies: see page 40
accessories: see page 52

Control and signalling units Ø 22

Harmony® XB4, metal

Specific functions

Pushbuttons for manual overload reset, hour counters, buzzers, fuse carrier

814340

XB4 BA8●1

Heads for manual overload reset pushbuttons

Shape of head	Travel mm	Actuation distance mm	Colour	Reference	Weight kg
With flush push					
	10	6…16	Black	**XB4 BA821**	0.037
			Red	**XB4 BA841**	0.037
			Blue	**XB4 BA861**	0.037
		16…26	Black	**XB4 BA822**	0.038
			Red	**XB4 BA842**	0.038
			Blue	**XB4 BA861**	0.038
	14	30…130	Black	**XB4 BA921**	0.058
			Red	**XB4 BA941**	0.058
			Blue	**XB4 BA961**	0.058
		130…257	Black	**XB4 BA922**	0.071
			Red	**XB4 BA942**	0.071
			Blue	**XB4 BA962**	0.071

814341

ZB4 BD912

Heads + mounting base for potentiometer *(1)*

Shape of head	Description	For use with	Reference	Weight kg
	For potentiometer with shaft length 45 to 50 mm	Ø 6 mm shaft	**ZB4 BD912**	0.080
		Ø 6.35 mm shaft	**ZB4 BD922**	0.080

814343

XB5 DS●

Hour counters

Characteristics	Supply voltage V	Reference	Weight kg
Indication 0…9999.9	⎓ 12…24 - 50/60 Hz	**XB5 DSB**	0.045
	∿ 120 -60 Hz	**XB5 DSG**	0.045
	∿ 230…240 -50 Hz	**XB5 DSM**	0.045

814344

XB5 KS●

Annunciators (IP 40 NEMA 1)

85 db buzzer: 4 kHz, with continuous or intermittent operation (connection diagram: see page 68)	⎓ 24 - 50/60 Hz	**XB5 KSB**	0.035
	∿ 120 - 50/60 Hz	**XB5 KSG**	0.035
	∿ 230…240 -50 Hz	**XB5 KSM**	0.035

814344

XB5 DT1S

Fuse carrier

Description	For use with	Reference	Weight kg
Fuse carrier	5 x 20 mm fuse 6.3 A - 250 V	**XB5 DT1S**	0.022

(1) Potentiometer not included.

Control and signalling units Ø 22

Harmony® XB4, metal
Specific functions
Joystick controllers, wobblesticks

Assembly of other products using: accessories: see page 52

814342

XD4 PA12

Joystick controllers (with 54 mm long operating shaft) *(1)*

Description	Operation	Spring return to zero position	Reference	Weight kg
Complete products (screw clamp terminal connections)				
2-direction	1 notch 1 N/O contact per direction	Without	**XD4 PA12**	0.116
		With	**XD4 PA22**	0.116
4-direction	1 notch 1 N/O contact per direction	Without	**XD4 PA14**	0.133
		With	**XD4 PA24**	0.133

814346

ZD4 PA103

814348

ZD4 PA203

814347

ZD4 PA12

Sub-assemblies for joystick controllers

Description	Functions		Reference	Weight kg
Complete body/contact assemblies (screw clamp terminal connections)	2-direction		**ZD4 PA103**	0.049
	4-direction		**ZD4 PA203**	0.058
Complete head assemblies with operating shaft	2-direction, stay put		**ZD4 PA12**	0.022
	2-direction, spring return to zero position		**ZD4 PA22**	0.022
	4-direction, stay put		**ZD4 PA14**	0.022
	4-direction, spring return to zero position		**ZD4 PA24**	0.022
Legends 30 x 48 mm for engraving	2-direction	Black one side Red reverse	**ZBG 2201**	0.001
		White one side Yellow reverse	**ZBG 2401**	0.001
Legends 48 x 48 mm for engraving	4-direction	Black one side Red reverse	**ZBG 4201**	0.002
		White one side Yellow reverse	**ZBG 4401**	0.002

109497

ZB4 BB2

Wobblestick heads

Shape of head	For use with	Colour	Reference	Weight kg
	Omnidirectional, spring return	Black	**ZB4 BB2**	0.058
		Red	**ZB4 BB4**	0.058

(1) Must not be used with standard contact blocks ZBE 10● (single) or ZBE 20● (double).

Other versions Joystick controllers and complete body/contact assemblies for joystick controllers with Faston connector terminals (6.35 or 2 x 2.8).
Please consult your Regional Sales Office.

Control and signalling units Ø 22

Harmony® XB4, metal

Body/contact assemblies - Screw clamp terminal connections

To combine with heads, see pages 16 to 38

Contact functions

Screw clamp terminal connections *(1)*

Simple functions unit

Description	Type of contact N/O	Type of contact N/C	Sold in lots of	Unit reference	Weight kg
Fixing collar + single contact block	1	–	1	**ZB4 BZ101**	0.053
	–	1	1	**ZB4 BZ102**	0.053
	2	–	1	**ZB4 BZ103**	0.062
	–	2	1	**ZB4 BZ104**	0.062
	1	1	1	**ZB4 BZ105**	0.062
	1	2	1	**ZB4 BZ141**	0.072
Single contact blocks	1	–	5	**ZBE 101**	0.011
	–	1	5	**ZBE 102**	0.011
Double contact blocks	2	–	5	**ZBE 203**	0.020
	–	2	5	**ZBE 204**	0.020
	1	1	5	**ZBE 205**	0.020
Contact blocks for low power switching, with gold flashed contacts	1	–	5	**ZBE 1016**	0.012
	–	1	5	**ZBE 1026**	0.012
Contact blocks for low power switching, with gold flashed contacts and dust protection *(2)*	1	–	5	**ZBE 1016P**	0.012
	–	1	5	**ZBE 1026P**	0.012

814133

ZB4 BZ101

814265

ZBE 101

814267

ZBE 203

Specific function units

Description	Type of contact N/O	Type of contact N/C	Sold in lots of	Unit reference	Weight kg
Contact block, with early make contact	1	–	5	**ZBE 201**	0.011
Contact block, with late break contact	–	1	5	**ZBE 202**	0.011

814265

ZBE 201

Description	Type of contact N/O+N/C	Type of contact N/O+N/O	Reference	Weight kg
Fixing collar + contact block for overlapping contacts function	1	–	**ZB4 BZ106**	0.062
Fixing collar + contact block for sequencing contacts function	–	1	**ZB4 BZ107**	0.062

814346

ZB4 BZ106

814346

ZB4 BZ107

Body/fixing collar

For use with	Sold in lots of	Unit reference	Weight kg
Electrical block (contact or light)	10	**ZB4 BZ009**	0.038

814264

ZB4 BZ009

(1) The contact blocks enable variable composition of body/contact assemblies. Maximum number of rows possible: 3. Either 3 rows of 3 single contacts or 1 row of 3 double contacts + 1 row of 3 single contacts (double contacts occupy the first 2 rows). Maximum number of contacts is specified on page 14.

(2) It is not possible to fit an additional contact block on the back of these contact blocks.

General : pages 2 to 9 | Characteristics : pages 10 to 13 | Dimensions : pages 62 to 73

Control and signalling units Ø 22

Harmony® XB4, metal

Body/contact assemblies - Faston connectors

To combine with heads, see pages 16 to 38

111290

ZB4 BZ1043

111291

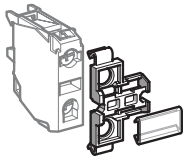
ZB4 BZ1053

121475

ZBE 1023

121508

ZBE 2043


814262

ZBZ 001

563527

XBY 2U

Contact functions

Faston connectors (6.35 or 2 x 2.8 mm) *(1)*

Simple functions units

Description	Type of contact N/O	Type of contact N/C	Sold in lots of	Unit reference	Weight kg
Fixing collar + single contact block	1	–	1	**ZB4 BZ1013**	0.053
	–	1	1	**ZB4 BZ1023**	0.053
	2	–	1	**ZB4 BZ1033**	0.062
	–	2	1	**ZB4 BZ1043**	0.062
	1	1	1	**ZB4 BZ1053**	0.062
Single contact blocks	1	–	5	**ZBE 1013** *(2)*	0.011
	–	1	5	**ZBE 1023** *(2)*	0.011
Double contact blocks	2	–	5	**ZBE 2033**	0.020
	–	2	5	**ZBE 2043**	0.020
	1	1	5	**ZBE 2053**	0.020
Contact blocks for low power switching, with gold flashed contacts	1	–	5	**ZBE 10163** *(2)*	0.012
	–	1	5	**ZBE 10263** *(2)*	0.012
Contact blocks for low power switching, with gold flashed contacts and dust protection *(3)*	1	–	5	**ZBE 1016P3** *(2)*	0.012
	–	1	5	**ZBE 1026P3** **(2)**	0.012

Specific function units

Description	Type of contact N/O	Type of contact N/C	Sold in lots of	Unit reference	Weight kg
Contact block, with early make contact	1	–	5	**ZBE 2013** *(2)*	0.011
Contact block, with late break contact	–	1	5	**ZBE 2023** *(2)*	0.011

Clip-on legend holders for electrical blocks with screw clamp terminal connections

Application	Sold in lots of	Unit reference	Weight kg
Identification of an XB4 B control or signalling unit	10	**ZBZ 001**	0.001

Sheet of 50 blank legends

Legend holder ZBZ 001	10	**ZBY 001**	0.023

"SIS Label" labelling software (for legends **ZBY 001**)

For legend design for English, French, German, Italian, Spanish	1	**XBY 2U**	0.100

(1) The contact blocks enable variable composition of body/contact assemblies. Maximum number of rows possible: 3. Either 3 rows of 3 single contacts or 1 row of 3 double contacts + 1 row of 3 single contacts (double contacts occupy the first 2 rows).

*(2) To order products with screw clamp terminal connections for lugs, replace the **3** at the end of the reference with a **9**. Example: **ZBE 1013** becomes **ZBE 1019**.*

(3) It is not possible to fit an additional contact block on the back of these contact blocks.

Control and signalling units Ø 22
Harmony® XB4, metal
Body/contact assemblies - Plug-in connector

To combine with heads, see pages 16 to 38

814135

ZB4 BZ1014

814136

ZB4 BZ1024

814278

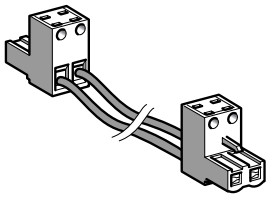
ZBE 1014

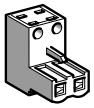
814279

ZBE 1024

814280

ZBV B●4

530719

APE 1C2250

814281

APE 1PAD21

814277

ZB4 BZ009

Contact functions: simple functions units

Plug-in connector *(1)*

Description	Type of contact N/O	Type of contact N/C	Sold in lots of	Unit reference	Weight kg
Fixing collar + single contact block	1	–	1	**ZB4 BZ1014**	0.050
	–	1	1	**ZB4 BZ1024**	0.050
	2	–	1	**ZB4 BZ1034**	0.058
	–	2	1	**ZB4 BZ1044**	0.058
	1	1	1	**ZB4 BZ1054**	0.058
	1	2	1	**ZB4 BZ1414**	0.064
Standard contact blocks	1	–	5	**ZBE 1014**	0.009
	–	1	5	**ZBE 1024**	0.009

Light blocks

Plug-in connector

Description	Supply voltage (V)	Colour of light source	Sold in lots of	Unit reference	Weight kg
Integral LED (to combine with heads for integral LED) Protected LED	≂ 24	White	5	**ZBV B14**	0.016
		Green	5	**ZBV B34**	0.016
		Red	5	**ZBV B44**	0.016
		Orange	5	**ZBV B54**	0.016
		Blue	5	**ZBV B64**	0.016
	∿ 48…120	White	5	**ZBV G14**	0.016
		Green	5	**ZBV G34**	0.016
		Red	5	**ZBV G44**	0.016
		Orange	5	**ZBV G54**	0.016
		Blue	5	**ZBV G64**	0.016
	∿ 230…240	White	5	**ZBV M14**	0.016
		Green	5	**ZBV M34**	0.016
		Red	5	**ZBV M44**	0.016
		Orange	5	**ZBV M54**	0.016
		Blue	5	**ZBV M64**	0.016

Connecting cables and connector

Description	Number of connectors	Wire c.s.a. mm^2	Length mm	Sold in lots of	Unit reference	Weight kg
Cables with connectors 2-pin, 5.08 mm pitch	1	0.75	500	8	**APE 1C2150**	0.120
	2	0.75	500	8	**APE 1C2250**	0.180
Self-stripping connector 2-pin, 5.08 mm pitch	–	0.75	–	16	**APE 1PAD21**	0.080
Spring terminal connector 2-pin, 5.08 mm pitch	–	0.2 to 2.5	–	10	**APE 1PRE21**	0.003

Body/fixing collar

For use with	Sold in lots of	Unit reference	Weight kg
Electrical block (contact or light)	10	**ZB4 BZ009**	0.038

(1) It is not possible to fit an additional contact block on the back of these contact blocks.

General : pages 2 to 9 | Characteristics : pages 10 to 13 | Dimensions : pages 62 to 73

Control and signalling units Ø 22

Harmony® XB4, metal

Body/contact assemblies for printed circuit board

To combine with heads, see pages 16 to 38

814287

ZBE 701

814288

ZBE 702

814289

ZBV B●7

814277

ZB4 BZ009

540159

ZBZ 01●

814286

ZB4 BZ079 + ZB4 BZ009

Contact blocks

For printed circuit board *(1)*

Description	Type of contact N/O	Type of contact N/C	Sold in lots of	Unit reference	Weight kg
Standard contact blocks	1	–	10	**ZBE 701**	0.002
	–	1	10	**ZBE 702**	0.002
Contact blocks for low power switching, with gold flashed contacts	1	–	10	**ZBE 7016**	0.003
	–	1	10	**ZBE 7026**	0.003

Light blocks

For printed circuit board *(1)*

Description	Supply voltage (V)	Colour of LED	Sold in lots of	Unit reference	Weight kg
Integral LED (to combine with heads for integral LED) Protected LED	≂ 24	White	5	**ZBV B17**	0.004
		Green	5	**ZBV B37**	0.004
		Red	5	**ZBV B47**	0.004
		Orange	5	**ZBV B57**	0.004
		Blue	5	**ZBV B67**	0.004

Adapter (socket)

For printed circuit board

For use with	Thickness of printed circuit board (mm)	Sold in lots of	Unit reference	Weight kg
Electrical block (contact or light)	1.6 ± 0.2	10	**ZBZ 010**	0.008
	2.2 ± 0.2	10	**ZBZ 011**	0.008
	3.2 ± 0.2	10	**ZBZ 012**	0.008

Body/fixing collar

For use with	Sold in lots of	Unit reference	Weight kg
Electrical block (contact or light)	10	**ZB4 BZ009**	0.038.

Accessories specifically for printed circuit board mounting *(1)*

Must be used in conjunction with adapter (socket) ZBZ 010

Description	For use with	Sold in lots of	Unit reference	Weight kg
Fixing collar/pillar	Printed circuit board support	10	**ZB4 BZ079**	0.003
Fixing screw for printed circuit board	Fixing collar/pillar ZB4 BZ079	10	**ZBZ 006**	0.011

(1) For details of support drilling and of printed circuit board: see page 73.

Control and signalling units Ø 22

Harmony® XB4, metal

Body/contact assemblies + light blocks with integral LED

To combine with:
heads, see pages 19 to 33
contacts, see page 40

ZB4 BW0●●3

Complete body/contact assemblies and light blocks *(1)*

Screw clamp terminal connections

Light source	Supply voltage	Type of contact		Colour of light source	Reference	Weight
	V	N/O	N/C			kg
Direct supply						
Integral LED	≂ 24	1	–	White	**ZB4 BW0B11**	0.064
				Green	**ZB4 BW0B31**	0.064
				Red	**ZB4 BW0B41**	0.064
				Orange	**ZB4 BW0B51**	0.064
				Blue	**ZB4 BW0B61**	0.064
		–	1	White	**ZB4 BW0B12**	0.064
				Green	**ZB4 BW0B32**	0.064
				Red	**ZB4 BW0B42**	0.064
				Orange	**ZB4 BW0B52**	0.064
				Blue	**ZB4 BW0B62**	0.064
		2	–	White	**ZB4 BW0B13**	0.074
				Green	**ZB4 BW0B33**	0.074
				Red	**ZB4 BW0B43**	0.074
				Orange	**ZB4 BW0B53**	0.074
				Blue	**ZB4 BW0B63**	0.074
		1	1	White	**ZB4 BW0B15**	0.074
				Green	**ZB4 BW0B35**	0.074
				Red	**ZB4 BW0B45**	0.074
				Orange	**ZB4 BW0B55**	0.074
				Blue	**ZB4 BW0B65**	0.074
	∼ 48...120	1	–	White	**ZB4 BW0G11**	0.064
				Green	**ZB4 BW0G31**	0.064
				Red	**ZB4 BW0G41**	0.064
				Orange	**ZB4 BW0G51**	0.064
				Blue	**ZB4 BW0G61**	0.064
		–	1	White	**ZB4 BW0G12**	0.064
				Green	**ZB4 BW0G32**	0.064
				Red	**ZB4 BW0G42**	0.064
				Orange	**ZB4 BW0G52**	0.064
				Blue	**ZB4 BW0G62**	0.064
		2	–	White	**ZB4 BW0G13**	0.074
				Green	**ZB4 BW0G33**	0.074
				Red	**ZB4 BW0G43**	0.074
				Orange	**ZB4 BW0G53**	0.074
				Blue	**ZB4 BW0G63**	0.074
		1	1	White	**ZB4 BW0G15**	0.074
				Green	**ZB4 BW0G35**	0.074
				Red	**ZB4 BW0G45**	0.074
				Orange	**ZB4 BW0G55**	0.074
				Blue	**ZB4 BW0G65**	0.074

Other versions Complete bodies with Faston connector terminals (6.35 or 2 x 2.8).
Please consult your Regional Sales Office.

(1) Can be fitted with additional contact blocks: see page 40.

Control and signalling units Ø 22
Harmony® XB4, metal
Body/contact assemblies + light blocks with integral LED

To combine with:
heads, see pages 19 to 33
contacts, see page 40

ZB4 BW0●●3

Complete body/contact assemblies and light blocks *(1) (continued)*
Screw clamp terminal connections

Light source	Supply voltage	Type of contact N/O	Type of contact N/C	Colour of light source	Reference	Weight
	V					kg
Direct supply *(continued)*						
Integral LED Protected LED	∿ 230…240	1	–	White	**ZB4 BW0M11**	0.064
				Green	**ZB4 BW0M31**	0.064
				Red	**ZB4 BW0M41**	0.064
				Orange	**ZB4 BW0M51**	0.064
				Blue	**ZB4 BW0M61**	0.064
		–	1	White	**ZB4 BW0M12**	0.064
				Green	**ZB4 BW0M32**	0.064
				Red	**ZB4 BW0M42**	0.064
				Orange	**ZB4 BW0M52**	0.064
				Blue	**ZB4 BW0M62**	0.064
		2	–	White	**ZB4 BW0M13**	0.074
				Green	**ZB4 BW0M33**	0.074
				Red	**ZB4 BW0M43**	0.074
				Orange	**ZB4 BW0M53**	0.074
				Blue	**ZB4 BW0M63**	0.074
		1	1	White	**ZB4 BW0M15**	0.074
				Green	**ZB4 BW0M35**	0.074
				Red	**ZB4 BW0M45**	0.074
				Orange	**ZB4 BW0M55**	0.074
				Blue	**ZB4 BW0M65**	0.074
Supply via integral transformer						
Integral LED Protected LED	∿ 400 V 50 Hz	1	1	White	**ZB4 BW05B15**	0.168
				Green	**ZB4 BW05B35**	0.168
				Red	**ZB4 BW05B45**	0.168
				Orange	**ZB4 BW05B55**	0.168
				Blue	**ZB4 BW05B65**	0.168
	∿ 400…460 V 60 Hz	1	1	White	**ZB4 BW08B15**	0.168
				Green	**ZB4 BW08B35**	0.168
				Red	**ZB4 BW08B45**	0.168
				Orange	**ZB4 BW08B55**	0.168
				Blue	**ZB4 BW08B65**	0.168
	∿ 550…600 V 60 Hz	1	1	White	**ZB4 BW09B15**	0.168
				Green	**ZB4 BW09B35**	0.168
				Red	**ZB4 BW09B45**	0.168
				Orange	**ZB4 BW09B55**	0.168
				Blue	**ZB4 BW09B65**	0.168

Other versions Complete bodies with Faston connector terminals (6.35 or 2 x 2.8).
Please consult your Regional Sales Office.

(1) Can be fitted with additional contact blocks: see page 40.

Control and signalling units Ø 22

Harmony® XB4, metal

Body/contact assemblies + light blocks with BA 9s base fitting

To combine with:
heads, see page 21
contacts, see page 40

ZB4 BW06●

ZB4 BW0●5

Complete body/contact assemblies and light blocks *(1)*

For bulb with BA 9s base fitting (incandescent, neon or LED)
Screw clamp terminal connections

Light source	Supply voltage V	Type of contact N/O	Type of contact N/C	Colour of light source	Reference	Weight kg
Direct supply						
BA9s base fitting bulb, 2.4 W max, not included *(2)*	⩽ 250	1	–	–	**ZB4 BW061**	0.063
		–	1	–	**ZB4 BW062**	0.063
		2	–	–	**ZB4 BW063**	0.073
		1	1	–	**ZB4 BW065**	0.073
Supply via integral transformer (1.2 VA, 6 V secondary)						
BA9s base fitting incandescent bulb, included	∿ 110…120 50/60 Hz	1	–	–	**ZB4 BW031**	0.141
		1	1	–	**ZB4 BW035**	0.151
	∿ 230 50 Hz ∿ 220…240 60 Hz	1	–	–	**ZB4 BW041**	0.141
		1	1	–	**ZB4 BW045**	0.151
	∿ 400 50 Hz	1	–	–	**ZB4 BW051**	0.141
		1	1	–	**ZB4 BW055**	0.151
BA9s base fitting LED, included	∿ 110…120 50/60 Hz	1	1	White	**ZB4 BW03D15**	0.151
				Green	**ZB4 BW03D35**	0.151
				Red	**ZB4 BW03D45**	0.151
				Orange	**ZB4 BW03D55**	0.151
				Blue	**ZB4 BW03D65**	0.151
	∿ 230 50 Hz ∿ 220…240 60 Hz	1	1	White	**ZB4 BW04D15**	0.151
				Green	**ZB4 BW04D35**	0.151
				Red	**ZB4 BW04D45**	0.151
				Orange	**ZB4 BW04D55**	0.151
				Blue	**ZB4 BW04D65**	0.151
	∿ 400 50/60 Hz	1	1	White	**ZB4 BW05D15**	0.152
				Green	**ZB4 BW05D35**	0.152
				Red	**ZB4 BW05D45**	0.152
				Orange	**ZB4 BW05D55**	0.152
				Blue	**ZB4 BW05D65**	0.152

Other versions Complete bodies with integral transformer incorporating Faston connector terminals (6.35 or 2 x 2.8). Please consult your Regional Sales Office.

(1) Can be fitted with additional contact blocks: see page 40.
(2) Bulb to be ordered separately: see page 60.

Control and signalling units Ø 22
Harmony® XB4, metal
Light blocks - "Test light" - Protection

To combine with:
heads, see page 20

814273

ZBV B●

522067

ZBZ G156

522068

ZBZ M156

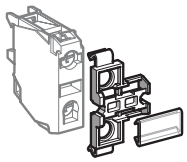
814274

ZBZ V●

814272

ZB4 BZ009

814269



ZBZ 001

563527

XBY 2U

Light blocks
Screw clamp terminal connections

Description	Supply voltage V	Colour of light source	Sold in lots of	Unit reference	Weight kg
Integral LED (to combine with heads for integral LED) Protected LED	⎓ 12	White	5	**ZBV J1**	0.017
		Green	5	**ZBV J3**	0.017
		Red	5	**ZBV J4**	0.017
		Orange	5	**ZBV J5**	0.017
		Blue	5	**ZBV J6**	0.017
	⎓ 24	White	5	**ZBV B1**	0.017
		Green	5	**ZBV B3**	0.017
		Red	5	**ZBV B4**	0.017
		Orange	5	**ZBV B5**	0.017
		Blue	5	**ZBV B6**	0.017
	⎓ 24…120	White	5	**ZBV BG1**	0.017
		Green	5	**ZBV BG3**	0.017
		Red	5	**ZBV BG4**	0.017
		Orange	5	**ZBV BG5**	0.017
		Blue	5	**ZBV BG6**	0.017
	∿ 110...120	White	5	**ZBV G1**	0.017
		Green	5	**ZBV G3**	0.017
		Red	5	**ZBV G4**	0.017
		Orange	5	**ZBV G5**	0.017
		Blue	5	**ZBV G6**	0.017
	∿ 230...240	White	5	**ZBV M1**	0.017
		Green	5	**ZBV M3**	0.017
		Red	5	**ZBV M4**	0.017
		Orange	5	**ZBV M5**	0.017
		Blue	5	**ZBV M6**	0.017
Direct supply for BA 9s base fitting bulb, 2.4 W max, **not included** *(1)*	⩽ 250	–	5	**ZBV 6**	0.016

Blocks for “test light” function

For use with	Supply voltage V	Description	Reference	Weight kg
Light blocks	⎓ 12 and 24 ⎓ 24…120	Single module, 1 connecting wire	**ZBZ G156(2)**	0.010
Light blocks with integral LED	∿ 48…230	Double module, with connecting wires	**ZBZ M156*(3)***	0.010

LED suppressors

For use with	Supply voltage V	Level of protection	Reference	Weight kg
Light blocks with integral LED fitted with screw clamp terminal connections	∿ 120	25…120 VA	**ZBZ VG**	0.010
	∿ 230	30…230 VA	**ZBZ VM**	0.010

Body/fixing collar

For use with	Sold in lots of	Unit reference	Weight kg
Electrical block (contact or light)	10	**ZB4 BZ009**	0.038

Clip-on legend holders for electrical blocks with screw clamp terminal connections

Identification of an XB4 B control or signalling unit	10	**ZBZ 001**	0.001

Sheet of 50 blank legends

Legend holder ZBZ 001	10	**ZBY 001**	0.023

“SIS Label” labelling software (for legends **ZBY 001**)

Application	Reference	Weight kg
Legend design for English, French, German, Italian, Spanish	**XBY 2U**	0.100.

(1) Bulb to be ordered separately: see page 60.
*(2) Block for use with ⎓ light blocks with integral LED types **ZBV J●, ZBV B●, ZBV BG●** or with direct supply light block for BA 9s bulb, **ZBV 6**.*
*(3) Block for use with ∿ light blocks with integral LED types **ZBV G●, ZBV M●**, see connection on page 70.*

Other versions Light blocks with Faston connector terminals (6.35 or 2 x 2.8).
Please consult your Regional Sales Office.

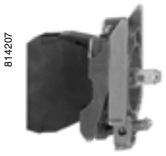
General : pages 2 to 9
Characteristics : pages 10 to 13
Dimensions : pages 62 to 73

Control and signalling units Ø 22

Harmony® XB4, metal

Body/light assemblies for pilot lights with integral LED

To combine with:
heads, see page 36
contacts, see page 40



ZB4 BV●●

Complete light bodies (fixing collar + light block with integral LED)

Screw clamp terminal connections

Light source	Supply voltage V	Colour of light source	Reference	Weight kg
Integral LED Protected LED	⎓ 12	White	**ZB4 BVJ1**	0.054
		Green	**ZB4 BVJ3**	0.054
		Red	**ZB4 BVJ4**	0.054
		Orange	**ZB4 BVJ5**	0.054
		Blue	**ZB4 BVJ6**	0.054
	⎓ 24 *(1)*	White	**ZB4 BVB1**	0.054
		Green	**ZB4 BVB3**	0.054
		Red	**ZB4 BVB4**	0.054
		Orange	**ZB4 BVB5**	0.054
		Blue	**ZB4 BVB6**	0.054
	⎓ 24…120	White	**ZB4 BVBG1**	0.054
		Green	**ZB4 BVBG3**	0.054
		Red	**ZB4 BVBG4**	0.054
		Orange	**ZB4 BVBG5**	0.054
		Blue	**ZB4 BVBG6**	0.054
	∿ 48...120 *(1)*	White	**ZB4 BVG1**	0.054
		Green	**ZB4 BVG3**	0.054
		Red	**ZB4 BVG4**	0.054
		Orange	**ZB4 BVG5**	0.054
		Blue	**ZB4 BVG6**	0.054
	∿ 230…240 *(1)*	White	**ZB4 BVM1**	0.054
		Green	**ZB4 BVM3**	0.054
		Red	**ZB4 BVM4**	0.054
		Orange	**ZB4 BVM5**	0.054
		Blue	**ZB4 BVM6**	0.054

ZB4 BVB●156

Complete light bodies with 3-terminal "test" function

(fixing collar + light block with integral LED + block for "test light" function)

Screw clamp terminal connections

Light source	Supply voltage V	Colour of light source	Reference	Weight kg
Integral LED Protected LED	⎓ 24 *(2)*	White	**ZB4 BVB1156**	0.054
		Green	**ZB4 BVB3156**	0.054
		Red	**ZB4 BVB4156**	0.054
		Orange	**ZB4 BVB5156**	0.054
		Blue	**ZB4 BVB6156**	0.054

Complete bodies with flashing pilot light (fixing collar + light block with integral LED)

Screw clamp terminal connections

Light source	Supply voltage V	Colour of light source	Reference	Weight kg
Integral LED Protected LED	⎓ 24	White	**ZB4 BV18B1**	0.054
		Green	**ZB4 BV18B3**	0.054
		Red	**ZB4 BV18B4**	0.054
		Orange	**ZB4 BV18B5**	0.054
		Blue	**ZB4 BV18B6**	0.054
	∿ 48…120	White	**ZB4 BV18G1**	0.054
		Green	**ZB4 BV18G3**	0.054
		Red	**ZB4 BV18G4**	0.054
		Orange	**ZB4 BV18G5**	0.054
		Blue	**ZB4 BV18G6**	0.054
	∿ 230…240	White	**ZB4 BV18M1**	0.054
		Green	**ZB4 BV18M3**	0.054
		Red	**ZB4 BV18M4**	0.054
		Orange	**ZB4 BV18M5**	0.054
		Blue	**ZB4 BV18M6**	0.054

(1) Complete bodies with Faston connector terminals (6.35 or 2 x 2.8), see page 41.
*(2) For a ∿ 120 or 230 V supply, use complete body **ZB4 BVG●** or **ZB4 BVM●** with block for "test light" function type **ZBZ M156**, see page 47.*

General : pages 2 to 9
Characteristics : pages 10 to 13
Dimensions : pages 62 to 73

Control and signalling units Ø 22

Harmony® XB4, metal

Light bodies for pilot lights with BA 9s base fitting

To combine with:
heads, see page 37
contacts, see page 40

814210

ZB4 BV6

814211

ZB4 BV●

Complete light bodies (fixing collar + light block)

For bulb with BA 9s base fitting (incandescent, neon or LED)
Screw clamp terminal connections

Light source	Supply voltage V	Colour of light source	Reference	Weight kg
Direct supply				
BA 9s base fitting bulb, 2.4 W max, not included *(1)*	⩽ 250	–	**ZB4 BV6**	0.052
Supply via integral transformer (1.2 VA, 6 V secondary)				
BA 9s base fitting incandescent bulb, included	∿ 110…120 -50/60 Hz	–	**ZB4 BV3**	0.130
	∿ 230 - 50 Hz ∿ 220…240 - 60 Hz	–	**ZB4 BV4**	0.130
	∿ 400 - 50 Hz	–	**ZB4 BV5**	0.131
	∿ 440…480 - 60 Hz	–	**ZB4 BV8**	0.128
	∿ 550…600 - 60 Hz	–	**ZB4 BV9**	0.131
BA 9s base fitting LED, included	∿ 110…120 - 50/60 Hz	White	**ZB4 BV3D1**	0.134
		Green	**ZB4 BV3D3**	0.134
		Red	**ZB4 BV3D4**	0.134
		Orange	**ZB4 BV3D5**	0.134
		Blue	**ZB4 BV3D6**	0.134
	∿ 230 - 50 Hz ∿ 220…240 - 60 Hz	White	**ZB4 BV4D1**	0.134
		Green	**ZB4 BV4D3**	0.134
		Red	**ZB4 BV4D4**	0.134
		Orange	**ZB4 BV4D5**	0.134
		Blue	**ZB4 BV4D6**	0.134
	∿ 400 - 50/60 Hz	White	**ZB4 BV5D1**	0.134
		Green	**ZB4 BV5D3**	0.134
		Red	**ZB4 BV5D4**	0.134
		Orange	**ZB4 BV5D5**	0.134
		Blue	**ZB4 BV5D6**	0.134

522070

ZB4 BV156

Complete light bodies with 3-terminal "test" function (fixing collar + light block)

For bulb with BA 9s base fitting (incandescent, neon or LED)
Screw clamp terminal connections

Direct supply				
BA 9s base fitting bulb, 2.4 W max, not included *(1)*	⩽ 250	–	**ZB4 BV156**	0.062

(1) Bulb to be ordered separately, see page 60.

Other versions Complete bodies with Faston connector terminals (6.35 or 2 x 2.8), *see page* 41.

Control and signalling units Ø 22

Harmony® XB4, metal

Accessories for heads: caps

ZBA ●

ZBL ●

Pushbutton caps - unmarked

For use with	Type of push	Colour	Sold in lots of	Unit reference	Weight kg
ZB4 BA0 circular pushbutton heads supplied without cap	Flush	White	10	**ZBA 1**	0.001
		Black	10	**ZBA 2**	0.001
		Green	10	**ZBA 3**	0.001
		Red	10	**ZBA 4**	0.001
		Yellow	10	**ZBA 5**	0.001
		Blue	10	**ZBA 6**	0.001
		6 colours *(1)*	1	**ZBA 9**	0.006
	Projecting	White	10	**ZBL 1**	0.001
		Black	10	**ZBL 2**	0.001
		Green	10	**ZBL 3**	0.001
		Red	10	**ZBL 4**	0.001
		Yellow	10	**ZBL 5**	0.001
		Blue	10	**ZBL 6**	0.001
		6 colours *(1)*	1	**ZBL 9**	0.006

ZBA ●33

Pushbutton caps - marked

For use with	Type of push	Marking		Colour of cap	Unit reference	Weight kg
		Text	Colour			
ZB4 BA0 circular pushbutton heads supplied without cap (sold in lots of 10)	Flush	I *(2)*	White	Green	**ZBA 331**	0.001
			Black	White	**ZBA 131**	0.001
		II	White	Green	**ZBA 336**	0.001
			Black	White	**ZBA 136**	0.001
		III	White	Green	**ZBA 337**	0.001
			Black	White	**ZBA 137**	0.001
		IV	White	Green	**ZBA 338**	0.001
			Black	White	**ZBA 138**	0.001
		START *(2)*	White	Green	**ZBA 333**	0.001
			Black	White	**ZBA 133**	0.001
		ON	White	Green	**ZBA 341**	0.001
			Black	White	**ZBA 141**	0.001
		MARCHE	White	Green	**ZBA 342**	0.001
			Black	White	**ZBA 142**	0.001
		UP *(2)*	Black	White	**ZBA 343**	0.001
		DOWN *(2)*	White	Black	**ZBA 344**	0.001
		⏻ *(2)*	White	Black	**ZBA 245**	0.001
			Black	White	**ZBA 145**	0.001
		⬆ *(3)*	White	Black	**ZBA 335**	0.001
			Black	White	**ZBA 334**	0.001
		O *(2)*	White	Red	**ZBA 432**	0.001
				Black	**ZBA 232**	0.001
		ARRET	White	Red	**ZBA 433**	0.001
				Black	**ZBA 233**	0.001
		STOP *(2)*	White	Red	**ZBA 434**	0.001
				Black	**ZBA 234**	0.001
		OFF	White	Red	**ZBA 435**	0.001
				Black	**ZBA 235**	0.001
		◈	White	Green	**ZBA 346**	0.001
		R (2)	White	Blue	**ZBA 639**	0.001
		+	White	Black	**ZBA 2934**	0.001
		–	White	Black	**ZBA 2935**	0.001

(1) Set of 6 different coloured caps: white, black, green, red, yellow, blue.
(2) Double injection moulded marking.
(3) Can be clipped-in at 90° steps, through 360°.

General : pages 2 to 9
Characteristics : pages 10 to 13
Dimensions : pages 62 to 73

Control and signalling units Ø 22

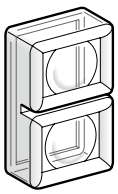
Harmony® XB4, metal

Accessories for heads: boots, lens caps

814334

ZBP 0

814335



ZBW 008

814336

ZBV 01●3

814337

ZBV 01●

Transparent boots for pushbuttons

Description	For use with pushbutton types	Sold in lots of	Unit reference	Weight kg
Single boots	Flush with circular head	10	**ZBP A**	0.002
	Projecting with circular head	10	**ZBP 0**	0.002
	Flush or projecting with circular head for food industry applications	10	**ZBP 0A**	0.002
Double boots	Flush or projecting double-headed	10	**ZBW 008**	0.005
	Flush double-headed	10	**ZBW 008F**	0.005
	Double-headed, for food industry applications	10	**ZBW 008A**	0.005

Coloured boots

Description	Colour	Sold in lots of	Unit reference	Weight kg
Coloured boots (can be replaced without dismantling the head)	Black	10	**ZB2 BP012**	0.003
	Green	10	**ZB2 BP013**	0.003
	Red	10	**ZB2 BP014**	0.003
	Yellow	10	**ZB2 BP015**	0.003
	Blue	10	**ZB2 BP016**	0.003

Lens caps

For use with	Colour	Sold in lots of	Unit reference	Weight kg
Lens caps for light sources with integral LED				
Pilot lights	White	10	**ZBV 0113**	0.002
	Green	10	**ZBV 0133**	0.002
	Red	10	**ZBV 0143**	0.002
	Orange	10	**ZBV 0153**	0.002
	Blue	10	**ZBV 0163**	0.002
	5 different coloured grooved lenses *(1)*	5	**ZBV 0103S**	0.010
Illuminated pushbuttons, with flush push	White	10	**ZBW 9113**	0.002
	Green	10	**ZBW 9133**	0.002
	Red	10	**ZBW 9143**	0.002
	Orange	10	**ZBW 9153**	0.002
	Blue	10	**ZBW 9163**	0.002
Illuminated pushbuttons, with projecting push	White	10	**ZBW 9313**	0.002
	Green	10	**ZBW 9333**	0.002
	Red	10	**ZBW 9343**	0.002
	Orange	10	**ZBW 9353**	0.002
	Blue	10	**ZBW 9363**	0.002
Lens caps for light sources with BA 9s base fitting				
Pilot lights	White	10	**ZBV 011**	0.002
	Green	10	**ZBV 013**	0.002
	Red	10	**ZBV 014**	0.002
	Orange	10	**ZBV 015**	0.002
	Blue	10	**ZBV 016**	0.002
	Clear	10	**ZBV 017**	0.002
Pushbuttons, illuminated, with flush push	White	10	**ZBW 911**	0.002
	Green	10	**ZBW 913**	0.002
	Red	10	**ZBW 914**	0.002
	Orange	10	**ZBW 915**	0.002
	Blue	10	**ZBW 916**	0.002
	Clear	10	**ZBW 917**	0.002
Pushbuttons, illuminated, with projecting push	White	10	**ZBW 931**	0.002
	Green	10	**ZBW 933**	0.002
	Red	10	**ZBW 934**	0.002
	Orange	10	**ZBW 935**	0.002
	Blue	10	**ZBW 936**	0.002
	Clear	10	**ZBW 937**	0.002

(1) Clear, green, red, orange, blue.

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Dimensions : pages 62 to 73

Control and signalling units Ø 22

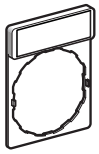
Harmony® XB4, metal

8 x 27 mm legends with 30 x 40 mm legend holders

814295

ZBZ 32

814296



ZBY ●101

814297

ZBY 2107

Standard (30 x 40 mm) legend holders for 8 x 27 mm legends *(1)*

Description	Legend		Sold in lots of	Unit reference	Weight
	Colour	Marking			kg
Without legend	–	–	10	**ZBZ 32**	0.001
With blank legend (for engraving)	Black or red background	–	10	**ZBY 2101**	0.002
	White or yellow background	–	10	**ZBY 4101**	0.002
With 8 x 27 mm legend (with International marking)	Black or red background	O (black background)	1	**ZBY 2146**	0.002
		O (red background)	1	**ZBY 2931**	0.002
		I	1	**ZBY 2147**	0.002
		II	1	**ZBY 2148**	0.002
		O-I	1	**ZBY 2178**	0.002
		I-II	1	**ZBY 2179**	0.002
		I-O-II	1	**ZBY 2186**	0.002
		AUTO	1	**ZBY 2115**	0.002
		STOP	1	**ZBY 2304**	0.002
With 8 x 27 mm legend (with French language marking)	Black or red background *(2)*	ARRET (red background)	1	**ZBY 2104**	0.002
		ARRET (black background)	1	**ZBY 0104**	0.002
		ARRET GENERAL	1	**ZBY 2129**	0.002
		ARRET REARMEMENT	1	**ZBY 2133**	0.002
		ARRET-MARCHE	1	**ZBY 2166**	0.002
		ARRIERE	1	**ZBY 2106**	0.002
		AUTO CYCLE-CYCLE	1	**ZBY 2198**	0.002
		AUTO CYCLE-MAIN	1	**ZBY 2199**	0.002
		AUTO-MAIN	1	**ZBY 2164**	0.002
		AUTO-O-MAIN	1	**ZBY 2185**	0.002
		AVANT	1	**ZBY 2105**	0.002
		AVANT-O-ARRIERE	1	**ZBY 2184**	0.002
		C-P-C-NORMAL	1	**ZBY 2165**	0.002
		CYCLE-MAIN	1	**ZBY 2197**	0.002
		DECLENCHEMENT	1	**ZBY 2132**	0.002
		DEFAUT (black background)	1	**ZBY 2134**	0.002
		DEFAUT (red background)	1	**ZBY 2135**	0.002
		DEPART CYCLE	1	**ZBY 2195**	0.002
		DESCENTE	1	**ZBY 2108**	0.002
		DROITE	1	**ZBY 2109**	0.002
		ENCLENCHEMENT	1	**ZBY 2131**	0.002
		EN SERVICE	1	**ZBY 2111**	0.002
		FERMETURE	1	**ZBY 2114**	0.002
		GAUCHE	1	**ZBY 2110**	0.002
		HORS SERVICE	1	**ZBY 2112**	0.002
		HORS-EN	1	**ZBY 2167**	0.002
		LENT	1	**ZBY 2127**	0.002
		MAIN	1	**ZBY 2116**	0.002
		MARCHE	1	**ZBY 2103**	0.002
		MONTEE	1	**ZBY 2107**	0.002
		OUVERTURE	1	**ZBY 2113**	0.002
		PHASE / PHASE	1	**ZBY 2196**	0.002
		REARMEMENT (red background)	1	**ZBY 2123**	0.002
		REARMEMENT (black background)	1	**ZBY 0123**	0.002
		SOUS TENSION	1	**ZBY 2126**	0.002
		VITE	1	**ZBY 2128**	0.002
	Yellow background	ARRET D'URGENCE	1	**ZBY 2130**	0.002

(1) For legends, see pages 54 to 56.
(2) "Start" functions: white letters on black background. "Stop" functions: white letters on red background (unless otherwise specified above).

General : pages 2 to 9
Characteristics : pages 10 to 13
Dimensions : pages 62 to 73

Control and signalling units Ø 22

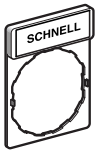
Harmony® XB4, metal

8 x 27 mm legends with 30 x 40 mm legend holders

814300

ZBY 2303

814299



ZBY 2228

Standard (30 x 40 mm) legend holders with 8 x 27 mm legends (continued)

Description	Legend		Reference	Weight kg
	Colour	Marking		
With legend (with English language marking)	Black or red background *(1)*	AUTO-HAND	**ZBY 2364**	0.002
		AUTO-O-HAND	**ZBY 2385**	0.002
		CLOSE	**ZBY 2314**	0.002
		DOWN	**ZBY 2308**	0.002
		FAST	**ZBY 2328**	0.002
		FORWARD	**ZBY 2305**	0.002
		HAND	**ZBY 2316**	0.002
		HAND-OFF-AUTO	**ZBY 2387**	0.002
		INCH	**ZBY 2321**	0.002
		LEFT	**ZBY 2310**	0.002
		OFF	**ZBY 2312**	0.002
		OFF-ON	**ZBY 2367**	0.002
		ON	**ZBY 2311**	0.002
		OPEN	**ZBY 2313**	0.002
		POWER ON	**ZBY 2326**	0.002
		RESET (red background)	**ZBY 2323**	0.002
		RESET (black background)	**ZBY 2322**	0.002
		REVERSE	**ZBY 2306**	0.002
		RIGHT	**ZBY 2309**	0.002
		RUN	**ZBY 2334**	0.002
		SLOW	**ZBY 2327**	0.002
		START	**ZBY 2303**	0.002
		STOP-START	**ZBY 2366**	0.002
		UP	**ZBY 2307**	0.002
	Yellow background	EMERGENCY STOP	**ZBY 2330**	0.002
With legend (with German language marking)	Black or red background *(1)*	AB	**ZBY 2208**	0.002
		AUF	**ZBY 2207**	0.002
		AUS	**ZBY 2204**	0.002
		AUS-EIN	**ZBY 2266**	0.002
		AUS-IN BETRIEB	**ZBY 2267**	0.002
		AUS-RÜCKSTELLUNG	**ZBY 2233**	0.002
		AUSSCHALTEN	**ZBY 2232**	0.002
		AUTO-HAND	**ZBY 2364**	0.002
		AUTO-O-HAND	**ZBY 2385**	0.002
		AUTOZYKL-HAND	**ZBY 2299**	0.002
		AUTOZYKL- 1 ZYKL	**ZBY 2298**	0.002
		C-P-C-NORMAL	**ZBY 2265**	0.002
		EIN	**ZBY 2203**	0.002
		EINSCHALTEN	**ZBY 2231**	0.002
		HAND	**ZBY 2316**	0.002
		LANGSAM	**ZBY 2227**	0.002
		LINKS	**ZBY 2210**	0.002
		NOT-AUS (red background)	**ZBY 2230**	0.002
		NOT-HALT	**ZBY 2229**	0.002
		ÖFFNEN	**ZBY 2213**	0.002
		RECHTS	**ZBY 2209**	0.002
		RÜCKSTELLUNG	**ZBY 2223**	0.002
		SCHLIESSEN	**ZBY 2214**	0.002
		SCHNELL	**ZBY 2228**	0.002
		SPANNUNG EIN	**ZBY 2226**	0.002
		STEUERUNG AUS	**ZBY 2212**	0.002
		STEUERUNG EIN	**ZBY 2211**	0.002
		STÖRUNG (black background)	**ZBY 2234**	0.002
		STÖRUNG (red background)	**ZBY 2235**	0.002
		VOR	**ZBY 2205**	0.002
		VOR-O-ZURÜCK	**ZBY 2284**	0.002
		ZURÜCK	**ZBY 2206**	0.002
		ZYKLUS-HAND	**ZBY 2297**	0.002
		ZYKLUSSTART	**ZBY 2295**	0.002
	Yellow background	NOT-AUS	**ZBY 22420001**	0.002

(1) "Start" functions: white letters on black background. "Stop" functions: white letters on red background (unless otherwise specified above).

General : pages 2 to 9
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Control and signalling units Ø 22

Harmony® XB4, metal

Legends 8 x 27 mm

814310

ZBY 02178

814311

ZBY 0●104

8 x 27 mm marked legends (for 30 x 40 mm legend holders ZBZ 32 and ZBZ 34)

Colour	Marking		Reference	Weight kg
Black or red background *(1)*	International	O (black background)	**ZBY 02146**	0.001
		O (red background)	**ZBY 02931**	0.001
		I	**ZBY 02147**	0.001
		II	**ZBY 02148**	0.001
		O-I	**ZBY 02178**	0.001
		I-II	**ZBY 02179**	0.001
		I-O-II	**ZBY 02186**	0.001
		AUTO	**ZBY 02115**	0.001
		STOP	**ZBY 02304**	0.001
	French	ARRET (red background)	**ZBY 02104**	0.001
		ARRET (black background)	**ZBY 00104**	0.001
		ARRET GENERAL	**ZBY 02129**	0.001
		ARRET REARMEMENT	**ZBY 02133**	0.001
		ARRET-MARCHE	**ZBY 02166**	0.001
		ARRIERE	**ZBY 02106**	0.001
		AUTO CYCLE-CYCLE	**ZBY 02198**	0.001
		AUTO CYCLE-MAIN	**ZBY 02199**	0.001
		AUTO-MAIN	**ZBY 02164**	0.001
		AUTO-O-MAIN	**ZBY 02185**	0.001
		AVANT	**ZBY 02105**	0.001
		AVANT-O-ARRIERE	**ZBY 02184**	0.001
		C-P-C-NORMAL	**ZBY 02165**	0.001
		CYCLE-MAIN	**ZBY 02197**	0.001
		DECLENCHEMENT	**ZBY 02132**	0.001
		DEFAUT (black background)	**ZBY 02134**	0.001
		DEFAUT (red background)	**ZBY 02135**	0.001
		DEPART CYCLE	**ZBY 02195**	0.001
		DESCENTE	**ZBY 02108**	0.001
		DROITE	**ZBY 02109**	0.001
		ENCLENCHEMENT	**ZBY 02131**	0.001
		EN SERVICE	**ZBY 02111**	0.001
		FERMETURE	**ZBY 02114**	0.001
		GAUCHE	**ZBY 02110**	0.001
		HORS SERVICE	**ZBY 02112**	0.001
		HORS-EN	**ZBY 02167**	0.001
		LENT	**ZBY 02127**	0.001
		MAIN	**ZBY 02116**	0.001
		MARCHE	**ZBY 02103**	0.001
		MONTEE	**ZBY 02107**	0.001
		OUVERTURE	**ZBY 02113**	0.001
		PHASE / PHASE	**ZBY 02196**	0.001
		REARMEMENT (red background)	**ZBY 02123**	0.001
		REARMEMENT (black background)	**ZBY 00123**	0.001
		SOUS TENSION	**ZBY 02126**	0.001
		VITE	**ZBY 02128**	0.001
Yellow background	French	ARRET D'URGENCE	**ZBY 02130**	0.001

(1) "Start" functions: white letters on black background. "Stop" functions: white letters on red background (unless otherwise specified above).

General : pages 2 to 9
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Control and signalling units Ø 22

Harmony® XB4, metal

Legends 8 x 27 mm

814313

ZBY 02303

814314

ZBY 02228

8 x 27 mm marked legends (for 30 x 40 mm legend holders ZBZ 32 and ZBZ 34) (continued)

Colour	Marking		Reference	Weight kg
Black or red background *(1)*	English	AUTO-HAND	**ZBY 02364**	0.001
		AUTO-O-HAND	**ZBY 02385**	0.001
		CLOSE	**ZBY 02314**	0.001
		DOWN	**ZBY 02308**	0.001
		EMERGENCY STOP	**ZBY 02330**	0.001
		FAST	**ZBY 02328**	0.001
		FORWARD	**ZBY 02305**	0.001
		HAND	**ZBY 02316**	0.001
		HAND-OFF-AUTO	**ZBY 02387**	0.001
		INCH	**ZBY 02321**	0.001
		LEFT	**ZBY 02310**	0.001
		OFF	**ZBY 02312**	0.001
		OFF-ON	**ZBY 02367**	0.001
		ON	**ZBY 02311**	0.001
		OPEN	**ZBY 02313**	0.001
		POWER ON	**ZBY 02326**	0.001
		RESET (red background)	**ZBY 02323**	0.001
		RESET (black background)	**ZBY 02322**	0.001
		REVERSE	**ZBY 02306**	0.001
		RIGHT	**ZBY 02309**	0.001
		RUN	**ZBY 02334**	0.001
		SLOW	**ZBY 02327**	0.001
		START	**ZBY 02303**	0.001
		STOP-START	**ZBY 02366**	0.001
		UP	**ZBY 02307**	0.001
	German	AB	**ZBY 02208**	0.001
		AUF	**ZBY 02207**	0.001
		AUS	**ZBY 02204**	0.001
		AUS-EIN	**ZBY 02266**	0.001
		AUS-IN BETRIEB	**ZBY 02267**	0.001
		AUS-RÜCKSTELLUNG	**ZBY 02233**	0.001
		AUSSCHALTEN	**ZBY 02232**	0.001
		AUTO-HAND	**ZBY 02364**	0.001
		AUTO-O-HAND	**ZBY 02385**	0.001
		AUTOZYKL-HAND	**ZBY 02299**	0.001
		AUTOZYKL- 1 ZYKL	**ZBY 02298**	0.001
		C-P-C-NORMAL	**ZBY 02265**	0.001
		EIN	**ZBY 02203**	0.001
		EINSCHALTEN	**ZBY 02231**	0.001
		HAND	**ZBY 02316**	0.001
		LANGSAM	**ZBY 02227**	0.001
		LINKS	**ZBY 02210**	0.001
		NOT-AUS (red background)	**ZBY 02230**	0.001
		NOT-HALT	**ZBY 02229**	0.001
		ÖFFNEN	**ZBY 02213**	0.001
		RECHTS	**ZBY 02209**	0.001
		RÜCKSTELLUNG	**ZBY 02223**	0.001
		SCHLIESSEN	**ZBY 02214**	0.001
		SCHNELL	**ZBY 02228**	0.001
		SPANNUNG EIN	**ZBY 02226**	0.001
		STEUERUNG AUS	**ZBY 02212**	0.001
		STEUERUNG EIN	**ZBY 02211**	0.001
		STÖRUNG (black background)	**ZBY 02234**	0.001
		STÖRUNG (red background)	**ZBY 02235**	0.001
		VOR	**ZBY 02205**	0.001
		VOR-O-ZURÜCK	**ZBY 02284**	0.001
		ZURÜCK	**ZBY 02206**	0.001
		ZYKLUS-HAND	**ZBY 02297**	0.001
		ZYKLUSSTART	**ZBY 02295**	0.001
Yellow background	English	EMERGENCY STOP	**ZBY 02330**	0.001
	German	NOT-AUS	**ZBY 022420001**	0.001

(1) "Start" functions: white letters on black background. "Stop" functions: white letters on red background (unless otherwise specified above).

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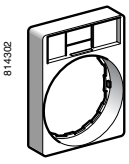
Control and signalling units Ø 22

Harmony® XB4, metal

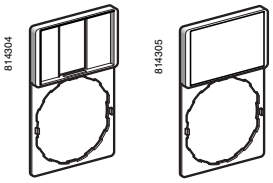
Legend holders for 8 x 27 or 18 x 27 mm legends for engraving or printing



ZBZ 34 *ZBY ●H101*

30 x 40 mm legend holder (flush mounting with bezel) for 8 x 27 mm legends

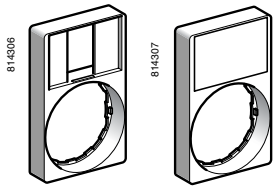
Description	Colour	Sold in lots of	Unit reference	Weight kg
Without legend	–	10	**ZBZ 34**	0.003
With blank legend	Black or red background	10	**ZBY 2H101**	0.004
	White or yellow background	10	**ZBY 4H101**	0.004



ZBZ 33 *ZBY 610●*

Standard (30 x 50 mm) legend holders for 18 x 27 mm legends

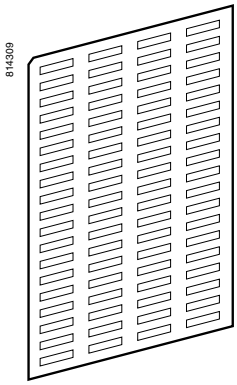
Description	Colour	Sold in lots of	Unit reference	Weight kg
Without legend	–	10	**ZBZ 33**	0.001
With blank legend	Black or red background	10	**ZBY 6101**	0.002
	White or yellow background	10	**ZBY 6102**	0.002



ZBZ 35 *ZBY 6H10●*

30 x 50 mm legend holder (flush mounting with bezel) for 18 x 27 mm legends

Description	Colour	Sold in lots of	Unit reference	Weight kg
Without legend	–	10	**ZBZ 35**	0.003
With blank legend	Black or red background	10	**ZBY 6H101**	0.004
	White or yellow background	10	**ZBY 6H102**	0.004



ZBY 4100

Legends for engraving

Description mm	For use with	Colour	Sold in lots of	Unit reference	Weight kg
8 x 27	30 x 40 mm legend holder	Black or red background	10	**ZBY 0101**	0.001
		White or yellow background	10	**ZBY 0102**	0.001
18 x 27	30 x 50 mm legend holder	Black or red background	10	**ZBY 5101**	0.001
		White or yellow background	10	**ZBY 5102**	0.001

Sheets of peel-off legends (with backing board and protective cover)

Description	For use with	Sold in lots of	Unit reference	Weight kg
Sheet of 76 legends 8 x 27 mm	30 x 40 mm legend holder ZBZ 32 and ZBZ 34	10	**ZBY 4100**	0.043
Sheet of 40 legends 18 x 27 mm	30 x 50 mm legend holder ZBZ 33 and ZBZ 35	10	**ZBY 5100**	0.044

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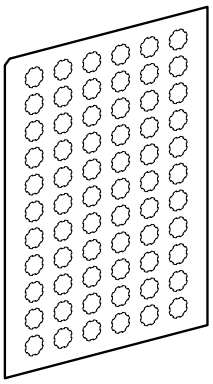
Control and signalling units Ø 22

Harmony® XB4, metal

Legends, for printing, pre-printed, labelling software

814316



ZBY 1101

Legends for XB4 B pushbutton, illuminated pushbuttons and pilot lights

Description	Marking		Sold in lots of	Unit reference	Weight kg
Sheets of 66 circular peel-off, transparent, self-adhesive legends	Without		10	**ZBY 1101**	0.017
Strips of 66 circular peel-off, transparent, self-adhesive legends	International	O	10	**ZBY 1146**	0.017
		I	10	**ZBY 1147**	0.017
		II	10	**ZBY 1148**	0.017
		III	10	**ZBY 1149**	0.017
		STOP	10	**ZBY 1304**	0.017
		↑	10	**ZBY 1912**	0.017
	French	ARRET	10	**ZBY 1104**	0.017
		ARRIERE	10	**ZBY 1106**	0.017
		AUTO	10	**ZBY 1115**	0.017
		AVANT	10	**ZBY 1105**	0.017
		DESCENTE	10	**ZBY 1108**	0.017
		MAIN	10	**ZBY 1116**	0.017
		MARCHE	10	**ZBY 1103**	0.017
		MONTEE	10	**ZBY 1107**	0.017
	English	HAND	10	**ZBY 1316**	0.017
		OFF	10	**ZBY 1312**	0.017
		ON	10	**ZBY 1311**	0.017
		START	10	**ZBY 1303**	0.017
	German	AB	10	**ZBY 1208**	0.017
		AUF	10	**ZBY 1207**	0.017
		AUS	10	**ZBY 1204**	0.017
		EIN	10	**ZBY 1203**	0.017
		ZU	10	**ZBY 1214**	0.017

563527

XBY 2U

"SIS Label" labelling software

Application	For use with	Reference	Weight kg
Legend design for English, French, German, Italian, Spanish	ZBY 1101 ZBY 0101 ZBY 0102 ZBY 5101 ZBY 5102 ZBY 001	**XBY 2U**	0.100

814318

ZBY 9130

Circular legends for Emergency stop mushroom head pushbuttons

Diameter mm	Colour	Marking on yellow background	Reference	Weight kg
60	Yellow	–	**ZBY 9101**	0.004
		ARRET D'URGENCE	**ZBY 9130**	0.004
		EMERGENCY STOP	**ZBY 9330**	0.004
		NOT-AUS	**ZBY 9230**	0.004
90	Yellow	–	**ZBY 8101**	0.008
		ARRET D'URGENCE	**ZBY 8130**	0.008
		EMERGENCY STOP	**ZBY 8330**	0.008
		NOT-AUS	**ZBY 8230**	0.008

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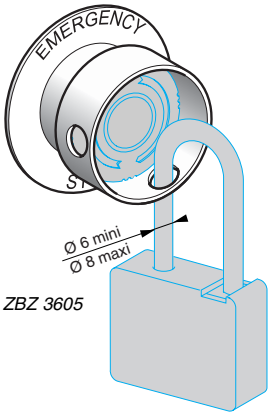
Control and signalling units Ø 22

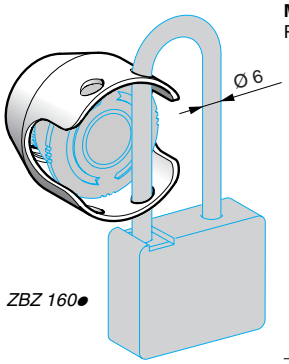
Harmony® XB4, metal

Accessories for pushbuttons: padlocking kit, protective guard, bellows seals, padlockable flaps

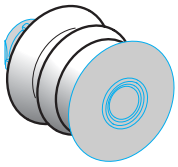


ZBZ 3605

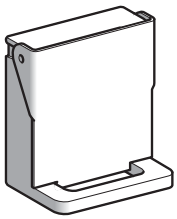
ZBY 9130T



ZBZ 160●



ZBZ ●8



ZB4 BZ64

Padlocking kit for Emergency Stop

Description	Application	Colour	Reference	Weight kg
Padlocking kit Conforming to EN 418/ISO 13850 *(1) (2)* (padlockable)	For Emergency Stop function only, with the following Ø 40 trigger-action pushbuttons: XB4 BT8● XB4 BS8● XB4 BS9● ZB4 BT8● ZB4 BS8● ZB4 BS9●	Yellow	**ZBZ 3605**	0.045

Description	Marking	Colour	Reference	Weight kg
Ø 60 mm legend for padlocking device ZBZ 3605	Without	Yellow	**ZBY 9101T**	0.004
	ARRET D'URGENCE	Yellow	**ZBY 9130T**	0.004
	EMERGENCY STOP	Yellow	**ZBY 9330T**	0.004
	NOT-AUS	Yellow	**ZBY 9230T**	0.004

Guards

Description	Application	Colour	Reference	Weight kg
Metal guards Padlockable *(2)*	For Emergency Stop function only, with the following Ø 40 trigger-action pushbuttons: XB4 BT8, XB4 BS8, XB4 BS9, ZB4 BT8, ZB4 BS8, ZB4 BS9.	Chromium plated	**ZBZ 1600**	0.046
		Black	**ZBZ 1602**	0.046
		Red	**ZBZ 1604**	0.046
		Yellow	**ZBZ 1605**	0.046
		Blue	**ZBZ 1606**	0.046
Plastic guard	Selector switches and key switches	Black	**ZBZ 2102**	0.005

Bellows seals for harsh environments (IP 69K)

Description	For use with	Colour Material	Sold in lots of	Unit reference	Weight kg
Bellows seals for harsh environments (humidity, dust, high-pressure cleaning)	Any Harmony XB4 metal, mushroom head pushbutton *(3)*, Ø 40 mm or Ø 60 mm (except ZB4 BR●16)	Red Silicone	2	**ZBZ 48** ▲	0.009
		Black EPDM	2	**ZBZ 28** ▲	0.009

Padlockable flaps

Description	For use with	Colour	Reference	Weight kg
Padlockable flaps	Pushbuttons	Black	**ZB4 BZ62**	0.076
		Red	**ZB4 BZ64**	0.076
		Yellow	**ZB4 BZ65**	0.076
		Blue	**ZB4 BZ66**	0.076

*(1) Standard circular legends are not compatible with this product. Use special legends **ZBY ●●T**.*
(2) No isolation function is possible when this guard is fitted.
*(3) Only when mounted on control stations. Use legends **ZBY 9●●●T**.*

▲ Available: 4th quarter 2006.

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Dimensions : pages 62 to 73

Control and signalling units Ø 22

Harmony® XB4, metal

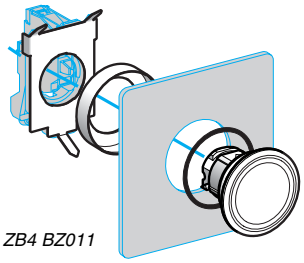
Accessories for pushbuttons: blanking plugs flush mounting kit , cable ducting support

ZB5 SZ3

Accessories

Blanking plug

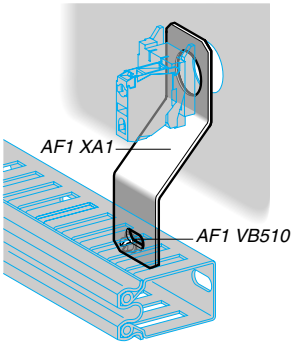
Description	For use with	Sold in lots of	Unit reference	Weight kg
Metal blanking plug, round, chromium plated *(1)*	Ø 22 control and signalling units	10	**ZB4 SZ3**	0.023
Plastic blanking plug, round, black (with fixing nut)	Ø 22 control and signalling units	10	**ZB5 SZ3**	0.009



ZB4 BZ011

Flush mounting kit

Description	For use with	Reference	Weight kg
Flush mounting kit	Pushbutton ZB4 B● with head mounted flush with bezel	**ZB4 BZ011**	0.007



Cable ducting support

Description	Application	Sold in lots of	Unit reference	Weight kg
Cable ducting support	Fixing beneath head	10	**AF1 XA1**	0.030
M5 x 10 screw, with hexagonal slotted head	For fixing cable ducting	100	**AF1 VB510**	0.003
Support	For XB4 B pushbuttons, switches and pilot lights	1	**DX1 AP52**	0.160

*(1) Body/fixing collar **ZB4 BZ009,** required for mounting, must be ordered separately, see page 43.*

Control and signalling units Ø 22

Harmony® XB4, metal

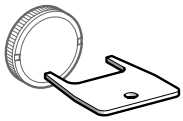
Accessories for illuminated pushbuttons: bulbs

DL1 CJ0●●●

DL1 CE●●●

DL1 CF●●●

XBF X13



ZBZ 8

Bulbs with BA 9s base fitting and associated accessories

Description	Characteristics	Colour	Sold in lots of	Unit reference	Weight kg
LEDs	≂ 24 V	White	1	**DL1 CJ0241**	0.002
		Green	1	**DL1 CJ0243**	0.002
		Red	1	**DL1 CJ0244**	0.002
		Orange	1	**DL1 CJ0245**	0.002
		Blue	1	**DL1 CJ0246**	0.002
	≂ 48 V	Green	1	**DL1 CJ0483**	0.002
		Red	1	**DL1 CJ0484**	0.002
		Orange	1	**DL1 CJ0485**	0.002
	6 V -1.2 W	White	1	**DL1 CD0061**	0.002
		Green	1	**DL1 CD0063**	0.002
		Red	1	**DL1 CD0064**	0.002
		Orange	1	**DL1 CD0065**	0.002
		Blue	1	**DL1 CD0066**	0.002
Incandescent bulbs	6 V -1.2 W	–	10	**DL1 CB006**	0.002
	24 V - 2 W	–	10	**DL1 CE024**	0.002
	120…130 V - 2.4 W	–	10	**DL1 CE130**	0.002
Neon bulbs	120…130 V	–	10	**DL1 CF110**	0.002
	230…240 V	–	10	**DL1 CF220**	0.002
Bulb extractor	–	–	1	**XBF X13**	0.005
Lens cap tightening tool	Illuminated pushbuttons, with flush push	–	1	**ZBZ 8**	0.009

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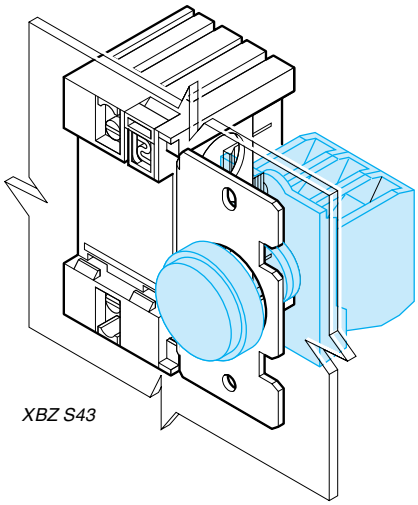
Control and signalling units Ø 22

Harmony® XB4, metal

Accessories for pushbuttons: keys, module interface

ZBG 455P



XBZ S43

Replacement keys

Description	Key number	Reference	Weight kg
For Emergency Stop key release heads and key switches			
Sets of 2 keys	455	**ZBG 455**	0.013
	421E	**ZBG 421E**	0.014
	458A	**ZBG 458A**	0.014
	520E	**ZBG 520E**	0.014
	3131A	**ZBG 3131A**	0.014
	4A185	**ZBD A185**	0.014
	LU1	**ZBD LU1**	0.014
	LU2	**ZBD LU2**	0.014
	LU3	**ZBD LU3**	0.014
	LU4	**ZBD LU4**	0.014
	LU5	**ZBD LU5**	0.014
	LU6	**ZBD LU6**	0.014
	LU7	**ZBD LU7**	0.014
	LU8	**ZBD LU8**	0.014
	LU9	**ZBD LU9**	0.014
	LU10	**ZBD LU10**	0.014
	LU11	**ZBD LU11**	0.014
	LU12	**ZBD LU12**	0.014
	LU13	**ZBD LU13**	0.014
	LU14	**ZBD LU14**	0.014
	8D1	**ZBD 8D1**	0.014
For booted selector switches			
Sets of 2 keys, one of which supplied booted (rubber boot)	455	**ZBG 455P**	–
	421E	**ZBG 421EP**	–
	458A	**ZBG 458AP**	–
	520E	**ZBG 520EP**	–
	3131A	**ZBG 3131AP**	–

Accessory for key switches

Description	Function	Reference	Weight kg
Keyhole cover (rubber cover)	Protection of lock barrel when no key inserted in lock	**ZBG P** ▲	

AS-i interface module for Ø 22 control and signalling units

Panel fixing, in conjunction with a Harmony pushbutton or switch

Description	Application	Reference	Weight kg
S7.F profile	4 inputs and 4 outputs, direct supply from the bus	**XBZ S43**	0.100

▲ Available: 4th quarter 2006.

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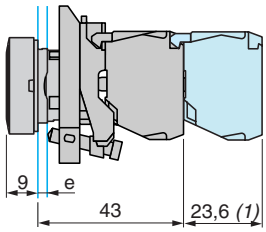
Control and signalling units Ø 22

Harmony® XB4, metal

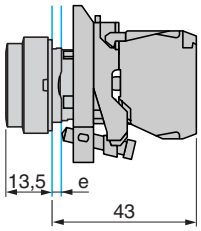
Complete units, XB4 B

Pushbuttons, spring return

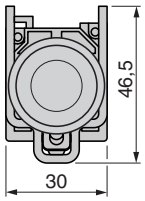
XB4 BA●●



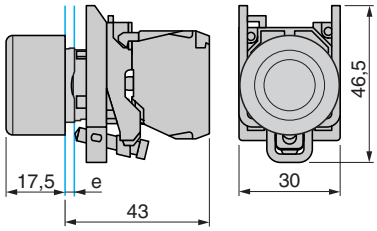
XB4 BL●●



Common face view



XB4 BP●●



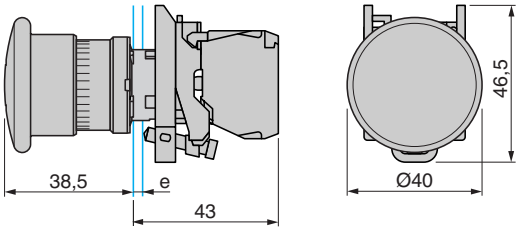
e: clamping thickness: 1 to 6 mm

(1) Additional row of contacts or double contact.

e: clamping thickness: 1 to 6 mm

Mushroom head pushbuttons, spring return

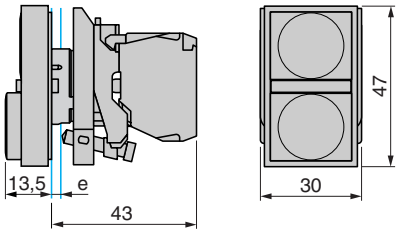
XB4 BC21



e: clamping thickness: 1 to 6 mm

Double-headed pushbuttons, spring return

XB4 BL●45

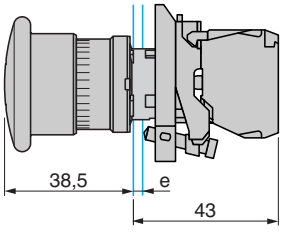


e: clamping thickness: 1 to 6 mm

Emergency stop mushroom head pushbuttons, trigger action and mechanical latching

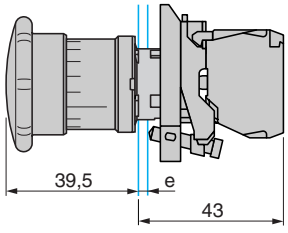
Push-pull

XB4 BT845



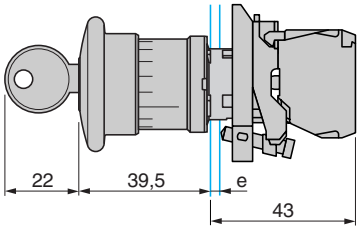
Turn to release

XB4 BS84441, BS8444, BS8445

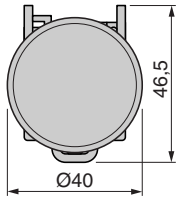


Key release

XB4 BS9445



Common face view



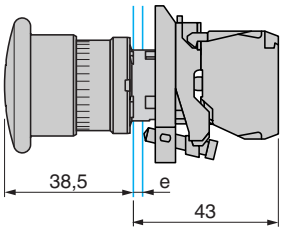
e: clamping thickness: 1 to 6 mm

e: clamping thickness: 1 to 6 mm

Emergency stop mushroom head pushbuttons, mechanical latching

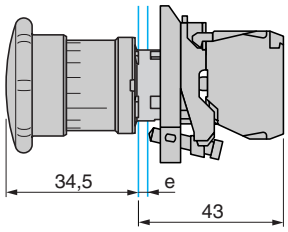
Push-pull

XB4 BT42



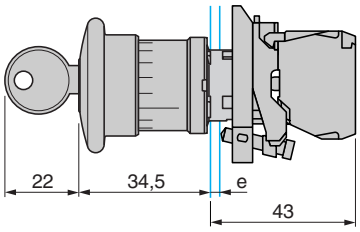
Turn to release

XB4 BS542

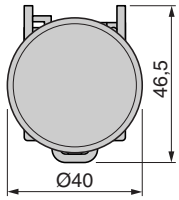


Key release

XB4 BS142



Common face view



e: clamping thickness: 1 to 6 mm

e: clamping thickness: 1 to 6 mm

General : pages 2 to 9
Characteristics : pages 10 to 13
References : pages 16 to 61

Control and signalling units Ø 22

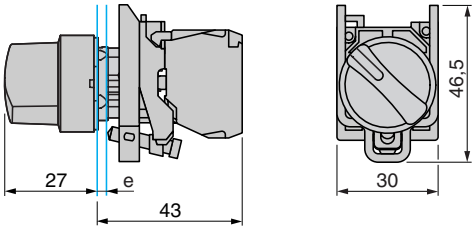
Harmony® XB4, metal

Pushbuttons, switches and pilot lights:
complete units, XB4 B

Selector switches

Standard handle operator

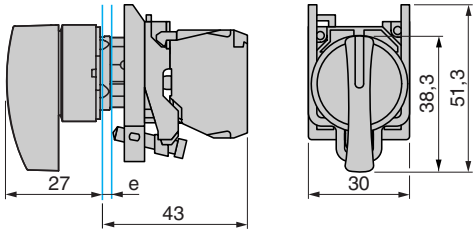
XB4 BD●●



e: clamping thickness: 1 to 6 mm

Long handle operator

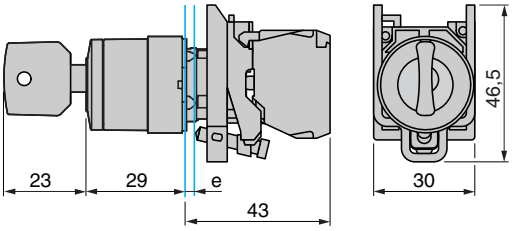
XB4 BJ●●



e: clamping thickness: 1 to 6 mm

Key switches

XB4 BG●●



e: clamping thickness: 1 to 6 mm

Control and signalling units Ø 22

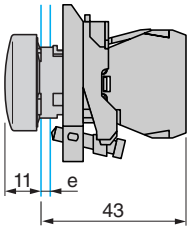
Harmony® XB4, metal

Pushbuttons, switches and pilot lights:
complete units, XB4 B

Pilot lights

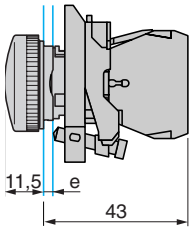
Integral LED

XB4 BVB●, BVG●, BVM●



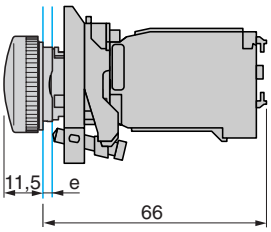
Direct supply

XB4 BV6●

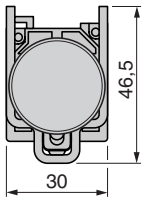


Via integral transformer

XB4 BV3●, BV4●



Common face view



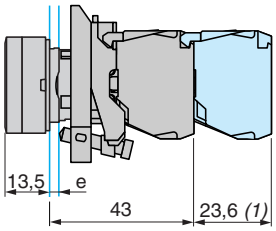
e: clamping thickness: 1 to 6 mm

e: clamping thickness: 1 to 6 mm

Illuminated pushbuttons, spring return

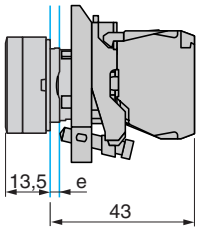
Integral LED

XB4 BWB3●●5



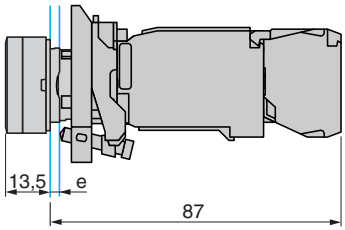
Direct supply

XB4 BW3●65

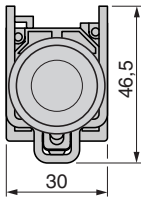


Via integral transformer

XB4 BW3●●5



Common face view



e: clamping thickness: 1 to 6 mm

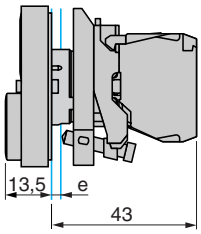
e: clamping thickness: 1 to 6 mm

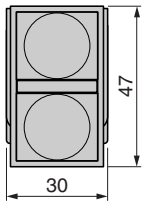
(1) Additional row of contacts or double contact

Double-headed pushbuttons with pilot light

Integral LED

XB4 BW84●5



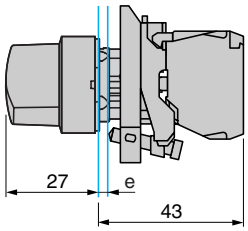


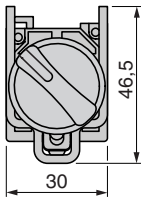
e: clamping thickness: 1 to 6 mm

Illuminated selector switches

Integral LED

XB4 BK12●●5

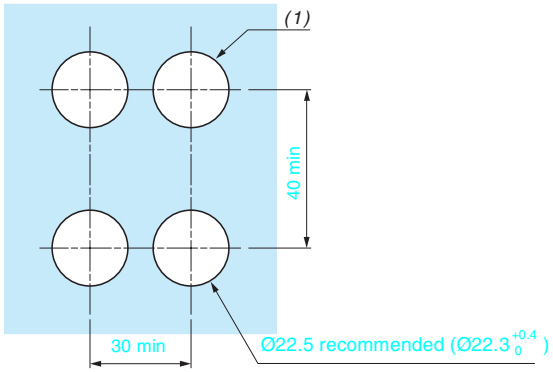




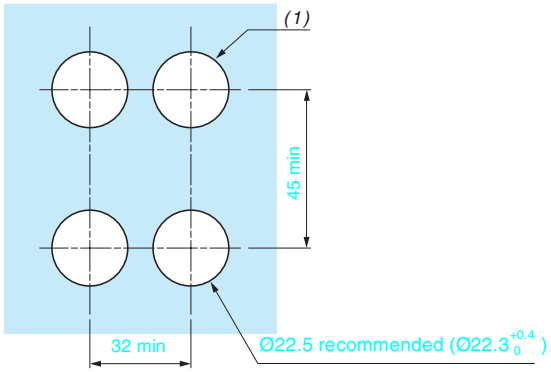
e: clamping thickness: 1 to 6 mm

Panel cut-out for pushbuttons, switches and pilot lights (finished holes, ready for installation)

Connection by screw clamp terminals or plug-in connectors or on printed circuit board



Connection by Faston connectors



(1) Diameter on finished panel or support.

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References : pages 16 to 61

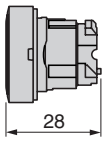
Control and signalling units Ø 22

Harmony® XB4, metal

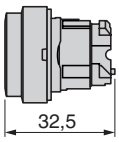
Pushbuttons, switches and pilot lights: sub-assemblies, ZB4 B

Heads for spring return pushbuttons

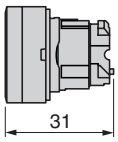
ZB4 BA●, ZB4 BA●●●
ZB4 BA●8



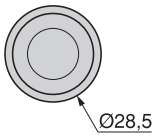
ZB4 BL●, ZB4 BL●●●



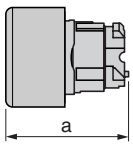
ZB4 BA●4, ZB4 BA●6

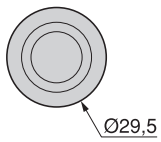


Common face view



ZB4 BP●●, ZB4 BP●S, ZB4 BP●83, ZB4 BP●

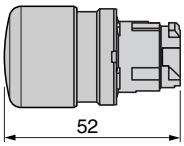


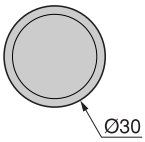


ZB4	a
BP●●	36.5
BP●S	33
BP●83	32
BP●	35

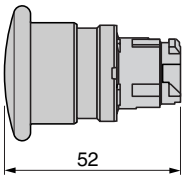
Mushroom heads for spring return pushbuttons

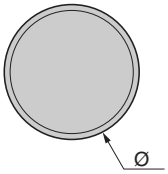
ZB4 BC●4





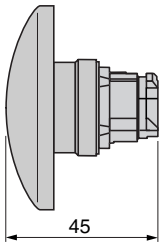
ZB4 BC●, ZB4 BR●

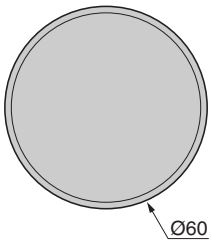




ZB4	Ø
BC●	40
BR●	60

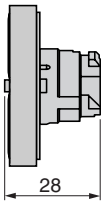
ZB4 BR●16



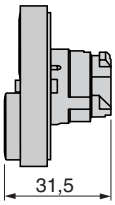


Heads for double-headed, spring return pushbuttons

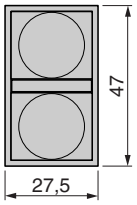
ZB4 BA81●●
ZB4 BA82●●



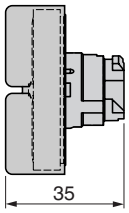
ZB4 BL83●●
ZB4 BL84●●



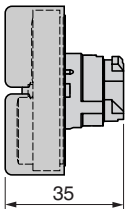
Common face view



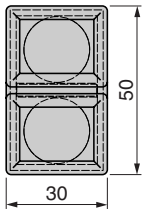
ZB4 BA91●●
ZB4 BA92●●



ZB4 BL93●●
ZB4 BL94●●

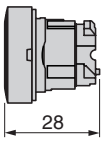


Common face view

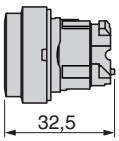


Heads for "push-push to release" pushbuttons

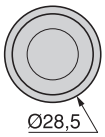
ZB4 BH0●



ZB4 BH●



Common face view



Control and signalling units Ø 22

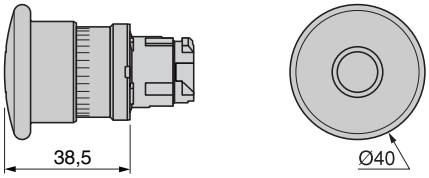
Harmony® XB4, metal

Pushbuttons, switches and pilot lights: sub-assemblies, ZB4 B

Mushroom heads for Emergency stop, trigger action and mechanical latching pushbuttons

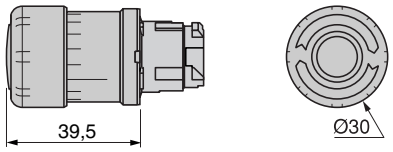
Push-pull

ZB4 BT84

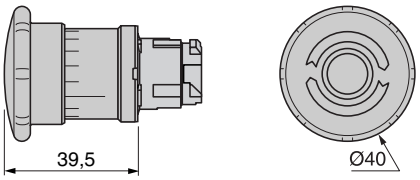


Turn to release

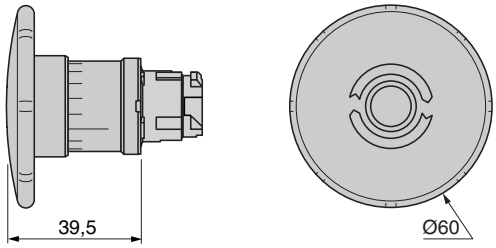
ZB4 BS834



ZB4 BS844

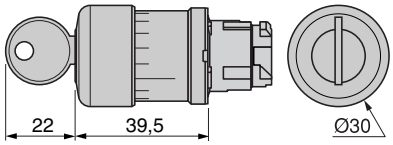


ZB4 BS864

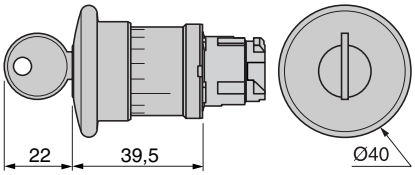


Key release

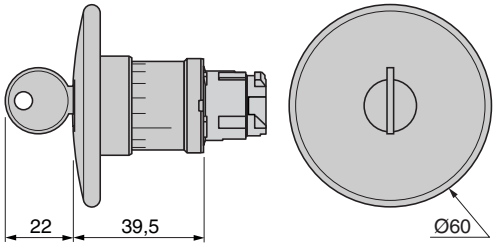
ZB4 BS934



ZB4 BS944



ZB4 BS964



Control and signalling units Ø 22

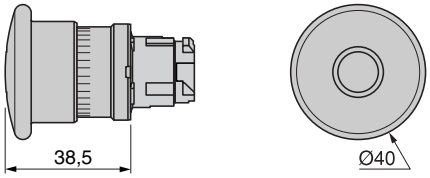
Harmony® XB4, metal

Pushbuttons, switches and pilot lights: sub-assemblies, ZB4 B

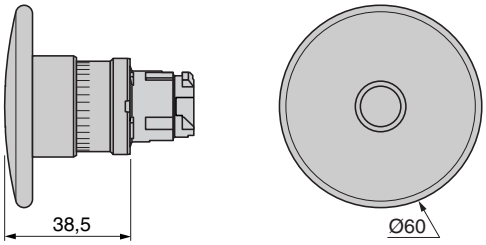
Mushroom heads for Emergency stop mechanical latching pushbuttons

Push-pull

ZB4 BT4

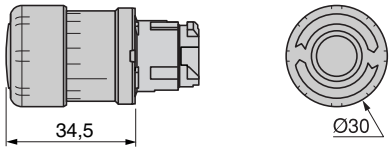


ZB4 BX4

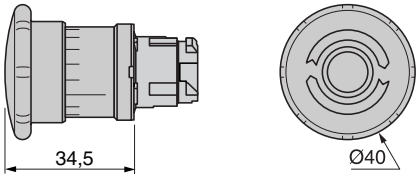


Turn to release

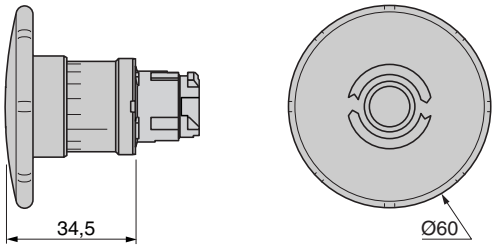
ZB4 BS44



ZB4 BS54

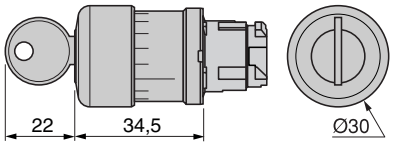


ZB4 BS64

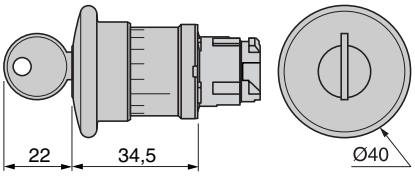


Key release

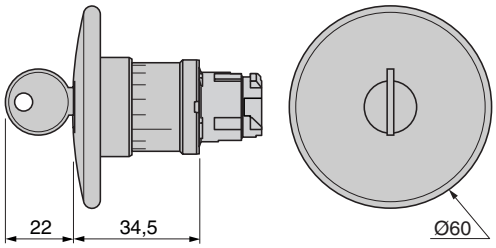
ZB4 BS74



ZB4 BS14



ZB4 BS24



Control and signalling units Ø 22

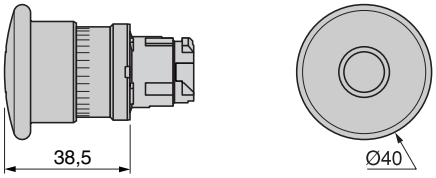
Harmony® XB4, metal

Pushbuttons, switches and pilot lights:
sub-assemblies, ZB4 B

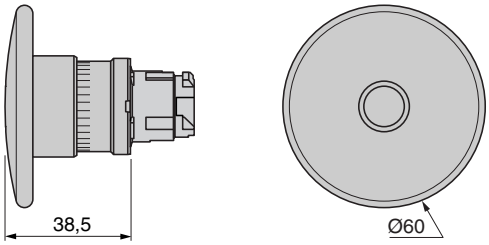
Mushroom heads for latching pushbuttons *(1)*

Push-pull

ZB4 BT2

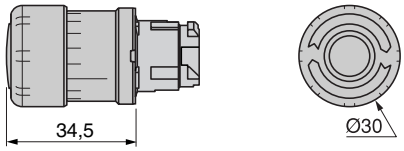


ZB4 BX2

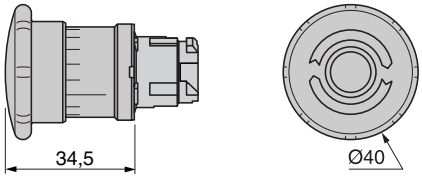


Turn to release

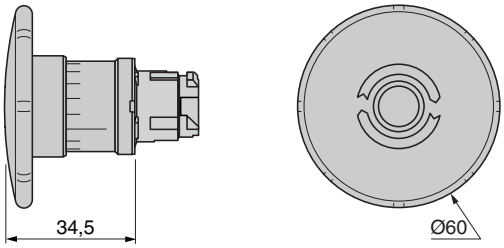
ZB4 BS42



ZB4 BS52, ZB4 BS55

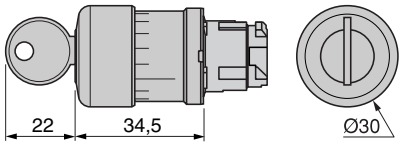


ZB4 BS62

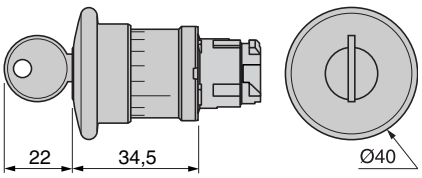


Key release

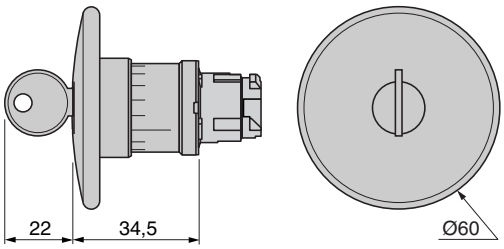
ZB4 BS72



ZB4 BS12



ZB4 BS22



(1) Red mushroom heads for Emergency stop, latching pushbuttons: see pages 66 and 67.

Control and signalling units Ø 22

Harmony® XB4, metal

Pushbuttons, switches and pilot lights: sub-assemblies, ZB4 B

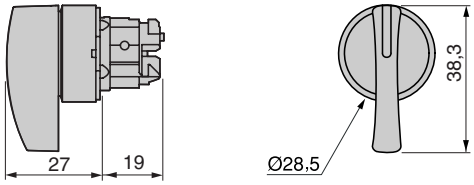
Heads for selector switches

Standard handle operator

ZB4 BD●, ZB4 BD0●M

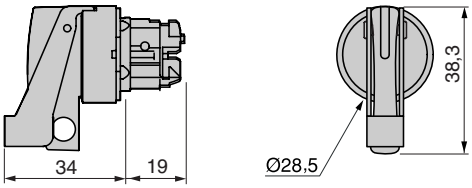
Long handle operator

ZB4 BJ●, ZB4 BD0●M



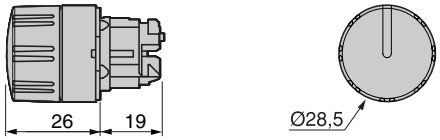
Padlockable long handle operator (6.35 mm shank max.)

ZB4 BJ●9●



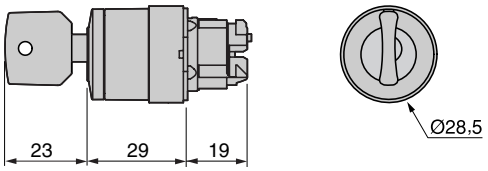
Black knurled knob

ZB4 BD●9



Key switches

ZB4 BG●, ZB4 BG0●, ZB4 BG0●M



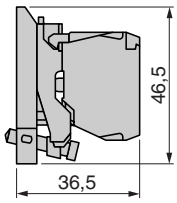
Heads for toggle switches

ZB4 BD●8

Bodies for pushbuttons and switches

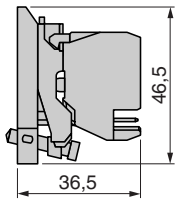
Screw clamp terminal connections

ZB4 BZ10●, ZB4 BZ141



Plug-in connector

ZB4 BZ10●4, ZB4 BZ1414



Control and signalling units Ø 22

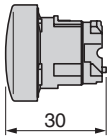
Harmony® XB4, metal

Pushbuttons, switches and pilot lights: sub-assemblies, ZB4 B

Heads for pilot lights, with light source

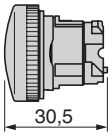
Integral LED

ZB4 BV0●3, ZB4 BV0●3S

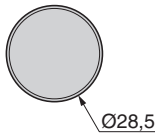


Incandescent, neon or LED

ZB4 BV0●, ZB4 BV0●S



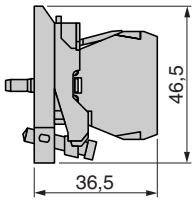
Common face view



Bodies for pilot lights, screw clamp terminal connections

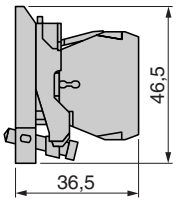
Integral LED

ZB4 BV●●



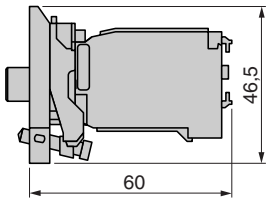
Direct supply, for BA 9s bulb

ZB4 BV6



Via integral transformer, for BA 9s bulb

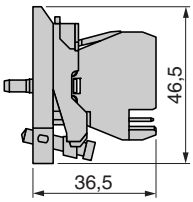
ZB4 BV●, ZB4 BV●D●



Bodies for pilot lights, plug-in connector

Integral LED

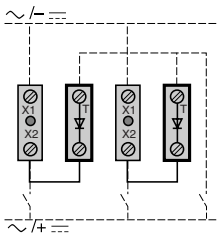
ZB4 BV●●4



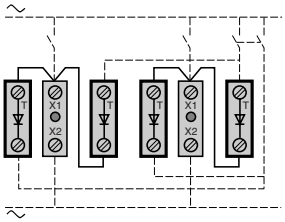
Connections

Blocks for "test light" function

ZBZ G156



ZBZ M156



Control and signalling units Ø 22

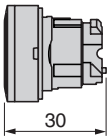
Harmony® XB4, metal

Pushbuttons, switches and pilot lights: sub-assemblies, ZB4 B

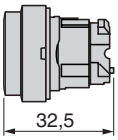
Heads for spring return illuminated pushbuttons, for light source types:

LED

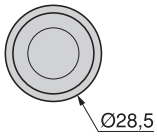
ZB4 BW3●3, ZB4 BW3●3S
ZB4 BW5●3, ZB4 BA●8



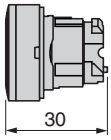
ZB4 BW1●3, ZB4 BL●8

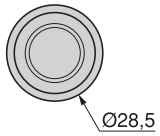


Common face view



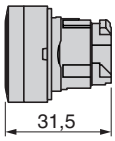
ZB4 BW9●3



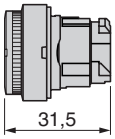


Incandescent or neon

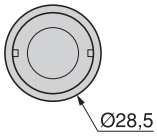
ZB4 BW3●3, ZB4 BW3●S



ZB4 BW1●

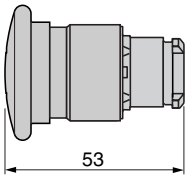


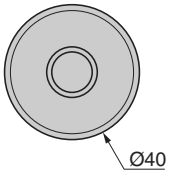
Common face view



Heads for Ø 40 mm mushroom head illuminated pushbuttons with LED

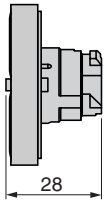
ZB4 BW4●3, ZB4 BW6●3



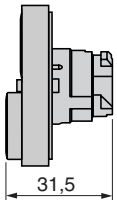


Heads for double-headed pushbuttons with pilot light

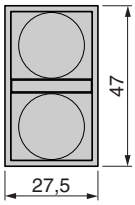
ZB4 BW81●●●3
ZB4 BW82●●●3



ZB4 BW83●●●3
ZB4 BW84●●●3

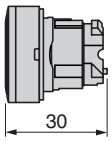


Common face view

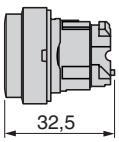


Heads for illuminated "push-push to release" pushbuttons

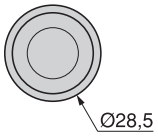
ZB4 BH0●3



ZB4 BH●3

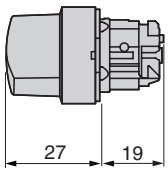


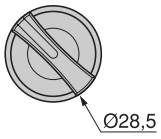
Common face view



Heads for illuminated selector switches with standard handle

ZB4 BK1●●●3



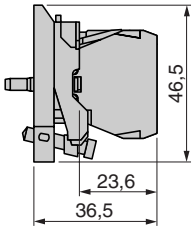


Bodies for illuminated pushbuttons and switches

Screw clamp terminal connections

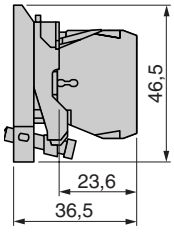
Integral LED

ZB4 BW0●●●



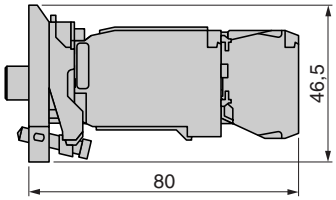
Direct supply, BA 9s bulb

ZB4 BW06●



Via integral transformer, BA 9s bulb

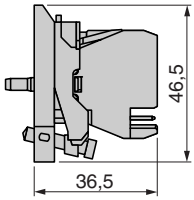
ZB4 BW0●●, BW0●D●●



Plug-in connector

Integral LED

ZB4 BW0●●●4



General : pages 2 to 9
Characteristics : pages 10 to 13
References : pages 16 to 61

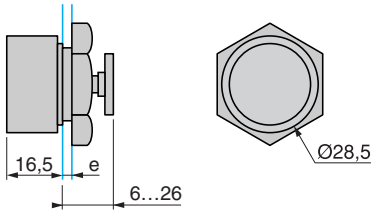
Control and signalling units Ø 22

Harmony® XB4, metal

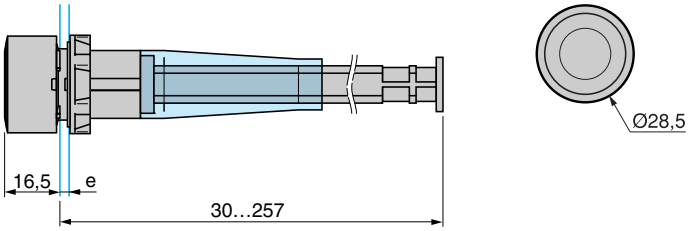
Pushbuttons, switches and pilot lights: complete units, XB4 B

Manual overload reset buttons

XB4 BA8●●



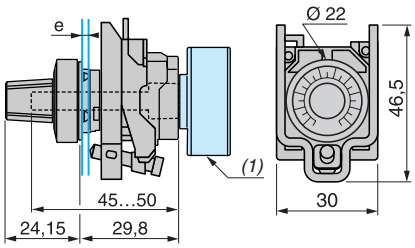
XB4 BA9●●



e: panel thickness 1 to 6 mm

Heads + mounting base for potentiometer

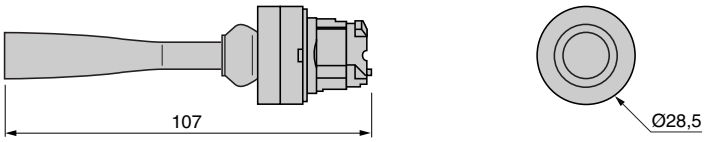
ZB4 BD9●2



(1) Potentiometer not included.

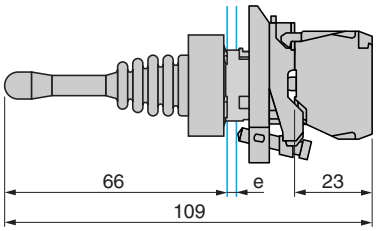
Wobblestick head

ZB4 BB●

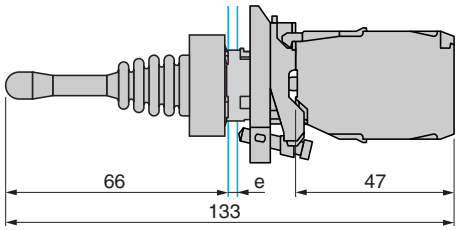


Joystick controllers

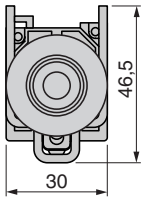
XD4 PA●2



XD4 PA●4



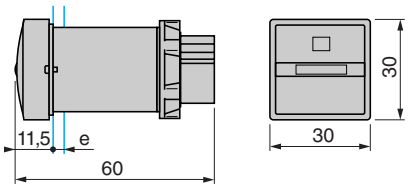
Common face view



e: panel thickness 1 to 6 mm

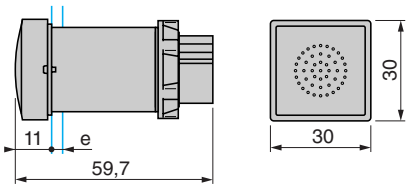
Hour counters

XB5 DS●



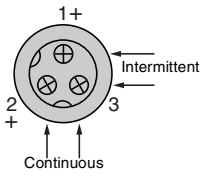
Annunciators

XB5 KS●



Cabling

XB5 KS●



e: panel thickness 1 to 6 mm

Control and signalling units Ø 22

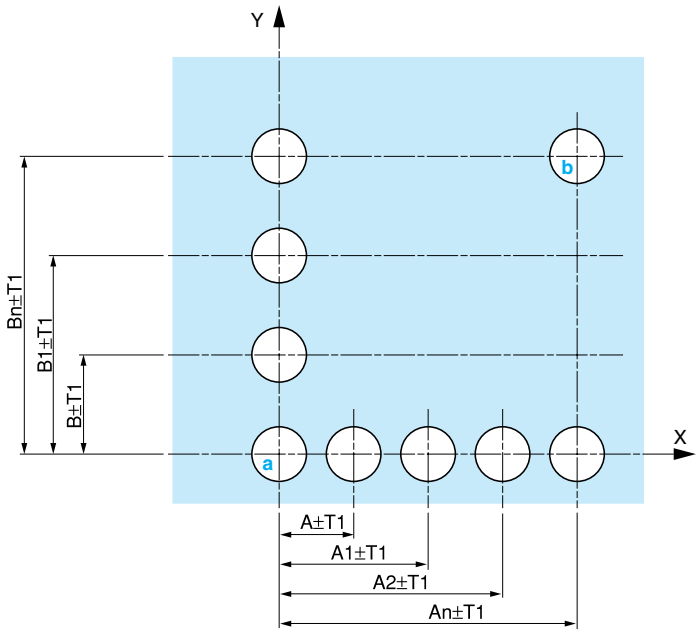
Harmony® XB4, metal

Pushbuttons, switches and pilot lights
for printed circuit board connection

Pushbuttons, switches and pilot lights for printed circuit board connection

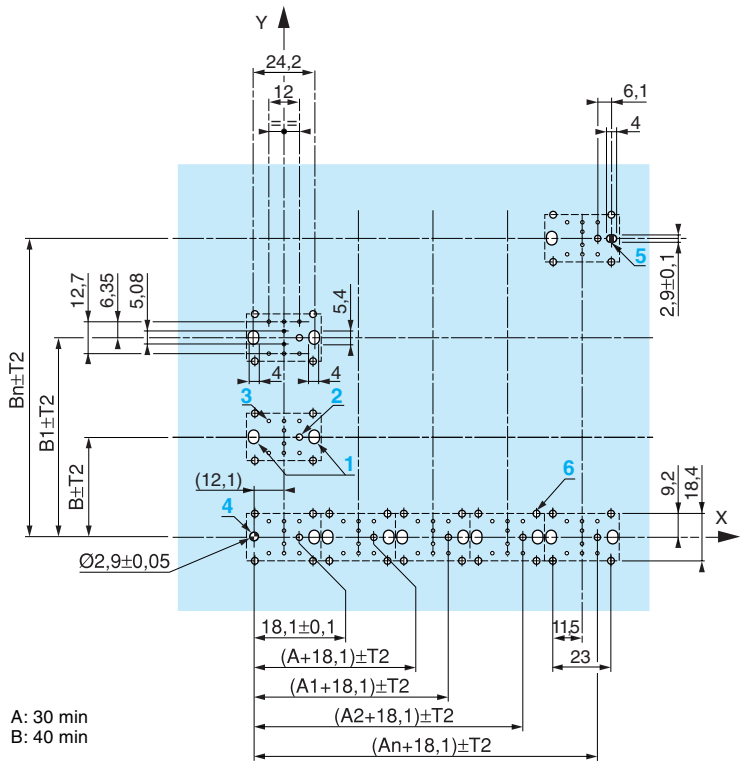
Panel cut-out (viewed from installer's side)

Dimensions in mm



Printed circuit board drillings (viewed from electrical block side)

Dimensions in mm

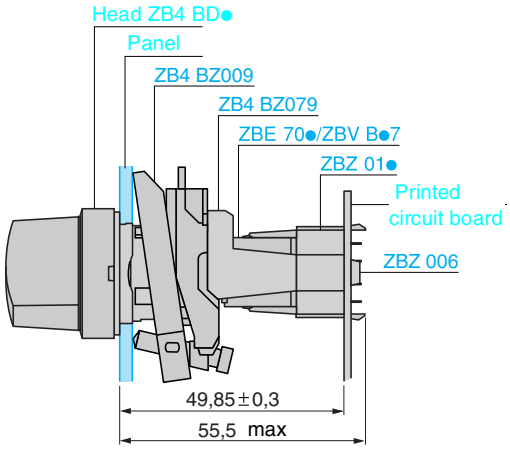


General tolerances of the panel and printed circuit board

The cumulative tolerance must not exceed 0.3 mm: T1 + T2 = 0.3 mm max.

■ Installation precautions:
□ Minimum thickness of circuit board: 1.6 mm.
□ Cut-out diameter: 22.4 mm ± 0.1 mm.
□ Orientation of body/fixing collar ZB4 BZ009: ± 2° 30' (excluding cut-outs marked a and b).
□ Tightening torque of screws ZBZ 006: 0.6 N.m. max.
□ Allow for one ZB4 BZ079 fixing collar/pillar and its fixing screws:
- every 90 mm horizontally (X), and 120 mm vertically (Y).
- with each selector switch head (ZB4 BD●, ZB4 BJ●, ZB4 BG●).

The fixing centres marked a and b are diagonally opposed and must align with those marked 4 and 5 on the printed circuit board.



■ **Mounting of adapter (socket) ZBZ 01● :**

1 2 elongated holes for ZBZ 006 screw access.

2 1 hole Ø 2.4 mm ± 0.05 for centring adapter ZBZ 01●.

3 8 x Ø 1.2 mm holes.

4 1 hole Ø 2.9 mm ± 0.05, for aligning the printed circuit board (with cut-out marked a).

5 1 elongated hole for aligning the printed circuit board (with cut-out marked b).

6 4 holes Ø 2.4 mm ± 0.05 for clipping in adapter ZBZ 01●.

Dimensions An + 18.1 relate to the Ø 2.4 mm ± 0.05 holes for centring adapter ZBZ 01●.

General : pages 2 to 9
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References : pages 16 to 61

Control and signalling units Ø 22

Harmony® XB5, plastic

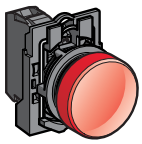
Pushbuttons, switches and pilot lights

Description

The Ø 22 range of plastic (double insulated) control and signalling units comprises:

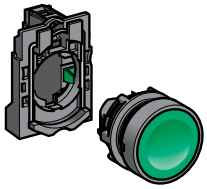
Complete units, XB5 A

Pushbuttons and switches



Pilot lights

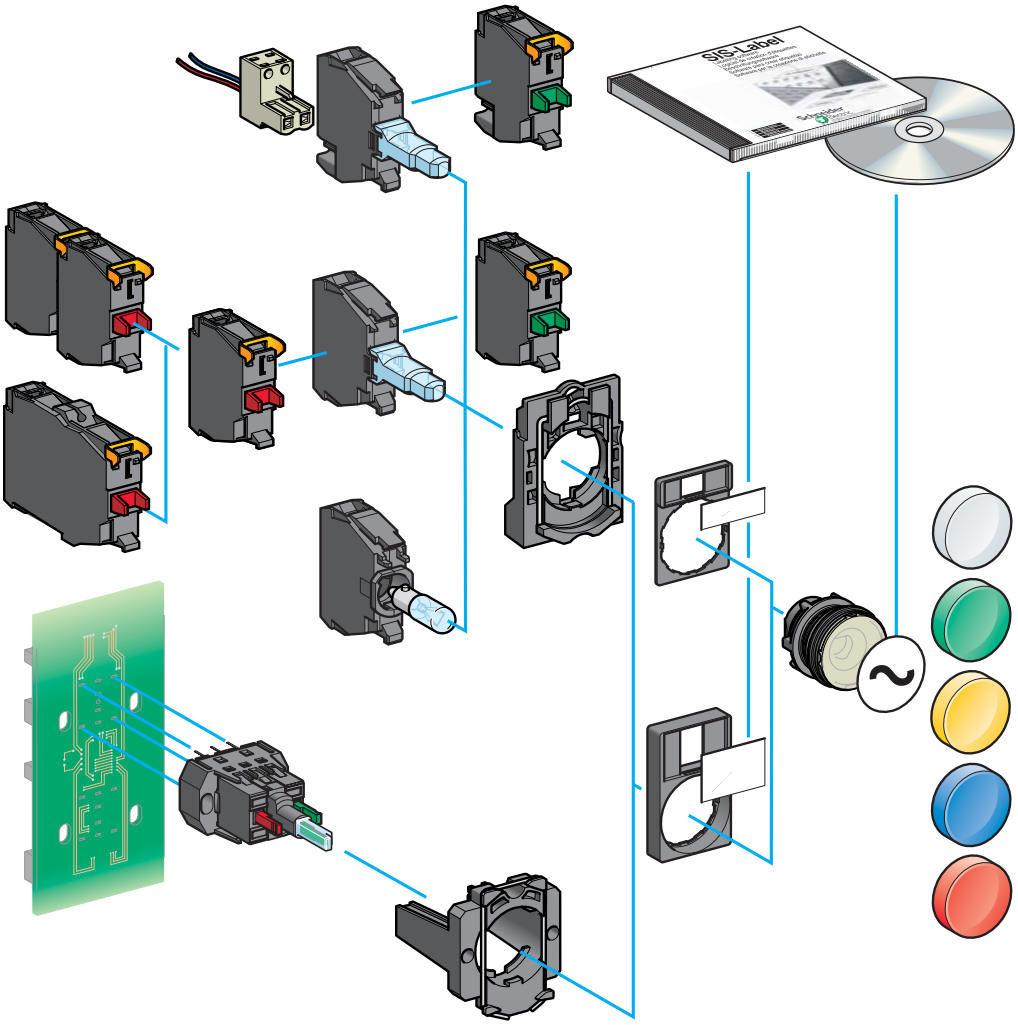
Sub-assemblies, ZB5 A



Pushbuttons and switches: body + head sub-assemblies

Pilot lights: body + head sub-assemblies

ZB component parts and accessories



Characteristics : pages 82 to 85
References : pages 88 to 137
Dimensions : pages 138 to 149

Control and signalling units Ø 22

Harmony® XB5, plastic

Pushbuttons, switches and pilot lights

Schematic library

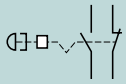
Contact functions (pushbuttons and Emergency stop pushbuttons)

Pushbutton
N/O contact

Pushbutton
N/C contact

Mushroom head
spring return
N/O contact

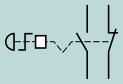
Emergency stop
mushroom head - Push-pull
N/C contact



Emergency stop trigger
action mushroom head -
Push-pull
N/O + N/C contacts

Emergency stop
mushroom head -
Turn to release
N/C contact

Emergency stop
mushroom head -
Turn to release, with key
N/C contact



Emergency stop trigger
action mushroom head -
Turn to release
N/O + N/C contacts

Emergency stop trigger
action mushroom head -
Turn to release, with key
N/O + N/C contacts

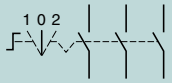
Double-headed
pushbutton -
N/O + N/C contacts

Early make contact block
N/O contact

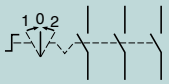
Late break contact block
N/C contact

Contact functions (selector switches)

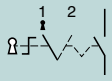
Selector switch
2-position stay put
N/O contact



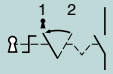
Selector switch
3-position stay put
N/O + N/O + N/O contacts



Selector switch
3-position
2 spring return to centre
N/O + N/O + N/O contacts



Selector switch
2-position stay put,
key withdrawal from LH
position - N/O contact

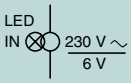


Selector switch
2-position spring return from right to left,
key withdrawal from LH position - N/O contact

Signalling functions

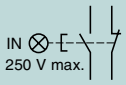
Pilot light with BA 9s base
fitting incandescent bulb

LED pilot light

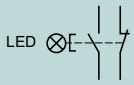


Pilot light with integral transformer
230 V primary, 6 V secondary
BA9s base fitting bulb, incandescent or LED

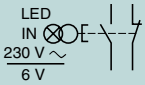
Combined functions, contact + signalling (pushbuttons and selector switches)



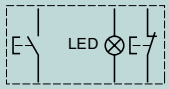
Illuminated pushbutton,
BA 9s base fitting
incandescent bulb
N/O + N/C contacts



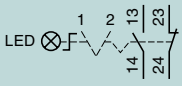
Illuminated pushbutton
with LED
N/O + N/C contacts



Illuminated pushbutton with integral transformer
230 V ~ 50/60 Hz primary, 6 V secondary
BA9s base fitting bulb, incandescent or LED
N/O + N/C contacts



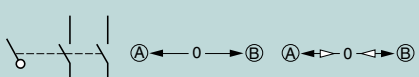
Double-headed
pushbutton
with LED pilot light



Illuminated selector switch
2-position stay put
with LED
N/O + N/C contacts

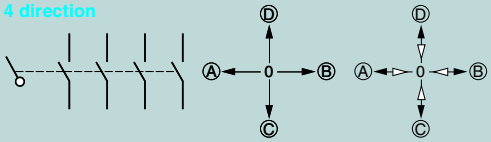
Joystick controller functions

2 direction



Without spring return With spring return

4 direction



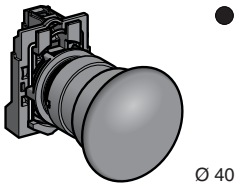
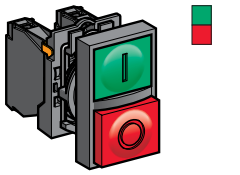
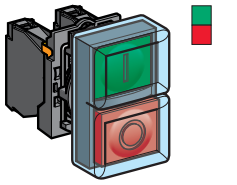
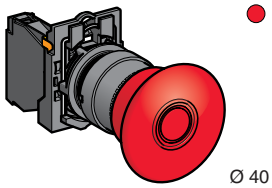
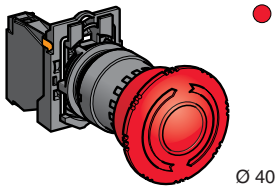
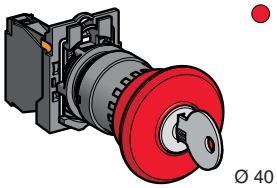
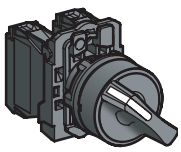
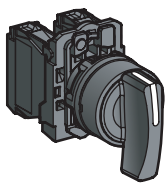
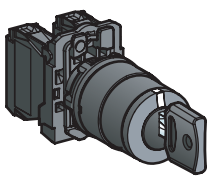
Without spring return With spring return

Characteristics : pages 82 to 85
References : pages 88 to 137
Dimensions : pages 138 to 149

Control and signalling units Ø 22

Harmony® XB5, plastic

Pushbuttons, switches and pilot lights:
complete units, XB5 A

Complete units	Contact functions		
Pushbuttons, spring return			
	Flush push, unmarked XB5 AA●1/AA42 see page 88	Flush push, with marking XB5 AA3311/AA33●1 see page 92	Projecting push, with marking XB5 AL4322 see page 92
			
	Booted flush push XB5 AP●1/AP42 see page 91	Projecting push, unmarked XB5 AL42 see page 90	Mushroom head XB5 AC21 see page 98
Double-headed pushbuttons, spring return			
	Flush push + projecting push XB5 AL845 see page 97	Booted flush push + projecting push XB5 AL945 see page 97	
Emergency stop mushroom head pushbuttons, Ø 40 ■ **trigger action and mechanical latching** **or** ■ **mechanical latching only**			
	Push-pull (EN 418/ISO13850) XB5 AT845 see page 100	Turn to release (EN 418/ISO13850) XB5 AS8●4 see page 100	Key release (EN 418/ISO13850) XB5 AS9445 see page 100
	Push-pull XB5 AT42 see page 101	Turn to release XB5 AS542 see page 101	Key release XB5 AS142 see page 101
Selector switches and key switches			
	Standard handle, black XB5 AD●● see page 104	Long handle, black XB5 AJ●● see page 108	Key switch XB5 AG●● see page 108

Characteristics : pages 82 to 85
References : pages 88 to 137
Dimensions : pages 138 to 149

Control and signalling units Ø 22

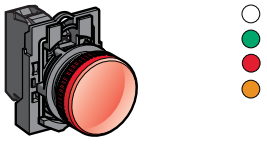
Harmony® XB5, plastic

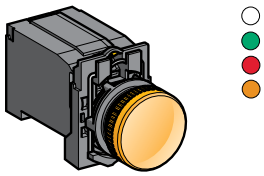
Pushbuttons, switches and pilot lights: complete units, XB5 A

Complete units *(continued)*

Signalling functions

Pilot lights

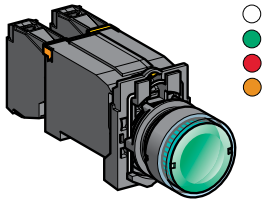




Integral LED	For bulb with BA 9s base fitting Direct supply	Via integral transformer
XB5 AVB●/AVG●/AVM● see page 110	XB5 AV6● see page 111	XB5 AV3●/AV4● see page 111

Combined functions (contact + signalling)

Illuminated pushbuttons, spring return, flush push



Integral LED	For bulb with BA 9s base fitting Direct supply	Via integral transformer
XB5 AW3●B5/AW3●G5/AW3●M5 see page 93	XB5 AW3●65 see page 95	XB5 AW3●35/AW3●45 see page 95

Double-headed pushbuttons, spring return, with pilot light

Integral LED
XB5 AW84●5 see page 97

Illuminated selector switches, standard handle

Integral LED
XB5 AK1●●3 see page 107

Control and signalling units Ø 22

Harmony® XB5, plastic

Pushbuttons, switches and pilot lights: sub-assemblies, ZB5 A

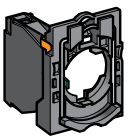
Non illuminated units for user assembly

Contact functions

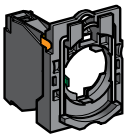
Body sub-assemblies

Head sub-assemblies

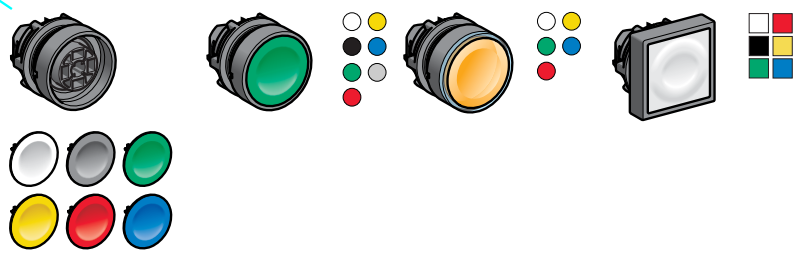
For pushbuttons, spring return, unmarked



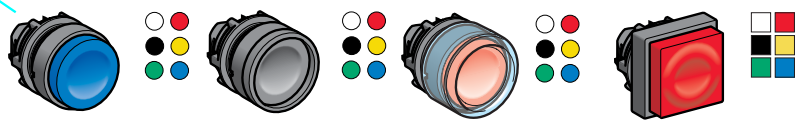
Screw clamp terminals
ZB5 AZ10●/AZ141
see page 114



Faston
ZB5 AZ10●3
see page 115



Flush push without cap/with set of 6 caps	Flush push	Flush push for insertion of legend	Flush push, cap mounted/not mounted
ZB5 AA0/AA9 see page 88	ZB5 AA● see page 88	ZB5 AA●8 see page 88	ZB5 CA0/CA● see page 88

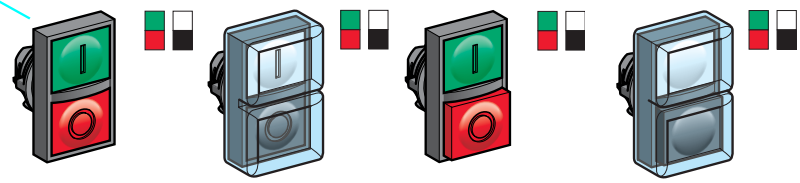


Projecting	Recessed push	Booted flush push, for insertion of legend	Projecting or recessed push
ZB5 AL● see page 90	ZB5 AA● see page 89	ZB5 AP●●/AP●S see page 90	ZB5 CA●/CL● see page 89

For pushbuttons, spring return, with marking

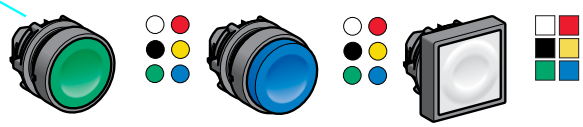
Flush push	Projecting push	Flush push
ZB5 AA●3●/AA●4● see page 92	ZB5 AL● see page 92	ZB5 CA●3●/CA●9● see page 92

For double-headed pushbuttons, spring return



Flush pushes (IP 40/IP 66) Unmarked/with marking		Flush push + projecting push (IP 40/IP 66) Unmarked/with marking	
ZB5 AA81●●/AA82●● see page 96	ZB5 AA91●●/AA92●● see page 96	ZB5 AL83●●/AL84●● see page 96	ZB5 AL93●●/AL94●● see page 96

For "push-push to release" pushbuttons

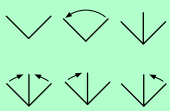


Flush push (caps mounted/not mounted)	Projecting push	Flush push (caps mounted/not mounted)
ZB5 AH●●/CH●● see page 102	ZB5 AH● see page 102	ZB5 CH0/CH0● see page 102

For "push-turn to release" pushbuttons

Key switches	Knurled knob *(1)*
ZB5 AFD● see page 103	ZB5 AF see page 103

(1) Knob positions



Characteristics : pages 82 to 85
References : pages 88 to 137
Dimensions : pages 138 to 149

Control and signalling units Ø 22

Harmony® XB5, plastic

Pushbuttons, switches and pilot lights:
sub-assemblies, ZB5 A

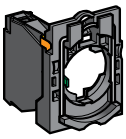
Non illuminated units for user assembly (continued)

Contact functions (continued)

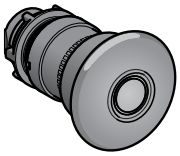
Bodysub-assemblies

Head sub-assemblies

For mushroom head pushbuttons



Ø 30
Ø 40
Ø 60



Ø 30
Ø 40
Ø 60

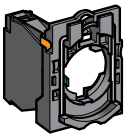
Screw clamp terminals
ZB5 AZ10●/AZ141
see page 114

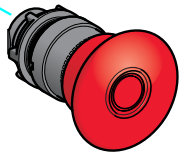
Spring
ZB5 AC●/AR●
see page 98

Latching
ZB5 A●2/AS●2/AS55
see page 99

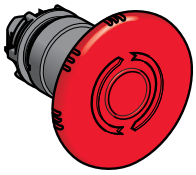
For mushroom head Emergency stop pushbuttons
- **trigger action and mechanical latching**

or
- **mechanical latching only**





Ø 30
Ø 40
Ø 60



Ø 30
Ø 40
Ø 60

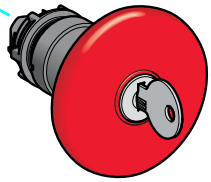
Faston
ZB5 AZ10●3
see page 115

Push-pull (EN 418/ISO 13850)
ZB5 AT84
see page 100

Turn to release (EN 418/ISO 13850)
ZB5 AS8●4
see page 100

Push-pull
ZB5 AT●/AX●
see page 101

Turn to release
ZB5 AS44/AS54/AS64
see page 101

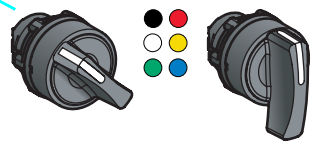


Ø 30
Ø 40
Ø 60

Key release (EN 418/ISO 13850)
ZB5 AS9●4/AS944D, see page 100

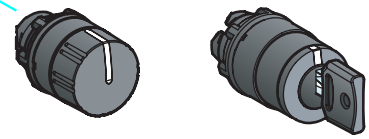
Key release
ZB5 AS●4/AS14D, see page 101

For selector switches and key switches



Standard handle *(1)*
ZB5 AD●
see page 104

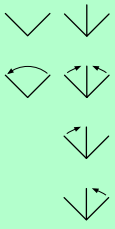
Long black handle *(1)*
ZB5 AJ●
see page 108



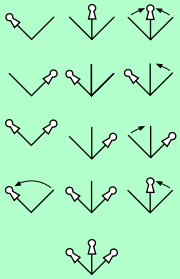
Knurled black knob *(1)*
ZB5 AD●9
see page 105

Key switch *(2)*
ZB5 AG●●
see page 108

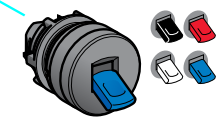
(1) Switch handle and knob positions



(2) Key switch positions
Key withdrawal positions



For toggle switches



2-position lever *(3)*
ZB5 AD●8
see page 105

(3) Lever positions

Control and signalling units Ø 22

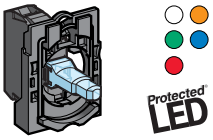
Harmony® XB5, plastic

Pushbuttons, switches and pilot lights: sub-assemblies, ZB5 A

Pilot lights
for user assembly

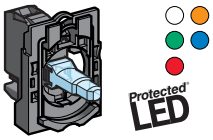
Signalling functions

Body sub-assemblies with integral LED



Connection: screw clamp terminals

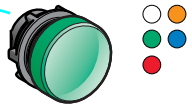
ZB5 AVB/AVG/AVM
see page 122



Connection: plug-in connector

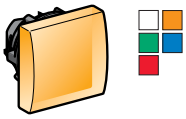
Please consult your Regional Sales Office

Head sub-assemblies



With lens fitted (insertion of legend)

ZB5 AV0●3/AV0●3E, see page 110

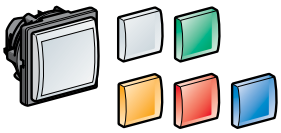


With lens fitted

ZB5 CV0●3, see page 110

With 5 lens caps (not fitted) for insertion of legend

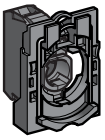
ZB5 AV003/AV0●3●, see page 110



With 5 separate lens caps, not fitted

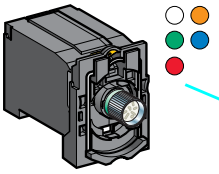
ZB5 CV003, see page 110

Body sub-assemblies for BA 9s bulb



Direct supply
Connection: screwclamp terminals

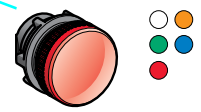
ZB5 AV6, see page 123



Via integral transformer
Connection: screw clamp terminals

ZB5 AV●/AV3D●/AV5D●
see page 123

Head sub-assemblies



With lens fitted

ZB5 AV0●, see page 110

Illuminated pushbuttons
for user assembly

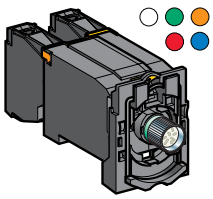
For illuminated pushbuttons, spring return

Combined functions (contact + signalling)

Body sub-assemblies for BA 9s bulb

Direct supply
Screw clamp terminals

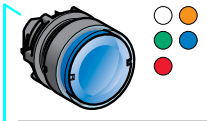
ZB5 AW06●, see page 120



Via integral transformer
Connection: screw clamp terminals

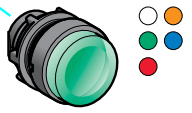
ZB5 AW03/4/5/3D/5D
see page 120

Head sub-assemblies



Flush

ZB5 AW3●/AW3●S, see page 94



Projecting

ZB5 AW1●/AW1●S, see page 94

Control and signalling units Ø 22

Harmony® XB5, plastic

Pushbuttons, switches and pilot lights: sub-assemblies, ZB5 A

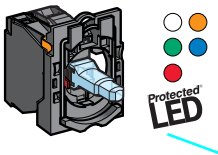
Illuminated pushbuttons for user assembly

Combined functions (contact + signalling) (continued)

Body sub-assemblies with integral LED

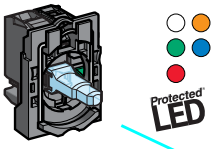
Head sub-assemblies

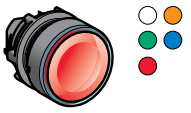
For illuminated pushbuttons, spring return



Screw clamp terminals

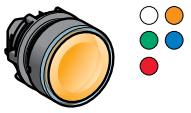
ZB5 AW0B/AW0G/ AW0M
see page 118





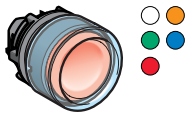
Flush push
Flush push with illuminated ring

ZB5 AW3●3/AW3●3S/AW9●3
see page 94



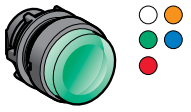
Flush push
for insertion of legend

ZB5 AA●8
see page 94



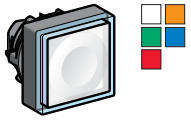
Booted flush push

ZB5 AW5●3
see page 94



Projecting push

ZB5 AW1●3/AW1●3S
see page 94



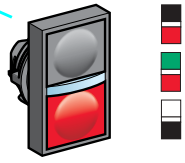
Flush or projecting push
Flush or projecting push for insertion of legend

ZB5 CW3●3/CW1●3
see page 94

For double-headed pushbuttons, spring return, with pilot light

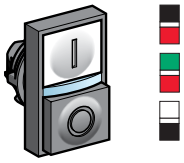
Plug-in connector

Please consult your Regional Sales Office



Flush push
Without/With marking

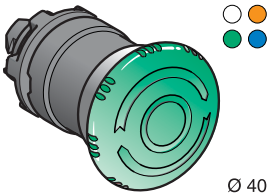
ZB5 AW81●●3, see page 96
ZB5 AW82●●3, see page 97



Flush push + projecting push
Without/With marking

ZB5 AW83●●3, see page 96
ZB5 AW84●●3, see page 96

For illuminated, mushroom head pushbuttons latching

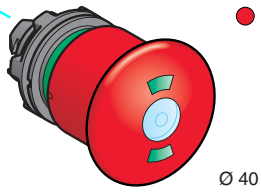


Turn to release

ZB5 AW7●3, see page 99

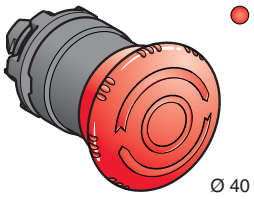
For illuminated mushroom head Emergency Stop pushbuttons
- **trigger action and mechanical latching**

or
- **mechanical latching only**



Push-pull with mechanical state indicator (EN 418/ISO 13850)

ZB5 AT8643M, see page 100

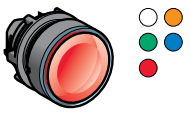


Push-pull

ZB5 AW743, see page 101

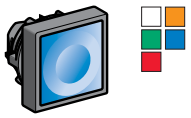
For illuminated "push-push to release" pushbuttons

For illuminated selector switches, standard handle



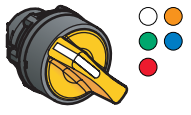
Flush or projecting "push-push to release"

ZB5 AH0●3/AH●3
see page 102



Flush "Push-push to release"

ZB5 CH3●3
see page 102



Standard handle *(1)*

ZB5 AK1●●3
see page 107

(1) Handle positions

Control and signalling units Ø 22
Harmony® XB5, plastic
Pushbuttons, switches and pilot lights

Environment			
Protective treatment standard version			"TH"
Ambient air temperature around the device	Storage	**°C**	- 40…+ 70
	Operation	**°C**	- 25…+ 70: LED and neon bulb versions - 25…+ 55: incandescent bulb version
Electric shock protection	Conforming to IEC 60536		Class II
Degree of protection	Conforming to IEC 60529		IP 66 IP 69 K (Selector switch) IP 54 (Emergency stop trigger action and mechanical latching pushbuttons with mechanical state indicator)
	Conforming to NEMA		NEMA type 4X and 13, unless otherwise stated
Resistance to high pressure washer		**Pa**	70 x 10^5 (70 bar); distance: 0.1 m Temperature: 55 °C
Mechanical shock protection	Conforming to IEC 50102		Non illuminated heads: IK 03 Illuminated heads: IK 05 Selector switch heads: IK 06
Conforming to standards			IEC/EN 60947-1, IEC/EN 60947-5-1, IEC/EN 60947-5-4, IEC/EN 60947-5-5, EN 418/ISO 13850 (Emergency stop trigger action and mechanical latching pushbuttons, see page 100), EN 81-1 (Emergency stop trigger action and mechanical latching pushbuttons with mechanical state indicator), see page 100 JIS C 4520, UL 508, CSA C22-2 n° 14
Product certifications	UL Listed, CSA		Standard single contacts with screw clamp terminals: A600; Q600 Double contacts with screw clamp terminals: A600; Q600 Light blocks with screw clamp terminals Joystick controllers XD5 PA/ZD5 PA: A600; R300 Special contact blocks: □ ZBE 201: A300; Q300 □ ZBE 202: A600; Q600
	UL Recognized, CSA		Standard single contacts for plug-in connector: A300; R300 Standard contacts for printed circuit board: B300; R300
	BV, RINA, LROS, DNV, GL		Standard single contacts and double contacts with screw clamp terminals:
Terminal referencing	Conforming to EN 50005 and EN 50013		
Characteristics of contact or combined contact and signalling functions **(see page 86)**			
Mechanical characteristics			
Contact operation	N/C or N/O		Slow break
Positive operation	Conforming to IEC/EN 60947-5-1 appendix K		All functions incorporating a N/C contact have positive opening operation
Operating travel (to change the electrical state)	Pushbutton	**mm**	Changing N/C state: 1.5 Changing N/O state: 2.6 Total travel: 4.3
Operating force	Pushbutton	**N**	Changing N/C state: 3.5 Changing N/O state: 3.8
	Additional contact only (extra to change state)	**N**	Single N/C contact: 2 Single N/O contact: 2.3
		N	Double N/C contact: 3.4 Double N/O contact: 5 Double contact N/C + N/O: 4.6
	Emergency stop with N/C + N/O	**N**	Standard push-pull: 45 Trigger action push-pull 50
		N	Standard turn to release and key release: 40 Trigger action turn to release and key release: 44

General: pages 74 to 81
References: pages 88 to 137
Dimensions: pages 138 to 149

Characteristics of contact or combined contact and signalling functions (continued) **(see page 86)**

Mechanical characteristics (continued)

Operating torque (to change the electrical state)	Selector switches		**N.m**	N/O contact: 0.14
	Additional contact only		**N.m**	N/O contact: 0.05
Mechanical durability (in millions of operating cycles)	Pushbutton	Spring return		5
		Double-headed		1
		Push-push to release		0.5
	Selector switch	Non illuminated		1
		Illuminated		0.5
	Toggle switch			0.5
	Emergency stop pushbutton			0.3 with 4 contacts 0.3 with 2 contacts (Emergency stop with mechanical state indicator)
	Joystick controller			1
	Standard contact block only			5
	Low power switching contact block only (dust protected)			0.5
Vibration resistance	Conforming to IEC 60068-2-6			Frequency: 2 to 500 Hz: 5 gn
Electric shock resistance	Conforming to IEC 60068-2-27			All functions except mushroom head pushbuttons, spring return: □ half sine wave acceleration 11 ms: 50 gn □ half sine wave acceleration 18 ms: 30 gn
				Mushroom head pushbutton, spring return □ half sine wave acceleration 11 ms: 15 gn

Electrical characteristics

Cabling capacity	Conforming to EN60947-1	**mm²**	Screw clamp terminals Min: 1 x 0.22 without cable end Max: 2 x 1.5 with cable end Cross headed screw (Pozidriv or Philips type 1), slotted for flat 4 and 5.5 mm screwdriver Tightening torque: 0.8 N.m (max 1.2 N.m)
Contact material	Silver alloy (Ag / Ni)		Standard single and double blocks with screw clamp terminals Blocks for plug-in connector Standard blocks for printed circuit board connection
	Gold flashed (Ag / Ni / Au)		Low power switching contact blocks with screw clamp terminals Low power switching contact blocks for printed circuit board connection
Short-circuit protection	Conforming to IEC/EN 60947-5-1	**A**	Standard single and double blocks with screw clamp terminals: 10 (gG cartridge fuse conforming to IEC 60269-1) Blocks for plug-in connector: 4 (gG cartridge fuse conforming to IEC 60269-1) Standard blocks for printed circuit board connection: 4 (gG cartridge fuse conforming to IEC 60269-1)
Rated thermal current	Conforming to IEC/EN 60947-5-1	**A**	Standard single and double blocks with screw clamp terminals: 10 Blocks for plug-in connector: 10 Standard blocks for printed circuit board connection : 6
Rated insulation voltage	Conforming to EN60947-1	**V**	Standard single and double blocks with screw clamp terminals: Ui = 600, degree of pollution 3 Blocks for plug-in connector or Faston connectors: Ui = 250, degree of pollution 3 Standard blocks for printed circuit board connection: Ui = 250, degree of pollution 3
Rated impulse withstand voltage	Conforming to EN60947-1	**kV**	Standard single and double blocks with screw clamp terminals: Uimp = 6 Blocks for plug-in connector: Uimp = 4 Standard blocks for printed circuit board connection: Uimp = 4

General: pages 74 to 81
References: pages 88 to 137
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Characteristics of contact or combined contact and signalling functions (continued) **(see page 86)**

Electrical characteristics (continued)

Rated operational characteristics Conforming to IEC/EN 60947-5-1	a.c. supply: utilisation category AC-15		Standard single and double blocks with screw clamp terminals: A600: Ue = 600 V and Ie = 1.2 A or Ue = 240 V and Ie = 3 A or Ue = 120 V and Ie = 6 A Blocks for plug-in connector: A300: Ue = 120 V and Ie = 6 A or Ue = 240 V and Ie = 3 A Standard blocks for printed circuit board connection: B300: Ue = 120 V and Ie = 3 A or Ue = 240 V and Ie = 1.5 A Special contact blocks: □ ZBE 201: A300: Ue = 240 V and Ie = 3 A or Ue = 120 V and Ie = 6 A (with insulation voltage Ui = 500 V) □ ZBE 202: A600: Ue = 600 V and Ie = 1.2 A or Ue = 240 V and Ie = 3 A or Ue = 120 V and Ie = 6 A
	d.c.supply: utilisation category DC-13		Standard single and double blocks with screw clamp terminals: Q600: Ue = 600 V and Ie = 0.1 A or Ue = 250 V and Ie = 0.27 A or Ue = 125 V and Ie = 0.55 A Joystick controllers XD5 PA/ZD5 PA: R300: Ue = 125 V and Ie = 0.22 A or Ue = 250 V and Ie = 0.1 A Blocks for plug-in connector: R300: Ue = 125 V and Ie = 0.22 A or Ue = 250 V and Ie = 0.1 A Standard blocks for printed circuit board connection: R300: Ue = 125 V and Ie = 0.22 A or Ue = 250 V and Ie = 0.1 A Special contact blocks: □ ZBE 201: Q300: Ue = 125 V and Ie = 0.55 A or Ue = 250 V and Ie = 0.27 A □ ZBE 202: Q600: Ue = 600 V and Ie = 0.1 A or Ue = 250 V and Ie = 0.27 A or Ue = 125 V and Ie = 0.55 A
Characteristics of special contact blocks for low power switching		**VA** **A** **V**	P max: 12 I max: 0.1 U max: 24
Electrical durability Conforming to IEC/EN 60947-5-1 appendix C Operating rate 3600 operating cycles/hour. Load factor: 0.5	a.c. supply for 1 million operating cycles utilisation category AC-15		Standard single blocks with screw clamp terminals:
		V **A**	24 4 — 120 3 — 230 2
			Standard double blocks with screw clamp terminals and blocks for plug-in connector:
		V **A**	24 3 — 120 1.5 — 230 1
	d.c. supply for 1 million operating cycles utilisation category DC-13		Standard single blocks with screw clamp terminals:
		V **A**	24 0.5 — 110 0.2
			Standard double blocks with screw clamp terminals and blocks for plug-in connector:
		V **A**	24 0.4 — 110 0.15
Electrical reliability Failure rate Conforming to IEC/EN 60947-5-4	In clean environment		Standard blocks: - at 17 V and 5 mA, $\lambda < 10^{-8}$ - at 5 V and 1 mA, $\lambda < 10^{-6}$ Special blocks with gold flashed contacts, for low power switching: - at 5 V and 1 mA, $\lambda < 10^{-7}$
	In dusty environment		Special blocks with gold flashed contacts and dust protection for low power switching only: - at 5 V and 1 mA, $\lambda < 10^{-7}$

General:
pages 74 to 81

References:
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Dimensions:
pages 138 to 149

Characteristics of illuminated units (pilot lights)

Mechanical characteristics

Vibration resistance	Conforming to IEC 60068-2-6		Frequency: 12 to 500 Hz: 5 gn
Electric shock resistance	Conforming to IEC 60068-2-27		Half sine wave acceleration 11 ms: 50 gn Half sine wave acceleration 18 ms: 30 gn

Electrical characteristics

Cabling capacity	Conforming to EN60947-1	**mm²**	Screw clamp terminals Min: 1 x 0.22 without cable end (1 x 0.34 for linking) Max: 2 x 1.5 with cable end
Rated insulation voltage	Conforming to EN60947-1	**V**	Direct supply pilot light blocks (BA 9s bulb): Ui = 250, degree of pollution 3 Pilot light blocks with integral LED: Ui = 250, degree of pollution 3 Pilot light blocks with transformer: Ui = 600, degree of pollution 3
Rated impulse withstand voltage	Conforming to EN60947-1	**kV**	Direct supply pilot light blocks (BA 9s bulb): Uimp = 4 Pilot light blocks with integral LED: Uimp = 4 Pilot light blocks with transformer: Uimp = 6

Specific characteristics of single light blocks with integral LED

Voltage limits	For rated voltage	**V**	12 V: 10 to 15 ⎓, 10.2 to 13.8 ∿ 24 V: 19.2 to 30 ⎓; 21.6 to 26.4 ∿ 24 to 120 V: 20 to 132 ≂ 48 to 120 V: 40 to 132 ∿ 240 V: 195 to 264 ∿
Current consumption	Applicable to all colours	**mA**	Blocks with ≂ 12 V supply: 18 Blocks with ≂ 24 V supply: 18 Blocks with ∿ 120 V supply: 14 Blocks with ∿ 240 V supply: 14
Service life	At rated voltage and at an ambient temperature of 25 °C	**H**	100 000
Surge withstand	Conforming to IEC 61000-4-5	**kV**	1
Resistance to fast transients	Conforming to IEC 61000-4-4	**kV**	2
Resistance to electromagnetic fields	Conforming to IEC 61000-4-3	**V/m**	10
Resistance to electrostatic discharges	Conforming to IEC 61000-4-2	**kV**	8: in free air, on insulating parts 6: on contact, on metal parts
Direct parallel connection across inductive load E.g.: contactor coil or solenoid	Maximum power of load	**VA**	For high power applications (≥ 30 VA), a **ZBZ V●** LED suppressor must be connected across the light block terminals (see page 121)
Electromagnetic emission	Conforming to IEC 55011		Class B

Specific characteristics

Fixing nut

Head tightening torque		**N.m**	2.2 (± 0.2)

Hour counters and annunciators

Voltage limits	Hour counter and annunciator	**V**	± 10% of the nominal voltage
Current consumption	Hour counter	**mA**	XB5 DSB: 7 to 15 XB5 DSG: 8 XB5 DSM: 8
	Annunciator	**mA**	5

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pages 74 to 81

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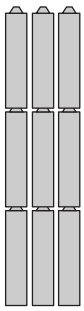
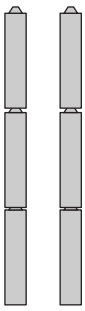
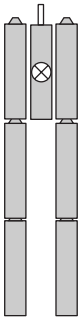
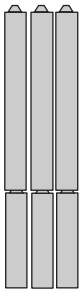
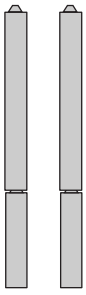
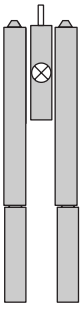
Control and signalling units Ø 22

Harmony® XB5, plastic

Contact mounting, contact sequence

Maximum recommended configurations guaranteeing achievement of catalogue characteristics

Unit type (complete units XB5 A, heads ZB5 A)		Pushbuttons, spring return XB5 AA●, ZB5 AA●, XB5 AC●, ZB5 BC● XB5 AL●, ZB5 AL● XB5 AP●, ZB5 AP● ZB5 AR●	Double-headed pushbuttons XB5 BL●45, ZB5 AL8●, ZB5 AA8●, ZB5 AA9●, ZB5 AL9●	Illuminated pushbuttons XB5 AW●, ZB5 AW● Double-headed illuminated pushbuttons XB5 BW84●, ZB5 AW8●●●●●3	
Solution using single contacts					
Solution using single and double contacts					
Maximum recommended configurations	Single contacts	9	6	6	
	Double contacts + single contacts	3 + 3	2 + 2	2 + 2	
	Light block	–	–	1	

Single contact

Double contact

Light block

Possible location

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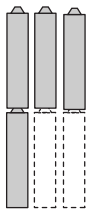
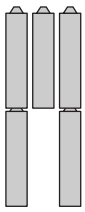
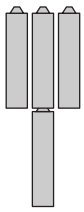
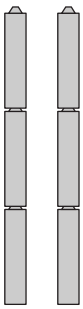
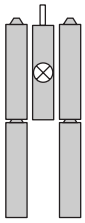
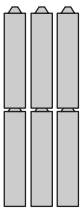
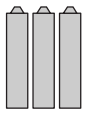
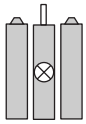
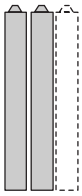
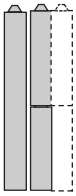
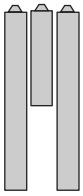
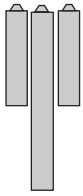
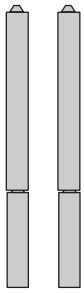
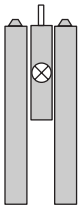
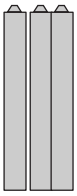
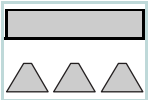
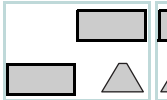
Dimensions : pages 138 to 149

	Emergency Stop XB5 AT●, ZB5 AT●, XB5 AS●, ZB5 AS●		Selector switches ■ Standard handle XB5 BD●, ZB5 AD●, ■ Long handle XB5 BJ●, ZB5 AJ●, ■ Knurled knob ZB5 AD●9, ■ Key switch XB5 BG●, ZB5 AG●			Illuminated selector switches with standard handle XB5 AK●, ZB5 AK● Illuminated Emergency Stop ZB5 AT8643M, ZB5 AW743	Toggle switches ZB5 AD●8 Pushbuttons, push-turn to release, knurled ZB5 AF●, or key-operated ZB5 FAD●	Pushbuttons, push-push ZB5 AH●	Illuminated pushbuttons, push-push ZB5 AH●3
									
								–	–
	4	4	5	4	6	4	6	3	2
	2 + 0	1 + 2	2 + 1	1 + 2	2 + 2	2 + 0	3 + 0	–	–
	–	–	–	–	–	1	–	–	1

Sequence of contacts fitted to selector switch bodies

Unit type			Selector switches													
			2-position						3-position							
			315°			45°			315°			0°			45°	
Push	Position	Top														
		Bottom														
	Location		G	C	D	G	C	D	G	C	D	G	C	D	G	C	D
	State		0	0	0	1	1	1	1	1	0	0	0	0	0	1	1
Contacts	N/O		□	□	□	■	■	■	■	■	□	□	□	□	□	■	■
	N/C		■	■	■	□	□	□	□	□	■	■	■	■	■	□	□

L left, C centre, R right
□ open, ■ closed

Control and signalling units Ø 22

Harmony® XB5, plastic

Spring return pushbuttons, unmarked

Assembly of other products using:
body/contact assemblies: see page 114
accessories: see pages 124 and 128

563465

XB5 AA31

814416

ZB5 AA0

814417

ZB5 AA5

101351

ZB5 AA68

814421

ZB5 CA5

Pushbuttons with flush push *(1)*

Screw clamp terminal connections

Shape of head	Type of push	Type of contact N/O	Type of contact N/C	Colour of push	Reference	Weight kg
Complete units						
	Flush	1	–	Black	**XB5 AA21** (ZB5 AZ101 + ZB5 AA2)	0.037
				Green	**XB5 AA31** (ZB5 AZ101 + ZB5 AA3)	0.037
				Yellow	**XB5 AA51** (ZB5 AZ101 + ZB5 AA5)	0.037
				Blue	**XB5 AA61** (ZB5 AZ101 + ZB5 AA6)	0.037
		–	1	Red	**XB5 AA42** (ZB5 AZ102 + ZB5 AA4)	0.037
Heads only, circular						
	Without cap *(2)*			–	**ZB5 AA0**	0.022
	Flush, with set of 6 coloured caps			6 colours *(3)*	**ZB5 AA9**	0.027
	Flush			White	**ZB5 AA1**	0.018
				Black	**ZB5 AA2**	0.018
				Green	**ZB5 AA3**	0.018
				Red	**ZB5 AA4**	0.018
				Yellow	**ZB5 AA5**	0.018
				Blue	**ZB5 AA6**	0.018
				Grey	**ZB5 AA8**	0.018
	Flush with transparent cap for insertion of legend *(4)*			White	**ZB5 AA18**	0.018
				Green	**ZB5 AA38**	0.018
				Red	**ZB5 AA48**	0.018
				Yellow	**ZB5 AA58**	0.018
				Blue	**ZB5 AA68**	0.018
	Flush (high bezel)			White	**ZB5 AA14**	0.020
				Black	**ZB5 AA24**	0.020
				Green	**ZB5 AA34**	0.020
				Red	**ZB5 AA44**	0.020
				Yellow	**ZB5 AA54**	0.020
				Blue	**ZB5 AA64**	0.020
Heads only, square						
	Without cap *(2)*			–	**ZB5 CA0**	0.022
	Flush			White	**ZB5 CA1**	0.019
				Black	**ZB5 CA2**	0.019
				Green	**ZB5 CA3**	0.019
				Red	**ZB5 CA4**	0.019
				Yellow	**ZB5 CA5**	0.019
				Blue	**ZB5 CA6**	0.019

(1) Recommended maximum number of contacts constituting the body (fixing collar + contact) associated with the head, see page 86.
(2) Coloured cap to be ordered separately: see page 124.
(3) Head supplied with 6 different coloured caps (white, black, green, red, yellow, blue) not fitted.
(4) For legend ordering information, see page 128.

General : pages 74 to 81
Characteristics : pages 82 to 85
Dimensions : pages 138 to 149

Control and signalling units Ø 22

Harmony® XB5, plastic

Spring return pushbuttons, unmarked

Assembly of other products using:
body/contact assemblies: see page 114
accessories: see pages 124 and 128

ZB5 AA16

Pushbuttons with recessed push *(1)*

High guard

Shape of head	Type of push	Colour	Reference	Weight kg
Heads only, circular				
	Recessed (high guard)	White	**ZB5 AA16**	0.020
		Black	**ZB5 AA26**	0.020
		Green	**ZB5 AA36**	0.020
		Red	**ZB5 AA46**	0.020
		Yellow	**ZB5 AA56**	0.020
		Blue	**ZB5 AA66**	0.020
Heads only, square				
	Recessed (high guard)	White	**ZB5 CA16**	0.012
		Black	**ZB5 CA26**	0.012
		Green	**ZB5 CA36**	0.012
		Red	**ZB5 CA46**	0.012
		Yellow	**ZB5 CA56**	0.012
		Blue	**ZB5 CA66**	0.012

109500

ZB5 CA16

(1) Recommended maximum number of contacts constituting the body (fixing collar + contact) associated with the head, see page 86.

Control and signalling units Ø 22

Harmony® XB5, plastic

Spring return pushbuttons, unmarked

Assembly of other products using:
body/contact assemblies: see page 114
accessories: see pages 124 and 128

563458

XB5 AL42

814418

ZB5 AL3

110280

ZB5 CL1

Pushbuttons with projecting push *(1)*

Screw clamp terminal connections

Shape of head	Type of push	Type of contact N/O	Type of contact N/C	Colour of push	Reference	Weight kg
Complete units						
	Projecting	–	1	Red	**XB5 AL42** (ZB5 AZ102 + ZB5 AL4)	0.038
Heads only, circular						
	Projecting			White	**ZB5 AL1**	0.019
				Black	**ZB5 AL2**	0.019
				Green	**ZB5 AL3**	0.019
				Red	**ZB5 AL4**	0.019
				Yellow	**ZB5 AL5**	0.019
				Blue	**ZB5 AL6**	0.019
Heads only, square						
	Projecting			White	**ZB5 CL1**	0.021
				Black	**ZB5 CL2**	0.021
				Green	**ZB5 CL3**	0.021
				Red	**ZB5 CL4**	0.021
				Yellow	**ZB5 CL5**	0.021
				Blue	**ZB5 CL6**	0.021

(1) Recommended maximum number of contacts constituting the body (fixing collar + contact) associated with the head, see page 86.

General : pages 74 to 81
Characteristics : pages 82 to 85
Dimensions : pages 138 to 149

Control and signalling units Ø 22

Harmony® XB5, plastic

Spring return pushbuttons, unmarked

Assembly of other products using:
body/contact assemblies: see page 114
combined sub-assemblies: see page 118
accessories: see page 128

563457

XB5 AP51

109499

ZB5 AP183

110267

ZB5 AP4

103545_1

ZB5 AP2S

Pushbuttons with booted head *(1)*

Screw clamp terminal connections

Shape of head	Type of push	Type of contact N/O	Type of contact N/C	Colour of push	Reference	Weight kg
Complete units						
	Booted, clear silicone (colour of push unobscured)	1	–	Black	**XB5 AP21** (ZB5 AZ101 + ZB5 AP2)	0.039
				Green	**XB5 AP31** (ZB5 AZ101 + ZB5 AP3)	0.039
				Yellow	**XB5 AP51** (ZB5 AZ101 + ZB5 AP5)	0.039
				Blue	**XB5 AP61** (ZB5 AZ101 + ZB5 AP6)	0.039
		–	1	Red	**XB5 AP42** (ZB5 AZ102 + ZB5 AP4)	0.039
Heads only						
	Flush, booted (clear), for insertion of legend *(2)* (colour of push unobscured)			White	**ZB5 AP18**	0.023
				Green	**ZB5 AP38**	0.023
				Red	**ZB5 AP48**	0.023
				Yellow	**ZB5 AP58**	0.023
				Blue	**ZB5 AP68**	0.023
	Flush, booted (clear), integral boot (colour of push unobscured)			White	**ZB5 AP183**	0.010
				Green	**ZB5 AP383**	0.010
				Red	**ZB5 AP483**	0.010
				Yellow	**ZB5 AP583**	0.010
				Blue	**ZB5 AP683**	0.010
	Projecting, booted (clear silicone) (colour of push unobscured)			White	**ZB5 AP1**	0.021
				Black	**ZB5 AP2**	0.021
				Green	**ZB5 AP3**	0.021
				Red	**ZB5 AP4**	0.021
				Yellow	**ZB5 AP5**	0.021
				Blue	**ZB5 AP6**	0.021
	Projecting, booted (coloured silicone) can be replaced without dismantling the head Compatible with legend holder			White	**ZB5 AP1S**	0.014
				Black	**ZB5 AP2S**	0.014
				Green	**ZB5 AP3S**	0.014
				Red	**ZB5 AP4S**	0.014
				Yellow	**ZB5 AP5S**	0.014
				Blue	**ZB5 AP6S**	0.014

(1) Recommended maximum number of contacts constituting the body (fixing collar + contact) associated with the head, see page 86.
(2) For legend ordering information, see page 128.

Control and signalling units Ø 22

Harmony® XB5, plastic

Spring return pushbuttons, with marking

Assembly of other products using:
body/contact assemblies: see page 114
accessories: see pages 124 and 128

563456

XB5 AA4322

814428

ZB5 AA331

814429

ZB5 AA432

110316

ZB5 CA432

814430

ZB5 AL232

Pushbuttons with flush or projecting push *(1)*

Screw clamp terminal connections

Shape of head	Type of push	Type of contact N/O	Type of contact N/C	Marking Text (colour)	Colour of push	Reference	Weight kg
Complete units							
	Flush	1	–	"I" (white)	Green	**XB5 AA3311** (ZB5 AZ101 + ZB5 AA331)	0.037
	Flush	–	1	"O" (white)	Red	**XB5 AA4322** (ZB5 AZ102 + ZB5 AA432)	0.037
	Projecting	–	1	"O" (white)	Red	**XB5 AL4322** ▲ (ZB5 AZ102 + ZB5 AL432)	0.037
	Flush *(2)*	1	–	↑ (black)	White	**XB5 AA3341** (ZB5 AZ101 + ZB5 AA334)	0.037
	Flush *(2)*	1	–	↑ (white)	Black	**XB5 AA3351** (ZB5 AZ101 + ZB5 AA335	0.037
Heads only, circular							
	Flush			"I" (white)	Green	**ZB5 AA331**	0.018
				"I" (black)	White	**ZB5 AA131**	0.018
				"II" (white)	Green	**ZB5 AA336**	0.018
				"II" (black)	White	**ZB5 AA136**	0.018
				"START" (white)	Green	**ZB5 AA333**	0.018
				"START" (black)	White	**ZB5 AA133**	0.018
				"ON" (white)	Green	**ZB5 AA341**	0.018
				"ON" (black)	White	**ZB5 AA141**	0.018
				"MARCHE" (white)	Green	**ZB5 AA342**	0.018
				"MARCHE" (black)	White	**ZB5 AA142**	0.018
				(white)	Black	**ZB5 AA245**	0.018
				(black)	White	**ZB5 AA145**	0.018
				"O" (white)	Red	**ZB5 AA432**	0.018
					Black	**ZB5 AA232**	0.018
				"ARRET" (white)	Red	**ZB5 AA433**	0.018
					Black	**ZB5 AA233**	0.018
				"STOP" (white)	Red	**ZB5 AA434**	0.018
					Black	**ZB5 AA234**	0.018
				"OFF" (white)	Red	**ZB5 AA435**	0.018
					Black	**ZB5 AA235**	0.018
				UP (black)	White	**ZB5 AA343**	0.018
				Down (white)	Black	**ZB5 AA344**	0.018
				↑ (white) *(2)*	Black	**ZB5 AA335**	0.018
				↑ (black) *(2)*	White	**ZB5 AA334**	0.018
Heads only, square							
	Flush *(2)*			"I" (white)	Green	**ZB5 CA331**	0.019
				"O" (white)	Red	**ZB5 CA432**	0.019
				"+" (white)	Black	**ZB5 CA2934**	0.019
				↑ (white)	Black	**ZB5 CA2912**	0.019
				"R" (white)	Blue	**ZB5 CA6939**	0.019
Heads only, circular							
	Projecting *(2)*			"O" (white)	Red	**ZB5 AL432**	0.019
					Black	**ZB5 AL232**	0.019
				"ARRET" (white)	Red	**ZB5 AL433**	0.019
					Black	**ZB5 AL233**	0.019
				"STOP" (white)	Red	**ZB5 AL434**	0.019
					Black	**ZB5 AL234**	0.019
				"OFF" (white)	Red	**ZB5 AL435**	0.019
					Black	**ZB5 AL235**	0.019

(1) Recommended maximum number of contacts constituting the body (fixing collar + contact) associated with the head, see page 86.

(2) Product supplied with cap not clipped-in, allowing orientation through 360° in 90° steps.

▲ Available:
3rd quarter 2006.

General : pages 74 to 81
Characteristics : pages 82 to 85
Dimensions : pages 138 to 149

Control and signalling units Ø 22

Harmony® XB5, plastic

Illuminated pushbuttons, spring return, with integral LED

Assembly of other products using:
body/contact assemblies: see page 114
accessories: see pages 124 and 128

814386

XB5 AW31B5

XB5 AW34G5

Illuminated pushbuttons with flush push *(1)*

Screw clamp terminal connections

Shape of head	Description	Type of contact N/O	Type of contact N/C	Supply voltage V	Colour of push	Reference	Weight kg
Complete units - With plain lens							
	Integral LED	1	1	≂ 24	White	**XB5 AW31B5** (ZB5 AW0B15 + ZB5 AW313)	0.056
					Green	**XB5 AW33B5** (ZB5 AW0B35 + ZB5 AW333)	0.056
					Red	**XB5 AW34B5** (ZB5 AW0B45 + ZB5 AW343)	0.056
					Orange	**XB5 AW35B5** (ZB5 AW0B55 + ZB5 AW353)	0.056
					Blue	**XB5 AW36B5** (ZB5 AW0B65 + ZB5 AW363)	0.056
				∿ 48...120	White	**XB5 AW31G5** (ZB5 AW0G15 + ZB5 AW313)	0.056
					Green	**XB5 AW33G5** (ZB5 AW0G35 + ZB5 AW333)	0.056
					Red	**XB5 AW34G5** (ZB5 AW0G45 + ZB5 AW343)	0.056
					Orange	**XB5 AW35G5** (ZB5 AW0G55 + ZB5 AW353)	0.056
					Blue	**XB5 AW36G5** (ZB5 AW0G65 + ZB5 AW363)	0.056
				∿ 230…240	White	**XB5 AW31M5** (ZB5 AW0M15 + ZB5 AW313)	0.056
					Green	**XB5 AW33M5** (ZB5 AW0M35 + ZB5 AW333)	0.056
					Red	**XB5 AW34M5** (ZB5 AW0M45 + ZB5 AW343)	0.056
					Orange	**XB5 AW35M5** (ZB5 AW0M55 + ZB5 AW353)	0.056
					Blue	**XB5 AW36M5** (ZB5 AW0M65 + ZB5 AW363)	0.056

(1) Recommended maximum number of contacts constituting the body (fixing collar + contact) associated with the head, see page 86.

General : pages 74 to 81
Characteristics : pages 82 to 85
Dimensions : pages 138 to 149

Control and signalling units Ø 22

Harmony® XB5, plastic

Illuminated pushbuttons, spring return, with integral LED

Assembly of other products using:
combined sub-assemblies: see page 120
accessories: see page 128

814556

ZB5 AW313

814557

ZB5 AW363

110406

ZB5 CW313

109498

ZB5 CW3136

814555

ZB5 AW143

110412

ZB5 CW143

Illuminated pushbuttons with flush push *(1)*

Shape of head	Type of push	Colour	Reference	Weight (kg)
Heads only, circular *(2)* **- With plain lens**				
Protected LED	**Flush**	White	**ZB5 AW313**	0.017
		Green	**ZB5 AW333**	0.017
		Red	**ZB5 AW343**	0.017
		Orange	**ZB5 AW353**	0.017
		Blue	**ZB5 AW363**	0.017
Protected LED	**Flush with illuminated ring**	White	**ZB5 AW913**	0.016
		Green	**ZB5 AW933**	0.016
		Red	**ZB5 AW943**	0.016
		Orange	**ZB5 AW953**	0.016
		Blue	**ZB5 AW963**	0.016
Protected LED	**Flush with clear boot**	White	**ZB5 AW513**	0.019
		Green	**ZB5 AW533**	0.019
		Red	**ZB5 AW543**	0.019
		Orange	**ZB5 AW553**	0.019
		Blue	**ZB5 AW563**	0.019
Protected LED	**Flush for insertion of legend** *(3)*	White	**ZB5 AA18**	0.018
		Green	**ZB5 AA38**	0.018
		Red	**ZB5 AA48**	0.018
		Orange	**ZB5 AA58**	0.018
		Blue	**ZB5 AA68**	0.018
Heads only, circular *(2)* **- With grooved lens** *(4)*				
Protected LED	**Flush**	White	**ZB5 AW313S**	0.017
		Green	**ZB5 AW333S**	0.017
		Red	**ZB5 AW343S**	0.017
		Orange	**ZB5 AW353S**	0.017
		Blue	**ZB5 AW363S**	0.017
Heads only, square *(2)*				
Protected LED	**Flush** (legend can be inserted)	White	**ZB5 CW313**	0.023
		Green	**ZB5 CW333**	0.023
		Red	**ZB5 CW343**	0.023
		Orange	**ZB5 CW353**	0.023
		Blue	**ZB5 CW363**	0.023
Protected LED	**Flush** (high guard)	White	**ZB5 CW3136**	0.014
		Green	**ZB5 CW3336**	0.014
		Red	**ZB5 CW3436**	0.014
		Orange	**ZB5 CW3536**	0.014
		Blue	**ZB5 CW3636**	0.014

Illuminated pushbuttons with projecting push *(1)*

Shape of head	Type of push	Colour	Reference	Weight (kg)
Heads only, circular *(2)* **- With plain lens**				
Protected LED	**Projecting**	White	**ZB5 AW113**	0.018
		Green	**ZB5 AW133**	0.018
		Red	**ZB5 AW143**	0.018
		Orange	**ZB5 AW153**	0.018
		Blue	**ZB5 AW163**	0.018
Heads only, circular *(2)* **- With grooved lens** *(4)*				
Protected LED	**Projecting**	White	**ZB5 AW113S**	0.017
		Green	**ZB5 AW133S**	0.017
		Red	**ZB5 AW143S**	0.017
		Orange	**ZB5 AW153S**	0.017
		Blue	**ZB5 AW163S**	0.017
Heads only, square *(2)*				
Protected LED	**Projecting** (legend can be inserted)	White	**ZB5 CW113**	0.024
		Green	**ZB5 CW133**	0.024
		Red	**ZB5 CW143**	0.024
		Orange	**ZB5 CW153**	0.024
		Blue	**ZB5 CW163**	0.024

(1) Recommended maximum number of contacts constituting the body (fixing collar + contact) associated with the head, see page 86.
(2) Only for use with bodies comprising a light source with integral LED.
(3) For legend ordering information, see page 128.
(4) For use in bright ambient light conditions (outdoors in sunlight, for example).

General : pages 74 to 81
Characteristics : pages 82 to 85
Dimensions : pages 138 to 149

Control and signalling units Ø 22

Harmony® XB5, plastic

Illuminated pushbuttons, spring return, with BA 9s base fitting

Assembly of other products using:
combined sub-assemblies: see page 120
accessories: see page 128

523844

XB5 AW3465

563461

XB5 AW3335

814559

ZB5 AW33

Illuminated pushbuttons with flush push *(1)*

Screw clamp terminal connections

Shape of head	Description	Type of contact N/O	Type of contact N/C	Supply voltage V	Colour of push	Reference	Weight kg
Complete units - With plain lens							
	Direct supply for bulb with BA 9s base fitting, 2.4 W max, **(bulb not included)**	1	1	≤ 250	White	**XB5 AW3165** (ZB5 AW065 + ZB5 AW31)	0.057
					Green	**XB5 AW3365** (ZB5 AW065 + ZB5 AW33)	0.057
					Red	**XB5 AW3465** (ZB5 AW065 + ZB5 AW34)	0.057
					Orange	**XB5 AW3565** (ZB5 AW065 + ZB5 AW35)	0.057
	Via integral transformer 1.2 VA, 6 V secondary, incandescent bulb with BA 9s base fitting, **(bulb included)**	1	1	∼ 110…120 50/60 Hz	White	**XB5 AW3135** (ZB5 AW035 + ZB5 AW31)	0.128
					Green	**XB5 AW3335** (ZB5 AW035 + ZB5 AW33)	0.128
					Red	**XB5 AW3435** (ZB5 AW035 + ZB5 AW34)	0.128
					Orange	**XB5 AW3535** (ZB5 AW035 + ZB5 AW35)	0.128
				∼ 230 50 Hz ∼ 220…240 60 Hz	White	**XB5 AW3145** (ZB5 AW045 + ZB5 AW31)	0.129
					Green	**XB5 AW3345** (ZB5 AW045 + ZB5 AW33)	0.129
					Red	**XB5 AW3445** (ZB5 AW045 + ZB5 AW34)	0.129
					Orange	**XB5 AW3545** (ZB5 AW045 + ZB5 AW35)	0.129
Heads only *(2)* **- With plain lens**							
	Flush				White	**ZB5 AW31**	0,018
					Green	**ZB5 AW33**	0,018
					Red	**ZB5 AW34**	0,018
					Orange	**ZB5 AW35**	0,018
					Blue	**ZB5 AW36**	0,018
					Clear	**ZB5 AW37**	0,018
Heads only *(2)* **- With grooved lens** *(3)*							
	Flush				White	**ZB5 AW31S**	0.018
					Green	**ZB5 AW33S**	0.018
					Red	**ZB5 AW34S**	0.018
					Orange	**ZB5 AW35S**	0.018
					Blue	**ZB5 AW36S**	0.018
					Clear	**ZB5 AW37S**	0.018

Illuminated pushbuttons with projecting push *(1)*

Heads only *(2)* **- With plain lens**							
	Projecting				White	**ZB5 AW11**	0.017
					Green	**ZB5 AW13**	0.017
					Red	**ZB5 AW14**	0.017
					Orange	**ZB5 AW15**	0.017
					Blue	**ZB5 AW16**	0.017
					Clear	**ZB5 AW17**	0.017
Heads only *(2)* **- With grooved lens** *(3)*							
	Projecting				White	**ZB5 AW11S**	0.018
					Green	**ZB5 AW13S**	0.018
					Red	**ZB5 AW14S**	0.018
					Orange	**ZB5 AW15S**	0.018
					Blue	**ZB5 AW16S**	0.018
					Clear	**ZB5 AW17S**	0.018

(1) Recommended maximum number of contacts constituting the body (fixing collar + contact) associated with the head, see page 86.
(2) Only for use with bodies comprising a light source with BA9s base fitting bulb (incandescent, neon or LED).
(3) For use in bright ambient light conditions (outdoors in sunlight, for example).

General : pages 74 to 81
Characteristics : pages 82 to 85
Dimensions : pages 138 to 149

Control and signalling units Ø 22

Harmony® XB5, plastic

Double-headed pushbuttons, spring return, unmarked

Assembly of other products using:
combined sub-assemblies: see page 118
accessories: see pages 125 and 128

814440

ZB5 AL8334

814442

ZB5 AL9334

Double-headed pushbuttons *(1)*

Shape of head	Description	Colour of pushes	Degree of protection	Reference	Weight kg
Heads only					
	2 flush pushes	Green Red	IP 40	**ZB5 AA8134**	0.022
			IP 66	**ZB5 AA9134**	0.027
		White Black	IP 40	**ZB5 AA8112**	0.022
			IP 66	**ZB5 AA9112**	0.027
	1 flush push **1 projecting push**	Green Red	IP 40	**ZB5 AL8334**	0.021
			IP 66	**ZB5 AL9334**	0.026
		White Black	IP 40	**ZB5 AL8312**	0.021
			IP 66	**ZB5 AL9312**	0.026

110421

ZB5 AW812743

814567

ZB5 AW833743

Double-headed pushbuttons with pilot light (IP 40) *(1) (2)*

Shape of head	Description	Colour of pushes	Colour of pilot light	Reference	Weight kg
Heads only *(3)*					
 	1 flush push **1 central pilot light** **1 flush push**	Black Red	Clear *(4)*	**ZB5 AW812743**	0.022
		Green Red	Clear *(4)*	**ZB5 AW813743**	0.022
		White Black	Clear *(4)*	**ZB5 AW811723**	0.022
 	1 flush push **1 central pilot light** **1 projecting push**	Black Red	Clear *(4)*	**ZB5 AW812743**	0.021
		Green Red	Clear *(4)*	**ZB5 AW833743**	0.021
		White Black	Clear *(4)*	**ZB5 AW831723**	0.021

(1) Recommended maximum number of contacts constituting the body (fixing collar + contact) associated with the head, see page 86.
*(2) For a head with IP 66 degree of protection or NEMA type 4X, fit a clear sealing boot **ZBW 008**, see page 126.*
(3) Only for use with bodies comprising a light source with integral LED.
(4) Colour of centrally positioned pilot light determined by the colour of the LED incorporated in the body sub-assembly.

General :
pages 74 to 81

Characteristics :
pages 82 to 85

Dimensions :
pages 138 to 149

Control and signalling units Ø 22

Harmony® XB5, plastic

Double-headed pushbuttons, spring return, with marking

Assembly of other products using:
combined sub-assemblies: see page 118
accessories: see pages 125 and 128

563560

XB5 AL845

814441

ZB5 AL8434

814405

XB5 AW84B5

814568

ZB5 AW823743

814569

ZB5 AW843743

Double-headed pushbuttons *(1)*

Screw clamp terminal connections

Shape of head	Description	Type of contact N/O	Type of contact N/C	Colour of pushes	Degree of protection	Reference	Weight kg
Complete units							
	1 flush green push (marked “I”) **1 projecting red push** (marked “O”)	1	1	Green Red	IP 40	**XB5 AL845** (ZB5 AZ105 + ZB5 AL8434)	0.049
					IP 66	**XB5 AL945** (ZB5 AZ105 + ZB5 AL9434)	0.054
Heads only							
	2 flush pushes (marked “I”) (marked “O”)			Green Red	IP 40	**ZB5 AA8234**	0.022
					IP 66	**ZB5 AA9234**	0.027
				White Black	IP 40	**ZB5 AA8212**	0.022
					IP 66	**ZB5 AA9212**	0.027
	1 flush push (marked “I”) **1 projecting push** (marked “O”)			Green Red	IP 40	**ZB5 AL8434**	0.021
					IP 66	**ZB5 AL9434**	0.026
				White Black	IP 40	**ZB5 AL8412**	0.021
					IP 66	**ZB5 AL9412**	0.026

Double-headed pushbuttons with integral LED (IP 40) *(1) (2)*

Screw clamp terminal connections

Shape of head	Description	Type of contact N/O	Type of contact N/C	Supply voltage V	Colour of pushes	Reference	Weight kg
Complete units, *(1)*							
Protected LED	**1 flush green push** (marked “I”) **1 orange pilot light** **1 projecting red push** (marked “O”)	1	1	≂ 24	Green Red	**XB5 AW84B5** (ZB5 AW0B55 + ZB5 AW843743)	0.060
				∿ 48...120	Green Red	**XB5 AW84G5** (ZB5 AW0G55 + ZB5 AW843743)	0.060
				∿ 230...240	Green Red	**XB5 AW84M5** (ZB5 AW0M55 + ZB5 AW843743)	0.060
Heads only *(3)*							
Protected LED	**1 flush push** (marked “I”) **1 clear central pilot light** *(4)* **1 flush push** (marked “O”)				Black Red	**ZB5 AW822743**	0.022
					Green Red	**ZB5 AW823743**	0.022
					White Black	**ZB5 AW821723**	0.021
Protected LED	**1 flush push** (marked “I”) **1 clear central pilot light** *(4)* **1 projecting push** (marked “O”)				Black Red	**ZB5 AW842743**	0.021
					Green Red	**ZB5 AW843743**	0.021
					White Black	**ZB5 AW841723**	0.021

(1) Recommended maximum number of contacts constituting the body (fixing collar + contact) associated with the head, see page 86.
*(2) For IP 66 degree of protection or NEMA type 4, fit a clear sealing boot **ZBW 008**, see page 126.*
(3) Only for use with bodies comprising a light source with integral LED.
(4) Colour of centrally positioned pilot light determined by the colour of the LED incorporated in the body sub-assembly.

General : pages 74 to 81
Characteristics : pages 82 to 85
Dimensions : pages 138 to 149

Control and signalling units Ø 22

Harmony® XB5, plastic

Mushroom head pushbuttons, spring return

Assembly of other products using:
body/contact assemblies: see page 114
accessories: see page 128

Mushroom head pushbuttons *(1) (2)*

Screw clamp terminal connections

Shape of head	Type of push	Type of contact N/O	Type of contact N/C	Push Ø (mm)	Colour	Reference	Weight kg
Complete units							
	Mushroom head	1	–	40	Black	**XB5 AC21** (ZB5 AZ101 + ZB5 AC2)	0.062
Heads only							
	Mushroom head			30	Black	**ZB5 AC24**	0.027
					Green	**ZB5 AC34**	0.027
					Red	**ZB5 AC44**	0.027
					Yellow	**ZB5 AC54**	0.027
					Blue	**ZB5 AC64**	0.027
				40	Black	**ZB5 AC2**	0.046
					Green	**ZB5 AC3**	0.046
					Red	**ZB5 AC4**	0.046
					Yellow	**ZB5 AC5**	0.046
					Blue	**ZB5 AC6**	0.046
				60	Black	**ZB5 AR2**	0.065
					Green	**ZB5 AR3**	0.065
					Red	**ZB5 AR4**	0.065
					Yellow	**ZB5 AR5**	0.065
					Blue	**ZB5 AR6**	0.065
				60 *(3)* Hemispherical	Black	**ZB5 AR216**	0.048
					Green	**ZB5 AR316**	0.048
					Red	**ZB5 AR416**	0.048
					Yellow	**ZB5 AR516**	0.048
					Blue	**ZB5 AR616**	0.048

563459

XB5 AC21

814444

ZB5 AC24

814445

ZB5 AC2

814446

ZB5 AR4

540160

ZB5 AR216

(1) These pushbuttons and heads cannot be used for an Emergency Stop function.
(2) Recommended maximum number of contacts constituting the body (fixing collar + contact) associated with the head, see page 86.
(3) Ergonomic product used in two-handed control applications. Recommended maximum number of contacts constituting the body (fixing collar + contact) associated with the head: 6.

General : pages 74 to 81
Characteristics : pages 82 to 85
Dimensions : pages 138 to 149

Control and signalling units Ø 22

Harmony® XB5, plastic

Mushroom head pushbuttons, latching

Assembly of other products using:
body/contact assemblies: see page 114
accessories: see page 128

110354

ZB5 AT2

53558

ZB5 AS62

523835

ZB5 AS72

Mushroom head pushbuttons *(1) (2)*

Shape of head	Type of reset	Push Ø (mm)	Push Colour	Reference	Weight kg
Heads only					
	Push-pull	30	Black	**ZB5 AT24**	0.044
		40	Black	**ZB5 AT2**	0.049
		60	Black	**ZB5 AX2**	0.067
	Turn to release	30	Black	**ZB5 AS42**	0.040
		40	Black	**ZB5 AS52**	0.044
		40	Yellow	**ZB5 AS55**	0.044
		60	Black	**ZB5 AS62**	0.064
	Key release (key n° 455) (2 keys included with head) *(3)* *(4)*	30	Black	**ZB5 AS72**	0.040
		40	Black	**ZB5 AS12**	0.044
		60	Black	**ZB5 AS22**	0.064

103547

ZB5 AW733

Illuminated mushroom head pushbuttons *(2)*

Shape of head	Type of reset	Push Ø (mm)	Push Colour	Reference	Weight kg
Heads only *(5)*					
Protected LED	**Turn to release**	40	White	**ZB5 AW713**	0.022
			Green	**ZB5 AW733**	0.022
			Orange	**ZB5 AW753**	0.022
			Blue	**ZB5 AW763**	0.022

(1) These pushbuttons and heads cannot be used for an Emergency Stop function.
(2) Recommended maximum number of contacts constituting the body (fixing collar + contact) associated with the head, see page 86.
(3) For specific keys with other numbers, please consult your Regional Sales Office.
(4) The symbol ⚷ indicates key withdrawal position(s).
(5) Only for use with bodies comprising a light source with integral LED.

General : pages 74 to 81
Characteristics : pages 82 to 85
Dimensions : pages 138 to 149

Control and signalling units Ø 22

Harmony® XB5, plastic
Emergency stop
Conforming to Machinery Directive 98/37/EC and standard EN 418/ISO 13850

Assembly of other products using:
body/contact assemblies: see page 114
combined sub-assemblies: see page 118
accessories: see pages 133 and 134

Mushroom head Emergency stop trigger action and mechanical latching pushbuttons conform to standard EN 418/ISO 13850, to Machinery Directive 98/37/EC and to standard IEC/EN 60947-5-5. Please consult your Regional Sales Office for a full explanation of these standards and directives.

107183
XB5 AT845

523852
XB5 AS8445

563449
XB5 AS9445

523853
ZB5 AS844

523854
ZB5 AT8643M

Emergency stop trigger action and mechanical latching pushbuttons (1)

Screw clamp terminal connections

Complete units

Shape of head	Type of reset	Type of contact N/O	Type of contact N/C	Push Ø (mm)	Push Colour	Reference	Weight kg
	Push-pull	1	1	40	Red	**XB5 AT845** (ZB5 AZ105 + ZB5 AT84)	0.076
	Turn to release	1	1	40	Red	**XB5 AS8445** (ZB5 AZ105 + ZB5 AS844)	0.072
		–	2	40	Red	**XB5 AS8444** (ZB5 AZ104 + ZB5 AS844)	0.072
	Key release (key n° 455) (2)	1	1	40	Red	**XB5 AS9445** (ZB5 AZ105 + ZB5 AS944)	0.112

Heads only

Shape of head	Type of reset	Push Ø (mm)	Push Colour	Reference	Weight kg
	Push-pull	30	Red	**ZB5 AT844** ▲	0.050
		40	Red	**ZB5 AT84**	0.050
	Turn to release	30	Red	**ZB5 AS834**	0.042
		40	Red	**ZB5 AS844**	0.046
	Key release (key n° 455) 2 keys included with head (3) (2)	30	Red	**ZB5 AS934**	0.068
		40	Red	**ZB5 AS944** (4)	0.071
		60	Red	**ZB5 AS934**	0.092
	Key release (key n° 4A185)	40	Red	**ZB5 AS944D**	0.071

Emergency stop trigger action and mechanical latching pushbuttons with mechanical state indicator (1)

For elevator inspection box applications

Heads only (6)

Shape of head	Type of reset	Push Ø (mm)	Push Colour	Reference	Weight kg
Protected LED	Push-pull (5)	40	Red	**ZB5 AT8643M**	0.034

(1) Recommended maximum number of contacts constituting the body (fixing collar + contact) associated with the head, see page 86.
(2) The symbol ⚷ indicates key withdrawal position(s).
(3) For specific keys with other numbers, please consult your Regional Sales Office.
(4) Other key numbers:
*- key n° 421E: add suffix **12** to the reference.*
*- key n° 458A: add suffix **10** to the reference.*
*- key n° 520E: add suffix **14** to the reference.*
*- key n° 3131A: add suffix **20** to the reference.*
*Example: To order a Ø 40 red mushroom head for a trigger action and mechanical latching Emergency Stop pushbutton, with release by key n° 421E, the reference becomes: **ZB5 AS94412**.*
(5) Cannot be used with metal guards ZBZ 160●.
(6) Only for use with bodies comprising a light source with integral LED.

▲ Available: 3rd quarter 2006.

General : pages 74 to 81
Characteristics : pages 82 to 85
Dimensions : pages 138 to 149

Control and signalling units Ø 22

Harmony® XB5, plastic

Emergency stop

Assembly of other products using:
body/contact assemblies: see page 114
combined sub-assemblies: see page 118
accessories: see pages 133 and 134

Emergency stop mechanical latching pushbuttons conform to standard IEC/EN 60947-5-5. Please consult your Regional Sales Office for a full explanation of these standards and directives.

563451

XB5 AS542

107185

ZB5 AT4

107189

ZB5 AS64

107192

ZB5 AS24

Emergency stop mechanical latching pushbuttons *(1)*

Screw clamp terminal connections

Shape of head	Type of reset	Type of contact N/O	Type of contact N/C	Push Ø mm	Push Colour	Reference	Weight kg
Complete units							
	Push-pull	–	1	40	Red	**XB5 AT42** (ZB5 AZ102 + ZB5 AT4)	0.065
	Turn to release	–	1	40	Red	**XB5 AS542** (ZB5 AZ102 + ZB5 AS54)	0.060
	Key release (key n° 455) *(2)*	–	1	40	Red	**XB5 AS142** (ZB5 AZ102 + ZB5 AS14)	0.075
Heads only							
	Push-pull			30	Red	**ZB5 AT44** ▲	0.049
				40	Red	**ZB5 AT4**	0.049
				60	Red	**ZB5 AX4**	0.067
	Turn to release			30	Red	**ZB5 AS44**	0.040
				40	Red	**ZB5 AS54**	0.044
				60	Red	**ZB5 AS64**	0.064
	Key release (key n° 455) 2 keys included with head) *(3)* *(2)*			30	Red	**ZB5 AS74**	0.040
				40	Red	**ZB5 AS14** *(4)*	0.044
				60	Red	**ZB5 AS24**	0.060
	Key release (key n° 4A185)			40	Red	**ZB5 AS14D**	0.044

Illuminated Emergency stop, mechanical latching pushbuttons *(1)*

Shape of head	Type of reset	Push Ø (mm)	Push Colour	Reference	Weight kg
Heads only *(5)*					
Protected LED	**Turn to release**	40	Red	**ZB5 AW743**	0.022

(1) Recommended maximum number of contacts constituting the body (fixing collar + contact) associated with the head, see page 86.
(2) The symbol ⚷ indicates key withdrawal position(s).
(3) For specific keys with other numbers, please consult your Regional Sales Office.
(4) Other key numbers:
*- key n° 421E: add suffix **12** to the reference.*
*- key n° 458A: add suffix **10** to the reference.*
*- key n° 520E: add suffix **14** to the reference.*
*- key n° 3131A: add suffix **20** to the reference.*
*Example: To order a Ø 40 red mushroom head for a trigger action and mechanical latching Emergency Stop pushbutton, with release by key n° 421E, the reference becomes: **ZB5 AS1412**.*
(5) Only for use with bodies comprising a light source with integral LED.

▲ Available:
3 rd quarter 2006.

General : pages 74 to 81
Characteristics : pages 82 to 85
Dimensions : pages 138 to 149

Control and signalling units Ø 22
Harmony® XB5, plastic
Pushbuttons, push-push

Assembly of other products using:
body/contact assemblies: see page 114
combined sub-assemblies: see page 118
accessories: see page 128

814439

ZB5 AH04

Pushbuttons with flush push *(1)*

Shape of head	Type of push	Colour of push	Reference	Weight kg
Heads only, circular				
	Without cap *(2)*	–	**ZB5 AH0**	0.018
	Flush	White	**ZB5 AH01**	0.018
		Black	**ZB5 AH02**	0.018
		Green	**ZB5 AH03**	0.018
		Red	**ZB5 AH04**	0.018
		Yellow	**ZB5 AH05**	0.018
		Blue	**ZB5 AH06**	0.018
Heads only, square				
	Without cap *(2)*	–	**ZB5 CH0**	0.020
	Flush	White	**ZB5 CH01**	0.020
		Black	**ZB5 CH02**	0.020
		Green	**ZB5 CH03**	0.020
		Red	**ZB5 CH04**	0.020
		Yellow	**ZB5 CH05**	0.020
		Blue	**ZB5 CH06**	0.020

Pushbuttons with projecting push *(1)*

Shape of head	Type of push	Colour of push	Reference	Weight kg
Heads only, circular				
	Projecting	White	**ZB5 AH1**	0.018
		Black	**ZB5 AH2**	0.018
		Green	**ZB5 AH3**	0.018
		Red	**ZB5 AH4**	0.018
		Yellow	**ZB5 AH5**	0.018
		Blue	**ZB5 AH6**	0.018

Illuminated pushbuttons with flush push *(1)*

Shape of head	Type of push	Colour of push	Reference	Weight kg
Heads only, circular *(3)*				
Protected LED	**Flush**	White	**ZB5 AH013**	0.017
		Green	**ZB5 AH033**	0.017
		Red	**ZB5 AH043**	0.017
		Orange	**ZB5 AH053**	0.017
		Blue	**ZB5 AH063**	0.017
Heads only, square *(3)*				
Protected LED	**Flush**	White	**ZB5 CH313**	0.018
		Green	**ZB5 CH333**	0.018
		Red	**ZB5 CH343**	0.018
		Orange	**ZB5 CH353**	0.018
		Blue	**ZB5 CH363**	0.018

113972

ZB5 CH343

Illuminated pushbuttons with projecting push *(1)*

Shape of head	Type of push	Colour of push	Reference	Weight kg
Heads only, circular *(3)*				
Protected LED	**Projecting**	White	**ZB5 AH13**	0.017
		Green	**ZB5 AH33**	0.017
		Red	**ZB5 AH43**	0.017
		Orange	**ZB5 AH53**	0.017
		Blue	**ZB5 AH63**	0.017

(1) Recommended maximum number of contacts constituting the body (fixing collar + contact) associated with the head, see page 86.
(2) Caps to be ordered separately, see page 124.
(3) Only for use with bodies comprising a light source with integral LED.

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Control and signalling units Ø 22

Harmony® XB5, plastic

Pushbuttons, "push-turn to release"

Assembly of other products using:
body/contact assemblies: see page 114
accessories: see page 128

523836

ZB5 AFDA

Pushbuttons with key-operated push *(1)*

Shape of head	Type of push	Locking	Key withdrawal	Reference	Weight kg
Heads only					
	Key n° 4A185	Both positions	Both positions	**ZB5 AFDA**	0.050
		Actuated position	Actuated position	**ZB5 AFDB**	0.050
		Rest position	Rest position	**ZB5 AFDC**	0.050
		Actuated position	Both positions	**ZB5 AFDD**	0.050
	Key LU1	Both positions	Both positions	**ZB5 AFDE01**	0.050
	Key LU2	Both positions	Both positions	**ZB5 AFDE02**	0.050
	Key LU3	Both positions	Both positions	**ZB5 AFDE03**	0.050
	Key LU4	Both positions	Both positions	**ZB5 AFDE04**	0.050
	Key LU5	Both positions	Both positions	**ZB5 AFDE05**	0.050
	Key LU6	Both positions	Both positions	**ZB5 AFDE06**	0.050
	Key LU7	Both positions	Both positions	**ZB5 AFDE07**	0.050
	Key LU8	Both positions	Both positions	**ZB5 AFDE08**	0.050
	Key LU9	Both positions	Both positions	**ZB5 AFDE09**	0.050
	Key LU10	Both positions	Both positions	**ZB5 AFDE10**	0.050
	Key LU11	Both positions	Both positions	**ZB5 AFDE11**	0.050
	Key LU12	Both positions	Both positions	**ZB5 AFDE12**	0.050
	Key LU13	Both positions	Both positions	**ZB5 AFDE13**	0.050
	Key LU14	Both positions	Both positions	**ZB5 AFDE14**	0.050
	Key LU15	Both positions	Both positions	**ZB5 AFDE15**	0.050

110321

ZB5 AF

110322

ZB5 AF351

Pushbuttons with knurled push *(1)*

Shape of head	Type of push	Marking	Reference	Weight kg
Heads only				
	Knurled without cap *(2)*	–	**ZB5 AF**	0.027
	Knurled with marked cap	↑ (white on black background)	**ZB5 AF351**	0.030

(1) Recommended maximum number of contacts constituting the body (fixing collar + contact) associated with the head, see page 86.
(2) Coloured caps to be ordered separately: see page 124.

Control and signalling units Ø 22

Harmony® XB5, plastic

Selector switches with standard handle

Assembly of other products using:
body/contact assemblies: see page 114
accessories: see page 128

106201

XB5 AD33

106215

ZB5 AD2

Selector switches with standard handle *(1)*

Screw clamp terminal connections

Shape of head	Type of operator	Type of contact N/O	Type of contact N/C	Positions Number	Positions Type	Reference	Weight kg
Complete units							
	Standard handle, black	1	–	2-position	Stay put	**XB5 AD21** (ZB5 AZ101 + ZB5 AD2)	0.043
		1	–		Spring return from right to left	**XB5 AD41** (ZB5 AZ101 + ZB5 AD4)	0.046
		1	1		Stay put	**XB5 AD25** (ZB5 AZ105 + ZB5 AD2)	0.043
		2	–	3-position	Stay put	**XB5 AD33** (ZB5 AZ103 + ZB5 AD3)	0.043
					Spring return to centre	**XB5 AD53** (ZB5 AZ103 + ZB5 AD5)	0.043
Heads only							
	Standard handle, black			2-position	Stay put	**ZB5 AD2**	0.017
					Spring return from right to left	**ZB5 AD4**	0.020
				3-position	Stay put	**ZB5 AD3**	0.017
					Spring return to centre	**ZB5 AD5**	0.017
					Spring return from left to centre	**ZB5 AD7**	0.017
					Spring return from right to centre	**ZB5 AD8**	0.017

Heads only with other coloured handles

Standard handle, white	add suffix **01** to the reference, example: **ZB5 AD201**
Standard handle, green	add suffix **03** to the reference, example: **ZB5 AD203**
Standard handle, red	add suffix **04** to the reference, example: **ZB5 AD204**
Standard handle, yellow	add suffix **05** to the reference, example: **ZB5 AD205**
Standard handle, blue	add suffix **06** to the reference, example: **ZB5 AD206**

(1) Recommended maximum number of contacts and sequence of contacts constituting the body (fixing collar + contact) associated with the head, see page 86.

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Characteristics : pages 82 to 85
Dimensions : pages 138 to 149

Control and signalling units Ø 22

Harmony® XB5, plastic

Selector switches with knurled knob - Toggle switches

Assembly of other products using:
body/contact assemblies: see page 114
accessories: see page 128

ZB5 AD39

Selector switches with knurled knob *(1)*

Shape of head	Type of operator	Positions Number	Positions Type	Reference	Weight kg
Heads only					
	Black knurled knob	2-position	Stay put	**ZB5 AD29**	0.020
			Spring return from right to left	**ZB5 AD49**	0.024
		3-position	Stay put	**ZB5 AD39**	0.020
			Spring return to centre	**ZB5 AD59**	0.020
			Spring return from left to centre	**ZB5 AD79**	0.020
			Spring return from right to centre	**ZB5 AD89**	0.020

ZB5 AD28

Toggle switches *(1)*

Shape of head	Type of operator	Positions Number	Positions Type	Reference	Weight kg
Heads only					
	Black lever	2-position	Stay put	**ZB5 AD28**	0.023
			Spring return	**ZB5 AD48**	0.023
	White lever	2-position	Stay put	**ZB5 AD2801**	0.023
	Red lever	2-position	Stay put	**ZB5 AD2804**	0.023
	Blue lever	2-position	Stay put	**ZB5 AD2806**	0.023

(1) Recommended maximum number of contacts and sequence of contacts constituting the body (fixing collar + contact) associated with the head, see page 86.

Control and signalling units Ø 22

Harmony® XB5, plastic

Illuminated selector switches with standard handle, with integral LED

Assembly of other products using:
combined sub-assemblies: see page 118
accessories: see page 128

XB5 AK123●5

XB5 AK124●5

XB5 AK125●5

Illuminated selector switches with standard handle, with integral LED *(1)*

Screw clamp terminal connections

Shape of head	Type of operator	Type of contact N/O	Type of contact N/C	Positions Number Type	Supply voltage V	Colour of handle	Reference	Weight kg
Complete units								
Protected LED	**Standard handle**	1	1	2-position Stay put	≂ 24	Green	**XB5 AK123B5** (ZB5 AW0B35 + ZB5 AK1233)	0.516
						Red	**XB5 AK124B5** (ZB5 AW0B45 + ZB5 AK1243)	0.516
						Orange	**XB5 AK125B5** (ZB5 AW0B55 + ZB5 AK1253)	0.516
					∿ 48...120	Green	**XB5 AK123G5** (ZB5 AW0G35 + ZB5 AK1233)	0.516
						Red	**XB5 AK124G5** (ZB5 AW0G45 + ZB5 AK1243)	0.516
						Orange	**XB5 AK125G5** (ZB5 AW0G55 + ZB5 AK1253)	0.516
					∿ 230...240	Green	**XB5 AK123M5** (ZB5 AW0M35 + ZB5 AK1233)	0.516
						Red	**XB5 AK124M5** (ZB5 AW0M45 + ZB5 AK1243)	0.516
						Orange	**XB5 AK125M5** (ZB5 AW0M55 + ZB5 AK1253)	0.516
		1	1	3-position Stay put	≂ 24	Green	**XB5 AK133B5** (ZB5 AW0B35 + ZB5 AK1333)	0.516
						Red	**XB5 AK134B5** (ZB5 AW0B45 + ZB5 AK1343)	0.516
						Orange	**XB5 AK135B5** (ZB5 AW0B55 + ZB5 AK1353)	0.516
					∿ 48...120	Green	**XB5 AK133G5** (ZB5 AW0G35 + ZB5 AK1333)	0.516
						Red	**XB5 AK134G5** (ZB5 AW0G45 + ZB5 AK1343)	0.516
						Orange	**XB5 AK135G5** (ZB5 AW0G55 + ZB5 AK1353)	0.516
					∿ 230...240	Green	**XB5 AK133M5** (ZB5 AW0M35 + ZB5 AK1333)	0.516
						Red	**XB5 AK134M5** (ZB5 AW0M45 + ZB5 AK1343)	0.516
						Orange	**XB5 AK135M5** (ZB5 AW0M55 + ZB5 AK1353)	0.516

(1) Recommended maximum number of contacts constituting the body (fixing collar + contact) associated with the head, see page 86.

General : pages 74 to 81
Characteristics : pages 82 to 85
Dimensions : pages 138 to 149

Control and signalling units Ø 22

Harmony® XB5, plastic

Illuminated selector switches with standard handle, with integral LED

Assembly of other products using:
combined sub-assemblies: see page 118
accessories: see page 128

ZB5 AK1263

ZB5 AK1463

Illuminated selector switches with standard handle, with integral LED (continued) *(1)*

Shape of head	Type of operator	Positions		Colour of handle	Reference	Weight kg
		Number	Type			
Heads only *(2)*						
	Standard handle	2-position	Stay put	White	**ZB5 AK1213**	0.016
				Green	**ZB5 AK1233**	0.016
				Red	**ZB5 AK1243**	0.016
				Orange	**ZB5 AK1253**	0.016
				Blue	**ZB5 AK1263**	0.016
			Spring return from right to left	White	**ZB5 AK1413**	0.017
				Green	**ZB5 AK1433**	0.017
				Red	**ZB5 AK1443**	0.017
				Orange	**ZB5 AK1453**	0.017
				Blue	**ZB5 AK1463**	0.017
		3-position	Stay put	White	**ZB5 AK1313**	0.016
				Green	**ZB5 AK1333**	0.016
				Red	**ZB5 AK1343**	0.016
				Orange	**ZB5 AK1353**	0.016
				Blue	**ZB5 AK1363**	0.016
			Spring return to centre	White	**ZB5 AK1513**	0.016
				Green	**ZB5 AK1533**	0.016
				Red	**ZB5 AK1543**	0.016
				Orange	**ZB5 AK1553**	0.016
				Blue	**ZB5 AK1563**	0.016
			Spring return from right to centre	White	**ZB5 AK1813**	0.016
				Green	**ZB5 AK1833**	0.016
				Red	**ZB5 AK1843**	0.016
				Orange	**ZB5 AK1853**	0.016
				Blue	**ZB5 AK1863**	0.016
			Spring return from left to centre	White	**ZB5 AK1713**	0.016
				Green	**ZB5 AK1733**	0.016
				Red	**ZB5 AK1743**	0.016
				Orange	**ZB5 AK1753**	0.016
				Blue	**ZB5 AK1763**	0.016

(1) Recommended maximum number of contacts constituting the body (fixing collar + contact) associated with the head, see page 86.
(2) Only for use with bodies comprising a light source with integral LED.

Control and signalling units Ø 22

Harmony® XB5, plastic

Selector switches with long handle, key switches

Assembly of other products using:
body/contact assemblies: see page 114
accessories: see page 128

106204

ZB5 AJ●3

106219

ZB5 AJ●

Selector switches with long handle *(1)*

Screw clamp terminal connections

Shape of head	Type of operator	Type of contact N/O	Type of contact N/C	Positions Number	Positions Type		Reference	Weight kg
Complete units								
	Long handle, black	1	–	2-position	Stay put		**XB5 AJ21** (ZB5 AZ101 + ZB5 AJ2)	0.043
		2	–	3-position	Stay put		**XB5 AJ33** (ZB5 AZ103 + ZB5 AJ3)	0.043
					Spring return to centre		**XB5 AJ53** (ZB5 AZ103 + ZB5 AJ5)	0.043
Heads only								
	Long handle, black			2-position	Stay put		**ZB5 AJ2**	0.017
					Spring return from right to left		**ZB5 AJ4**	0.020
				3-position	Stay put		**ZB5 AJ3**	0.017
					Spring return to centre		**ZB5 AJ5**	0.017
					Spring return from left to centre		**ZB5 AJ7**	0.017
					Spring return from right to centre		**ZB5 AJ8**	0.017

106203

XB5 AG●3

Key switches *(1)*

Screw clamp terminal connections

Shape of head	Type of operator	Type of contact N/O	Type of contact N/C	Positions Number	Positions Type *(2)*		Reference	Weight kg
Complete units								
	Key switch with key n° 455	1	–	2-position	Stay put		**XB5 AG21** (ZB5 AZ101 + ZB5 AG2)	0.831
							XB5 AG41 (ZB5 AZ101 + ZB5 AG4)	0.831
					Spring return to left		**XB5 AG61** (ZB5 AZ101 + ZB5 AG6)	0.870
		2	–	3-position	Stay put		**XB5 AG03** (ZB5 AZ103 + ZB5 AG0)	0.831
							XB5 AG33 (ZB5 AZ103 + ZB5 AG3)	0.831

(1) Recommended maximum number of contacts and sequence of contacts constituting the body (fixing collar + contact) associated with the head, see page 86.
(2) The symbol ⚷ indicates key withdrawal position(s).

General : pages 74 to 81
Characteristics : pages 82 to 85
Dimensions : pages 138 to 149

Control and signalling units Ø 22

Harmony® XB5, plastic

Key switches

Key n° 455, 8D1, 421E, 458A, 520E or 3131A

Assembly of other products using:
body/contact assemblies: see page 114
accessories: see page 128

106224

ZB5 AG2

106223

ZB5 AG3

Key switches (continued) *(1)*

Screw clamp terminal connections

Shape of head	Type of operator	Positions *(2)* Number	Type		Reference	Weight kg
Heads only						
	Key switch with key n° 455 *(3) (4)*	2-position	Stay put		**ZB5 AG2**	0.057
					ZB5 AG02	0.057
					ZB5 AG4	0.057
			Spring return from right to left		**ZB5 AG6**	0.061
		3-position	Stay put		**ZB5 AG0**	0.057
					ZB5 AG3	0.057
					ZB5 AG5	0.057
					ZB5 AG9	0.057
					ZB5 AG09	0.057
			Spring return from left to centre		**ZB5 AG1**	0.057
			Spring return to centre		**ZB5 AG7**	0.057
			Spring return from right to centre		**ZB5 AG8**	0.057
					ZB5 AG05	0.057
					ZB5 AG08	0.057
	Key switch with key n° 8D1	2-position	Stay put		**ZB5 AG2D**	0.057
					ZB5 AG02D	0.057
					ZB5 AG4D	0.057
		2-position	Spring return from right to left		**ZB5 AG6D**	0.061
		3-position	Stay put		**ZB5 AG0D**	0.057
					ZB5 AG3D	0.057
					ZB5 AG5D	0.057
					ZB5 AG9D	0.057
					ZB5 AG09D	0.057
					ZB5 AG03D	0.057
					ZB5 AG04D	0.057
		3-position	Spring return from left to centre		**ZB5 AG06D**	0.057
					ZB5 AG1D	0.057
					ZB5 AG07D	0.057
		3-position	Spring return from right to centre		**ZB5 AG8D**	0.057
					ZB5 AG08D	0.057
					ZB5 AG05D	0.057
		2-position	Spring return to centre		**ZB5 AG7D**	0.057

(1) Recommended maximum number of contacts and sequence of contacts constituting the body (fixing collar + contact) associated with the head, see page 86.
(2) The symbol ⚷ indicates key withdrawal position(s).
*(3) Other key numbers: Key n° 421E: add suffix **12** to the reference. Key n° 458A: add suffix **10** to the reference. Key n° 520E: add suffix **14** to the reference. Key n° 3131A: add suffix **2 0** to the reference.*
*Example: For a switch head with key n° 421E, 2-position stay put with key withdrawal from the left-hand position, the reference becomes: **ZB5 AG212**.*
(4) For specific keys with other numbers, please consult your Regional Sales Office.

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Characteristics : pages 82 to 85
Dimensions : pages 138 to 149

Control and signalling units Ø 22

Harmony® XB5, plastic

Pilot lights with integral LED

Assembly of other products using:
light block sub-assemblies: see page 48
accessories: see pages 124 and 128

814388

XB5 AVB1

Pilot lights with integral LED

Screw clamp terminal connections

Shape of head	Supply voltage V	Colour	Reference	Weight kg
Complete units				
■ With plain lens				
Protected LED	⎓ 24	White	**XB5 AVB1** (ZB5 AVB1 + ZB5 AV013)	0.038
		Green	**XB5 AVB3** (ZB5 AVB3 + ZB5 AV033)	0.038
		Red	**XB5 AVB4** (ZB5 AVB4 + ZB5 AV043)	0.038
		Orange	**XB5 AVB5** (ZB5 AVB5 + ZB5 AV053)	0.038
		Blue	**XB5 AVB6** (ZB5 AVB6 + ZB5 AV063)	0.038
	~ 48...120	White	**XB5 AVG1** (ZB5 AVG1 + ZB5 AV013)	0.038
		Green	**XB5 AVG3** (ZB5 AVG3 + ZB5 AV033)	0.038
		Red	**XB5 AVG4** (ZB5 AVG4 + ZB5 AV043)	0.038
		Orange	**XB5 AVG5** (ZB5 AVG5 + ZB5 AV053)	0.038
		Blue	**XB5 AVG6** (ZB5 AVG6 + ZB5 AV063)	0.038
	~ 230...240	White	**XB5 AVM1** (ZB5 AVM1 + ZB5 AV013)	0.038
		Green	**XB5 AVM3** (ZB5 AVM3 + ZB5 AV033)	0.038
		Red	**XB5 AVM4** (ZB5 AVM4 + ZB5 AV043)	0.038
		Orange	**XB5 AVM5** (ZB5 AVM5 + ZB5 AV053)	0.038
		Blue	**XB5 AVM6** (ZB5 AVM6 + ZB5 AV063)	0.038

Heads only, circular *(1)*

Shape of head	For use with body comprising light source type	Colour of lens	Reference	Weight kg
■ With plain lens				
	Integral LED only	White	**ZB5 AV013**	0.017
		Green	**ZB5 AV033**	0.017
		Red	**ZB5 AV043**	0.017
		Orange	**ZB5 AV053**	0.017
		Blue	**ZB5 AV063**	0.017
		5 colours *(2) (3)*	**ZB5 AV003**	0.017
■ With plain lens, for insertion of legend *(3)*				
	Integral LED only	White	**ZB5 AV013E**	0.017
		Green	**ZB5 AV033E**	0.017
		Red	**ZB5 AV043E**	0.017
		Orange	**ZB5 AV053E**	0.017
		Blue	**ZB5 AV063E**	0.017
■ With grooved lens *(4)*				
	Integral LED only	White	**ZB5 AV013S**	0.017
		Green	**ZB5 AV033S**	0.017
		Red	**ZB5 AV043S**	0.017
		Orange	**ZB5 AV053S**	0.017
		Blue	**ZB5 AV063S**	0.017

814529

ZB5 AV053

Heads only, square *(1)*

Shape of head		Colour	Reference	Weight kg
■ With plain lens				
	Integral LED only	White	**ZB5 CV013**	0.020
		Green	**ZB5 CV033**	0.020
		Red	**ZB5 CV043**	0.020
		Orange	**ZB5 CV053**	0.020
		Blue	**ZB5 CV063**	0.020
		5 colours *(2)*	**ZB5 CV003**	0.028

814530

ZB5 CV063

(1) Only for use with bodies comprising a light source with integral LED.
(2) Head supplied with 5 different coloured lenses (white, green, red, orange, blue) not fitted, for insertion of legend.
(3) For legend ordering information: see page 128.
(4) For use in bright ambient light conditions (outdoors in sunlight, for example).

General : pages 74 to 81
Characteristics : pages 82 to 85
Dimensions : pages 138 to 149

Control and signalling units Ø 22

Harmony® XB5, plastic

Pilot lights with BA 9s base fitting

Assembly of other products using:
light block sub-assemblies: see page 122
accessories: see pages 124 and 128

814392

XB5 AV63

814391

XB5 AV34

814528

ZB5 AV01

Pilot lights with BA 9s base fitting, with plain lens

Screw clamp terminal connections

Shape of head	Supply voltage V	Colour	Reference	Weight kg
Complete units - With plain lens				
■ Direct supply, for BA 9s bulb, U ⩽ 250 V, 2.4 W max (bulb not included)				
	≤ 250	White	**XB5 AV61** (ZB5 AV6 + ZB5 AV01)	0.037
		Green	**XB5 AV63** (ZB5 AV6 + ZB5 AV03)	0.037
		Red	**XB5 AV64** (ZB5 AV6 + ZB5 AV04)	0.037
		Orange	**XB5 AV65** (ZB5 AV6 + ZB5 AV05)	0.037
■ Via integral transformer, 1.2 VA, 6 V secondary, with BA 9s incandescent bulb (included)				
	∿ 110...120 - 50/60 Hz	White	**XB5 AV31** (ZB5 AV3 + ZB5 AV01)	0.109
		Green	**XB5 AV33** (ZB5 AV3 + ZB5 AV03)	0.109
		Red	**XB5 AV34** (ZB5 AV3 + ZB5 AV04)	0.109
		Orange	**XB5 AV35** (ZB5 AV3 + ZB5 AV05)	0.109
	∿ 230 - 50 Hz ∿ 220...240 - 60 Hz	White	**XB5 AV41** (ZB5 AV4 + ZB5 AV01)	0.110
		Green	**XB5 AV43** (ZB5 AV4 + ZB5 AV03)	0.110
		Red	**XB5 AV44** (ZB5 AV4 + ZB5 AV04)	0.110
		Orange	**XB5 AV45** (ZB5 AV4 + ZB5 AV05)	0.110

Heads only *(1)*

Shape of head	For use with body comprising light source type	Colour of lens	Reference	Weight kg
■ With plain lens				
	With BA 9s base fitting (incandescent, neon or LED)	White	**ZB5 AV01**	0.018
		Green	**ZB5 AV03**	0.018
		Red	**ZB5 AV04**	0.018
		Orange	**ZB5 AV05**	0.018
		Blue	**ZB5 AV06**	0.018
		Clear	**ZB5 AV07**	0.018
■ With grooved lens *(2)*				
	With BA 9s base fitting (neon or LED only)	White	**ZB5 AV01S**	0.017
		Green	**ZB5 AV03S**	0.017
		Red	**ZB5 AV04S**	0.017
		Orange	**ZB5 AV05S**	0.017
		Blue	**ZB5 AV06S**	0.017
		Clear	**ZB5 AV07S**	0.017

(1) Only for use with bodies comprising a light source with BA 9s base fitting (incandescent, neon or LED).
(2) For use in bright ambient light conditions (outdoors in sunlight, for example).

General : pages 74 to 81
Characteristics : pages 82 to 85
Dimensions : pages 138 to 149

Control and signalling units Ø 22

Harmony® XB5, plastic

Specific functions

Pushbuttons for manual overload reset, hour counters, buzzers, fuse carrier

Assembly of other products using:
body/contact assemblies: see page 114
accessories: see page 128

563091

XB5 AA

Manual overload reset buttons (travel 10 mm)

Shape of head	Actuation distance mm	Marking	Colour	Reference	Weight kg
Without cap *(1)*					
	17…120	–	–	**XB5 AA801**	0.027
	120…257	–	–	**XB5 AA802**	0.040
With flush push					
	17…120	Without	Green	**XB5 AA831**	0.027
			Red	**XB5 AA841**	0.027
			Blue	**XB5 AA861**	0.027
		O	Red	**XB5 AA84101**	0.027
		R	Blue	**XB5 AA86102**	0.027
	120…257	Without	Green	**XB5 AA832**	0.040
			Red	**XB5 AA842**	0.040
			Blue	**XB5 AA862**	0.040
		O	Red	**XB5 AA84201**	0.040
		R	Blue	**XB5 AA86202**	0.040
With projecting push					
	17…120	O	Red	**XB5 AL84101**	0.027
	120…257	O	Red	**XB5 AL84201**	0.040

109501

ZB5 AD

Heads + mounting base for potentiometer *(2)*

Shape of head	Description	For use with	Reference	Weight kg
	For potentiometer with shaft length 45 to 50 mm	Ø 6 mm shaft	**ZB5 AD912**	0.032
		Ø 6.35 mm shaft	**ZB5 AD922**	0.032

814343

XB5 DS●

Hour counters

Characteristics	Supply voltage V	Reference	Weight kg
Indication 0…9999.9	≂ 12…24 - 50/60 Hz	**XB5 DSB**	0.045
	∿ 120 -60 Hz	**XB5 DSG**	0.045
	∿ 230…240 -50 Hz	**XB5 DSM**	0.045

814344

XB5 KS●

Annunciators (IP 40 NEMA 1)

85 db buzzer: 4 kHz, with continuous or intermittent operation (connection diagram: see page 68)	≂ 24 - 50/60 Hz	**XB5 KSB**	0.035
	∿ 120 - 50/60 Hz	**XB5 KSG**	0.035
	∿ 230…240 -50 Hz	**XB5 KSM**	0.035

814344

XB5 DT1S

Fuse carrier

Description	For use with	Reference	Weight kg
Fuse carrier	5 x 20 mm fuse 6.3 A - 250 V	**XB5 DT1S**	0.022

(1) Coloured cap to be ordered separately: see page 124.
(2) Potentiometer not included.

General : pages 74 to 81
Characteristics : pages 82 to 85
Dimensions : pages 138 to 149

Control and signalling units Ø 22

Harmony® XB5, plastic

Specific functions

Joystick controllers, wobblesticks

Assembly of other products using: accessories: see page 128

563161

XD5 PA12

Joystick controllers (with 54 mm long operating shaft) *(1)*

Description	Operation	Spring return to zero position	Reference	Weight kg
Complete products (screw clamp terminal connections)				
2-direction	1 notch 1 N/O contact per direction	Without	**XD5 PA12**	0.060
		With	**XD5 PA22**	0.060
4-direction	1 notch 1 N/O contact per direction	Without	**XD5 PA14**	0.077
		With	**XD5 PA24**	0.077

814667

ZD5 PA103

814666

ZD5 PA203

Sub-assemblies for joystick controllers

Description	For use with		Reference	Weight kg
Complete body/contact assemblies (screw clamp terminal connections	2-direction		**ZD5 PA103**	0.049
	4-direction		**ZD5 PA203**	0.058
Complete head assemblies with operating shaft	2-direction, stay put		**ZD5 PA12**	0.022
	2-direction, spring return to zero position		**ZD5 PA22**	0.022
	4-direction, stay put		**ZD5 PA14**	0.022
	4-direction, spring return to zero position		**ZD5 PA24**	0.022
Legends 30 x 48 mm for engraving	2-direction	Black one side Red reverse	**ZBG 2201**	0.001
		White one side Yellow reverse	**ZBG 2401**	0.001
Legends 48 x 48 mm for engraving	4-direction	Black one side Red reverse	**ZBG 4201**	0.002
		White one side Yellow reverse	**ZBG 4401**	0.002

563162

ZD5 PA12

(1) Must not be used with standard contact blocks ZBE 10● (single) or ZBE 20● (double).

Other versions Joystick controllers and complete body/contact assemblies for joystick controllers with Faston connector terminals (6.35 or 2 x 2.8).
Please consult your Regional Sales Office.

General : pages 74 to 81
Characteristics : pages 82 to 85
Dimensions : pages 138 to 149

Control and signalling units Ø 22

Harmony® XB5, plastic

Body/contact assemblies -Screw clamp terminal connections

To combine with heads, see pages 88 to 112

814411

ZB5 AZ101

814265

ZBE 101

814267

ZBE 203

814265

ZBE 201

814667

ZB5 AZ106

814667

ZB5 AZ107

814588

ZB5 AZ009

Contact functions

Screw clamp terminal connections *(1)*

Simple functions unit

Description	Type of contact N/O	Type of contact N/C	Sold in lots of	Unit reference	Weight kg
Fixing collar + single contact block	1	–	1	**ZB5 AZ101**	0.021
	–	1	1	**ZB5 AZ102**	0.021
	2	–	1	**ZB5 AZ103**	0.030
	–	2	1	**ZB5 AZ104**	0.030
	1	1	1	**ZB5 AZ105**	0.030
	1	2	1	**ZB5 AZ141**	0.040
Standard single contact blocks	1	–	5	**ZBE 101**	0.011
	–	1	5	**ZBE 102**	0.011
Standard double contact blocks	2	–	5	**ZBE 203**	0.020
	–	2	5	**ZBE 204**	0.020
	1	1	5	**ZBE 205**	0.020
Contact blocks for low power switching, with gold flashed contacts	1	–	5	**ZBE 1016**	0.012
	–	1	5	**ZBE 1026**	0.012
Contact blocks for low power switching, with gold flashed contacts and dust protection *(2)*	1	–	5	**ZBE 1016P**	0.012
	–	1	5	**ZBE 1026P**	0.012

Specific function units

Description	Type of contact N/O	Type of contact N/C	Sold in lots of	Unit reference	Weight kg
Contact block, with early make contact	1	–	5	**ZBE 201**	0.011
Contact block, with late break contact	–	1	5	**ZBE 202**	0.011

Description	Type of contact N/O+N/C	Type of contact N/O+N/O	Reference	Weight kg
Fixing collar + contact block for overlapping contacts function	1	–	**ZB5 AZ106**	0.030
Fixing collar + contact block for sequencing contacts function	–	1	**ZB5 AZ107**	0.030

Body/fixing collar

For use with	Sold in lots of	Unit reference	Weight kg
Electrical block (contact or light)	10	**ZB5 AZ009**	0.006

(1) The contact blocks enable variable composition of body/contact assemblies. Maximum number of rows possible: 3. Either 3 rows of 3 single contacts or 1 row of 3 double contacts + 1 row of 3 single contacts (double contacts occupy the first 2 rows). The maximum number of contacts is specified on page 86.

(2) It is not possible to fit an additional contact block on the back of these contact blocks.

General : pages 74 to 81
Characteristics : pages 82 to 85
Dimensions : pages 138 to 149

Control and signalling units Ø 22

Harmony® XB5, plastic

Body/contact assemblies - Faston connectors

To combine with heads, see pages 88 to 112

111294

ZB5 AZ1013

111295

ZB5 AZ1023

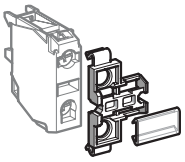
121475

ZBE 1023

121508

ZBE 2043

814262



ZBZ 001

563527

XBY 2U

Contact functions

Faston connectors (6.35 or 2 x 2.8 mm) *(1)*

Simple functions units

Description	Type of contact N/O	Type of contact N/C	Sold in lots of	Unit reference	Weight kg
Fixing collar + single contact block	1	–	1	**ZB5 AZ1013**	0.021
	–	1	1	**ZB5 AZ1023**	0.021
	2	–	1	**ZB5 AZ1033**	0.030
	–	2	1	**ZB5 AZ1043**	0.030
	1	1	1	**ZB5 AZ1053**	0.030
Standard single contact blocks	1	–	5	**ZBE 1013** *(2)*	0.011
	–	1	5	**ZBE 1023** *(2)*	0.011
Standard double contact blocks	2	–	5	**ZBE 2033**	0.020
	–	2	5	**ZBE 2043**	0.020
	1	1	5	**ZBE 2053**	0.020
Contact blocks for low power switching, with gold flashed contacts	1	–	5	**ZBE 10163** *(2)*	0.012
	–	1	5	**ZBE 10263** *(2)*	0.012
Contact blocks for low power switching, with gold flashed contacts and dust protection *(3)*	1	–	5	**ZBE 1016P3** *(2)*	0.012
	–	1	5	**ZBE 1026P3 (2)**	0.012

Specific function units

Description	Type of contact N/O	Type of contact N/C	Sold in lots of	Unit reference	Weight kg
Contact block, with early make contact	1	–	5	**ZBE 2013** *(2)*	0.011
Contact block, with late break contact	–	1	5	**ZBE 2023** *(2)*	0.011

Clip-on legend holders for electrical blocks with screw clamp terminal connections

Application	Sold in lots of	Unit reference	Weight kg
Identification of an XB5 A control or signalling unit	10	**ZBZ 001**	0.001

Sheet of 50 blank legends

Legend holder ZBZ 001	10	**ZBY 001**	0.023

"SIS Label" labelling software (for legends **ZBY 001**)

For legend design for English, French, German, Italian, Spanish	1	**XBY 2U**	0.100

(1) The contact blocks enable variable composition of body/contact assemblies. Maximum number of rows possible: 3. Either 3 rows of 3 single contacts or 1 row of 3 double contacts + 1 row of 3 single contacts (double contacts occupy the first 2 rows).

*(2) To order products with screw clamp terminal connections for lugs, replace the **3** at the end of the reference with a **9**. Example: **ZBE 1013** becomes **ZBE 1019**.*

(3) It is not possible to fit an additional contact block on the back of these contact blocks.

General : pages 74 to 81
Characteristics : pages 82 to 85
Dimensions : pages 138 to 149

Control and signalling units Ø 22

Harmony® XB5, plastic

Body/contact assemblies - Plug-in connector

To combine with heads, see pages 88 to 112

814408

ZB5 AZ1014

814410

ZB5 AZ1024

814278

ZBE 1014

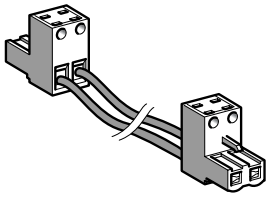
814279

ZBE 1024

814280

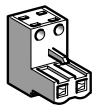
ZBV B●4

530719



APE 1C2250

814281



APE 1PAD21

814588

ZB5 AZ009

Contact functions: simple functions units

Plug-in connector *(1)*

Description	Type of contact N/O	Type of contact N/C	Sold in lots of	Unit reference	Weight kg
Fixing collar + single contact block	1	–	1	**ZB5 AZ1014**	0.018
	–	1	1	**ZB5 AZ1024**	0.018
	2	–	1	**ZB5 AZ1034**	0.026
	–	2	1	**ZB5 AZ1044**	0.026
	1	1	1	**ZB5 AZ1054**	0.026
	1	2	1	**ZB5 AZ1414**	0.036
Standard contact blocks	1	–	5	**ZBE 1014**	0.009
	–	1	5	**ZBE 1024**	0.009

Light blocks

Plug-in connector

Description	Supply voltage V	Colour of light source	Sold in lots of	Unit reference	Weight kg
Integral LED (to combine with heads for integral LED) Protected LED	⎓ 24	White	5	**ZBV B14**	0.016
		Green	5	**ZBV B34**	0.016
		Red	5	**ZBV B44**	0.016
		Orange	5	**ZBV B54**	0.016
		Blue	5	**ZBV B64**	0.016
	~ 48…120	White	5	**ZBV G14**	0.016
		Green	5	**ZBV G34**	0.016
		Red	5	**ZBV G44**	0.016
		Orange	5	**ZBV G54**	0.016
		Blue	5	**ZBV G64**	0.016
	~ 230…240	White	5	**ZBV M14**	0.016
		Green	5	**ZBV M34**	0.016
		Red	5	**ZBV M44**	0.016
		Orange	5	**ZBV M54**	0.016
		Blue	5	**ZBV M64**	0.016

Connecting cables and connector

Description	Number of connectors	Wire c.s.a. mm²	Length mm	Sold in lots of	Unit reference	Weight kg
Cables with connectors 2-pin, 5.08 mm pitch	1	0.75	500	8	**APE 1C2150**	0.120
	2	0.75	500	8	**APE 1C2250**	0.180
Self-stripping connector 2-pin, 5.08 mm pitch	–	0.75	–	16	**APE 1PAD21**	0.080
Spring terminal connector 2-pin, 5.08 mm pitch	–	0.2 to 2.5	–	10	**APE 1PRE21**	0.003

Body/fixing collar

For use with	Sold in lots of	Unit reference	Weight kg
Electrical block (contact or light)	10	**ZB5 AZ009**	0.006

(1) It is not possible to fit an additional contact block on the back of these contact blocks.

General : pages 74 to 81
Characteristics : pages 82 to 85
Dimensions : pages 138 to 149

Control and signalling units Ø 22

Harmony® XB5, plastic

Body/contact assemblies for printed circuit board

To combine with heads, see pages 88 to 112

814287

ZBE 701

814288

ZBE 702

814289

ZBV B●7

Contact blocks

For printed circuit board *(1)*

Description	Type of contact N/O	Type of contact N/C	Sold in lots of	Unit reference	Weight kg
Standard contact blocks	1	–	10	**ZBE 701**	0.002
	–	1	10	**ZBE 702**	0.002
Contact blocks for low power switching, with gold flashed contacts	1	–	10	**ZBE 7016**	0.003
	–	1	10	**ZBE 7026**	0.003

Light blocks

For printed circuit board *(1)*

Description	Supply voltage V	Colour of LED	Sold in Lots of	Unit reference	Weight kg
Integral LED (to combine with heads for integral LED) Protected LED	≂ 24	White	5	**ZBV B17**	0.004
		Green	5	**ZBV B37**	0.004
		Red	5	**ZBV B47**	0.004
		Orange	5	**ZBV B57**	0.004
		Blue	5	**ZBV B67**	0.004

Adapter (socket)

For printed circuit board

For use with	Thickness of printed circuit board (mm)	Sold in lots of	Unit reference	Weight kg
Electrical block (contact or light)	1.6 ± 0.2	10	**ZBZ 010**	0.008
	2.2 ± 0.2	10	**ZBZ 011**	0.008
	3.2 ± 0.2	10	**ZBZ 012**	0.008

540159

ZBZ 01●

Body/fixing collar

For use with	Sold in lots of	Unit reference	Weight kg
Electrical block (contact or light)	10	**ZB5 AZ009**	0.006

814588

ZB5 AZ009

Accessories specifically for printed circuit board mounting *(1)*

Must be used in conjunction with adapter (socket) ZBZ 010.

Description	For use with	Sold in lots of	Unit reference	Weight kg
Fixing collar/pillar	Printed circuit board support	10	**ZB5 AZ079**	0.003
Fixing screw for printed circuit board	Fixing collar/pillar ZB5 AZ079	10	**ZBZ 006**	0.011

(1) For details of support drilling and of printed circuit board: see page 149.

General : pages 74 to 81
Characteristics : pages 82 to 85
Dimensions : pages 138 to 149

Control and signalling units Ø 22

Harmony® XB5, plastic

Body/contact assemblies + light blocks with integral LED

To combine with:
heads, see pages 93 to 109
contacts, see page 114

ZB5 AW0●●1

ZB5 AW0●●3

Complete body/contact assemblies and light blocks *(1)*

Screw clamp terminal connections

Light source	Supply voltage	Type of contact N/O	Type of contact N/C	Colour of light source	Reference	Weight
	V					kg
Direct supply						
Integral LED Protected LED	≂ 24	1	–	White	**ZB5 AW0B11**	0.032
				Green	**ZB5 AW0B31**	0.032
				Red	**ZB5 AW0B41**	0.032
				Orange	**ZB5 AW0B51**	0.032
				Blue	**ZB5 AW0B61**	0.032
		–	1	White	**ZB5 AW0B12**	0.032
				Green	**ZB5 AW0B32**	0.032
				Red	**ZB5 AW0B42**	0.032
				Orange	**ZB5 AW0B52**	0.032
				Blue	**ZB5 AW0B62**	0.032
		2	–	White	**ZB5 AW0B13**	0.042
				Green	**ZB5 AW0B33**	0.042
				Red	**ZB5 AW0B43**	0.042
				Orange	**ZB5 AW0B53**	0.042
				Blue	**ZB5 AW0B63**	0.042
		1	1	White	**ZB5 AW0B15**	0.042
				Green	**ZB5 AW0B35**	0.042
				Red	**ZB5 AW0B45**	0.042
				Orange	**ZB5 AW0B55**	0.042
				Blue	**ZB5 AW0B65**	0.042
	~ 48...120	1	–	White	**ZB5 AW0G11**	0.032
				Green	**ZB5 AW0G31**	0.032
				Red	**ZB5 AW0G41**	0.032
				Orange	**ZB5 AW0G51**	0.032
				Blue	**ZB5 AW0G61**	0.032
		–	1	White	**ZB5 AW0G12**	0.032
				Green	**ZB5 AW0G32**	0.032
				Red	**ZB5 AW0G42**	0.032
				Orange	**ZB5 AW0G52**	0.032
				Blue	**ZB5 AW0G62**	0.032
		2	–	White	**ZB5 AW0G13**	0.042
				Green	**ZB5 AW0G33**	0.042
				Red	**ZB5 AW0G43**	0.042
				Orange	**ZB5 AW0G53**	0.042
				Blue	**ZB5 AW0G63**	0.042
		1	1	White	**ZB5 AW0G15**	0.042
				Green	**ZB5 AW0G35**	0.042
				Red	**ZB5 AW0G45**	0.042
				Orange	**ZB5 AW0G55**	0.042
				Blue	**ZB5 AW0G65**	0.042

(1) Can be fitted with additional contact blocks: see page 114.

Other versions Complete bodies with Faston connector terminals (6.35 or 2 x 2.8).
Please consult your Regional Sales Office.

General : pages 74 to 81
Characteristics : pages 82 to 85
Dimensions : pages 138 to 149

Control and signalling units Ø 22

Harmony® XB5, plastic

Body/contact assemblies + light blocks with integral LED

To combine with:
heads, see pages 93 to 109
contacts, see page 114

814537

ZB5 AW0●●1

814536

ZB5 AW0●●3

Complete body/contact assemblies and light blocks *(1) (continued)*

Screw clamp terminal connections

Light source	Supply voltage	Type of contact N/O	Type of contact N/C	Colour of light source	Reference	Weight
	V					kg
Direct supply *(continued)*						
Integral LED Protected LED	∿ 230…240	1	–	White	**ZB5 AW0B11**	0.032
				Green	**ZB5 AW0M31**	0.032
				Red	**ZB5 AW0M41**	0.032
				Orange	**ZB5 AW0M51**	0.032
				Blue	**ZB5 AW0M61**	0.032
		–	1	White	**ZB5 AW0M12**	0.032
				Green	**ZB5 AW0M32**	0.032
				Red	**ZB5 AW0M42**	0.032
				Orange	**ZB5 AW0M52**	0.032
				Blue	**ZB5 AW0M62**	0.032
		2	–	White	**ZB5 AW0M13**	0.042
				Green	**ZB5 AW0M33**	0.042
				Red	**ZB5 AW0M43**	0.042
				Orange	**ZB5 AW0M53**	0.042
				Blue	**ZB5 AW0M63**	0.042
		1	1	White	**ZB5 AW0M15**	0.042
				Green	**ZB5 AW0M35**	0.042
				Red	**ZB5 AW0M45**	0.042
				Orange	**ZB5 AW0M55**	0.042
				Blue	**ZB5 AW0M65**	0.042
Supply via integral transformer						
Integral LED Protected LED	∿ 400 V 50 Hz	1	1	White	**ZB5 AW05B15**	0.136
				Green	**ZB5 AW05B35**	0.136
				Red	**ZB5 AW05B45**	0.136
				Orange	**ZB5 AW05B55**	0.136
				Blue	**ZB5 AW05B65**	0.136
	∿ 400…460 V 60 Hz	1	1	White	**ZB5 AW08B15**	0.136
				Green	**ZB5 AW08B35**	0.136
				Red	**ZB5 AW08B45**	0.136
				Orange	**ZB5 AW08B55**	0.136
				Blue	**ZB5 AW08B65**	0.136
	∿ 550…600 V 60 Hz	1	1	White	**ZB5 AW09B15**	0.136
				Green	**ZB5 AW09B35**	0.136
				Red	**ZB5 AW09B45**	0.136
				Orange	**ZB5 AW09B55**	0.136
				Blue	**ZB5 AW09B65**	0.136

(1) Can be fitted with additional contact blocks: see page 114.

Other versions Complete bodies with Faston connector terminals (6.35 or 2 x 2.8).
Please consult your Regional Sales Office.

General : pages 74 to 81
Characteristics : pages 82 to 85
Dimensions : pages 138 to 149

Control and signalling units Ø 22

Harmony® XB5, plastic

Body/contact assemblies + light blocks with BA 9s base fitting

To combine with:
heads, see pages 92 to 107
contacts, see page 114

814549

ZB5 AW065

563158

ZB5 AW035

Complete body/contact assemblies and light blocks *(1)*

For bulb with BA 9s base fitting (incandescent, neon or LED)
Screw clamp terminal connections

Light source	Supply voltage V	Type of contact N/O	Type of contact N/C	Colour of light source	Reference	Weight kg
Direct supply						
BA 9s base fitting bulb, 2.4 W max., not included *(2)*	⩽ 250	1	–	–	**ZB5 AW061**	0.031
		–	1	–	**ZB5 AW062**	0.031
		2	–	–	**ZB5 AW063**	0.041
		1	1	–	**ZB5 AW065**	0.041
Supply via integral transformer (1.2 VA, 6 V secondary)						
Incandescent BA 9s base fitting bulb, included	∿ 110…120 50/60 Hz	1	–	–	**ZB5 AW031**	0.110
		1	1	–	**ZB5 AW035**	0.119
	∿ 230 50 Hz ∿ 220…240 60 Hz	1	–	–	**ZB5 AW041**	0.110
		1	1	–	**ZB5 AW045**	0.119
	∿ 400 50 Hz	1	–	–	**ZB5 AW051**	0.110
		1	1	–	**ZB5 AW055**	0.119
BA9s base fitting LED, included	∿ 110…120 50/60 Hz	1	1	White	**ZB5 AW03D15**	0.119
				Green	**ZB5 AW03D35**	0.119
				Red	**ZB5 AW03D45**	0.119
				Orange	**ZB5 AW03D55**	0.119
				Blue	**ZB5 AW03D65**	0.119
	∿ 230 50 Hz ∿ 220…240 60 Hz	1	1	White	**ZB5 AW04D15**	0.119
				Green	**ZB5 AW04D35**	0.119
				Red	**ZB5 AW04D45**	0.119
				Orange	**ZB5 AW04D55**	0.119
				Blue	**ZB5 AW04D65**	0.119
	∿ 400 50/60 Hz	1	1	White	**ZB5 AW05D15**	0.120
				Green	**ZB5 AW05D35**	0.120
				Red	**ZB5 AW05D45**	0.120
				Orange	**ZB5 AW05D55**	0.120
				Blue	**ZB5 AW05D65**	0.120

(1) Can be fitted with additional contact blocks: see page 114.
(2) Bulb to be ordered separately: see page 136.

Other versions Complete bodies with integral transformer incorporating Faston connector terminals (6.35 or 2 x 2.8). Please consult your Regional Sales Office.

General : pages 74 to 81
Characteristics : pages 82 to 85
Dimensions : pages 138 to 149

Control and signalling units Ø 22
Harmony® XB5, plastic
Light blocks - "Test light" - Protection

To combine with:
heads, see page 94

814273

ZBV B●

522067

ZBZ G156

522068

ZBZ M156

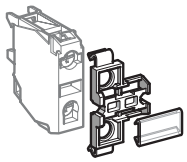
814274

ZBZ V●

814588

ZB5 AZ009

814269



ZBZ 001

563527

XBY 2U

Light blocks
Screw clamp terminal connections

Description	Supply voltage V	Colour of light source	Sold in lots of	Unit reference	Weight kg
Integral LED (to combine with head for integral LED) Protected LED	⎓ 12	White	5	**ZBV J1**	0.017
		Green	5	**ZBV J3**	0.017
		Red	5	**ZBV J4**	0.017
		Orange	5	**ZBV J5**	0.017
		Blue	5	**ZBV J6**	0.017
	⎓ 24	White	5	**ZBV B1**	0.017
		Green	5	**ZBV B3**	0.017
		Red	5	**ZBV B4**	0.017
		Orange	5	**ZBV B5**	0.017
		Blue	5	**ZBV B6**	0.017
	⎓ 24…120	White	5	**ZBV BG1**	0.017
		Green	5	**ZBV BG3**	0.017
		Red	5	**ZBV BG4**	0.017
		Orange	5	**ZBV BG5**	0.017
		Blue	5	**ZBV BG6**	0.017
	∿ 110...120	White	5	**ZBV G1**	0.017
		Green	5	**ZBV G3**	0.017
		Red	5	**ZBV G4**	0.017
		Orange	5	**ZBV G5**	0.017
		Blue	5	**ZBV G6**	0.017
	∿ 230...1240	White	5	**ZBV M1**	0.017
		Green	5	**ZBV M3**	0.017
		Red	5	**ZBV M4**	0.017
		Orange	5	**ZBV M5**	0.017
		Blue	5	**ZBV M6**	0.017
Direct supply for bulb with BA 9s base fitting, 2.4 W max, **not included** *(1)*	⩽ 250	–	5	**ZBV 6**	0.016

Blocks for “test light” function

For use with	Supply voltage V	Description	Reference	Weight kg
Light blocks	⎓ 12 and 24 ⎓ 24…120	Single module, 1 connecting wire	**ZBZ G156(2)**	0.010
Light blocks with integral LED	∿ 48…230	Double module, with connecting wires	**ZBZ M156*(3)***	0.010

LED suppressors

For use with	Supply voltage V	Level of protection	Reference	Weight kg
Light blocks with integral LED fitted with screw clamp terminal connections	∿ 120	25…120 VA	**ZBZ VG**	0.010
	∿ 230	30…230 VA	**ZBZ VM**	0.010

Body/fixing collar

For use with	Sold in lots of	Unit reference	Weight kg
Electrical block (contact or light)	10	**ZB5 AZ009**	0.006

Clip-on legend holders for electrical blocks with screw clamp terminal connections

Identification of an XB5 A control or signalling unit	10	**ZBZ 001**	0.001

Sheet of 50 blank legends

Legend holder ZBZ 001	10	**ZBY 001**	0.023

“SIS Label” labelling software (for legends **ZBY 001**)

Application	Reference	Weight kg
Legend design for English, French, German, Italian, Spanish	**XBY 2U**	0.100

(1) Bulb to be ordered separately: see page 136.
*(2) Block for use with ⎓ light blocks with integral LED types **ZBV J●, ZBV B●, ZBV BG●** or with direct supply light block for BA 9s bulb, **ZBV 6**.*
*(3) Block for use with ∿ light blocks with integral LED types **ZBV G●, ZBV M●**, see connection on page 146.*

Other versions Light blocks with Faston connector terminals (6.35 or 2 x 2.8).
Please consult your Regional Sales Office.

General : pages 74 to 81
Characteristics : pages 82 to 85
Dimensions : pages 138 to 149

Control and signalling units Ø 22

Harmony® XB5, plastic

Body/light assemblies for pilot lights with integral LED

To combine with:
heads, see page 110
contacts, see page 114

563090

ZB5 AV●●

Complete light bodies (fixing collar + light block with integral LED)

Screw clamp terminal connections

Light source	Supply voltage V	Colour of light source	Reference	Weight kg
Integral LED Protected LED	⎓ 12	White	**ZB5 AVJ1**	0.022
		Green	**ZB5 AVJ3**	0.022
		Red	**ZB5 AVJ4**	0.022
		Orange	**ZB5 AVJ5**	0.022
		Blue	**ZB5 AVJ6**	0.022
	⎓ 24 *(1)*	White	**ZB5 AVB1**	0.022
		Green	**ZB5 AVB3**	0.022
		Red	**ZB5 AVB4**	0.022
		Orange	**ZB5 AVB5**	0.022
		Blue	**ZB5 AVB6**	0.022
	⎓24…120	White	**ZB5 AVBG1**	0.022
		Green	**ZB5 AVBG3**	0.022
		Red	**ZB5 AVBG4**	0.022
		Orange	**ZB5 AVBG5**	0.022
		Blue	**ZB5 AVBG6**	0.022
	∿ 48...120 *(1)*	White	**ZB5 AVG1**	0.022
		Green	**ZB5 AVG3**	0.022
		Red	**ZB5 AVG4**	0.022
		Orange	**ZB5 AVG5**	0.022
		Blue	**ZB5 AVG6**	0.022
	∿ 230…240 *(1)*	White	**ZB5 AVM1**	0.022
		Green	**ZB5 AVM3**	0.022
		Red	**ZB5 AVM4**	0.022
		Orange	**ZB5 AVM5**	0.022
		Blue	**ZB5 AVM6**	0.022

522071

ZB5 AVB● 156

Complete light bodies with 3-terminal "test" function

(fixing collar + light block with integral LED + block for "test light" function)

Screw clamp terminal connections

Light source	Supply voltage V	Colour of light source	Reference	Weight kg
Integral LED Protected LED	⎓ 24 *(2)*	White	**ZB5 AVB1156**	0.022
		Green	**ZB5 AVB3156**	0.022
		Red	**ZB5 AVB4156**	0.022
		Orange	**ZB5 AVB5156**	0.022
		Blue	**ZB5 AVB6156**	0.022

Complete bodies with flashing pilot light (fixing collar + light block with integral LED)

Screw clamp terminal connections

Light source	Supply voltage V	Colour of light source	Reference	Weight kg
Integral LED Protected LED	⎓ 24	White	**ZB5 AV18B1**	0.022
		Green	**ZB5 AV18B3**	0.022
		Red	**ZB5 AV18B4**	0.022
		Orange	**ZB5 AV18B5**	0.022
		Blue	**ZB5 AV18B6**	0.022
	∿ 48…120	White	**ZB5 AV18G1**	0.022
		Green	**ZB5 AV18G3**	0.022
		Red	**ZB5 AV18G4**	0.022
		Orange	**ZB5 AV18G5**	0.022
		Blue	**ZB5 AV18G6**	0.022
	∿ 230…240	White	**ZB5 AV18M1**	0.022
		Green	**ZB5 AV18M3**	0.022
		Red	**ZB5 AV18M4**	0.022
		Orange	**ZB5 AV18M5**	0.022
		Blue	**ZB5 AV18M6**	0.022

(1) Complete bodies with Faston connector terminals (6.35 or 2 x 2.8), see page 115.
*(2) For a ∿ 120 or 230 V supply, use complete body **ZB5 BVG●** or **ZB5 BVM●** with block for "test light" function type **ZBZ M156**, see page 121.*

General : pages 74 to 81
Characteristics : pages 82 to 85
Dimensions : pages 138 to 149

Control and signalling units Ø 22

Harmony® XB5, plastic

Light bodies for pilot lights with BA 9s base fitting

To combine with:
heads, see page 111
contacts, see page 114

814524

ZB5 AV6

814523

ZB5 AV3

Complete light bodies (fixing collar + light block)

For bulb with BA 9s base fitting (incandescent, neon or LED)
Screw clamp terminal connections

Light source	Supply voltage V	Colour of light source	Reference	Weight kg
Direct supply				
BA 9s base fitting bulb, 2.4 W max, not included *(1)*	⩽ 250	–	**ZB5 AV6**	0.022
Supply via integral transformer (1.2 VA, 6 V secondary)				
BA 9s base fitting incandescent bulb, included	∿ 110…120 -50/60 Hz	–	**ZB5 AV3**	0.099
	∿ 230 - 50 Hz ∿ 220…240 - 60 Hz	–	**ZB5 AV4**	0.099
	∿ 400 - 50 Hz	–	**ZB5 AV5**	0.099
	∿ 440…480 - 60 Hz	–	**ZB5 AV8**	0.099
	∿ 550…600 - 60 Hz	–	**ZB5 AV9**	0.099
BA 9s base fitting LED, included	∿ 110…120 -50/60 Hz	White	**ZB5 AV3D1**	0.102
		Green	**ZB5 AV3D3**	0.102
		Red	**ZB5 AV3D4**	0.102
		Orange	**ZB5 AV3D5**	0.102
		Blue	**ZB5 AV3D6**	0.102
	∿ 230 - 50 Hz ∿ 220…240 - 60 Hz	White	**ZB5 AV4D1**	0.102
		Green	**ZB5 AV4D3**	0.102
		Red	**ZB5 AV4D4**	0.102
		Orange	**ZB5 AV4D5**	0.102
		Blue	**ZB5 AV4D6**	0.102
	∿ 400 - 50/60 Hz	White	**ZB5 AV5D1**	0.102
		Green	**ZB5 AV5D3**	0.102
		Red	**ZB5 AV5D4**	0.102
		Orange	**ZB5 AV5D5**	0.102
		Blue	**ZB5 AV5D6**	0.102

522068

ZB5 AV156

Complete light bodies with 3-terminal "test" function (fixing collar + light block)

For bulb with BA 9s base fitting (incandescent, neon or LED)
Screw clamp terminal connections

Direct supply				
BA 9s base fitting bulb, 2.4 W max, not included *(1)*	⩽ 250	–	**ZB5 AV156**	0.021

(1) Bulb to be ordered separately, see page 136.

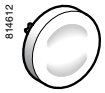
Other versions Complete bodies with Faston connector terminals (6.35 or 2 x 2.8), *see page* 115.

Control and signalling units Ø 22

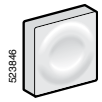
Harmony® XB5, plastic

Accessories for heads: unmarked pushbutton caps

ZBA ●



ZBL ●



ZBC 1

Pushbutton caps - unmarked

For use with	Type of push	Colour	Sold in lots of	Unit reference	Weight kg
ZB5 AA0 circular pushbutton heads supplied without cap	Flush	White	10	**ZBA 1**	0.001
		Black	10	**ZBA 2**	0.001
		Green	10	**ZBA 3**	0.001
		Red	10	**ZBA 4**	0.001
		Yellow	10	**ZBA 5**	0.001
		Blue	10	**ZBA 6**	0.001
		6 colours *(1)*	1	**ZBA 9**	0.006
	Projecting	White	10	**ZBL 1**	0.001
		Black	10	**ZBL 2**	0.001
		Green	10	**ZBL 3**	0.001
		Red	10	**ZBL 4**	0.001
		Yellow	10	**ZBL 5**	0.001
		Blue	10	**ZBL 6**	0.001
		6 colours *(1)*	1	**ZBL 9**	0.006
ZB5 CA0 circular pushbutton heads supplied without cap	Flush	White	10	**ZBC 1**	0.001
		Black	10	**ZBC 2**	0.001
		Green	10	**ZBC 3**	0.001
		Red	10	**ZBC 4**	0.001
		Yellow	10	**ZBC 5**	0.001
		Blue	10	**ZBC 6**	0.001

(1) Set of 6 different coloured caps: white, black, green, red, yellow, blue.

General : pages 74 to 81
Characteristics : pages 82 to 85
Dimensions : pages 138 to 149

Control and signalling units Ø 22

Harmony® XB5, plastic

Accessories for heads: marked pushbutton caps

814613

ZBA ●33

Pushbutton caps - marked

For use with	Type of push	Marking		Colour of cap	Unit reference	Weight kg
		Text	Colour			
ZB5 AA0 circular pushbutton heads supplied without cap (sold in lots of 10)	Flush	I *(1)*	White	Green	**ZBA 331**	0.001
			Black	White	**ZBA 131**	0.001
		II	White	Green	**ZBA 336**	0.001
			Black	White	**ZBA 136**	0.001
		III	White	Green	**ZBA 337**	0.001
			Black	White	**ZBA 137**	0.001
		IV	White	Green	**ZBA 338**	0.001
			Black	White	**ZBL 138**	0.001
		START *(1)*	White	Green	**ZBA 333**	0.001
			Black	White	**ZBA 133**	0.001
		ON	White	Green	**ZBA 341**	0.001
			Black	White	**ZBA 141**	0.001
		MARCHE	White	Green	**ZBA 342**	0.001
			Black	White	**ZBA 142**	0.001
		UP *(1)*	Black	White	**ZBA 343**	0.001
		DOWN *(1)*	White	Black	**ZBA 344**	0.001
		⏉ *(1)*	White	Black	**ZBA 245**	0.001
			Black	White	**ZBA 145**	0.001
		⬆ *(2)*	White	Black	**ZBA 335**	0.001
			Black	White	**ZBA 334**	0.001
		O *(1)*	White	Red	**ZBA 432**	0.001
				Black	**ZBA 232**	0.001
		ARRET	White	Red	**ZBA 433**	0.001
				Black	**ZBA 233**	0.001
		STOP *(1)*	White	Red	**ZBA 434**	0.001
				Black	**ZBA 234**	0.001
		OFF	White	Red	**ZBA 435**	0.001
				Black	**ZBA 235**	0.001
		⏀	White	Green	**ZBA 346**	0.001
		R *(1)*	White	Blue	**ZBA 639**	0.001
		+	White	Black	**ZBA 2934**	0.001
		–	White	Black	**ZBA 2935**	0.001

(1) Double injection moulded marking.
(2) Can be clipped-in at 90° steps, through 360°.

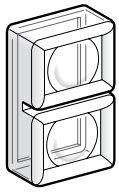
General : pages 74 to 81
Characteristics : pages 82 to 85
Dimensions : pages 138 to 149

Control and signalling units Ø 22
Harmony® XB5, plastic
Accessories for heads: boots

814334

ZBP 0

814655



ZBW 008

Transparent boots for pushbuttons

Description	For use with pushbutton types	Sold in lots of	Unit reference	Weight kg
Single boots	Flush with circular head	10	**ZBP A**	0.002
	Projecting with circular head	10	**ZBP 0**	0.002
	Flush or projecting with circular head for food industry applications	10	**ZBP 0A**	0.002
Double boots	Flush or projecting double-headed	10	**ZBW 008**	0.005
	Flush double-headed	10	**ZBW 008F**	0.005
	Double-headed, for food industry applications	10	**ZBW 008A**	0.005

Coloured boots

Description	Colour	Sold in lots of	Unit reference	Weight kg
Coloured boots (can be replaced without dismantling the head)	Black	10	**ZB2 BP012**	0.003
	Green	10	**ZB2 BP013**	0.003
	Red	10	**ZB2 BP014**	0.003
	Orange	10	**ZB2 BP015**	0.003
	Blue	10	**ZB2 BP016**	0.003

General : pages 74 to 81
Characteristics : pages 82 to 85
Dimensions : pages 138 to 149

Control and signalling units Ø 22

Harmony® XB5, plastic

Accessories for heads: lens caps

ZBV 01●3

ZBV 01●

Lens caps

For use with	Colour	Sold in lots of	Unit reference	Weight kg
Circular lens caps for light sources with integral LED				
Pilot lights	White	10	**ZBV 0113**	0.002
	Green	10	**ZBV 0133**	0.002
	Red	10	**ZBV 0143**	0.002
	Orange	10	**ZBV 0153**	0.002
	Blue	10	**ZBV 0163**	0.002
	5 different coloured grooved lenses *(1)*	1	**ZBV 0103S**	0.010
Illuminated pushbuttons, with flush push	White	10	**ZBW 9113**	0.002
	Green	10	**ZBW 9133**	0.002
	Red	10	**ZBW 9143**	0.002
	Orange	10	**ZBW 9153**	0.002
	Blue	10	**ZBW 9163**	0.002
Illuminated pushbuttons, with projecting push	White	10	**ZBW 9313**	0.002
	Green	10	**ZBW 9333**	0.002
	Red	10	**ZBW 9343**	0.002
	Orange	10	**ZBW 9353**	0.002
	Blue	10	**ZBW 9363**	0.002
Square lens caps for light sources with integral LED				
Pilot lights	White	10	**ZBC V0113**	0.002
	Green	10	**ZBC V0133**	0.002
	Red	10	**ZBC V0143**	0.002
	Orange	10	**ZBC V0153**	0.002
	Blue	10	**ZBC V0163**	0.002
Illuminated pushbuttons, with flush push	White	10	**ZBC W9113**	0.002
	Green	10	**ZBC W9133**	0.002
	Red	10	**ZBC W9143**	0.002
	Orange	10	**ZBC W9153**	0.002
	Blue	10	**ZBC W9163**	0.002
Illuminated pushbuttons, with projecting push	White	10	**ZBC W9313**	0.002
	Green	10	**ZBC W9333**	0.002
	Red	10	**ZBC W9343**	0.002
	Orange	10	**ZBC W9353**	0.002
	Blue	10	**ZBC W9363**	0.002
Circular lens caps for light sources with BA 9s base fitting				
Pilot lights	White	10	**ZBV 011**	0.002
	Green	10	**ZBV 013**	0.002
	Red	10	**ZBV 014**	0.002
	Orange	10	**ZBV 015**	0.002
	Blue	10	**ZBV 016**	0.002
	Clear	10	**ZBV 017**	0.002
Illuminated pushbuttons, with flush push	White	10	**ZBW 911**	0.002
	Green	10	**ZBW 913**	0.002
	Red	10	**ZBW 914**	0.002
	Orange	10	**ZBW 915**	0.002
	Blue	10	**ZBW 916**	0.002
	Clear	10	**ZBW 917**	0.002
Illuminated pushbuttons, with projecting push	White	10	**ZBW 931**	0.002
	Green	10	**ZBW 933**	0.002
	Red	10	**ZBW 934**	0.002
	Orange	10	**ZBW 935**	0.002
	Blue	10	**ZBW 936**	0.002
	Clear	10	**ZBW 937**	0.002

(1) Clear, green, red, orange, blue.

General : pages 74 to 81
Characteristics : pages 82 to 85
Dimensions : pages 138 to 149

Control and signalling units Ø 22

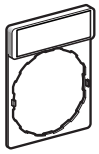
Harmony® style 5, plastic

8 x 27 mm legends with 30 x 40 mm legend holders

814295

ZBZ 32

814296



ZBY ●101

814297

ZBY 2107

Standard (30 x 40 mm) legend holders for 8 x 27 mm legends *(1)*

Description	Legend		Sold in lots of	Unit reference	Weight
	Colour	Marking			kg
Without legend	–	–	10	**ZBZ 32**	0.001
With blank legend (for engraving)	Black or red background	–	10	**ZBY 2101**	0.002
	White or yellow background	–	10	**ZBY 4101**	0.002
With 8 x 27 mm legend (with International marking)	Black or red background	O (black background)	1	**ZBY 2146**	0.002
		O (red background)	1	**ZBY 2931**	0.002
		I	1	**ZBY 2147**	0.002
		II	1	**ZBY 2148**	0.002
		O-I	1	**ZBY 2178**	0.002
		I-II	1	**ZBY 2179**	0.002
		I-O-II	1	**ZBY 2186**	0.002
		AUTO	1	**ZBY 2115**	0.002
		STOP	1	**ZBY 2304**	0.002
With 8 x 27 mm legend (with French language marking)	Black or red background *(2)*	ARRET (red background)	1	**ZBY 2104**	0.002
		ARRET (black background)	1	**ZBY 0104**	0.002
		ARRET GENERAL	1	**ZBY 2129**	0.002
		ARRET REARMEMENT	1	**ZBY 2133**	0.002
		ARRET-MARCHE	1	**ZBY 2166**	0.002
		ARRIERE	1	**ZBY 2106**	0.002
		AUTO CYCLE-CYCLE	1	**ZBY 2198**	0.002
		AUTO CYCLE-MAIN	1	**ZBY 2199**	0.002
		AUTO-MAIN	1	**ZBY 2164**	0.002
		AUTO-O-MAIN	1	**ZBY 2185**	0.002
		AVANT	1	**ZBY 2105**	0.002
		AVANT-O-ARRIERE	1	**ZBY 2184**	0.002
		C-P-C-NORMAL	1	**ZBY 2165**	0.002
		CYCLE-MAIN	1	**ZBY 2197**	0.002
		DECLENCHEMENT	1	**ZBY 2132**	0.002
		DEFAUT (black background)	1	**ZBY 2134**	0.002
		DEFAUT (red background)	1	**ZBY 2135**	0.002
		DEPART CYCLE	1	**ZBY 2195**	0.002
		DESCENTE	1	**ZBY 2108**	0.002
		DROITE	1	**ZBY 2109**	0.002
		ENCLENCHEMENT	1	**ZBY 2131**	0.002
		EN SERVICE	1	**ZBY 2111**	0.002
		FERMETURE	1	**ZBY 2114**	0.002
		GAUCHE	1	**ZBY 2110**	0.002
		HORS SERVICE	1	**ZBY 2112**	0.002
		HORS-EN	1	**ZBY 2167**	0.002
		LENT	1	**ZBY 2127**	0.002
		MAIN	1	**ZBY 2116**	0.002
		MARCHE	1	**ZBY 2103**	0.002
		MONTEE	1	**ZBY 2107**	0.002
		OUVERTURE	1	**ZBY 2113**	0.002
		PHASE / PHASE	1	**ZBY 2196**	0.002
		REARMEMENT (red background)	1	**ZBY 2123**	0.002
		REARMEMENT (black background)	1	**ZBY 0123**	0.002
		SOUS TENSION	1	**ZBY 2126**	0.002
		VITE	1	**ZBY 2128**	0.002
	Yellow background	ARRET D'URGENCE	1	**ZBY 2130**	0.002

(1) For legends, see pages 130 to 132.
(2) "Start" functions: white letters on black background. "Stop" functions: white letters on red background (unless otherwise specified above).

General : pages 74 to 81
Characteristics : pages 82 to 85
Dimensions : pages 138 to 149

Control and signalling units Ø 22

Harmony® style 5, plastic

8 x 27 mm legends with 30 x 40 mm legend holders

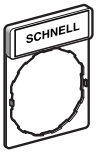
814300

ZBY 2303

Standard (30 x 40 mm) legend holders with 8 x 27 mm legends (continued)

Description	Legend		Reference	Weight kg
	Colour	Marking		
With legend (with English language marking)	Black or red background *(1)*	AUTO-HAND	**ZBY 2364**	0.002
		AUTO-O-HAND	**ZBY 2385**	0.002
		CLOSE	**ZBY 2314**	0.002
		DOWN	**ZBY 2308**	0.002
		FAST	**ZBY 2328**	0.002
		FORWARD	**ZBY 2305**	0.002
		HAND	**ZBY 2316**	0.002
		HAND-OFF-AUTO	**ZBY 2387**	0.002
		INCH	**ZBY 2321**	0.002
		LEFT	**ZBY 2310**	0.002
		OFF	**ZBY 2312**	0.002
		OFF-ON	**ZBY 2367**	0.002
		ON	**ZBY 2311**	0.002
		OPEN	**ZBY 2313**	0.002
		POWER ON	**ZBY 2326**	0.002
		RESET (red background)	**ZBY 2323**	0.002
		RESET (black background)	**ZBY 2322**	0.002
		REVERSE	**ZBY 2306**	0.002
		RIGHT	**ZBY 2309**	0.002
		RUN	**ZBY 2334**	0.002
		SLOW	**ZBY 2327**	0.002
		START	**ZBY 2303**	0.002
		STOP-START	**ZBY 2366**	0.002
		UP	**ZBY 2307**	0.002
	Yellow background	EMERGENCY STOP	**ZBY 2330**	0.002
With legend (with German language marking)	Black or red background *(1)*	AB	**ZBY 2208**	0.002
		AUF	**ZBY 2207**	0.002
		AUS	**ZBY 2204**	0.002
		AUS-EIN	**ZBY 2266**	0.002
		AUS-IN BETRIEB	**ZBY 2267**	0.002
		AUS-RÜCKSTELLUNG	**ZBY 2233**	0.002
		AUSSCHALTEN	**ZBY 2232**	0.002
		AUTO-HAND	**ZBY 2364**	0.002
		AUTO-O-HAND	**ZBY 2385**	0.002
		AUTOZYKL-HAND	**ZBY 2299**	0.002
		AUTOZYKL-1 ZYKL	**ZBY 2298**	0.002
		C-P-C-NORMAL	**ZBY 2265**	0.002
		EIN	**ZBY 2203**	0.002
		EINSCHALTEN	**ZBY 2231**	0.002
		HAND	**ZBY 2316**	0.002
		LANGSAM	**ZBY 2227**	0.002
		LINKS	**ZBY 2210**	0.002
		NOT-AUS (red background)	**ZBY 2230**	0.002
		NOT-HALT	**ZBY 2229**	0.002
		ÖFFNEN	**ZBY 2213**	0.002
		RECHTS	**ZBY 2209**	0.002
		RÜCKSTELLUNG	**ZBY 2223**	0.002
		SCHLIESSEN	**ZBY 2214**	0.002
		SCHNELL	**ZBY 2228**	0.002
		SPANNUNG EIN	**ZBY 2226**	0.002
		STEUERUNG AUS	**ZBY 2212**	0.002
		STEUERUNG EIN	**ZBY 2211**	0.002
		STÖRUNG (black background)	**ZBY 2234**	0.002
		STÖRUNG (red background)	**ZBY 2235**	0.002
		VOR	**ZBY 2205**	0.002
		VOR-O-ZURÜCK	**ZBY 2284**	0.002
		ZURÜCK	**ZBY 2206**	0.002
		ZYKLUS-HAND	**ZBY 2297**	0.002
		ZYKLUSSTART	**ZBY 2295**	0.002
	Yellow background	NOT-AUS	**ZBY 22420001**	0.002

814299



ZBY 2228

(1) "Start" functions: white letters on black background. "Stop" functions: white letters on red background (unless otherwise specified above).

General : pages 74 to 81
Characteristics : pages 82 to 85
Dimensions : pages 138 to 149

Control and signalling units Ø 22

Harmony® style 5, plastic

Legends 8 x 27 mm

814310

ZBY 02178

814311

ZBY 0●104

8 x 27 mm marked legends (for 30 x 40 mm legend holders ZBZ 32 and ZBZ 34)

Colour	Marking		Reference	Weight kg
Black or red background *(1)*	International	O (black background)	**ZBY 02146**	0.001
		O (red background)	**ZBY 02931**	0.001
		I	**ZBY 02147**	0.001
		II	**ZBY 02148**	0.001
		O-I	**ZBY 02178**	0.001
		I-II	**ZBY 02179**	0.001
		I-O-II	**ZBY 02186**	0.001
		AUTO	**ZBY 02115**	0.001
		STOP	**ZBY 02304**	0.001
	French	ARRET (red background)	**ZBY 02104**	0.001
		ARRET (black background)	**ZBY 00104**	0.001
		ARRET GENERAL	**ZBY 02129**	0.001
		ARRET REARMEMENT	**ZBY 02133**	0.001
		ARRET-MARCHE	**ZBY 02166**	0.001
		ARRIERE	**ZBY 02106**	0.001
		AUTO CYCLE-CYCLE	**ZBY 02198**	0.001
		AUTO CYCLE-MAIN	**ZBY 02199**	0.001
		AUTO-MAIN	**ZBY 02164**	0.001
		AUTO-O-MAIN	**ZBY 02185**	0.001
		AVANT	**ZBY 02105**	0.001
		AVANT-O-ARRIERE	**ZBY 02184**	0.001
		C-P-C-NORMAL	**ZBY 02165**	0.001
		CYCLE-MAIN	**ZBY 02197**	0.001
		DECLENCHEMENT	**ZBY 02132**	0.001
		DEFAUT (black background)	**ZBY 02134**	0.001
		DEFAUT (red background)	**ZBY 02135**	0.001
		DEPART CYCLE	**ZBY 02195**	0.001
		DESCENTE	**ZBY 02108**	0.001
		DROITE	**ZBY 02109**	0.001
		ENCLENCHEMENT	**ZBY 02131**	0.001
		EN SERVICE	**ZBY 02111**	0.001
		FERMETURE	**ZBY 02114**	0.001
		GAUCHE	**ZBY 02110**	0.001
		HORS SERVICE	**ZBY 02112**	0.001
		HORS-EN	**ZBY 02167**	0.001
		LENT	**ZBY 02127**	0.001
		MAIN	**ZBY 02116**	0.001
		MARCHE	**ZBY 02103**	0.001
		MONTEE	**ZBY 02107**	0.001
		OUVERTURE	**ZBY 02113**	0.001
		PHASE / PHASE	**ZBY 02196**	0.001
		REARMEMENT (red background)	**ZBY 02123**	0.001
		REARMEMENT (black background)	**ZBY 00123**	0.001
		SOUS TENSION	**ZBY 02126**	0.001
		VITE	**ZBY 02128**	0.001
Yellow background	French	ARRET D'URGENCE	**ZBY 02130**	0.001

(1) "Start" functions: white letters on black background. "Stop" functions: white letters on red background (unless otherwise specified above).

General : pages 74 to 81
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Control and signalling units Ø 22

Harmony® style 5, plastic

Legends 8 x 27 mm

814313

ZBY 02303

814314

ZBY 02228

8 x 27 mm marked legends (for 30 x 40 mm legend holders ZBZ 32 and ZBZ 34) (continued)

Colour	Marking		Reference	Weight kg
Black or red background *(1)*	English	AUTO-HAND	**ZBY 02364**	0.001
		AUTO-O-HAND	**ZBY 02385**	0.001
		CLOSE	**ZBY 02314**	0.001
		DOWN	**ZBY 02308**	0.001
		EMERGENCY STOP	**ZBY 02330**	0.001
		FAST	**ZBY 02328**	0.001
		FORWARD	**ZBY 02305**	0.001
		HAND	**ZBY 02316**	0.001
		HAND-OFF-AUTO	**ZBY 02387**	0.001
		INCH	**ZBY 02321**	0.001
		LEFT	**ZBY 02310**	0.001
		OFF	**ZBY 02312**	0.001
		OFF-ON	**ZBY 02367**	0.001
		ON	**ZBY 02311**	0.001
		OPEN	**ZBY 02313**	0.001
		POWER ON	**ZBY 02326**	0.001
		RESET (red background)	**ZBY 02323**	0.001
		RESET (black background)	**ZBY 02322**	0.001
		REVERSE	**ZBY 02306**	0.001
		RIGHT	**ZBY 02309**	0.001
		RUN	**ZBY 02334**	0.001
		SLOW	**ZBY 02327**	0.001
		START	**ZBY 02303**	0.001
		STOP-START	**ZBY 02366**	0.001
		UP	**ZBY 02307**	0.001
	German	AB	**ZBY 02208**	0.001
		AUF	**ZBY 02207**	0.001
		AUS	**ZBY 02204**	0.001
		AUS-EIN	**ZBY 02266**	0.001
		AUS-IN BETRIEB	**ZBY 02267**	0.001
		AUS-RÜCKSTELLUNG	**ZBY 02233**	0.001
		AUSSCHALTEN	**ZBY 02232**	0.001
		AUTO-HAND	**ZBY 02364**	0.001
		AUTO-O-HAND	**ZBY 02385**	0.001
		AUTOZYKL-HAND	**ZBY 02299**	0.001
		AUTOZYKL-1 ZYKL	**ZBY 02298**	0.001
		C-P-C-NORMAL	**ZBY 02265**	0.001
		EIN	**ZBY 02203**	0.001
		EINSCHALTEN	**ZBY 02231**	0.001
		HAND	**ZBY 02316**	0.001
		LANGSAM	**ZBY 02227**	0.001
		LINKS	**ZBY 02210**	0.001
		NOT-AUS (red background)	**ZBY 02230**	0.001
		NOT-HALT	**ZBY 02229**	0.001
		ÖFFNEN	**ZBY 02213**	0.001
		RECHTS	**ZBY 02209**	0.001
		RÜCKSTELLUNG	**ZBY 02223**	0.001
		SCHLIESSEN	**ZBY 02214**	0.001
		SCHNELL	**ZBY 02228**	0.001
		SPANNUNG EIN	**ZBY 02226**	0.001
		STEUERUNG AUS	**ZBY 02212**	0.001
		STEUERUNG EIN	**ZBY 02211**	0.001
		STÖRUNG (black background)	**ZBY 02234**	0.001
		STÖRUNG (red background)	**ZBY 02235**	0.001
		VOR	**ZBY 02205**	0.001
		VOR-O-ZURÜCK	**ZBY 02284**	0.001
		ZURÜCK	**ZBY 02206**	0.001
		ZYKLUS-HAND	**ZBY 02297**	0.001
		ZYKLUSSTART	**ZBY 02295**	0.001
Yellow background	English	EMERGENCY STOP	**ZBY 02330**	0.001
	German	NOT-AUS	**ZBY 022420001**	0.001

(1) "Start" functions: white letters on black background. "Stop" functions: white letters on red background (unless otherwise specified above).

General : pages 74 to 81
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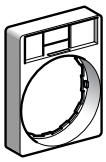
Control and signalling units Ø 22

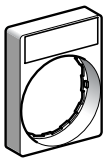
Harmony® style 5, plastic

Legend holders for 8 x 27 or 18 x 27 mm legends for engraving or printing

814620 814621



ZBZ 34

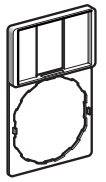


ZBY ●H101

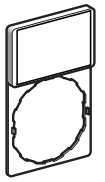
30 x 40 mm legend holder (flush mounting with bezel) for 8 x 27 mm legends

Description	For use with	Colour	Sold in lots of	Unit reference	Weight kg
Without legend	Circular heads	–	10	**ZBZ 34**	0.003
	Square heads	–	10	**ZBC Z34**	0.002
With blank legend	Circular heads	Black or red background	10	**ZBY 2H101**	0.004
		White or yellow background	10	**ZBY 4H101**	0.004
	Square heads	Black or red background	10	**ZBC Y2H101**	0.002
		White or yellow background	10	**ZBC Y4H101**	0.002

814622 814623



ZBZ 33



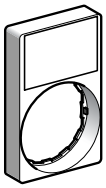
ZBY 610●

Standard (30 x 50 mm) legend holders for 18 x 27 mm legends

Description	For use with	Colour	Sold in lots of	Unit reference	Weight kg
Without legend	Circular and square heads	–	10	**ZBZ 33**	0.001
With blank legend	**Circular and square heads**	Black or red background	10	**ZBY 6101**	0.002
		White or yellow background	10	**ZBY 6102**	0.002

814624 814625

ZBZ 35

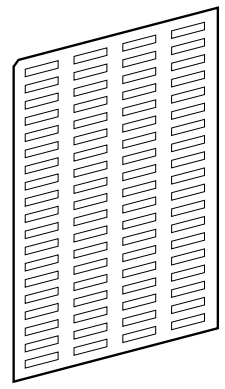


ZBY 6H10●

30 x 50 mm legend holder (flush mounting with bezel) for 18 x 27 mm legends

Description	For use with	Colour	Sold in lots of	Unit reference	Weight kg
Without legend	Circular heads	–	10	**ZBZ 35**	0.003
	Square heads	–	10	**ZBC Z35**	0.002
With blank legend	Circular heads	Black or red background	10	**ZBY 6H101**	0.004
		White or yellow background	10	**ZBY 6H102**	0.004
	Square heads	Black or red background	10	**ZBC Y6H101**	0.003
		White or yellow background	10	**ZBC Y6H102**	0.003

814627



ZBY 4100

Legends for engraving

Description mm	For use with	Colour	Sold in lots of	Unit reference	Weight kg
8 x 27	30 x 40 mm legend holder	Black or red background	10	**ZBY 0101**	0.001
		White or yellow background	10	**ZBY 0102**	0.001
18 x 27	30 x 50 mm legend holder	Black or red background	10	**ZBY 5101**	0.001
		White or yellow background	10	**ZBY 5102**	0.001

Sheets of peel-off legends (with backing board and protective cover)

Description	For use with	Sold in lots of	Unit reference	Weight kg
Sheet of 76 8 x 27 mm legends	30 x 40 mm legend holder ZBZ 32 and ZBZ 34	10	**ZBY 4100**	0.043
Sheet of 40 18 x 27 mm legends	30 x 50 mm legend holder ZBZ 33 and ZBZ 35	10	**ZBY 5100**	0.044

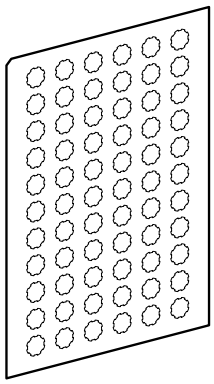
General : pages 74 to 81
Characteristics : pages 82 to 85
Dimensions : pages 138 to 149

Control and signalling units Ø 22

Harmony® style 5, plastic

Legends, for printing, pre-printed, labelling software

814634



ZBY 1101

Legends for pushbuttons, switches and pilot lights XB5 A

Description	Marking		Sold in lots of	Unit reference	Weight kg
Sheets of 66 circular peel-off, transparent, self-adhesive legends	Without		10	**ZBY 1101**	0.017
Strips of 66 circular peel-off, transparent, self-adhesive legends	International	O	10	**ZBY 1146**	0.017
		I	10	**ZBY 1147**	0.017
		II	10	**ZBY 1148**	0.017
		III	10	**ZBY 1149**	0.017
		STOP	10	**ZBY 1304**	0.017
		⬆	10	**ZBY 1912**	0.017
	French	ARRET	10	**ZBY 1104**	0.017
		ARRIERE	10	**ZBY 1106**	0.017
		AUTO	10	**ZBY 1115**	0.017
		AVANT	10	**ZBY 1105**	0.017
		DESCENTE	10	**ZBY 1108**	0.017
		MAIN	10	**ZBY 1116**	0.017
		MARCHE	10	**ZBY 1103**	0.017
		MONTEE	10	**ZBY 1107**	0.017
	English	HAND	10	**ZBY 1316**	0.017
		OFF	10	**ZBY 1312**	0.017
		ON	10	**ZBY 1311**	0.017
		START	10	**ZBY 1303**	0.017
	German	AB	10	**ZBY 1208**	0.017
		AUF	10	**ZBY 1207**	0.017
		AUS	10	**ZBY 1204**	0.017
		EIN	10	**ZBY 1203**	0.017
		ZU	10	**ZBY 1214**	0.017
Strip of 66 square peel-off, transparent, self-adhesive legends	Without		10	**ZBC Y1101**	0.017

563527

XBY 2U

"SIS Label" labelling software

Application	Reference	Weight kg
Legend design for English, French, German, Italian, Spanish	**XBY 2U**	0.100

563089

ZBY 9330

Circular legends for Emergency stop mushroom head pushbuttons

Diameter mm	Colour	Marking on yellow background	Reference	Weight kg
60	Yellow	Without	**ZBY 9101**	0.004
		ARRET D'URGENCE	**ZBY 9130**	0.004
		EMERGENCY STOP	**ZBY 9330**	0.004
		NOT-AUS	**ZBY 9230**	0.004
90	Yellow	Without	**ZBY 8101**	0.008
		ARRET D'URGENCE	**ZBY 8130**	0.008
		EMERGENCY STOP	**ZBY 8330**	0.008
		NOT-AUS	**ZBY 8230**	0.008

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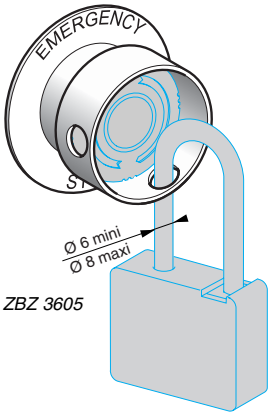
Dimensions : pages 138 to 149

Control and signalling units Ø 22

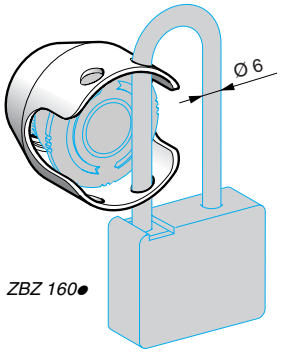
Harmony® XB5, plastic

Accessories for pushbuttons: padlocking kit, protective guard, bellows seals, padlockable flaps

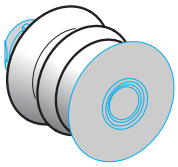


ZBZ 3605

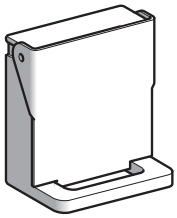
ZBY 9130T



ZBZ 160●



ZBZ ●8



ZB4 BZ64

Padlocking kit for Emergency Stop

Description	Application	Colour	Reference	Weight kg
Padlocking kit Conforming to EN 418/ISO 13850 *(1) (2)* (padlockable)	For Emergency Stop function only, with the following Ø 40 trigger-action pushbuttons: XB5 AT8● XB5 AS8● XB5 AS9● ZB5 AT8● ZB5 AS8● ZB5 AS9●	Yellow	**ZBZ 3605**	0.045

Description	Marking	Colour	Reference	Weight kg
Ø 60 mm legend for padlocking device ZBZ 3605	Without	Yellow	**ZBY 9101T**	0.004
	ARRET D'URGENCE	Yellow	**ZBY 9130T**	0.004
	EMERGENCY STOP	Yellow	**ZBY 9330T**	0.004
	NOT-AUS	Yellow	**ZBY 9230T**	0.004

Guards

Description	Application	Colour	Reference	Weight kg
Metal guards Padlockable *(2)*	For Emergency Stop function only, with the following Ø 40 trigger-action pushbuttons: XB5 AT8● XB5 AS8● XB5 AS9● ZB5 AT8● ZB5 AS8● ZB5 AS9●	Chromium plated	**ZBZ 1600**	0.046
		Black	**ZBZ 1602**	0.046
		Red	**ZBZ 1604**	0.046
		Yellow	**ZBZ 1605**	0.046
		Blue	**ZBZ 1606**	0.046
Plastic guard	Selector switches and key switches	Black	**ZBZ 2102**	0.005

Bellows seals for harsh environments (IP 69K)

Description	For use with	Colour Material	Sold in lots of	Unit reference	Weight kg
Bellows seals for harsh environments (humidity, dust, high-pressure cleaning)	Any Harmony XB5 plastic, mushroom head pushbutton *(3)*, Ø 40 mm or Ø 60 mm (except ZB5 AR●16)	Red Silicone	2	**ZBZ 48** ▲	0.009
		Black EPDM	2	**ZBZ 28** ▲	0.009

Padlockable flaps

Description	For use with	Colour	Reference	Weight kg
Padlockable flaps	Pushbuttons	Black	**ZB4 BZ62**	0.076
		Red	**ZB4 BZ64**	0.076
		Yellow	**ZB4 BZ65**	0.076
		Blue	**ZB4 BZ66**	0.076

*(1) Standard circular legends are not compatible with this product. Use special legends **ZBY ●●T**.*
(2) No isolation function is possible when this guard is fitted.
*(3) Only when mounted on control stations. Use legends **ZBY 9●●●T**.*

▲ Available: 4th quarter 2006.

General : pages 74 to 81
Characteristics : pages 82 to 85
Dimensions : pages 138 to 149

Control and signalling units Ø 22

Harmony® XB5, plastic

Accessories for pushbuttons: blanking plugs flush mounting kit , cable ducting support

ZB5 SZ3

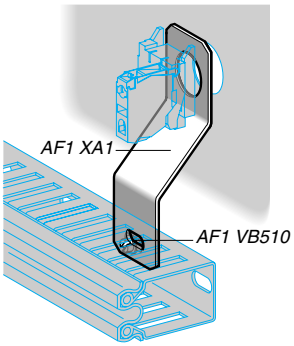
Accessories

Blanking plug

Description	For use with	Sold in lots of	Unit reference	Weight kg
Plastic blanking plug, square, black (with fixing nut) *(1)*	Ø 22 control and signalling units	10	**ZB5 SZ5**	0.009
Plastic blanking plug, round, black (with fixing nut)	Ø 22 control and signalling units	10	**ZB5 SZ3**	0.009

Cable ducting support

Description	Application	Sold in lots of	Unit reference	Weight kg
Cable ducting support	Fixing beneath head	10	**AF1 XA1**	0.030
M5 x 10 screw, with hexagonal slotted head	For fixing cable ducting	100	**AF1 VB510**	0.003
Support	For XB5 A pushbuttons, switches and pilot lights	1	**DX1 AP52**	0.160



*(1) Body/fixing collar **ZB5 AZ009,** required for mounting, must be ordered separately, see page 43.*

Control and signalling units Ø 22

Harmony® XB5, plastic

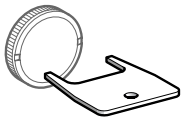
Accessories for illuminated pushbuttons: bulbs

DL1 CJ0●●●

DL1 CE●●●

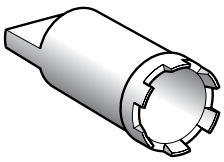
DL1 CF●●●

XBF X13



ZBZ 8

814640



ZB5 AZ905

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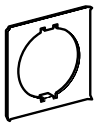


ZB5 AZ902

Bulbs with BA 9s base fitting and associated accessories

Description	Characteristics	Colour	Sold in lots of	Unit reference	Weight kg
LEDs	≂ 24 V	White	1	**DL1 CJ0241**	0.002
		Green	1	**DL1 CJ0243**	0.002
		Red	1	**DL1 CJ0244**	0.002
		Orange	1	**DL1 CJ0245**	0.002
		Blue	1	**DL1 CJ0246**	0.002
	≂ 48 V	Green	1	**DL1 CJ0483**	0.002
		Red	1	**DL1 CJ0484**	0.002
		Orange	1	**DL1 CJ0485**	0.002
	6 V -1.2 W	White	1	**DL1 CD0061**	0.002
		Green	1	**DL1 CD0063**	0.002
		Red	1	**DL1 CD0064**	0.002
		Orange	1	**DL1 CD0065**	0.002
		Blue	1	**DL1 CD0066**	0.002
Incandescent bulbs	6 V -1.2 W	–	10	**DL1 CB006**	0.002
	24 V - 2 W	–	10	**DL1 CE024**	0.002
	120…130 V - 2.4 W	–	10	**DL1 CE130**	0.002
Neon bulbs	120…130 V	–	10	**DL1 CF110**	0.002
	230…240 V	–	10	**DL1 CF220**	0.002
Bulb extractor	–	–	1	**XBF X13**	0.005
Lens cap tightening tool	Illuminated pushbuttons, with flush push	–	1	**ZBZ 8**	0.009

Description	Application	Sold in lots of	Unit reference	Weight kg
Add-on square trim				
Add-on square trim	Gives a square appearance to ZB5 A circular heads	10	**ZB5 AZ31**	0.002
Nut				
Nut	Head fixing	10	**ZB5 AZ901**	0.002
Tightening tool				
Tightening tool	Tightening head fixing nut ZB5 AZ901	1	**ZB5 AZ905**	0.016
Anti-rotation plate				
Anti-rotation plate	Prevents rotation of the head	10	**ZB5 AZ902**	0.008

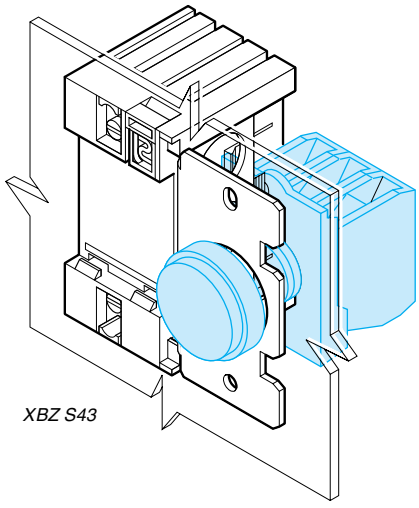
General : pages 74 to 81
Characteristics : pages 82 to 85
Dimensions : pages 138 to 149

Control and signalling units Ø 22

Harmony® XB5, plastic

Accessories for pushbuttons: keys, interface module

ZBG 455P



XBZ S43

Replacement keys

Description	Key number	Reference	Weight kg
For Emergency Stop key release heads and key switches			
Sets of 2 keys	455	**ZBG 455**	0.013
	421E	**ZBG 421E**	0.014
	458A	**ZBG 458A**	0.014
	520E	**ZBG 520E**	0.014
	3131A	**ZBG 3131A**	0.014
	4A185	**ZBD A185**	0.014
	LU1	**ZBD LU1**	0.014
	LU2	**ZBD LU2**	0.014
	LU3	**ZBD LU3**	0.014
	LU4	**ZBD LU4**	0.014
	LU5	**ZBD LU5**	0.014
	LU6	**ZBD LU6**	0.014
	LU7	**ZBD LU7**	0.014
	LU8	**ZBD LU8**	0.014
	LU9	**ZBD LU9**	0.014
	LU10	**ZBD LU10**	0.014
	LU11	**ZBD LU11**	0.014
	LU12	**ZBD LU12**	0.014
	LU13	**ZBD LU13**	0.014
	LU14	**ZBD LU14**	0.014
	8D1	**ZBD 8D1**	0.014
For booted selector switches			
Sets of 2 keys, one of which supplied booted (rubber boot)	455	**ZBG 455P**	–
	421E	**ZBG 421EP**	–
	458A	**ZBG 458AP**	–
	520E	**ZBG 520EP**	–
	3131A	**ZBG 3131AP**	–

Accessory for key switches

Description	Function	Reference	Weight kg
Keyhole cover (rubber cover)	Protection of lock barrel when no key inserted in lock	**ZBG P** ▲	–

AS-Interface module for Ø 22 control and signalling units

Panel fixing, in conjunction with a Harmony pushbutton or switch

Description	Application	Reference	Weight kg
S7.F profile	4 inputs and 4 outputs direct supply from the bus	**XBZ S43**	0.100

▲ Available: 4th quarter 2006.

General : pages 74 to 81
Characteristics : pages 82 to 85
Dimensions : pages 138 to 149

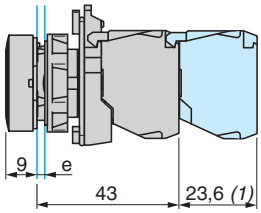
Control and signalling units Ø 22

Harmony® XB5, plastic

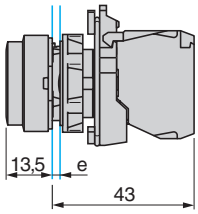
Pushbuttons, switches and pilot lights: complete units, XB5 A

Pushbuttons, spring return

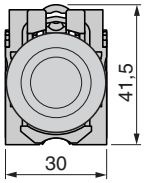
XB5 AA●●



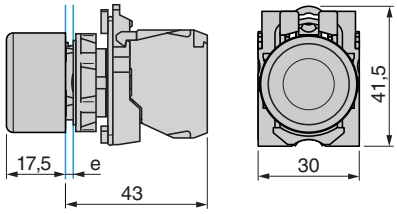
XB5 AL●●



Common face view



XB5 AP●●



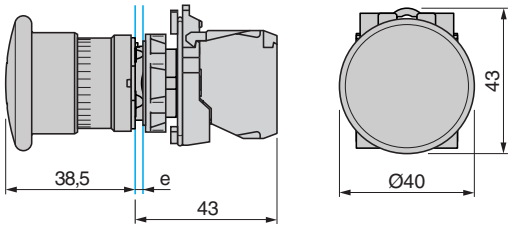
e: clamping thickness: 1 to 6 mm

(1) Additional row of contacts or double contact.

e: clamping thickness: 1 to 6 mm

Mushroom head pushbuttons, spring return

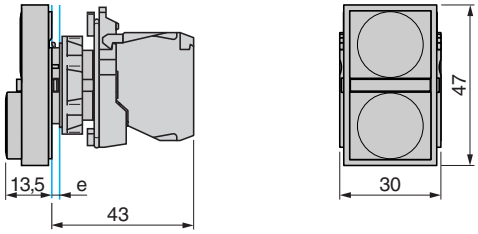
XB5 AC21



e: clamping thickness: 1 to 6 mm

Double-headed pushbuttons, spring return

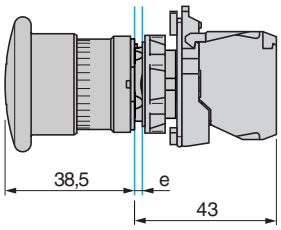
XB5 AL●45



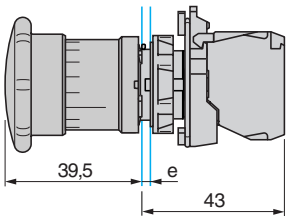
e: clamping thickness: 1 to 6 mm

Emergency stop mushroom head pushbuttons, trigger action and mechanical latching

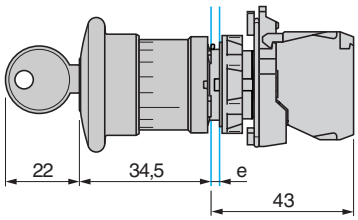
XB5 AT845



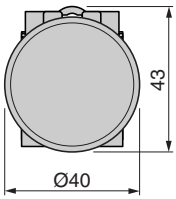
XB5 AS8445



XB5 AS9445



Common face view

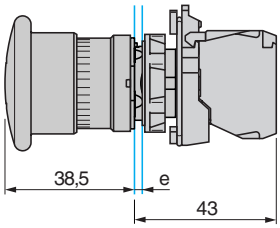


e: clamping thickness: 1 to 6 mm

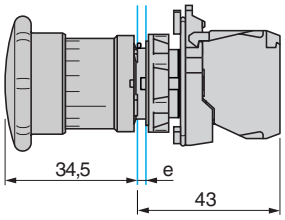
e: clamping thickness: 1 to 6 mm

Emergency stop mushroom head pushbuttons, mechanical latching

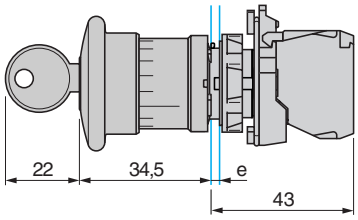
XB5 AT42



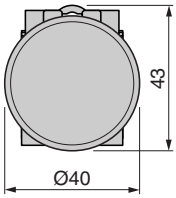
XB5 AS542



XB5 AS142



Common face view



e: clamping thickness: 1 to 6 mm

e: clamping thickness: 1 to 6 mm

General : pages 74 to 81
Characteristics : pages 82 to 85
References : pages 88 to 123

Control and signalling units Ø 22

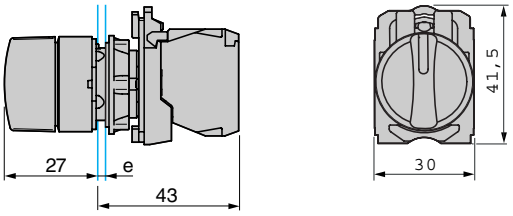
Harmony® XB5, plastic

Pushbuttons, switches and pilot lights: complete units, XB5 A

Selector switches

Standard handle

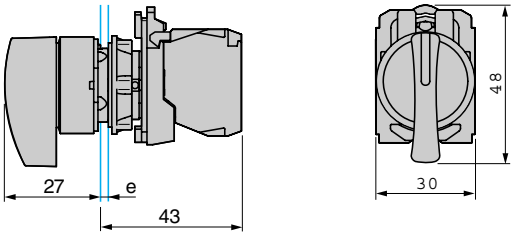
XB5 AD●●



e: clamping thickness: 1 to 6 mm

Long handle operator

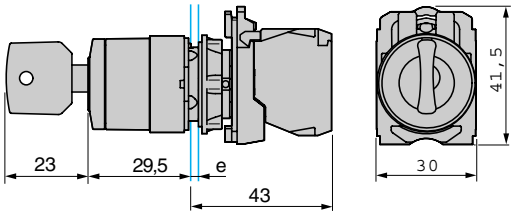
XB5 AJ●●



e: clamping thickness: 1 to 6 mm

Key switches

XB5 AG●●



e: clamping thickness: 1 to 6 mm

Control and signalling units Ø 22

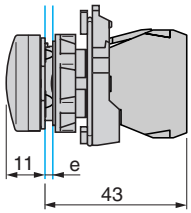
Harmony® XB5, plastic

Pushbuttons, switches and pilot lights:
complete units, XB5 A

Pilot lights

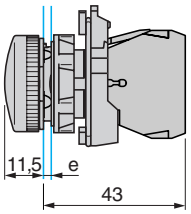
Integral LED

XB5 AVB●, AVG●, AVM●



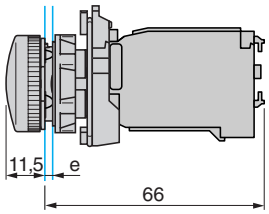
Direct supply

XB5 AV6●

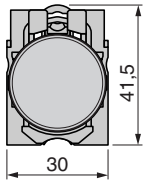


Via integral transformer

XB5 AV3●, AV4●



Common face view



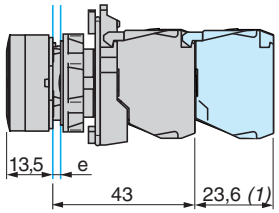
e: clamping thickness: 1 to 6 mm

e: clamping thickness: 1 to 6 mm

Illuminated pushbuttons

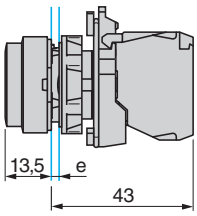
Integral LED

XB5 AW3●●5



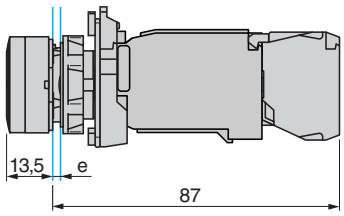
Direct supply

XB5 AW3●65

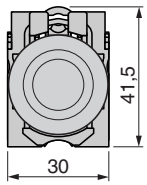


Via integral transformer

XB5 AW3●●5



Common face view



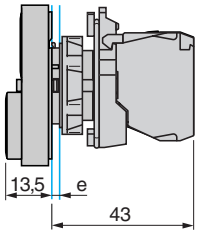
(1) Additional row of contacts or double contact.
e: clamping thickness: 1 to 6 mm

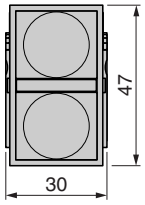
e: clamping thickness: 1 to 6 mm

Double-headed pushbuttons with pilot light

Integral LED

XB5 AW84●5



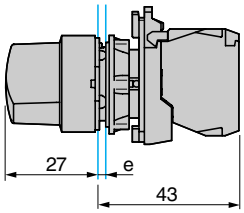


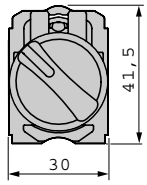
e: clamping thickness: 1 to 6 mm

Illuminated selector switches

Integral LED

XB5 AK12●●5

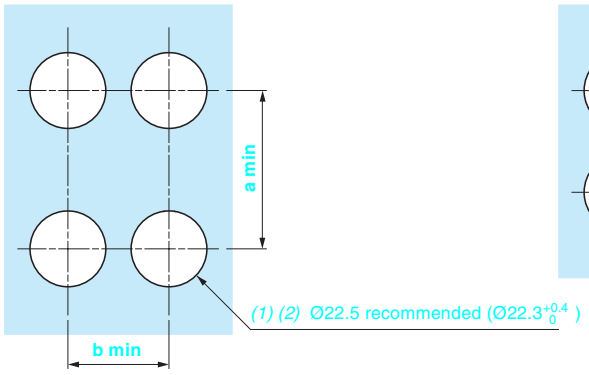


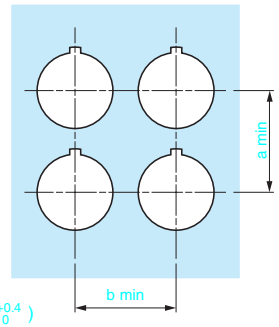


e: clamping thickness: 1 to 6 mm

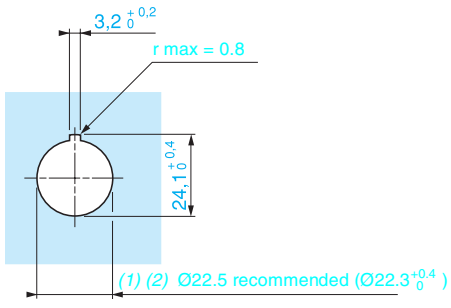
Panel cut-out for pushbuttons, switches and pilot lights (finished holes, ready for installation)

Connection by screw clamp terminals or plug-in connectors or on printed circuit board





Detail of lug recess



(1) Diameter on finished panel or support.
(2) For selector switches and Emergency stop buttons, use of an anti-rotation plate type ZB5 AZ902 is recommended, see page 136.

Connection	a	b
By screw clamp terminals or plug-in connector	40	30
By Faston connectors	45	32
On printed circuit board	30	30

General : pages 74 to 81
Characteristics : pages 82 to 85
References : pages 88 to 123

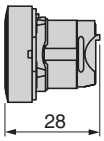
Control and signalling units Ø 22

Harmony® XB5, plastic

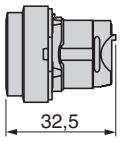
Pushbuttons, switches and pilot lights: sub-assemblies, ZB5 A

Heads for spring return pushbuttons

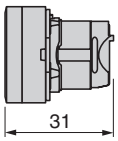
ZB5 AA●, AA●●●, ZB5 AA●8



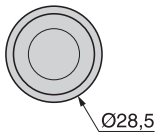
ZB5 AL●, ZB5 AL●●●



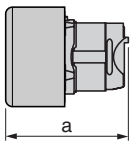
ZB5 AA●4, ZB5 AA●6

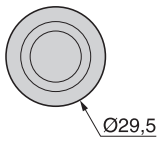


Common face view

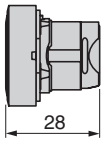


ZB5 AP●●, ZB5 AP●S, ZB5 AP●83, ZB5 AP●

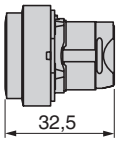




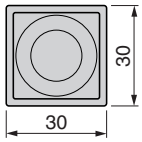
ZB5 CA●, ZB5 CA0



ZB5 CL●



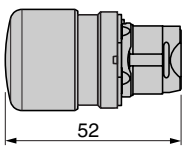
Common face view

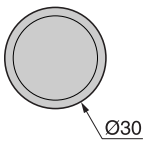


ZB5	a
AP●●	36.5
AP●S	33
AP●83	32
AP●	35

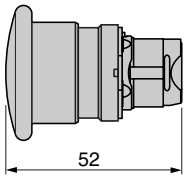
Mushroom heads for spring return pushbuttons

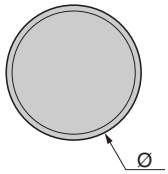
ZB5 AC●4



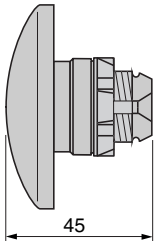


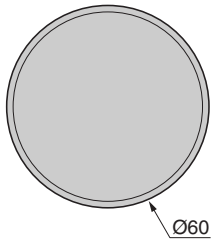
ZB5 AC●, AR●





ZB5 AR●16

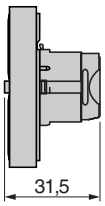




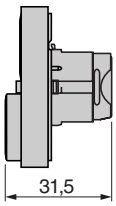
ZB5	Ø
AC●	40
AR●	60

Heads for double-headed, spring return pushbuttons

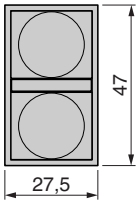
ZB5 AA81●●, ZB5 AA82●●



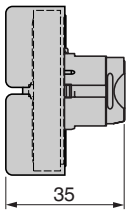
ZB5 AL83●●, ZB5 AL84●●



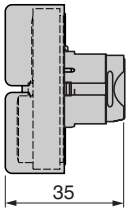
Common face view



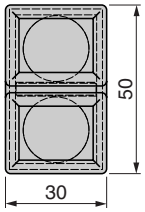
ZB5 AA91●● ZB5 AA92●●



ZB5 AL93●● ZB5 AL94●●

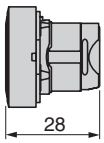


Common face view

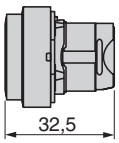


Heads for "Push-push to release" pushbuttons

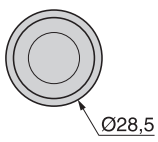
ZB5 AH0●



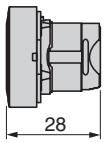
ZB5 AH●

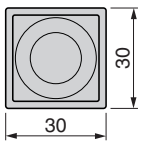


Common face view



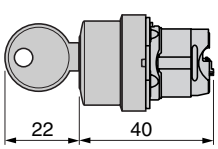
ZB5 CH0●

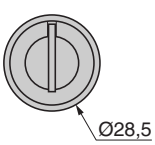




Heads for lockable "Push-turn" pushbuttons

ZB5 AFD





General : pages 74 to 81
Characteristics : pages 82 to 85
References : pages 88 to 123

Control and signalling units Ø 22

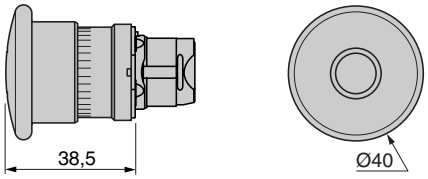
Harmony® XB5, plastic

Pushbuttons, switches and pilot lights: sub-assemblies, ZB5 A

Mushroom heads for Emergency stop trigger action and mechanical latching pushbuttons

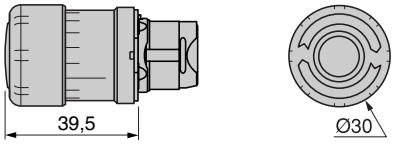
Push-pull

ZB5 AT84

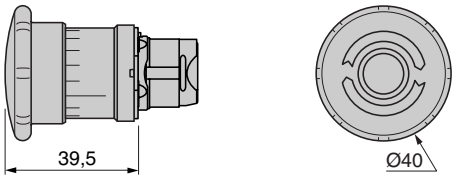


Turn to release

ZB5 AS834

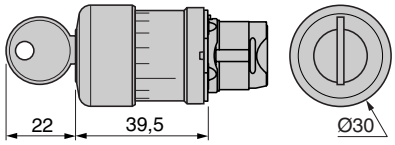


ZB5 AS844

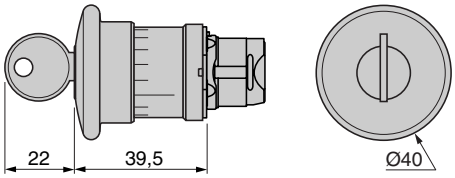


Key release

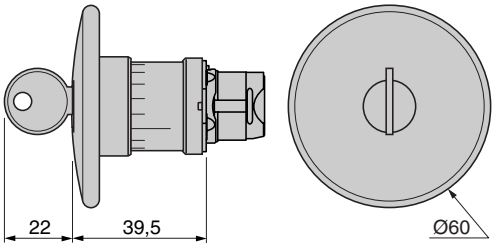
ZB5 AS934



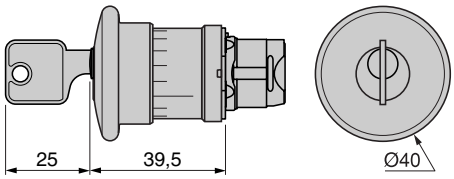
ZB5 AS944



ZB5 AS964



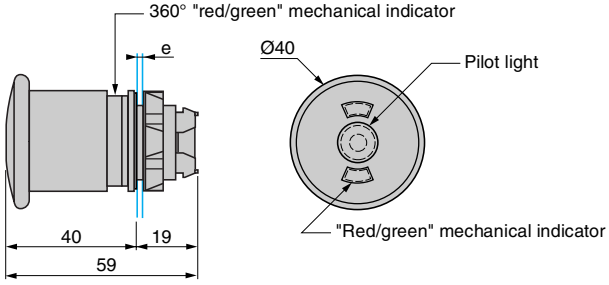
ZB5 AS944D



Illuminated mushroom heads for Emergency stop trigger action and mechanical latching pushbuttons

Push-pull with pilot light or mechanical state indicator

ZB5 AT8643M



e: panel thickness 1 to 6 mm

General : pages 74 to 81
Characteristics : pages 82 to 85
References : pages 88 to 123

Control and signalling units Ø 22

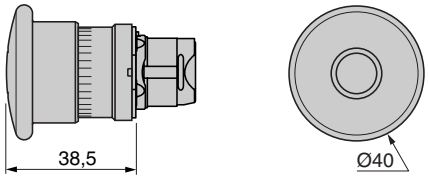
Harmony® XB5, plastic

Pushbuttons, switches and pilot lights: sub-assemblies, ZB5 A

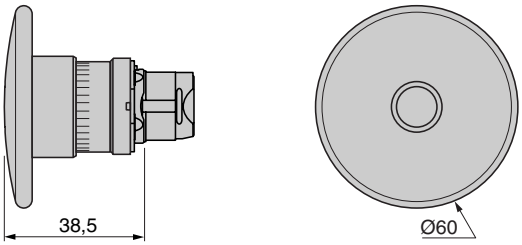
Mushroom heads for Emergency stop mechanical latching pushbuttons

Push-pull

ZB5 AT4

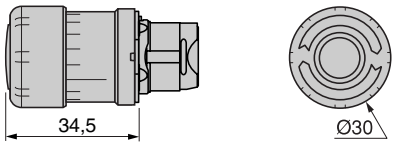


ZB5 AX4

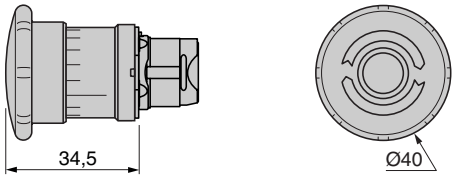


Turn to release

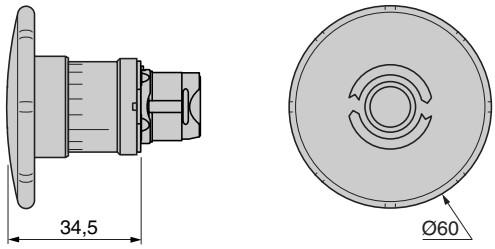
ZB5 AS44



ZB5 AS54

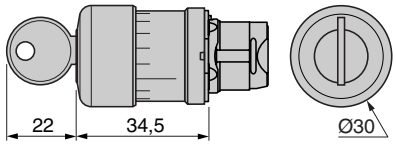


ZB5 AS64

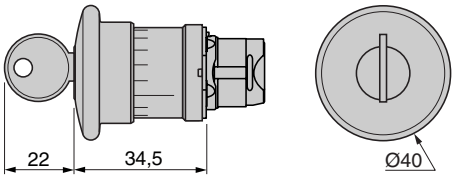


Key release

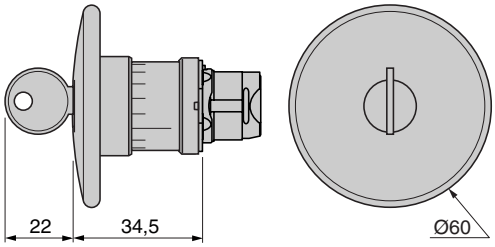
ZB5 AS74



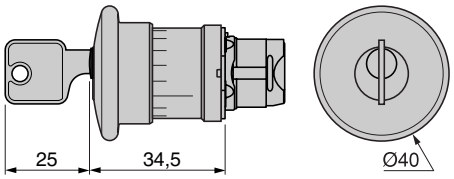
ZB5 AS14



ZB5 AS24



ZB5 AS14D



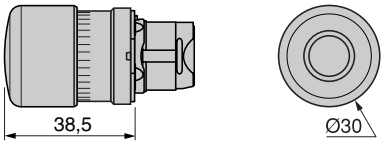
Control and signalling units Ø 22

Harmony® XB5, plastic
Pushbuttons, switches and pilot lights:
sub-assemblies, ZB5 A

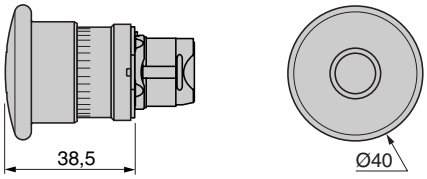
Mushroom heads for latching pushbuttons *(1)*

Push-pull

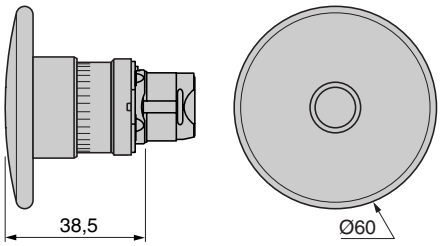
ZB5 AT24



ZB5 AT2

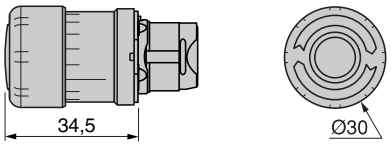


ZB5 AX2

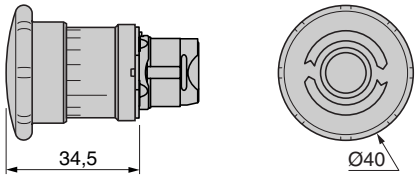


Turn to release

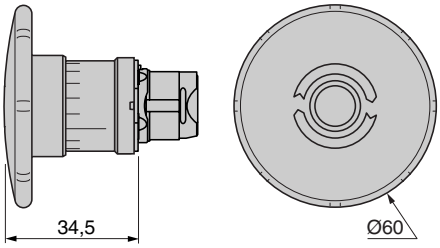
ZB5 AS42



ZB5 AS52, ZB5 AS55

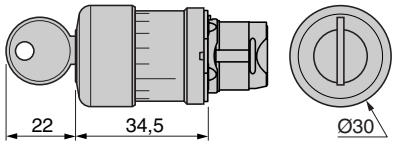


ZB5 AS62

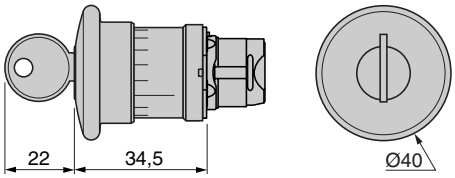


Key release

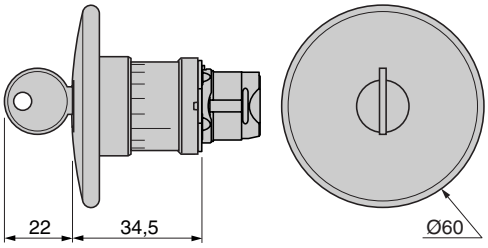
ZB5 AS72



ZB5 AS12



ZB5 AS22



(1) Red mushroom heads for Emergency stop, latching pushbuttons: see pages 142 and 143.

Control and signalling units Ø 22

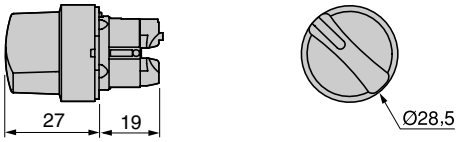
Harmony® XB5, plastic

Pushbuttons, switches and pilot lights: sub-assemblies, ZB5 A

Heads for selector switches

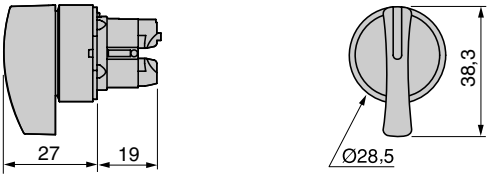
Standard handle

ZB5 AD●, ZB5 AD●M



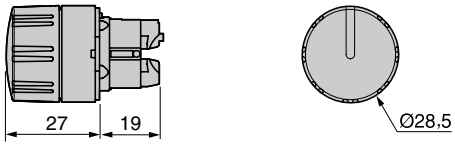
Long handle operator

ZB5 AJ●, ZB5 AJ●M



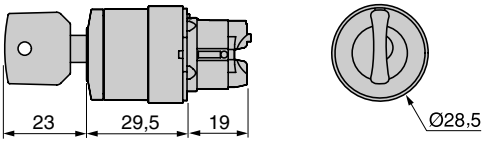
Black knurled knob

ZB5 AD●9



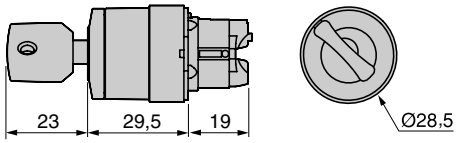
Key switch (Ronis n° 455)

ZB5 AG●, ZB5 AG0●, ZB5 AG●M



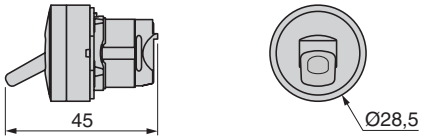
Key switch (DOM n° 8D1)

ZB5 AGD



Heads for toggle switches

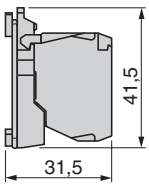
ZB5 AD●8



Bodies for pushbuttons and switches

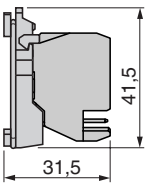
Screw clamp terminal connections

ZB5 AZ10●, ZB5 AZ141



Plug-in connector

ZB5 AZ10●4, ZB5 AZ1414



Control and signalling units Ø 22

Harmony® XB5, plastic

Pushbuttons, switches and pilot lights: sub-assemblies, ZB5 A

Heads for pilot lights, with light source

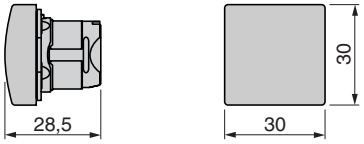
Integral LED

ZB5 AV0●3

Incandescent, neon or LED

ZB5 AV0●, AV0●S

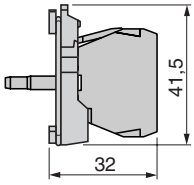
ZB5 CV0●3, CH3●3



Bodies for pilot lights, screw clamp terminal connections

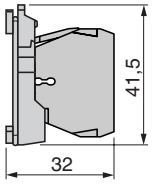
Integral LED

ZB5 AV●●



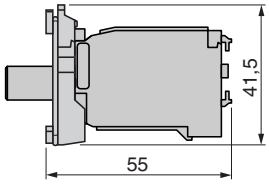
Direct supply for BA 9s bulb

ZB5 AV6



With integral transformer for BA 9s bulb

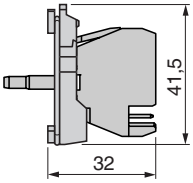
ZB5 AV●, AV●D●



Bodies for pilot lights, plug-in connector

Integral LED

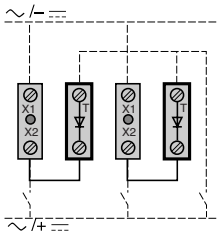
ZB5 AV●●4



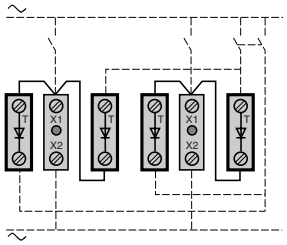
Blocks for “test light” function

Connections

ZBZ G156



ZBZ M156



General : pages 74 to 81
Characteristics : pages 82 to 85
References : pages 88 to 123

Control and signalling units Ø 22

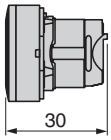
Harmony® XB5, plastic

Pushbuttons, switches and pilot lights: sub-assemblies, ZB5 A

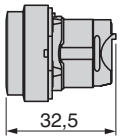
Heads for spring return illuminated pushbuttons, for light source types:

LED

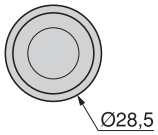
ZB5 AW3●3, AW3●3S, ZB5 AA●8



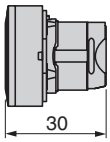
ZB5 AW1●3, ZB5 AW1●3S, ZB5 AL●8

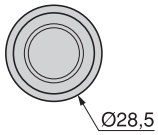


Common face view

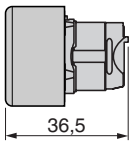


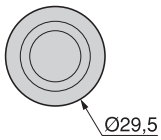
ZB5 AW9●3



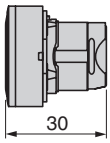


ZB5 AW5●3

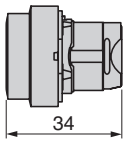




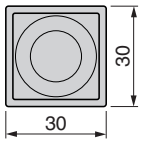
ZB5 CW3●3



ZB5 CW1●3

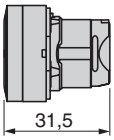


Common face view

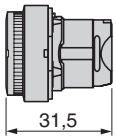


Bulb with BA 9s base fitting

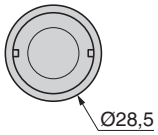
ZB5 AW3●, AW3●S



ZB5 AW1●, ZB5 AW1●S

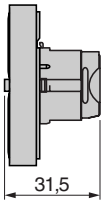


Common face view

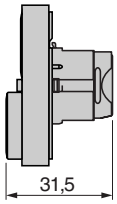


Heads for double-headed pushbuttons with pilot light

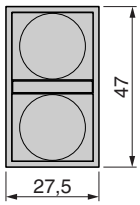
ZB5 AW81●●●3, ZB5 AW82●●●3



ZB5 AW83●●●3, ZB5 AW84●●●3

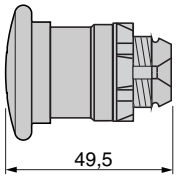


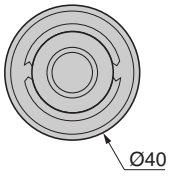
Common face view



Heads for illuminated, latching, mushroom head pushbuttons

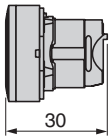
ZB5 AW7●3



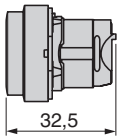


Heads for illuminated "push-push to release" pushbuttons

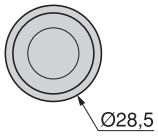
ZB5 AH0●3



ZB5 AH●3

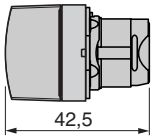


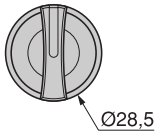
Common face view



Heads for illuminated selector switches with standard handle

ZB5 AK1●●●3





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References : pages 88 to 123

Control and signalling units Ø 22

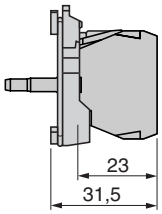
Harmony® XB5, plastic

Pushbuttons, switches and pilot lights:
complete units or sub-assemblies

Bodies for illuminated pushbuttons and selector switches, screw clamp terminal connections

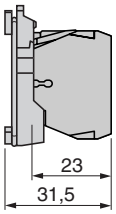
Integral LED

ZB5 AW0●●●



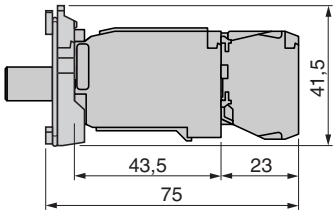
Direct supply for BA 9s bulb

ZB5 AW06●



Integral transformer for BA 9s bulb

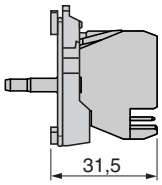
ZB5 AW0●●, ZB5 AW0●D●●



Bodies for illuminated pushbuttons and selector switches, plug-in connector

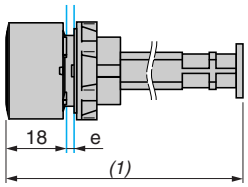
Integral LED

ZB5 AW0●●●4



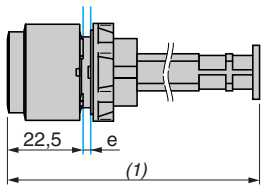
Manual overload reset buttons

XB5 A8●●●



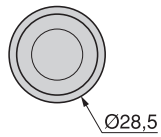
e: panel thickness 1 to 6 mm

XB5 AL8●●●



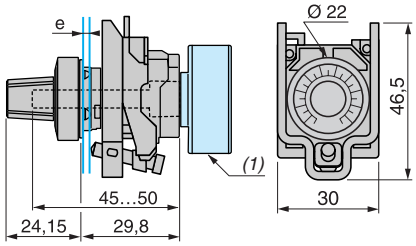
(1) Value not yet communicated

Common face view



Head + mounting base for potentiometer

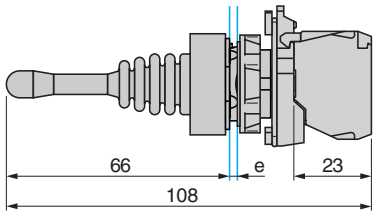
ZB5 AD9●2



(1) Potentiometer not included.

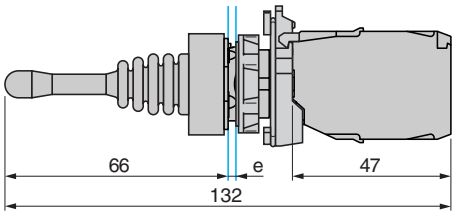
Joystick controllers

XD5 PA●2

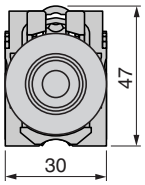


e: panel thickness 1 to 6 mm

XD5 PA●4

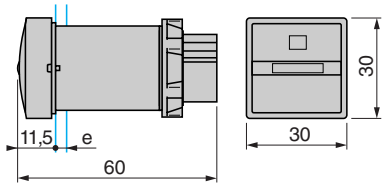


Common face view



Hour counters

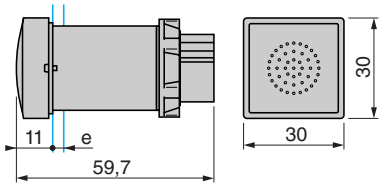
XB5 DS●



e: panel thickness 1 to 6 mm

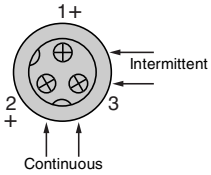
Annunciators

XB5 KS●



Cabling

XB5 KS●



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Control and signalling units Ø 22

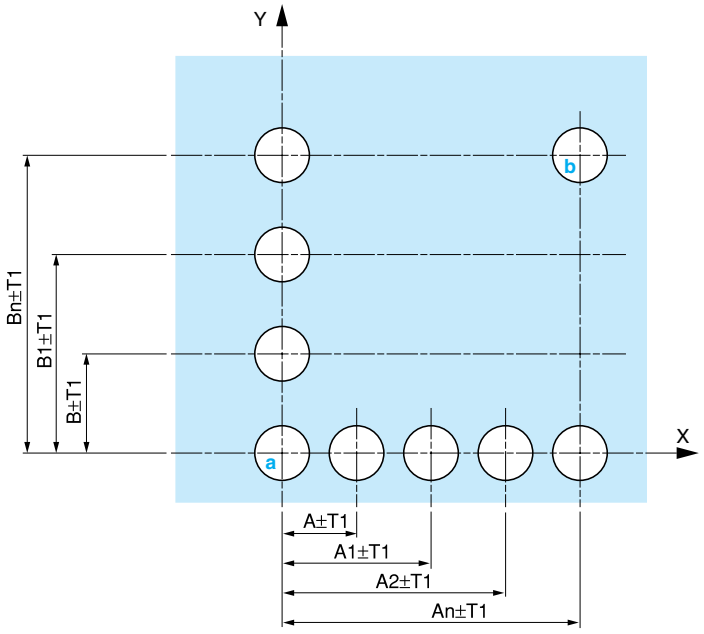
Harmony® XB5, plastic

Pushbuttons, switches and pilot lights: for printed circuit board connection

Pushbuttons, switches and pilot lights for printed circuit board connection

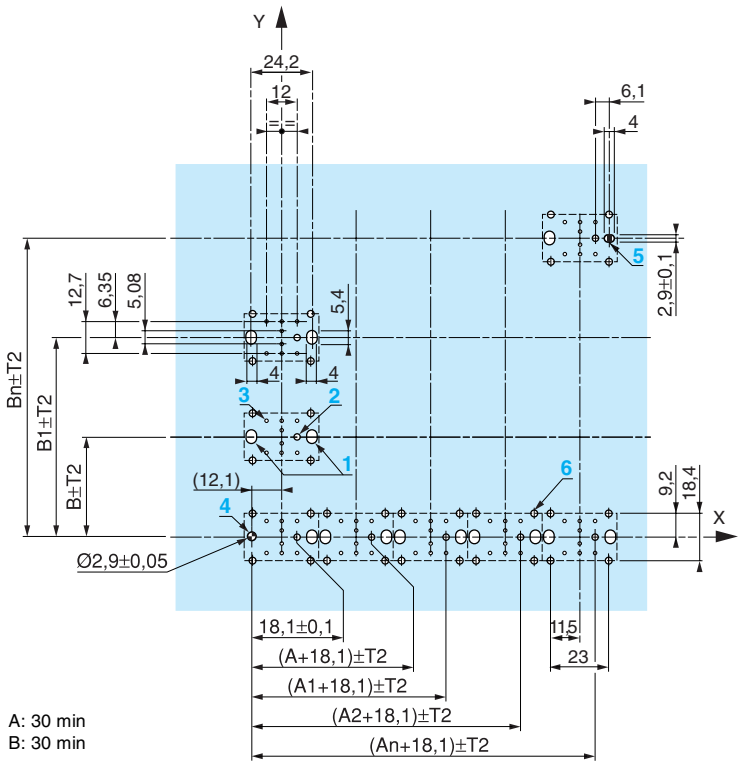
Panel cut-out (viewed from installer's side)

Dimensions in mm



Printed circuit board drillings (viewed from electrical block side)

Dimensions in mm

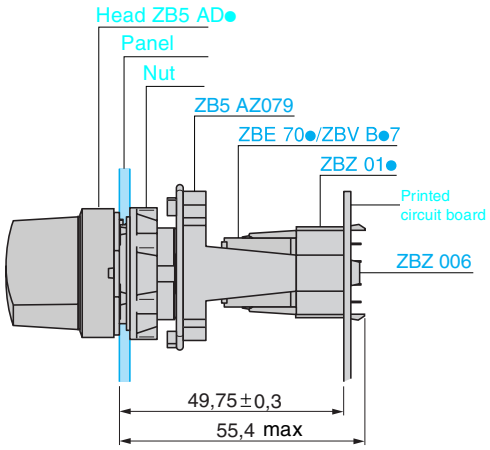


General tolerances of the panel and printed circuit board

The cumulative tolerance must not exceed 0.3 mm: T1 + T2 = 0.3 mm max.

■ Installation precautions:
□ Minimum thickness of circuit board: 1.6 mm.
□ Cut-out diameter: 22.4 mm ± 0.1 mm.
□ Orientation of body/fixing collar ZB5 BZ079: ± 2° 30' (excluding cut-outs marked a and b).
□ Tightening torque of screws ZBZ 006: 0.6 N.m. max.
□ Allow for one ZB5 BZ079 fixing collar/pillar and its fixing screws:
- every 90 mm horizontally (X), and 120 mm vertically (Y),
- with each selector switch head (ZB5 AD●, ZB5 AJ●, ZB5 AG●).

The fixing centres marked a and b are diagonally opposed and must align with those marked 4 and 5 on the printed circuit board.



■ Mounting of adapter (socket) ZBZ 01● :

1 2 elongated holes for ZBZ 006 screw access.

2 1 hole Ø 2.4 mm ± 0.05 for centring adapter ZBZ 01●.

3 8 x Ø 1.2 mm holes.

4 1 hole Ø 2.9 mm ± 0.05, for aligning the printed circuit board (with cut-out marked a).

5 1 elongated hole for aligning the printed circuit board (with cut-out marked b).

6 4 holes Ø 2.4 mm ± 0.05 for clipping in adapter ZBZ 01●.

Dimensions An + 18.1 relate to the Ø 2.4 mm ± 0.05 holes for centring adapter ZBZ 01●.

General : pages 74 to 81
Characteristics : pages 82 to 85
References : pages 88 to 123

Control and signalling units

Applications		Pilot lights	Pushbuttons, selector switches and pilot lights			
Description of the range		■ LED pilot lights	■ Pushbuttons ■ Mushroom head Emergency Stop buttons ■ Selector switches and key switches ■ Illuminated pushbuttons ■ Pilot lights			
Features	Products	Monolithic, compact, low consumption	Complete units or sub-assemblies (body + head)	Complete units or sub-assemblies (body + head)	Complete units or sub-assemblies (body + head)	Monolithic
	Bezel	Double insulated	Double insulated	Metal, chromium plated or black	Double insulated	Double insulated
	Shape of head	Circular	Circular, square or rectangular	Circular	Circular or square	Circular
Drilling or cut-out for fixing		Ø 8 and Ø 12	Ø 16	Ø 22	Ø 22	Ø 22 and Ø 25
Degree of protection	Conforming to IEC 60529 and NF C 20-010	IP 40 IP 65 with seal	IP 65	IP 66	IP 66	IP 54
Cabling		Tags for 2.8 x 0.5 mm connectors, or threaded connector	Faston connectors Solder pins for printed circuit boards	Screw clamp terminal connections Connector With adaptor for printed circuit board	Screw clamp terminal connections Connector With adaptor for printed circuit board	Screw clamp terminal connections
Mounting	Panel thickness	1…8 mm	1…6 mm	1…6 mm	1…6 mm	1…6 mm
	On Profil KT● front panels	–	–	Yes	Yes	Yes, depending on model
Type references		**XVL A**	**XB6**	**XB4**	**XB5**	**XB7 E**
Pages		Consult our catalogue “Control and signalling components”		16 to 39	88 to 113	Consult our catalogue “Control and signalling components”

Digital display units	Pushbuttons, selector switches and pilot lights	Joystick controllers			Cam switches	Profil front panel
■ LED display (7 segment + decimal point)	■ Pushbuttons ■ Mushroom head Emergency Stop buttons ■ Selector switches and key switches ■ Illuminated pushbuttons ■ Pilot lights	■ 2 or 4 direction ■ Stay put or spring return			■ Switches ■ Stepping switches ■ Reversing and changeover switches ■ Ammeter switches ■ Voltmeter switches ■ Reversing switches ■ Star-delta and reversing star-delta switches ■ Pole change switches	■ 3 sizes of front panel for mounting 4, 8 or 12 Ø 22 mm control and signalling units ■ With/without location for Emergency Stop pushbutton ■ With/without printed circuit
Sub-assemblies (body + single-digit head)	Complete units or sub-assemblies (body + head)	Complete units or sub-assemblies (body + head with lever)			Complete units or sub-assemblies (body + front panel + head)	Aluminium front panels for mounting Ø 22 mm control and signalling units, double insulated and metal
Double insulated	Chromium plated metal or double insulated	Chromium plated metal		Double insulated, black	Metal, chromium plated or black Double insulated	–
Circular	Hexagonal	Circular			Square	–
Ø 22	Ø 30	Ø 22			Ø 16 or Ø 22: series K10 Ø 22 and multifixing: series K1/K2 4 holes, 48 or 68 centres: series K30…K150	–
IP 65		IP 65	IP 66	IP 65	IP 65: series K10 IP 40, IP 65 with seal: series K1/K2 IP 40: series K30…K150	IP 65
Connector	Screw and captive cable clamp connections	Screw and captive cable clamp connections			Screw and captive cable clamp connections	–
1…5 mm	1…6 mm				0.5…6 mm (depending on model)	–
Yes	–	Yes			–	–
ZA2 VA	**9001 K, 9001 SK**	**XD4 PA**	**XD2 GA**	**XD5 PA**	**K10, K1, K2, K30, K50, K63, K115, K150**	**KT●**
Consult our catalogue “Control and signalling components”						

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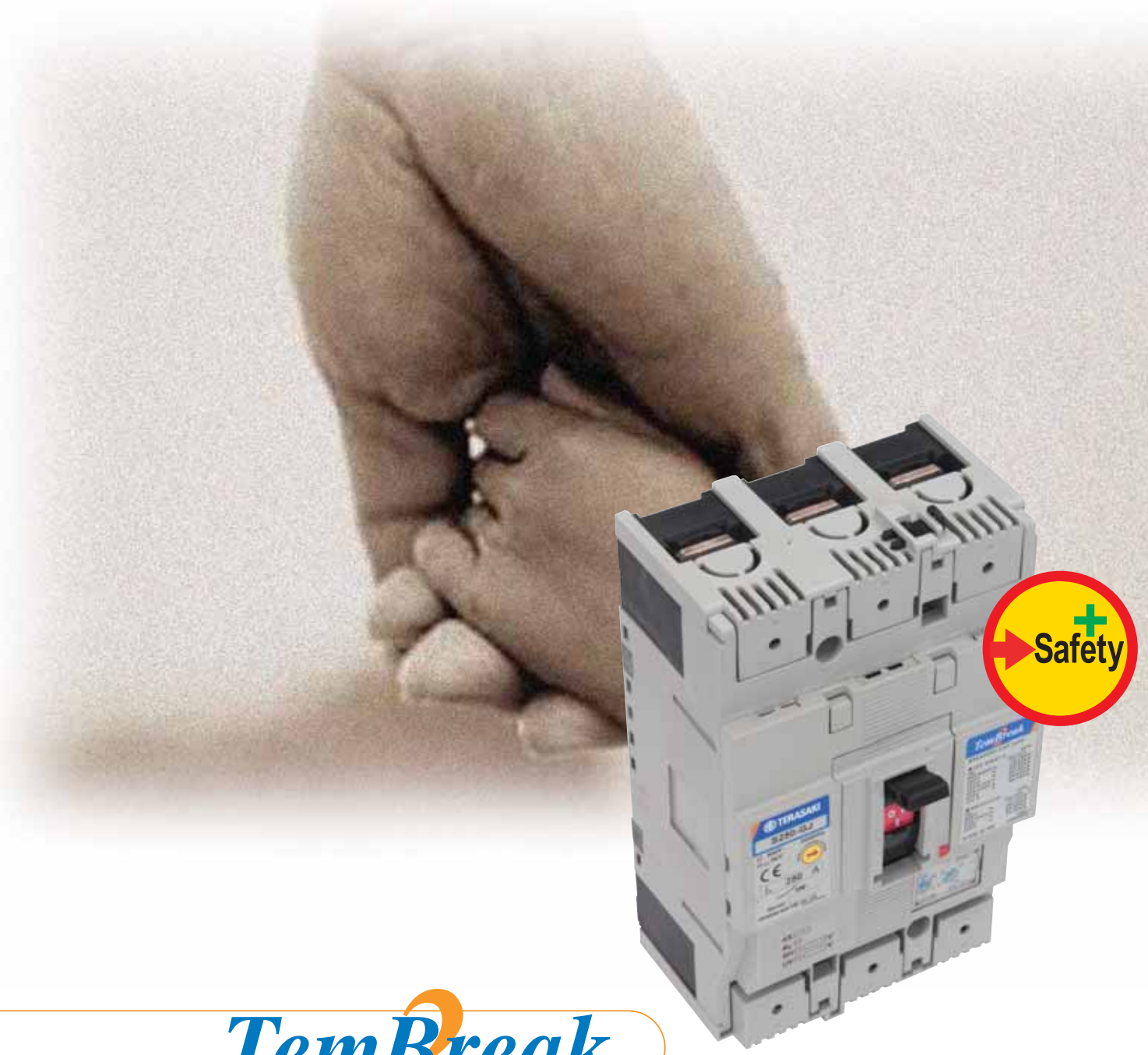
TERASAKI
Innovators in Protection Technology



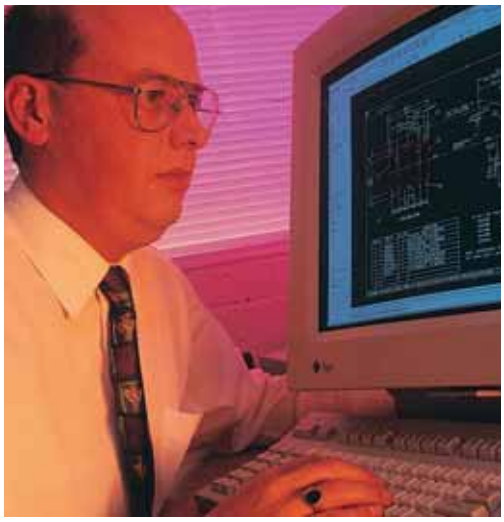
TemBreak2

The Ultimate Safety Breaker

OUR CUSTOMER CARE COMMITMENTS

Quality is Guaranteed

All products supplied from this catalogue carry a guarantee against defects in materials and workmanship for a period of 12 months from date of purchase as standard.



Quality is Accredited

Terasaki has ISO 9001 accreditation for the manufacture, sale and distribution of all products featured in this catalogue.

Ordering is Easy

We have made ordering easy for you by colour coding the sections of this catalogue and including order codes. If you need help with ordering or selection, please call one of the telephone numbers shown below.

Technical Support is Free

We offer free technical support and application software to all customers. This could range from selecting a product for an unusual application through to carrying out a protection study. Please call one of the telephone numbers shown below.

CUSTOMER SERVICE CONTACT DETAILS

Italy:	+39 02 92278300	**Australia and New Zealand:**	+61 3 9429 2999
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Sweden:	+46 8 55628230	**Malaysia:**	+60 3 55493820
Denmark:	+45 70 260057	**Singapore:**	+65 6744 9752
UK and all other countries in Europe, Middle East and Africa:	+44 141 9411940	**China:**	+86 20 8270 8556
		Japan and all other countries in Asia:	+81 6 67919323

Safety and protection are the prime purposes of Terasaki products. You care about safety and protection. The users of products you specify care about safety and protection.
We call TemBreak 2 the Ultimate Safety Breaker. Throughout this catalogue you will see our Safety+ mark. This is designed to draw your attention to safety features which exceed international standards.

Please read further to discover the benefits of TemBreak 2.

THE TEMBREAK 2 PRODUCT LINES

TEMBREAK 2

MOULDED CASE CIRCUIT BREAKERS

Rated current (I_n) from 20A to 630A. Breaking Capacity (I_{cu}) from 25kA to 200kA at 415V AC.

TEMBREAK 2

MINI MOULDED CASE CIRCUIT BREAKERS

Rated current (I_n) from 10A to 100A.
Breaking Capacity (I_{cu}) of 10kA at 415V AC.

TEMBREAK

MOULDED CASE CIRCUIT BREAKERS

Rated current (I_n) from 630A to 1600A. Breaking Capacity (I_{cu}) from 50kA to 125kA at 415V AC.

TEMBREAK 2
MOULDED CASE CIRCUIT BREAKERS
16A TO 630A

1. **Welcome to TemBreak 2**
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   - **10 Reasons to use TemBreak 2** 7
   - **Safety Plus** 9
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3. Operating Characteristics
4. Application Data
5. Accessories
6. Installation
7. Dimensions

TEMBREAK 2
MINI MOULDED CASE CIRCUIT BREAKERS
10A TO 100A

8. TemBreak 2 MINI Moulded Case Circuit Breakers

TEMBREAK
MOULDED CASE CIRCUIT BREAKERS
630A TO 1600A

9. TemBreak Moulded Case Circuit Breakers

WELCOME TO TEMBREAK 2

EASY SELECTION GUIDE

The TemBreak 2 range of products includes:

- Moulded Case Circuit Breakers (MCCBs)
- Switch-Disconnectors in the same compact moulded case frame sizes as MCCBs
- A comprehensive range of accessories which are common to MCCBs and Switch-Disconnectors. All internal accessories are common to all frame sizes.

Key to Model and Type Designations

Model Denoted by

Type Denoted by

E	Economical
S	Standard
H	High
L	Limiting*

C	Low breaking capacity
N	Medium breaking capacity
G	High breaking capacity
P	Extra High breaking capacity

S	125	G	J

Frame rating, In (A)

F	Fixed thermal, fixed magnetic
J	Adjustable thermal, adjustable magnetic
E	Electronic protection
N	No protection

*All TemBreak 2 MCCBs limit short-circuit faults by opening in less than 5ms. Limiting (L) models open particularly quickly.

EASY SELECTION GUIDE

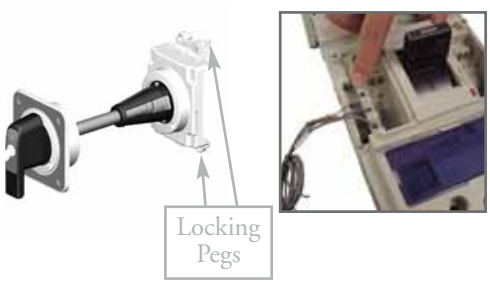
Frame Rating (A)	50/100	125	160/250	400/630	800/1250/1600
MCCBs					
Model / Type / Icu (kA)		E125 NJ 25	E250 NJ 25	E400 NJ 25	
				E630 NE 36	
		S125 NF 25	S160 NF 25	S400 CJ 36	
		S125 NJ 36	S160 NJ 36	S400 NJ 50	
		S125 GJ 65	S160 GJ 65	S400 NE 50	
			S250 NJ 36	S400 GJ 70	
			S250 NE 36	S400 GE 70	
			S250 GJ 65	S400 PJ 85	
			S250 GE 65	S400 PE 85	
			S250 PE 70	S630 CE 50	
				S630 GE 70	
		H125* NJ 125	H160 NJ 125	H400 NE 125	
			H250 NJ 125		
			H250 NE 125		
		L125* NJ 200	L160 NJ 200	L400 NE 200	
			L250 NJ 200		
E	TemBreak 2 Mini Moulded Case Circuit Breakers. Refer to Section 8				TemBreak Moulded Case Circuit Breakers. Refer to Section 9
S					
H					
L					
In (A)	100 ↕ 10	125 ↕ 16	250 ↕ 16	630 ↕ 250	1600 ↕ 630
Switch-Disconnectors					
Model / Type		S125 NN	S160 NN S250 NN	S400 NN S630 NN	

Note: All breaking capacities are r.m.s. symmetrical at 415V AC

*250A Frame

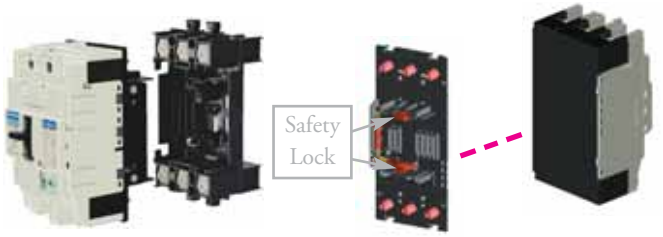
10 REASONS TO USE TEMBREAK 2

1. FIELD-INSTALLABLE ACCESSORIES



- Accessories can be fitted by the switchboard builder or added by the end-user. All internal accessories are common for TemBreak 2 MCCBs.
- Handles and motor operators can be rapidly fitted using the locking pegs. It takes **less than 10 seconds to secure a handle or motor** to the MCCB – a great time saving compared to alternative products.
- All accessories are endurance tested to the same level as the host MCCB.

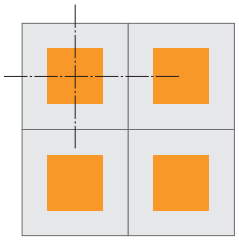
2. SAFETY LOCK FOR PLUG-IN VERSIONS



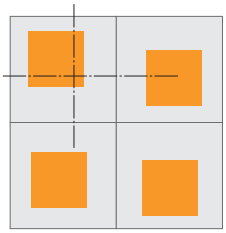
Plug-in MCCB and base *Plug-in connection kit, including safety lock*

The plug-in MCCB is locked to the base when the toggle is ON. It cannot be removed unless the toggle is OFF or TRIPPED. The safety lock prevents a trip occurring as the MCCB is being removed from the base.

3. SYMMETRICAL DOOR CUTOUT PATTERNS



Using TemBreak 2 Operating Handles



Using other MCCB Operating Handles

Door cutout patterns for handles are symmetrical, even when breakers are mounted in opposite directions.

4. MODULAR SIZES

All current ratings up to 630A can be supplied in **2 sizes:** the 250A and 630A sizes.

The compact 125A size offers **the same** features and performance but with reduced dimensions and cost.

5. ADVANCED L.C.D. DISPLAY, OCR

The XOW-1S OCR comes standard with the backlit LCD display. It can monitor and indicate phase currents, voltages, power, energy, power factor, harmonic currents, and more. Data communications via Modbus, an open network, are supported.

10 REASONS TO USE TEMBREAK 2

6. COMPACT CHANGEOVERS

Changeover Pair with Link Interlock and Motor Operators

Viewed from Below (250A frame)

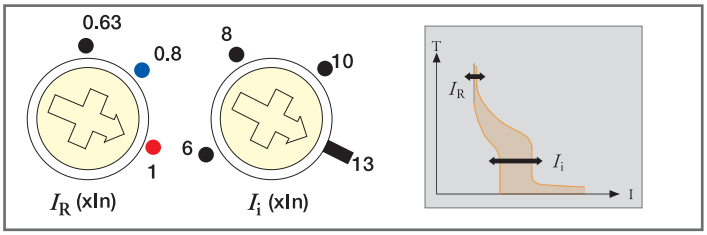
The mechanical interlock is installed on the front of the MCCB, and is compatible with motor operators and handles. An automatic changeover system can be assembled in a few minutes by a switchboard builder or end-user.

7. DIRECT OPENING

Under the heading "Measures to minimise the risk in the event of failure", IEC 60204-1 Safety of Machinery-Electrical Equipment of Machinery includes the following recommendation:

"-the use of switching devices having positive (or direct) opening operation."

8. UNSURPASSED FLEXIBILITY



Overload protection is adjustable between 63% and 100% of the rating.

Short-circuit protection is adjustable on all thermal magnetic models.

Short-circuit protection settings are suitable for motor starting on all models, including the compact 125A frame.

9. CUSTOMISED TRIPPING TIMES

If you require a characteristic which is not available as a preset on our electronic protection unit, send us the details and we will program a customised characteristic to suit your application. (Within certain limits - contact us for details).

10. VISUAL SAFETY

Coloured indicators display the ON or OFF status. The indicators are fully covered if the breaker trips, and black is the only visible colour.

WELCOME TO TEMBREAK 2

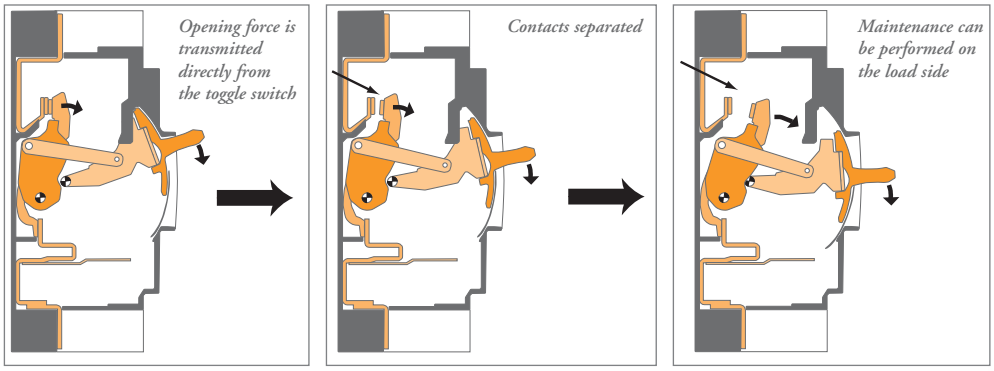
SAFETY PLUS

Terasaki have an innovative approach to product design. Our goal is to develop products which not only meet, but exceed recognised standards.

We use our knowledge of related applications to improve circuit breaker designs. For instance, when developing the Direct Opening Action, we applied ideas from a machinery safety standard to the design of the TemBreak 2 switching mechanism.

This proactive development policy confirms our reputation as Innovators in Protection Technology.

Machine Safety

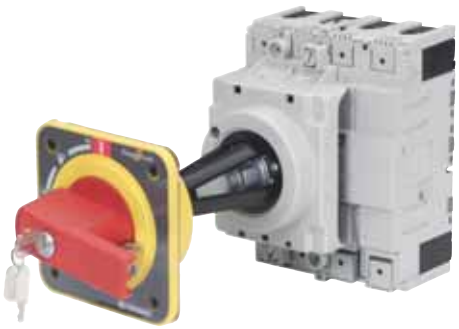


TemBreak 2 MCCBs are marked with IEC symbol indicating Direct Opening Action. ⊖

The robust mechanism ensures that the force you apply to the toggle is transmitted directly to the contacts.

Under the heading "Measures to minimise risk in the event of failure", IEC 60204-1 Safety of Machinery - Electrical Equipment of Machines includes the following recommendation:

" - the use of switching devices having positive (or direct) opening operation."



TemBreak 2 MCCBs help you to comply with the world's most stringent safety standards. It is one of the safest switching devices for machinery.

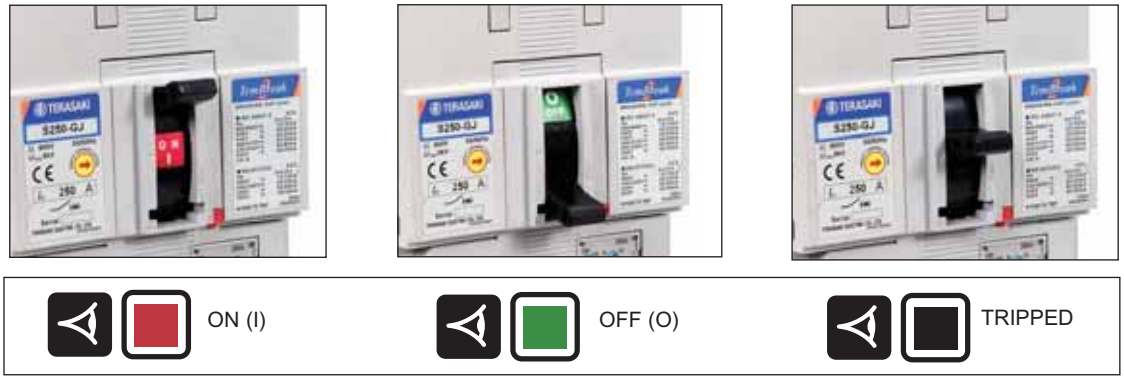
SAFETY PLUS

Visual Safety

You can easily see if a breaker is open, closed or tripped. **SAFETY+** coloured indicators boldly display the ON or OFF status. The indicators are fully covered if a breaker trips, and black is the only visible colour.

This is a ***unique*** safety feature. You can identify faulty circuits at a glance.

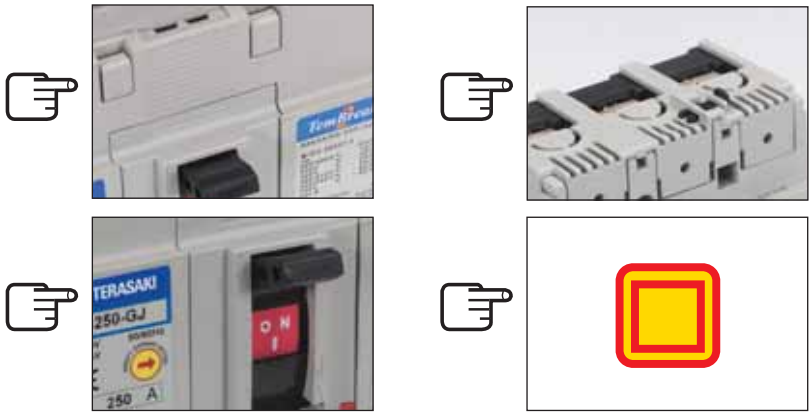
The toggle position always matches the position of the main contacts.



Touch Safety

The risk of touching live parts has been minimised by design.
These features reduce the risk of touching live parts:

- There are no exposed metal screws on the front face
- IP20 protection at the terminals
- IP30 protection at the toggle
- If the toggle is broken by accident or misuse, no live part is exposed
- No live parts are exposed when fitting accessories
- Double Insulation



WELCOME TO TEMBREAK 2

EXCEEDING STANDARDS

Safety Plus

TemBreak 2 MCCBs exceed the requirements of recognised standards.

International Compliance

- The TemBreak 2 MCCB complies with the international standard **IEC 60947-2**
- TemBreak 2 Switch Disconnectors comply with **IEC 60947-3**
- Accessories comply with **IEC 60947-5-1 or IEC 61058-1**
- The entire range conforms to the IEC general rules for switchgear, **IEC 60947-1**
- TemBreak 2 MCCBs comply with **JIS C 8201-2-1 Ann.1**
- The TemBreak 2 range complies with the EC Low Voltage Directive and all models are CE marked
- TemBreak 2 MCCBs carry the IEC symbol indicating Direct Opening Action as defined by **IEC 60947-5-1. IEC 60204-1, Safety of Machinery - Electrical Equipment of Machines** recommends that switches used for machinery have Direct Opening Action to minimise risk in the event of failure

Independent Tests

TemBreak 2 circuit breakers have been tested at independent laboratories as well as in Terasaki's own laboratory in Osaka, Japan. Copies of independent test reports are available on request.

Marine Approvals

TemBreak 2 MCCBs are approved by the leading marine approval organisations.

REDUCING ENVIRONMENTAL IMPACT

Longer Life Cycle

It makes good environmental sense to install a product with a long life expectancy. If you install a TemBreak 2 MCCB, you can expect it to stay in service for at least 30,000 mechanical operations (250A Frame). This is 22,000 more operations than recommended by IEC 60947-2, the international standard for circuit breakers.

If a system must be upgraded in future, we have made the following provisions for recycling:

1. The modular design of TemBreak 2 allows component parts and accessories to be easily disassembled and separately disposed of. Moulded parts do not contain any embedded metal parts.
2. Materials are clearly marked to allow future identification for easy recycling.

1

2

Uses Eco-friendly Materials

The following materials are used in most TemBreak 2 circuit breakers:

- Thermoplastic resin not containing PBBs or PBDEs
- Lead-free solder
- Cadmium-free contacts

Lighter and Smaller

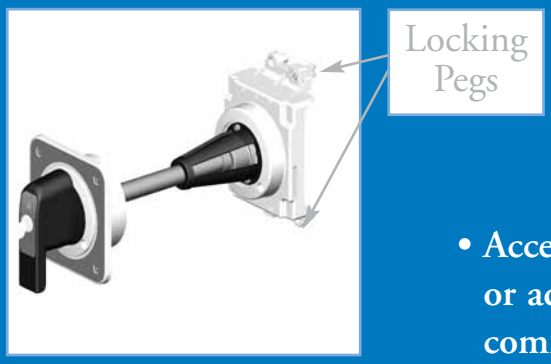
Components with low weight and volume make life easy for users, but high performance from smaller products also means less material used and less waste produced.

ISO 14001

Terasaki operate an Environmental Management System accredited to ISO 14001:1999. This requires us to monitor and measure the environmental performance of our activities, products and services in order to continually improve such performance.

Further information about this standard can be found on the internet at: www.tc207.org

FIELD-INSTALLABLE ACCESSORIES



- Accessories can be fitted by the switchboard builder or added by the end-user. All internal accessories are common for TemBreak 2 MCCBs.
- Handles and motor operators can be rapidly fitted using the locking pegs. It takes **less than 10 seconds to secure a handle or motor** to the MCCB – a great time saving compared to alternative products.
- All accessories are endurance tested to the same level as the host MCCB.

TEMBREAK 2
MOULDED CASE CIRCUIT BREAKERS
16A TO 630A

1. Welcome to TemBreak 2

2. Ratings and Specifications

- **MCCBs** 15
- **Switch-Disconnectors** 19

3. Operating Characteristics

4. Application Data

5. Accessories

6. Installation

7. Dimensions

TEMBREAK 2
MINI MOULDED CASE CIRCUIT BREAKERS
10A TO 100A

8. TemBreak 2 MINI Moulded Case Circuit Breakers

TEMBREAK
MOULDED CASE CIRCUIT BREAKERS
630A TO 1600A

9. TemBreak Moulded Case Circuit Breakers

RATINGS AND SPECIFICATIONS

SECTION 2

MCCB ELECTRICAL CHARACTERISTICS TO IEC 60947-2, EN 60947-2, JIS C 8201-2-1 ANN.1, AS/NZS 3947-2, NEMA AB-1

Frame	Quantity	Unit	Condition	125						160				
Model				E125	S125	S125	S125	H125	L125	S160	S160	S160	H160	L160
Number of Poles				3, 4	1	3, 4	3,4	3, 4	3, 4	1	3, 4	3, 4	3, 4	3, 4
Type				NJ	NF	NJ	GJ	NJ	NJ	NF	NJ	GJ	NJ	NJ
Nominal current ratings														
	I_n	(A)	45°C	20,32,50, 63,100,125	16,20,25, 32,40,50, 63, 80, 100,125	20,32,50, 63,100,125	20,32,50, 63,100,125	20,32,50, 63,100,125	20,32,50, 63,100,125	16,20,25,32, 40,50,63,80, 100,125,160	20,32,50,63, 100,125,160	50,63,100, 125,160	160	160
Electrical characteristics														
Rated operational voltage	U_e	(V)	AC 50/60 Hz	525	240	690	690	690	690	415	690	690	690	690
			DC	500	-	600	600	600	600	125	600	600	600	600
Rated insulation voltage	U_i	(V)		800	800	800	800	800	800	800	800	800	800	800
Rated impulse withstand voltage	U_{imp}	(kV)		8	8	8	8	8	8	8	8	8	8	8
Ultimate breaking capacity (IEC, JIS, AS/NZS)	I_{cu}	(kA)	690V AC	-	-	6	6	20	25	-	7.5 (5*)	7.5	20	25
			525V AC	8	-	22	25	45	65	-	25 (18*)	25	45	65
			440V AC	15	-	25	50	120	180	-	25 (18*)	50	120	180
			400/415V AC	25	-	36	65	125	200	-	36 (30*)	65	125	200
			220/240V AC	35	25	50	85	150	200	25	65 (42*)	85	150	200
			250V DC	25	-	25	40	40	40	-	40 (30*)	40	40	40
Service breaking capacity (IEC, JIS, AS/NZS)	I_{cs}	(kA)	690V AC	-	-	6	6	15	20	-	7.5 (5*)	7.5	15	20
			525V AC	6	-	22	22	45	65	-	25 (18*)	25	45	65
			440V AC	12	-	25	25	80	135	-	25 (18*)	25	80	135
			400/415V AC	19	-	36/30	36/33	85	150	-	36 (25*)	36	85	150
			220/240V AC	27	13	50	85	150	150	19	65 (35*)	85	150	150
			250V DC	19	-	19	40	40	40	-	40 (25*)	40	40	40
Rated breaking capacity (NEMA)		(kA)	480V AC	8	-	22	25	45	65	-	22 (18*)	25	45	65
			240VAC	35	25	50	85	150	200	25	65 (42*)	85	150	200
Protection														
Adjustable thermal, adjustable magnetic				■		■	■	■	■		■	■	■	■
Fixed thermal, fixed magnetic					■					■				
Microprocessor														
Utilisation category				A	A	A	A	A	A	A	A	A	A	A
Installation														
Front connection (FC)				■	■	■	■	■	■	■	■	■	■	■
Extension bar (FB)				•	•	•	•	•	•	•	•	•	•	•
Cable clamp (FW)				•	•	•	•	•	•	•	•	•	•	•
Rear connection (RC)				•	-	•	•	•	•	-	•	•	•	•
Plug-in (PM)				•	-	•	•	•	•	-	•	•	•	•
Draw- out (DR)				-	-	-	-	-	-	-	-	-	-	-
DIN rail mounting (DA)				•	•	•	•	-	-	-	-	-	-	-
Dimensions	h	(mm)		155	155	155	155	165	165	165	165	165	165	165
	w	(mm)	3 pole, (1 pole)	90	(30)	90	90	105	105	(35)	105	105	105	105
			4 pole	120		120	120	140	140	-	140	140	140	140
	d	(mm)		68	68	68	68	103	103	68	68	68	103	103
Weight	W	(kg)	3 pole, (1 pole)	1.1	(0.45)	1.1	1.1	2.4	2.4	(0.5)	1.5	1.5	2.5	2.5
			4 pole	1.4		1.4	1.4	3.2	3.2		1.9	1.9	3.3	3.3
Operation														
Direct Opening Action				■	■	■	■	■	■	■	■	■	■	■
Toggle operation				■	■	■	■	■	■	■	■	■	■	■
Door mounted (HP) / Breaker mounted handle (HB)				•	-	•	•	•	•	-	•	•	•	•
Motor operation (MC)				•	-	•	•	•	•	-	•	•	•	•
Endurance	Electrical	cycles	440V AC	← 30,000 →						← 20,000 →			← 20,000 →	
	Mechanical	cycles		← 30,000 →						← 30,000 →			← 30,000 →	

■ Standard • Optional - Not Available

*Applies only to 20A and 32A models

RATINGS AND SPECIFICATIONS

SECTION 2

MCCB ELECTRICAL CHARACTERISTICS TO IEC 60947-2, EN 60947-2, JIS C 8201-2-1 ANN.1, AS/NZS 3947-2, NEMA AB-1

Frame	Quantity	Unit	Condition	250									400										630			>630
Model				E250	S250	S250	S250	S250	S250	H250	H250	L250	E400	S400	S400	S400	S400	S400	S400	S400	H400	L400	E630	S630	S630	
Number of Poles				3, 4	3, 4	3, 4	3, 4	3, 4	3, 4	3, 4	3, 4	3, 4	3, 4	3, 4	3, 4	3,4	3, 4	3, 4	3, 4	3, 4	3, 4	3, 4	3,4	3, 4	3, 4	
Type				NJ	NJ	GJ	NE	GE	PE	NJ	NE	NJ	NJ	CJ	NJ	NE	GJ	GE	PJ	PE	NE	NE	NE	CE	GE	
Nominal current ratings																										
	I_n	(A)	45°C	20,32 50,63 100,125 160,200 250	160 200 250	160 200 250	40, 125, 250	40, 125, 250	40, 125, 250	160, 250**	40, 125, 250	160, 250**	250, 400	250, 400	250, 400	250, 400	250, 400	250, 400	250, 400	250, 400	250, 400	250, 400	630	630	630	
Electrical characteristics																										
Rated operational voltage	U_e	(V)	AC 50/60 Hz	525	690	690	690	690	690	690	690	690	500	690	690	690	690	690	690	690	690	690	690*	690*	690*	
			DC	500	600	600	-	-	-	600	-	600	500	600	600	-	600	-	600	-	-	-	-	-	-	
Rated insulation voltage	U_i	(V)		800	800	800	800	800	800	800	800	800	800	800	800	800	800	800	800	800	800	800	800	800	800	
Rated impulse withstand voltage	U_{imp}	(kV)		8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	
Ultimate breaking capacity (IEC, JIS, AS/NZS)	I_{cu}	(kA)	690V AC	-	7.5	7.5	7.5	7.5	20	20	20	25	-	15	20	20	20	20	20	20	35	50	10*	20*	20*	
			525V AC	10	25	25	25	25	35	45	45	65	15	22	30	30	30	30	30	30	45	65	15	30	30	
			440V AC	15	25	50	25	50	50	120	120	180	22	30	45	45	65	65	80	80	120	180	25	45	65	
			400/415V AC	25	36	65	36	65	70	125	125	200	25	36	50	50	70	70	85	85	125	200	36	50	70	
			220/240V AC	35	65	85	65	85	125	150	150	200	35	50	85	85	100	100	100	100	150	200	50	85	100	
			250V DC	25	40	40	-	-	-	40	-	40	25	40	40	-	40	-	40	-	-	40	-	-	-	
Service breaking capacity (IEC, JIS, AS/NZS)	I_{cs}	(kA)	690V AC	-	7.5	7.5	7.5	7.5	15	15	15	20	-	15	15	15	15	15	15	15	35	50	10*	15*	15*	
			525V AC	7.5	25	25	25	25	35	45	45	65	15	22	30	30	30	30	30	30	45	65	15	30	30	
			440V AC	12	25	25	25	25	50	80	80	135	22	30	45	45	50	50	80	80	80	135	25	45	50	
			400/415V AC	19	36	36	36	36	70	85	85	150	25	36	50	50	50	50	85	85	85	150	36	50	50	
			220/240V AC	27	65	85	65	85	125	150	150	150	35	50	85	85	85	85	85	85	150	150	50	85	85	
			250V DC	19	40	40	-	-	-	40	-	40	19	40	40	-	40	-	40	-	-	-	-	-	-	
Rated breaking capacity (NEMA)		(kA)	480V AC	10	22	25	25	25	35	45	45	65	15	22	25	25	30	30	30	30	45	65	15	25	30	
			240VAC	35	65	85	65	85	125	150	150	200	35	50	85	85	100	100	100	100	150	200	50	85	100	
Rated short-time withstand current	I_{cw}	(kA)	0.3 Seconds	-	-	-	-	-	-	-	-	-	-	-	-	5	-	5	-	5	5	5	-	-	-	
Protection																										
Adjustable thermal, adjustable magnetic				■	■	■				■		■	■	■	■		■		■							
Fixed thermal, fixed magnetic							■	■	■		■					■		■		■	■	■	■	■	■	
Microprocessor																										
Utilisation category				A	A	A	A	A	A	A	A	A	A	A	A	B	A	B	A	B	B	B	A	A	A	
Installation																										
Front connection (FC)				■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
Extension bar (FB)				•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
Cable clamp (FW)				•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	–	–	–	
Rear connection (RC)				•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
Plug-in (PM)				•	•	•	•	•	-	†	-	†	•	•	•	•	•	•	•	•	•	•	‡	‡	‡	
Draw- out (DR)				-	-	-	-	-	-	-	-	-	•	•	•	•	•	•	•	•	•	•	-	-	-	
DIN rail mounting (DA)				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Dimensions	h	(mm)		165	165	165	165	165	165	165	165	165	260	260	260	260	260	260	260	260	260	260	260	260	260	
	w	(mm)	3 pole	105	105	105	105	105	105	105	105	105	140	140	140	140	140	140	40	140	140	140	140	140	140	
		(mm)	4 pole	140	140	140	140	140	140	140	140	140	185	185	185	185	185	185	185	185	185	185	185	185	185	
	d	(mm)		68	68	68	103	103	103	103	103	103	103	103	103	103	103	103	103	103	140	140	103	103	103	
Weight	W	(kg)	3 pole	1.5	1.5	1.5	2.3	2.3	2.5	2.4	2.5	2.4	4.2	4.2	4.2	4.3	4.2	4.3	4.2	4.3	7.1	7.1	5.0	5.0	5.0	
			4 pole	1.9	1.9	1.9	3.1	3.1	3.3	3.2	3.3	3.2	5.6	5.6	5.6	5.7	5.6	5.7	5.6	5.7	9.4	9.4	6.5	6.5	6.5	
Operation																										
Direct Opening Action				■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
Toggle operation				■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
Door mounted (HP) / Breaker mounted handle (HB)				•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
Motor operation (MC)				•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
Endurance	Electrical	cycles	415V AC	10,000									4,500										4,500			
	Mechanical	cycles		30,000									15,000										15,000			

TURN TO PAGE 165, SECTION 9, FOR RATINGS AND SPECIFICATIONS OF MCCBs FROM 630A TO 1600A

■ Standard • Optional - Not Available

*MCCB cannot be used in IT systems at this voltage.
**Max. rating 225A for Plug-in.
† Refer to Temperature Ratings, Section 6.
‡ Contact us for details.

RATINGS AND SPECIFICATIONS

SECTION 2

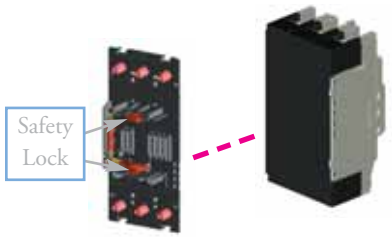
SWITCH-DISCONNECTOR ELECTRICAL CHARACTERISTICS TO IEC 60947-3, EN 60947-3, AS/NZS 3947-3

Frame	Quantity	Unit	Condition	125	160	250	400	630
Model				S125	S160	S250	S400	S630
Number of Poles				3,4	3,4	3,4	3,4	3,4
Type				NN	NN	NN	NN	NN
Nominal current ratings								
	I_e	(A)		125	160	250	400	630
Electrical characteristics								
Rated operational voltage	U_e	(V)	AC 50/60 Hz	690	690	690	690	690
			DC	600	600	600	600	600
Rated insulation voltage	U_i	(V)		800	800	800	800	800
Rated impulse withstand voltage	U_{imp}	(kV)		8	8	8	8	8
Rated short -circuit making capacity	I_{cm}	(kA peak)		3.6	6	6	9	9
Rated short-time withstand current	I_{cw}	(kA rms)	0.3 Seconds	2	3	3	5	5
Utilisation category to IEC 60947-3			AC	AC-23A	AC-23A	AC-23A	AC-23A	AC-23A
			DC	DC-22A	DC-22A	DC-22A	DC-22A	DC-22A
Installation								
Front connection (FC)				■	■	■	■	■
Extension bar (FB)				•	•	•	•	•
Cable clamp (FW)				•	•	•	•	•
Rear connection (RC)				•	•	•	•	•
Plug-in (PM)				•	•	•	•	ǂ
Draw- out (DR)				-	-	-	-	-
DIN rail mounting (DA)				•	-	-	-	-
Dimensions	h	(mm)		155	165	165	260	260
	w	(mm)	3 pole	90	105	105	140	140
			4 pole	120	140	140	185	185
	d	(mm)		68	68	68	103	103
Weight	W	(kg)	3 pole	1.1	1.5	1.5	4.2	4.4
			4 pole	1.4	1.9	1.9	5.6	5.8
Operation								
Direct Opening Action				■	■	■	■	■
Toggle operation				■	■	■	■	■
Door mounted (HP) / Breaker mounted handle (HB)				•	•	•	•	•
Motor operation (MC)				•	•	•	•	•
Endurance	Electrical	cycles	415V AC	30,000	20,000	10,000	4,500	4,500
	Mechanical	cycles		30,000	30,000	30,000	15,000	15,000

■ Standard • Optional - Not Available ǂ Contact us for details.

SAFETY LOCK FOR PLUG-IN VERSIONS

Plug-in MCCB and base



Plug-in connection kit, including safety lock

The plug-in MCCB is locked to the base when the toggle is ON. It cannot be removed unless the toggle is OFF or TRIPPED. The safety lock prevents a trip occurring as the MCCB is being removed from the base.

Safety+

2

OPERATING CHARACTERISTICS

TEMBREAK 2
MOULDED CASE CIRCUIT BREAKERS 16A TO 630A

1. Welcome to TemBreak 2
2. Ratings and Specifications
3. **Operating Characteristics**
   - Thermal Magnetic Protection 23
   - Thermal Magnetic Time / Current Characteristics 26
   - Electronic Protection
     - Standard type 32
     - With LCD 39
   - Electronic Time / Current Characteristics
     - Standard type 36
     - With LCD 43
   - Let-through Peak Current Characteristics 45
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4. Application Data
5. Accessories
6. Installation
7. Dimensions

TEMBREAK 2
MINI MOULDED CASE CIRCUIT BREAKERS 10A TO 100A

8. TemBreak 2 MINI Moulded Case Circuit Breakers

TEMBREAK
MOULDED CASE CIRCUIT BREAKERS 630A TO 1600A

9. TemBreak Moulded Case Circuit Breakers

OPERATING CHARACTERISTICS

THERMAL MAGNETIC PROTECTION

TemBreak 2 MCCBs from 125A frame to 400A frame are available with thermal magnetic protection units. Refer to Section 9 for details of TemBreak thermal magnetic MCCBs up to 800A.

Thermal Magnetic trip units are especially suited to the following applications:

- Installations where harmonic distortion of current waveforms is likely. They operate inherently on the root mean square (rms) heating effect of current.
- DC circuits. Refer to Section 4, "The Application of MCCBs in DC Systems" for more information.

3 Pole MCCB with Adjustable Thermal and Adjustable Magnetic Characteristics

Single Pole MCCB with Fixed Characteristics

Models with Adjustable Thermal and Adjustable Magnetic Characteristics

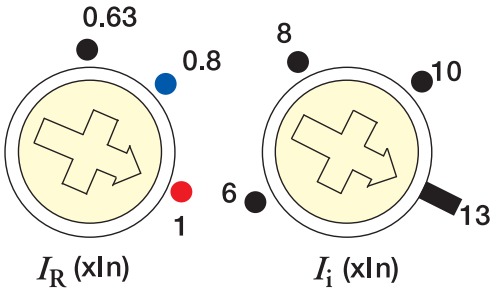
All standard 3 pole and 4 pole TemBreak 2 thermal magnetic models have adjustable thermal and adjustable magnetic characteristics.

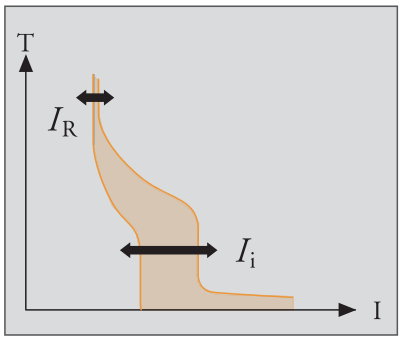
Traditionally, thermal magnetic MCCBs have had adjustable thermal with fixed magnetic characteristics. The fixed magnetic element can limit the application of the MCCB.

An adjustable magnetic characteristic allows short-circuit protection to be matched to the load and supply characteristics, for example motor inrush currents or generator short-circuit currents. Lowering the short-circuit tripping threshold can allow a higher earth-loop impedance in an installation and provide end-of-cable protection with the correct disconnection times.

THERMAL MAGNETIC PROTECTION

Adjustment Dials





1. I_R is the thermal element adjustment dial and is used to set the rated current to match the conductor rating.

   I_R can be set between 0.63 and 1.0 times I_n.

2. I_i is the magnetic element adjustment dial and is used to set the short circuit tripping threshold to suit the application.

   I_i can be set between 6 and 12 times I_n on 125A and 400A frame models.

   I_i can be set between 6 and 13 times I_n on 250A frame models with ratings of 160A, 200A and 250A.

   I_i can be set between 6 and 12 times I_n on 250A frame models with ratings of 125A and less.

Models, Types and Rated Currents of Thermal Elements

Model	Type	Current Rating In (A)
S125	-NF	16, 20, 25, 32, 40, 50, 63, 80, 100, 125
E125	-NJ	20, 32, 50, 63, 100, 125
S125	-NJ	20, 32, 50, 63, 100, 125
S125	-GJ	20, 32, 50, 63, 100, 125
H125	-NJ	20, 32, 50, 63, 100, 125
L125	-NJ	20, 32, 50, 63, 100, 125
S160	-NF	16, 20, 25, 32, 40, 50, 63, 80, 100, 125, 160
S160	-NJ	20, 32, 50, 63, 100, 125, 160
S160	-GJ	50, 63, 100, 125, 160
H160	-NJ	160
L160	-NJ	160
E250	-NJ	20, 32, 50, 63, 100, 125, 160, 200, 250
S250	-NJ	160, 200, 250
S250	-GJ	160, 200, 250
H250	-NJ	160, 250*
L250	-NJ	160, 250*
E400	-NJ	250, 400
S400	-CJ	250, 400
S400	-NJ	250, 400
S400	-GJ	250, 400

*225A for Plug-in

THERMAL MAGNETIC PROTECTION

Single Pole MCCBs

Single pole models have fixed thermal and fixed magnetic characteristics.

Generator Protection

Generators may need specially modified protection characteristics, based on their short-circuit capability.

If a generator is capable of delivering short-circuit current greater than six times its full load current, a standard TemBreak 2 thermal magnetic MCCB may be used, with I_i set at less than the available short-circuit current. (Note that MCCBs, with fixed magnetic characteristics may not be suitable for this application.)

A thermal magnetic MCCB with low instantaneous protection may be used where the generator short-circuit current is less than six times its full load current. These are modified versions of the standard MCCB.

Four pole MCCBs with low instantaneous protection have protection on the neutral pole as standard. The magnetic characteristic of MCCBs with low instantaneous protection is fixed at the following values:

Model	Magnetic Trip Current
E125	$3xI_n$
S125	$3xI_n$
S160	$3xI_n$
E250	$3xI_n$
S250	$3xI_n$
E400	$3.5xI_n$
S400	$3.5xI_n$

Neutral Pole Protection

Neutral pole protection is available as an optional extra on four pole thermal magnetic MCCBs. The thermal and magnetic elements in the neutral pole are related to those in the phase poles as follows:

	Phase Trip Threshold	Neutral Trip Threshold
Thermal	I_r (adjustable)	I_N (adjustable)= I_n
Magnetic	I_i (adjustable)	I_i (adjustable)

Motor Protection

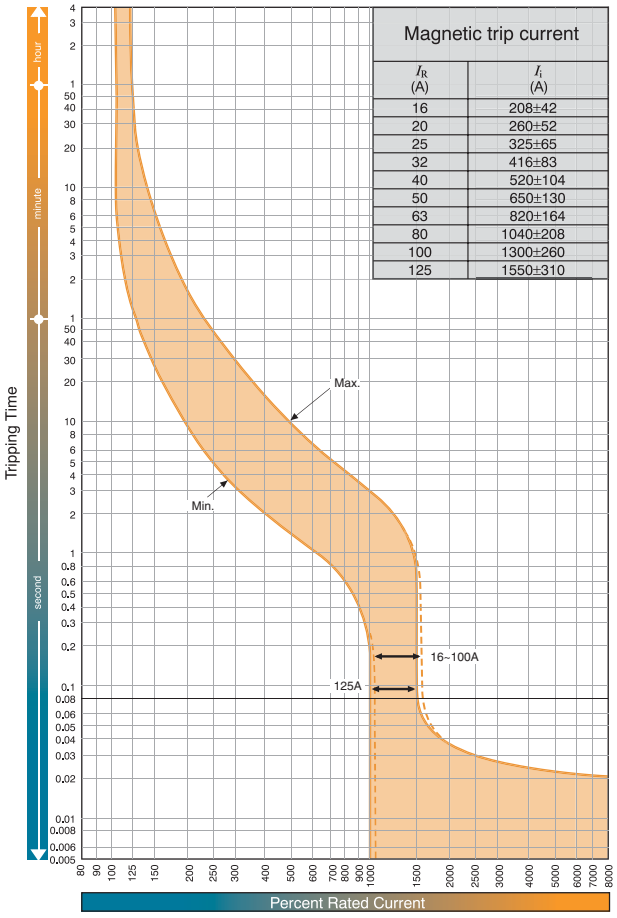
MCCBs feeding motors are often only required to provide protection from short-circuits. Overload protection is provided by a dedicated thermal or electronic overload relay. Tembreak 2 MCCBs without thermal protection elements are available for this application. Four pole MCCBs with magnetic trip only have protection on the neutral pole as standard.

THERMAL MAGNETIC CHARACTERISTICS

Single Pole MCCBs

Time/current characteristic curves

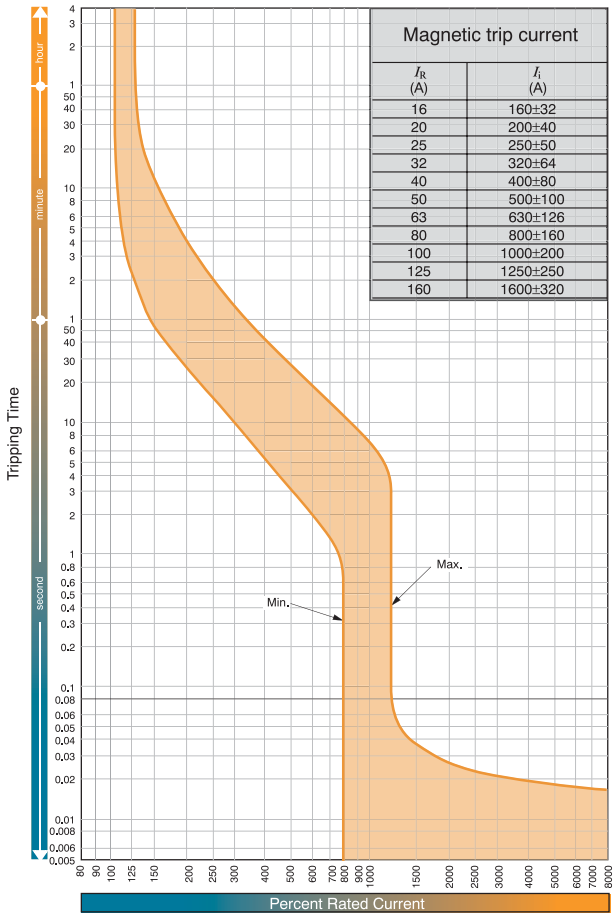
S125-NF



Magnetic trip current	
I_R (A)	I_i (A)
16	208±42
20	260±52
25	325±65
32	416±83
40	520±104
50	650±130
63	820±164
80	1040±208
100	1300±260
125	1550±310

Time/current characteristic curves

S160-NF



Magnetic trip current	
I_R (A)	I_i (A)
16	160±32
20	200±40
25	250±50
32	320±64
40	400±80
50	500±100
63	630±126
80	800±160
100	1000±200
125	1250±250
160	1600±320

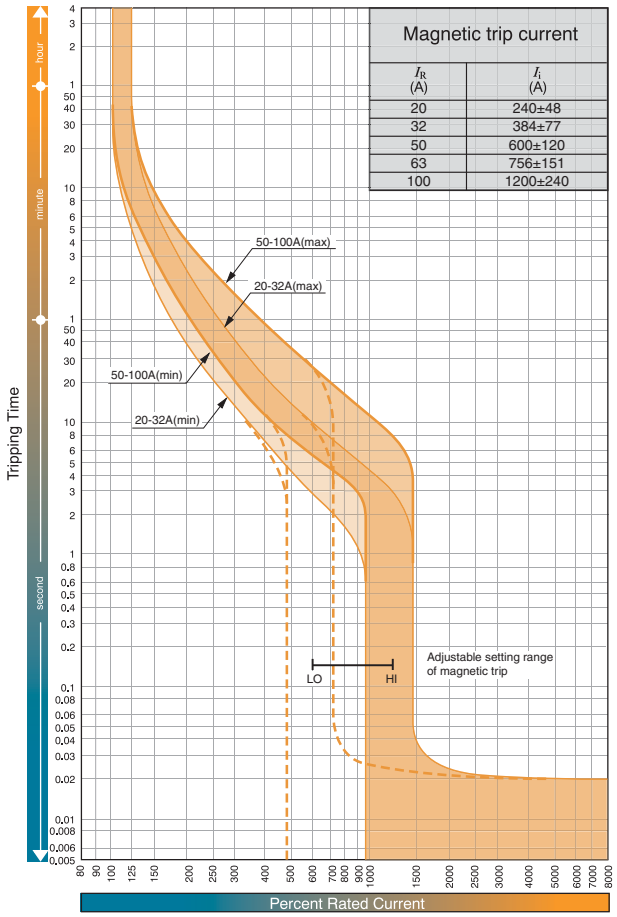
SECTION 3

THERMAL MAGNETIC CHARACTERISTICS

125A Frame

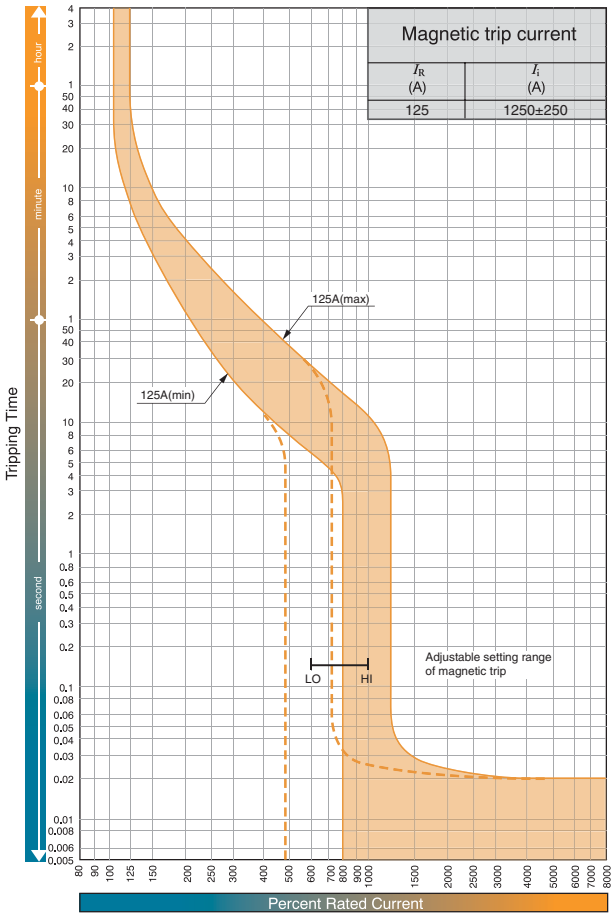
Time/current characteristic curves

E125-NJ, S125-NJ, S125-GJ



Time/current characteristic curves

E125-NJ, S125-NJ, S125-GJ

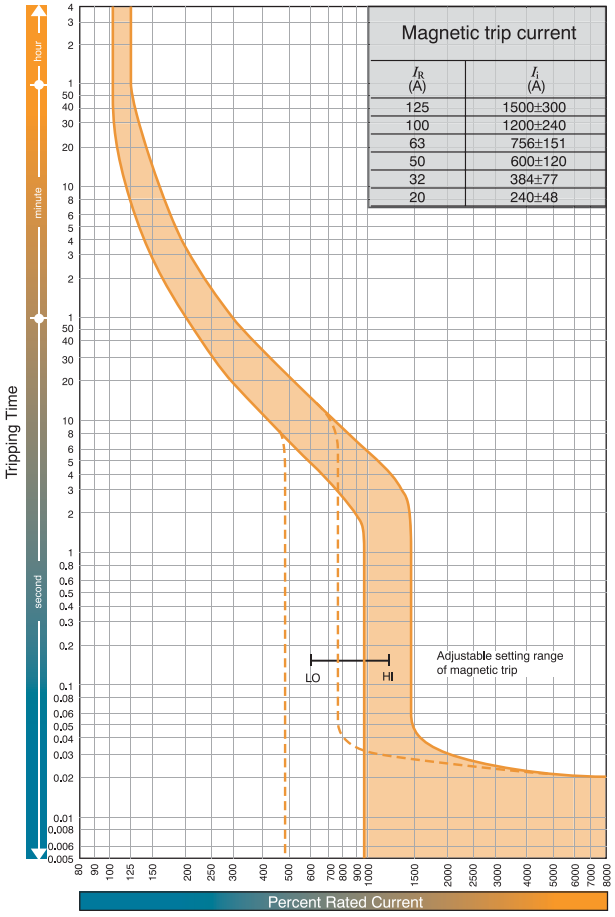


THERMAL MAGNETIC CHARACTERISTICS

125A Frame

Time/current characteristic curves

H125-NJ, L125-NJ



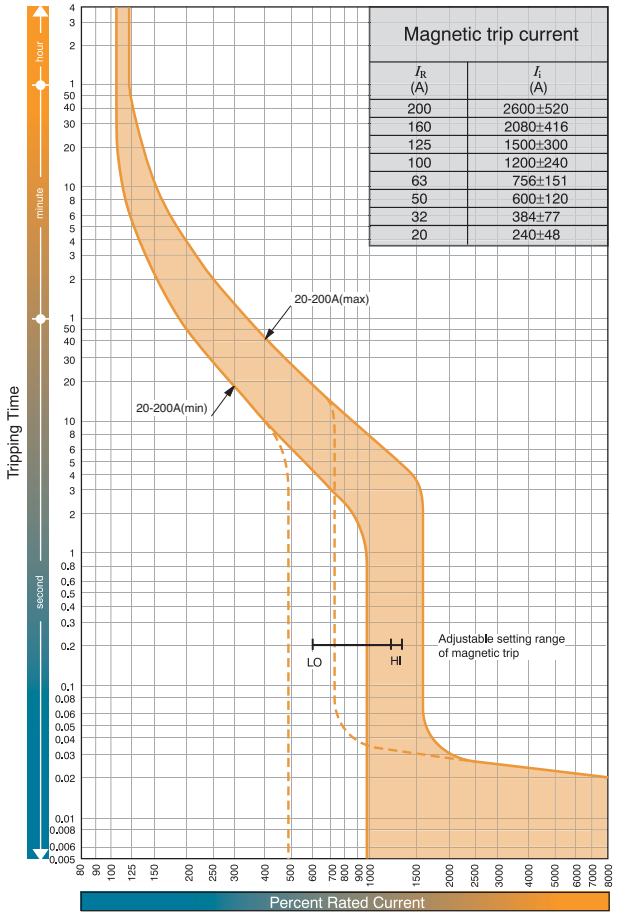
SECTION 3

THERMAL MAGNETIC CHARACTERISTICS

160A and 250A Frames

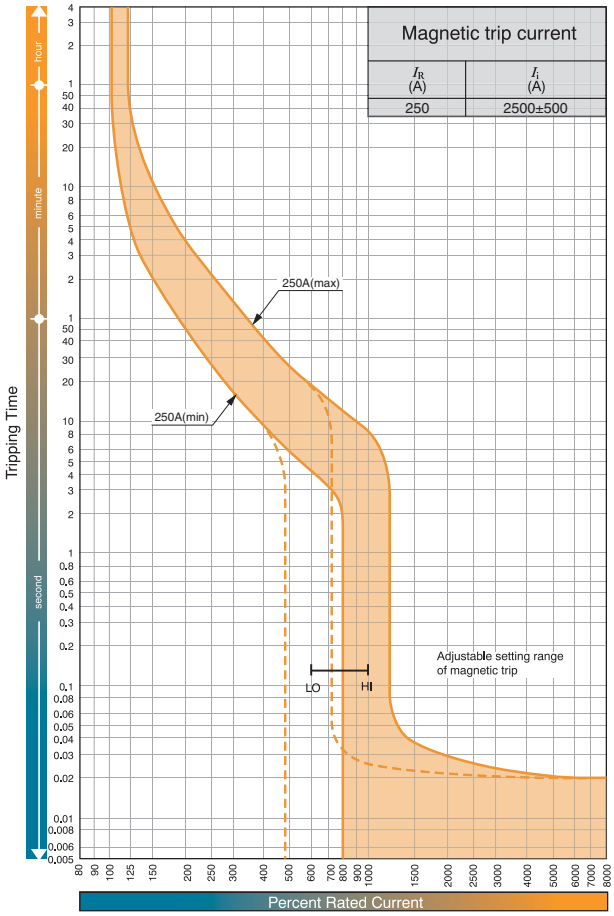
Time/current characteristic curves

S160-NJ, S160-GJ, E250-NJ, S250-NJ, S250-GJ



Time/current characteristic curves

E250-NJ, S250-NJ, S250-GJ

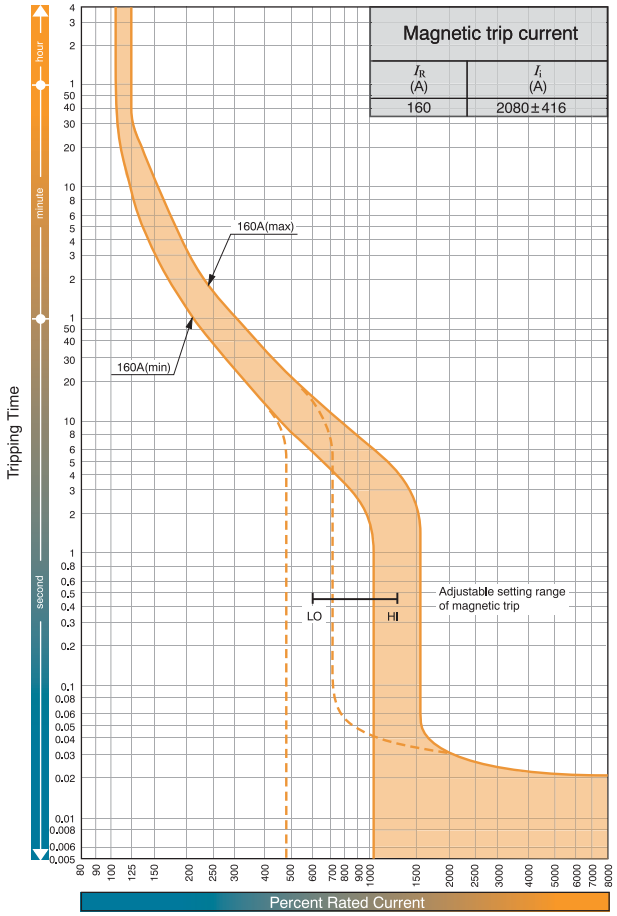


THERMAL MAGNETIC CHARACTERISTICS

160A and 250A Frames

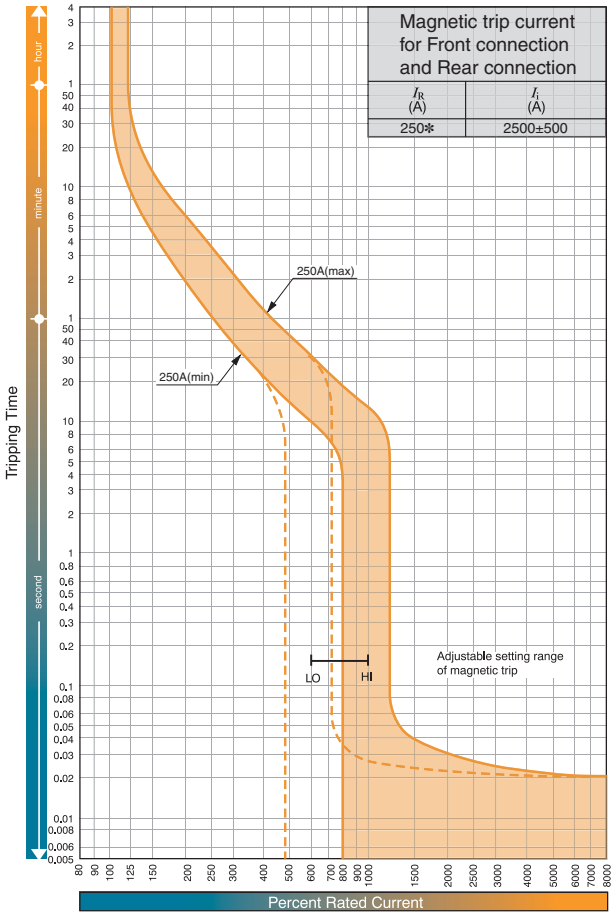
Time/current characteristic curves

H160-NJ, H250-NJ, L160-NJ, L250-NJ



Time/current characteristic curves

H250-NJ, L250-NJ



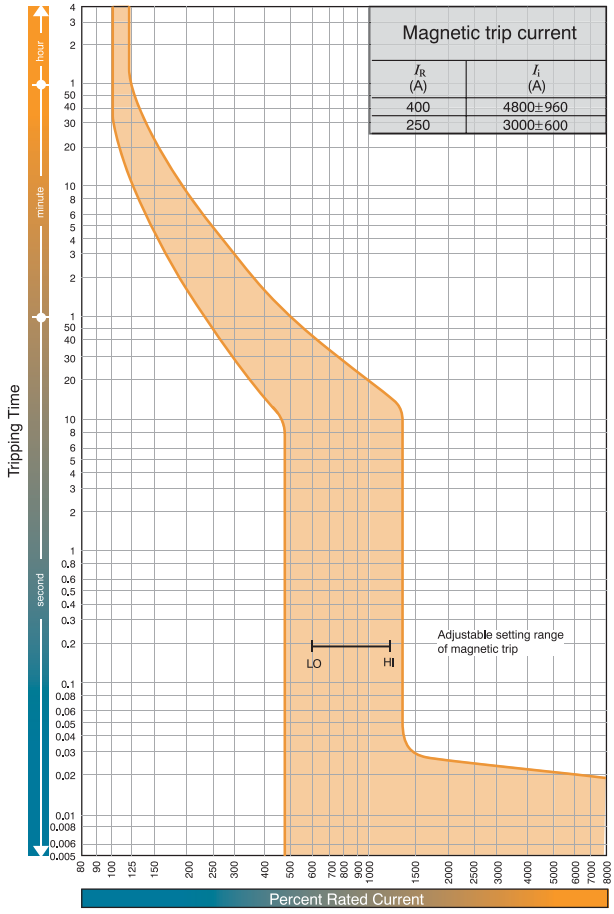
✻ For Plug-in connection,
Max. rating 225A
I_i=2925A±585A

THERMAL MAGNETIC CHARACTERISTICS

400A Frame

Time/current characteristic curves

E400-NJ, S400-CJ, S400-NJ, S400-GJ, S400-PJ



ELECTRONIC PROTECTION (STANDARD TYPE)

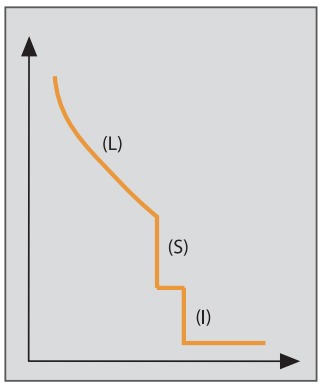
TemBreak 2 MCCBs from 250A frame to 630A frame are available with electronic protection units. Current ratings, I_n, of 40A, 125A, 160A, 250A, 400A and 630A are available. These offer great flexibility as their characteristics can be set to suit a wide range of application conditions. Overload protection can be set between 0.4 and 1.0 times I_n.

Terasaki offer one of the most adaptable protection units on the market:

If you require a characteristic which is not available as a preset on our standard electronic protection unit, send us the details and we will program a customised characteristic to your specification.*

Selecting a Preset Characteristic for a 400A TemBreak 2 MCCB with Electronic Protection

Every TemBreak 2 electronic protection unit includes overload protection (L), delayed short-circuit protection (S) and instantaneous protection (I) as standard.



Electronic Protection Characteristic

*Characteristic is programmable within certain limits. Contact us for details.

ELECTRONIC PROTECTION (STANDARD TYPE)

Optional Functions

Three optional functions are available:

Ground Fault Trip (G)

This function trips the MCCB after time delay, t_g, if the ground fault current exceeds the preset threshold, I_g. Ground fault protection can be enabled and disabled by operating a DIP switch on the electronic protection unit. An external current transformer is available if the ground fault trip function is required on a 3 pole MCCB, in a 3 phase, 4 wire system.

Neutral Protection (N)

Neutral protection trips the MCCB after time delay, t_N, if current in the neutral conductor exceeds the rated current, I_n, of the MCCB. The time delay characteristic is identical to that of the overload characteristic (L).

Preferential Trip Alarm (P)

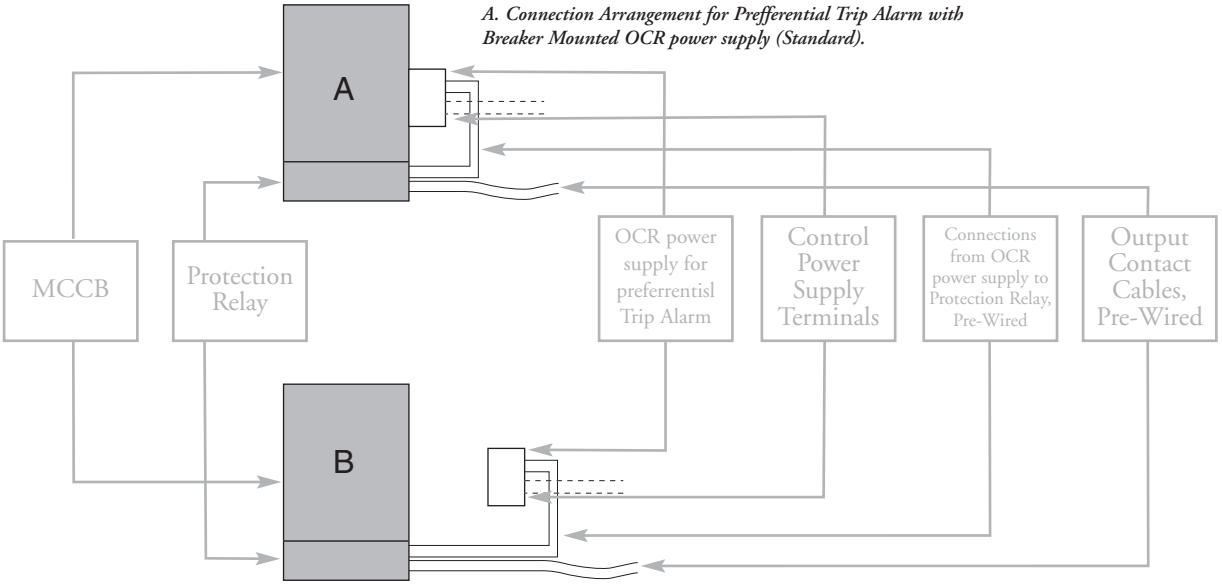
An LED and volt-free output contact are activated after a time delay, t_p, if the load current exceeds the preset threshold, I_p.

An OCR power supply is required for operation of the preferential trip alarm. This is mounted as shown below, either on the side of the breaker (250A, 400A, 630A – standard), or remotely (400A, 630A only – on request). Ratings, specifications and wiring arrangements are shown below. Dimensions of the OCR power supply for preferential trip alarm can be found in Section 7. Note that the breaker mounted terminal block is not compatible with the OCR power supply for Front-Connected and Rear-Connected MCCBs described in Section 5, if the OCR power supply is mounted on the right side of the breaker.

Control Power Supply Specifications		
Frame (A)	250	400/630
Voltage	200-240V AC	200-240V AC
Rated Power	2VA	2VA

Rated Current of Output Contact		
Frame (A)	250	400/630
125V AC, resistive load	3A	3A
125V AC, inductive load	2A	2A
250V AC, resistive load	3A	3A
250V AC, inductive load	2A	2A
30V DC, resistive load	2A	2A
30V DC, inductive load	2A	2A

ELECTRONIC PROTECTION (STANDARD TYPE)



A. Connection Arrangement for Prefferential Trip Alarm with Breaker Mounted OCR power supply (Standard).

B. Connection Arrangement for Prefferential Trip Alarm with Remotely Mounted OCR power supply (On Request).

How to Specify Optional Functions

Optional functions must be specified at the time of order. Descriptions for electronic MCCBs include a 1-4 digit alphabetic code after the type designation which details the combination of optional functions. For example:

S400-GE **APG** 3P 400A FC - includes preferential trip and ground fault trip.

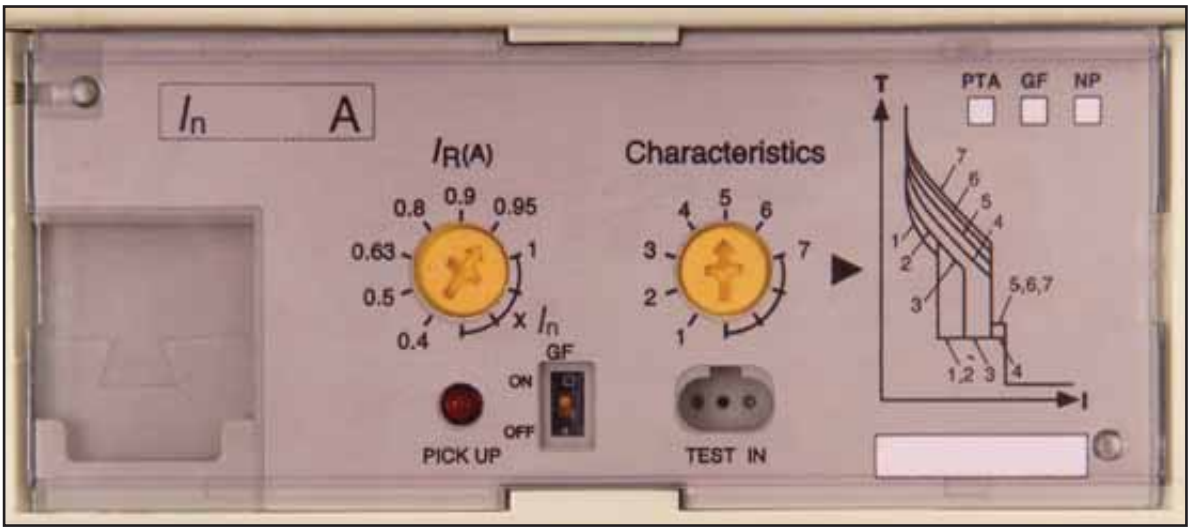
The table below lists codes for all the optional functions currently available:

		Optional Function			
I_n	Poles	Code	Ground Fault (G)	Neutral Protection (N)	Preferential Trip Alarm (P)
250	3	AP	-	-	■
	4	AP	-	-	■
		AN	-	■	-
		APN	-	■	■
400	3	AP	-	-	■
		AG	■	-	-
		APG	■	-	■
	4	AP	-	-	■
		AN	-	■	-
		APN	-	■	■
		AGN	■	■	-
		APGN	■	■	■
630	3	AP	-	-	■
		AG	■	-	-
		APG	■	-	■
	4	AP	-	-	■
		AN	-	■	-
		APN	-	■	■
		AGN	■	■	-
		APGN	■	■	■

■ Available - Not Available

ELECTRONIC PROTECTION (STANDARD TYPE)

Adjustment Dials



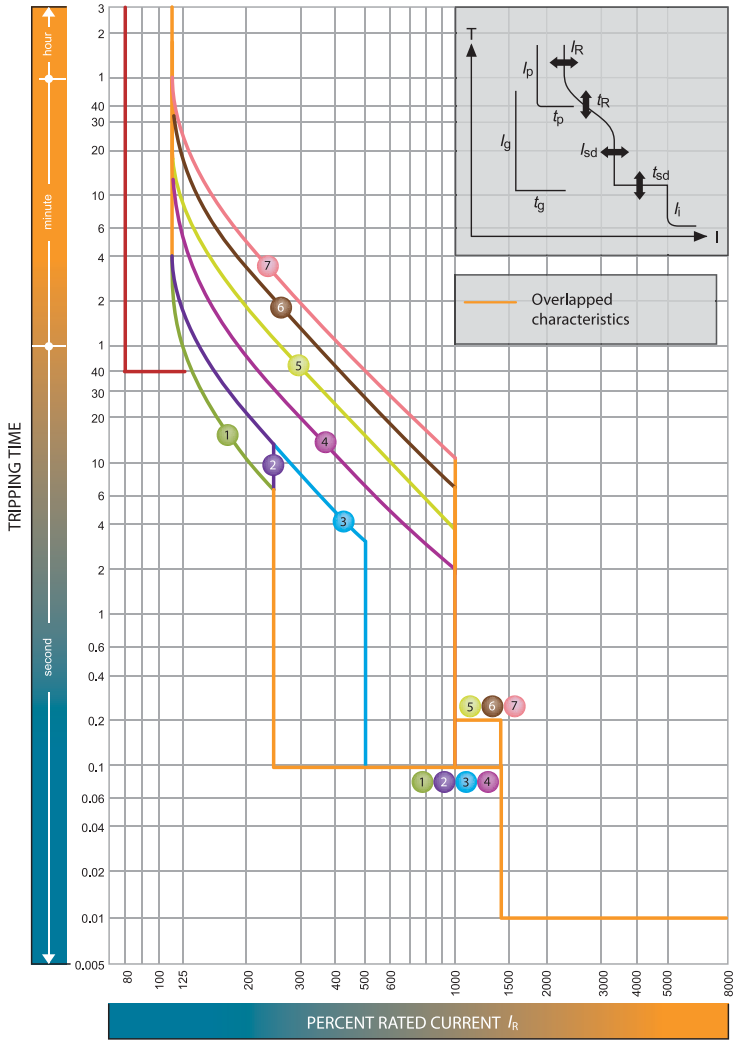
The left adjustment dial sets the rated current to match the conductor rating. The right adjustment dial selects one of seven preset characteristics on 250A and 400A models, and one of six preset characteristics on 630A models. The effects of the left adjustment dial (labelled I_R(A)), and the right adjustment dial (labelled Characteristics) are detailed in the tables shown underneath each time / current graph.

Tolerances of Characteristics

Characteristics		Tolerance
Long Time Delay	t_R	± 20%
Short Time Delay	I_{sd}	± 15%
	t_{sd}	Total clearing time +50ms, resettable time -20ms
Instantaneous	I_i	± 20%
Preferential Trip Alarm	I_p	± 10%
	t_p	± 10%
Ground Fault Trip	I_g	± 15%
	t_g	Total clearing time +50ms, resettable time -20ms
Neutral Protection	I_N	± 15%

ELECTRONIC CHARACTERISTICS (STANDARD TYPE)

S250-NE, S250-GE, S250-PE, H250-NE



I_n = 250A; 125A; 40A Note(1)

			I_R (A)							
			LTD Pick-up current I_R	x/n	0.4	0.5	0.63	0.8	0.9	0.95	1.0

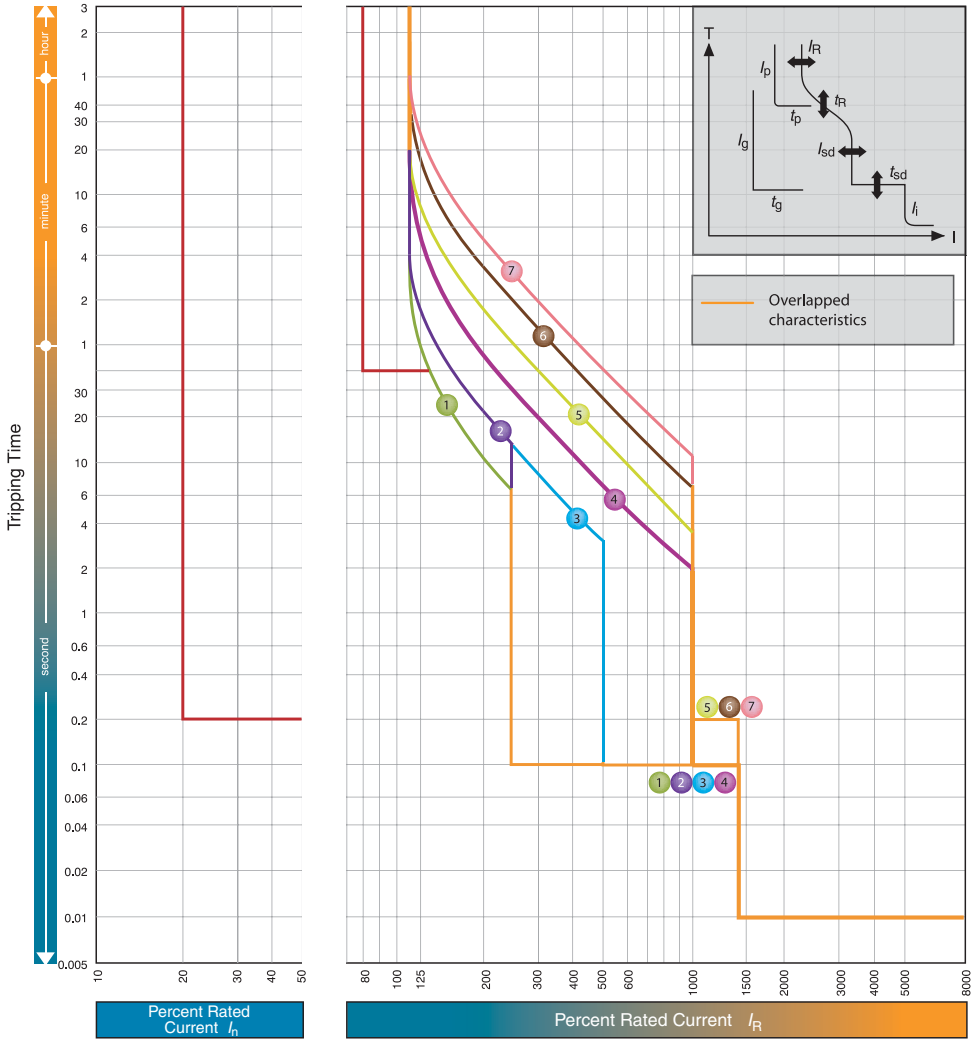
	Characteristics		No.	1	2	3	4	5
Standard	LT	t_R	(s)	11	21	21	5	7.5
				at 200% x I_R			at 600% x I_R	
	ST	I_{sd}	x/I_R	2.5		5	10	
		t_{sd}	(s)	0.1				0.2
	INST	I_i	x/I_R	14(Max: 13 x I_n) Note (2)				
Option	PTA	I_p	x/I_R	0.8				
		t_p	(s)	40				
	NP	I_N	x/I_R	1.0 Note (3)				
		t_N	(s)	$t_N = t_R$				

Note
(1) For Plug-in (PM), I_n=225A instead of 250A, I_R=(0.5, 0.63, 0.8, 0.9, 0.95, 1.0) x I_n 6 graduations
(2) I_i max. = 13 x I_n. (3) Characteristic of neutral protection (t_N vs. I_N) is identical to characteristic of phase protection (t_R vs. I_R).

OPERATING CHARACTERISTICS

ELECTRONIC CHARACTERISTICS (STANDARD TYPE)

S400-NE, S400-GE, S400-PE, H400-NE, L400-NE



I_n = 400A; 250A Note(1)

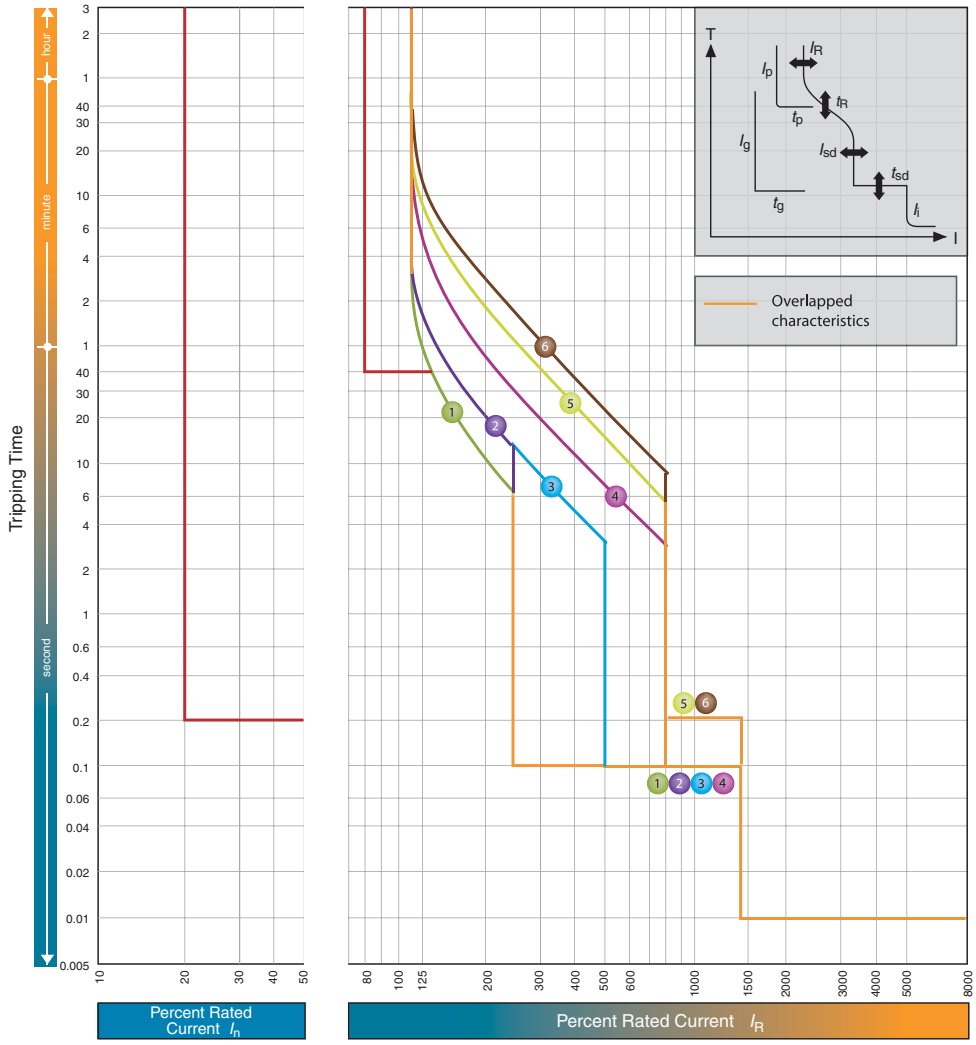
			I_R (A)							
			LTD Pick-up current I_R	x/n	0.4	0.5	0.63	0.8	0.9	0.95	1.0
	Characteristics			No.	1	2	3	4	5	6	7
Standard	LT	t_R		(s)	11	21	21	5	10	19	29
					at 200% x I_R			at 600% x I_R			
	ST	I_{sd}		xI_R	2.5		5	10			
		t_{sd}		(s)	0.1				0.2		
	INST	I_i		xI_R	14(Max: 13 x I_n) Note (2)						
Option	PTA	I_p		xI_R	0.8						
		t_p		(s)	40						
	GF Note(4)	I_g		xI_n	0.2						
		t_g		(s)	0.2						
	NP	I_N		xI_R	1.0/0.5 Note(3)						
		t_N		(s)	t_N=t_R						

Note

(1) GF is not available when In is 250A. (2) I_i max. = 13 x I_n. (3) 1.0 x I_R or 0.5 x I_R can be selected. Characteristic of neutral protection (t_N vs. I_N) is identical to characteristic of phase protection (t_R vs. I_R). (4) When you specify GF on MCCBs with 3 poles the terminal block is automatically fitted to connect with the external neutral CT for 3 phases 4 wires system. See terminal blocks in section 7.

ELECTRONIC CHARACTERISTICS (STANDARD TYPE)

E630-NE, S630-CE, S630-GE



I_n = 630A

I_R (A)									
LTD Pick-up current	I_R	xI_n	0.4	0.5	0.63	0.8	0.85	0.9	0.95	1.0

	Characteristics		No.	1	2	3	4	5	6
Standard	LT	t_R	(s)	11	21	21	5	10	16
				at 200% x I_R			at 600% x I_R		
	ST	I_{sd}	xI_R	2.5		5	8		
		t_{sd}	(s)	0.1				0.2	
	INST	I_i	xI_R	14(Max: 10 x I_n) Note (1)					
Option	PTA	I_p	xI_R	0.8					
		t_p	(s)	40					
	GF Note(3)	I_g	xI_n	0.2					
		t_g	(s)	0.2					
	NP	I_N	xI_R	1.0/0.5 Note(2)					
		t_N	(s)	t_N=t_R					

Note

(1) I_i max. = 10 x I_n. (2) 1.0 x I_R or 0.5 x I_R can be selected. Characteristic of neutral protection (t_N vs. I_N) is identical to characteristic of phase protection (t_R vs. I_R). (3) When you specify GF on MCCBs with 3 poles the terminal block is automatically fitted to connect with the external neutral CT for 3 phases 4 wires system. See terminal blocks in section 7.

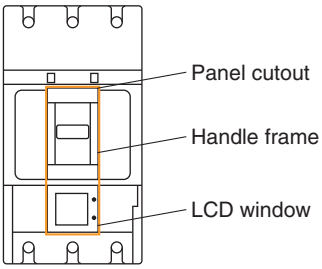
ELECTRONIC PROTECTION (WITH LCD)

Appearance

The TemBreak2 enhanced electronic breaker with integrated VT and CT monitors the current, voltage, instantaneous electrical power, integrated electrical energy and power factor of a circuit and displays their values on the LCD on the front of the breaker. This breaker using the Modbus protocol allows data such as measured values and event/fault logs to be transmitted to an external device.

- The LCD window provides the phase currents, line voltages (and their maximum values), power factor, electrical power and electrical energy. It can also provide the 1st to 19th harmonic currents for each phase.

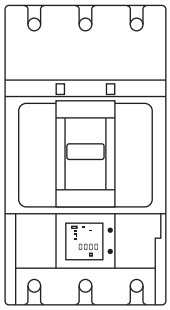
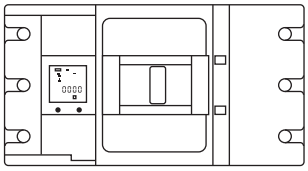
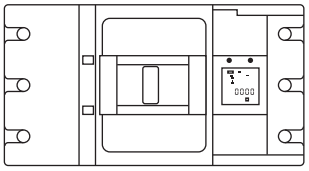
- When a fault occurs, the cause of the fault and the fault current are indicated on the LCD. Data in memory is stored even if the power is lost. You can view event or fault logs after the power is restored.



The LCD window is equal to the handle frame in width; the panel cutout can be made easily.

ELECTRONIC PROTECTION (WITH LCD)

● The breaker is available in three LCD orientations corresponding to the installation orientations of the breaker.

Vertical (move the handle up to ON) (Standard orientation)	Horizontal (move the handle right to ON)	Horizontal (move the handle left to ON)
		

If the breaker is installed in a horizontal orientation, please specify "Horizontal (move the handle right to ON)" or "Horizontal (move the handle left to ON)" when ordering. Otherwise the standard orientation "Vertical (move the handle up to ON)" will apply.

OCR Power Supply for Electronic Protection with LCD

The XOW OCR, protection relays, requires control power.
The OCR power supply is installed on the right side of the breaker as standard. This can also be installed separately to the breaker. Please specify when ordering.

Note ①: When the OCR power supply is installed on the right side of the breaker, the breaker cannot be equipped with a terminal block for connection to the shunt trip device and under voltage trip device.

● Specifications of OCR power supply

Control voltage Note ② (Rated voltage)	100 – 120 VAC or 200 – 240 VAC
Current consumption	2VA

Note ②: The permissible range of the control voltage is 85 to 110% of the rated voltage.
Please specify the rated voltage when ordering.

Dimensions of the OCR power supply can be found in Section 7.

OPERATING CHARACTERISTICS

ELECTRONIC PROTECTION (WITH LCD)

ELECTRONIC PROTECTION (WITH LCD)

Available types

Type of OCR	Protective function				Alarm function	Display			Measurement/event indication						Communication function	External indicator	Test function	Indication via output contact	Control power supply
	Long time-delay trip Short time-delay trip Instantaneous trip	Ground fault trip	N-phase protection	Phase rotation protection	Pre-trip alarm	LCD window	LCD backlight		Current	Voltage, electrical power, electrical energy, power factor, demand electrical power	Electrical energy pulse	Harmonic current	Trip event log	Alarm event log					
	A	GF	NP	NS	PTA						W	H			C	I		Y	
XOW-1L-A	●	—	—	—	—	●	—		●	—	—	—	●	●	—	—	●	—	Required
XOW-1L-AGN	●	●	●	—	—	●	—		●	—	—	—	●	●	—	—	●	—	Required
XOW-1L-AP	●	—	—	—	●	●	—		●	—	—	—	●	●	—	—	●	●	Required
XOW-1L-APGNS	●	●	●	●	●	●	—		●	—	—	—	●	●	—	—	●	●	Required
XOW-1L-APC	●	—	—	—	●	●	—		●	—	—	—	●	●	●	—	●	●	Required
XOW-1L-APGNSC	●	●	●	●	●	●	—		●	—	—	—	●	●	●	—	●	●	Required
XOW-1S-A	●	—	—	—	—	●	●		●	●	—	—	●	●	—	—	●	—	Required
XOW-1S-AGN	●	●	●	—	—	●	●		●	●	—	—	●	●	—	—	●	—	Required
XOW-1S-AP	●	—	—	—	●	●	●		●	●	—	—	●	●	—	—	●	●	Required
XOW-1S-APGNS	●	●	●	●	●	●	●		●	●	—	—	●	●	—	—	●	●	Required
XOW-1S-APCWH	●	—	—	—	●	●	●		●	●	●	●	●	●	●	○	●	●	Required
XOW-1S-APGNSCWH	●	●	●	●	●	●	●		●	●	●	●	●	●	●	○	●	●	Required

● : Standard equipment
○ : Optional
— : Not applicable

Measurement/event indication function specifications

Measurement/event (accuracy)		Modbus communication function ○ : Yes —: Non	Note
Load current (±1.5%)	Present value for each phase	○	Ground fault current and negative-phase current can be displayed depending on the specifications.
	Present max value	○	Among L1, L2, L3 phases, the phase having the highest current is subject to measurement and the value of the current is displayed.
Line voltage (±1.0%)	Present value of each line voltage	○	
	Present max value	○	
	Present phase voltage value for each phase	○	Applies to 4-pole breakers only.
Harmonic current (±2.5%)	Present value of 3rd, 5th, 7th, ...19th harmonic current for each phase	—	
Electrical power (±2.5%)	Present value	○	
	Demand value	○	
	Max demand value	○	
Electrical energy (±2.5%)	Electrical energy	○	
Power factor (±5%)	Present value	○	
Trip event log	Fault current (±1.5%)	○	
	Indication of cause	○	
Alarm event log	Cause of alarm, Indication of operated value	○	

Note: Electrical energy is stored every hour and the fault current and cause of fault are stored every time a fault occurs in a flash memory.

Network interface I/O specifications

Item	Modbus line
Communication protocol	RS-485
Communication mode	2-wire, half-duplex
Topology	Multi-drop bus
Transmission rate	19.2 kbps max
Transmission distance	1.2 km max (at 19.2 kbps)
Data format	Modbus-RTU
Max number of nodes	1–31

SECTION 3

ELECTRONIC CHARACTERISTICS (WITH LCD)

Specifications of over-current release

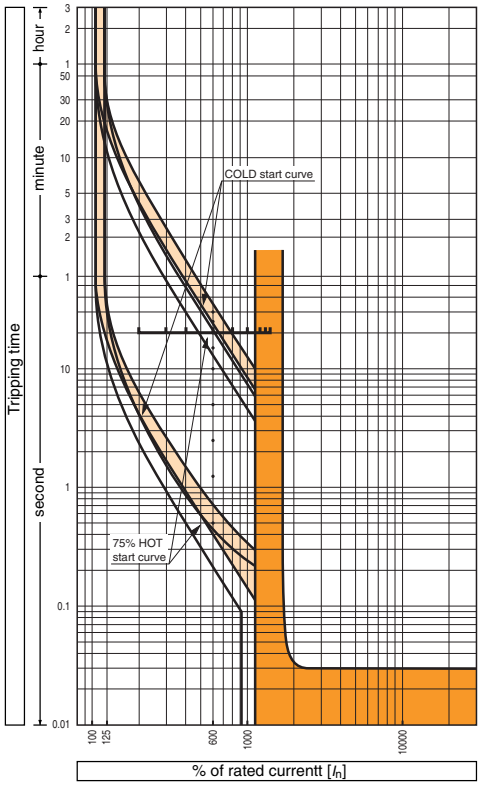
Applicable MCCB type	CT rated primary current I_{CT}
S400-NE, S400-GE, S400-PE, H400-NE, L400-NE	250A
	400A
E630-NE, S630-CE, S630-GE	630A

Protective function		Symbol	Setting range
Rated current (A)		I_n	[I_{CT}] x (0.5-0.63-0.8-1.0)
Long time-delay trip LT	Pick-up current (A)	I_R	[I_n] x (0.8-0.85-0.9-0.95-1.0) • Non tripping at not more than [I_R] x 1.05 • Tripping at more than [I_R] x 1.05 and not more than [I_R] x 1.2
	Time-delay (s)	t_R	(0.5-1.25-2.5-5-10-15-20-25-30) (sec) at 600% of [I_R] ① Time-delay setting tolerance: ±20%, +0.13s –0s
	COLD/HOT	—	COLD/HOT
Short time-delay trip ST	Pick-up current (A)	I_{sd}	[I_n] x (1-1.5-2-2.5-3-4-6-8-10-NON) ② Current setting tolerance: ±15%
	Time-delay (s)	t_{sd}	I^2t OFF: 0.05-0.1-0.2-0.3s (Definite time characteristic) I^2t ON: 0.05-0.1-0.2-0.3s (Ramp characteristic at less than 1000% of [I_n], Definite time characteristic at 1000% or more of [I_n])
	I^2t ramp characteristic	—	OFF/ON
Instantaneous trip INST	Pick-up current (A)	I_i	[I_n] x (2-3-4-6-8-10-12-13-14-NON) ③④ Current setting tolerance: ±20%
Ground fault trip GF	Pick-up current (A)	I_g	[I_{CT}] x (0.2-0.3-0.4-NON) Current setting tolerance: ±20%
	Time-delay (s)	t_g	I^2t OFF: 0.1-0.2-0.3-0.4-0.8s (Definite time characteristic) Time-delay setting tolerance: +50ms –20ms I^2t ON: 0.1-0.2-0.3-0.4-0.8s (Ramp characteristic at less than 40% of [I_{CT}], Definite time characteristic at 40% or more of [I_{CT}]) Time-delay setting tolerance: ±15%, +50ms –20ms
	I^2t ramp characteristic	—	OFF/ON
	Mode	—	TRIP/OFF ⑤
N-phase protection NP	Pick-up current (A)	I_N	[I_{CT}] x (0.4-0.5-0.63-0.8-1.0-NON) • Non tripping at not more than [I_N] x 1.05 • Tripping at more than [I_N] x 1.05 and not more than [I_N] x 1.2
	Time-delay (s)	t_N	Tripping at 600% of [I_N] with LT time-delay [t_R].
	COLD/HOT	—	COLD/HOT
Phase rotation protection NS	Pick-up current (A)	I_{NS}	[I_n] x (0.2-0.3-0.4-0.5-0.6-0.7-0.8-0.9-1.0) Current setting tolerance: ±10%
	Time-delay (s)	t_{NS}	(0.4-0.8-1.2-1.6-2.0-2.4-2.8-3.2-3.6-4.0) (sec) at 150% of [I_{NS}] Time-delay setting tolerance: ±20%, +0.13s –0s
	Mode	—	TRIP/OFF ⑤
Pre-trip alarm PTA	Pick-up current (A)	I_P	[I_n] x (0.7-0.8-0.9-1.0) Current setting tolerance: ±10%
	Time-delay (s)	t_P	5-10-15-20-40-60-80-120-160-200s more than [I_P] Time-delay setting tolerance: ±10%, +0.1s –0s
	Mode	—	AL/OFF ⑤

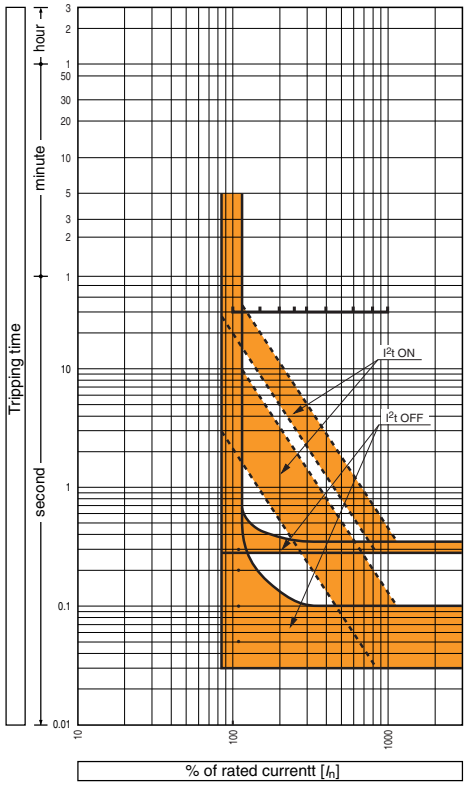
Note ①: For E630, S630, (0.5-1.25-2.5-5-10-15-16)sec.
②: For E630, S630, [I_n] x (1-1.5-2-2.5-3-4-6-8-NON).
③: For S400, H400 and L400, the max. pick-up current is set to 1300% x [I_{CT}].
For E630, S630, the max. pick-up current is set to 1000% x [I_{CT}]
④: When the short time delay trip function has been set to NON, the instantaneous trip function cannot be set to NON. When the instantaneous trip function has been set to NON, the short time delay trip function cannot be set to NON.
⑤: Selecting "OFF" disables protective functions.
Unless otherwise specified when ordering, the settings will default to those underlined in the table above.

ELECTRONIC CHARACTERISTICS (WITH LCD)

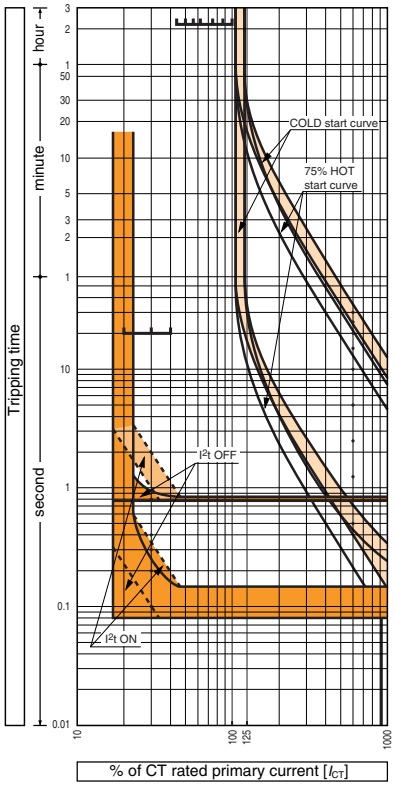
Long time-delay and instantaneous trip



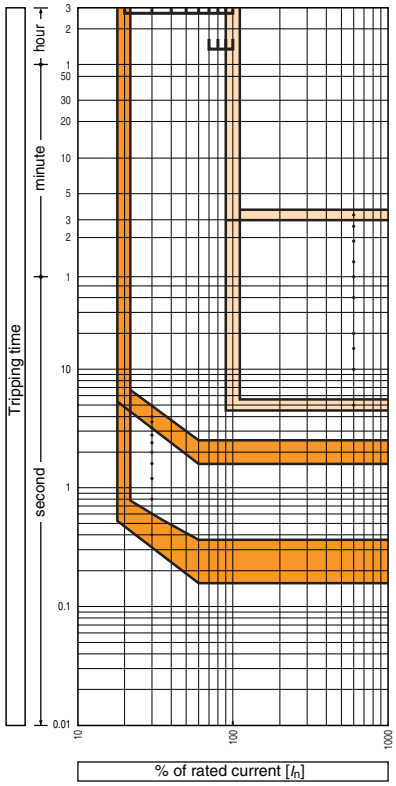
Short time-delay trip



N-phase protection and ground fault trip

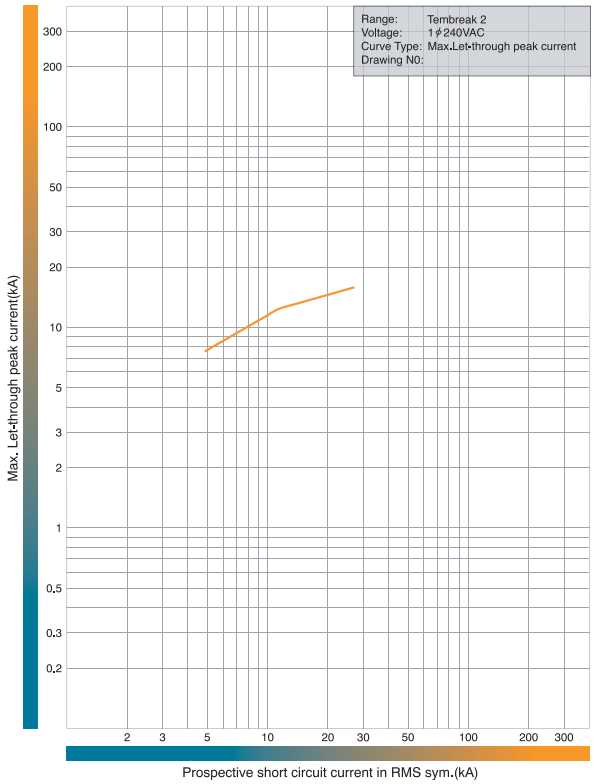


Phase rotation protection and pre-trip alarm

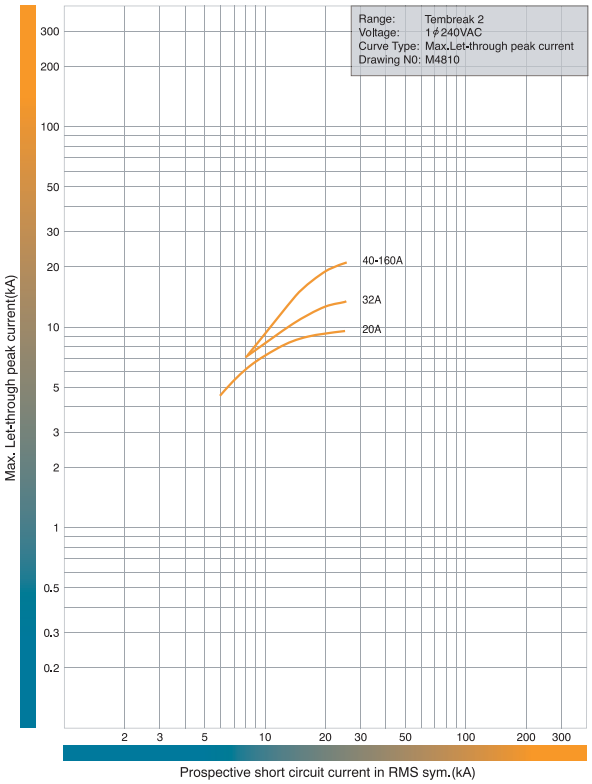


LET-THROUGH PEAK CURRENT CHARACTERISTICS

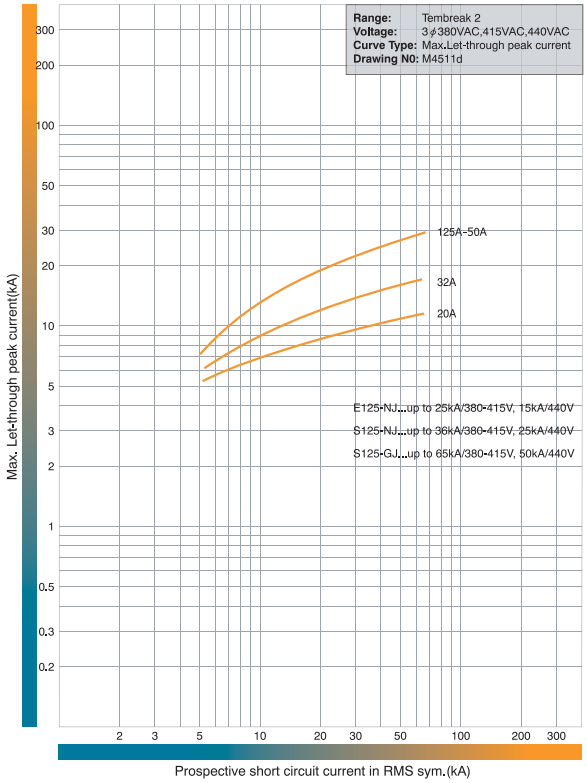
S125-NF. 240V AC



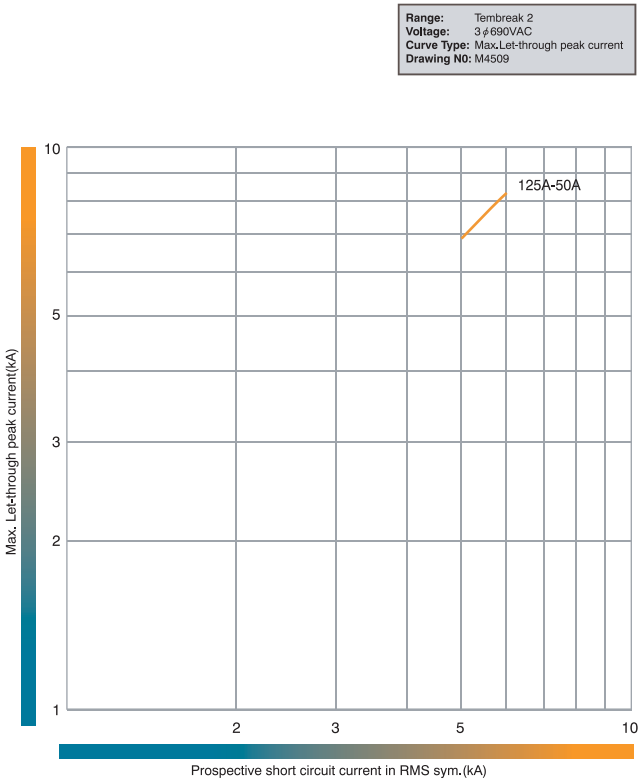
S160-NF. 240V AC.



E125-NJ, S125-NJ, S125-GJ. 440V AC.

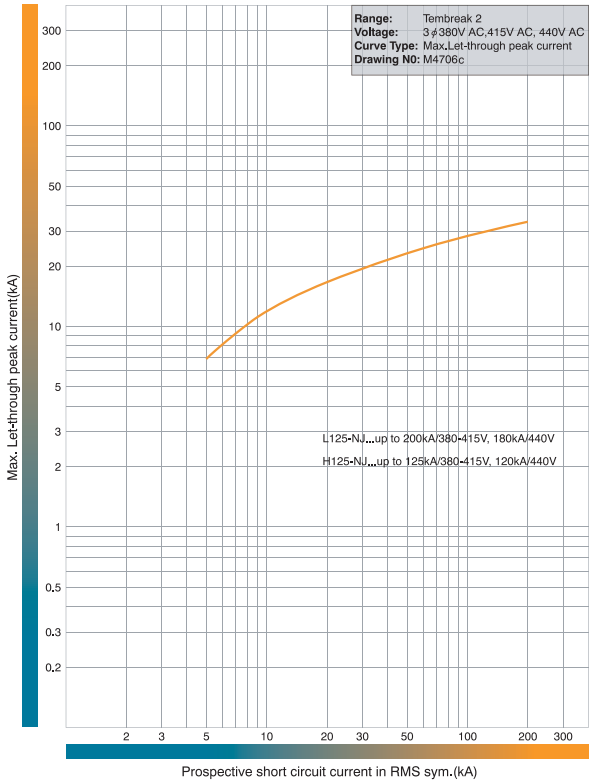


S125-NJ, S125-GJ. 690V AC.

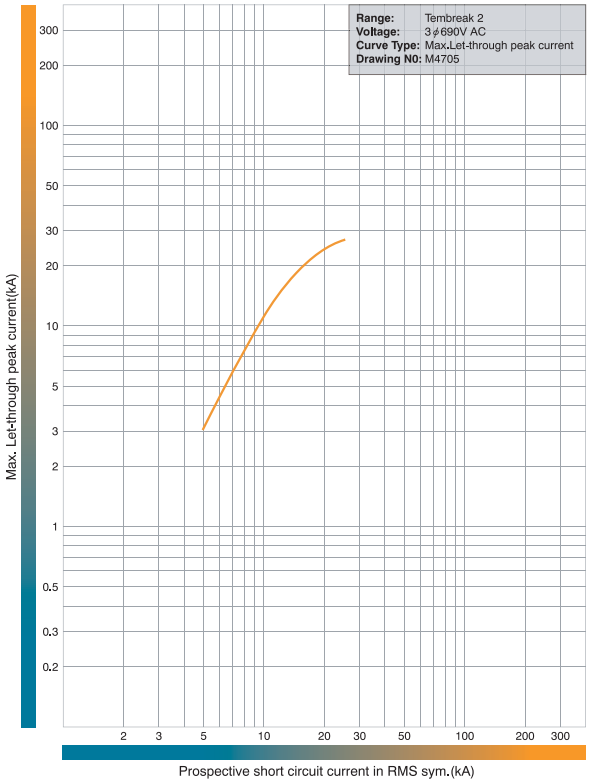


LET-THROUGH PEAK CURRENT CHARACTERISTICS

H125-NJ, L125-NJ. 440V AC.



H125-NJ, L125-NJ. 690V AC



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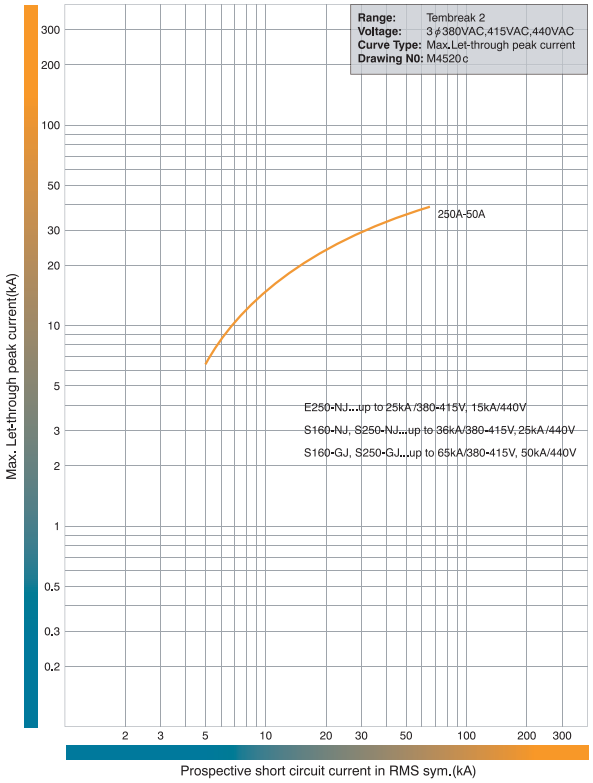
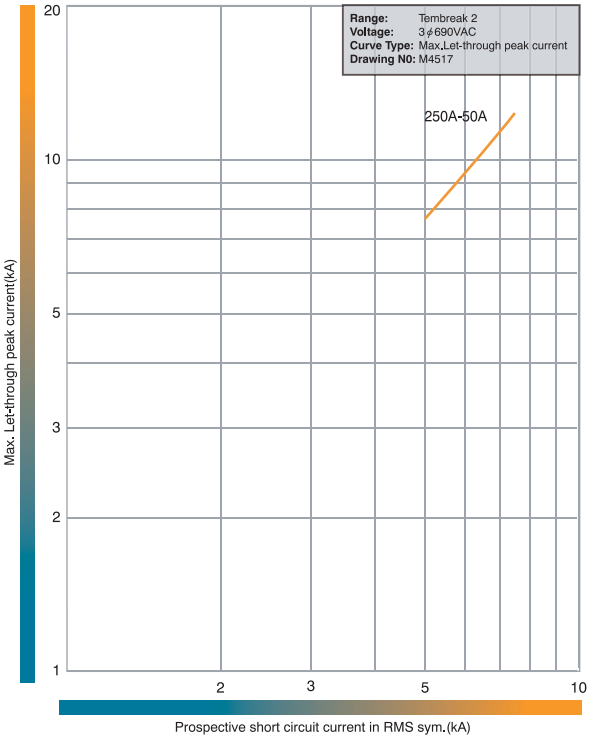


S160-NJ, S160-GJ, S250-NJ, S250-GJ. 690V AC.



LET-THROUGH PEAK CURRENT CHARACTERISTICS

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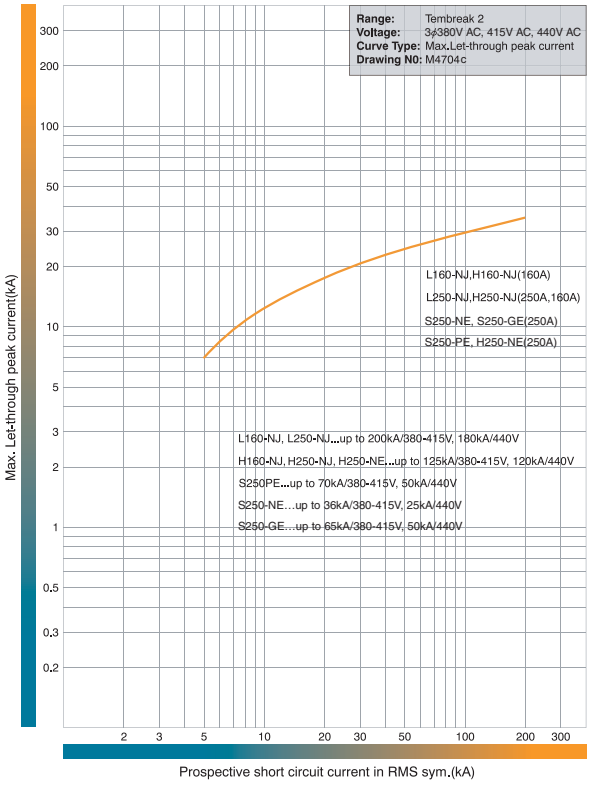
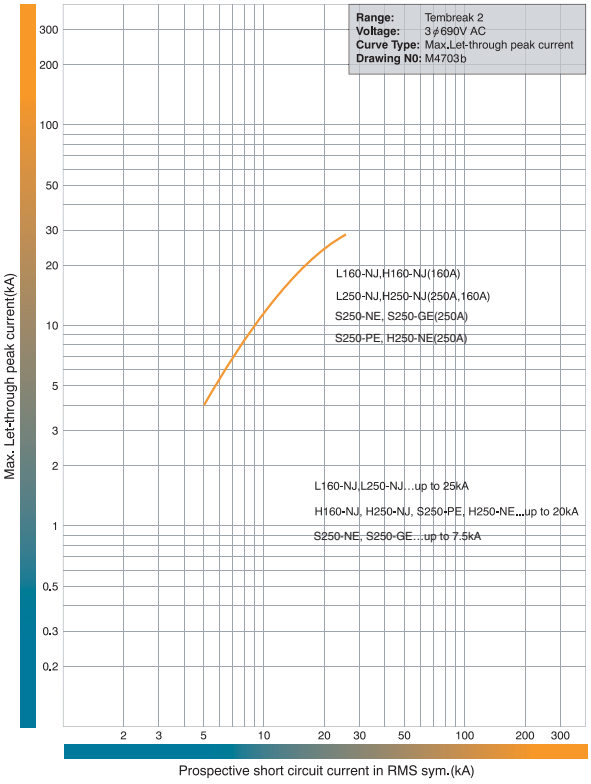
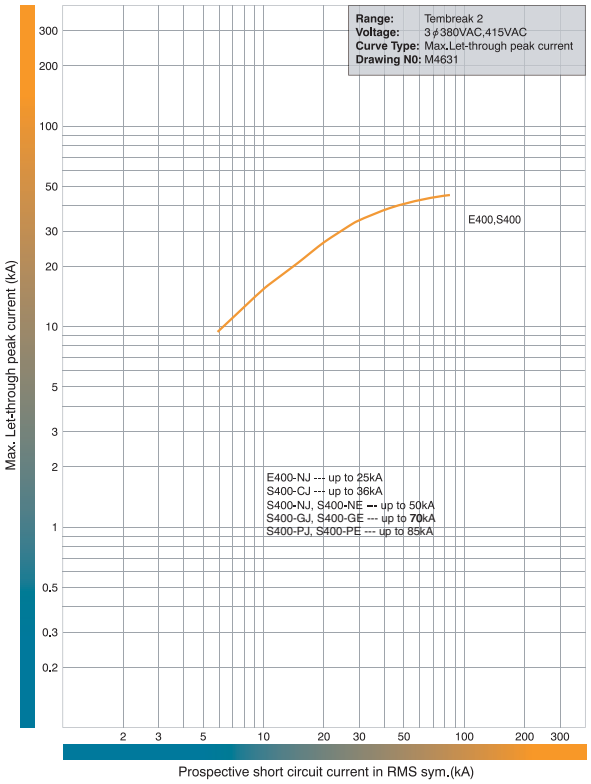


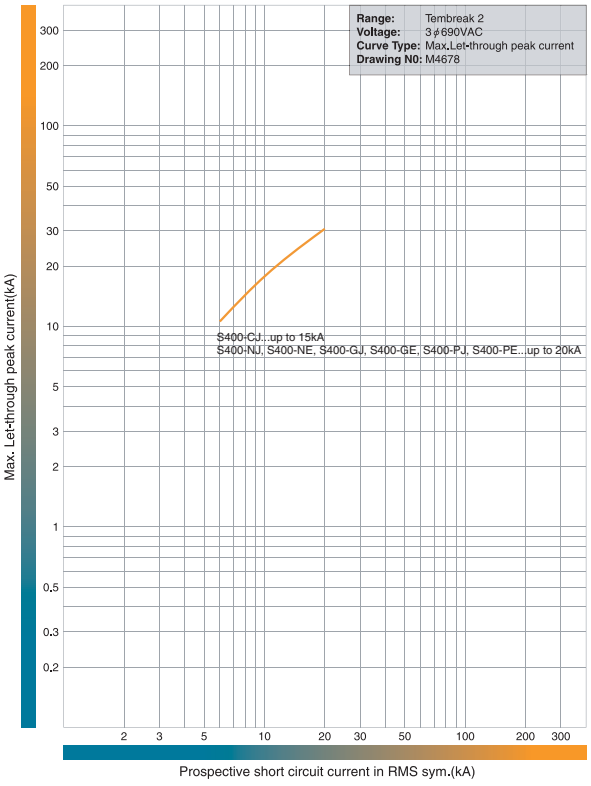
H160-NJ, L160-NJ, S250-NE, S250-GE, S250-PE, H250-NJ, H250-NE, L250-NJ. 690V AC.



E400-NJ, S400-CJ, S400-NJ, S400-NE, S400-GJ, S400-GE, S400-PJ, S400-PE. 415V AC.

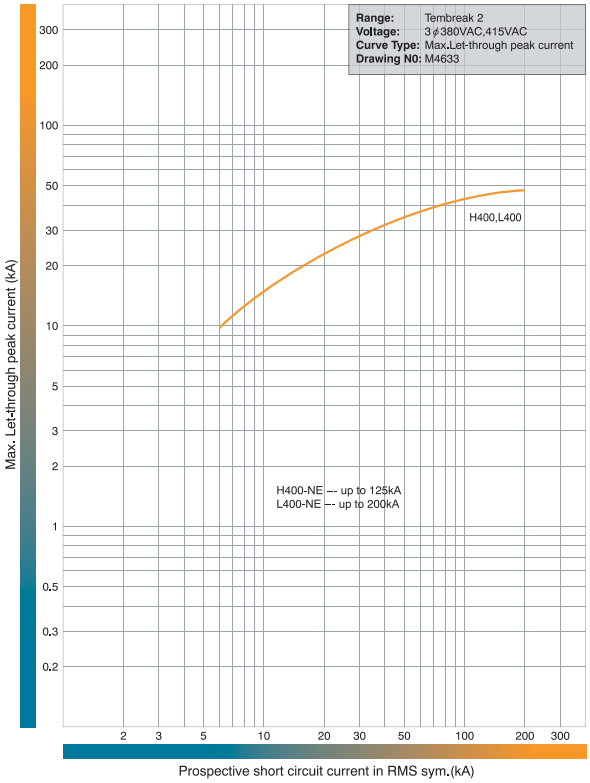


S400-CJ, S400-NJ, S400-NE, S400-GJ, S400-GE, S400-PJ, S400-PE. 690V AC.

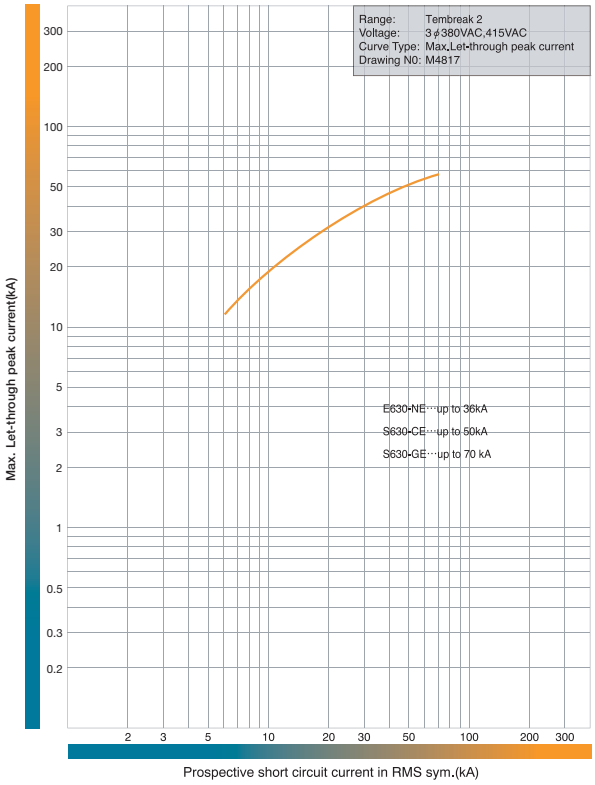


LET-THROUGH PEAK CURRENT CHARACTERISTICS

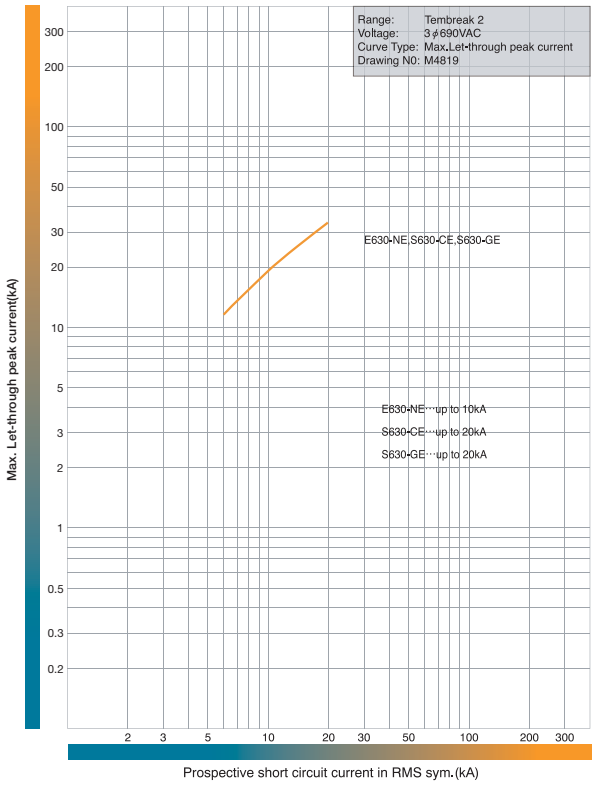
H400-NE, L400-NE. 415V AC.



E630-NE, S630-CE, S630-GE. 415V AC.

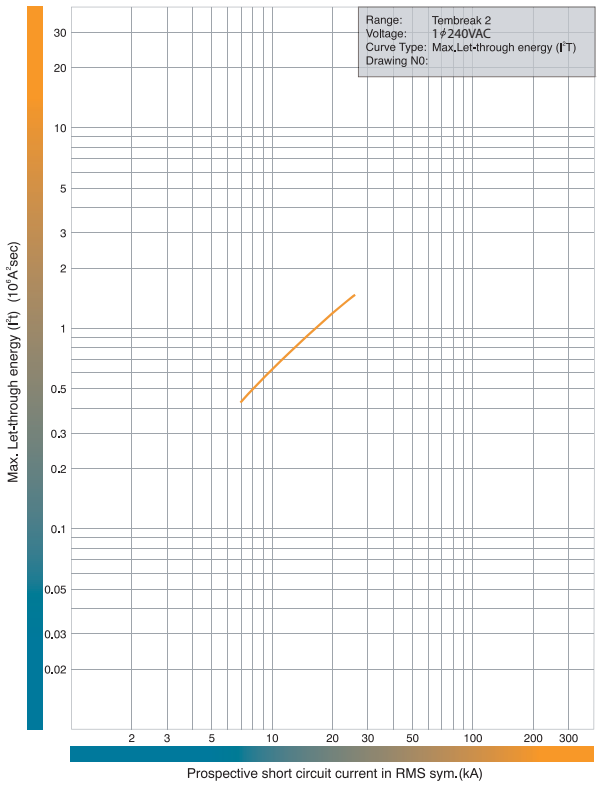


E630-NE, S630-CE, S630-GE. 690V AC.

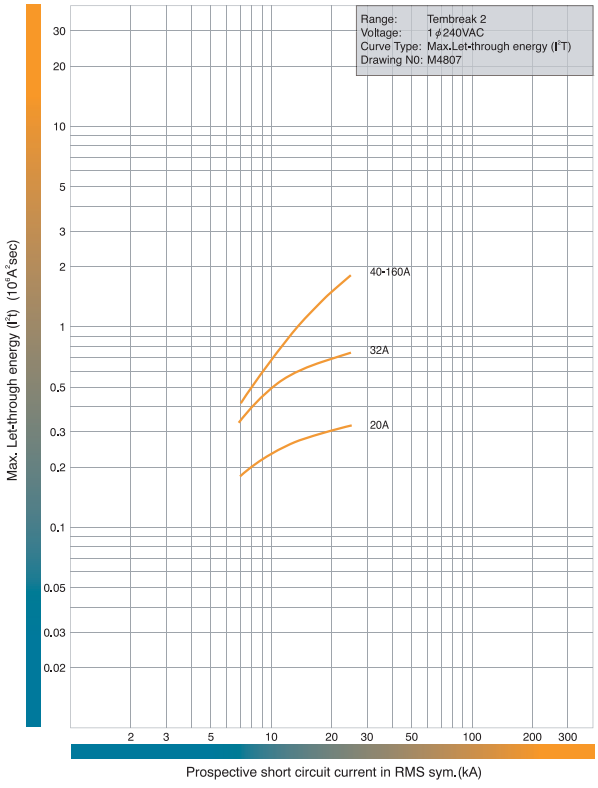


LET-THROUGH ENERGY CHARACTERISTICS

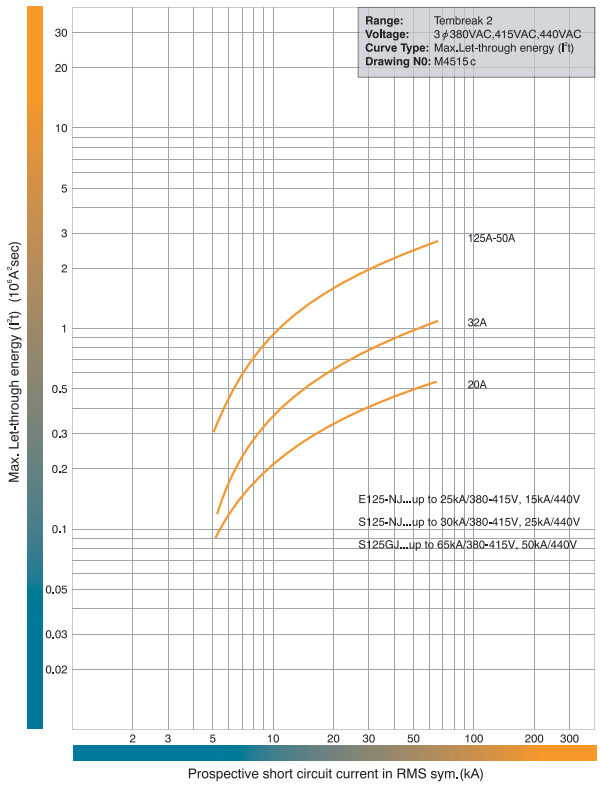
S125-NF. 240V AC



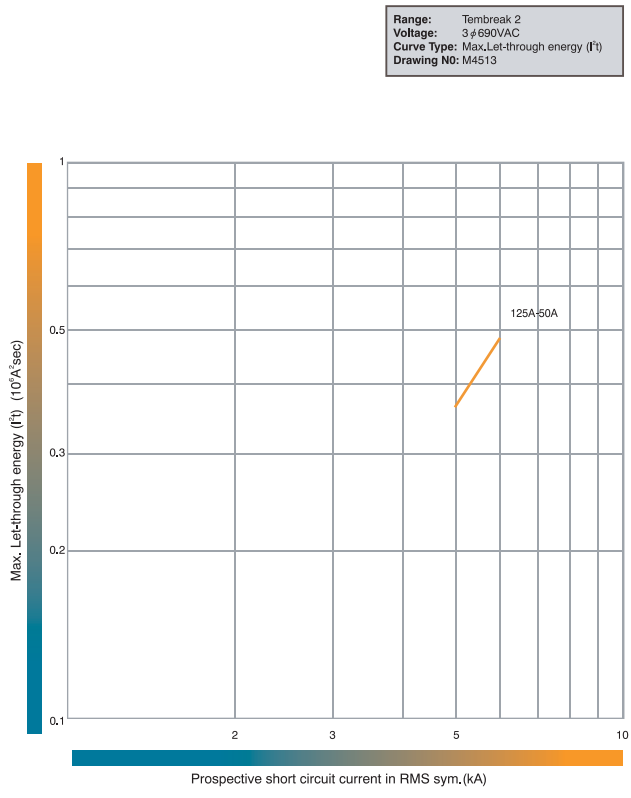
S160-NF. 240V AC



E125-NJ, S125-NJ, S125-GJ. 440V AC.

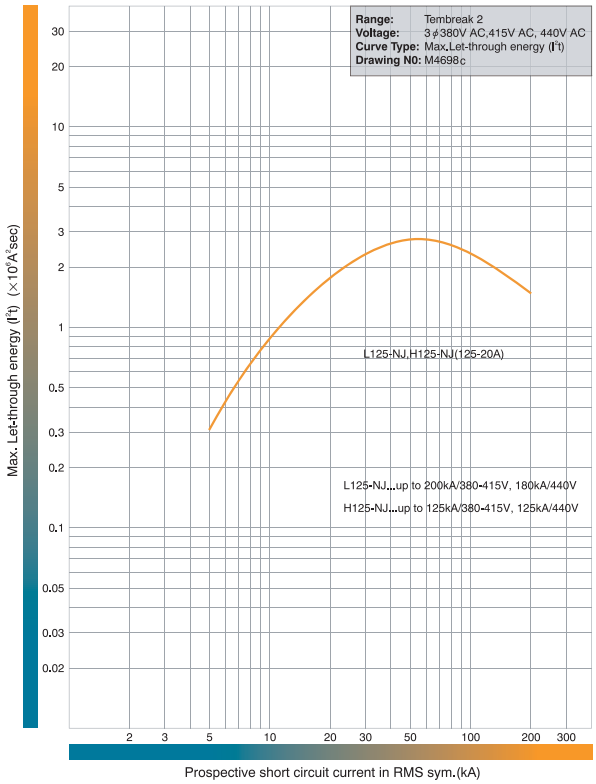


S125-NJ, S125-GJ. 690V AC.

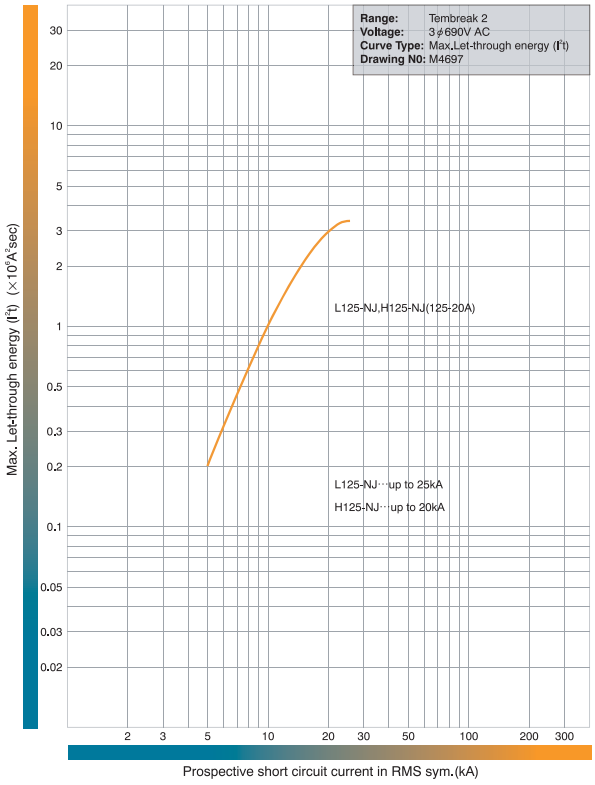


LET-THROUGH ENERGY CHARACTERISTICS

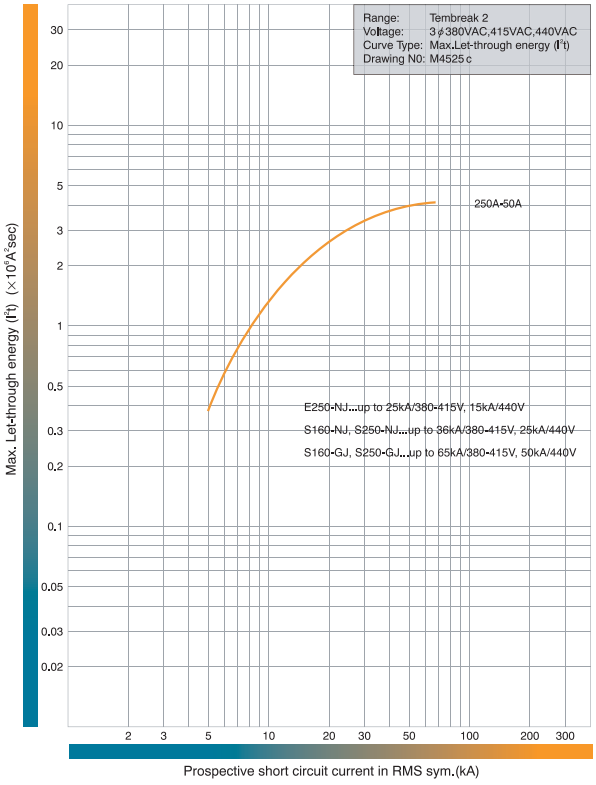
H125-NJ, L125-NJ. 440V AC.



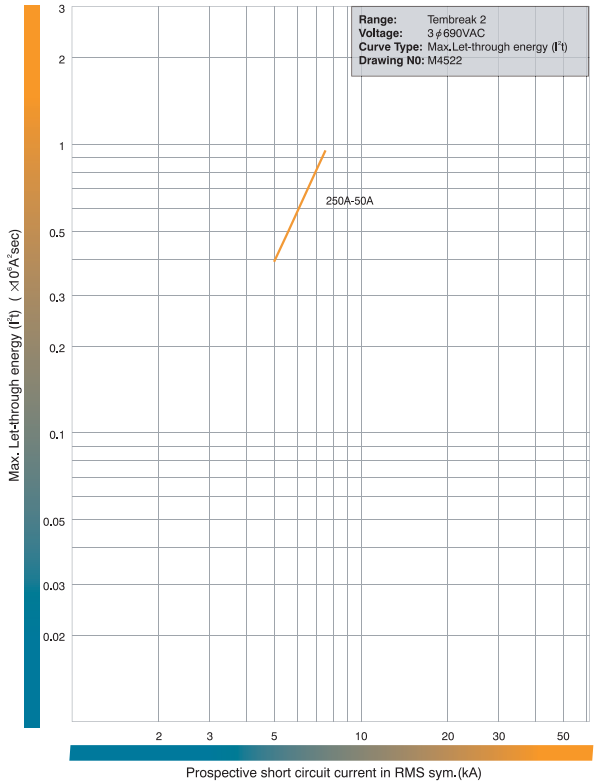
H125-NJ, L125-NJ. 690V AC



S160-NJ, S160-GJ, E250-NJ, S250-NJ, S250-GJ. 440V AC.

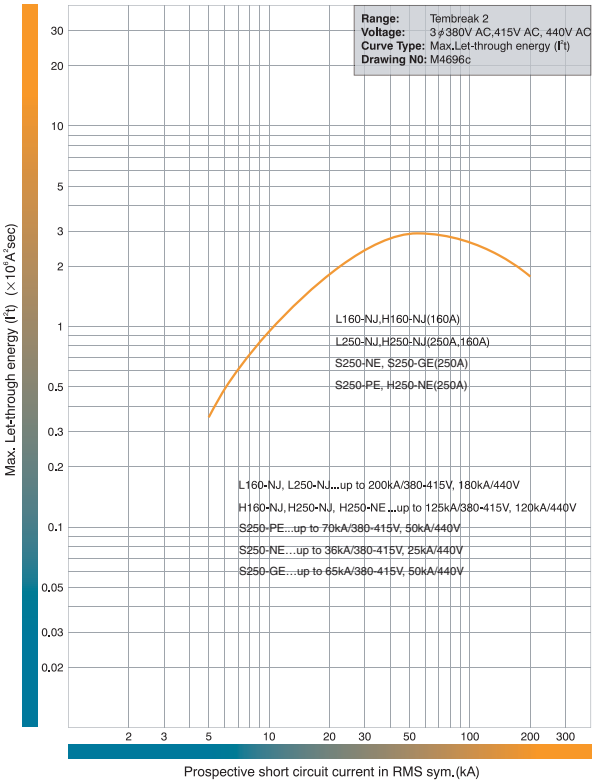


S160-NJ, S160-GJ, S250-NJ, S250-GJ. 690V AC.

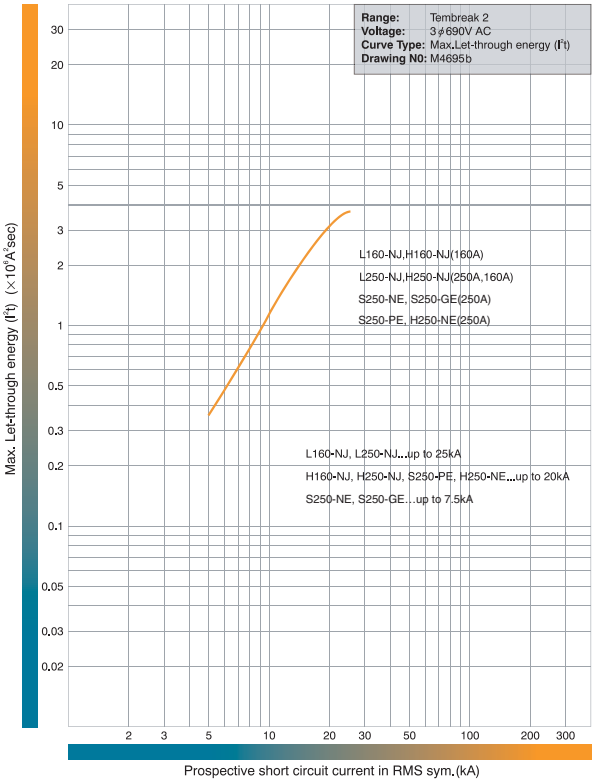


LET-THROUGH ENERGY CHARACTERISTICS

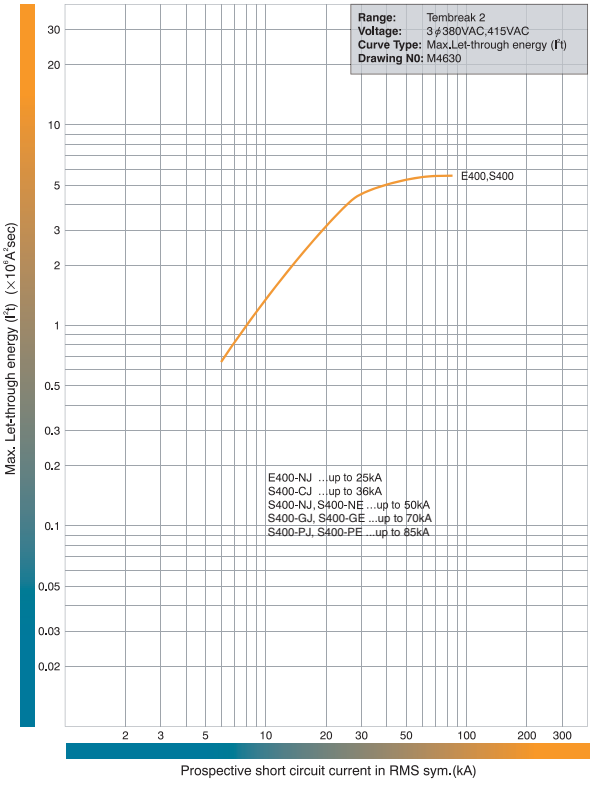
H160-NJ, L160-NJ, S250-NE, S250-GE, S250-PE, H250-NE, H250-NJ, L250-NJ. 440V AC.



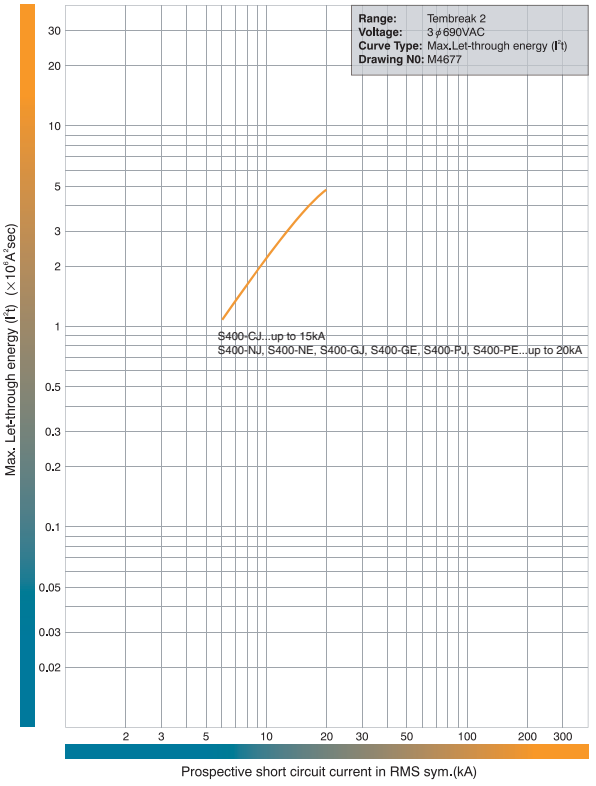
H160-NJ, L160-NJ,S250-NE, S250-GE, S250-PE, H250-NE, H250-NJ, L250-NJ. 690V AC.



E400-NJ, S400-CJ, S400-NJ, S400-NE, S400-GJ, S400-GE, S400-PJ, S400-PE. 415V AC.

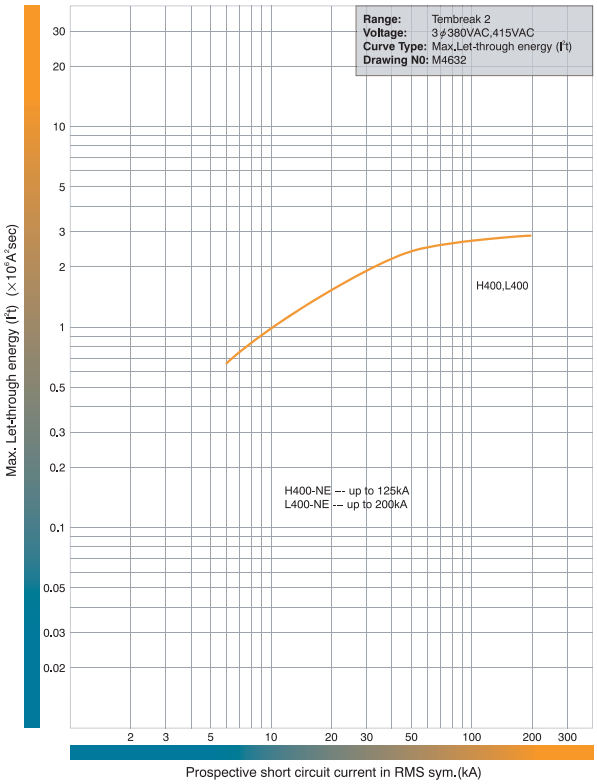


S400-CJ, S400-NJ, S400-NE, S400-GJ, S400-GE, S400-PJ, S400-PE. 690V AC.

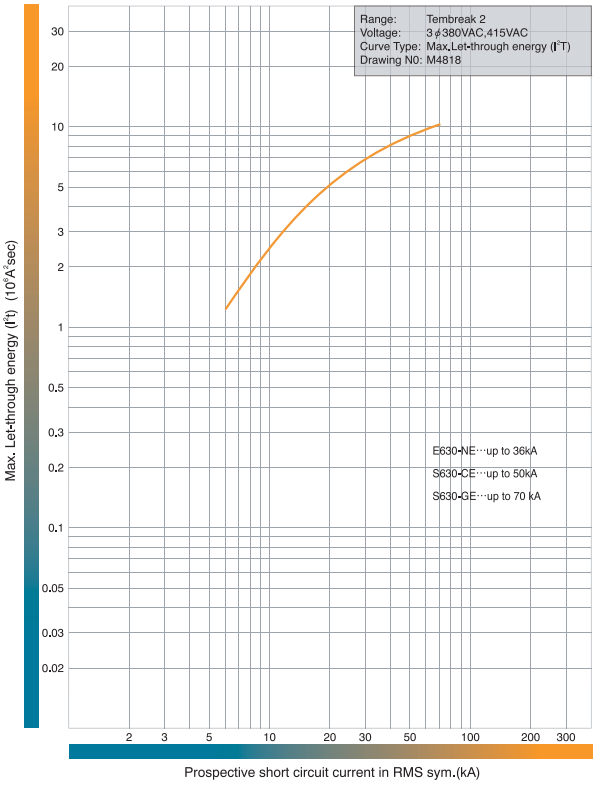


LET-THROUGH ENERGY CHARACTERISTICS

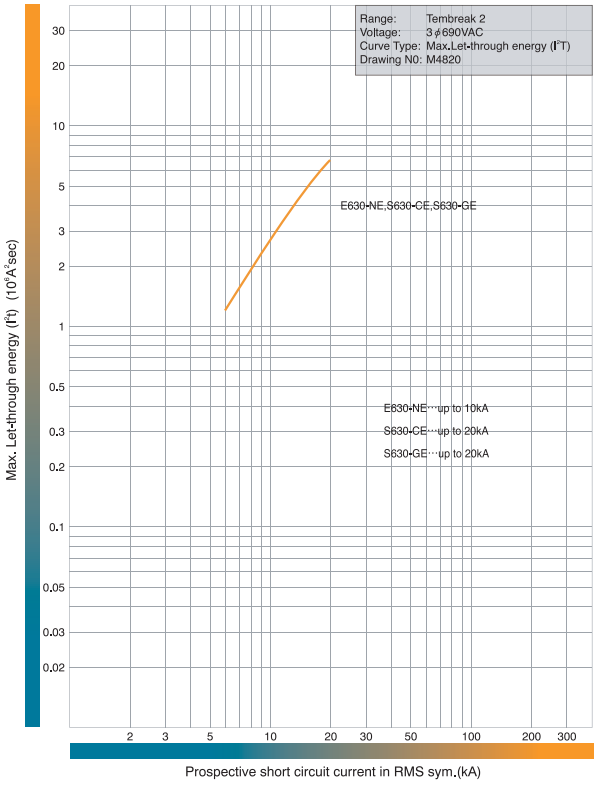
H400-NE, L400-NE. 415V AC.



E630-NE, S630-CE, S630-GE. 415V AC.

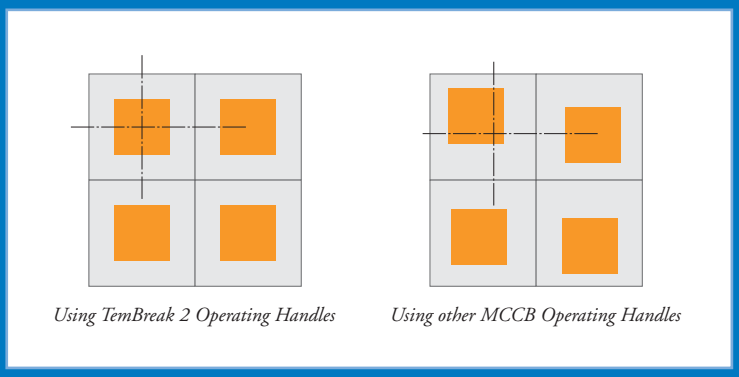


E630-NE, S630-CE, S630-GE. 690V AC.



SYMMETRICAL DOOR CUTOUT PATTERNS

Door cutout patterns for handles are symmetrical, even when breakers are mounted in opposite directions.



Using TemBreak 2 Operating Handles

Using other MCCB Operating Handles

TEMBREAK 2
MOULDED CASE CIRCUIT BREAKERS
16A TO 630A

1. Welcome to TemBreak 2
2. Ratings and Specifications
3. Operating Characteristics
4. **Application Data**
   - **What is Discrimination?** 55
   - **How to Read the Discrimination Tables** 55
   - **Discrimination Tables** 57
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5. Accessories
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TEMBREAK 2
MINI MOULDED CASE CIRCUIT BREAKERS 10A TO 100A

8. TemBreak 2 MINI Moulded Case Circuit Breakers

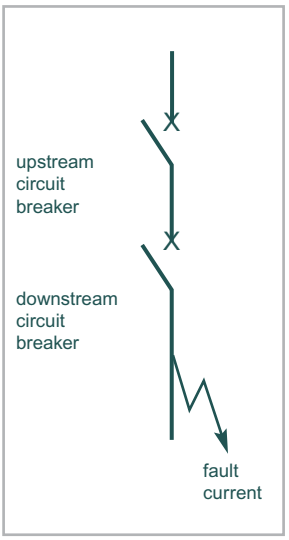
TEMBREAK
MOULDED CASE CIRCUIT BREAKERS 630A TO 1600A

9. TemBreak Moulded Case Circuit Breakers

DISCRIMINATION

WHAT IS DISCRIMINATION?

Discrimination, also called selectivity, is the co-ordination of protective devices such that a fault is cleared by the protective device installed immediately upstream of the fault, and by that device alone.



Total discrimination

Discrimination is said to be total if the downstream circuit breaker opens and the upstream circuit breaker remains closed. This ensures maximum availability of the system.

Partial discrimination

Discrimination is partial if the above condition is not fulfiled up to the prospective short-circuit current, but to a lesser value, termed the selectivity limit current (I_s).

Above this value both circuit breakers could open, resulting in loss of selectivity.

HOW TO READ THE DISCRIMINATION TABLES

Boxes containing the letter "T" indicate total discrimination between the relevant upstream and downstream circuit-breakers. Total discrimination applies for all fault levels up to the breaking capacity of the upstream or the downstream circuit breaker, whichever is the lesser.

For the other boxes, discrimination is either partial or there is no discrimination.

If discrimination is partial then the value of the selectivity limit current, I_s, is shown in the box.

Worked Examples

Q (1) A main switchboard requires a 1600A ACB feeding a 400A MCCB. The fault level is 65kA. What combination of protective devices would provide total discrimination?

A (1) A TemPower2 ACB AR216S feeding a TemBreak2 S400-GJ would provide total discrimination up to 65kA. See page 57

Note: Discrimination would be total whether the TemPower 2 ACB had an integral or external protection relay because I_{cw} (I_s) = I_{cs}.

Most other ACBs have I_{cw} (I_s) <I_{cs}.

HOW TO READ THE DISCRIMINATION TABLES

Q (2) A Sub distribution board requires a 630A MCCB feeding a 250A MCCB. The fault level is 65kA. What combination of protective devices would provide total discrimination?

A (2) Using a TemBreak 2 S630-GE MCCB feeding a TemBreak 2 S250-GJ would provide total discrimination up to 65kA. See page 59

Q (3) A final distribution board contains a 125A MCCB incomer feeding a 32A Type B MCB. Is discrimination between these devices possible?

A (3) A TemBreak 2 MCCB type S160-NJ/125A feeding a TemDin 2 MCB would provide total discrimination. See page 58

Alternatively **ANY OTHER** MCB can be used provided it has energy limiting ability of class 3 in accordance with EN 60898.

DISCRIMINATION TABLES

Upstream: TemPower 2 ACB with or without Integral Protection Relay. Downstream: TemBreak 2 MCCB.

Upstream ACB

Frame			800A	1250A		1600A			2000A			2500A		3200A		4000A	5000A	6300A	
	Model		AR208S	AR212S	AR212H	AR216S	AR216H	AR316H	AR220S	AR220H	AR320H	AR325S	AR325H	AR332S	AR332H	AR440SB	AR650S	AR663S	AR663H
		Breaking Capacity	65kA	65kA	80kA	65kA	80kA	100kA	65kA	80kA	100A	85kA	100kA	85kA	100kA	100kA	120kA	120kA	135kA
125A	E125NJ	25kA	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	S125NJ	36kA	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	S125GJ	65kA	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	H125NJ	125kA	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	L125NJ	200kA	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
160A/ 250A	S160NJ	36kA	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	S160GJ	65kA	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	E250NJ	25kA	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	S250NJ	36kA	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	S250GJ	65kA	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	S250PE	70kA	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	H250NJ	125kA	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	L250NJ	200KA	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
400A/ 630A	E400NJ	25kA	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	S400CJ	36kA	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	S400NJ	50kA	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	S400NE	50kA	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	S400GJ	70kA	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	S400GE	70kA	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	S400PJ	85kA	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	S400PE	85kA	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	H400NJ	125kA	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	H400NE	125kA	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	E630NE	36kA	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	S630CE	50kA	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	S630GE	70kA	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
800A	XS800NJ	65kA	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	XH800SE	65kA	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	XH800PJ	100kA	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	XS800SE	50kA	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
1250A/ 1600A	XS1250SE	65kA	-	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	XS1600SE	85kA	-	-	-	T	T	T	T	T	T	T	T	T	T	T	T	T	T

Downstream MCCB

Notes: 1. All ACB's have I_i set at NON, MCR ON.
2. Assuming ACB time settings are greater than MCCB.
3. The above table is in accordance with IEC 60947-2, Annex A.
4. External relay can be used - Contact Terasaki for further details.
5. All values shown at 400V AC.

T= Total Selectivity

DISCRIMINATION TABLES

Upstream: TemBreak 2 MCCB (thermal-magnetic)
Downstream: MCB

Upstream MCCB

Downstream MCB	S125NJ (36kA) E125NJ (25kA)						S160NJ (36kA)							S250NJ (36kA) E250NJ (25kA)									S400NJ	
In	20A	32A	50A	63A	100A	125A	20A	32A	50A	63A	100A	125A	160A	20A	32A	50A	63A	100A	125A	160A	200A	250A	250A	400A
6A	260	T	T	T	T	T	260	T	T	T	T	T	T	260	T	T	T	T	T	T	T	T	T	T
10A	260	420	T	T	T	T	260	420	T	T	T	T	T	260	420	T	T	T	T	T	T	T	T	T
16A	260	420	650	T	T	T	260	420	650	T	T	T	T	260	420	650	T	T	T	T	T	T	T	T
20A	260	420	650	1000	T	T	260	420	650	1000	T	T	T	260	420	650	1000	T	T	T	T	T	T	T
25A	260	420	650	1000	T	T	260	420	650	1000	T	T	T	260	420	650	1000	T	T	T	T	T	T	T
32A	260	420	650	1000	1500	T	260	420	650	1000	1500	T	T	260	420	650	1000	1500	T	T	T	T	T	T
40A	260	420	650	1000	1500	2000	260	420	650	1000	1500	2000	T	260	420	650	1000	1500	2000	T	T	T	T	T
50A	260	420	650	1000	1500	2000	260	420	650	1000	1500	2000	3000	260	420	650	1000	1500	2000	3000	T	T	T	T
63A	260	420	650	1000	1500	2000	260	420	650	1000	1500	2000	3000	260	420	650	1000	1500	2000	3000	2600	T	T	T

Notes:
1. MCBs can be of any manufacture provided they are Energy class three as defined in EN 60898.
2. Table based on type B MCBs
3. MCBs can be 6kA or 10kA at 400V
4. The above table is in accordance with IEC 60947-2, Annex A.
5. All values shown at 400V AC.
6. *Is* expressed in A.

T= Total Selectivity

DISCRIMINATION TABLES

Upstream: TemBreak 2 MCCB (electronic).
Downstream: TemBreak 2 MCCB.

Upstream MCCB

Frame			250A				400A					630A			800A		1250A	1600A
	Model		S250NE	S250GE	S250PE	H250NE	S400NE	S400GE	S400PE	H400NE	L400NE	E630NE	S630NE	S630GE	XS800SE	XH800SE	XS1250SE	XS1600SE
		Breaking Capacity	36kA	65kA	70kA	125kA	50kA	70kA	85kA	125kA	200kA	36kA	50kA	70kA	50kA	65kA	85kA	100kA
50A	S50NF	10kA	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
100A	E100NF	10kA	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
125A	E125NJ	25kA	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	S125NJ	36kA	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	S125GJ	65kA	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	H125NJ	125kA	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
160A/ 250A	S160NJ	36kA	-	-	-	-	T	T	T	T	T	T	T	T	T	T	T	T
	S160GJ	65kA	-	-	-	-	T	T	T	T	T	T	T	T	T	50	T	T
	H160NJ	125kA	-	-	-	-	-	-	-	T	T	T	T	T	T	T	T	T
	E250NJ	25kA	-	-	-	-	T	T	T	T	T	T	T	T	T	T	T	T
	S250NJ	36kA	-	-	-	-	T	T	T	T	T	T	T	T	T	T	T	T
	S250GJ	65kA	-	-	-	-	T	T	T	T	T	T	T	T	T	50	T	T
	H250NJ	125kA	-	-	-	-	-	-	-	T	T	T	T	T	T	50	T	T
	S250PE	70kA	-	-	-	-	-	-	-	T	T	T	T	T	T	T	T	T
	H250NE	125kA	-	-	-	-	-	-	-	T	T	T	T	T	T	T	T	T
400A/ 630A	E400NJ	25kA	-	-	-	-	-	-	-	-	-	10	10	10	T	T	T	T
	S400CJ	36kA	-	-	-	-	-	-	-	-	-	10	10	10	25	25	T	T
	S400NJ	50kA	-	-	-	-	-	-	-	-	-	10	10	10	25	25	T	T
	S400NE	50kA	-	-	-	-	-	-	-	-	-	10	10	10	25	25	T	T
	S400GJ	70kA	-	-	-	-	-	-	-	-	-	10	10	10	25	25	T	T
	S400GE	70kA	-	-	-	-	-	-	-	-	-	10	10	10	25	25	T	T
	S400PJ	85kA	-	-	-	-	-	-	-	-	-	10	10	10	25	25	T	T
	S400PE	85kA	-	-	-	-	-	-	-	-	-	10	10	10	25	25	T	T
	H400NJ	125kA	-	-	-	-	-	-	-	-	-	10	10	10	25	25	T	T
	H400NE	125kA	-	-	-	-	-	-	-	-	-	10	10	10	25	25	T	T
	E630NE	36kA	-	-	-	-	-	-	-	-	-	-	-	-	25	25	T	T
	S630CE	50kA	-	-	-	-	-	-	-	-	-	-	-	-	25	25	T	T
	S630GE	70kA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	T	T

Downstream MCCB

T= Total Selectivity

Notes: 1. All pick-up current and time delay settings are to be set at maximum for upstream MCCBs.
2. The above table is in accordance with IEC 60947-2, Annex A.
3. All values shown at 400V AC.
4. I_s expressed in kA.

WHAT IS CASCADING?

Cascading is a technique where the current limiting capability of upstream circuit breakers is used to permit the installation of lower rated and therefore lower cost circuit breakers downstream.

The upstream TemBreak 2 circuit breaker acts as a resistance against short-circuit currents. With this assistance, downstream circuit breakers with breaking capacities lower than the prospective short-circuit at their point of installation can interrupt the reduced short-circuit current.

Since the current is limited downstream of the limiting circuit breaker, cascading applies to all switchgear in the downstream circuit. It is not restricted to two consecutive devices.

Cascading is recognised by the following standards related to electrical installations:

IEC 60364

BS 7671

AS/NZS 3000

The Advantages

Installation of a single limiting circuit-breaker results in considerable simplifications and savings for the entire downstream installation:

- Simplification of selection of devices using the cascading tables
- Savings on downstream devices. Cascading allows circuit-breakers with lower ratings to be used.

In addition the application of cascading will reduce both electrodynamic and thermal stress within the installation.

HOW TO READ THE CASCADE TABLES

The value shown in the table is the increased breaking capacity, expressed in kA, that can be achieved if the downstream MCCB is backed up by the appropriate upstream MCCB.

Worked Examples:

Q (1) A 36kA panelboard is required with a 400A incomer and 125A outgoing MCCBs. Can cascading be applied?

A (1) A cost effective solution would be to use an S400-CJ incomer rated at 36kA and E125-NJ MCCBs rated at 25kA downstream.

The upstream S400-CJ MCCB would back up the downstream E125-NJ to 36kA. If this was an 8 Way panelboard you have managed to save cost by installing eight 25kA MCCBs rather than eight 36kA MCCBs.

Q (2) If the same 8 way panelboard was to be used in an 80kA installation, what MCCBs could be used?

A (2) You could still use the E125-NJ provided it was backed up by an L400-NE. The Current limiting capacity of the 400A MCCB would back up the E125A from 25kA to 85kA.

CASCADE TABLES

Upstream: TemBreak 2 MCCB.
Downstream: TemDin 2 MCB.

Upstream MCCB

Downstream MCB	Model	E125NJ (25kA)	S125NJ (36kA)	S125GJ (65kA)	S160NJ (36kA)	S160GJ (65kA)	E250NJ (25kA)	S250NJ (36kA)	S250GJ (65kA)
	In	125A	125A	125A	160A	160A	250A	250A	250A
DS (6kA)	6A	14	14	14	12	12	12	12	12
	10A	14	14	14	12	12	12	12	12
	16A	14	14	14	12	12	12	12	12
	20A	14	14	14	12	12	12	12	12
	25A	14	14	14	12	12	12	12	12
	32A	14	14	14	12	12	12	12	12
	40A	12	12	12	10	10	10	10	10
	50A	12	12	12	10	10	10	10	10
	63A	12	12	12	10	10	10	10	10

Notes: 1. All values shown at 400V AC.
2. Cascade fault level limit is expressed in kA.

Upstream MCCB

Downstream MCB	Model	E125NJ (25kA)	S125NJ (36kA)	S125GJ (65kA)	S160NJ (36kA)	S160GJ (65kA)	E250NJ (25kA)	S250NJ (36kA)	S250GJ (65kA)
	In	125A	125A	125A	160A	160A	250A	250A	250A
DH (10kA)	6A	25	30	30	25	25	25	25	25
	10A	25	30	30	25	25	25	25	25
	16A	25	30	30	25	25	25	25	25
	20A	25	30	30	25	25	25	25	25
	25A	25	30	30	25	25	25	25	25
	32A	25	30	30	25	25	25	25	25
	40A	25	30	30	23	23	23	20	23
	50A	25	30	30	23	23	23	23	23
	63A	25	30	30	23	23	23	23	23

Notes: 1. All values shown at 400V AC.
2. Cascade fault level limit is expressed in kA.

CASCADE TABLES

Upstream: TemBreak 2 MCCB.
Downstream: TemBreak 2 MCCB.

Upstream MCCB

Downstream MCCB			125A					160A/250A									
	Model		E125NJ	S125NJ	S125GJ	H125NJ	L125NJ	S160NJ	S160GJ	H160NJ	L160NJ	E250NJ	S250NJ	S250GJ	S250PE	H250NJ H250NE	L250NJ
		Breaking Capacity	25kA	36kA	65kA	125kA	200kA	36kA	65kA	125kA	200kA	25kA	36kA	65kA	70kA	125kA	200kA
50A	S50NF	10kA	25	25	25	25	25	15	15	25	25	15	15	15	15	25	25
	E100NF	10kA	25	25	25	25	25	15	15	25	25	15	15	15	15	25	25
125A	E125NJ	25kA	-	36	50	65	85	36	50	65	85	-	36	50	50	65	85
	S125NJ	36kA	-	-	65	85	125	-	65	85	125	-	-	65	65	85	125
	S125GJ	65kA	-	-	-	125	150	-	-	125	150	-	-	-	70	125	150
	H125NJ	125kA	-	-	-	-	200	-	-	-	200	-	-	-	-	-	200
160A/ 250A	S160NJ	36kA	-	-	-	-	-	-	65	85	125	-	-	65	65	85	125
	S160GJ	65kA	-	-	-	-	-	-	-	125	150	-	-	-	70	125	150
	H160NJ	125kA	-	-	-	-	-	-	-	-	200	-	-	-	-	-	200
	E250NJ	25kA	-	-	-	-	-	-	-	-	-	-	36	50	50	65	85
	S250NJ	36kA	-	-	-	-	-	-	-	-	-	-	-	65	65	85	125
	S250GJ	65kA	-	-	-	-	-	-	-	-	-	-	-	-	70	125	150
	S250PE	70kA	-	-	-	-	-	-	-	-	-	-	-	-	-	125	150
	H250NJ	125kA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	200

Notes: 1. All values shown at 400V AC.
2. Cascade fault level limit is expressed in kA.

Upstream MCCB

Downstream MCCB			400A						630A				800A				1250A/1600A	
	Model		S400CJ	S400NJ S400NE	S400GJ S400GE	S400PJ S400PE	H400NE	L400NE	E630NE	S630CE	S630GE	TL630NE	XS800SE	XS800NJ	XH800SE	TL800NE	XS1250SE	XS1600SE
		Breaking Capacity	36kA	50kA	70kA	85kA	125kA	200kA	36kA	50kA	70kA	125kA	50kA	65kA	65kA	125kA	85kA	100KA
125A	E125NJ	25kA	36	36	50	50	65	85	36	36	50	-	-	36	36	-	-	-
	S125NJ	36kA	-	50	65	65	85	125	-	50	65	-	-	50	50	-	-	-
	S125GJ	65kA	-	-	70	85	125	150	-	-	70	-	-	-	-	-	-	-
	H125NJ	125kA	-	-	-	-	-	200	-	-	-	-	-	-	-	-	-	-
160A/ 250A	S160NJ	36kA	-	50	65	65	85	125	-	50	65	-	50	65	65	-	-	-
	S160GJ	65kA	-	-	70	85	125	150	-	-	70	-	-	-	-	-	-	-
	H160NJ	125kA	-	-	-	-	-	200	-	-	-	-	-	-	-	-	-	-
	E250NJ	25kA	36	36	50	50	65	85	36	36	50	-	36	50	50	-	-	-
	S250NJ	36kA	-	50	65	65	85	125	-	50	65	-	50	65	65	-	-	-
	S250GJ	65kA	-	-	70	85	125	150	-	-	70	-	-	-	-	-	-	-
	S250PE	70kA	-	-	-	-	125	150	-	-	-	-	-	-	-	-	-	-
	H250NJ	125kA	-	-	-	-	-	200	-	-	-	-	-	-	-	-	-	-
400A	E400NJ	25kA	36	36	50	50	65	85	36	36	50	36	36	50	50	36	36	36
	S400CJ	36kA	-	50	65	65	70	100	-	50	65	50	50	65	65	50	50	50
	S400NJ	50kA	-	-	70	70	85	125	-	-	70	65	-	-	65	65	65	65
	S400GJ	70kA	-	-	-	85	125	150	-	-	-	-	-	-	-	-	-	85
	S400PJ	85kA	-	-	-	-	125	150	-	-	-	-	-	-	-	-	-	85
	H400NJ	125kA	-	-	-	-	-	200	-	-	-	-	-	-	-	-	-	-

Notes: 1. All values shown at 400V AC.
2. Cascade fault level limit is expressed in kA.

The Application of MCCBs in DC Systems

Terasaki's MCCBs provide an excellent range of protection for DC installations. We offer MCCBs of up to 1000A with DC overload protection and up to 2500A with DC short-circuit protection.

Protection Method

Current transformers require alternating current to generate magnetic flux thereby inducing current to flow in the secondary winding. Any device which relies on current transformers for measurement or detection of current is therefore unsuitable for protection of DC systems. Most electronic MCCBs fall into this category.

The most common method of detecting DC overloads is by the use of a thermal element. Short-circuit protection in DC circuits is provided by electromagnetic tripping elements.

Tripping Characteristics

The time-current characteristics of a thermal element, such as those published in Section 3, are unaffected by the frequency of current applied. They hold good for both AC and DC currents.

A magnetic element operates on the instantaneous value of the current waveform. This means that in practice in an AC circuit, it will operate at the peak value of the sinusoidal waveform. Tripping characteristics are published in AC root mean square (rms) Amperes (A). This means that the value of AC instantaneous current, I_p, which will operate the element is equal to the rms current multiplied by $\sqrt{2}$. Similarly, the value of DC instantaneous current which will operate the element is equal to the AC rms current multiplied by $\sqrt{2}$.

DC operating current of magnetic element = $\sqrt{2}$ x AC rms operating current of magnetic element.

Time Constant

Time constants associated with DC circuits prevent the voltage of the circuit from reacting immediately when a load current is suddenly interrupted.

The time constant, τ, of a circuit indicates how quickly voltage across capacitors and current through inductors react to transient conditions.

The time constant of a capacitive circuit is the product of capacitance and resistance:
$\tau = RC$ (s).
The time constant of an inductive circuit is given by:
$\tau = L/R$ (s).

The Application of MCCBs in DC Systems

Time Constant

Transient voltages and currents, including those produced by switching, do not approximate their steady state values until 5 time constants have elapsed.

Fault currents occurring in circuits with high time constants are extremely difficult to interrupt due to the lagging voltage. All DC breaking capacities in this section are shown with the assumption that the time constant of the circuit is restricted to the values shown below.

Fault Level	τ
Near the rated current, I_n, of the circuit breaker	<2.0ms
<2.5 x I_n	<2.5ms
<10kA	<7ms
>10kA	<15ms

Breaking Capacity

The short-circuit ratings of MCCBs suitable for DC installations are shown in the table below. In some cases, two or more poles must be connected in series to achieve the given rating, this is also indicated in the table.

DC Breaking Capacity, Icu (kA), Protection and Reference								
Voltage	250V DC	350V DC	500V DC		600V DC		Protection	
Poles in Series	2	3	3	4	3	4	Overload	Short Circuit
E125-NJ	25	-	-	-	-	-	Thermal, adjustable	Magnetic, adjustable
S125-ND	25	10	-	7.5	-	5	Thermal, adjustable	Magnetic, adjustable
S125-GJ	40	-	-	-	-	-	Thermal, adjustable	Magnetic, adjustable
S160-ND	40 (30†)	10	-	7.5	-	5	Thermal, adjustable	Magnetic, adjustable
E250-NJ	25	-	-	-	-	-	Thermal, adjustable	Magnetic, adjustable
S250-ND	40	10	-	7.5	-	5	Thermal, adjustable	Magnetic, adjustable
E400-NJ	25	-	-	-	-	-	Thermal, adjustable	Magnetic, adjustable
S400-CJ	40	-	-	-	-	-	Thermal, adjustable	Magnetic, adjustable
S400-ND	40	20	15	15	15	15	Thermal, adjustable	Magnetic, adjustable
XS800NJ	50	30	20	20	20	20	Thermal, adjustable	Magnetic, adjustable
XS1000ND	50	30	20	20	20	20	Thermal, fixed	Magnetic, adjustable
XS1250ND	50	50	50	50	20	20	-	Magnetic, adjustable
XS1600ND	50	50	50	50	20	20	-	Magnetic, adjustable
XS2000ND	50	50	50	50	20	20	-	Magnetic, adjustable
XS2500ND	50	50	50	50	20	20	-	Magnetic, adjustable

Notes: † Applies only to 20A and 32A models.

TEMBREAK 2

MOULDED CASE CIRCUIT BREAKERS 16A TO 630A

1. Welcome to TemBreak 2
2. Ratings and Specifications
3. Operating Characteristics
4. Application Data
5. **Accessories**
   - **Electrical Control (Internal Accessories)** 67
   - **Termination of Control Wiring** 72
   - **Electrical Control (Motorised Operation)** 73
   - **Operating Handles & Locking Devices** 76
   - **Insulation Accessories** 78
   - **Dual Supply Changeover Systems** 81
6. Installation
7. Dimensions

TEMBREAK 2

MINI MOULDED CASE CIRCUIT BREAKERS 10A TO 100A

8. TemBreak 2 MINI Moulded Case Circuit Breakers

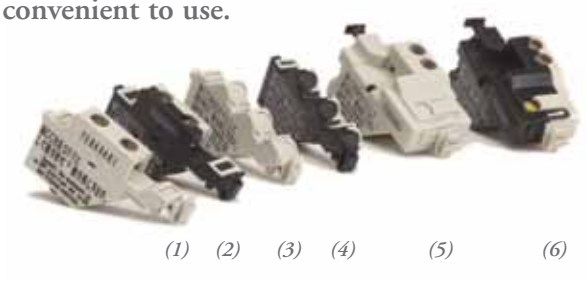
TEMBREAK

MOULDED CASE CIRCUIT BREAKERS 630A TO 1600A

9. TemBreak Moulded Case Circuit Breakers

ELECTRICAL CONTROL USING INTERNALLY MOUNTED ACCESSORIES

Electrical control accessories for TemBreak 2 are designed with the installer in mind. Status and alarm contacts, remote tripping coils and undervoltage
protection coils are of modular design and convenient to use.



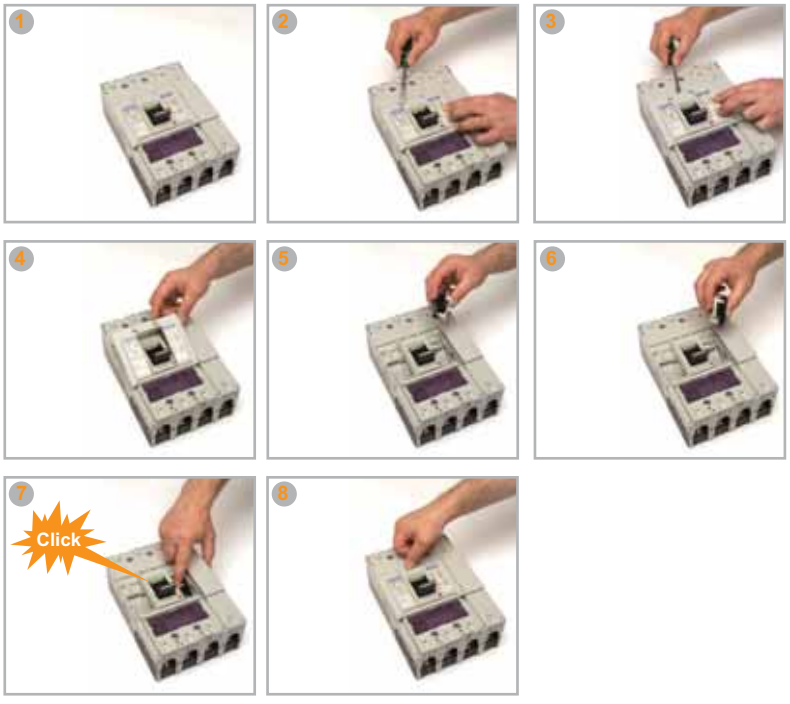
(1) (2) (3) (4) (5) (6)

1) Heavy-duty auxiliary switch
2) Heavy-duty alarm switch
3) General-purpose auxiliary switch
4) General-purpose alarm switch
5) Shunt trip
6) Undervoltage trip

- Every accessory fits every MCCB and Switch-Disconnector in the range.
- All accessories are endurance tested to the same level as MCCBs.
- TemBreak 2 internal accessories are easily **field-installable.**
- All accessories are individually packaged and are supplied with fitting instructions.
- Control wiring is terminated on the accessory screw terminal. Alternatively a terminal block which clips to the side of the MCCB is available.

Installing Accessories in a 4 pole S400 model

The internal accessories can be easily installed in the field without special tools or product training.

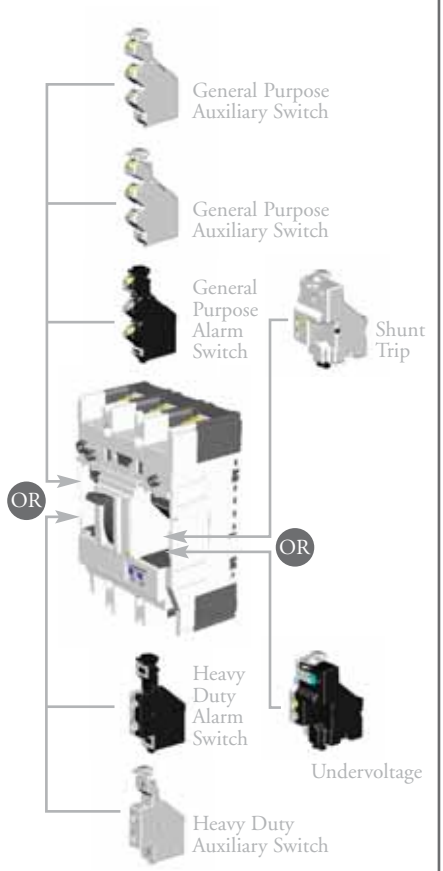
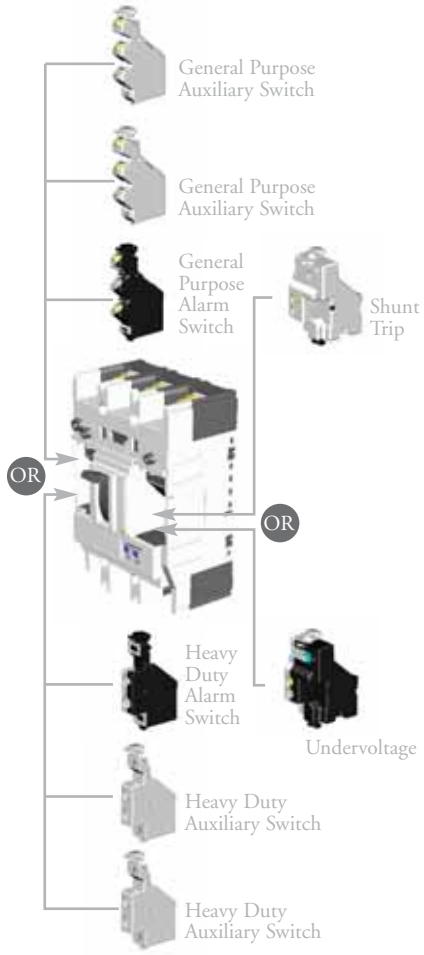
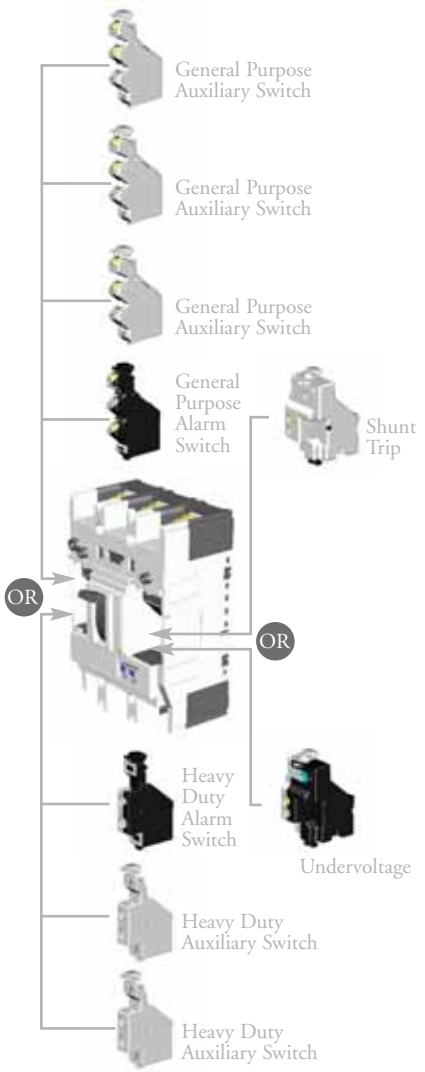


Easy field-Installation of Accessories

- Internal accessory can be simply plugged into position
- No tools are required for this, except a screwdriver to lift the MCCB front cover clips.
- Accessories fit with a firm click when installed correctly.
- Colour coding of accessories helps identification and installation

ELECTRICAL CONTROL USING INTERNALLY MOUNTED ACCESSORIES

Valid Maximum Accessory Combinations

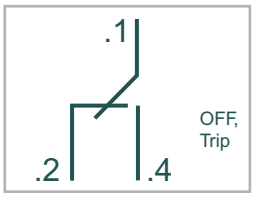
Frame size (A): 125	160 and 250	400 and 630
		

- Status indication switches mount in the left side of the MCCB.
  General purpose and heavy duty status indication switches cannot be mixed in the same MCCB.
  Only one alarm switch can be fitted to an MCCB.
- Shunt trips and undervoltage trips mount in the right side of the MCCB.
- It is not possible to install a shunt trip and an undervoltage trip in an MCCB as they occupy the same location. Undervoltage trips can provide remote tripping if necessary by wiring a normally closed contact or pushbutton in series with the protected supply.
- Undervoltage trips with time delays require an external time delay controller which clips to the side of the MCCB.

ELECTRICAL CONTROL USING INTERNALLY MOUNTED ACCESSORIES

Status Indication Switches

General Purpose Auxiliary Switch



Terminal Designations and Function of General Purpose Auxiliary Switch

General Purpose Auxiliary Switch (AX)

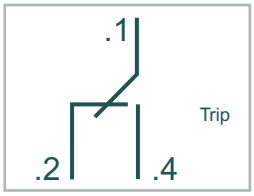
An auxiliary switch electrically indicates the ON or OFF status of the MCCB. The general purpose type is a changeover switch with 3 terminals.

A microcurrent version is available for switching currents as low as 1mA.

Auxiliary switches are colour coded grey. The cable capacity of the terminals is 0.5 to 1.25mm^2.

The general purpose auxiliary switch meets the requirements of IEC 61058-1.

General Purpose Alarm Switch



Terminal Designations and Function of General Purpose Alarm Switch

General Purpose Alarm Switch (AL)

An alarm switch electrically indicates the TRIP status of the MCCB. The general purpose type is a changeover switch with 3 terminals.

A microcurrent version is available for switching currents as low as 1mA.

Alarm switches are colour coded grey and black. The cable capacity of the terminals is 0.5 to 1.25mm^2.

The general purpose alarm switch meets the requirements of IEC 61058-1.

General purpose auxiliaries and alarm switch ratings

Volts (V)	AC Amperes (A)		Volts (V)	DC Amperes (A)		Minimum Load
	Resistive Load	Inductive Load		Resistive Load	Inductive Load	
440	-	-	250	-	-	100mA at
240	3	2	125	0.4	0.05	15V DC.
110	3	2	30	3	2	

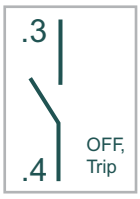
Microcurrent versions

DC Volts (V)	DC Amperes (A) Resistive Load	Minimum Load
30	0.1	1mA at 5V DC and 30V DC.

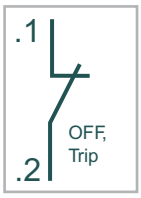
ELECTRICAL CONTROL USING INTERNALLY MOUNTED ACCESSORIES

Status Indication Switches

Heavy Duty Auxiliary Switch

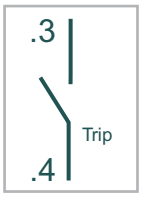


Terminal Designations and Function of Heavy Duty Auxiliary Switch, a contact

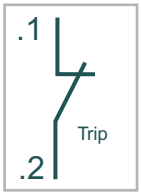


Terminal Designations and Function of Heavy Duty Auxiliary Switch, b contact

Heavy Duty Alarm Switch



Terminal Designations and Function of Heavy Duty Alarm Switch, a contact



Terminal Designations and Function of Heavy Duty Alarm Switch, b contact

Ratings of Heavy Duty Auxiliary and Alarm Switches					
AC			DC		
Volts (V)	Amperes (A)		Volts (V)	Amperes (A)	
	Resistive Load	Inductive Load		Resistive Load	Inductive Load
500	1	1	-		
440	3	3	250	0.5	0.5
240	4	4	125	1	1
110	5	5	48	3	2.5
48	6	6	24	6	2.5

Heavy Duty Auxiliary Switch (AX)

The heavy duty auxiliary switch has an impulse withstand voltage (Uimp) of 6kV and is suitable for isolating safety circuits. The auxiliary switch electrically indicates the ON or OFF status of the MCCB. The heavy duty type is a bridge switch with two terminals. It is available in either normally open or normally closed configurations.

Heavy duty auxiliary switches are colour coded grey. The cable capacity of the terminals is 1.25 to 2.5mm^2.

The heavy duty auxiliary switch meets the requirements of IEC 60947-5-1.

It has direct opening action, recommended by IEC 60204-1 Safety of Machinery - Electrical Equipment for Machines.

Heavy Duty Alarm Switch (AL)

The heavy duty alarm switch has an impulse withstand voltage (Uimp) of 6kV and is suitable for isolating control circuits. The alarm switch electrically indicates the TRIP status of the MCCB. The heavy duty type is a bridge switch with two terminals. It is available in either normally open or normally closed configurations.

Heavy duty auxiliary switches are colour coded grey and black. The cable capacity of the terminals is 1.25 to 2.5mm^2.

The heavy duty alarm switch meets the requirements of IEC 60947-5-1.

It has direct opening action, recommended by IEC 60204-1 Safety of Machinery - Electrical Equipment for Machines.

ELECTRICAL CONTROL USING INTERNALLY MOUNTED ACCESSORIES

Remote Tripping Devices

Shunt Trip (SHT)

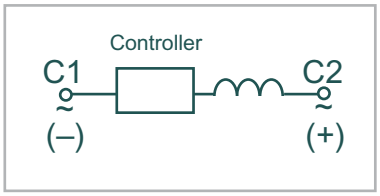
A shunt trip allows an MCCB to be tripped remotely on the application of the rated coil voltage across the shunt trip terminals. TemBreak 2 shunt trips have **continuously rated coils** and are suitable for use in electrical interlocking applications.

The MCCB contacts and toggle will move to the tripped position when the shunt trip is operated.

The permissible voltage range is 85% to 110% for AC or 75% to 125% for DC.

The cable capacity of the terminals is 0.5 to 1.25mm². Shunt trips are colour coded grey.

Shunt Trips



Terminal Designations of Shunt Trips

Ratings of Shunt Trips							
Rated Voltage	Voltage AC			Voltage DC			
	100-120	200-240	380-450	24	48	100-120	200-240
Excitation Current (A)	0.014	0.014	0.0065	0.03	0.03	0.011	0.011

Under Voltage Trip (UVT)

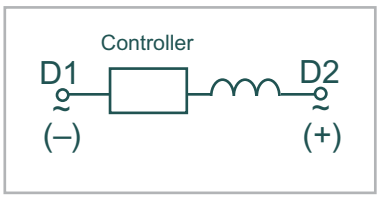
An undervoltage trip will trip the breaker automatically when the voltage applied to the terminals of the undervoltage coil drops to between 70% and 35% of its voltage rating. The undervoltage trip prevents the circuit breaker being closed unless a voltage corresponding to at least 85% of its voltage rating is applied across the terminals of the undervoltage coil.

The MCCB contacts and toggle will move to the tripped position when the under-voltage trip operates.

Undervoltage trips with AC operating voltages are available with 500ms time delays. Time-delay units are fitted to the outside of MCCBs.

The cable capacity of the terminals is 0.5 to 1.25mm². Undervoltage trips are colour coded grey and black.

Undervoltage Trips



Terminal Designations of Undervoltage Trips

Ratings of Undervoltage Trips						
	Power supply capacity (VA)			Excitation current (mA)		
Rated Voltage	Voltage AC			Voltage DC		
	100-120	200-240	380-450	24	100-120	200-240
Power Supply Capacity (VA)	1.4	1.4	2.28	23	10	10

TERMINATION OF CONTROL WIRING

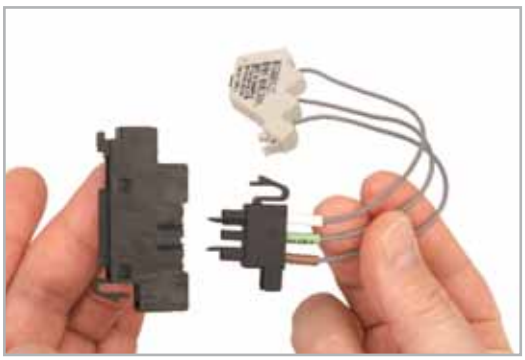
Terminal blocks are for optional use with all types of internally mounted accessory.

Terminal Block for Plug-in MCCBs

The terminal block for a plug-in MCCB consists of:

- a male section pre-fitted with 3 cables with which clips easily to the back of the MCCB
- a female section with 3 user terminals which clips easily into the plug-in base.

Up to 4 terminal blocks can be installed on a 125A, 160A or 250A frame MCCB. Up to 5 terminal blocks can be installed on a 400A or 630A frame MCCB.



Terminal Block for Plug-in MCCBs

Terminal Block for Front-Connected and Rear-Connected MCCBs (TF)

A terminal block facilitates convenient and accessible control wiring to internally mounted accessories especially the accessories with lead wire.
It allows the use of control wiring cables with larger cross-sectional area than permitted by the internal accessories themselves.

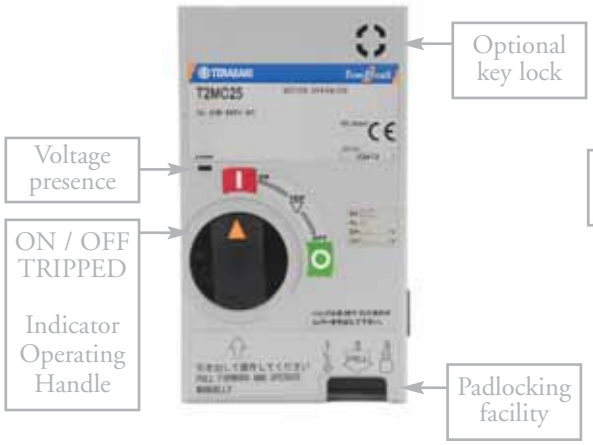
This terminal block can be clipped to either side of the MCCB. If mounted on the left incoming wiring will be fed vertically up to the terminals. If mounted on the right, the incoming wiring will be fed vertically down to the terminals.

The maximum incoming cable size to the terminal block is 2.0mm^2. 11terminals or 6 terminals can be specified. See page 120.

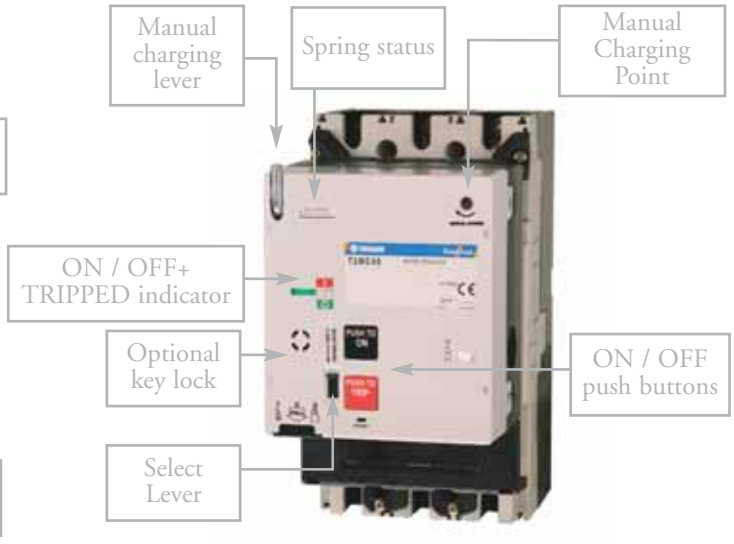
Terminal Block for Front-Connected and Rear-Connected MCCBs

ELECTRICAL CONTROL USING MOTORISED OPERATION

Overview – Motor Operators (MC)



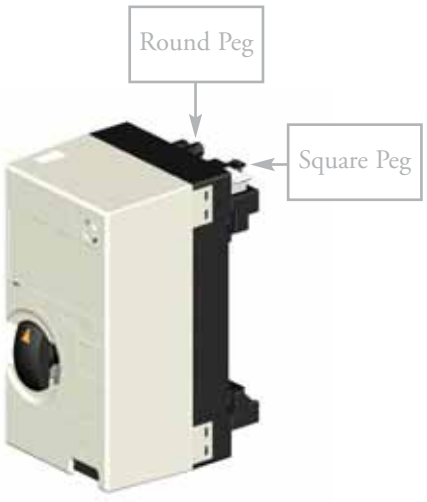
Motor Operator for 125A and 250A Frame MCCB's



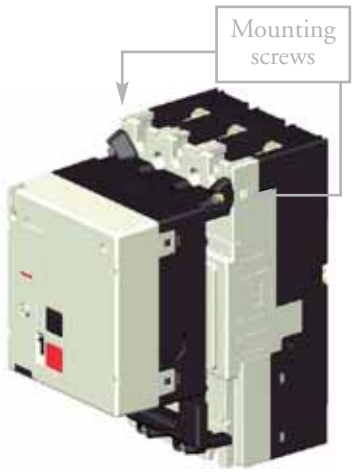
Motor Operator for 400A and 630A Frame MCCB's

Motor operators provide the possibility of opening and closing an MCCB on application of electrical control signals. TemBreak 2 motor operators are extremely reliable, having been designed to endure the same switching duty as the host MCCB.

- Easy field-installation.
- Fast operation (≤100ms).
- Positive contact indication.
- Padlocking facility as standard (Maximum 3, hasp diameter 8mm).
- Optional keylock.
- Versions available with automatic reset function.
- Voltage presence indication.



Motor Operator for 125A and 250A frame MCCB's



Motor Operator for 400A and 630A frame MCCB's

Motor operators for 125A and 250A frame are mounted on the front of the breaker. They can be rapidly fitted by locating the round pegs and square pegs on the motor into corresponding round and square holes on the breaker. It takes less than 10 seconds to secure the motor to the MCCB.Two levers securely lock the motor into position. No tools are needed to fit the motor operator.

400A frame and 630A frame motor operators are held in place with mounting screws. They can be installed easily in the field.

ELECTRICAL CONTROL USING MOTORISED OPERATION

Indication of ON, OFF or TRIPPED Status

The handle of 125A and 250A frame motor operators has dual functions:

1. Indication of ON, OFF or TRIPPED status as shown in the photographs below;
2. Manual operation when handle is pulled out. The supply to electrical control circuits inside the motor operator is cut when the handle is pulled out.

MCCB on

MCCB off

MCCB tripped

Motor operators for 400A and 630A frame MCCBs incorporate a mechanical flag which indicates the ON, OFF and TRIPPED status of the MCCB. They can be manually charged using the lever provided.

Ratings and Specifications

Frame size of host MCCB (A)		125, 160, 250	400, 630
Rated operating voltage	100-110 V AC	■	■
	200-220 V AC	■	■
	230-240 V AC	■	■
	24 V DC	■	■
	48 V DC	■	■
	100-110 V DC	■	■
Operating current/ Starting current Peak value (A)	100-110 V AC	4.5/8	ON ---/1.9; OFF, RESET 1.3/3.8
	200-220 V AC	4/8	ON ---/3.3; OFF, RESET 0.9/3.8
	230-240 V AC	3.5/7	ON ---/3.3; OFF, RESET 0.9/3.8
	24 V DC	18/26	ON ---/9.2; OFF, RESET 4.3/9.8
	48 V DC	12/18	ON ---/3.8; OFF/RESET 2.0/5.2
	100-110 V DC	2/6	ON ---/1.3; OFF/RESET 1.2/2.9
	200-220 V DC	2.2/5.5	—
Operating method		Direct drive	Spring charging
Operating time (s)	ON	0.1	0.1
	OFF	0.1	1.5
	RESET	0.1	1.5
Operating switch rating	100V, 0.1 A, Opening voltage 44V, current 4mA		100V, 0.1 A, Opening voltage 48V, current 1mA
Power supply required	300 VA minimum		300VA minimum
Dielectric properties (1 min)	1500 V AC (1000V AC for 24V DC and 48V DC motors)		
Weight	1.4 kg		3.5kg

■= Available

Note: Operating times shown in the above table apply only when the rated operational voltage is supplied to the motor operator. The voltage supplied to the motor operator must be within the range of 85% and 110% of the rated operating voltage.

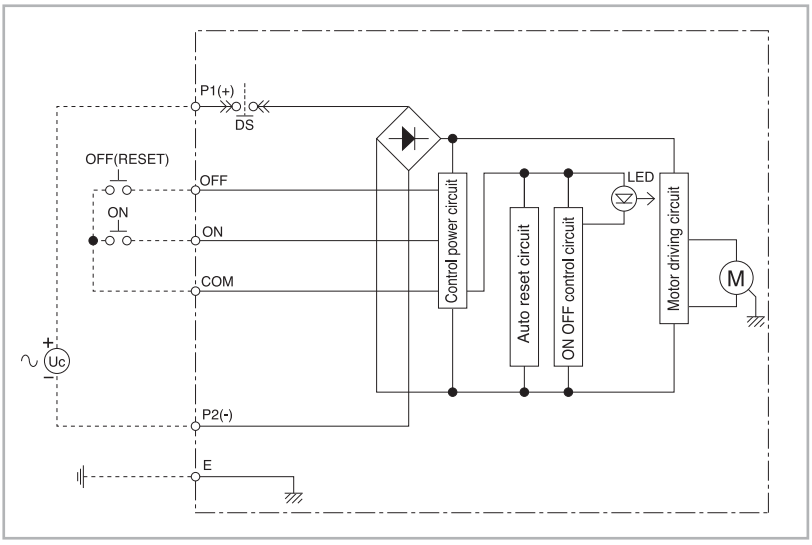
ELECTRICAL CONTROL USING MOTORISED OPERATION

Motor Operator Control Circuits

MCCB and Motor Operator Showing Control Wiring Socket

Control Wiring Plug

The Control circuits for Motor Operators are connected using a simple plug and socket system.



Control circuit for Motor Operators

Operation

The motor operator incorporates a self-hold circuit for the closing and opening signals. Therefore a momentary open or close signal will ensure a complete operation.

When the breaker trips, the breaker is reset by applying a signal to the OFF terminals of the motor.

When a UVT is used with a motor operator, design the control circuit so that the UVT is energised **before** a reset or close signal is sent to the motor operator. A 40ms time delay in the reset and close signals is sufficient to allow the UVT to energise.

When a shunt trip is used with a motor operator, design the control circuit so that the shunt trip is de-energised before a reset or close signal is sent to the motor operator.

When a mechanical interlock is used with motor operators, design the control circuit to provide electrical interlocking between the motor operators. The electrical interlocking should prevent a close signal being sent to a motor operator unless the other motor operator and circuit breaker are in the OFF position.

Auto- reset

Two types of motor operator are available: motor operators without auto-reset and motor operators with auto-reset. The correct type of motor operator should be selected for the application. MCCB auxiliary and alarm switches do not have to be used in the control circuits for motor operators whether they have auto-reset or not, saving cost and space.

OPERATING HANDLES & LOCKING DEVICES

TemBreak 2 external operating handles are extremely reliable, having been designed to endure the same switching duty as the host MCCB.

It is easy to fit the operating unit to the MCCB. Fitting involves three easy steps:

1. Align breaker toggle with operating mechanism
2. Push external operating handle into position (the handle's round pegs locate securely in the breaker's round holes and the external operating handle's* square pegs in the breaker's square holes).
3. Twist locking screws through 45 degrees.*

Safety Features

- Door interlock mechanism with override facility included as standard
- IP54 as standard (door mounted version), IP3X as standard (breaker mounted version)
- IP65 optional (door mounted version), IP5X optional (breaker mounted version)
- Locks OFF with up to 3 padlocks (8mm hasps)
- Optional keylock in OFF position
- Available in black or red and yellow
- A trip test can be performed with the external operating handle fitted to the MCCB

Orientation

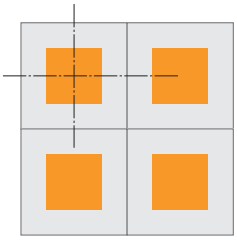
To switch the breaker from OFF to ON the external operating handle is rotated through 90 degrees in a clockwise direction.

MCCB ON

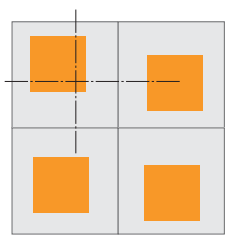
MCCB ON

The ON (I) and OFF (O) indication of the external operating handle can be re-oriented in steps of 90 degrees with respect to the operating mechanism. This allows the indication position to remain the same whether the breaker is mounted vertically (right side up or upside down) or horizontally (on its left side or on its right side). The hole cut-out dimensions for a panel or door will remain unchanged if the external operating handle is re-oriented. The external operating handle's axis of rotation is on the intersection of the centre lines of a 3P MCCB. This means that the positioning of the door cutouts is symmetrical for breakers mounted horizontally on either side of a vertical busbar system.

Cubicle Door Cutouts



Using TemBreak 2 Operating Handles

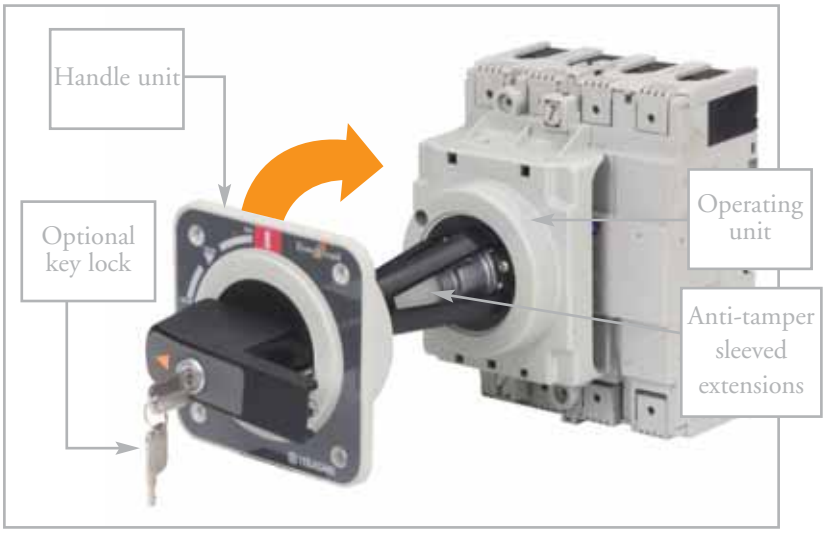


Using other MCCB Operating Handles

*external operating handles for 400A and 630A Frame models are secured with four screws.

OPERATING HANDLES & LOCKING DEVICES

Door Mounted Handle (HP)



Door Mounted Handle with Optional Keylock

The door mounted handle is used to operate a circuit breaker mounted inside a cubicle from outside the door. It consists of an operating mechanism that is mounted on the breaker, an operating handle that is mounted on the door, and a shaft that transmits the turning force from the handle to the operating unit. The shaft can be cut to the required length.

Breaker Mounted Handle (HB)

Breaker Mounted Handle Padlocked in the OFF Position

This external operating handle is used to operate a circuit breaker mounted just behind a compartment door with the door closed. The operating unit and the handle itself are mounted directly onto the circuit breaker. The handle protrudes through a cutout in the door. A moulded door flange is supplied with the external operating handle which covers the cutout from the front.

Padlocking and keylocking is possible in the OFF position.

Locking Devices

Toggle locking devices allow MCCBs to be locked ON or OFF using up to three padlocks. Locking devices for 125A, 160A and 250A frame models accept padlocks with 5mm hasp diameter. Locking devices for 400A and 630A frame models accept padlocks with 8mm hasp diameter.

S250 Locked OFF

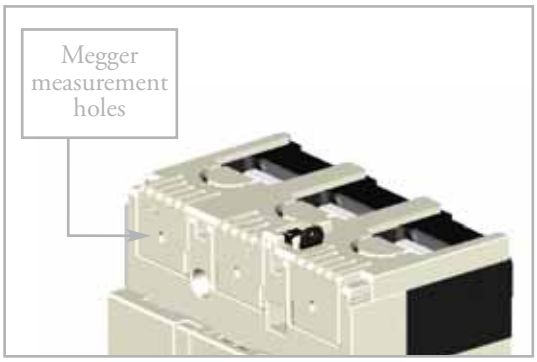
S400 Locked OFF

Fittings for Castell and Fortress locks are available. They are suitable for use on toggle-operated MCCBs, or on door mounted handles (HP) for MCCBs.

INSULATION ACCESSORIES

Terminal Covers

Terminal covers are used to prevent direct contact with live MCCB terminations. They also provide additional insulation to reduce the possibility of a short circuit between phases or to earth when large conductors are used.



General features

- Terminal covers require no tools for installation
- All terminal covers have an IP20 ingress protection rating
- Terminal covers are ordered individually. Two terminal covers are required to cover both the line and load terminals of an MCCB. Each cover can either be fitted to the top or bottom of the MCCB
- Terminal covers have a megger measurement hole of 4mm diameter on each phase.

Terminal Cover Lock with Lead Seal

Options

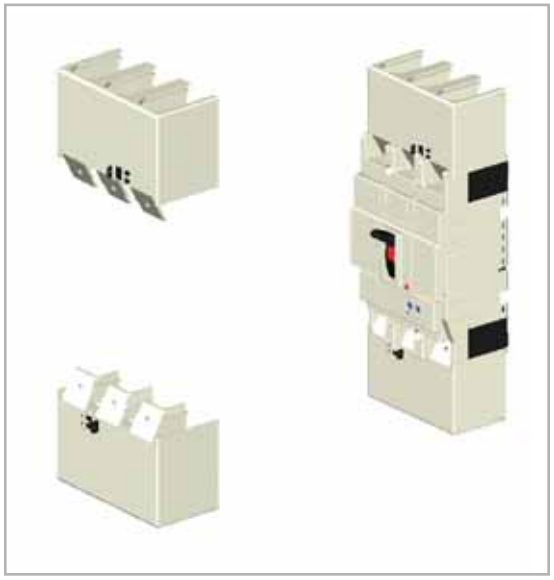
- A terminal cover lock allows an anti-tampering seal to be added.
- An earth barrier can be added to terminal covers for front connection. The earth barrier provides insulation at the rear of the terminations.

Earth Barrier Fitted to Rear of Terminal Cover

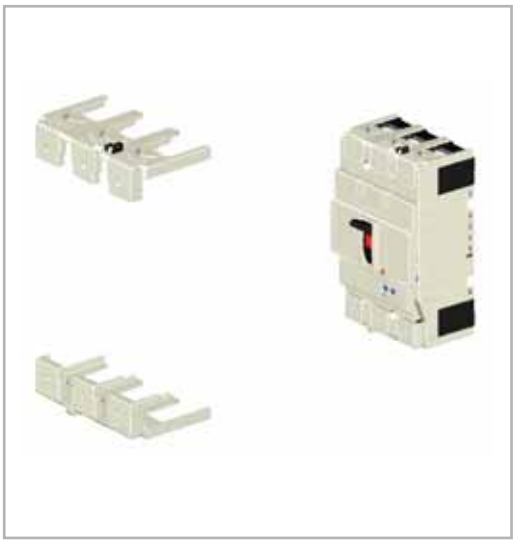
INSULATION ACCESSORIES

Terminal Covers for Front Connection (CF)

Terminal covers for front connection are suitable for covering the exposed live parts of conductors terminated on the MCCB.



Terminal Covers for Front Connection



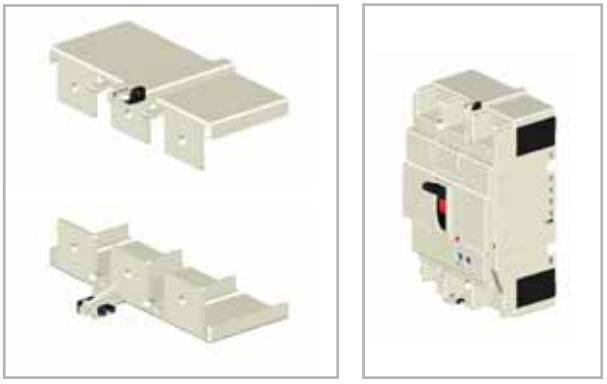
Flush Terminal Covers

Flush Terminal Covers (CS)

Flush terminal covers are useful for increasing the ingress protection rating at the terminals without increasing the overall length. They can be used with busbar and for direct entry of stranded cable (with cable clamp terminals (FW), refer to Section 6, Installation).
Flush terminal covers are identical to rear terminal covers for 400A and 630A frame models.
The user can remove a section of the rear terminal cover using a tool to allow entry of the conductor.

Terminal covers for Rear Connection (CR)

Terminal covers for rear connection may be used on MCCBs fitted with rear connections (RC) or plug-in connections (PM). They prevent access to the terminals from the front and top.



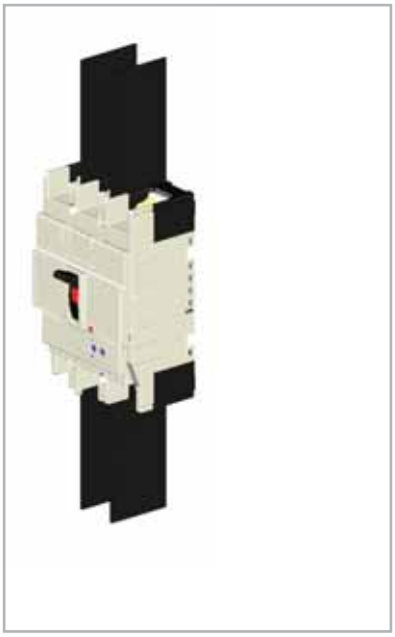
Terminal Covers for Rear Connection

INSULATION ACCESSORIES

Interpole Barriers (BA)

Interpole barriers provide maximum insulation between phases at the terminals of the MCCB. They cannot be fitted at the same time as any of the terminal covers. Interpole barriers for use on one end of the MCCB are supplied as standard. Additional interpole barriers can be ordered individually. All interpole barriers can easily be fitted to either end of an MCCB.

MCCB moulds have been designed to accept an additional interpole barrier between two adjacent MCCBs.



MCCB Fitted with Interpole Barriers on Both Ends

Interpole Barriers between Adjacent MCCBs

ACCESSORIES FOR DUAL SUPPLY CHANGEOVER SYSTEMS

Where more than one AC voltage source is available to a distribution system it is often necessary to prevent multiple sources supplying the system at one time. Interlocking accessories are used together with two MCCBs to prevent both being in the ON state simultaneously. This provides a secure mechanical means of preventing the connection of two supply sources.

An automatic changeover controller can monitor the status of two supplies and control the switching of two MCCBs according to pre-programmed parameters. When an automatic changeover controller is interfaced to a pair of interlocked MCCBs fitted with remote control accessories, a secure, fully automatic changeover system is achieved.

Link Interlock

Changeover Pair with Link Interlock and Motor Operators

Viewed from Below

Link Interlock (ML)

Link interlocks consist of a mechanism mounted to each MCCB in an adjacently mounted pair. The link between each mechanism inhibits the closure of one MCCB unless the other is in the OFF position.

Link interlocks can be used on a mixture of 3 and 4 pole breakers of the same frame size.

The TemBreak 2 link interlock is an innovative design breakthrough which will save space, time and money for switchboard builders in that:

- Installation is extremely simple. Link interlocks are field-installable and only require a screwdriver to fit.
- Link interlocks replace the accessory cover on the front of the breaker
- Motor operators and operating handles are compatible with link interlocks
- The interlock is installed on the front of the MCCB and does not therefore interfere with copperwork or cables
- No need to buy factory-built backplates with MCCBs and interlocks pre-fitted
- **An automatic changeover pair consisting of an interlocked pair of MCCBs with internal control accessories and motor operators can be assembled in a few minutes!**

ACCESSORIES FOR DUAL SUPPLY CHANGEOVER SYSTEMS

Wire Interlock (MW)

Wire interlocks consist of two mechanisms connected by a cable. The mechanisms are mounted on two MCCBs located at a distance from each other which is limited by the length and bend radius of the cable. The mechanisms and cable inhibit the closure of one MCCB unless the other is in the OFF position. Each mechanism is ordered separately. Cables of 1.0m or 1.5m length are also ordered as separate items.

Wire interlocks can be used on a mixture of 3 and 4 pole MCCBs of different frame sizes. This allows potential cost savings by using lower rated MCCBs for the alternative power supply. MCCBs can be mounted in different switchboard compartment or on different planes.

Changeover Pair with Wire Interlock and Motor Operators

View from above

The TemBreak 2 wire interlock is an innovative design breakthrough which will save space, time and money for switchboard builders in that:

- Installation is extremely simple. Wire interlocks are field-installable.
- Wire interlocks replace the accessory cover on the front of the breaker
- Motor operators and operating handles are compatible with wire interlocks
- Interlocking of MCCBs mounted in different compartments is possible
- No need to buy factory-built backplates with MCCBs and interlocks pre-fitted
- **An automatic changeover pair consisting of an interlocked pair of MCCBs with internal control accessories and motor operators can be assembled in a few minutes!**

Slide Interlock (MS)

Slide interlocks are manually operated toggle locking devices which can be installed between two adjacent MCCBs. Depending on the position of the slide, one or other of the MCCBs on either side of a slide interlock is inhibited from being in the ON position.

Slide interlocks can be used between MCCBs of the same number of poles and of the same frame size.

Slide interlocks can be installed in the field and are padlockable in both positions.

Slide Interlock Installed Between two MCCBs

ACCESSORIES FOR DUAL SUPPLY CHANGEOVER SYSTEMS

TemTransfer Automatic Changeover Controller

The TemTransfer is a fully configurable **Automatic Changeover Controller** (ACC). It is designed to monitor the incoming AC mains supply (1 or 3 phases) for under/over voltage and under/over frequency. Should these fall out of limits, the module will issue a start command to the generating set controller. Once the set is available and producing an output within limits the ACC will control the transfer devices and switch the load from the mains to the generating set. Should the mains supply return to within limits the module will command a return to the mains supply and shut down the generator after a suitable cooling run. Various timing sequences are used to prevent nuisance starting and supply breaks.

TemTransfer is compatible with TemPower 2 ACBs, TemBreak 2 MCCBs and TemContact contactors.

When TemTransfer is used with a pair of TemBreak 2 MCCBs, additional control wiring and components may be necessary for some control schemes. Contact us for details.

Terasaki can supply TemTransfer pre-configured to specification, or unconfigured with an optional interface kit.

Configuration is by PC based software and the interface kit using an FCC68 socket on the rear of the module. This allows rapid and secure configuration of the module. The FCC68 socket also provides full real-time diagnostics on the status of the ACC, its inputs and outputs.

Configuration and connection options allow for a wide range of **higher functions** such as *'Auto start inhibit'*, *'Manual restore to mains'*, *'Load inhibit'* (both mains and gen-set), *'Lamp test'*, *Push-button transfer control, External mains* or *Gen-set failure inputs,* etc.

The four position key-switch allows for mode selection:-

- Auto Mode
- Auto mode with manual return to Mains
- Run generator off load
- Run generator on load

A clear mimic diagram with 'International' symbols and LEDs provide clear indication of supply availability and load switching status. Further LED indication is provided for *'Start delay in progress'* and *'Mains return timer active'*. Two **user configurable LED's** are provided to allow the user to display specific states (defaulted to indicate that the closing procedure of the Mains or Generator circuit breaker has been started).

Five **user configurable relays** are provided to allow control of contactors, different circuit breaker types and engine control modules and alarm systems.

The controller features a self seeking power supply which will utilise power from the Mains AC supply or the Generator AC supply. A DC supply to the module is not essential for basic operation, though some 'higher' functions require it (such as system diagnostics).

The module is mounted in a robust plastic case, connection to the module is via plug and socket connectors.

TemTransfer Automatic Changeover Controller

ACCESSORIES FOR DUAL SUPPLY CHANGEOVER SYSTEMS

Specifications

DC Supply

The TemTransfer is normally powered from the AC sensing supplies. It will only draw power from the DC supply if both AC supplies are not present.

DC power should be supplied from a low voltage supply between 8 to 35V continuous. It is able to operate at 0V for 50ms during cranking, providing supply was at least 10V before dropout and supply recovers to 5V. This is achieved without the need for internal batteries.

Maximum operating current:
150mA @ 12V, 95mA @ 24V.

Maximum standby current (AC powered supply)
34.7 mA @ 115V. 16.1mA @ 230V.

3 Low voltage auxiliary relay contacts:
8Amp DC rated 1 each: NO+NC C/O
(a and b C/O contacts)

2 Mains rated relay contacts:
8Amp RMS rated 1 each NO+NC.
(a and b contacts)

Dimensions:
96 x 144 x 155 DIN STANDARD.

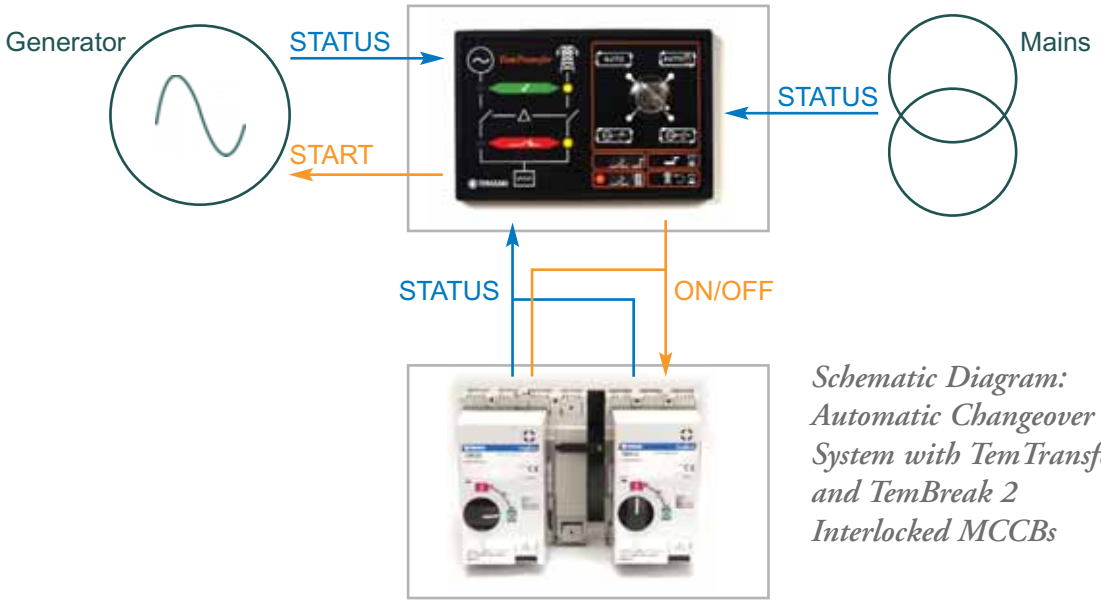
Operating temperature range:
-15 to +55oC

Indication LED's:
Mains Available/On Load, Generator Available/On load, Start Delay, Mains Return Delay and 2 User Configurable.

Operating voltage: - Specify on ordering.

AC Voltage Input Range (for AC Powered Operation):
115V Version:- 88 - 160 V ac RMS
230V Version:- 176 - 305 V ac RMS

AC Voltage Input/Adjustment Range (Sensing Operation):
115V Version:- 55 - 152 V ac RMS
230V Version:- 110 - 304 V ac RMS
AC Frequency Input/Adjustment Range:10 - 75 Hz



Schematic Diagram: Automatic Changeover System with TemTransfer and TemBreak 2 Interlocked MCCBs

SECTION 5

MODULAR SIZES

All current ratings up to 630A can be supplied in **2 sizes:** the 250A and 630A sizes.

The compact 125A size offers **the same** features and performance but with reduced dimensions and cost.

5

TEMBREAK 2

MOULDED CASE CIRCUIT BREAKERS 16A TO 630A

1. Welcome to TemBreak 2
2. Ratings and Specifications
3. Operating Characteristics
4. Application Data
5. Accessories
6. **Installation**
   - Connection and Mounting Options and Accessories 87
   - Insulation Distances 92
   - Mounting Angle 94
   - Direction of Power Supply 94
   - Standard Installation Environment and Special Treatments 95
   - Temperature Ratings 96
7. Dimensions

TEMBREAK 2

MINI MOULDED CASE CIRCUIT BREAKERS 10A TO 100A

8. TemBreak 2 MINI Moulded Case Circuit Breakers

TEMBREAK

MOULDED CASE CIRCUIT BREAKERS 630A TO 1600A

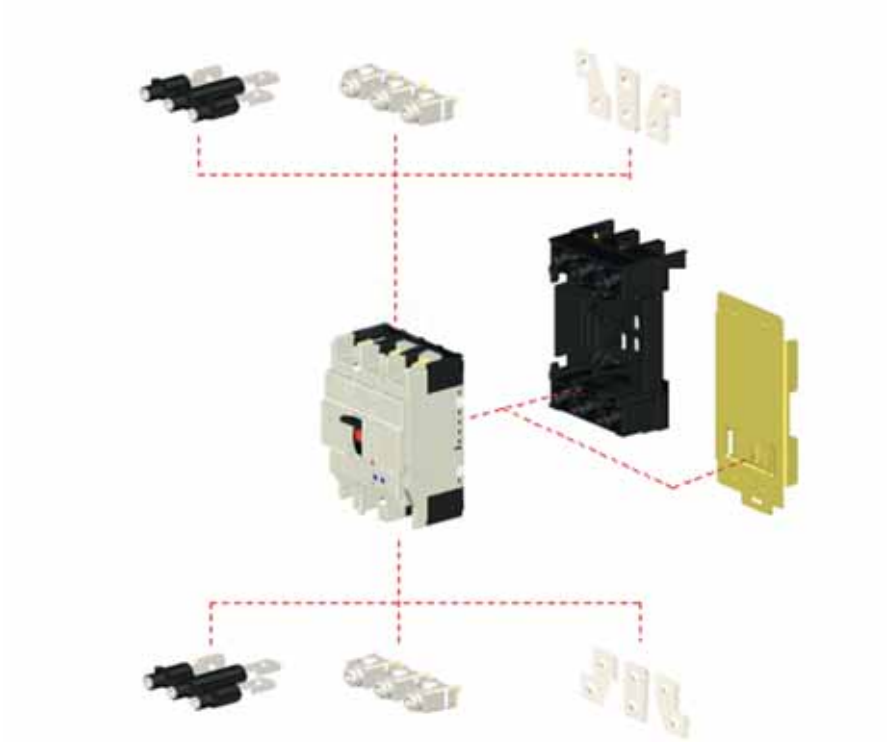
9. TemBreak Moulded Case Circuit Breakers

CONNECTION AND MOUNTING OPTIONS AND ACCESSORIES

TemBreak 2 MCCBs connection and mounting accessories facilitate easy installation in any arrangement. Breakers and accessories are easy to fit. They are designed to provide safe and secure termination and mounting points. 125A and 160A/250A frame models have a choice of 45mm front cutout patterns

Optional 45mm Cutout Patterns

Connection and mounting options overview diagram



Overview of Connection and Mounting Accessories

Please refer to Section 2, Ratings and Specifications, for details of the connection and mounting options which are available for each model.

Please refer to Section 7, Dimensions, for detailed dimensions of connection and mounting options and accessories.

Note that one set of mounting screws is supplied as standard with every circuit breaker or switch disconnector purchased.

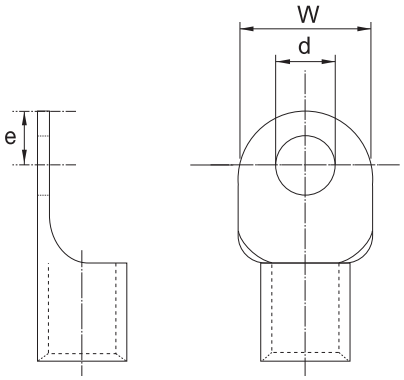
CONNECTION AND MOUNTING OPTIONS AND ACCESSORIES

Connection of Busbars and Terminated Cables

This connection method is standard for all **front connected** (FC) MCCB models. Solid conductors or cables terminated with crimp lug terminals can be used.

Serrated Terminal Surface

Each terminal on 160A and 250A models has a serrated surface. This provides excellent grip for heavy cables terminated with crimp lug terminals, thereby preventing sideways rotation of the lug.



Maximum Dimensions of Compression Terminals			
Frame Size (A)	125*	160 & 250	400 & 630
Width, W (mm)	17	25	25
Diameter, d (mm)	9	9	11
Maximum from centre to tip, e(mm)	8.5	10	12

Connection of Large Conductors and Multiple Conductors

Flat bars (FB) are terminal extensions which can be fitted to line or load side terminals and are used to connect large conductors and multiple conductors. Available for field fitting in sets of 3 or 4 bars.

*H125 and L125 are 250A frame size

CONNECTION AND MOUNTING OPTIONS AND ACCESSORIES

Direct Entry of Stranded Cable

Cable clamp terminals (FW) can be used to secure stranded cable directly to the MCCB. Available for field fitting in sets of 3 or 4.

MCCB Model	Cable Capacity (mm^2)
E125, S125, S125-NF	1.5 to 50 (1 cable)
H125, L125, S160-NF	1.5 to 70 (1 cable)
S160, E250, S250, H250, L250	35 to 120 (1 cable)
E400, S400, H400, L400	80 to 240 (1 cable)
	60 to 120 (2 cables)

Termination in Separate Compartment

Rear connections (RC) allow termination of conductors in a different switchboard compartment to the MCCB body.

The stud can be rotated in steps of 45 degrees in the field.

CONNECTION AND MOUNTING OPTIONS AND ACCESSORIES

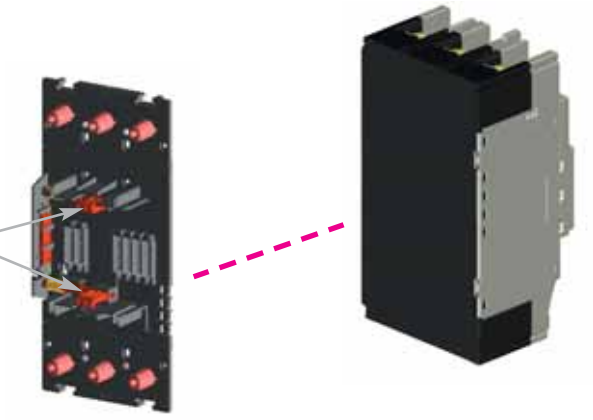
Plug-in Mounting

The plug in mounting system allows fast replacement of the MCCB body without the need to disturb the terminations. Solid conductors or cables terminated with compression terminals can be used.

Plug-In Safety Lock

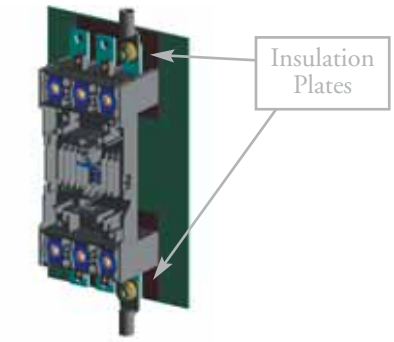
The plug-in MCCB body is **automatically locked to the base** when the contacts are closed (toggle ON). It cannot be removed unless the contacts are in the isolated position (toggle OFF or TRIPPED). This system ensures safe removal of the MCCB from the base.

Plug-in MCCB and base



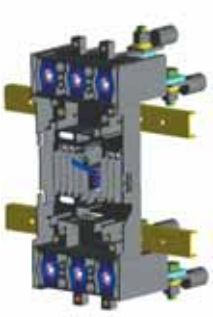
Plug-in connections and safety lock are fitted to the back of the MCCB

The connection bars for plug-in bases are optional and can be configured in the field either for front or rear access. The illustrations below show possible mounting and connection options for plug in bases.



1. Mounted on base plate with connection bars mounted for front access.
   Insulation plates are supplied as standard and must be fitted.

2. Terminations in separate compartment. Connection bars are mounted for top access at the top and rear access at the bottom.



3. Mounted on angle bars. Connection bars are mounted for rear access.

CONNECTION AND MOUNTING OPTIONS AND ACCESSORIES

Mounting on 35mm DIN Rail

The DIN rail adaptor is easily fitted to the rear of 3 pole E125 and S125 models to allow clip mounting of the MCCB to 35mm DIN rail.

The 45mm cutout of TemBreak 2 devices makes them suitable for mounting alongside modular devices in distribution boards.

Door Flanges

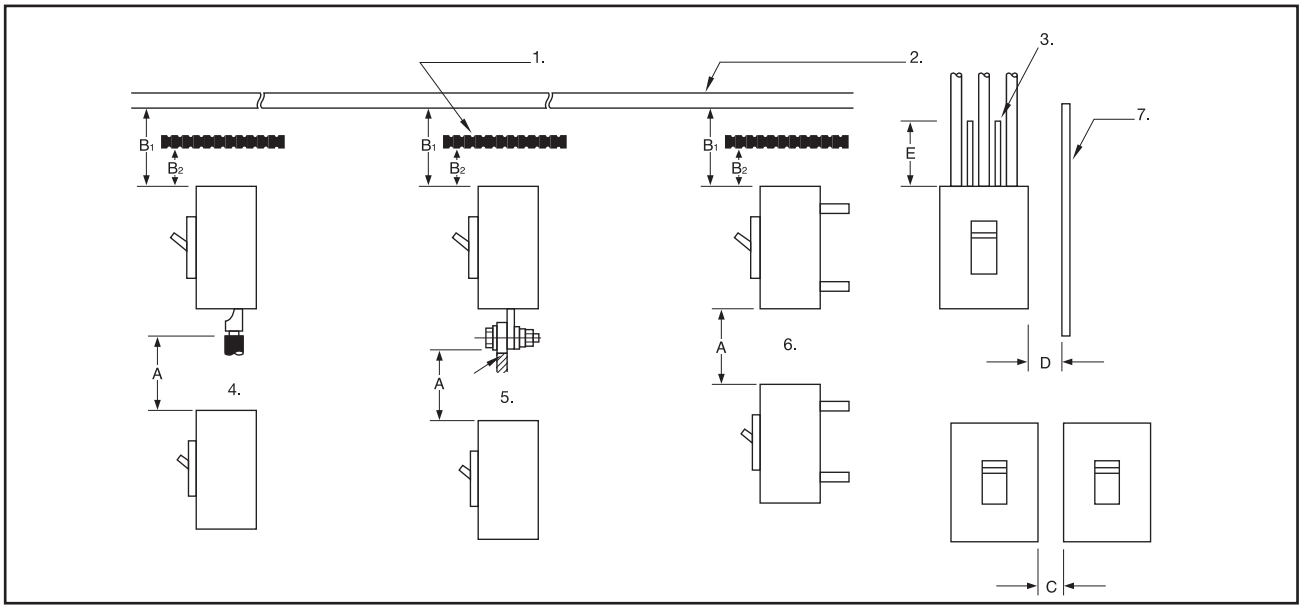
A range of flanges which improves the appearance of door cutouts is available. These are suitable for toggle-operated and motor-operated MCCBs and switch-disconnectors.

INSULATION DISTANCES

The insulation distances between the MCCB and earthed metal parts and insulators shown in this section must be maintained to prevent arcing faults occurring due to conductive ionised gas. In cases where other specifications require different insulation distances to those shown here, the greater distance must be maintained. In cases where two different models are installed one above the other, the insulation distance between the two models should be as for the lower model.

ATTENTION

Exposed conductors must be insulated up to the breaker terminals. Interpole barriers or optional terminal covers are recommended. If optional terminal covers are used, insulate the exposed conductor until it overlaps the terminal cover.



1. Insulation plate
2. Top plate (earthed metal)
3. Insulation tube or tape
4. Front-connected type
5. Front-connected type with extension bar
6. Rear-connected type, plug-in type
7. Side panel
8. **A.** Distance from lower breaker to exposed live part of upper breaker terminal (front-connected type) or distance from lower breaker to end face of upper breaker (rear-connected type or plug-in type)
   B1. Distance from end face of breaker to top plate
   B2. Distance from end face of breaker to insulation plate
   C. Gap between breakers
   D. Distance from side of breaker to side panel (earthed metal)
   E. Dimensions of insulation over exposed conductors

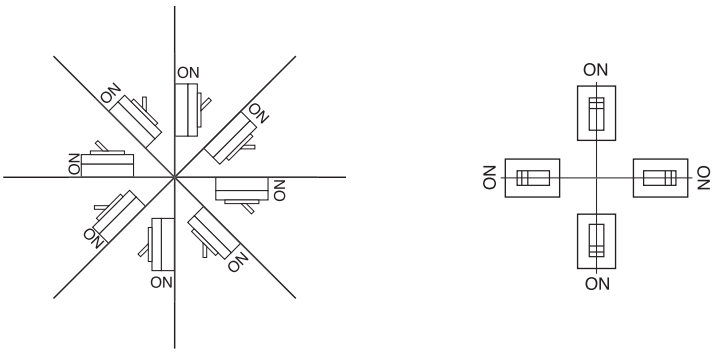
INSULATION DISTANCE IN mm (AT 690V AC MAXIMUM)

Model	Type	A	B1	B2	C	D	E
E125	NJ	50	40(2)	10	0	25	*(1)
S125	NF	50	40(2)	10	0	25	*(1)
S125	NJ	50	40(2)	10	0	25	*(1)
S125	GJ	75	45	25	0	25	*(1)
H125	NJ	100	80	60	0	50	*(1)
L125	NJ	100	80	60	0	50	*(1)
S160	NF	50	40	30	0	25	*(1)
S160	NJ	50	40	30	0	25	*(1)
S160	GJ	100	80	60	0	50	*(1)
H160	NJ	100	80	60	0	50	*(1)
L160	NJ	100	80	60	0	50	*(1)
E250	NJ	50	40	30	0	25	*(1)
S250	NJ	50	40	30	0	25	*(1)
S250	NE	50	40	30	0	25	*(1)
S250	GJ	100	80	30	0	25	*(1)
S250	GE	100	80	30	0	25	*(1)
S250	PE	100	80	60	0	50	*(1)
H250	NJ	100	80	60	0	50	*(1)
H250	NE	100	80	60	0	50	*(1)
L250	NJ	100	80	60	0	50	*(1)
E400	NJ	100	80	40	0	30	*(1)
S400	CJ	100	80	40	0	30	*(1)
S400	NJ	100	80	40	0	30	*(1)
S400	GJ	100	80	40	0	30	*(1)
S400	GE	100	80	40	0	30	*(1)
S400	PJ	100	80	40	0	30	*(1)
S400	PE	100	80	40	0	30	*(1)
H400	NE	120	120	80	0	80	*(1)
L400	NE	120	120	80	0	80	*(1)
E630	NE	120	100	80	0	80	*(1)
S630	CE	120	100	80	0	80	*(1)
S630	GE	120	100	80	0	80	*(1)

***Note:** (1) Insulate the exposed conductor until it overlaps the moulded case at the terminal, or the terminal cover.
(2) 10mm at 440V AC Maximum.

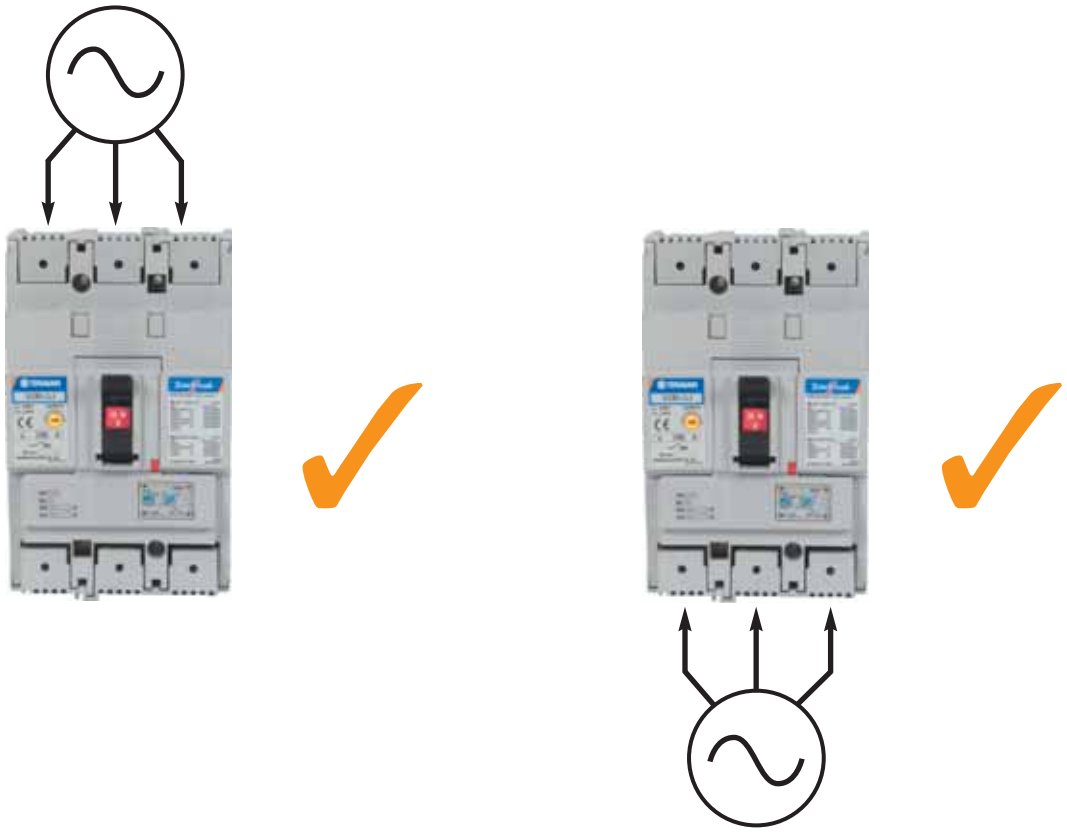
MOUNTING ANGLE

TemBreak 2 MCCBs may be mounted at any angle without affecting performance.



Mounting angle does not affect performance.

DIRECTION OF POWER SUPPLY



Power can be supplied through TemBreak 2 MCCBs in either direction without loss of performance.

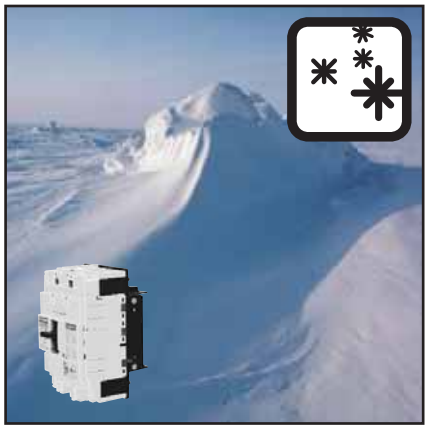
STANDARD INSTALLATION ENVIRONMENT AND SPECIAL TREATMENTS

TemBreak 2 MCCBs are intended for installation in the following conditions as standard:

- Operating ambient temperature -5 degrees C to 45 degrees C. Refer to page 90 for thermal derating information above this temperature.
- Relative humidity of up to 85%.
- Altitude up to 2000m.
- Atmospheres free from dust, smoke, corrosive gases, inflammable gases, moisture and salt.

For installation in conditions more onerous than those described above, contact Terasaki for details.

The following special treatments have been developed for installation in specific environmental conditions:



- Low temperature treatment. For installation at temperatures down to -40 degrees C for storage and -20 degrees C for operation. The environment must be free from rapid changes in temperature that result in the formation of condensation.

- Fungus-moisture proofing. For installation at temperatures up to 60 degrees C and relative humidity of up to 95%. The environment must be free from rapid changes in temperature.

- Anti-corrosion treatment. MCCB is surface treated to increase resistance to corrosion.
  If the MCCB is to be installed in atmosphere that contains excessive volumes of corrosive gases or moisture, it should be house in an airtight enclosure.

TEMPERATURE RATINGS

Calibration Temperature: 45°C

MCCB Type	Connection Type	Rating at calibration temperature (45°C)	Rated Current (A)			
			50°C	55°C	60°C	65°C
E125-NJ S125-NJ S125-GJ	Front Rear Plug-in	20A	19	18.5	18	17.5
		32A	31	30.5	30	29
		50A	48	45	43	41
		63A	60	57	55	52
		100A	97	94	90	87
		125A	121	117	113	109
H125-NJ L125-NJ	Front Rear Plug-in	20A	19	18.5	18	17.5
		32A	31	30	29	28
		50A	48	47	45	44
		63A	61	59	57	55
		100A	97	95	92	89
		125A	121	118	114	111
S160-NJ	Front Rear Plug-in	20A	19	18.5	18	17.5
		32A	31	30	29	28
S160-MJ S160-GJ		50A	48	46	44	42
		63A	61	59	57	55
		100A	97	94	91	88
		125A	121	117	113	109
		160A	156	151	146	141
H160-NJ L160-NJ	Front Rear Plug-in	160A	156	151	147	143
E250-NJ	Front Rear Plug-in	20A	19	18.5	18	17.5
		32A	31	30	29	28
		50A	48	46	44	42
		63A	61	59	57	55
		100A	97	94	91	88
		125A	121	117	113	109
E250-NJ S250-NJ S250-GJ	Front Rear Plug-in	160A	156	151	146	141
		250A	243	235	227	219
H250-NJ L250-NJ	Front Rear Plug-in	160A	156	151	147	143
	Front Rear	250A	244	237	230	223
E400-NJ S400-CJ S400-NJ S400-GJ S400-PJ	Front Rear Plug-in	250A	244	237	230	223
		400A	390	380	369	358

Calibration Temperature: 30°C

MCCB Type	Connection Type	Rating at calibration temperature (30°C)	Rated Current (A)						
			35°C	40°C	45°C	50°C	55°C	60°C	65°C
H250-NJ L250-NJ	Plug-in Conn.	250A	244	236	225	219	209	200	190

MCCB Type	Connection Type	Rating	Rated Current (A)							
			30°C	35°C	40°C	45°C	50°C	55°C	60°C	65°C
S250-NE S250-GE	Front Rear	250A	250	250	250	250	237.5	225	200	200
	Plug-in	250A	250	237.5	225	225	200	200	157.5	157.5
S250-PE H250-NE	Front Rear	250A	250	250	250	250	237.5	225	200	200
S400-NE S400-GE S400-PE	Front Rear Plug-in	250A	250	250	250	250	250	250	225	200
		400A	400	400	400	400	400	380	360	320
H400-NE L400-NE	Front Rear	250A	250	250	250	250	250	250	225	200
		400A	400	400	400	400	400	380	360	320
	Plug-in	250A	250	250	250	250	250	250	225	200
		400A	400	400	400	400	400	380	360	320
E630-NE S630-CE S630-GE	Front Rear*	630A	630	630	630	630	598.5	598.5	567	504

*Contact us for details of plug-in versions

COMPACT CHANGEOVERS

Changeover Pair with Link Interlock and Motor Operators

Viewed from Below (250A frame)

The mechanical interlock is installed on the front of the MCCB, and is compatible with motor operators and handles. An automatic changeover system can be assembled in a few minutes by a switchboard builder or end-user.

TEMBREAK 2

MOULDED CASE CIRCUIT BREAKERS 16A TO 630A

1. Welcome to TemBreak 2
2. Ratings and Specifications
3. Operating Characteristics
4. Application Data
5. Accessories
6. Installation
7. **Dimensions**

- S125-NF, S160-NF 99
- E125-NJ, S125-NJ, S125-GJ, S125-NN 100
- S160-NJ, S160-GJ, E250-NJ, S250-NJ, S250-GJ, S250-NN 102
- H125-NJ, L125-NJ, H160-NJ, L160-NJ, S250-NE, S250-GE, S250-PE, H250-NJ, H250-NE, L250-NJ 104
- E400-NJ, S400-CJ, S400-NJ, S400-GJ, S400-PJ, S400-NE, S400-GE, S400-PE, S400-NN 106
- H400-NE, L400-NE 108
- E630-NE, S630-CE, S630-GE, S630-NN 110
- Operating Handles 112
- Terminal Covers 117
- Interpole Barriers 119
- Terminal Blocks for Front-Connected and Rear-Connected MCCBs 120
- OCR Power Supply for Electronic Protection
  - Standard type 122
  - With LCD 124
- Slide Interlocks 125
- Link Interlocks 128
- Wire Interlocks 132
- Position of Trip Button 136
- External Neutral CT/Door Flanges 137

TEMBREAK 2

MINI MOULDED CASE CIRCUIT BREAKERS 10A TO 100A

8. TemBreak 2 MINI Moulded Case Circuit Breakers

TEMBREAK

MOULDED CASE CIRCUIT BREAKERS 630A TO 1600A

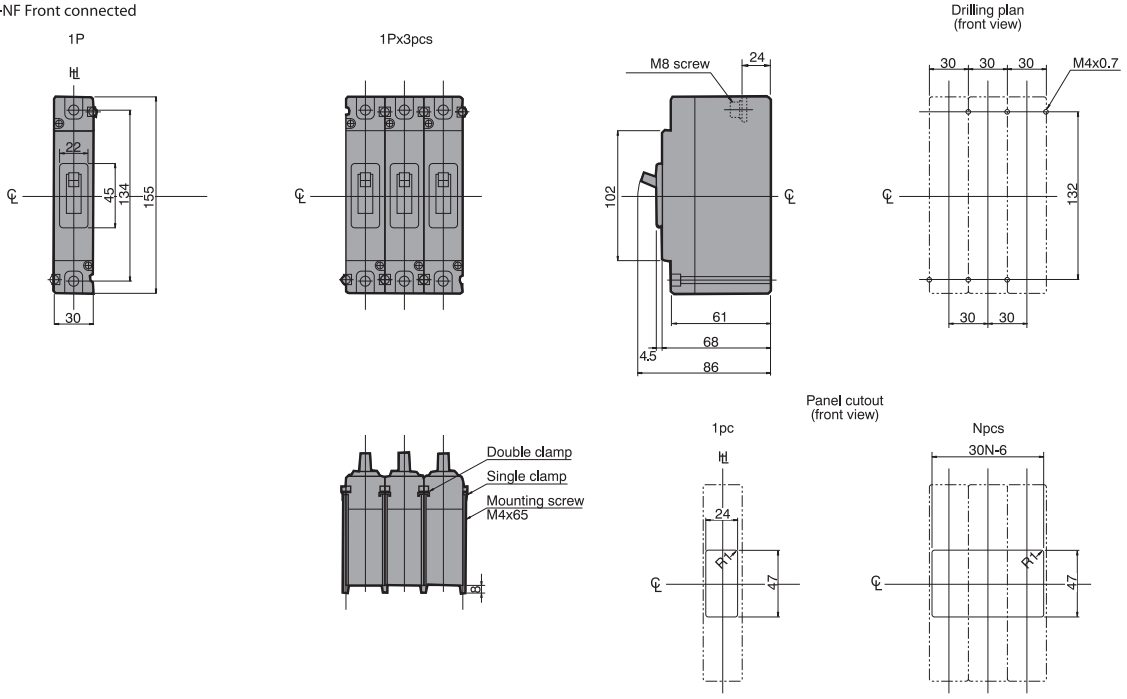
9. TemBreak Moulded Case Circuit Breakers

DIMENSIONS

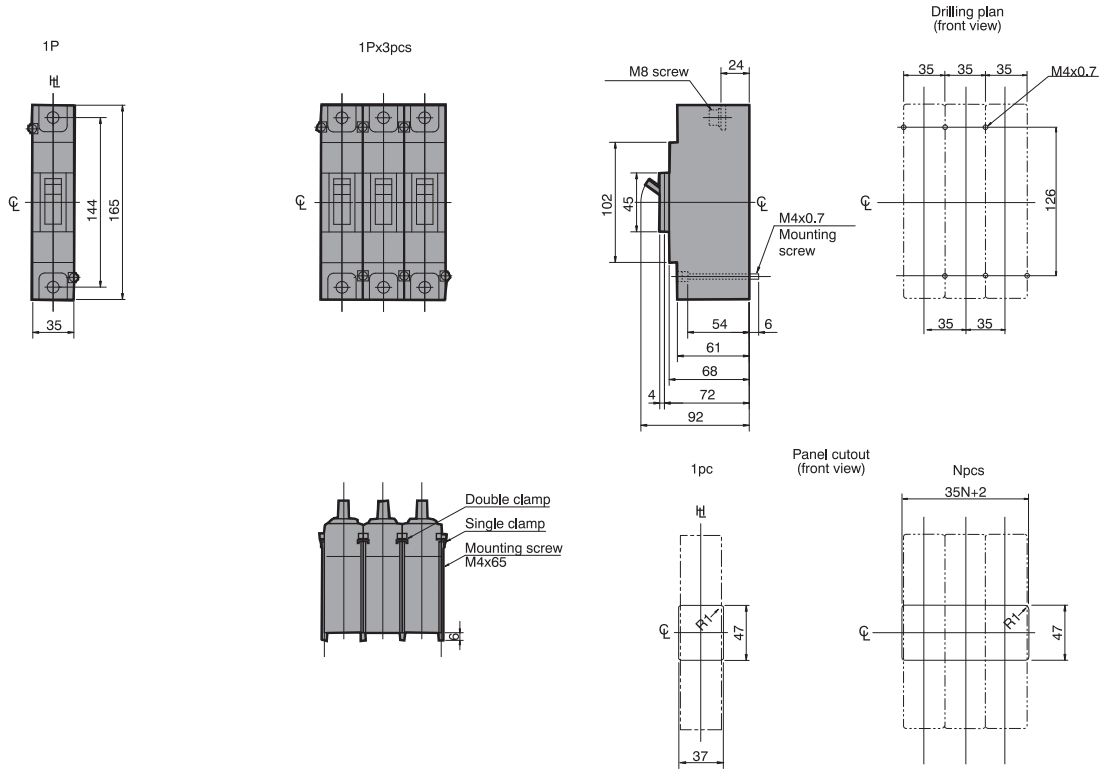
S125-NF, S160-NF

ASL: Arrangement Standard Line
HL: Handle Frame Centre Line

S125-NF Front connected



S160-NF Front connected

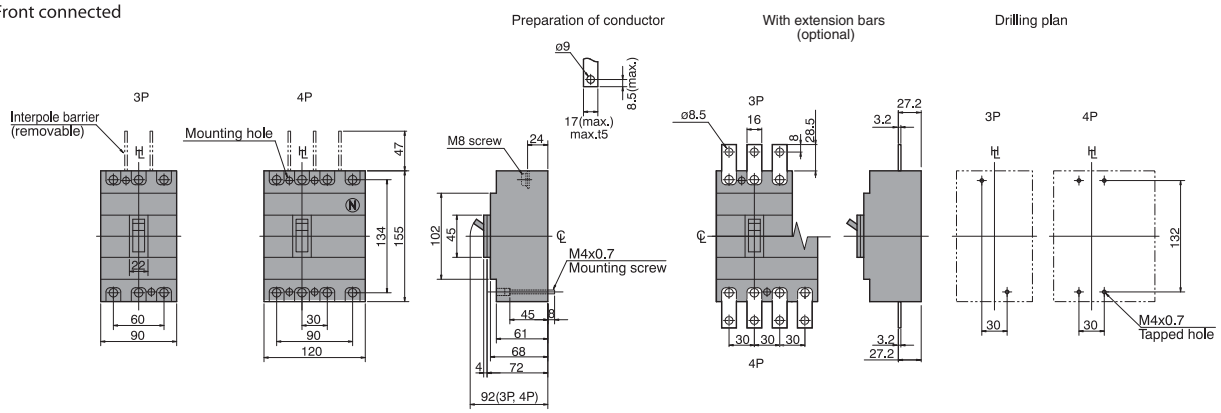


SECTION 7

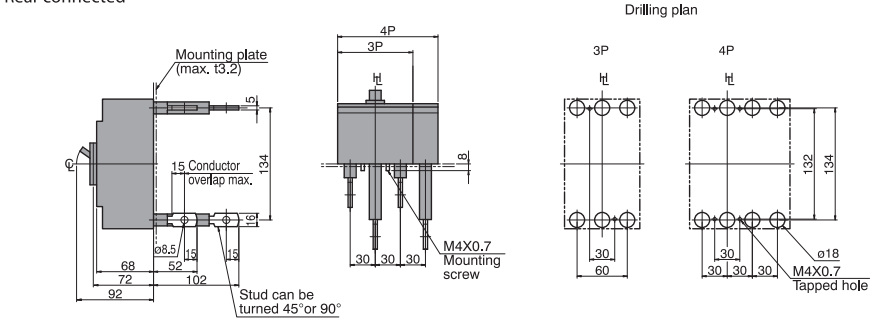
E125-NJ, S125-NJ, S125-GJ, S125-NN

ASL: Arrangement Standard Line
⊬ : Handle Frame Centre Line

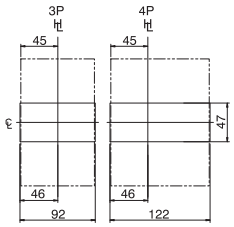
Front connected



Rear connected

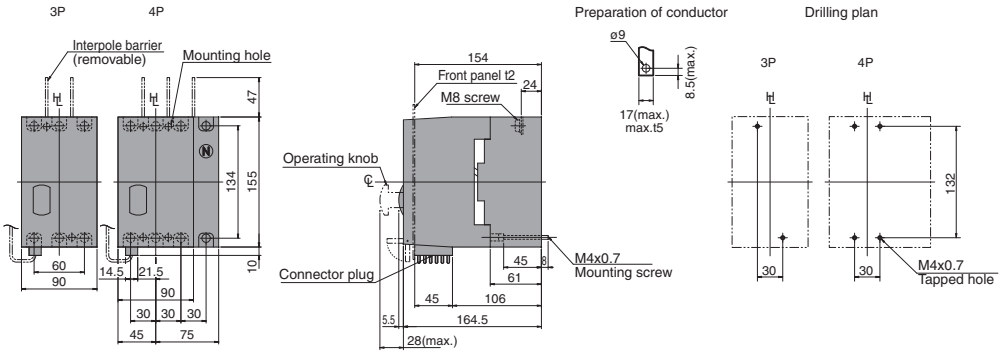


Panel cutout (Front view)

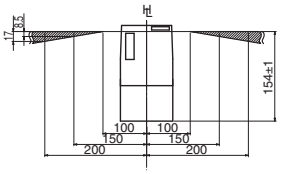


Panel cutout dimensions shown give an allowance of 1.0mm around the handle escutcheon.

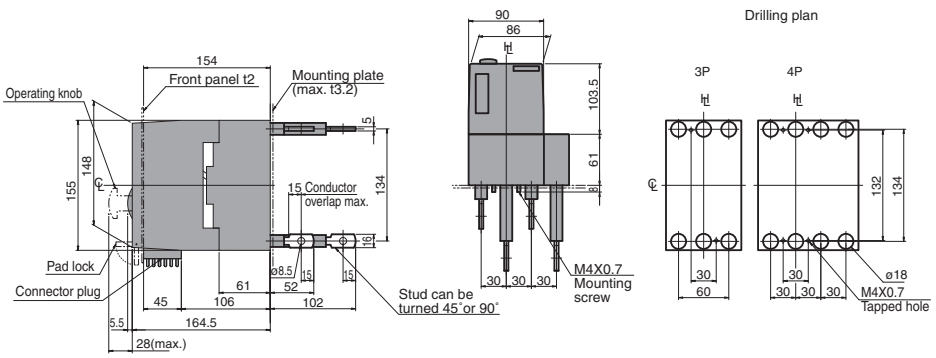
Front connected with Motor Operator



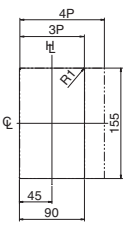
Panel hinge position (hatching area) bottom view



Rear connected with Motor Operator



Panel cutout (Front view)



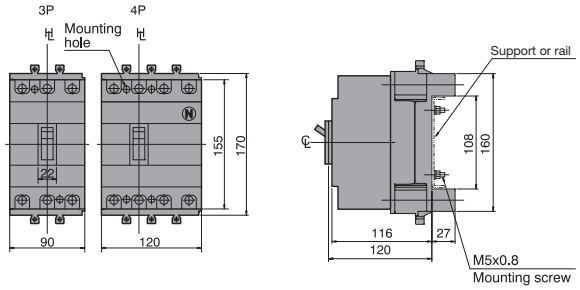
Panel cutout dimensions shown give an allowance of 1.5mm around the handle escutcheon.

SECTION 7

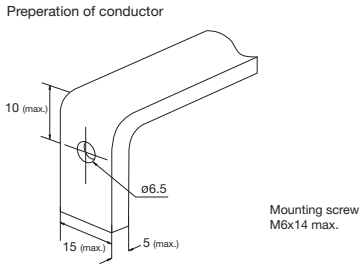
E125-NJ, S125-NJ, S125-GJ, S125-NN Plug-in Versions

ASL: Arrangement Standard Line
⊬: Handle Frame Centre Line

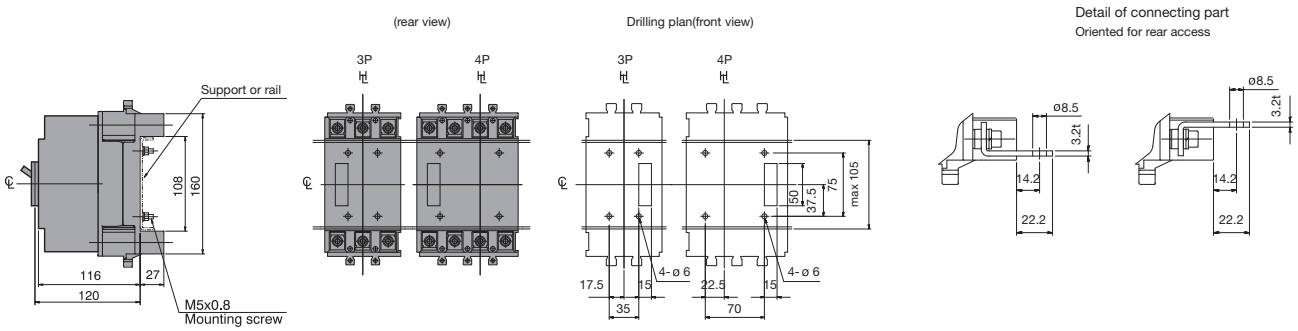
Outline Dimensions



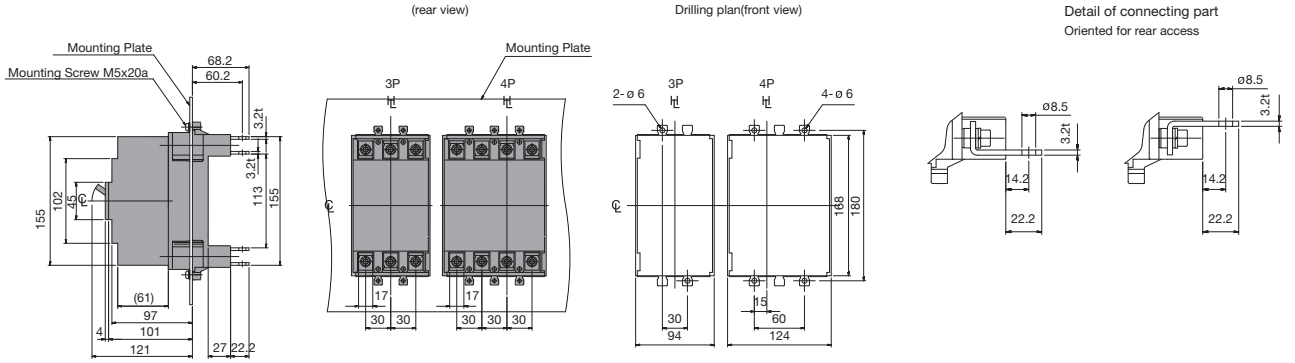
Termination of Busbar



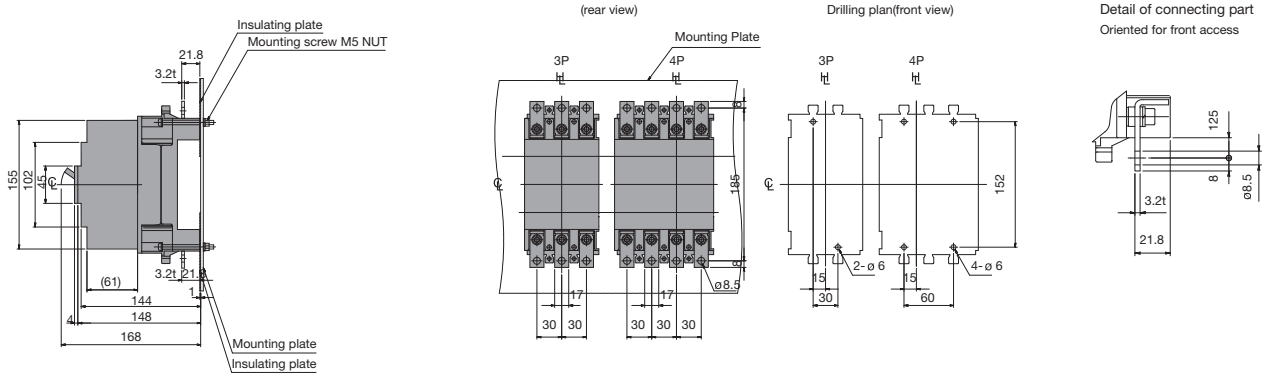
Mounting on a support or rails (shown with optional connection bars oriented for rear access)



Mounting through the backplate (shown with optional connection bars oriented for rear access)



Mounting on the backplate (optional connection bars must be oriented for front access)



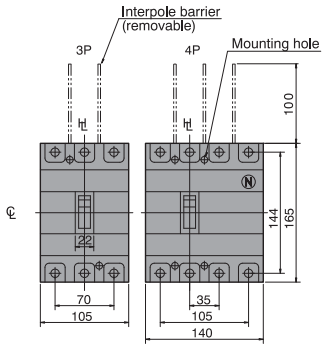
Note that the insulation plate (supplied as standard) must be fitted between the base and the backplate.

SECTION 7

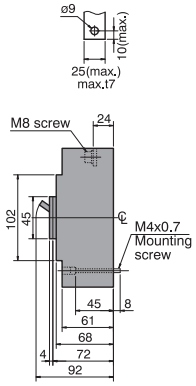
S160-NJ, S160-GJ, E250-NJ, S250-NJ, S250-GJ, S250-NN

ASL: Arrangement Standard Line
℄ : Handle Frame Centre Line

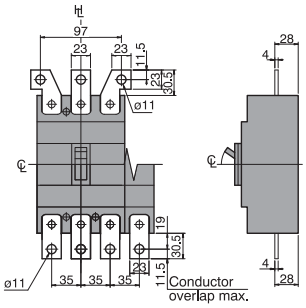
Front connected



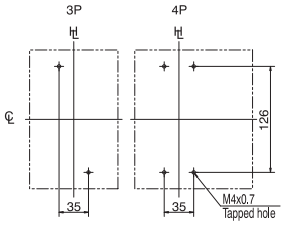
Preparation of conductor



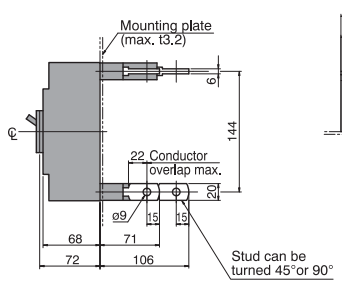
With extension bars
(optional)

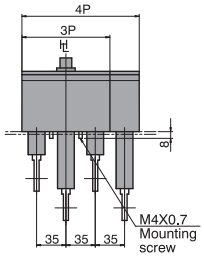


Drilling plan

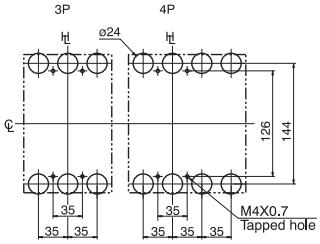


Rear connected

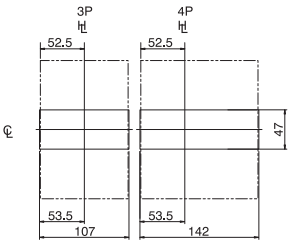




Drilling plan

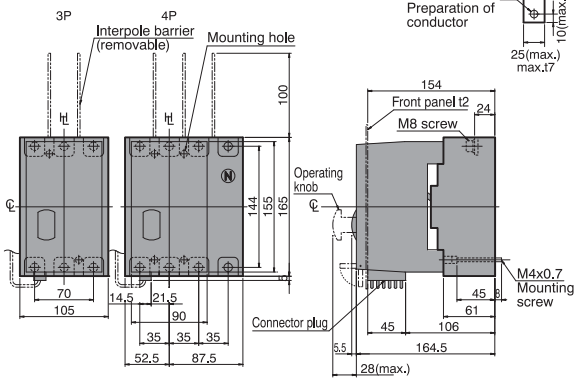


Panel cutout
(Front view)



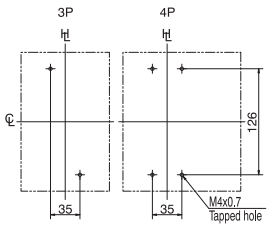
Panel cutout dimensions shown
give an allowance of 1.0mm
around the handle escutcheon.

Front connected with Motor Operator

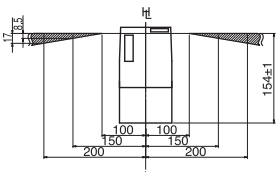


Preparation of
conductor

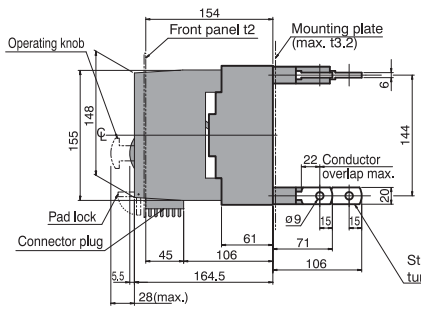
Drilling plan

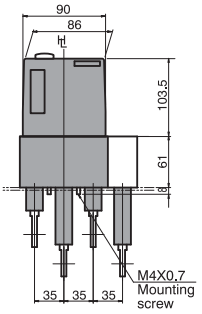


Panel hinge position (hatching area)
bottom view

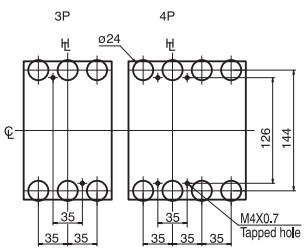


Rear connected with Motor Operator

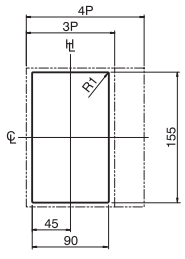




Drilling plan



Panel cutout
(Front view)



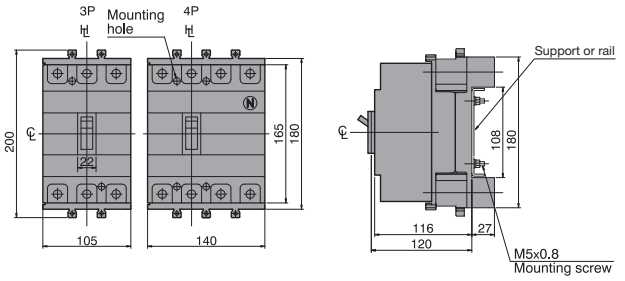
Panel cutout dimensions shown
give an allowance of 1.5mm
around the handle escutcheon.

SECTION 7

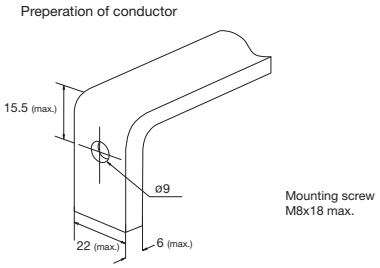
S160-NJ, S160-GJ, E250-NJ, S250-NJ, S250-GJ, S250-NN
Plug-in Versions

ASL: Arrangement Standard Line
℄ : Handle Frame Centre Line

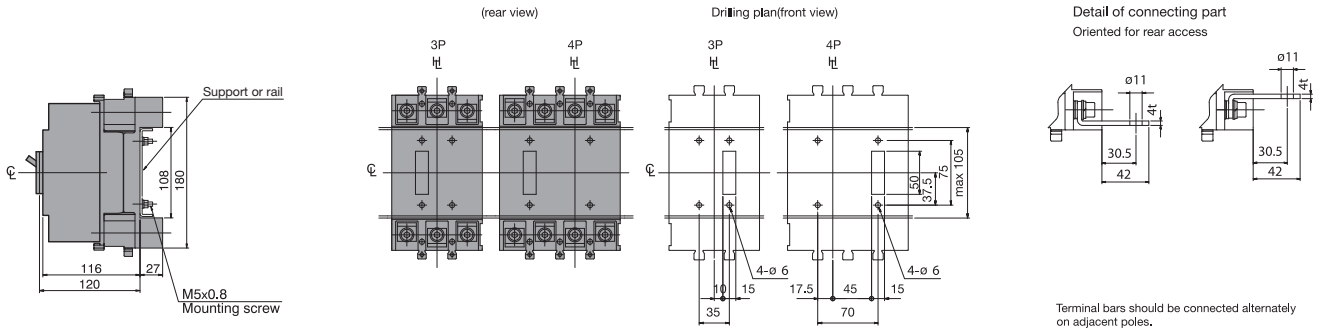
Outline Dimensions



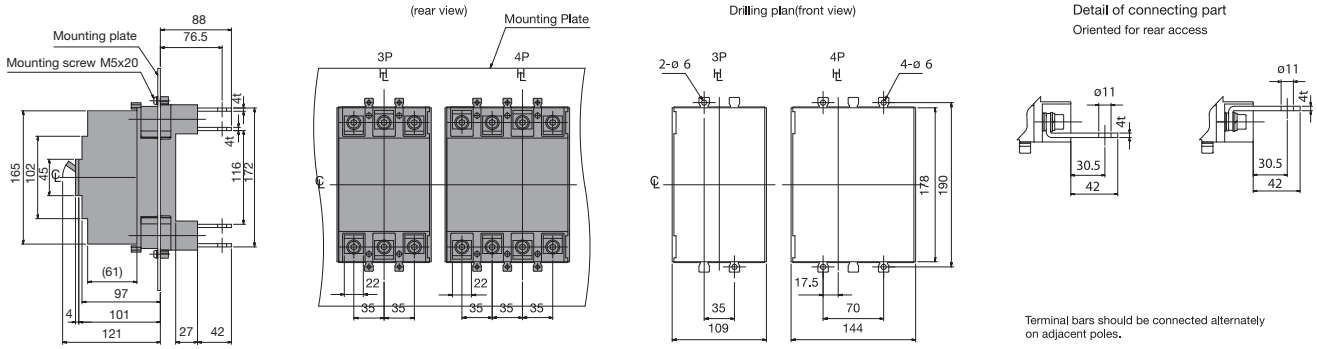
Termination of Busbar



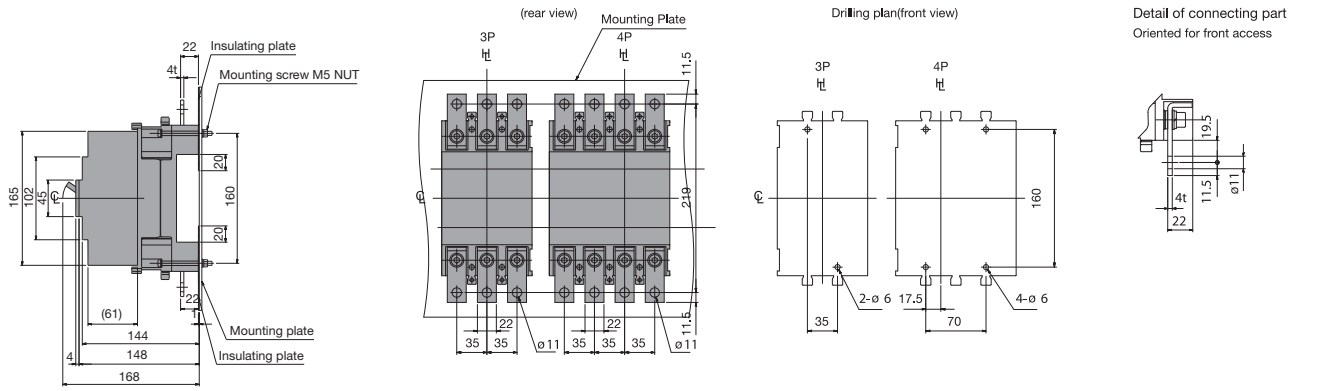
Mounting on a support or rails (shown with optional connection bars oriented for rear access)



Mounting through the backplate (shown with optional connection bars oriented for rear access)



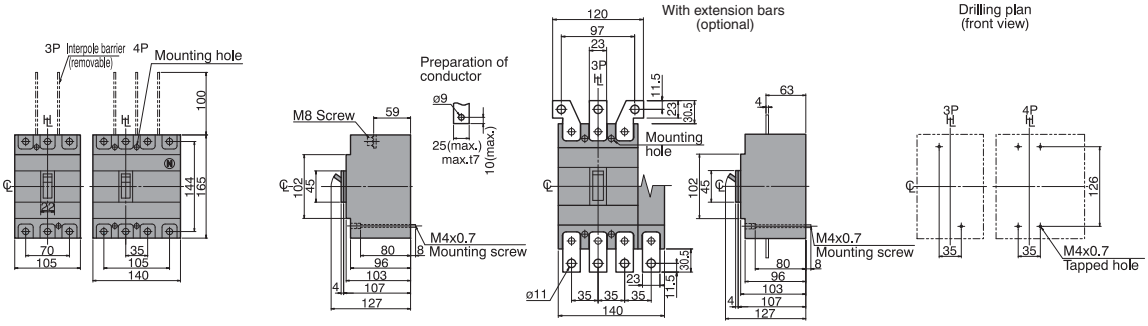
Mounting on the backplate (optional connection bars must be oriented for front access)



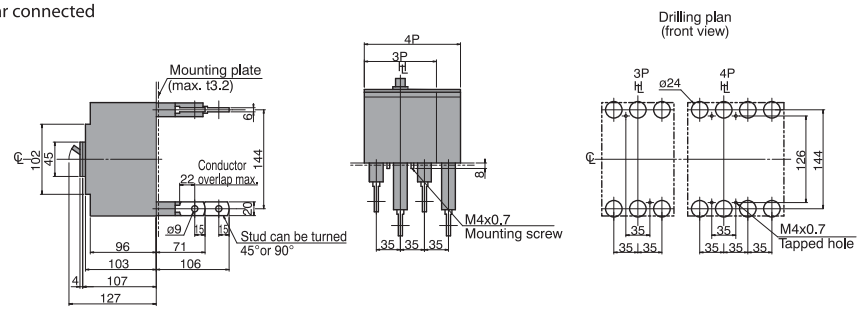
H125-NJ, L125-NJ, H160-NJ, L160-NJ, S250-NE, S250-GE, S250-PE, H250-NJ, H250-NE, L250-NJ

ASL: Arrangement Standard Line
H : Handle Frame Centre Line

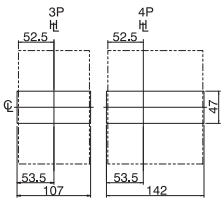
Front connected



Rear connected

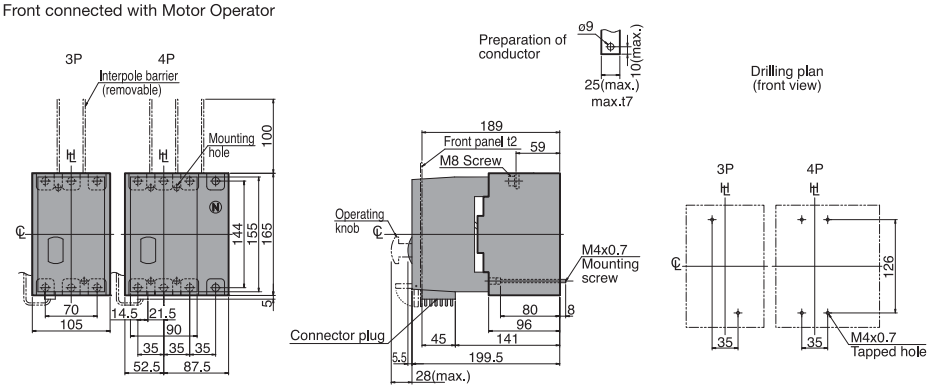


Panel cutout (front view)

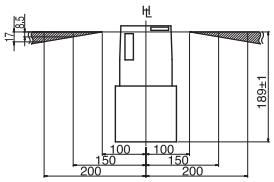


Panel cutout dimensions shown give an allowance of 1.0mm around the handle escutcheon.

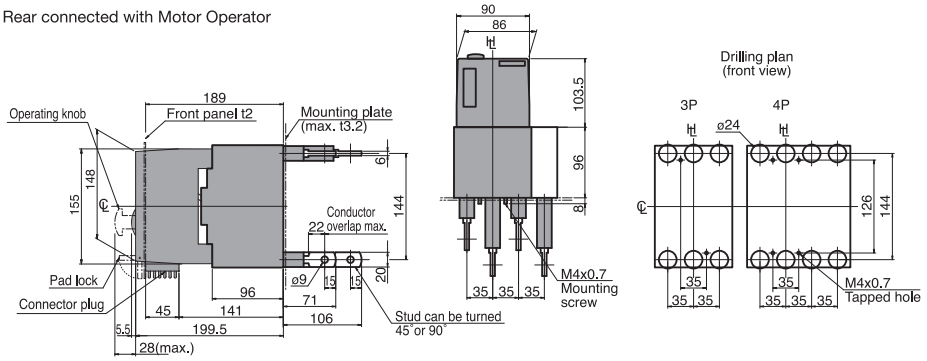
Front connected with Motor Operator



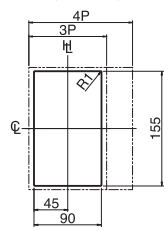
Panel hinge position (hatching area) bottom view



Rear connected with Motor Operator



Panel cutout (front view)



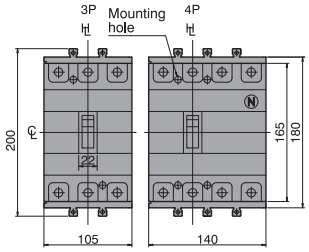
Panel cutout dimensions shown give an allowance of 1.5mm around the handle escutcheon.

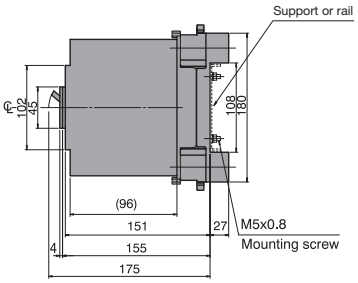
SECTION 7

H125-NJ, L125-NJ, H160-NJ, L160-NJ, S250-NE, S250-GE, H250-NJ, L250-NJ. Plug-in Versions

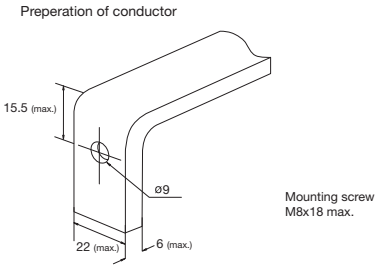
ASL: Arrangement Standard Line
: Handle Frame Centre Line

Outline Dimensions

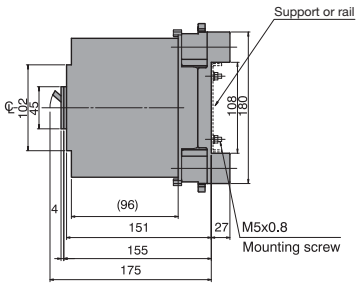


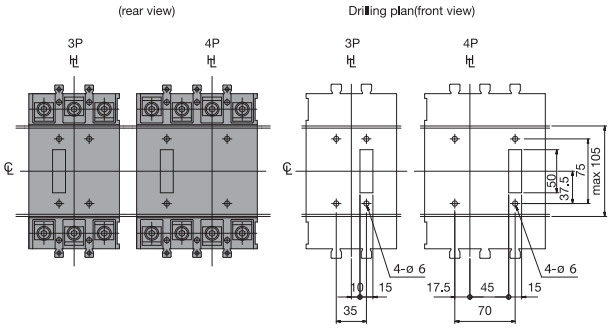


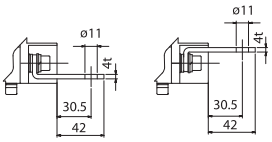
Termination of Busbar



Mounting on a support or rails (shown with optional connection bars oriented for rear access)

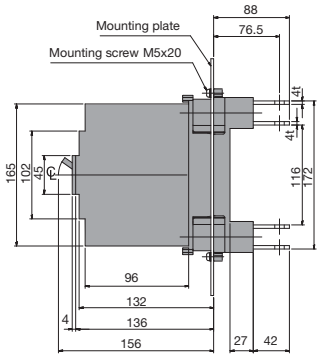


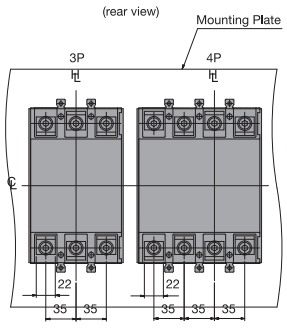


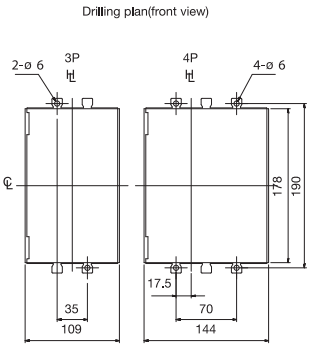


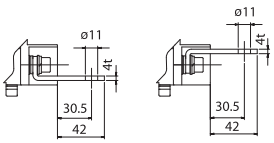
Terminal bars should be connected alternately on adjacent poles.

Mounting through the backplate (shown with optional connection bars oriented for rear access)



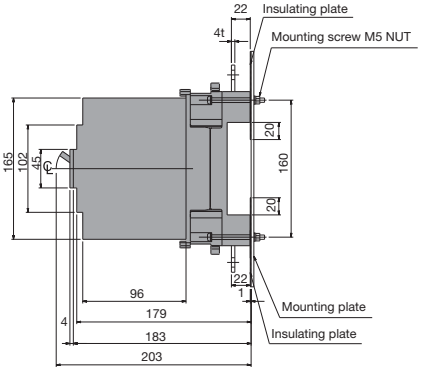


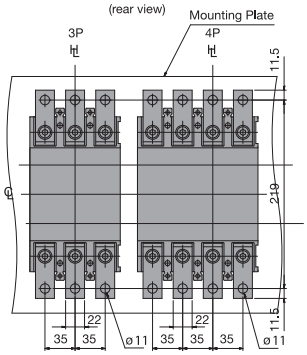


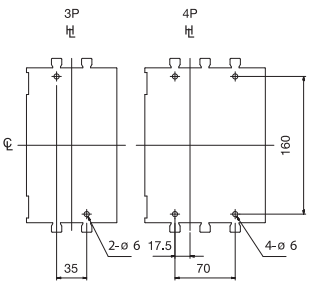


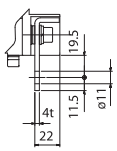
Terminal bars should be connected alternately on adjacent poles.

Mounting on the backplate (optional connection bars must be oriented for front access)





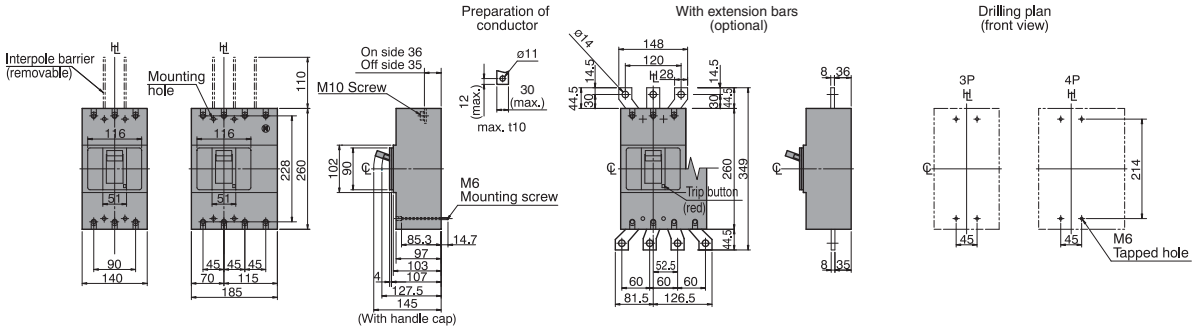




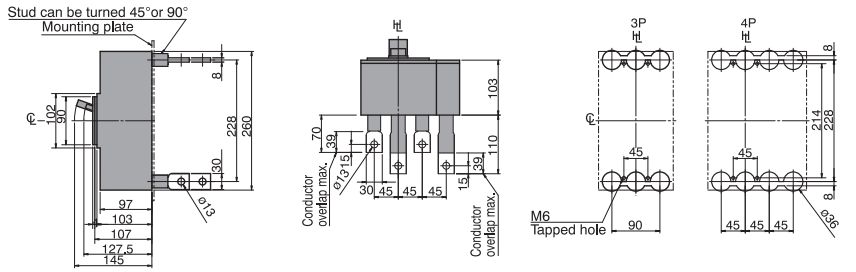
E400-NJ, S400-CJ, S400-NJ, S400-NE, S400-GJ, S400-GE, S400-PJ, S400-PE, S400-NN

ASL: Arrangement Standard Line
: Handle Frame Centre Line

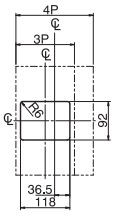
Front connected



Rear connected

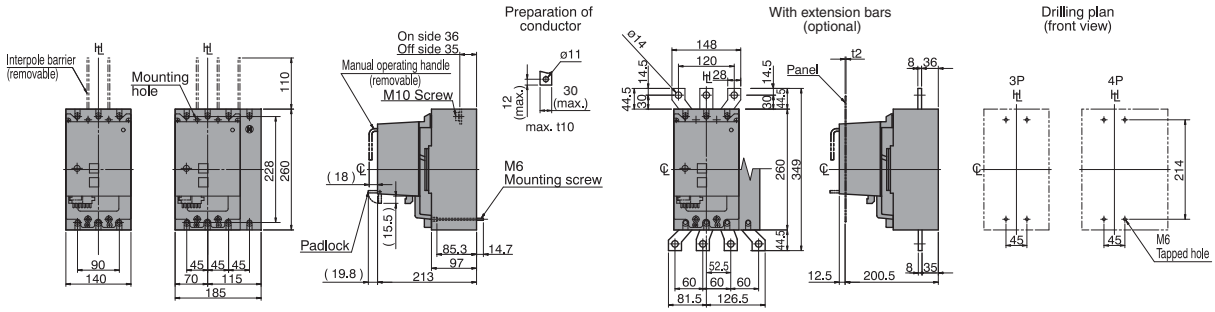


Panel cutout (front view)

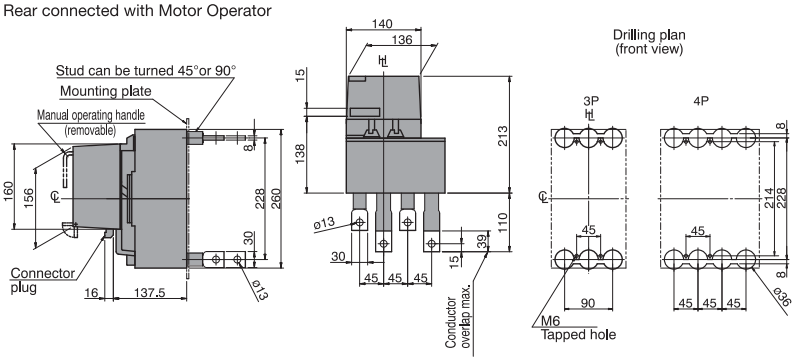


Panel cutout dimensions shown give an allowance of 1.0mm around the handle escutcheon.

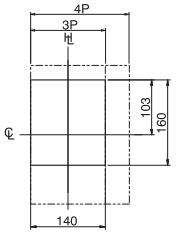
Front connected with Motor Operator



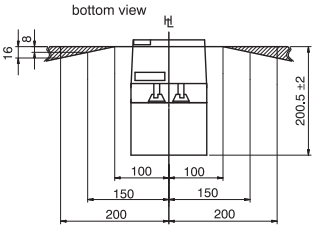
Rear connected with Motor Operator



Panel cutout (front view)



Panel hinge position (hatching area)



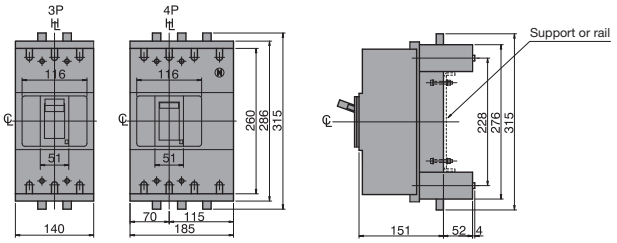
Panel cutout dimensions shown give an allowance of 1.5mm around motor operator

SECTION 7

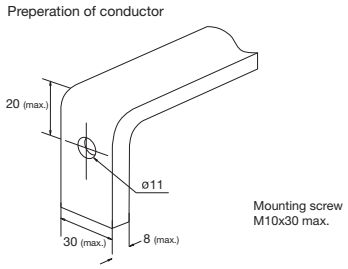
E400-NJ, S400-CJ, S400-NJ, S400-NE, S400-GJ, S400-GE, S400-PJ, S400-PE, S400-NN Plug-in Versions

ASL: Arrangement Standard Line
℄ : Handle Frame Centre Line

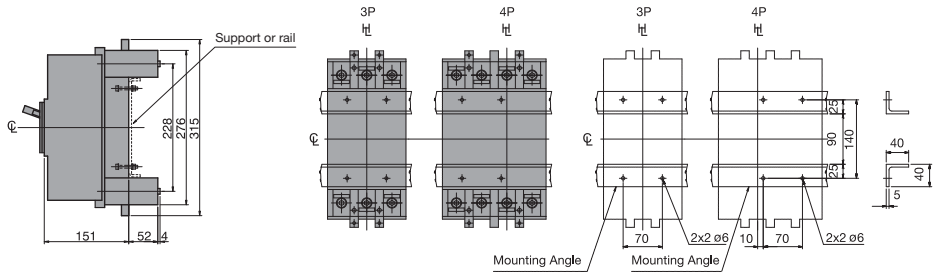
Outline Dimensions



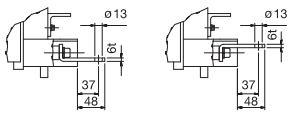
Termination of Busbar



Mounting on a support or rails (shown with optional connection bars oriented for rear access)

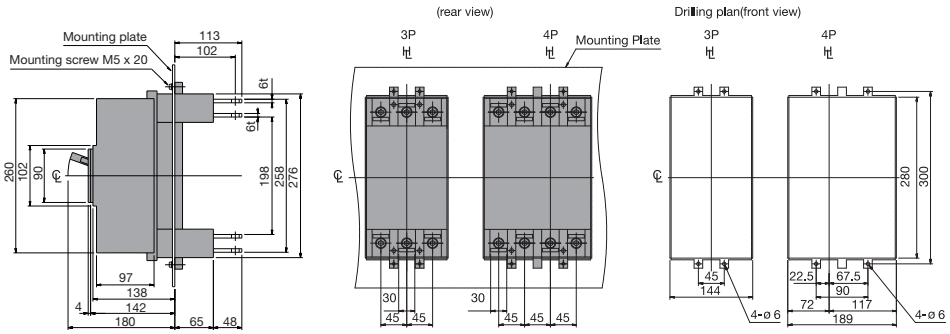


Detail of connecting part
Oriented for rear access

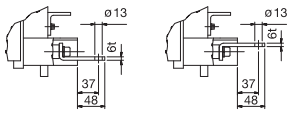


Terminal bars should be connected alternately on adjacent poles.

Mounting through the backplate (shown with optional connection bars oriented for rear access)

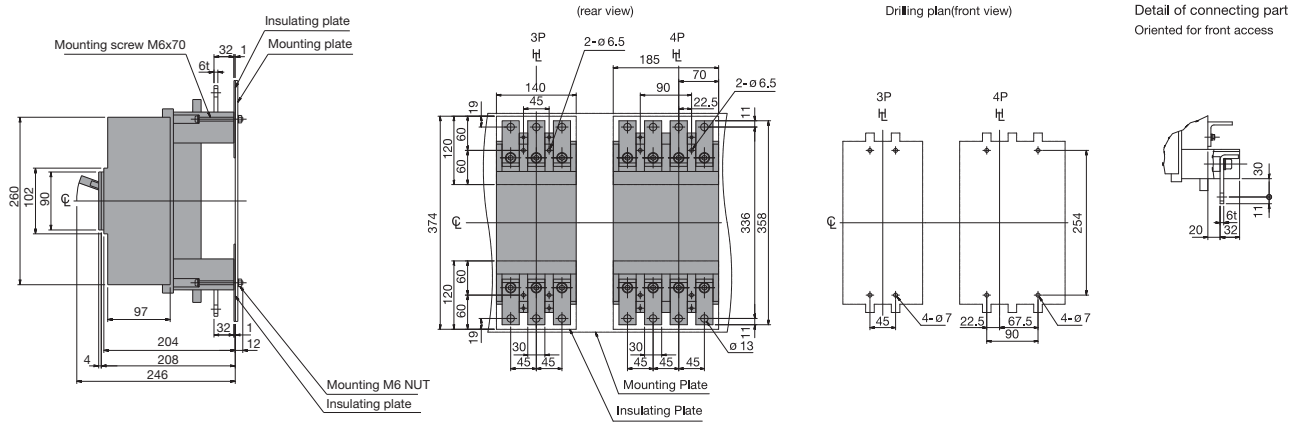


Detail of connecting part
Oriented for rear access



Terminal bars should be connected alternately on adjacent poles.

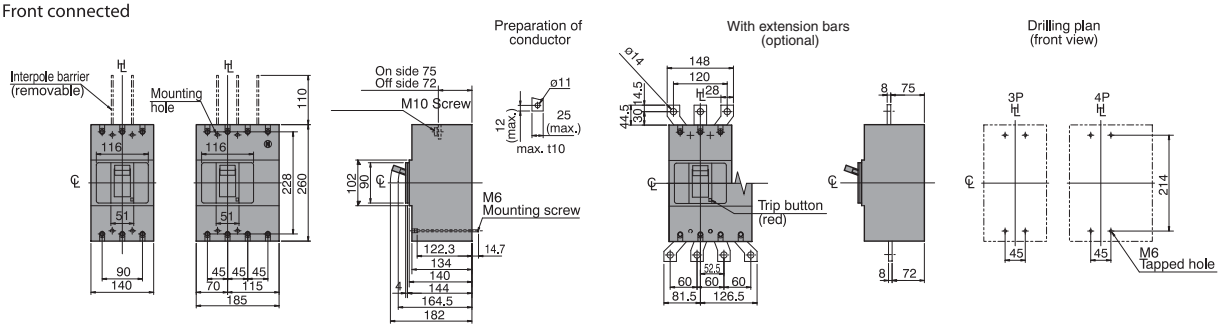
Mounting on the backplate (optional connection bars must be oriented for front access)



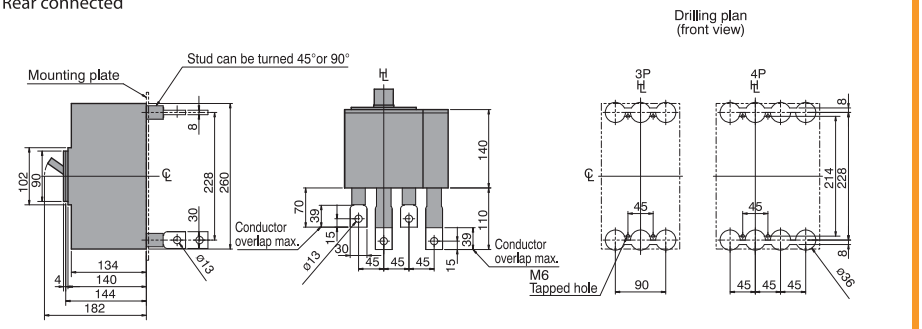
H400-NE, L400-NE

ASL: Arrangement Standard Line
H : Handle Frame Centre Line

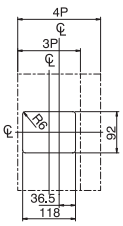
Front connected



Rear connected

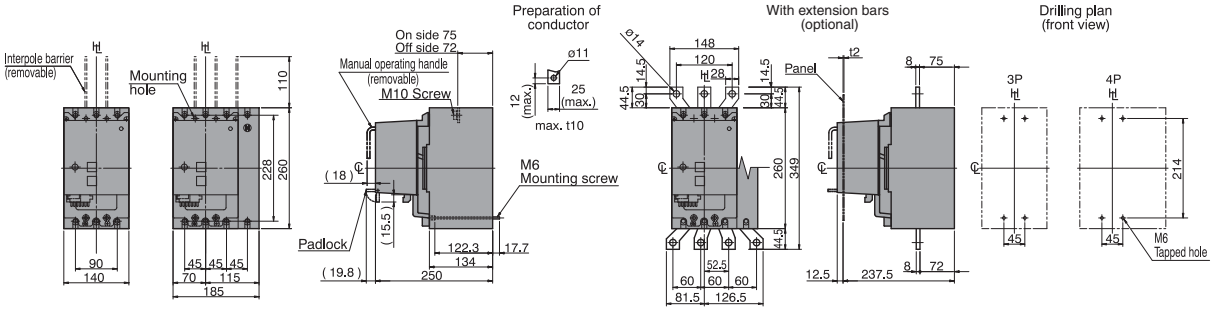


Panel cutout (front view)

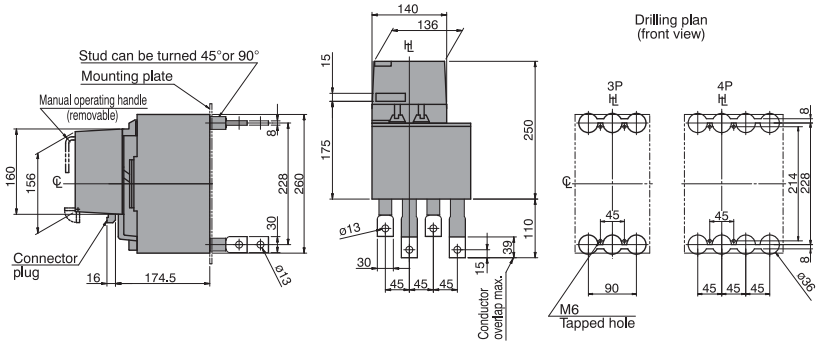


Panel cutout dimensions shown give an allowance of 1.0mm around the handle escutcheon.

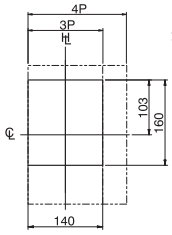
Front connected with Motor Operator



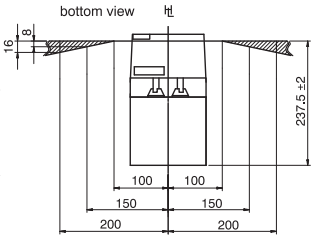
Rear connected with Motor Operator



Panel cutout (front view)



Panel hinge position (hatching area)



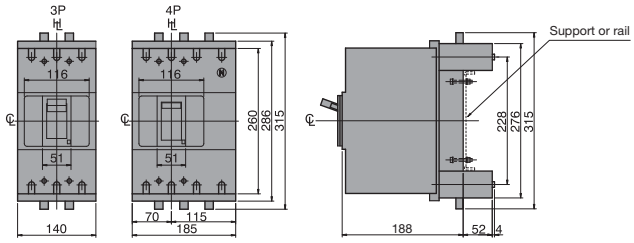
Panel cutout dimensions shown give an allowance of 1.5mm around motor operator

SECTION 7

H400-NE, L400-NE. Plug-in Versions

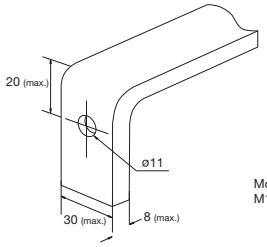
ASL: Arrangement Standard Line
H : Handle Frame Centre Line

Outline Dimensions



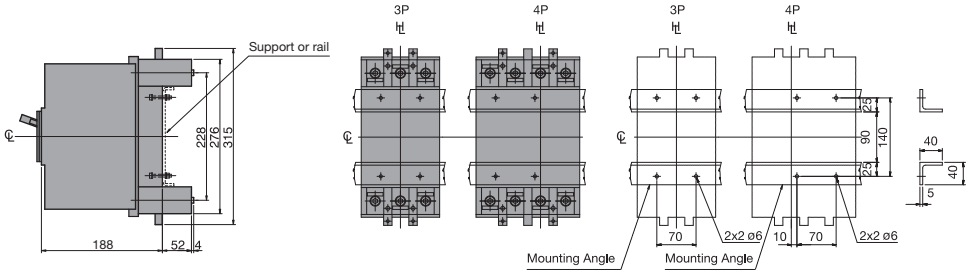
Termination of Busbar

Preperation of conductor

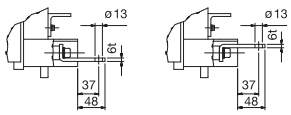


Mounting screw
M10x30 max.

Mounting on a support or rails (shown with optional connection bars oriented for rear access)

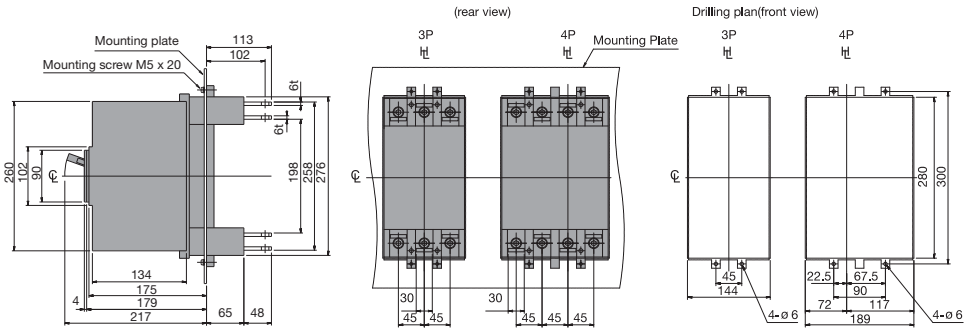


Detail of connecting part
Oriented for rear access

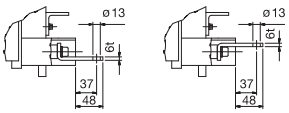


Terminal bars should be connected alternately on adjacent poles.

Mounting through the backplate (shown with optional connection bars oriented for rear access)

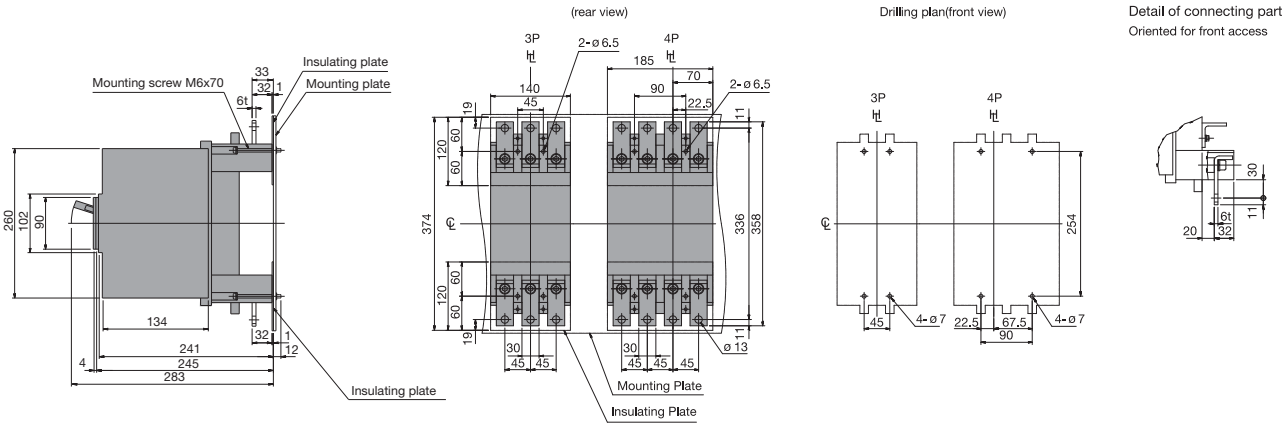


Detail of connecting part
Oriented for rear access



Terminal bars should be connected alternately on adjacent poles.

Mounting on the backplate (optional connection bars must be oriented for front access)



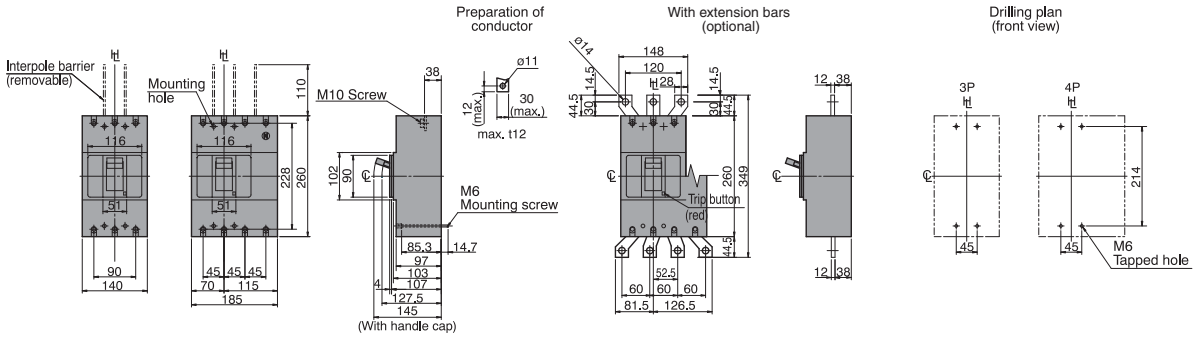
Detail of connecting part
Oriented for front access

SECTION 7

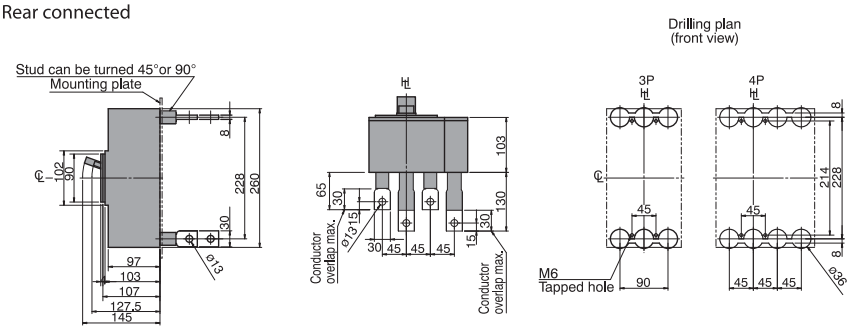
E630-NE, S630-CE, S630-GE, S630-NN

ASL: Arrangement Standard Line
H: Handle Frame Centre Line

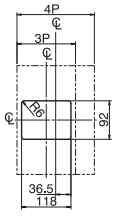
Front connected



Rear connected



Panel cutout (front view)



Panel cutout dimensions shown give an allowance of 1.0mm around the handle escutcheon.

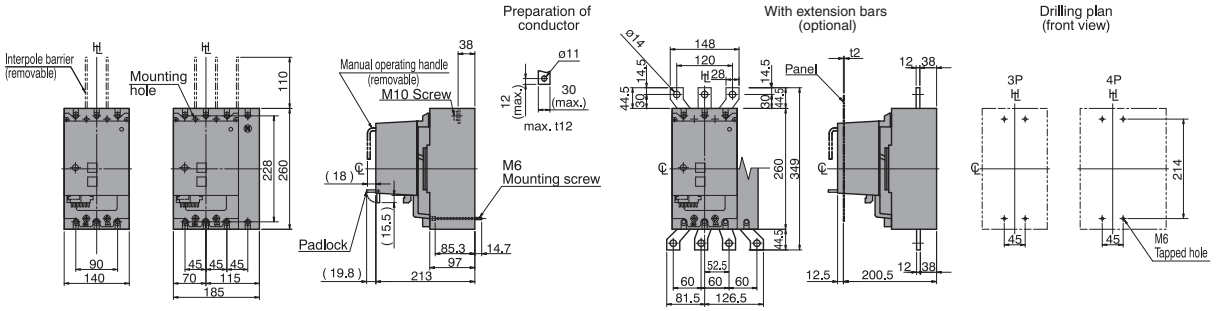
SECTION 7

DIMENSIONS

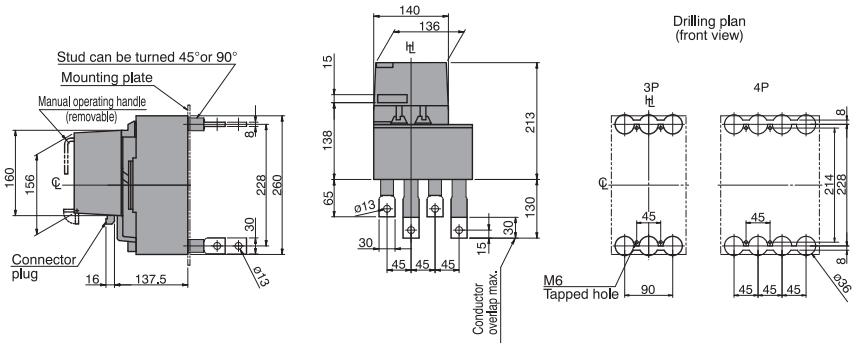
E630-NE, S630-CE, S630-GE, S630-NN with Motor Operators

ASL: Arrangement Standard Line
H : Handle Frame Centre Line

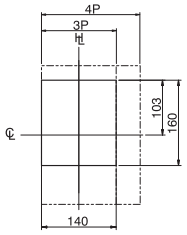
Front connected



Rear connected with Motor Operator



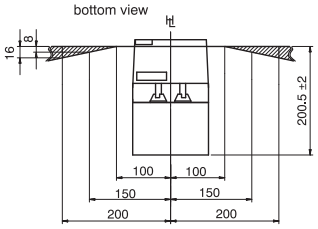
Panel cutout (front view)



Panel cutout dimensions shown give an allowance of 1.5mm around motor operator

Panel hinge position (hatching area)

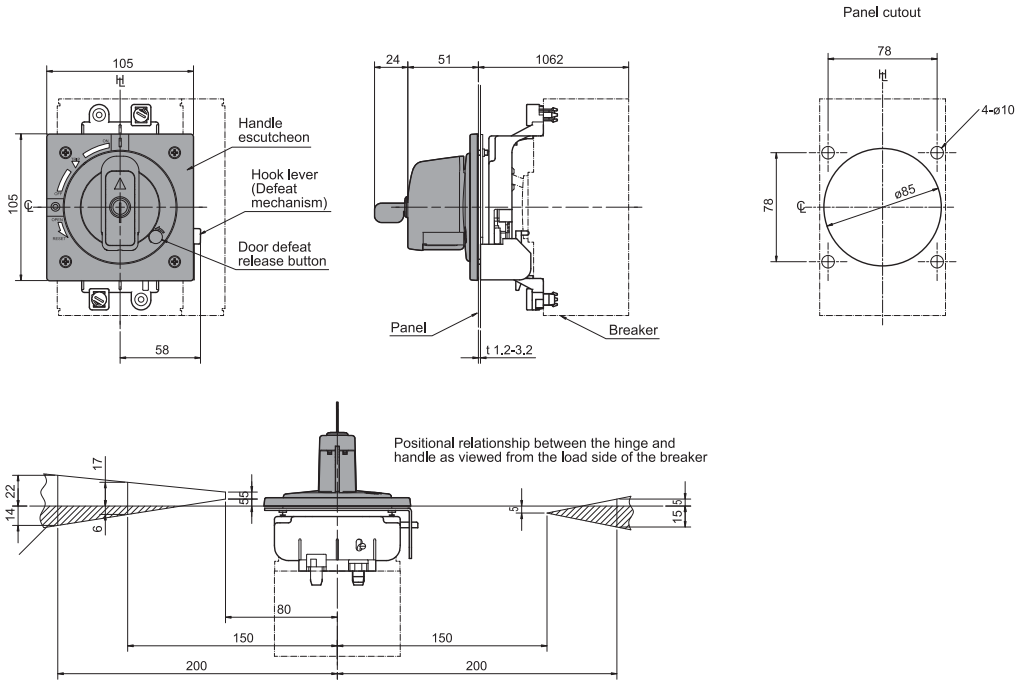
bottom view



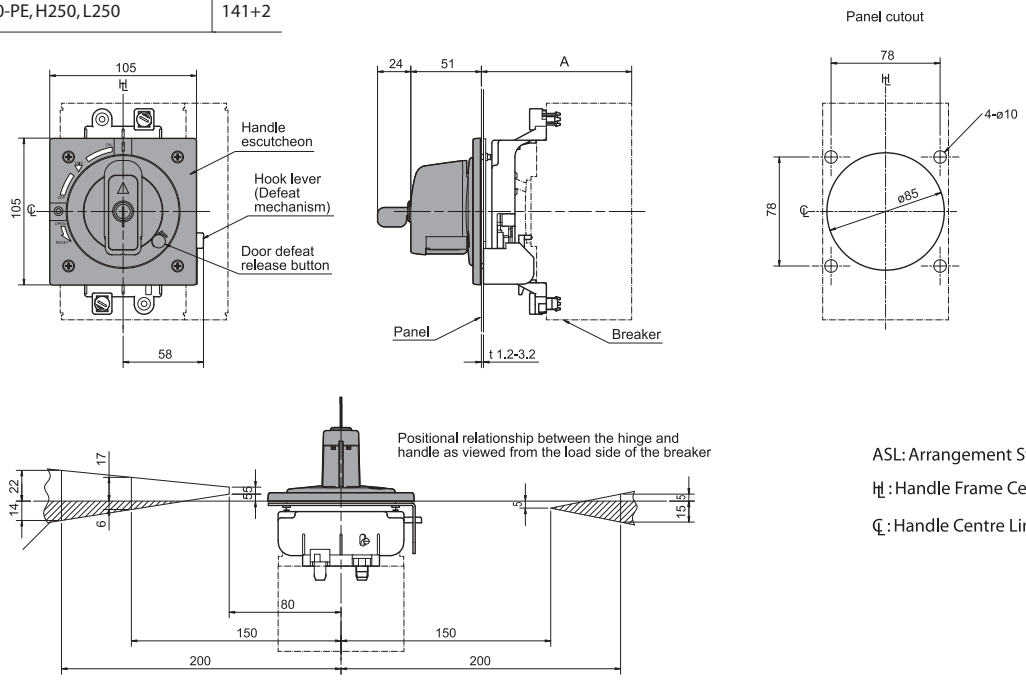
SECTION 7

Breaker Mounted Handle

Applicable MCCB
E125, S125



Applicable MCCB	A
S160-NJ, E250-NJ, S250-NJ, S250-GJ, S250-NN	106+2
H125, L125, H160, L160, S250-NE, S250-GE, S250-PE, H250, L250	141+2



ASL: Arrangement Standard Line

H: Handle Frame Centre Line

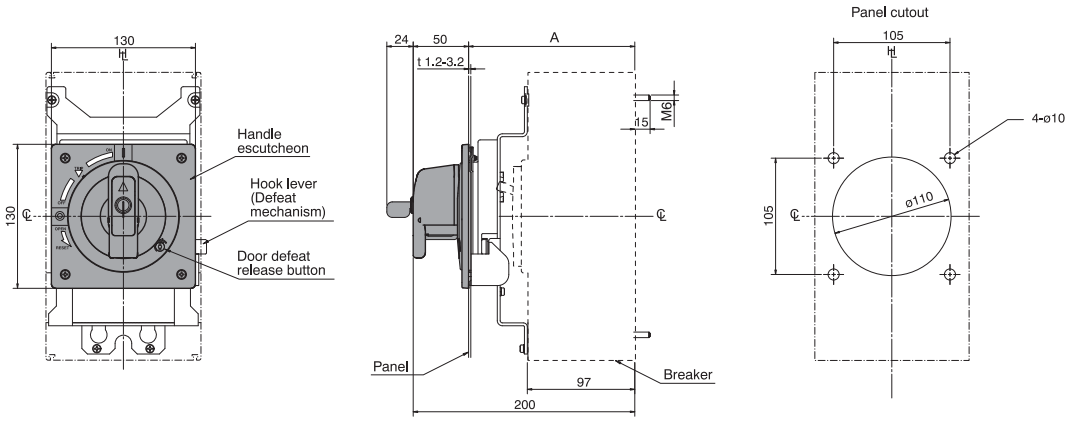
℄: Handle Centre Line

SECTION 7

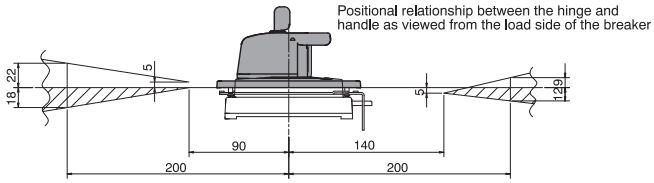
DIMENSIONS

Breaker Mounted Handle

Applicable MCCB	A
E400 S400 E630 S630	150±2
H400 L400	187±2



ASL: Arrangement Standard Line
⊬: Handle Frame Centre Line
℄: Handle Centre Line

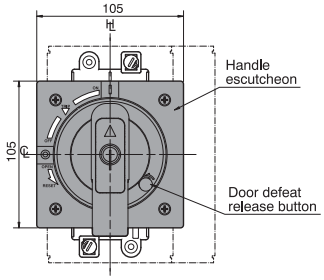


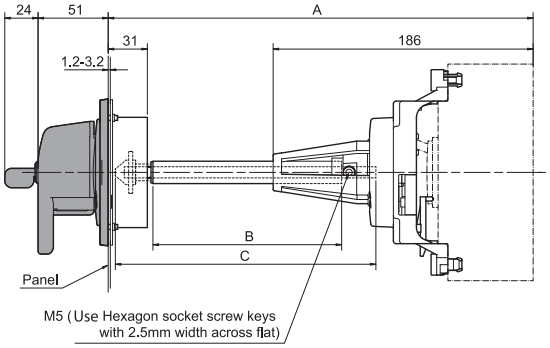
SECTION 7

Door Mounted Handle

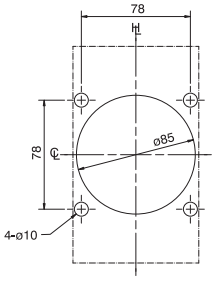
Applicable MCCB	A ⁎1	B	C	Shaft support
E125 S125	543 max.	370	421	With +

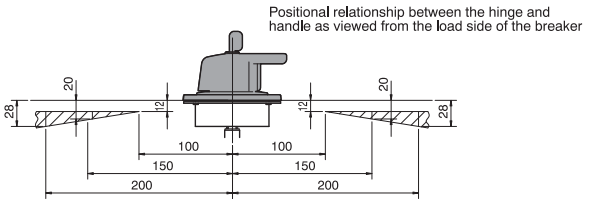
⁎1: Max. means the maximum length for A without cutting the shaft.
+ The shaft can be cut to the required length. If it is necessary to cut the shaft so short that it does not protrude beyond the shaft support, the shaft support may be removed.





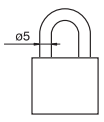
Panel cutout





ASL: Arrangement Standard Line
℄ : Handle Frame Centre Line
℄ : Handle Centre Line

Padlock dimensions (mm)



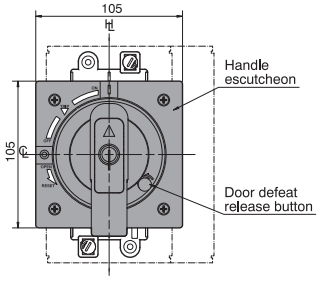
DIMENSIONS

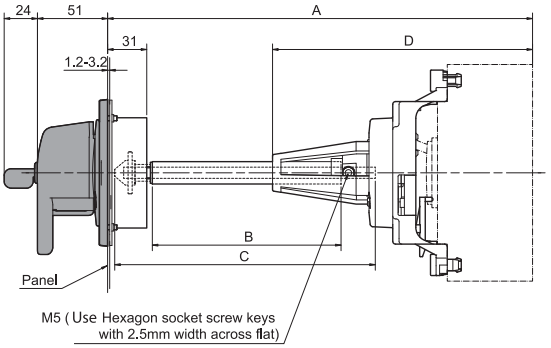
Door Mounted Handle

Applicable MCCB	A✻1	B	C	D	Shaft support
S160-NJ, E250-NJ, S250-NJ, S250-GJ S250-NN	543 max.	370	421	186	With +
H125, L125, H160, L160, S250-NE, S250-GE, S250-PE, H250, L250	578 max.	370	421	221	With +

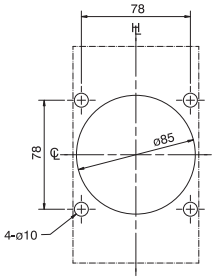
✻1: Max. means the maximum length for A without cutting the shaft.

+ The shaft can be cut to the required length. If it is necessary to cut the shaft so short that it does not protrude beyond the shaft support, the shaft support may be removed.

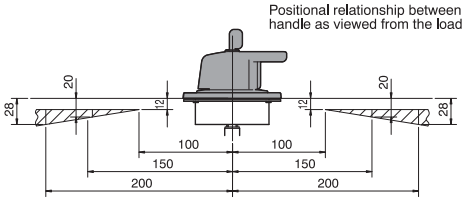




Panel cutout



Positional relationship between the hinge and handle as viewed from the load side of the breaker

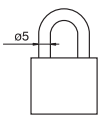


ASL: Arrangement Standard Line

⊬: Handle Frame Centre Line

℄: Handle Centre Line

Padlock dimensions (mm)

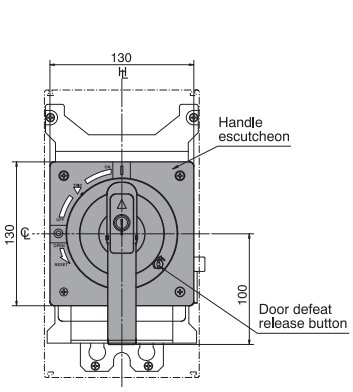


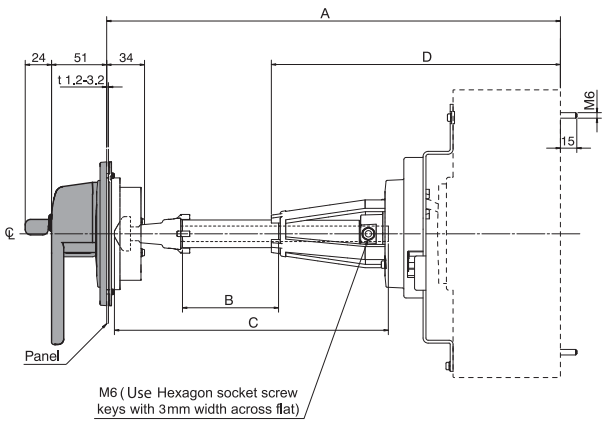
SECTION 7

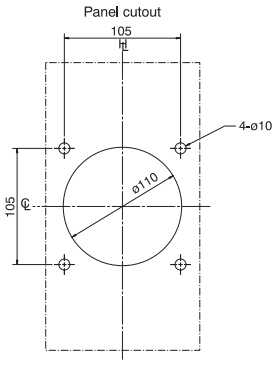
Door Mounted Handle

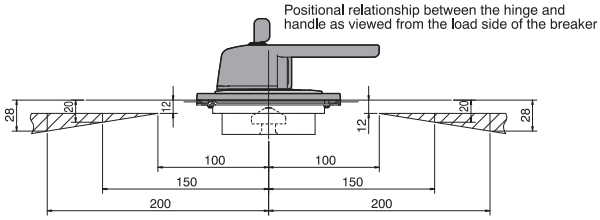
Applicable MCCB	A✻1	B	C	D	Shaft support
E400 E630	270 min.	12	107.5	—	Without
S400 S630	610 max.	280	447.5	261	With +
H400	307 min.	12	107.5	—	Without
L400	647 max.	280	447.5	298	With +

✻1: Min. means the minimum length for A by cutting the shaft.
Max. means the maximum length for A without cutting the shaft.
+ The shaft can be cut to the required length. If it is necessary to cut the shaft so short that it does not protrude beyond the shaft support, the shaft support may be removed.



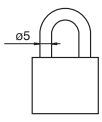






ASL: Arrangement Standard Line
H: Handle Frame Centre Line
C: Handle Centre Line

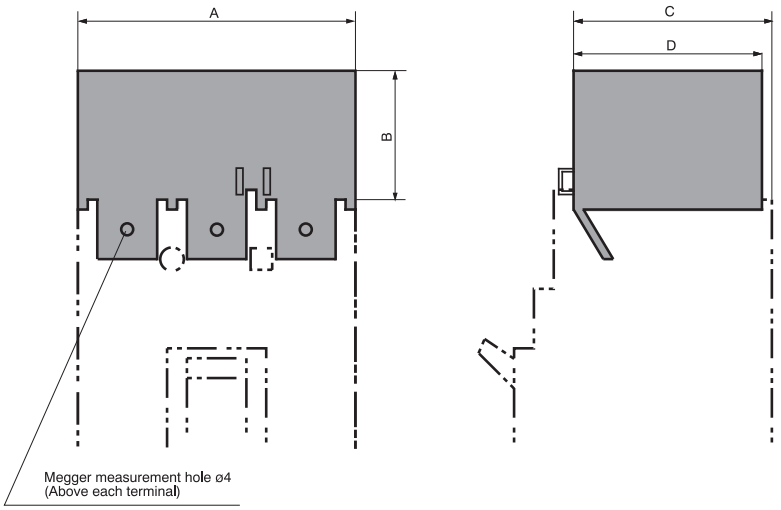
Padlock dimensions (mm)



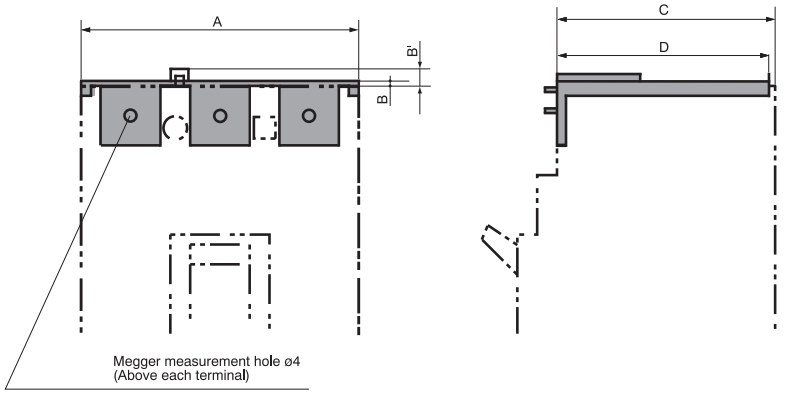
SECTION 7

Terminal Covers

Terminal covers for Front connected MCCB's (CF)



Terminal covers for Solderless terminal type MCCB's (CS)

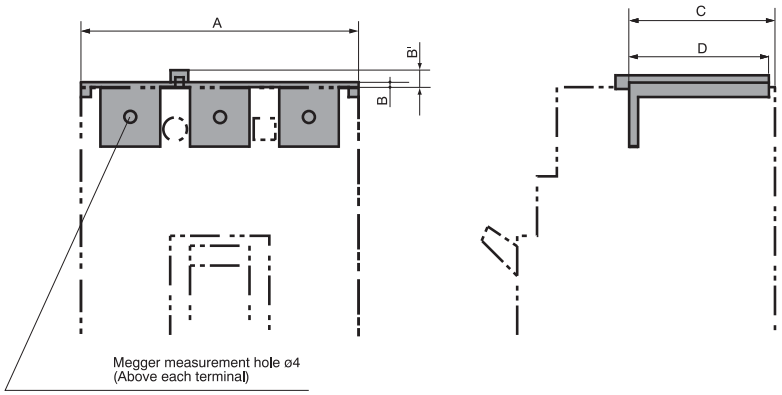


MCCB type	Connection	A			B			B'	C			D		
		1P	3P	4P	1P	3P	4P	3P, 4P	1P	3P	4P	1P	3P	4P
E125,S125	Front conn.	30	90	120	40	40	40	—	48	48	48	46	46	46
	Cable clamp	30	90	120	2.5	2.5	2.5	6	62.5	61	61	60	59.5	59.5
S160,-NJ, S160NN	Front conn. (1)	35	105	140	55	55	55	—	54	54	54	52	52	52
E250-NJ, S250-NJ, S250-GJ, S250-NN	Cable clamp	35	105	140	2.5	2.5	2.5	6	63	61	61	49.5	59.5	59.5
H125, L125, H160, L160, S250-NE, S250-GE, S250-PE H250, L250	Front conn. (1)	—	105	140	—	55	55	—	—	89	89	—	87	87
	Cable clamp	—	105	140	—	2.5	2.5	4.5	—	96	96	—	59.5	59.5
E400, S400	Front conn.	—	180	240	—	110	114	—	—	97	99	—	96	98
E630, S630	Cable clamp	—	140	185	—	3	3	4.5	—	97	97	—	93	93
H400, L400	Front conn.	—	180	240	—	110	114	—	—	134	136	—	96	98
	Cable clamp	—	140	185	—	3	3	4.5	—	134	134	—	93	93

Notes:
(1): Not applicable when flat bars (FB) are fitted.

Terminal Covers

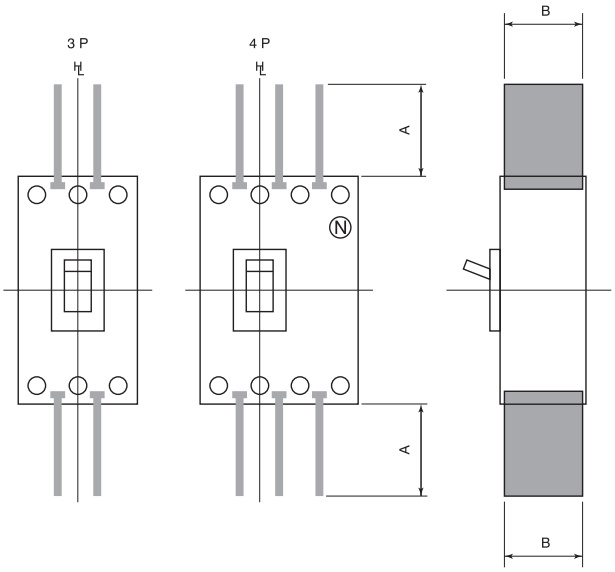
Terminal covers for Rear connected and Plug-in MCCB's (CR)



MCCB type	A		B	B'	C	D
	3 poles	4 poles				
E125, S125	90	120	2	6	41.5	40.5
S160, E250, S250-NJ, S250-GJ, S250-NN	105	140	2	6	41.5	39.5
H125, L125, H160, L160, S250-NE, S250-GE, S250-PE, H250, L250	105	140	2	6	77.5	39.5
E400, S400, H400, L400, E630, S630	140	185	3	4.5	97	93

Interpole Barriers

Terminal Interpole Barriers (BA)



MCCB type	A	B
E125, S125	47	53
S160, E250, S250-NJ, S250-GJ, S250-NN	100	53
H125, L125, H160, L160, S250-NE, S250-GE, S250-PE, H250, L250	100	88
E400, S400, E630, S630	110	95
H400, L400	110	95

ASL: Arrangement Standard Line
℄ : Handle Frame Centre Line
℄ : Handle Centre Line

Terminal Blocks for Front-Connected and Rear-Connected MCCBs

11 terminals

Left terminal designations
Example

With SHT	With UVT
AXc1	AXc1
AXb1	AXb1
AXa1	AXa1
AXc2	AXc2
AXb2	AXb2
AXa2	AXa2
ALc1	ALc1
ALb1	ALb1
ALa1	ALa1
C1	D1
C2	D2

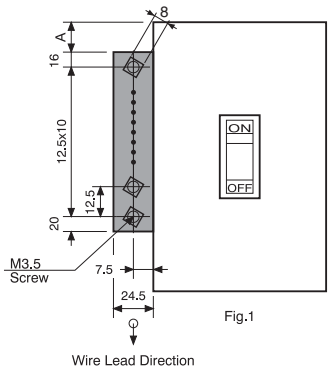


Fig.1

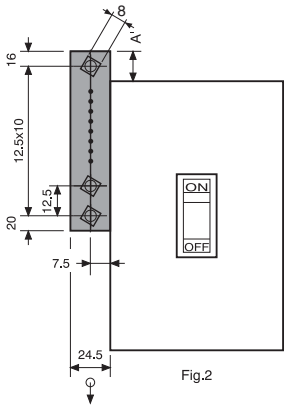
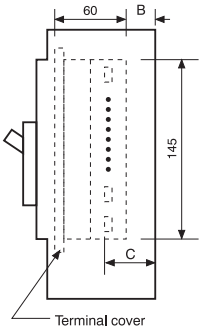


Fig.2



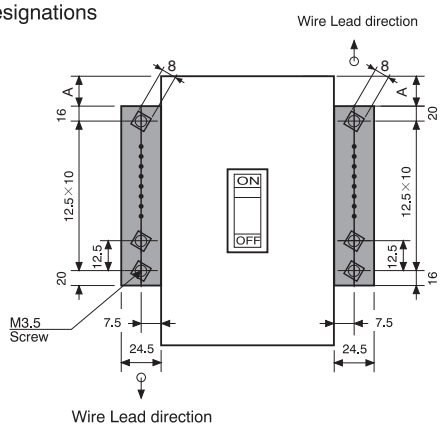
MCCB type	A	A'	B	C	Fig
E125, S125	—	3	0.5	40	2
S160, E250, S250-NJ, S250-GJ, S250-NN	2	—	0.5	40	1
H125, L125, H160, L160, S250-NE, S250-GE, S250-PE, H250, L250	2	—	35.5	75	1

Comments:
1. The tightening torque for the M3.5 terminal screw is 0.9 to 1.2 Nm.
2. Connection wire size is 2.5 mm² (max).

11 terminals

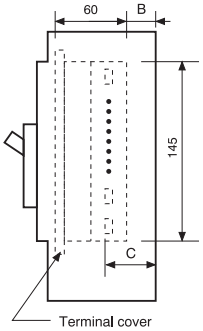
Left terminal designations

AXc1
AXb1
AXa1
AXc2
AXb2
AXa2
ALc1
ALb1
ALa1
AXc3
AXb3



Right terminal designations

With SHT	With UVT
PALc	PALc
PALa	PALa
k	k
l	l
C1	D1
C2	D2

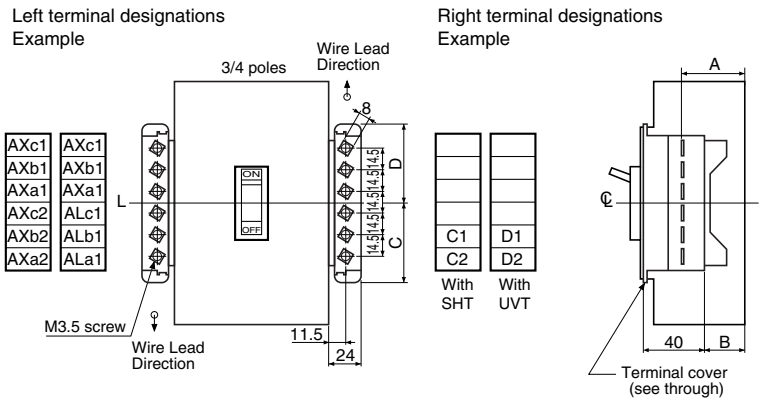


MCCB type	A	B	C
E400, S400, E630, S630	39.5	30.5	70
H400, L400	39.5	67.5	107

Comments:
1. The tightening torque for the M3.5 terminal screw is 0.9 to 1.2 Nm.
2. Connection wire size is 2.5 mm² (max).
3. When you specify Ground Fault Trip on electronic MCCBs with 3 poles the terminal block is automatically fitted to connect with the external neutral CT for 3 phases 4 wires system.

Terminal Blocks for Front-Connected and Rear-Connected MCCBs

6 terminals



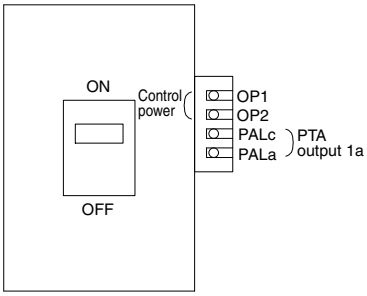
MCCB Type	A	B	C	D
E125, S125	42.5	27	53	53
S160, E250, S250-NJ, S250-GJ, S250-NN	42.5	27	53	53
H125, L125, H160, L160, S250-NE, S250-GE, S250-PE, H250, L250	77.5	62	53	53
E400, S400, E630, S630	72.5	57	43	63
H400, L400	109.5	94	43	63

Comments
1. The tightening torque for the M3.5 terminal screws is 0.9 to 1.2 Nm.
2. Connection wire size is 1.25mm2 (max).

OCR Power Supply for Electronic Protection (Standard type)

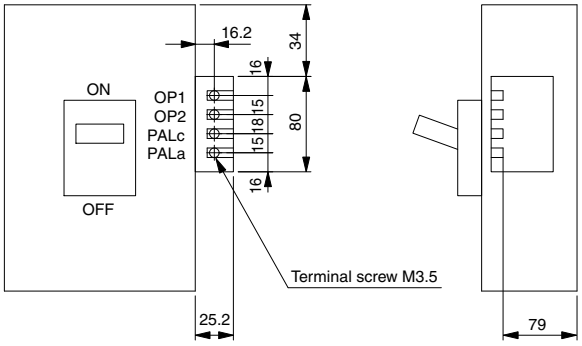
MCCB Type
S250-NE, S250-GE, S250-PE, H250-NE

Connection diagram



Notes: Separate installation of the OCR power supply is not available.

Mounting dimensions



Notes: 1. Tightening torque of terminal screws: 0.9 – 1.2 N·m
2. Applicable wire size: 2.0 mm^2 max

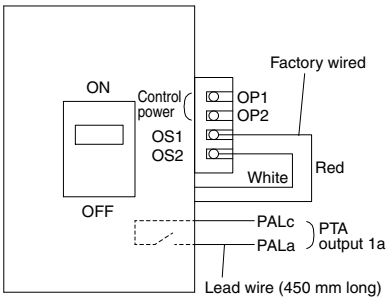
SECTION 7

OCR Power Supply for Electronic Protection (Standard type)

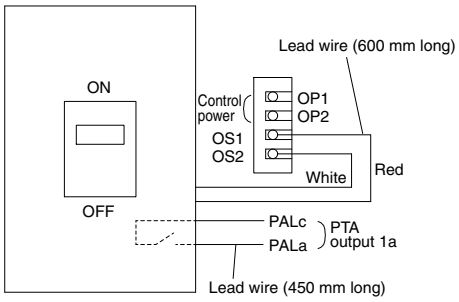
MCCB Type	A	B	C	D
S400-NE, S400-GE, S400-PE, E630-NE, S630-CE, S630-GE	71	74	25.2	16.2
H400-NE, L400-NE	71	111	25.2	16.2

Connection diagram

OCR power supply installed on the breaker

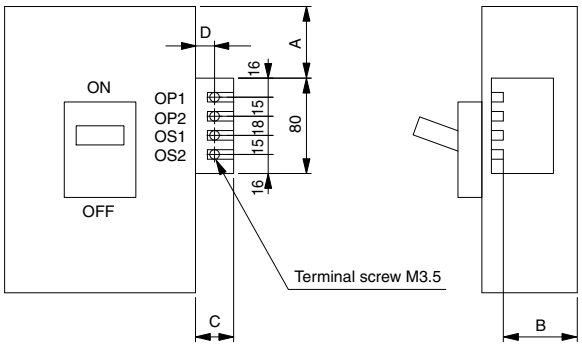


OCR power supply installed separately to the breaker



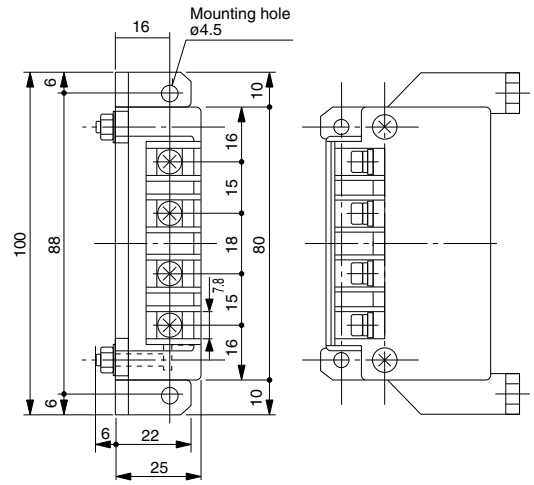
Mounting dimensions

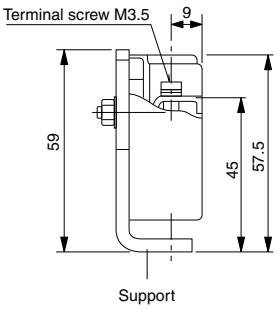
OCR power supply installed on the breaker



Notes: 1. Tightening torque of terminal screws: 0.9 – 1.2 N·m
2. Applicable lead wire size: 2.0 mm^2 max

OCR power supply installed separately to the breaker



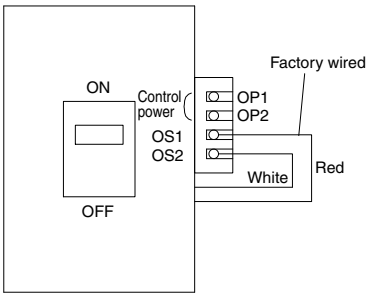


OCR Power Supply for Electronic Protection (with LCD)

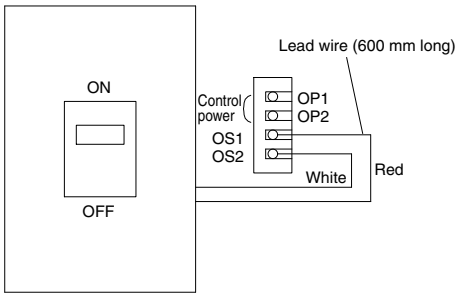
MCCB Type	A	B	C	D
S400-NE, S400-GE, S400-PE, E630-NE, S630-CE, S630-GE	71	74	25.2	16.2
H400-NE, L400-NE	71	111	25.2	16.2

Connection diagram

OCR power supply installed on the breaker

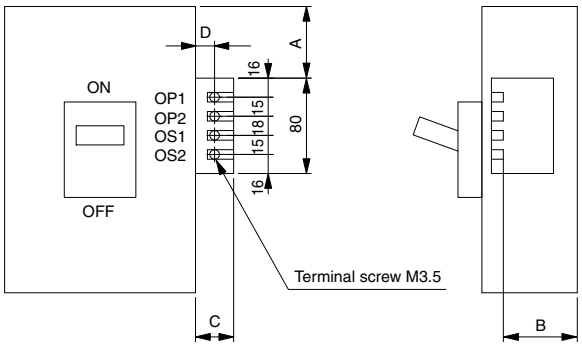


OCR power supply installed separately to the breaker



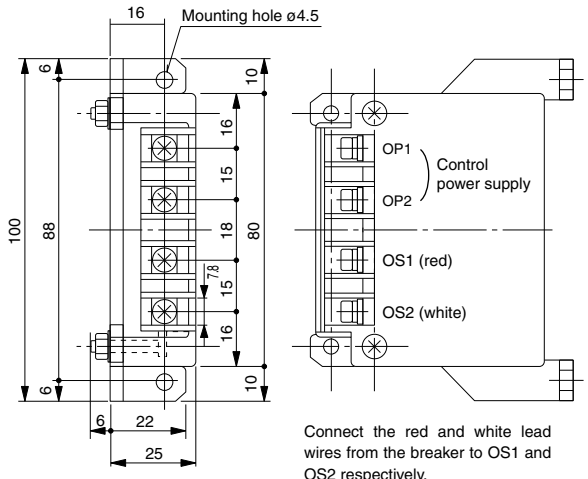
Mounting dimensions

OCR power supply installed on the breaker

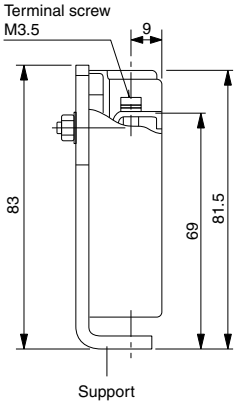


Notes: 1. Tightening torque of terminal screws: 0.9 – 1.2 N·m
2. Applicable lead wire size: 2.0 mm^2 max

OCR power supply installed separately to the breaker



Connect the red and white lead wires from the breaker to OS1 and OS2 respectively.
(Max lead wire length : 600 mm)



SECTION 7

DIMENSIONS

Slide Interlocks

ASL : Arrangement Standard Line ℍ : Handle Frame Centre Line ℄ : Handle Centre Line

Mechanical Interlocks slide type (MS)

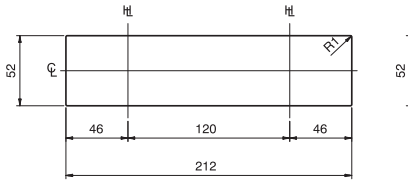
For 125A frame size

MCCB Type	Poles	Conn.	Parts No.	A
E125, S1225	3	FC, RC	T2MS123SF	91.7
	4	FC, RC	T2MS124SF	91.7

Panel Cutout

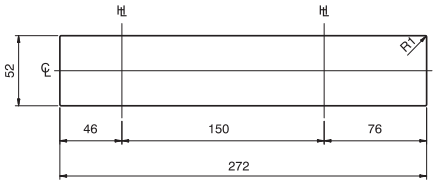
T2MS123SF

3P

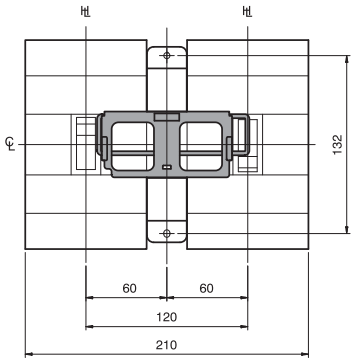


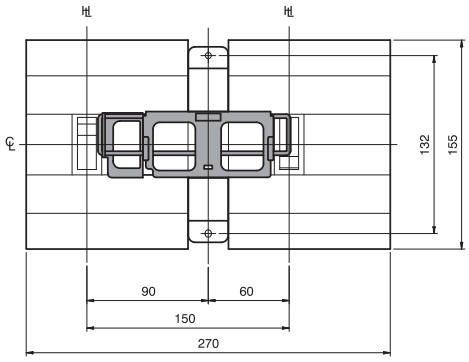
T2MS124SF

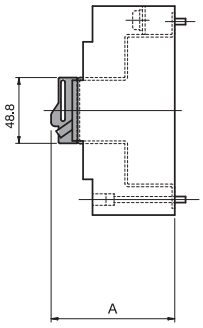
4P

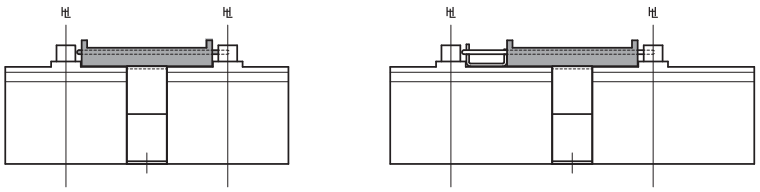


Panel cutout dimensions shown give an allowance of 1.0 mm around the handle escutcheon.

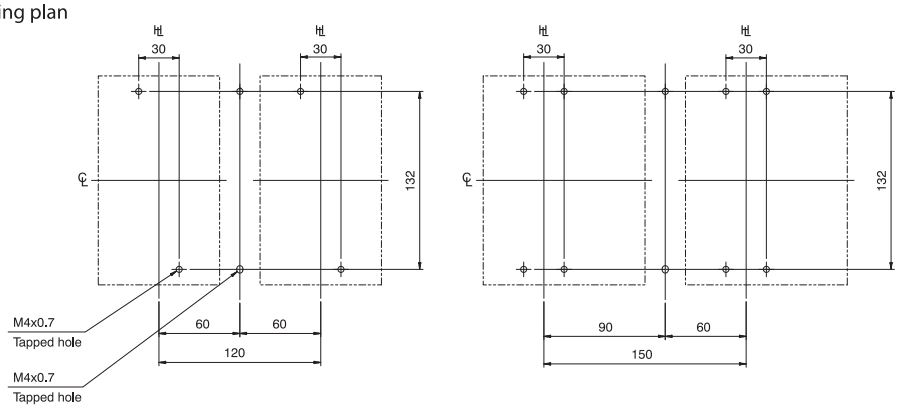








Drilling plan



SECTION 7

Slide Interlocks

ASL : Arrangement Standard Line ℍ : Handle Frame Centre Line ℄ : Handle Centre Line

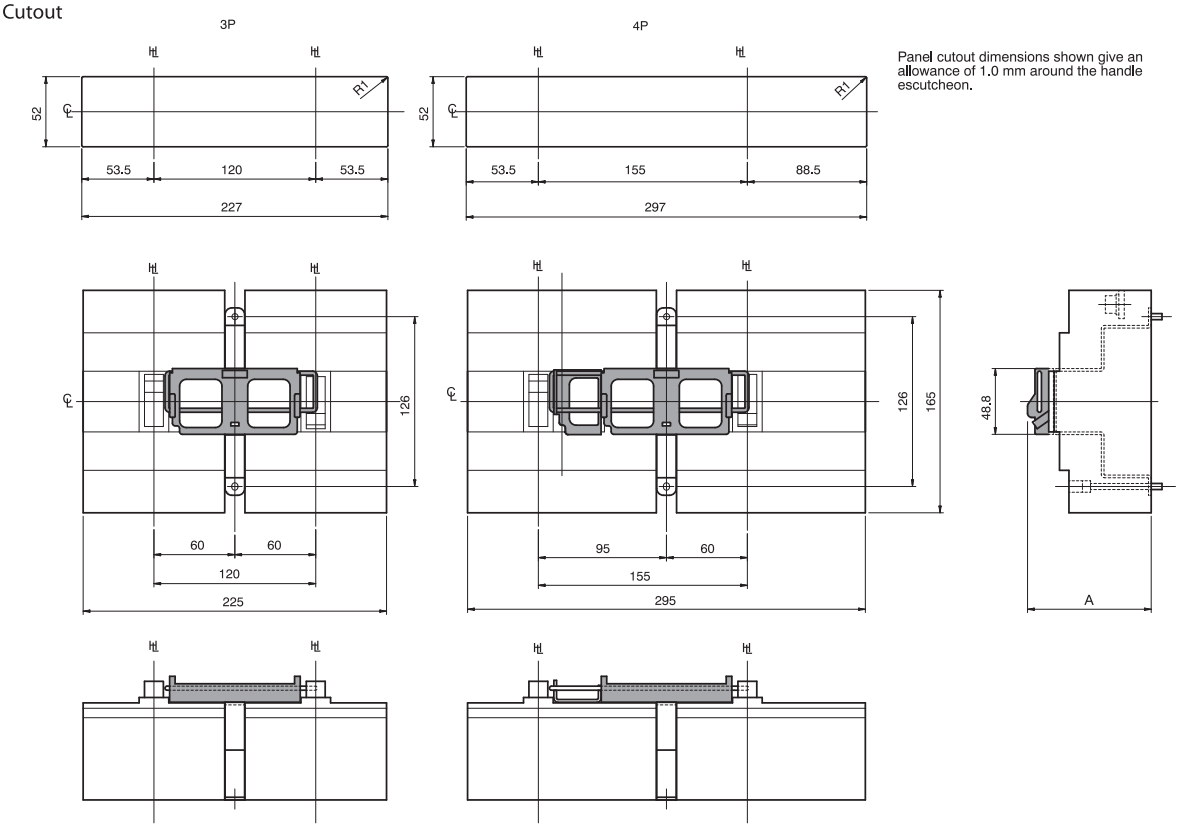
Mechanical Interlocks slide type (MS)

For 125A, 160A, 250A frame size

MCCB Type	Poles	Conn.	Parts No.	A
S160, E250, S250-NJ, S250GJ, S250-NN	3	FC, RC	T2MS253SF	91.7
	4	FC, RC	T2MS254SF	
H125, L125, H160, L160, S250-NE, S250-GE, S250-PE, H250, L250	3	FC, RC	T2MS253LF	126.7
	4	FC, RC	T2MS254LF	

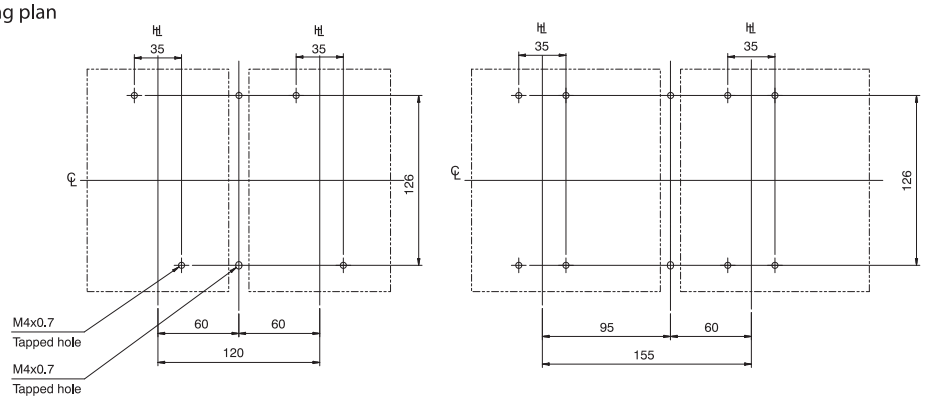
Panel Cutout

T2MS253SF/T2MS253LF



Panel cutout dimensions shown give an allowance of 1.0 mm around the handle escutcheon.

Drilling plan



Slide Interlocks

ASL : Arrangement Standard Line ℍ : Handle Frame Centre Line ℄ : Handle Centre Line

Mechanical Interlocks slide type (MS)

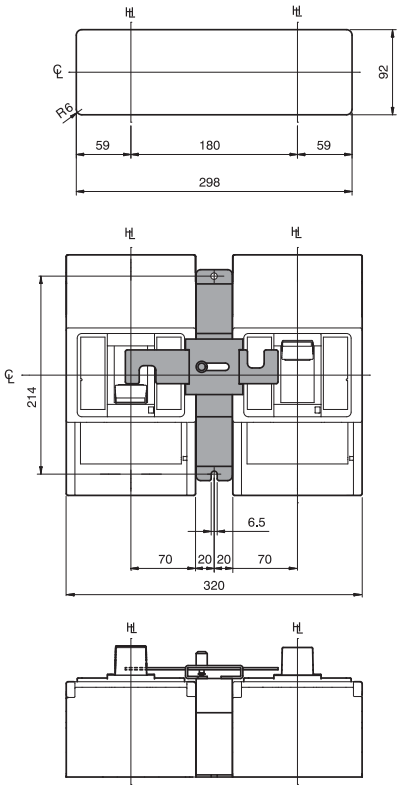
For 400A, 630A frame size

MCCB Type	Poles	Conn.	Parts No.	A
E400, S400, E630, S630	3	FC, RC	T2MS403SF	135.5
	4	FC, RC	T2MS404SF	
H400, L400	3	FC, RC	T2MS403LF	172.5
	4	FC, RC	T2MS404LF	

Panel Cutout

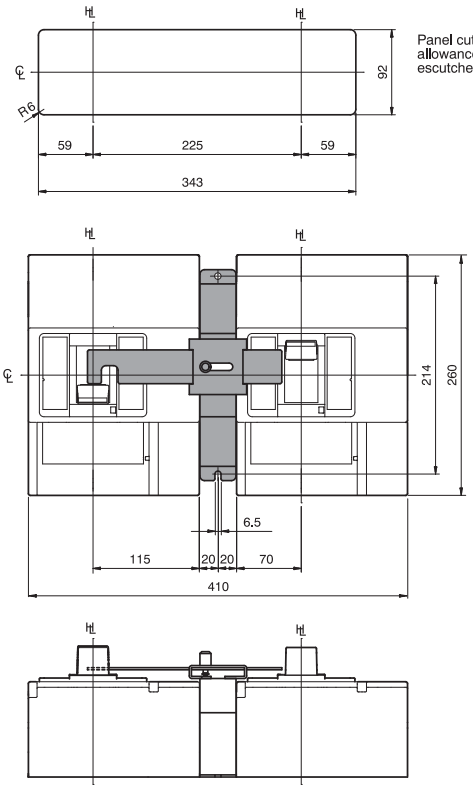
T2MS403SF/T2MS403LF

3P

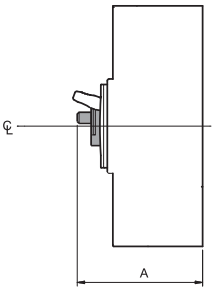


T2MS404SF/T2MS404LF

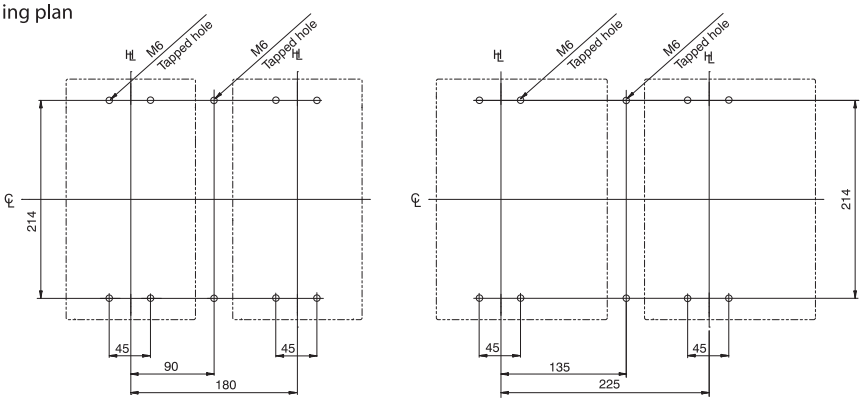
4P



Panel cutout dimensions shown give an allowance of 1.0 mm around the handle escutcheon.



Drilling plan



SECTION 7

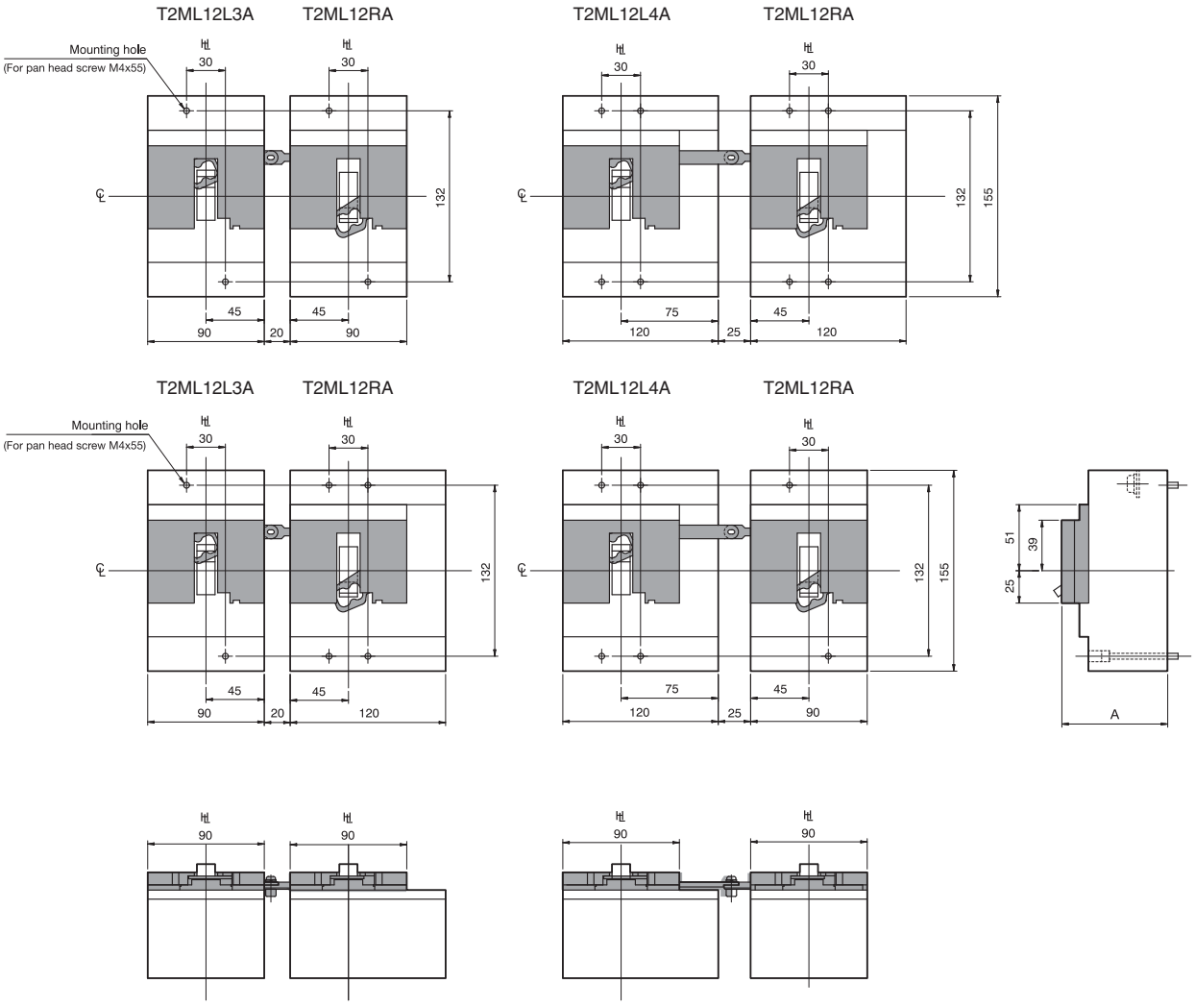
Link Interlocks

ASL : Arrangement Standard Line ℍ : Handle Frame Centre Line ℄ : Handle Centre Line

Mechanical Interlocks link type (ML)

For 125A frame size

MCCB Type	Poles	Position	Parts No.	A
E125, S125	3	Right	T2ML12RA	81.7
	4			
	3	Left	T2ML12L3A	
	4		T2ML12L4A	



Link Interlocks

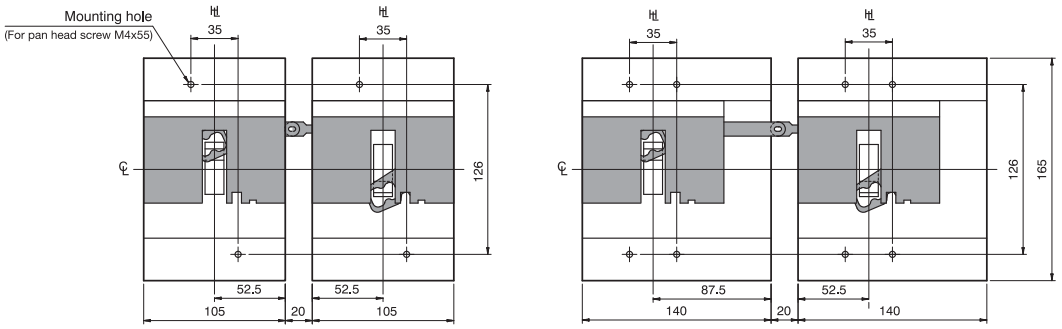
ASL : Arrangement Standard Line ℍ : Handle Frame Centre Line ℄ : Handle Centre Line

Mechanical Interlocks link type (ML)

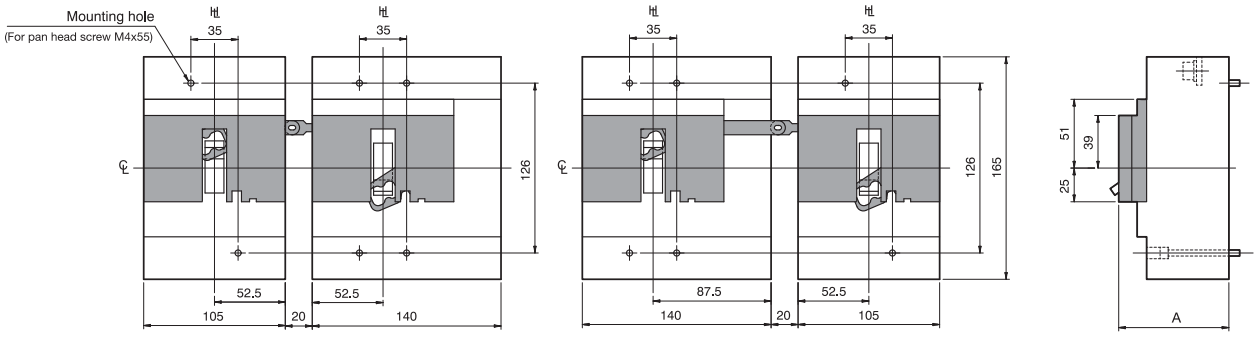
For 125A, 160A, 250A frame size

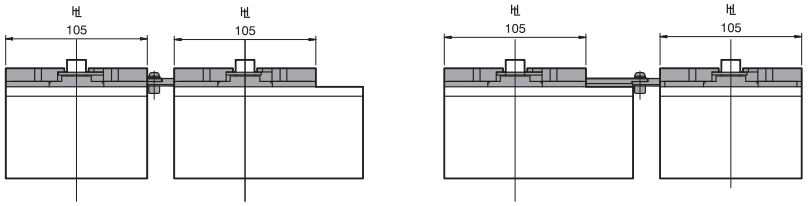
MCCB Type	Poles	Position	Parts No.	A
S160, E250, S250-NJ, S250-GJ, S250-NN	3	Right	T2ML25RA	81.7
	4			
	3	Left	T2ML25L3A	
	4		T2ML25L4A	
H125, L125, H160, L160, S250-NE, S250-GE, S250-PE, H250, L250	3	Right	T2ML25RA	116.7
	4			
	3	Left	T2ML25L3A	
	4		T2ML25L4A	

T2ML25L3A T2ML25RA T2ML25L4A T2ML25RA



T2ML25L3A T2ML25RA T2ML25L4A T2ML25RA





Link Interlocks with motor operators

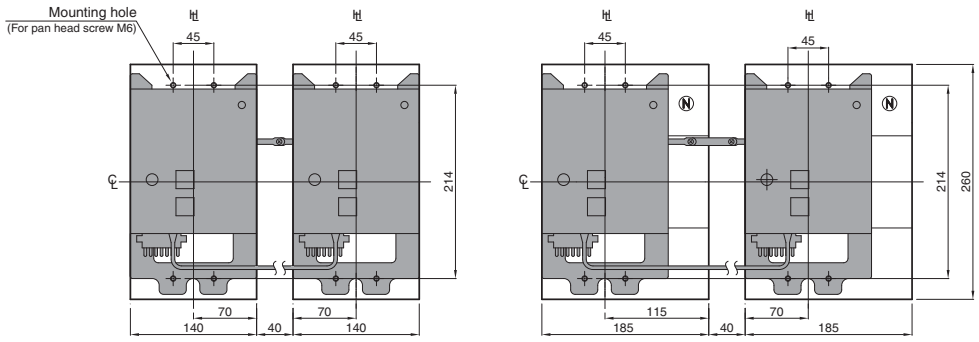
ASL : Arrangement Standard Line ℍ : Handle Frame Centre Line ℄ : Handle Centre Line

Mechanical Interlocks link type (ML)

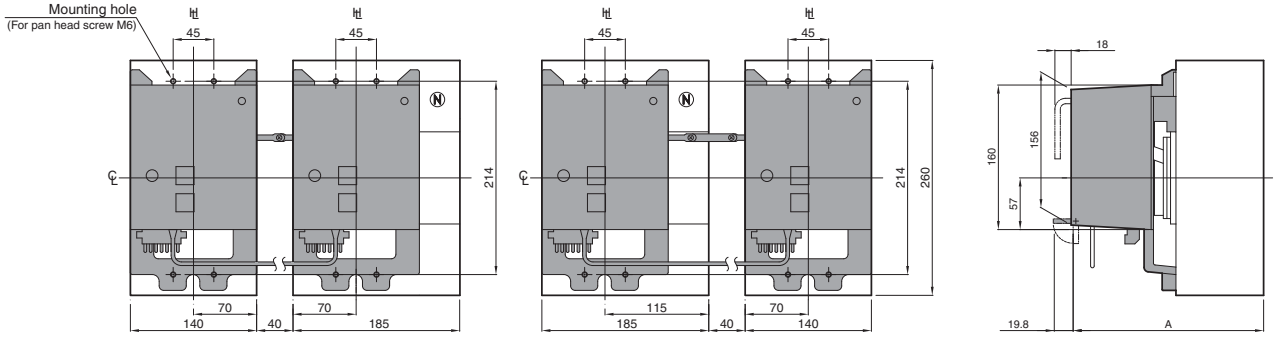
For 400A, 630A frame size

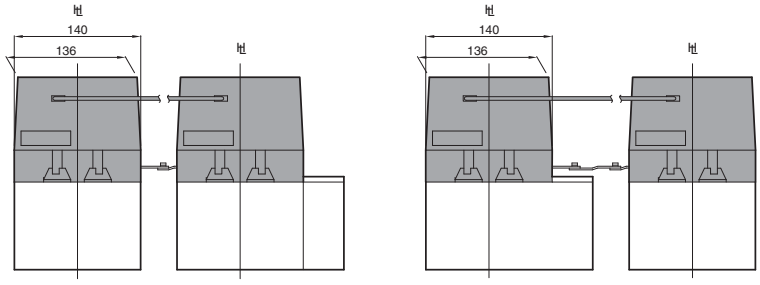
MCCB Type	Poles	Position	Parts No.	A
E400, S400 E630, S630	3	Right	T2ML40RA	213
	4			
	3	Left	T2ML40L3A	
	4		T2ML40L4A	
H400, L400	3	Right	T2ML40RA	250
	4			
	3	Left	T2ML40L3A	
	4		T2ML40L4A	

T2ML40L3A T2ML40RA T2ML40L4A T2ML40RA



T2ML40L3A T2ML40RA T2ML40L4A T2ML40RA





For 400A and 630A frame, the link mechanical interlocks can not be used without motor operators. Please specify also the motor operators when ordering. Furthermore, please request the additional labels for the breakers to TERASAKI and put the labels on the side of the breakers.

Link Interlocks with breaker mounted handles

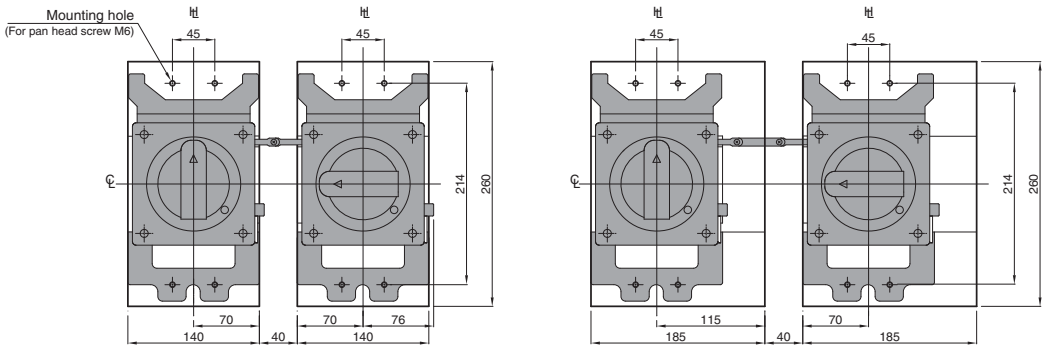
ASL : Arrangement Standard Line ⊬ : Handle Frame Centre Line ℄ : Handle Centre Line

Mechanical Interlocks link type (ML)

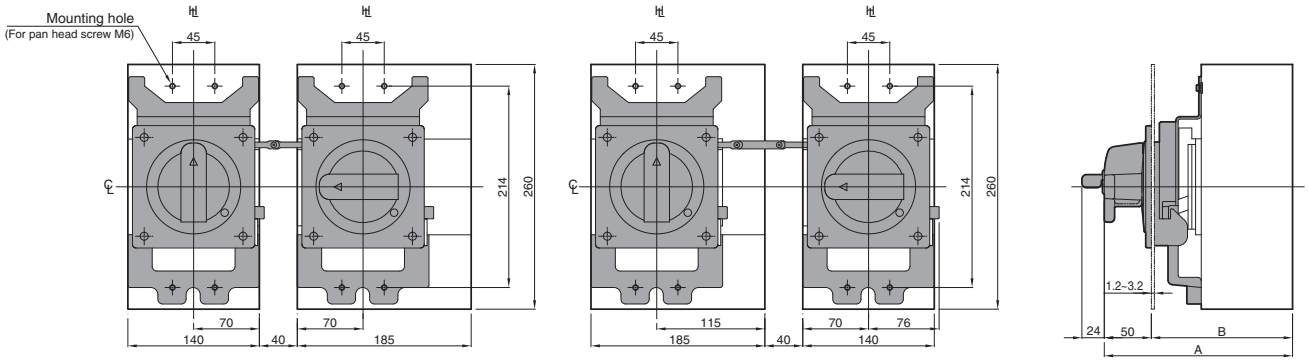
For 400A, 630A frame size

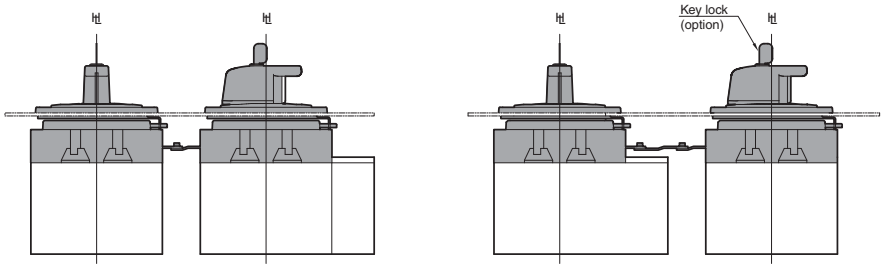
MCCB Type	Poles	Position	Parts No.	A	B
E400, S400 E630, S630	3	Right	T2ML40RA	200	150±2
	4				
	3	Left	T2ML40L3A		
	4		T2ML40L4A		
H400, L400	3	Right	T2ML40RA	237	187±2
	4				
	3	Left	T2ML40L3A		
	4		T2ML40L4A		

T2ML40L3A T2ML40RA T2ML40L4A T2ML40RA



T2ML40L3A T2ML40RA T2ML40L4A T2ML40RA





For 400A and 630A frame, the link mechanical interlocks can not be used without breaker mounted handles. Please specify also the breaker mounted handles when ordering. Furthermore, please request the additional labels for the breakers to TERASAKI and put the labels on the side of the breakers.

Wire Interlocks

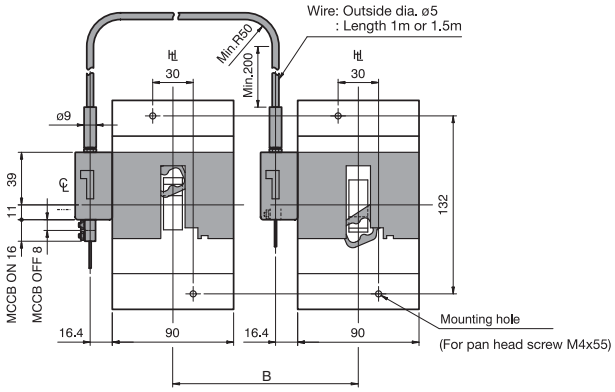
ASL : Arrangement Standard Line ℍ : Handle Frame Centre Line ℄ : Handle Centre Line

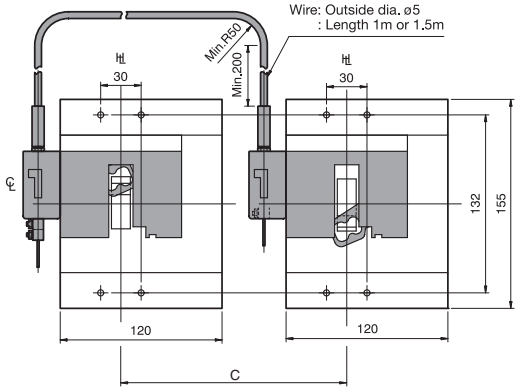
Mechanical Interlocks wire type (MW)

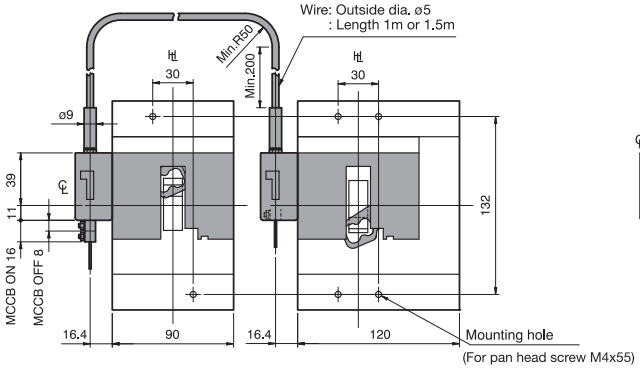
For 125A frame size

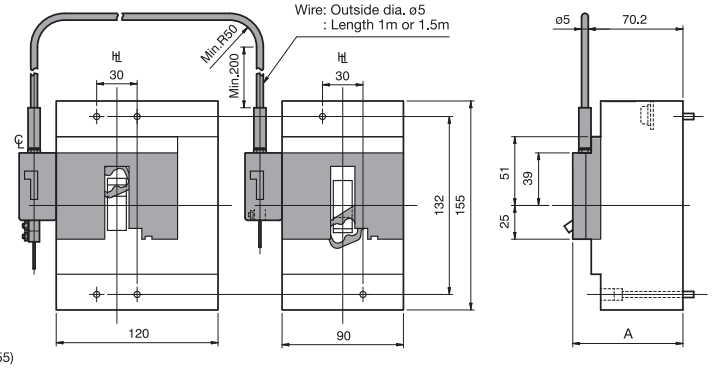
MCCB Type	Parts No.	A
E125, S125	T2MW12CA	81.7

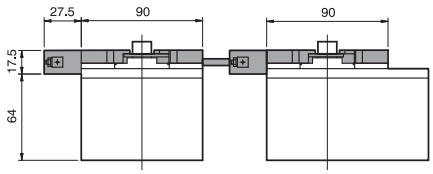
Cable length	Parts No.	B	C
1.0m	T2MW00SA	130min. – 480max.	160min. – 480max.
1.5m	T2MW00LA	130min. – 980max.	160min. – 980max.

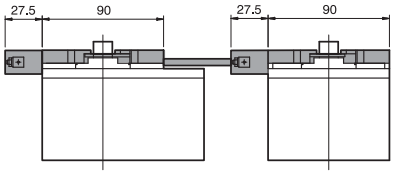












SECTION 7

Wire Interlocks

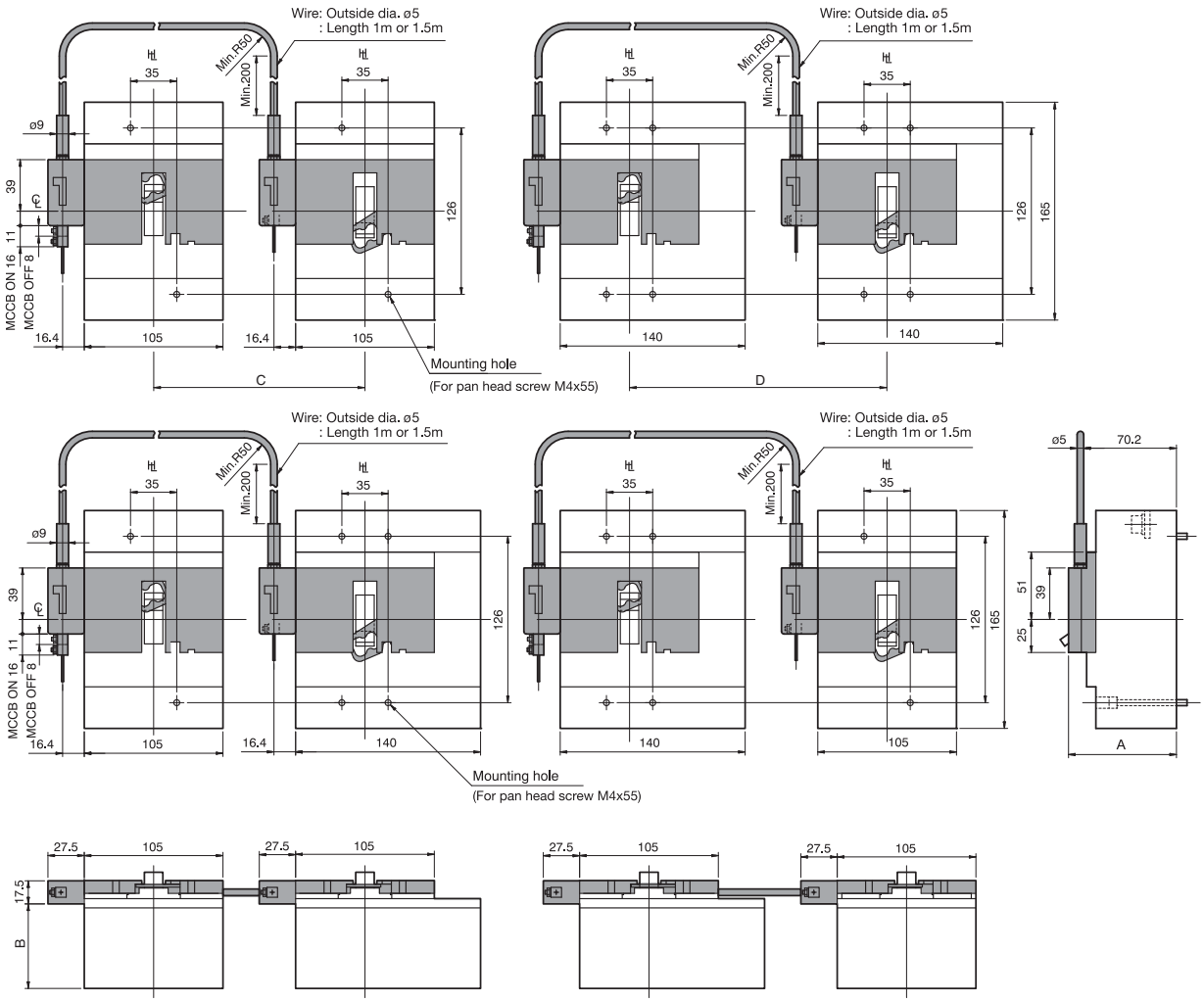
ASL : Arrangement Standard Line ℍ : Handle Frame Centre Line ℄ : Handle Centre Line

Mechanical Interlocks wire type (MW)

For 125A, 160A, 250A frame size

MCCB Type	Parts No.	A	B
S160, E250, S250-NJ S250-GJ, S250-NN	T2MW25CA	81.7	64
H125, L125, H160, L160, S250-NE, S250-GE, S250-PE, H250, L250	T2MW25CA	116.7	99

Cable length	Parts No.	B	C
1.0m	T2MW00SA	155min. – 480max.	180min. – 480max.
1.5m	T2MW00LA	155min. – 980max.	180min. – 980max.



Wire Interlocks with motor operators

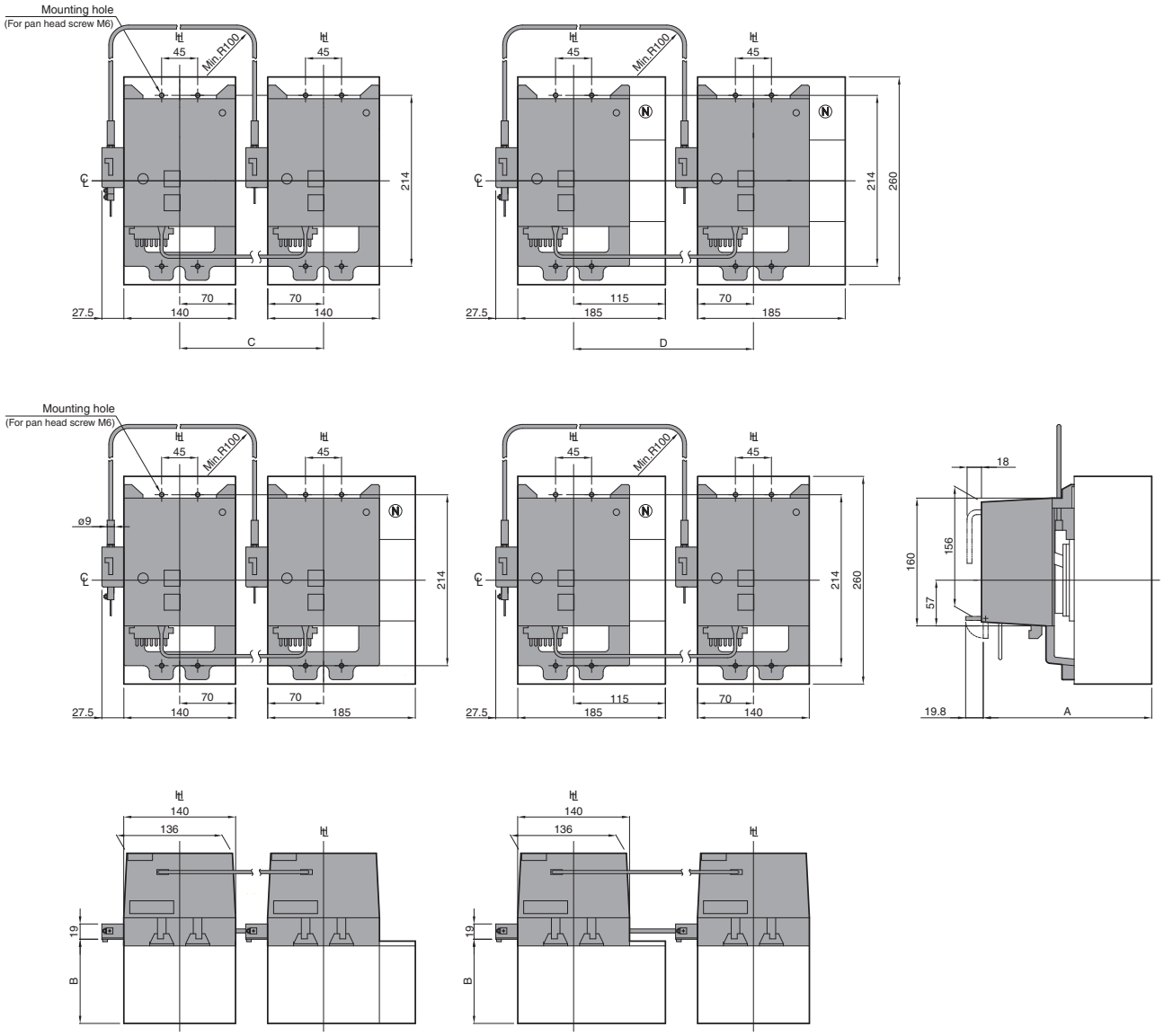
ASL : Arrangement Standard Line　　⊬ : Handle Frame Centre Line　　℄ : Handle Centre Line

Mechanical Interlocks wire type (MW)

For 400A, 630A frame size

MCCB Type	Parts No.	A	B
E400, S400, E630, S630	T2MW40CA	213	105.4
H400, L400	T2MW40CA	250	142.4

Cable length	Parts No.	B	C
1.0m	T2MW00SA	180min. – 480max.	225min. – 480max.
1.5m	T2MW00LA	180min. – 930max.	225min. – 930max.



For 400A and 630A frame, the wire mechanical interlocks can not be used without motor operators. Please specify also the motor operators when ordering. Furthermore, please request the additional labels for the breakers to TERASAKI and put the labels on the side of the breakers.

SECTION 7

Wire Interlocks with breaker mounted handles

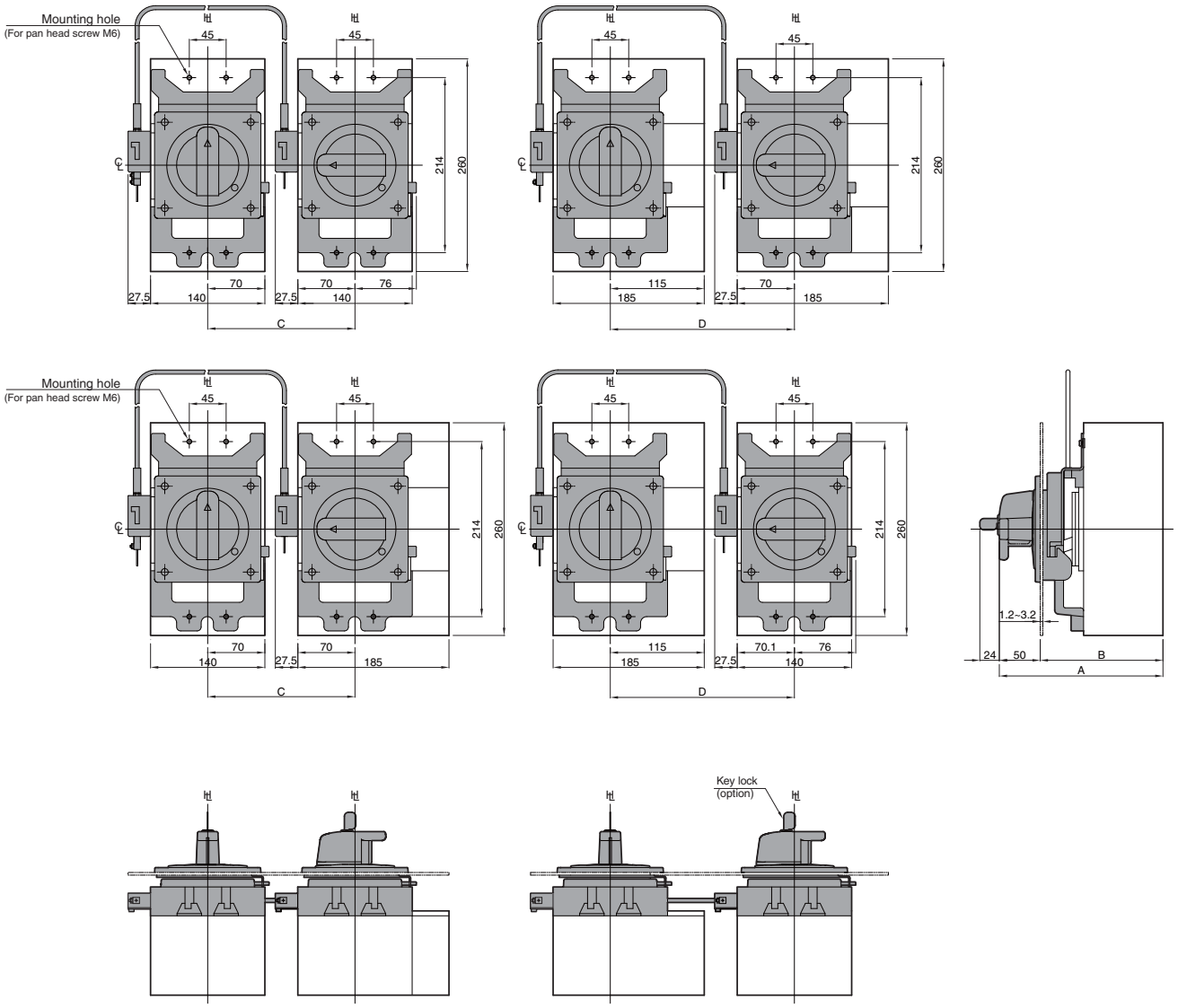
ASL : Arrangement Standard Line　　⊬ : Handle Frame Centre Line　　℄ : Handle Centre Line

Mechanical Interlocks wire type (MW)

For 400A, 630A frame size

MCCB Type	Parts No.	A	B
E400, S400, E630, S630	T2MW40CA	200	150±2
H400, L400	T2MW40CA	237	187±2

Cable length	Parts No.	B	C
1.0m	T2MW00SA	180min. – 430max.	225min. – 430max.
1.5m	T2MW00LA	180min. – 930max.	225min. – 930max.



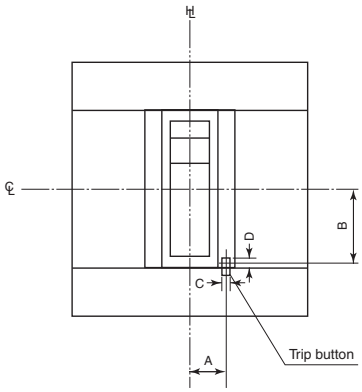
For 400A and 630A frame, the wire mechanical interlocks can not be used without breaker mounted handles. Please specify also the breaker mounted handles when ordering. Furthermore, please request the additional labels for the breakers to TERASAKI and put the labels on the side of the breakers.

Position of Trip Button

ASL : Arrangement Standard Line ℍ : Handle Frame Centre Line ℄ : Handle Centre Line

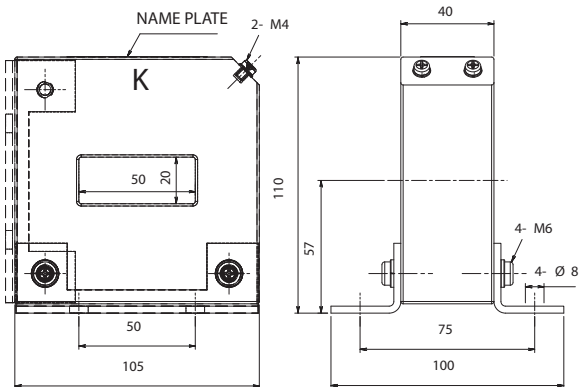
MCCB Type	Poles	A	B	C	D
E125, S125	3, 4	13.8	20.4	3.3	4.3
S160, E250, S250-NJ, S250-GJ, S250-NN,	3, 4	17.2	20.4	3.3	4.3
H125, L125, H160, L160, S250-NE, S250-GE, S250-PE, H250, L250	3, 4	17.2	20.4	3.3	4.3
E400, S400 H400, L400 E630 S630	3, 4	21.6	37.2	5.3	6.6

Positions of Trip Button

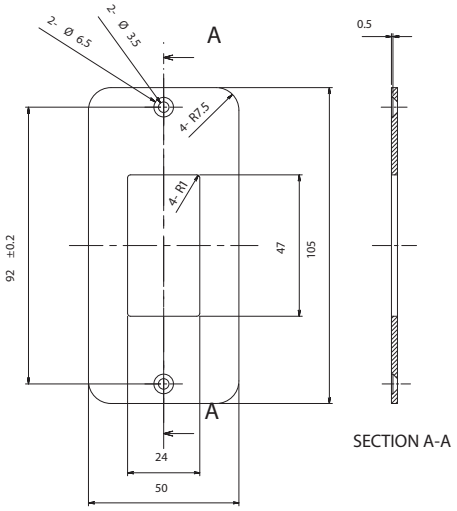


DIMENSIONS

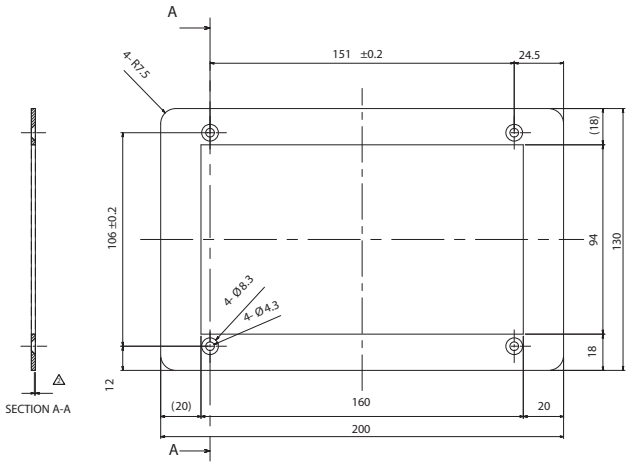
External Neutral CT



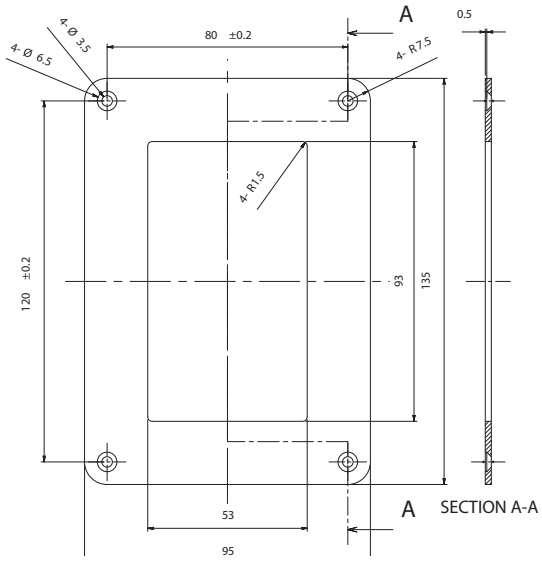
Door Flanges



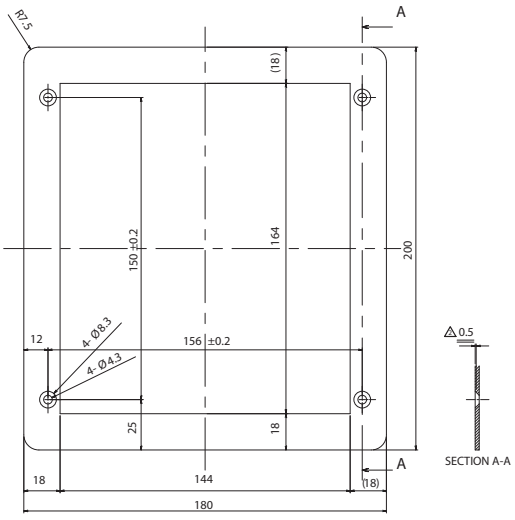
Door Flange for toggle-operated 125A and 250A frame



Door Flange for motor-operated 125A and 250A frame



Door Flange for toggle-operated 400A and 630A frame



Door Flange for motor-operated 400A and 630A frame

MEMO

DIRECT OPENING

Under the heading "Measures to minimise the risk in the event of failure", IEC 60204-1 Safety of Machinery-Electrical Equipment Machinery includes the following recommendation:

"-the use of switching devices having positive (or direct) opening operation."

7

TEMBREAK 2

MOULDED CASE CIRCUIT BREAKERS 16A TO 630A

1. Welcome to TemBreak 2
2. Ratings and Specifications
3. Operating Characteristics
4. Application Data
5. Accessories
6. Installation
7. Dimensions

TEMBREAK 2

MINI MOULDED CASE CIRCUIT BREAKERS 10A TO 100A

8. TemBreak 2 MINI Moulded Case Circuit Breakers

- Easy Selection Guide 141
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TEMBREAK

MOULDED CASE CIRCUIT BREAKERS 630A TO 1600A

9. TemBreak Moulded Case Circuit Breakers

TEMBREAK 2 MINI MOULDED CASE CIRCUIT BREAKERS

MINI MOULDED CASE CIRCUIT BREAKERS

EASY SELECTION GUIDE

You can save space and money with Terasaki's new compact and economical Mini Moulded Case Circuit Breakers.

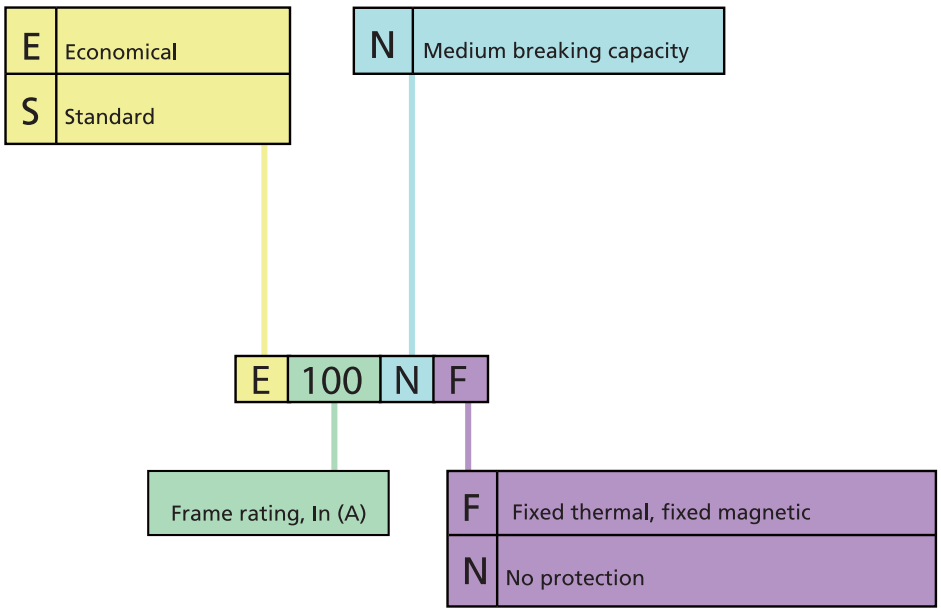
The range of products includes:

- Moulded Case Circuit Breakers (MCCBs)
- Switch Disconnectors in the same compact moulded case frame sizes as MCCBs
- A comprehensive range of accessories.

KEY TO MODEL AND TYPE DESIGNATIONS

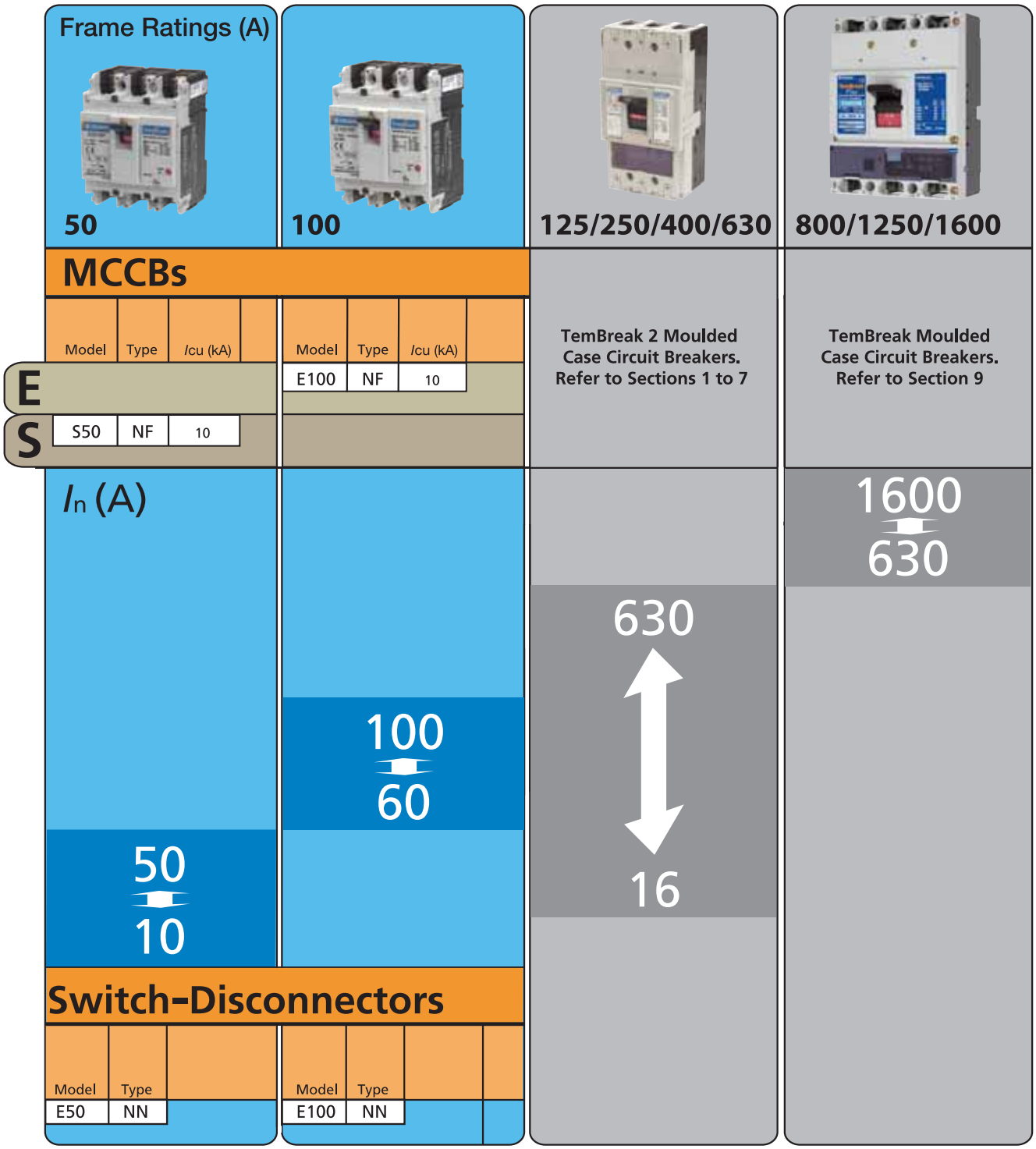
Model Denoted by

Type Denoted by



SECTION 8

EASY SELECTION GUIDE



Note: All breaking capacities are r.m.s. symmetrical at 415V AC

RATINGS AND SPECIFICATIONS

Mini MCCB Electrical Characteristics to IEC 60947-2, EN 60947-2, JIS C 8201-2-1 Ann.1, AS/NZS 3947-2, NEMA-AB1

Frame	Quantity	Unit	Condition	50	100
Model				S50	E100
Number of Poles				2, 3	2, 3
Type				NF	NF
Nominal current ratings					
	I_n	(A)	40°C	10, 15, 20, 30 40, 50	60, 75, 100
Electrical characteristics					
Rated operational voltage	U_e	(V)	AC 50/60 Hz	600	600
			DC	250	250
Rated insulation voltage	U_i	(V)		690	690
Rated impulse withstand voltage	U_{imp}	(kV)		6	6
Ultimate breaking capacity (IEC, JIS, AS/NZS)	I_{cu}	(kA)	600V AC	5	5
			500V AC	7.5	7.5
			380/440V AC	10	10
			220/240V AC	25	25
			250V DC	5	5
Service breaking capacity (IEC, JIS, AS/NZS)	I_{cs}	(kA)	600V AC	3	3
			500V AC	4	4
			380/440V AC	5	5
			220/240V AC	13	13
			250V DC	3	3
Rated breaking capacity (NEMA)		(kA)	480V AC	-	-
			240VAC	-	-
Protection					
Adjustable thermal, adjustable magnetic				■	■
Fixed thermal, fixed magnetic					
Microprocessor					
Utilisation category				A	A
Installation					
Front connection (FC)				■	■
Extension bar (FB)				-	-
Cable clamp (FW)				-	-
Rear connection (RC)				•	•
Plug-in (PM)				-	-
Draw- out (DR)				-	-
DIN rail mounting (DA)				■	■
Dimensions	h	(mm)		100	100
	w	(mm)	2 pole	50	50
			3 pole	75	75
	d	(mm)		60	60
Operation					
Direct Opening Action				-	-
Toggle operation				■	■
Door mounted (HP) / Breaker mounted handle (HB)				-	-
Motor operation (MC)				-	-

SECTION 8

■ Standard • Optional - Not Available

RATINGS AND SPECIFICATIONS

Mini Switch Disconnectors Electrical Characteristics to IEC 60947-3, EN 60947-3, AS/NZS 3947-3

Frame	Quantity	Unit	Condition	50	100
Model				E50	E100
Number of Poles				2, 3	2, 3
Type				NN	NN
Nominal current ratings					
	I_n	(A)		50	100
Electrical characteristics					
Rated operational voltage	U_e	(V)	AC 50/60 Hz	550	600
			DC	250	250
Rated insulation voltage	U_i	(V)		690	690
Rated impulse withstand voltage	U_{imp}	(kV)		6	6
Rated Short-circuit making capacity	I_{cm}	(kA peak)		1.5	1.5
Rated Short-time withstand current	I_{cw}	(kA rms)	1 Second	1	1.2
Utilisation category			AC	AC-22A	AC-22A
			DC	DC-22A	DC22-A
Installation					
Front connection (FC)				■	■
Extension bar (FB)				•	•
Cable clamp (FW)				-	-
Rear connection (RC)				•	•
Plug-in (PM)				-	-
Draw- out (DR)				-	-
DIN rail mounting (DA)				■	■
Dimensions	h	(mm)		100	100
	w	(mm)	2 pole	50	50
			3 pole	75	75
	d	(mm)		60	60
Operation					
Direct Opening Action				-	-
Toggle operation				■	■
Door mounted (HP) / Breaker mounted handle (HB)				-	-
Motor operation (MC)				-	-

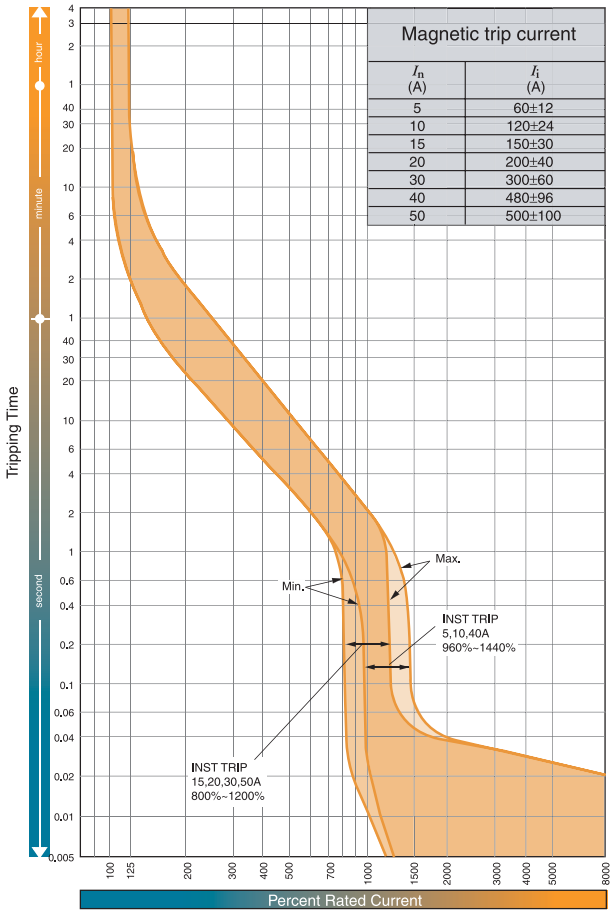
SECTION 8

OPERATING CHARACTERISTICS

50A and 100A Frame

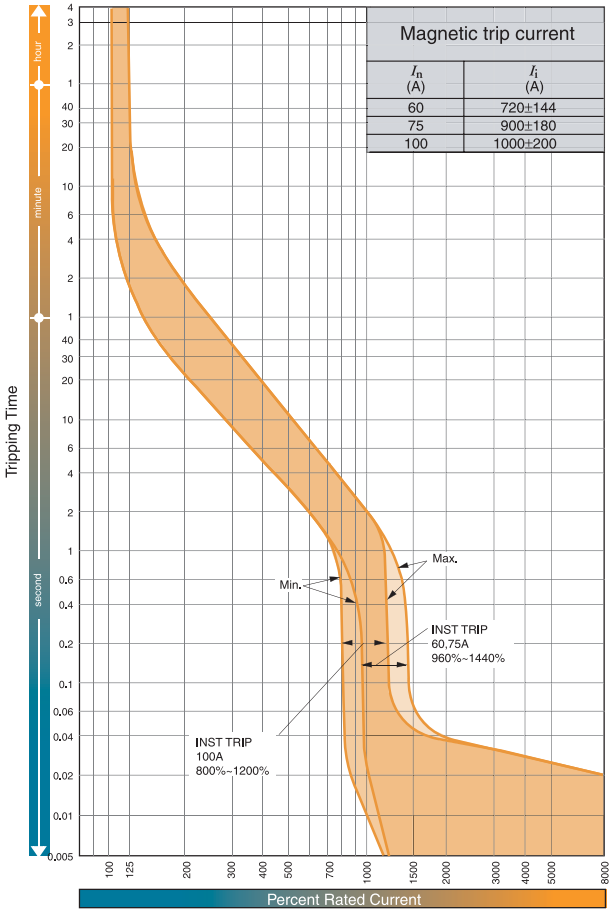
Time/current characteristic curves

S50-NF

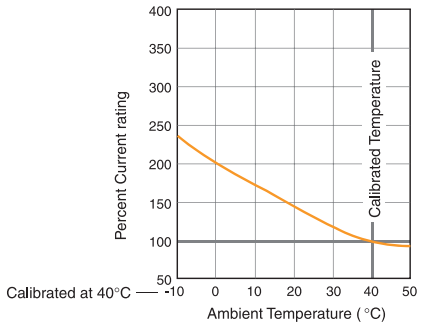


Time/current characteristic curves

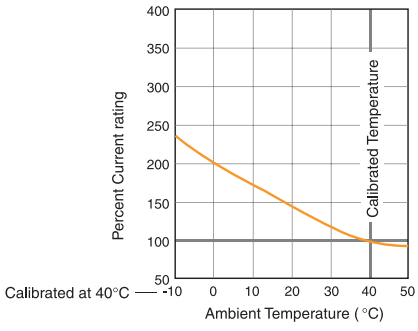
E100-NF



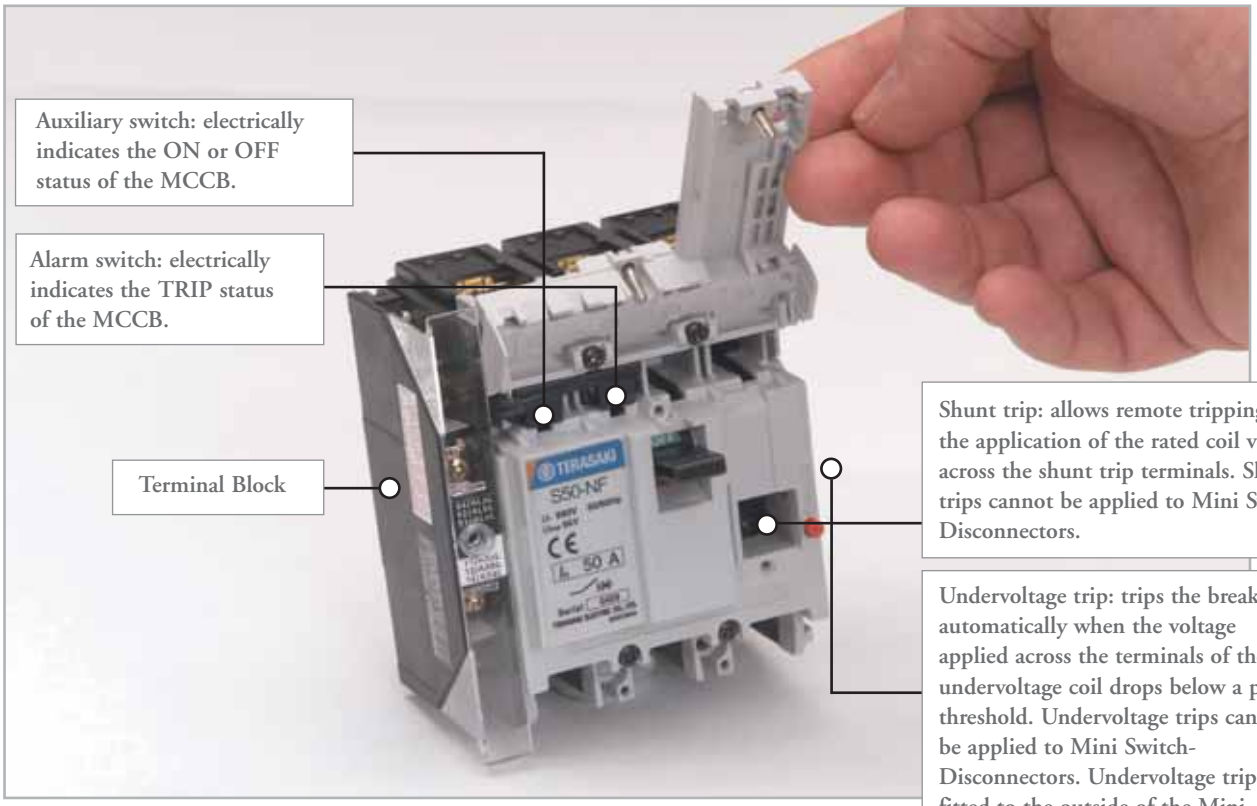
Ambient compensating curves



Ambient compensating curves



ELECTRICAL CONTROL ACCESSORIES

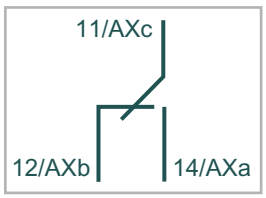


S50-NF with Terminal Block Installed and Accessory Hatch Opened

Maximum Permitted Combinations of Electrical Control Accessories

1. Left-hand side internal accessory location: 1 auxiliary switch AND 1 alarm switch.
2. Right-hand side internal accessory location: (1 auxiliary switch AND 1 alarm switch) OR 1 shunt trip.
3. Right-hand side external accessory location: 1 undervoltage trip. The undervoltage trip cannot be used in the same Mini MCCB as a shunt trip. The undervoltage trip is compatible with 1 auxiliary and 1 alarm switch installed in the right-hand side internal accessory location.

ELECTRICAL CONTROL ACCESSORIES

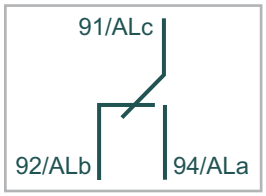


Terminal Designations and Function of Mini Auxiliary Switch

Mini Auxiliary Switch (AX)

An auxiliary switch electrically indicates the ON or OFF status of the MCCB. The Mini type is a changeover switch with 3 terminals.

A microcurrent version is available for switching currents as low as 1mA.



Terminal Designations and Function of Mini Alarm Switch

Mini Alarm Switch (AL)

An alarm switch electrically indicates the TRIP status of the MCCB. The Mini type is a changeover switch with 3 terminals.

A microcurrent version is available for switching currents as low as 1mA.

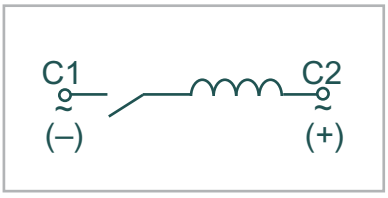
Ratings of Auxiliary and Alarm Switches

Auxiliaries and Alarm Switch ratings						
AC			DC			
Volts (V)	Amperes (A)		Volts (V)	Amperes (A)		Minimum Load
	Resistive Load	Inductive Load		Resistive Load	Inductive Load	
480	-	-	250	0.3	0.3	160mA
250	5	5	125	0.6	0.6	at 5V DC.
125	5	5	30	3	3	30mA at 30V DC.

Microcurrent versions		
DC		
Volts (V)	Amperes (A) Resistive Load	Minimum Load
30	0.1	1mA at 5V DC to 30V DC.

Ratings of Shunt Trip

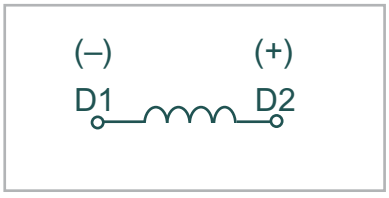
Excitation current (A) peak value (value at maximum voltage)				
Rated Voltage (V)	Voltage (AC)			Voltage (DC)
	100-120	200-240	380-450	100-110
Excitation Current (A)	1.5	0.75	0.53	1.5



Terminal Designations of Shunt Trips

Ratings of Undervoltage Trip

Power supply capacity (VA)				Excitation current (mA)
Rated Voltage (V)	Voltage (AC)			Voltage (DC)
	100	200	400	100-110
Power supply capacity (VA)	2.8	3.4	4.4	28.6



Terminal Designations of Undervoltage Trips

SECTION 8

TERMINATION OF CONTROL WIRING

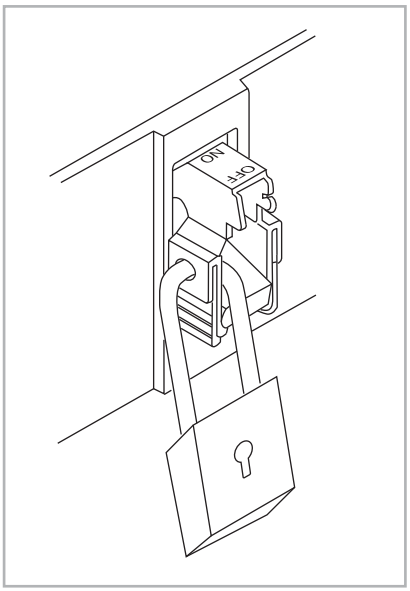
Terminal Block

Mini MCCB with Terminal Block Installed

A terminal block facilitates convenient and accessible control wiring to electrical accessories. The terminal block allows the use of control cables with cross-sectional area of up to 2mm^2. Tightening torque for the terminal screws is 0.9 to 1.2Nm.

TOGGLE LOCK

A Toggle lock is an optional accessory which enables the user to padlock the handle of the Mini MCCB in either the OFF or ON position. The Mini MCCB has a trip-free mechanism meaning that the contacts will open to clear an overcurrent even if the handle is locked ON.



Toggle Lock

INSULATION ACCESSORIES

Terminal Covers for S50 and E100

Terminal Covers are used to prevent direct contact with live Mini MCCB terminations. They also provide additional insulation that reduces the possibility of a short circuit between phases or to earth.

Terminal covers are available for Mini MCCBs with front and rear connection terminals.

Earth barriers are available which insulate the rear of the MCCB from the surface on which it is mounted.

Interpole Barriers for S50 and E100

Interpole barriers provide maximum insulation between phases at the terminals of the Mini MCCB.

MECHANICAL INTERLOCKS

Interlocks for TemBreak 2 Mini MCCBs are manually operated toggle locking devices which can be installed between two adjacent MCCBs. Depending on the position of the slide, one or other of the MCCBs is prevented from being switched ON.

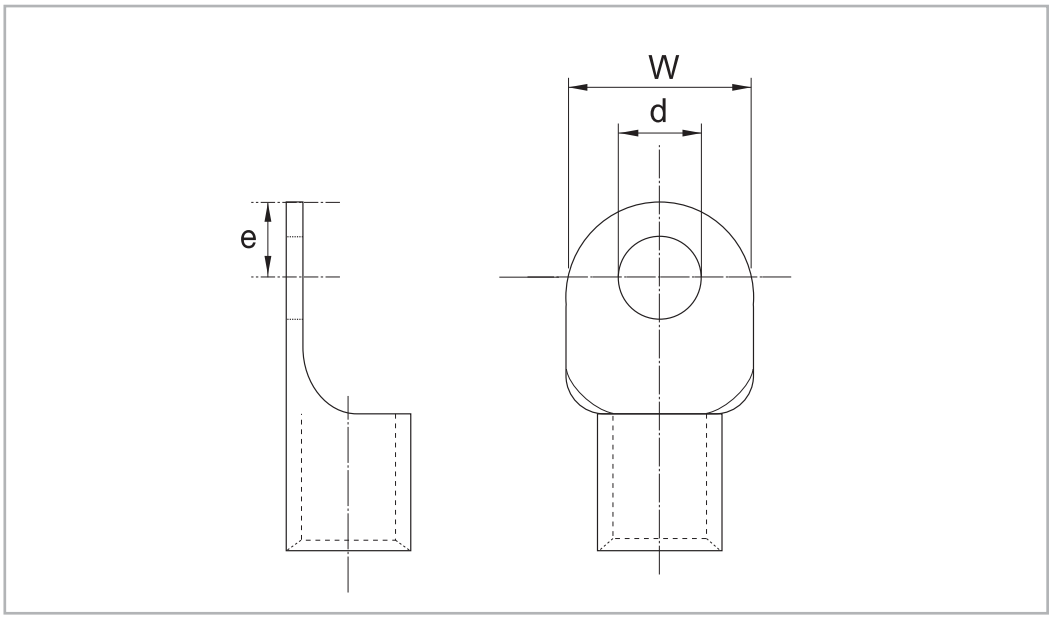
Mechanical interlocks can be used between any two Mini MCCBs.

Mechanical interlocks can be installed in the field and are padlockable in both positions.

INSTALLATION

Connection of Busbars and Terminated Cables

This connection method is standard for all front connected (FC) Mini MCCBs. Solid conductors or cables terminated with compression terminals can be used.



Maximum Dimensions of Compression Terminals		
Frame Size (A)	50	100
Width, w (mm)	15	15
Diameter, d (mm)	5.5	9
Hole distance, h (mm)	7	7

INSTALLATION

Mounting on DIN Rail

S50 and E100 Mounted on 35mm DIN Rail

TemBreak 2 Mini MCCBs can be clip mounted to 35mm DIN rail. The DIN rail clips are built-in to the MCCB as standard.

Termination in a Separate Compartment

S50 Fitted with Rear Connections

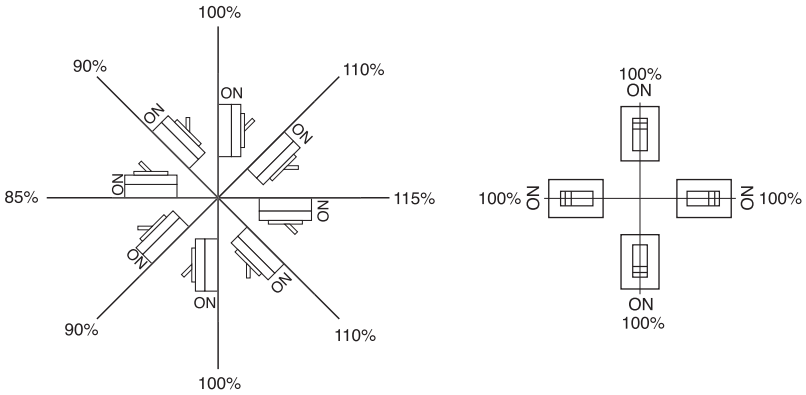
Rear Connections for Field Installation

Rear connections allow termination of conductors in a different switchboard compartment to the MCCB body.

The stud can be rotated in steps of 90 degrees in the field.

INSTALLATION

Mounting Angle

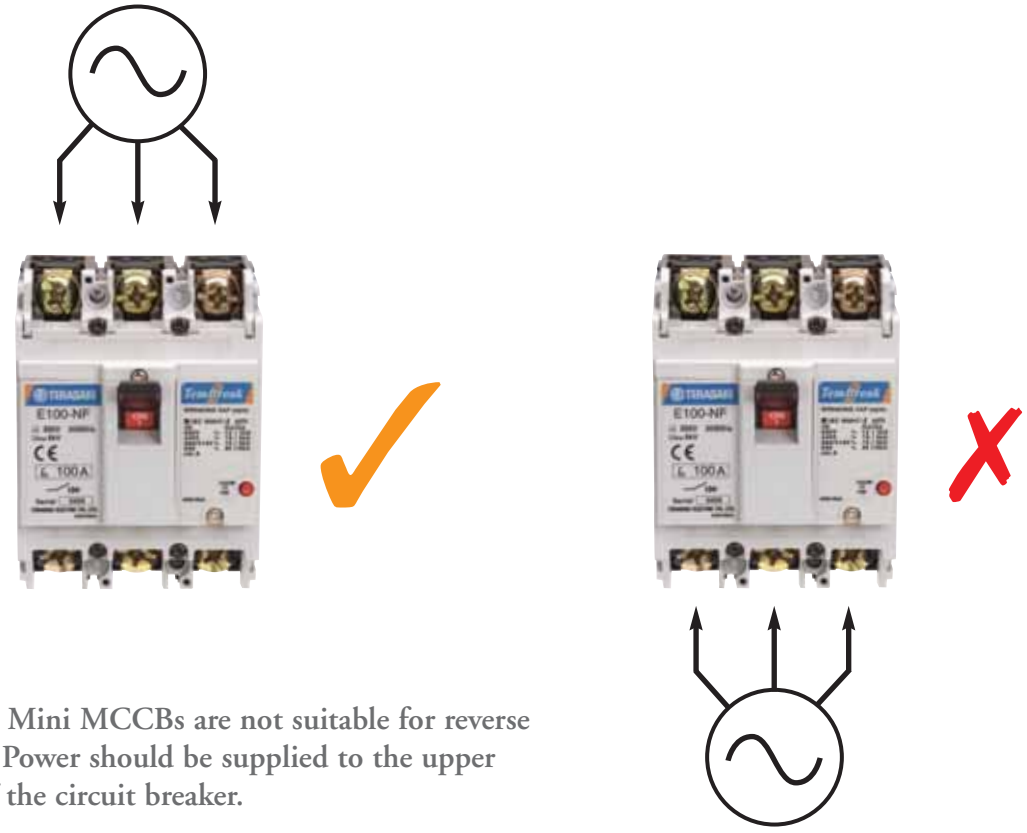


Percentage Change in Rated Current, I_R, According to Mounting Angle

Overload protection of TemBreak 2 Mini MCCBs is provided by magnetic-hydraulic elements. The overload tripping characteristics vary depending upon the mounting angle due to the effect of gravitational force that the iron core in the oil dashpot receives.

It is recommended that the breakers be oriented vertically where possible.

Direction of Power Supply



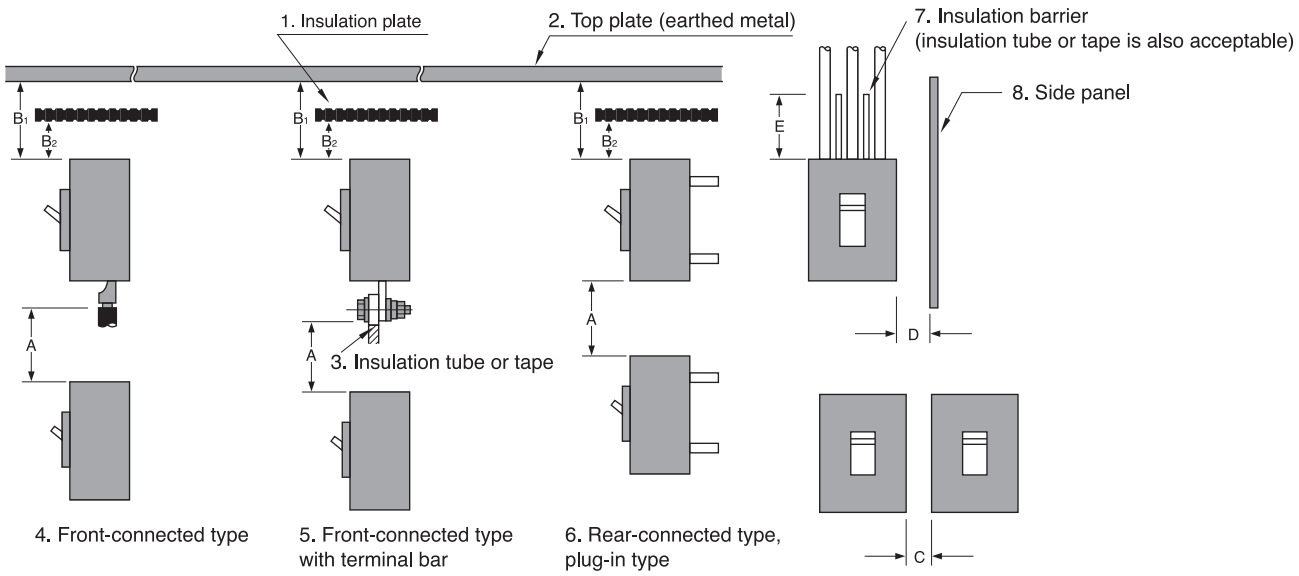
TemBreak 2 Mini MCCBs are not suitable for reverse connection. Power should be supplied to the upper terminals of the circuit breaker.

INSULATION DISTANCES

The insulation distances between the MCCB and earthed metal parts and insulators shown in this section must be maintained to prevent arcing faults occurring due to conductive ionised gas. In cases where other specifications require different insulation distances to those shown here, the greater distance must be maintained. In cases where two different models are installed one above the other, the insulation distance between the two models should be as for the lower model.

ATTENTION

Exposed conductors must be insulated up to the breaker terminals. Interpole barriers or optional terminal covers are recommended. If optional terminal covers are used, insulate the exposed conductor until it overlaps the terminal cover.



A. Distance from lower breaker to exposed live part of upper breaker terminal (front-connected type) or distance from lower breaker to end face of upper breaker (rear-connected type or plug-in type).

B1. Distance from end face of breaker to top plate.

B2. Distance from end face of breaker to insulation plate.

C. Gap between breakers.

D. Distance from side of breaker to side panel (earthed metal).

E. Dimensions of insulation over exposed conductors.

INSULATION DISTANCE IN mm (AT 440V AC MAXIMUM)

Model	Type	A	B1	B2	C	D	E
S50	NF	50	50	50	0	25	*(1)
E100	NF	50	50	50	0	25	*(1)

1. Insulate the exposed conductor until it overlaps the moulded case at the terminal, or the terminal cover.

STANDARD INSTALLATION ENVIRONMENT AND SPECIAL TREATMENTS

TemBreak 2 Mini MCCBs are intended for installation in the following conditions as standard:

- Operating ambient temperature -5 degrees C to 40 degrees C.
- Relative humidity of up to 85%.
- Altitude up to 2000m.
- Atmospheres free from dust, smoke, corrosive gases, inflammable gases, moisture and salt.

For installation in conditions more onerous than those described above, contact Terasaki for details.

The following special treatments have been developed for installation in specific environmental conditions:

- Low temperature treatment. For installation at temperatures down to -40 degrees C for storage and -20 degrees C for operation. The environment must be free from rapid changes in temperature that result in the formation of condensation.

- Fungus-moisture proofing. For installation at temperatures up to 60 degrees C and relative humidity of up to 95%. The environment must be free from rapid changes in temperature.

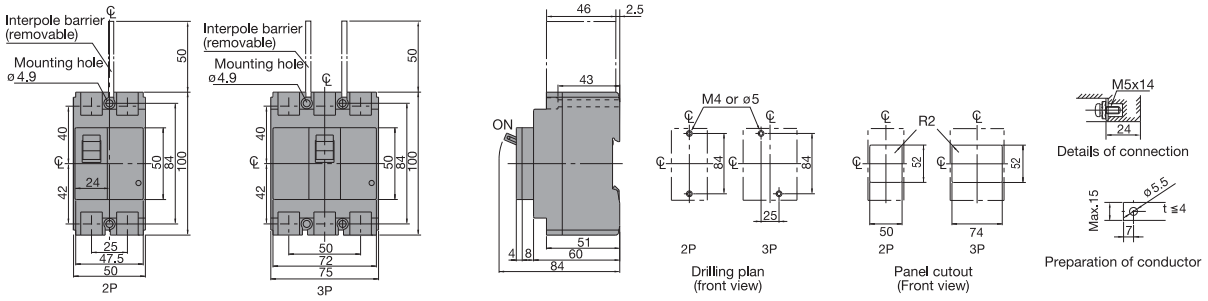
- Anti-corrosion treatment. MCCB is surface treated to increase resistance to corrosion. If the MCCB is to be installed in atmosphere that contains excessive volumes of corrosive gases or moisture, it should be house in an airtight enclosure.

DIMENSIONS

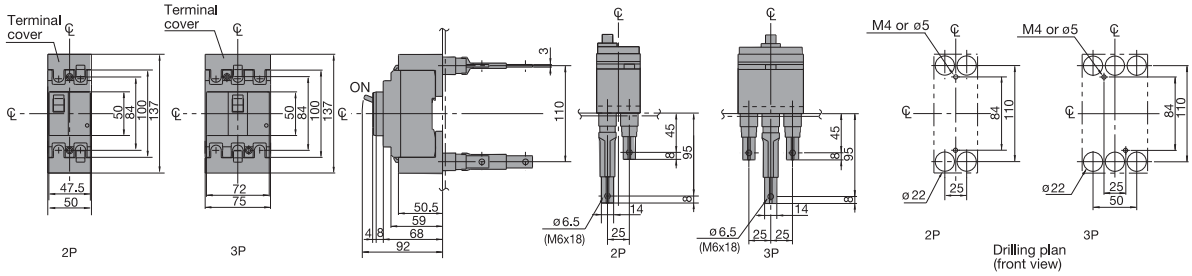
S50-NF

ASL: Arrangement Standard Line
H : Handle Frame Centre Line

Front Connected



Rear Connected



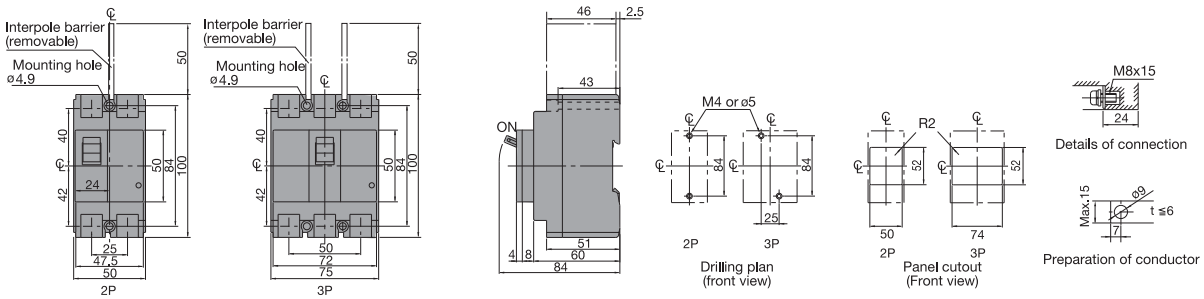
Note: In the normal shipment mode, both terminals on the line side and the load side are in the horizontal direction.

DIMENSIONS

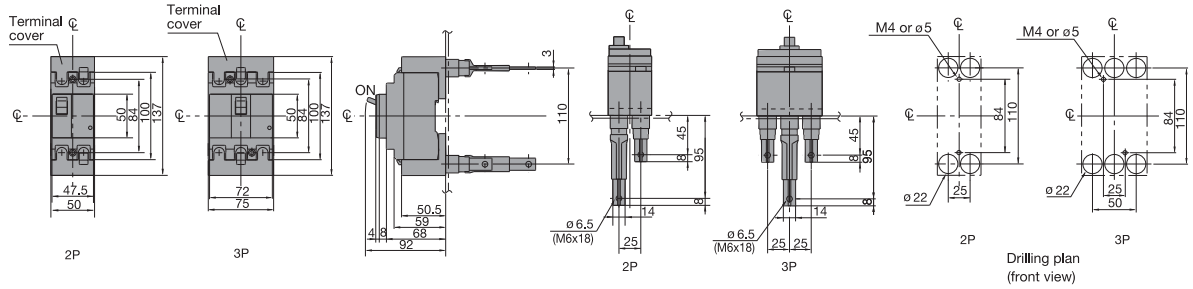
E100-NF

ASL: Arrangement Standard Line
⊬ : Handle Frame Centre Line

Front Connected



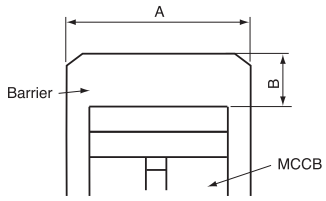
Rear Connected



Note: In the normal shipment mode, both terminals on the line side and the load side are in the horizontal direction.

DIMENSIONS

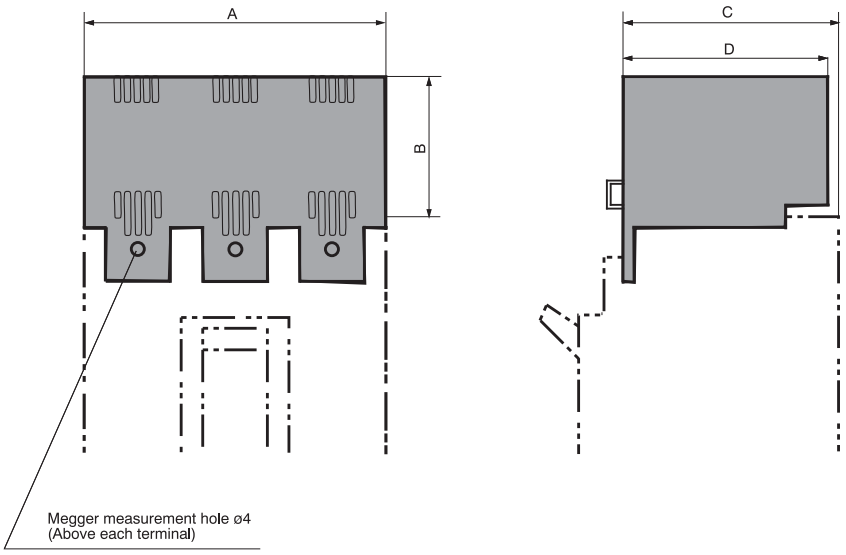
Earth Barriers



MCCB type	Connection	A (1)	B (2)
S50, E100	Front conn.	125	43

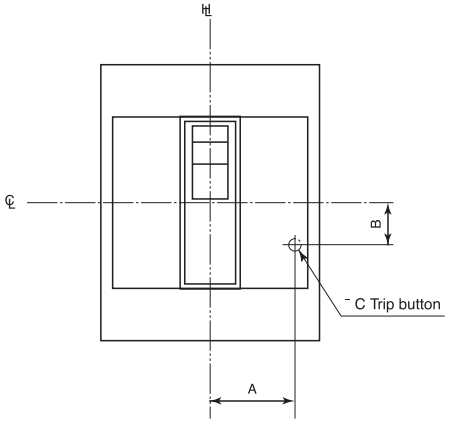
Notes:
(1): Possible to cut to 75mm or 100mm
(2): Possible to cut to 35mm

Terminal Covers



MCCB type	Connection	A(2P)	A(3P)	B	C	D	colour
S50, E100	Front conn.	50	75	40	53	53	Black

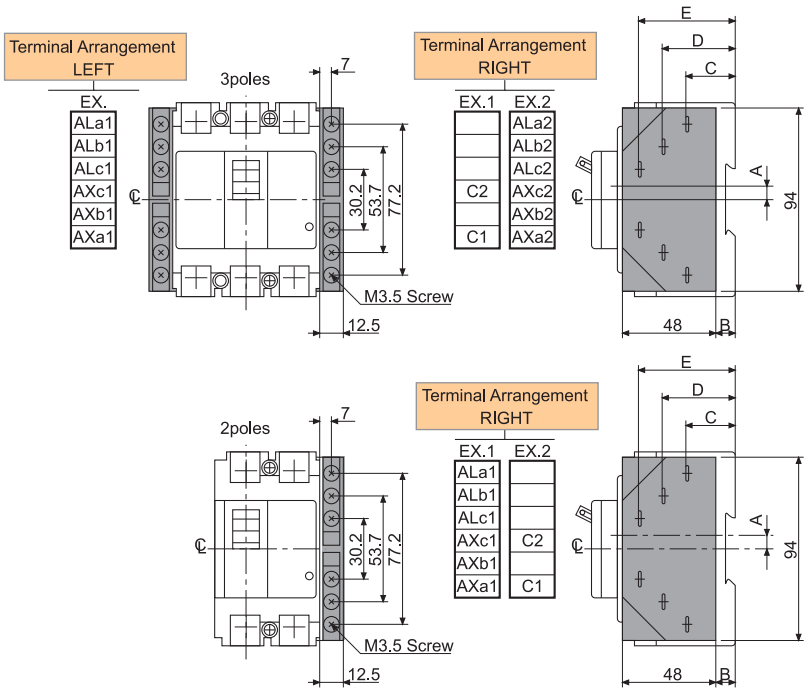
Position of Trip Button



MCCB type	A	B	C
S50, E100, 2P	20.2	13.5	4
S50, E100, 3P	32.7	13.5	4

DIMENSIONS

Terminal Block



MCCB type	A	B	C	D	E
S50, E100	0	10.5	23.6	36	48.3

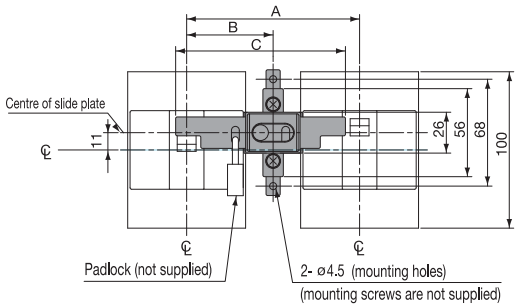
SECTION 8

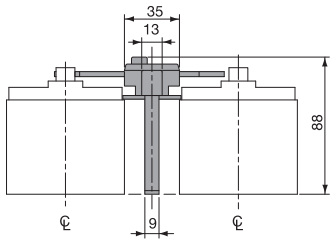
DIMENSIONS

Mechanical Interlock

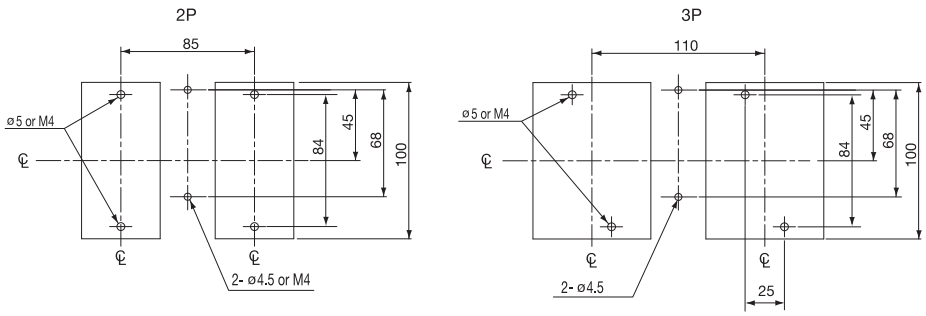
ASL: Arrangement Standard Line
℄ : Handle Frame Centre Line

Mechanical Interlocks slide type (MS)
For 50A, 100A frame size





Drilling plan



MCCB type	Pole	A	B	C	Colour
S50, E100	2	85	42.5	83	Black
	3	110	55	108	Black

SECTION 8

MINI MOULDED CASE CIRCUIT BREAKERS

You can save space and money with Terasaki's new compact and economical Mini Moulded Case Circuit Breakers.

The range of products includes:

- Moulded Case Circuit Breakers (MCCBs)
- Switch Disconnectors in the same compact moulded case frame sizes as MCCBs
- A comprehensive range of accessories.

TEMBREAK 2

MOULDED CASE CIRCUIT BREAKERS 16A TO 630A

1. Welcome to TemBreak 2
2. Ratings and Specifications
3. Operating Characteristics
4. Application Data
5. Accessories
6. Installation
7. Dimensions

TEMBREAK 2

MINI MOULDED CASE CIRCUIT BREAKERS 10A TO 100A

8. TemBreak 2 MINI Moulded Case Circuit Breakers

TEMBREAK

MOULDED CASE CIRCUIT BREAKERS 630A TO 1600A

9. TemBreak Moulded Case Circuit Breakers

- Easy Selection Guide 163
- Ratings and Specifications 165
- Operating Characteristics 169
- Electrical Control Using Internally Mounted Accessories 171
- Electrical Control Using Motor Operation 175
- Operating Handles 177
- Insulation Accessories 179
- Toggle Accessories 180
- Mechanical Interlocks 181
- Installation 182
- Dimensions 189

SECTION 9

TEMBREAK MOULDED CASE CIRCUIT BREAKERS

EASY SELECTION GUIDE

The TemBreak range of products includes:

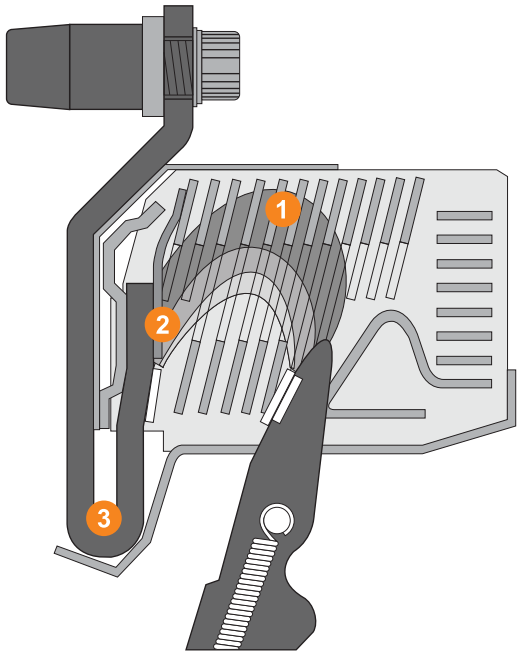
-Moulded Case Circuit Breakers
-Switch-Disconnectors
-A comprehensive range of accessories.

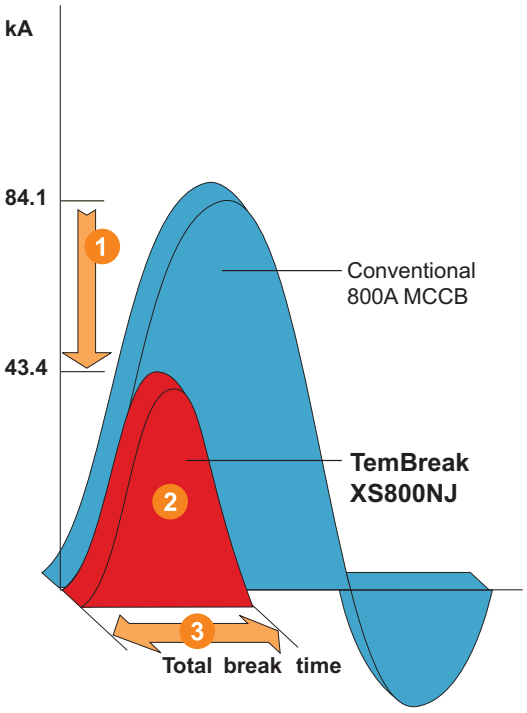
EXCEPTIONAL CURRENT LIMITING

Terasaki's ingenuity in current breaking is exemplified by the Fast Break Mechanism (FBM) of the TemBreak range.

The quick breaking performance of TemBreak provides exceptional current limiting characteristics.

F.B.M - Fast Break Mechanism → Provides → **Exceptional Current Limitation**





1. Quick-break arc chutes
2. Dual repulsive contacts
3. U-shaped conductors

Provides

1. Reduced Peak let through minimises electrodynamic stress on conductors
2. Reduced i^2t energy let through minimises thermal stress on conductors
3. Reduced tripping time minimises damage after fault to both system and MCCB

SECTION 9

EASY SELECTION GUIDE

Frame	Ratings (A)			
		800	1250	1600
50-100	125-630			
TemBreak 2 Moulded Case Circuit Breakers. Refer to Section 8	TemBreak 2 Moulded Case Circuit Breakers. Refer to Sections 1 to 7			

MCCBs

Model	Type	Icu (kA)
XS800	NJ	65
XS800	SE	50
XH800	SE	65
XH800	PJ	100
XH800	PE	65
TL800	NE	125

Model	Type	Icu (kA)
XS1250	CE	50
XS1250	SE	85
TL1250	NE	125

Model	Type	Icu (kA)
XS1600	CE	50
XS1600	SE	100

In (A)			
		800 ↕ 630	1250 ↕ 1000
	630 ↕ 20		
10 ↕ 100			
			1600

Switch-Disconnectors

Model	Type
XS800	NN

Model	Type
XS1250	NN

Model	Type
XS1600	NN

Note: All breaking capacities are r.m.s. symmetrical at 400V AC

TEMBREAK MOULDED CASE CIRCUIT BREAKERS

RATINGS AND SPECIFICATIONS

TemBreak MCCB Electrical Characteristics to IEC 60947-2, EN 60947-2, JIS C 8201-2-1 Ann. 1, AS/NZS 3947-3, NEMA-AB1

Frame	Quantity	Unit	Condition	800	800	800	800	800	1600	1250	1250	1600	1600	1600	
Model				XS800NJ	XS800SE	XH800SE	XH800PJ	XH800PE	TL800NE	XS1250CE	XS1250SE	TL1250NE	XS1600CE	XS1600SE	>1600
Number of Poles				3, 4	3, 4	3, 4	3, 4	3, 4	3, 4	3, 4	3, 4	3, 4	3, 4	3, 4	
Nominal current ratings															
	I_n	(A)	45°C	630, 800	800	800	630, 800	800	630, 800	1000, 1250	1000, 1250	1000, 1250	1600	1600	
Electrical characteristics															
Rated operational voltage	U_e	(V)	AC 50/60 Hz	690	690	690	690	690	690	690	690	690	690	690	
			DC	250	-	-	250	-	-	-	-	-	-	-	
Rated insulation voltage	U_i	(V)		690	690	690	690	690	690	690	690	690	690	690	
Rated impulse withstand voltage	U_{imp}	(kV)		8	8	8	8	8	8	8	8	8	8	8	
Ultimate breaking capacity (IEC, JIS, AS/NZS)	I_{cu}	(kA)	690V AC*	20	20	20	45	20	45	20	25	45	20	45	
			525V AC	35	35	42	65	42	75	35	45	75	35	65	
			440V AC	50	50	65	85	65	125	50	65	125	50	85	
			415V AC	50	50	65	85	65	125	50	65	125	50	85	
			380/400V AC	65	50	65	100	65	125	50	85	125	50	100	
			220/240V AC	85	85	100	125	100	150	85	100	150	85	125	
			250V DC	50	-	-	50	-	-	-	-	-	-	-	
Service breaking capacity (IEC, JIS, AS/NZS)	I_{cs}	(kA)	690V AC*	10	10	10	23	10	34	10	19	34	10	34	
			525V AC	18	18	21	33	21	57	18	34	57	18	50	
			440V AC	25	25	33	43	50	70	25	50	65	25	65	
			415V AC	25	25	33	50	50	70	25	50	65	25	65	
			380/400V AC	33	25	33	50	50	70	25	65	65	25	75	
			220/240V AC	43	43	50	63	50	113	43	75	113	43	94	
			250V DC	25	-	-	25	-	-	-	-	-	-	-	
Rated short-time withstand current	I_{cw}	(kA rms)	0.3 Seconds	-	10	10	-	10	15	15	15	15	20	20	
Rated breaking capacity (NEMA)		(kA)	480V AC	50	50	65	50	65	75	50	65	75	50	85	
			240V AC	85	85	85	85	85	150	85	85	150	85	125	
Protection															
Adjustable thermal, adjustable magnetic				■			■								
Fixed hydraulic, fixed magnetic					■	■		■	■	■	■	■	■	■	
Microprocessor															
Utilisation category				A	B	B	A	B	B	B	B	B	B	B	
Installation															
Front connection (FC)				-	-	-	-	-	-	-	-	-	-	-	
Extension bar (FB)				■	■	■	■	■	■	■	■	■	■	■	
Cable clamp (FW)				•	•	•	•	•	-	-	-	-	-	-	
Rear connection (RC)				•	•	•	•	•	•	•	•	•	•	•	
Plug-in (PM)				•	•	•	•	•	•	•	•	•	-	-	
Draw-out (DR)				•	•	•	•	•	•	•	•	•	•	•	
DIN rail mounting (DA)				-	-	-	-	-	-	-	-	-	-	-	
Dimensions	h	(mm)		273	273	273	273	273	370	370	370	370	370	370	
	w	(mm)	3 pole	210	210	210	210	210	210	210	210	210	210	210	
			4 pole	280	280	280	280	280	280	280	280	280	280	280	
	d	(mm)		103	103	103	103	103	140	120	120	140	140	140	
Weight	w	(kg)	3 pole	9.4	9.7	9.7	9.4	9.7	25.8	22.0	22.0	26.0	27.0	27.0	
			4 pole	12.2	12.5	12.5	12.2	12.5	33.5	28.0	28.0	33.7	35.0	35.0	
Operation															
Toggle operation				■	■	■	■	■	■	■	■	■	■	■	
Door mounted (HP) / Breaker mounted handle (HB)				•	•	•	•	•	•	•	•	•	•	•	
Motor operation (MC)				•	•	•	•	•	•	•	•	•	•	•	

Visit www.terasaki.com for details of MCCBs up to 2500A

■ Standard • Optional - Not Available

*MCCBs cannot be used in IT earthed systems at this voltage.

SECTION 9

TEMBREAK MOULDED CASE CIRCUIT BREAKERS

RATINGS AND SPECIFICATIONS

TemBreak Switch-Disconnectors Electrical Characteristics to IEC 60947-3, EN 60947-3, AS/NZS 3947-3

Frame	Quantity	Unit	Condition	800	1250	1600
Model				XS800NN	XS1250NN	XS1600NN
Number of Poles				3, 4	3, 4	3, 4
Nominal current ratings						
	I_e	(A)		800	1250	1600
Electrical characteristics						
Rated operational voltage	U_e	(V)	AC 50/60 Hz	690	690	690
			DC	250	250	250
Rated insulation voltage	U_i	(V)		690	690	690
Rated impulse withstand voltage	U_{imp}	(kV)		8	8	8
Rated short-circuit making capacity	I_{cm}	(kA peak)		15	32	45
Rated short-time withstand current	I_{cw}	(kA rms)	0.3 Seconds	9.6	15	20
Utilisation category			AC	AC-23A	AC-23A	AC-23A
			DC	DC-22A	DC-22A	DC-22A
Installation						
Front connection (FC)				-	-	-
Extension bar (FB)				■	■	■
Cable clamp (FW)				•	-	-
Rear connection (RC)				•	•	•
Plug-in (PM)				•	•	-
Draw-out (DR)				•	•	•
DIN rail mounting (DA)				-	-	-
Dimensions	h	(mm)		273	370	370
	w	(mm)	3 pole	210	210	210
			4 pole	280	280	280
	d	(mm)		103	120	140
Weight	w	(kg)	3 pole	9.4	20.4	24.9
			4 pole	12.2	26.4	32.9
Operation						
Toggle operation				■	■	■
Door mounted (HP) / Breaker mounted handle (HB)				•	•	•
Motor operation (MC)				•	•	•

SECTION 9

■ Standard • Optional - Not Available

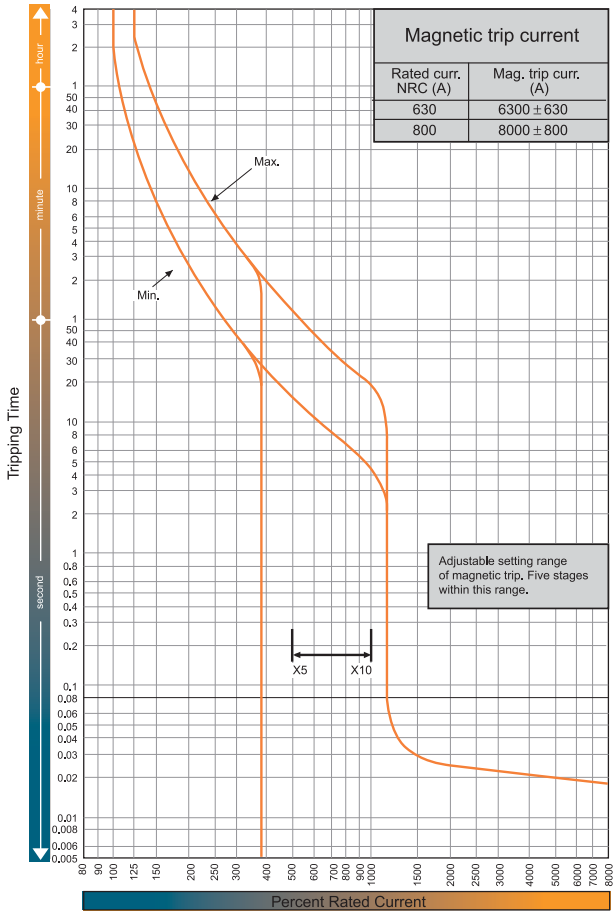
SECTION 9

OPERATING CHARACTERISTICS

800A Frame MCCBs

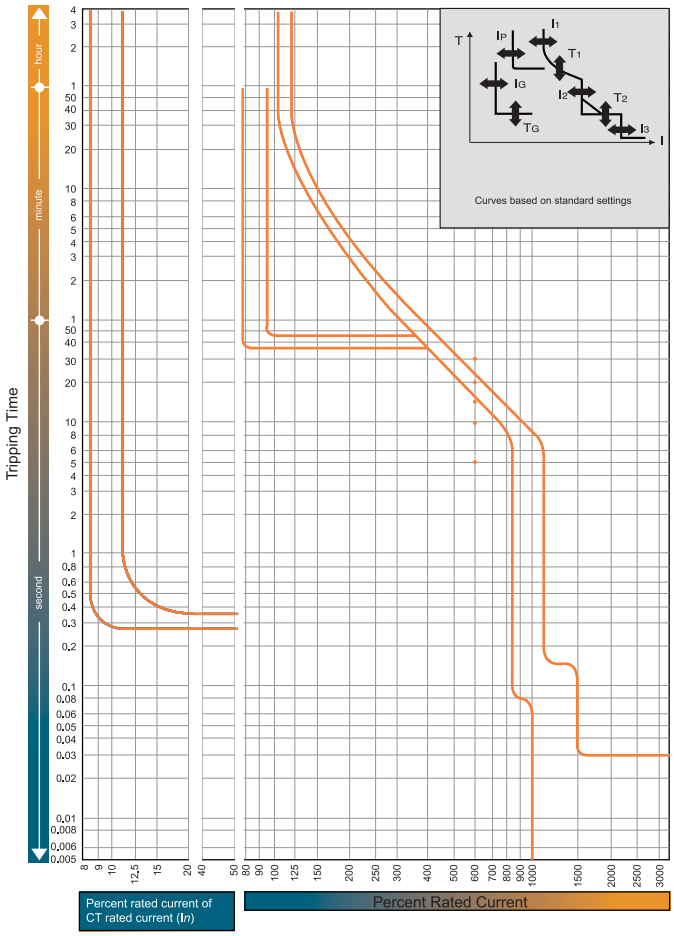
Time/current characteristic curves

XS800NJ, XH800PJ

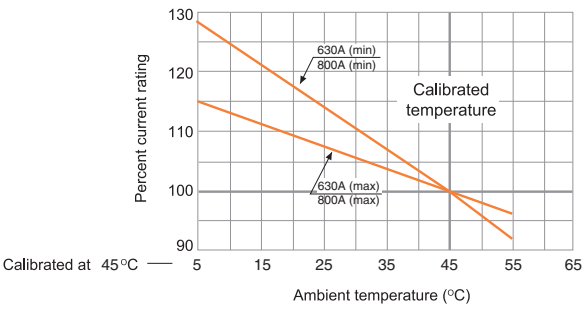


Time/current characteristic curves

XS800SE, XH800SE, XH800PE



Ambient compensating curves



Over current tripping characteristics

CT rated current (A) (In)	630,800
Base current setting (A): (Io)	(In) x (0.63-0.8-1.0)
Long time-delay pick-up current (A): (I_1)	(Io) x (0.8-0.85-0.9-0.95-1.0) Non-tripping at (I_1) setting x 105% and below. Tripping at 125% & above.
Long time-delay time settings (S) (T_1)	(5–10–15–20–30) at (I_1) x 600% current. Setting tolerance ± 20%
Short time-delay pick-up current (A): (I_2)	(Io) x (2-4-6-8-10) Setting tolerance ± 15%
Short time-delay time settings (S) (T_2)	Opening time (0.1, 0.15, 0.2, 0.25, 0.3) in the definite time-delay. Total clearing time is + 50 mS and resettable time -20mS for the time-delay setting.
Instantaneous trip pick-up current (A) (I_3)	Continuously adjustable from (Io) x (3 to12) Setting tolerance ± 20%
* Pre-trip alarm pick-up current (A) (I_P)	(I_1) x (0.7, 0.8, 0.9, 1.0) Setting tolerance ±10%
* Pre-trip alarm time setting (S) (T_P)	40 fixed definite time-delay.Setting tolerance ±10%
* Ground fault trip pick-up current (A): (I_G)	Continiuously adjustable from (In) x (0.1 to 0.4) Setting tolerance ± 15%
* Ground fault trip time setting (S): (T_G)	Opening time (0.1-0.2-0.3-0.4-0.8) in the definite time-delay. Total clearing time is + 50mS and resettable time is - 20mS for the time-delay settings

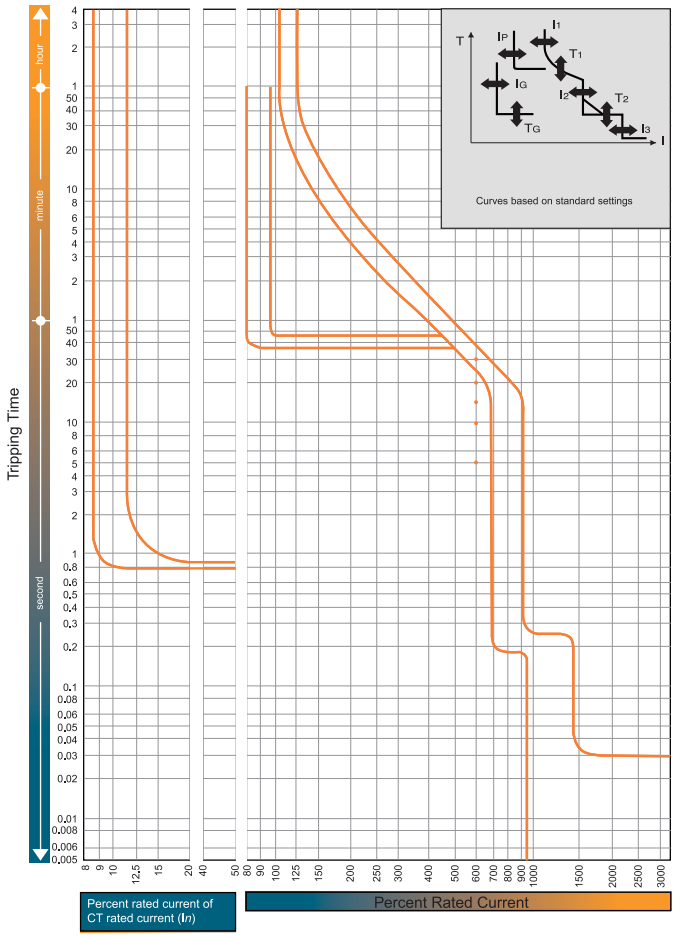
Note: * Optional
Note: The underlined values will be applied as standard ratings unless otherwise specified when ordering.

OPERATING CHARACTERISTICS

1250A and 1600A Frame MCCBs

Time/current characteristic curves

TL800NE, XS1250CE, XS1250SE, TL1250NE, XS1600CE, XS1600SE



Over current tripping characteristics

CT rated current (A) (In)	630, 800, 1000, 1250, 1600
Base current setting (A): (Io)	(In) x (0.63-0.8-1.0)
Long time-delay pick-up current (A): (I_1)	(Io) x (0.8-0.85-0.9-0.95-1.0) Non-tripping at (I_1) setting x 105% and below. Tripping at 125% & above.
Long time-delay time settings (S) (T_1)	(5–10–15–20–30) at (I_1) x 600% current. Setting tolerance ± 20%
Short time-delay pick-up current (A): (I_2)	(Io) x (2-4-6-8-10) Setting tolerance ± 15%
Short time-delay time settings (S) (T_2)	Opening time (0.1, 0.15, 0.2, 0.25, 0.3) in the definite time-delay. Total clearing time is + 50 mS and resettable time -20mS for the time-delay setting.
Instantaneous trip pick-up current (A) (I_3)	Continuously adjustable from (Io) x (3 to 12) Setting tolerance ± 20%
* Pre-trip alarm pick-up current (A) (I_P)	(I_1) x (0.7, 0.8, 0.9, 1.0) Setting tolerance ±10%
* Pre-trip alarm time setting (S) (T_P)	40 fixed definite time-delay.Setting tolerance ±10%
* Ground fault trip pick-up current (A): (I_G)	Continiuously adjustable from (In) x (0.1 to 0.4) Setting tolerance ± 15%
* Ground fault trip time setting (S): (T_G)	Opening time (0.1-0.2-0.3-0.4-0.8) in the definite time-delay. Total clearing time is + 50mS and resettable time is - 20mS for the time-delay settings

Note: * Optional
Note: The underlined values will be applied as standard ratings unless otherwise specified when ordering.

ELECTRICAL CONTROL USING INTERNALLY MOUNTED ACCESSORIES

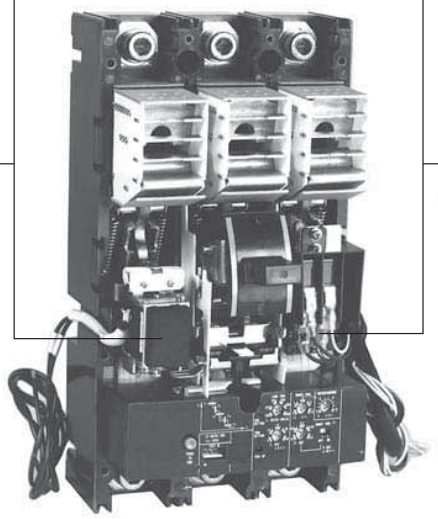
Shunt Trip (SHT)

Remote tripping of the breaker

Undervoltage Trip (UVT)

Automatically trips the breaker when the circuit voltage falls below pre-set value. Remote tripping of the breaker is also possible.
Note: The UVT controller is installed externally, when provided with AC UVT. (Refer to Dimensions)

Note: The SHT and UVT cannot be mounted in the same breaker.



Auxiliary Switch (AX)

Electrically indicates On/Off status of the breaker.

Alarm Switch (AL)

Electrically indicates when the breaker is in the "Tripped" state.

Overview of Internally Mounted Accessories

ELECTRICAL CONTROL USING INTERNALLY MOUNTED ACCESSORIES

Valid Combinations of Internally Mounted Accessories

Accessory Combinations

Breaker type

XS800NJ
XS800SE
XH800SE
XH800PJ
XH800PE
TL800NE
XS1250CE
XS1250SE
TL1250NE
XS1600CE
XS1600SE

Internally mounted accessories

AX,AXE

AL,ALE

SHT

UVT

AX
AL

AX
SHT

AX
UVT

AL
SHT

AL
UVT

AX
AL
SHT

AX
AL
UVT

Key:

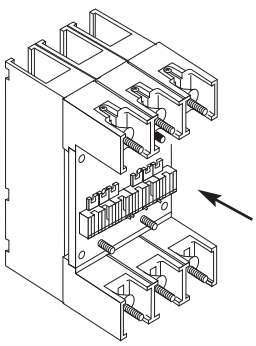
AX – Auxiliary switch

AL – Alarm switch

SHT – Shunt trip

UVT – Undervoltage trip

Handle – Left pole, Right pole



Accessory Combinations for Plug-in MCCBs

Frame (A)		800-1250A Frame
Number of auxiliary terminals to be installed (maximum)		
SHT	LINE	S1 S2
	LOAD	
UVT	LINE	P1 P2
	LOAD	
1AB	LINE	AXc1 AXa1 AXb1
	LOAD	
2AB	LINE	AXc1 AXa1 AXb1
	LOAD	AXc2 AXa2 AXb2
3AB	LINE	AXc1 AXa1 AXb1 AXc3
	LOAD	AXc2 AXa2 AXb2 AXa3 AXb3
SHT & 1AB	LINE	AXc1 AXa1 AXb1 S1 S2
	LOAD	
SHT & 2AB	LINE	AXc1 AXa1 AXb1 AXc2 AXa2 AXb2 S1 S2
	LOAD	
SHT & 3AB	LINE	AXc1 AXa1 AXb1 AXc3 S1 S2
	LOAD	AXc2 AXa2 AXb2 AXa3 AXb3
UVT & 1AB	LINE	AXc1 AXa1 AXb1 P1 P2
	LOAD	
UVT & 2AB	LINE	AXc1 AXa1 AXb1 AXc2 AXa2 AXb2 P1 P2
	LOAD	
UVT & 3AB	LINE	AXc1 AXa1 AXb1 AXc3 P1 P2
	LOAD	AXc2 AXa2 AXb2 AXa3 AXb3
ALT & 1AB	LINE	AXc1 AXa1 AXb1 ALc1 ALa1 ALb1
	LOAD	
ALT & 2AB	LINE	AXc1 AXa1 AXb1 AXc2 AXa2 AXb2 ALc1 ALa2 ALb1
	LOAD	
UVT & ALT & 1AB	LINE	AXc1 AXa1 AXb1 ALc1 ALa2 ALb2 P1 P2
	LOAD	
UVT & ALT & 2AB †	LINE	AXc1 AXa1 AXb1 AXc2 AXa2 AXb2 ALc1 ALa2 P1 P2
	LOAD	
SHT & ALT & 1AB	LINE	AXc1 AXa1 AXb1 ALc1 ALa1 ALb1 S1 S2
	LOAD	
SHT & ALT & 2AB †	LINE	AXc1 AXa1 AXb1 AXc2 AXa2 AXb2 ALc1 ALa1 S1 S2
	LOAD	
ALT	LINE	ALc1 ALa1 ALb1
	LOAD	
SHT & ALT	LINE	ALc1 ALa1 ALb1 S1 S2
	LOAD	
UVT & ALT	LINE	ALc1 ALa1 ALb1 P1 P2
	LOAD	

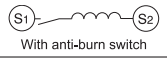
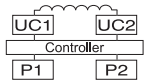
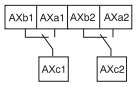
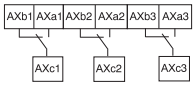
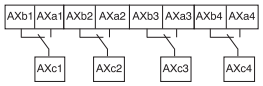
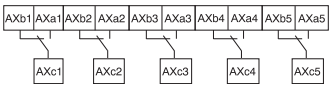
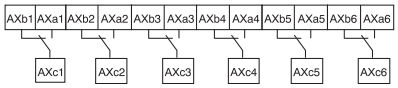
† : Alarm switch is an 'a' contact only
Note 1 : DC UVT without controller will have terminals U_1 and U_2
Note 2 : AXc1, AXc2 Due to restricted space, these terminals are common

The arrangements shown above represent the view on the arrow, that is, looking at the MCCB body from the rear.

SECTION 9

ELECTRICAL CONTROL USING INTERNALLY MOUNTED ACCESSORIES

Connection Diagrams and Terminal Numbers

Shunt trip (SHT)	3, 4P Provided with anti-burn switch		
Undervoltage trip (UVT)	3, 4P	AC rated voltage	
		DC rated voltage	
Auxiliary switch (AX)	3, 4P	No. of mountings 1 unit	
		2 units	
		3 units	
		4 units	
		5 units	
		6 units	
Alarm switch (AL)	3, 4P		

Ratings of Auxiliary Switches (AX) and Alarm Switches (AL)

AC	Voltage (V)		480	250	125
	Current (A)	Resistive load	3	5	5
		Lamp load	0.3	1.5	2
		Inductive load	2	5	5
		Motor load	0.4	2	3
DC	Voltage (V)		250	125	30
	Current (A)	Resistive load	0.3	0.6	5
		Lamp load	0.05	0.1	3
		Inductive load	0.3	0.6	4
		Motor load	0.05	0.1	3

ELECTRICAL CONTROL USING INTERNALLY MOUNTED ACCESSORIES

Operation of Auxiliary and Alarm Switches

Switch type	Breaker 'ON'	Breaker 'OFF'	Breaker 'TRIP'
AX	AXb1 AXa1 / AXc1	AXb1 AXa1 / AXc1	AXb1 AXa1 / AXc1

Switch type	Breaker 'ON'	Breaker 'OFF'	Breaker 'TRIP'
AL	ALb1 ALa1 / ALc1	ALb1 ALa1 / ALc1	ALb1 ALa1 / ALc1

Ratings of Shunt Trips

Rate voltage:	Exciting coil current [peak value (A)] Values at the highest voltage (60Hz for AC use)					
	110-115VAC	200-480VAC	24VDC	48VDC	100-115VDC	200-230VDC
	1.1	0.93	2.52	1.55	0.67	0.35

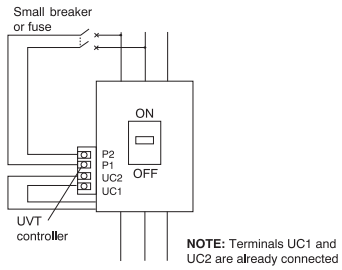
Note: AC rated, permissible operating voltage range is 85 to 110%. DC 75 to 125%.
Note: Special voltages available on request. Contact Terasaki for details.

Ratings of Undervoltage Trips

Rated voltage:	Power supply, VA (with UVT controller			Exciting coil current (mA)	
	100-120VAC	200-240VAC	300-450VAC	24VDC	100-115VDC
	5VA	5VA	5VA	22.7	6.0

Note: Tripping voltage is 35-70% of the rated voltage. Resettable voltage is 85% or less, of the rated voltage.
Note: Special voltages available on request. Contact Terasaki for details

If the UVT is for AC use, an external controller will be installed. The controller is fitted to the left side of the breaker as standard. The controller may be installed separately if required (please specify location). Separate installation is necessary when mechanical interlocks are fitted. UVT controllers incorporating time delay units are also available (contact us for details). Refer to dimensions of terminal blocks for the mounting positions of UVT controllers.

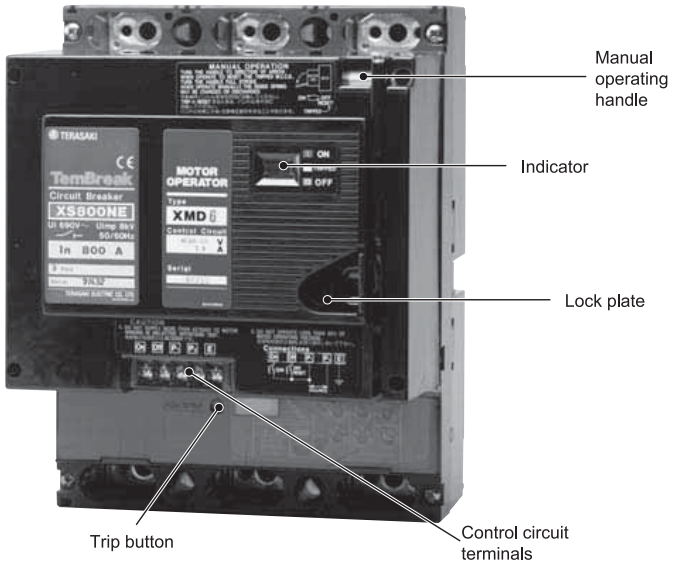


Connection of UVT Controller

Termination of Control Wiring

Leads for internally mounted accessories can be connected to the terminal block. Each terminal block has six terminals. Terminal arrangements are standardised. Refer to dimensions for standard terminal arrangements.

ELECTRICAL CONTROL USING MOTORISED OPERATION



Type XMD6, XMD9

Positive contact indication

Colour coding indicates the true position of the contacts clearly: ON (red), OFF (green), TRIP (white).

Easy maintenance

Breaker mounting, removal, and even setting changes can be done without removing the motor operator.

Manual ON/OFF operation with one stroke

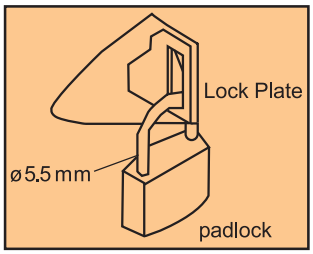
Fast closing operation

Closing in 60ms or less. The closing time remains constant over repeated operations.

Ratings and Specifications

Type of Motor Operators			XMD6	XMD9
Applicable Breakers			XS800NJ	TL800NE
			XS800SE	XS1250CE
			XH800SE	XS1250NE
			XH800PJ	TL1250NE
			XH800PE	XS1600CE
				XS1600NE
Rated Operating Voltage (V)	AC	100-115V 50/60Hz	•	•
		200-230V 50/60Hz	•	•
	DC	100-110V	•	•
		24V	•	•
Lock in "OFF" position (standard)			•	•
Manual Trip Button			*	*
Steady-state r.m.s. Amp/inrush Amp (A)	AC100 -115V	ON ① OFF, RESET①	–/3.1	–/3.1
			1.8/6.0	1.8/6.0
	AC200 -230V	ON ② OFF, RESET②	–/1.2	–/1.2
			1.0/3.2	1.0/3.2
	DC100 -110V	ON ③ OFF, RESET③	–/0.8	–/0.8
			1.1/4.2	1.1/4.2
	DC24V	ON	–/4.5	–/4.5
		OFF, RESET	4.0/12.0	4.0/12.0
Type of operation			Spring Charged	Spring Charged
Operating Time(s)	ON (Maximium values)		0.06	0.06
	OFF, RESET ④		3	3
Control Switch Ratings			250V, 5A	250V, 5A
Power Source Capacity (VA)			300VA	300VA
Dielectric withstand voltage			AC1500V (AC500V)	AC1500V (AC500V)
The value in brackets for 24V DC				
Weight (kg)			5.6	6.4

* Trip button on breaker to be used (accessible with motor fitted)



The breaker can be padlocked in the "OFF" position by pulling out the lock plate, and locking it with a padlock.
When the breaker is "ON", the lock plate cannot be pulled out.
Up to three locks can be used.
Padlocks not supplied.

NOTE
• : Yes or available
① : Maximum values at AC115V, 50Hz
② : Maximum values at AC230V, 50Hz
③ : Maximum values at DC110V
④ : Maximum values at the rated operating voltages

ELECTRICAL CONTROL USING MOTORISED OPERATION

Motorised operation

ON CONTROL
When the ON switch is closed, the latch release coil (LRC) is excited and the closing spring is released. The breaker quickly closes and goes into ON status. When the closing spring is released, the limit switch (LS) is opened and the LRC is de-excited.

OFF CONTROL
When the off switch is closed, self-hold control relay (Y) is activated and motor (M) operates to charge the closing spring. The breaker changes to OFF status.

RESET CONTROL
When the breaker is in TRIP status, closing the OFF switch activates self-hold control relay (Y) and starts motor (M). Motor (M) charges the closing spring and resets the breaker.

Manual operation

ON, OFF (RESET)
The breaker can be opened (OFF or RESET) and closed (ON) alternately by pulling the operating lever down in one full stroke. ON/OFF operation of the breaker is possible without charging or releasing the closing spring.

Emergency Trip
Opening the breaker (OFF) using the motor operator takes up to 3 seconds. If a remote emergency OFF function is necessary, incorporate the shunt trip device (SHT) or the undervoltage trip device (UVT) into the breaker.

PRECAUTIONS REGARDING USAGE

- If using the UVT option, be sure to reset the UVT before closing the breaker.
- The motor operator must be supplied with voltage within the following range:
  DC: 75-110% of rated voltage
  AC: 85-110% of rated voltage
  Operation at low voltage may burn out the motor.

Anti-pumping function

When the breaker is turned ON and the closing spring is released, self-hold control relay X is activate. Xa-contact is held closed, and Xb-contact is opened. While the ON switch is closed, latch release coil (LRC) will not be excited even if the OFF switch is closed or an automatic reset circuit is being used. Pumping is thus prevented.

Automatic charge/discharge function

If the breaker is closed manually (ON) while the power source is on, the handle switch (HS) induces automatic release of the closing spring. Likewise, if the breaker is opened manually (OFF), the springs are automatically charged. If the breaker is opened or closed while the power source is off, later when the power source is turned on, the closing spring will automatically be charged or discharged to match the ON/OFF status of the breaker. This automatic charge/discharge function is necessary to prepare the closing mechanism for the next ON/OFF operation. The sound of the charging or discharging of the spring should not be mistaken for a malfunction.

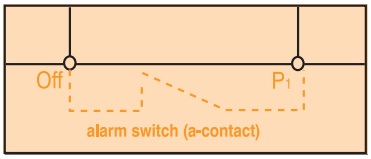
Automatic reset

An alarm switch (a-contact) fitted in the breaker, can be used to induce recharging of the closing spring and automatically reset the MCCB. Connect the automatic reset circuit as shown below.

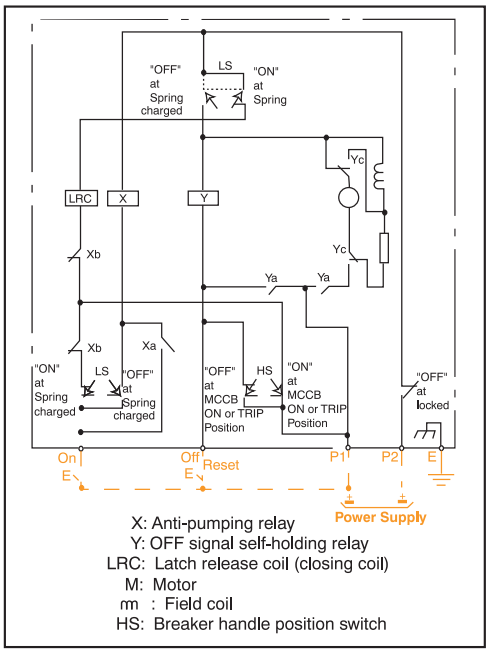
If the alarm switch is used, a pulse signal will be produced in the automatic reset circuit when the alarm is activated. Be sure to use a self-hold circuit to avoid possible problems caused by this pulse signal.

It is recommended that a time delay of approximately 3 minutes is introduced to the automatic reset circuit for thermal magnetic MCCB's. In the event of an overload trip this will prevent the motor operator repeatedly driving the MCCB between the tripped and reset positions while the thermal element is hot.

If an alarm signal is also required for external control, use a 2 alarm switch combination.



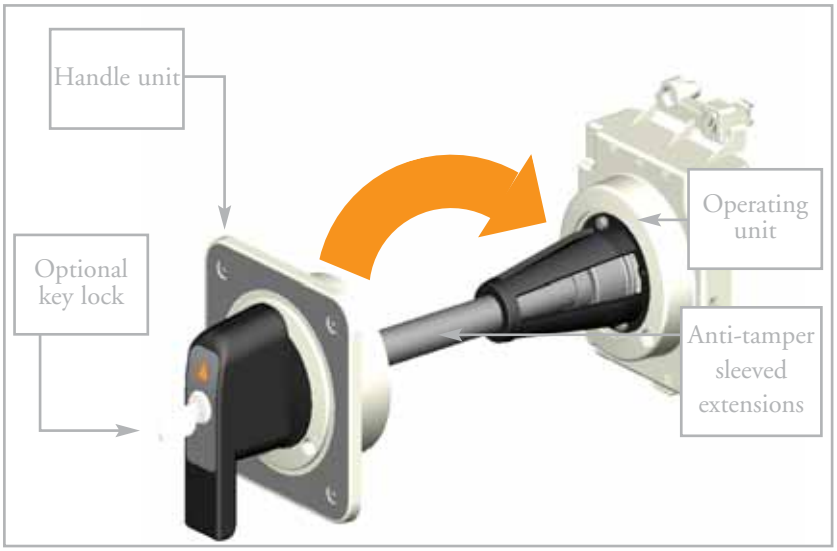
Control circuit AC and DC



Note: Customer wiring shown in orange

OPERATING HANDLES

Door Mounted Handle



Door Mounted Handle with Optional Keylock

The door mounted operating handle is used to operate a circuit breaker mounted inside a cubicle from outside the door. It consists of an operating mechanism that is mounted on the breaker, an operating handle that is mounted on the door, and a shaft that transmits the turning force from the handle to the operating unit. The shaft can be cut to the required length.

The appearance and operation of this handle match those of the door mounted handle for Tembreak 2 MCCBs (details in Section 5).

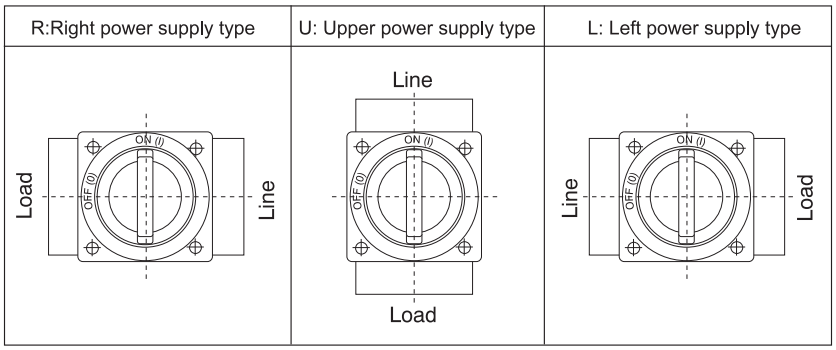
This means that a switchboard containing a combination of TemBreak and TemBreak 2 MCCBs from this catalogue can be operated with handles which all look the same, and work the same way.

OPERATING HANDLES

Breaker Mounted Handle

90° ON/OFF OPERATION.

The handle operation and ON/OFF indicator are the same irrespective of the breaker mounting direction, being vertical or horizontal. This also applies to the panel cut-out.



Double insulation structure

Provides an even higher degree of safety.

Panel lock mechanism

The panel door cannot be opened when the handle is in the ON or OFF position. The panel door can only be opened in the RESET position.

•Equipped with a lock (reverse interlock) mechanism which does not permit the breaker to be closed while the panel door is opened. The lock can be released.

•When the panel lock release is turned counterclockwise the panel door can be opened even when the handle is in the ON or OFF position.

Handle Lock Mechanism

The handle can be locked in the ON or OFF position. Upto 3 padlocks can be fitted (padlock not supplied).

Ordering code

Please specify the correct type code when ordering

TFJXX – U

Mounting Direction	
U	Upper power supply
L	Left hand power supply
R	Right hand power supply

Additional Options

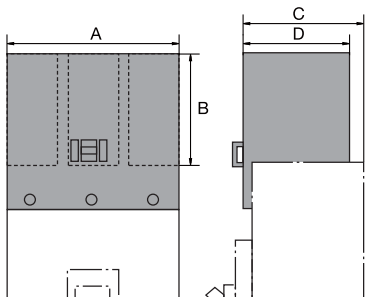
Please specify at the time of ordering

	Standard	Option
Colour	Black	Yellow base Red handle
IP	3X	55

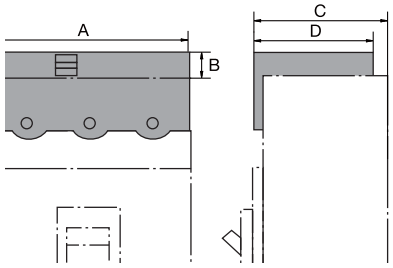
INSULATION ACCESSORIES

Terminal Covers

Terminal covers prevent exposure of terminals and other live parts.



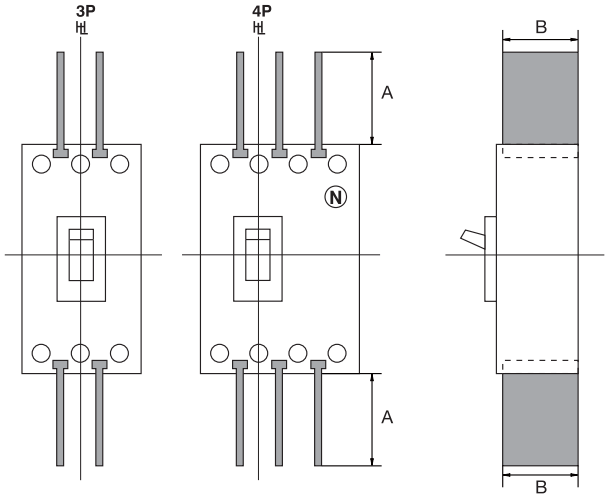
Terminal Covers for Front Connection.

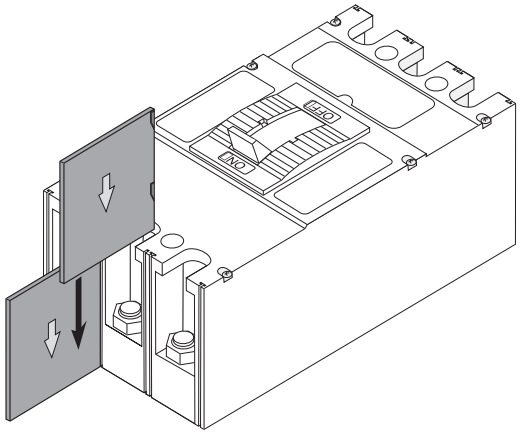


Terminal Covers for Rear Connection and Plug-in.

Interpole Barriers

Interpole barriers provide maximum insulation between phases at the terminals of the MCCB. They can not be fitted at the same time as any of the terminal covers. Interpole barriers can easily be fitted to either end of an MCCB.



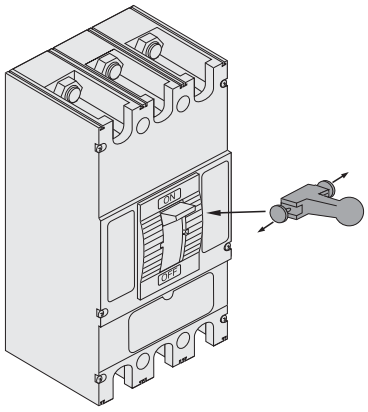


Interpole Barriers

TOGGLE ACCESSORIES

Toggle Extension

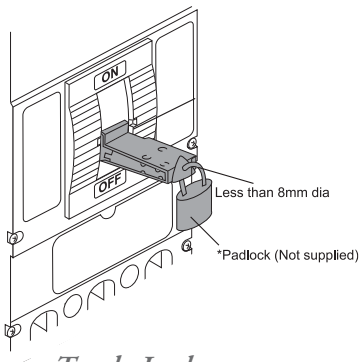
The toggle extension provides extra leverage for the operator when performing manual ON, OFF and RESET operations.



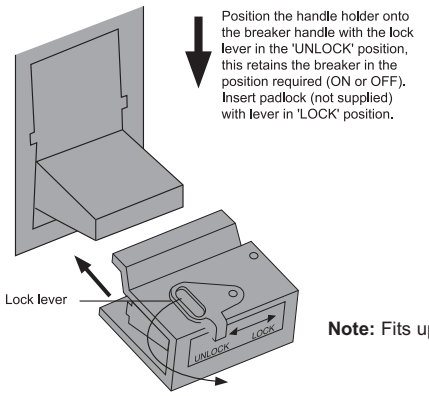
Toggle Extension

Toggle Lock

The toggle lock enables padlocking of the MCCB in either the ON or OFF position. Padlocks are not supplied.



Toggle Lock



Note: Fits up to three padlocks

Key Lock

MCCBs , including those fitted with door mounted handles and some motor operators can be supplied with Castell locking systems. Contact us for details.

Door Flange

A door flange provides a neat finish for the toggle cutout on the outside of the panel door.

MECHANICAL INTERLOCKS

Rear Interlock

Rear interlocks consist of a mechanism mounted at the back of each MCCB of an adjacently mounted pair. The interlock inhibits the closure of one MCCB if the other is already in the ON position. MCCBs cannot be mounted directly to a flat plate, but are installed on a frame to ensure space for the interlock mechanism.

Two MCCBs or switch-disconnectors of the same frame size may be rear interlocked.

An operating handle or motor operator can be fitted to an MCCB with rear interlock.

Wire Interlock

Wire interlocks consist of two mechanisms connected by a cable. The mechanisms are mounted on the back of two MCCBs located at a distance from each other which is limited by the length and bend radius of the cable. The mechanisms inhibit the closure of one MCCB if the other is already in the ON position. MCCBs cannot be mounted directly to a flat plate, but are installed on a frame to ensure space for the interlock mechanism.

Any two of the TemBreak MCCBs or switch disconnectors featured in this catalogue may be wire interlocked.

An operating handle or motor operator can be fitted to an MCCB with rear interlock.

TemTransfer Automatic Changeover Controller

TemBreak MCCBs can be configured to provide automatic supply changeover. They are compatible with the TemTransfer changeover controller. Refer to section 5 for details.

Slide Interlock

Slide interlocks are manually operated toggle locking devices which can be installed between two adjacent MCCBs. Depending on the position of the interlock, one or other of the MCCBs is inhibited from being in the ON position.

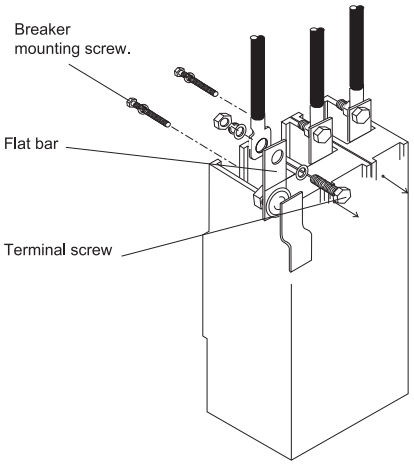
Two MCCBs or switch-disconnectors of the same frame size may be slide interlocked.

Operating handles and motor operators cannot be fitted to MCCBs with slide interlocks.

INSTALLATION

Connection of Large Conductors and Multiple Conductors

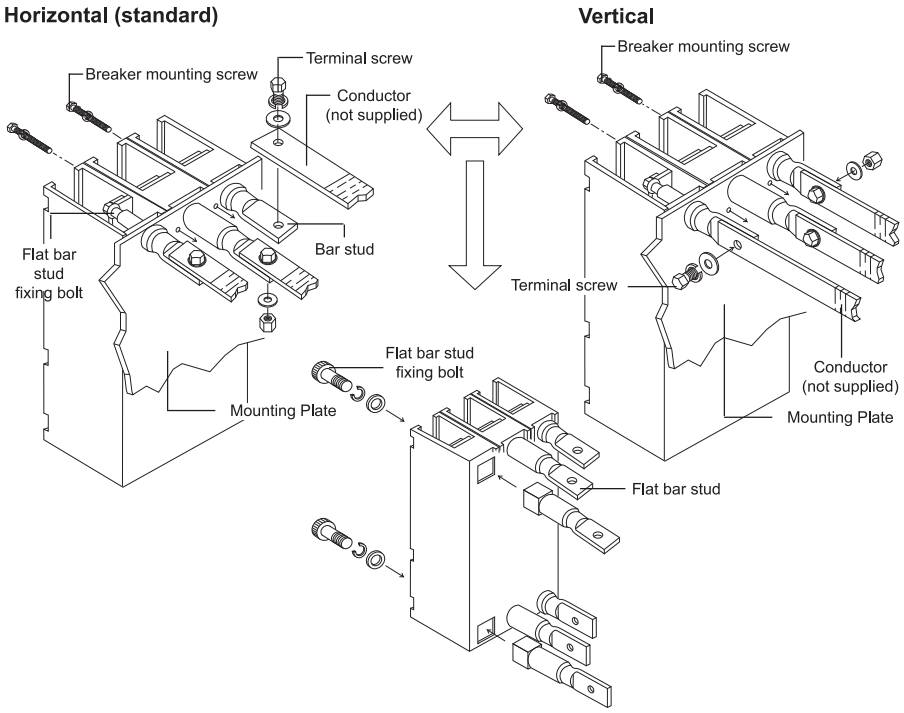
Flat bars are terminal extensions which can be fitted to line or load side terminals and are used to connect large conductors and multiple conductors.



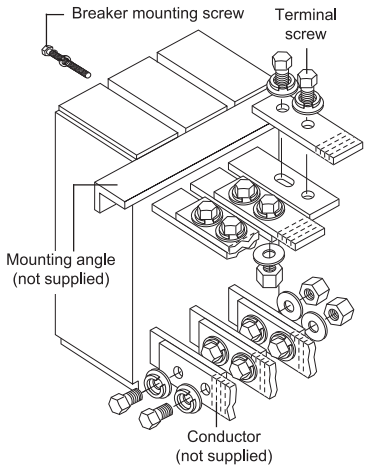
INSTALLATION

Termination in a Separate Compartment

Rear connections allow termination of conductors in a different switchboard compartment to the MCCB body. Optional.



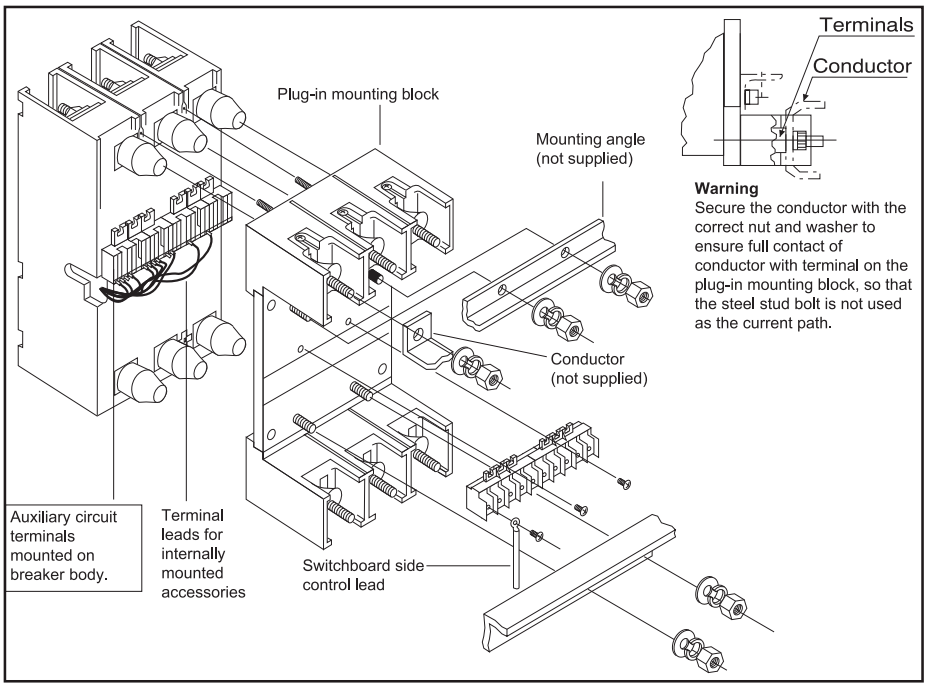
Rear Connections for 800A Frame MCCBs



Rear Connections for 1250A and 1600A frame MCCBs

Plug-in Mounting

The plug-in mounting system allows fast replacement of the MCCB body without the need to disturb the terminations. Solid conductors or cables terminated with compression terminals can be used. Plug-in mounting is available for 800A and 1250A frame MCCBs.



IP20 Protection (Optional)

IP-20 degree of protection and safety trip are available for plug-in type breakers, for switch-board and distribution board use.

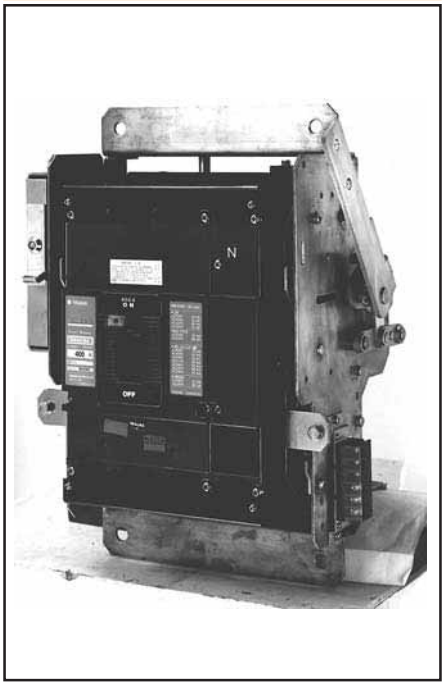
Safety Trip (Optional)

(Trip first, plug-in mechanism)
The breaker will trip automatically, if it is withdrawn while still in the 'ON' position. It is not possible to "plug-in" the breaker when it is in the 'ON' position.

Drawout Mounting

Two types of drawout mounting system are used, depending on the frame size of the MCCB.

Two-position type



800A frame and 1250A frame

- The plug-in type breaker is housed in the draw-out cradle.
- The draw out cradle has two positions “Connected” and “Isolated”.
- The auxiliary circuits are automatically connected or isolated by the auxiliary circuit terminals on the plug-in breaker. Manual connector type is available on request.When a motor operator is fitted, the circuits are manually connected (manual connector type).
- Safety Trip (first trip draw out mechanism). The breaker will trip automatically if it is drawn out while still in the “on” position.
- Position keylock in isolated position (optional) available on request.
- Position switch (1ab) in Connected position (optional) available on request.
- IP-20 degree of protection (Standard)

Three-position type

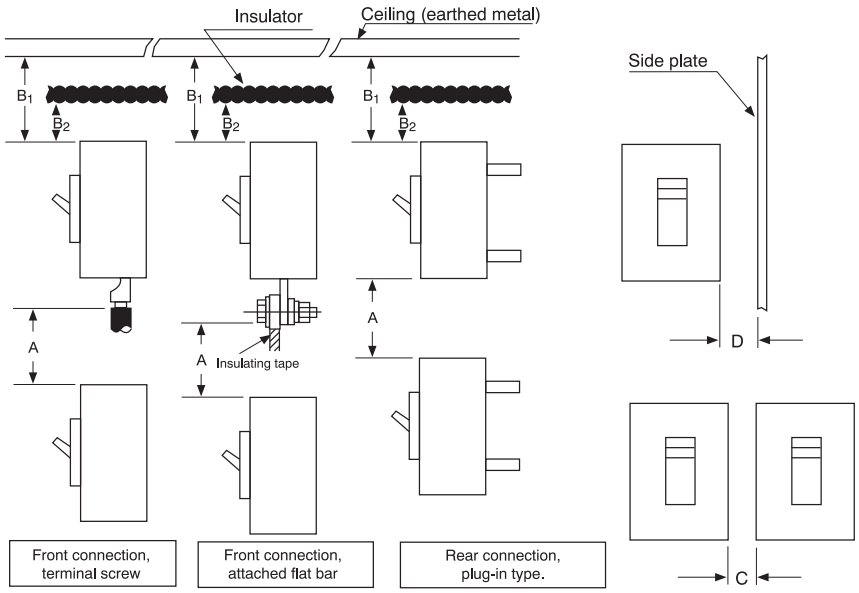
1600A frame

- The draw out cradle has three positions “Connected”, "Test" and “Isolated”.
- The auxiliary circuits are automatically connected and isolated by the disconnect contacts.
  The auxiliary circuits are as follows:
  Connected in “Connected” and “Test” positions and isolated in the “Isolated” position.
- Safety shutters are available (optional) which automatically cover the live parts on the cradle side in the isolated position.
- Safety trip (trip first, draw-out mechanism)
  The breaker will trip automatically if it is drawn out while still in the “ON” position.

Insulation Distances

Attention

Exposed conductors must be insulated up to the breaker terminals. Interpole barriers or optional terminal covers are recommended. If optional terminal covers are used, insulate the exposed conductor until it overlaps the terminal cover.



A : Distance (refer to Table 1) from lower breaker to open charging part of terminal on upper breaker (front connection) or the distance from lower breaker to upper breaker end (rear connection and plug-in type).
B_1 : Distance from breaker end to ceiling (earthed metal)
B_2 : Distance from breaker end to insulator
C : Clearance between breakers
D : Distance from breaker side to side plate (earthed metal)

This table is valid for 380/415V

Table 1

Breaker		A	B_1	B_2	C	D
XS800NJ	XS800SE	120	70	40	0	30
XH800SE	XH800PE	150	80	50	0	40
XH800PJ		150	150	100	0	100
XS1250CE	XS1250SE	150	70	40	0	30
TL800NE XS1600CE	TL1250NE XS1600SE	150	150	100	0	100

Standard Installation Environments and Special Treatments

Tembreak Ciruit Breakers are designed and built to be used under standard operating conditions. Breakers required for conditions other than standard are available on request. Please specify when ordering.

Standard operating conditions are in accordance with IEC 60947-2
Operating ambient temperature - 5° C to 40° C
When a thermal magnetic breaker is used at a temperature exceeding its calibrated temperature of 40°c, 45°c or 50°c, the operating current should be reduced in accordance with ambient compensation curves, section 3. Please contact Terasaki for temperature performance details of microprocessor protected breakers.
Relative humidity 85% max
Altitude 2,000m max
Note:*Atmosphere should not contain dust, smoke, corrosive gases, inflammable gases, moisture or salt.

Special environment	Specification	Nameplate indication
Low Temperatuer Treatment	This is specially treated for storage and use at low temperature. The lowest limit is -40° C for storage and -20° C for use. The breaker is calibrated at 40° C or, 45° C for marine use and requires an appropriate adjustment of the specified characteristics. At low temperatures the environment must be free from rapid temperature changes that result in condensation forming or freezing of the breaker.	PROOFED FOR LOW TEMPERATURE Storage -40° C or higher Operation -20° C or higher
Fungus-moisture Proofing	The dielectric strength and other electrical properties of insulating materials that are likely to deteriorate at high temperature and high humidity. The tropicalised breaker uses specially selected materials and special surface treatment for such conditions. **Note**: The maximum conditions for use are 60° C ambient and 95% relative humidity provided that there are no rapid changes in temperature likely to occur. Contact Terasaki for details.	FUNGUS MOISTURE PROOFING
Anti-corrosion Treatment	The corrosive resistant breaker is specially surface treated for increased corrosion resistance. **Note**: If the breaker is to be used in an atmosphere that has an excess of corrosive gases or moisture and salt then the breaker must be housed in an air tight box, container or cabinet.	CORROSIVE RESISTING

Power Consumption

Breaker	Rated current (A)	Internal resistance (DC mΩ) Value per pole		Power consumption (DC W) Value per pole	
		FC	Plug-in	FC	Plug-in
XS800NJ	800	0.07	0.11	44.8	70.4
XS800SE	400	0.07	0.11	11.2	17.6
XH800SE	450	0.07	0.11	14.2	22.3
XH800PJ	500	0.07	0.11	17.5	27.5
XH800PE	600	0.07	0.11	25.2	39.6
	700	0.07	0.11	34.3	53.9
	800	0.07	0.11	44.8	70.4
XS1250CE	600	0.04	0.053	14.4	19.1
XS1250SE	700	0.04	0.053	19.6	26.0
	800	0.04	0.053	25.6	33.9
	1000	0.04	0.053	40.0	53.0
	1250	0.04	0.053	57.6	76.3
XS1600CE	800	0.022	** 0.039	14.1	25.0
XS1600SE	900	0.022	** 0.039	17.8	31.6
TL800NE	1000	0.022	** 0.039	22.0	39.0
TL1250NE	1200	0.022	** 0.039	31.7	56.2
	1400	0.022	** 0.039	43.1	76.4
	1600	0.022	** 0.039	56.3	99.8

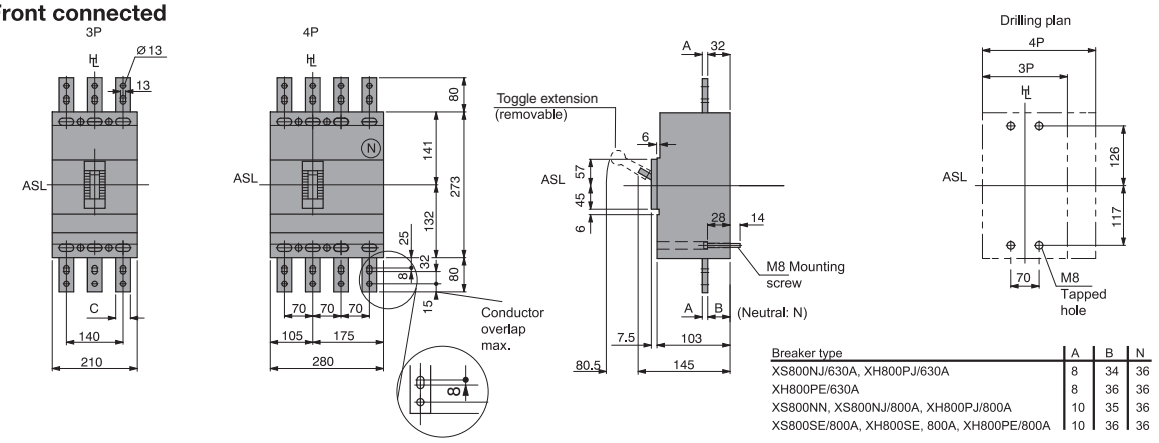
Note: * Value of rear connected type breaker. ** Value of draw-out type breaker.
Note: All values are intended as a guide only

DIMENSIONS

XS800NN, XS800NJ, XS800SE, XH800SE, XH800PJ, XH800PE

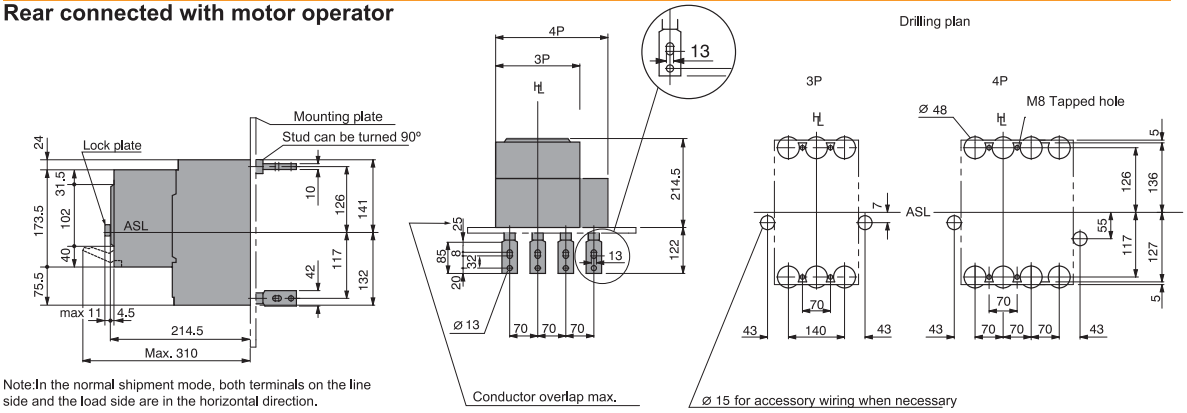
ASL: Arrangement Standard Line
HL : Handle Frame Centre Line

Front connected



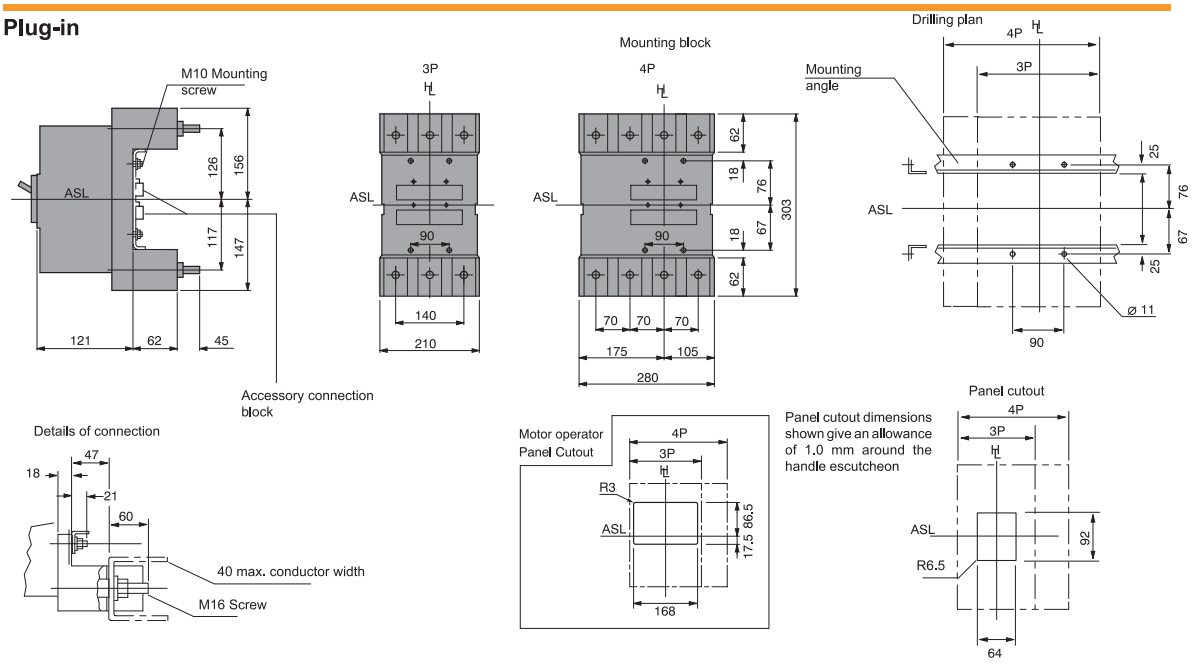
Breaker type	A	B	N
XS800NJ/630A, XH800PJ/630A	8	34	36
XH800PE/630A	8	36	36
XS800NN, XS800NJ/800A, XH800PJ/800A	10	35	36
XS800SE/800A, XH800SE, 800A, XH800PE/800A	10	36	36

Rear connected with motor operator



Note:In the normal shipment mode, both terminals on the line side and the load side are in the horizontal direction.

Plug-in

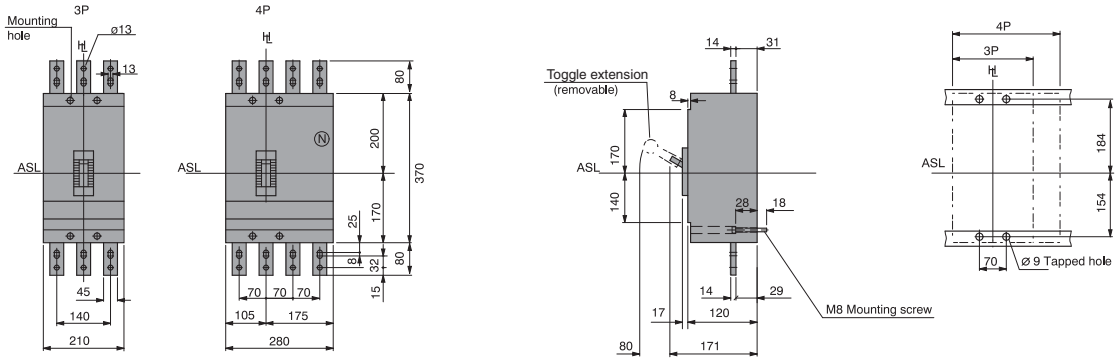


DIMENSIONS

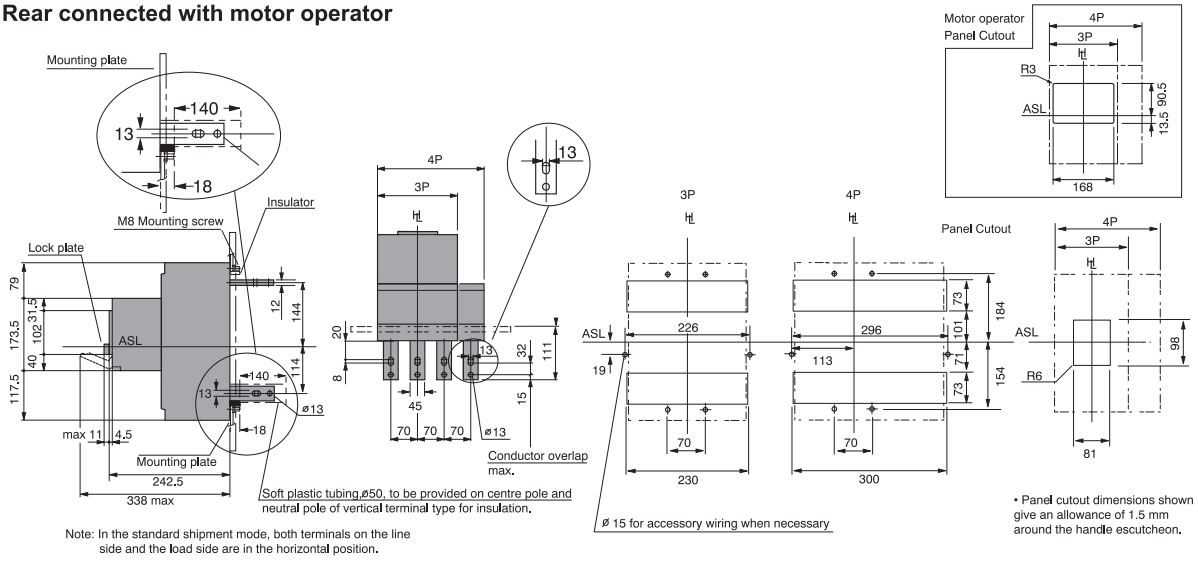
XS1250NN, XS1250CE, XS1250SE

ASL: Arrangement Standard Line
⊢⊣ : Handle Frame Centre Line

Front connected

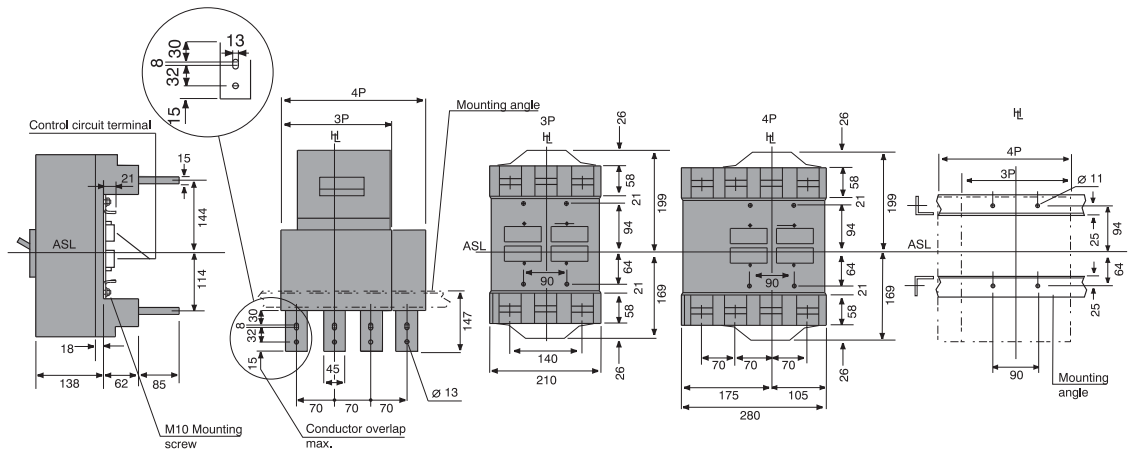


Rear connected with motor operator



Note: In the standard shipment mode, both terminals on the line side and the load side are in the horizontal position.

Plug-in

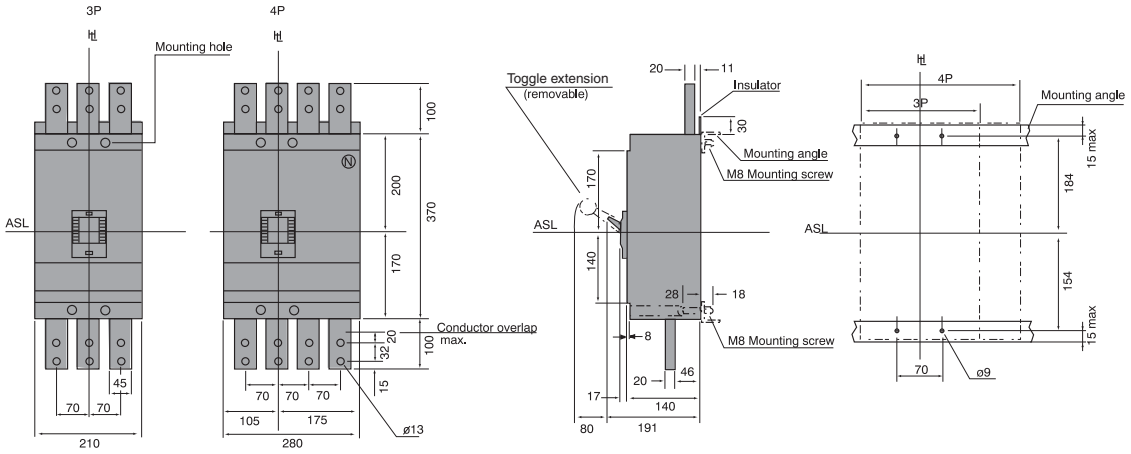


DIMENSIONS

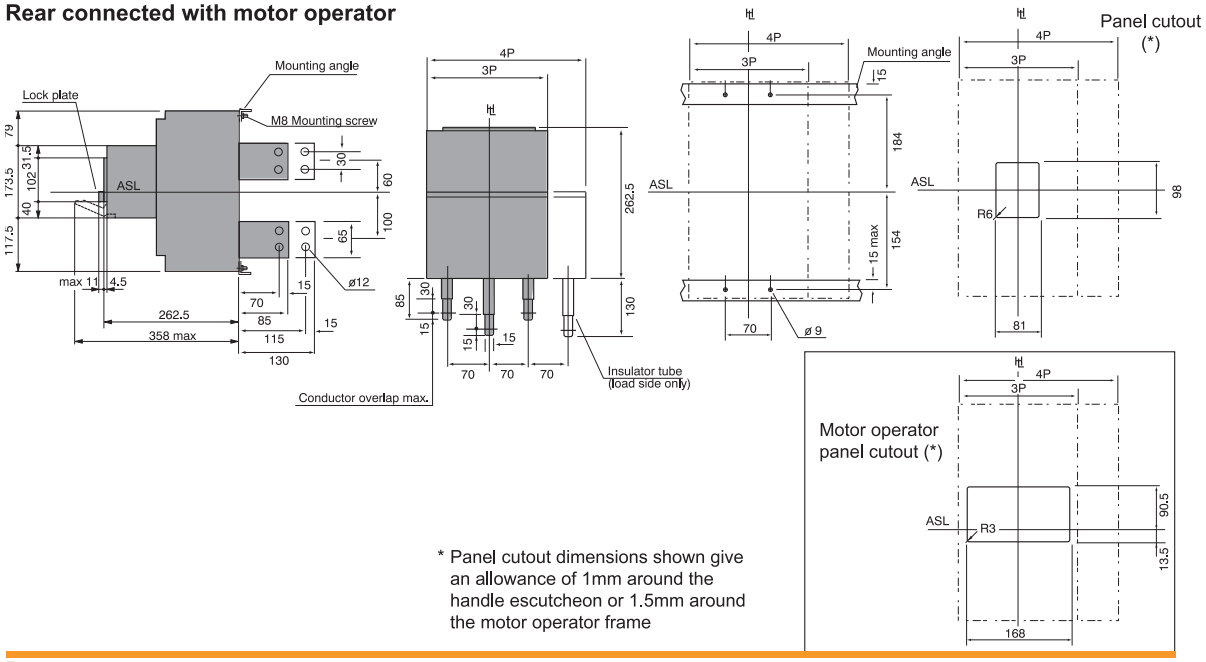
TL800NE, TL1250NE, XS1600NN, XS1600CE, XS1600SE

ASL: Arrangement Standard Line
℄ : Handle Frame Centre Line

Front connected

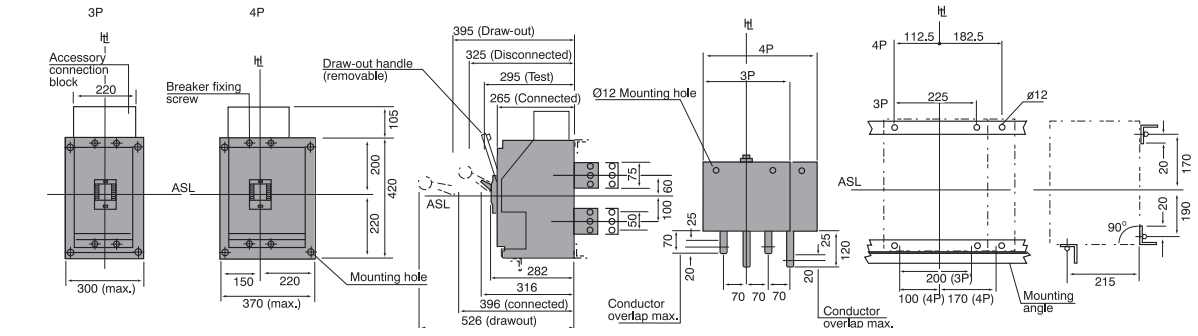


Rear connected with motor operator



* Panel cutout dimensions shown give an allowance of 1mm around the handle escutcheon or 1.5mm around the motor operator frame

Draw-out

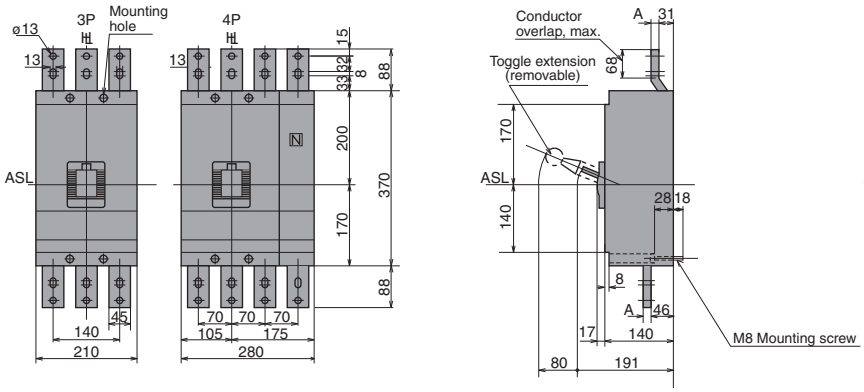


DIMENSIONS

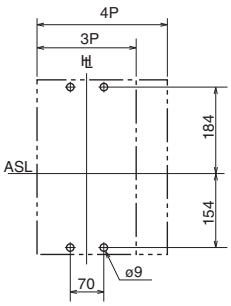
TL-800NE, TL-1250NE

ASL: Arrangement Standard Line
HL : Handle Frame Centre Line

Front connected

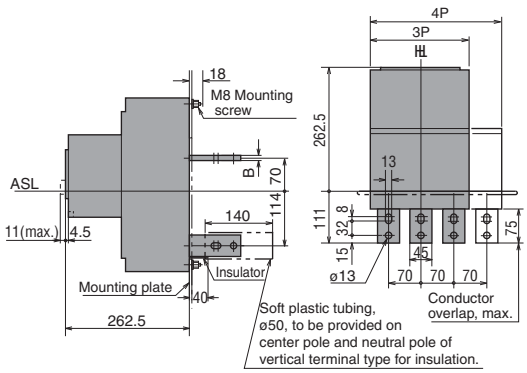


Drilling plan

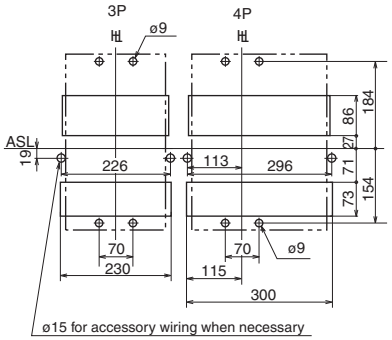


Breaker type	A	B
TL-800NE	10	10
TL-1250NE	14	12

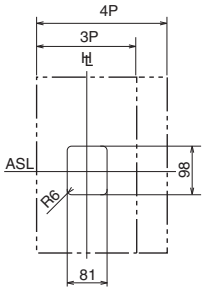
Rear connected with motor operator



Drilling plan



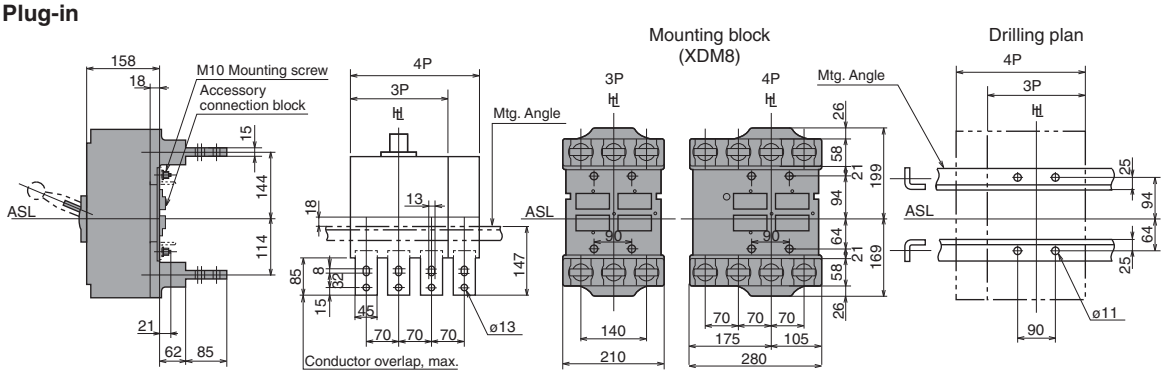
Panel cutout



• Panel cutout dimensions shown give an allowance of 1.5 mm around the handle escutcheon.

Note: In the standard shipment mode, both terminals on the line side and the load side are in horizontal direction.
For the vertical arrangement, specify it when ordering.

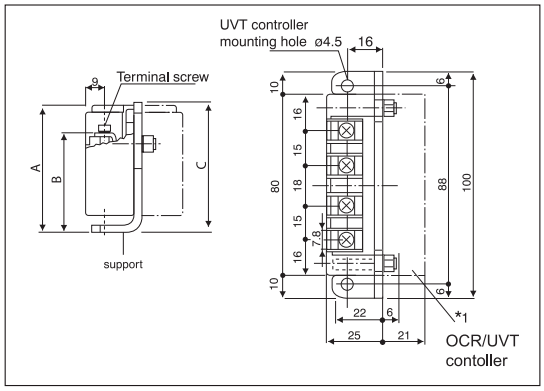
Plug-in



DIMENSIONS

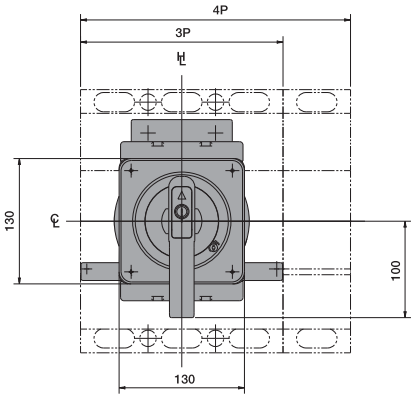
UVT Controller/ OCR Controller

UVT controller, outside configuration

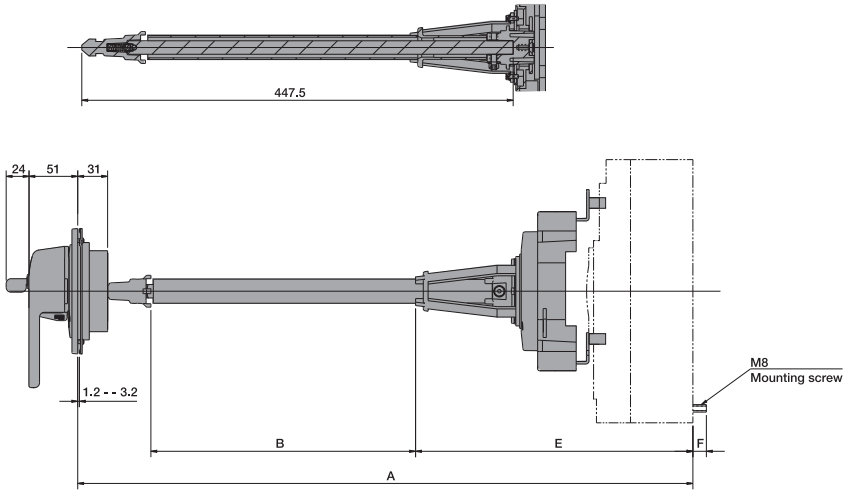


	A	B	C
OCR controller	57.5	45	59
UVT controller	81.5	69	83

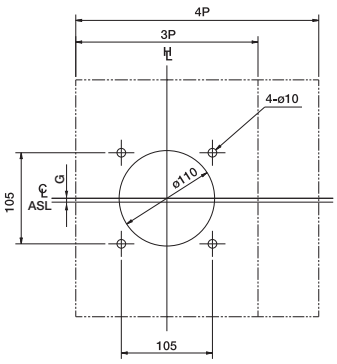
Door Mounted Handle



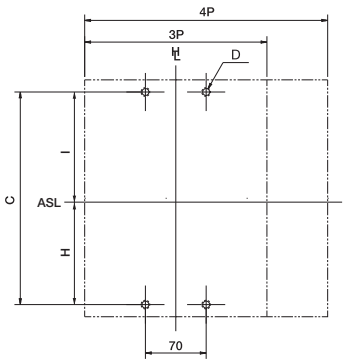
*The Handle shows "ON" position



Panel cutout

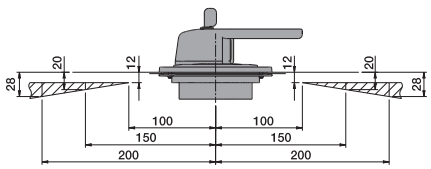


Drilling plan



Positional relationship between the hinge and handle as viewed from the OFF side the breaker.

The hinge nust be positioned in the hatched area.



*The handle shows "OFF" position

: Handle Frame Centre Line

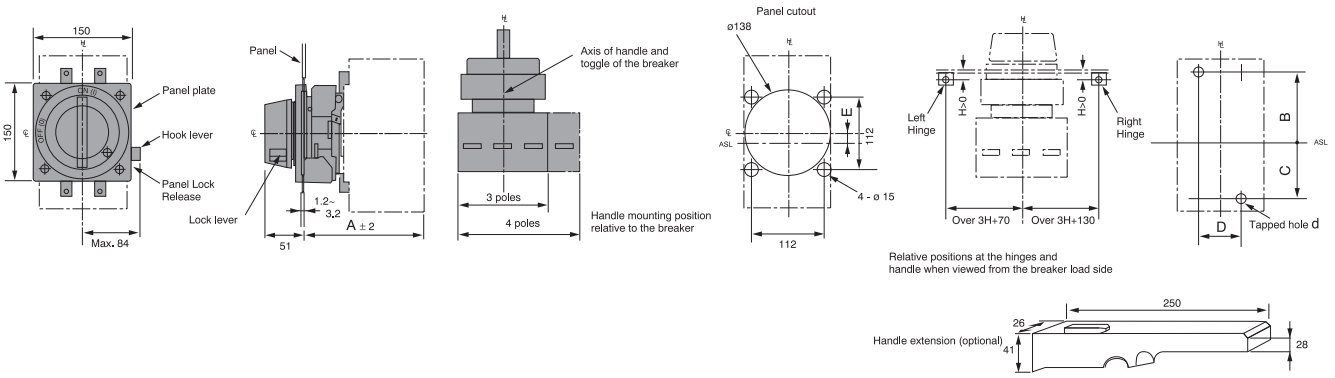
Dimensions table (mm)

Frame (A)	Breaker	A	B	C	D	E	F	G	H	I	Shaft Support
800	XS800NJ XS800SE XH800SE XH800PJ XH800PE	638	280	243	M8	288	14	4.5	117	126	Included
1250	XS1250CE XS1250SE	667	280	338	ø9	317	18	4.5	117	126	Included
1600	XS1600CE XS1600SE TL800NE TL1250NE	687	280	338	ø9	337	18	15	154	184	Included

1. Dimension A is the maximum dimension without the shaft being cut.
2. The shaft can be cut to the required length. If it is neccessary to cut the shaft so short that it does not protrude beyond the shaft support, the shaft support may be removed.

DIMENSIONS

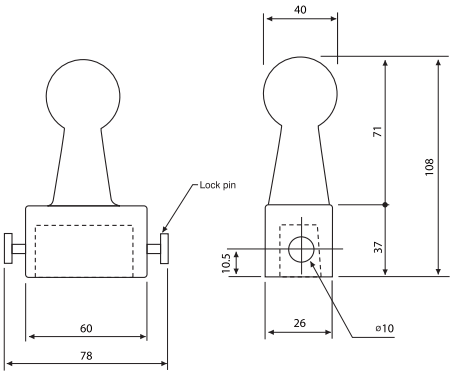
Breaker Mounted Handle



Dimensions table (mm)

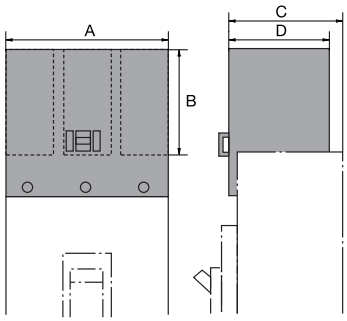
Frame (A)	Breaker	A	B	C	D	d	E
800	XS800PJ	168	126	117	70	M8	+4.5
	XS800NJ						
	XS800SE						
	XH800PE						
	XH800SE						
1250	XS1250CE	197	184	154	70	Ø9	+15
	XS1250SE						
1600	XS1600CE	217	184	154	70	Ø9	+15
	XS1600SE						
	TL800NE						
	TL1250NE						

Toggle Extension



DIMENSIONS

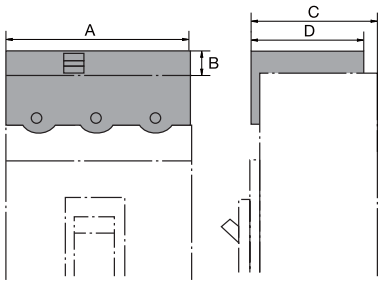
Terminal Covers for Front-Connections



Dimensions table (mm)

Frame (A)	Breaker	Pole	A	B	C	D
800	XS800NJ, XH800PJ	3	215	130	99.5 ('ON' side)	99
	XS800SE, XH800SE, XH800PE	4	285		102.5 ('OFF' side)	
1250	XS1250SE, XS1250CE	3	215	130	115	99
		4	285			

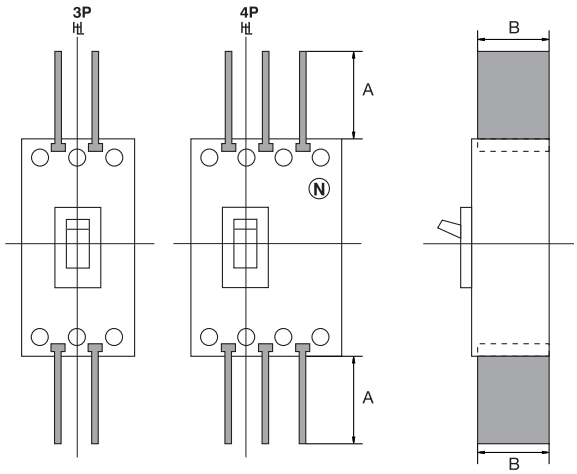
Terminal Covers for Rear Connections and Plug-in Connections



Dimensions table (mm)

Frame (A)	Breaker	Pole	A	B	C	D
800	XS800NJ, XH800PJ	3	206	14	102 ('ON' side)	100.5
	XS800SE, XH800SE, XH800PE	4	280	18	102 ('OFF' side)	98

Interpole Barriers



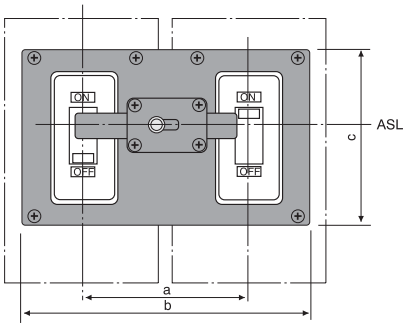
Dimensions table (mm)

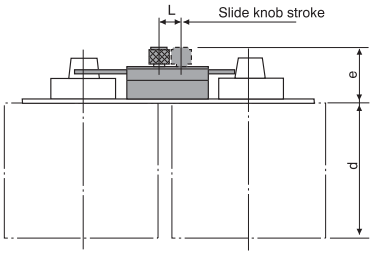
Frame (A)	Breaker	A	B
800	XS800NJ, XH800PJ, XS800SE, XH800SE, XH800PE, TL800NE	110	95
1250	XS1250SE, XS1250CE, TL1250NE	110	95
1600	XS1600CE, XS1600SE	110	95

DIMENSIONS

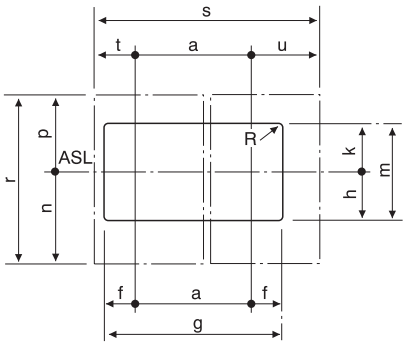
Front Mechanical Interlock

ASL: Arrangement Standard Line





Panel cut-out

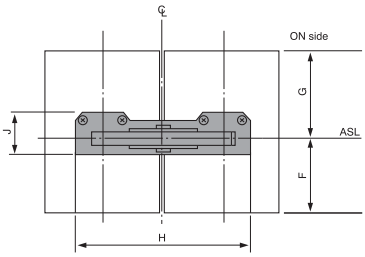


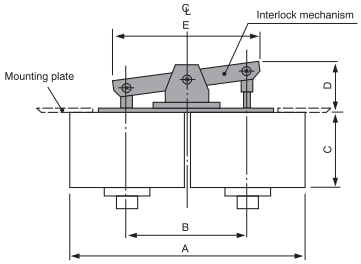
Dimensions table (mm)

Frame (A)	Breaker	Pole	a	b	c	d	e	f	g	h	k	m	n	p	r	s	t	u	L	R
800	XS800NJ	3	220	350	136	103	31.6	66.5	353	57.5	81.5	139	132	141	273	430	105	105	30	8.5
	XS800SE	4	290	420	136	103	31.6	66.5	423	57.5	81.5	139	132	141	273	570	105	175	30	
	XH800PJ XH800SE XH800PE																			
1250	XS1250SE	3	220	340	129	120	39.6	61.5	343	58	74	132	170	200	370	430	105	105	30	8.5
	XS1250CE	4	290	410	129	120	39.6	61.5	413	58	74	132	170	200	370	570	105	175	30	8.5
1600	XS1600SE TL800NE	3	220	340	129	140	39.6	61.5	343	58	74	132	170	200	370	430	105	105	30	8.5
	TL1250NE XS1600CE	4	290	410	129	140	39.6	61.5	413	58	74	132	170	200	370	570	105	175	30	8.5

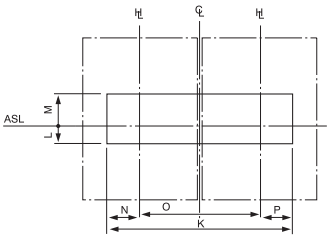
Rear Mechanical Interlock

ASL: Arrangement Standard Line
℄ :Handle Frame Centre Line





Panel cut-out

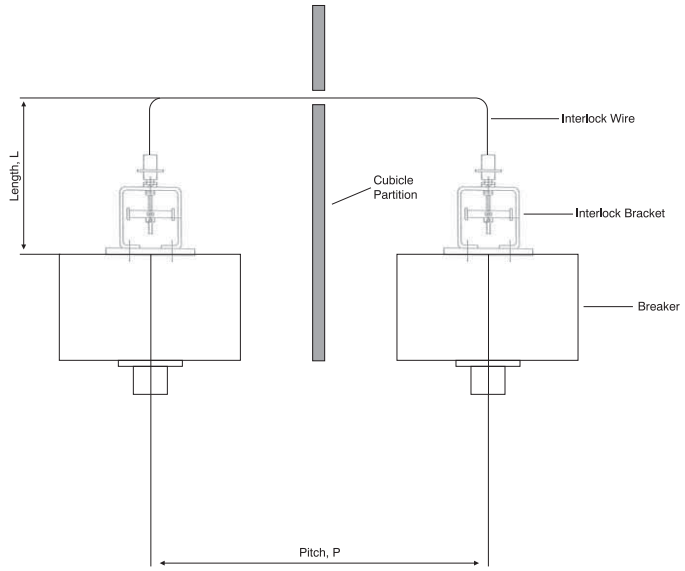


Dimensions table (mm)

Frame (A)	Breaker	Pole	A	B	C	D	E	F	G	H	J	K	L	M	N	O	P
800	XS800NJ	3	430	220	103	74	250	132	141	430	83	440	41	52	110	220	110
	XS800SE	4	570	290	103	74	320	132	141	500	83	510	41	52	110	290	110
	XH800PJ XH800SE XH800PE																

DIMENSIONS

Wire Mechanical Interlock

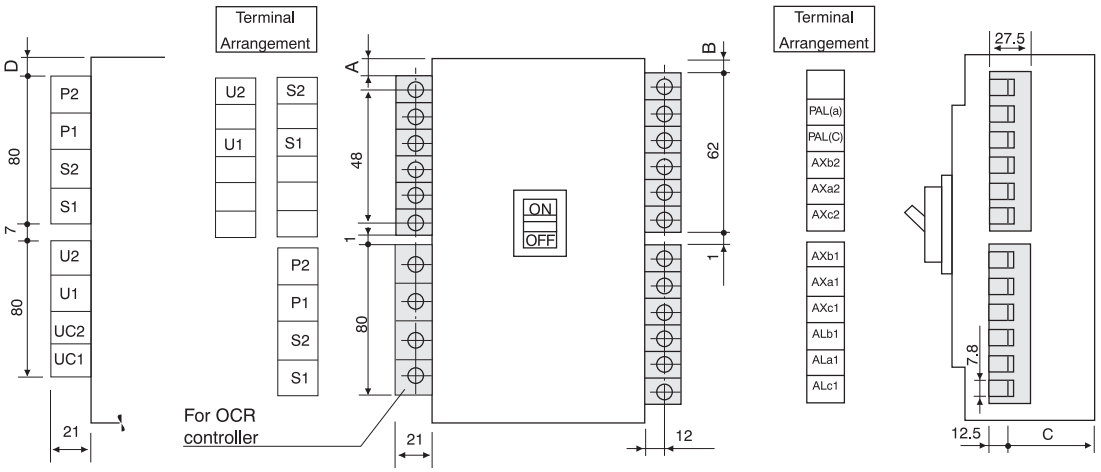


Installation of wire mechanical interlock

Wire Length (m)	Mounting Pitch, P (mm)	Hole Position Length, L (mm)	Wire Support Method
1.5	1000 ⬇ 900 ⬇ 750 ⬇	550 ⬇ 600 ⬇ 700 ⬇	Support 2 points at equal intervals
1.0	650 ⬇ 500 ⬇ 350 ⬇ * (1) * (2)	450 ⬇ 500 ⬇ 530	Support at the centre

* (1): minimum of 60mm + cubicle partition thickness
* (2): minimum of arc base distance if vertical.
⬇ : intermediate dimensions are acceptable.

Terminal Blocks

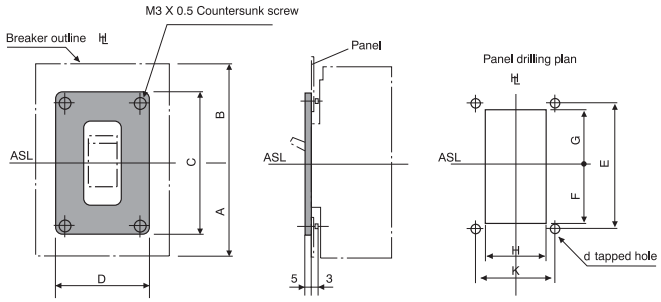


Dimensions table (mm)

Frame (A)	Breaker	A	B	C	D
800	XS800NJ XS800SE XH800PJ XH800SE XH800PE	88	88	60	64
1250	XS1250SE XS1250CE	51	51	72	51
1600	XS1600CE XS1600SE TL1250NE TL800NE	51	51	92	51

DIMENSIONS

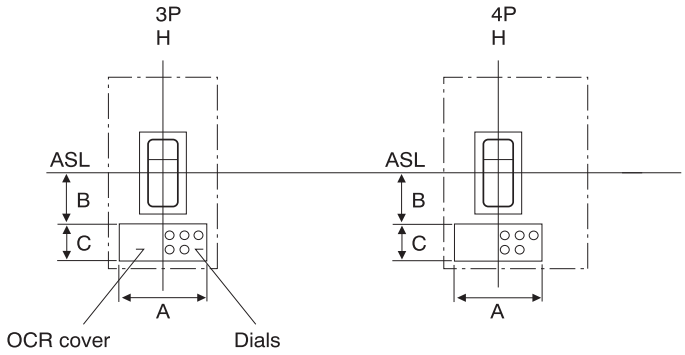
Door Flange



Dimensions table (mm)

Frame (A)	Breaker	A	B	C	D	E	F Min	F Max	G Min	G Max	H Min	H Max	K	d
800	XS800NJ XS800SE XH800PJ XH800SE XH800PE	132	141	135	95	120	48	56	48	56	70	90	80	M3x0.5
1250	XS1250SE XS1250CE	170	200	150	120	135	51	63.5	51	63.5	85	115	80	M3x0.5
1600	XS1600SE XS1600CE TL800NE TL1250NE	170	200	150	120	135	51	63.5	51	63.5	85	115	80	M3x0.5

Panel Cutout for Adjustment Dials

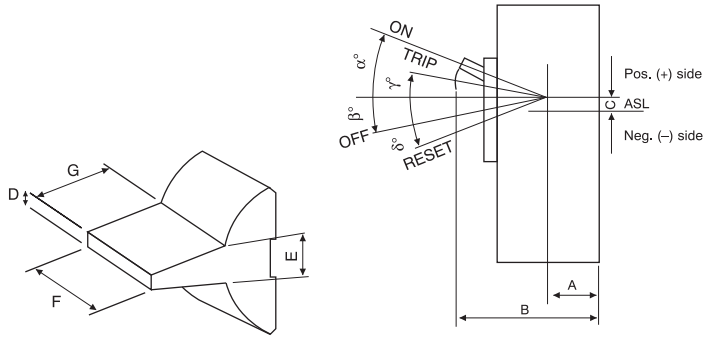


Dimension table (mm)

Frame size (A)	MCCB type	Dimensions A	B	C
800	XS800NJ XS800SE XH800PJ XH800PE XH800SE	210	57	48.5
1250	XS1250CE XS1250SE	210	57.5	58
1600	XS1600CE XS1600SE TL800NE TL1250NE	210	57.5	58

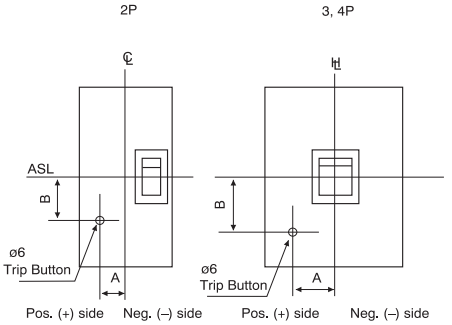
DIMENSIONS

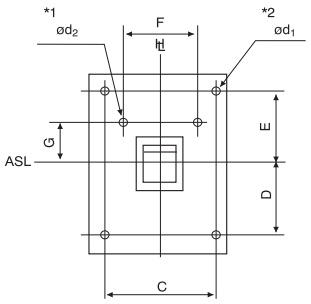
Toggle Operation and Dimensions



Frame (A)	Breaker	Operation angles				Dimensions (mm)							Operation effort (kgf.)			
800	XS800NJ XS800SE XH800PJ XH800PE XH800SE	20	8.5	11	10.5	43.2	144	-6.8	11	12.5	40	33	12.3	15	24	100.8
1250	XS1250CE XS1250SE	22	4	12	9	73.5	171.8	-2.8	11	12.5	40	30	16	30	35	98.3
1600	XS1600CE XS1600SE TL800NE TL1250NE	22	4	12	9	93.5	191.8	-2.8	11	12.5	40	30	16	30	35	98.3

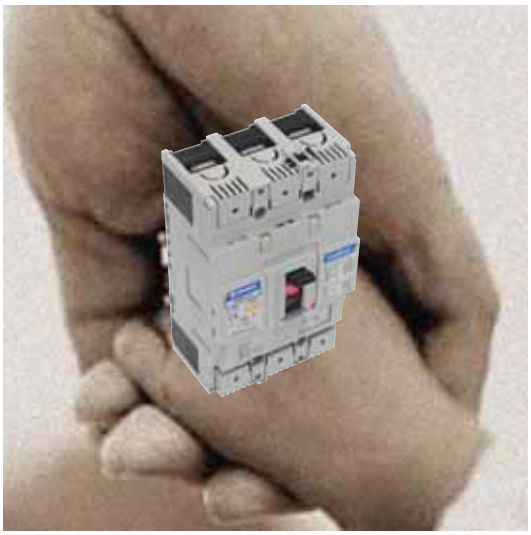
Position of Trip Button and Externally Mounted Accessories





Frame (A)	Breaker	Poles	Trip button		Diameter					Lower hole			
			A	B	C	D	E	F	G	$ød_1$	Depth	$ød_2$	Depth
800	XS800NJ XS800SE XH800PJ XH800PE XH800SE	3 4	+15	74	90 160	125.5	134.5	105	73	4.65	5.1	5.65	6
1250	XS1250CE XS1250SE	3 4	0	72.5	100 170	155	185	–	–	4.65	5	–	–
1600	XS1600CE XS1600SE TL800NE TL1250NE	3 4	0	72.5	100 170	155	185	–	–	4.65	5	–	–

TERASAKI
Innovators in Protection Technology



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Ratings and specifications are subject to change without notice.

CAT REF. '09-I61E

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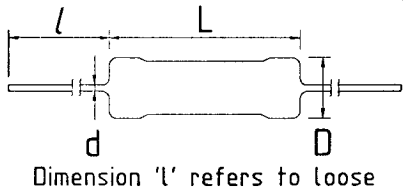
Email: terasaki@vip.163.com

NEOHM®

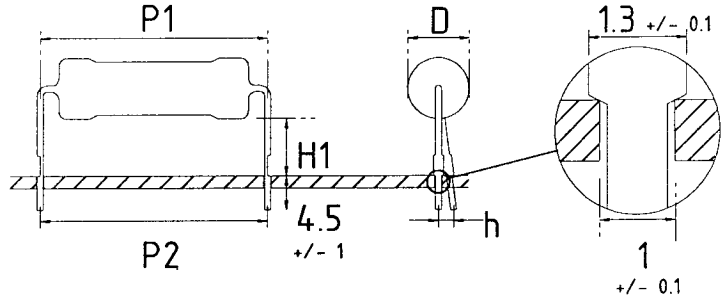
Series **ROX**

FLAME PROOF POWER METAL OXIDE FILM RESISTORS

OUTLINE DIAGRAM



Dimension 'l' refers to loose packaged product only.



DIMENSIONS

Standard Range Leaded

Style	L ± 1	D	d nom	l min
ROX05	9	3 ± 0.5	0.7	25
ROX1	11	4 ± 0.5	0.7	25
ROX2	16	6 ± 1	0.8	35

Standard Range Pre-formed

P1 ± 0.5	P2 ± 2	H1	h max
12.5	12.5	7.5 ± 1.5	2.0
15	15	7.5 ±1.5	2.0
20	20	7.5 ± 2.0	3.0

"S" Range Leaded

Style	L ± 1	D ± 0.5	d nom	l min
ROX05S	6.5	2.3	0.6	25
ROX1SS	6.5	2.3	0.6	25
ROX1S	9	3	0.7	25
ROX2S	11	4	0.8	25
ROX3S	15	5.5	0.8	35
ROX5S	25 ± 2	8.5 ± 1	0.8	35

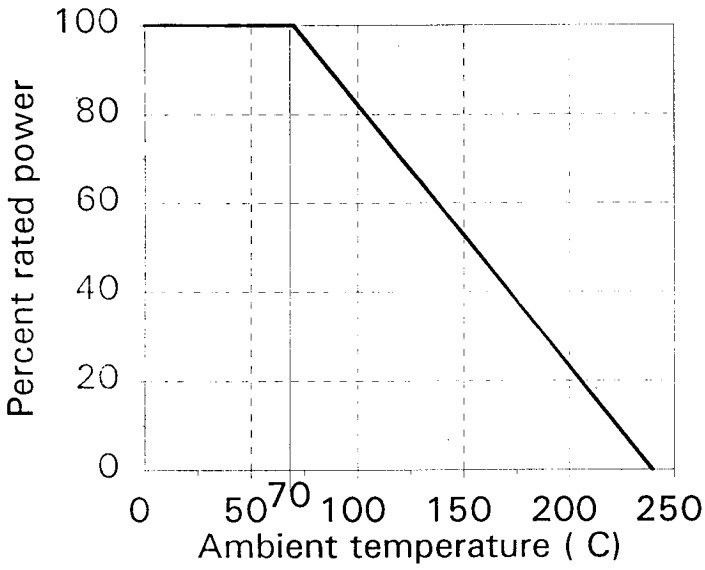
"S" Range Pre-formed

P1 ± 0.5	P2 ± 2	H1	h max
10	10	7.5 ± 1.5	2.0
10	10	7.5 ± 1.5	2.0
12.5	12.5	7.5 ± 0.5	2.0
15	15	7.5 ± 1.5	2.9
20	20	7.5 ± 2.0	3.0
30	30	7.5 ± 2.0	3.0

RATINGS AND CHARACTERISTICS

	Units	ROX05	ROX1	ROX2	ROX05S	ROX1SS	ROX1S	ROX2S	ROX3S	ROX5S
Rated power @ 70 °C	Watts	0.5	1	2	0.5	1	1	2	3	5
Resistance range	ohms	0.1 - 75k	0.1 - 100	0.1 - 120	0.1 - 22k	1 - 200R	0.1 - 68k	0.1 - 68k	0.1 - 100	0.1 - 100
Tolerance	%	2% 5%								
Selection Series		E24								
Limiting Element Voltage	Volts	250	350	350	250	350	350	350	350	500
Maximum Overload voltage	Volts	400	600	600	400	400	600	600	600	800
Max Intermittent overload voltage	Volts	500	750	750	500	500	750	750	750	1500
Temperature coefficient	ppm/°C	±300								
Operating Temperature Range	°C	-55 to +235								
Climatic category		55/235/56								
Dielectric strength	Volts	250	350	350	250	350	350	350	350	500
Insulation resistance	M ohms	1,000 Mohms								

DERATING CURVE
ROX05 - ROX5S



TECHNOLOGY AND SUGGESTED APPLICATIONS

The resistive element comprises a metal oxide film deposited on a ceramic former. The element is protected by a flameproof coating which will withstand overload conditions without flame or mechanical damage. They are recommended for use in applications such as line protection etc..

MOUNTING

The resistors are suitable for processing on automatic insertion equipment and cutting and bending machines.

MARKING

The resistors are marked with a four band colour code in accordance with IEC 62.

ORDERING INFORMATION

Orders for these components should include the following information :-

Type, tolerance and value
e.g. ROX3S 5% 1kO

For preformed components add suffix "BL"
e.g. ROX3S 5% 1kO BL

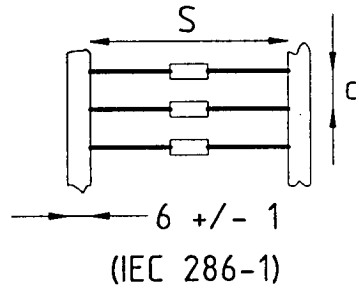
PERFORMANCE CHARACTERISTICS

The evaluation of the performance characteristics is carried out with reference to IECQ Specifications QC 400 000 and QC 400 100

Long term tests ± (5% + 0.1ohm)		Short term tests ± (1% + 0.05ohm)	
Test ref		Test ref	
4.23	Climatic sequence	4.13	Overload
4.24	Damp heat, steady state	4.16	Robustness of terminations
4.25.1	Endurance at 70 °C	4.18	Resistance to soldering heat
4.25.3	Endurance at 200 °C	4.19	Rapid change of temperature
		4.22	Vibration

CROSS REFERENCE & PACKAGING

New style reference	Previous style reference	Quantity per ammo pack	Std. tape spacing * S ± 1	Component spacing c ± 0.5
ROX05	ROX0410	2,000	52	5
ROX1	ROX0512	1,000	52	5
ROX2	ROX0717	1,000	63	10
ROX05S	ROX0410S	2,000	52	5
ROX1SS	N/A	2,000	52	5
ROX1S	ROX0512S	2,000	52	5
ROX2S	ROX0717S	1,000	52	5
ROX3S	ROX0515	1,000	63	10
ROX5S	ROX0942S	500	63	10



* Other tape spacings available on request
Other packaging styles are available on request

DS401/4

NEOHM
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Telephone: 0161-624 0261 Fax: 0161-624 5109

Croster Electronics Ltd. reserve the right to change specifications without notice

0036/M/IECQ/UK FM 31691 M/0185/CECC/UK

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Safety Instructions

1 Compliance with Instructions in the manual

The Purchaser/User should comply with the instructions and information given in this manual and ensure that all personnel to be associated with the apparatus under this contract are made familiar with the information contained herein.

2 Installation

The **Purchaser**/User should ensure that the apparatus under this contract is correctly installed in a suitable location by technically qualified and competent persons.

Apparatus supplied as loose components, devices or sub assemblies could, when energised, constitute a safety hazard. The Purchaser/User should ensure that such apparatus is installed in a secure location and that adequate information about the installation is provided to all associated with it.

3 Operation and Maintenance

3.1 Guidance Notes for Users on the Safety of Personnel

a) During normal use ensure that plant operators:

- are fully conversant with all controls, particularly those associated with emergency stops.
- comply with safety warning notices and keep all enclosures shut.
- are trained to recognise signs of maloperation and know what action to take in the event of trouble or difficulty.

b) During maintenance, testing etc, ensure that only technically competent and authorised persons are permitted to carry out work and that they:

- comply with statutory requirements.
- are fully conversant with the apparatus and the system of which it is a part, and recognise the safety hazards which could arise.
- isolate the apparatus completely, where possible, before opening enclosures and prove it is dead before starting work. Precautions must be taken to ensure that the isolated apparatus cannot become live whilst any work is being carried out.
- comply with safe working procedures for safety of themselves and others, including the use of temporary barriers and warning notices.
- are conversant with the information provided, particularly on matters relating to safety.
- recognise the hazards which can arise when working on live apparatus and take all necessary precautions.

- functionally check the apparatus and then mechanically and/or electrically test it in accordance with this manual and good working practice before putting the apparatus into service.
- take account of the possibility that the apparatus may have been modified without proper reference to the manufacturer and to take extreme caution at all times before, during and after any work is carried out.

If there is any doubt as to the correct and safe method of working then further assistance should be sought from NCE Switchgear.

NAMEPLATE DETAILS
CATHODE SEALING SHOP MCC

CIRCUIT DESIGNATION LABELS

COMP'T	DESCRIPTION
A1	11KW DOL SPARE (BREAKER ONLY)
A2	
A3	
A4	
A5	
A6	INCOMING SUPPLY METERING
A7	INCOMING CABLE CONNECTIONS
B1	F2 CATHODE BAR HEATING FURNACE CONVEYOR NO.1 STARTER 4480-MBMB-0001-M1-ST
B2	F2 CATHODE BAR HEATING FURNACE CONVEYOR NO.2 STARTER 4480-MBMB-0001-M2-ST
B3	F2 CATHODE BAR HEATING FURNACE CONVEYOR NO.3 STARTER 4480-MBMB-0001-M3-ST
B4	F2 CATHODE BAR HEATING FURNACE CONVEYOR NO.4 STARTER 4480-MBMB-0001-M4-ST
C1	R6 ROLLER CONVEYOR AT BAR FURNACE EXIT STARTER 4480-MJRO-0004-M1-ST
C2	R2 ROLLER CONVEYOR FOR BLOCK & BAR ASSEMBLY STARTER 4480-MJRO-0007-M1-ST
C3	R4B PRESTRESSING & SEALING STATION CONVEYOR B STARTER 4480-MZAC-0002-M1-ST
C4	R4A PRESTRESSING & SEALING STATION CONVEYOR A STARTER 4480-MZAC-0001-M1-ST
D1	0.75KW DOL SPARE (BREAKER ONLY)
D2	R7 ROLLER CONVEYOR AT BLOCK OVEN EXIT STARTER 4480-MJRO-0005-M1-ST
D3	
D4	R1 ROLLER CONVEYOR AT BLOCK OVEN EXIT STARTER 4480-MJRO-0005-M1-ST
D5	H1 HYDRAULIC POWER UNIT PUMP A STARTER 4480-MPFO-0001-M1
D6	R3 ROLLER CONVEYOR AFTER SEALING STATION STARTER 4480-MJRO-0006-M1
D7	H1 HYDRAULIC POWER UNIT PUMP 8 STARTER 4480-MPFO-0001-M2
D8	R5 ROLLER CONVEYOR AT COOLING & TURNING STATION STARTER 4480-MJRO-0008-M1
D9	
D10	1.1KW DOL SPARE (BREAKER ONLY)
D11	C3 CONVEYOR BETWEEN SHOT BLASTING MACHINE & OVEN STARTER 4480-MHCD-0003-M1-ST
D12	G1 POSITIONING GANTRY FOR BLOCK AND BARS STARTER 4480-MQLK-0001-M1-ST
E1	C1 CHAIN CONVEYOR OF BLOCK OVEN STARTER 4480-MHCD-0001-M1-ST
E2	S1 CATHODE BAR SHOTBLASTING MACHINE BLAST WHEEL No.1 STARTER 4480-MZBP-0001-M1-ST
E3	C2 CONVEYOR UPSTREAM OF SHOTBLASTING MACHINE STARTER 4480-MHCD-0002-M1-ST
E4	S1 CATHODE BAR SHOTBLASTING MACHINE BLAST WHEEL No.2 STARTER 4480-MZBP-0001-M2-ST
E5	C4 CHAIN CONVEYOR FOR SEALED CATHODE 4480-MHCD-0004-M1-ST
E6	S1 CATHODE BAR SHOTBLATING MACHINE SCREW 4480-MZBP-0001-M7-ST
E7	F1 CATHODE BLOCK OVEN FAN A 4480-MEEP-0001-M1-ST
E8	F1 CATHODE BLOCK OVEN FAN B 4480-MEEP-0001-M1-ST
E9	R9 ROLLER CONVEYOR AT SHOTBLASTING MACHINE ENTRANCE STARTER 4480-MJRO-0001-M1-ST
E10	R8 ROLLER CONVEYOR AT SHOTBLASTING MACHINE ENTRANCE STARTER 4480-MJRO-0002-M1-ST
F1	D1 DUST COLLECTOR FOR SHOTBLASTING MACHINE FAN STARTER 4480-MACO-0001-M1-ST
F2	3.7KW DOL SPARE (BREAKER ONLY)
F3	S1 CATHODE BAR SHOTBLASTING MACHINE BLAST WHEEL No.3 STARTER 4480-MZBP-0001-M3-ST
F4	F3 LADLE PRE-HEATING COMBUSTION FAN STARTER 4480-MBAD-0001-M1-ST
F5	S1 CATHODE BAR SHOTBLASTING MACHINE BLAST WHEEL No.4 STARTER 4480-MZBP-0001-M4-ST
F6	F4A CAST IRON INGOT DRYING STATION A COMBUSTION FAN STARTER 4480-MEVD-0001-M1-ST
F7	S1 CATHODE BAR SHOTBLASTING MACHINE ELEVATOR STARTER 4480-MZBP-0001-M5-ST
F8	F4B CAST IRON INGOT DRYING STATION B COMBUSTION FAN STARTER 4480-MEVD-0002-M1-ST

F9	F1 CATHODE BLOCK OVEN FAN C STARTER 4480-MEEP-0001-M3-ST
F10	S1 CATHODE BAR SHOTBLASTING MACHINE WORK CONVEYOR STARTER 4480-MZBP-0001-M6-ST
F11	
G1	ETHERNET EQUIPMENT
G2	W1 CHILLER FOR HYDRAULIC POWER UNIT STARTER 4480-MEHX-0001-W1-ST
G2	
G3	230V DISTRIBUTION
G4	460/230V 10KVA TRANSFORMER

FLOOR LEVELLING REQUIREMENTS
DOCUMENT No. C6608N

1) Switchboards require to be mounted on a suitable surface (concrete, metal base etc...).

2) If the surface of this is not level appropriate steps require to be taken to resolve same.

3) At switchboard installation any minor level deviations (which show up on busbar fish plates & section bolt holes not lining up) can be overcome by insertion of metal shim plates underneath joining sections bases.

INSTALLATION INSTRUCTIONS
DOCUMENT No. C6608T

DELIVERY

All switchboards will be split into appropriate shipping lengths & be delivered within enclosed crates.

INSTALLATION

1) Check packing list for switchboard section detail.

2) Dismantle crate.

3) Centralise crane lifting chains above the section lifting eyes & affix suitable lifting shackles onto same.

4) Lower chains/lifting shackles & fix onto lifting eyes (all lifting eyes must be used).

5) Raise crane head & take up tension on chains.

6) Raise section approximately 6 inches & check section is hanging level.

7) If section is level lift section into switchroom position

8) If section is not hanging level lower to ground & after slackening chains re-align same & repeat stages 5, 6 & 7.

SECTION FIXING/RE-ASSEMBLY

1) Fix all sections to base using appropriate fixings.

2) Remove appropriate access covers.

3) Bolt together sections working from further section from entry point. Using fixing screws supplied the fixings run vertically at front and rear of sections.

4) Bolt together Busbar connecting plates & torque same to 17NM.

5) Re-connect ethernet wiring between sections by using NCE wiring diagram. All ethernet cables are run within switchboard cableway & at despatch, coiled at panel splits.